

2021 ENGINE

Engine Heating System And Engine Cooling System - Canyon, Colorado

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

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

NOTE:

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

Application
Engine Coolant Thermostat Housing Seal
Engine Coolant Thermostat Seal
Engine Oil Cooler Seal
Heater Inlet and Outlet Pipe Gasket
Thermostat Bypass Pipe Gasket
Water Outlet Seal
Water Pump Gasket
Water Pump Inlet Pipe Seal
Water Pump Seal

Single Use Threaded Fastener/Component Tightening Specifications**NOTE:**

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

Application	Specification
	Metric (English)
Engine Front Cover Bolt (LGZ)	15 N.m (11 lb ft)
Water Pump Bolt (LGZ)	15 N.m (11 lb ft)

Reusable Threaded Fastener Tightening Specifications**NOTE:**

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

Application	Specification
	Metric (English)
Coolant Heater (LWN)	50 N.m (37 lb ft)
Engine Coolant Air Bleed Pipe Bolt (LGZ)	10 N.m (89 lb in)
Engine Coolant Fan Shroud Bolt (LCV LGZ)	10 N.m (89 lb in)
Engine Coolant Fan Shroud Bolt (LWN)	7 N.m (62 lb in)
Engine Coolant Fan Rear Shroud Bolt (LWN)	22 N.m (16 lb ft)
Engine Coolant Heater (LCV)	50 N.m (37 lb ft)
Engine Coolant Thermostat Housing Bolt (LGZ)	10 N.m (89 lb in)
Engine Coolant Thermostat Housing Fastener (LCV)	10 N.m (89 lb in)
Engine Coolant Thermostat Nut (LWN)	9 N.m (80 lb in)

NOTE:

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

Application	Specification
	Metric (English)
Engine Oil Cooler Bolt (Large, LWN)	25 N.m (18 lb ft)
Engine Oil Cooler Bolt (Small, LWN)	10 N.m (89 lb in)
Engine Oil Cooler Pipe @ Engine Block Fastener (LWN)	9 N.m (80 lb in)
Engine Oil Cooler Pipe Fastener (LWN)	10 N.m (89 lb in)
Engine Oil Cooler Pipe Quick Connect (LGZ)	35 N.m (26 lb ft)
Fan Blade Bolt (LCV LGZ)	7 N.m (62 lb in)
Fan Blade Bolt (LWN)	10 N.m (89 lb in)
Fan Blade Clutch	100 N.m (74 lb ft)
Fan Blade Clutch Wiring Harness Bracket Bolt (LWN)	9 N.m (80 lb in)
Fuel Feed Hose Protector Bolt (LWN)	10 N.m (89 lb in)
Fuel Feed Hose Protector Nut (LWN)	10 N.m (89 lb in)
Heater Inlet and Outlet Pipe Bolt (LGZ)	9 N.m (80 lb in)
Radiator Inlet Hose Bracket Bolt (LWN)	9 N.m (80 lb in)
Radiator Inlet Pipe Bolt (LCV)	58 N.m (43 lb ft)
Radiator Inlet Pipe @ Transmission Fastener (LCV)	9 N.m (80 lb in)
Radiator Side Mount Bracket Bolt	10 N.m (89 lb in)
Radiator Surge Tank Nut	9 N.m (80 lb in)
Radiator Surge Tank Outlet Pipe Nut (LWN)	22 N.m (16 lb ft)
Radiator Upper Bracket Bolt	9 N.m (80 lb in)
Thermostat Bypass Pipe Fastener (LCV)	10 N.m (89 lb in)
Thermostat Heater Shield Fastener (LCV)	5 N.m (44 lb in)
Transmission Fluid Cooler Pipe Bracket Bolt (LWN)	9 N.m (80 lb in)
Turbocharger Coolant Feed Pipe Hollow Screw (LWN)	35 N.m (26 lb ft)
Turbocharger Coolant Return Pipe Bolt (LWN)	35 N.m (26 lb ft)
Water Outlet Bolt (LGZ)	10 N.m (89 lb in)
Water Outlet Fastener (LCV)	12 N.m (106 lb in)
Water Pump Bolt (LWN)	25 N.m (18 lb ft)
Water Pump Fastener (LCV)	25 N.m (18 lb ft)
Water Pump Inlet Pipe Bolt (LGZ)	10 N.m (89 lb in)
Water Pump Inlet Pipe Bolt (LWN)	25 N.m (18 lb ft)
Water Pump Pulley Bolt (LGZ)	10 N.m (89 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System		
2.5L LCV	9.1 L	9.6 qt
2.8L LWN	10.53 L	11.1 qt
3.6L LGZ	10.60 L	11.2 qt

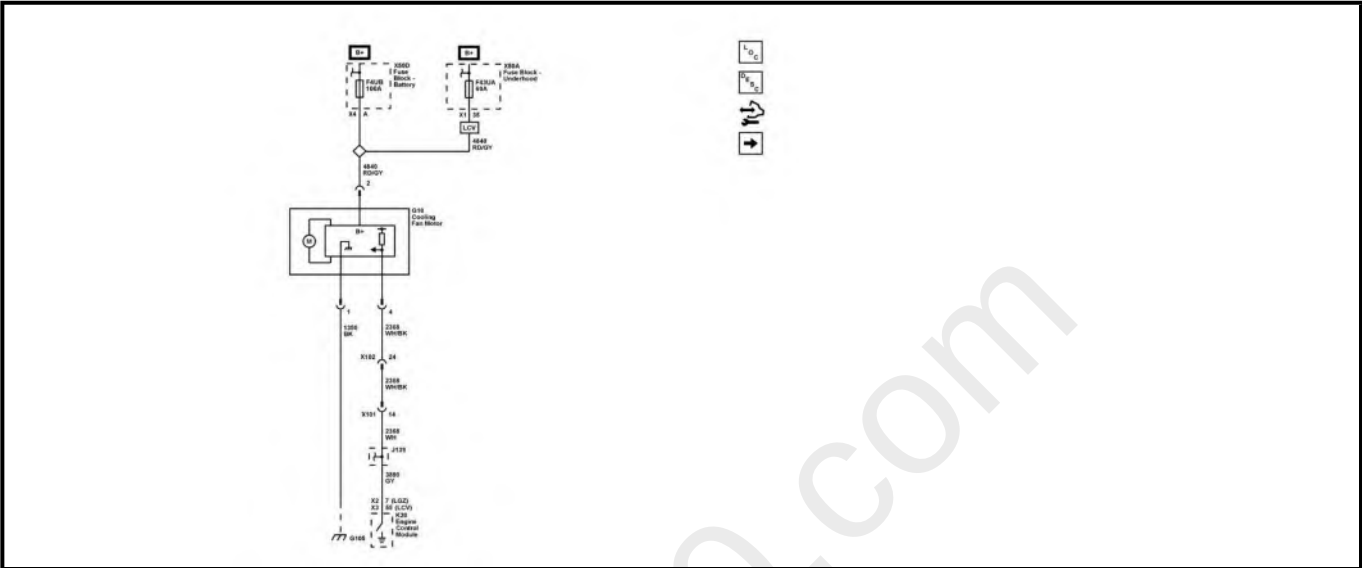
ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Engine Cooling System	DEX-COOLB®	12346290	10953464
Engine Cooling System	Coolant System Tracer Dye	89022219	89022220

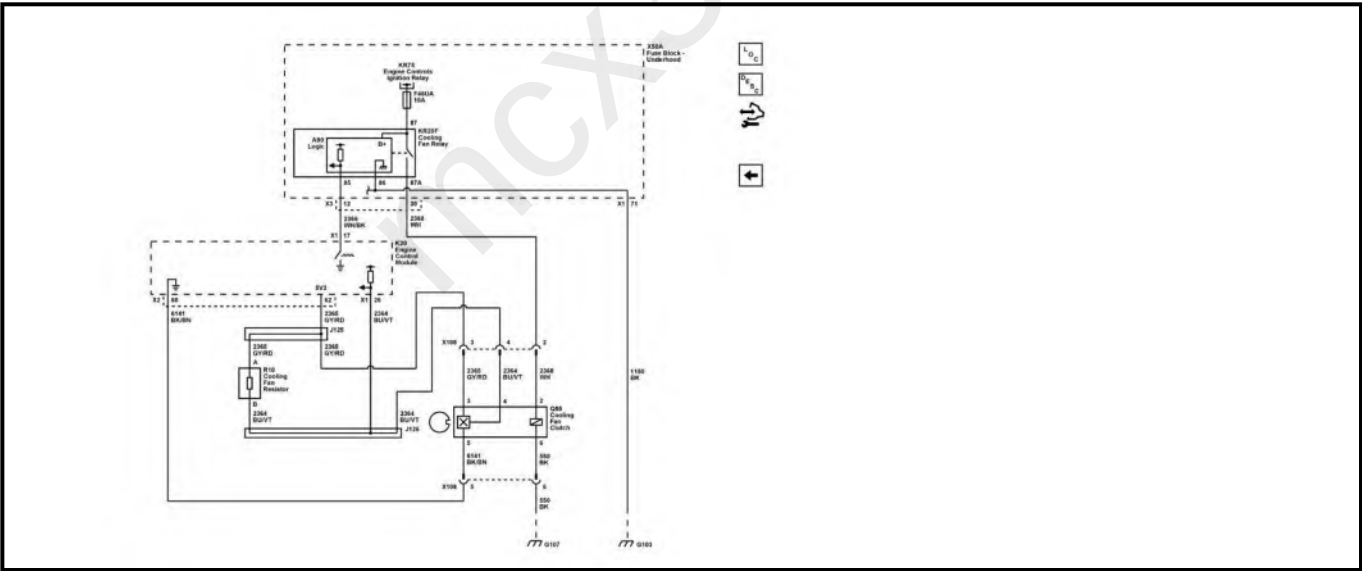
SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Fans (LCV/LGZ)



Engine Cooling Fans (LWN)



DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P00B3 OR P00B4

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](#)

DTC Descriptor

DTC P00B3

Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage

DTC P00B4

Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	-
Low Reference	-	P00B4**	*	-
*Internal control module or component damage may occur if the circuit shorts to B+.				
**Additional DTCs may set.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At normal operating temperature. Parameter Normal Range: 88 to 105B°C (190 to 221B°F)			
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-

Circuit/System Description

For an overview of the component/system, refer to [Cooling System Description and Operation \(LGZ, LWN\)](#), or [Cooling System Description and Operation \(LCV\)](#).

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B203 Radiator Coolant Temperature Sensor	The sensor is a negative temperature coefficient thermistor. As the temperature of the air, fluid, or metal increases, the resistance of the sensor decreases, varying the voltage on the signal circuit.
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

P00B3

- Engine = Running - For greater than 10 s
- IAT Sensor = Colder than 70B°C (158B°F)

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

P00B4

- Engine = Running - For greater than 60 s
- IAT Sensor = Warmer than -7B°C (19B°F)

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

Conditions for Setting the DTC

P00B3

Radiator Coolant Temperature Sensor = Warmer than 149B°C (300B°F) - For greater than 5 s

P00B4

Radiator Coolant Temperature Sensor = Colder than -39B°C (-38B°F) - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

- A/C Compressor = Off
- Cooling Fan = On
- Engine Coolant Temperature - Gauge = Inoperative

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

After starting a cold engine, the following scan tool parameter value should rise steadily and then stabilize:
Radiator Coolant Temperature Sensor - The temperature should stabilize after the component has opened:
Engine Coolant Thermostat

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **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

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: Radiator Coolant Temperature Sensor = -39 to 149B°C (-38 to 300B°F)
 - **If not between -39 and 149B°C (-38 and 300B°F)**

Refer to: Circuit/System Testing

- **Go to next step: If between -39 and 149B°C (-38 and 300B°F)**
3. Verify the scan tool parameter: Radiator Coolant Temperature Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B203 Radiator Coolant Temperature Sensor
- Wiggle the harness and connector: X1 @ K20 Engine Control Module
- **If the value spikes or drops out**

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

- **Go to next step: If the value does not spike or drop out**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

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**

5. All OK.

Circuit/System Testing

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: B203 Radiator Coolant Temperature Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ 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
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Radiator Coolant Temperature Sensor = Colder than -39B°C (-38B°F)

- **If -39B°C (-38B°F) or warmer**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ 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 colder than -39B°C (-38B°F)**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 2
7. Verify the scan tool parameter: Radiator Coolant Temperature Sensor = Warmer than 149B°C (300B°F)

- **If 149B°C (300B°F) or colder**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
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: Signal circuit terminal 1 @ 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: Signal circuit terminal 1 @ 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

- **Go to next step: If warmer than 149B°C (300B°F)**

8. Test or replace the component: B203 Radiator Coolant Temperature Sensor

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B203 Radiator Coolant Temperature Sensor
3. Test for 42 to 78, 834 ohms between the test points: Signal terminal 1 & Low Reference terminal 2
 - **If not between 42 and 78, 834 ohms**

Replace the component: B203 Radiator Coolant Temperature Sensor

- **Go to next step: If between 42 and 78, 834 ohms**

4. Verify the value is within the range listed in the table: [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#)

- **If not in the specified range**

Replace the component: B203 Radiator Coolant Temperature Sensor

- **Go to next step: If in the specified range**

5. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: B203 Radiator Coolant Temperature Sensor

- **Go to next step: If infinite resistance**

6. All OK.

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement - Radiator \(LCV\)](#) - B203 Radiator Coolant Temperature Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P00B7, P0597-P0599, OR P2181 - E41 ENGINE COOLANT THERMOSTAT HEATER MALFUNCTION

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](#)

DTC Descriptor

DTC P00B7

Engine Coolant Flow Insufficient

DTC P0597

Engine Coolant Thermostat Heater Control Circuit

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTC P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

DTC P2181

Engine Cooling System Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0597, P0598*	P0597, P0598	-	P00B7, P2181
Control	P0598	P0597	P0599	P00B7, P2181

*Additional DTCs may set.

Mechanical Condition

Component	DTC	Condition
E41 Engine Coolant Thermostat Heater	P00B7, P2181	Slow Response/Stuck
Coolant	P00B7, P2181	• Antifreeze Concentration - Incorrect • Degraded

Component	DTC	Condition
		• Fill Level - Low
Coolant Hose	P00B7	Collapsed/Restricted
Cooling Fan	P2181	Always On
Engine	P00B7	• Cylinder Head - Cracked / Restricted • Engine Block - Cracked / Restricted
Radiator	P00B7, P2181	• Flow Restricted - Air/Coolant • Pressure - Incorrect • Coolant - Leaking • Fill Cap - Loose
Water Pump	P00B7	• Belt - Loose/Missing/Visible Damage • Propeller - Visible Damage

Circuit/System Description

For an overview of the component/system, refer to [Cooling System Description and Operation \(LGZ, LWN\)](#), or [Cooling System Description and Operation \(LCV\)](#).

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

Component	Description
E41 Engine Coolant Thermostat Heater	The thermostat has a build-in heating resistor. When the resistor heats up, the thermostat opens more, resulting in a lower engine operating temperature. The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 103B°C (217B°F) and cycle between 105B°C (221B°F) and 110B°C (230B°F).
K20 Engine Control Module	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

P00B7

- DTC P00B3, P00B4, P00B6, P0116, P0117, P0118, P0119 = Not set
- ECT Sensor = Greater than 120B°C (248B°F)
- Engine = Running - For greater than 5 min

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

P0597, P0598, P0599

Ignition = On or Engine = Running

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

P2181

- DTC P00B3, P00B4, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0117, P0118, P111E, P112F = Not set
- ECT Sensor @ Start-up = -10 to 45B°C (14 to 113B°F)
- Engine Coolant Thermostat Heater Command = Greater than 10%
- Fuel Alcohol Content = Less than 100%
- IAT Sensor @ Start-up = -7 to 60B°C (19 to 140B°F)
- Ignition = Off - For greater than 2 h

Engine = Running - For 2 to 30 min

- MAF Sensor = 11 to 100 g/s

Frequency the DTC runs = Once - Per ignition cycle - After the running conditions are met

Conditions for Setting the DTC

P00B7

ECT Sensor 1 & ECT Sensor 2 = Not within 40B°C (72B°F) of each other - For greater than 30 s

P0597, P0598, P0599

Control Circuit = Commanded state does not match the actual state - For greater than 15 s

P2181

E41 Engine Coolant Thermostat Heater = Stuck Open - For greater than 4 min

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

{P0597, P0598, P0599} Cooling Fan = On

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

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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 P00B3, P00B4, P00B6, P0116, P0117, P0118, P0119, P0128 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

3. Verify DTC P00B7, P2181 is not set.

- **If any of the DTCs are set**

Refer to: Circuit/System Testing

- **Go to next step: If none of the DTCs are set**

4. 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**

Replace G10 Cooling Fan Motor

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

5. Perform the scan tool control function: Engine Coolant Thermostat Heater - On and Off

Verify the scan tool parameter:

- Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status = Not Run or OK
- Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status = Not Run or OK
- Engine Coolant Thermostat Heater Control Circuit Open Test Status = Not Run or OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

6. Ignition/Vehicle - Off

NOTE: Depending on ambient temperature, it may take up to 8 h to reach the specified temperature.

7. Ignition - On / Vehicle - In Service Mode

Verify the following parameters are within 5B°C (9B°F) of each other:

- Ambient Air Temperature

- ECT Sensor
- **If not within 5B°C (9B°F) of each other**

Repeat the procedure starting at step 6 - Wait until the conditions are met

- **Go to next step: If within 5B°C (9B°F) of each other**

8. Perform the following action:

- HVAC Controls - Off
- Hood - Closed

9. Engine - Idling

Verify the scan tool parameter: ECT Sensor =

- {Ambient Air Temperature = 10B°C (50B°F)} Greater than 90B°C (194B°F) - Within 26 min
- {Ambient Air Temperature = 20B°C (68B°F)} Greater than 90B°C (194B°F) - Within 22 min
- {Ambient Air Temperature = 27B°C (80B°F)} Greater than 90B°C (194B°F) - Within 18 min
- **If 90B°C (194B°F) or colder**

Test or replace the component: E41 Engine Coolant Thermostat Heater

- **Go to next step: If warmer than 90B°C (194B°F)**

10. Perform the scan tool control function: Engine Coolant Thermostat Heater and Cooling Fan

1. Engine Coolant Thermostat Heater - 100%
 2. Cooling Fan - 90%
 3. Engine Speed - 1, 800 to 2, 200 RPM
- Verify the scan tool parameter: ECT Sensor = Less than 85B°C (185B°F) - Within 5 min
 - **If 85B°C (185B°F) or warmer**

Refer to: Circuit/System Testing

- **Go to next step: If colder than 85B°C (185B°F)**

11. Perform the scan tool control function: Engine Coolant Thermostat Heater and Cooling Fan

1. Engine Coolant Thermostat Heater - 0%
 2. Cooling Fan - 0%
 3. Engine Speed - 1, 800 to 2, 200 RPM
- Verify the scan tool parameter: ECT Sensor = Greater than 102B°C (215B°F) - Within 5 min
 - **If 102B°C (215B°F) or colder**

Test or replace the component: E41 Engine Coolant Thermostat Heater

- **Go to next step: If warmer than 102B°C (215B°F)**

12. {If a DTC was not set - Refer to the next step} Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

13. All OK.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: E41 Engine Coolant Thermostat Heater
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ignition 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: Ignition circuit terminal 1 @ Component harness & 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: Ignition circuit terminal 1 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: E41 Engine Coolant Thermostat Heater
 - **Go to next step: If the test lamp turns On**
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 2 & B+
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 2 @ 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 does not turn On**
6. Remove - Test Lamp
7. Perform the scan tool control function: Engine Coolant Thermostat Heater - On

Verify the scan tool parameter: Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status = OK

- **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If the specified state**
8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 2 & Ignition circuit terminal 1
 9. Perform the scan tool control function: Engine Coolant Thermostat Heater - On

Verify the scan tool parameter: Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status = Malfunction

- **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ 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
- **Go to next step: If the specified state**
10. Verify DTC P00B7, P2181 is not set.
 - **If any of the DTCs are set**

Refer to:
 - Diagnostic Fault Information - Mechanical Condition
 - [Symptoms - Engine Cooling](#)
 - **Go to next step: If none of the DTCs are set**
11. Test or replace the component: E41 Engine Coolant Thermostat Heater

Repair Instructions

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

- [Engine Coolant Thermostat Housing Replacement \(LCV\)](#), or [Engine Coolant Thermostat Housing Replacement \(LGZ\)](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0480, P0691, OR P0692 (WITH LWN)

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](#)

DTC Descriptor

DTC P0480

Cooling Fan Speed Output Circuit

DTC P0691

Cooling Fan Speed Output Circuit Low Voltage

DTC P0692

Cooling Fan Speed Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0480, P0691*	P0480	-	-
Control - Terminal 85 @ KR20F Cooling Fan Relay	P0691*	P0480	P0692	-
Control - Terminal 87A @ Q85 Cooling Fan Clutch	P0480*	P0483	P0483	P0483

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground	-	P0483	-	P0483
*Opens the fuse that supplies voltage to the component.				

Circuit/System Description

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

Circuit	Description
Ignition	Supplied from a fuse.
Control - Terminal 85 @ KR20F Cooling Fan Relay	The output circuit is switched to ground to activate the component. The output is PWM controlled.
Control - Terminal 87A @ Q85 Cooling Fan Clutch	The output circuit is switched from 12 V to ground to activate the component. The output is PWM controlled.
Ground	Chassis Ground

Component	Description
KR20F Cooling Fan Relay	A solid-state relay is an electronic switching device that is switched on or off when an external voltage is applied to its control terminals. It has the same function as an electromechanical relay, but no moving parts.
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.
Q85 Cooling Fan Clutch	The solenoid valve controls the flow of fluid to the clutch housing which couples or decouples the cooling fan.

Conditions for Running the DTC

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

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

Conditions for Setting the DTC

The commanded state of the driver and the actual state of the control circuit do not match 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](#) , or [Inline Harness Connector End Views - Index](#) or [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](#)

[Circuit/System Verification](#)

1. Engine - Idling
2. Perform the scan tool control function: Cooling Fan - Command the component to the maximum position/speed & Release Control

Verify the scan tool parameter:

- Cooling Fan Control Circuit Low Voltage Test Status = Not Run or OK
- Cooling Fan Control Circuit Open Test Status = Not Run or OK
- Cooling Fan Control Circuit High Voltage Test Status = Not Run or OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Verify the scan tool parameter:

- Cooling Fan Control Circuit Low Voltage Test Status = Not Run or OK
- Cooling Fan Control Circuit Open Test Status = Not Run or OK
- Cooling Fan Control Circuit High Voltage Test Status = Not Run or OK
 - Perform the action while monitoring the parameter:
- Wiggle the harness and connector: KR20F Cooling Fan Relay
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

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

- **Go to next step: If the specified state**

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

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**

5. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off

2. Remove the component: KR20F Cooling Fan Relay

3. Verify a test lamp turns On between the test points: Ground circuit terminal 86 @ Relay Socket & B+

- **If the test lamp does not turn On**

1. Disconnect the ground connection: Ground terminal

2. Test for less than 2 ohms between the test points: Ground circuit terminal 86 & The other end of the circuit @ Ground terminal

- 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**

4. Ignition - On / Vehicle - In Service Mode

5. Verify a test lamp turns On between the test points: Ignition circuit terminal 87 @ Relay Socket & 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: Ignition circuit terminal 87 & Output terminal @ F92UA 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. Disconnect the electrical connector: Q85 Cooling Fan Clutch

3. Test for infinite resistance between the test points: Control circuit terminal 87A @ Relay Socket & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Connect the component: KR20F Cooling Fan Relay

5. Engine - Idling

6. Perform the scan tool control function: Cooling Fan - Command the component to the maximum position/speed & Release Control

Verify the fuse does not open.

- If the fuse is open - Replace the component: KR20F Cooling Fan Relay
- If the fuse does not open - Test or replace the component: Q85 Cooling Fan Clutch

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

6. Verify the scan tool parameter: Cooling Fan Control Circuit Open Test Status = Malfunction

- **If not the specified state**

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 85 @ Relay Socket & Ground

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

- Go to next step: If infinite resistance
4. Ignition - On / Vehicle - In Service Mode
 5. Test for less than 1 V between the test points: Control circuit terminal 85 @ Relay Socket & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

7. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 85 & Ignition circuit terminal 87 @ Relay Socket

Verify the scan tool parameter: Cooling Fan Control Circuit High Voltage Test Status - Malfunction

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 85 @ Relay Socket & 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

- **Go to next step: If the specified state**

8. Test or replace the component: KR20F Cooling Fan Relay

Component Testing

Q85 Cooling Fan Clutch

NOTE: Testing is performed on the component side of the harness connector.

1. Disconnect the electrical connector: Q85 Cooling Fan Clutch
2. Test for 7 to 17 ohms between the test points: Control circuit terminal 2 & Ground circuit terminal 1

- **If not within specified range**

Replace the component: Q85 Cooling Fan Clutch

- **Go to next step: If within the specified range**

3. Test for infinite resistance between the test points:

- Circuit terminal 2 & Circuit terminal 3
- Circuit terminal 2 & Circuit terminal 4
- Circuit terminal 2 & Circuit terminal 5
- Circuit terminal 2 & Component

- **If less than infinite resistance**

Replace the component: Q85 Cooling Fan Clutch

- **Go to next step: If infinite resistance**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Fan Blade Clutch Replacement (LWN)** - Q85 Cooling Fan Clutch

- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0483

Diagnostic Instructions

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

DTC Descriptor

DTC P0483

Engine Cooling Fan System Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Controls Ignition Relay	P0691	P0481	P0692	-
B+ - Relay Coil	-	P0480, P0691	-	-
KR20F Cooling Fan Relay	P0480 or P0691	P0480	P0480 or P0692, P0693	-
Cooling Fan Speed Sensor Low Reference	-	P0526	-	-
Cooling Fan Speed Sensor 5V Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Cooling Fan Speed Sensor Circuit	P0526	P0526	P0526	-
Ground	-	P0483	P0483, P0495	-
Cooling Fan Control Circuit	P0480	P0483	P0483, P0495	-

Circuit/System Description

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

Component	Description
KR20F Cooling Fan Relay	A relay is a switch that is actuated by a solenoid.
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.
R10 Cooling Fan Resistor	This resistor can be switched in series to the motor to reduce

Component	Description
	the motor's speed.
Q85 Cooling Fan Clutch	When the relay energizes the solenoid, the spring loaded valve opens, allowing fluid to flow through, increasing cooling fan speed. When the solenoid is de-energized, the spring loaded valve closes, allowing fluid to flow back to storage chamber, decreasing the cooling fan speed.

Conditions for Running the DTC

- DTC P0526 is set. - Greater than 30 s
- Greater than 36% Duty Cycle

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

Conditions for Setting the DTC

1. Cooling Fan Speed = Less than 4 RPM

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 , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Electrical Information Reference

- Electrical Center Identification Views
- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

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.

1. Ignition Off
2. Verify a condition does not exist with the component: Q85 Cooling Fan Clutch
 - Drive Belt - Loose/Worn
 - Cooling Fan - Seized/Visible Damage
 - Oil Leaks between the sealing land

- **If a condition exists**

Repair or replace as necessary

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

3. Ignition - On / Vehicle - In Service Mode

4. Verify DTC P0480, P0526 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

5. Perform the scan tool control function: Cooling Fan - Increase & Decrease

Verify the scan tool parameter: Cooling Fan Speed = Desired Cooling Fan Speed

- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

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

7. Verify DTC P0483 is not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

8. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the component: KR20F Cooling Fan Relay

3. Test for less than 5 ohms between the test points: Ground terminal 86 & Ground

- **If 5 ohms or greater**

1. Test for less than 2 ohms between the test points: Ground circuit & The other end of the circuit

- 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.

- **Go to next step: If less than 5 ohms**

4. Disconnect the electrical connector: Q85 Cooling Fan Clutch

5. Test for less than 5 ohms between the test points: Ground terminal 6 & Ground

- **If 5 ohms or greater**

1. Test for less than 2 ohms between the test points: Ground terminal 6 & Chassis Ground

- 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 less than 5 ohms**

6. Install the component: KR20F Cooling Fan Relay

7. Ignition On - Engine Running

8. Verify a test lamp turns On between the test points: B+ circuit terminal 2 & Ground

- **If the test lamp does not turn On and the circuit fuse is 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 Off
2. Remove - Test Lamp
3. Test for infinite resistance between the test points: Control circuit terminal B & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal B & Cooling Fan Relay 4
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: KR20F Cooling Fan Relay

• **If the test lamp does not flash**

1. Ignition Off
2. Disconnect the component: KR20F Cooling Fan Relay
3. Test for less than 1 V between the test points: Control circuit terminal B & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: KR20F Cooling Fan Relay

• **Go to next step: If the test lamp flashes**

9. Replace the component: Q85 Cooling Fan Clutch

Component Testing

EV Fan Clutch Solenoid Valve Test

1. Disconnect the electrical connector: Q85 Cooling Fan Clutch
2. Test for 7 to 17 ohms between the test points: Terminal A & Terminal B
 - **If not between 7 and 17 ohms**
 1. Replace the component: Q85 Cooling Fan Clutch
 - **Go to next step: If between 7 and 17 ohms**
3. Test for infinite resistance between the test points:
 - 2 to 5
 - 2 to 4
 - 2 to 3
 - **If less than infinite resistance**
 1. Repair or replace the component(s) as necessary: Jumper Harness
 - **Go to next step: If infinite resistance**
 1. Replace the component: Q85 Cooling Fan Clutch

Repair Instructions

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

- [Control Module References](#)
- [Fan Blade Clutch Replacement \(LWN\)](#)
- Thermostat Diagnosis [Thermostat Diagnosis](#)

DTC P0494, P30EE, P30EF, OR U0632 - COOLING FAN MALFUNCTION

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](#)

DTC Descriptor

DTC P0494

Cooling Fan Speed Too Low

DTC P30EE

Fan 1 Speed Too Low

DTC P30EF

Fan 1 Speed Too High

DTC U0632

Lost Communication with Cooling Fan 1

Circuit/System Description

For an overview of the component/system, refer to [Cooling System Description and Operation \(LGZ, LWN\)](#), or [Cooling System Description and Operation \(LCV\)](#).

Circuit	Description
B+	Supplied from a fuse.
Serial Data	Digitally encoded information for communication between devices.
Ground	Chassis Ground

Component	Description
G10 Cooling Fan Motor	The control module and the DC motor are one assembly.
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

- {P30EE, P30EF} DTC U0632 = Not set
- Cooling Fan = Commanded On
- Ignition = On
- Ignition Voltage = Greater than 11 V
- {U0632} Power Mode = Run

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

Conditions for Setting the DTC

P0494

Cooling Fan Speed Desired Cooling Fan Speed For greater than 16 s

P30EE

Cooling Fan Speed = Greater than 3, 999 RPM or Less than a predefined threshold - For greater than 16 s

P30EF

Cooling Fan Speed = Less than 110 RPM - For greater than 16 s

U0632

Serial data message from component: G10 Cooling Fan Motor = Not Received For greater than 1 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 , or **Inline Harness Connector End Views - Index** or **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

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode

NOTE: This step only applies to the following component DTCs: Engine Cooling Fan

2. Verify DTC U0632 is not set and no other DTCs are set.
 - If DTC U0632 is set and no other DTCs are set

Refer to: Circuit/System Testing

- **Go to next step: If DTC U0632 is not set and other DTCs are set**

3. Ignition/Vehicle - Off

4. Verify a condition does not exist with the component:

- Cooling Fan Motor - Binding or Sticking/Worn/Visible Damage
- Blade - Cracked/Foreign objects/Missing/Visible Damage
- **If a condition exists**

Repair or replace as necessary

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

5. Ignition - On / Vehicle - In Service Mode

6. Perform the scan tool control function: Cooling Fan - Increase & Release Control

Verify the component turns On and Off: Cooling Fan

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

Replace the component: G10 Cooling Fan Motor

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

7. Perform the scan tool control function: Cooling Fan - Increase & Decrease

Verify the scan tool parameter: Cooling Fan Speed = Desired Cooling Fan Speed

- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

8. Perform the scan tool control function: Cooling Fan - Increase

Verify a condition does not exist with the component: Engine Cooling Fan - 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.

- 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**

9. 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**

Repeat step 2

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

10. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: G10 Cooling Fan Motor
3. Test for less than 10 ohms between the test points: Ground terminal 2 & Ground
 - **If greater than 10 ohms**
 1. Disconnect the ground connection: Ground terminal
 2. Test for less than 2 ohms between the test points: Ground terminal 2 & Ground
 - 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 less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. 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. 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**
6. Test for 8 to 10 V between the test points: Serial Data circuit terminal 4 @ Component harness & Ground
 - **If less than 8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Serial Data circuit terminal 4 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Serial Data 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 greater than 10 V**
 1. Ignition/Vehicle - Off
 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: Serial Data circuit terminal 4 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 8 and 10 V**
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 Shroud Replacement \(LCV, LGZ\)](#).
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0495

Diagnostic Instructions

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

DTC Descriptor

DTC P0495

Cooling Fan Speed Too High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Controls Ignition Relay	P0691	P0481	P0692	-
B+ - Relay Coil	-	P0480, P0691	-	-
KR20F Cooling Fan Relay	P0480 or P0691	P0480	P0480 or P0692, P0693	-
Cooling Fan Speed Sensor Low Reference	-	P0526	-	-
Cooling Fan Speed Sensor 5V Reference	P0106, P0107, P0335, P057C, P0651, P16A0, P16B0	P0526	P0108, P0651, P16A0, P16B0	-
Cooling Fan Speed Sensor Circuit	P0526	P0526	P0526	-
Ground	-	P0483	-	-
Cooling Fan Control Circuit	P0480	P0483	P0483, P0495	-

Circuit/System Description

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

Component	Description
KR20F Cooling Fan Relay	A relay is a switch that is actuated by a solenoid. Optional: This is a non-serviceable soldered-on component.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs.

Component	Description
	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.
Q85 Cooling Fan Clutch	When the relay energizes the solenoid, the spring loaded valve opens allowing fluid to flow through, increasing cooling fan speed. When the solenoid is de-energized, the spring loaded valve closes, allowing fluid to flow back to storage chamber, decreasing the cooling fan speed.

Conditions for Running the DTC

- DTC P0026, P007C, P007D, P0112, P0113, P0117, P0118, P0335, P0336, P0340, P0341, P0480, P0495, P0526 = Not set
- Battery Voltage = Greater than 11 V
- Barometric Pressure = Greater than 75 kPa (10.8 PSI)
- Engine = On Greater than 10 s
- Engine Coolant Temperature... = Warmer than 70B°C (158B°F)
- Cooling Fan Duty Cycle Command = Greater than 15%
- Intake Air Temperature = Warmer than -7B°C (19B°F)
- The engine speed must be between 200 and 5,320 RPM to perform this test.

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 - Greater than 1 min
- Desired Cooling Fan Speed Actual Greater than 500 RPM

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 , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Electrical Information Reference

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

Circuit/System Verification

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.

1. Ignition Off
2. Verify a condition does not exist with the component: Q85 Cooling Fan Clutch
 - Drive Belt - Loose/Worn
 - Cooling Fan - Seized/Visible Damage
 - Oil Leaks between the sealing land
 - **If a condition exists**

Repair or replace as necessary

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

3. Ignition - On / Vehicle - In Service Mode
4. Verify DTC P0480, P0483, P0526 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

5. Operate the vehicle under the following conditions:

- Engine Speed @ 1500 RPM
- Accessories = Off
- For greater than 10 min

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

6. Verify DTC P0495 is not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

7. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: Q85 Cooling Fan Clutch
3. Verify a test lamp turns On between the test points: B+ circuit terminal 2 & Ground

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

4. Perform the scan tool control function: Cooling Fan - Increase - 50%

Verify the test lamp flashes

- **If the test lamp turns On but does not change brightness**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate component: KR20F Cooling Fan Relay

1. Test for less than 1 V between the test points: Control circuit terminal B & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: KR20F Cooling Fan Relay
- **Go to next step: If the test lamp flashes**
5. Replace the component: Q85 Cooling Fan Clutch

Repair Instructions

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

- [Control Module References](#)
- [Fan Blade Clutch Replacement \(LWN\)](#)

DTC P0526

Diagnostic Instructions

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

DTC Descriptor

DTC P0526

Cooling Fan Speed Sensor Circuit

Diagnostic Fault Information

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

Circuit/System Description

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

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTC P0526 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0526 is a Type B DTC.

Reference Information

Schematic Reference

Engine Heating/Cooling Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Description and Operation

Cooling Fan Description and Operation (with LWN), or Cooling Fan Description and Operation (with LCY, LGZ).

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Observe the DTC information with a scan tool. Verify DTC P0651 is not set.
 - **If a DTC is set**
 Refer to DTC P0641, P0651, P0697, or P06A3
 - **Go to next step: If no DTC is set**
2. Observe the DTC information with a scan tool. Verify DTC P0526 is not set.
 - **If a DTC is set**

Refer to **DTC P0526**

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

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

- **If 0 RPM**

Refer to Circuit/System Testing.

- **Go to next step: If greater than 0 RPM**

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

- **If DTC sets**

Refer to Circuit/System Testing

- **If no DTC is set**

5. All OK.

Circuit/System Testing

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

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

- **If greater than 5 Ω**

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

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

- **Go to next step: If less than 5 Ω**

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

- **If less than 4.8 V**

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- Go to next step: If infinite resistance.

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

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

- **If greater than 5.2**

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

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

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

- **Go to next step: If between 4.8 - 5.2 V**

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

- **If less than 4.8 V**

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
 - Go to next step: If infinite resistance.
3. Test for less than 2 Ω in the signal circuit terminal end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2**
1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the signal circuit terminal and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If between 4.8 - 5.2 V**
5. Test or replace the Q85 Cooling Fan Clutch.

Repair Instructions

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

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

DTC P112F (LCV OR LGZ)

Diagnostic Instructions

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

DTC Descriptor

DTC P112F

Radiator Coolant Temperature Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P112F
Low Reference	-	P00B4	P00B4*	P112F

* Internal ECM or sensor damage may occur if the circuit is shorted to B+.

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running in Closed Loop			
Parameter Normal Range: Varies with ambient temperature			
Signal	140B°C (284B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)*
Low Reference	-	-40B°C (-40B°F)	-40B°C (-40B°F)*

* Internal ECM or sensor damage may occur if the circuit is shorted to B+.

Circuit Description

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

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

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTC P112F is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P112F is a Type B DTC.

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

Electrical Information Reference

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

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120B°C (-38 to +248B°F) and changes with engine run time.
 - **If not between -39 to + 120B°C (-38 to +248B°F) or does not change**
Refer to Circuit/System Testing.
 - **Go to next step: If between -39 to + 120B°C (-38 to +248B°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
5. All OK.

Circuit/System Testing

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

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V

3. Ignition OFF

4. 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 warmer than 140B°C (284B°F)**

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

Component Testing

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

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

2. Test the engine coolant temperature sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance table and verify that the resistance is within 5 percent of the specification.
 - If not within the specified range, replace the B34B Engine Coolant Temperature Sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Engine Coolant Temperature Sensor Replacement - Radiator (LCV).
- Engine Control Module Replacement for ECM replacement, setup, and programming

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 (with LWN), or Cooling Fan Description and Operation (with LCV, LGZ), or Cooling System Description and Operation (LGZ, LWN), or Cooling System Description and Operation (LCV).

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 cooling fan control module is thermally protected to prevent module damage in the case of a short circuit condition in the cooling fan motor.

Diagnostic Aids

- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fan ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate engine controls subsection.
- A delay or ramp up of approximately 12 seconds may occur before the cooling fan activates or changes speed when being commanded with a scan tool.
- In order to set certain DTCs the PCM must command the Cooling Fan system On. Using the scan tool to operate the Cooling Fan will not set certain DTCs. In these cases run the vehicle until it reaches an appropriate condition for the PCM to command the Cooling Fans On.

