

ENGINE

Engine Cooling - Canyon, Colorado

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

Temperature	Resistance
150°C (302°F)	47 to 49 ohms
140°C (284°F)	58 to 62 ohms
130°C (266°F)	76 to 80 ohms
120°C (248°F)	98 to 104 ohms
110°C (230°F)	130 to 136 ohms
100°C (212°F)	174 to 182 ohms
90°C (194°F)	237 to 247 ohms
80°C (176°F)	327 to 341 ohms
70°C (158°F)	459 to 479 ohms
60°C (140°F)	656 to 686 ohms
50°C (122°F)	958 to 1002 ohms
45°C (113°F)	1167 to 1223 ohms
40°C (104°F)	1430 to 1500 ohms
35°C (95°F)	1763 to 1849 ohms
30°C (86°F)	2185 to 2295 ohms
25°C (77°F)	2725 to 2865 ohms
20°C (68°F)	3418 to 3604 ohms
15°C (59°F)	4318 to 4564 ohms
10°C (50°F)	5493 to 5823 ohms
5°C (41°F)	7041 to 7485 ohms
0°C (32°F)	9097 to 9701 ohms
-5°C (23°F)	11844 to 12678 ohms
-10°C (14°F)	15540 to 16700 ohms
-15°C (5°F)	20559 to 22183 ohms
-20°C (-4°F)	27439 to 29725 ohms
-30°C (-22°F)	50264 to 54924 ohms
-40°C (-40°F)	95953 to 105777 ohms

FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Engine Coolant Fan Bolts (LCV)	7 N.m	62 lb in
Engine Coolant Fan Shroud Bolts	10 N.m	89 lb in
Engine Coolant Heater Cord Bracket Fastener	9 N.m	80 lb in
Engine Coolant Heater Cord Fastener	9 N.m	80 lb in
Engine Coolant Heater Ground Lead	9 N.m	80 lb in
Engine Coolant Lower Thermostat Housing Fasteners (LFX)	10 N.m	89 lb in

Application	Type of Material	Specification	
		Metric	US English
Engine Coolant Thermostat Heater Shield Fasteners (LCV)		5 N.m	44 lb in
Engine Coolant Thermostat Housing Fasteners (LCV)		10 N.m	89 lb in
Engine Coolant Thermostat Nut (LWN)		9 N.m	80 lb in
Engine Harness Ground Fastener (LCV)		25 N.m	18 lb ft
Engine Oil Cooler Bolt (LWN)		25 N.m	18 lb ft
Engine Oil Cooler Pipe Bolt (LWN)		10 N.m	89 lb in
Heater Inlet Pipe Fastener (LFX)		10 N.m	89 lb in
Heater Outlet Pipe Fastener (LFX)		10 N.m	89 lb in
Radiator Drain Cock (LCV)		1.9 N.m	17 lb in
Radiator Outlet Pipe Bracket Support Fasteners (LFX)		58 N.m	43 lb ft
Radiator Outlet Pipe Fastener (LFX)		22 N.m	16 lb ft
Radiator Side Brace Bracket Bolt		10 N.m	89 lb in
Radiator Surge Tank Nut		9 N.m	80 lb in
Radiator Upper Bracket Support Fastener		9 N.m	80 lb in
Radiator Vent Valve (LCV)		1.9 N.m	17 lb in
Thermostat Bypass Pipe Fastener (LCV)		10 N.m	89 lb in
Turbocharger Coolant Feed Pipe Hollow Screw (LWN)		35 N.m	26 lb ft
Turbocharger Coolant Return Pipe Hollow Screw (LWN)		35 N.m	26 lb ft
Water Outlet Fasteners (LCV)		12 N.m	106 lb in
Water Outlet Fasteners (LFX)		10 N.m	89 lb in
Water Pump Fasteners (LCV, LWN))		25 N.m	18 lb ft
Water Pump Fasteners (LFX)		10 N.m	89 lb in
Water Pump Inlet Pipe Fasteners (LCV, LWN)		25 N.m	18 lb ft
Water Pump Inlet Pipe Fasteners (LFX)		10 N.m	89 lb in
Water Pump Pulley Fasteners (LFX)		12 N.m	106 lb in

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System		
2.5L (LCV)	9.1 L	9.61 qt
2.8L (LWN)	11.2 L	11.83 qt
3.6L (LFX)	12.35 L	13.05 qt

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
DEX-COOLÂ®	Coolant	12346290	10953464

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Fans (LCV/LFX)

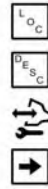
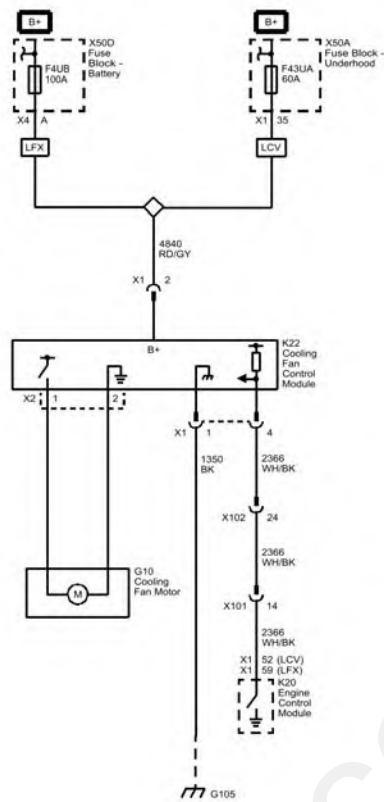


Fig. 1: Engine Cooling Fans (LCV/LFX)
 Courtesy of GENERAL MOTORS COMPANY

Engine Cooling Fans (LWN)

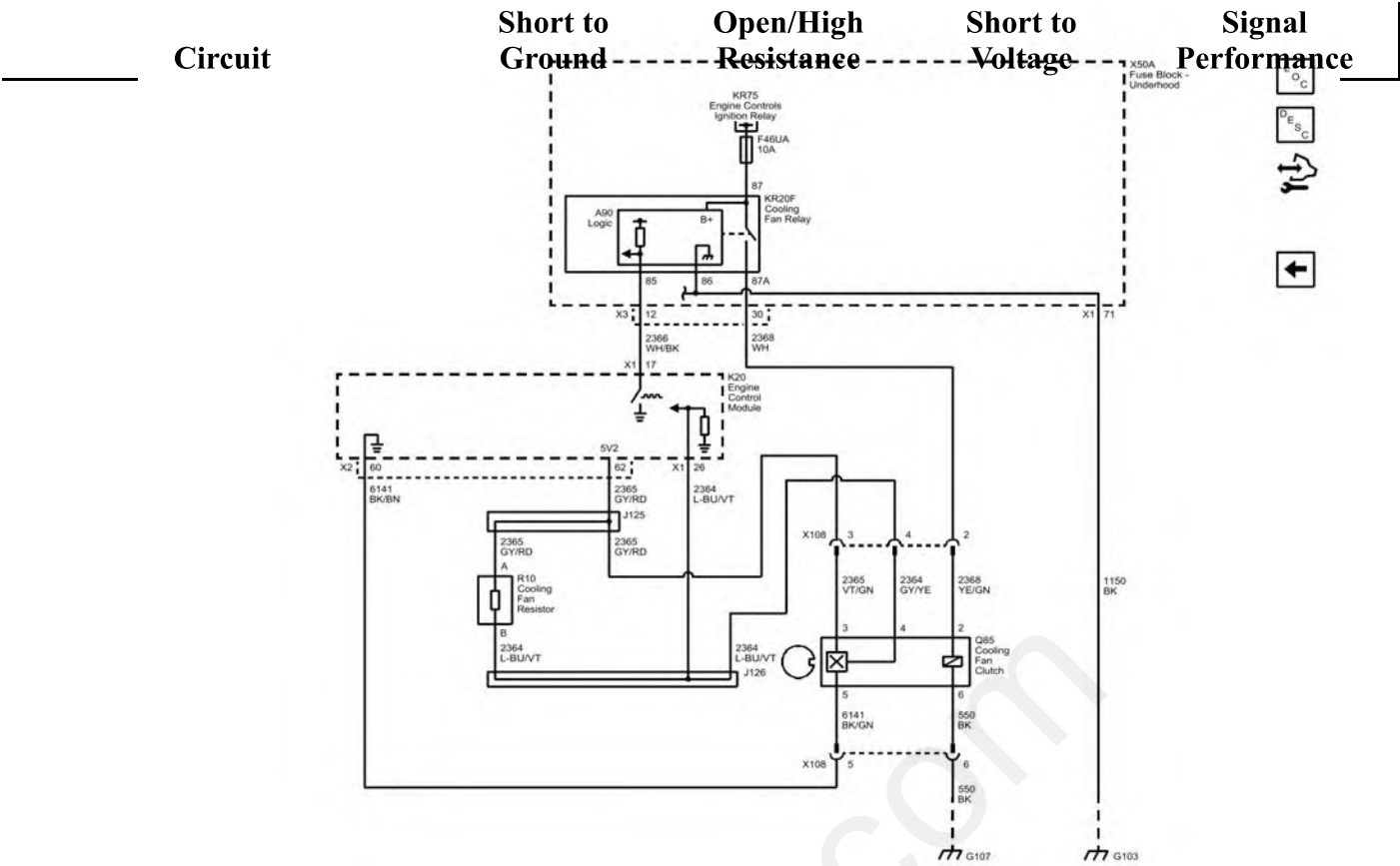


Fig. 2: Engine Cooling Fans (LWN)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P00B3 OR P00B4 : RADIATOR COOLANT TEMPERATURE SENSOR (LCV OR 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 P00B3

Radiator Coolant Temperature Sensor Circuit Low Voltage

DTC P00B4

Radiator Coolant Temperature Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6

RCT Circuit	Short to Ground	RCT Resistance	Open	Short to Voltage
Circuit	Ground	Resistance	Voltage	Performance
Low Reference	-	P00B4	-	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit/System Description

NOTE: The radiator coolant temperature sensor is referred to as B34B Engine Coolant Temperature Sensor 2 in schematics and other areas.

The radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. This diagnostic checks for an open, short to ground or an intermittent circuit condition between the engine control module (ECM) and RCT sensor.

The following table illustrates the difference between temperature, resistance, and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P00B3

- The engine run time is greater than 10 s.
- The intake air temperature (IAT) is colder than 70Â°C (158Â°F).
- The DTC runs continuously when the above conditions are met.

P00B4

- The engine run time is greater than 60 s.
- The intake air temperature (IAT) is warmer than -7Â°C (19Â°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P00B3

The ECM detects that the RCT sensor is warmer than 149Â°C (300Â°F) for greater than 10 s.

P00B4

The scan tool only displays to -40Â°C (-40Â°F).

The ECM detects that the RCT sensor is colder than -60°C (-76°F) for greater than 10 s.

Action Taken When the DTC Sets

- DTCs P00B3 and P00B4 are Type B DTCs.
- The cooling fans will be commanded ON by the ECM.
- The engine coolant temperature gauge is inoperative.

Conditions for Clearing the MIL/DTC

P00B3 and P00B4 are Type B DTCs.

Diagnostic Aids

NOTE: The engine coolant temperature (ECT) sensor is mounted on the engine and the radiator coolant temperature (RCT) sensor is mounted on the radiator.

- As the thermostat opens, the RCT sensor temperature should rise steadily, then stabilize once the thermostat opens completely.
- Test the RCT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor.
- If the vehicle has sat for greater than 8 hours, the ECT sensor and the RCT sensor values should display within 3°C (5°F).

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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.

ie scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120Â°C (-38 to +248Â°F) and changes with engine run time.

- **If not between -39 to + 120Â°C (-38 to +248Â°F) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to + 120Â°C (-38 to +248Â°F) and changes**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference terminal 2 and ground.

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Ignition ON.

4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39Â°C (-38Â°F).

- **If warmer than -39Â°C (-38Â°F)**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 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 colder than -39Â°C (-38Â°F)**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.

6. Verify the scan tool Radiator Coolant Temperature Sensor parameter is warmer than 149Â°C (300Â°F).

- **If colder than the 149Â°C (300Â°F)**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

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

3. Ignition OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the B34B Engine Coolant Temperature Sensor.

7. Test or replace the B34B Engine Coolant Temperature Sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34 Engine Coolant Temperature Sensor.
2. Test the RCT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance](#) table. The resistance values should be in range of the table values.

- **If not within the specified range**
 - Replace the B34 Engine Coolant Temperature Sensor.
- **If within the specified range**

3. Test for infinite resistance between each terminal and the sensor housing.

- **If less than infinite resistance**

Replace the B34 Engine Coolant Temperature Sensor.

- **If infinite resistance**

4. All OK.

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement - Radiator \(LCV\)](#) for radiator coolant temperature sensor replacement.
- [Engine Control Module Replacement](#) for engine control module replacement, programming, and setup.

DTC P00B7: ENGINE COOLANT FLOW INSUFFICIENT

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 P00B7

Engine Coolant Flow Insufficient

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radiator Coolant Temperature Sensor Signal	P00B3	P00B4	P00B4*	P112F
Low Reference	-	P00B4	P00B4*	P112F
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Circuit	Short to Ground	Open	Short to Voltage
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Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running in Closed Loop			
Parameter Normal Range: Varies with ambient temperature			
Radiator Coolant Temperature Sensor Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The engine control module (ECM) monitors the temperature of the engine radiator coolant. The ECM controls the thermostat with a pulse width modulated (PWM) signal. The ECM compares the radiator coolant temperature to the engine coolant temperature in order to determine if there sufficient coolant flow through the thermostat.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P0117, P0118, P111E, and P112F are not set.
- The engine run time is greater than 5 m.
- The engine coolant temperature is warmer than 99Â°C (210Â°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and + 150Â°C (-40 and +302Â°F).

The ECM detects the difference between the RCT sensor and the ECT sensor is greater than 30Â°C (86Â°F) when the ECT sensor is warmer than 117Â°C (243Â°F) for greater than 30 s.

Action Taken When the DTC Sets

DTC P00B7 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P00B7 is a Type B DTC.

Diagnostic Aids

- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will start to open at approximately 97Â°C (207Â°F).
- A resistance condition in the RCT sensor circuits may cause this DTC. This condition results in a greater voltage on the RCT sensor signal circuit, which is interpreted by the ECM as a colder RCT.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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Description and Operation

Cooling System Description and Operation (LFX)Cooling System Description and Operation (LWN)

Electrical Information Reference

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- 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 that DTC P00B3, P00B4, P0117, P0118, P0480, P0481, P0597, P0598, P0599, P111E, or P112F are not set.
 - **If DTC P00B3, P00B4, P0117, P0118, P0480, P0481, P0597, P0598, P0599, P111E, or P112F are set**

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

- **If DTC P00B3, P00B4, P0117, P0118, P0480, P0481, P0597, P0598, P0599, P111E, or P112F are not set**
3. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.
 - **If the coolant in the radiator surge tank is not at the correct level or there are engine coolant leaks**

Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill), and Loss of Coolant.

- **If the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks**
4. Verify the engine cooling fan operates.
 - **If the engine cooling fan does not operate**
- Refer to Cooling Fan Inoperative.
- **If the engine cooling fan operates**

NOTE: Depending on ambient temperature, it may take up to 4 min for the temperature to decrease less than the specified value.

5. Engine idling for 15 min with the A/C OFF.

Depending on ambient temperature, it may take up to 4 minutes for the temperature to decrease less than the specified value.

6. Command the Engine Coolant Thermostat Heater to 100 % with a scan tool. Increase the engine speed to 3,000 RPM. Observe the scan tool ECT sensor parameter. The temperature should decrease to less than 85°C (185°F).

- **If ECT is warmer than 85°C (185°F)**

Refer to Circuit/System Testing.

- **If ECT is colder than 85°C (185°F)**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Vehicle OFF, inspect the cooling system for the conditions below. Refer to [Symptoms - Engine Cooling](#).

- Weak coolant solution
- Obstructed radiator air flow or bent radiator fins
- Blocked cooling system passages
- Radiator hoses that are restricted, collapsed, or deteriorated
- Damaged water pump and or belt
- Loss of cooling system pressure
 - Leaking surge tank cap
 - Radiator hoses
- Cylinder head or an engine block that is cracked or plugged
- **If a condition was found**

Repair as necessary.

- **If a condition was not found**

2. Replace the Engine Coolant Thermostat.

Repair Instructions

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

Engine Coolant Thermostat Housing Replacement (LCV)Engine Coolant Thermostat Housing Replacement (LFX)

DTC P0480, P0691, OR P0692: COOLING FAN SPEED (GAS)

Diagnostic Instructions

- Review **Circuit 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 Control 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*	P0480, P0691	-	-
Cooling Fan Control Module Ground	-	-	-	-
Cooling Fan Control Module Control	P0480, P0691	P0480, P0691	P0692	-
*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

P0691, and P0692 are Type B DTCs.

Diagnostic Aids

- A delay or ramp up of approximately 12 seconds may occur before the cooling fan activates or changes speed when being commanded with a scan tool.
- In order to set certain DTCs the PCM must command the Cooling Fan system On. Using the scan tool to operate the Cooling Fan will not set certain DTCs. In these cases run the vehicle until it reaches an appropriate condition for the PCM to command the Cooling Fans On.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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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.

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

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.
 - **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.

• If 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 K22 Cooling Fan Control Module.

2. Ignition ON, 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 K22 Cooling Fan Control Module.

- **If the test lamp illuminates**

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.

3. Connect a DMM, set on the diode setting, between the K22 Cooling Fan Control Module control circuit terminal 4 and ground.

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 K22 Cooling Fan Control Module control circuit terminal 4 and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If greater than 2.5 V or displays O.L.**

5. Command the cooling fan ON to 90% with a scan tool.

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.

Test for less than 1 V between the K22 Cooling Fan Control Module control circuit terminal 4 and ground	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- 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 end to end.

- 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 K20 Cooling Fan Control Module.

Repair Instructions

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

- [Fan Blade Replacement](#) for G10 Cooling Fan Motor or K22 Cooling Fan Control Module replacement.
- [Control Module References](#) for ECM replacement, setup, and programming

DTC P0480, P0691, OR P0692: COOLING FAN SPEED (LWN DIESEL)

Diagnostic Instructions

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

DTC Descriptor

DTC 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
Fan Relay Voltage Supply	-	P0480, P0691	-	-
Fan Relay Control	P0691	P0480	P0692	-
Fan Speed Sensor Low Reference	-	P0526	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fan Speed Sensor 5-Volt Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Fan Speed Sensor Signal	P0526	P0526	P0526	-
Fan Clutch Ground	-	P0483	-	-
Fan Clutch Control	P0480	P0483	P0483, P0495	-

Circuit/System Description

The engine control module (ECM) pulse width modulates (PWM) a 12-volt signal from the cooling fan relay, to control the cooling fan relay on time. The cooling fan relay varies the voltage drop across the cooling fan clutch solenoid in relation to the PWM signal from the ECM, which allows the cooling fan to operate at variable speeds.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V.
- The engine is operating.
- The engine speed is greater than 600 RPM.
- DTC P0480 runs continuously when the conditions above exist for greater than 6 s.

Conditions for Setting the DTC

The ECM detects that the commanded state of the ECM driver, and the actual state of the cooling fan relay control circuit do not match for greater than 1 s.

Action Taken When the DTC Sets

DTC P0480, P0691, P0692 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0480, P0691, P0692 are Type B DTCs.

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

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. Engine running.
2. Verify DTC P0480, P0691, or P0692 is not set.
 - **If DTC is set**

Refer to Circuit/System Testing
 - **If no DTC is set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the a DTC does not set.
 - **If a DTC sets**

Refer to Circuit/System Testing
 - **If no DTC is set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the KR20F Cooling Fan Relay.
2. Test for less than 5 Ω between the fan relay ground circuit terminal 86 and ground.
 - **If 5 Ω or greater**
 1. 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 less than 5 Ω**
3. Ignition ON, verify that a test lamp illuminates between the ignition voltage circuit terminal 87 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Replace the X50A Fuse Block - Underhood
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Disconnect the harness connector at the Q85 Cooling Fan Clutch.
 2. Test for infinite resistance between the fan relay controlled output circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the Q85 Cooling Fan Clutch.
 - **If the test lamp illuminates**
 1. Connect test lamp between KR20F Cooling Fan Relay circuit terminal 85 and B+.

Engine running, verify test lamp flashes rapidly and increases in intensity while commanding the cooling fan from 0-50 %.

- **If the test lamp does not illuminate**

1. Ignition OFF, and all vehicle systems OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the Fan Relay control circuit terminal and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

4. Replace the Q85 Cooling Fan Clutch.
5. Test or replace the KR20F Cooling Fan Relay.

Component Testing

EV Fan Clutch Solenoid Valve Test

1. Disconnect the harness connector at the cooling fan clutch.
2. Test for 7-17 Ω between terminal B and terminal A of the jumper harness connector.
 - **If not within specified range**
 1. Replace the Q85 Cooling Fan Clutch.
 - **If within specified range**
3. Test for infinite resistance between the jumper harness terminals listed below.
 - 2 and 5
 - 2 and 4
 - 2 and 3
 - 2 and the fan clutch housing/ground
 - **If less than infinite**
 1. Repair or replace the jumper harness.
 - **If infinite**
 1. Replace the Q85 Cooling Fan Clutch.

Repair Instructions

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

- [Fan Blade Clutch Replacement \(LWN\)](#)
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P0483 OR P0493: COOLING FAN SYSTEM PERFORMANCE (LWN DIESEL)

Diagnostic Instructions

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

DTC Descriptor

DTC P0483

Fan System Performance Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fan Relay Voltage Supply	-	P0480, P0691	-	-
Fan Relay Control	P0691	P0480	P0692	-
Fan Speed Sensor Low Reference	-	P0526	-	-
Fan Speed Sensor 5-Volt Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Fan Speed Sensor Signal	P0526	P0526	P0526	-
Fan Clutch Ground	-	P0483	-	-
Fan Clutch Control	P0480	P0483	P0483, P0495	-

Circuit/System Description

The engine control module (ECM) pulse width modulates (PWM) a 12-volt signal from the cooling fan relay, to control the cooling fan relay on time. The cooling fan relay varies the voltage drop across the cooling fan clutch solenoid in relation to the PWM signal from the ECM, which allows the cooling fan to operate at variable speeds.

Conditions for Running the DTC

- DTC P0016, P007C, P007D, P0112, P0113, P0117, P0118, P0335, P0336, P0340, P0341, P0480, P0495, or P0526 is not set.
- The engine is operating for greater than 10 s.
- The engine speed is between 200-5, 320 RPM.
- The Barometric Pressure (BARO) is greater than 75 kPa.
- The engine coolant temperature is warmer than 70°C (158°F).
- The intake air temperature (IAT) is warmer than -7°C (19°F).
 - The ambient air temperature is warmer than -7°C (19°F)
- The ECM commanded fan duty cycle is greater than 15 %.
- The cooling fan input shaft speed is steady.
- DTC P0483 runs continuously every 100 ms when the conditions above exist.

Conditions for Setting the DTC

- The difference between the desired and the actual cooling fan speeds is 500 RPM or greater.
- The condition exists for 1 minute.

Action Taken When the DTC Sets

DTC P0483 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0483 is a Type B DTC.

Reference Information

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 OFF, inspect the cooling fan and the drive belt for the conditions listed below:

- A loose, worn, or mis-routed drive belt.
- Oil leaks at the cooling fan clutch.
- A free-spinning cooling fan.
- A seized cooling fan clutch.
- A broken cooling fan.
- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. Ignition ON.

3. Verify DTC P0480 or P0526 is not set.

- **If a DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If no DTC is set**

4. Verify the difference between the scan tool Fan Speed and Desired Fan Speed parameters is less than 500 RPM while operating the engine at 1,500 RPM and slowly commanding the Cooling Fan from 10 % to 80 %, then back to 10 % with a scan tool.

- **If not within 500 RPM**

Refer to Circuit/System Testing.

- **If within 500 RPM**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

6. Verify that P0483 does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If no DTC is set**

7. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the KR20F Cooling Fan Relay.

2. Test for less than 5 Ω between the fan relay ground circuit terminal 86 and ground.

- **If 5 Ω or greater**

1. 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 less than 5 Ω**

3. Disconnect the harness connector at the Q85 Cooling Fan Clutch.

4. Test for less than 5 Ω between the Q85 Cooling Fan Clutch ground circuit terminal 6 and ground.

- **If 5 Ω or greater**

1. 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 less than 5 Ω**

5. Install the KR20F Cooling Fan Relay.

6. Connect a test lamp between the Q85 Cooling Fan Clutch control circuit terminal 2 and ground, engine running.

7. Verify a test lamp illuminates and flashes ON and OFF while commanding the Cooling Fan to 50 % with a scan tool.

- **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 infinite resistance between the control circuit terminal B and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω between the cooling fan clutch circuit terminal B and the cooling fan relay terminal 4.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the KR20F Cooling Fan Relay.

- **If the test lamp illuminates without flashing**

1. Ignition OFF, disconnect the KR20F Cooling Fan Relay, ignition ON.

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If less than 1 V, replace the KR20F Cooling Fan Relay.

- **If the test lamp flashes**

8. Test or replace the cooling fan clutch assembly.

Component Testing

EV Fan Clutch Solenoid Valve Test

1. Disconnect the harness connector at the cooling fan clutch.
2. Test for 7-17 Ω between terminal B and terminal A of the jumper harness connector.
 - **If not within specified range**
 1. Replace the Q85 Cooling Fan Clutch.
 - **If within specified range**
3. Test for infinite resistance between the jumper harness terminals listed below.
 - 2 and 5
 - 2 and 4
 - 2 and 3
 - 2 and the fan clutch housing/ground
 - **If less than infinite**
 1. Repair or replace the jumper harness.
 - **If infinite**
 1. Replace the Q85 Cooling Fan Clutch.

Repair Instructions

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

- [Fan Blade Clutch Replacement \(LWN\)](#)
- [Control Module References](#) for replacement, programming and setup.

DTC P0495: COOLING FAN SPEED TOO HIGH ((LWN) DIESEL)

Diagnostic Instructions

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

DTC Descriptor

DTC P0495

Cooling Fan Speed Too High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fan Relay Voltage Supply	-	P0480, P0691	-	-
Fan Relay Control	P0691	P0480	P0692	-
Fan Speed Sensor Low Reference	-	P0526	-	-
Fan Speed Sensor 5-Volt Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Fan Speed Sensor Signal	P0526	P0526	P0526	-
Fan Clutch Ground	-	P0483	-	-
Fan Clutch Control	P0480	P0483	P0483, P0495	-

Circuit/System Description

The engine control module (ECM) pulse width modulates (PWM) a 12-volt signal from the cooling fan relay, to control the cooling fan relay on time. The cooling fan relay varies the voltage drop across the cooling fan clutch solenoid in relation to the PWM signal from the ECM, which allows the cooling fan to operate at variable speeds.

Conditions for Running the DTC

- DTC P0016, P0112, P0113, P0117, P0118, P0335, P0336, P0340, P0341, P0480, P0483, P0526, P2228, or P2229 is not set.
- The engine is operating for greater than 10 s.
- The engine speed is greater than 1, 181 RPM.
- The engine OFF time after the previous ignition cycle was greater than 0 s.
- The ambient air temperature (AAT) is warmer than -40Â°C (-40Â°F).
- The BARO is greater than 55 kPa.
- The ECM commanded fan duty cycle is less than 45 %.
- DTC P0495 runs continuously when the conditions above exist.

Conditions for Setting the DTC

- The cooling fan speed is greater than 1, 500 RPM for 80 s.

Action Taken When the DTC Sets

DTC P0495 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0495 is a Type B DTC.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 OFF, verify the fan clutch is not seized or binding.
2. Ignition ON, Verify DTC P0480, P0483, or P0526 is not set.

- **If a DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If no DTC is set**

3. Operate the engine at 1, 500 RPM in operating temperature with all accessories turned OFF, for greater than 10 minutes.

NOTE: Depending on elevation above sea level it may take up to 52 minutes for the fan clutch to completely disengage.

- 4.
5. Verify DTC P0495 is not set.

- **If the DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q85 Cooling Fan Clutch.
2. Connect a test lamp between the Q85 Cooling Fan Clutch voltage control circuit terminal 2 and ground, ignition ON.

NOTE: Engine may have to be running to control the Cooling Fan Solenoid Valve.

3. Command the Cooling Fan Solenoid Valve to 50 % with a scan tool.

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If the test lamp illuminates and flashes ON and OFF, the circuit is shorted to ground.
- If the test lamp illuminates without flashing, the circuit is open or has high resistance.

1. Ignition OFF, disconnect the KR20F Cooling Fan Relay, ignition ON.
2. Test for less than 1 V between the Q85 Cooling Fan Clutch voltage control circuit terminal 2 and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the KR20F Cooling Fan Relay.
- If the test lamp flashes
5. Replace the Q85 Cooling Fan Clutch.

Repair Instructions

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

- [Fan Blade Clutch Replacement \(LWN\)](#)
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P0526: COOLING FAN SPEED SENSOR CIRCUIT (LWN DIESEL)

Diagnostic Instructions

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

DTC Descriptor

DTC P0526

Cooling Fan Speed Sensor Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fan Relay Voltage Supply	-	P0480, P0691	-	-
Fan Relay Control	P0691	P0480	P0692	-
Fan Speed Sensor Low Reference	-	P0526	-	-
Fan Speed Sensor 5-Volt Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Fan Speed Sensor Signal	P0526	P0526	P0526	-
Fan Clutch Ground	-	P0483	-	-
Fan Clutch Control	P0480	P0483	P0483, P0495	-

Circuit/System Description

NOTE: The schematic may include the component R10 Cooling Fan Resistor which is used to prevent a voltage spike to the ECM.

Control module (ECM) uses the cooling fan speed signal in order to determine the actual fan speed in relation to the desired fan speed. The ECM uses the cooling fan speed signal in order to reduce the cooling fan noise and maintain the powertrain cooling requirements. The ECM supplies a 5-volt reference and low reference circuit to clutch hall effect sensor in the cooling fan clutch. The hall effect sensor returns a signal pulse through the signal circuit in response to the reluctor track, which is located inside the fan clutch.

Conditions for Running the DTC

- The ECM commanded fan duty cycle is greater than 36 % for greater than 2s.
- DTC P0526 runs continuously when the conditions above exist for greater than 30 S.

Conditions for Setting the DTC

- The ECM detects that the cooling fan speed signal is less than 4 RPM.
- DTC P0526 sets if the condition above exists for greater than 2 min.

Action Taken When the DTC Sets

DTC P0526 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0526 is a Type B DTC.

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. Observe the DTC information with a scan tool. Verify DTC P0651 is not set.

a DTC is set

Refer to [DTC P0641, P0651, P0697, or P06A3](#)

- **If no DTC is set**

2. Observe the DTC information with a scan tool. Verify DTC P0526 is not set.

- **If a DTC is set**

Refer to [DTC P0526 \(LWN Diesel\)](#)

- **If no DTC is set**

3. Engine running, verify the scan tool Fan Speed parameter is greater than 0 RPM.

- **If 0 RPM**

Refer to Circuit/System Testing.

- **If greater than 0 RPM**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If DTC sets**

Refer to Circuit/System Testing

- **If no DTC is set**

5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q85 Cooling Fan Clutch.

2. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for less than 5 Ω between low reference circuit terminal 5 and ground.

- **If greater than 5 Ω**

1. Disconnect the X2 harness connector at the K20 Engine Control Module. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit terminal and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the 5 V reference circuit terminal end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2**

Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for less than 1 V between the 5 V reference circuit terminal and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

• **If between 4.8- 5.2 V**

4. Test for 4.8-5.2 V between the signal circuit terminal 4 and ground.

• **If less than 4.8 V**

1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 4 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the signal circuit terminal end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

• **If greater than 5.2**

1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for less than 1 V between the signal circuit terminal and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

• **If between 4.8- 5.2 V**

5. Test or replace the Q85 Cooling Fan Clutch.

Repair Instructions

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

- [Fan Blade Clutch Replacement \(LWN\)](#)
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P0597-P0599: ENGINE COOLANT THERMOSTAT (LCV OR 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 Descriptor

DTC P0597

Engine Coolant Thermostat Heater Control Circuit

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Coolant Thermostat Heater Control Circuit		High Voltage		

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voltage	P0031, P0443, P0597, P0598*, P06DA, P06DB	P0031, P0443, P0597, P0598, P06DA, P06DB	-	-
Thermostat Control Circuit	P0598	P0597	P0599, P0690	-
*Opens the fuse that supplies voltage to the engine coolant thermostat				

Circuit/System Description

The engine control module (ECM) controls the pulse width modulated (PWM) thermostat. The thermostat controls coolant flow and regulates the engine operating temperature. Ignition voltage is supplied directly to the thermostat through a fuse. The ECM controls the thermostat by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTCs

- The ignition is ON, or the engine is running.
- The DTCs run continuously once the above condition is 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 15 seconds.

Action Taken When the DTC Sets

- DTCs P0597, P0598, and P0599 are Type B DTCs.
- The engine control module commands the engine cooling fans ON.

Conditions for Clearing the DTC

DTCs P0597, P0598, and P0599 are Type B DTCs.

Diagnostic Aids

- A low engine coolant level could cause the thermostat heater to overheat and set a DTC.
- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 80Â°C (176Â°F). The mechanical thermostat will cycle from approximately 85Â°C (185Â°F) to approximately 102Â°C (215Â°F).

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. [Loss of Coolant](#), and [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
 - **If the coolant level is not correct**

Repair as necessary
 - **If the coolant level is correct**
2. Ignition ON
3. Verify the parameters listed below do not display Malfunction when commanding the Engine Coolant Thermostat Heater ON and OFF with a scan tool.
 - Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status
 - Engine Coolant Thermostat Heater Control Circuit Open Test Status
 - Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
4. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
5. Verify the DTC does not set.
 - **If any DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the E41 Engine Coolant Thermostat Heater, Ignition ON.
2. Verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.

the test lamp does not illuminate and the circuit fuse is good

1. Ignition OFF.

2. Test for less than 2 Ω in the ignition 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.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, test all the components connected to fuse and replace as necessary.

• **If the test lamp illuminates**

3. Connect a test lamp between the ignition circuit terminal 1 and the control circuit terminal 2, command the Engine Coolant Thermostat Heater to Increase to 100 % and Decrease to 0 % with a scan tool.

4. Verify that a test lamp turns On and OFF.

• **If the test is always ON**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the control 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 is always OFF**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

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

1. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module

• **If the test lamp turns On and OFF**

5. Test or replace the E41 Engine Coolant Thermostat Heater.

Repair Instructions

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

- [Engine Coolant Thermostat Housing Replacement \(LCV\)](#)[Engine Coolant Thermostat Housing Replacement \(LFX\)](#) for E41 engine coolant thermostat heater replacement.
- [Control Module References](#) engine control module replacement, programming, and setup.

DTC P112F: RADIATOR COOLANT TEMPERATURE SENSOR NOT PLAUSIBLE (LCV OR 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 Descriptor

RCT Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radiator Coolant Temperature Sensor	Not Plausible			

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P112F
Low Reference	-	P00B4	P00B4*	P112F
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running in Closed Loop			
Parameter Normal Range: Varies with ambient temperature			
Signal	140Â°C (284Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The engine coolant radiator temperature sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. The engine control module (ECM) supplies 5 volts to the engine coolant radiator temperature signal circuit and supplies a ground to the low reference circuit. The purpose of this diagnostic is to determine if the input from the RCT sensor is skewed warmer than normal. The internal clock of the ECM will record the amount of time the engine is OFF. If the required engine OFF time is met at start-up, the ECM will compare the temperature difference between the actual measured RCT and ECT sensors.

The following table illustrates the difference between temperature, resistance, and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

- DTCs P00B3, P00B4, P0112, P0113, P0117, P0118, P0502, P0503, P111E or P2610 are not set.
- The vehicle has been OFF for greater than 8 hours before vehicle ON.
- The engine is running.
- The intake air temperature (IAT) is warmer than -7Â°C (19Â°F).
- The fuel level is greater than 10 percent.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM determines the absolute difference of temperature between the RCT start up temperature and ECT start up temperature is greater than 20Â°C (68Â°F).

Action Taken When the DTC Sets

a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P112F is a Type B DTC.

Diagnostic Aids

- As the thermostat opens, the radiator coolant temperature sensor signal should rise steadily, then stabilize once the thermostat opens completely.
- Inspect for the correct operation of the engine cooling system and verify the correct coolant level.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120Â°C (-38 to +248Â°F) and changes with engine run time.
 - **If not between -39 to + 120Â°C (-38 to +248Â°F) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to + 120Â°C (-38 to +248Â°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

the DTC does not set

5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39 $^{\circ}$ C (-38 $^{\circ}$ F).
 - **If warmer than -39 $^{\circ}$ C (-38 $^{\circ}$ F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 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 colder than -39 $^{\circ}$ C (-38 $^{\circ}$ F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Ignition ON, Verify the scan tool Radiator Coolant Temperature Sensor parameter is warmer than 140 $^{\circ}$ C (284 $^{\circ}$ F).
 - **If colder than the 140 $^{\circ}$ C (284 $^{\circ}$ F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - **If warmer than 140 $^{\circ}$ C (284 $^{\circ}$ F)**
7. Test or replace the B34B Engine Coolant Temperature Sensor 2.

Component Testing

1. Vehicle OFF, remove the B34B Engine Coolant Temperature Sensor.

NOTE: A thermometer can be used to test the sensor off the vehicle.

2. Test the engine coolant temperature sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance](#) table and verify that the resistance is within 5 percent of the specification.

not within the specified range, replace the B34B Engine Coolant Temperature Sensor.

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement - Radiator \(LCV\)](#)
- [Engine Control Module Replacement](#) for ECM replacement, setup, and programming

DTC P1258: ENGINE COOLANT OVERTEMPERATURE

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 132Â°C (270Â°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

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Cooling Fan Description and Operation
- Instrument Cluster Description and Operation (Base) Instrument Cluster Description and Operation (Uplevel)
- 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 (LCV or LFX) K20 Engine Control Module: Scan Tool Information (LKH or LWN) 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 (Gas) DTC P0480, P0691, or P0692 (LWN Diesel).

- **If no DTCs is set**

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

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

- **Cooling fan does not operate**

Refer to Cooling Fan Inoperative.

- **Cooling fan operates**

4. Verify that the engine does not overheat.

- **Engine overheats**

Refer to Engine Overheating.

- **Engine does not overheat**

5. Operate the vehicle within the conditions 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

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

DTC P2181: ENGINE COOLING SYSTEM PERFORMANCE

Diagnostic Instructions

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

DTC Descriptor

DTC P2181

Engine Cooling System Performance

Circuit/System Description

The engine control module (ECM) monitors temperature difference between the engine coolant temperature (ECT) sensor and the radiator coolant temperature (RCT) sensor during a cold start-up. The purpose of this diagnostic is to analyze the engine coolant thermostat for being stuck open.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0117, P0118, P111E or P112F are not set.
- The vehicle has had a minimum ignition OFF time of 7 h.
- The engine run time is between 90 s and 30 min.
- The engine coolant temperature (ECT) sensor at start-up is between -10Â° C to 75Â° C (14Â° F to 167Â° F).
- The intake air temperature (IAT) sensor is between -7Â° C to 52Â° C (19Â° F to 126Â° F).
- The Engine Coolant Thermostat Heater Command is less than 20 %.
- The airflow into the engine is between 8 to 30 g/s.
- The Ethanol in the fuel is less than 87 %.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM detects the engine coolant thermostat is stuck open for at least 90 s.

Action Taken When the DTC Sets

DTC P2181 is a Type B DTC

Conditions for Clearing the DTC

DTC P2181 is a Type B DTC

Diagnostic Aids

- Insufficient vehicle interior heating is an indication of improper thermostat operation.

1 tool Desired ECT Sensor and the ECT Sensor parameters should be within 5Â° C (41Â° F) when the engine is at operating temperature.

- A resistance condition in the ECT sensor circuits may cause this DTC. This condition results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation (LFX)Cooling System Description and Operation (LWN)

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. Engine running, observe the DTC information with a scan tool. DTC P00B3, P00B4, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0117, P0118, P111E or P112F should not be set.

- **If DTC P00B3, P00B4, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0117, P0118, P111E or P112F is set**

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

- **If DTC P00B3, P00B4, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0117, P0118, P111E or P112F is not set**

2. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.

- **If the coolant in the radiator surge tank is not at the correct level or there are engine coolant leaks**

Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill), and Loss of Coolant.

- **If the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks**

the engine cooling fan is not ON at all times.

- **If the engine cooling fan is ON at all times**

Refer to [Cooling Fan Always On](#).

- **If the engine cooling is not ON at all times**

4. Engine idling for 15 min with the A/C OFF.

5. Command the Engine Coolant Thermostat Heater to 0 % with a scan tool. Increase the engine speed to 3,000 RPM. Observe the scan tool ECT sensor parameter for 5 min or until the ECT sensor is between 82Â° C and 102Â° C (180Â° F and 215Â° F)

- **If ECT sensor is not between 82Â° C and 102Â° C (180Â° F and 215Â° F)**

Replace the engine coolant thermostat.

- **If ECT sensor is between 82Â° C and 102Â° C (180Â° F and 215Â° F)**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to step 1.

- **If the DTC does not set**

8. All OK.

Repair Instructions

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

[Engine Coolant Thermostat Housing Replacement \(LCV\)](#)[Engine Coolant Thermostat Housing Replacement \(LFX\)](#) for Engine Coolant Thermostat Replacement.

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

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

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to [Cooling Fan Description and Operation](#), and [Cooling System Description and Operation \(LFX\)](#)[Cooling System Description and Operation \(LWN\)](#).

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

ent 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 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.
- 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.
- In order to set certain DTCs the PCM must command the Cooling Fan system On. Using the scan tool to operate the Cooling Fan will not set certain DTCs. In these cases run the vehicle until it reaches an appropriate condition for the PCM to command the Cooling Fans On.

Reference Information

Schematic Reference

[Engine Heating/Cooling Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

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 \(Gas\)](#)[DTC P0480, P0691, or P0692 \(LWN Diesel\)](#).
 - **If no DTC is set.**
3. Verify the scan tool Cooling Fan Motor Command parameter is 0 %.
 - **If greater than 0 %**

Refer to Diagnostic Aids and [Symptoms - Engine Cooling](#) for further diagnosis.
 - **If 0 %**
4. Verify that the G10 Cooling Fan Motor is not operating.
 - **If the G10 Cooling Fan Motor is operating**

Refer to Circuit/System Testing.
 - **If the G10 Cooling Fan Motor is not operating**
5. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the G10 Cooling Fan Motor harness connector X2 at the K22 Cooling Fan Control Module, ignition ON.
3. Verify that the G10 Cooling Fan Motor is not operating.
 - **If the G10 Cooling Fan Motor is operating**
 1. Ignition OFF.
 2. Test for less than 1 V between the G10 Cooling Fan Motor harness connector terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - **If the G10 Cooling Fan Motor is not operating**
4. Replace the K22 Cooling Fan Control Module.

Repair Instructions

Diagnostic Repair Verification after completing the repair.

- **Fan Blade Replacement** for G10 Cooling Fan Motor or K22 Cooling Fan Control Module 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

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 \(Gas\)](#)[DTC P0480, P0691, or P0692 \(LWN Diesel\)](#).

- **If no DTC is set.**

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

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

Refer to Circuit/System Testing

- **The cooling fan activates and increases in speed**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K22 Cooling Fan Control Module.
2. Verify that a test lamp illuminates between the ground circuit terminal 14 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**

Test or replace the G10 Cooling Fan Motor.

Repair Instructions

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

• **Control Module References**

ENGINE OVERHEATING

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			
1	Check for a loss of coolant. Refer to Loss of Coolant . 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 Fill)Cooling System Draining and Filling (Vac n Fill) . 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 Fill)Cooling System Draining and Filling (Vac n Fill) . Does the engine still overheat?	Go to Step 9	System OK
9	NOTE: Use the correct pressure cap. Check the system for loss of pressure. Refer to Pressure Cap Testing Is there a loss of pressure?	Go to Step 10	Go to Step 11
10	Repair any leaks, as necessary. Does the engine still overheat?	Go to Step 11	System OK
11	Check for a faulty engine coolant temperature sensor. Is the engine coolant temperature sensor faulty?	Go to Step 12	Go to Step 13
12	Replace the engine coolant temperature sensor. Refer to Engine Coolant Temperature Sensor Replacement , 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 Flushing 3. Refill the coolant. Refer to Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill) 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 Engine Coolant Fan Shroud Replacement (LFX) Engine Coolant Fan Shroud Replacement (LCV) Engine Coolant Fan Shroud Replacement (LWN) . Does the engine still overheat?	Go to Step 19	System OK
19	Check for a thermostat that is stuck closed. Is the thermostat stuck closed?	Go to Step 20	Go to Step 21
20	Replace the thermostat. Refer Engine Coolant Thermostat Housing Replacement (LCV) Engine Coolant Thermostat Housing Replacement (LFX) . Does the engine still overheat?	Go to Step 21	System OK
21	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to Step 22	-
22	Replace the water pump. Refer to Water Pump Replacement (LFX) Water Pump Replacement (LCV) Water Pump Replacement (LWN) . 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 Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-

Step	Action	Yes	No
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill) . Is the action complete?	Go to Step 5	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 19	Go to Step 6
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 7	Go to Step 8
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. 2. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 20	Go to Step 8
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Engine block • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 21	Go to Step 10
10	1. Pressure test the cooling system. Refer to Cooling System Leak Testing . 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8. Are any leaks present?	Go to Step 21	Go to Step 11
11	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing . Does the coolant pressure cap hold pressure?	Go to Step 12	Go to Step 16

Step	Action	Yes	No
12	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering near the HVAC module Is coolant present?	Go to Step 21	Go to Step 13
13	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to Step 14	Go to Step 15
14	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to Step 17	Go to Step 15
15	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 18	Go to Step 22
16	Replace the coolant pressure cap. Is the repair complete?	Go to Step 22	-
17	1. Replace the radiator. Refer to Radiator Replacement (LFX) Radiator Replacement (LCV) Radiator Replacement (LWN) . 2. Replace the oil and filter. Refer to Engine Oil and Oil Filter Replacement . Is the repair complete?	Go to Step 22	-
18	1. Replace the radiator. Refer to Radiator Replacement (LFX) Radiator Replacement (LCV) Radiator Replacement (LWN) . 2. Service the automatic transmission. Refer to the following: Engine Coolant/Water in Transmission . Is the repair complete?	Go to Step 22	-
19	Repair the engine overheating condition. Refer to Engine Overheating . Is the repair complete?	Go to Step 22	-
20	Repair the engine internal coolant leak. Refer to Coolant in Combustion Chamber , or Coolant in Engine Oil . Is the repair complete?	Go to Step 22	-
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 22	-

Step	Action	Yes	No
22	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS

Tools Required

J 24731 Tempil Stick

Use one of the following procedures in testing for a malfunctioning thermostat.

Thermostat Test Procedure Using Tempil Sticks

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

1. Use a tempil stick in order to find the opening and the closing temperatures of the coolant thermostat.
 - **J 24731** Tempil Stick -188 tempil stick melts at 87Â°C (188Â°F). The thermostat should begin to open.
 - **J 24731** Tempil Stick -206 tempil stick melts at 97Â°C (206Â°F). The thermostat should be fully open.
2. Replace the coolant thermostat if it does not operate properly between this temperature range.

Thermostat Test Procedure Using Glycol

Inspect the operation of the thermostat by hanging the thermostat on a hook in a 50/50 percent solution of DEX-COOLÂ® and clean drinkable water.

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

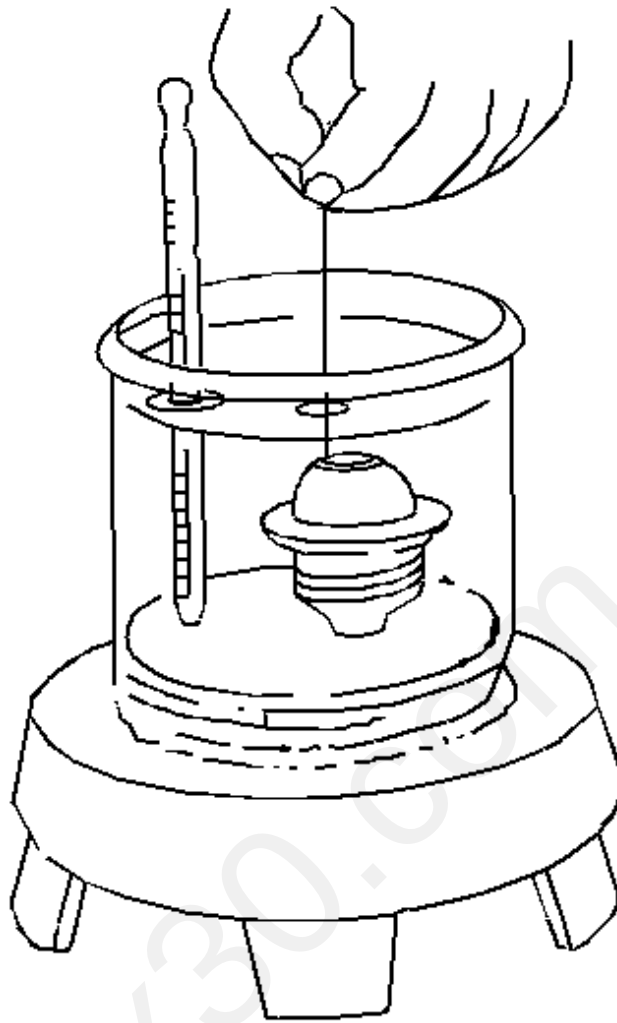


Fig. 3: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS COMPANY

1. Completely submerge the thermostat in the glycol solution. The solution should be 11°C (22°F) above the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should open.

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

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

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.

Step	Description	Action	Yes	No
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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 -18°C (0°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 -18°C (0°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 or replace the coolant heater cord.

Repair Instructions

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

- [Coolant Heater Replacement \(LCV\)](#)[Coolant Heater Replacement \(LFX\)](#)[Coolant Heater Replacement \(LWN\)](#)
- [Coolant Heater Cord Replacement \(LFX\)](#)[Coolant Heater Cord Replacement \(LCV\)](#)[Coolant Heater Cord Replacement \(LWN\)](#)

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Step	Action	Yes	No

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 (LCV) Engine Coolant Thermostat Housing Replacement (LFX) . 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

To avoid being burned, do not remove the radiator cap or surge tank 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.

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



Fig. 4: Identifying Pressure Cap Tester

Courtesy of GENERAL MOTORS COMPANY

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

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

Note the rate of pressure loss.

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

COOLANT LEAK TESTING

Special Tools

01 Cooling System Pressure Tester

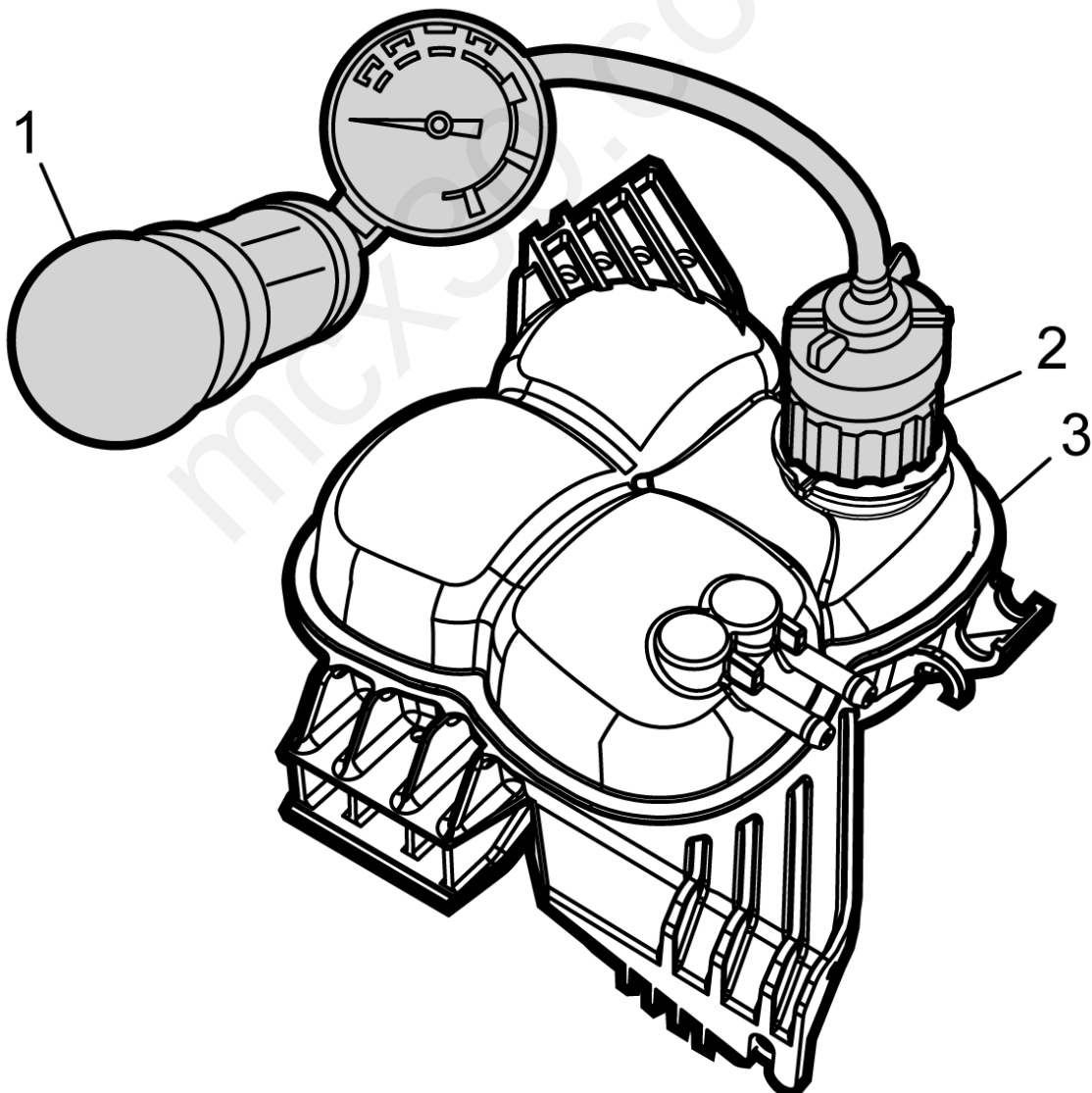
- **J-42401** Radiator Cap/Surge Tank Test Adapter

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

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

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

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to [Pressure Cap Testing](#).
3. Wash the pressure cap mating surface with water.



Cooling System Pressure Tester And Radiator Cap/Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

4. Use the **J-24460-01** cooling system pressure tester (1) with the **J-42401** radiator cap/surge tank test adapter (2) in order to apply pressure to the cooling system (3).

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.

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

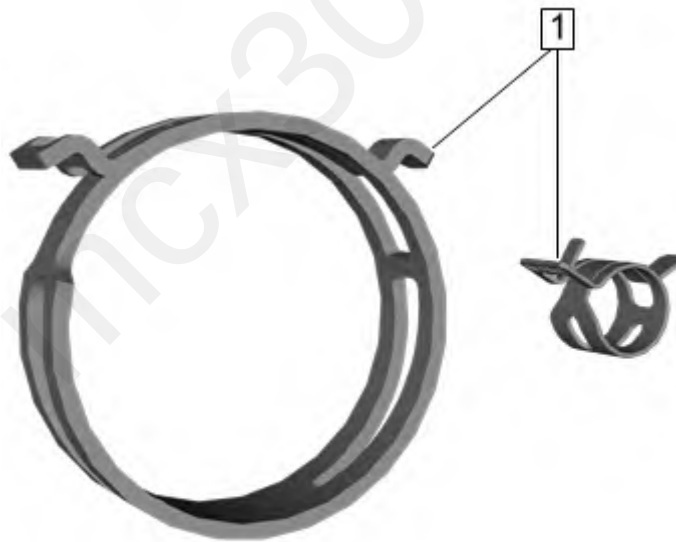


Fig. 6: Spring Type Hose Clamps

Courtesy of GENERAL MOTORS COMPANY

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

These 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.

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 FILL)

Special Tools

- **J 26568** Coolant and Battery Tester

Draining Procedure

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

1. Follow the steps below in order to remove the surge tank fill cap:
 1. Slowly rotate the cap counterclockwise.
 2. Stop rotating and allow the hissing to stop.
 3. After all the hissing stops, continue turning counterclockwise in order to remove the cap.
2. To drain the cooling system, remove the radiator drain cock from the radiator. Refer to [Radiator Drain Cock Replacement \(LFX\)](#)[Radiator Drain Cock Replacement \(LCV, LWN\)](#).
3. If a complete engine block drain is required, remove the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets.
4. Inspect the coolant.
5. Follow the appropriate procedure based on the condition of the coolant:
 - Normal in appearance-Follow the filling procedure.
 - Discolored-Follow the flush procedure. Refer to [Flushing](#).

Filling Procedure

CAUTION:

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

1. Install the radiator drain cock to the radiator. Refer to [Radiator Drain Cock Replacement \(LFX\)](#)[Radiator Drain Cock Replacement \(LCV, LWN\)](#).
2. If the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets were removed, install the gaskets and plugs. Refer to [Fastener Specifications](#).
3. Lower the vehicle.

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

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

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

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

COOLING SYSTEM DRAINING AND FILLING (VAC N FILL)

Special Tools

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

Draining Procedure

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

1. Park the vehicle on a level surface.
2. Remove the coolant pressure cap.
3. To drain the cooling system, remove the radiator drain cock from the radiator. [Radiator Drain Cock Replacement \(LFX\)](#)[Radiator Drain Cock Replacement \(LCV, LWN\)](#).
4. If a complete engine block drain is required, remove the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets.

the coolant.

6. Follow the appropriate procedure based on the condition of the coolant.

- Normal in appearance-Follow the filling procedure.
- Discolored-Follow the flush procedure. [Flushing](#).

Vac-N-Fill Procedure

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

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

1. Install the radiator drain cock to the radiator. [Radiator Drain Cock Replacement \(LFX\)](#)[Radiator Drain Cock Replacement \(LCV, LWN\)](#).
2. If the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets were removed, install the gaskets and plugs. [Fastener Specifications](#) .
3. Lower the vehicle.
4. Install the **J 42401** radiator cap and surge tank test adapter.

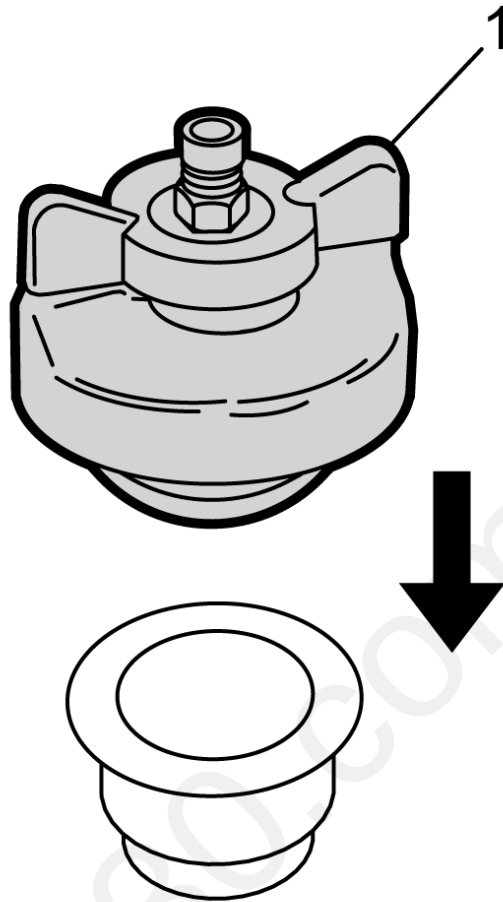


Fig. 7: Radiator Cap & Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

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

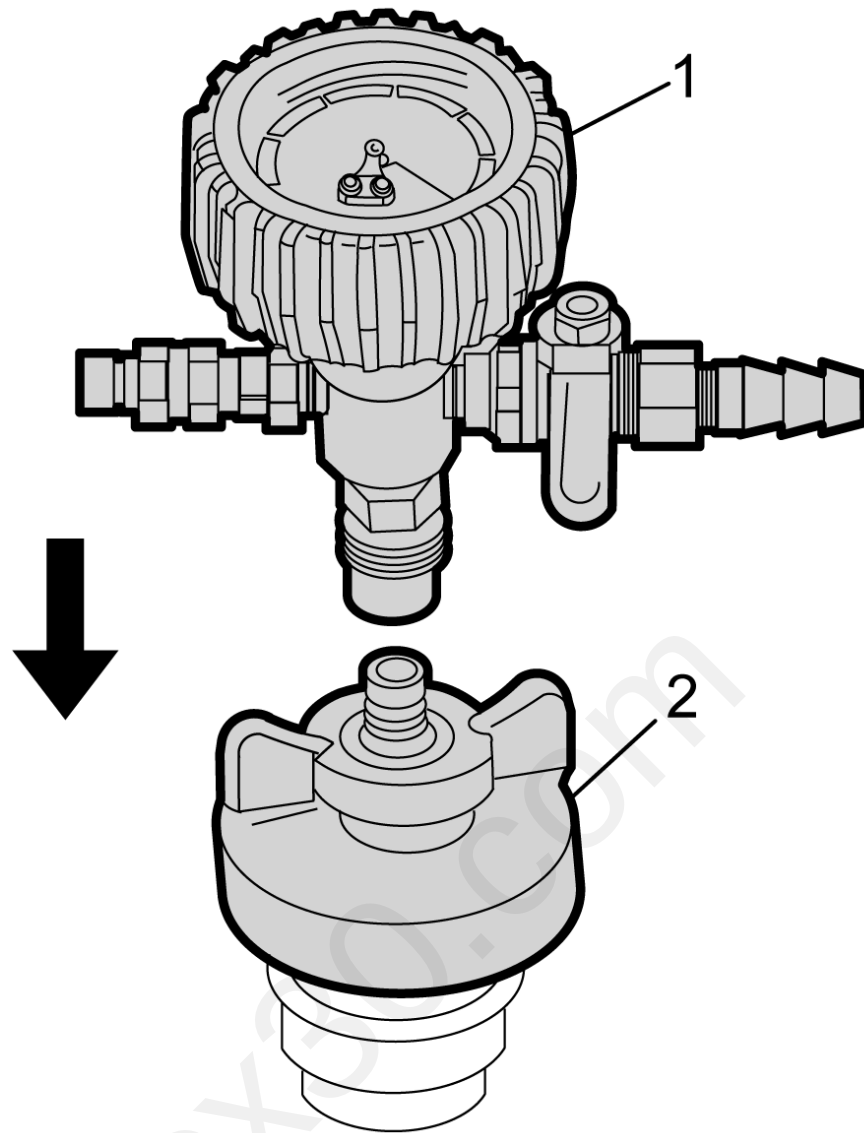


Fig. 8: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

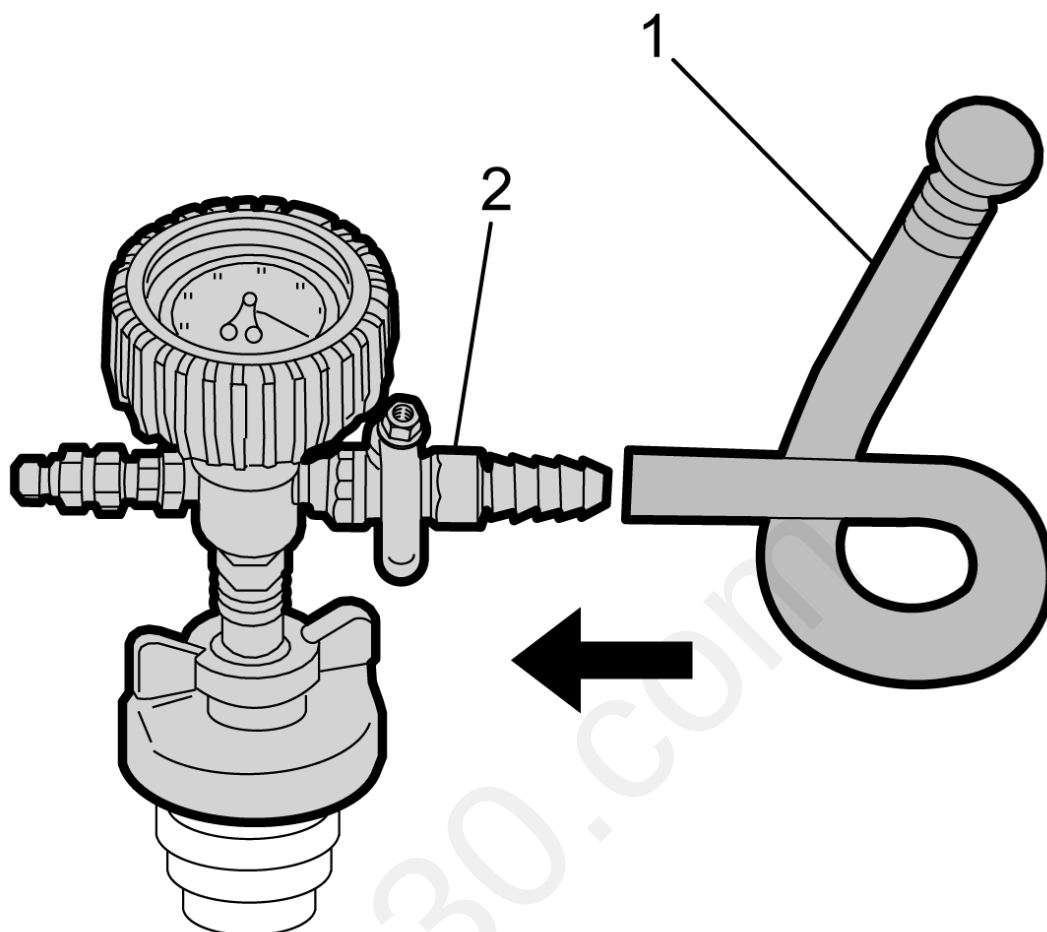


Fig. 9: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

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

Ensure that the valve is closed.

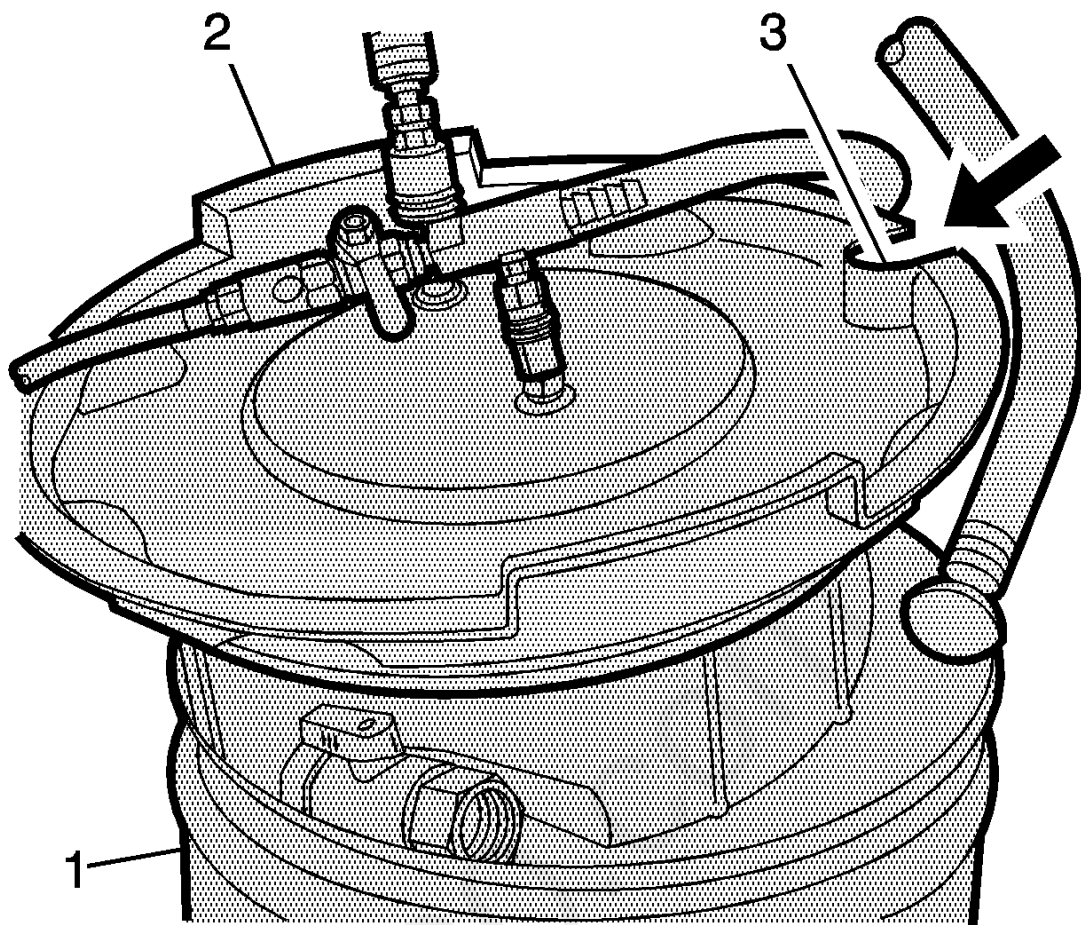


Fig. 10: Graduated Reservoir, Vacuum Tank & Cut-Out Area

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

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

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

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

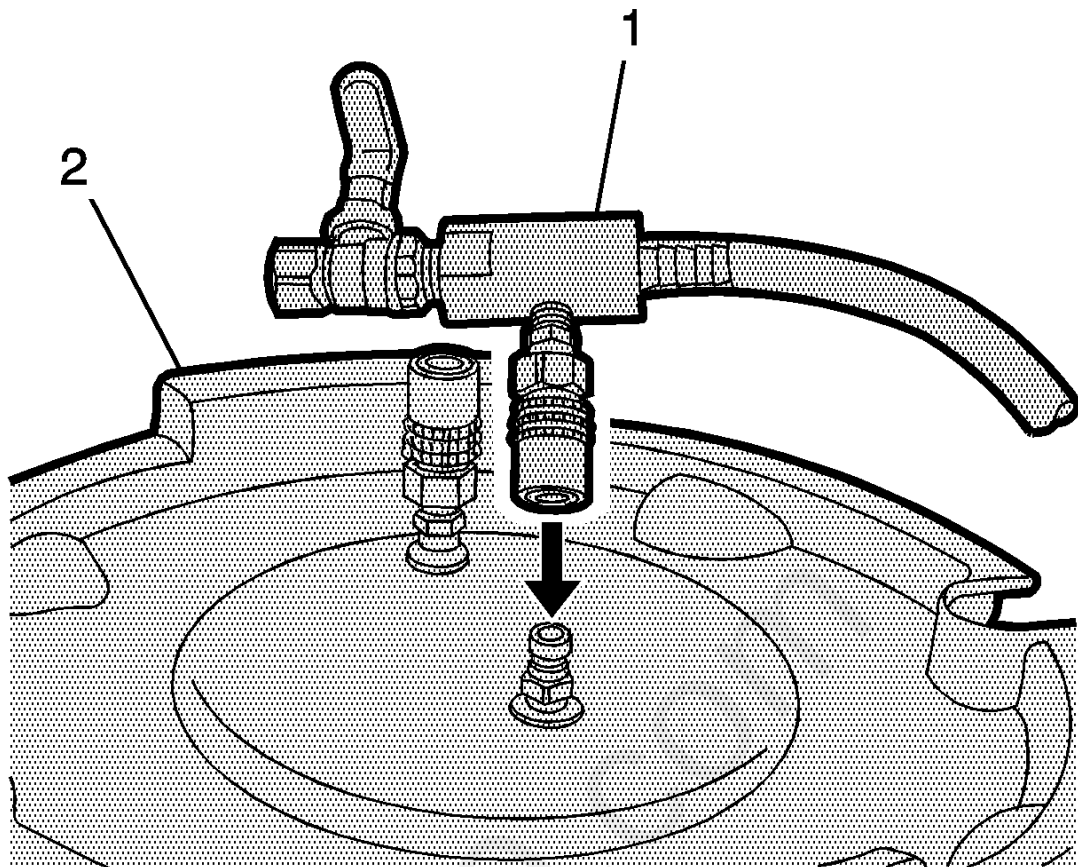


Fig. 11: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Attach the venture assembly (1) to the vacuum tank (2).

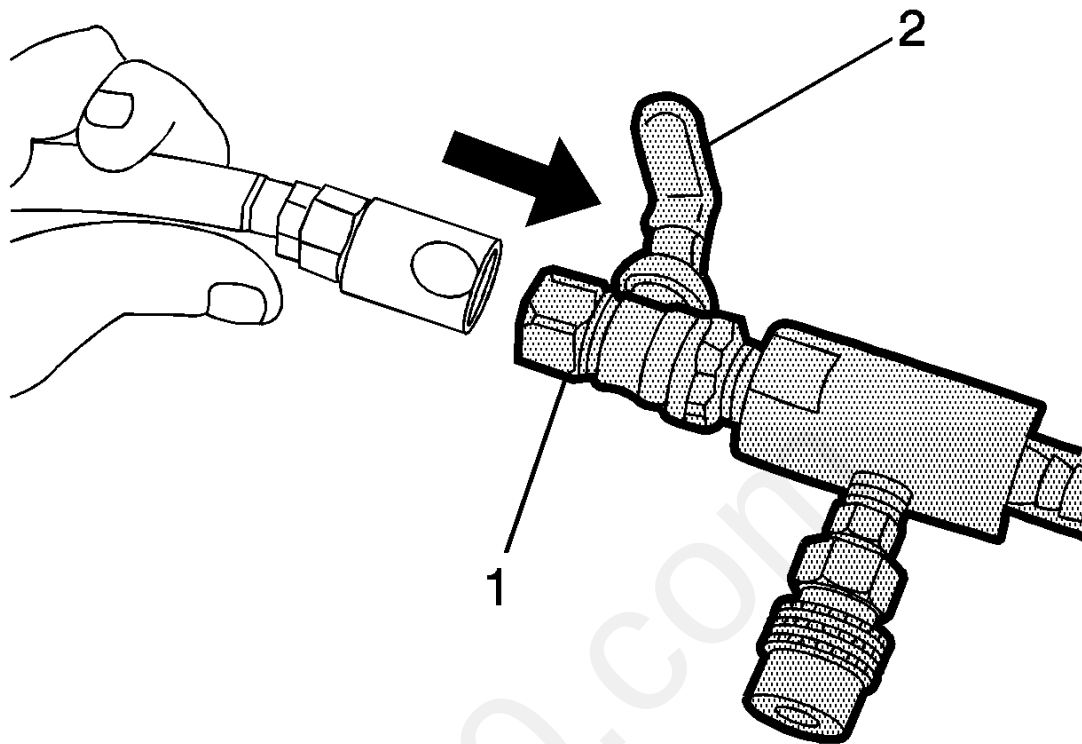


Fig. 12: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

12. Attach a shop air hose to the venturi assembly (1).
Ensure the valve (2) on the venturi assembly is closed.

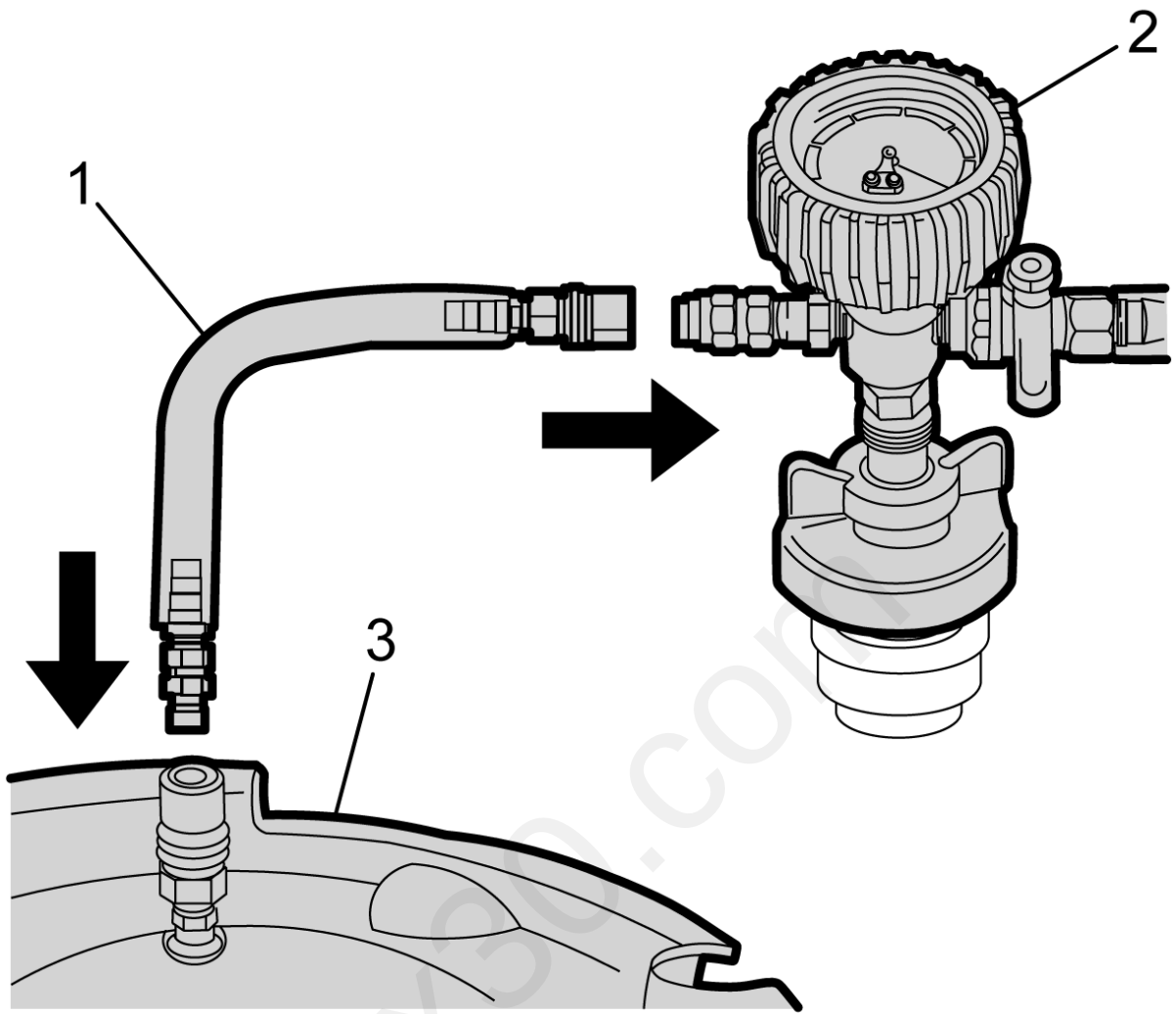


Fig. 13: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

13. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).
14. Clamp off the overflow hose.

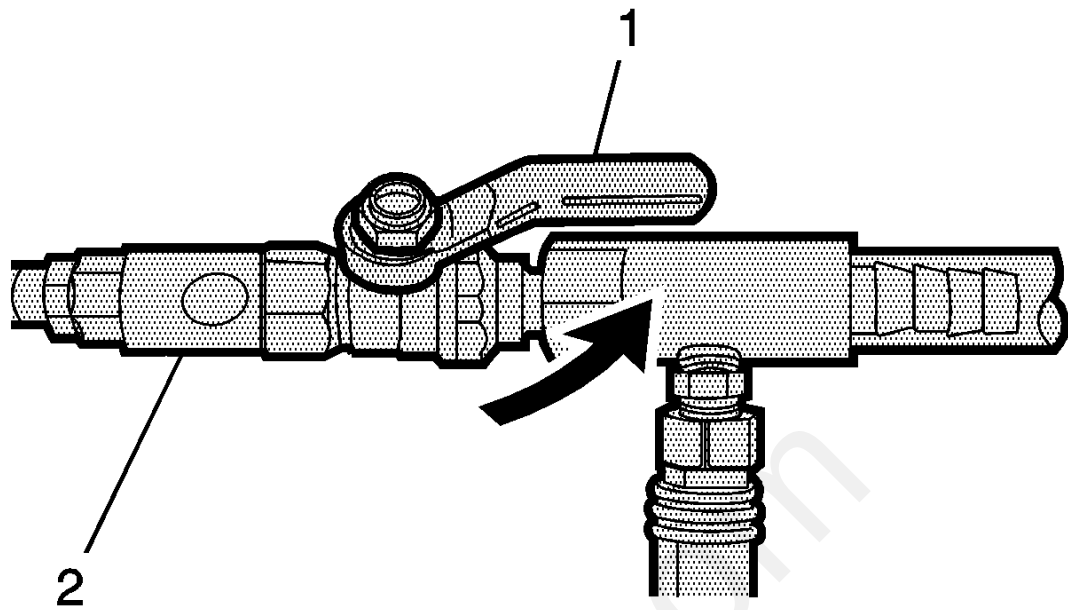


Fig. 14: Valve & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

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

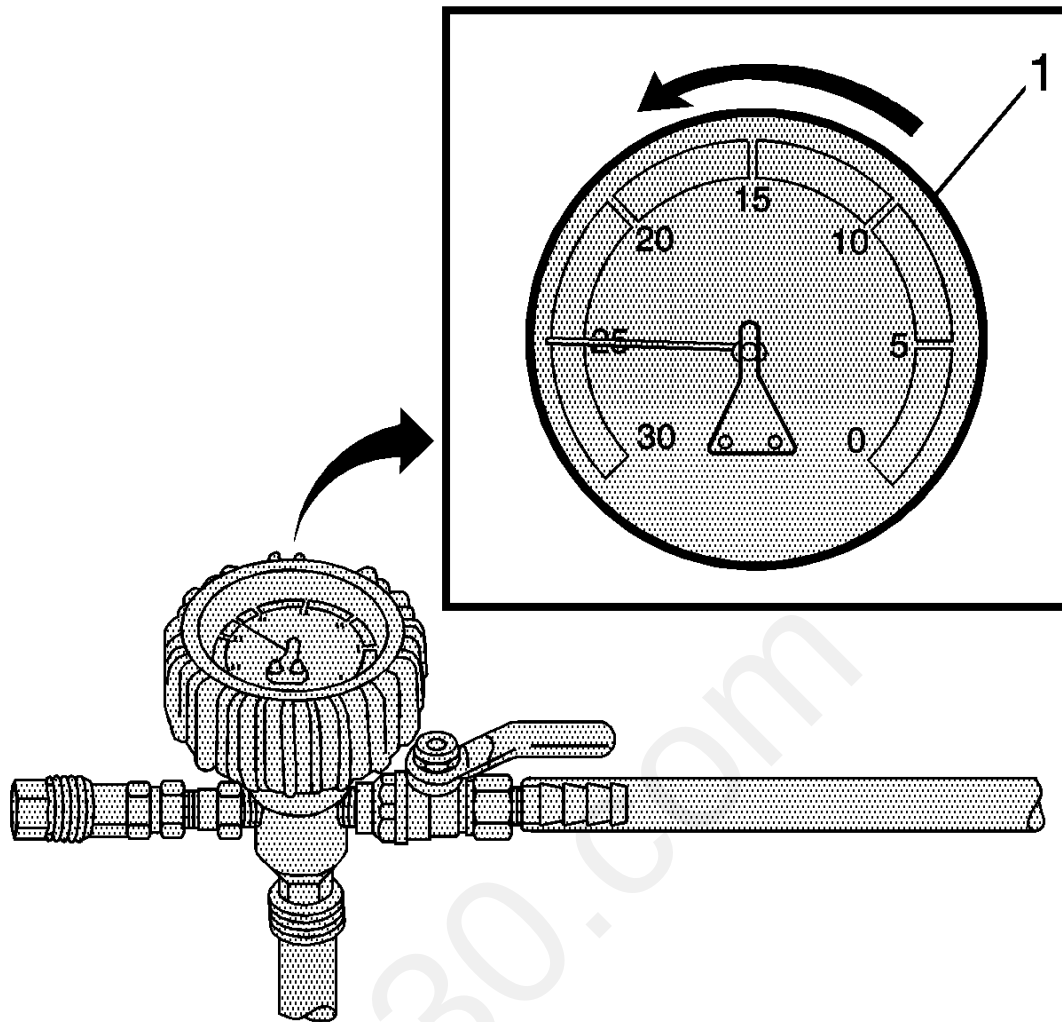


Fig. 15: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

16. 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.

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

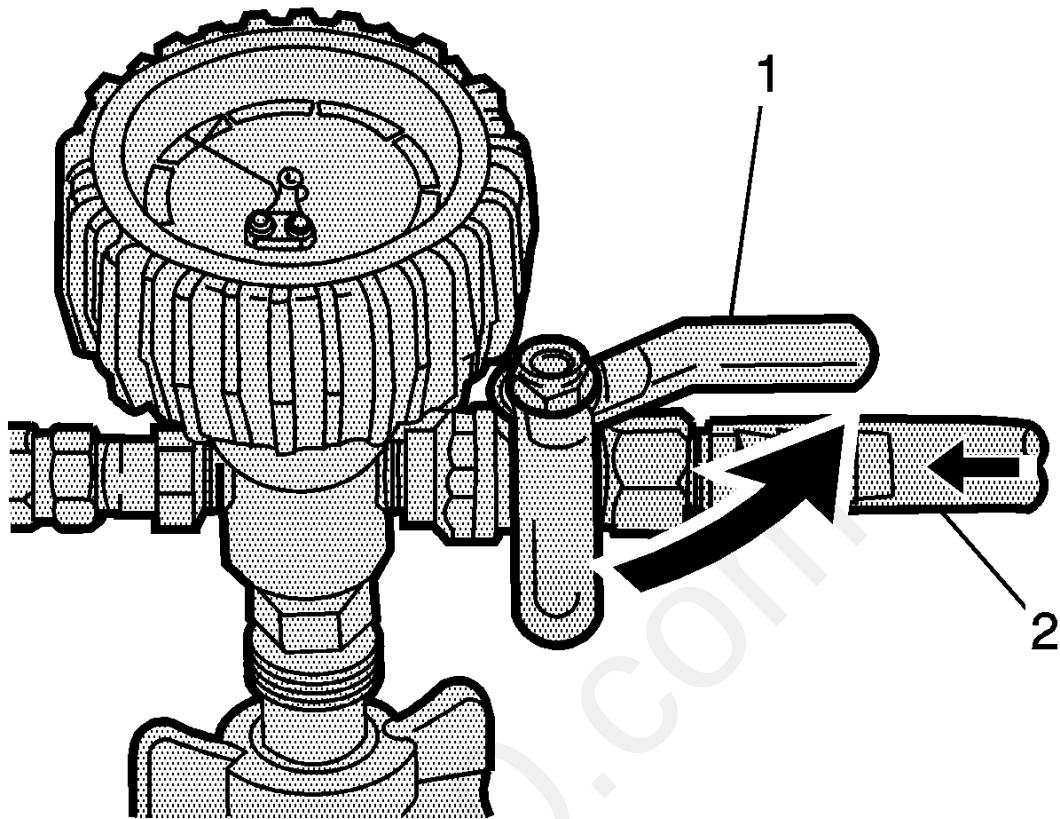


Fig. 16: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

18. 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.
19. Close the valve on the venture assembly.
20. 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](#).

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

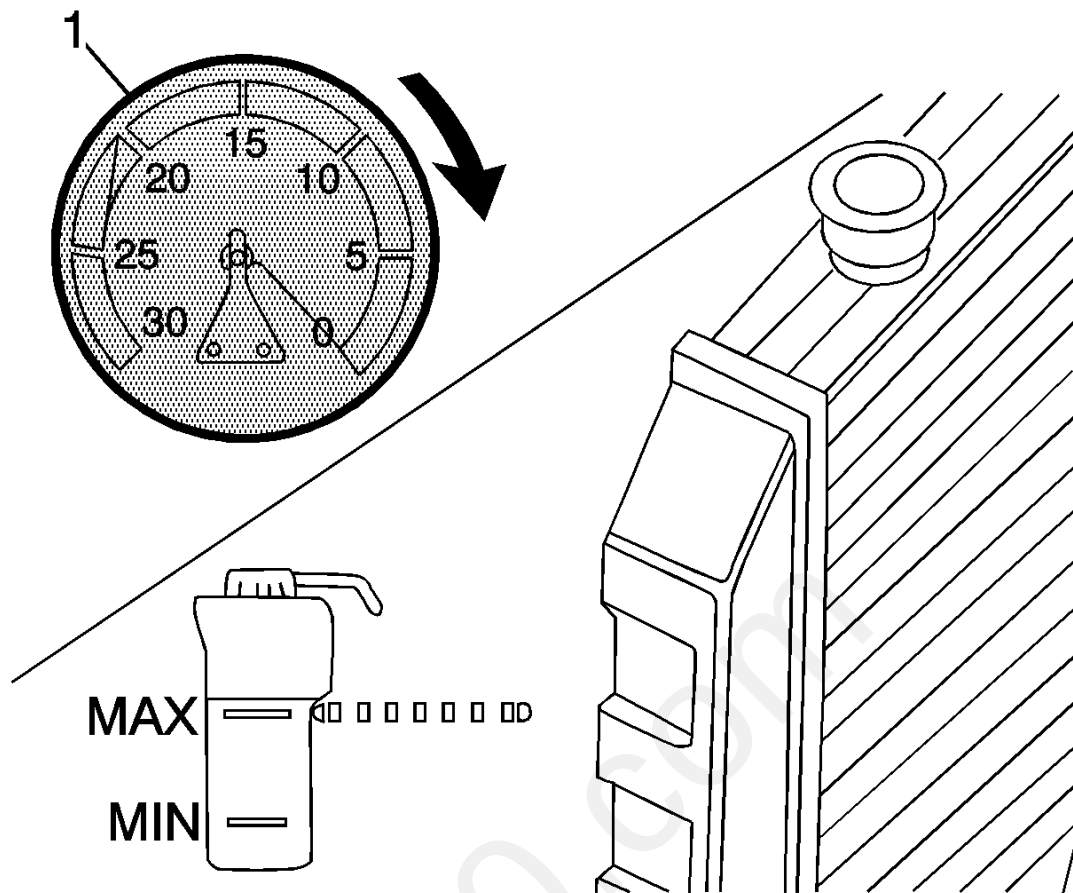


Fig. 17: Vacuum Gauge At Zero

Courtesy of GENERAL MOTORS COMPANY

22. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11-17.
23. Remove the **J 42401** radiator cap and surge tank test adapter.
24. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
25. Add coolant to the system as necessary.
26. Inspect the concentration of the coolant mixture using **J 26568** coolant and battery tester.

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

27. Detach the vacuum hose from the vacuum gauge assembly.

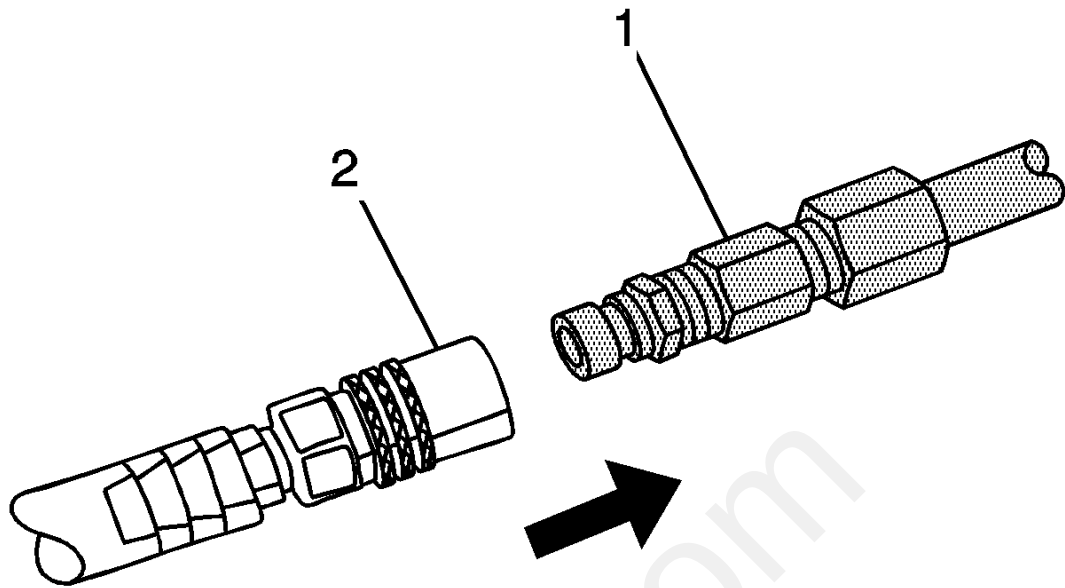


Fig. 18: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

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

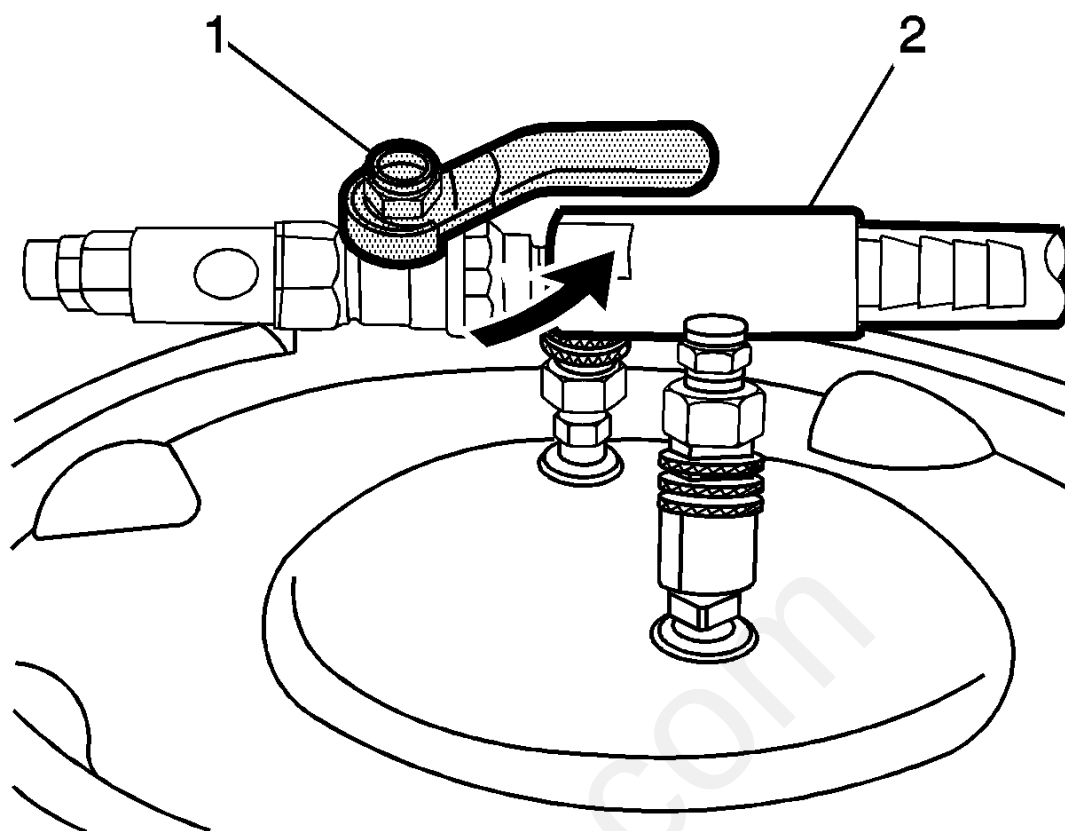


Fig. 19: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

29. Open the valve (1) on the venture assembly (2) to start a vacuum draw.

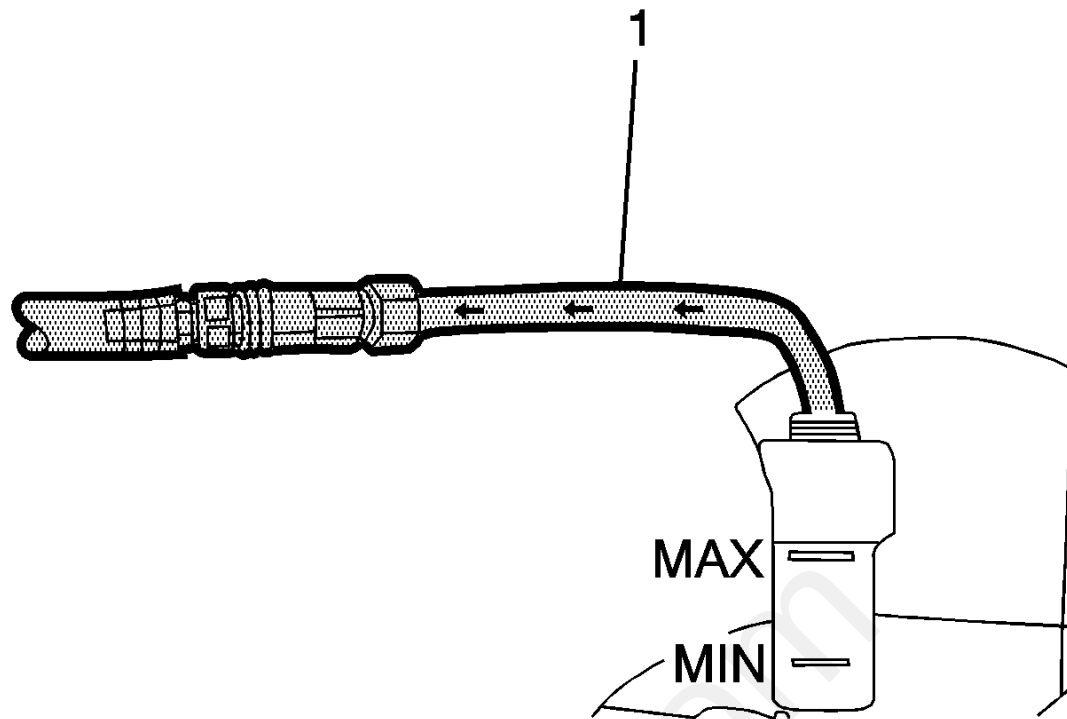


Fig. 20: Coolant Extraction Hose

Courtesy of GENERAL MOTORS COMPANY

30. Use the extraction hose (1) to draw out coolant to the proper level.
31. 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.
32. Start the engine.
33. Run the engine at 2, 000-2, 500 RPM until the engine reaches normal operating temperature. Engine should reach an operating temperature of 90°C (194°F) and the upper radiator hose should be HOT.
34. Allow the engine to idle for 3 minutes.
35. Shut the engine OFF.
36. Allow the engine to cool.
37. Top off the coolant as necessary
38. Inspect the concentration of the engine coolant using the J 26568 coolant and battery tester.
39. Install the radiator cap.
40. Rinse away any excess coolant from the engine and the engine compartment.
41. Inspect the cooling system for leaks.

FLUSHING

- 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.

When the cooling system becomes contaminated, the cooling system should be flushed thoroughly to remove the contaminants before the engine is seriously damaged.

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the radiator surge tank. [Radiator Surge Tank Replacement \(LCV and LFX\)](#)[Radiator Surge Tank Replacement \(LWN\)](#).
3. Clean and flush the radiator surge tank with clean, drinkable water.
4. Install the radiator surge tank. [Radiator Surge Tank Replacement \(LCV and LFX\)](#)[Radiator Surge Tank Replacement \(LWN\)](#).
5. Follow the drain and fill procedure using only clean, drinkable water. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).

RADIATOR CLEANING

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

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

NOTE:

Callout	Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.
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Keep compressed air stream perpendicular to the core face and allow adequate distance of the air nozzle to the core face so not to cause fin damage.

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

RADIATOR SURGE TANK REPLACEMENT (LCV AND LFX)

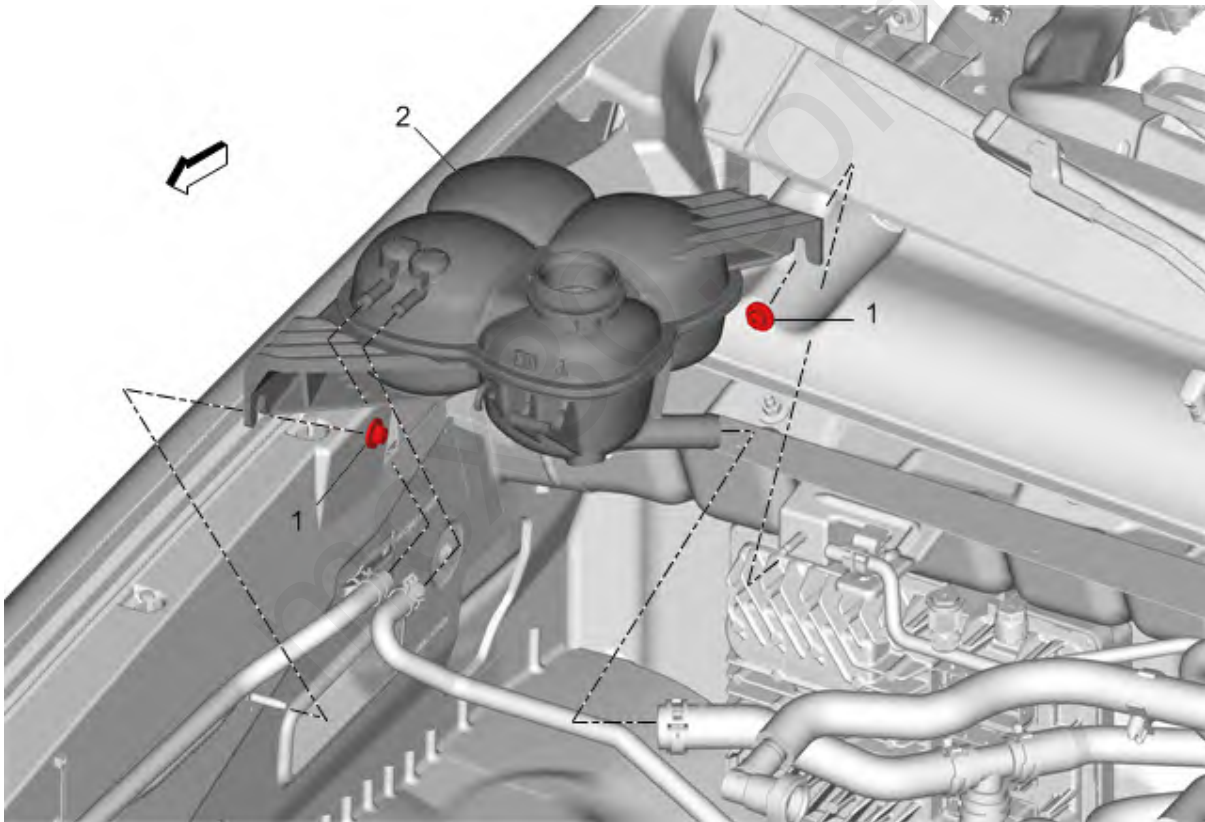


Fig. 21: Radiator Surge Tank
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Caution	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Remove the radiator vent outlet hose from the radiator surge tank and position out of the way. Refer to Radiator Vent Outlet Hose Replacement. 3. Remove the coolant recovery reservoir hose from the radiator surge tank and position out of the way. Refer to Coolant Recovery Reservoir Hose Replacement (LFX)Coolant Recovery Reservoir Hose Replacement (LCV). 4. Remove the heater outlet hose from the surge tank and position out of the way. Refer to Heater Outlet Hose Replacement (Radiator Surge Tank to Outlet Heater Hose Tee) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Core Tube LFX) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Outlet Pipe LFX) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Core Tube LCV) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Water Outlet LCV) .	
1	Radiator Surge Tank Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Procedures 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks.

RADIATOR SURGE TANK REPLACEMENT (LWN)

Serial	Component Name
2	Radiator Surge Tank Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Check the cooling system for leaks.

