

2018 ENGINE**Engine Heating And Cooling - Traverse****SPECIFICATIONS****TEMPERATURE VERSUS RESISTANCE**

Temperature	Resistance
150Â°C (302Â°F)	42 to 44 ohms
140Â°C (284Â°F)	53 to 57 ohms
130Â°C (266Â°F)	68 to 72 ohms
120Â°C (248Â°F)	88 to 92 ohms
110Â°C (230Â°F)	114 to 120 ohms
100Â°C (212Â°F)	151 to 159 ohms
90Â°C (194Â°F)	203 to 215 ohms
80Â°C (176Â°F)	275 to 293 ohms
70Â°C (158Â°F)	379 to 405 ohms
60Â°C (140Â°F)	532 to 572 ohms
50Â°C (122Â°F)	762 to 824 ohms
45Â°C (113Â°F)	921 to 997 ohms
40Â°C (104Â°F)	1118 to 1212 ohms
35Â°C (95Â°F)	1366 to 1484 ohms
30Â°C (86Â°F)	1683 to 1829 ohms
25Â°C (77Â°F)	2088 to 2266 ohms
20Â°C (68Â°F)	2608 to 2828 ohms
15Â°C (59Â°F)	3289 to 3567 ohms
10Â°C (50Â°F)	4182 to 4532 ohms
5Â°C (41Â°F)	5356 to 5800 ohms
0Â°C (32Â°F)	6914 to 7484 ohms
-5Â°C (23Â°F)	8994 to 9732 ohms
-10Â°C (14Â°F)	11796 to 12762 ohms
-15Â°C (5Â°F)	15589 to 16871 ohms
-20Â°C (-4Â°F)	20791 to 22517 ohms
-30Â°C (-22Â°F)	37991 to 41273 ohms
-40Â°C (-40Â°F)	72230 to 78834 ohms

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

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

Application
Engine Coolant Air Bleed Pipe Seal
Engine Coolant Thermostat Housing Gasket
Engine Oil Cooler Seal
Thermostat Bypass Pipe Gasket
Turbocharger Coolant Feed Pipe Gasket
Turbocharger Coolant Feed Pipe Washer
Water Outlet O-Ring Seal
Water Outlet Seal

NOTE:

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

Application
Water Pump Gasket
Water Pump Seal

Reusable Threaded Fastener Tightening Specifications

NOTE:

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

Application	Specification
	Metric (English)
Auxiliary Water Pump Bracket Bolt	22 N.m (16 lb ft)
Engine Coolant Air Bleed Pipe Fastener	10 N.m (89 lb in)
Engine Coolant Fan Bolt	5 N.m (44 lb in)
Engine Coolant Thermostat Housing Bolt	10 N.m (89 lb in)
Engine Oil Cooler Core Bolt	50 N.m (37 lb ft)
Engine Oil Cooler Pipe Fastener	10 N.m (89 lb in)
Heater Water Auxiliary Pump Bolt	9 N.m (80 lb in)
Intake Manifold Cover Stud	9 N.m (80 lb in)
Radiator Air Baffle Bolt	9 N.m (80 lb in)
Radiator Air Lower Baffle Bolt	2.5 N.m (22 lb in)
Radiator Air Upper Baffle Bolt	2.5 N.m (22 lb in)
Radiator Surge Tank Bolt	9 N.m (80 lb in)
Radiator Surge Tank Outlet Pipe Bolt	5 N.m (44 lb in)
Radiator Upper Bracket Bolt	22 N.m (16 lb ft)
Thermostat Bypass Pipe Bolt	10 N.m (89 lb in)
Turbocharger Coolant Feed Pipe Bolt	10 N.m (89 lb in)
Turbocharger Coolant Feed Pipe Hollow Screw	35 N.m (26 lb ft)
Turbocharger Coolant Return Pipe Bolt	10 N.m (89 lb in)
Turbocharger Coolant Return Pipe Hollow Screw	35 N.m (26 lb ft)
Water Outlet Bolt	10 N.m (89 lb in)
Water Pump Bolt (LFY)	
First Pass	10 N.m (89 lb in)
Final Pass	45 degrees
Water Pump Bolt (LTG)	25 N.m (18 lb ft)
Water Pump Pulley Bolt	10 N.m (89 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling Systems		
2.0 (LTG) Engine	11.1 L	11.7 qt
3.6 (LFY) Engine with V08	14.7 L	15.5 qt
3.6 (LFY) Engine without V08	14.6 L	15.4 qt

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

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

Diagnostic Fault Information

Circuit	Description
Control	The output circuit is switched to ground to activate the component. The output is PWM controlled.

Component	Description
G10 Cooling Fan Motor	An electric DC motor. The control module receives a PWM signal from the control module K20 and converts it into another PWM signal which directly supplies the fan motor.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- Ignition = On
- Battery Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Heating/Cooling Wiring Schematics

Connector End View Reference

Master Electrical Component List

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

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode

2. Perform the scan tool control function: Cooling Fan - From 0 to 90% and back to 0%.

Verify the component turns On and Off: G10 Cooling Fan Motor

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **Go to next step: If the component turns On and Off**

3. Ignition - On/Vehicle - In Service Mode

4. Perform the scan tool control function: Cooling Fan - 0 to 90%

Verify a condition does not exist with the component: G10 Cooling Fan Motor - Turns Off

WARNING: Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. These fans are electric and can turn ON whether or not the engine is running and physical contact may result in bodily injury.

Perform the action while monitoring the component:

- Wiggle the harness and connector: G10 Cooling Fan Motor
- Wiggle the harness and connector: K20 Engine Control Module
- **If a condition exists**

Repair as necessary - Wiring/Terminal(s)/Electrical Connector (s)

- **Go to next step: If no condition exists**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: G10 Cooling Fan Motor

3. Ignition - On/Vehicle - In Service Mode

4. Verify a test lamp turns On between the test points: B+ circuit terminal 1 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Test for less than 2 ohms between the test points: B+ circuit terminal 1 & Output terminal @ Fuse

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Test for infinite resistance between the test points: B+ circuit terminal 1 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: G10 Cooling Fan Motor

- **Go to next step: If the test lamp turns On**

5. Connect a test lamp between the test points: Control circuit terminal 4 & B+

6. Perform the scan tool control function: Cooling Fan - From 0 to 90% and back to 0%.

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 4 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Control circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If the test lamp is always On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 4 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp turns On and Off**

7. Test or replace the component: G10 Cooling Fan Motor

Repair Instructions

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

- [Engine Coolant Fan Replacement](#) - G10 Cooling Fan Motor
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P111E

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 P111E

Engine Coolant Temperature Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Signal	P0117	P0118	P0118	P0118	P0128, P111E
Low Reference	-	P0118	P0118	-	P0128

Typical Scan Tool Data

ECT Sensor Temperature

Circuit	Short to Ground	Open	Short to Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -39 to +120Â°C (-38 to +248Â°F)			
ECT Sensor	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)

Circuit/System Description

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

This DTC detects either a biased high or low ECT sensor. This is done by comparing the ECT sensor output to two other temperature sensor outputs after a soak condition.

Conditions for Running the DTC

- DTCs P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0502, P0503, P0601, P1621, or P2610 are not set.
- The vehicle has had a minimum ignition OFF time of 8 hours.
- The engine is running.
- The previous engine run time is greater than 600 seconds.

OR

- The vehicle has had a minimum ignition OFF time of 8 hours.
- The engine is running.
- The previous ECT at engine shutdown is warmer than 75Â°C (+167Â°F).
- The previous accumulated mass air flow (MAF) is greater than 6, 000 grams.
- The previous engine run time is greater than 600 seconds.
- This DTC runs once per ignition cycle within the enabling conditions.

Conditions for Setting the DTC

- The ECM detects a temperature difference at power-up that indicates the ECT sensor is 50Â°C (122Â°F) warmer than the intake air temperature (IAT) sensor and the outside air temperature (OAT) sensor.

OR

- The ECM detects the temperature at power-up of the ECT sensor is between 16Â°C (61Â°F) and 50Â°C (122Â°F) warmer than the IAT and the OAT sensor, and NO engine block heater was detected.

OR

- The ECM detects a temperature difference at power-up that indicates the ECT sensor is 16Â°C (61Â°F) colder than the IAT sensor and the OAT sensor.

OR

- The ECM detects a temperature difference at power-up that indicates the ECT sensor is 16Â°C (61Â°F) warmer than the IAT sensor, and the OAT sensor, and the engine cranked for greater than 10 s without starting.

Action Taken When the DTC Sets

- DTC P111E is a Type B DTC.
- A/C disabled.
- Cooling Fans ON.

Conditions for Clearing the MIL/DTC

DTC P111E is a Type B DTC.

Diagnostic Aids

- Engine coolant that is leaking through the sensor will create a high resistance short to ground. This condition results in less voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a warmer ECT.
- The ECM memory which includes the ignition OFF timer is maintained by battery power. If the ECM or the battery are disconnected for less than 15 seconds the proper operation of the ECM memory and the timer can be disrupted. Always disconnect these components for greater than 30 seconds.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. Turn OFF the ignition.
2. Inspect the cooling system surge tank for the proper engine coolant level. Refer to [Cooling System Leak Testing](#), and [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).
3. If the ignition has been OFF for 8 hours or greater, the IAT sensor, the IAT sensor 2, and the ECT sensor should be within 9Â°C (16Â°F) of each other and also the ambient temperature. Ignition ON, observe the scan tool IAT Sensor, IAT Sensor 2 and the ECT Sensor parameters. Compare those sensor parameters to each other and also to the ambient temperature to determine if the ECT sensor is skewed warmer.
4. Engine running, observe the ECT Sensor parameter. The reading should be between -39 to +120Â°C (-38 to +248Â°F) depending on the current ambient temperature and the vehicle operating conditions.
5. 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.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the B34 Engine Coolant Temperature Sensor harness connector at the sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 2/A and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool ECT Sensor parameter is colder than -39Â°C (-38Â°F).
 - **If warmer than -39Â°C (-38Â°F)**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1/B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance.
3. Test for less than 2 Ω 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
 - **Go to next step: If colder than -39 $^{\circ}$ C (-38 $^{\circ}$ F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1/B and the low reference circuit terminal 2/A.
6. Verify the scan tool ECT sensor parameter is warmer than 149 $^{\circ}$ C (300 $^{\circ}$ F).
 - **If warmer than 149 $^{\circ}$ C (300 $^{\circ}$ 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.
 - Go to next step: If less than 1 V
7. Test or replace the B34 engine coolant temperature sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34 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 - Engine Coolant Temperature Sensor](#) table. The resistance values should be in range of the table values.
 - **If not within the specified range**

Replace the B34 Engine Coolant Temperature Sensor.

 - **Go to next step: If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
 - **If less than infinite resistance**

Replace the B34 Engine Coolant Temperature Sensor.

 - **Go to next step: If infinite resistance**
4. All OK.

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement](#)
- [Control Module References](#) for K20 Engine Control Module replacement, programming, and setup.

DTC P1258

Diagnostic Instructions

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

DTC Descriptors

DTC P1258

Engine Coolant Overtemperature - Protection Mode Active

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

The ECM detects that engine coolant temperature is warmer than 132Â°C (270Â°F) for 2 seconds or greater.

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

DTC P1258 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[K20 Engine Control Module: Scan Tool Information](#) for scan tool information

Circuit/System Verification

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

- **If a DTC is set**

Refer to [DTC P0480, P0691, or P0692](#).

- **Go to next step: If no DTCs is set**

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

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

- **Cooling fan does not operate**

Refer to [Cooling Fan Inoperative](#).

- **Go to next step: Cooling fan operates**

4. Verify that the engine does not overheat.

- **Engine overheats**

Refer to [Engine Overheating](#).

- **Go to next step: Engine does not overheat**

5. Operate the vehicle within the conditions that the customer experienced and verify the DTC does not set.

- **If the DTC sets**

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

- **Go to next step: If the DTC does not set**

6. All OK

Repair Instructions

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

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

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

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

Visual/Physical Inspection

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

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

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

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

- Ensure that the control module grounds are clean, tight, and correctly located.

- Inspect cooling system hoses and pipes for splits, kinks, and improper connections. Inspect thoroughly for any type of leak or restriction.
- 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:

- [Engine Overheating](#)
- [Loss of Coolant](#)
- [Thermostat Diagnosis](#)
- [Engine Fails To Reach Normal Operating Temperature](#)

COOLING FAN ALWAYS ON

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system is composed of one electric cooling fan and a cooling fan control module. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to prevent undesirable noise and vibration. The cooling fan control module is thermally protected to prevent module damage in the case of a short circuit condition in the cooling fan motor.

Diagnostic Aids

- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fan ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate engine controls subsection.
- The cooling fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4%. This is a normal condition.

Reference Information

Schematic Reference

Engine Heating/Cooling Wiring Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Refer to DTC P0480, P0691, or P0692.
 - **Go to next step: If no DTC is set.**
3. Verify the scan tool Cooling Fan Motor Command parameter is less than 4%.
 - **If 4% or greater**

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

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

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the G10 Cooling Fan Motor harness connector X2 at the K22 Cooling Fan Control Module, ignition ON.

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

Repair Instructions

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

- [Engine Coolant Fan Replacement](#)
- [Control Module References](#)

COOLING FAN INOPERATIVE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	P0480, P0691*	P0480, P0691	-	-
Control	P0480, P0691	P0480, P0691	P0692	-
Control	-	1	-	-
1. Cooling Fan = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Cooling Fan Description and Operation](#)

Circuit	Description
B+	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component. The output is PWM controlled.

Component	Description
G10 Cooling Fan Motor	An electric DC motor. The control module receives a PWM signal from the control module K20 and converts it into another PWM signal which directly supplies the fan motor.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Reference Information

Schematic Reference

[Engine Heating/Cooling Wiring Schematics](#)

Master Electrical Component List

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

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0480, P0691, P0692 is not set.
 - **If any DTC is set**
Refer to: [DTC P0480, P0691, or P0692](#)
 - **Go to next step: If none of the DTCs are set**
3. Perform the scan tool control function: Cooling Fan - From 0 to 90% and back to 0%.

Verify the component turns On and Off: G10 Cooling Fan Motor

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **Go to next step: If the component turns On and Off**

4. Ignition - On/Vehicle - In Service Mode
5. Perform the scan tool control function: Cooling Fan - 0 to 90%

Verify a condition does not exist with the component: G10 Cooling Fan Motor - Turns Off

Perform the action while monitoring the component:

- Wiggle the harness and connector: G10 Cooling Fan Motor
- Wiggle the harness and connector: K20 Engine Control Module
- **If a condition exists**

Repair as necessary - Wiring/Terminal(s)/Electrical Connector (s)

- **Go to next step: If no condition exists**

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.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

7. All OK.

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: G10 Cooling Fan Motor
3. Ignition - On/Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ground circuit terminal 2 & B+
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: B+ circuit terminal 1 & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **Go to next step: If the test lamp turns On**
5. Test or replace the component: G10 Cooling Fan Motor

Repair Instructions

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

- [Engine Coolant Fan Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

ENGINE OVERHEATING

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition. • The engine temperature gauge is in the red (overheat) zone and/or the engine temperature indicator is ON. • Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the ground while the engine is running.			
1	1. Inspect and fill the cooling system, as necessary. Refer to Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) . 2. Inspect the cooling system for leaks, as necessary. 3. Repair the cooling system leaks, as necessary. Has the inspection/repair been performed?	Go to Step 2	-
2	1. Start the engine and allow the engine to run at approximately 1, 200 RPM. 2. Use the Scan Tool in order to verify the overheat condition. Does the Scan Tool verify the engine overheat condition?	Go to Step 3	Go to Diagnostic System Check - Vehicle
3	1. Verify that the cooling fans are operating properly. 2. Repair the cooling fan system, as necessary. Does the engine still overheat?	Go to Step 4	System OK

Step	Action	Yes	No
4	Perform the following inspections: - Inspect the radiator and the A/C condenser cooling fins for debris or any other obstruction. - Inspect the drive belt system and the drive belt tensioner for proper operation in order to ensure that the coolant pump is rotating properly. - Inspect for loose, damaged and/or missing air deflector (s). - Check for a pinched or kinked cooling system hose. - Repair the systems as necessary. Does the engine still overheat?	Go to Step 5	System OK
5	Inspect the thermostat for proper operation. Refer to Thermostat Diagnosis. Did you find and correct the condition?	-	Go to Step 6
6	IMPORTANT: Excessive coolant freeze point protection MAY cause the coolant to boil at low temperatures. - Inspect for the proper coolant concentration (mixture). Correct the coolant concentration as necessary. - Remove the radiator cap. - Start the engine and inspect for a constant flow of air bubbles in the engine coolant. Is there a constant flow of air bubbles in the engine coolant?	Go to Step 7	Go to Step 8
7	The probable cause of the engine overheat is combustion chamber gasses leaking into the cooling system. This condition is usually caused by the following: - A worn or damaged cylinder head gasket - A worn or damaged cylinder head - A worn and/or damaged engine block Verify this condition by inspecting the spark plug electrodes and porcelain surrounding the spark plug electrode for signs of coolant. Replace and/or repair the engine internal component (s), as necessary, in order to repair the engine internal coolant leak. Does the engine still overheat?	Go to Step 1	System OK
8	The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Refer to Flushing. Does the engine still overheat?	Go to Step 9	System OK
9	IMPORTANT: It is unlikely that the water pump is the cause of the overheat condition. If NONE of the cooling system passages are restricted, replace the coolant pump. Refer to Water Pump Replacement (LTG)Water Pump Replacement (LFY). Does the engine still overheat?	Go to Step 1	System OK

LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms, or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Diagnostic System Check - Vehicle Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716) Cooling System Draining and Filling (Static Fill) Is the action complete?	Go to Step 5	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 19	Go to Step 6
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 7	Go to Step 8
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. 2. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 20	Go to Step 8
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Throttle body • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 21	Go to Step 10
10	1. Pressure test the cooling system. Cooling System Leak Testing 2. With the cooling system pressurized, visually inspect the components listed in steps 7, 8 and 9. Are any leaks present?	Go to Step 21	Go to Step 11
11	Pressure test the coolant pressure cap. Pressure Cap Testing Does the coolant pressure cap hold pressure?	Go to Step 12	Go to Step 16

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

THERMOSTAT DIAGNOSIS

Tools Required

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

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

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

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

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

COOLANT HEATER INOPERATIVE

Diagnostic Instructions

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

Circuit/System Description

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

Reference Information

Electrical Information Reference

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

Circuit/System Testing

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

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

Repair Instructions

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

- [Engine Coolant Heater Replacement \(LFY\)](#).
- [Engine Coolant Heater Cord Replacement](#)

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

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

PRESSURE CAP TESTING

Special Tools

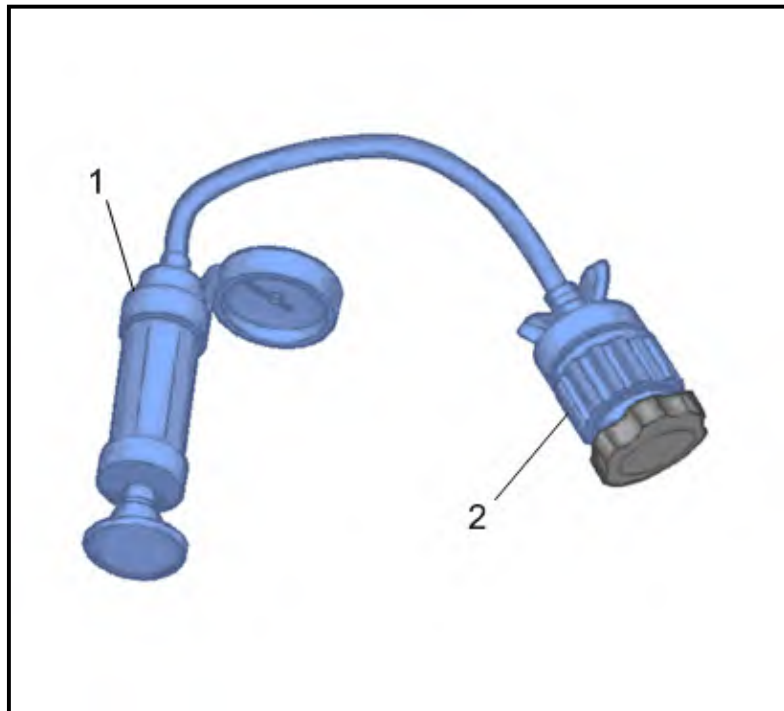
- **GE-24460-A** Cooling System Pressure Tester
- **GE-42401-A** Radiator Cap/Surge Tank Test Adapter Kit

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

Pressure Cap Testing

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

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.
- 3.



Use the **GE-24460-01** Cooling System Pressure Tester (1) with **GE-42401-A** Radiator Cap/Surge Tank Test Adapter Kit (2) in order to test the pressure cap.

4. Test the pressure cap for the following conditions:
 - Pressure release when the **GE-24460-01** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
 - Maintain the rated pressure for at least 10 seconds.Note the rate of pressure loss.
5. Replace the pressure cap under the following conditions:
 - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
 - The pressure cap does not hold the rated pressure.

COOLING SYSTEM LEAK TESTING

Special Tools

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

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

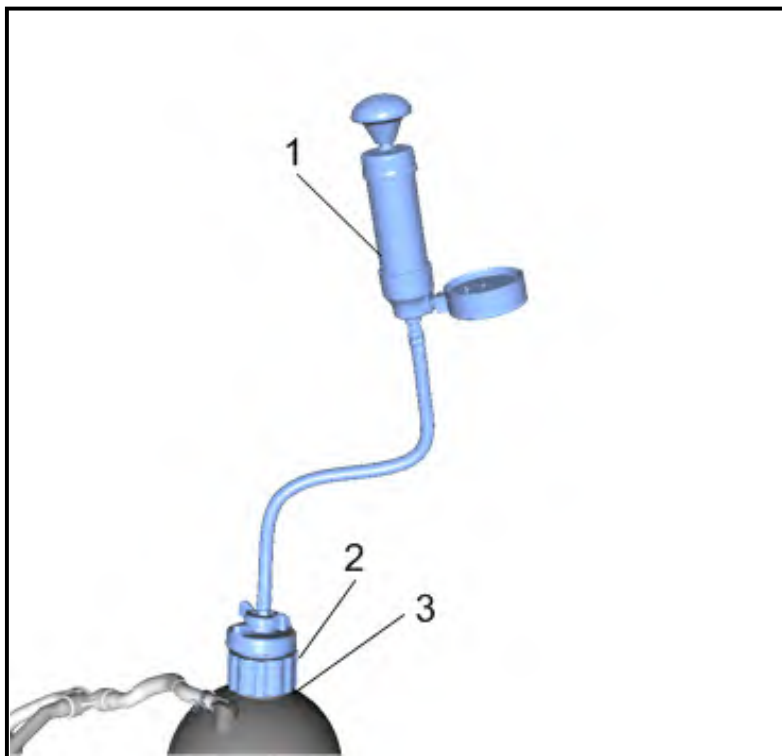
WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine,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

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

1. Remove the pressure cap.
2. Test the operation of the pressure cap. [Pressure Cap Testing](#)

3. Wash the pressure cap mating surface with water.

4.



Use the **GE-24460-01** Cooling System Pressure Tester (1) with the **GE-42401-3** Radiator Cap/Surge Tank Test Adapter (2) and **GE-42401-2** Radiator Cap/Surge Tank Test Adapter (2) in order to apply pressure to the cooling system.

Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

HOSE CLAMP REPLACEMENT GUIDELINES - SPRING TYPE

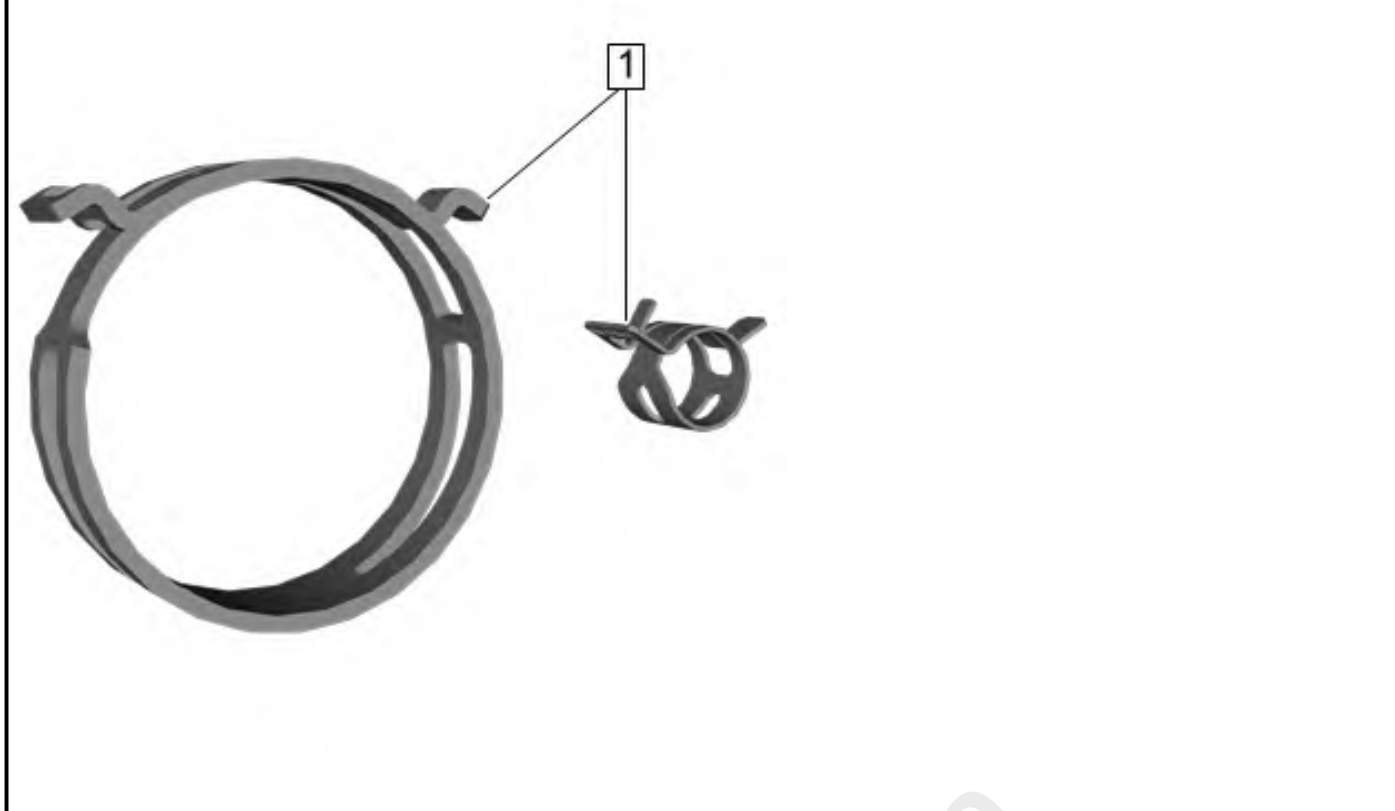
Special Tools

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

Equivalent regional tools: **Special Tools**

Spring Type Hose Clamp Replacement Guidelines





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

COOLING SYSTEM DRAINING AND FILLING (GE 47716)

Special Tools

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

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

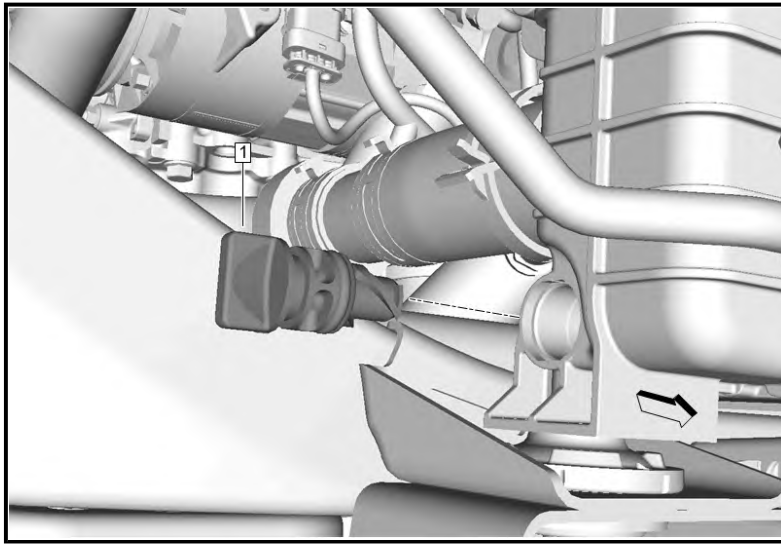
Draining Procedure

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

1. Remove the coolant pressure cap.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .

3. Place a drain pan under the drain cock.

4.



Loosen the radiator drain cock (1). [Radiator Drain Cock Replacement \(LFY\)](#)[Radiator Drain Cock Replacement \(LTG\)](#)

5. Drain the cooling system.

6. Tighten the radiator drain cock (1). [Radiator Drain Cock Replacement \(LFY\)](#)[Radiator Drain Cock Replacement \(LTG\)](#)

7. Lower the vehicle.

8. Inspect the coolant.

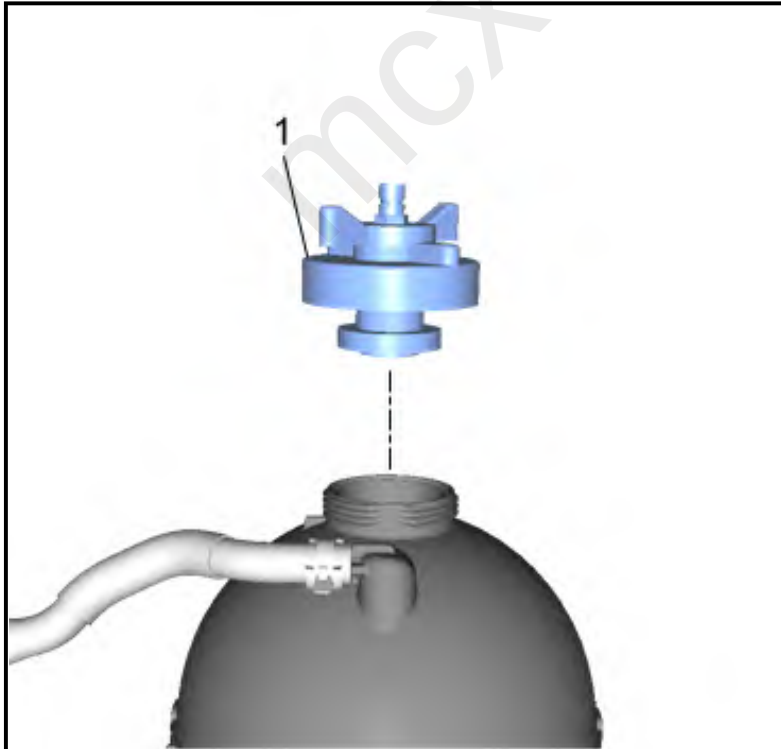
9. Follow the appropriate procedure based on the condition of the coolant.

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

Vac-N-Fill Procedure

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

2.

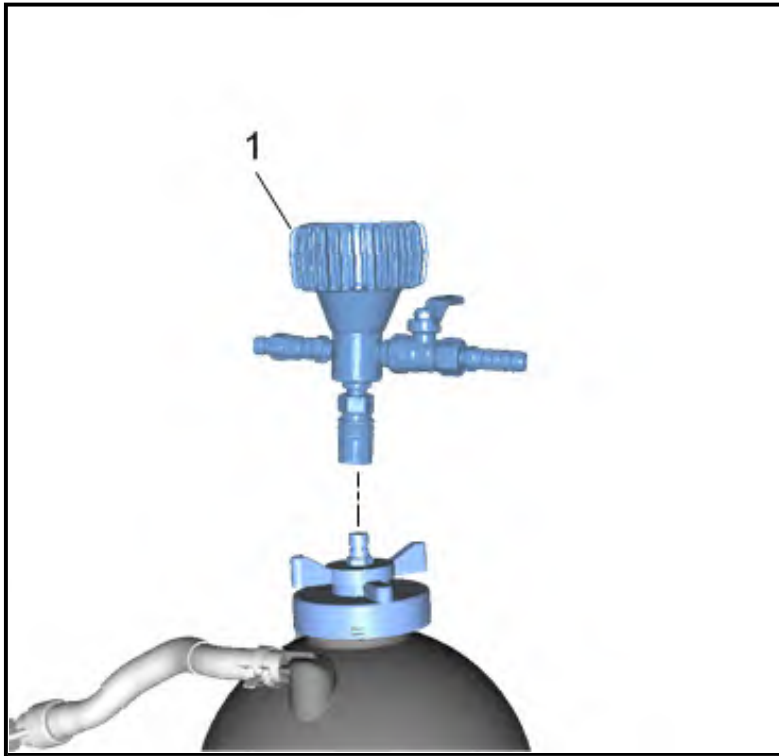


WARNING:

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.

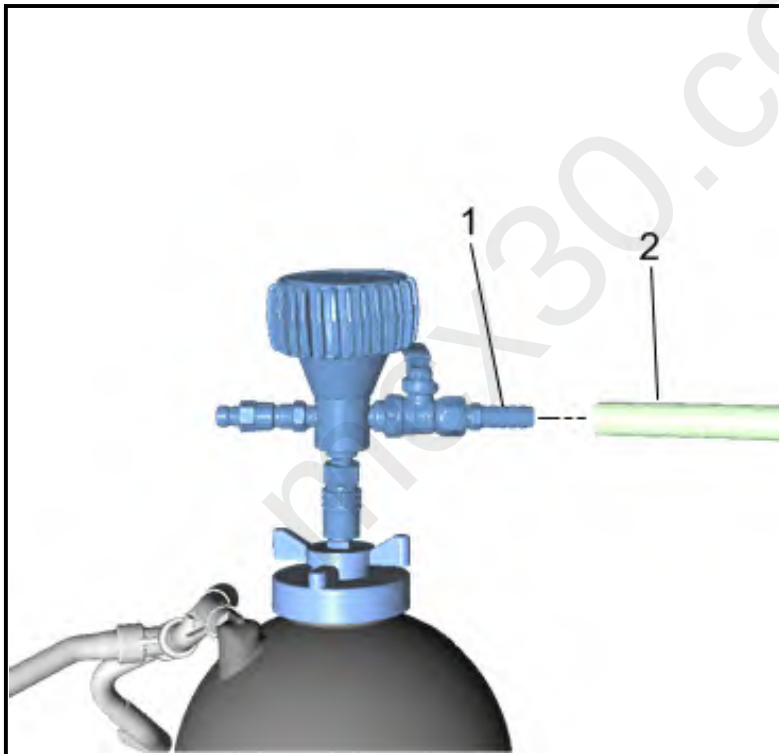
Attach the Vac N Fill cap to the **J 42401-A** Radiator Cap and Surge Tank Test Adapter (1).

3.



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

4.

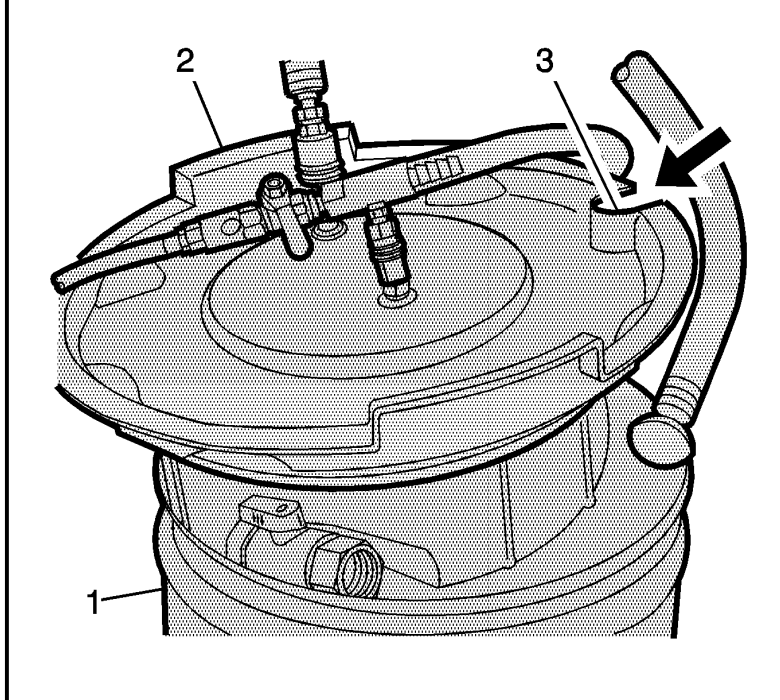


Attach the fill hose (2) to the barb fitting on the vacuum gauge assembly (1).

Ensure that the valve is closed.

5.





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

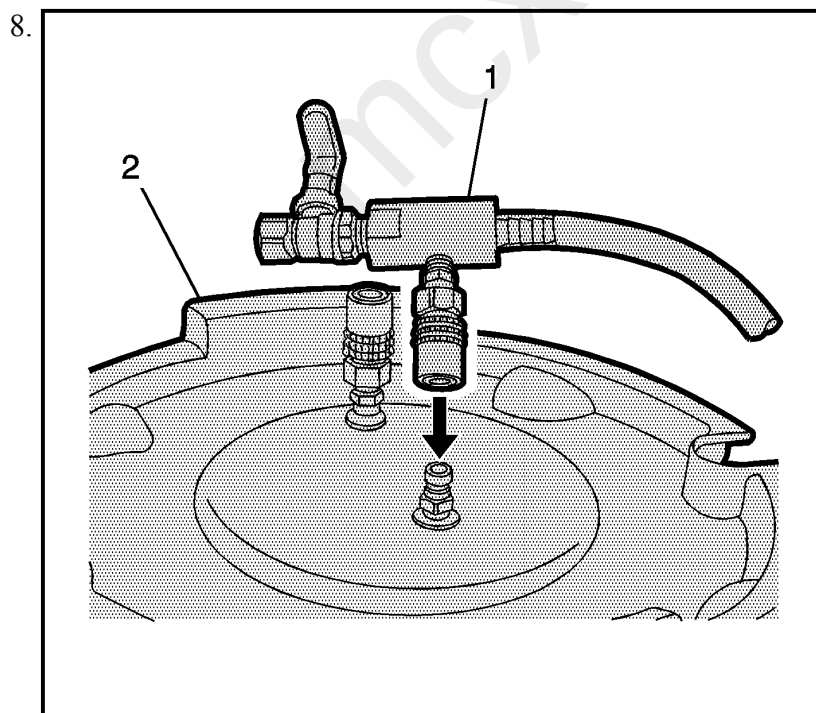
Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

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

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

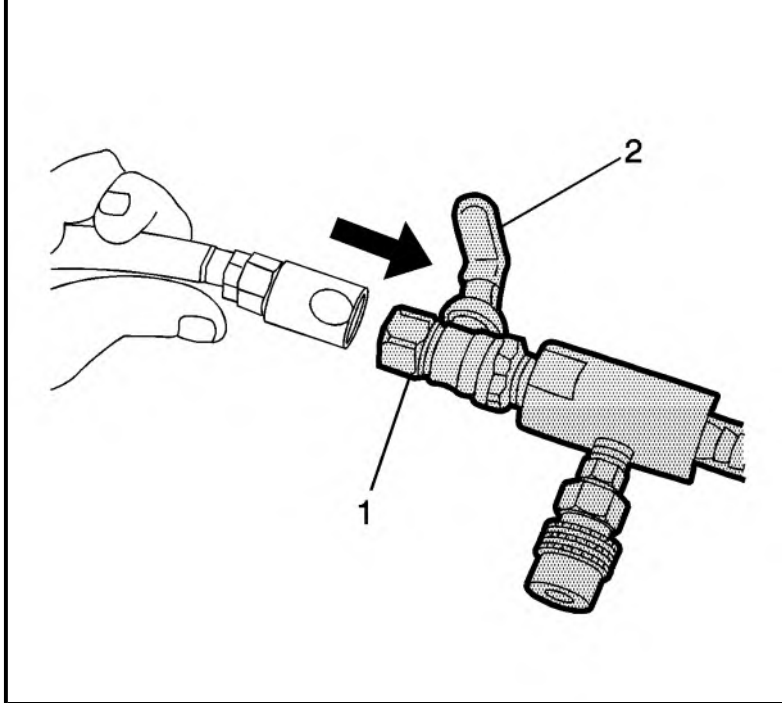
NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

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



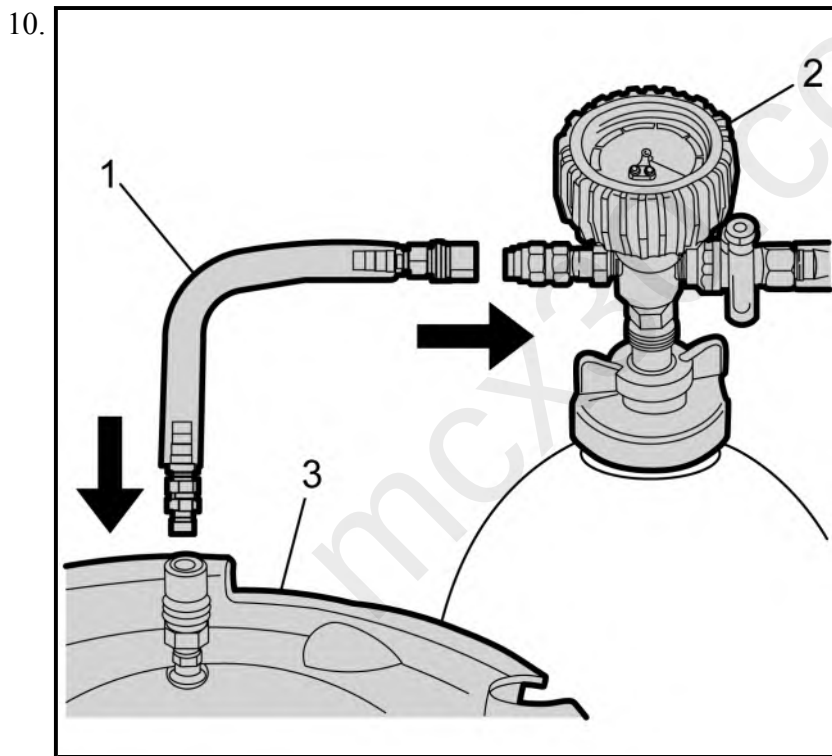
Attach the venturi assembly (1) to the vacuum tank (2).





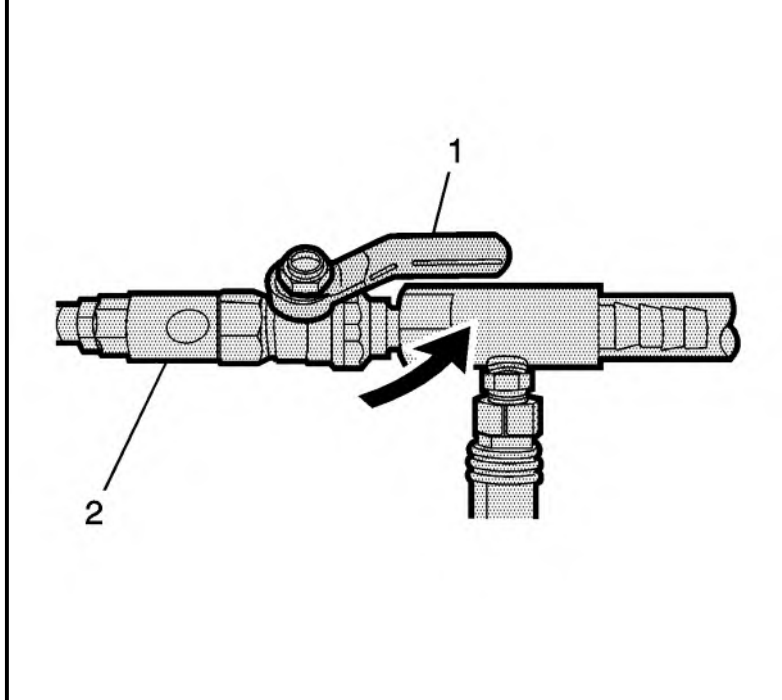
Attach a shop air hose to the venturi assembly (1).

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

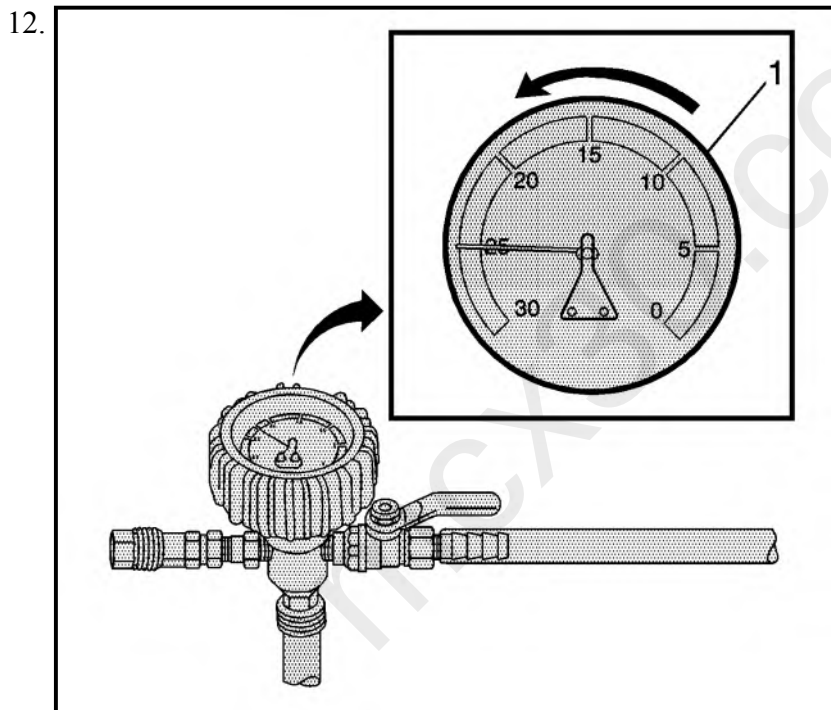


Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).





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

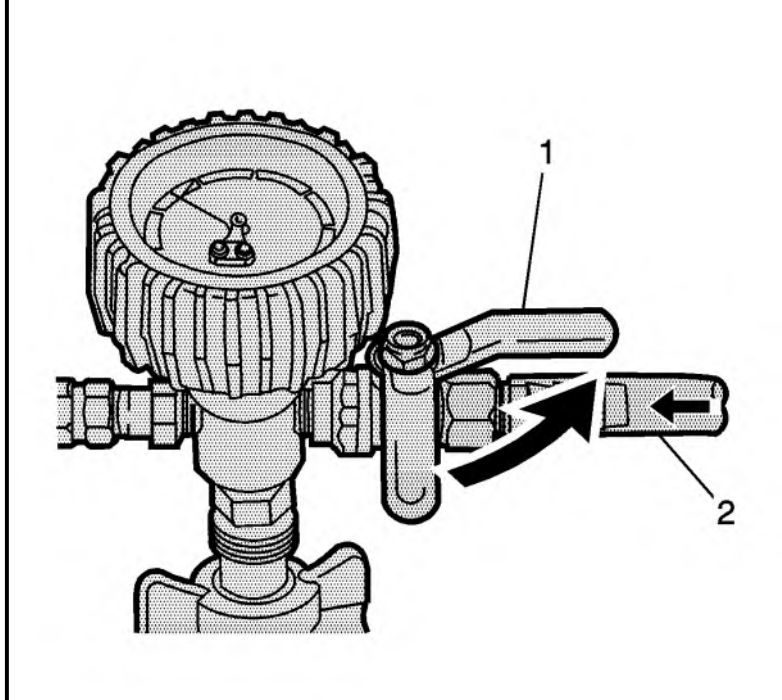


Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

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

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



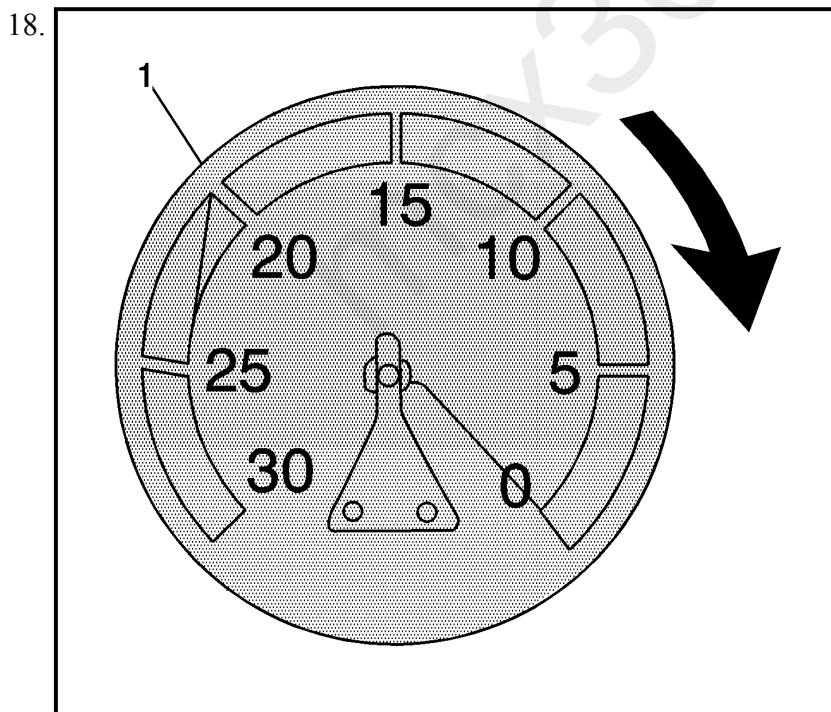


Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.

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

If vacuum loss is observed, refer to [Loss of Coolant](#).

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



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

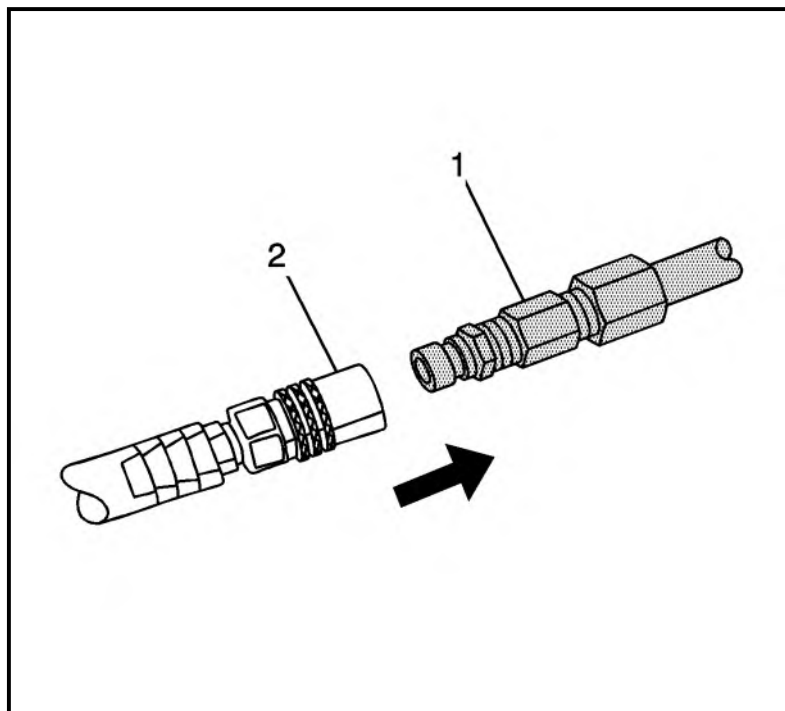
19. Detach the Vac N Fill cap from the **J 42401-A** Radiator Cap and Surge Tank Test Adapter.
20. Remove the **J 42401-A** Radiator Cap and Surge Tank Test Adapter from the coolant surge tank.
21. Add coolant to the system as necessary.
22. Inspect the concentration of the coolant mixture using **J 26568** Coolant and Battery Fluid Tester.

NOTE: After filling the cooling system, the extraction hose can be used to remove

excess coolant to achieve the proper coolant level.

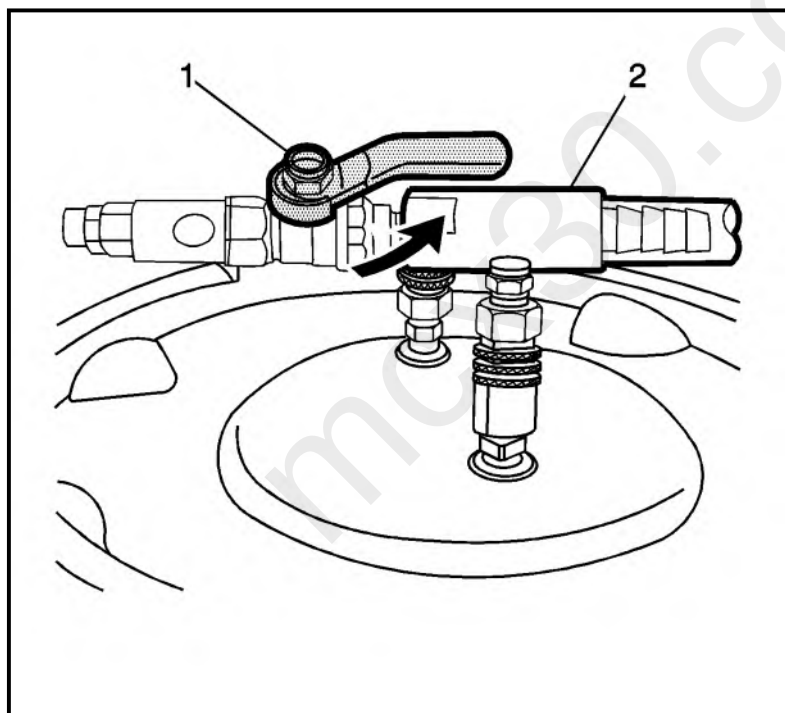
23. Detach the vacuum hose from the vacuum gauge assembly.

24.



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

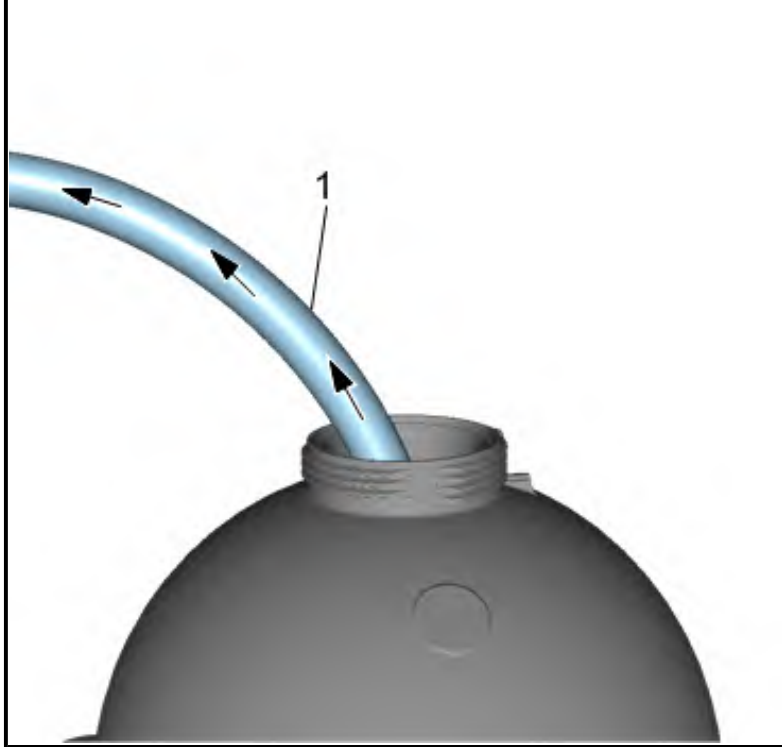
25.



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

26.





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

27. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.
28. Install the radiator surge tank cap.

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Special Tools

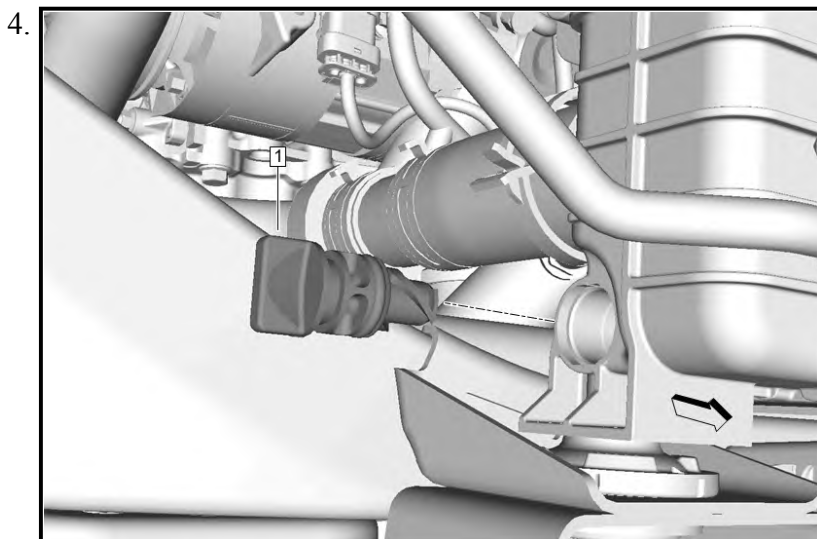
GE-26568 Coolant and Battery Fluid Tester

Equivalent regional tools: [Special Tools](#)

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. Place a drain pan under the drain cock.



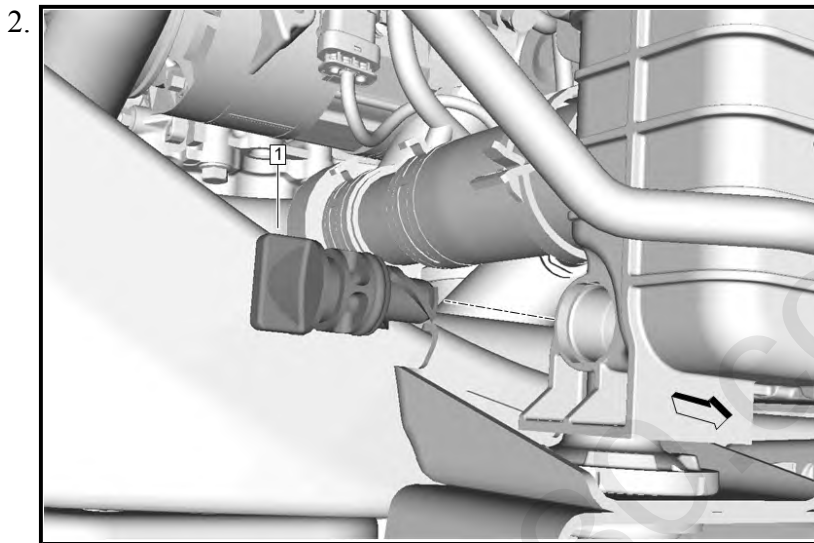
Loosen the radiator drain cock (1). [Radiator Drain Cock Replacement \(LFY\)](#)[Radiator Drain Cock Replacement \(LTG\)](#)

5. Drain the cooling system.
6. Lower the vehicle.
7. Inspect the coolant.
8. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance - Follow the filling procedure.
 - Discolored - Follow the flush procedure. [Flushing](#)

Filling Procedure

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

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)



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

Tighten the radiator drain cock (1). [Radiator Drain Cock Replacement \(LFY\)](#)[Radiator Drain Cock Replacement \(LTG\)](#)

3. Lower the vehicle.

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

4. Slowly fill the radiator with a 50/50 coolant mixture until the coolant level reaches the base of the radiator surge tank. [Approximate Fluid Capacities](#)
5. 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.
6. Start the engine and allow the engine to idle in PARK or NEUTRAL with the parking brake engaged.
7. Slowly fill the coolant mixture until the level stabilizes at the base of the radiator surge tank.
8. Install the coolant pressure cap.
9. Raise the engine RPM to 2500 RPM for 30 - 40 seconds.
10. Shut the engine OFF.
11. 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.
12. Inspect the concentration of the engine coolant using the **GE-26568** Coolant and Battery Fluid Tester.
13. Inspect and if necessary, fill the coolant reservoir bottle as necessary.
14. Rinse away any excess coolant from the engine and the engine compartment.
15. Inspect the cooling system for leaks.
16. Top off the radiator surge tank if necessary.

COOLANT SYSTEM FLUSHING

NOTE:

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

1. Block the drive wheels.
2. Place the transmission in PARK (P).
3. Engage the park brake.
4. Run the engine until the thermostat opens.
5. Stop the engine.

WARNING: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

6. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).
7. Fill the cooling system when flushing is complete. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).

FLUSHING

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RADIATOR CLEANING

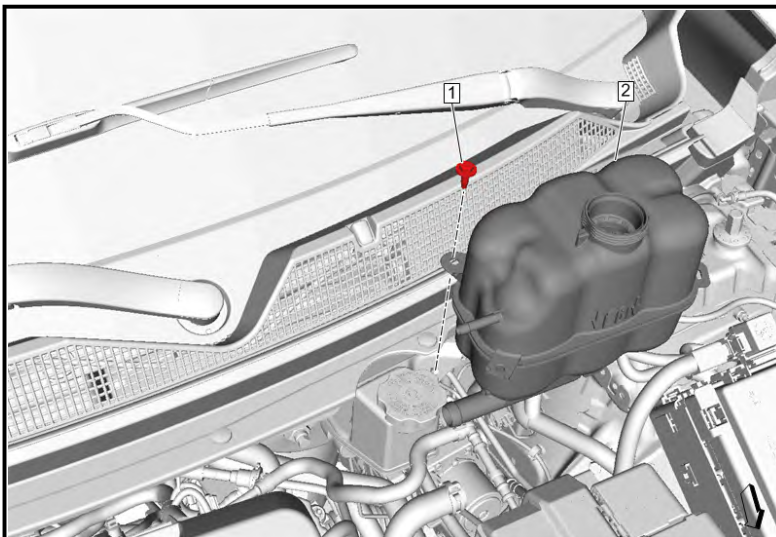
WARNING: NEVER spray water on a hot heat exchanger. The resulting steam could cause personal injury.

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

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

- Some conditions may require the use of warm water and a mild detergent.
- Clean the Auxiliary Transmission Oil Cooler (ATOC) fins. (LFY with V08)
- Clean the Transmission Oil Cooler (TOC) fins. (LTG without V08)
- Clean between the ATOC and the A/C condenser.
- Clean between the ATOC and the radiator.
- Clean the Charged Air Cooler (CAC) fins. (LTG)
- Clean between the CAC and the A/C condenser.
- Clean between the CAC and the radiator.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

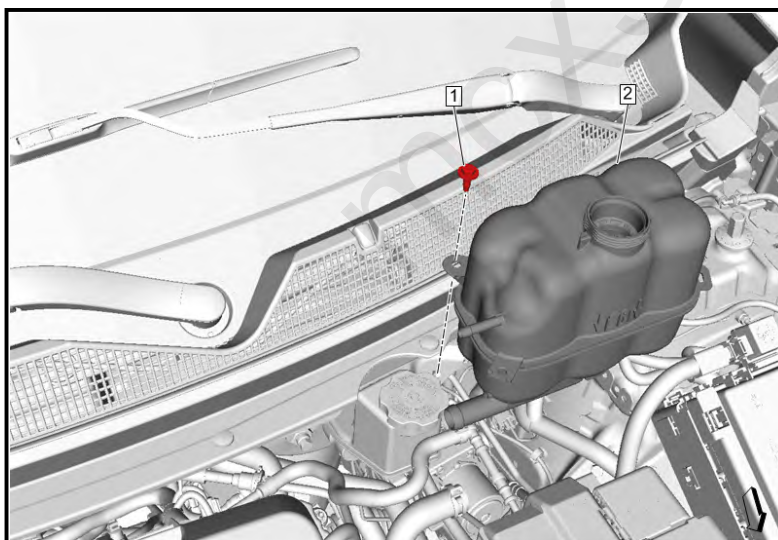
RADIATOR SURGE TANK REPLACEMENT (LFY)



Callout	Component Name
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Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Radiator Surge Tank Overflow Hose @ Radiator Surge Tank - Remove - Radiator Surge Tank Overflow Hose Replacement (LFY Radiator Surge Tank to Engine Coolant Air Bleed Pipe)Radiator Surge Tank Overflow Hose Replacement (LFY Engine Coolant Air Bleed Pipe to Radiator) 3. Radiator Surge Tank Outlet Hose @ Radiator Surge Tank - Remove - Radiator Surge Tank Outlet Hose Replacement (LFY) 4. {If equipped} Power Transfer Unit Vent Hose @ Radiator Surge Tank - Remove - Power Transfer Unit Vent Replacement	
1	Radiator Surge Tank Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK REPLACEMENT (LTG)



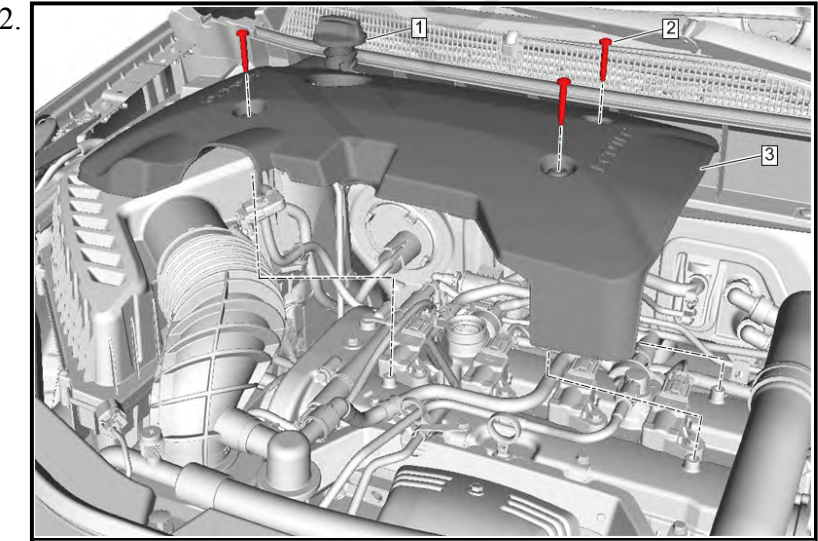
Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Radiator Surge Tank Overflow Hose @ Radiator Surge Tank - Remove - Radiator Surge Tank Overflow Hose Replacement (LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator) 3. Heater Outlet Hose @ Radiator Surge Tank - Remove - Heater Outlet Hose Replacement (LTG Radiator Surge Tank to Heater Outlet Hose Connector) 4. {If equipped} Power Transfer Unit Vent Hose @ Radiator Surge Tank - Remove - Power Transfer Unit Vent Replacement	
1	Radiator Surge Tank Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OUTLET PIPE REPLACEMENT (LTG)

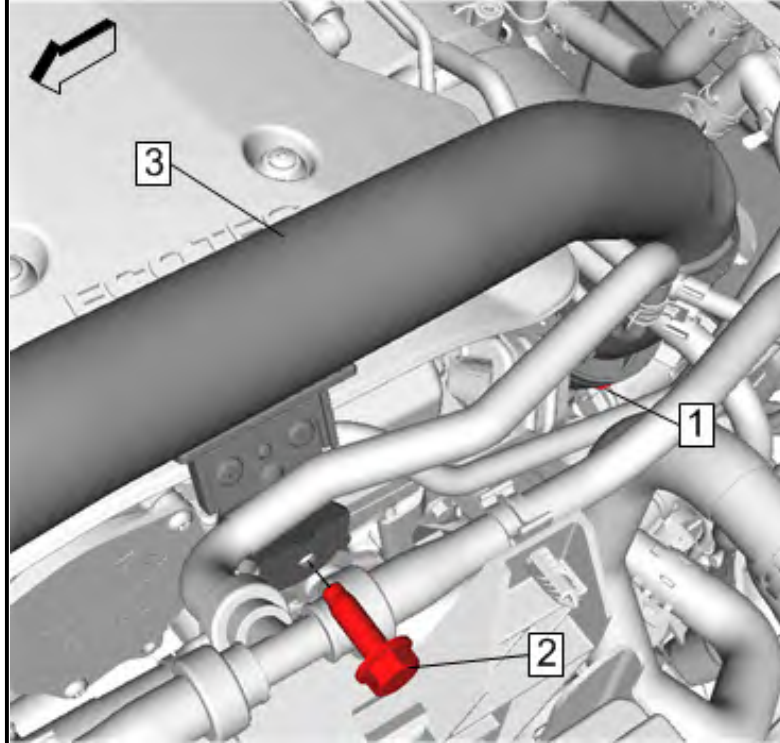
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

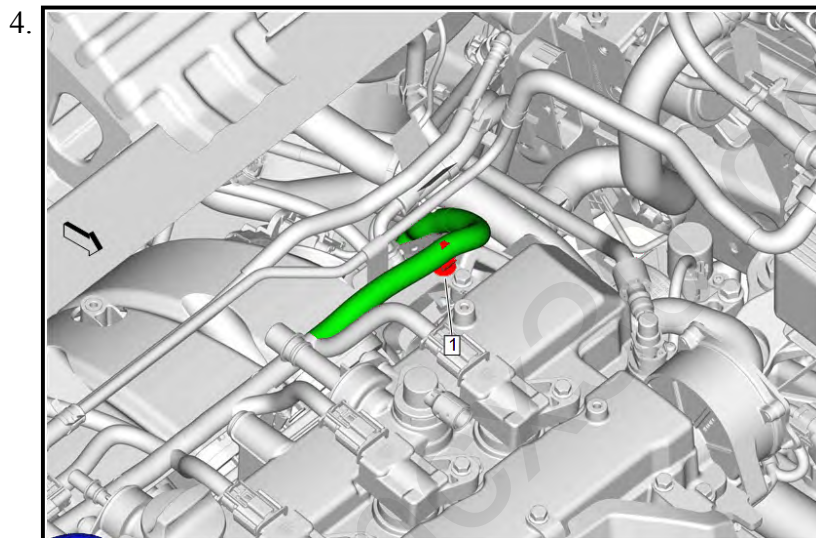


Intake Manifold Cover (3) - Remove - [Intake Manifold Cover Replacement](#)



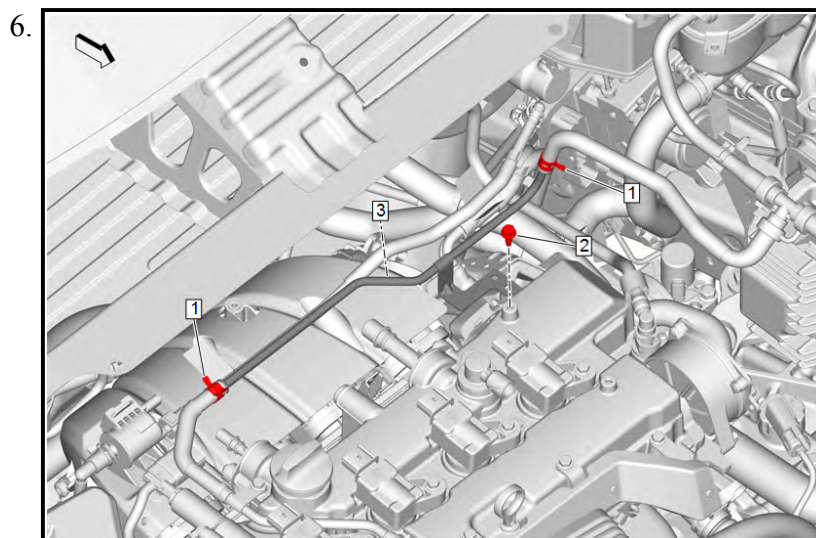


Charge Air Cooler Outlet Air Hose (3) - Remove - [Charge Air Cooler Outlet Air Hose Replacement](#)



Engine Wiring Harness Clip (1) @ Radiator Surge Tank Outlet Pipe - Remove

5. Reposition the wiring harness.

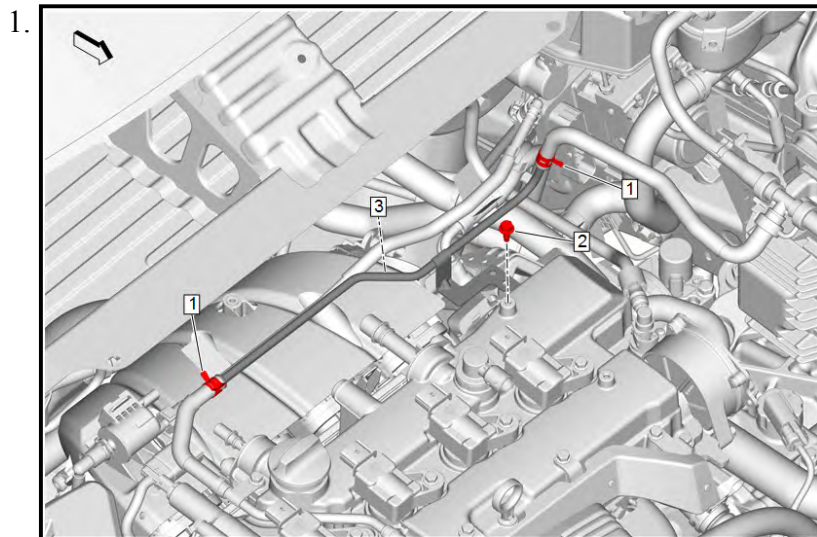


Hose Clamp (1) - Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

7. Radiator Surge Tank Inlet Hose Bolt (2) - Remove

8. Radiator Surge Tank Outlet Pipe (3) - Remove

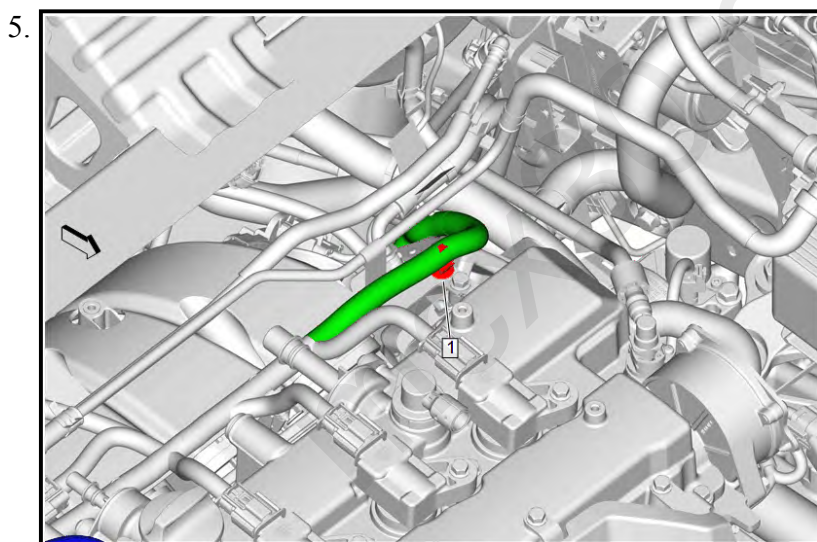
Installation Procedure



Radiator Surge Tank Outlet Pipe (3) - Install

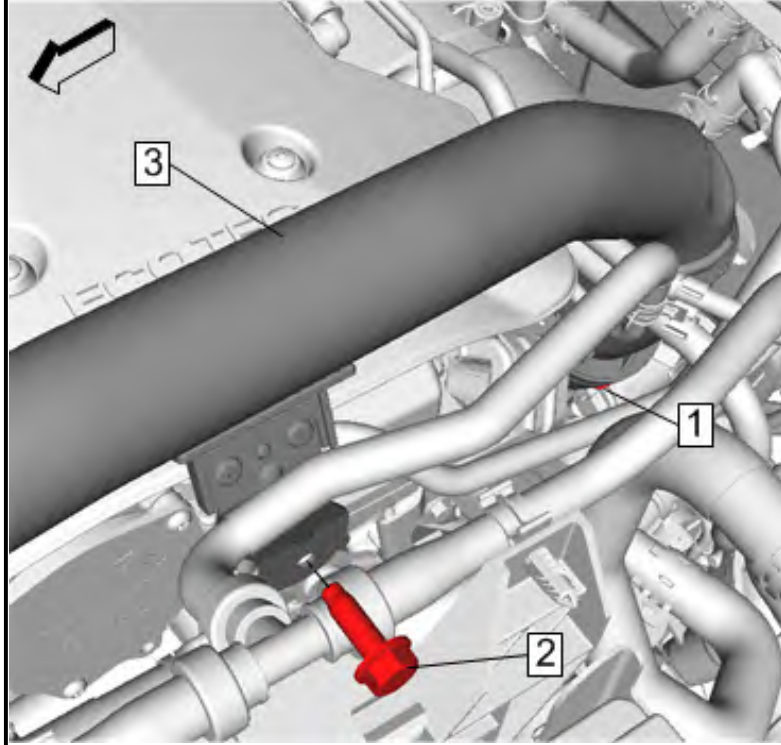
CAUTION: Refer to [Fastener Caution](#) .

2. Radiator Surge Tank Inlet Hose Bolt (2) - Install and tighten 5 N.m (44 lb in)
3. Hose Clamp (1) - Engage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Position the wiring harness.

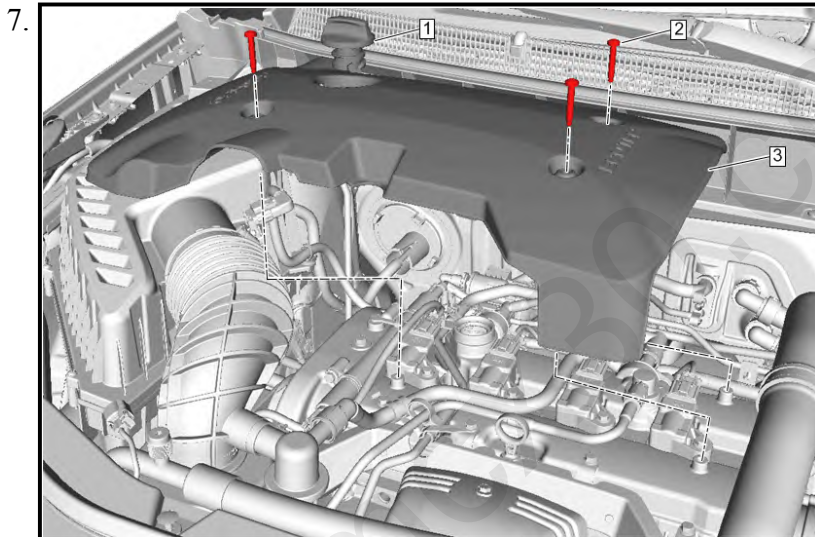


Engine Wiring Harness Clip (1) @ Radiator Surge Tank Outlet Pipe - Install





Charge Air Cooler Outlet Air Hose (3) - Install - [Charge Air Cooler Outlet Air Hose Replacement](#)

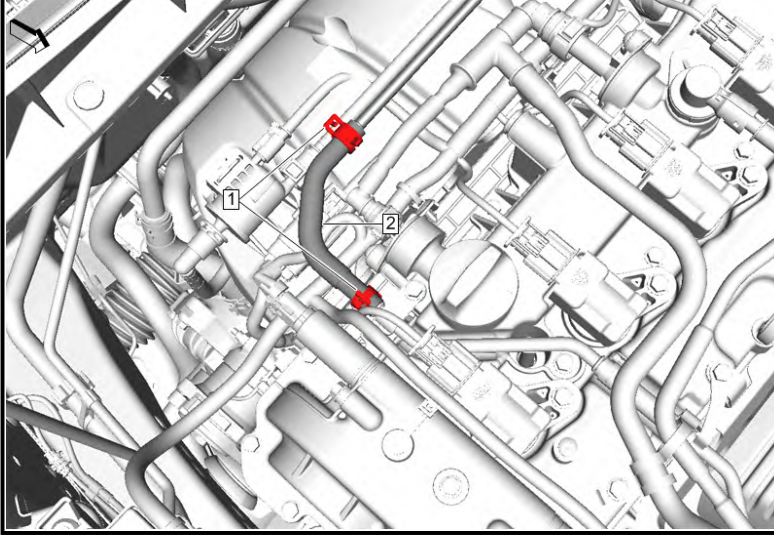


Intake Manifold Cover (3) - Install - [Intake Manifold Cover Replacement](#)

8. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
9. Start the engine and inspect for leaks.

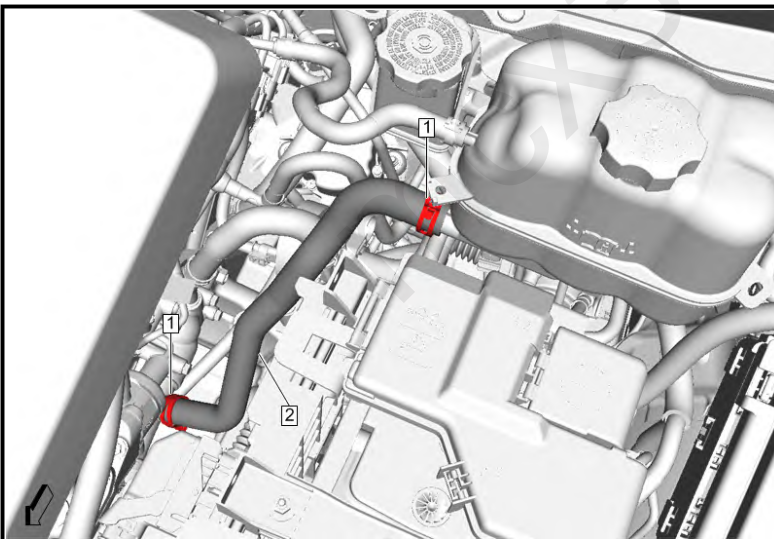
RADIATOR SURGE TANK INLET HOSE REPLACEMENT (LTG FROM RADIATOR SURGE TANK OUTLET PIPE TO ENGINE COOLANT AIR BLEED PIPE)





Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Radiator Surge Tank Inlet Hose Clamp [2x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>
2	Radiator Surge Tank Inlet Hose Procedure 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill)</u> 2. Start the engine and check for coolant leaks.