Reference Information

Schematic Reference

[Engine Heating/Cooling Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or **[Inline Harness Connector End Views - Index](#)** or **[Component Connector End Views - Index](#)**

Description and Operation

[Cooling Fan Description and Operation \(with LWN\)](#), or **[Cooling Fan Description and Operation \(with LCY, LGZ\)](#)**

Electrical Information Reference

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

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 (with LWN)**.
 - **Go to next step: If no DTC is set.**
3. Verify the scan tool Cooling Fan Motor Command parameter is 0 %.
 - **If greater than 0 %**

Refer to Diagnostic Aids and **Symptoms - Engine Cooling** for further diagnosis.
 - **Go to next step: If 0 %**
4. Verify that the G10 Cooling Fan Motor is not operating.
 - **If the G10 Cooling Fan Motor is operating**

Refer to Circuit/System Testing.
 - **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 OFF.
 2. Test for less than 1 V between the G10 Cooling Fan Motor harness connector terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - **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 repair.

- **Fan Blade Replacement (LCV, LGZ)**, or **Fan Blade Replacement (LWN)** for G10 Cooling Fan Motor or K22 Cooling Fan Control Module replacement.
- **Control Module References**

ENGINE OVERHEATING

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			

Step	Action	Yes	No
1	Check for a loss of coolant. Loss of Coolant Is there a loss of coolant?	Go to Step 2	Go to Step 3
2	Fill the system to the specified level. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) . Does the engine still overheat?	Go to Step 3	System OK
3	Check for kinked or pinched surge tank hoses, especially at the radiator. Are any surge tank hoses kinked or pinched?	Go to Step 4	Go to Step 5
4	1. Relieve any kinks by rerouting the hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to Step 5	System OK
5	Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors?	Go to Step 6	Go to Step 7
6	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to Step 7	System OK
7	Check the coolant concentration. Does the coolant concentration test correctly?	Go to Step 9	Go to Step 8
8	Replace the coolant, if necessary. Refer to Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) . Does the engine still overheat?	Go to Step 9	System OK
9	NOTE: Use the correct pressure cap. Check the system for loss of pressure. Pressure Cap Testing Is there a loss of pressure?	Go to Step 10	Go to Step 11
10	Repair any leaks, as necessary. Does the engine still overheat?	Go to Step 11	System OK
11	Check for a faulty engine coolant temperature sensor. Is the engine coolant temperature sensor faulty?	Go to Step 12	Go to Step 13
12	Replace the engine coolant temperature sensor. Engine Coolant Temperature Sensor Replacement , or Engine Coolant Temperature Sensor Replacement Does the engine still overheat?	Go to Step 13	System OK
13	Check the radiator for any air flow obstructions or bent fins. Is there any airflow obstruction or bent fins?	Go to Step 14	Go to Step 15
14	1. Remove or relocate add-on parts that block air flow to the radiator. 2. Clean any debris from the radiator core. Does the engine still overheat?	Go to Step 15	System OK
15	Check for any blocked cooling system passages. Are there any blocked cooling system passages?	Go to Step 16	Go to Step 17

Step	Action	Yes	No
16	1. Remove any obstruction. 2. Flush the cooling system, as required. Flushing 3. Refill the coolant. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) . Does the engine still overheat?	Go to Step 17	System OK
17	Check for an inoperative cooling fan. Is the cooling fan inoperative?	Go to Step 18	Go to Step 19
18	Replace the cooling fan shroud. Engine Coolant Fan Shroud Replacement (LCV, LGZ) , or Engine Coolant Fan Shroud Replacement (LWN) . Does the engine still overheat?	Go to Step 19	System OK
19	Check for a thermostat that is stuck closed. Is the thermostat stuck closed?	Go to Step 20	Go to Step 21
20	Replace the thermostat. Engine Coolant Thermostat Housing Replacement (LCV) , or Engine Coolant Thermostat Housing Replacement (LGZ) . Does the engine still overheat?	Go to Step 21	System OK
21	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to Step 22	-
22	Replace the water pump. Water Pump Replacement (LCV) , or Water Pump Replacement (LWN) , or Water Pump Replacement (LGZ) . Does the engine still overheat?	-	System OK

LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms, or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) . Is the action complete?	Go to Step 5	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 19	Go to Step 6
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 7	Go to Step 8
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust.	Go to Step 20	Go to Step 8

Step	Action	Yes	No
	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?		
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Engine block • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 21	Go to Step 10
10	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8. Are any leaks present?	Go to Step 21	Go to Step 11
11	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 12	Go to Step 16
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	-

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

THERMOSTAT DIAGNOSIS

Tools Required

J 24731 Tempil Stick

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

Thermostat Test Procedure Using Tempil Sticks

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

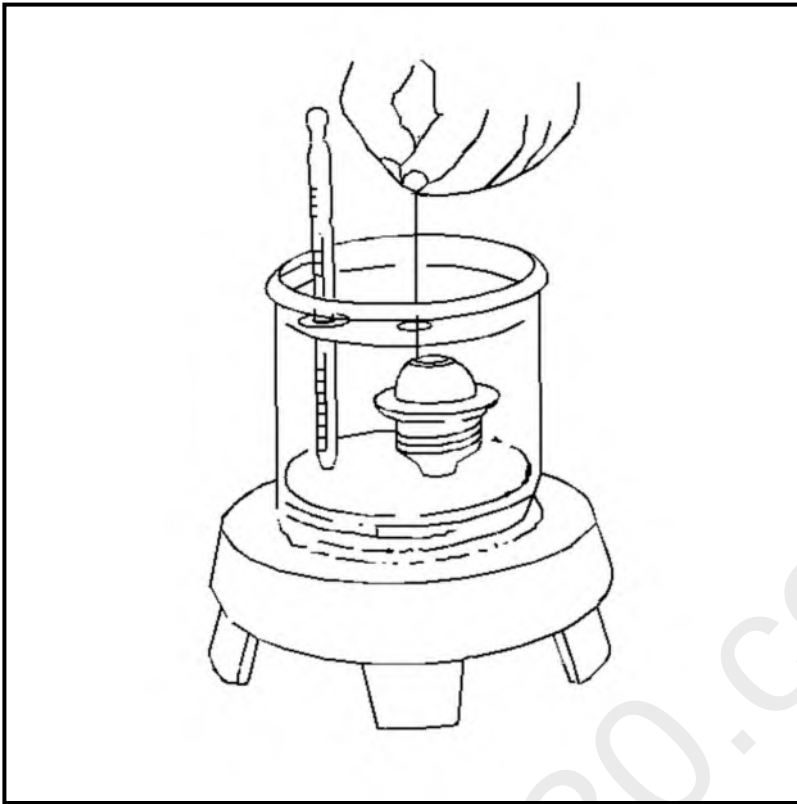
- Use a tempil stick in order to find the opening and the closing temperatures of the coolant thermostat.
 - J 24731** Tempil Stick -188 tempil stick melts at 87B°C +/-2 degrees (188B°F). The thermostat should begin to open.
 - J 24731** Tempil Stick -206 tempil stick melts at 97B°C +/-2 degrees (206B°F).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

Thermostat Test Procedure Using Glycol

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

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

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



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

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

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

COOLANT HEATER INOPERATIVE (WITHOUT DIESEL)

Diagnostic Instructions

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

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 -18B°C (0B°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 -18B°C (0B°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 or replace the coolant heater cord.

Repair Instructions

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

- [Coolant Heater Replacement \(LCV\)](#), or [Coolant Heater Replacement \(LGZ\)](#)
- [Coolant Heater Cord Replacement \(LCV\)](#), or [Coolant Heater Cord Replacement \(LGZ\)](#)

COOLANT HEATER INOPERATIVE (WITH DIESEL)

Diagnostic Instructions

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

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. 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

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 or replace the coolant heater cord.

Repair Instructions

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

- **Coolant Heater Replacement (LWN)**
- **Coolant Heater Cord Replacement (LWN)**

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. <u>Cooling Fan Always On</u> 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. <u>Thermostat Diagnosis</u> Is the thermostat operating properly?	Go to Step 1	Go to Step 6

Step	Action	Yes	No
6	1. Replace the water outlet. Water Outlet Replacement (LCV) , or Water Outlet Replacement (LGZ) . 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK

PRESSURE CAP TESTING

Special Tools

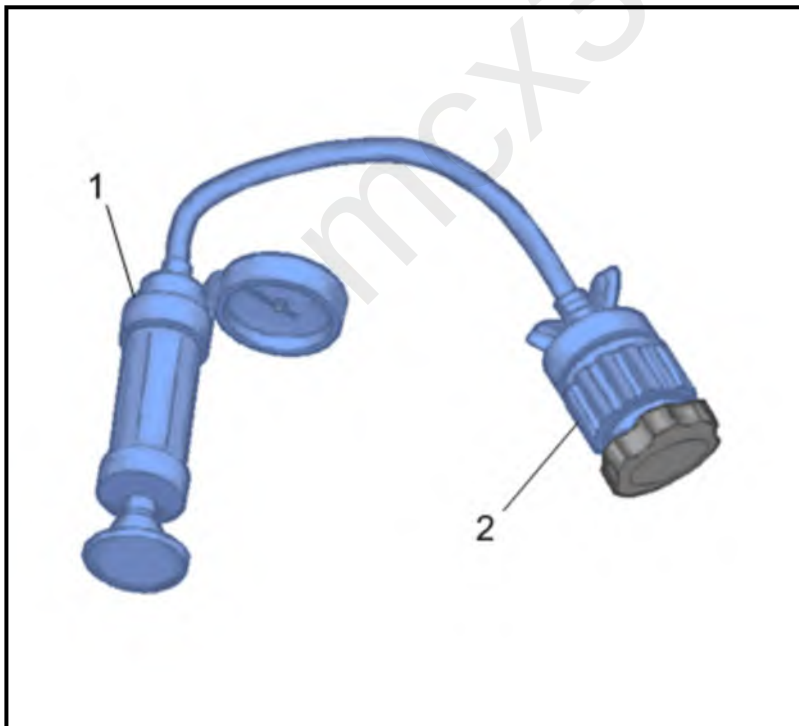
- EN-24460-A Cooling System Pressure Tester
- GE-42401-A Radiator Cap / Surge Tank Test Adapter

Equivalent regional tools: **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 EN-24460-A Cooling System Pressure Tester (1) with GE-42401-A Radiator Cap / Surge Tank Test Adapter (2) in order to test the pressure cap.



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

4. Test the pressure cap for the following conditions:

- Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
- Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:

- The pressure cap does not release pressure which exceeds the rated pressure of the cap.
- The pressure cap does not hold the rated pressure.

COOLING SYSTEM LEAK TESTING

Special Tools

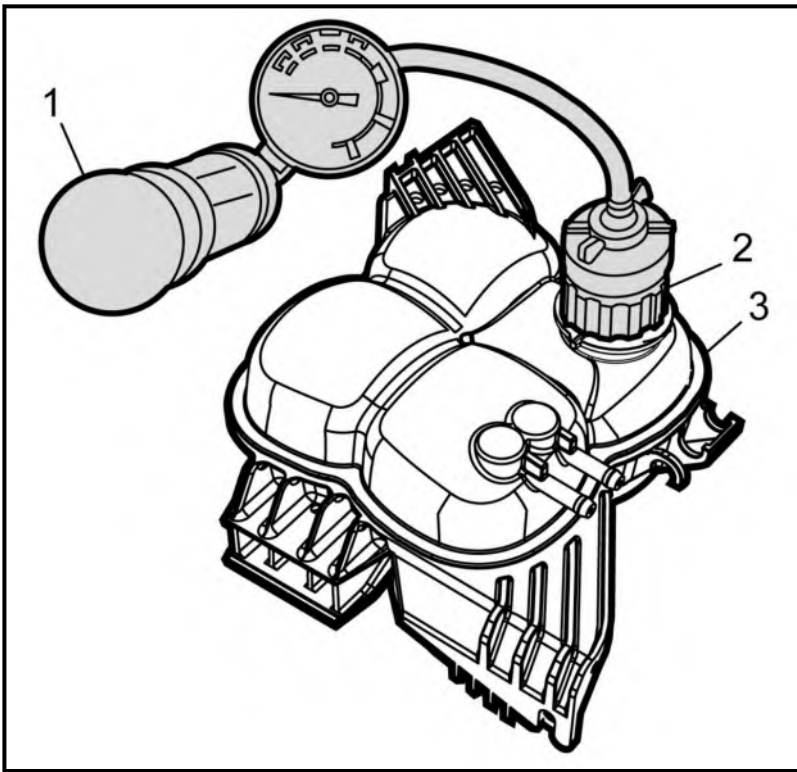
- **J-24460-01** Cooling System Pressure Tester
- **J-42401** Radiator Cap/Surge Tank Test Adapter

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

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

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

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to [Pressure Cap Testing](#).
3. Wash the pressure cap mating surface with water.
4. Use the **J-24460-01** cooling system pressure tester (1) with the **J-42401** radiator cap/surge tank test adapter (2) in order to apply pressure to the cooling system (3).



Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

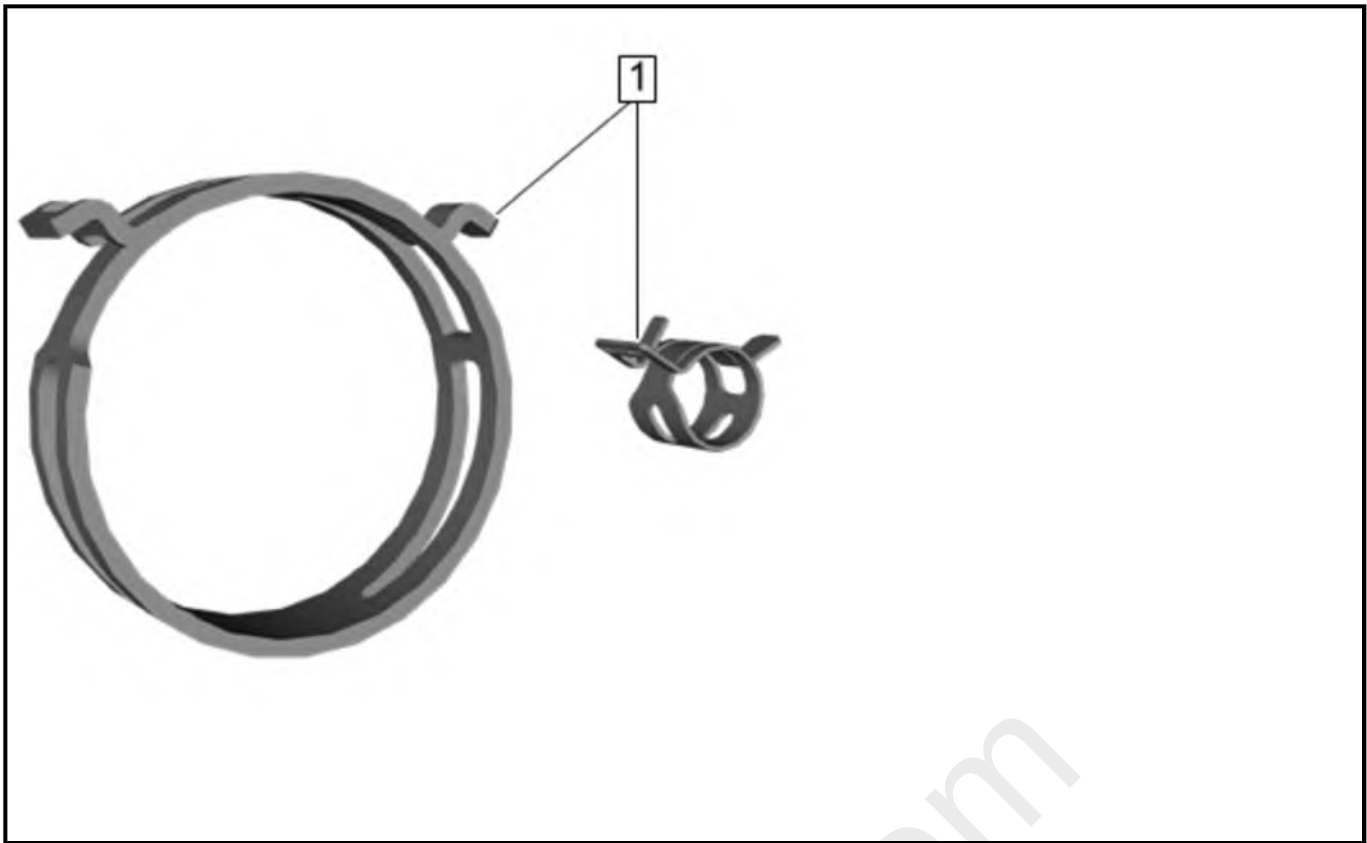
HOSE CLAMP REPLACEMENT GUIDELINES - SPRING TYPE

Special Tools

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

Equivalent regional tools: [Special Tools](#)

Spring Type Hose Clamp Replacement Guidelines



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

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

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

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

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

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

Removing The Spring Type Hose Clamp

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

- If the spring type hose clamp will not easily separate from the hose and/or the clamp tears or damages the hose, both the hose and hose clamp must be replaced

- If the spring type hose clamp is easily removed from the hose, the clamp can be reused provided that the clamp does not have any of the conditions as noted above.

If The Spring Type Hose Clamp Is Being Reused

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

When Reusing The Spring Type Hose Clamp and Replacing The Hose

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

When Reusing The Spring Type Hose Clamp with an Existing Hose

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

If The Spring Type Hose Clamp Is Being Replaced

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

When Replacing The Spring Type Hose Clamp and Replacing The Hose

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

When Replacing The Spring Type Hose Clamp with an Existing Hose

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

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Special Tools

- **J 26568** Coolant and Battery Tester

Draining Procedure

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

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

Filling Procedure

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

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

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

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

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

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

COOLING SYSTEM DRAINING AND FILLING (VAC N FILL)

Special Tools

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

Draining Procedure

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

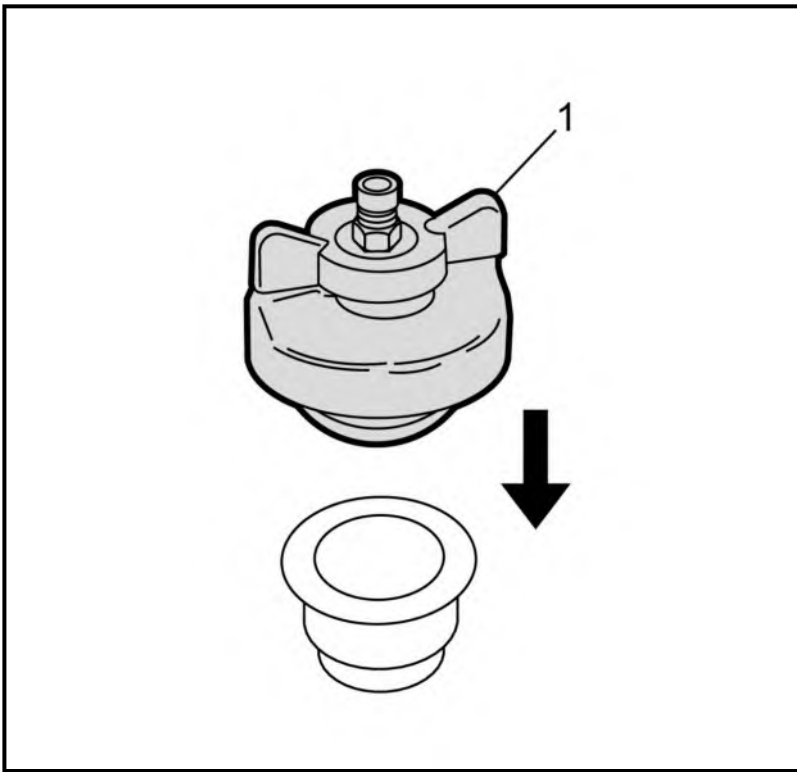
1. Park the vehicle on a level surface.
2. Remove the coolant pressure cap.
3. To drain the cooling system, remove the radiator drain cock from the radiator. [Radiator Drain Cock Replacement \(LCV, LWN, LGZ\)](#).
4. If a complete engine block drain is required, remove the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets.
5. Inspect the coolant.
6. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance - Follow the filling procedure.
 - Discolored - Follow the flush procedure. [Flushing](#).

Vac-N-Fill Procedure

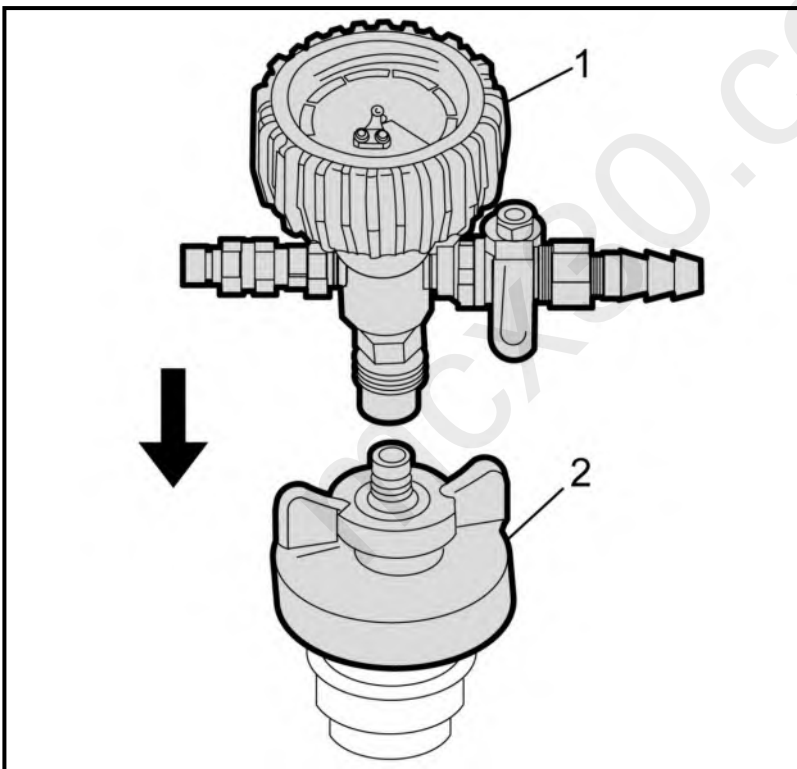
CAUTION: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

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

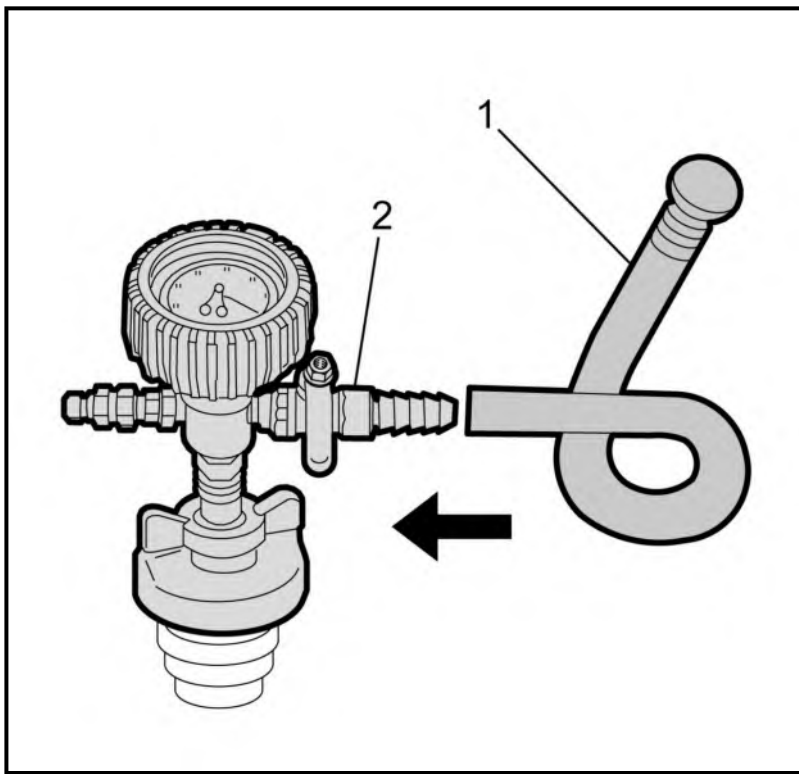
1. Install the radiator drain cock to the radiator. [Radiator Drain Cock Replacement \(LCV, LWN, LGZ\)](#).
2. If the left and right side center engine block coolant drain hole plugs and engine block coolant drain hole plug gaskets were removed, install the gaskets and plugs. [Fastener Specifications](#).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



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

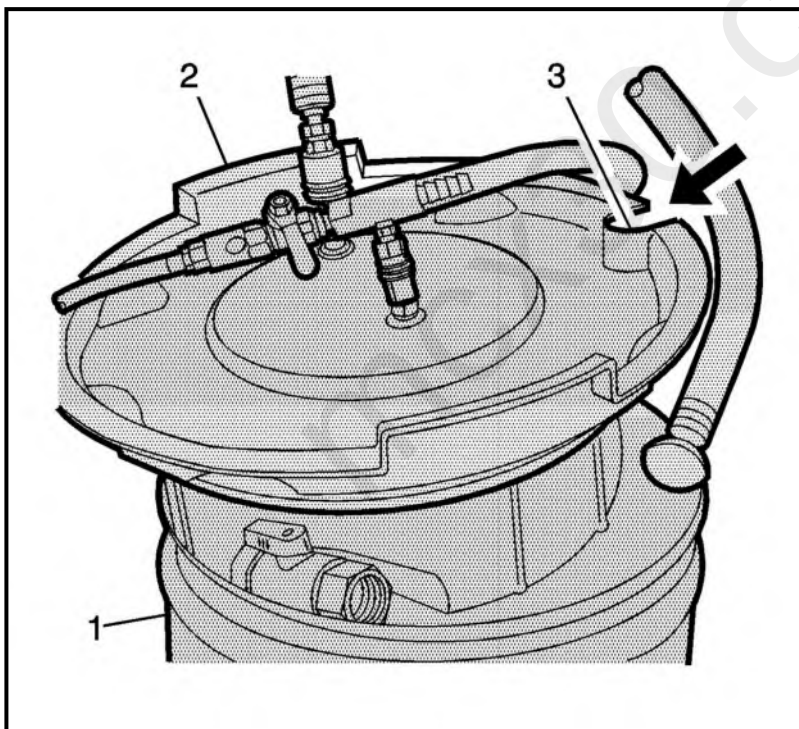


7. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).



Ensure that the valve is closed.

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



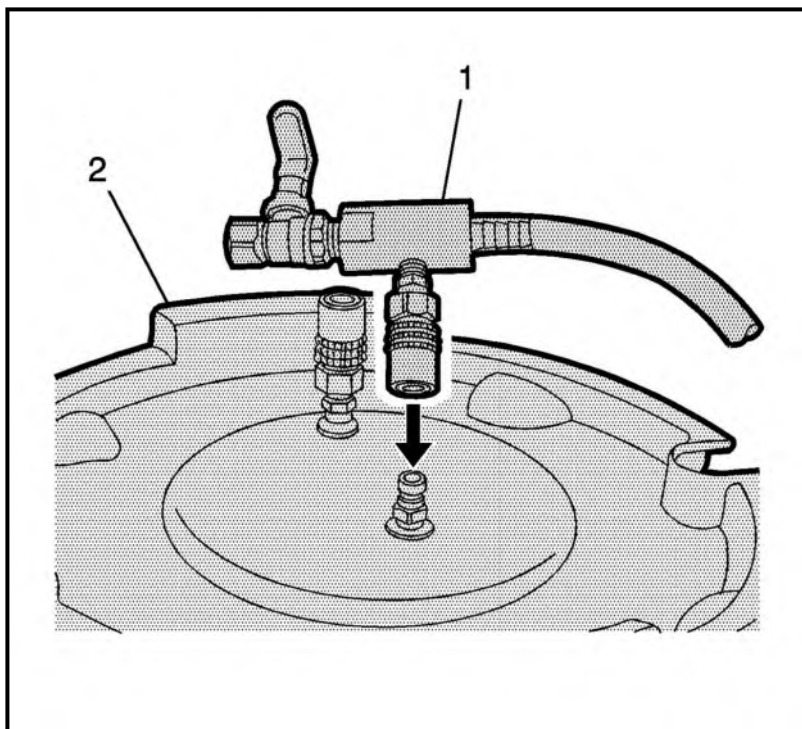
NOTE: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water. Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

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

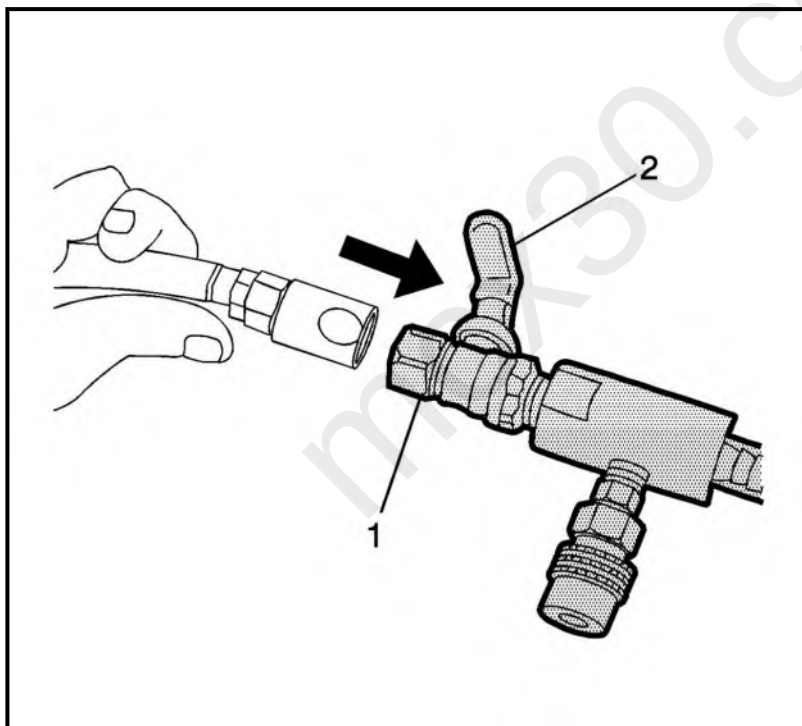
NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

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

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

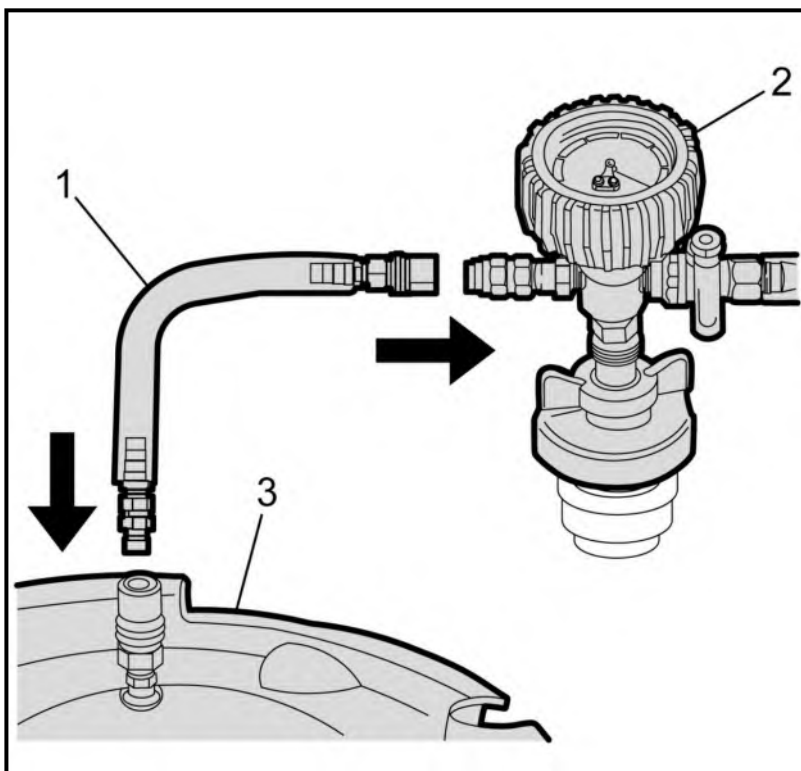


12. Attach a shop air hose to the venture assembly (1).



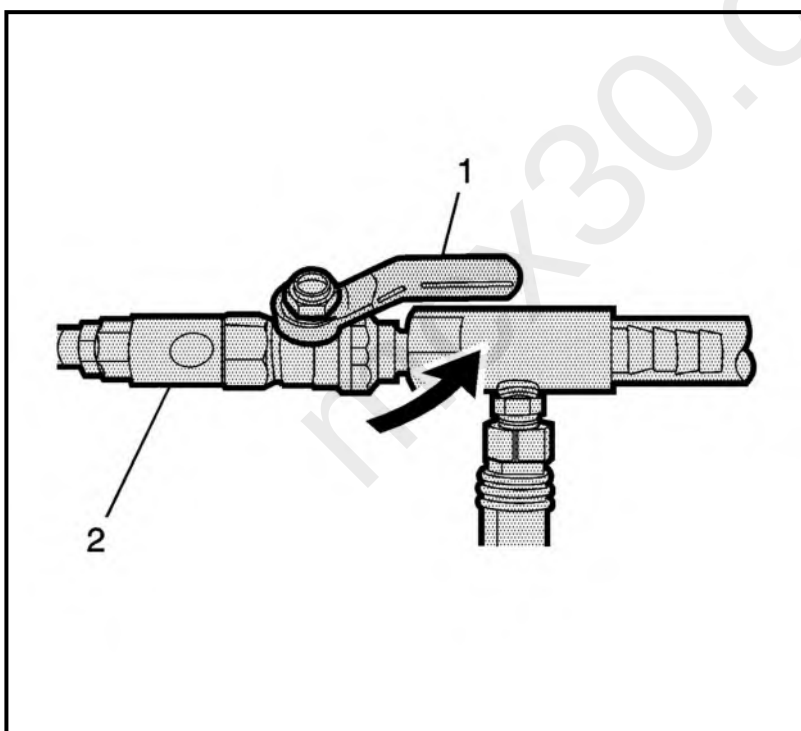
Ensure the valve (2) on the venture assembly is closed.

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

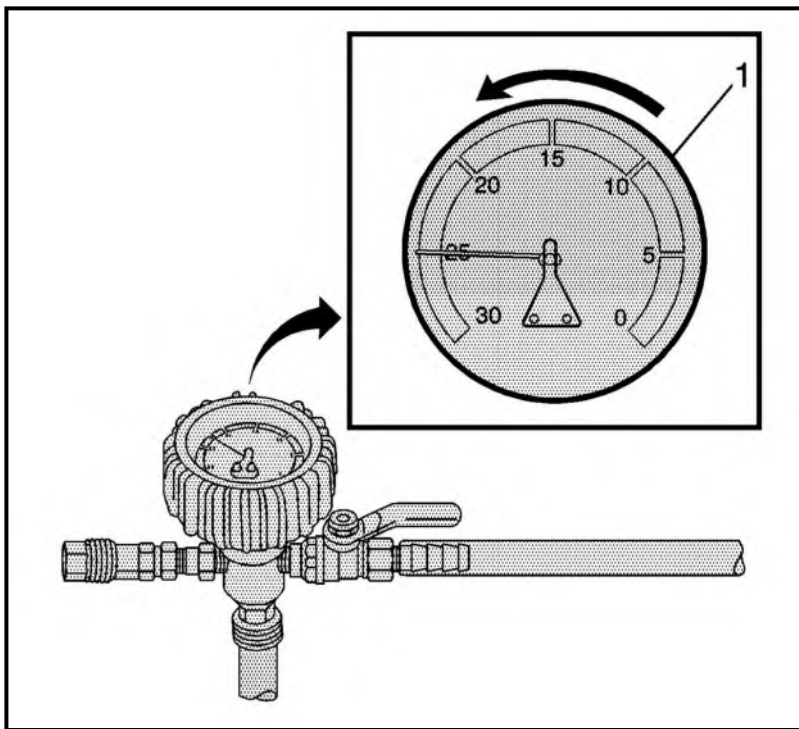


14. Clamp off the overflow hose.

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

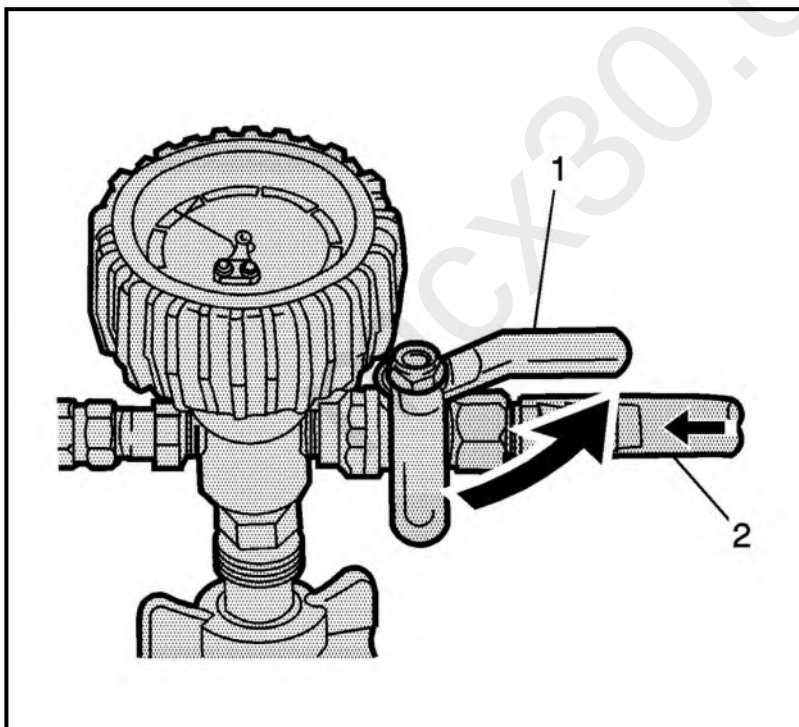


16. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).



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

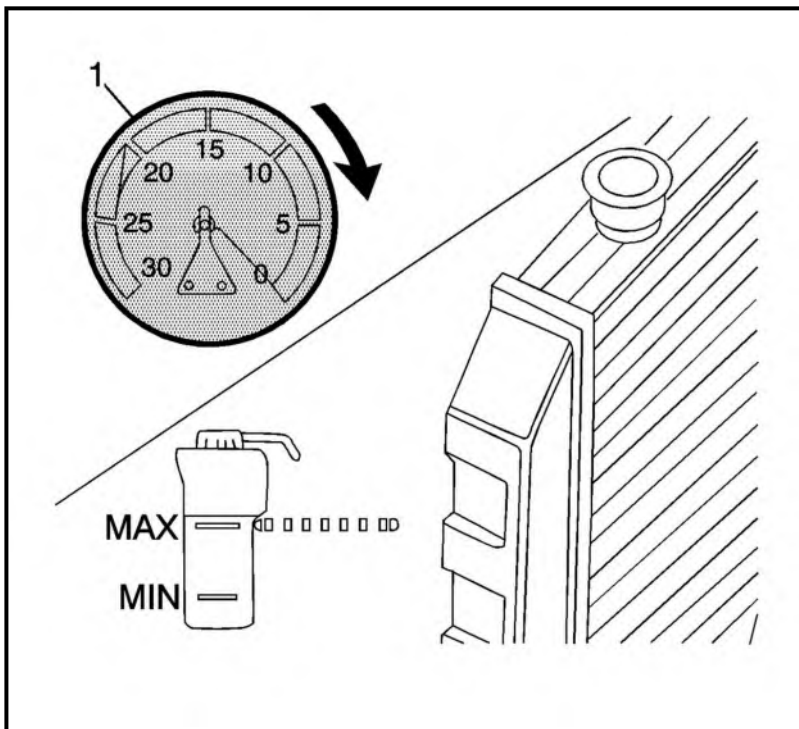
17. To aid in the fill process, position the graduated reservoir above the coolant fill port.
18. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.