RADIATOR SURGE TANK OUTLET PIPE REPLACEMENT (LWN)

Removal Procedure

Special Tools

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

Equivalent regional tools:[Special Tools](#)

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

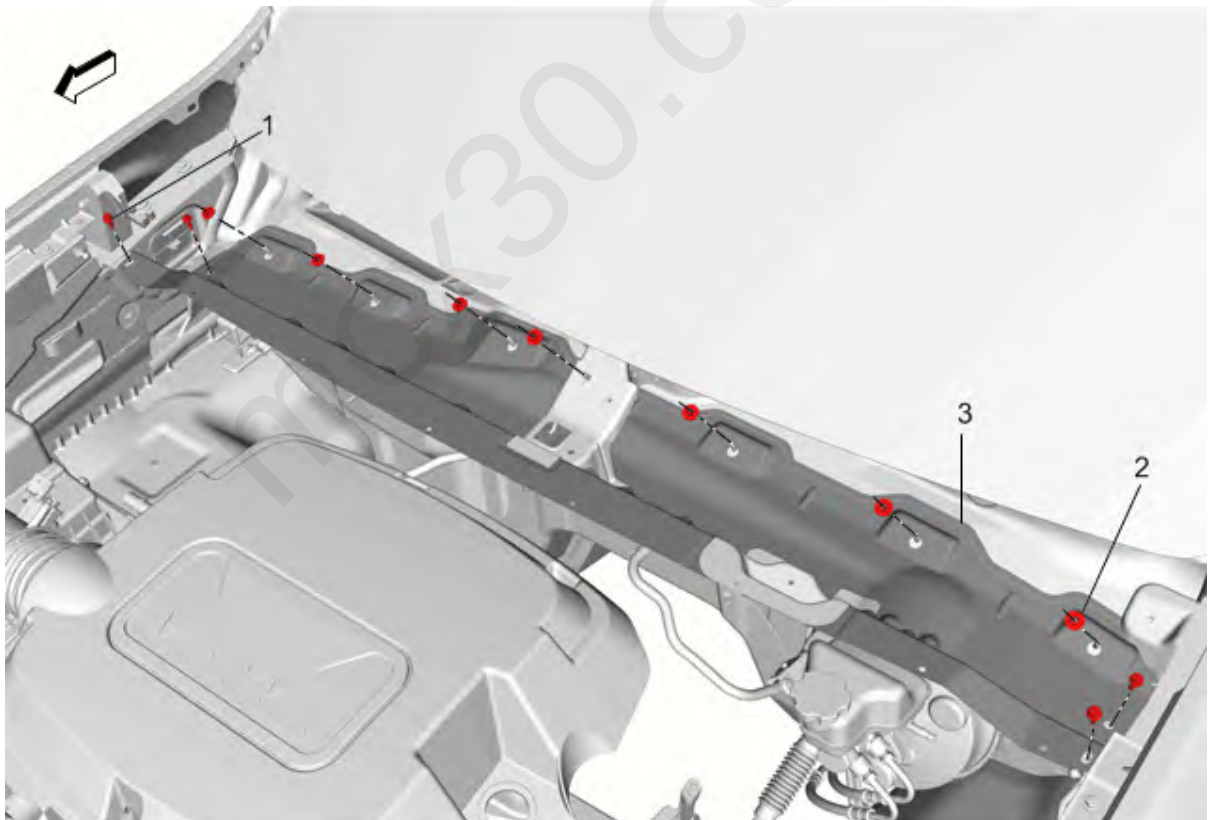


Fig. 23: Plenum Front Panel

Courtesy of GENERAL MOTORS COMPANY

2. Remove Plenum Front Panel.[Plenum Front Panel Replacement](#)

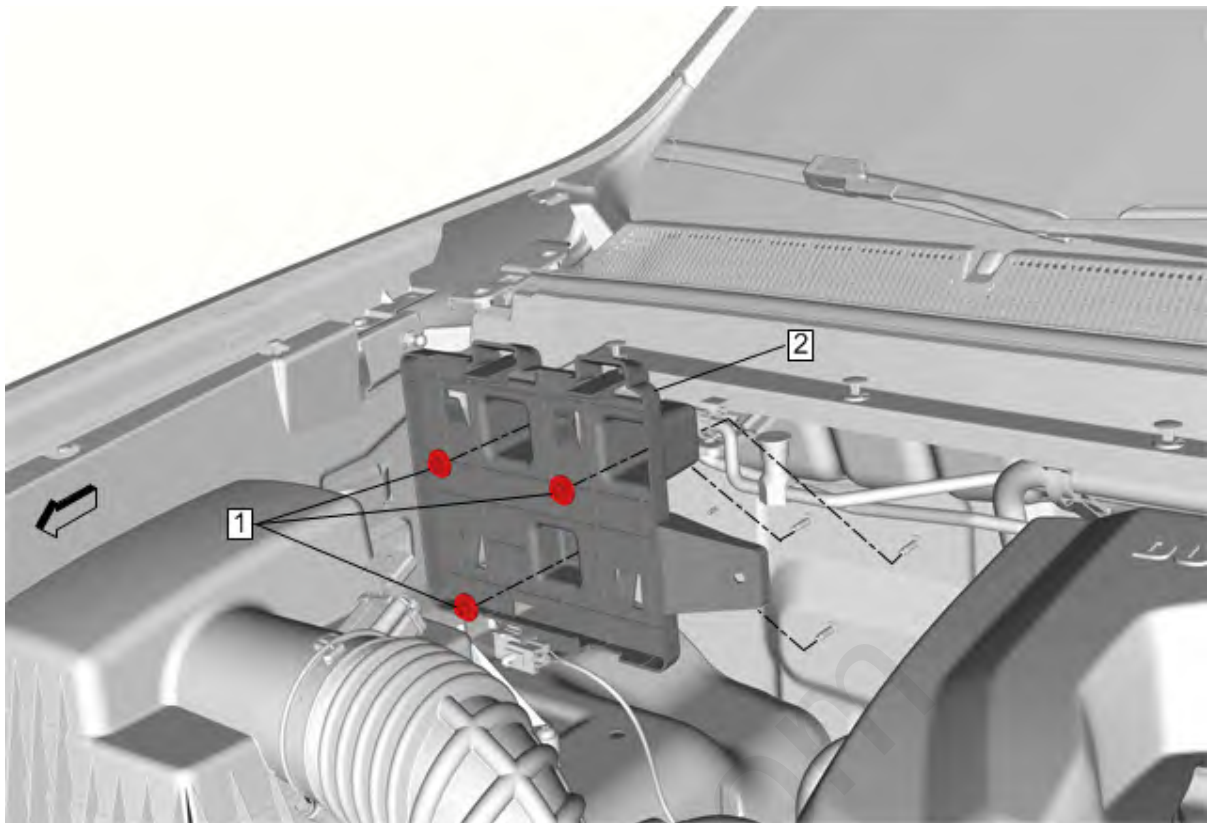


Fig. 24: Engine Control Module Bracket
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Control Module Bracket. [Engine Control Module Bracket Replacement](#)

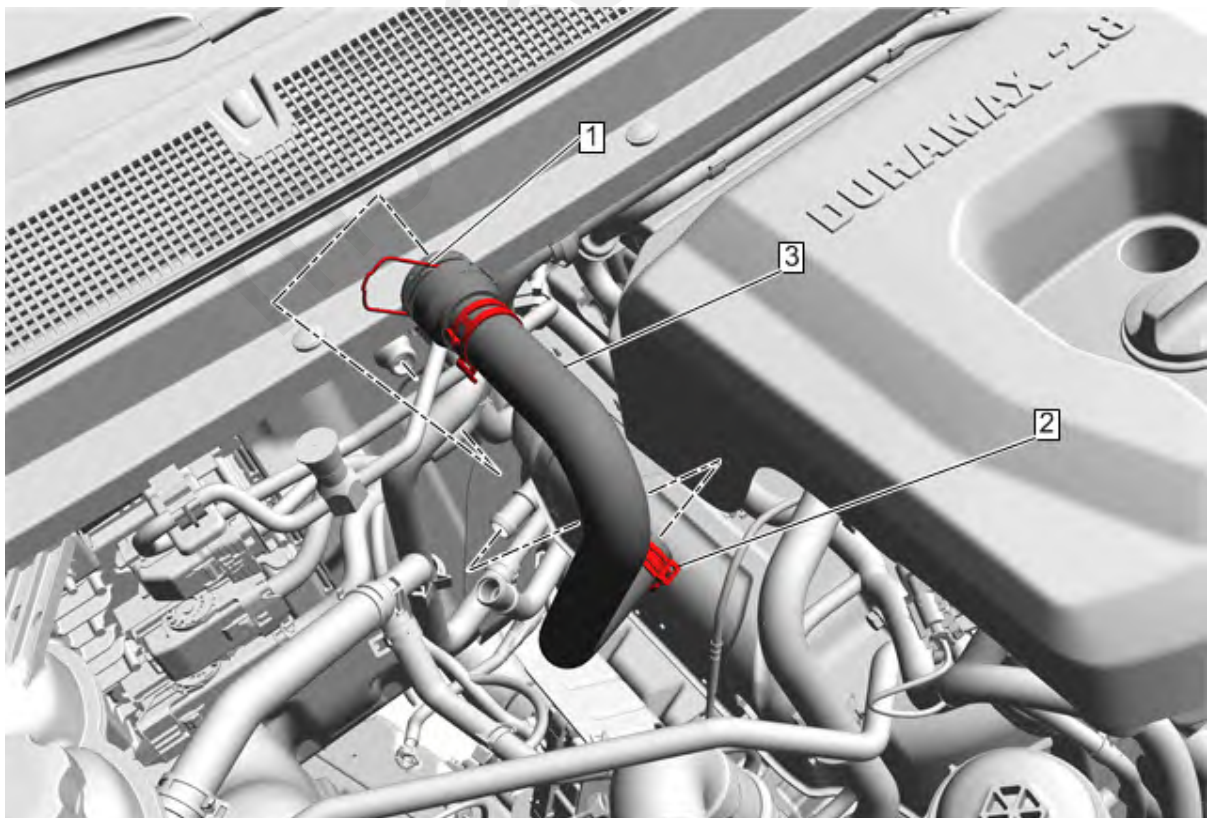


Fig. 25: Heater Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Heater Inlet Hose (3) @Radiator Surge Tank Outlet Pipe [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#)

5. Reposition the heater inlet hose out of the way.

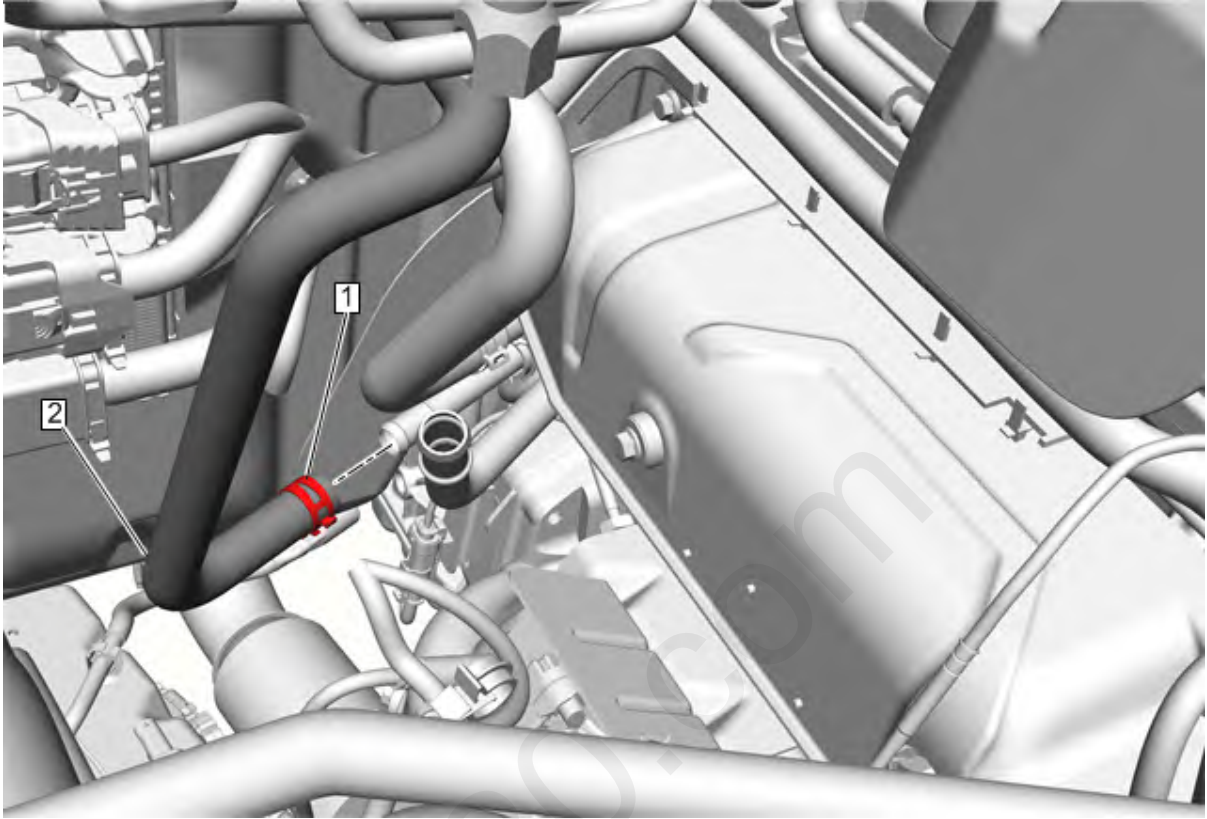


Fig. 26: Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Remove Heater Outlet Hose (2) @Radiator Surge Tank Outlet Pipe. [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#)

7. Reposition the heater outlet hose out of the way.

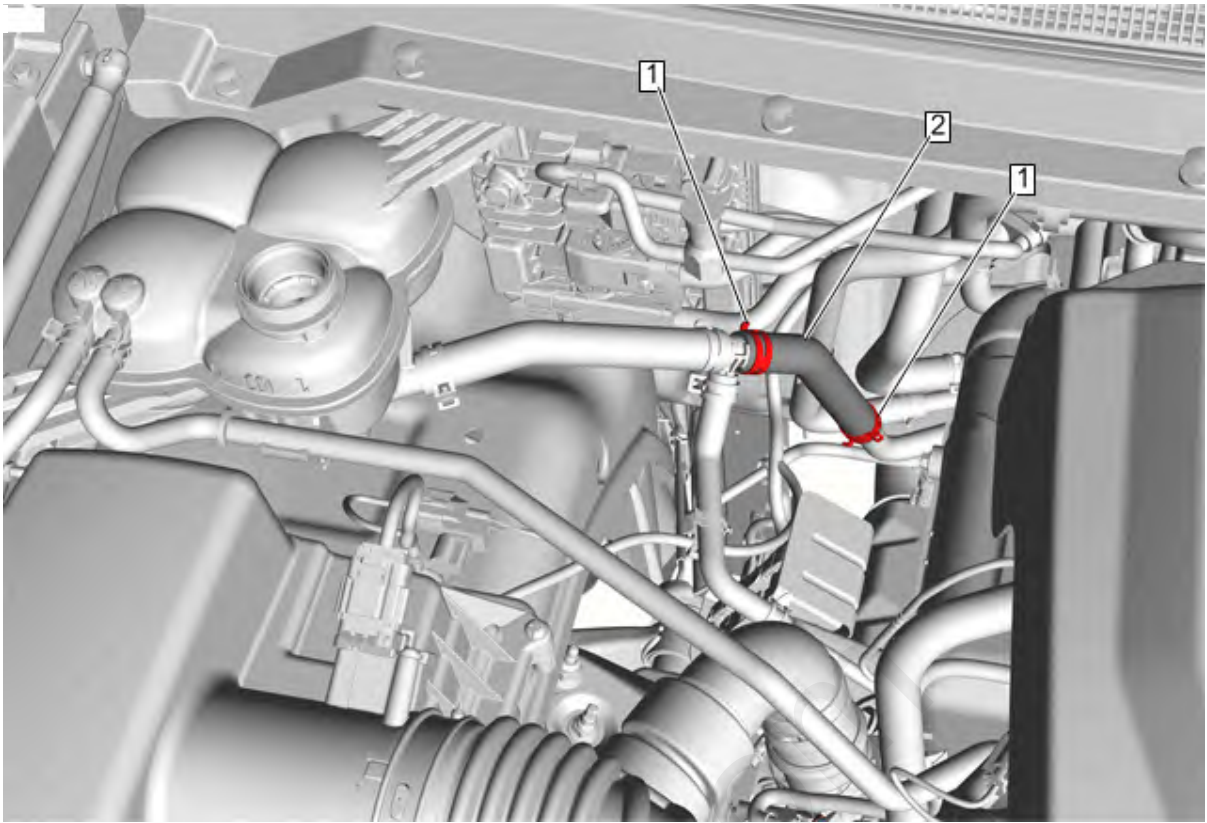


Fig. 27: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Remove Radiator Surge Tank Outlet Hose (2) @Radiator Surge Tank Outlet Pipe.**Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Radiator Surge Tank Outlet Pipe)Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Turbocharger Coolant Return Pipe)Radiator Surge Tank Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Outlet Pipe LWN)**
9. Reposition the radiator surge tank outlet hose out of the way.

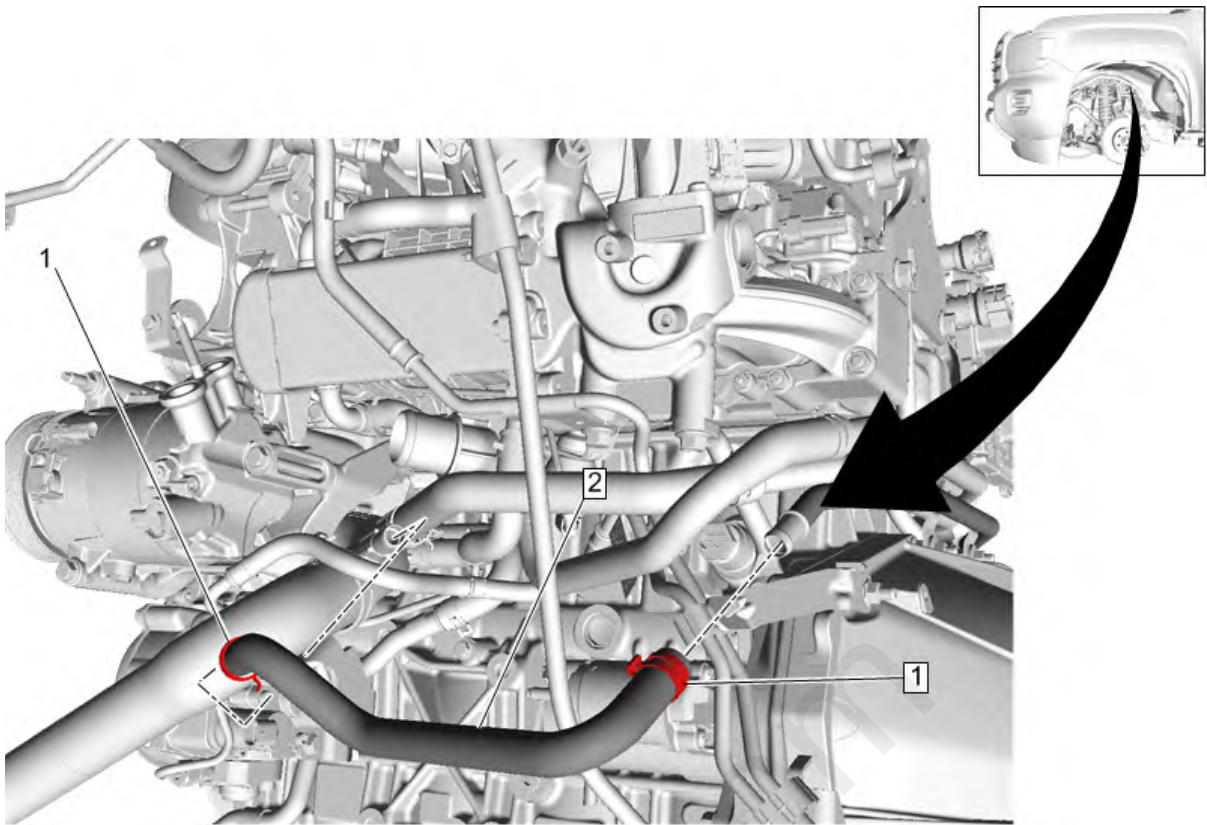
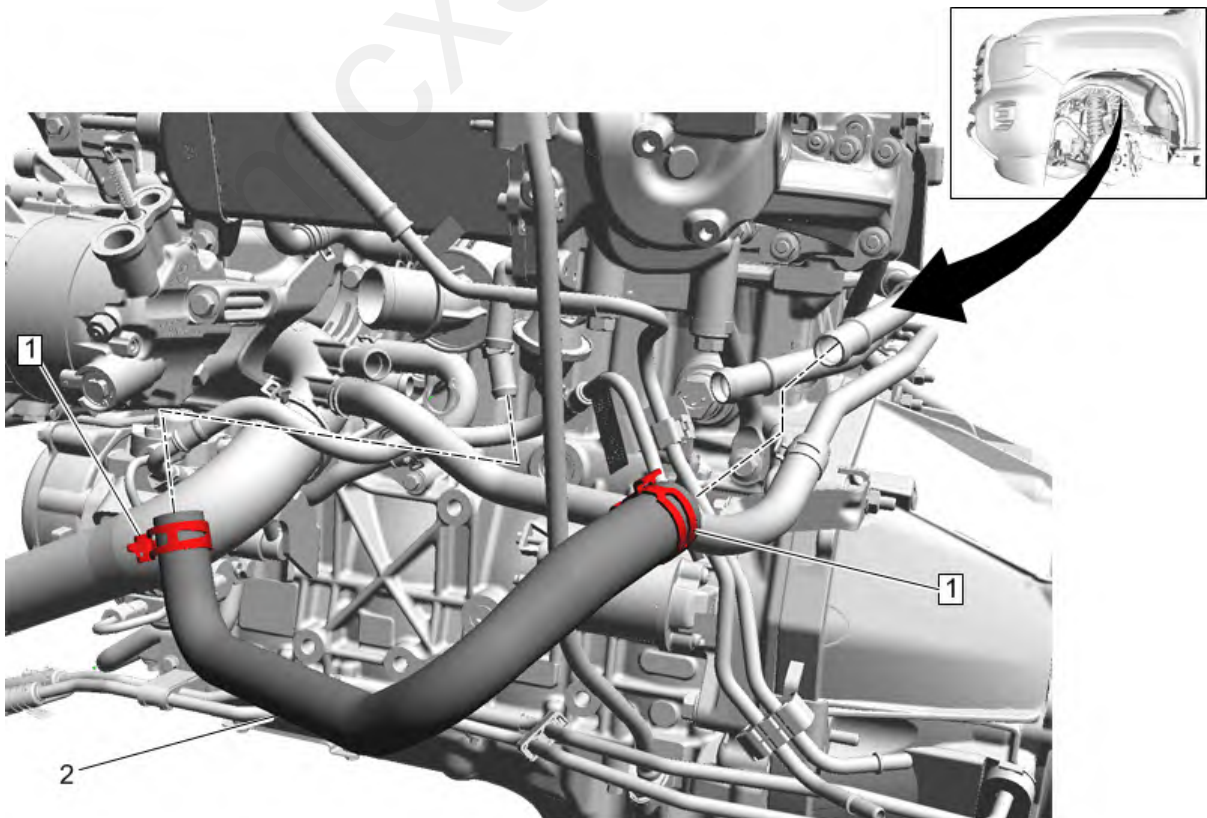


Fig. 28: Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

10. Remove Heater Outlet Hose (2) to Water Pump Inlet Pipe @ Radiator Surge Tank Outlet Pipe **Heater Outlet Hose Replacement (Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN) Heater Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN)**



Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

11. Remove Heater Inlet Hose (2) to Engine Coolant Thermostat Assembly @Radiator Surge Tank Outlet Pipe
Heater Inlet Hose Replacement (Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN)
Heater Inlet Hose Replacement (Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN)

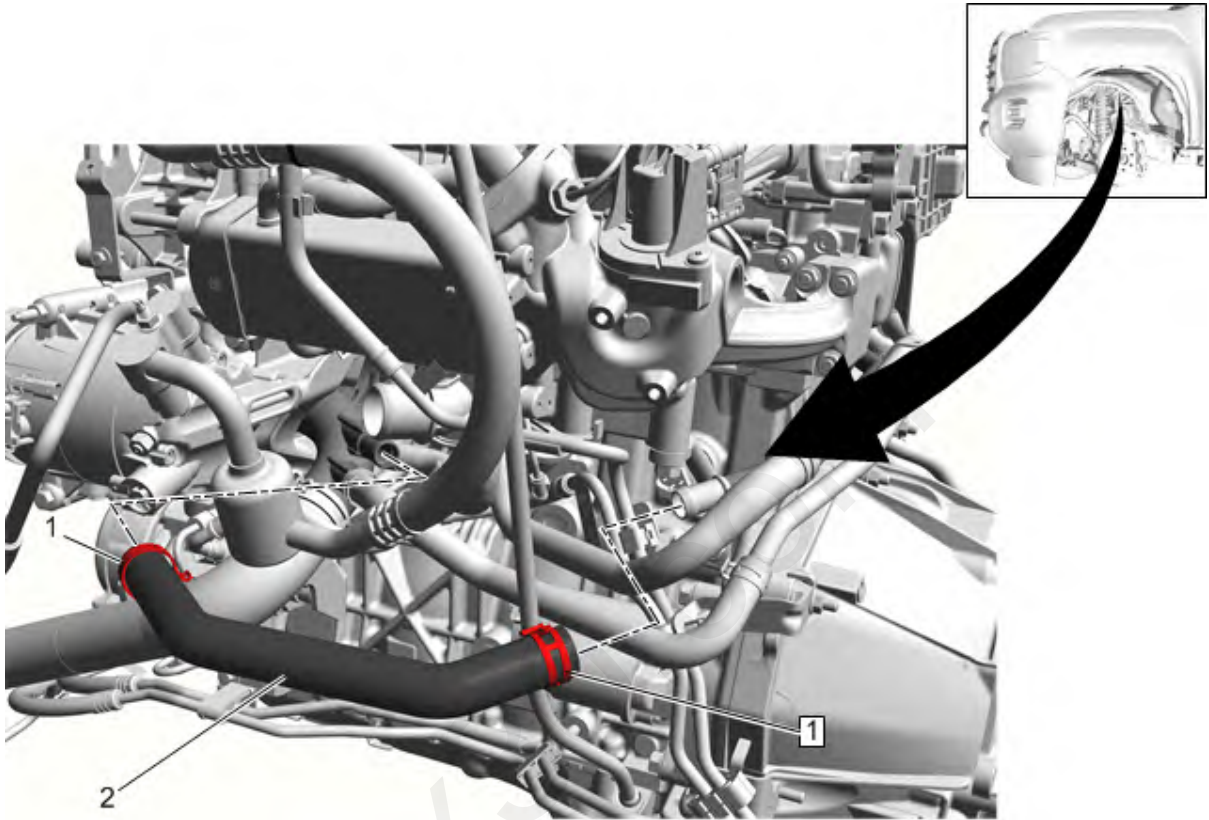


Fig. 30: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

12. Remove Radiator Surge Tank Outlet Hose (2) to Water Pump Outlet Pipe @Radiator Surge Tank Outlet Pipe. Radiator Surge Tank Outlet Hose Replacement (T Connection to Surge Tank)Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Radiator Surge Tank Outlet Pipe)Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Turbocharger Coolant Return Pipe)Radiator Surge Tank Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Outlet Pipe LWN)

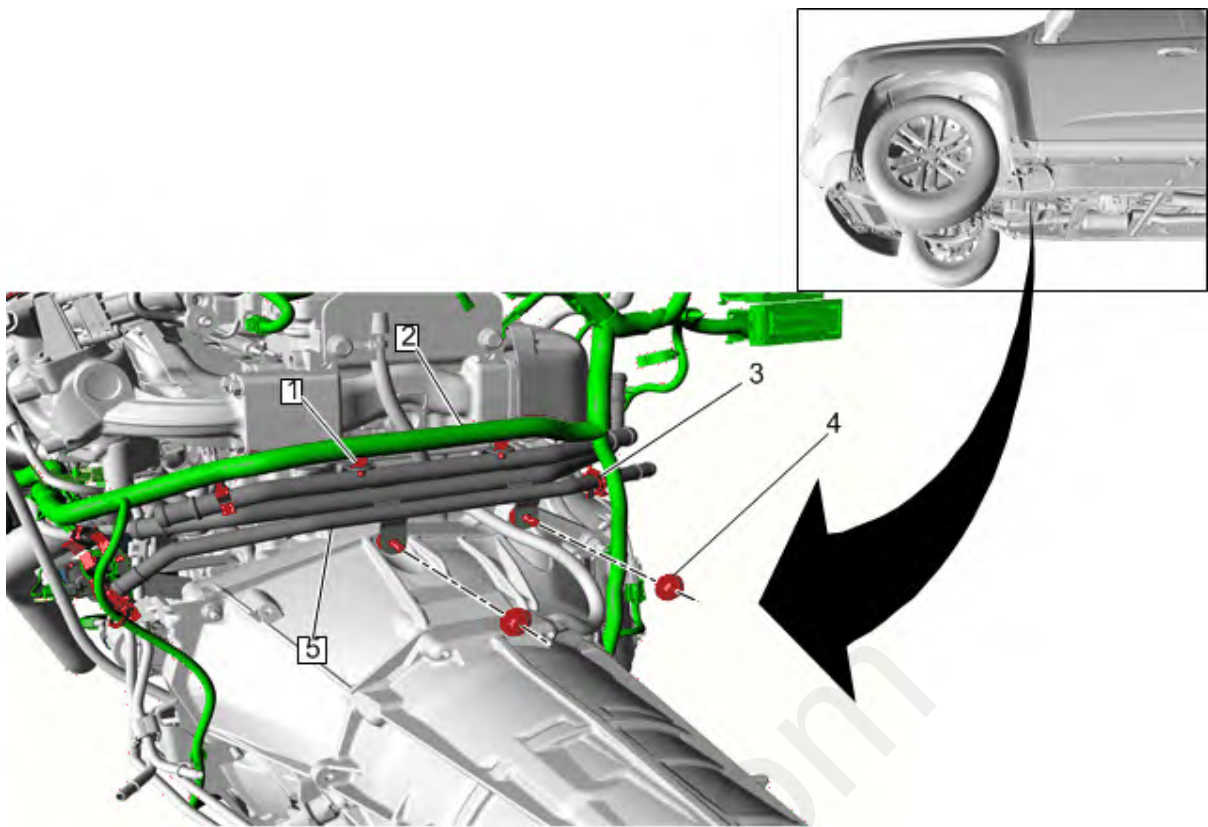


Fig. 31: Engine Wiring Harness Retainer

Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Wiring Harness Retainer (1) @Radiator Surge Tank Outlet Pipe
14. Unclip the engine wiring harness (3)
15. Reposition the wiring harness (2)
16. Remove Radiator Surge Tank Outlet PipeNut (4)
17. Remove Radiator Surge Tank Outlet Pipe (5)

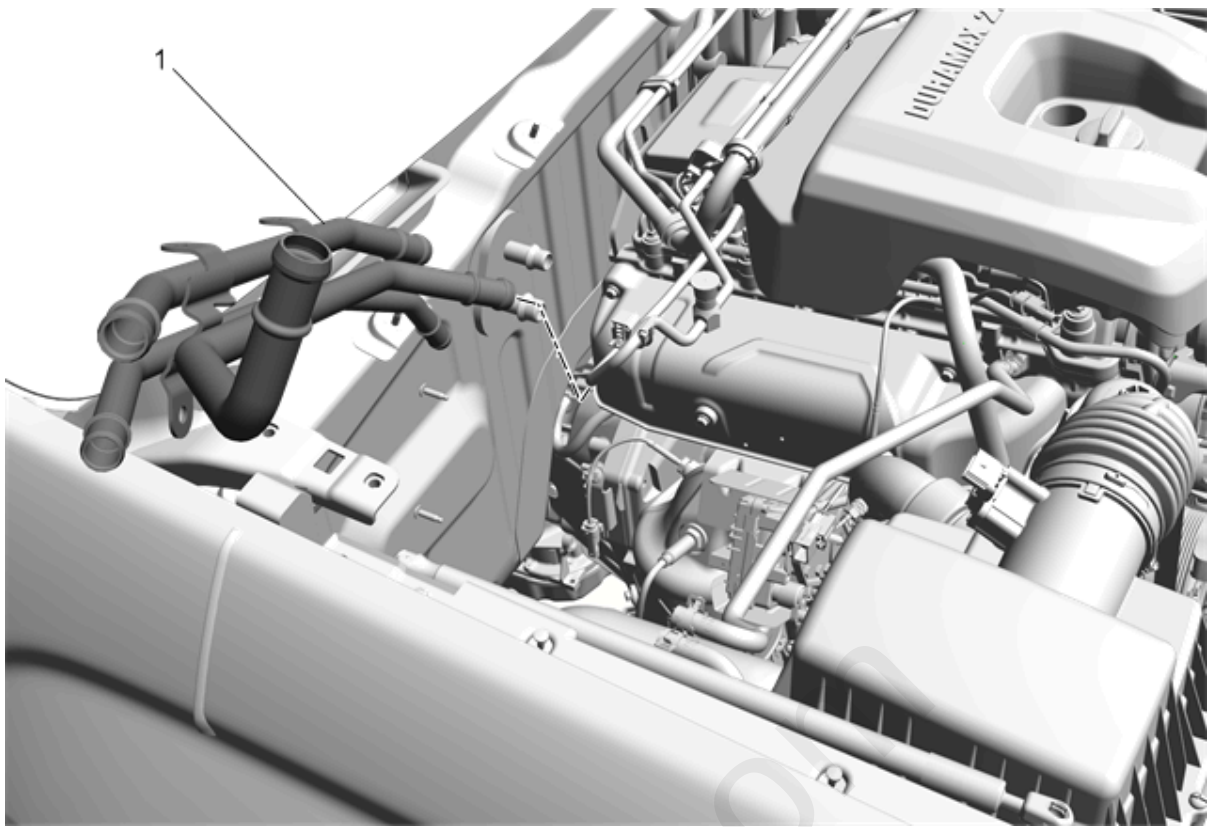
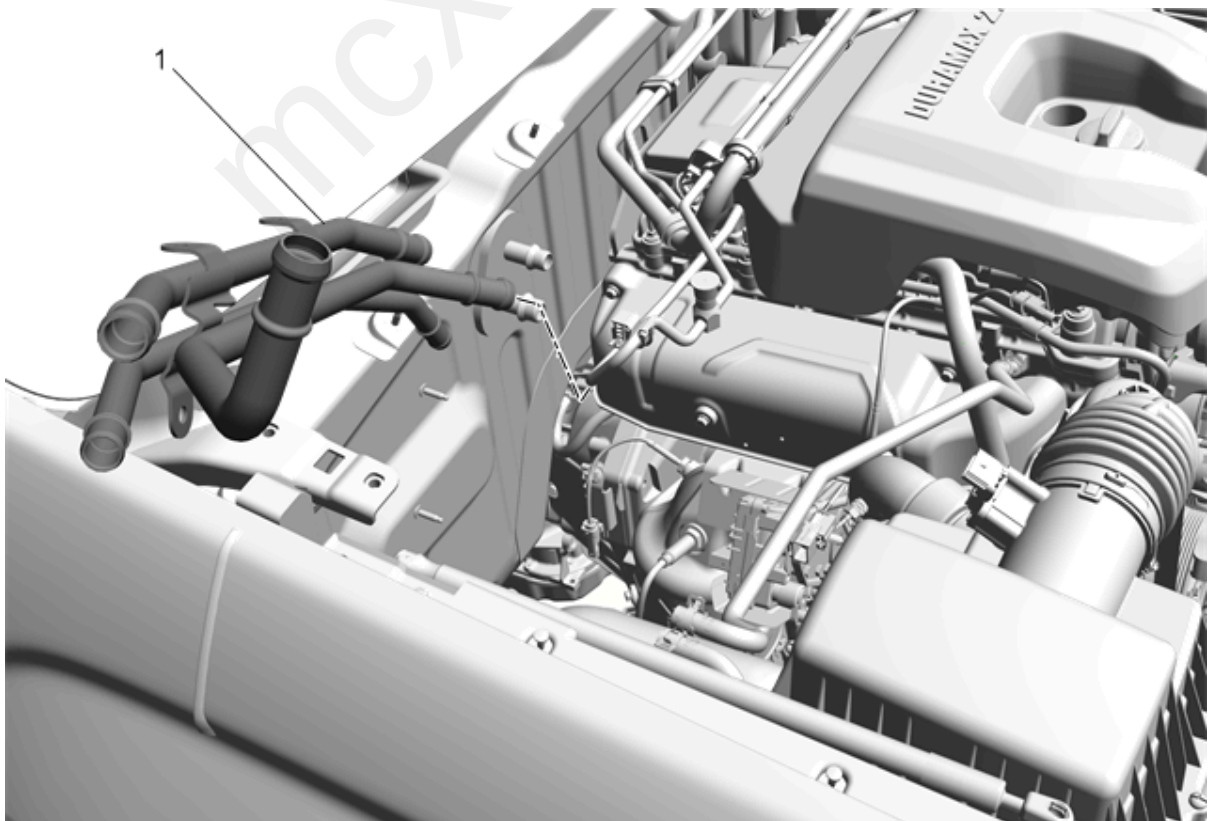


Fig. 32: Radiator Surge Tank Outlet Pipe Assembly
Courtesy of GENERAL MOTORS COMPANY

18. Maneuver the radiator surge tank outlet pipe assembly (5) out from behind the right side of the engine assembly.

Installation Procedure



Radiator Surge Tank Outlet Pipe Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Maneuver the radiator surge tank outlet pipe assembly (1) back behind the right side of the engine assembly.

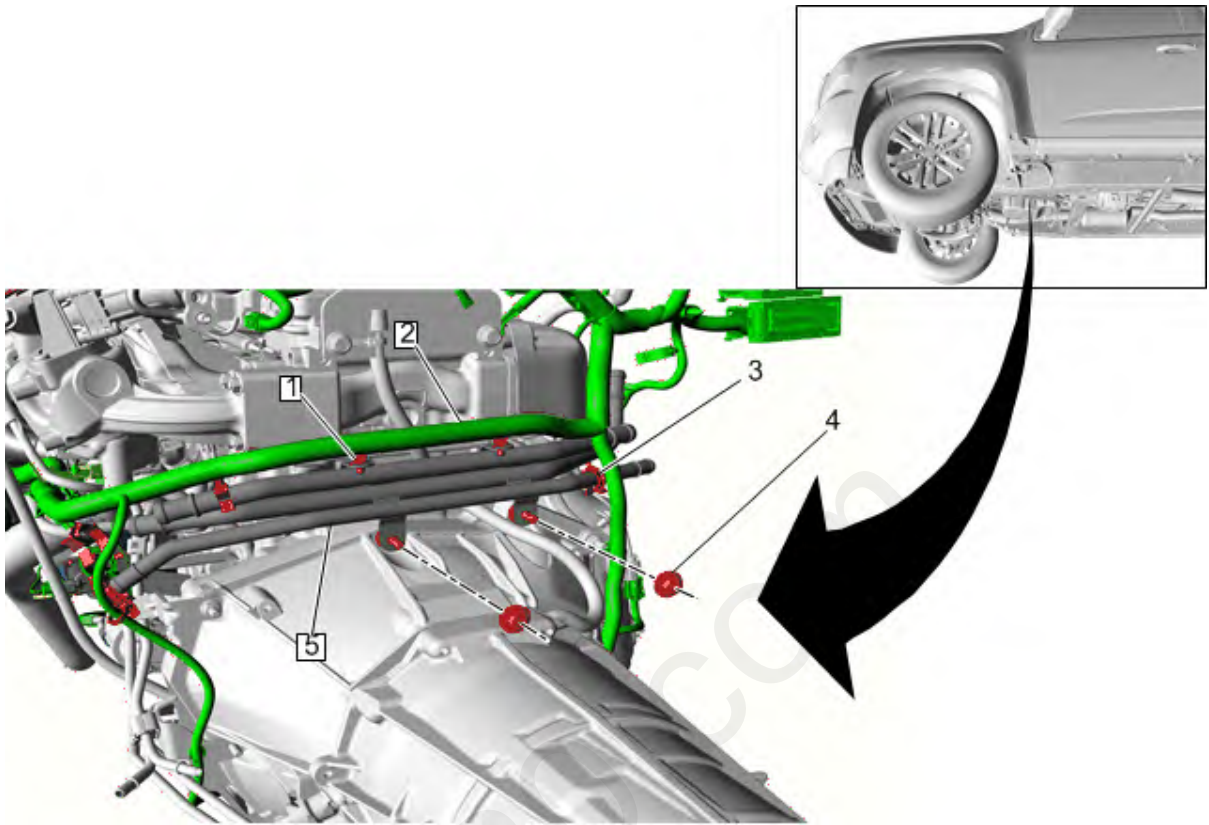


Fig. 34: Engine Wiring Harness Retainer
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install Radiator Surge Tank Outlet Pipe (5)
3. Instal Radiator Surge Tank Outlet PipeNut (4) and tighten 22 N.m (16 lb ft)
4. Reposition the wiring harness (2)
5. Clip the engine wiring harness to the radiator surge tank outlet pipe assembly (3)
6. Instal Engine Wiring Harness Retainer (1) @Radiator Surge Tank Outlet Pipe

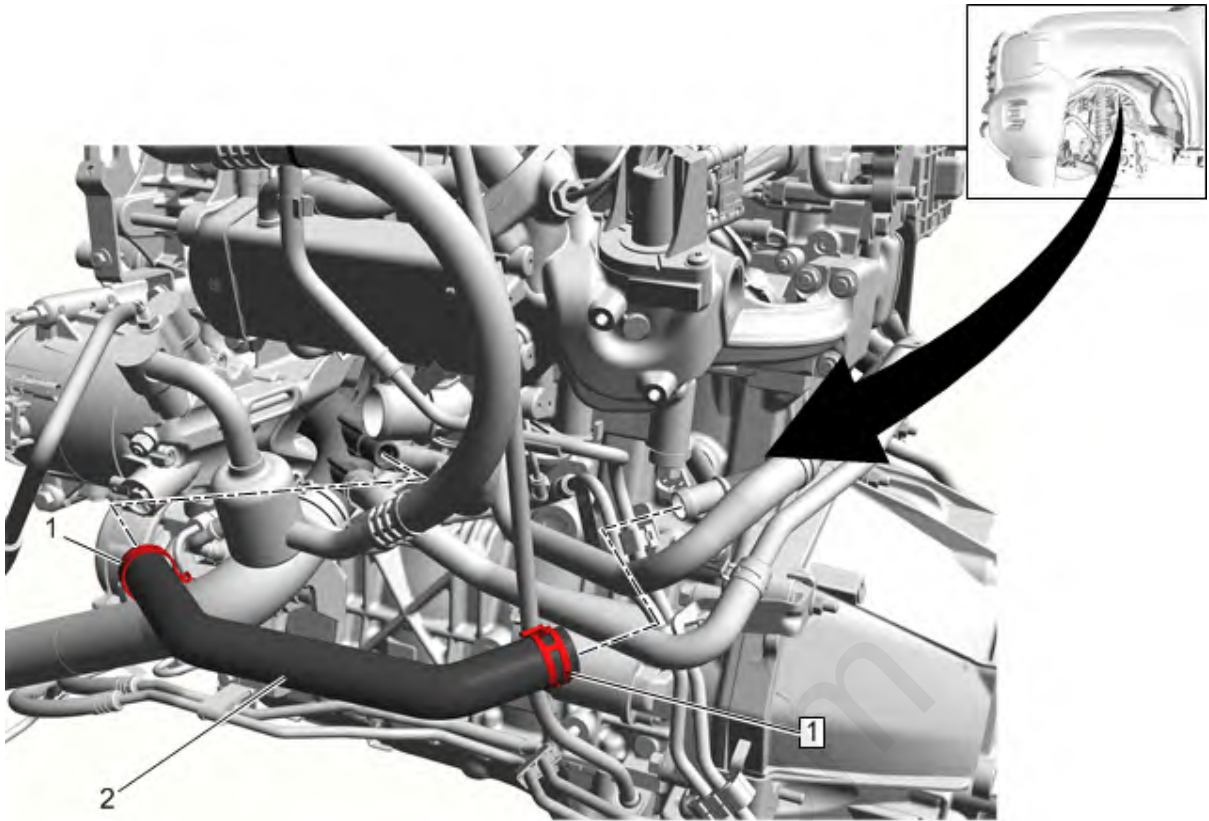


Fig. 35: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install Radiator Surge Tank Outlet Hose (2) to Water Pump Outlet Pipe @Radiator Surge Tank Outlet Pipe
Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Radiator Surge Tank Outlet Pipe)
Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Turbocharger Coolant Return Pipe)
Radiator Surge Tank Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Outlet Pipe LWN)

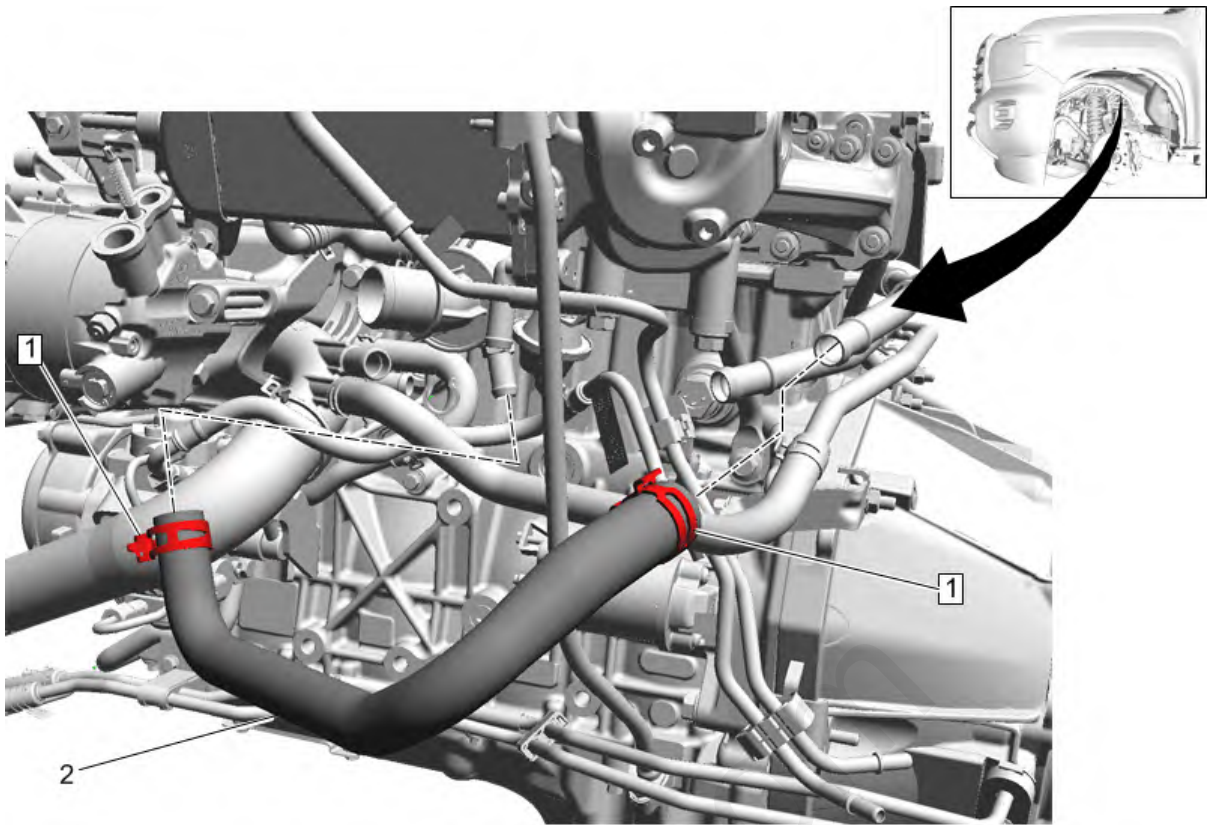
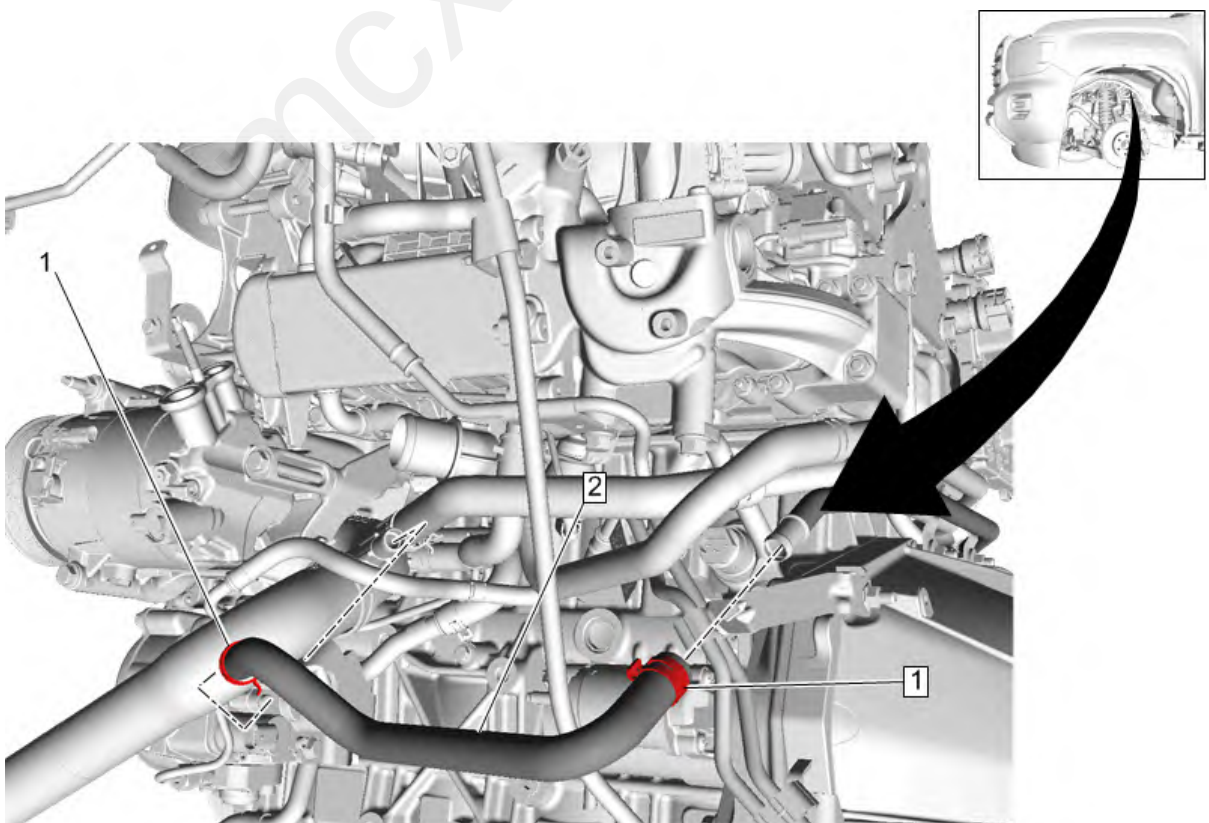


Fig. 36: Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Install Heater Inlet Hose (2) to Engine Coolant Thermostat Assembly @Radiator Surge Tank Outlet Pipe. **Heater Inlet Hose Replacement (Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN) Heater Inlet Hose Replacement (Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN)**



Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Install Heater Outlet Hose (2) to Water Pump Inlet Pipe@Radiator Surge Tank Outlet Pipe Heater Outlet Hose Replacement (Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN) Heater Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN)

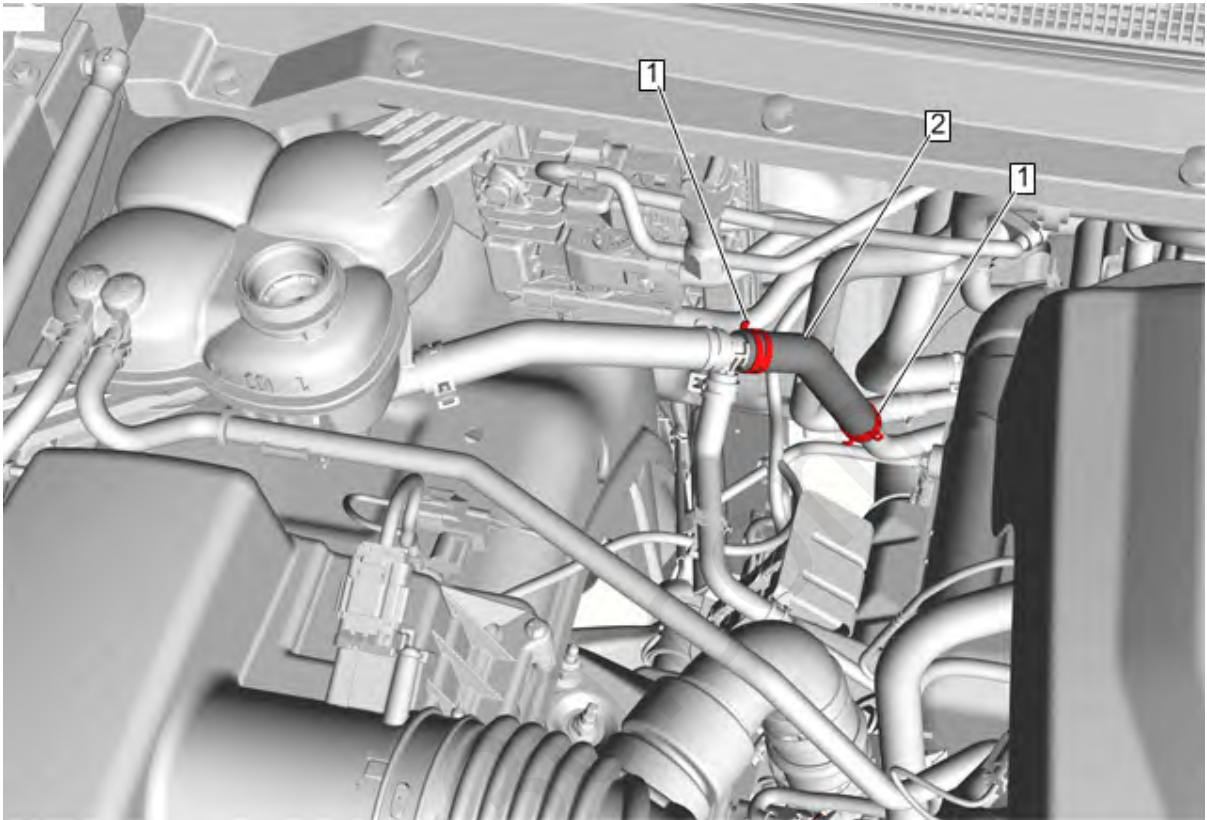


Fig. 38: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

10. Install Radiator Surge Tank Outlet Hose (2) @Radiator Surge Tank Outlet Pipe Radiator Surge Tank Outlet Hose Replacement (T Connection to Surge Tank)Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Radiator Surge Tank Outlet Pipe)Radiator Surge Tank Outlet Hose Replacement (LWN Tee Connection to Turbocharger Coolant Return Pipe)Radiator Surge Tank Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Outlet Pipe LWN)

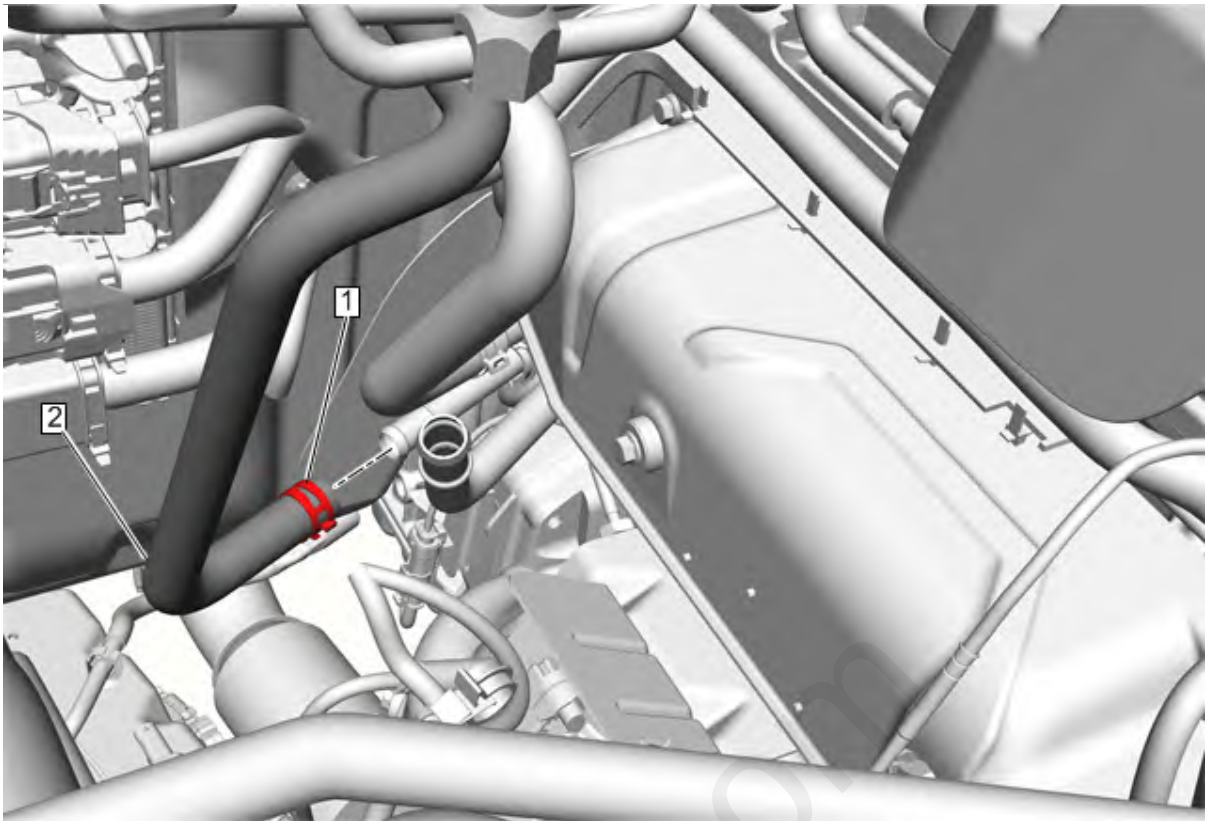
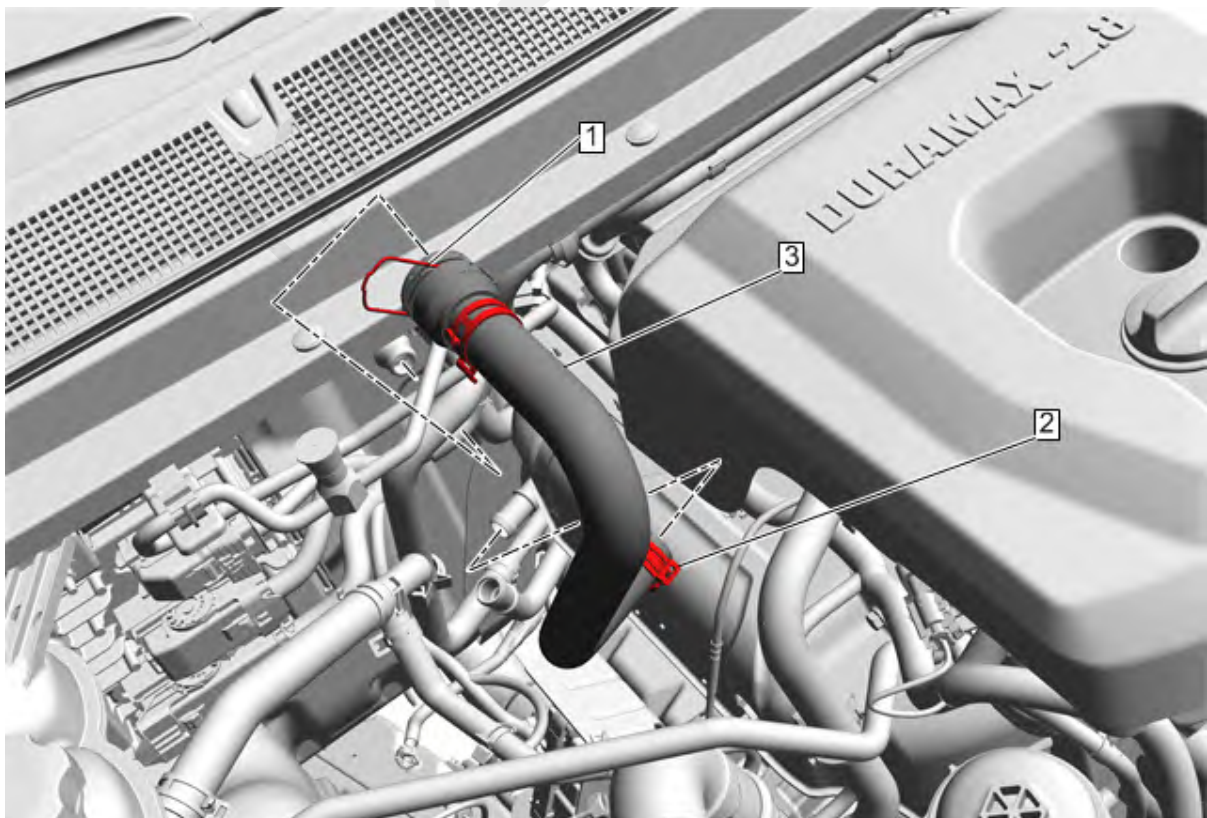


Fig. 39: Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

11. Install Heater Outlet Hose (2) @Radiator Surge Tank Outlet Pipe [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#)



Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

12. Install Heater Inlet Hose (3) @Radiator Surge Tank Outlet Pipe [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#)

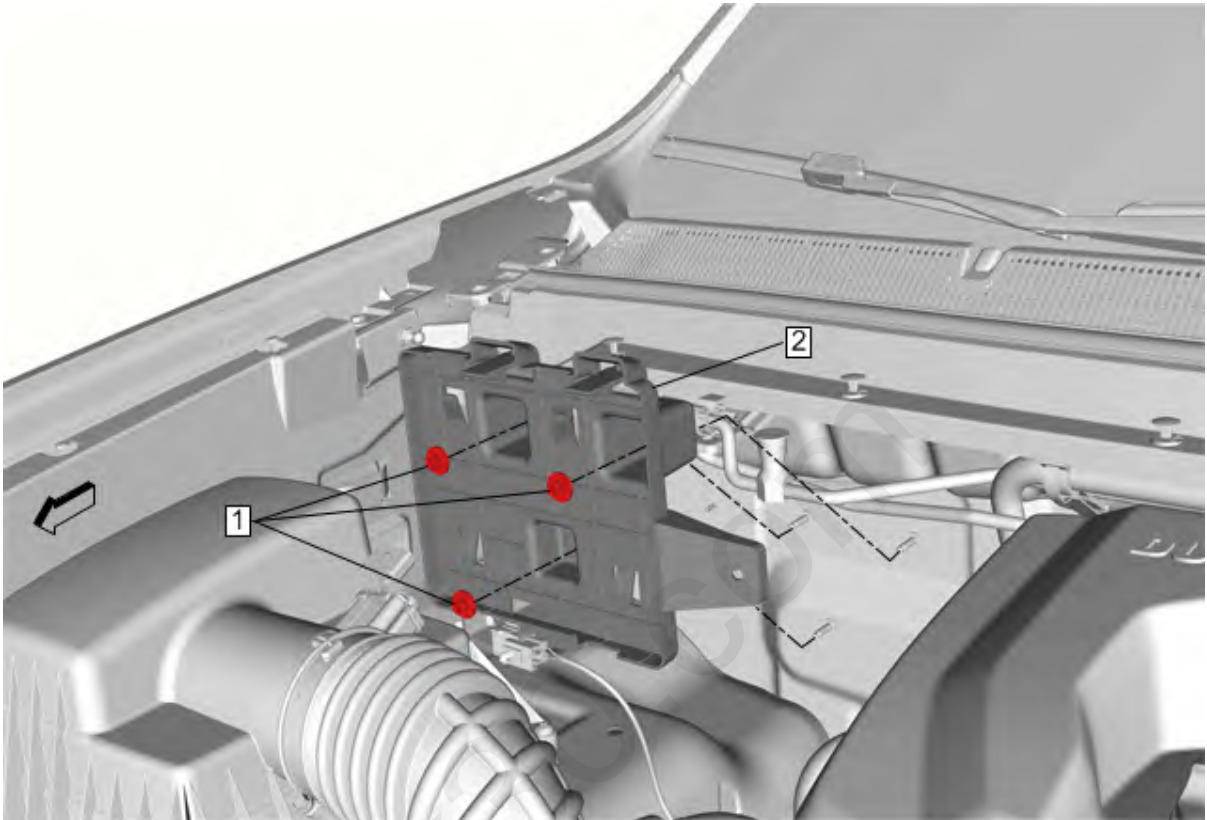


Fig. 41: Engine Control Module Bracket

Courtesy of GENERAL MOTORS COMPANY

13. Install Engine Control Module Bracket (2). [Engine Control Module Bracket Replacement](#) .

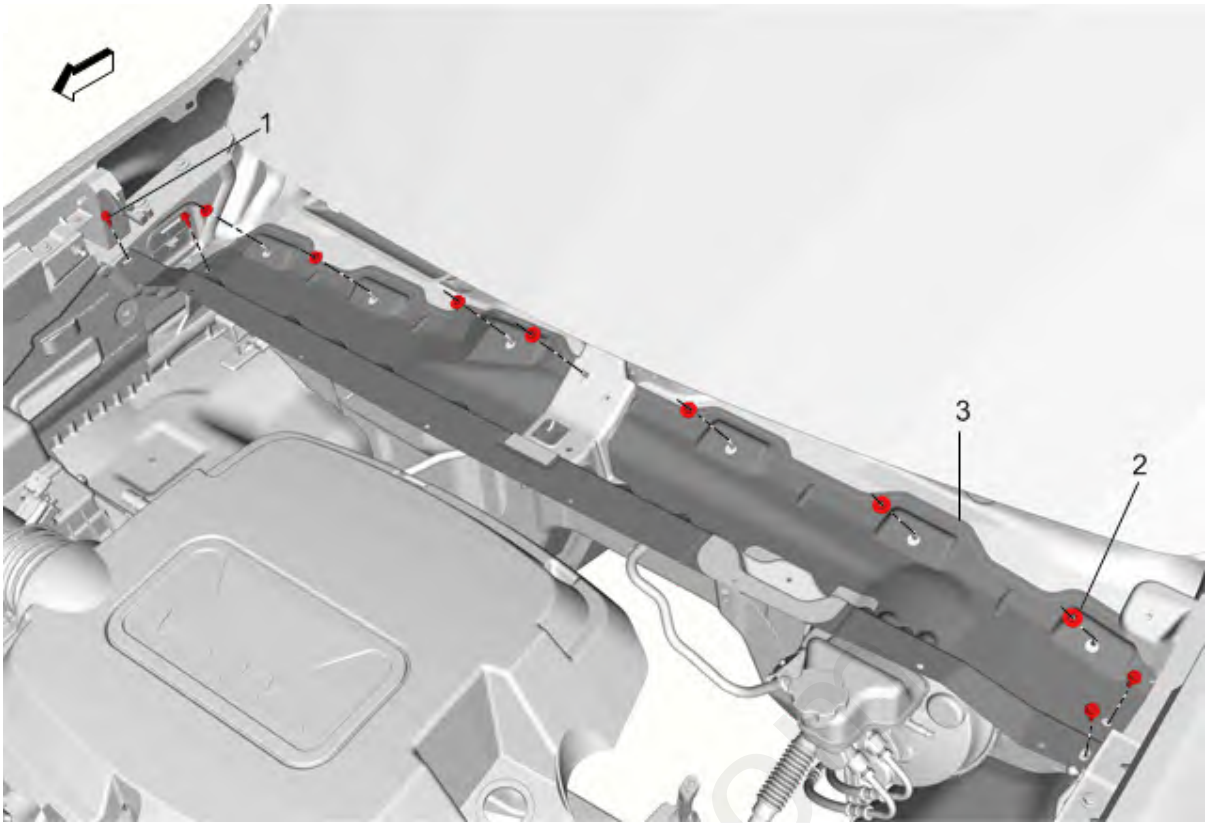


Fig. 42: Plenum Front Panel

Courtesy of GENERAL MOTORS COMPANY

14. Install Plenum Front Panel (3). [Plenum Front Panel Replacement](#)
15. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
16. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT

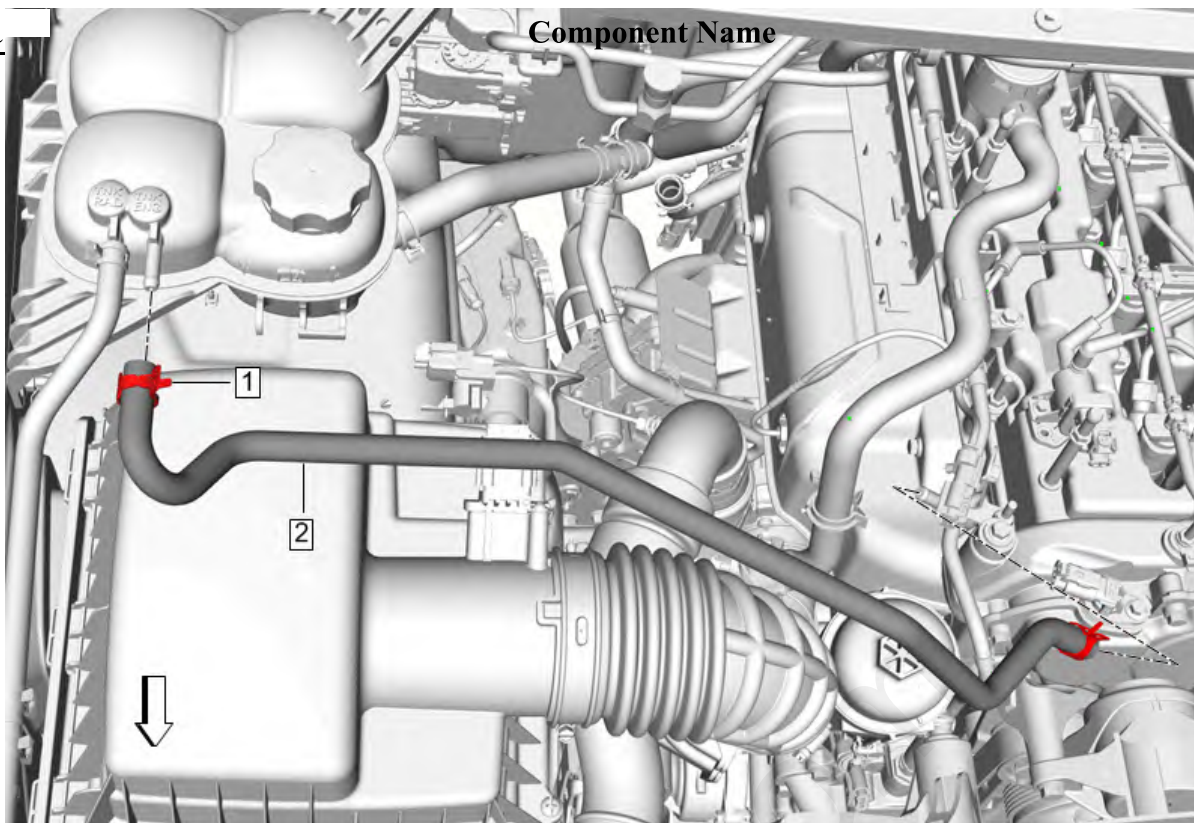


Fig. 43: Radiator Surge Tank Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Intake Manifold Cover Replacement	
1	Radiator Surge Tank Inlet Hose Clamp (Qty: 2) Procedure Reposition the radiator surge tank inlet hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Surge Tank Inlet Hose Procedure 1. Unclip the radiator surge tank inlet hose from the radiator surge tank. 2. Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 3. Check the cooling system for leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (T CONNECTION TO SURGE TANK)

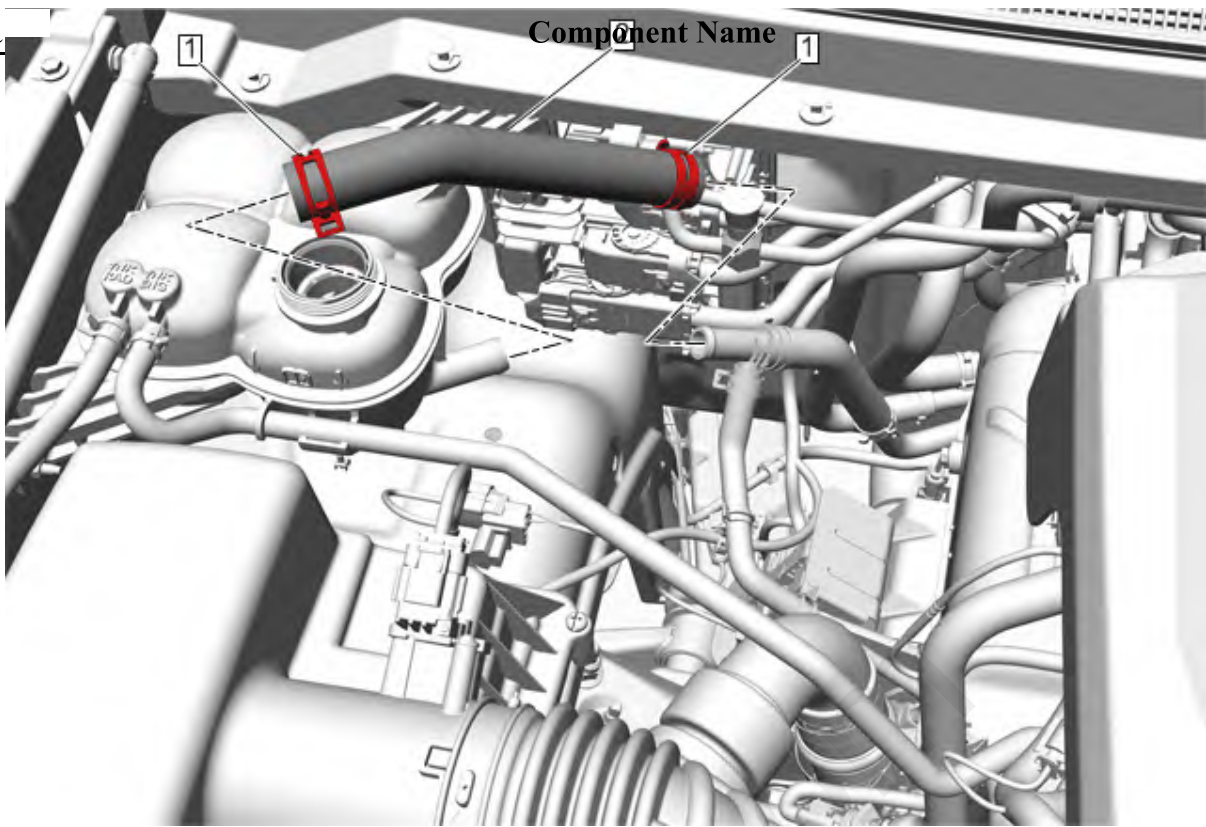


Fig. 44: Radiator Surge Tank Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill)	
1	Radiator Surge Tank Outlet Hose Clamp (Qty: 2) Procedure Reposition the heater outlet hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Surge Tank Outlet Hose Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Check the cooling system for leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LWN TEE CONNECTION TO RADIATOR SURGE TANK OUTLET PIPE)

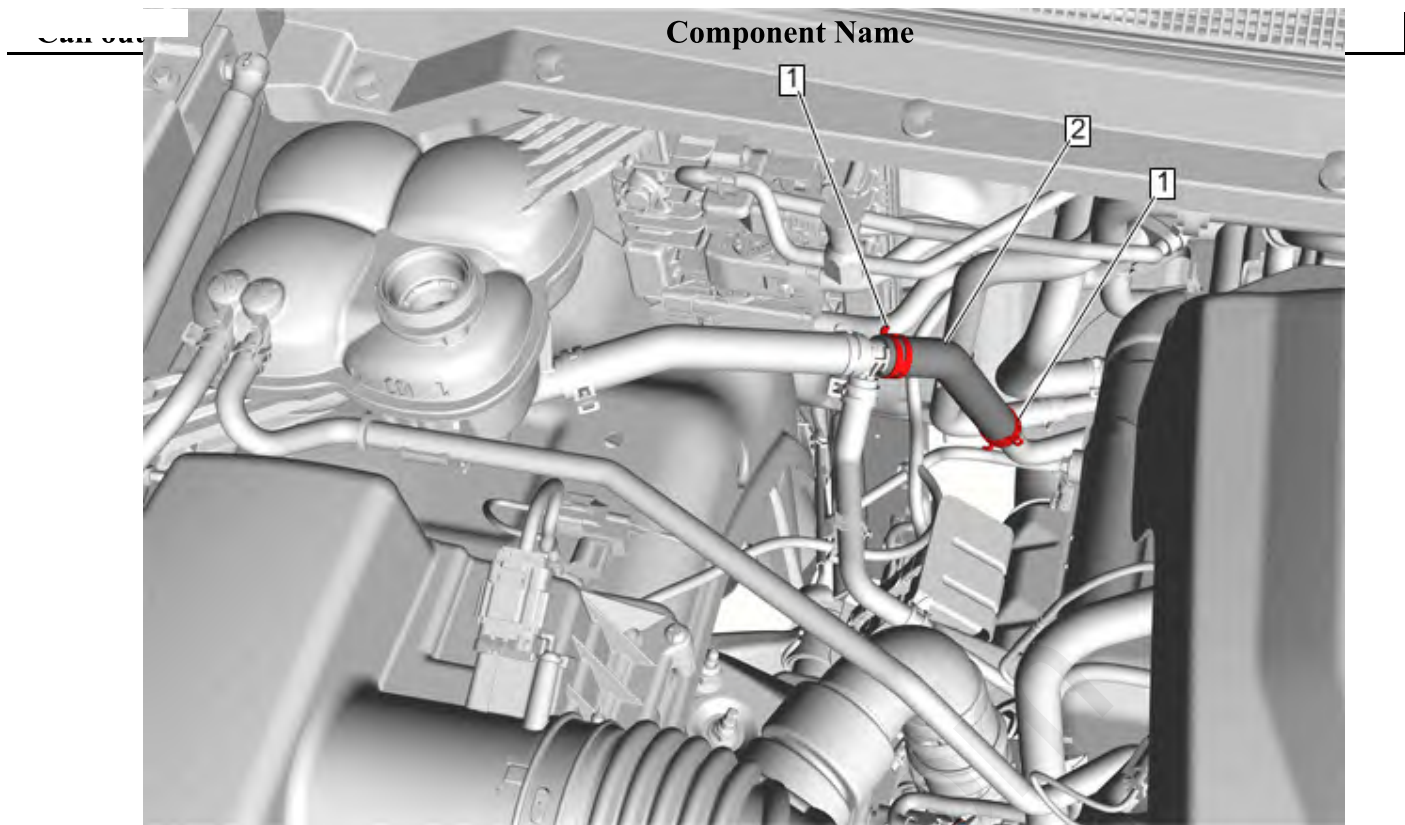


Fig. 45: Radiator Surge Tank Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Surge Tank Outlet Hose Clamp (Qty: 2) Procedure Reposition the radiator surge tank outlet hose clamp using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
2	Radiator Surge Tank Outlet Hose Procedures 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u> 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LWN TEE CONNECTION TO TURBOCHARGER COOLANT RETURN PIPE)

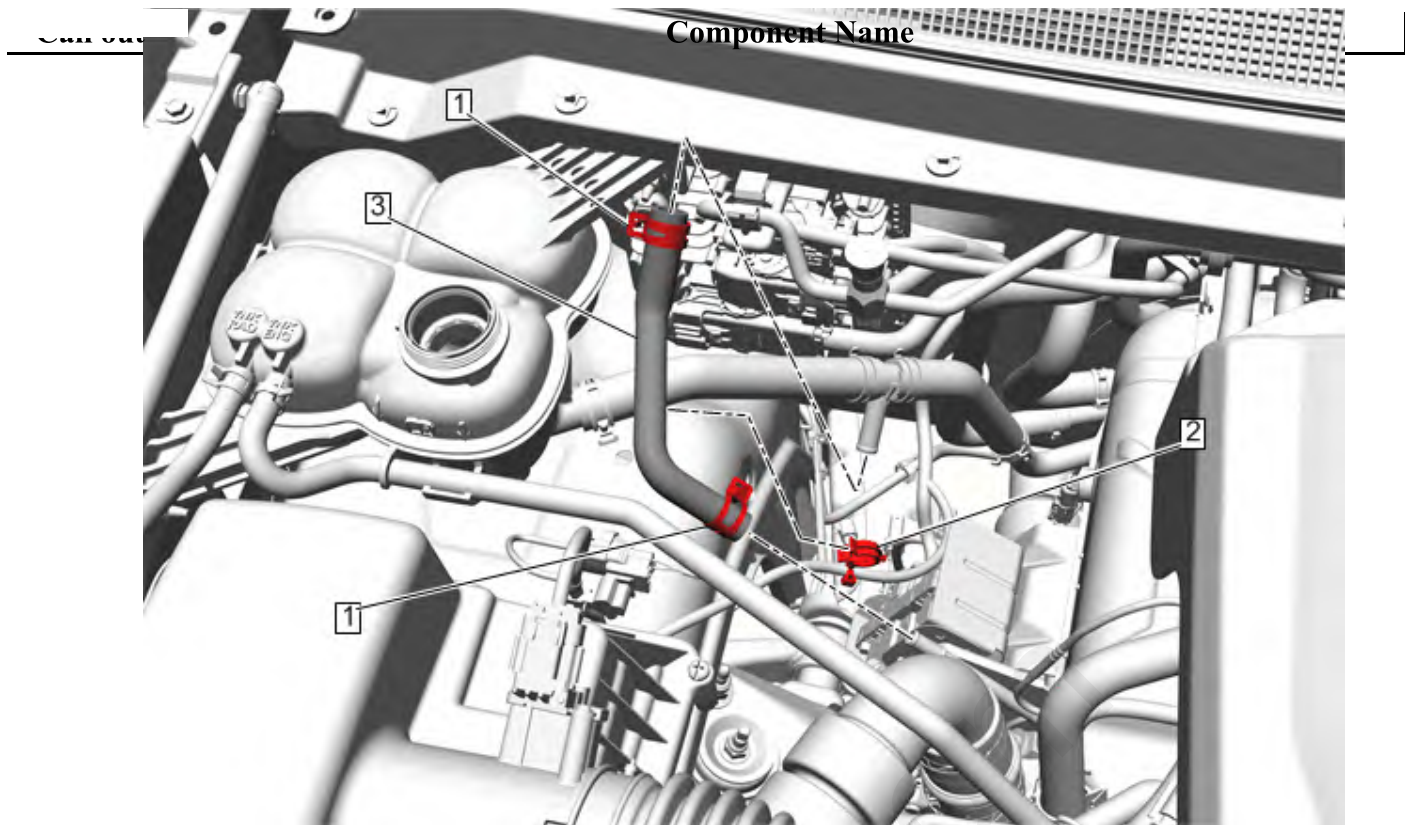


Fig. 46: Radiator Surge Tank Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Surge Tank Outlet Hose Clamp (Qty: 2) Procedure Reposition the radiator surge tank outlet hose clamp using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
2	Wiring Harness Clip
3	Radiator Surge Tank Outlet Hose Procedures 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u> 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (RADIATOR SURGE TANK OUTLET PIPE TO WATER PUMP OULET PIPE LWN)

Removal Procedure

Special Tools

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

Additional tools: **Special Tools**

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill)****Cooling System Draining and Filling (Vac n Fill)**
2. Disconnect and reposition harness as necessary.

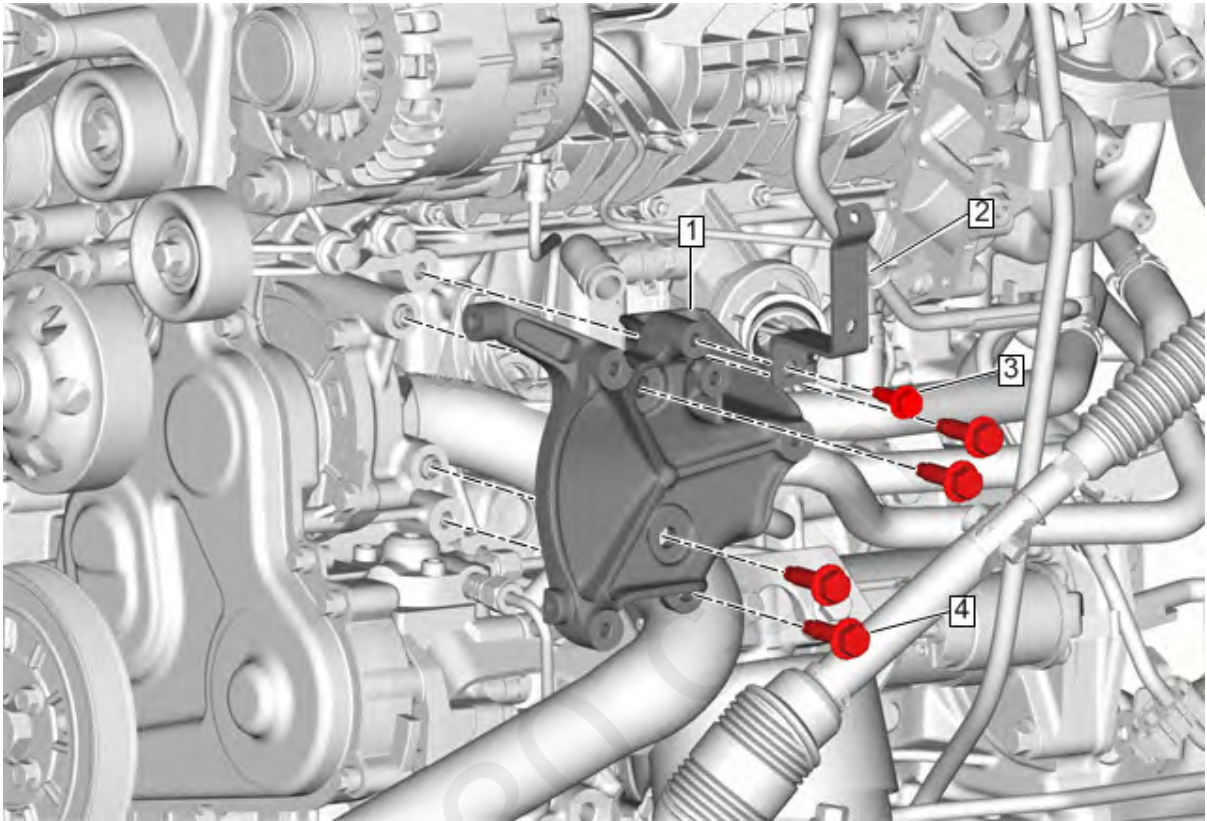


Fig. 47: Air Conditioning Compressor Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Conditioning Compressor Bracket (1). **Air Conditioning Compressor Bracket Replacement (LWN)**
4. Remove the c style with tie wrap clips from the radiator surge tank outlet hose as necessary.

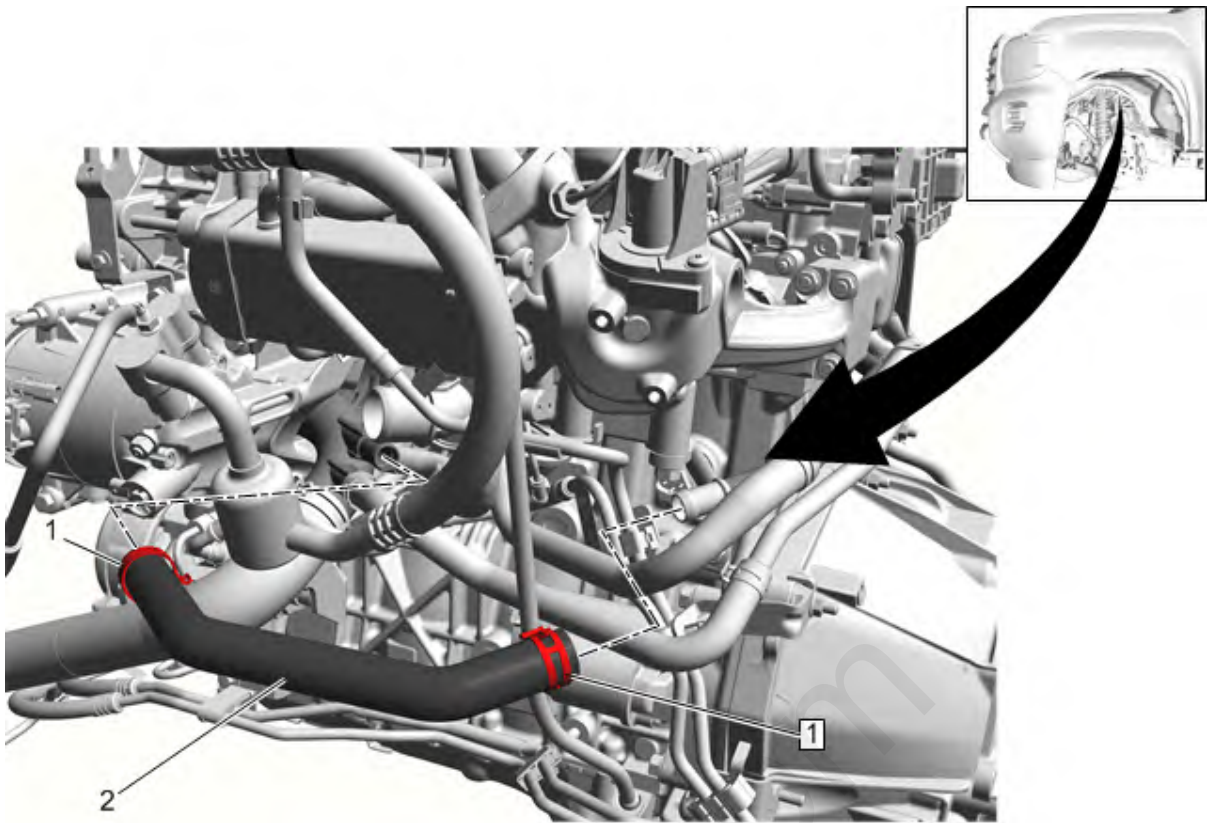


Fig. 48: Radiator Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Radiator Surge Tank Outlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

6. Remove Radiator Surge Tank Outlet Hose (2)

Installation Procedure

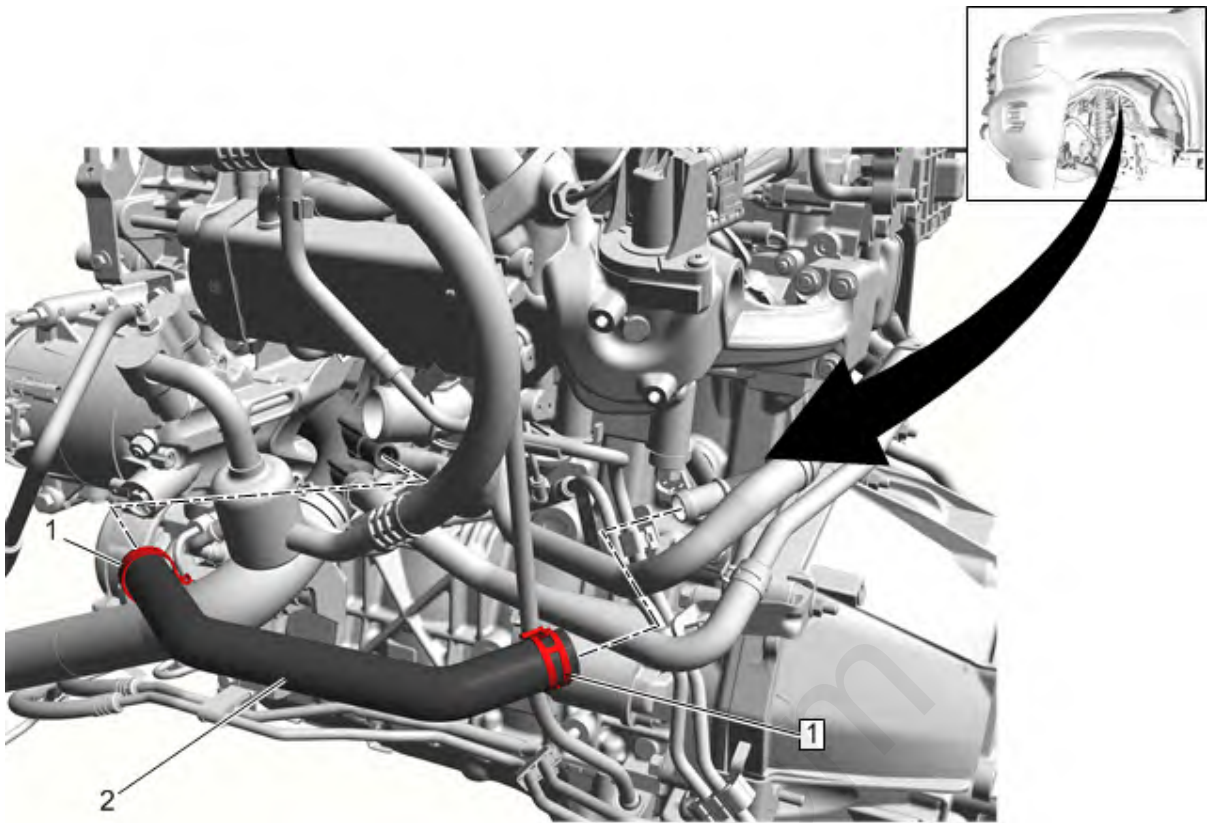


Fig. 49: Radiator Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Surge Tank Outlet Hose (2)
2. Engage Radiator Surge Tank Outlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

3. Install the C style with tie wrap clips onto the radiator surge tank outlet hose.

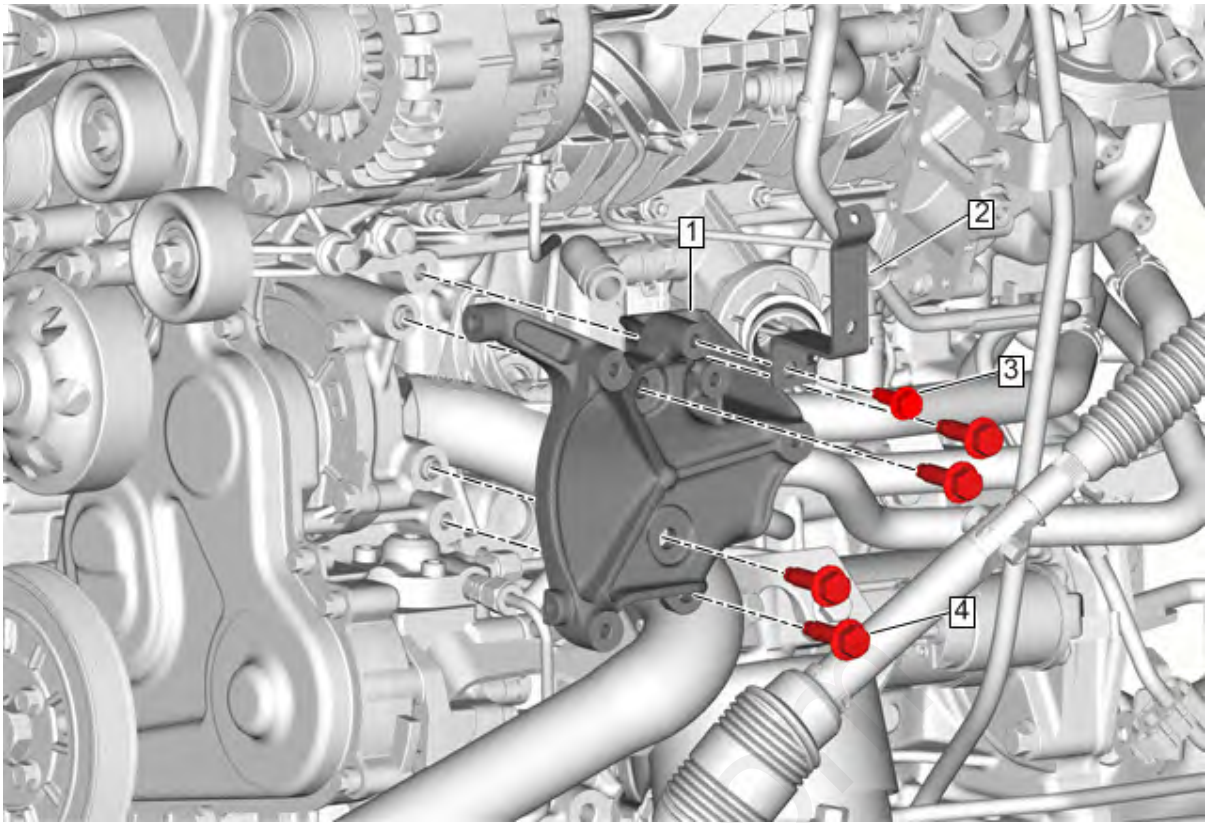


Fig. 50: Air Conditioning Compressor Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install Air Conditioning Compressor Bracket (1) **Air Conditioning Compressor Bracket Replacement (LWN)**
5. Route the wiring harness back to the original position and secure.
6. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill)**
7. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OUTLET HOSE TEE REPLACEMENT (LWN)

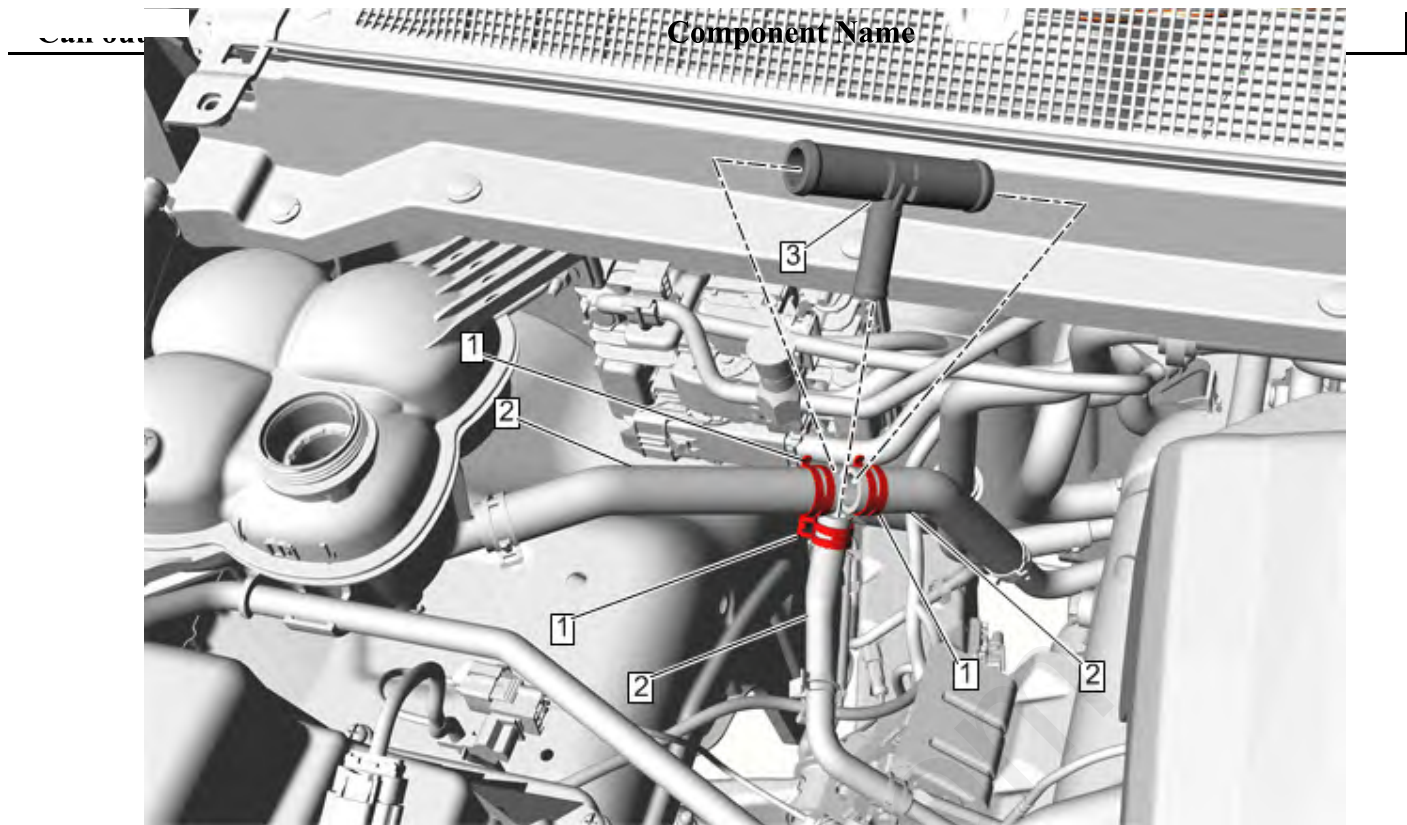


Fig. 51: Radiator Surge Tank Outlet Hose Tee (LWN)
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Surge Tank Outlet Hose Clamp (Qty: 3) Procedure Reposition the radiator surge tank outlet hose clamp using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
2	Radiator Surge Tank Outlet Hose (Qty: 3) Procedure Remove Radiator Surge Tank Outlet Hose@Radiator Surge Tank Outlet Hose Tee
3	Radiator Surge Tank Outlet Hose Tee Procedures 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u> 2. Start the engine and check for coolant leaks.

RADIATOR INLET PIPE REPLACEMENT (LCV)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

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

1. Remove the radiator surge tank. Refer to [Radiator Surge Tank Replacement \(LCV and LFX\)](#).
2. Remove the air cleaner outlet duct and air cleaner assembly. Refer to [Air Cleaner Outlet Duct Replacement](#) , and [Air Cleaner Assembly Replacement](#) .
3. Remove the radiator inlet hose from the inlet pipe side. Refer to [Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#)[Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#).
4. Remove Plenum Front Panel.[Plenum Front Panel Replacement](#)

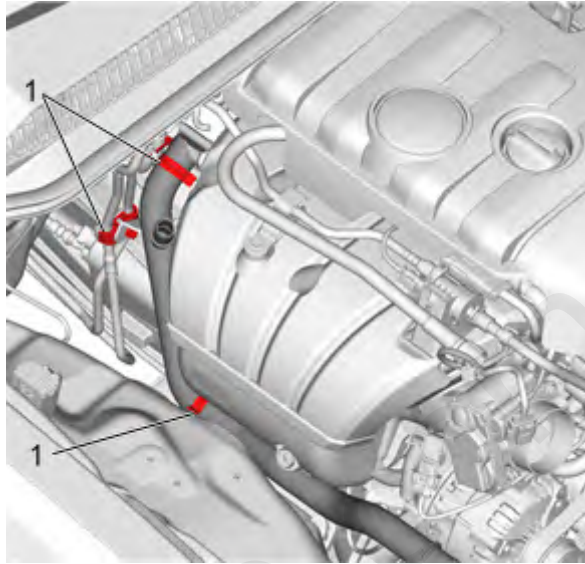


Fig. 52: Inlet Pipe From Retainers

Courtesy of GENERAL MOTORS COMPANY

5. Release the inlet pipe from the retainers (1).

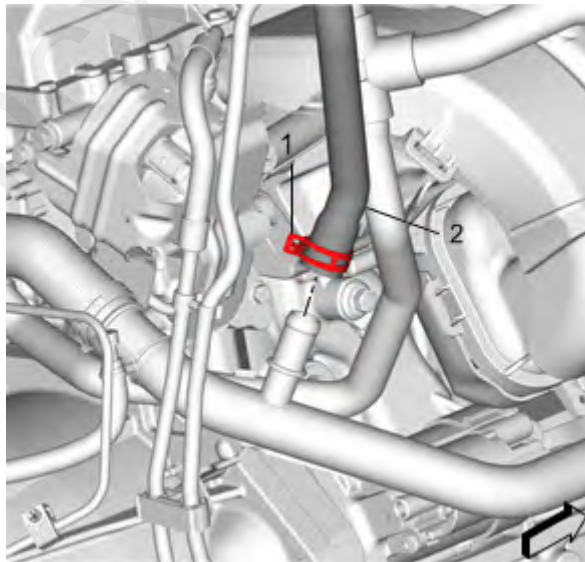


Fig. 53: Heater Outlet Hose Clamp And Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Relieve tension on the heater outlet hose clamp (1) at the radiator inlet pipe using *BO-38185* Hose Clamp Pliers.
7. Remove the heater outlet hose (2) from the radiator inlet pipe.

e vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

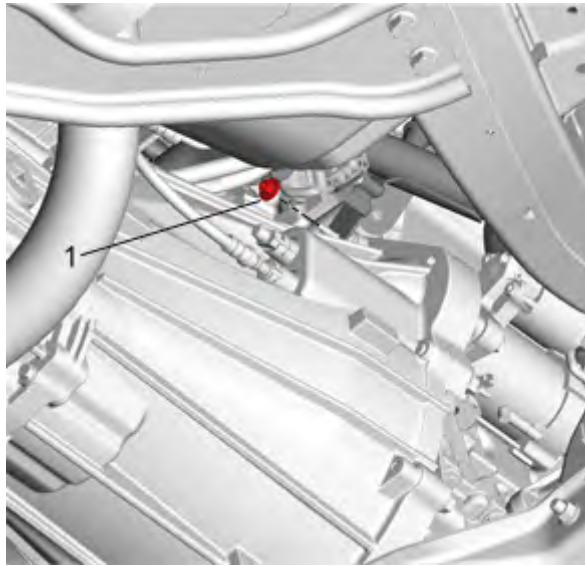


Fig. 54: Transmission Fastener

Courtesy of GENERAL MOTORS COMPANY

9. Remove the inlet pipe to transmission fastener (1).

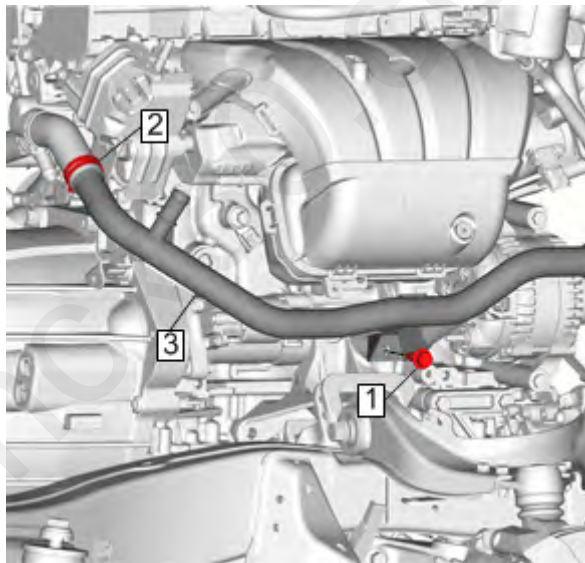


Fig. 55: Inlet Pipe Fastener

Courtesy of GENERAL MOTORS COMPANY

10. Remove the inlet pipe fastener (1).
11. Relieve tension on the inlet pipe clamp (2) using *BO-38185* then remove the inlet pipe (3) from the engine.

Installation Procedure

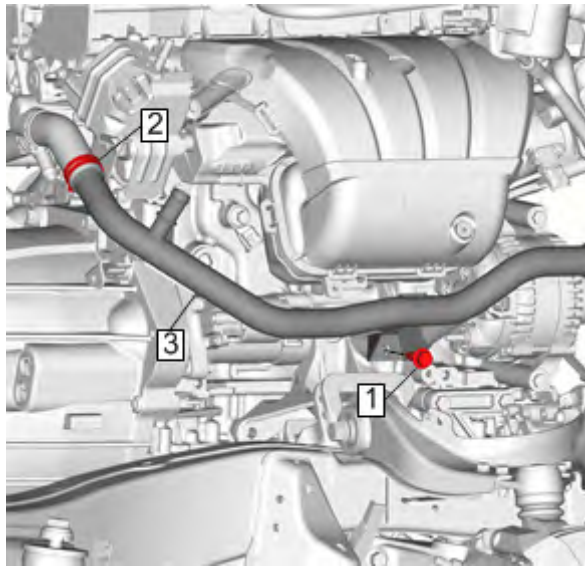


Fig. 56: Inlet Pipe Fastener

Courtesy of GENERAL MOTORS COMPANY

1. Position the radiator inlet pipe (3) then install it into the inlet hose.
2. Properly position the inlet pipe hose clamp (2) using *BO-38185* Hose Clamp Pliers then release the pliers to allow tension to secure the hose.

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

3. Hand start the inlet pipe fastener (1). Tighten to 58 N.m (43 lb ft).

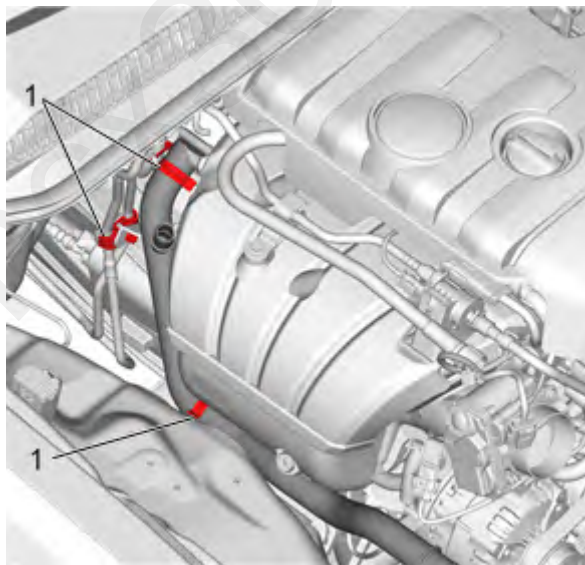


Fig. 57: Inlet Pipe From Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Secure the inlet pipe on the radiator inlet pipe retainers (1).