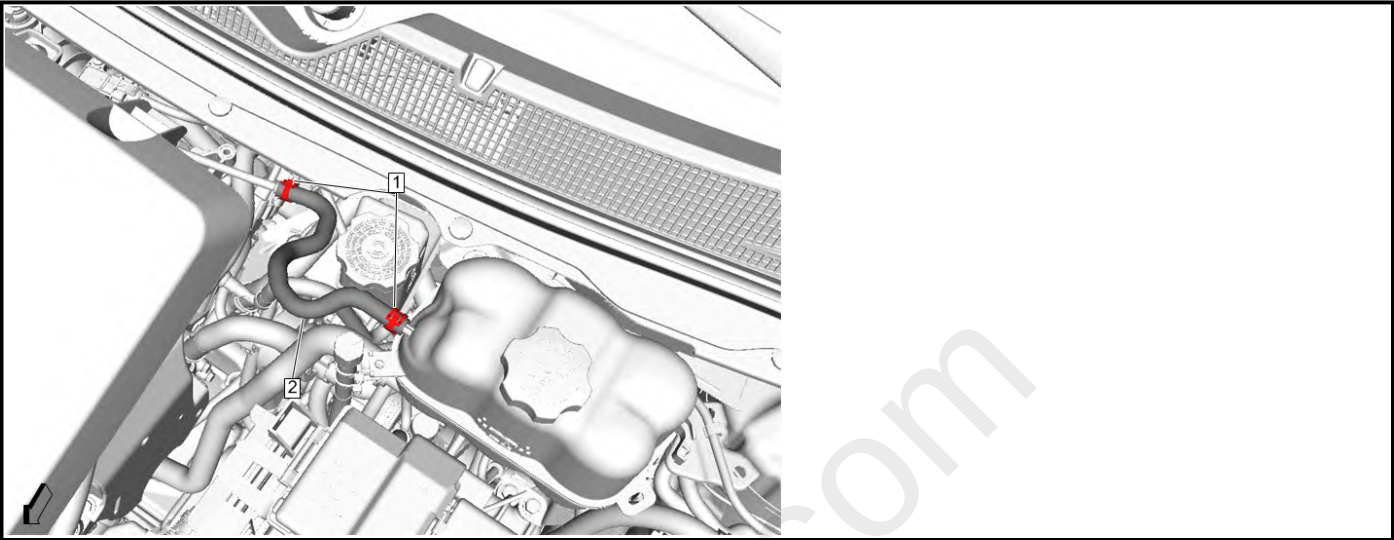
RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (LFY)



Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. <u>Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill)</u> 2. Engine Control Module - Reposition - <u>Engine Control Module Replacement</u>	
1	Radiator Surge Tank Outlet Hose Clamp [2x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>

Callout	Component Name
2	Radiator Surge Tank Outlet Hose Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OVERFLOW HOSE REPLACEMENT (LFY RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE)

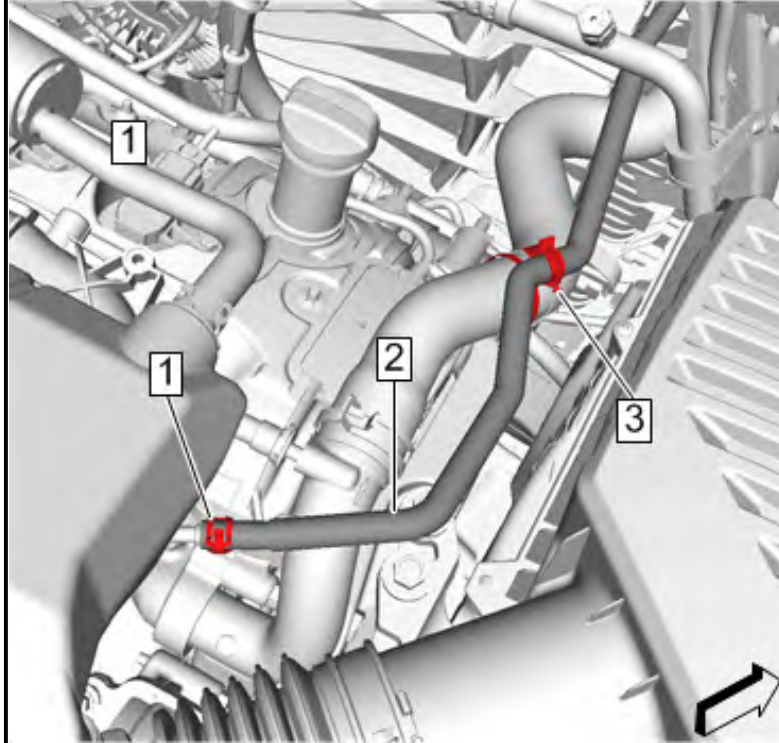


Callout	Component Name
1	Radiator Surge Tank Overflow Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Surge Tank Overflow Hose Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OVERFLOW HOSE REPLACEMENT (LFY ENGINE COOLANT AIR BLEED PIPE TO RADIATOR)

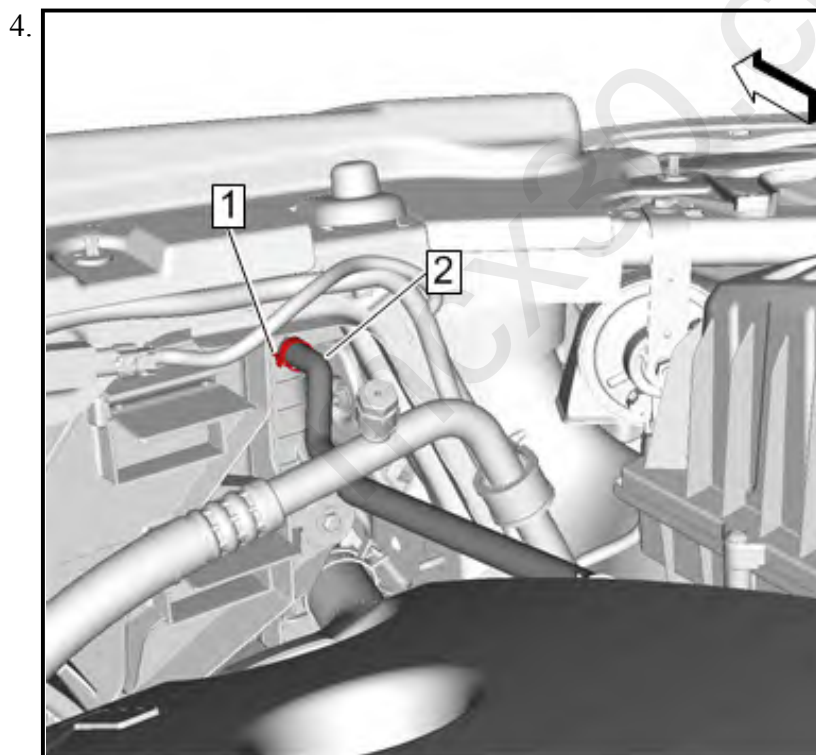
Removal Procedure

1.



Radiator Outlet Hose Strap (3) @ Radiator Surge Tank Overflow Hose - Remove

2. Radiator Surge Tank Overflow Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Radiator Surge Tank Overflow Hose (2) @ Engine Coolant Air Bleed Pipe - Remove

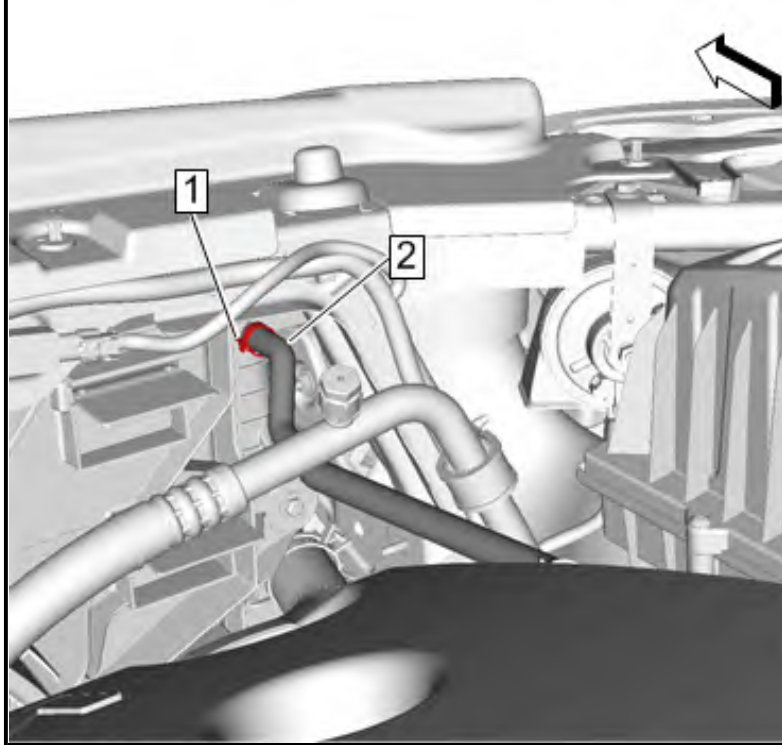


Radiator Surge Tank Overflow Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Surge Tank Overflow Hose (2) @ - Radiator - Remove
6. Radiator Surge Tank Overflow Hose (2) - Remove

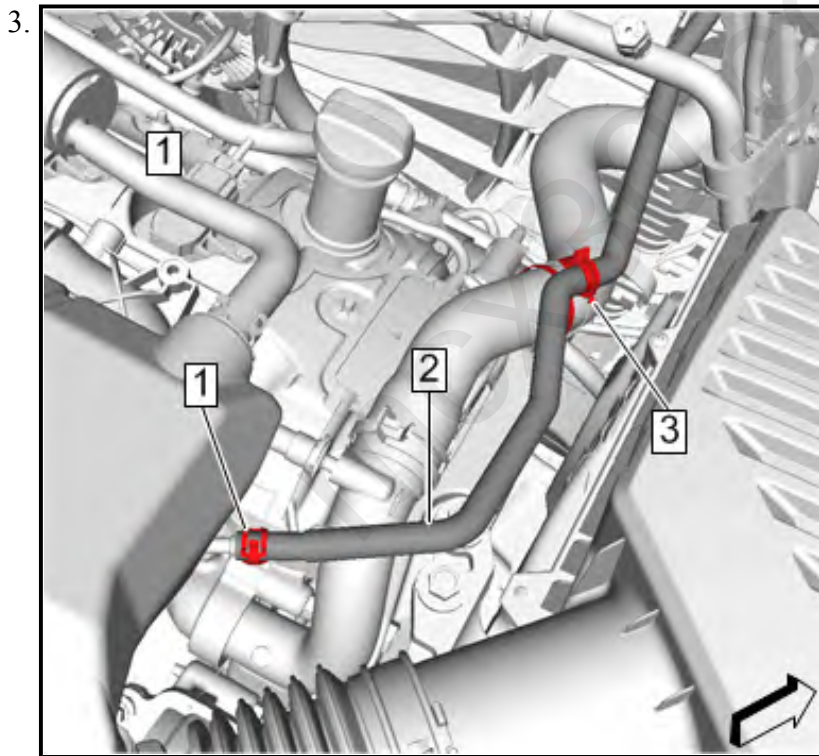
Installation Procedure





Radiator Surge Tank Overflow Hose (2) @ - Radiator - Install

2. Radiator Surge Tank Overflow Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)



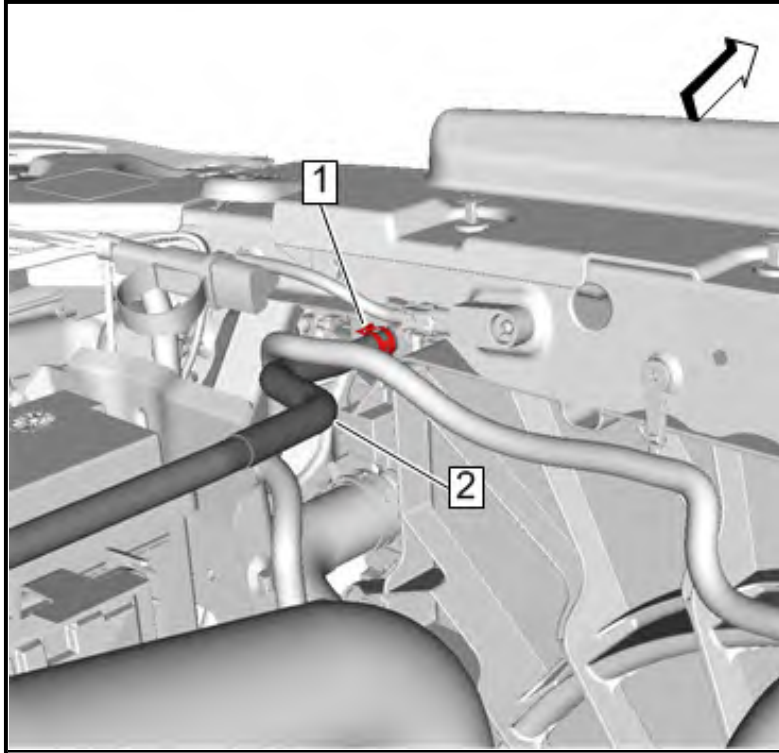
Radiator Surge Tank Overflow Hose (2) @ Engine Coolant Air Bleed Pipe - Install

4. Radiator Surge Tank Overflow Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Radiator Outlet Hose Strap (3) @ Radiator Surge Tank Overflow Hose - Install
6. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
7. Start the engine and inspect for leaks.

RADIATOR SURGE TANK OVERFLOW HOSE REPLACEMENT (LTG RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE TO RADIATOR)

Removal Procedure

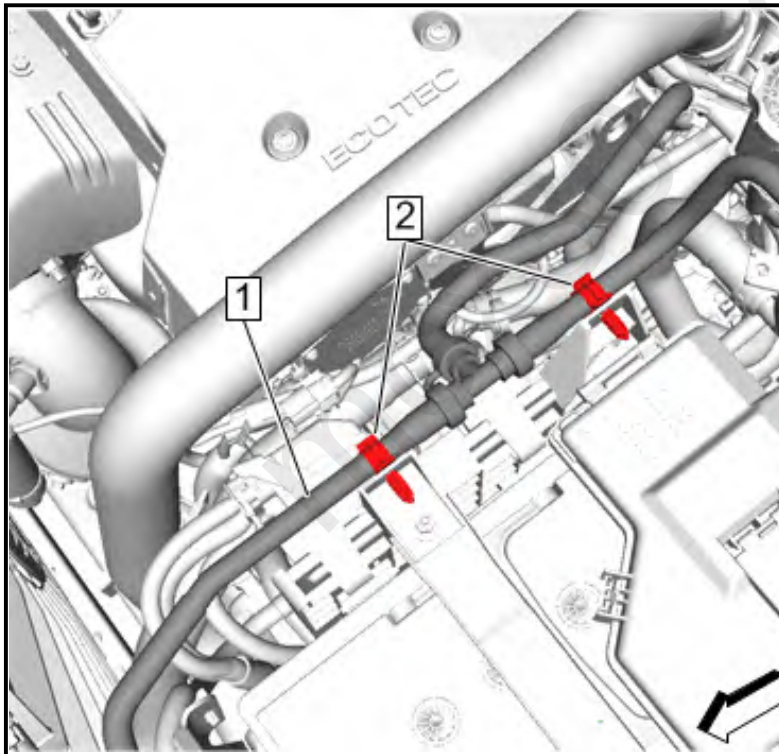
1.



Radiator Surge Tank Overflow Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

2. Radiator Surge Tank Overflow Hose (2) @ Radiator - Remove

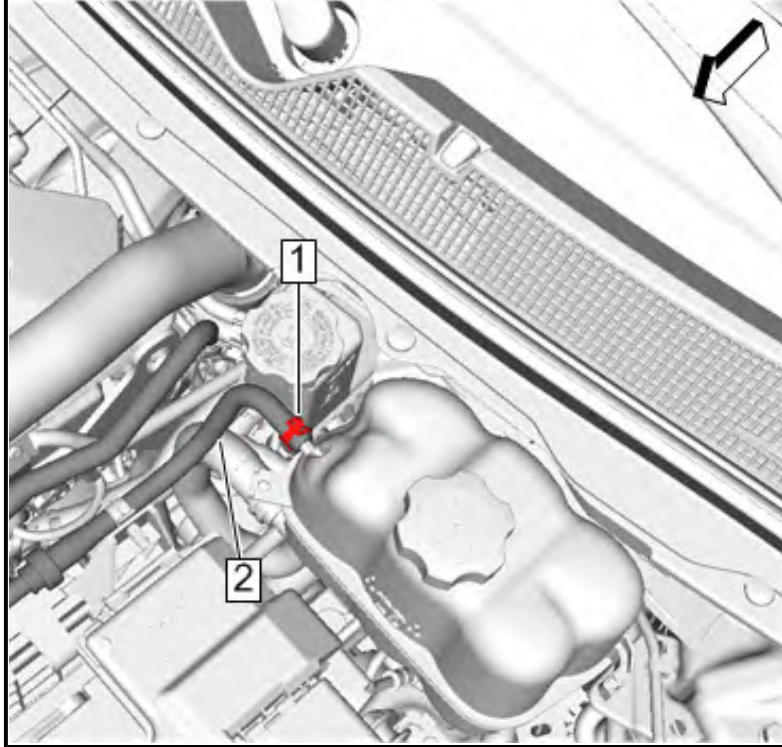
3.



Radiator Surge Tank Overflow Hose (1) @ Hose Clip (2) - Disengage [2x]

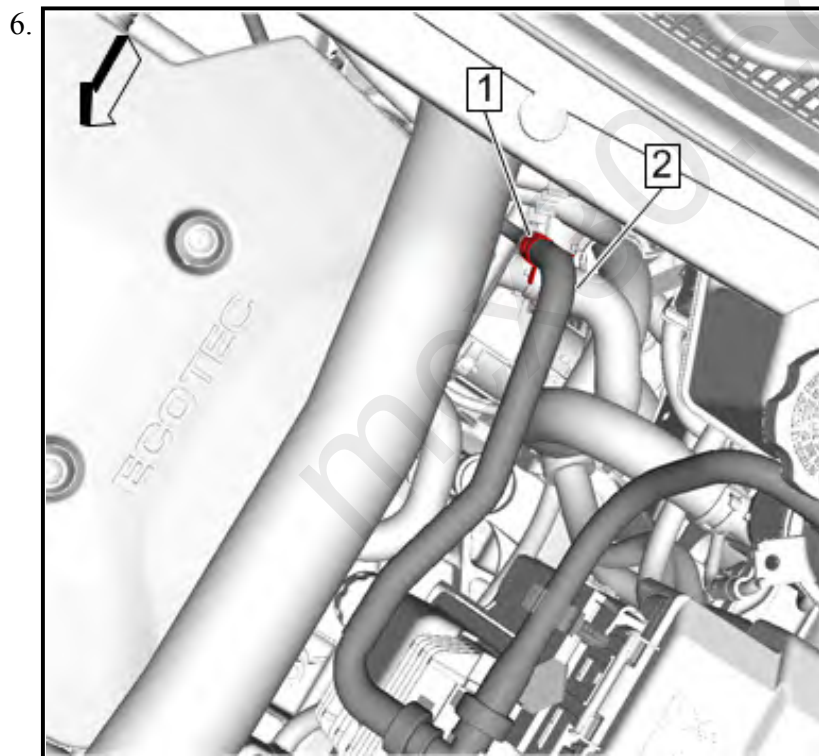
4.





Radiator Surge Tank Overflow Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank - Remove



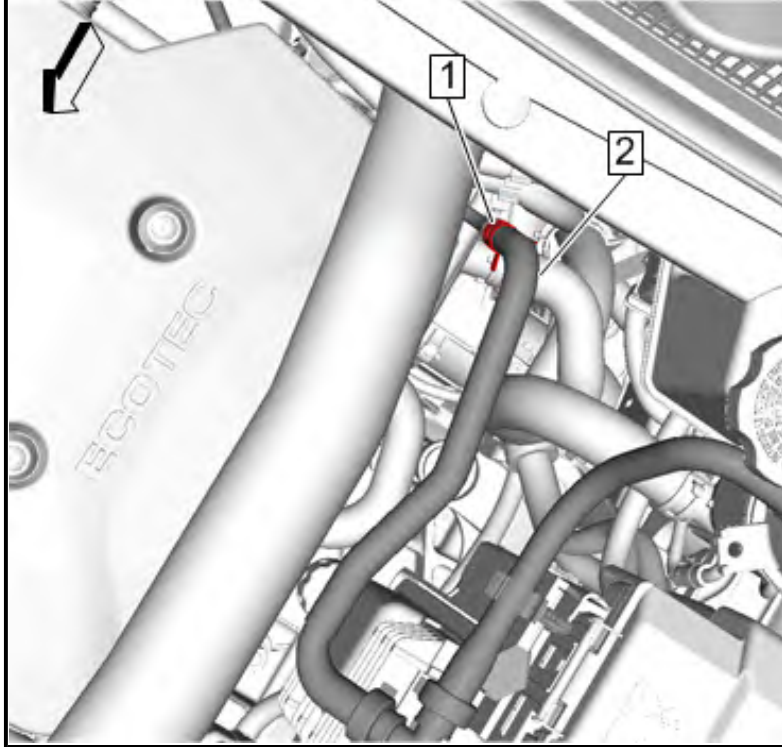
Radiator Surge Tank Overflow Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

7. Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank Outlet Pipe - Remove

8. Transfer components as necessary.

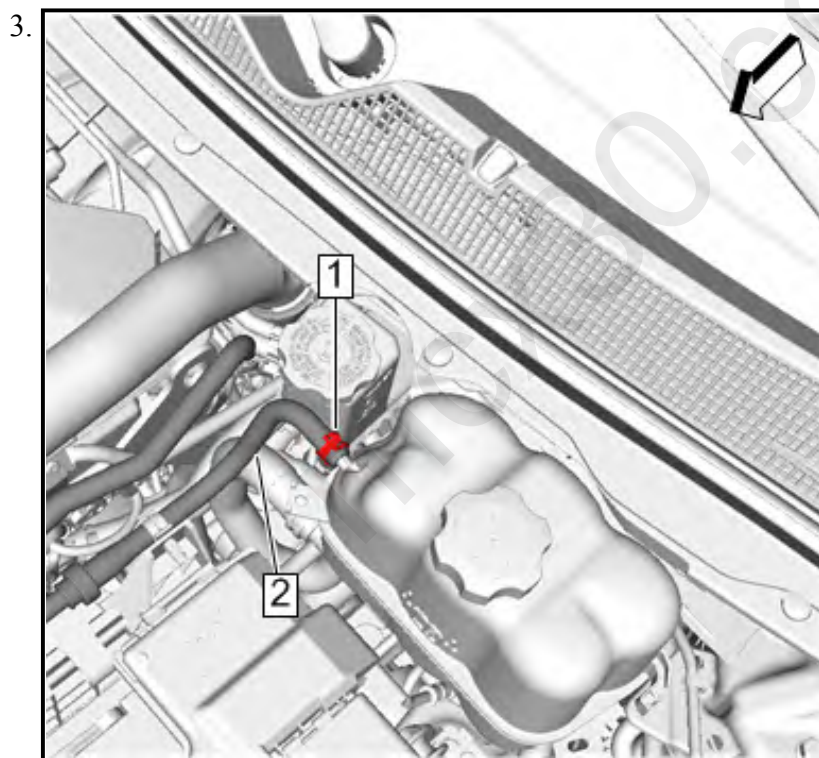
Installation Procedure





Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank Outlet Pipe - Install

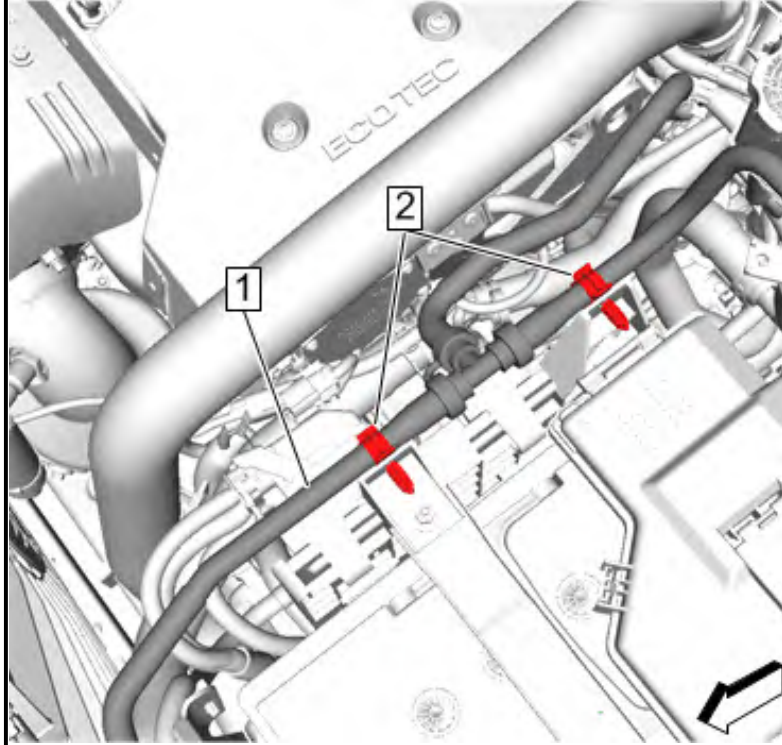
2. Radiator Surge Tank Overflow Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)



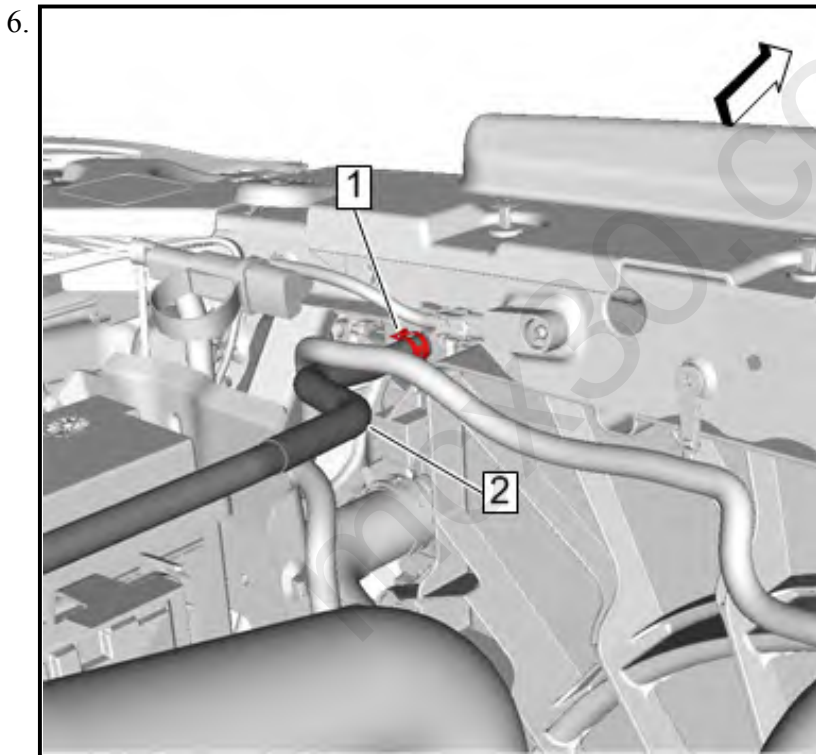
Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank - Install

4. Radiator Surge Tank Overflow Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)





Radiator Surge Tank Overflow Hose (1) @ Hose Clip (2) - Engage [2x]



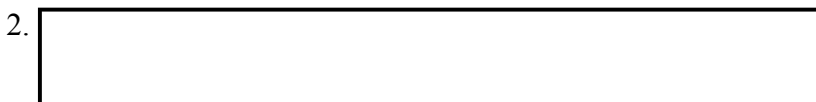
Radiator Surge Tank Overflow Hose (2) @ Radiator - Install

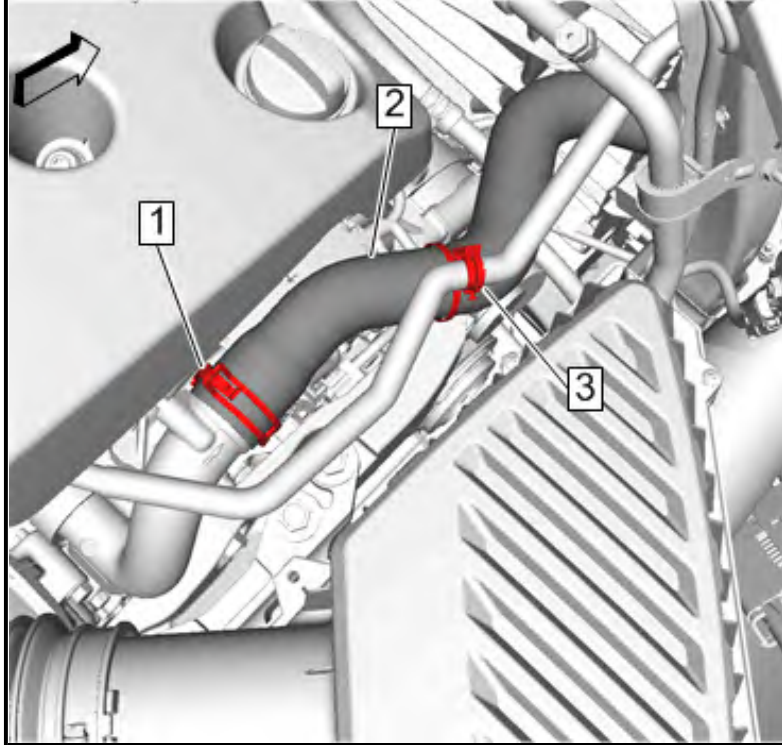
7. Radiator Surge Tank Overflow Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
8. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
9. Start the engine and check for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT (LFY)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

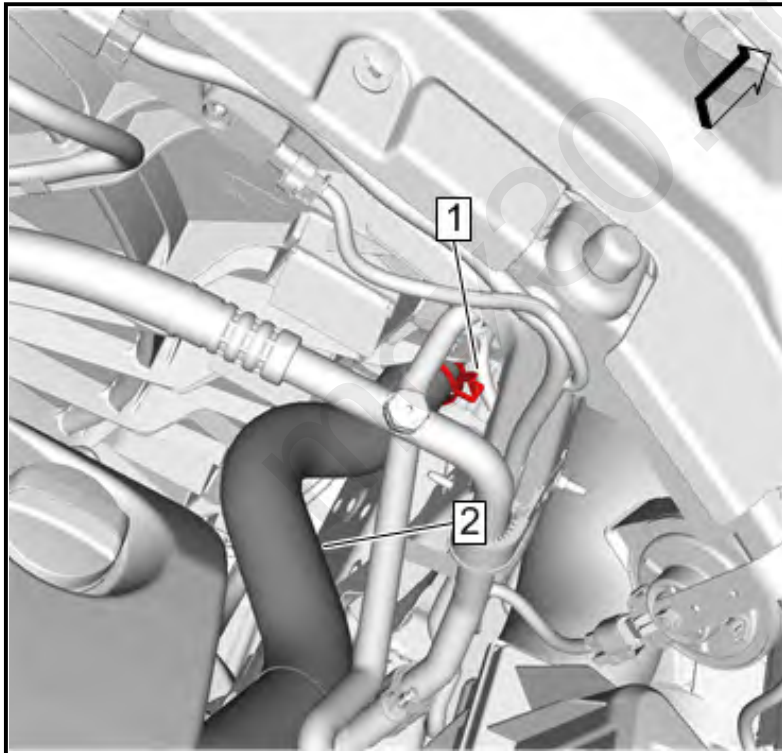




Radiator Outlet Hose Strap (3) @ Radiator Surge Tank Overflow Hose - Remove

3. Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Radiator Inlet Hose (2) @ Water Outlet - Remove

5.



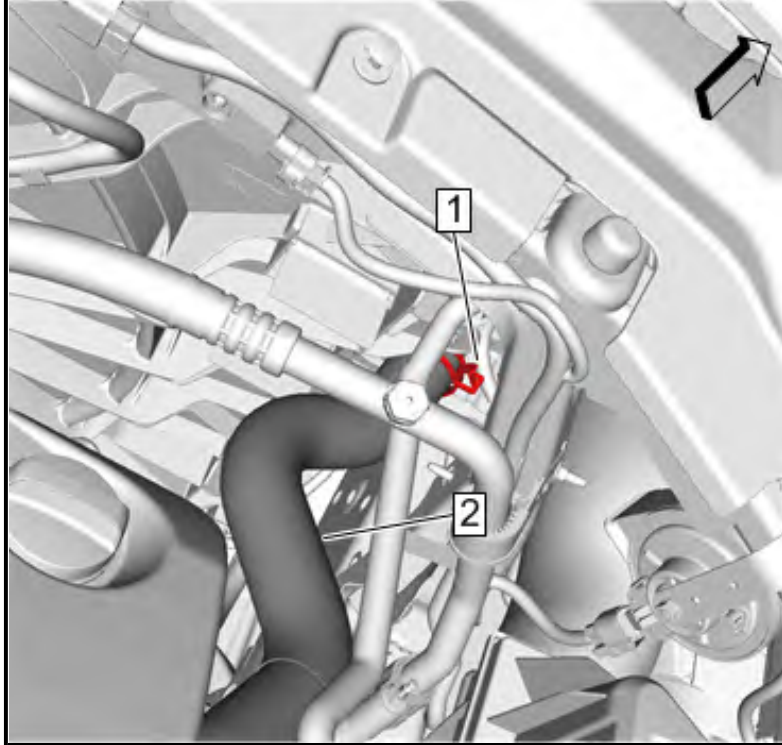
Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

6. Radiator Inlet Hose (2) @ Radiator - Remove
7. Radiator Inlet Hose (2) - Remove

Installation Procedure

1.

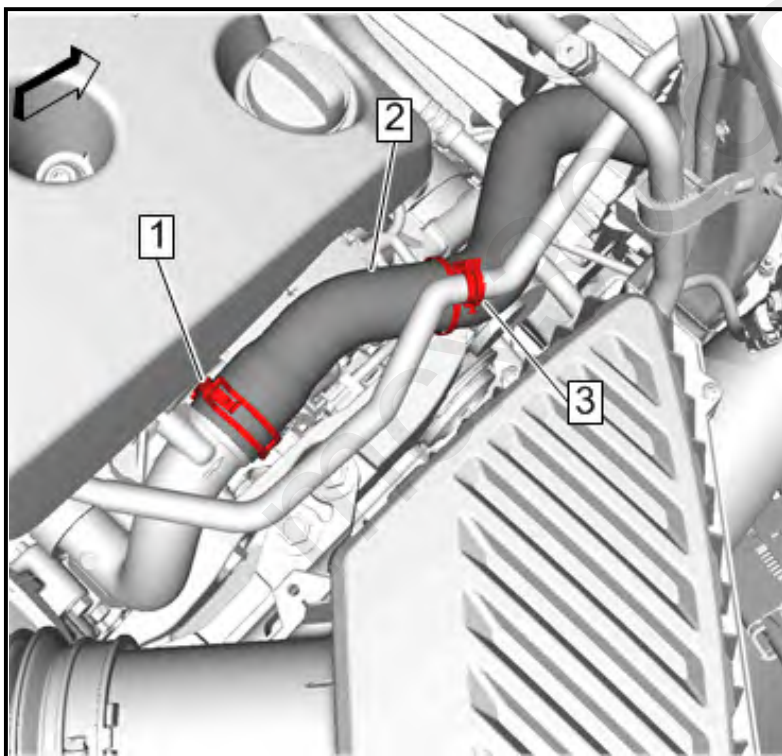




Radiator Inlet Hose (2) @ - Radiator - Install

2. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

3.



Radiator Inlet Hose (2) @ Water Outlet - Install

4. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Outlet Hose Strap (3) @ Radiator Surge Tank Overflow Hose - Install

6. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

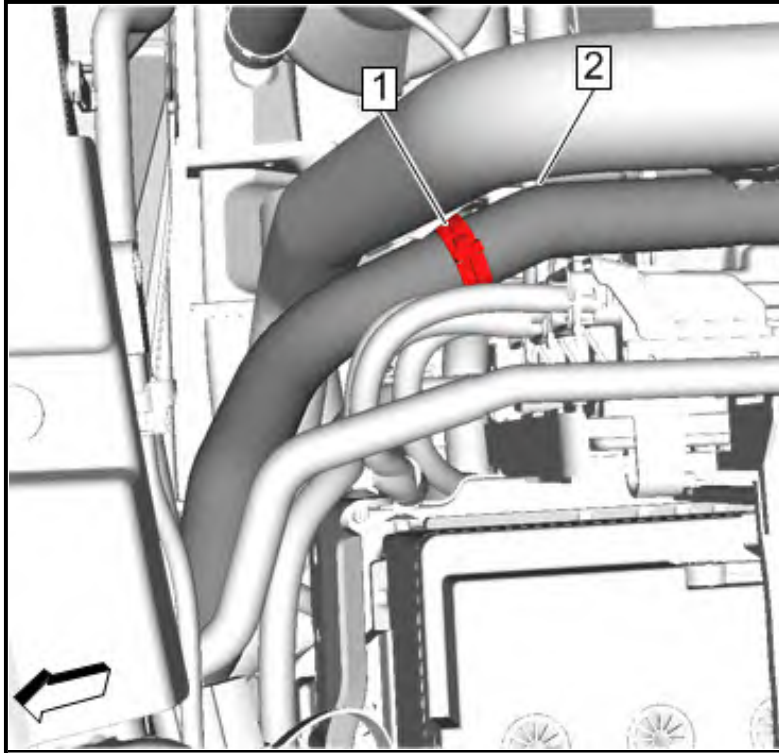
7. Start the engine and inspect for leaks.

RADIATOR INLET HOSE REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

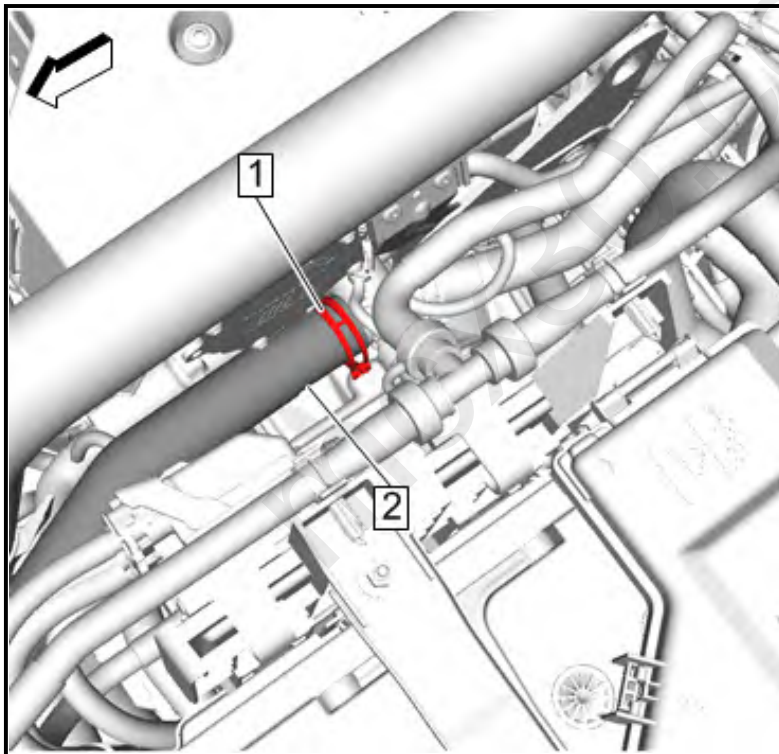
2.



Radiator Inlet Hose Clip (1) @ Radiator Inlet Hose (2) - Remove

3. Reposition the wiring harness.

4.

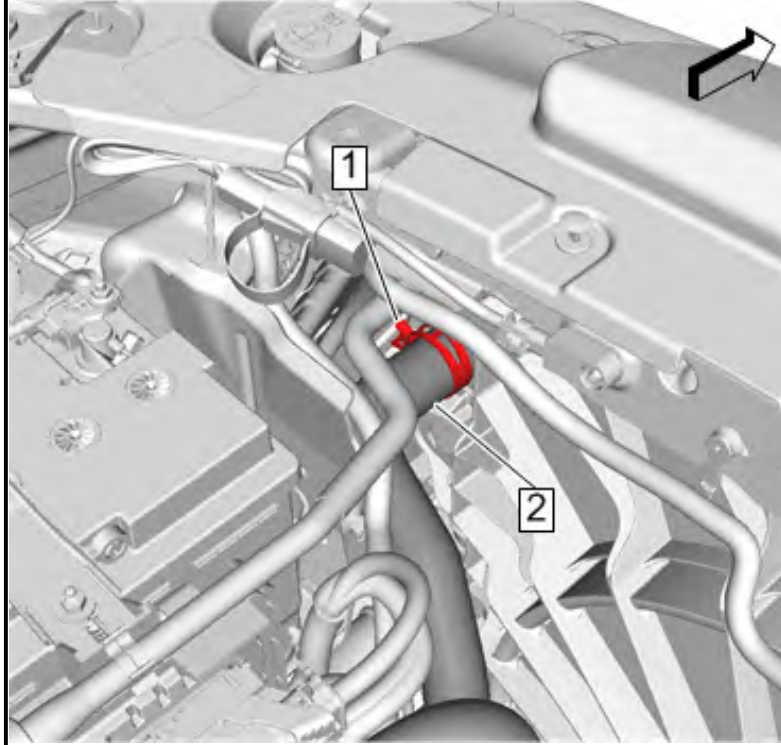


Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Inlet Hose (2) @ Water Outlet - Remove

6.

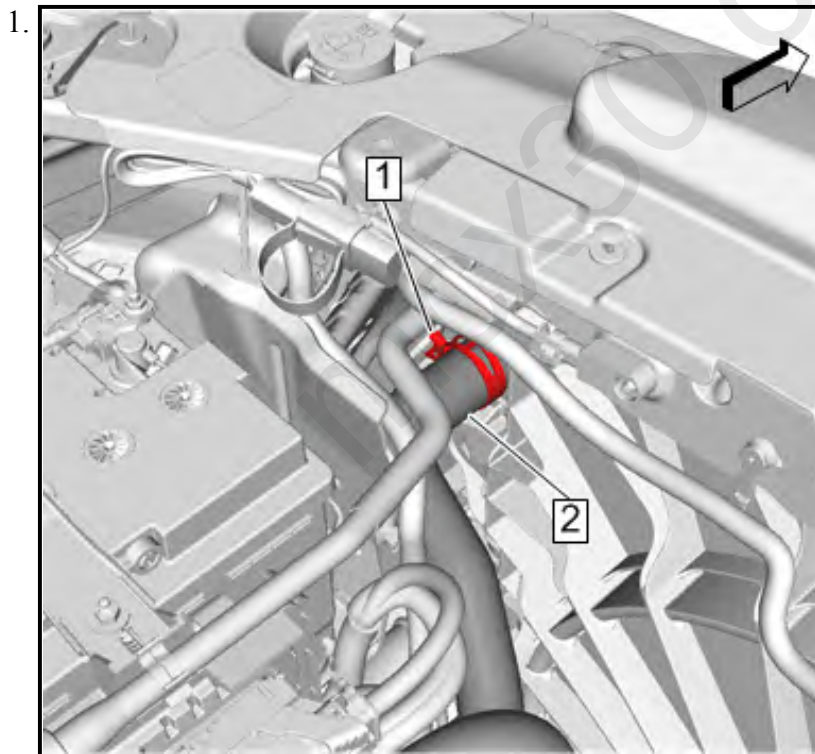




Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

7. Radiator Inlet Hose (2) @ Radiator - Remove
8. Radiator Inlet Hose (2) - Remove

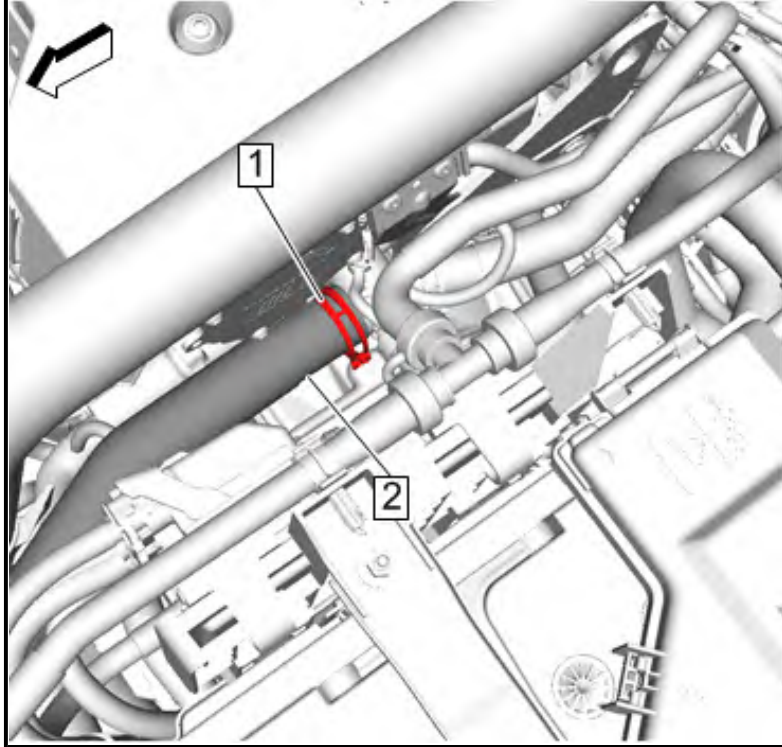
Installation Procedure



Radiator Inlet Hose (2) @ Radiator - Install

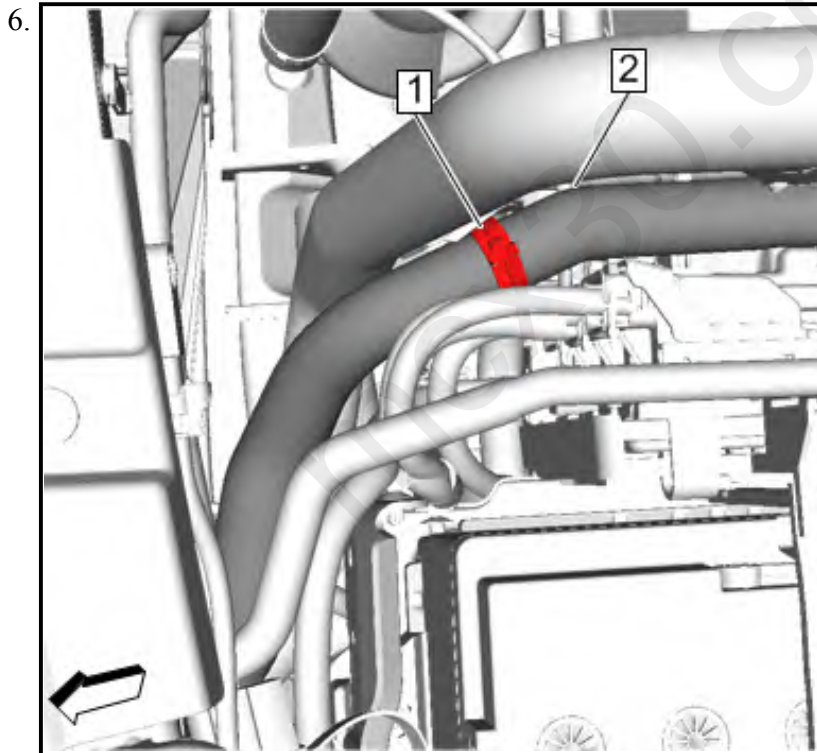
2. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)





Radiator Inlet Hose (2) @ Water Outlet - Install

4. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Reposition the wiring harness.



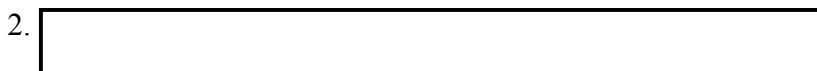
Radiator Inlet Hose Clip (1) @ Radiator Inlet Hose (2) - Install

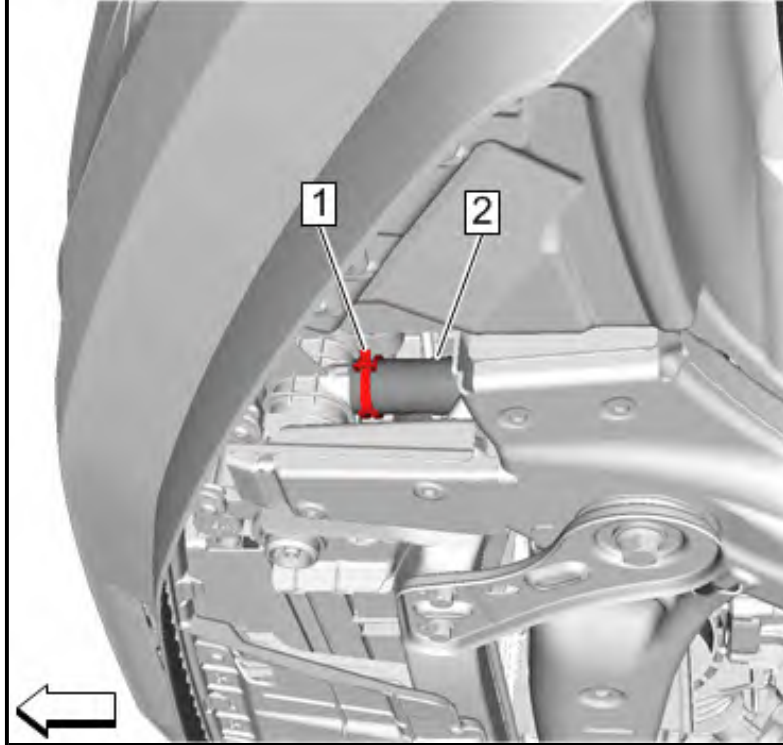
7. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
8. Start the engine and inspect for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LFY)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

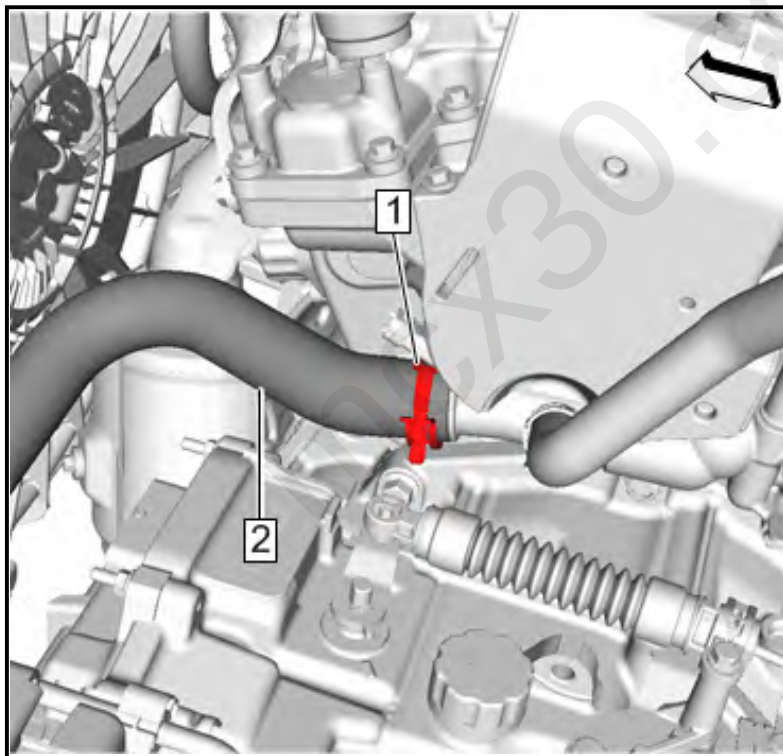




Radiator Outlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

3. Radiator Outlet Hose (2) @ Radiator - Remove
4. Lower the vehicle.

5.



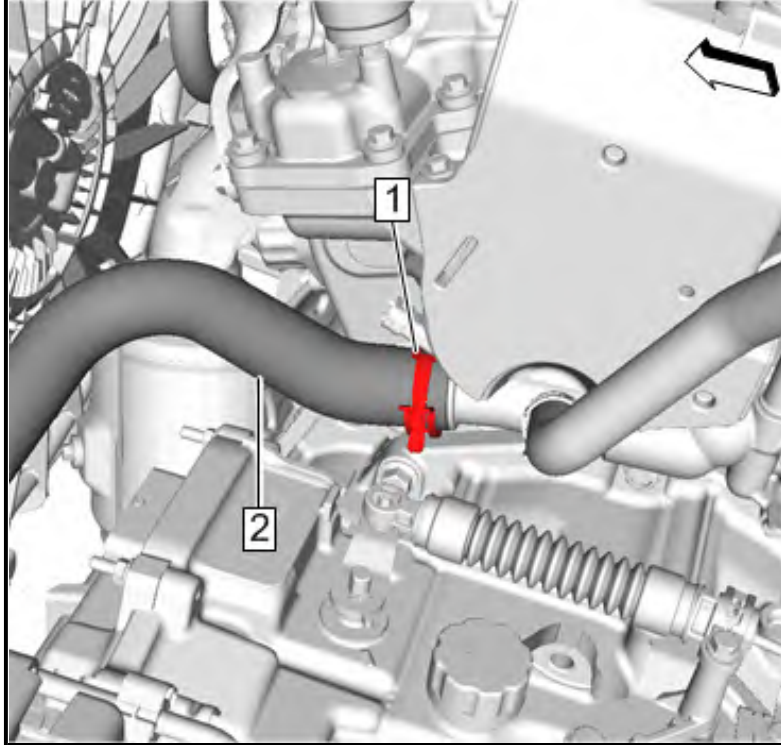
Radiator Outlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

6. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing - Remove
7. Radiator Outlet Hose (2) - Remove

Installation Procedure

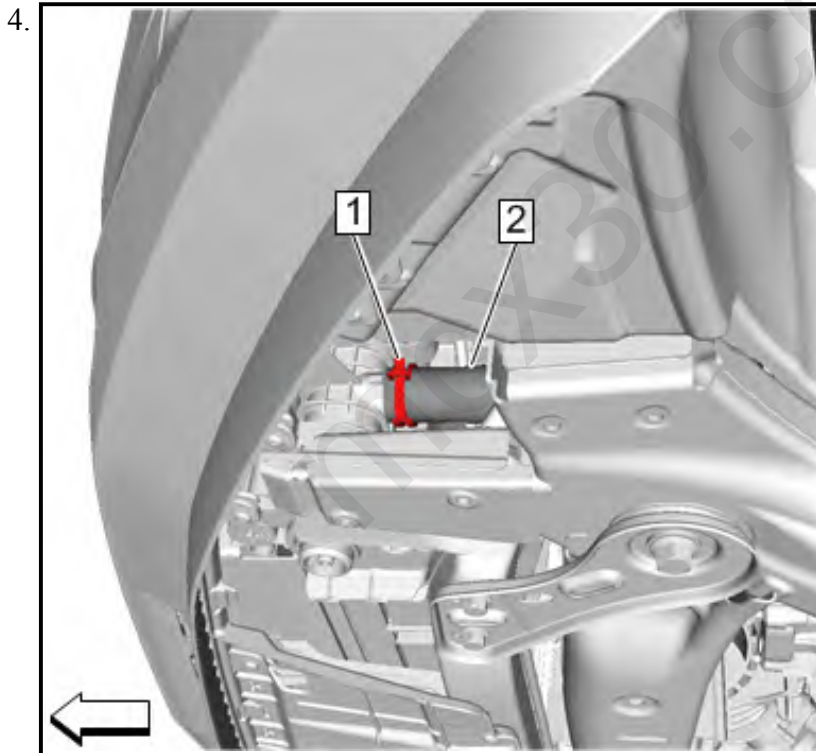
1.





Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing - Install

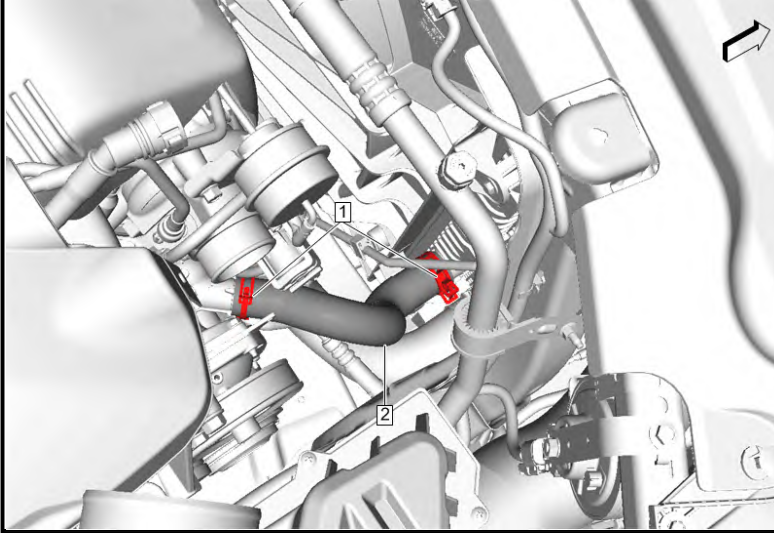
2. Radiator Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)



Radiator Outlet Hose (2) @ Radiator - Install

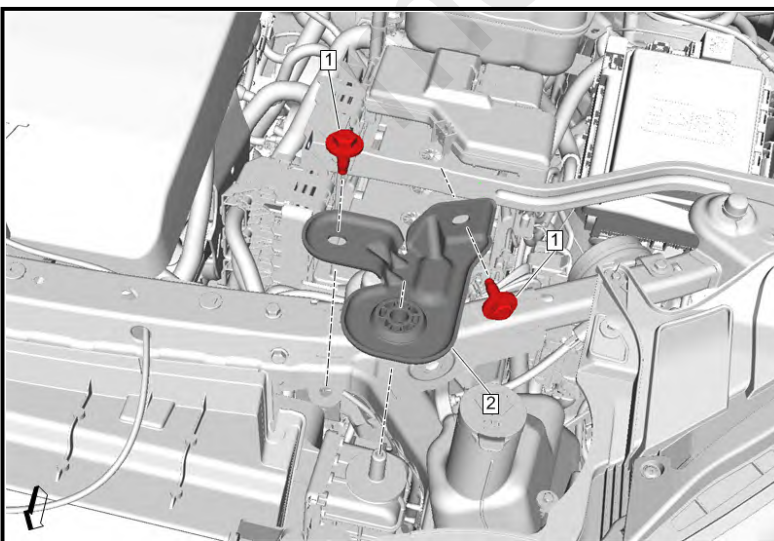
5. Radiator Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
7. Start the engine and inspect for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LTG)



Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill). 2. Air Cleaner Outlet Duct - Remove - Air Cleaner Outlet Duct Replacement (Non-Tamperproof). Air Cleaner Outlet Duct Replacement (Tamperproof).	
1	Radiator Outlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Outlet Hose Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill). 2. Start the engine and check for coolant leaks.

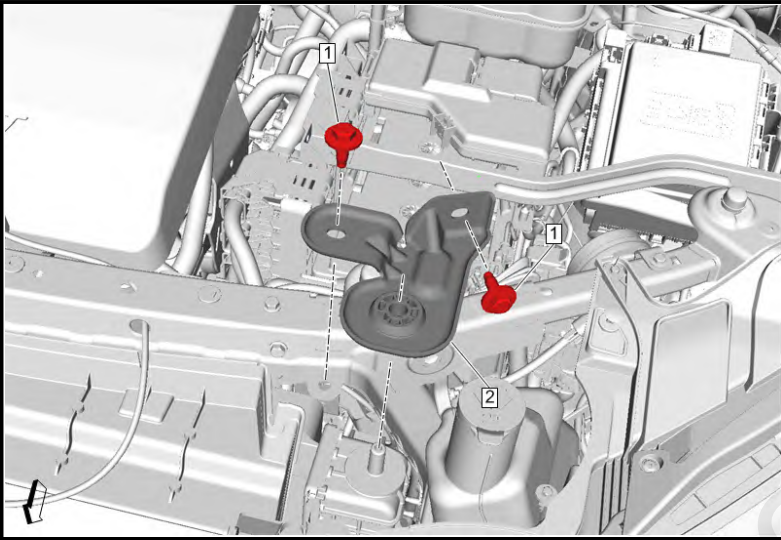
RADIATOR UPPER BRACKET REPLACEMENT - LEFT SIDE (LFY)



Callout	Component Name
Preliminary Procedure Intake Air Splash Shield Replacement	
Empty space for additional preliminary procedures	

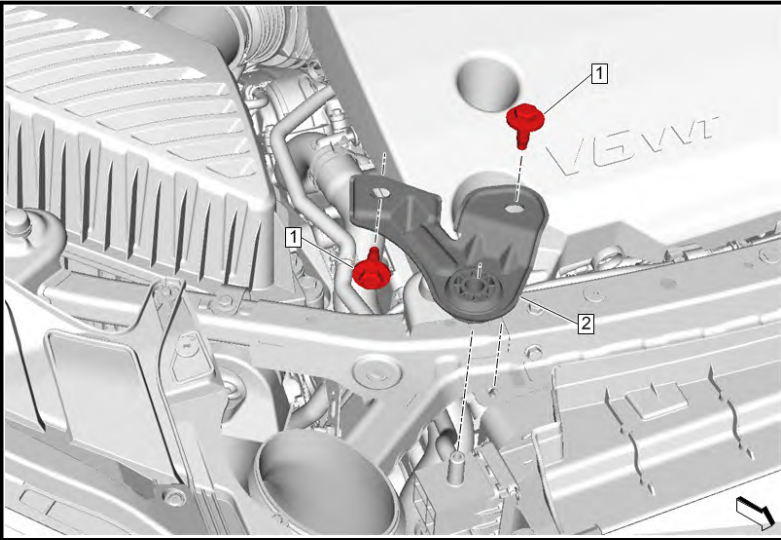
Callout	Component Name
1	Radiator Upper Bracket Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Upper Bracket

RADIATOR UPPER BRACKET REPLACEMENT - LEFT SIDE (LTG)



Callout	Component Name
Preliminary Procedure Intake Air Splash Shield Replacement	
1	Radiator Upper Bracket Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Upper Bracket

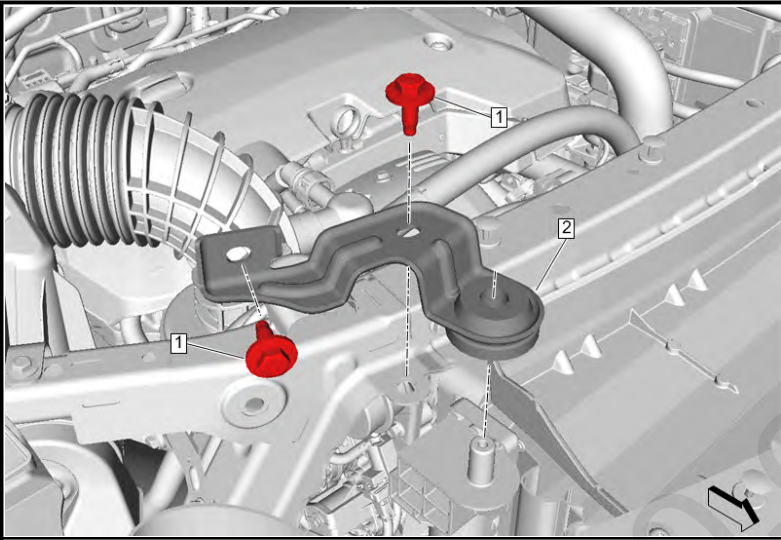
RADIATOR UPPER BRACKET REPLACEMENT - RIGHT SIDE (LFY)



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

Callout	Component Name
Preliminary Procedure Intake Air Splash Shield Replacement	
1	Radiator Upper Bracket Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Upper Bracket

RADIATOR UPPER BRACKET REPLACEMENT - RIGHT SIDE (LTG)



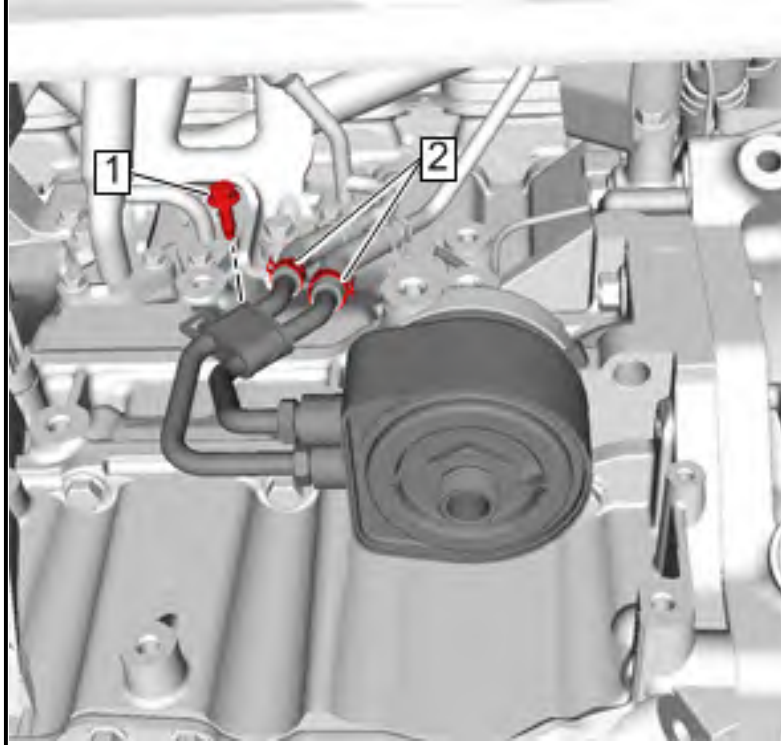
Callout	Component Name
Preliminary Procedure Intake Air Splash Shield Replacement	
1	Radiator Upper Bracket Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Upper Bracket

ENGINE OIL COOLER REPLACEMENT

Removal Procedure

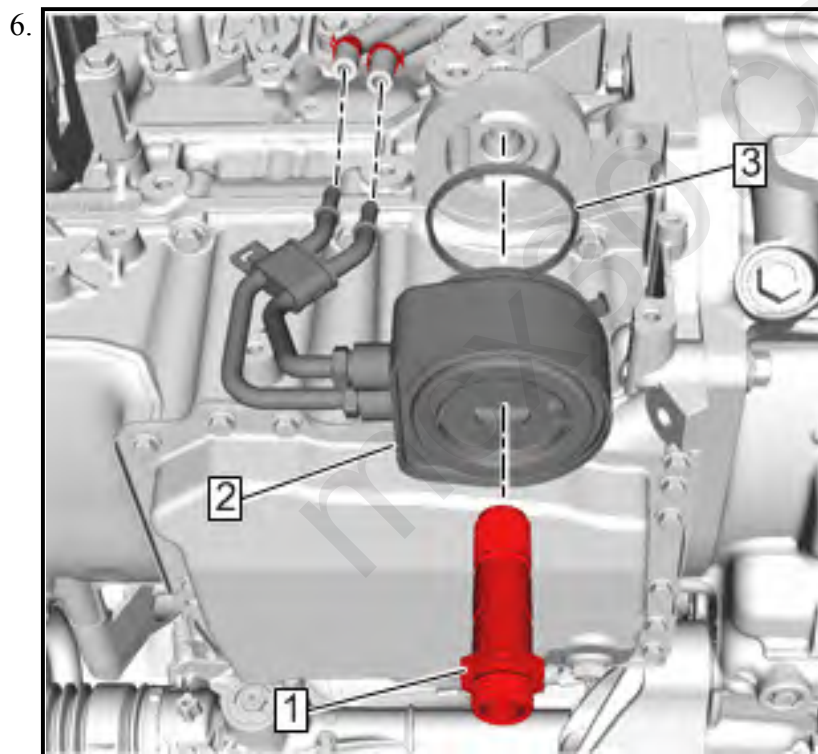
1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
2. Remove the engine oil filter. [Engine Oil and Oil Filter Replacement](#)
3. Oil Pump Flow Control Valve Heat Shield - Remove - [Oil Pump Flow Control Valve Heat Shield Replacement](#)

4.



Engine Oil Cooler Pipe Fastener (1) - Remove

5. Engine Oil Cooler Hose Clamp (2) - Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)



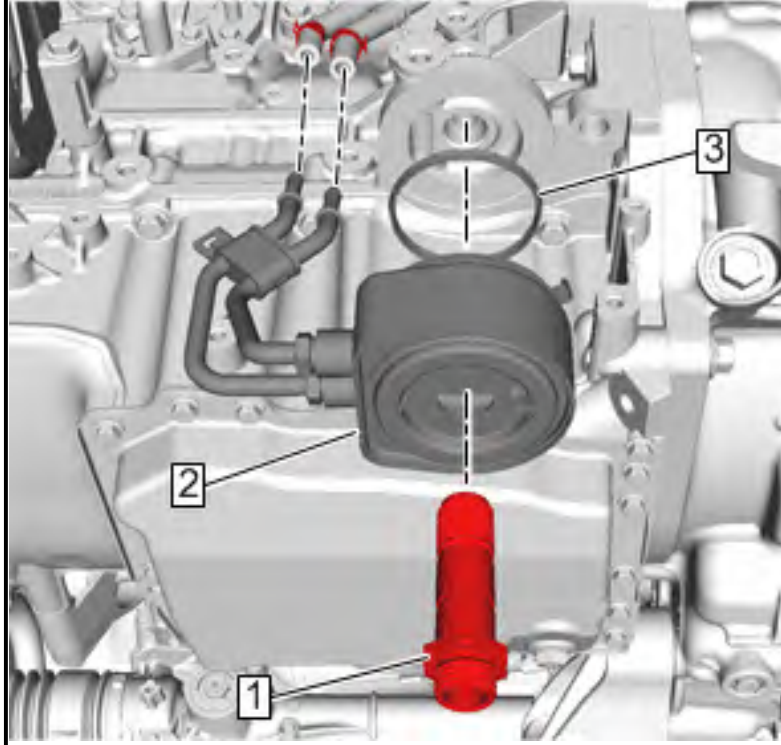
Engine Oil Cooler Core Bolt (1) - Remove

7. Engine Oil Cooler (2) - Remove

8. Engine Oil Cooler Seal (3) - Remove and DISCARD

Installation Procedure

1.

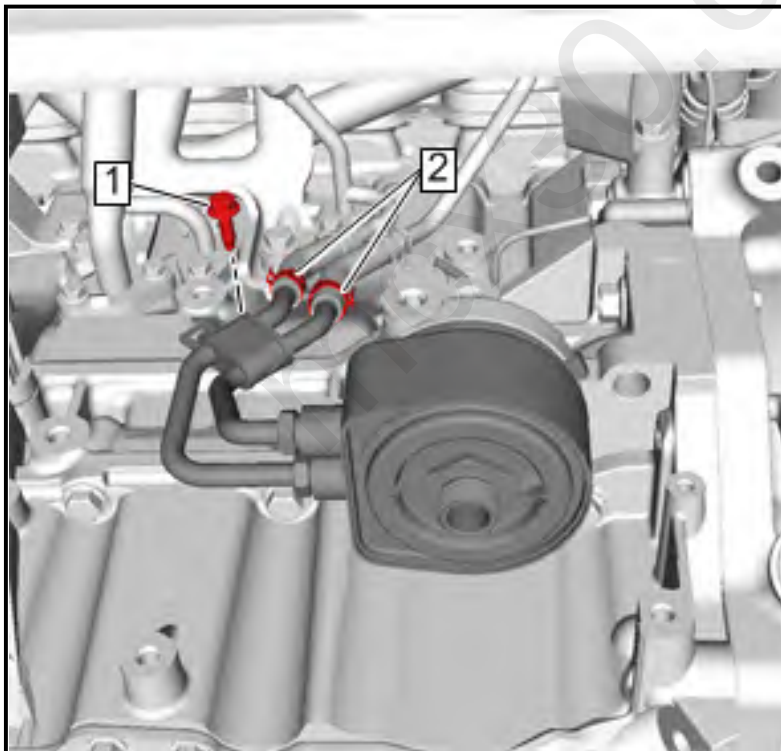


NOTE: Install a **NEW** seal.

Engine Oil Cooler Seal (3) - Install

2. Engine Oil Cooler (2) - Install
3. Engine Oil Cooler Core Bolt (1) - Hand tighten

4.

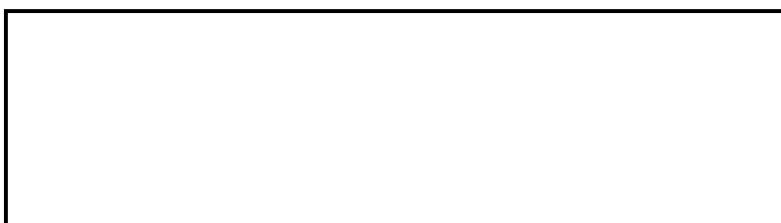


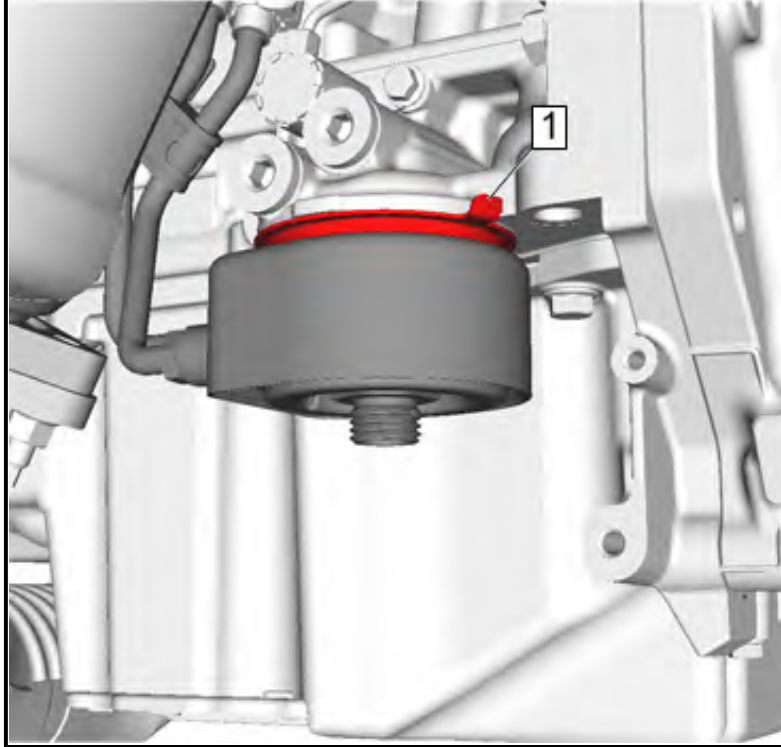
Engine Oil Cooler Hose Clamp (2) - Engage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

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

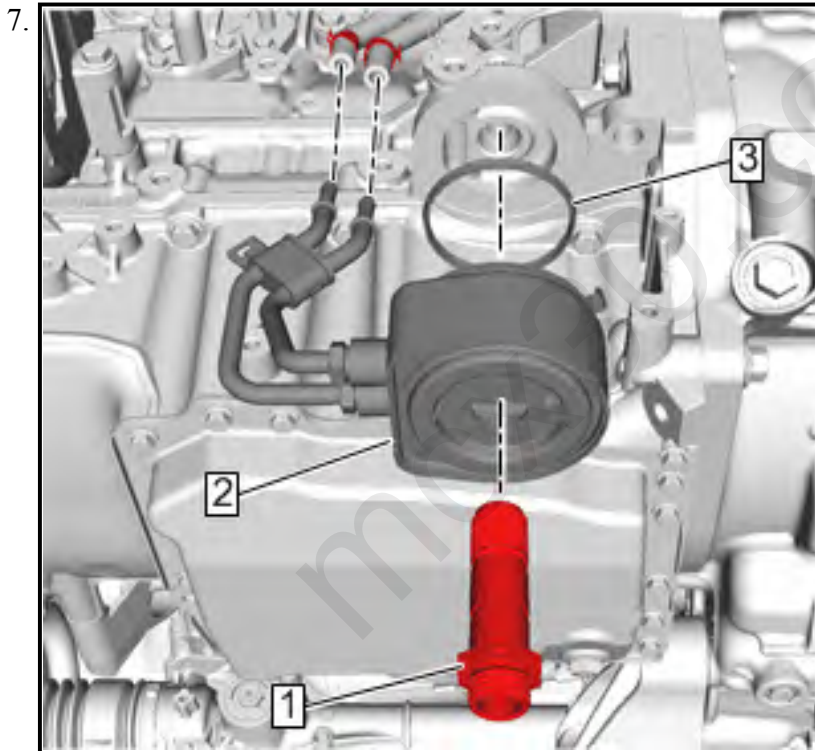
5. Engine Oil Cooler Pipe Fastener (1) - Install and tighten 10 N.m (89 lb in)

6.





Ensure that the engine oil cooler locating tab (1) is positioned against the engine block.



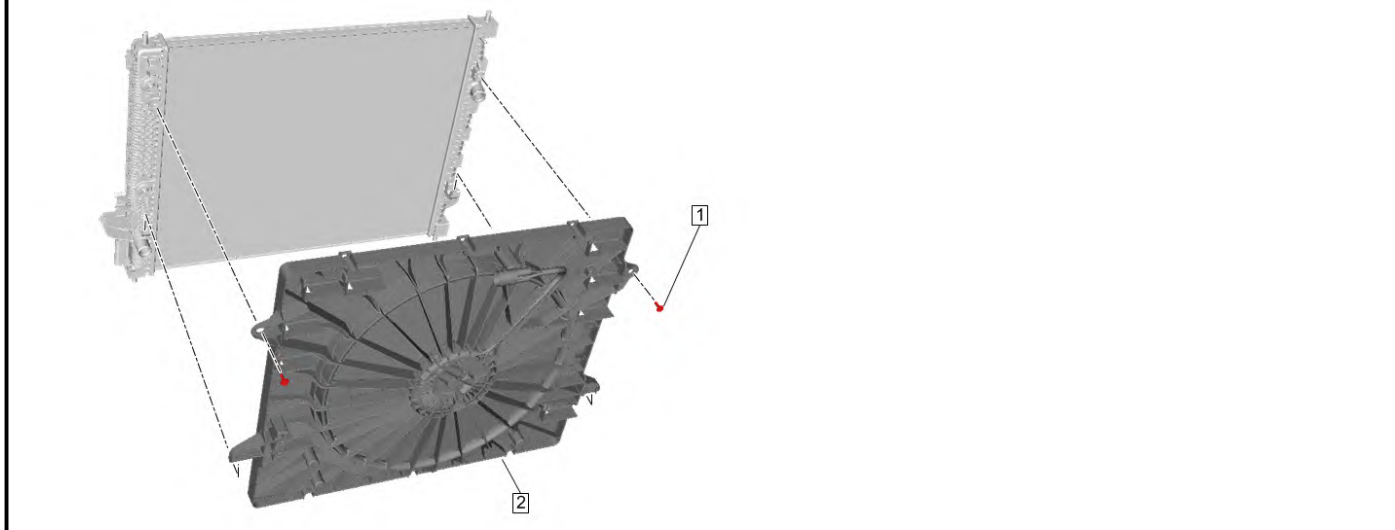
CAUTION: Refer to [Component Fastener Tightening Caution](#) .

