

2017 ENGINE**Engine Heating and Cooling - Encore, Trax****SPECIFICATIONS****TEMPERATURE VERSUS RESISTANCE**

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

FASTENER SPECIFICATIONS**Single Use Non-Threaded Fasteners/Components**

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>
Application
Engine Oil Cooler Gasket
Thermostat Bypass Pipe Gasket
Thermostat Housing Gasket
Turbocharger Coolant Feed Pipe Copper Washer
Turbocharger Coolant Feed Pipe Gasket
Turbocharger Coolant Feed Pipe Seal Ring
Turbocharger Coolant Return Pipe Clamp
Turbocharger Coolant Return Pipe Copper Washer

NOTE:

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

Application
Water Outlet Seal
Water Pump Gasket
Water Pump Inlet Pipe Seal
Water Pump Seal
Engine Coolant Thermostat Housing Seal
Engine Oil Cooler Seals
Turbocharger Feed Pipe Retainer

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

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

Application	Specification
	Metric (English)
Rear Transmission Mount Through Bolt	80 N.m (59 lb ft) Plus 45 to 60 Degrees
Transmission Bolt (LE2)	75 N.m (55 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE:

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

Application	Specification
	Metric (English)
Drain Plug	2 N.m (18 lb in)
Engine Coolant Fan Bolt	5 N.m (44 lb in)
Engine Coolant Fan Bolt (LE2)	6 N.m (53 lb in)
Engine Coolant Fan Shroud Bolt (LE2)	6 N.m (53 lb in)
Engine Coolant Fan Retaining Bolt (LUV)	10 N.m (89 lb in)
Engine Coolant Thermostat (2H0)	10 N.m (89 lb in)
Engine Coolant Thermostat Housing Bolt (2H0)	8 N.m (71 lb in)
Engine Coolant Thermostat Housing Bracket Nut (2H0)	6 N.m (53 lb in)
Engine Coolant Thermostat Housing Bolt (LE2)	10 N.m (89 lb in)
Engine Oil Cooler Assembly Bolt (2H0)	25 N.m (18 lb ft)
Engine Oil Cooler Bolt (LUV)	10 N.m (89 lb in)
Engine Oil Cooler Housing Bolt (LUV)	25 N.m (18 lb ft)
Engine Oil Cooler Inlet Pipe Bolt (LUV)	10 N.m (89 lb in)
Engine Oil Cooler Inlet Pipe Bracket Bolt (LUV)	20 N.m (15 lb ft)
Engine Oil Cooler Large Bolt (LE2)	8 N.m (71 lb ft)
Engine Oil Cooler Outlet Pipe Bolt (2H0)	10 N.m (89 lb in)
Engine Oil Cooler Outlet Pipe Bolt (LUV)	10 N.m (79 lb ft)
Engine Oil Cooler Pipe Bolt (2H0)	8 N.m (71 lb ft)
Engine Oil Cooler Small Bolt (LE2)	10 N.m (79 lb ft)
Radiator Bolt (LE2)	6 N.m (53 lb in)
Radiator Mounting Pin Bolt	5 N.m (44 lb in)
Radiator Surge Tank Bolt (LE2)	5 N.m (44 lb in)
Radiator Upper Bracket Bolt (2H0, LUV)	18 N.m (13 lb ft)
Radiator Upper Mount Bracket Bolt (LE2)	18 N.m (13 lb ft)
Thermostat Bypass Pipe Bolt (LE2)	10 N.m (89 lb in)

NOTE:

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

Application	Specification
	Metric (English)
Turbocharger Coolant Feed Pipe Bolt (LUV)	10 N.m (89 lb in)
Turbocharger Coolant Feed Pipe Hollow Bolt (LE2)	35 N.m (26 lb ft)
Turbocharger Coolant Feed Pipe Quick Connect (LUV)	20 N.m (15 lb ft)
Turbocharger Coolant Return Pipe Bracket Bolt (LE2, LUV)	10 N.m (89 lb in)
Turbocharger Coolant Return Pipe Hollow Bolt (LE2)	35 N.m (26 lb ft)
Turbocharger Coolant Return Pipe Quick Connect (LUV)	20 N.m (15 lb ft)
Vent Screw	1.9 N.m (17 lb in)
Water Inlet Pipe Bolt (LUV)	9 N.m (80 lb in)
Water Outlet Bolt (LE2)	10 N.m (89 lb in)
Water Outlet Bolt (LUV)	8 N.m (71 lb in)
Water Pump Bolt (2H0)	8 N.m (71 lb in)
Water Pump Bolt (LE2)	10 N.m (89 lb in)
Water Pump Bolt (LUV)	
First Pass:	8 N.m (71 lb in)
NOTE: Does not apply to all bolts. Review repair procedure. Second Pass:	Plus 30 Degrees
Water Pump Housing Bolt (LE2)	25 N.m (18 lb ft)
Water Pump Pulley Bolt (2H0)	20 N.m (15 lb ft)
Water Pump Pulley Bolt (LUV)	22 N.m (16 lb ft)
Wiring Harness Bracket Nut (2H0)	10 N.m (89 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System		
1.4L (LUJ, LUV, LE2)	7.35 L	7.77 qt
1.8L (2H0)	6.35 L	6.71 qt

ENGINE COOLING SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English
Cooling System		
Cooling Filling Quantity	Approximate Fluid Capacities	
Water Pump Design	Rotary Pump	
Thermostat		
Start of Opening	97Â°C	207Â°F
Fully Open	112Â°C	234Â°F

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

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

Application	Type of Material	GM Part Number	
		United States	Canada
Extended Life Coolant Leak Detection Dye	Dye	89022219	89022220

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS (BUICK)

Engine Cooling (Buick)

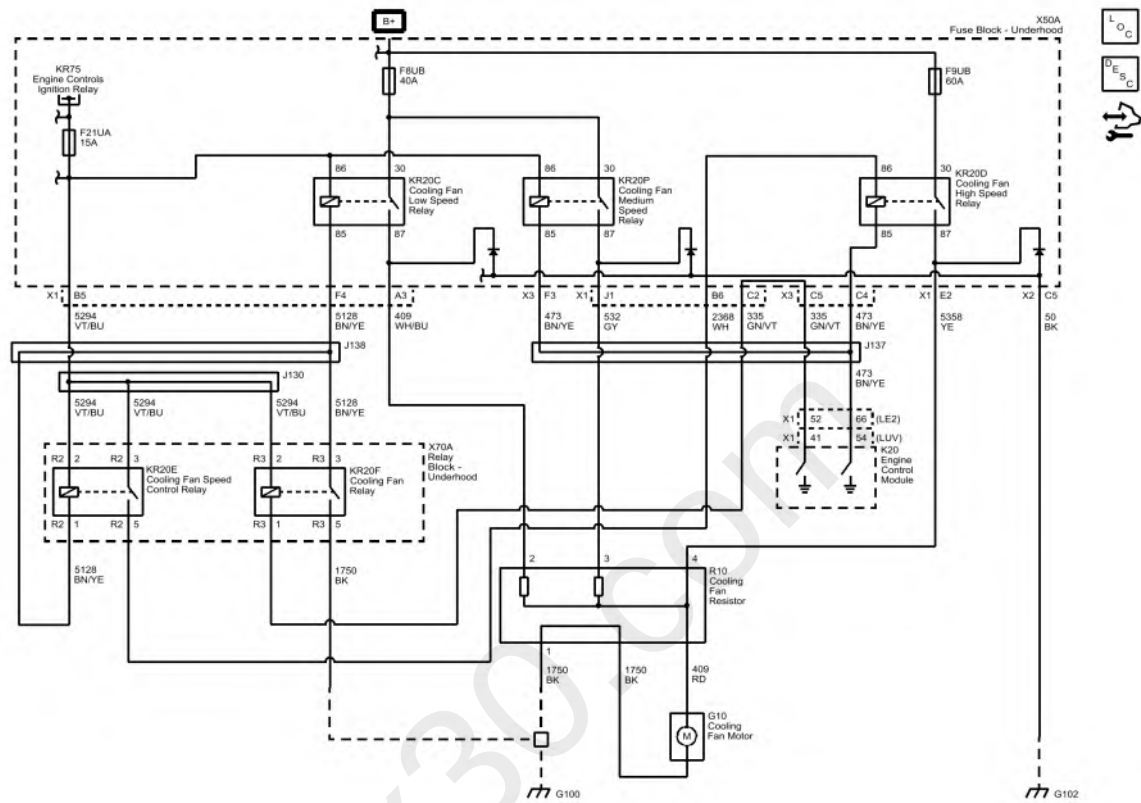


Fig. 1: Engine Cooling (Buick)
Courtesy of GENERAL MOTORS COMPANY

ENGINE HEATING/COOLING WIRING SCHEMATICS (CHEVROLET)

Engine Cooling (Chevrolet with LUV)

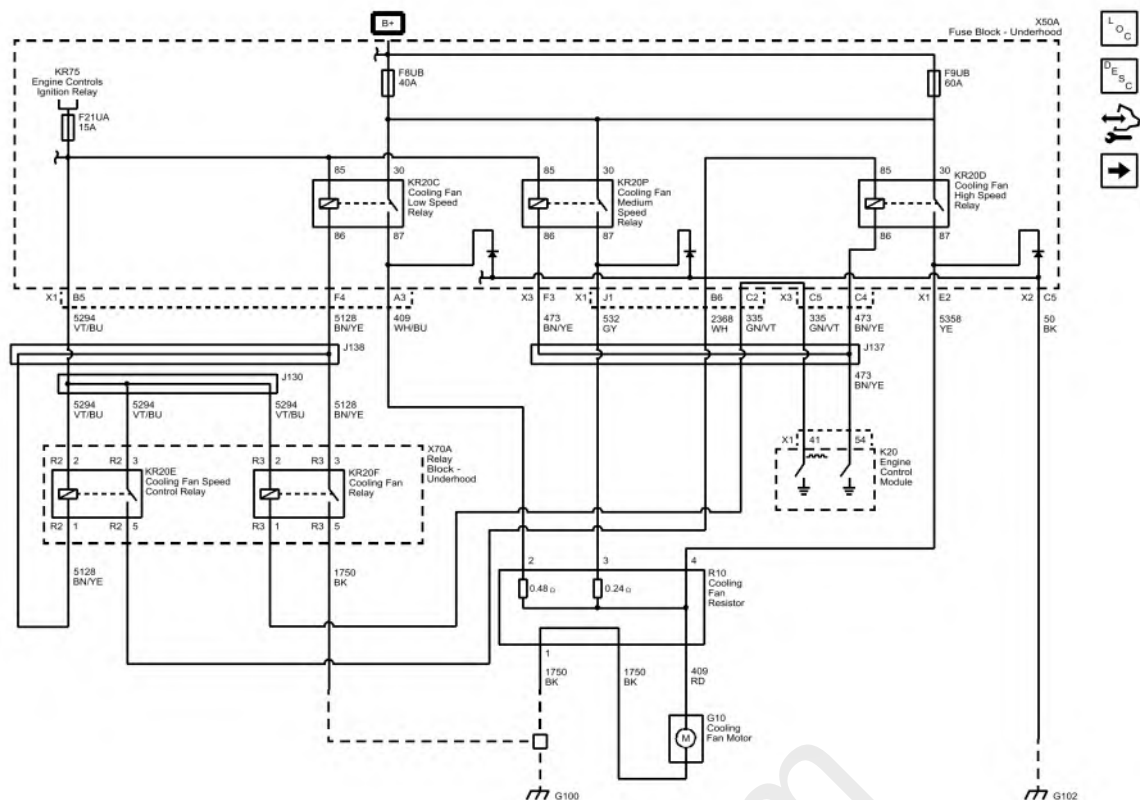


Fig. 2: Engine Cooling (Chevrolet with LUV)
Courtesy of GENERAL MOTORS COMPANY

Engine Cooling (Chevrolet with 2H0)

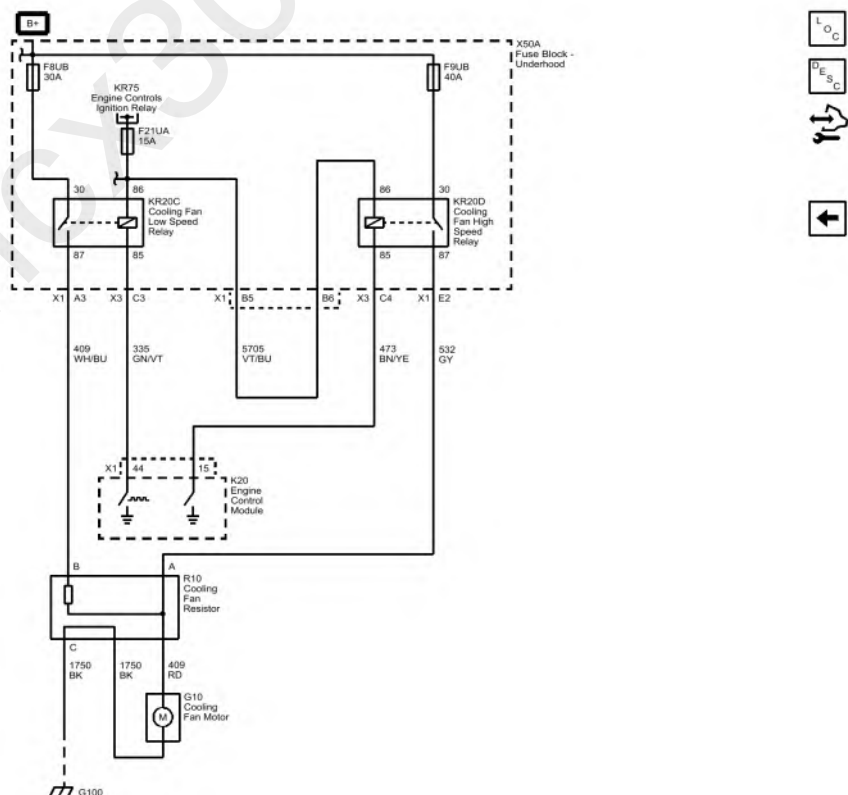


Fig. 3: Engine Cooling (Chevrolet with 2H0)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P00B3 OR P00B4: RADIATOR COOLANT TEMPERATURE (RCT) SENSOR

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 (RCT) Sensor Circuit Low Voltage

DTC P00B4

Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	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			
Radiator Coolant Temperature Sensor 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/System Description

NOTE: The radiator coolant temperature sensor is referred to as B203 Engine Coolant Temperature Sensor 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. The engine control module (ECM) supplies 5 volts to the RCT signal circuit and supplies a ground to the low reference circuit.

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

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

The ECM detects that the RCT sensor is colder than -60Â°C (-76Â°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.
- The AC compressor will be commanded OFF.

Conditions for Clearing the MIL/DTC

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 RCT sensor and the ECT sensor values should display within 3Â°C (5Â°F).

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#) [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

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.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) and changes with engine run time.

- **If not between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) 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. Vehicle Off, disconnect the harness connector at the B203 Engine Coolant Radiator Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than $2\ \Omega$ between the low reference circuit terminal 2 and ground.

- **If $2\ \Omega$ or greater**

1. Vehicle Off, disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for less than $2\ \Omega$ in the low reference circuit end to end.

- If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.

- If less than $2\ \Omega$, replace the K20 Engine Control Module.

- **If less than $2\ \Omega$**

3. Vehicle in Service Mode.

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

- **If warmer than -39°C (-38°F)**

1. Vehicle Off, disconnect the X1 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°C (-38°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 140°C (284°F).

- **If colder than the 140°C (284°F)**

1. Vehicle Off, disconnect the X1 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

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. Vehicle Off.

4. Test for less than $2\ \Omega$ in the signal circuit end to end.

- If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.

- If less than $2\ \Omega$, replace the K20 Engine Control Module.

- **If warmer than 140°C (284°F)**

7. Test or replace the B203 Engine Coolant Radiator Temperature Sensor.

Component Testing

1. Vehicle Off, remove the B203 Engine Coolant Radiator Temperature Sensor.

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

2. Test the B203 Engine Coolant Radiator Temperature Sensor by varying the sensor temperature while measuring the sensor resistance. Compare the readings with the [Temperature Versus Resistance](#) table and verify that the resistance is within 5 percent of the specification.
 - If not within the specified range, replace the B203 Engine Coolant Radiator Temperature Sensor.

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement \(Water Outlet\)](#) [Engine Coolant Temperature Sensor Replacement \(Radiator\)](#)

for Radiator Coolant Temperature Sensor replacement.

- [Control Module References](#) for ECM 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
Coolant Temperature Sensor Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	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 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 uses a pulse width modulated (PWM) signal to control the electrical thermostat heater circuit. The ECM compares the radiator coolant temperature to the engine coolant temperature in order to determine if there is sufficient coolant flow through the thermostat.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0116, P0117, P0118, and P0119 are not set.
- The engine run time is greater than 5 m.
- The engine coolant temperature is greater than 80Â°C (176Â°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 40Â°C (104Â°F) when the ECT sensor is warmer than 120Â°C (248Â°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 will operate mechanically without assist from the electric heater once it reaches a certain temperature. The mechanical thermostat will open at approximately 103Â°C (217Â°F).
- A resistance condition in the RCT sensor circuits may set 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 \(Buick with LUV\)](#) [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Cooling System Description and Operation \(LUV, LE2\)](#) [Cooling System Description and Operation \(2HO\)](#)

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 that DTC P00B3, P00B4, P00B6, P0116, P0117, P0118, or P0119 is not set.
 - **If DTC P00B3, P00B4, P00B6, P0116, P0117 P0118, or P0119 is set.**
 Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If DTC P00B3, P00B4, P00B6, P0116, P0117 P0118, or P0119 is 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](#), 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. Using the scan tool, select Control Functions, Cooling Fan, Cooling Fan Relays 1, 2, and 3. Command the Cooling Fan ON and OFF.

- **If the cooling fan does not turn ON and OFF**

Refer to [Cooling Fan Inoperative](#).

- **If the cooling fan turns ON and OFF**

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

NOTE: 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 107Â°C (225Â°F).

- **If ECT is warmer than 107Â°C (225Â°F)**

Refer to Circuit/System Testing.

- **If ECT is colder than 107Â°C (225Â°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 listed 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 repair.

DTC P0480 OR P0481: COOLING FAN RELAY 1 CONTROL CIRCUIT (2H0)**Diagnostic Instructions**

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

DTC Descriptors**DTC P0480**

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relay 2 Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Voltage Supply	P0481	P0480, P0481	-	-
Relay Switch B+	1	1	-	-
KR20C Cooling Fan Low Speed Relay Control	P0480	P0480	P0480, 3	-
KR20D Cooling Fan High Speed Relay Control	P0481	P0481	P0481, 3	-
Relay Controlled Output	1	1	2	-
1. Fans inoperative without a DTC. 2. Fans always ON without a DTC. 3. The ECM must be commanding the relay ON in order for the DTC to set.				

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, 2 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes 1 resistor mounted in the cooling fan shroud. This combination of components enables the ECM to operate the cooling fan at 2 speeds using two fan control circuits. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each 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. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Conditions for Running the DTC

- The ignition voltage is 11-18 volts.
- The engine speed is 400 RPM or greater.
- The ECM has commanded the output driver ON and OFF at least once during the ignition cycle.
- The DTCs run continuously when the conditions above are met.

Conditions for Setting the DTC

The commanded state of the ECM 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 and P0481 are Type C DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0480 and P0481 are Type C DTCs.

Diagnostic Aids

- The ECM has the capability of providing command to the fan relays even when a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at low speed
 - Cooling Fan Relay 2 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics (Buick) Engine Heating/Cooling Schematics (Chevrolet)

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)
- Electrical Center Identification Views (Buick) Electrical Center Identification Views (Chevrolet)

Description and Operation

Cooling Fan Description and Operation (2H0 or LDE)

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 an audible click is heard or felt from each cooling fan relay when commanding the cooling fan ON and OFF with a scan tool.
 - **If a click is not heard or felt at each of the relays**

Refer to Circuit/System Testing.
 - **If a click is heard or felt at each of the relays**
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.

1. Ignition OFF, disconnect the cooling fan relays listed below:

- KR20C Cooling Fan Low Speed Relay
- KR20D Cooling Fan High Speed Relay

NOTE: The following test must be performed on each of the relay coil ignition circuits.

2. Ignition ON, verify that a test lamp illuminates between the relay coil ignition circuit terminal listed below and ground:

- KR20C Cooling Fan Low Speed Relay terminal 85
- KR20D Cooling Fan High Speed Relay terminal 85
- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit of the appropriate cooling fan relay, 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, remove the test lamp.

2. Test for infinite resistance between the relay coil ignition circuits listed below and ground:

- KR20C Cooling Fan Low Speed Relay terminal 85
- KR20D Cooling Fan High Speed Relay terminal 85
- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, test all of the appropriate relays for a shorted condition and replace as necessary.

• **If the test lamp illuminates**

3. Ignition OFF, remove the test lamp, ignition ON.

NOTE: The following tests must be performed on the two fan relay control circuits.

4. Connect a DMM, set on the diode setting, between a control circuit terminal listed below and ground:

- KR20C Cooling Fan Low Speed Relay terminal 86
- KR20D Cooling Fan High Speed relay terminal 86

5. Verify the DMM reading is greater than 2.5 V or displays O.L.

• **If 2.5 V or less**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the appropriate relay coil 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 greater than 2.5 V or displays O.L.**

NOTE: The following test must be performed on the two fan relay circuits.

6. Verify the DMM reading is less than 1 V when commanding the Cooling Fan Relays ON with a scan tool.

• **If 1 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the appropriate cooling fan relay control 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 appropriate cooling fan relay 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 less than 1 V**

7. Test or replace the appropriate cooling fan relay.

Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70-110 Ω between terminals 85/2 and 86/1.

- **If less than 70 Ω or greater than 110 Ω**

Replace the cooling fan relay.

- **If between 70-110 Ω**

4. Test for infinite resistance between following terminals:

- 30/3 and 86/1
- 30/3 and 87/5
- 30/3 and 85/2
- 85/2 and 87/5

- **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.
6. Install a jumper wire between relay terminal 86/1 and ground.
7. Test for less than 2 Ω between terminals 30/3 and 87/5.

- **If 2 Ω or greater**

Replace the cooling fan relay.

- **If less than 2 Ω**

8. All OK.

Repair Instructions

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

- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- [Control Module References](#) for ECM replacement, programming, and setup

DTC P0480, P0481, P0691, P0692, P0693, OR P0694: COOLING FAN RELAY

Diagnostic Instructions

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

DTC Descriptors

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

DTC P0691

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relays 2 and 3 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relays 2 and 3 Control Circuit High Voltage

Diagnostic Fault Information**KR20C Cooling Fan Low Speed Relay**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480, P0691	2	-	-
Relay Switch B+	1	2	-	-
Relay Coil Control	3	2	4	-
Relay Controlled Output	1	2	3	-
1. Low and medium speed fan inoperative without a DTC. 2. Low speed fan inoperative without a DTC. 3. Low speed fan always ON without a DTC. 4. Low and high speed fan inoperative without a DTC.				

KR20D Cooling Fan High Speed Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480, P0691	2	1	-
Relay Switch B+	2	2	-	-
Relay Control	P0481 or P0693	P0481	P0481 or P0694	-
Relay Controlled Output	2	2	3	-
1. Medium speed fan replaced by high speed fan without a DTC. 2. High speed fan inoperative without a DTC. 3. High speed fan always ON without a DTC.				

KR20E Cooling Fan Speed Control Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480, P0691	1	-	-
Relay Switch Ignition	P0480, P0691	1	-	-
Relay Coil Control	2	1	3	-
Relay Controlled Output	1	1	4	-
1. High speed fan inoperative without a DTC. 2. Low speed fan always ON without a DTC. 3. Low and high speed fan inoperative without a DTC. 4. Medium speed fan inoperative without a DTC.				

KR20F Cooling Fan Relay

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480, P0691	P0480	-	-
Relay Switch Ignition	1	2	-	-
Relay Control	P0480 or P0691	P0480	P0480 or P0692	-
Relay Controlled Output	-	2	-	-
1. Low speed fan always ON without a DTC. 2. Low speed fan and high speed fan inoperative.				

KR20P Cooling Fan Medium Speed Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	-	P0481	-	-
Relay Switch B+	1	2	-	-
Relay Control	P0481 or P0693	P0481	P0481 or P0694	-
Relay Controlled Output	1	2	3	-
1. Low and medium speed fan inoperative without a DTC. 2. Medium speed fan inoperative without a DTC. 3. Medium speed fan always ON without a DTC.				

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Conditions for Running the DTC

- The ignition voltage is greater 11 volts.
- The ECM has commanded the output driver ON and OFF at least once during the ignition cycle.
- The DTCs run continuously when the conditions above are met.

Conditions for Setting the DTC

The commanded state of the ECM 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 P0481, P0691, P0692, P0693, and P0694 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0480 P0481, P0691, P0692, P0693, and P0694 are Type B DTCs.

Diagnostic Aids

- The ECM has the capability of providing command to the fan relays even when a scan tool output control is being used. Always refer to the scan tool Cooling Fan Relay Command parameters to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics (Buick) Engine Heating/Cooling Schematics (Chevrolet)

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)
- Electrical Center Identification Views (Buick) Electrical Center Identification Views (Chevrolet)

Description and Operation

Cooling Fan Description and Operation (2H0 or LDE) Cooling Fan Description and Operation (LUV or LUJ) Cooling Fan Description and Operation (LUD)

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 an audible click is heard or felt from each cooling fan relay when commanding the cooling fan ON and OFF with a scan tool.
 - **If a click is not heard or felt at each of the relays**

Refer to Circuit/System Testing.
 - **If a click is heard or felt at each of the relays**
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

1. Ignition OFF, disconnect the KR20 cooling fan relays listed below:
 - KR20F Cooling Fan Relay
 - KR20P Cooling Fan Medium Speed Relay
 - KR20D Cooling Fan High Speed Relay

NOTE: The following test must be performed on each of the relay coil ignition circuits.

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:

- KR20F Cooling Fan Relay terminal 85/2
- KR20P Cooling Fan Medium Speed Relay terminal 86/1
- **If the test lamp does not illuminate and the 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 ignition circuit of the appropriate KR20 Cooling Fan Relay, 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 relay coil ignition circuits listed below and ground:
 - KR20F Cooling Fan Relay terminal 85/2
 - KR20D Cooling Fan High Speed Relay terminal 86/1
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test all of the appropriate KR20 Cooling Fan Relays for a short and replace as necessary.

- **If the test lamp illuminates**

3. Ignition OFF, remove the test lamp, ignition ON.

NOTE: The following tests must be performed on all three fan relay control circuits.

4. Connect a DMM, set on the diode setting, between a control circuit terminal listed below and ground:

- KR20F Cooling Fan Relay terminal 86/1
- KR20P Cooling Fan Medium Speed Relay terminal 85/2
- KR20D Cooling Fan High Speed Relay terminal 85/2

5. Verify the DMM reading is greater than 2.5 V or displays O.L.

- **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. Disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the appropriate relay coil 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 greater than 2.5 V or displays O.L.**

NOTE: The following test must be performed on all three fan relay circuits.

6. Verify the DMM reading is less than 1 V when commanding the Cooling Fan Relays ON with a scan tool.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the appropriate KR20 Cooling Fan Relay control 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 appropriate KR20 Cooling Fan Relay 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 less than 1 V**

7. Test or replace the appropriate KR20 Cooling Fan Relay.

1. Ignition OFF.
2. Disconnect a KR20 Cooling Fan Relay.
3. Test for 70-110 Ω between terminals 85/2 and 86/1. 95-135 Ω for the KR20F Cooling Fan Relay.
 - **If less than or greater than the specified range**
 Replace the KR20 Cooling Fan Relay.
 - **If within the specified range**
4. Test for infinite resistance between the following terminals:
 - 30/3 and 86/1
 - 30/3 and 87/5
 - 30/3 and 85/2
 - 85/2 and 87/5
 - **If less than infinite resistance**
 Replace the KR20 Cooling Fan Relay.
 - **If infinite resistance**
5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.
6. Install a jumper wire between relay terminal 86/1 and ground.
7. Test for less than 2 Ω between terminals 30/3 and 87/5.
 - **If 2 Ω or greater**
 Replace the KR20 Cooling Fan Relay.
 - **If less than 2 Ω**
8. All OK.

Repair Instructions

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

- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- [Control Module References](#) for ECM replacement, setup, and programming

DTC P0597-P0599: ENGINE COOLANT THERMOSTAT HEATER CONTROL

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](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC P0597

Engine Coolant Thermostat Heater Control Circuit Malfunction

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTC P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0597, 1	P0597, 1	-	-
Control	P0598	P0598	P0597, P0599	-
1. Thermostat Heater Malfunction				

Circuit/System Description

The ECM controls the pulse width modulated (PWM) thermostat. The engine coolant thermostat heater controls coolant flow and regulates the engine operating temperature. The ignition relay supplies 12 V to the thermostat through a fuse. The ECM controls the engine coolant thermostat heater 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 DTC

- The ignition is ON, or the engine is running.
- The ignition voltage is greater than 9 V.
- DTC P0597, P0598, and P0599 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 15 s.

Action Taken When the DTC Sets

DTC P0597, P0598, P0599 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0597, P0598, 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). The heater is part of the thermostat. The engine coolant thermostat heater and the thermostat housing are serviced as an assembly.

Reference Information

Schematic Reference

Engine Controls Schematics (Chevrolet with 2H0)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

Description and Operation

Cooling Fan Description and Operation (2H0 or LDE)Cooling Fan Description and Operation (LUV or LUJ)Cooling Fan Description and Operation (LUD)

Electrical Information Reference

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

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**
 - **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.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 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, remove the test lamp.
 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 Replacement \(2H0\)Engine Coolant Thermostat Replacement \(LUV\)](#) for E41 engine coolant thermostat heater replacement.
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P112F: RADIATOR COOLANT TEMPERATURE SENSOR NOT PLAUSIBLE

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 P112F

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	-	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			
Parameter Normal Range: Varies with ambient temperature			
Signal	140 $\hat{A}$ °C (284 $\hat{A}$ °F)	-40 $\hat{A}$ °C (-40 $\hat{A}$ °F)	-40 $\hat{A}$ °C (-40 $\hat{A}$ °F)*
Low Reference	-	-40 $\hat{A}$ °C (-40 $\hat{A}$ °F)	-40 $\hat{A}$ °C (-40 $\hat{A}$ °F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

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

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 -7°C (19°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 20°C (68°F).

Action Taken When the DTC Sets

DTC P112F is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P112F is a Type B DTC.

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 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 (Chevrolet with 2H0)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE). COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

Electrical Information Reference

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

DTC Type Reference

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 $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) and changes with engine run time.
 - **If not between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) or does not change**

Refer to Circuit/System Testing.
 - **If between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) 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 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than $5\ \Omega$ between the low reference terminal 2 and ground.
 - **If $5\ \Omega$ or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than $2\ \Omega$ in the low reference circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **If less than $5\ \Omega$**
3. Ignition ON.
4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°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°C (-38°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°C (284°F).
 - **If colder than the 140°C (284°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 $2\ \Omega$ in the signal 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 warmer than 140 $^{\circ}$ C (284 $^{\circ}$ F)**

7. Test or replace the B34B Engine Coolant Temperature Sensor 2.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor.
2. Test the ECT 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 B34B 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 B34B Engine Coolant Temperature Sensor.
 - **If infinite resistance**
4. All OK.

Repair Instructions

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

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

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 2 h.
- The engine run time is between 2 and 30 m.
- The engine coolant temperature (ECT) sensor at start-up is between -10 $^{\circ}$ to 45 $^{\circ}$ C (14 $^{\circ}$ to 113 $^{\circ}$ F).
- The intake air temperature (IAT) sensor is between -7 $^{\circ}$ to 60 $^{\circ}$ C (19 $^{\circ}$ to 140 $^{\circ}$ F).
- The Engine Coolant Thermostat Heater Command is less than 10 %.

- The airflow into the engine is between 11 to 100 g/s.
- The Ethanol in the fuel is less than 100 %.
- 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 4 m.

Action Taken When the DTC Sets

DTC P00B7 is a Type B DTC.

Conditions for Clearing the DTC

DTC P00B7 is a Type B DTC.

Diagnostic Aids

- Insufficient vehicle interior heating is an indication of improper thermostat operation.
- The scan 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 (Buick with LE2)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

Description and Operation

Cooling System Description and Operation (LUV, LE2) Cooling System Description and Operation (2HO)

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](#), and [Loss of Coolant](#).

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

3. Verify 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 82°C and 102°C (180°F and 215°F)

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

Replace the engine coolant thermostat.

- If ECT sensor is between 82°C and 102°C (180°F and 215°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 repair.

[Engine Coolant Thermostat Housing Replacement \(2H0\)Engine Coolant Thermostat Housing Replacement \(LE2\)](#)

DTC P2600-P2603: AUXILIARY COOLANT PUMP

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 P2600

Auxiliary Coolant Pump Relay Control Circuit

DTC P2601

Auxiliary Coolant Pump Performance

DTC P2602

Auxiliary Coolant Pump Relay Control Circuit Low Voltage

DTC P2603

Auxiliary Coolant Pump Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Auxiliary Coolant Pump Relay Coil Ignition Voltage	-	P2600	1	P2601
Auxiliary Coolant Pump Relay Control	P2600, P2602, 2	P2600, P2602, 1	P2600, P2603	P2601
1. Auxiliary coolant pump inoperative. 2. Auxiliary coolant pump always ON				

Typical Scan Tool Data

Auxiliary Coolant Pump Relay Control Circuit Open, Low, or High Voltage Test Status

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage test and Not Run for High Voltage test • Component ON - Not Run for Open/Low Voltage test and OK for High Voltage test			
Ignition Voltage	Malfunction	Malfunction	-
Auxiliary Coolant Pump Relay Control	Malfunction	Malfunction	Not Run

Circuit/System Description

The auxiliary heater coolant pump relay provides power to the heater coolant pump. The engine control module (ECM) commands the ON when the engine is not running. The ECM applies ground to the coil side of the auxiliary pump relay. This energizes the coil and applies voltage directly to the pump motor through the switch side of the relay. The heater coolant pump is used for powertrain cooling and HVAC.

Conditions for Running the DTC

- Ignition is ON.
- Engine is not running.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTCs P2600-P2603 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

The DTCs are Type B DTCs.

Conditions for Clearing the DTC

The DTCs are Type BDTCs.

Reference Information

Schematic Reference

- [Engine Heating/Cooling Schematics \(Buick\)](#)[Engine Heating/Cooling Schematics \(Chevrolet\)](#)

- [HVAC Schematics \(Buick with CJ2\)](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)
- [Electrical Center Identification Views \(Buick\)](#), [Electrical Center Identification Views \(Chevrolet\)](#)

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, verify that DTC P0480, P0481, P0691, P0692, P0693 or P0694 are not set.
 - If a DTC is set, refer to [DTC P0480, P0481, P0691, P0692, P0693, or P0694](#) for further diagnosis.

NOTE: There is a slight delay before the cooling fan activates and reaches full speed.

2. Command the cooling fan ON from 0-90 % with a scan tool. Verify that the cooling fan turns ON and operates as commanded.
 - If the cooling fan does not respond to the commanded states, refer to [Cooling Fan Inoperative](#) for further diagnosis.
3. Ignition ON.
4. Verify the KR33 Auxiliary Heater Coolant Pump Relay turns on and off/clicks when commanding the KR33 Auxiliary Heater Coolant Pump Relay On and Off with a scan tool
5. Verify the parameters listed below do not display Malfunction when commanding the KR33 Auxiliary Heater Coolant Pump Relay ON and OFF On and Off with a scan tool
 - Auxiliary Coolant Pump Relay Control Circuit Open Test Status
 - Auxiliary Coolant Pump Relay Control Circuit Low Voltage Test Status
 - Auxiliary Coolant Pump Relay Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing
 - **If Malfunction is not displayed**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect KR33 Auxiliary Heater Coolant Pump Relay, Ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 85 and ground
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp
 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, remove the test lamp
2. Test for infinite between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - if infinite resistance, test or replace the KR33 Auxiliary Heater Coolant Pump Relay.
- **If the test lamp illuminates**
3. Connect a test lamp between the ignition circuit terminal 86 and the control circuit terminal 85.
4. Verify the test lamp turns ON and OFF when commanding the KR33 Auxiliary Heater Coolant Pump Relay On and Off with a scan tool.
 - **If the test lamp is always off.**
 1. Ignition OFF, remove the test lamp, 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
 3. Ignition OFF.
 4. 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 illuminates**
5. Test or Replace the KR33 Auxiliary Heater Coolant Pump Relay.

Component Testing

1. Ignition OFF, disconnect and remove the KR33 Auxiliary Heater Coolant Pump Relay.
2. Test for 70-110 Ω between terminals 85 and 86.
 - **If less than 70 Ω or greater than 110 Ω**
 Replace the KR33 Auxiliary Heater Coolant Pump Relay
 - **If between 70-110 Ω**
3. Test for infinite resistance between the terminals listed below:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - **If less than infinite resistance**
 Replace the KR33 Auxiliary Heater Coolant Pump Relay
 - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87
 - **If 2 Ω or greater**
 Replace the KR33 Auxiliary Heater Coolant Pump Relay
 - **If less than 2 Ω**
6. All OK

Repair Instructions

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

- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#) for KR33 Auxiliary Heater Coolant Pump Relay replacement.

- [Control Module References](#) for ECM replacement, setup, and programming

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 \(2H0 or LDE\)](#), [Cooling Fan Description and Operation \(LUV or LUJ\)](#), [Cooling Fan Description and Operation \(LUD\)](#), and [Cooling System Description and Operation \(LUV, LE2\)](#), [Cooling System Description and Operation \(2HO\)](#).

Visual/Physical Inspection

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

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

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

Several of the symptom procedures call for a careful visual and physical inspection. This can lead to correcting a condition without further tests and can save time. This inspection should include the following:

- Ensure that the control module grounds are clean, tight, and correctly located.
- Inspect cooling system hoses and pipes for splits, kinks, and improper connections. Inspect thoroughly for any type of leak or restriction.
- Inspect for a dirty or restricted radiator or HVAC condenser.
- Inspect for aftermarket devices which could affect the operation of the cooling system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the coolant recovery reservoir for proper coolant level.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movement of a component. Refer to the following for a list to help isolate an intermittent condition:

- Water intrusion in connectors, terminals, or components
- Poor connector mating
- Terminal contact
- High circuit or component resistance-High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness' that are routed too tight, or chaffed circuits

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

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

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Cooling Fan Always On](#)
- [Cooling Fan Inoperative](#)
- [Engine Overheating](#)
- [Loss of Coolant](#)
- [Thermostat Diagnosis](#)
- [Engine Fails To Reach Normal Operating Temperature](#)

COOLING FAN ALWAYS ON

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed
- Certain resistance conditions with intake air temperature (IAT) or engine coolant temperature (ECT) sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans 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 Specifications of the appropriate engine controls subsection.
- If the cooling fan operates at high speed when the ECM is requesting medium speed operation, test or replace the KR20E Cooling Fan Speed Control Relay.

Reference Information

Schematic Reference

[Engine Heating/Cooling Schematics \(Buick\)](#)[Engine Heating/Cooling Schematics \(Chevrolet\)](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\), COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)
- [Electrical Center Identification Views \(Buick\)](#) [Electrical Center Identification Views \(Chevrolet\)](#)

Description and Operation

[Cooling Fan Description and Operation \(2H0 or LDE\)](#)[Cooling Fan Description and Operation \(LUV or LUJ\)](#)[Cooling Fan Description and Operation \(LUD\)](#)

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 there are no cooling system DTCs set.
 - **If any DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no DTCs are set**
3. Verify the scan tool parameters listed below display OFF.
 - Cooling Fan Relay 1 Command
 - Cooling Fan Relays 2 and 3 Command
 - **If a scan tool parameter displays ON**
Refer to Diagnostic Aids and [Symptoms - Engine Cooling](#) for further diagnosis.
 - **If both scan tool parameters display OFF**
4. Verify that the fan is not activated.
 - **If the fan is operating**
Refer to Circuit/System Testing.
 - **If the fan is OFF**
5. All OK.

Circuit/System Testing

NOTE: The following tests must be performed on each cooling fan relay.

1. Ignition OFF, disconnect each cooling fan relay one at a time, in the order listed below, ignition ON:
 - KR20F Cooling Fan Relay
 - KR20C Cooling Fan Low Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
 - KR20D Cooling Fan High Speed Relay
2. Verify that the cooling fan is not activated after each relay is removed.
 - **If the cooling fan is ON with all of the listed relays removed**
 1. Ignition OFF, disconnect the harness connector at the R10 Cooling Fan Resistor, ignition ON.
 2. Test for less than 1 V between the relay controlled output circuit terminal listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 87/5

- KR20P Cooling Fan Medium Speed Relay terminal 87/5
- KR20D Cooling Fan High Speed Relay terminal 87/5
- If 1 V or greater, repair the short to voltage in the appropriate circuit.

- **If the cooling fan is OFF after a listed relay is removed**

3. Replace the appropriate cooling fan relay.

Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70-110 Ω between terminals 85/2 and 86/1.

- **If less than or greater than the specified range**

Replace the cooling fan relay.

- **If within the specified range**

4. Test for infinite resistance between the following terminals:

- 30/3 and 86/1
- 30/3 and 87/5
- 30/3 and 85/2
- 85/2 and 87/5

- **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.

6. Install a jumper wire between relay terminal 86/1 and ground.

7. Test for less than 2 Ω between terminals 30/3 and 87/5.

- **If 2 Ω or greater**

Replace the cooling fan relay.

- **If less than 2 Ω**

8. All OK.

Repair Instructions

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

[Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)

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 cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed

- Cooling Fan Relay 2 and 3 operates the fan at a medium speed
- Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics (Buick) Engine Heating/Cooling Schematics (Chevrolet)

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE) COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)
- Electrical Center Identification Views (Buick) Electrical Center Identification Views (Chevrolet)

Description and Operation

Cooling Fan Description and Operation (2H0 or LDE) Cooling Fan Description and Operation (LUV or LUJ) Cooling Fan Description and Operation (LUD)

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, P0481, P0691, P0692, P0693, or P0694 is not set.
 - **If a DTC is set**
Refer to DTC P0480, P0481, P0691, P0692, P0693, or P0694.
 - **If no DTC is set**
3. Verify that the G10 Cooling Fan Motor operates at low, medium, and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.
 - **If the cooling fan does not operate at all speeds**
Refer to Circuit/System Testing.
 - **If the cooling fan operates at all speeds**
4. All OK.

Circuit/System Testing

Inoperative in All Speeds

1. Ignition OFF, disconnect the harness connector at the R10 Cooling Fan Resistor.
2. Verify a test lamp illuminates between the ground circuit terminal 1 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If the test lamp illuminates**

3. Test or replace the G10 Cooling Fan Motor. Replace the cooling fan fuses if necessary.

Low, Medium, or High Speed Inoperative

1. Ignition OFF.
2. Disconnect the following cooling fan relays, ignition ON:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20E Cooling Fan Speed Control Relay
 - KR20F Cooling Fan Relay
 - KR20P Cooling Fan Medium Speed Relay
3. Verify a test lamp illuminates between ground and each of the cooling fan relay B+ circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 30/3
 - KR20D Cooling Fan High Speed Relay terminal 30/3
 - KR20P Cooling Fan Medium Speed Relay terminal 30/3
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the appropriate relay 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, disconnect the harness connector at the R10 Cooling Fan Resistor.
 2. Test for infinite resistance between the appropriate relay controlled output circuit terminal listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 87/5
 - KR20D Cooling Fan High Speed Relay terminal 87/5
 - KR20P Cooling Fan Medium Speed Relay terminal 87/5
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test or replace the G10 Cooling Fan Motor, replace the fuse as necessary.
 - **If the test lamp illuminates**
4. Verify a test lamp illuminates between the KR20F Cooling Fan Relay output circuit terminal 87/5 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 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**
5. Ignition OFF, Install the KR20F Cooling Fan Relay, ignition ON.
6. Verify a test lamp illuminates between each of the cooling fan relay ignition circuit terminals listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 86/1
 - KR20E Cooling Fan Speed Control Relay terminal 85/2 and 30/3
 - **If the test lamp does not illuminate at each terminal**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω between the appropriate relay ignition circuit terminal and the fuse.
 - 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 illuminates at each terminal**

7. Command the cooling fan ON at low speed with a scan tool.
8. Verify a test lamp illuminates between B+ and each of the relay control circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 85
 - KR20E Cooling Fan Speed Control Relay terminal 86
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the KR20F Cooling Fan Relay.
 2. Test for less than 2 Ω between the KR20F Cooling Fan Relay terminal 30/3 and the relay control circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 85
 - KR20E Cooling Fan Speed Control Relay terminal 86
 - 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**
 9. Ignition OFF, install the KR20E Cooling Fan Speed Control Relay, ignition ON.
10. Command the cooling fan ON at low speed with a scan tool.
11. Verify a test lamp illuminates between the KR20D Cooling Fan High Speed Relay ignition circuit terminal 85/1 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the KR20E Cooling Fan Speed Control Relay.
 2. Test for less than 2 Ω between the KR20D Cooling Fan High Speed Relay terminal 85/1 and KR20E Cooling Fan Speed Control Relay terminal 87/5.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the KR20E Cooling Fan Speed Control Relay.
 - **If the test lamp illuminates**
 12. Ignition OFF, install all of the previously removed cooling fan relays. Disconnect the harness connector at the R10 Cooling Fan Resistor, ignition ON.
13. Command the cooling fan ON at high speed with a scan tool.
14. Verify a test lamp illuminates between ground and each of the R10 Cooling Fan Resistor circuit terminals listed below:
 - R10 Cooling Fan Resistor low speed circuit terminal 2
 - R10 Cooling Fan Resistor medium speed circuit terminal 3
 - R10 Cooling Fan Resistor high speed circuit terminal 4
 - **If the test lamp does not illuminate at each terminal**
 1. Ignition OFF, remove the test lamp.
 2. Disconnect the appropriate relay from the list below:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
 3. Test for less than 2 Ω in the relay controlled output circuit, end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the relay.
 - **If the test lamp illuminates at each terminal**
 15. Test or replace the G10 Cooling Fan Motor.

Component Testing

Relay Test

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70-110 Ω between terminals 85/2 and 86/1.
 - **If less than or greater than the specified range**

Replace the cooling fan relay.

- **If within the specified range**

4. Test for infinite resistance between the following terminals:

- 30/3 and 86/1
- 30/3 and 87/5
- 30/3 and 85/2
- 85/2 and 87/5

- **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.

6. Install a jumper wire between relay terminal 86/1 and ground.

7. Test for less than 2 Ω between terminals 30/3 and 87/5.

- **If 2 Ω or greater**

Replace the cooling fan relay.

- **If less than 2 Ω**

8. All OK.

Cooling Fan Motor Test

1. Ignition OFF.

2. Disconnect the harness connector at the R10 Cooling Fan Resistor.

3. Connect a jumper wire between the R10 Cooling Fan Resistor terminal 1 and ground.

4. Connect an appropriately fused jumper wire between a R10 Cooling Fan Resistor terminal listed below and B+.

- R10 Cooling Fan Resistor low speed terminal 2
- R10 Cooling Fan Resistor medium speed terminal 3
- R10 Cooling Fan Resistor high speed terminal 4

5. Verify the G10 Cooling Fan Motor operates when voltage is applied to each terminal.

- **The cooling fan does not operate**

Replace the G10 Cooling Fan Motor.

- **The cooling fan operates**

6. All OK.

Repair Instructions

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

- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Front Compartment Fuse Block Replacement**
- **Engine Coolant Fan Replacement (LUV)****Engine Coolant Fan Replacement (2H0)****Engine Coolant Fan Replacement (LE2)**

ENGINE OVERHEATING

Checks	Actions
Check for a loss of the coolant.	Add the coolant.
Check for weak coolant solution.	Confirm that the coolant solution is 50/50 mixture of ethylene glycol and water.

Checks	Actions
Check the front of the radiator for any dirt, any leaves, or any insects.	Clean the front of the radiator
Check for leakage from the hoses, the coolant pump, the heater, the thermostat housing, the radiator, the core plugs, or the head gasket.	Replace any damaged components.
Check for a faulty thermostat.	Replace a damaged thermostat.
Check for retarded ignition timing.	Perform an ECM code diagnosis. Confirm the integrity of the timing belt.
Check for an improperly operating electric cooling fan.	Replace the electric cooling fan.
Check for radiator hoses that are plugged or rotted.	Replace any damaged radiator hoses.
Check for a faulty water pump.	Replace a faulty water pump.
Check for a faulty surge tank cap.	Replace a faulty surge tank cap.
Check for a cylinder head or an engine block that is cracked or plugged.	Repair the damaged cylinder head or the damaged engine block.

LOSS OF COOLANT

Checks	Actions
Check for a leak in the radiator.	Replace a damaged radiator.
Check for a leak in the following locations: • Surge tank • Hose	Replace the following parts: • Surge tank • Hose
Check for the following loose or damaged parts: • Radiator hoses • Heater hoses • Connections	Reseat the hoses. Replace the hoses or the clamps.
Check for leaks in the coolant pump seal.	Replace the coolant pump seal.
Check for leaks in the coolant pump gasket.	Replace the coolant pump gasket.
Check for an improper cylinder head torque.	Tighten the cylinder head bolts to specifications. Replace the cylinder head gasket, if needed.
Check for leaks in the following locations: • Intake manifold • Cylinder head gasket • Cylinder block plug • Heater core • Radiator drain plug	Repair or replace any components, as needed, to correct the leak.

THERMOSTAT DIAGNOSIS

Step	Action	Values	Yes	No

Step	Action	Values	Yes	No
1	1. Pressure test the cooling system and the cap for leaks. 2. Repair any leaks before proceeding. These engines use a 90Â°C (194Â°F) thermostat. The ambient temperatures should be within the specified range given. 3. Set the HVAC controls in the OFF position. 4. Run the cold engine at idle (68-70Â°F) for 15-20 minutes before checking the engine temperature. 5. Check the engine coolant temperature at idle with the scan tool. Is the engine coolant temperature (ECT) between 90-105Â°C (194-221Â°F)?	13-38Â°C (55-100Â°F)	System OK	Go to Step 2
2	Is the ECT below 90Â°C (194Â°F)?	-	Go to Step 3	Go to Step 4
3	The thermostat is opening early, or the thermostat seal is leaking. Replace the thermostat and the thermostat seal. Is the repair complete?	-	System OK	-
4	Is the ECT over 105Â°C (221Â°F)?	-	Go to Step 5	-
5	Is the radiator inlet hot?	-	Go to Step 6	Go to Step 7
6	1. Turn ON the heater. 2. Check if hot air is coming from the heater outlets. Is the air hot?	-	Go to Step 11	Go to Step 12
7	There may be air in the system. 1. Add coolant to the surge tank if the coolant level is low. Refer to Cooling System Draining and Filling. 2. Recheck the radiator inlet hose. Is the inlet hose hot?	-	Go to Step 6	Go to Step 8
8	Inspect for blockage in the following areas: • The cylinder head • The radiator • The radiator hoses Is there a blockage?	-	Go to Step 9	Go to Step 10
9	1. Repair the blockage. 2. Recheck the coolant temperature with the the scan tool. Is the repair complete?	-	System OK	-

Step	Action	Values	Yes	No
10	1. Replace the thermostat. Refer to Engine Coolant Thermostat Replacement (2H0)Engine Coolant Thermostat Replacement (LUV) . 2. Recheck the coolant temperature with the scan tool. Is the repair complete?	-	System OK	-
11	Inspect for blockage in the radiator. Is there any blockage?	-	Go to Step 9	Go to Step 10
12	1. Accelerate the engine several times in order to remove any air from the system. 2. Inspect for blockage in the heater circuit. 3. Inspect for any pinched or buckled hoses. Is there any blockage?	-	Go to Step 9	Go to Step 13
13	Is the repair complete?	Å	System OK	-

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Step	Action	Yes	No
1	Check the coolant level in the radiator surge tank. Refer to Cooling System Draining and Filling . Is the coolant at the proper level?	Go to Step 3	Go to Step 2
2	Add coolant to the radiator surge tank as necessary. Does the engine still fail to reach normal operating temperatures?	Go to Step 3	System OK
3	Check for a blockage in the coolant passages. Are there any blockages in the coolant passages?	Go to Step 4	Go to Step 5
4	Flush the cooling system or flow check the radiator. Does the engine still fail to reach normal operating temperatures?	Go to Step 5	System OK
5	Check to see if the incorrect thermostat was installed or if it is stuck or sticks in the open position. Was the incorrect thermostat installed, or is it stuck or does it stick in the open position?	Go to Step 6	-
6	Replace the thermostat. Refer to Engine Coolant Thermostat Replacement (2H0)Engine Coolant Thermostat Replacement (LUV) . Does the engine still fail to reach normal operating temperature?	-	System OK

COOLING SYSTEM LEAK TESTING

Special Tools

- EN 471 Adapter
- EN 6327 A Cooling System 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 surge tank cap.
2. Check the coolant level.

Fill the coolant level to the COLD mark if necessary.

3. Pull the coolant expansion tank from the bracket in the direction of the battery.

NOTE: Follow manufacturer instructions.

4. Attach the coolant system tester with **EN 471** adapter and **EN 6327 A** adapter to the coolant expansion tank.
5. Apply approximately 100 kPa (15 psi) to the cooling system.
6. Check the cooling system for leaks.
7. Remove the cooling system tester.
 - Release the pressure
 - Remove the cooling system tester with **EN 471** adapter
8. Install the surge tank cap.

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

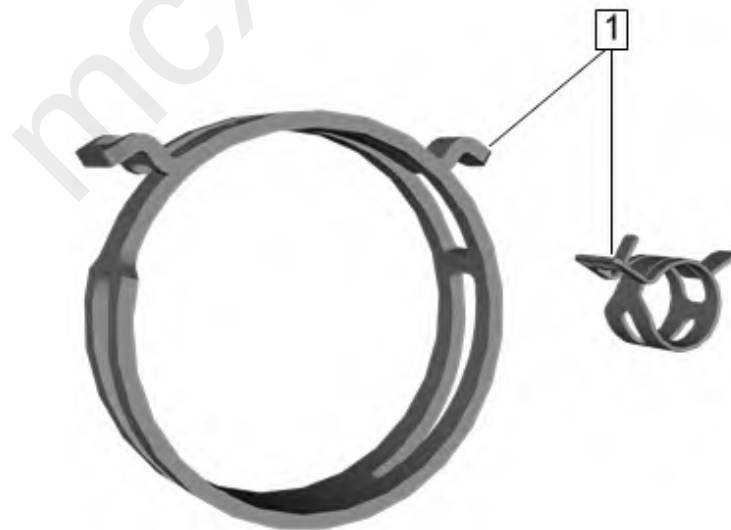


Fig. 4: Spring Type Hose Clamps

Courtesy of GENERAL MOTORS COMPANY

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

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

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

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

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

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

Removing The Spring Type Hose Clamp

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

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

If The Spring Type Hose Clamp Is Being Reused

It is extremely important that the spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Reusing The Spring Type Hose Clamp and Replacing The Hose

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

When Reusing The Spring Type Hose Clamp with an Existing Hose

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

If The Spring Type Hose Clamp Is Being Replaced

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

When Replacing The Spring Type Hose Clamp and Replacing The Hose

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

When Replacing The Spring Type Hose Clamp with an Existing Hose

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

COOLING SYSTEM DRAINING AND FILLING

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. Remove the coolant pressure cap from the radiator surge tank.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Remove the underbody front air deflector. [Underbody Front Air Deflector Replacement](#)
4. Place a drain pan under the drain cock.

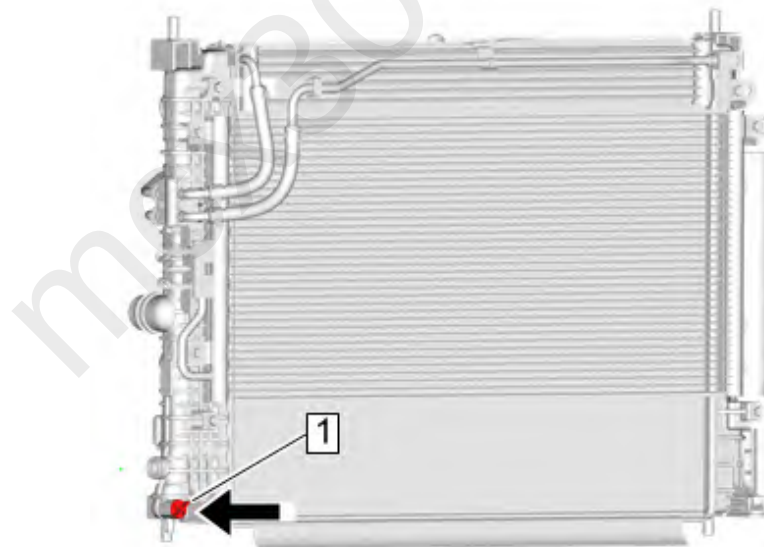


Fig. 5: Radiator Drain Cock

Courtesy of GENERAL MOTORS COMPANY

5. Loosen the radiator drain cock (1).
6. Drain the cooling system.
7. Lower the vehicle.
8. Inspect the coolant.
9. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance-Follow the filling procedure.
 - Discolored-Follow the flush procedure. [Coolant System 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. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

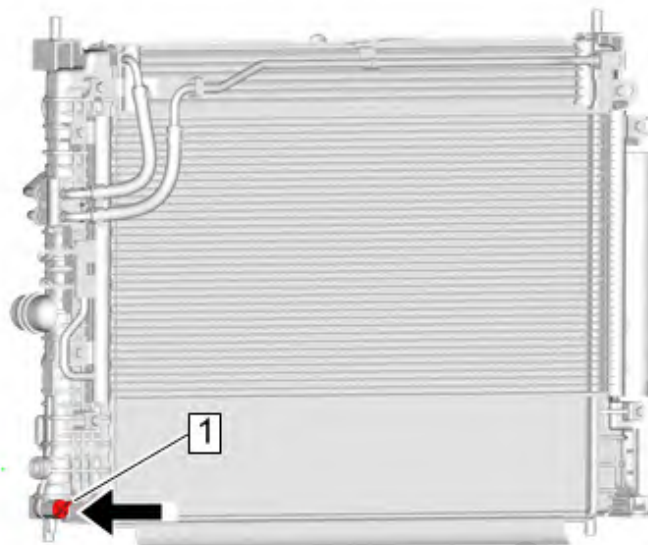


Fig. 6: Radiator Drain Cock

Courtesy of GENERAL MOTORS COMPANY

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

2. Tighten the radiator drain cock (1) to 2 N.m (18 lb in).
3. Install the underbody front air deflector. [Underbody Front Air Deflector Replacement](#)
4. Lower the vehicle.

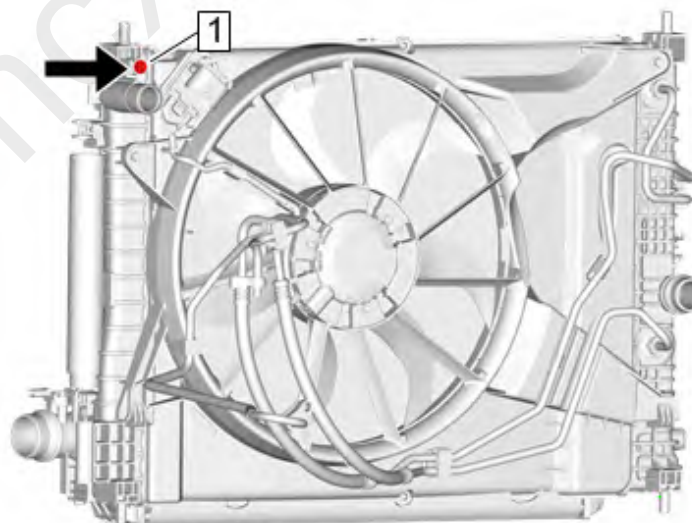


Fig. 7: Vent Screw

Courtesy of GENERAL MOTORS COMPANY

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

NOTE: The vent screw has a feature (1) to allow air to escape when the vent screw is in the open position.

5. Remove the vent screw (1) on the radiator and turn in one thread to allow venting of the cooling system.
6. Slowly add a mixture of 50/50 DEX-COOLÂ® antifreeze and clean drinkable water to the surge tank until coolant is present at the vent screw (1). [Approximate Fluid Capacities](#)
7. Tighten the vent screw (1) to 1.9 (17 lb in).
8. Continue to slowly fill the radiator with a 50/50 coolant mixture until the coolant level reaches the base of the radiator surge tank.
9. Allow 30 seconds for the coolant level to stabilize and continue to fill the coolant filler neck until the level stabilizes for at least 2 minutes.
10. Start the engine and allow to the engine to idle in PARK or NEUTRAL with the parking brake engaged.
11. Slowly fill the coolant mixture until the level stabilizes at the base of the radiator surge tank.
12. Install the coolant pressure cap.
13. Raise the engine RPM to 2500 rpm for 30-40 seconds.
14. Shut the engine OFF.
15. Allow the engine to cool, remove coolant fill cap and repeat steps 4-10 until the coolant level has completely stabilized within the radiator surge tank.
16. Inspect and if necessary, fill the coolant reservoir bottle as necessary.
17. Rinse away any excess coolant from the engine and the engine compartment.
18. Inspect the cooling system for leaks.
19. Top off the radiator surge tank if necessary.

COOLANT SYSTEM FLUSHING

NOTE:

- Do not use a chemical flush.
- Store used coolant in the proper manner, such as in a used engine coolant holding tank.
- Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical.
- Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.
- Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufactures instruction. However, always remove the thermostat before back flushing the system.

1. Apply the parking brake.
2. Drain the coolant. Refer to [Cooling System Draining and Filling](#).
3. Fill the cooling system with clean drinkable water. Refer to [Cooling System Draining and Filling](#).
4. Start the engine and run at 2, 000 RPM until the thermostat opens.
5. Turn OFF the engine.
6. Drain the coolant system. Refer to [Cooling System Draining and Filling](#).
7. Repeat the above procedure until the water from the coolant system is colorless.
8. Drain the coolant system. Refer to [Cooling System Draining and Filling](#).
9. Repeat the above procedure until the water from the coolant system is colorless. Refer to [Cooling System Draining and Filling](#).

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: Blow compressed air through the engine side of the radiator to remove any foreign

material, such as insects, leaves, and dust.

- Warm water and mild soap may be needed in some conditions.
- Wash the A/C condenser fin.
- Wash the A/C condenser and radiator thoroughly.
- Wash the radiator cooling fin.
- Repair any damaged cooling fin.

RADIATOR SURGE TANK REPLACEMENT (LUV, 2H0)

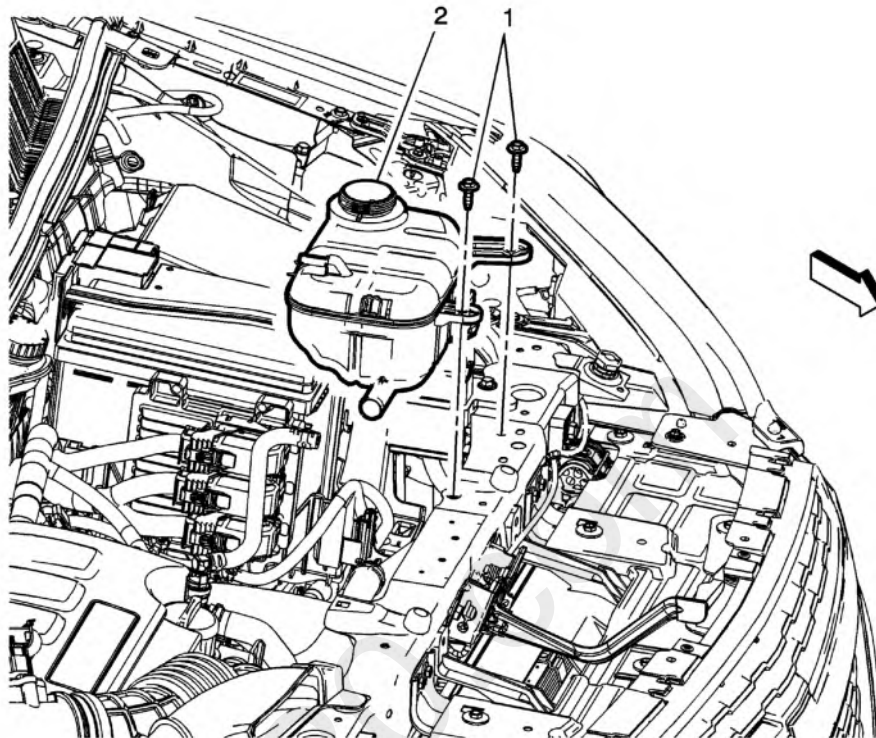


Fig. 8: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the engine cooling system. Refer to Cooling System Draining and Filling. 2. Remove the front bumper fascia opening upper cover. Refer to Front Bumper Fascia Opening Upper Cover Replacement. 3. Remove the radiator surge tank outlet hose from the radiator surge tank. Refer to Radiator Surge Tank Outlet Hose Replacement (LUV)Radiator Surge Tank Outlet Hose Replacement (2H0). 4. Remove the engine coolant air bleed hose. Refer to Engine Coolant Air Bleed Hose Replacement (2H0)Engine Coolant Air Bleed Hose Replacement (LUV).	
1	Radiator Surge Tank Bolt (Qty: 2) CAUTION: Refer to Fastener Caution .
2	Radiator Surge Tank Procedure 1. Fill the engine coolant to the proper level. Refer to Cooling System Draining and Filling. 2. Inspect the engine cooling system for leaks. Refer to Cooling System Leak Testing.