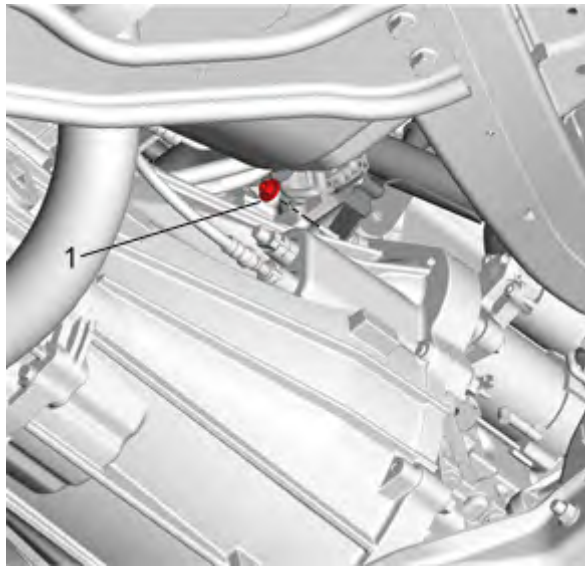


Fig. 58: Transmission Fastener

Courtesy of GENERAL MOTORS COMPANY

5. Install the inlet pipe to transmission fastener (1). Tighten to 9 N.m (80 lb in).
6. Lower the vehicle.
7. Install Plenum Front Panel. [Plenum Front Panel Replacement](#)
8. Install the radiator inlet hose. Refer to [Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#) [Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#).

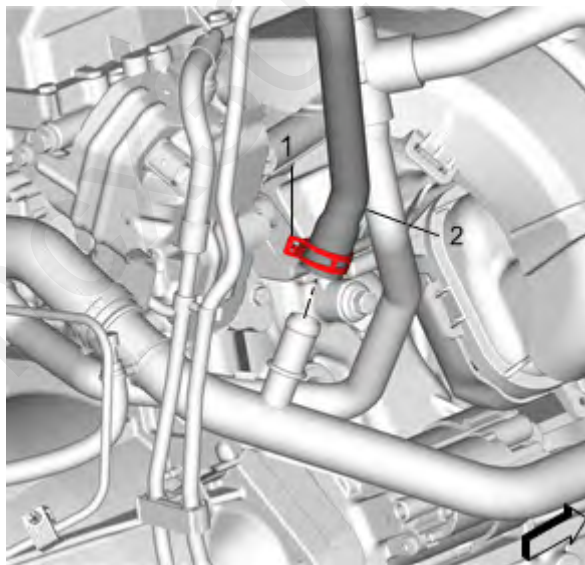


Fig. 59: Heater Outlet Hose Clamp And Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Install the heater outlet hose (2).
10. Properly position the heater outlet hose clamp (1) using *BO-38185* Hose Clamp Pliers then release the pliers to allow tension to secure the hose.
11. Install the air cleaner outlet duct and air cleaner assembly. Refer to [Air Cleaner Outlet Duct Replacement](#) , and [Air Cleaner Assembly Replacement](#) .
12. Install the radiator surge tank. Refer to [Radiator Surge Tank Replacement \(LCV and LFX\)](#).

Callout | cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).

14. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT (LFX)

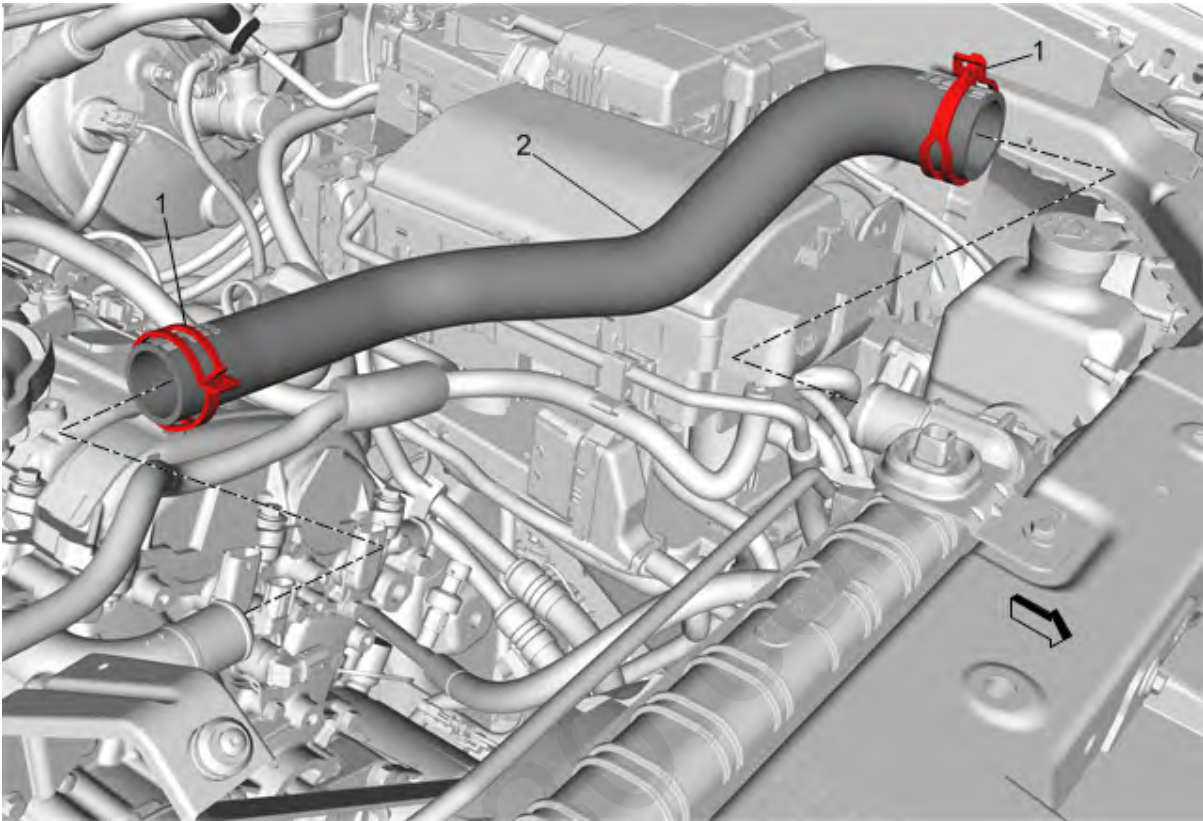


Fig. 60: Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement . 2. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill).	
1	Radiator Inlet Hose Clamp (Qty: 2) Procedure Reposition the radiator inlet hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Inspect the cooling system for leaks.



RADIATOR INLET HOSE REPLACEMENT (LCV INLET PIPE TO WATER OUTLET)

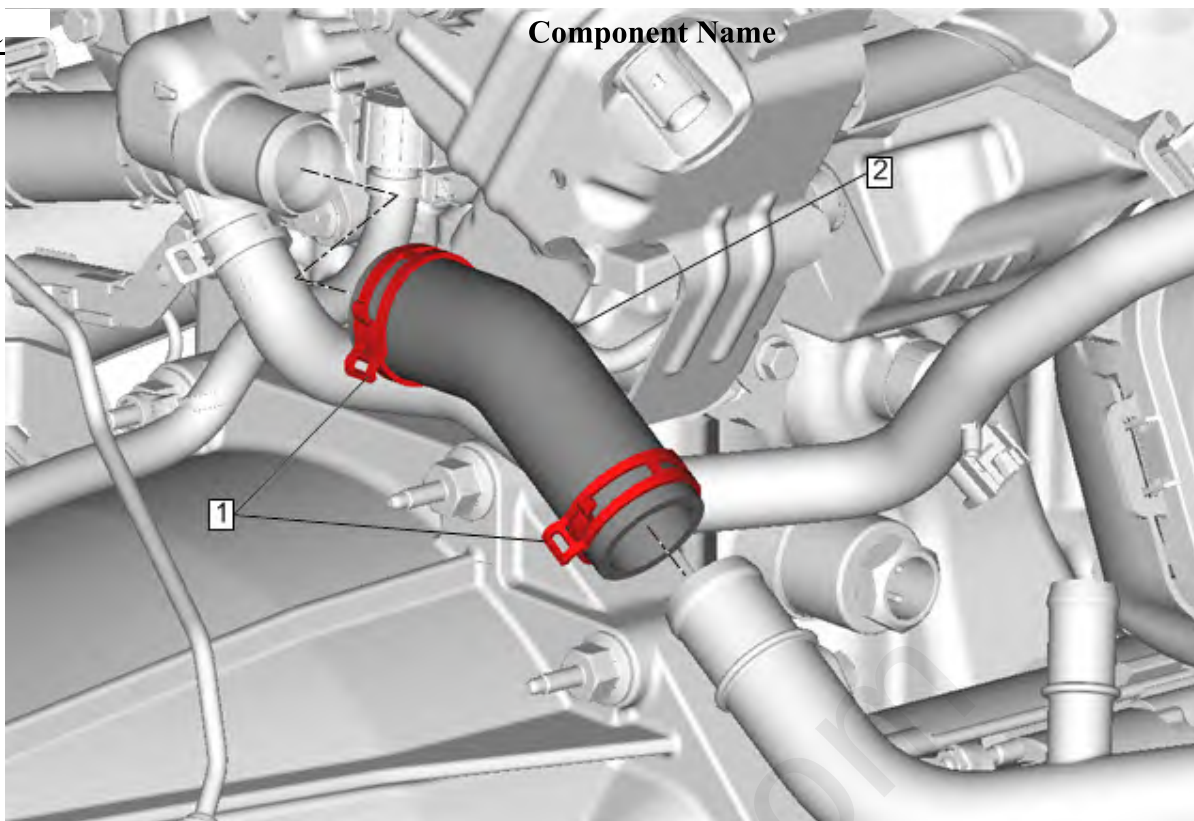


Fig. 62: Radiator Inlet Hose (LCV Inlet Pipe to Water Outlet)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the radiator inlet pipe. Refer to Radiator Inlet Pipe Replacement (LCV). 2. Drain and fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill).	
1	Radiator Inlet Hose Clamp (Qty 2) Procedure Reposition the radiator inlet hose clamps using the BO 38185 hose clamp pliers. Special Tools BO 38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Inlet Hose Procedures Check the cooling system for leaks.

RADIATOR INLET HOSE REPLACEMENT (RADIATOR SIDE LWN)

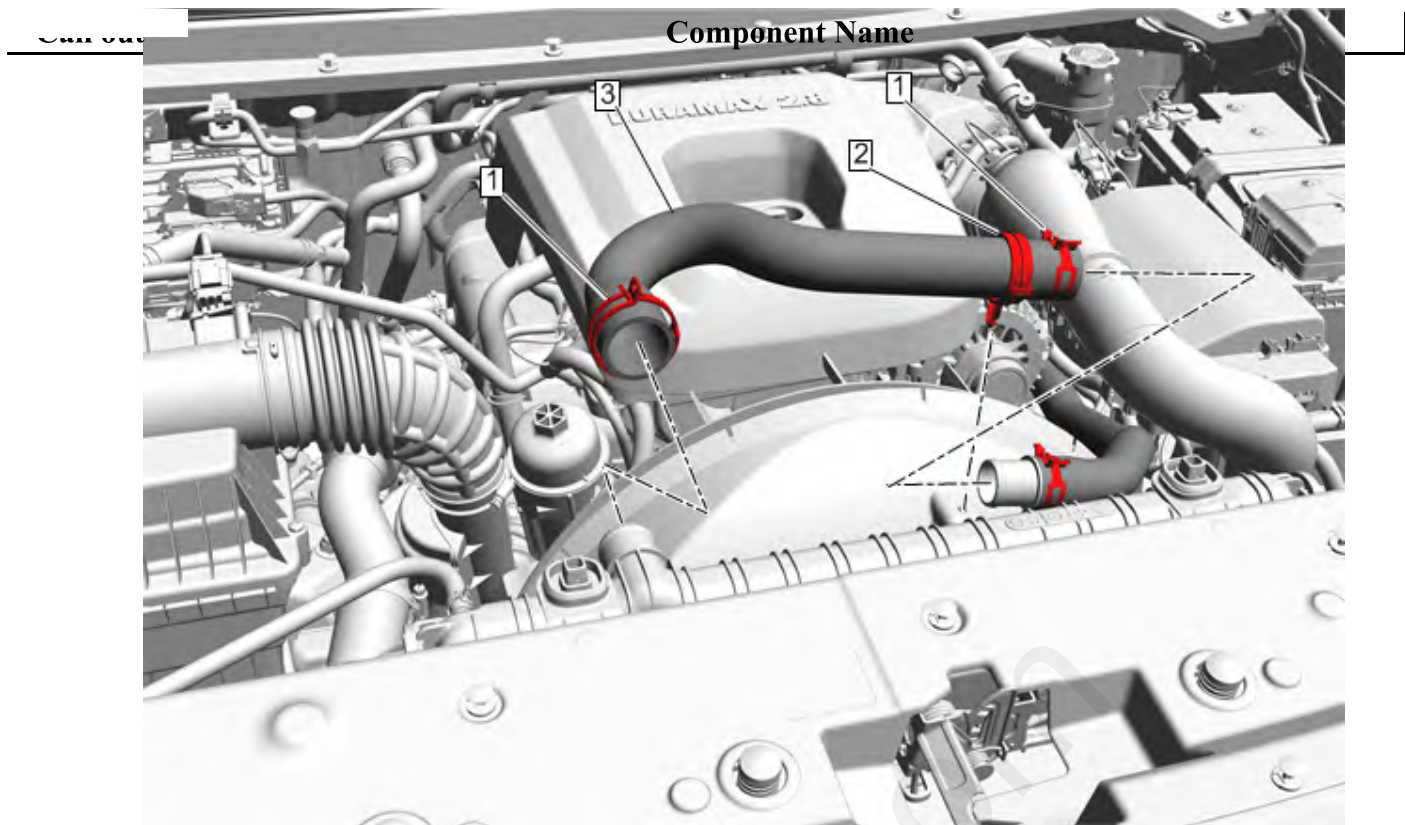


Fig. 63: Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Inlet Hose Clamp (Qty: 2) Procedure Reposition the heater inlet hose clamp using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
2	Radiator Inlet Hose Retainer
3	Radiator Inlet Hose@Radiator Procedures 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u> 2. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT (ENGINE SIDE LWN)

Removal Procedure

Special Tools

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

Additional tools: **Special Tools**

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

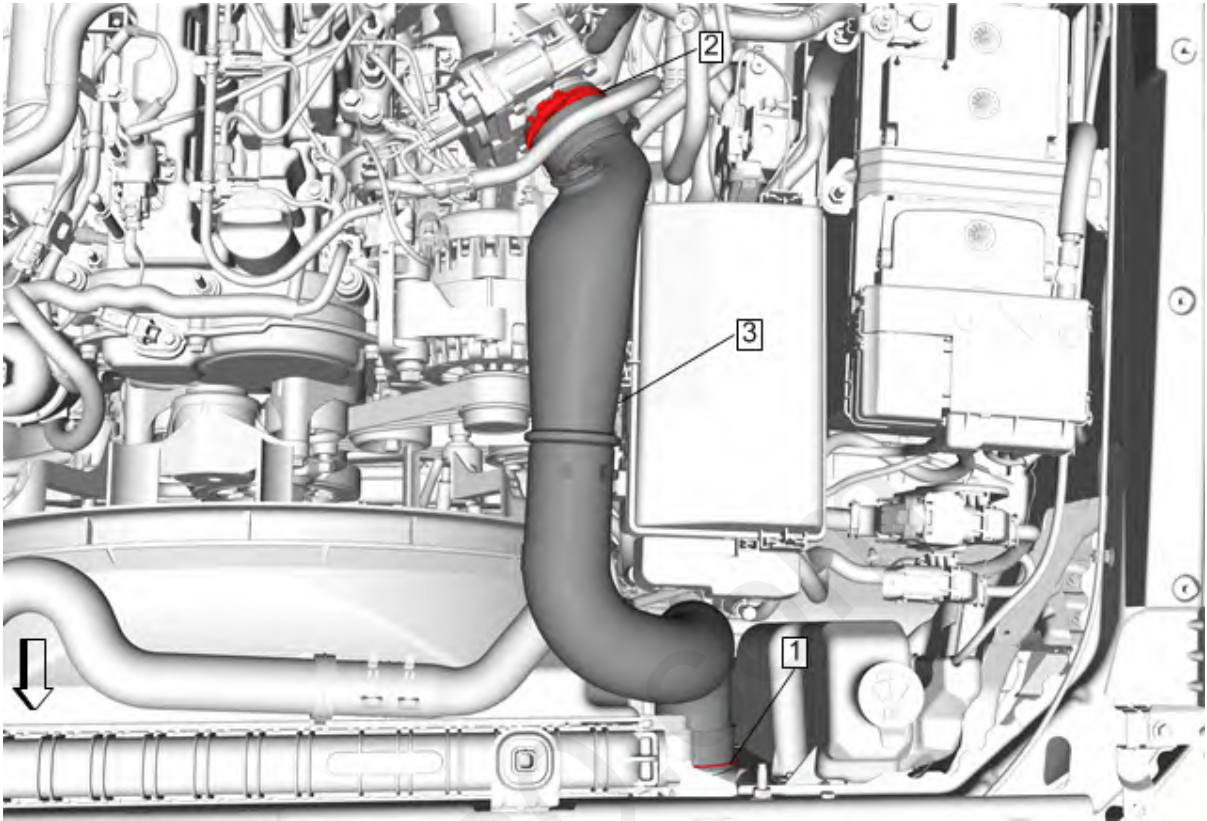


Fig. 64: Charge Air Cooler Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

2. Remove Charge Air Cooler Outlet Duct (3) **Charge Air Cooler Outlet Duct Replacement**

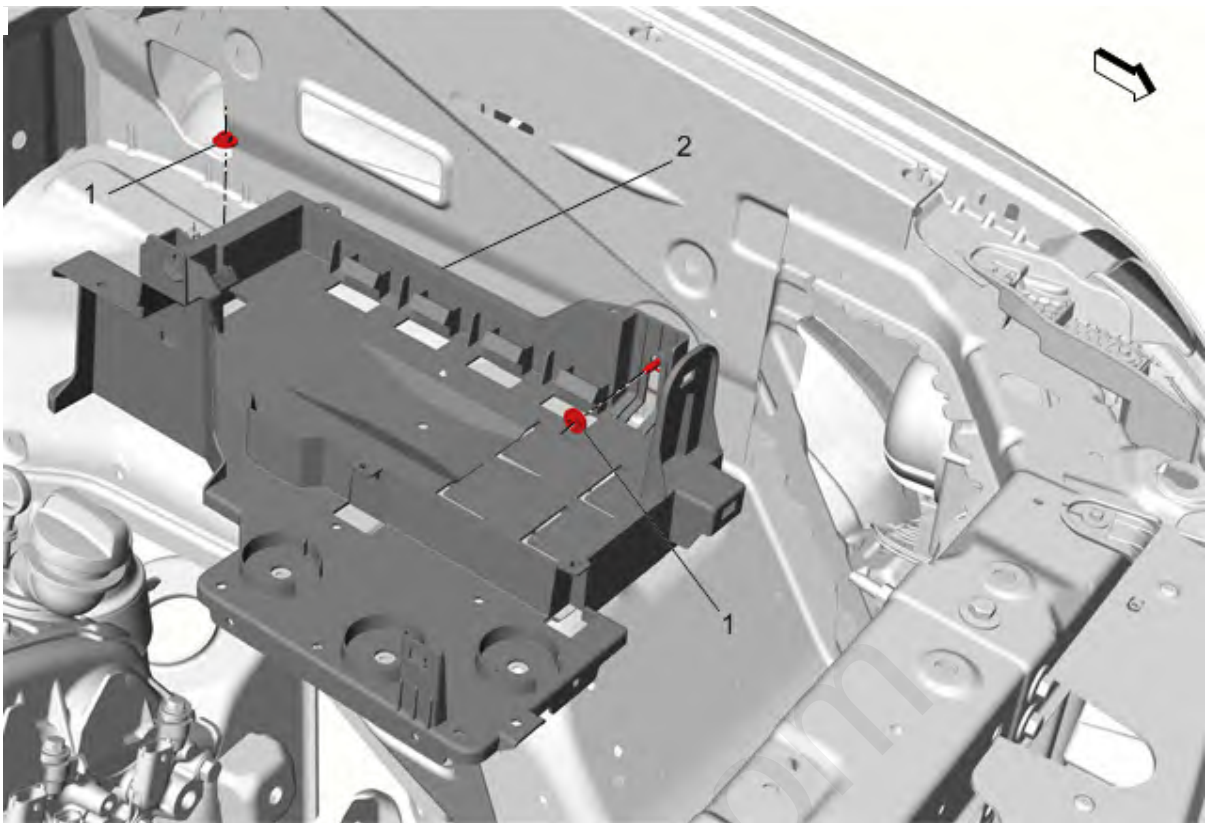
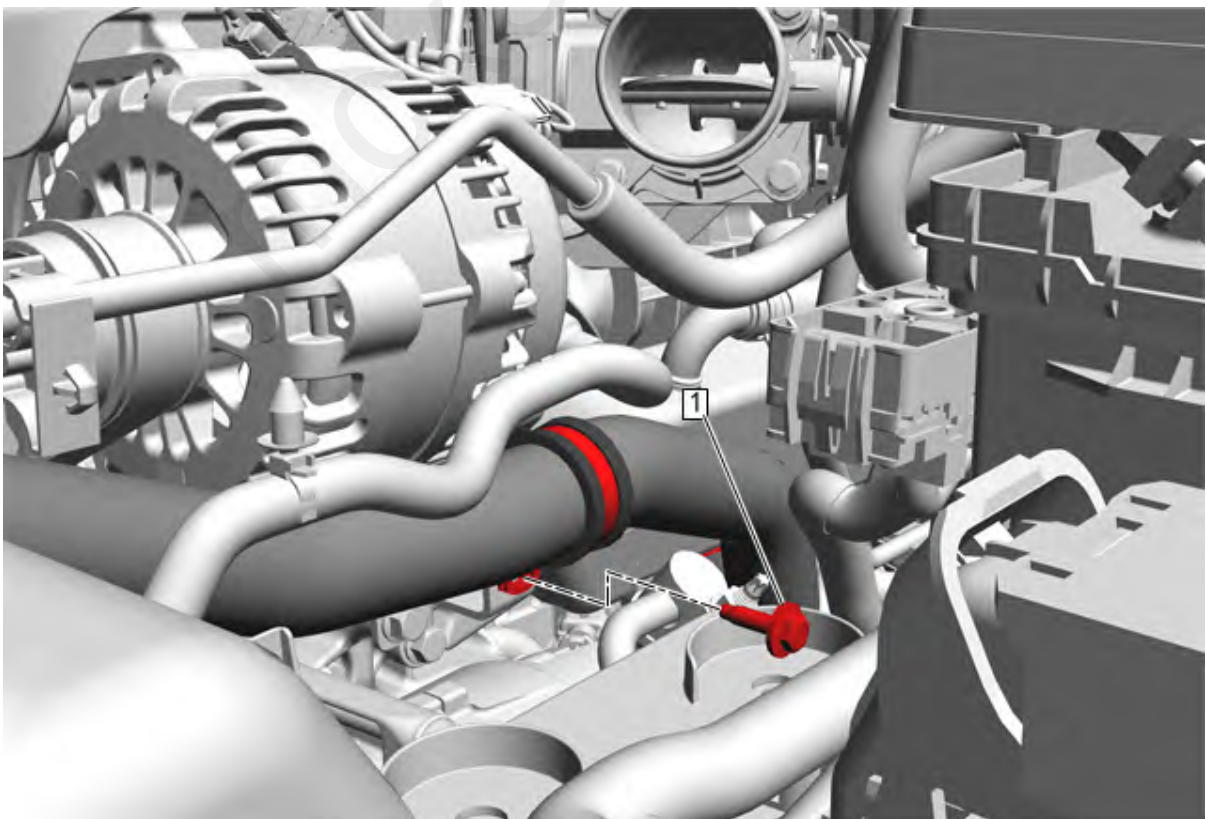


Fig. 65: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

3. Remove Battery Tray [Battery Tray Replacement](#)
4. Disconnect and reposition harness as necessary.



Radiator Inlet Hose Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove Radiator Inlet Hose Bracket Bolt (1)

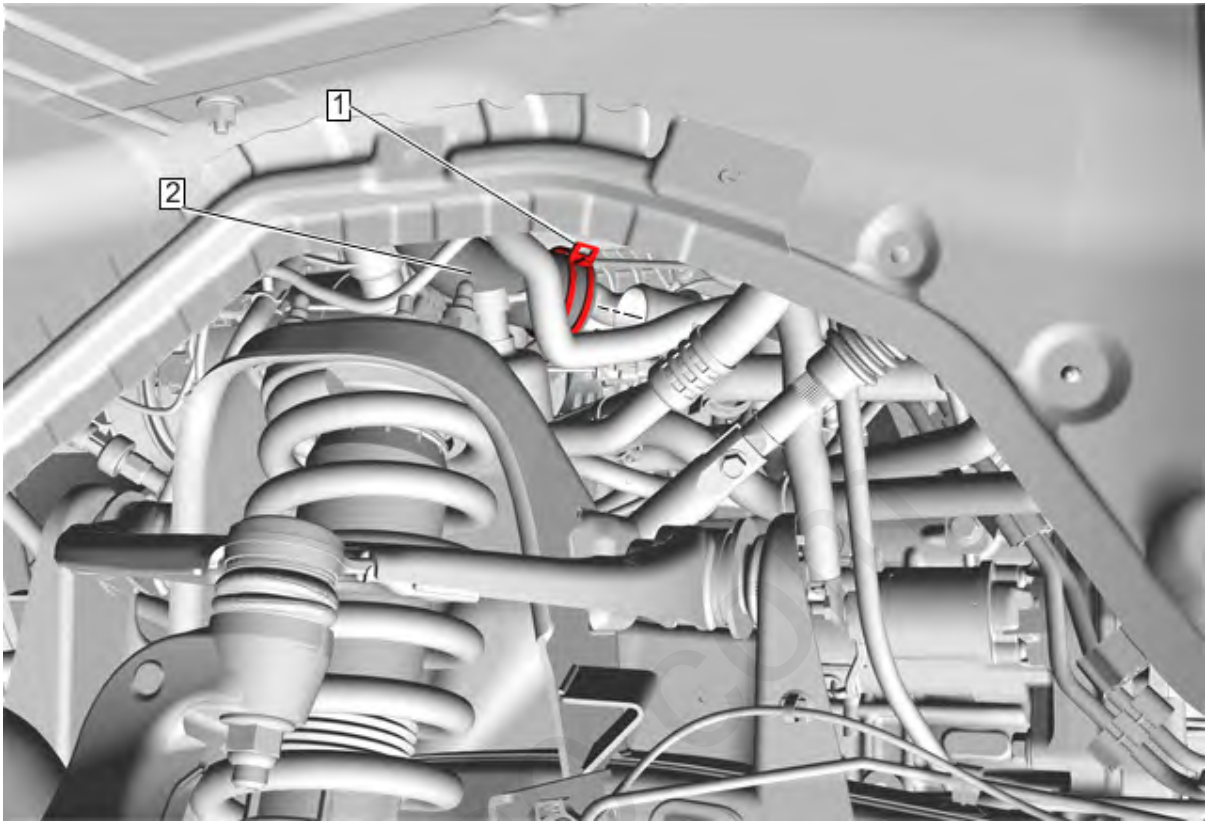


Fig. 67: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Disengage Radiator Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

7. Remove Radiator Inlet Hose (2) @Engine Coolant Thermostat Outlet

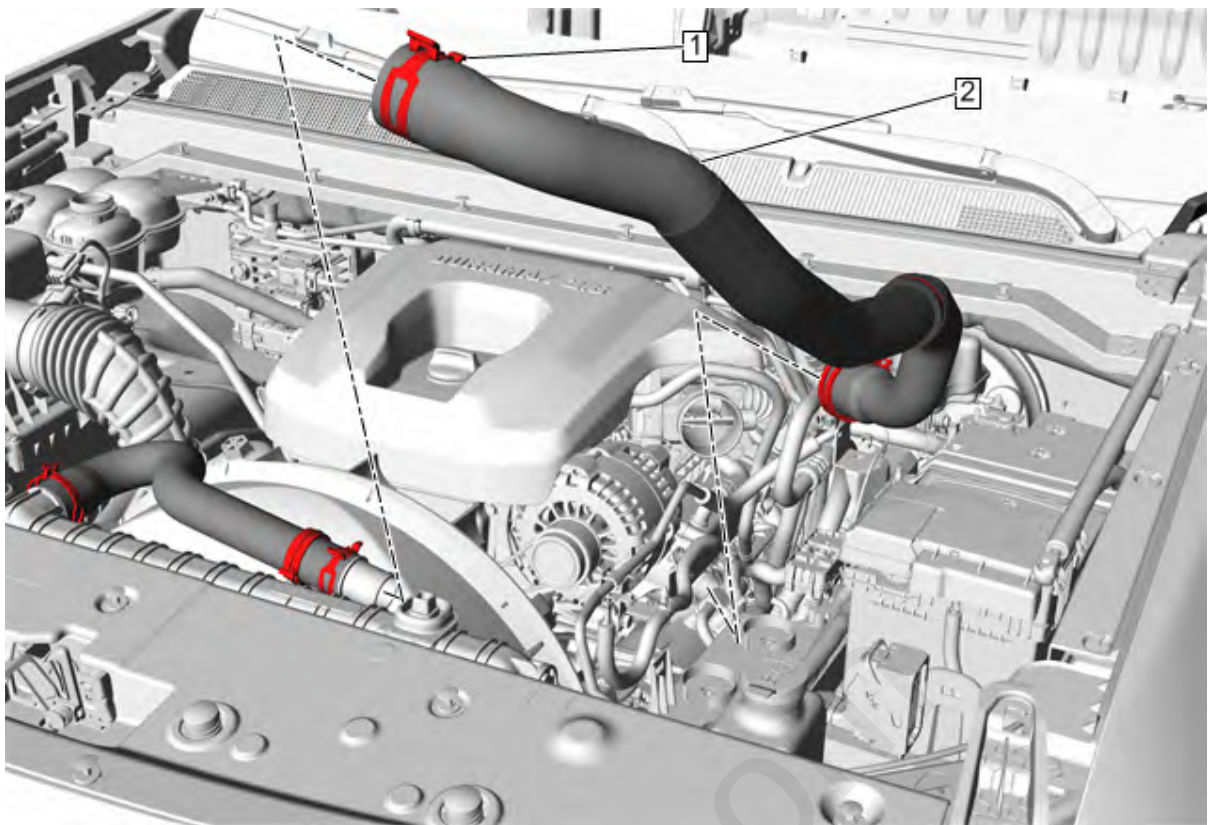


Fig. 68: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Disengage Radiator Inlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers

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

10. Maneuver the radiator inlet hose (2) out from the engine compartment.

Installation Procedure

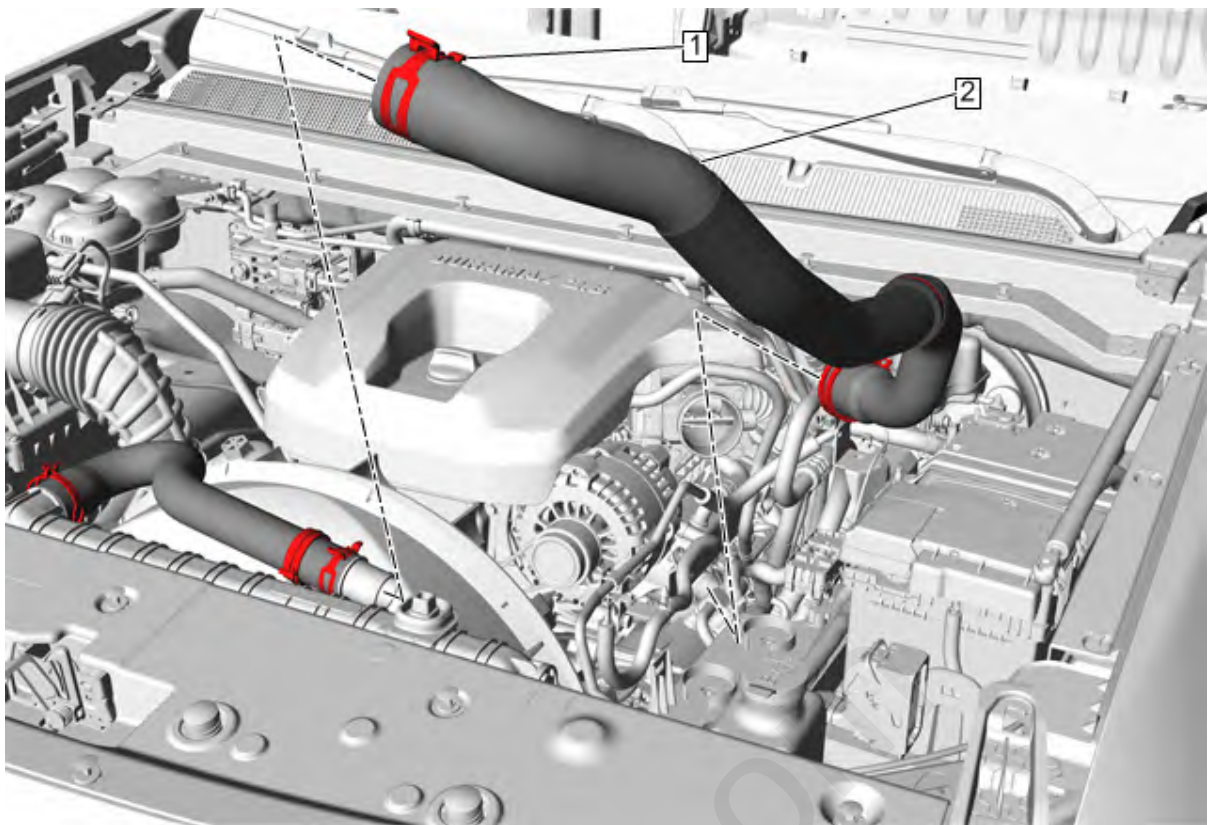


Fig. 69: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Route the radiator inlet hose (2) back into the engine compartment.
2. Install Radiator Inlet Hose (2) @Radiator Inlet Hose Connector
3. Engage Radiator Inlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers

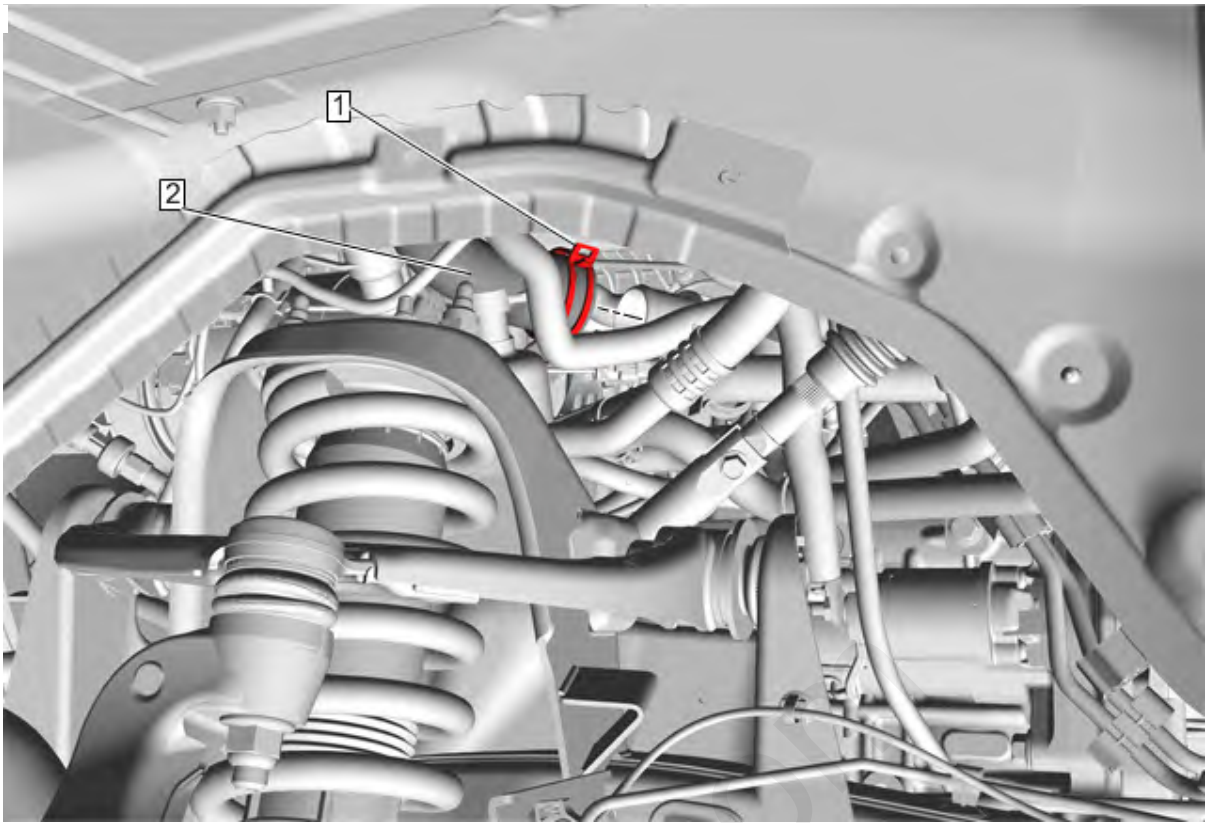
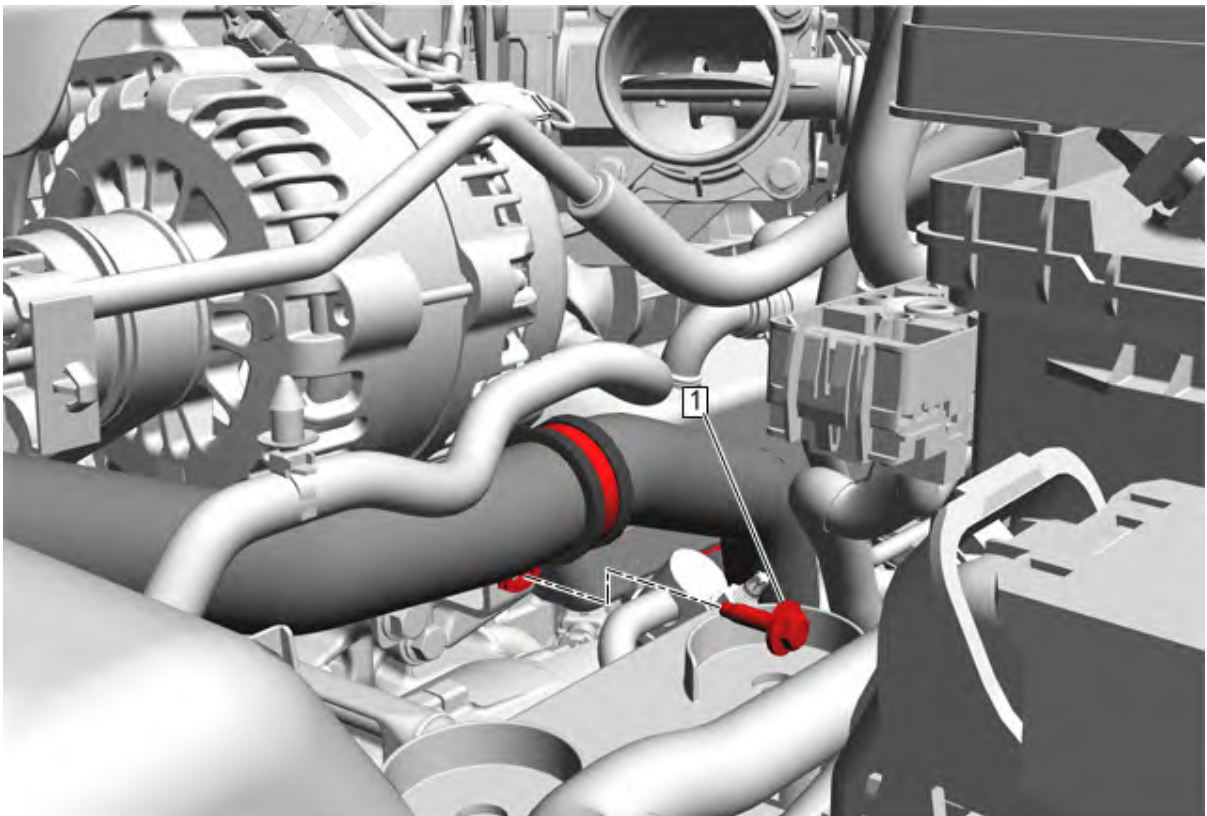


Fig. 70: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Inlet Hose (2) @Engine Coolant ThermostatOutlet
5. Engage Radiator Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.



Radiator Inlet Hose Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

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

6. Install Radiator Inlet Hose Bracket Bolt (1) and tighten 9 N.m (80 lb in)
7. Route the wiring harness back to the original position and secure.

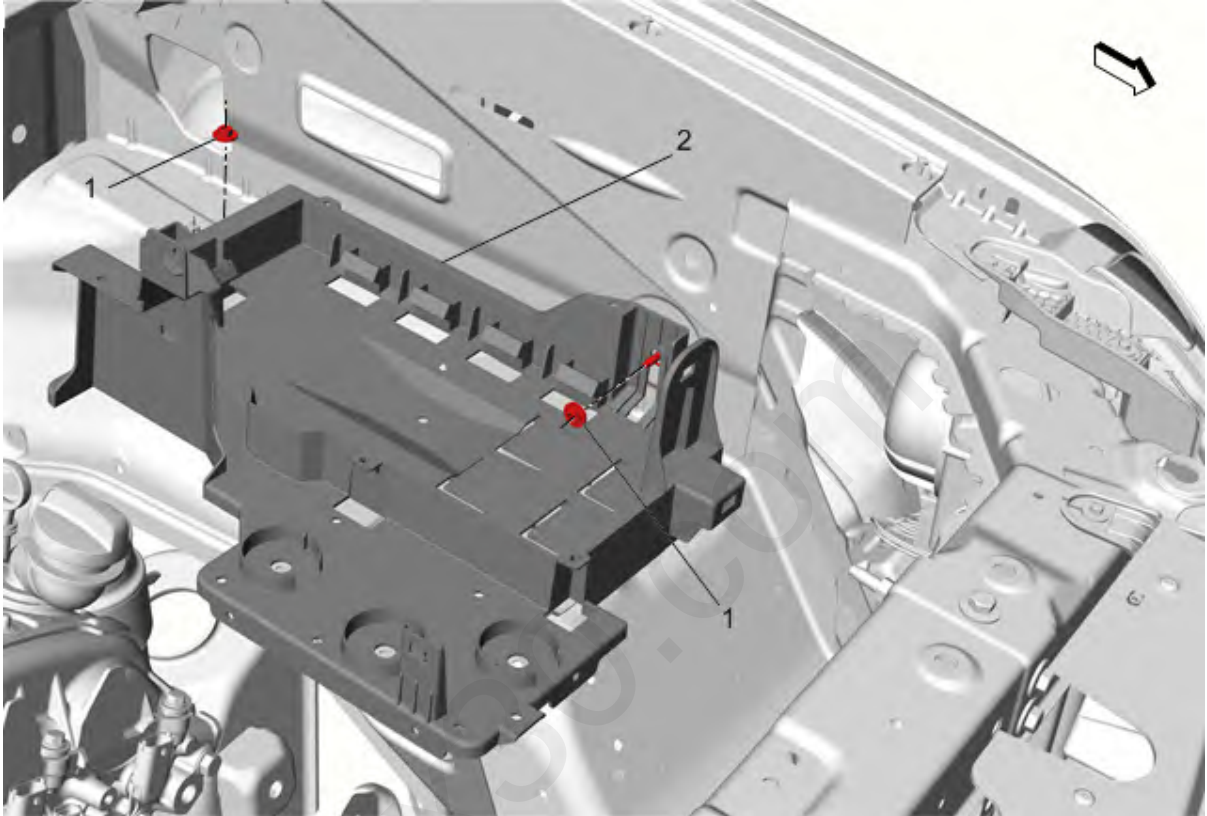


Fig. 72: Battery Tray
Courtesy of GENERAL MOTORS COMPANY

8. Install Battery Tray. [Battery Tray Replacement](#)

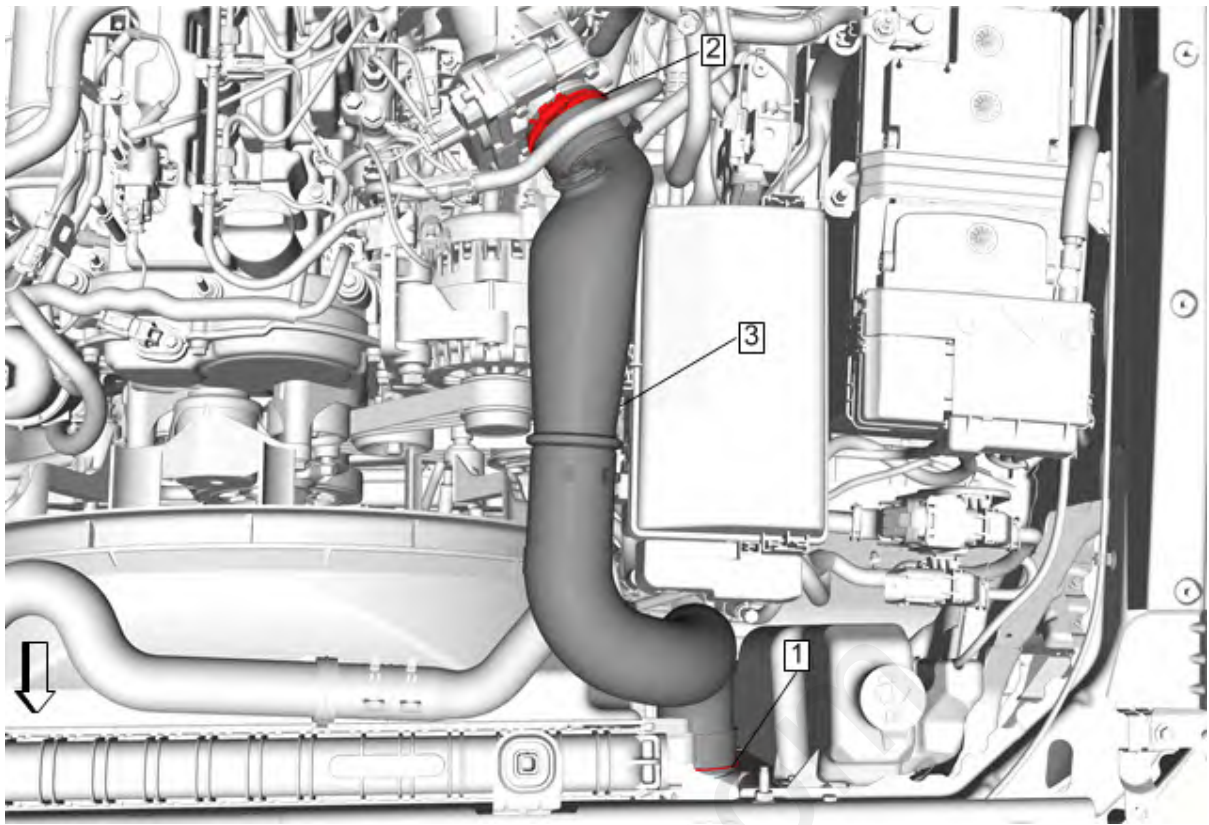


Fig. 73: Charge Air Cooler Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

9. Install Charge Air Cooler Outlet Duct (3) **Charge Air Cooler Outlet Duct Replacement**
10. Fill the cooling system. **Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill)**
11. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE CONNECTOR REPLACEMENT (LWN)

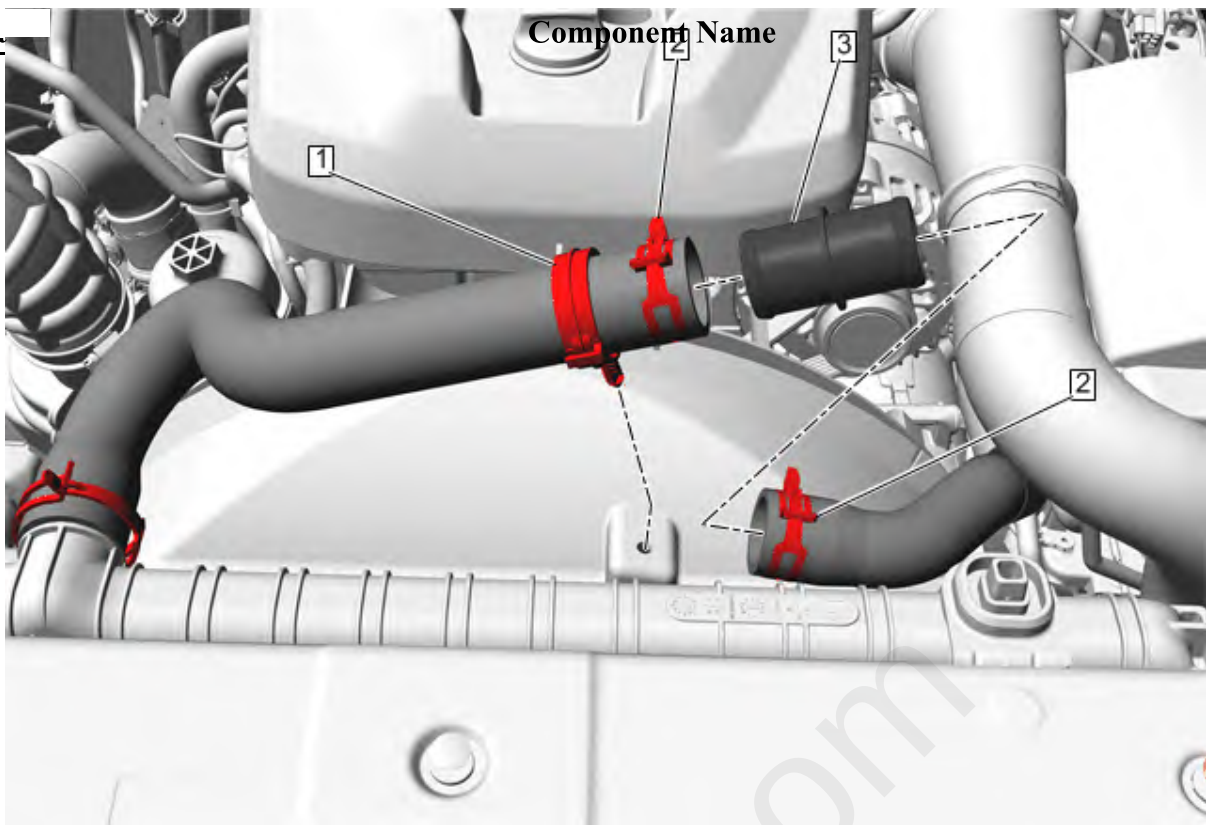


Fig. 74: Radiator Inlet Hose Connector (LWN)
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Inlet Hose Retainer
2	Radiator Inlet Hose Clamp (Qty: 2) Procedure Disengage Radiator Inlet Hose Clamp using the BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
3	Radiator Inlet Hose Connector Procedures 1. Radiator Inlet Hose Connector@Radiator Inlet HoseÂ»Remove 2. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)</u> 3. Start the engine and check for coolant leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LFX)

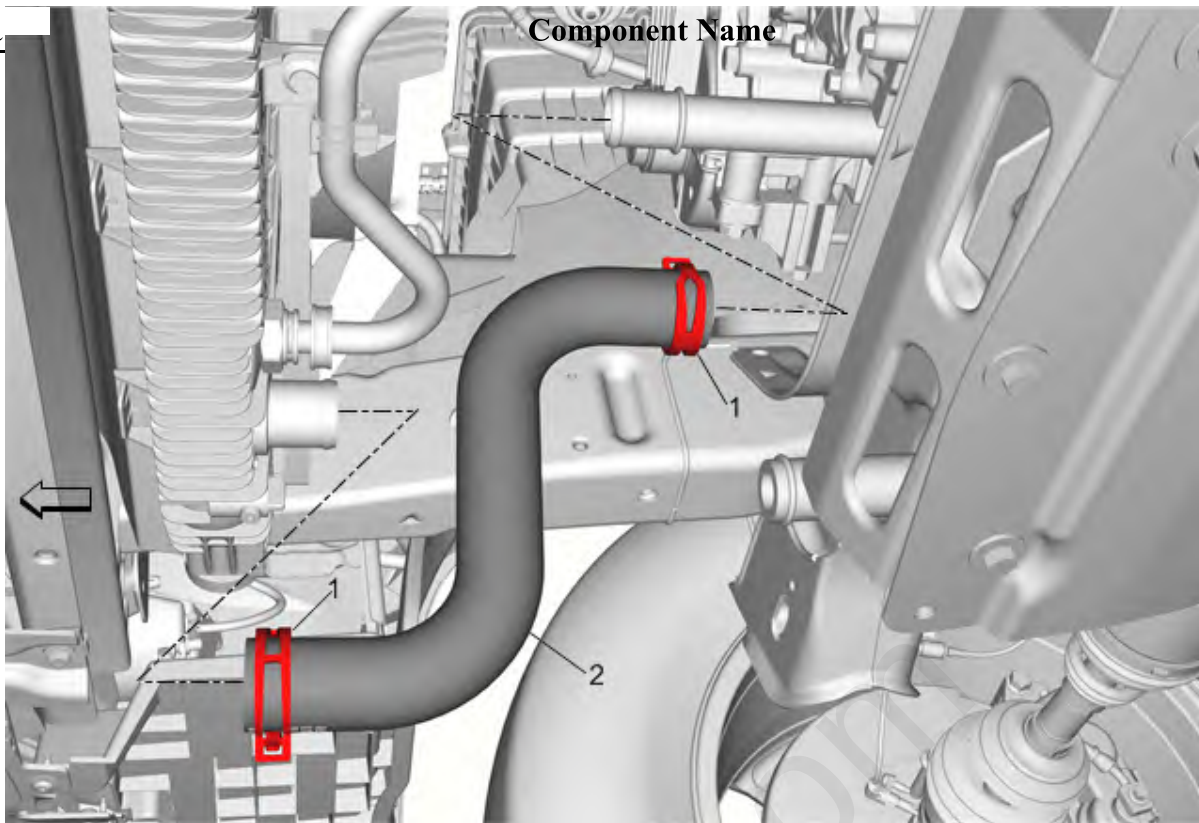


Fig. 75: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the underbody splash shield. Refer to Underbody Splash Shield Replacement 2. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill).	
1	Radiator Outlet Hose Clamp (Qty: 2) Procedure Reposition the radiator outlet hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Outlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Inspect the cooling system for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LCV)

Removal Procedure

e cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)

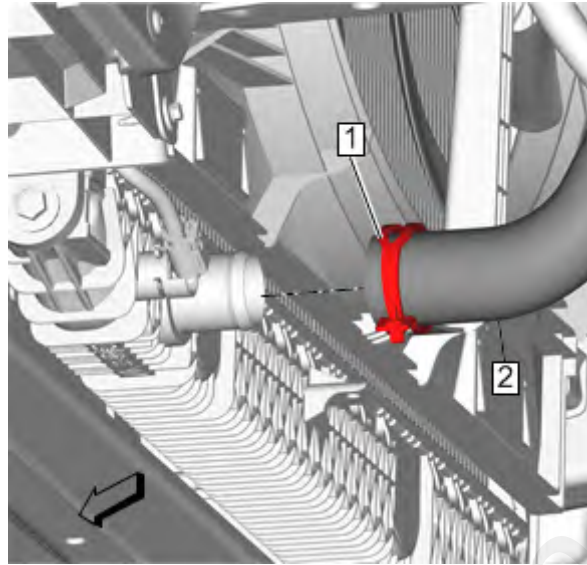


Fig. 76: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Disengage Radiator Outlet Hose Clamp (1) @Radiator Outlet Hose **BO-38185** Hose Clamp Pliers
3. Remove Radiator Outlet Hose (2) @Radiator
4. Lower the vehicle.
5. Remove Air Cleaner Outlet Duct. Air Cleaner Outlet Duct Replacement

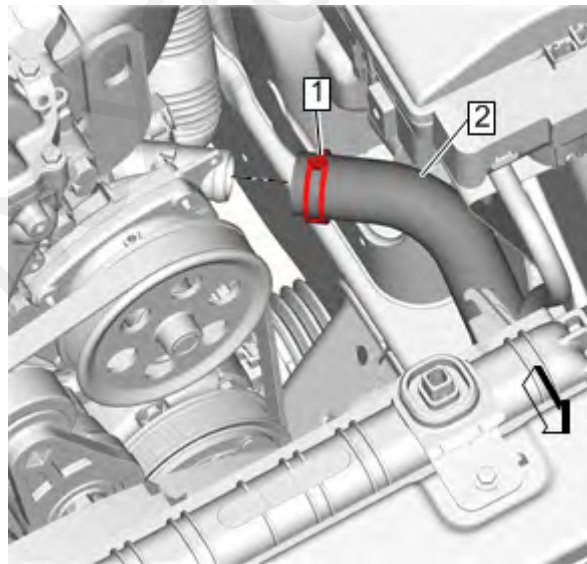


Fig. 77: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Disengage Radiator Outlet Hose Clamp (1) @Radiator Outlet Hose **BO-38185** Hose Clamp Pliers
7. Remove Radiator Outlet Hose (2) @Engine Coolant Thermostat Housing

Installation Procedure

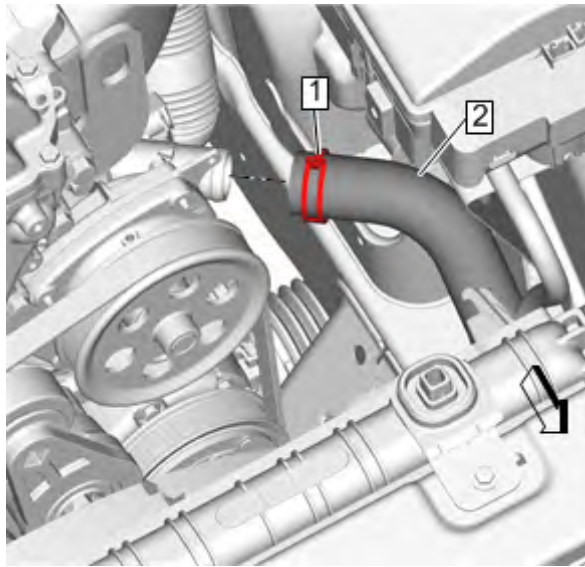


Fig. 78: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Outlet Hose (2) @Engine Coolant Thermostat Housing
2. Engage Radiator Outlet Hose Clamp (1) @Radiator Outlet Hose **BO-38185** Hose Clamp Pliers
3. Raise the vehicle.

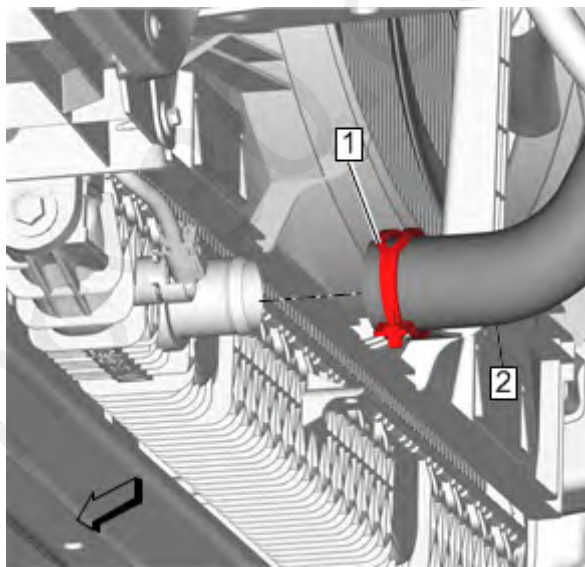


Fig. 79: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Outlet Hose (2) @Radiator
5. Engage Radiator Outlet Hose Clamp (1) @Radiator Outlet Hose **BO-38185** Hose Clamp Pliers
6. Install Air Cleaner Outlet Duct. [Air Cleaner Outlet Duct Replacement](#)
7. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
8. Check the cooling system for leaks. [Cooling System Leak Testing](#)

RADIATOR OUTLET HOSE REPLACEMENT (LWN)

Removal Procedure

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

Equivalent regional tools: **Special Tools**

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

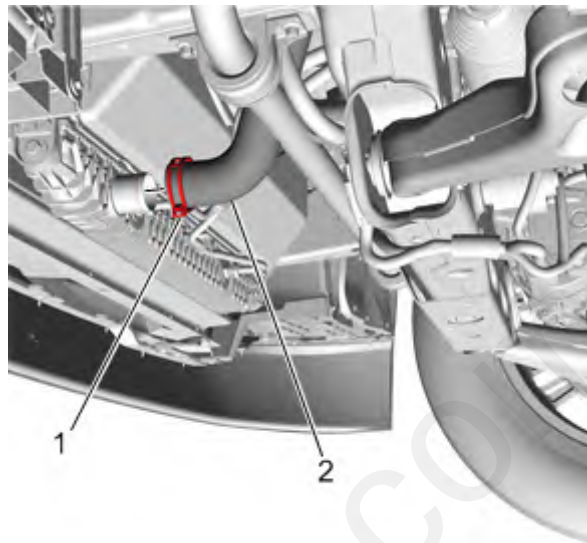
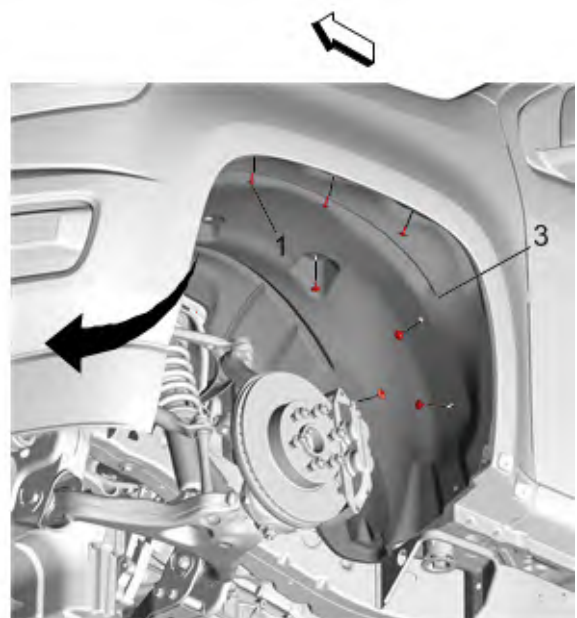
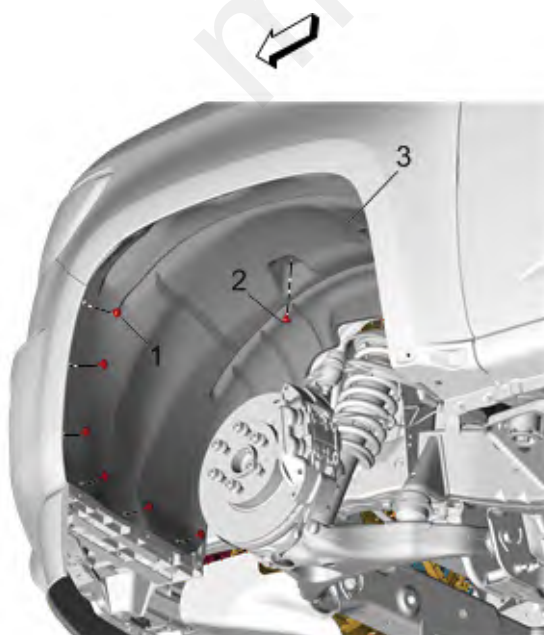


Fig. 80: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Disengage Radiator Outlet Hose Clamp (1)
Use the **BO-38185** Hose Clamp Pliers
3. Remove Radiator Outlet Hose (2) @Radiator Assembly



Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Wheelhouse Liner (3). Front Wheelhouse Liner Replacement

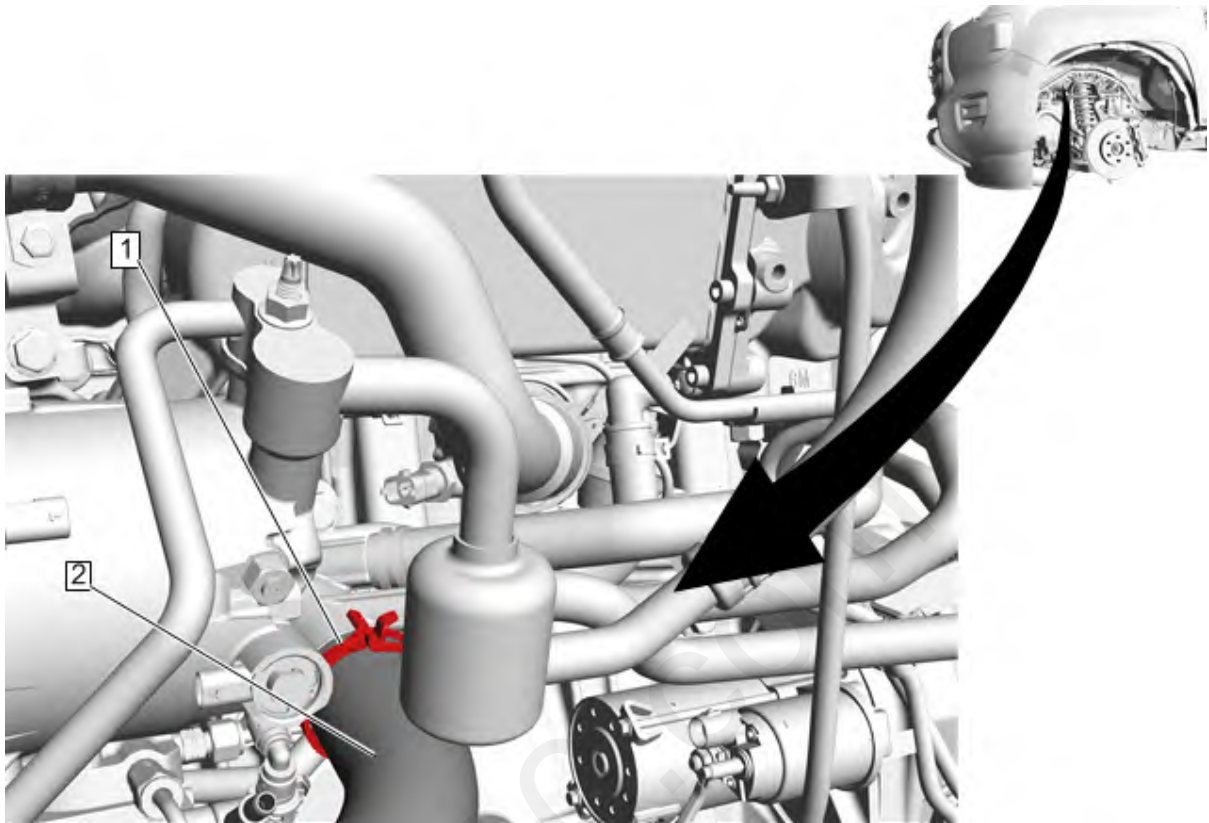
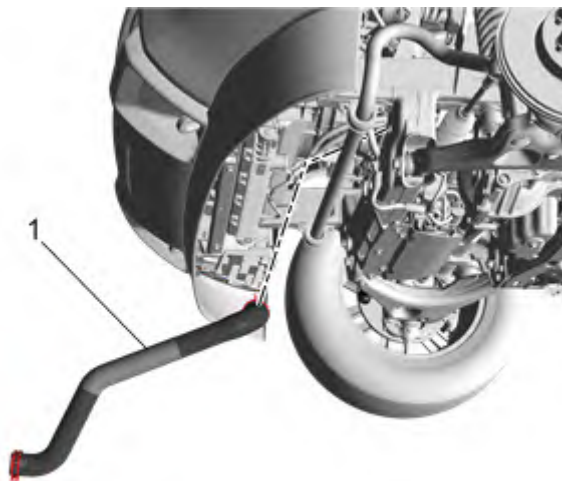


Fig. 82: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Radiator Outlet Hose Clamp (1)
Use the **GE-47622** Hose Clamp Pliers.
6. Remove Radiator Outlet Hose (2) @Water Pump Inlet Pipe



Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove Radiator Outlet Hose (1)

Installation Procedure

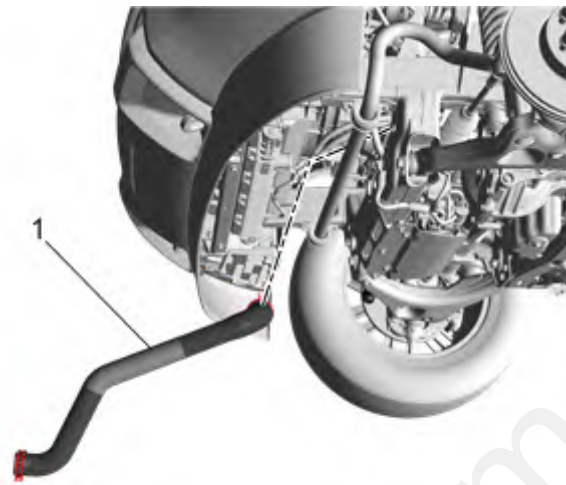


Fig. 84: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Outlet Hose (1)

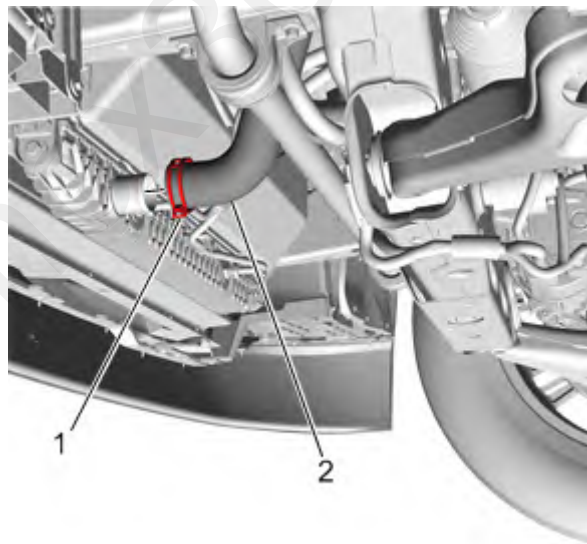


Fig. 85: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

2. Install Radiator Outlet Hose (2) @Radiator Assembly
3. Engage Radiator Outlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers

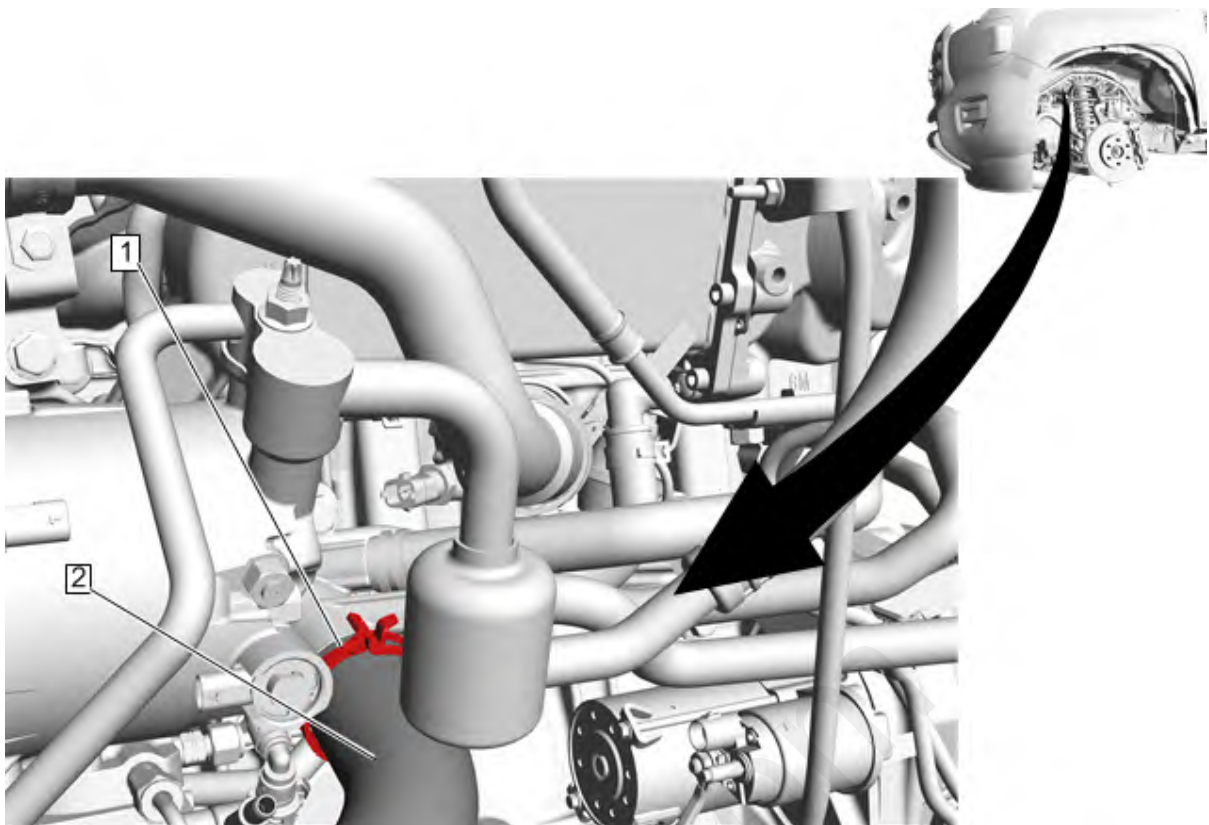


Fig. 86: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Outlet Hose (2) @Water Pump Inlet Pipe
5. Engage Radiator Outlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

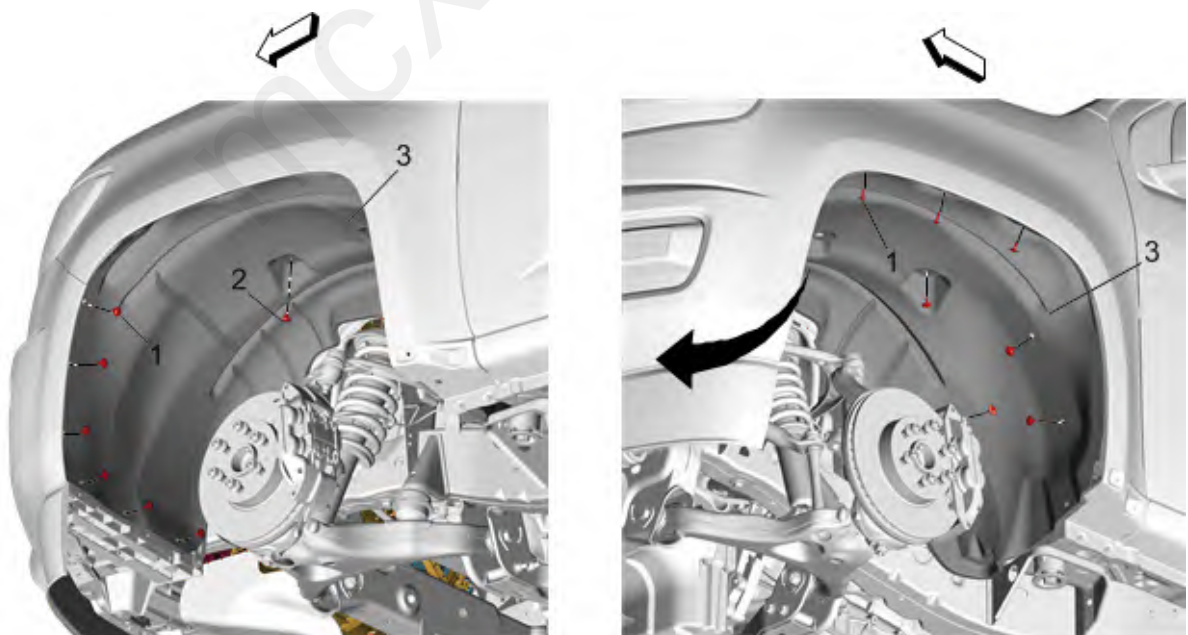


Fig. 87: Front Wheelhouse Liner

Courtesy of GENERAL MOTORS COMPANY

6. Install Front Wheelhouse Liner (3). **Front Wheelhouse Liner Replacement**

8. Start the engine and check for coolant leaks.

RADIATOR OUTLET PIPE REPLACEMENT

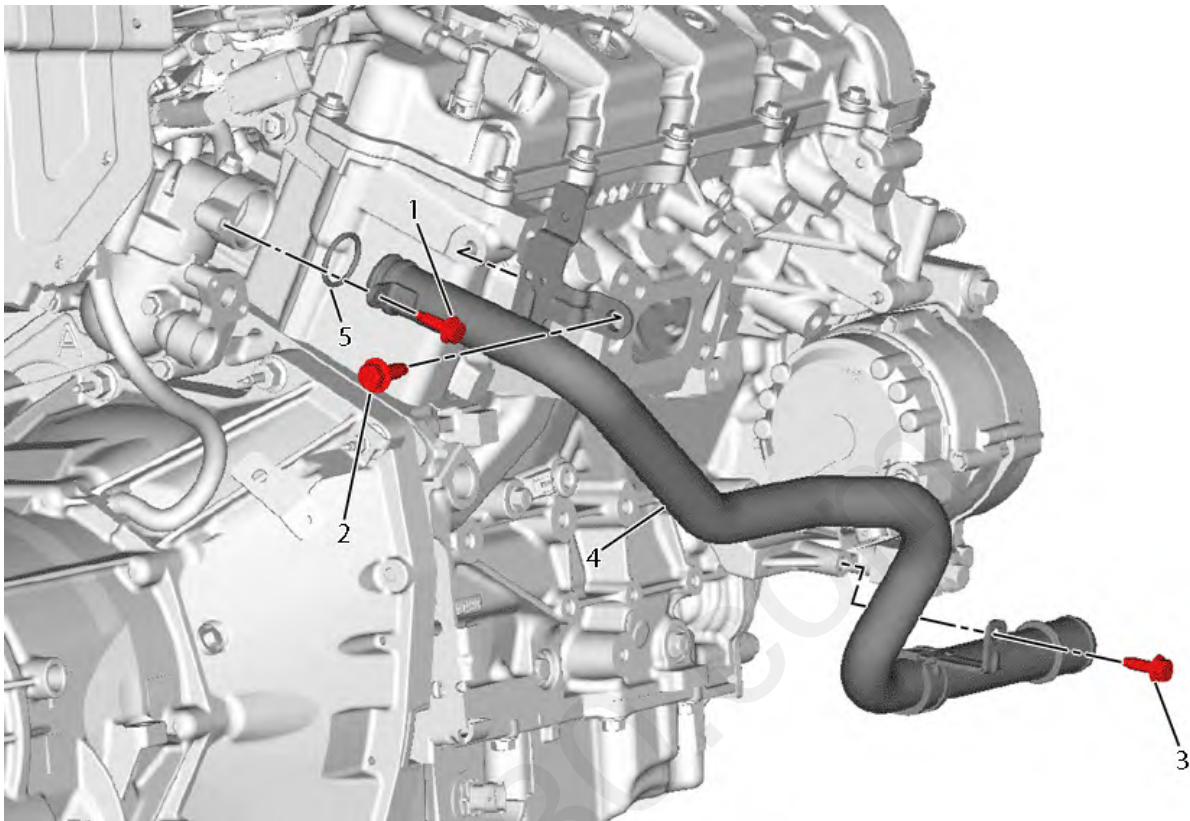


Fig. 88: Radiator Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the plenum front panel. Refer to Plenum Front Panel Replacement . 2. Remove the right side catalytic converter. Refer to Catalytic Converter Replacement - Right Side (LFX) . 3. Remove the engine front splash shield. Refer to Engine Front Splash Shield Replacement . 4. Remove the passenger side front wheelhouse liner. Refer to Front Wheelhouse Liner Replacement . 5. Remove the generator. Refer to Generator Replacement (LFX) Generator Replacement (LCV) Generator Replacement (LWN) . 6. Remove the engine coolant heater cord. Refer to Coolant Heater Cord Replacement (LFX)Coolant Heater Cord Replacement (LCV)Coolant Heater Cord Replacement (LWN). 7. Disconnect the radiator outlet hose from the radiator outlet pipe. Refer to Radiator Outlet Hose Replacement (LFX)Radiator Outlet Hose Replacement (LCV)Radiator Outlet Hose Replacement (LWN).	

Callout	Component Name
1	Radiator Outlet Pipe Bolt CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Outlet Pipe Bolt Tighten 58 N.m (43 lb ft)
3	Radiator Outlet Pipe Bolt Tighten 22 N.m (16 lb ft)
4	Radiator Outlet Pipe Procedure Detach the wire harness retainer from pipe.
5	Radiator Outlet Pipe O-ring Seal Procedure Install a NEW seal.

RADIATOR UPPER BRACKET REPLACEMENT

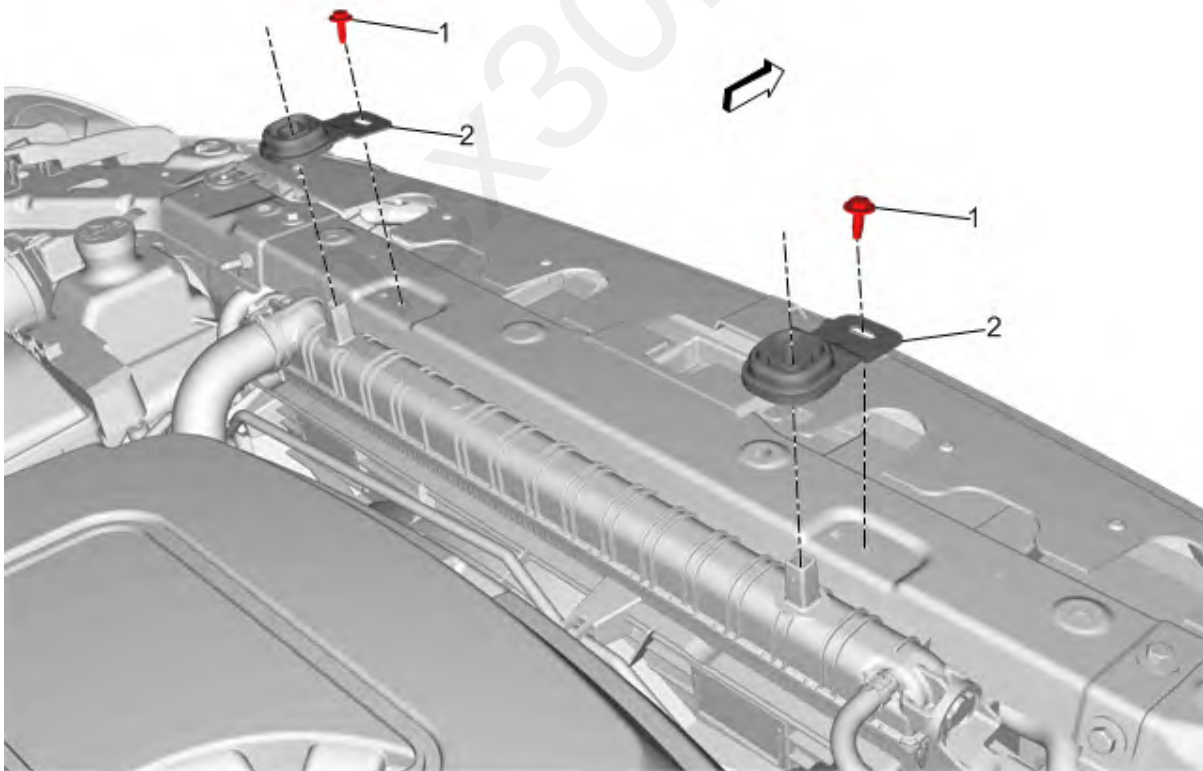


Fig. 89: Radiator Upper Brackets

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure	
Remove Front Compartment Front Sight Shield Replacement { If equipped }	
1	Radiator Upper Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Upper Bracket (Qty: 2)

RADIATOR SIDE MOUNT BRACKET REPLACEMENT - LEFT SIDE

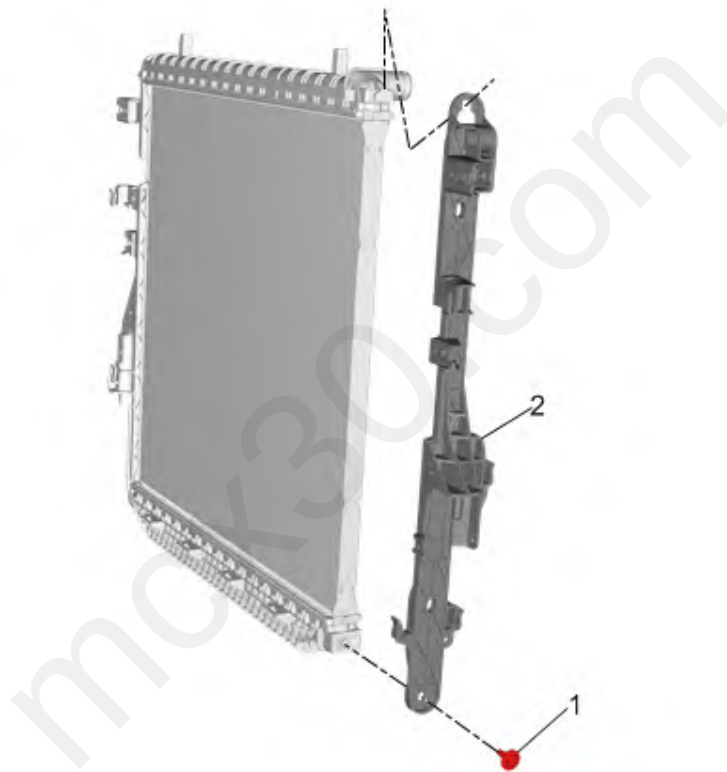


Fig. 90: Radiator Side Mount Bracket - Left Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove the radiator. Refer to Radiator Replacement (LFX) Radiator Replacement (LCV) Radiator Replacement (LWN) .	

Callout	Component Name
1	Radiator Side Mount Bracket Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Radiator Side Mount Bracket

RADIATOR SIDE MOUNT BRACKET REPLACEMENT - RIGHT SIDE

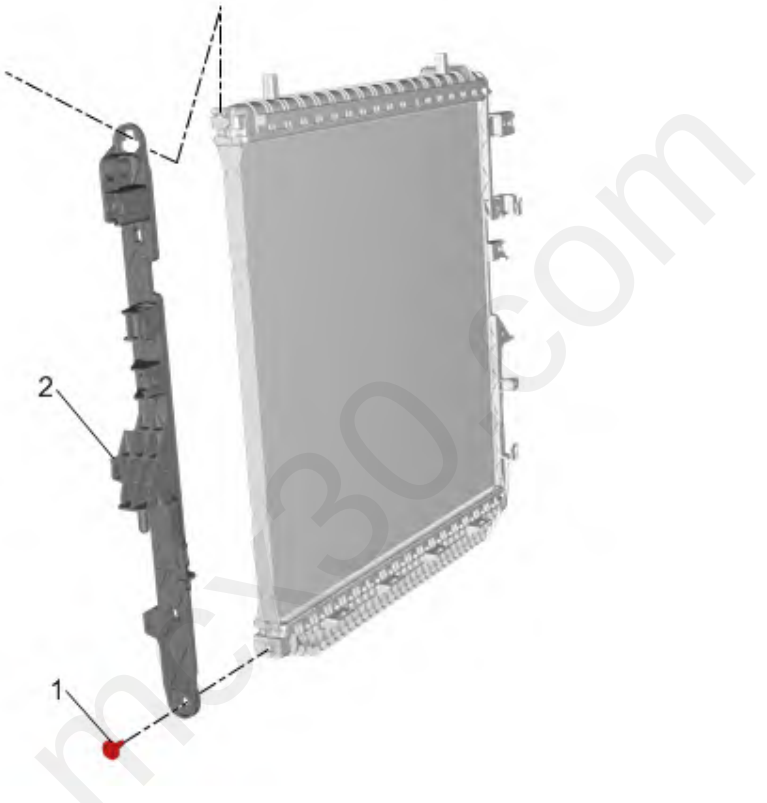


Fig. 91: Radiator Side Mount Bracket - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the radiator. Refer to Radiator Replacement (LFX) Radiator Replacement (LCV) Radiator Replacement (LWN) .	
1	Radiator Side Mount Bracket Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Radiator Side Mount Bracket

VENT OUTLET HOSE REPLACEMENT

Component Name

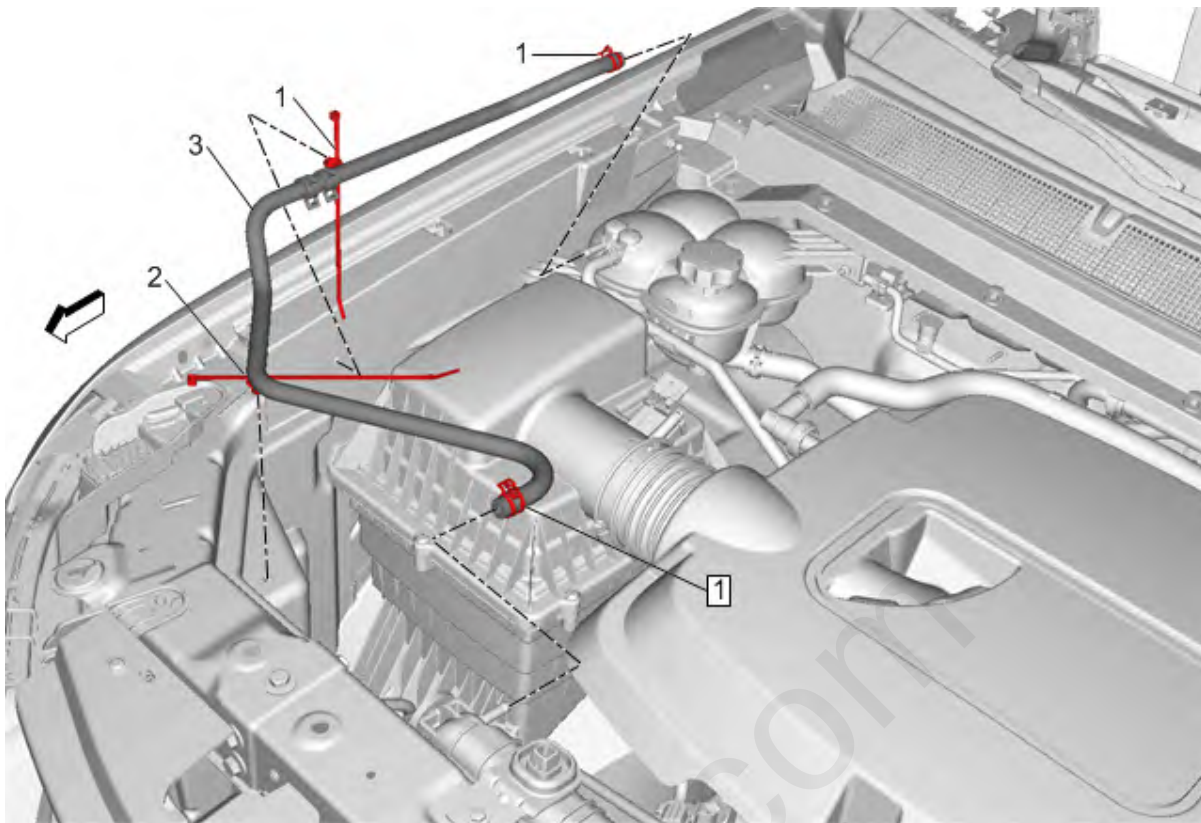


Fig. 92: Radiator Vent Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Radiator Vent Outlet Hose Clamp (Qty: 2) Procedure Disengage the tension on the radiator vent outlet hose clamps using the BO-38185 hose clamp pliers. Special Tool BO-38185 Hose Clamp Pliers
2	Radiator Vent Outlet Hose Tie Strap (Qty: 2)
3	Radiator Vent Outlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Inspect the cooling system for leaks.

ENGINE OIL COOLER REPLACEMENT (LWN)

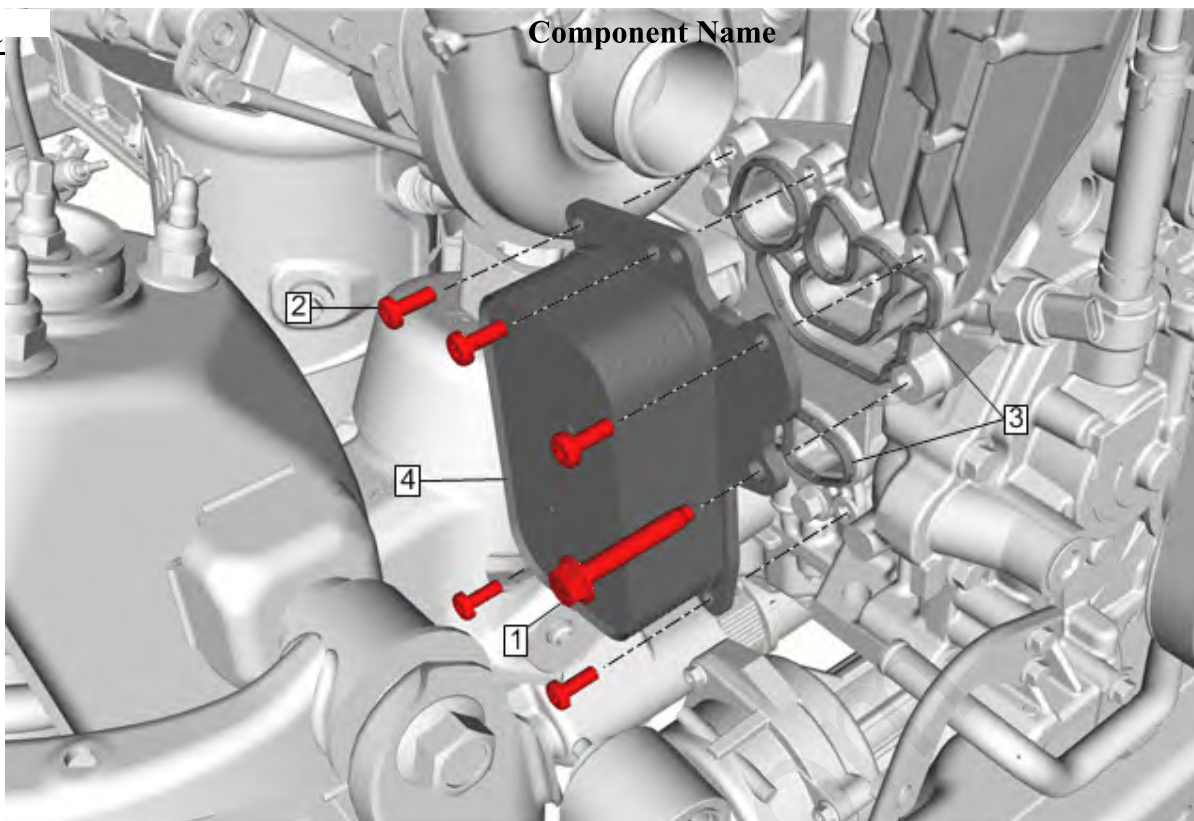


Fig. 93: Engine Oil Cooler (LWN)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Air Cleaner Assembly Replacement 2. Charge Air Cooler Inlet Duct Replacement	
1	Engine Oil Cooler Bolt CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)
2	Engine Oil Cooler Bolt (Qty: 5) Tighten 10 N.m (89 lb in)
3	Engine Oil Cooler Seal
4	Engine Oil Cooler Procedure Clean the engine oil cooler to the oil filter housing sealing surfaces.

ENGINE OIL COOLER OUTLET HOSE REPLACEMENT (LWN)

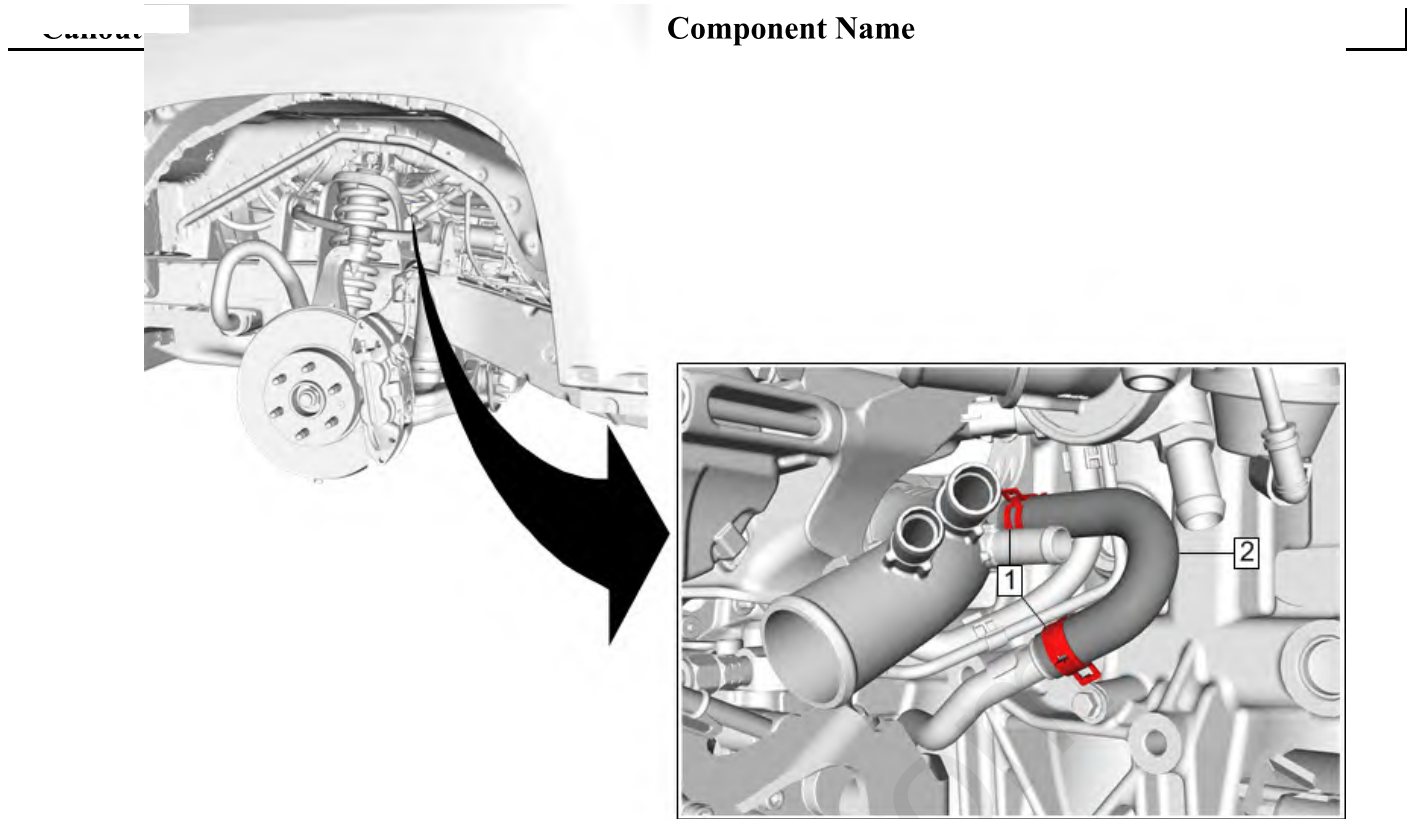


Fig. 94: Engine Oil Cooler Outlet Hose (LWN)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. <u>Cooling System Draining and Filling (Static Fill)</u> Cooling System Draining and Filling (Vac n Fill) 2. <u>Air Conditioning Compressor Bracket Replacement (LWN)</u>	
1	Engine Oil Cooler Outlet Hose Clamp (Qty: 2)
2	Engine Oil Cooler Outlet Hose

ENGINE OIL COOLER INLET HOSE REPLACEMENT (LWN)

Removal Procedure

Special Tools

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

Equivalent regional tools:Special Tools

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

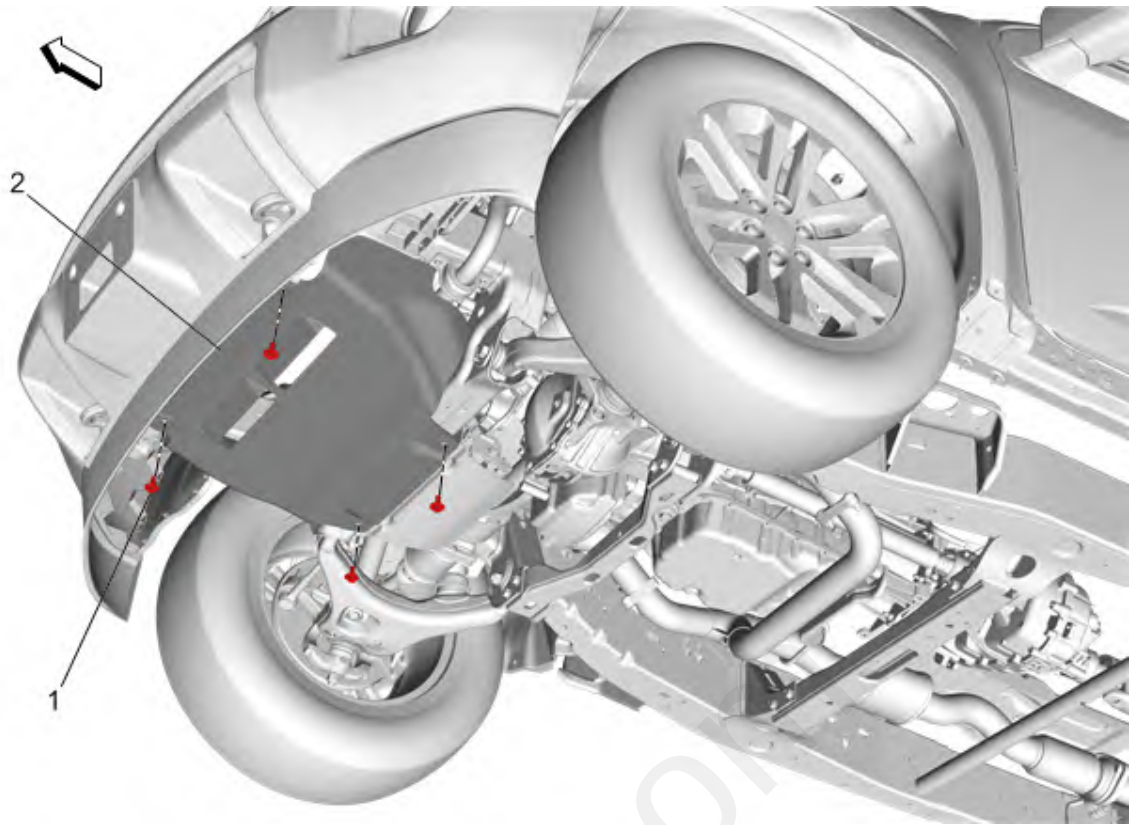


Fig. 95: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

2. Remove Underbody Splash Shield (2) **Underbody Splash Shield Replacement**

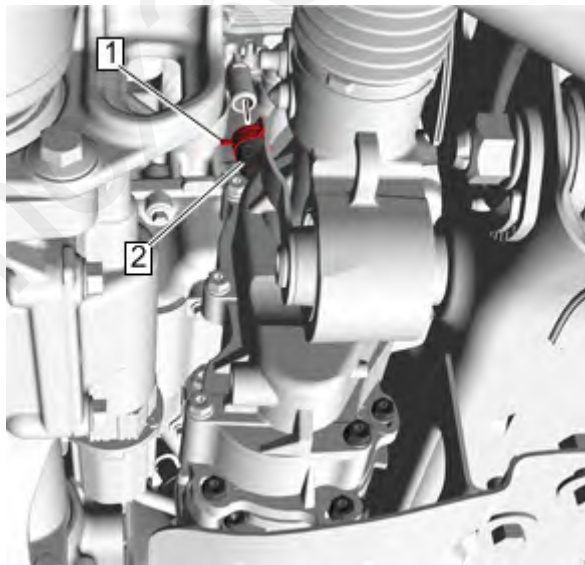


Fig. 96: Engine Oil Cooler Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

3. Disengage Engine Oil Cooler Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

4. Remove Engine Oil Cooler Inlet Hose (2) @Engine Oil Cooler

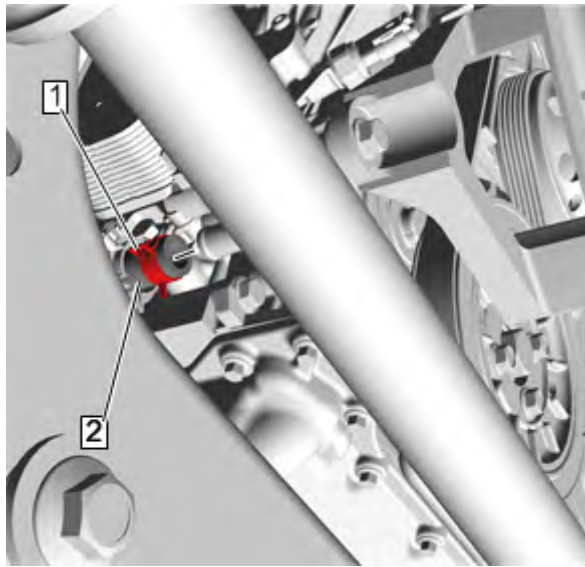


Fig. 97: Engine Oil Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Engine Oil Cooler Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

6. Remove Engine Oil Cooler Inlet Hose (2) @Engine Oil Cooler Pipe

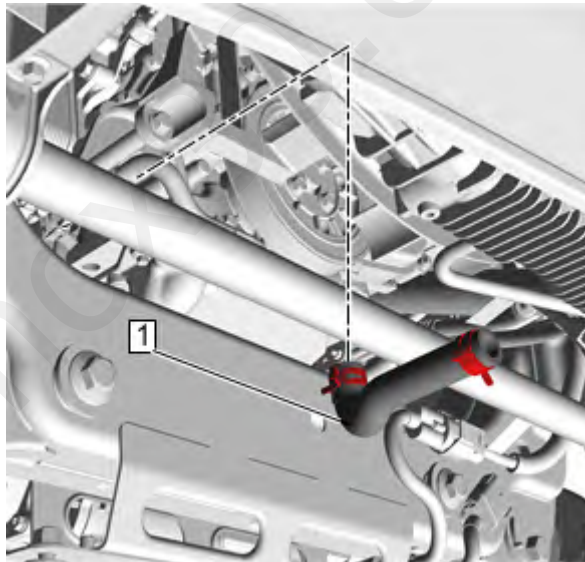


Fig. 98: Engine Oil Cooler Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove Engine Oil Cooler Inlet Hose (1)

Installation Procedure

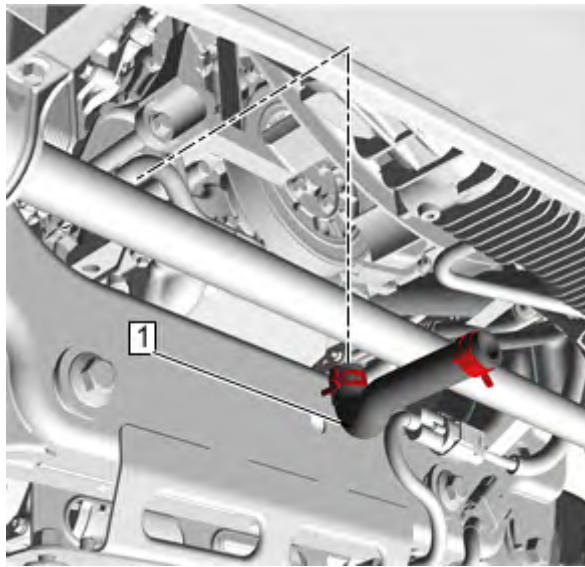


Fig. 99: Engine Oil Cooler Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Oil Cooler Inlet Hose (1)

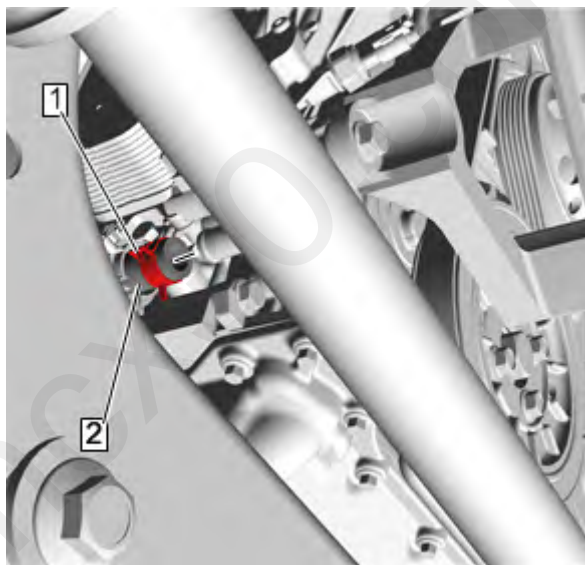


Fig. 100: Engine Oil Cooler Inlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Oil Cooler Inlet Hose (2) @Engine Oil Cooler Pipe
3. Engage Engine Oil Cooler Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

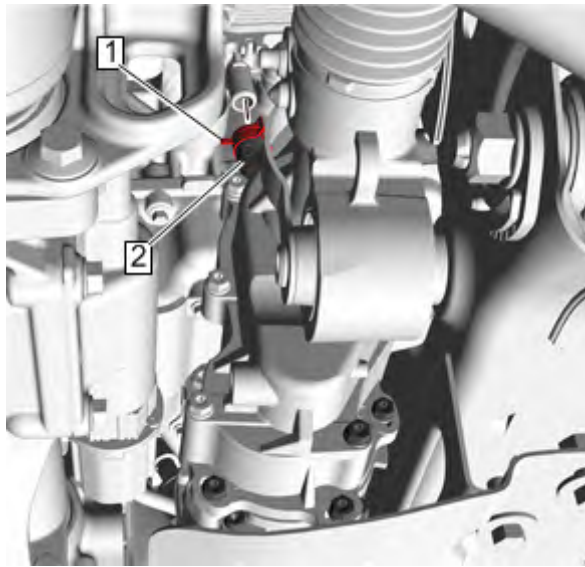


Fig. 101: Engine Oil Cooler Inlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Oil Cooler Inlet Hose (2) @Engine Oil Cooler
5. Engage Engine Oil Cooler Inlet Hose Clamp (1)

Use the **GE-47622** Hose Clamp Pliers.