Engine Oil Cooler Core Bolt (1) - Tighten 50 N.m (37 lb ft)

8. Oil Pump Flow Control Valve Heat Shield - Install - [Oil Pump Flow Control Valve Heat Shield Replacement](#)
9. Change the engine oil and filter. [Engine Oil and Oil Filter Replacement](#)
10. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#)

ENGINE COOLANT FAN REPLACEMENT



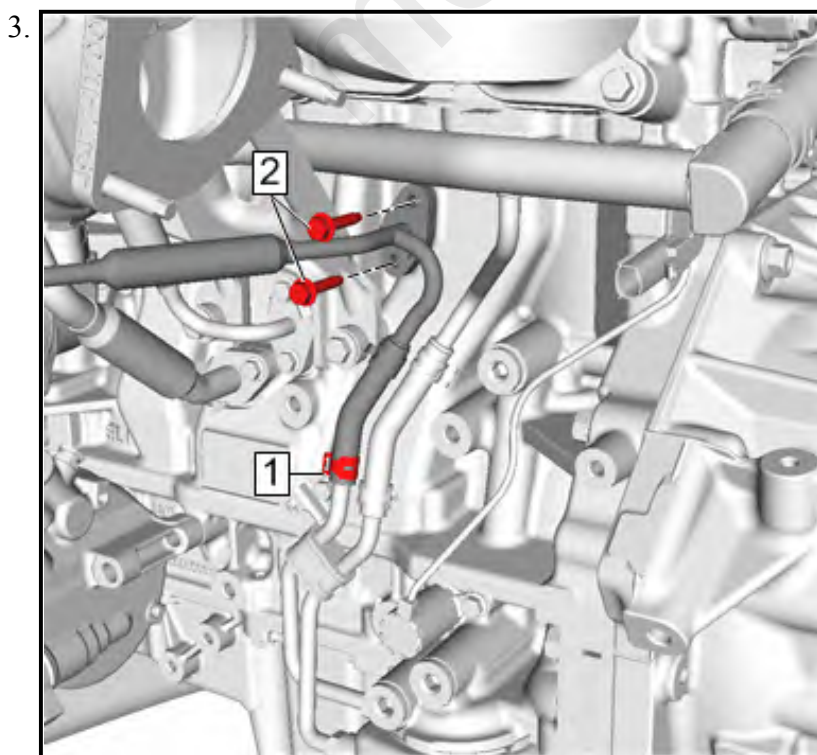


Callout	Component Name
Preliminary Procedure	
Radiator - Remove - Radiator Replacement	
1	Engine Coolant Fan Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
2	Engine Coolant Fan

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT

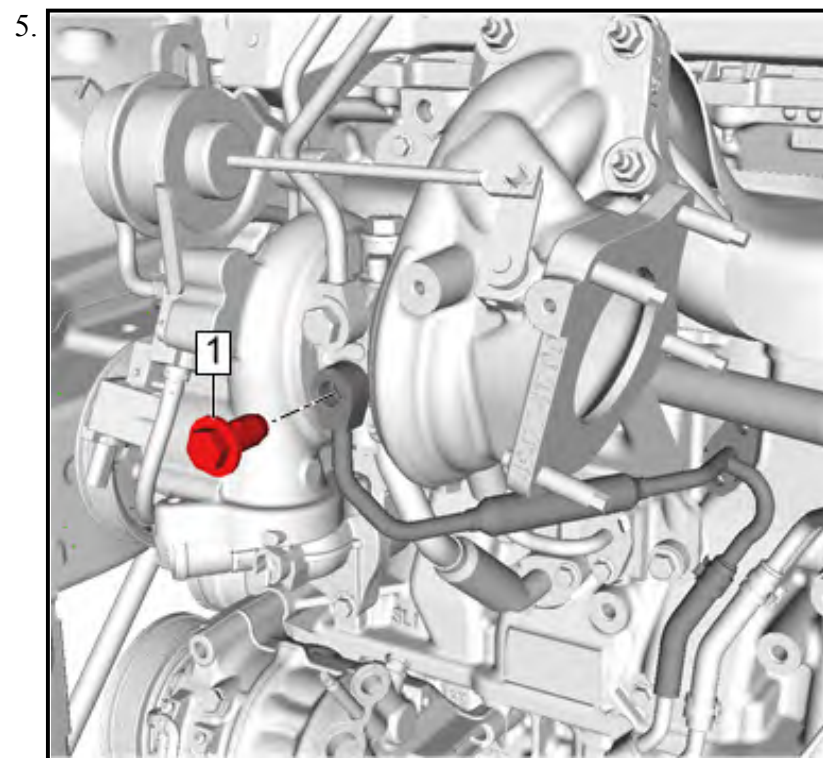
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
2. Warm Up Three-Way Catalytic Converter - Remove - [Warm Up Three-Way Catalytic Converter Replacement \(LTG\)](#)

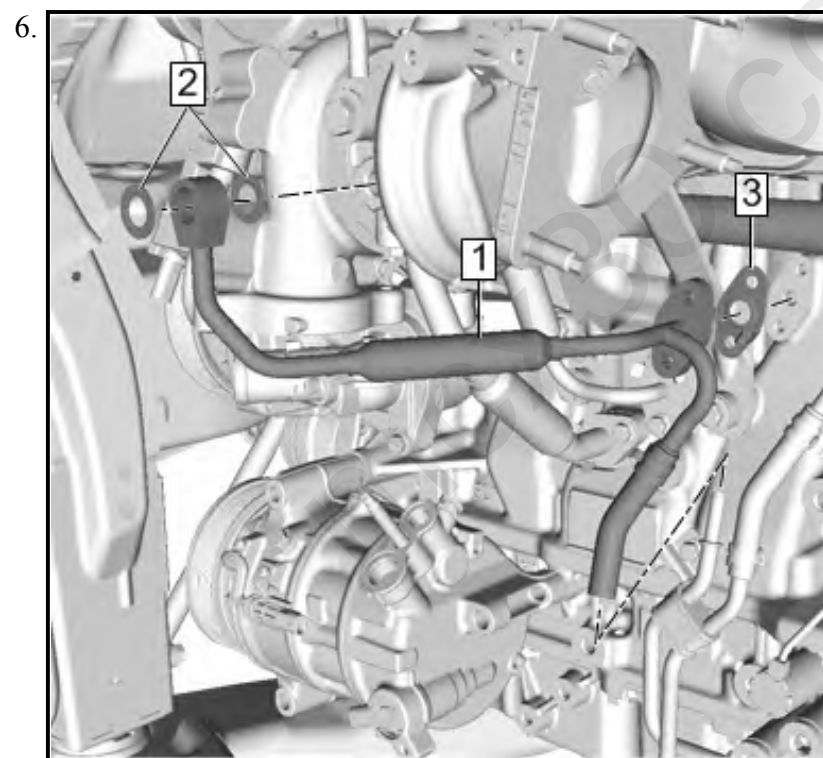


Turbocharger Coolant Feed Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

4. Turbocharger Coolant Feed Pipe Bolt (2) - Remove [2x]



Turbocharger Coolant Feed Pipe Hollow Screw (1) - Remove



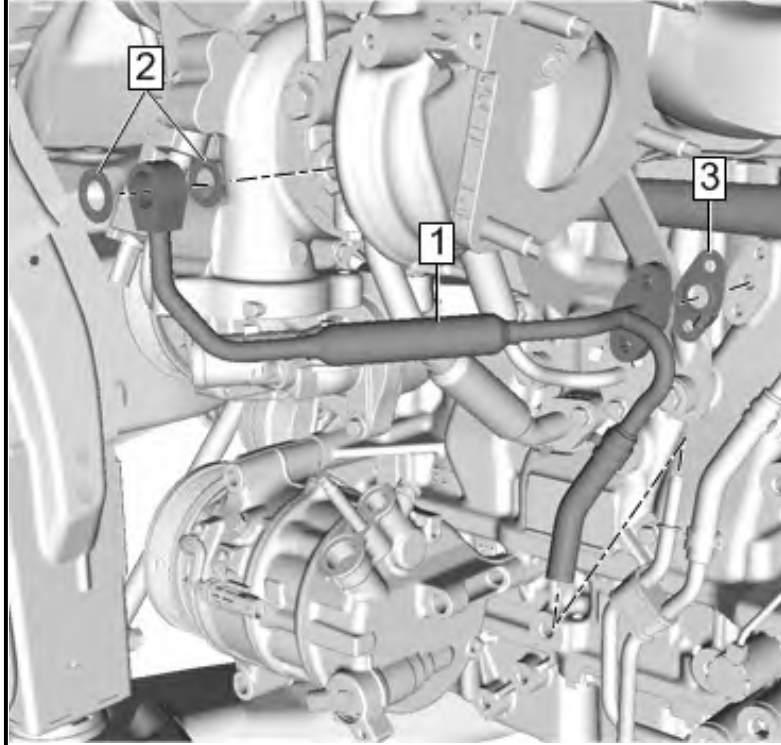
Turbocharger Coolant Feed Pipe (1) - Remove

7. Turbocharger Coolant Feed Pipe Washer (2) - Remove and DISCARD [2x]

8. Turbocharger Coolant Feed Pipe Gasket (3) - Remove and DISCARD

Installation Procedure



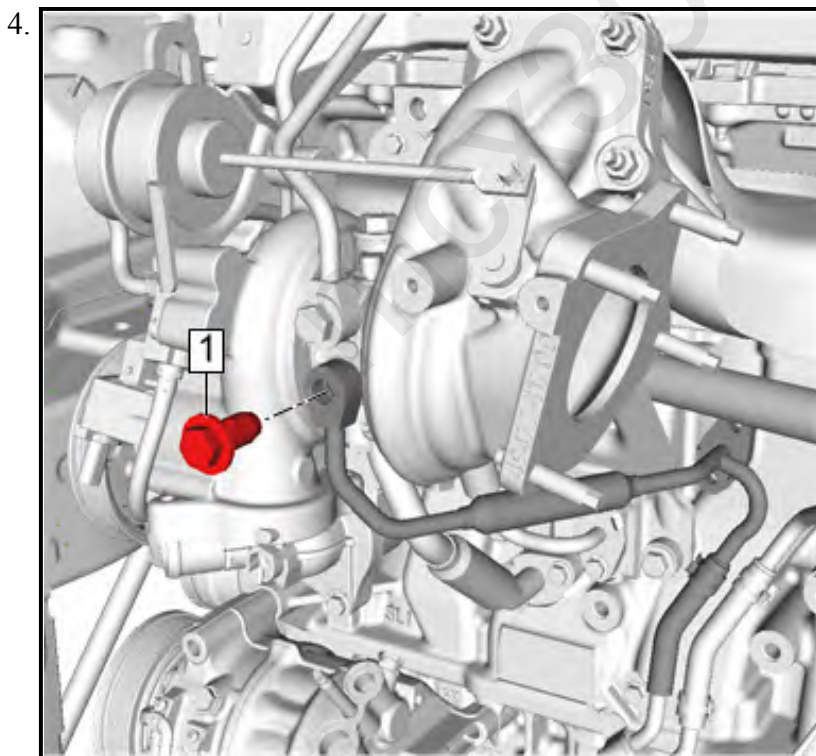


NOTE: Install a NEW gasket.

Turbocharger Coolant Feed Pipe Gasket (3) - Install

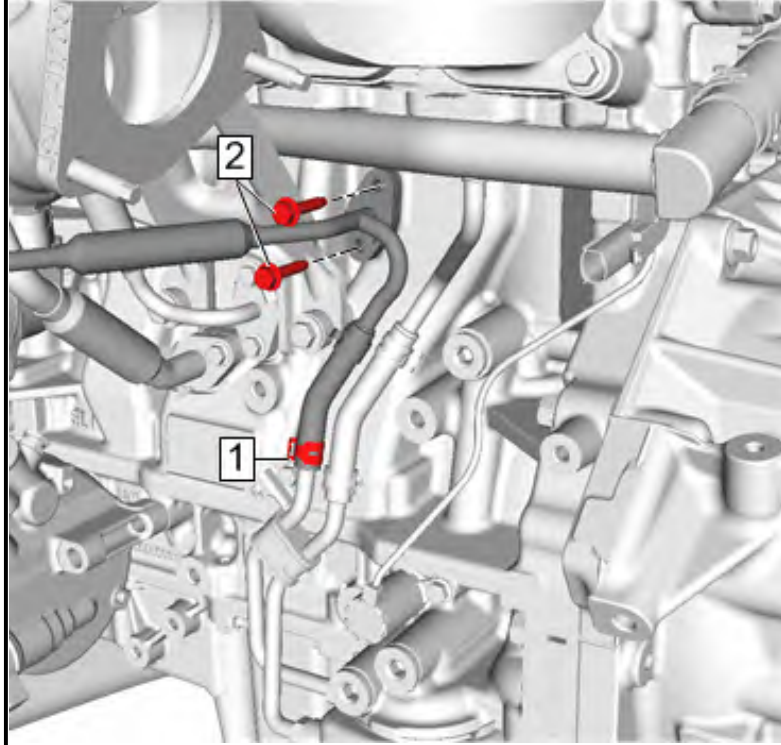
NOTE: Install a NEW washer.

2. Turbocharger Coolant Feed Pipe Washer (2) - Install [2x]
3. Turbocharger Coolant Feed Pipe (1) - Install



Turbocharger Coolant Feed Pipe Hollow Screw (1) - Hand tighten

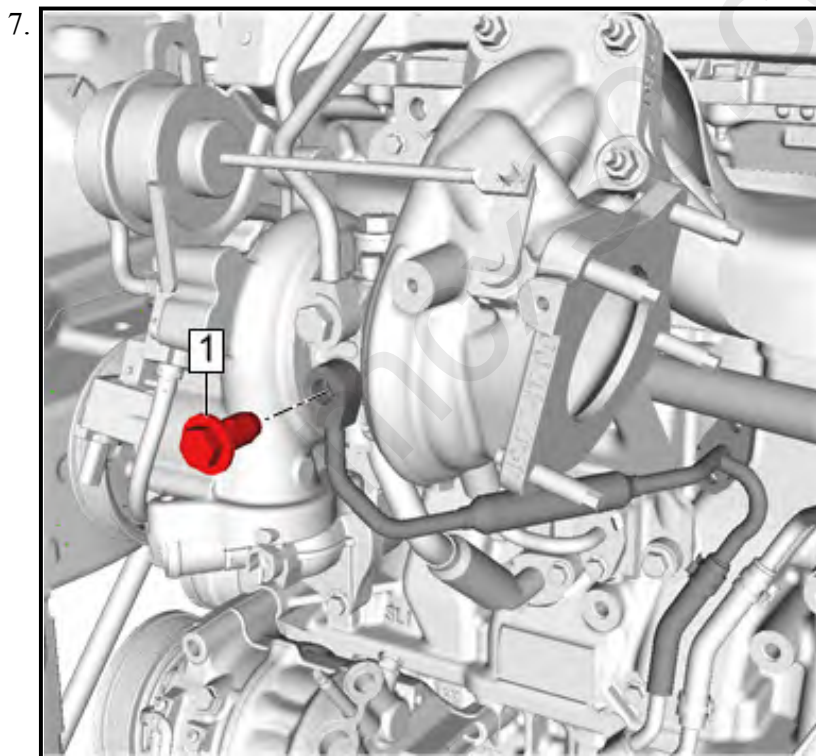




CAUTION: Refer to [Fastener Caution](#) .

Turbocharger Coolant Feed Pipe Bolt (2) - Install and tighten [2x] 10 N.m (89 lb in)

6. Turbocharger Coolant Feed Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)



Turbocharger Coolant Feed Pipe Hollow Screw (1) - Tighten 35 N.m (26 lb ft)

8. Warm Up Three-Way Catalytic Converter - Install - [Warm Up Three-Way Catalytic Converter Replacement \(LTG\)](#)

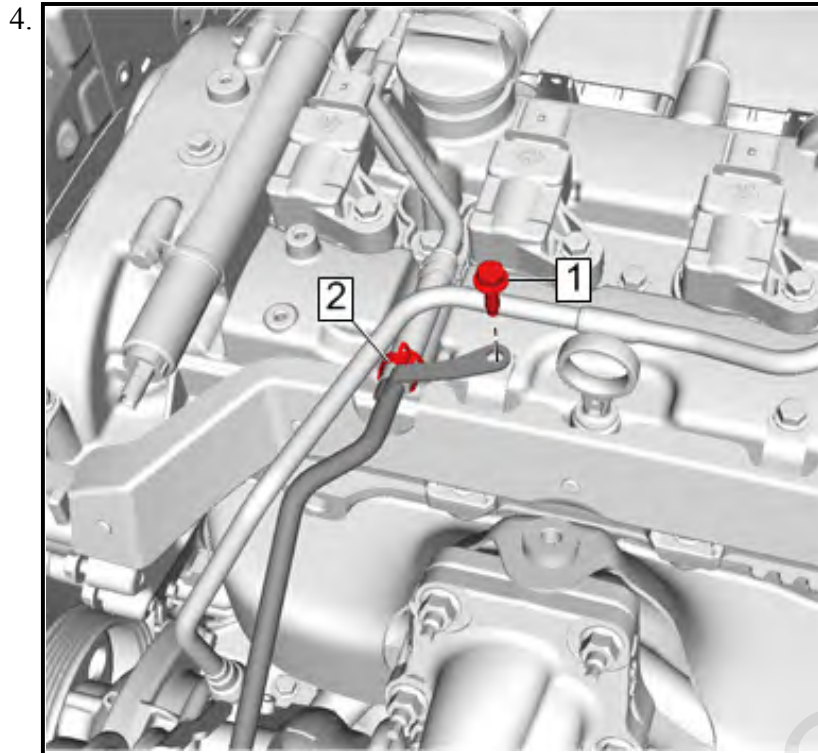
9. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#)

10. Start the engine and check for leaks.

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT

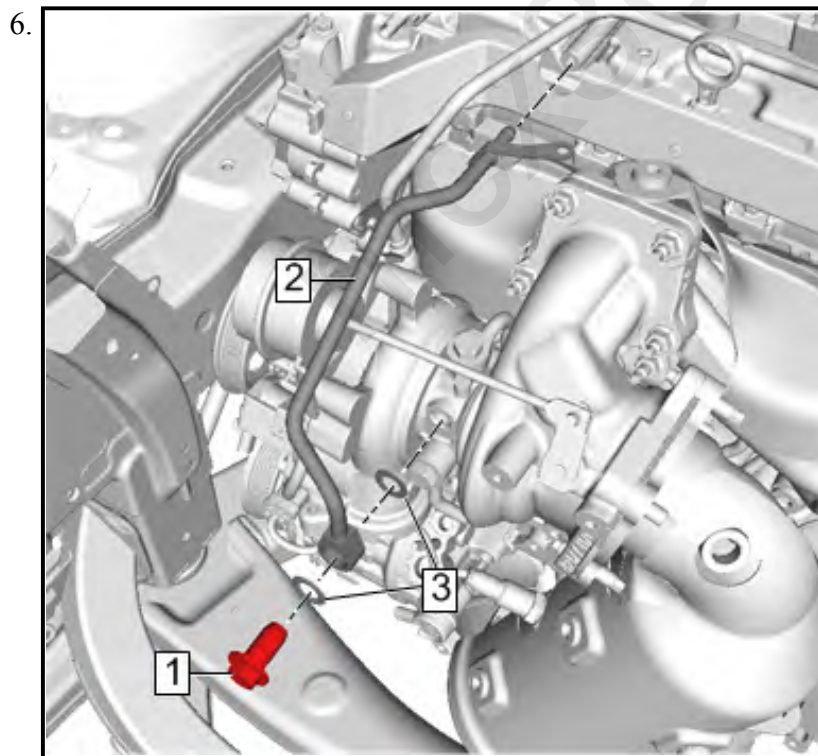
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)](#)[Cooling System Draining and Filling \(Static Fill\)](#)
2. Intake Manifold Cover - Remove - [Intake Manifold Cover Replacement](#)
3. Turbocharger Heat Shield - Remove - [Turbocharger Heat Shield Replacement](#)



Turbocharger Coolant Return Pipe Clamp (2) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

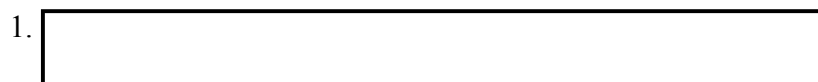
5. Turbocharger Coolant Return Pipe Bolt (1) - Remove

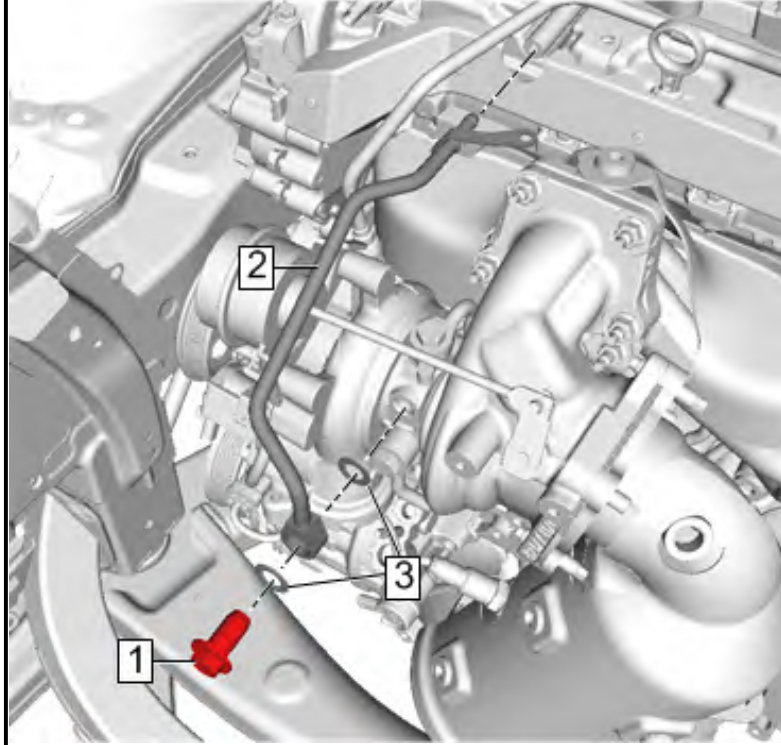


Turbocharger Coolant Return Pipe Hollow Screw (1) - Remove

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

Installation Procedure

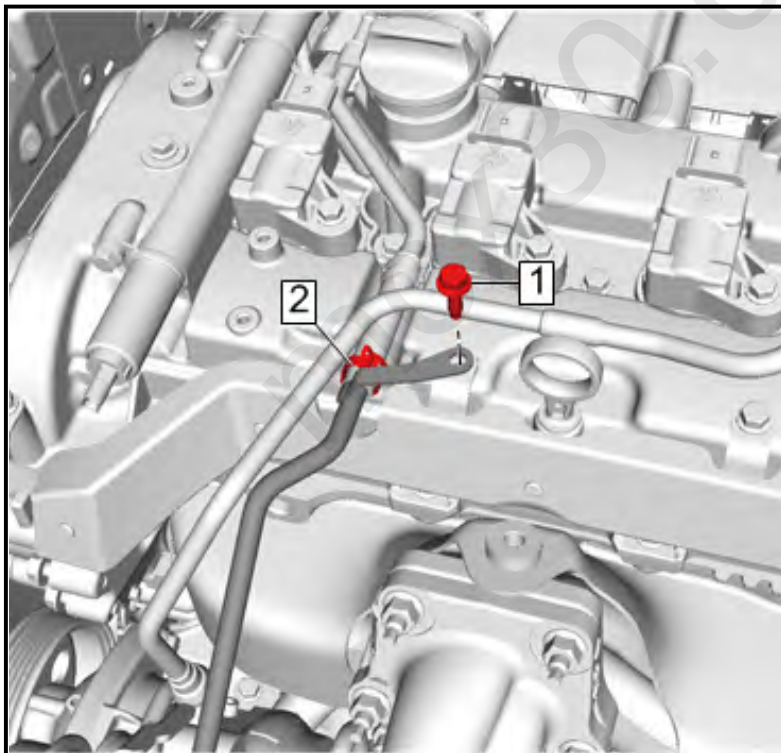




NOTE: Install a **NEW** washer.

Turbocharger Coolant Return Pipe Washer (3) - Install [2x]

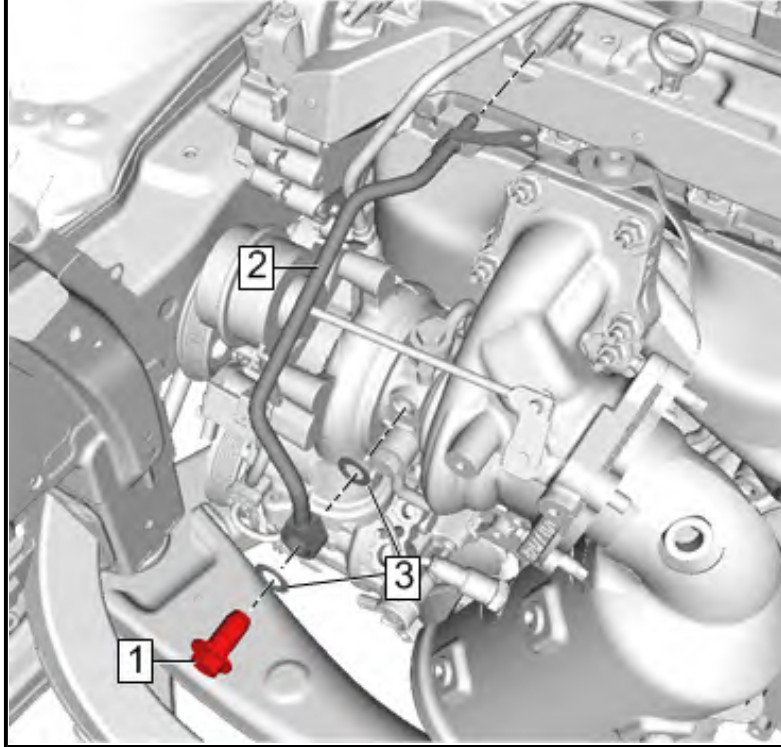
2. Turbocharger Coolant Return Pipe (2) - Install
3. Turbocharger Coolant Return Pipe Hollow Screw (1) - Hand tighten
- 4.



CAUTION: Refer to **Fastener Caution** .

Turbocharger Coolant Return Pipe Bolt (1) - Install and tighten 10 N.m (89 lb in)

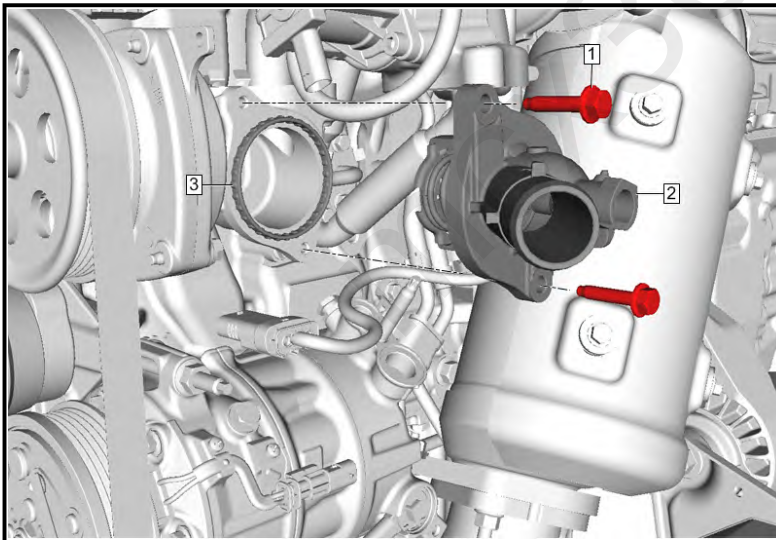
5. Turbocharger Coolant Return Pipe Clamp (2) - Engage - **Hose Clamp Replacement Guidelines - Spring Type**
- 6.



Turbocharger Coolant Return Pipe Hollow Screw (1) - Tighten 35 N.m (26 lb ft)

7. Turbocharger Heat Shield - Remove - [Turbocharger Heat Shield Replacement](#)
8. Intake Manifold Cover - Remove - [Intake Manifold Cover Replacement](#)
9. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\)](#)[Cooling System Draining and Filling \(Static Fill\)](#)
10. Start the engine and check for leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LTG)



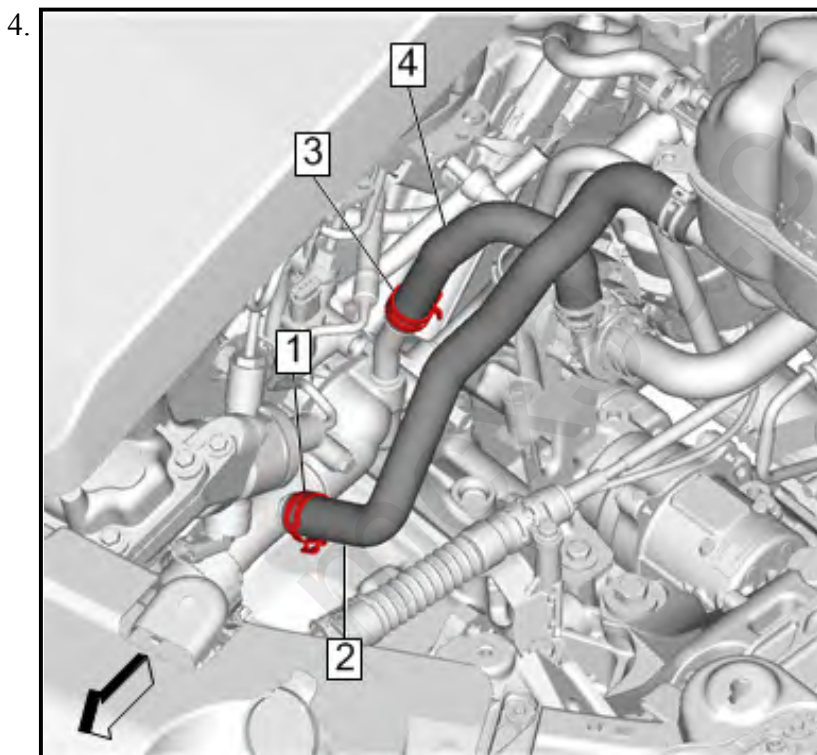
Callout	Component Name
Preliminary Procedures	
1.	Air Cleaner Outlet Duct Replacement (Non-Tamperproof) Air Cleaner Outlet Duct Replacement (Tamperproof)
2.	Radiator Outlet Hose Replacement (LFY) Radiator Outlet Hose Replacement (LTG)

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

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LFY)

Removal Procedure

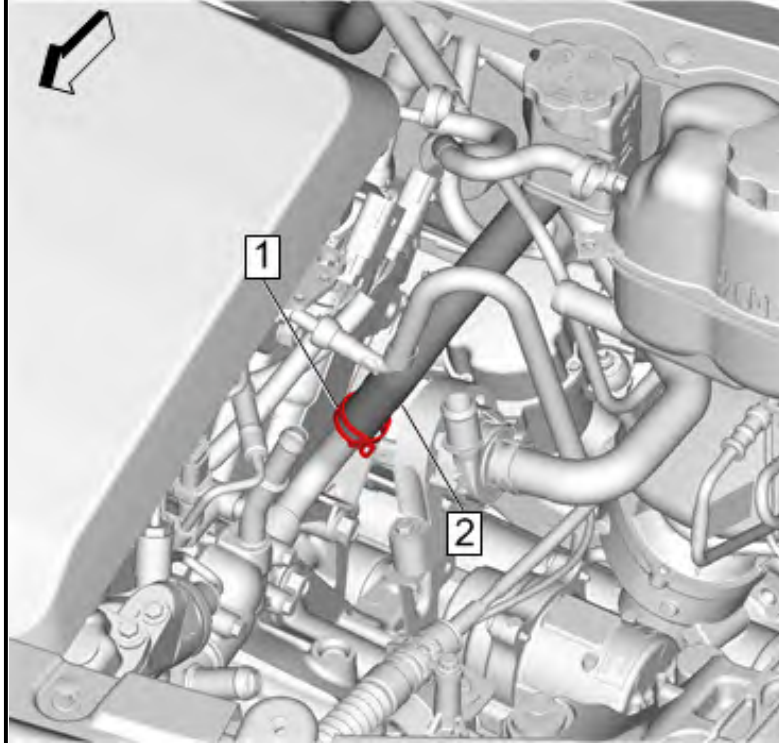
1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
2. Remove the engine control module bracket. [Engine Control Module Bracket Replacement](#)
3. Remove the engine rear noise shield. [Engine Rear Noise Shield Replacement](#)



Radiator Surge Tank Outlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Surge Tank Outlet Hose (2) @ Engine Coolant Thermostat Housing - Remove
6. Heater Outlet Hose Clamp (3) @ Engine Coolant Thermostat Housing - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Heater Outlet Hose (4) @ Engine Coolant Thermostat Housing - Remove

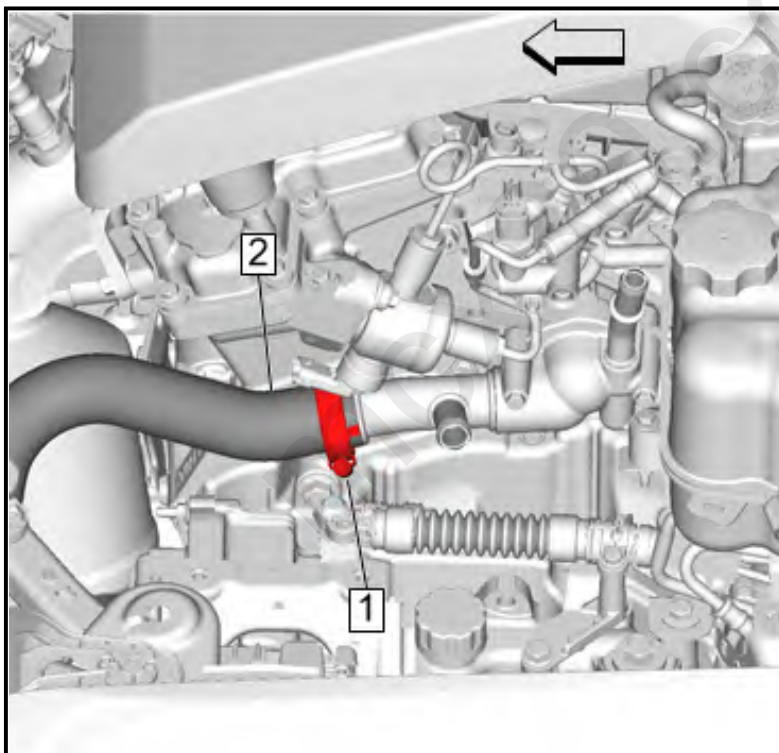




Heater Inlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

9. Heater Inlet Hose (2) @ Engine Coolant Thermostat Housing - Remove

10.

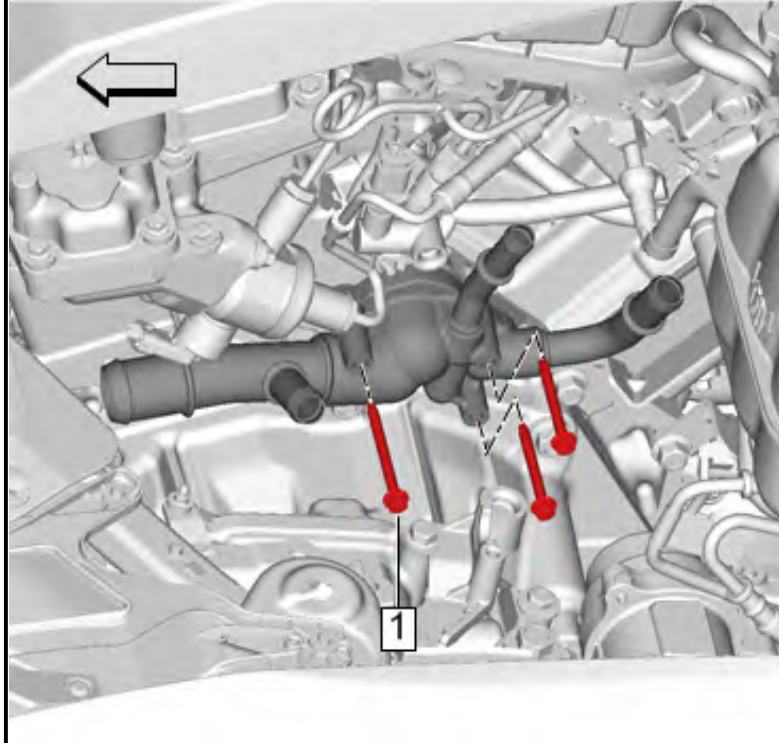


Radiator Outlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

11. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing - Remove

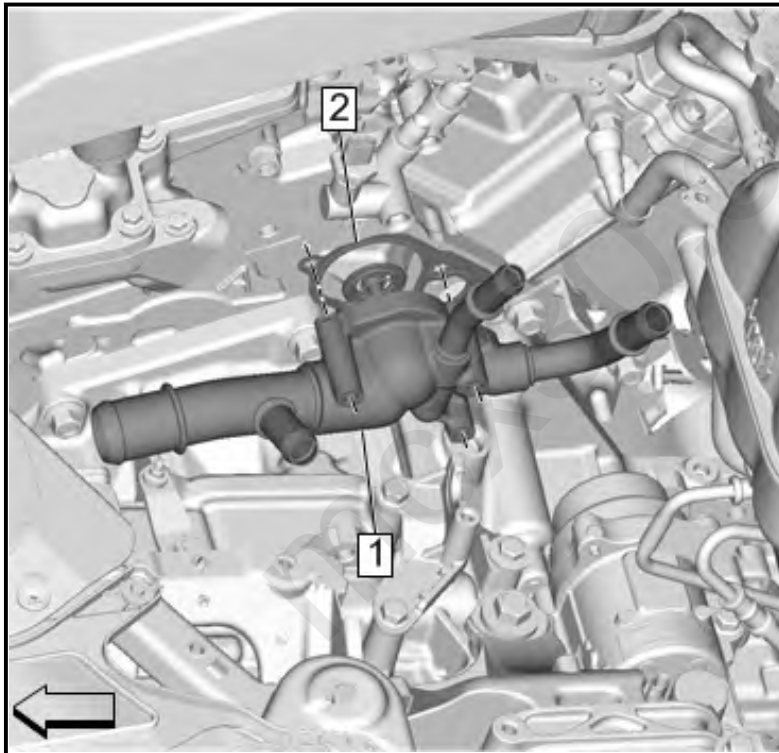
12.





Engine Coolant Thermostat Housing Bolt (1) - Remove [3x]

13.



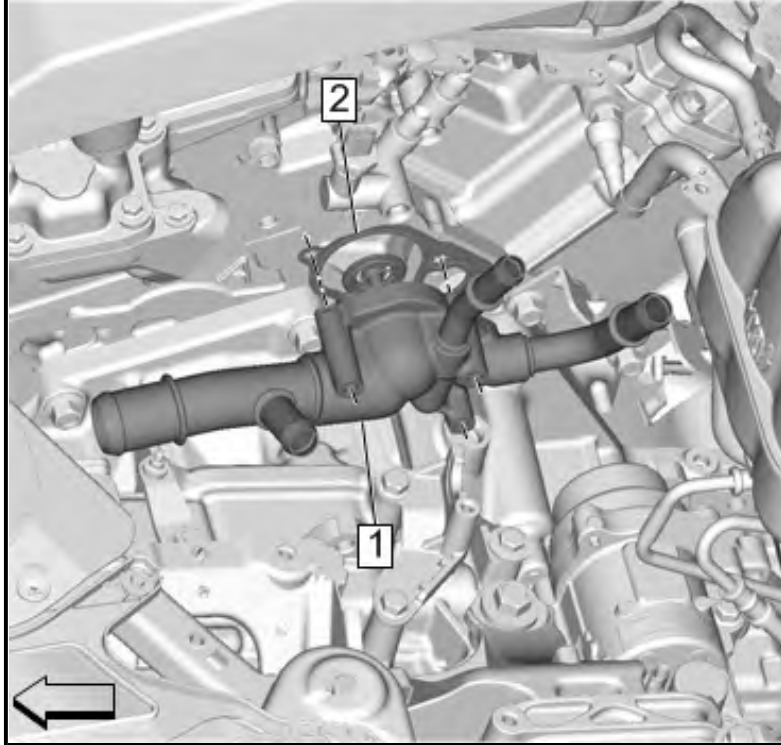
Engine Coolant Thermostat Housing (1) - Remove

14. Engine Coolant Thermostat Housing Gasket (2) - Remove and DISCARD

Installation Procedure

1.

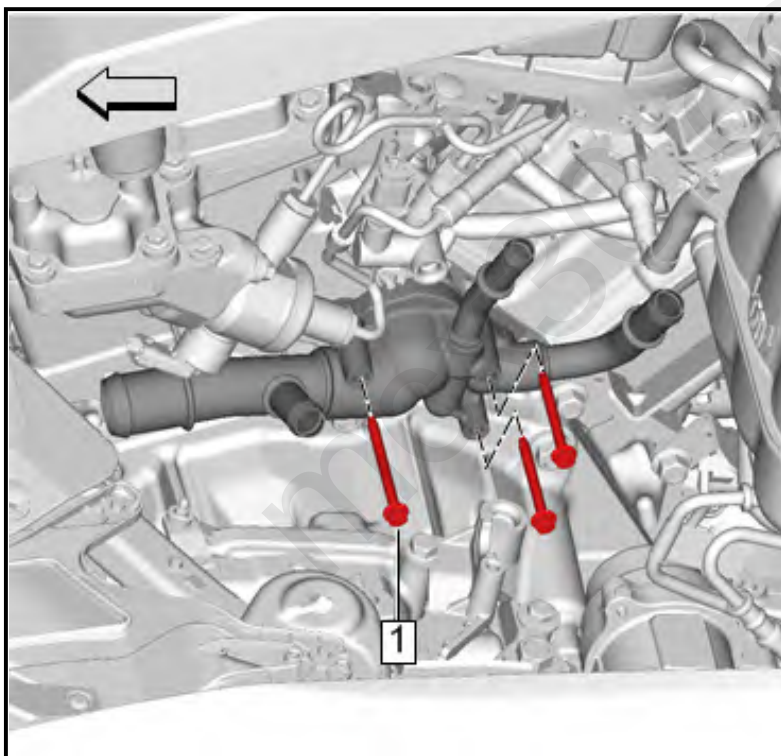




Engine Coolant Thermostat Housing Gasket (2) - Install a NEW gasket.

2. Engine Coolant Thermostat Housing (1) - Install

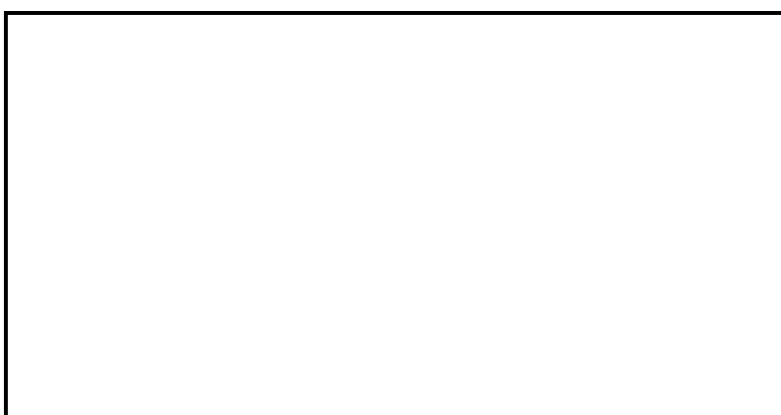
3.

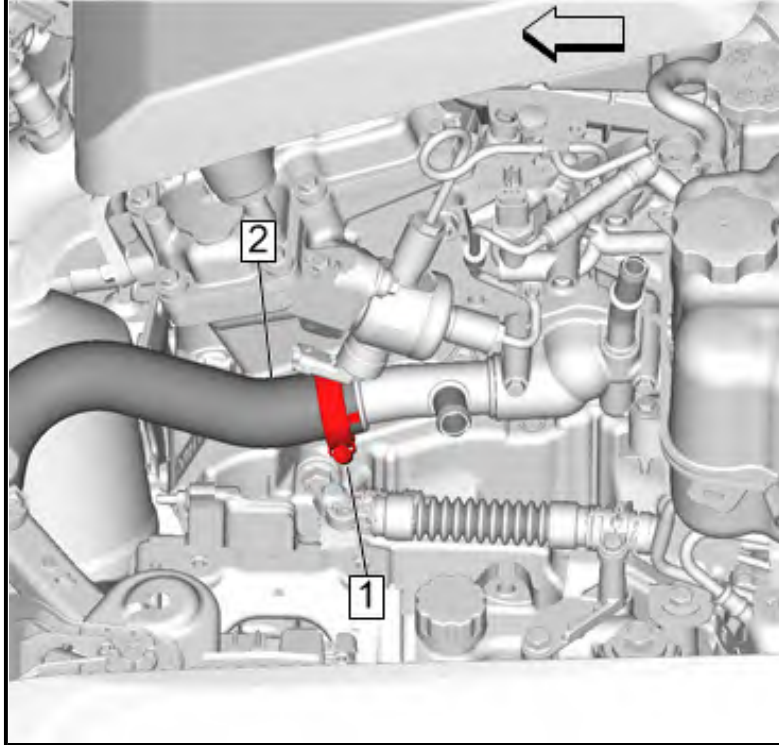


CAUTION: Refer to [Fastener Caution](#) .

Engine Coolant Thermostat Housing Bolt (1) - Install and tighten 10 N.m (89 lb in) [3x]

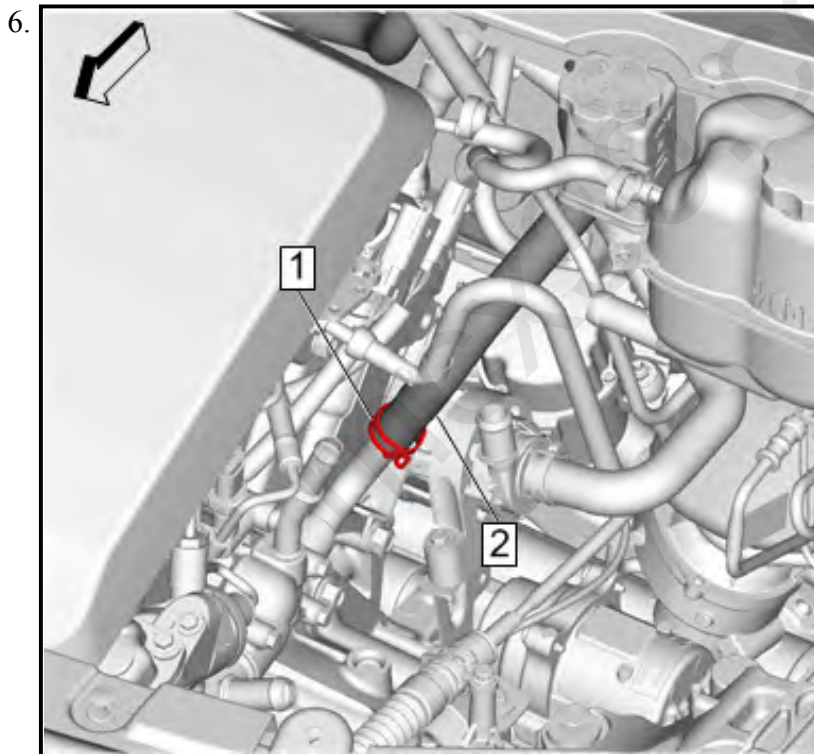
4.





Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing - Install

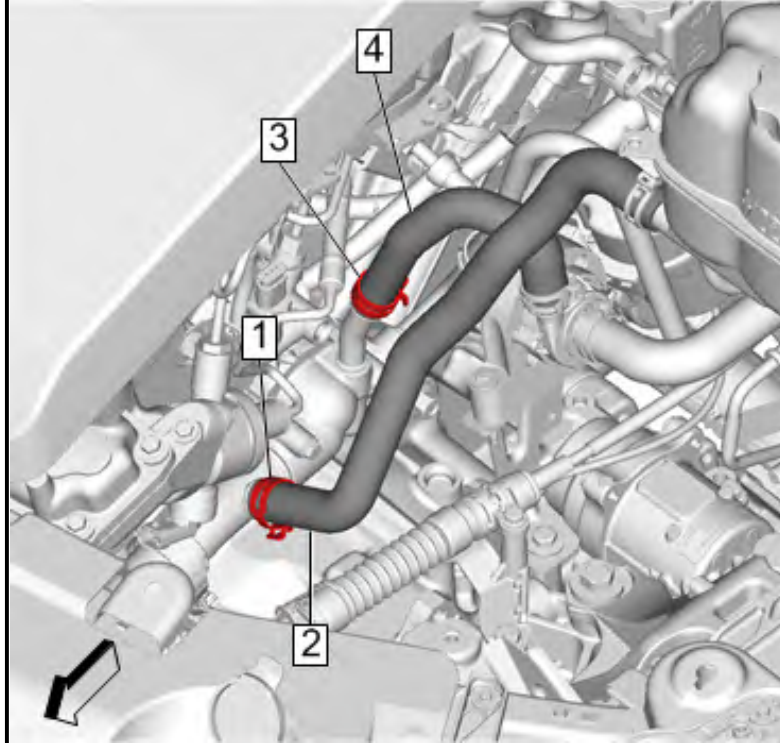
5. Radiator Outlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)



Heater Inlet Hose (2) @ Engine Coolant Thermostat Housing - Install

7. Heater Inlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

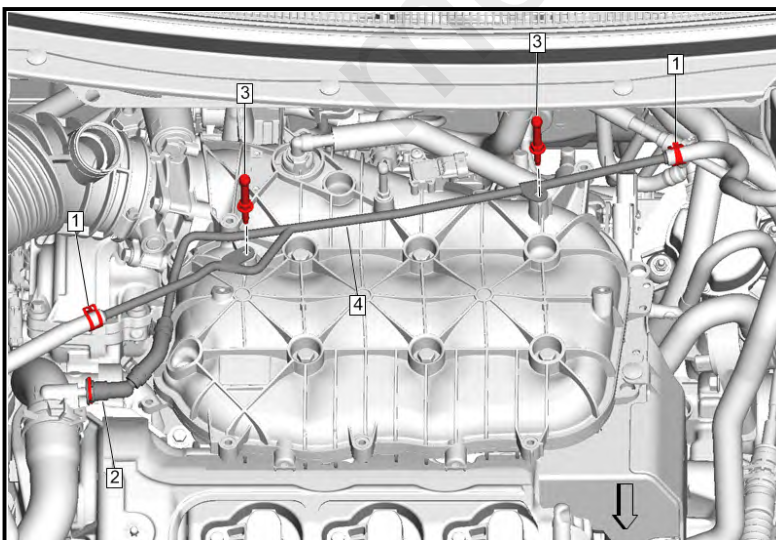




Heater Outlet Hose (4) @ Engine Coolant Thermostat Housing - Install

9. Heater Outlet Hose Clamp (3) @ Engine Coolant Thermostat Housing - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
10. Radiator Surge Tank Outlet Hose (2) @ Engine Coolant Thermostat Housing - Install
11. Radiator Surge Tank Outlet Hose Clamp (1) @ Engine Coolant Thermostat Housing - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
12. Install the engine rear noise shield. [Engine Rear Noise Shield Replacement](#)
13. Install the engine control module bracket. [Engine Control Module Bracket Replacement](#)
14. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#)
15. Start the engine and check for coolant leaks.

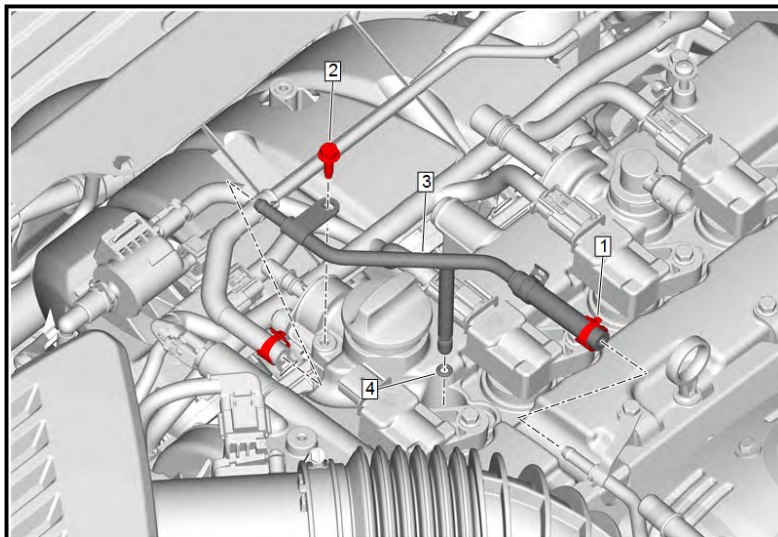
ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (LFY)



Callout	Component Name
Preliminary Procedures	
1. Intake Manifold Cover Replacement 2. Air Cleaner Outlet Duct Replacement	
1	Radiator Surge Tank Overflow Hose Clamp [2x] Hose Clamp Replacement Guidelines - Spring Type

Callout	Component Name
2	Engine Coolant Air Bleed Hose Pipe Fitting Plastic Collar Quick Connect Fitting Service
3	Intake Manifold Cover Stud CAUTION: Refer to Fastener Caution . Tighten: 9 N.m (80 lb in)
4	Engine Coolant Air Bleed Pipe

ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (LTG)



Callout	Component Name
Preliminary Procedures Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) Positive Crankcase Ventilation Valve Replacement Turbocharger Coolant Return Pipe Replacement Positive Crankcase Ventilation Hose/Pipe/Tube Replacement - Disconnect the electrical wiring harness connector from the ignition coil.	
1	Hose Clamp [2x] Hose Clamp Replacement Guidelines - Spring Type
2	Engine Coolant Air Bleed Pipe Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Engine Coolant Air Bleed Pipe
4	Engine Coolant Air Bleed Pipe O-Ring Procedure Install NEW

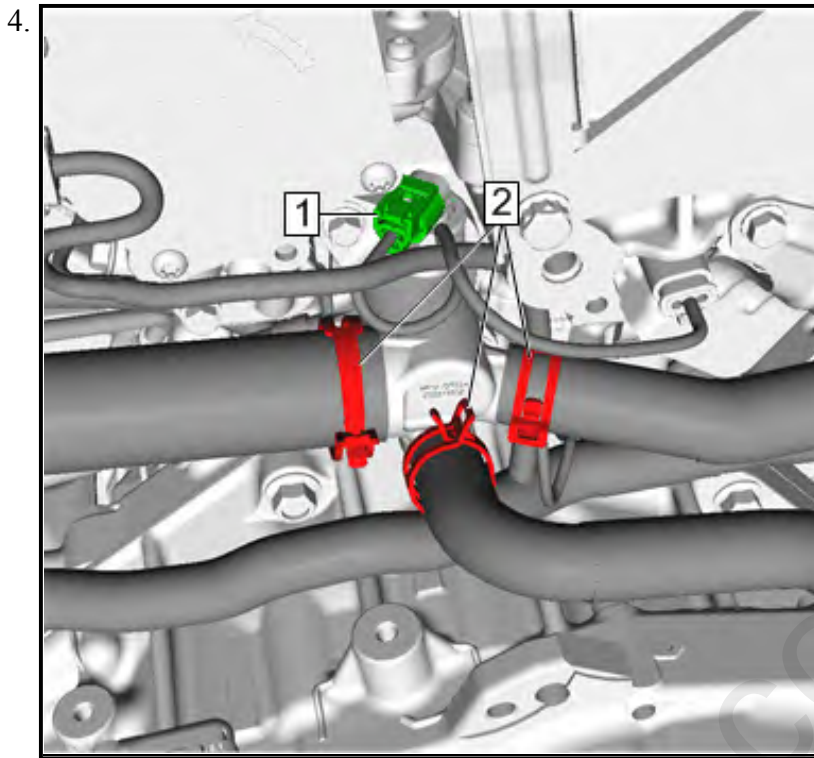
WATER OUTLET REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#).

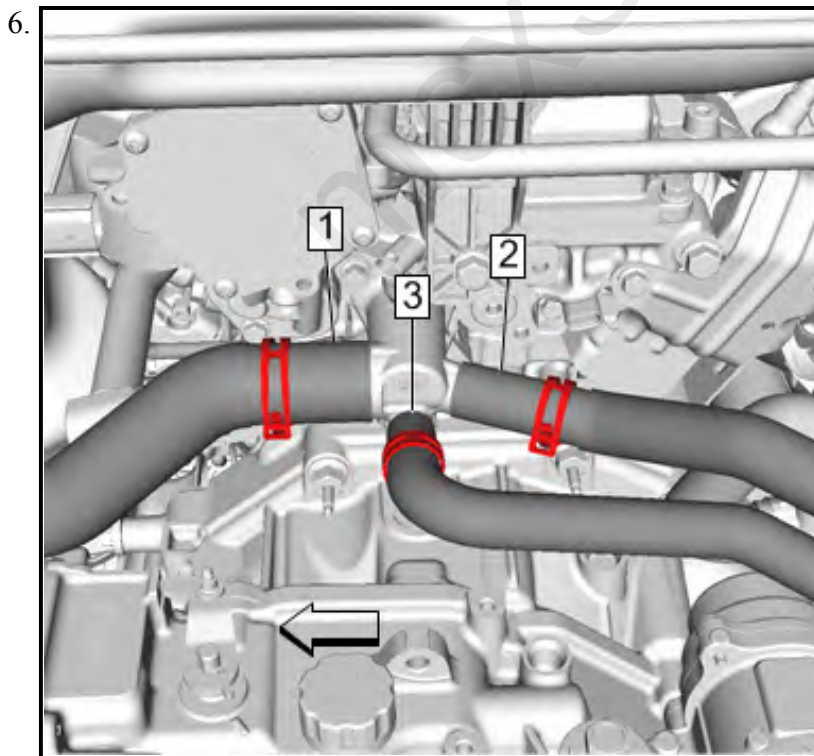
NOTE: Reposition the engine control module with the wiring harness attached.

2. Engine Control Module - Remove and position aside - [Engine Control Module Replacement](#)
3. Battery Tray - Remove - [Battery Tray Replacement](#)



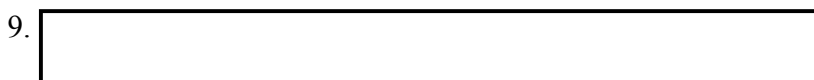
Engine Coolant Temperature Sensor (1) - Disconnect

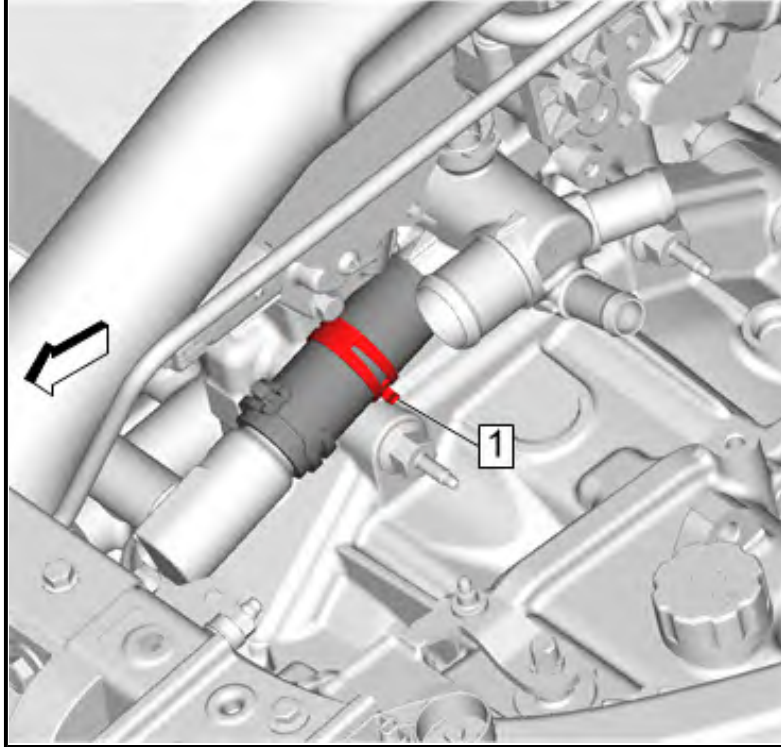
5. Hose Clamp (2) - Disengage [3x] - [Hose Clamp Replacement Guidelines - Spring Type](#)



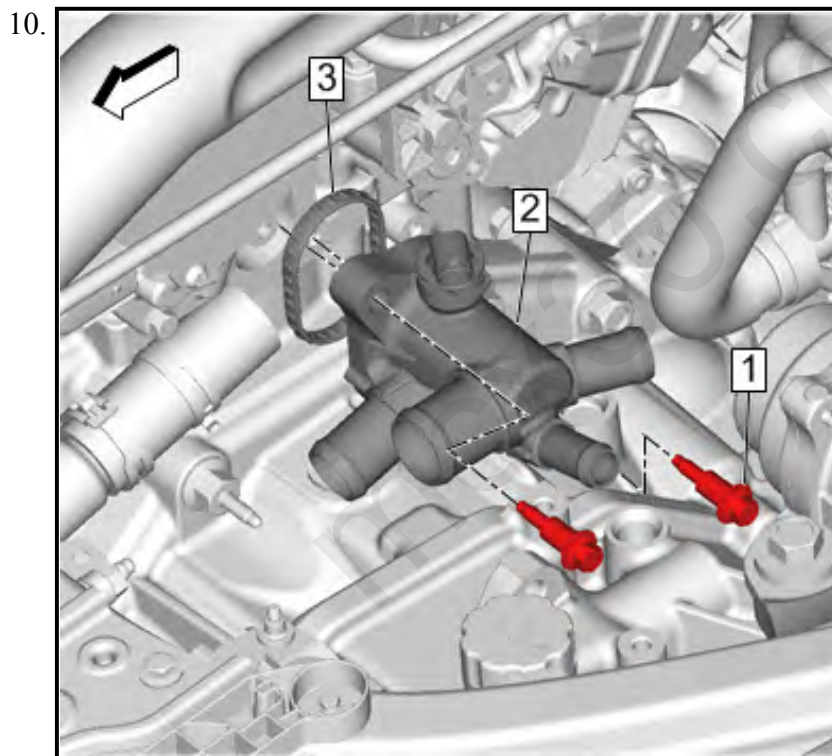
Radiator Inlet Hose (1) @ Water Outlet - Disconnect

7. Heater Inlet Hose (2) @ Water Outlet - Disconnect
8. Heater Water Auxiliary Pump Inlet Hose (3) @ Water Outlet - Disconnect





Thermostat Bypass Hose Clamp (1) @ Water Outlet - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



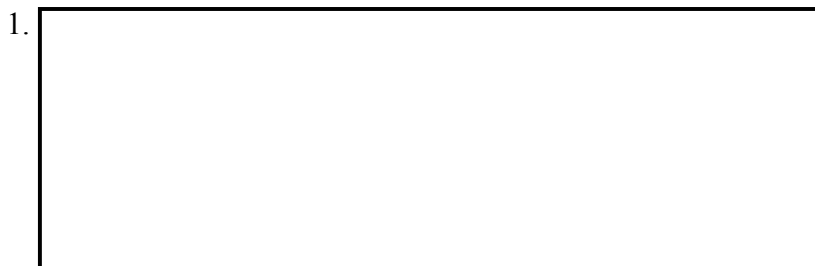
NOTE: Separate the thermostat bypass hose from the water outlet during removal.

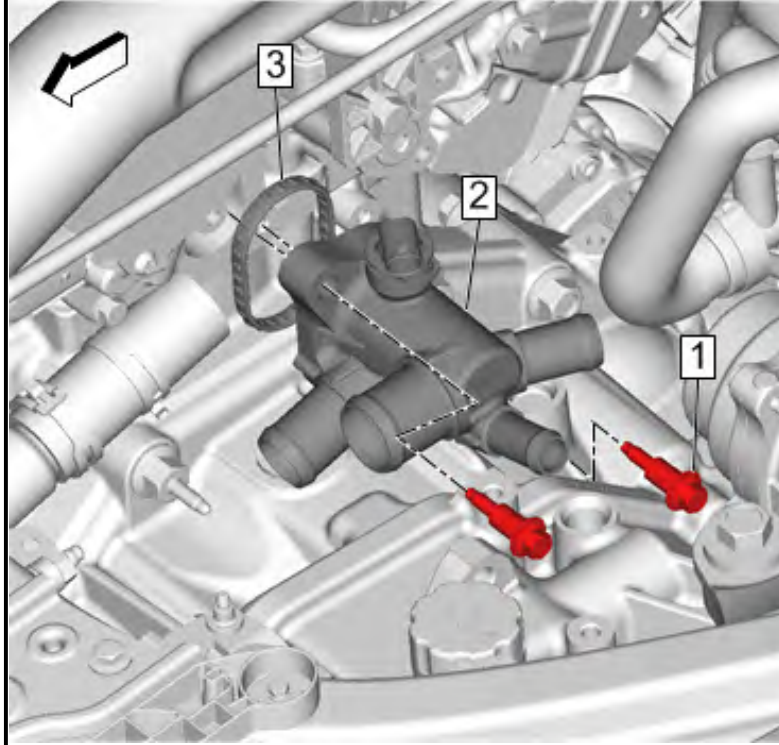
Water Outlet Bolt (1) - Remove [2x]

11. Water Outlet (2) - Remove

12. Water Outlet Seal (3) - Remove and DISCARD

Installation Procedure





NOTE: Install the thermostat bypass hose onto the water outlet during installation.

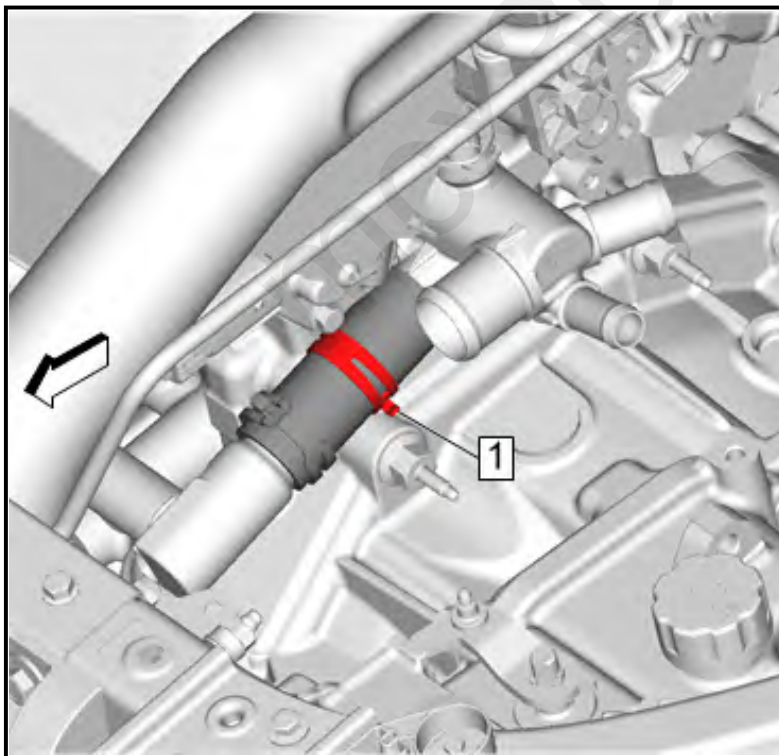
Water Outlet Seal (3) - Install a NEW seal.

2. Water Outlet (2) - Install

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

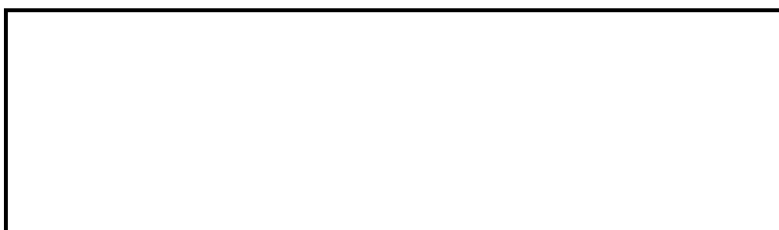
3. Water Outlet Bolt (1) - Install and tighten [2x] 10 N.m (89 lb in)

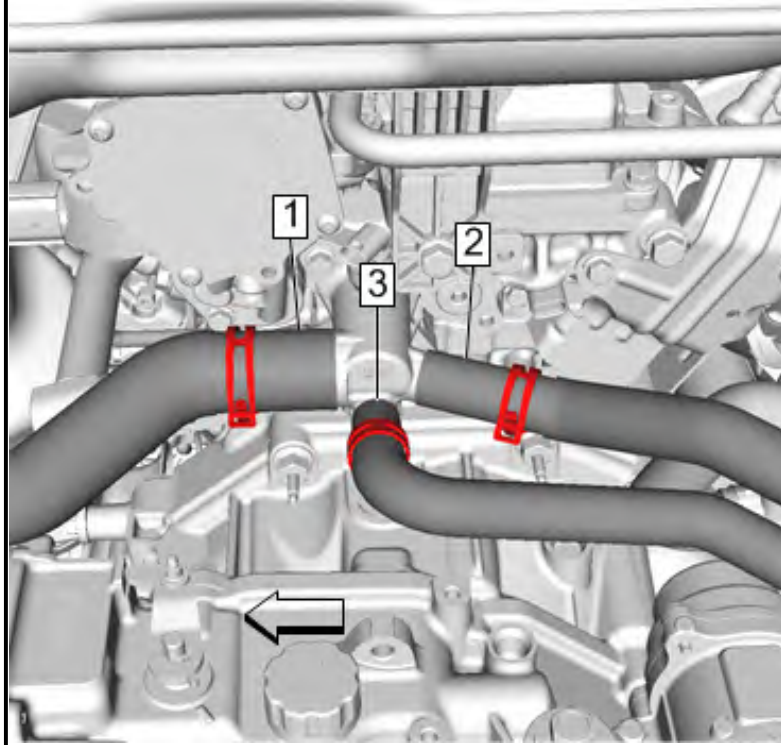
4.



Thermostat Bypass Hose Clamp (1) @ Water Outlet - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5.

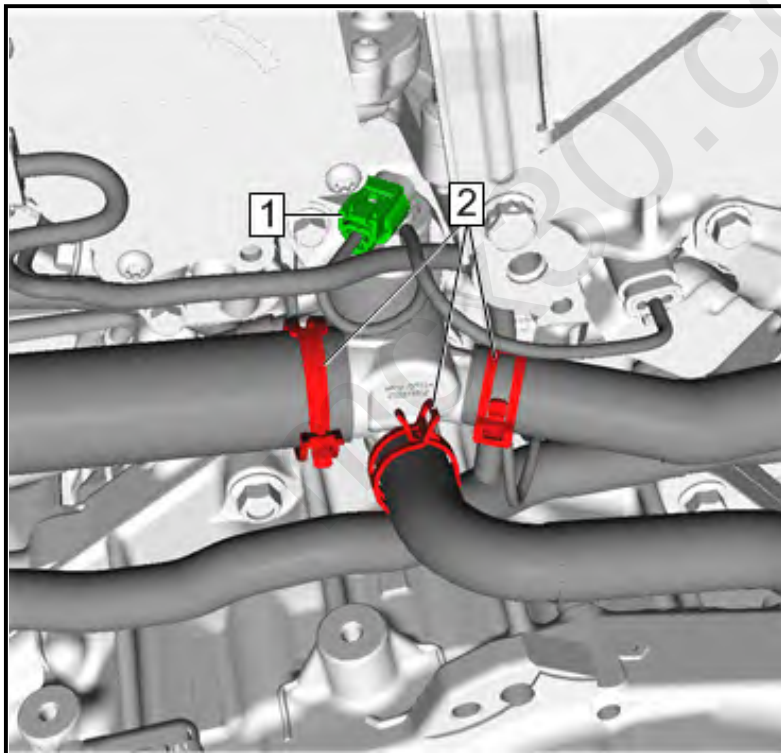




Heater Water Auxiliary Pump Inlet Hose (3) @ Water Outlet - Connect

6. Heater Inlet Hose (2) @ Water Outlet - Connect
7. Radiator Inlet Hose (1) @ Water Outlet - Connect

8.



Hose Clamp (2) - Engage [3x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

9. Engine Coolant Temperature Sensor (1) - Connect
10. Battery Tray - Install - [Battery Tray Replacement](#)
11. Engine Control Module - Install - [Engine Control Module Replacement](#)
12. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#)
13. Start the engine and check for leaks.

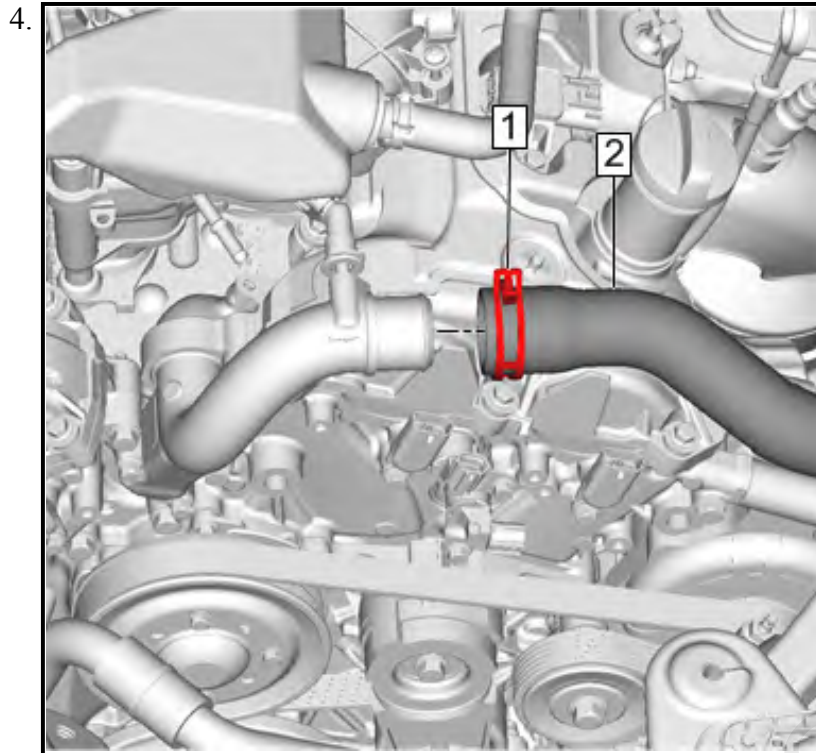
WATER OUTLET REPLACEMENT (LFY)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#)

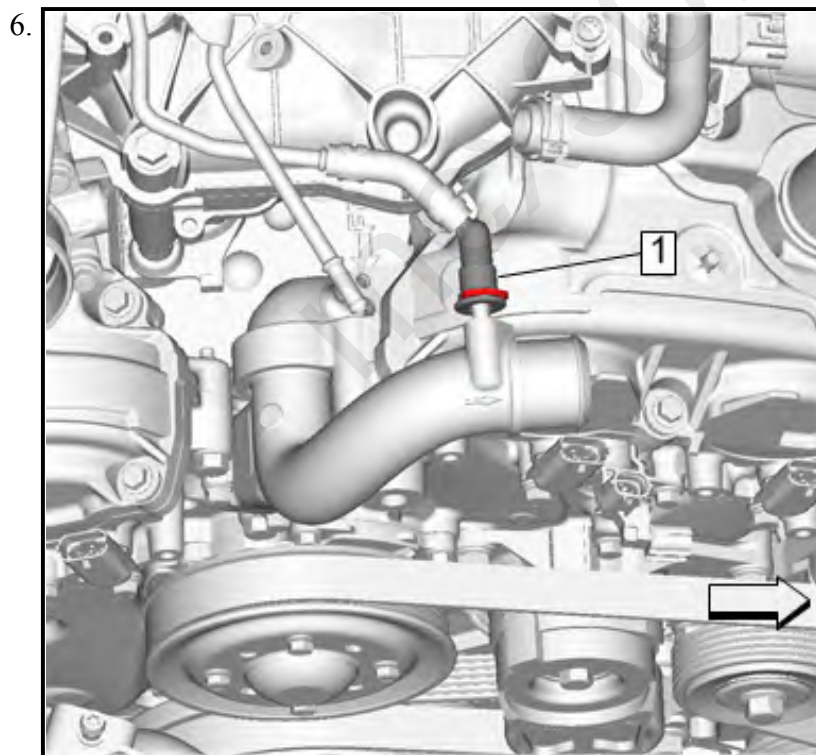
2. Intake Manifold Cover - Remove - [Intake Manifold Cover Replacement](#)

3. Air Cleaner Assembly - Remove - [Air Cleaner Assembly Replacement](#)



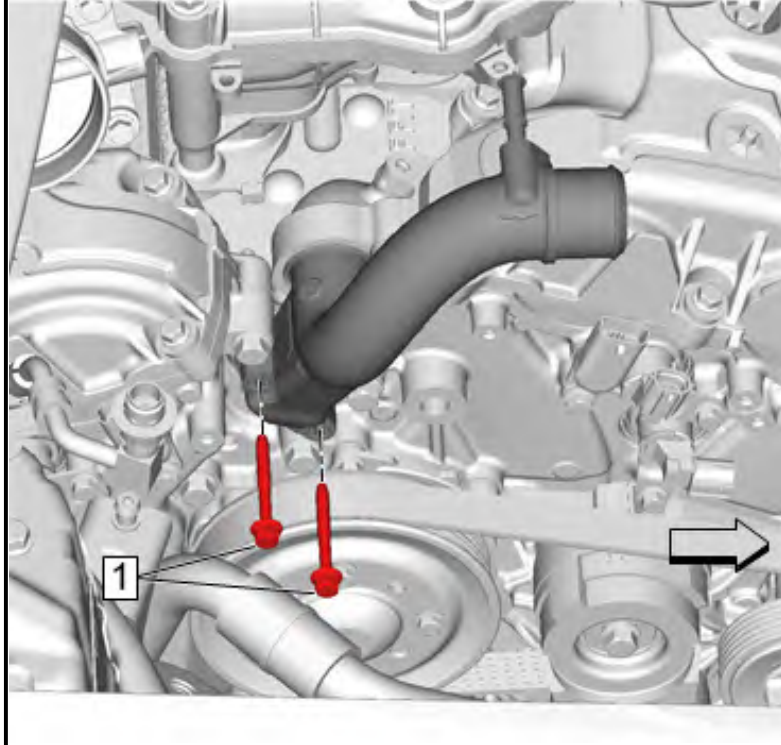
Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Radiator Inlet Hose (2) @ Water Outlet - Remove



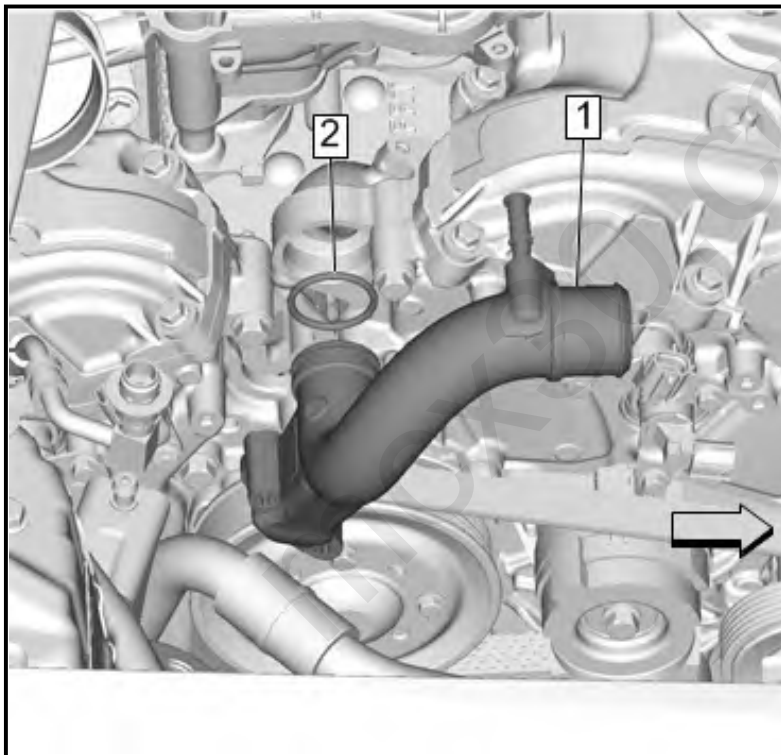
Engine Coolant Air Bleed Pipe Fitting (1) @ Water Outlet - Disengage - [Plastic Collar Quick Connect Fitting Service](#)





Water Outlet Bolt (1) - Remove [2x]

8.



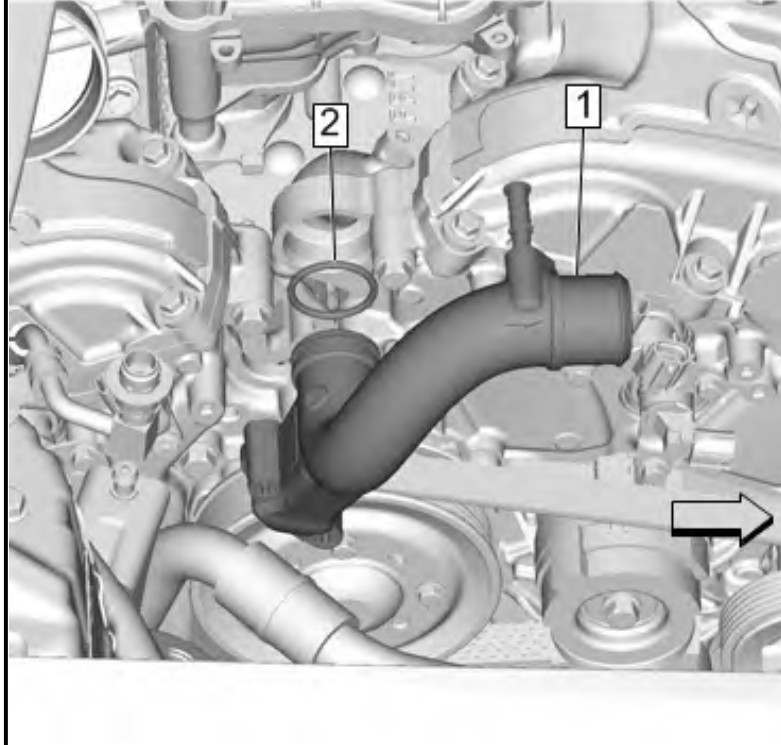
Water Outlet (1) - Remove

9. Water Outlet O-Ring Seal (2) - Remove and DISCARD

Installation Procedure

1.

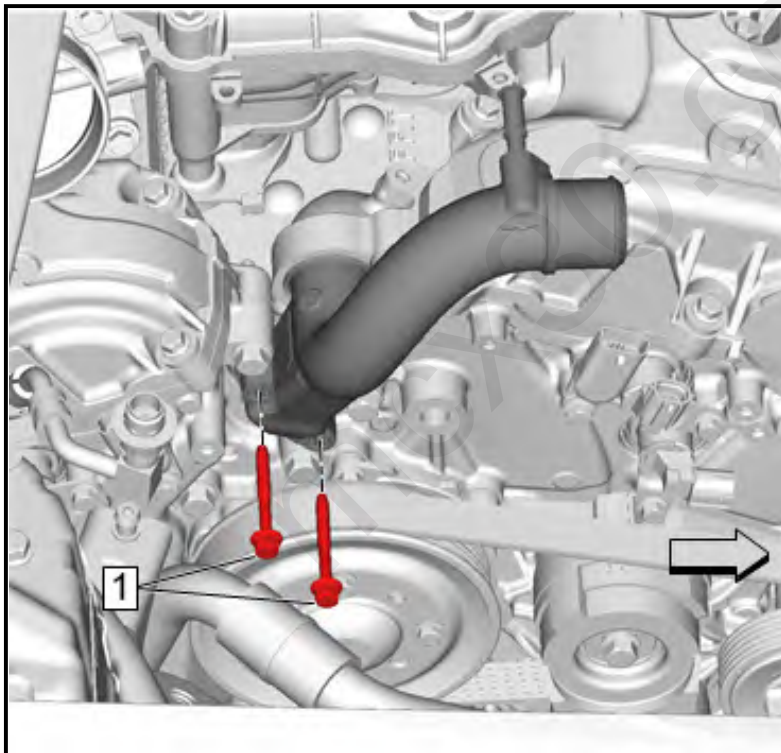




Water Outlet O-Ring Seal (2) - Install a NEW O-ring seal.

2. Water Outlet (1) - Install

3.

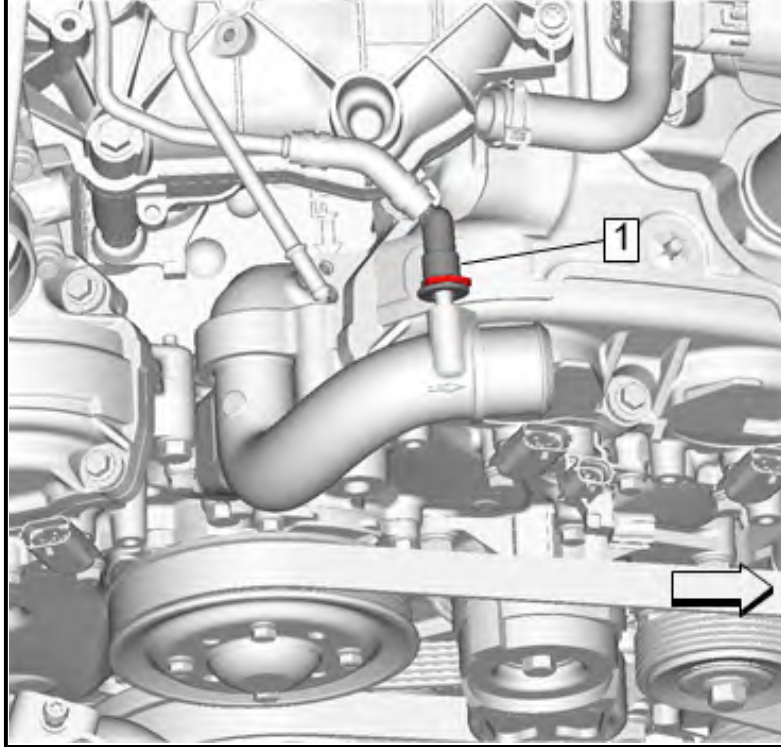


CAUTION: Refer to [Fastener Caution](#) .

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

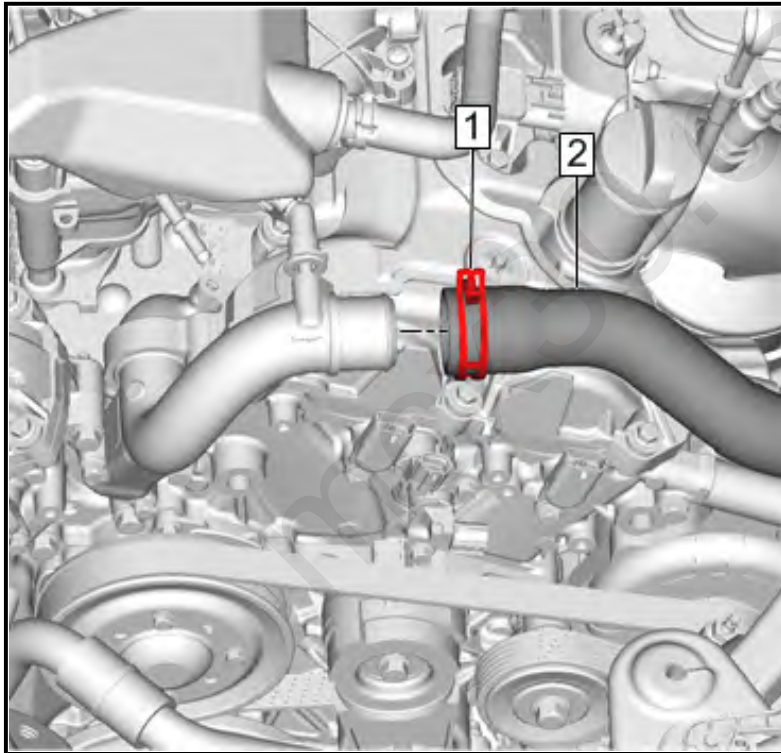
4.





Engine Coolant Air Bleed Pipe Fitting (1) @ Water Outlet - Engage - [Plastic Collar Quick Connect Fitting Service](#)

5.