RADIATOR SURGE TANK REPLACEMENT (LE2)

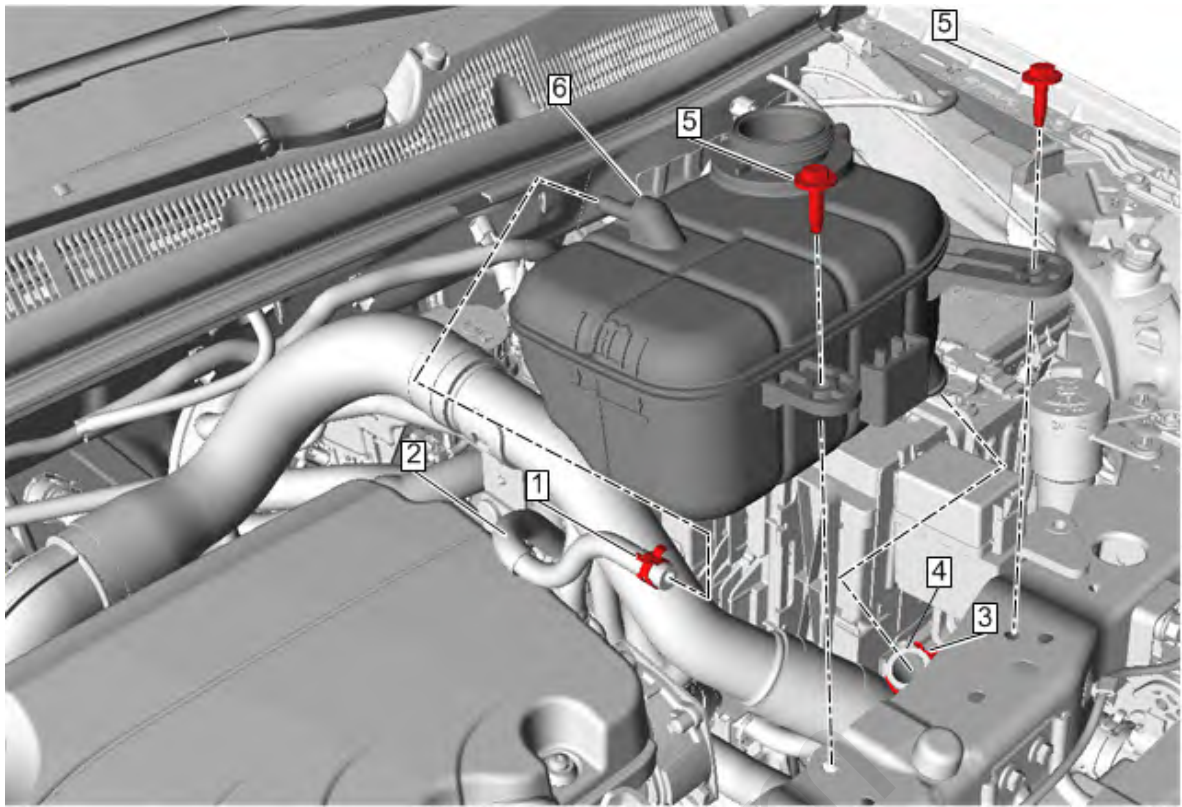


Fig. 9: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Cooling System Draining and Filling Front Bumper Fascia Opening Upper Cover Replacement	
1	Engine Coolant Air Bleed Hose Clamp Procedure Reposition the heater outlet hose clamps using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
2	Engine Coolant Air Bleed Hose
3	Radiator Surge Tank Outlet Hose Clamp Procedure Reposition the heater outlet hose clamps using BO-38185 Hose Clamp Pliers. Special Tools BO-38185 Hose Clamp Pliers
4	Radiator Surge Tank Outlet Hose
5	Radiator Surge Tank Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
6	Radiator Surge Tank Procedure - Fill the engine coolant to the proper level. Cooling System Draining and Filling - Check the cooling system for leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LUV)

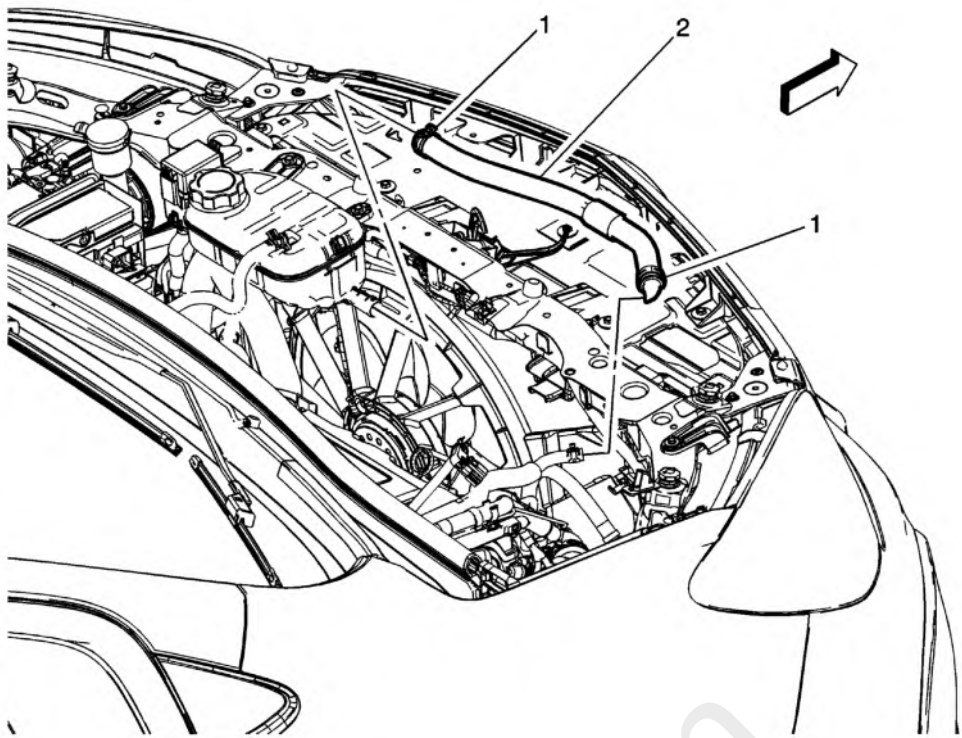


Fig. 10: Radiator Surge Tank Outlet Hose (LUV)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the coolant. Refer to Cooling System Draining and Filling . 2. Remove the air cleaner inlet duct assembly. Refer to Air Cleaner Inlet Duct Replacement .	
1	Radiator Surge Tank Outlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Radiator Surge Tank Outlet Hose

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (2H0)

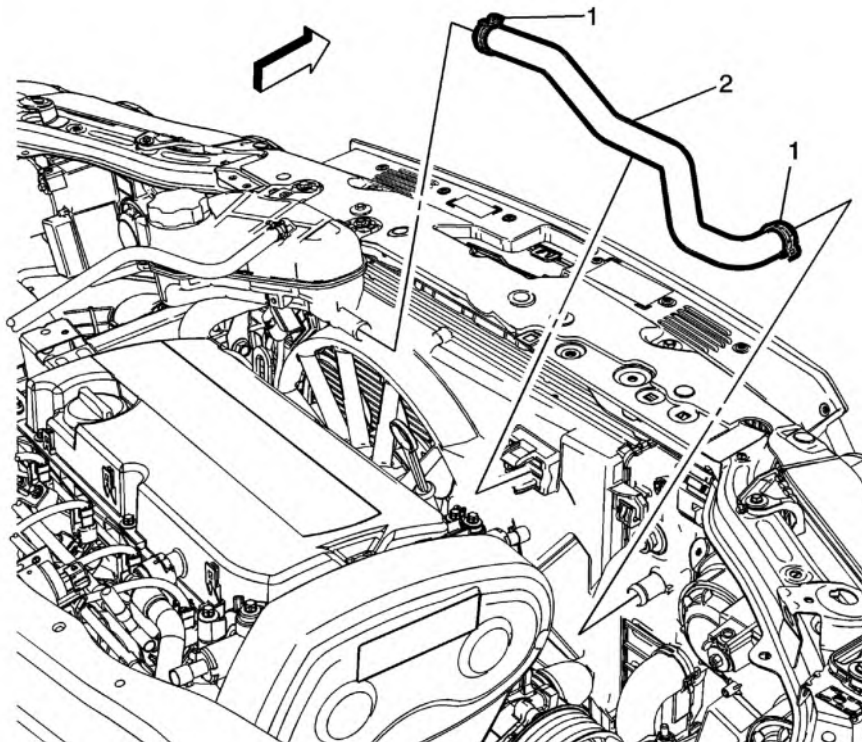


Fig. 11: Radiator Surge Tank Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the coolant. Refer to Cooling System Draining and Filling. 2. Remove the air cleaner inlet duct assembly. Refer to Air Cleaner Inlet Duct Replacement (2H0).	
1	Radiator Surge Tank Outlet Hose Clamps (Qty: 2) Procedure Reposition the radiator surge tank outlet hose clamps using GE-47622 hose clamp pliers. Special Tools GE-47622 Hose Clamp Pliers For equivalent regional tools, Refer to Special Tools .
2	Radiator Surge Tank Outlet Hose Procedure Unclip radiator surge tank outlet hose from fan shroud.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LE2 SURGE TANK OUTLET SIDE)

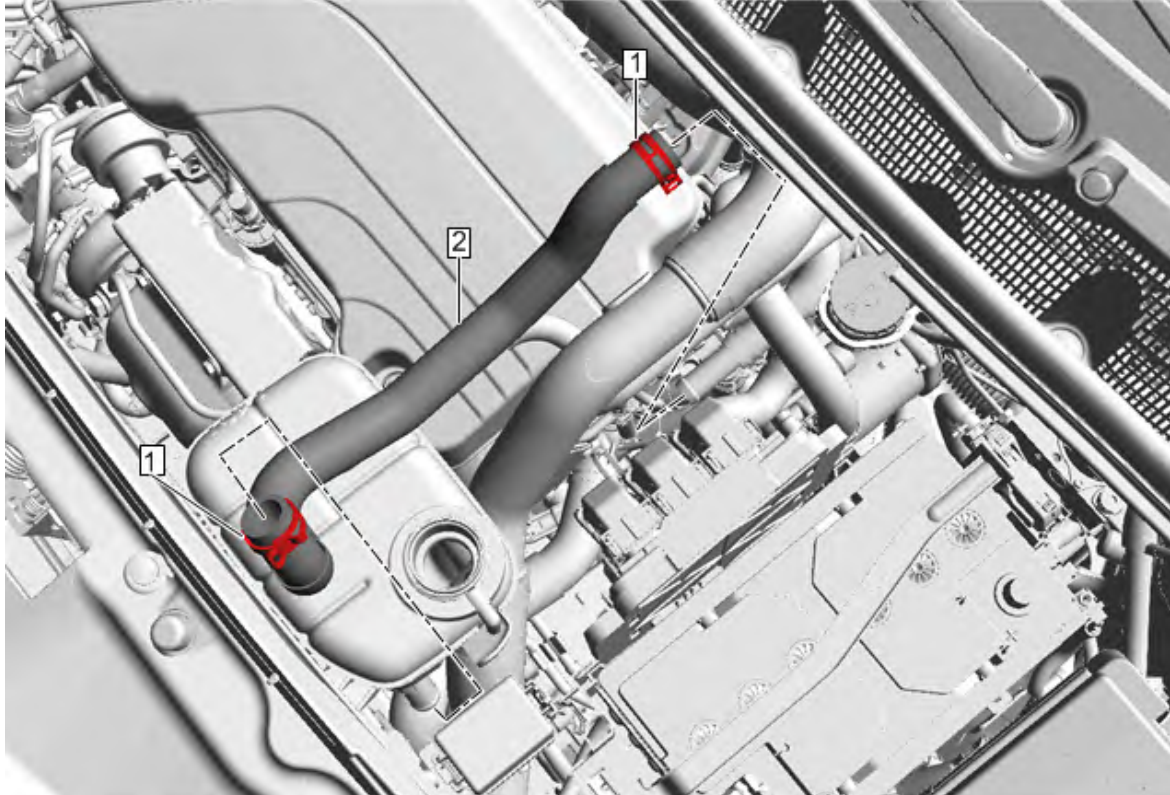


Fig. 12: Radiator Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Cooling System Draining and Filling 2. Reposition Radiator Surge Tank Replacement (LE2) 3. Remove Charge Air Cooler Outlet Air Hose Replacement	
1	Radiator Surge Tank Hose Clamp (Qty: 2) Procedure Reposition the radiator surge tank outlet hose clamps using 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 engine coolant to the proper level. Cooling System Draining and Filling 2. Check the cooling system for leaks.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LE2 INTERMEDIATE HOSE PIECE)

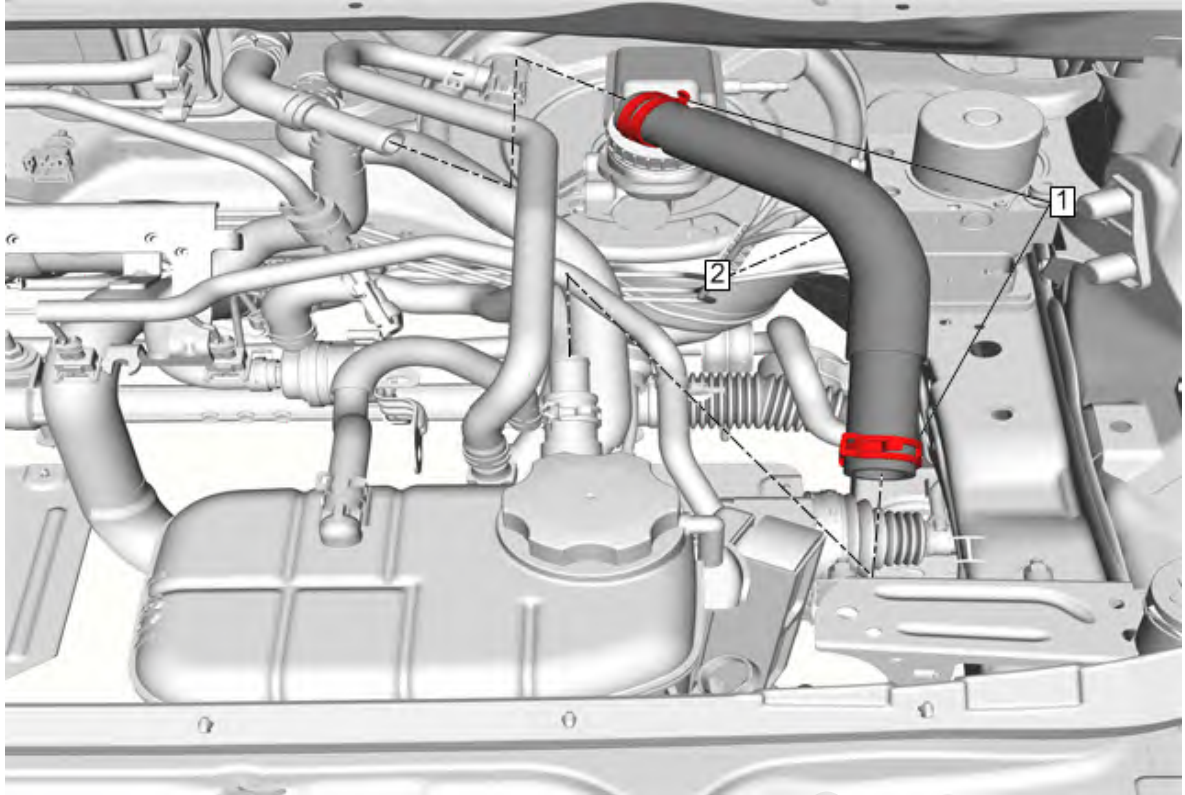


Fig. 13: Radiator Surge Tank Outlet Hose (LE2 Intermediate Hose Piece)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. 2. Remove Charge Air Cooler Outlet Air Hose Replacement	
1	Clamp (Qty: 2) Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Surge Tank Outlet Intermediate Hose

RADIATOR SURGE TANK OUTLET HOSE TEE REPLACEMENT (LE2)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove Charge Air Cooler Outlet Hose - [Charge Air Cooler Outlet Air Hose Replacement](#)

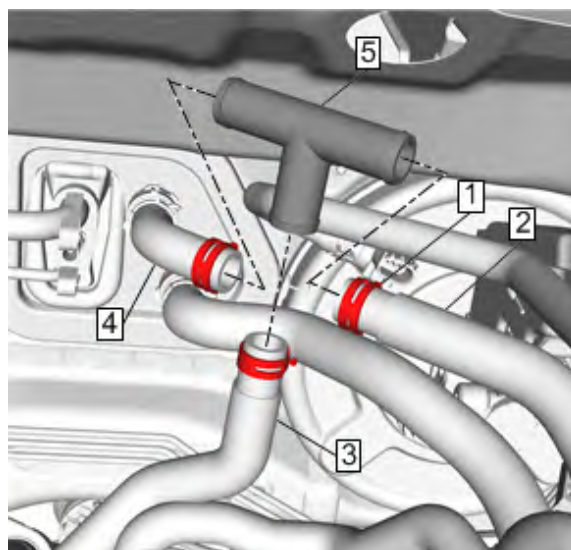


Fig. 14: Radiator Surge Tank Outlet Hose Tee (LE2)

Courtesy of GENERAL MOTORS COMPANY

3. Disengage Heater Outlet Hose Clamp (1)

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

4. Remove Radiator Surge Tank Outlet Intermediate Hose (2)
5. Remove Heater Water Auxiliary Pump Inlet Hose (3)
6. Remove Heater Outlet Hose- Front (4)
7. Remove Radiator Surge Tank Outlet Hose Tee (5)

Installation Procedure

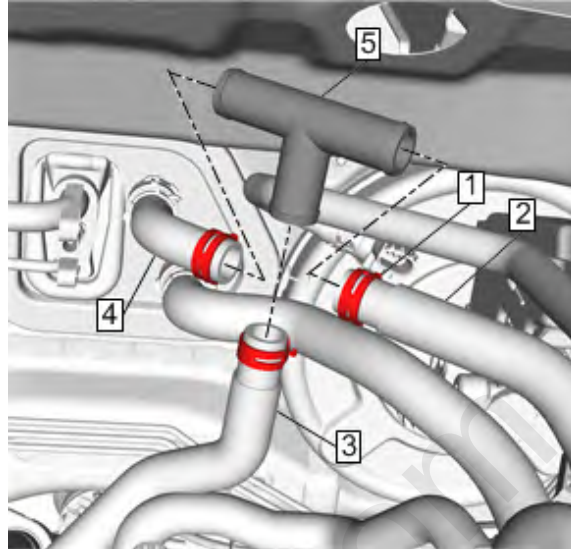


Fig. 15: Radiator Surge Tank Outlet Hose Tee (LE2).

Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Surge Tank Outlet Hose Tee (5)
2. Install Heater Outlet Hose- Front (4)
3. Install Heater Water Auxiliary Pump Inlet Hose (3)
4. Install Radiator Surge Tank Outlet Intermediate Hose (2)
5. Engage Heater Outlet Hose Clamp (1)

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

6. Install Charge Air Cooler Outlet Hose - [Charge Air Cooler Outlet Air Hose Replacement](#)
7. Fill the cooling system to the proper level. [Cooling System Draining and Filling](#)
8. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT (LUV)

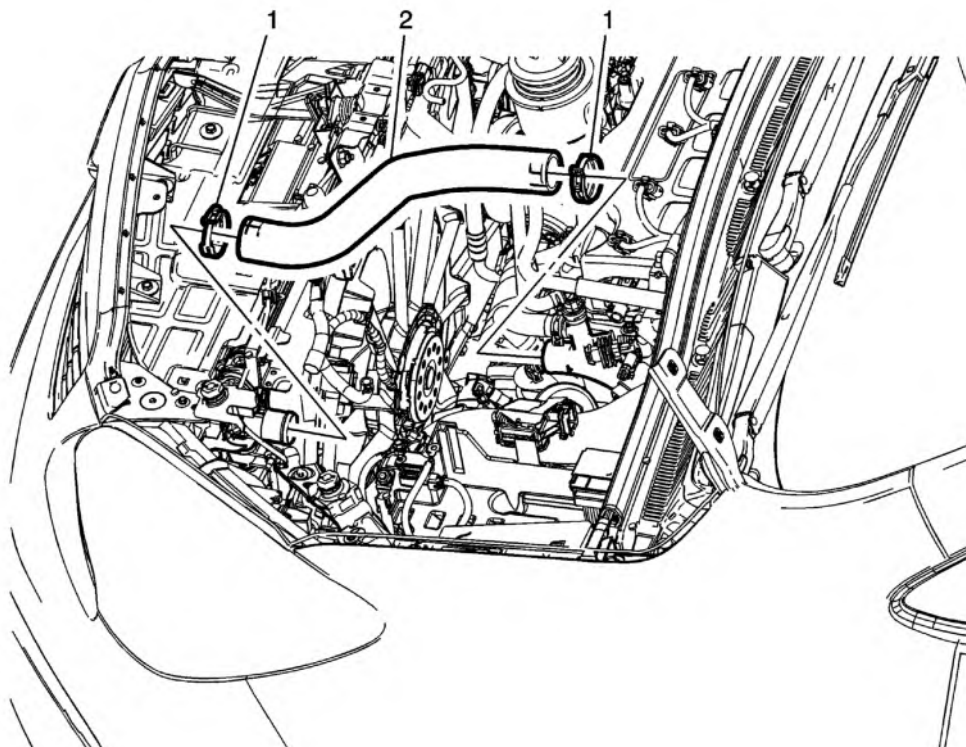


Fig. 16: Radiator Inlet Hose (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling. 2. Remove the radiator surge tank, and reposition the radiator surge tank out of the way. Refer to Radiator Surge Tank Replacement (LUV, 2H0). 3. Disconnect the electrical connectors.	
1	Radiator Inlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Radiator Inlet Hose

RADIATOR INLET HOSE REPLACEMENT (2H0)

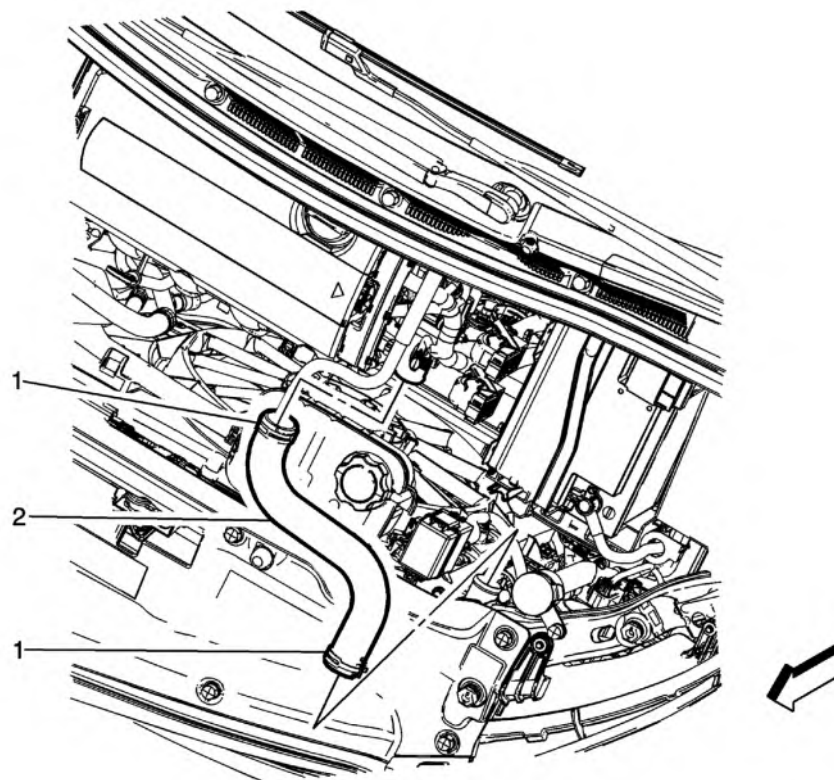


Fig. 17: Radiator Inlet Hose (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
Drain the cooling system. Refer to Cooling System Draining and Filling .	
1	Radiator Inlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Radiator Inlet Hose

RADIATOR INLET HOSE REPLACEMENT (LE2)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)

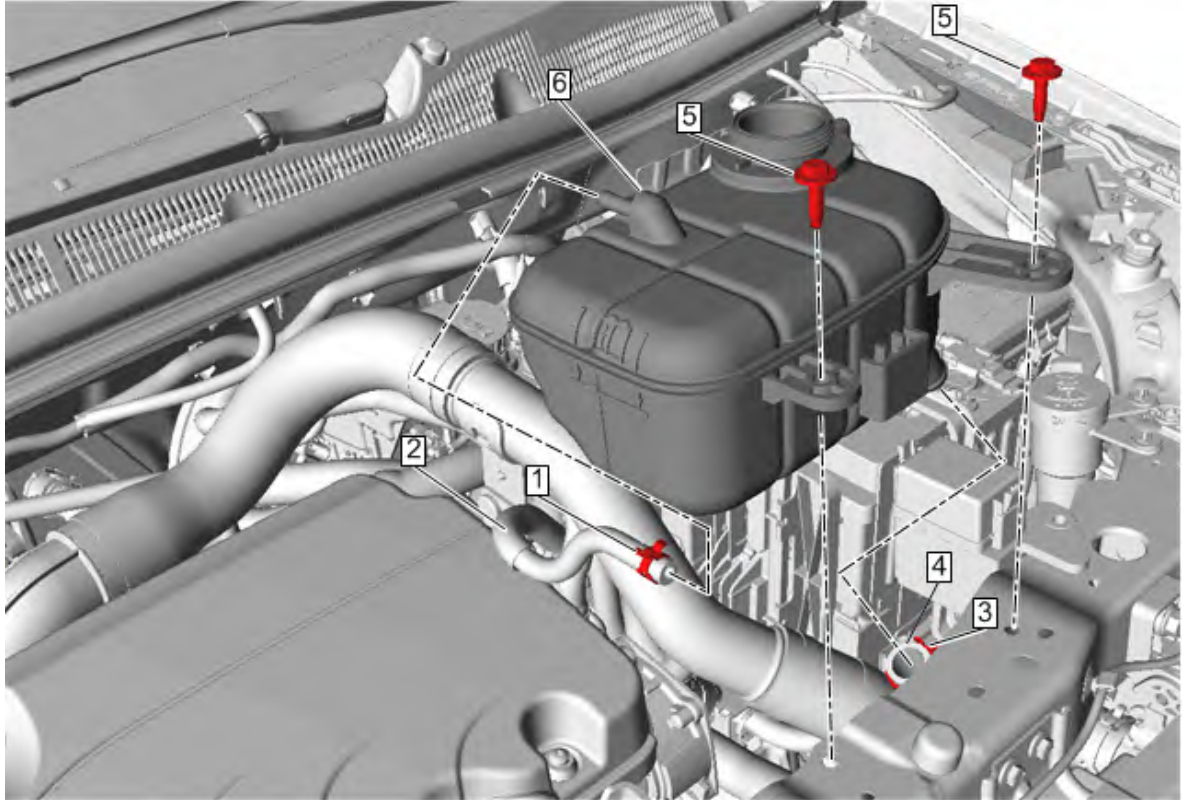


Fig. 18: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

2. Remove **Radiator Surge Tank Replacement (LE2)** (6)

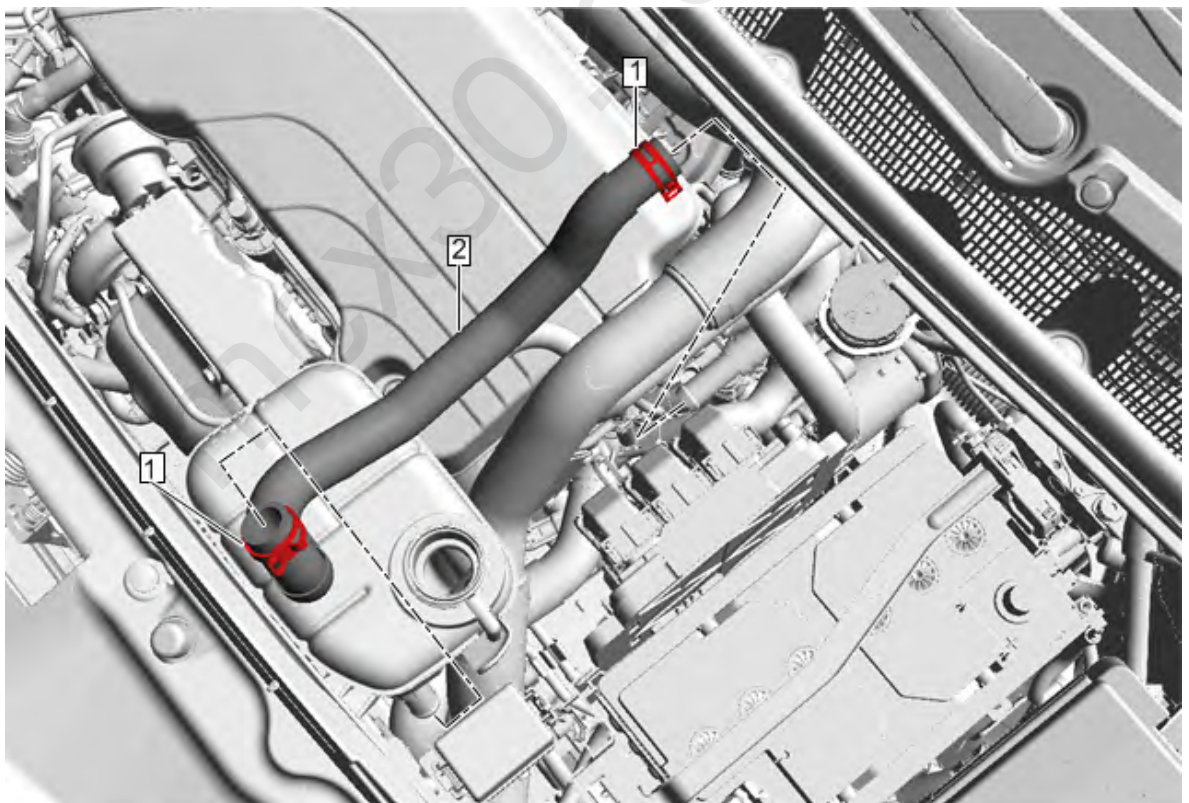


Fig. 19: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

3. Remove **Radiator Surge Tank Outlet Hose Replacement (LE2 Surge Tank Outlet Side)****Radiator Surge Tank Outlet Hose Replacement (LE2 Intermediate Hose Piece)** (2)

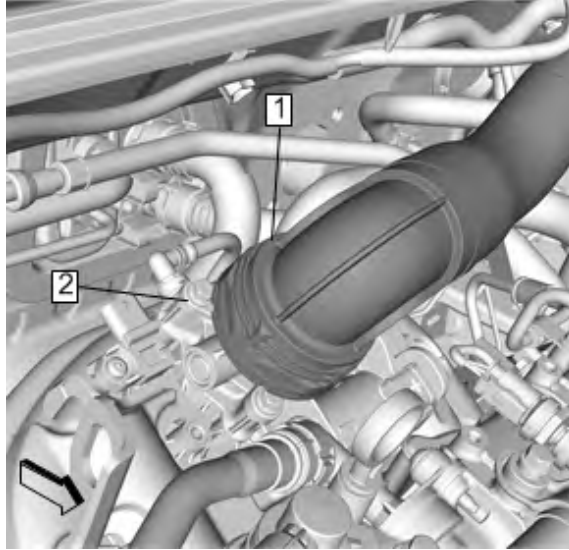


Fig. 20: Charge Air Cooler Outlet Air Hose At Throttle Body.
Courtesy of GENERAL MOTORS COMPANY

4. Remove Charge Air Cooler Outlet Air Hose (1) - **Charge Air Cooler Outlet Air Hose Replacement**

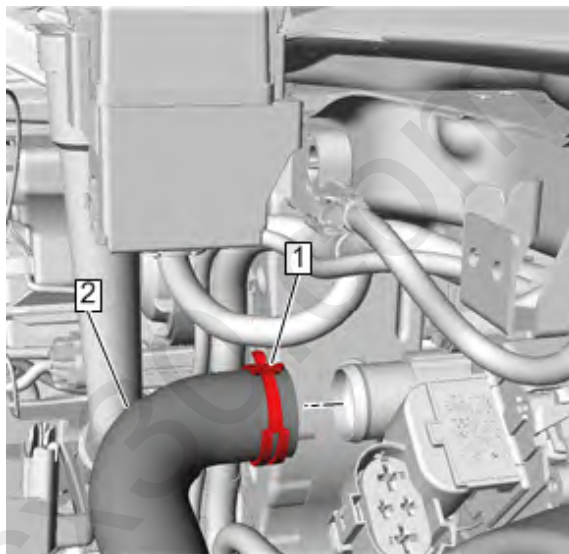


Fig. 21: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Radiator Inlet Hose Clamp (1) @Radiator

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

6. Remove Radiator Inlet Hose (2) @Radiator



Fig. 22: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Disengage Radiator Inlet Hose Clamp (1) @Engine

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

8. Remove Radiator Inlet Hose (2) @Engine
9. Remove Radiator Inlet Hose (2)

Installation Procedure



Fig. 23: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Inlet Hose (2)
2. Install Radiator Inlet Hose (2) @Engine
3. Engage Radiator Inlet Hose Clamp (1) @Engine

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

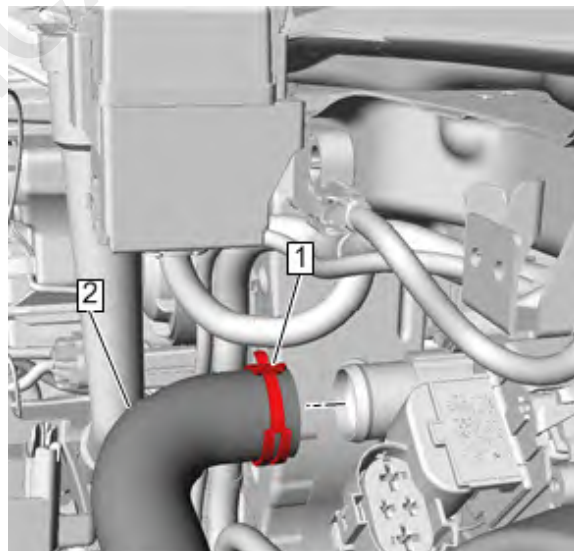


Fig. 24: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Inlet Hose (2) @Radiator

Engage Radiator Inlet Hose Clamp (1) @Radiator

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

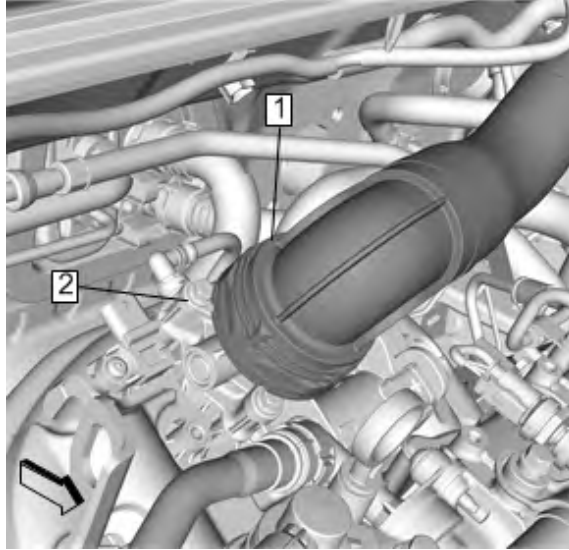


Fig. 25: Charge Air Cooler Outlet Air Hose At Throttle Body

Courtesy of GENERAL MOTORS COMPANY

5. Install Charge Air Cooler Outlet Air Hose (1) - **Charge Air Cooler Outlet Air Hose Replacement**

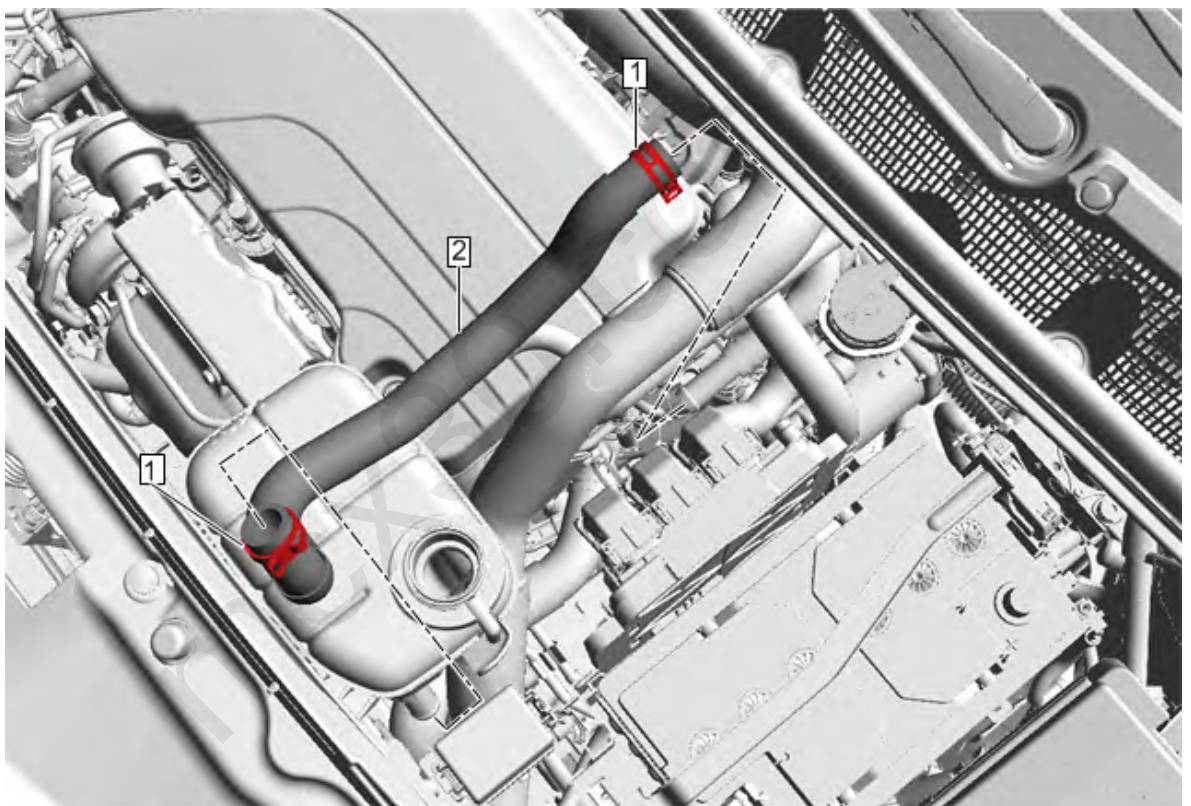


Fig. 26: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Install **Radiator Surge Tank Outlet Hose Replacement (LE2 Surge Tank Outlet Side)****Radiator Surge Tank Outlet Hose Replacement (LE2 Intermediate Hose Piece)** (2)

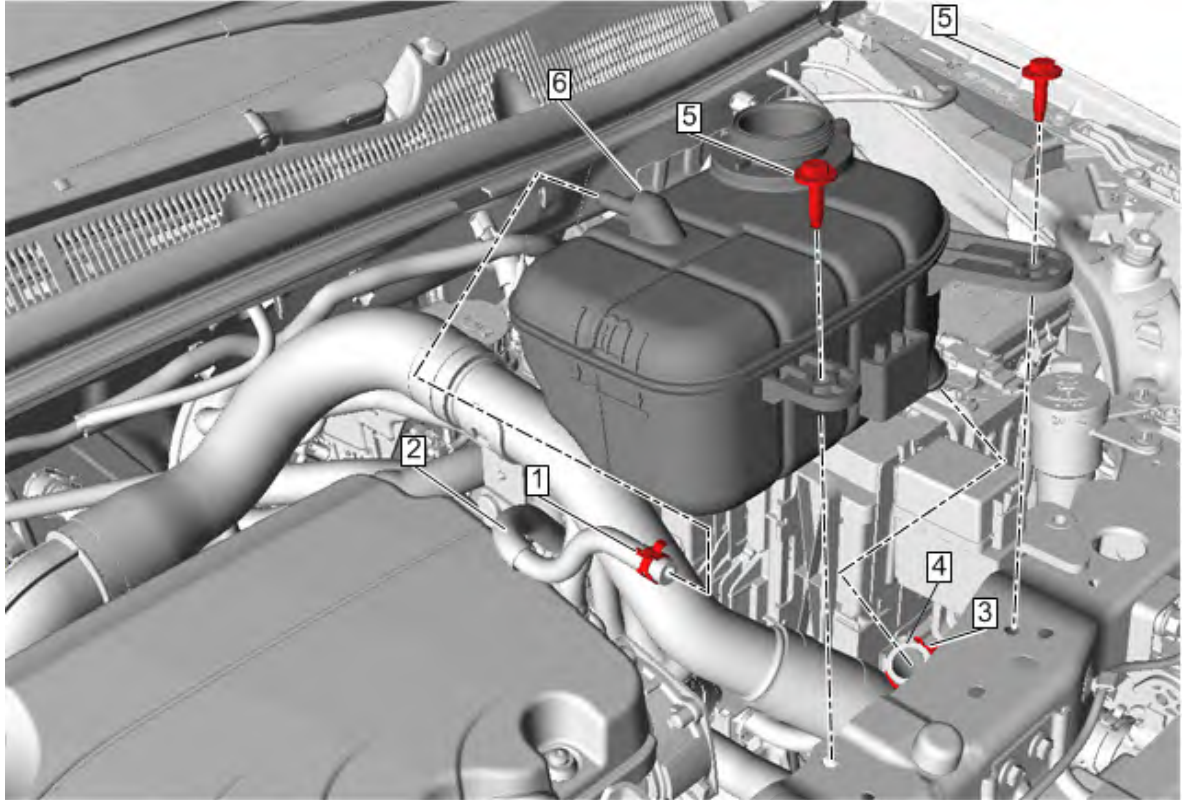


Fig. 27: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

7. Install **Radiator Surge Tank Replacement (LE2)** (6)
8. Fill the engine coolant to the proper level. **Cooling System Draining and Filling**
9. Check the cooling system for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LUV)

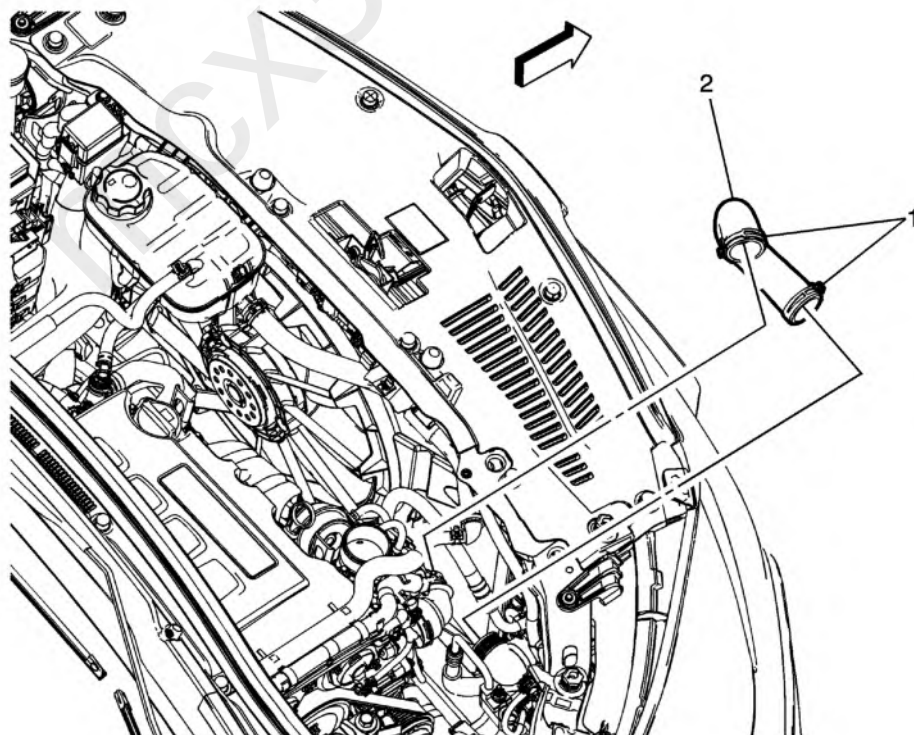


Fig. 28: Radiator Outlet Hose (LUV)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling . 2. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .	
1	Radiator Outlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Radiator Outlet Hose

RADIATOR OUTLET HOSE REPLACEMENT (2H0)

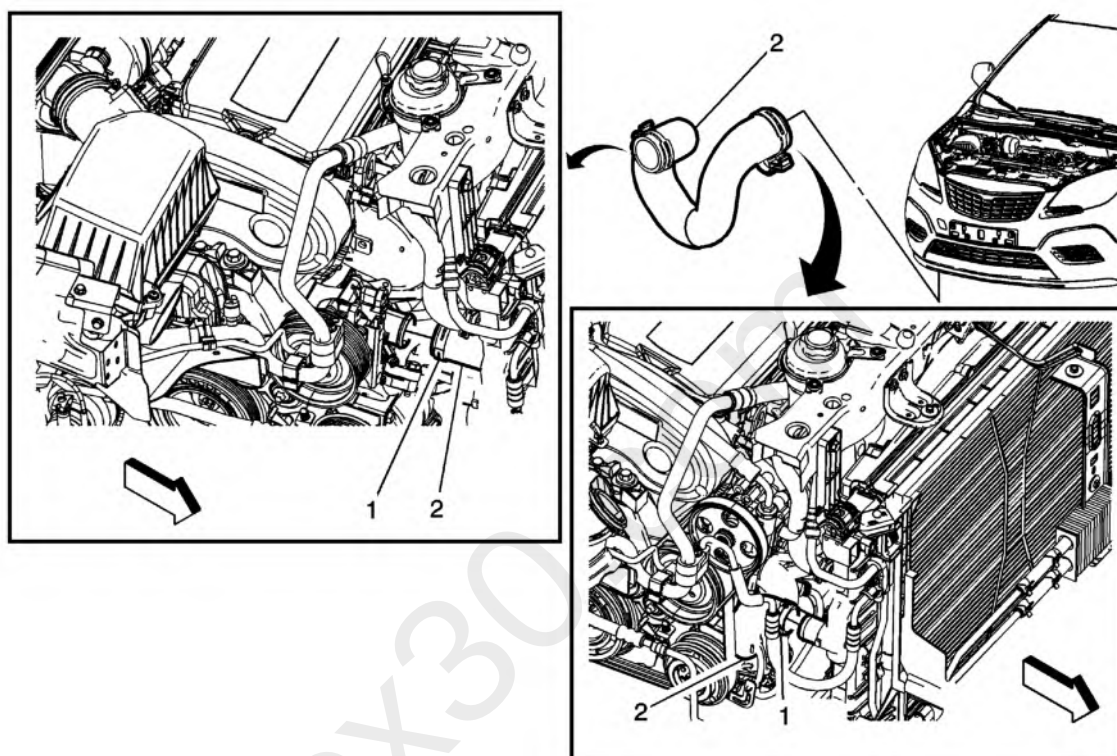


Fig. 29: Radiator Outlet Hose (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Drain the cooling system. Refer to Cooling System Draining and Filling .	
1	Radiator Outlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Radiator Outlet Hose

RADIATOR OUTLET HOSE REPLACEMENT (LE2)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)

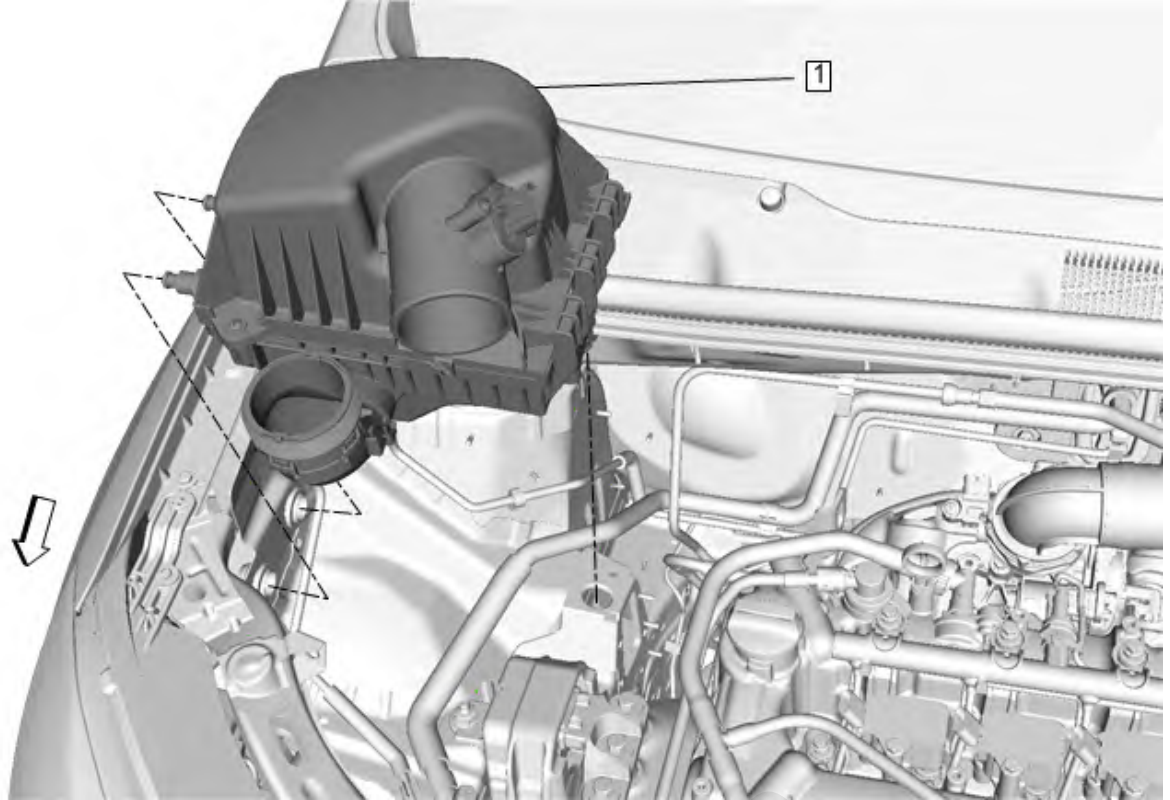


Fig. 30: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Remove Air Cleaner Assembly Replacement (1)

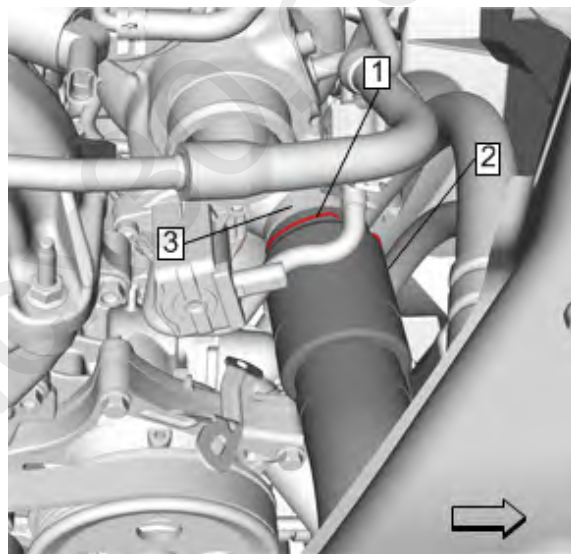


Fig. 31: Charge Air Cooler Inlet Air Hose

Courtesy of GENERAL MOTORS COMPANY

3. Remove Charge Air Cooler Inlet Air Hose Replacement (2)

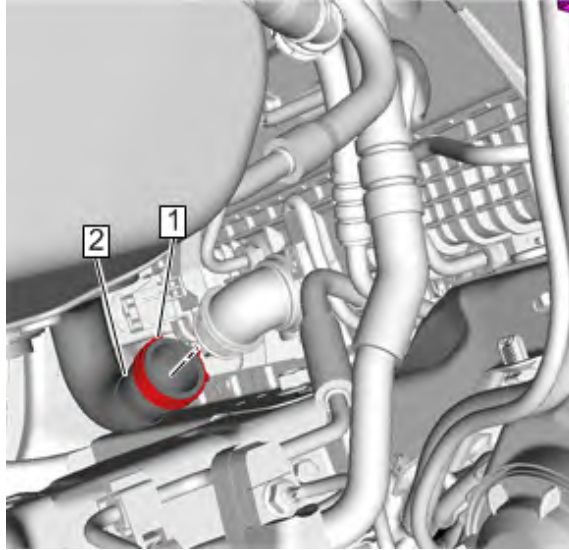


Fig. 32: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Disengage Radiator Outlet Hose Clamp (1) @Radiator

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

5. Remove Radiator Outlet Hose (2) @Radiator

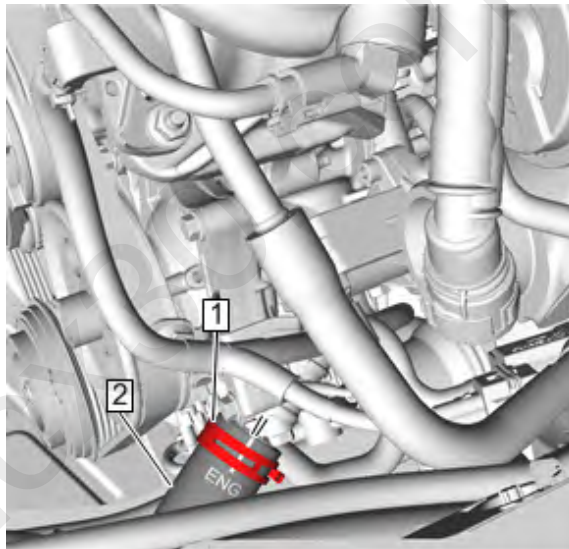


Fig. 33: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Disengage Radiator Outlet Hose Clamp (1) @Engine

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

7. Remove Radiator Outlet Hose (2) @Engine
8. Remove Radiator Outlet Hose (2)

Installation Procedure

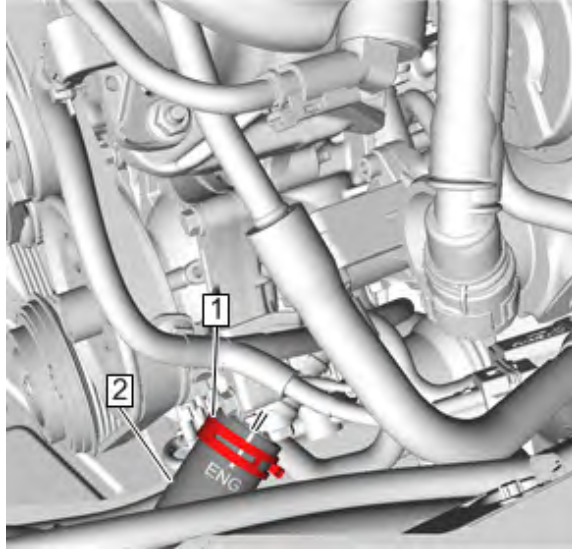


Fig. 34: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

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

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

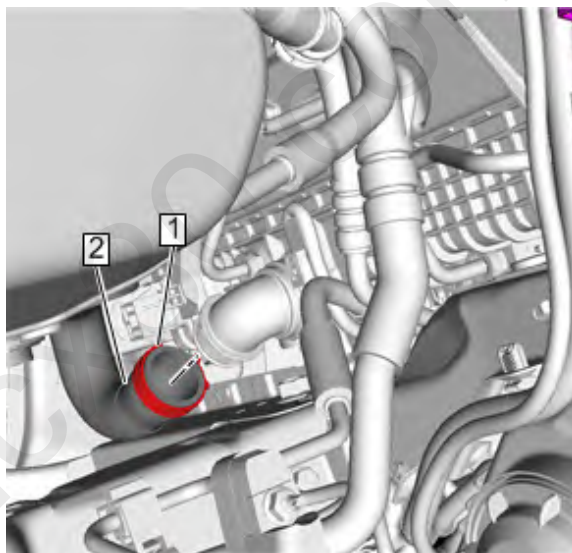


Fig. 35: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Outlet Hose (2) @Radiator
- Engage Radiator Outlet Hose Clamp (1) @Radiator

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

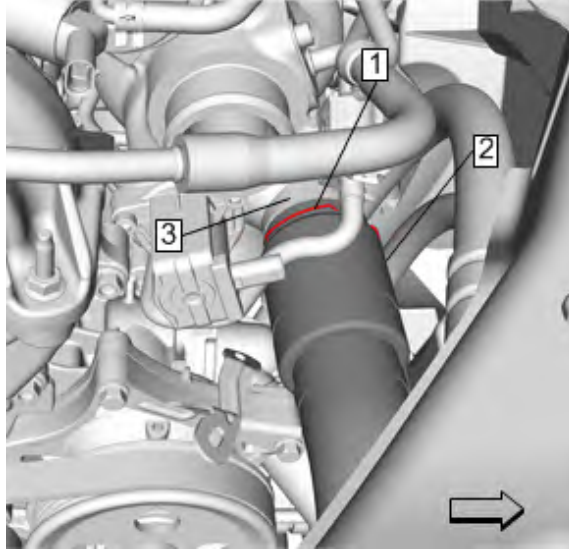


Fig. 36: Charge Air Cooler Inlet Air Hose
 Courtesy of GENERAL MOTORS COMPANY

5. Install Charge Air Cooler Inlet Air Hose Replacement (2)

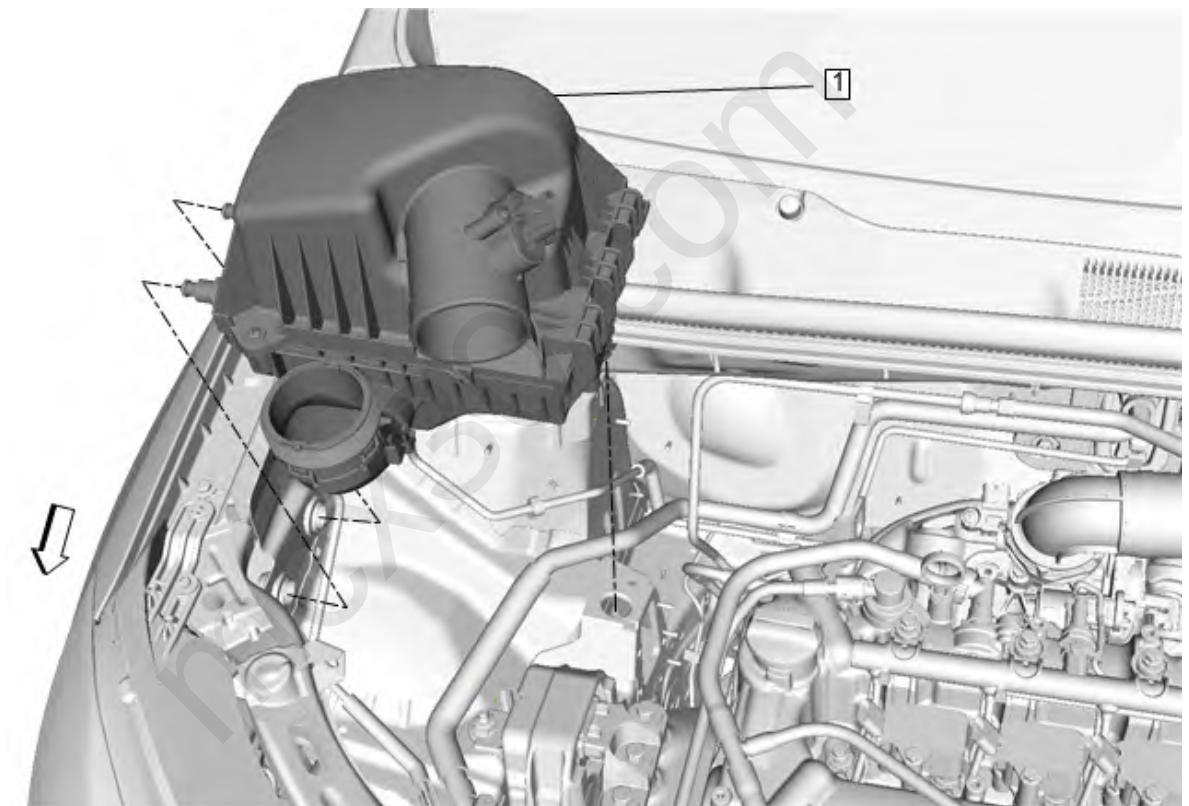


Fig. 37: Air Cleaner Assembly
 Courtesy of GENERAL MOTORS COMPANY

6. Install Air Cleaner Assembly Replacement (1)
7. Fill the engine coolant to the proper level. Cooling System Draining and Filling
8. Check the cooling system for leaks.

RADIATOR OUTLET HOSE CONNECTOR REPLACEMENT - RADIATOR SIDE (LUV, LE2)

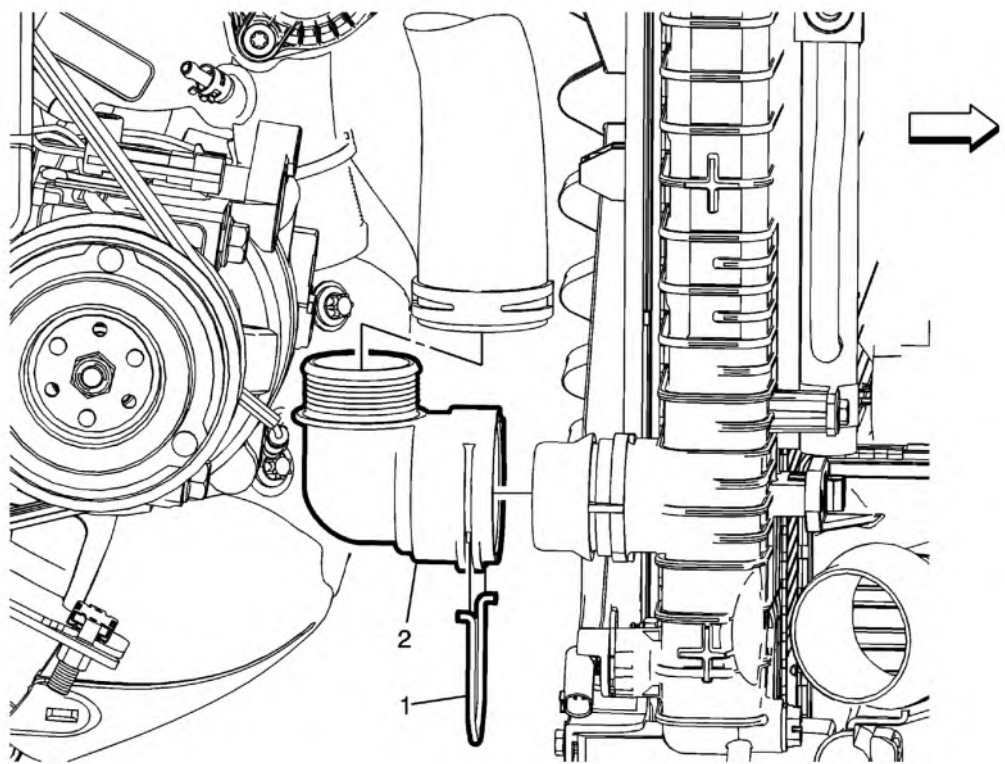


Fig. 38: Radiator Outlet Hose Connector - Radiator Side (LUV, LE2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Drain the engine coolant. Refer to Cooling System Draining and Filling. 2. Remove the radiator outlet hose from the radiator outlet hose connector and position out of the way. Refer to Radiator Outlet Hose Replacement (LUV)Radiator Outlet Hose Replacement (LE2).	
1	Radiator Outlet Hose Connector Retaining Clip
2	Radiator Outlet Hose Connector

RADIATOR OUTLET HOSE CONNECTOR REPLACEMENT - ENGINE SIDE (LUV)

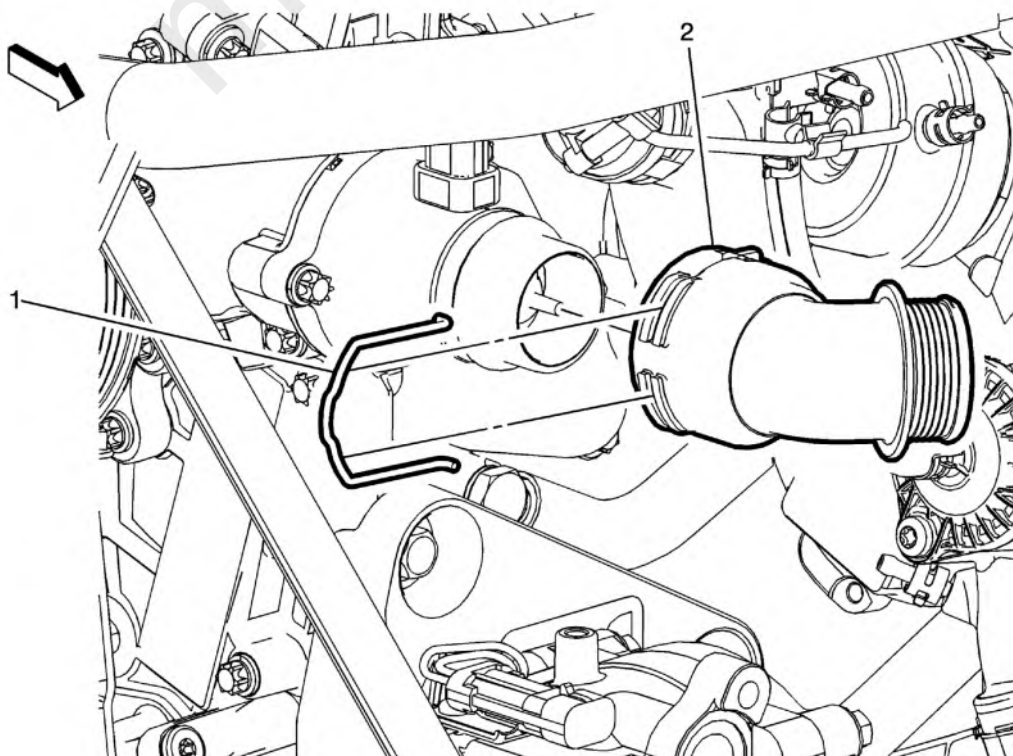


Fig. 39: Radiator Outlet Hose Connector - Engine Side (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Drain the engine coolant. Refer to Cooling System Draining and Filling . 2. Remove the radiator outlet hose from the radiator outlet hose connector. Refer to Radiator Outlet Hose Replacement (LUV) .	
1	Radiator Outlet Hose Connector Retaining Clip
2	Radiator Outlet Hose Connector

RADIATOR MOUNTING STUD REPAIR

Repair Procedure

NOTE: If the radiator is leaky, replace it. Refer to [Radiator Replacement \(LUV\)](#)[Radiator Replacement \(2H0\)](#)[Radiator Replacement \(LE2\)](#).

1. Pressure test the cooling system. Refer to [Cooling System Leak Testing](#).

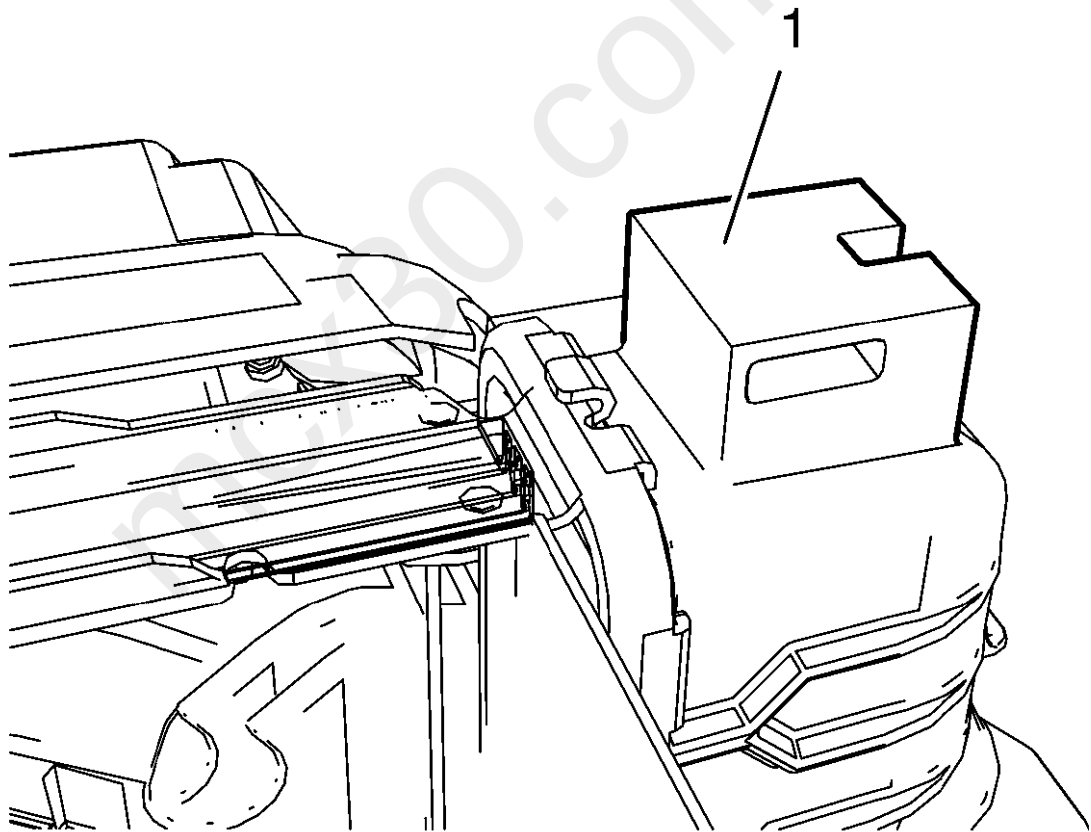


Fig. 40: Identifying Fracture Surface
 Courtesy of GENERAL MOTORS COMPANY

2. Grind the fracture surface (1) with a proper tool.
3. Drill a hole in the center of the fractured surface, using a 6 mm (0.24 in) drill.

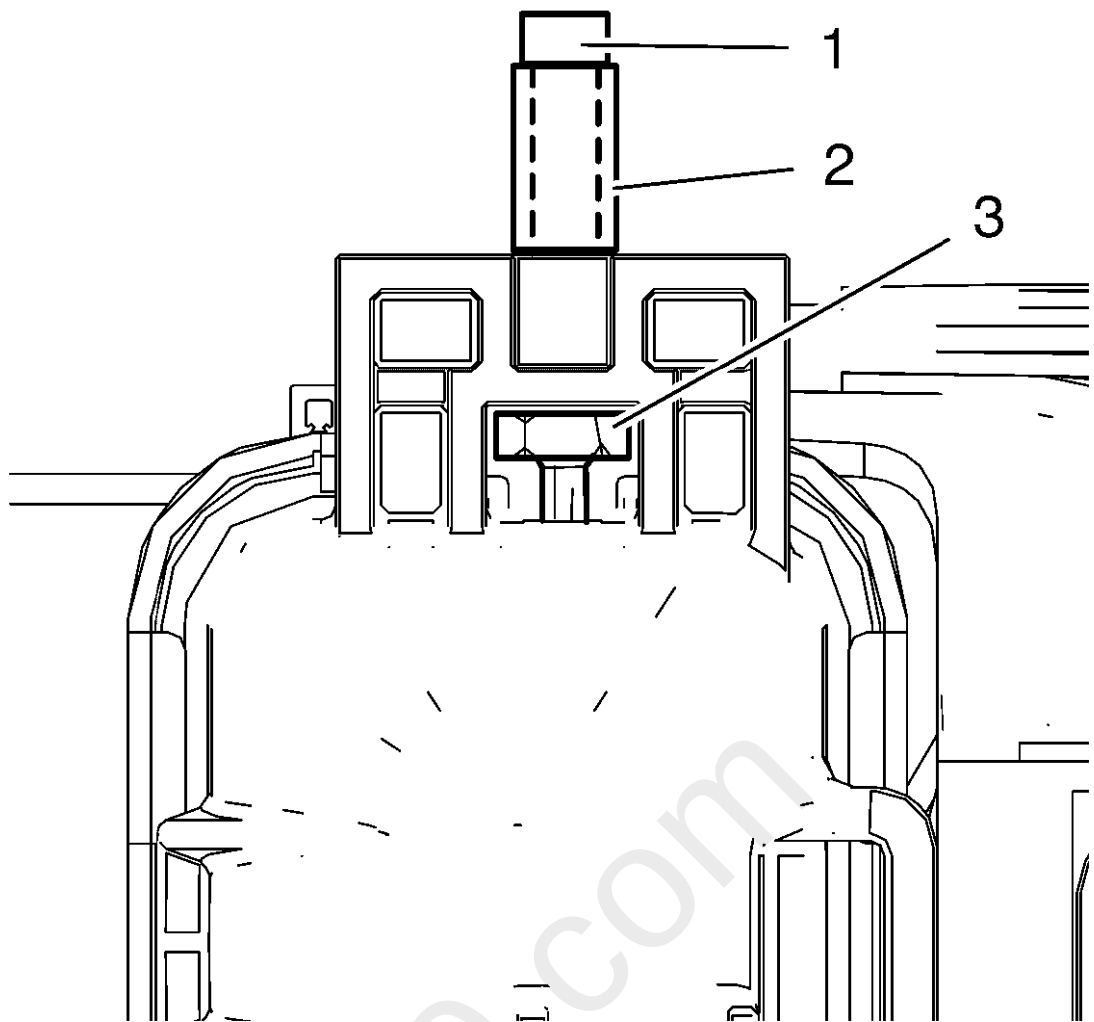


Fig. 41: Radiator Mounting Pin, Nut And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the new radiator mounting pin (2).

- Install the nut (3).

NOTE: The bolt should not be longer than 35 mm (1.38 in).

- Install the radiator mounting pin (2) with the bolt (1).

CAUTION: Refer to Fastener Caution .