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

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

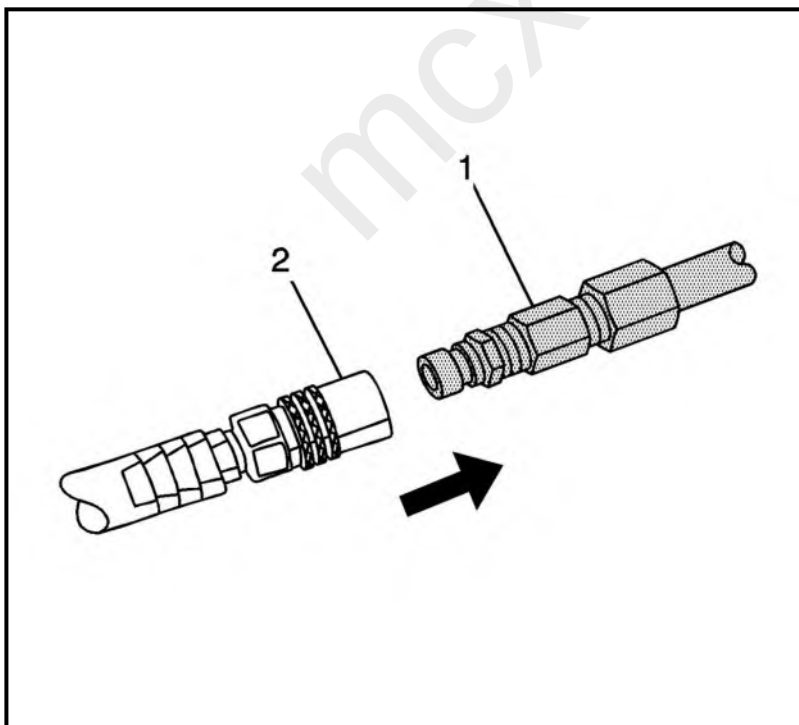
21. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
22. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11 - 17.



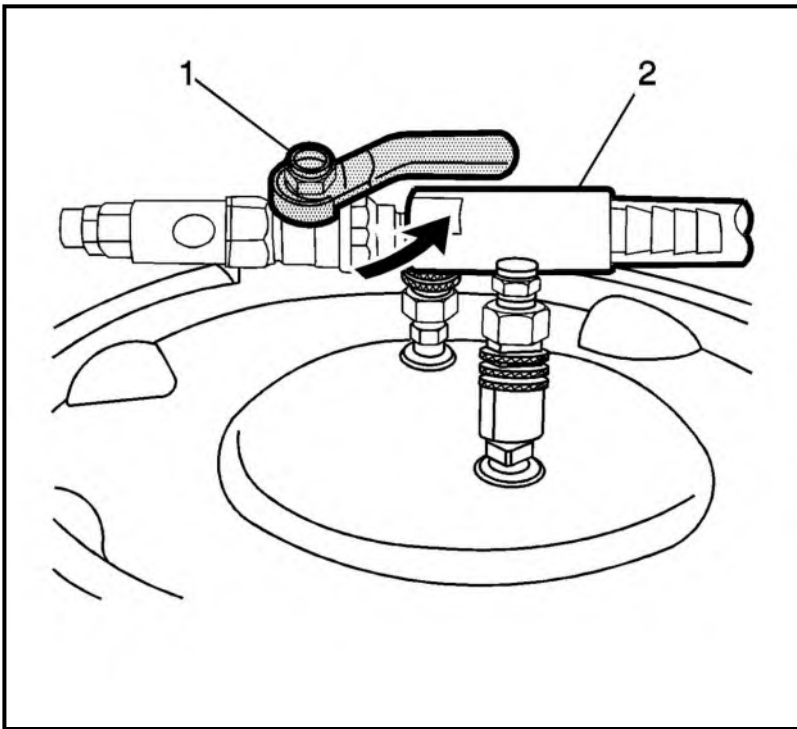
23. Remove the **J 42401** radiator cap and surge tank test adapter.
24. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
25. Add coolant to the system as necessary.
26. Inspect the concentration of the coolant mixture using **J 26568** coolant and battery tester.

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

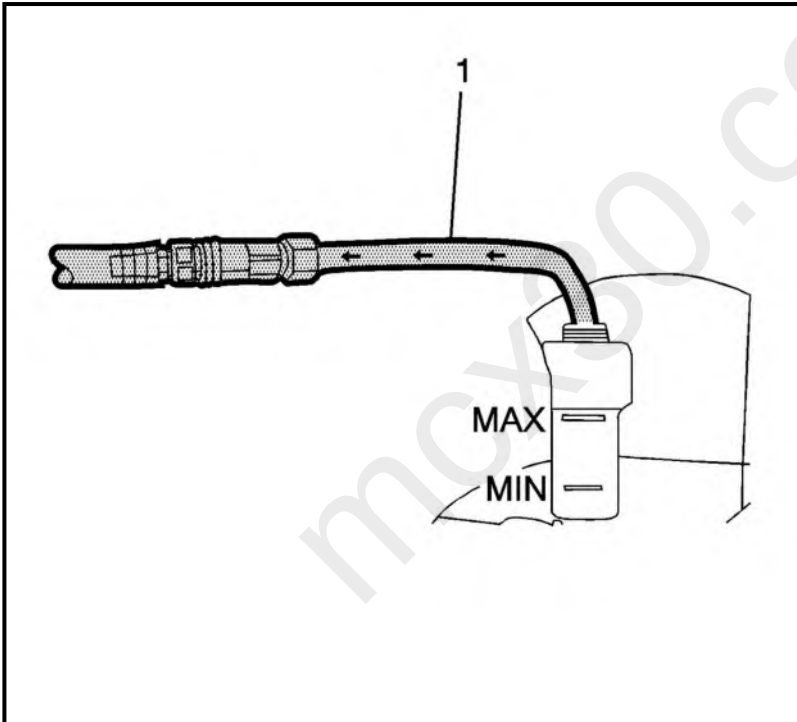
27. Detach the vacuum hose form the vacuum gauge assembly.
28. Attach the extraction hose (1) to the vacuum hose (2).



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



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



31. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.
32. Start the engine.
33. Run the engine at 2, 000 - 2, 500 RPM until the engine reaches normal operating temperature. Engine should reach an operating temperature of 90B°C (194B°F) and the upper radiator hose should be HOT.
34. Allow the engine to idle for 3 minutes.
35. Shut the engine OFF.
36. Allow the engine to cool.
37. Top off the coolant as necessary
38. Inspect the concentration of the engine coolant using the *J 26568* coolant and battery tester.
39. Install the radiator cap.
40. Rinse away any excess coolant from the engine and the engine compartment.

41. Inspect the cooling system for leaks.

FLUSHING

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.

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

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

ENGINE RADIATOR CLEANING

WARNING:

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

CAUTION:

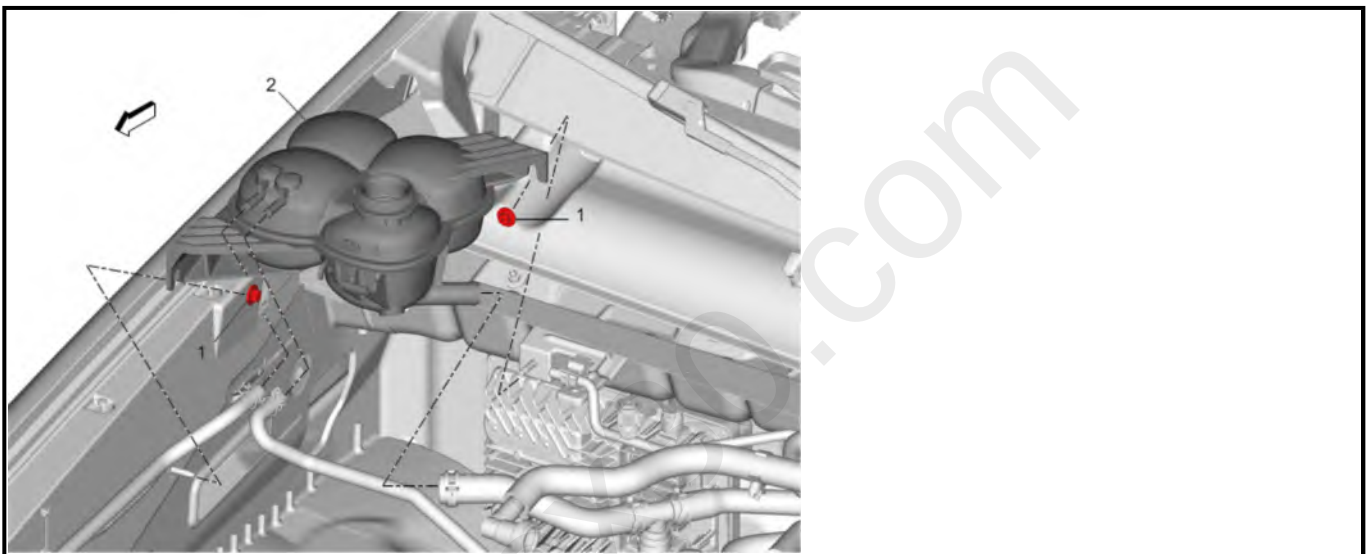
The heat exchanger fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

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

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

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

RADIATOR SURGE TANK REPLACEMENT (LCV, LGZ)

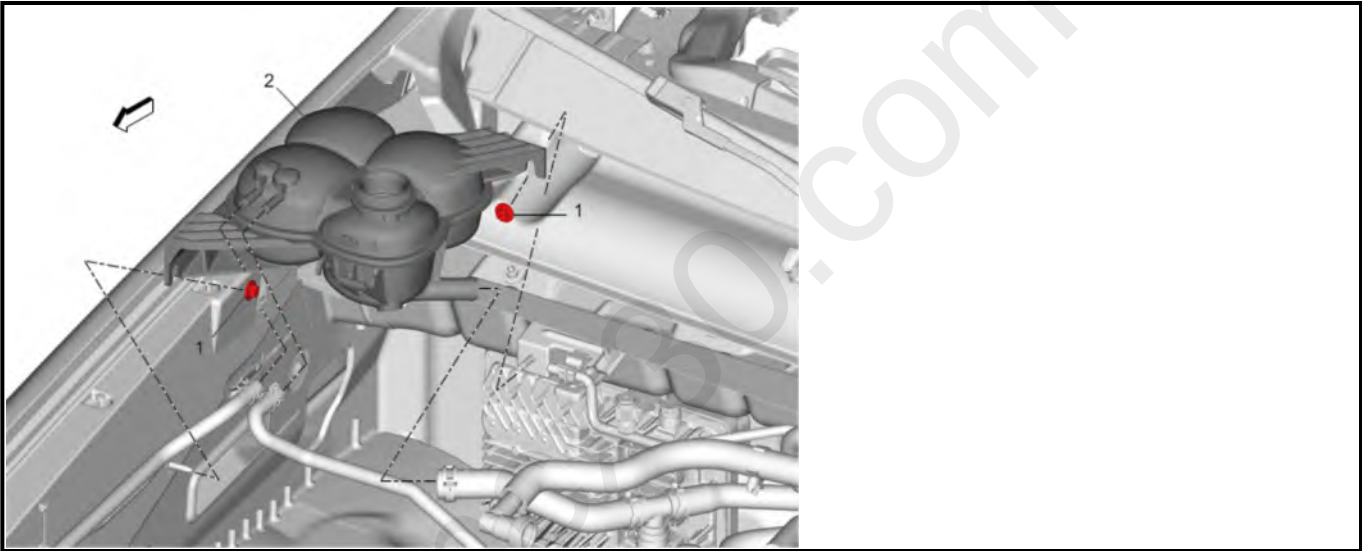


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	
1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) .	
2. Remove the radiator vent outlet hose from the radiator surge tank and position out of the way. Refer to Radiator Vent Outlet Hose Replacement (LCV, LGZ) .	
3. Remove the coolant recovery reservoir hose from the radiator surge tank and position out of the way. Refer to Coolant Recovery Reservoir Hose Replacement (LCV) , or Coolant Recovery Reservoir Hose Replacement (LGZ) .	
4. Remove the heater outlet hose from the surge tank and position out of the way. Refer to Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Heater Core Tube LCV) , or Heater Outlet Hose Replacement (Heater Outlet Hose Tee to Water Outlet LCV) , or Heater Outlet Hose Replacement (LGZ Surge Tank to Connection) , or Heater Outlet Hose Replacement (Heater Outlet Hose Connector to Heater Core Tube LGZ) , or Heater Outlet Hose Replacement (Heater Outlet Hose Connector to Heater Inlet Outlet Pipe LGZ) .	
1	Radiator Surge Tank Nut (Qty: 2)

Callout	Component Name
	CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Procedures 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks.

RADIATOR SURGE TANK REPLACEMENT (LWN)



NOTE: Callouts in the following chart represent components shown in graphic above.

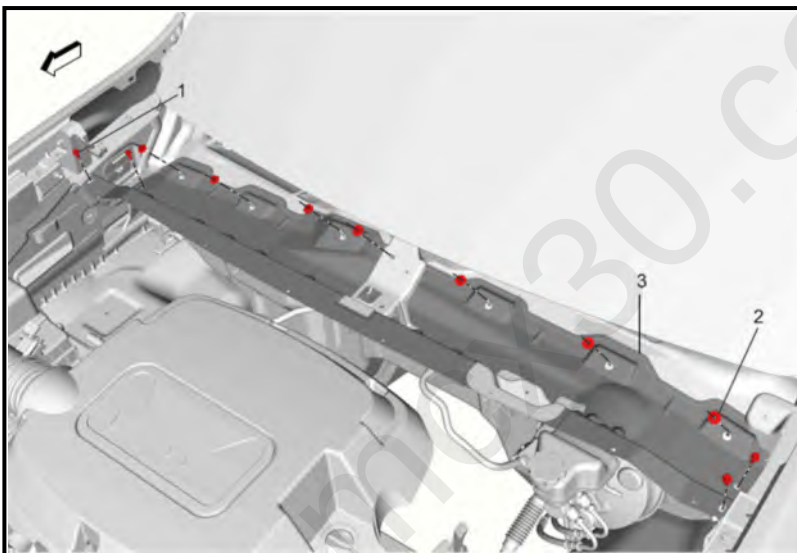
Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Radiator Vent Outlet Hose @ Radiator Surge Tank - Reposition away - Radiator Vent Outlet Hose Replacement (LWN). 3. Radiator Surge Tank Inlet Hose @ Radiator Surge Tank - Reposition away - Radiator Surge Tank Inlet Hose Replacement (LWN). 4. Radiator Surge Tank Outlet Hose @ Radiator Surge Tank - Reposition away Radiator Surge Tank Outlet Hose Replacement (LWN T Connection to Surge Tank).	
1	Radiator Surge Tank Nut [2x] CAUTION: Refer to Fastener

Callout	Component Name
	Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Procedure 1. Fill the cooling system. <u>Cooling System Draining and Filling (Static Fill)</u>, or <u>Cooling System Draining and Filling (Vac n Fill)</u>. 2. Check the cooling system for leaks.

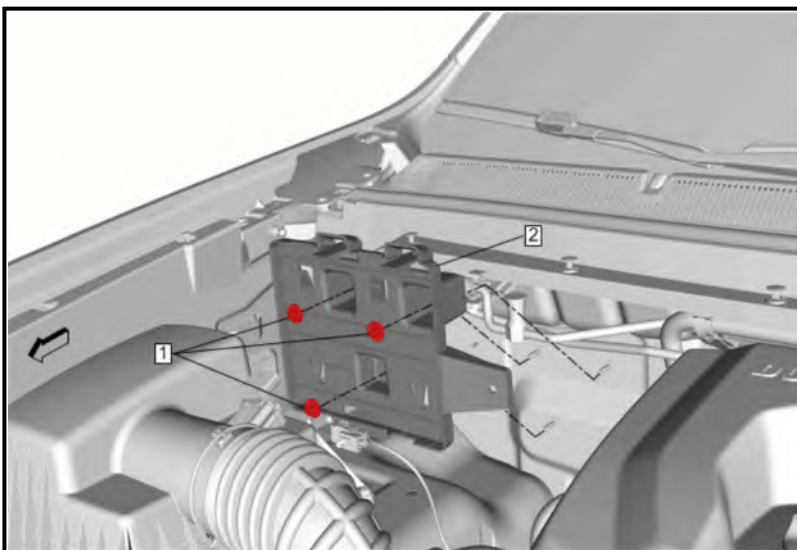
RADIATOR SURGE TANK OUTLET PIPE REPLACEMENT (LWN)

Removal Procedure

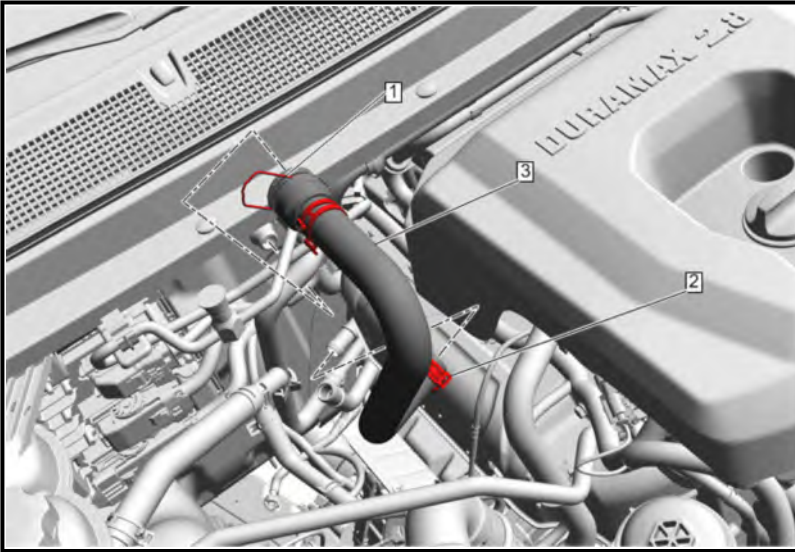
1. Drain the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill).
2. Plenum Front Panel Replacement (3) - Remove



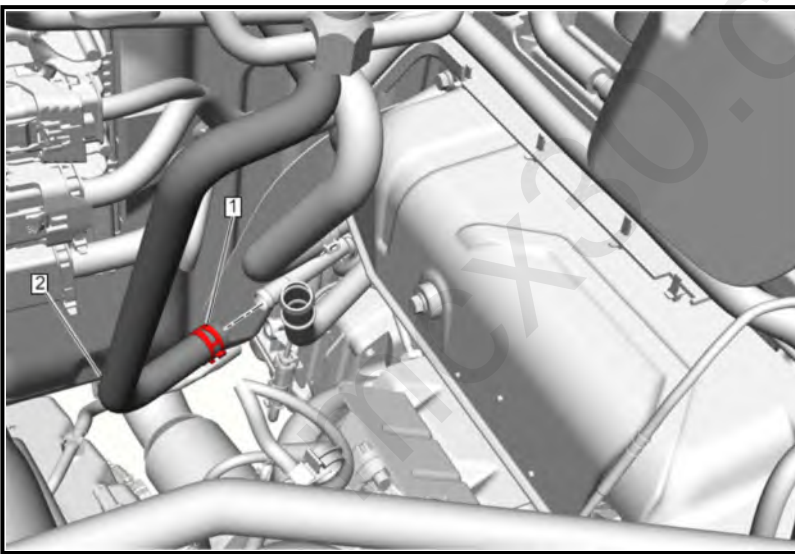
3. Engine Control Module Bracket Replacement (2) - Remove



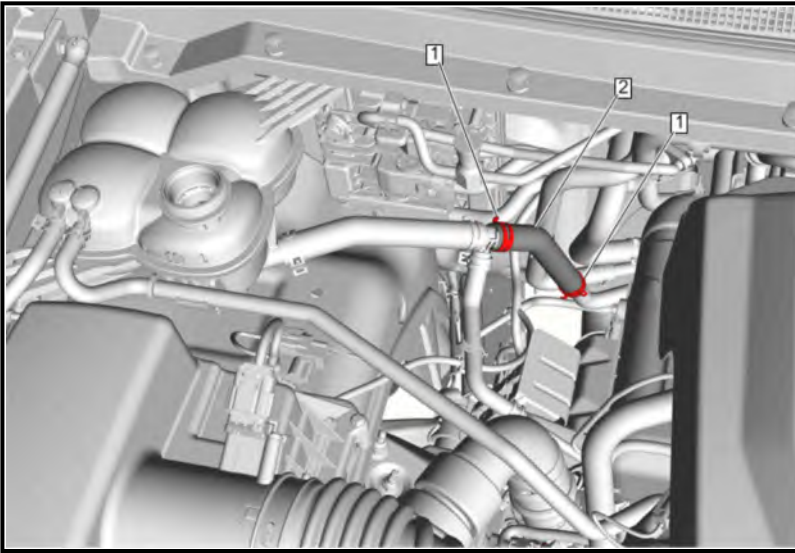
4. Heater Inlet Hose (3) @ Radiator Surge Tank Outlet Pipe - Remove - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#).



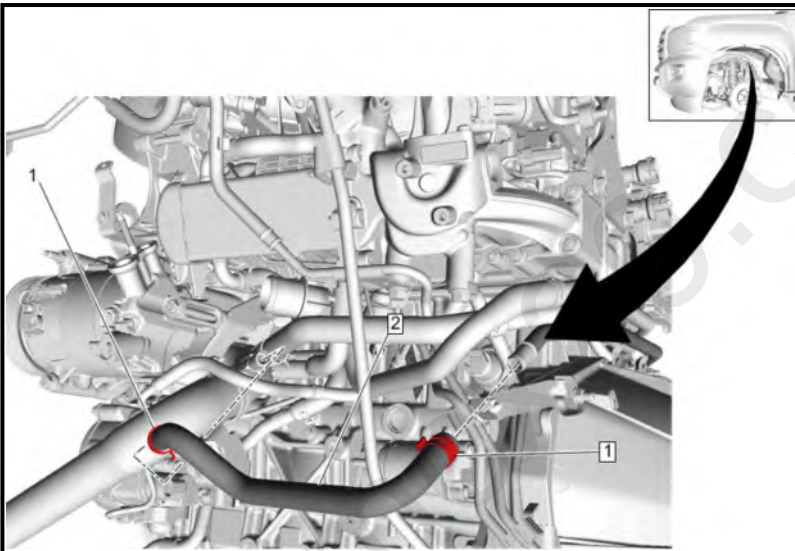
5. Reposition the heater inlet hose out of the way.
6. Heater Outlet Hose (2) @ Radiator Surge Tank Outlet Pipe - Remove - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).



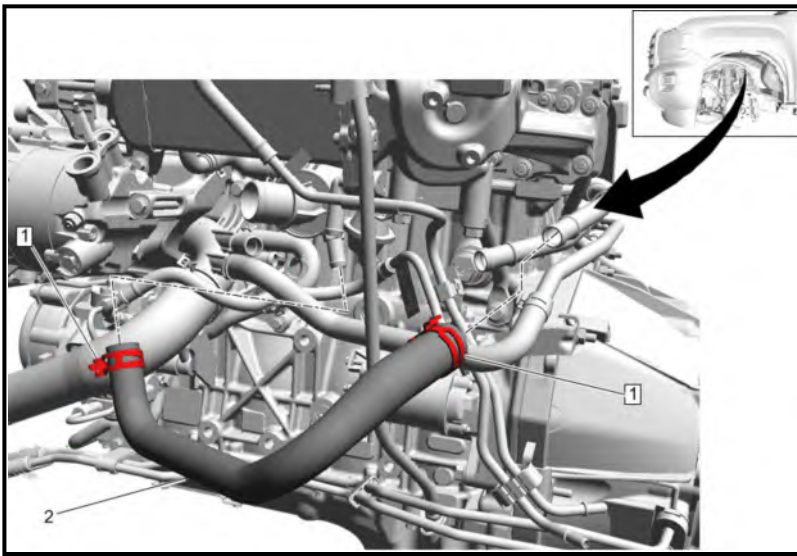
7. Reposition the heater outlet hose out of the way.
8. Radiator Surge Tank Outlet Hose (2) @ Radiator Surge Tank Outlet Pipe - Remove - [Radiator Surge Tank Outlet Hose Replacement \(LWN T Connection to Surge Tank\)](#).



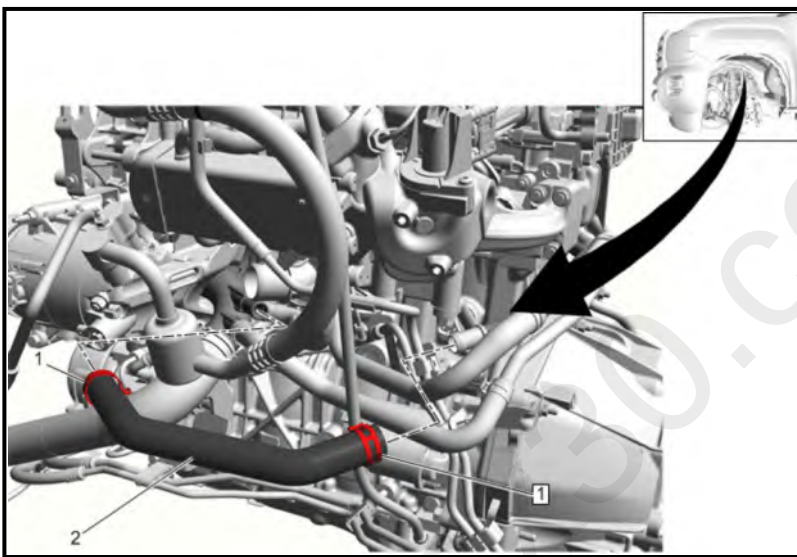
9. Reposition the radiator surge tank outlet hose out of the way.
10. Heater Outlet Hose (2) to Water Pump Inlet Pipe @ Radiator Surge Tank Outlet Pipe - Remove - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).



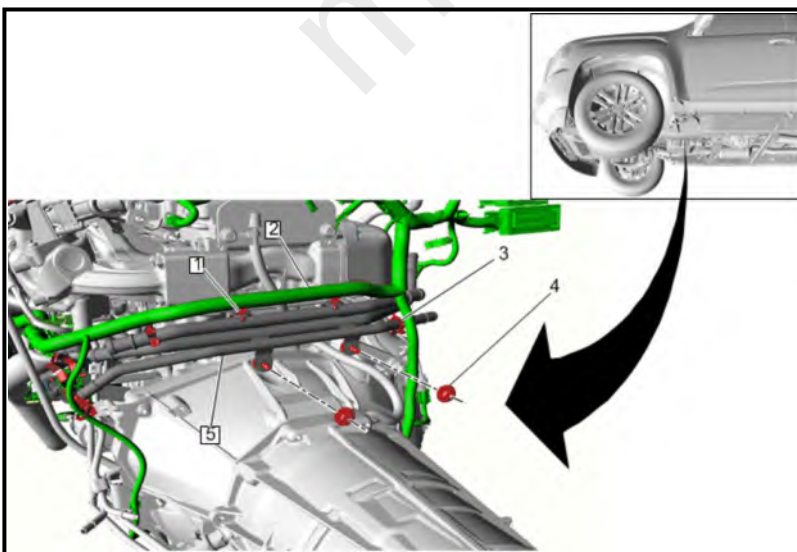
11. Heater Inlet Hose (2) to Engine Coolant Thermostat Assembly @ Radiator Surge Tank Outlet Pipe - Remove - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#).



12. Radiator Surge Tank Outlet Hose (2) to Water Pump Outlet Pipe @ Radiator Surge Tank Outlet Pipe - Remove - **Radiator Surge Tank Outlet Hose Replacement (LWN T Connection to Surge Tank)**

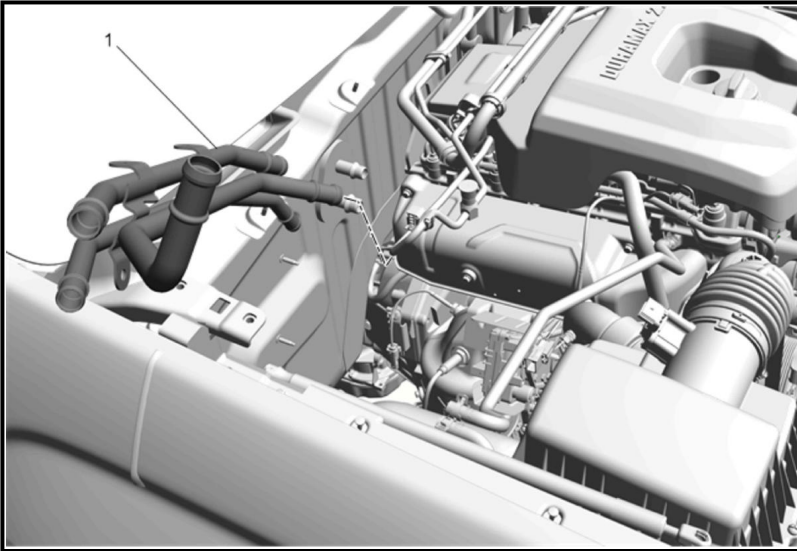


13. Engine Wiring Harness Retainer (1) @ Radiator Surge Tank Outlet Pipe - Remove [2x]



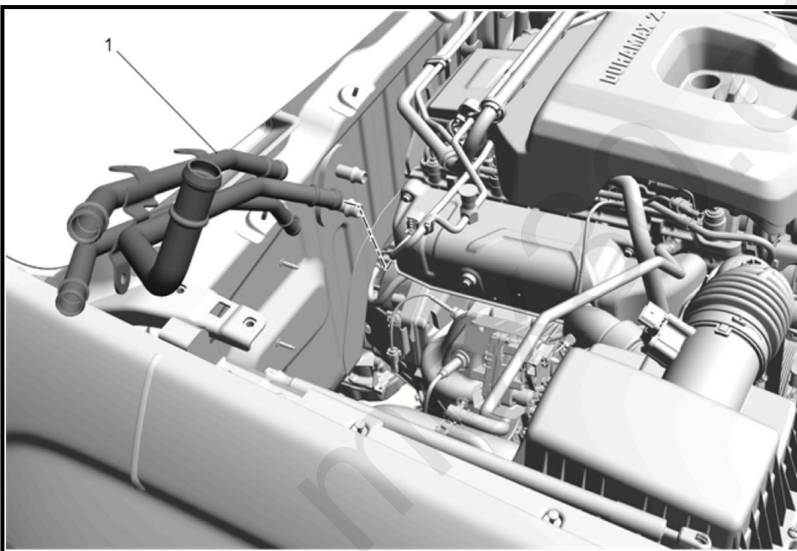
14. Unclip the engine wiring harness (3)
 15. Reposition the wiring harness (2)
 16. Radiator Surge Tank Outlet Pipe Nut (4) - Remove [2x]
 17. Radiator Surge Tank Outlet Pipe (5) - Remove

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

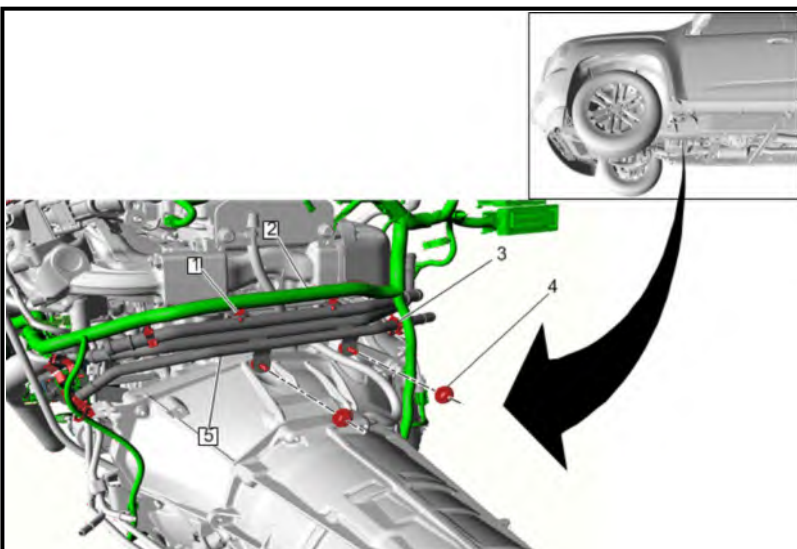


Installation Procedure

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

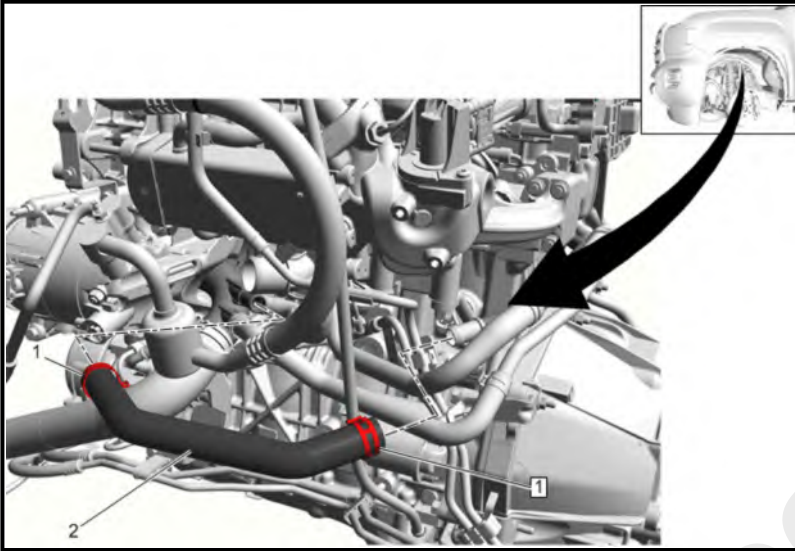


2. Radiator Surge Tank Outlet Pipe (5) - Install

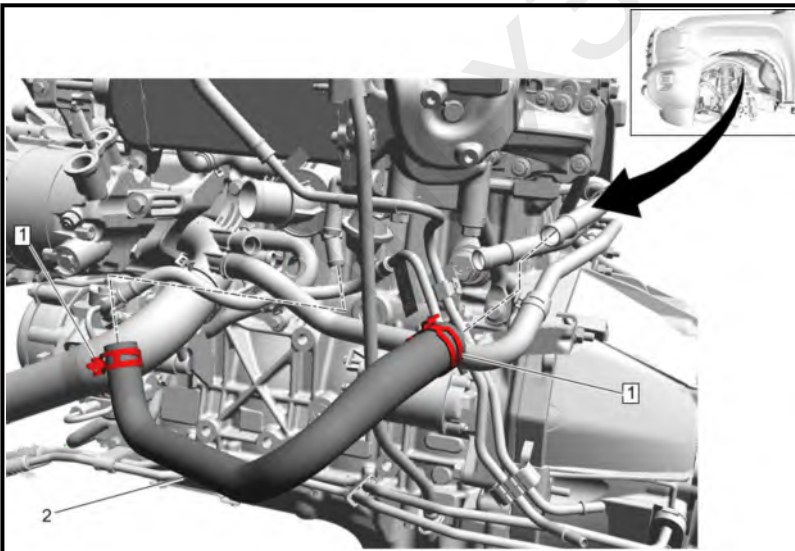


CAUTION: Refer to [Fastener Caution](#) .

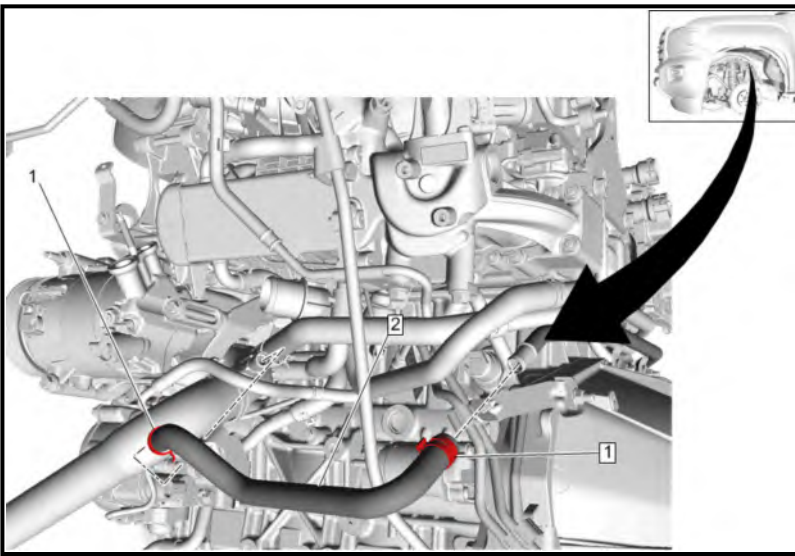
3. Radiator Surge Tank Outlet Pipe Nut (4) - Install and tighten [2x] 22 N.m (16 lb ft)
4. Reposition the wiring harness (2)
5. Clip the engine wiring harness to the radiator surge tank outlet pipe assembly (3).
6. Engine Wiring Harness Retainer (1) @ Radiator Surge Tank Outlet Pipe - Install [2x]
7. Radiator Surge Tank Outlet Hose (2) to Water Pump Outlet Pipe @ Radiator Surge Tank Outlet Pipe - Install - [Radiator Surge Tank Outlet Hose Replacement \(LWN T Connection to Surge Tank\)](#).



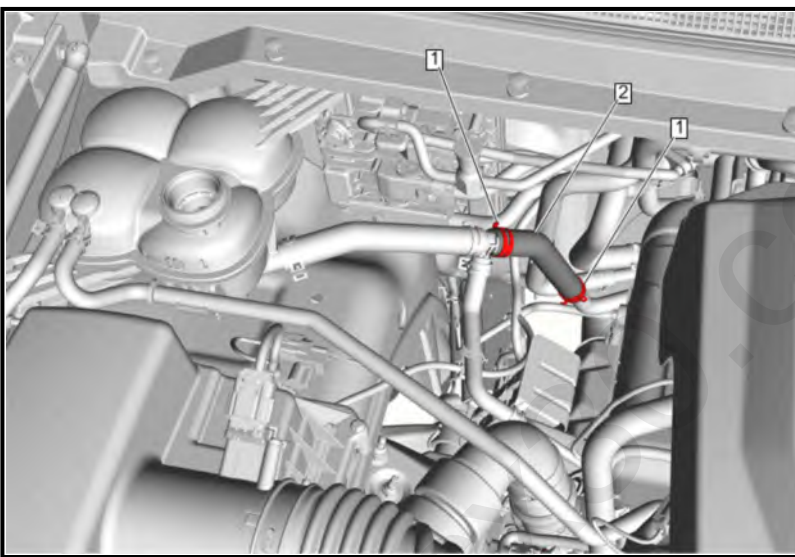
8. Heater Inlet Hose (2) to Engine Coolant Thermostat Assembly @ Radiator Surge Tank Outlet Pipe - Install - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#).