Radiator Inlet Hose (2) @ Water Outlet - Install

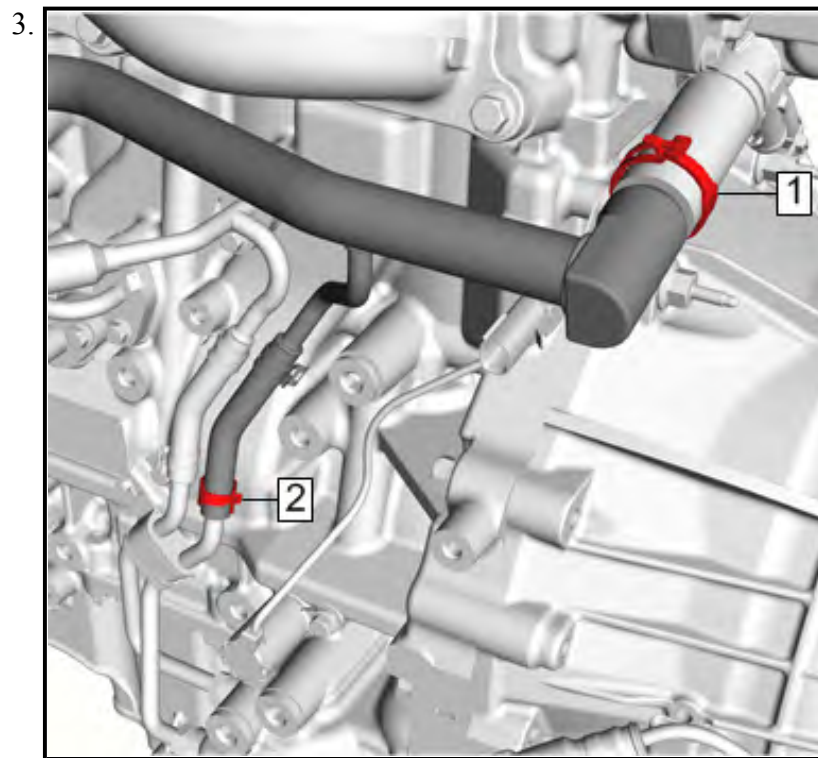
6. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Air Cleaner Assembly - Install - [Air Cleaner Assembly Replacement](#)
8. Intake Manifold Cover - Install - [Intake Manifold Cover Replacement](#)
9. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
10. Start the engine and check for coolant leaks.

THERMOSTAT BYPASS PIPE REPLACEMENT

Removal Procedure

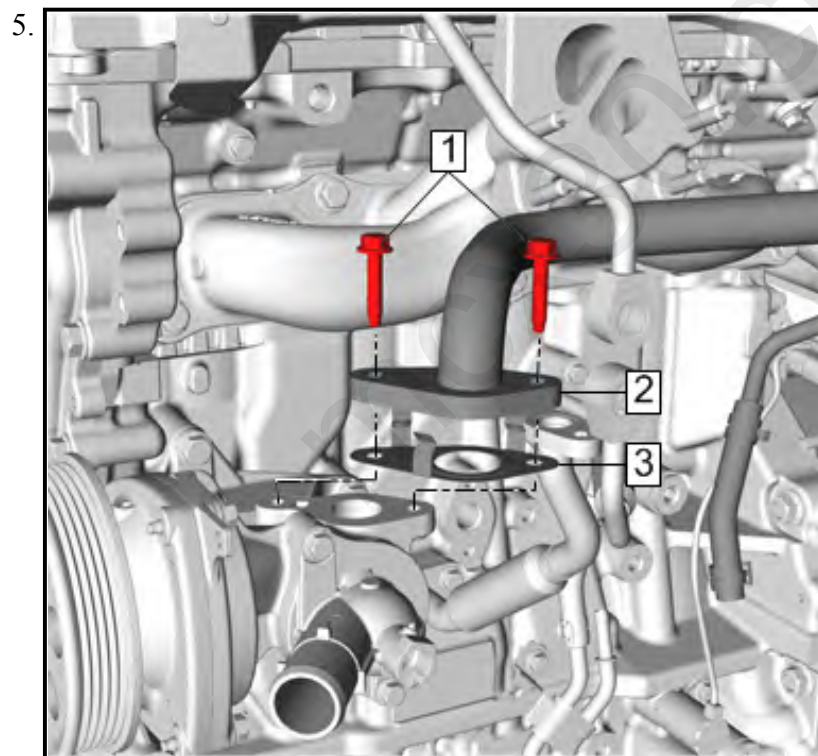
1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

2. Exhaust Manifold Brace - Remove - [Exhaust Manifold Brace Replacement](#)



Thermostat Bypass Hose Clamp (1) - Disengage

4. Engine Oil Cooler Inlet Hose Clamp (2) - Disengage



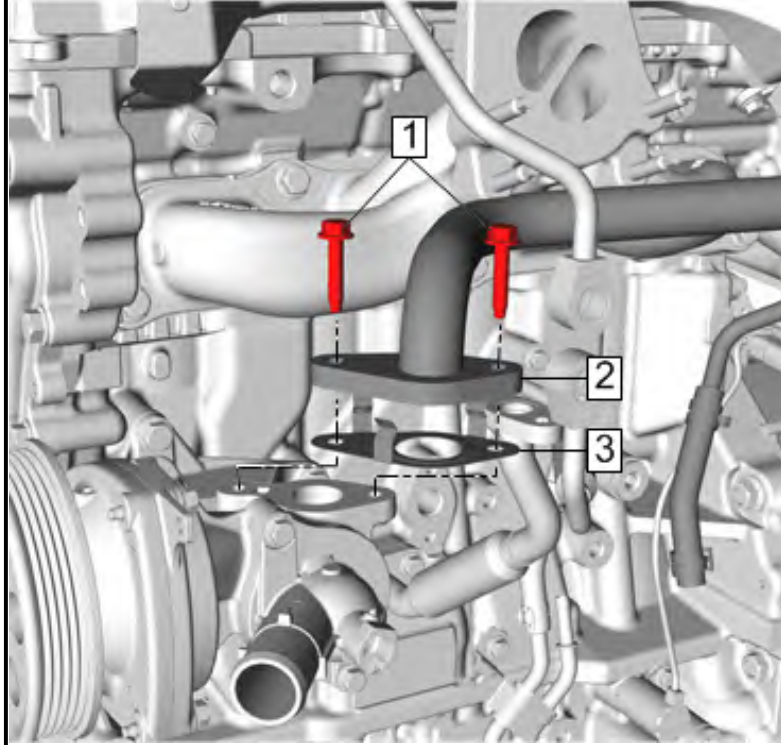
Thermostat Bypass Pipe Bolt (1) - Remove [2x]

6. Thermostat Bypass Pipe (2) - Remove

7. Thermostat Bypass Pipe Gasket (3) - Remove and DISCARD

Installation Procedure





NOTE: Install a NEW thermostat bypass pipe gasket.

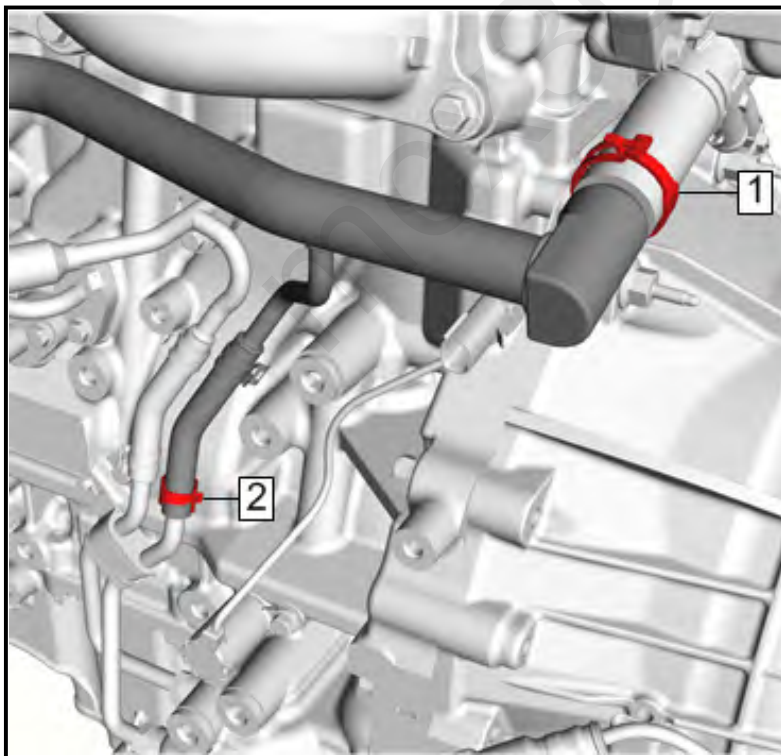
Thermostat Bypass Pipe Gasket (3) - Install

2. Thermostat Bypass Pipe (2) - Install

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

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

4.



Engine Oil Cooler Inlet Hose Clamp (2) - Engage

5. Thermostat Bypass Hose Clamp (1) - Engage

6. Exhaust Manifold Brace - Install - [Exhaust Manifold Brace Replacement](#)

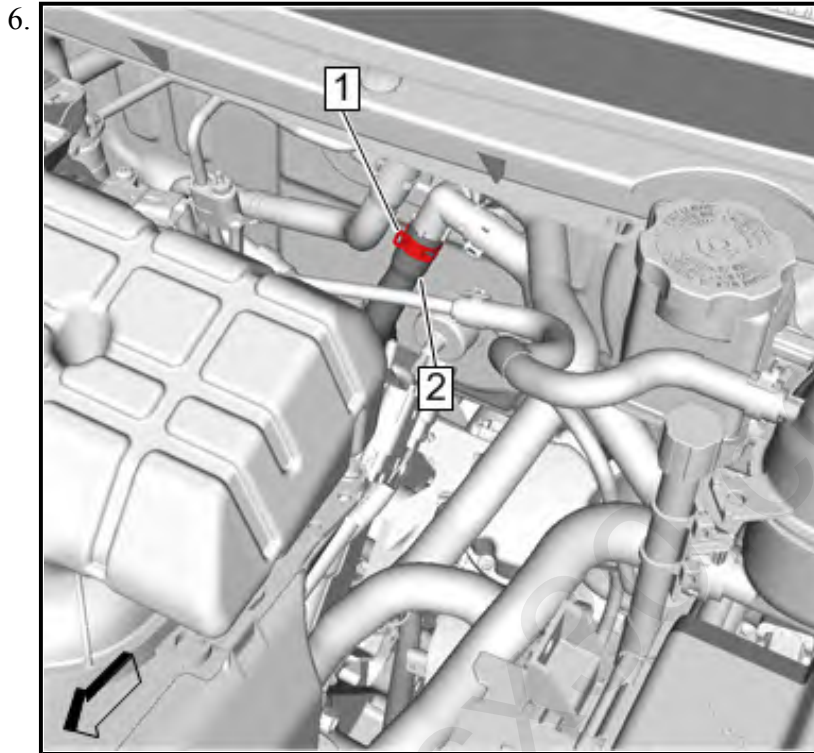
7. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

8. Start the engine and check for leaks.

HEATER WATER BYPASS INLET HOSE REPLACEMENT (AUXILIARY AIR CONDITIONING EVAPORATOR INTERMEDIATE TUBE TO CONNECTOR)

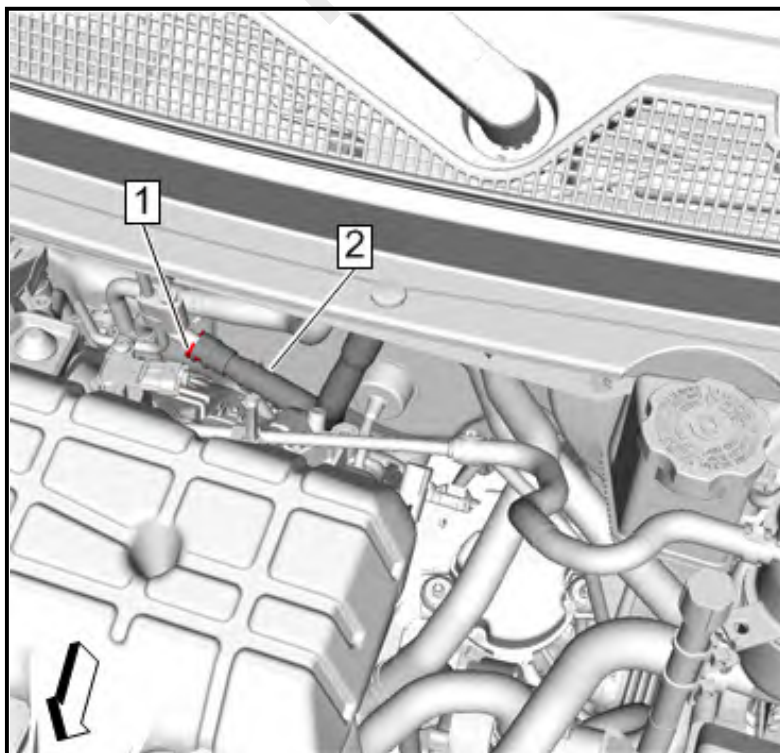
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
2. Lower the vehicle.
3. Power Brake Booster Vacuum Hose - Reposition - [Power Brake Booster Vacuum Hose Replacement \(LTG\)Power Brake Booster Vacuum Hose Replacement \(LFY\)](#)
4. Positive Crankcase Ventilation Tube - Reposition - [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Air Cleaner Outlet Duct to Camshaft Cover\) Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Intake Manifold to Camshaft Cover\)](#)
5. Reposition the wiring harness.



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

7. Heater Water Bypass Inlet Hose (2) @ Heater Outlet Hose Connector - Remove
- 8.



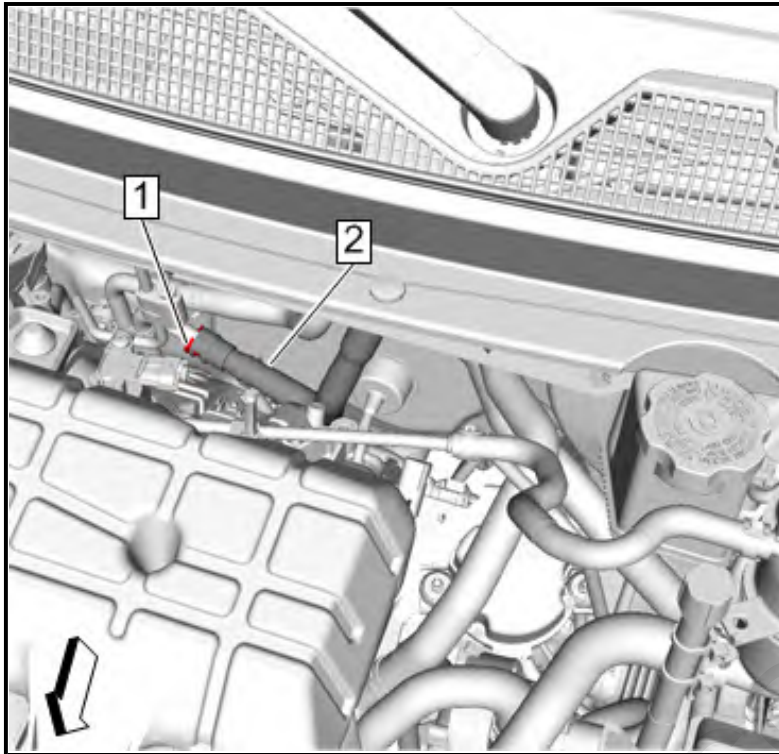
Heater Water Bypass Inlet Hose Retainer (1) - Disengage

9. Heater Water Bypass Inlet Hose (2) @ Auxiliary Air Conditioning Evaporator Intermediate Tube - Remove

10. Heater Water Bypass Inlet Hose (2) - Remove

Installation Procedure

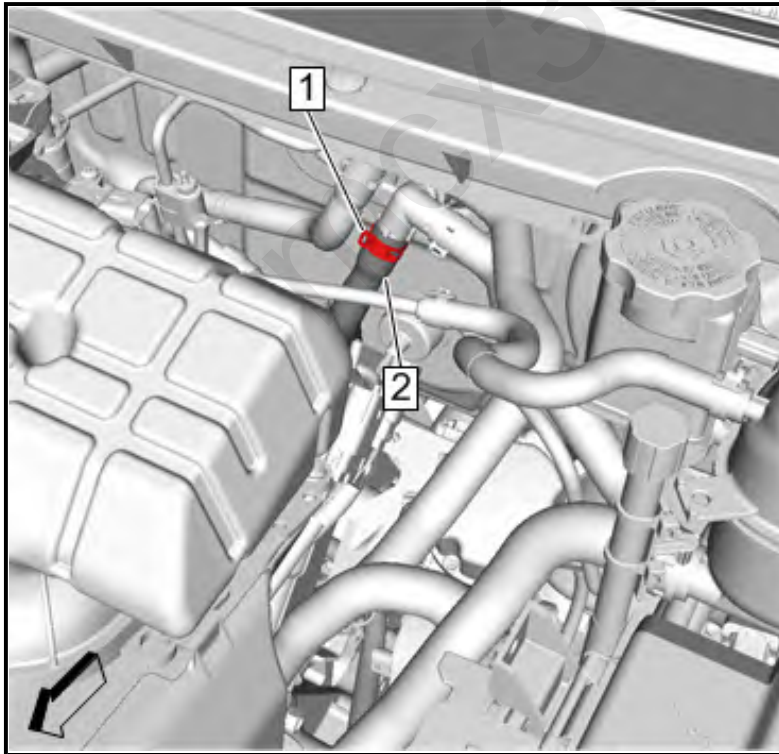
1.



Heater Water Bypass Inlet Hose (2) @ Auxiliary Air Conditioning Evaporator Intermediate Tube - Install

2. Heater Water Bypass Inlet Hose Retainer (1) - Engage

3.



Heater Water Bypass Inlet Hose (2) @ Heater Outlet Hose Connector - Install

4. Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

5. Reposition the wiring harness.

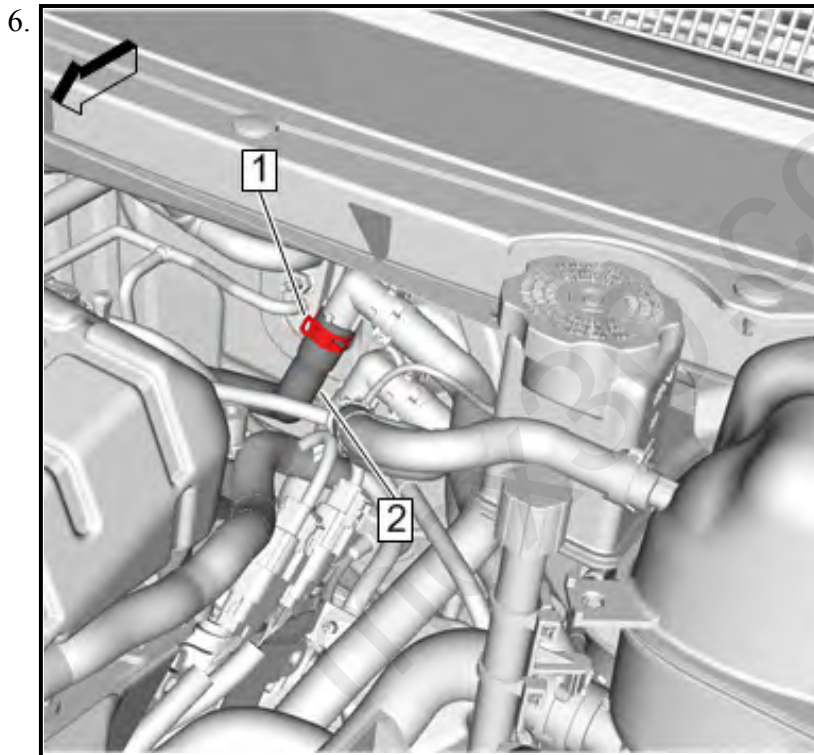
6. Positive Crankcase Ventilation Tube - Reposition - [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Air Cleaner Outlet Duct to Camshaft Cover\)](#) [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Intake Manifold to Camshaft Cover\)](#)

7. Power Brake Booster Vacuum Hose - Reposition - [Power Brake Booster Vacuum Hose Replacement \(LTG\)](#)
[Power Brake Booster Vacuum Hose Replacement \(LFY\)](#)
8. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)](#)[Cooling System Draining and Filling \(Static Fill\)](#)
9. Start the engine and inspect for leaks.

HEATER WATER BYPASS OUTLET HOSE REPLACEMENT (LFY AUXILIARY AIR CONDITIONING EVAPORATOR INTERMEDIATE TUBE TO CONNECTOR)

Removal Procedure

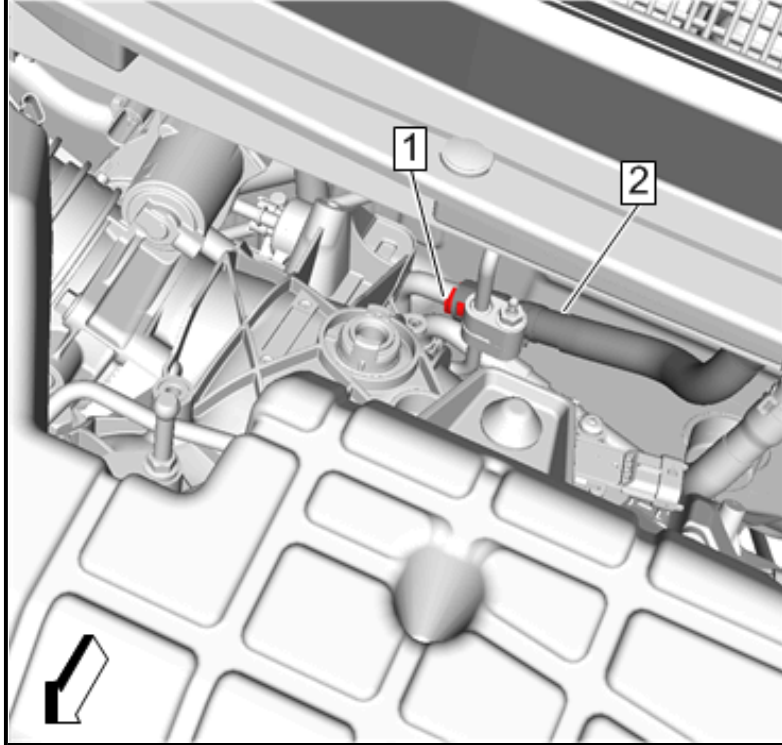
1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)](#)[Cooling System Draining and Filling \(Static Fill\)](#)
2. Lower the vehicle.
3. {If equipped} Power Brake Booster Vacuum Hose - Reposition - [Power Brake Booster Vacuum Hose Replacement \(LFY\)](#)
4. Positive Crankcase Ventilation Tube - Reposition - [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Air Cleaner Outlet Duct to Camshaft Cover\)](#) [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Intake Manifold to Camshaft Cover\)](#)
5. Reposition the wiring harness.



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

7. Heater Water Bypass Outlet Hose (2) @ Heater Outlet Hose Connector - Remove
- 8.

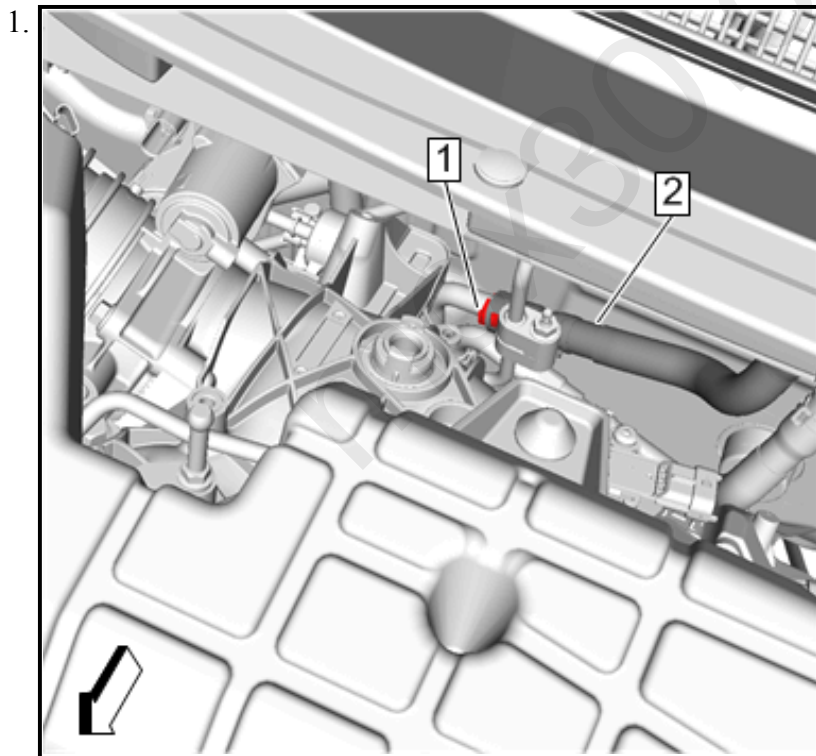




Heater Water Bypass Outlet Hose Retainer (1) - Disengage

9. Heater Water Bypass Outlet Hose (2) @ Auxiliary Air Conditioning Evaporator Intermediate Tube - Remove
10. Heater Water Bypass Outlet Hose (2) - Remove

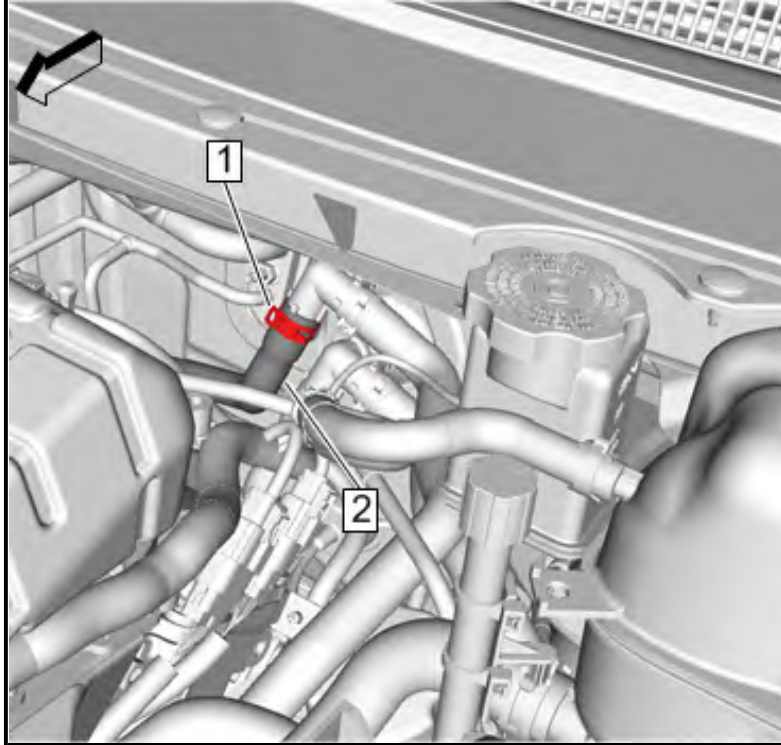
Installation Procedure



Heater Water Bypass Outlet Hose (2) @ Auxiliary Air Conditioning Evaporator Intermediate Tube - Install

2. Heater Water Bypass Outlet Hose Retainer (1) - Engage

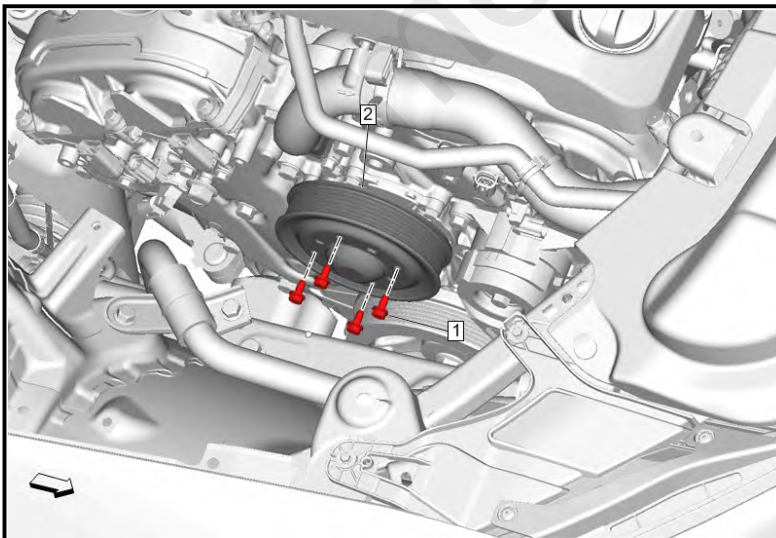




Heater Water Bypass Outlet Hose (2) @ Heater Outlet Hose Connector - Install

4. Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Reposition the wiring harness.
6. Positive Crankcase Ventilation Tube - Reposition - [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Air Cleaner Outlet Duct to Camshaft Cover\)](#) [Positive Crankcase Ventilation Hose/Pipe/Tube Replacement \(Intake Manifold to Camshaft Cover\)](#)
7. {If equipped} Power Brake Booster Vacuum Hose - Reposition - [Power Brake Booster Vacuum Hose Replacement \(LFY\)](#)
8. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)](#) [Cooling System Draining and Filling \(Static Fill\)](#)
9. Start the engine and inspect for leaks.

WATER PUMP PULLEY REPLACEMENT (LFY)



Callout	Component Name
Preliminary Procedures	
1.	Engine Mount Bracket Replacement - Right Side
2.	Drive Belt Replacement

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

WATER PUMP REPLACEMENT (LTG)

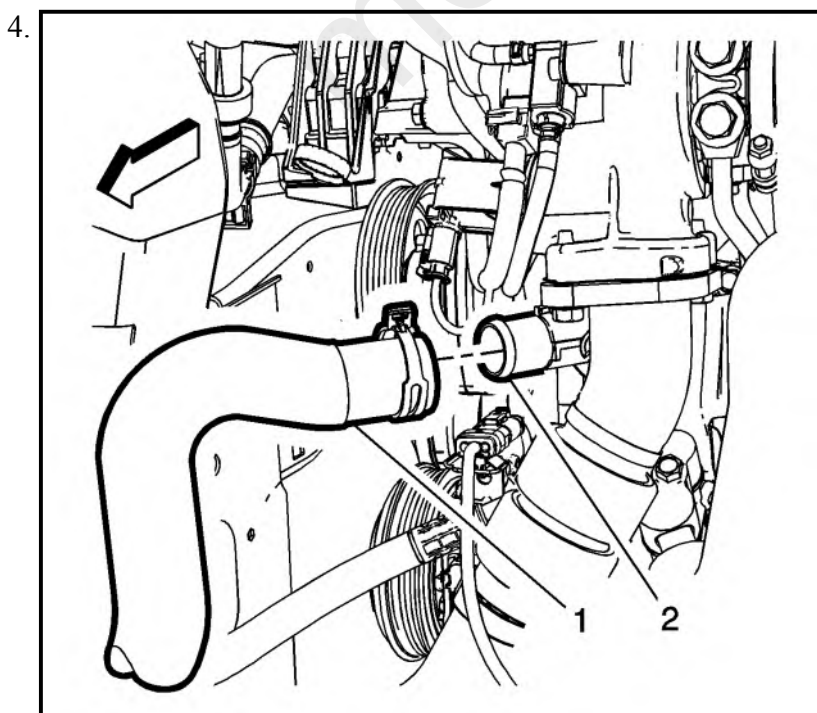
Special Tools

BO-38185 Hose Clamp Pliers

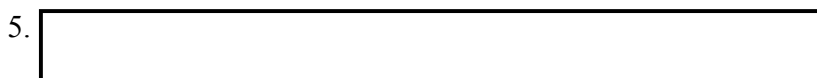
For equivalent regional tools, refer to **Special Tools**.

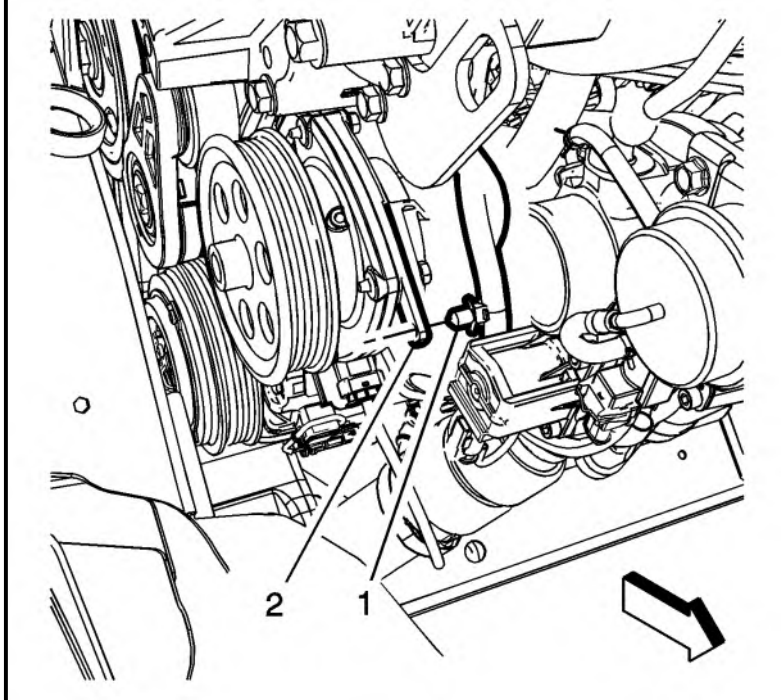
Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill)**.
2. Remove the drive belt. Refer to **Drive Belt Replacement** .
3. Remove the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement** .

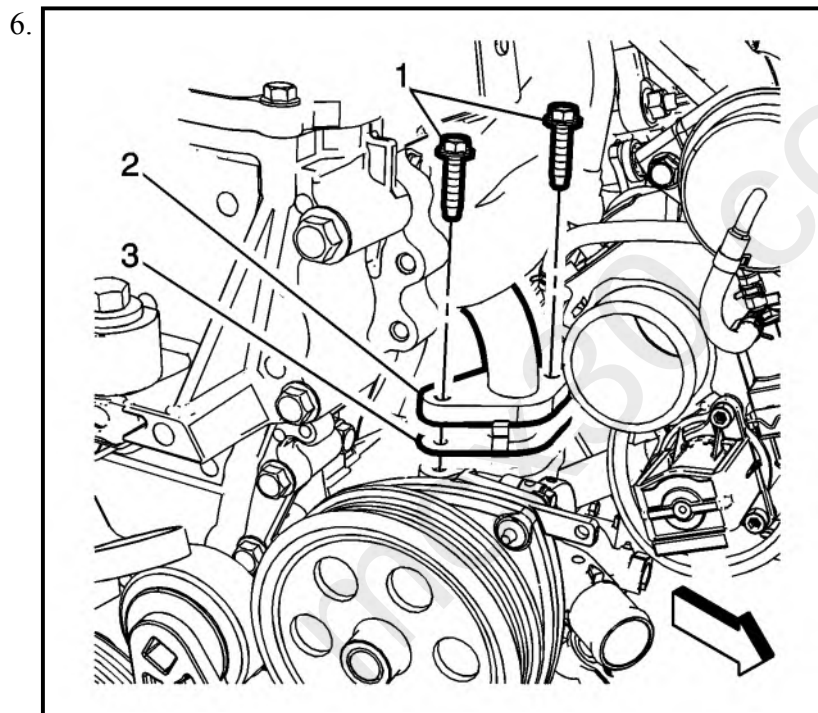


Using the BO-38185 hose clamp pliers, remove the radiator outlet hose (1) from the water outlet (2).



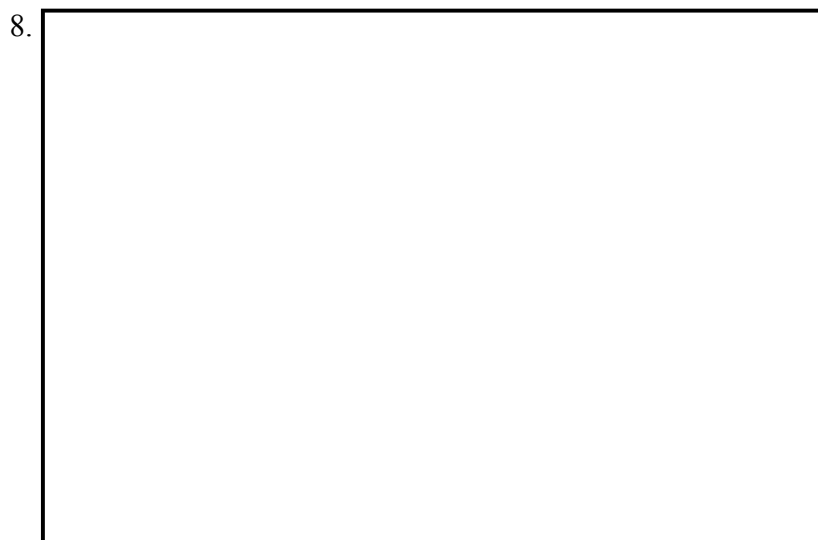


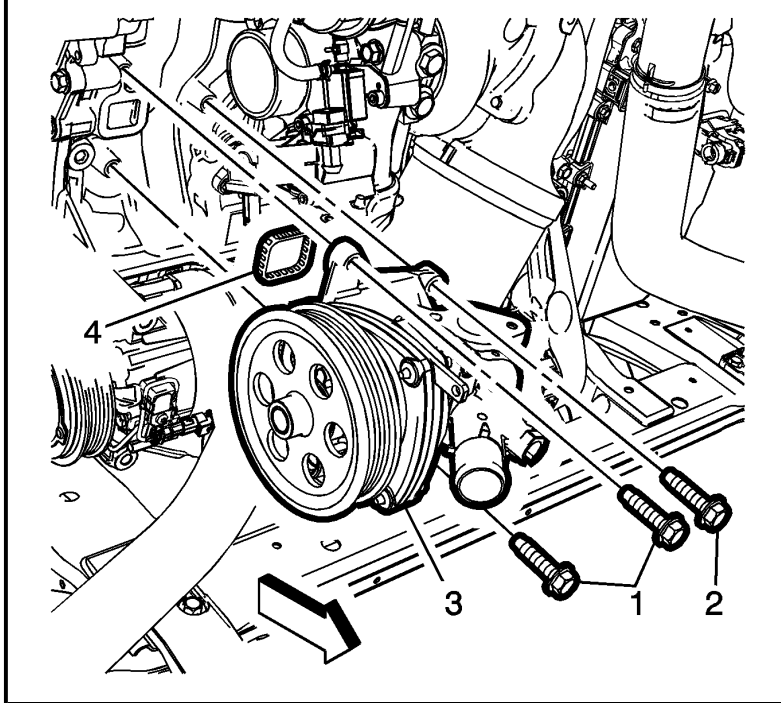
Remove the engine harness retainer (1) from the water pump (2).



Remove the thermostat bypass pipe fasteners (1) and remove the thermostat bypass pipe (2) from the water pump.

7. Discard the thermostat bypass pipe gasket (3).

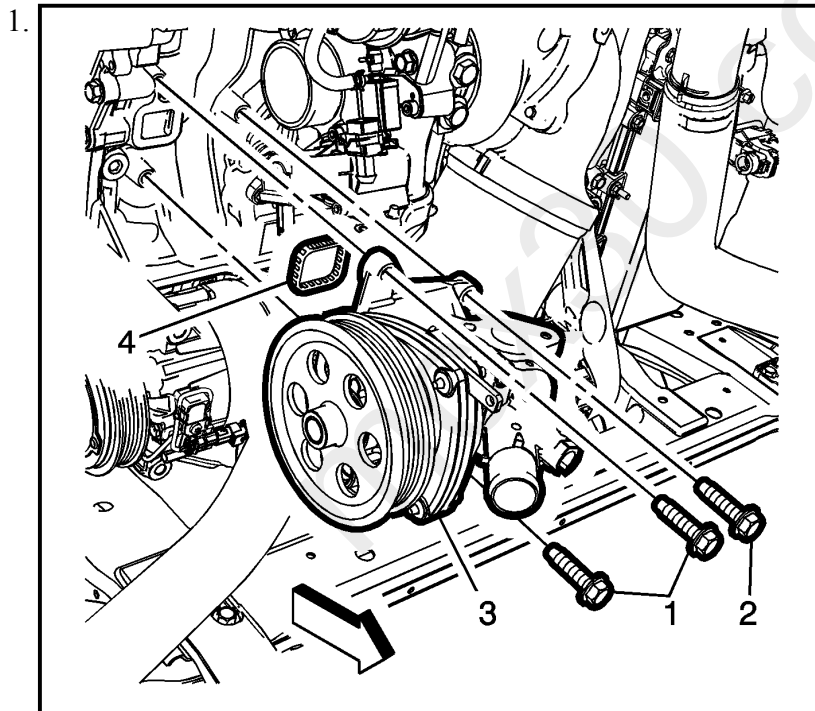




Remove the water pump fasteners (1) and (2) remove the water pump (3).

9. Discard the water pump seal (4).

Installation Procedure



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

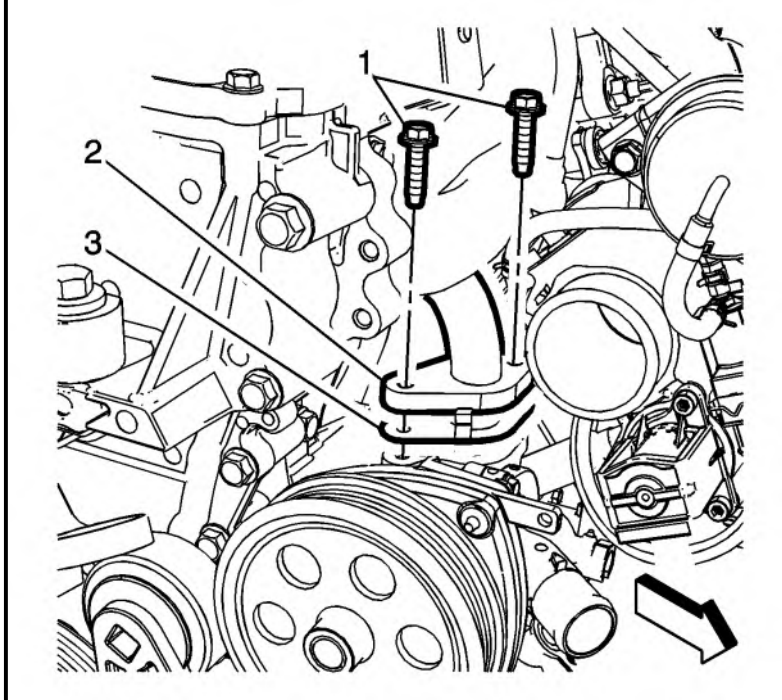
Install the water pump (3) into position with a NEW water pump seal (4) and hand tighten the bolts.

2. Tighten (1) bolts to 25 N.m (18 lb ft).

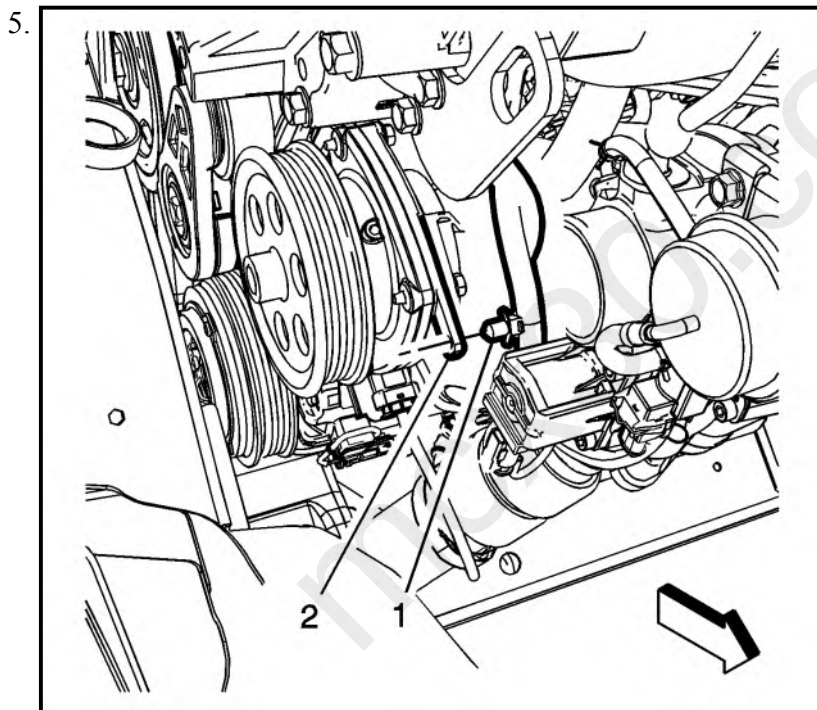
3. Tighten (2) bolt to 25 N.m (18 lb ft).

4.



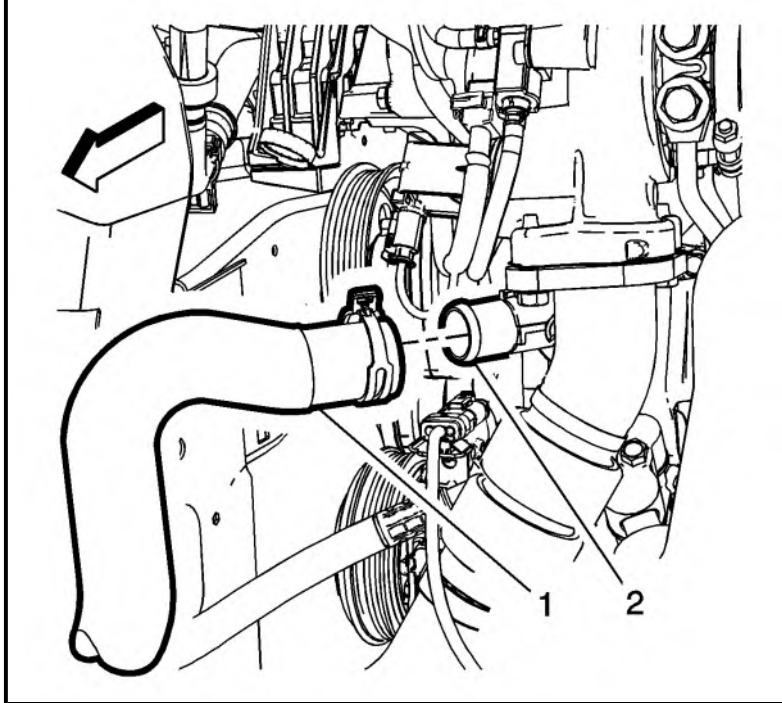


Install the thermostat bypass pipe (2) to the water pump with a NEW gasket (3) and tighten the fasteners (1) to 10 N.m (89 lb in).



Install the engine wiring harness retainer (1) to the water pump (2).





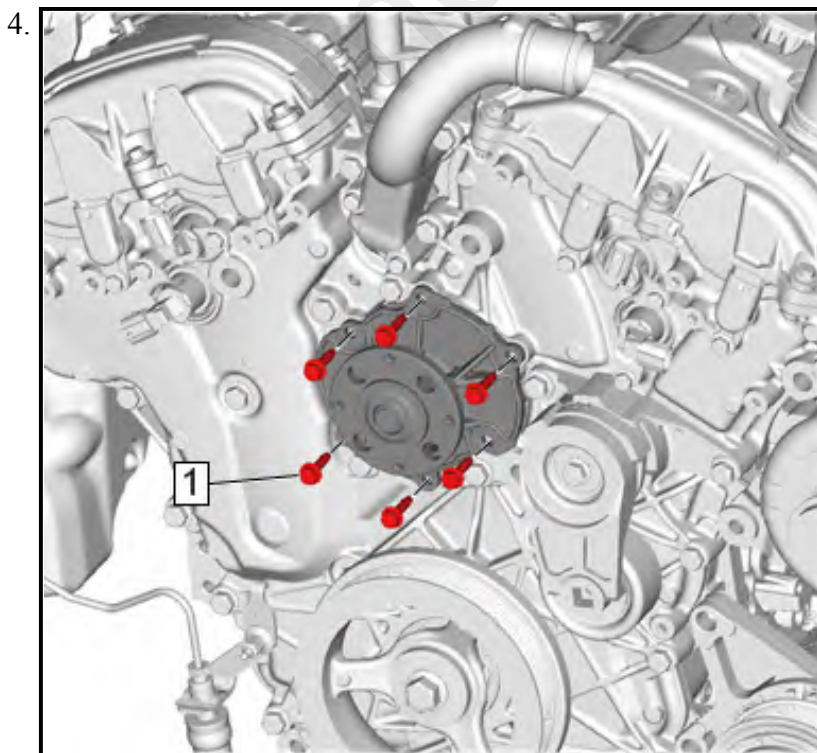
Using the BO-38185 hose clamp pliers, install the radiator outlet hose (1) to the water outlet (2).

7. Install the drive belt. Refer to [Drive Belt Replacement](#) .
8. Install the exhaust manifold heat shield. Refer to [Exhaust Manifold Heat Shield Replacement](#) .
9. Fill the cooling system. Refer to [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).
10. Start the engine and check for coolant leaks.

WATER PUMP REPLACEMENT (LFY)

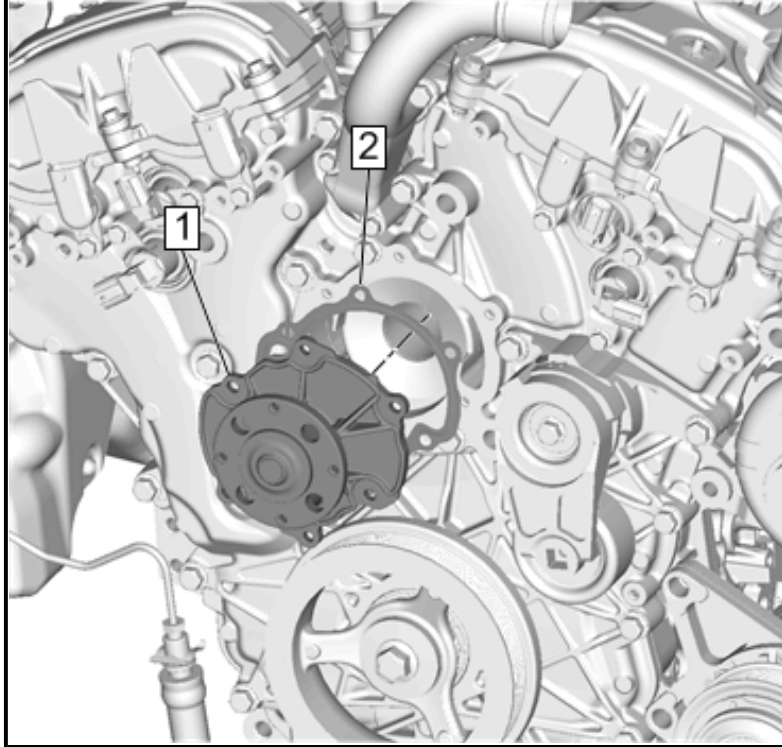
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).
2. Engine Mount @ Right Side - Remove - [Engine Mount Replacement - Right Side](#)
3. Water Pump Pulley - Remove - [Water Pump Pulley Replacement \(LFY\)](#)



Water Pump Bolt (1) - Remove [6x]

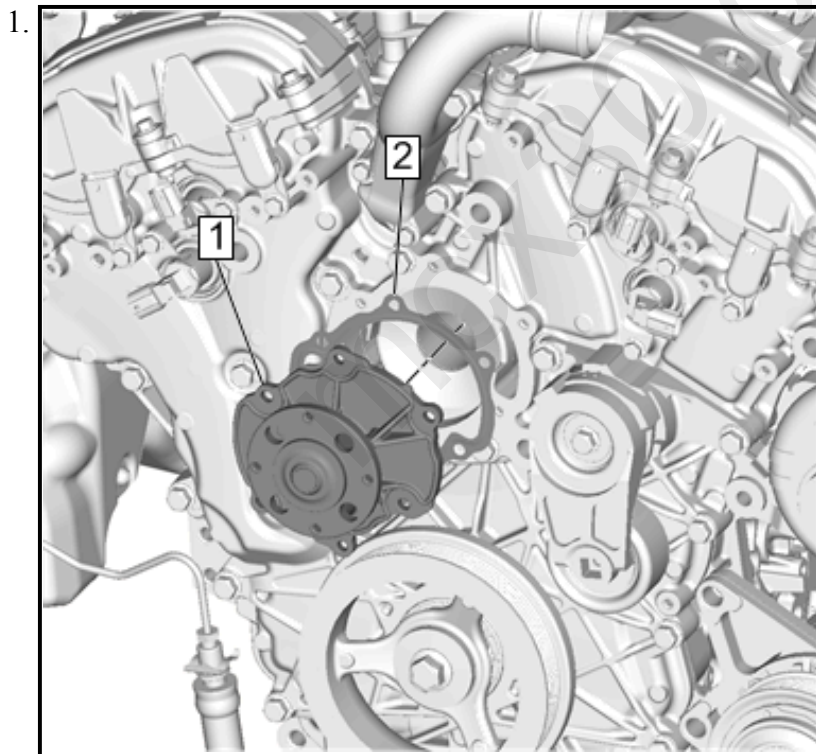
5.



Water Pump (1) - Remove

6. Water Pump Gasket (2) - Remove and DISCARD
7. Carefully clean the water pump sealing surfaces.

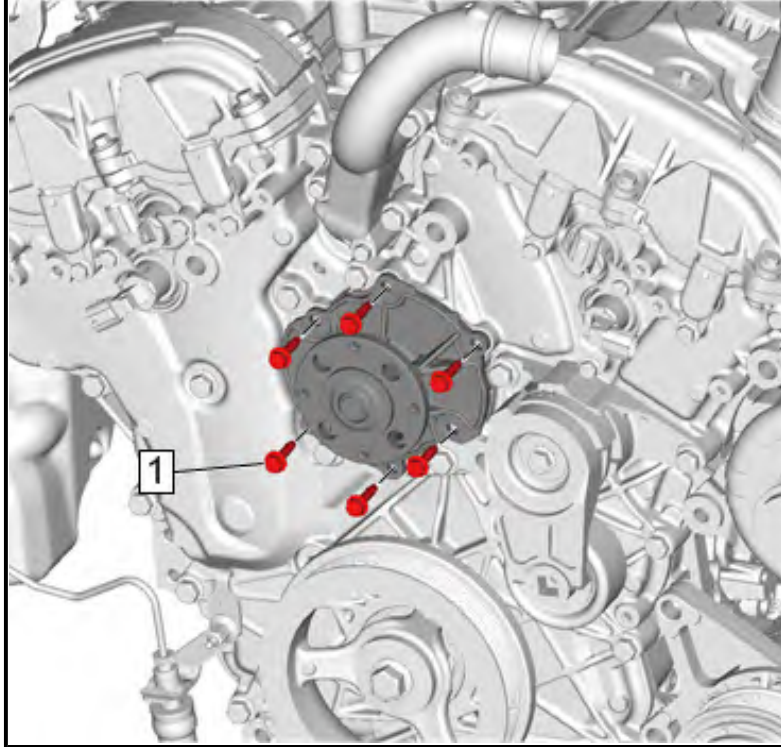
Installation Procedure



Water Pump Gasket (2) - Install a NEW gasket.

2. Water Pump (1) - Install





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

Water Pump Bolt (1) - Install [6x]

Tighten

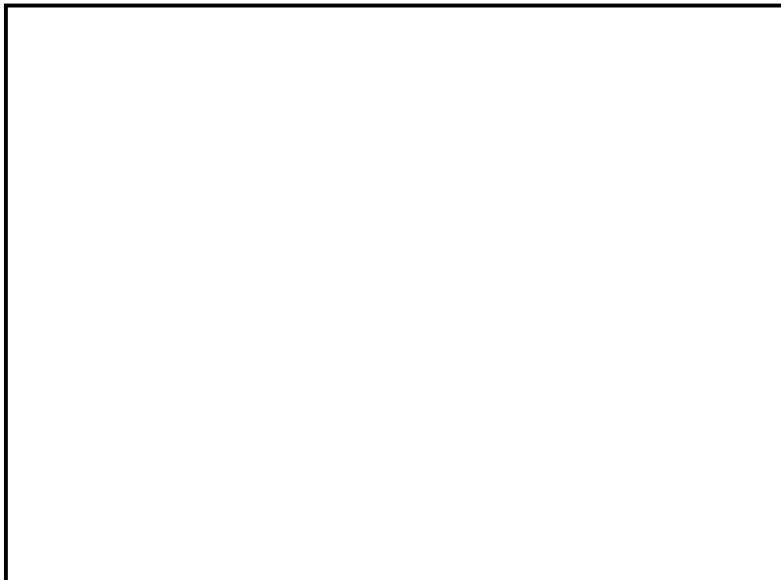
1. First Pass: 10 N.m (89 lb in)
2. Final Pass: (45 degrees)
4. Water Pump Pulley - Install - [Water Pump Pulley Replacement \(LFY\)](#)
5. Engine Mount @ Right Side - Install - [Engine Mount Replacement - Right Side](#)
6. Fill the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
7. Start the engine and check for leaks.

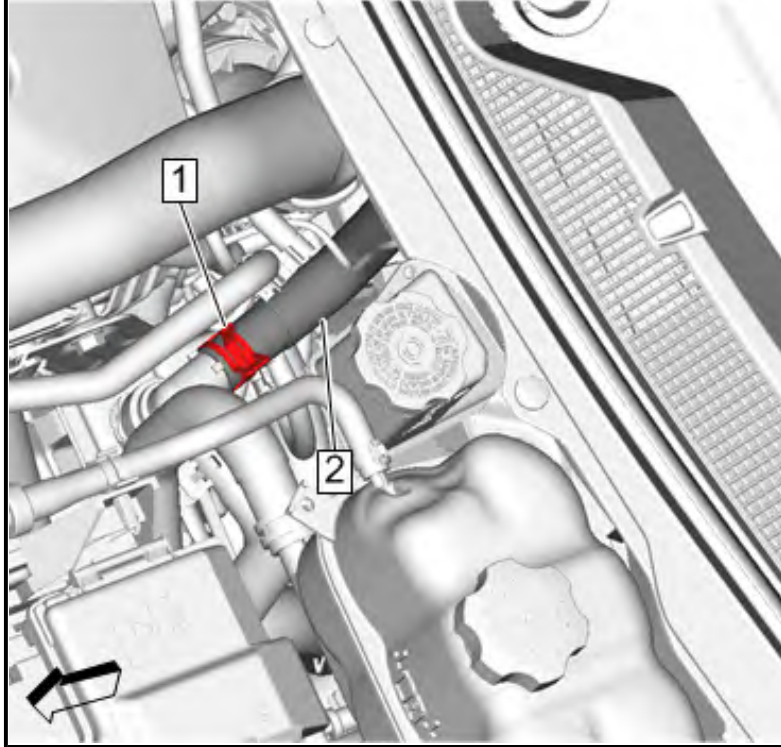
AUXILIARY WATER PUMP REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
2. Reposition the wiring harness.
3. Heater Vent Hose - Remove - [Heater Vent Hose Replacement \(LTG Water Outlet to Heater Outlet Hose Connector\)](#)

4.





Heater Coolant Heater Air Supply Hose (2) @ Heater Outlet Hose Connector - Remove - [Heater Coolant Heater Air Supply Hose Replacement \(LTG\)](#).

5.

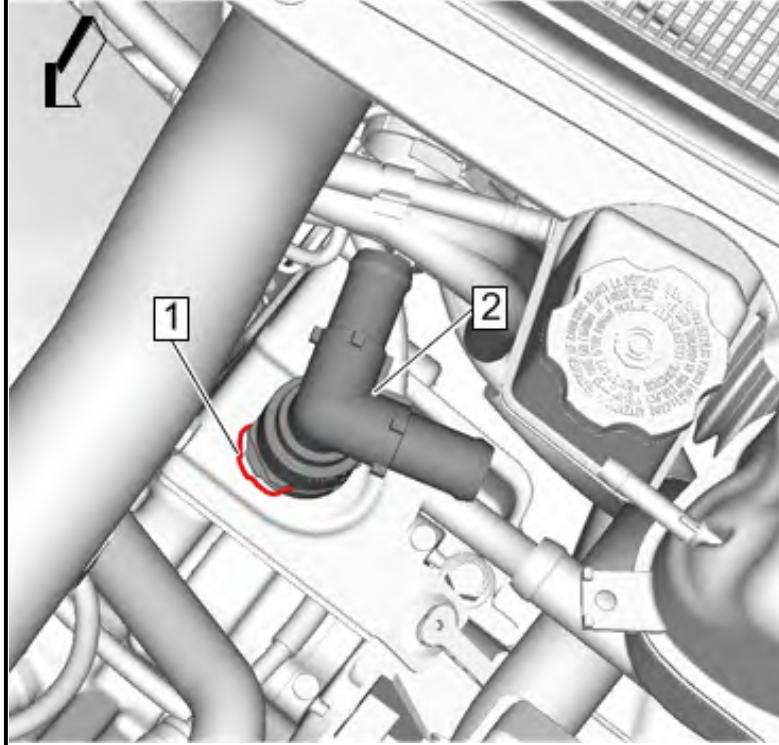


Heater Outlet Hose (2) - Remove - [Heater Outlet Hose Replacement \(LTG Radiator Surge Tank to Heater Outlet Hose Connector\)](#).

6. Intake Manifold Cover - Remove - [Intake Manifold Cover Replacement](#)

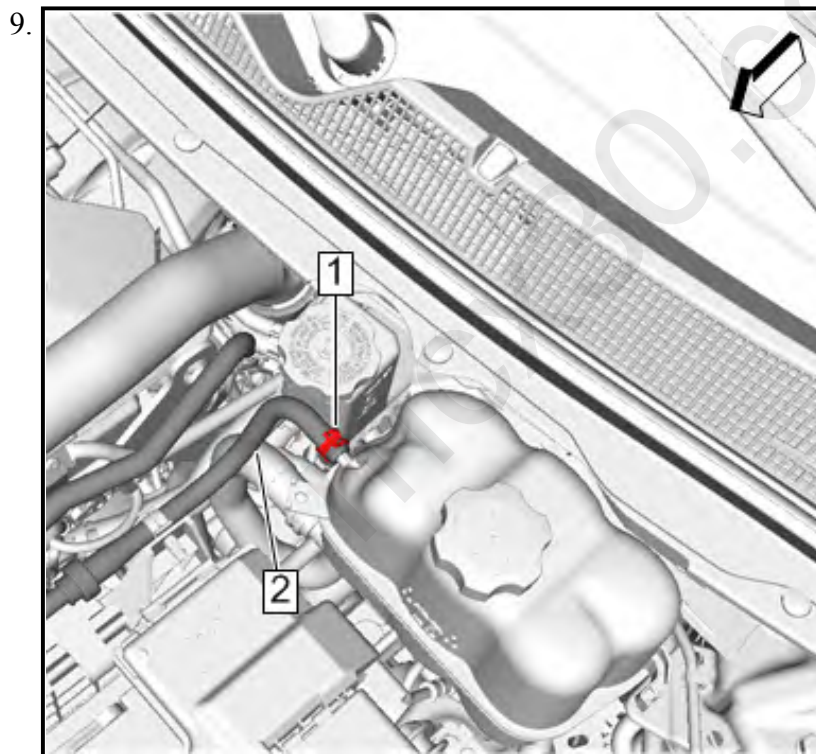
7.





Heater Outlet Hose Connector (2) - Remove - [Heater Outlet Hose Connector Replacement \(LTG at Heater Inlet Hose Bracket\)](#) [Heater Outlet Hose Connector Replacement \(LTG At Heater Core Outlet Tube\)](#).

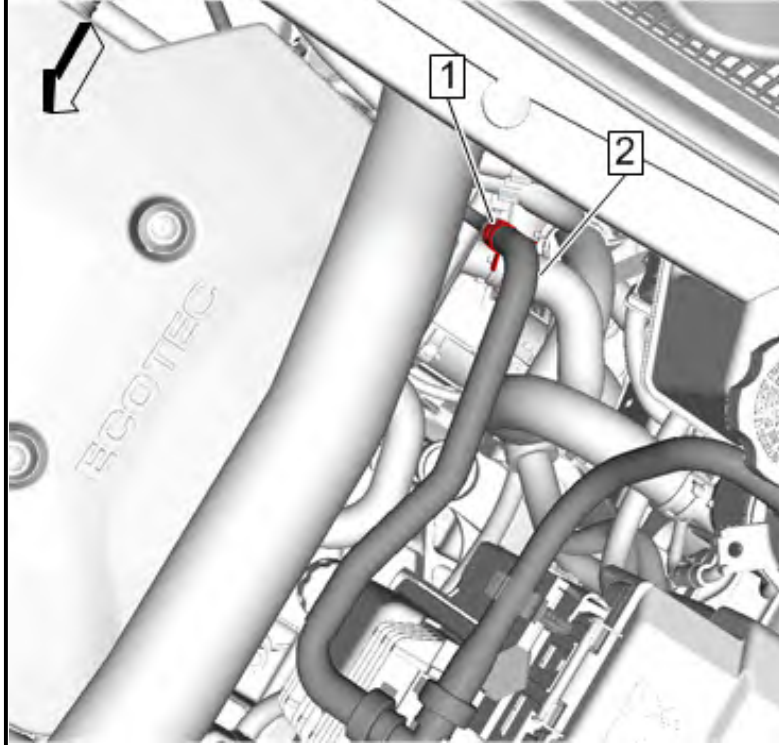
8. Wiring Harness Retainer @ Heater Inlet Hose Bracket - Remove [2x]



Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank - Remove - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#).

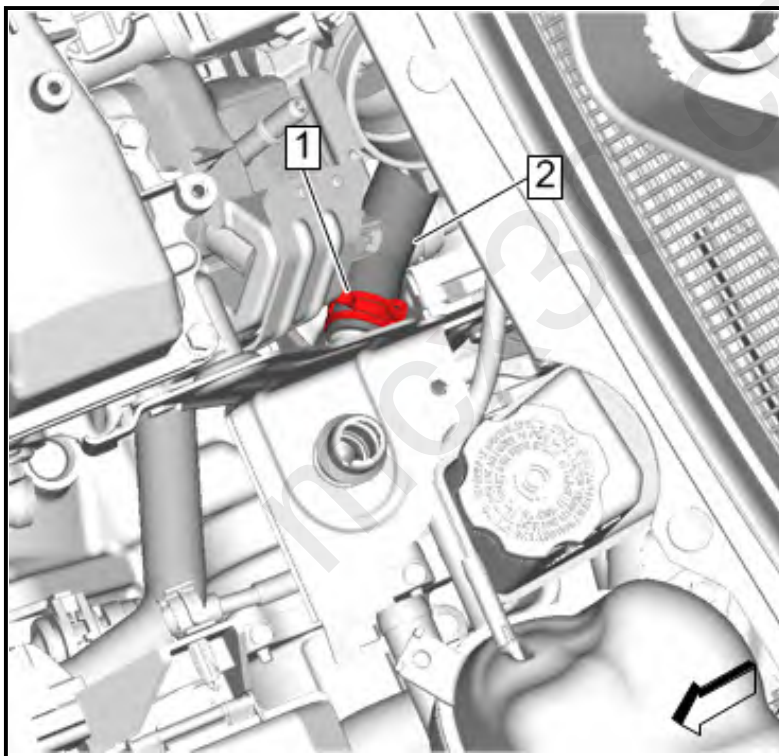
10.





Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank Outlet Pipe - Remove - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#)

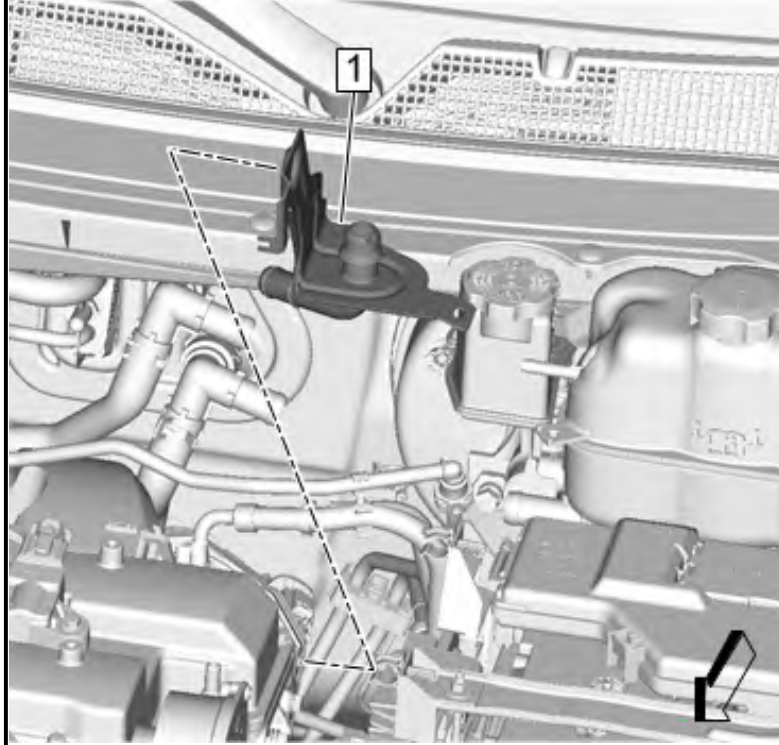
11.



Auxiliary Heater Inlet Hose (2) @ Heater Inlet Hose Bracket - Remove - [Auxiliary Heater Inlet Hose Replacement \(LTG\)](#)

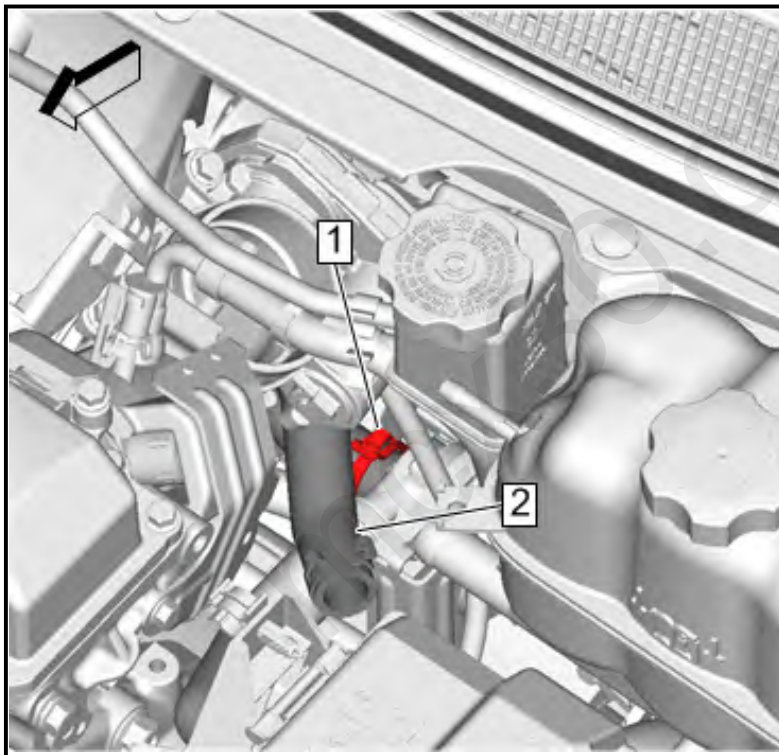
12.





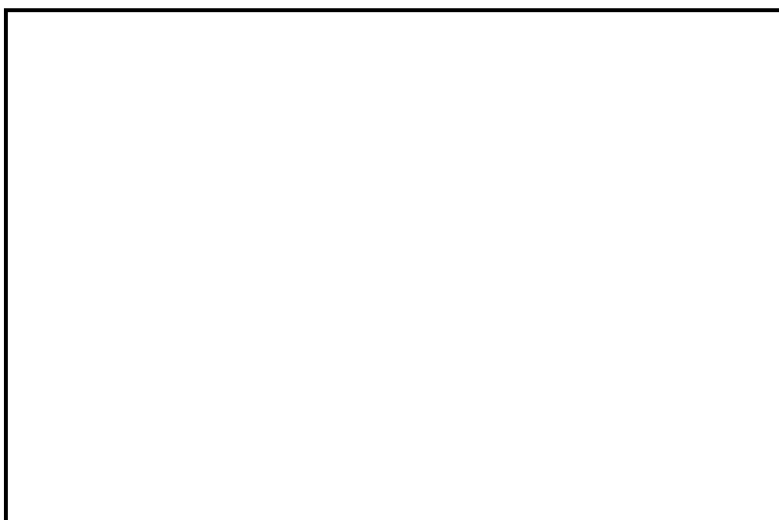
Heater Inlet Hose Bracket (1) - Remove - [Heater Inlet Hose Bracket Replacement \(LTG\)](#)

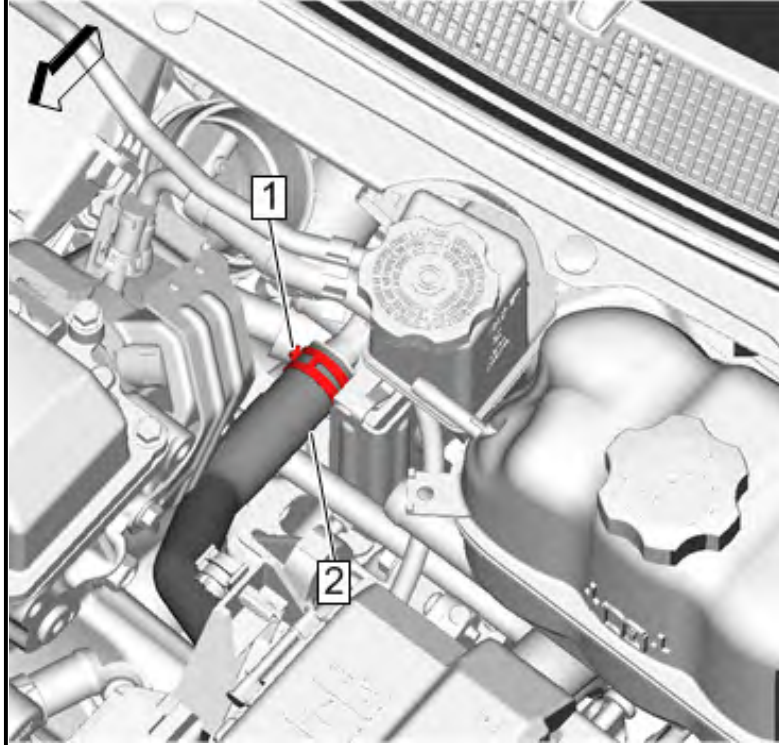
13.



Auxiliary Heater Inlet Hose (2) @ Auxiliary Water Pump - Remove - [Auxiliary Heater Inlet Hose Replacement \(LTG\)](#)

14.

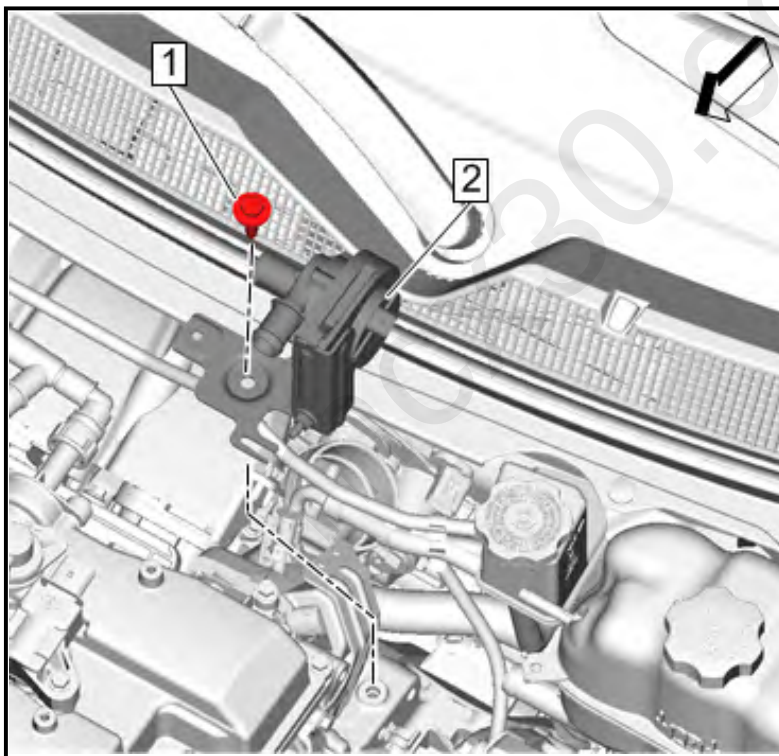




Auxiliary Heater Outlet Hose (2) @ Auxiliary Water Pump - Remove - [Auxiliary Heater Outlet Hose Replacement \(LTG\)](#)

15. Electrical Connector @ Auxiliary Water Pump - Disconnect

16.

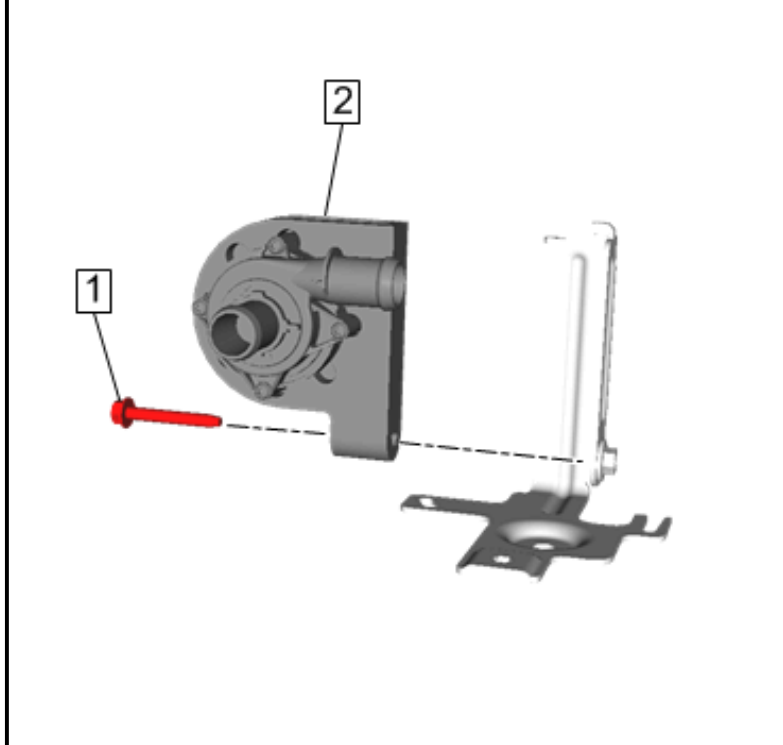


Auxiliary Water Pump Bracket Bolt (1) - Remove

17. Auxiliary Water Pump (2) - Remove

18.



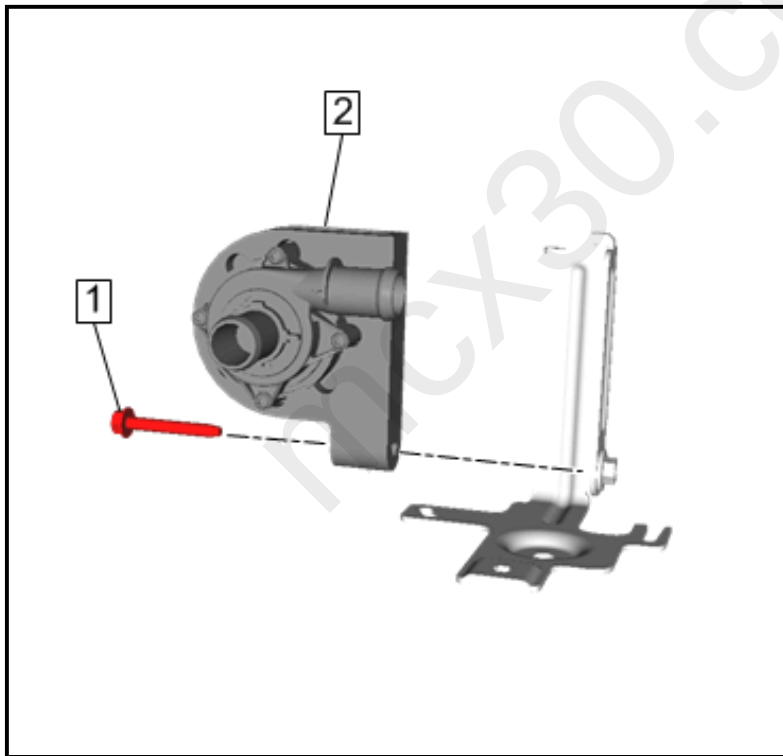


Heater Water Auxiliary Pump Bolt (1) - Remove

19. Auxiliary Water Pump (2) @ Heater Water Auxiliary Pump Bracket - Remove

Installation Procedure

1.



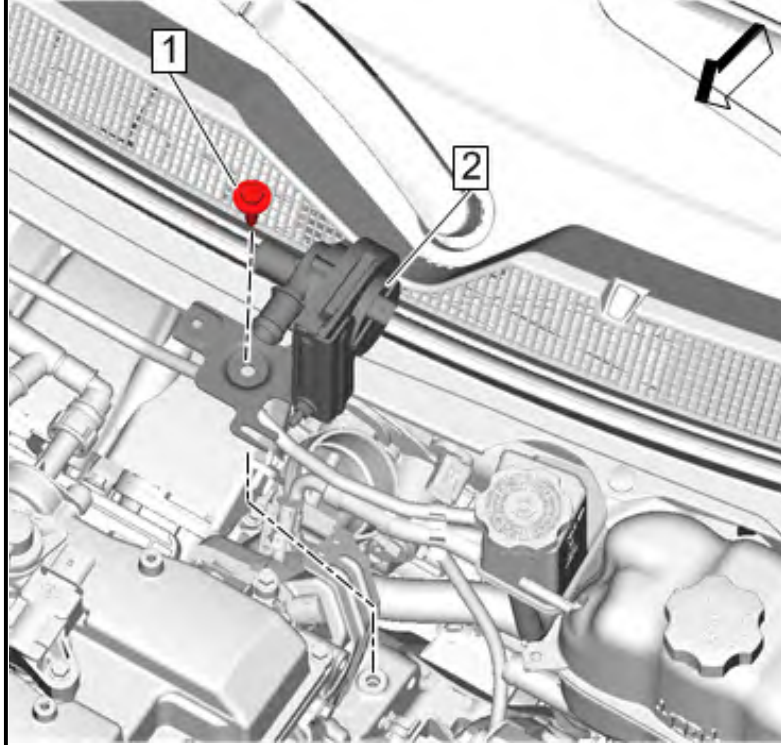
Auxiliary Water Pump (2) @ Heater Water Auxiliary Pump Bracket - Install

CAUTION: Refer to Fastener Caution .

2. Heater Water Auxiliary Pump Bolt (1) - Install and tighten 9 N.m (80 lb in)

3.