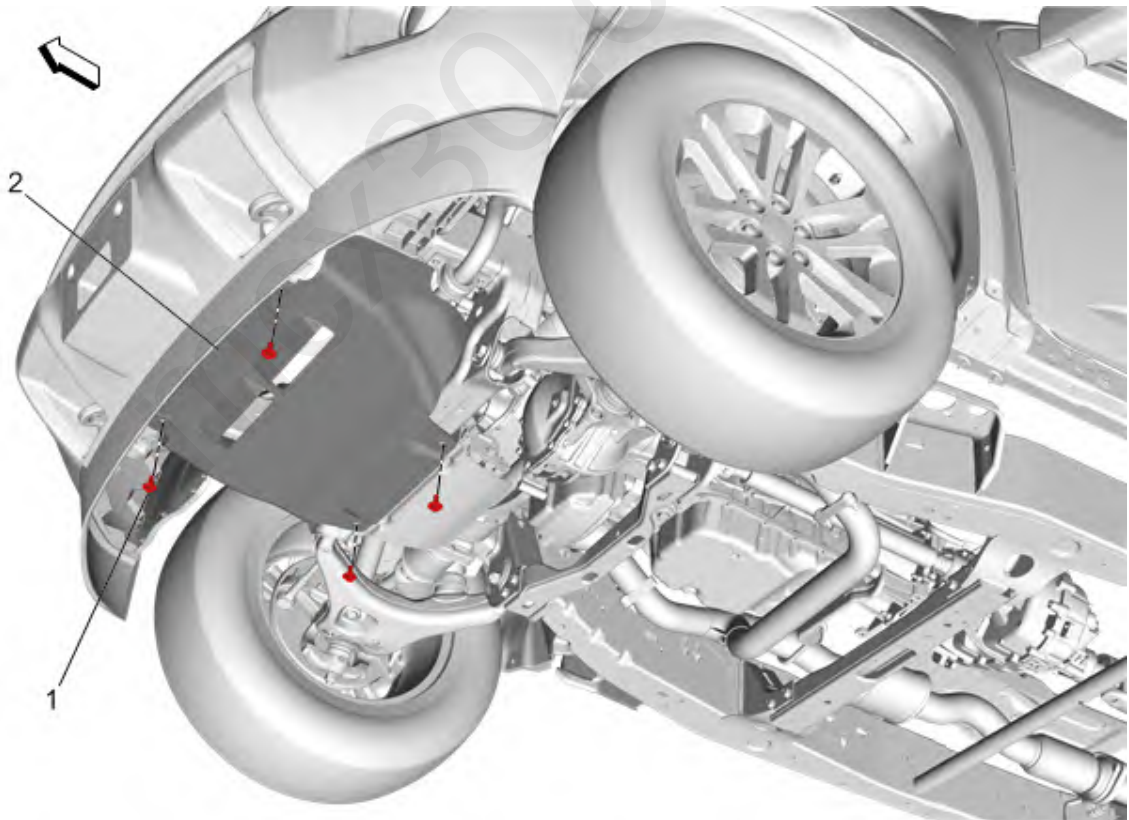


Fig. 102: Underbody Splash Shield
 Courtesy of GENERAL MOTORS COMPANY

6. Install Underbody Splash Shield (2). **Underbody Splash Shield Replacement**
7. Fill the cooling system. **Cooling System Draining and Filling (Static Fill)****Cooling System Draining and Filling (Vac n Fill)**

: engine and check for coolant leaks.

ENGINE OIL COOLER PIPE REPLACEMENT (LWN 2WD)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

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

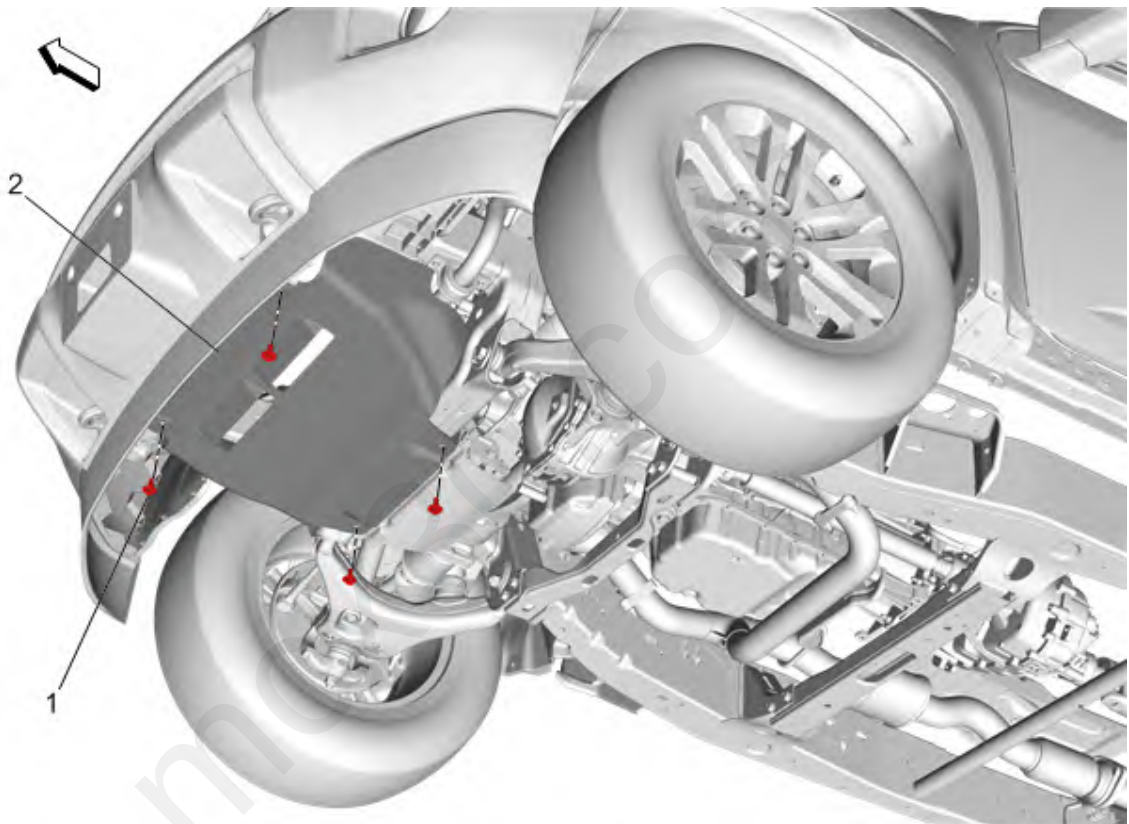


Fig. 103: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

2. Remove Underbody Splash Shield (2). **Underbody Splash Shield Replacement**
3. Remove Engine Mount Bracket Replacement - Left Side **Engine Mount Bracket Replacement - Left Side**

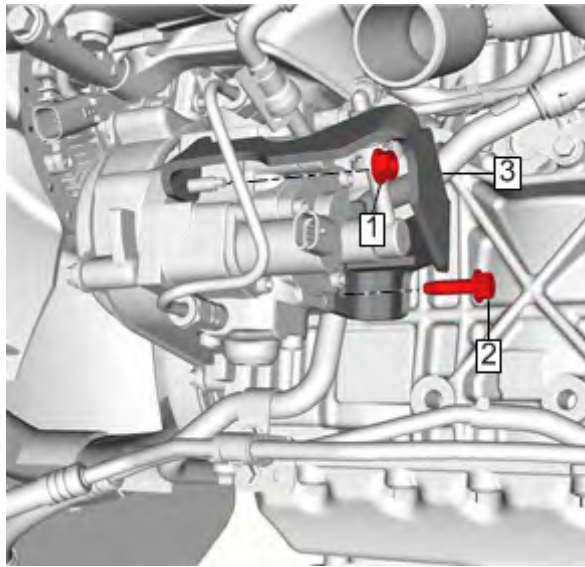


Fig. 104: Fuel Feed Hose Protector Nut

Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuel Feed Hose Protector Nut (1)
5. Remove Fuel Feed Hose Protector Bolt (2)
6. Remove Fuel Feed Hose Protector (3)

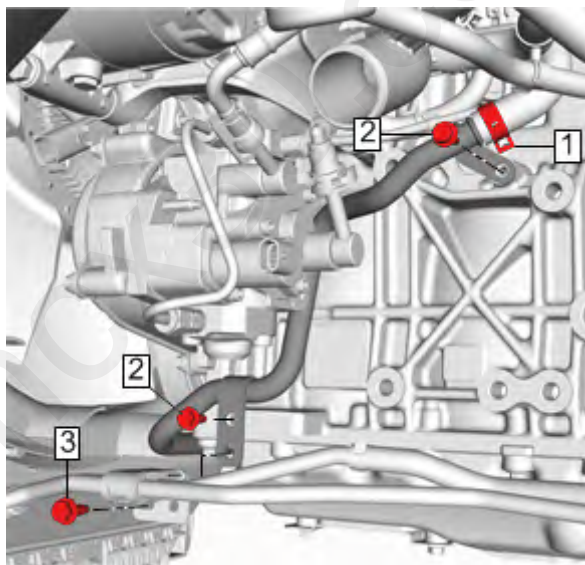


Fig. 105: Engine Oil Cooler Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

7. Disengage Engine Oil Cooler Outlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers.

8. Remove Engine Oil Cooler Pipe Fastener (2)
9. Remove Transmission Fluid Cooler Pipe Bracket Bolt (3)
10. Remove Engine Oil Cooler Pipe Fastener (4)

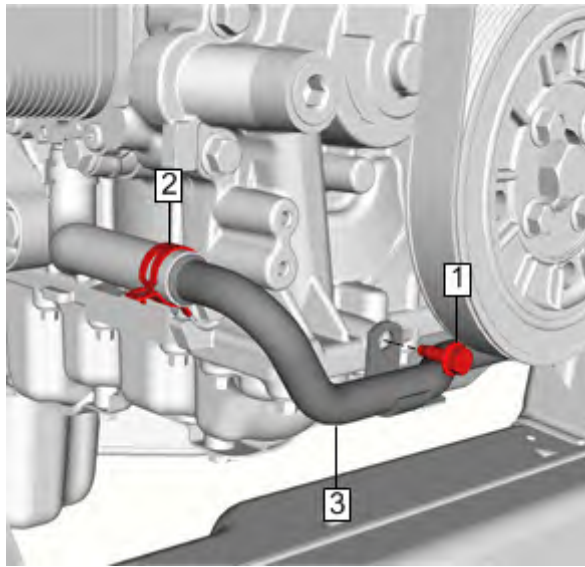


Fig. 106: Engine Oil Cooler Pipe Fastener
Courtesy of GENERAL MOTORS COMPANY

11. Remove Engine Oil Cooler Pipe Fastener (1)
12. Disengage Engine Oil Cooler Inlet Hose Clamp (2)

Use the **BO-38185** Hose Clamp Pliers.

13. Remove Engine Oil Cooler Pipe (3)

Installation Procedure

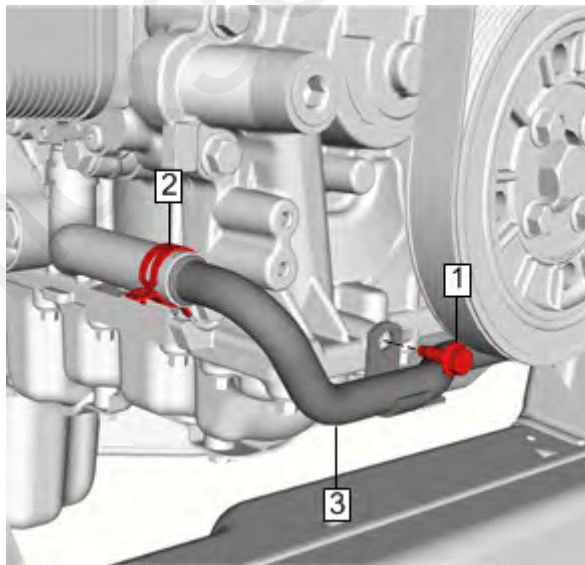


Fig. 107: Engine Oil Cooler Pipe Fastener
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Oil Cooler Pipe (3)
2. Engage Engine Oil Cooler Inlet Hose Clamp (2)

Use the **BO-38185** Hose Clamp Pliers.

CAUTION: Refer to **Fastener Caution** .

Engine Oil Cooler Pipe Fastener (1) and tighten 10 N.m (89 lb in)

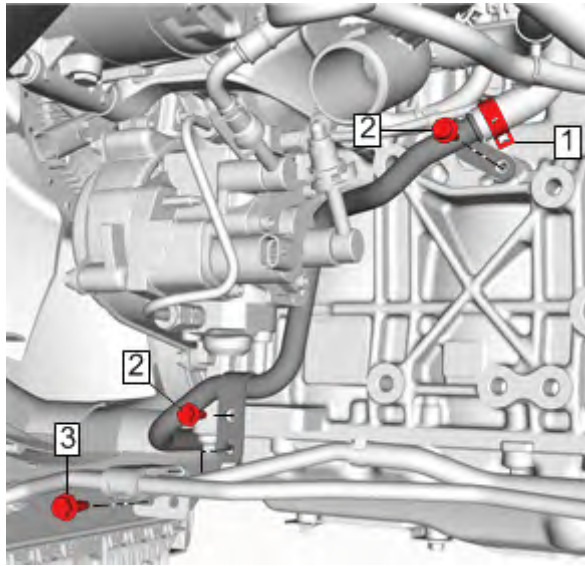


Fig. 108: Engine Oil Cooler Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Oil Cooler Pipe Fastener (2) and tighten 9 N.m (80 lb in)
5. Install Transmission Fluid Cooler Pipe Bracket Bolt (3) and tighten 9 N.m (80 lb in)
6. Engage Engine Oil Cooler Outlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers.

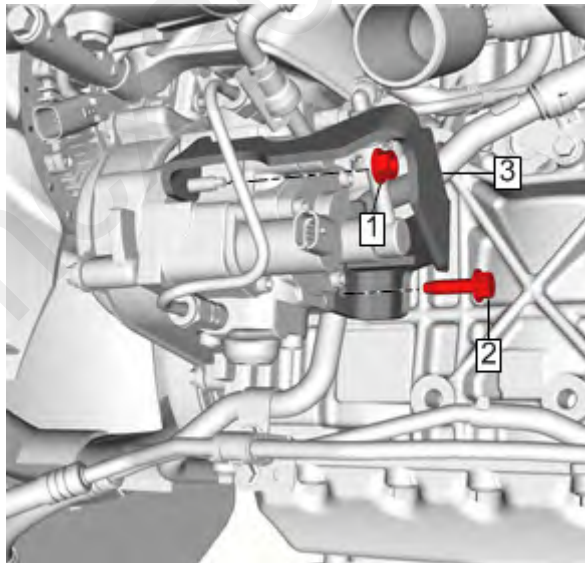


Fig. 109: Fuel Feed Hose Protector Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Feed Hose Protector (3)
8. Install Fuel Feed Hose Protector Bolt (2) and tighten 10 N.m (89 lb in)
9. Install Fuel Feed Hose Protector Nut (1) and tighten 10 N.m (89 lb in)
10. Install Engine Mount Bracket - Left Side [Engine Mount Bracket Replacement - Left Side](#)

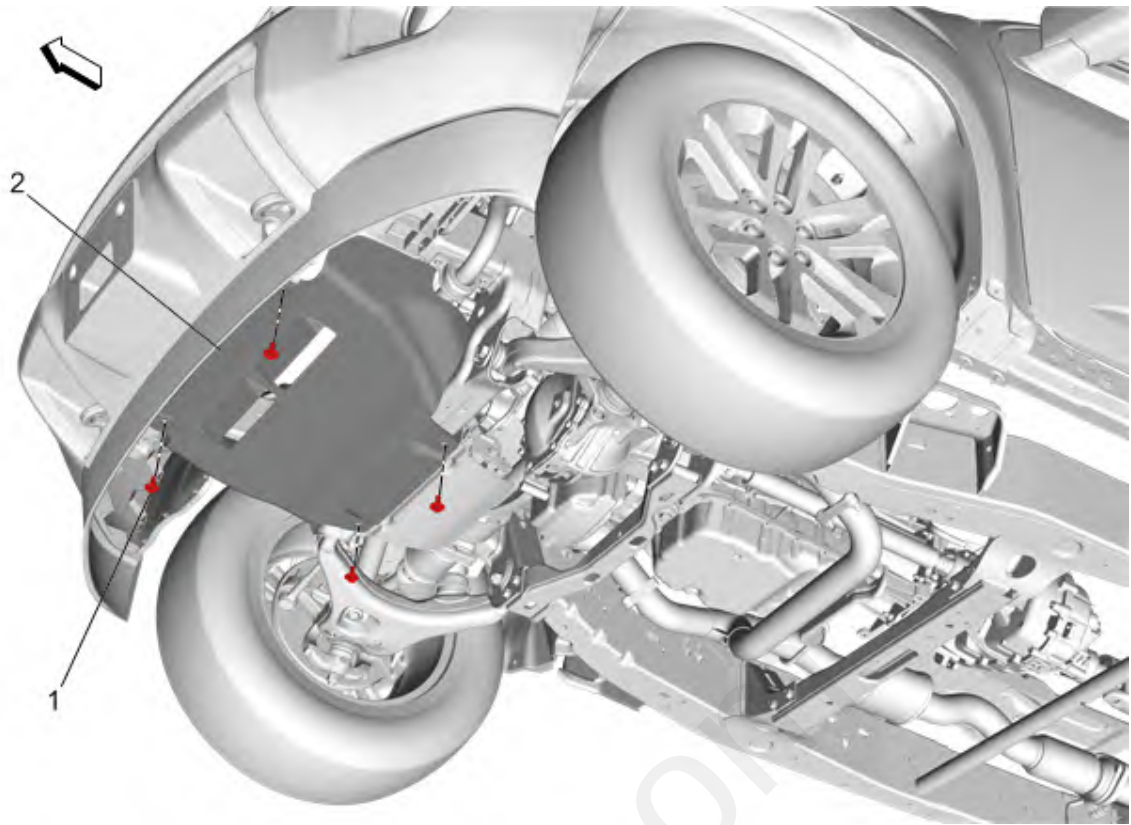


Fig. 110: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

11. Install Underbody Splash Shield (2). [Underbody Splash Shield Replacement](#)
12. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
13. Start the engine and check for coolant leaks.

ENGINE OIL COOLER PIPE REPLACEMENT (LWN 4WD)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

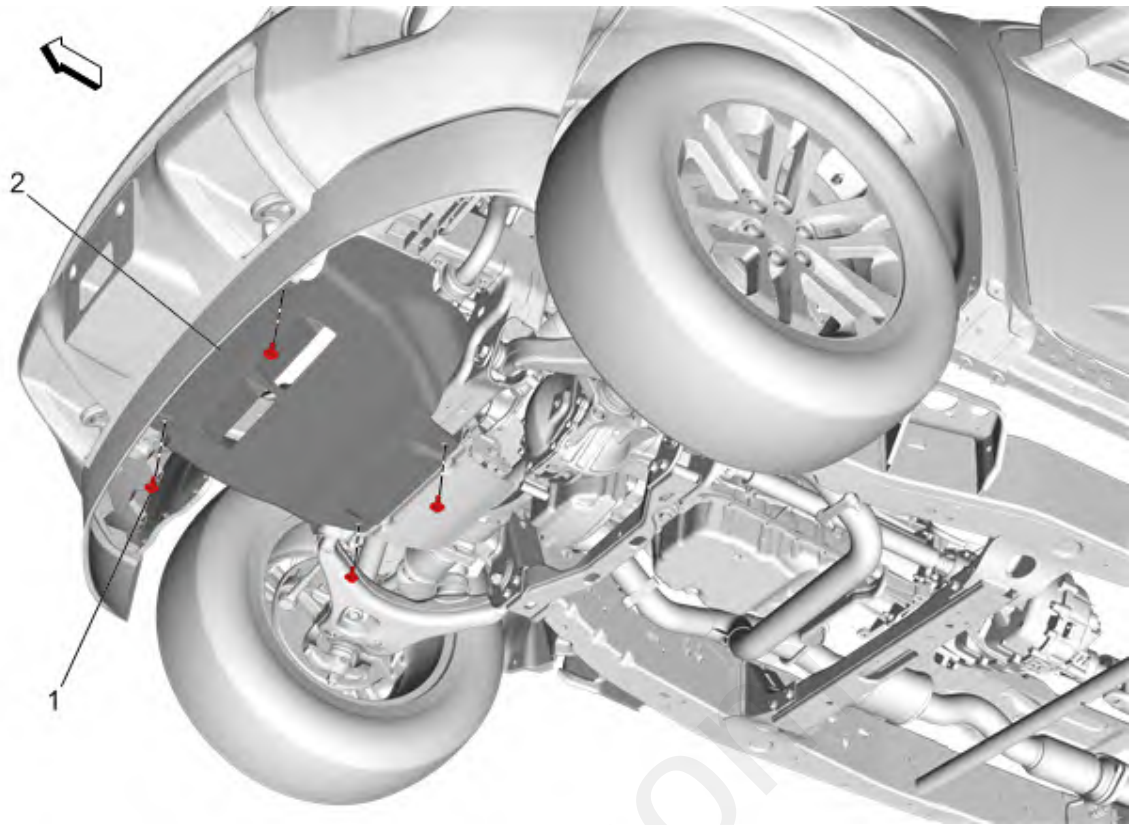


Fig. 111: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

2. Remove Underbody Splash Shield (2). [Underbody Splash Shield Replacement](#)
3. Remove Front Axle. [Front Axle Replacement](#)
4. Remove Engine Mount Bracket - Left Side [Engine Mount Bracket Replacement - Left Side](#)

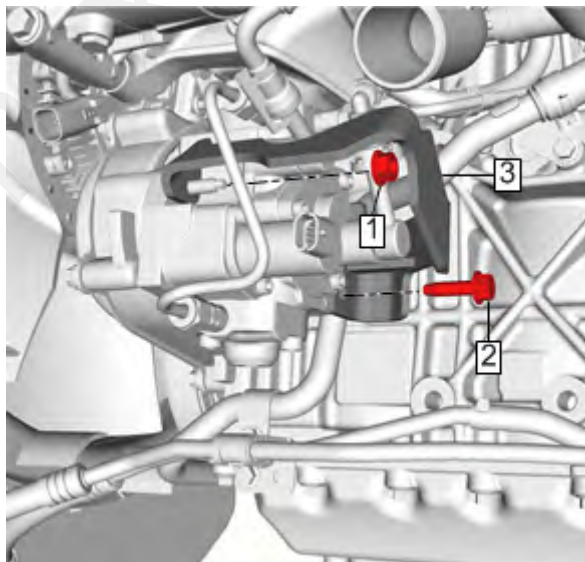


Fig. 112: Fuel Feed Hose Protector Nut

Courtesy of GENERAL MOTORS COMPANY

5. Remove Fuel Feed Hose Protector Nut (1)
6. Remove Fuel Feed Hose Protector Bolt (2)
7. Remove Fuel Feed Hose Protector (3)

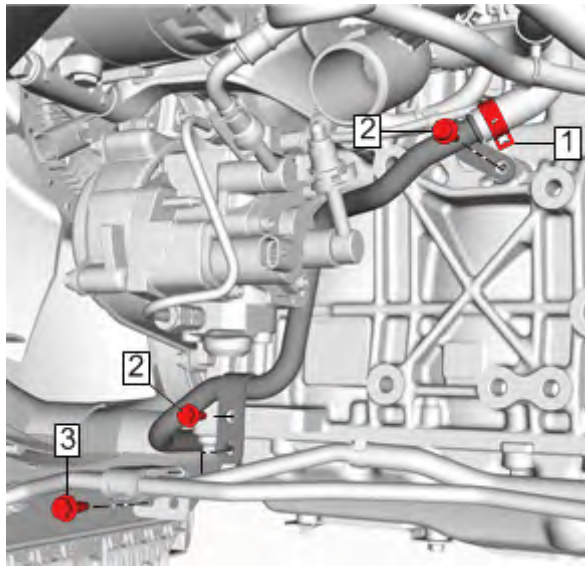


Fig. 113: Engine Oil Cooler Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Disengage Engine Oil Cooler Outlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers.

9. Remove Engine Oil Cooler Pipe Fastener (2)

10. Remove Transmission Fluid Cooler Pipe Bracket Bolt (3)

11. Remove Engine Oil Cooler Pipe Fastener (4)

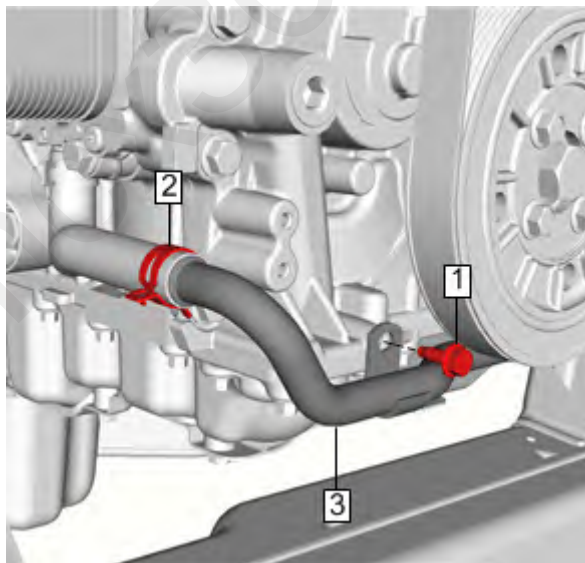


Fig. 114: Engine Oil Cooler Pipe Fastener
Courtesy of GENERAL MOTORS COMPANY

12. Remove Engine Oil Cooler Pipe Fastener (1)

13. Disengage Engine Oil Cooler Inlet Hose Clamp (2)

Use the **BO-38185** Hose Clamp Pliers.

14. Remove Engine Oil Cooler Pipe (3)

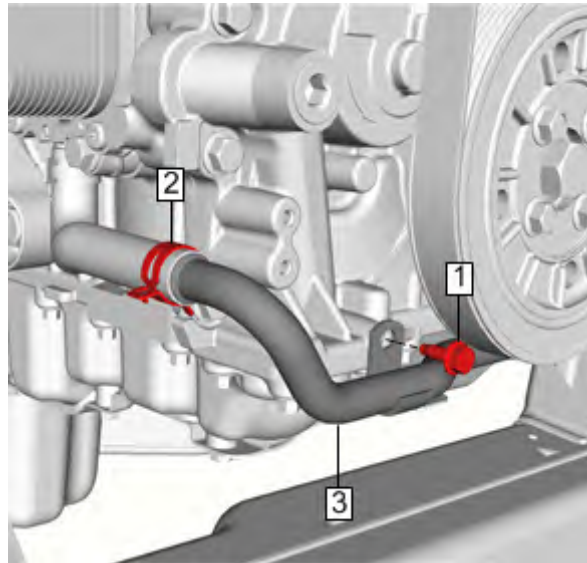


Fig. 115: Engine Oil Cooler Pipe Fastener
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Oil Cooler Pipe (3)
2. Engage Engine Oil Cooler Inlet Hose Clamp (2)

Use the **BO-38185** Hose Clamp Pliers.

CAUTION: Refer to **Fastener Caution** .

3. Install Engine Oil Cooler Pipe Fastener (1) and tighten 10 N.m (89 lb in)

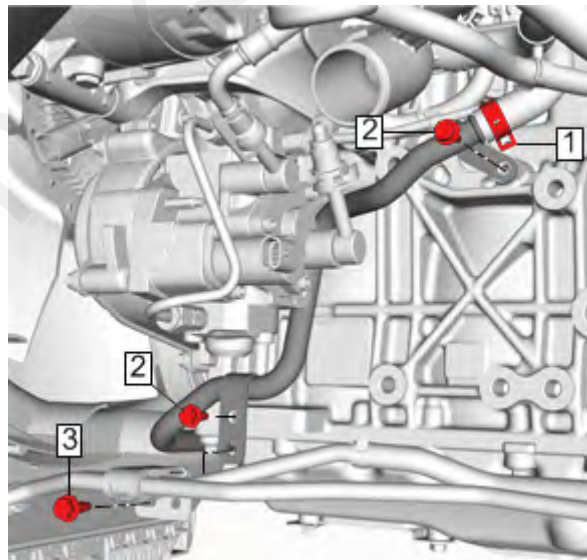


Fig. 116: Engine Oil Cooler Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Oil Cooler Pipe Fastener (2) and tighten 9 N.m (80 lb in)
5. Install Transmission Fluid Cooler Pipe Bracket Bolt (3) and tighten 9 N.m (80 lb in)
6. Engage Engine Oil Cooler Outlet Hose Clamp (1)

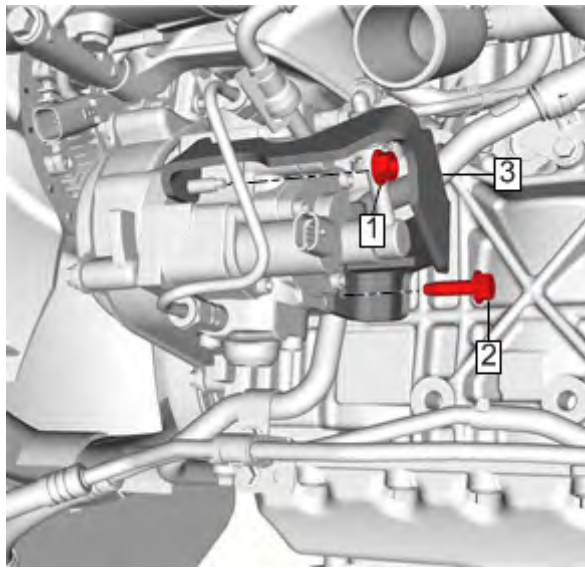


Fig. 117: Fuel Feed Hose Protector Nut

Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Feed Hose Protector (3)
8. Install Fuel Feed Hose Protector Bolt (2) and tighten 10 N.m (89 lb in)
9. Install Fuel Feed Hose Protector Nut (1) and tighten 10 N.m (89 lb in)
10. Install Engine Mount Bracket - Left Side [Engine Mount Bracket Replacement - Left Side](#) .
11. Install Front Axle. [Front Axle Replacement](#) .

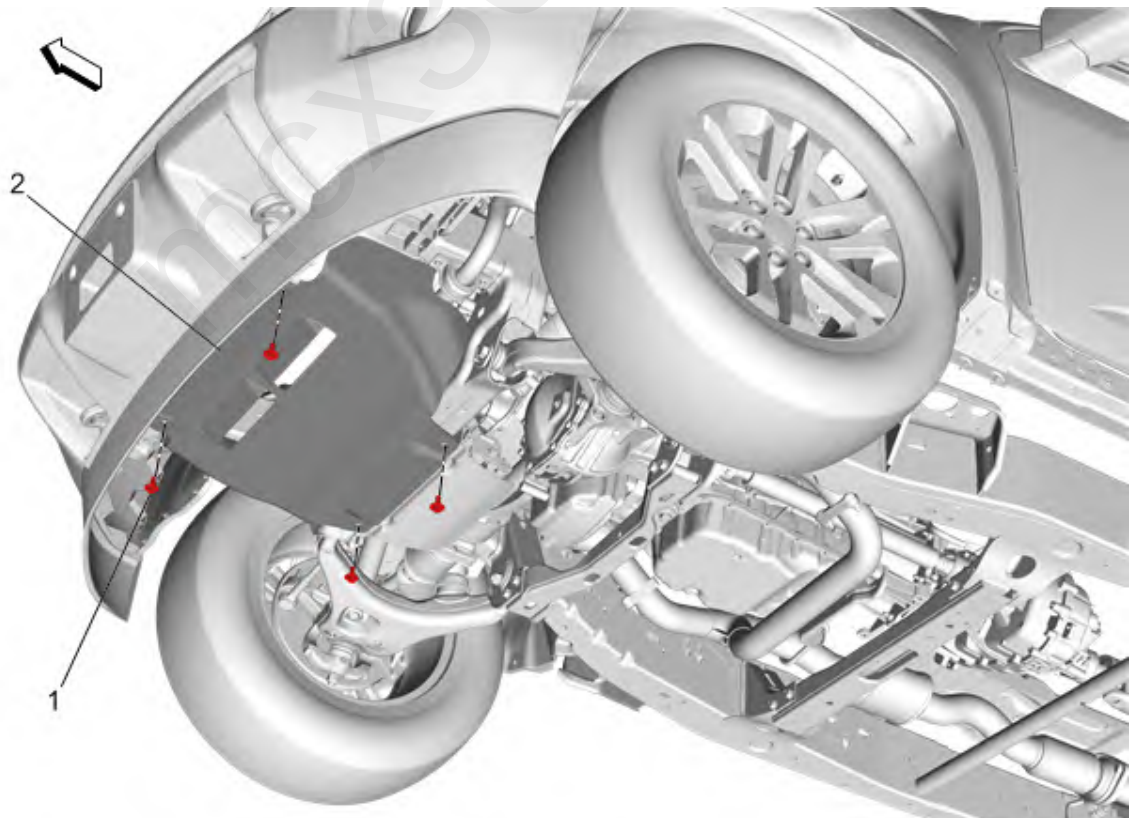


Fig. 118: Underbody Splash Shield

Courtesy of GENERAL MOTORS COMPANY

Callout	Underbody Splash Shield (2).	Underbody Splash Shield Replacement
		Component Name
13.	Fill the cooling system.	Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)
14.	Start the engine and check for coolant leaks.	

FAN BLADE REPLACEMENT

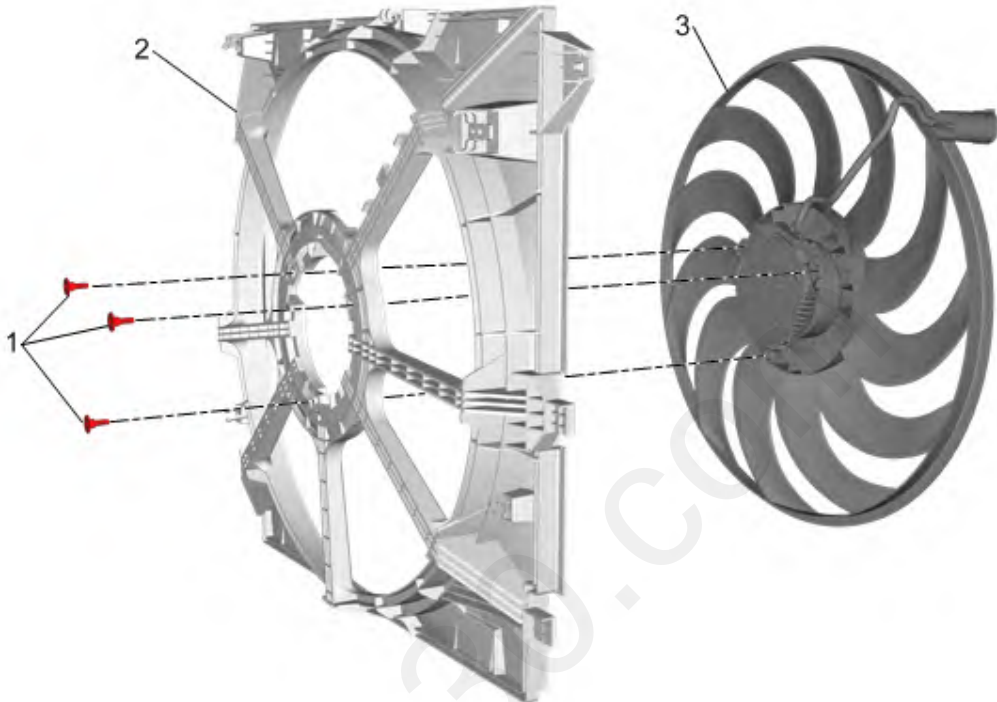


Fig. 119: Fan Blade
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove the engine coolant fan shroud. Refer to Engine Coolant Fan Shroud Replacement (LFX) Engine Coolant Fan Shroud Replacement (LCV) Engine Coolant Fan Shroud Replacement (LWN) .	
1	Fan Blade Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 7 N.m (62 lb in)
2	Engine Coolant Fan Shroud
3	Fan Blade Procedure Unclip the engine coolant fan motor wiring from the engine coolant fan shroud.

FAN BLADE REPLACEMENT (LWN)

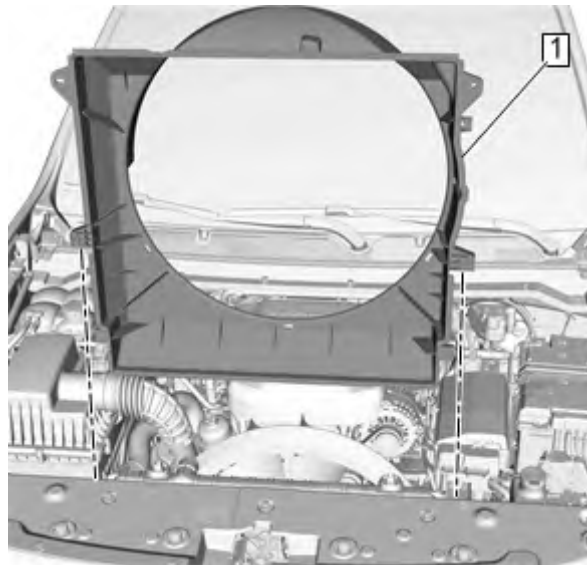


Fig. 120: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

1. Remove Engine Coolant Fan Shroud (1). **Engine Coolant Fan Shroud Replacement (LFX)Engine Coolant Fan Shroud Replacement (LCV)Engine Coolant Fan Shroud Replacement (LWN)**

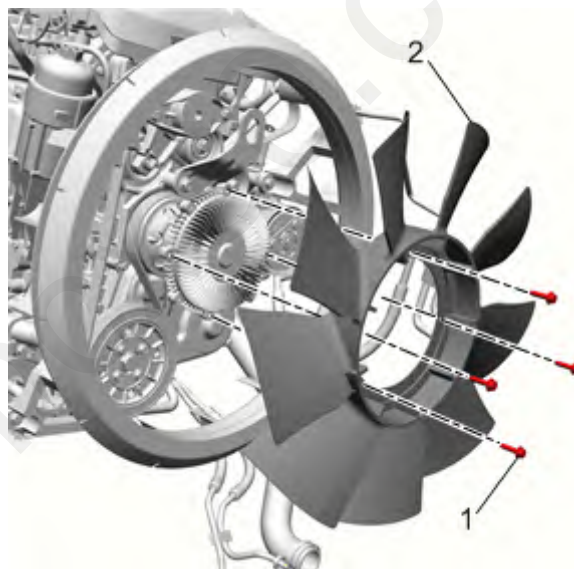


Fig. 121: Fan Blade Bolt

Courtesy of GENERAL MOTORS COMPANY

2. Remove Fan Blade Bolt (1)
3. Remove Fan Blade (2) @Fan Blade Clutch

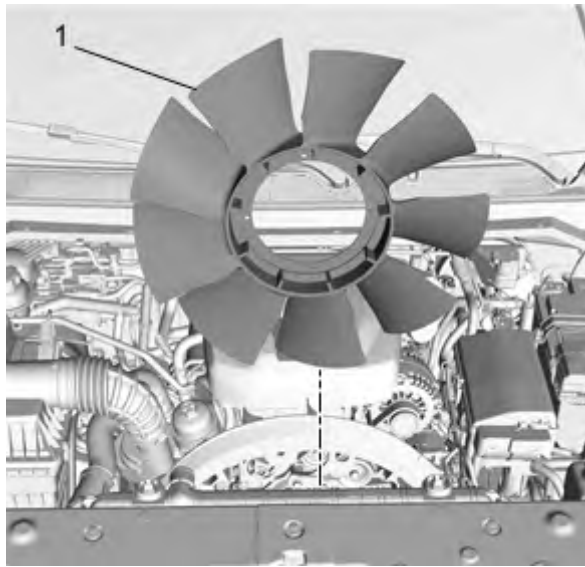


Fig. 122: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

4. Remove Fan Blade (1)

Installation Procedure

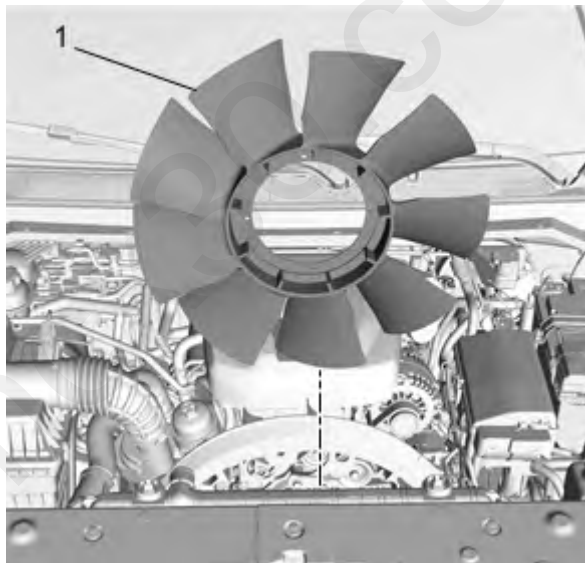


Fig. 123: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

1. Install Fan Blade (1)

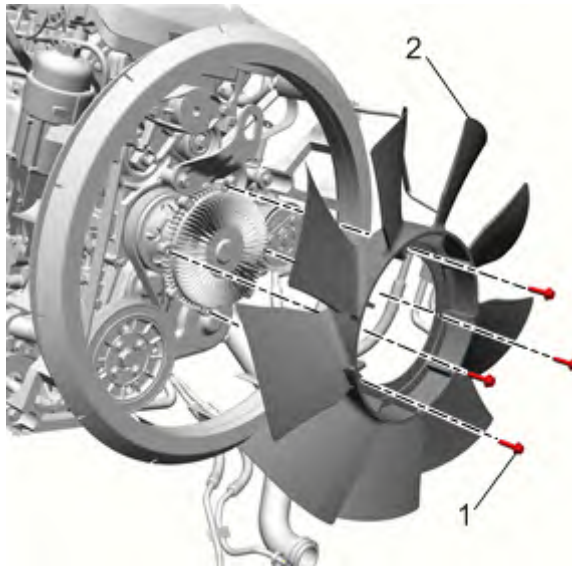


Fig. 124: Fan Blade Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install Fan Blade (2) @Fan Blade Clutch
3. Install Fan Blade Bolt (1) and tighten 9 N.m (80 lb in)

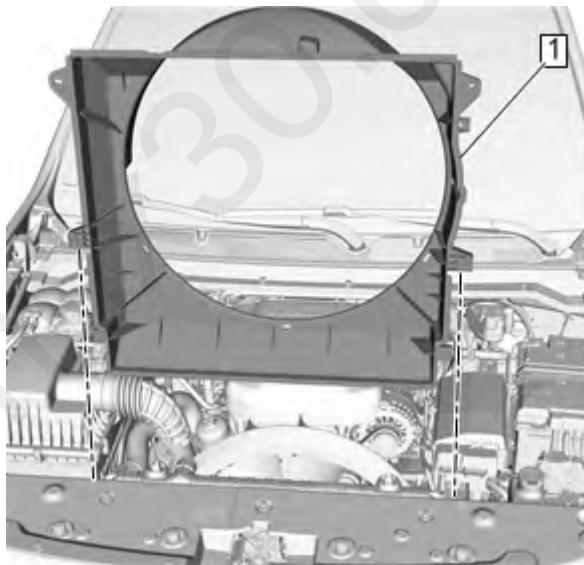


Fig. 125: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Coolant Fan Shroud (1).**Engine Coolant Fan Shroud Replacement (LFX)Engine Coolant Fan Shroud Replacement (LCV)Engine Coolant Fan Shroud Replacement (LWN)**

FAN BLADE CLUTCH REPLACEMENT (LWN)

Removal Procedure

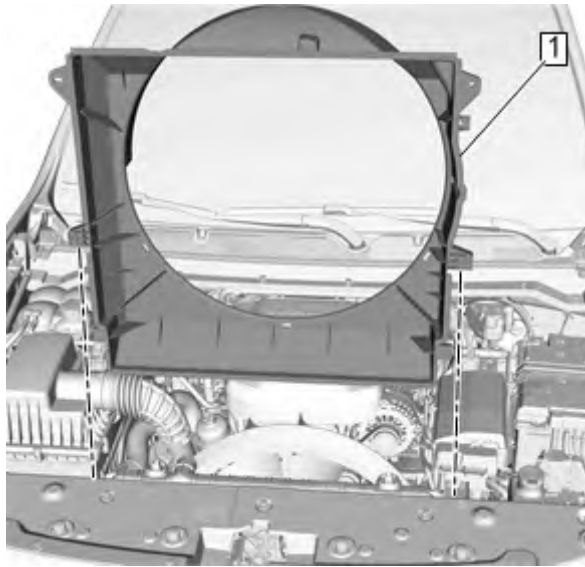


Fig. 126: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

1. Remove Engine Coolant Fan Shroud (1). [Engine Coolant Fan Shroud Replacement \(LFX\)](#)[Engine Coolant Fan Shroud Replacement \(LCV\)](#)[Engine Coolant Fan Shroud Replacement \(LWN\)](#)

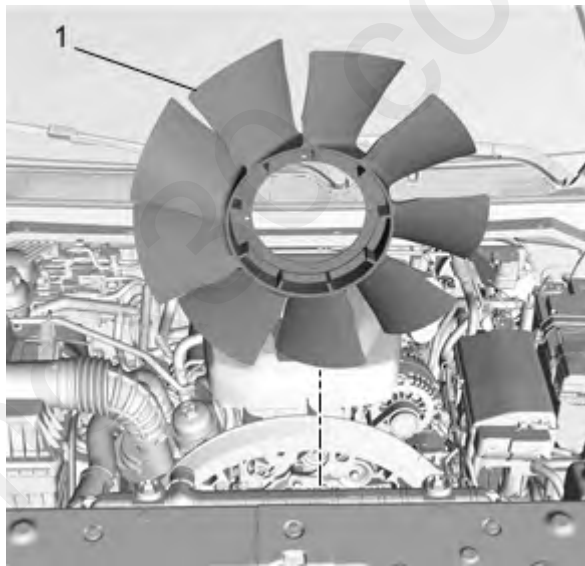


Fig. 127: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

2. Remove Fan Blade (1). [Fan Blade Replacement](#)[Fan Blade Replacement \(LWN\)](#)



Fig. 128: Engine Coolant Fan Rear Shroud
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Coolant Fan Rear Shroud (1) **Engine Coolant Fan Rear Shroud Replacement (LWN)**
4. Disconnect Electrical Connector@Fan Blade Clutch
5. Remove Fan Blade Clutch Wiring Harness Bracket Bolt (4)

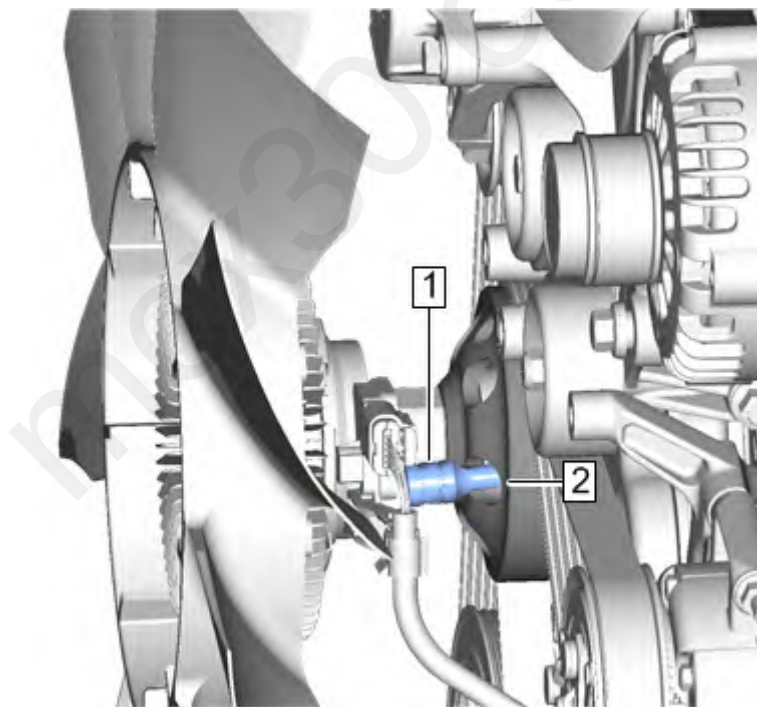


Fig. 129: Blunt End Tool And Engine Coolant Fan Bracket Pulley
 Courtesy of GENERAL MOTORS COMPANY

6. Insert a suitable blunt end tool (1) into one of the holes in the engine coolant fan bracket pulley (2) preventing the pulley from turning allowing the fan clutch to be removed.

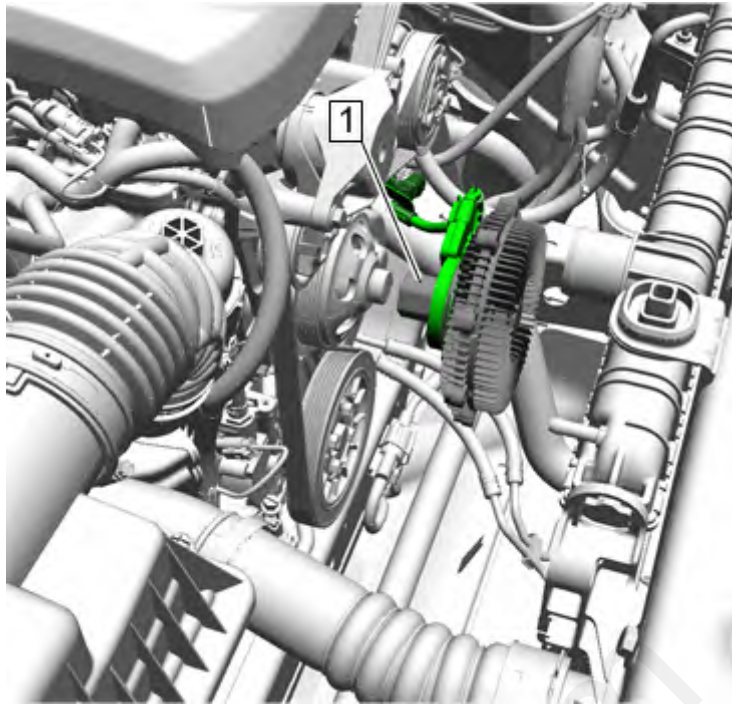


Fig. 130: Fan Blade Clutch

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fan Blade Clutch (1) @Engine Coolant Fan Bracket Pulley

Installation Procedure

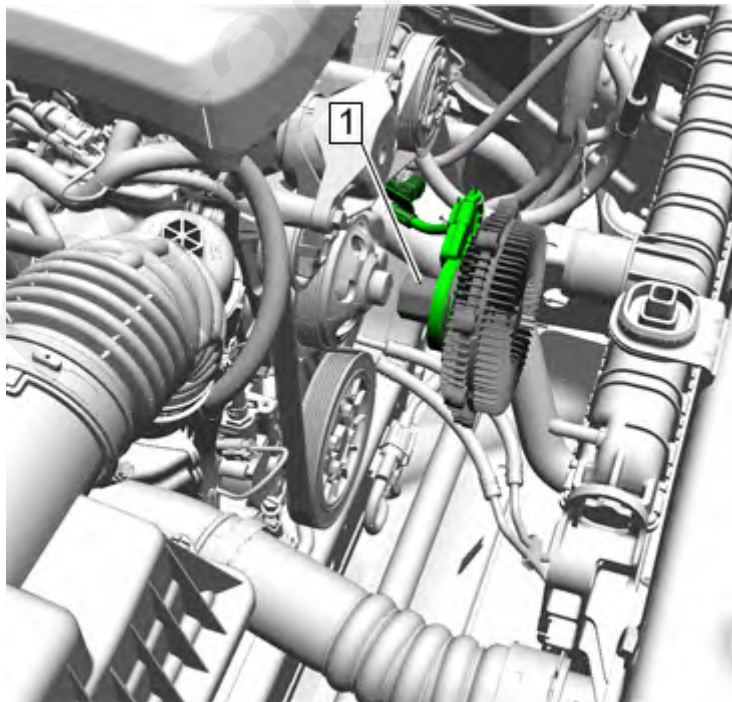


Fig. 131: Fan Blade Clutch

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

1. Install Fan Blade Clutch (1) @Engine Coolant Fan Bracket Pulley and tighten 58 N.m (43 lb ft)

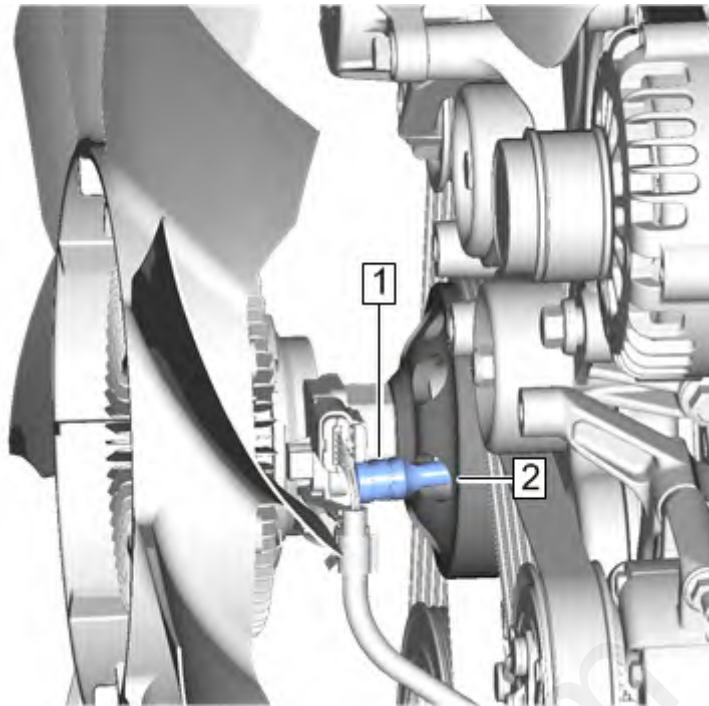


Fig. 132: Blunt End Tool And Engine Coolant Fan Bracket Pulley
 Courtesy of GENERAL MOTORS COMPANY

2. Remove the suitable blunt ended tool (1) from the engine coolant fan bracket pulley (2).
3. Connect Electrical Connector@Fan Blade Clutch



Fig. 133: Engine Coolant Fan Rear Shroud
 Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Coolant Fan Rear Shroud (1) [Engine Coolant Fan Rear Shroud Replacement \(LWN\)](#)

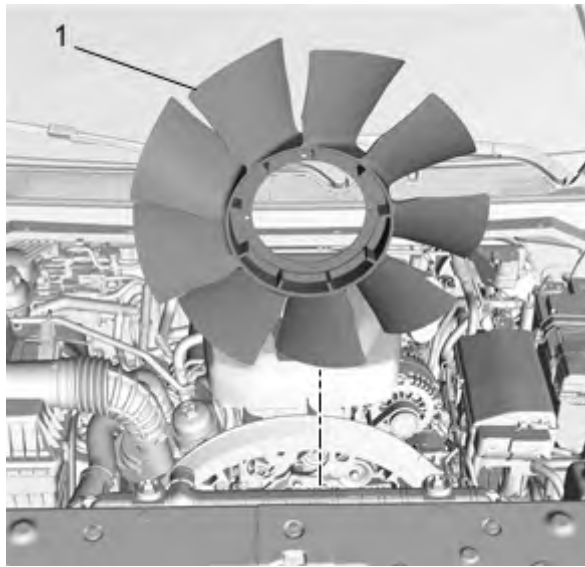


Fig. 134: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

5. Install Fan Blade (1). [Fan Blade Replacement](#)[Fan Blade Replacement \(LWN\)](#)

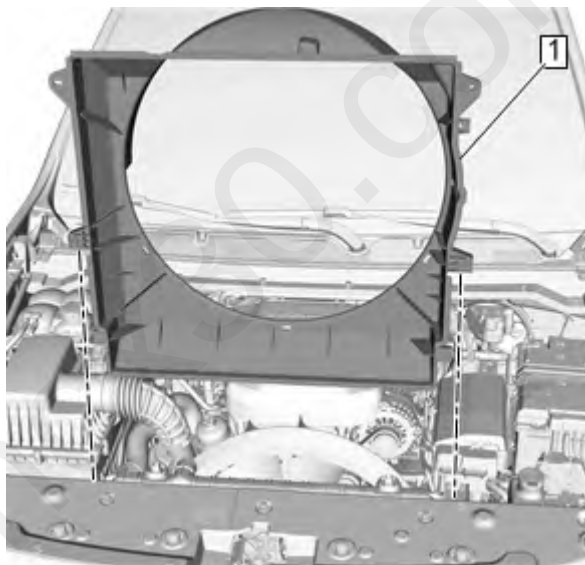


Fig. 135: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

6. Install Engine Coolant Fan Shroud (1). [Engine Coolant Fan Shroud Replacement \(LFX\)](#)[Engine Coolant Fan Shroud Replacement \(LCV\)](#)[Engine Coolant Fan Shroud Replacement \(LWN\)](#)

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT (LWN)

Removal Procedure

1. Remove Turbocharger. [Turbocharger Replacement](#)

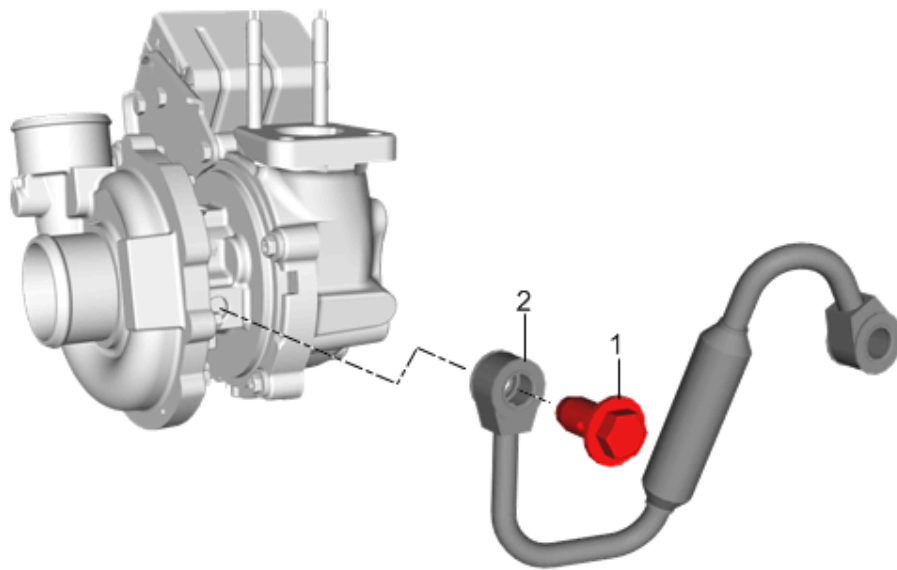
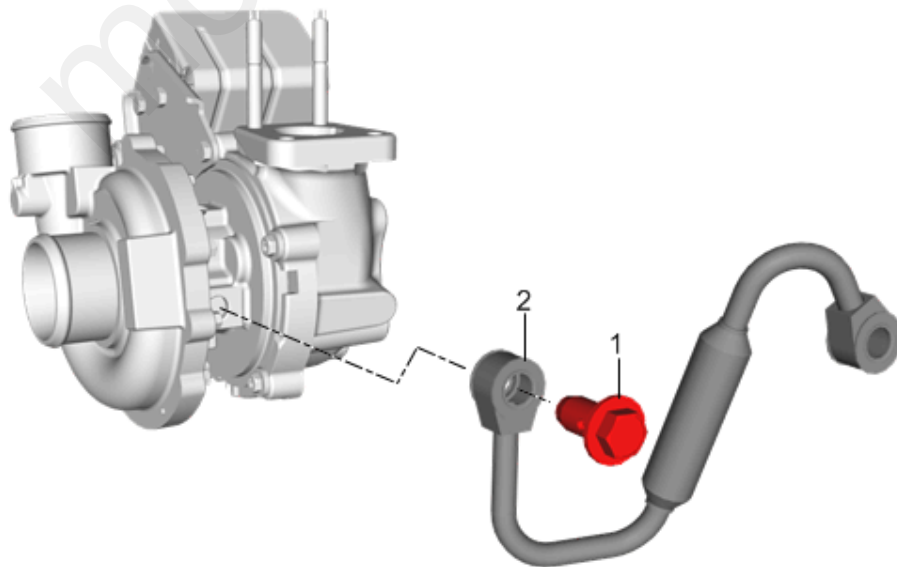


Fig. 136: Turbocharger Coolant Feed Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Remove Turbocharger Coolant Feed Pipe Hollow Screw (1).
3. Remove Turbocharger Coolant Feed Pipe (2).

Installation Procedure



': Turbocharger Coolant Feed Pipe
Courtesy of GENERAL MOTORS COMPANY

1. Install Turbocharger Coolant Feed Pipe (2).

CAUTION: Refer to **Fastener Caution** .

2. Install Turbocharger Coolant Feed Pipe Hollow Screw (1) and tighten 35 N.m (26 lb ft)
3. Install Turbocharger. **Turbocharger Replacement**

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT (LWN)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

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



Fig. 138: Radiator Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Reposition Radiator Surge Tank Outlet Hose Clamp (1)

Use the **BO-38185** Hose Clamp Pliers.

3. Disconnect Radiator Surge Tank Outlet Hose (2) @Turbocharger Coolant Return Pipe

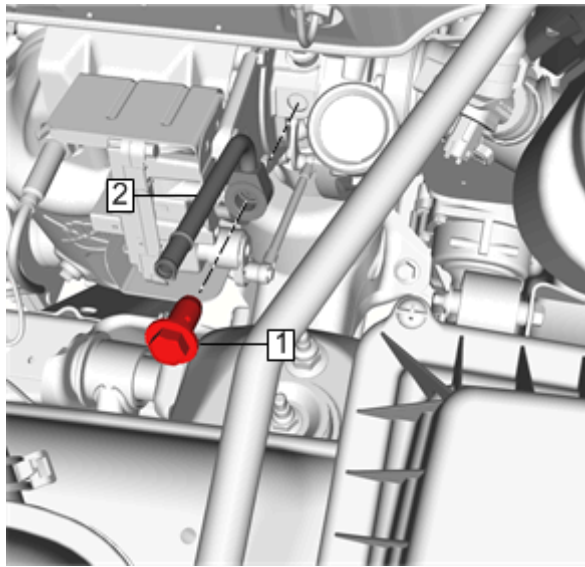


Fig. 139: Turbocharger Coolant Return Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Turbocharger Coolant Return Pipe Bolt (1)
5. Remove Turbocharger Coolant Return Pipe (2)

Installation Procedure

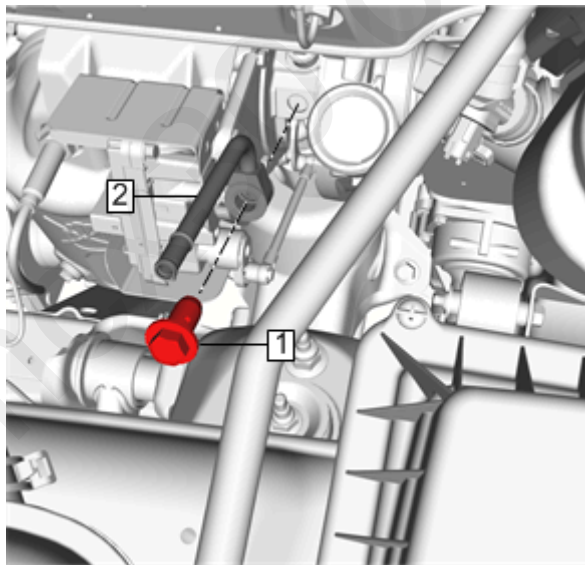


Fig. 140: Turbocharger Coolant Return Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install Turbocharger Coolant Return Pipe (2)

CAUTION: Refer to **Fastener Caution** .

2. Install Turbocharger Coolant Return Pipe Bolt (1) and tighten 35 N.m (26 lb ft)



Fig. 141: Radiator Surge Tank Outlet Hose Clamp

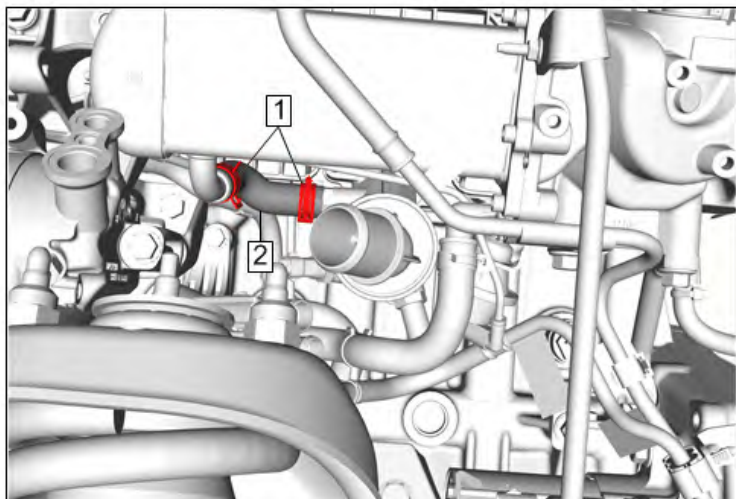
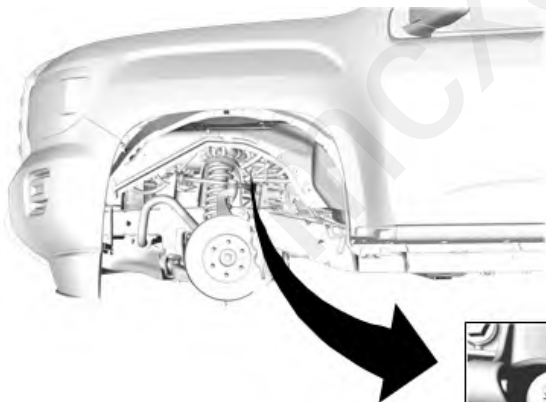
Courtesy of GENERAL MOTORS COMPANY

3. Connect Radiator Surge Tank Outlet Hose (2) @Turbocharger Coolant Return Pipe
4. Install Radiator Surge Tank Outlet Hose Clamp (1).

Use the **BO-38185** Hose Clamp Pliers.

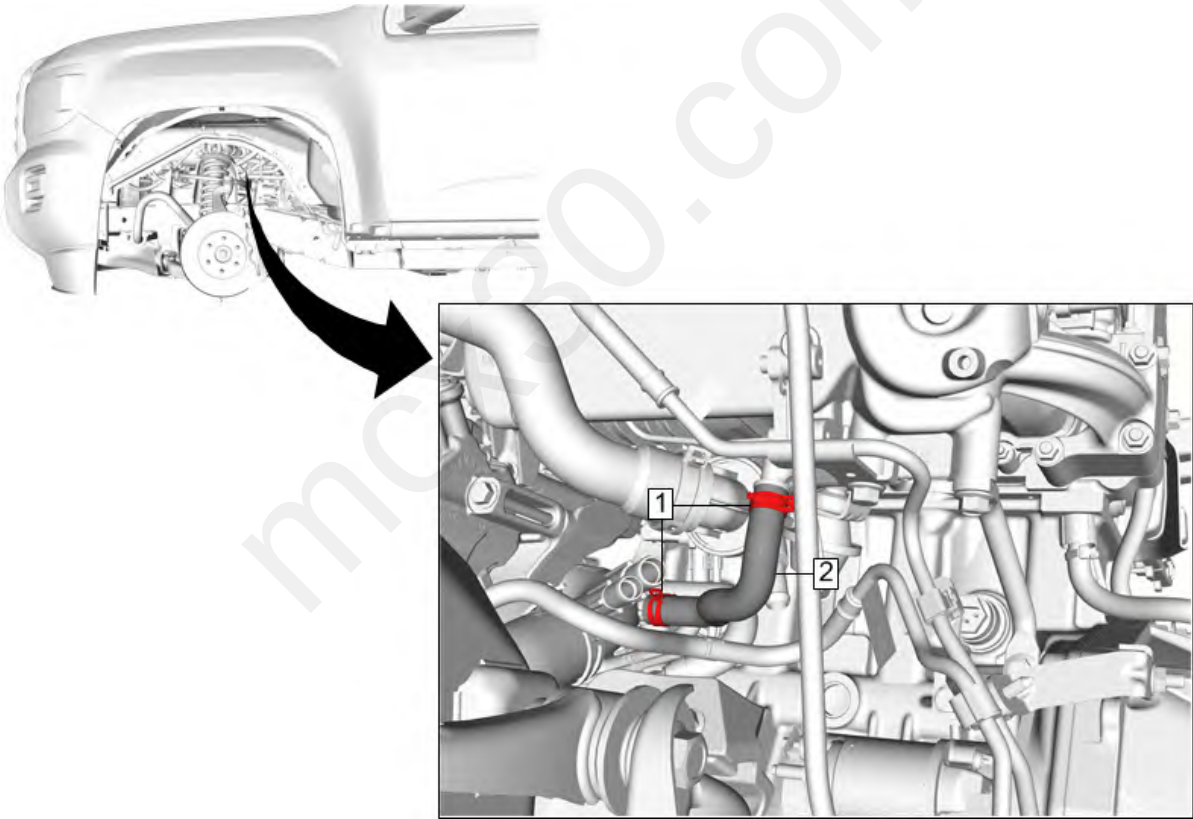
5. Fill the cooling system. **Cooling System Draining and Filling (Static Fill)****Cooling System Draining and Filling (Vac n Fill)**
6. Start the engine and check for coolant leaks.

EXHAUST GAS RECIRCULATION MANIFOLD COOLING FEED HOSE REPLACEMENT (LWN)



Callout	Component Name
Preliminary Procedures 1. Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill) 2. Front Wheelhouse Liner Replacement	
1	Hose Clamp (Qty: 2) Procedure Reposition the hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Exhaust Gas Recirculation Manifold Cooling Feed Hose

EXHAUST GAS RECIRCULATION MANIFOLD COOLING RETURN HOSE REPLACEMENT (LWN)



[Fig. 143: Exhaust Gas Recirculation Manifold Cooling Return Hose \(LWN\)](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures	
1. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Air Conditioning Compressor Bracket Replacement (LWN)	
1	Hose Clamp (Qty: 2) Procedure Reposition the hose clamps using the BO-38185 hose clamp pliers. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Exhaust Gas Recirculation Manifold Cooling Return Hose

THERMOSTAT BYPASS HOSE REPLACEMENT

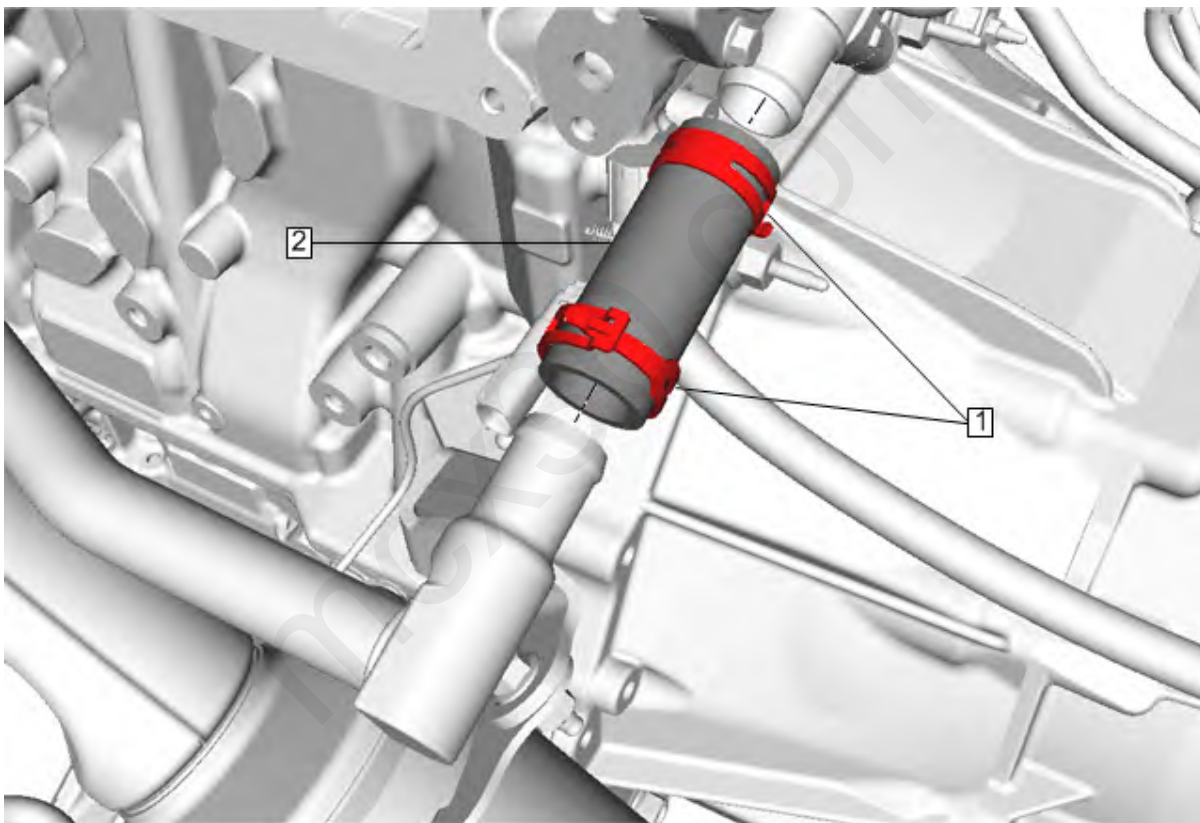


Fig. 144: Thermostat Bypass Hose

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Remove Plenum Front Panel. Plenum Front Panel Replacement 3. Remove Thermostat Bypass Pipe. Thermostat Bypass Pipe Replacement	

Current	Component Name
1	Clamp (Qty: 2) Procedure Reposition the thermostat bypass hose clamps using the BO 38185 hose clamp pliers. Special Tools BO 38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Thermostat Bypass Hose Procedure Check the cooling system for leaks.

WATER PUMP INLET PIPE REPLACEMENT (LWN)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
2. Remove Air Conditioning Compressor Bracket. [Air Conditioning Compressor Bracket Replacement \(LWN\)](#)

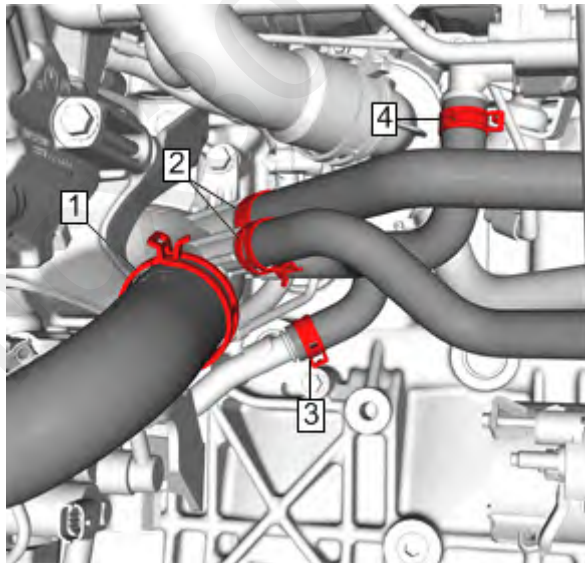


Fig. 145: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Radiator Outlet Hose (1)
Use the **BO-38185** Hose Clamp Pliers.
4. Disconnect Heater Inlet and Outlet Hose (2)
Use the **BO-38185** Hose Clamp Pliers.
5. Disconnect Engine Oil Cooler Hose (3)

BO-38185 Hose Clamp Pliers.

6. Disconnect Exhaust Gas Recirculation Manifold Cooling Return Hose (4)

Use the **BO-38185** Hose Clamp Pliers.

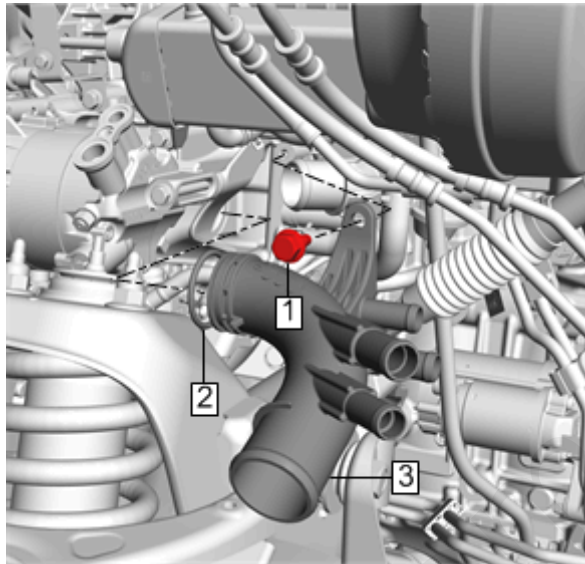


Fig. 146: Water Pump Inlet Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove Water Pump Inlet Pipe Bolt (1)
8. Remove Water Pump Inlet Pipe (3)
9. Remove Water Pump Inlet Pipe Seal (2) and DISCARD
10. Transfer components as necessary.

Installation Procedure

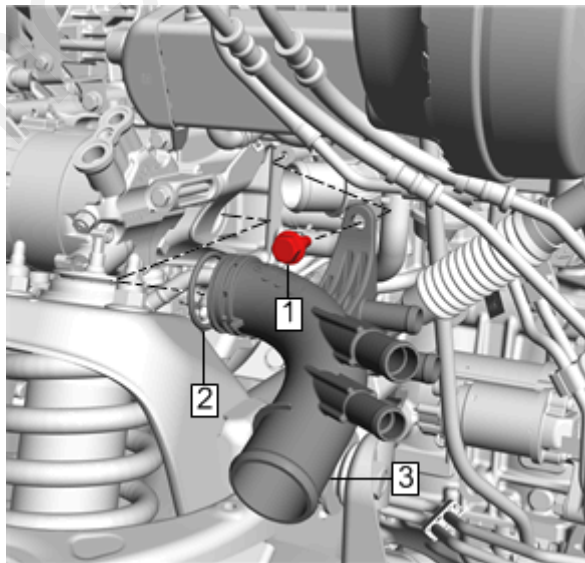


Fig. 147: Water Pump Inlet Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW seal.

Water Pump Inlet Pipe Seal (2)

2. Install Water Pump Inlet Pipe (3)

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

3. Install Water Pump Inlet Pipe Bolt (1) and tighten 25 N.m (18 lb ft)

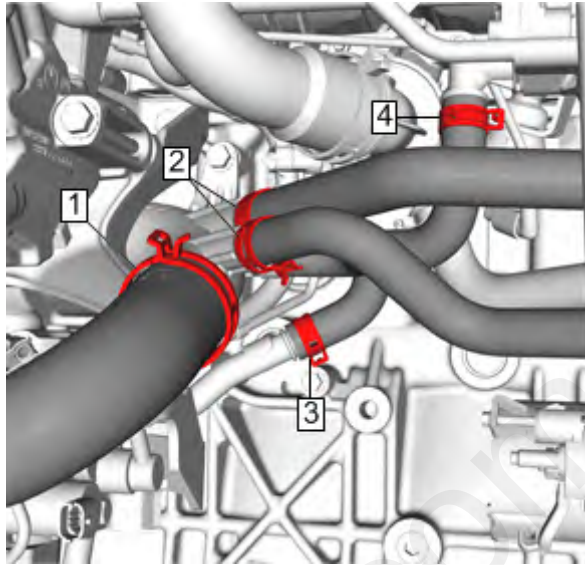


Fig. 148: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Connect Exhaust Gas Recirculation Manifold Cooling Return Hose (4)

Use the **BO-38185** Hose Clamp Pliers.

5. Connect Engine Oil Cooler Hose (3)

Use the **BO-38185** Hose Clamp Pliers.

6. Connect Heater Inlet and Outlet Hose (2)

Use the **BO-38185** Hose Clamp Pliers.

7. Connect Radiator Outlet Hose (1)

Use the **BO-38185** Hose Clamp Pliers.

8. Install Air Conditioning Compressor Bracket [Air Conditioning Compressor Bracket Replacement \(LWN\)](#)

9. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

10. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LCV)

Removal Procedure

Special Tools

se Clamp Pliers

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

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the exhaust manifold heat shield. Refer to [Exhaust Manifold Heat Shield Replacement \(LCV\)](#) .

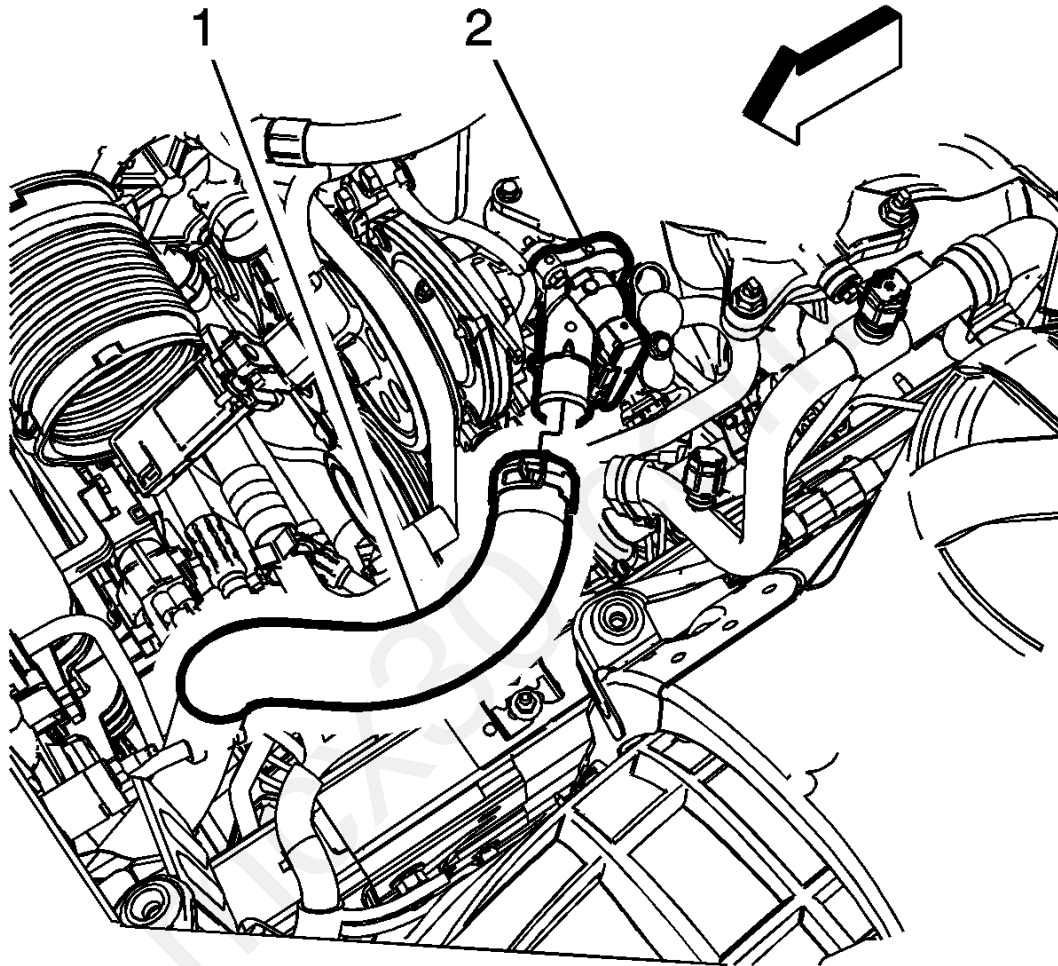


Fig. 149: Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

3. Remove the radiator outlet hose (1) from the engine coolant thermostat housing (2).

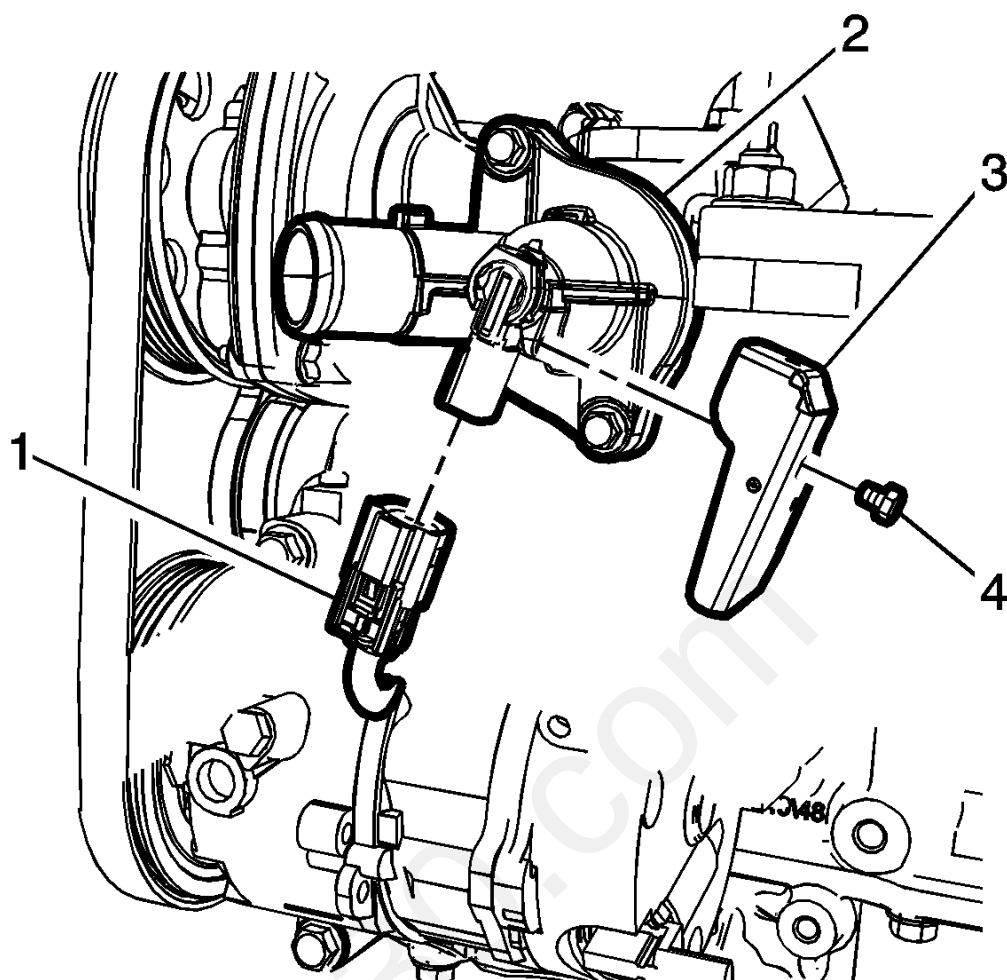


Fig. 150: Thermostat Heater Heat Shield

Courtesy of GENERAL MOTORS COMPANY

4. Remove the thermostat heater heat shield fastener (4) and remove the thermostat heater heat shield (3).
5. Disconnect the thermostat heater connector (1).

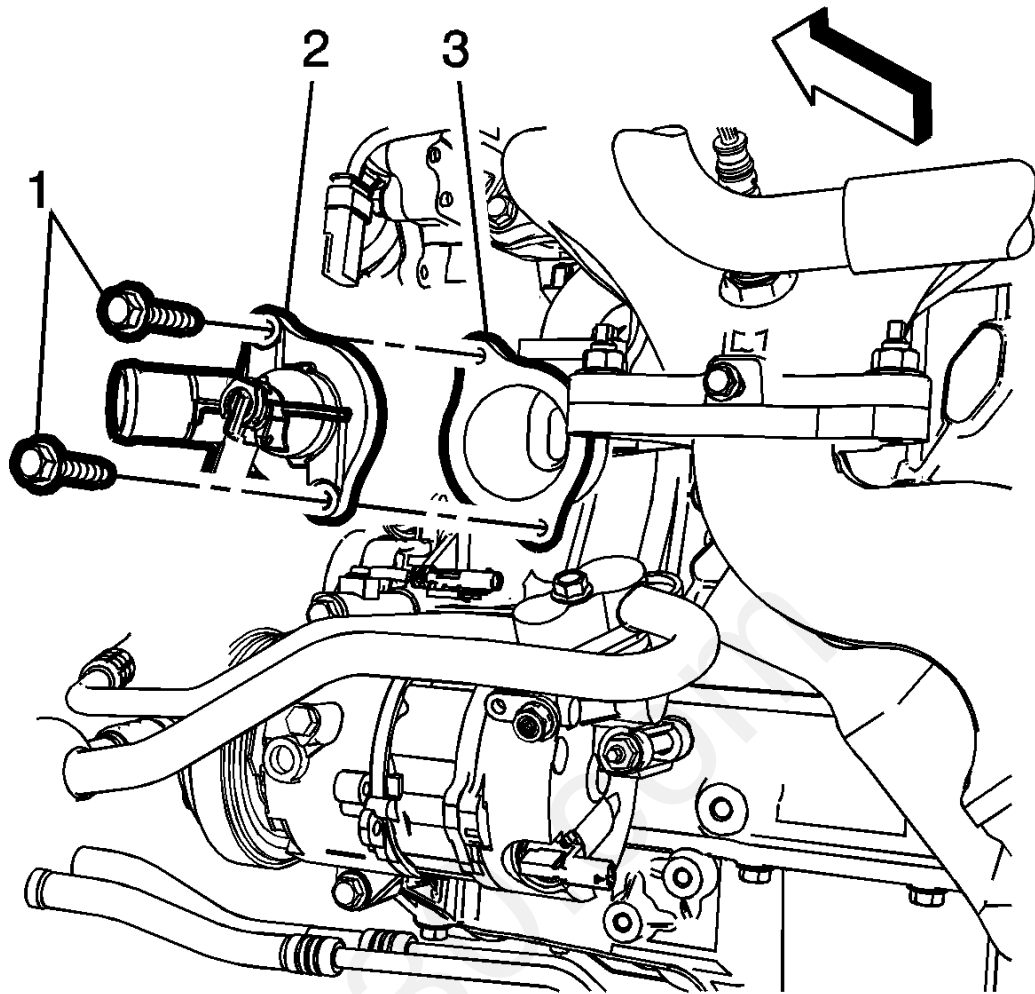


Fig. 151: Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine coolant thermostat housing fasteners (1) and remove the engine coolant thermostat housing (2).
7. Discard the engine coolant thermostat housing gasket (3).
8. Transfer the thermostat heater if replacing the thermostat housing with the thermostat.

Installation Procedure

1. Clean the sealing surfaces.

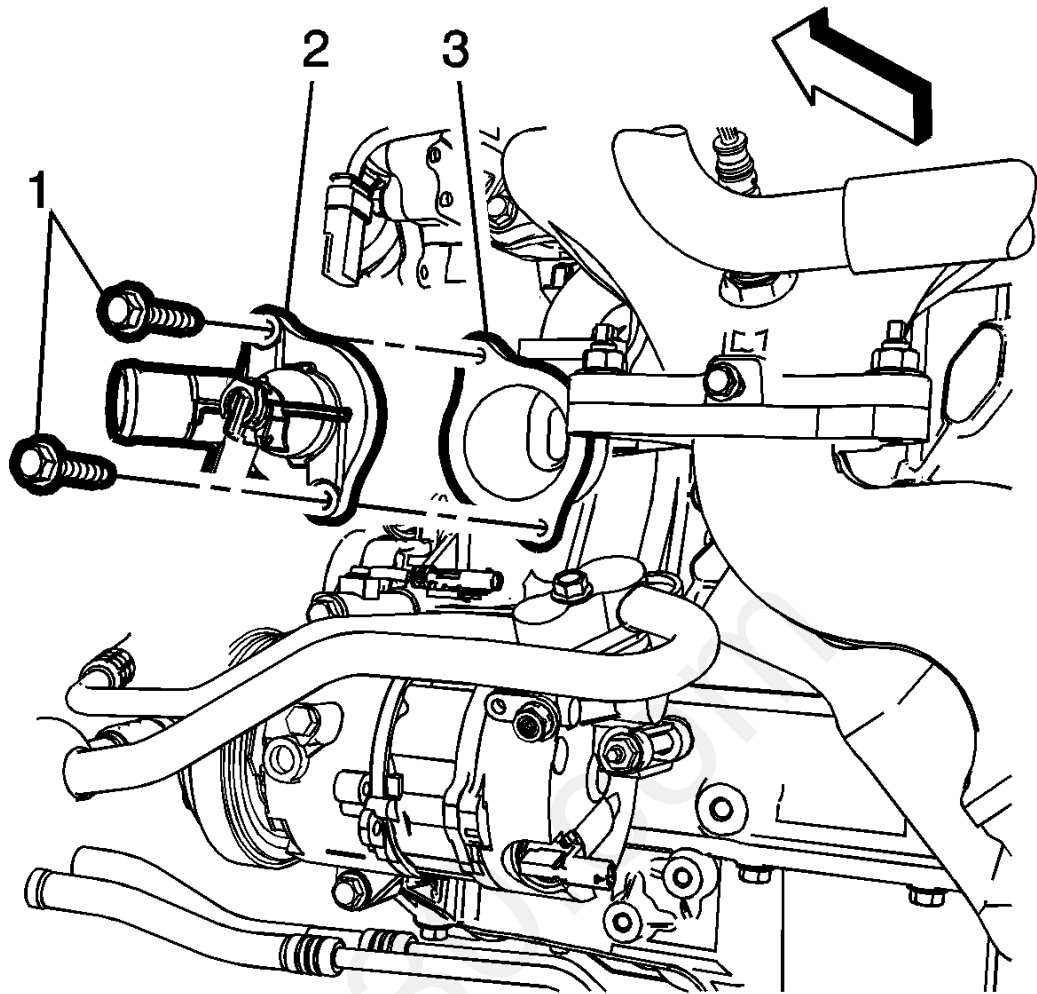


Fig. 152: Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the engine coolant thermostat housing (2) to the water pump housing with a NEW gasket (3) and tighten the fasteners (1) to 10 N.m (89 lb in).

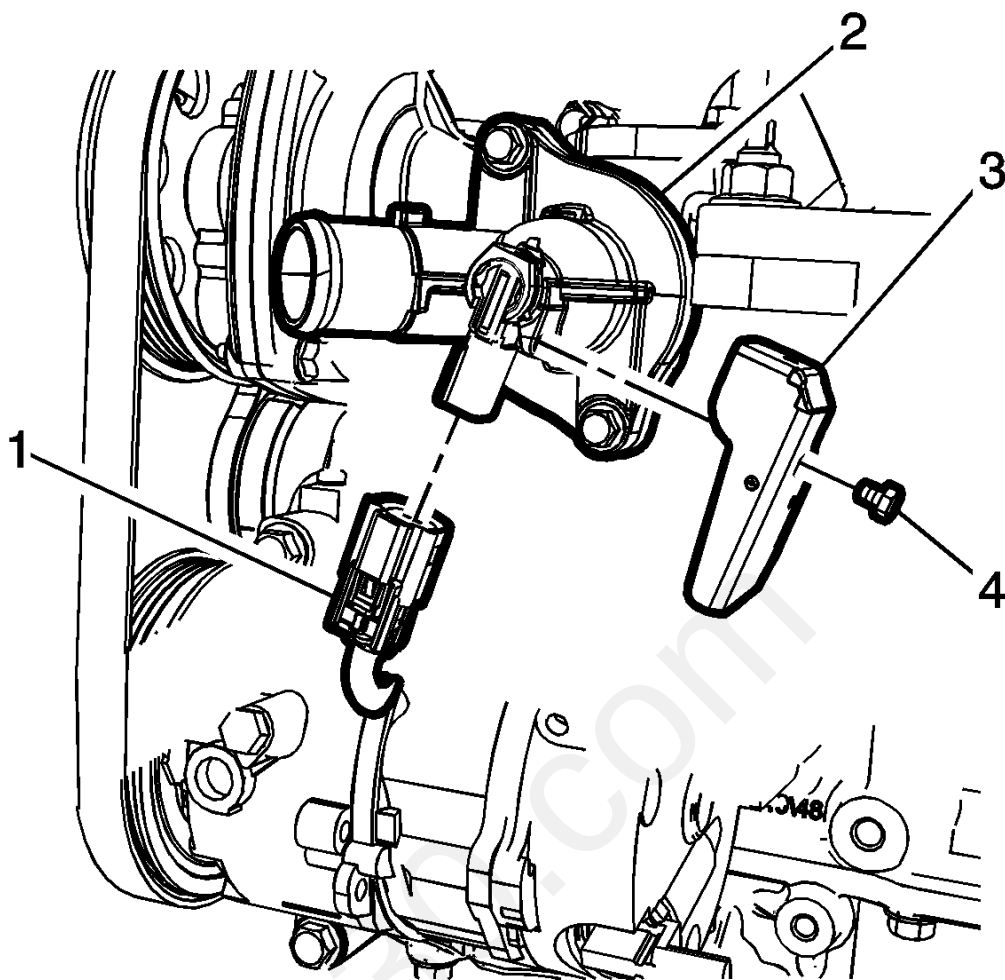


Fig. 153: Thermostat Heater Heat Shield

Courtesy of GENERAL MOTORS COMPANY

3. Connect the thermostat heater connector (1).
4. Install the thermostat heater shield (3) and tighten the fastener (4) to 5 N.m (44 lb in).

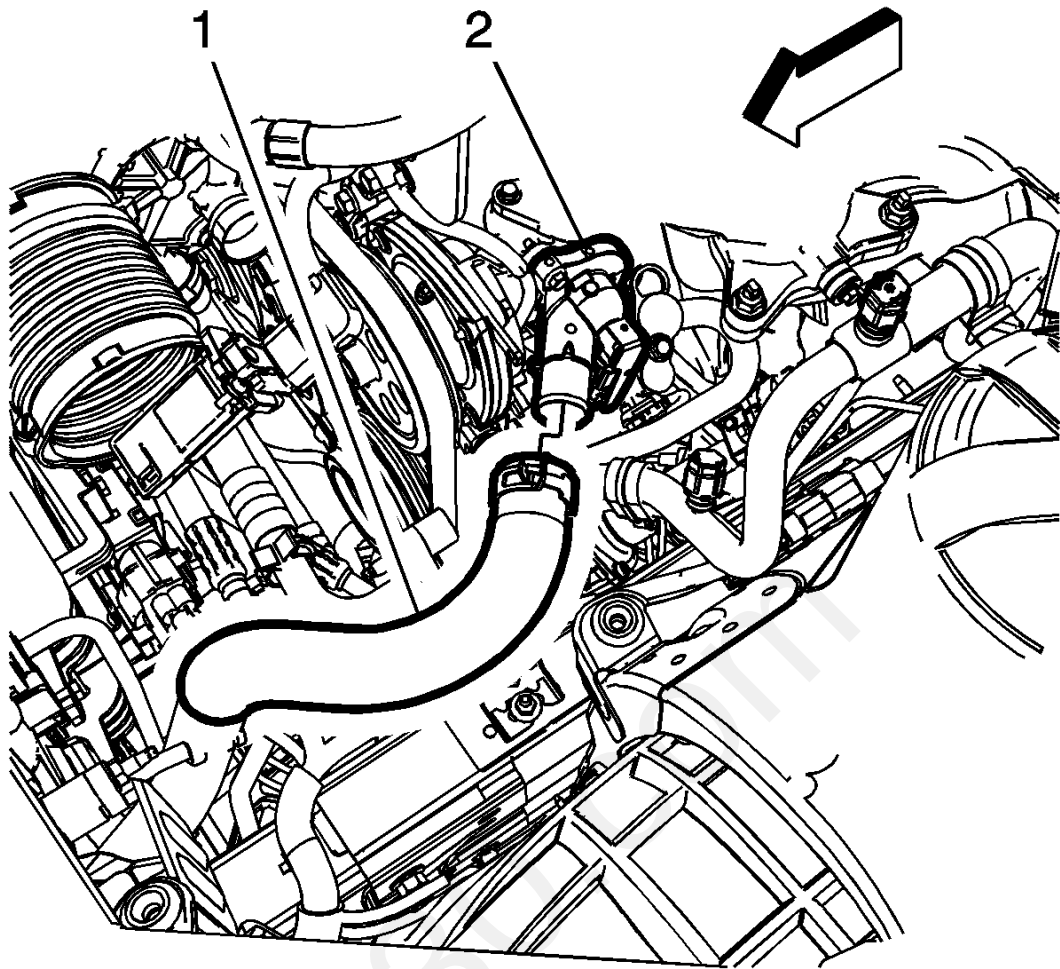


Fig. 154: Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

5. Install the radiator outlet hose (1) to the engine coolant thermostat housing (2).
6. Install the exhaust manifold heat shield. Refer to [Exhaust Manifold Heat Shield Replacement \(LCV\)](#) .
7. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
8. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LFX)

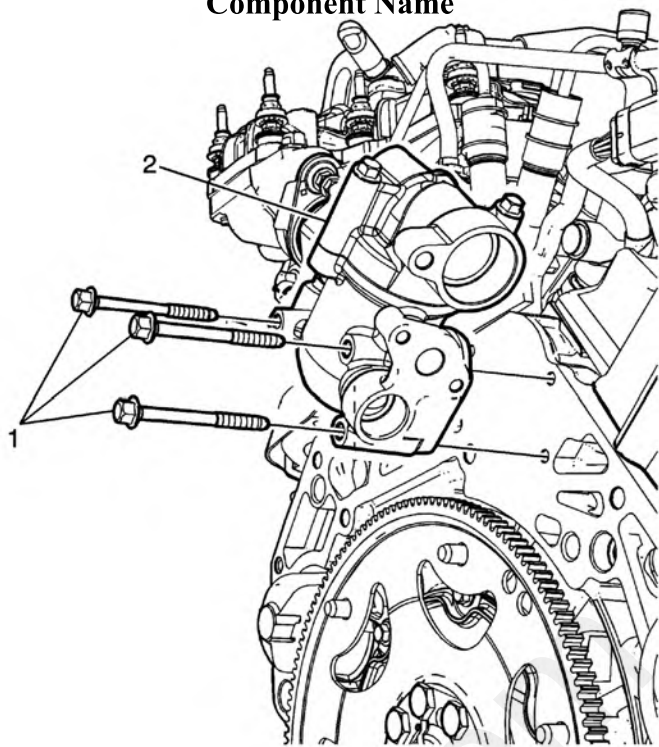


Fig. 155: Engine Coolant Thermostat Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the fuel pipe shield. Refer to Fuel Pipe Shield Replacement . 2. Disconnect the radiator outlet pipe. Refer to Radiator Outlet Pipe Replacement. 3. Disconnect the heater inlet and outlet pipe assembly from the thermostat housing. Refer to Heater Inlet And Outlet Pipe Replacement. 4. Remove the intake manifold. Refer to Intake Manifold Replacement . 5. Remove the fuel feed front hose. Refer to Fuel Feed Front Hose Replacement . 6. Remove the fuel feed intermediate pipe. Refer to Fuel Feed Intermediate Pipe Replacement .	
1	Thermostat Housing Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT REPLACEMENT (LWN)

Removal Procedure

Special Tools

se Clamp Pliers

Equivalent regional tools: Special Tools

1. Drain the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)
2. Remove Front Wheelhouse Liner. Front Wheelhouse Liner Replacement

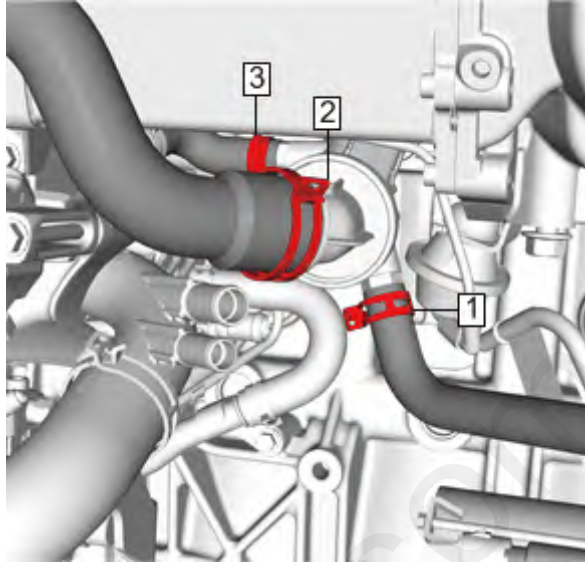


Fig. 156: Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Heater Inlet Hose (1)

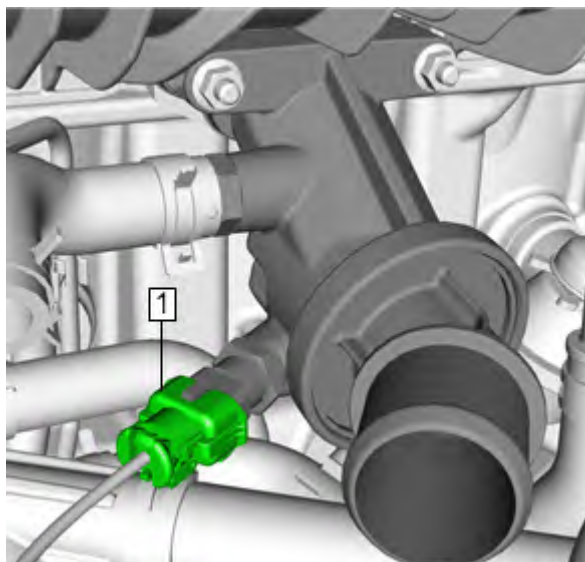
Use the **BO-38185** Hose Clamp Pliers.