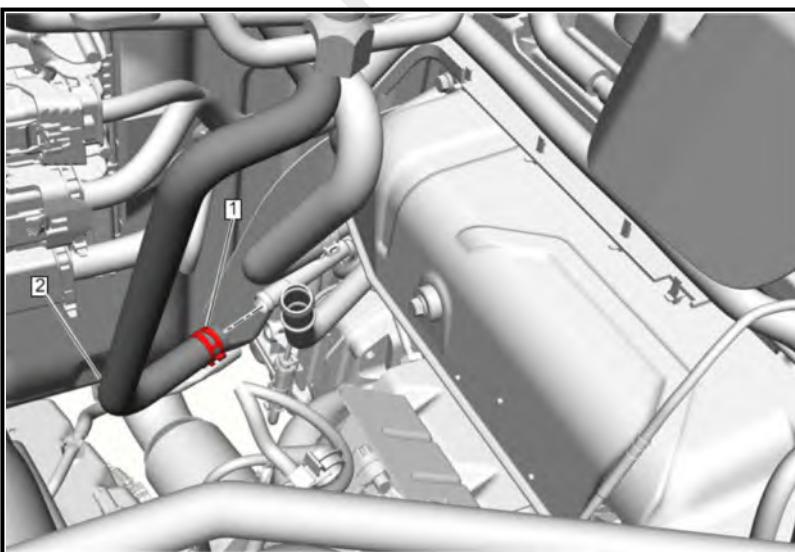
9. Heater Outlet Hose (2) to Water Pump Inlet Pipe @ Radiator Surge Tank Outlet Pipe - Install - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).



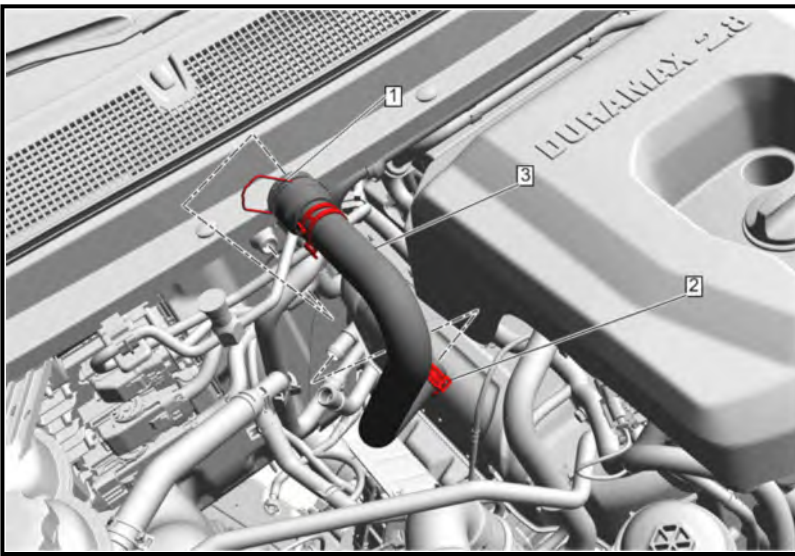
10. Radiator Surge Tank Outlet Hose (2) @ Radiator Surge Tank Outlet Pipe - Install - [Radiator Surge Tank Outlet Hose Replacement \(LWN T Connection to Surge Tank\)](#).



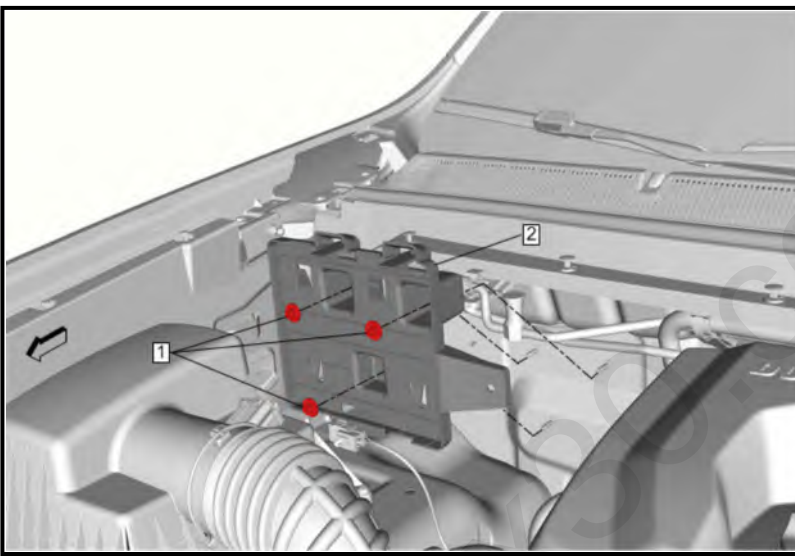
11. Heater Outlet Hose (2) @ Radiator Surge Tank Outlet Pipe - Install - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#), or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).



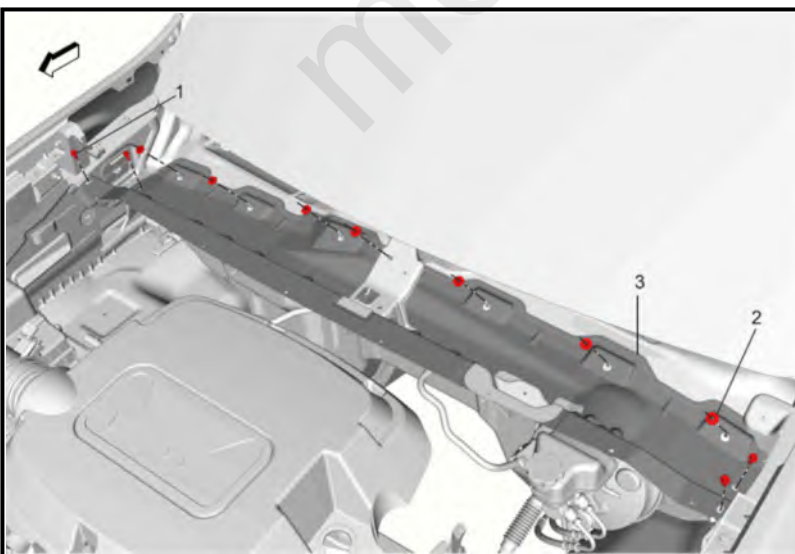
12. Heater Inlet Hose (3) @ Radiator Surge Tank Outlet Pipe - Install - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#), or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#).



13. **Engine Control Module Bracket Replacement (2) - Install**



14. **Plenum Front Panel Replacement (3) - Install**

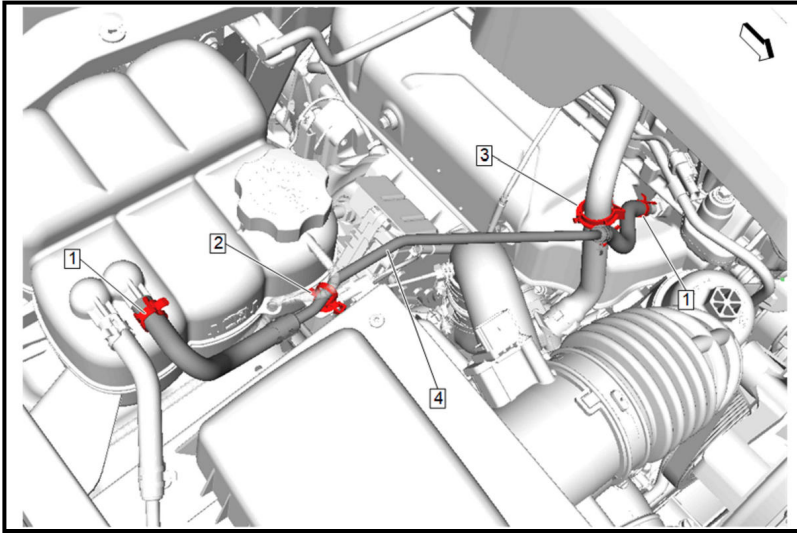


15. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill)**, or **Cooling System Draining and Filling (Vac n Fill)**.
16. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (LWN)

Removal Procedure

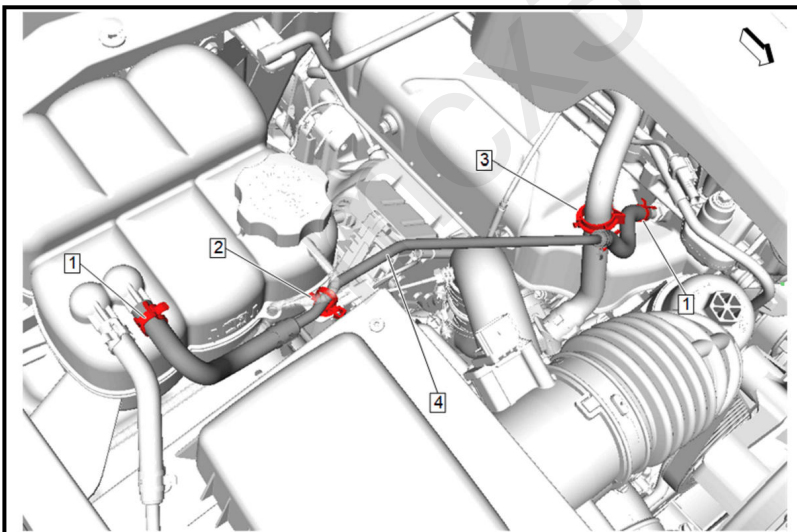
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Coolant Recovery Reservoir Hose Clamp (1) - Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)



3. Hose Clip (2) - Remove
4. Radiator Surge Tank Inlet Hose Clip (3) - Remove
5. Radiator Surge Tank Inlet Hose (4) - Remove

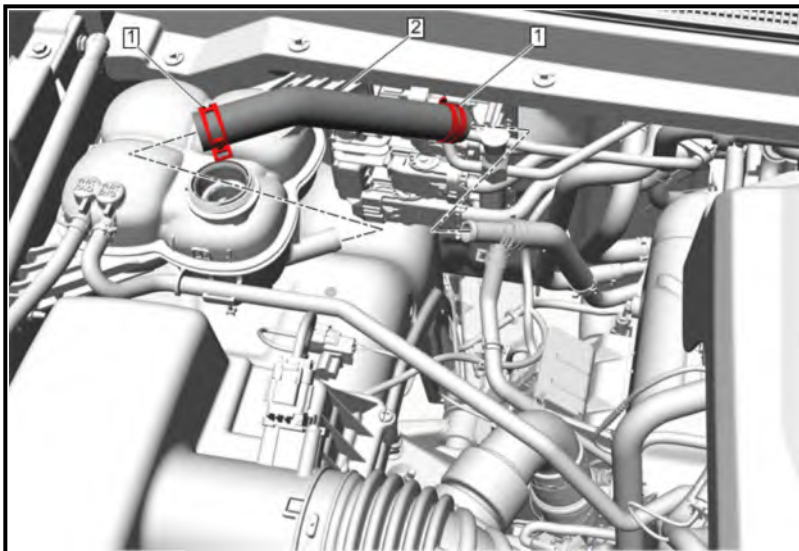
Installation Procedure

1. Radiator Surge Tank Inlet Hose (4) - Install



2. Radiator Surge Tank Inlet Hose Clip (3) - Install
3. Hose Clip (2) - Install
4. Coolant Recovery Reservoir Hose Clamp (1) - Engage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
6. Start the engine and check for coolant leaks.

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



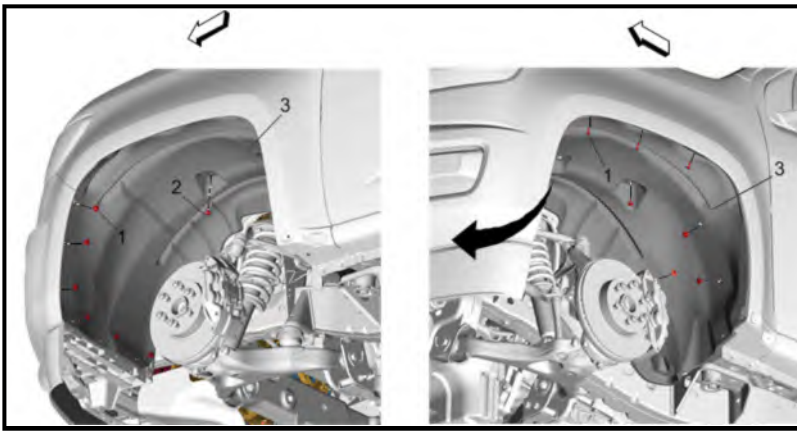
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Drain the cooling system. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill)	
1	Radiator Surge Tank Outlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Surge Tank Outlet Hose Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks.

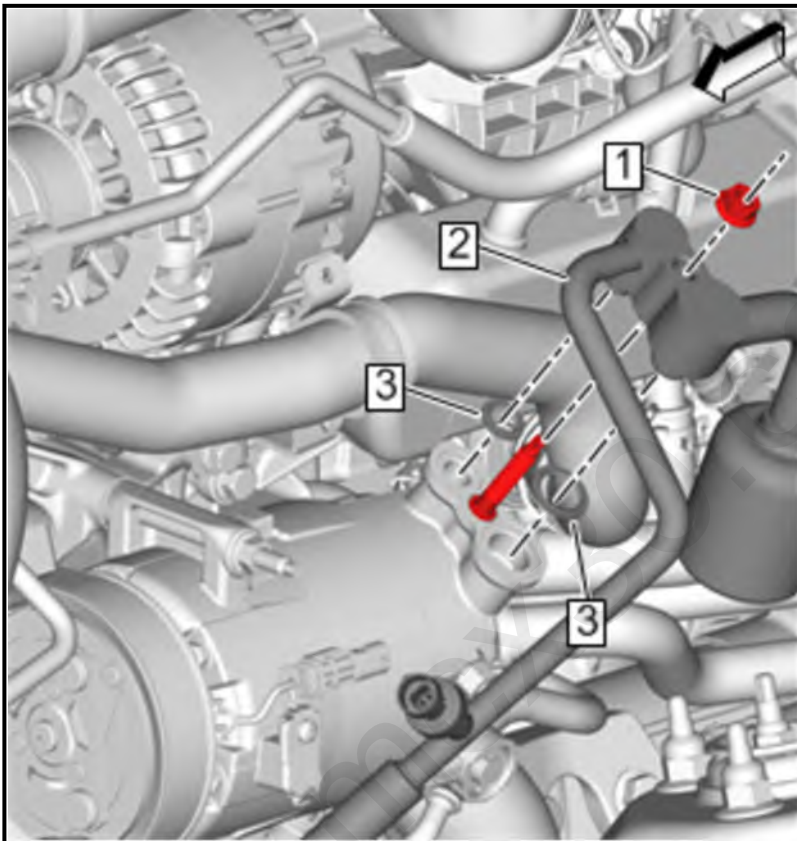
RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT - RADIATOR SURGE TANK OUTLET PIPE TO WATER PUMP INLET PIPE (LWN)

Removal Procedure

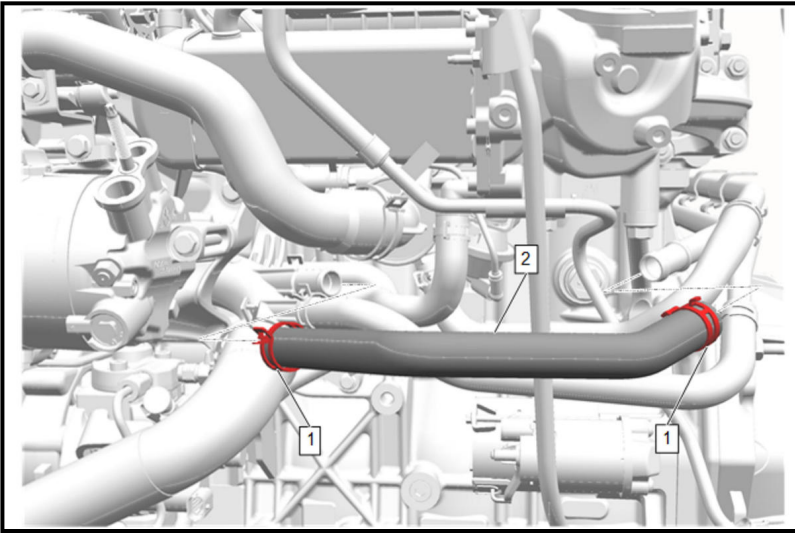
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Front Wheelhouse Front Liner (3)-Left Side - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).



3. Air Conditioning Compressor Hose (2) - Remove - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)



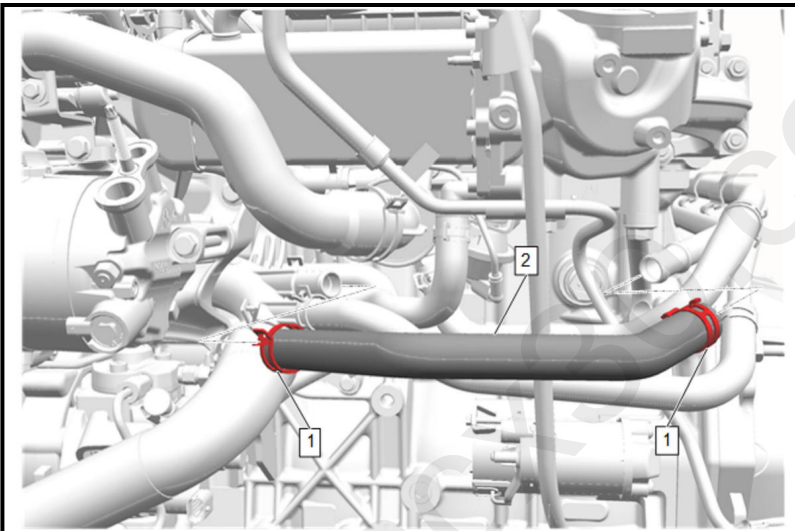
4. Disconnect and reposition harness as necessary.
5. Heater Inlet and Outlet Pipe Clamp (1) - Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)



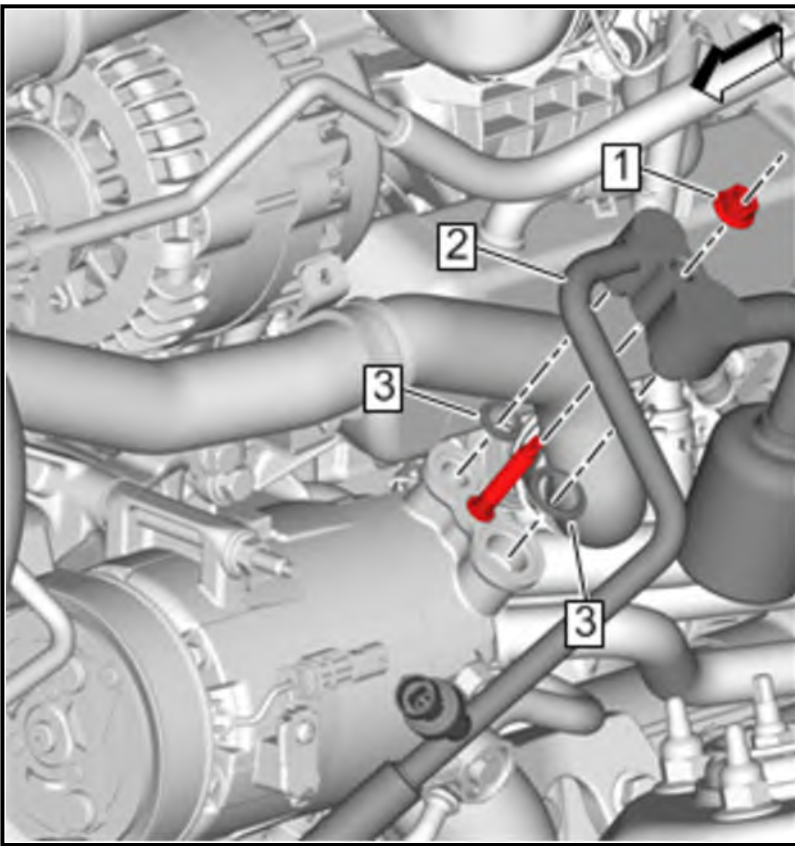
6. Radiator Surge Tank Outlet Hose (2) - Remove

Installation Procedure

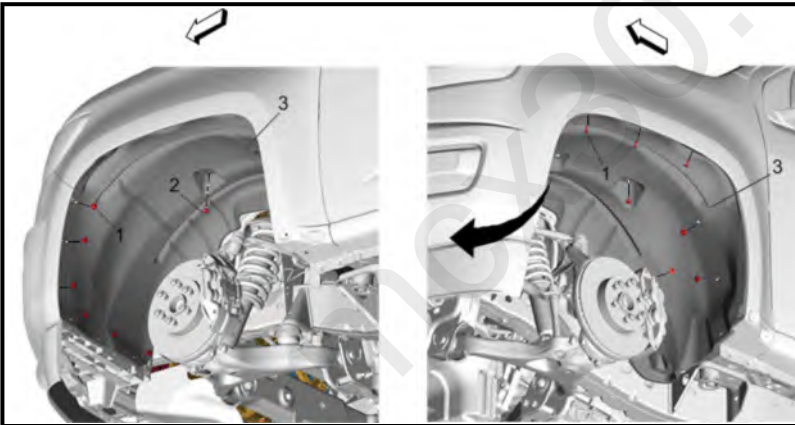
1. Radiator Surge Tank Outlet Hose (2) - Install



2. Heater Inlet and Outlet Pipe Clamp (1) - Engage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Air Conditioning Compressor Hose (2) - Install - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)

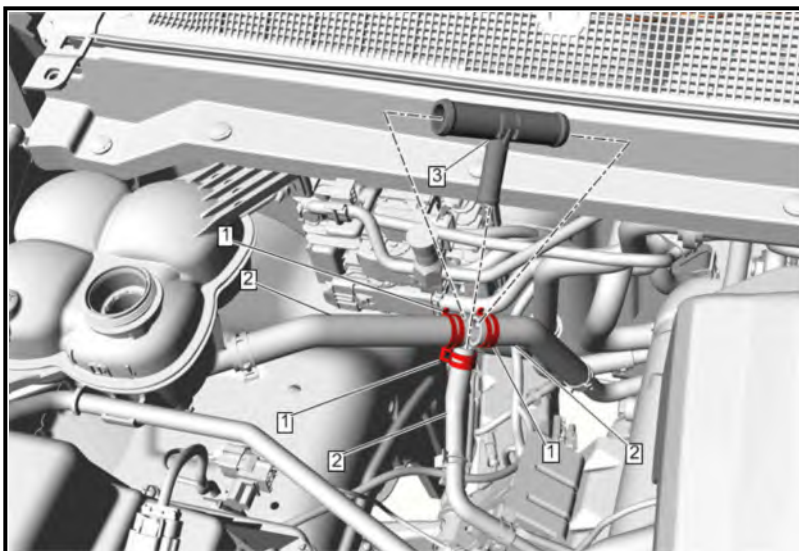


4. Front Wheelhouse Front Liner (3)-Left Side - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)



5. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
6. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK OUTLET HOSE TEE REPLACEMENT (LWN)

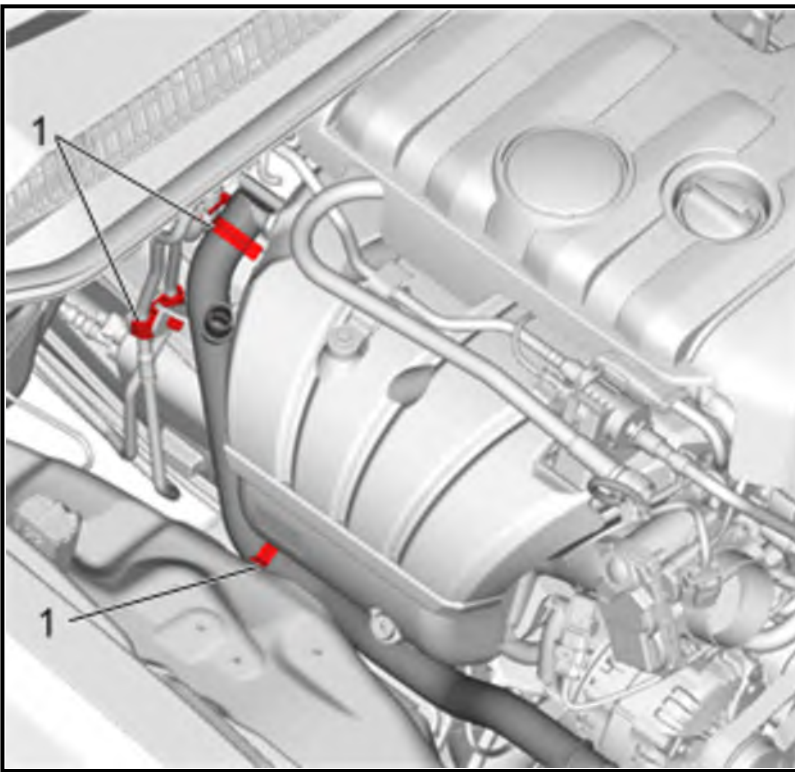


Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)</u> , or <u>Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Surge Tank Outlet Hose Clamp [3x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>
2	Radiator Surge Tank Outlet Hose [3x] Procedure Radiator Surge Tank Outlet Hose @ Radiator Surge Tank Outlet Hose Tee - Remove
3	Radiator Surge Tank Outlet Hose Tee Procedures 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)</u>, or <u>Cooling System Draining and Filling (Vac n Fill)</u> 2. Start the engine and check for coolant leaks.

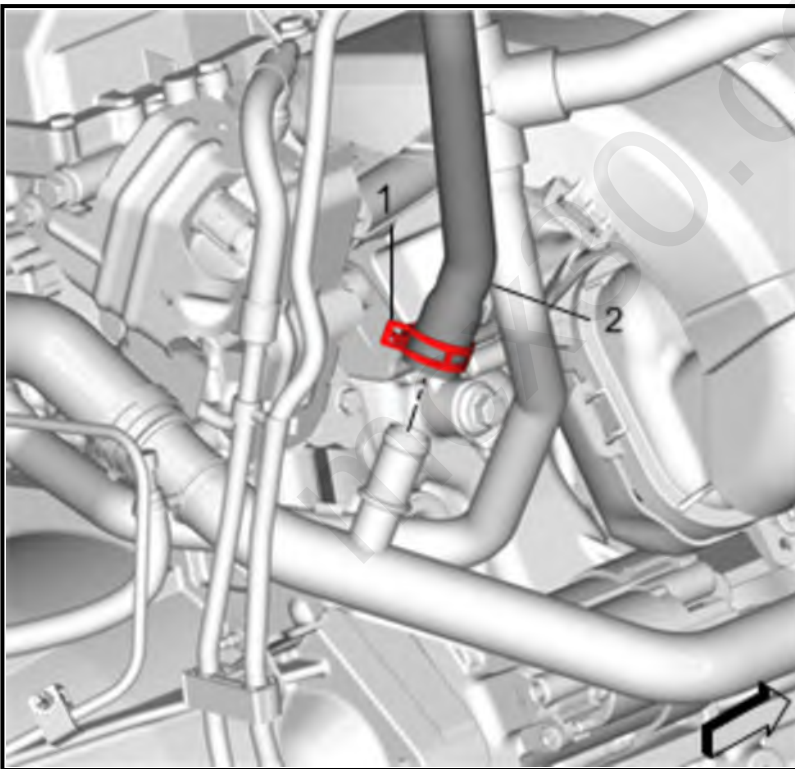
RADIATOR INLET PIPE REPLACEMENT (LCV)

Removal Procedure

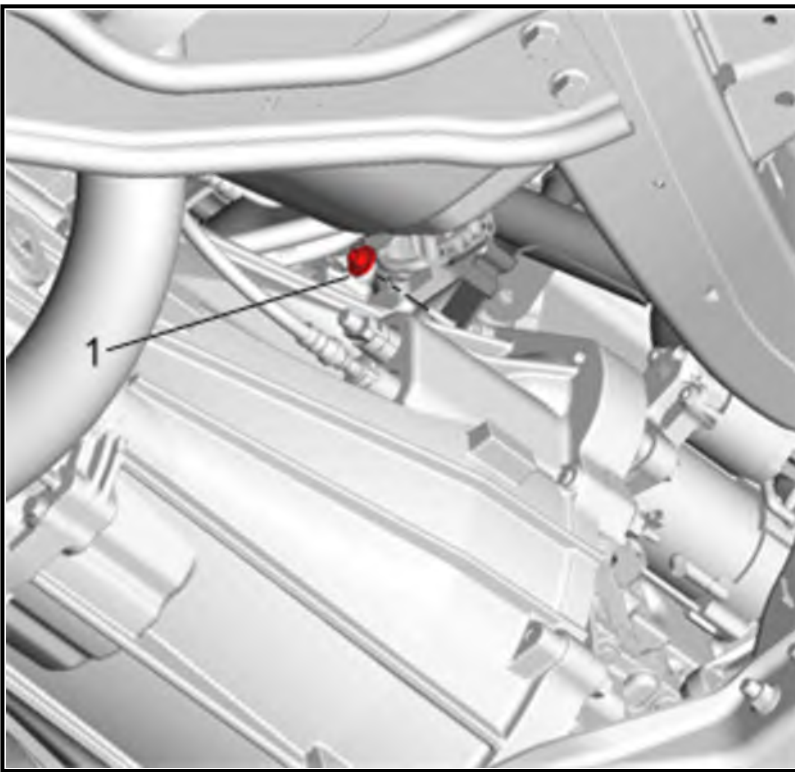
1. Remove the radiator surge tank. Radiator Surge Tank Replacement (LCV, LGZ).
2. Remove the air cleaner outlet duct and air cleaner assembly. Air Cleaner Outlet Duct Replacement , or Air Cleaner Assembly Replacement
3. Remove the radiator inlet hose from the inlet pipe side. Radiator Inlet Hose Replacement (LCV Radiator to Inlet Pipe), or Radiator Inlet Hose Replacement (LCV Inlet Pipe to Water Outlet).
4. Remove the plenum front panel. Plenum Front Panel Replacement
5. Release the inlet pipe from the retainers (1).



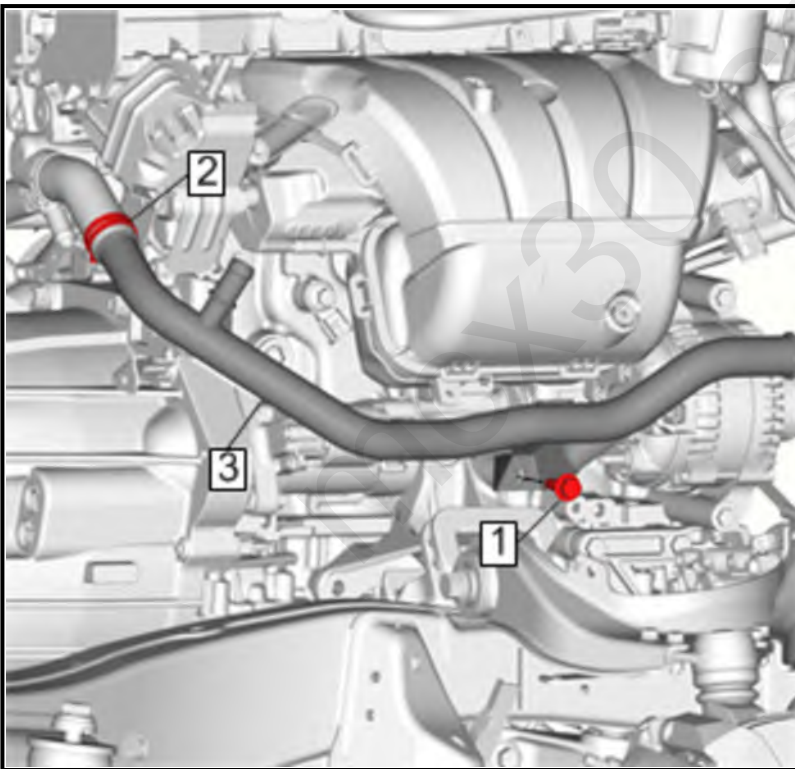
6. Disengage the heater outlet hose clamp (1). [Hose Clamp Replacement Guidelines - Spring Type](#)



- 7. Remove the heater outlet hose (2) from the radiator inlet pipe.
- 8. Raise the vehicle. [Lifting and Jacking the Vehicle](#)
- 9. Remove the inlet pipe to transmission fastener (1).



10. Remove the inlet pipe fastener (1).

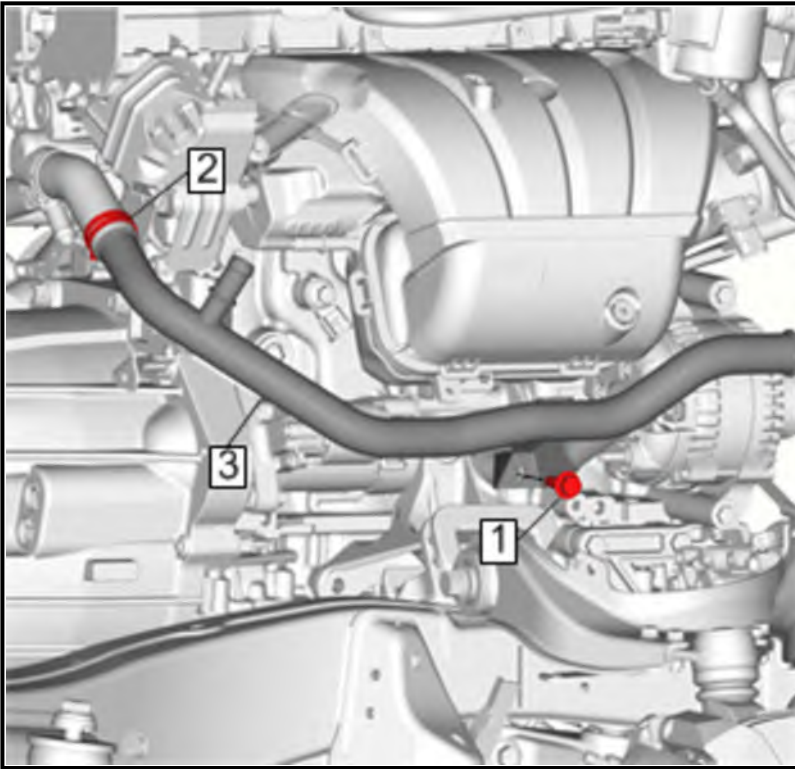


11. Disengage the inlet pipe clamp (2). [Hose Clamp Replacement Guidelines - Spring Type](#)

12. Remove the inlet pipe (3) from the engine.

Installation Procedure

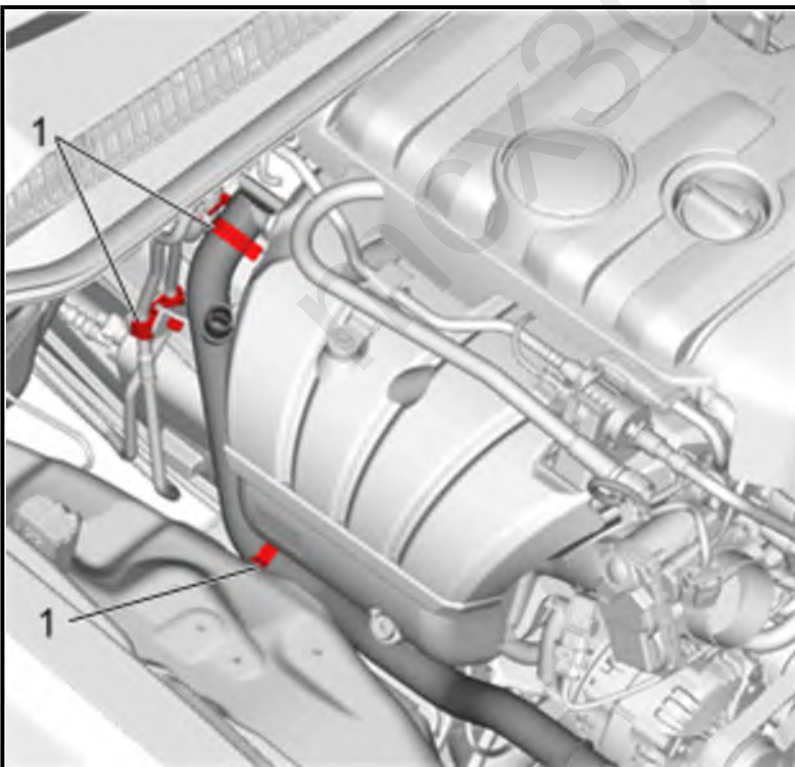
1. Position the radiator inlet pipe (3) then install it into the inlet hose.



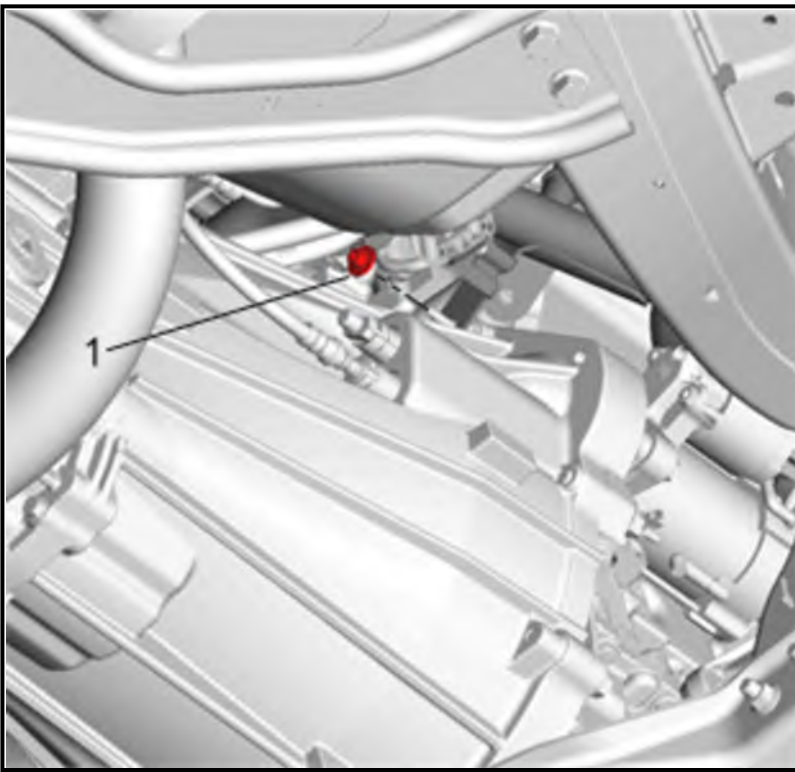
2. Engage the inlet pipe hose clamp (2). [Hose Clamp Replacement Guidelines - Spring Type](#)

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

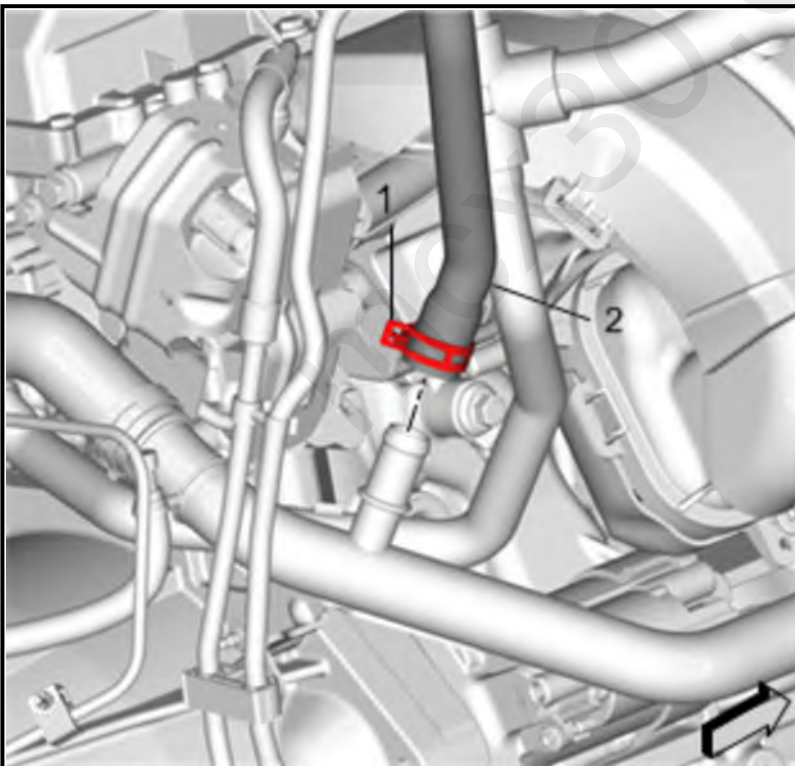
3. Hand start the inlet pipe fastener (1). Tighten to 58 N.m (43 lb ft).
4. Secure the inlet pipe on the radiator inlet pipe retainers (1).