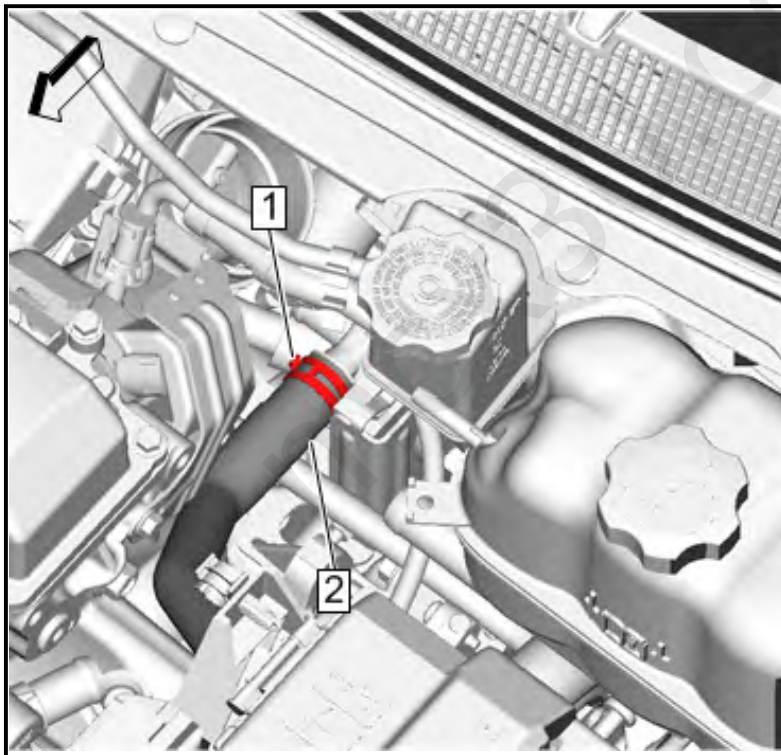




Auxiliary Water Pump (2) - Install

4. Auxiliary Water Pump Bracket Bolt (1) - Install and tighten 22 N.m (16 lb ft)
5. Electrical Connector @ Auxiliary Water Pump - Connect

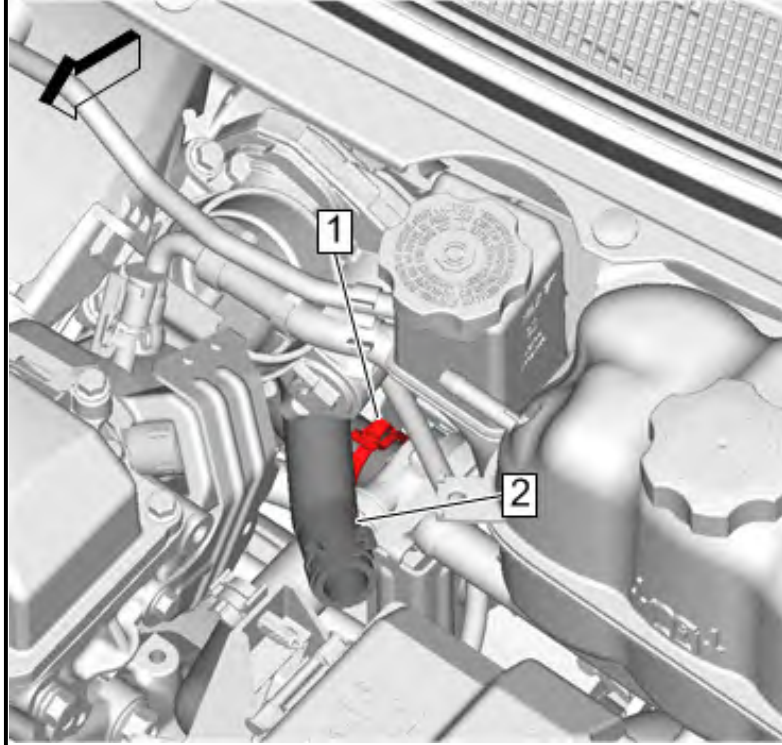
6.



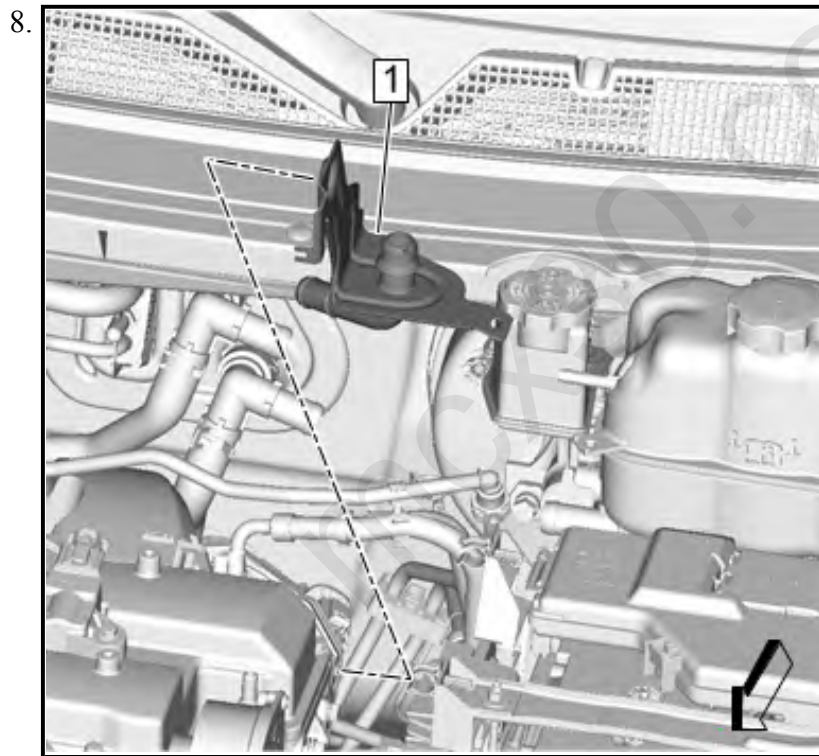
Auxiliary Heater Outlet Hose (2) @ Auxiliary Water Pump - Install - [Auxiliary Heater Outlet Hose Replacement \(LTG\)](#)

7.

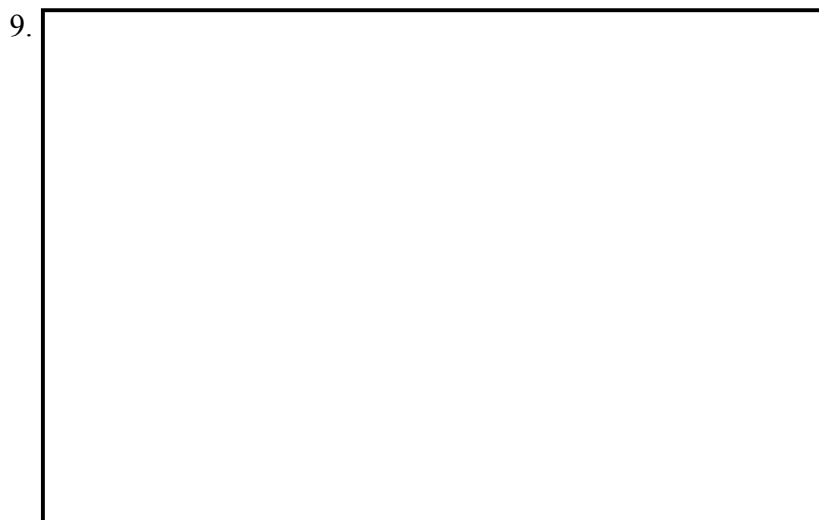


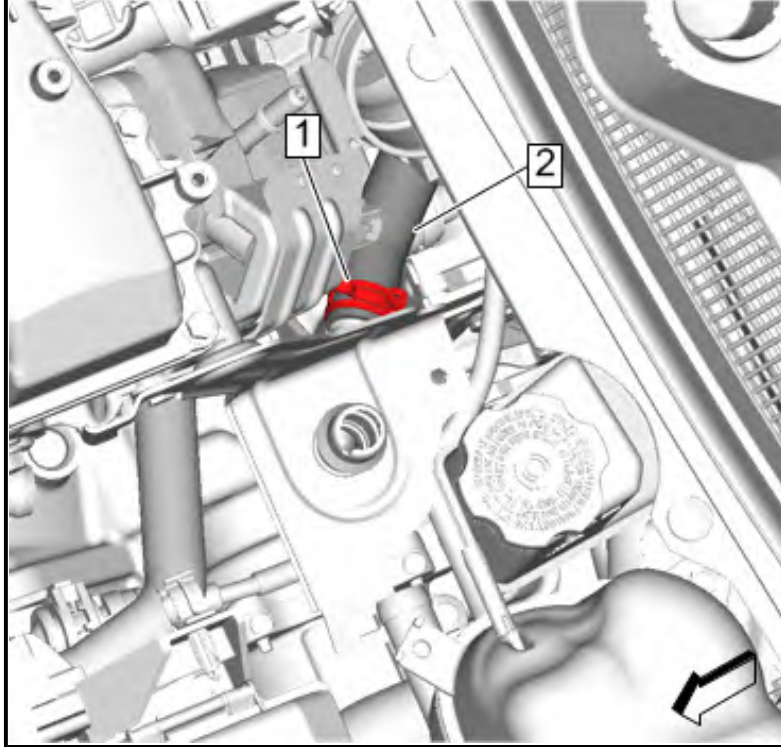


Auxiliary Heater Inlet Hose (2) @ Auxiliary Water Pump - Install - [Auxiliary Heater Inlet Hose Replacement \(LTG\)](#)



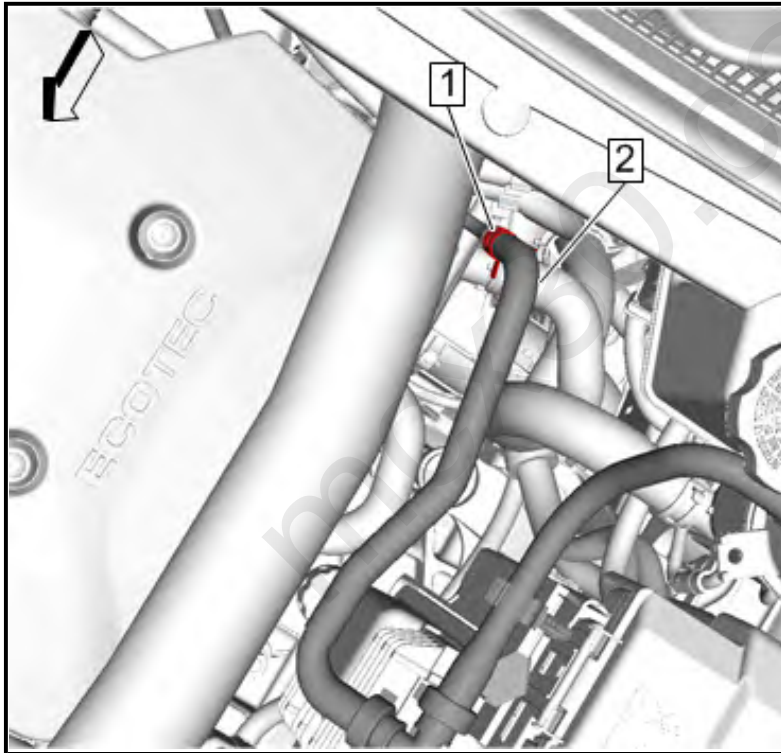
Heater Inlet Hose Bracket (1) - Install - [Heater Inlet Hose Bracket Replacement \(LTG\)](#)





Auxiliary Heater Inlet Hose (2) @ Heater Inlet Hose Bracket - Install - [Auxiliary Heater Inlet Hose Replacement \(LTG\)](#)

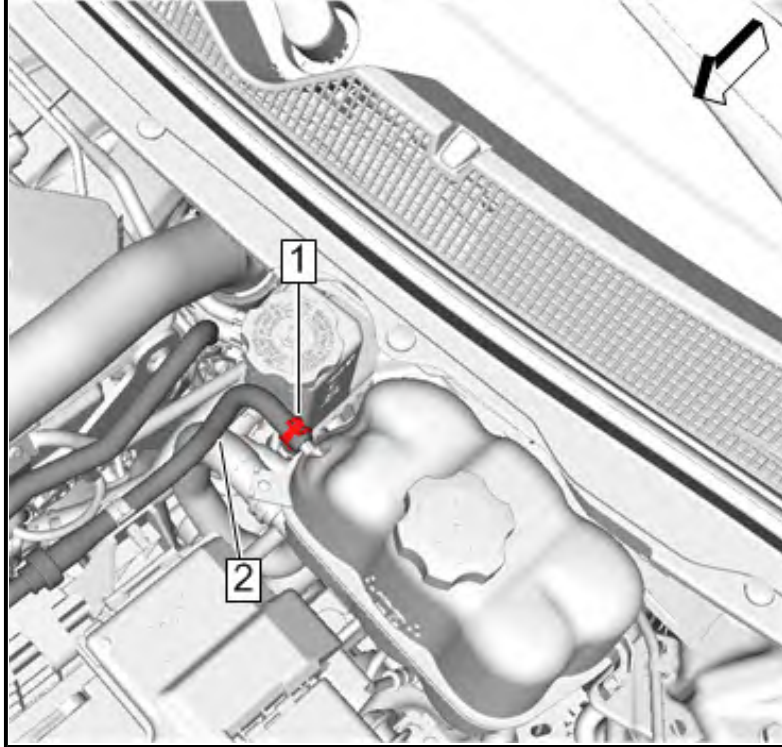
10.



Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank Outlet Pipe - Install - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#)

11.

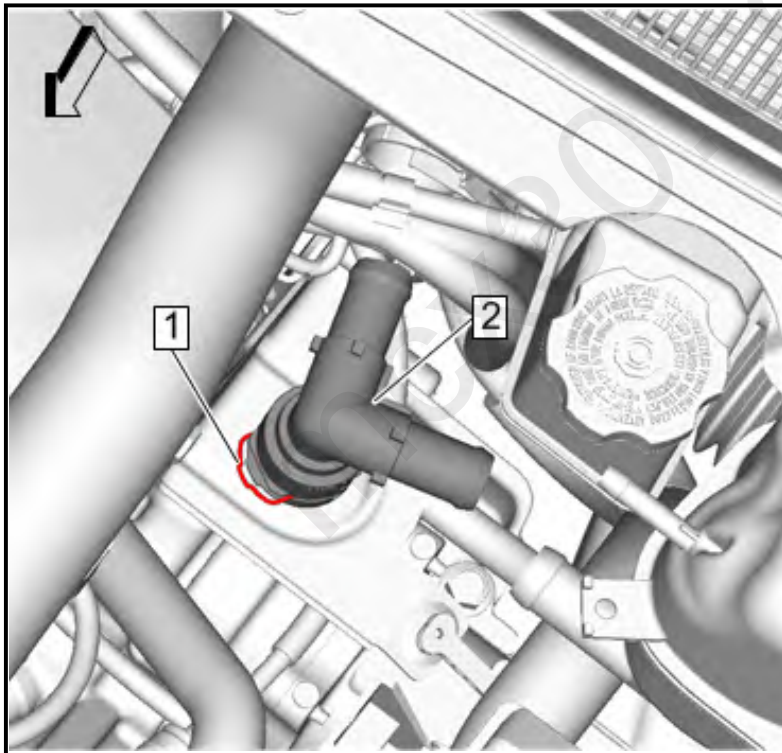




Radiator Surge Tank Overflow Hose (2) @ Radiator Surge Tank - Install - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#)

12. Wiring Harness Retainer @ Heater Inlet Hose Bracket - Install [2x]

13.



Heater Outlet Hose Connector (2) - Install - [Heater Outlet Hose Connector Replacement \(LTG at Heater Inlet Hose Bracket\)](#) [Heater Outlet Hose Connector Replacement \(LTG At Heater Core Outlet Tube\)](#)

14. Intake Manifold Cover - Install - [Intake Manifold Cover Replacement](#)

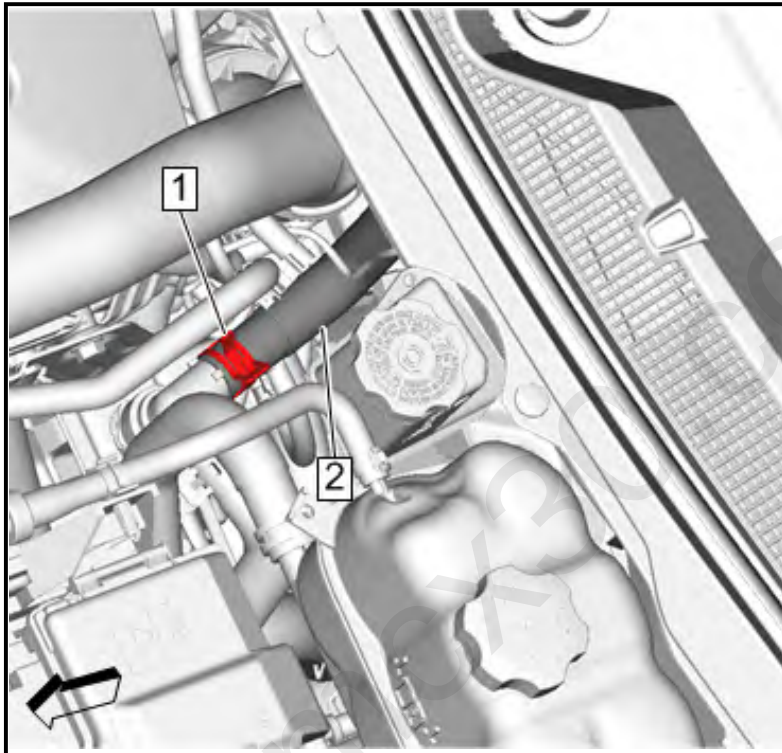
15.





Heater Outlet Hose (2) - Install - [Heater Outlet Hose Replacement \(LTG Radiator Surge Tank to Heater Outlet Hose Connector\)](#).

16.

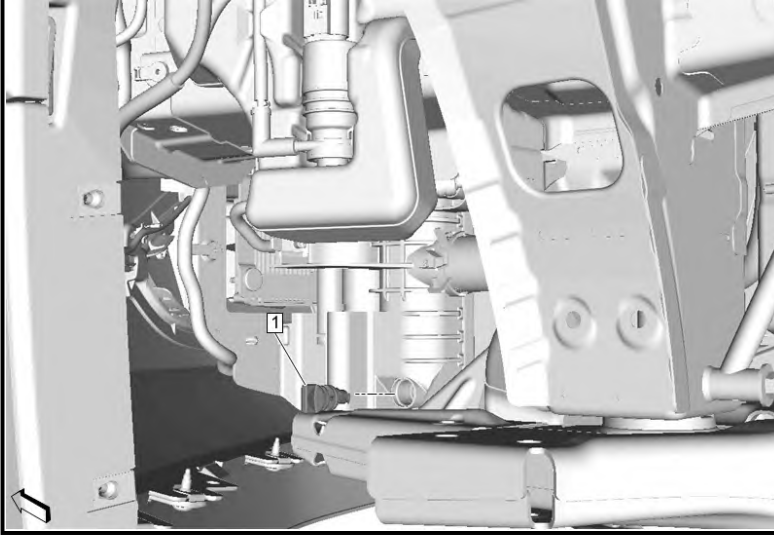


Heater Coolant Heater Air Supply Hose (2) @ Heater Outlet Hose Connector - Install - [Heater Coolant Heater Air Supply Hose Replacement \(LTG\)](#).

17. Heater Vent Hose - Install - [Heater Vent Hose Replacement \(LTG Water Outlet to Heater Outlet Hose Connector\)](#).
18. Reposition the wiring harness.
19. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static Fill\)](#).
20. Start the engine and inspect for leaks.

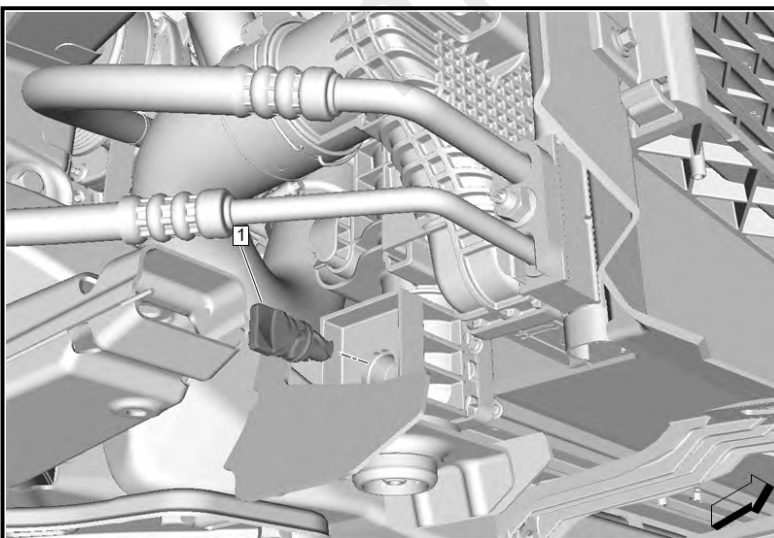
RADIATOR DRAIN COCK REPLACEMENT (LFY)





Callout	Component Name
Preliminary Procedures 1. Front Wheelhouse Liner-Left Side - Remove - Front Wheelhouse Liner Replacement 2. Place a drain pan under the vehicle. 3. Attach a rubber hose to the radiator drain port to guide the coolant into the drain pan.	
1	Radiator Drain Cock CAUTION: Refer to Component Fastener Tightening Caution . Procedures 1. Remove the drain pan. 2. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill) 3. Start the engine and check for coolant leaks.

RADIATOR DRAIN COCK REPLACEMENT (LTG)



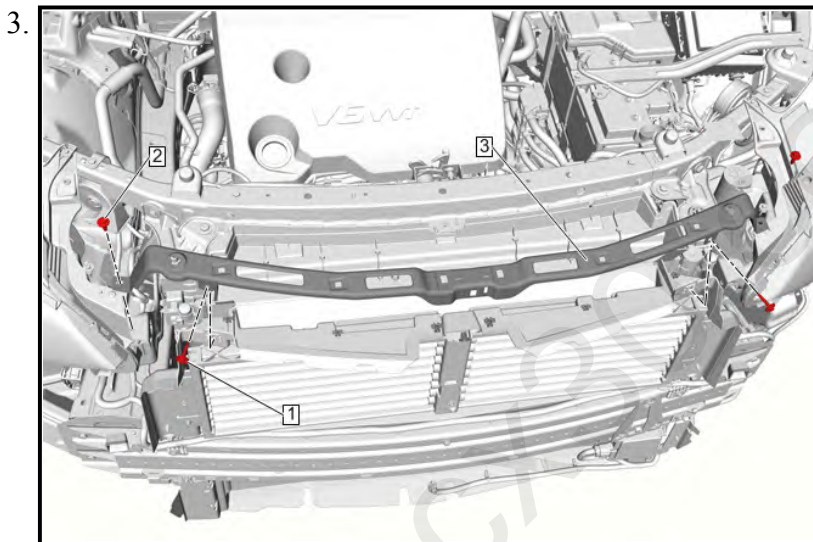
Callout	Component Name
Preliminary Procedures 1. Place a drain pan under the vehicle. 2. Attach a rubber hose to the radiator drain port to guide the coolant into the drain pan.	

Callout	Component Name
1	Radiator Drain Cock CAUTION: Refer to Component Fastener Tightening Caution . Procedures 1. Remove the drain pan. 2. Fill the cooling system to the proper level. Cooling System Draining and Filling (GE 47716)Cooling System Draining and Filling (Static Fill). 3. Start the engine and check for coolant leaks.

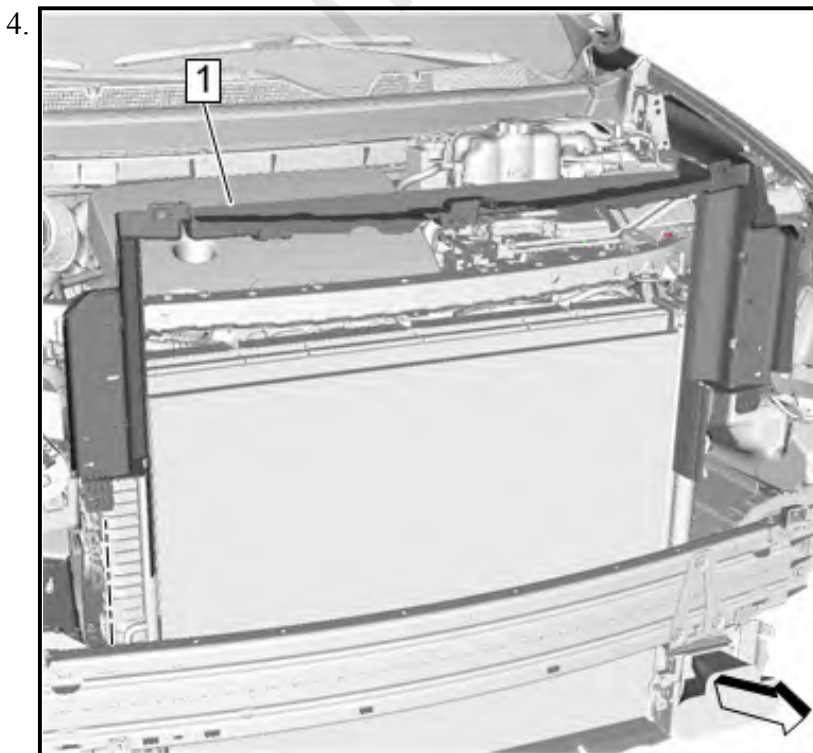
ENGINE COOLANT FAN MODULE RADIATOR ASSEMBLY REMOVAL AND INSTALLATION (LFY WITH V08)

Removal Procedure

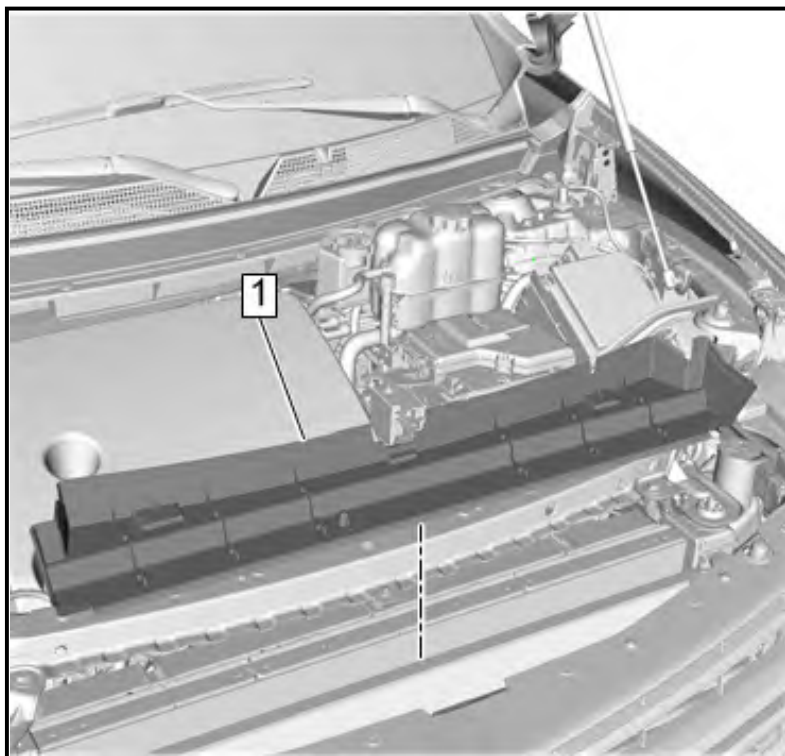
1. Intake Air Splash Shield - Remove - [Intake Air Splash Shield Replacement](#)
2. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)



Front Bumper Fascia Center Support (3) - Remove - [Front Bumper Fascia Center Support Replacement](#)

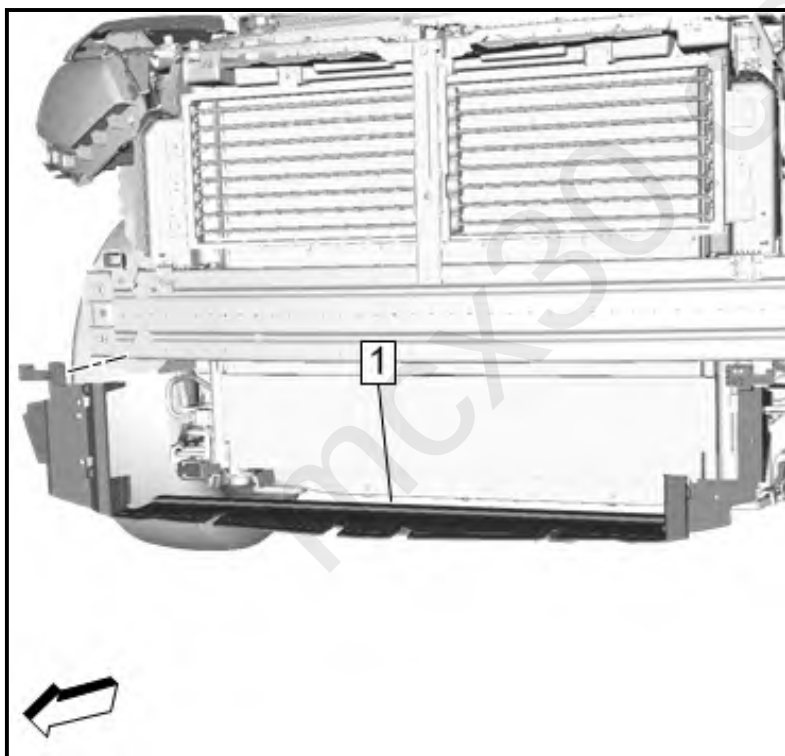


5.



Radiator Air Baffle (1) - Remove - [Radiator Air Baffle Replacement](#)

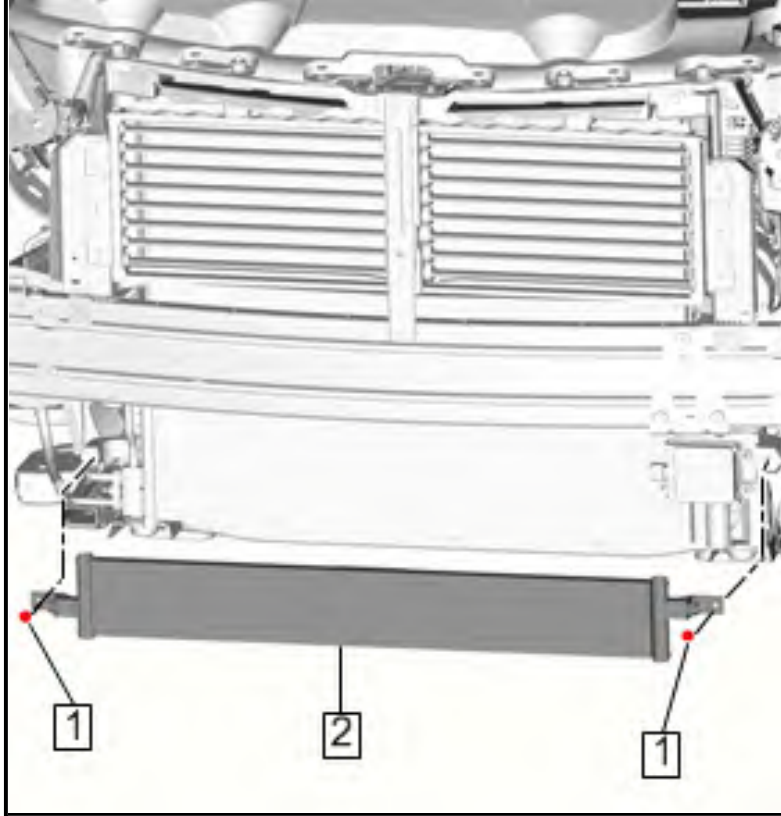
6.



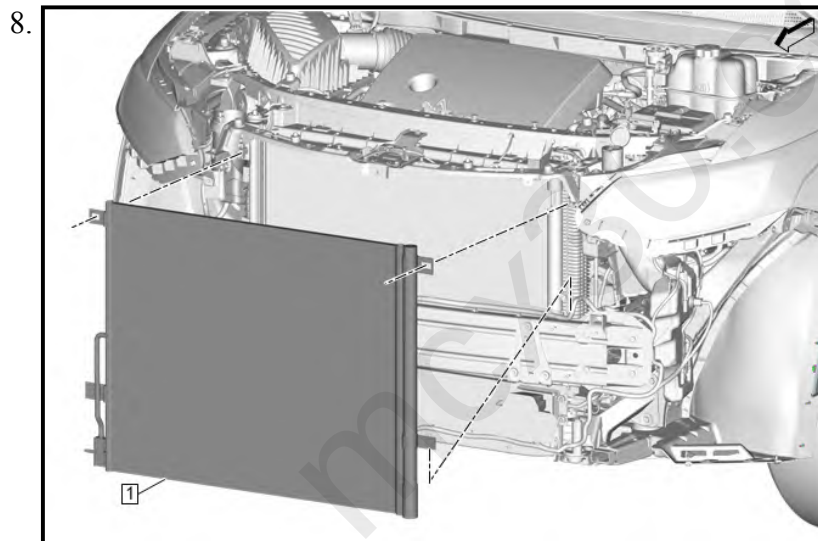
Radiator Air Lower Baffle (1) - Remove - [Radiator Air Lower Baffle Replacement \(LFY with V08\)](#)

7.





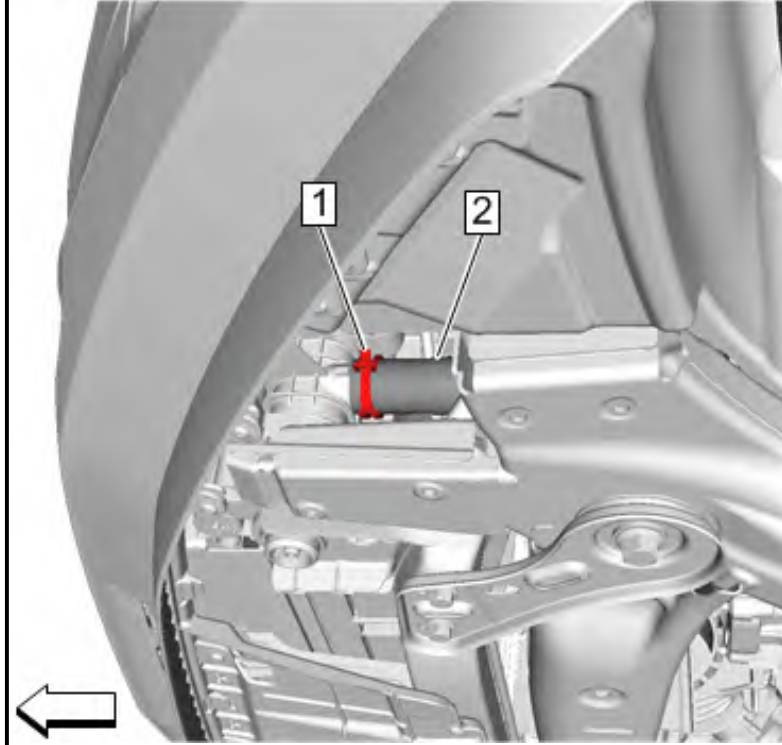
Transmission Fluid Auxiliary Cooler (2) - Remove - [Transmission Fluid Auxiliary Cooler Replacement \(LFY\)](#)



Air Conditioning Condenser (1) - Remove - [Air Conditioning Condenser Replacement \(LFY\)](#)

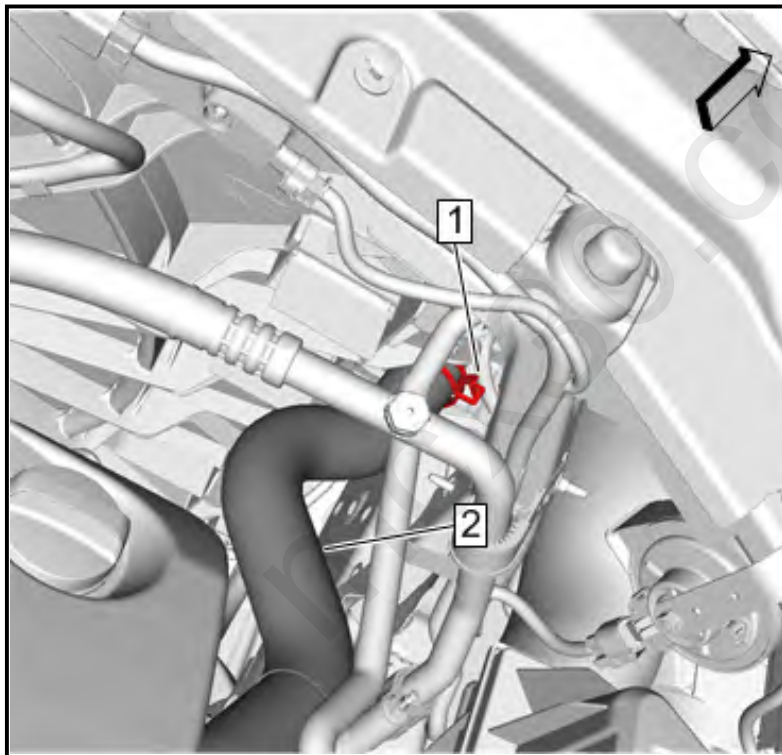
9. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)





Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LFY\)](#).

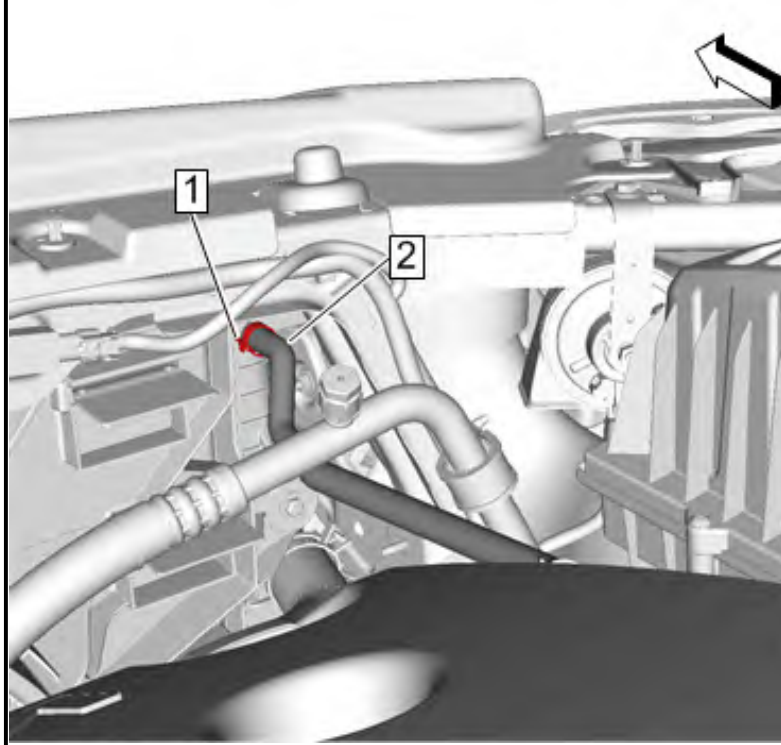
11.



Radiator Inlet Hose (2) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LFY\)](#).

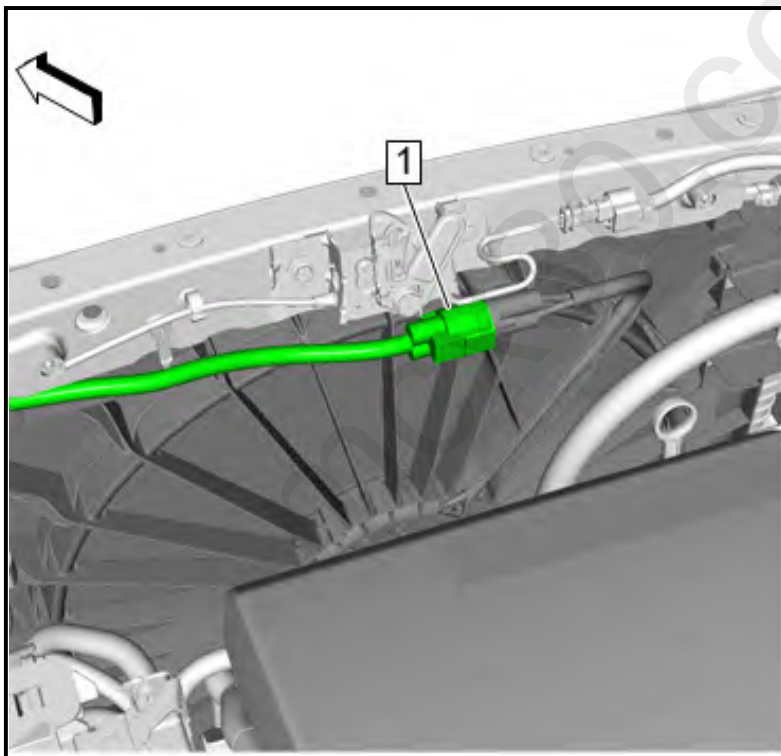
12.





Radiator Surge Tank Overflow Hose (2) @ Radiator - Remove - **Radiator Surge Tank Overflow Hose Replacement (LFY Radiator Surge Tank to Engine Coolant Air Bleed Pipe) Radiator Surge Tank Overflow Hose Replacement (LFY Engine Coolant Air Bleed Pipe to Radiator).**

13.

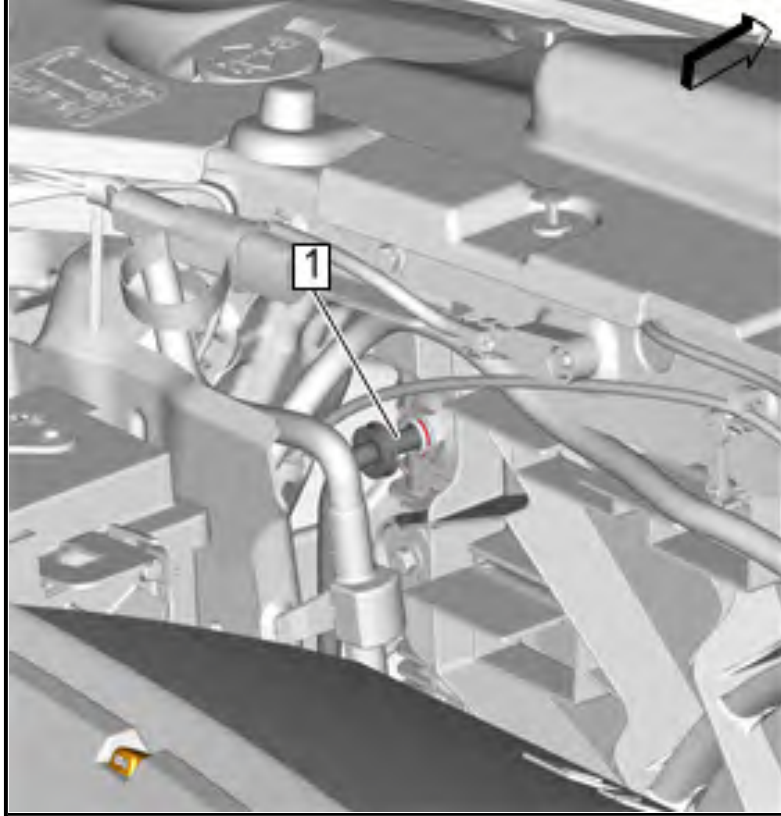


Electrical Connector (1) @ Engine Coolant Fan - Disconnect

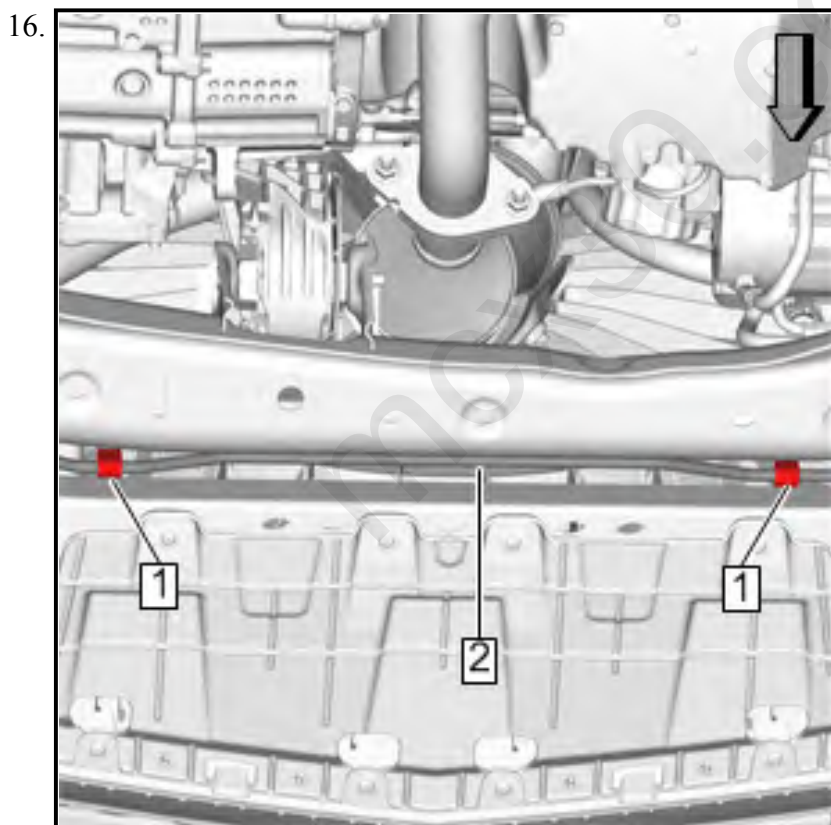
14. Wiring Harness @ Engine Coolant Fan - Disconnect

15.

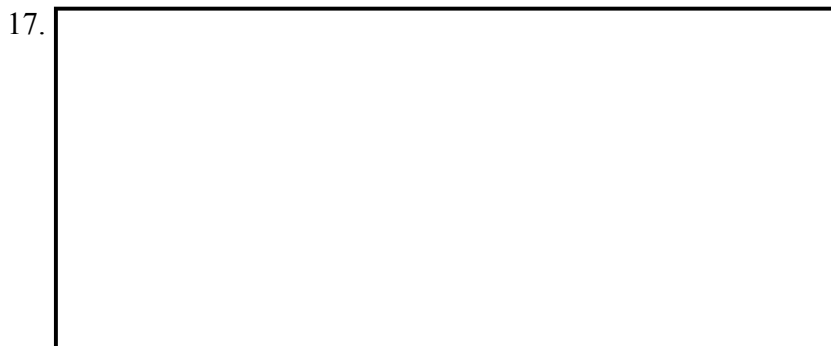


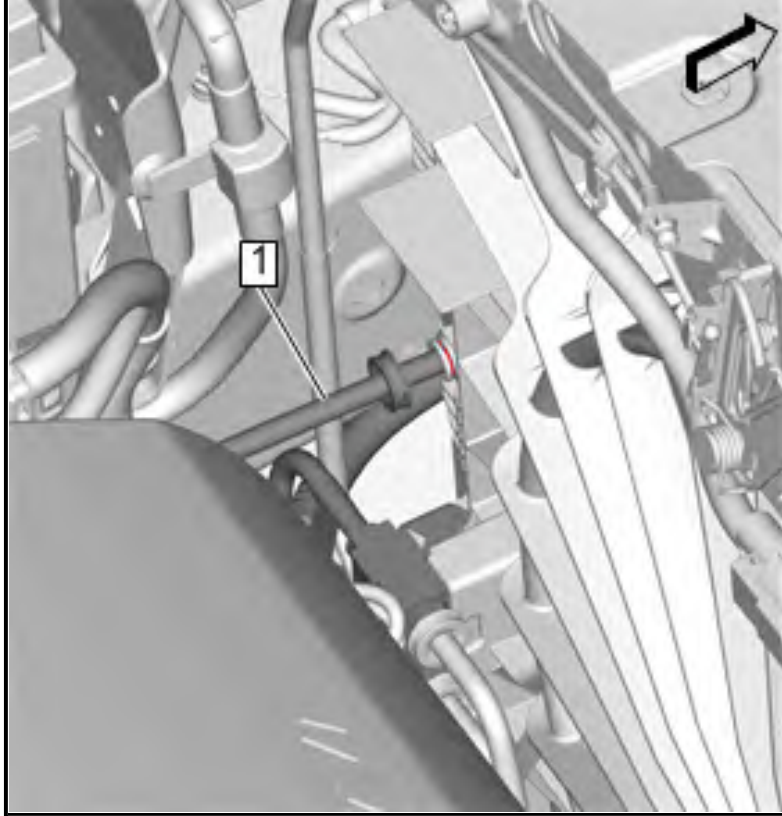


Transmission Fluid Cooler Pipe (1) @ Radiator - Remove - [Transmission Fluid Cooler Pipe Replacement \(with V08\)](#)



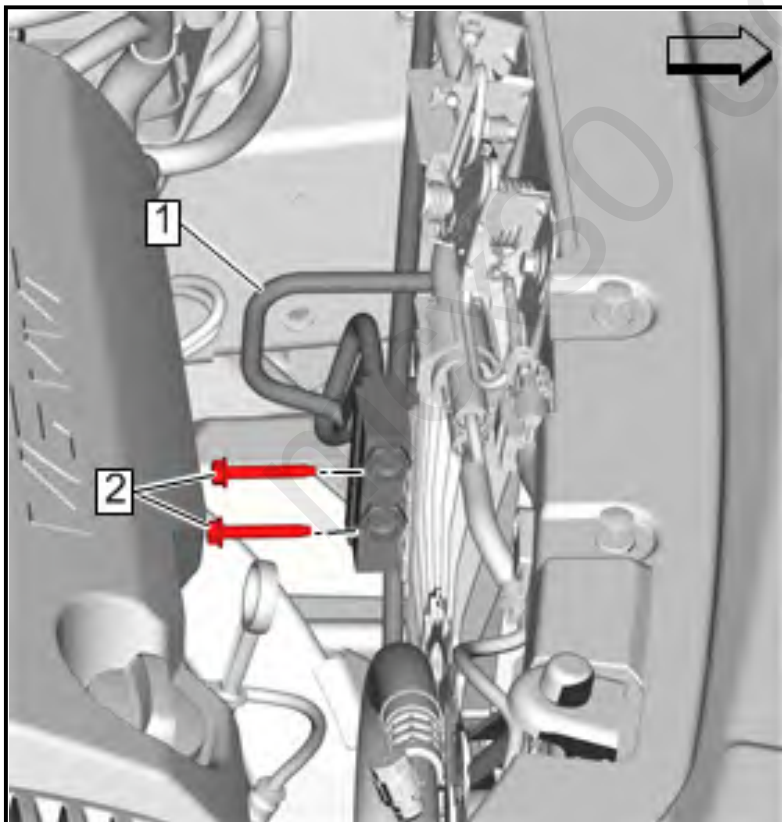
Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan - Remove [2x] - [Transmission Fluid Cooler Pipe Replacement \(with V08\)](#)





Transmission Fluid Cooler Thermal Bypass Valve (1) @ Radiator - Remove - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LFY\)](#)

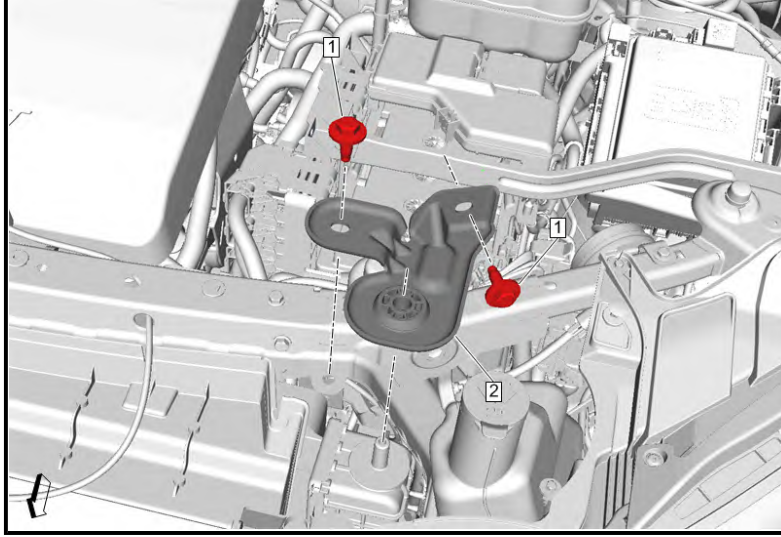
18.



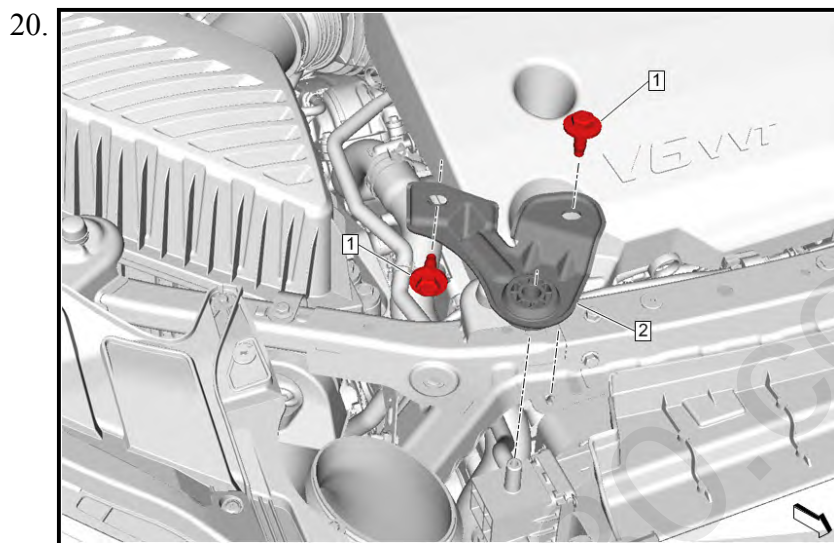
Transmission Fluid Cooler Thermal Bypass Valve (1) @ Engine Coolant Fan - Remove - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LFY\)](#)

19.

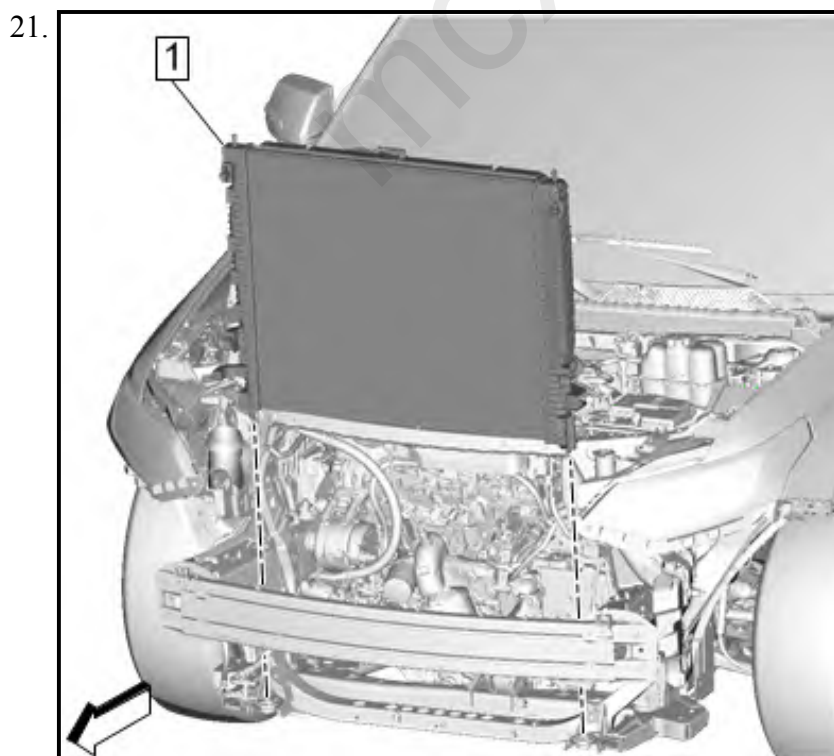




Radiator Upper Bracket-Left Side (2) - Remove - [Radiator Upper Bracket Replacement - Left Side \(LFY\)](#)

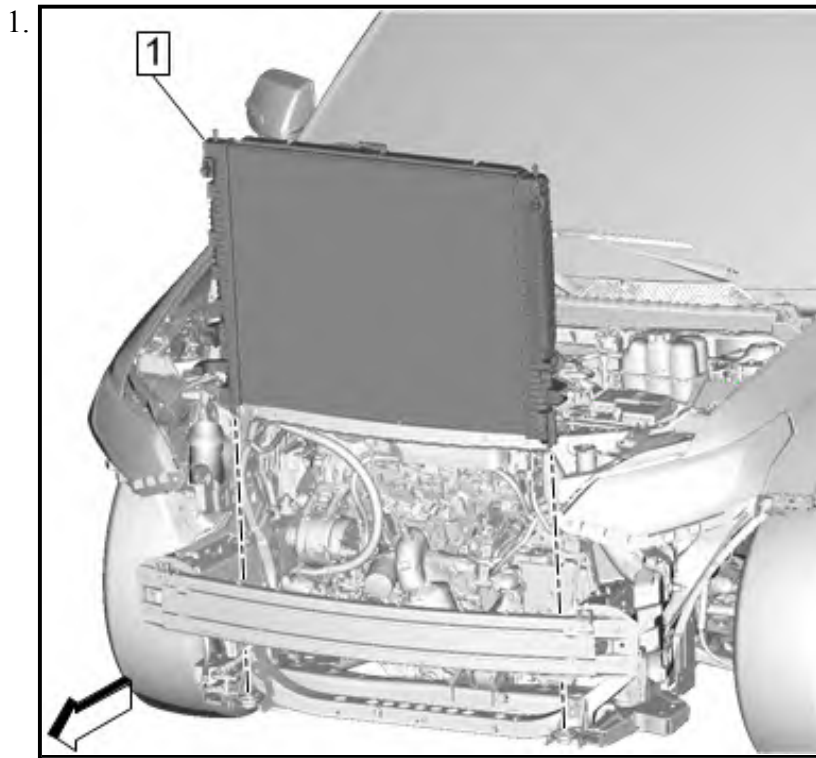


Radiator Upper Bracket-Right Side (2) - Remove - [Radiator Upper Bracket Replacement - Right Side \(LFY\)](#)

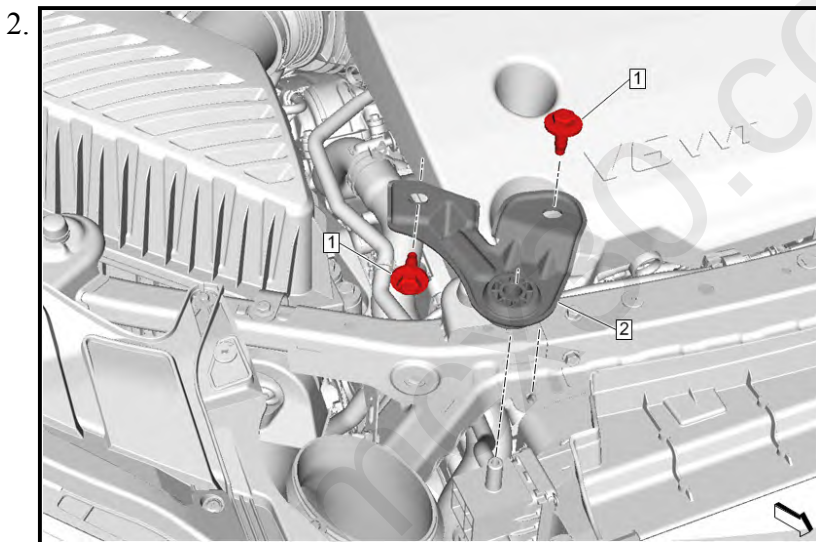


Engine Coolant Fan Module Radiator (1) - Remove

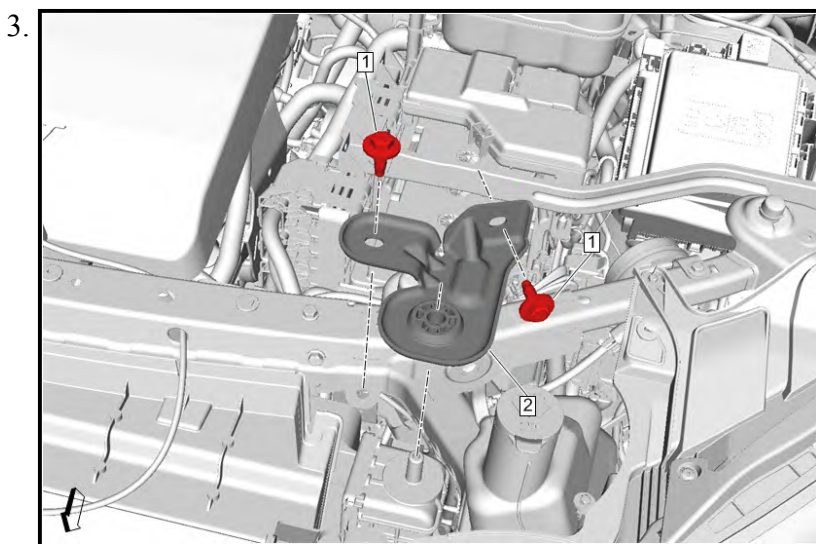
22. Transfer components as necessary.



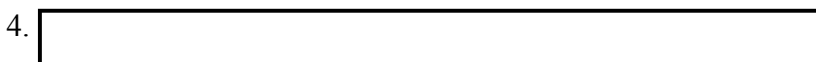
Engine Coolant Fan Module Radiator (1) - Install

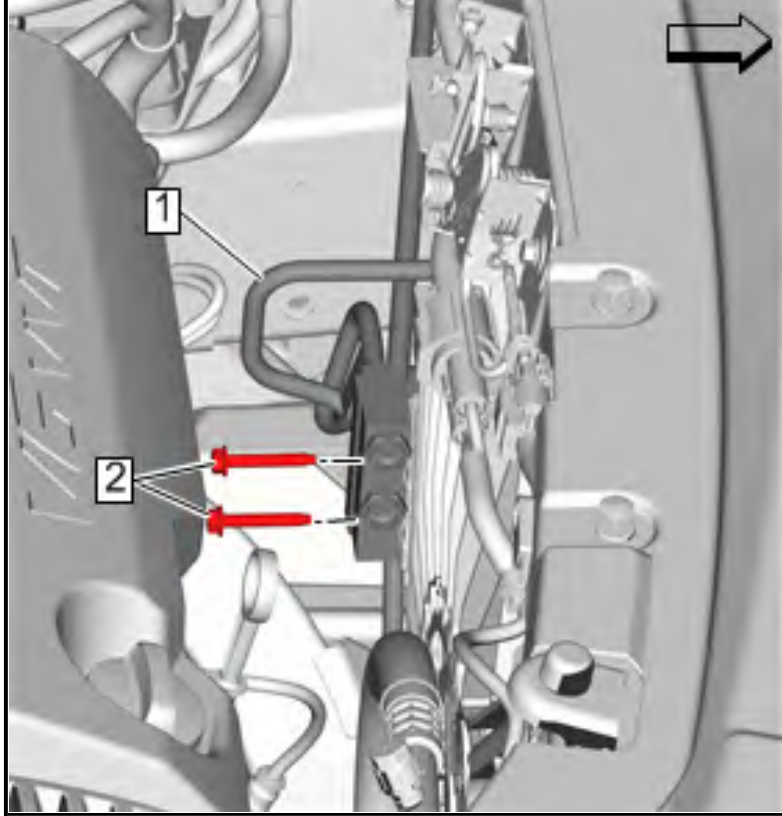


Radiator Upper Bracket-Right Side (2) - Install - [Radiator Upper Bracket Replacement - Right Side \(LFY\)](#)

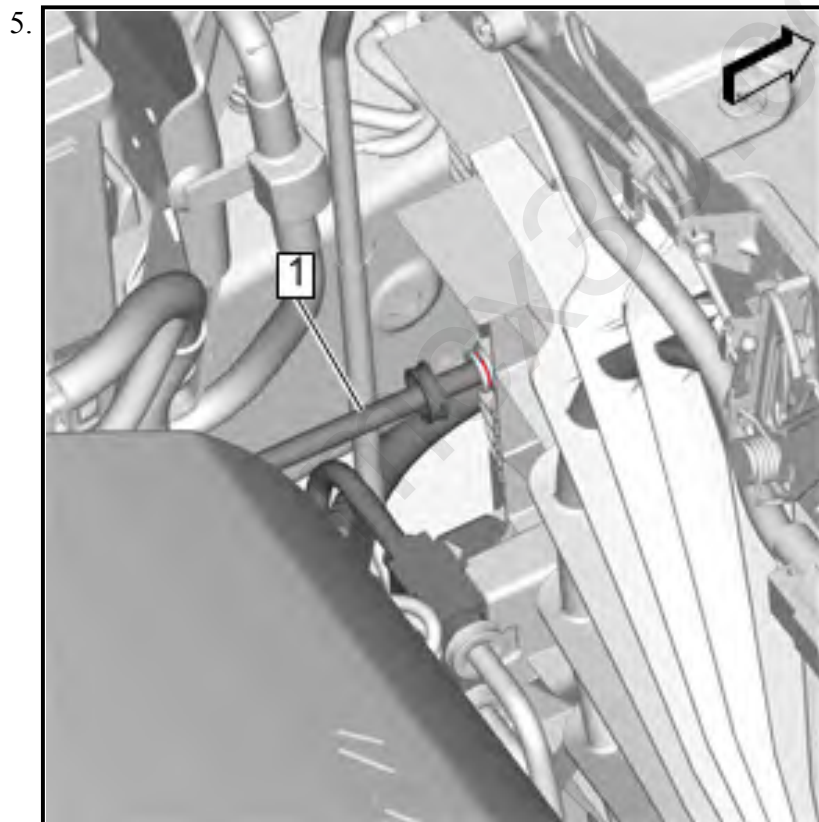


Radiator Upper Bracket-Left Side (2) - Install - [Radiator Upper Bracket Replacement - Left Side \(LFY\)](#)

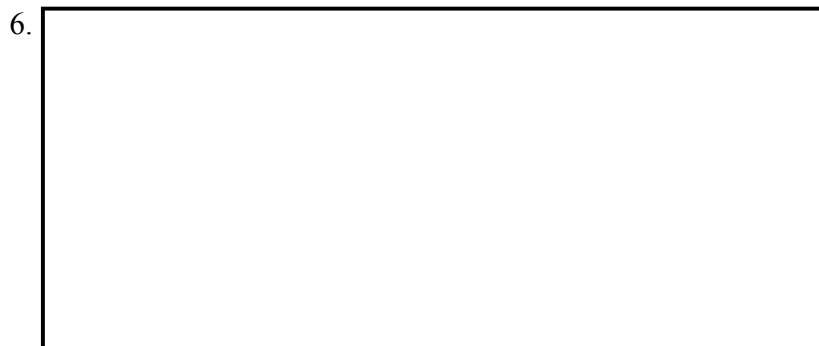


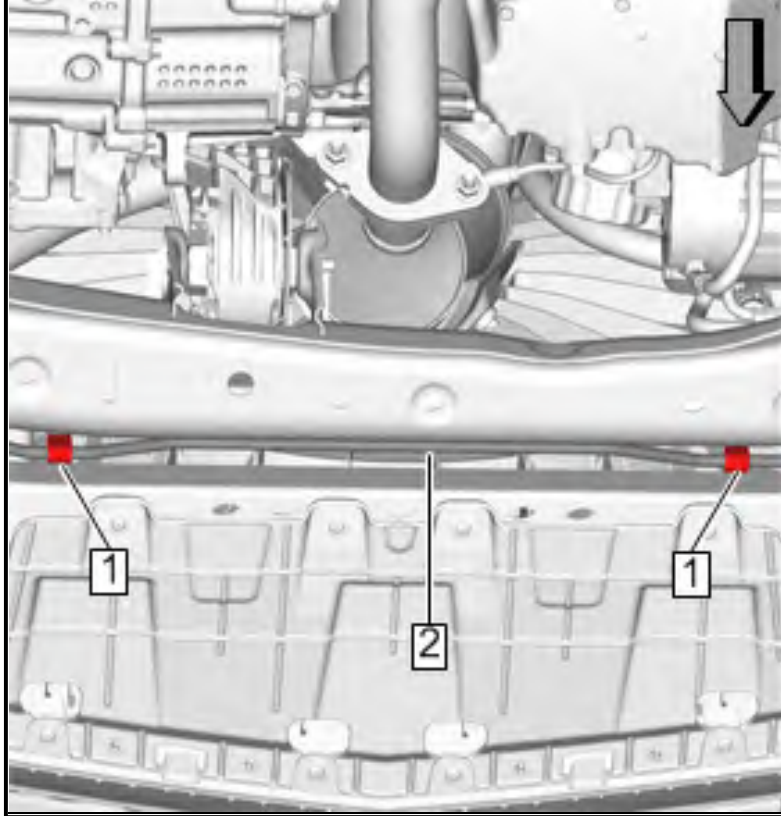


Transmission Fluid Cooler Thermal Bypass Valve @ Engine Coolant Fan (1) - Install - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LFY\)](#)



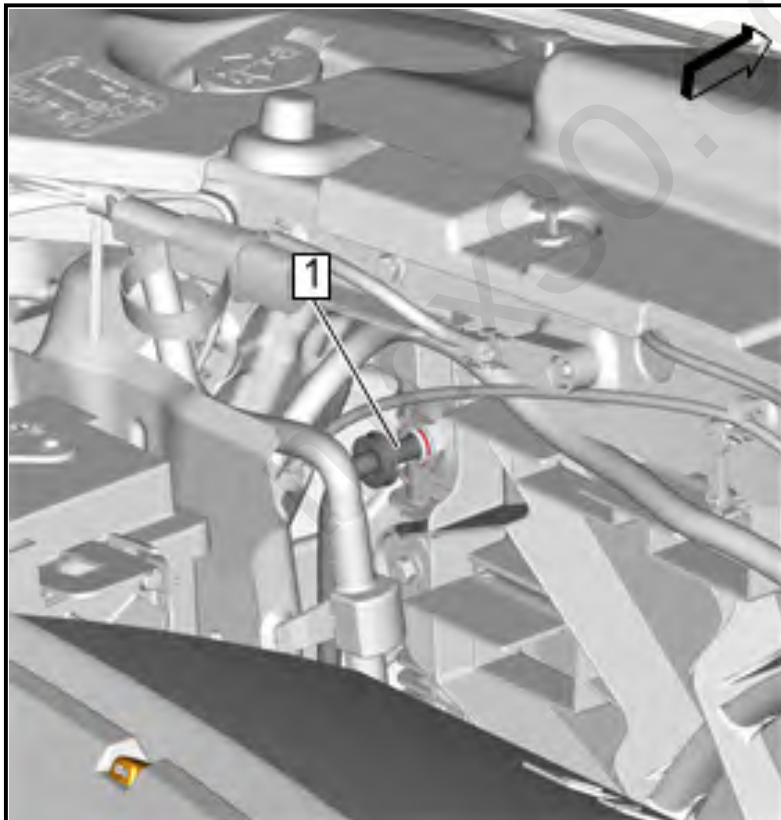
Transmission Fluid Cooler Thermal Bypass Valve (1) @ Radiator - Install - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LFY\)](#)





Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan - Install [2x] - [Transmission Fluid Cooler Pipe Replacement \(with V08\)](#)

7.

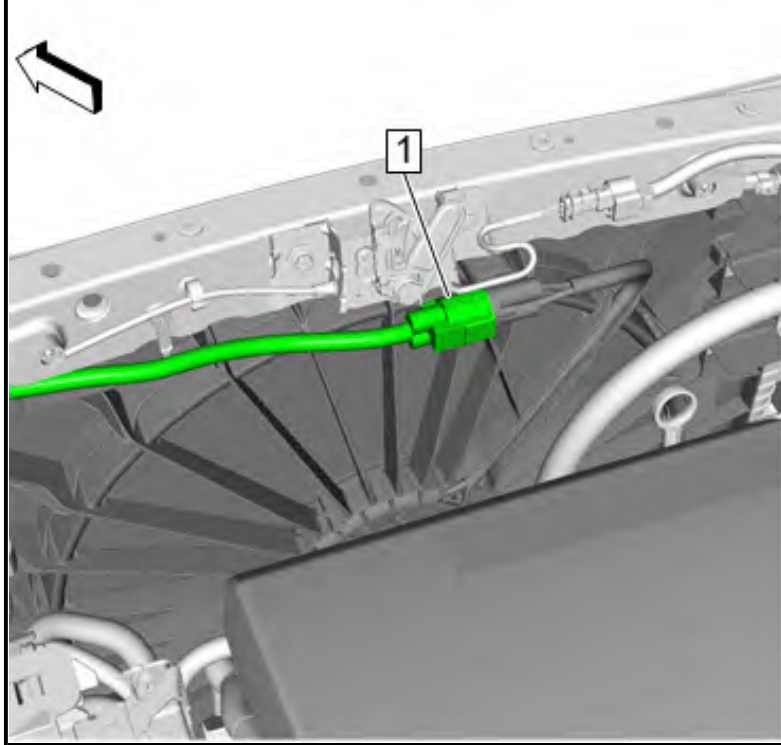


Transmission Fluid Cooler Pipe (1) @ Radiator - Install - [Transmission Fluid Cooler Pipe Replacement \(with V08\)](#)

8. Wiring Harness @ Engine Coolant Fan - Connect

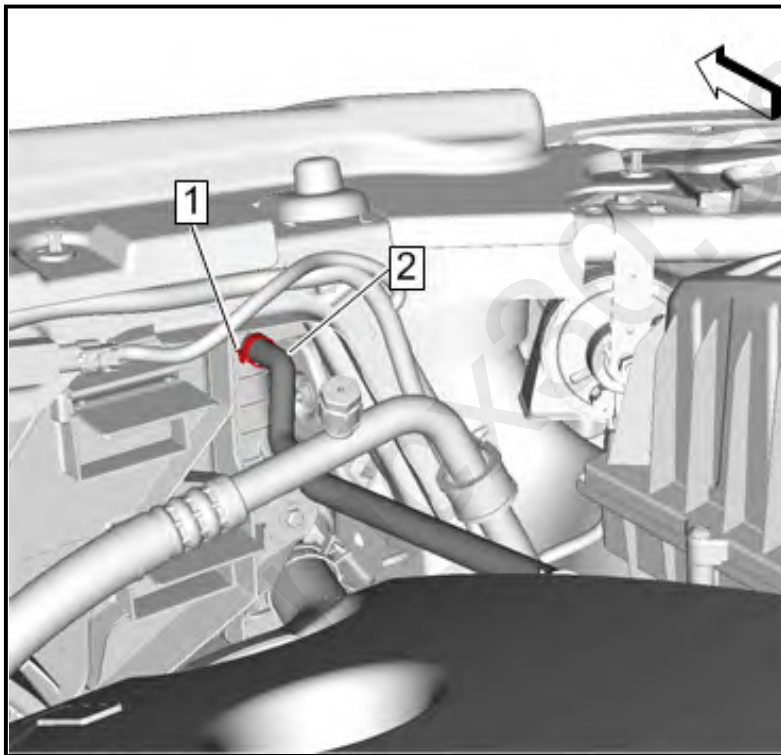
9.





Electrical Connector (1) @ Engine Coolant Fan - Connect

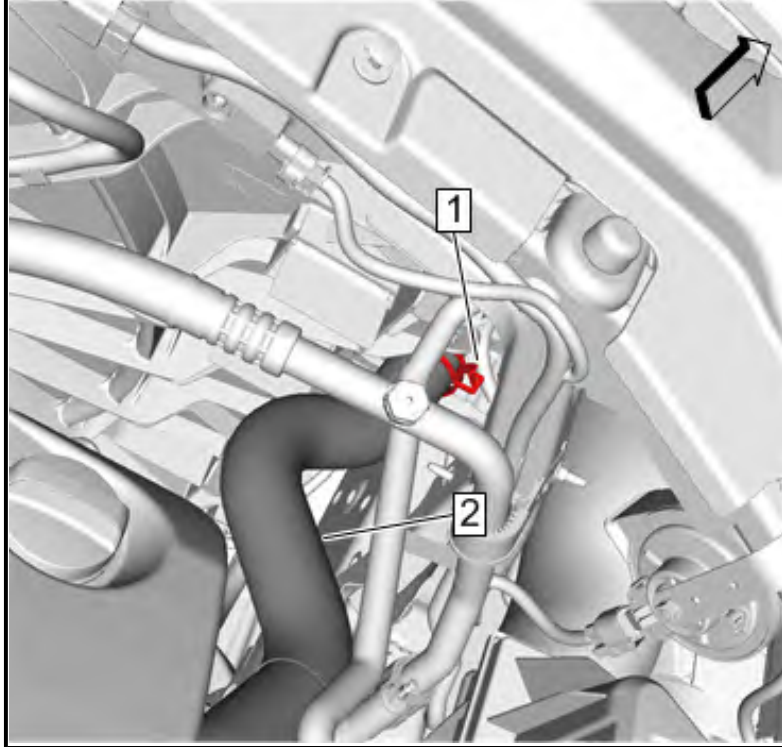
10.



Radiator Surge Tank Overflow Hose (2) @ Radiator - Install - **Radiator Surge Tank Overflow Hose Replacement (LFY Radiator Surge Tank to Engine Coolant Air Bleed Pipe)****Radiator Surge Tank Overflow Hose Replacement (LFY Engine Coolant Air Bleed Pipe to Radiator)**

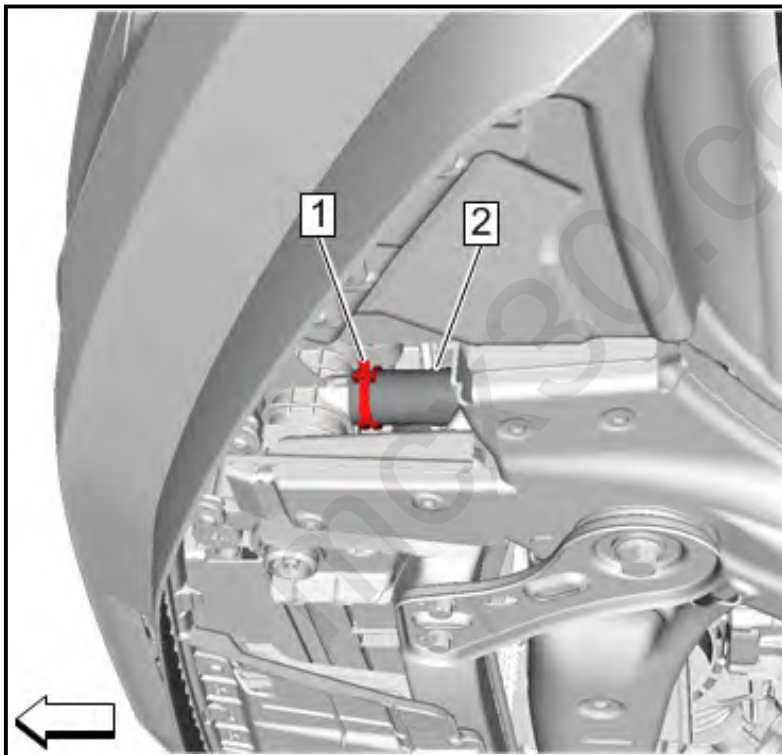
11.





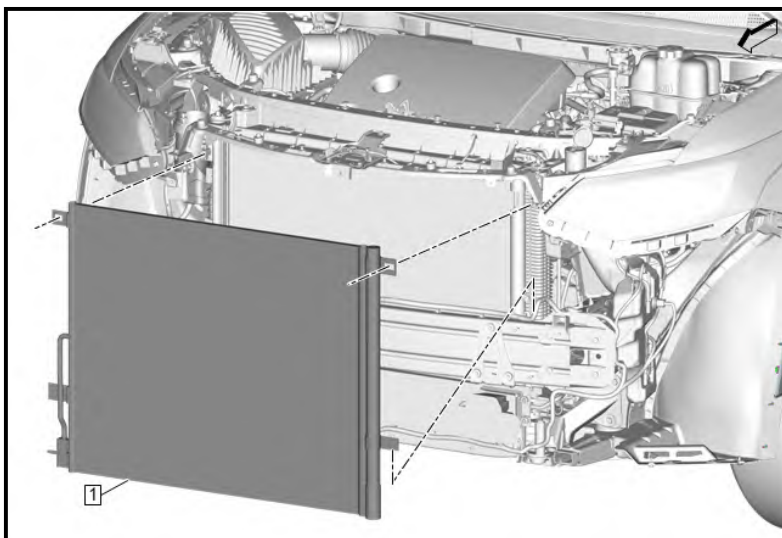
Radiator Inlet Hose (2) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LFY\)](#)

12.

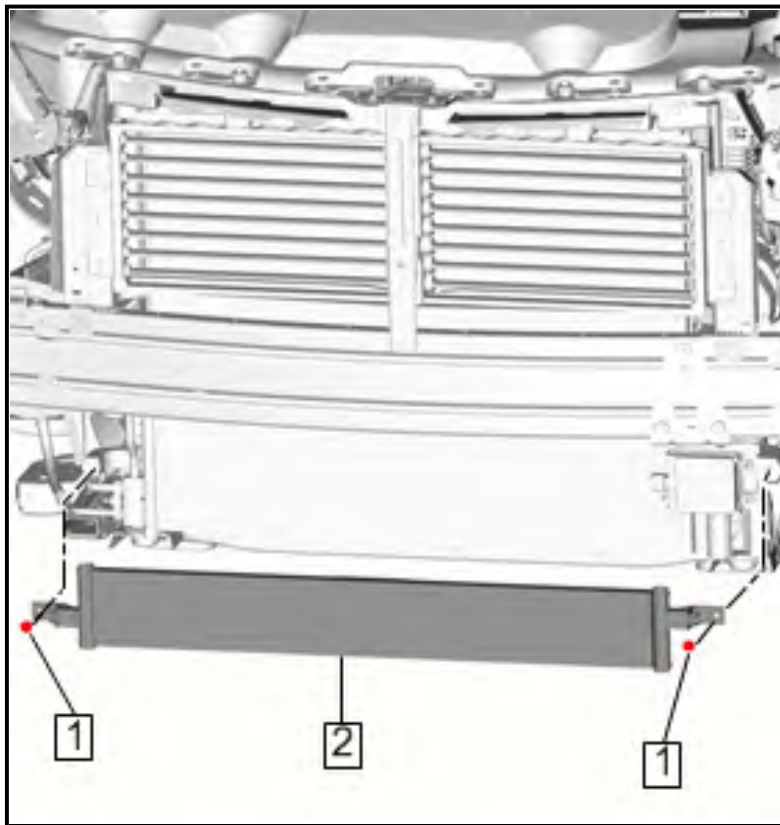


Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LFY\)](#)

13.