4. Disconnect Radiator Inlet Hose (2)

Use the **BO-38185** Hose Clamp Pliers.

5. Disconnect Exhaust Gas Recirculation Manifold Cooling Feed Hose (3)

Use the **BO-38185** Hose Clamp Pliers.



': Engine Coolant Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Engine Coolant Temperature Sensor Electrical Connector (1)

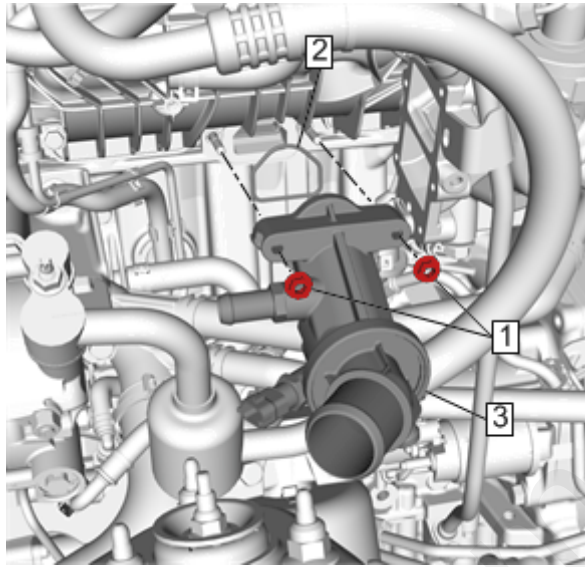


Fig. 158: Engine Coolant Thermostat Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove Engine Coolant Thermostat Nut (1)
8. Remove Engine Coolant Thermostat (3)
9. Remove Engine Coolant Thermostat Seal (2) and DISCARD

Installation Procedure

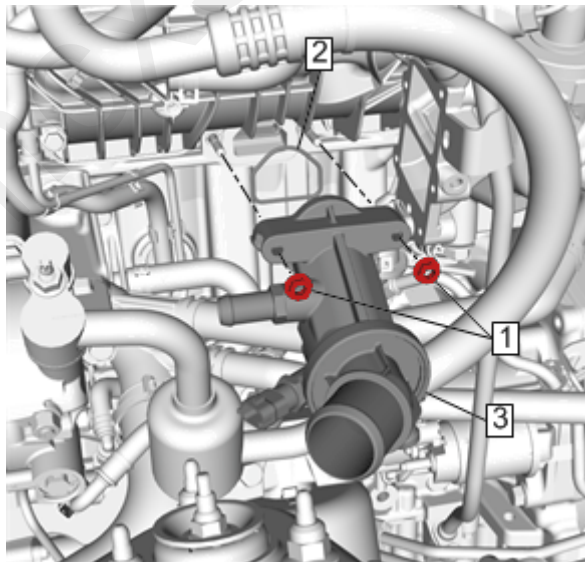


Fig. 159: Engine Coolant Thermostat Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW seal.

1. Install Engine Coolant Thermostat Seal (2)
2. Install Engine Coolant Thermostat (3)

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

3. Install Engine Coolant Thermostat Nut (1) and tighten 9 N.m (80 lb in)

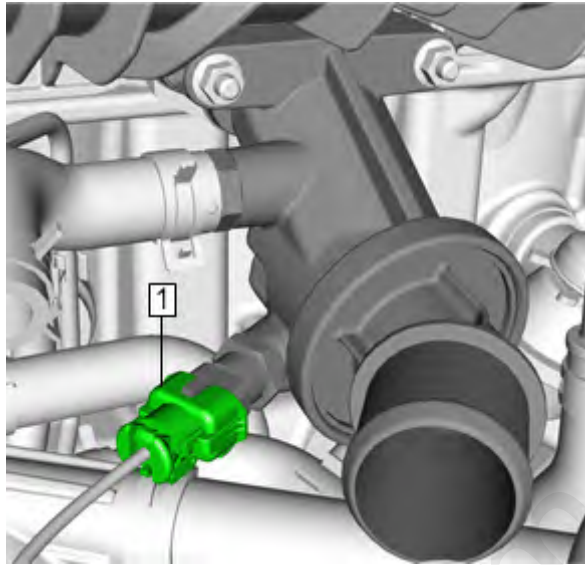


Fig. 160: Engine Coolant Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect Engine Coolant Temperature Sensor Electrical Connector (1)

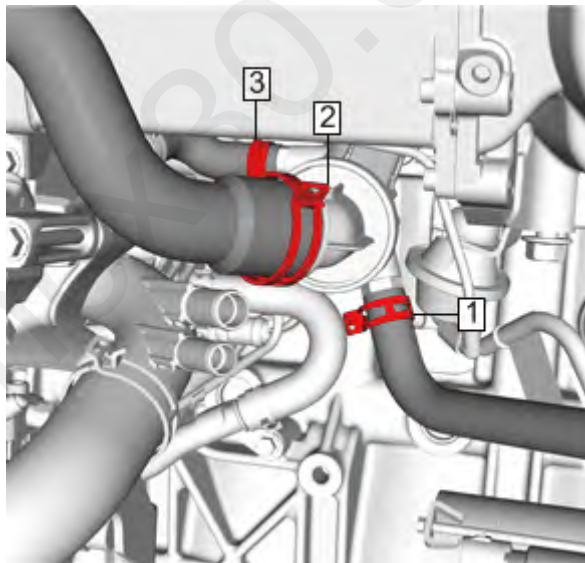


Fig. 161: Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Connect Exhaust Gas Recirculation Manifold Cooling Feed Hose (3)

Use the **BO-38185** Hose Clamp Pliers.

6. Connect Radiator Inlet Hose (2)

Use the **BO-38185** Hose Clamp Pliers.

7. Connect Heater Inlet Hose (1)

- 8. Install Front Wheelhouse Liner.[Front Wheelhouse Liner Replacement](#)
- 9. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
- 10. Start the engine and check for coolant leaks.

ENGINE COOLANT AIR BLEED PIPE REPLACEMENT

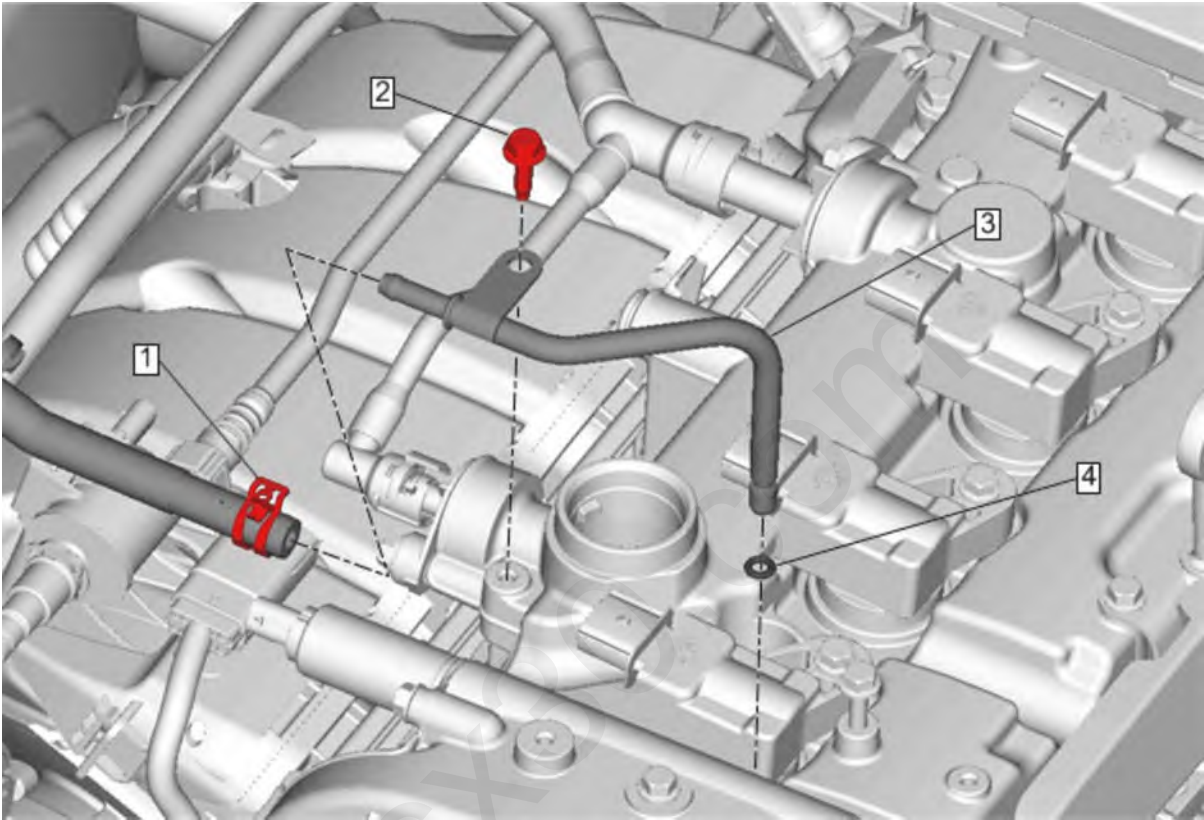


Fig. 162: Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement . 3. Remove the positive crankcase ventilation hose/pipe/tube. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement . 4. Disconnect the electrical wiring harness connector from the ignition coil.	
Special Tools BO-38185 Hose Clamp PliersFor equivalent regional tools, refer to Special Tools .	

Callout	Component Name
1	Coolant Recovery Reservoir Inlet Hose
2	Engine Coolant Air Bleed Pipe Fastener
3	Engine Coolant Air Bleed Pipe
4	Engine Coolant Air Bleed Pipe Seal

COOLANT RECOVERY RESERVOIR HOSE REPLACEMENT (LFX)

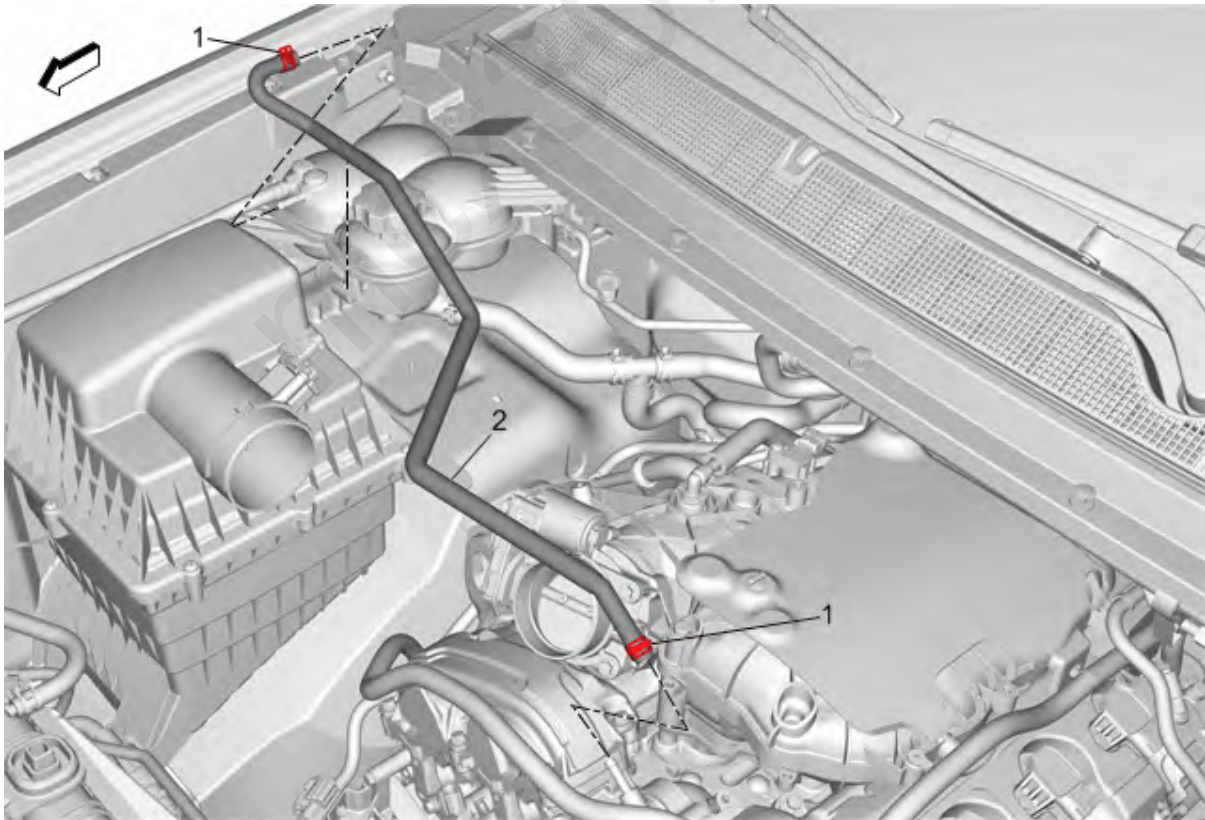


Fig. 163: Coolant Recovery Reservoir Hose (LFX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	Component Name
Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement .	
1	Coolant Recovery Reservoir Hose Clamp (Qty: 2) Procedure Disengage the tension on the coolant recovery reservoir hose clamps using the BO-38185 hose clamp pliers. Special Tool BO-38185 hose clamp pliers
2	Coolant Recovery Reservoir Hose Procedures 1. Unclip the coolant recovery reservoir hose from the radiator surge tank. 2. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 3. Inspect the cooling system for leaks.

COOLANT RECOVERY RESERVOIR HOSE REPLACEMENT (LCV)

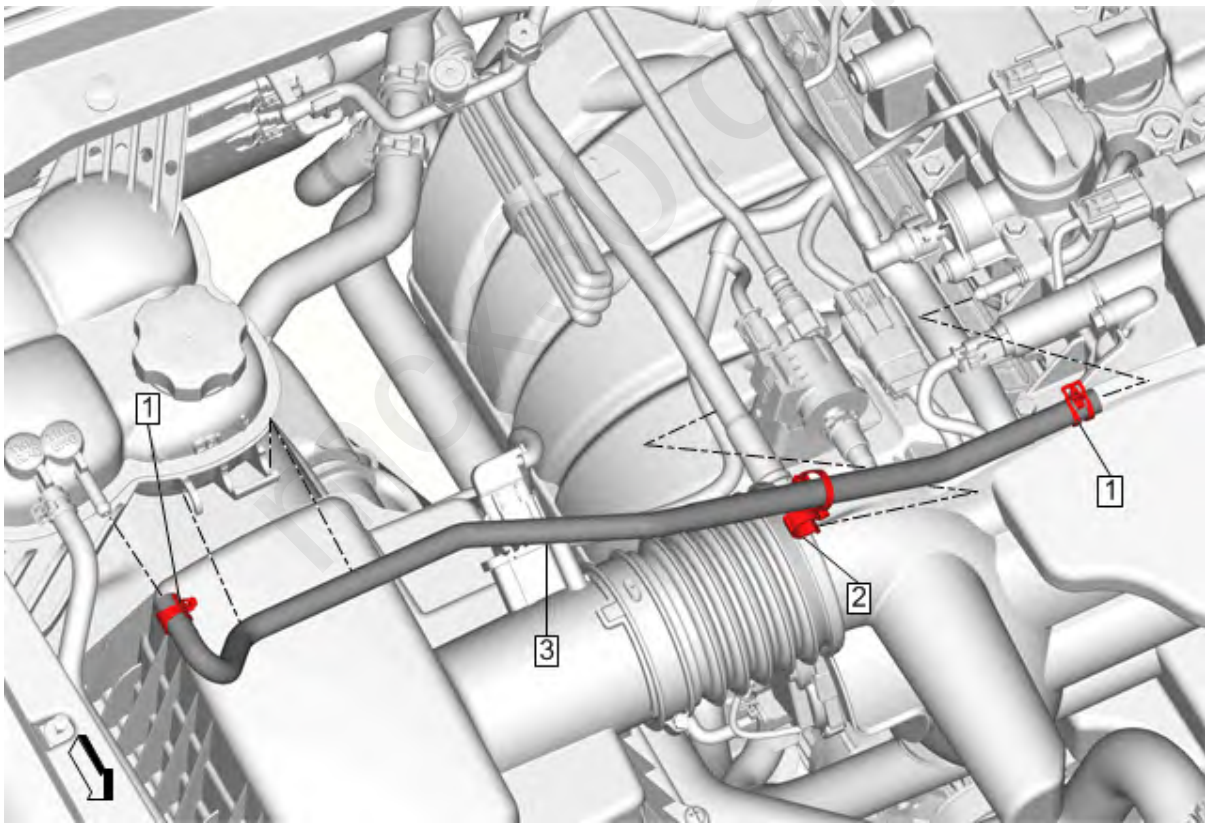


Fig. 164: Coolant Recovery Reservoir Hose (LCV)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Intake Manifold Cover Replacement	

Callout	Component Name
1	Coolant Recovery Reservoir Hose Clamp (Qty: 2) Procedure Disengage BO-38185 hose clamp pliers. Special Tool BO-38185 hose clamp pliers
2	Coolant Recovery Reservoir Hose Clip Procedure Unclip the coolant recovery reservoir hose from the positive crankcase ventilation tube.
3	Coolant Recovery Reservoir Hose Procedure 1. Unclip the coolant recovery reservoir hose from the radiator surge tank. 2. Check the engine coolant level and fill to the proper level if necessary. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)

WATER OUTLET REPLACEMENT (LFX)

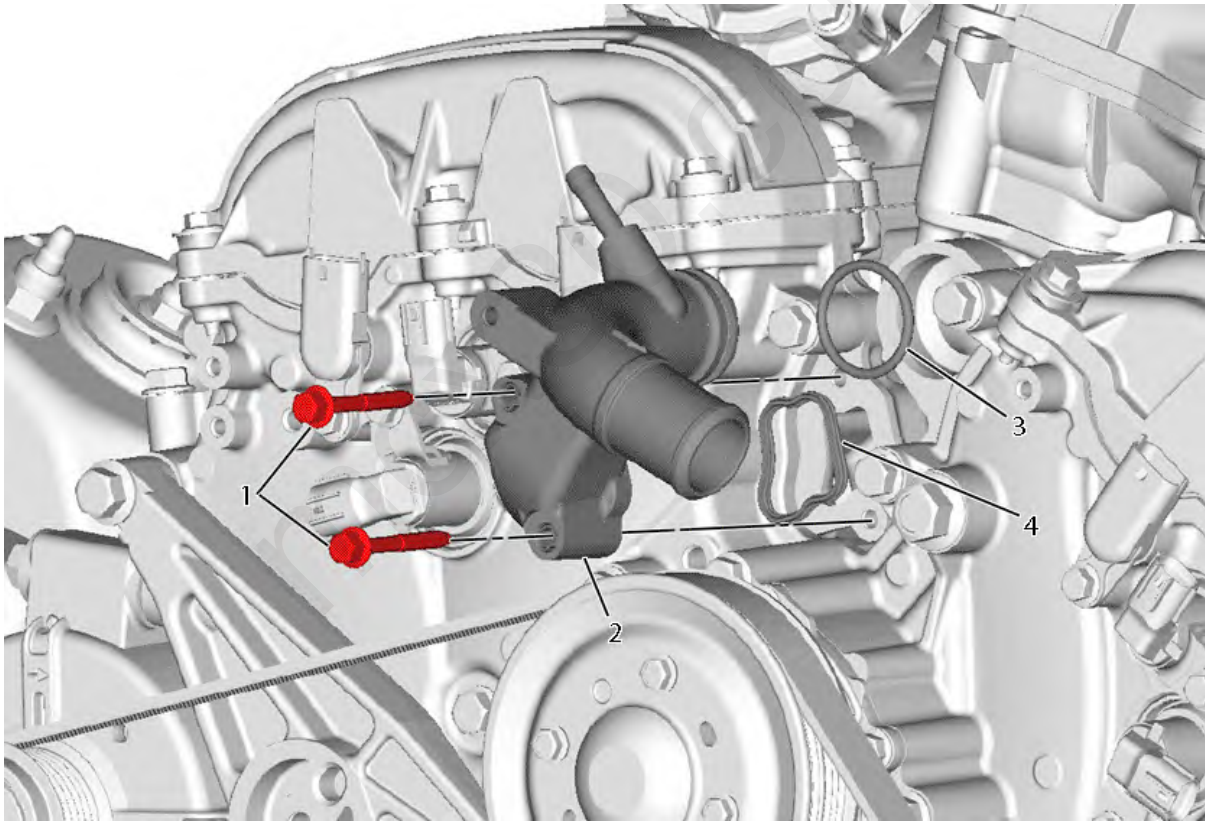


Fig. 165: Water Outlet (LFX)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Disconnect the coolant recovery reservoir hose. Refer to Coolant Recovery Reservoir Hose Replacement (LFX). 3. Remove the air cleaner outlet duct bracket. 4. Disconnect the radiator inlet hose. Refer to Radiator Inlet Hose Replacement (LFX).	
1	Water Outlet Fasteners (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Water Outlet Procedure Clean the mating surfaces.
3	O-ring seal Procedure Install a NEW seal.
4	Water Outlet Seal Procedure Install a NEW seal.

WATER OUTLET REPLACEMENT (LCV)

Removal Procedure

Special Tools

BO-38185 Hose Clamp Pliers

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

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#) .
3. Remove the plenum front panel. Refer to [Plenum Front Panel Replacement](#) .
4. Remove the thermostat bypass pipe fasteners in order to remove the thermostat bypass pipe from the water pump. Discard the gasket

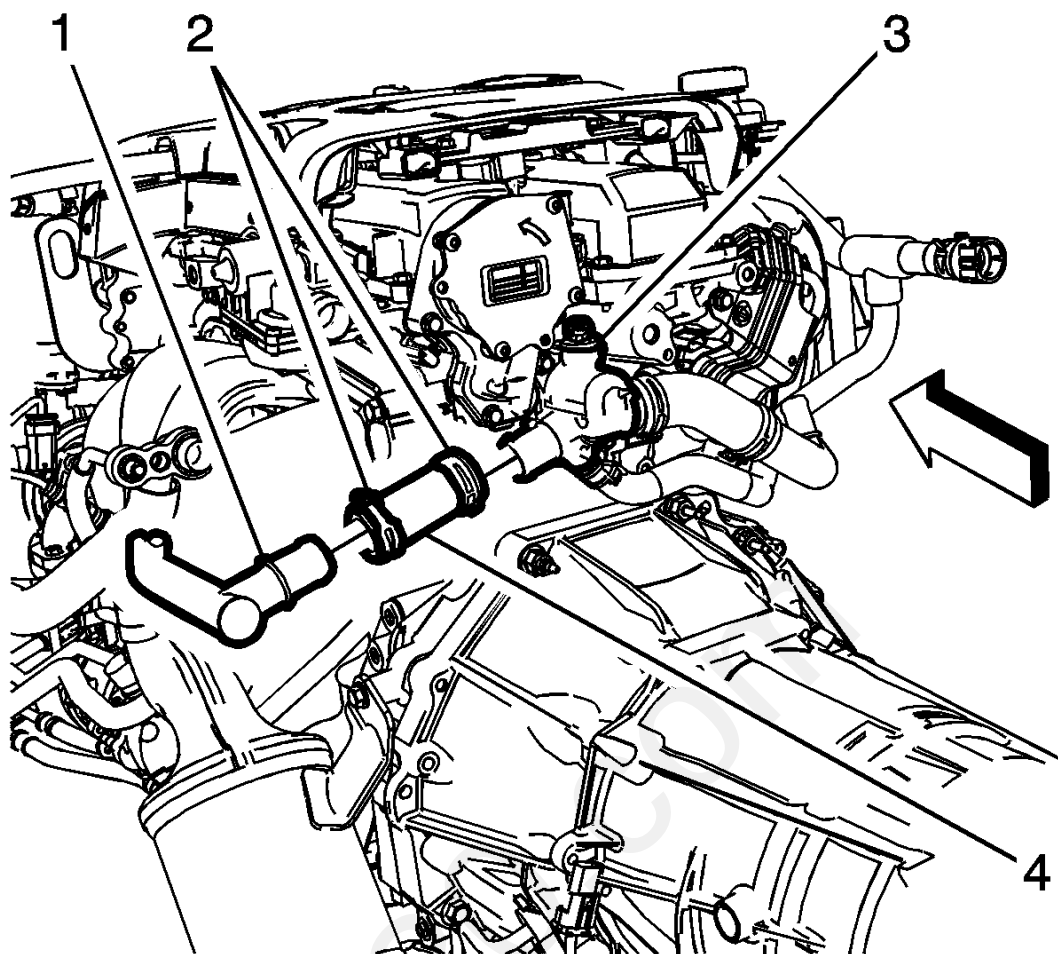


Fig. 166: Thermostat Bypass Hose

Courtesy of GENERAL MOTORS COMPANY

5. Remove the thermostat bypass hose (2) from the water outlet (3).

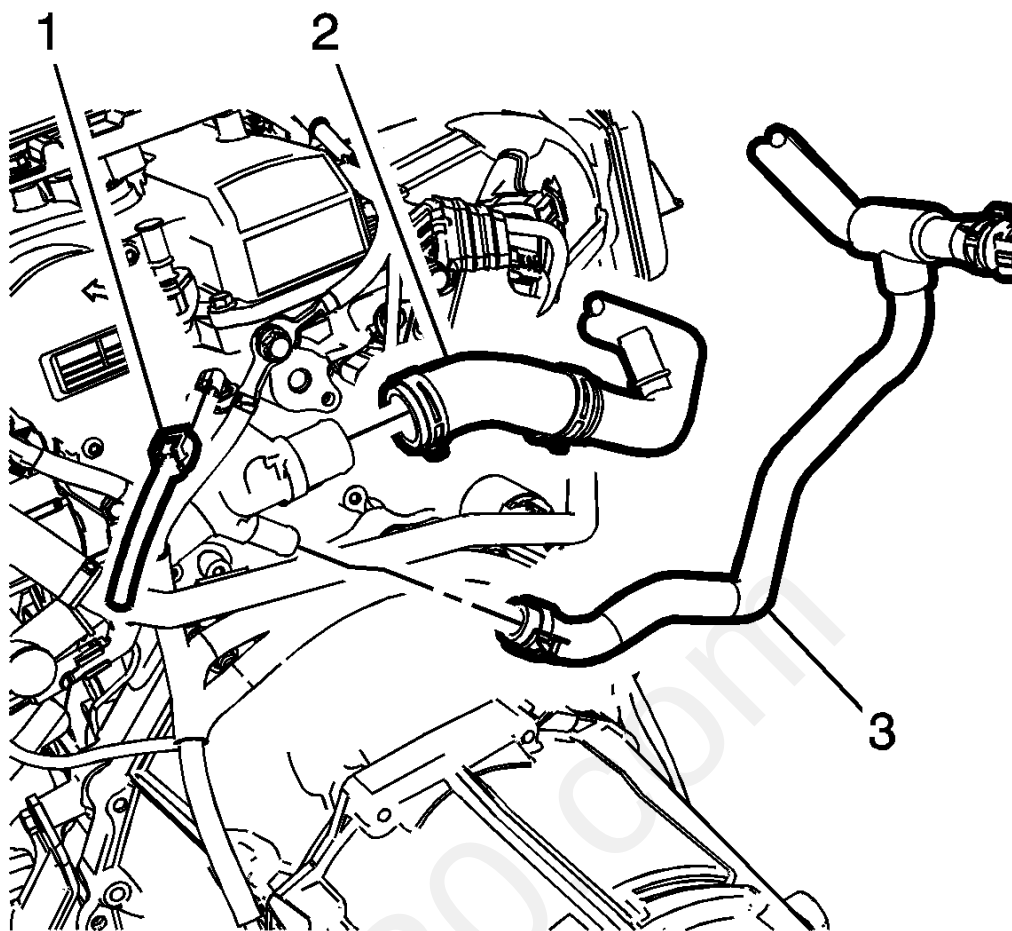


Fig. 167: Engine Coolant Temperature (ECT) Sensor

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the engine coolant temperature (ECT) sensor connector (1).
7. Remove the radiator inlet hose (2) and the heater outlet hose (3), from the water outlet.

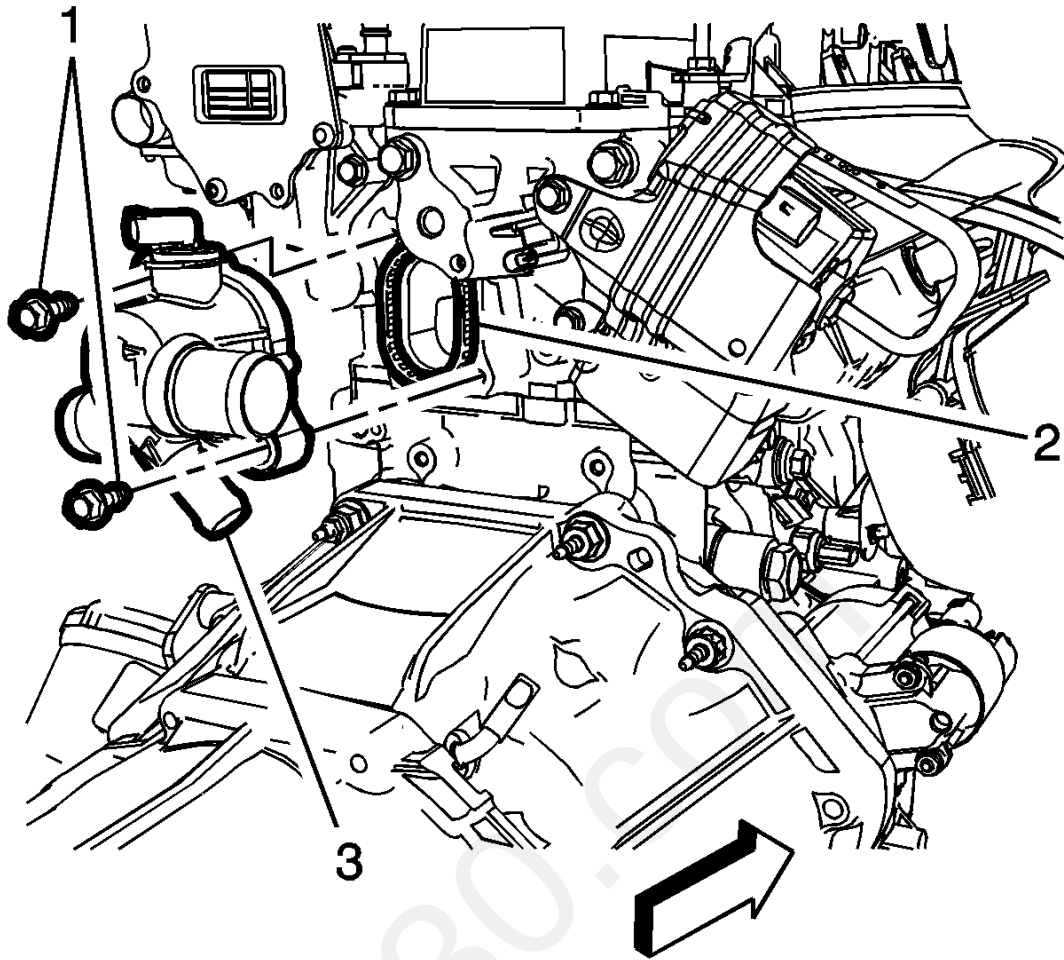


Fig. 168: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

8. Remove the water outlet fasteners (1) and remove the water outlet (3).
9. Discard the water outlet seal (2).

Installation Procedure

1. Clean the sealing surfaces.

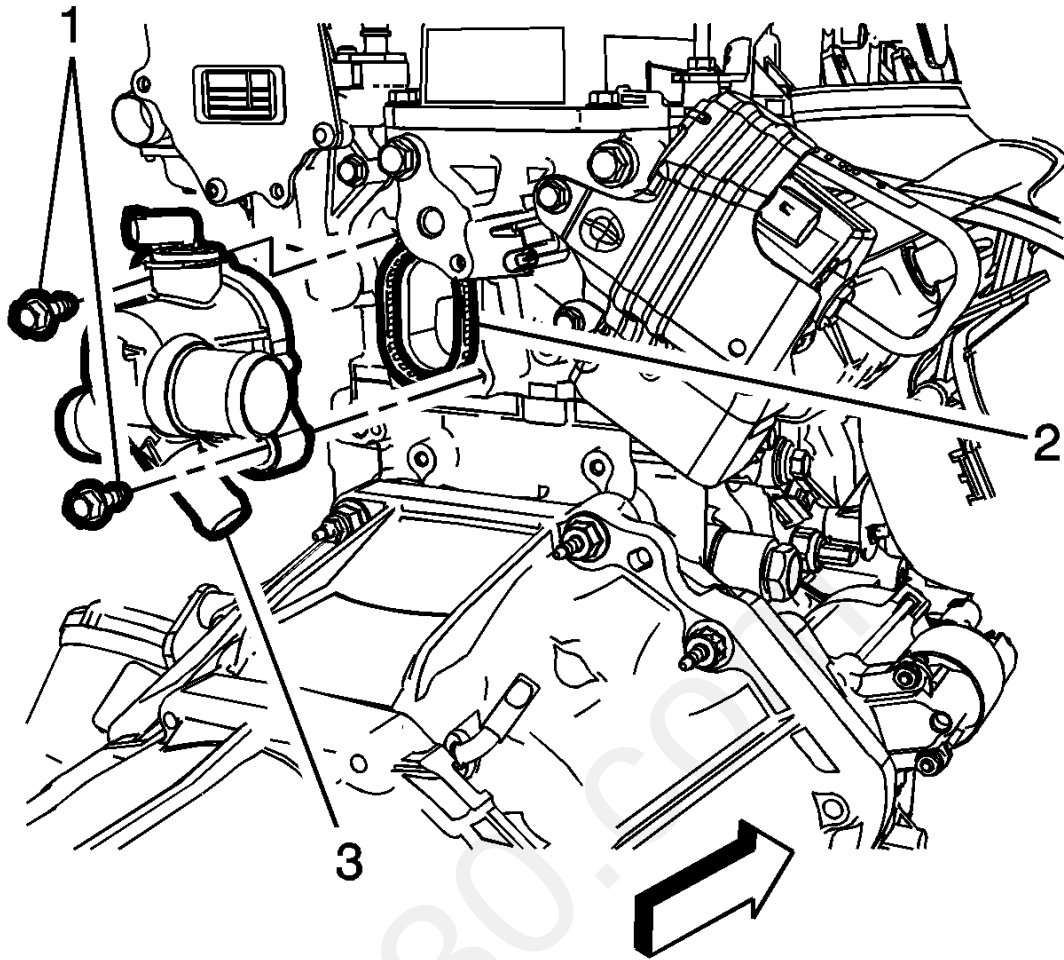


Fig. 169: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the water outlet (3) to the engine block with a NEW seal (2) and tighten the fasteners (1) to 12 N.m (106 lb in).

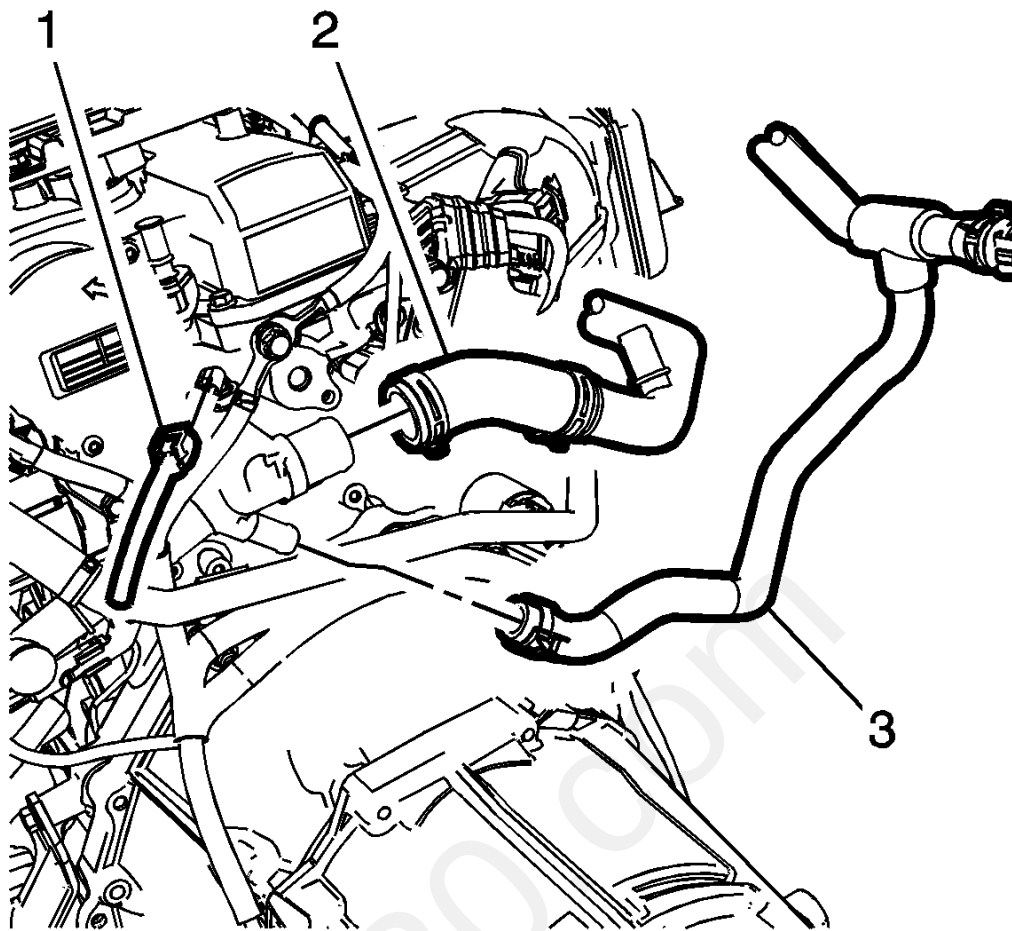


Fig. 170: Engine Coolant Temperature (ECT) Sensor

Courtesy of GENERAL MOTORS COMPANY

3. Install the heater outlet hose (3) and the radiator inlet hose (2) to the water outlet.
4. Connect the ECT sensor connector (1).

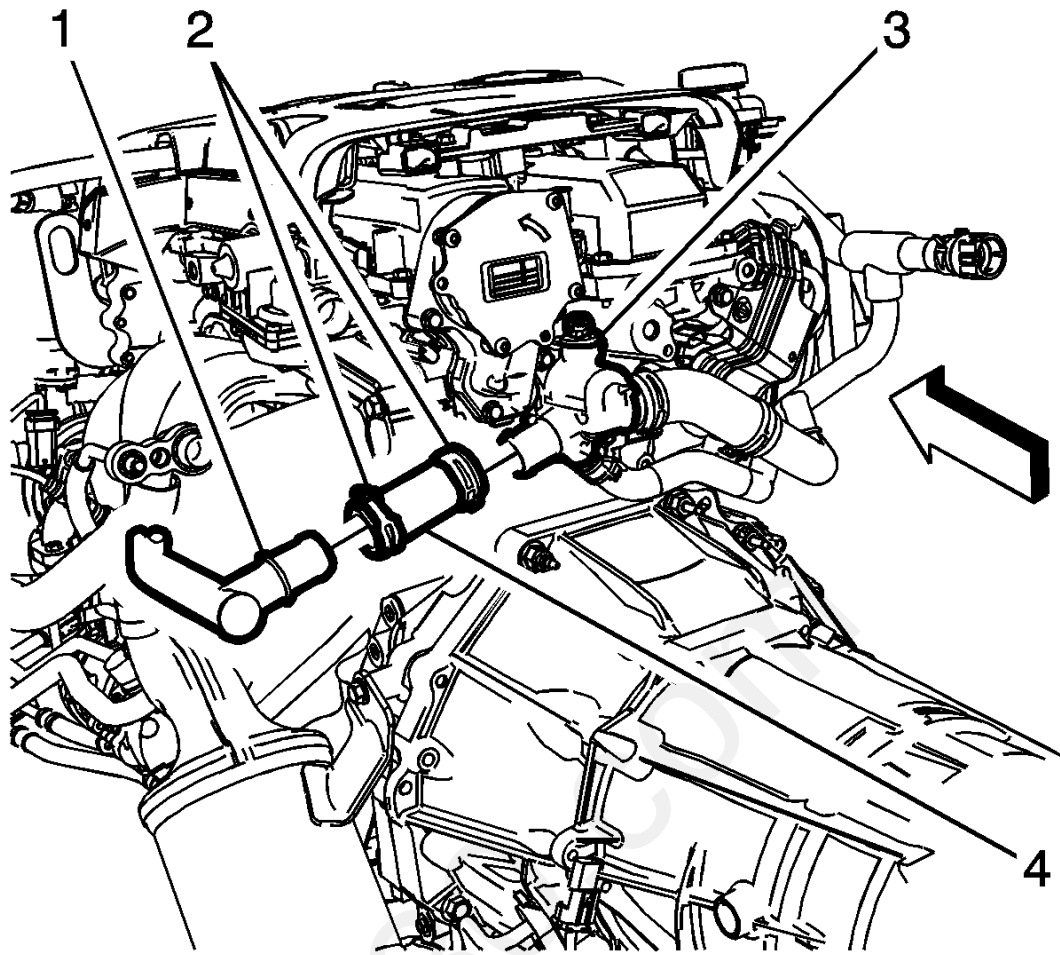


Fig. 171: Thermostat Bypass Hose

Courtesy of GENERAL MOTORS COMPANY

5. Install the thermostat bypass hose (2) to the water outlet (3)..
6. Install the thermostat bypass pipe using a NEW gasket.
7. Install the thermostat bypass pipe fasteners and tighten them to 10 N.m (89 lb in).
8. Install the plenum front panel. Refer to [Plenum Front Panel Replacement](#) .
9. Install the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#) .
10. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
11. Start the engine and check for coolant leaks.

THERMOSTAT BYPASS PIPE REPLACEMENT

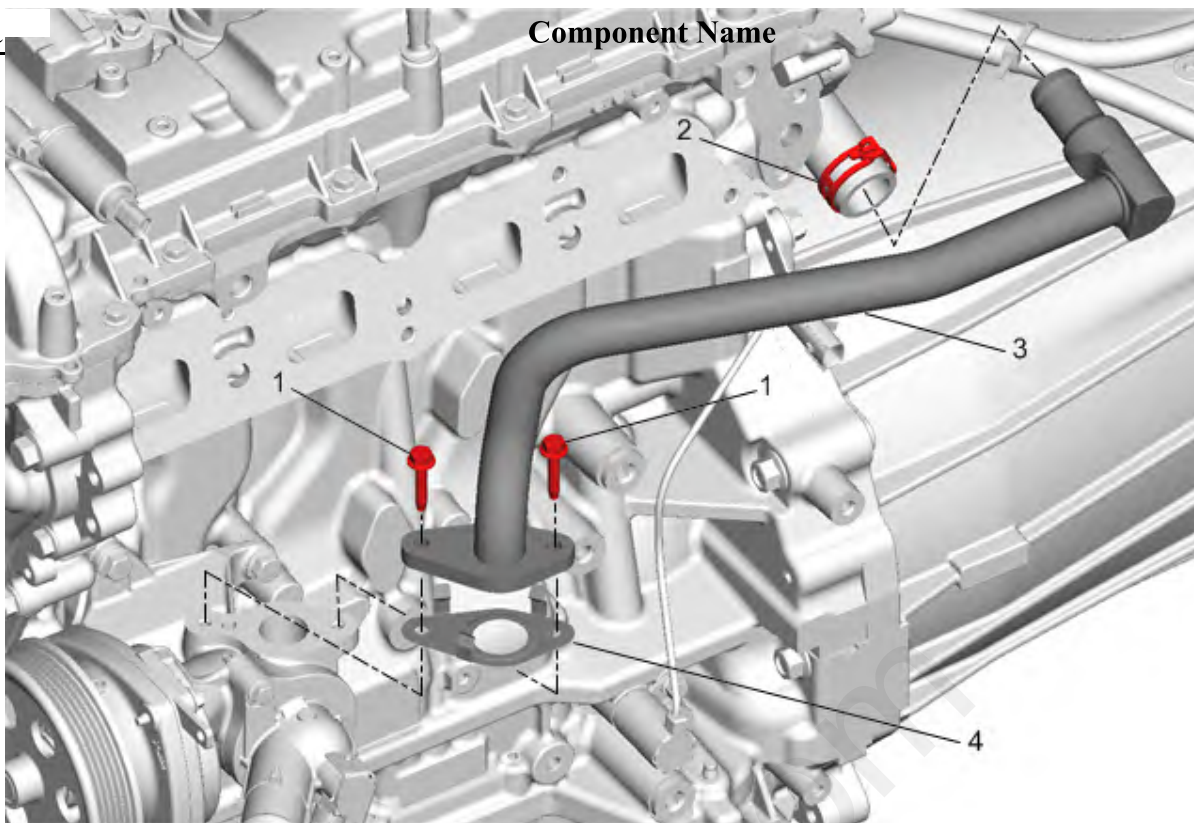


Fig. 172: Thermostat Bypass Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Remove the exhaust manifold. Refer to Exhaust Manifold Replacement (LCV) Exhaust Manifold Replacement (LWN) . 3. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement .	
Special Tools BO-38185 Hose Clamp PliersFor equivalent regional tools, refer to Special Tools .	
1	Thermostat Bypass Pipe Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten: 10 N.m (89 lb in)
2	Thermostat Bypass Pipe Hose Clamp Procedure Replace hose clamp if necessary.
3	Thermostat Bypass Pipe
4	Thermostat Bypass Pipe Gasket Procedure Install a NEW gasket.

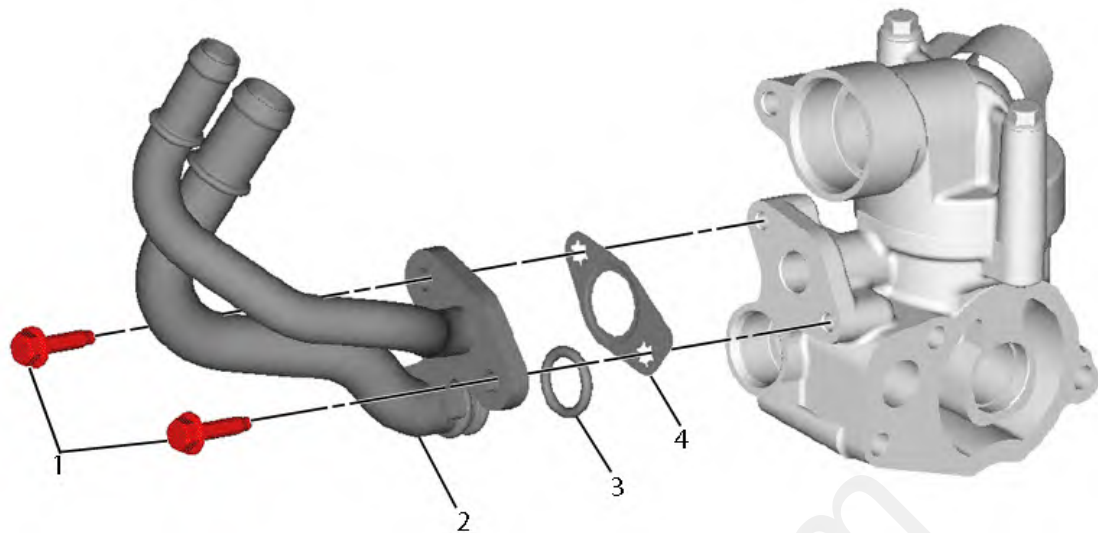


Fig. 173: Heater Inlet And Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Engine Rear Noise Shield Replacement Radiator Outlet Pipe Replacement Heater Inlet Hose Replacement (LFX) Heater Inlet Hose Replacement (LCV) Heater Inlet Hose Replacement (Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN) Heater Inlet Hose Replacement (Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN) - Remove the heater outlet hose - heater outlet hose tee to heater outlet pipe. Refer to Heater Outlet Hose Replacement (Radiator Surge Tank to Outlet Heater Hose Tee) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Core Tube LFX) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Outlet Pipe LFX) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Core Tube LCV) Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Water Outlet LCV) Heater Outlet Hose Replacement (Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN) Heater Outlet Hose Replacement (Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN) .	

Current	Component Name
1	Heater Inlet and Outlet Pipe Fasteners (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Heater Inlet and Outlet Pipe
3	Heater Inlet and Outlet Pipe Seal NOTE: Replace with a NEW seal.
4	Heater Inlet and Outlet Pipe Gasket NOTE: Replace with a NEW gasket.

WATER PUMP REPLACEMENT (LFX)

Special Tools

EN 46104 Water Pump Pulley Holder

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

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove Air Cleaner Outlet Duct. [Air Cleaner Outlet Duct Replacement](#)
3. Remove the drive belt. Refer to [Drive Belt Replacement](#) .

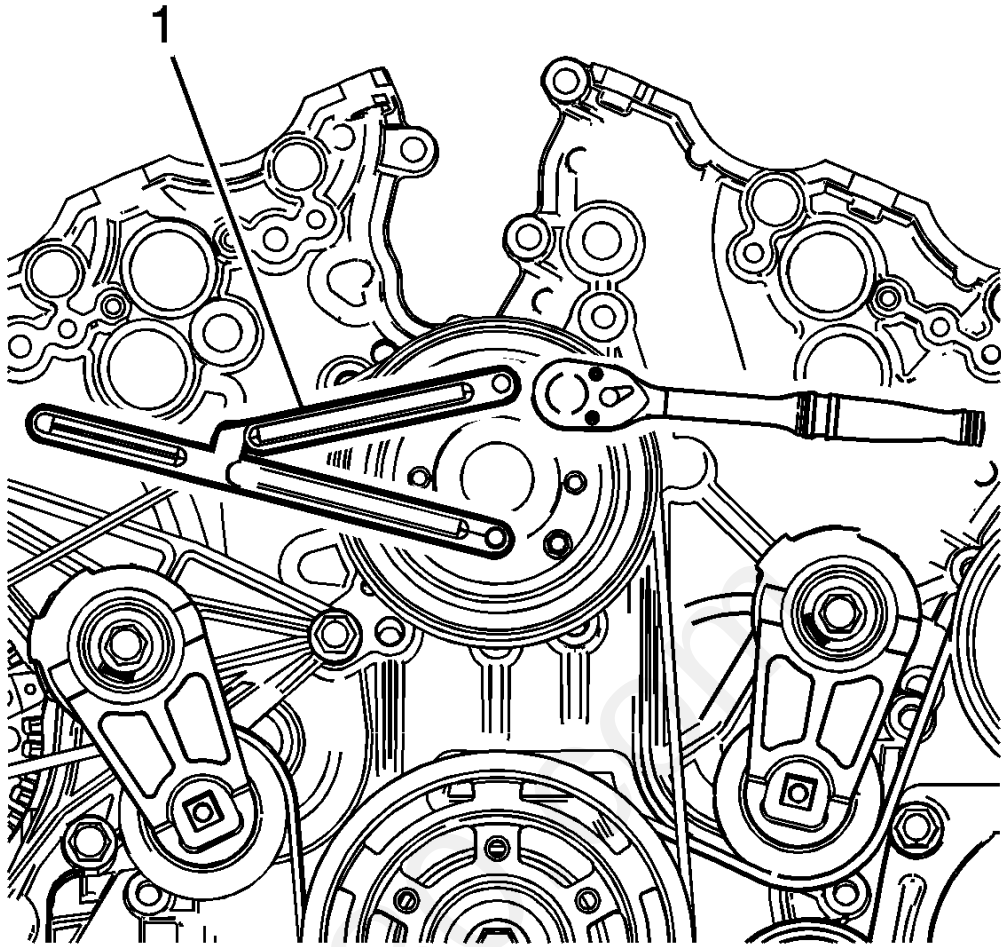


Fig. 174: Securing Water Pump Pulley With EN 46104

Courtesy of GENERAL MOTORS COMPANY

4. Use the **EN 46104** water pump pulley holder (1) to retain the pulley.

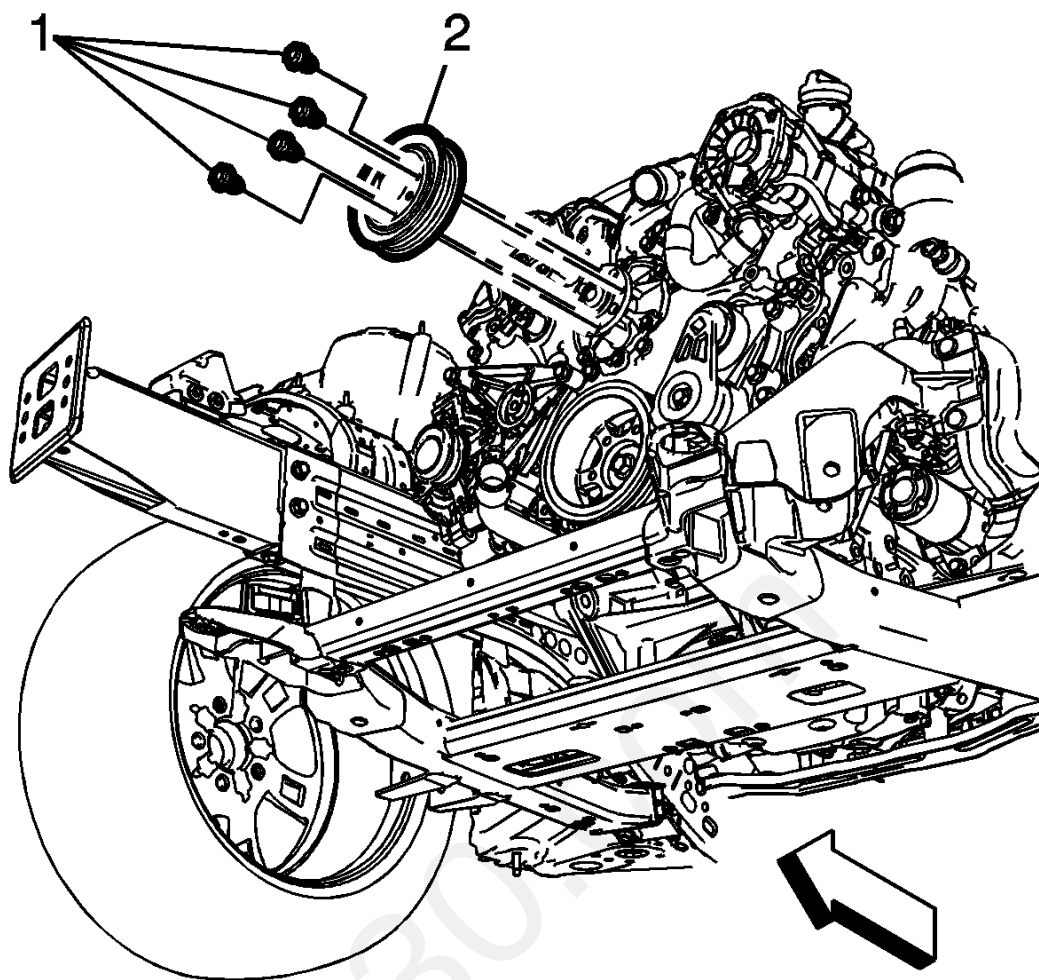


Fig. 175: Water Pump Pulley

Courtesy of GENERAL MOTORS COMPANY

5. Remove the water pump pulley fasteners (1).
6. Remove the water pump pulley (2).

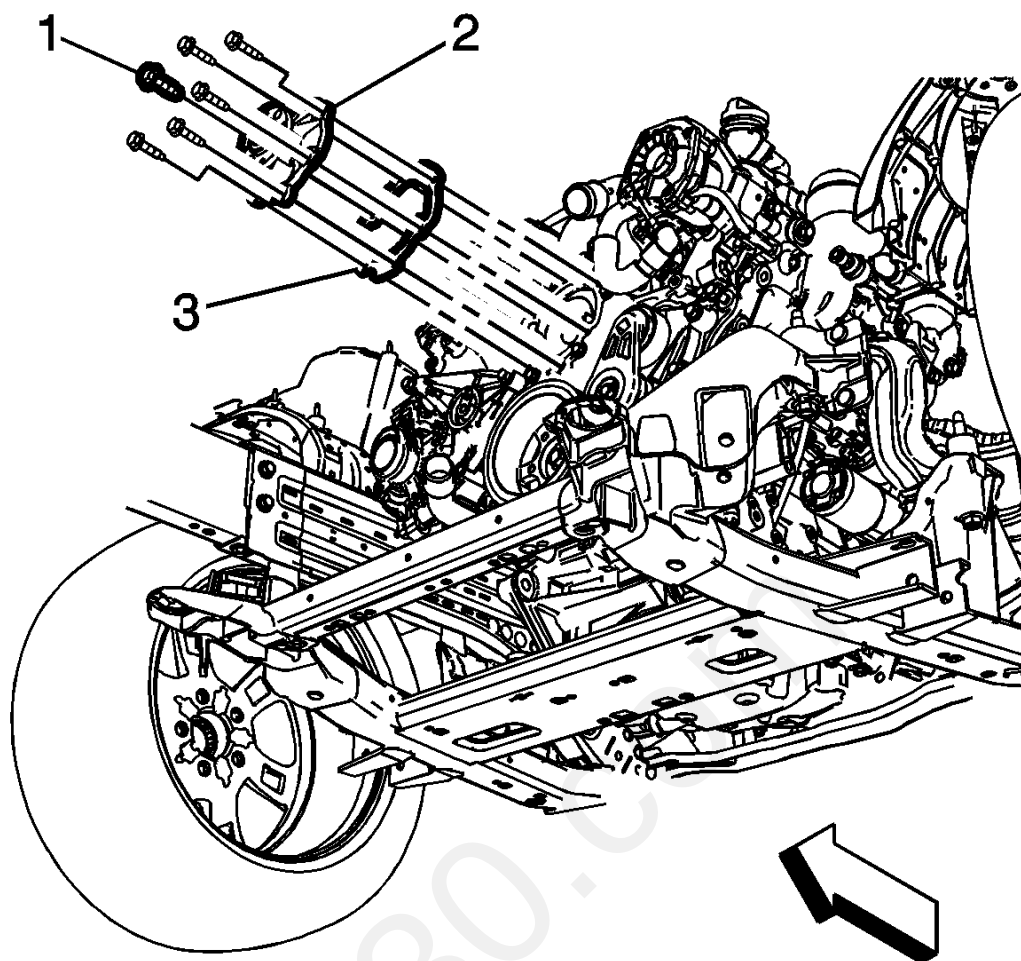


Fig. 176: Water Pump

Courtesy of GENERAL MOTORS COMPANY

7. Remove the water pump fasteners (1) and DISCARD the fasteners.
8. Remove the water pump (2) and discard the water pump gasket (3).
9. Carefully clean the water pump sealing surfaces.

Installation Procedure

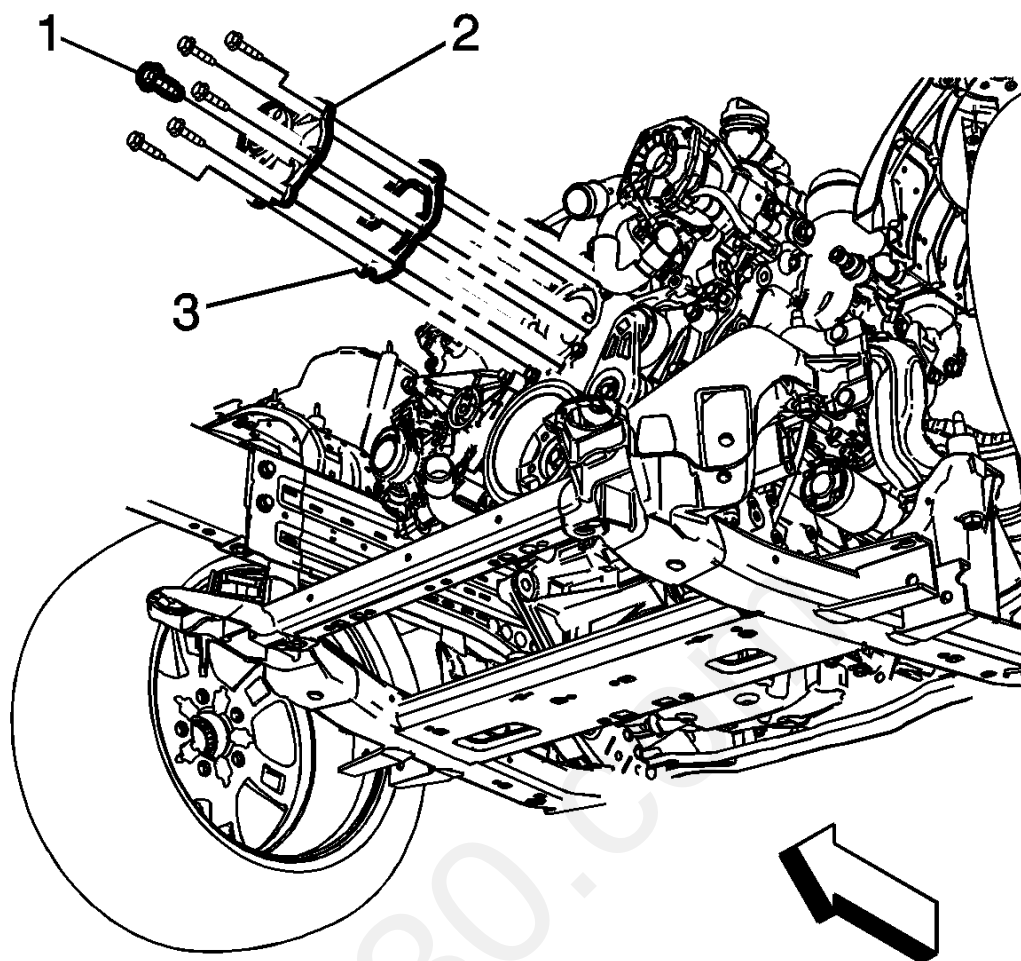


Fig. 177: Water Pump

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW water pump gasket (3).
2. Install the water pump and hand tighten the water pump fasteners (1).

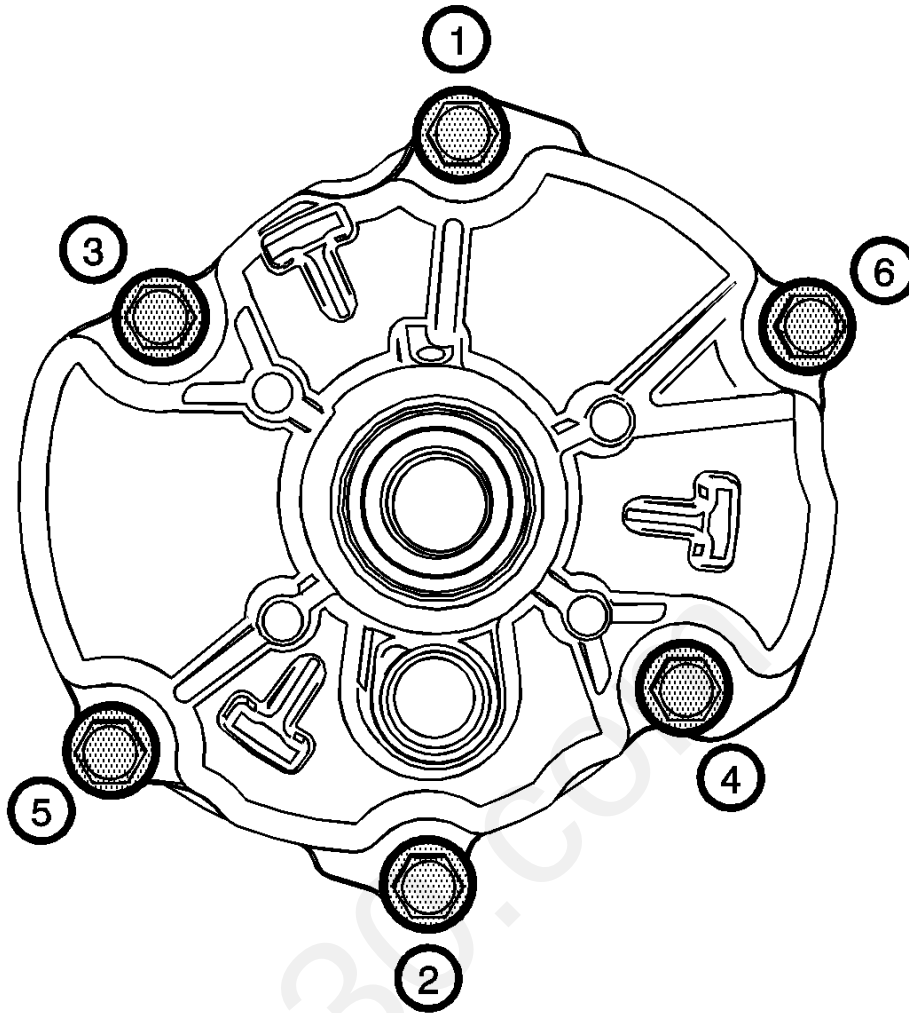


Fig. 178: Water Pump Bolts Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

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** .

3. Tighten the water pump fasteners in the sequence.
 1. On the initial pass, tighten the fasteners in sequence to 10 N.m (89 lb in).
 2. On the second pass, tighten the fasteners in sequence to 10 N.m (89 lb in).
 3. On the final pass, tighten the fasteners in sequence shown an additional 45 degrees.

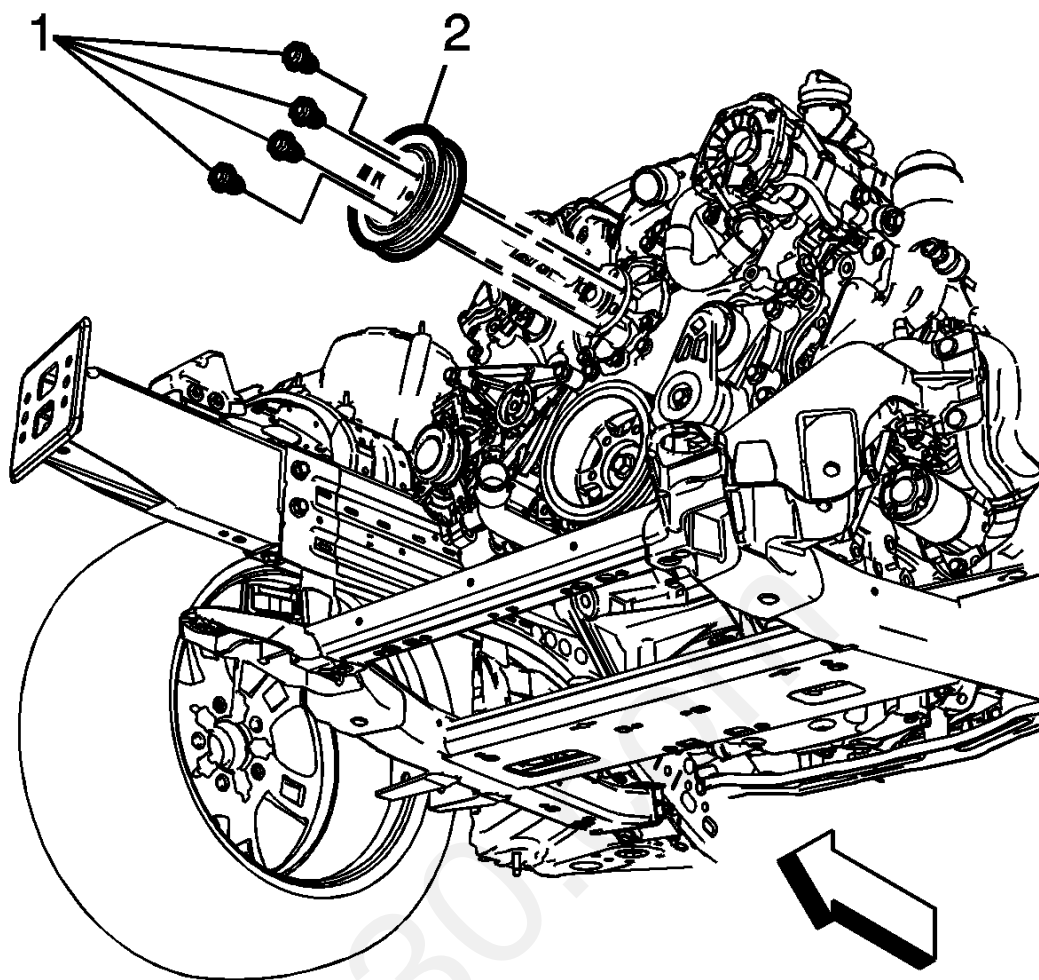


Fig. 179: Water Pump Pulley

Courtesy of GENERAL MOTORS COMPANY

4. Install the water pump pulley (2) and hand tighten the water pump pulley fasteners (1).

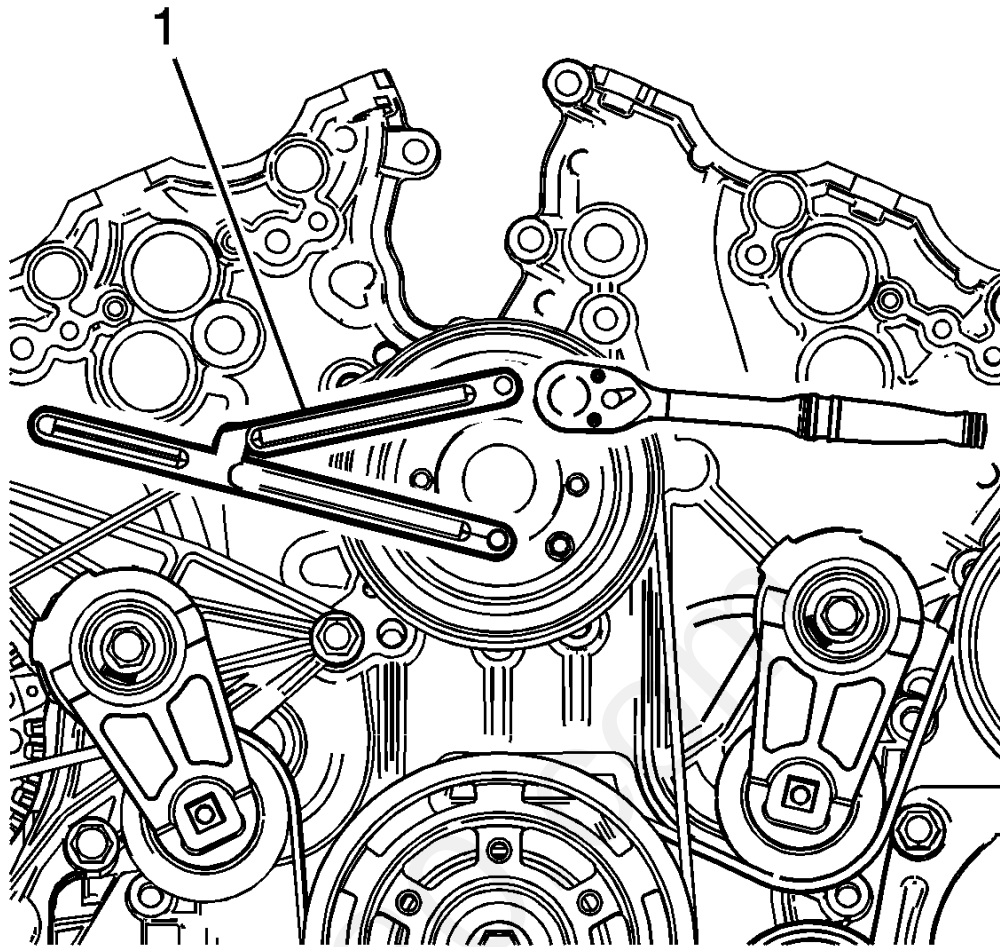


Fig. 180: Securing Water Pump Pulley With EN 46104

Courtesy of GENERAL MOTORS COMPANY

5. Use the **EN 46104** water pump pulley holder (1) to hold the pulley.
6. Tighten the water pump pulley fasteners to 12 N.m (108 lb in).
7. Install the drive belt. Refer to [Drive Belt Replacement](#) .
8. Install Air Cleaner Outlet Duct. [Air Cleaner Outlet Duct Replacement](#)
9. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).

WATER PUMP REPLACEMENT (LCV)

Special Tools

BO-38185 Hose Clamp Pliers

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

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the drive belt. Refer to [Drive Belt Replacement](#) .

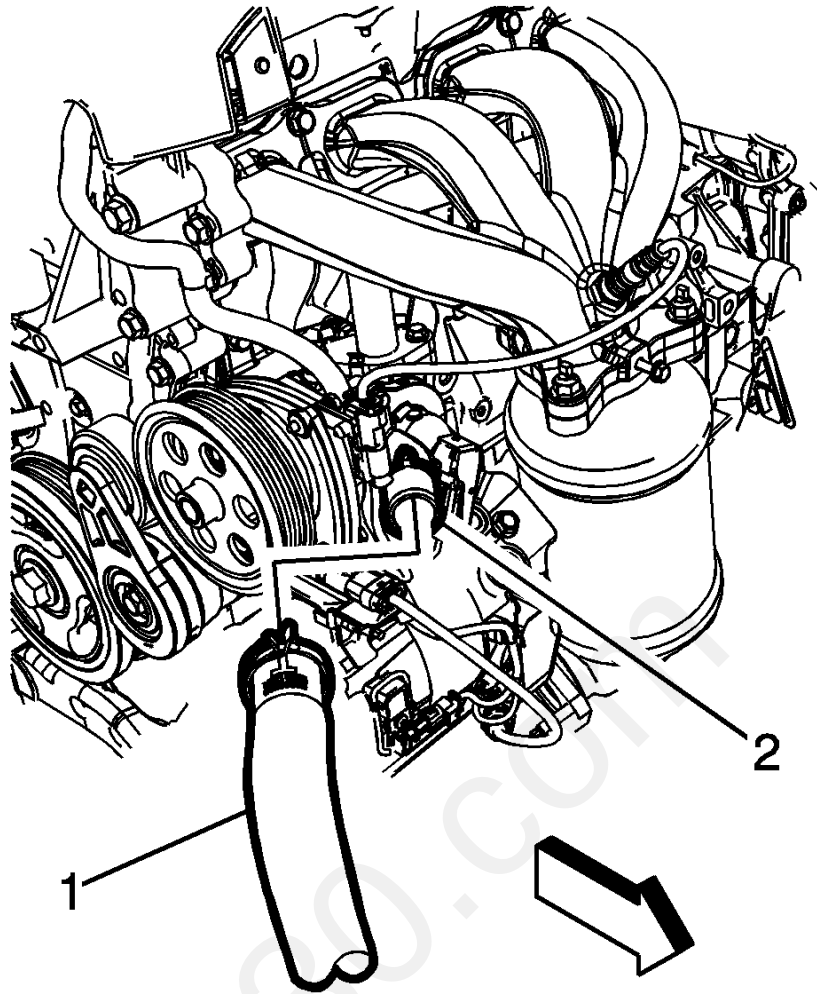


Fig. 181: Radiator Outlet Hose And Water Outlet

Courtesy of GENERAL MOTORS COMPANY

3. Using the BO-38185 hose clamp pliers, remove the radiator outlet hose (1) from the water outlet (2).
4. Remove the exhaust manifold heat shield. Refer to [**Exhaust Manifold Heat Shield Replacement \(LCV\)**](#).

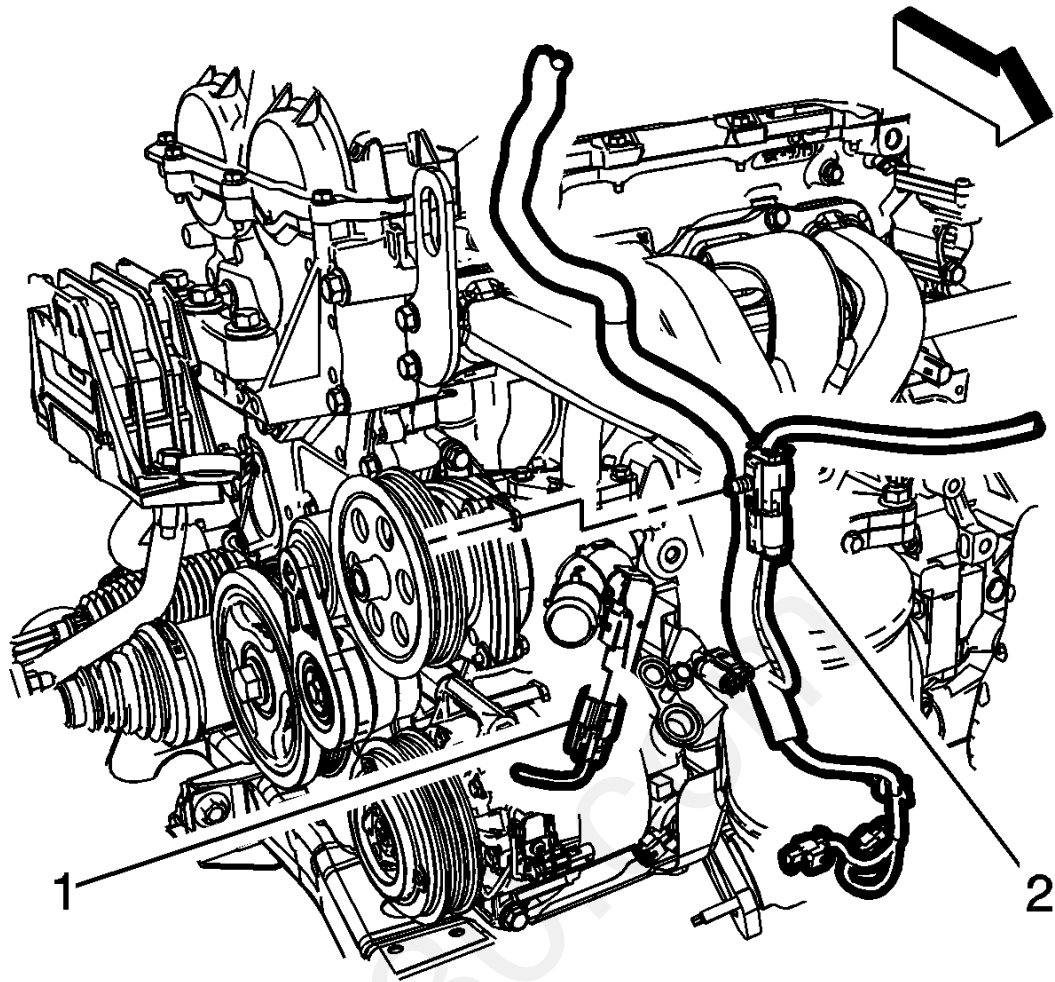


Fig. 182: Thermostat Housing Connector

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the thermostat housing connector (1) and remove the engine harness retainer (2) from the water pump.

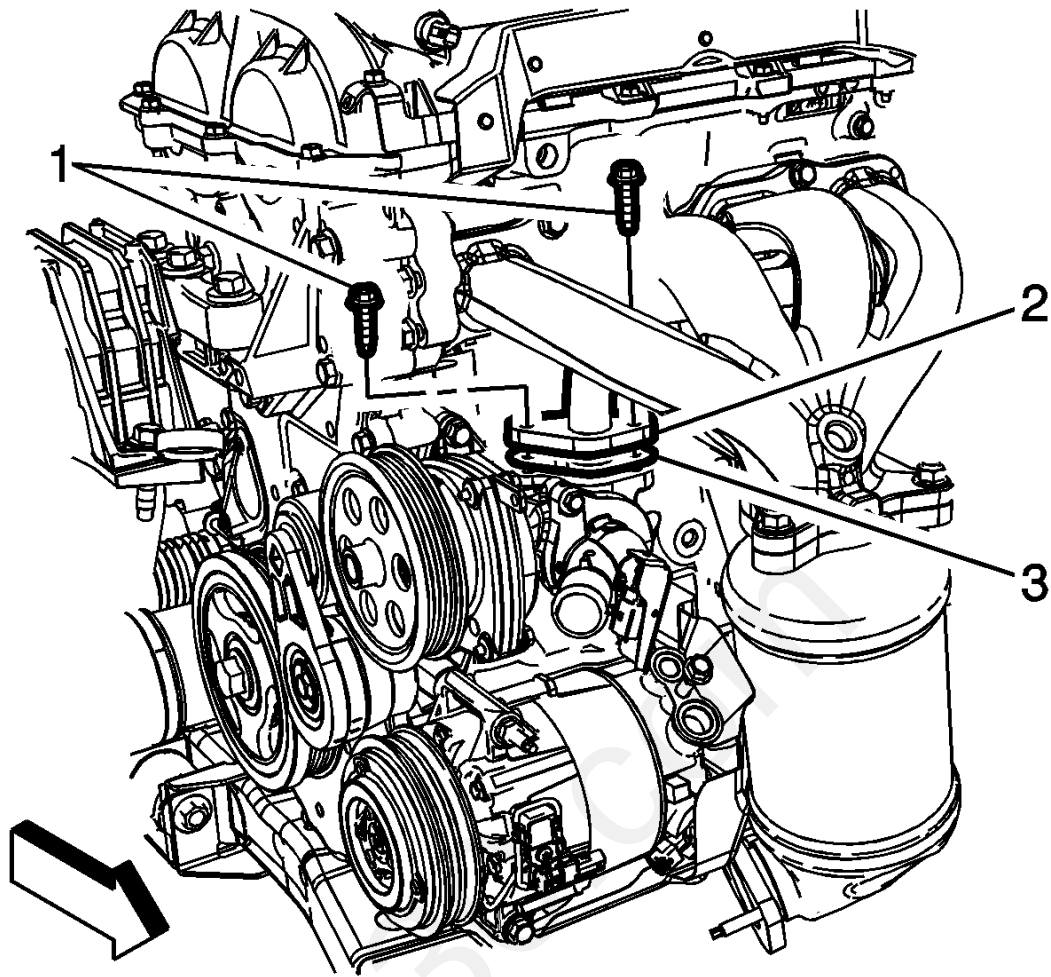


Fig. 183: Thermostat Bypass Pipe Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Remove the thermostat bypass pipe fasteners (1) and remove the thermostat bypass pipe (2) from the water pump.
7. Discard the thermostat bypass pipe gasket (3).

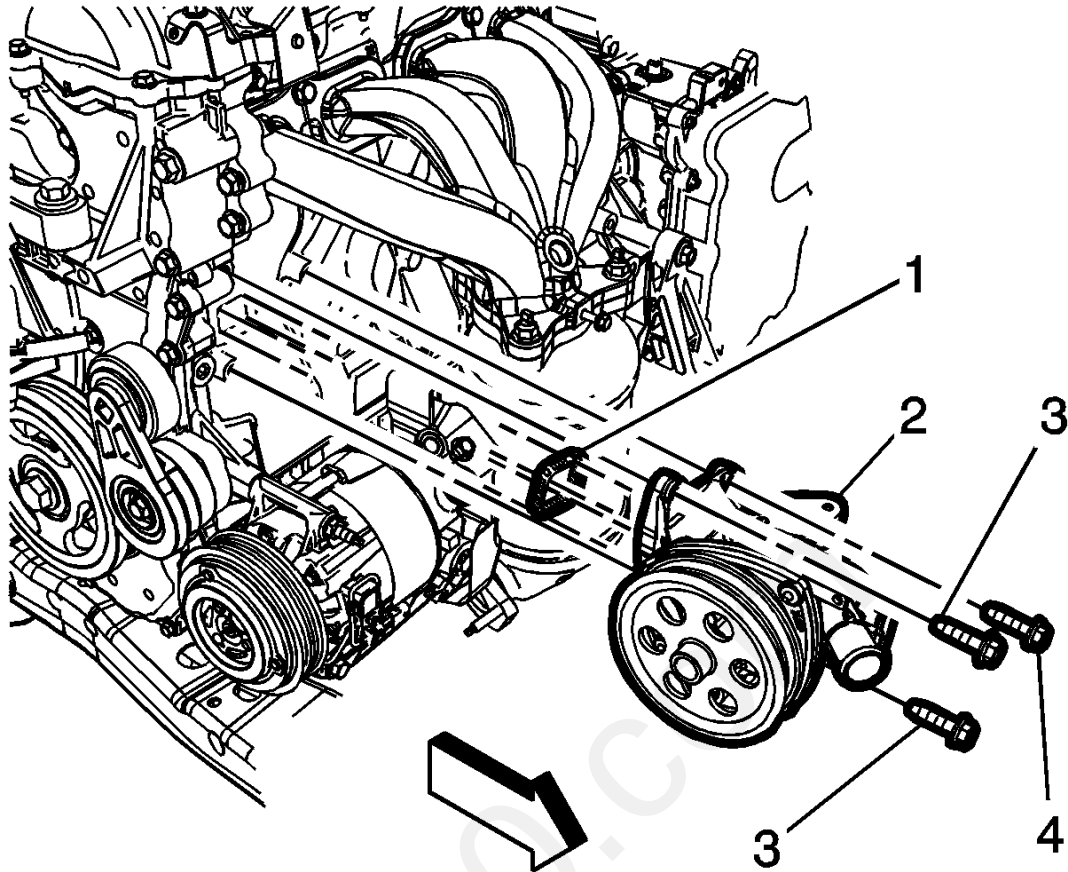


Fig. 184: Water Pump Fasteners

Courtesy of GENERAL MOTORS COMPANY

8. Remove the water pump fasteners (3) and remove the water pump (2).
9. Discard the water pump seal (1).

Installation Procedure

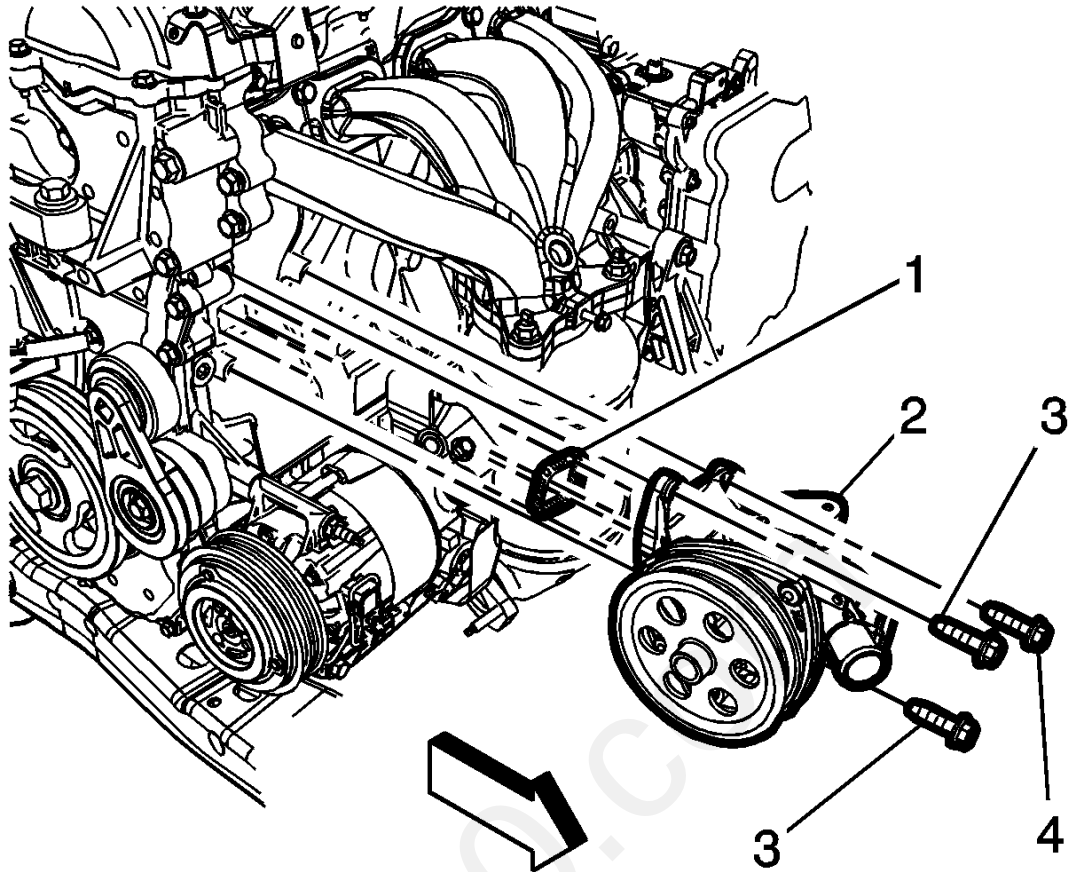


Fig. 185: Water Pump Fasteners

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

1. Install the water pump (2) into position with a NEW water pump seal (1) and tighten the fasteners (3) to 25 N.m (18 lb ft).

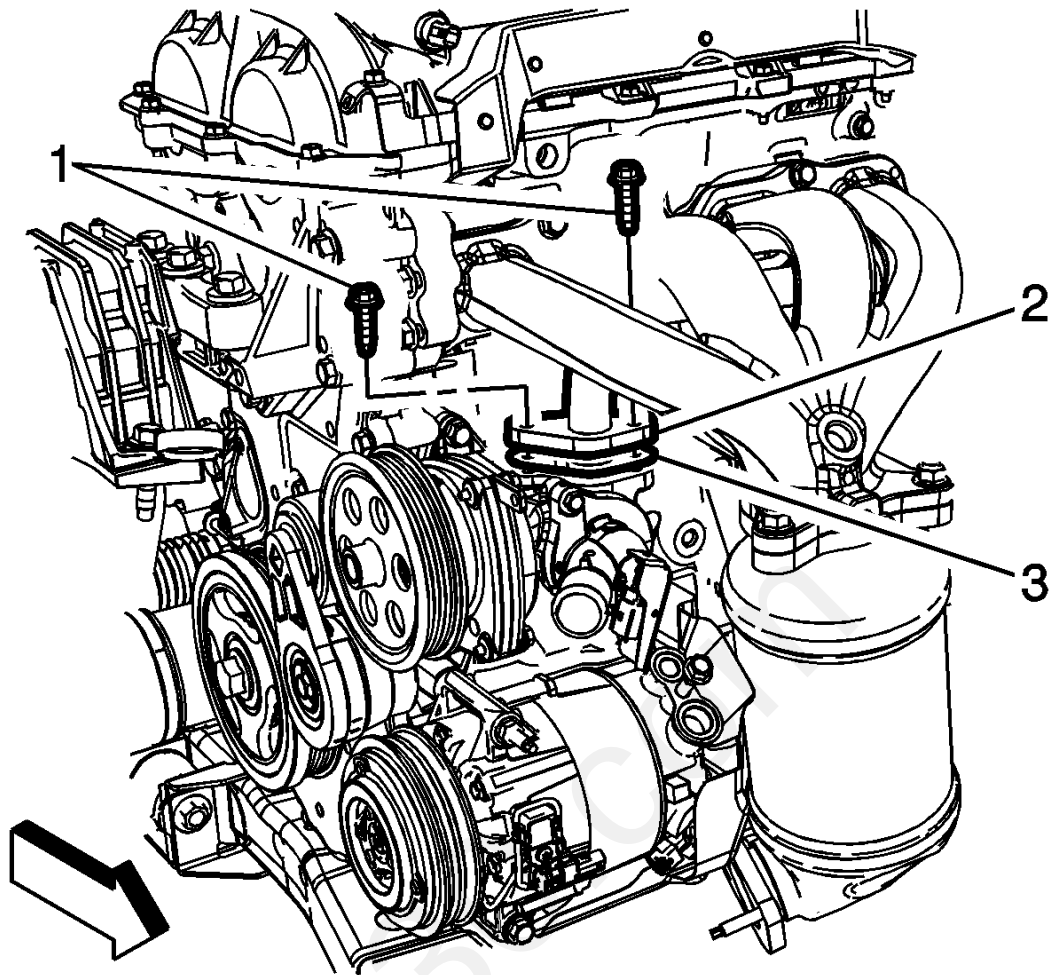


Fig. 186: Thermostat Bypass Pipe Fasteners

Courtesy of GENERAL MOTORS COMPANY

2. Install the thermostat bypass pipe (2) to the water pump with a NEW gasket (3) and tighten the fasteners (1) to 10 N.m (89 lb in).

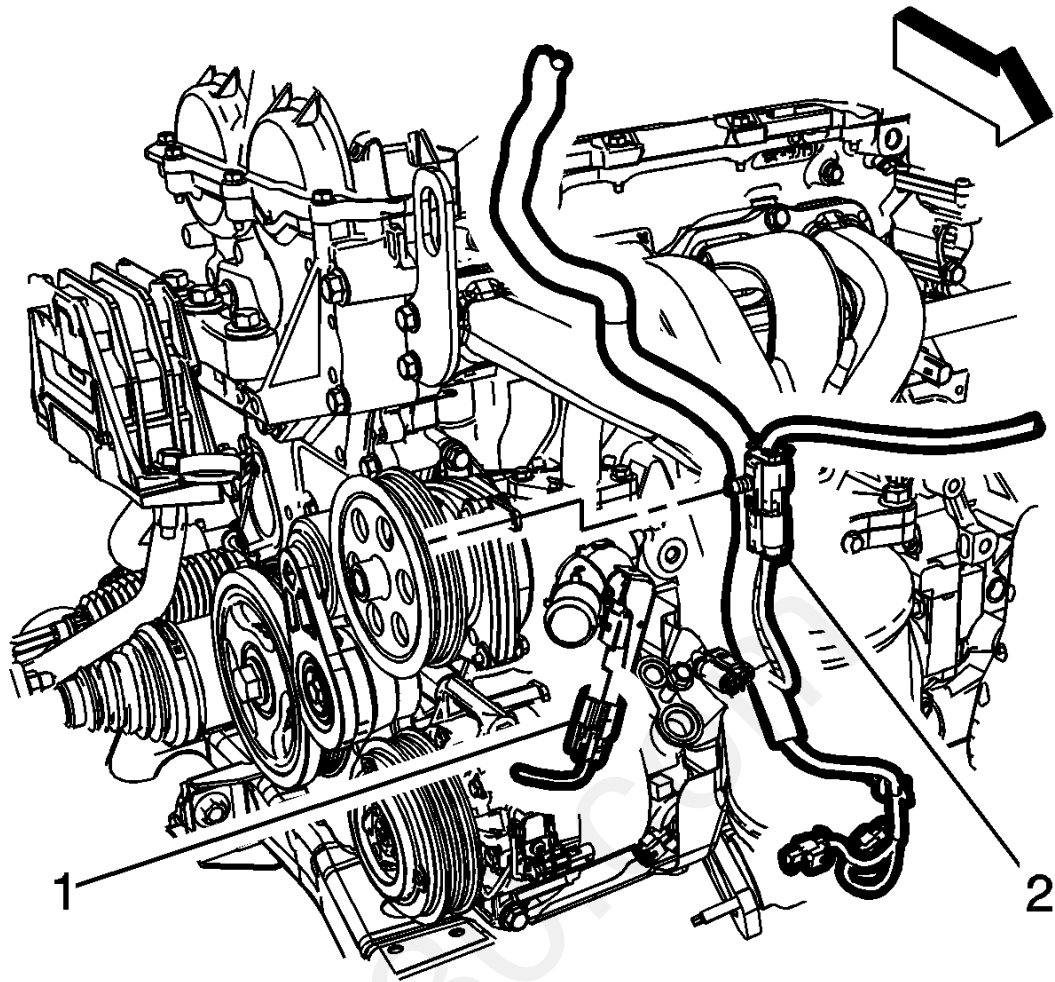


Fig. 187: Thermostat Housing Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect the connector (1) to the water outlet.
4. Install the exhaust manifold heat shield. Refer to [Exhaust Manifold Heat Shield Replacement \(LCV\)](#).
5. Install the engine wiring harness retainer (2) to the water pump.

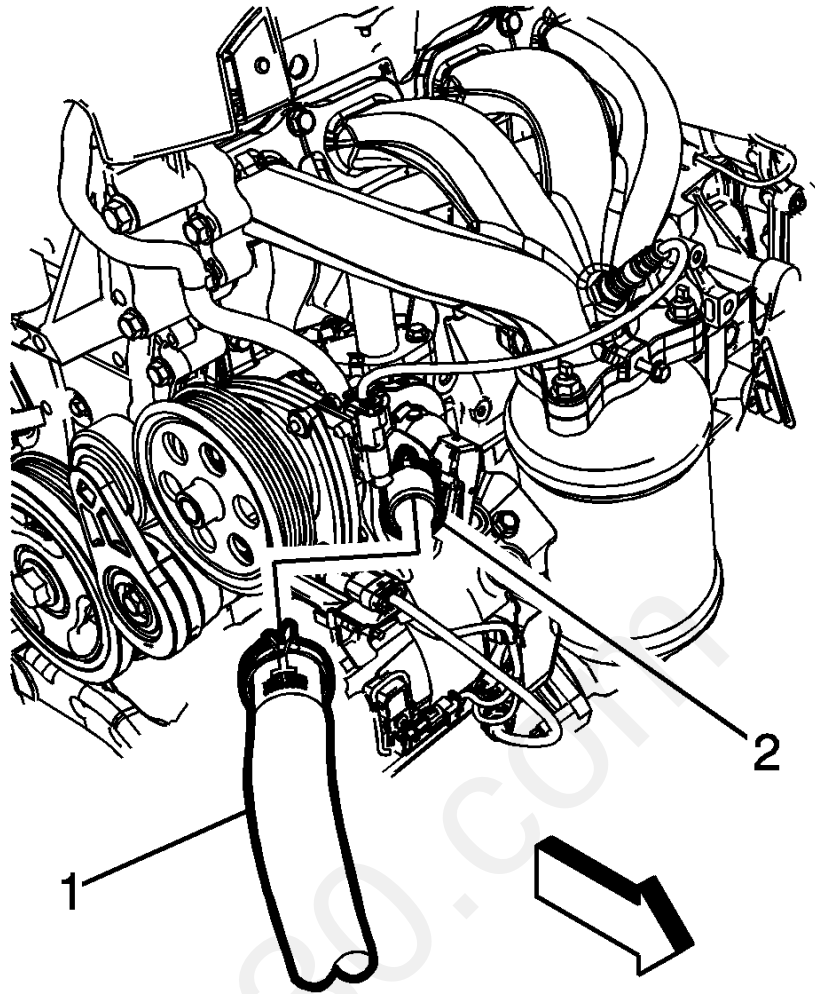


Fig. 188: Radiator Outlet Hose And Water Outlet
Courtesy of GENERAL MOTORS COMPANY

6. Using the BO-38185 hose clamp pliers, install the radiator outlet hose (1) to the water outlet (2).
7. Install the drive belt. Refer to [Drive Belt Replacement](#) .
8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
9. Start the engine and check for coolant leaks.

WATER PUMP REPLACEMENT (LWN)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
2. Remove Timing Belt Rear Cover. [Timing Belt Rear Cover Replacement](#)

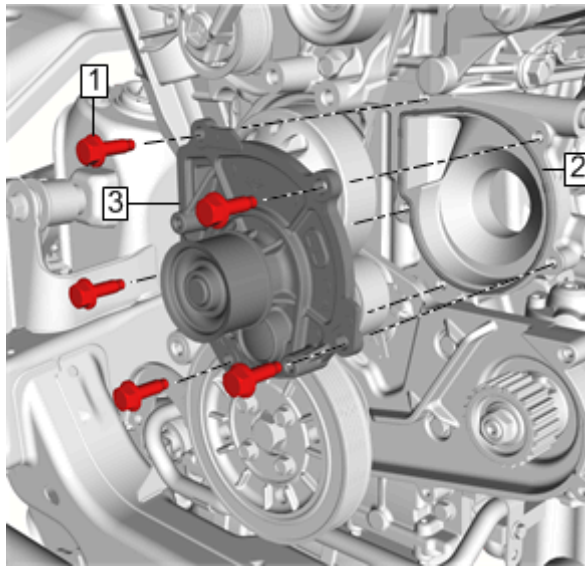


Fig. 189: Water Pump Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Remove Water Pump Bolt (1).
4. Remove Water Pump (3).
5. Remove Water Pump Seal (2) and DISCARD

Installation Procedure

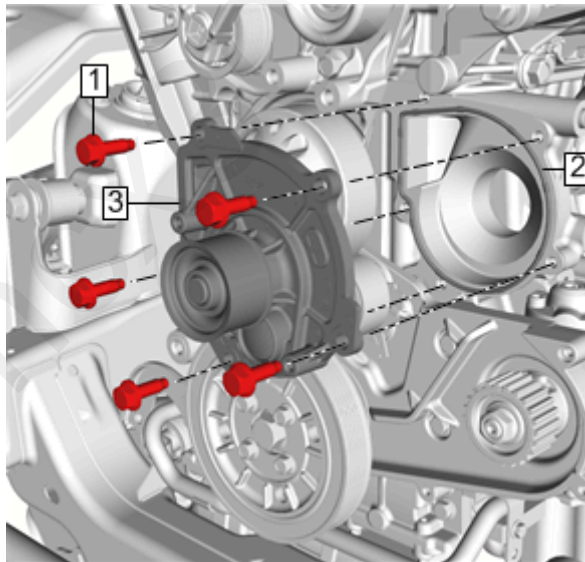


Fig. 190: Water Pump Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW seal.

1. Install Water Pump Seal (2)
2. Install Water Pump (3)

CAUTION: Refer to **Fastener Caution** .

3. Install Water Pump Bolt (1) and tighten 25 N.m (18 lb ft)

Callout	Timing Belt Rear Cover. Timing Belt Rear Cover Replacement	Component Name
5.	Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)	
6.	Start the engine and check for coolant leaks.	

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - RADIATOR (LCV)

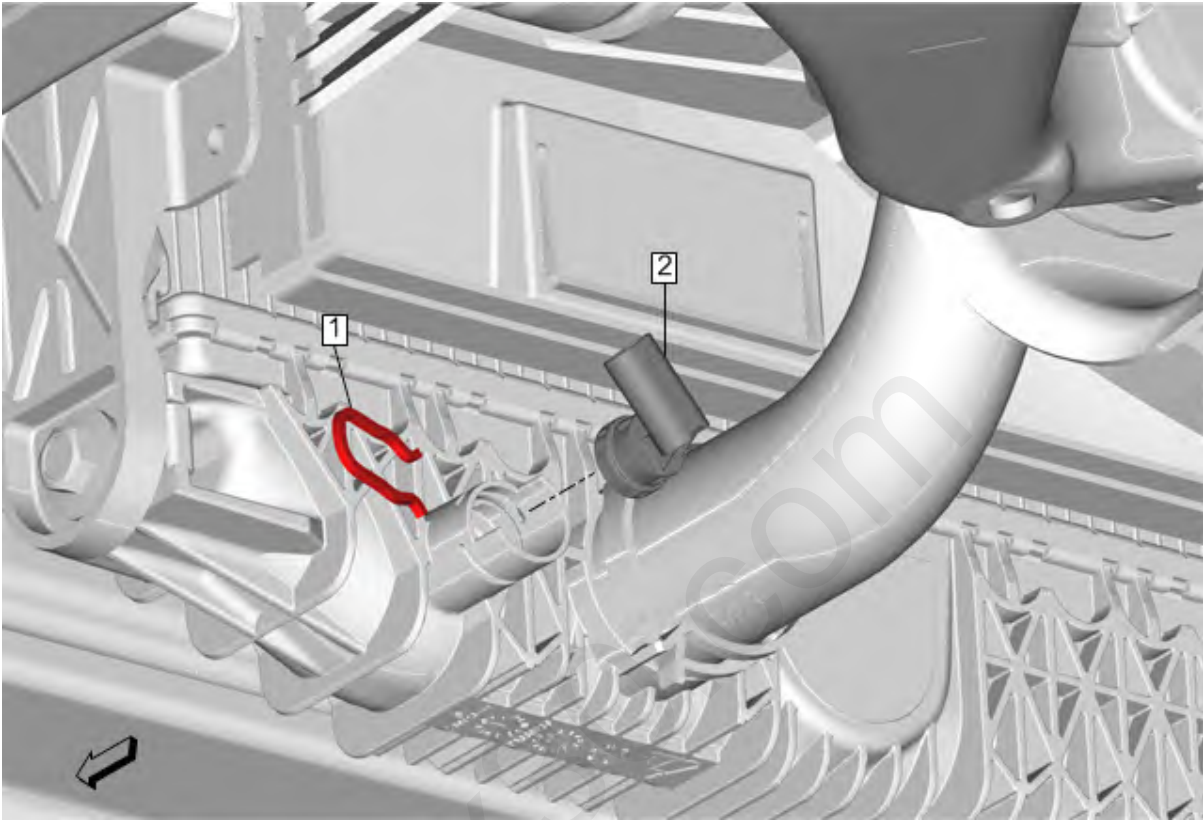


Fig. 191: Engine Coolant Temperature Sensor - Radiator (LCV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Disconnect the electrical connector from the engine coolant temperature sensor.	
1	Engine Coolant Temperature Sensor Retainer
2	Engine Coolant Temperature Sensor Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks. Cooling System Leak Testing.