5. Tighten the bolt 5 N.m (44 lb in).

RADIATOR UPPER BRACKET REPLACEMENT (2H0)

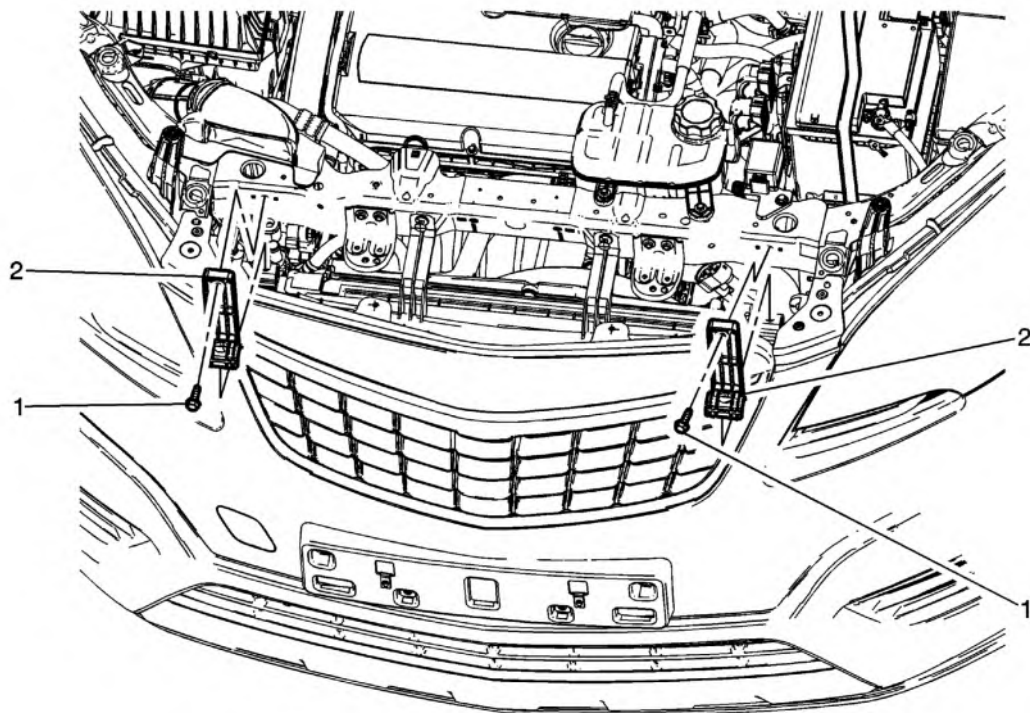


Fig. 42: Radiator Upper Bracket (2H0)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia opening upper cover. Refer to Front Bumper Fascia Opening Upper Cover Replacement .	
1	Radiator Upper Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 18 N.m (13 lb ft)
2	Radiator Upper Bracket (Qty: 2)

RADIATOR UPPER BRACKET REPLACEMENT (LUV)

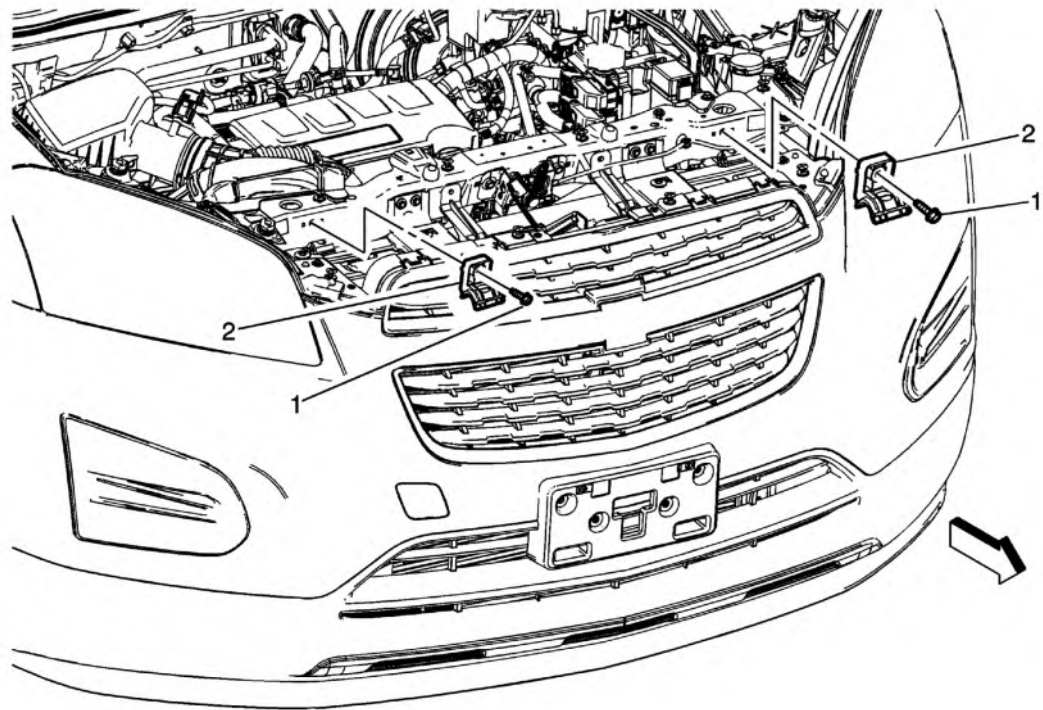


Fig. 43: Radiator Upper Bracket (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia opening upper cover. Refer to Front Bumper Fascia Opening Upper Cover Replacement .	
1	Radiator Upper Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 18 N.m (13 lb ft)
2	Radiator Upper Bracket (Qty: 2)

RADIATOR UPPER BRACKET REPLACEMENT (LE2)

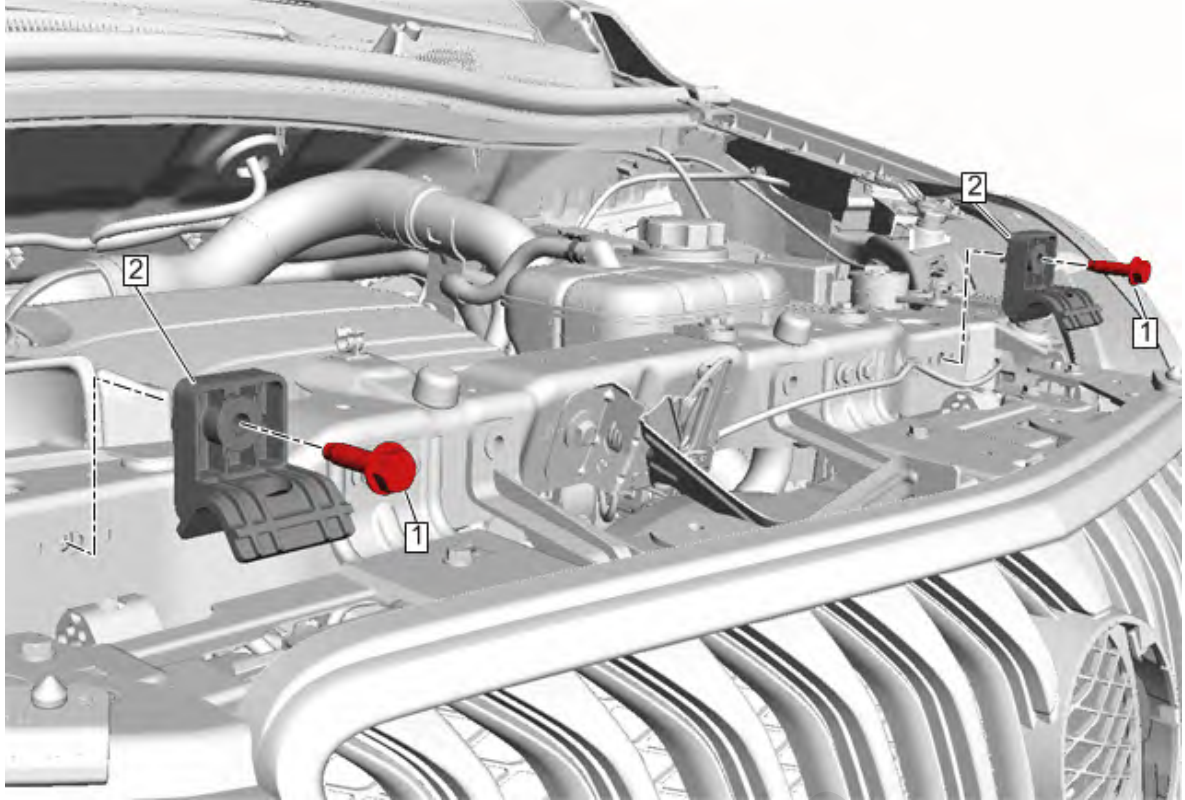


Fig. 44: Radiator Upper Bracket (LE2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Opening Upper Cover Replacement	
1	Radiator Upper Mount Bracket Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 18 N.m (13 lb ft)
2	Radiator Upper Bracket (Qty: 2)

THROTTLE BODY HEATER INLET HOSE REPLACEMENT (2H0)

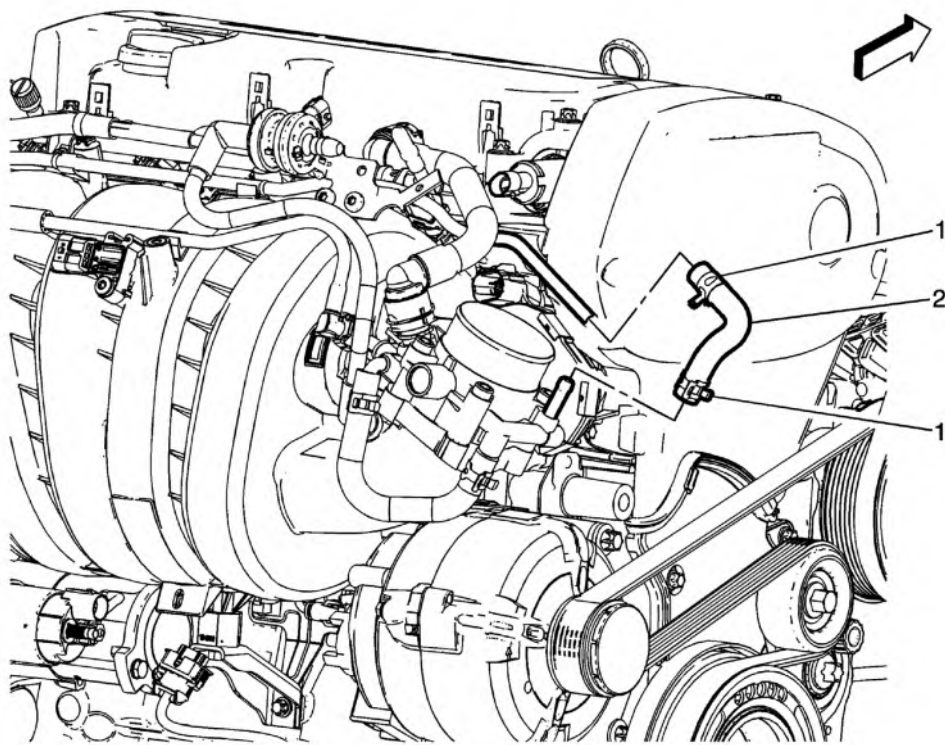


Fig. 45: Throttle Body Heater Inlet Hose (2H0)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement (2H0). 2. Drain the cooling system. Refer to Cooling System Draining and Filling.	
1	Throttle Body Heater Inlet Hose Clamp (Qty: 2) Procedure Reposition the throttle body heater inlet hose clamps from the throttle body. NOTE: Replace hose clamps if necessary. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Throttle Body Heater Inlet Hose

THROTTLE BODY HEATER INLET PIPE REPLACEMENT (2H0)

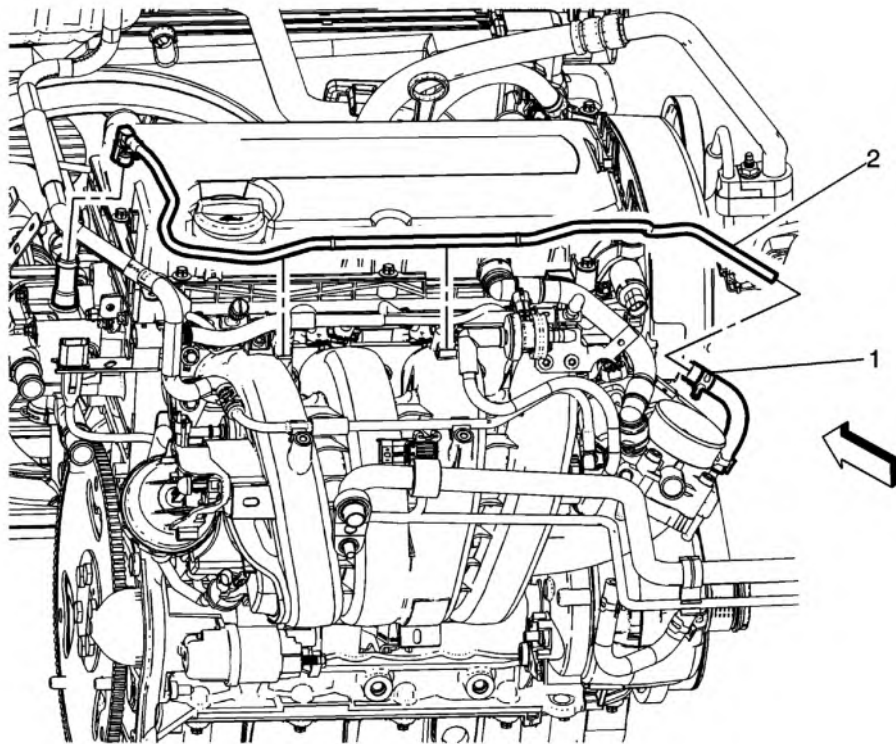


Fig. 46: Throttle Body Heater Inlet Pipe (2H0)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling . NOTE: Replace hose clamp if necessary.	
Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .	
1	Throttle Body Heater Inlet Hose Procedure Reposition throttle body heater inlet hose clamp using the BO-38185 Hose Clamp Pliers. NOTE: Replace hose clamps if necessary. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Throttle Body Heater Inlet Pipe Procedure 1. Unclip the throttle body heater inlet pipe from the top of the intake manifold. 2. Disconnect throttle body heater inlet pipe from the thermostat housing.

THROTTLE BODY HEATER OUTLET PIPE REPLACEMENT (2H0)

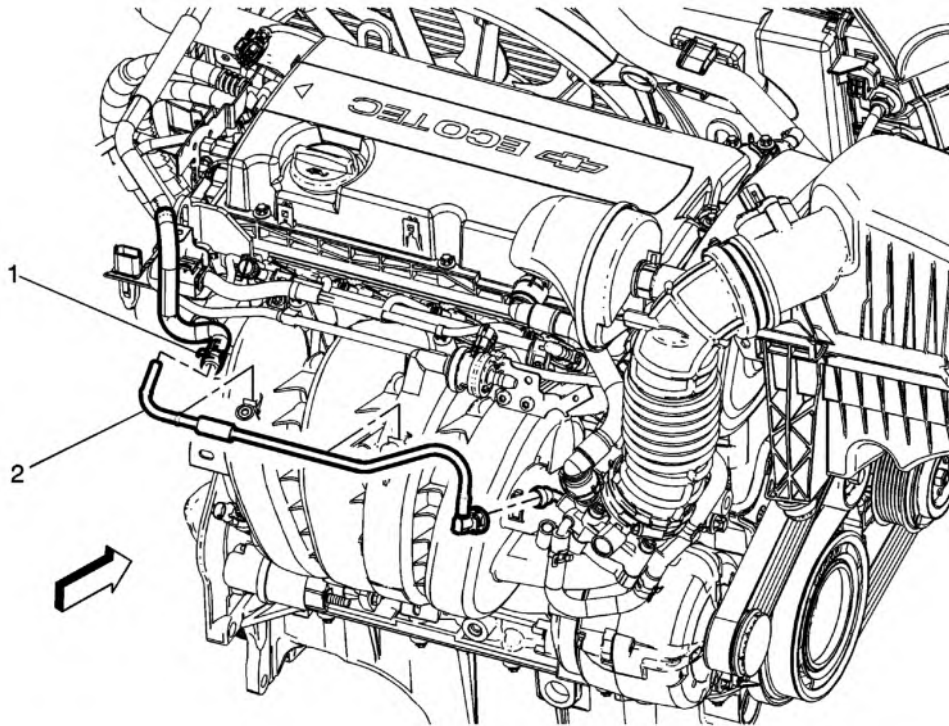


Fig. 47: Throttle Body Heater Outlet Pipe (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling .	
1	Engine Coolant Air Bleed Hose Clamp Procedure Reposition the engine coolant air bleed hose clamp using the BO-38185 Hose Clamp Pliers. NOTE: Replace hose clamps if necessary. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Throttle Body Heater Outlet Pipe Procedure 1. Unclip the throttle body heater inlet pipe from the middle of the intake manifold. 2. Remove the throttle body heater outlet pipe from the throttle body.

THROTTLE BODY HEATER OUTLET HOSE REPLACEMENT (2H0)

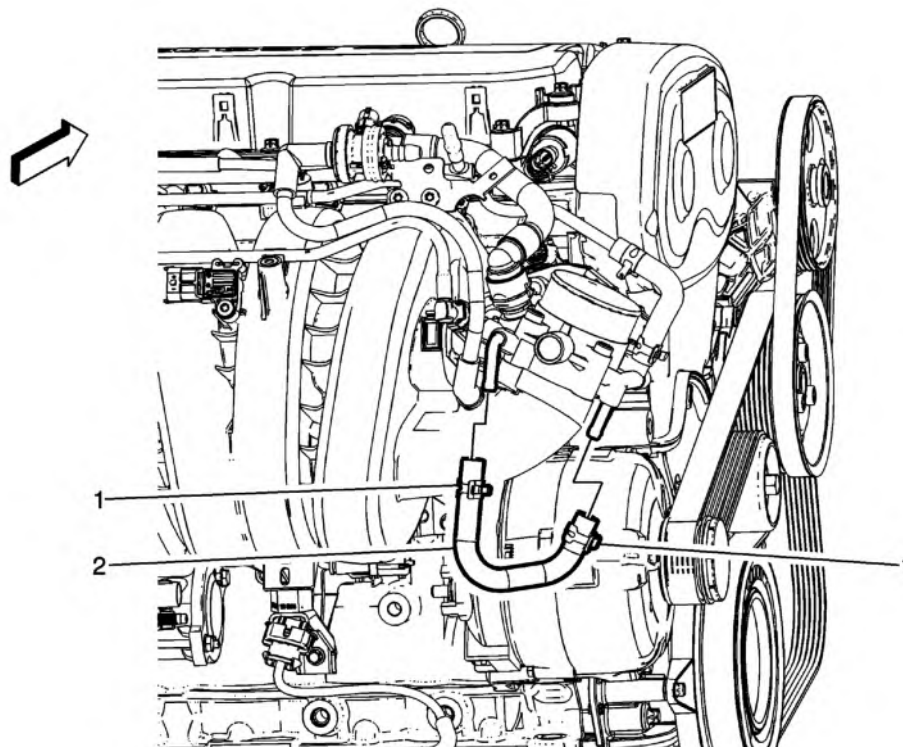


Fig. 48: Throttle Body Heater Outlet Hose (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to Cooling System Draining and Filling. 2. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement (2H0).	
1	Throttle Body Heater Outlet Hose Clamp (Qty: 2) Procedure Reposition the throttle body heater inlet hose clamps from the throttle body. NOTE: Replace hose clamps if necessary. Special Tools BO-38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Throttle Body Heater Outlet Hose

ENGINE OIL COOLER REPLACEMENT (LE2)

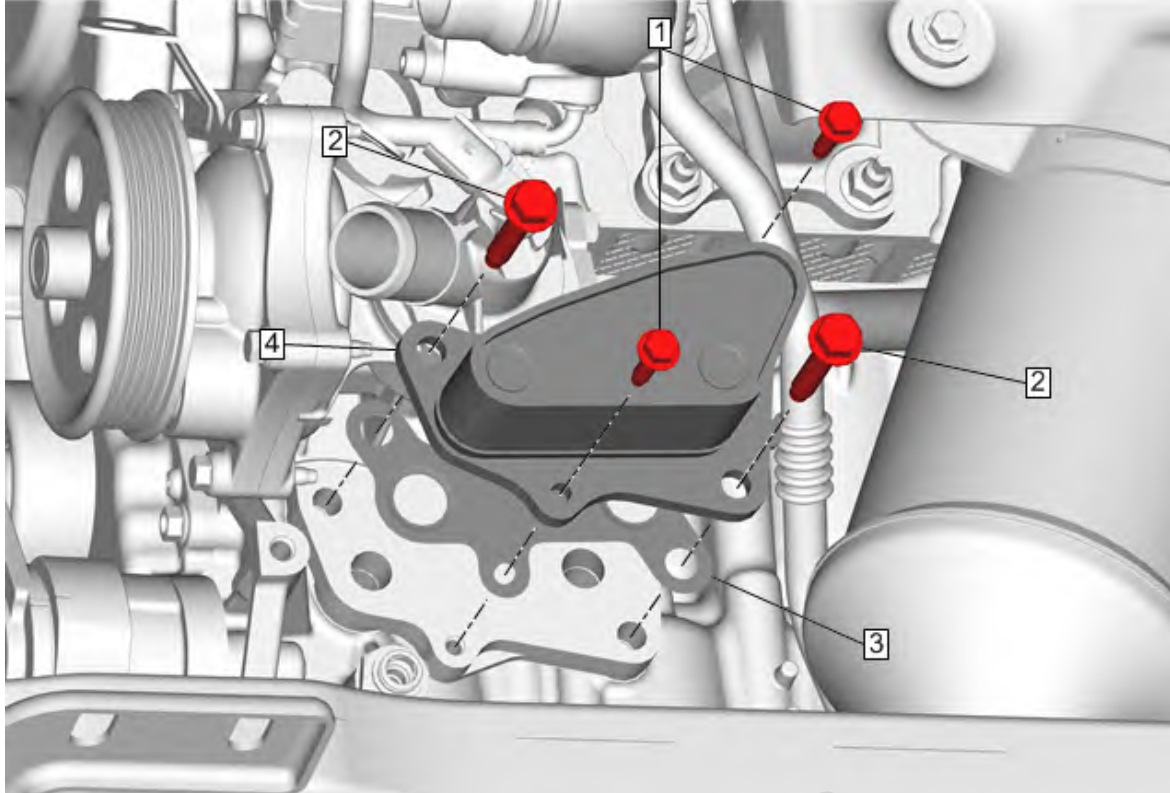


Fig. 49: Engine Oil Cooler (LE2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Cooling System Draining and Filling 2. Drain the engine oil. Engine Oil and Oil Filter Replacement 3. Air Conditioning Compressor Bracket Replacement (LE2)	
1	Engine Oil Cooler Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Engine Oil Cooler Bolt (Qty: 2) Tighten 25 N.m (18 lb ft)
3	Gasket Procedure Install a NEW engine oil cooler gasket.
4	Engine Oil Cooler

ENGINE OIL COOLER REPLACEMENT (2H0)

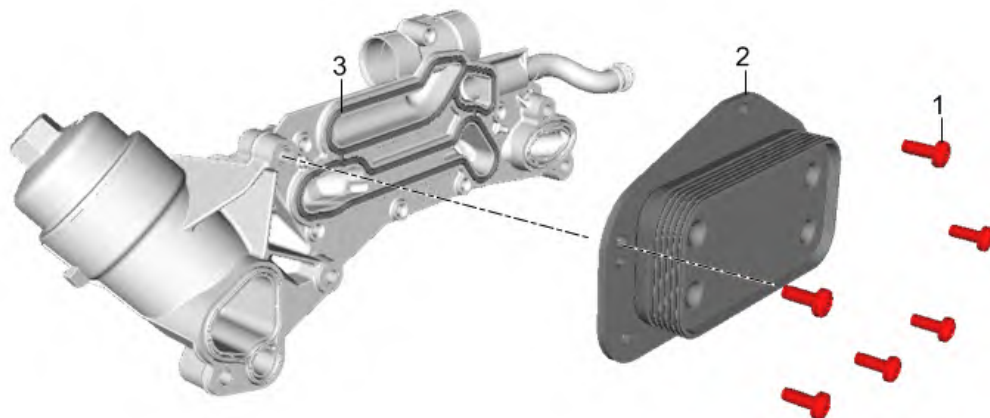


Fig. 50: Engine Oil Cooler (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Engine Oil Cooler Housing Replacement	
1	Engine Oil Cooler Bolt (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Engine Oil Cooler
3	Engine Oil Cooler Seal Procedure Install a NEW engine oil cooler seal.

ENGINE OIL COOLER COOLANT INLET HOSE REPLACEMENT (LUV)

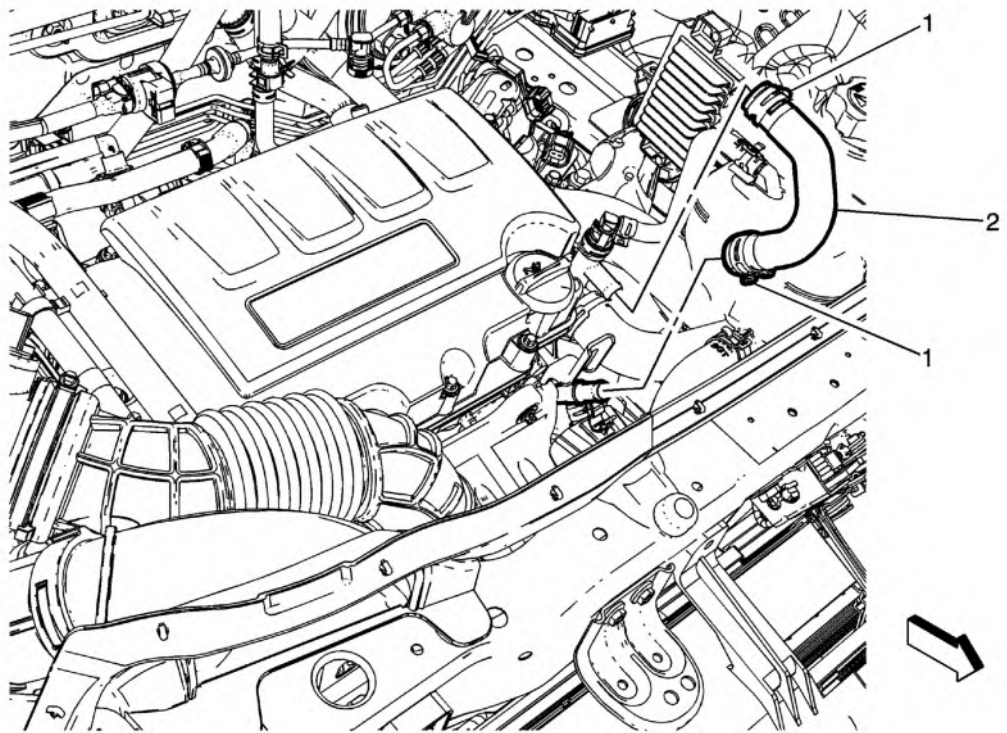


Fig. 51: Engine Oil Cooler Coolant Inlet Hose (LUV)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Oil Cooler Coolant Inlet Hose Clamp (Qty: 2) Procedure Reposition the engine oil cooler coolant inlet hose using the BO-38185 Hose Clamp Pliers NOTE: Replace hose clamps if necessary. Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools.
2	Engine Oil Cooler Coolant Inlet Hose

ENGINE OIL COOLER PIPE REPLACEMENT (2H0)

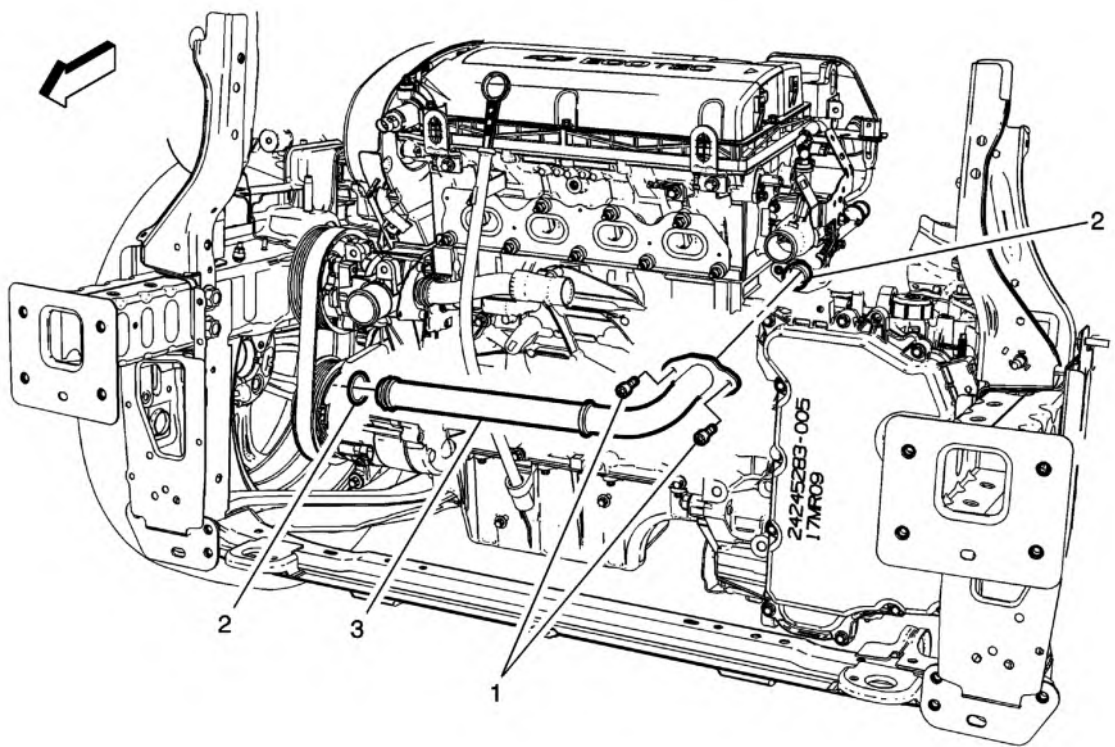


Fig. 52: Engine Oil Cooler Pipe (2H0)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling. 2. Remove the catalytic converter. Refer to Catalytic Converter Replacement (2H0).	
1	Engine Oil Cooler Outlet Pipe Bolts (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 8 N.m (71 lb in)
2	Seals NOTE: Replace with NEW seals.
3	Engine Oil Cooler Outlet Pipe

ENGINE OIL COOLER INLET PIPE REPLACEMENT (LUV)

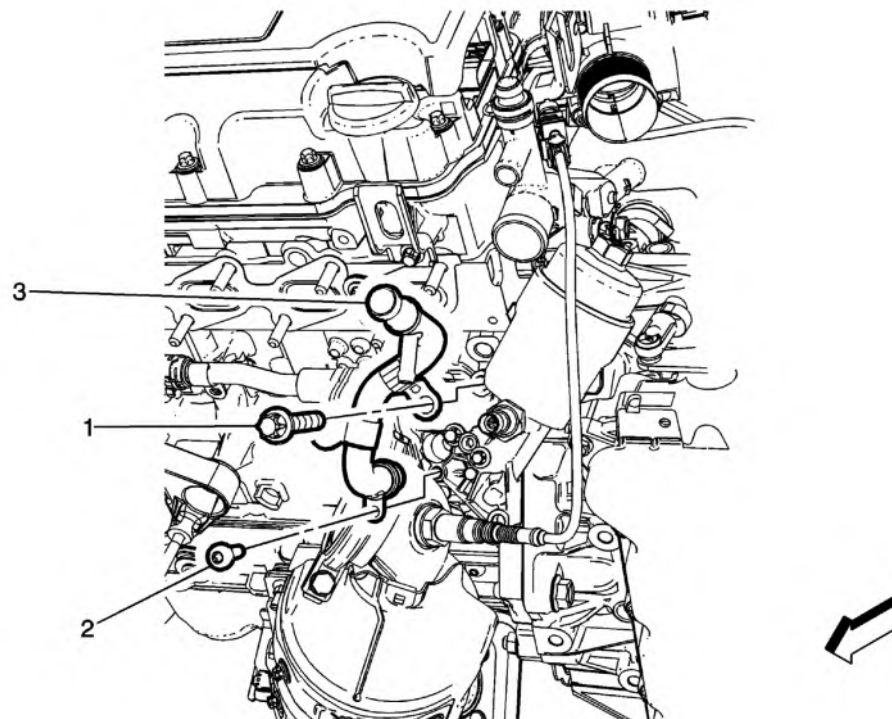


Fig. 53: Engine Oil Cooler Inlet Pipe (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling. 2. Remove the engine oil cooler coolant inlet hose. Refer to Engine Oil Cooler Coolant Inlet Hose Replacement (LUV). 3. Remove the turbo charger. Refer to Turbocharger Replacement.	
1	Engine Oil Cooler Fastener CAUTION: Refer to Fastener Caution . 10 N.m (89 lb in)
2	Engine Oil Cooler Housing Fastener CAUTION: Refer to Fastener Caution . 25 N.m (18 lb ft)
3	Engine Oil Cooler Inlet Pipe

ENGINE OIL COOLER INLET PIPE REPLACEMENT (2H0)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#).
2. Remove the catalytic converter. Refer to [Catalytic Converter Replacement \(2H0\)](#).

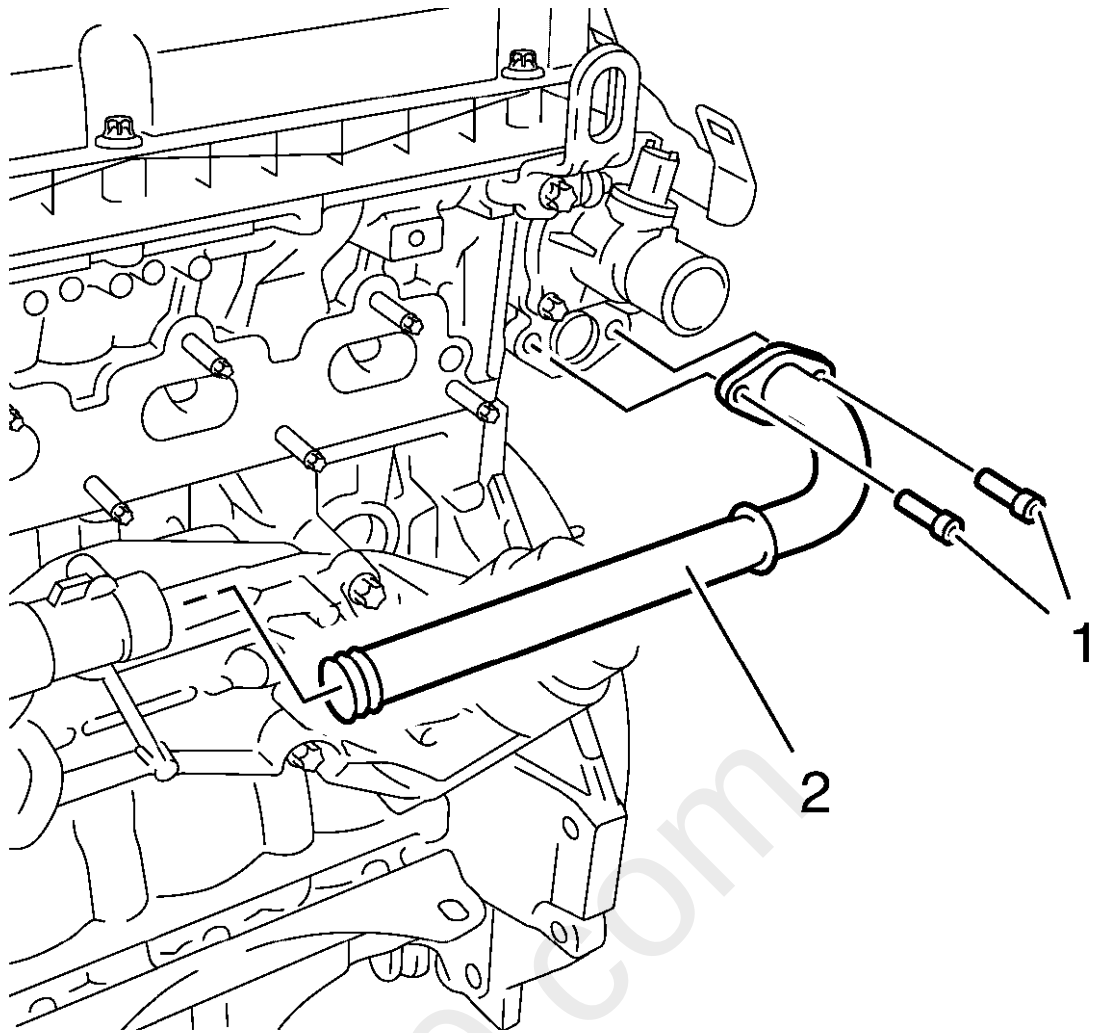


Fig. 54: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the engine oil cooler pipe bolts (1) and the engine oil cooler pipe (2).

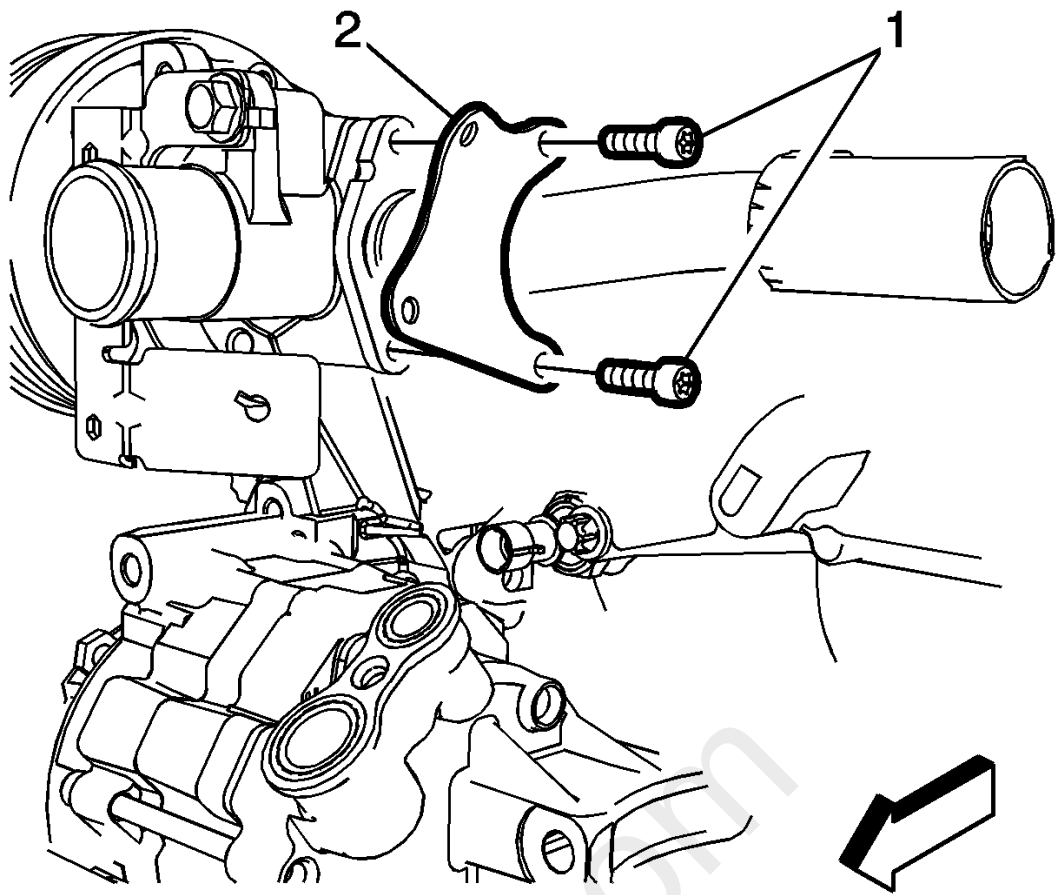


Fig. 55: Engine Oil Cooler Outlet Pipe Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the engine oil cooler outlet pipe bolts (1) and the engine control module (ECM) harness bracket (2).

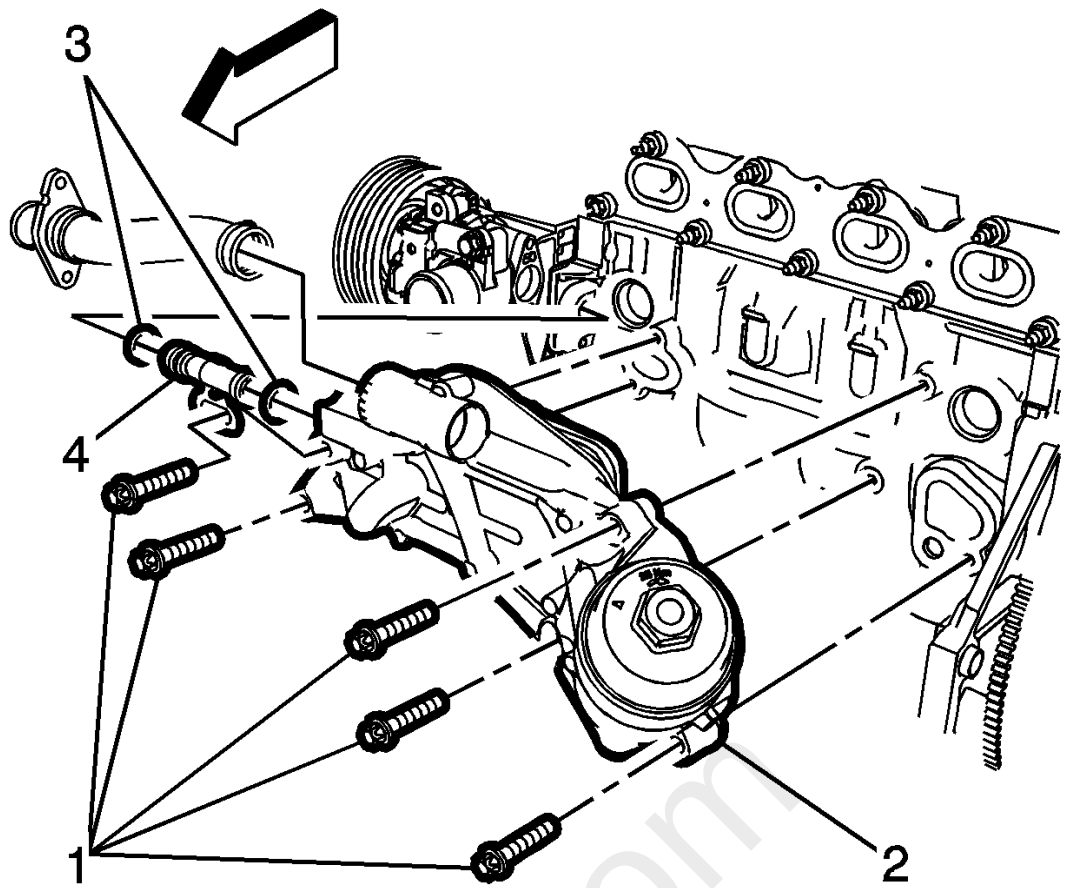


Fig. 56: Engine Oil Cooler Assembly

Courtesy of GENERAL MOTORS COMPANY

5. Remove the engine oil cooler assembly bolts (1) and remove the cooler (2).
6. Remove the engine oil cooler inlet pipe (4) and seals (3).

Installation Procedure

1. Replace the seals on the engine oil cooler outlet pipe and the engine oil cooler pipe.

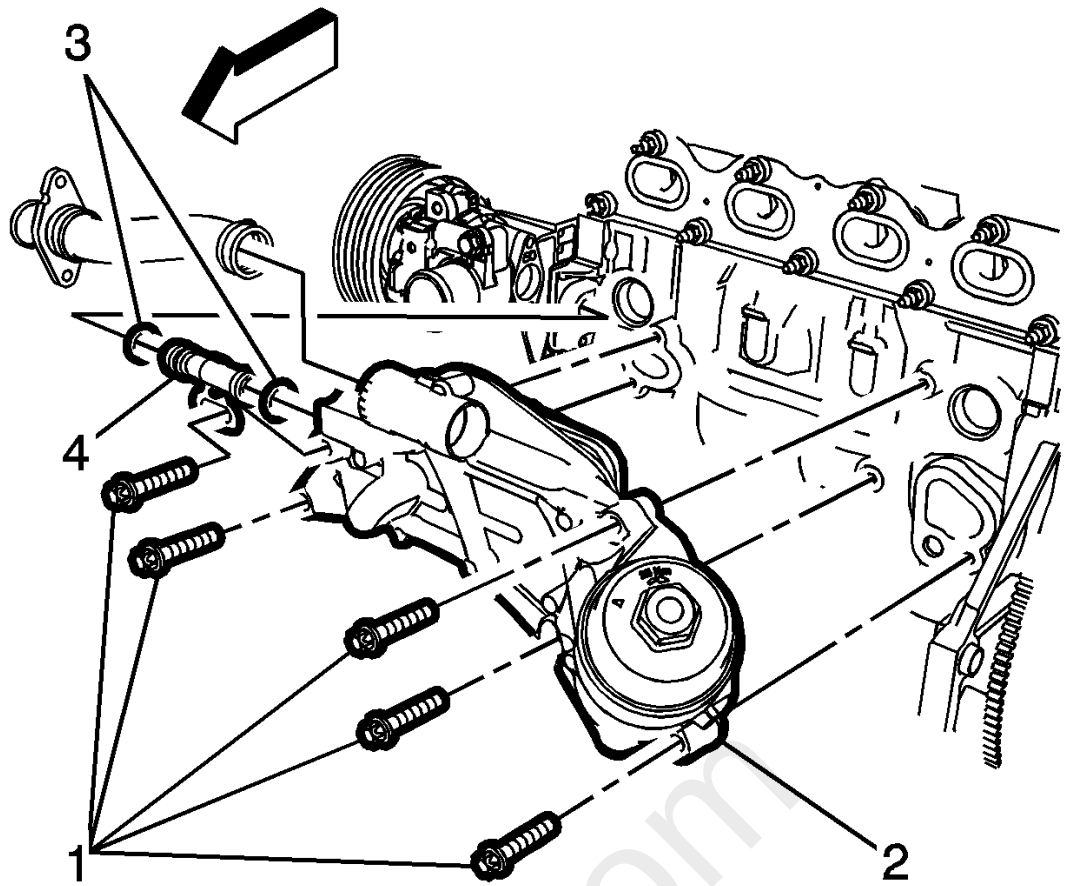


Fig. 57: Engine Oil Cooler Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Install the engine oil cooler inlet pipe (4) with NEW seals (3) to the engine oil cooler assembly.
3. Position the engine oil cooler assembly (2) to the engine block.

CAUTION: Refer to **Fastener Caution** .

4. Install the engine oil cooler assembly bolts (1) and tighten to 25 N.m (19 lb ft).

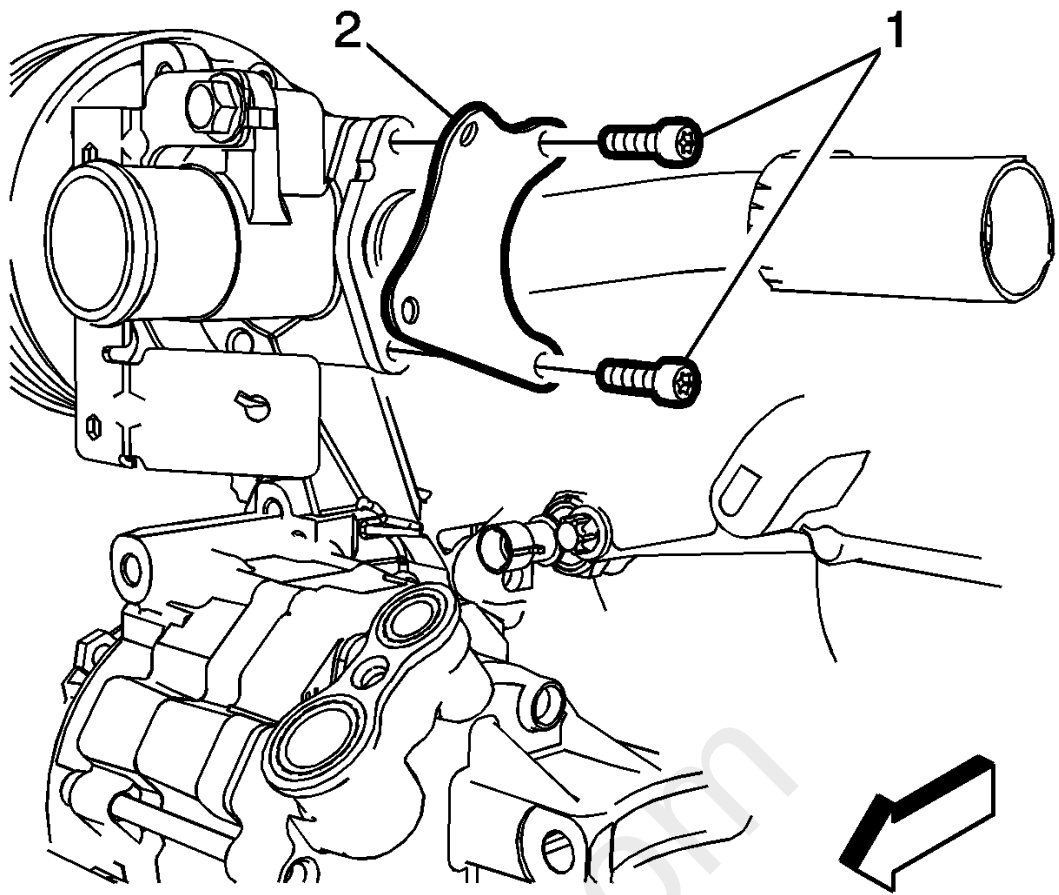


Fig. 58: Engine Oil Cooler Outlet Pipe Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the engine oil cooler outlet pipe mounting bolts (1) and ECM bracket (2) to the water pump housing and tighten to 8 N.m (71 lb in).

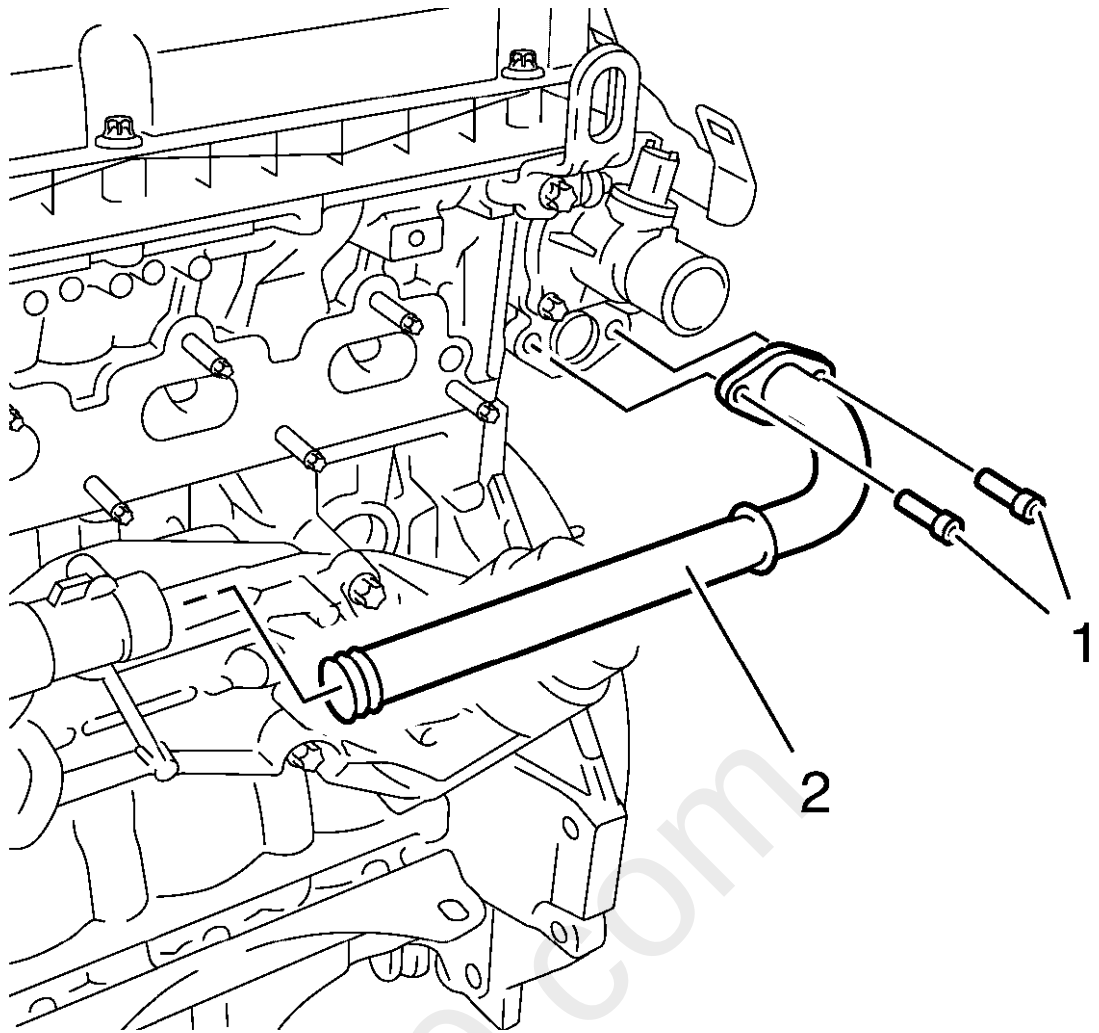


Fig. 59: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the engine oil cooler pipe (2) to the thermostat housing and tighten bolts (1) to 8 N.m (71 lb in).
7. Install the catalytic converter. Refer to [Catalytic Converter Replacement \(2H0\)](#).
8. Fill the cooling system. Refer to [Cooling System Draining and Filling](#).
9. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN REPLACEMENT (LUV)

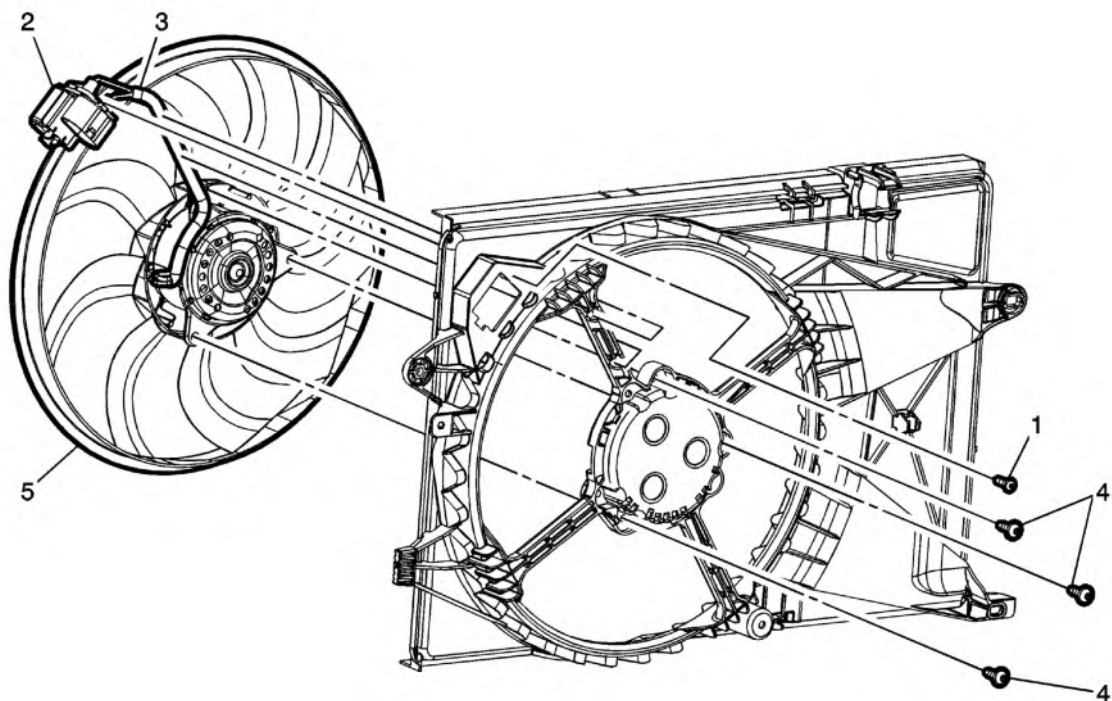


Fig. 60: Engine Coolant Fan (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove the engine coolant fan shroud from the vehicle. Refer to Engine Coolant Fan Shroud Replacement (2H0) .	
1	Engine Coolant Fan Resistor Bolt
2	Engine Coolant Fan Resistor
3	Resistor Wiring Harness. Procedure Unclip resistor harness from the shroud.
4	Engine Coolant Fan Bolt (Qty: 3)
5	Engine Coolant Fan Procedure Remove the engine coolant fan from the shroud.

ENGINE COOLANT FAN REPLACEMENT (2H0)

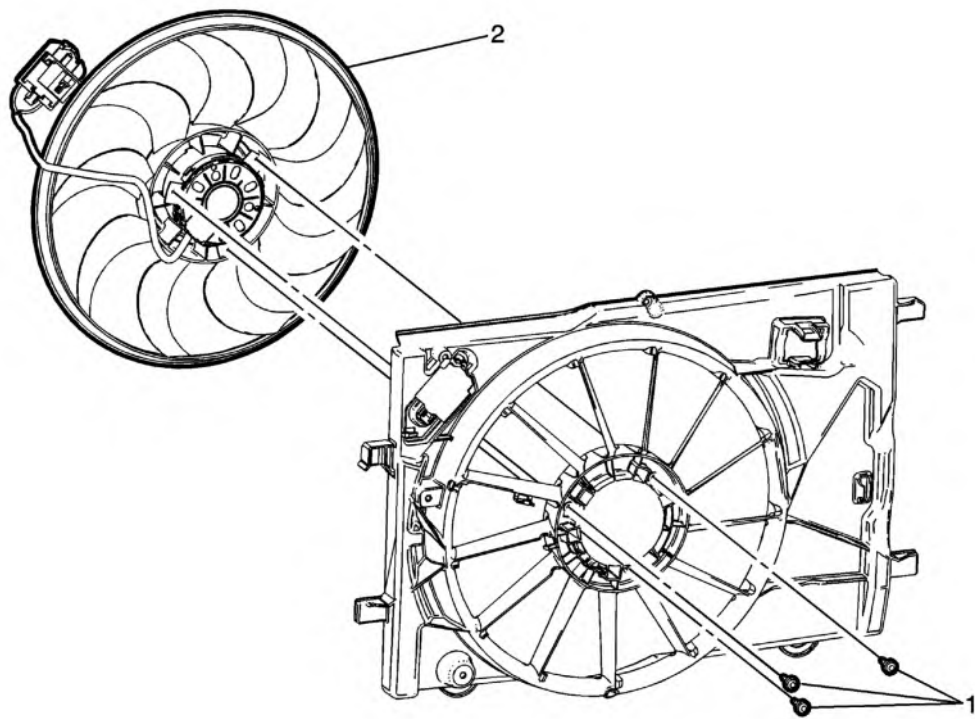


Fig. 61: Engine Coolant Fan (2H0)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the engine coolant fan shroud. Refer to Engine Coolant Fan Shroud Replacement (2H0). 2. Unclip the electrical wiring harness from the fan shroud. 3. Unclip the electrical resistor and mount from the fan shroud.	
1	Engine Coolant Fan Motor Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . 6 N.m (53 lb in)
2	Engine Coolant Fan Motor Assembly

ENGINE COOLANT FAN REPLACEMENT (LE2)

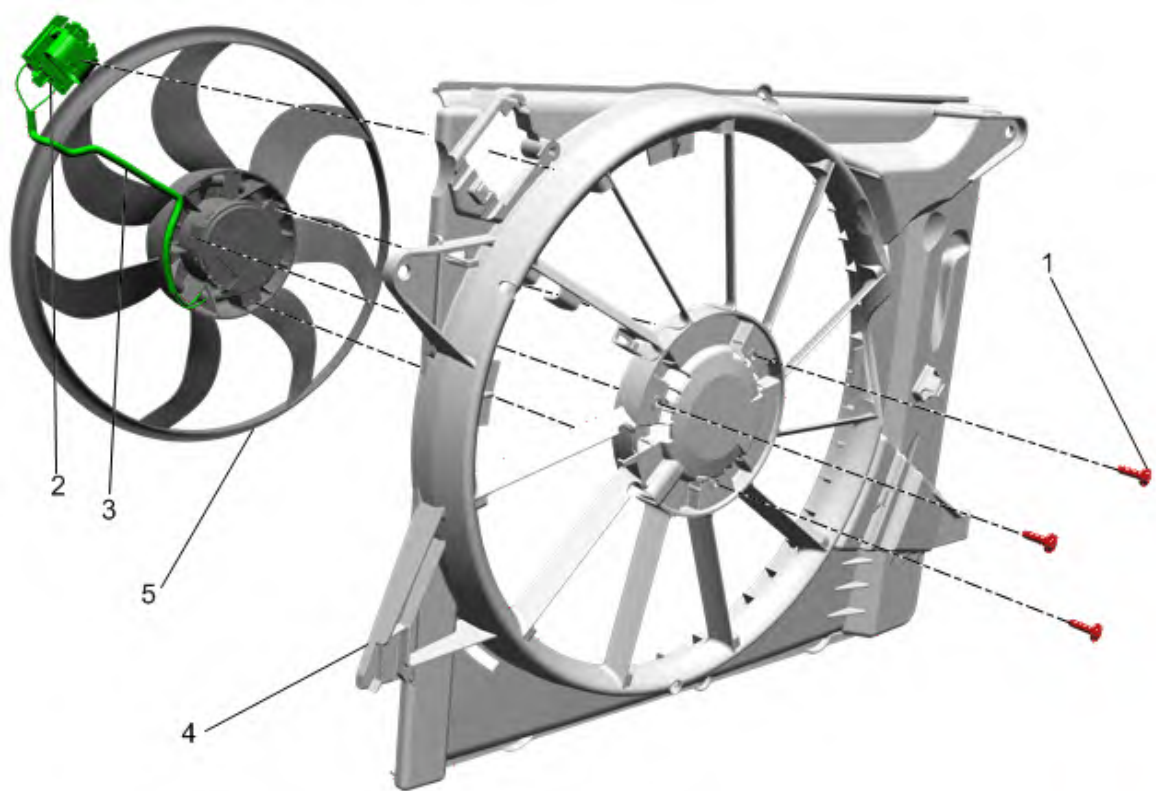


Fig. 62: Engine Coolant Fan (LE2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Engine Coolant Fan Shroud Replacement (LE2)	
1	Engine Coolant Fan Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
2	Engine Coolant Fan Resistor Procedure Unclip engine coolant fan resistor from the shroud.
3	Resistor Wiring Harness. Procedure Unclip resistor harness from the shroud.
4	Engine Coolant Fan Shroud
5	Engine Coolant Fan - Motor Assembly

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT (LUV)

Special Tools

EN-49940 Remover Quick Connector

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

Removal Procedure

NOTE: Leave the refrigerant lines attached and reposition the air conditioning compressor to gain access. It is not necessary to recover the refrigerant.

1. Reposition Air Conditioning Compressor - **Air Conditioning Compressor Replacement (LUV)**
2. Remove Air Conditioning Compressor Bracket - **Air Conditioning Compressor Bracket Replacement (LUV)**

3. Remove Catalytic Converter - [Catalytic Converter Replacement \(LUV\)](#)

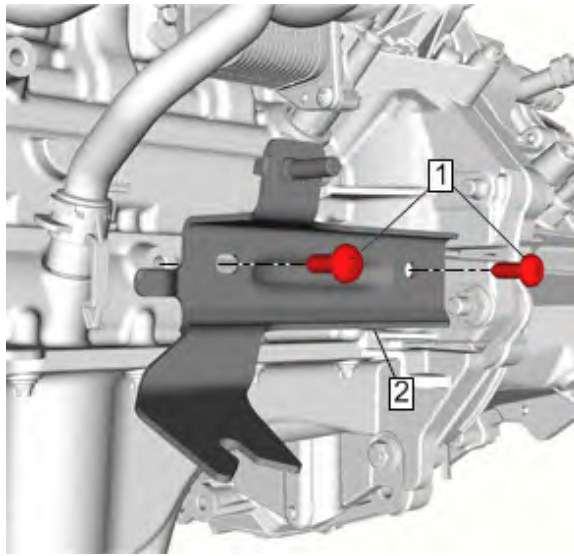


Fig. 63: Catalytic Converter Bracket Bolt And Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Remove Catalytic Converter Bracket Bolt (1)
5. Remove Catalytic Converter Bracket (2)
6. Drain the coolant. [Cooling System Draining and Filling](#)

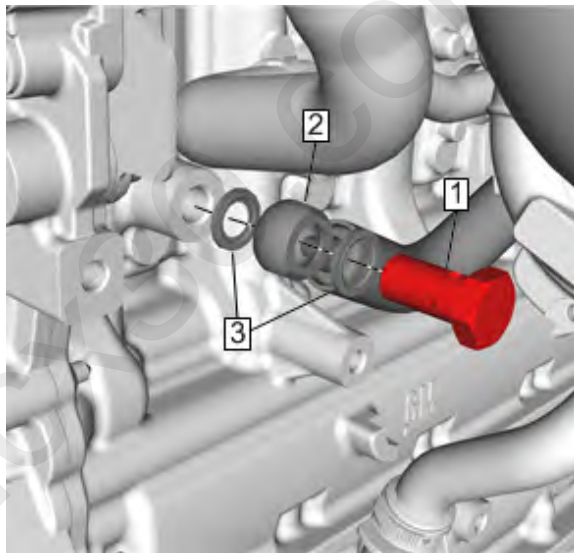


Fig. 64: Turbocharger Coolant Feed Pipe Hollow Screw And Seal Rings
Courtesy of GENERAL MOTORS COMPANY

7. Remove Turbocharger Coolant Feed Pipe Hollow Screw (1)
8. Remove Turbocharger Coolant Feed Pipe (2)
9. Remove and DISCARD the seal rings (3).

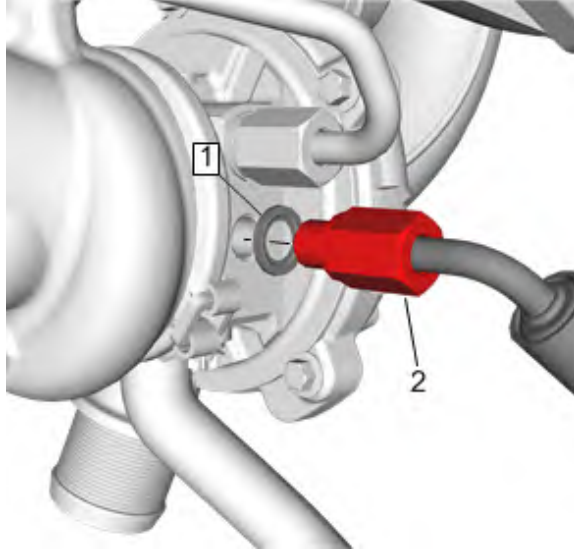


Fig. 65: Turbocharger Coolant Feed Pipe And Seal Ring
Courtesy of GENERAL MOTORS COMPANY

10. Remove Turbocharger Coolant Feed Pipe (2)
11. Remove and DISCARD the seal ring (1).

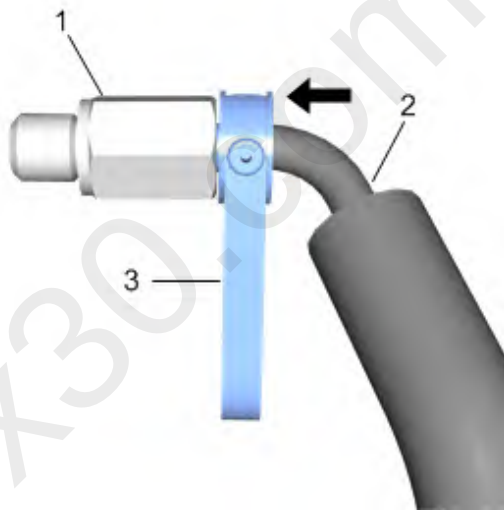


Fig. 66: Remover, Turbocharger Coolant Feed Pipe And Quick Fitting Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: The quick fitting connectors should always be replaced when the turbocharger coolant pipes are removed.

12. Install the **EN-49940** remover (3) to the turbocharger coolant feed pipe (2) and the quick fitting connector (1) as shown.
13. Compress the **EN-49940** remover and remove the turbocharger coolant feed pipe.
14. DISCARD the quick fitting connector.

Installation Procedure

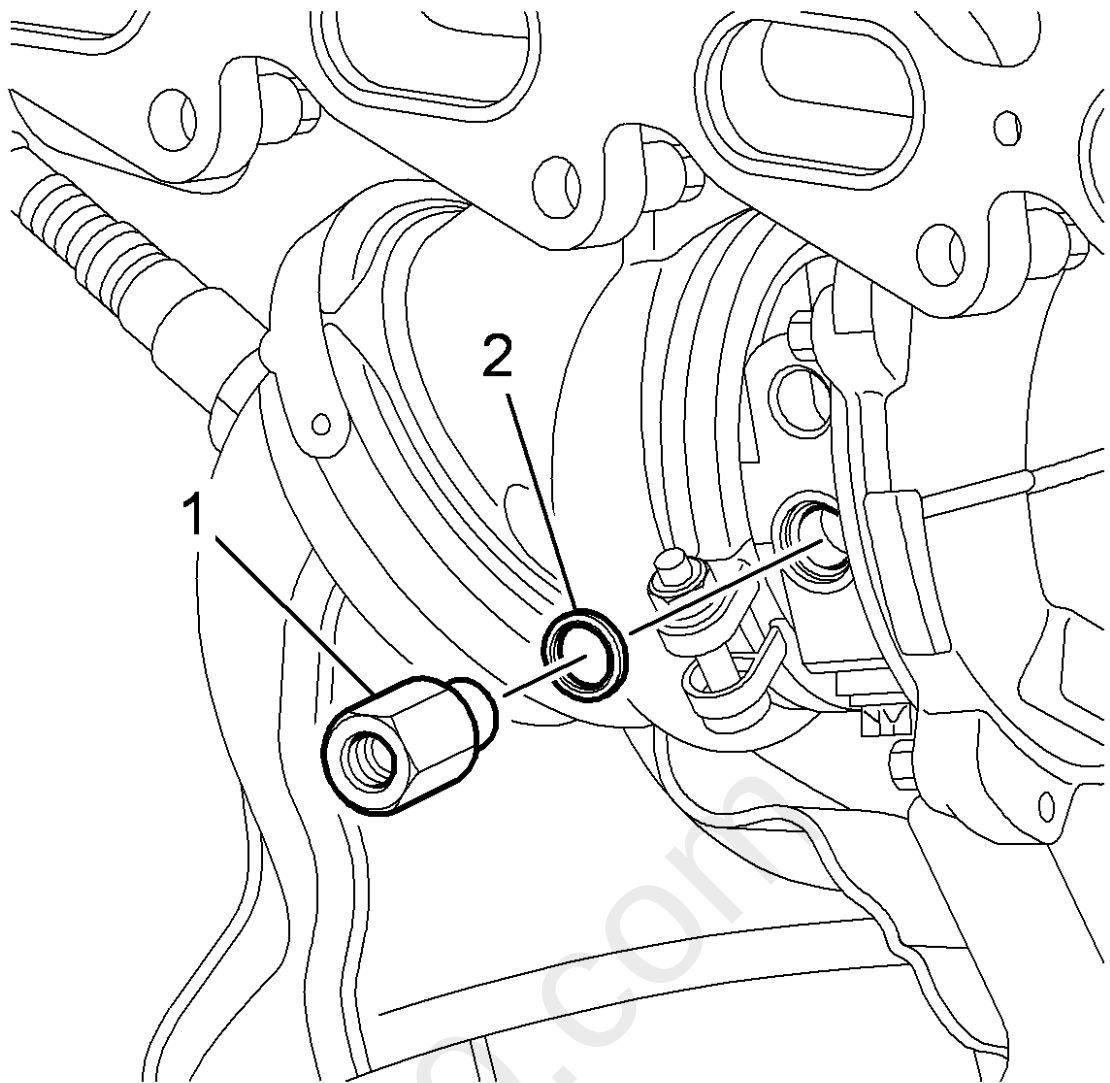


Fig. 67: Quick Fitting Connector And Seal Ring
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW quick connector fitting seal ring.