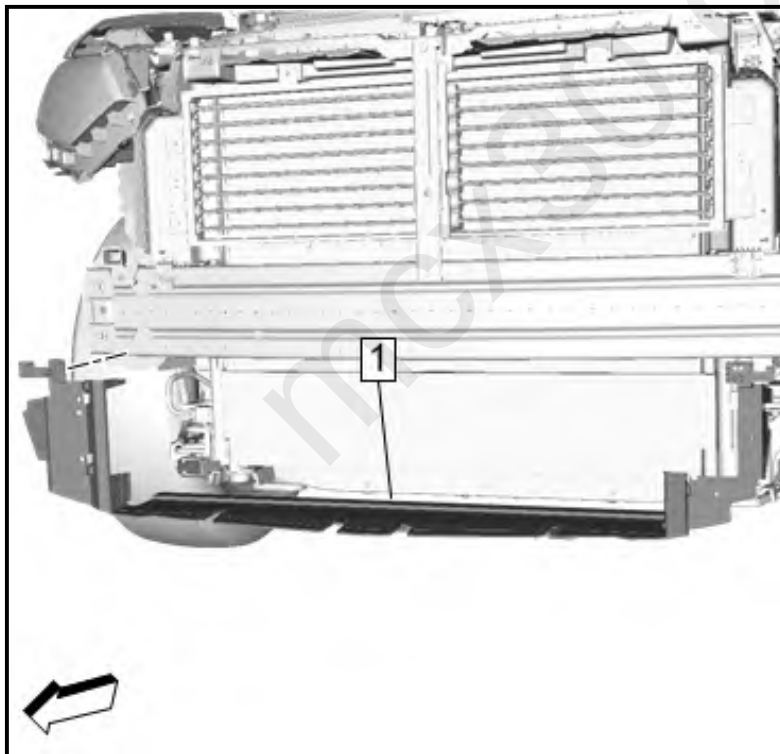


14.



Transmission Fluid Auxiliary Cooler (2) - Install - [Transmission Fluid Auxiliary Cooler Replacement \(LFY\)](#).

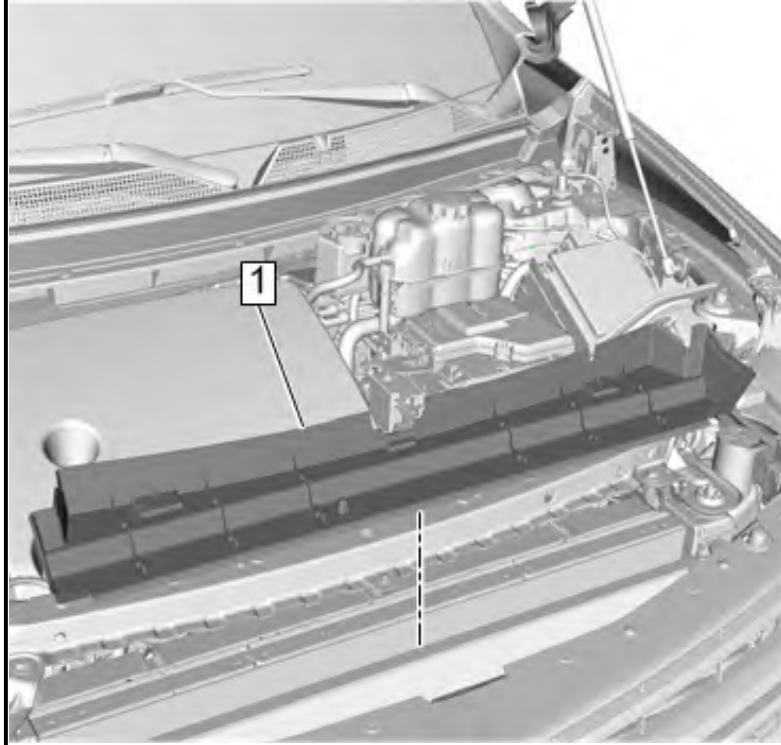
15.



Radiator Air Lower Baffle (1) - Install - [Radiator Air Lower Baffle Replacement \(LFY with V08\)](#).

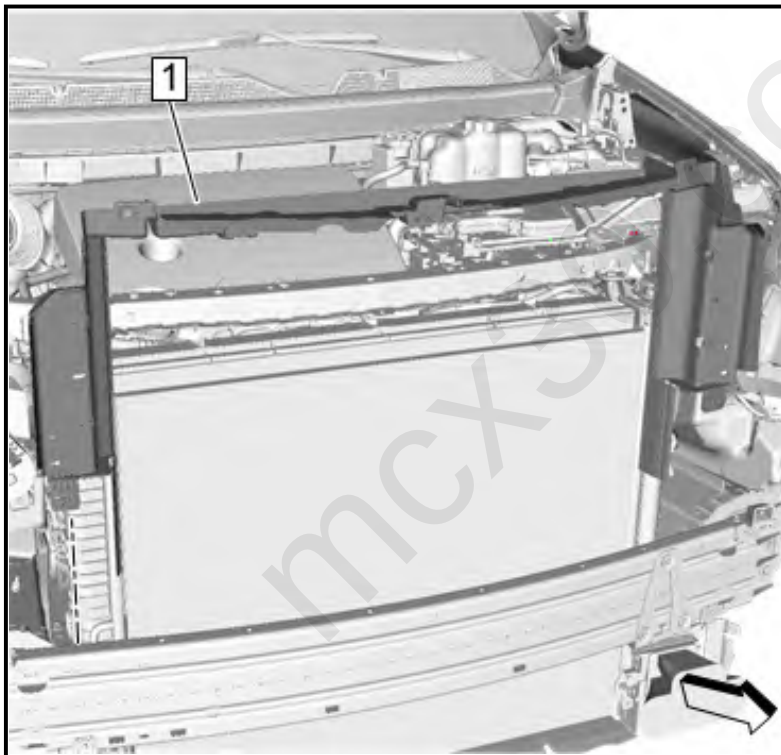
16.





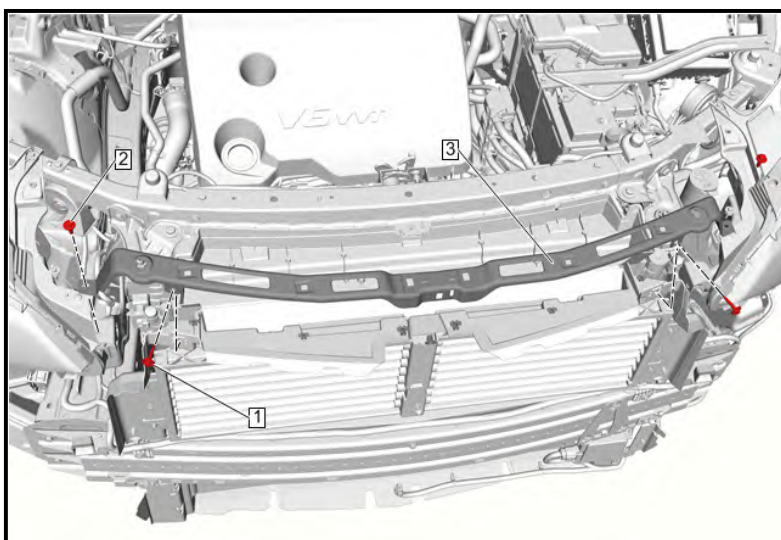
Radiator Air Baffle (1) - Install - [Radiator Air Baffle Replacement](#)

17.



Radiator Air Upper Baffle (1) - Install - [Radiator Air Upper Baffle Replacement](#)

18.



Front Bumper Fascia Center Support (3) - Install - [Front Bumper Fascia Center Support Replacement](#)

19. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

20. Intake Air Splash Shield - Install - [Intake Air Splash Shield Replacement](#)

21. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)

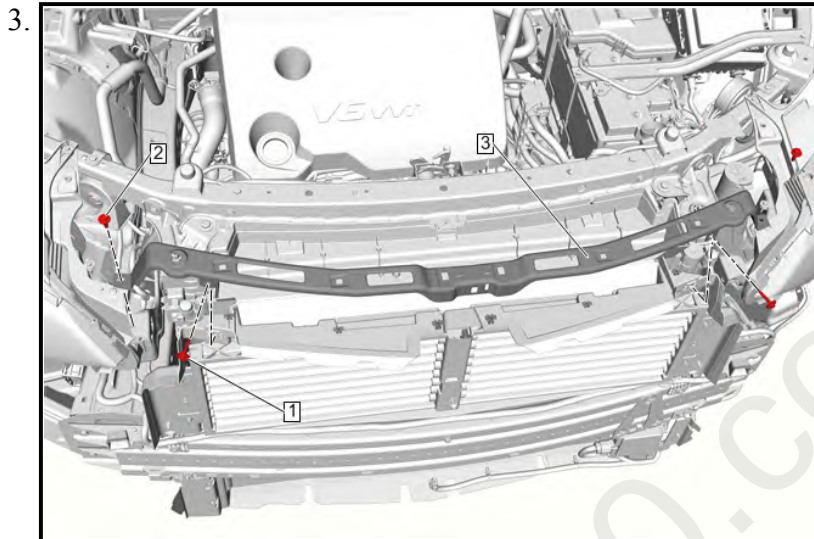
22. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN MODULE RADIATOR ASSEMBLY REMOVAL AND INSTALLATION (LFY WITHOUT V08)

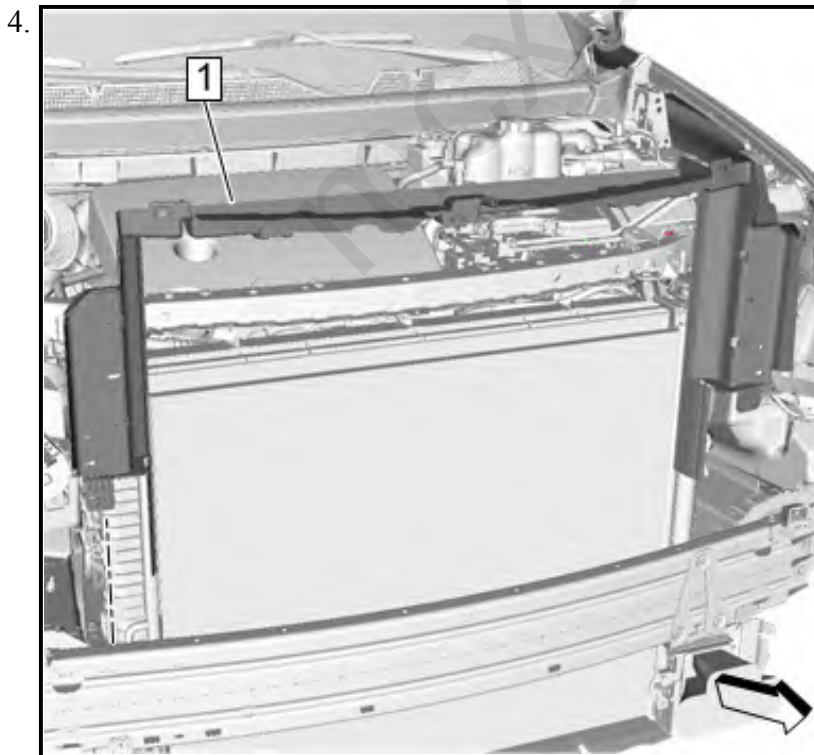
Removal Procedure

1. Intake Air Splash Shield - Remove - [Intake Air Splash Shield Replacement](#)

2. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)

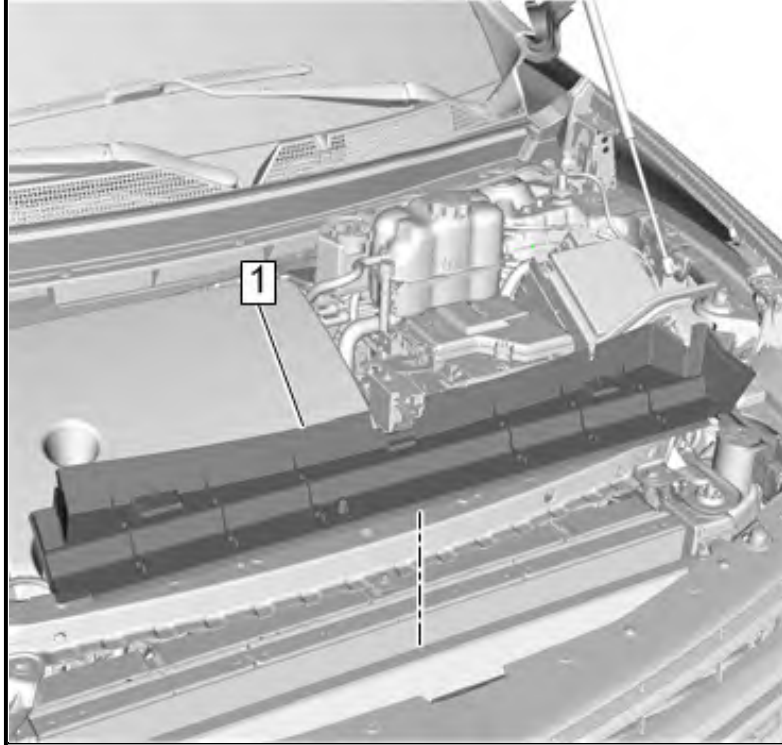


Front Bumper Fascia Center Support (3) - Remove - [Front Bumper Fascia Center Support Replacement](#)

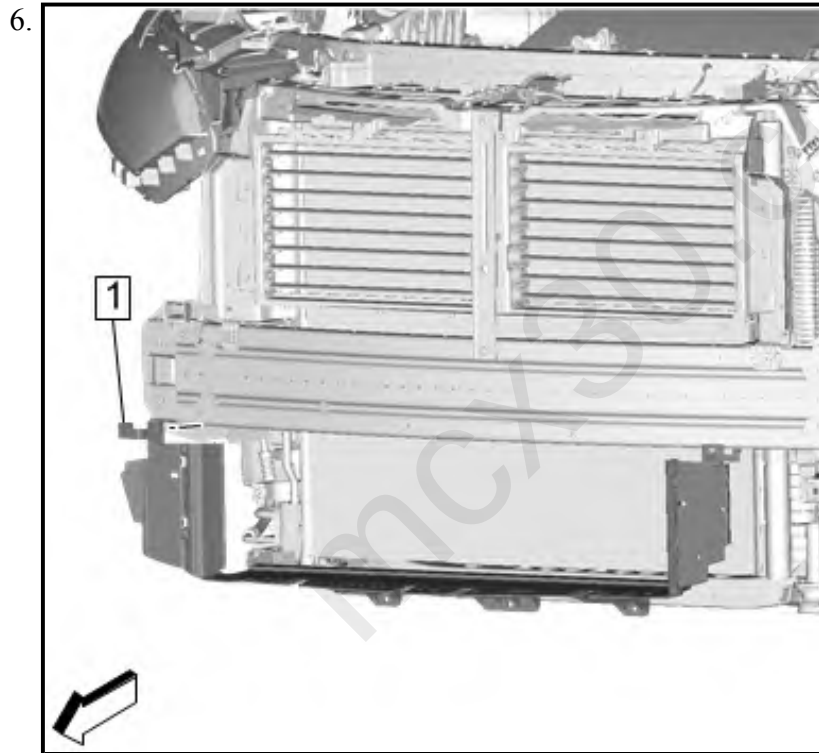


Radiator Air Upper Baffle (1) - Remove - [Radiator Air Upper Baffle Replacement](#)

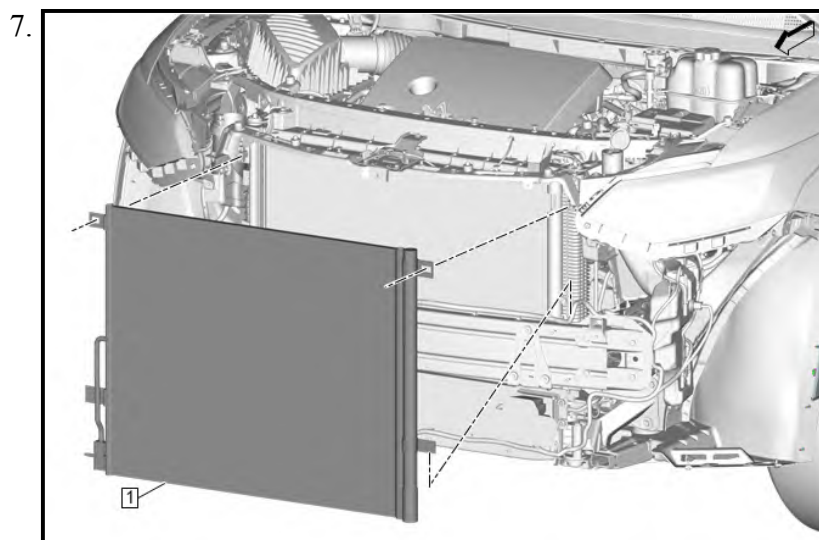




Radiator Air Baffle (1) - Remove - [Radiator Air Baffle Replacement](#)

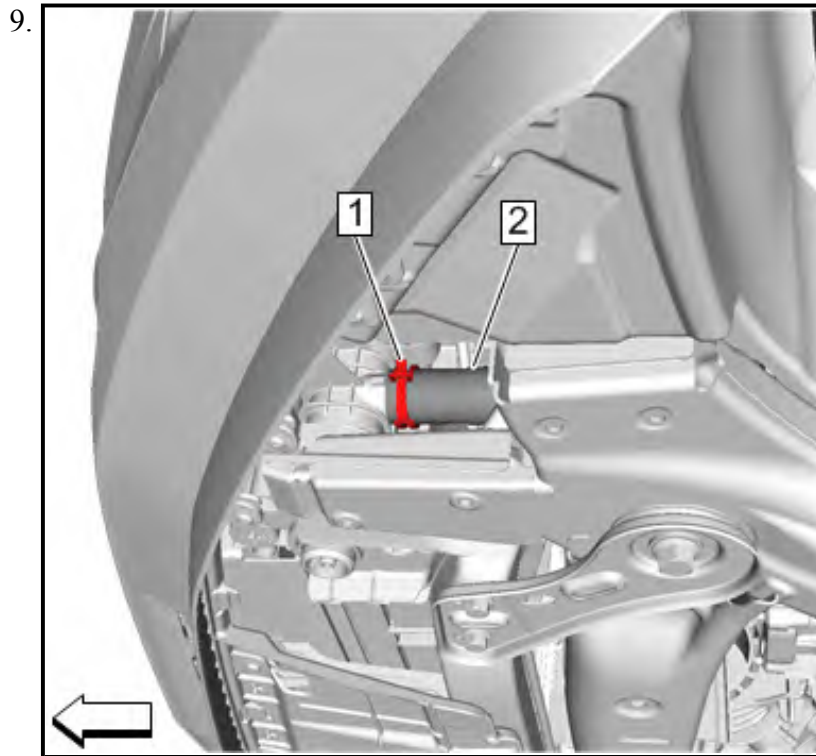


Radiator Air Lower Baffle (1) - Remove - [Radiator Air Lower Baffle Replacement \(LFY without V08\)](#)

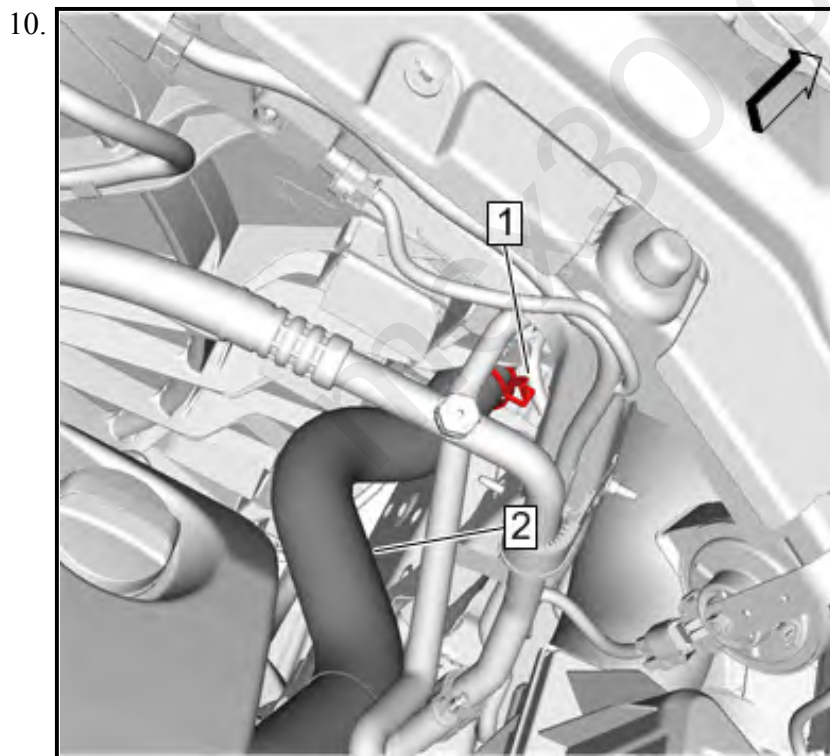


Air Conditioning Condenser (1) - Remove - [Air Conditioning Condenser Replacement \(LFY\)](#).

8. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).

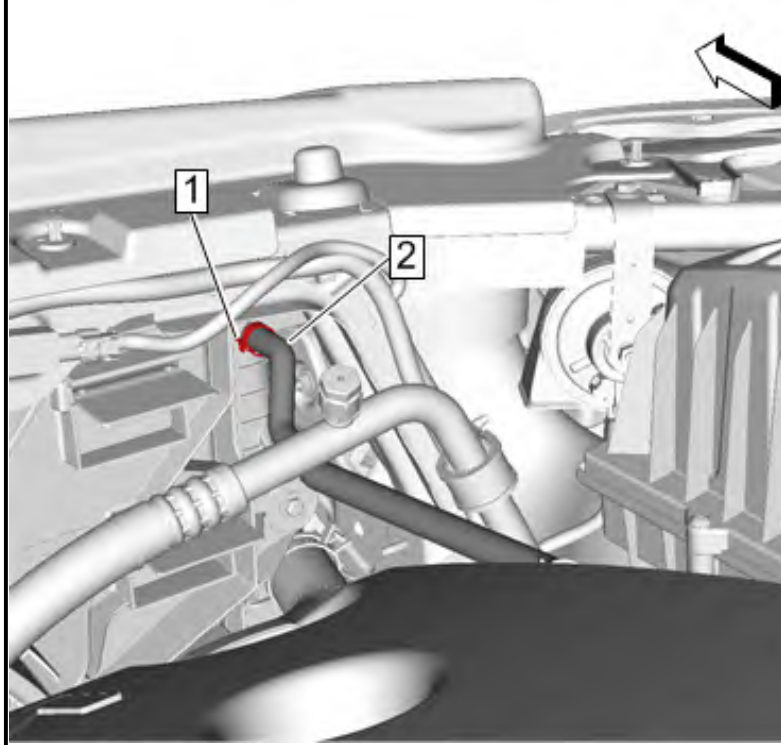


Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LFY\)](#).



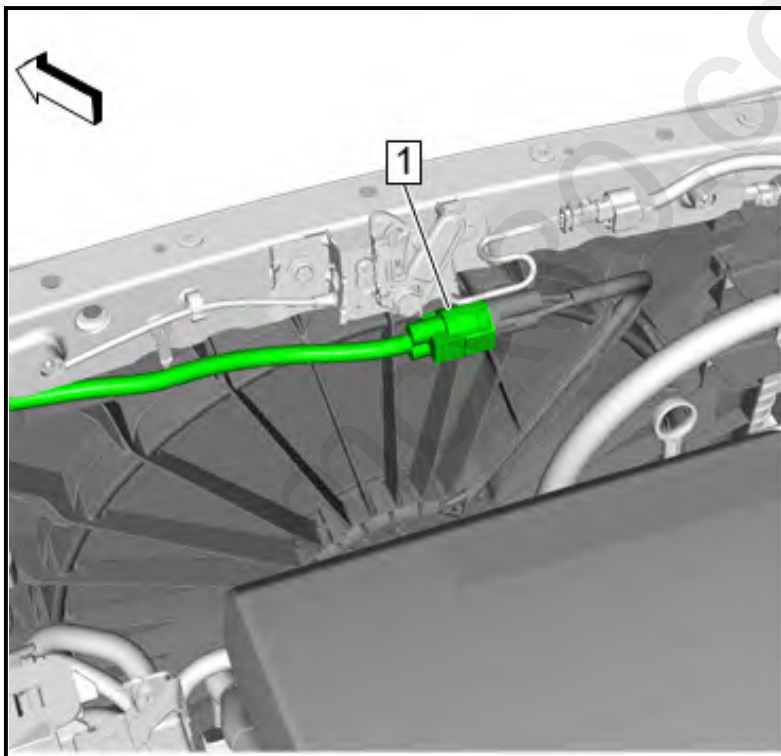
Radiator Inlet Hose (2) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LFY\)](#).





Radiator Surge Tank Overflow Hose (2) @ Radiator - Remove - Radiator Surge Tank Overflow Hose Replacement (LFY Radiator Surge Tank to Engine Coolant Air Bleed Pipe) Radiator Surge Tank Overflow Hose Replacement (LFY Engine Coolant Air Bleed Pipe to Radiator).

12.

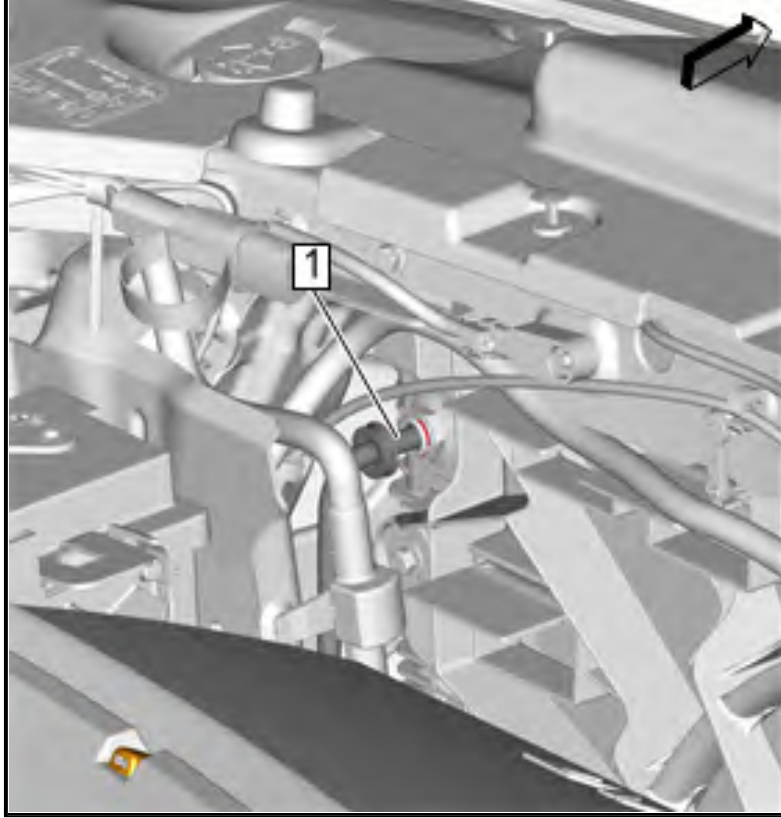


Electrical Connector (1) @ Engine Coolant Fan - Disconnect

13. Wiring Harness @ Engine Coolant Fan - Disconnect

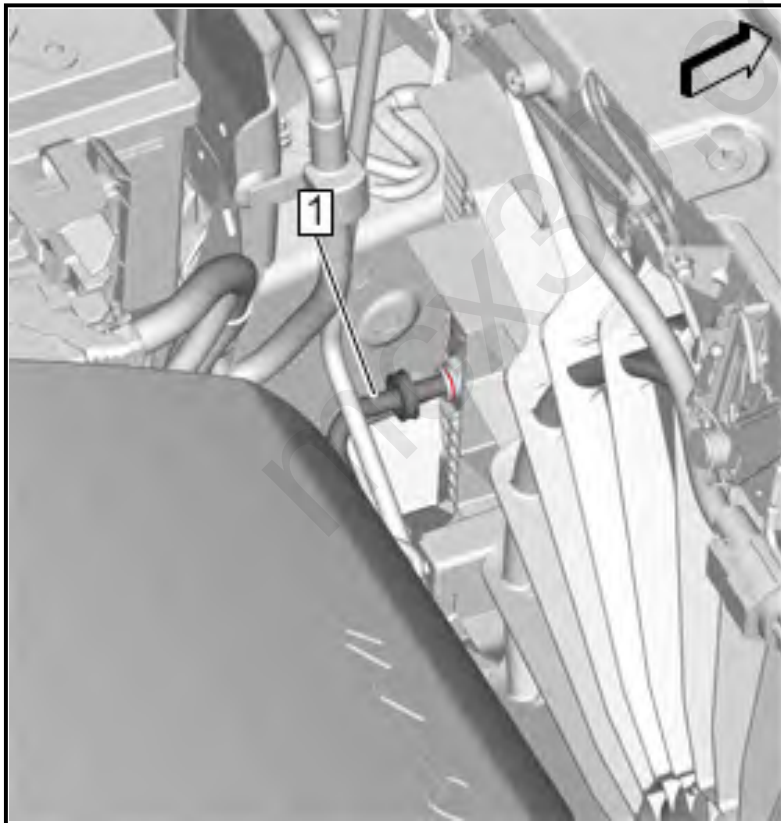
14.





Transmission Fluid Cooler Outlet Pipe (1) @ Radiator - Remove - [Transmission Fluid Cooler Outlet Pipe Replacement \(LFY without V08\)](#)

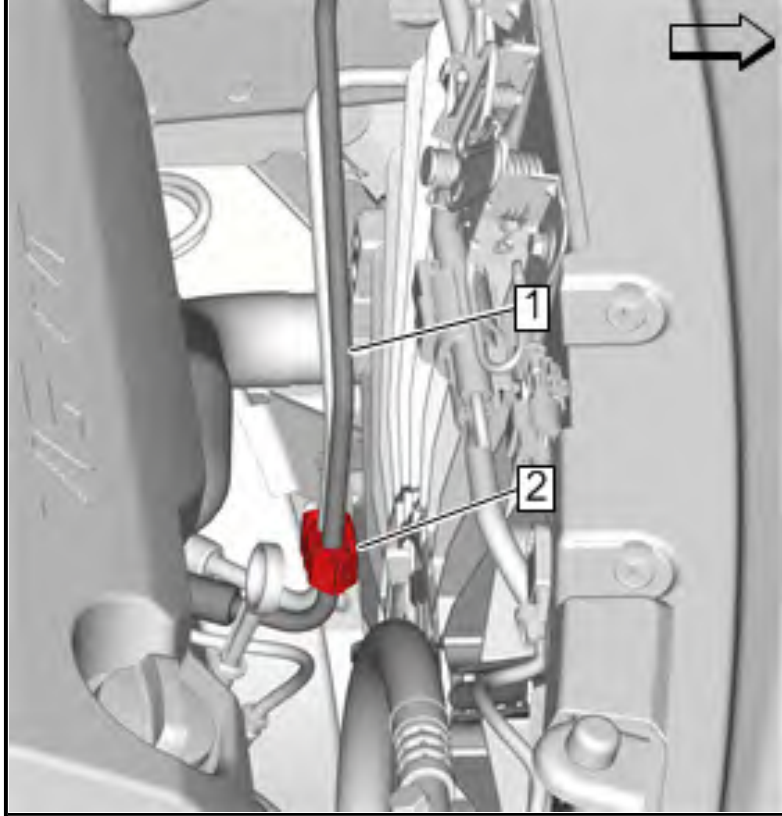
15.



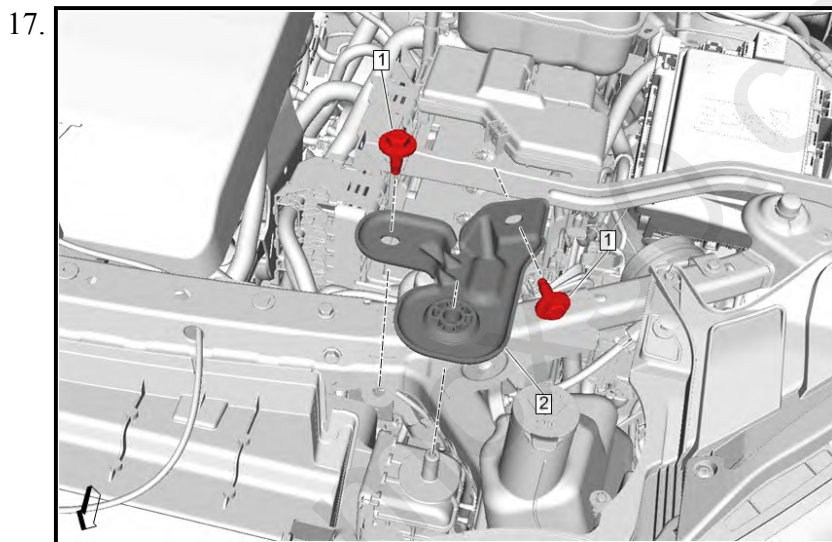
Transmission Fluid Cooler Inlet Pipe (1) @ Radiator - Remove - [Transmission Fluid Cooler Inlet Pipe Replacement \(LFY without V08\)](#)

16.

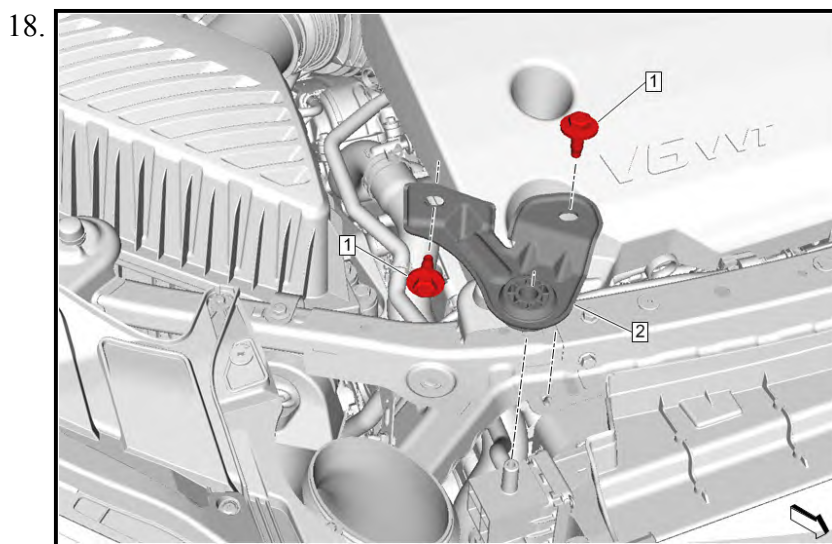




Transmission Fluid Cooler Pipe Clip (2) @ Engine Coolant Fan - Remove

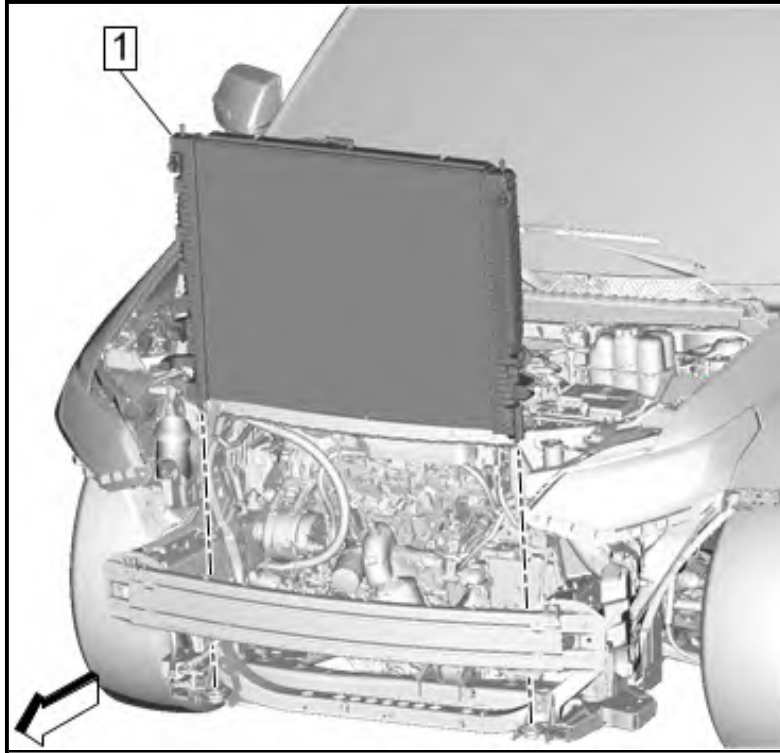


Radiator Upper Bracket-Left Side (2) - Remove - [Radiator Upper Bracket Replacement - Left Side \(LFY\)](#)



Radiator Upper Bracket-Right Side (2) - Remove - [Radiator Upper Bracket Replacement - Right Side \(LFY\)](#)

19.

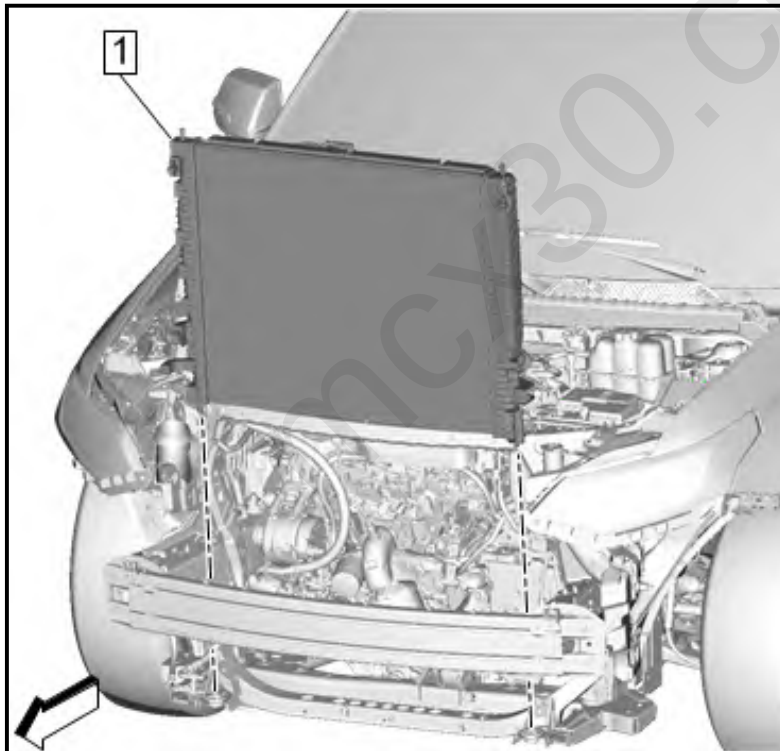


Engine Coolant Fan Module Radiator (1) - Remove

20. Transfer components as necessary.

Installation Procedure

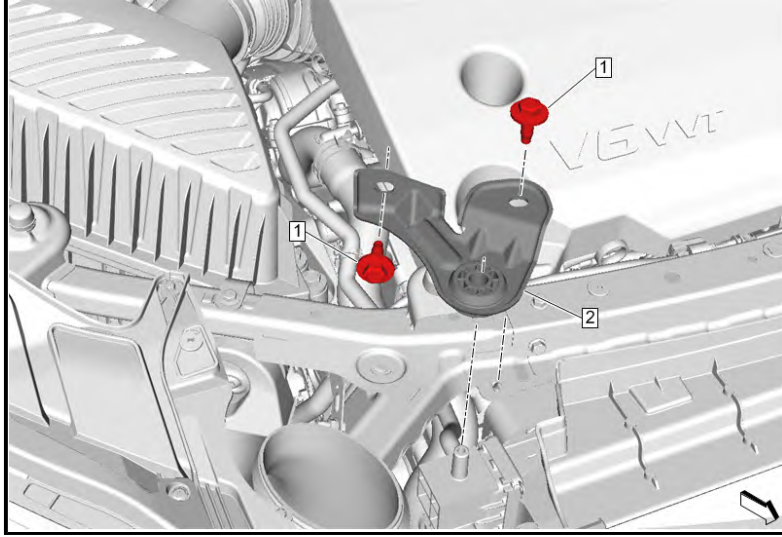
1.



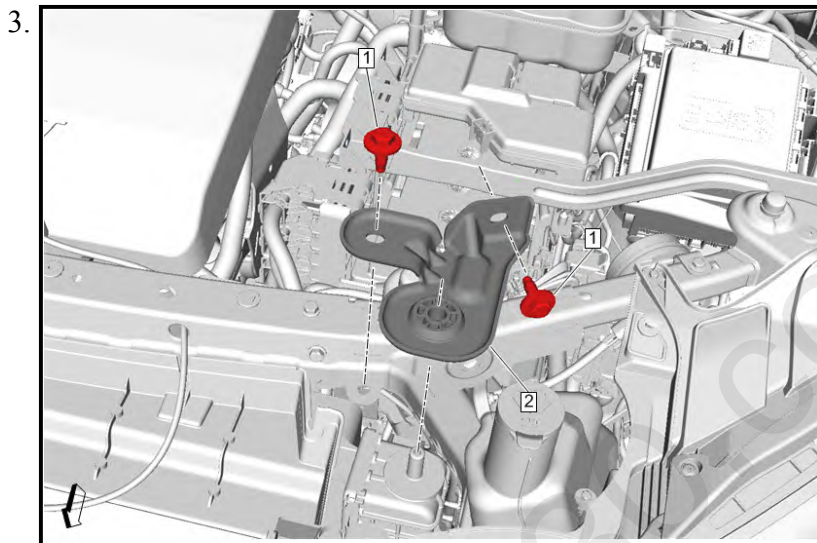
Engine Coolant Fan Module Radiator (1) - Install

2.

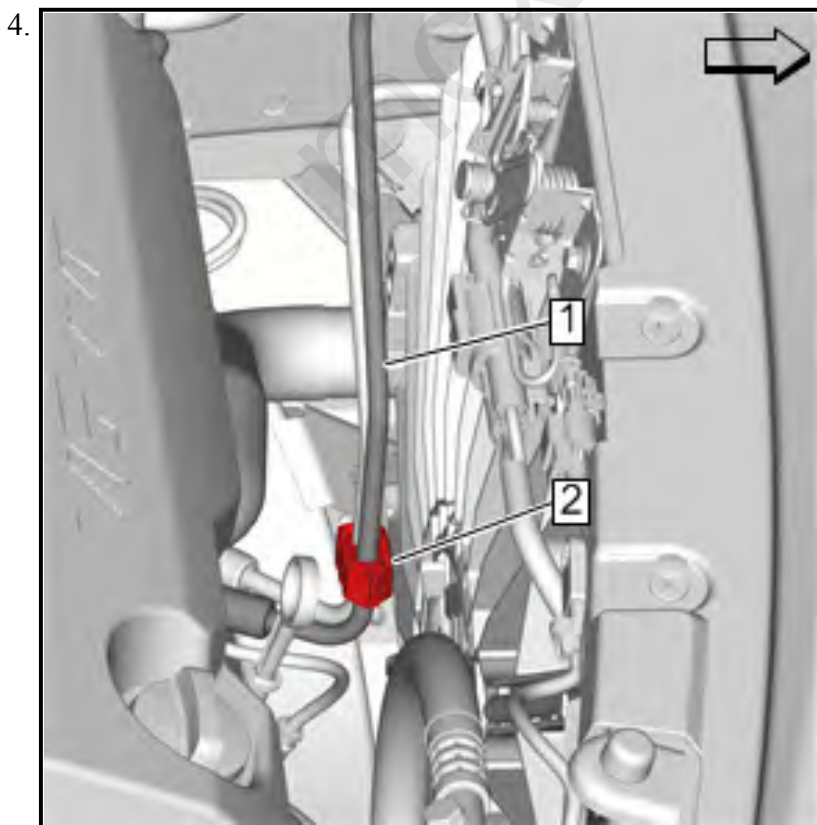




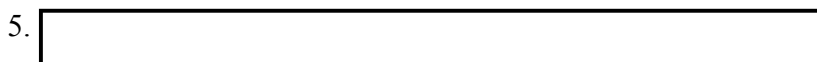
Radiator Upper Bracket-Right Side (2) - Install - [Radiator Upper Bracket Replacement - Right Side \(LFY\)](#)

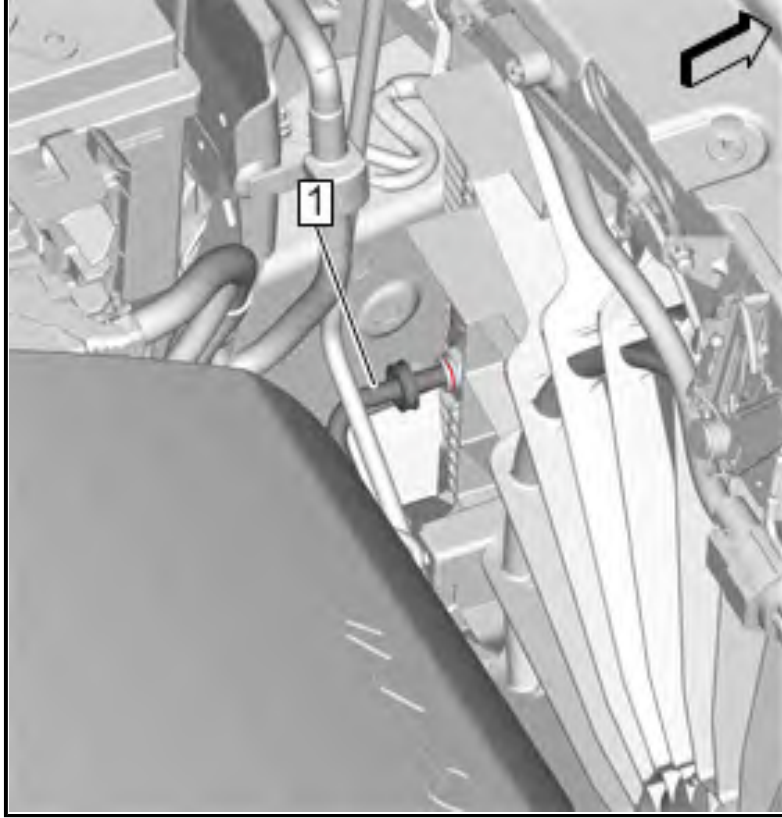


Radiator Upper Bracket-Left Side (2) - Install - [Radiator Upper Bracket Replacement - Left Side \(LFY\)](#)

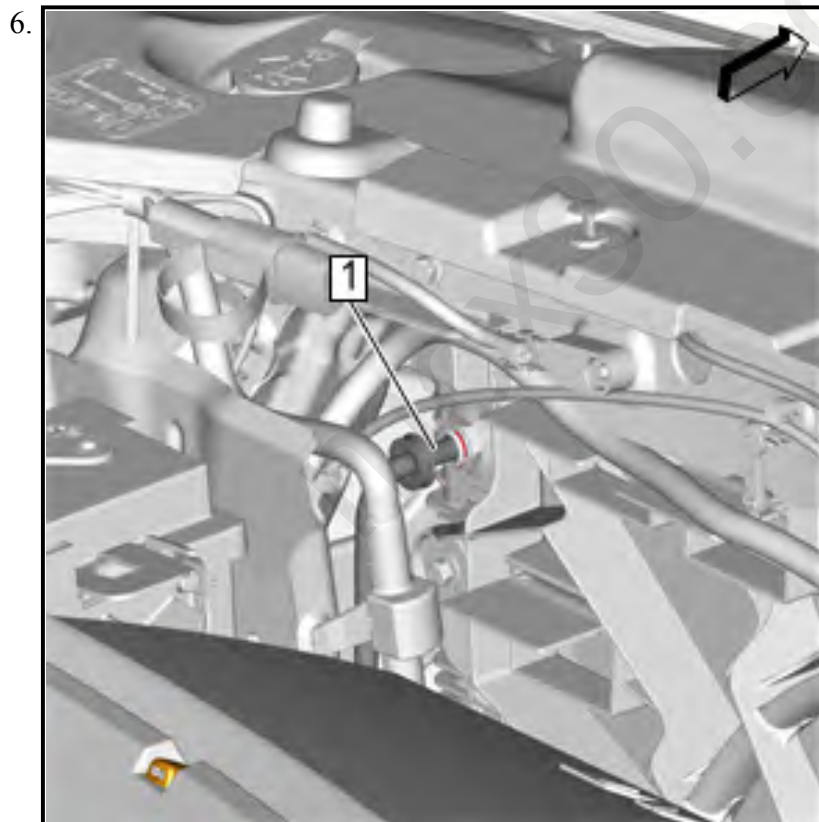


Transmission Fluid Cooler Pipe Clip (2) @ Engine Coolant Fan - Install





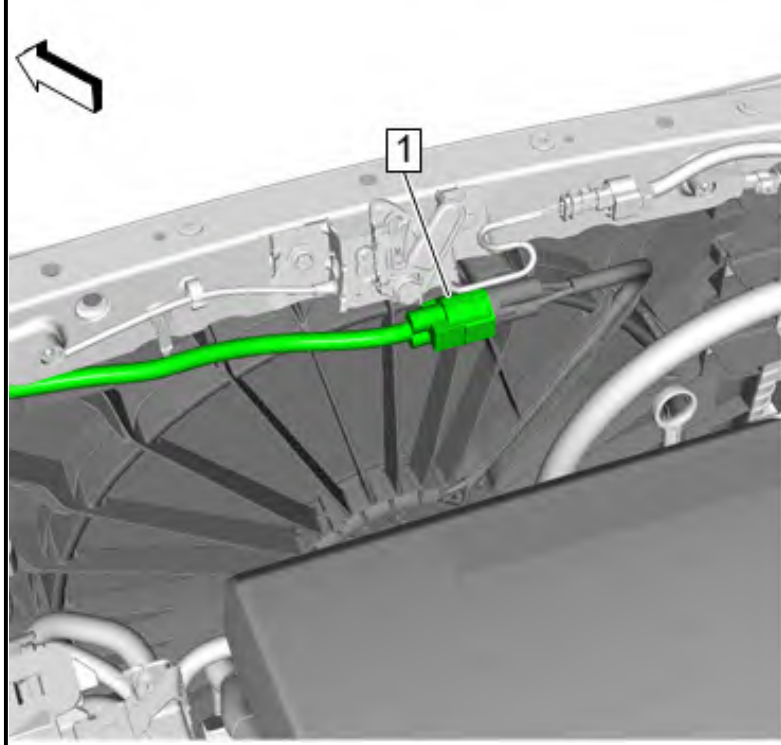
Transmission Fluid Cooler Inlet Pipe (1) @ Radiator - Install - [Transmission Fluid Cooler Inlet Pipe Replacement \(LFY without V08\)](#)



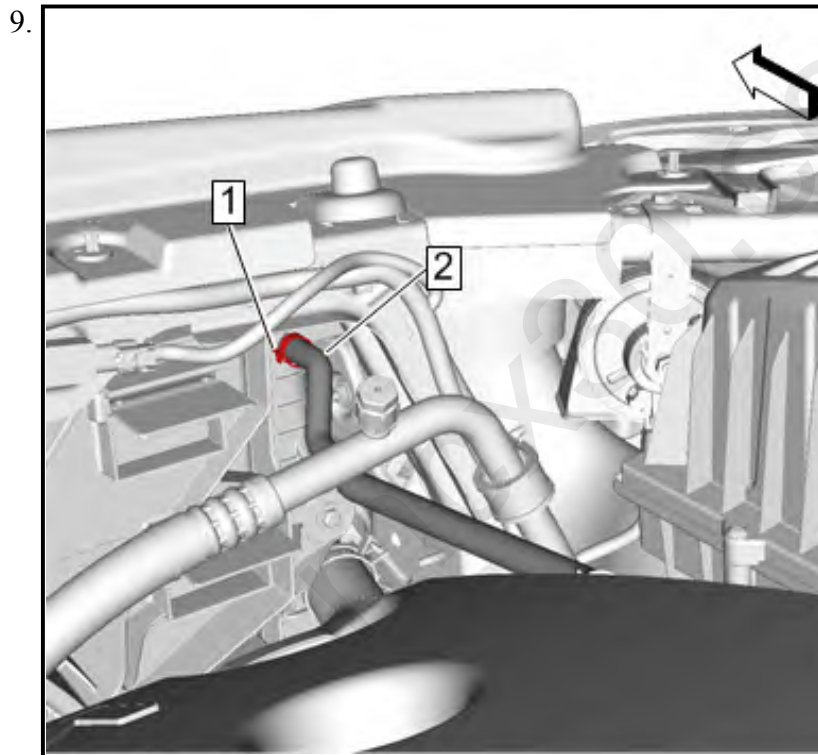
Transmission Fluid Cooler Outlet Pipe (1) @ Radiator - Install - [Transmission Fluid Cooler Outlet Pipe Replacement \(LFY without V08\)](#)

7. Wiring Harness @ Engine Coolant Fan - Connect



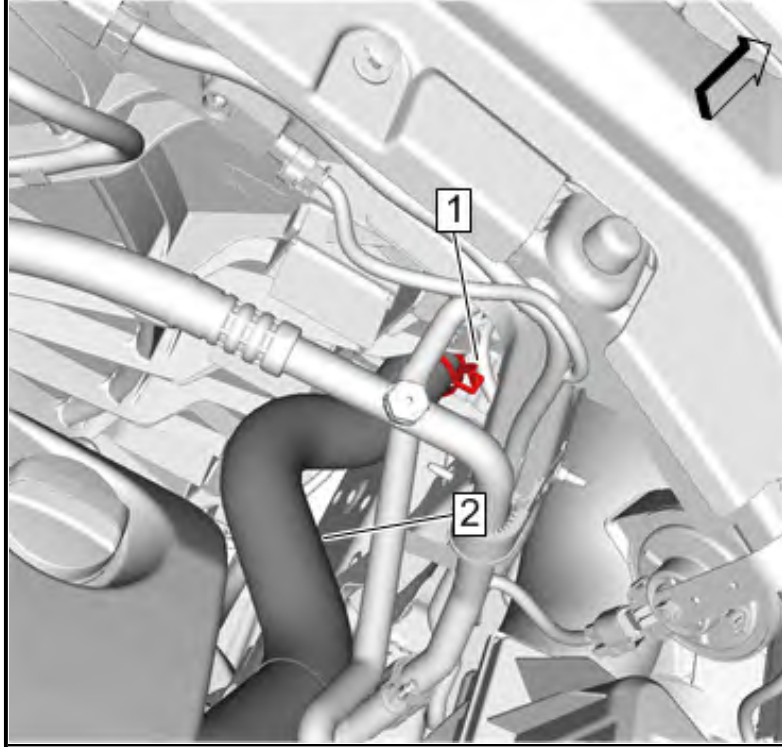


Electrical Connector (1) @ Engine Coolant Fan - Connect



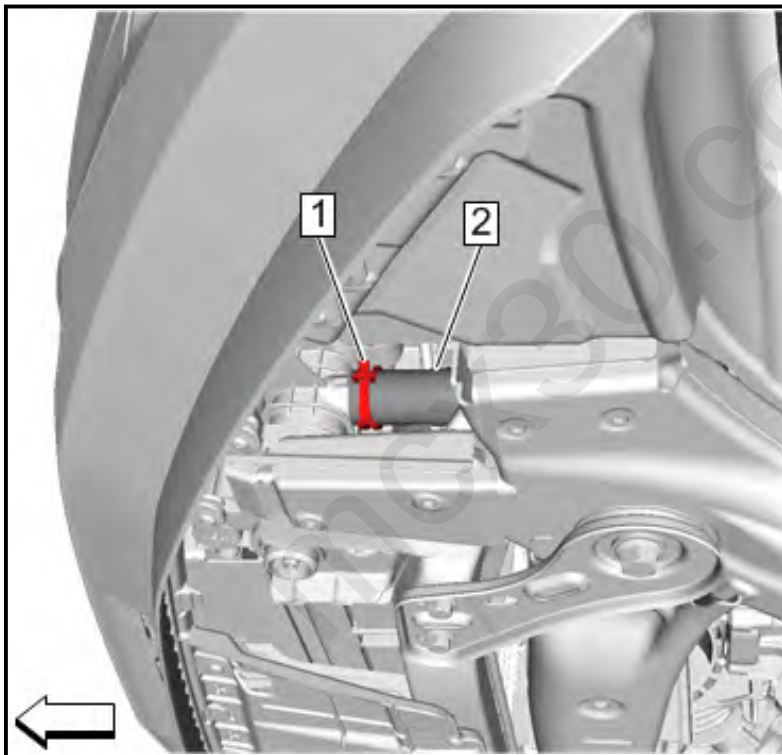
Radiator Surge Tank Overflow Hose (2) @ Radiator - Install - [Radiator Surge Tank Overflow Hose Replacement \(LFY Radiator Surge Tank to Engine Coolant Air Bleed Pipe\)](#)[Radiator Surge Tank Overflow Hose Replacement \(LFY Engine Coolant Air Bleed Pipe to Radiator\)](#)





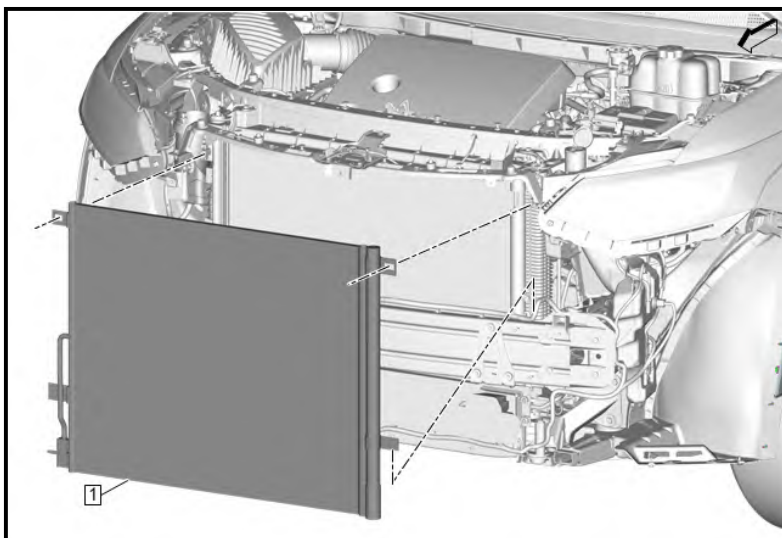
Radiator Inlet Hose (2) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LFY\)](#)

11.

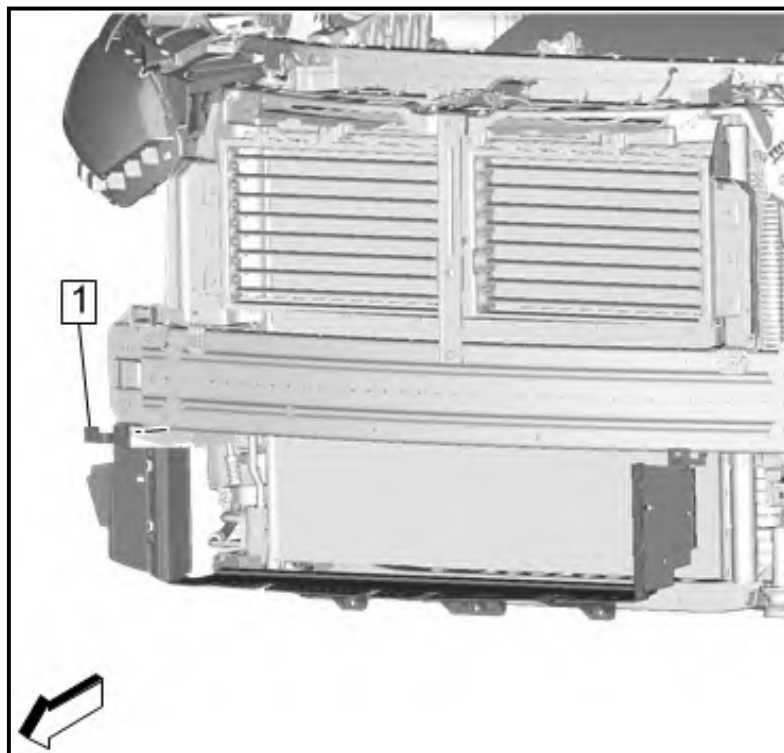


Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LFY\)](#)

12.

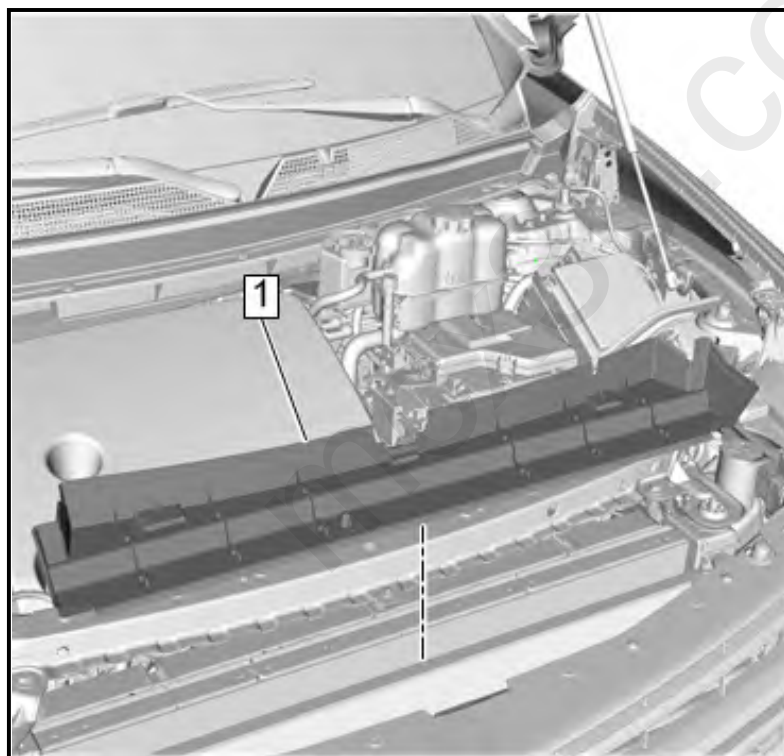


13.



Radiator Air Lower Baffle (1) - Install - [Radiator Air Lower Baffle Replacement \(LFY without V08\)](#).

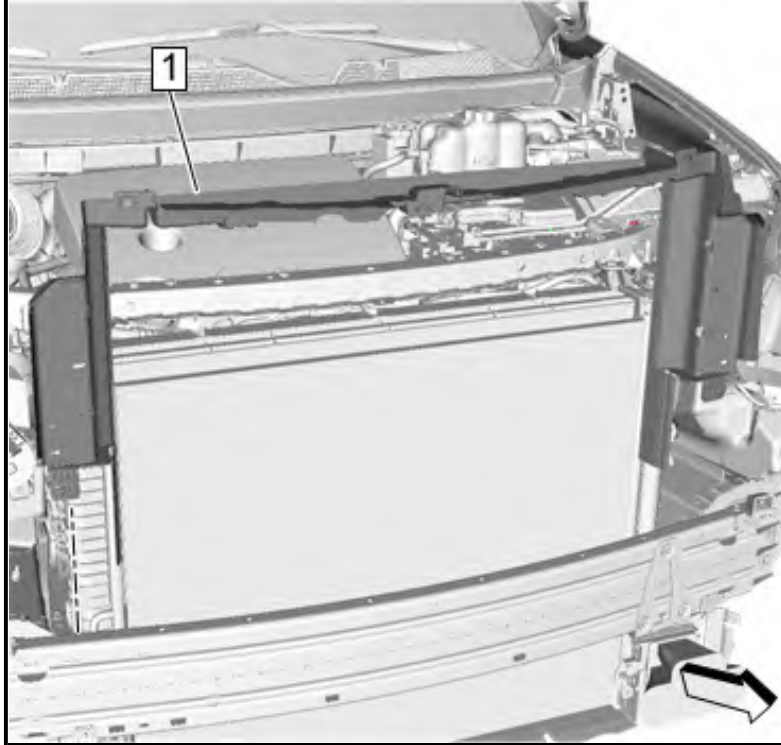
14.



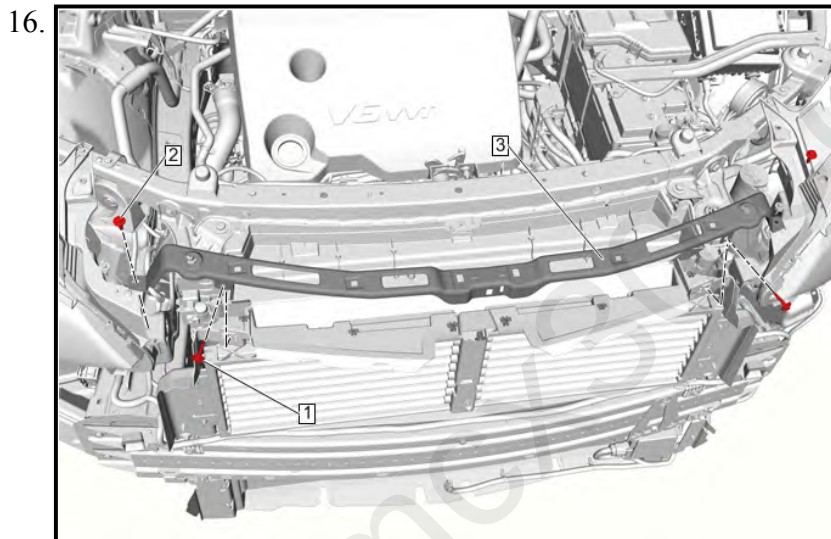
Radiator Air Baffle (1) - Install - [Radiator Air Baffle Replacement](#)

15.





Radiator Air Upper Baffle (1) - Install - [Radiator Air Upper Baffle Replacement](#)



Front Bumper Fascia Center Support (3) - Install - [Front Bumper Fascia Center Support Replacement](#)

17. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

18. Intake Air Splash Shield - Install - [Intake Air Splash Shield Replacement](#)

19. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).

20. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN MODULE RADIATOR ASSEMBLY REMOVAL AND INSTALLATION (LTG)

Removal Procedure

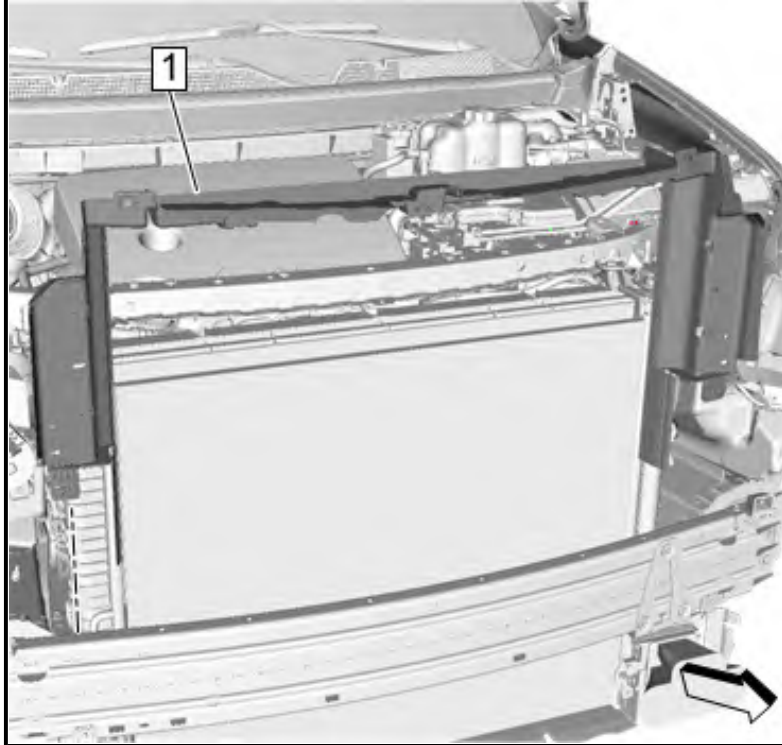
1. Intake Air Splash Shield - Remove - [Intake Air Splash Shield Replacement](#)

2. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)

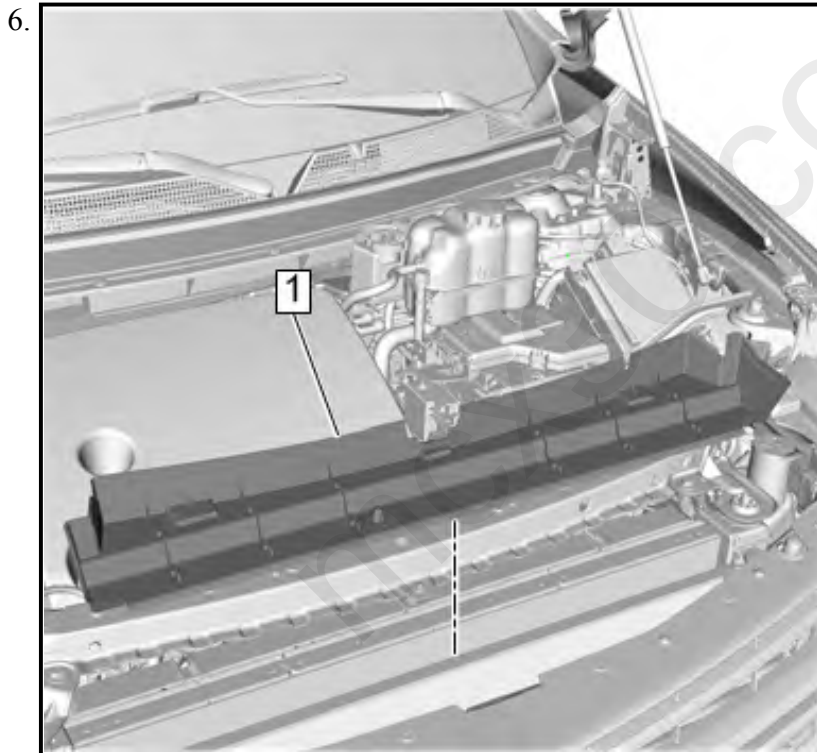
3. Drain the cooling system. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#).

4. Front Bumper Fascia Center Support - Remove - [Front Bumper Fascia Center Support Replacement](#)

5.

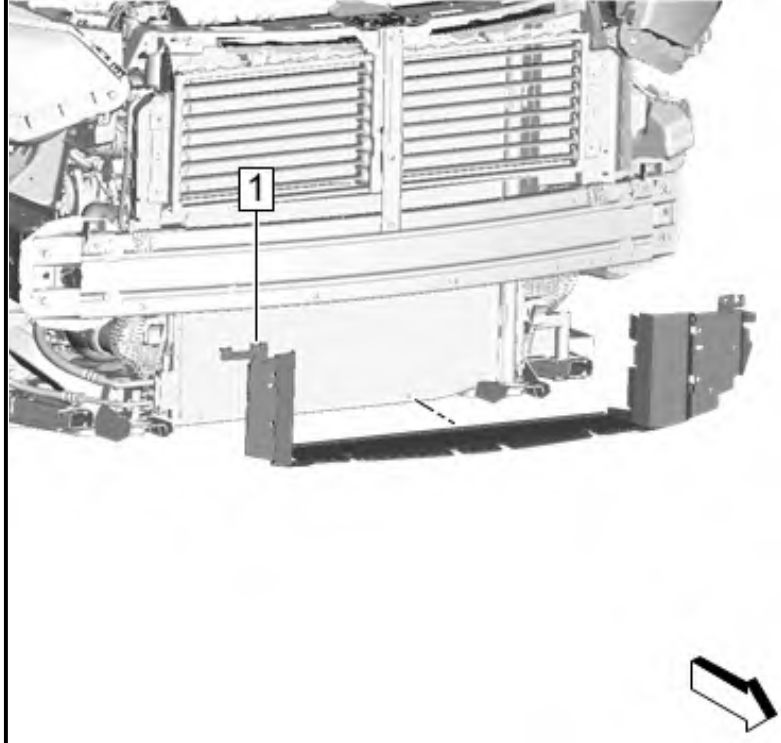


Radiator Air Upper Baffle (1) - Remove - [Radiator Air Upper Baffle Replacement](#)



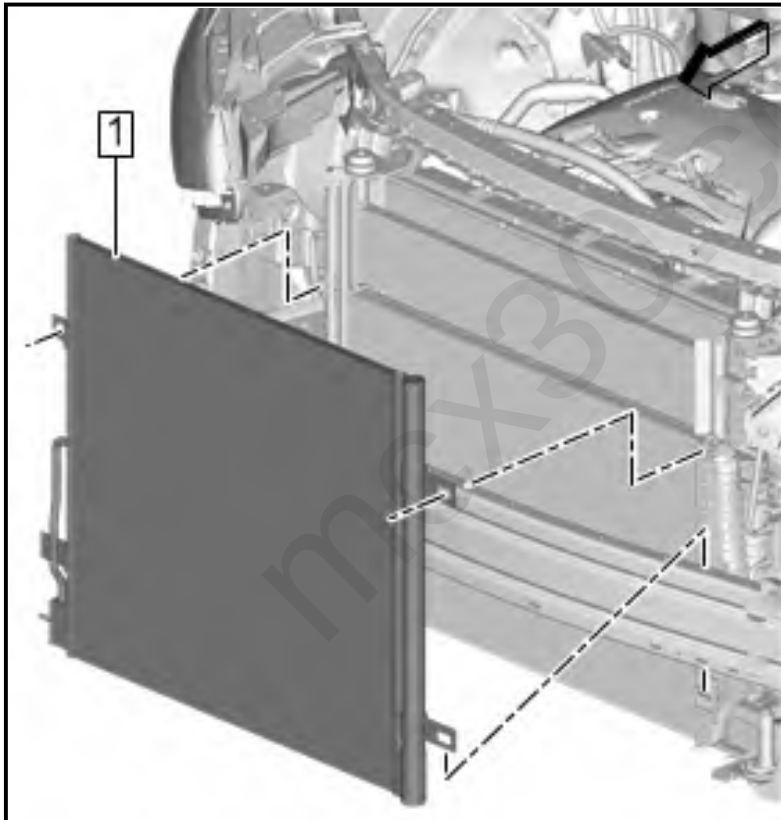
Radiator Air Baffle (1) - Remove - [Radiator Air Baffle Replacement](#)





Radiator Air Lower Baffle (1) - Remove - [Radiator Air Lower Baffle Replacement \(LTG\)](#)

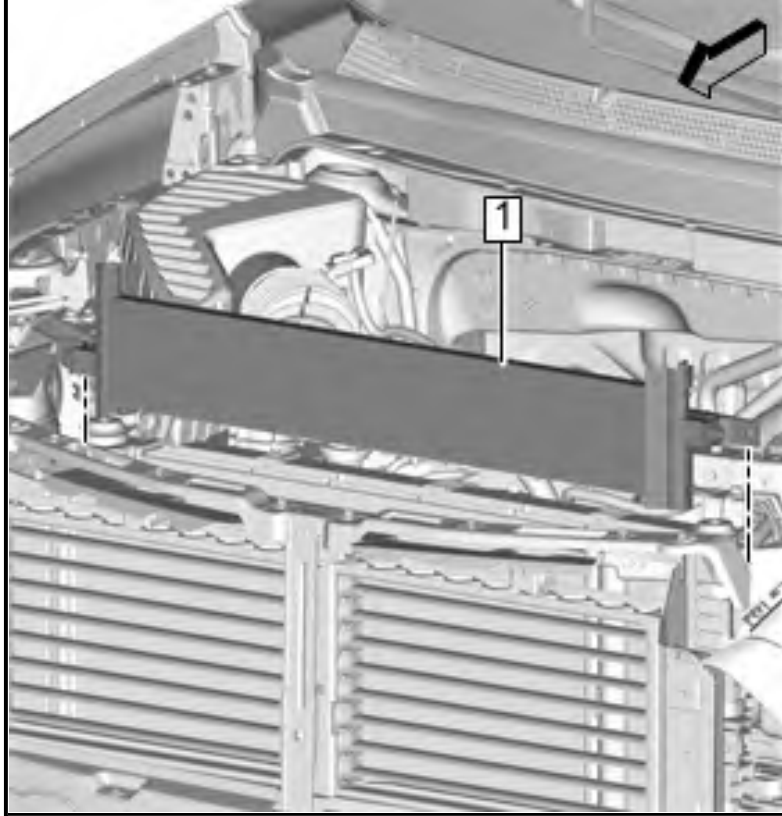
8.



Air Conditioning Condenser (1) - Remove - [Air Conditioning Condenser Replacement \(LTG\)](#)

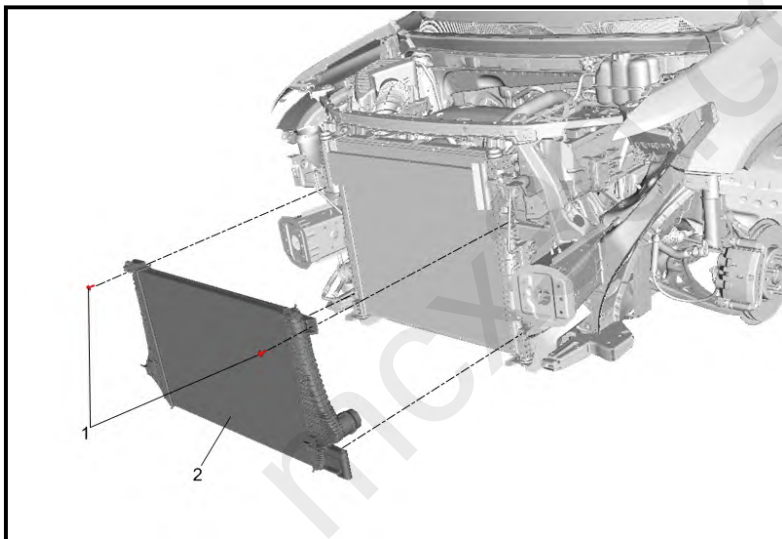
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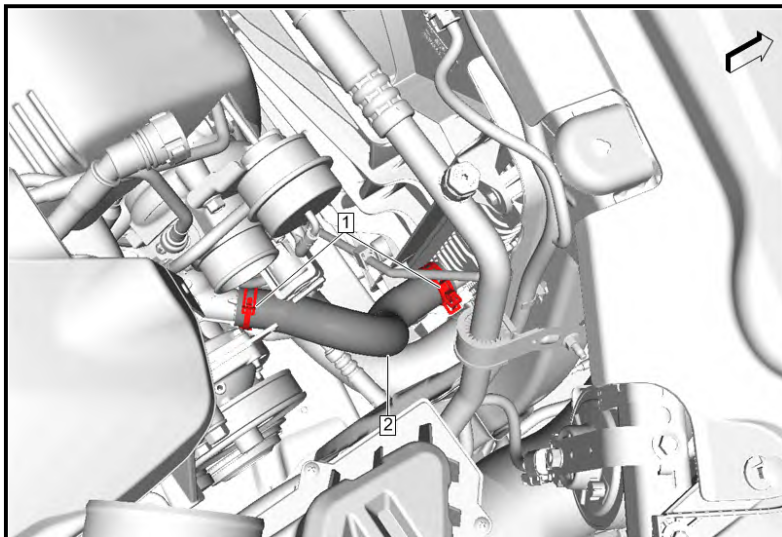
Transmission Fluid Auxiliary Cooler (1) - Remove - [Transmission Fluid Auxiliary Cooler Replacement \(LTG\)](#)

10.



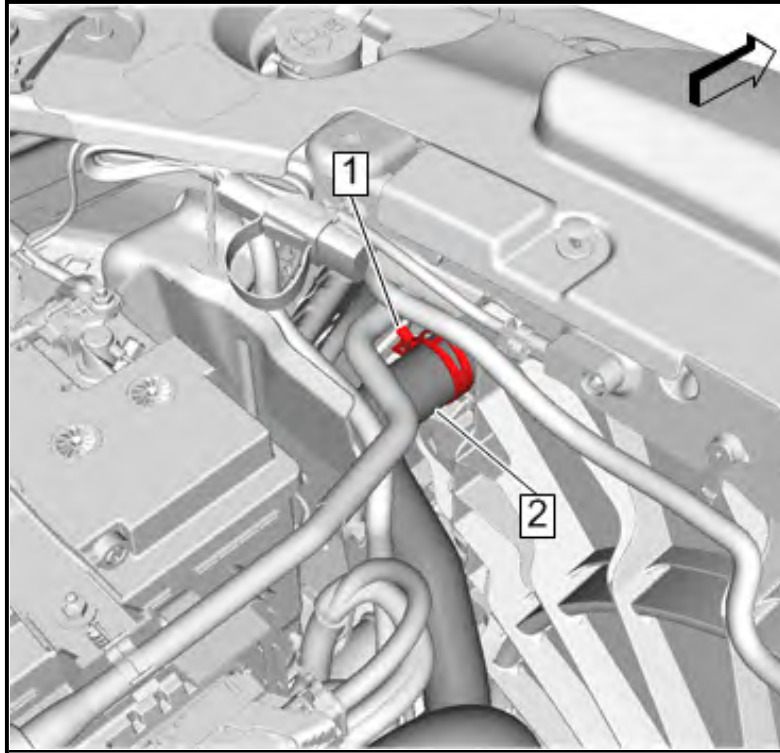
Charge Air Cooler (2) - Remove - [Charge Air Cooler Replacement](#)

11.



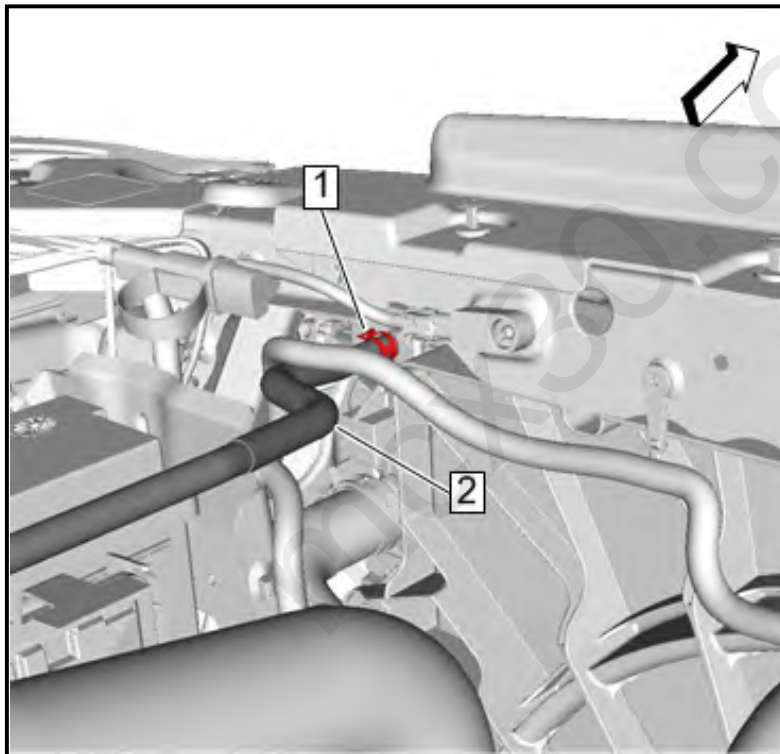
Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LTG\)](#)

12.