RADIATOR DRAIN COCK REPLACEMENT (LFX)

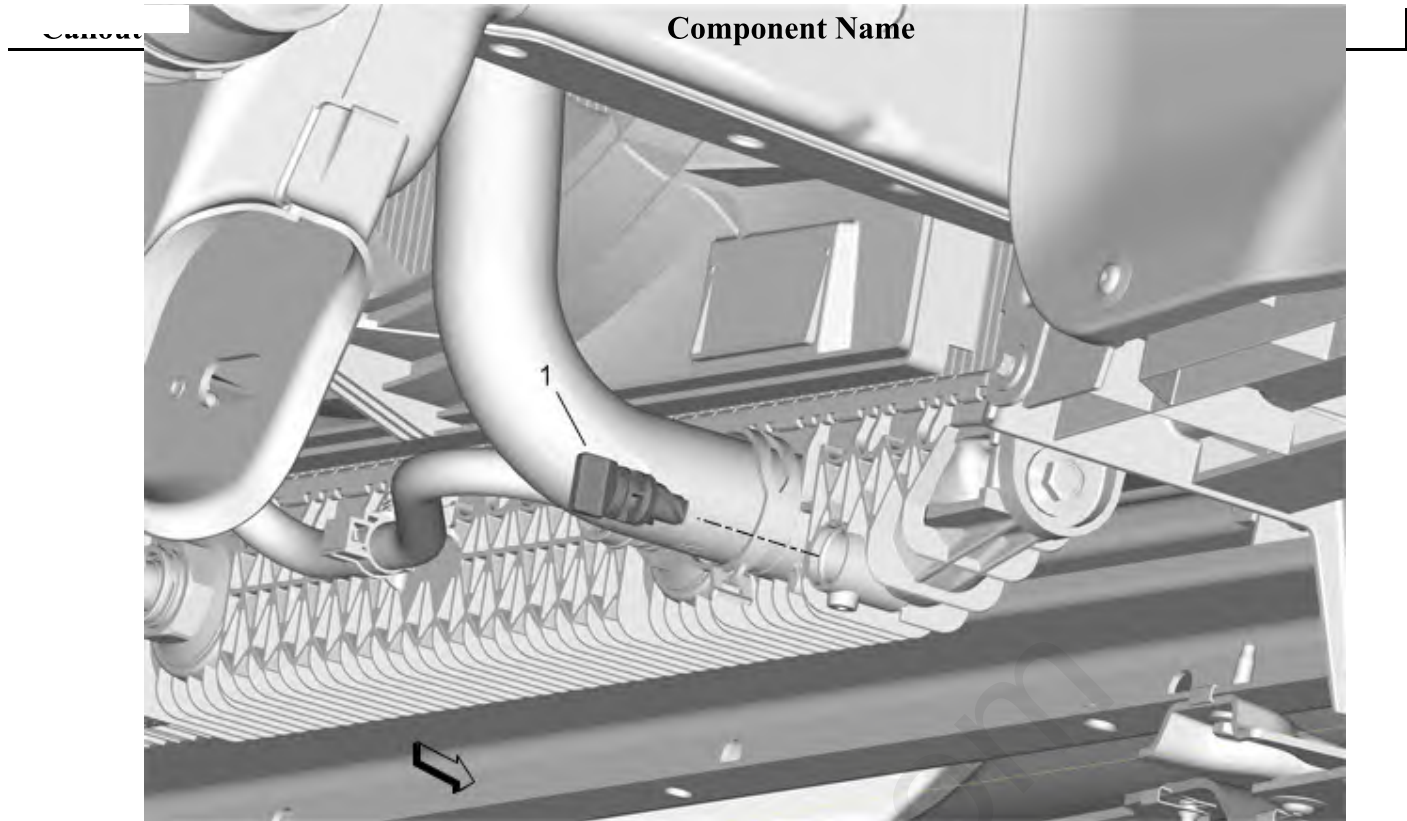


Fig. 192: Radiator Drain Cock (LFX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the underbody splash shield. Refer to Underbody Splash Shield Replacement . 3. Place a drain pan under the radiator drain cock.	
1	Radiator Drain Cock Procedures 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks.

RADIATOR DRAIN COCK REPLACEMENT (LCV, LWN)

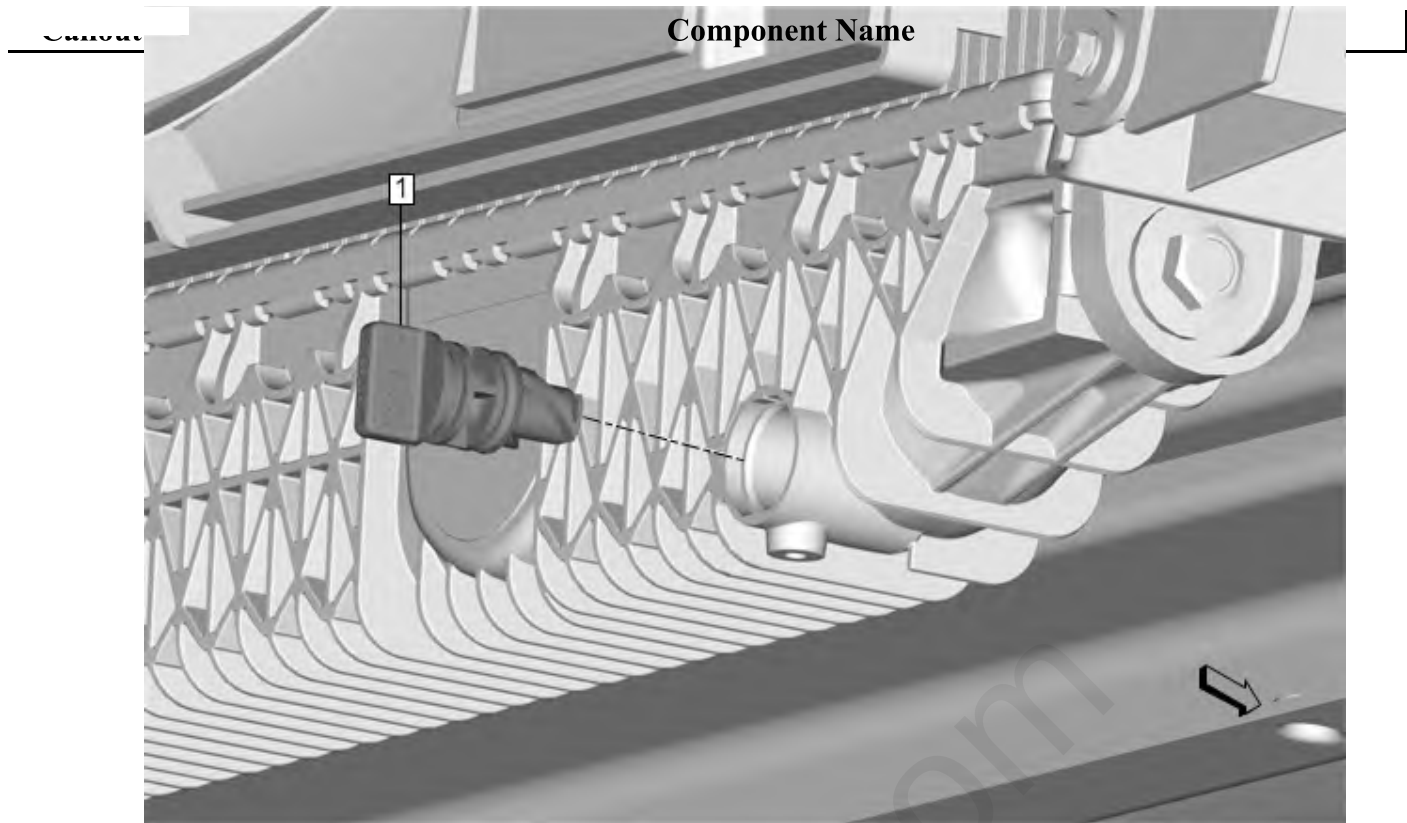


Fig. 193: Radiator Drain Cock (LCV, LWN)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Underbody Splash Shield Replacement 2. Drain the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)	
1	Radiator Drain Cock Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Check the cooling system for leaks. Cooling System Leak Testing.

ENGINE COOLANT FAN SHROUD REPLACEMENT (LFX)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).

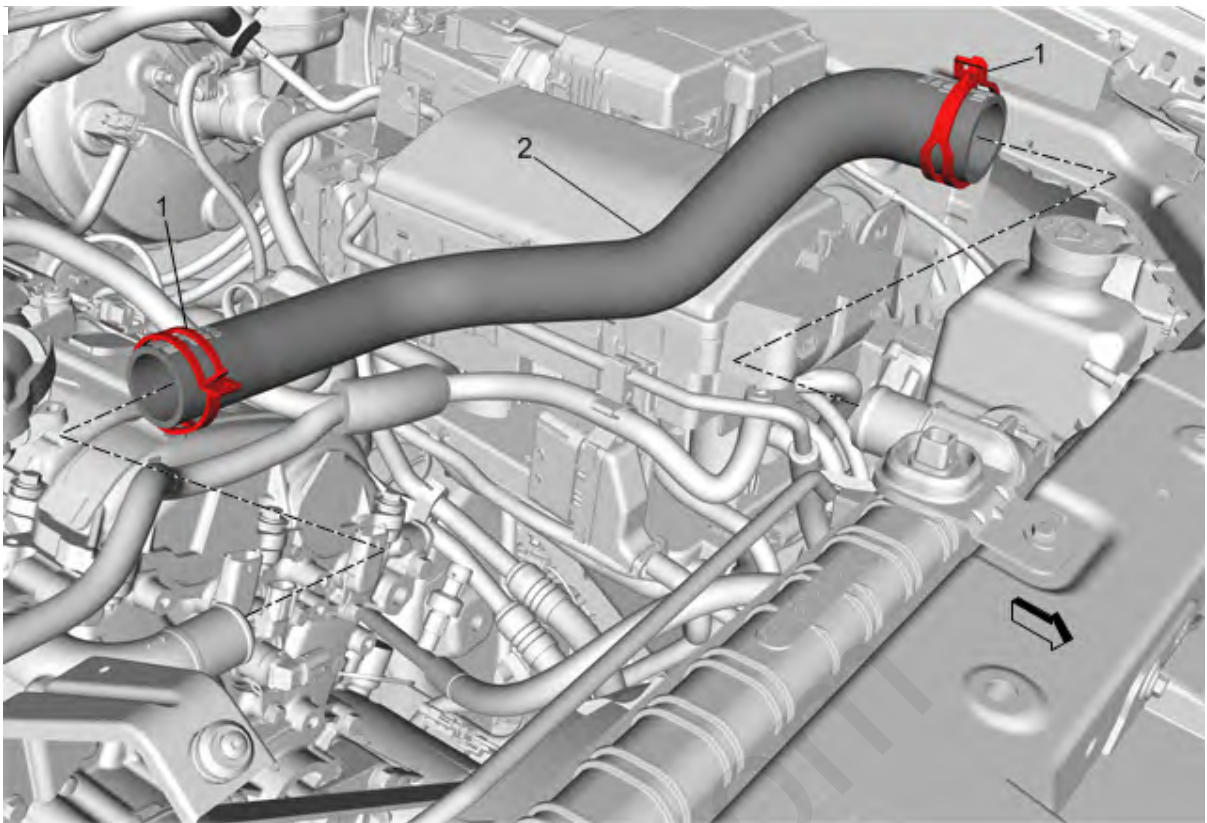


Fig. 194: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Remove the radiator inlet hose (2) from the radiator. Refer to [Radiator Inlet Hose Replacement \(LFX\)](#).

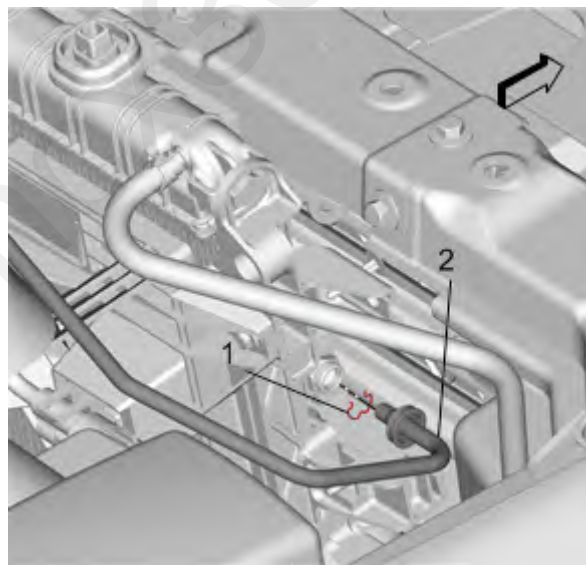


Fig. 195: Transmission Fluid Cooler Inlet And Outlet Pipe Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

3. Remove the transmission fluid inlet and outlet pipe (2) from the air conditioning condenser/multi-cooler and unclip from the engine cooling fan shroud. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LFX\)](#).
4. Disconnect the electrical connector.

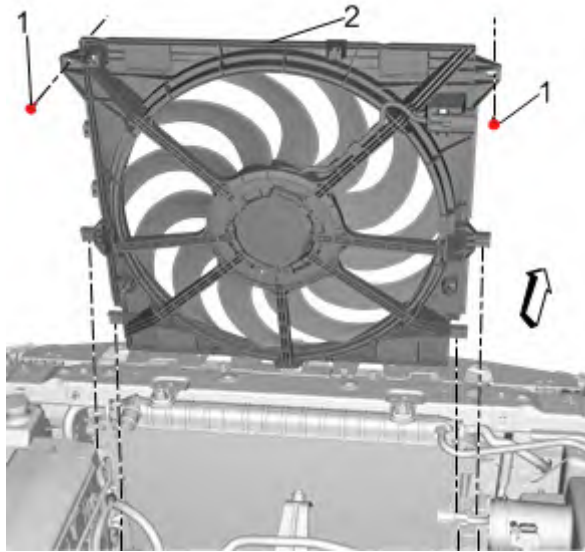


Fig. 196: Engine Coolant Fan Shroud Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the engine coolant fan shroud bolts (1) from the radiator.
6. Remove the engine coolant fan shroud and fan blade as an assembly (2) from the radiator

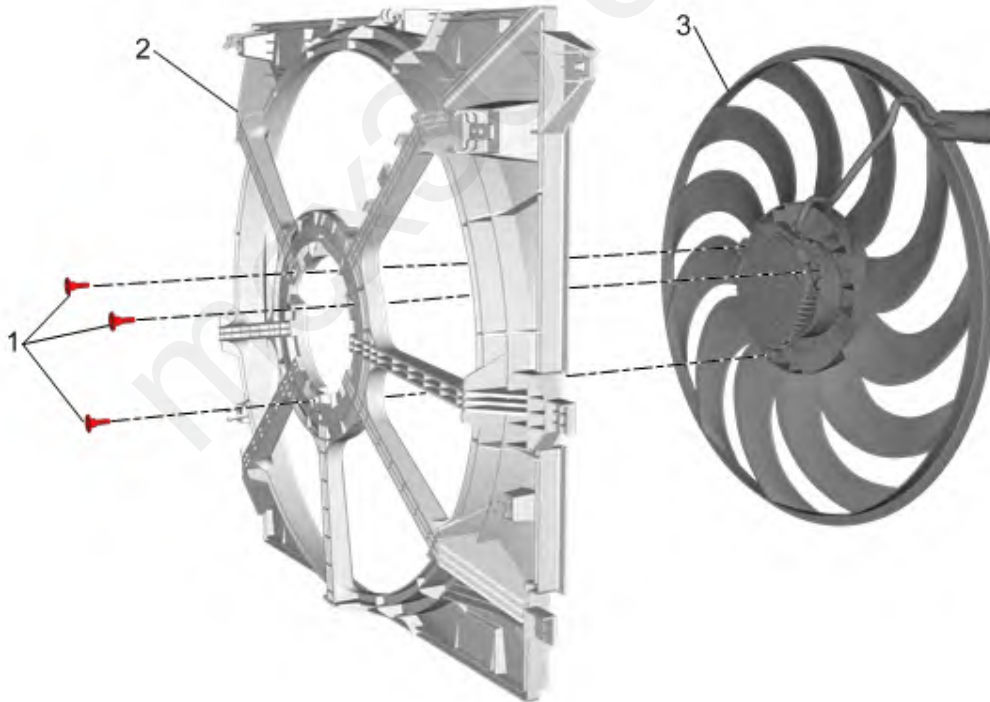


Fig. 197: Fan Blade
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the fan blade (3). Refer to [Fan Blade Replacement](#).

Installation Procedure

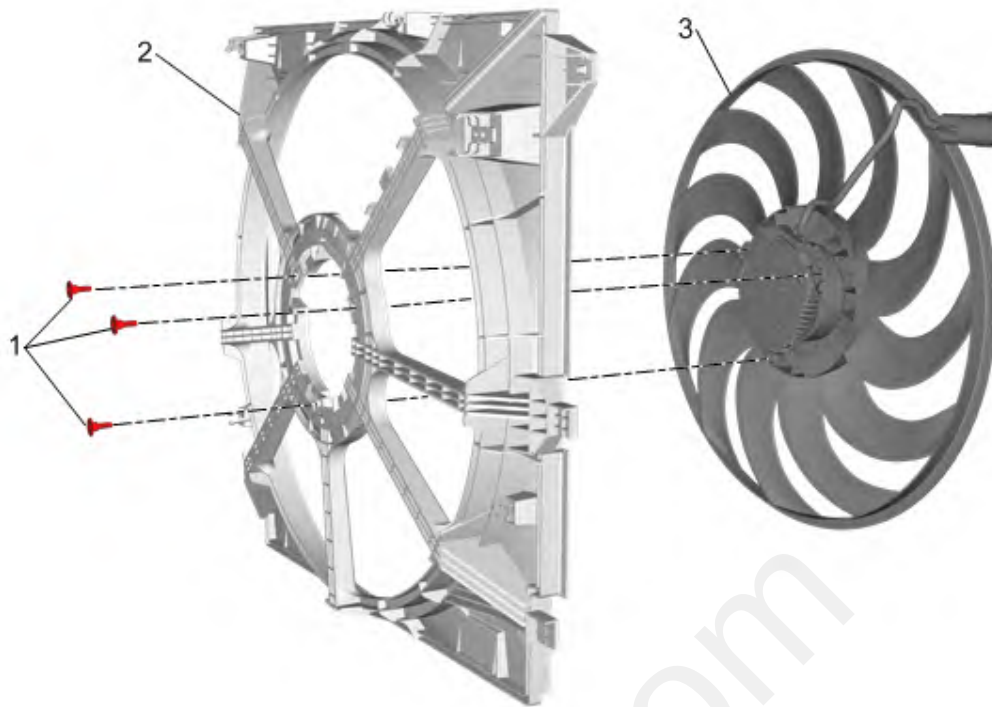


Fig. 198: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

1. Install the fan blade (3). Refer to [Fan Blade Replacement](#).

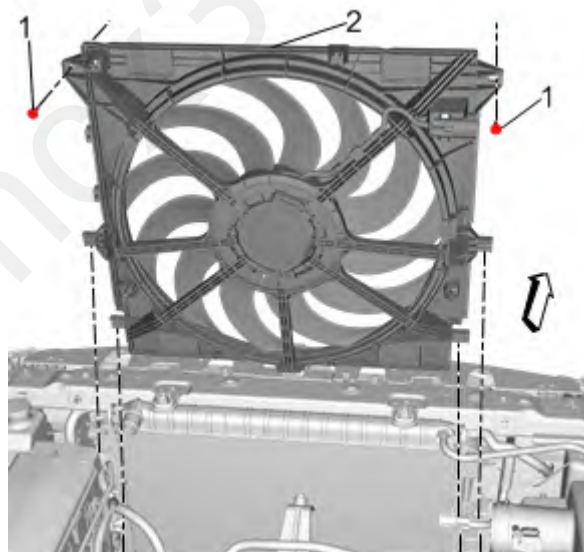


Fig. 199: Engine Coolant Fan Shroud Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Install the engine coolant fan shroud and fan blade as an assembly (2) to the radiator

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

3. Install the engine coolant fan shroud bolts (1) to the radiator and tighten to 10 N.m (89 lb in).
4. Connect the electrical connector.

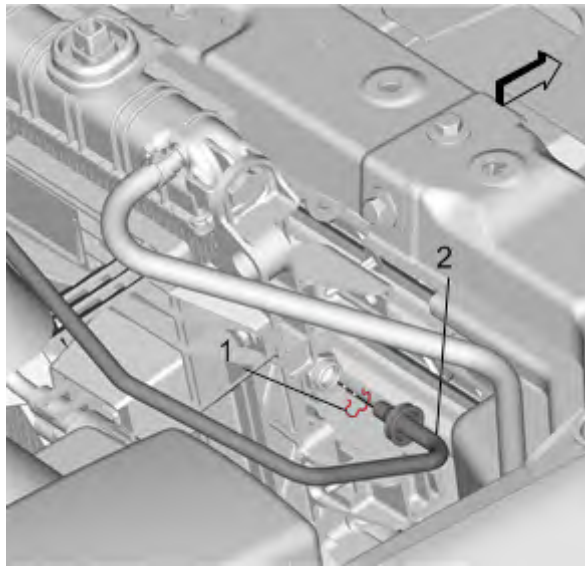


Fig. 200: Transmission Fluid Cooler Inlet And Outlet Pipe Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

5. Clip the transmission fluid cooler inlet and outlet pipe (2) to the engine cooling fan shroud and install the transmission fluid cooler inlet and outlet pipe to the air conditioning condenser/multi-cooler. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LFX\)](#).

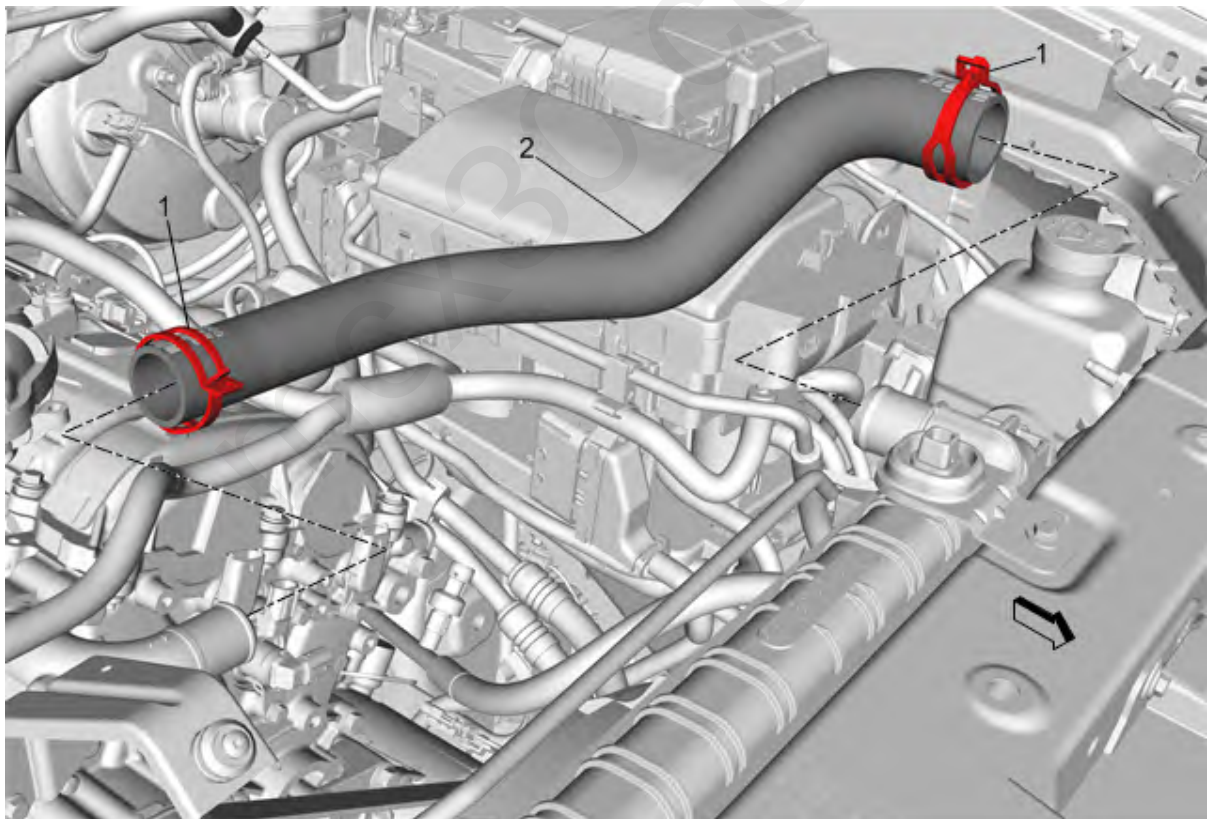


Fig. 201: Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

6. Install the radiator inlet hose (2) to the radiator. Refer to [Radiator Inlet Hose Replacement \(LFX\)](#).
7. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
8. Inspect the cooling system for leaks.

OLANT FAN SHROUD REPLACEMENT (LCV)

Removal Procedure

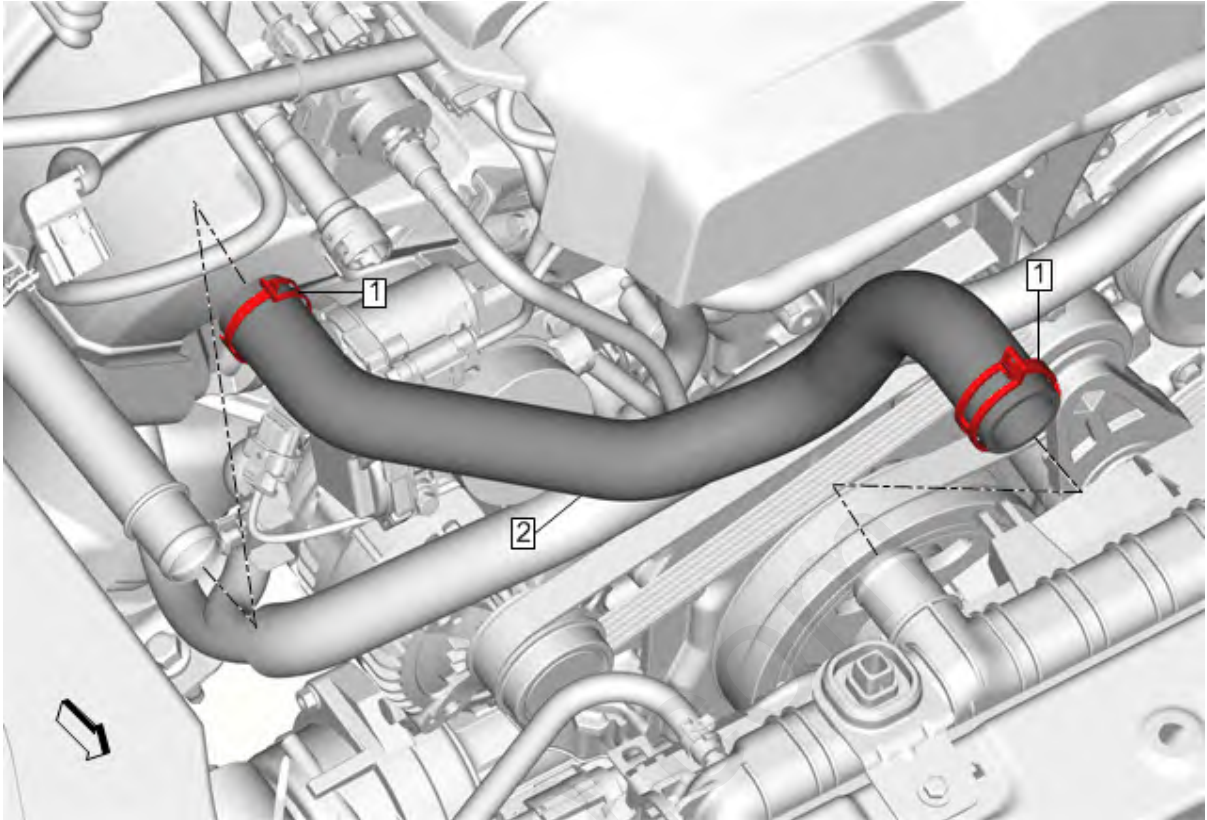


Fig. 202: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Remove Radiator Inlet Hose (2) @Radiator **Radiator Inlet Hose Replacement (LCV Radiator to Inlet Pipe)****Radiator Inlet Hose Replacement (LCV Inlet Pipe to Water Outlet).**

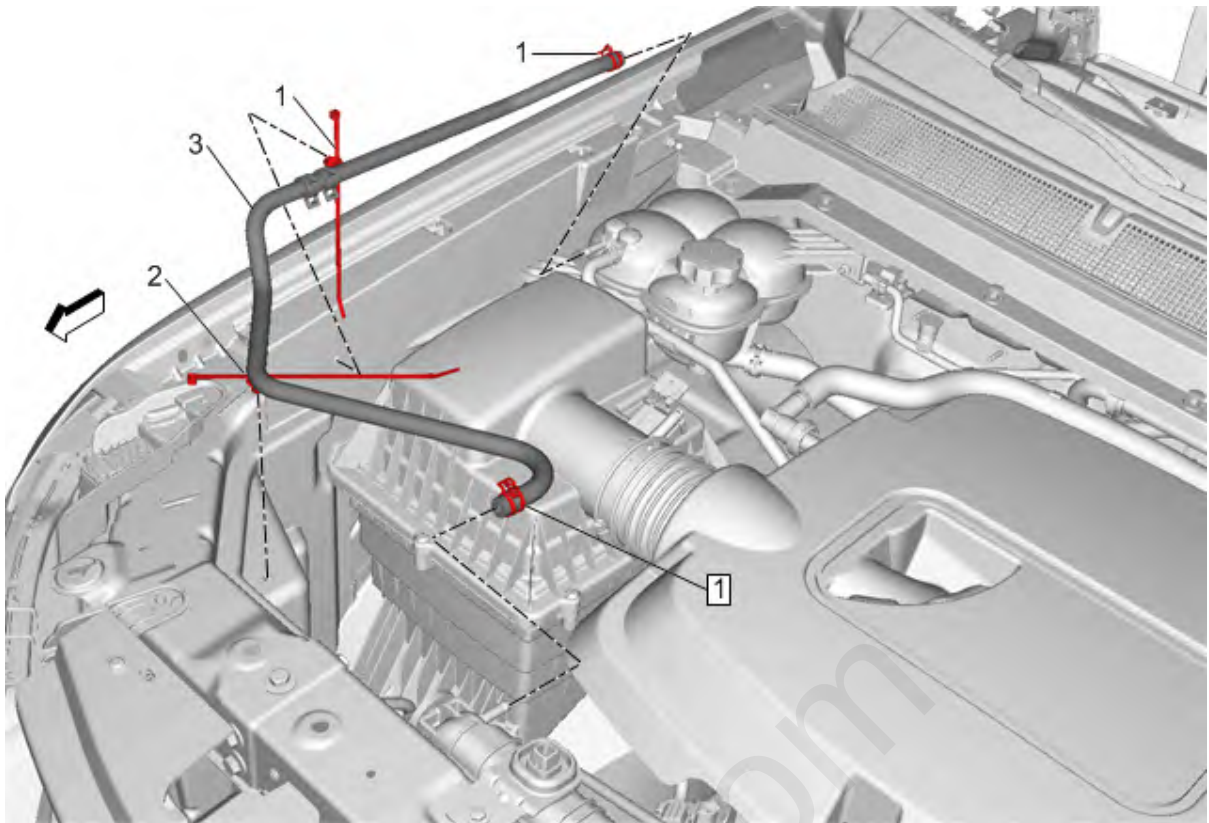


Fig. 203: Radiator Vent Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Remove Radiator Vent Outlet Hose (3) @Radiator [Radiator Vent Outlet Hose Replacement](#)
3. Disconnect the electrical connector.
4. Unclip the transmission fluid cooler inlet and outlet pipe from the engine coolant fan shroud if equipped.

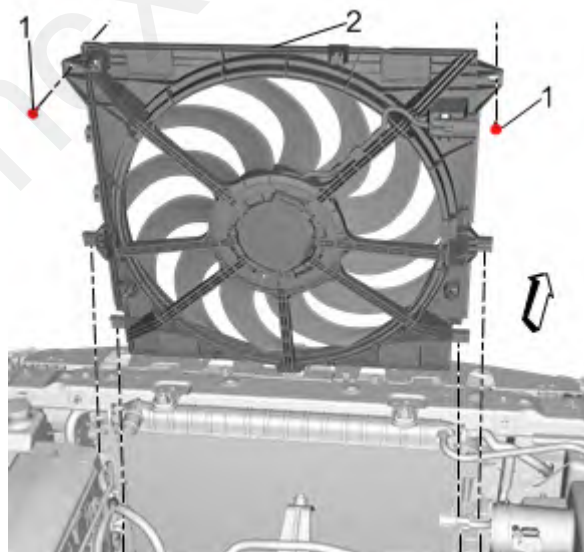


Fig. 204: Engine Coolant Fan Shroud Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove Engine Coolant Fan Shroud Bolt (1)
6. Remove Engine Coolant Fan Shroud (2)

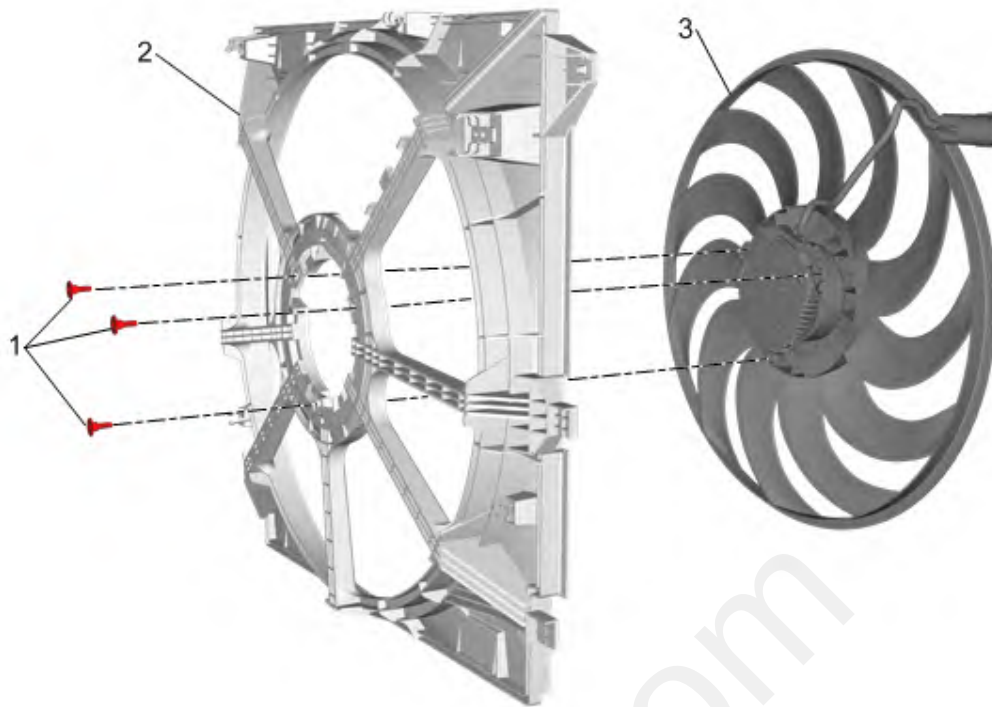
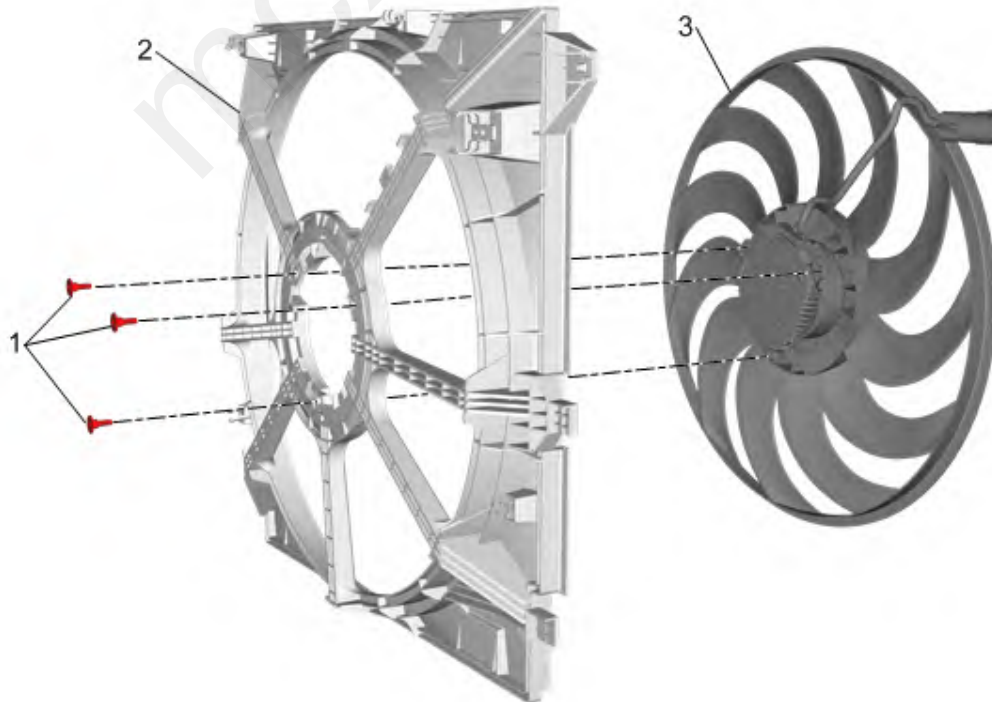


Fig. 205: Fan Blade

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fan Blade (3). **Fan Blade Replacement.**

Installation Procedure



3. Fan Blade
Courtesy of GENERAL MOTORS COMPANY

1. Install Fan Blade (3) **Fan Blade Replacement.**

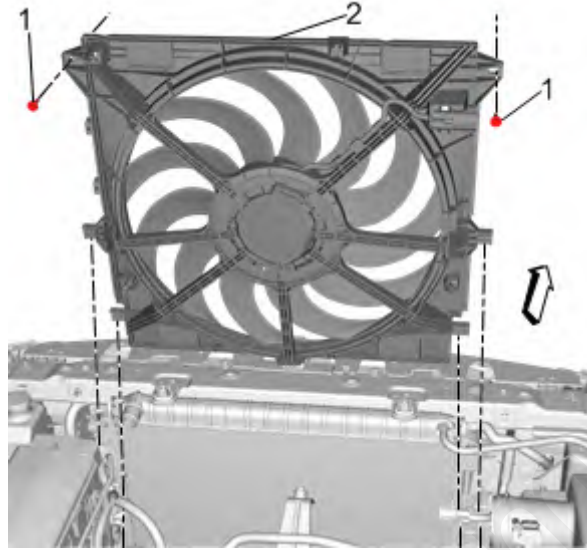


Fig. 207: Engine Coolant Fan Shroud Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Coolant Fan Shroud (2)

CAUTION: Refer to **Fastener Caution** .

3. Install Engine Coolant Fan Shroud Bolt (1) 10 N.m (89 lb in)
4. Clip the transmission fluid cooler inlet and outlet pipe to the engine coolant fan shroud if equipped.
5. Connect the electrical connector.

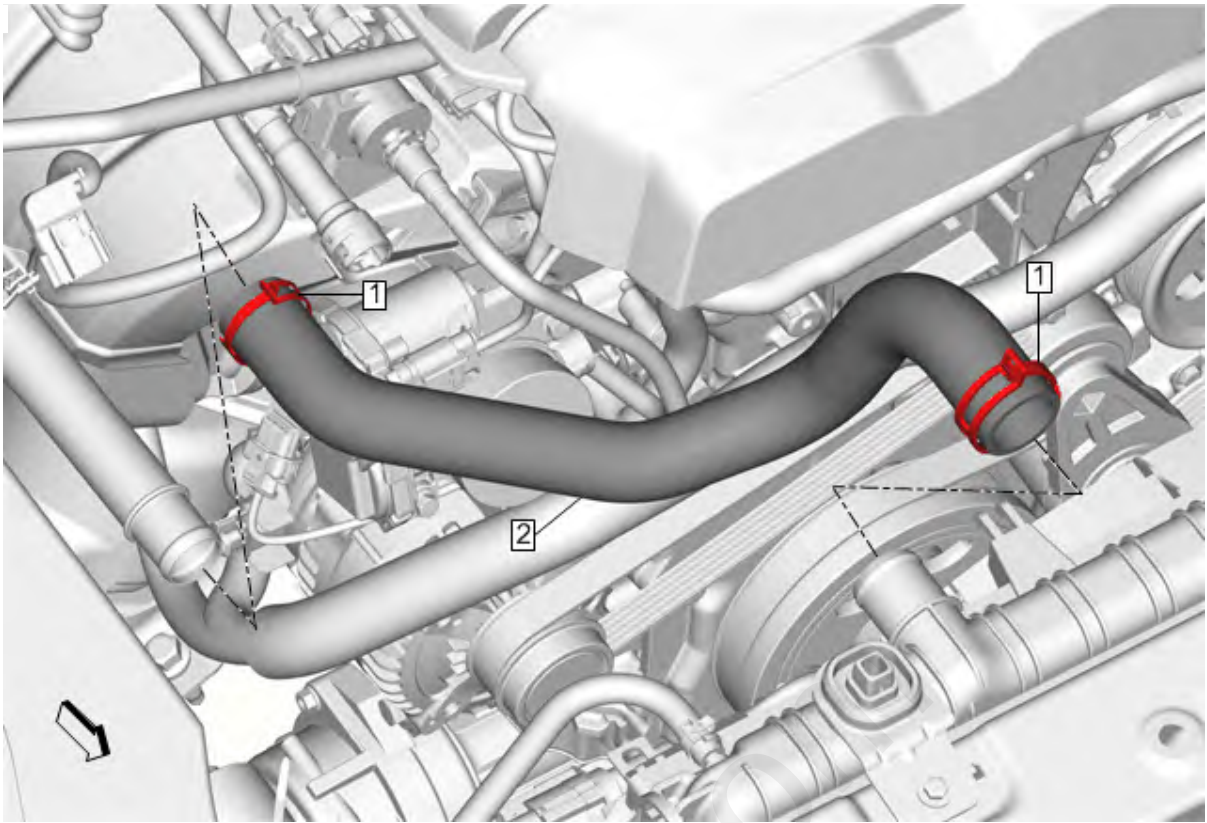
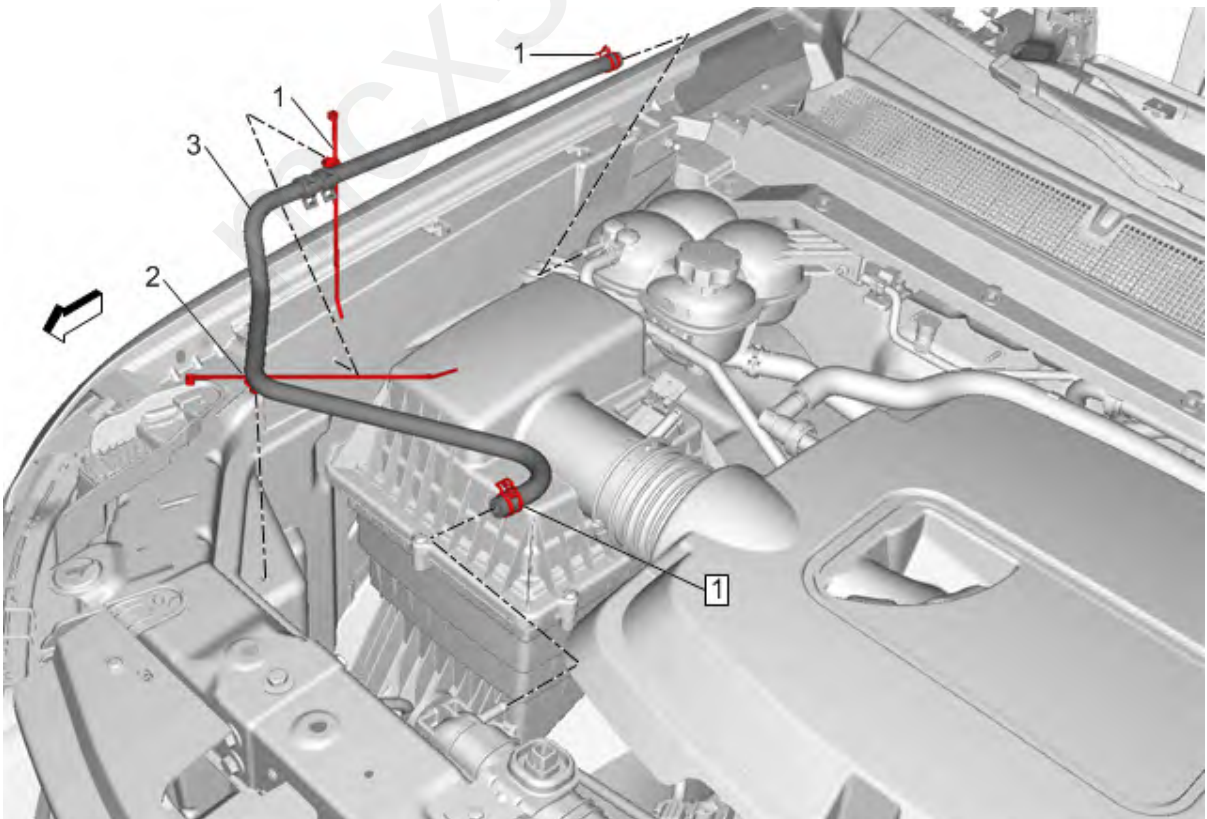


Fig. 208: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Install Radiator Inlet Hose (2) @Radiator **Radiator Inlet Hose Replacement (LCV Radiator to Inlet Pipe)****Radiator Inlet Hose Replacement (LCV Inlet Pipe to Water Outlet).**



! Radiator Vent Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Install Radiator Vent Outlet Hose (3) @Radiator [Radiator Vent Outlet Hose Replacement](#)
8. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
9. Check the cooling system for leaks.

ENGINE COOLANT FAN SHROUD REPLACEMENT (LWN)

Removal Procedure

Special Tools

- **BO-38185** Hose Clamp Pliers

Equivalent regional tools:[Special Tools](#)

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

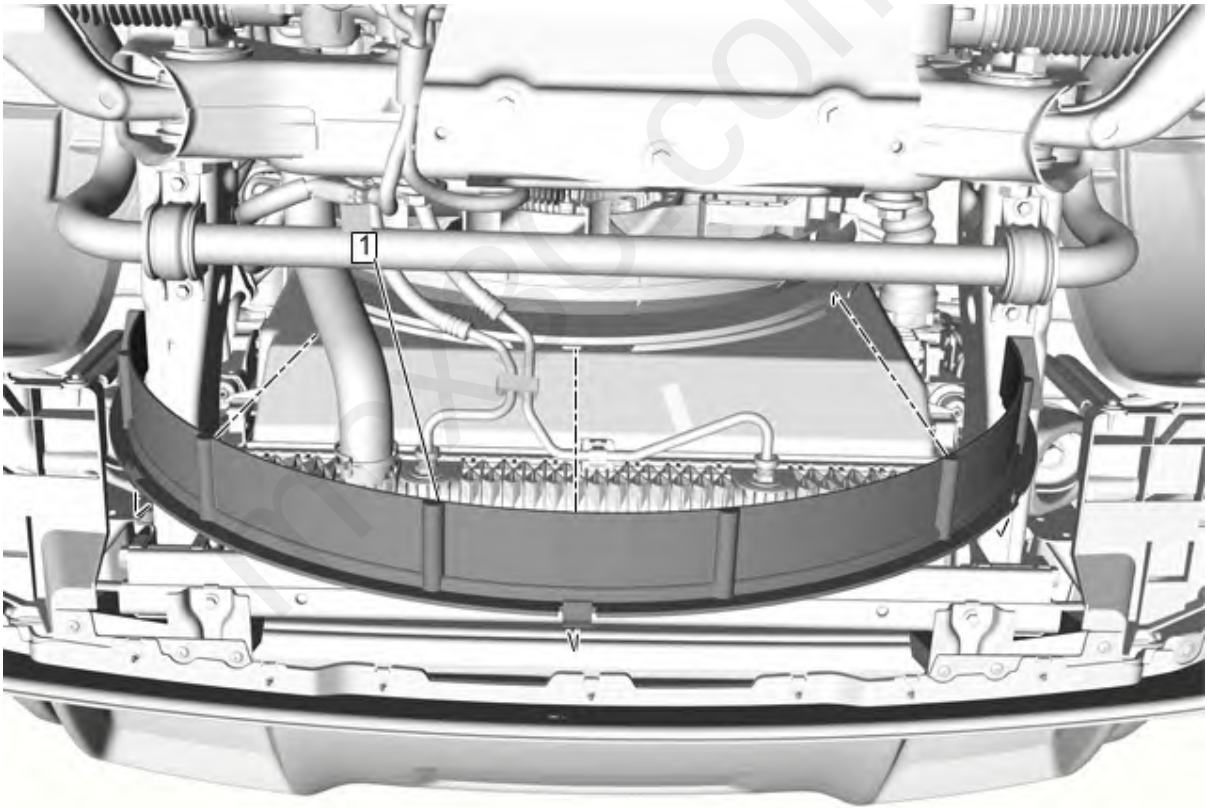


Fig. 210: Engine Coolant Fan Lower Shroud
Courtesy of GENERAL MOTORS COMPANY

2. Remove Engine Coolant Fan Lower Shroud (1). [Engine Coolant Fan Lower Shroud Replacement \(LWN\)](#)

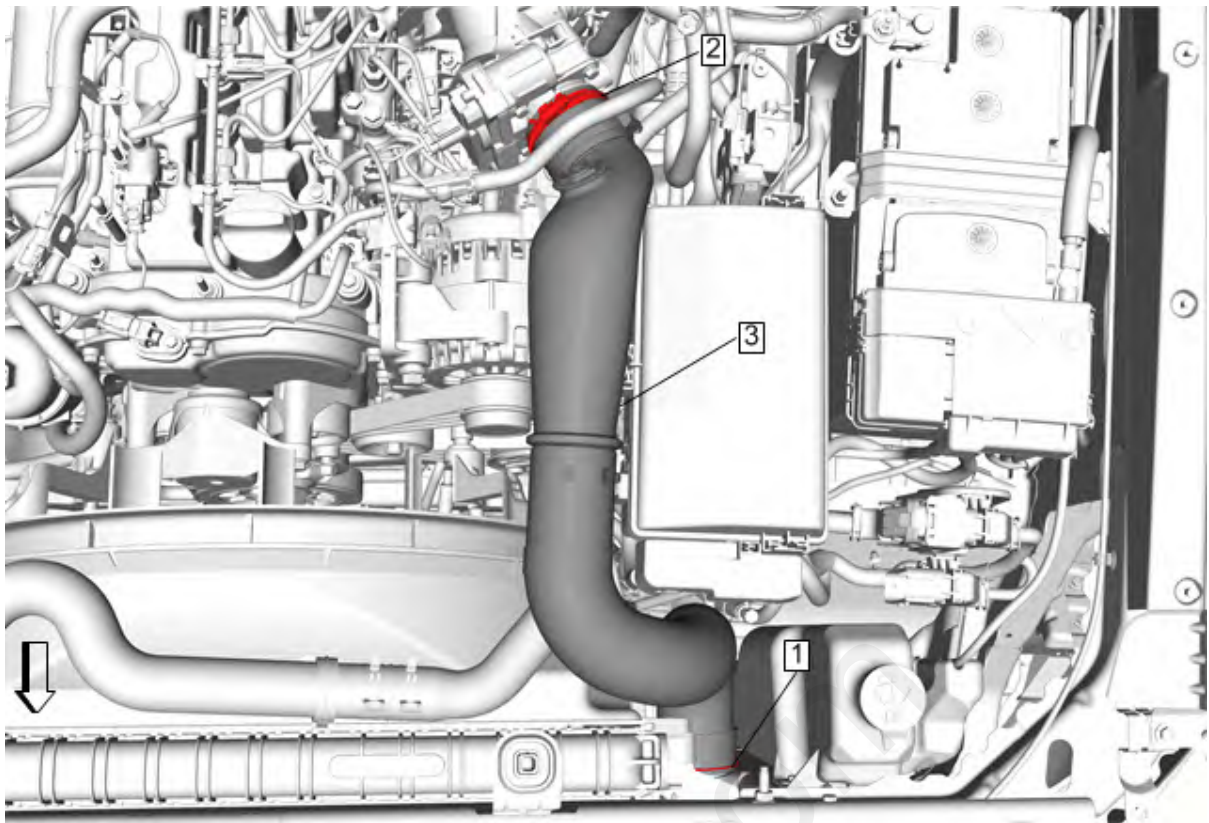


Fig. 211: Charge Air Cooler Outlet Duct
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Charge Air Cooler Outlet Duct (3). **Charge Air Cooler Outlet Duct Replacement**

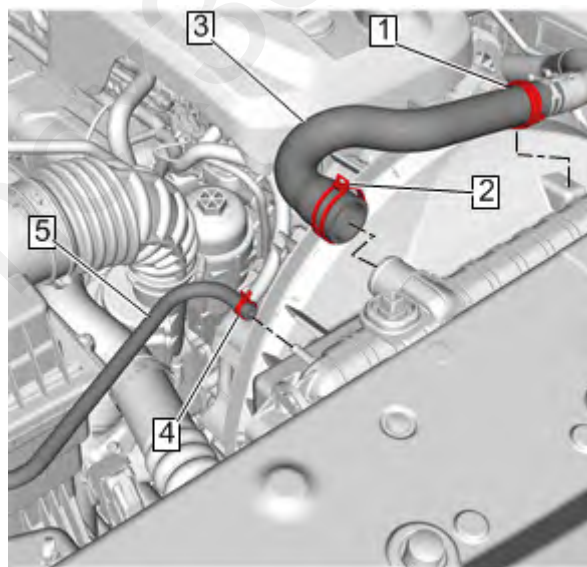


Fig. 212: Radiator Inlet Hose Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Inlet Hose Retainer (1)
5. Disengage Radiator Inlet Hose Clamp (2)
- Use the **BO-38185** Hose Clamp Pliers
6. Remove Radiator Inlet Hose (3) @Radiator Assembly

Remove Radiator Vent Outlet Hose Clamp (4)

Use the **BO-38185** Hose Clamp Pliers.

8. Remove Radiator Vent Outlet Hose (5) @Radiator Assembly

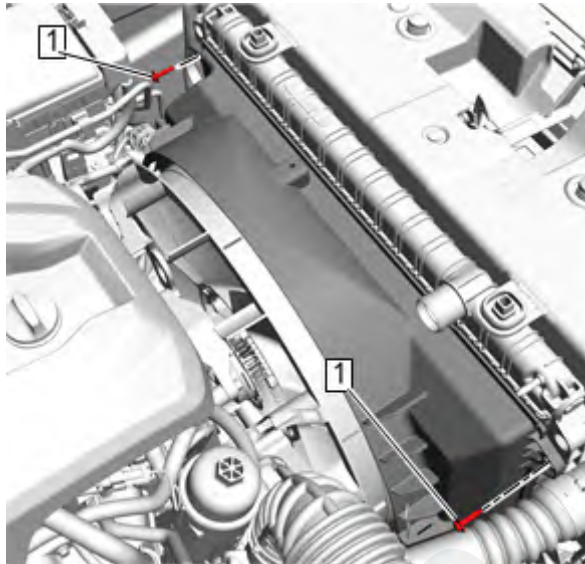


Fig. 213: Engine Coolant Fan Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove Engine Coolant Fan Shroud Bolt (1)

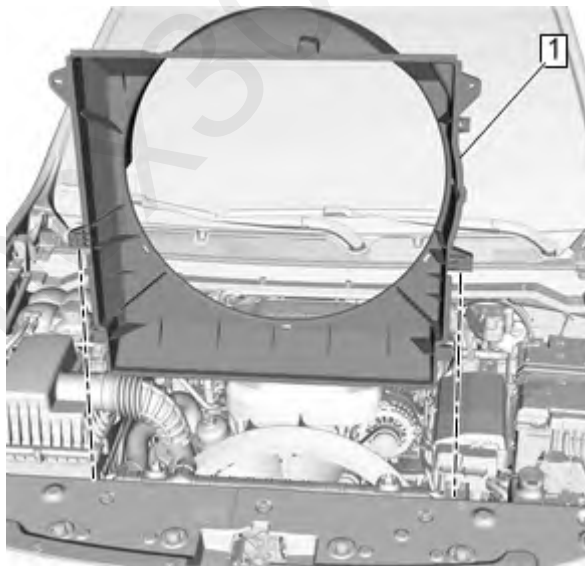


Fig. 214: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

10. Remove Engine Coolant Fan Shroud (1)

Installation Procedure

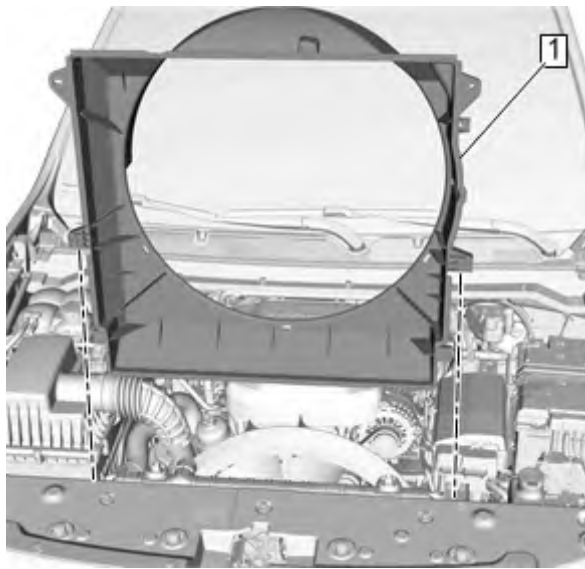


Fig. 215: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Coolant Fan Shroud (1)

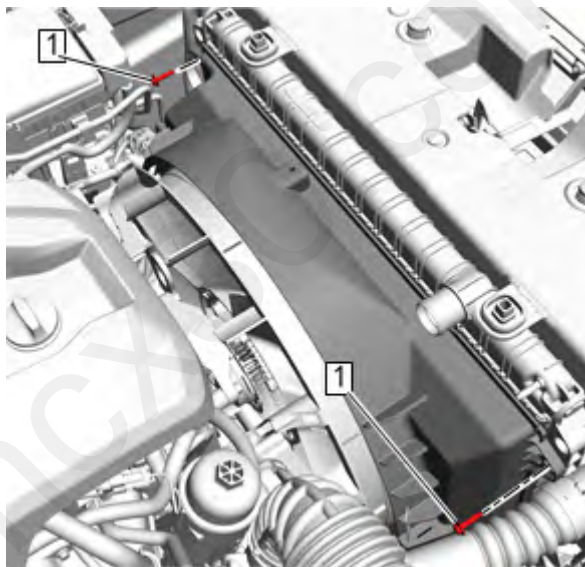


Fig. 216: Engine Coolant Fan Shroud Bolt

Courtesy of GENERAL MOTORS COMPANY

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

2. Install Engine Coolant Fan Shroud Bolt (1) and tighten 7 N.m (62 lb in)

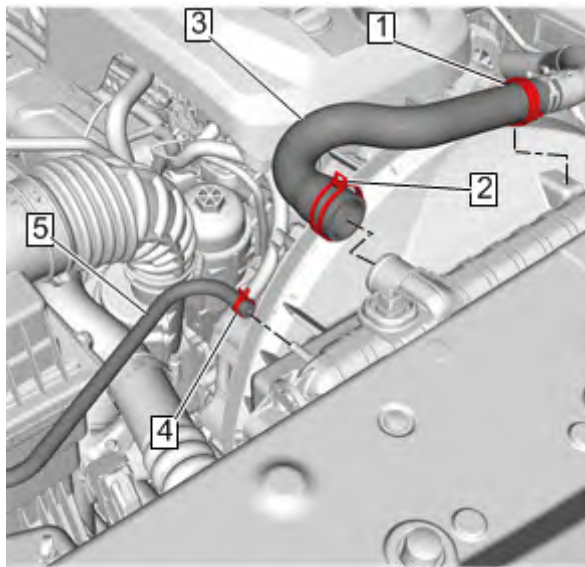


Fig. 217: Radiator Inlet Hose Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Vent Outlet Hose (5) @Radiator Assembly

4. Engage Radiator Vent Outlet Hose Clamp (4)

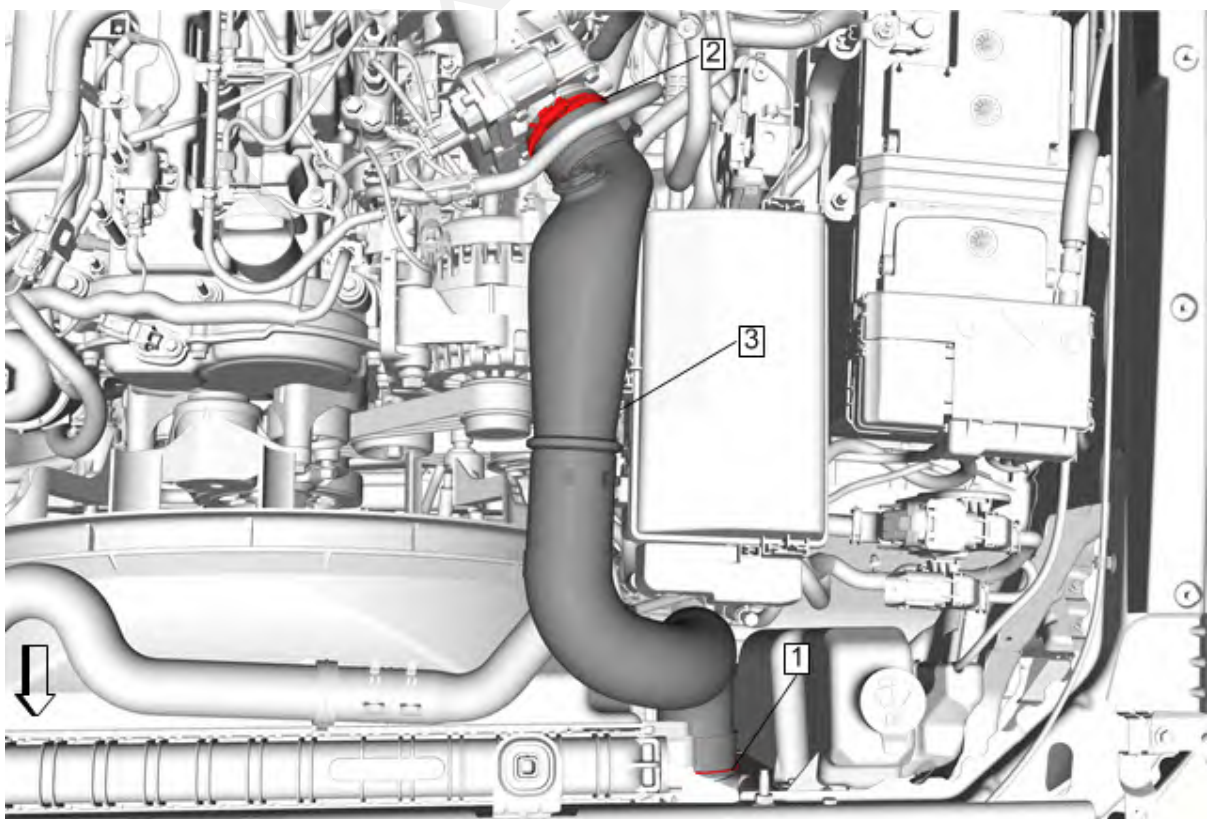
Use the **BO-38185** Hose Clamp Pliers.

5. Install Radiator Inlet Hose (3) @Radiator Assembly

6. Engage Radiator Inlet Hose Clamp (2)

Use the **BO-38185** Hose Clamp Pliers

7. Install Radiator Inlet Hose Retainer (1)



3: Charge Air Cooler Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

8. Install Charge Air Cooler Outlet Duct (3) **Charge Air Cooler Outlet Duct Replacement**

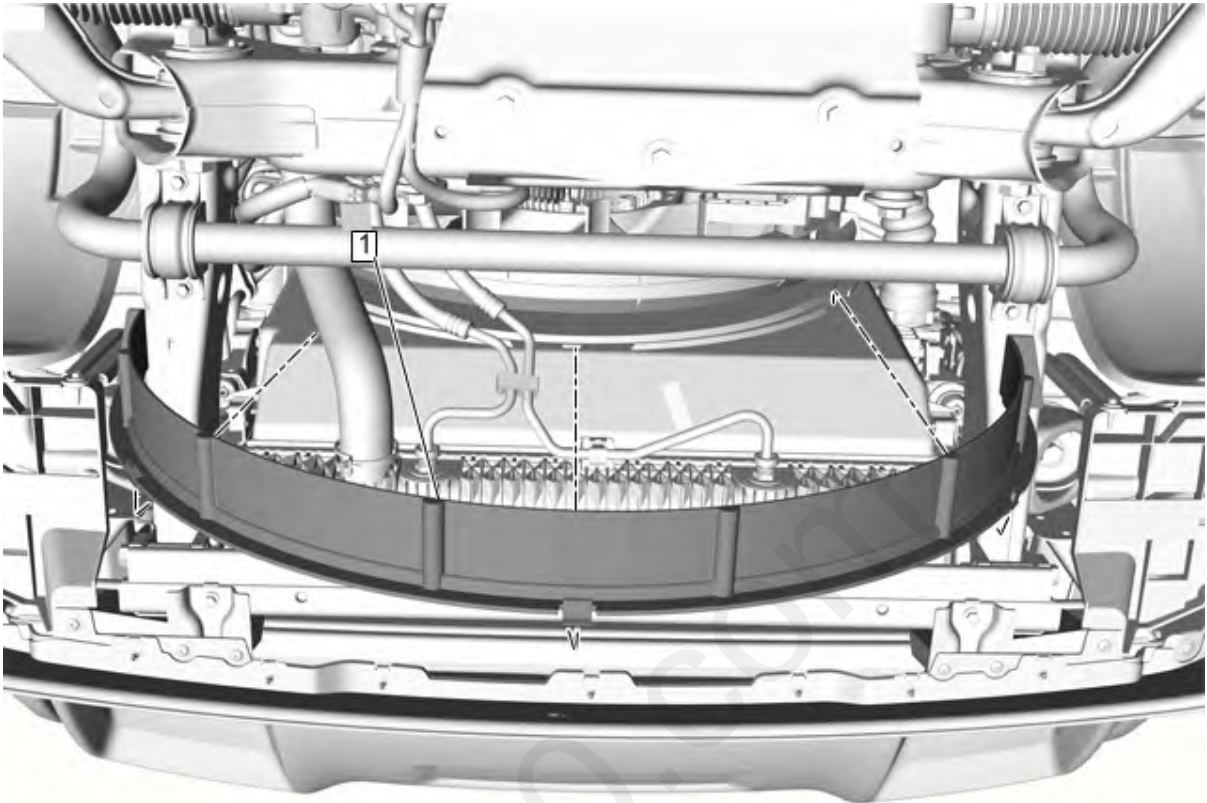


Fig. 219: Engine Coolant Fan Lower Shroud
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Coolant Fan Lower Shroud (1). **Engine Coolant Fan Lower Shroud Replacement (LWN)**
10. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill) Cooling System Draining and Filling (Vac n Fill)**
11. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN LOWER SHROUD REPLACEMENT (LWN)

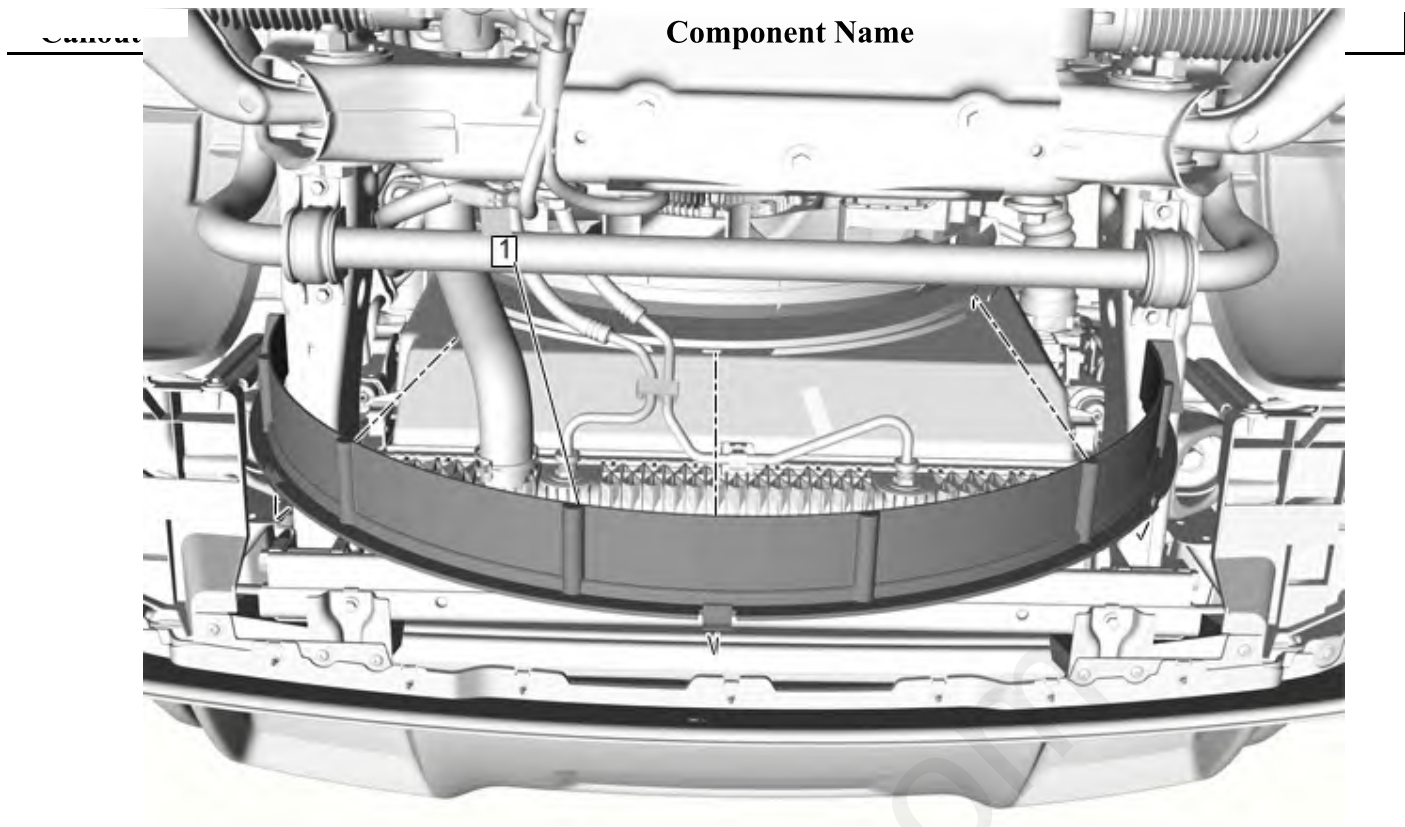
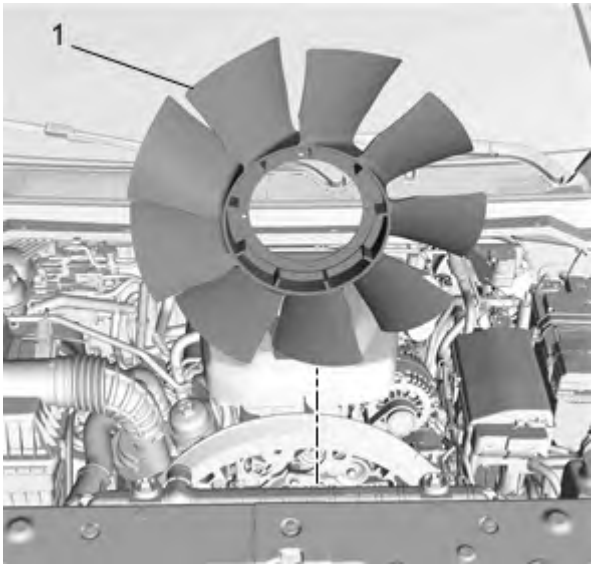


Fig. 220: Engine Coolant Fan Lower Shroud
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Underbody Splash Shield Replacement</u>	
1	Engine Coolant Fan Lower Shroud Procedure Unclip the engine coolant fan lower shroud from the engine coolant fan shroud.

ENGINE COOLANT FAN REAR SHROUD REPLACEMENT (LWN)

Removal Procedure



: Fan Blade
Courtesy of GENERAL MOTORS COMPANY

1. Remove Fan Blade (1). **Fan Blade Replacement (LWN)**

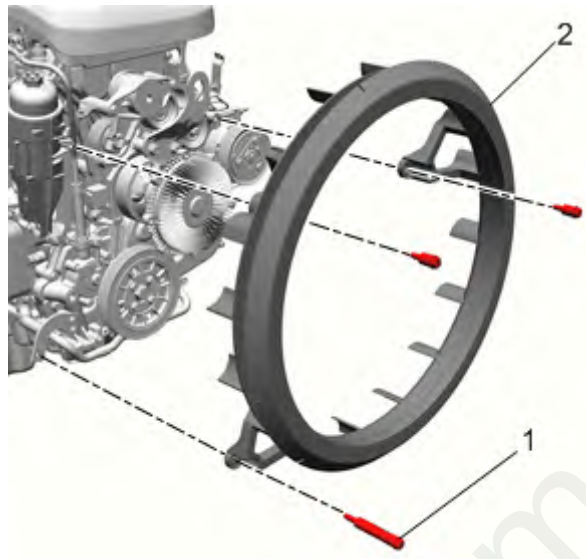


Fig. 222: Engine Coolant Fan Rear Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Remove Engine Coolant Fan Rear Shroud Bolt (1)
3. Remove Engine Coolant Fan Rear Shroud (2) @Engine Assembly

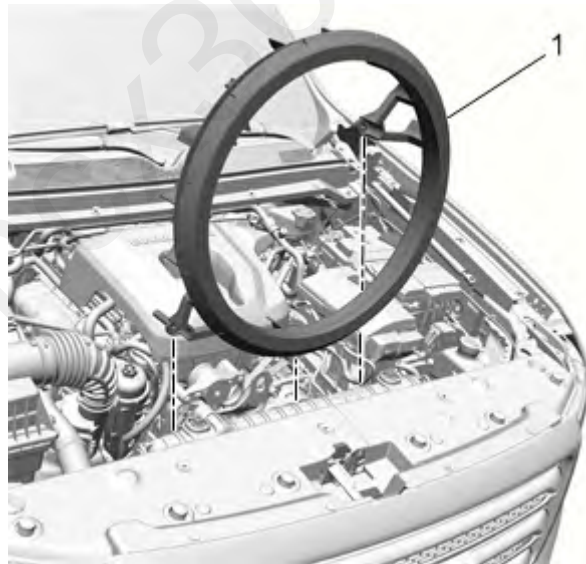


Fig. 223: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

4. Remove Engine Coolant Fan Rear Shroud (1) from the Vehicle

Installation Procedure



Fig. 224: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

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

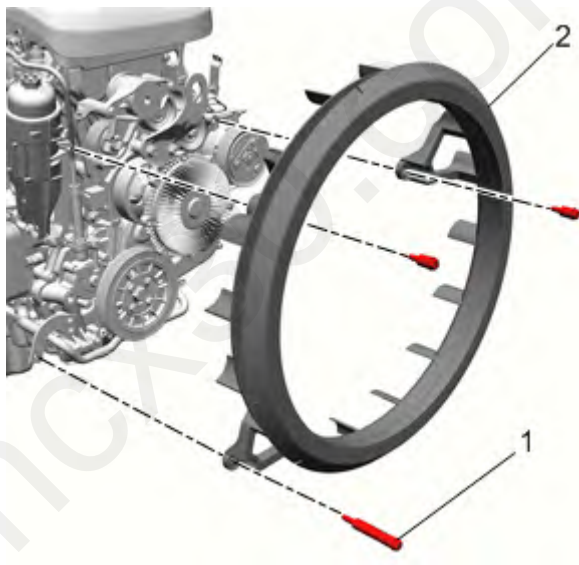


Fig. 225: Engine Coolant Fan Rear Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

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

2. Install Engine Coolant Fan Rear Shroud (2) @Engine Assembly
3. Install Engine Coolant Fan Rear Shroud Bolt (1) and tighten 22 N.m (16 lb ft)

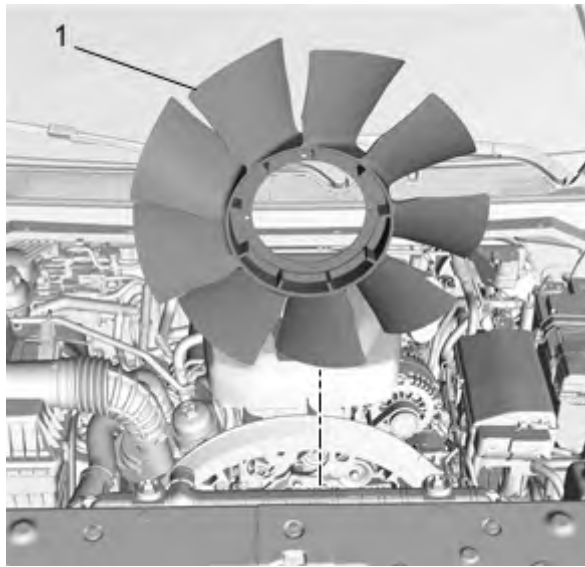


Fig. 226: Fan Blade

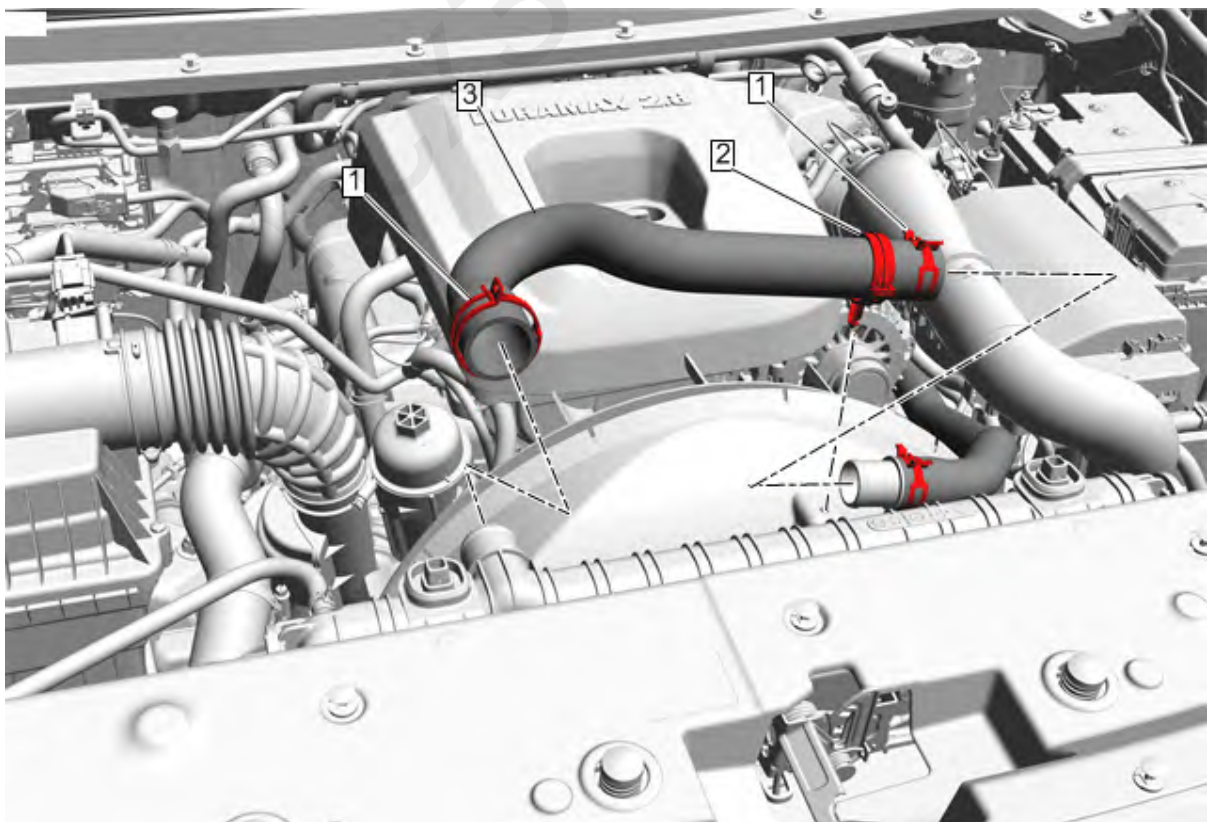
Courtesy of GENERAL MOTORS COMPANY

4. Install Fan Blade (1). **Fan Blade Replacement (LWN)**

CONDENSER, FAN, AND RADIATOR ASSEMBLY REMOVAL AND INSTALLATION

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill)**
2. Recover the refrigerant. **Refrigerant Recovery and Recharging**



': Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Inlet Hose (1) @Radiator [Radiator Inlet Hose Replacement \(LFX\)](#)[Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#)[Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#)[Radiator Inlet Hose Replacement \(Radiator Side LWN\)](#)[Radiator Inlet Hose Replacement \(Engine Side LWN\)](#)

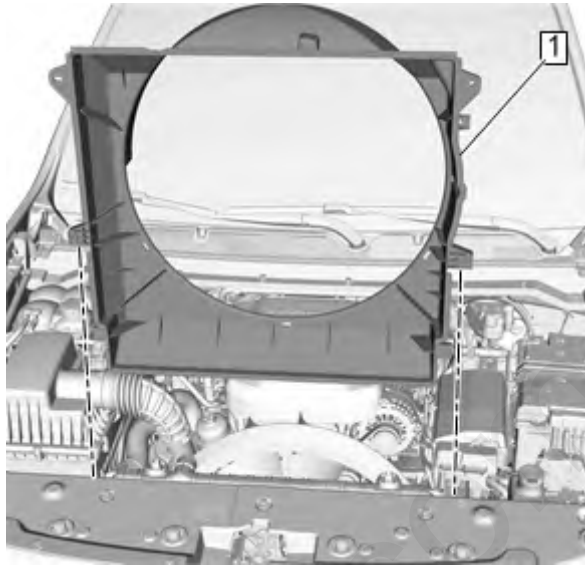


Fig. 228: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

4. Remove Engine Coolant Fan Shroud (2) [Engine Coolant Fan Shroud Replacement \(LFX\)](#)[Engine Coolant Fan Shroud Replacement \(LCV\)](#)[Engine Coolant Fan Shroud Replacement \(LWN\)](#)

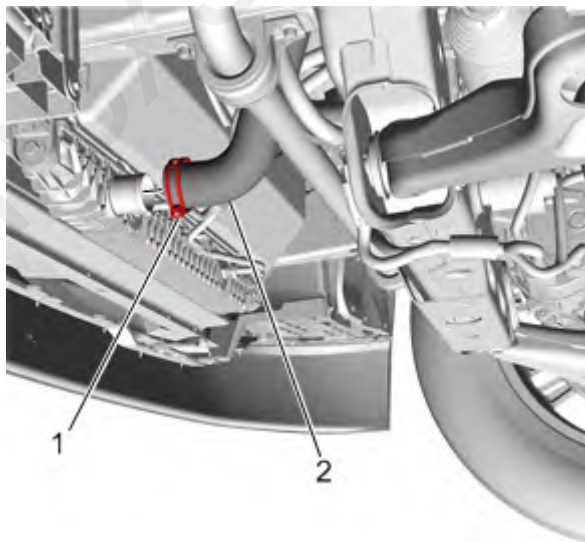


Fig. 229: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Remove Radiator Outlet Hose (2) @Radiator [Radiator Outlet Hose Replacement \(LFX\)](#)[Radiator Outlet Hose Replacement \(LCV\)](#)[Radiator Outlet Hose Replacement \(LWN\)](#)

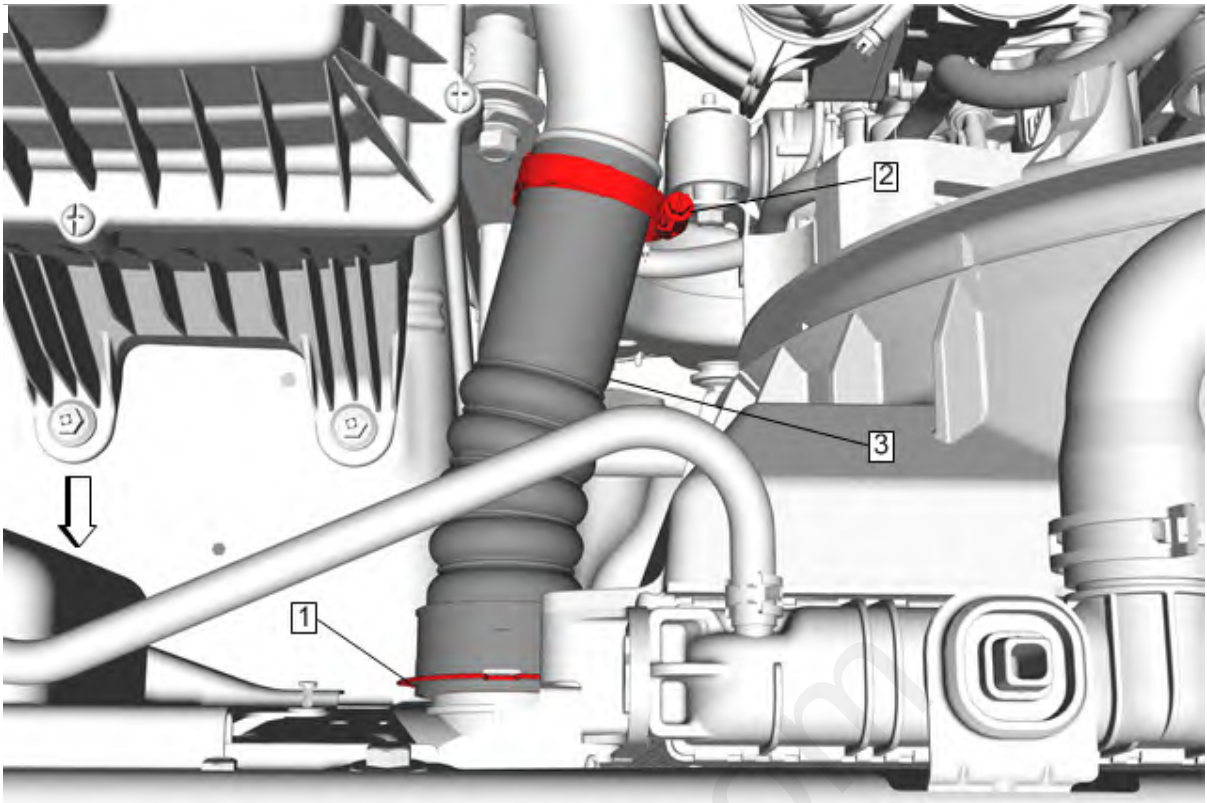
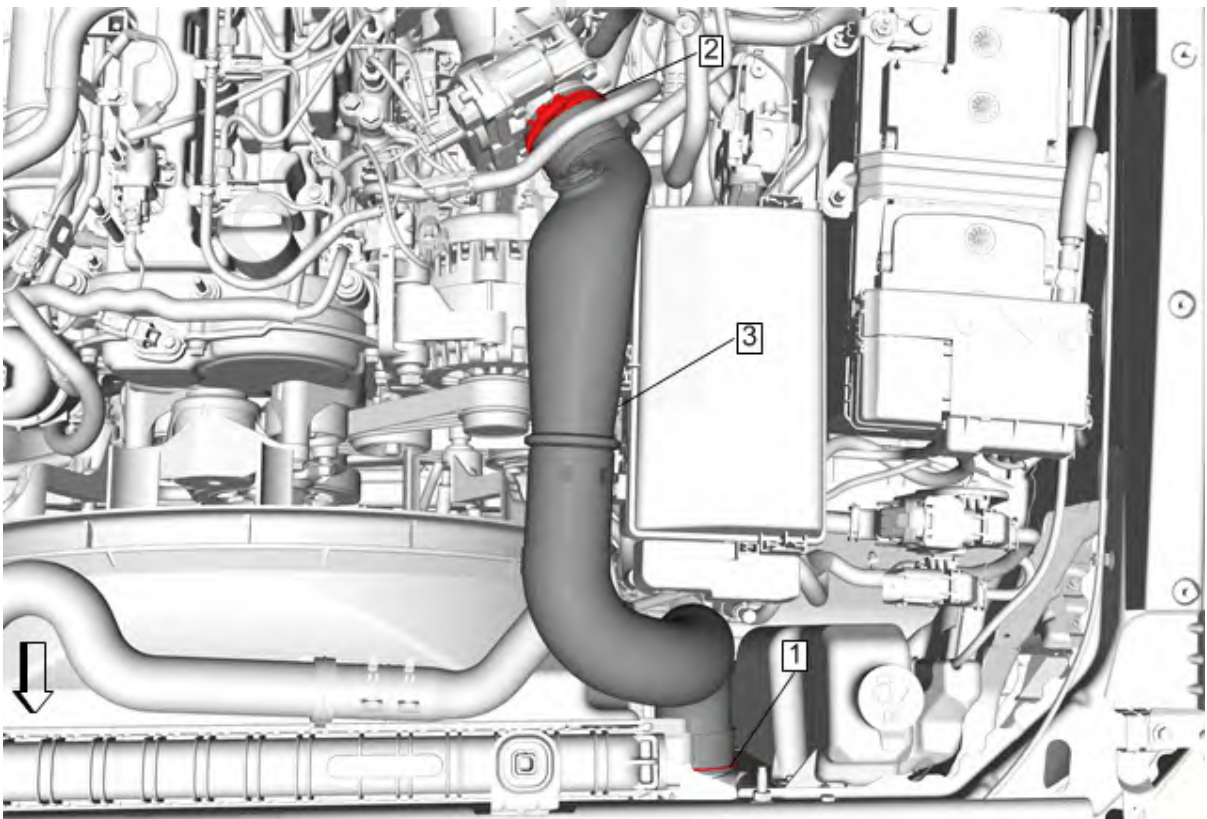


Fig. 230: Charge Air Cooler Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Remove Charge Air Cooler Inlet Hose (3) @Charge Air Cooler **Charge Air Cooler Inlet Hose Replacement**



: Charge Air Cooler Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

7. Remove Charge Air Cooler Outlet Duct (3) @Charge Air Cooler **Charge Air Cooler Outlet Duct Replacement**

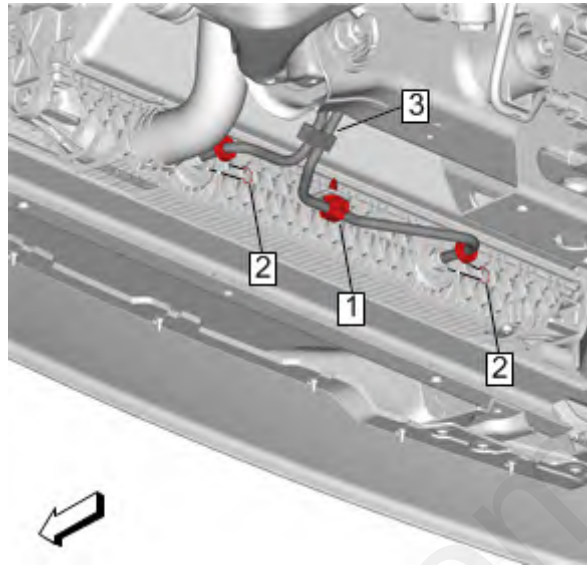


Fig. 232: Transmission Fluid Cooler Inlet and Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

8. Remove Transmission Fluid Cooler Inlet and Outlet Pipe (3) @Radiator **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LFX)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LCV)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LWN)**
9. Remove Front Bumper Fascia **Front Bumper Fascia Replacement (GMC)** **Front Bumper Fascia Replacement (Chevrolet)**
10. Remove Upper and Lower Front Bumper Shutters **Front Bumper Shutter Baffle Replacement (Lower)** **Front Bumper Shutter Baffle Replacement (Upper)**

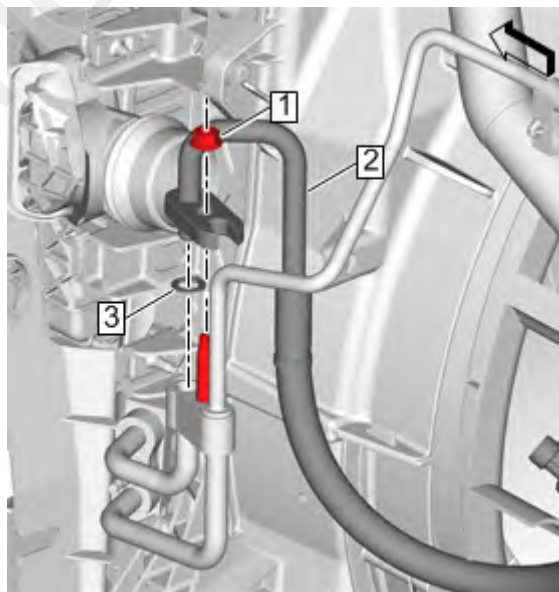


Fig. 233: Air Conditioning Compressor Hose
Courtesy of GENERAL MOTORS COMPANY

② Air Conditioning Compressor Hose (2) @Air Conditioning Condenser [Air Conditioning Compressor Hose Replacement \(LFX\)](#) [Air Conditioning Compressor Hose Replacement \(LCV\)](#) [Air Conditioning Compressor Hose Replacement \(LWN\)](#)

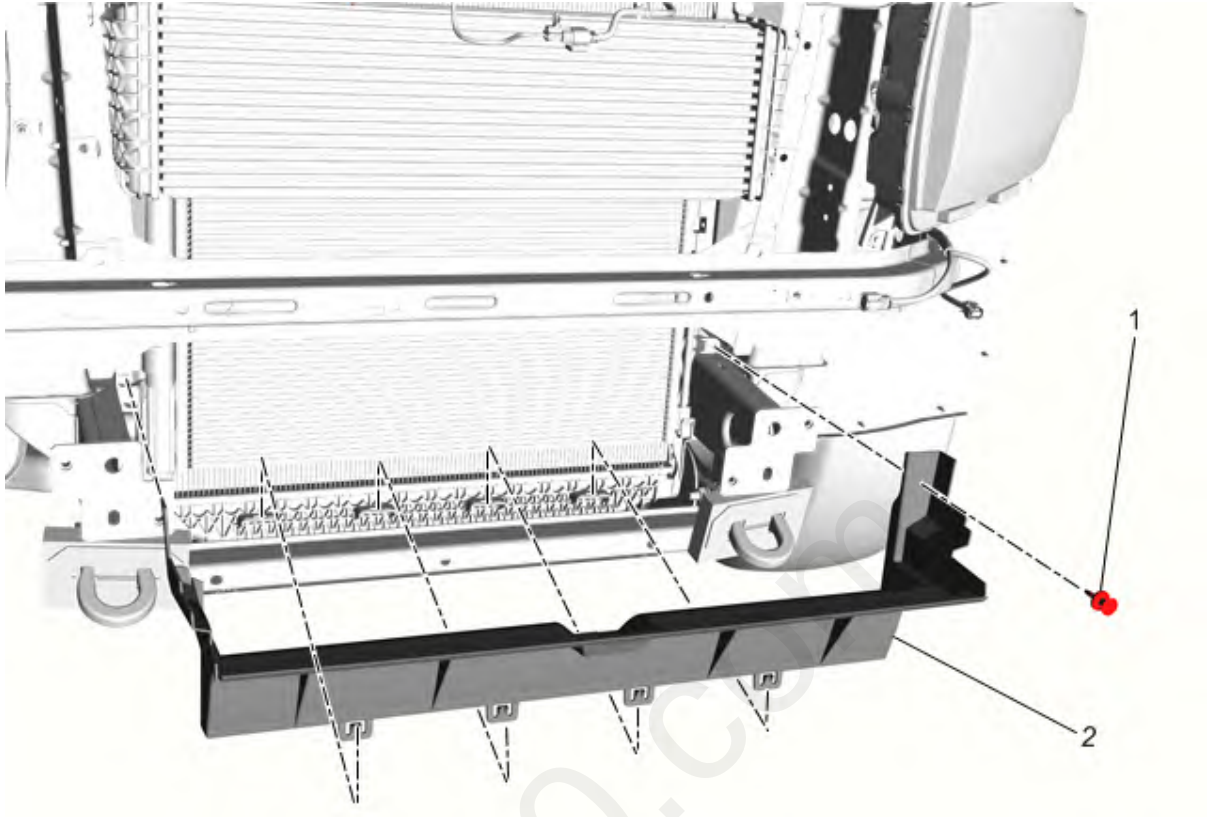
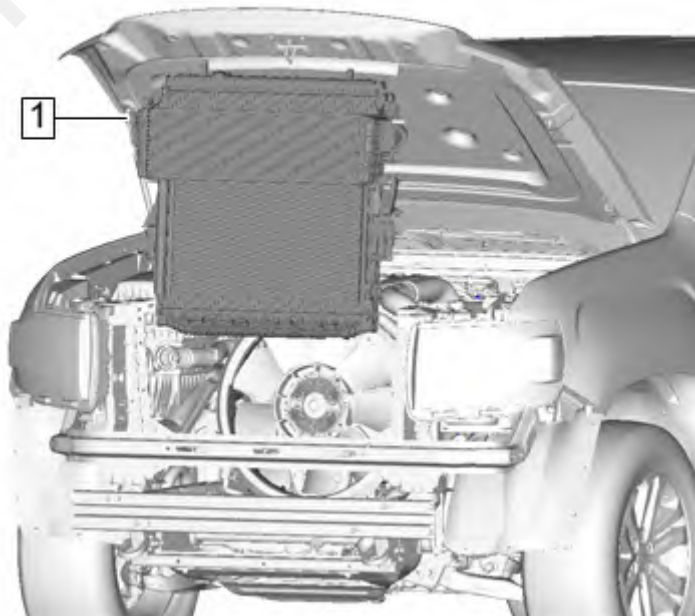


Fig. 234: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

12. Remove Radiator Air Lower Baffle (2) [Radiator Air Lower Baffle Replacement](#) [Radiator Air Lower Baffle Replacement \(LWN\)](#)
13. Remove Radiator Vent Outlet Hose (3) @Radiator [Radiator Vent Outlet Hose Replacement](#)



i: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

14. Remove Radiator Assembly (1)

Installation Procedure

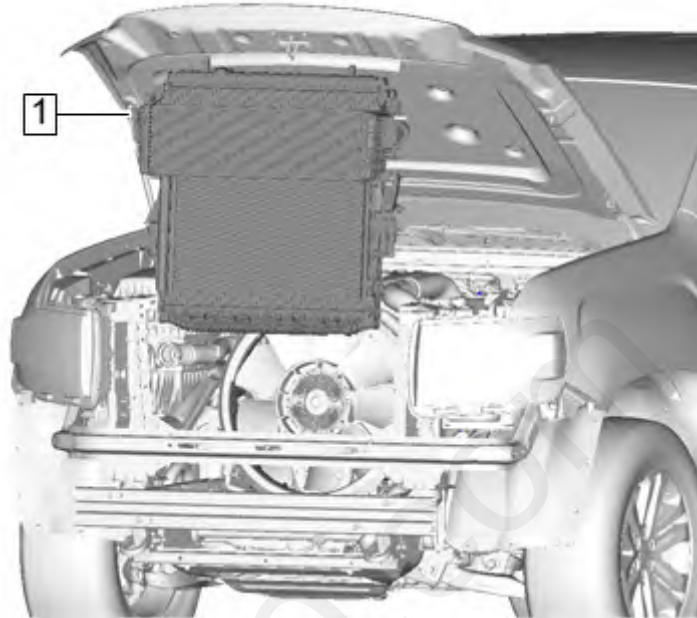


Fig. 236: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Assembly (1)
2. Install Radiator Vent Outlet Hose (3) @Radiator **Radiator Vent Outlet Hose Replacement**

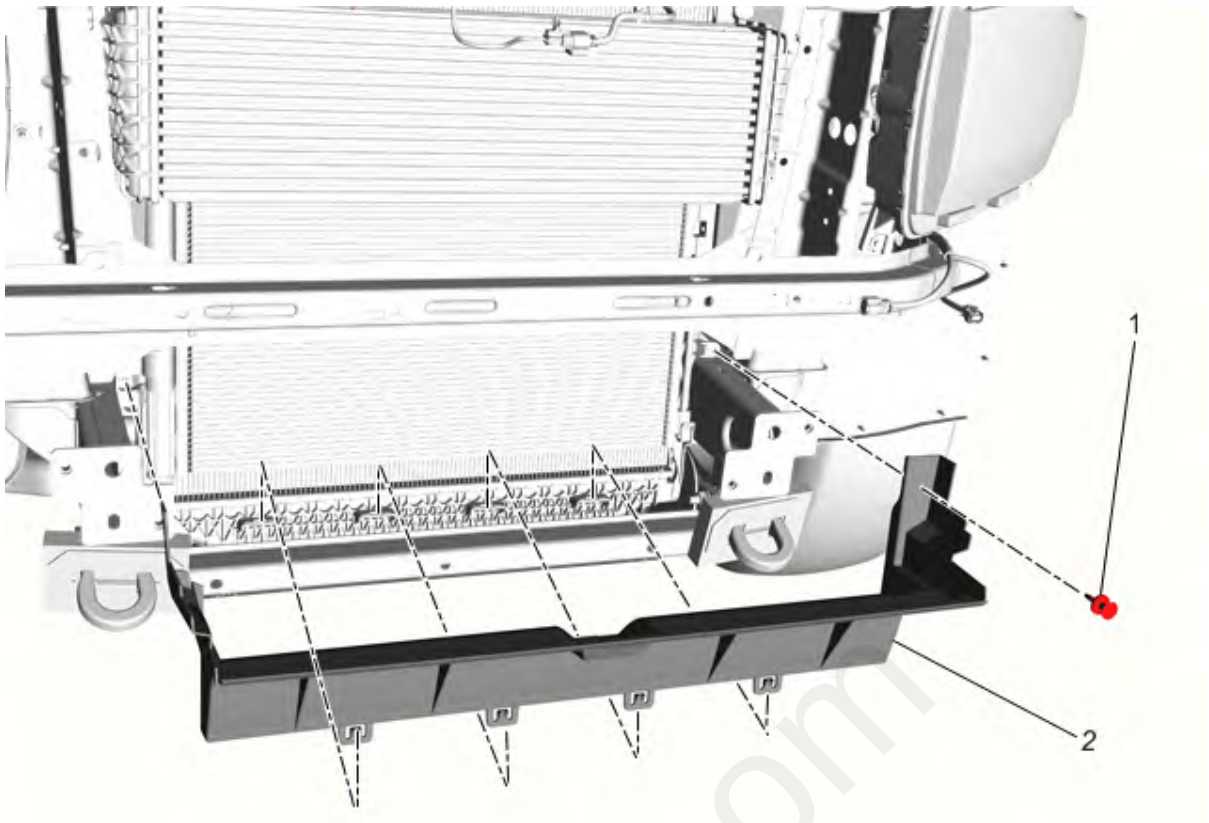


Fig. 237: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Air Lower Baffle (2) [Radiator Air Lower Baffle ReplacementRadiator Air Lower Baffle Replacement \(LWN\)](#)

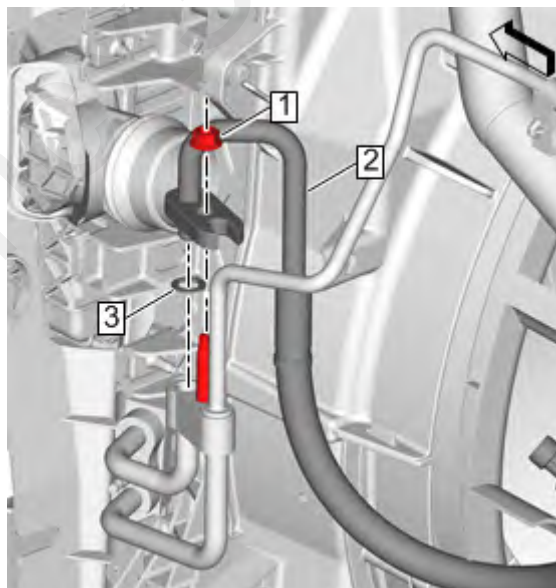


Fig. 238: Air Conditioning Compressor Hose

Courtesy of GENERAL MOTORS COMPANY

4. Install Air Conditioning Compressor Hose (2) @Air Conditioning Condenser [Air Conditioning Compressor Hose Replacement \(LFX\) Air Conditioning Compressor Hose Replacement \(LCV\) Air Conditioning Compressor Hose Replacement \(LWN\)](#)

Upper and Lower Front Bumper Shutters [Front Bumper Shutter Baffle Replacement \(Lower\)](#)
[Front Bumper Shutter Baffle Replacement \(Upper\)](#)

6. Install Front Bumper Fascia [Front Bumper Fascia Replacement \(GMC\)](#) [Front Bumper Fascia Replacement \(Chevrolet\)](#)

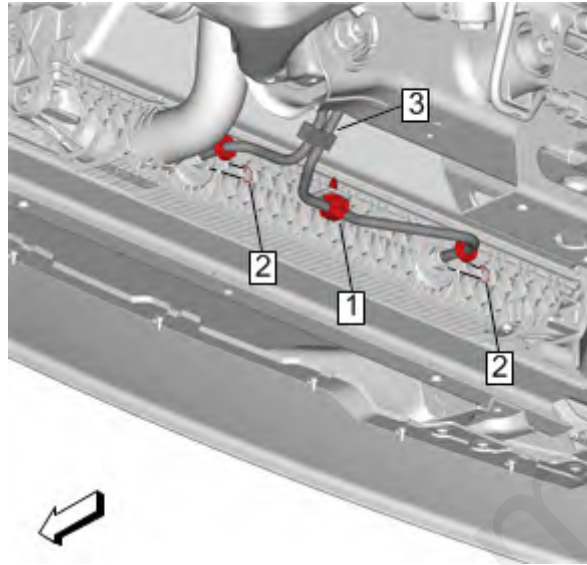


Fig. 239: Transmission Fluid Cooler Inlet and Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

7. Install Transmission Fluid Cooler Inlet and Outlet Pipe (3) @Radiator [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LFX\)](#) [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LCV\)](#) [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LWN\)](#)