5. Install the inlet pipe to transmission fastener (1). Tighten to 9 N.m (80 lb in).



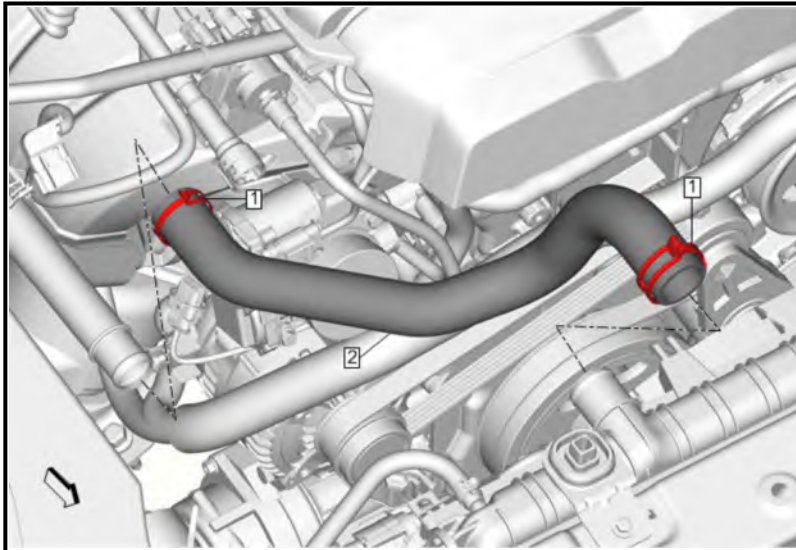
6. Lower the vehicle.
7. Install the radiator inlet hose. [Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#), or [Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#).
8. Install the heater outlet hose (2).



9. Engage the heater outlet hose clamp (1). [Hose Clamp Replacement Guidelines - Spring Type](#)
10. Install the air cleaner outlet duct and air cleaner assembly. [Air Cleaner Outlet Duct Replacement](#) , or [Air Cleaner Assembly Replacement](#)
11. Install the plenum front panel. [Plenum Front Panel Replacement](#)
12. Install the radiator surge tank. [Radiator Surge Tank Replacement \(LCV, LGZ\)](#).
13. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).

14. Start the engine and check for coolant leaks.

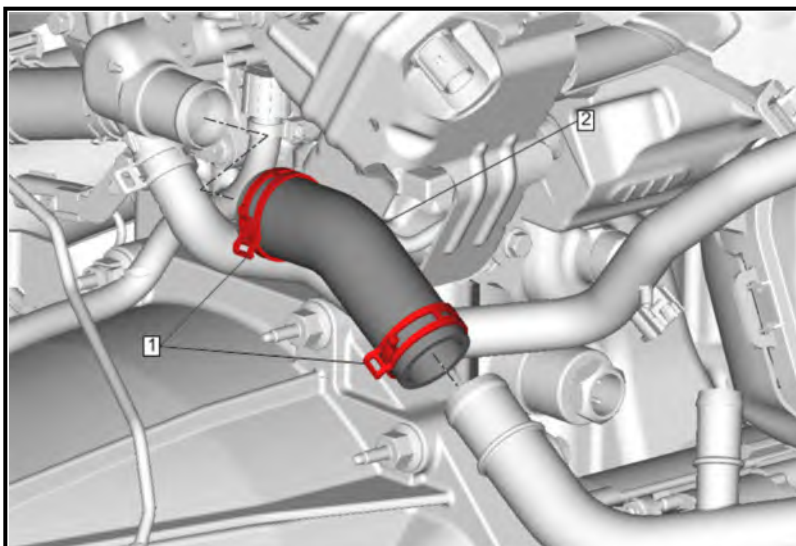
RADIATOR INLET HOSE REPLACEMENT (LCV RADIATOR TO INLET PIPE)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Drain the cooling system. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) .	
1	Radiator Inlet Hose Clamp [2x] Procedure Reposition the radiator inlet hose clamp. Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Inlet Hose Procedure 1. Fill the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Start the engine and check for coolant leaks.

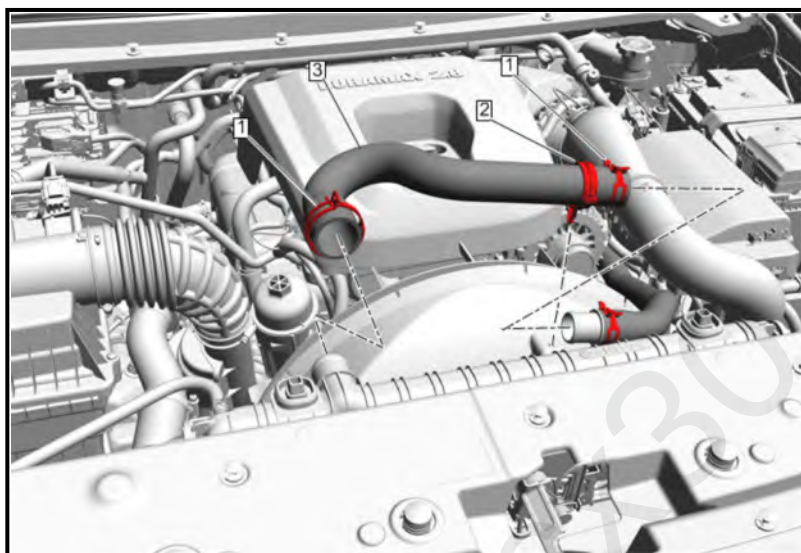
RADIATOR INLET HOSE REPLACEMENT (LCV INLET PIPE TO WATER OUTLET)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure 1. Remove the radiator inlet pipe. Radiator Inlet Pipe Replacement (LCV) . 2. Drain and fill the cooling system. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) .	
1	Radiator Inlet Hose Clamp (Qty 2) Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Inlet Hose Procedures Check the cooling system for leaks.

RADIATOR INLET HOSE REPLACEMENT (LWN RADIATOR SIDE)

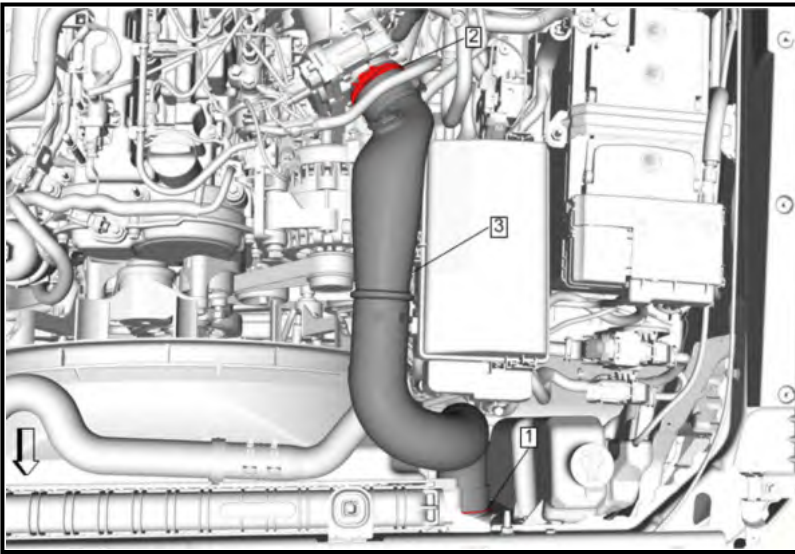


Call out	Component Name
Preliminary Procedure Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill)	
1	Radiator Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Inlet Hose Retainer
3	Radiator Inlet Hose @ Radiator Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) . 2. Start the engine and check for coolant leaks.

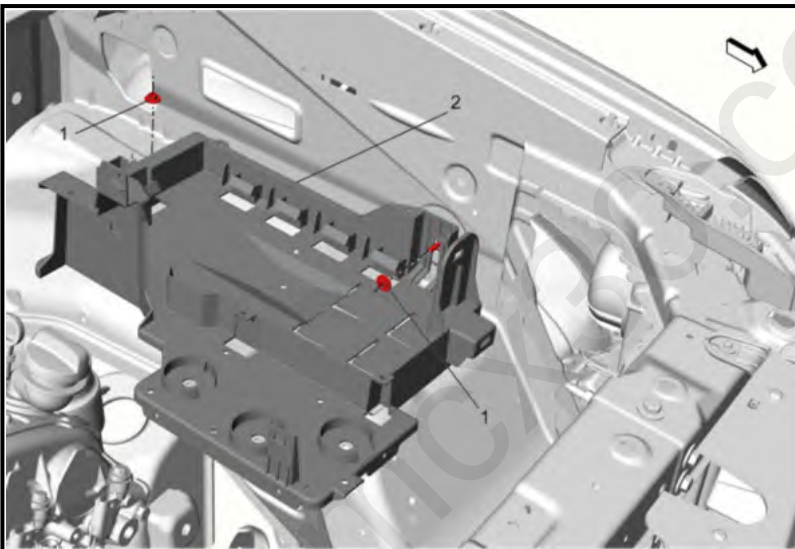
RADIATOR INLET HOSE REPLACEMENT (LWN ENGINE SIDE)

Removal Procedure

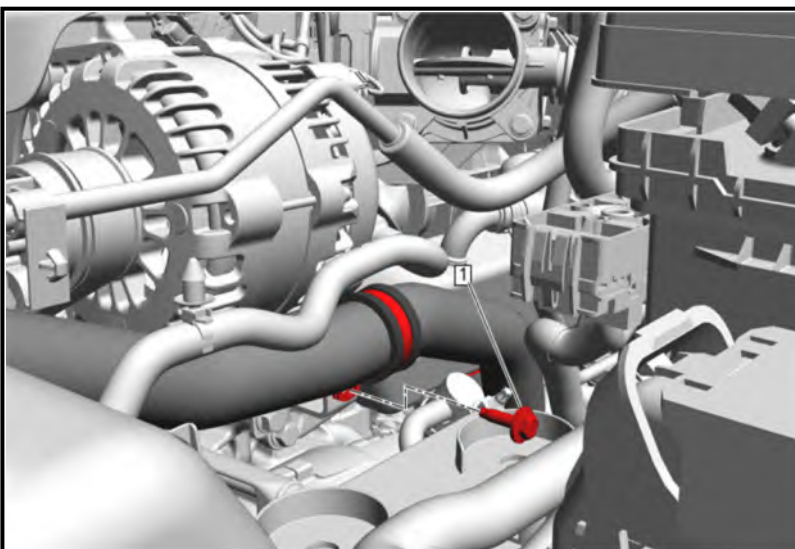
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Charge Air Cooler Outlet Duct (3) - Remove - [Charge Air Cooler Outlet Duct Replacement](#)



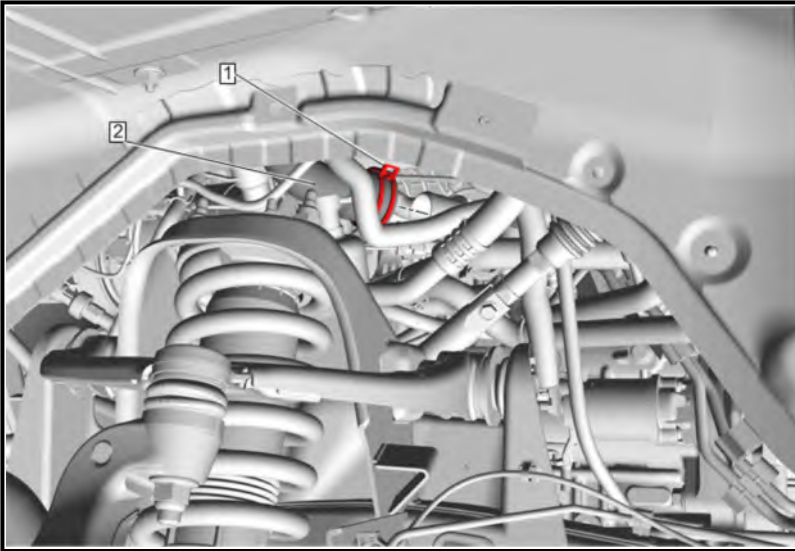
3. Battery Tray - Remove - [Battery Tray Replacement](#)



4. Disconnect and reposition harness as necessary.
5. Radiator Inlet Hose Bracket Bolt (1) - Remove

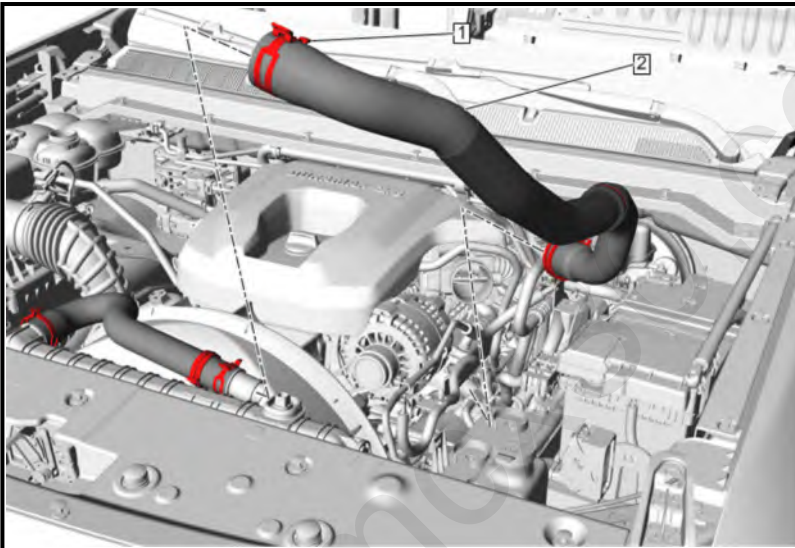


6. Radiator Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



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

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

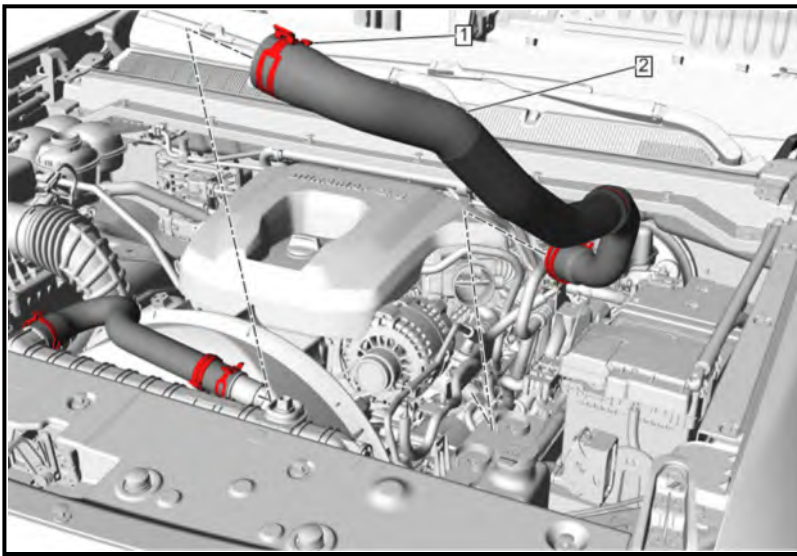


9. Radiator Inlet Hose (2) @ Radiator Inlet Hose Connector - Remove

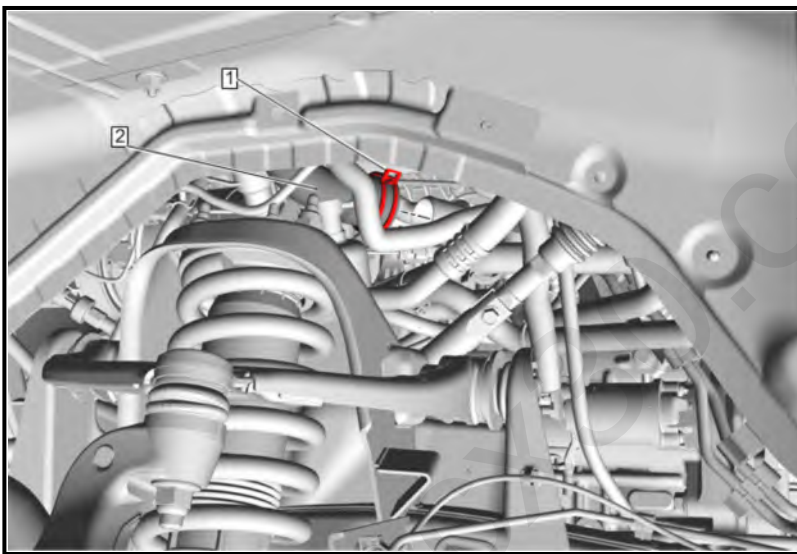
10. Maneuver the radiator inlet hose (2) out from the engine compartment.

Installation Procedure

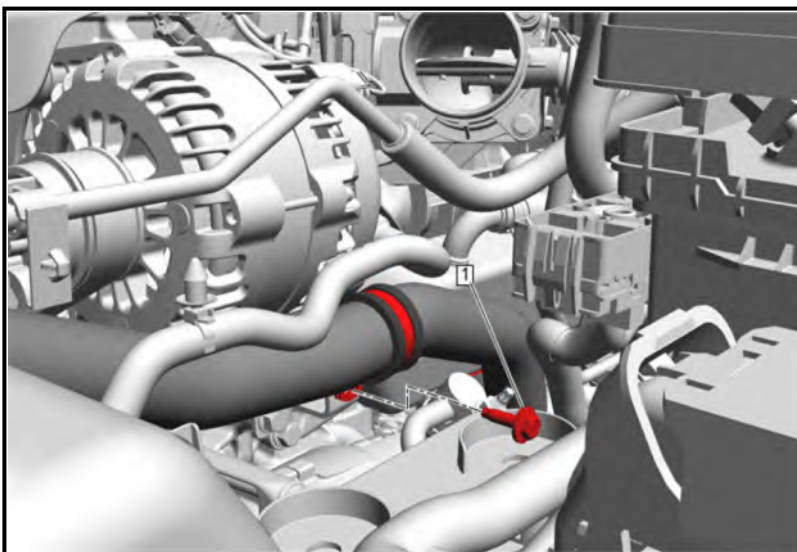
1. Route the radiator inlet hose (2) back into the engine compartment.



2. Radiator Inlet Hose (2) @ Radiator Inlet Hose Connector - Install
3. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Radiator Inlet Hose (2) @ Engine Coolant Thermostat Outlet - Install

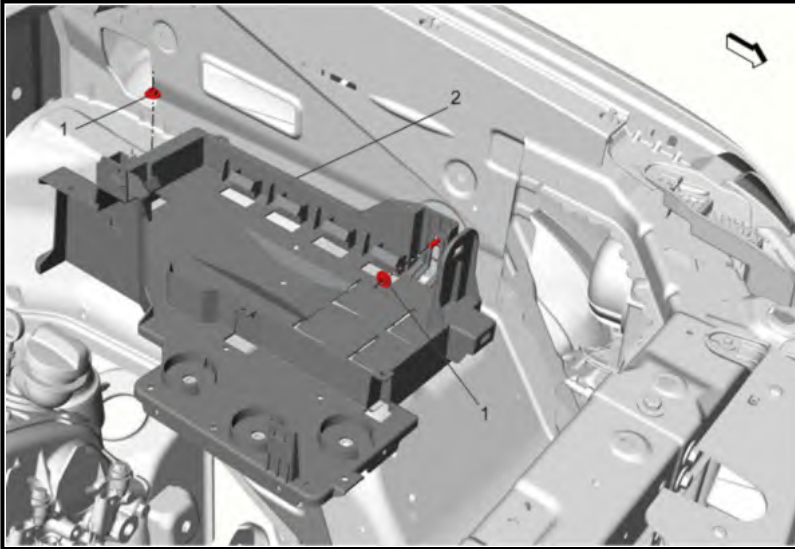


5. Radiator Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Radiator Inlet Hose Bracket Bolt (1) - Install and tighten 9 N.m (80 lb in)

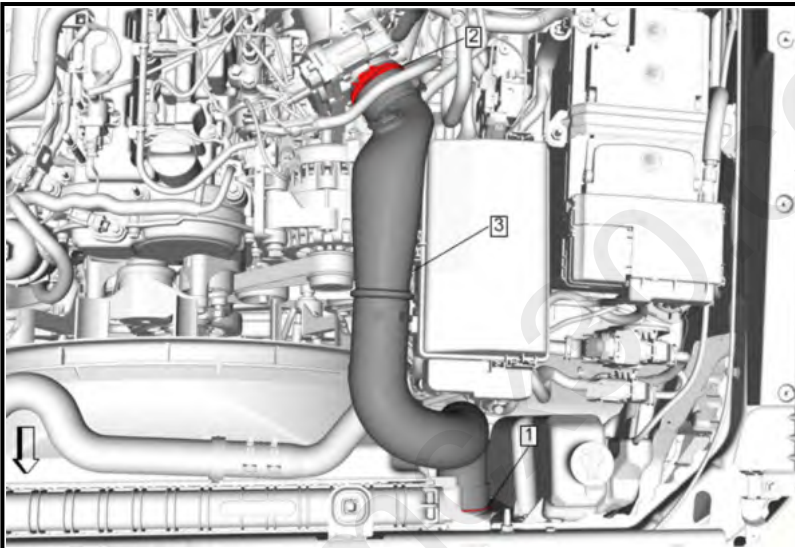


CAUTION: Refer to [Fastener Caution](#) .

7. Route the wiring harness back to the original position and secure.
8. Battery Tray - Install - [Battery Tray Replacement](#)

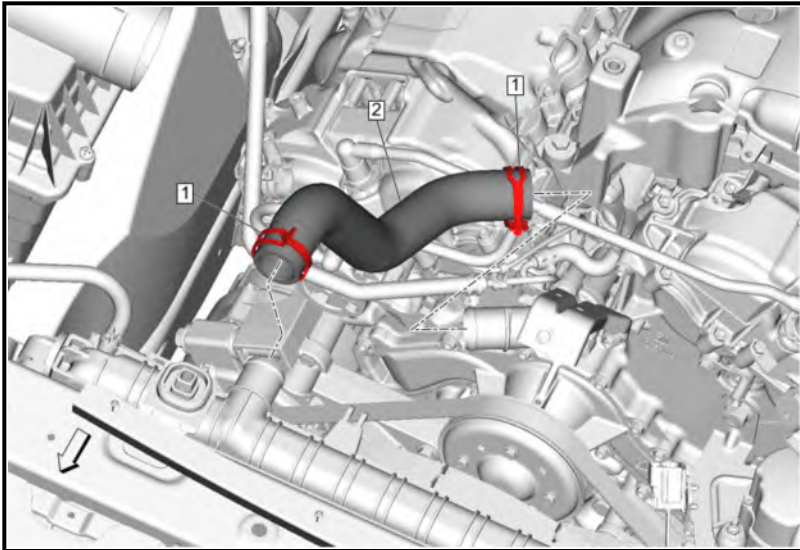


9. Charge Air Cooler Outlet Duct (3) - Install - [Charge Air Cooler Outlet Duct Replacement](#)



10. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
11. Start the engine and check for coolant leaks.

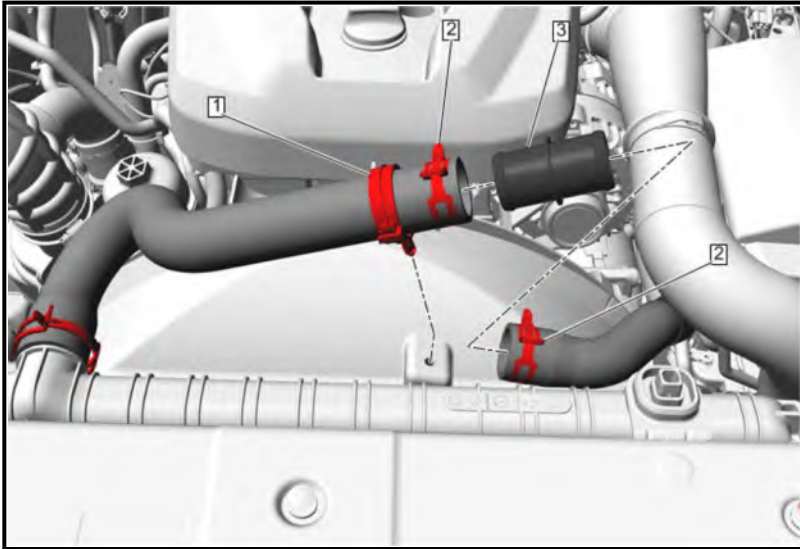
RADIATOR INLET HOSE REPLACEMENT (LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. <u>Cooling System Draining and Filling (Static Fill)</u>, or <u>Cooling System Draining and Filling (Vac n Fill)</u>. 2. <u>Air Cleaner Outlet Duct Replacement</u>	
1	Radiator Inlet Hose Clamp [2x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>
2	Radiator Inlet Hose Procedure 1. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)</u>, or <u>Cooling System Draining and Filling (Vac n Fill)</u>. 2. Inspect the cooling system for leaks.

RADIATOR INLET HOSE CONNECTOR REPLACEMENT (LWN)

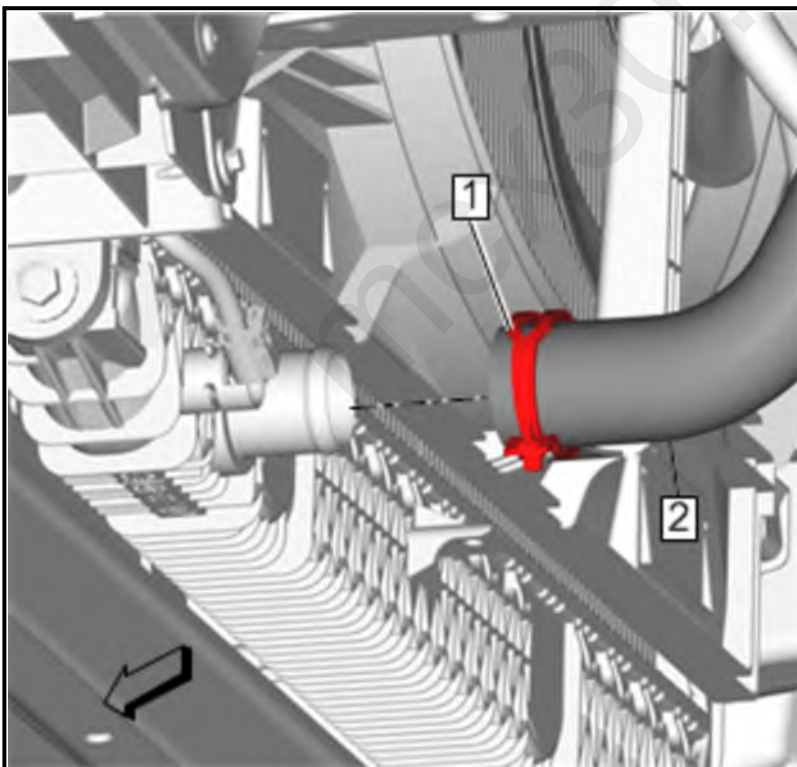


Call out	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static Fill)</u> , or <u>Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Inlet Hose Retainer
2	Radiator Inlet Hose Clamp [2x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>
3	Radiator Inlet Hose Connector Procedures 1. Radiator Inlet Hose Connector @ Radiator Inlet Hose - Remove 2. Fill the cooling system to the proper level. <u>Cooling System Draining and Filling (Static Fill)</u>, or <u>Cooling System Draining and Filling (Vac n Fill)</u> 3. Start the engine and check for coolant leaks.

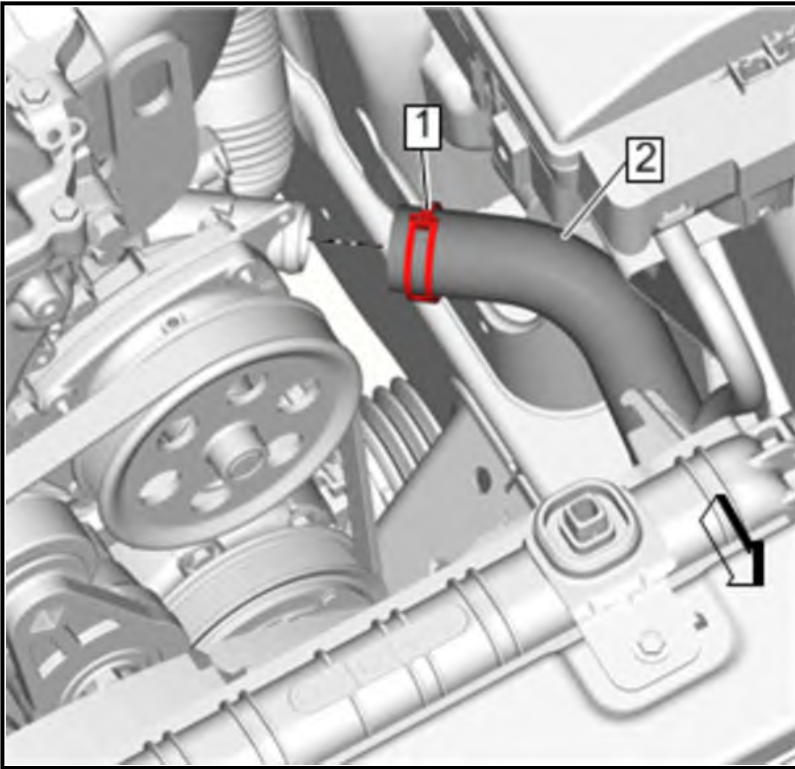
RADIATOR OUTLET HOSE REPLACEMENT (LCV)

Removal Procedure

1. Drain the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill)
2. Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose - Disengage - Hose Clamp Replacement Guidelines - Spring Type



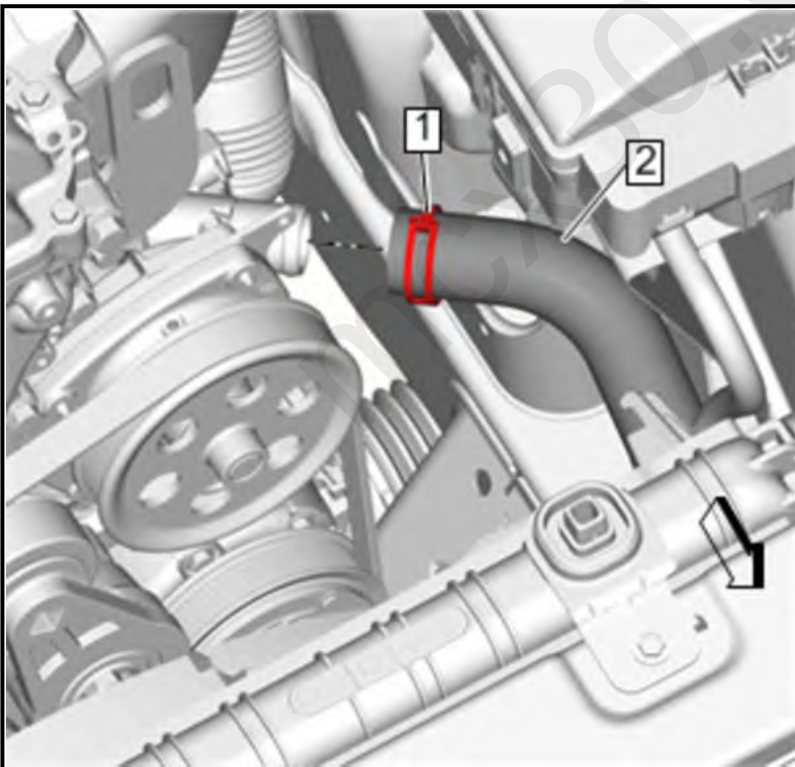
3. Radiator Outlet Hose (2) @ Radiator - Remove
4. Lower the vehicle.
5. Air Cleaner Outlet Duct Replacement - Remove
6. Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose - Disengage - Hose Clamp Replacement Guidelines - Spring Type



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

Installation Procedure

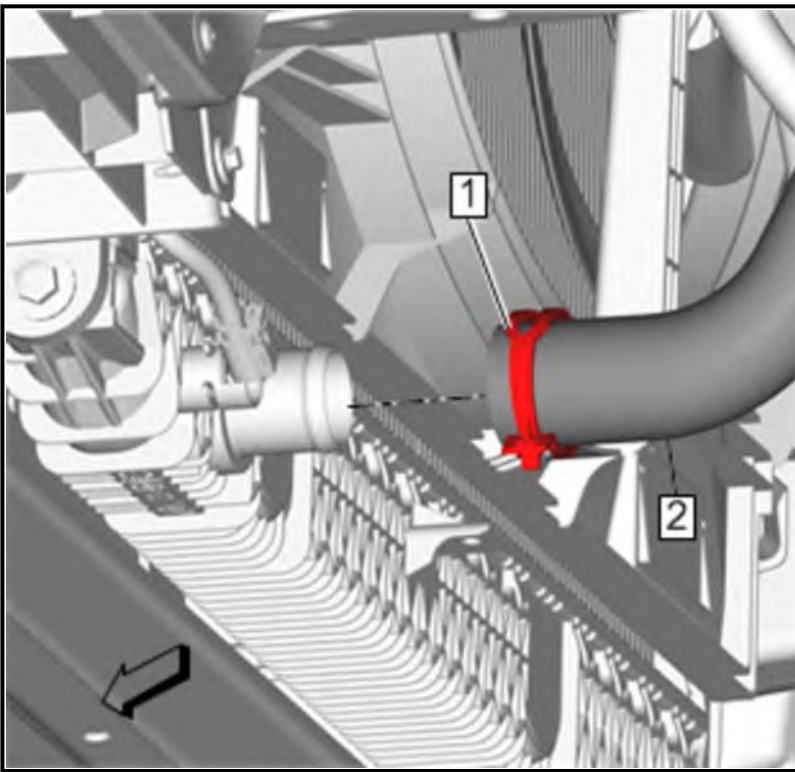
1. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing - Install



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

3. Raise the vehicle.

4. Radiator Outlet Hose (2) @ Radiator - Install

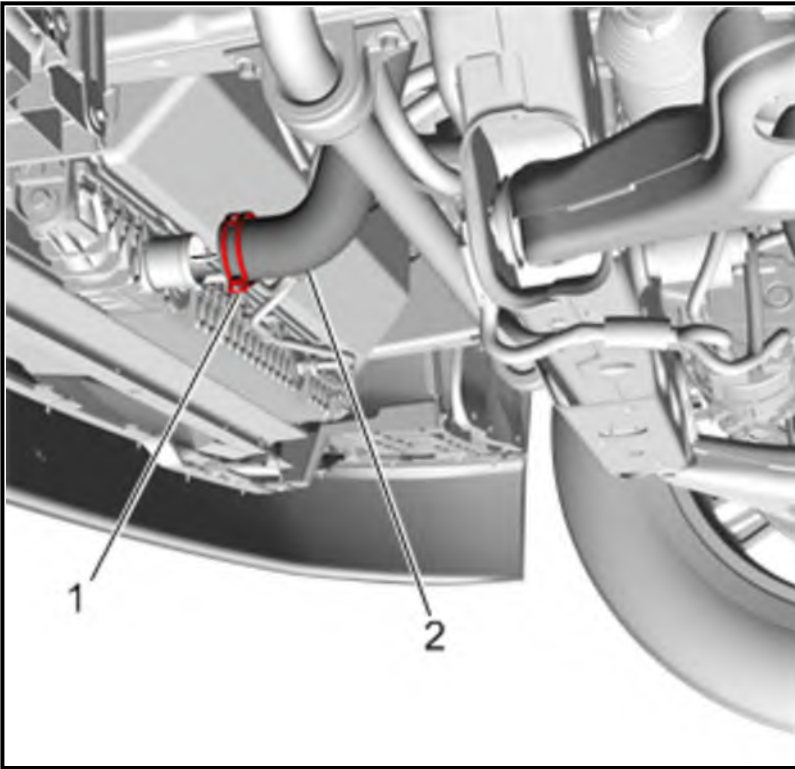


5. Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. [Air Cleaner Outlet Duct Replacement](#) - Install
7. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
8. Check the cooling system for leaks. [Cooling System Leak Testing](#)

RADIATOR OUTLET HOSE REPLACEMENT (LWN)

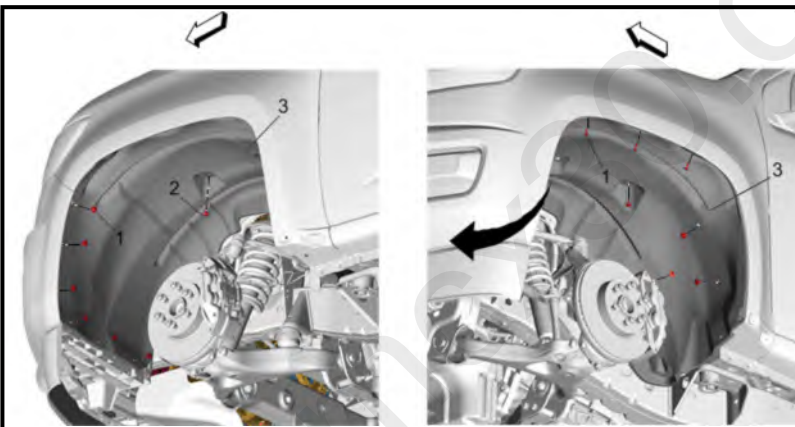
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
2. Radiator Outlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

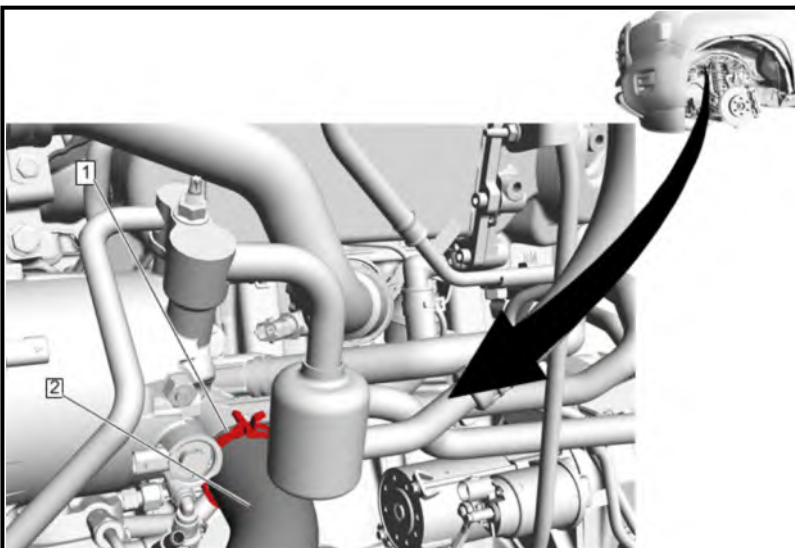


3. Radiator Outlet Hose (2) @ Radiator Assembly - Remove

4. Front Wheelhouse Liner Replacement (Without ZR2) , or Front Wheelhouse Liner Replacement (With ZR2) , or Front Wheelhouse Liner Replacement (Bison) (3) - Left Side - Remove