Radiator Inlet Hose (2) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LTG\)](#)

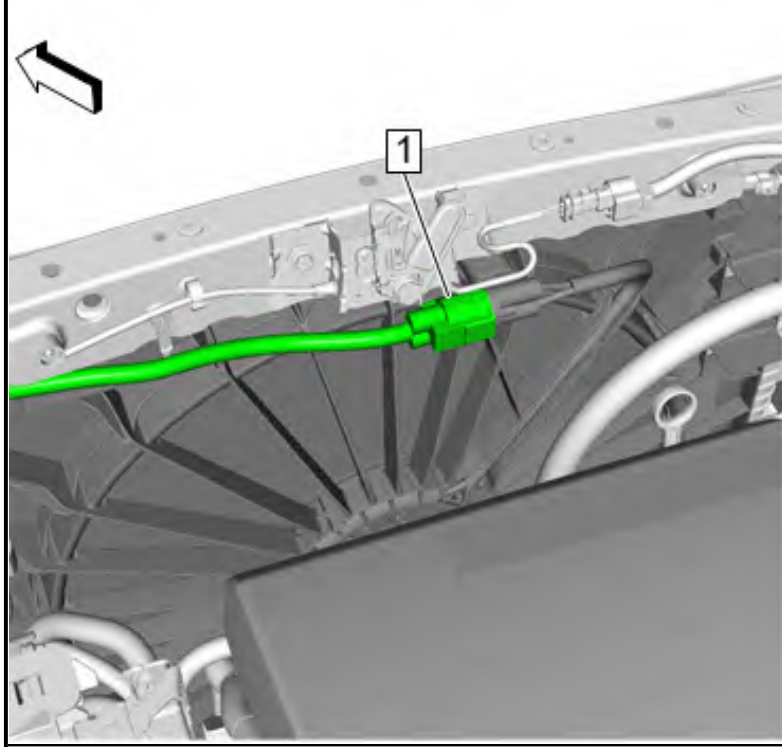
13.



Radiator Surge Tank Overflow Hose (2) @ Radiator - Remove - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#)

14.



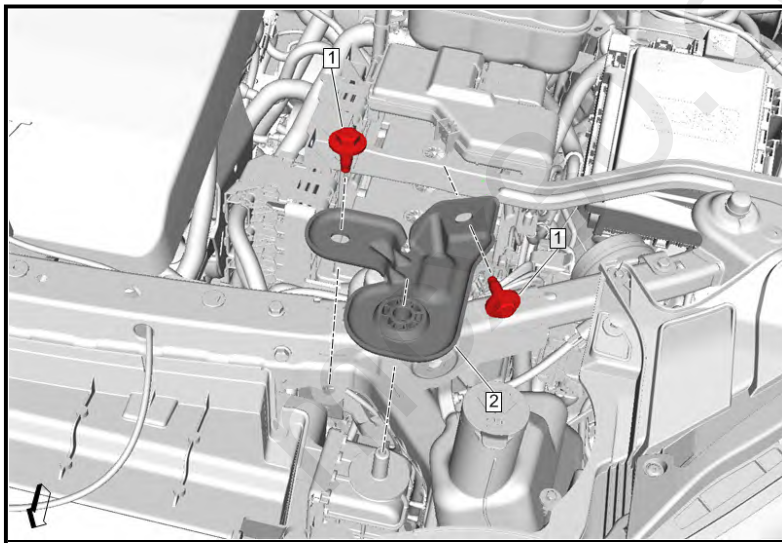


Electrical Connector (1) @ Engine Coolant Fan - Disconnect

15. Wiring Harness @ Engine Coolant Fan - Disconnect

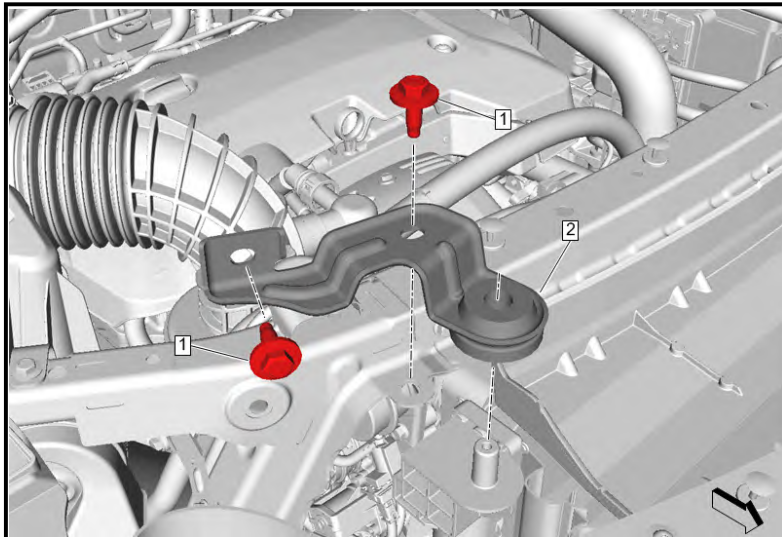
16. Transmission Fluid Cooler Thermal Bypass Valve - Remove - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LTG\)](#)

17.

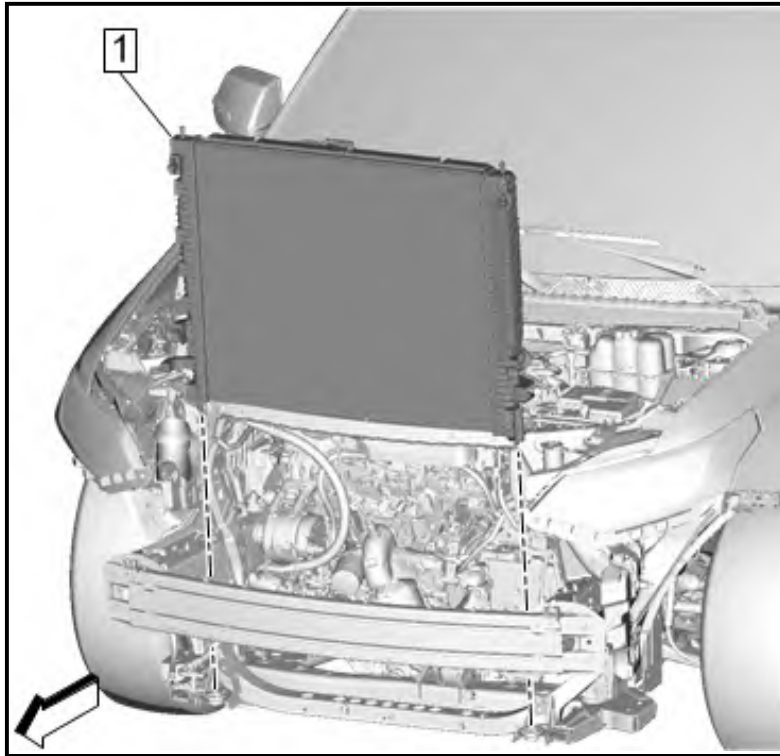


Radiator Upper Bracket-Left Side (2) - Remove - [Radiator Upper Bracket Replacement - Left Side \(LTG\)](#)

18.



19.

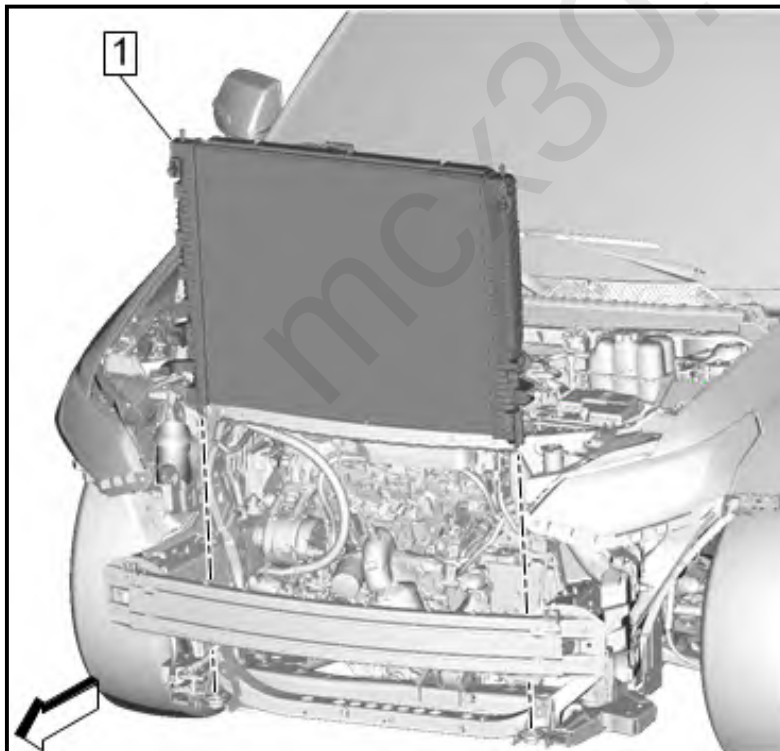


Engine Coolant Fan Module Radiator (1) - Remove

20. Transfer components as necessary.

Installation Procedure

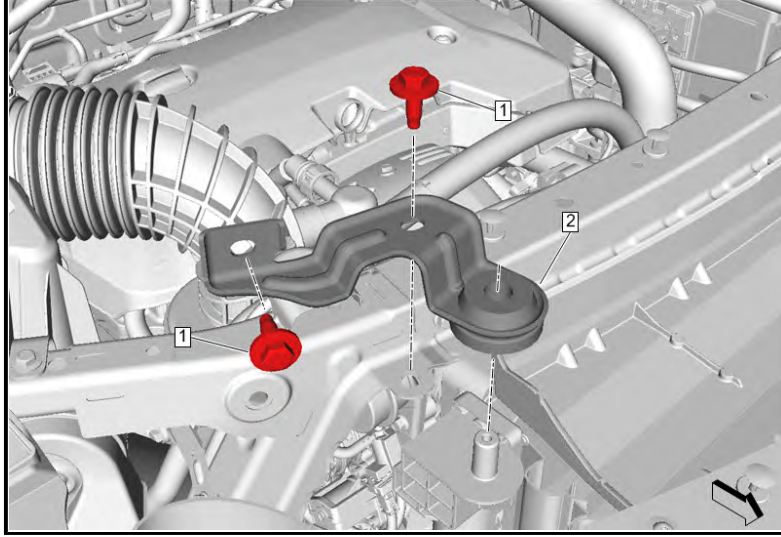
1.



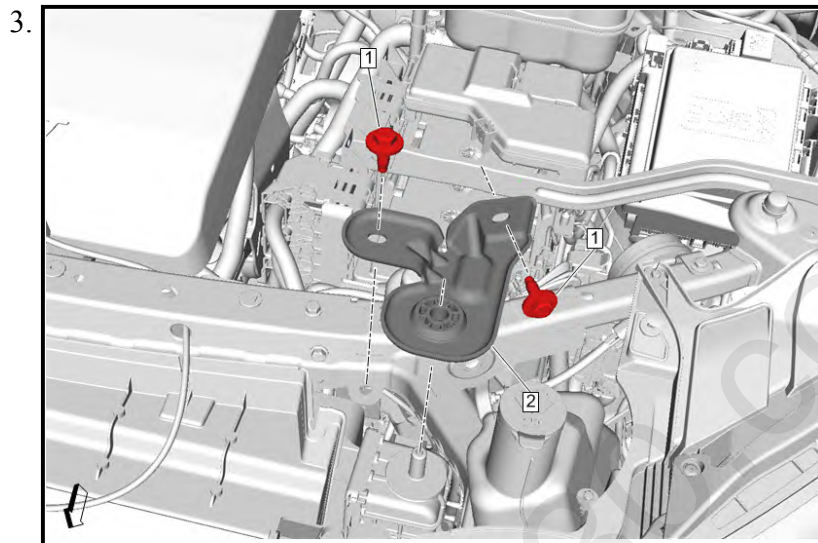
Engine Coolant Fan Module Radiator (1) - Install

2.



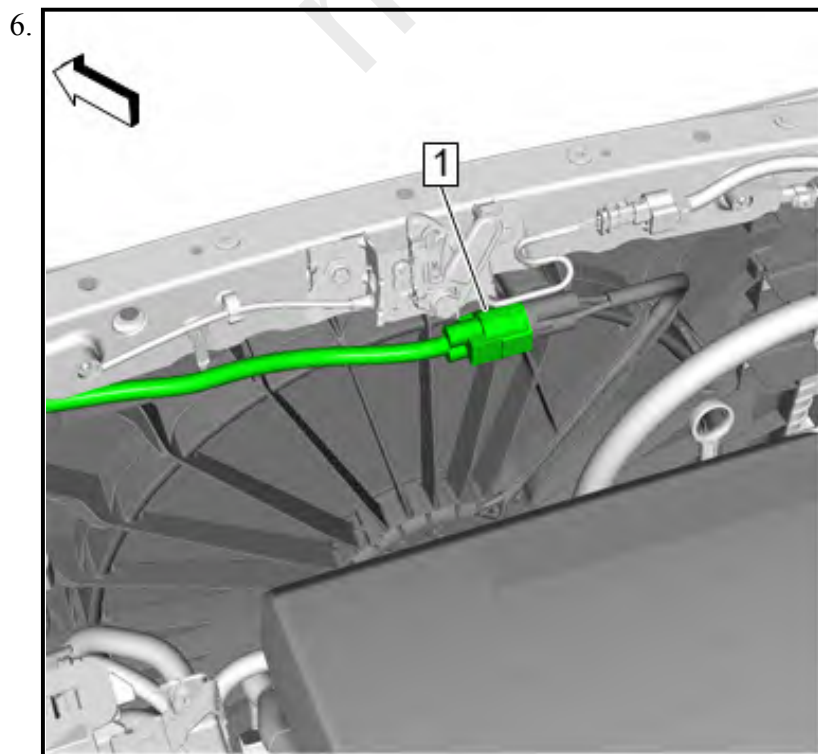


Radiator Upper Bracket-Right Side (2) - Install - [Radiator Upper Bracket Replacement - Right Side \(LTG\)](#)



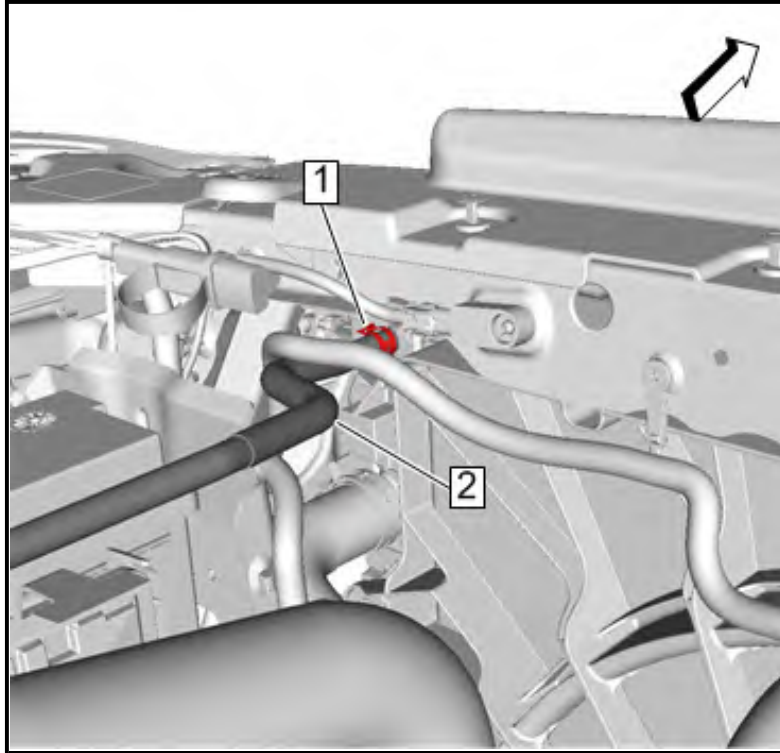
Radiator Upper Bracket-Left Side (2) - Install - [Radiator Upper Bracket Replacement - Left Side \(LTG\)](#)

4. Transmission Fluid Cooler Thermal Bypass Valve - Install - [Transmission Fluid Cooler Thermal Bypass Valve Replacement \(LTG\)](#)
5. Wiring Harness @ Engine Coolant Fan - Connect



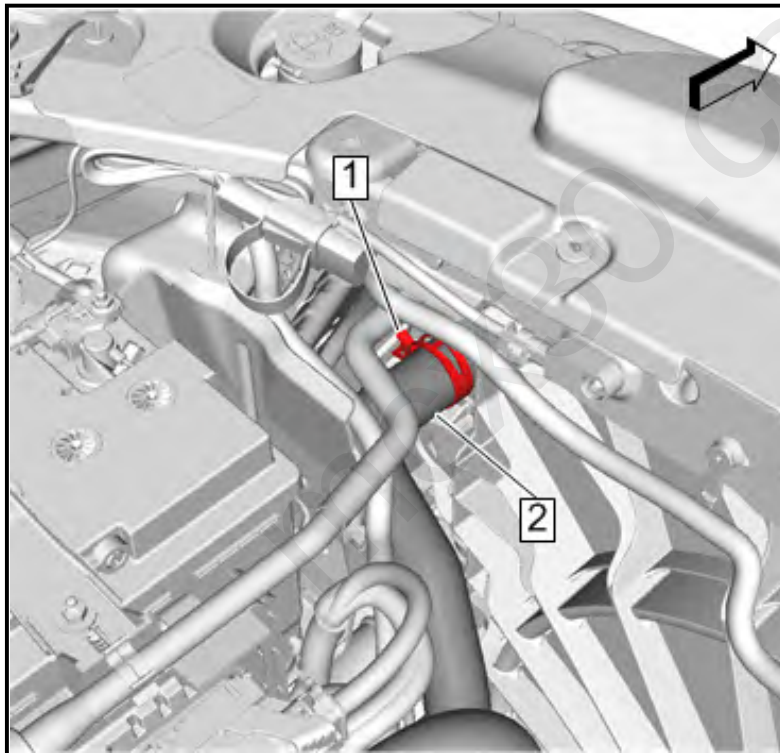
Electrical Connector (1) @ Engine Coolant Fan - Connect

7.



Radiator Surge Tank Overflow Hose (2) @ Radiator - Install - [Radiator Surge Tank Overflow Hose Replacement \(LTG Radiator Surge Tank to Engine Coolant Air Bleed Pipe to Radiator\)](#).

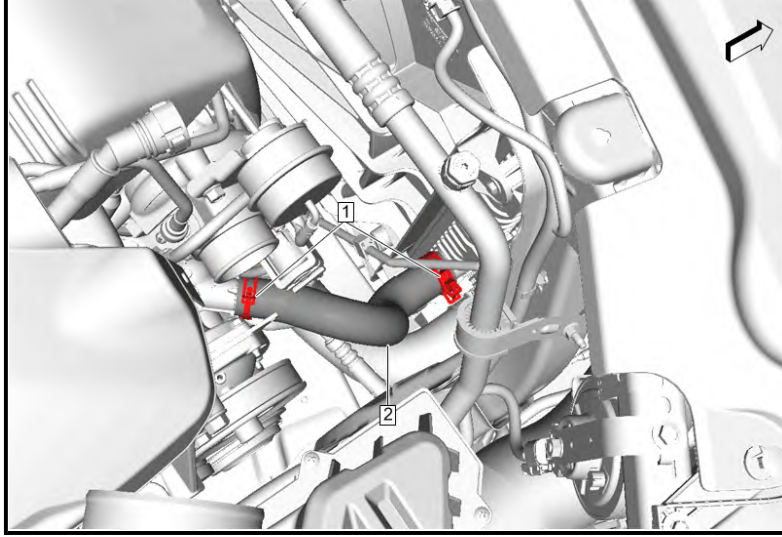
8.



Radiator Inlet Hose (2) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LTG\)](#).

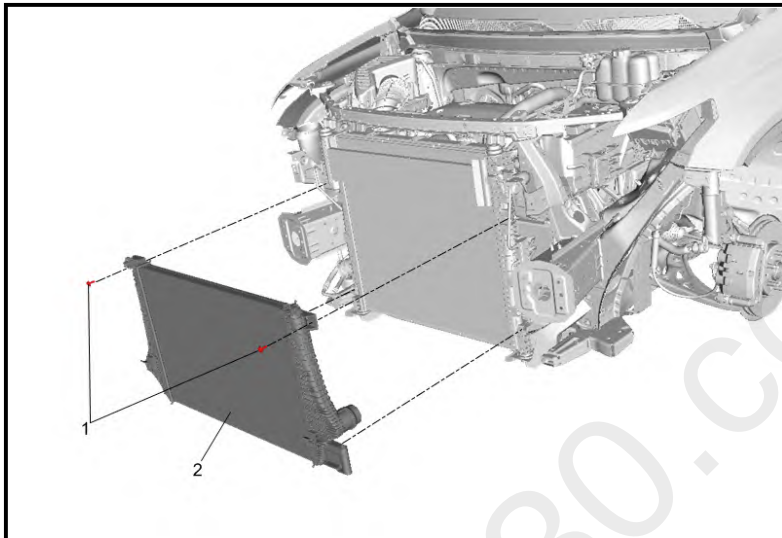
9.





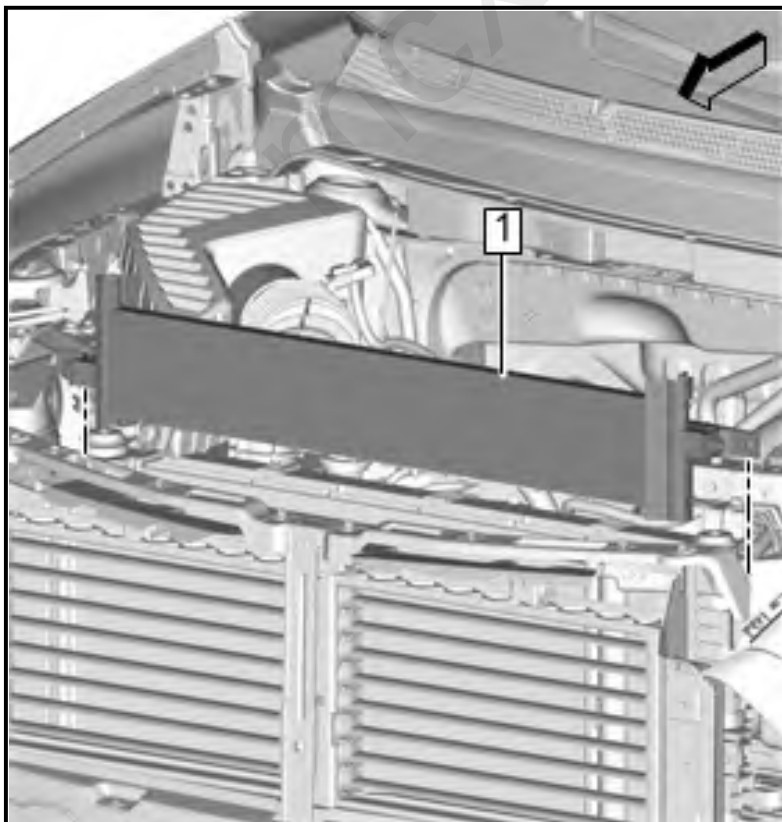
Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LTG\)](#)

10.



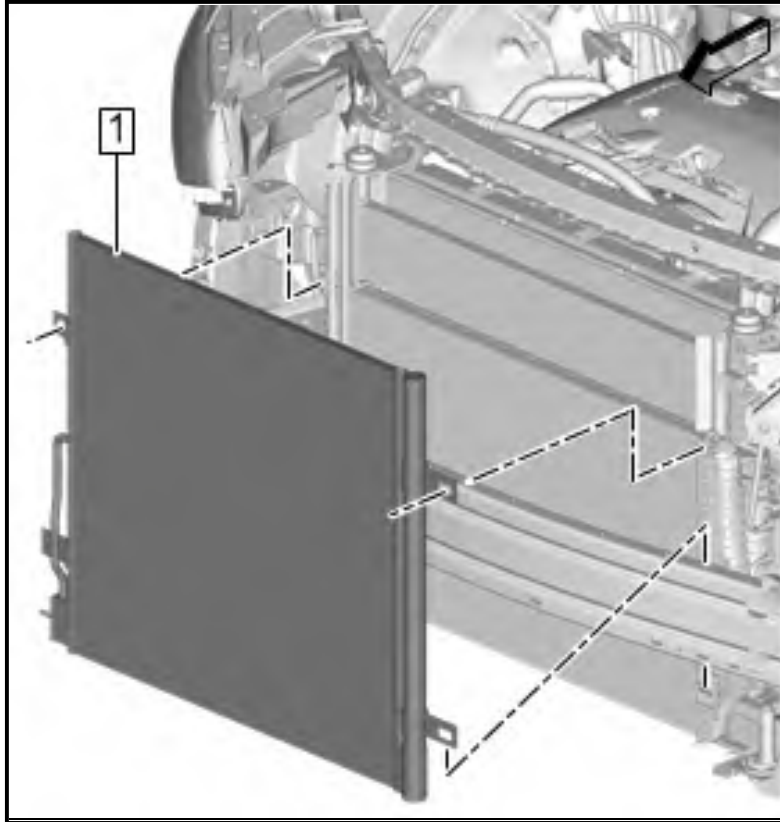
Charge Air Cooler (2) - Install - [Charge Air Cooler Replacement](#)

11.



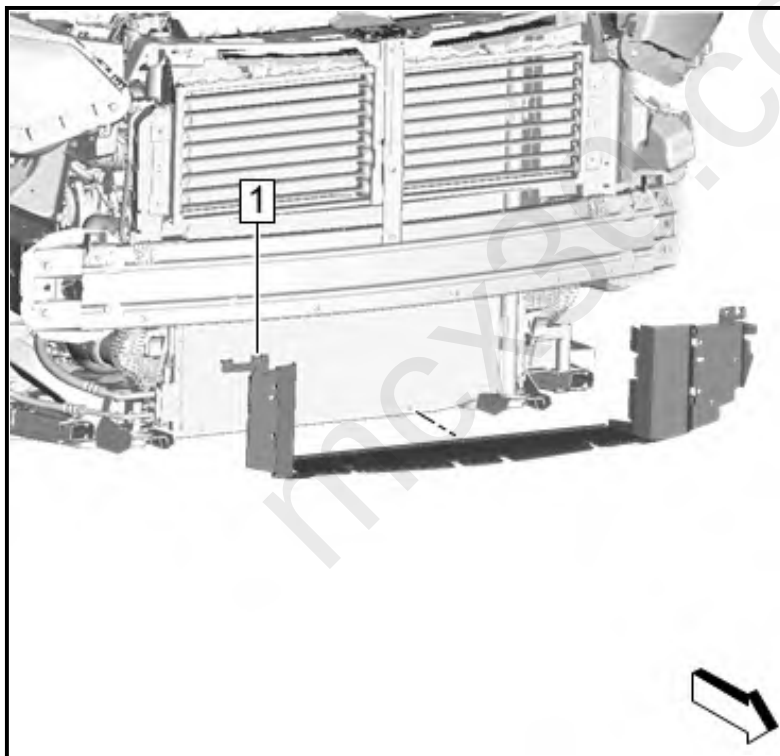
Transmission Fluid Auxiliary Cooler (1) - Install - [Transmission Fluid Auxiliary Cooler Replacement \(LTG\)](#)

12.



Air Conditioning Condenser (1) - Install - [Air Conditioning Condenser Replacement \(LTG\)](#)

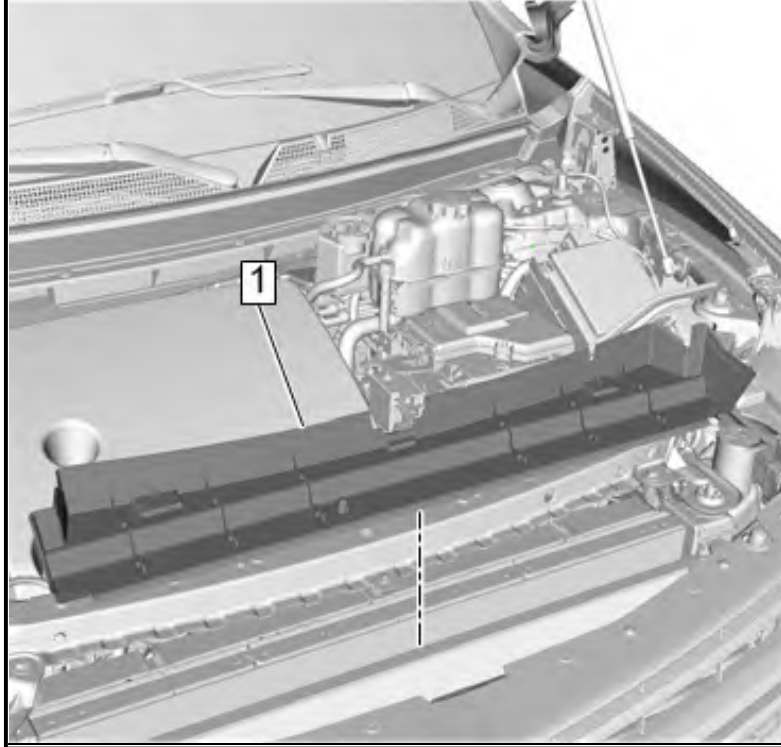
13.



Radiator Air Lower Baffle (1) - Install - [Radiator Air Lower Baffle Replacement \(LTG\)](#)

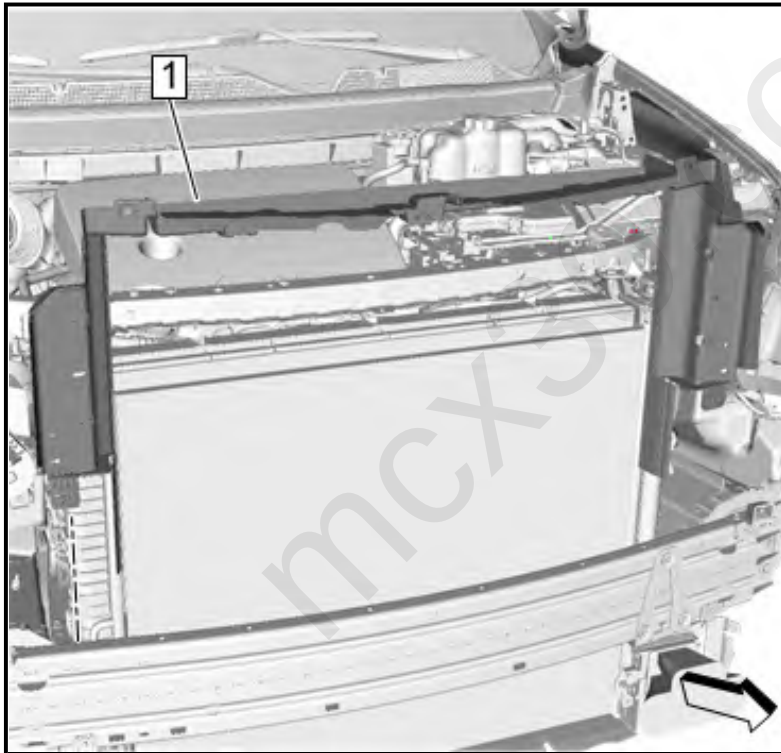
14.





Radiator Air Baffle (1) - Install - [Radiator Air Baffle Replacement](#)

15.



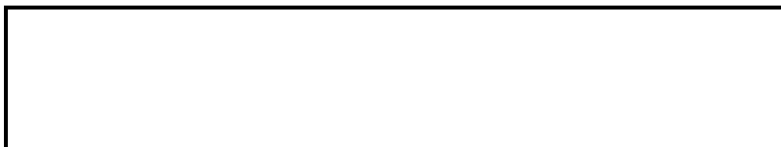
Radiator Air Upper Baffle (1) - Install - [Radiator Air Upper Baffle Replacement](#)

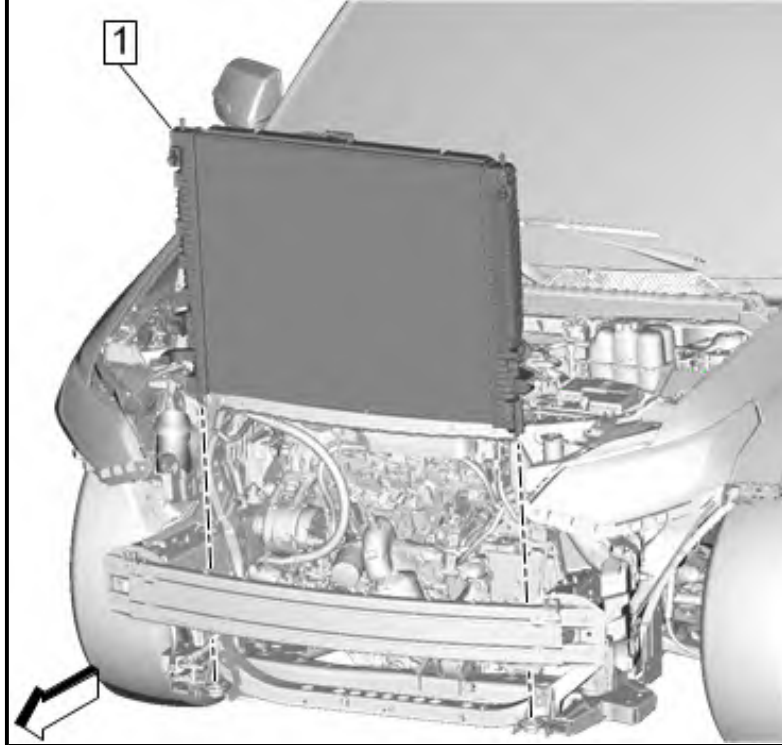
16. Front Bumper Fascia Center Support - Install - [Front Bumper Fascia Center Support Replacement](#)
17. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)
18. Intake Air Splash Shield - Install - [Intake Air Splash Shield Replacement](#)
19. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(GE 47716\)Cooling System Draining and Filling \(Static Fill\)](#)
20. Start the engine and check for coolant leaks.

RADIATOR REPLACEMENT

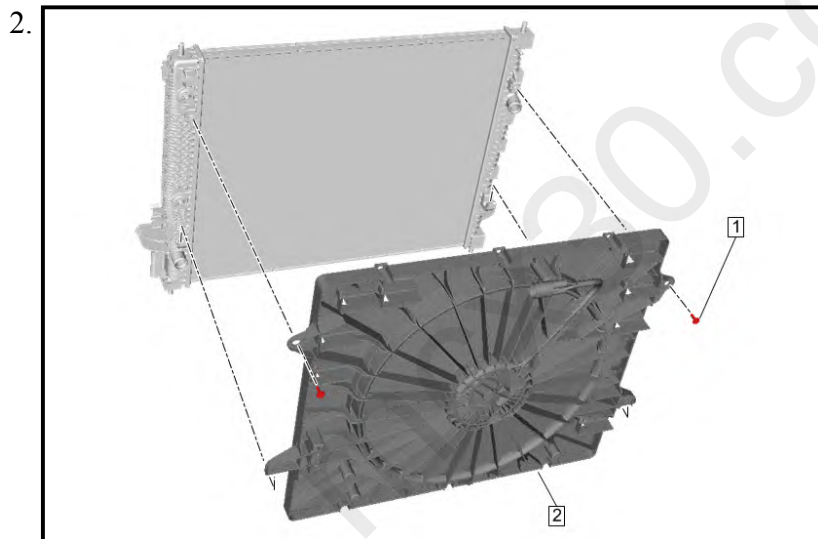
Removal Procedure

1.





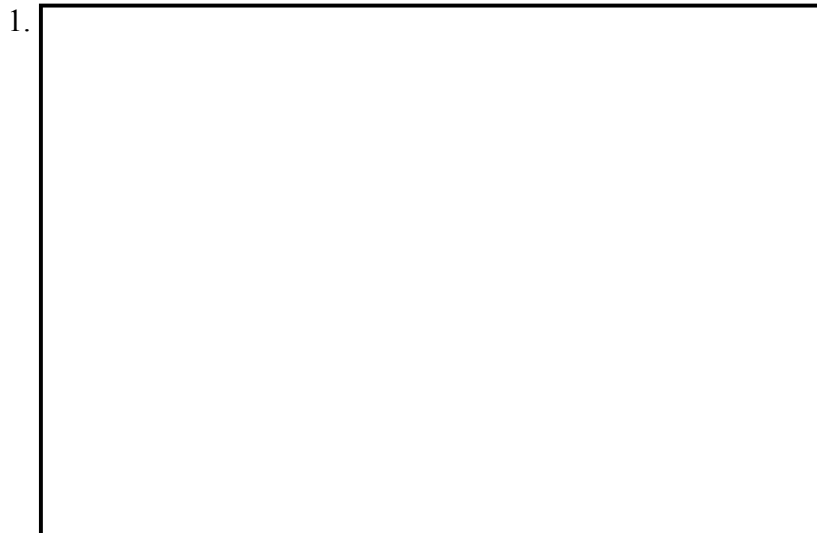
Engine Coolant Fan Module Radiator (1) - Remove - [Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LFY with V08\)](#)[Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LFY without V08\)](#)[Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LTG\)](#)

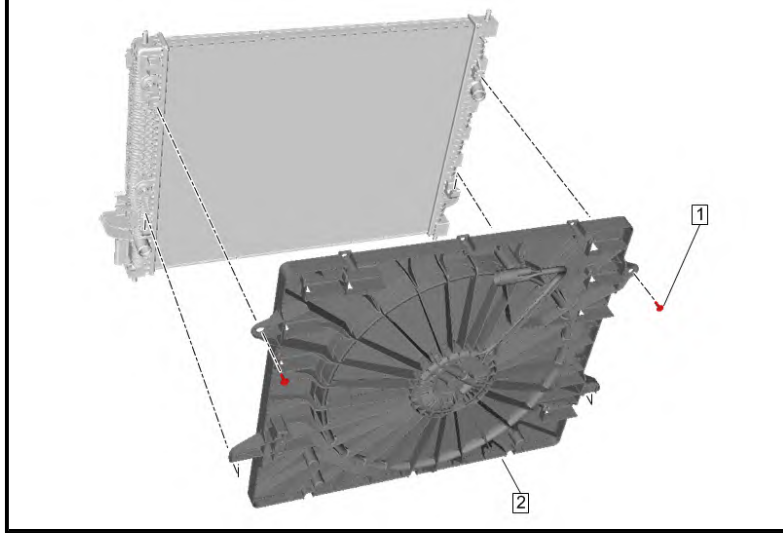


Engine Coolant Fan (2) @ Radiator - Remove - [Engine Coolant Fan Replacement](#)

3. Transfer components as necessary.

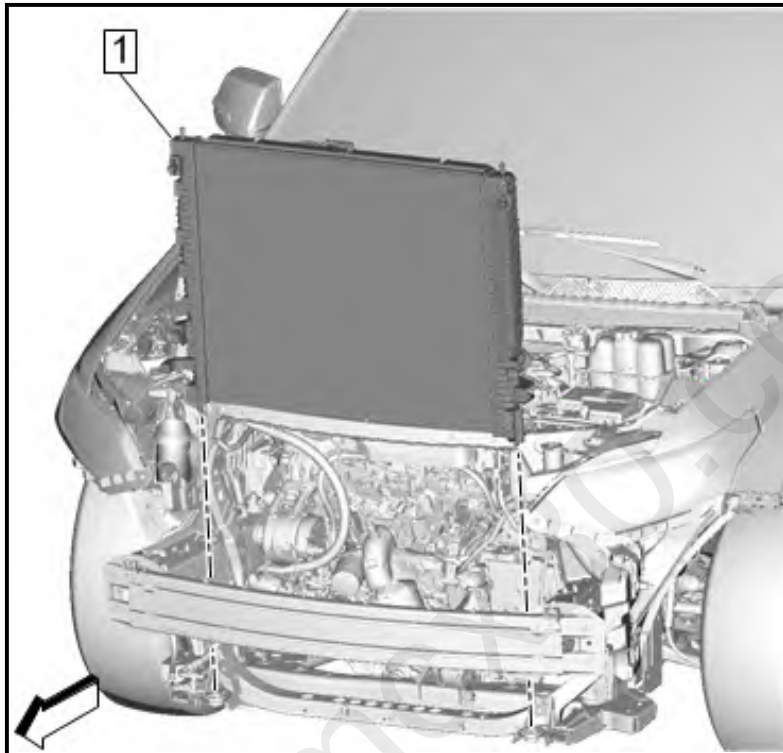
Installation Procedure





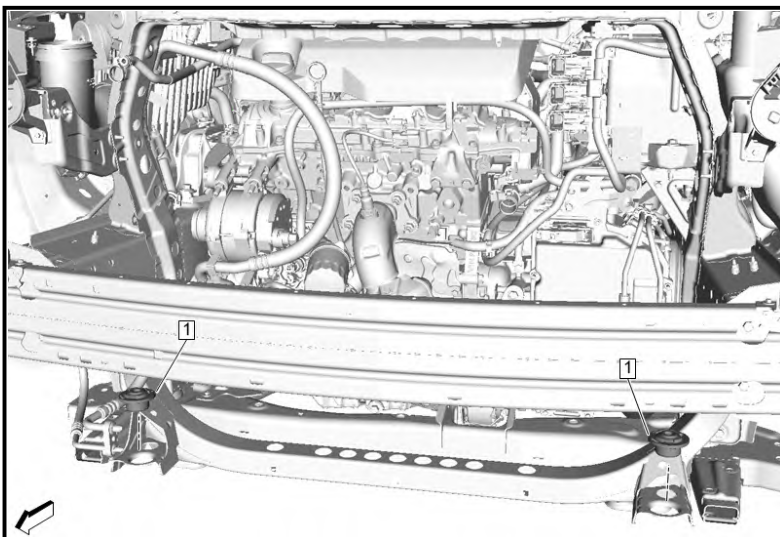
Engine Coolant Fan (2) @ Radiator - Install - [Engine Coolant Fan Replacement](#)

2.



Engine Coolant Fan Module Radiator (1) - Install - [Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LFY with V08\)](#)[Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LFY without V08\)](#)[Engine Coolant Fan Module Radiator Assembly Removal and Installation \(LTG\)](#)

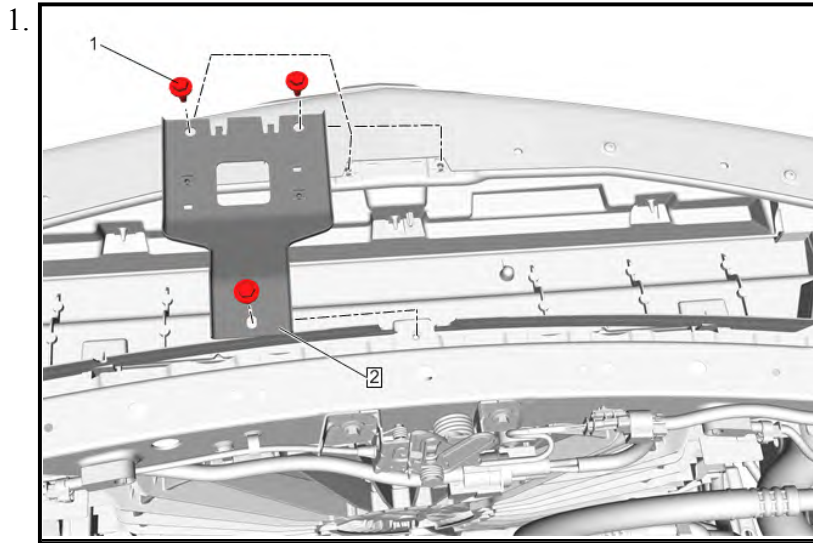
RADIATOR LOWER INSULATOR REPLACEMENT (LFY)



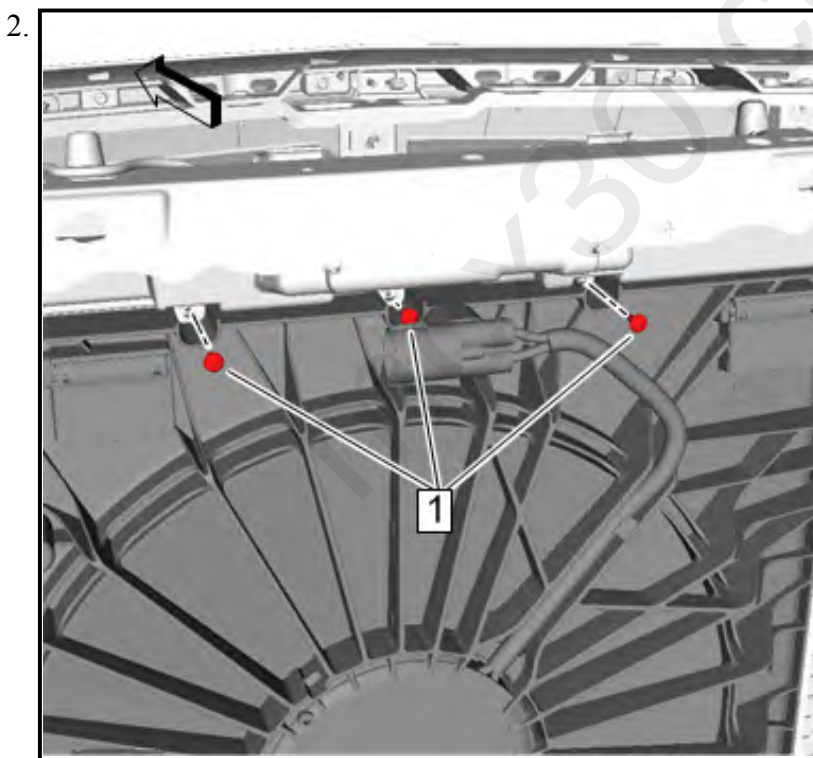
Callout	Component Name
Preliminary Procedure	
Radiator - Remove - <u>Radiator Replacement</u>	
1	Radiator Lower Insulator [2x]

RADIATOR AIR BAFFLE REPLACEMENT

Removal Procedure

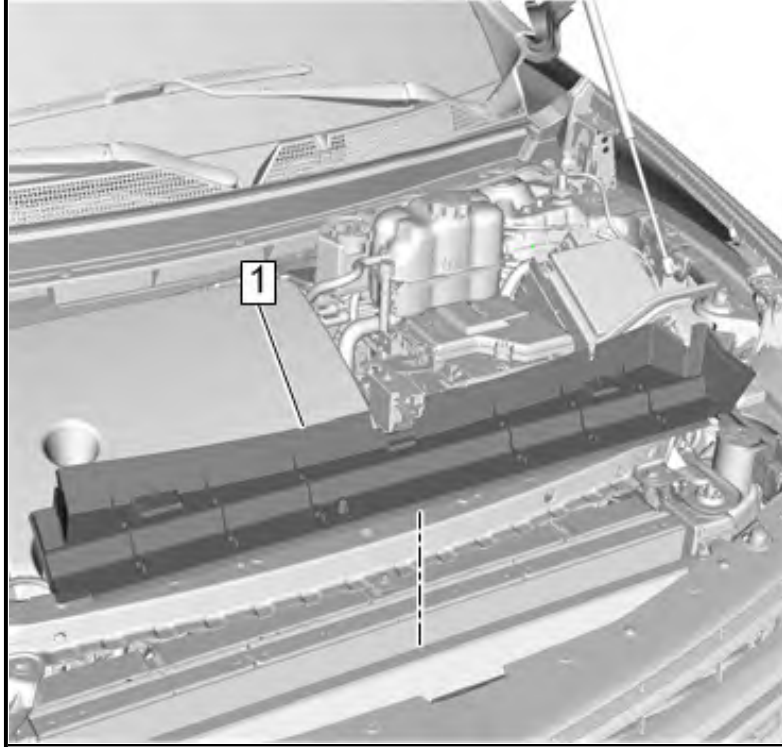


Front Bumper Fascia Support Brace - Upper (2) - Remove - **Front Bumper Fascia Support Brace Replacement - Upper**



Radiator Air Baffle Bolt (1) @ Engine Coolant Fan - Remove [3x]

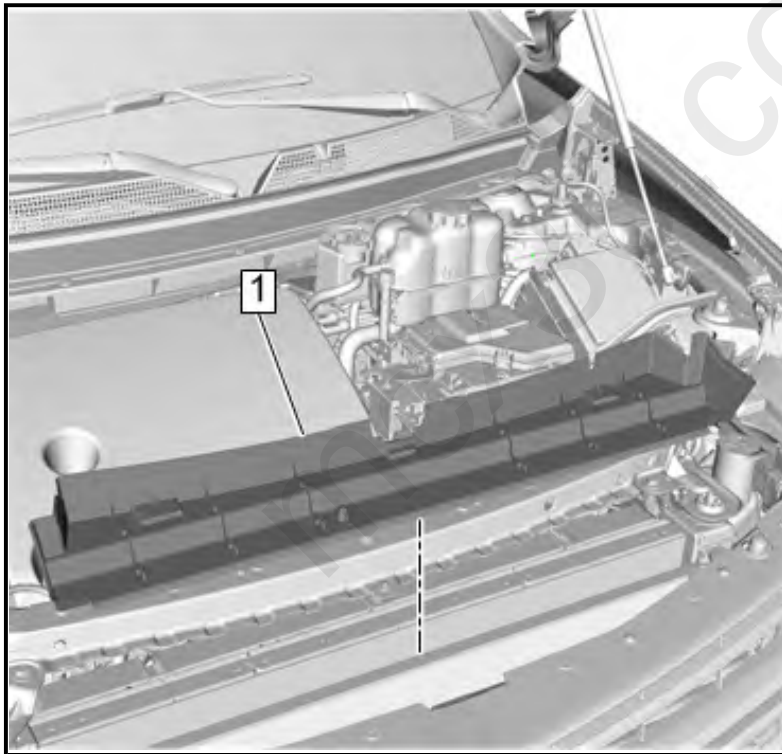




Radiator Air Baffle (1) - Remove

Installation Procedure

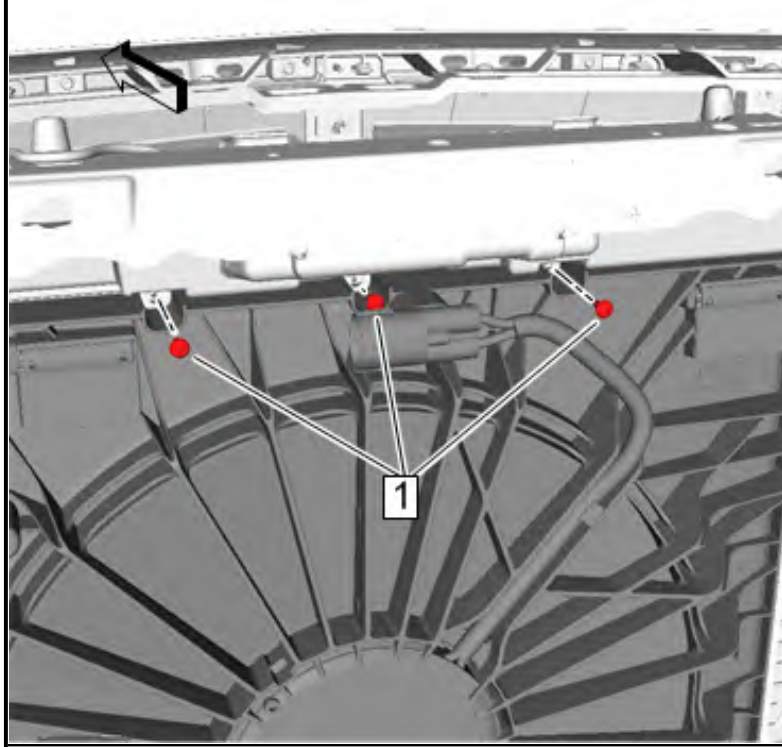
1.



Radiator Air Baffle (1) - Install

2.

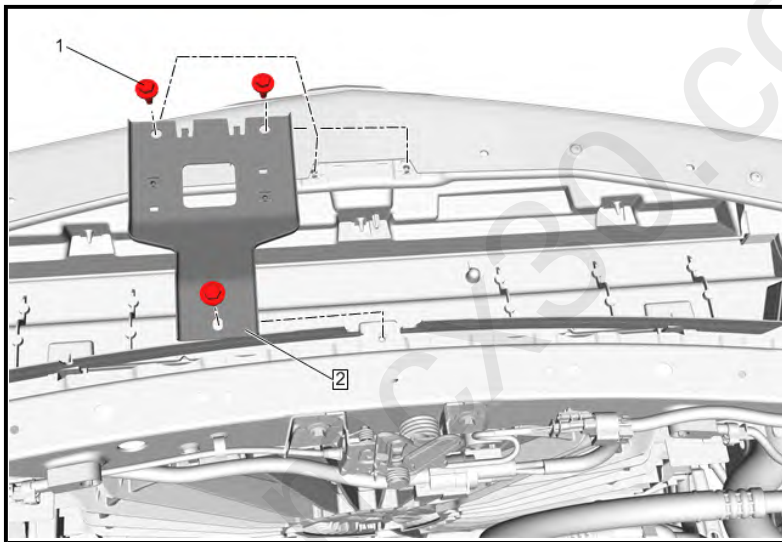




CAUTION: Refer to [Fastener Caution](#) .

Radiator Air Baffle Bolt (1) @ Engine Coolant Fan - Install and tighten [3x] 9 N.m (80 lb in)

3.



Front Bumper Fascia Support Brace - Upper (2) - Install - [Front Bumper Fascia Support Brace Replacement - Upper](#)

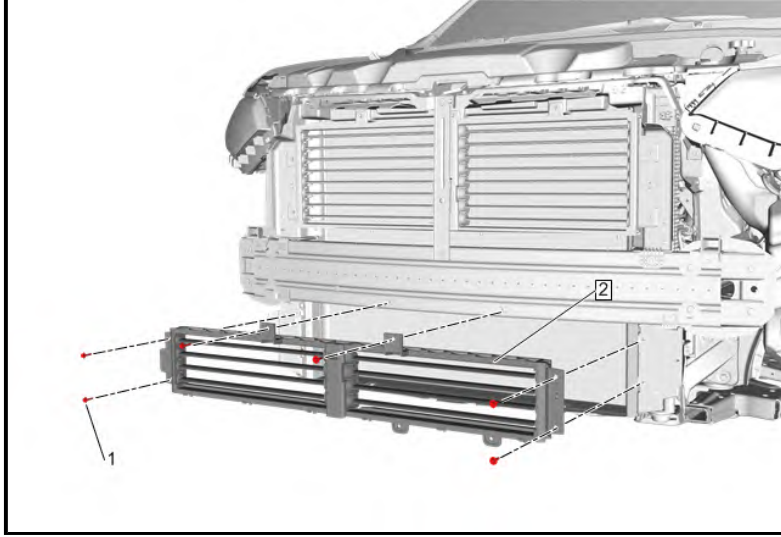
RADIATOR AIR LOWER BAFFLE REPLACEMENT (LFY WITH V08)

Removal Procedure

1. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)

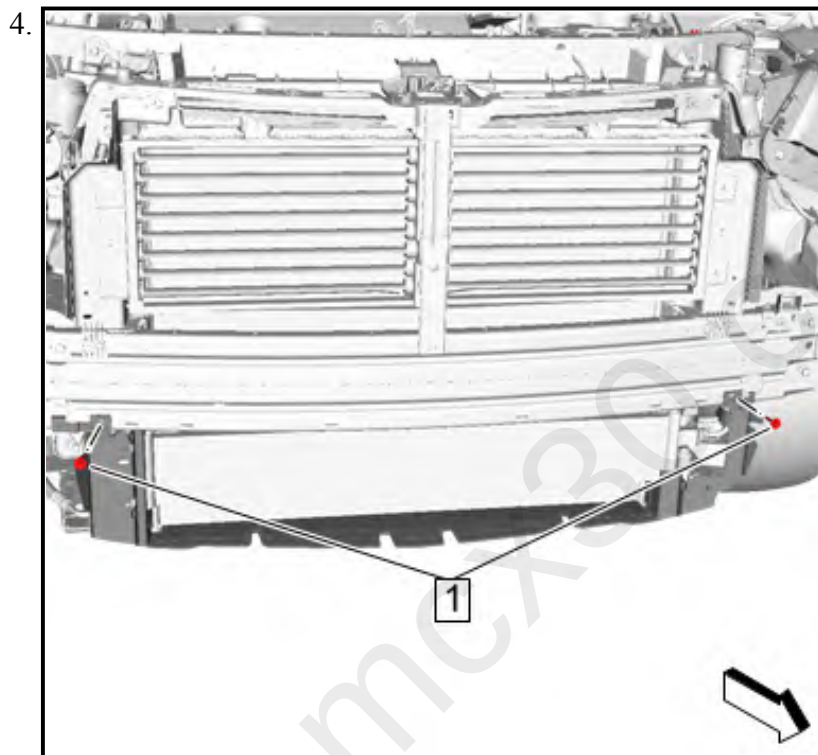
2.





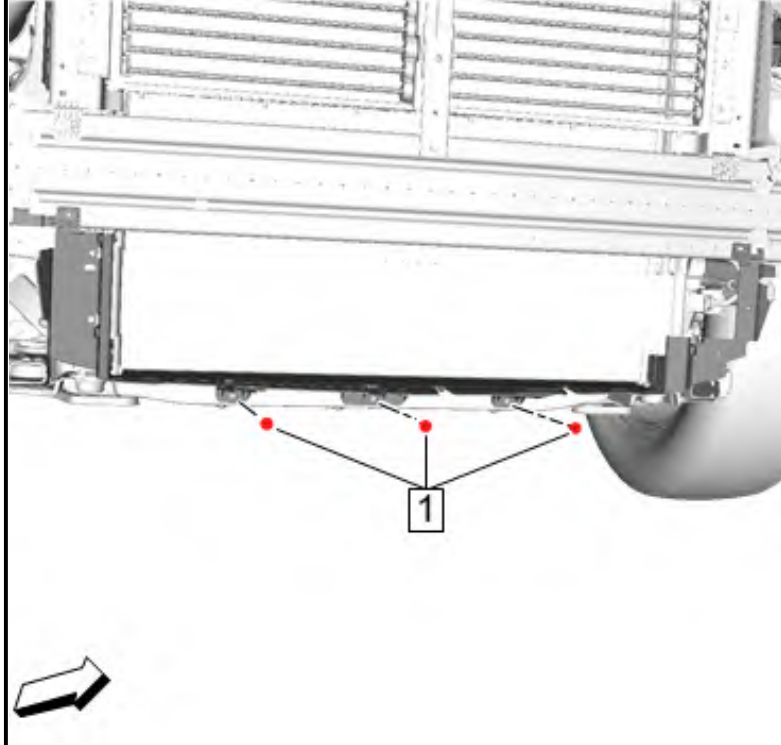
{If equipped} Front Bumper Shutter - Lower (2) - Remove - [Front Bumper Shutter Replacement \(Lower\)](#)

3. Wiring Harness @ Radiator Air Lower Baffle - Remove

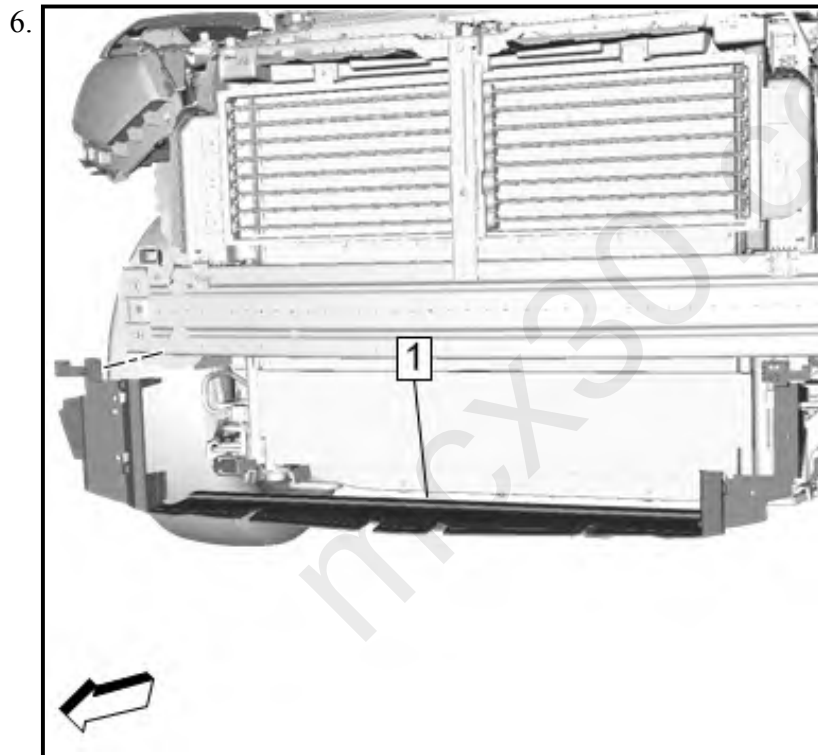


Radiator Air Lower Baffle Bolt (1) - Remove [2x]





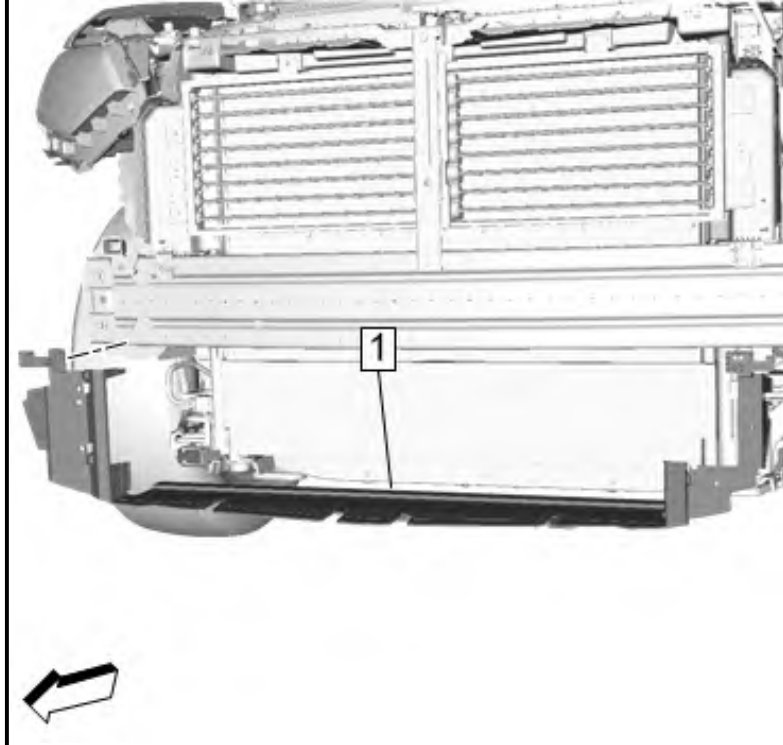
Radiator Air Lower Baffle Bolt (1) - Remove [3x]



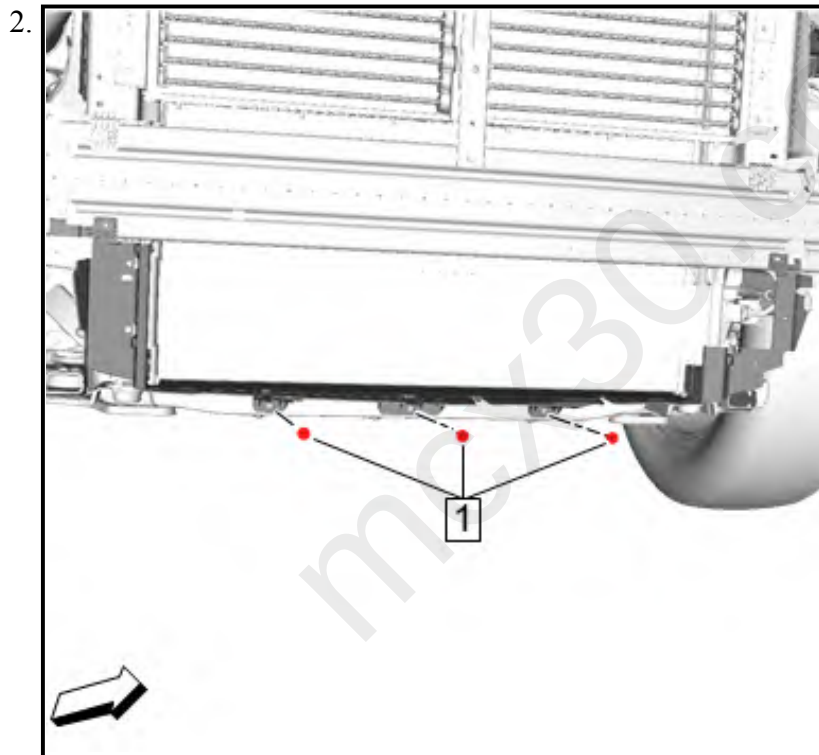
Radiator Air Lower Baffle (1) - Remove

Installation Procedure





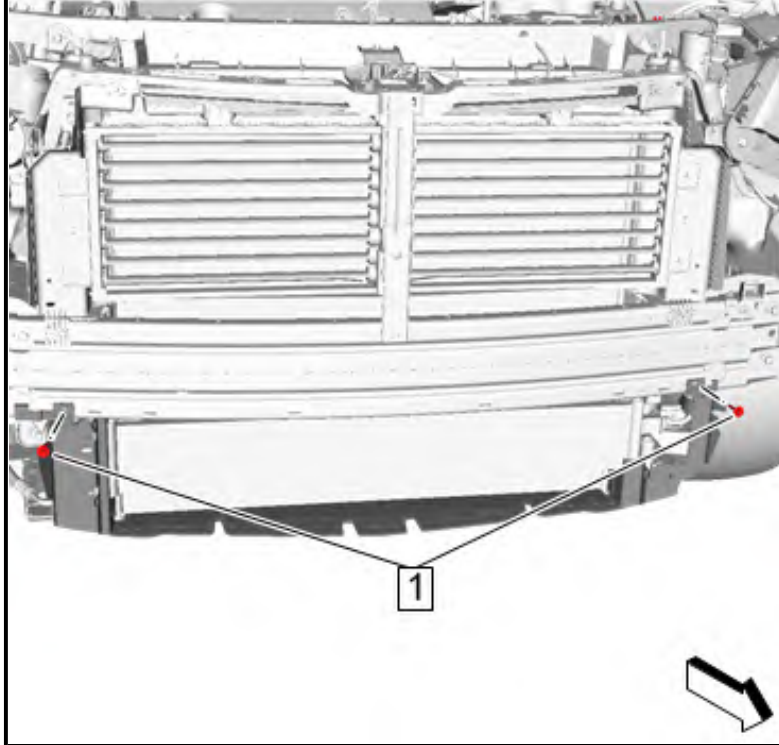
Radiator Air Lower Baffle (1) - Install



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

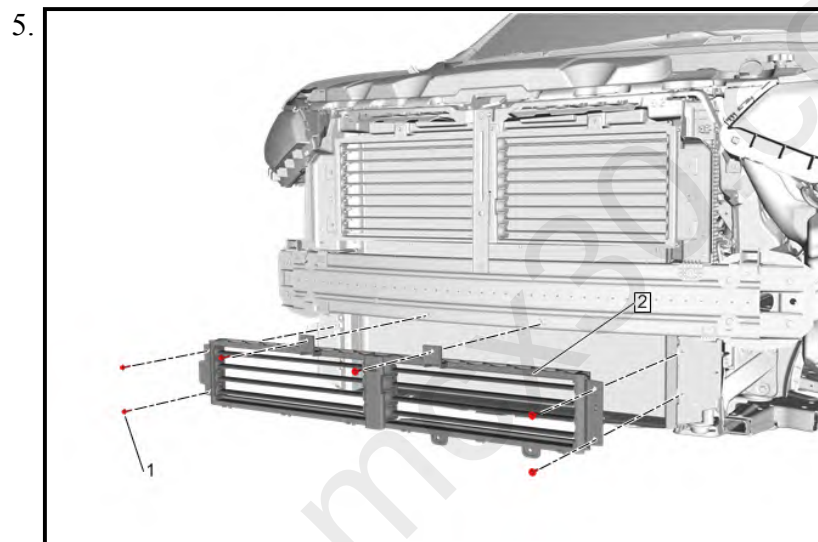
Radiator Air Lower Baffle Bolt (1) - Install and tighten [3x] 2.5 N.m (22 lb in)





Radiator Air Lower Baffle Bolt (1) - Install and tighten [2x] 2.5 N.m (22 lb in)

4. Wiring Harness @ Radiator Air Lower Baffle - Install



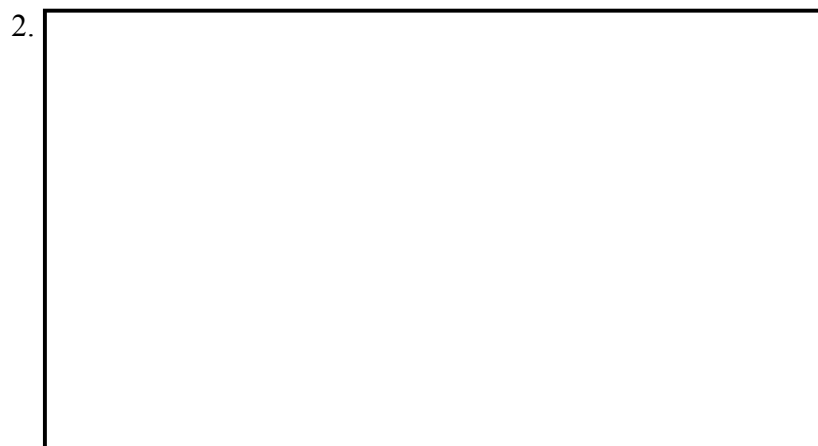
{If equipped} Front Bumper Shutter - Lower (2) - Install - [Front Bumper Shutter Replacement \(Lower\)](#)

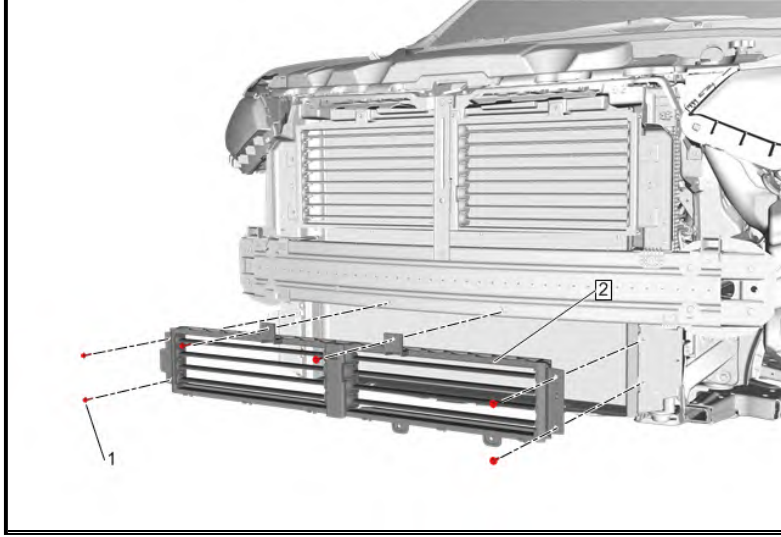
6. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

RADIATOR AIR LOWER BAFFLE REPLACEMENT (LFY WITHOUT V08)

Removal Procedure

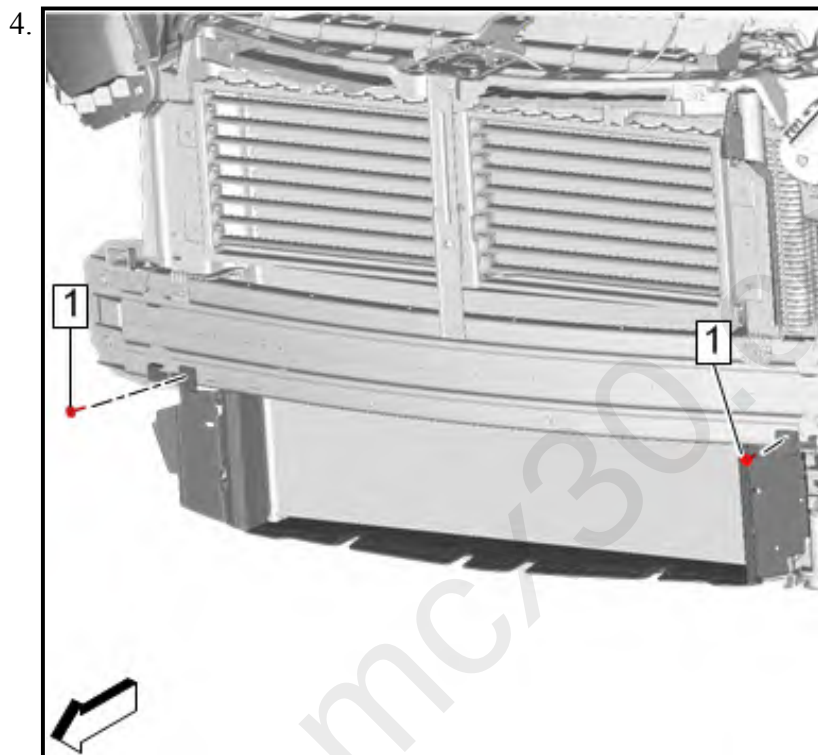
1. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)





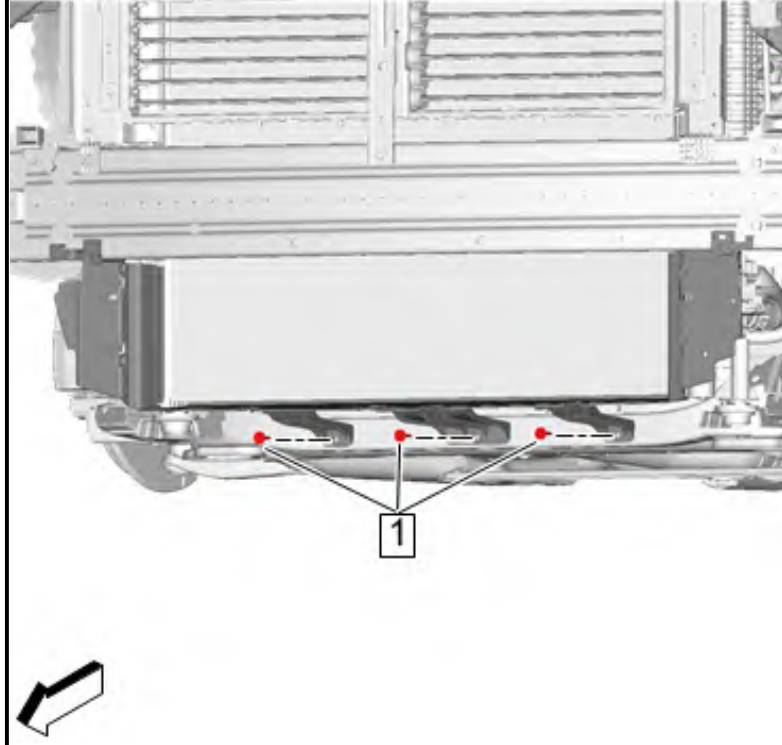
{If equipped} Front Bumper Shutter - Lower (2) - Remove - **Front Bumper Shutter Replacement (Lower)**

3. Wiring Harness @ Radiator Air Lower Baffle - Remove

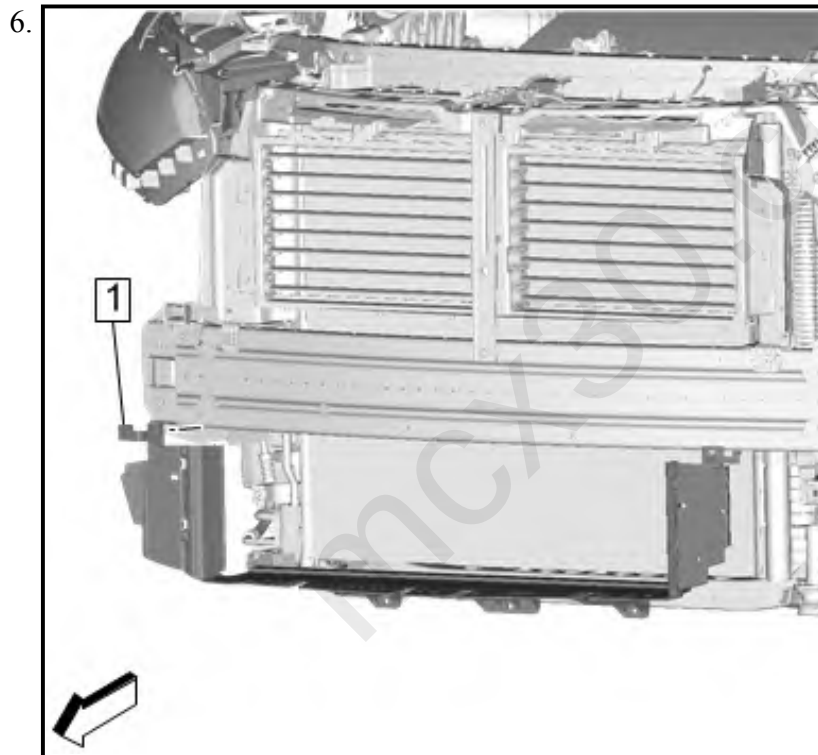


Radiator Air Lower Baffle Bolt (1) - Remove [2x]





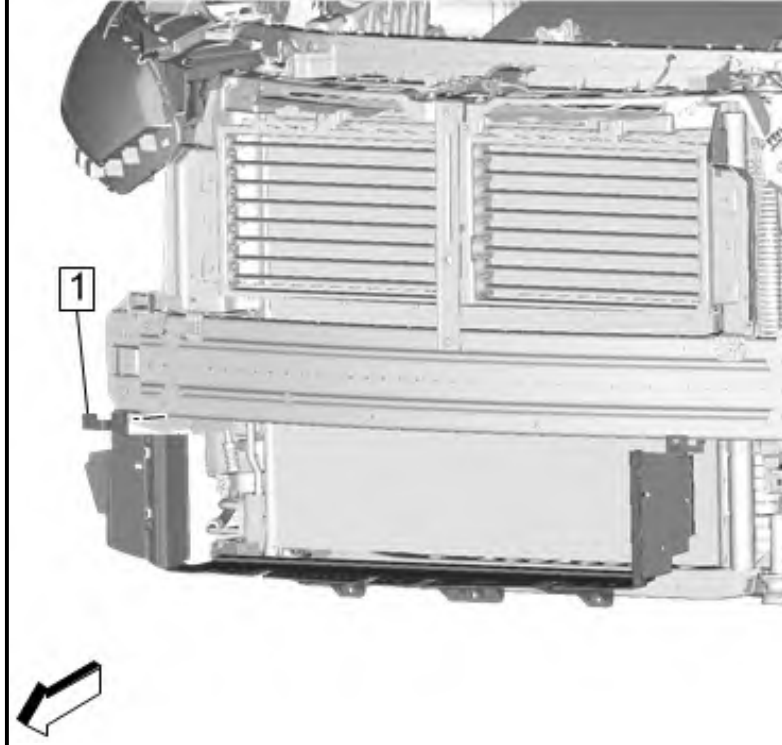
Radiator Air Lower Baffle Bolt (1) - Remove [3x]



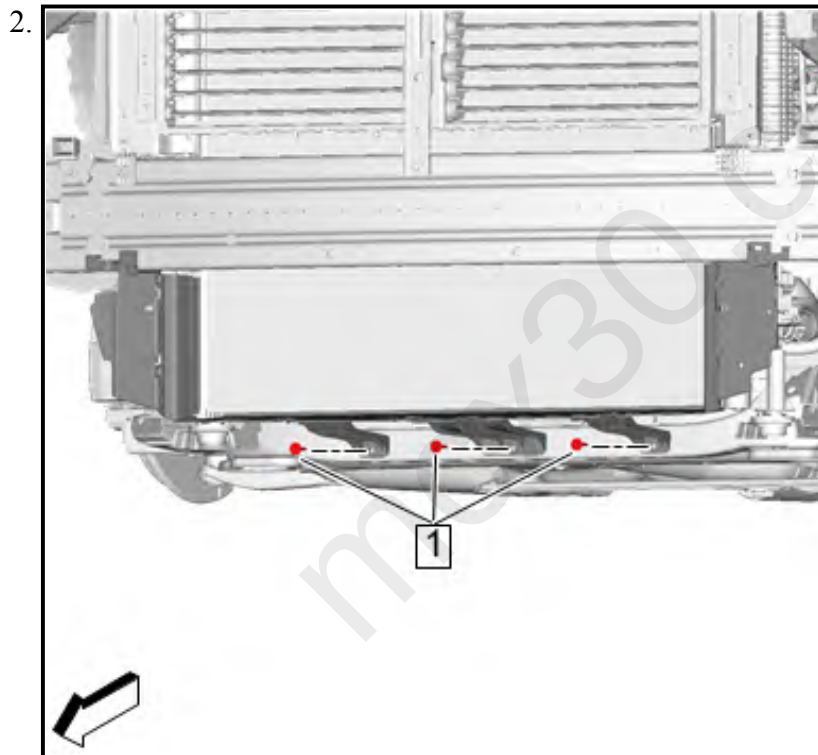
Radiator Air Lower Baffle (1) - Remove

Installation Procedure





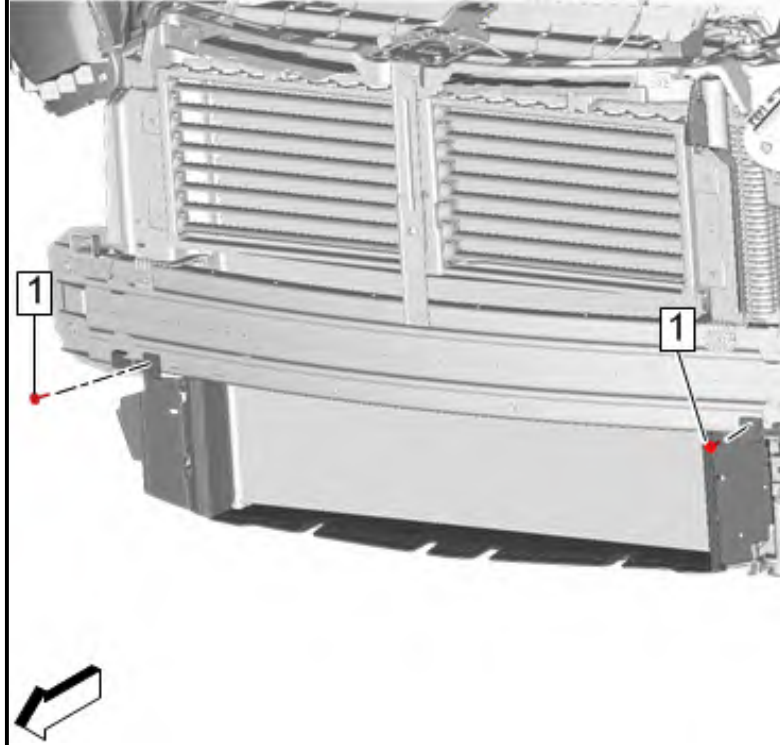
Radiator Air Lower Baffle (1) - Install



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

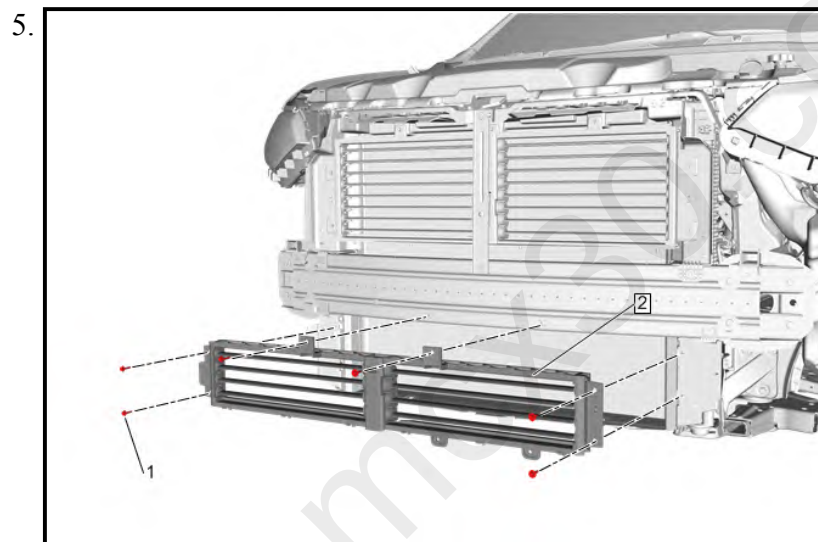
Radiator Air Lower Baffle Bolt (1) - Install and tighten [3x] 2.5 N.m (22 lb in)





Radiator Air Lower Baffle Bolt (1) - Install and tighten [2x] 2.5 N.m (22 lb in)

4. Wiring Harness @ Radiator Air Lower Baffle - Install



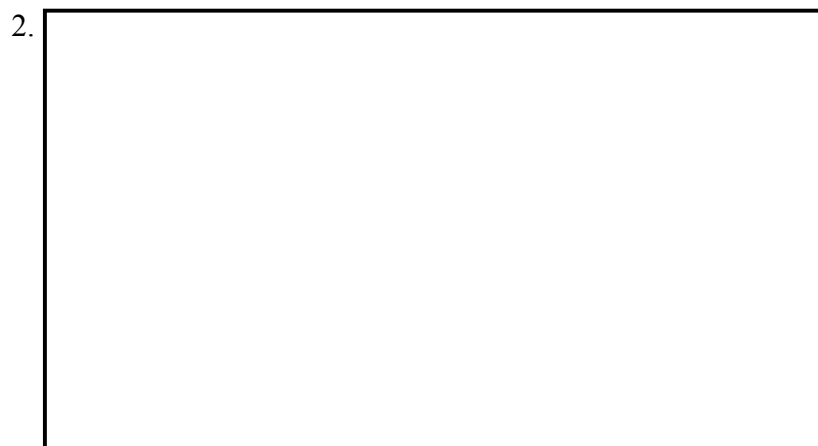
{If equipped} Front Bumper Shutter - Lower (2) - Install - [Front Bumper Shutter Replacement \(Lower\)](#)

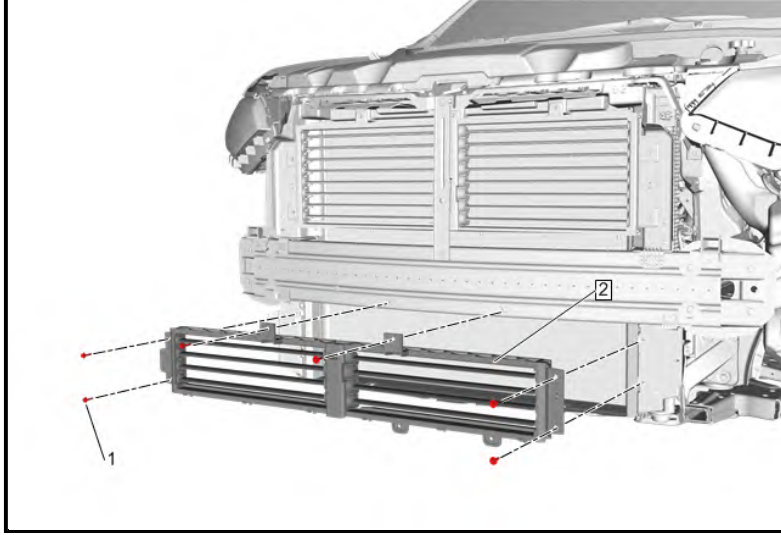
6. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

RADIATOR AIR LOWER BAFFLE REPLACEMENT (LTG)

Removal Procedure

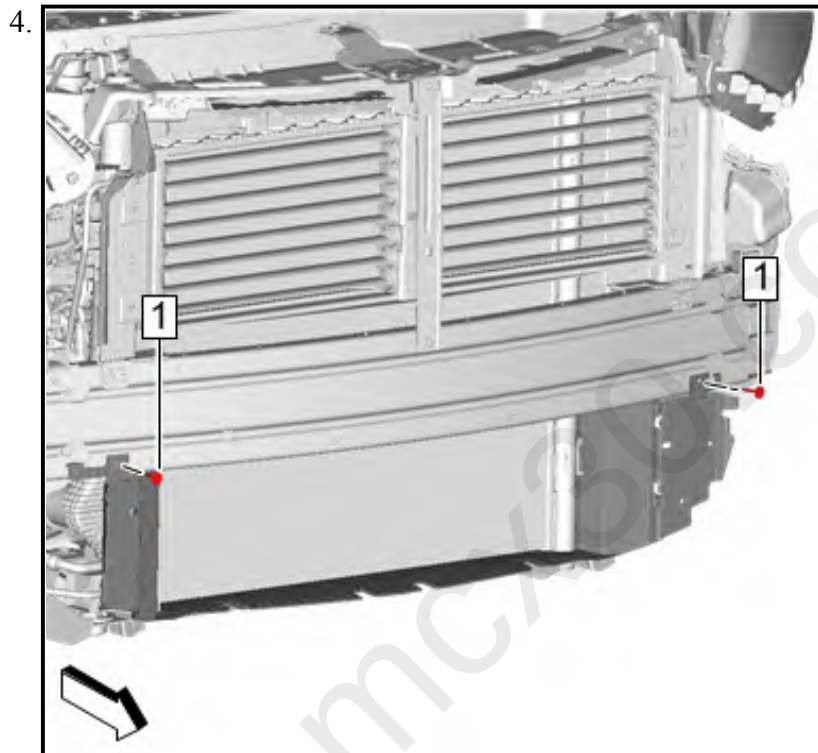
1. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)





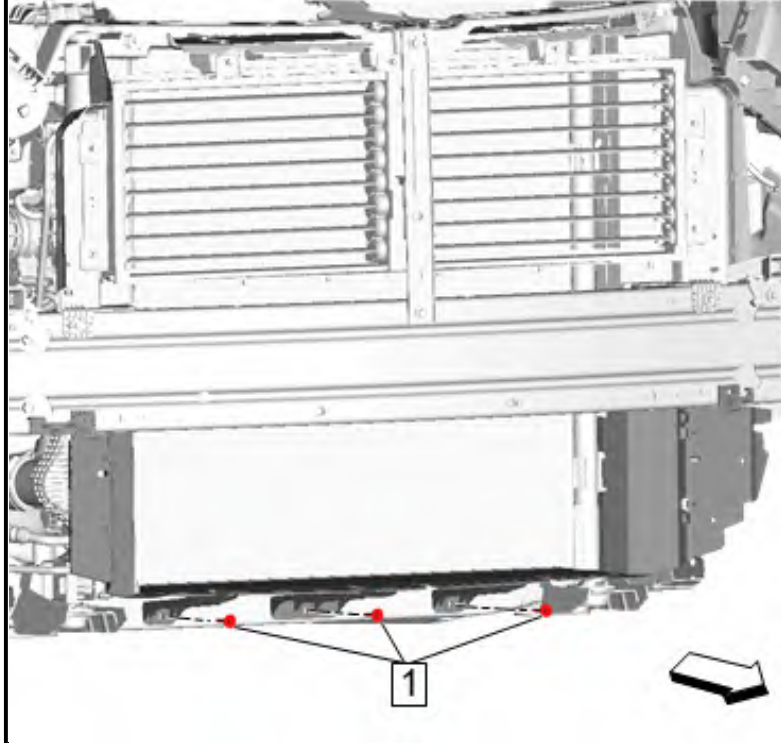
{If equipped} Front Bumper Shutter - Lower (2) - Remove - **Front Bumper Shutter Replacement (Lower)**

3. Wiring Harness @ Radiator Air Lower Baffle - Remove



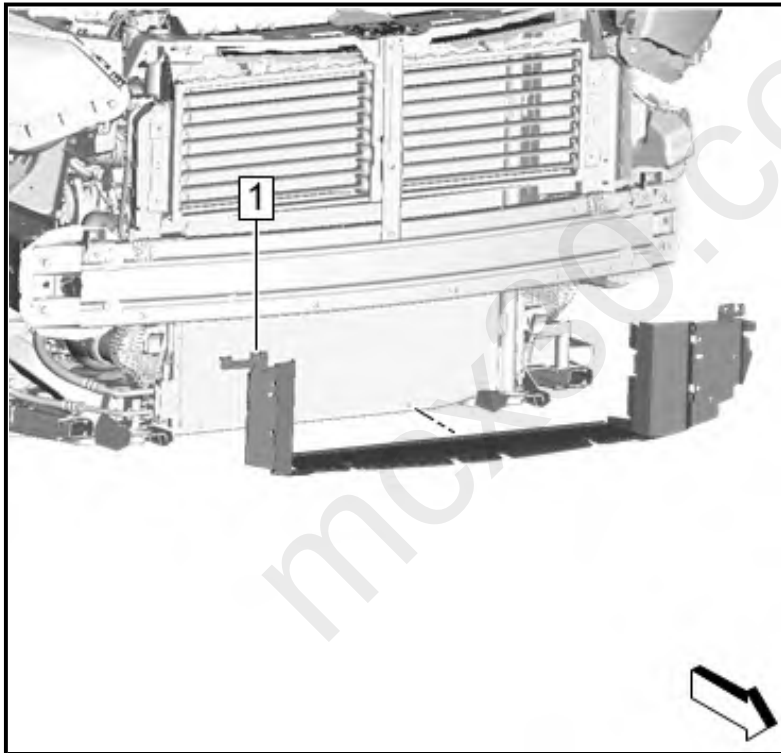
Radiator Air Lower Baffle Bolt (1) - Remove [2x]





Radiator Air Lower Baffle Bolt (1) - Remove [3x]

6.