1. Install Seal Ring (2)

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

NOTE: Install a NEW quick connector fitting.

2. Install Quick Connect Fitting (1) and tighten 20 N.m (15 lb ft)

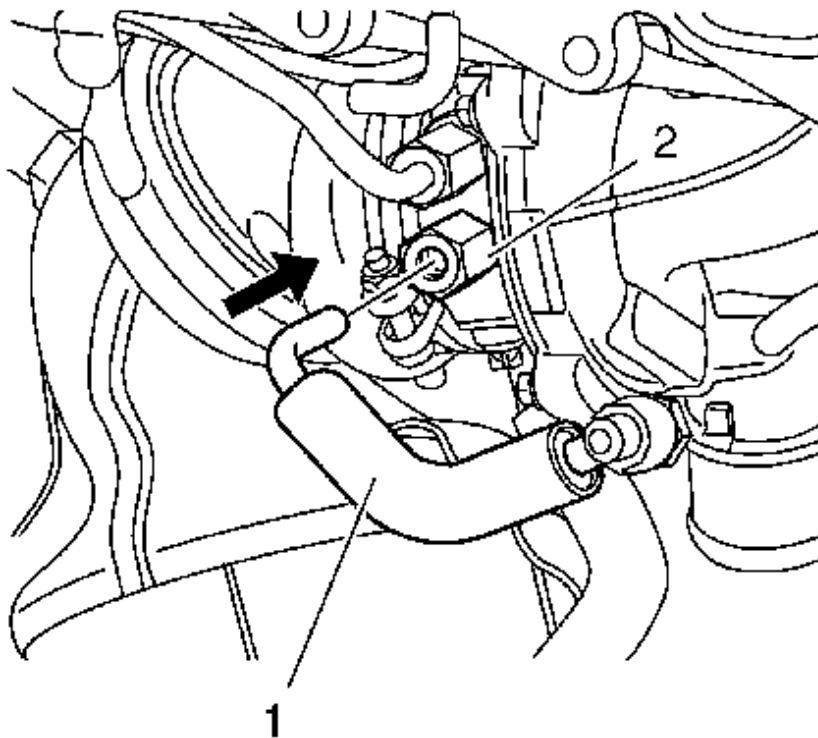


Fig. 68: Turbocharger Coolant Feed Pipe
Courtesy of GENERAL MOTORS COMPANY

3. Install the turbocharger coolant feed pipe (1) to the quick fitting connector (2) by pushing in the direction of the arrow until an audible engagement is heard.

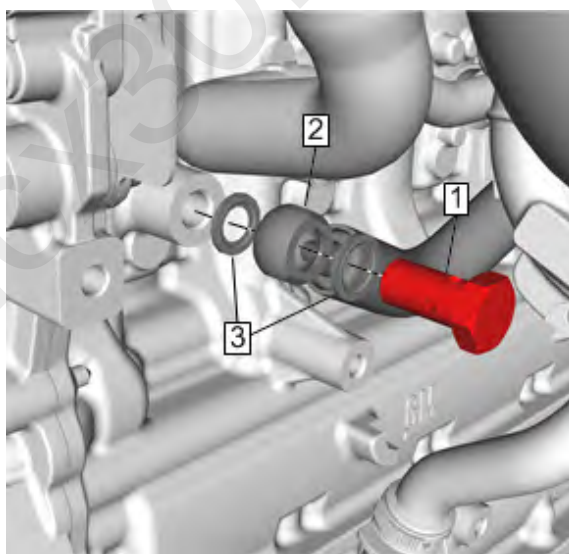


Fig. 69: Turbocharger Coolant Feed Pipe Hollow Screw And Seal Rings
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Install NEW seal rings.**

4. Install Seal Ring (3)
5. Install Turbocharger Coolant Feed Pipe (2)
6. Install Turbocharger Coolant Feed Pipe Hollow Screw (1) and tighten 20 N.m (15 lb ft)

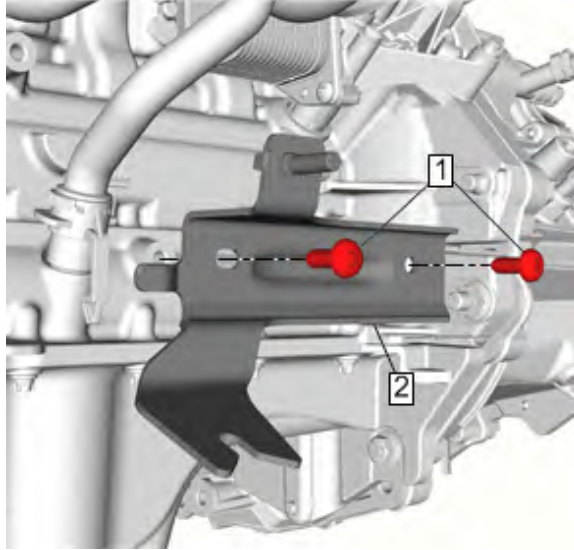


Fig. 70: Catalytic Converter Bracket Bolt And Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Install Catalytic Converter Bracket (2)
8. Install Catalytic Converter Bracket Bolt (1) and tighten 22 N.m (16 lb ft)
9. Install Catalytic Converter - [Catalytic Converter Replacement \(LUV\)](#)
10. Install Air Conditioning Compressor Bracket - [Air Conditioning Compressor Bracket Replacement \(LUV\)](#)
11. Install Air Conditioning Compressor - [Air Conditioning Compressor Replacement \(LUV\)](#)
12. Fill the cooling system. [Cooling System Draining and Filling](#)

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT (LE2)

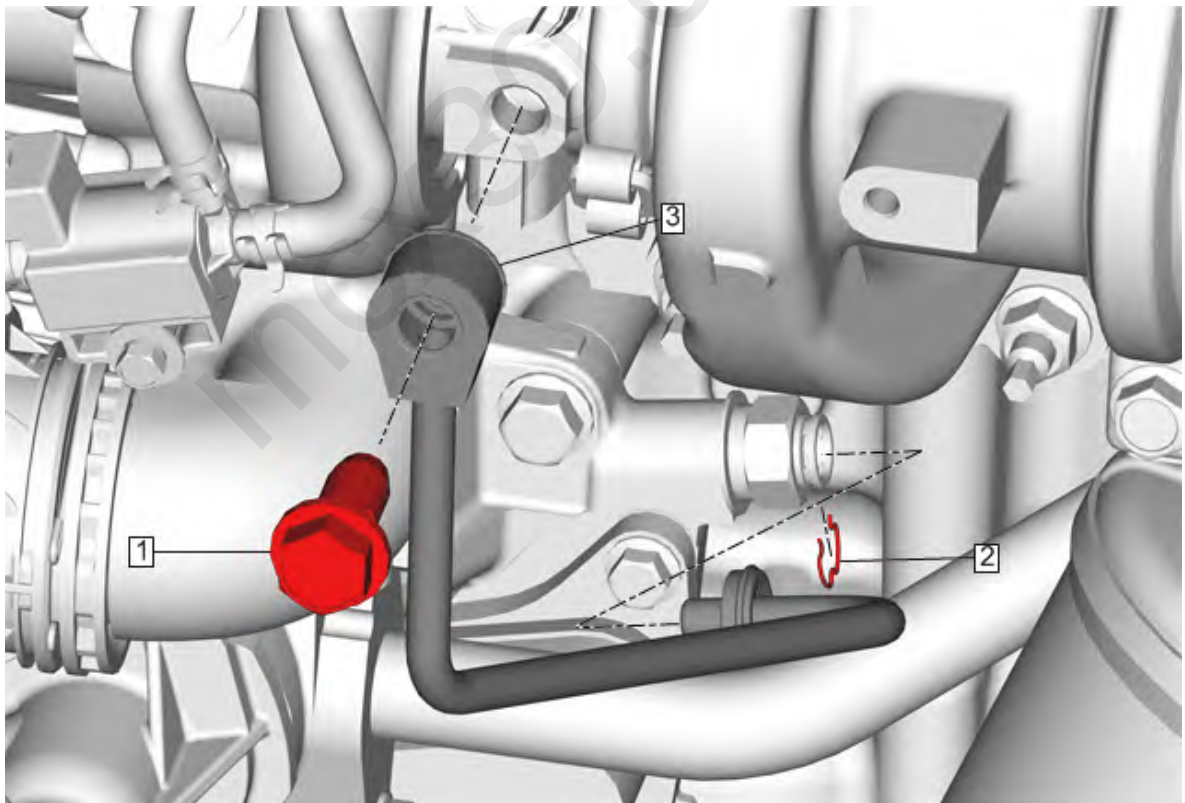
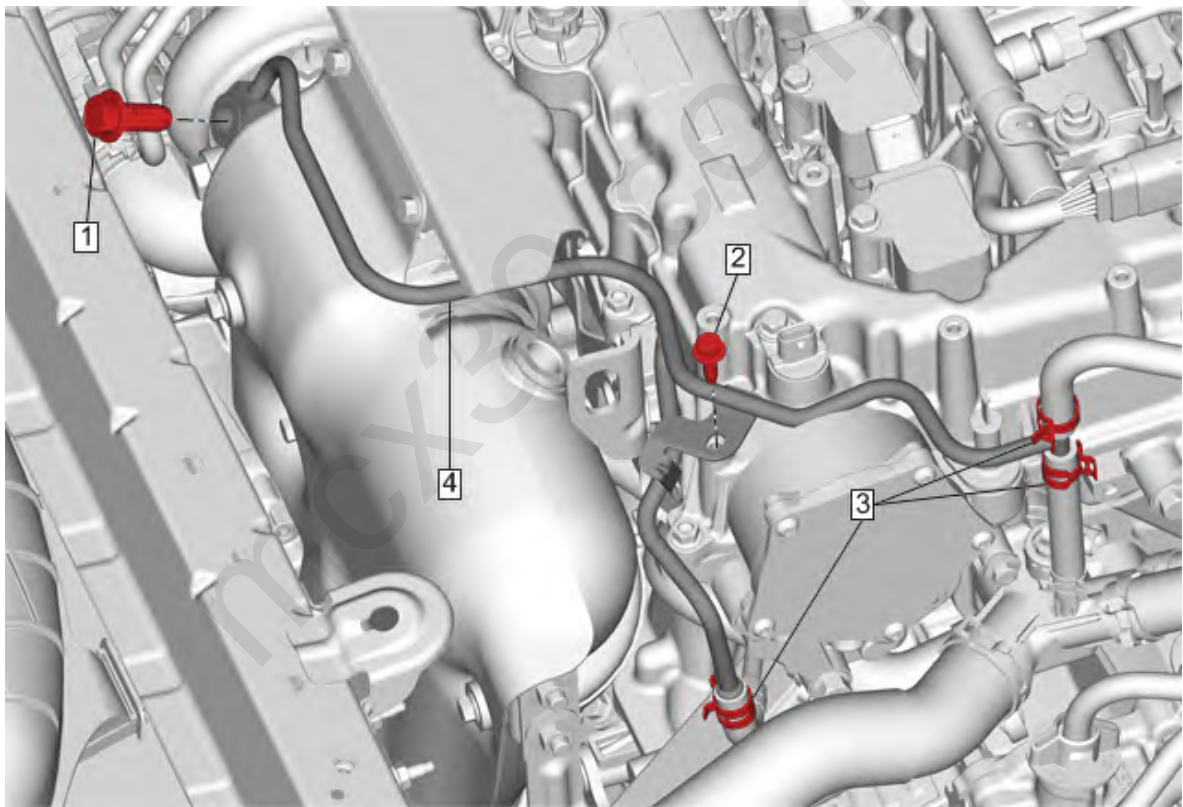


Fig. 71: Turbocharger Coolant Feed Pipe (LE2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling 2. Turbocharger Heat Shield Replacement 3. Catalytic Converter Replacement (LE2)	
1	Turbocharger Coolant Feed Pipe Fastener CAUTION: Refer to Fastener Caution . Tighten 35 N.m (26 lb ft)
2	Retainer Procedure Install a NEW retainer.
3	Turbocharger Coolant Feed Pipe

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT (LE2)



[Fig. 72: Turbocharger Coolant Return Pipe \(LE2\)](#)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Cooling System Draining and Filling 2. Intake Manifold Cover Replacement 3. Reposition Radiator Surge Tank Replacement (LE2) 4. Disconnect the heated oxygen sensor electrical connector. 5. Reposition Charge Air Cooler Outlet Air Hose Replacement	

Callout	Component Name
1	Turbocharger Coolant Return Pipe Fastener CAUTION: Refer to Fastener Caution . Tighten 35 N.m (26 lb ft)
2	Turbocharger Coolant Return Pipe Fastener Tighten 10 N.m (89 lb in)
3	Clamp (Qty: 3) Procedure Install a NEW clamp.
4	Turbocharger Coolant Return Pipe

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT (LUV)

Special Tools

EN-49940 Quick Connector Remover

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

Removal Procedure

1. Reposition Radiator Surge Tank - [Radiator Surge Tank Replacement \(LUV, 2H0\)](#)
2. Remove Turbocharger Oil Feed Pipe - [Turbocharger Oil Feed Pipe Replacement](#)

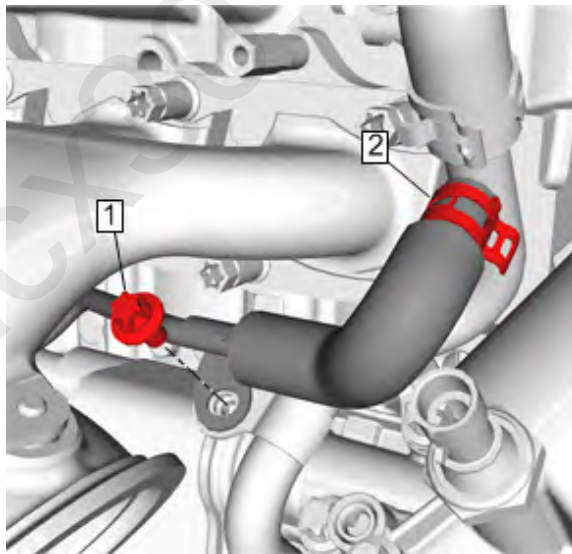


Fig. 73: Turbocharger Coolant Return Pipe Hose Clamp And Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Remove Turbocharger Coolant Return Pipe Bracket Bolt (1)
4. Disengage Turbocharger Coolant Return Pipe Hose Clamp (2)
5. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
6. Remove Turbocharger Coolant Feed Pipe - [Turbocharger Coolant Feed Pipe Replacement \(LUV\)](#)
7. Remove Turbocharger Oil Return Pipe - [Turbocharger Oil Return Pipe Replacement](#)

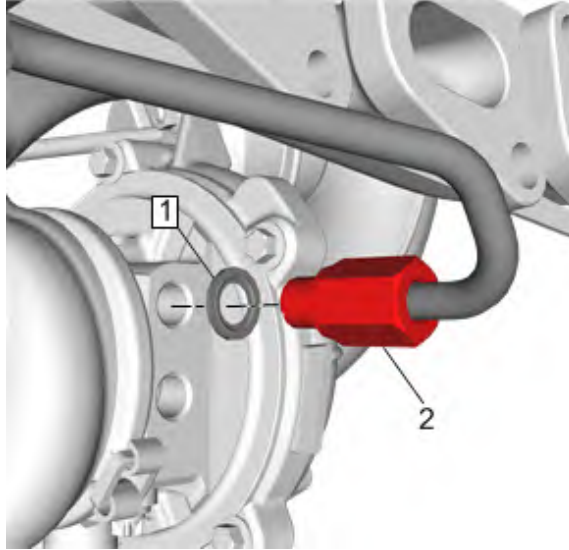


Fig. 74: Engine Oil Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

8. Remove Turbocharger Coolant Return Pipe (2)
9. Remove and DISCARD the seal ring (1).

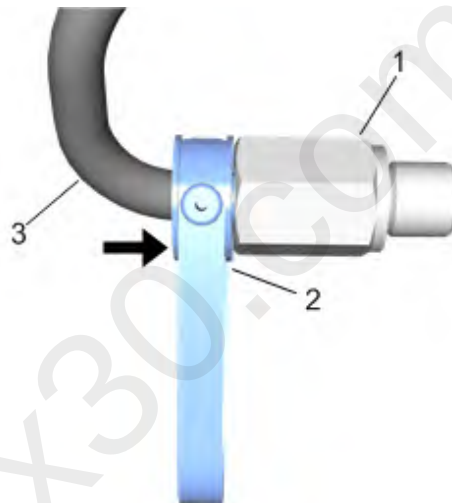


Fig. 75: Remover

Courtesy of GENERAL MOTORS COMPANY

NOTE: The quick fitting connectors should always be replaced when the turbocharger coolant pipes are removed.

10. Install the **EN-49940** remover (2) to the turbocharger coolant return pipe (3) and the quick fitting connector (1) as shown.
11. Compress the **EN-49940** remover and remove the turbocharger coolant return pipe.
12. DISCARD the quick fitting connector.

Installation Procedure

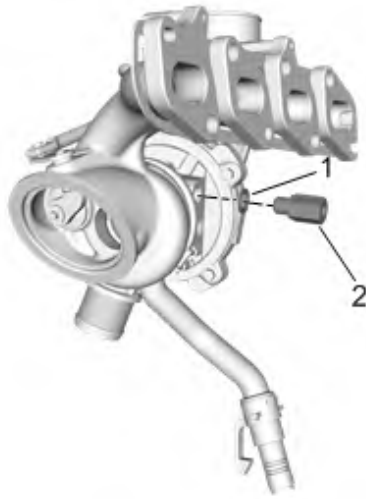


Fig. 76: Quick Fitting Connector Seal Ring
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW quick connector fitting seal ring.

1. Install Seal Ring (1)

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

NOTE: Install a NEW quick connector fitting.

2. Install Quick Connect Fitting (2) and tighten 20 N.m (15 lb ft)

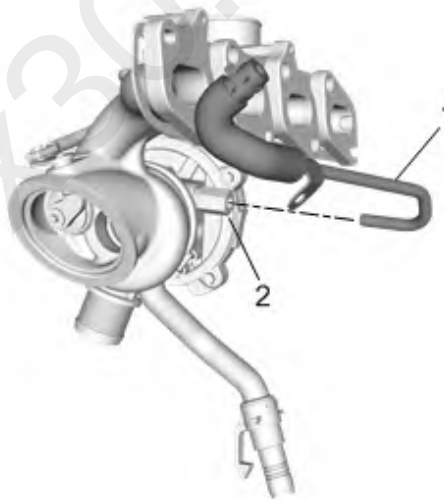


Fig. 77: Turbocharger Coolant Return Pipe And Quick Connect Fitting
 Courtesy of GENERAL MOTORS COMPANY

3. Install the turbocharger coolant return pipe (1) to the quick fitting connector (2) by pushing in the direction of the arrow until an audible engagement is heard.
4. Install Turbocharger Oil Return Pipe - [Turbocharger Oil Return Pipe Replacement](#)
5. Install Turbocharger Coolant Feed Pipe - [Turbocharger Coolant Feed Pipe Replacement \(LUV\)](#)
6. Lower the vehicle. [Lifting and Jacking the Vehicle](#)



- CAUTION:** Refer to Fastener Caution .

- ## THERMOSTAT BYPASS HOSE REPLACEMENT (LE2)



Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Radiator Inlet Hose Replacement (LE2) 2. Vacuum Pump Assembly Replacement 3. Water Outlet Replacement (LE2)	
1	Clamp (Qty: 2) Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Thermostat Bypass Hose

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (2H0)

Removal Procedure

CAUTION: Refer to [Engine Coolant Thermostat Housing Caution](#) .

1. Remove the battery tray. Refer to [Battery Tray Replacement](#) .
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
3. Drain the cooling system. Refer to [Cooling System Draining and Filling](#).

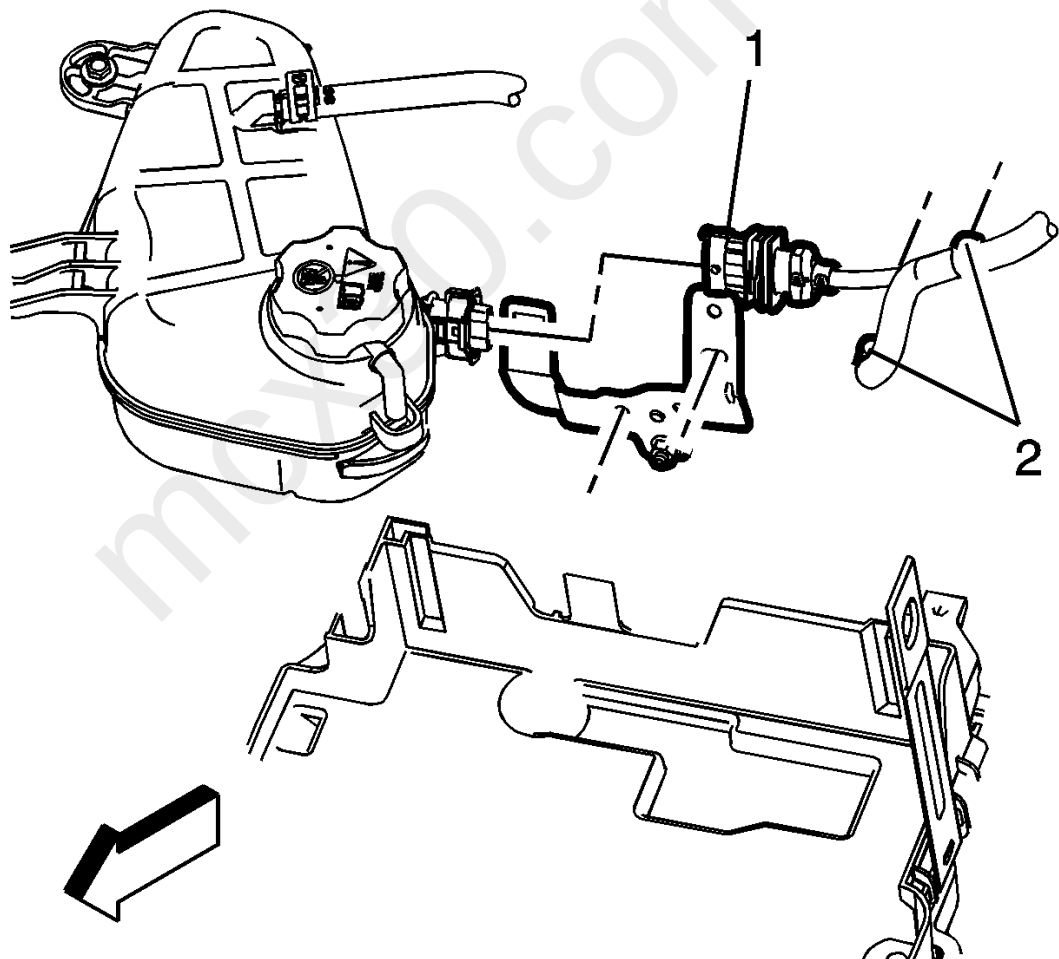


Fig. 80: Engine Harness Connector & Fasteners

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the engine harness connector (1) and harness fasteners (2) from the engine harness bracket, attached to the thermostat housing.

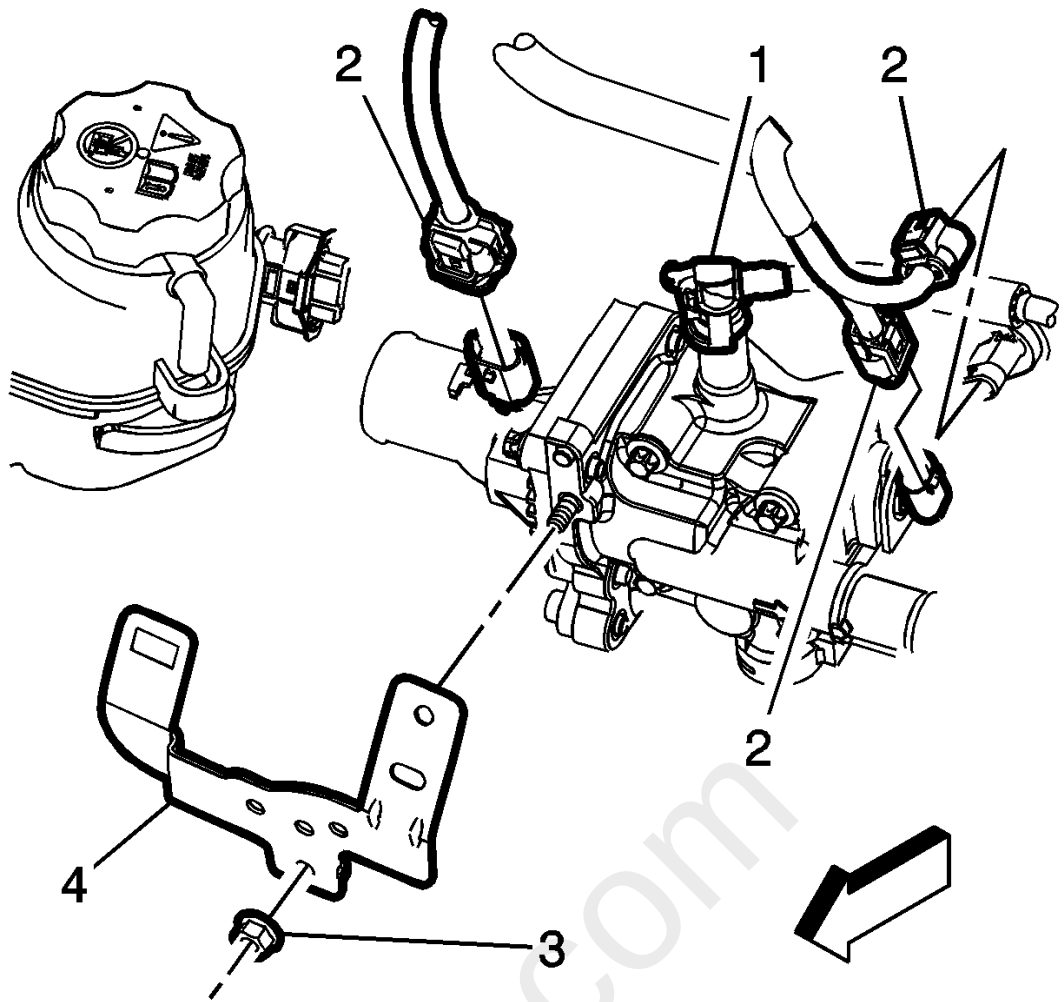


Fig. 81: Wiring Harness Bracket & Nut
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the throttle body heater inlet hose (1) and the electrical connectors (2) to the thermostat housing.
6. Remove the engine harness bracket nut (3) and bracket (4) from the thermostat housing.

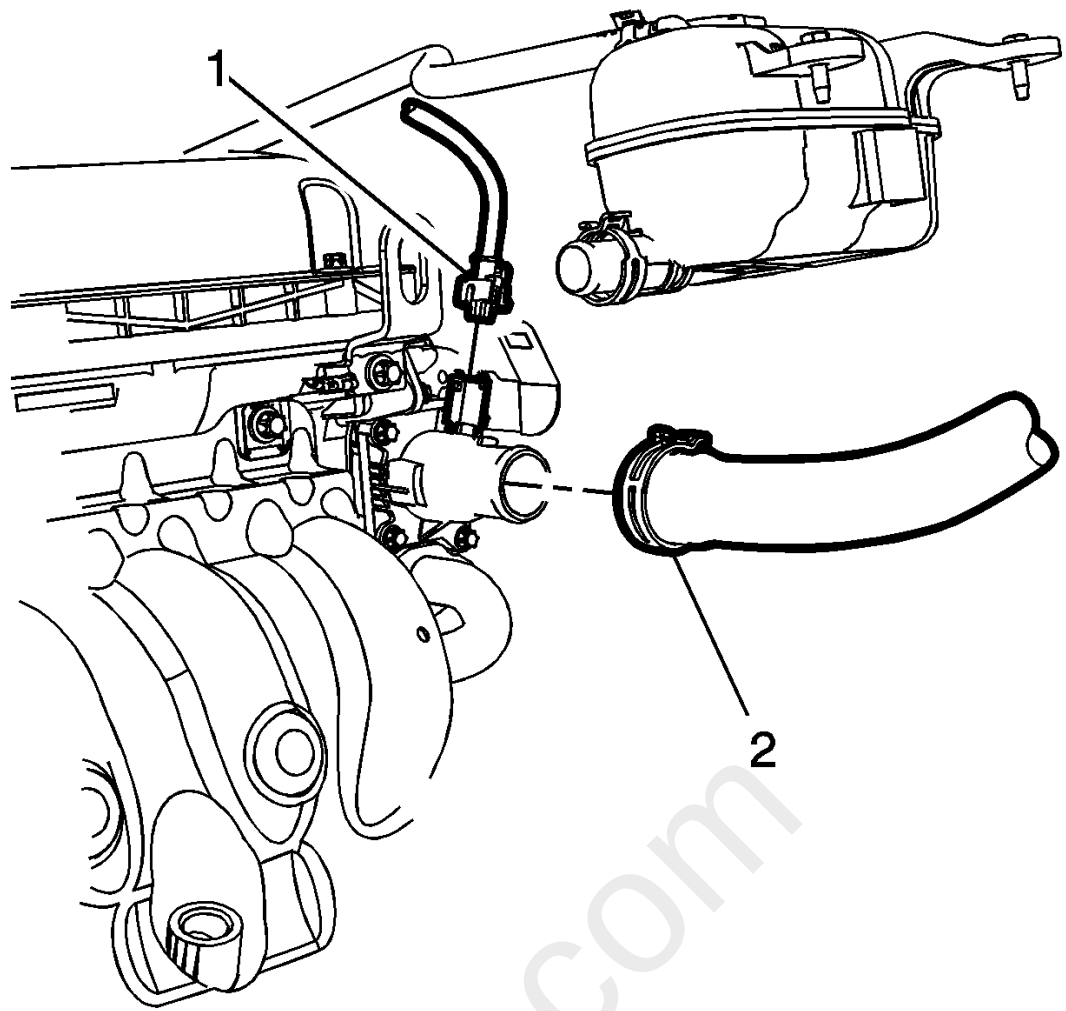


Fig. 82: Thermostat Heating Element Sensor & Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove the radiator inlet hose (2) to the engine coolant thermostat housing.
8. Remove the heater outlet hose from the engine coolant thermostat housing. Refer to [Heater Outlet Hose Replacement \(2H0\)](#).
9. Remove the heater inlet hose from the engine coolant thermostat housing. Refer to [Heater Inlet Hose Replacement \(2H0\)](#).

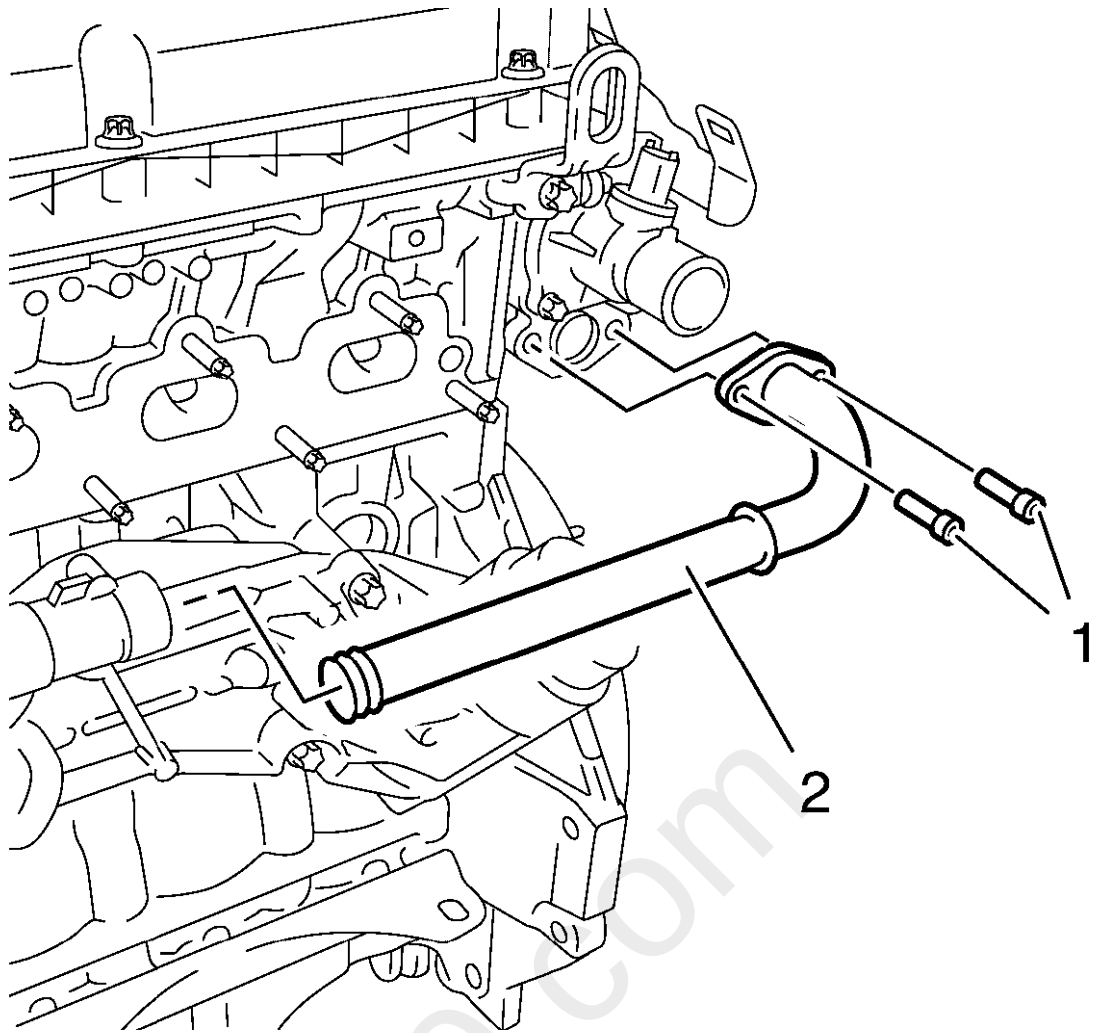


Fig. 83: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine oil cooler outlet pipe bolts (1).
11. Remove the engine oil cooler outlet pipe (2) from the engine coolant thermostat housing.

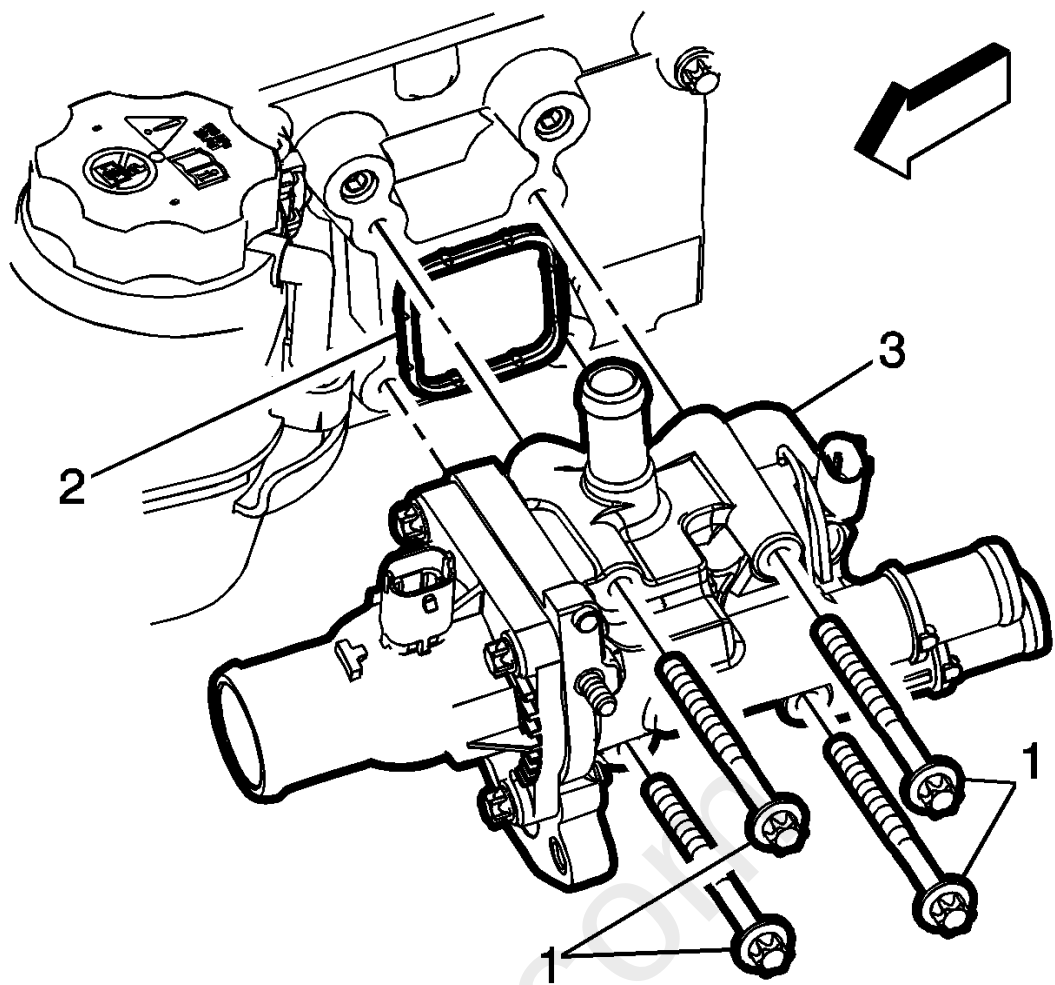


Fig. 84: Engine Coolant Thermostat Housing, Seal And Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the engine coolant thermostat housing mounting bolts (1) and discard the seal (2).
13. Remove the engine coolant thermostat housing (3) from the engine.

Installation Procedure

1. Clean the sealing surface.

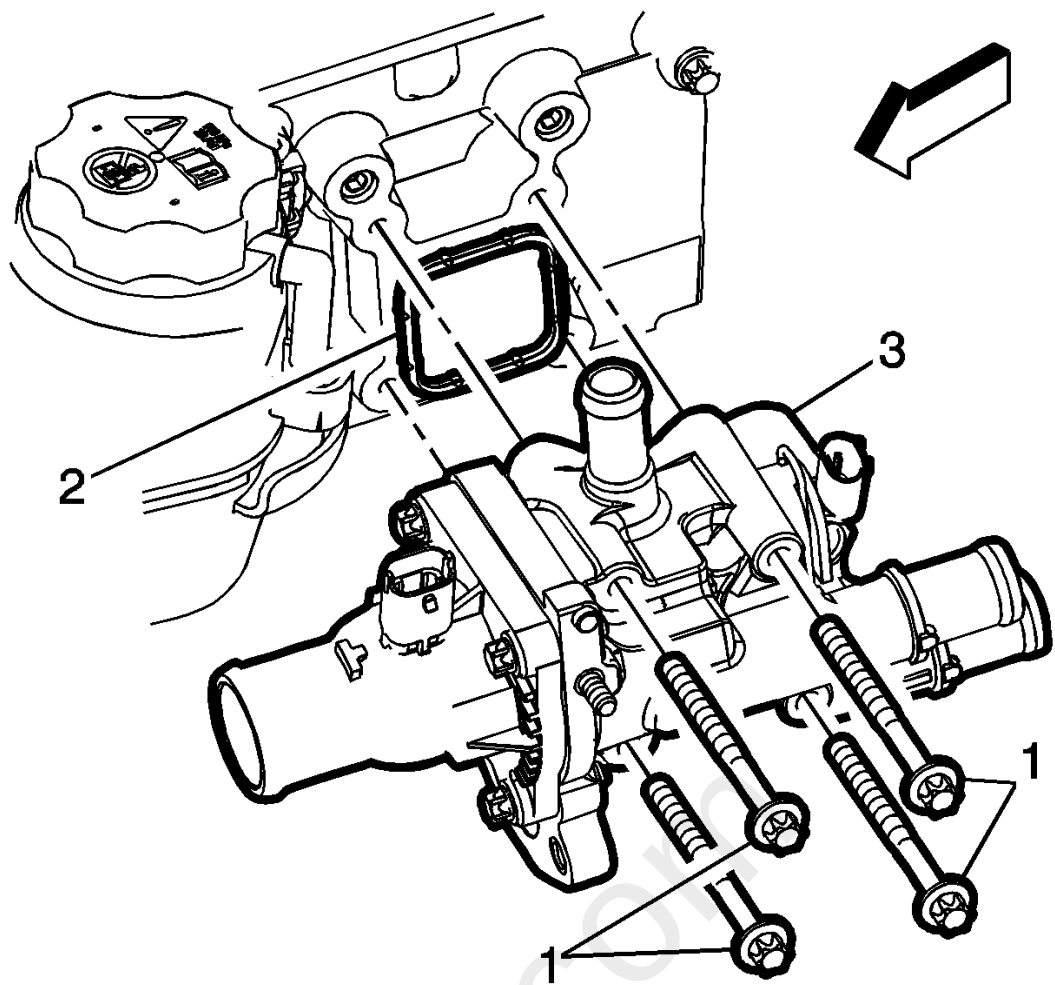


Fig. 85: Engine Coolant Thermostat Housing, Seal And Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW engine coolant thermostat housing seal (2).
3. Loosely install the engine coolant thermostat housing mounting bolts (1).

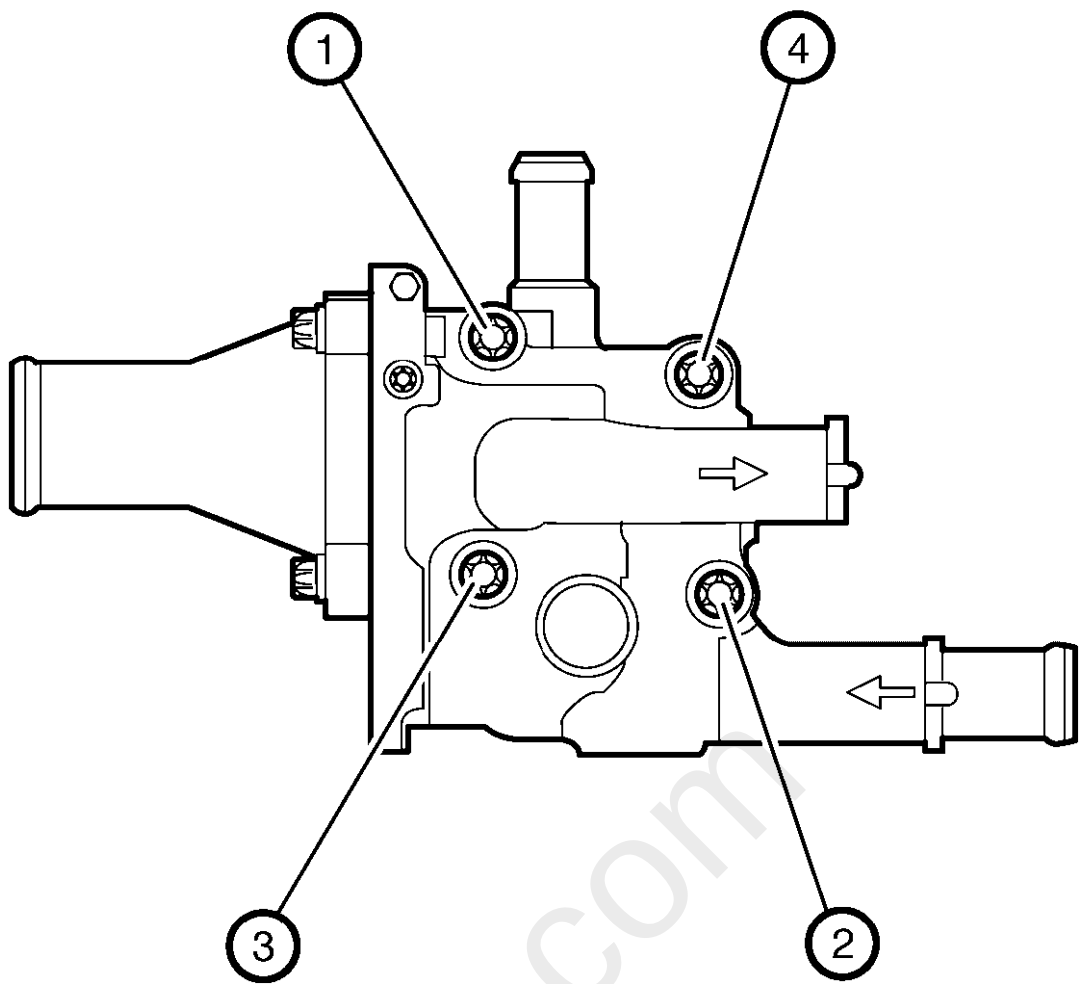


Fig. 86: Identifying Engine Coolant Thermostat Housing Bolts Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Following the proper fastener tightening sequence and torque is essential. Failure to do so may fracture the thermostat housing.

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

4. Tighten the 4 engine coolant thermostat housing bolts to 8 N.m (71 lb in) in sequence (1-2-3-4).

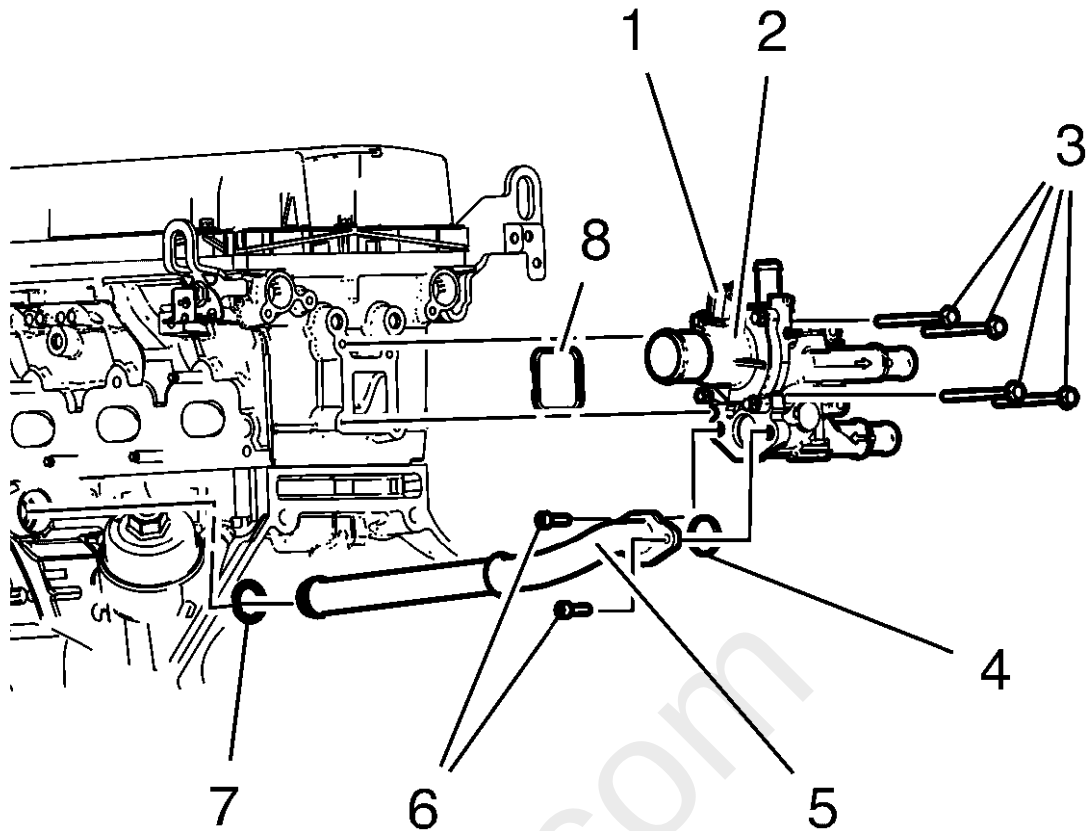


Fig. 87: Identifying Engine Coolant Temperature Sensor Connector, Engine Oil Cooler Pipe And Thermostat Housing

Courtesy of GENERAL MOTORS COMPANY

5. Install NEW engine oil cooler pipe seals (4, 7).

NOTE: Push the engine oil cooler pipe into the engine oil cooler.

6. Install the engine oil cooler pipe (5).
7. Install the 2 engine oil cooler pipe bolts (6) and tighten to 8 N.m (71 lb in).
8. Install the heater inlet hose to the engine coolant thermostat housing. Refer to [Heater Inlet Hose Replacement \(2H0\)](#).
9. Install the heater outlet hose to the engine coolant thermostat housing. Refer to [Heater Outlet Hose Replacement \(2H0\)](#).

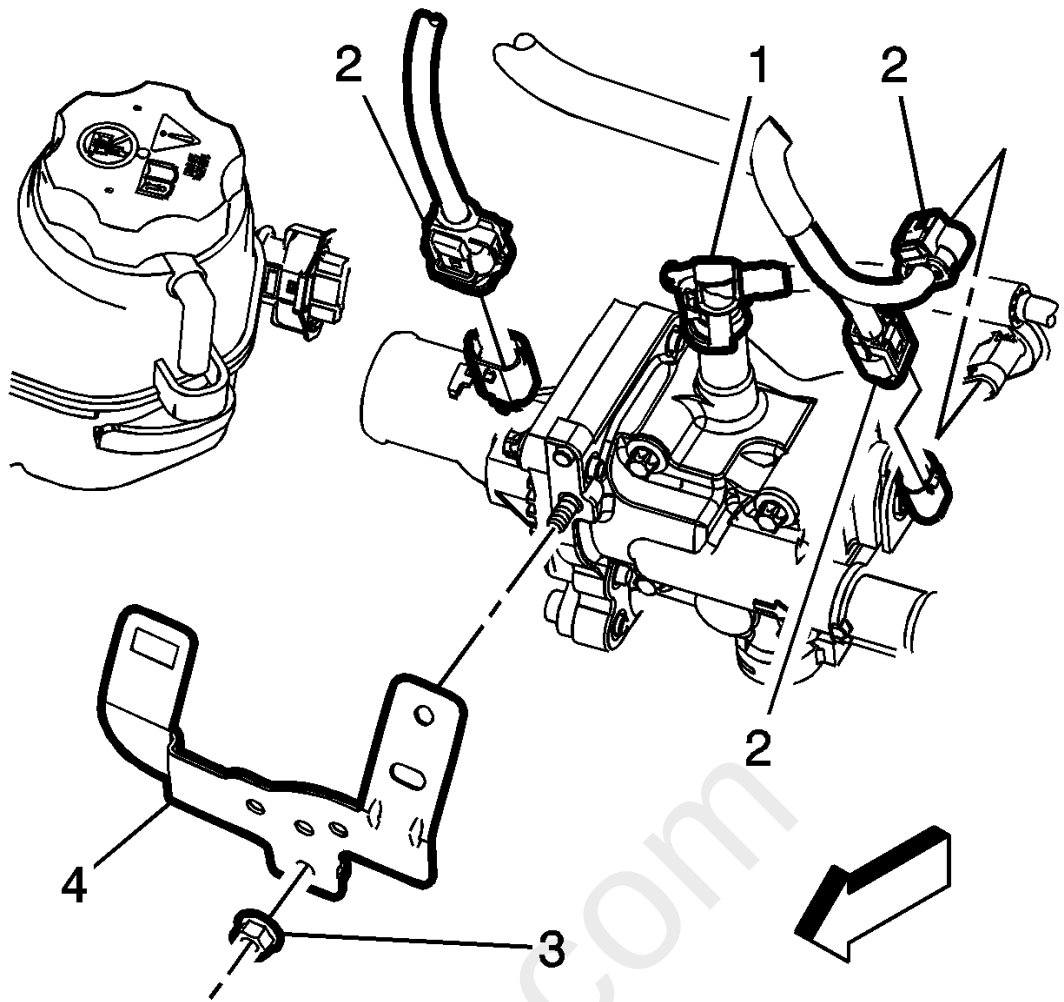


Fig. 88: Wiring Harness Bracket & Nut
Courtesy of GENERAL MOTORS COMPANY

10. Connect the electrical connectors (2) to the engine coolant thermostat housing.
11. Install the throttle body heater inlet hose (1) to the engine coolant thermostat housing.
12. Install the engine coolant thermostat housing bracket (4) and nut (3) and tighten to 6 N.m (53 lb in).

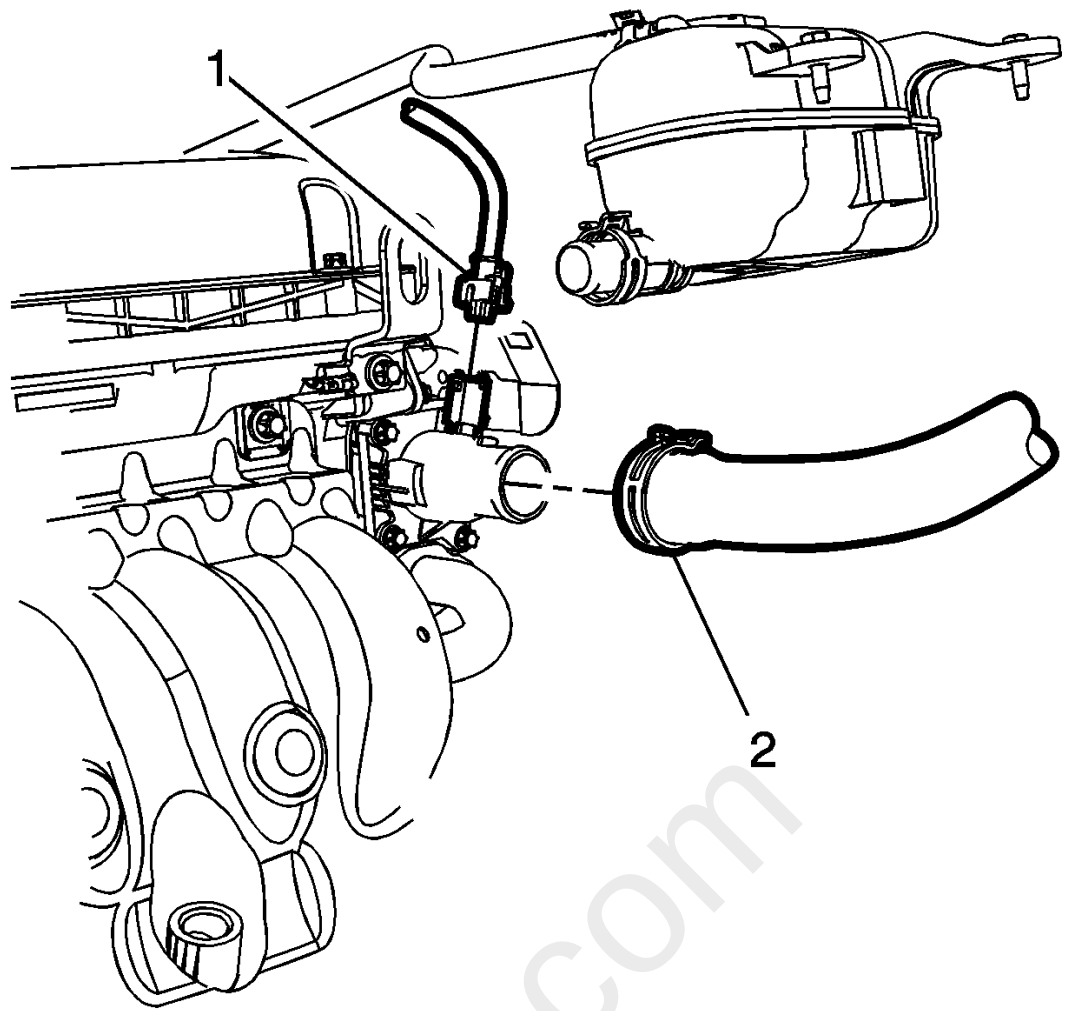


Fig. 89: Thermostat Heating Element Sensor & Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Install the radiator inlet hose (2) to the engine coolant thermostat housing.
14. Fill the cooling system. Refer to [Cooling System Draining and Filling](#).
15. Install the battery tray. Refer to [Battery Tray Replacement](#).
16. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LE2)

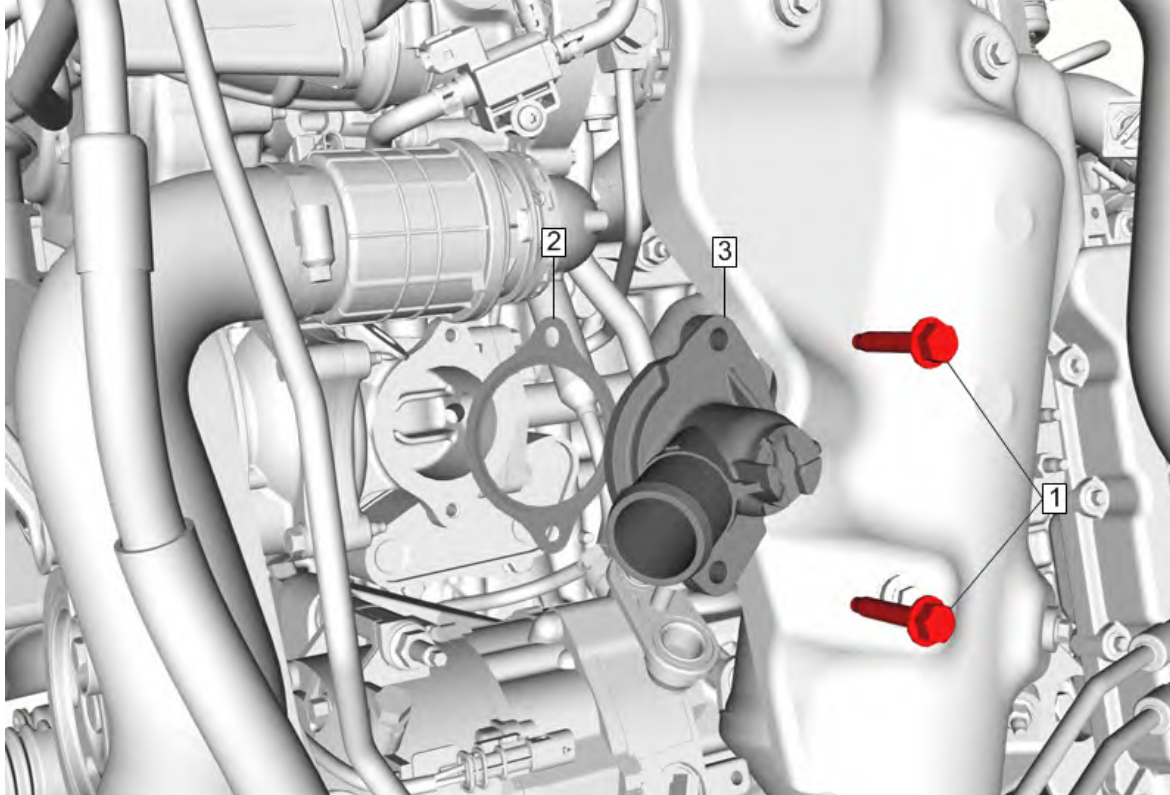


Fig. 90: Engine Coolant Thermostat Housing (LE2).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Disconnect Radiator Outlet Hose Replacement (LE2) @Engine Coolant Thermostat Housing	
1	Engine Coolant Thermostat Housing Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Gasket Procedure Install a NEW gasket.
3	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT REPLACEMENT (2H0)

Removal Procedure

WARNING: Refer to **Battery Disconnect Warning** .

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection (without KL9)**, **Battery Negative Cable Disconnection and Connection (with KL9)** .
2. Drain the coolant. Refer to **Cooling System Draining and Filling**.

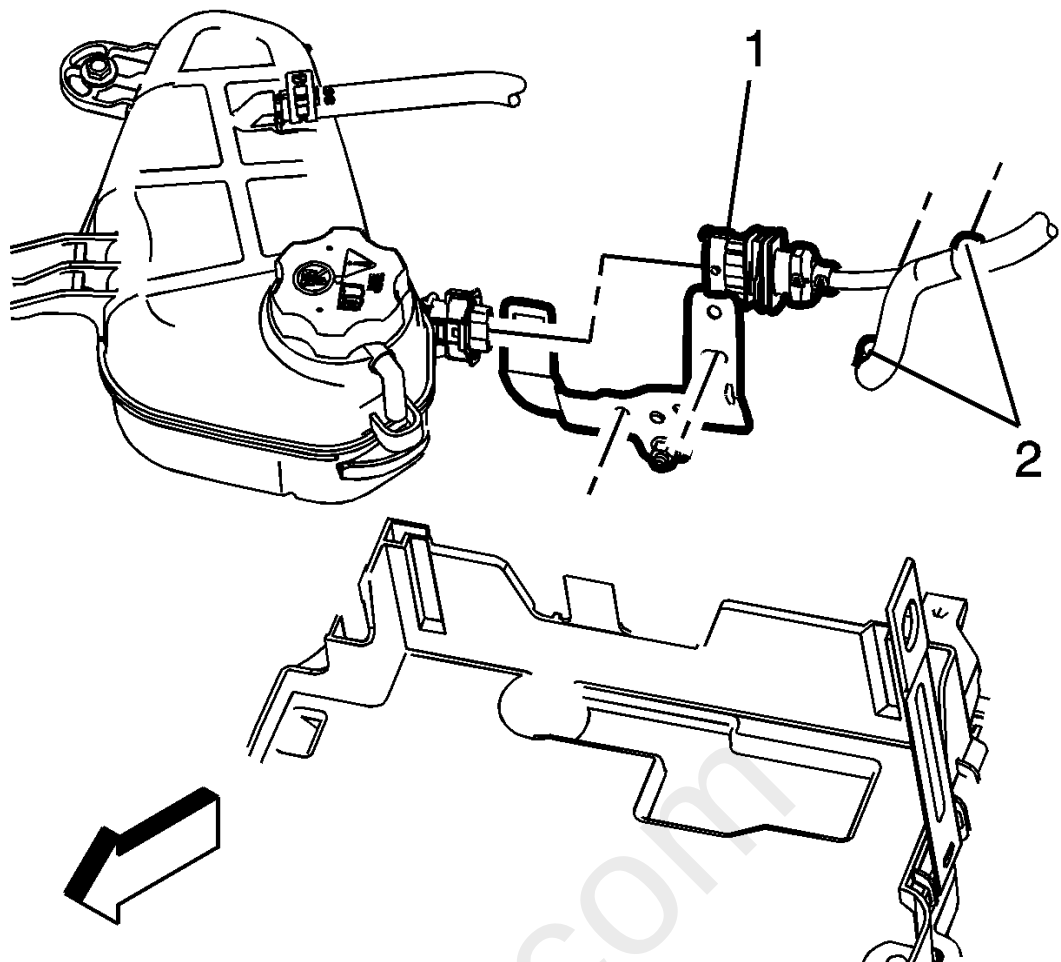


Fig. 91: Engine Harness Connector & Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the engine wiring harness connector (1) and retainers (2).

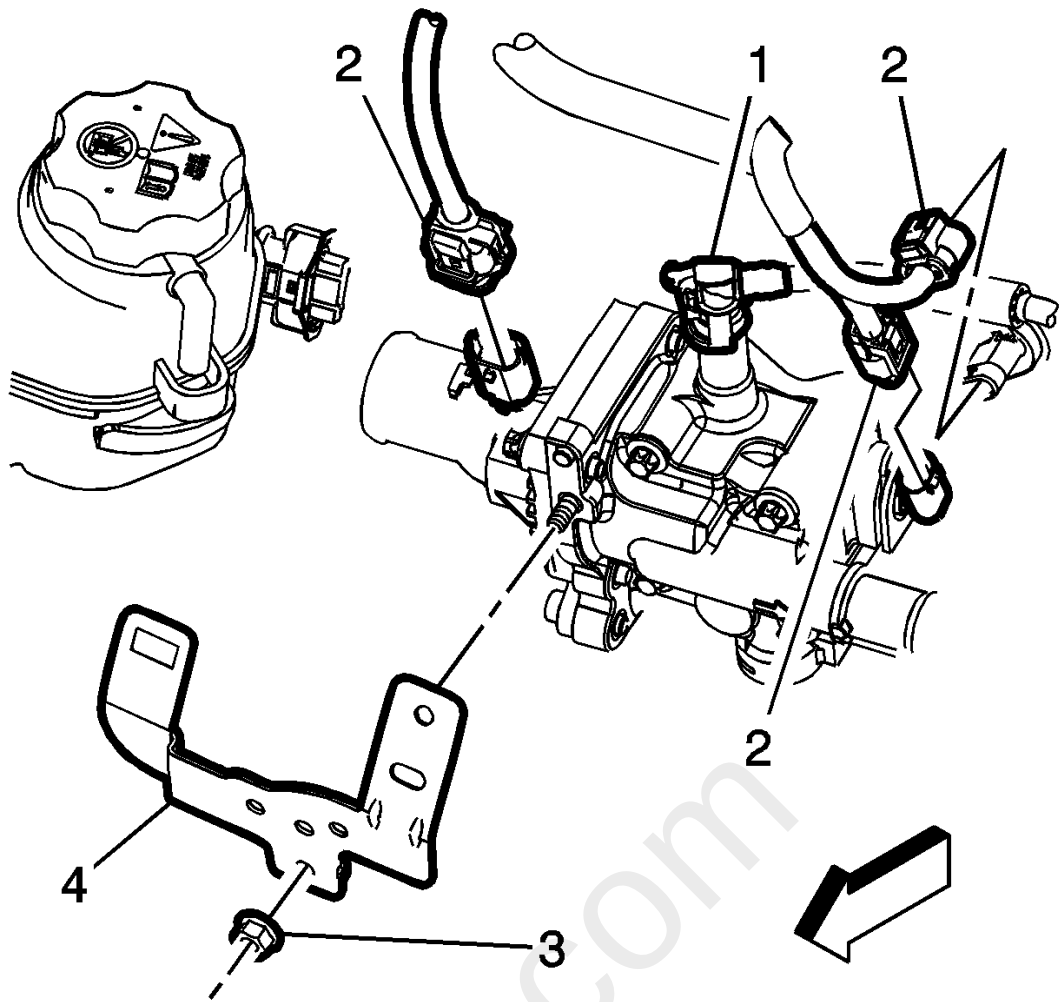


Fig. 92: Wiring Harness Bracket & Nut
Courtesy of GENERAL MOTORS COMPANY

4. Remove the wiring harness bracket nut (3) and bracket (4).

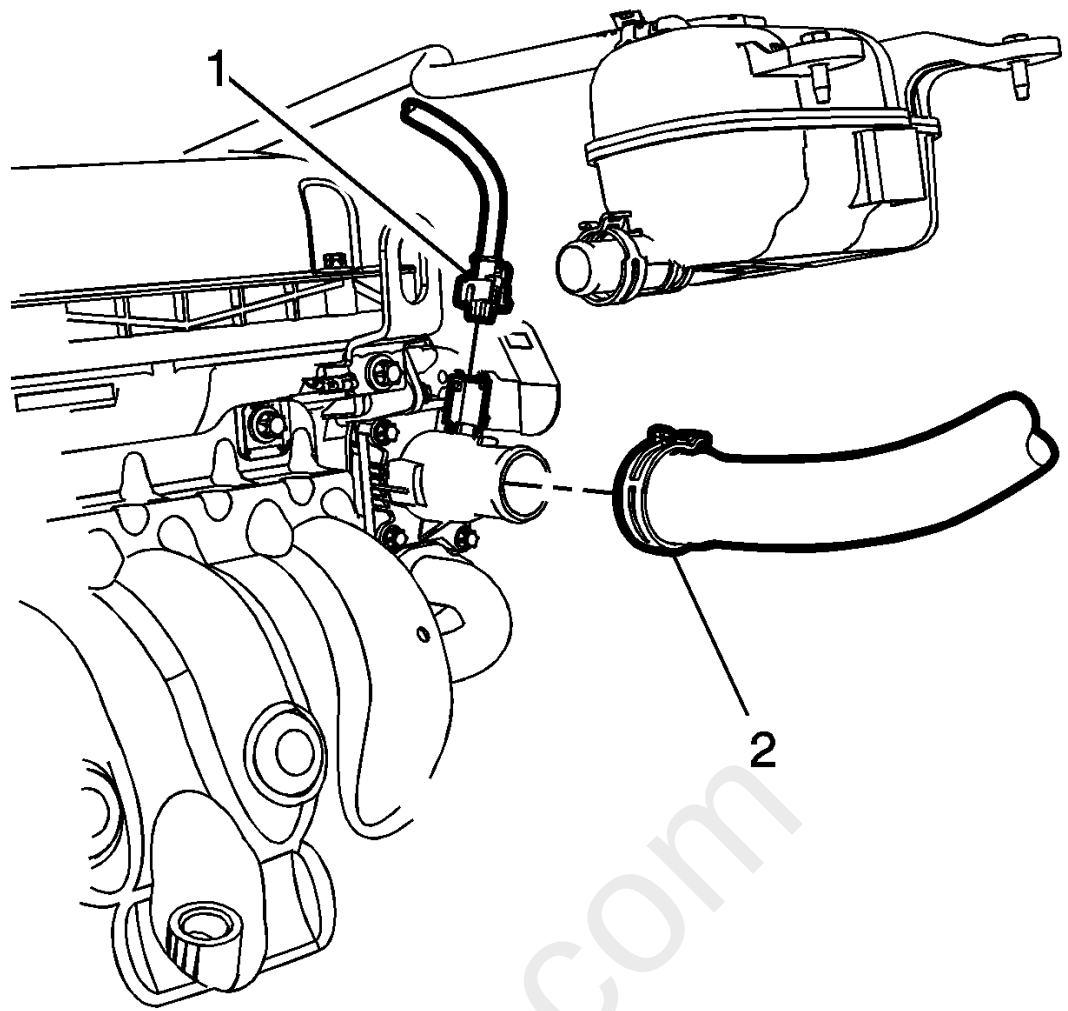


Fig. 93: Thermostat Heating Element Sensor & Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. If equipped, disconnect the thermostat heating element sensor (1) and remove the radiator inlet hose (2).