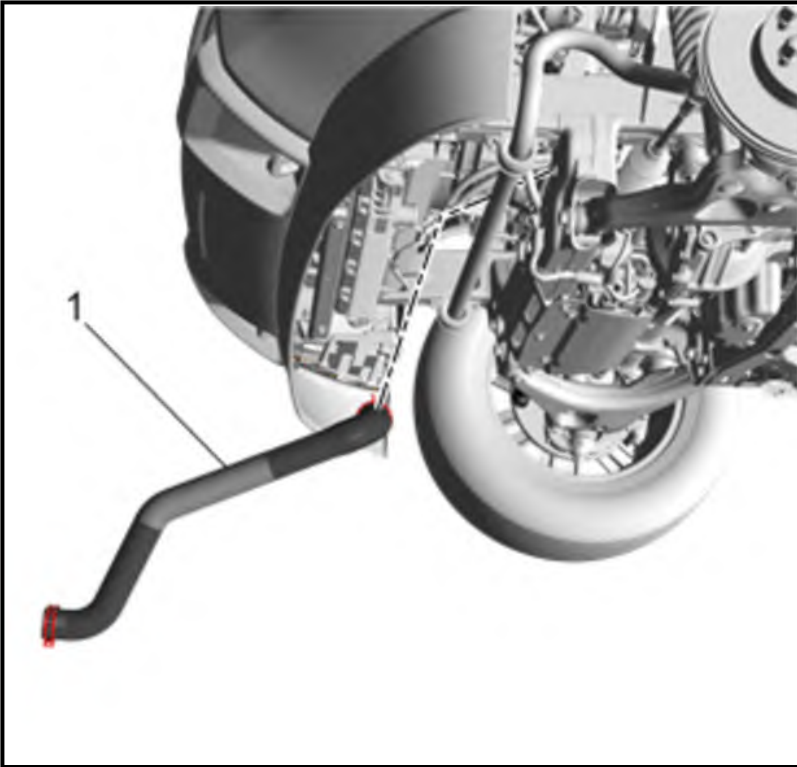


5. Radiator Outlet Hose Clamp (1) - Disengage - Hose Clamp Replacement Guidelines - Spring Type



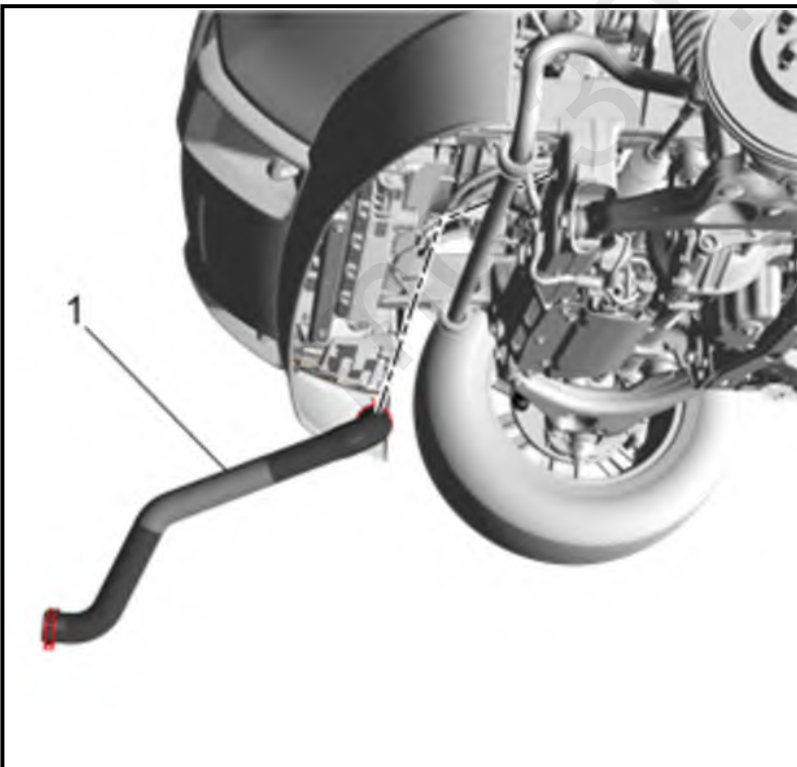
6. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe - Remove

7. Radiator Outlet Hose (1) - Remove

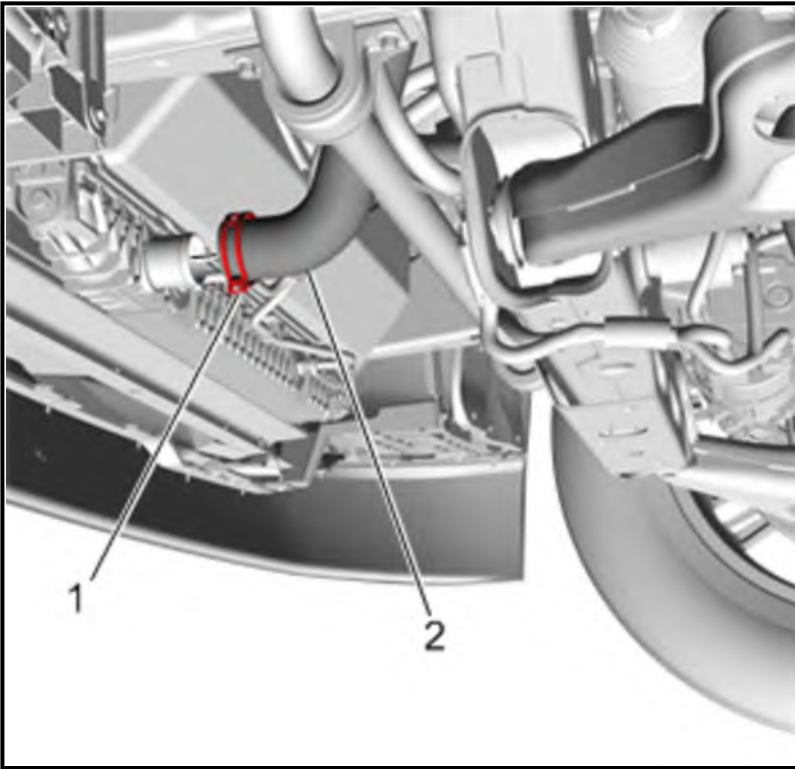


Installation Procedure

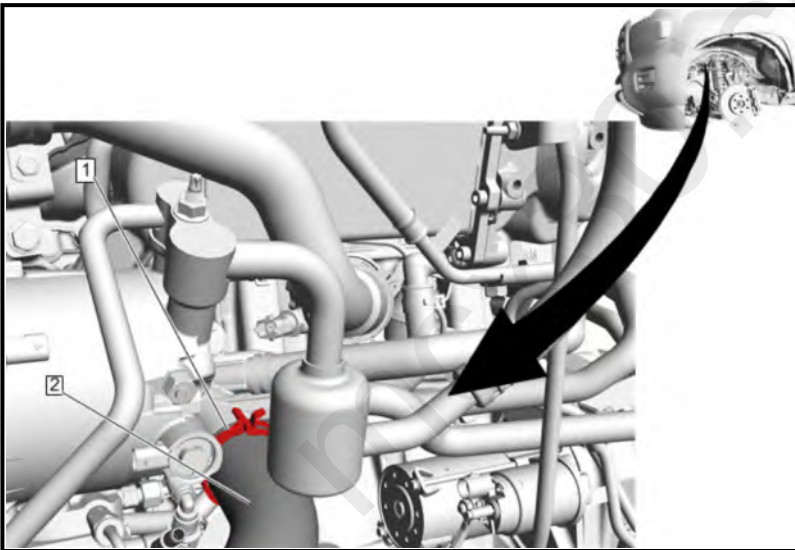
1. Radiator Outlet Hose (1) - Install



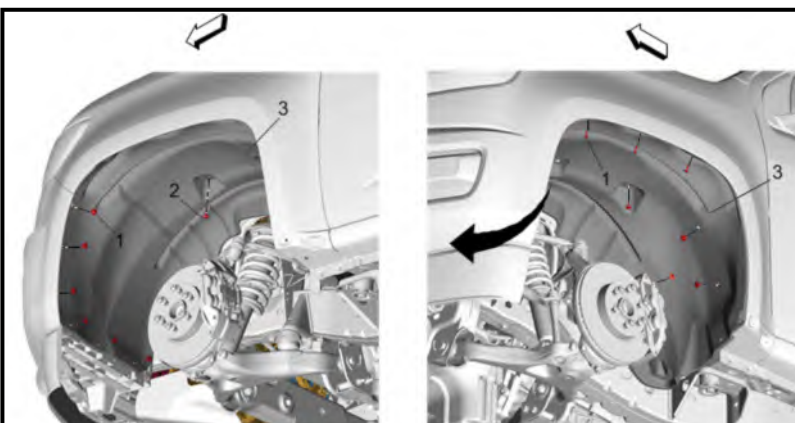
2. Radiator Outlet Hose (2) @ Radiator Assembly - Install



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



5. Radiator Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#) (3) - Left Side - Install

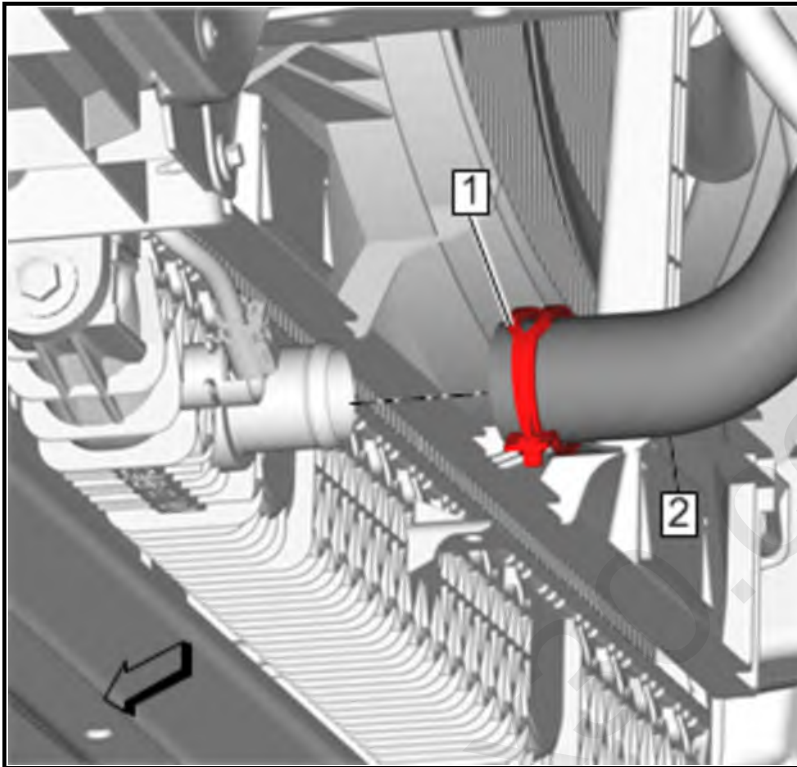


7. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
8. Start the engine and check for coolant leaks.

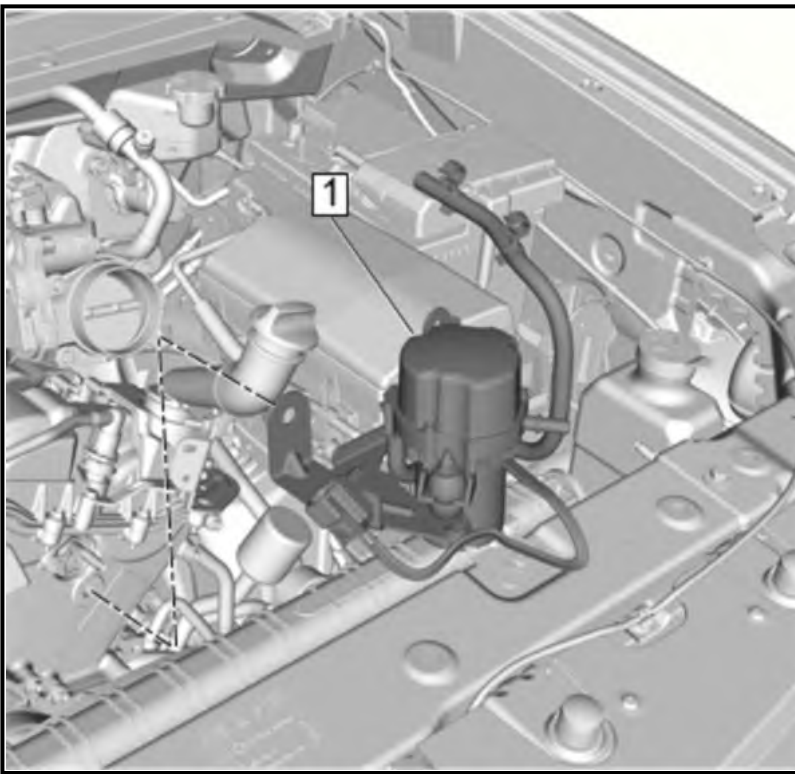
RADIATOR OUTLET HOSE REPLACEMENT (LGZ)

Removal Procedure

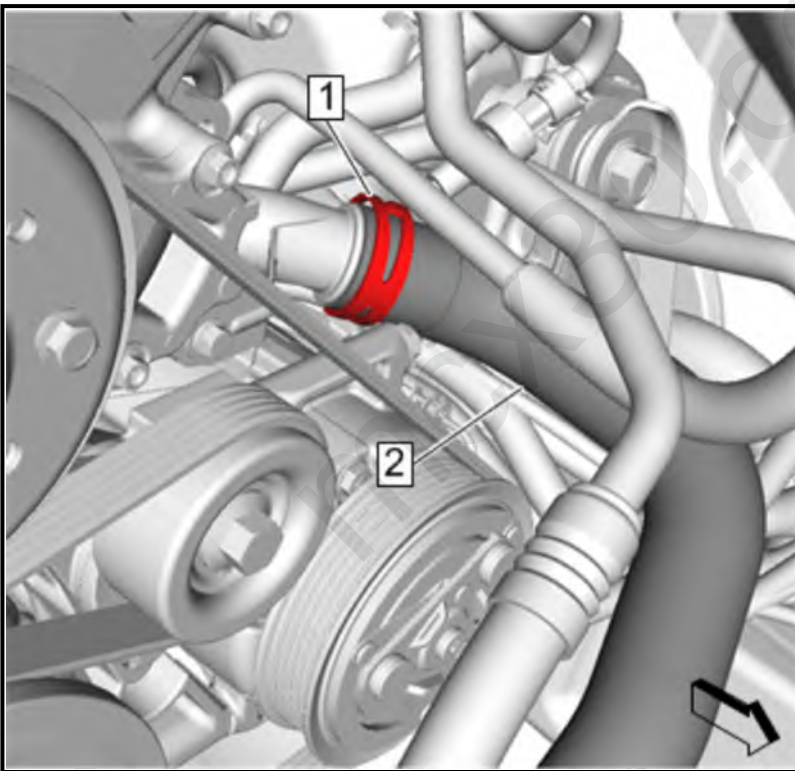
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Radiator Outlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



3. Radiator Outlet Hose (2) @ Radiator - Remove
4. Lower the vehicle.
5. Power Brake Booster Pump (1) - Remove - [Power Brake Booster Pump Replacement](#)



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

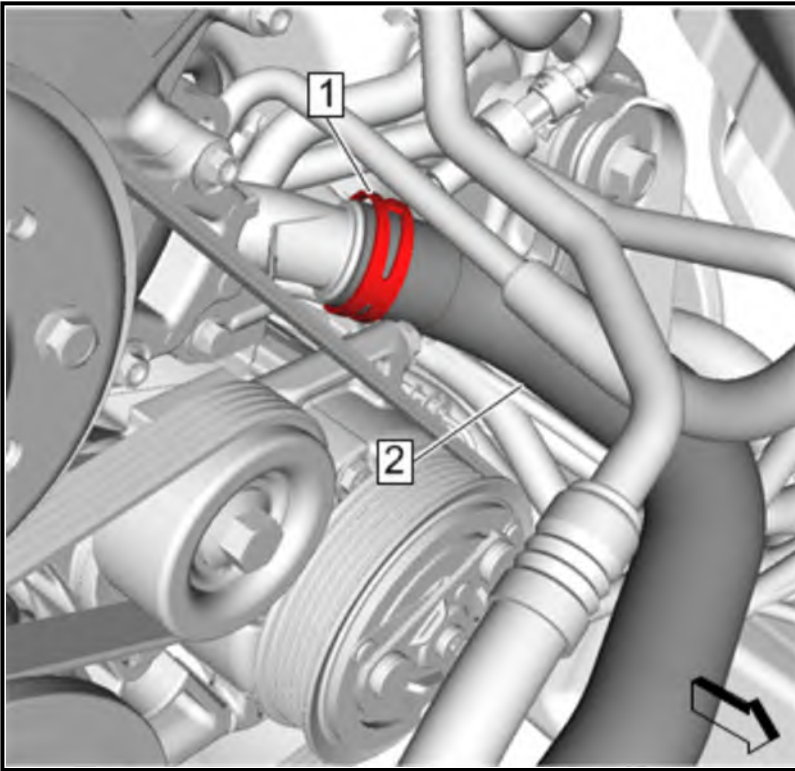


7. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe - Remove

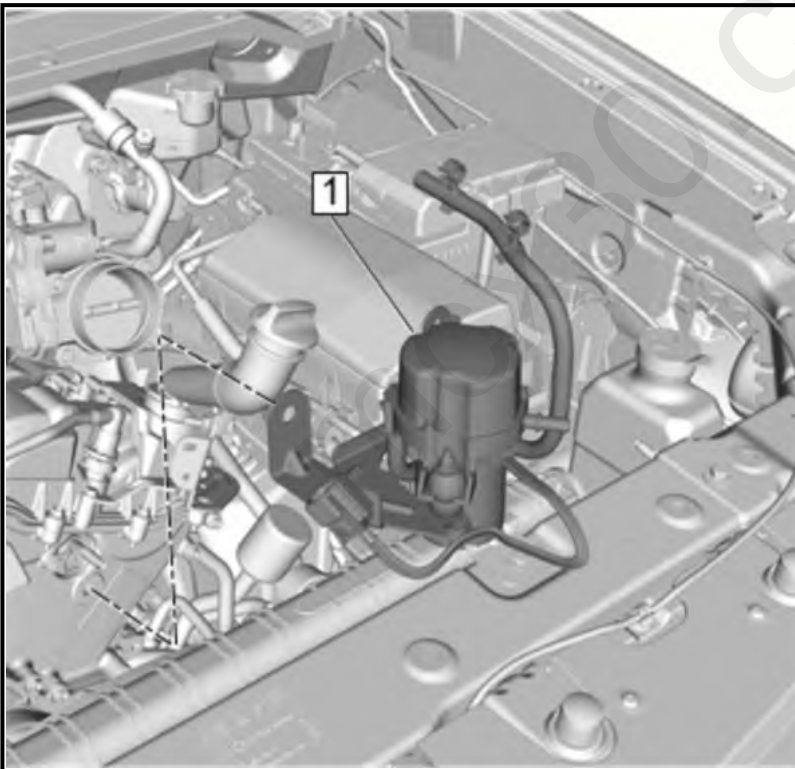
8. Radiator Outlet Hose (2) - Remove

Installation Procedure

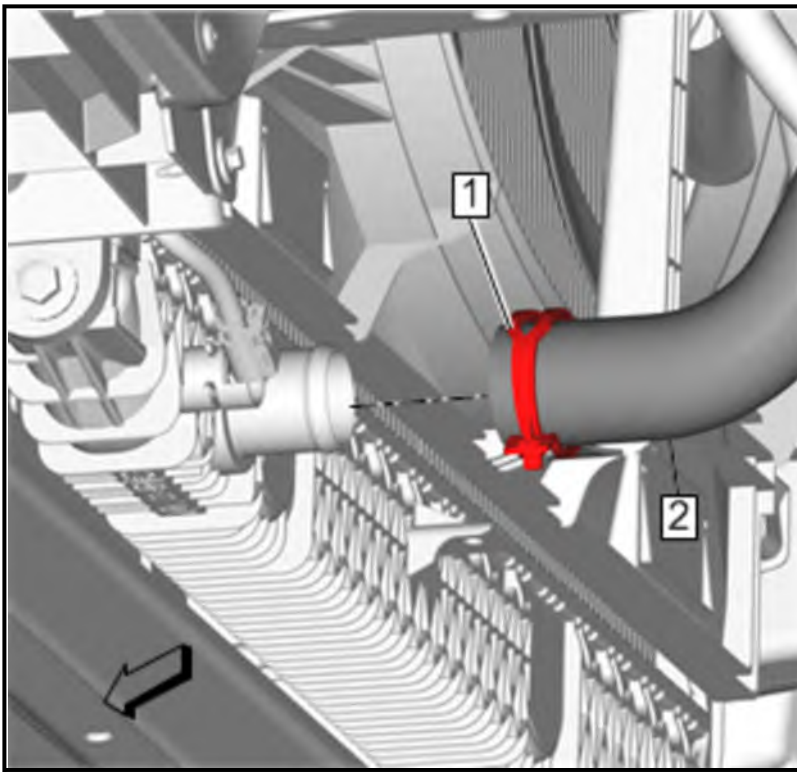
1. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe - Install



- 2. Radiator Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
- 3. Power Brake Booster Pump (1) - Install - [Power Brake Booster Pump Replacement](#)

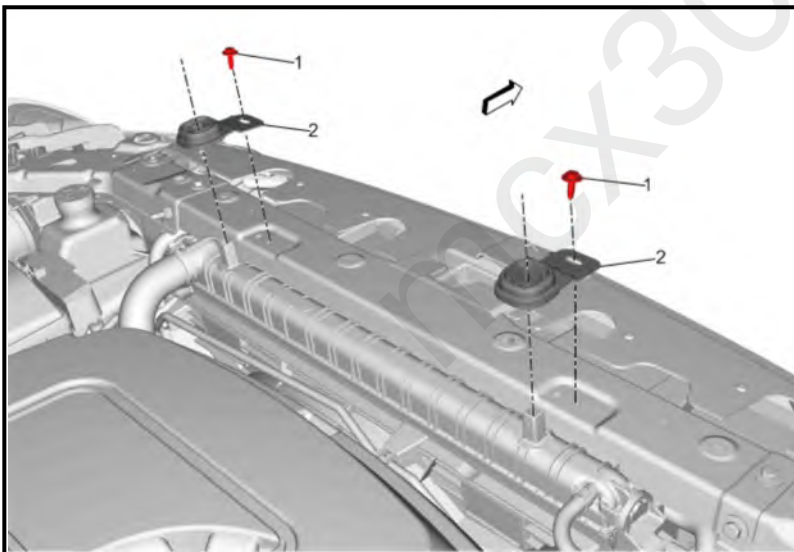


- 4. Raise the vehicle.
- 5. Radiator Outlet Hose (2) @ Radiator - Install



6. Radiator Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
8. Check the cooling system for leaks. [Cooling System Leak Testing](#)

RADIATOR UPPER BRACKET REPLACEMENT

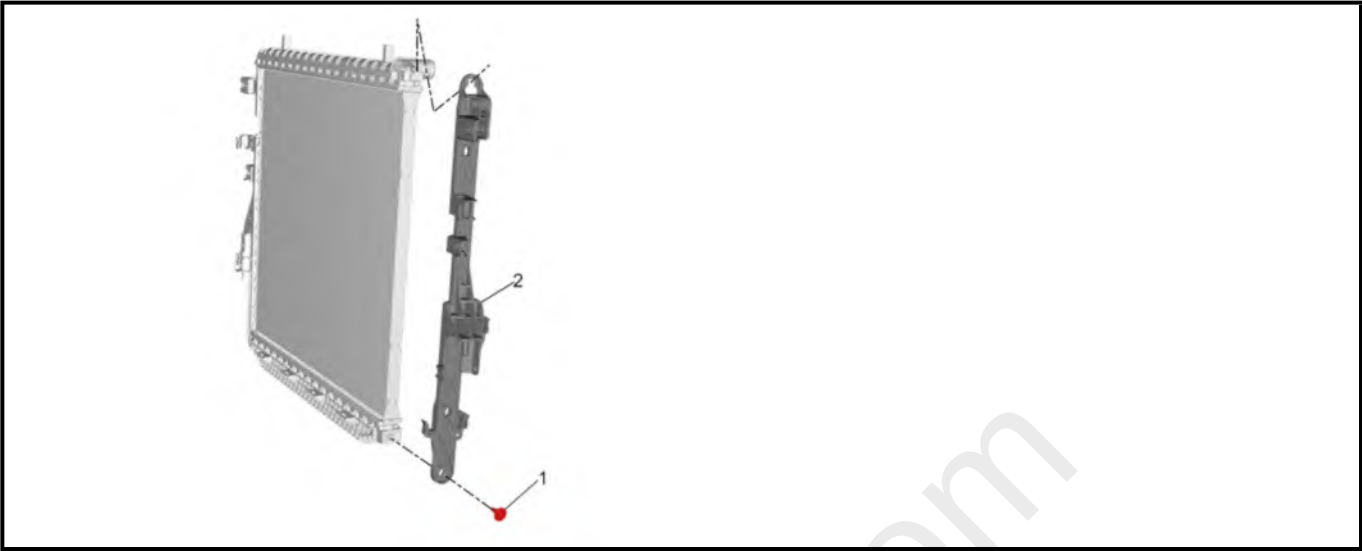


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure	
Front Compartment Front Sight Shield Replacement - Remove {If equipped}	
1	Radiator Upper Bracket Bolt (Qty: 2)
	CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 9 Y (80 lb in)
2	Radiator Upper Bracket (Qty: 2)

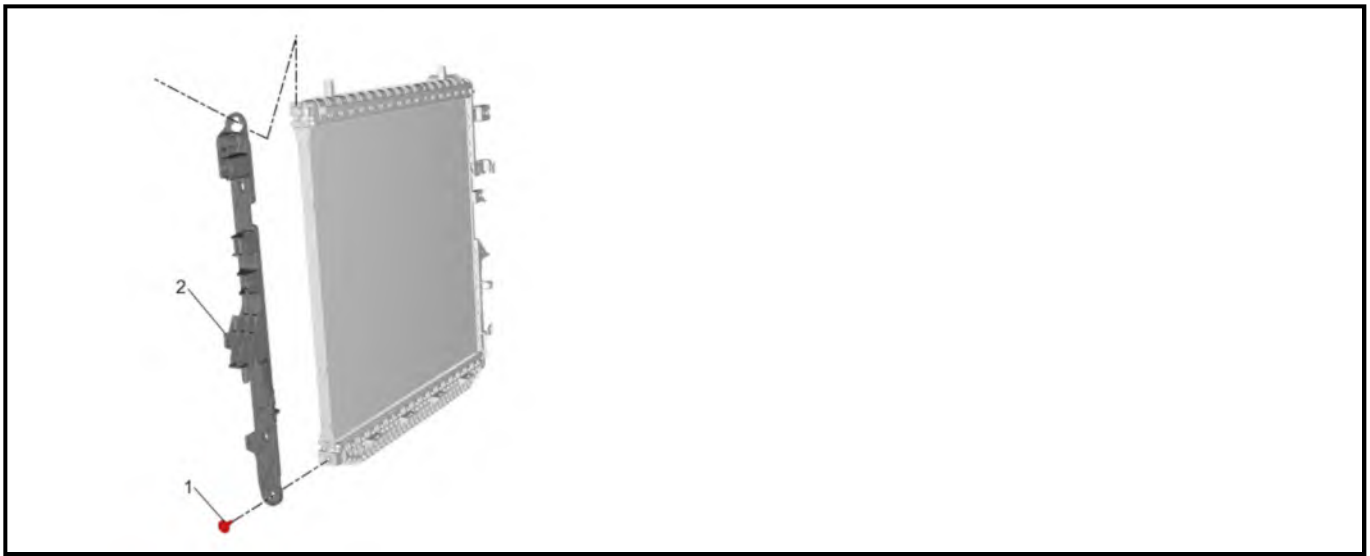
RADIATOR SIDE MOUNTING BRACKET REPLACEMENT - LEFT SIDE



NOTE: Callouts in the following chart represent components shown in graphic above.

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

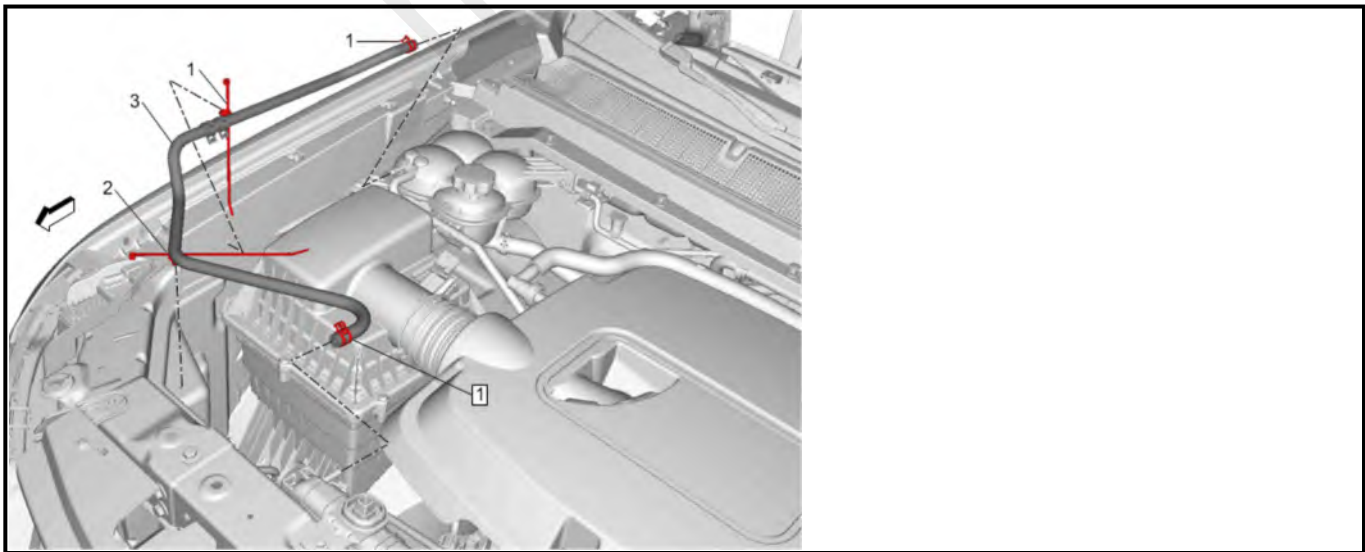
RADIATOR SIDE MOUNTING BRACKET REPLACEMENT - RIGHT SIDE



NOTE: Callouts in the following chart represent components shown in graphic above.

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

RADIATOR VENT OUTLET HOSE REPLACEMENT (LCV, LGZ)



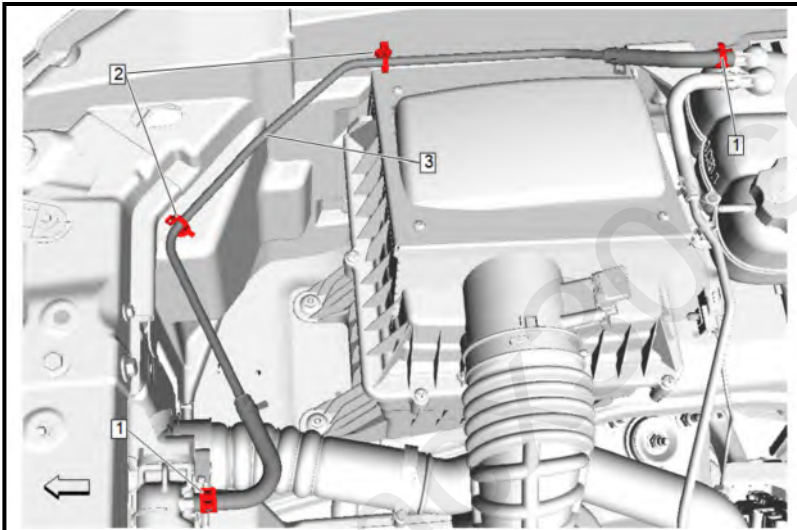
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
1	Radiator Vent Outlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Vent Outlet Hose Clip [2x]
3	Radiator Vent Outlet Hose Procedure 1. Fill the cooling system to the proper level. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Check the cooling system for leaks.

RADIATOR VENT OUTLET HOSE REPLACEMENT (LWN)

Removal Procedure

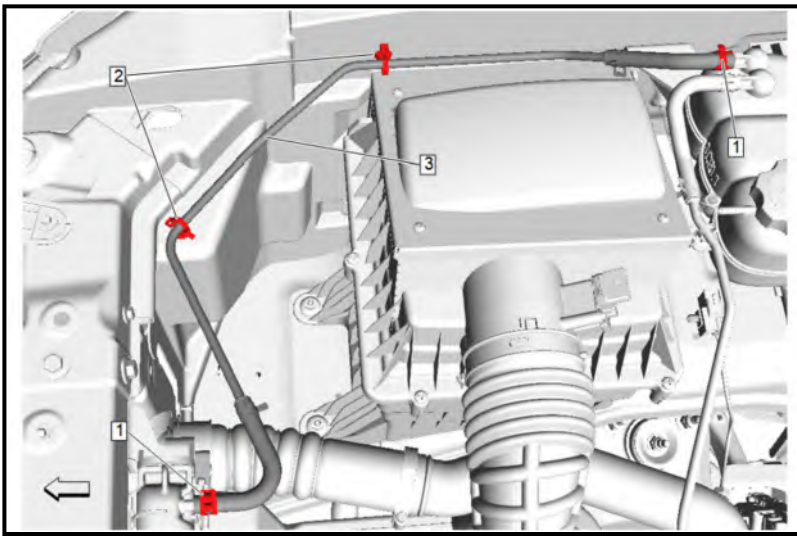
1. Place absorbent cloths below the radiator vent outlet hose to capture any residual coolant.
2. Hose Clamp (1) - Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)



3. Retainer (2) - Remove [2x]
4. Radiator Vent Outlet Hose (3) - Remove

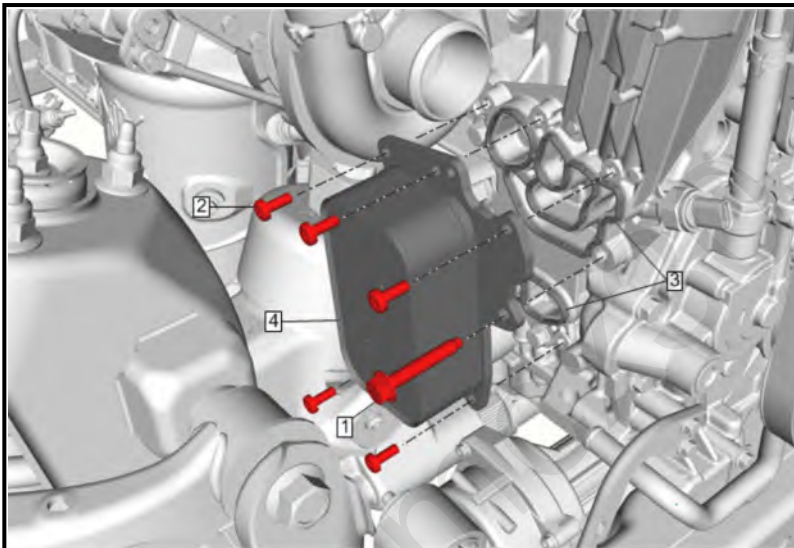
Installation Procedure

1. Radiator Vent Outlet Hose (3) - Install



2. Retainer (2) - Install [2x]
3. Hose Clamp (1) - Engage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Fill the cooling system to the proper level. [Adhesives, Fluids, Lubricants, and Sealers](#)
5. Start the engine and check for coolant leaks.

ENGINE OIL COOLER REPLACEMENT (LWN)

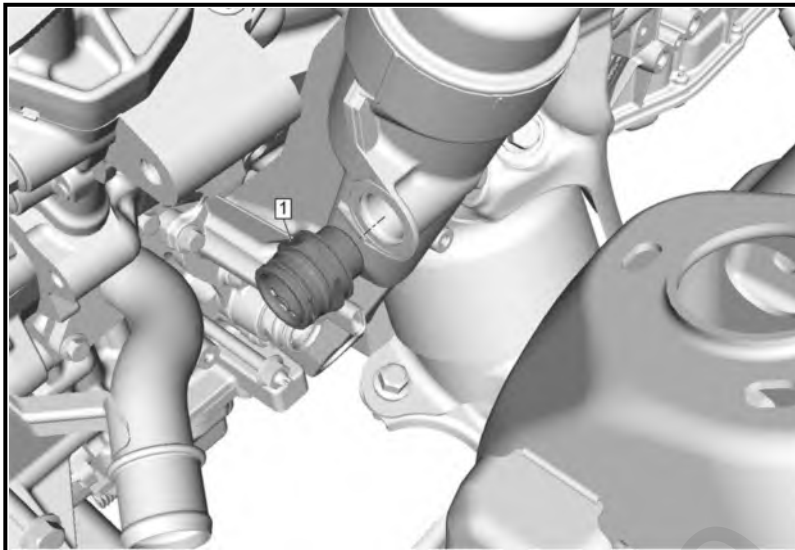


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Air Cleaner Assembly Replacement 2. Charge Air Cooler Inlet Duct Replacement	
1	Engine Oil Cooler Bolt CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)

Callout	Component Name
2	Engine Oil Cooler Bolt [5x] Tighten 10 N.m (89 lb in)
3	Engine Oil Cooler Seal
4	Engine Oil Cooler Procedure Clean the engine oil cooler to the oil filter housing sealing surfaces.