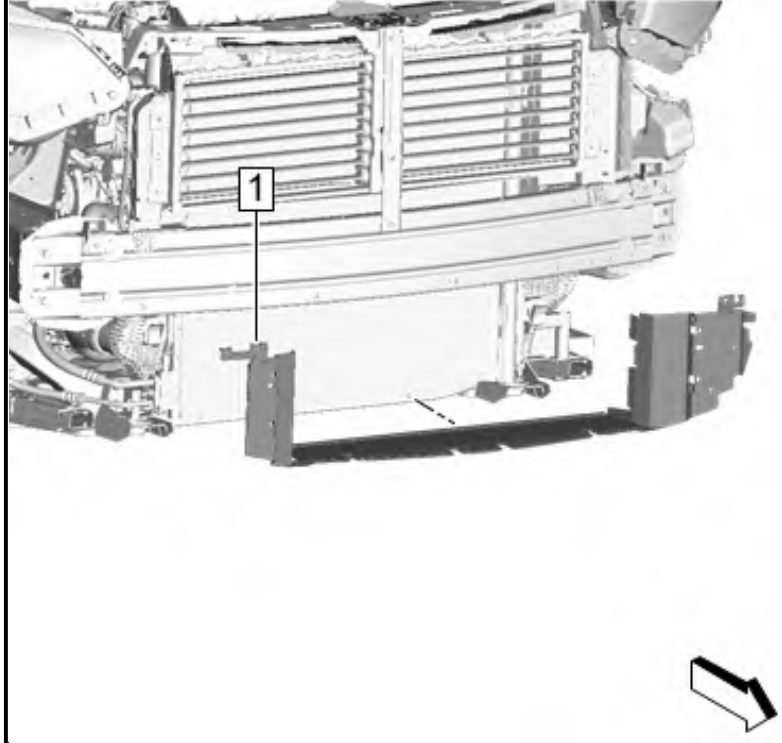


Radiator Air Lower Baffle (1) - Remove

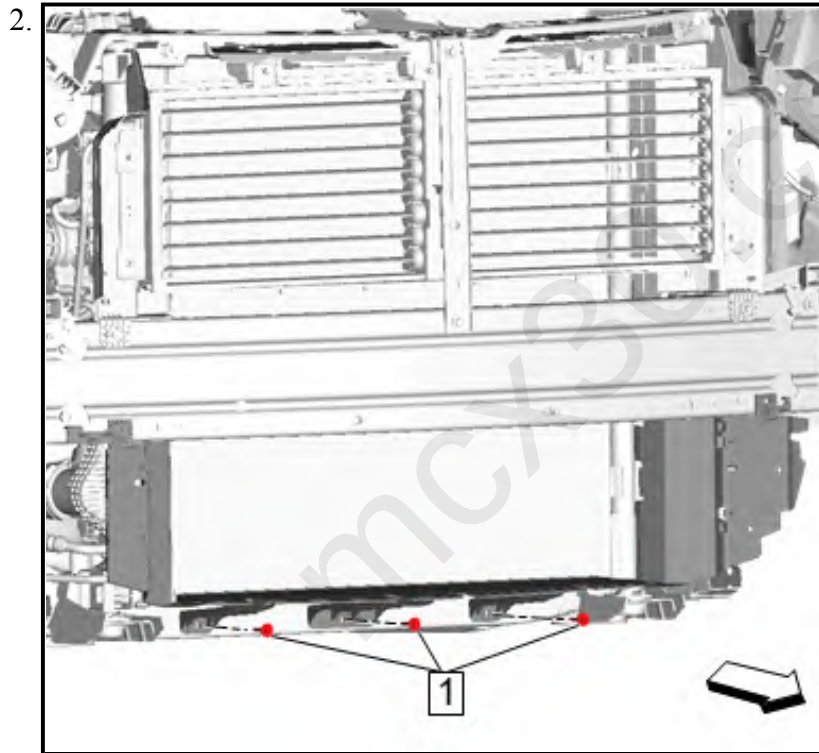
Installation Procedure

1.





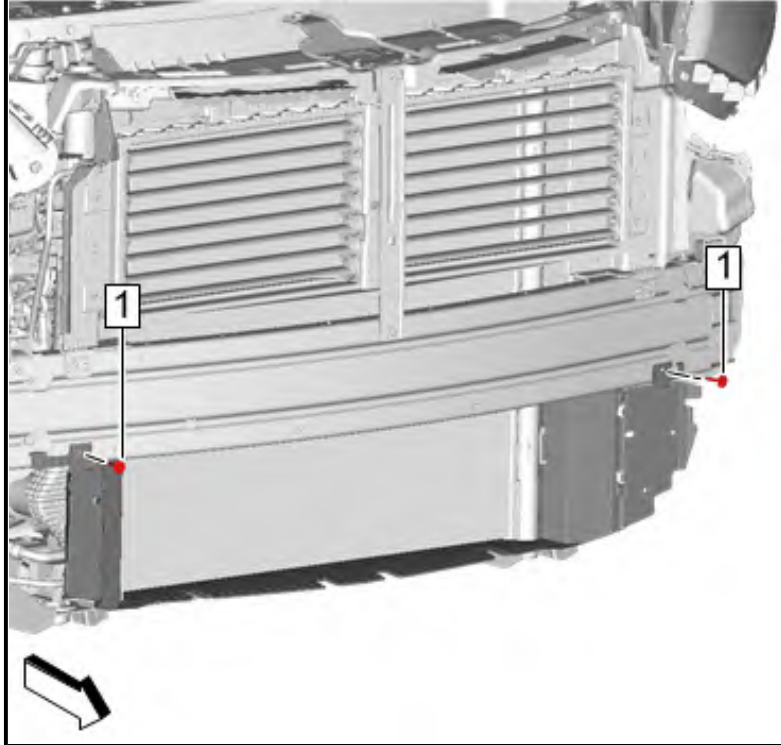
Radiator Air Lower Baffle (1) - Install



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

Radiator Air Lower Baffle Bolt (1) - Install and tighten [3x] 2.5 N.m (22 lb in)

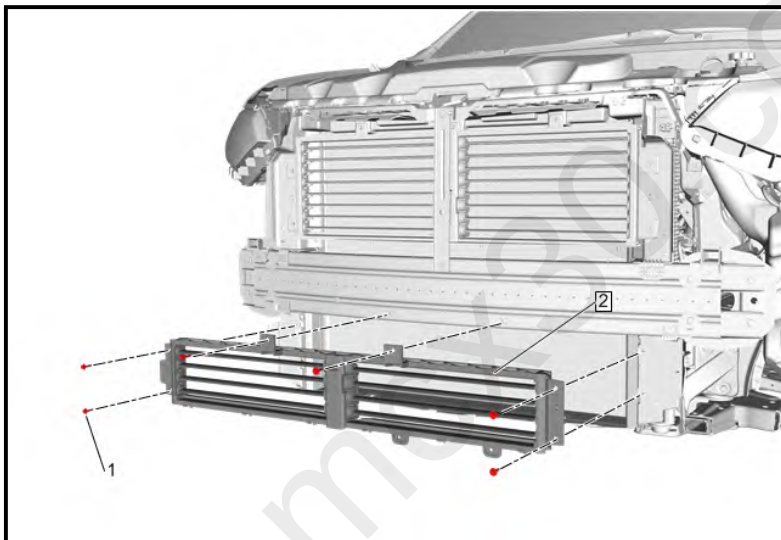




Radiator Air Lower Baffle Bolt (1) - Install and tighten [2x] 2.5 N.m (22 lb in)

4. Wiring Harness @ Radiator Air Lower Baffle - Install

5.



{If equipped} Front Bumper Shutter - Lower (2) - Install - [Front Bumper Shutter Replacement \(Lower\)](#)

6. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

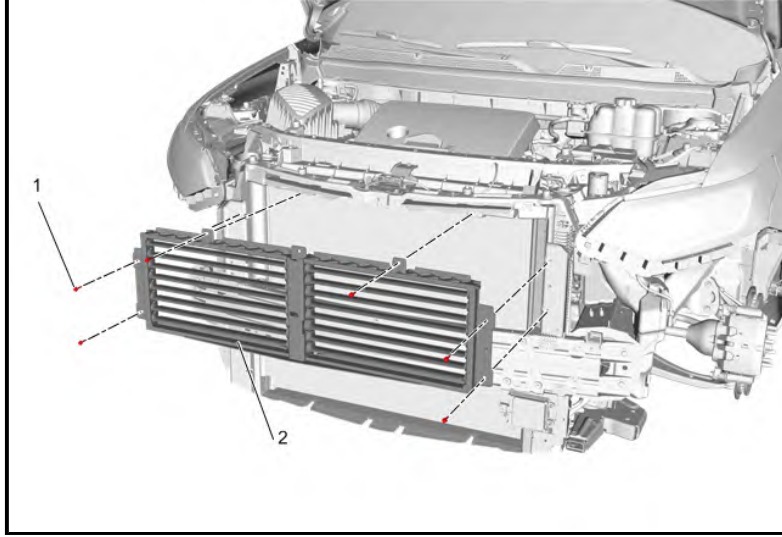
RADIATOR AIR UPPER BAFFLE REPLACEMENT

Removal Procedure

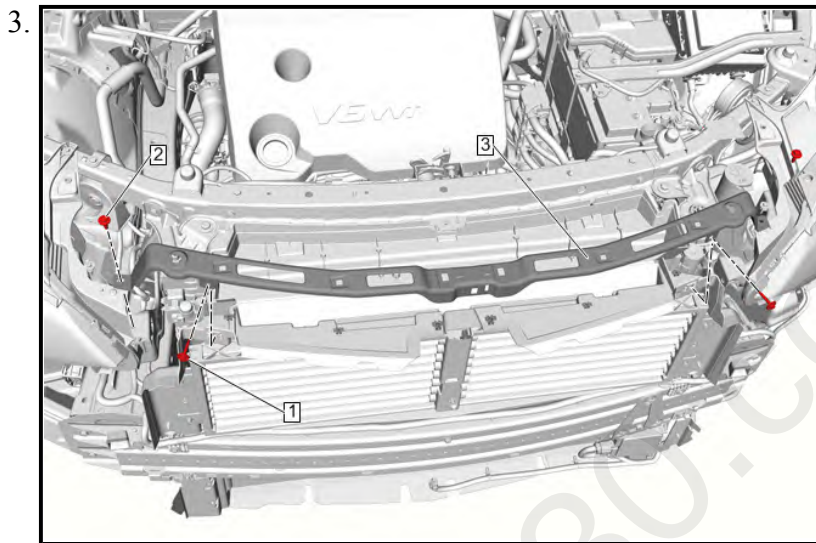
1. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement](#)

2.



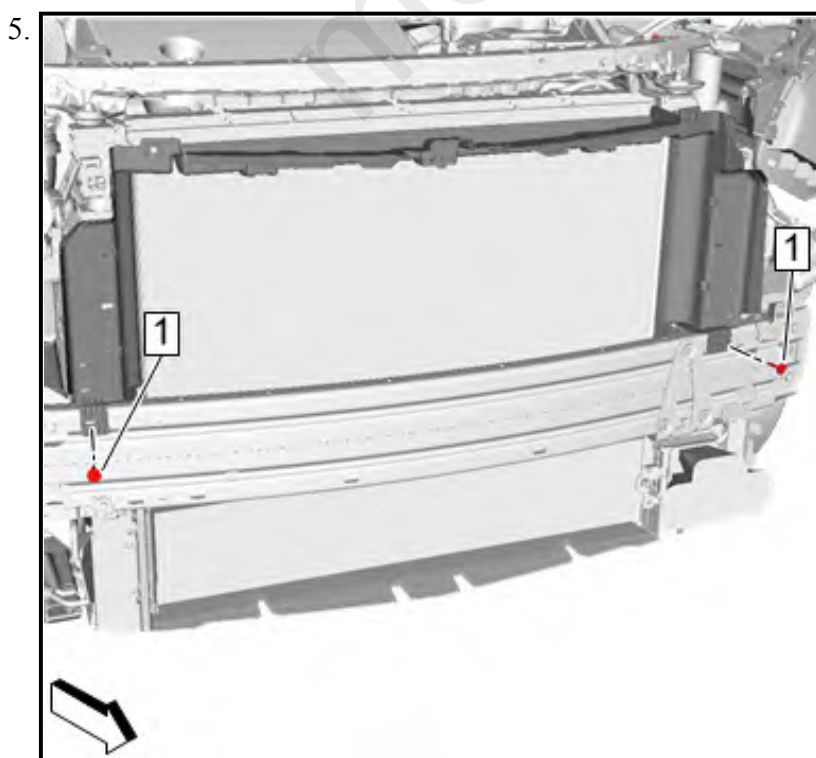


{If equipped} Front Bumper Shutter- Upper (2) - Remove - [Front Bumper Shutter Replacement \(Upper\)](#)



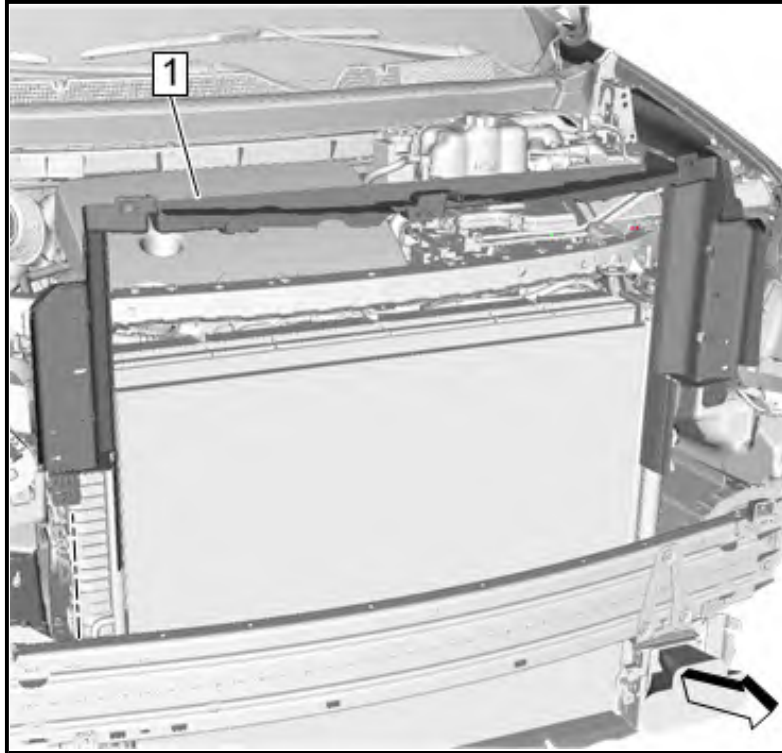
Front Bumper Fascia Center Support - Upper (3) - Remove - [Front Bumper Fascia Center Support Replacement](#)

4. Wiring Harness @ Radiator Air Upper Baffle - Remove



Radiator Air Upper Baffle Bolt (1) - Remove [2x]

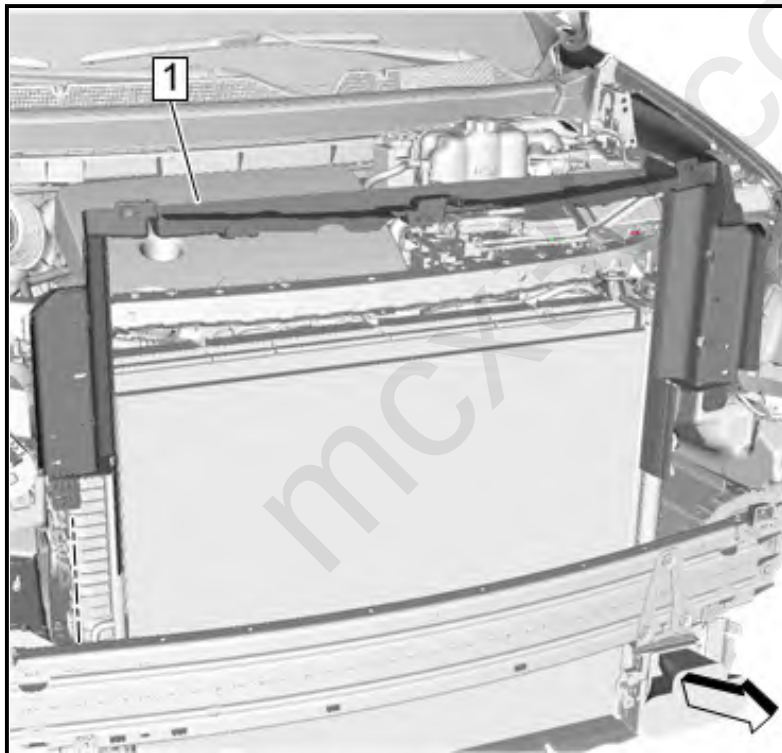
6.



Radiator Air Upper Baffle (1) - Remove

Installation Procedure

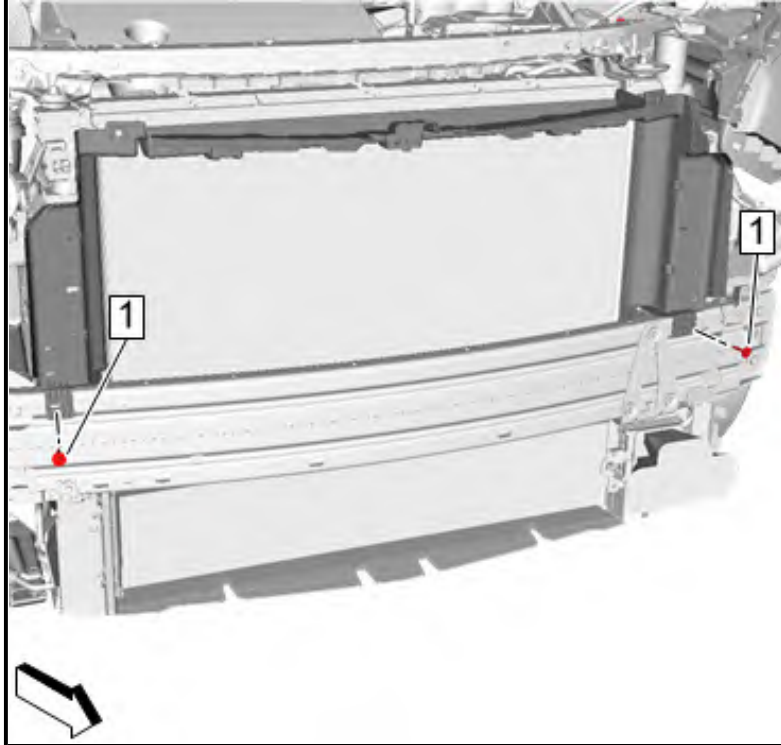
1.



Radiator Air Upper Baffle (1) - Install

2.

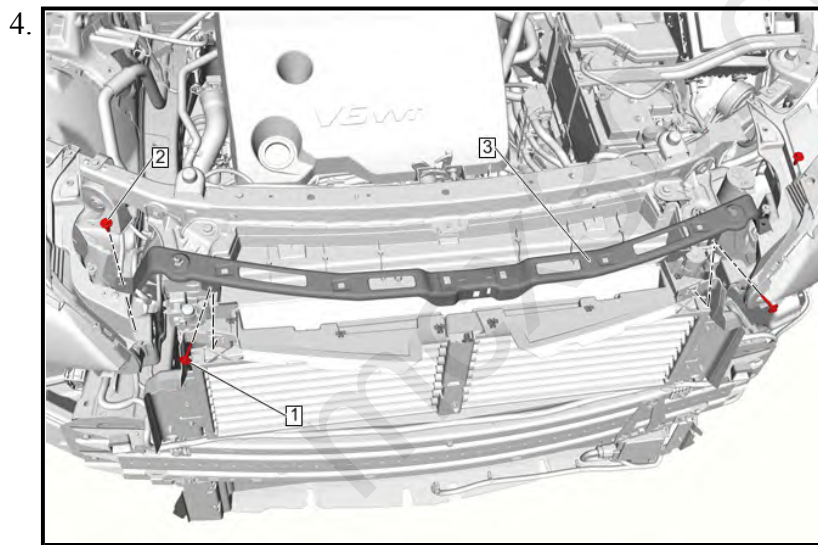




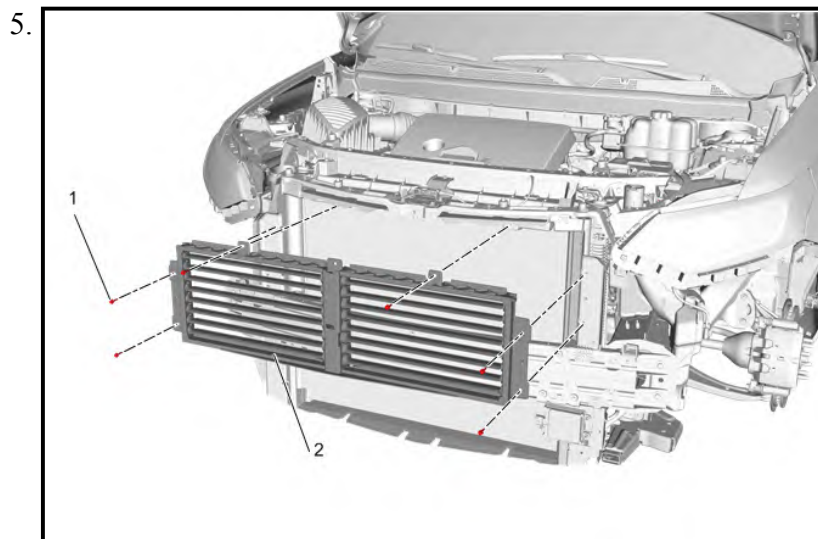
CAUTION: Refer to [Fastener Caution](#) .

Radiator Air Upper Baffle Bolt (1) - Install and tighten [2x] 2.5 N.m (22 lb in)

3. Wiring Harness @ Radiator Air Upper Baffle - Install



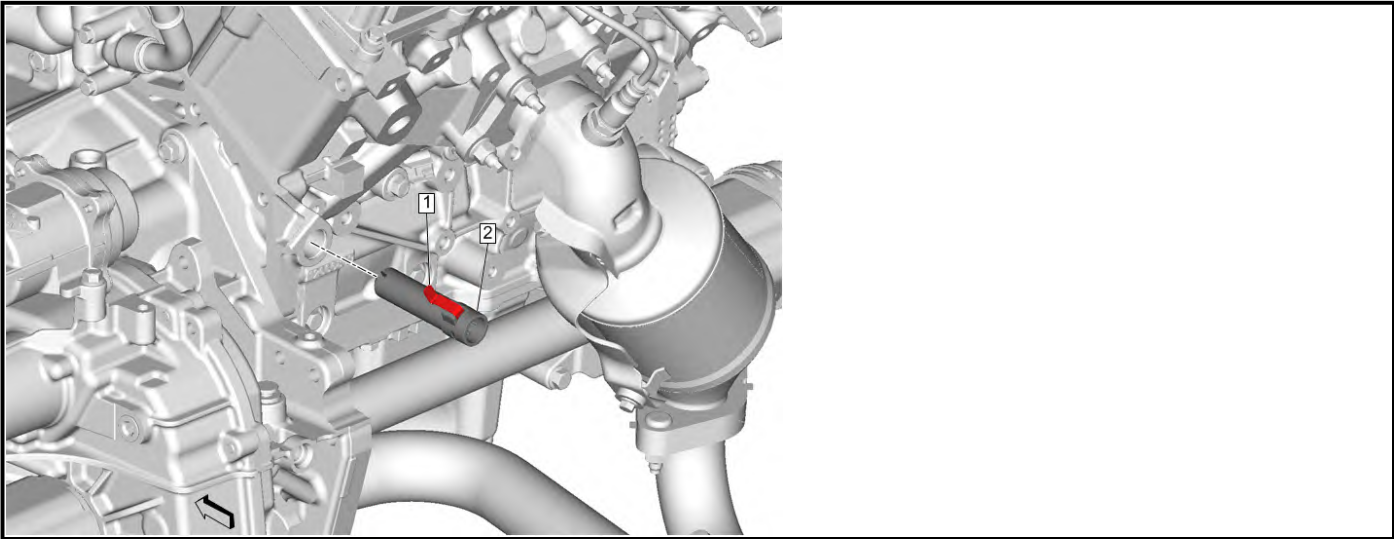
Front Bumper Fascia Center Support - Upper (3) - Install - [Front Bumper Fascia Center Support Replacement](#)



{If equipped} Front Bumper Shutter - Upper (2) - Install - [Front Bumper Shutter Replacement \(Upper\)](#)

6. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement](#)

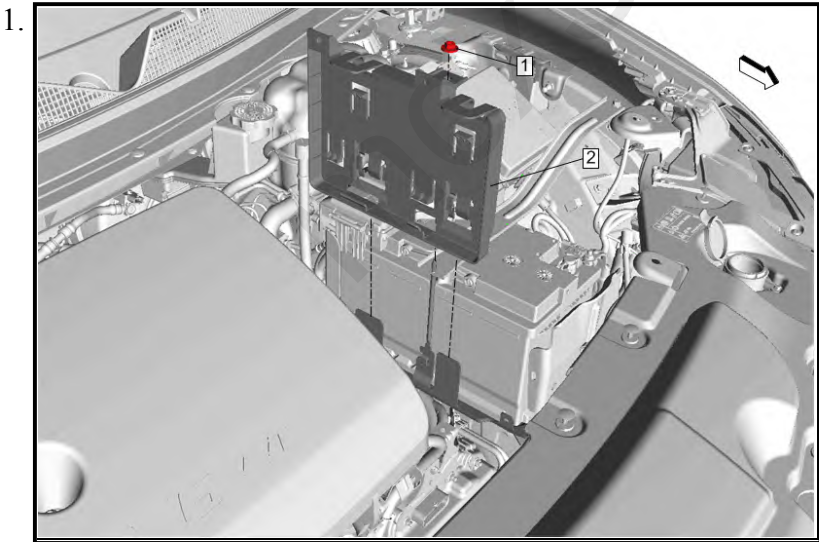
ENGINE COOLANT HEATER REPLACEMENT (LFY)



Callout	Component Name
Preliminary Procedure Lifting and Jacking the Vehicle	
1	Engine Coolant Heater Clip
2	Engine Coolant Heater Procedure Disconnect the coolant heater cord.

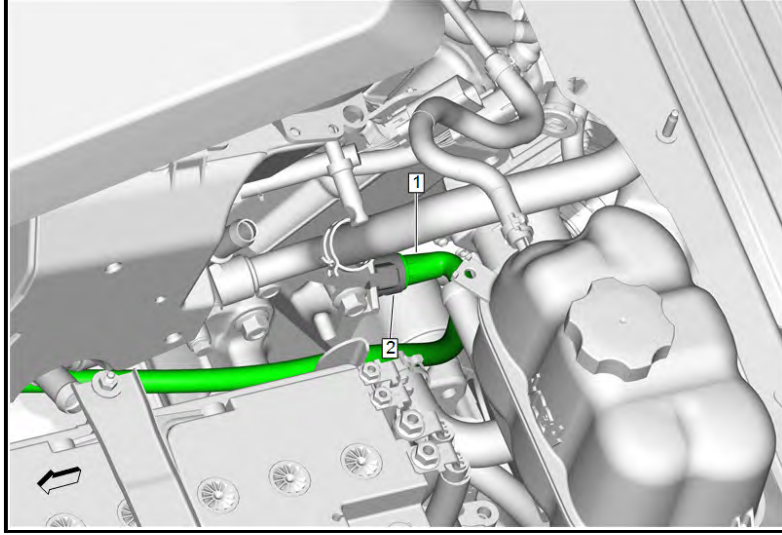
ENGINE COOLANT HEATER CORD REPLACEMENT

Removal Procedure

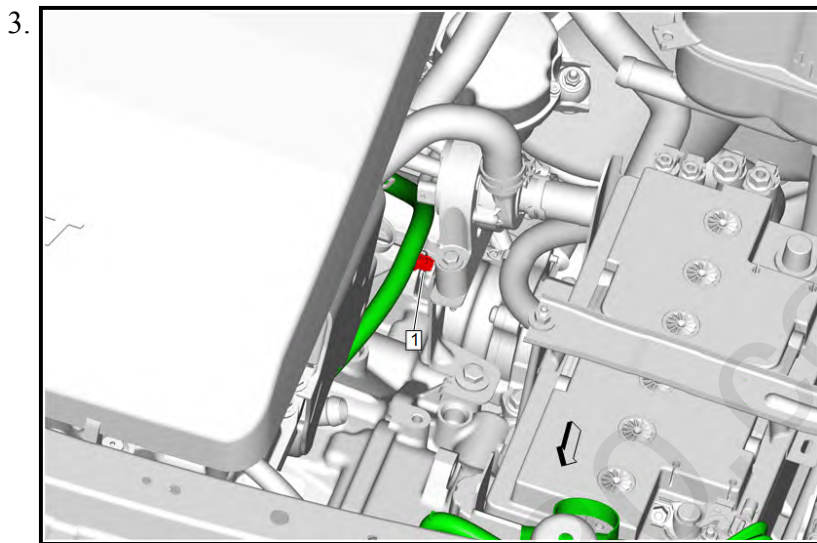


Engine Control Module Bracket (2) - Remove - [Engine Control Module Bracket Replacement](#)

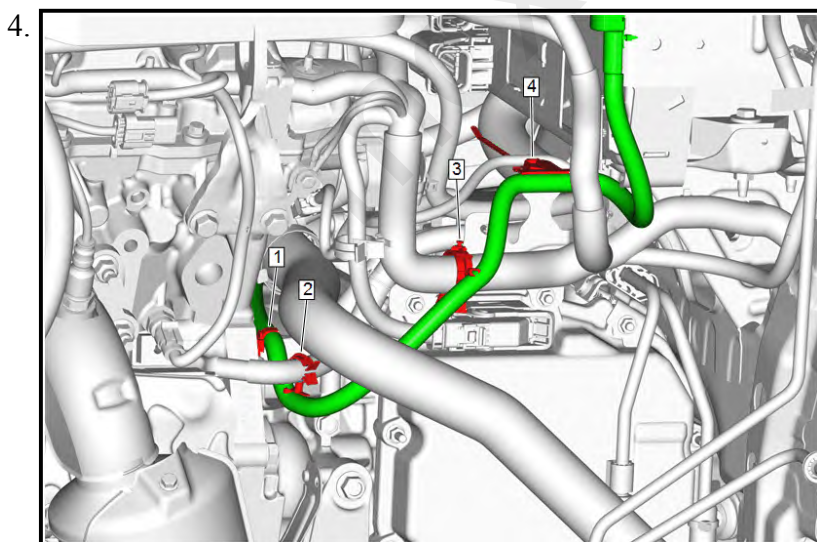




Engine Coolant Heater Cord (1) @ Engine Coolant Heater (2) - Disconnect



Engine Coolant Heater Cord Retainer (1) @ Heater Water Auxiliary Pump Bracket - Separate



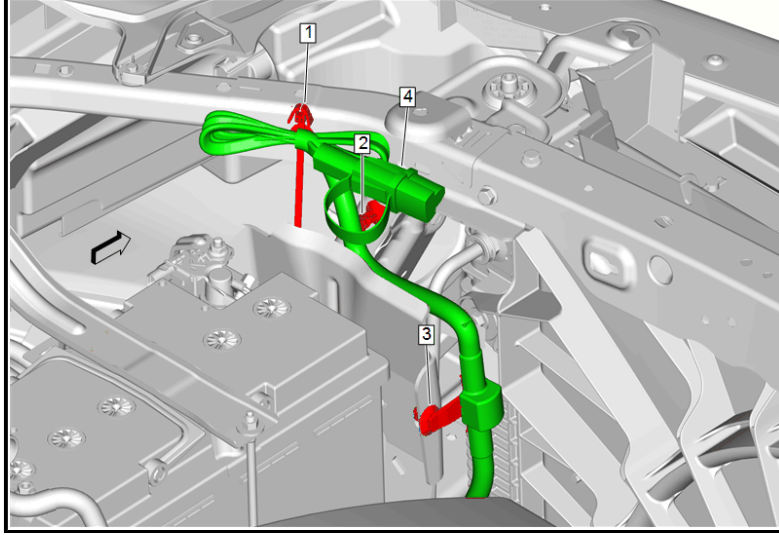
Engine Coolant Heater Cord Retainer (1) @ Engine Block - Separate

5. Engine Coolant Heater Cord Retainer (2) @ Battery Positive Cable - Separate

6. Engine Coolant Heater Cord Retainer (3) @ Engine Wiring Harness - Separate

7. Engine Coolant Heater Cord Retainer (4) @ Transmission Wiring Harness Bracket - Separate

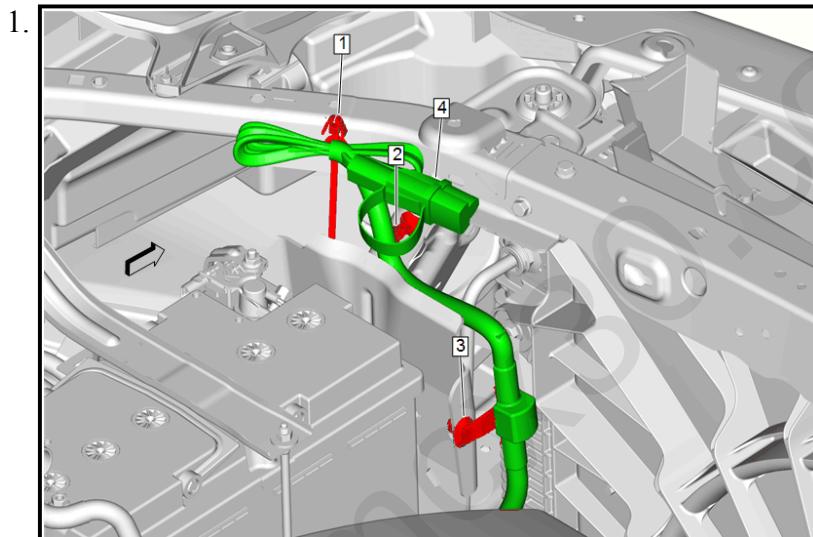




Engine Coolant Heater Cord Retainer (1) @ Upper Tie Bar - Separate

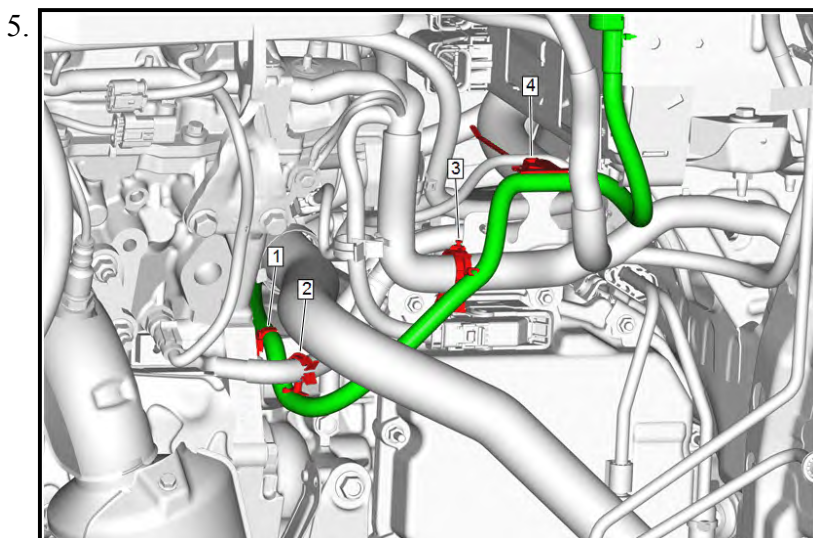
9. Engine Coolant Heater Cord Retainer (2) @ Upper Tie Bar Mounting Outer Extension - Separate
10. Engine Coolant Heater Cord Retainer (3) @ Battery Tray Front Shield - Separate
11. Engine Coolant Heater Cord (4) - Remove

Installation Procedure



Engine Coolant Heater Cord (4) - Install

2. Engine Coolant Heater Cord Retainer (3) @ Battery Tray Front Shield - Install
3. Engine Coolant Heater Cord Retainer (2) @ Upper Tie Bar Mounting Outer Extension - Install
4. Engine Coolant Heater Cord Retainer (1) @ Upper Tie Bar - Install

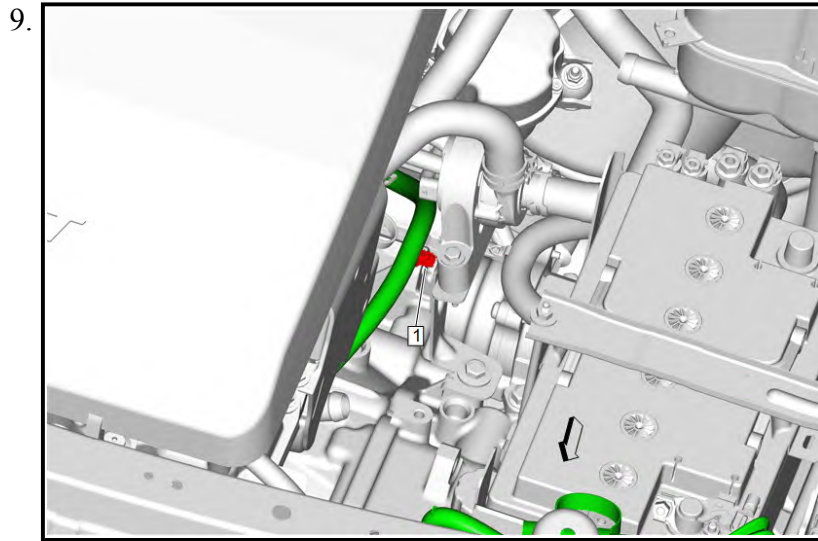


Engine Coolant Heater Cord Retainer (4) @ Transmission Wiring Harness Bracket - Install

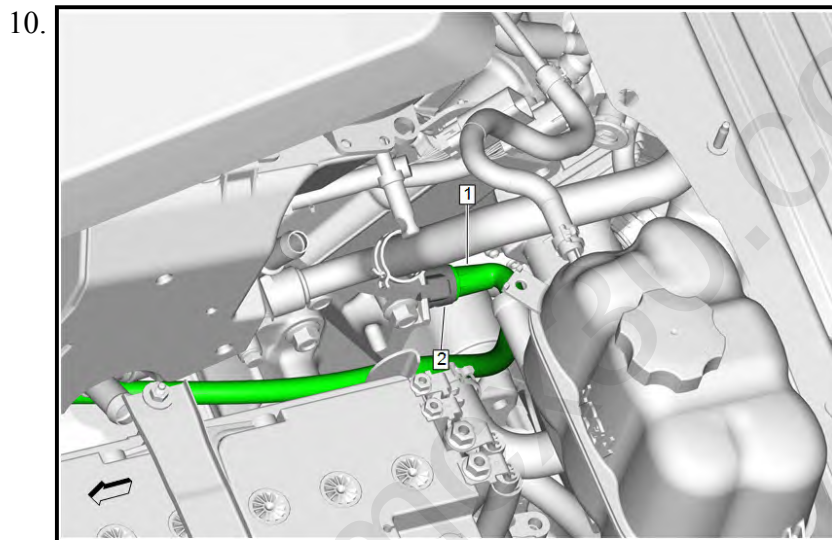
6. Engine Coolant Heater Cord Retainer (3) @ Engine Wiring Harness - Install

7. Engine Coolant Heater Cord Retainer (2) @ Battery Positive Cable - Install

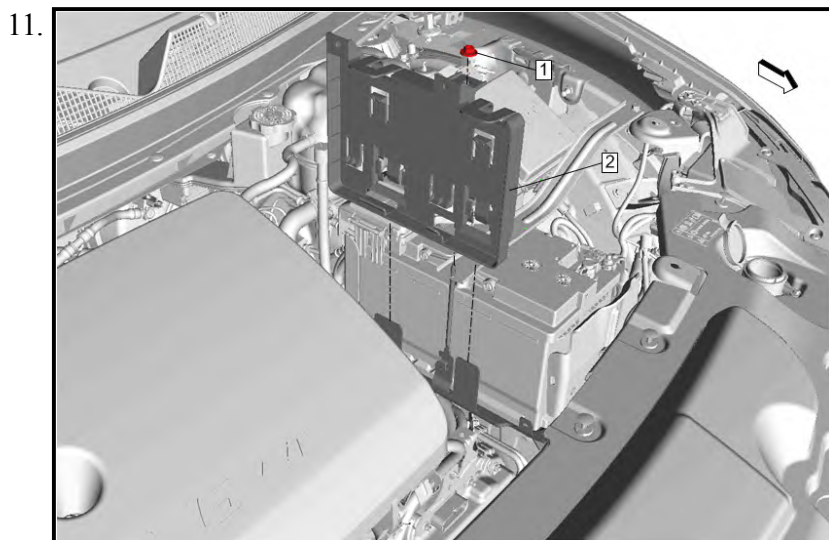
8. Engine Coolant Heater Cord Retainer (1) @ Engine Block - Install



Engine Coolant Heater Cord Retainer (1) @ Heater Water Auxiliary Pump Bracket - Install



Engine Coolant Heater Cord (1) @ Engine Coolant Heater (2) - Connect



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

DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system is composed of 1 electric cooling fan, fan motor and 1 control module. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal, which allows the cooling fan to operate at variable speeds.

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

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

Cooling System 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 SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Description and Operation

For cooling fan description and operation, refer to [Cooling Fan Description and Operation](#).

Engine Coolant

Engine coolant is the key element of the heating system. The engine thermostat controls the normal engine operating coolant temperature. Coolant pumped out of the engine block enters the heater core through the inlet heater hose. The air flowing through the HVAC module absorbs the heat of the coolant flowing through the heater core. The coolant then exits the heater core through the heater outlet hose. To prevent the coolant from boiling after the engine is turned off an after-boil/heater coolant pump is used.

The HVAC control module will command the after-boil/heater coolant pump on when the engine is off under the following conditions:

- The engine is OFF.
- The engine coolant temperature is greater than 101°C (214°F).

The above coolant flow circuits are designed to show the coolant flow related to the coolant by-pass valve positions only. The thermostat function and thermostat coolant flow paths are not shown.

Coolant Warning Messages

The radio will display the following messages if the following conditions exist in the cooling system.

- Engine hot - A/C OFF, is displayed if the coolant temperature is greater than 117°C (243°F) for domestic vehicles or 115°C (239°F) for imports.
- Engine coolant hot - idle engine, is displayed if the coolant temperature is greater than 118°C (245°F).
- Engine overheated - stop engine, is displayed if the coolant temperature is greater than 123°C (253°F).

Coolant Heater

The optional engine coolant heater (RPO K05) operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather -29°C (-20°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the system cools slowly or not at all. This allows the engine to warm quickly.

Cooling Cycle

The thermostat is located between the radiator outlet and the water pump inlet. At normal operating temperature, coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. In cold conditions, the thermostat will bypass the radiator, and the pump will draw coolant directly from the engine outlet.

Coolant is then pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

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

Coolant is also directed to the throttle body. There it circulates through passages in the casting. During initial warm-up, the coolant assists in warming the throttle body. During normal operating temperatures, the coolant assists in keeping the throttle body cool.

From the cylinder heads, the coolant is then forced to the engine outlet. Coolant leaves the engine through four different routes:

1. Through the engine outlet fitting to the radiator. This path is blocked at cold conditions by the thermostat at the engine inlet fitting.
2. Through the radiator bypass.
3. To the heater core for passenger compartment heat and defrost.
4. Through the vent hose to the surge tank, providing continuous direction of the cooling system.

Operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and clean drinkable water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a crossflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire core assembly is then brazed forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock which is located in the bottom of the driver's side tank. The drain cock includes the drain cock and drain cock seal.

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

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Pressure Cap

The pressure cap is a cap that seals and pressurizes the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring and protects the radiator by relieving pressure if it exceeds 18 psi. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, could cause the radiator hoses to collapse.

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

Surge Tank

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

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. This is an advantage to 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 system cooling. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle to flow through the radiator and increase cooling. Air baffles are also used to direct airflow into the radiator and increase cooling. Air seals prevent air from bypassing the radiator and A/C condenser. Air seals also prevent recirculation of the air for better hot weather cooling and A/C condenser performance.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing 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. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The purpose of the water pump is to circulate coolant throughout the cooling system. The water pump is driven by the crankshaft via the drive belt.

Thermostat

The thermostat is a coolant flow control component. Its purpose is to regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a piston. When the element is heated, it expands and exerts pressure against a rubber diaphragm. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up quickly. After the coolant temperature reaches rated thermostat opening temperature, the thermostat valve will open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, even after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Charged Air Cooler

The Charged Air Cooler (CAC) is an air to air heat exchanger which is located below the transmission oil cooler and between the A/C condenser and the radiator. Forced intake air from the turbocharger is plumbed to the CAC through inlet duct. The forced intake air passes through the CAC cooling the air. The cooled air is plumbed to the throttle body through the outlet duct. The cooled intake air helps provide a more efficient fuel/air combustion.

Transmission Oil Cooler

CAUTION:

The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission, and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

LFY with V08

There are 2 transmission oil coolers in a series in the heavy duty transmission oil cooler system. The fluid is pumped from the transmission to a Thermal Bypass Valve (TBV) which begins to open at 80°C (176°F) and is fully open at 96°C (205°F). The fluid is then pumped to the initial transmission oil cooler which is a heat exchanger located in the side tank of the radiator. The transmission oil temperature is partially regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. The oil out of the cooler is plumbed to an air-to-oil cooler in front of the A/C condenser. The transmission oil temperature is regulated by the temperature of the ambient air passing over the heat exchanger. This cooler provides additional cooling for heavy duty trailering. The transmission oil is then directed back to the transmission through the TBV.

LTG without V08

The transmission oil cooler is an air to oil heat exchanger which is located above the Charged Air Cooler (CAC) and between the A/C condenser and the radiator. The fluid is pumped from the transmission to a Thermal Bypass Valve (TBV) which begins to open at 80°C (176°F) and is fully open at 96°C (205°F). The fluid is then pumped to the transmission oil cooler. The transmission oil temperature is regulated by the ambient air temperature passing over the heat exchanger. The transmission oil is then directed back to the transmission through the TBV.

Transmission Oil Cooler Lines

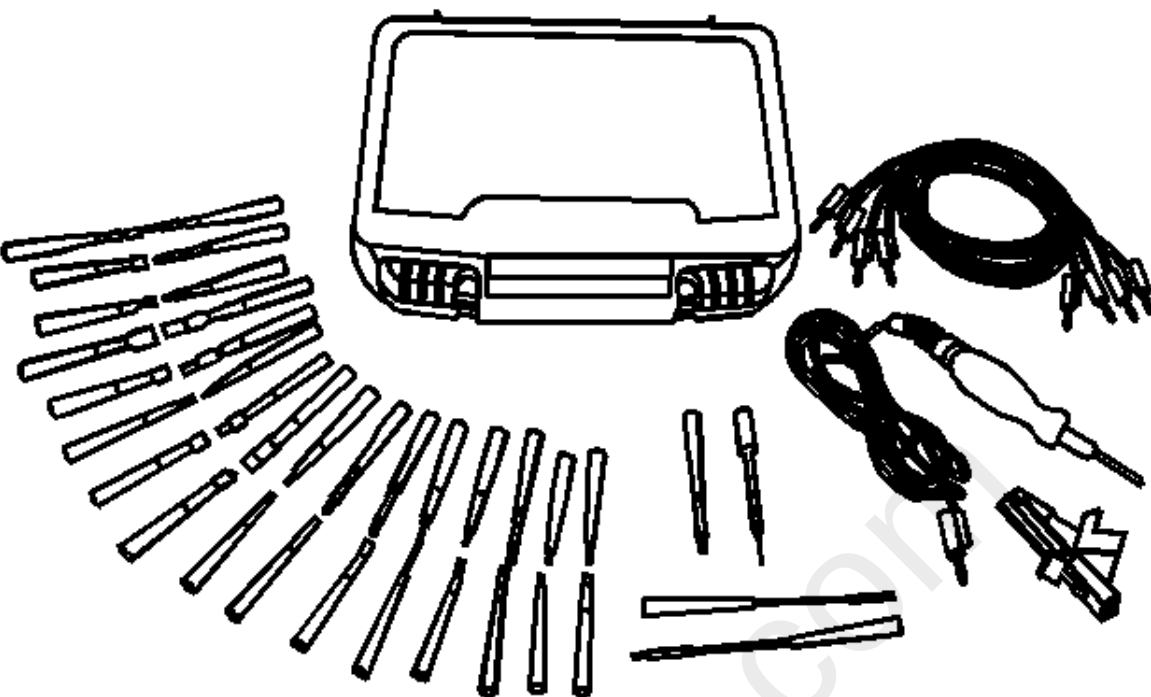
CAUTION: The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission, and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

Lines from the transmission bring oil pumped at a high pressure to the cooler and back to the transmission.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

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

Illustration	Tool Number/Description
 A line drawing of a terminal test kit. The kit includes a rectangular carrying case with a latch. In front of the case, there is a large bundle of 30 different types of test leads, each with a unique shape and size, arranged in a fan shape. To the right of the case, there is a coiled cable with multiple pins, a single test lead with a probe tip, and a small connector block.	EL 35616-F J 35616-F Terminal Test Kit

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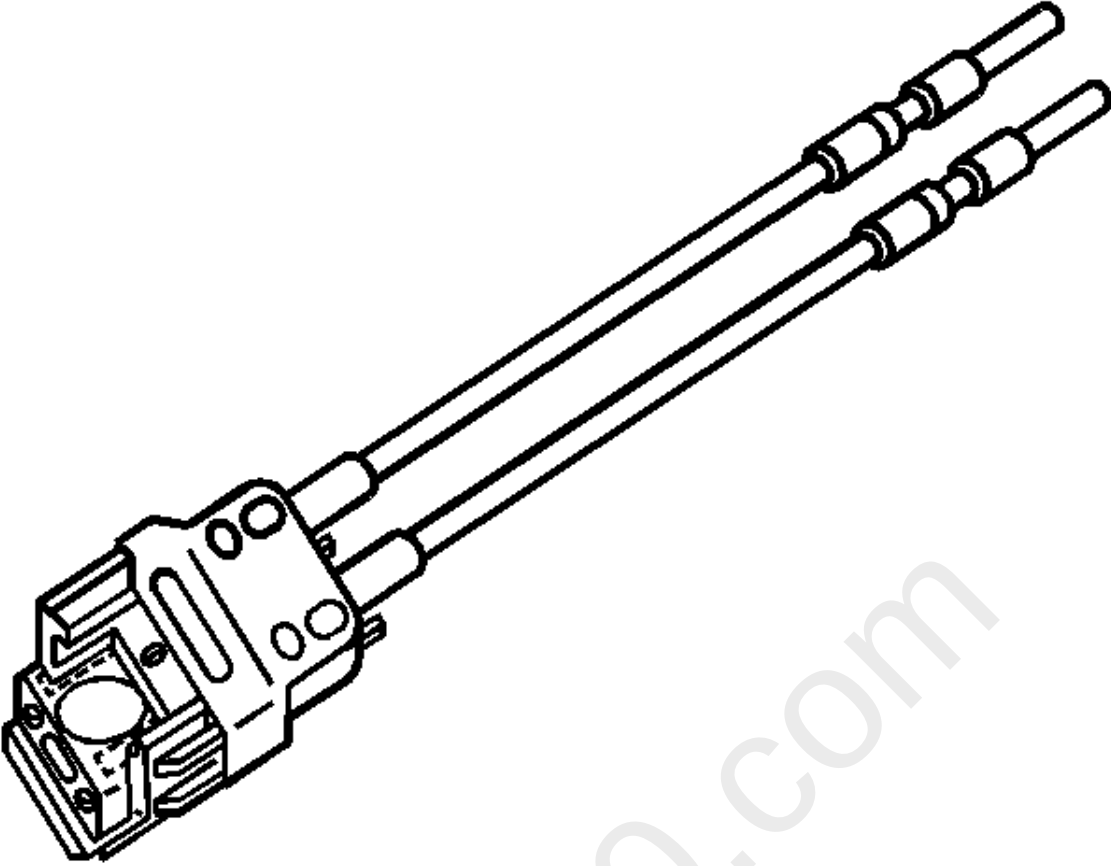
Illustration	Tool Number/Description
	EL 36169-HD J 36169 Heavy Duty Fused Jumper
	EN 24460-A J 24460-01 Cooling System Pressure Tester

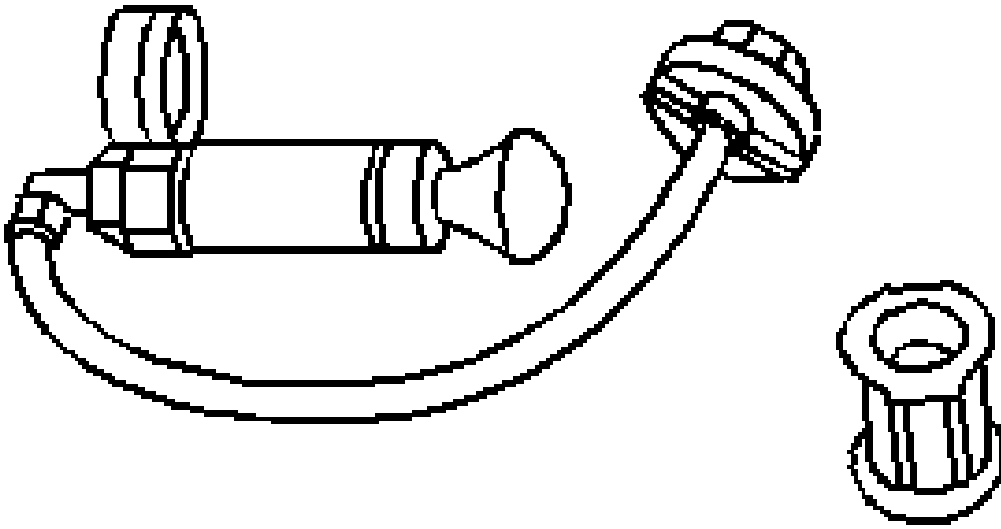
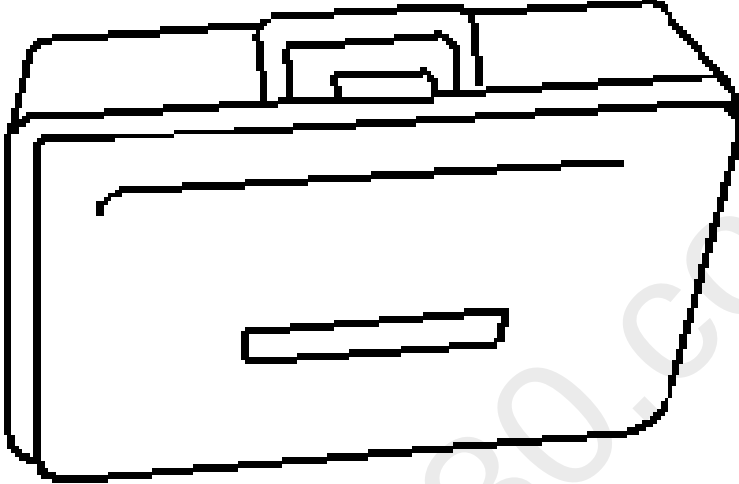
Illustration	Tool Number/Description
  A line drawing of a hand pump assembly. It consists of a cylindrical pump body with a handle on top. A hose is connected to the side of the pump, leading to a nozzle. A separate nozzle is also shown. Below the pump assembly is a rectangular carrying case with a handle and a latch.	

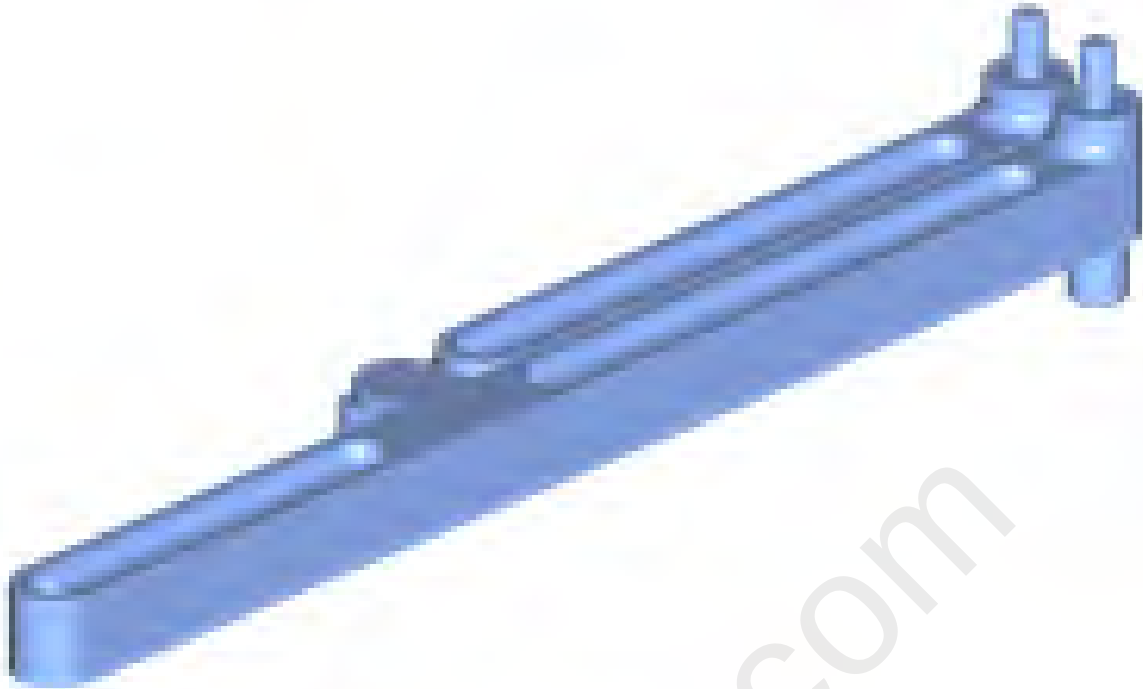
Illustration	Tool Number/Description
	EN 46104 J 46104 Water Pump Pulley Holding Tool
	GE 24731 J 24731 Tempil Stick

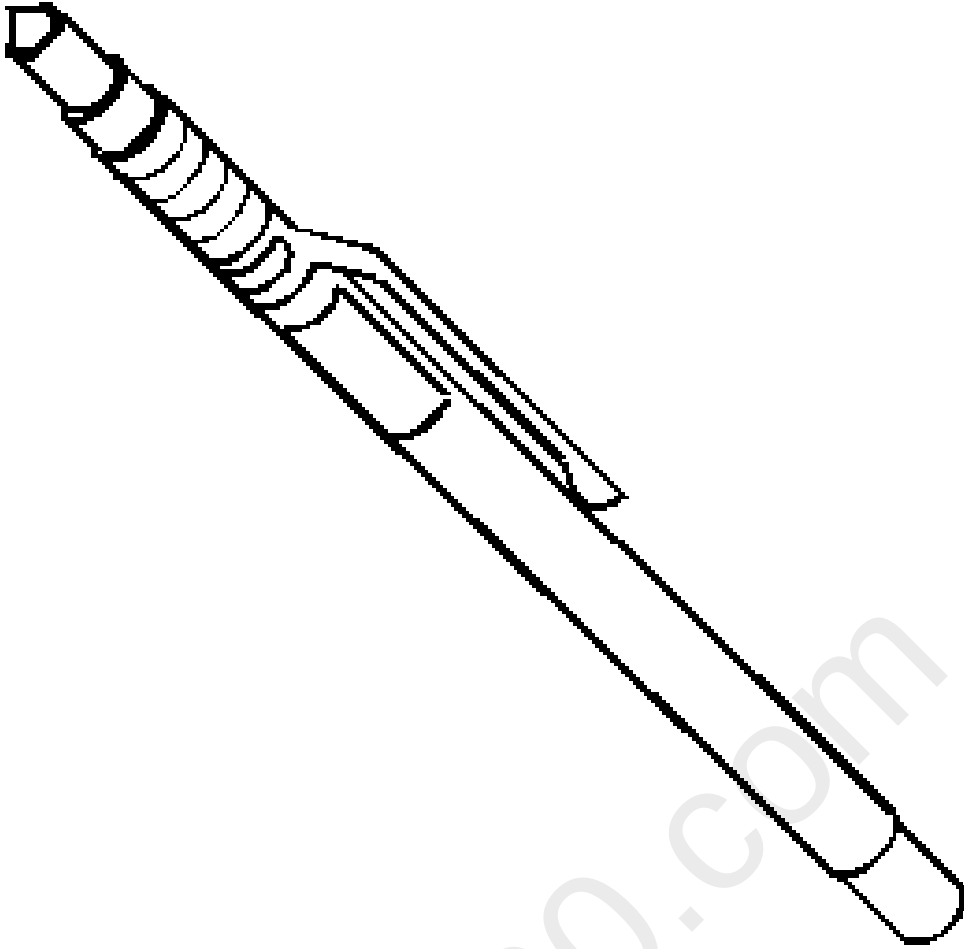
Illustration	Tool Number/Description
	

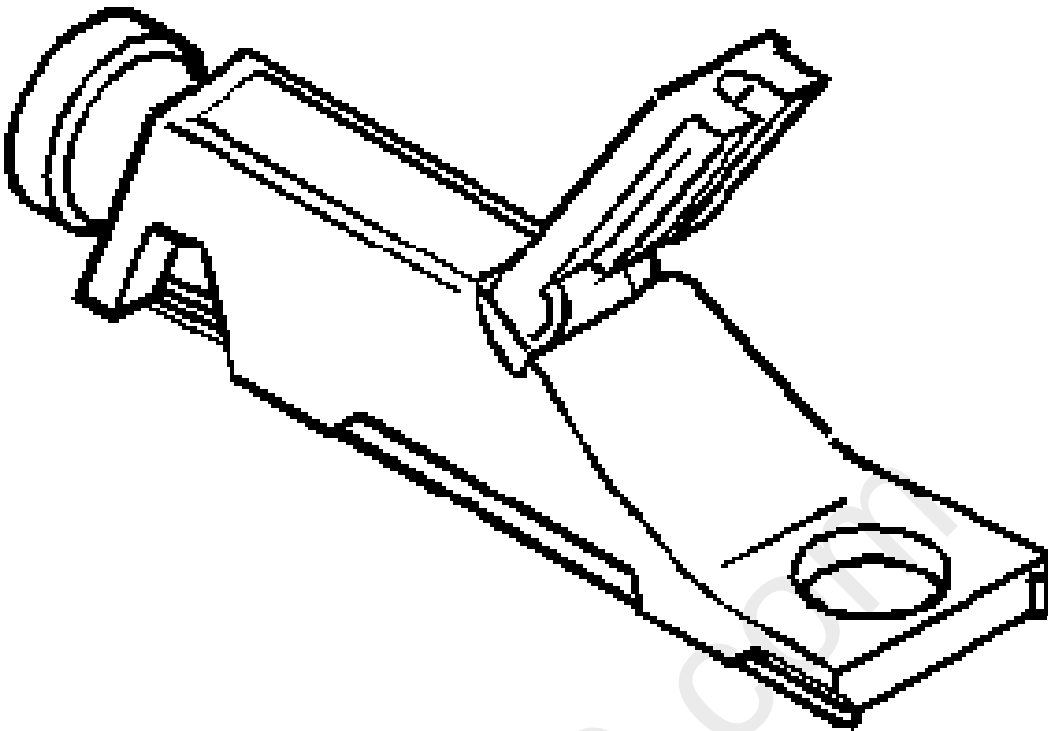
Illustration	Tool Number/Description
	GE 26568 J 26568 Coolant and Battery Fluid Tester
	GE 42401-A J 42401 Radiator Cap and Surge Tank Test Adapter

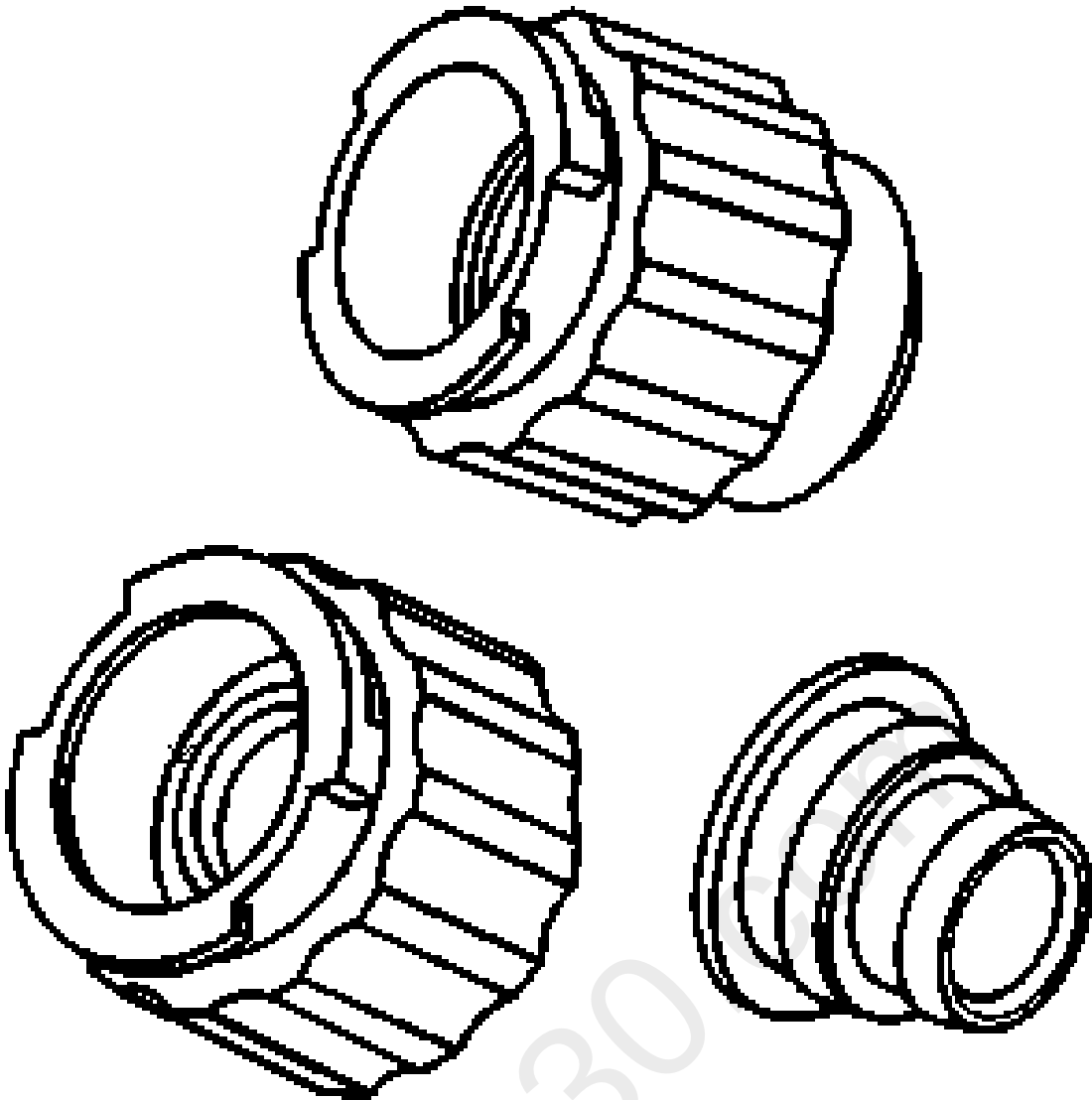
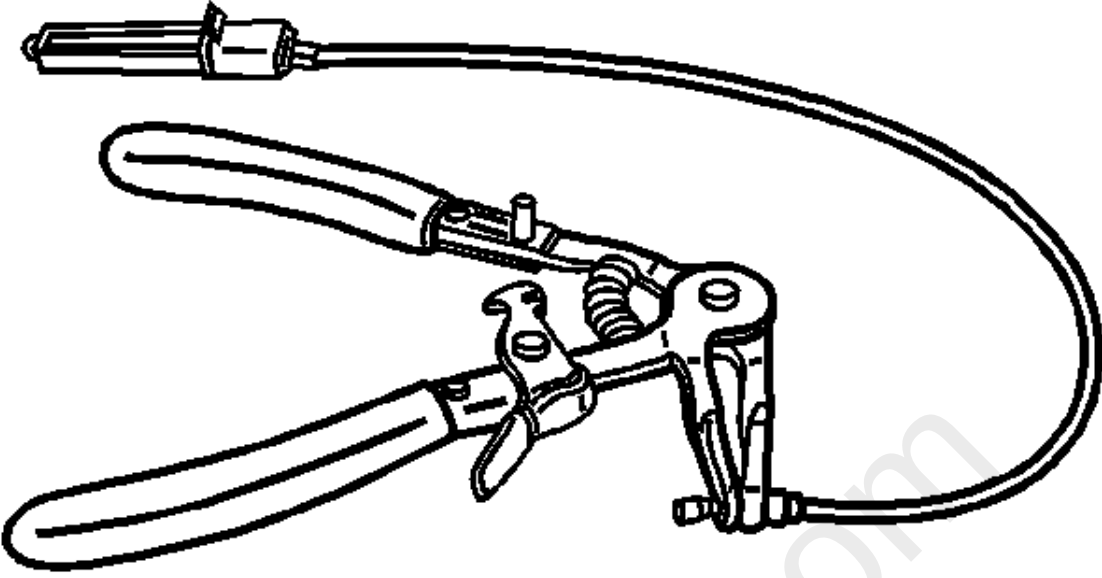
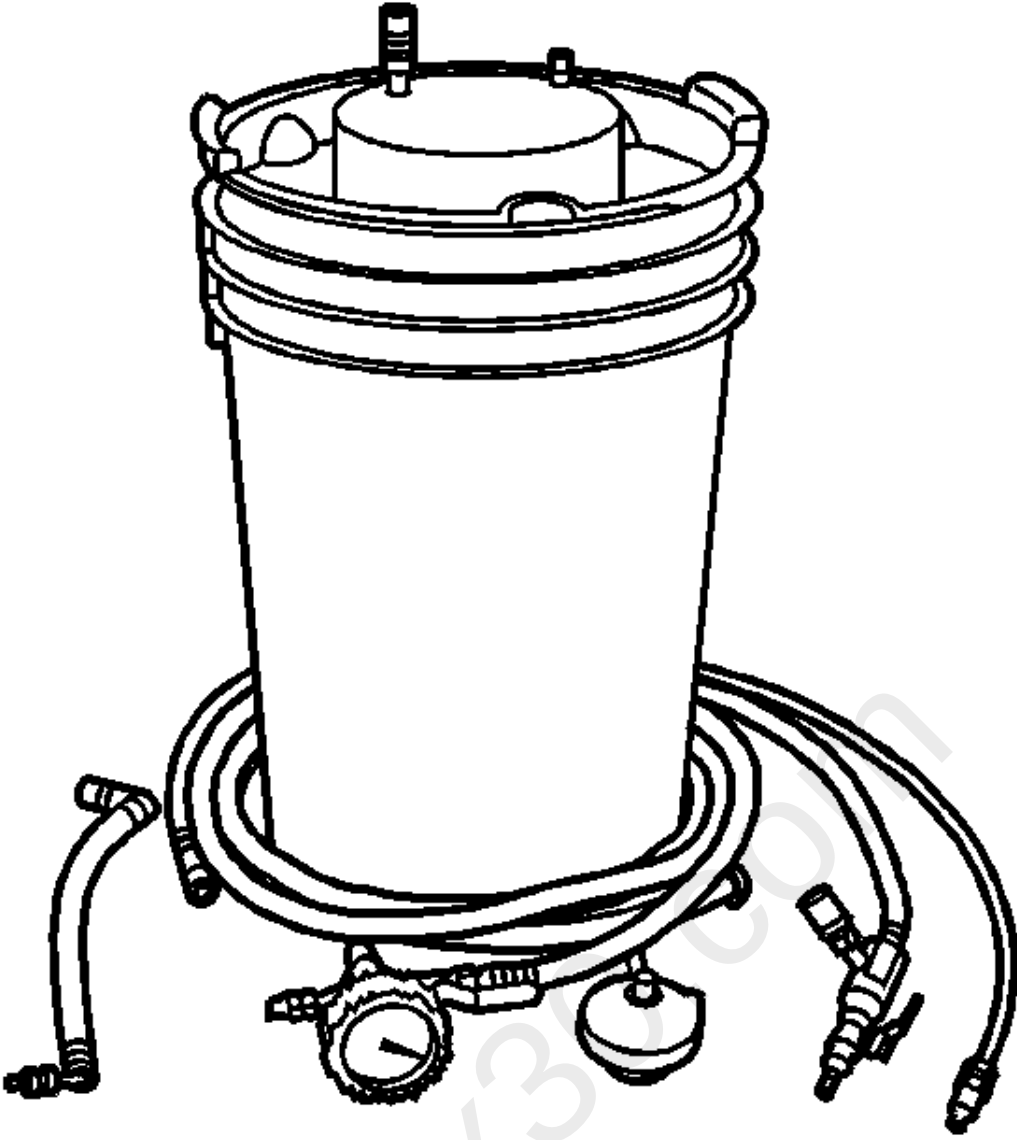
Illustration	Tool Number/Description
 The illustration shows three mechanical components. At the top is a large flanged nut with a wide, flat top flange and a threaded body. Below it to the left is a large flanged bolt with a similar wide flange and threaded body. To the right of the large bolt is a 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 Hose Clamp Pliers

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