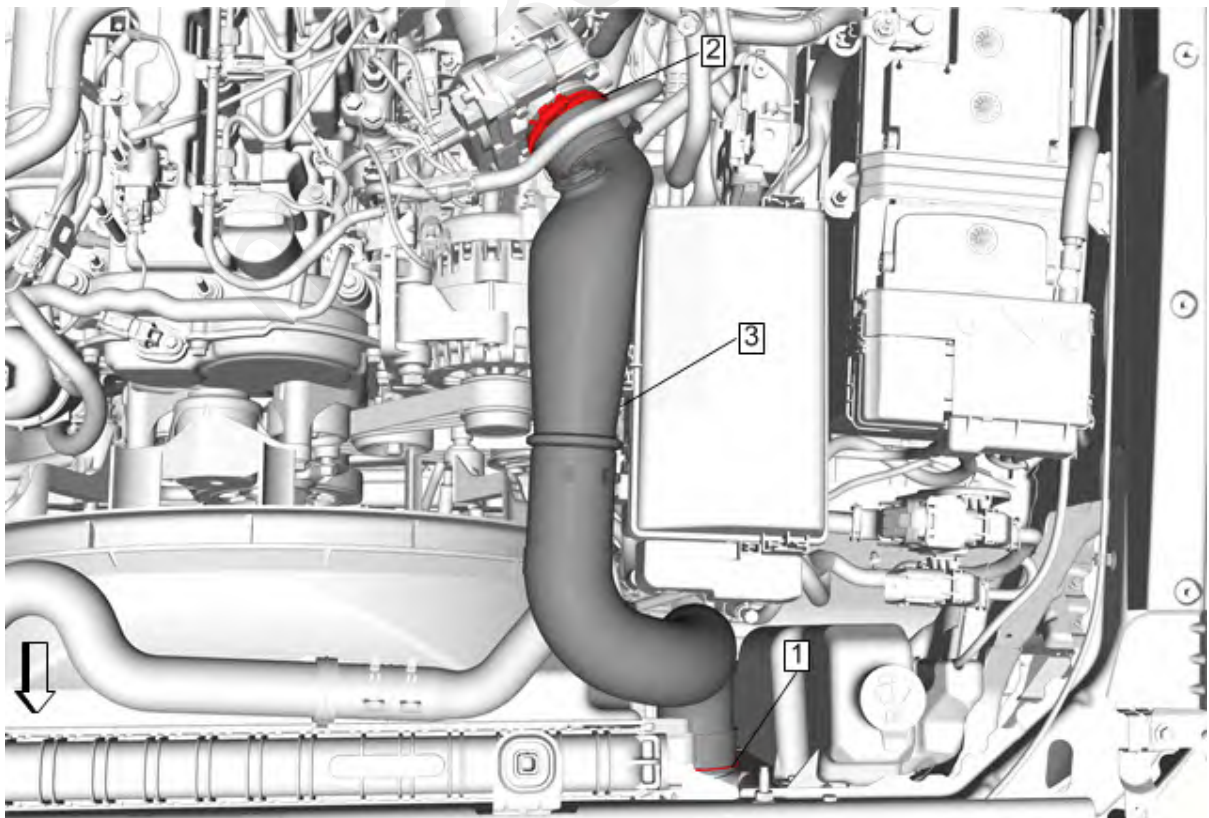


Fig. 240: Charge Air Cooler Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Outlet Duct (3) @Charge Air Cooler [Charge Air Cooler Outlet Duct Replacement](#)

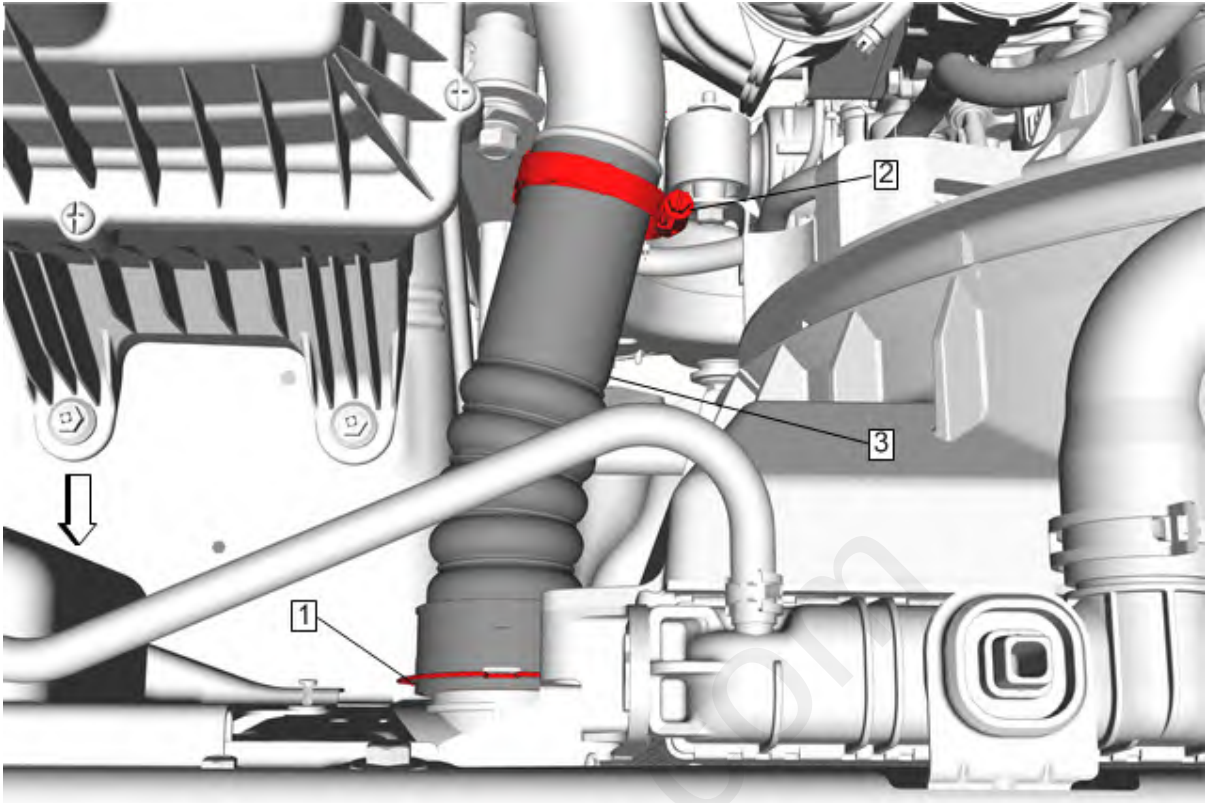


Fig. 241: Charge Air Cooler Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

9. Install Charge Air Cooler Inlet Hose (3) @Charge Air Cooler [Charge Air Cooler Inlet Hose Replacement](#)

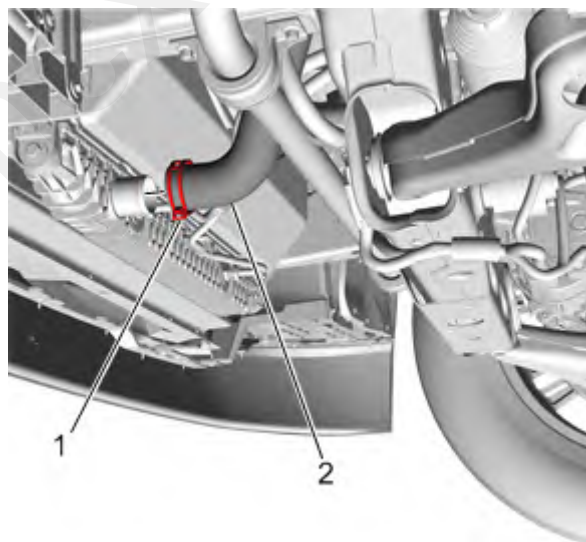


Fig. 242: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Install Radiator Outlet Hose (2) @Radiator [Radiator Outlet Hose Replacement \(LFX\)](#)[Radiator Outlet Hose Replacement \(LCV\)](#)[Radiator Outlet Hose Replacement \(LWN\)](#)

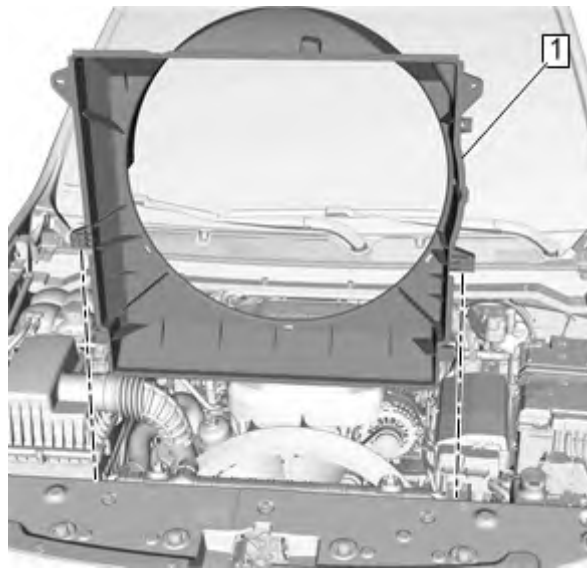


Fig. 243: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

11. Install Engine Coolant Fan Shroud (1) [Engine Coolant Fan Shroud Replacement \(LFX\)Engine Coolant Fan Shroud Replacement \(LCV\)Engine Coolant Fan Shroud Replacement \(LWN\)](#)

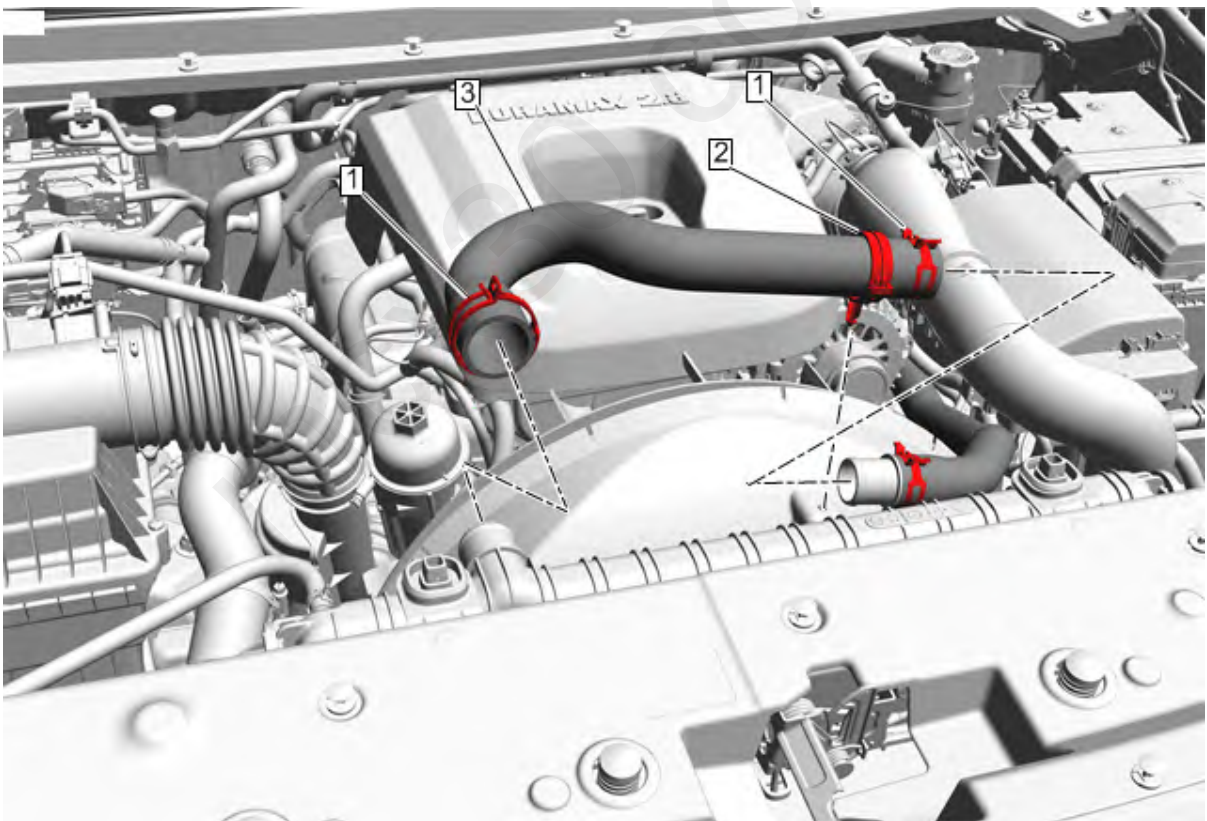


Fig. 244: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

12. Install Radiator Inlet Hose (1) @Radiator [Radiator Inlet Hose Replacement \(LFX\)Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)Radiator Inlet Hose Replacement \(Radiator Side LWN\)Radiator Inlet Hose Replacement \(Engine Side LWN\)](#)
13. Recharge the refrigerant. [Refrigerant Recovery and Recharging](#)

cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

15. Start the engine and check for coolant leaks.

RADIATOR REPLACEMENT (LFX)

Removal Procedure

1. Drain the engine cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)

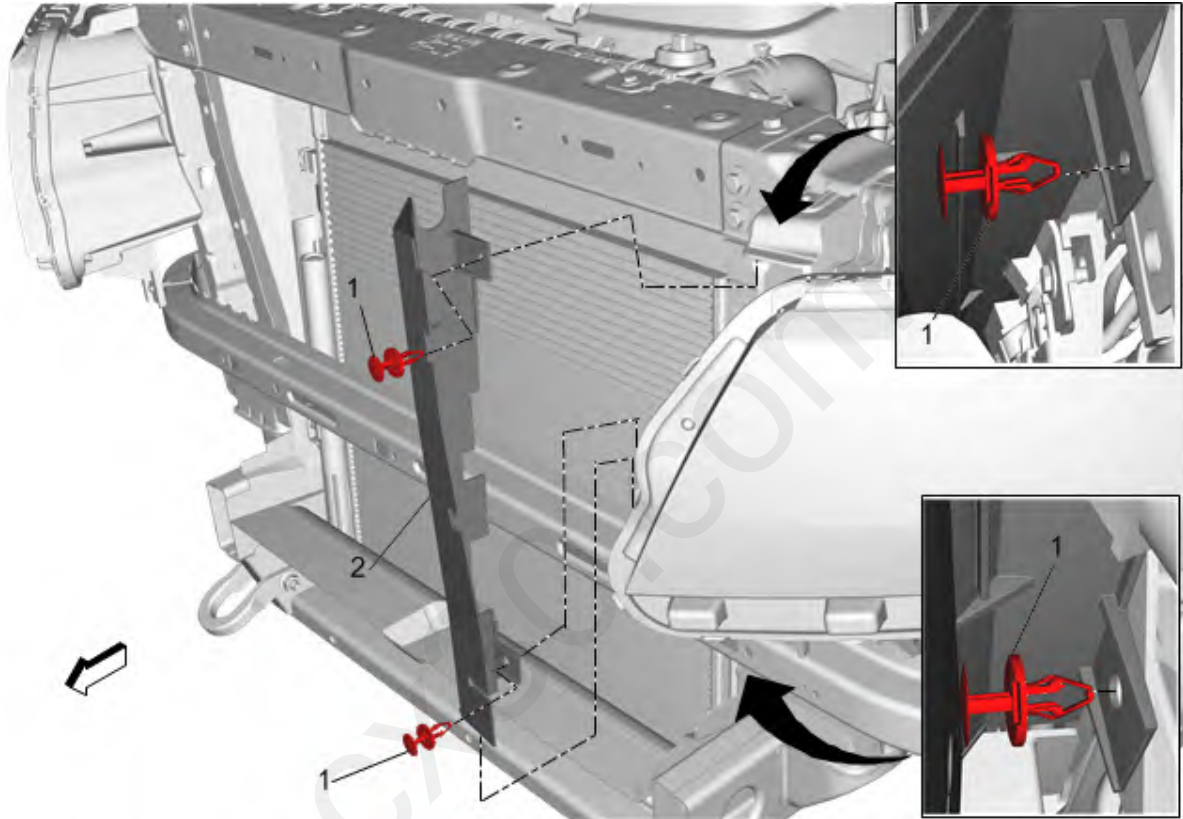


Fig. 245: Left Side Radiator Air Side Baffle

Courtesy of GENERAL MOTORS COMPANY

2. Remove the left side radiator air side baffle (2). [Radiator Air Side Baffle Replacement - Left Side](#)

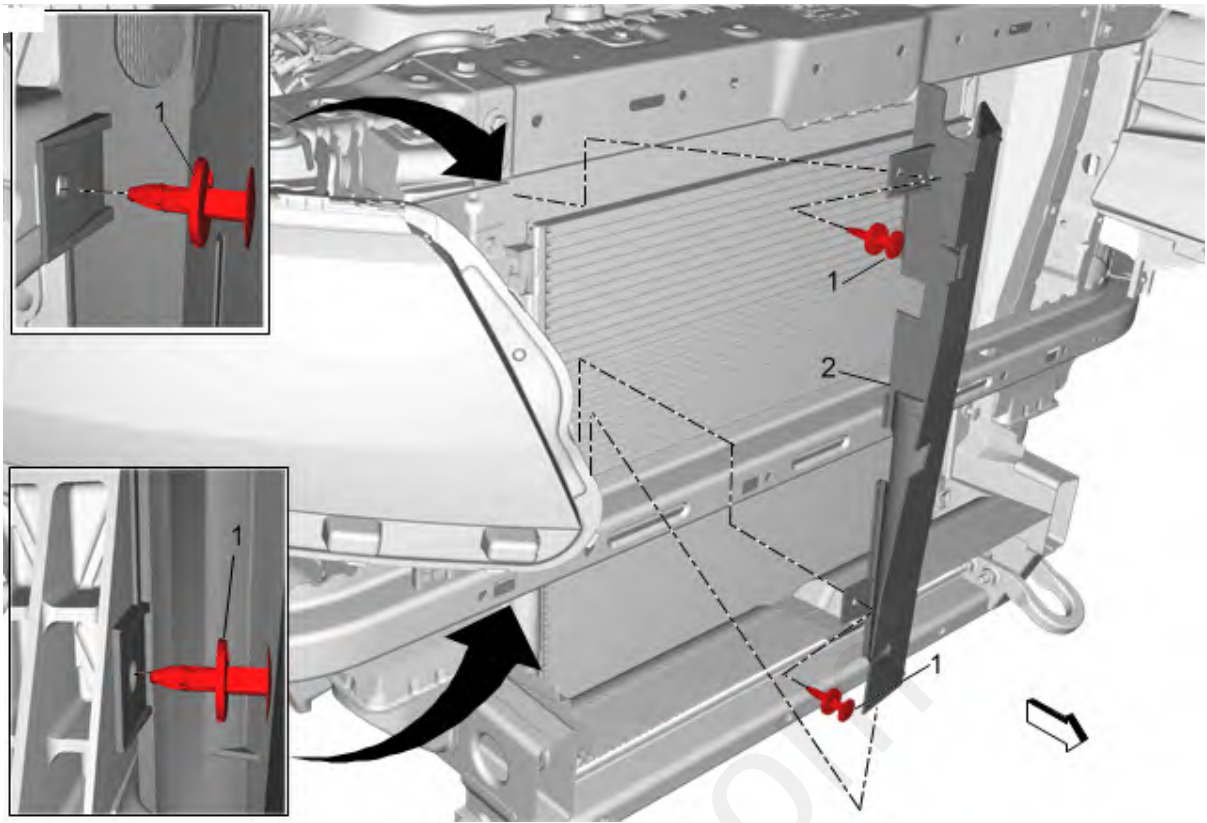


Fig. 246: Right Side Radiator Air Side Baffle
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the right side radiator air side baffle (2). [Radiator Air Side Baffle Replacement - Right Side](#)

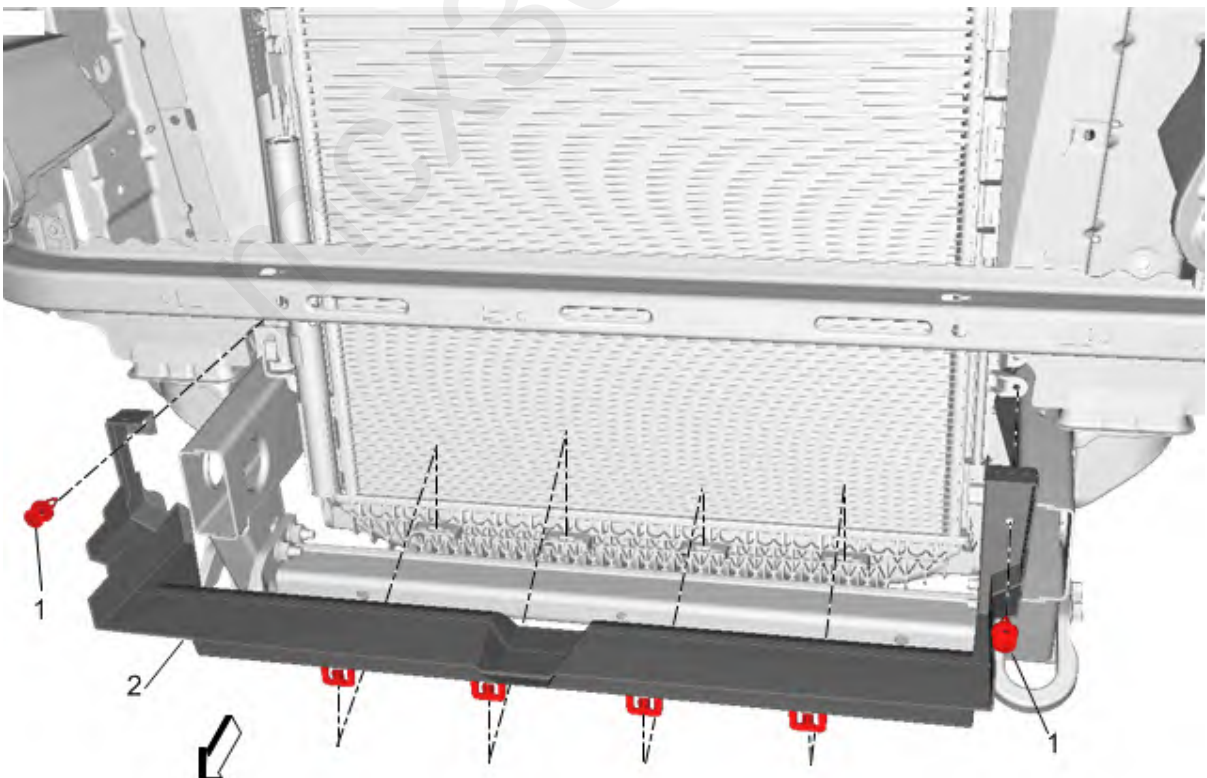


Fig. 247: Radiator Air Lower Baffle
 Courtesy of GENERAL MOTORS COMPANY

the radiator air lower baffle (2). [Radiator Air Lower Baffle Replacement](#)

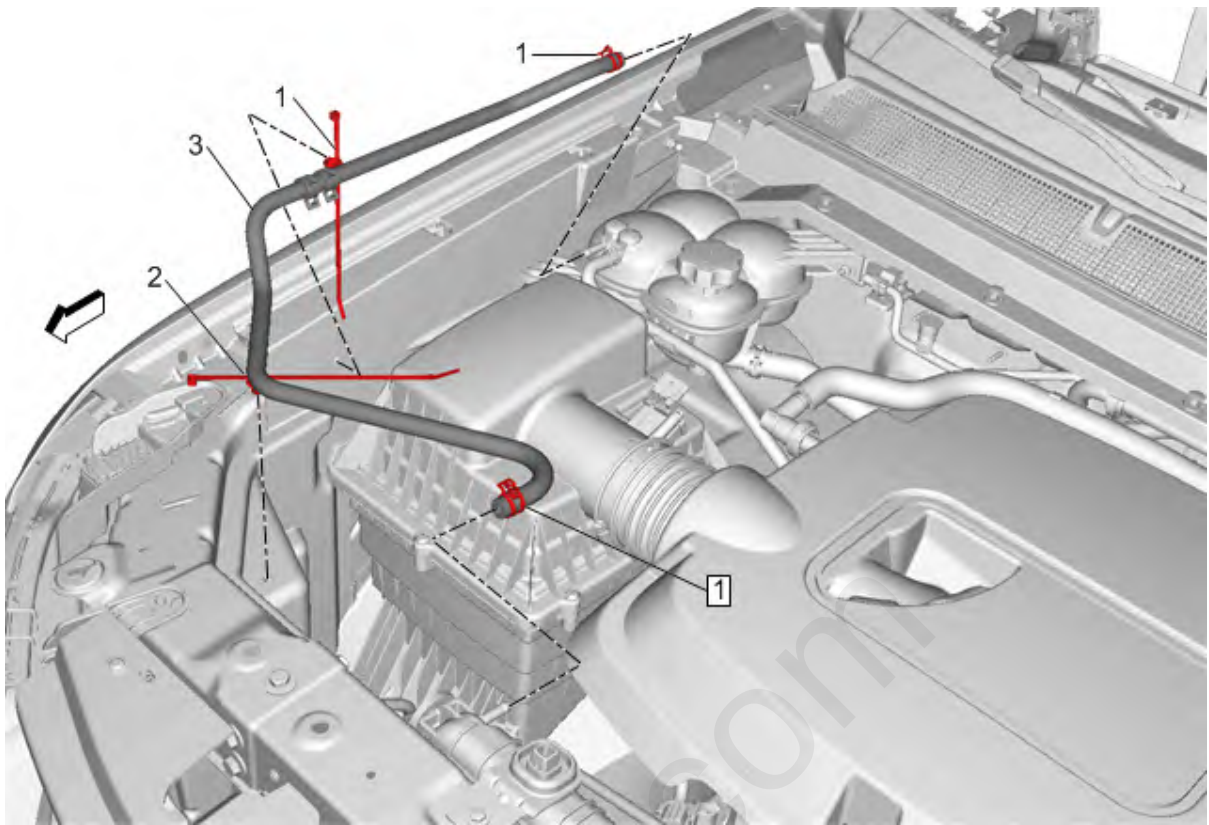
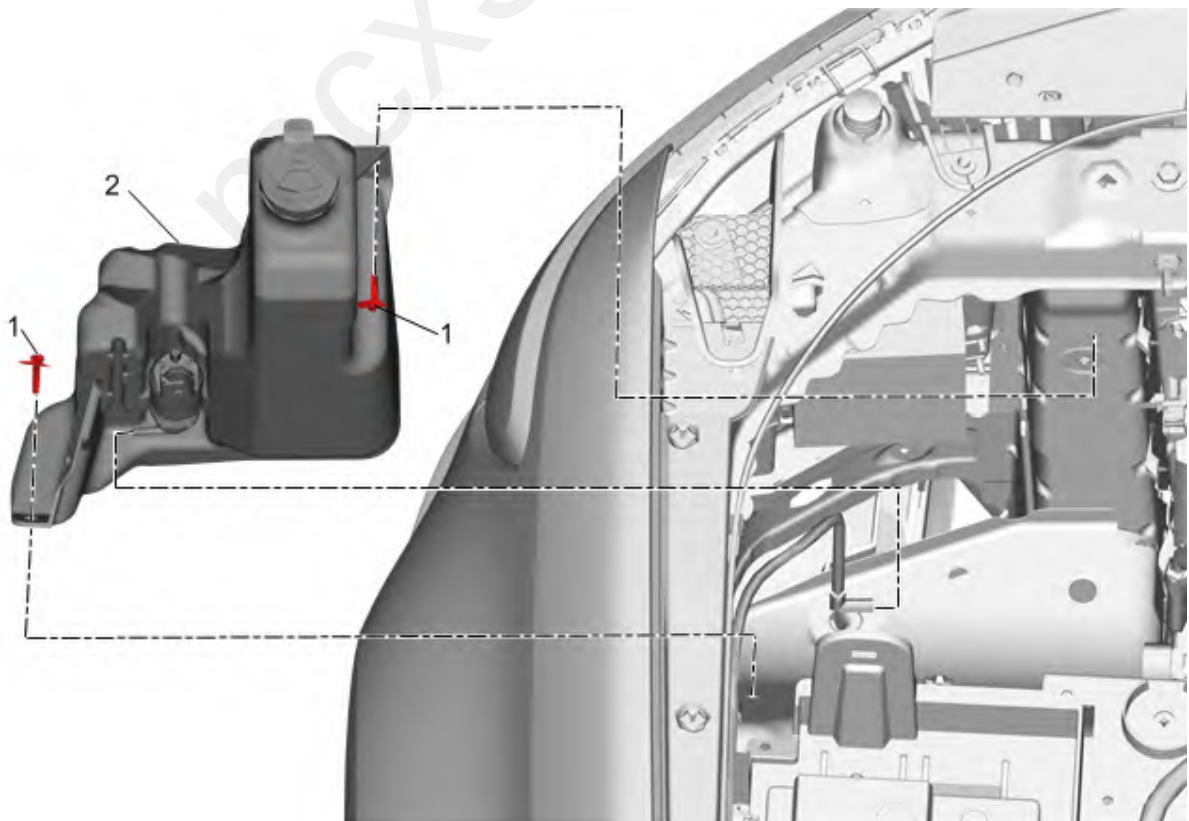


Fig. 248: Radiator Vent Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Remove the radiator vent outlet hose (3) from the radiator. [Radiator Vent Outlet Hose Replacement](#)



1: Windshield Washer Solvent Container
Courtesy of GENERAL MOTORS COMPANY

6. Remove Windshield Washer Solvent Container **Windshield Washer Solvent Container Replacement**

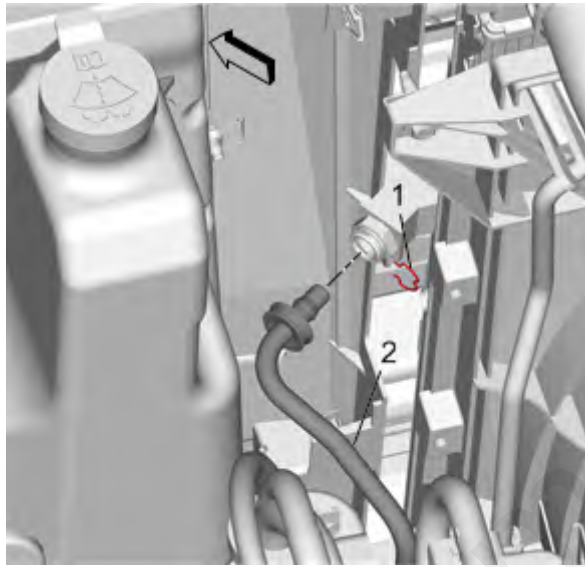


Fig. 250: Transmission Fluid Cooler Inlet And Outlet Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

7. Remove the transmission fluid cooler inlet and outlet pipe (2) from the air conditioning condenser.
Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LFX)

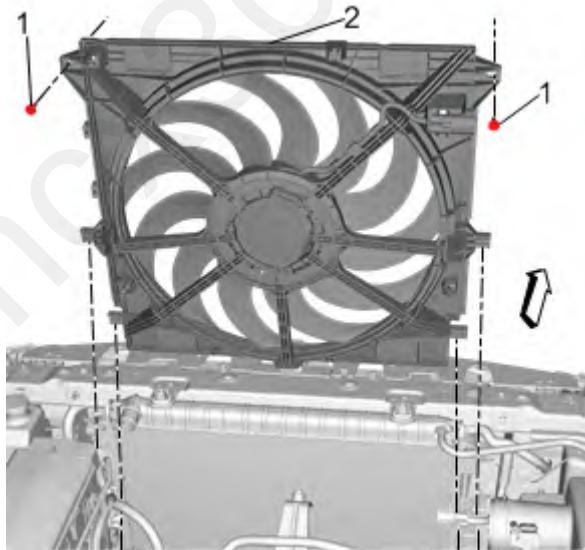


Fig. 251: Engine Coolant Fan Shroud Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the engine coolant fan shroud (2) from the radiator. **Engine Coolant Fan Shroud Replacement (LFX)**

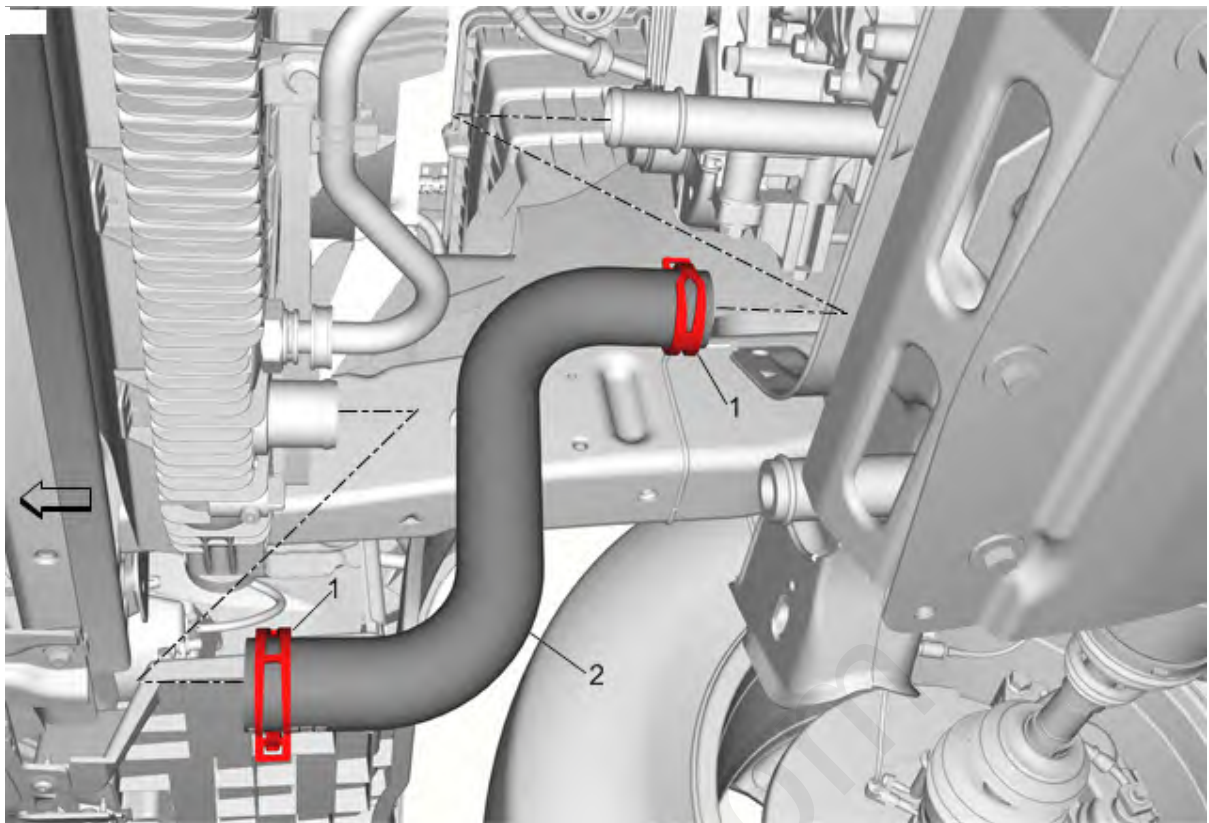
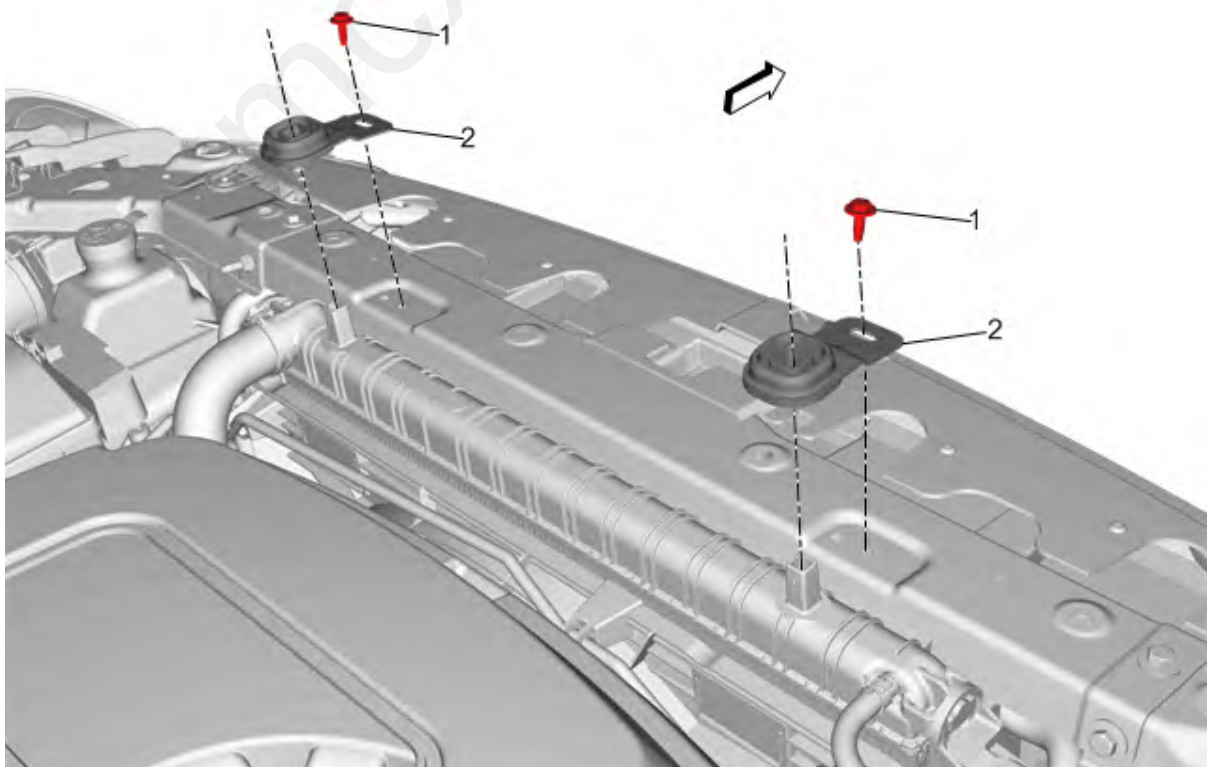


Fig. 252: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Remove the radiator outlet hose (2) from the radiator. [Radiator Outlet Hose Replacement \(LFX\)](#)
10. Remove the engine oil cooler inlet hose from the radiator. [Engine Oil Cooler Inlet Hose Replacement](#)
11. Remove the engine oil cooler outlet hose from the radiator. [Engine Oil Cooler Outlet Hose Replacement](#)



1: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

12. Remove the radiator upper brackets. **Radiator Upper Bracket Replacement**

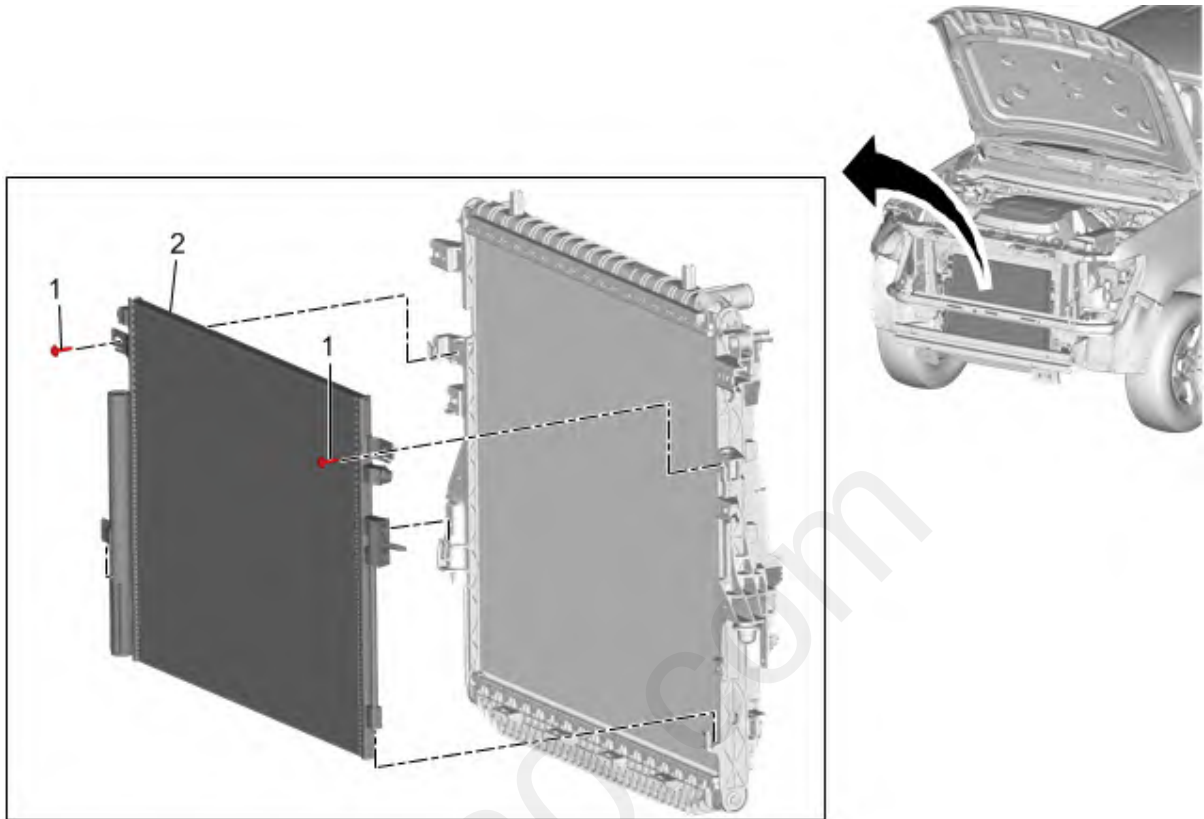


Fig. 254: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

13. Remove the air conditioning condenser bolts (1). **Air Conditioning Condenser Replacement**
14. Without removing the air conditioning evaporative connector hose/tube and compressor and condenser hose, position the air conditioning condenser (2) forward off of the radiator.

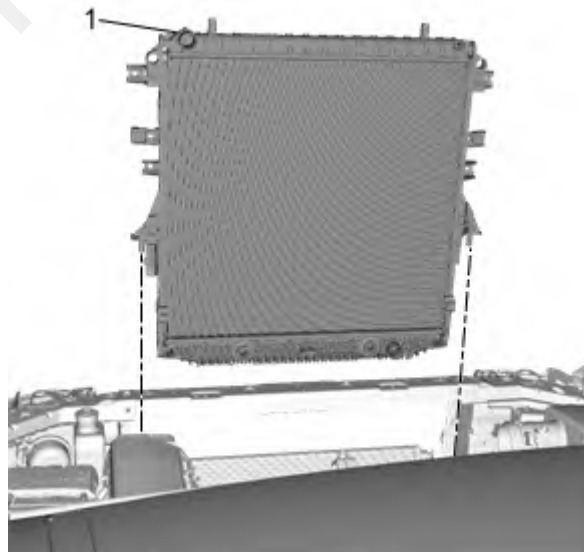


Fig. 255: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

radiator assembly (1) back, and lift up to remove the radiator assembly from the vehicle.

16. Transfer components as necessary.

Installation Procedure

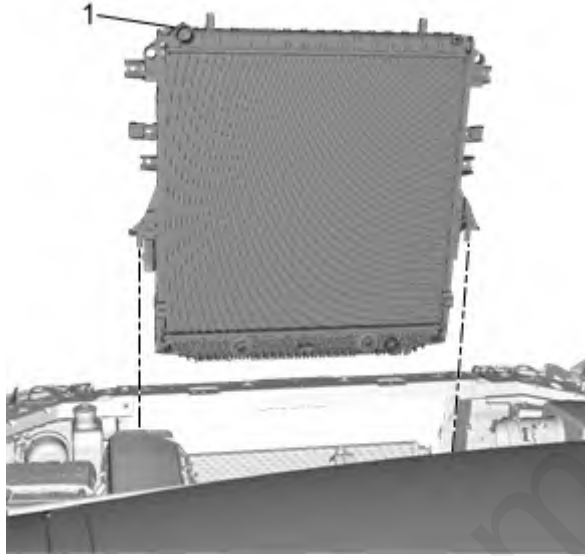


Fig. 256: Radiator Assembly

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator assembly (1) into the vehicle.

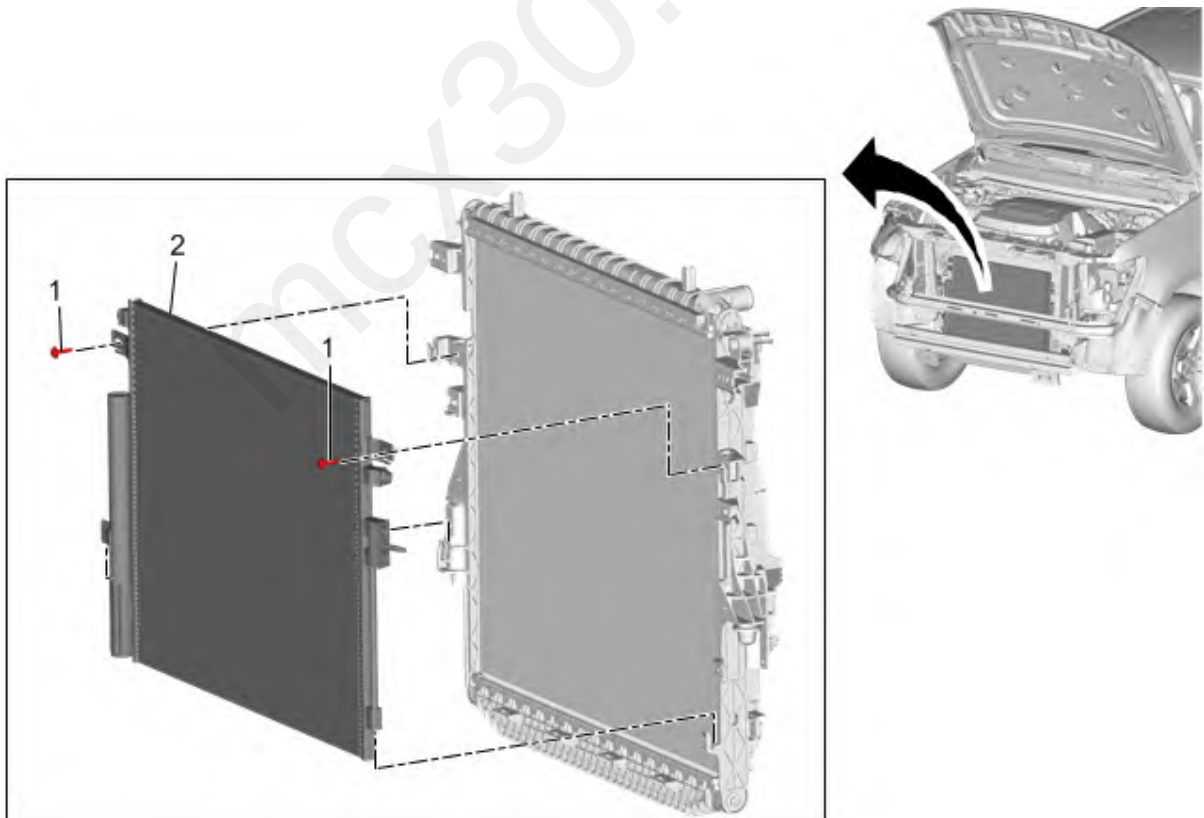


Fig. 257: Air Conditioning Condenser

Courtesy of GENERAL MOTORS COMPANY

2. Position the air conditioning condenser (2) onto the radiator.

ie air conditioning condenser bolts (1). [Air Conditioning Condenser Replacement](#)

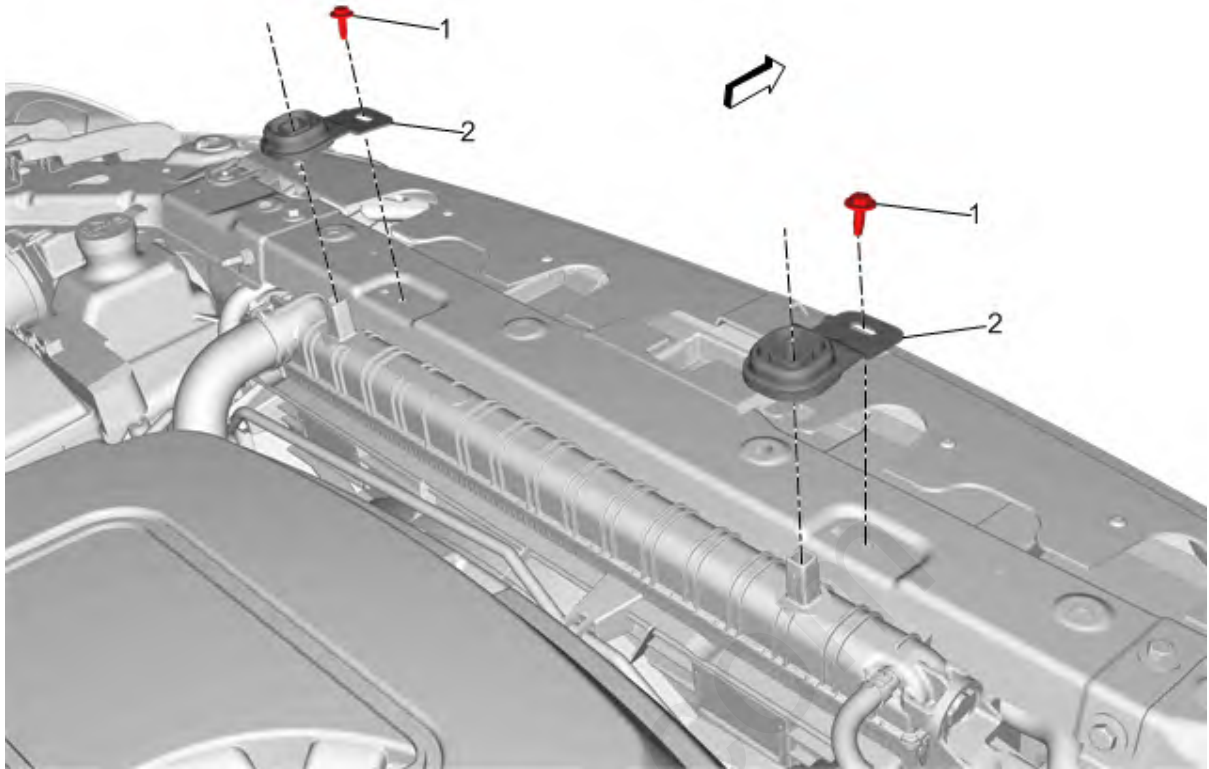


Fig. 258: Radiator Upper Brackets

Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator upper brackets. [Radiator Upper Bracket Replacement](#)
5. Install the engine oil cooler outlet hose to the radiator. [Engine Oil Cooler Outlet Hose Replacement](#)
6. Install the engine oil cooler inlet hose to the radiator. [Engine Oil Cooler Inlet Hose Replacement](#)

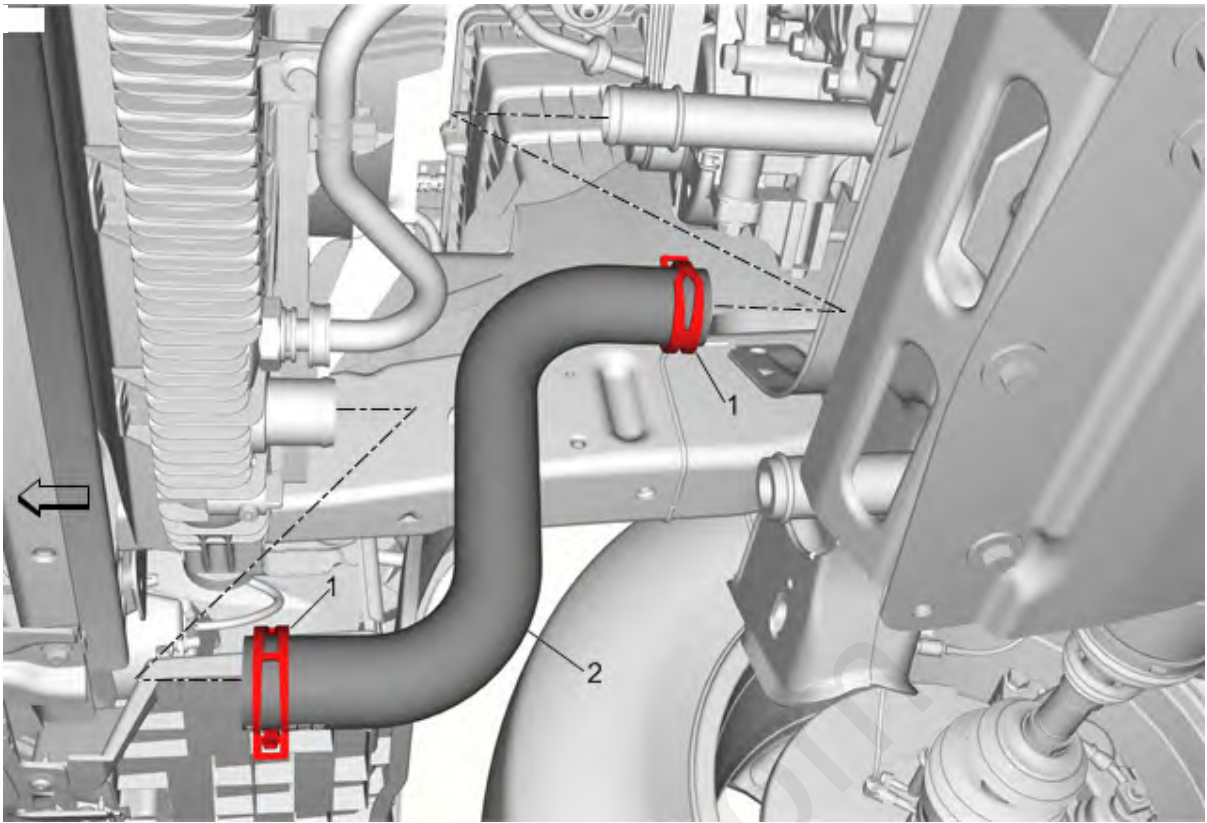


Fig. 259: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install the radiator outlet hose (2) to the radiator. **Radiator Outlet Hose Replacement (LFX)**

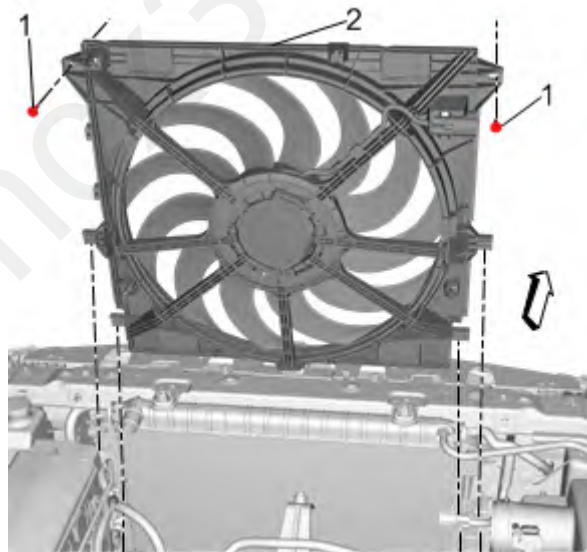


Fig. 260: Engine Coolant Fan Shroud Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Install the engine coolant fan shroud (2) to the radiator. **Engine Coolant Fan Shroud Replacement (LFX)**

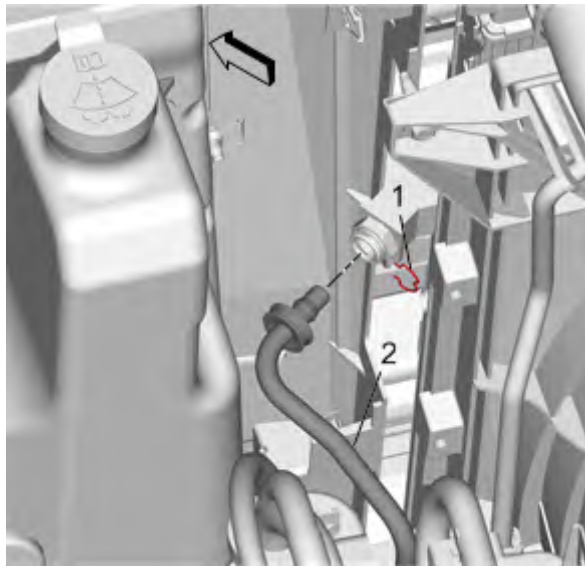


Fig. 261: Transmission Fluid Cooler Inlet And Outlet Pipe Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

9. Install the transmission fluid cooler inlet and outlet pipe (2) to the air conditioning condenser. **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LFX)**

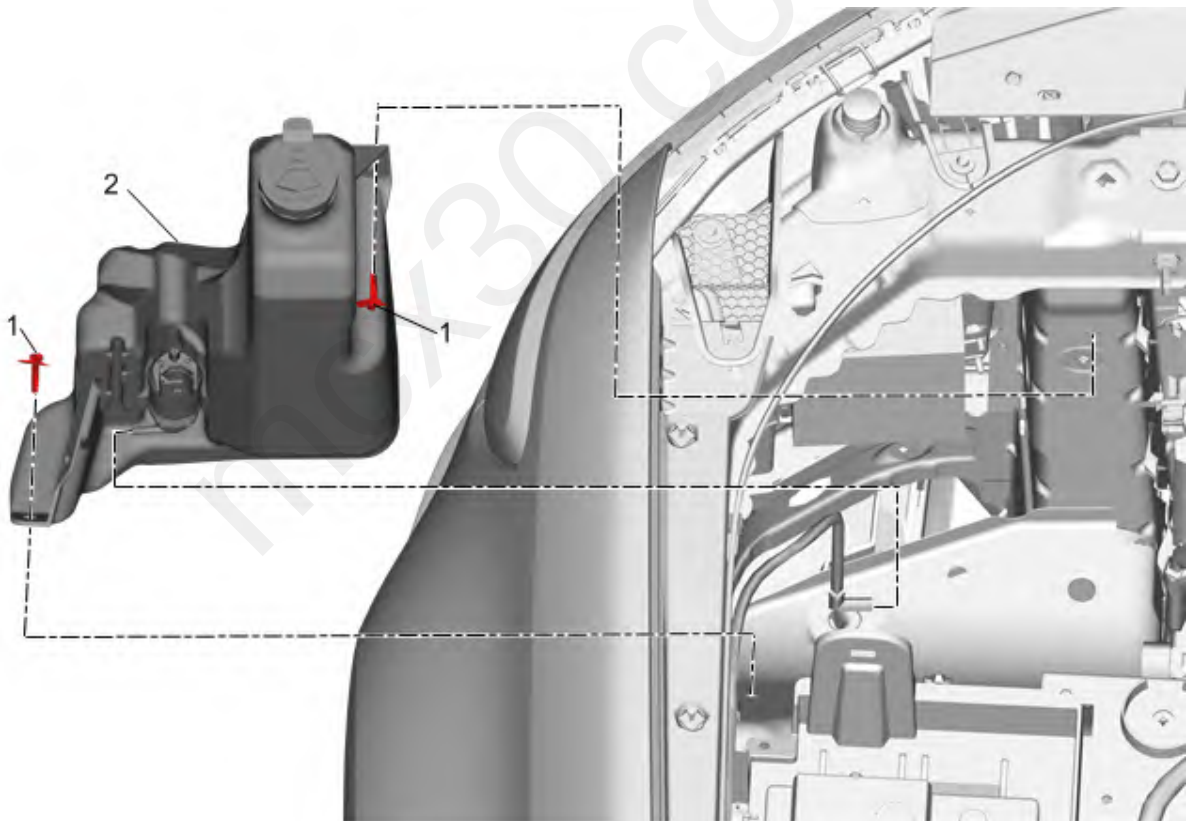


Fig. 262: Windshield Washer Solvent Container
 Courtesy of GENERAL MOTORS COMPANY

10. Install Windshield Washer Solvent Container. **Windshield Washer Solvent Container Replacement**

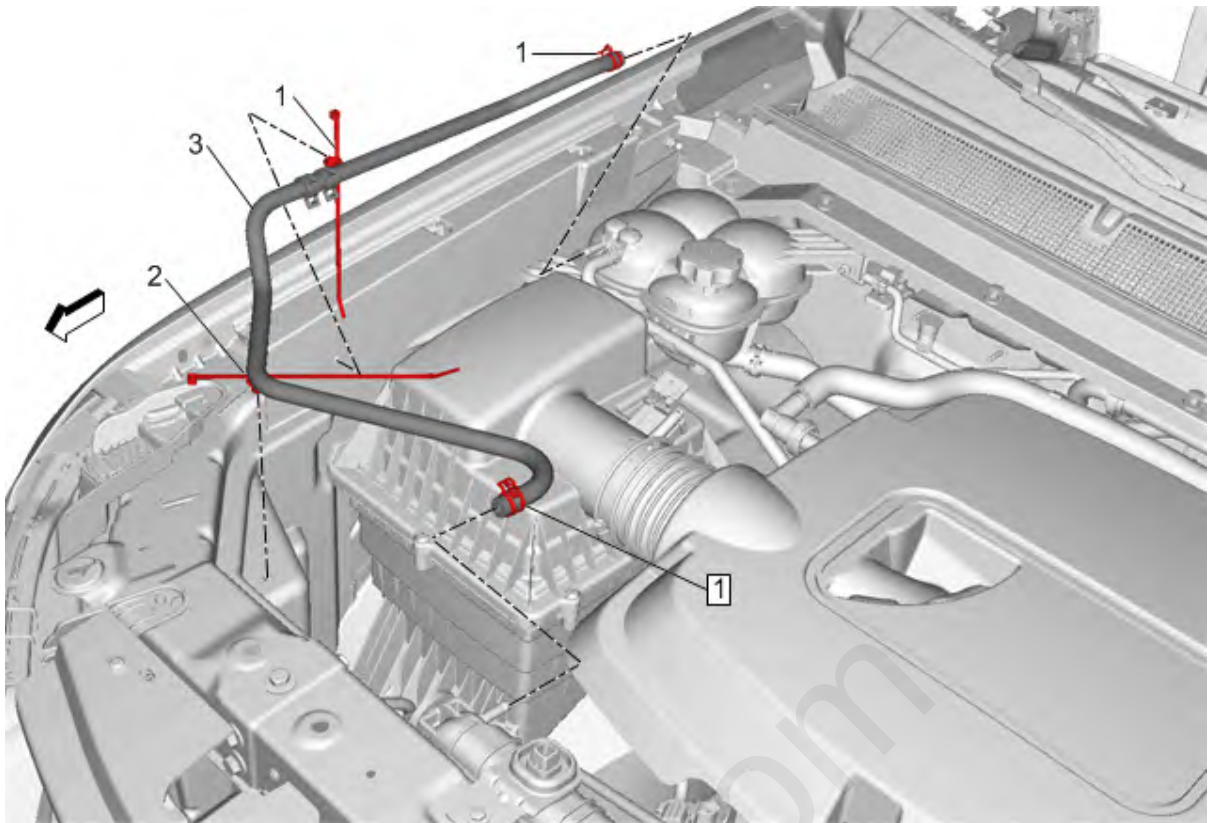


Fig. 263: Radiator Vent Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

11. Install the radiator vent outlet hose (3) to the radiator. [Radiator Vent Outlet Hose Replacement](#)

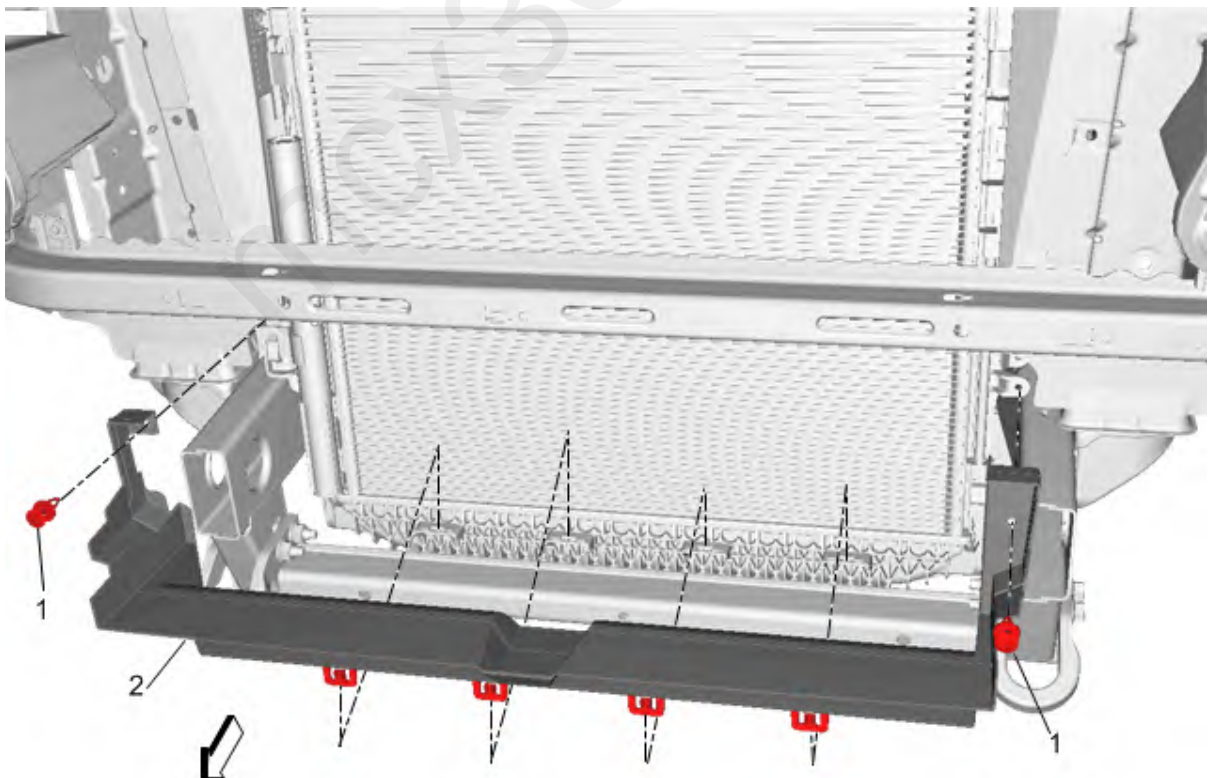


Fig. 264: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

ie radiator air lower baffle (2). [Radiator Air Lower Baffle Replacement](#)

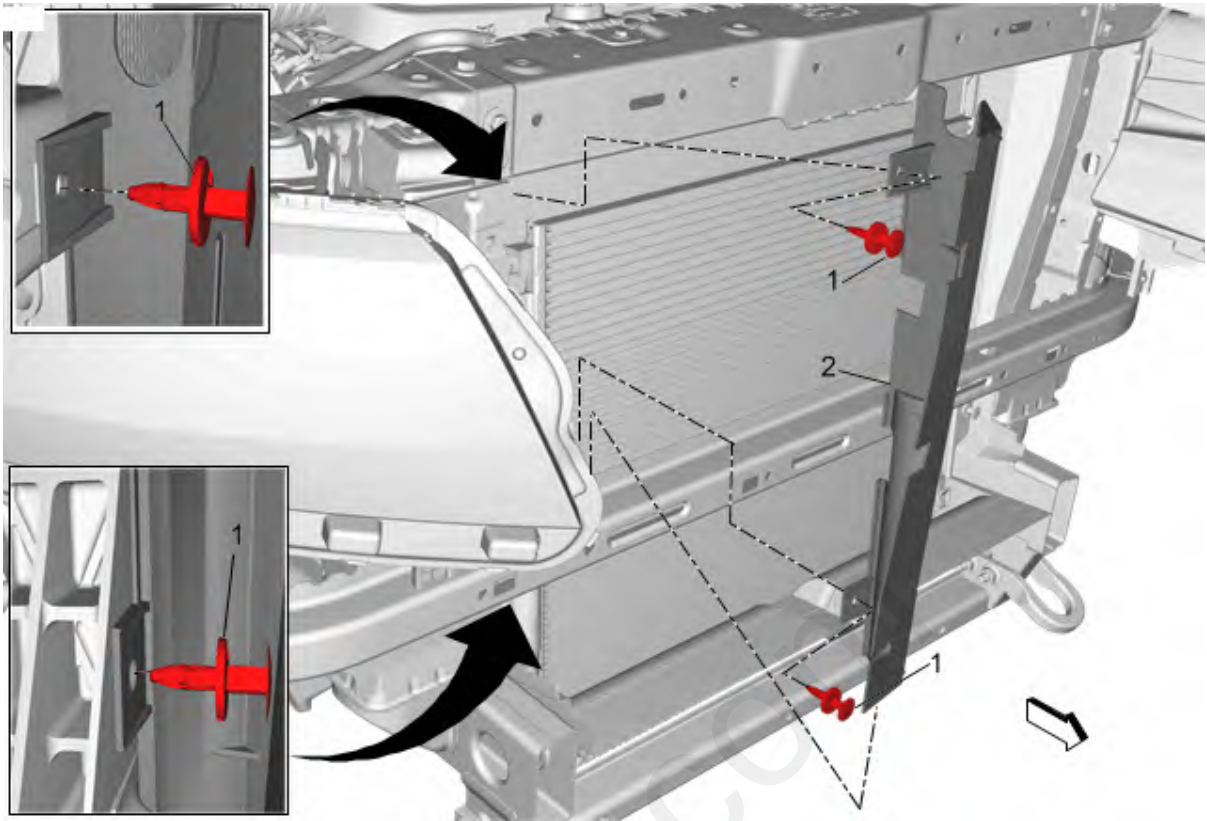


Fig. 265: Right Side Radiator Air Side Baffle
Courtesy of GENERAL MOTORS COMPANY

13. Install the right side radiator air side baffle (2). [Radiator Air Side Baffle Replacement - Right Side](#)

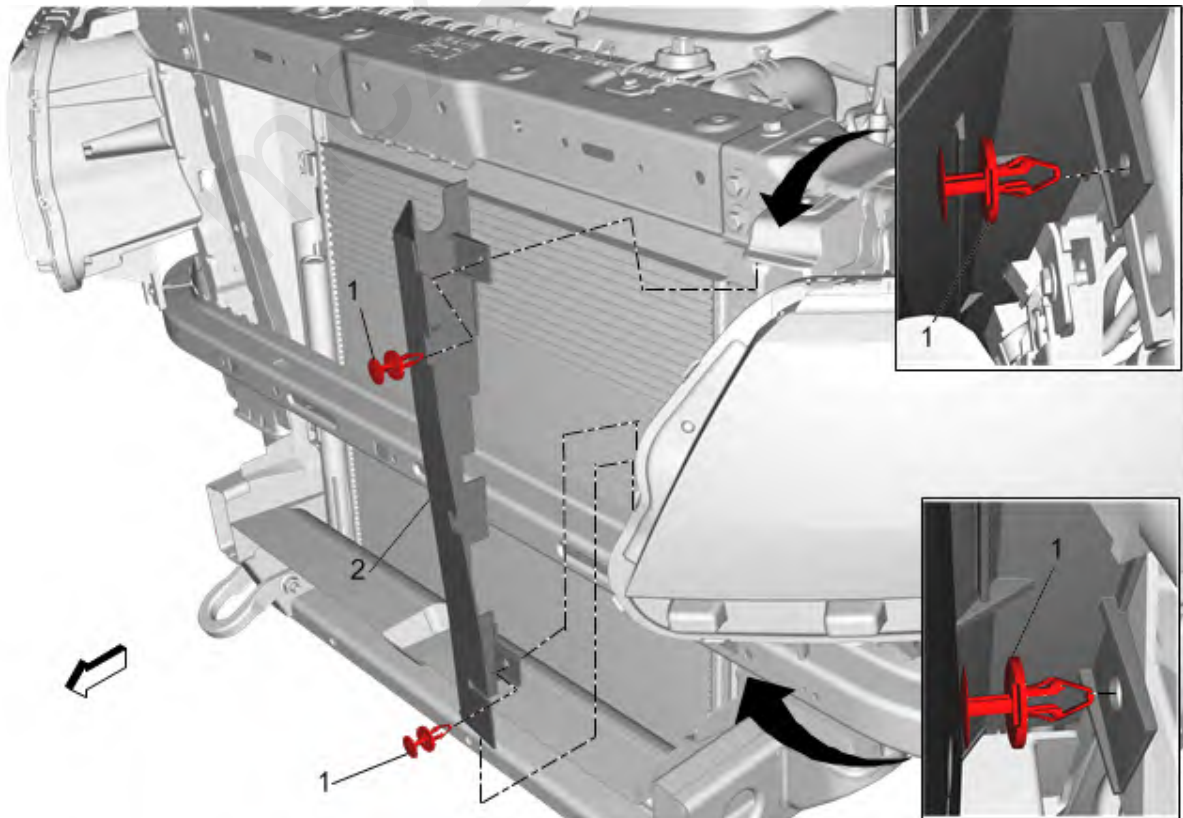


Fig. 267: Left Side Radiator Air Side Baffle
Courtesy of GENERAL MOTORS COMPANY

14. Install the left side radiator air side baffle (2). [Radiator Air Side Baffle Replacement - Left Side](#)
15. Fill the engine cooling system. [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#)
16. Check the cooling system for leaks.

RADIATOR REPLACEMENT (LCV)

Removal Procedure

1. Drain the engine cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).

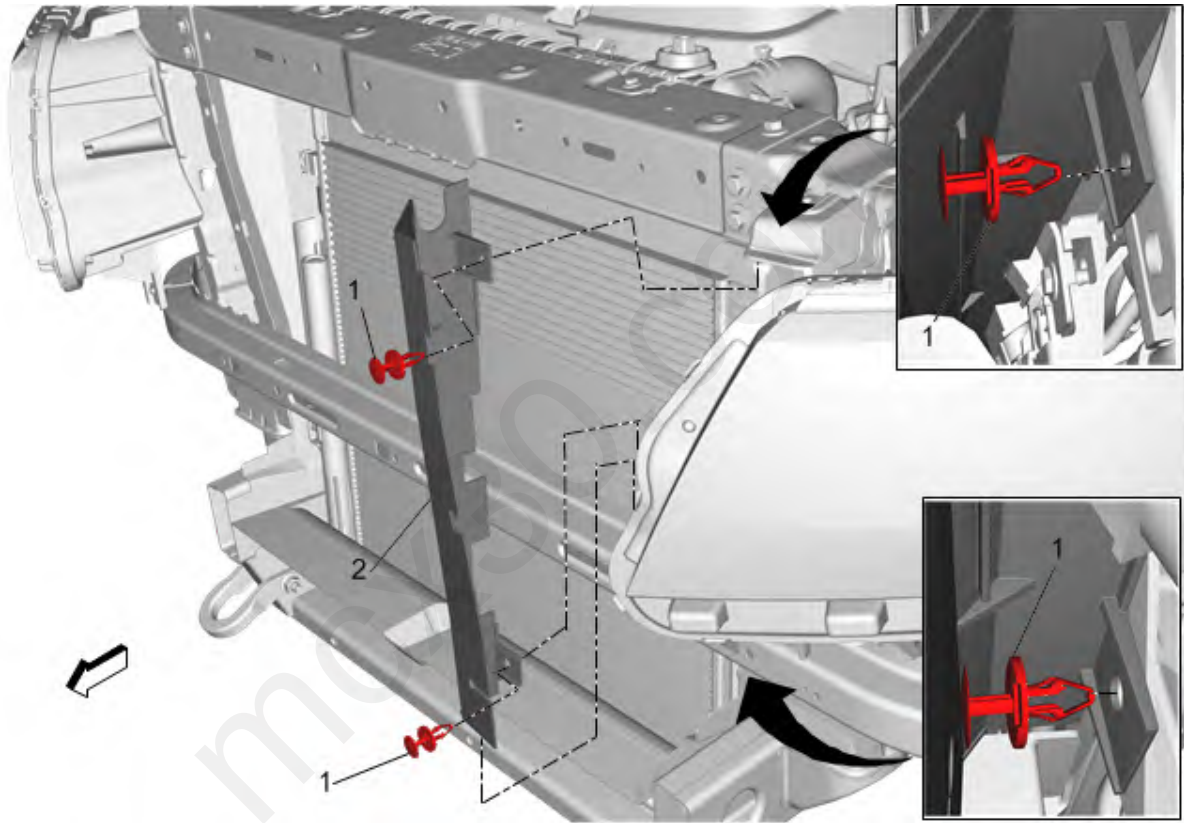


Fig. 267: Left Side Radiator Air Side Baffle
Courtesy of GENERAL MOTORS COMPANY

2. Remove the left side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Left Side](#).

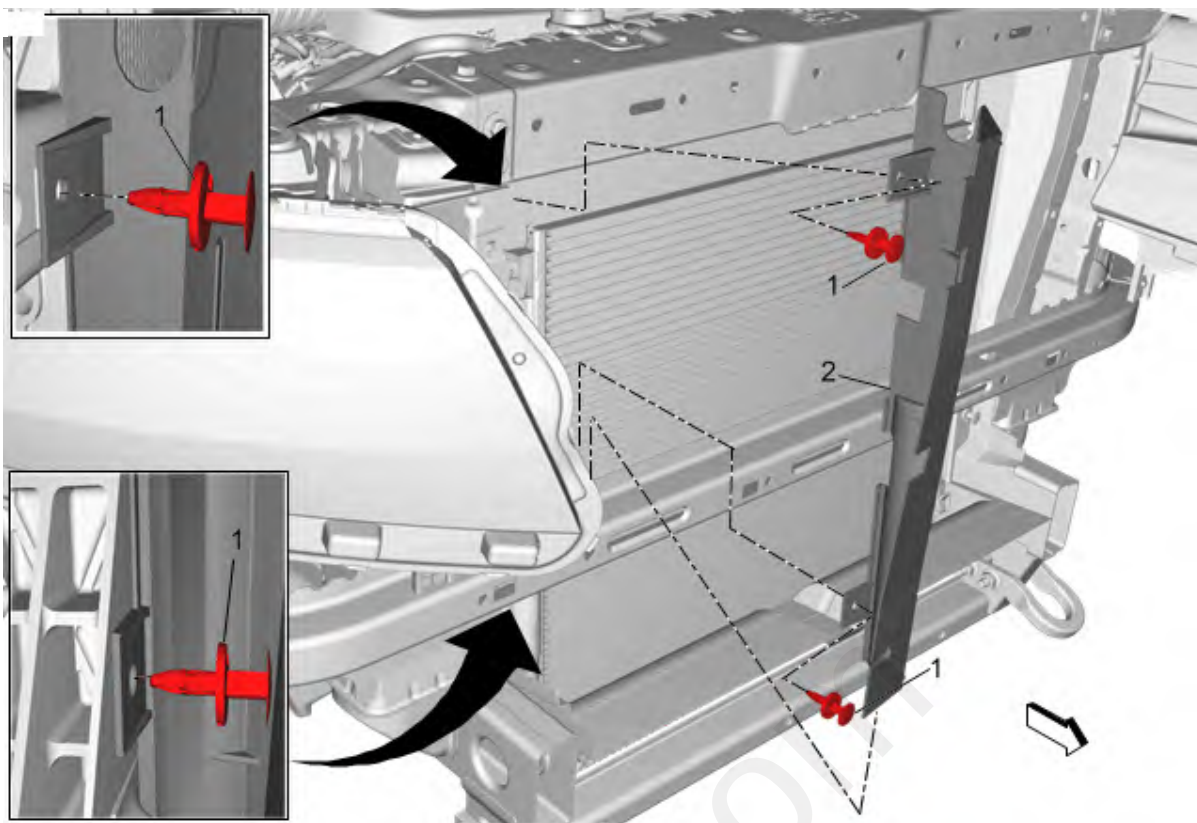
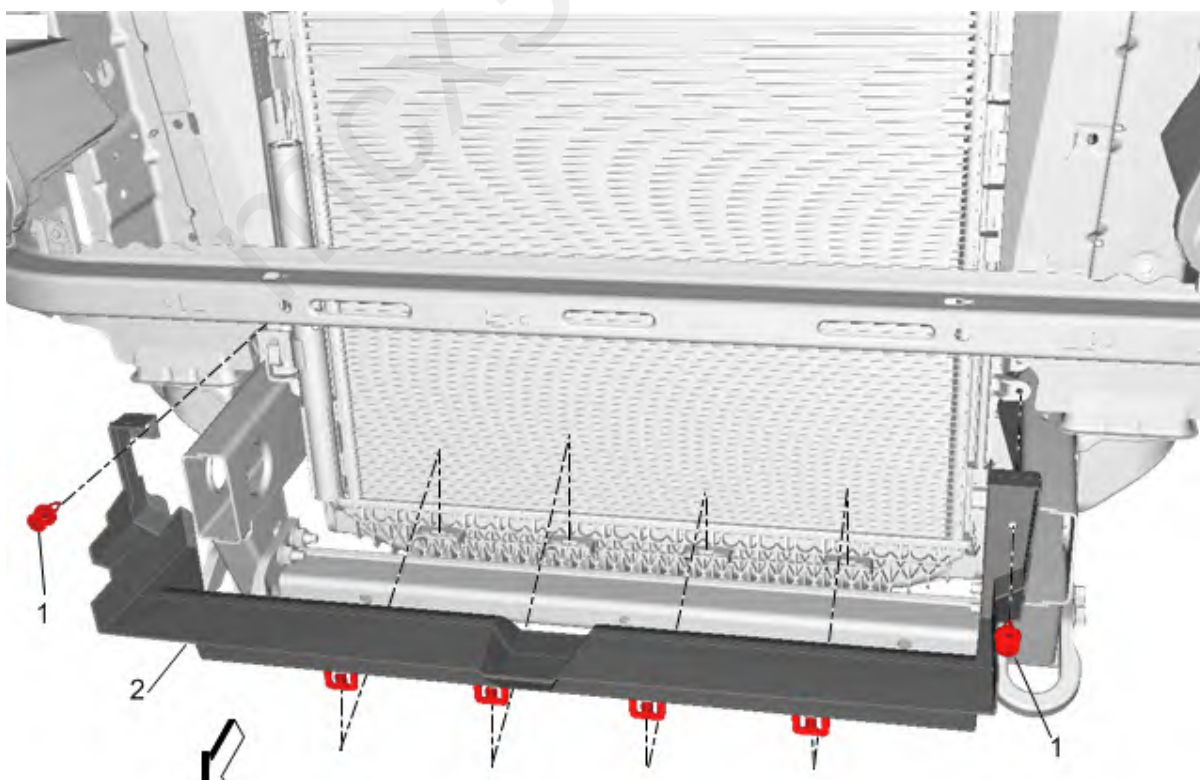


Fig. 268: Right Side Radiator Air Side Baffle
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the right side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Right Side](#).



1: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

4. Remove the radiator air lower baffle (2). Refer to [Radiator Air Lower Baffle Replacement \(LWN\)](#).
5. Remove the transmission fluid cooler inlet and outlet pipe from the air conditioning condenser if equipped. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LCV\)](#).

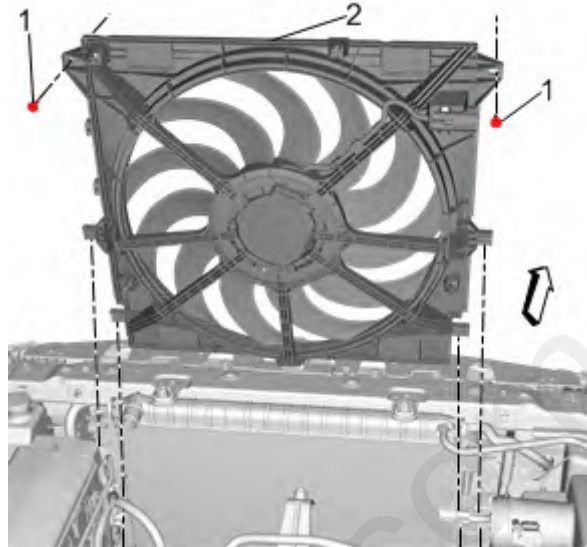


Fig. 270: Engine Coolant Fan Shroud Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine coolant fan shroud (2) from the radiator. Refer to [Engine Coolant Fan Shroud Replacement \(LCV\)](#).

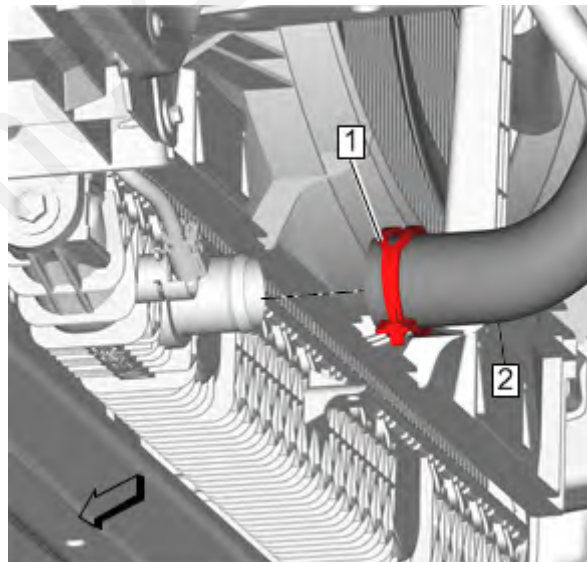


Fig. 271: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

7. Remove the radiator outlet hose (2) from the radiator. Refer to [Radiator Outlet Hose Replacement \(LCV\)](#).

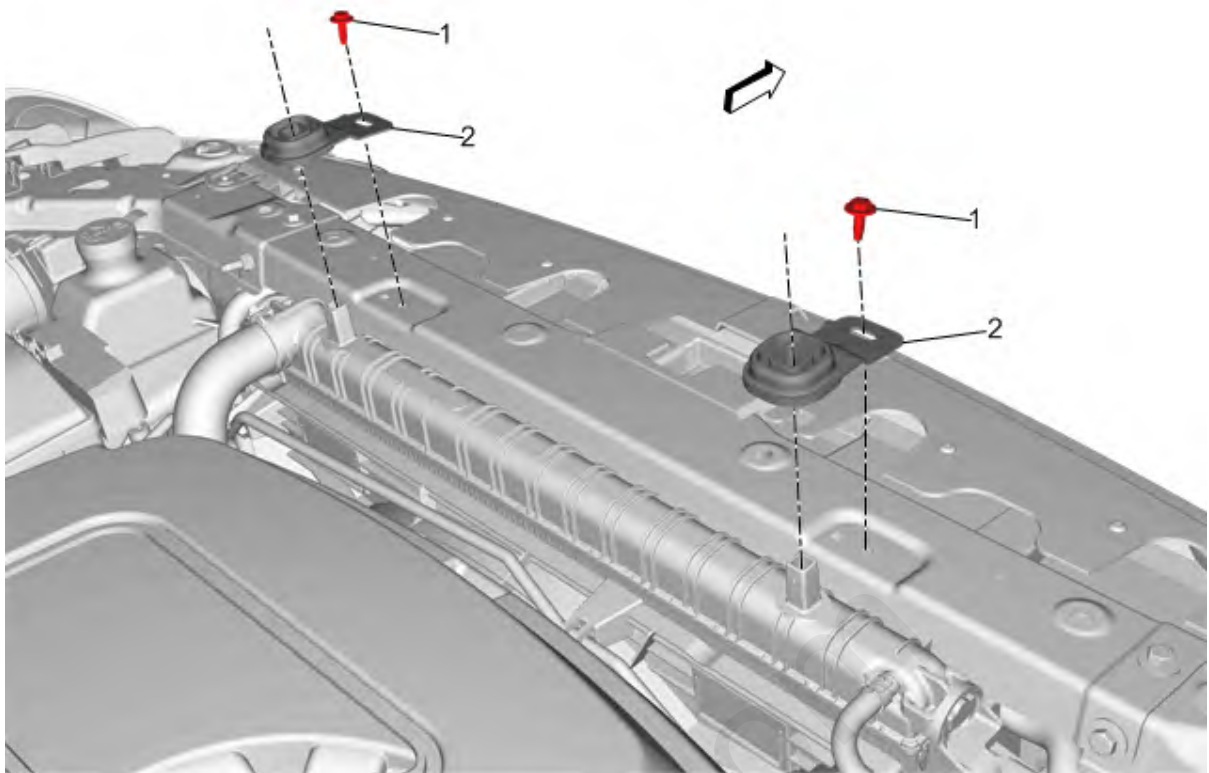


Fig. 272: Radiator Upper Brackets

Courtesy of GENERAL MOTORS COMPANY

8. Remove the radiator upper brackets. Refer to [Radiator Upper Bracket Replacement](#).

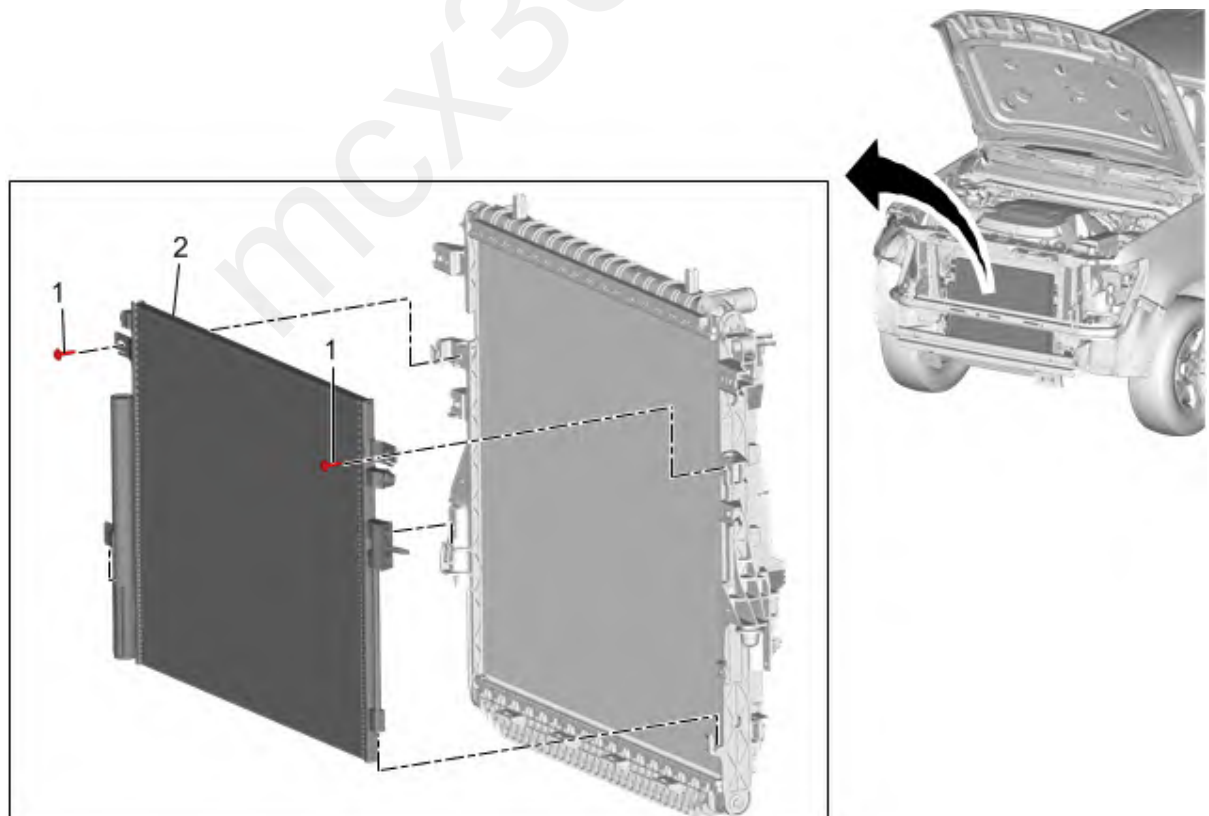


Fig. 273: Air Conditioning Condenser

Courtesy of GENERAL MOTORS COMPANY

- : the air conditioning condenser bolts (1). Refer to [Air Conditioning Condenser Replacement](#) .
10. Without removing the air conditioning evaporative connector hose/tube and compressor and condenser hose, position the air conditioning condenser (2) forward off of the radiator.

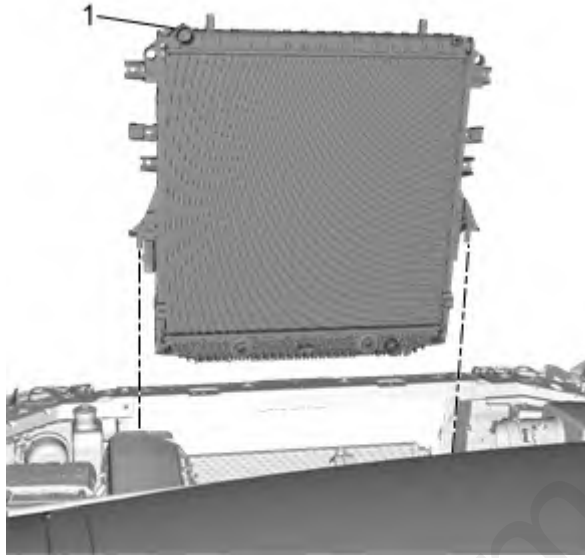


Fig. 274: Radiator Assembly

Courtesy of GENERAL MOTORS COMPANY

11. Tilt the radiator assembly (1) back, and lift up to remove the radiator assembly from the vehicle.
12. Transfer components as necessary.

Installation Procedure

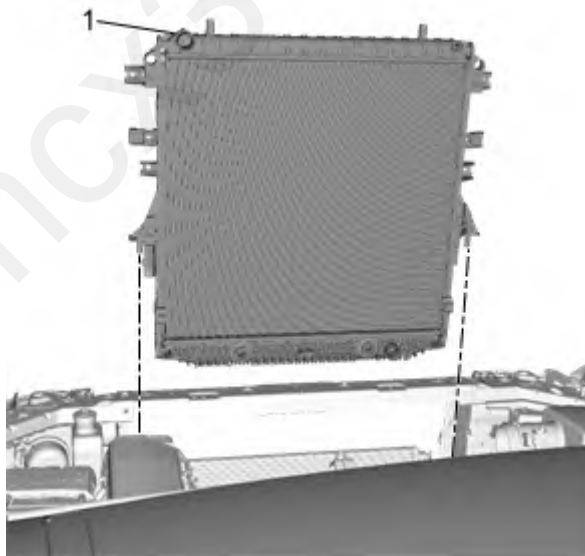


Fig. 275: Radiator Assembly

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator assembly (1) into the vehicle.

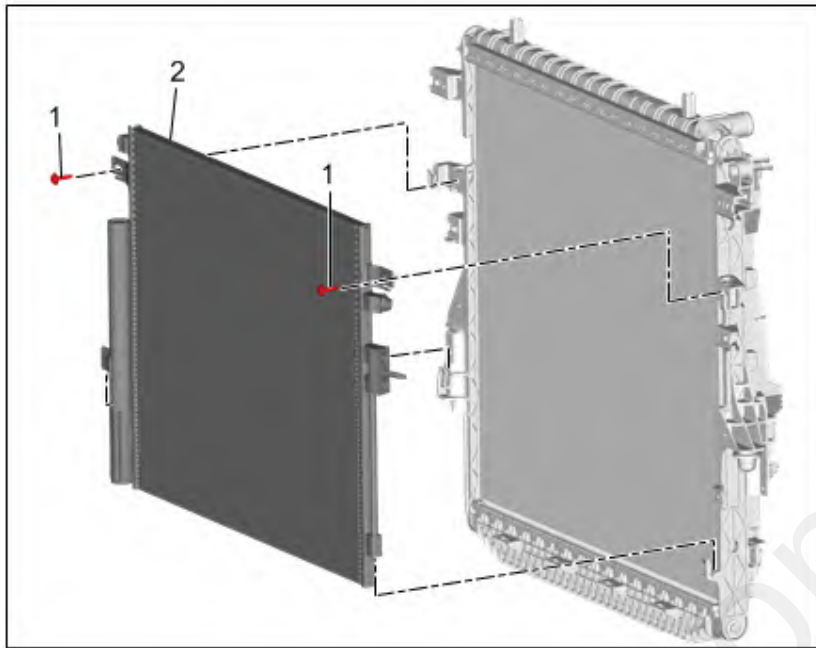
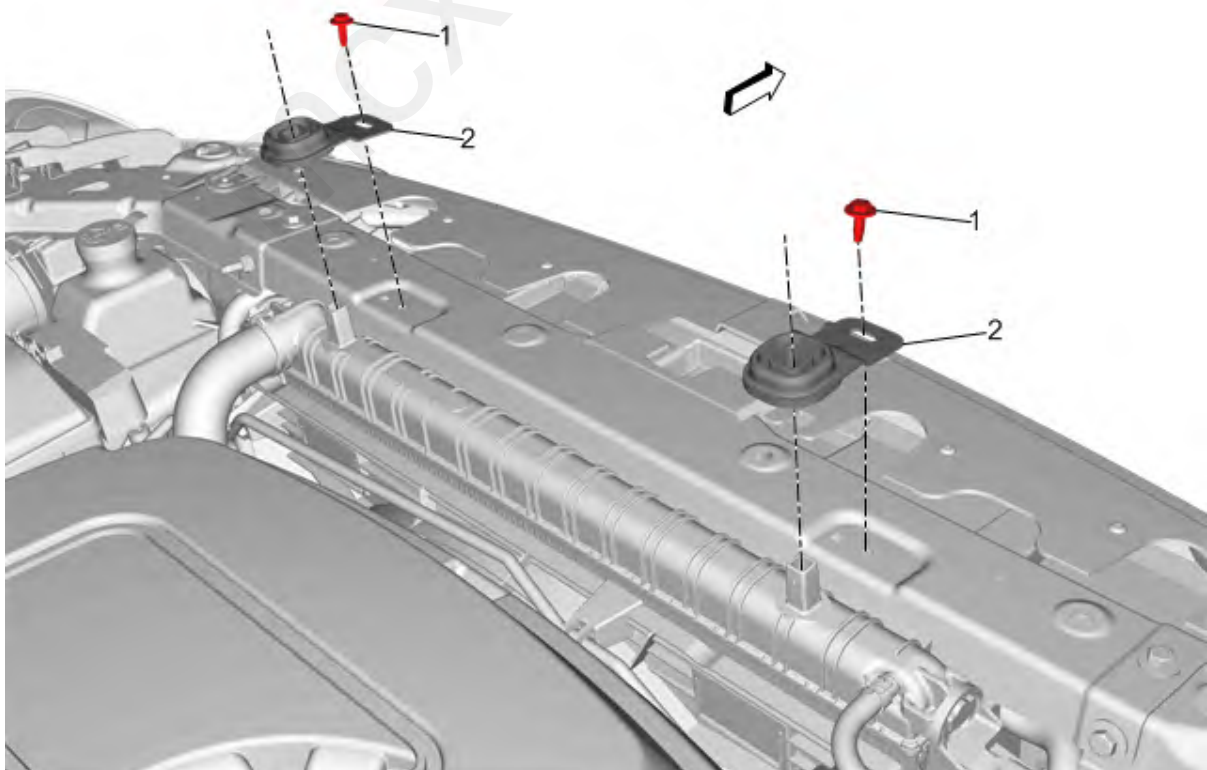


Fig. 276: Air Conditioning Condenser

Courtesy of GENERAL MOTORS COMPANY

2. Position the air conditioning condenser (2) onto the radiator.
3. Install the air conditioning condenser bolts (1). Refer to [Air Conditioning Condenser Replacement](#) .



': Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator upper brackets. Refer to [Radiator Upper Bracket Replacement](#).

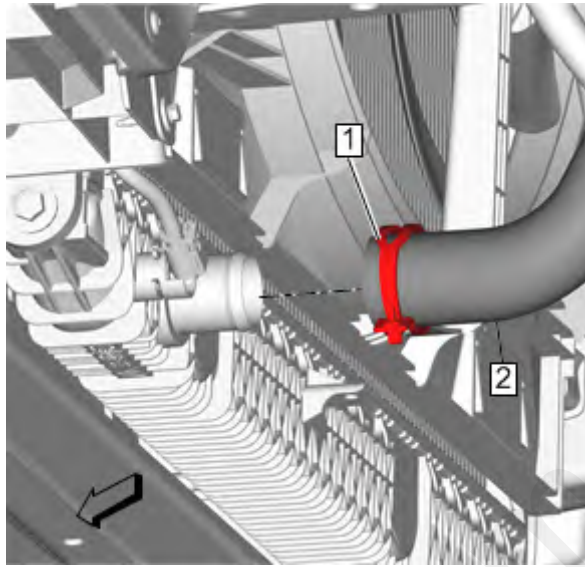


Fig. 278: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install the radiator outlet hose (2) to the radiator. Refer to [Radiator Outlet Hose Replacement \(LCV\)](#).

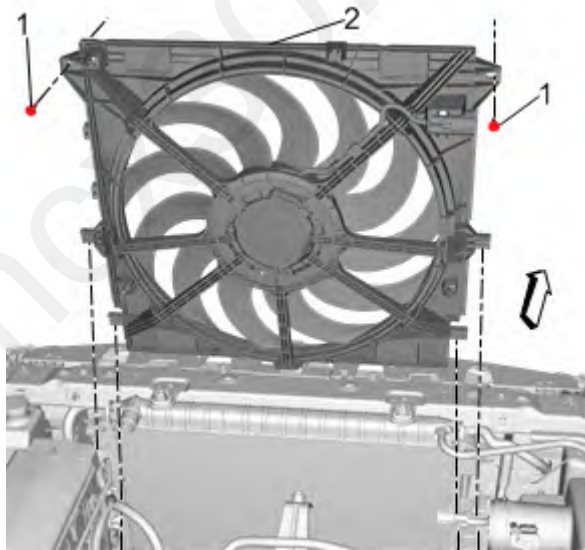


Fig. 279: Engine Coolant Fan Shroud Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the engine coolant fan shroud (2) to the radiator. Refer to [Engine Coolant Fan Shroud Replacement \(LCV\)](#).
7. Install the transmission fluid cooler inlet and outlet pipe (2) to the air conditioning condenser if equipped. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LCV\)](#) .

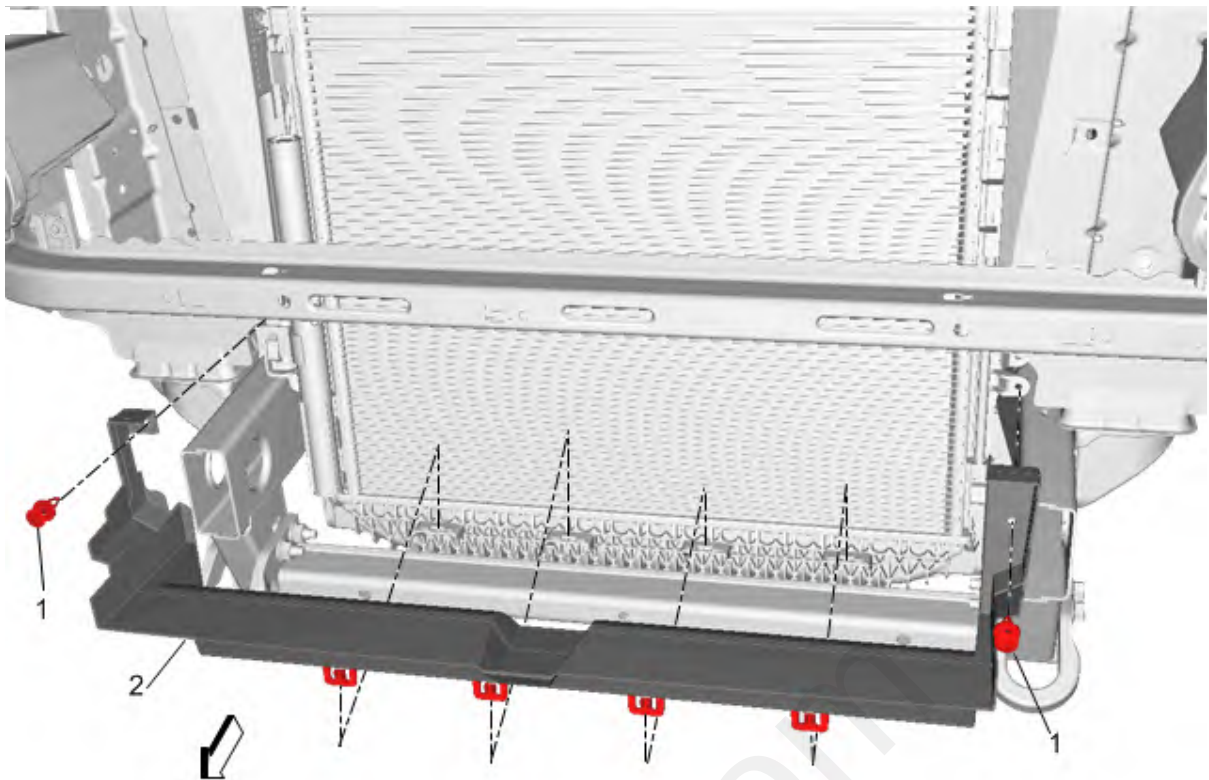


Fig. 280: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

8. Install the radiator air lower baffle (2). Refer to [Radiator Air Lower Baffle Replacement](#).

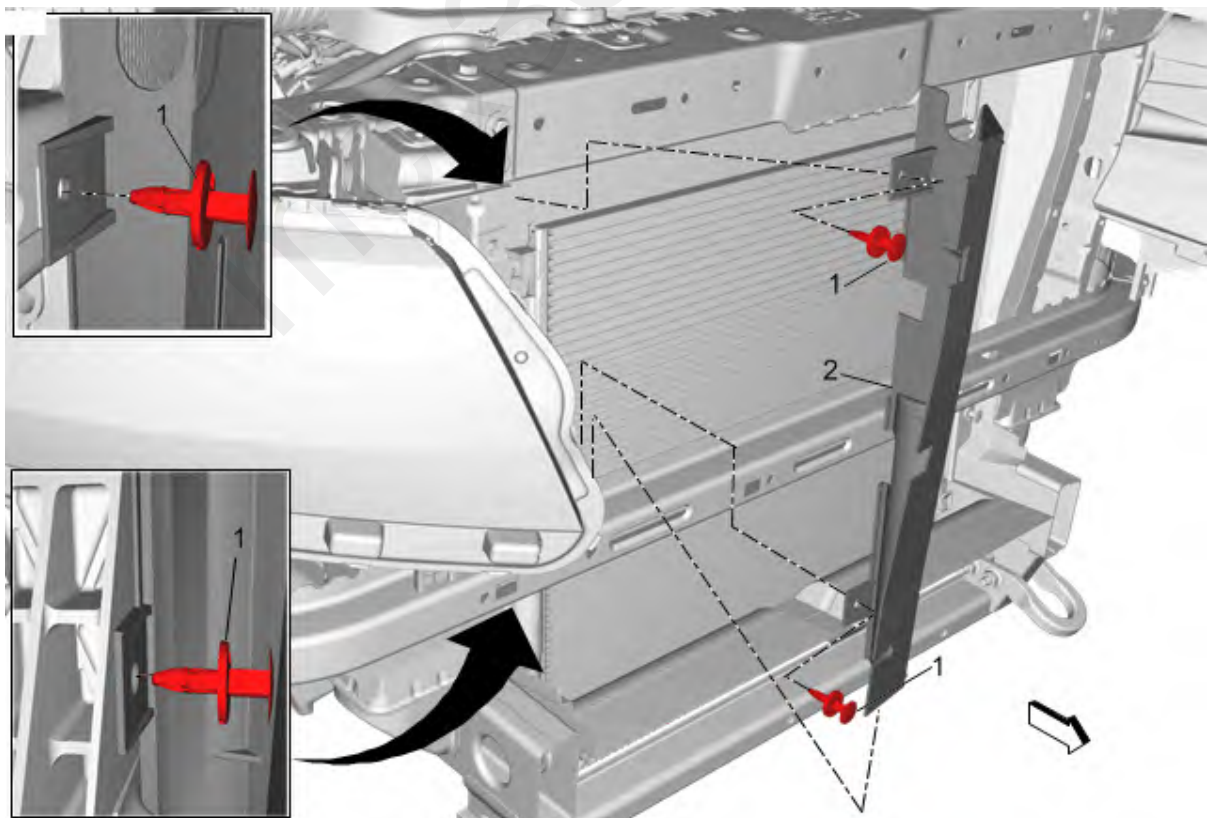


Fig. 281: Right Side Radiator Air Side Baffle

Courtesy of GENERAL MOTORS COMPANY

the right side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Right Side](#).