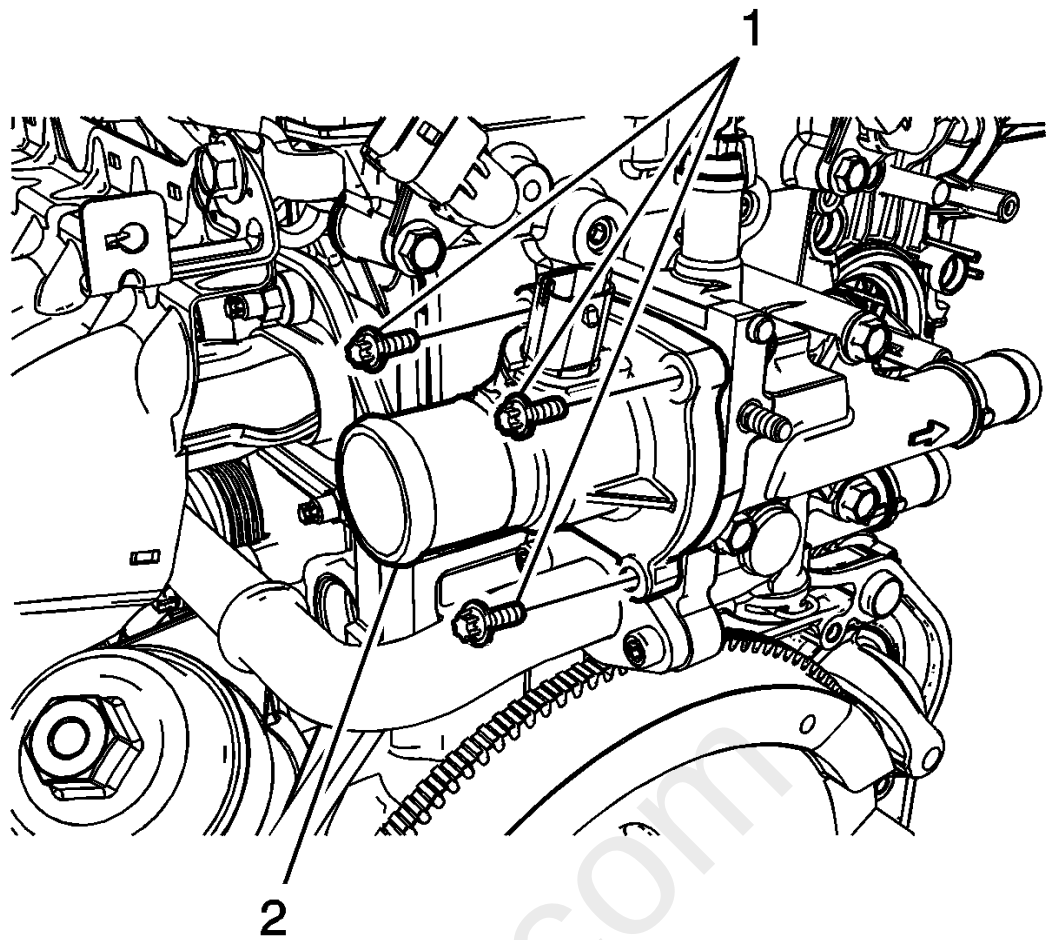


Fig. 94: Thermostat Housing And Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the thermostat housing retaining bolts (1).

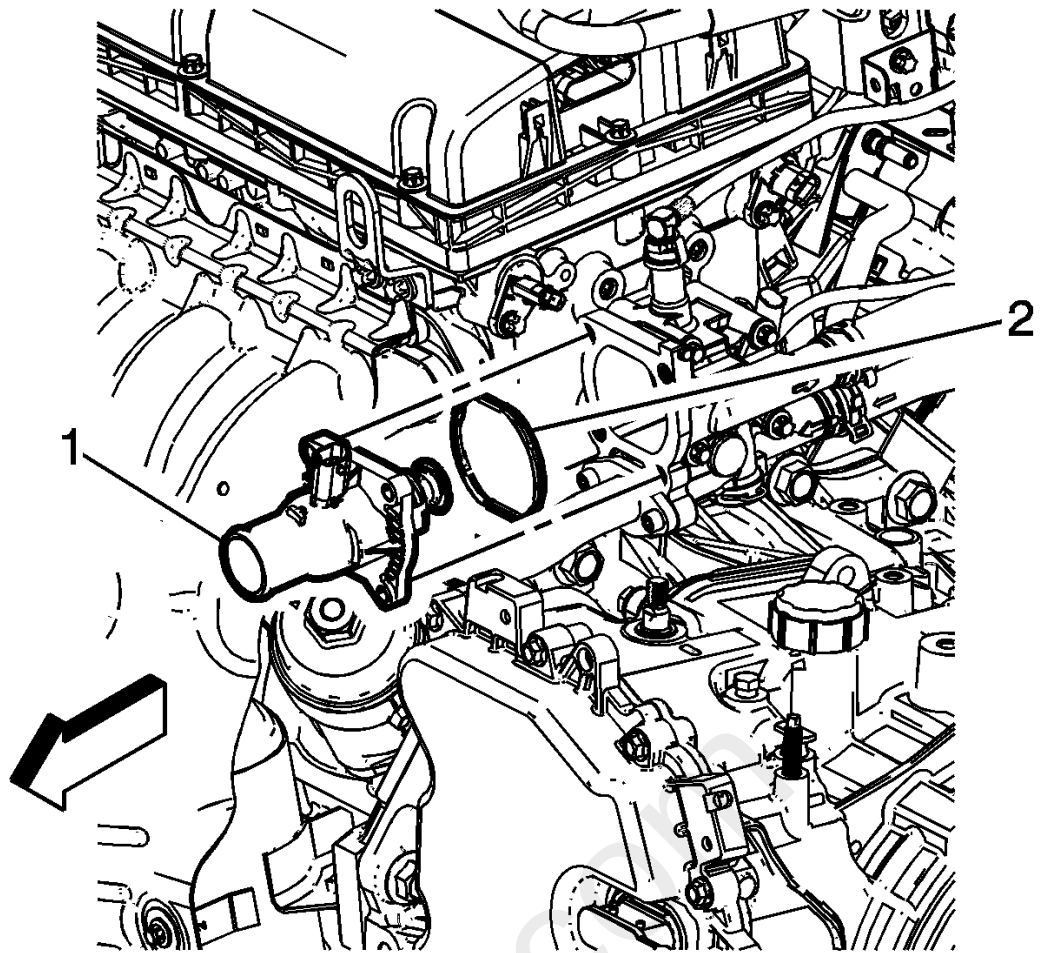


Fig. 95: Thermostat And Discard Seal
Courtesy of GENERAL MOTORS COMPANY

7. Remove the thermostat (1) and discard the seal (2).

Installation Procedure

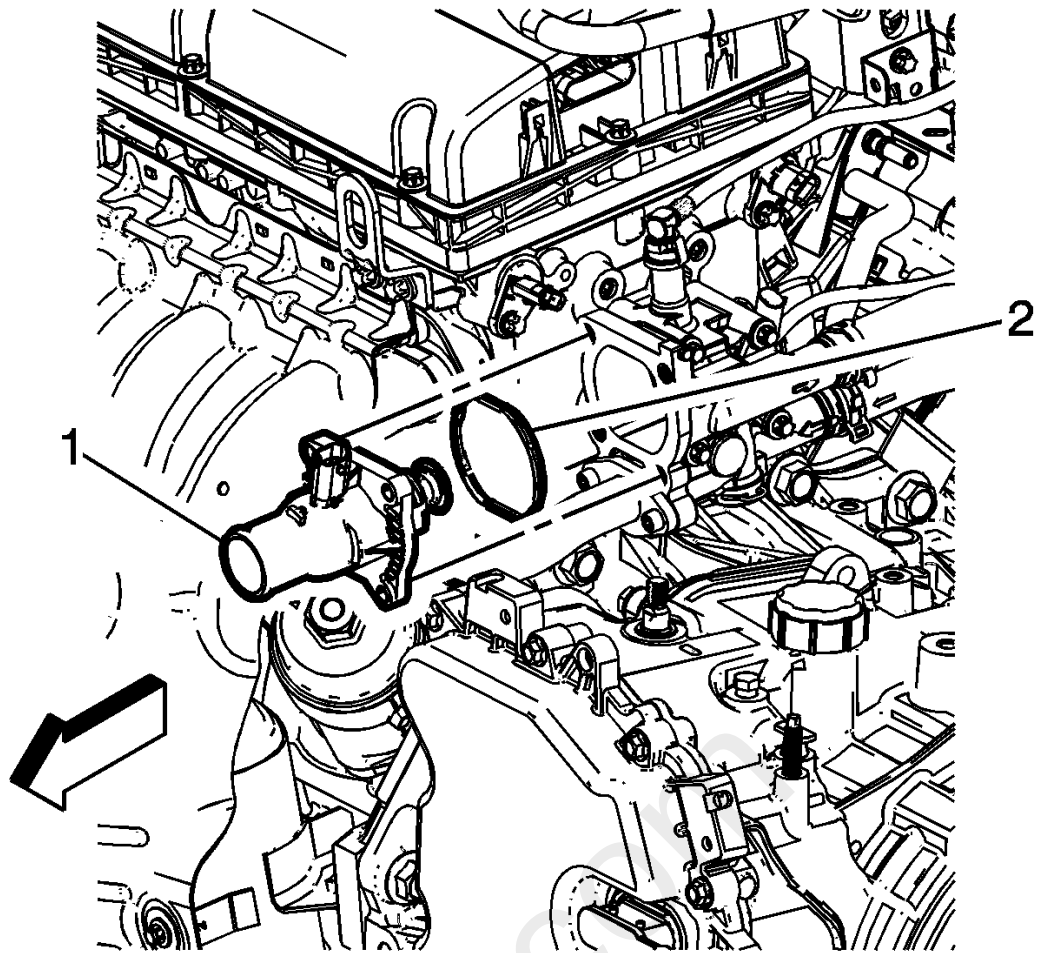


Fig. 96: Thermostat And Discard Seal

Courtesy of GENERAL MOTORS COMPANY

1. Fit the thermostat (1) to the thermostat housing using a NEW seal (2).

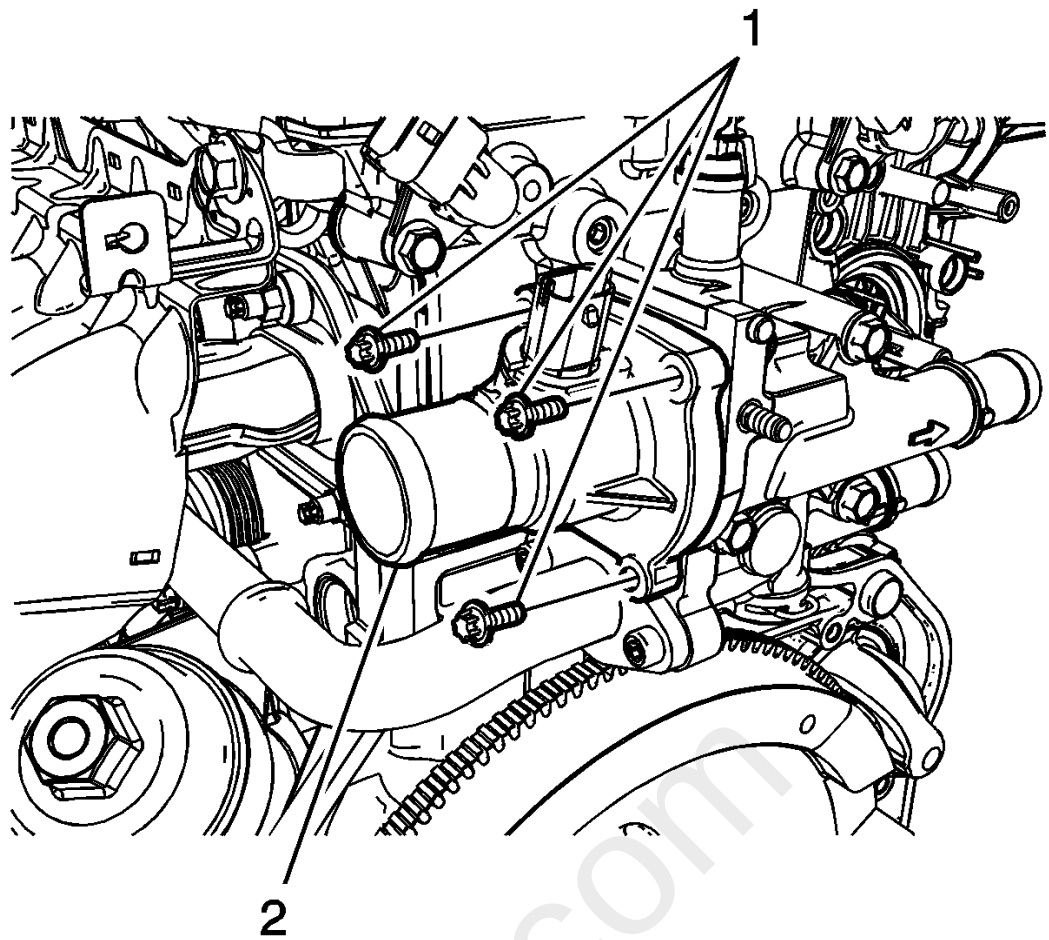


Fig. 97: Thermostat Housing And Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the thermostat (2) and tighten the thermostat bolts (1) to 10 N.m (89 lb in).

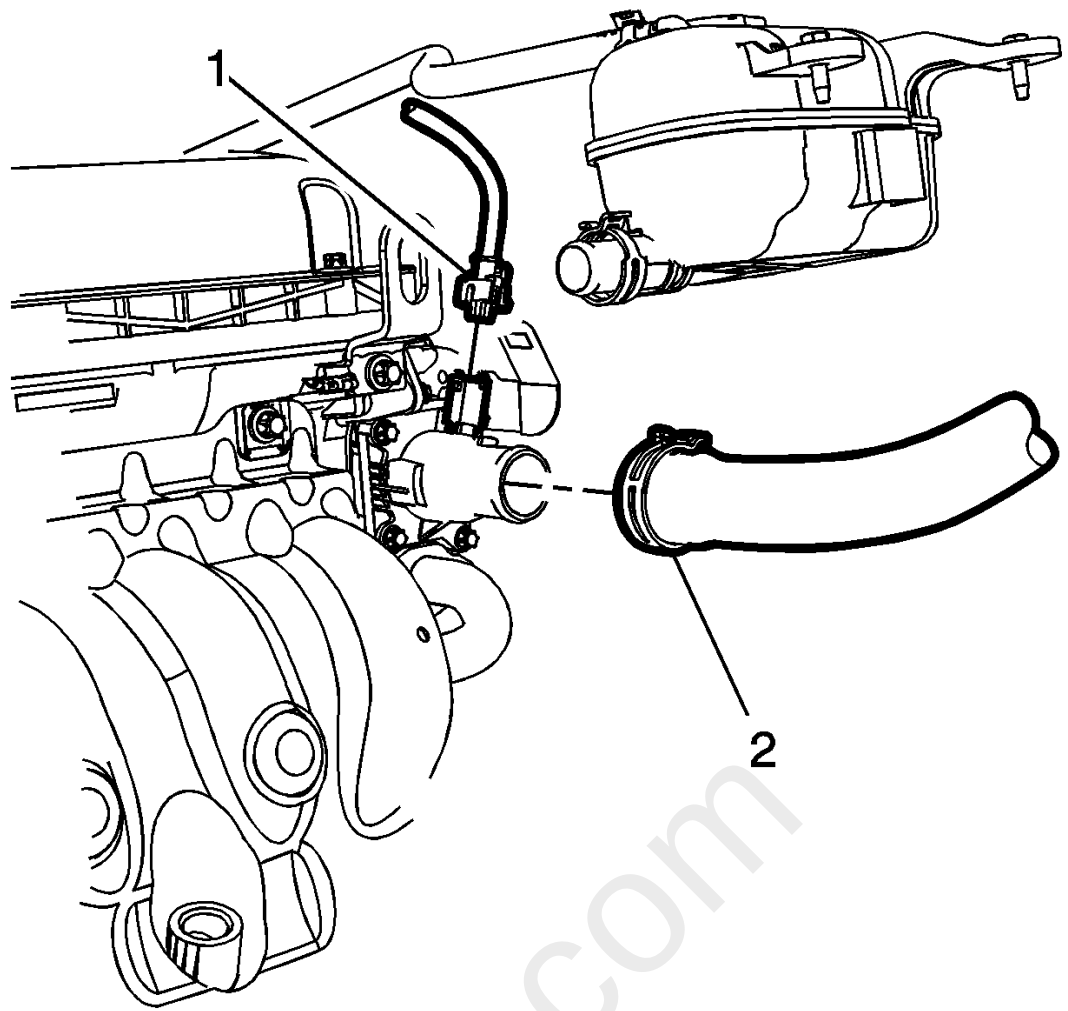


Fig. 98: Thermostat Heating Element Sensor & Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Install the radiator inlet hose (2) and connect the thermostat heating element sensor (1).

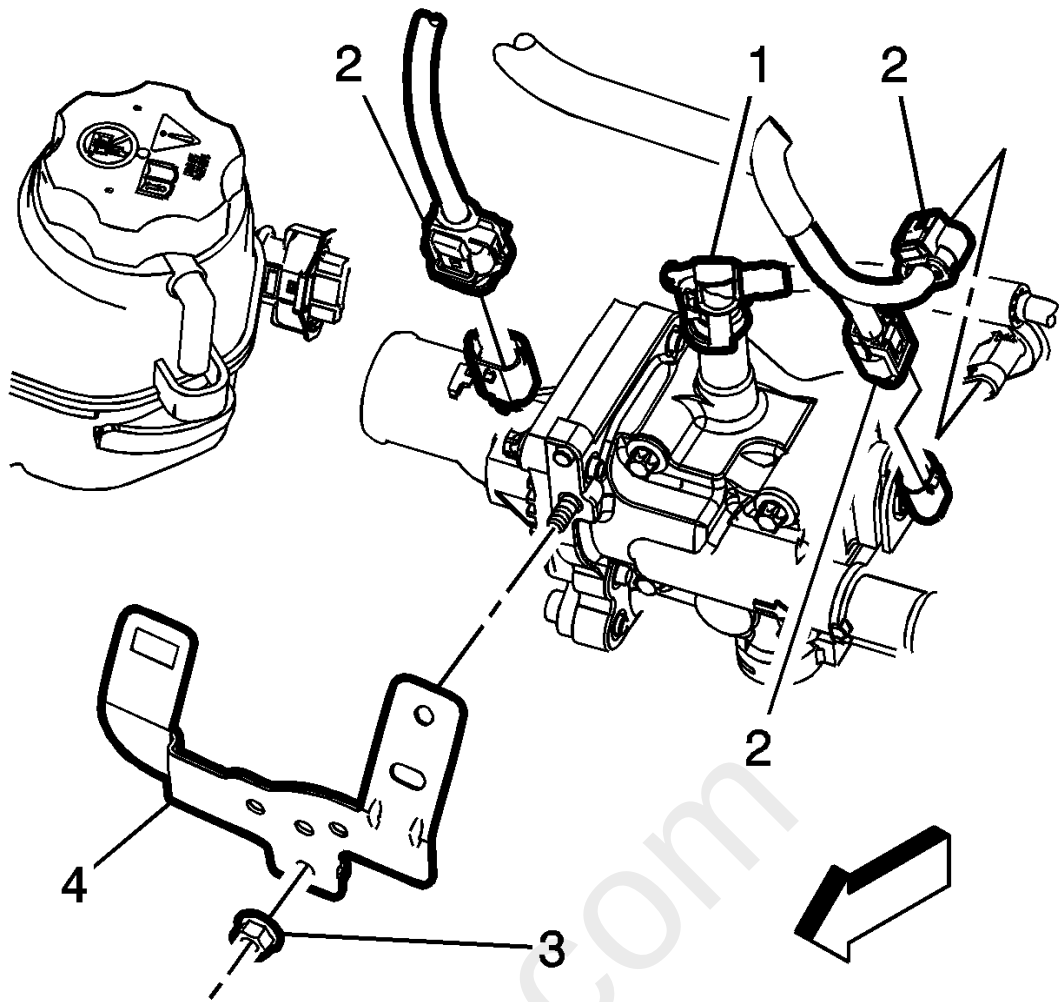


Fig. 99: Wiring Harness Bracket & Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the wiring harness bracket (4) and tighten the nut (3) to 10 N.m (89 lb in).

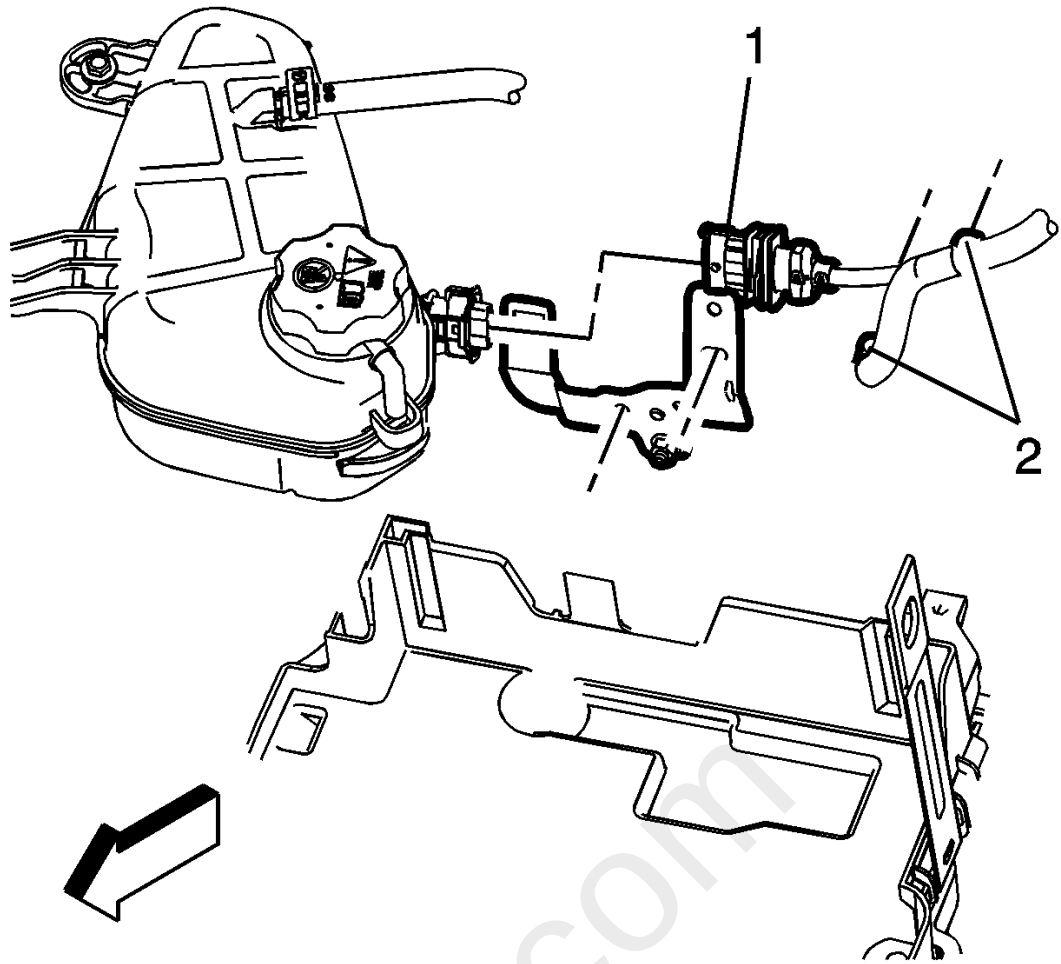


Fig. 100: Engine Harness Connector & Fasteners

Courtesy of GENERAL MOTORS COMPANY

5. Connect the engine harness connector (1) and harness retainers (2) to the bracket.
6. Refill the engine cooling system. Refer to [Cooling System Draining and Filling](#).
7. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#) .
8. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT REPLACEMENT (LUV)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#).
2. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .

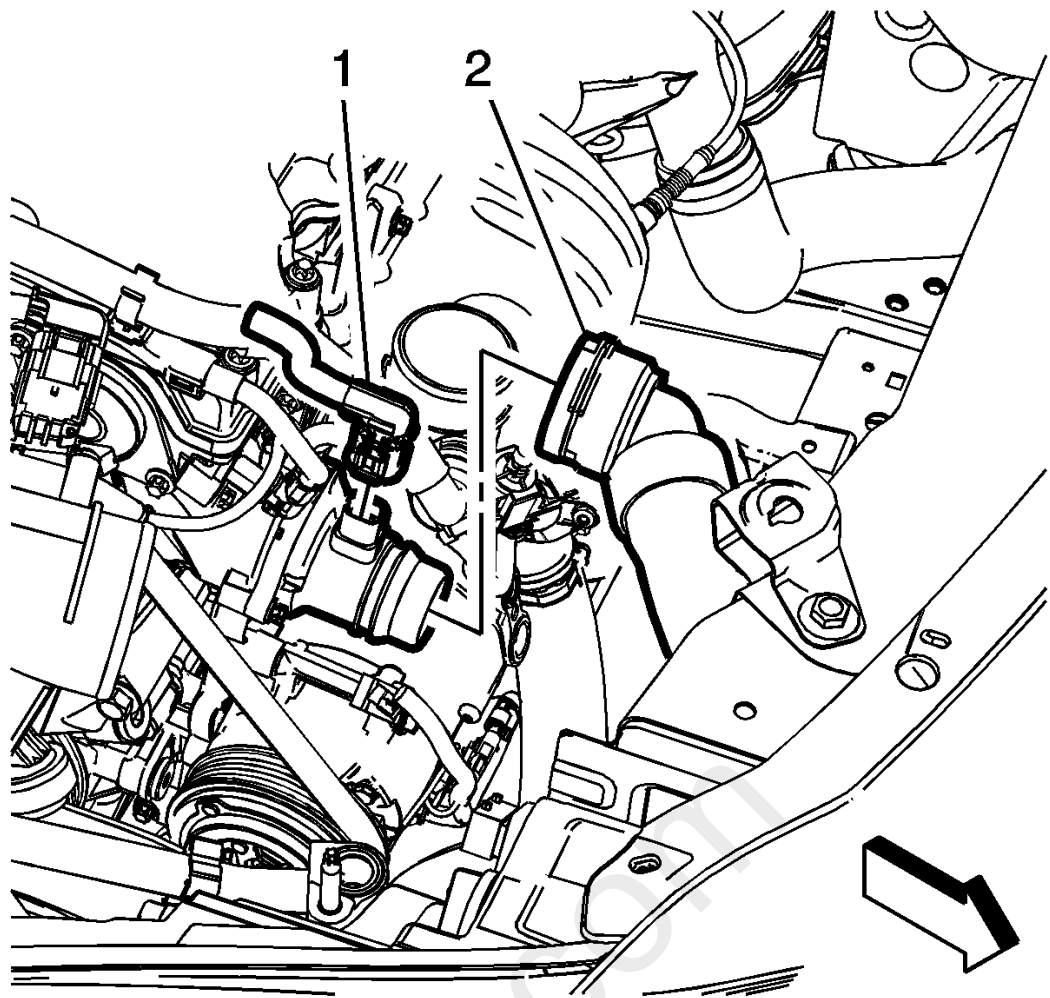


Fig. 101: Engine Coolant Temperature Sensor Connector & Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Remove the engine coolant temperature sensor connector (1).
4. Disconnect the radiator outlet hose connector (2) from the engine coolant thermostat and reposition. Refer to [**Radiator Outlet Hose Connector Replacement - Engine Side \(LUV\)**](#).

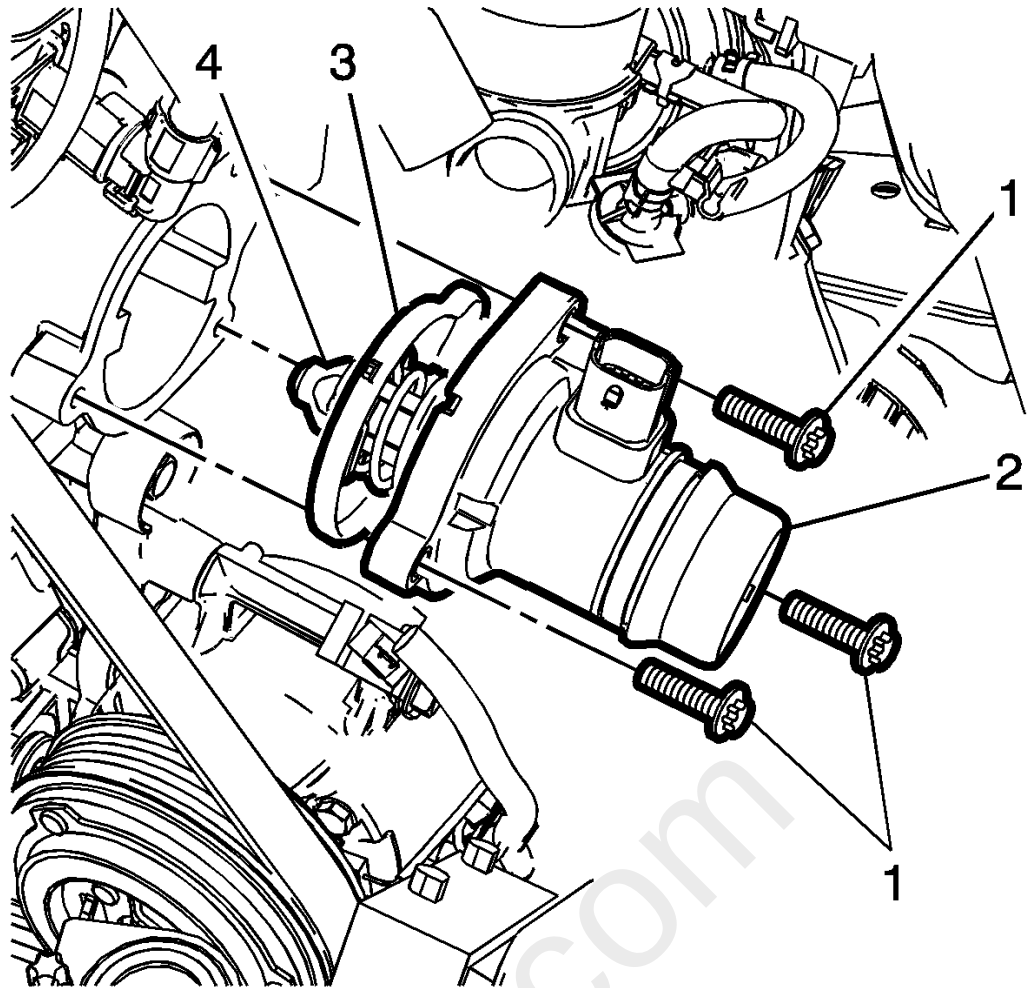


Fig. 102: Engine Coolant Thermostat Components
Courtesy of GENERAL MOTORS COMPANY

5. Remove the water inlet pipe mounting fasteners (1).
6. Remove the water inlet seal (3) and discard.
7. Remove the thermostat (4).

Installation Procedure

1. Clean the sealing surface.

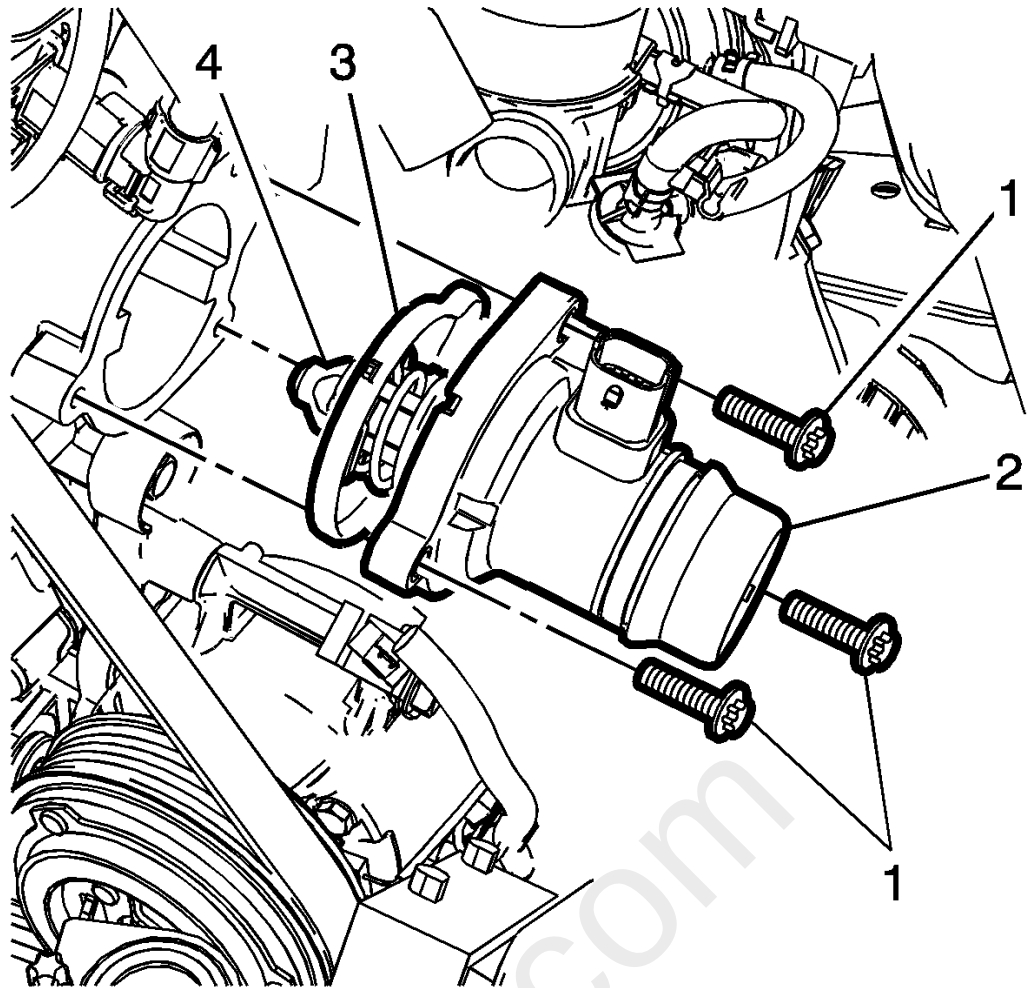


Fig. 103: Engine Coolant Thermostat Components

Courtesy of GENERAL MOTORS COMPANY

2. Install the engine thermostat (4) into the water inlet pipe (2) with a NEW seal (3).
3. Tighten the water inlet pipe mounting fasteners (1) to 9 N.m (80 lb in).

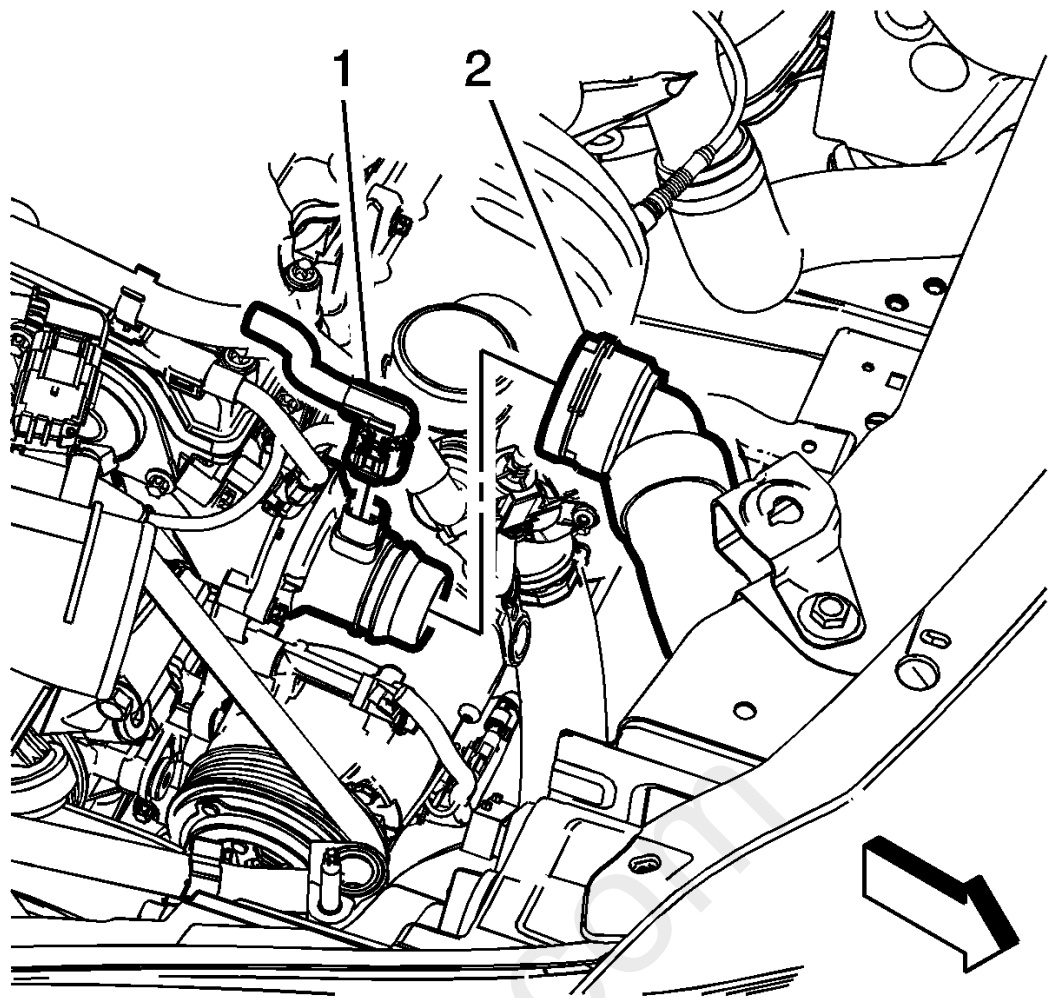


Fig. 104: Engine Coolant Temperature Sensor Connector & Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator outlet hose connector (2) to the engine coolant thermostat. Refer to [Radiator Outlet Hose Connector Replacement - Engine Side \(LUV\)](#).
5. Connect the engine coolant temperature sensor connector (1).
6. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#).
7. Fill the cooling system. Refer to [Cooling System Draining and Filling](#).
8. After repairs, inspect cooling system for leaks.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (2H0)

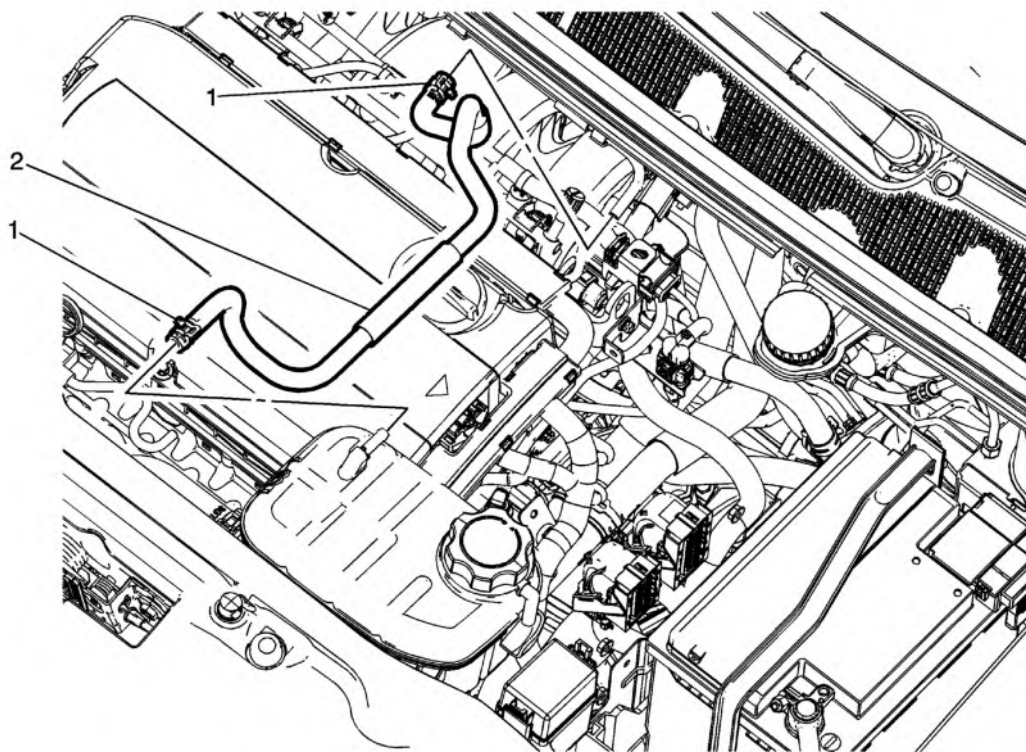


Fig. 105: Engine Coolant Air Bleed Hose (2HO)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Coolant Air Bleed Hose Clamps (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Engine Coolant Air Bleed Hose Procedure Add engine coolant to the surge tank, if necessary.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (LUV)

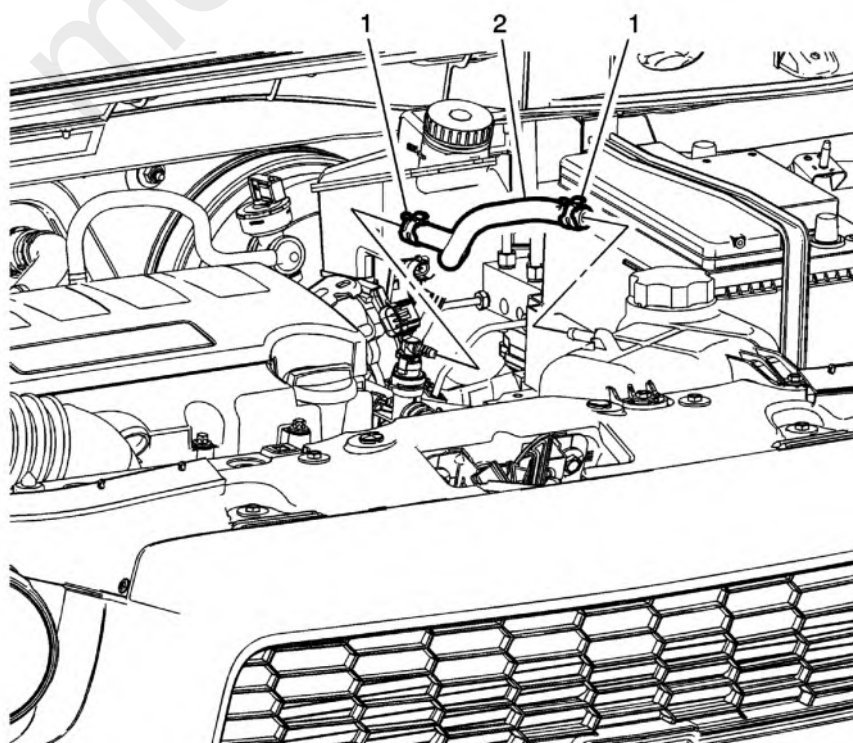


Fig. 106: Engine Coolant Air Bleed Hose (LUV)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Coolant Air Bleed Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers. For equivalent regional tools, refer to Special Tools .
2	Engine Coolant Air Bleed Hose

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (SURGE TANK TO TURBOCHARGER COOLANT RETURN PIPE - LE2)

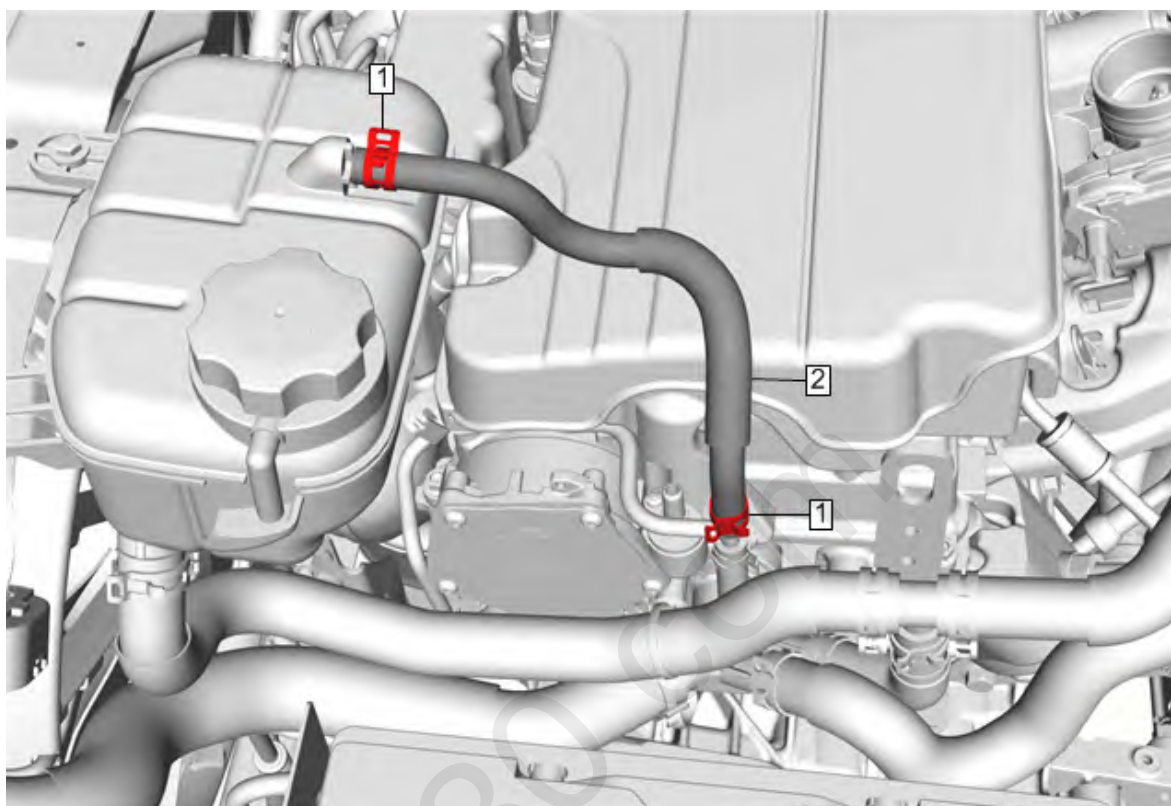


Fig. 107: Engine Coolant Air Bleed Hose (Surge Tank to Turbocharger Coolant Return Pipe - LE2).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Cooling System Draining and Filling	
1	Engine Coolant Air Bleed Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers
2	Engine Coolant Air Bleed Hose

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (TURBOCHARGER COOLANT RETURN PIPE TO WATER OUTLET - LE2)

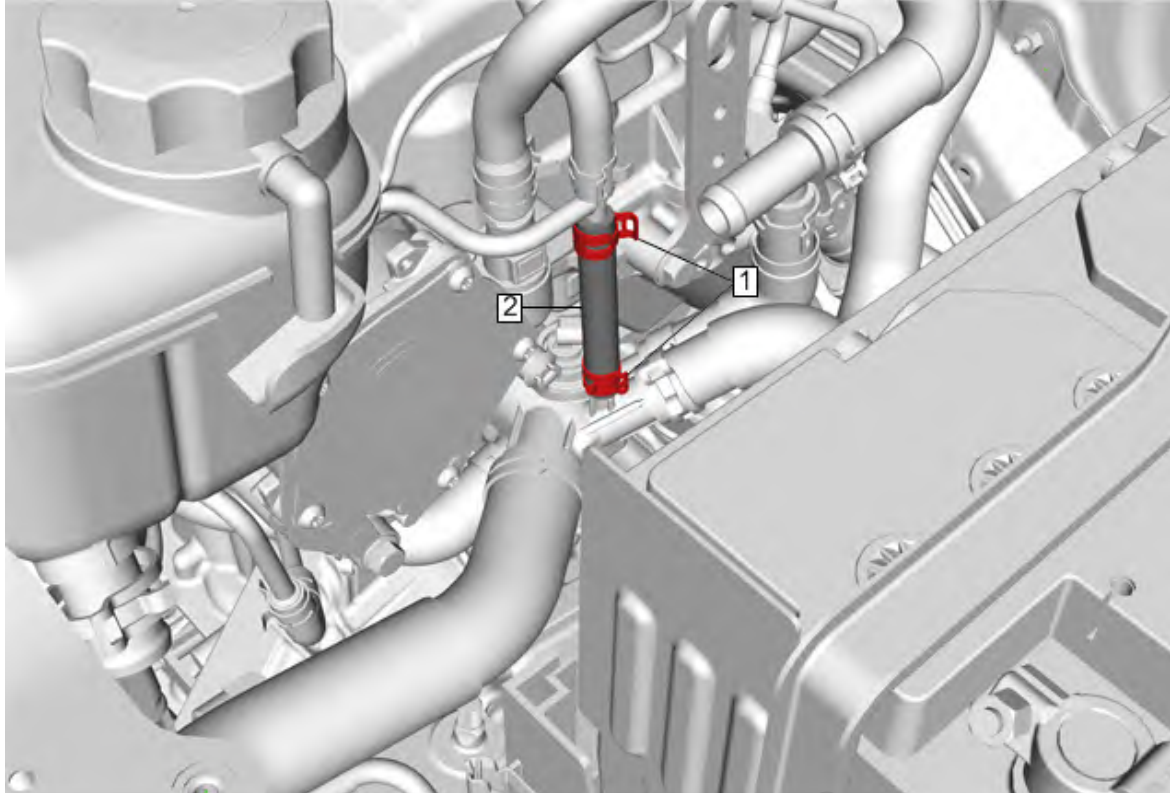


Fig. 108: Engine Coolant Air Bleed Hose (Turbocharger Coolant Return Pipe to Water Outlet - LE2).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Cooling System Draining and Filling 2. Reposition Radiator Surge Tank Replacement (LE2)	
1	Engine Coolant Air Bleed Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers
2	Engine Coolant Air Bleed Hose

WATER OUTLET REPLACEMENT (LUV)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#).
2. Remove the charge air cooler outlet air hose from the throttle body. Refer to [Charge Air Cooler Outlet Air Hose Replacement](#).
3. Remove the engine coolant air bleed hose from the water outlet. Refer to [Engine Coolant Air Bleed Hose Replacement \(LUV\)](#).
4. Remove the heater inlet hose from the water outlet. Refer to [Heater Inlet Hose Replacement \(2H0\)](#), [Heater Inlet Hose Replacement \(LUV\)](#), [Heater Inlet Hose Replacement \(LE2\)](#).
5. Remove the radiator inlet hose from the water outlet. Refer to [Radiator Inlet Hose Replacement \(LUV\)](#).
6. Remove the engine oil cooler coolant inlet hose from the water outlet. Refer to [Engine Oil Cooler Coolant Inlet Hose Replacement \(LUV\)](#).
7. Disconnect the engine coolant temperature sensor (water outlet) wiring harness connector.

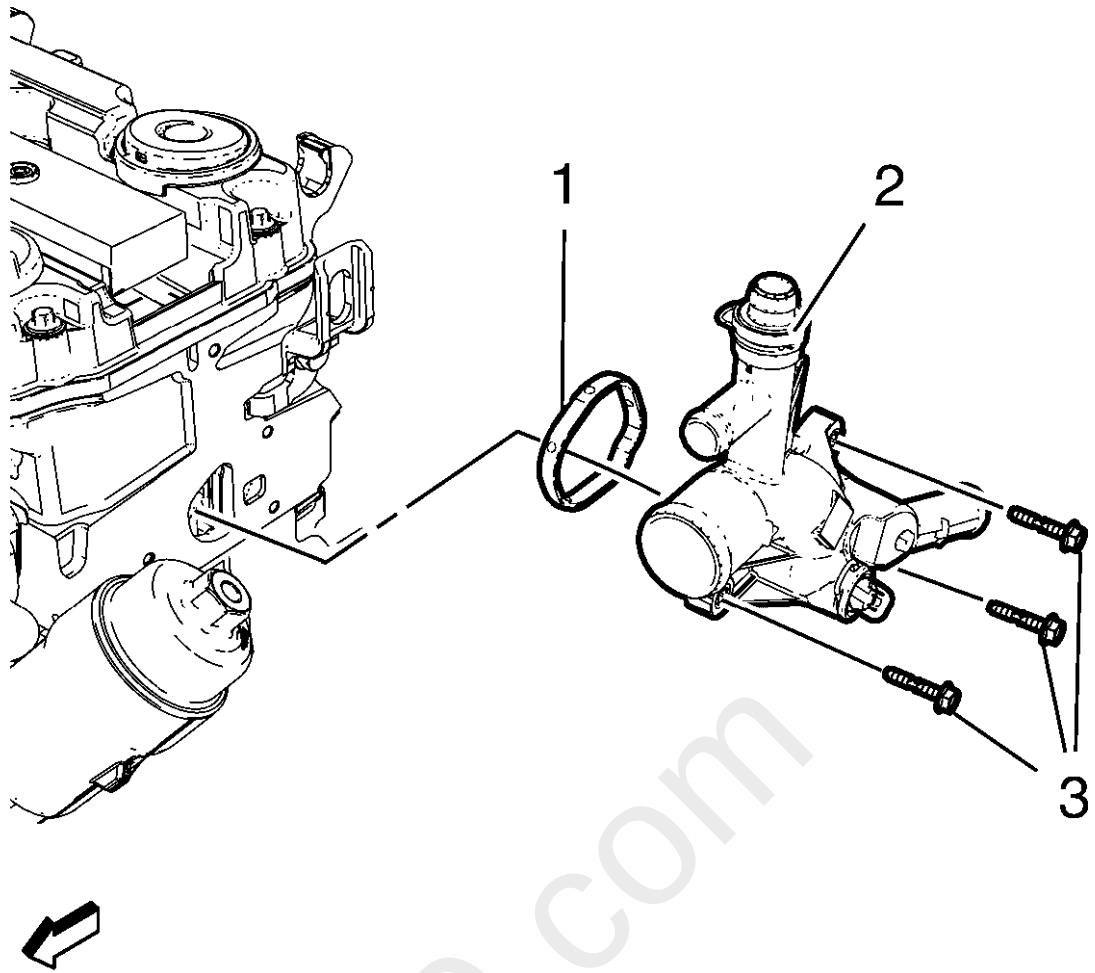


Fig. 109: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

8. Remove the 3 water outlet bolts (3).
9. Remove the water outlet (2) and the water outlet seal ring (1).

Installation Procedure

1. Clean the sealing surfaces.

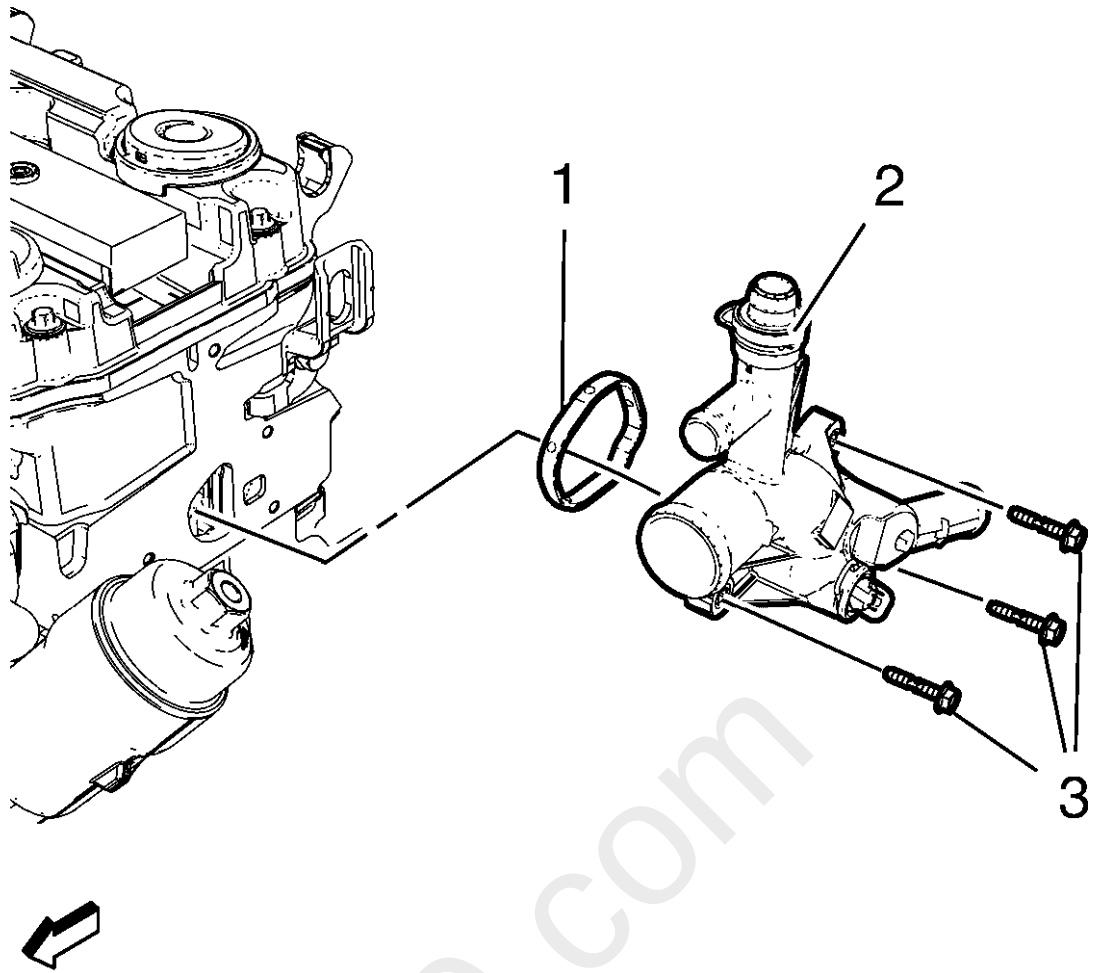


Fig. 110: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

2. Install the water outlet (2) and a NEW water outlet seal ring (1).

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

3. Install the 3 water outlet bolts (3) and tighten to 8 N.m (71 lb in).
4. Connect the engine coolant temperature sensor (water outlet) wiring harness connector.
5. Install the engine oil cooler coolant inlet hose to the water outlet. Refer to [Engine Oil Cooler Coolant Inlet Hose Replacement \(LUV\)](#).
6. Install the radiator inlet hose to the water outlet. Refer to [Radiator Inlet Hose Replacement \(LUV\)](#).
7. Install the heater inlet hose to the water outlet. Refer to [Heater Inlet Hose Replacement \(LUV\)](#) .
8. Install the engine coolant air bleed hose to the water outlet. Refer to [Engine Coolant Air Bleed Hose Replacement \(LUV\)](#).
9. Install the charge air cooler outlet air hose to the throttle body. Refer to [Charge Air Cooler Outlet Air Hose Replacement](#) .
10. Fill the cooling system. Refer to [Cooling System Draining and Filling](#).

WATER OUTLET REPLACEMENT (LE2)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove Charge Air Cooler Outlet Air Hose - [Charge Air Cooler Outlet Air Hose Replacement](#)

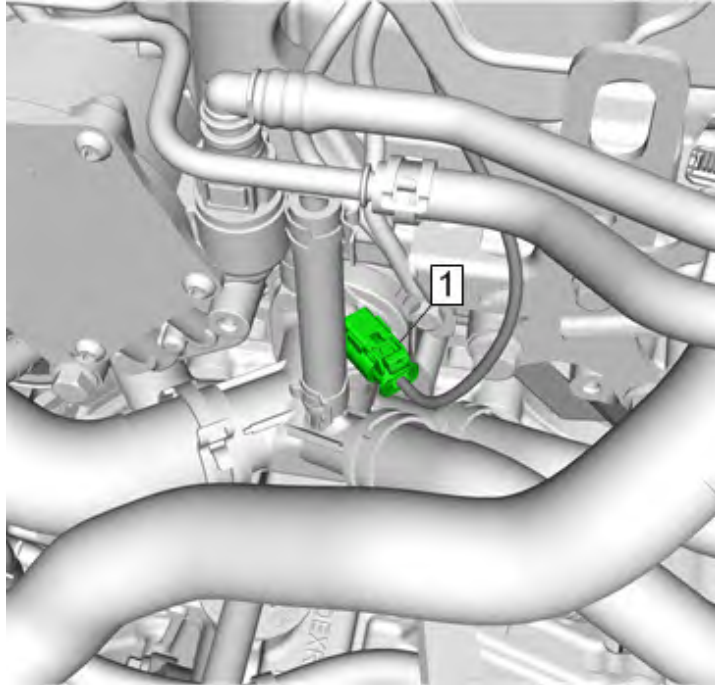


Fig. 111: Engine Coolant Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

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

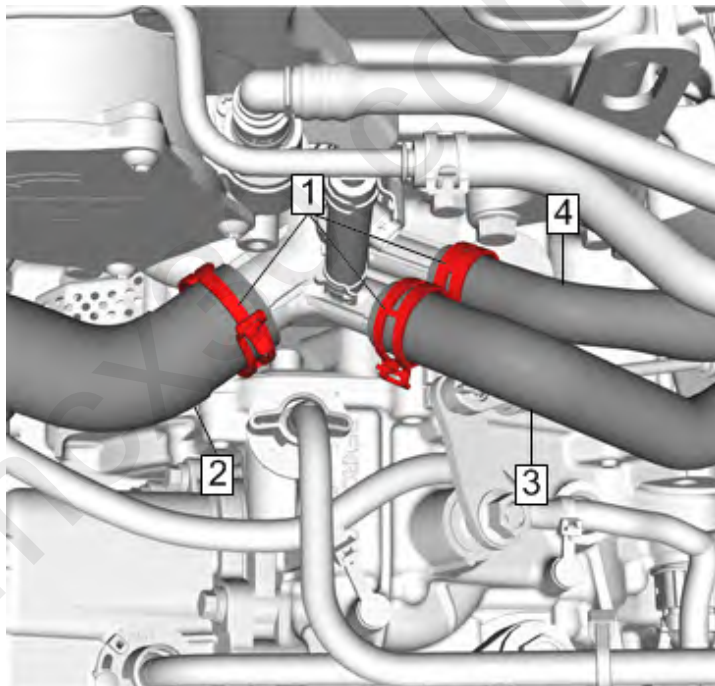


Fig. 112: Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Hose Clamp (1) - **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove Radiator Inlet Hose (2)
6. Remove Heater Inlet Hose (3)
7. Remove Heater Outlet Hose (4)

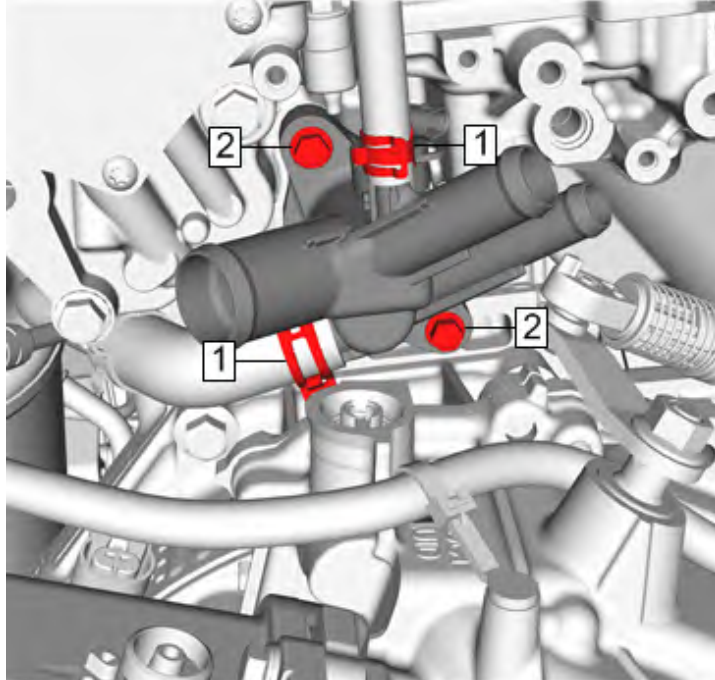


Fig. 113: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

8. Disengage Hose Clamp (1) - [Hose Clamp Replacement Guidelines - Spring Type](#)
9. Remove Water Outlet Bolt (2)

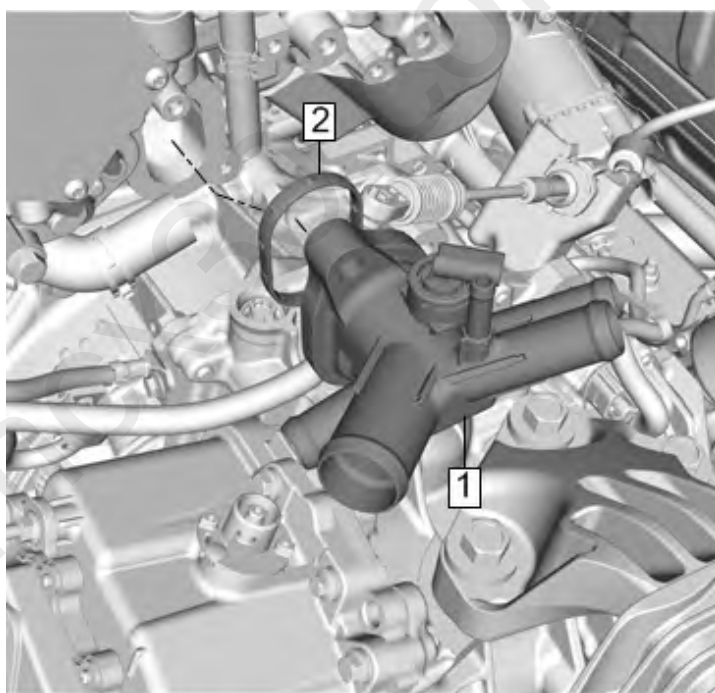


Fig. 114: Water Outlet Seal

Courtesy of GENERAL MOTORS COMPANY

10. Remove Water Outlet (1)
11. Remove Water Outlet Seal (2) and DISCARD

Installation Procedure

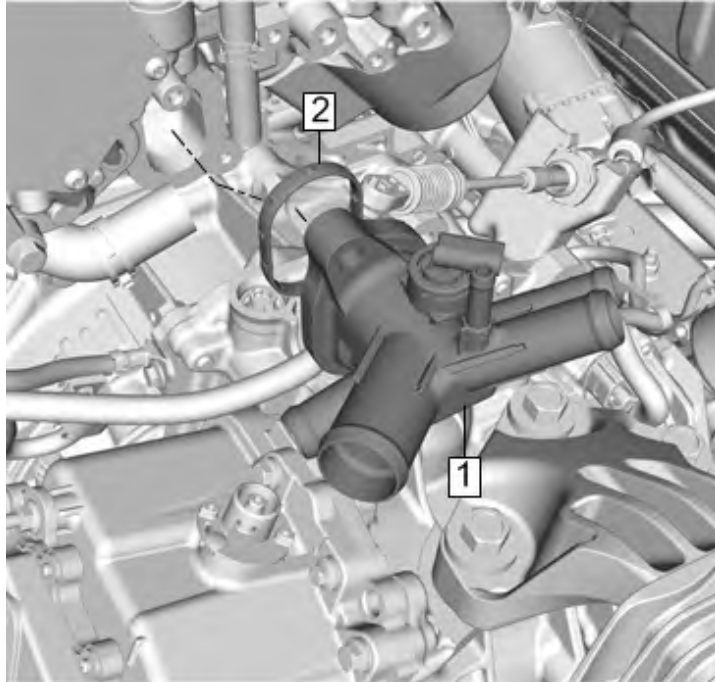


Fig. 115: Water Outlet Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW seal.