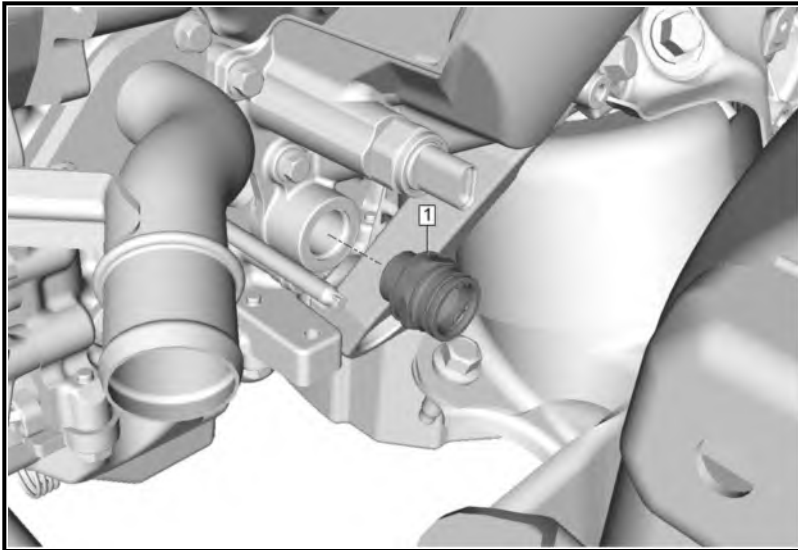
ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING REPLACEMENT (OUTLET, LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Engine Oil Cooler Outlet Pipe @ Oil Filter Adapter - Disconnect - <u>Engine Oil Cooler Outlet Pipe Replacement (LGZ)</u>	
1	Engine Oil Cooler Pipe Quick Connect Fitting CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Tighten 35 N.m (26 lb ft)

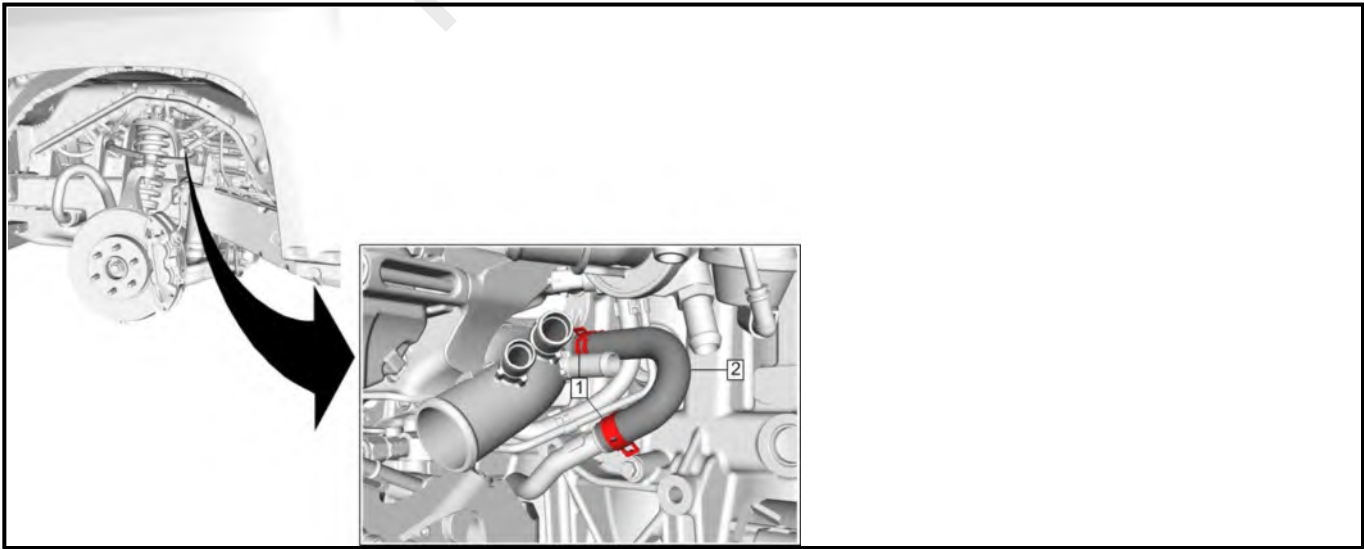
ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING REPLACEMENT (INLET, LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Engine Oil Cooler Inlet Pipe @ Oil Filter Adapter - Disconnect - Engine Oil Cooler Inlet Pipe Replacement (LGZ, 2WD) , or Engine Oil Cooler Inlet Pipe Replacement (LGZ, 4WD) .	
1	Engine Oil Cooler Pipe Quick Connect Fitting CAUTION: Refer to Component Fastener Tightening Caution . Tighten 35 N.m (26 lb ft)

ENGINE OIL COOLER OUTLET HOSE REPLACEMENT (LWN)



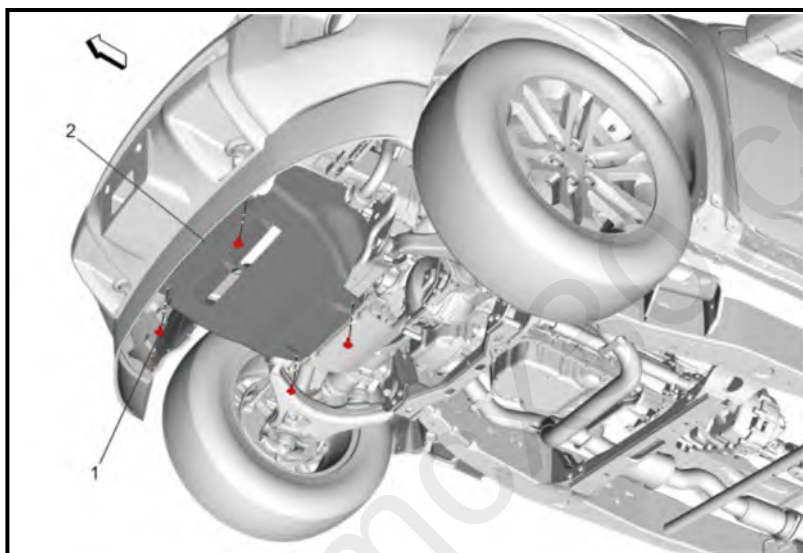
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	
1. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) 2. Air Conditioning Compressor Bracket Replacement (LWN)	
1	Engine Oil Cooler Outlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Oil Cooler Outlet Hose

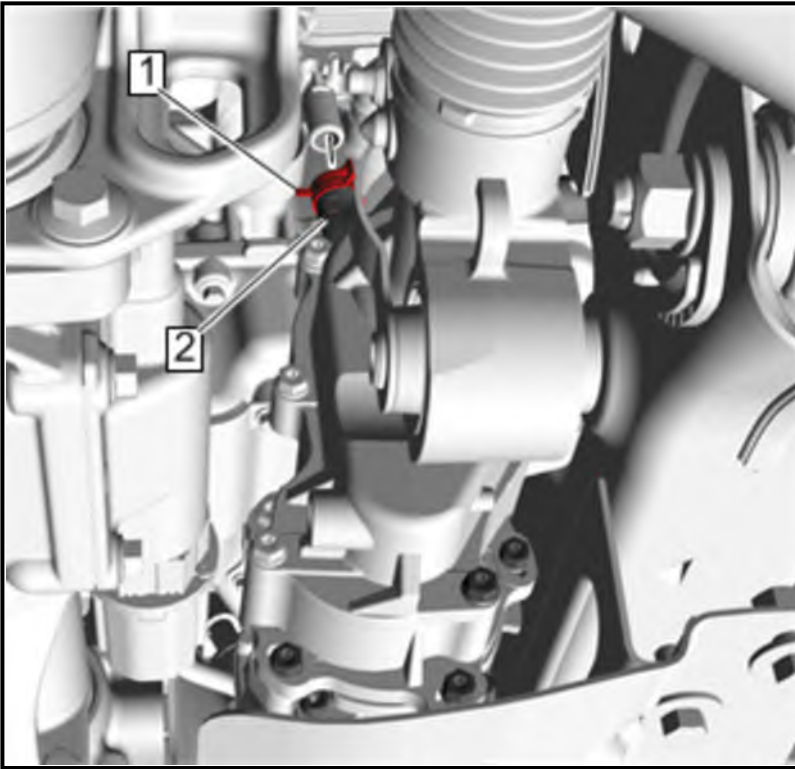
ENGINE OIL COOLER INLET HOSE REPLACEMENT (LWN)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#) (2) - Remove

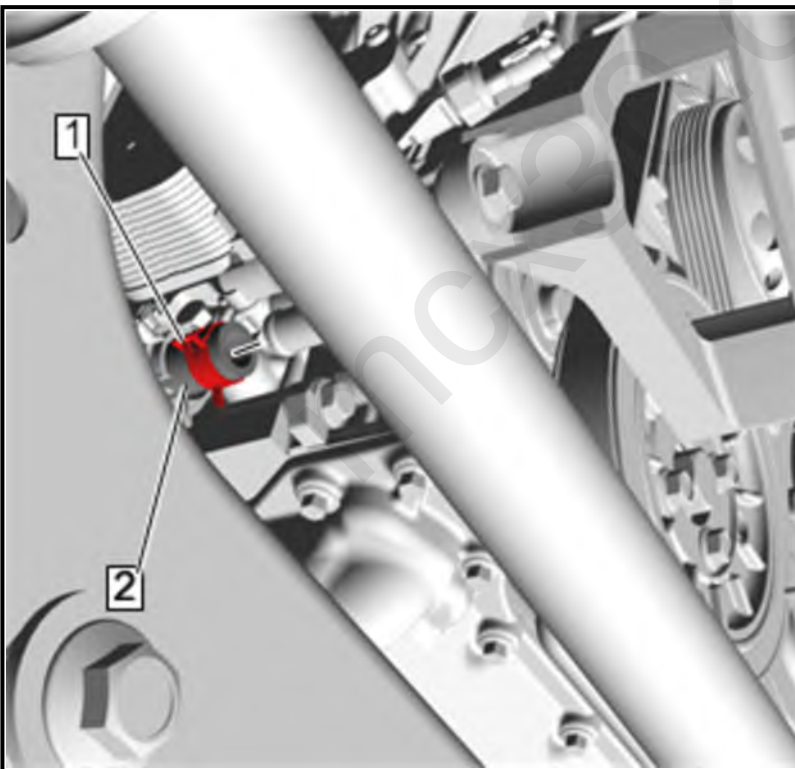


3. Engine Oil Cooler Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



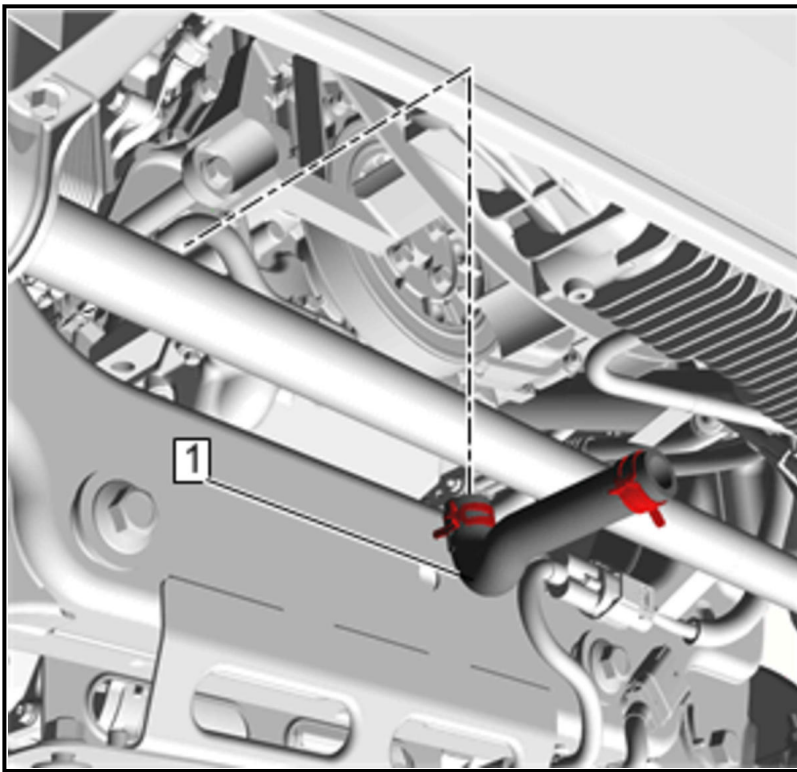
4. Engine Oil Cooler Inlet Hose (2) @ Engine Oil Cooler - Remove

5. Engine Oil Cooler Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



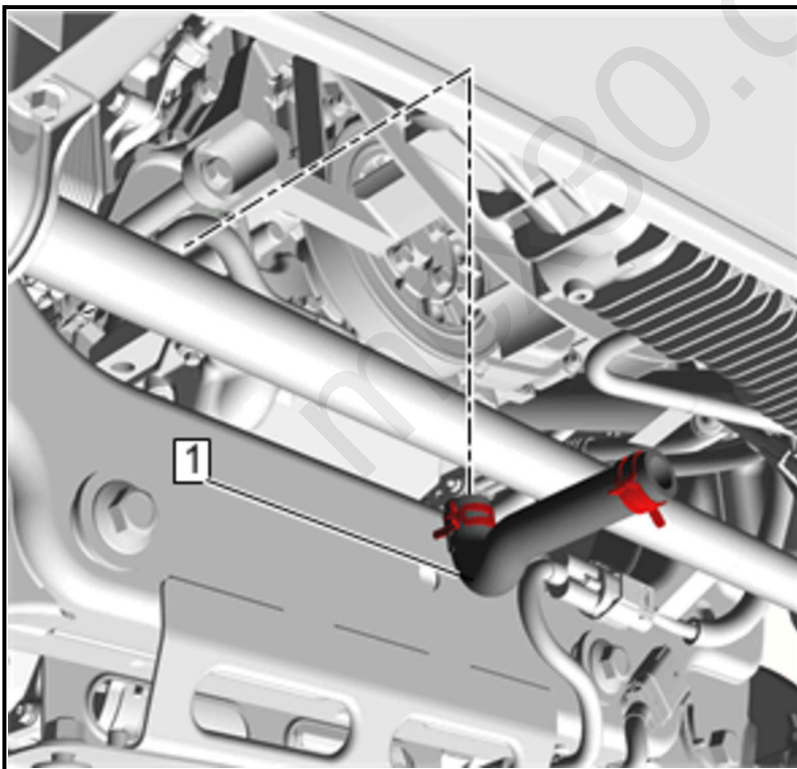
6. Engine Oil Cooler Inlet Hose (2) @ Engine Oil Cooler Pipe - Remove

7. Engine Oil Cooler Inlet Hose (1) - Remove

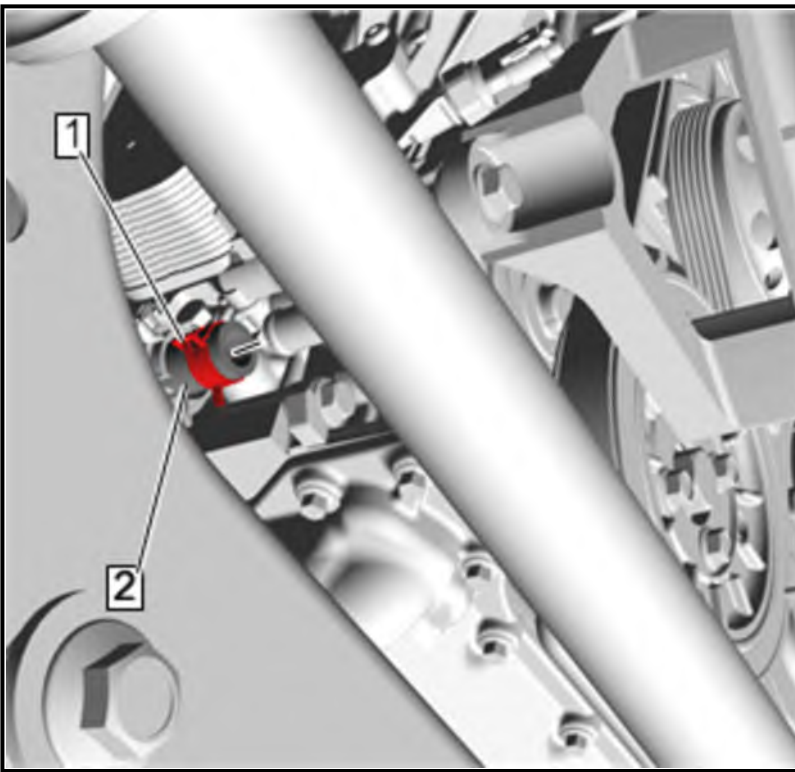


Installation Procedure

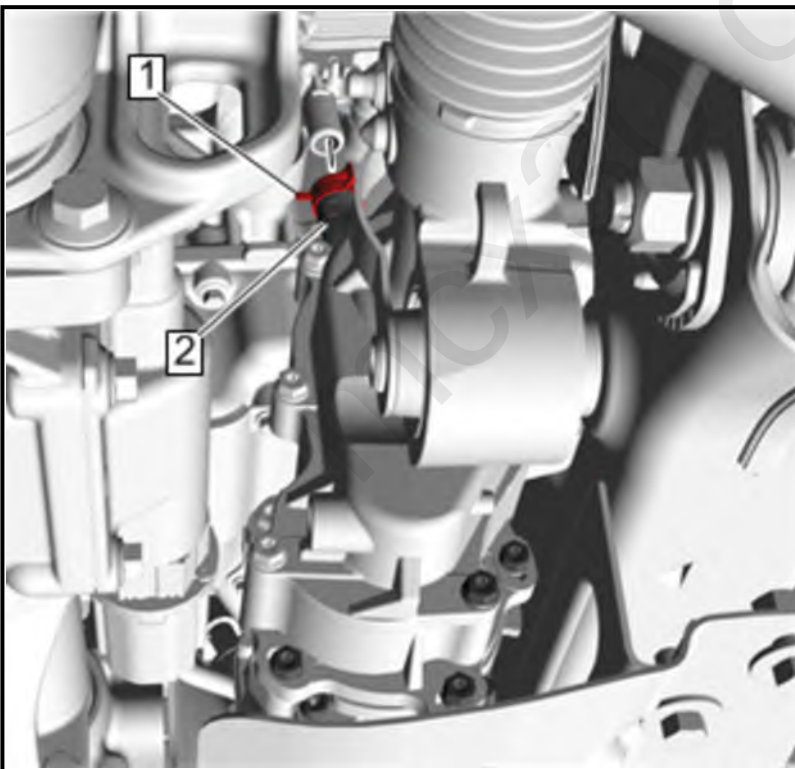
1. Engine Oil Cooler Inlet Hose (1) - Install



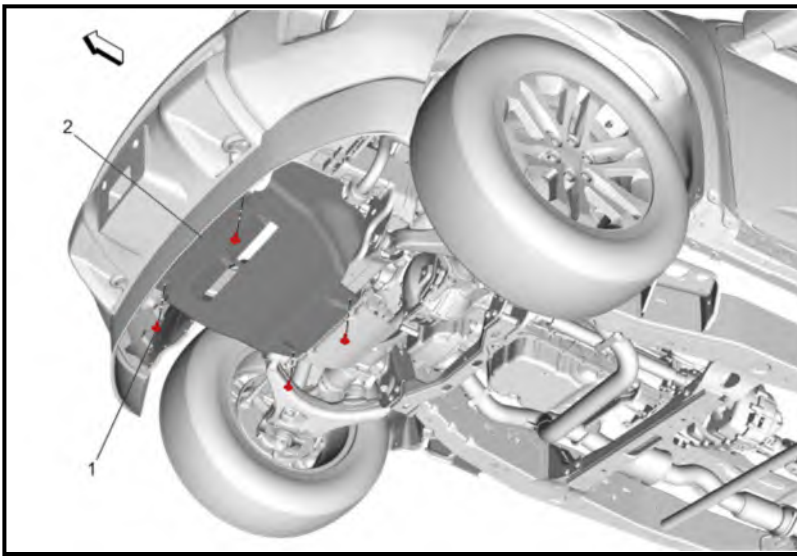
2. Engine Oil Cooler Inlet Hose (2) @ Engine Oil Cooler Pipe - Install



3. Engine Oil Cooler Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Engine Oil Cooler Inlet Hose (2) @ Engine Oil Cooler - Install



5. Engine Oil Cooler Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#) (2) - Install

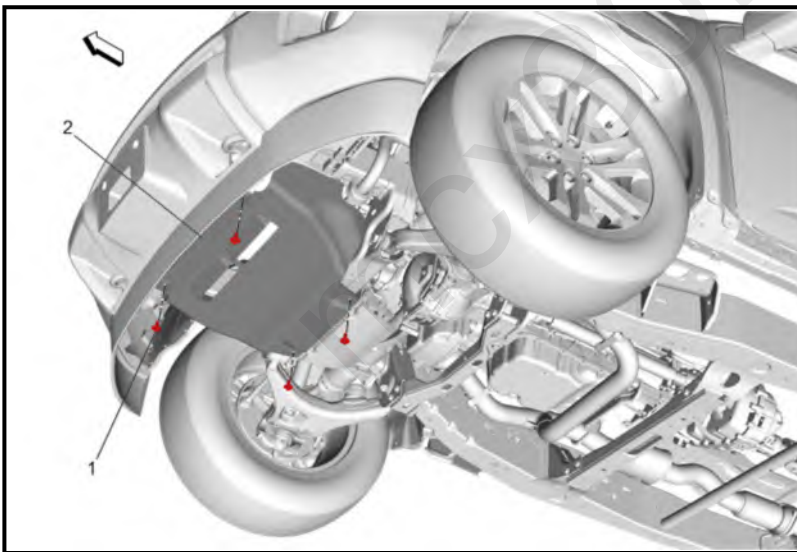


7. Fill the cooling system. [Cooling System Draining and Filling.\(Static Fill\)](#), or [Cooling System Draining and Filling.\(Vac n Fill\)](#)
8. Start the engine and check for coolant leaks.

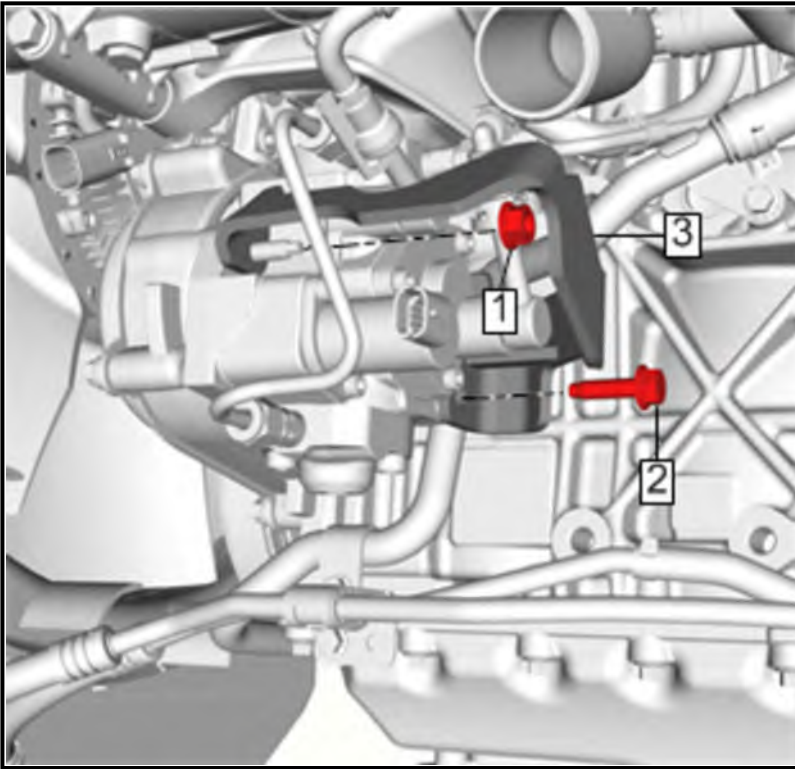
ENGINE OIL COOLER PIPE REPLACEMENT (LWN)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling.\(Static Fill\)](#), or [Cooling System Draining and Filling.\(Vac n Fill\)](#)
2. [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#) (2) - Remove



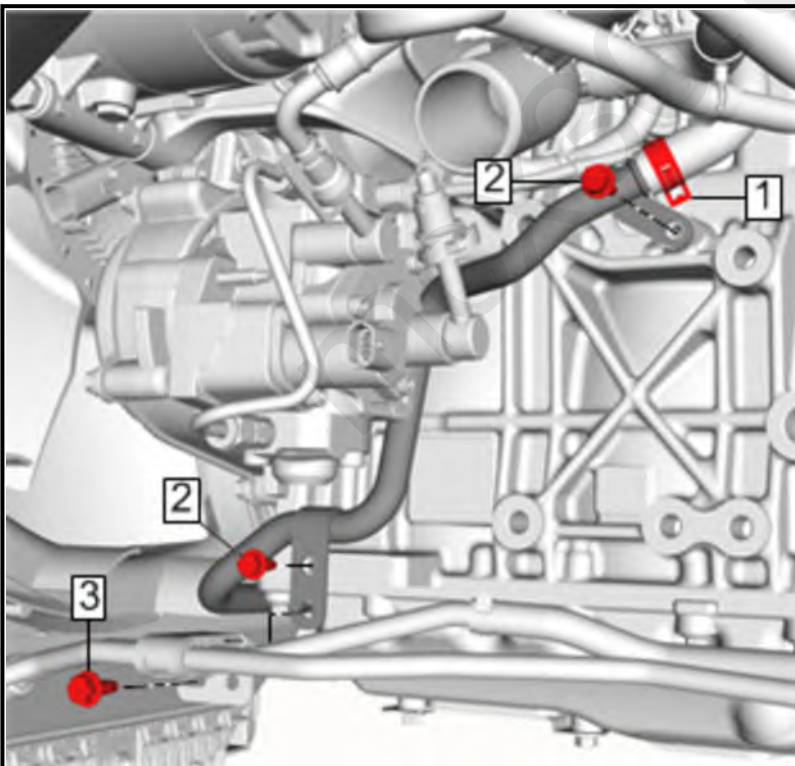
3. [Engine Mount Bracket Replacement - Left Side](#) - Remove
4. Fuel Feed Hose Protector Nut (1) - Remove



5. Fuel Feed Hose Protector Bolt (2) - Remove

6. Fuel Feed Hose Protector (3) - Remove

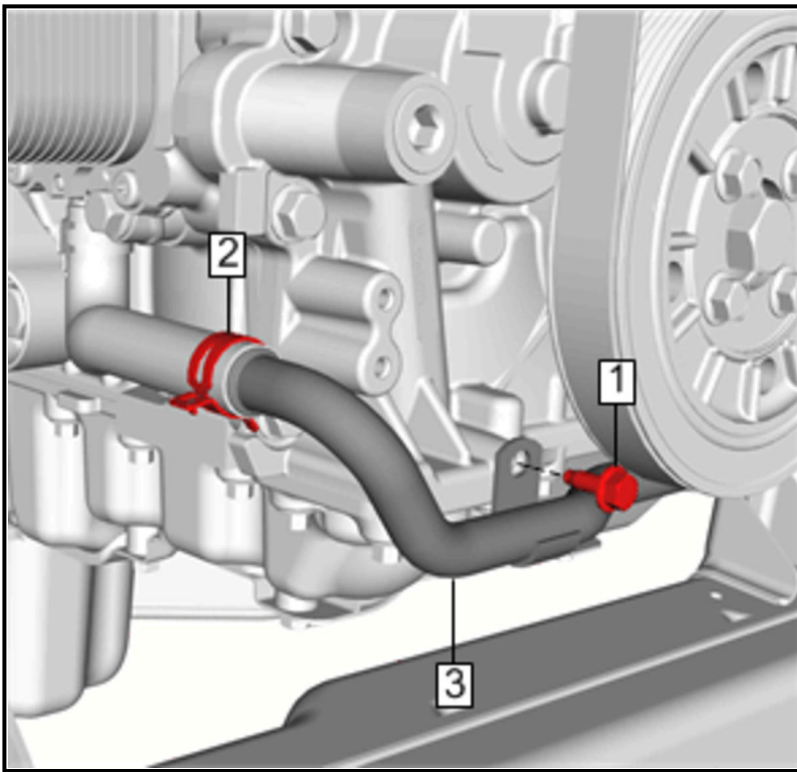
7. Engine Oil Cooler Outlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



8. Engine Oil Cooler Pipe Fastener (2) - Remove [2x]

9. Transmission Fluid Cooler Pipe Bracket Bolt (3) - Remove

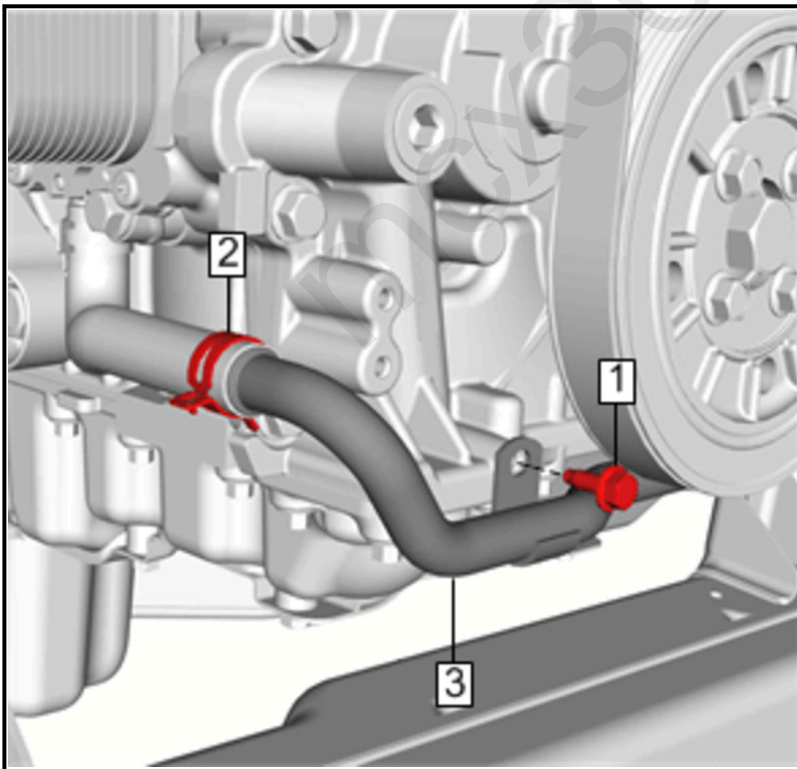
10. Engine Oil Cooler Pipe Fastener (1) - Remove



11. Engine Oil Cooler Inlet Hose Clamp (2) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)
12. Engine Oil Cooler Pipe (3) - Remove

Installation Procedure

1. Engine Oil Cooler Pipe (3) - Install

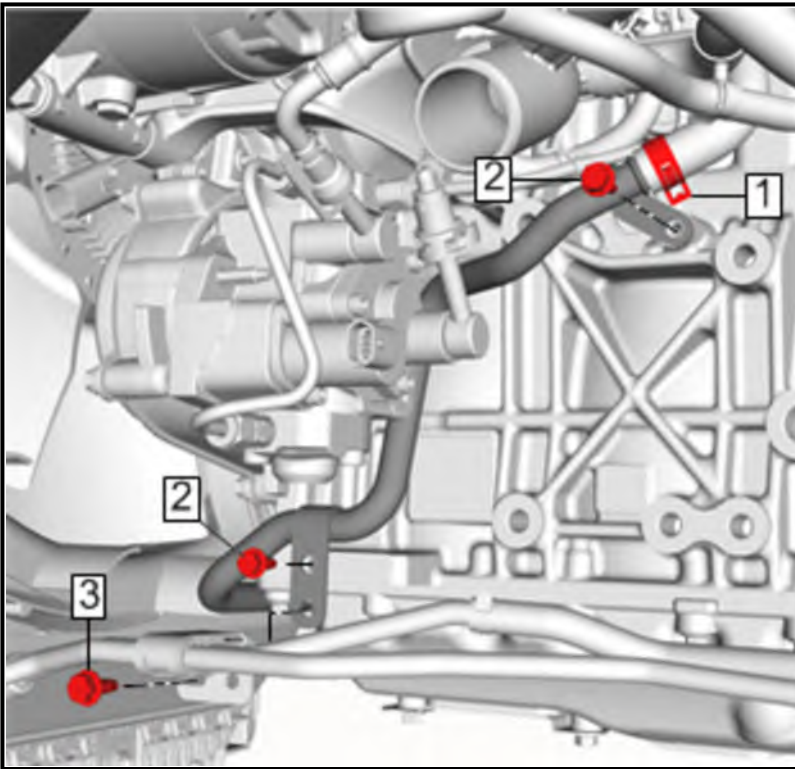


2. Engine Oil Cooler Inlet Hose Clamp (2) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

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

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

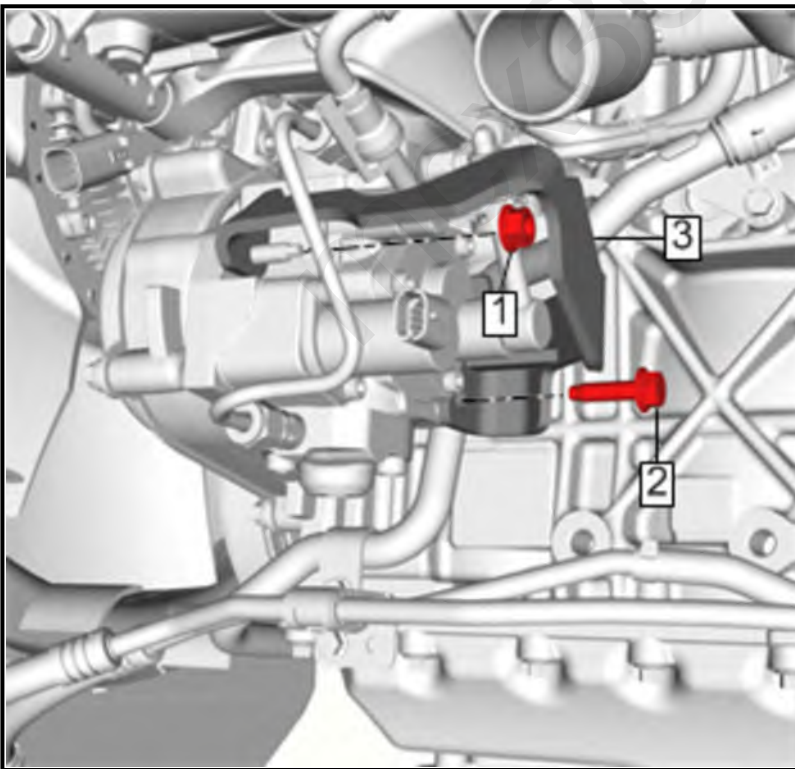
4. Engine Oil Cooler Pipe Fastener (2) - Install and tighten [2x] 9 N.m (80 lb in)



5. Transmission Fluid Cooler Pipe Bracket Bolt (3) - Install and tighten 9 N.m (80 lb in)

6. Engine Oil Cooler Outlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)

7. Fuel Feed Hose Protector (3) - Install

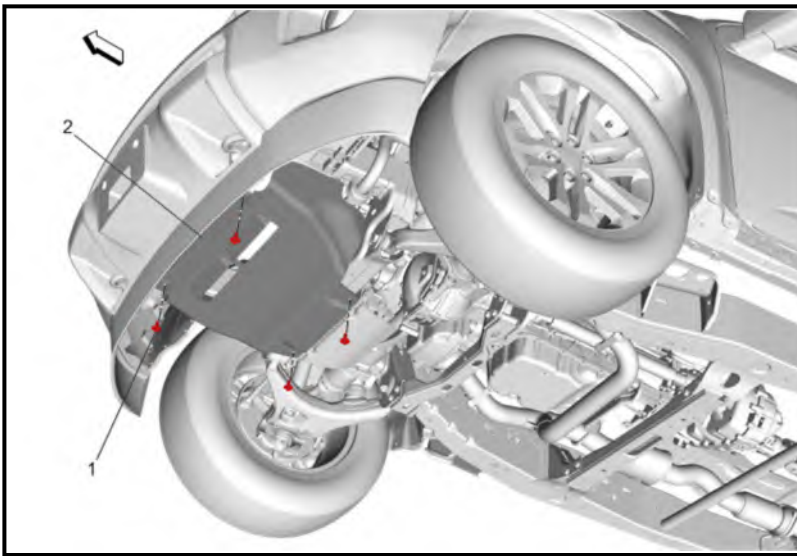


8. Fuel Feed Hose Protector Bolt (2) - Install and tighten 10 N.m (89 lb in)

9. Fuel Feed Hose Protector Nut (1) - Install and tighten 10 N.m (89 lb in)

10. [Engine Mount Bracket Replacement - Left Side](#) - Install

11. [Underbody Splash Shield Replacement \(without ZR2\)](#), or [Underbody Splash Shield Replacement \(with ZR2\)](#), or [Underbody Splash Shield Replacement \(Bison\)](#) (2) - Install

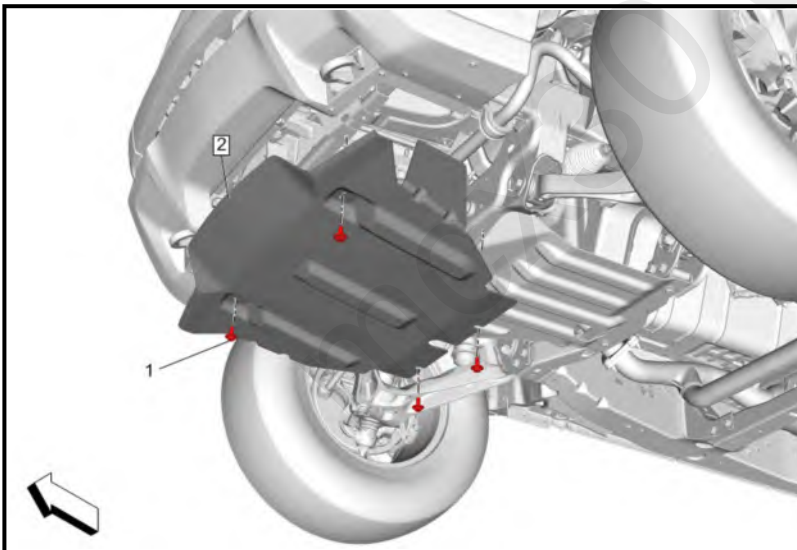


12. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
13. Start the engine and check for coolant leaks.