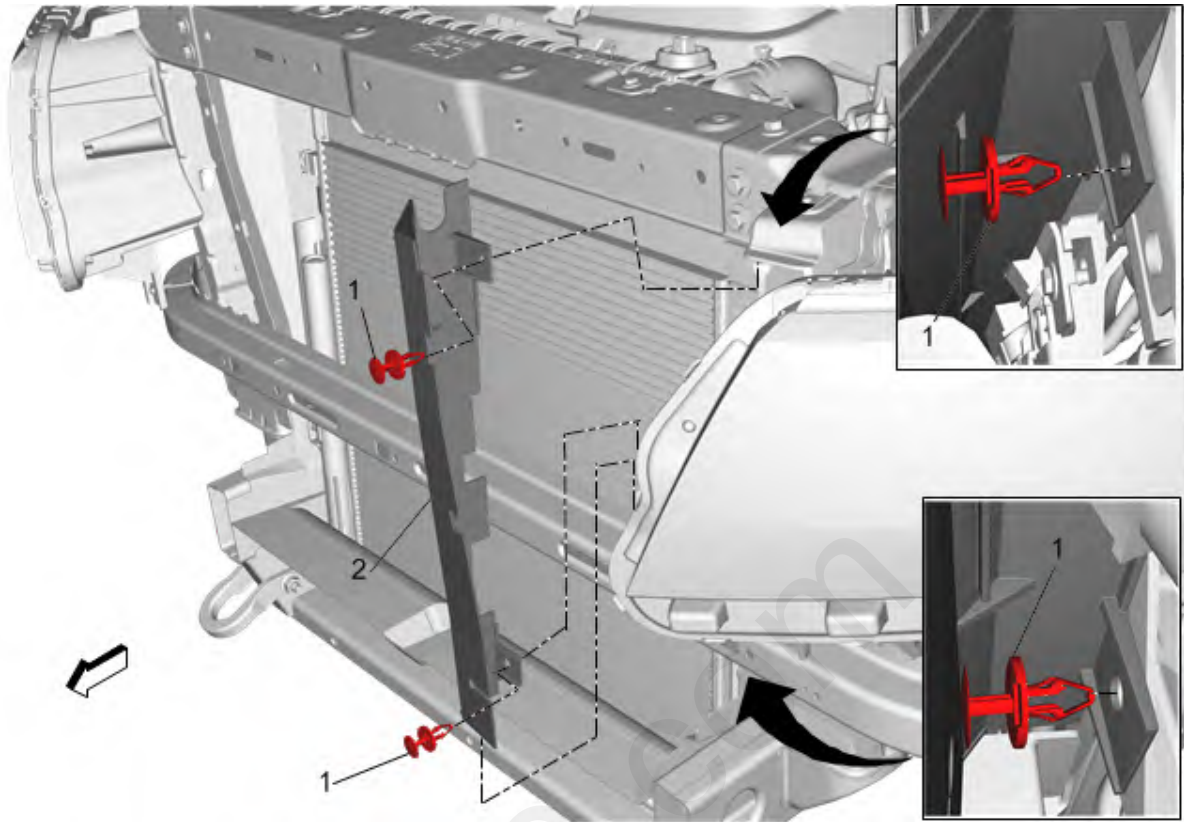


Fig. 282: Left Side Radiator Air Side Baffle
Courtesy of GENERAL MOTORS COMPANY

10. Install the left side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Left Side](#).
11. Fill the engine cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#)[Cooling System Draining and Filling \(Vac n Fill\)](#).
12. Inspect the cooling system for leaks.

RADIATOR REPLACEMENT (LWN)

Removal Procedure

1. Remove Radiator Assembly [Condenser, Fan, and Radiator Assembly Removal and Installation](#)

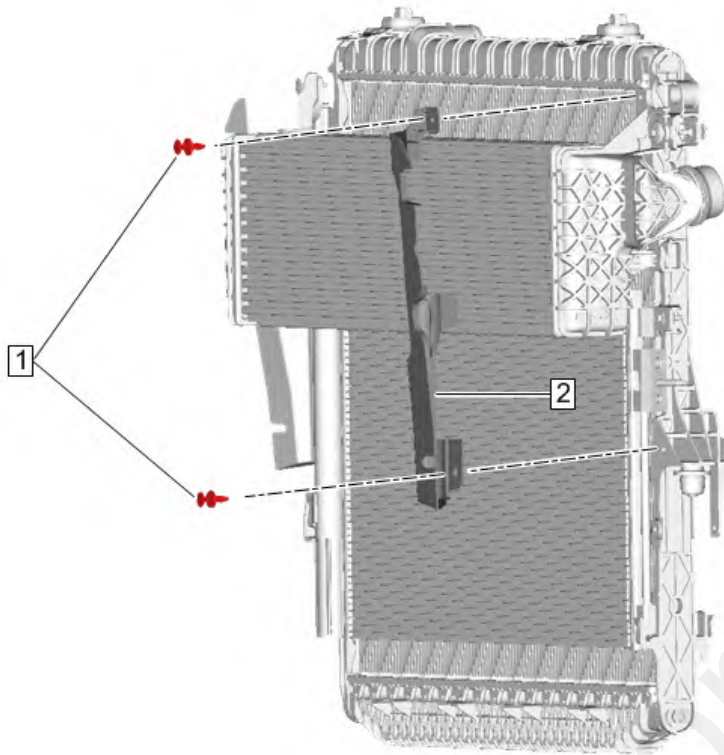


Fig. 283: Radiator Air Side Baffle - Left Side
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Radiator Air Side Baffle - Left Side (2) **Radiator Air Side Baffle Replacement - Left Side (LWN)**

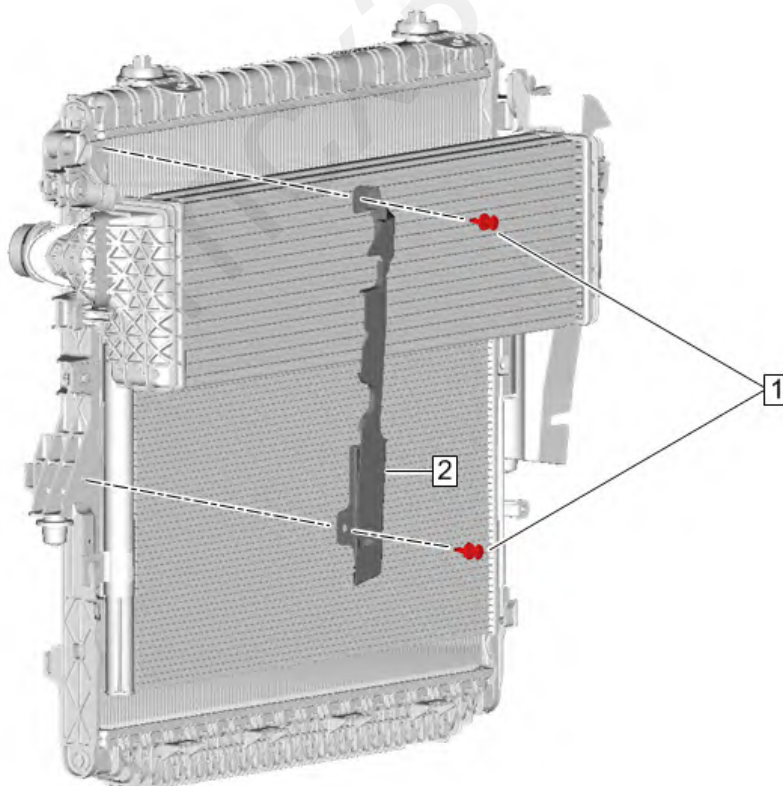


Fig. 284: Radiator Air Side Baffle - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Radiator Air Side Baffle - Right Side (2) [Radiator Air Side Baffle Replacement - Right Side \(LWN\)](#)

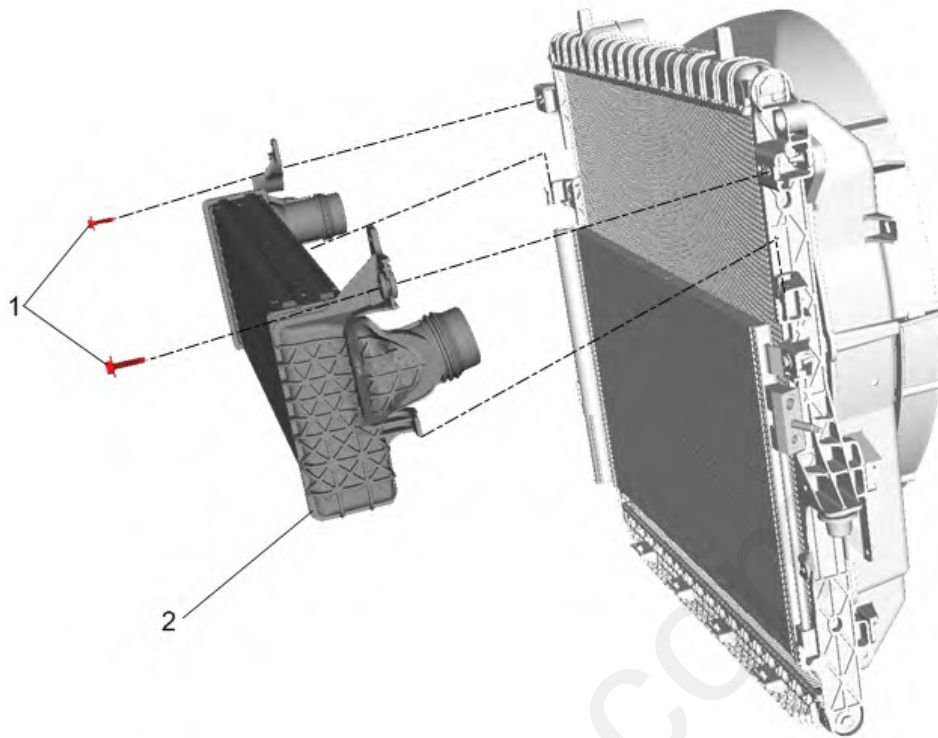


Fig. 285: Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

4. Remove Charge Air Cooler (2) [Charge Air Cooler Replacement](#)

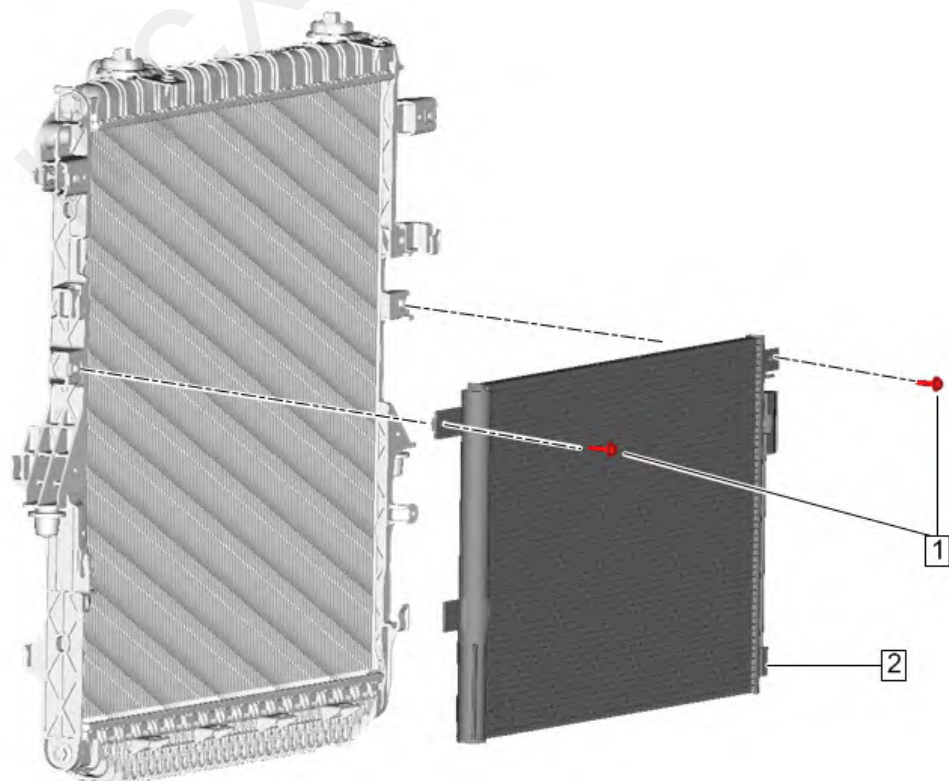


Fig. 286: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

5. Remove Air Conditioning Condenser (2) [Air Conditioning Condenser Replacement \(LWN\)](#)
6. Transfer components as necessary.

Installation Procedure

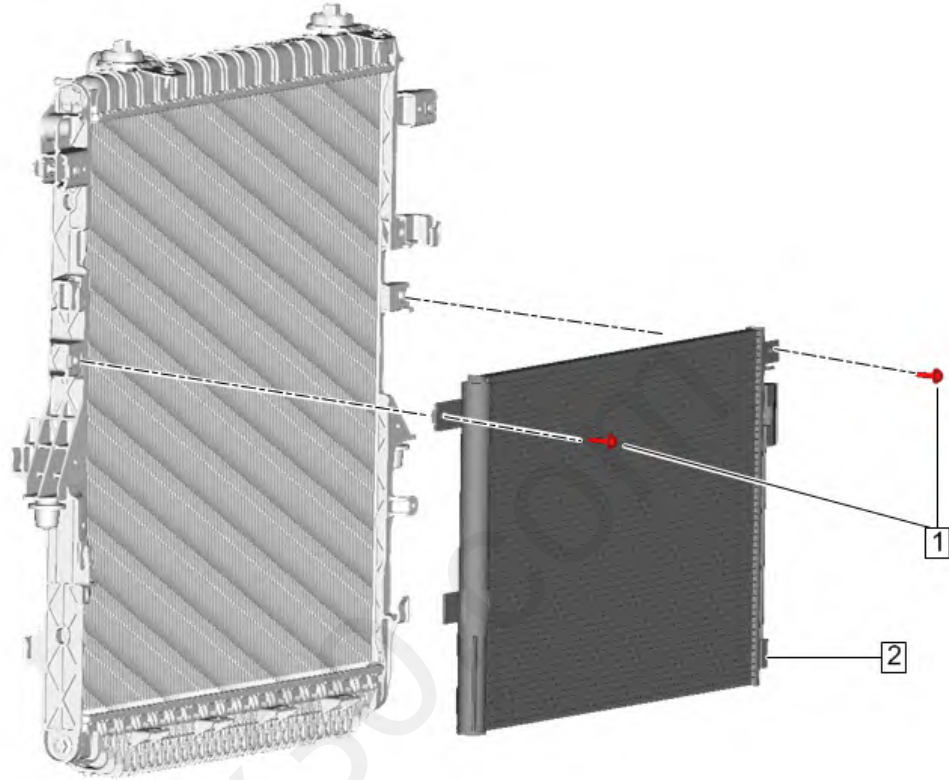


Fig. 287: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

1. Install Air Conditioning Condenser (2) [Air Conditioning Condenser Replacement \(LWN\)](#)

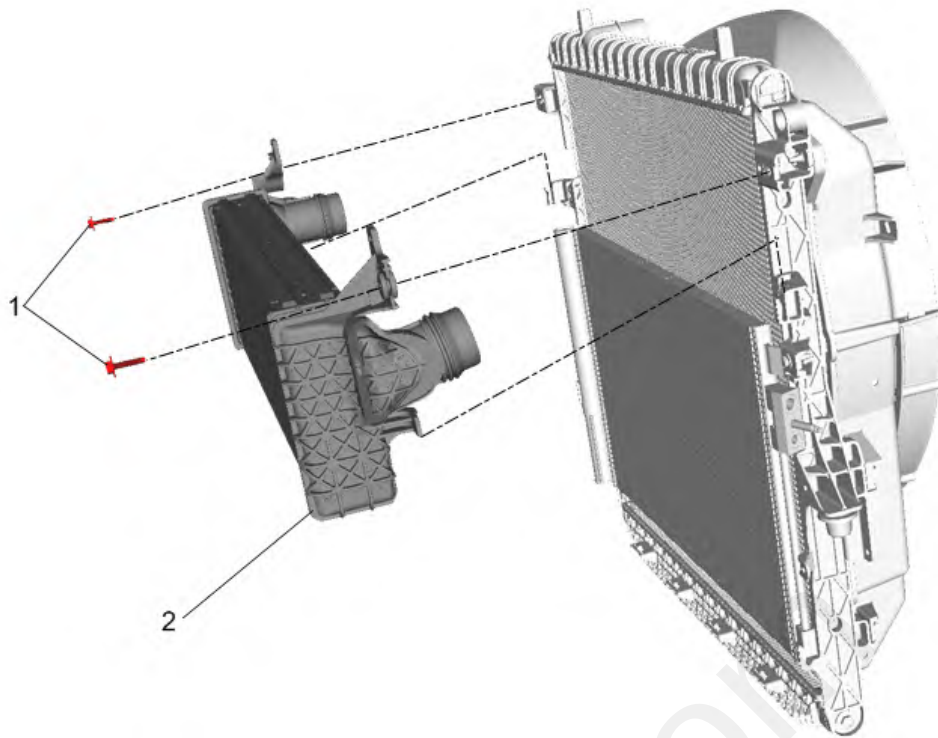


Fig. 288: Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

2. Install Charge Air Cooler (2) [Charge Air Cooler Replacement](#)

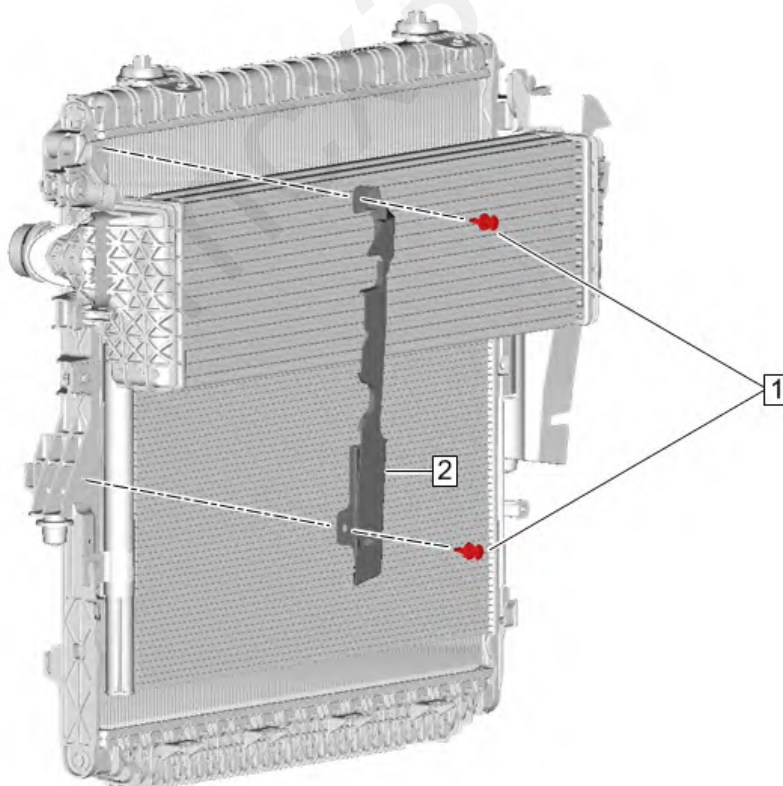


Fig. 289: Radiator Air Side Baffle - Right Side

Courtesy of GENERAL MOTORS COMPANY

Radiator Air Side Baffle - Right Side (2) [Radiator Air Side Baffle Replacement - Right Side \(LWN\)](#)

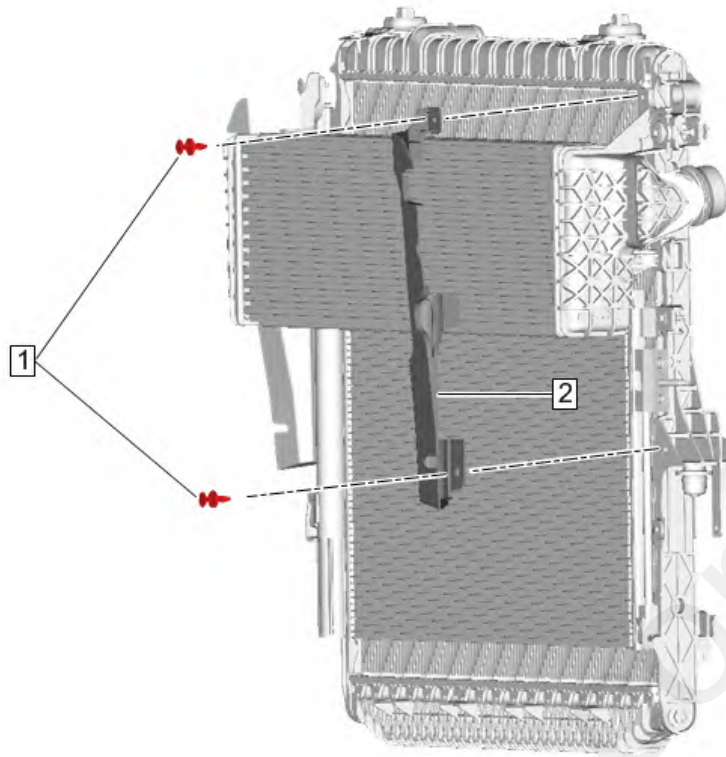


Fig. 290: Radiator Air Side Baffle - Left Side
Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Air Side Baffle - Left Side (2) [Radiator Air Side Baffle Replacement - Left Side \(LWN\)](#)
5. Install Radiator Assembly. [Condenser, Fan, and Radiator Assembly Removal and Installation](#)

RADIATOR LOWER INSULATOR REPLACEMENT

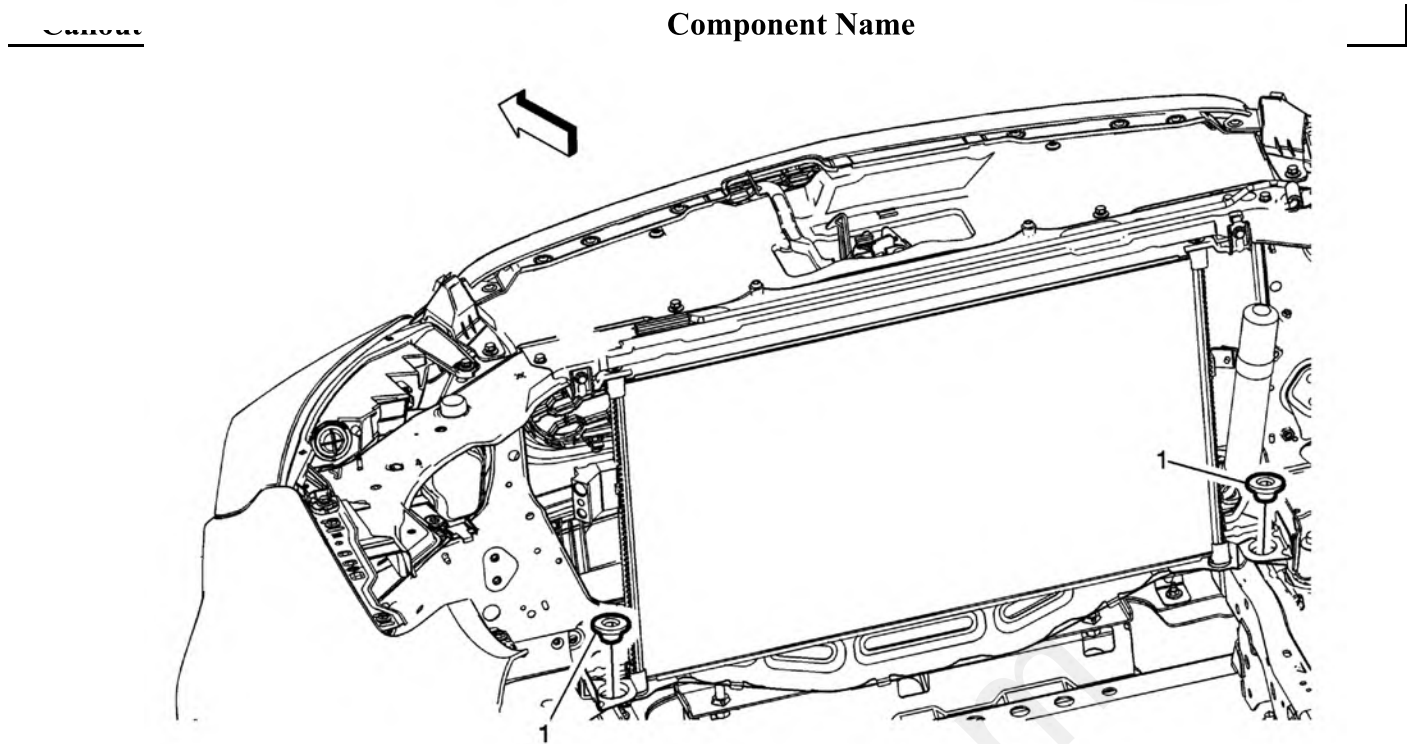


Fig. 291: Radiator Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove radiator. Refer to Radiator Replacement (LFX) Radiator Replacement (LCV) Radiator Replacement (LWN) .	
1	Radiator Lower Insulator/Mount (Qty: 2)

RADIATOR AIR LOWER BAFFLE REPLACEMENT

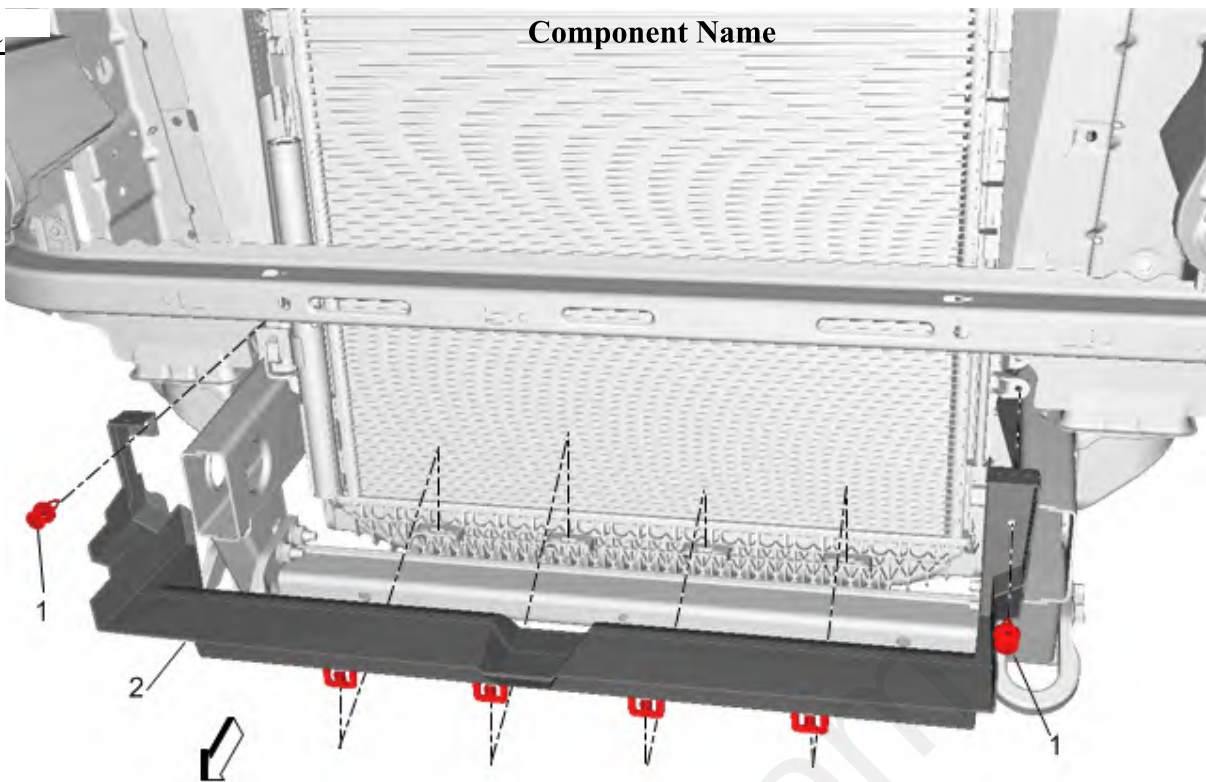


Fig. 292: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. <u>Front Bumper Shutter Replacement</u> 2. <u>Front Bumper Impact Bar Replacement</u>	
1	Radiator Air Lower Baffle Retainer (Qty: 2)
2	Radiator Air Lower Baffle

RADIATOR AIR LOWER BAFFLE REPLACEMENT (LWN)

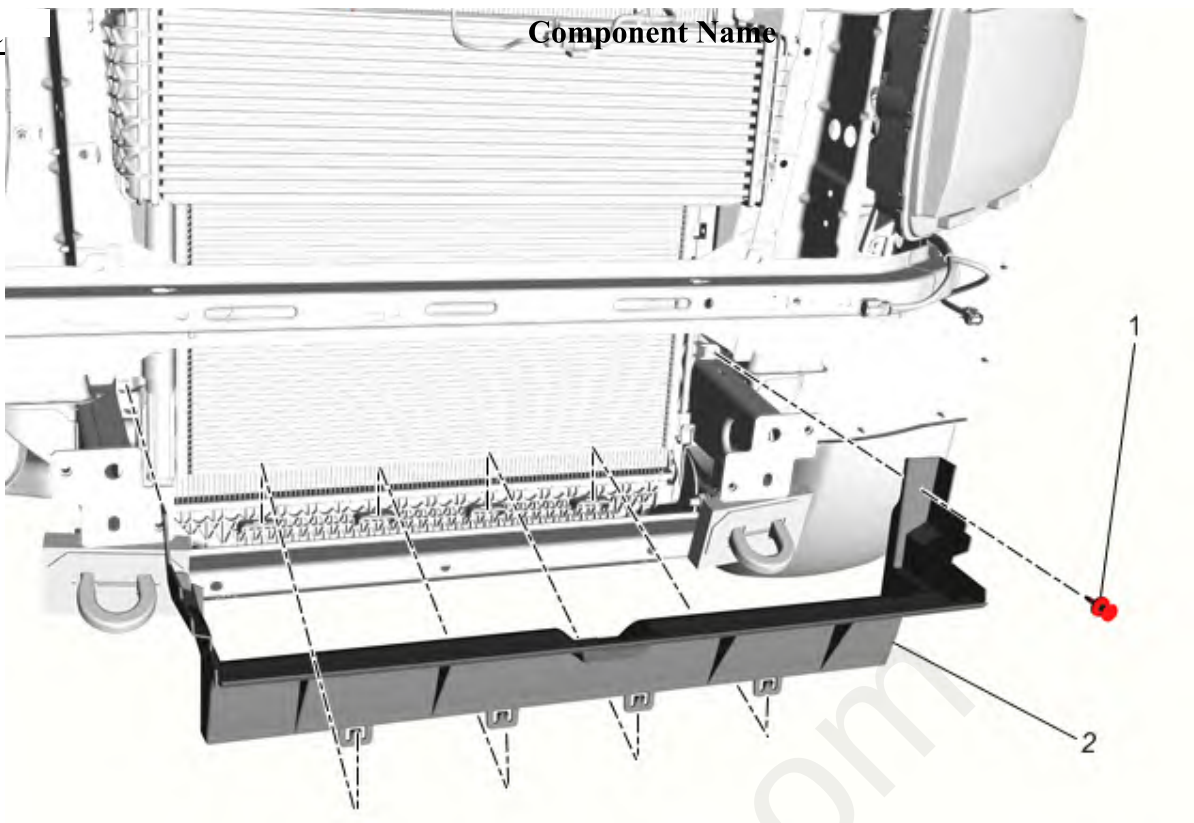


Fig. 293: Radiator Air Lower Baffle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Front Bumper Shutter Replacement</u> <u>Front Bumper Impact Bar Replacement</u>	
1	Radiator Air Lower BafflePush Pin
2	Radiator Air Lower Baffle

RADIATOR AIR SIDE BAFFLE REPLACEMENT - LEFT SIDE

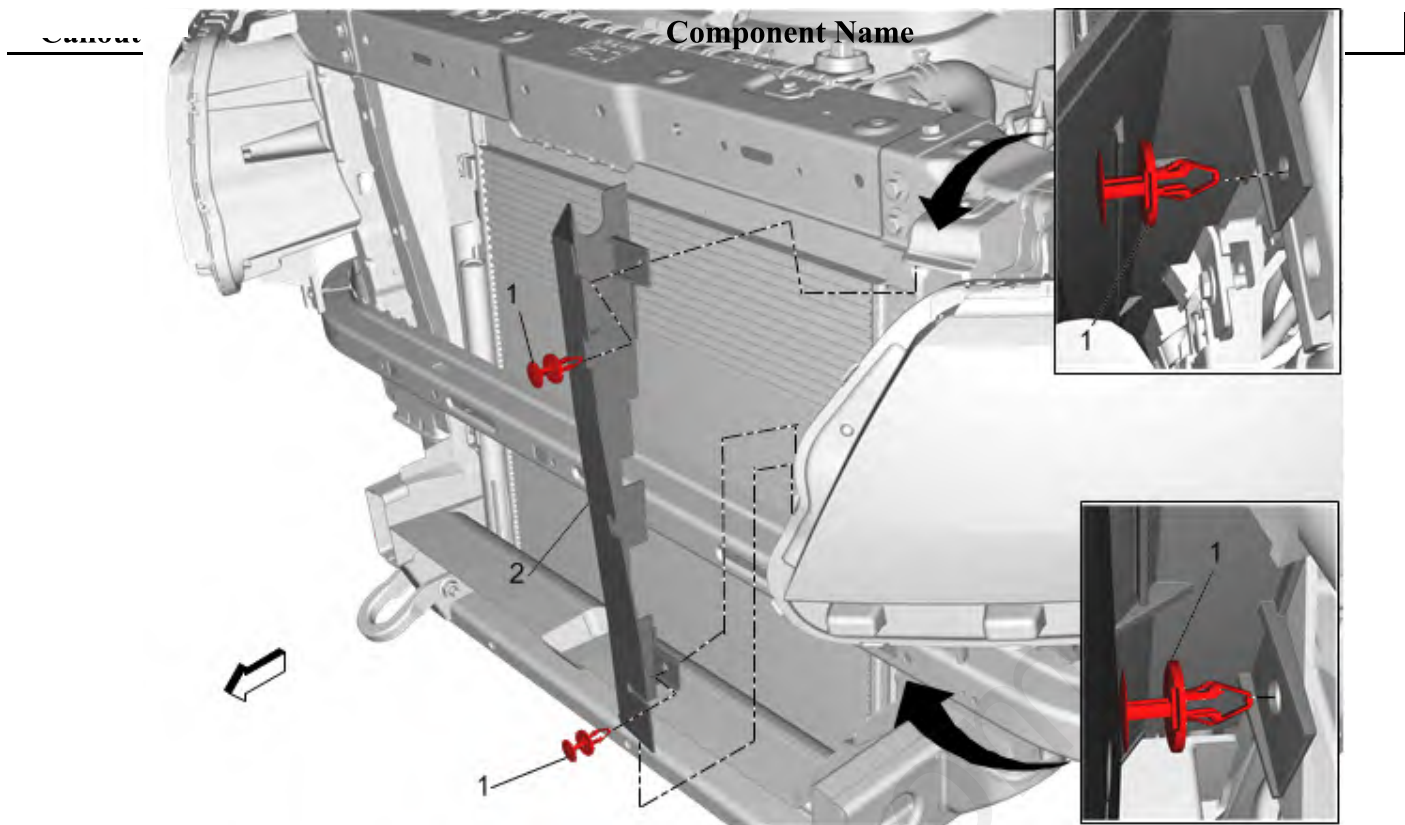


Fig. 294: Left Side Radiator Air Side Baffle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Bumper Shutter Replacement Front End Sheet Metal Diagonal Brace Replacement	
1	Radiator Air Side Baffle Retainer (Qty: 2) Procedure Fold back flexible portion of radiator air side baffle to gain access to the radiator air side baffle retainers.
2	Radiator Air Side Baffle

RADIATOR AIR SIDE BAFFLE REPLACEMENT - LEFT SIDE (LWN)

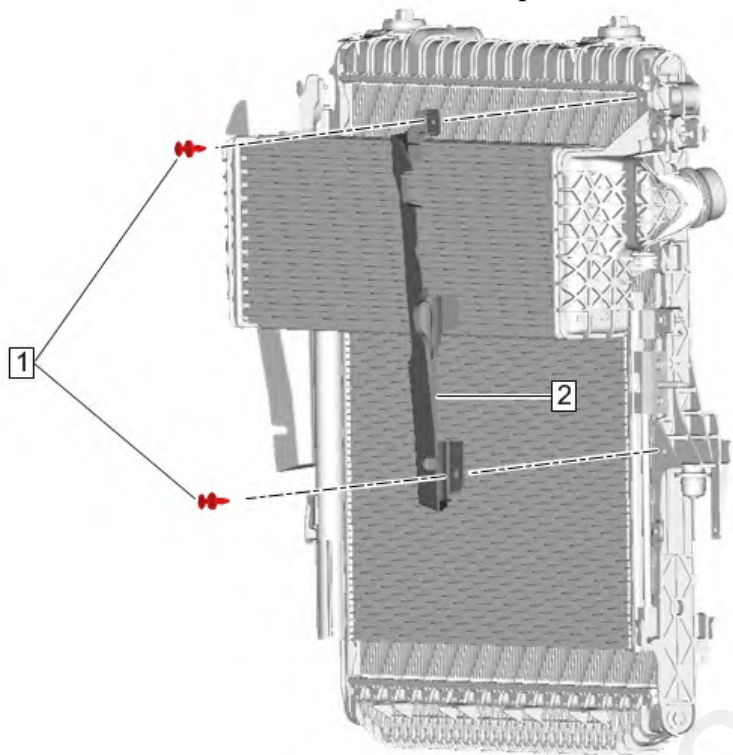


Fig. 295: Radiator Air Side Baffle - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Condenser, Fan, and Radiator Assembly Removal and Installation</u>	
1	Push Pin (1) (Qty: 2)
2	Radiator Air Side Baffle - Left Side

RADIATOR AIR SIDE BAFFLE REPLACEMENT - RIGHT SIDE

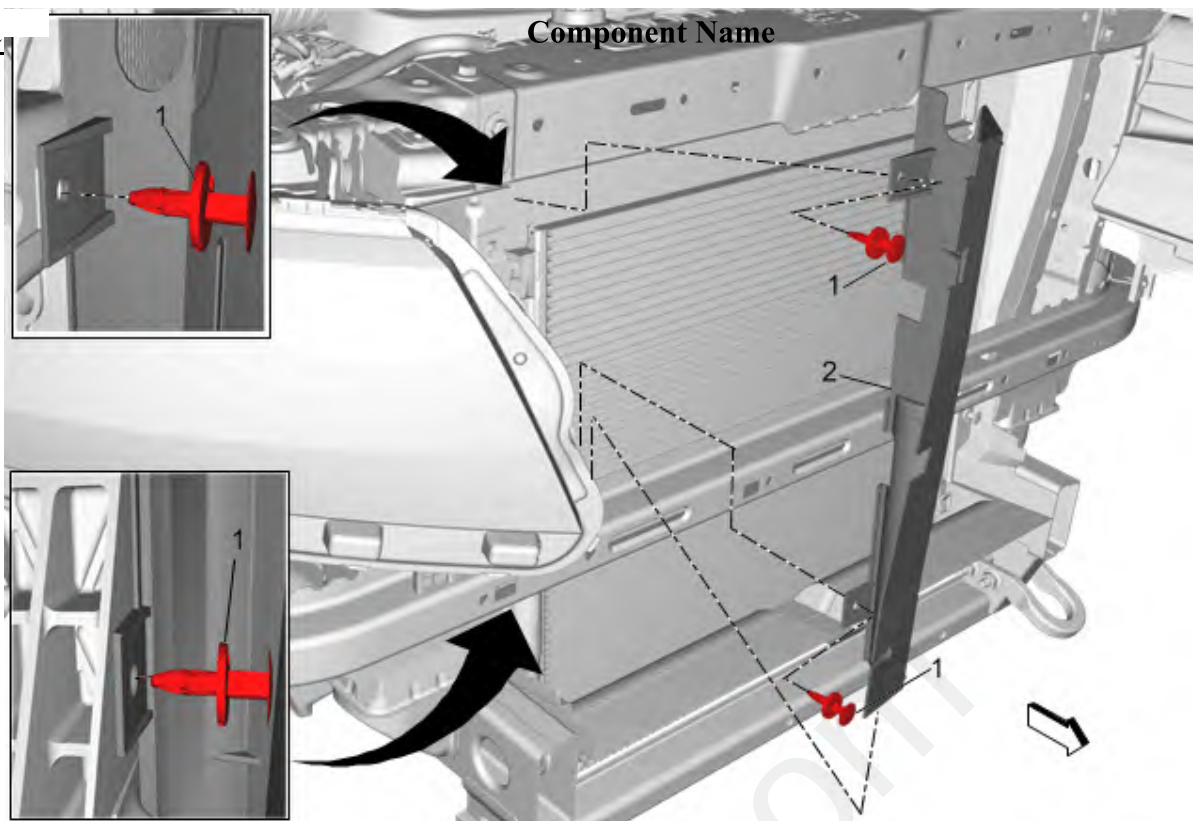


Fig. 296: Right Side Radiator Air Side Baffle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Front Bumper Shutter Replacement</u> <u>Front End Sheet Metal Diagonal Brace Replacement</u>	
1	Radiator Air Side Baffle Retainer (Qty: 2) Procedure Fold back flexible portion of radiator air side baffle to gain access to the radiator air side baffle retainers.
2	Radiator Air Side Baffle

RADIATOR AIR SIDE BAFFLE REPLACEMENT - RIGHT SIDE (LWN)

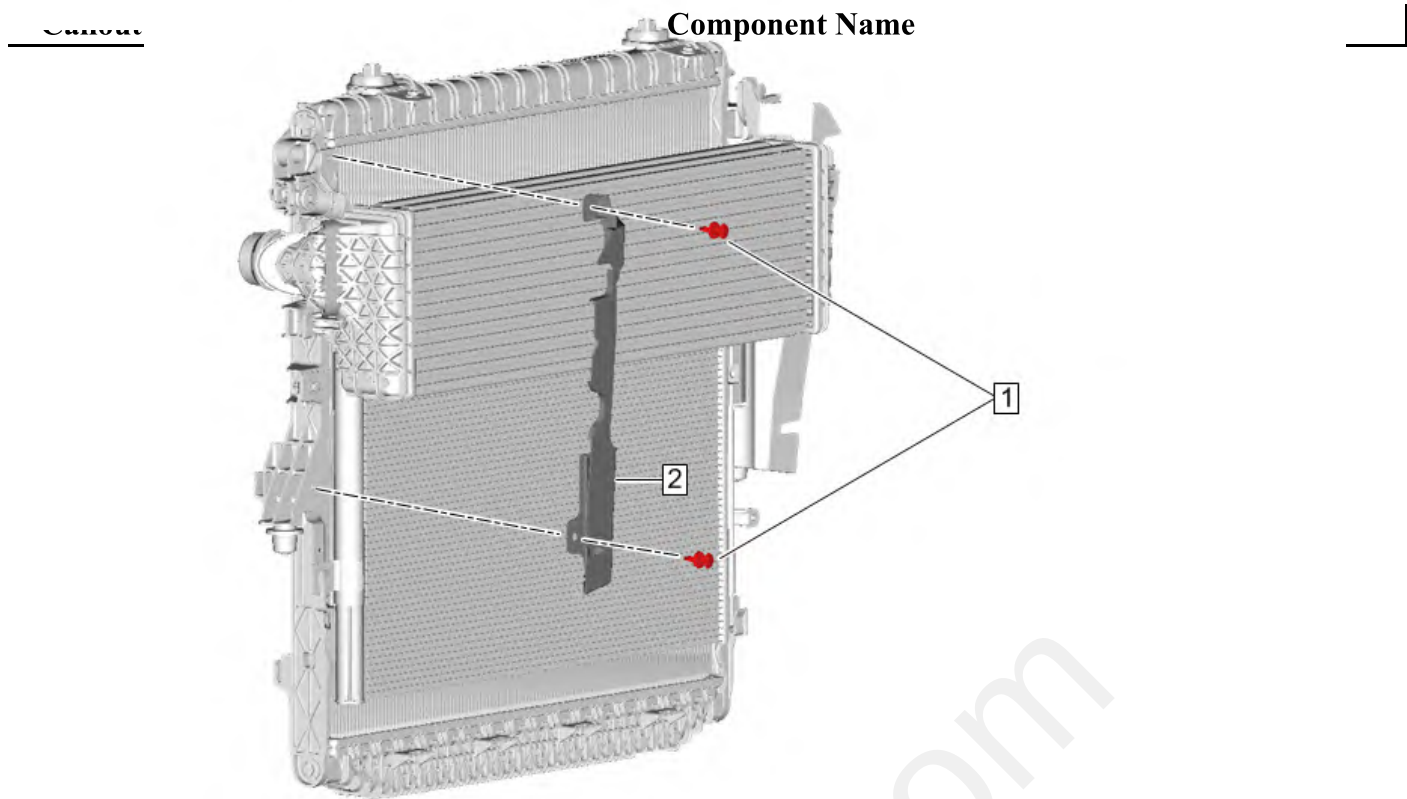


Fig. 297: Radiator Air Side Baffle - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Condenser, Fan, and Radiator Assembly Removal and Installation</u>	
1	Push Pin (1) (Qty: 2)
2	Radiator Air Side Baffle - Right Side

COOLANT HEATER REPLACEMENT (LCV)

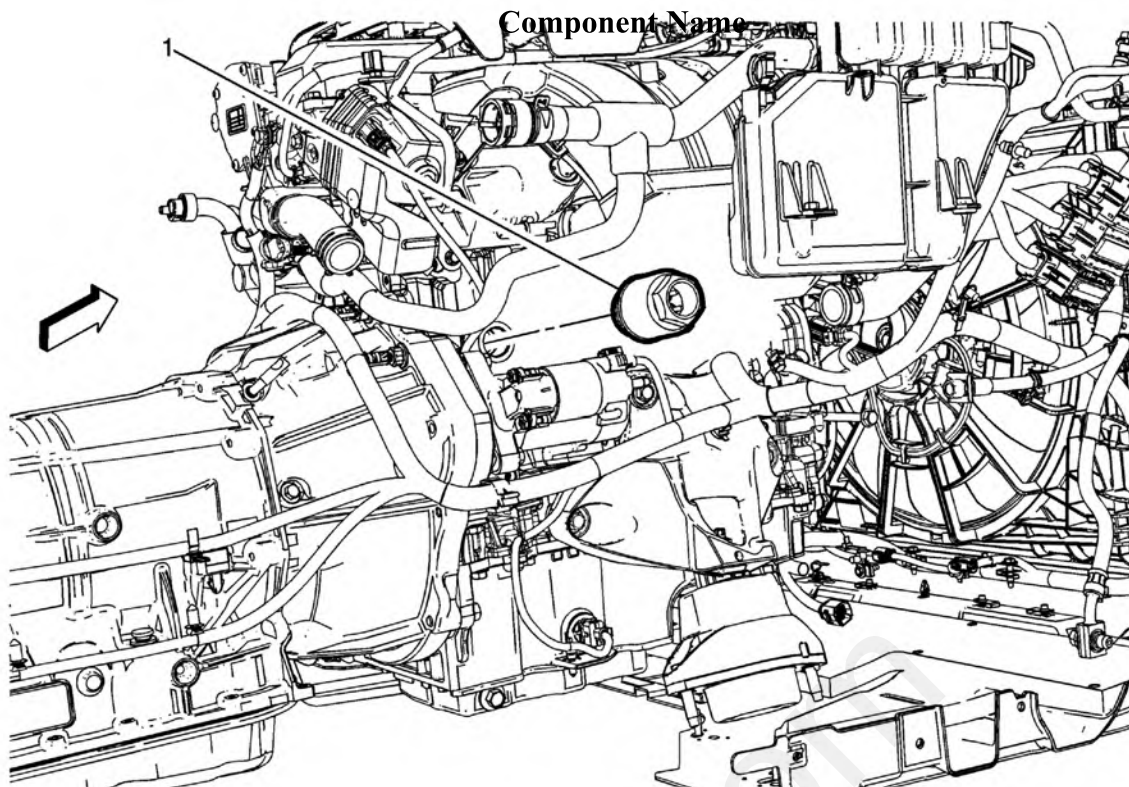


Fig. 298: Coolant Heater

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill). 2. Remove the starter. Refer to Starter Replacement (LCV).	
1	Engine Coolant Heater CAUTION: Refer to Fastener Caution . Procedure Disconnect the engine coolant heater cord. Tighten 50 N.m (37 lb ft)

COOLANT HEATER REPLACEMENT (LFX)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the catalytic converter - right side. Refer to [Catalytic Converter Replacement - Right Side \(LFX\)](#)

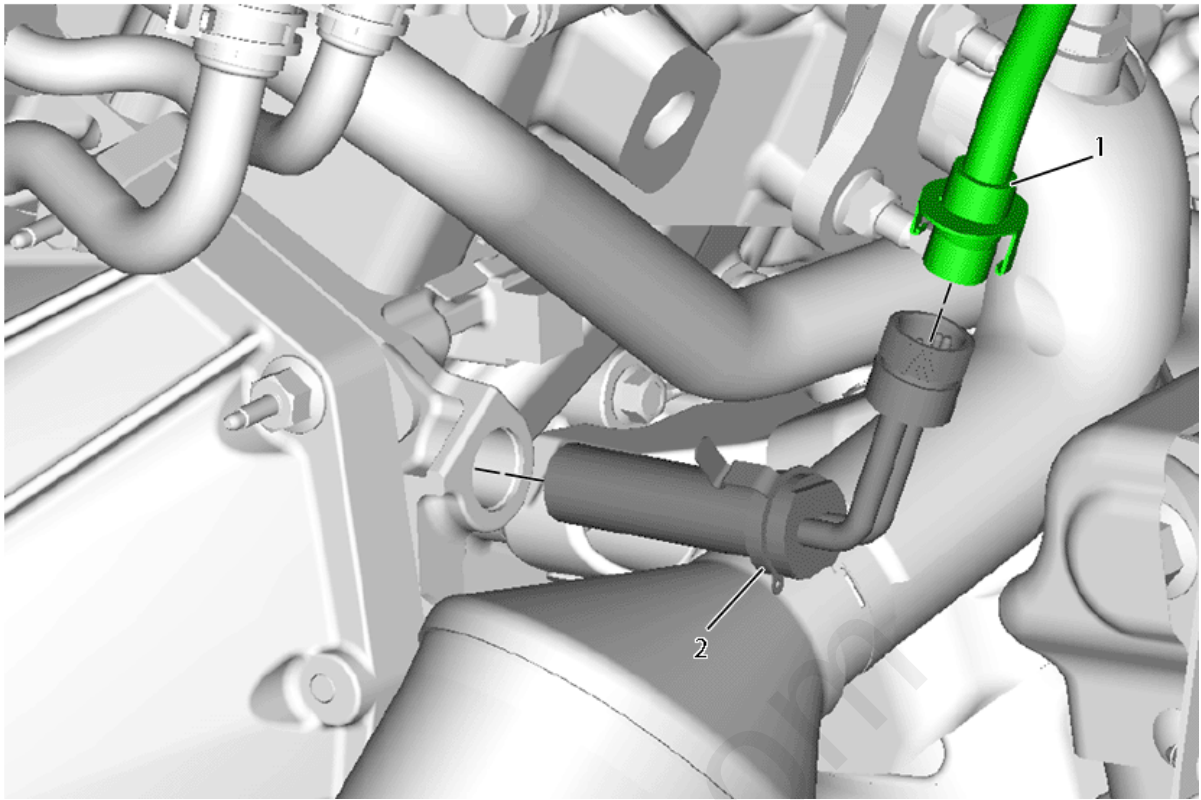
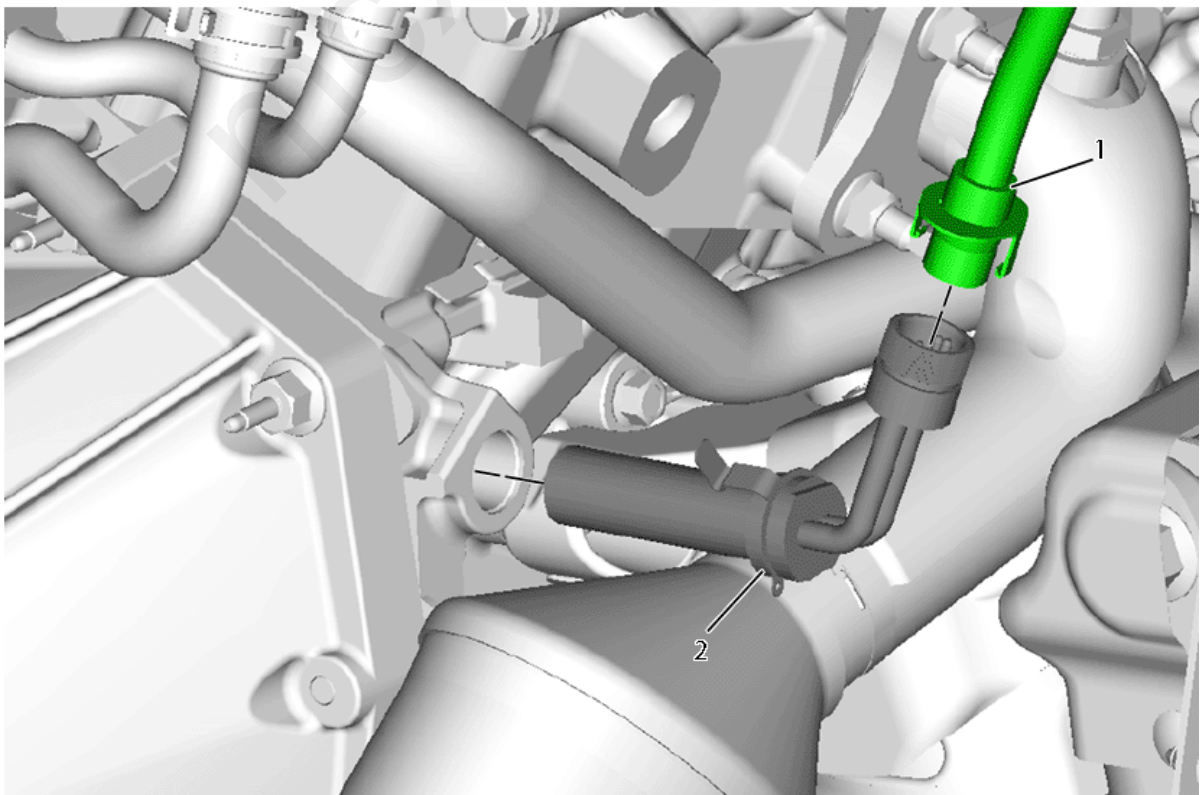


Fig. 299: Coolant Heater Cord

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the coolant heater cord (1) from the coolant heater (2).
4. Remove the coolant heater (2).

Installation Procedure



1. Install the coolant heater (2).
2. Connect the coolant heater cord (1) to the coolant heater (2).
3. Install the catalytic converter - right side. Refer to [Catalytic Converter Replacement - Right Side \(LFX\)](#) .
4. Lower the vehicle.

COOLANT HEATER REPLACEMENT (LWN)

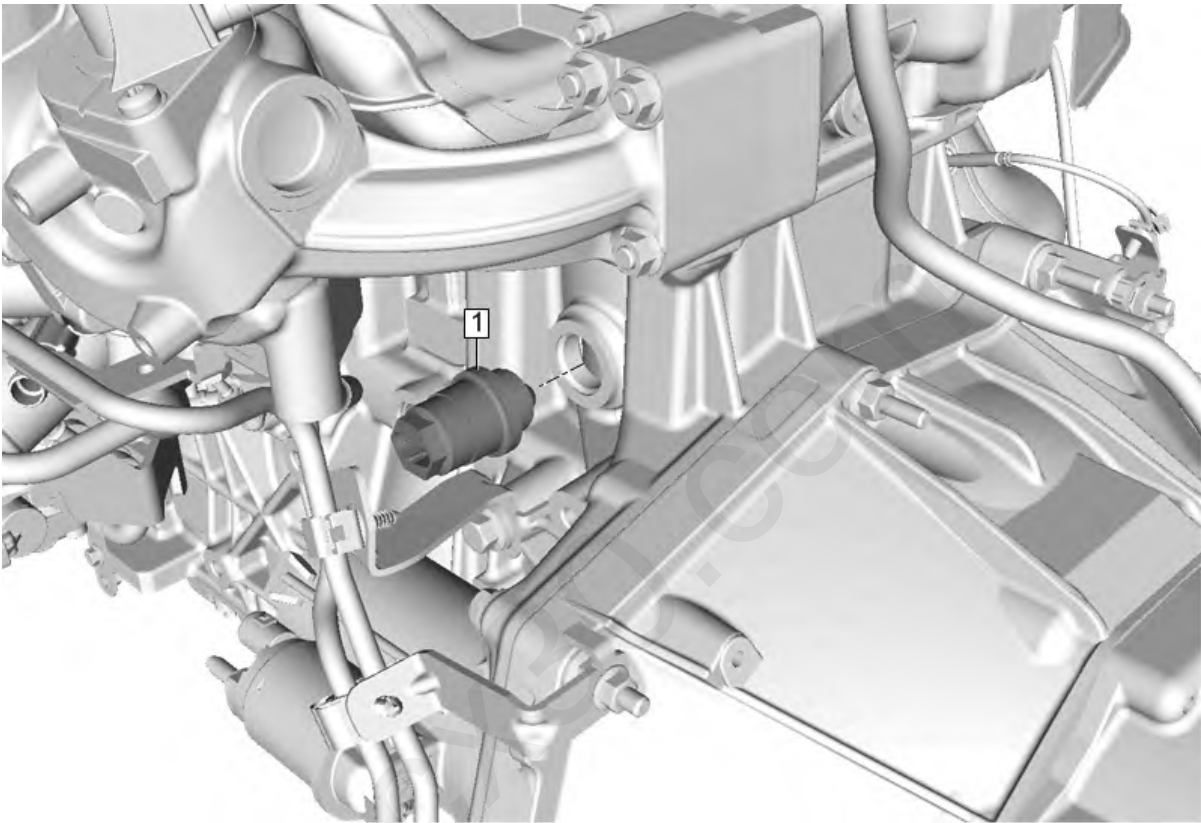


Fig. 301: Coolant Heater Replacement (LWN)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the coolant. Cooling System Draining and Filling (Static Fill)Cooling System Draining and Filling (Vac n Fill) 2. Remove Starter Starter Replacement (LWN) 3. Disconnect Coolant Heater Cord Coolant Heater Cord Replacement (LWN)	
1	Coolant Heater CAUTION: Refer to Component Fastener Tightening Caution . Tighten 50 N.m (37 lb ft)

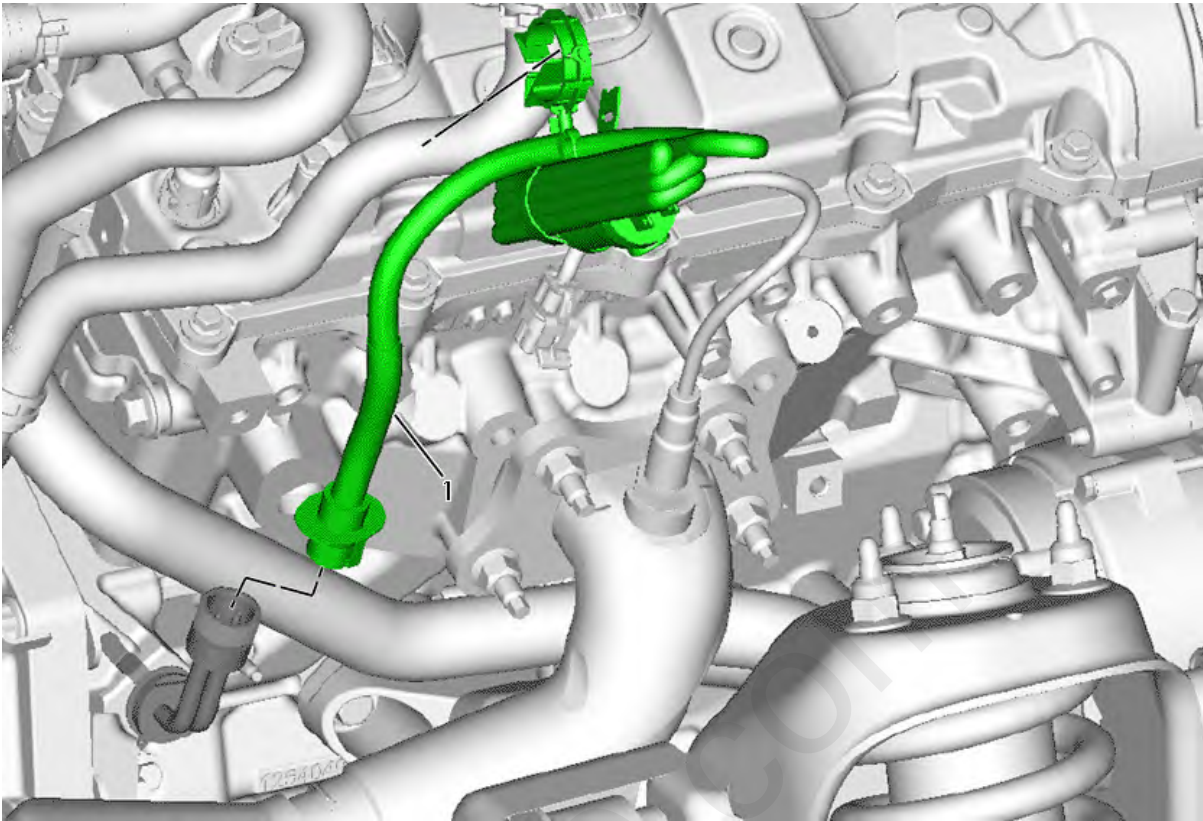


Fig. 302: Coolant Heater Cord (LFX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Coolant Heater Cord Procedure 1. Disconnect the coolant heater cord from the coolant heater. 2. Disconnect the three coolant heater cord retainers from the coolant hose.

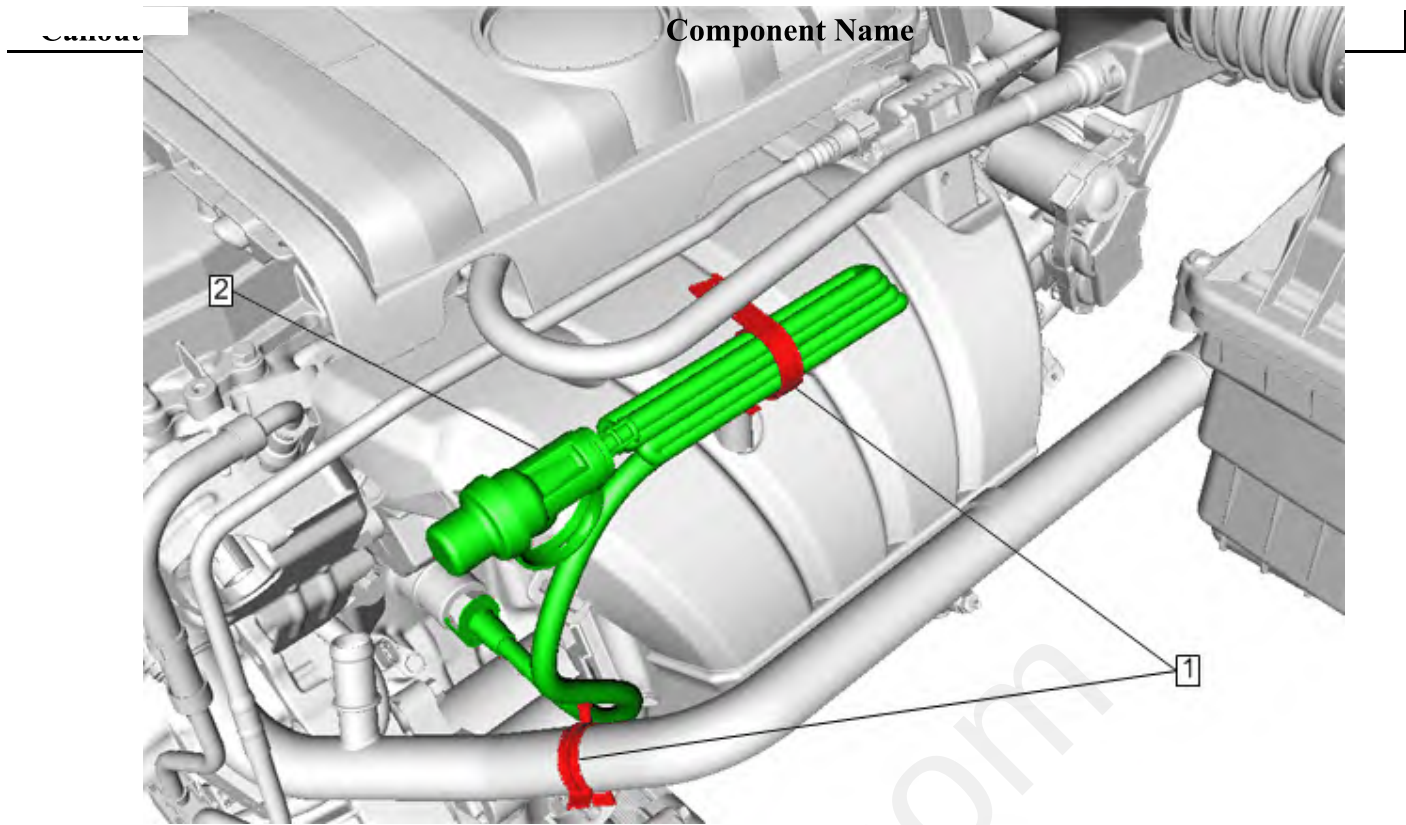


Fig. 303: Coolant Heater Cord (LCV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Coolant Heater Cord Procedure Disconnect the coolant heater cord from the coolant heater.
2	Coolant Heater Cord Retainer Procedure Disconnect the coolant heater cord retainers.

COOLANT HEATER CORD REPLACEMENT (LWN)

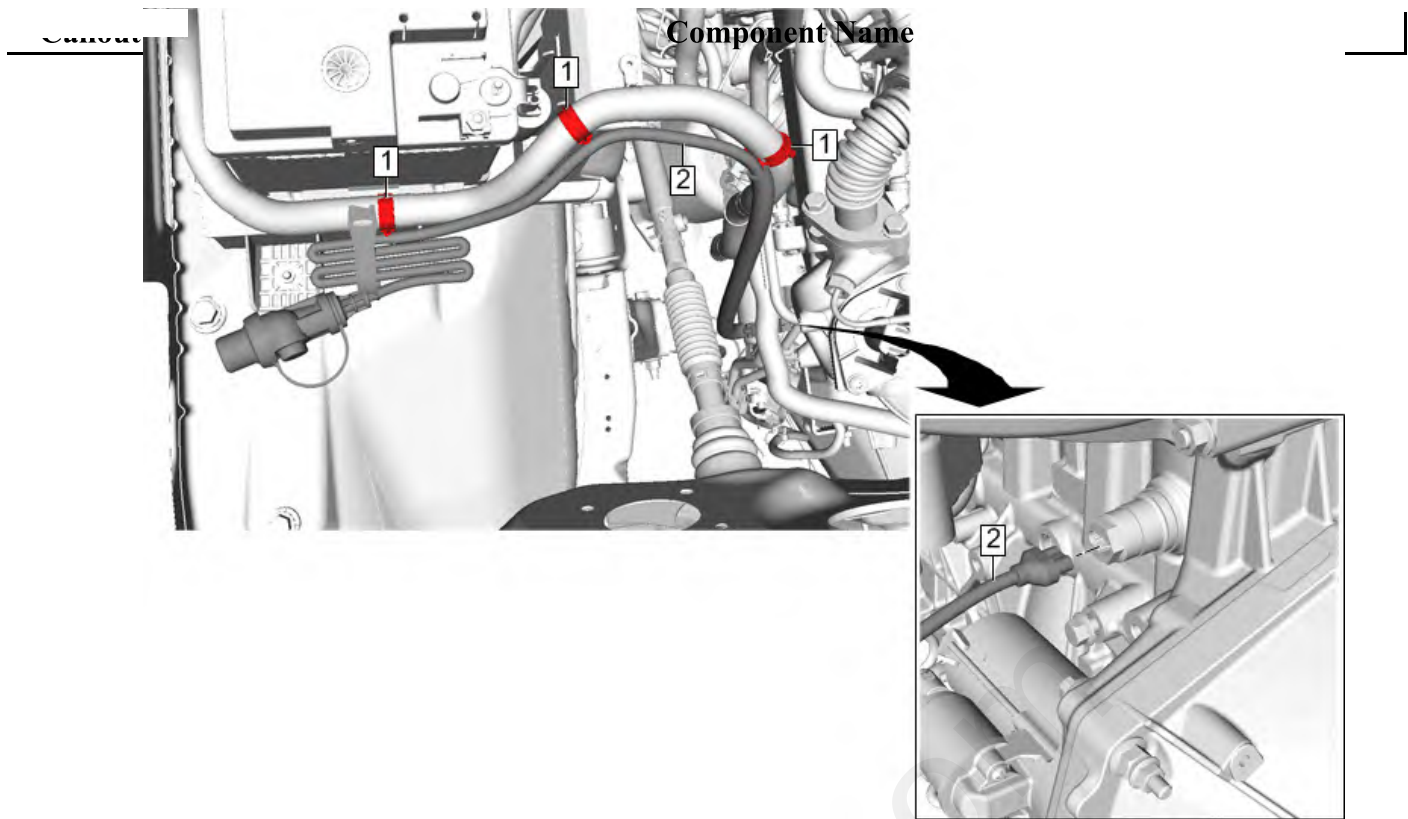


Fig. 304: Coolant Heater Cord (LWN)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Coolant Heater Cord Retaining Clip (Qty: 3)
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

iges 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 (LFX)

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the system cools slowly or not at all. This allows the engine to warm quickly.

Cooling Cycle

Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. Some coolant will then be pumped from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost.

Coolant is also pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

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

From the cylinder heads, the coolant is then forced to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine is warmed, or it will flow through the thermostat and into the radiator where it is cooled and the coolant cycle is completed.

Operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and clean drinkable water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a downflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire assembly is then brazed forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum

end of the core. The radiator also has a drain cock which is located in the bottom right of the lower tank. The drain cock includes the drain cock and drain cock seal.

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

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the overflow tank. As the coolant circulates, air is allowed to exit. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Pressure Cap

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

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

Surge Tank

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

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

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

Air Baffles and Seals

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

Engine Oil Cooler

The engine oil cooler is a heat exchanger located inside the lower end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds the oil cooler in the radiator.

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

Transmission Oil Cooler

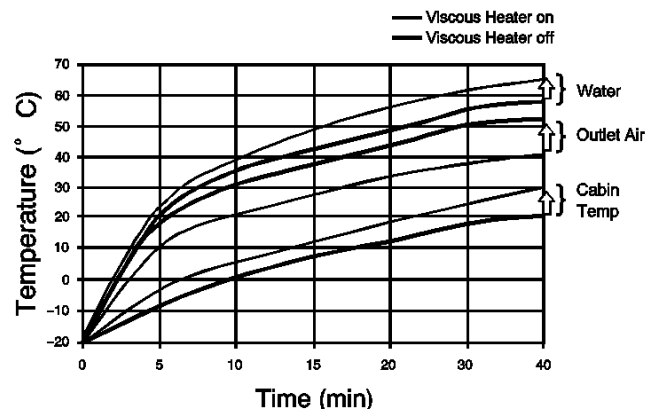
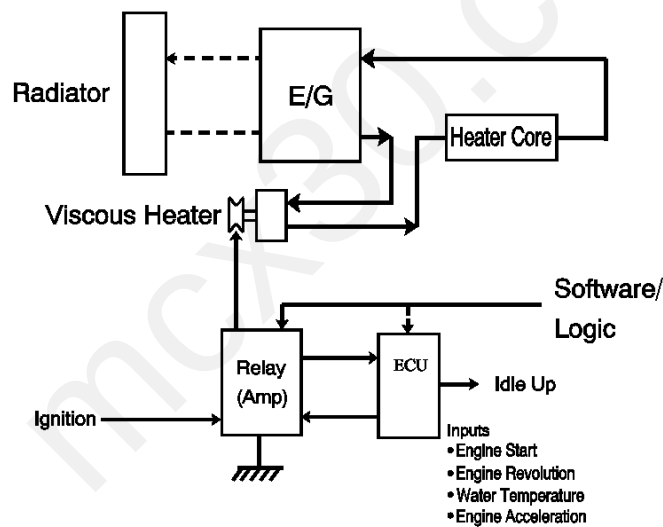
The transmission oil cooler is a heat exchanger. The air conditioning condenser is a multi-cooler that contains the transmission oil cooler heat exchanger. The transmission fluid temperature is regulated by the temperature of the air passing through the heat exchanger.

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

COOLING SYSTEM DESCRIPTION AND OPERATION (LWN)

Coolant Heater

The optional engine coolant heater (RPO C32) or Viscous Heater is released only for the Diesel engines and operates using the mechanical radial torque from the engine crank to heat the coolant through the heated silicone oil from the friction among two plates. It designed to warm the coolant in the engine block area for improved heating comfort in very cold weather -20°C (-4°F). After the engine is warm the Clutch is disengaged and the Viscous Heater stops working



Condition: Ambient -20°C , "stop and go" traffic, vehicle=diesel mini-van

Cooling System

The cooling systems 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 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 it 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 it absorbs additional heat.

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 it will flow through the thermostat and into the radiator where it 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 suitable drinking water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger. It consists of a core and 2 tanks. The aluminum core is a tube and fin downflow 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 left hand tank. The drain cock unit includes the drain cock and drain cock seal.

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

Pressure Cap

The pressure cap seals the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling

e. 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 above 140 kPa (20 psi). When the cooling system pressure exceeds the rating of the pressure cap, it raises the pressure valve, venting the excess pressure.

As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Coolant Recovery System

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

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure in the cooling system gets too high above 105 kPa (15 psi), it will open the pressure valve in the pressure cap. This allows the coolant, which has expanded due to being heated, to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is that it eliminates almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

2.8L VMM Cooling Fan and Clutch

The engine cooling fan and clutch are driven by the crankshaft via the drive belt. The cooling fan draws air through the radiator to improve the transfer of heat from the coolant to the atmosphere. As the fan blades spin, they pull cool, outside air past the radiator core. The fan clutch drives the cooling fan. The fan clutch controls the amount of torque that is transmitted from the crankshaft to the fan blades. The clutch allows more torque to engage on the fan when the engine operating temperature increases and/or the vehicle speed is low. As the torque increases, the fan turns more quickly (see below figure of the Temperature Modulation Test). The fan clutch decreases the torque applied to the cooling fan when the engine temperature decreases and/or the vehicle speed is high. As the torque decreases, the fan speed decreases. One natural and non desired behavior of the Fan Clutch is the "Morning Sickness" which is the early unwanted engagement of the Clutch when the engine is off for several hours (during one night as an example), and is specially noticed due to noticeable fan noise. Additionally the phenomenon is more noticeable at low under hood temperatures and at engine rpm spills. This occurs because the oil seats in the working chamber of the Clutch and it's viscosity is high. When the Clutch starts spinning the oil is pushed against the internal walls thorough centrifugal force and goes to the Reservoir and the Clutch is disengaged. This behavior is controlled at the supplier to be minimum (see Cold Pump Out Test curve below) and avoid customer complains due to the noise it causes making them think it is not working properly.

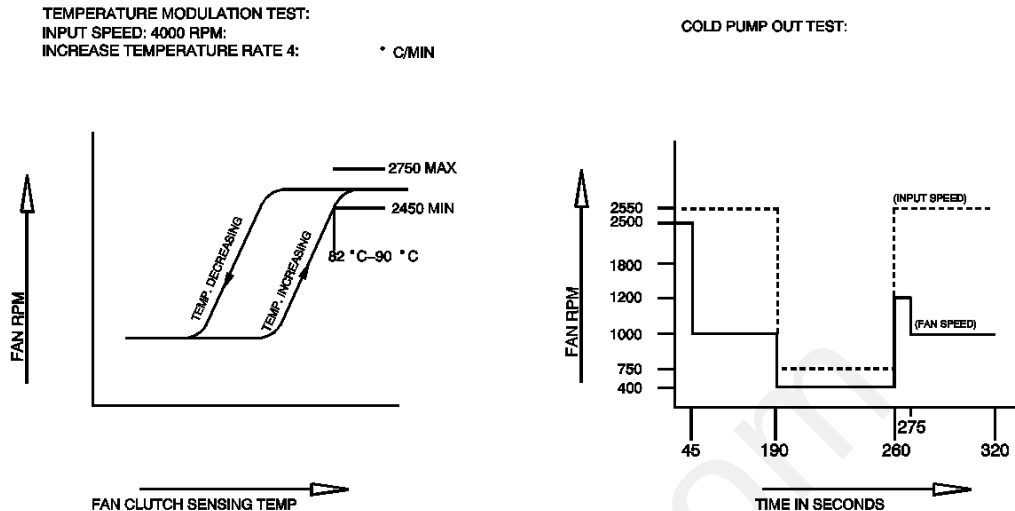


Fig. 306: Temperature Modulation Test
Courtesy of GENERAL MOTORS COMPANY

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.

2.5L ECOTEC Gasoline Engine Single Cooling Fan Description and Operation

The engine cooling fan system consists of one electrical cooling fan, a resistor module mounted with the cooling fan shroud, and three fan relays. The relays are arranged in a series parallel (S/P) configuration that allows the engine control module (ECM) to operate the fan at low, medium, or high speeds, depending on cooling requirements. The cooling fan and fan relays receive battery voltage from the underhood fuse block. The ground path for the operation of the cooling fan is provided at (see electrical schematic).

Low Speed Operation

The ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The fan 1 relay coil closes the relay contacts to supply battery voltage from the FAN 1 fuse through the high resistance circuit of the cooling fan resistor module, and the fan motor supply voltage circuit to operate the cooling fan at low speed.

1 Operation

The ECM energizes the fan 2 and S/P relays by grounding the fan 2 relay control circuit. The energized fan 2 relay coil closes the relay contacts to supply battery voltage from the FAN 2 fuse. The voltage passes through the medium resistance circuit of the cooling fan resistor module, and the fan motor voltage supply circuit to operate the cooling fan at medium speed. At the same time, the energized S/P relay coil switches the dual pole contact position to prevent voltage from passing through the S/P relay to the low resistance circuit of the resistor module.

High Speed Operation

The ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The ECM also energizes the high speed fan 2 relay and the S/P fan relay by grounding the fan 2 relay control circuit. The energized S/P fan relay coil switches the dual pole contact position, allowing voltage from the FAN 1 fuse to pass through the S/P relay to the low resistance circuit of the cooling fan resistor module, and the motor voltage supply circuit to operate the cooling fan at high speed. The energized fan 2 relay also provides voltage from the FAN 2 fuse through the medium resistance circuit of the cooling fan resistor module. This provides a back up to high speed operation if a condition exists in the high speed cooling fan circuit.

High Feature V6 Gasoline Engine Dual Cooling Fan Description and Operation

The engine cooling fan system consists of 2 electric cooling fans and 3 fan relays. The relays are arranged in a series/parallel (S/P) configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds. The cooling fans receive positive voltage from the cooling fan relays which receive battery positive voltage from the underhood fuse block.

Low Speed Operation

In low speed operation, the ECM applies ground to the coil side of the cooling fan low speed relay. This energizes the coil and applies voltage directly to the right cooling fan through the switch side of the low speed relay. The right cooling fan is connected in series to the left cooling fan through the de-energized series/parallel (S/P) cooling fan speed control relay. The series circuit operates both fans at low speed.

High Speed Operation

In high speed operation, the ECM applies a ground to the coil side of the cooling fan low speed relay, the S/P cooling fan speed control relay, and the cooling fan high speed relay. When energized, the high speed fan relay applies voltage directly to the left cooling fan through the switch side of the relay. Simultaneously, the low speed fan relay and the S/P speed control relay provide ignition voltage and a direct path to ground for the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

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 mounted on the pump shaft and consists of a series of flat or curved blades or vanes on a flat plate. 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. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The purpose of the water pump is to circulate coolant throughout the cooling system. The water pump is driven by the crankshaft via the drive belt.

Thermostat

It is a coolant flow control component. Its purpose is to help regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a small piston. When the element is heated, it expands and exerts pressure against the small piston. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up. After the coolant temperature reaches the rated thermostat opening temperature, the thermostat valve will open. 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, after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the lower Radiator tank. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator.

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

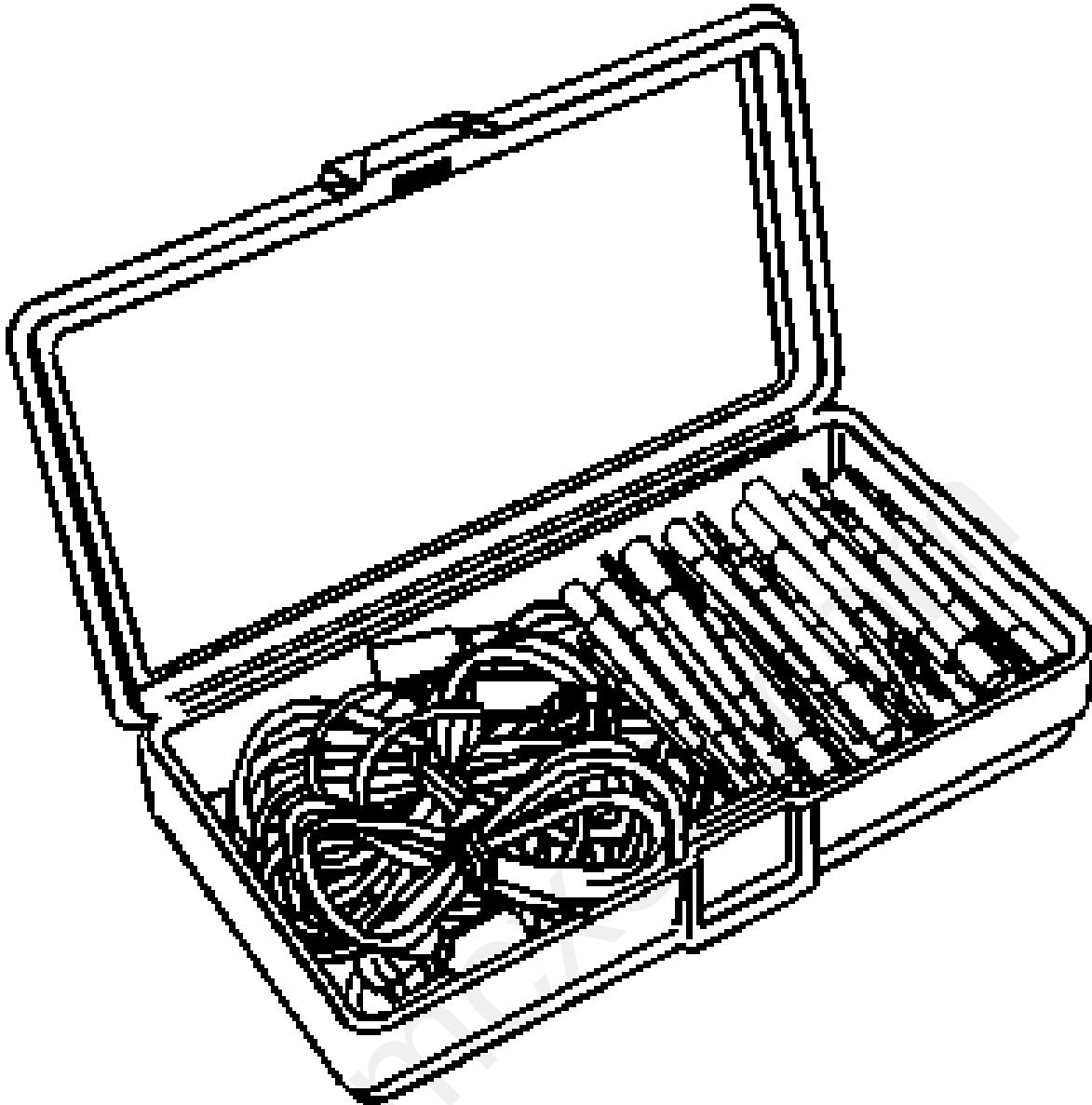
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

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

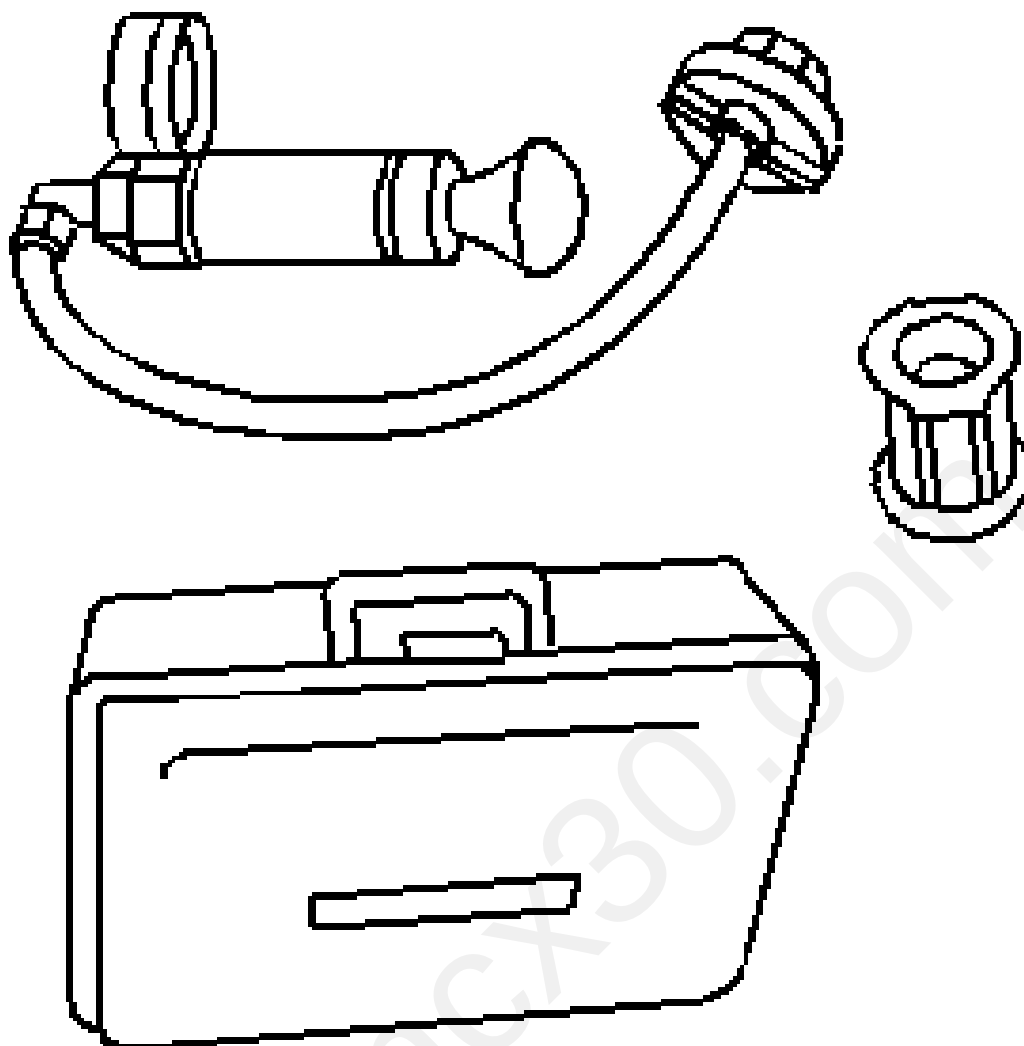
Illustration



Tool
Number/
Description

EL-35616-F
Connector
Test Adapter
Kit

Illustration



Tool
Number/
Description

EN-24460-A
J-24460-01
Cooling
System
Pressure
Tester

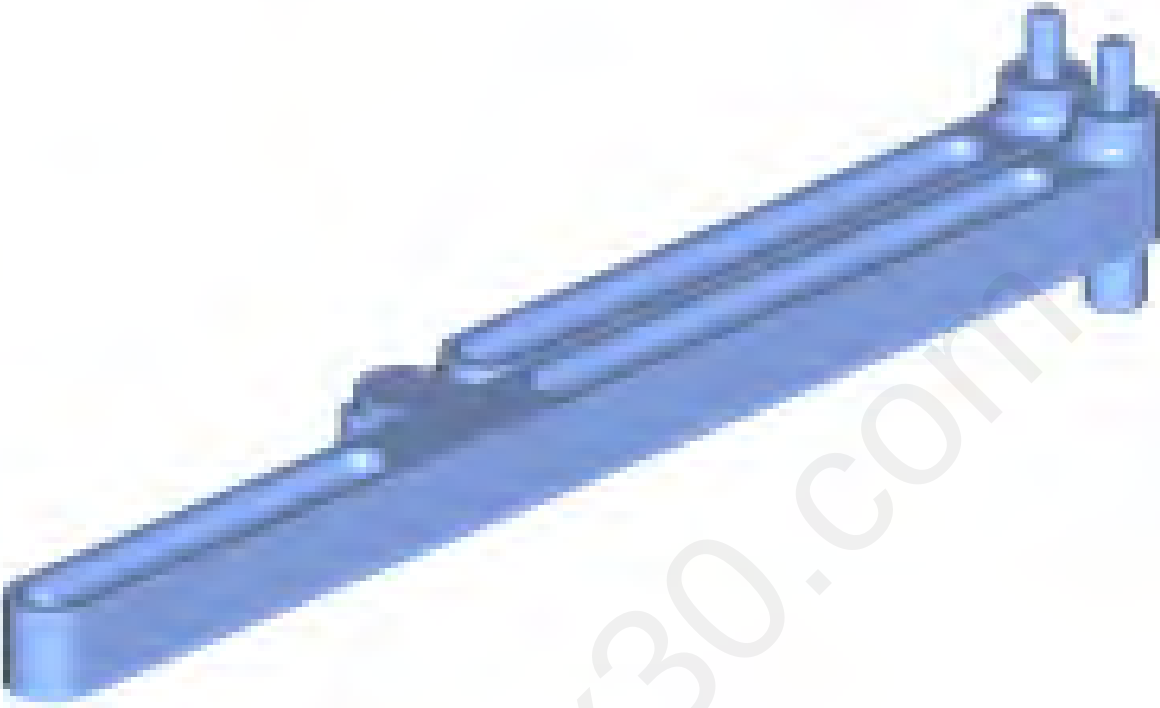
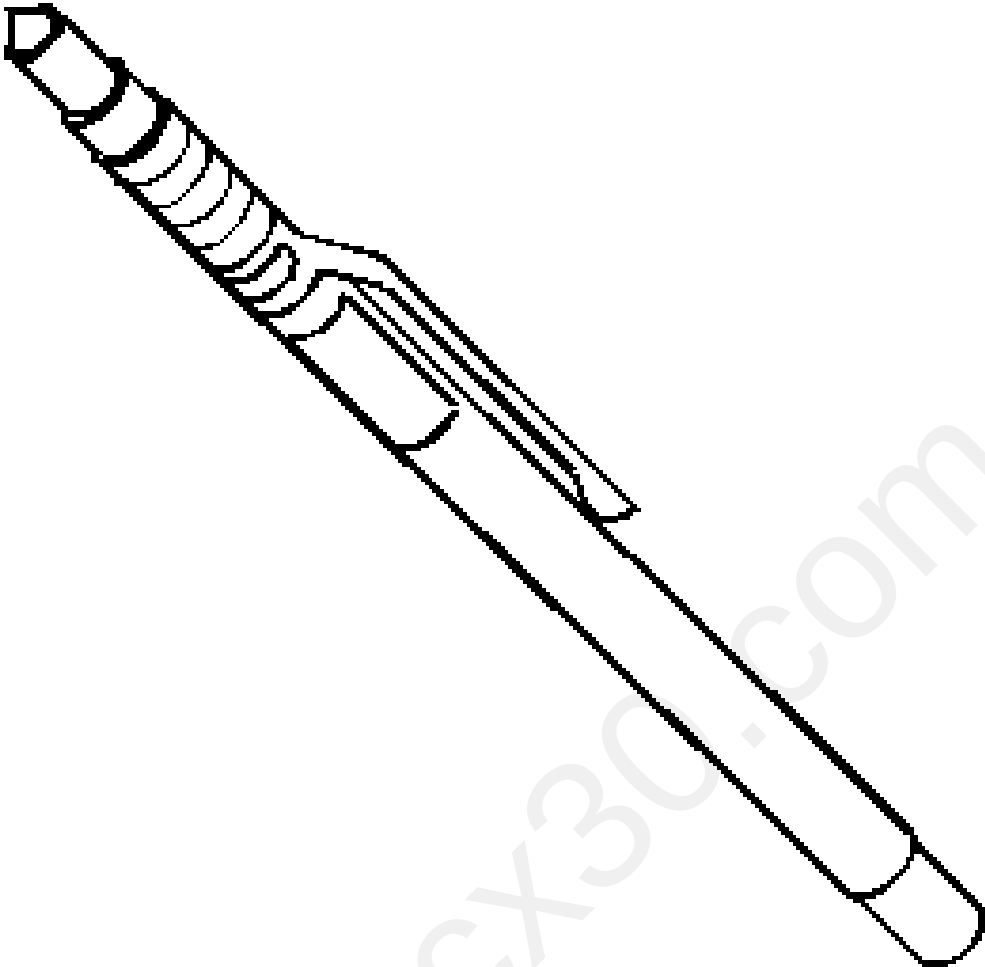
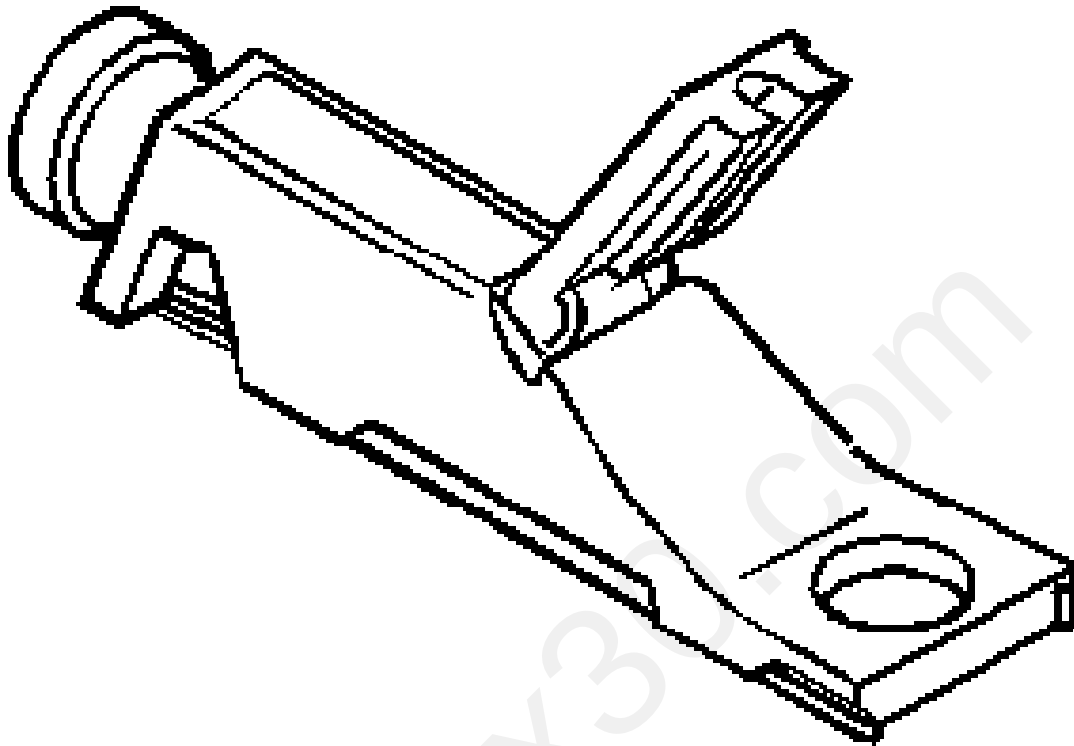
Illustration	Tool Number/ Description
	EN-46104 J-46104 Water Pump Pulley Holding Tool

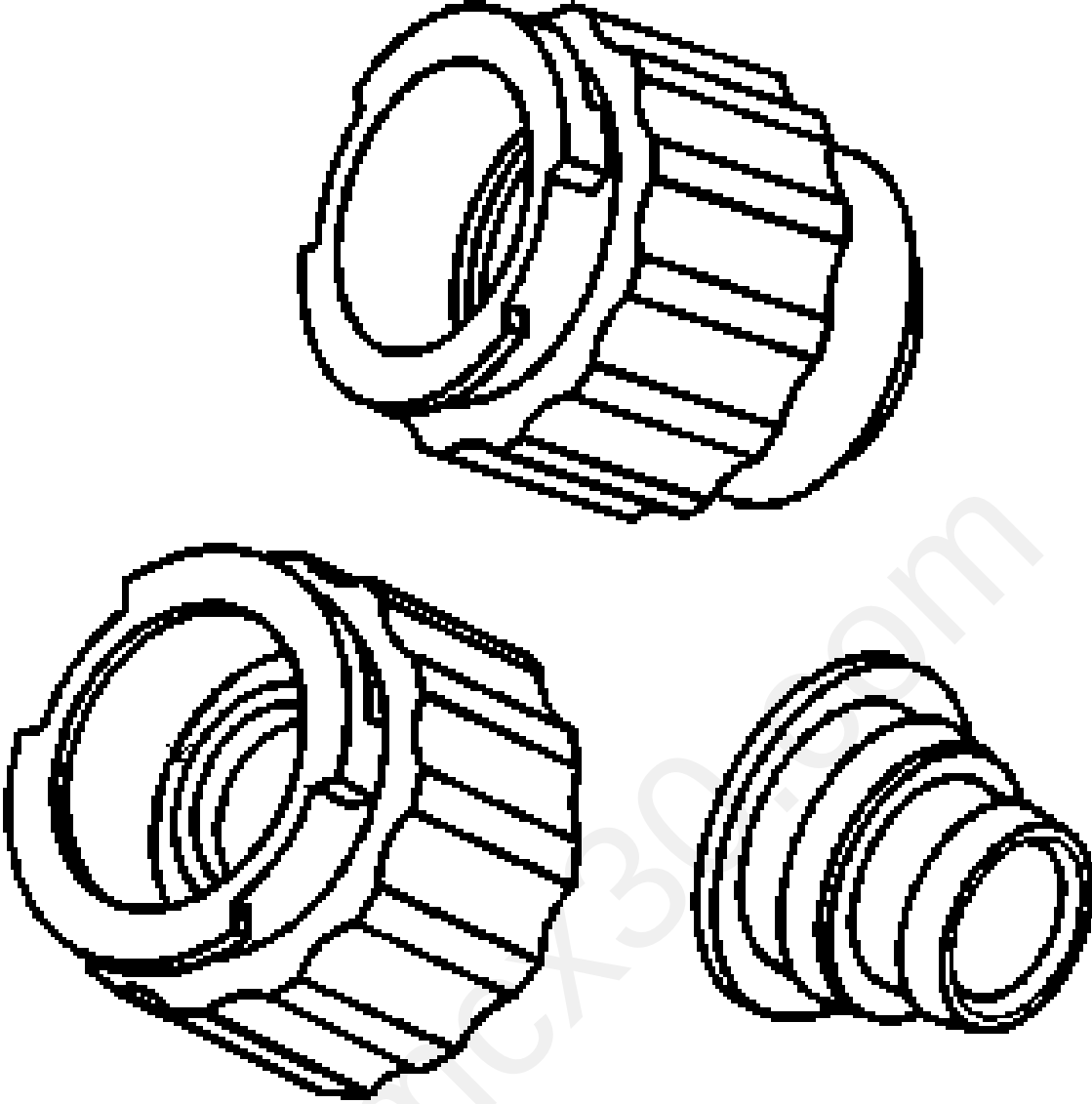
Illustration	Tool Number/ Description
	GE-24731 J-24731 Tempilstick

Illustration

**Tool
Number/
Description**

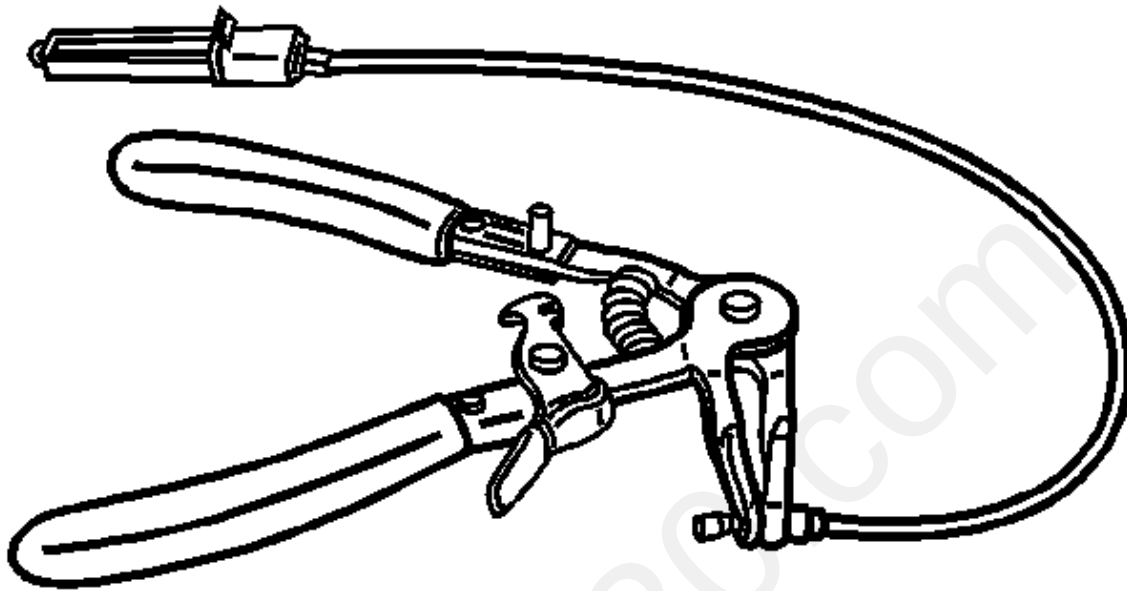


GE-26568
J-26568
Coolant and
Battery Fluid
Tester

Illustration	Tool Number/ Description
	GE-42401-A J-42401 Adapter Cooling System

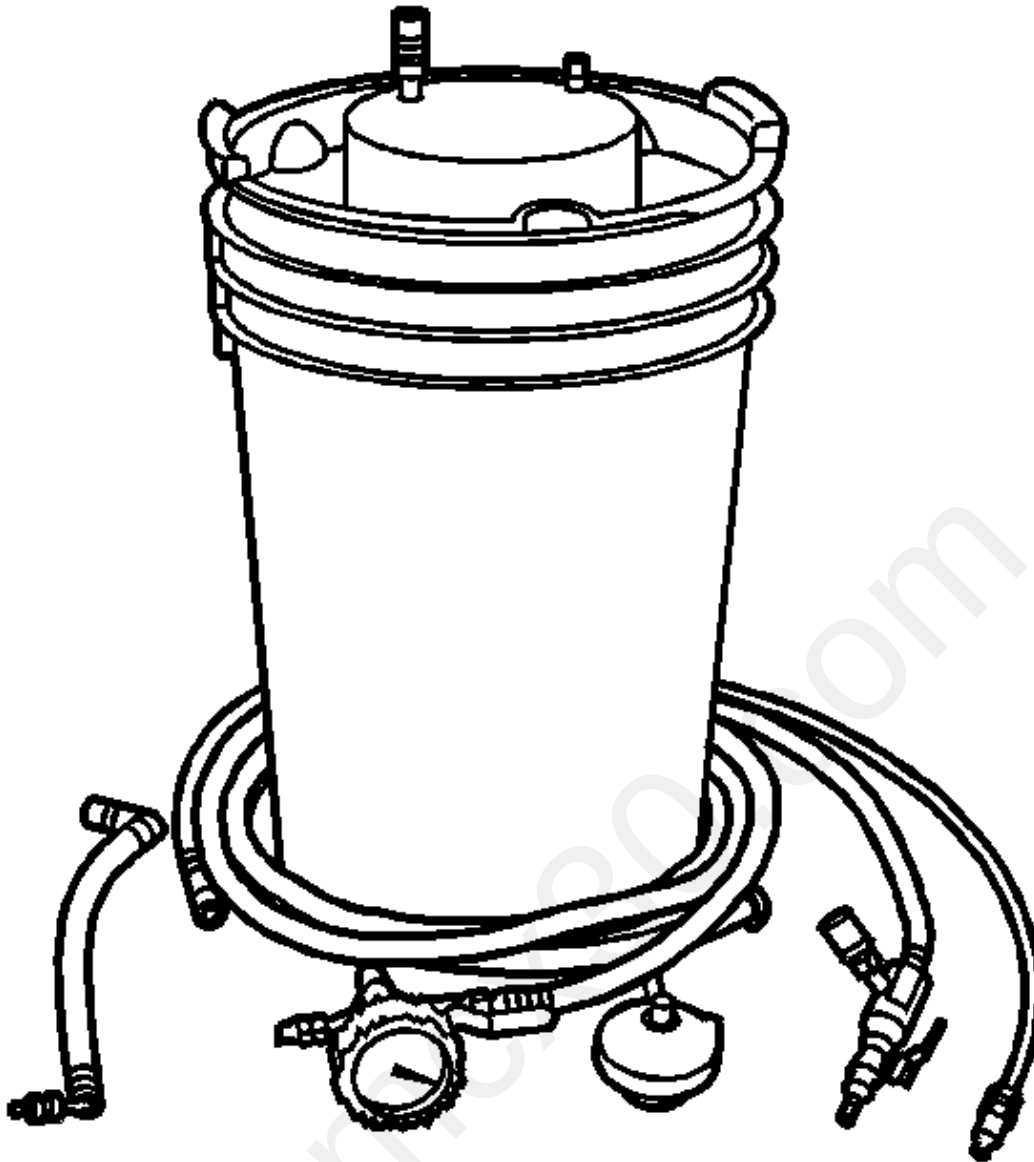
Illustration

Tool
Number/
Description



GE 47622
Hose Clamp
Pliers

Illustration



Tool
Number/
Description

GE-47716
Vac N Fill
Coolant Refill
Tool