1. Install Water Outlet Seal (2)
2. Install Water Outlet (1)

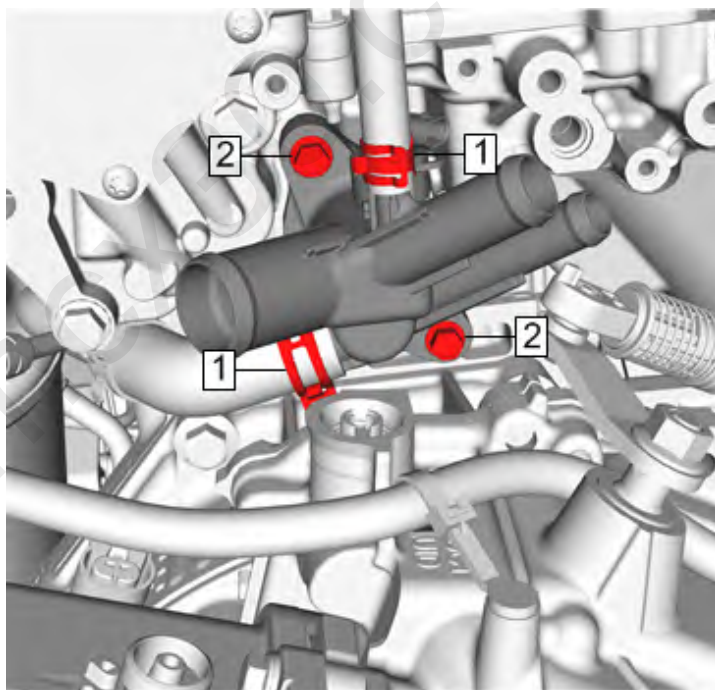


Fig. 116: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

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

3. Install Water Outlet Bolt (2) and tighten 10 N.m (89 lb in)
4. Engage Hose Clamp (1) - [Hose Clamp Replacement Guidelines - Spring Type](#)

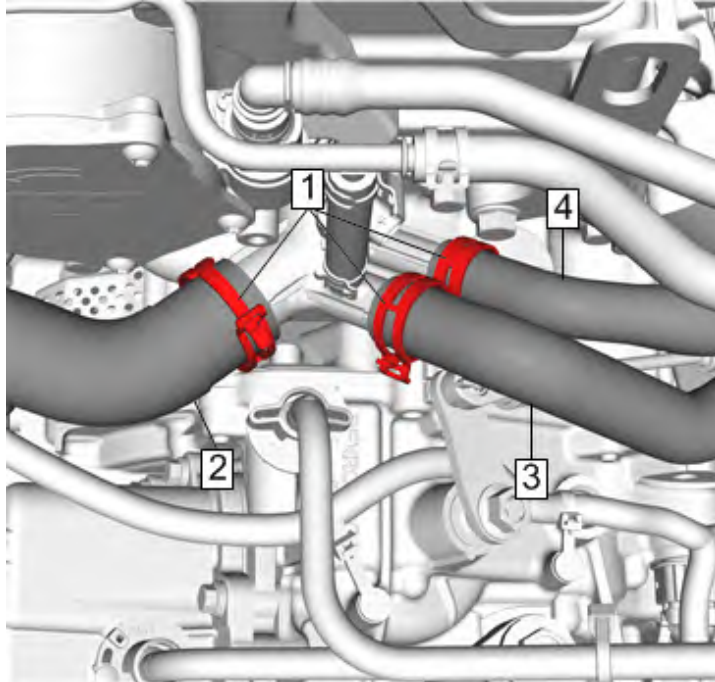


Fig. 117: Hoses And Clamps

Courtesy of GENERAL MOTORS COMPANY

5. Connect Heater Outlet Hose (4)
6. Connect Heater Inlet Hose (3)
7. Connect Radiator Inlet Hose (2)
8. Engage Hose Clamp (3) - [Hose Clamp Replacement Guidelines - Spring Type](#)

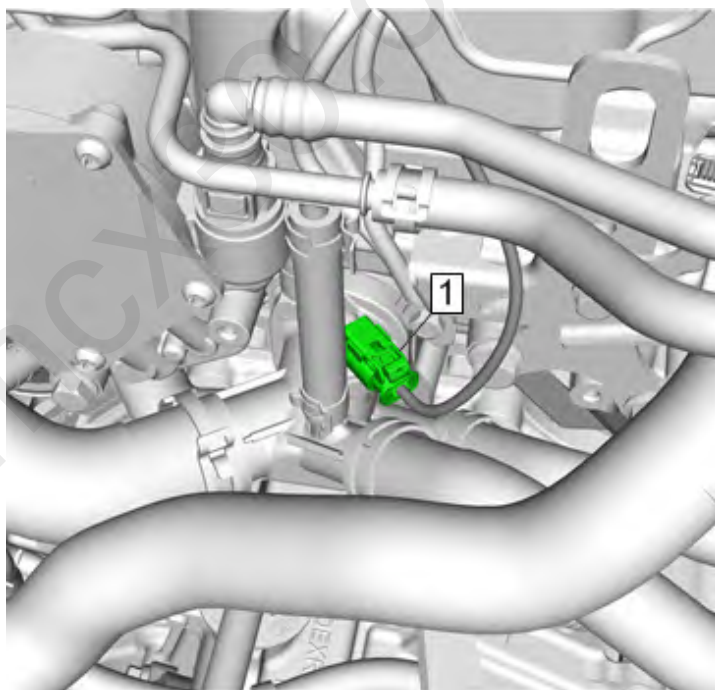


Fig. 118: Engine Coolant Temperature Sensor Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

9. Connect Engine Coolant Temperature Sensor Electrical Connector (1)
10. Install Charge Air Cooler Outlet Air Hose - [Charge Air Cooler Outlet Air Hose Replacement](#)
11. Fill the cooling system. [Cooling System Draining and Filling](#)

THERMOSTAT BYPASS PIPE REPLACEMENT (LE2)

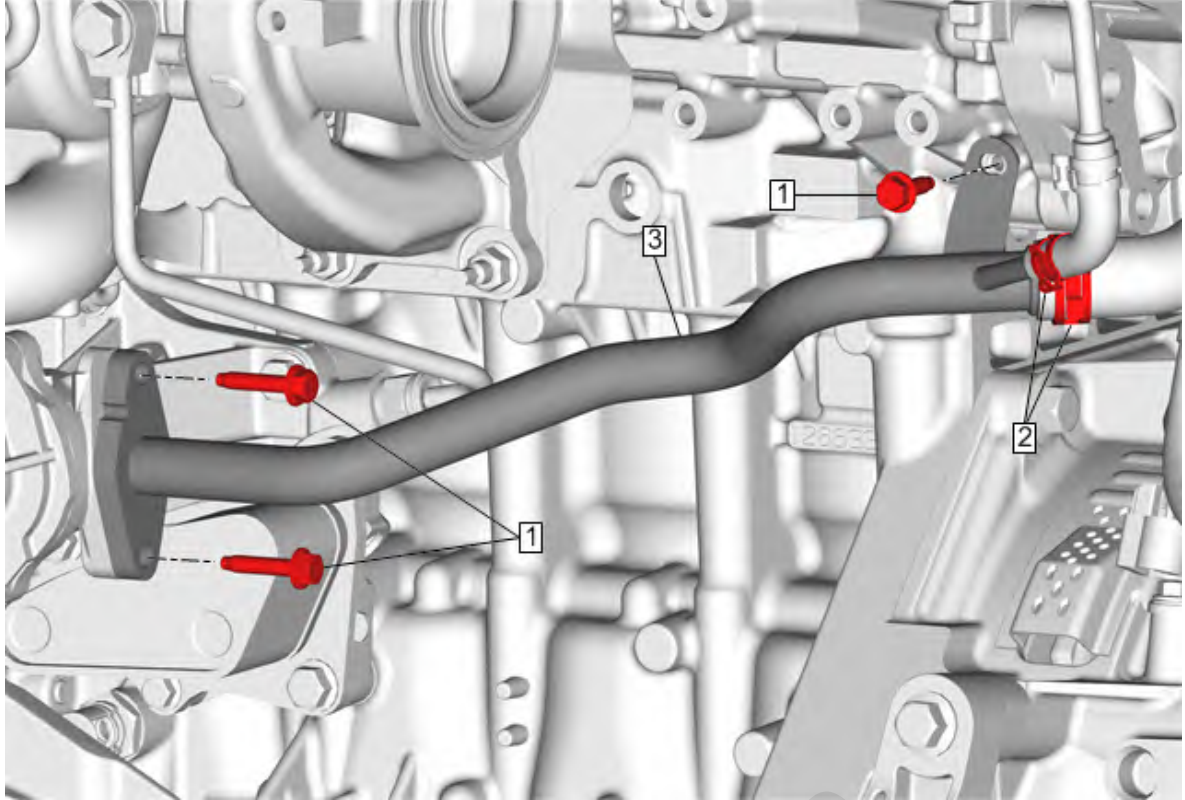


Fig. 119: Thermostat Bypass Pipe (LE2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Cooling System Draining and Filling. 2. Catalytic Converter Replacement (LE2)	
1	Thermostat Bypass Pipe Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Clamp (Qty: 2)
3	Thermostat Bypass Pipe Procedure Install a NEW gasket.

WATER PUMP PULLEY REPLACEMENT (LUV)

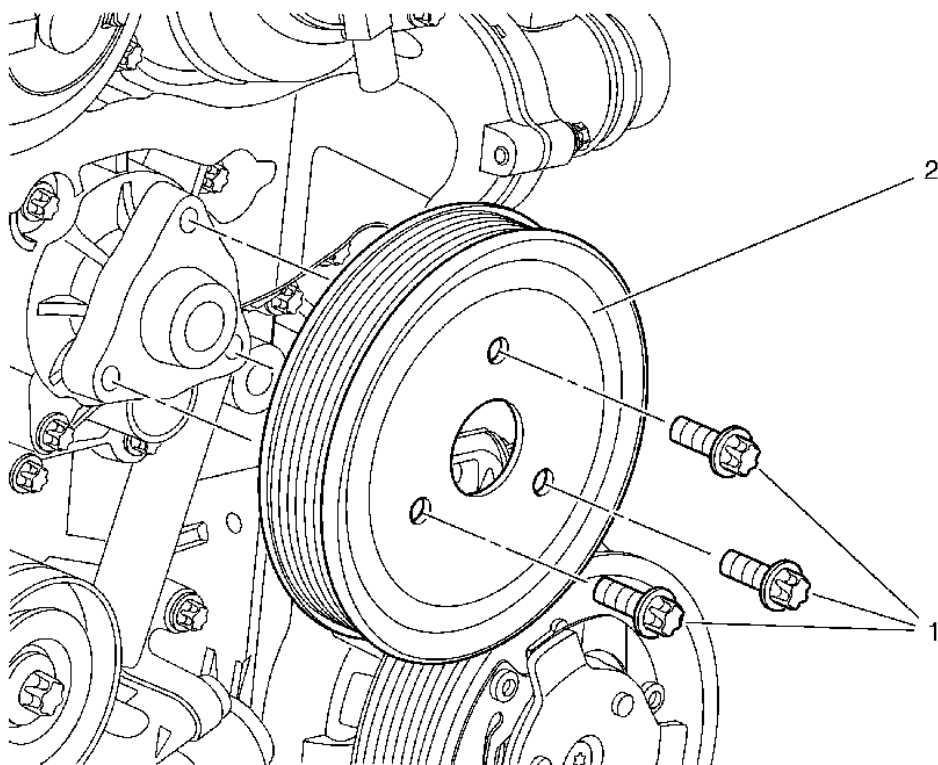


Fig. 120: Water Pump Pulley (LUV)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the right engine mount bracket. Refer to Engine Mount Bracket Replacement - Right Side . 2. Remove the drive belt. Refer to Drive Belt Replacement .	
1	Water Pump Pulley Fastener CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Water Pump Pulley

WATER PUMP PULLEY REPLACEMENT (2H0)

Removal Procedure

1. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(without KL9\)](#), [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove Engine Mount - [Engine Mount Replacement](#)
3. Raise the vehicle. [Lifting and Jacking the Vehicle](#)

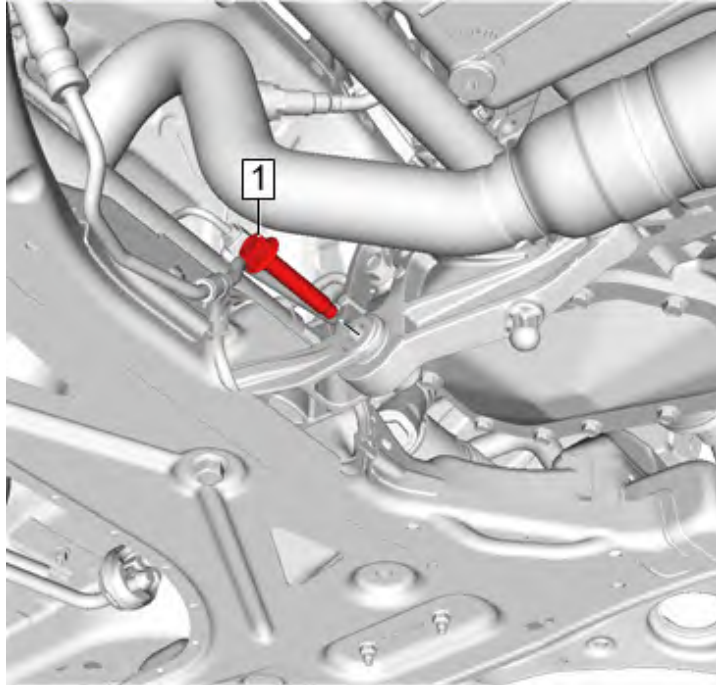
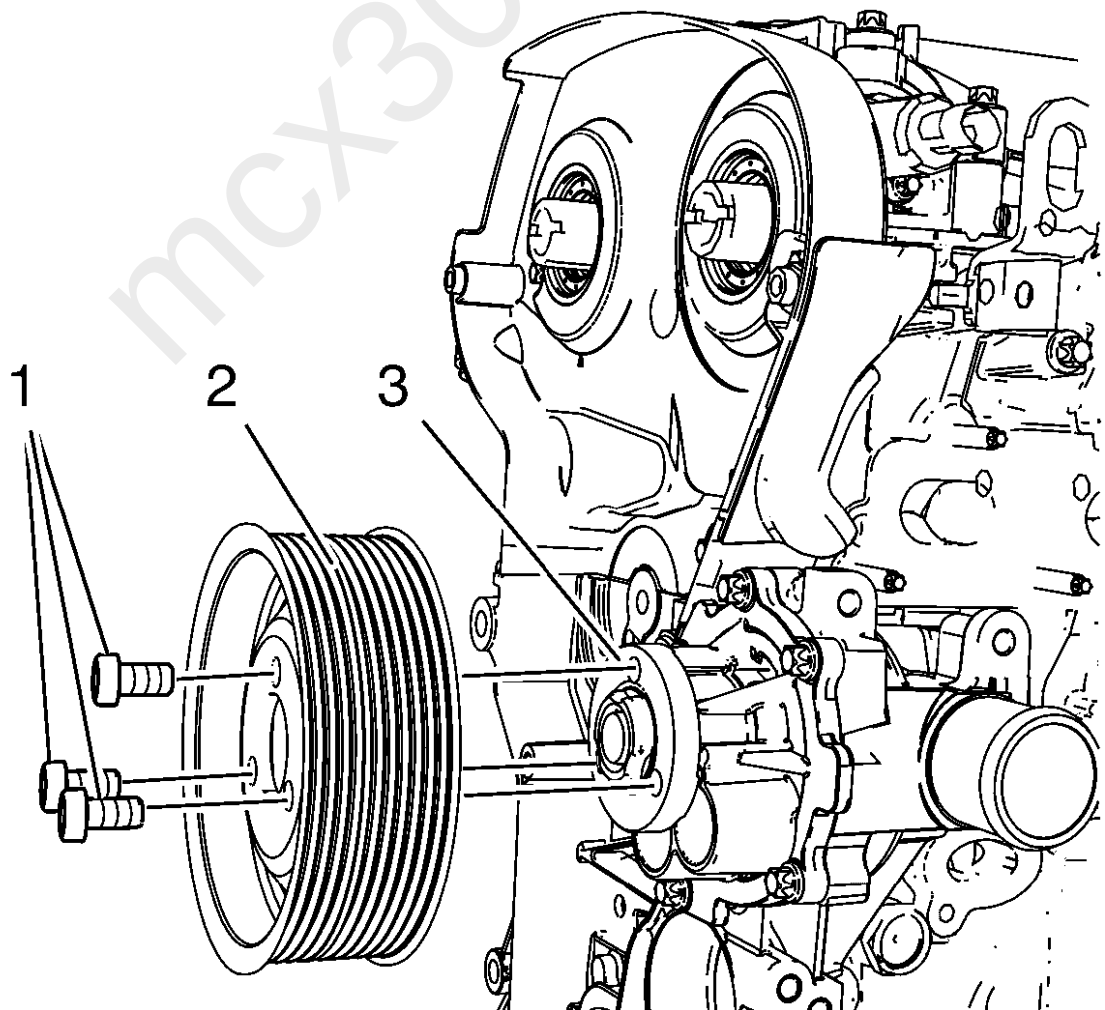


Fig. 121: Rear Transmission Mount Through Bolt
 Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Transmission Mount Through Bolt (1) and DISCARD
5. Lower the vehicle. [Lifting and Jacking the Vehicle](#)
6. Using the engine support fixture, carefully lower the engine to gain access to the water pump pulley.
7. Raise the vehicle. [Lifting and Jacking the Vehicle](#)
8. Remove Drive Belt Tensioner - [Drive Belt Tensioner Replacement](#)



9. Remove Water Pump Pulley Bolt (1)
10. Remove Water Pump Pulley (2)

Installation Procedure

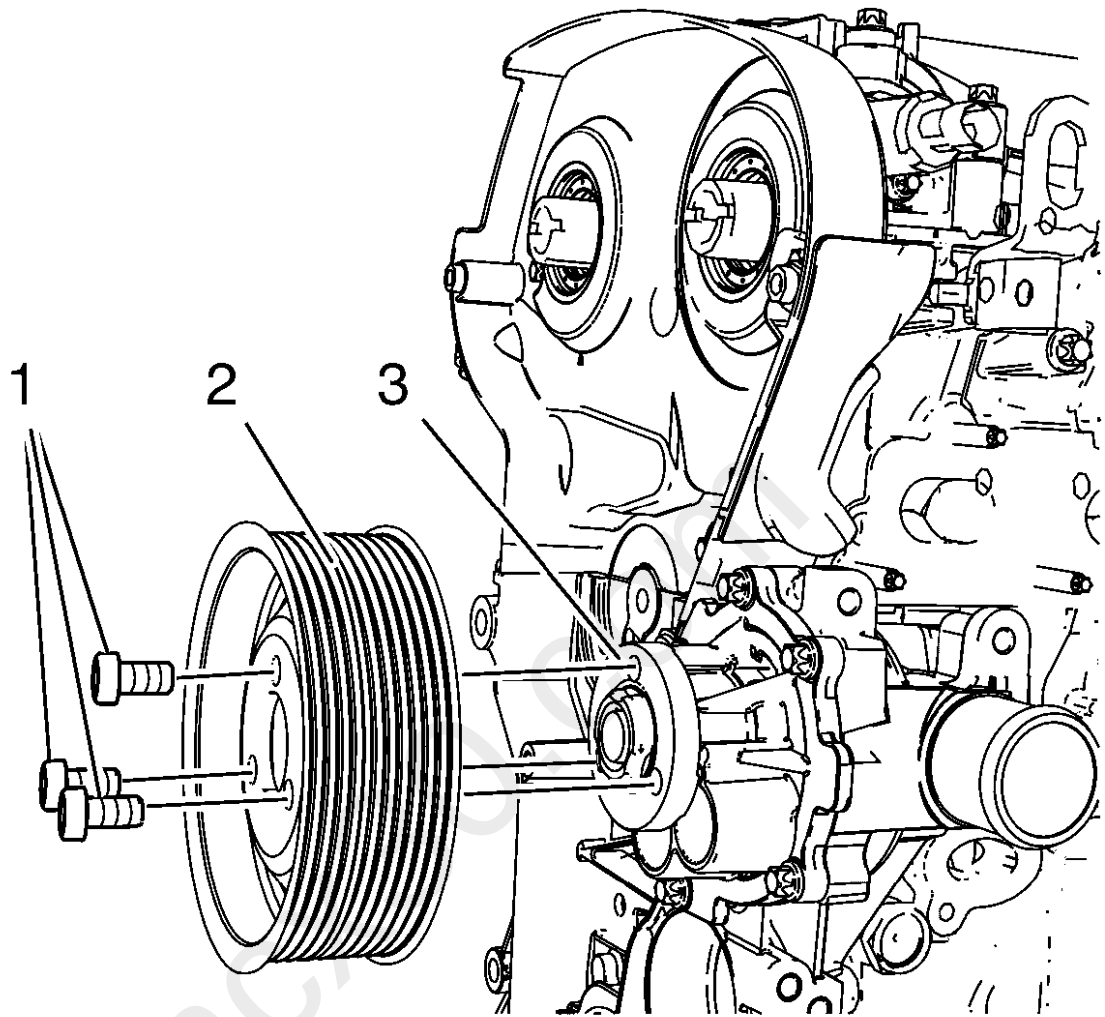


Fig. 123: Water Pump And Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

1. Install Water Pump Pulley (2)

CAUTION: Refer to **Fastener Caution** .

2. Install Water Pump Pulley Bolt (1) and tighten 20 N.m (15 lb ft)
3. Install Drive Belt Tensioner - **Drive Belt Tensioner Replacement**
4. Lower the vehicle. **Lifting and Jacking the Vehicle**
5. Using the engine support fixture, carefully raise the engine into position.
6. Install Engine Mount - **Engine Mount Replacement**
7. Raise the vehicle. **Lifting and Jacking the Vehicle**

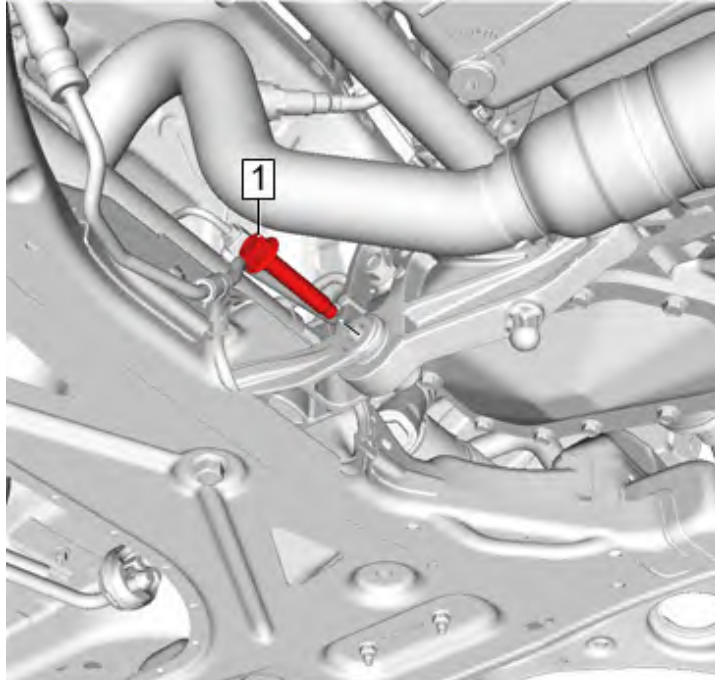


Fig. 124: Rear Transmission Mount Through Bolt
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW Bolt.

8. Install Rear Transmission Mount Through Bolt (1) and tighten 80 N.m (59 lb ft) plus 45 to 60 degrees.
9. Lower the vehicle. [Lifting and Jacking the Vehicle](#)
10. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)
[Battery Negative Cable Disconnection and Connection \(with KL9\)](#)

WATER PUMP REPLACEMENT (2H0)

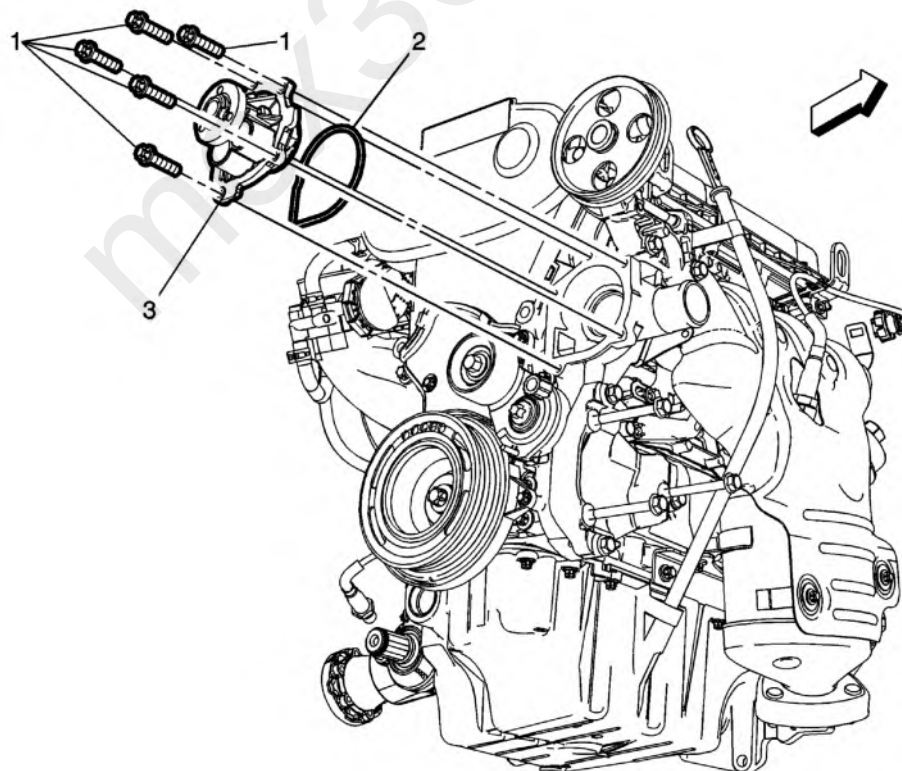


Fig. 125: Water Pump (2H0)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling. 2. Remove the water pump pulley. Refer to Water Pump Pulley Replacement (2H0).	
1	Water Pump Fastener (Qty: 5) CAUTION: Refer to Fastener Caution . Tighten 8 N.m (71 lb in)
2	Water Pump Seal
3	Water Pump

WATER PUMP REPLACEMENT (LUV)

Special Tools

EN-45059 Angle Meter

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

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove the engine coolant thermostat from water pump. [Engine Coolant Thermostat Replacement \(LUV\)](#)
3. Remove the water pump pulley. [Water Pump Pulley Replacement \(LUV\)](#)
4. Remove the heater outlet hose from the water pump. [Heater Outlet Hose Replacement \(LUV\)](#) [Heater Outlet Hose Replacement \(LUV Rear\)](#)

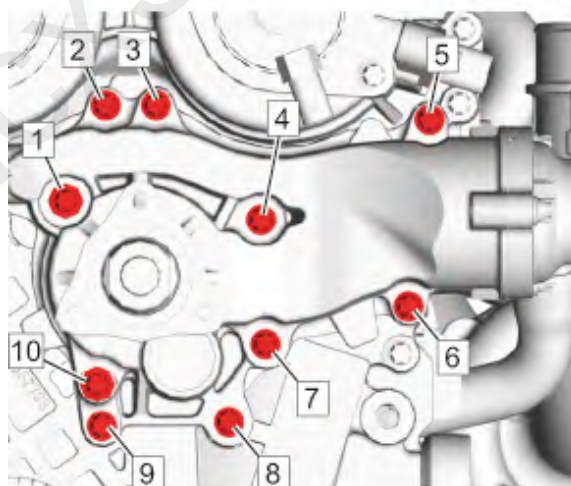


Fig. 126: Identifying Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD the 2 front cover bolts (1, 8).
6. Remove the remaining 8 bolts (2-7, 9, 10).
7. The water pump and engine front cover bolts are located as followed:
 1. Engine front cover special bolt without cone end 60 mm (2.362 in) (1, 10).
 2. Engine front cover standard bolt with cone end 52 mm (2.047 in) (2, 6, 8).
 3. Water pump bolt 25 mm (0.984 in) (3-5, 7, 9).

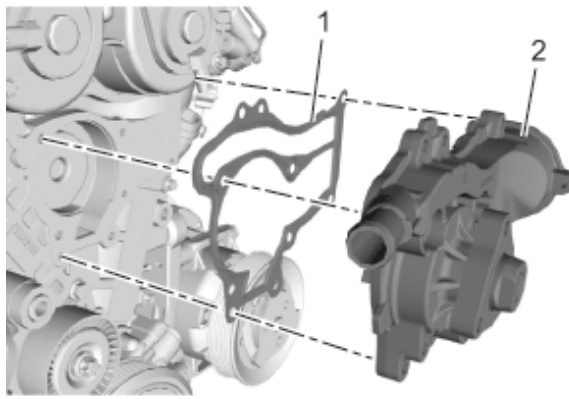


Fig. 127: Identifying Gasket And Water Pump
Courtesy of GENERAL MOTORS COMPANY

8. Remove Water Pump (2)
9. Remove and DISCARD the gasket.(1)

Installation Procedure

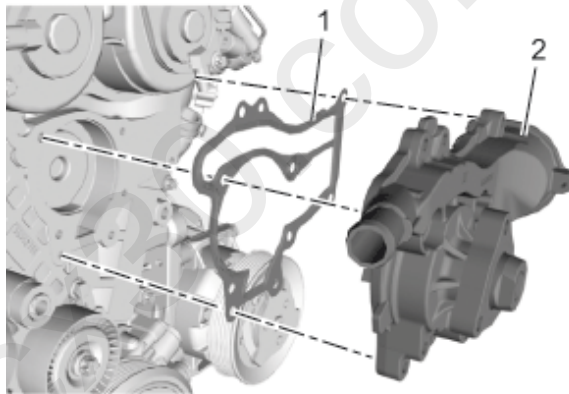


Fig. 128: Identifying Gasket And Water Pump
Courtesy of GENERAL MOTORS COMPANY

1. Clean the sealing surfaces.
Install a NEW gasket.(1)
2. Install Water Pump (2)

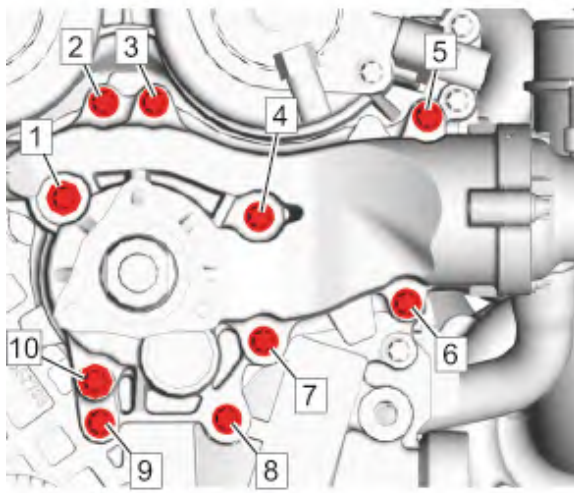


Fig. 129: Identifying Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the different bolt length.

3. Install the 2 NEW front cover bolts (1, 8).
4. Install the remaining 8 bolts (2-7, 9, 10).

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

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

5. Tighten the 5 water pump bolts (3-5, 7, 9) and the 5 engine front cover bolts (1, 2, 6, 8, 10) in a cross sequence to 8 N.m (71 lb in).
6. Tighten ONLY the 2 front cover bolts (1, 8) to an additional 30 degrees, using the **EN-45059** meter.
 - Bolt (1) 60 mm (2.362 in)
 - Bolt (8) 52 mm (2.047 in)
7. Install the heater outlet hose from the water pump. [Heater Outlet Hose Replacement \(LUV\)](#). [Heater Outlet Hose Replacement \(LUV Rear\)](#).
8. Install the water pump pulley. [Water Pump Pulley Replacement \(LUV\)](#).
9. Install the engine coolant thermostat to the water pump. [Engine Coolant Thermostat Replacement \(LUV\)](#).
10. Fill the cooling system. [Cooling System Draining and Filling](#)

WATER PUMP REPLACEMENT (LE2)

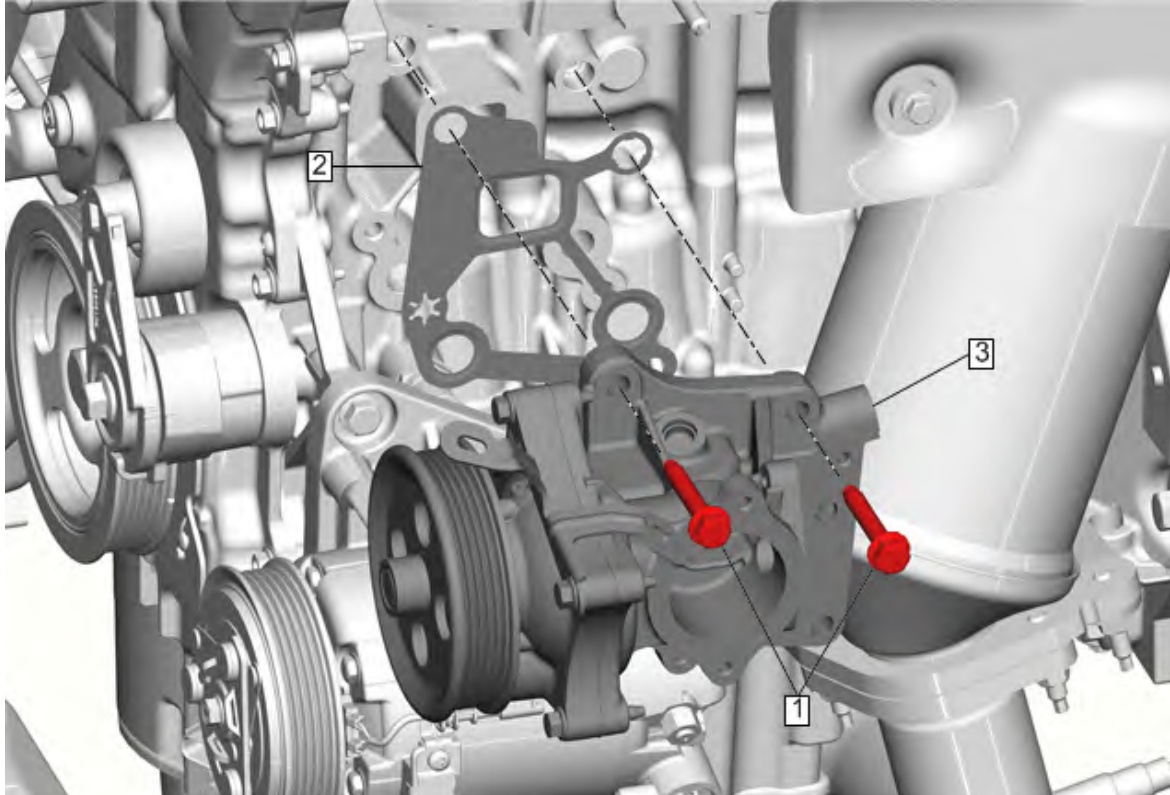


Fig. 130: Water Pump Bolt

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Air Cleaner Outlet Duct Replacement 2. Engine Oil Cooler Replacement (LE2) 3. Engine Coolant Thermostat Housing Replacement (LE2) 4. Reposition Turbocharger Oil Feed Pipe Replacement 5. Disconnect Thermostat Bypass Pipe Replacement (LE2)@Water Pump 6. Turbocharger Coolant Feed Pipe Replacement (LE2) 7. Disconnect Charge Air Cooler Inlet Air Hose Replacement @Turbocharger	
1	Water Pump Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)
2	Gasket Procedure Install a NEW gasket.
3	Water Pump

WATER PUMP HOUSING REPLACEMENT (LE2)

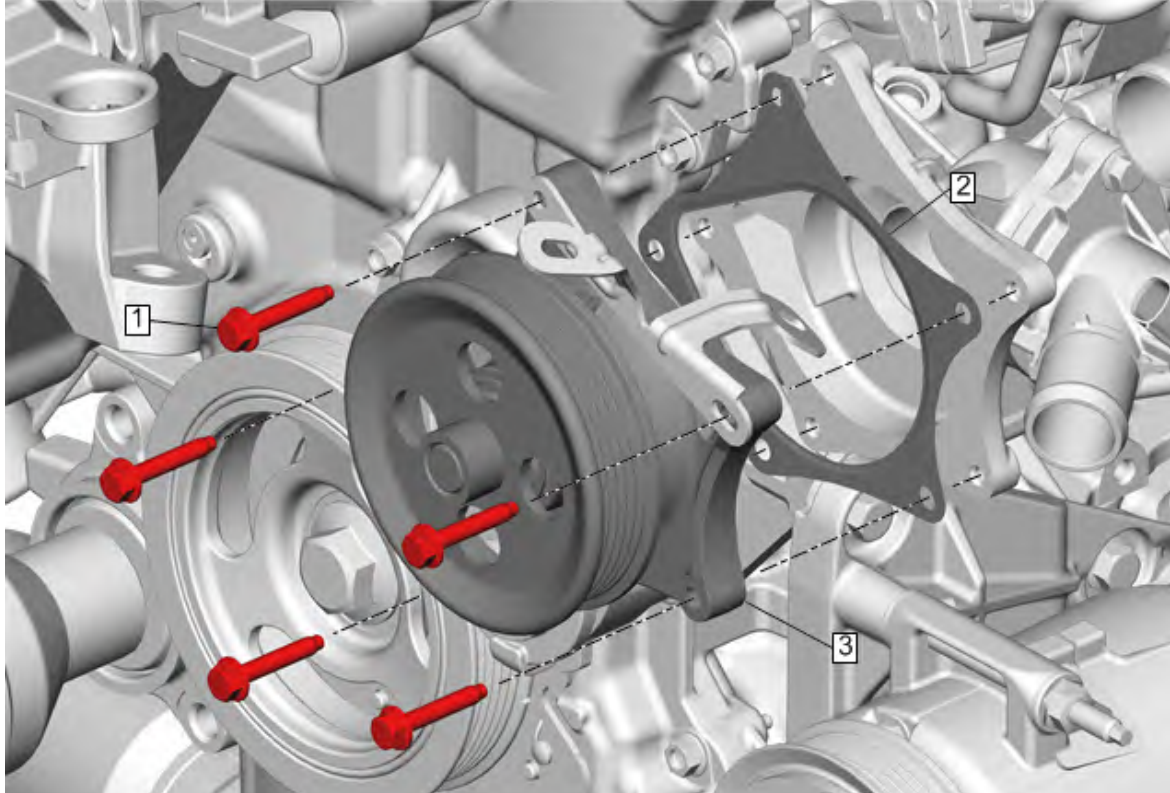


Fig. 131: Water Pump (LE2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Cooling System Draining and Filling 2. Air Cleaner Outlet Duct Replacement 3. Drive Belt Replacement 4. Drive Belt Tensioner Replacement	
1	Water Pump Housing Bolt (Qty: 5) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Gasket Procedure Install a NEW gasket.
3	Water Pump Housing

AUXILIARY WATER PUMP REPLACEMENT (LE2)

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](#)

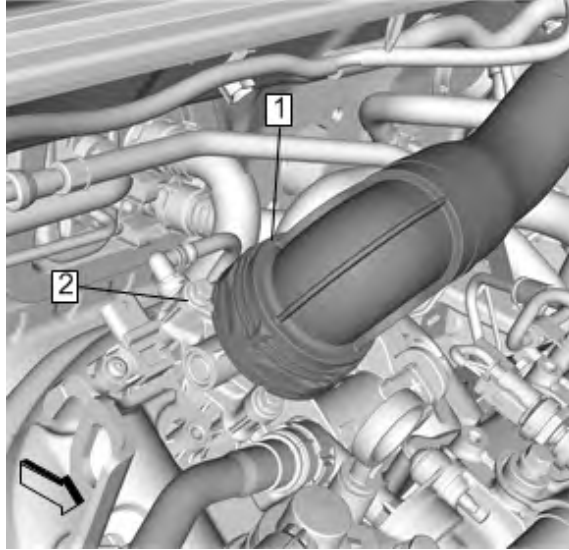


Fig. 132: Charge Air Cooler Outlet Air Hose At Throttle Body.
Courtesy of GENERAL MOTORS COMPANY

2. Reposition the charge air cooler outlet air hose out of the way. (1)[Charge Air Cooler Outlet Air Hose Replacement](#)

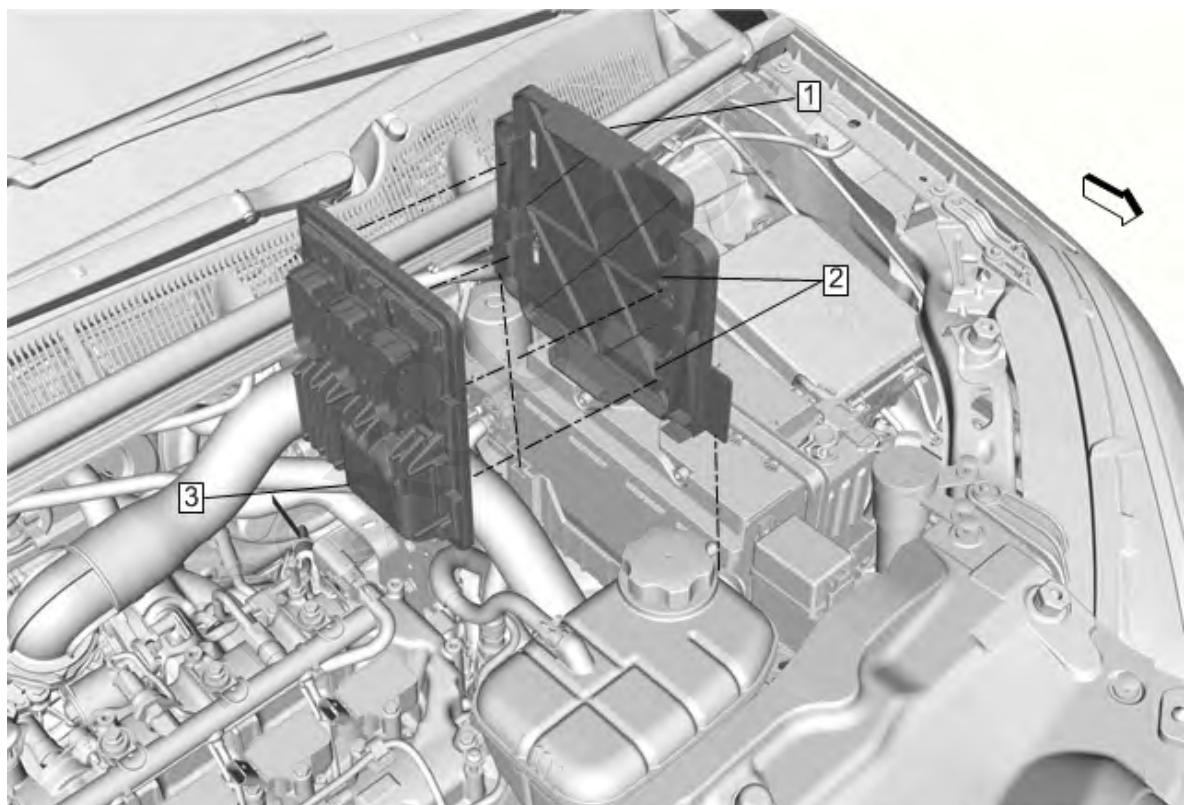


Fig. 133: Engine Control Module
Courtesy of GENERAL MOTORS COMPANY

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

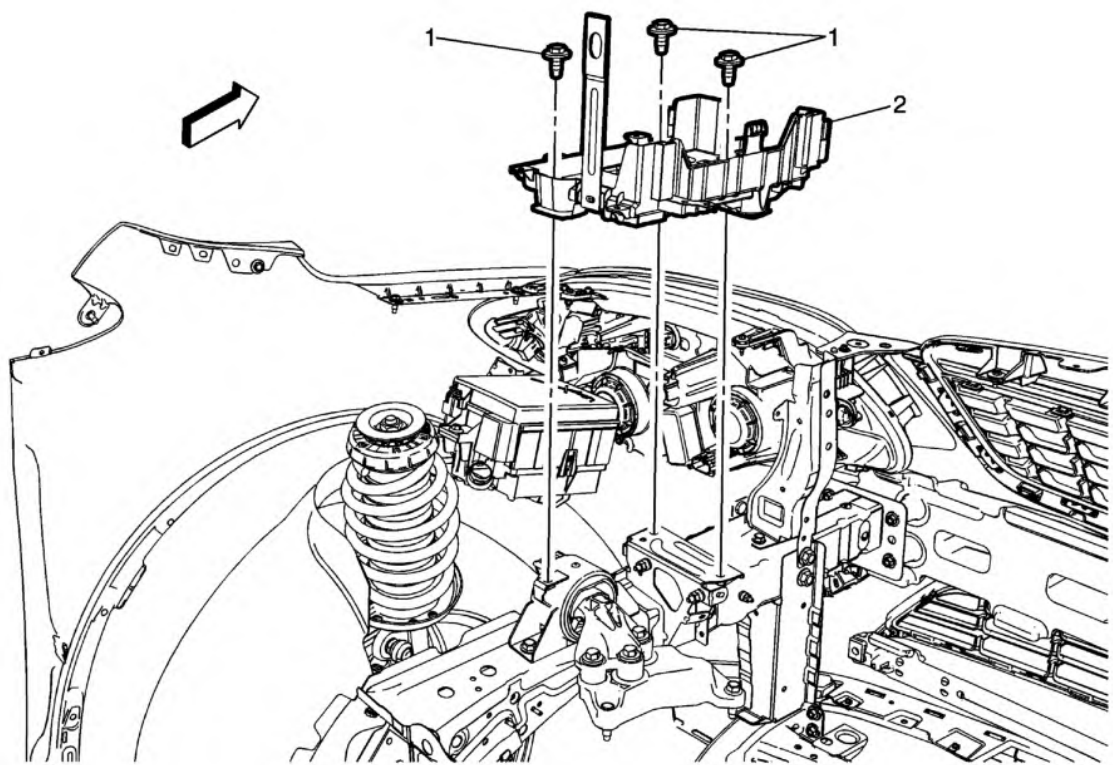


Fig. 134: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

4. Remove **Battery Tray Replacement** (2)

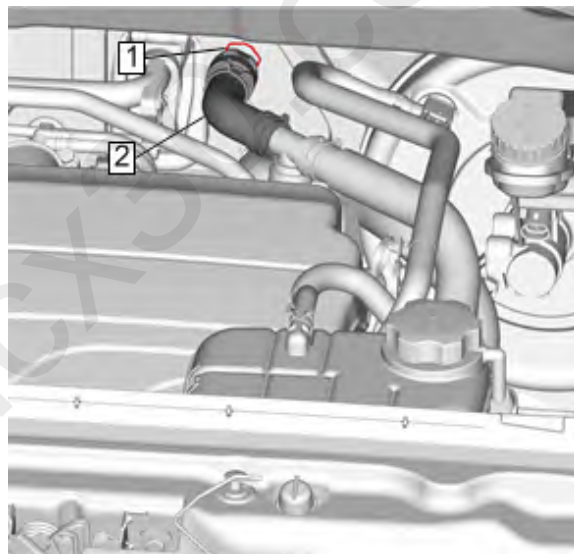


Fig. 135: Heater Water Auxiliary Pump Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Remove the retainer from the quick connect fitting.(1) @Heater Water Auxiliary Pump Inlet Hose
6. Remove Heater Water Auxiliary Pump Inlet Hose (2)

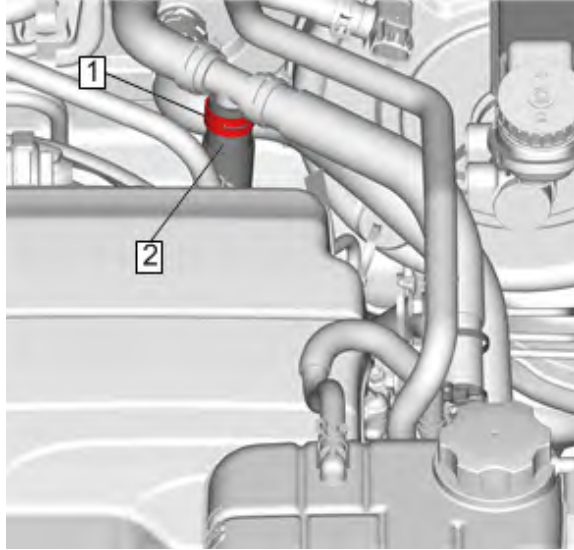


Fig. 136: Auxiliary Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Disengage Auxiliary Heater Inlet Hose Clamp (1)
8. Remove Auxiliary Heater Inlet Hose (2)

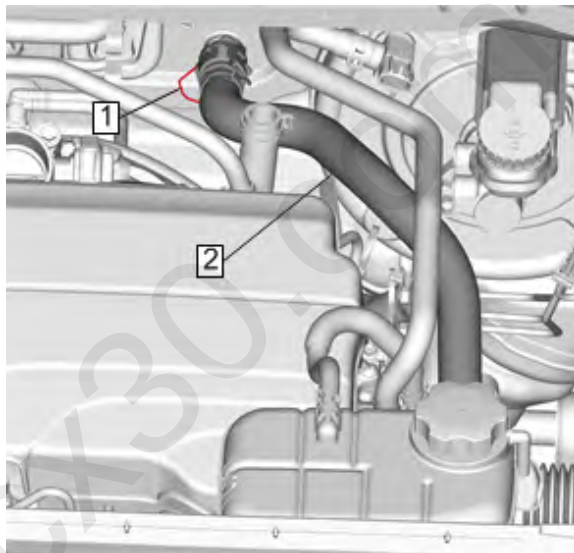


Fig. 137: Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Remove the retainer from the quick connect fitting.(1) @Heater Inlet Hose
10. Remove Heater Inlet Hose (2)

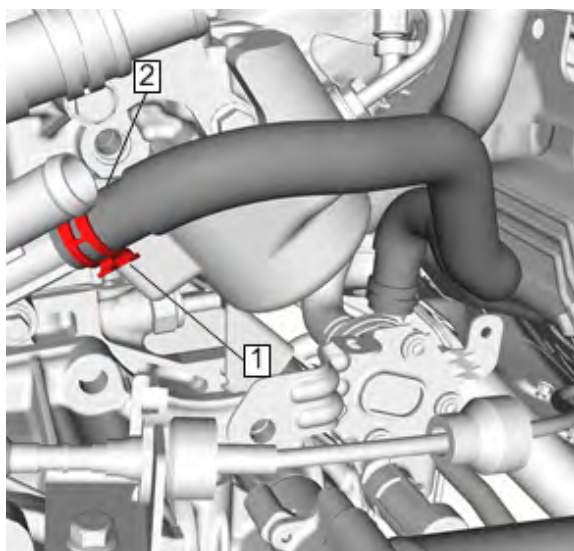


Fig. 138: Heater Water Auxiliary Pump Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

11. Disengage Heater Water Auxiliary Pump Outlet Hose Clamp (1)
12. Remove Heater Water Auxiliary Pump Outlet Hose (1) @Water Outlet Pipe

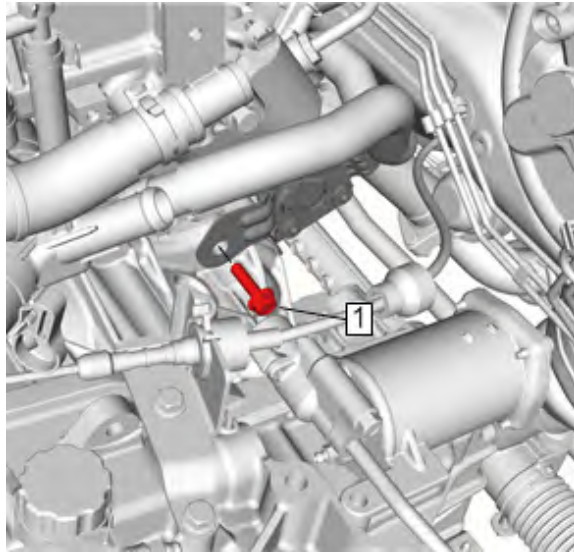


Fig. 139: Transmission Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Remove Transmission Bolt (1)

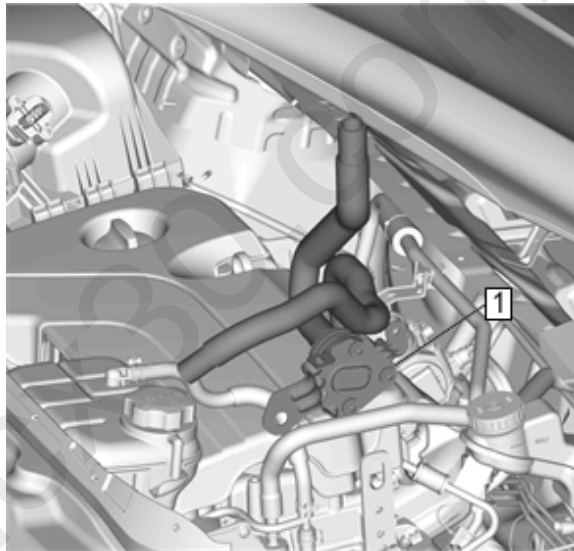


Fig. 140: Auxiliary Water Pump
Courtesy of GENERAL MOTORS COMPANY

14. Remove Auxiliary Water Pump (1)

Installation Procedure



Fig. 141: Auxiliary Water Pump
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Water Pump (1)
2. Install Transmission Bolt (1) and tighten 75 N.m (55 lb ft)

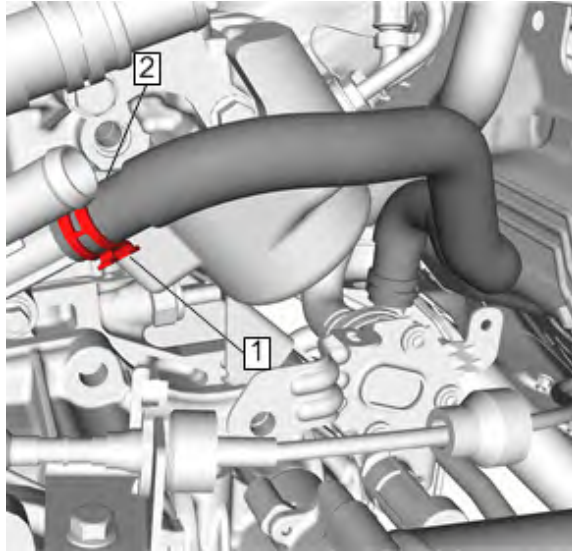


Fig. 142: Heater Water Auxiliary Pump Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Install Heater Water Auxiliary Pump Outlet Hose (2) @Water Outlet Pipe
4. Engage Heater Water Auxiliary Pump Outlet Hose Clamp (1)

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

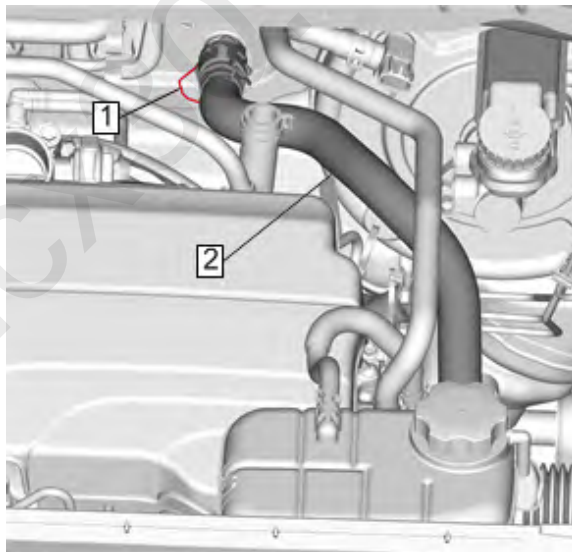


Fig. 143: Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install Auxiliary Heater Inlet Hose (2)
6. Install the retainer to the quick connect fitting.(1)

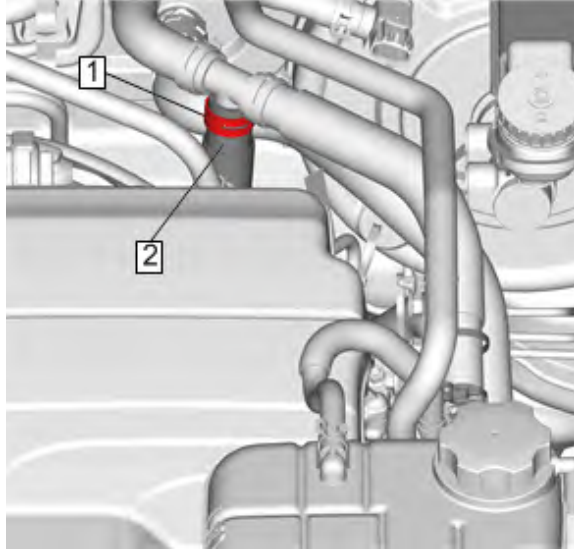


Fig. 144: Auxiliary Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Install Auxiliary Heater Inlet Hose (2)
8. Engage Auxiliary Heater Inlet Hose Clamp (1)

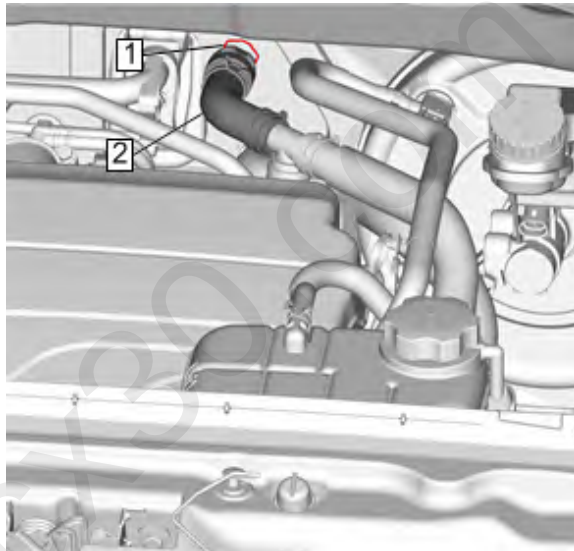


Fig. 145: Heater Water Auxiliary Pump Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

9. Install Heater Water Auxiliary Pump Inlet Hose (2)
10. Install the retainer to the quick connect fitting.(1)

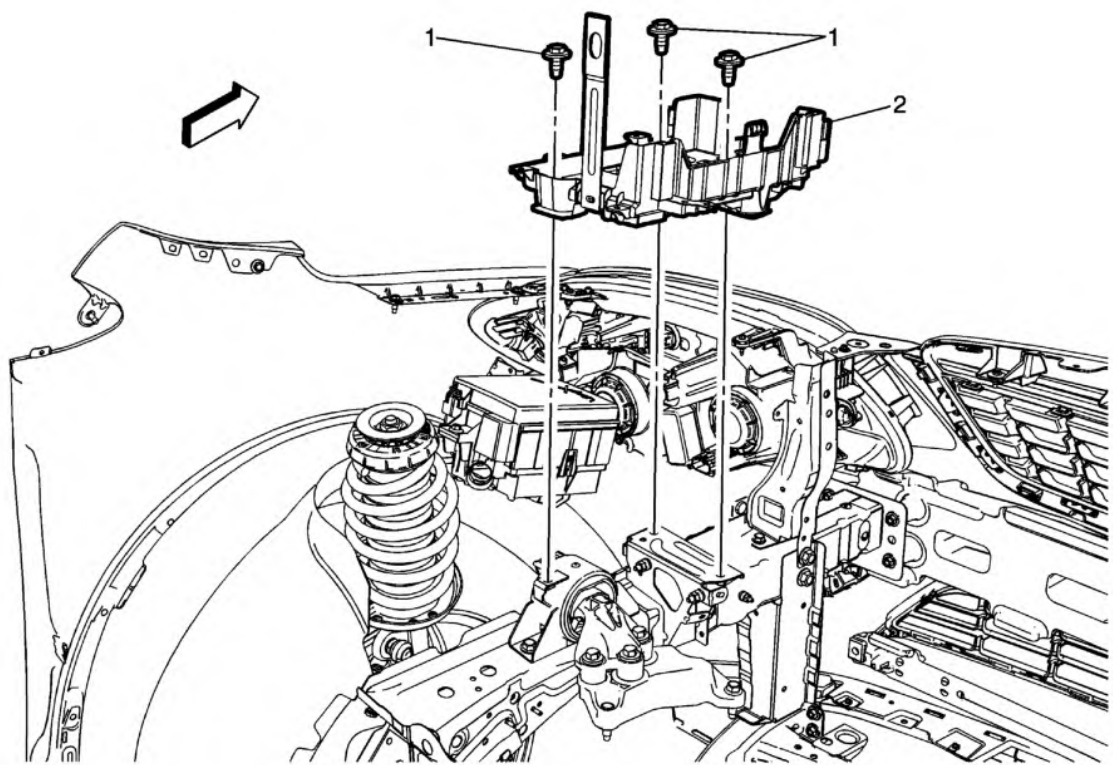


Fig. 146: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

11. Install **Battery Tray Replacement** (2)

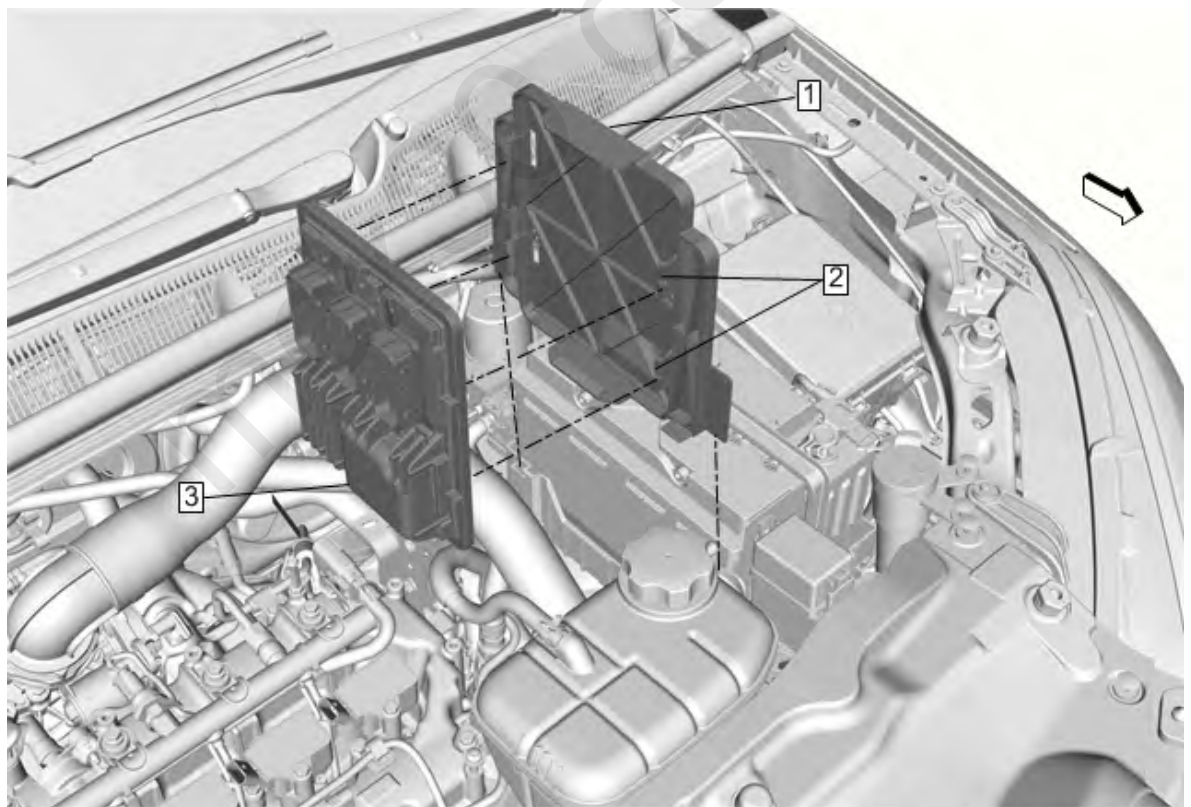


Fig. 147: Engine Control Module

Courtesy of GENERAL MOTORS COMPANY

12. Install **Engine Control Module Replacement** (3)

Callout	Component Name
Preliminary Procedures 1. Remove the radiator surge tank. Refer to Radiator Surge Tank Replacement (LUV, 2H0). 2. Remove the power steering reservoir. Refer to Power Steering Fluid Reservoir Replacement . 3. Remove the air cleaner inlet duct. Refer to Air Cleaner Inlet Duct Replacement (2H0) . 4. Remove the radiator inlet hose. Refer to Radiator Inlet Hose Replacement (2H0). 5. Remove the radiator outlet hose. Refer to Radiator Outlet Hose Replacement (2H0). 6. Remove the front compartment fuse auxiliary block from the tie bar and reposition out of the way. 7. Unclip transmission cooler lines from shroud if equipped. 8. Disconnect any electrical connectors from the fan shroud.	
1	Engine Coolant Fan Shroud Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . 6 N.m (53 lb in)
2	Engine Coolant Fan Shroud Procedure Unclip the engine coolant fan shroud from the radiator.

ENGINE COOLANT FAN SHROUD REPLACEMENT (LUV)

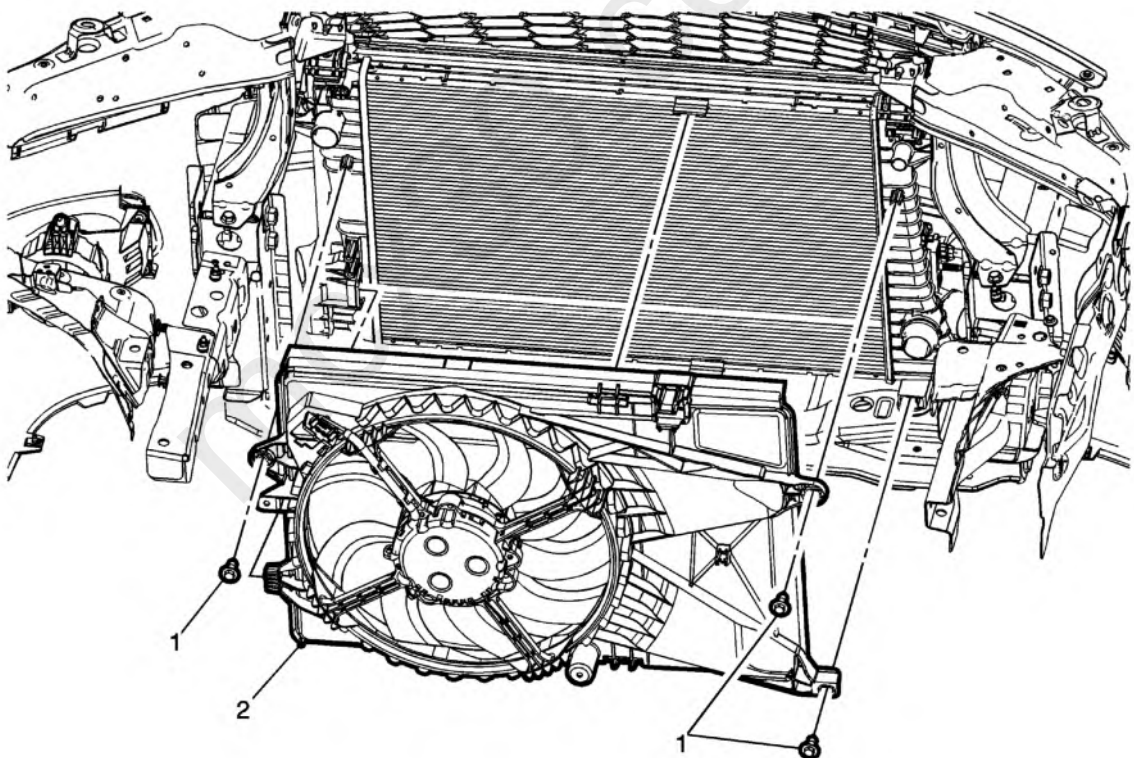


Fig. 150: Engine Coolant Fan Shroud (LUV)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure 1. Remove the radiator surge tank. Refer to Radiator Surge Tank Replacement (LUV, 2H0). 2. Unclip transmission cooler lines from shroud if equipped. 3. Unclip radiator surge tank outlet hose from fan shroud. 4. Disconnect the electrical connectors from the fan shroud. 5. Remove the radiator inlet hose. Refer to Radiator Inlet Hose Replacement (LUV). 6. Remove the front compartment front center insulator. Refer to Front Compartment Front Center Insulator Replacement. 7. Remove the radiator outlet hose. Refer to Radiator Outlet Hose Replacement (LUV).	
1	Engine Coolant Fan Shroud Bolt (Qty: 3) CAUTION: Refer to Fastener Caution .
2	Engine Coolant Fan Shroud

ENGINE COOLANT FAN SHROUD REPLACEMENT (LE2)

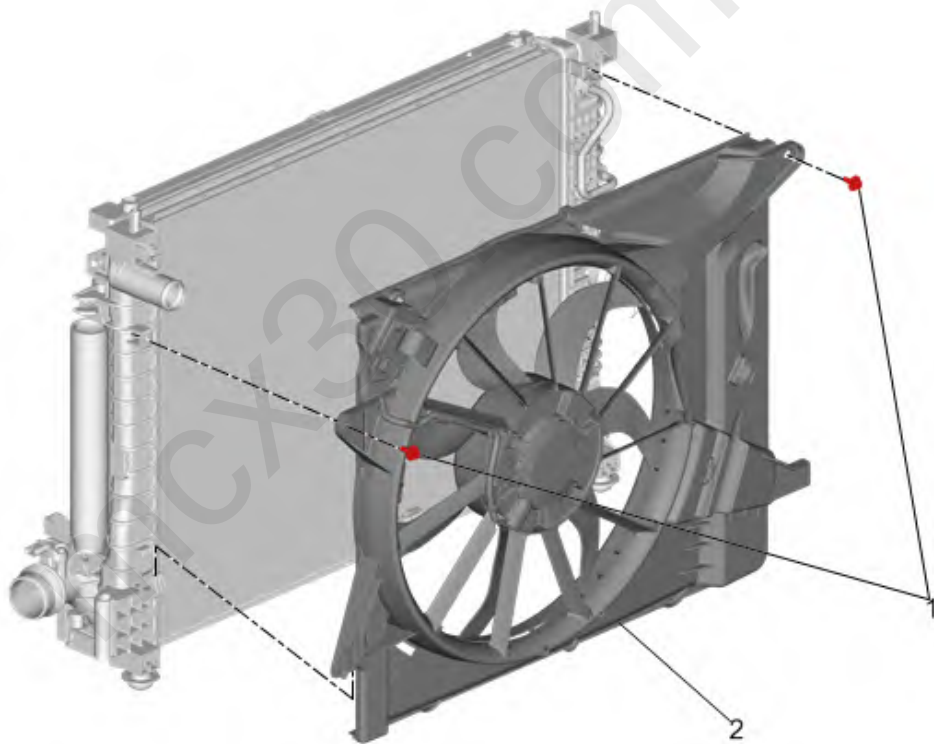


Fig. 151: Engine Coolant Fan Shroud (LE2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Radiator Replacement (LE2)	
1	Engine Coolant Fan Shroud Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
2	Engine Coolant Fan Shroud

RADIATOR REPLACEMENT (LUV)

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#), [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove the front bumper fascia. Refer to [Front Bumper Fascia Replacement \(Chevrolet\)](#), [Front Bumper Fascia Replacement \(Buick\)](#).
3. Drain the coolant fluid. Refer to [Cooling System Draining and Filling](#).
4. Recover the air conditioning refrigerant. Refer to [Refrigerant Recovery and Recharging \(R-134a\)](#).
5. Remove the radiator outlet hose from the radiator. Refer to [Radiator Outlet Hose Replacement \(LUV\)](#).
6. Remove the radiator inlet hose from the radiator. Refer to [Radiator Outlet Hose Replacement \(LUV\)](#).
7. Remove the center support bracket. Refer to [Front Bumper Fascia Center Support Replacement](#).
8. Remove the front bumper lower impact bar. Refer to [Front Bumper Lower Impact Bar Replacement \(Chevrolet\)](#).
9. Remove the radiator air upper baffle and deflector. Refer to [Radiator Air Upper Baffle and Deflector Replacement \(LE2 LUV\)](#).
10. Remove the radiator air lower baffle and deflector. Refer to [Radiator Air Lower Baffle and Deflector Replacement \(LUV\)](#).
11. Remove the charge air cooler. Refer to [Charge Air Cooler Replacement](#).
12. Remove the condenser. Refer to [Air Conditioning Condenser Replacement \(LUV\)](#).

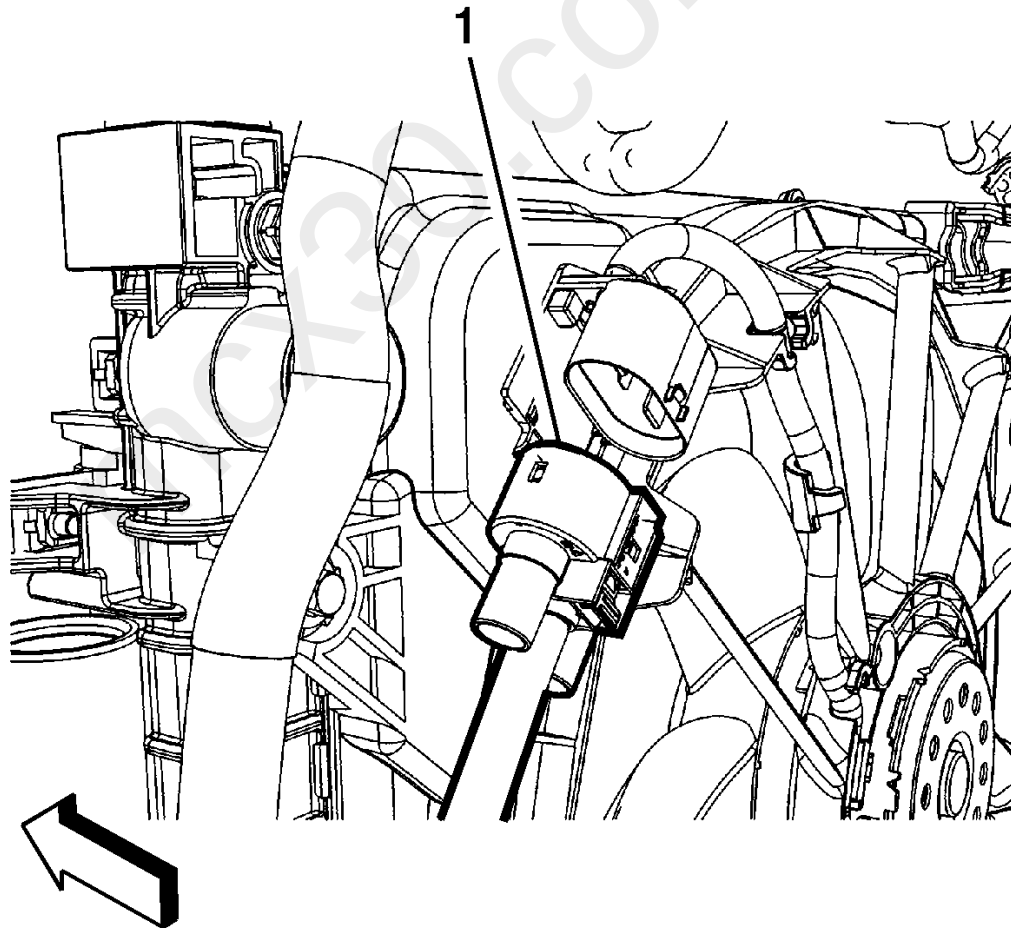


Fig. 152: Coolant Fan Wiring Harness Connector

Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the coolant fan wiring harness connector (1).
14. Remove the temperature sensor from the radiator. Refer to [Engine Coolant Temperature Sensor Replacement \(Water Outlet\)](#), [Engine Coolant Temperature Sensor Replacement \(Radiator\)](#).
15. Remove both radiator upper brackets. Refer to [Radiator Upper Bracket Replacement \(LUV\)](#).

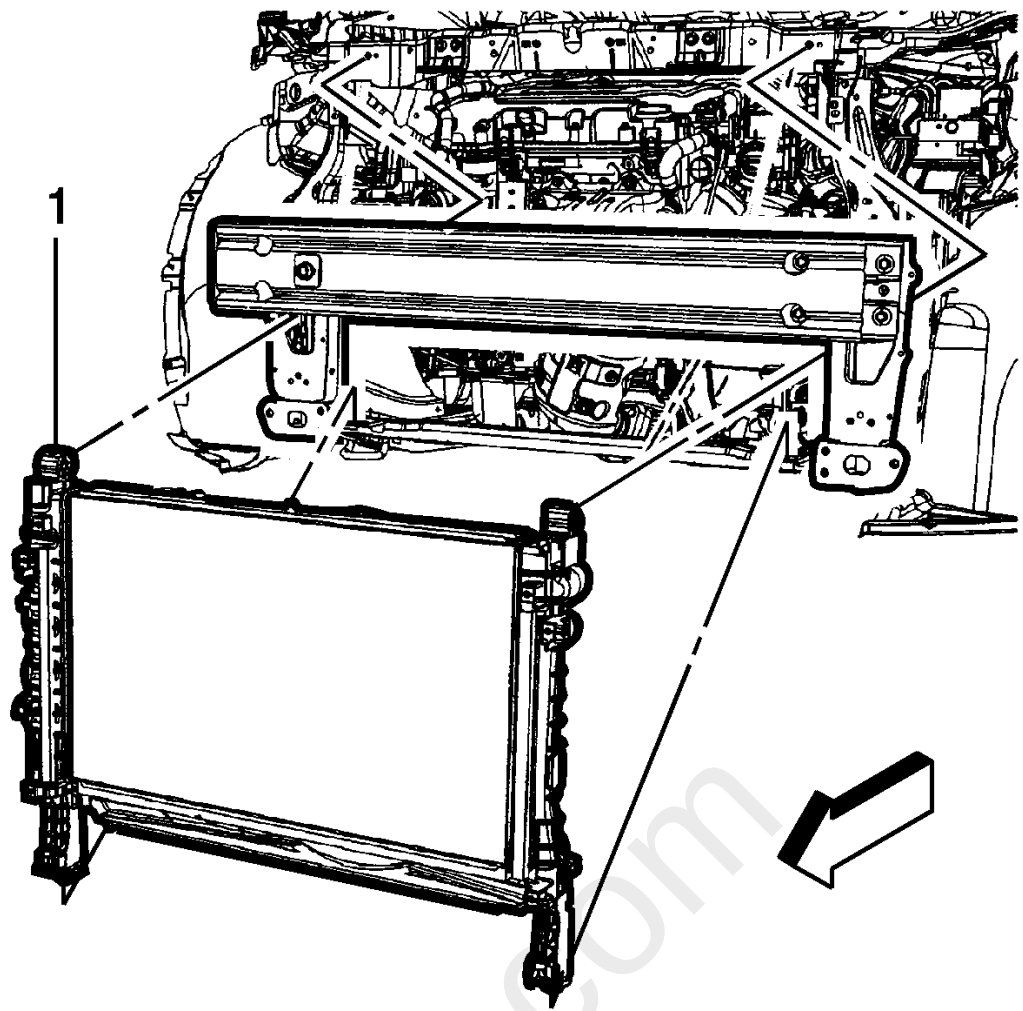


Fig. 153: Radiator

Courtesy of GENERAL MOTORS COMPANY

16. Remove the radiator (1) downward, and place the radiator on the table.

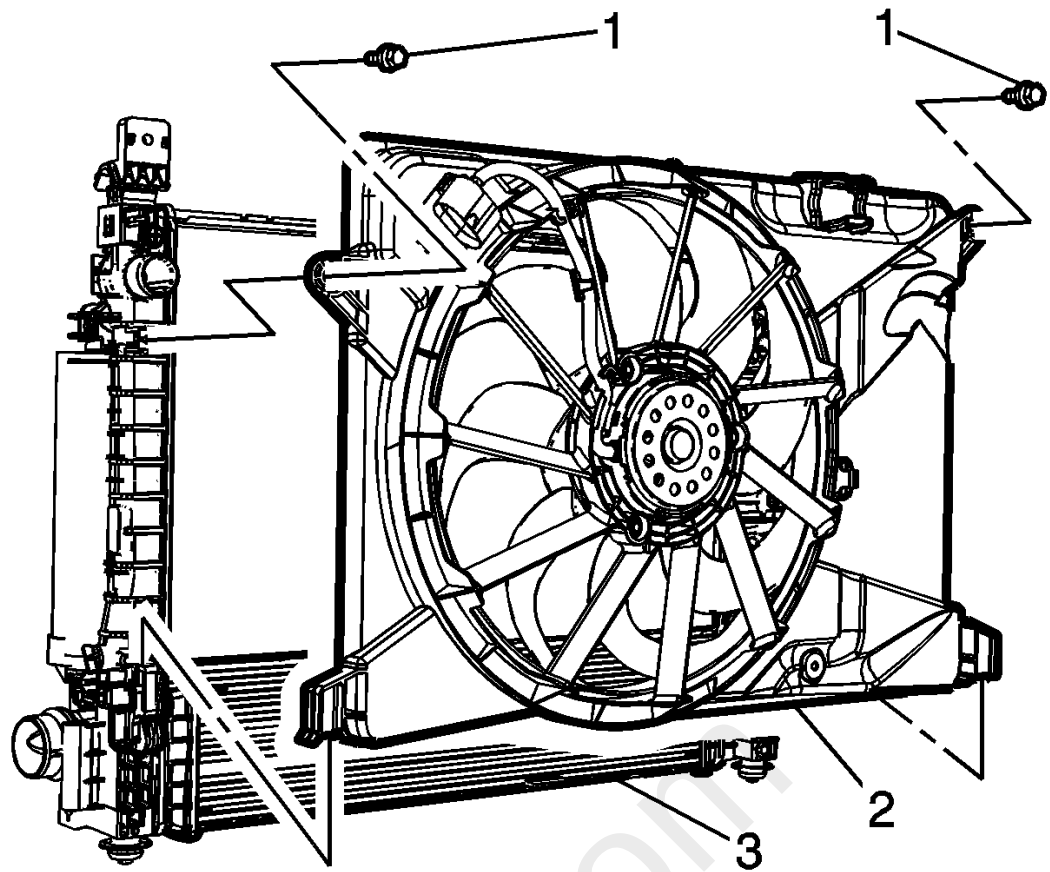


Fig. 154: Engine Cooling Fan

Courtesy of GENERAL MOTORS COMPANY

17. Remove the engine cooling fan retaining bolts (1).
18. Remove the engine cooling fan (2) from the radiator (3).

Installation Procedure

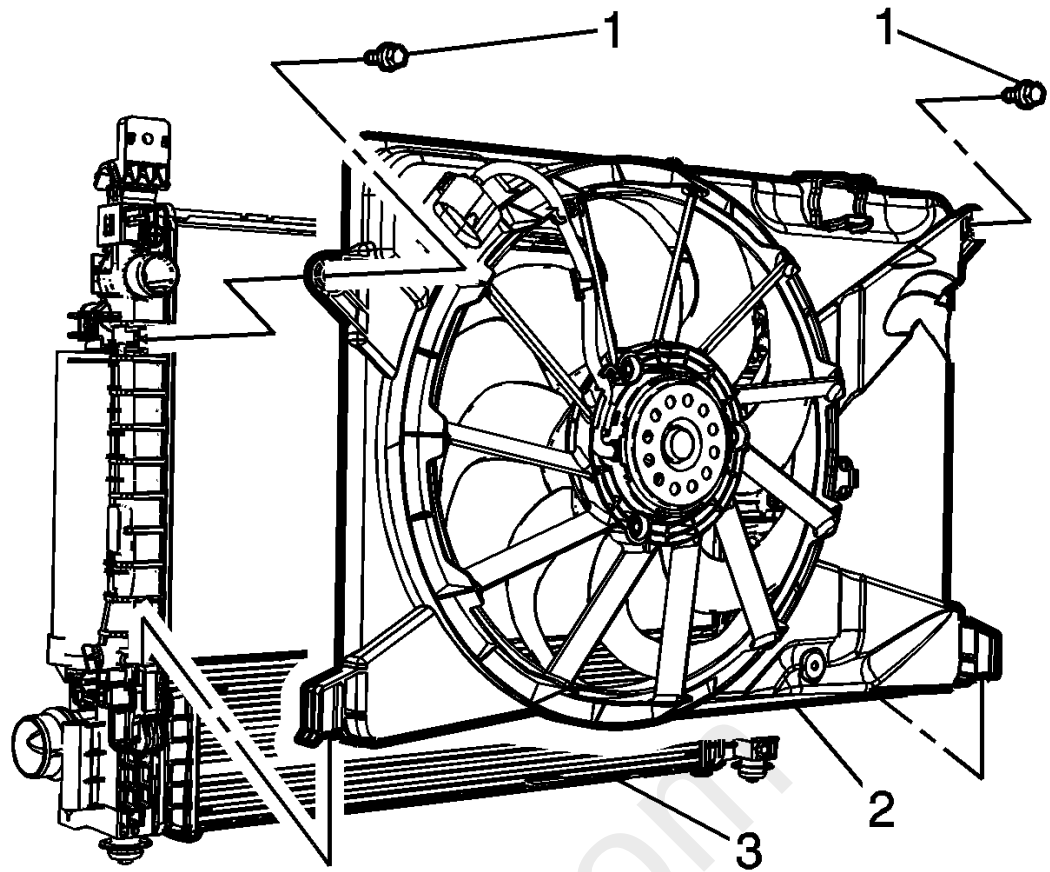


Fig. 155: Engine Cooling Fan

Courtesy of GENERAL MOTORS COMPANY

1. Position the engine cooling fan (2) to the radiator (3).

CAUTION: Refer to **Fastener Caution** .

2. Install the engine cooling fan retaining bolts (1) and tighten to 10 N.m (89 lb in).

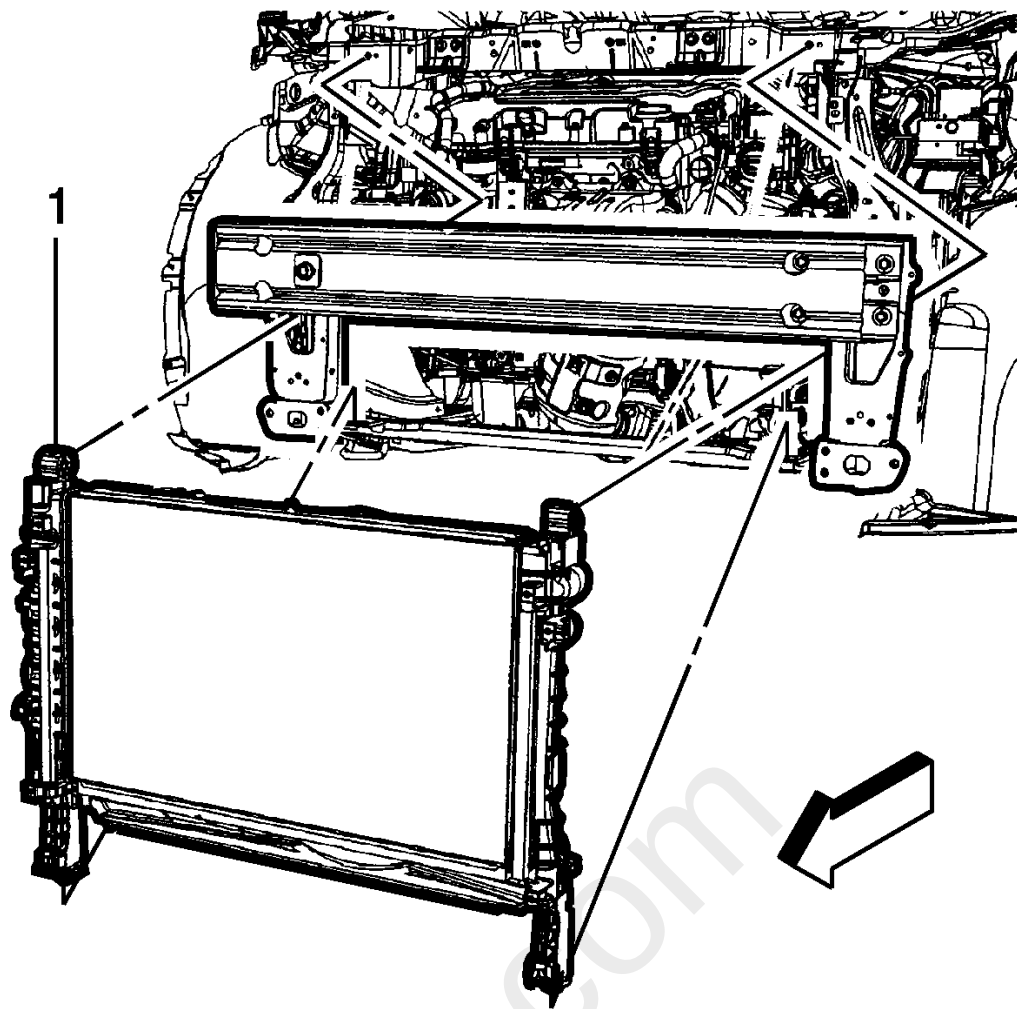


Fig. 156: Radiator

Courtesy of GENERAL MOTORS COMPANY

3. Reposition the radiator, and install both radiator upper brackets. Refer to [Radiator Upper Bracket Replacement \(LUV\)](#).
4. Install the temperature sensor to the radiator. Refer to [Engine Coolant Temperature Sensor Replacement \(Water Outlet\)](#), [Engine Coolant Temperature Sensor Replacement \(Radiator\)](#).

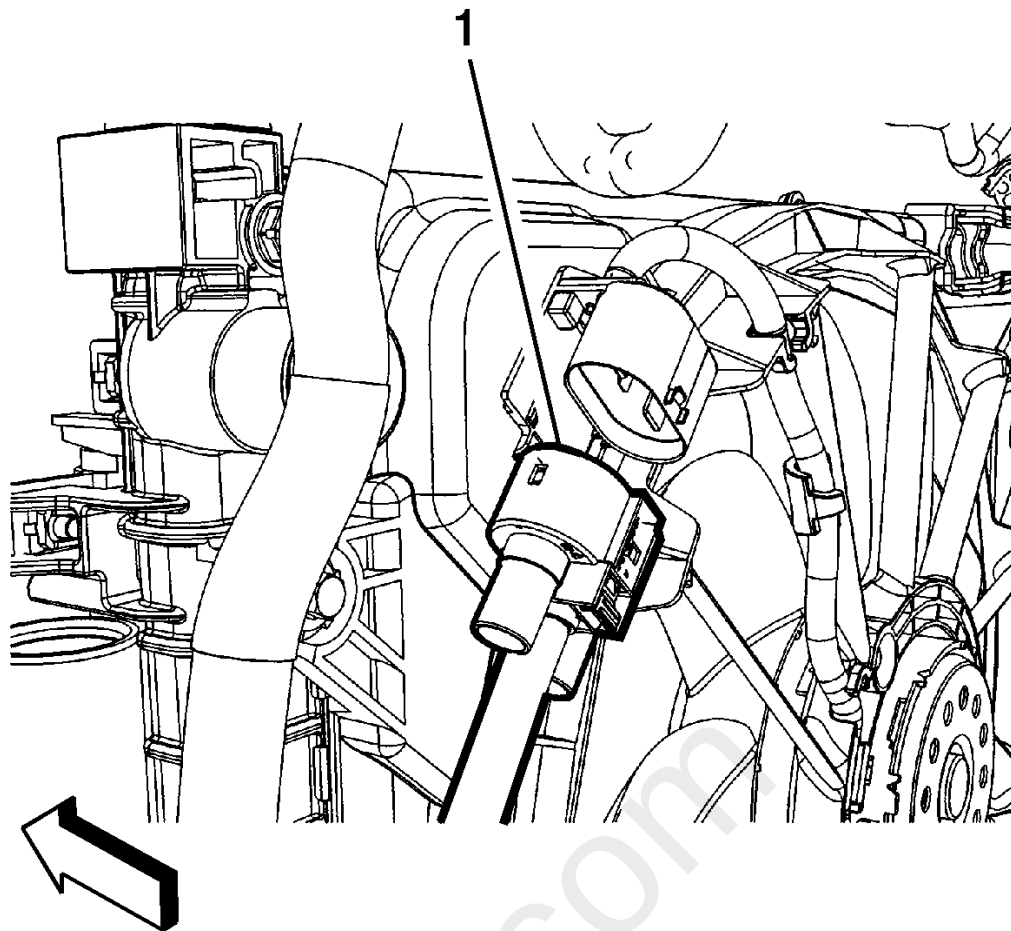


Fig. 157: Coolant Fan Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect the coolant fan wiring harness connector (1).
6. Install the condenser. Refer to [Air Conditioning Condenser Replacement \(LUV\)](#).
7. Install the charge air cooler. Refer to [Charge Air Cooler Replacement](#).
8. Install the radiator air lower baffle and deflector. Refer to [Radiator Air Lower Baffle and Deflector Replacement \(LUV\)](#).
9. Install the radiator air upper baffle and deflector. Refer to [Radiator Air Upper Baffle and Deflector Replacement \(LE2 LUV\)](#).
10. Install the front bumper lower impact bar. Refer to [Front Bumper Lower Impact Bar Replacement \(Chevrolet\)](#).
11. Install the center support bracket. Refer to [Front Bumper Fascia Center Support Replacement](#).
12. Install the radiator inlet hose to the radiator. Refer to [Radiator Outlet Hose Replacement \(LUV\)](#).
13. Install the radiator outlet hose to the radiator. Refer to [Radiator Outlet Hose Replacement \(LUV\)](#).
14. Fill the air conditioning refrigerant. Refer to [Refrigerant Recovery and Recharging \(R-134a\)](#).
15. Fill the coolant fluid. Refer to [Cooling System Draining and Filling](#).
16. Install the front bumper fascia. Refer to [Front Bumper Fascia Replacement \(Chevrolet\)](#), [Front Bumper Fascia Replacement \(Buick\)](#).
17. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#), [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

RADIATOR REPLACEMENT (2H0)

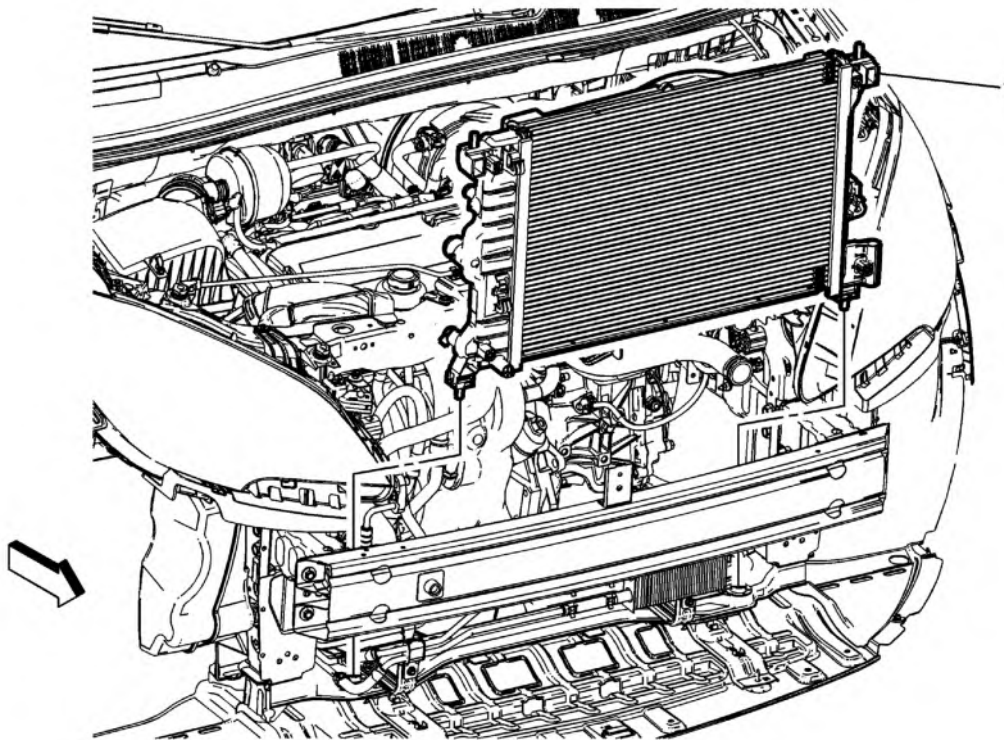


Fig. 158: Radiator (2H0)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Remove the air conditioning condenser. Refer to Air Conditioning Condenser Replacement (LUV), Air Conditioning Condenser Replacement (LE2). 2. Disconnect the radiator inlet and outlet hoses from the radiator assembly. Refer to Radiator Inlet Hose Replacement (2H0), and Radiator Outlet Hose Replacement (2H0). 3. Remove the transmission fluid auxiliary cooler and the transmission fluid cooler inlet pipe from the radiator if equipped. Refer to Transmission Fluid Cooler Inlet Pipe Replacement (2H0). 4. Remove the radiator upper brackets. Refer to Radiator Upper Bracket Replacement (2H0).	
1	Radiator Procedure Unclip the engine coolant fan shroud from the radiator.

RADIATOR REPLACEMENT (LE2)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Recover the refrigerant. [Refrigerant Recovery and Recharging \(R-134a\)](#)
3. Remove Hood Primary and Secondary Latch - [Hood Primary and Secondary Latch Replacement \(Buick\)](#)

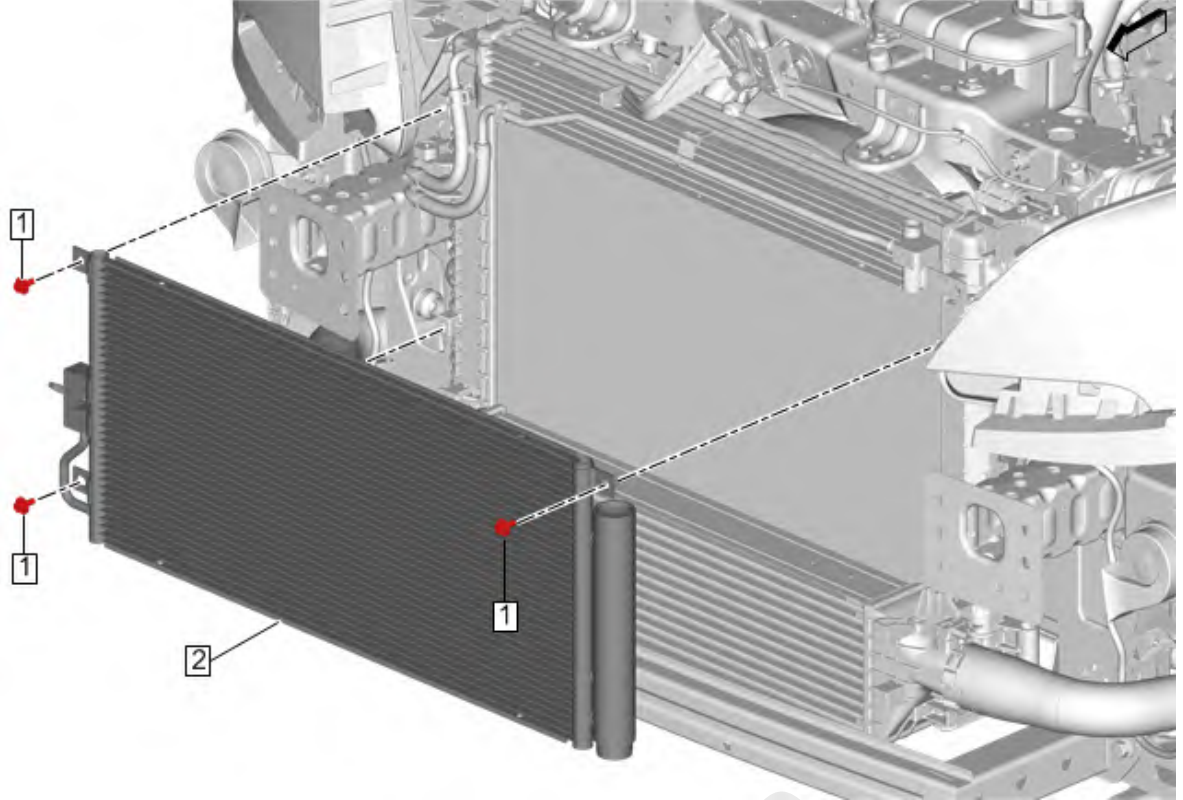


Fig. 159: Air Conditioning Condenser (LE2)
 Courtesy of GENERAL MOTORS COMPANY

4. Remove Air Conditioning Condenser (2) - [Air Conditioning Condenser Replacement \(LE2\)](#)

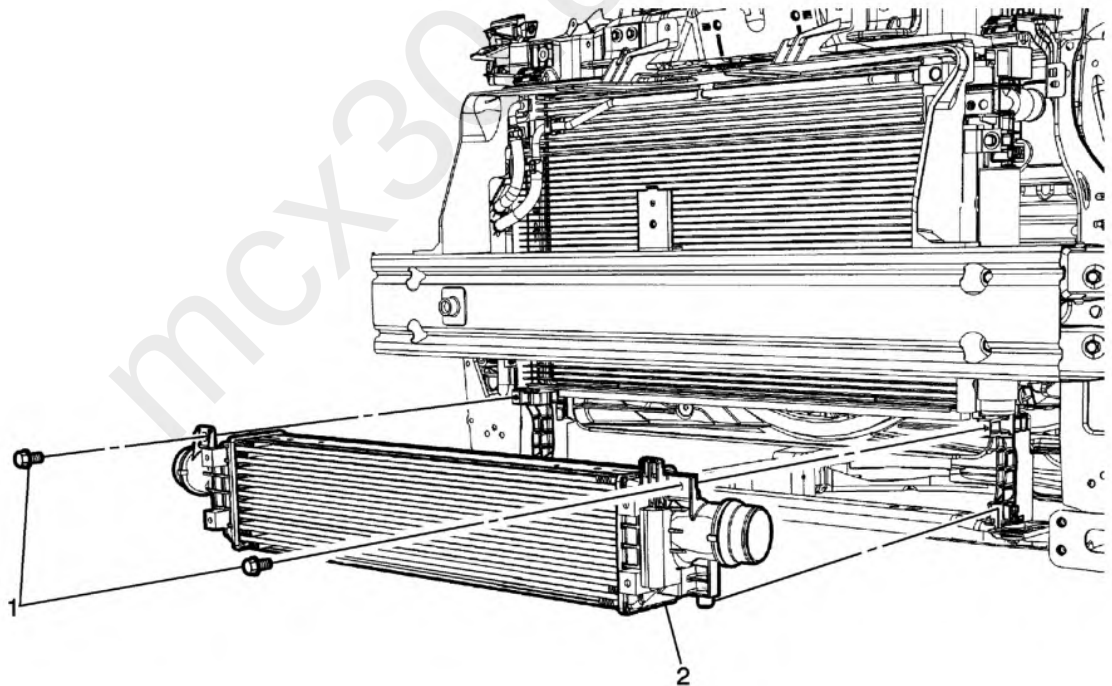


Fig. 160: Charge Air Cooler
 Courtesy of GENERAL MOTORS COMPANY

5. Remove Charge Air Cooler (2)- [Charge Air Cooler Replacement](#)

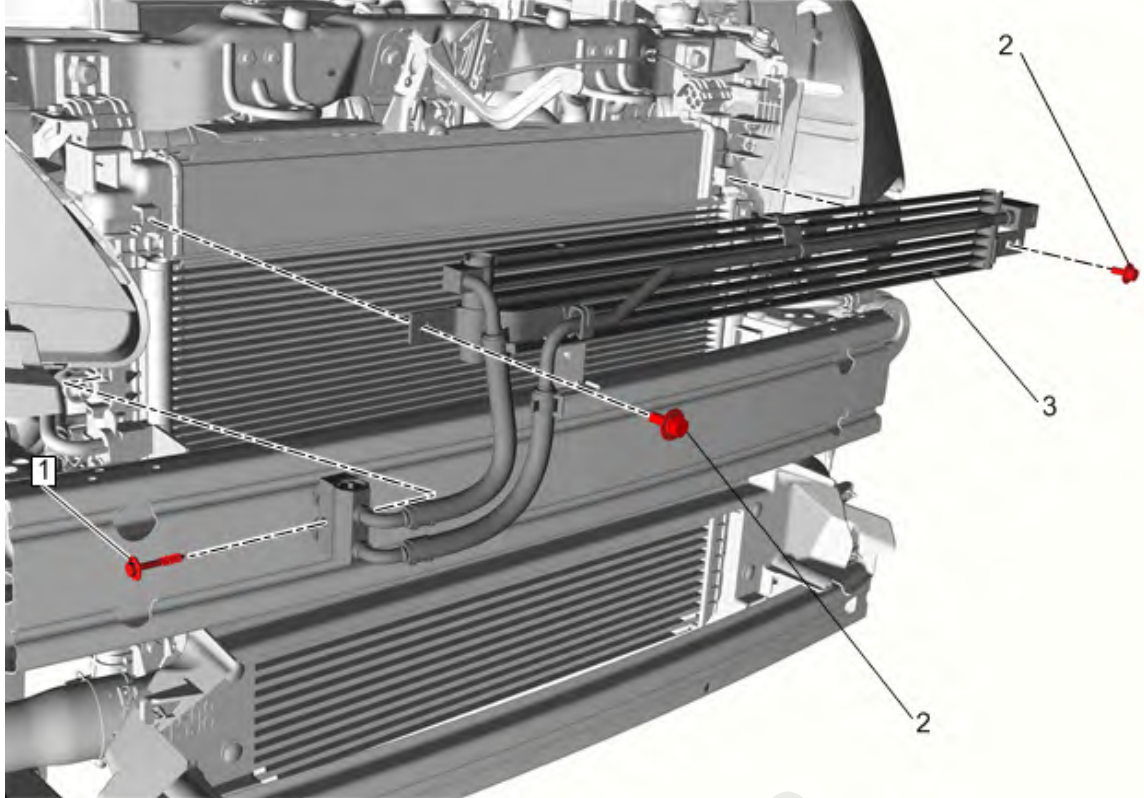


Fig. 161: Transmission Fluid Auxiliary Cooler (LE2 MNH)

Courtesy of GENERAL MOTORS COMPANY

6. Remove Transmission Fluid Auxiliary Cooler (3) - [Transmission Fluid Auxiliary Cooler Replacement \(LE2\)](#)

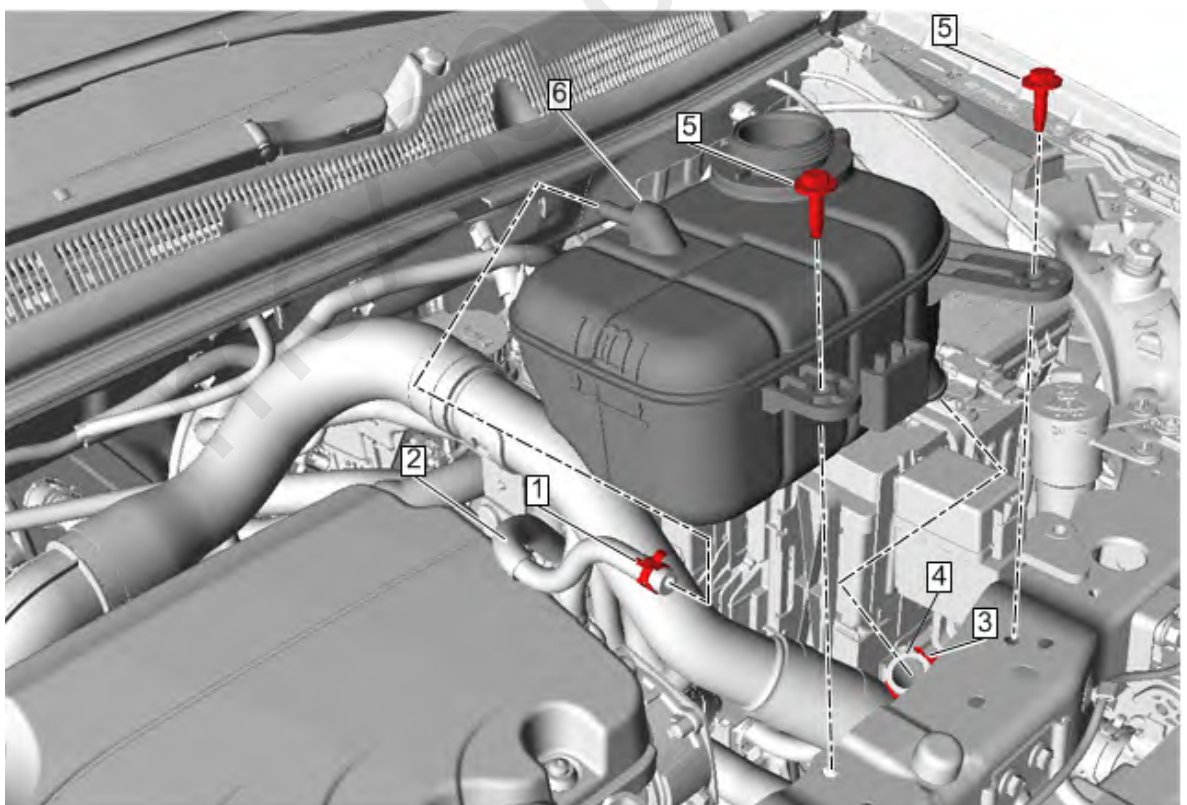


Fig. 162: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

7. Remove Radiator Surge Tank (6) - [Radiator Surge Tank Replacement \(LE2\)](#)

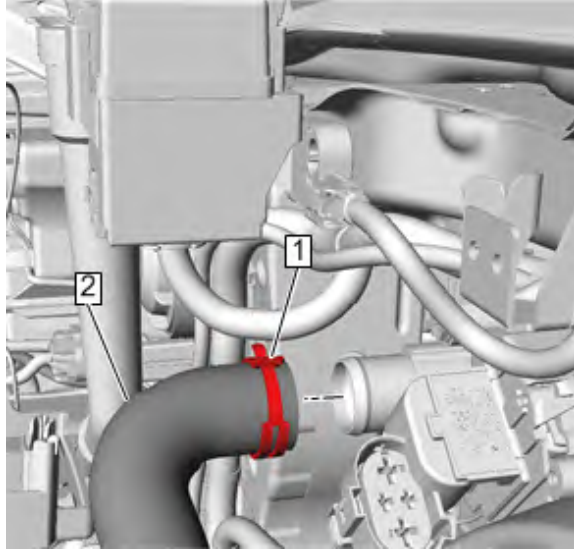


Fig. 163: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Remove Radiator Inlet Hose (2) @Radiator Assembly - [**Radiator Inlet Hose Replacement \(LE2\)**](#)

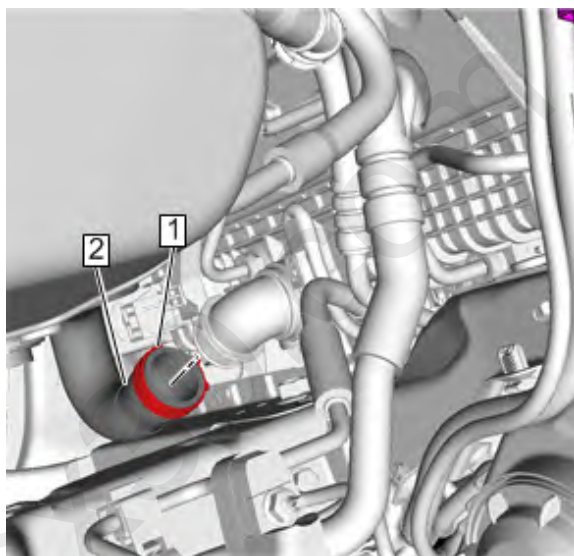


Fig. 164: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Remove Radiator Outlet Hose (2) @Radiator Assembly - [**Radiator Outlet Hose Replacement \(LE2\)**](#)

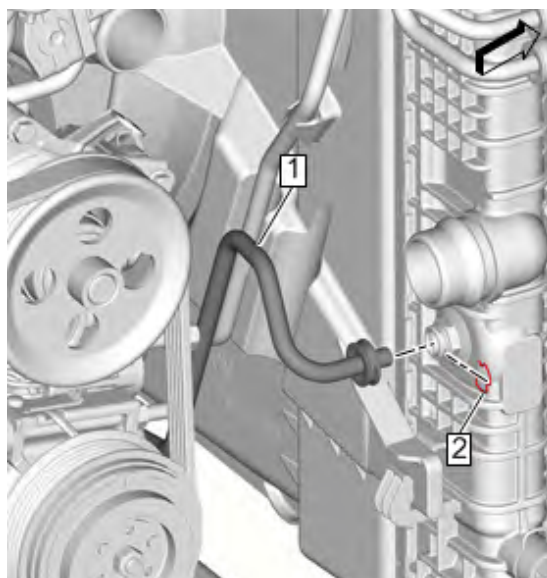


Fig. 165: Transmission Fluid Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

10. Remove Transmission Fluid Cooler Inlet Pipe (1) @Radiator Assembly - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LE2\)](#).
11. Disconnect the engine coolant temperature sensor electrical connector.
12. Disconnect the engine coolant fan connector.

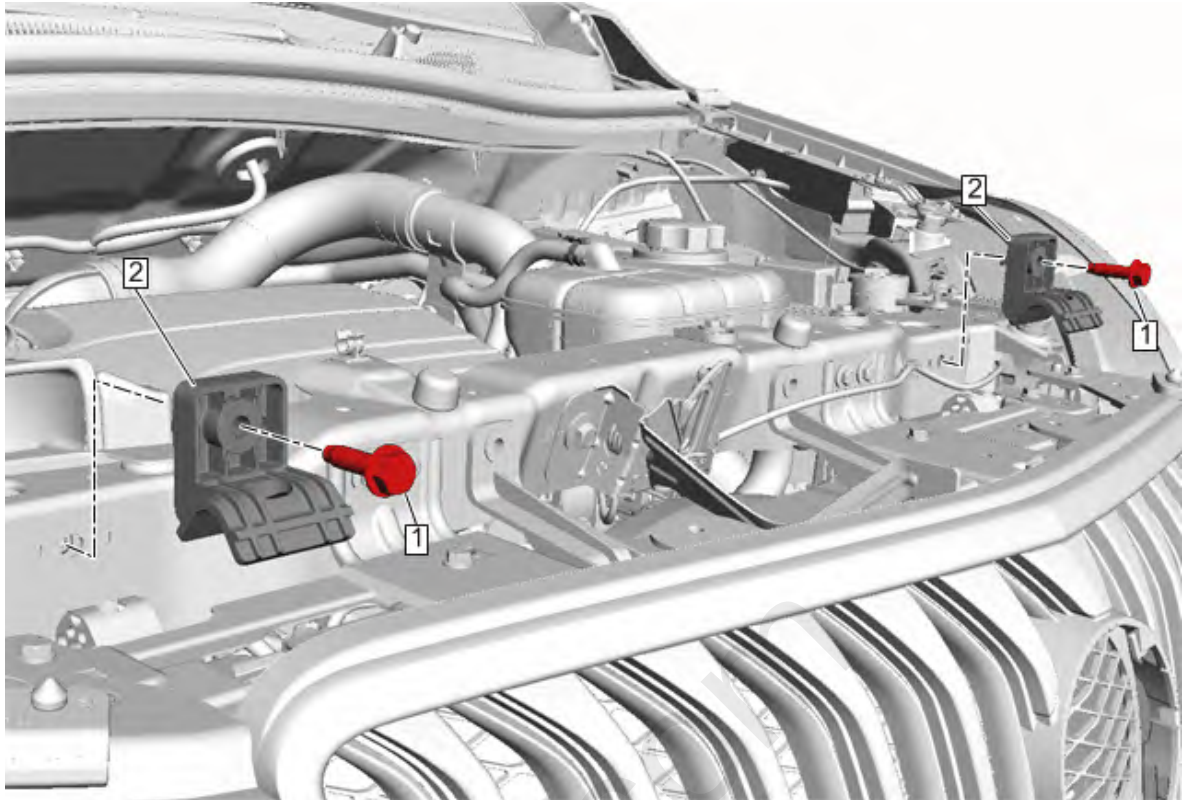


Fig. 166: Radiator Upper Bracket (LE2)

Courtesy of GENERAL MOTORS COMPANY

13. Remove Radiator Upper Bracket (2) - [Radiator Upper Bracket Replacement \(LE2\)](#).

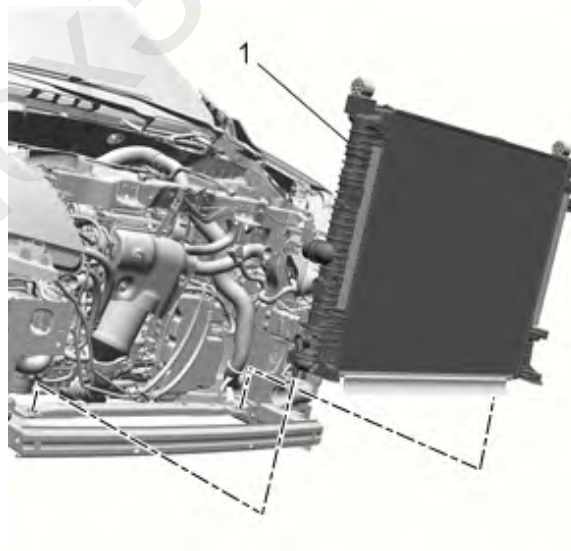


Fig. 167: Radiator

Courtesy of GENERAL MOTORS COMPANY

14. Remove Radiator Assembly (1)

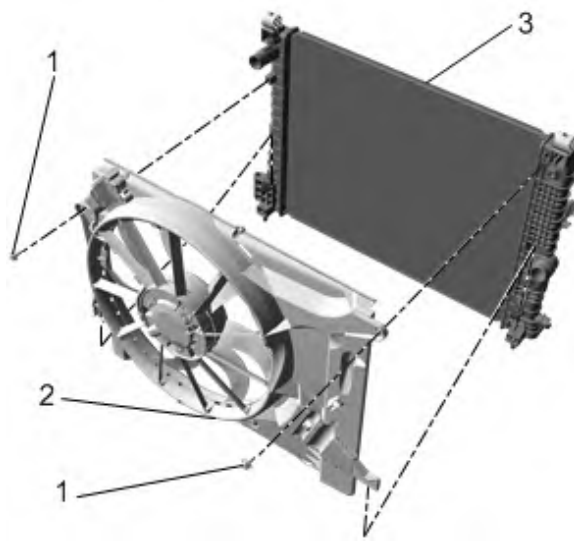


Fig. 168: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

15. Remove Radiator Bolt (1)
16. Remove Engine Coolant Fan Shroud (2)
17. Radiator (3)

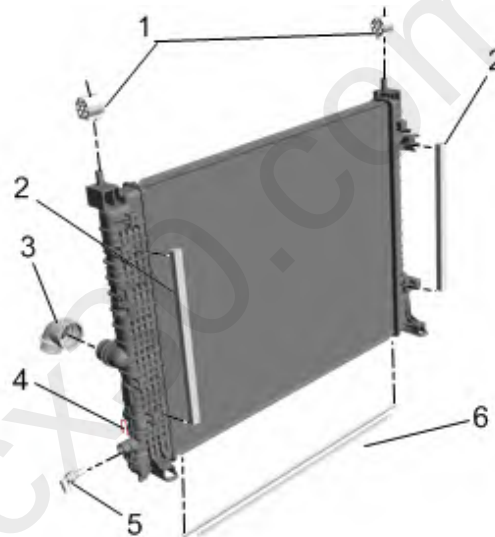


Fig. 169: Radiator Components

Courtesy of GENERAL MOTORS COMPANY

18. Remove Radiator Upper Insulator (1)
19. Remove Air Conditioning Condenser Seal (2)
20. Remove Radiator Outlet Hose Connector (3) - **Radiator Outlet Hose Connector Replacement - Radiator Side (LUV, LE2)**
21. Remove Engine Coolant Temperature Sensor Retainer (4)
22. Remove Engine Coolant Temperature Sensor (5)
23. Remove Lower Radiator Frame (6)

Installation Procedure

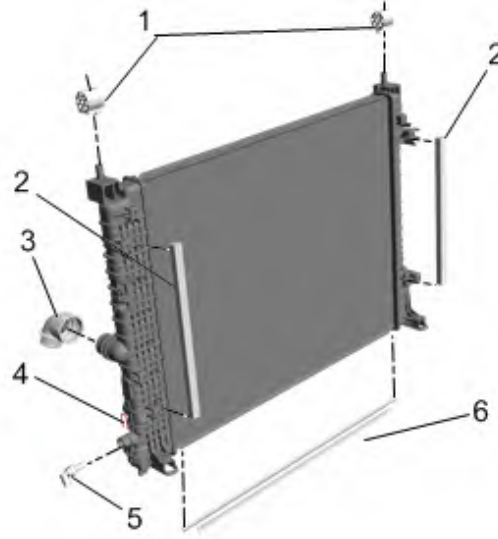


Fig. 170: Radiator Components

Courtesy of GENERAL MOTORS COMPANY

1. Install Lower Radiator Frame (6)
2. Install Engine Coolant Temperature Sensor (5)
3. Install Engine Coolant Temperature Sensor Retainer (4)
4. Install Radiator Outlet Hose Connector (3) - **Radiator Outlet Hose Connector Replacement - Radiator Side (LUV, LE2)**
5. Install Air Conditioning Condenser Seal (2)
6. Install Radiator Upper Insulator (1)

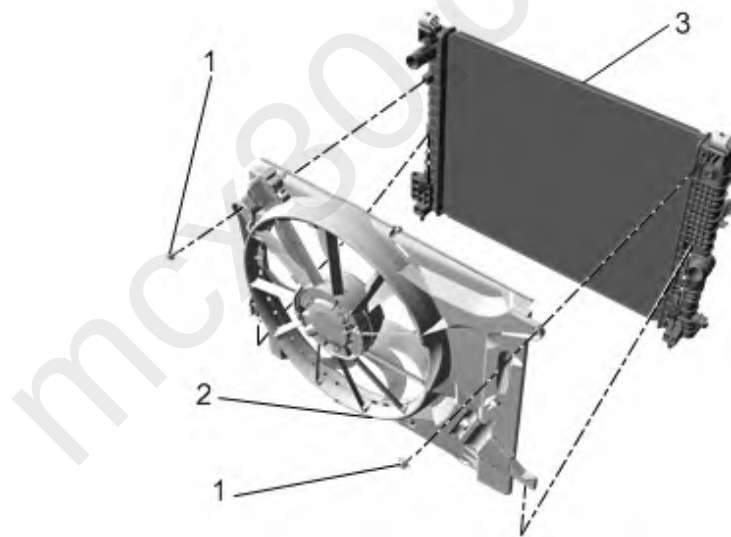


Fig. 171: Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

7. Install Radiator (3)
8. Install Engine Coolant Fan Shroud (2)
9. Install Radiator Bolt (1) and tighten 6 N.m (53 lb in)

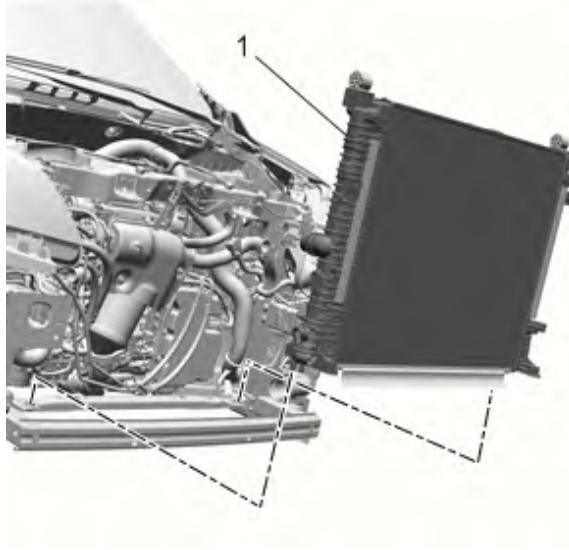


Fig. 172: Radiator

Courtesy of GENERAL MOTORS COMPANY

10. Install Radiator Assembly (1)

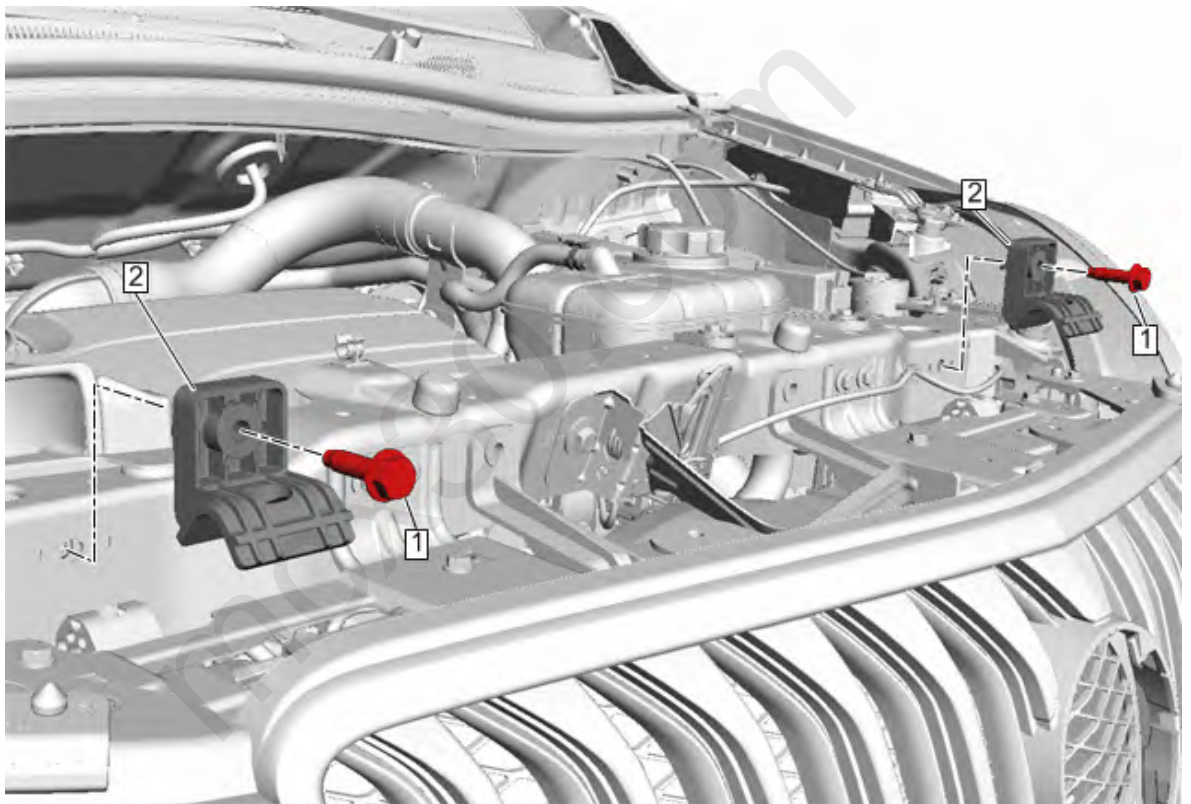


Fig. 173: Radiator Upper Bracket (LE2)

Courtesy of GENERAL MOTORS COMPANY

11. Install Radiator Upper Bracket (2) - **Radiator Upper Bracket Replacement (LE2)**
12. Connect the engine coolant fan connector.
13. Connect the engine coolant temperature sensor electrical connector.

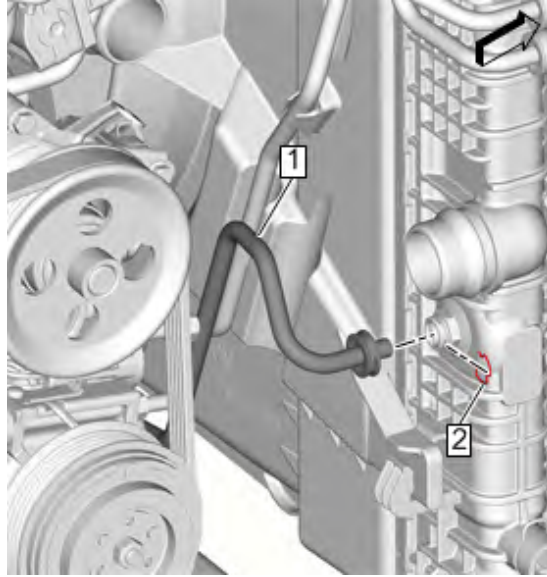


Fig. 174: Transmission Fluid Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

14. Install Transmission Fluid Cooler Inlet Pipe (1) @Radiator Assembly - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LE2)**.

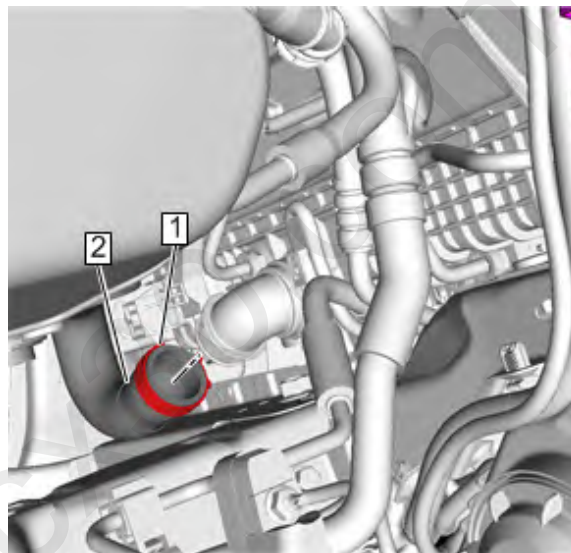


Fig. 175: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

15. Install Radiator Outlet Hose (2) @Radiator Assembly - **Radiator Outlet Hose Replacement (LE2)**.

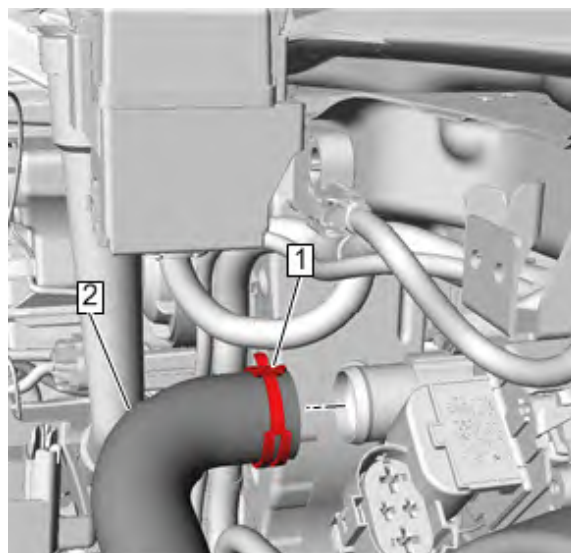


Fig. 176: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

16. Install Radiator Inlet Hose (2) @Radiator Assembly - [Radiator Inlet Hose Replacement \(LE2\)](#)

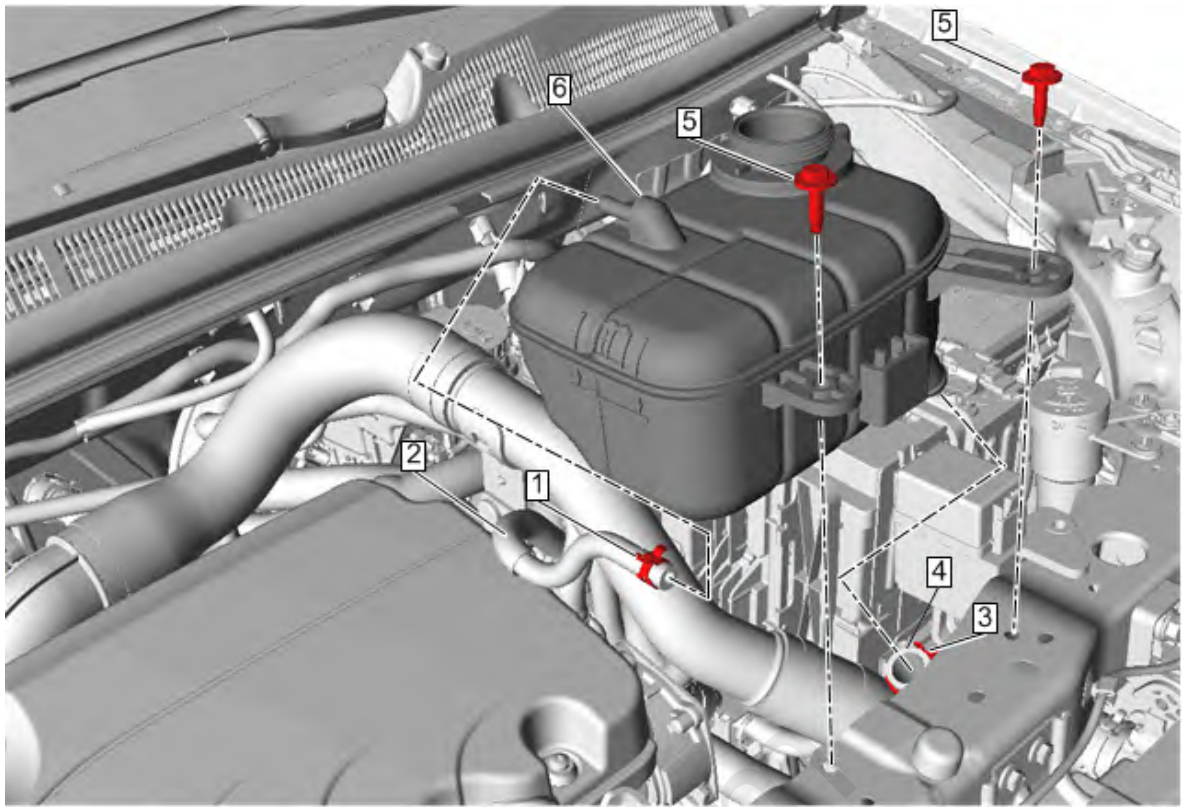


Fig. 177: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

17. Install Radiator Surge Tank (6) - [Radiator Surge Tank Replacement \(LE2\)](#)

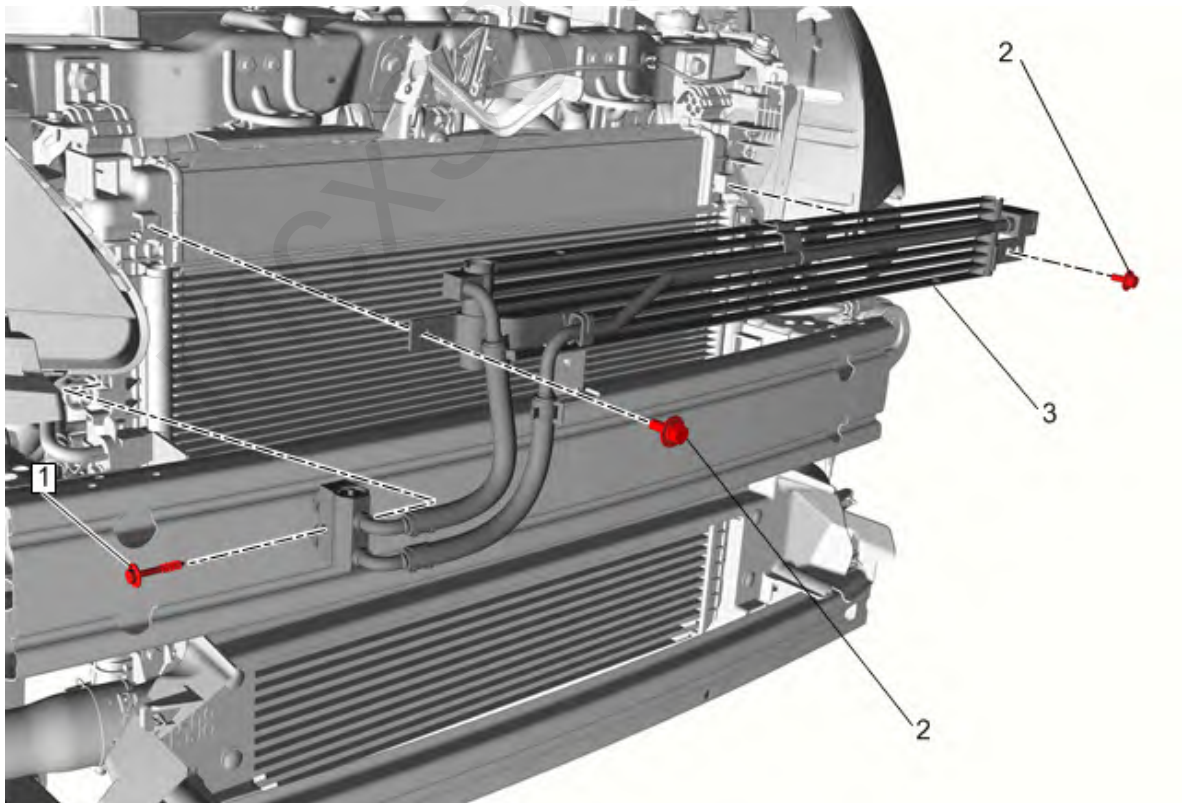


Fig. 178: Transmission Fluid Auxiliary Cooler (LE2 MNH)

Courtesy of GENERAL MOTORS COMPANY

18. Install Transmission Fluid Auxiliary Cooler (3) - [Transmission Fluid Auxiliary Cooler Replacement \(LE2\)](#)

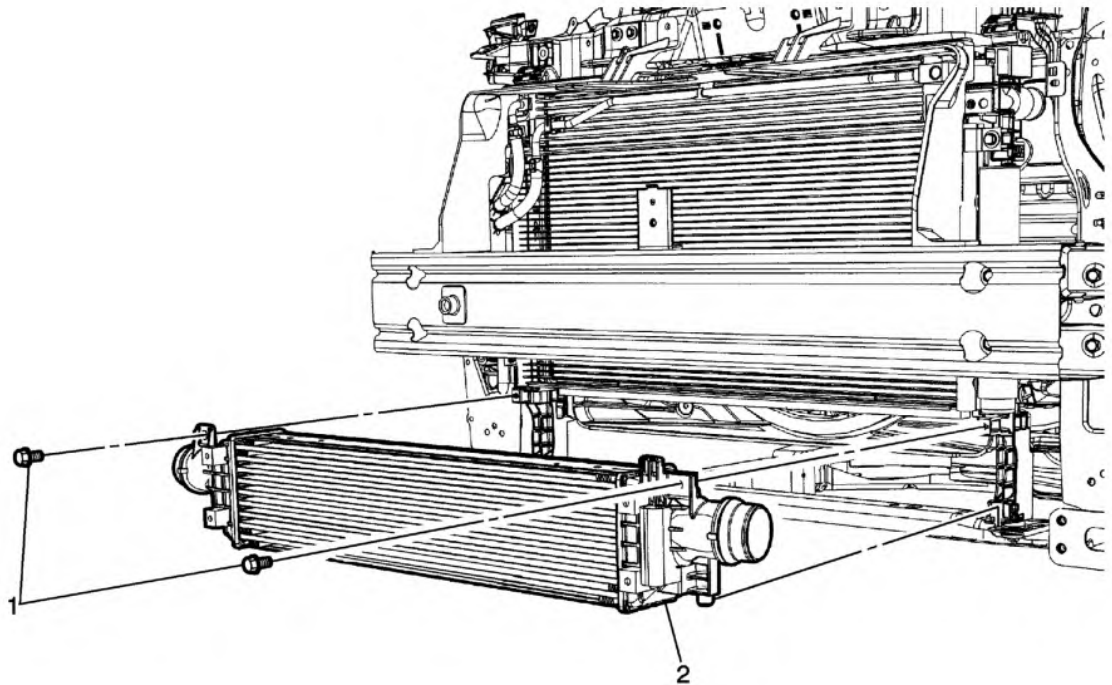


Fig. 179: Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

19. Install Charge Air Cooler (2) - [Charge Air Cooler Replacement](#)

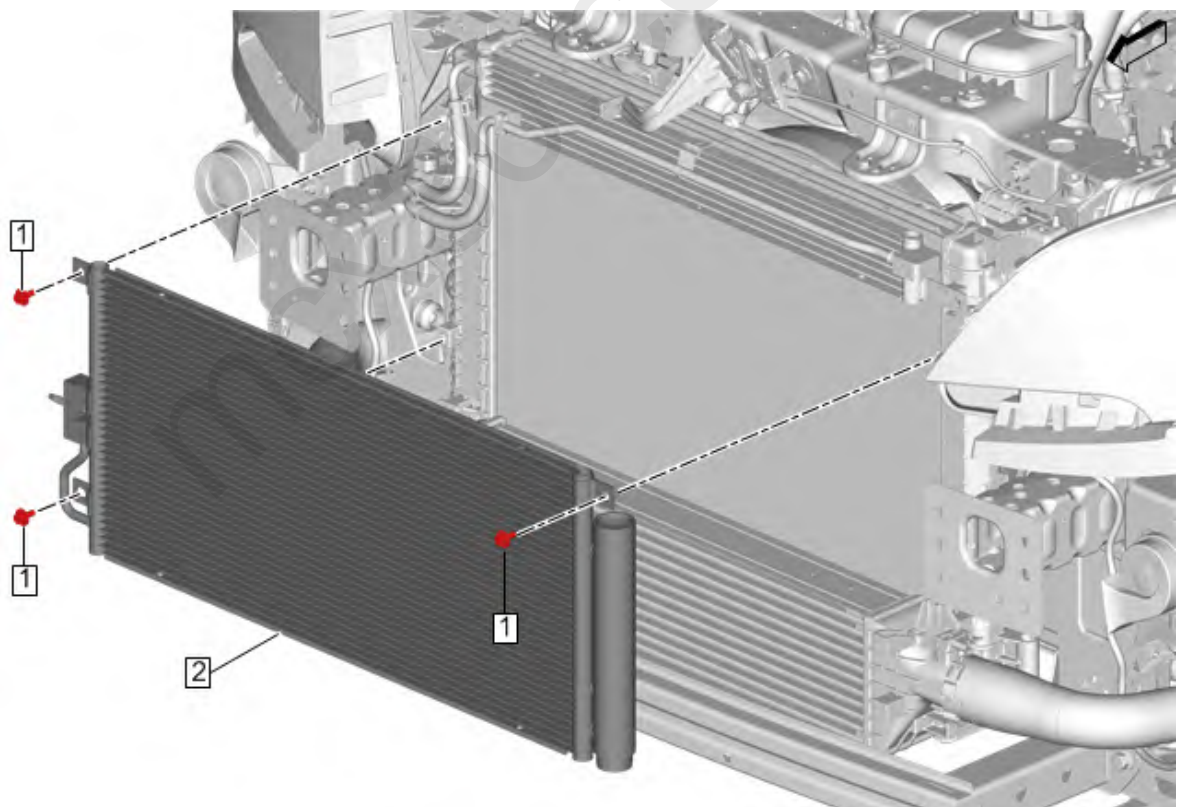


Fig. 180: Air Conditioning Condenser (LE2)

Courtesy of GENERAL MOTORS COMPANY

20. Install Air Conditioning Condenser (2) - [Air Conditioning Condenser Replacement \(LE2\)](#)
21. Install Hood Primary and Secondary Latch - [Hood Primary and Secondary Latch Replacement \(Buick\)](#)
22. Fill and inspect the transmission fluid level. [Transmission Fluid Level and Condition Check](#)
23. Recharge the refrigerant. [Refrigerant Recovery and Recharging \(R-134a\)](#)
24. Fill the cooling system. [Cooling System Draining and Filling](#)
25. Start the engine and check for coolant leaks.

26. Inspect for refrigerant leaks.
27. Inspect for transmission fluid leaks.

RADIATOR UPPER INSULATOR REPLACEMENT (LE2)

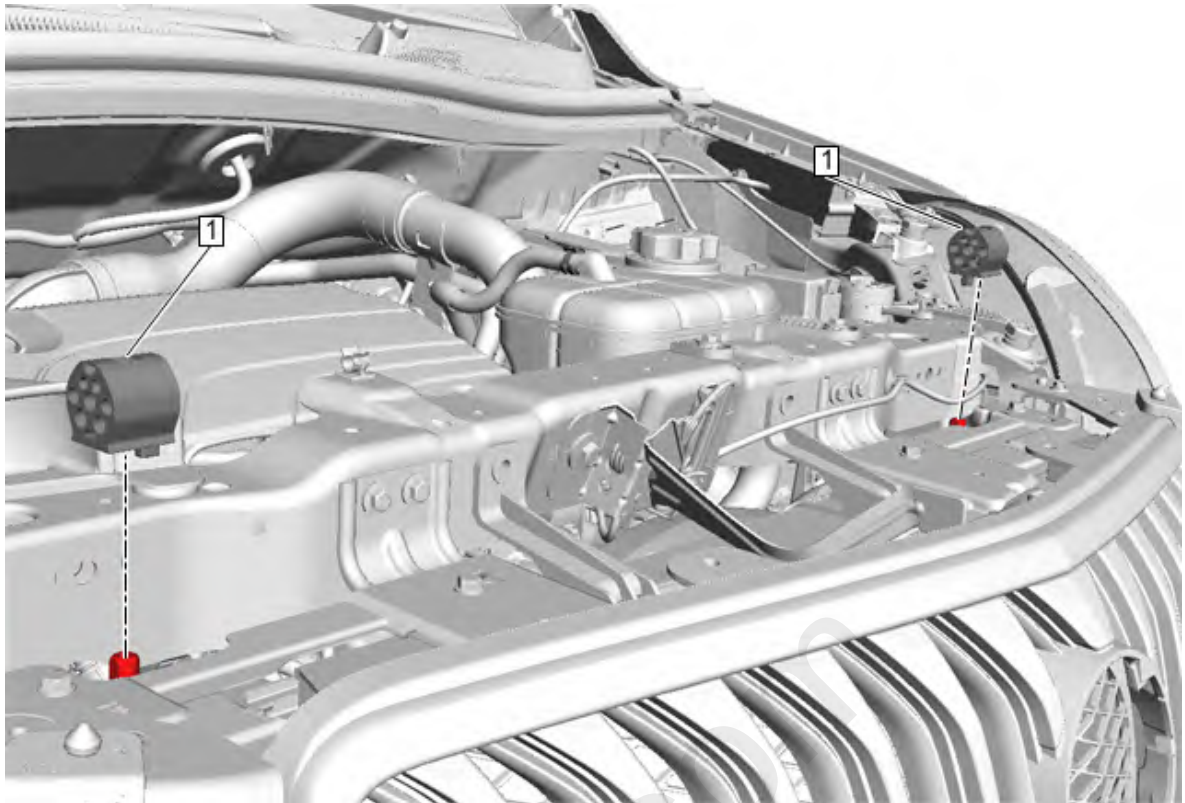


Fig. 181: Radiator Upper Insulator (LE2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. <u>Front Bumper Fascia Opening Upper Cover Replacement</u>	
2. <u>Radiator Upper Bracket Replacement (LE2)</u>	
1	Radiator Upper Insulator (Qty: 2)

RADIATOR LOWER INSULATOR REPLACEMENT (LE2)

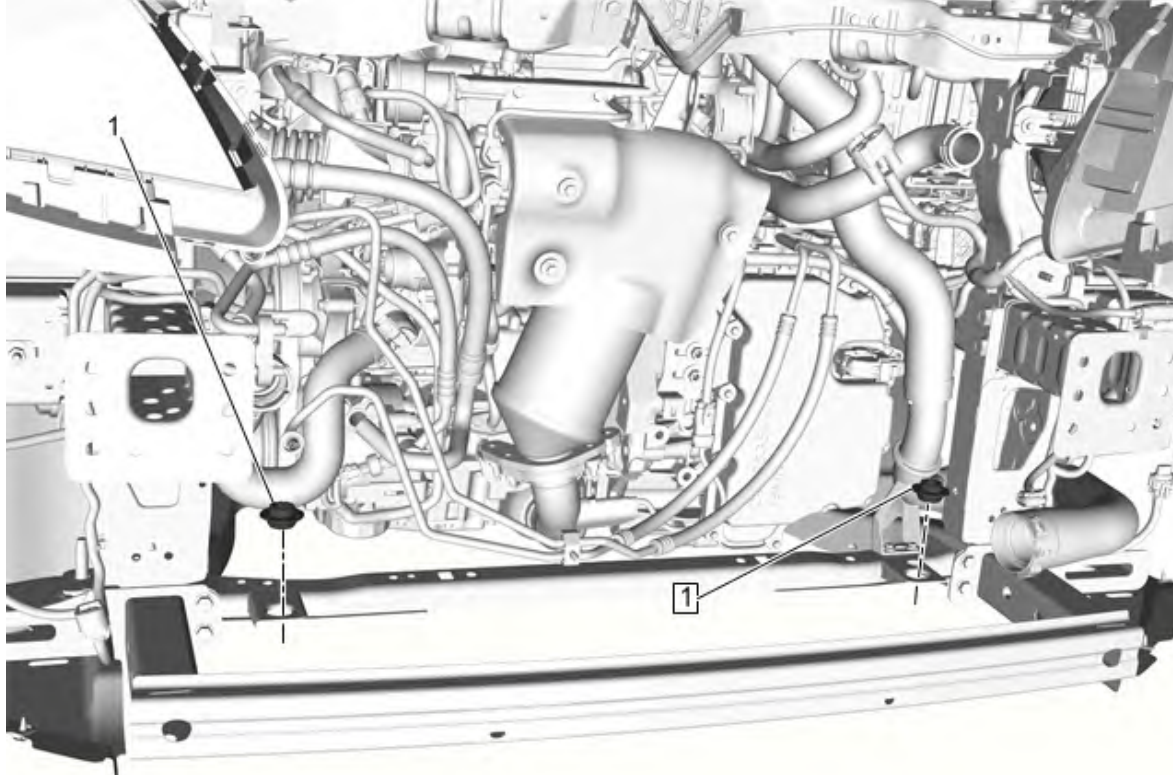


Fig. 182: Radiator Lower Insulator Replacement (LE2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Radiator Replacement (LE2)</u>	
1	Radiator Lower Insulator (Qty: 2)

RADIATOR SUPPORT BAFFLE REPLACEMENT

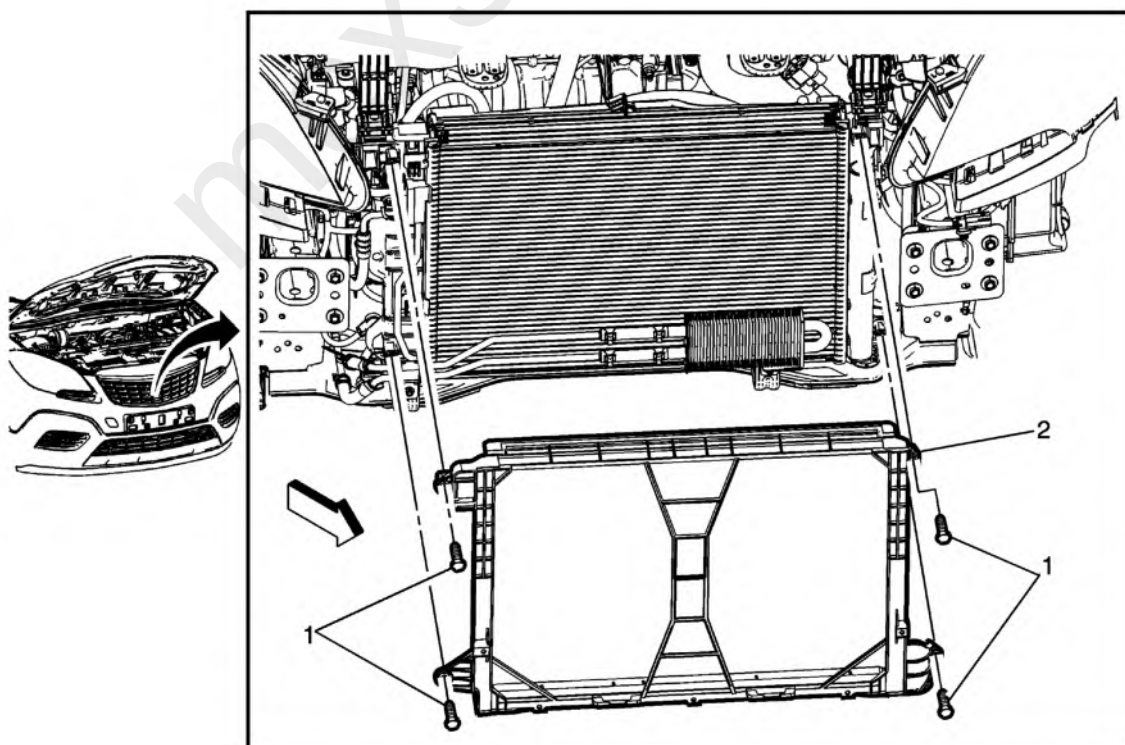


Fig. 183: Radiator Support Baffle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures	
1. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement (Chevrolet), Front Bumper Fascia Replacement (Buick) . 2. Remove the front bumper fascia upper support. Refer to Front Bumper Fascia Upper Support Replacement (Chevrolet) . 3. Remove the radiator air lower baffle and deflector. Refer to Radiator Air Lower Baffle and Deflector Replacement (LE2)Radiator Air Lower Baffle and Deflector Replacement (2H0)Radiator Air Lower Baffle and Deflector Replacement (LUV). 4. Remove the air upper baffle and deflector. Refer to Radiator Air Upper Baffle and Deflector Replacement (2H0)Radiator Air Upper Baffle and Deflector Replacement (LE2 LUV). 5. Disconnect the transmission fluid auxiliary cooler from the radiator support baffle if equipped. Refer to Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection .	
1	Radiator Support Baffle Fastener (Qty: 4) CAUTION: Refer to Fastener Caution .
2	Radiator Support Baffle Procedure Tilt the radiator support bracket forward and lift to remove from the vehicle.

RADIATOR AIR LOWER BAFFLE AND DEFLECTOR REPLACEMENT (LE2)

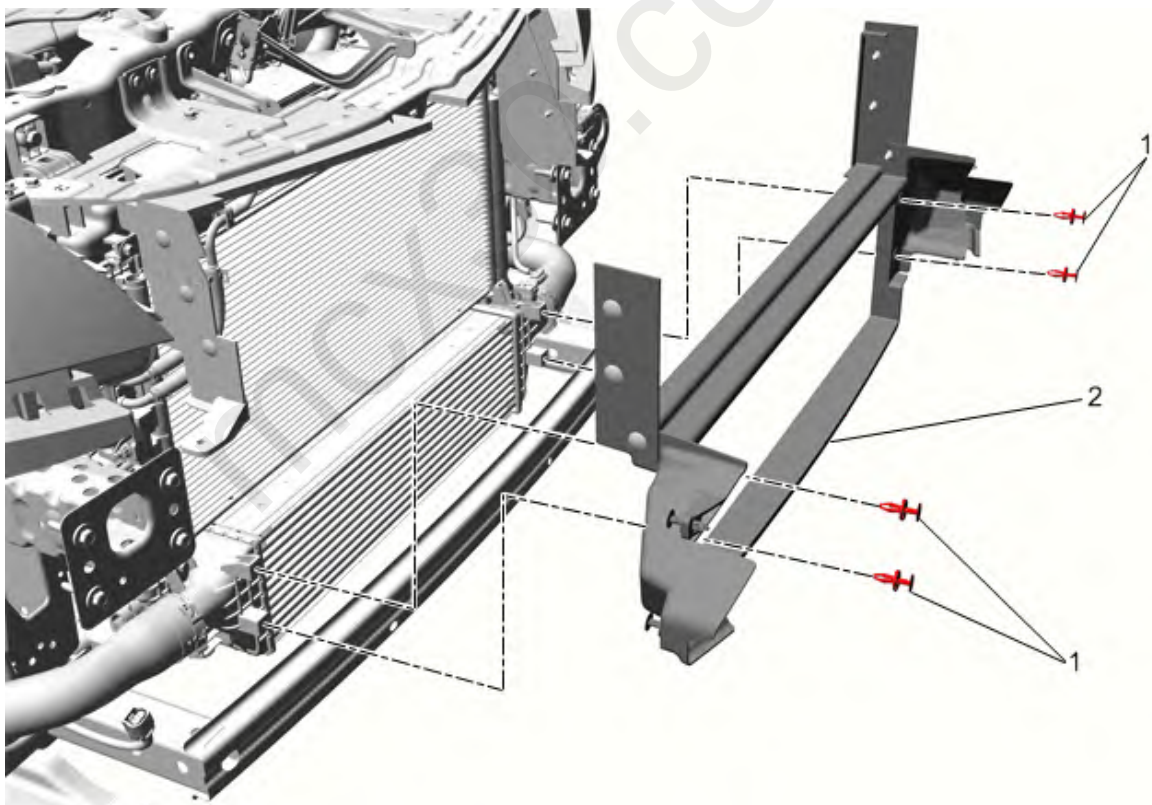


Fig. 184: Radiator Air Lower Baffle (LE2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Front Bumper Fascia Replacement (Buick). 2. Front Bumper Lower Impact Bar Replacement (Chevrolet).	
1	Radiator Air Baffle Retainer (Qty: 4)
2	Radiator Air Lower Baffle

Removal Procedure

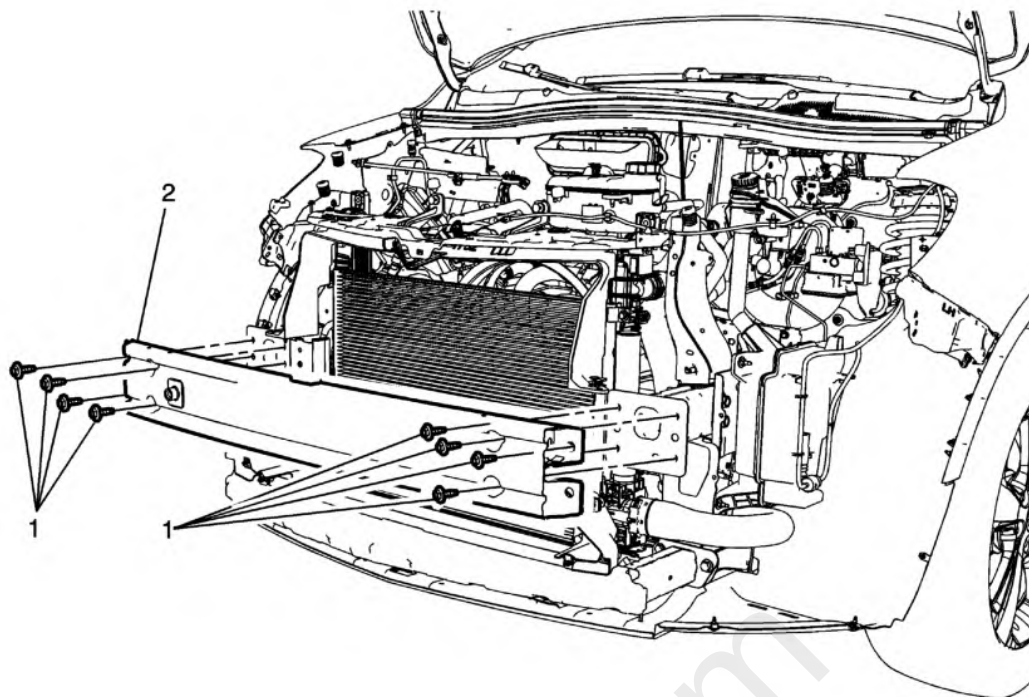


Fig. 185: Front Bumper Upper Impact Bar

Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Bumper Upper Impact Bar (2) - **Front Bumper Upper Impact Bar Replacement**

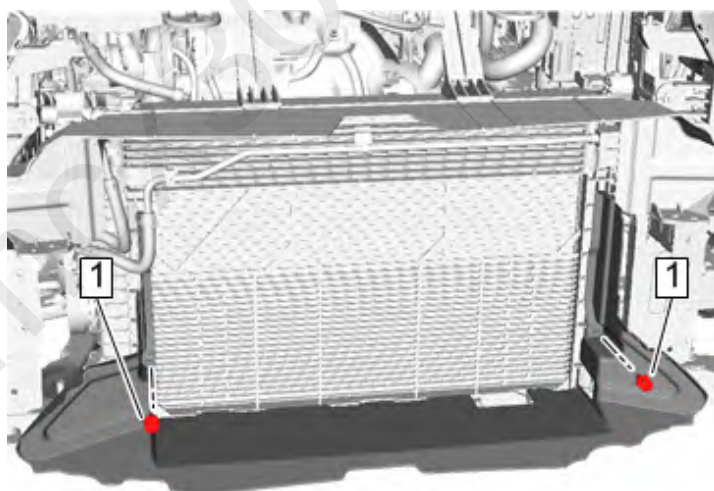


Fig. 186: Radiator Air Lower Baffle Retainer

Courtesy of GENERAL MOTORS COMPANY

2. Remove Radiator Air Lower Baffle Retainer (1)

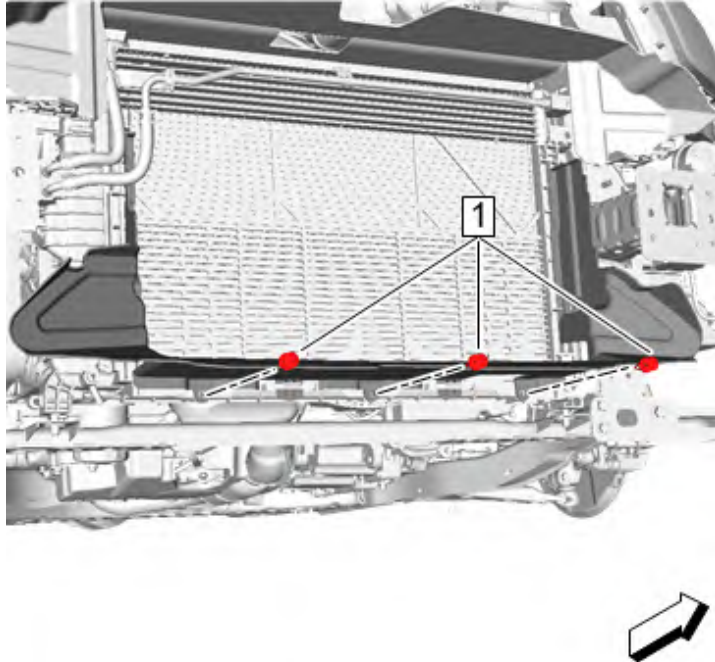


Fig. 187: Radiator Air Lower Baffle Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Air Lower Baffle Retainer (1)

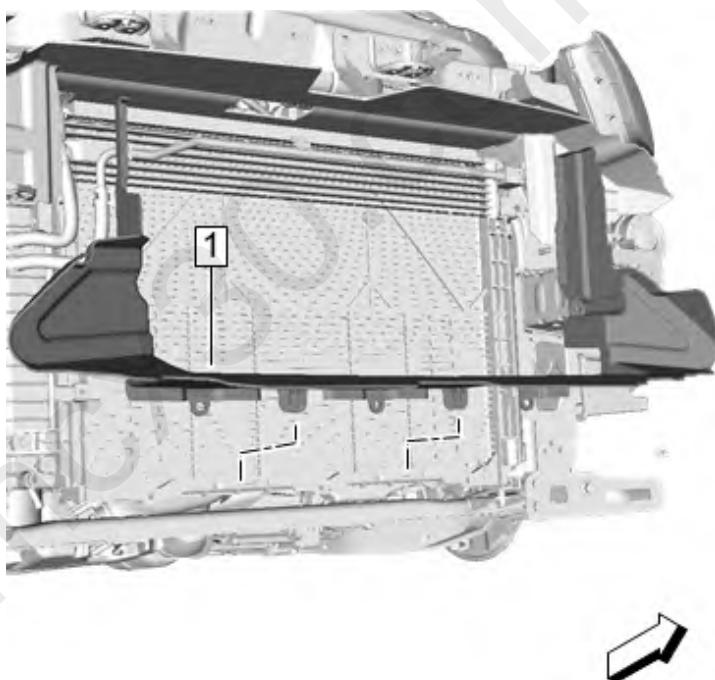


Fig. 188: Radiator Air Lower Baffle
Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Air Lower Baffle (1)

Installation Procedure

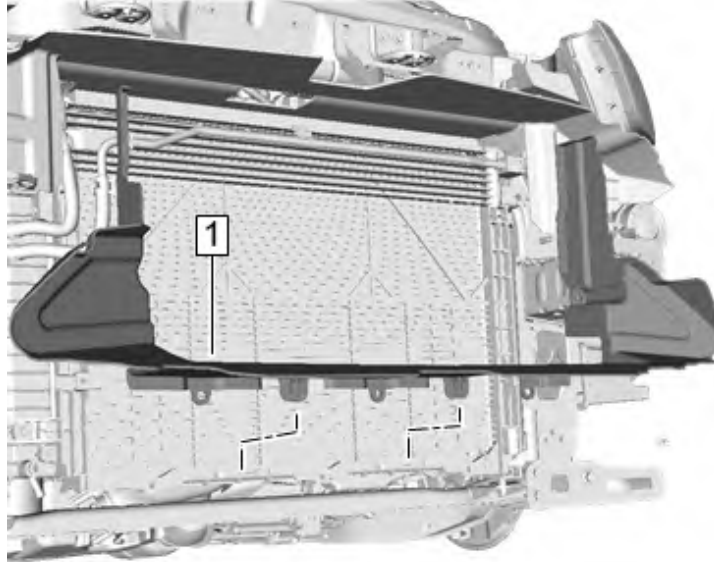


Fig. 189: Radiator Air Lower Baffle
 Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Air Lower Baffle (1)

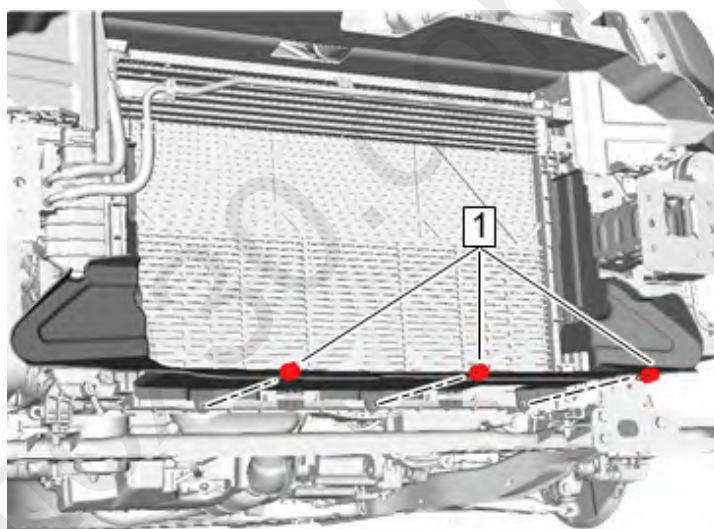


Fig. 190: Radiator Air Lower Baffle Retainer
 Courtesy of GENERAL MOTORS COMPANY

2. Install Radiator Air Lower Baffle Retainer (1)

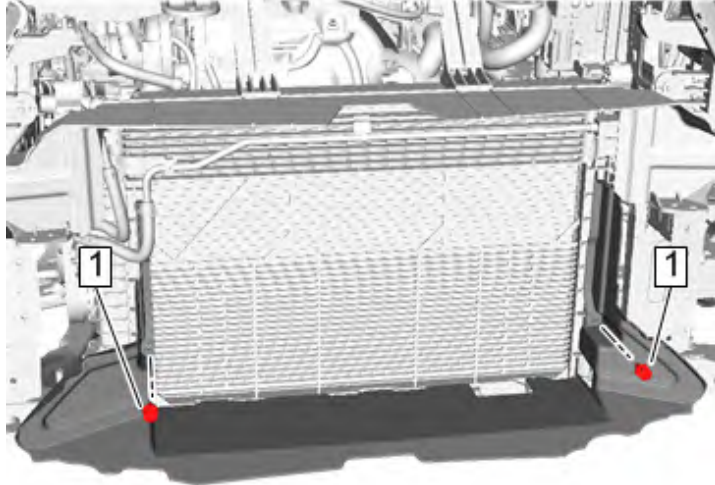


Fig. 191: Radiator Air Lower Baffle Retainer
 Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Air Lower Baffle Retainer (1)

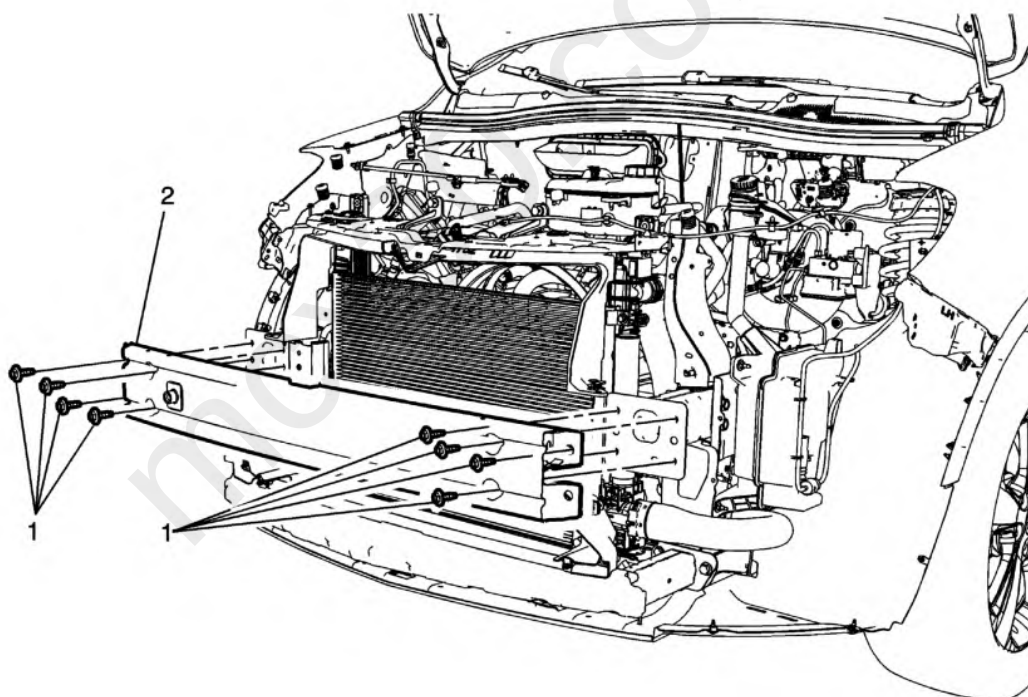


Fig. 192: Front Bumper Upper Impact Bar
 Courtesy of GENERAL MOTORS COMPANY

4. Install Front Bumper Upper Impact Bar (2) - [Front Bumper Upper Impact Bar Replacement](#)

RADIATOR AIR LOWER BAFFLE AND DEFLECTOR REPLACEMENT (LUV)

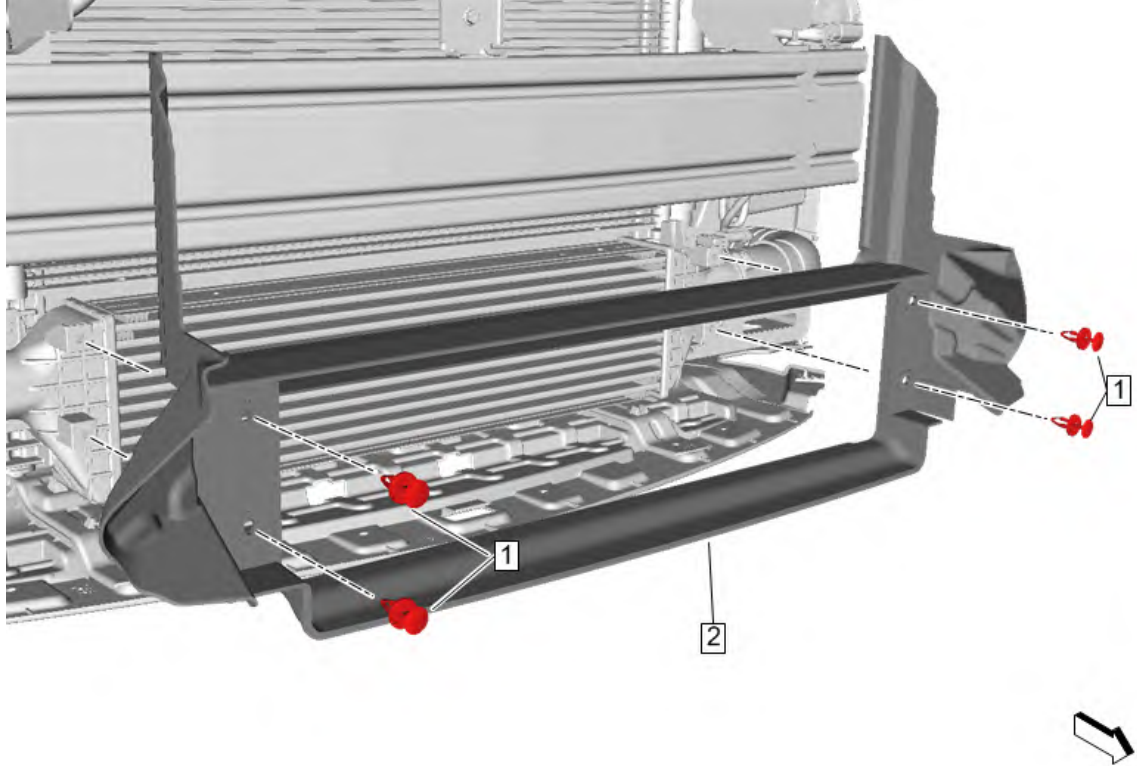


Fig. 193: Radiator Air Lower Baffle and Deflector (LUV)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Front Bumper Lower Impact Bar Replacement (Chevrolet)	
1	Radiator Air Baffle Retainer (Qty: 4)
2	Radiator Air Lower Baffle

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT (2H0)

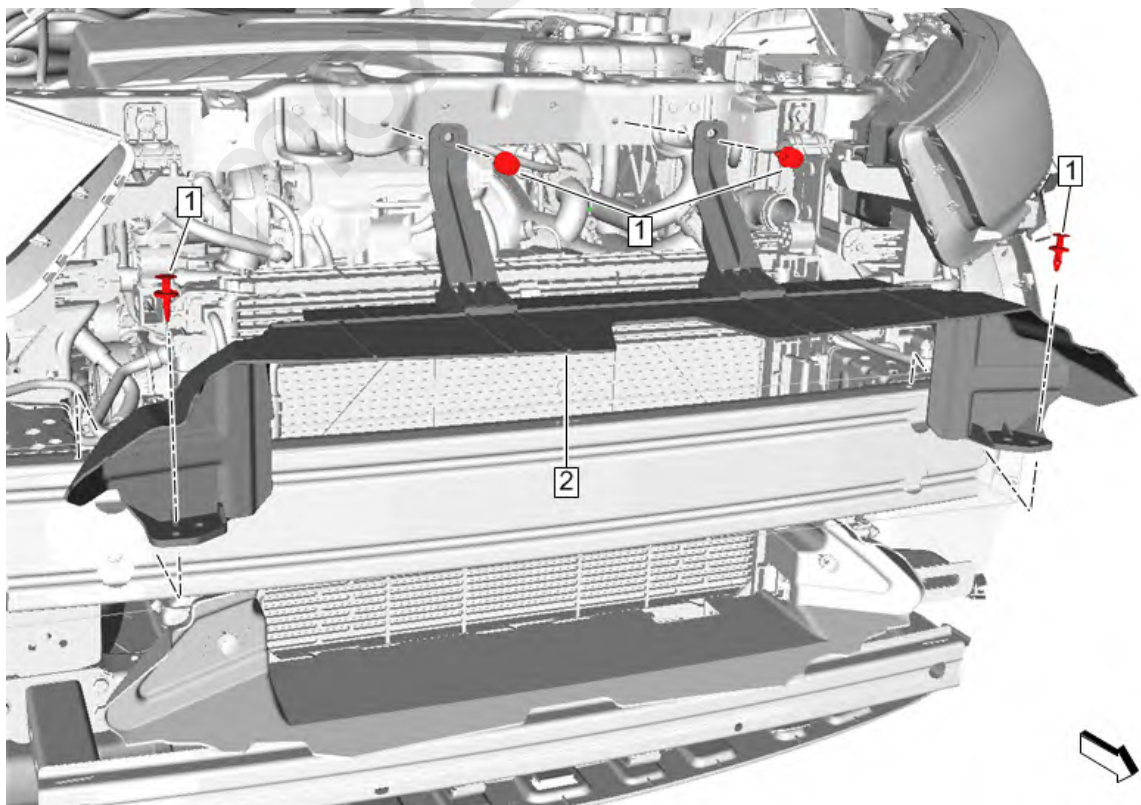


Fig. 194: Radiator Air Upper Baffle and Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Upper Support Replacement (Chevrolet)	
1	Radiator Air Baffle Retainer (Qty: 4)
2	Radiator Air Upper Baffle

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT (LE2 LUV)

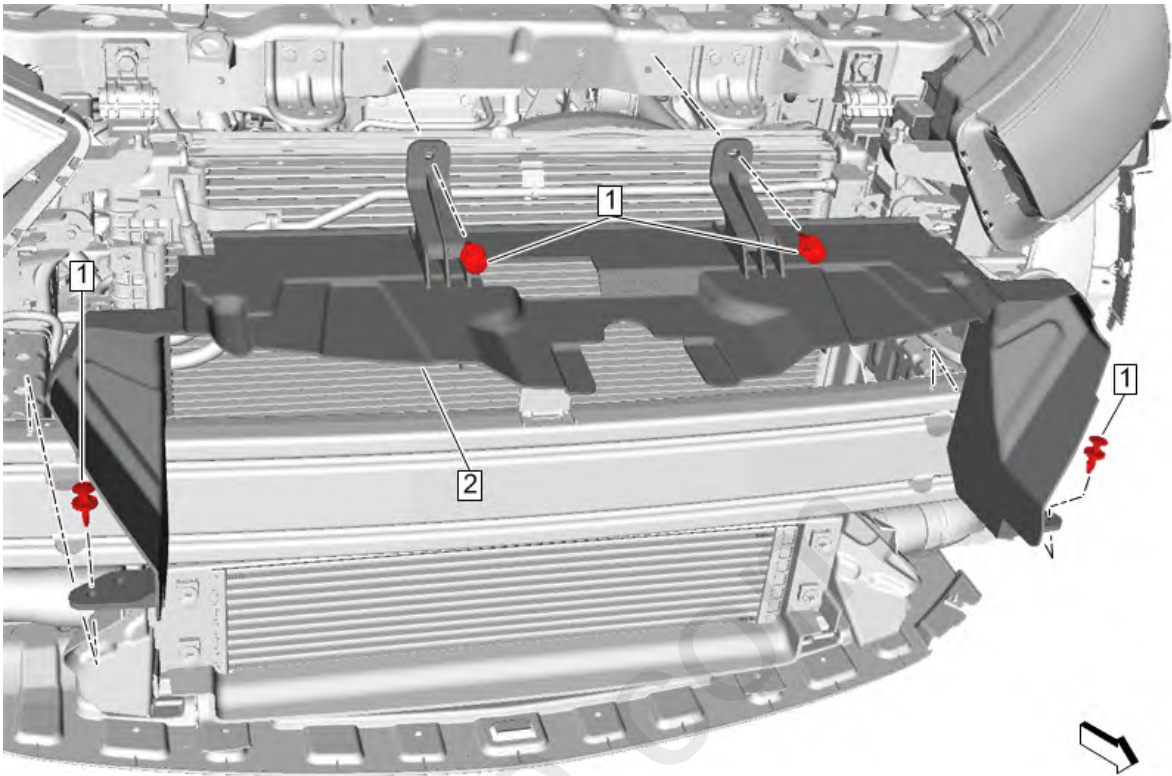


Fig. 195: Radiator Air Upper Baffle and Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Upper Support Replacement (Chevrolet)	
1	Radiator Air Baffle Retainer (Qty: 4)
2	Radiator Air Upper Baffle

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION (2H0 OR LDE)

System Overview

The engine cooling fan system is composed of one cooling fan, 2 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes 1 resistor mounted in the cooling fan shroud. The cooling fan resistor may be a stand alone component, or a part of the cooling fan motor and harness assembly. This combination of components enables the ECM to operate the cooling fan at 2 speeds using two fan control circuits. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Low Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the low speed cooling fan relay. The energized low speed relay switch closes to supply B+ through the cooling fan resistor, to the engine cooling fan motor. The result is cooling fan operation at a reduced speed.

High Speed Operation

The ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan high speed relay. The energized high speed relay switch closes to supply B+ directly to the engine cooling fan motor, by-passing the

cooling fan resistor. The result is cooling fan operation at full speed.

Cooling System Electronic Component Description and Operation

Coolant Heater

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. A weather shield on the cord is provided to protect the plug when not in use.

Engine or Radiator Coolant Temperature Sensor

The engine coolant temperature (ECT) sensor or radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine or radiator coolant. The ECM supplies 5 V to the sensor signal circuit and a ground for the low reference circuit.

Engine Coolant Thermostat Heater

The ECM controls the pulse width modulated (PWM) thermostat heater circuit. The engine coolant thermostat heater helps control coolant flow and regulates the engine operating temperature. The ignition relay supplies 12 V to the thermostat through a fuse. The ECM controls the engine coolant thermostat heater 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.

Electronic Coolant Pump

The switchable water pump is always ON in the default position. When commanded, an actuator disengages a clutch that decouples the pump from the engine. An Engine Material Sensor has been introduced on the engine head for the switchable water pump control and engine protection purposes. The engine metal temperature (EMT) sensor is present only if the switchable water pump is present in the specific application.

Engine Metal Temperature Sensor/Cylinder Head Temperature Sensor

The cylinder head temperature sensor is a variable resistor that measures the temperature of the cylinder head. The engine control module (ECM) supplies 5 V to the cylinder head temperature sensor signal circuit and a ground for the low reference circuit.

Electro-Viscous (EV) Fan Clutch

The ECM controls the EV fan clutch operation. The ECM regulates a 12-volt pulse width modulated signal (PWM) to the cooling fan relay. The PWM signal determines the ON time of the relay. As the ECM command increases, so does the ON time of the relay. The relay ON time directly controls the amount of time the solenoid, which is internal to the fan clutch, is energized. When the solenoid in the fan clutch is energized, it opens the spring loaded valve and allows fluid to flow from the storage chamber to the fluid coupling of the cooling fan clutch, which increases the fan speed. When the solenoid is de-energized, the spring loaded valve closes, and allows the fluid in the coupling of the fan clutch to drain back to the storage chamber, which reduces fan speed. The rapid modulation of the fan clutch solenoid valve gives the ECM the ability to precisely control the amount of fluid that remains in the fluid coupler, allowing more effective regulation of the fan speed and powertrain cooling requirements.

COOLING FAN DESCRIPTION AND OPERATION (LUV OR LUJ)

The engine cooling fan system is composed of one cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Low Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the cooling fan relay. The energized cooling fan relay completes a ground, through the switch side of the relay, for the coils of the cooling fan low speed relay and the cooling fan speed control relay. The speed control relay activates and supplies B+ to the coil side of the cooling fan high speed relay. The high speed relay remains inactive because the ECM is not commanding the FAN 2 control circuit ON. The energized low speed relay switch closes to supply B+ through the internal low speed resistor of the engine cooling fan motor. The result is cooling fan operation at a reduced speed.

Medium Speed Operation

The ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan high speed, and medium speed relays. The high speed relay remains inactive because the ECM is not commanding the FAN 1 control circuit ON. The energized medium speed relay switch closes to supply B+ through the internal medium speed resistor of the engine cooling fan motor. The result is cooling fan operation at a medium speed.

High Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the cooling fan relay. The energized cooling fan relay completes a ground, through the switch side of the relay, for the coil of the cooling fan speed control relay. The energized speed control relay switch closes to supply B+ to the coil side of cooling fan high speed relay. Simultaneously, the ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan high speed relay. The energized high speed relay switch closes to supply B+ directly to the engine cooling fan motor, by-passing the fans internal resistors. The result is cooling fan operation at full speed.

COOLING FAN DESCRIPTION AND OPERATION (LUD)

The engine cooling fan system is composed of one cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Low Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the cooling fan relay. The energized cooling fan relay completes a ground, through the switch side of the relay, for the coils of the cooling fan low speed relay and the cooling fan speed control relay. The speed control relay activates and supplies B+ to the coil side of the cooling fan high speed relay. The high speed relay remains inactive because the ECM is not commanding the FAN 2 control circuit ON. The energized low speed relay switch closes to supply B+ through the internal low speed resistor of the engine cooling fan motor. The result is cooling fan operation at a reduced speed.

Medium Speed Operation

The ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan medium speed relay. The energized medium speed relay switch closes to supply B+ through the internal medium speed resistor of the engine cooling fan motor. The result is cooling fan operation at a medium speed.

High Speed Operation

The ECM applies ground at the FAN 1 control circuit for the coil side of the cooling fan relay. The energized cooling fan relay completes a ground, through the switch side of the relay, for the coil of the cooling fan speed control relay. The energized speed control relay switch closes to supply B+ to the coil side of cooling fan high speed relay. Simultaneously, the ECM applies ground at the FAN 2 control circuit for the coil side of the cooling fan high speed relay. The energized high speed relay switch closes to supply B+ directly to the engine cooling fan motor, by-passing the fans internal resistors. The result is cooling fan operation at full speed.

COOLING SYSTEM DESCRIPTION AND OPERATION (LUV, LE2)

Engine Coolant Indicators

- The instrument panel cluster (IPC) shows the engine temperature on the temperature gauge. The value is sent on the data communication line from engine control module (ECM). When the coolant temperature is more than 128Â°C (262Â°F) IPC receives a discrete input from ECM requesting illumination.
- The IPC performs the display test at the start of each ignition cycle. The IPC illuminates the TEMP indicator.

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the body control module (BCM) detects an open or a high voltage level on the coolant level indicator control circuit, for at least 10 seconds, it will send a GM LAN message to the driver information center (DIC) requesting display of the low coolant level message. There is approximately a 10-second delay before the BCM sends the GM LAN message to prevent the message from being displayed, due to coolant sloshing in the surge tank.

Coolant Heater

The optional engine coolant heater operates using AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant flows from the radiator outlet and into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where the coolant absorbs heat.

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

Coolant is also directed to the throttle body. There the coolant circulates through passages in the casting. During initial start up, the coolant assists in warming the throttle body.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature, or the coolant will flow through the thermostat and into the radiator where the coolant is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components.

Coolant

The engine coolant is a solution made up of a 50/50 mixture of drinking water and anti-freeze. 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 consisting of a core and 2 tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator also has a drain cock located in the bottom of the left hand tank. The drain cock unit includes the drain cock and drain cock seal.

Heat is removed from the coolant as the coolant passes through the radiator. The fins on the core transfer heat from the coolant passing through the tubes. Air passing between the fins absorbs the heat and cools the coolant.

Pressure Cap

The pressure cap seals and pressurizes the cooling system. The cap contains a blow off, or pressure valve and a vacuum, or an atmospheric valve:

- The pressure valve is held against the seat by a spring that protects the radiator by relieving pressure that exceeds 15 psi.
- The vacuum valve is held against the seat by a spring that permits opening of the valve to relieve vacuum created when the cooling system cools. The vacuum, if not relieved, might cause the radiator to collapse.

The pressure cap allows the cooling system pressure to build up when the temperature increases. As the pressure builds, the boiling point of the coolant increases. Therefore, the 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 becomes, the faster the heat transfers from the radiator into the cooler air.

The pressure in the cooling system can get too high. When the pressure exceeds the strength of the spring, the pressure valve rises, venting the excess pressure.

As the engine cools, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open. This equalizes the pressure in the cooling system with the atmospheric pressure, preventing the radiator 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. This tank 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 within the cooling system gets too high, the pressure valve in the pressure cap will open. This allows the coolant, which has expanded due to heat, 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 the elimination of almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings, which never need to be lubricated. With a sealed bearing, grease cannot leak out, and dirt and water cannot get in.

The water pump circulates coolant throughout the cooling system. The pump is driven by the crankshaft from the drive belt.

Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is located in the front of the engine at the water pump inlet. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the

metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve. To provide fuel economy and low emission benefit during part load driving condition, the electric controlled thermostat enables changing the thermostat opening temperature. Basically, the thermostat begins to open at 103°C / 217°F and is fully open at 117°C / 243°F when the electric energy not assisted.

If a certain driving environment encountered that requiring better cooling performance, the ECM orders to put electric energy to the thermostat. The energized electric heater in the wax pellet gives thermal energy to the wax for assisting the wax expansion. Then the thermostat valve opens earlier than the specified coolant temperature. For this vehicle, the programmed temperature set value by the ECM is 103°C / 217°F for cold and part load driving mode and 90°C (194°F) for hot and full load driving mode.

Transmission Oil Cooler

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

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

COOLING SYSTEM DESCRIPTION AND OPERATION (2HO)

Engine Coolant Indicators

- The instrument panel cluster (IPC) shows the engine temperature on the temperature gauge. The value is sent on the data communication line from engine control module (ECM). When the coolant temperature is more than 128°C (262°F) IPC receives a discrete input from ECM requesting illumination.
- The IPC performs the display test at the start of each ignition cycle. The IPC illuminates the TEMP indicator.

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the body control module (BCM) detects an open or a high voltage level on the coolant level indicator control circuit, for at least 10 seconds, it will send a GM LAN message to the driver information center (DIC) requesting display of the low coolant level message. There is approximately a 10-second delay before the BCM sends the GM LAN message to prevent the message from being displayed, due to coolant sloshing in the surge tank.

Coolant Heater

The optional engine coolant heater operates using AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant flows from the radiator outlet and into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where the coolant absorbs heat.

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

absorbs additional heat.

Coolant is also directed to the throttle body. There the coolant circulates through passages in the casting. During initial start up, the coolant assists in warming the throttle body.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature, or the coolant will flow through the thermostat and into the radiator where the coolant is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components.

Coolant

The engine coolant is a solution made up of a 50/50 mixture of drinking water and anti-freeze. 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 consisting of a core and 2 tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator also has a drain cock located in the bottom of the left hand tank. The drain cock unit includes the drain cock and drain cock seal.

Heat is removed from the coolant as the coolant passes through the radiator. The fins on the core transfer heat from the coolant passing through the tubes. Air passing between the fins absorbs the heat and cools the coolant.

Pressure Cap

The pressure cap seals and pressurizes the cooling system. The cap contains a blow off, or pressure valve and a vacuum, or an atmospheric valve:

- The pressure valve is held against the seat by a spring that protects the radiator by relieving pressure that exceeds 15 psi.
- The vacuum valve is held against the seat by a spring that permits opening of the valve to relieve vacuum created when the cooling system cools. The vacuum, if not relieved, might cause the radiator to collapse.

The pressure cap allows the cooling system pressure to build up when the temperature increases. As the pressure builds, the boiling point of the coolant increases. Therefore, the 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 becomes, the faster the heat transfers from the radiator into the cooler air.

The pressure in the cooling system can get too high. When the pressure exceeds the strength of the spring, the pressure valve rises, venting the excess pressure.

As the engine cools, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open. This equalizes the pressure in the cooling system with the atmospheric pressure, preventing the radiator 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. This tank 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 within the cooling system gets too high, the pressure valve in the pressure cap will open. This allows the coolant, which has expanded due to heat, 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 the elimination of almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings, which never need to be lubricated. With a sealed bearing, grease cannot leak out, and dirt and water cannot get in.

The water pump circulates coolant throughout the cooling system. The pump is driven by the crankshaft from the drive belt.

Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the rear of the cylinder head. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve. To provide fuel economy and low emission benefit during part load driving condition, the electric controlled thermostat enables changing the thermostat opening temperature. Basically, the thermostat begins to open at 105Â° C (221Â° F) and is fully open at 120Â° C (248Â° F) when the electric energy not assisted.

If a certain driving environment encountered that requiring better cooling performance, the ECM orders to put electric energy to the thermostat. The energized electric heater in the wax pellet gives thermal energy to the wax for assisting the wax expansion. Then the thermostat valve opens earlier than the specified coolant temperature. For this vehicle, the programmed temperature set value by the ECM is 105Â° C (221Â° F) for cold and part load driving mode and 90Â° C (194Â° F) for hot and full load driving mode.

Transmission Oil Cooler

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

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

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

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

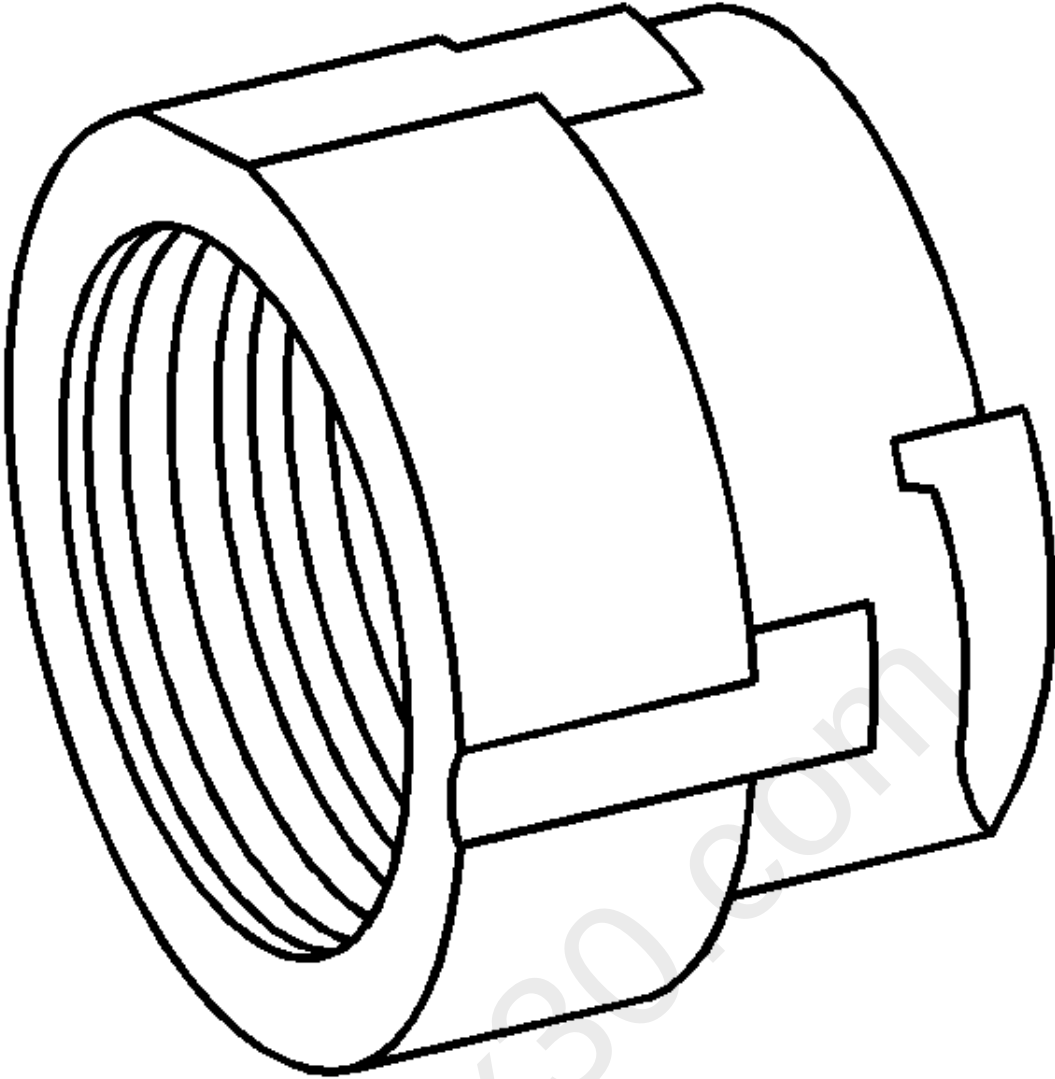
Illustration	Tool Number/Description
	EN-471 KM-471 J-36649 J-42070 Adapter
	EN-24460-A J-24460-01 Cooling System Pressure Tester

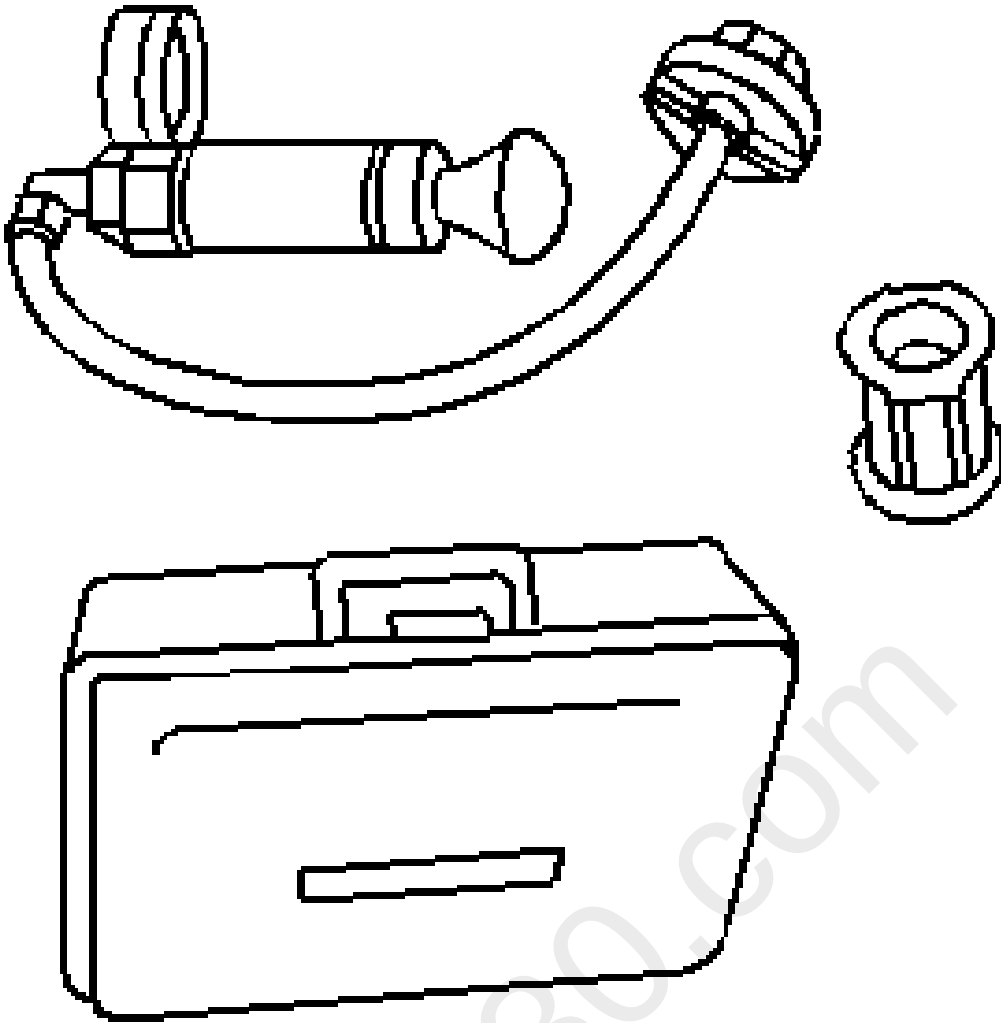
Illustration	Tool Number/Description
 A line drawing of a hand pump sprayer. It consists of a cylindrical pump handle with a T-shaped grip, connected to a flexible hose. The hose ends in a spray nozzle. A separate, smaller spray nozzle is shown to the right. Below these items is a rectangular carrying case with a handle on top and a latch on the front. A diagonal watermark 'mcx30.com' is visible across the bottom half of the illustration area.	

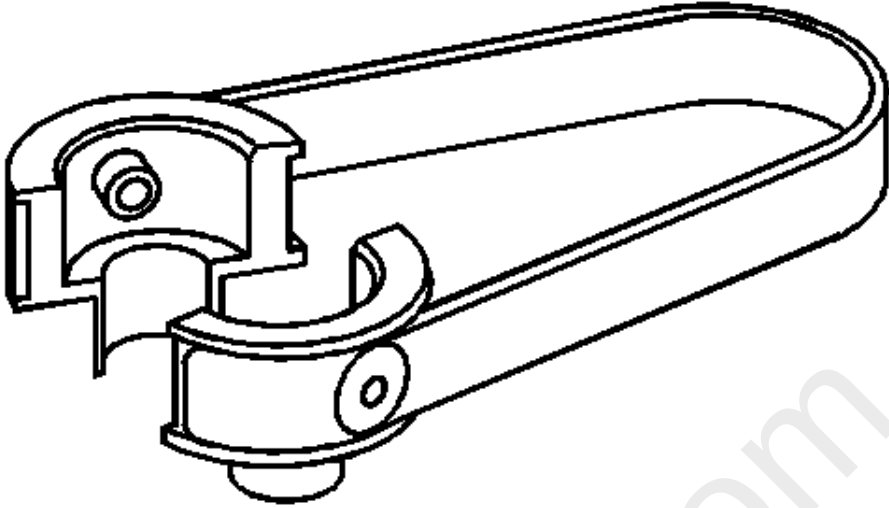
Illustration	Tool Number/Description
 A line drawing of a U-shaped metal tool. The tool has a long, flat, U-shaped body. At one end, there is a hook-like structure with a circular pin or bolt passing through it. The other end of the U-shape has a similar structure, also with a circular pin or bolt. The tool appears to be designed for connecting or disconnecting components.	EN-49940 J-37088-A Remover Quick Connector

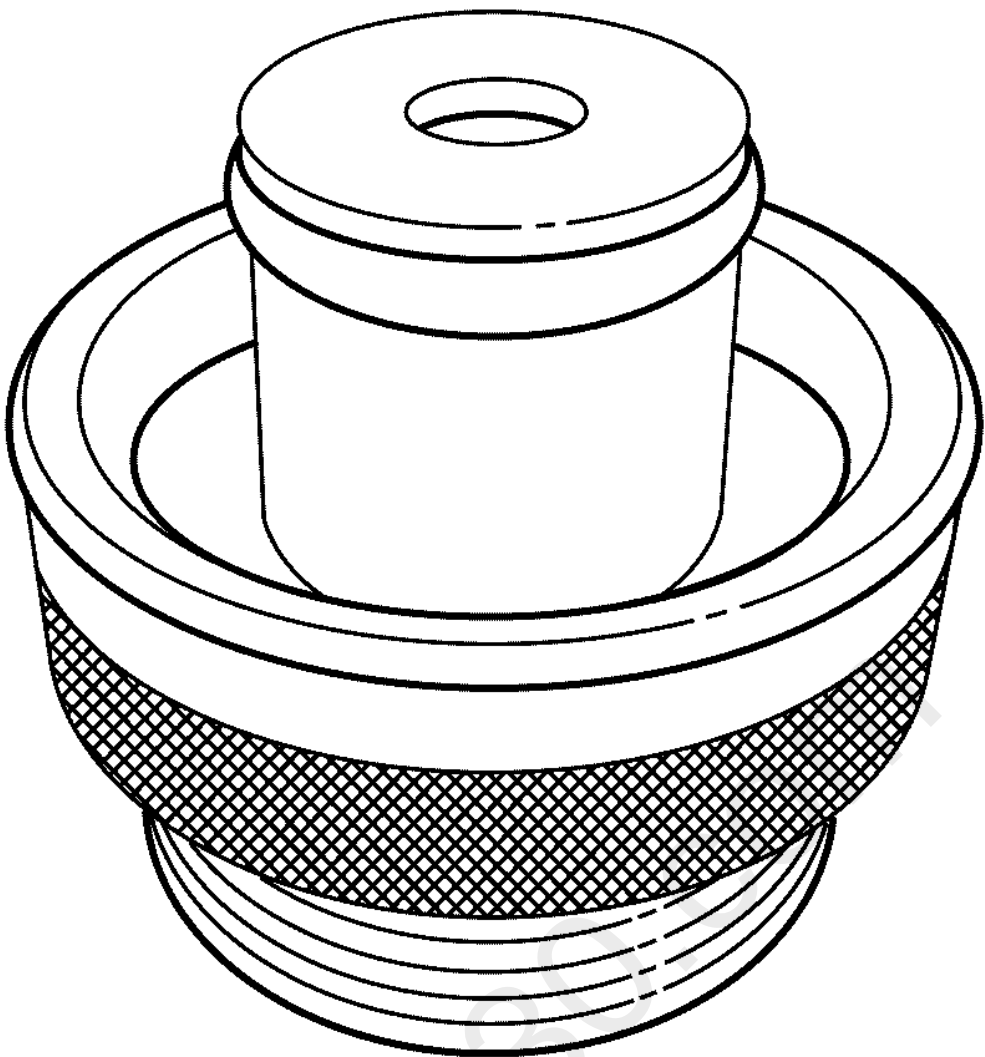
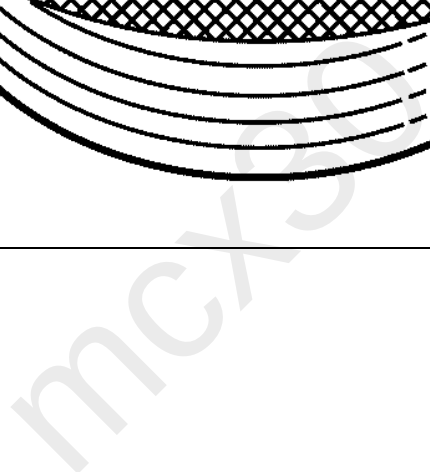
Illustration	Tool Number/Description
	EN-6327-A KM-6327-A J-24460 J-42401 Cooling System Test Adapter
	GE 42401-A J 42401 Radiator Cap and Surge Tank Test Adapter

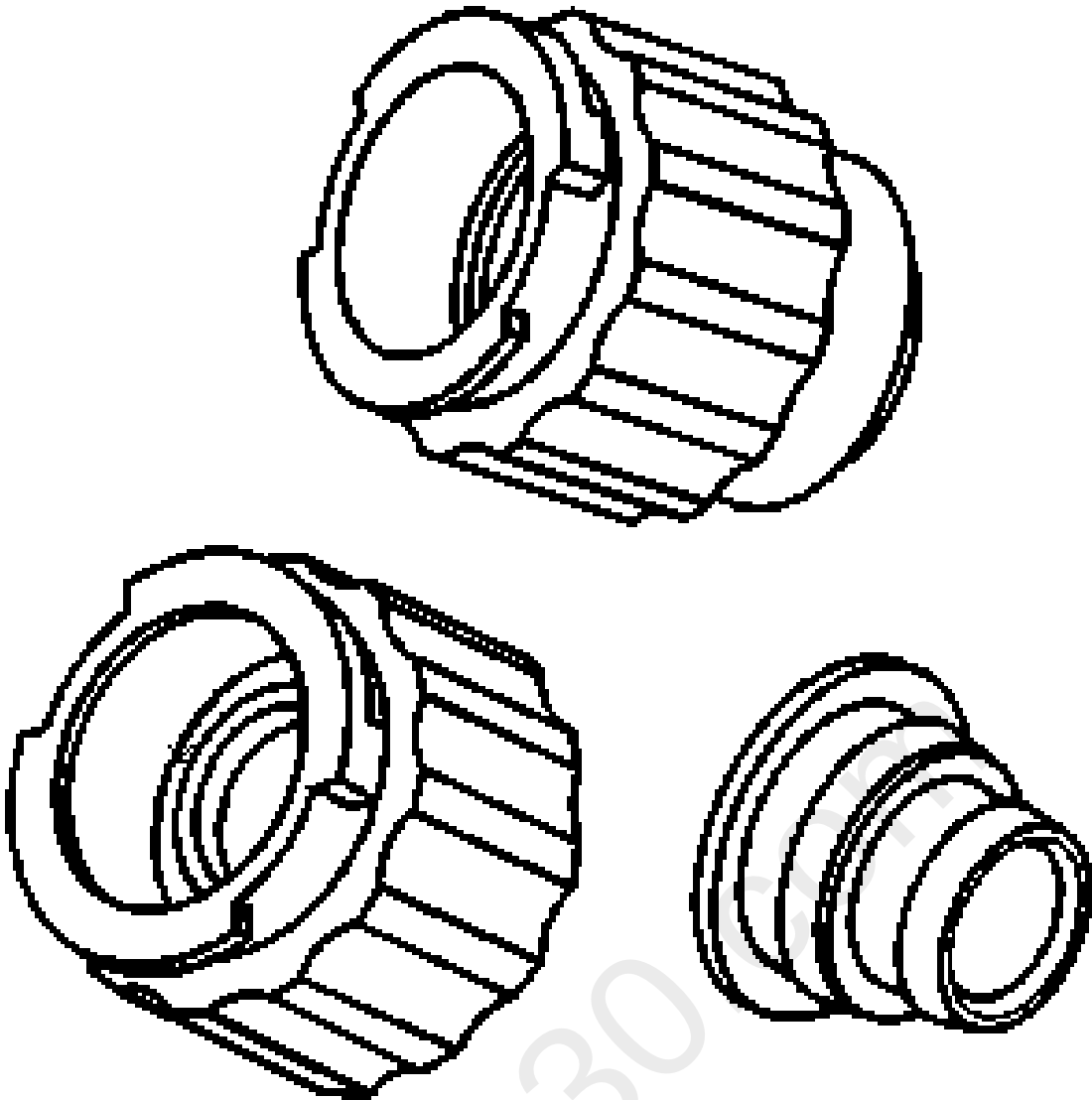
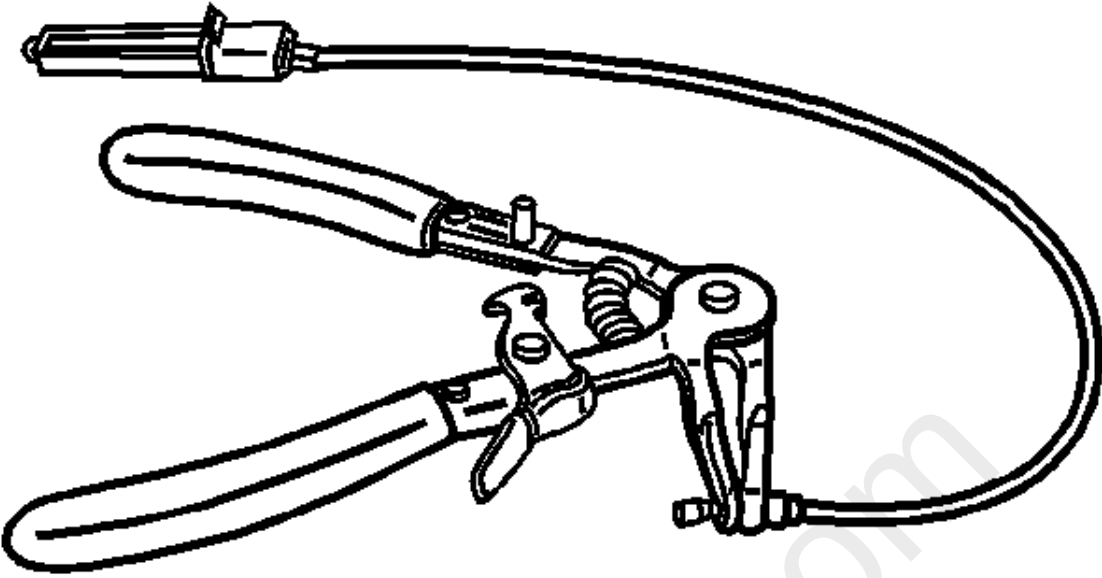
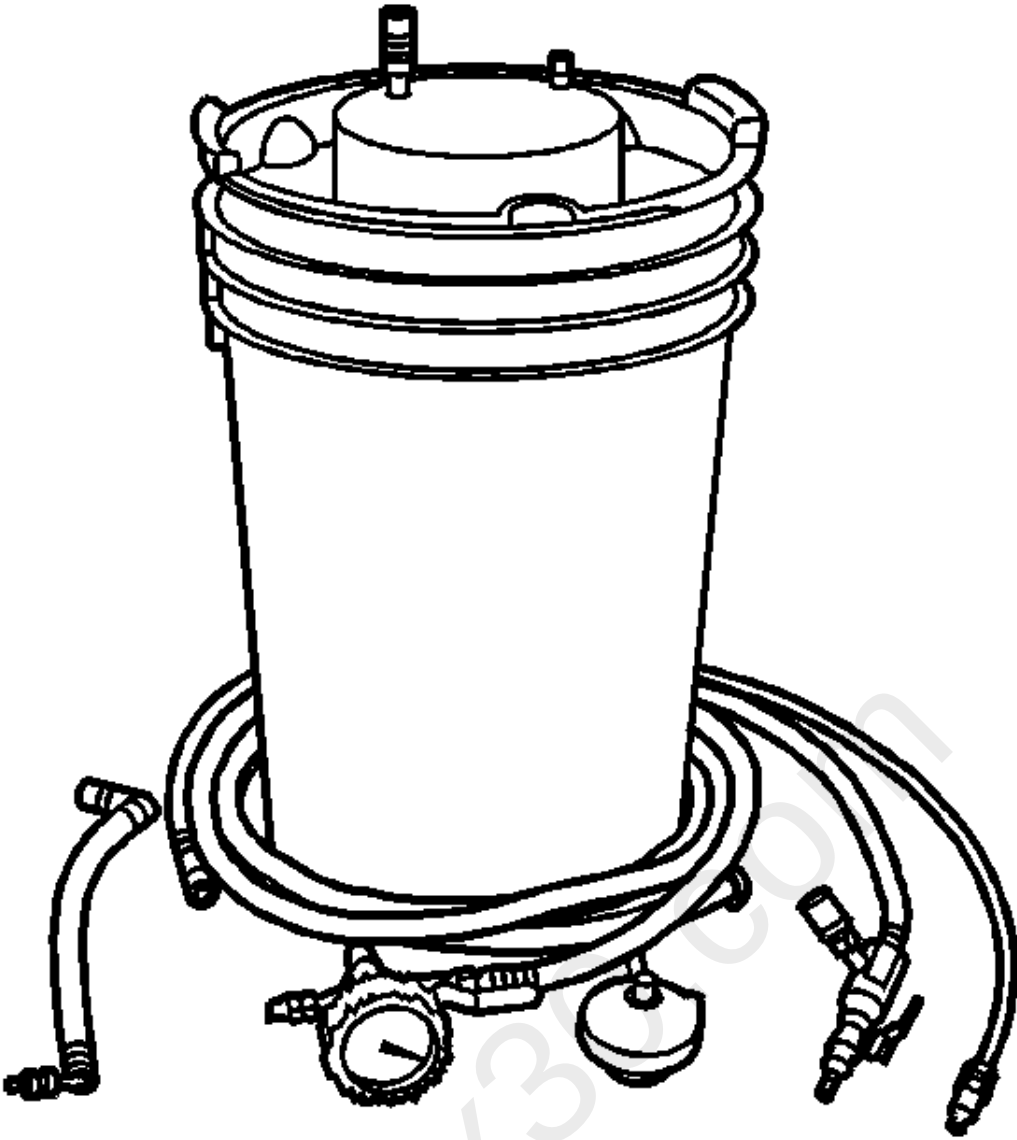
Illustration	Tool Number/Description
 The illustration shows three mechanical components. At the top is a large flanged nut with a wide, flat top flange and a threaded body. Below it to the left is a large flanged bolt with a similar wide flange and threaded body. To the right of the large bolt is a smaller flanged bolt with a narrower flange and a shorter threaded body. A faint 'mcx30' watermark is visible across the bottom half of the page.	

Illustration	Tool Number/Description
	GE-47622 J-47622 Hose Clamp Pliers

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