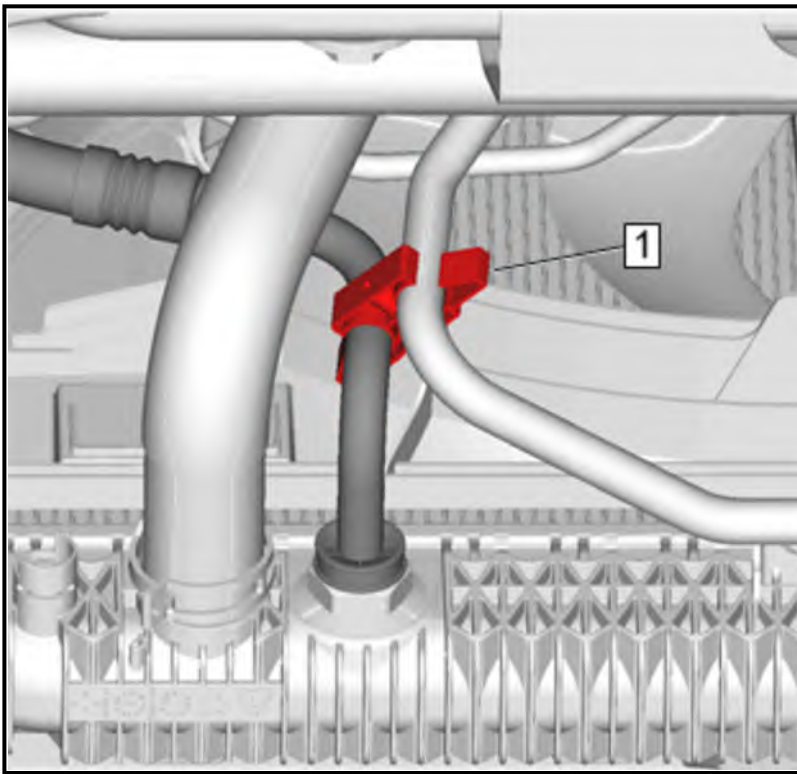
ENGINE OIL COOLER INLET PIPE REPLACEMENT (LGZ, 2WD)

Removal Procedure

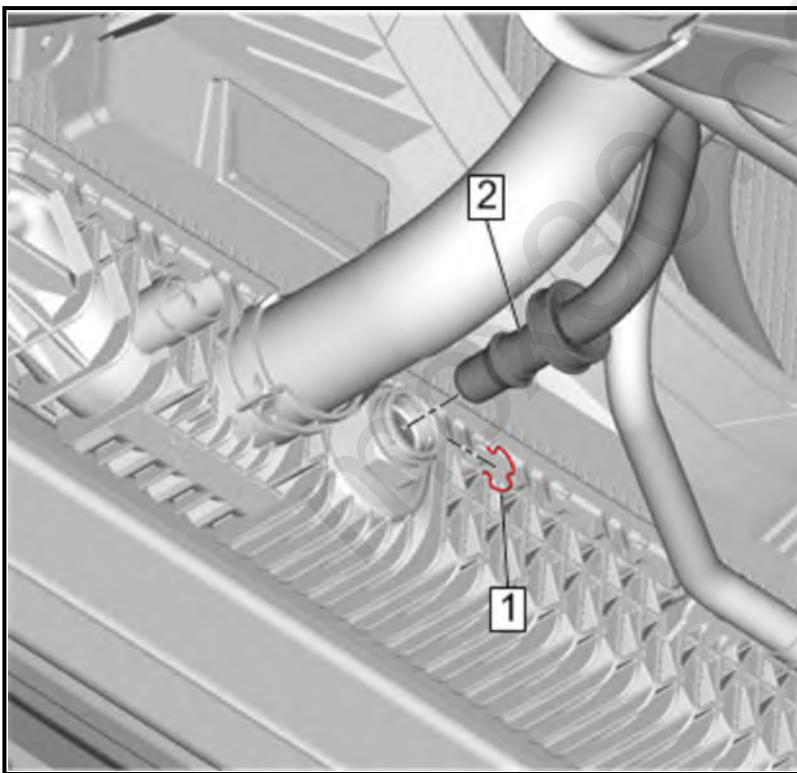
1. Underbody Splash Shield (2) - Remove - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)



2. Engine Oil Cooler Pipe Clip (1) - Remove

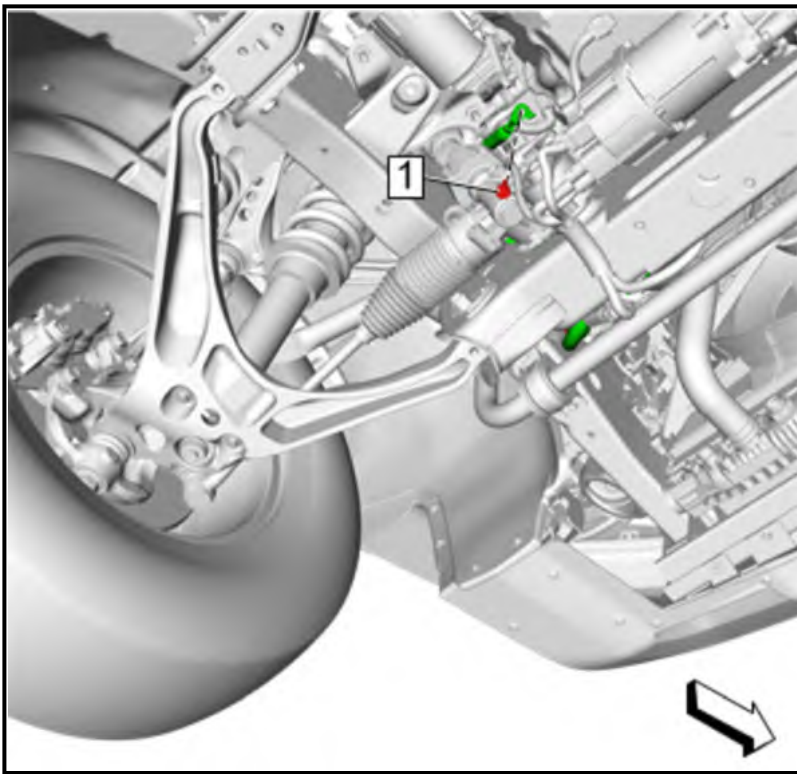


3. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Remove



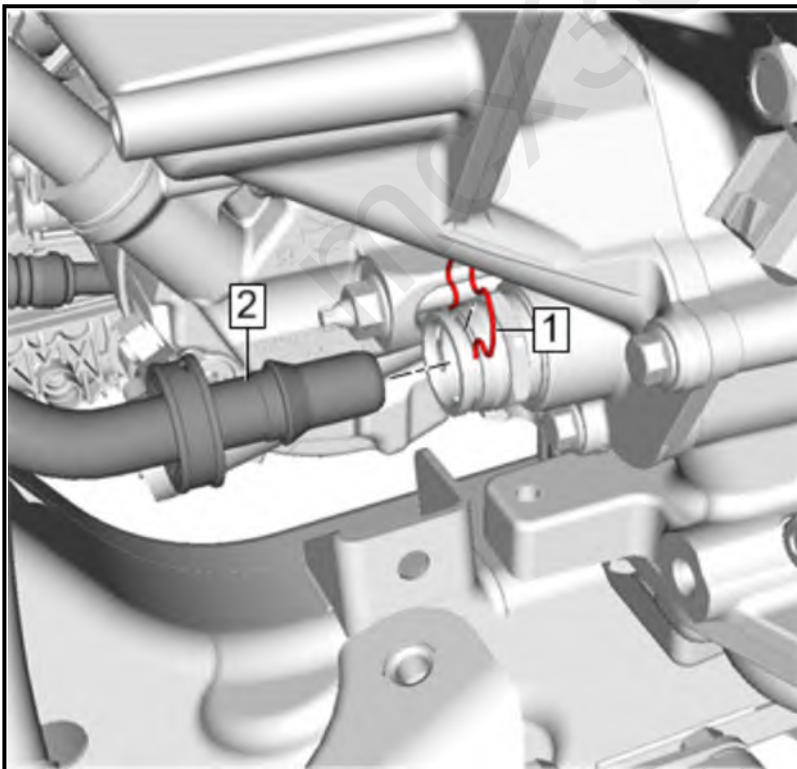
4. Engine Oil Cooler Inlet Pipe (2) - Remove

5. Battery Negative Cable Ground Fastener (1) - Remove



NOTE: Position the battery negative cable aside to again access to the engine cooler inlet pipe and connector retainer.

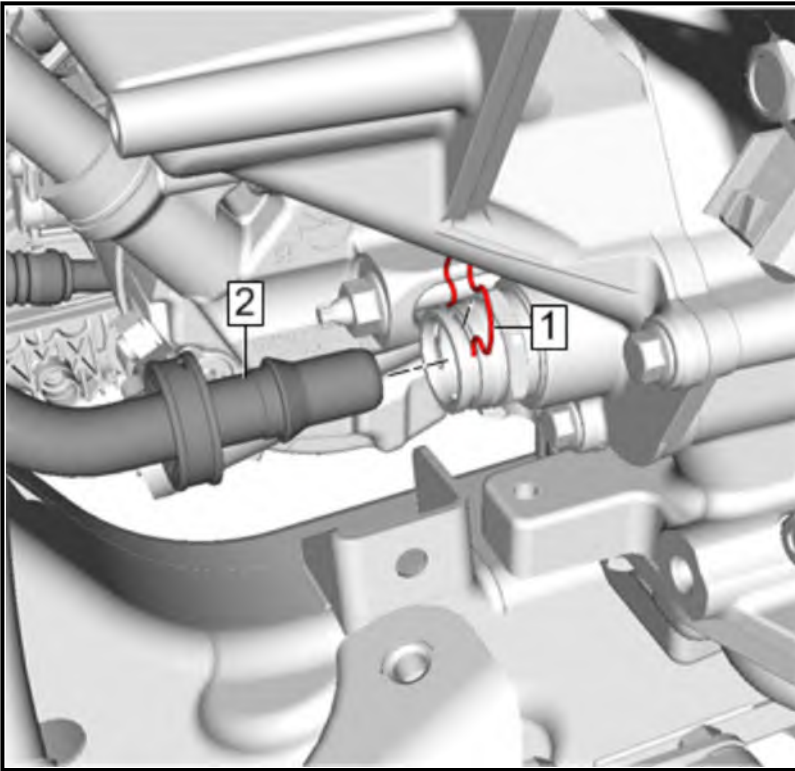
6. Battery Negative Cable - Position aside
7. Remove the left front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
8. Engine Oil Cooler Pipe Quick Connector Retainer (1) - Remove



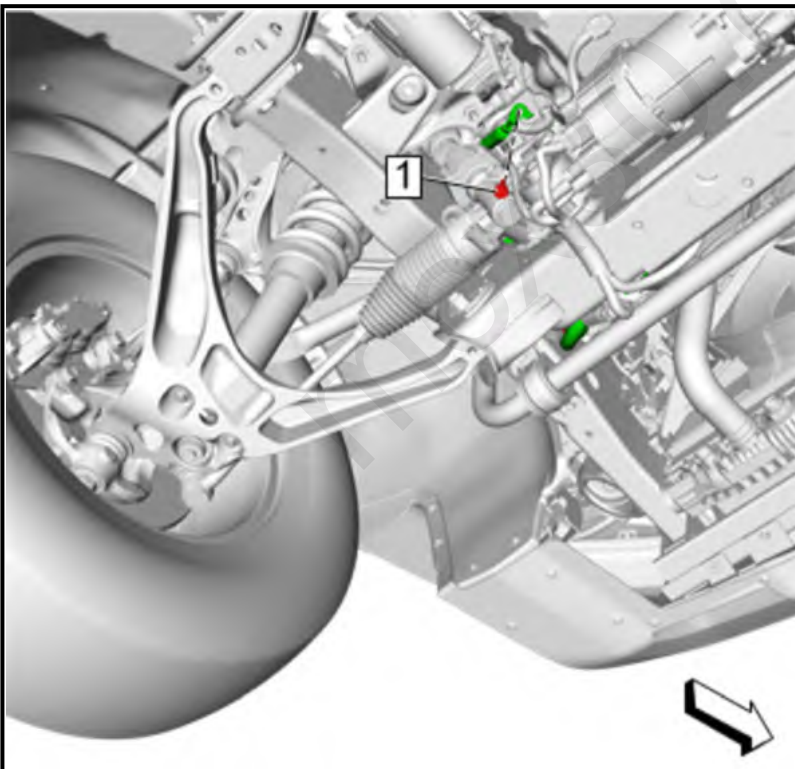
9. Engine Oil Cooler Inlet Pipe (2) - Remove

Installation Procedure

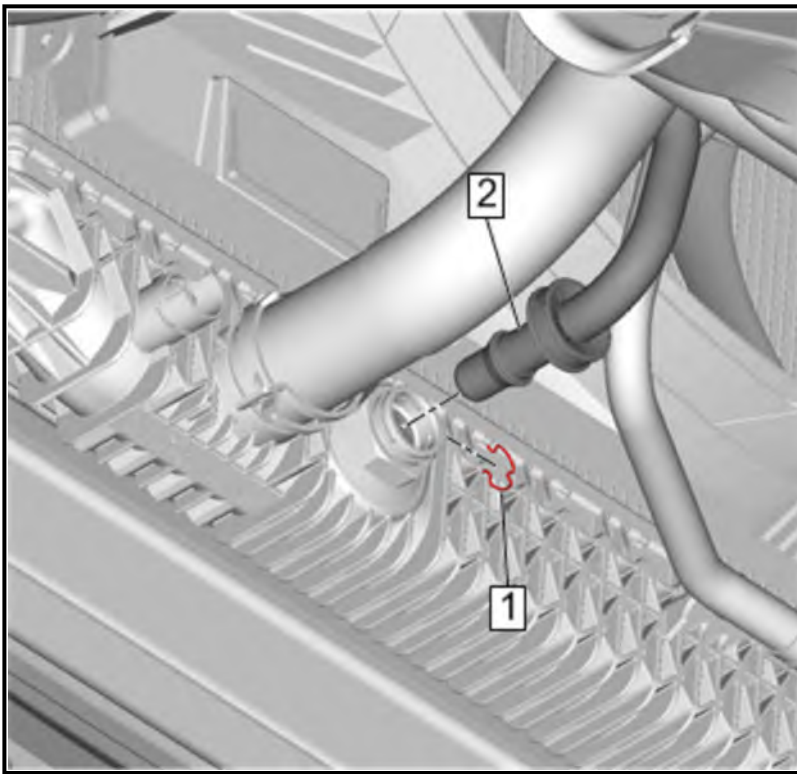
1. Engine Oil Cooler Inlet Pipe (2) - Install



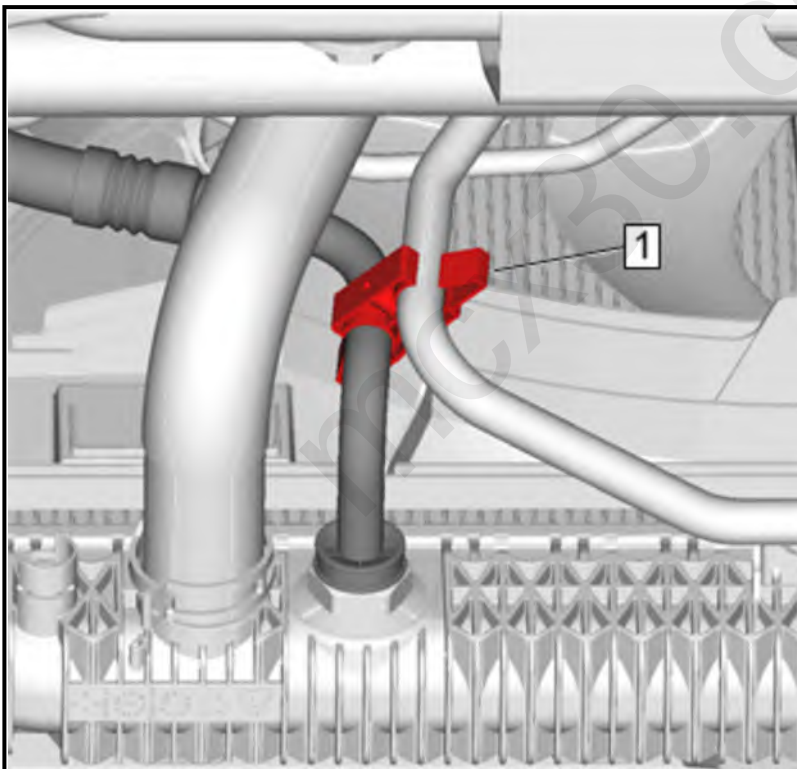
2. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install
3. Install the left front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
4. Battery Negative Cable - Install



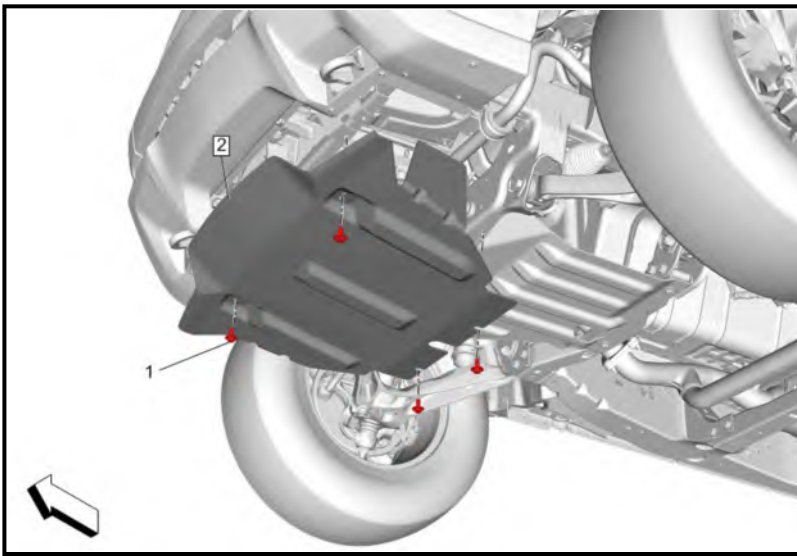
5. Battery Negative Cable Ground Fastener (1) - Install - [Battery Negative Cable Replacement \(LGZ\)](#)
6. Engine Oil Cooler Inlet Pipe (2) - Install



7. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install
8. Engine Oil Cooler Pipe Clip (1) - Install



9. Underbody Splash Shield (2) - Install - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)



ENGINE OIL COOLER INLET PIPE REPLACEMENT (LGZ, 4WD)

CAUTION: Care must be taken during removal and installation of the Electronic Power Steering (EPS) components to not hit or break the EPS motor/controller module or module harness connectors. If the EPS motor/ controller module or module connectors are damaged, the complete component must be replaced.

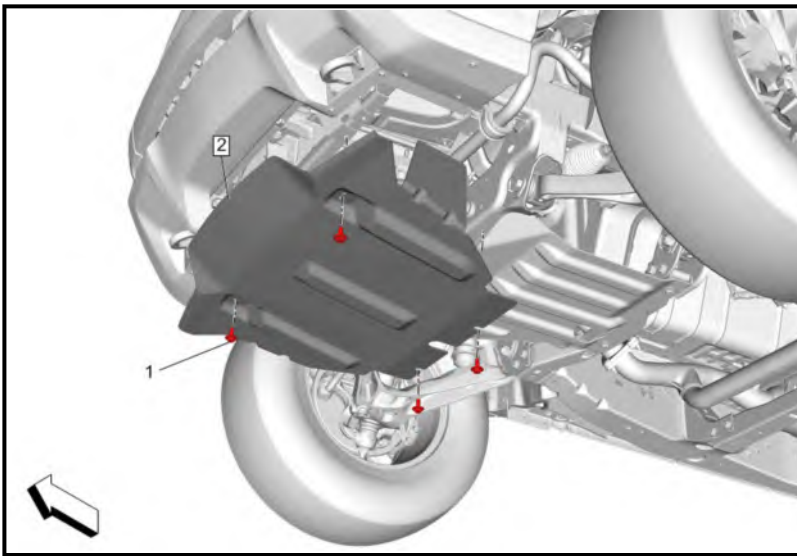
CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

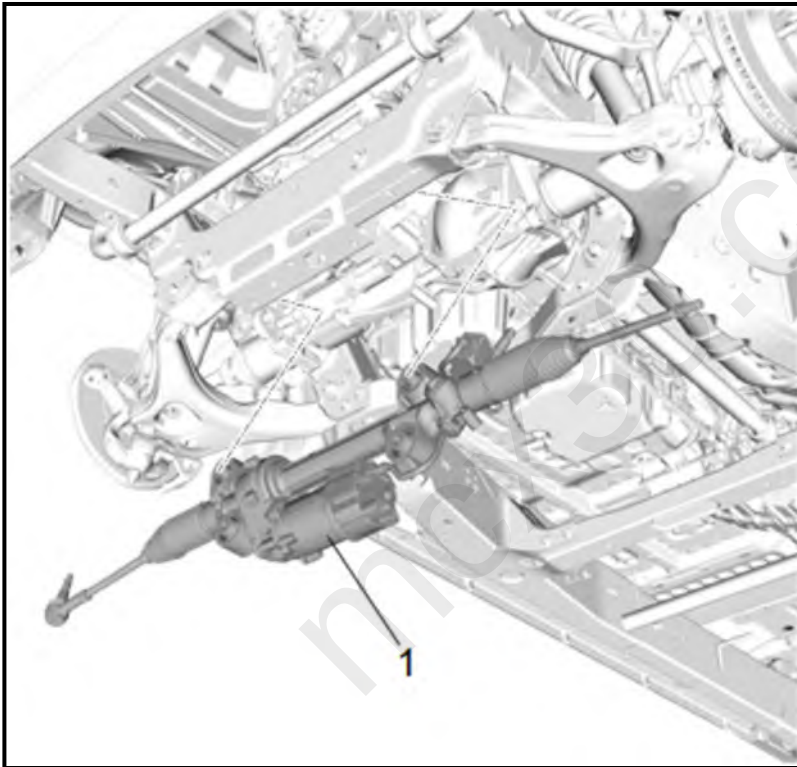
After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

Removal Procedure

1. With the steering wheel in the straight ahead position, LOCK the steering column.
2. Underbody Splash Shield (2) - Remove - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)

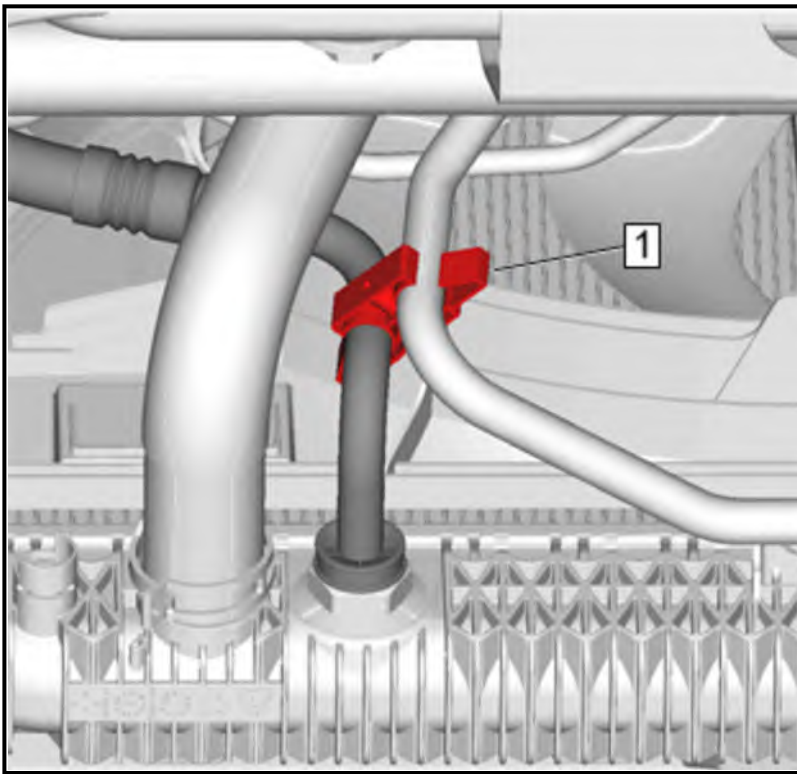


3. Place scribe/alignment marks at the steering gear mounting interface.
4. Lower the electric belt drive rack and pinion steering gear (1) enough to gain clearance to remove the engine oil cooler inlet pipe. [Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#)

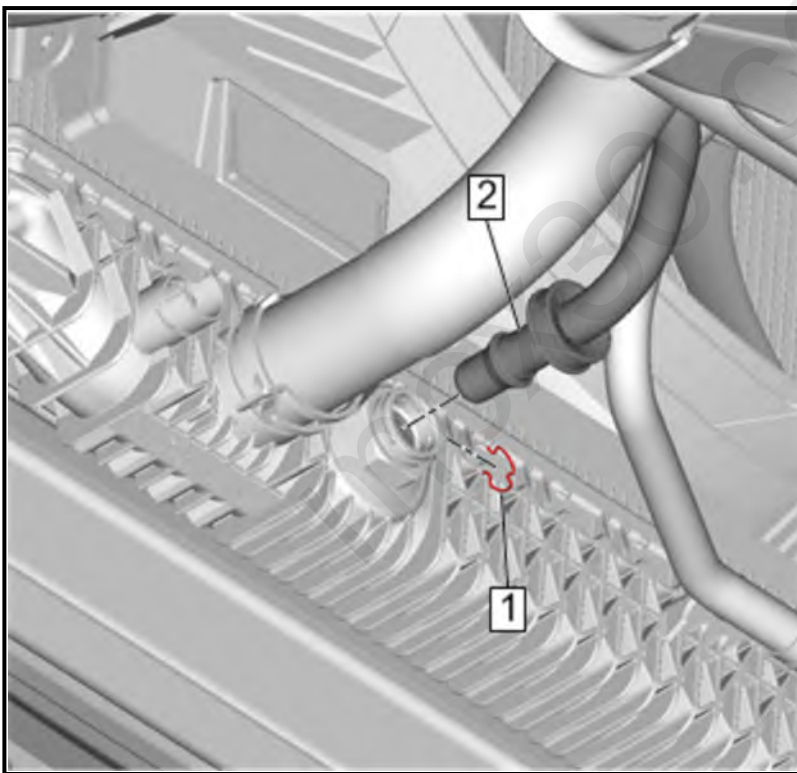


NOTE: It is not necessary to remove the electric belt drive rack and pinion steering gear from the vehicle or disconnect the outer tie rod ends.

5. Engine Oil Cooler Pipe Clip (1) - Remove



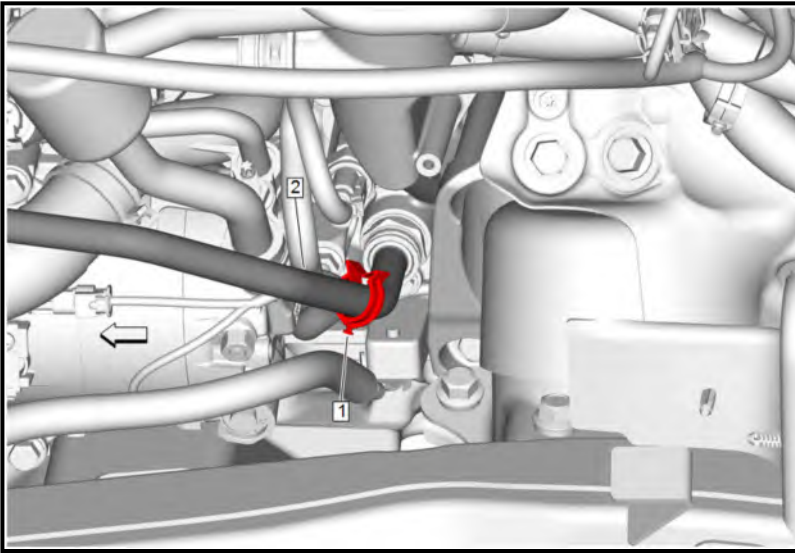
6. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Remove



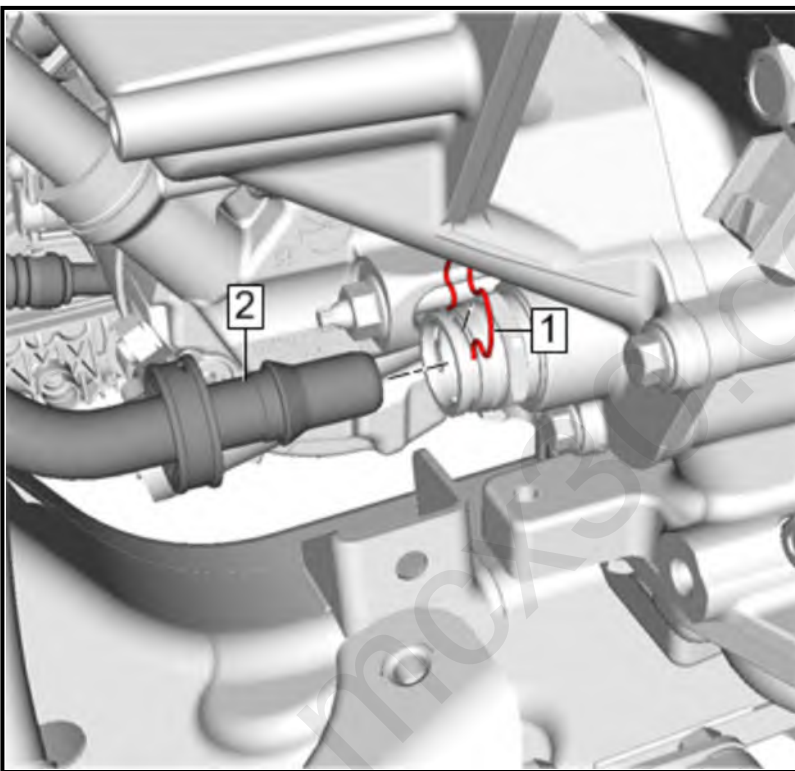
NOTE: Place a suitable container under the engine cooler inlet pipe as oil will drain from the inlet pipe and radiator when removed.

7. Engine Oil Cooler Inlet Pipe (2) - Remove

8. Wiring Harness Retainer (1) @ Engine Oil Cooler Inlet Pipe (2) - Remove



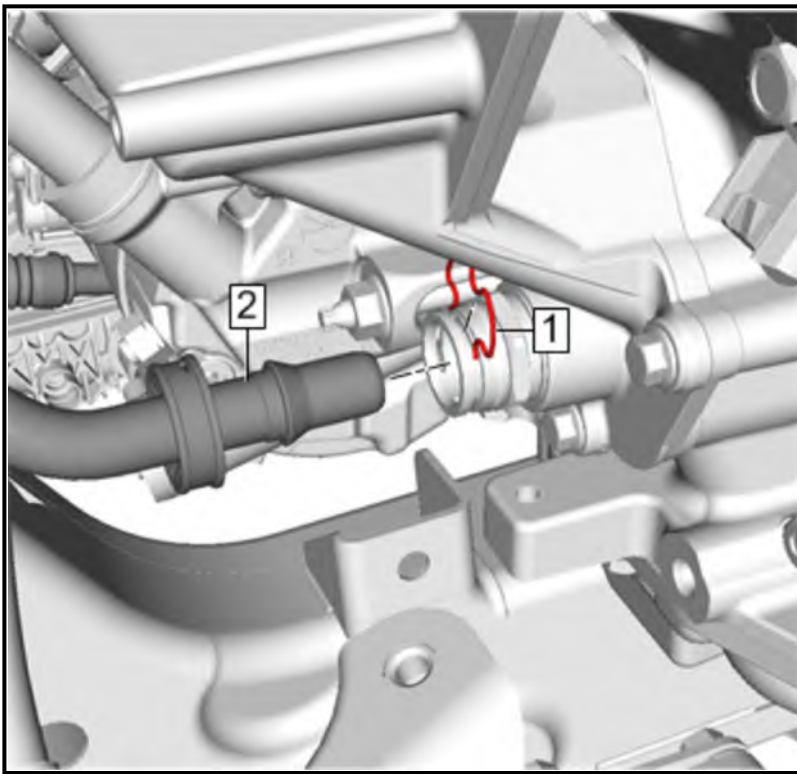
9. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Remove



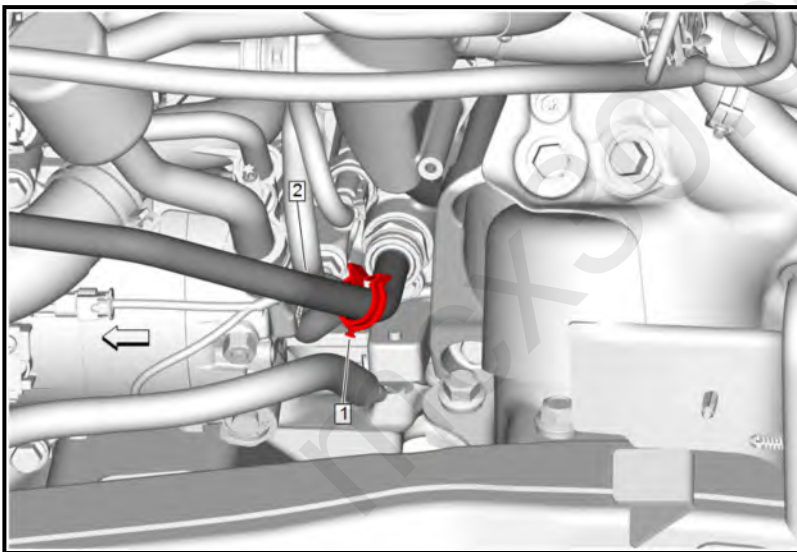
10. Engine Oil Cooler Inlet Pipe (2) - Remove

Installation Procedure

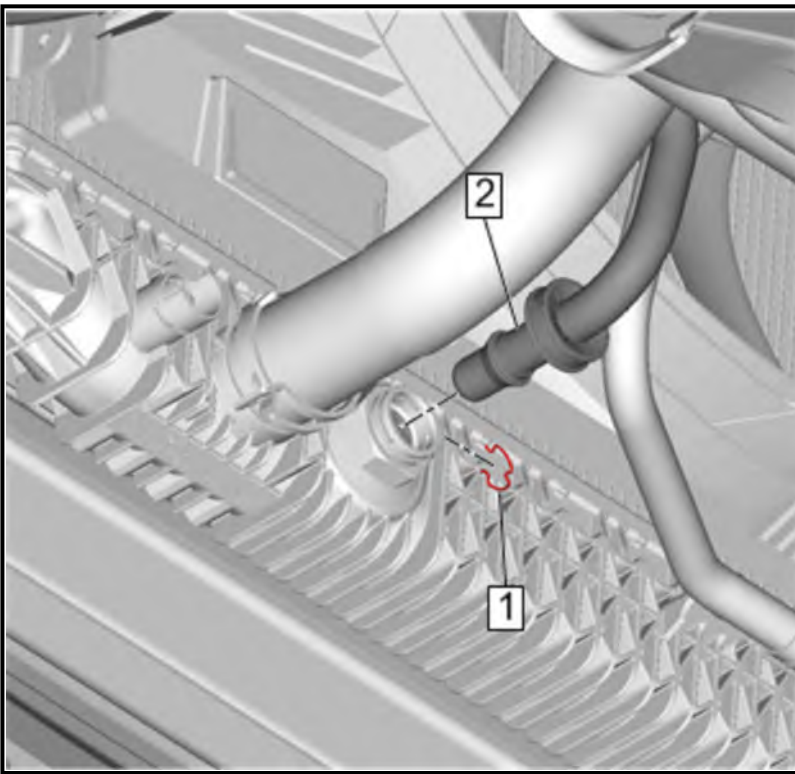
1. Engine Oil Cooler Inlet Pipe (2) - Install



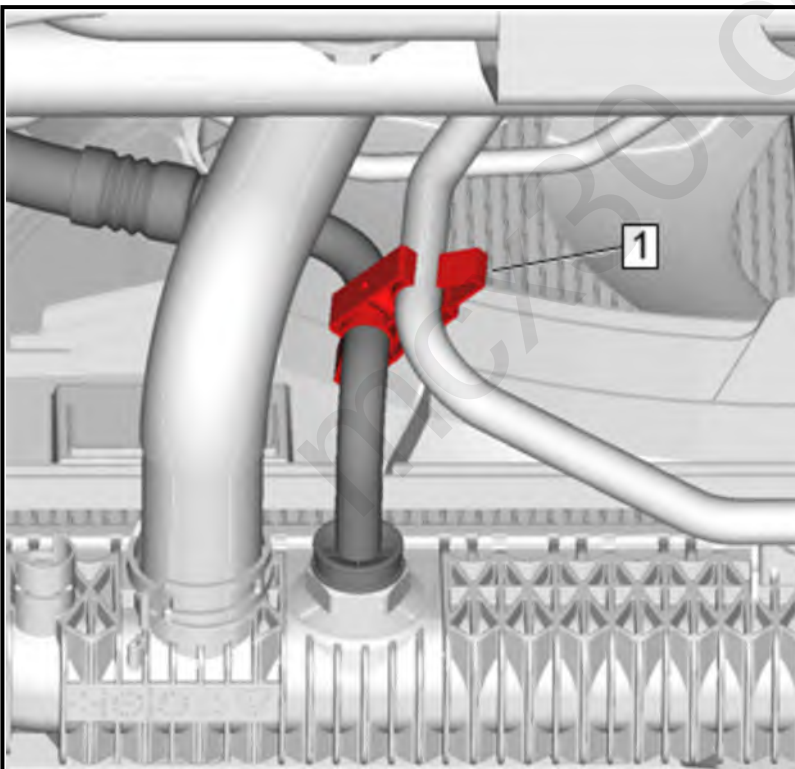
2. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install
3. Wiring Harness Retainer (1) @ Engine Oil Cooler Inlet Pipe (2) - Install



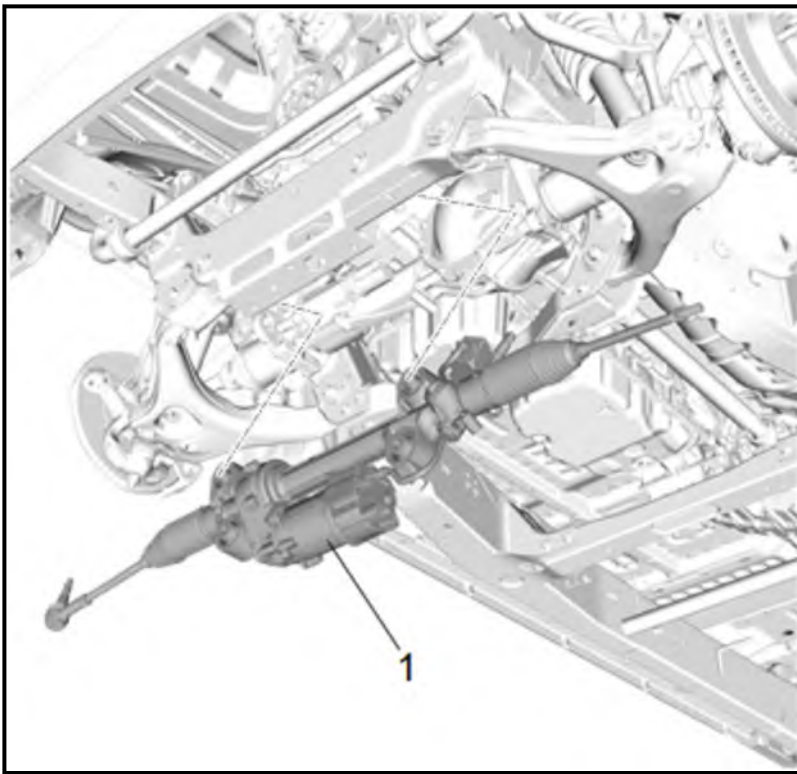
4. Engine Oil Cooler Inlet Pipe (2) - Install



5. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install
6. Engine Oil Cooler Pipe Clip (1) - Install

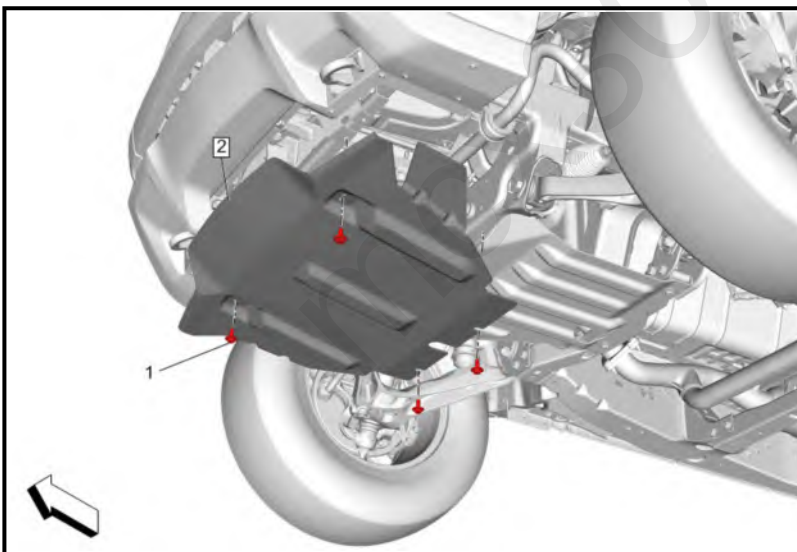


7. Align the electric belt drive rack and pinion steering gear (1) to the scribe/alignment marks and install.
[Electric Belt Drive Rack and Pinion Steering Gear Replacement \(4WD\)](#)



NOTE: Aligning the steering gear to the scribe/alignment marks eliminates the need for wheel alignment.

8. Underbody Splash Shield (2) - Install - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)

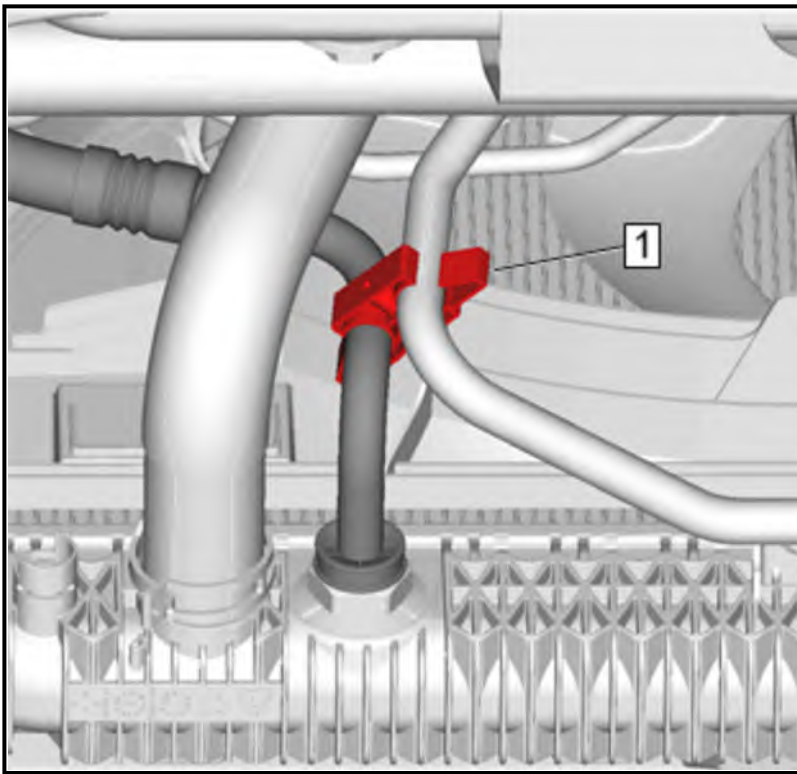


9. Unlock the steering column.
10. Check the engine oil level and adjust as necessary.

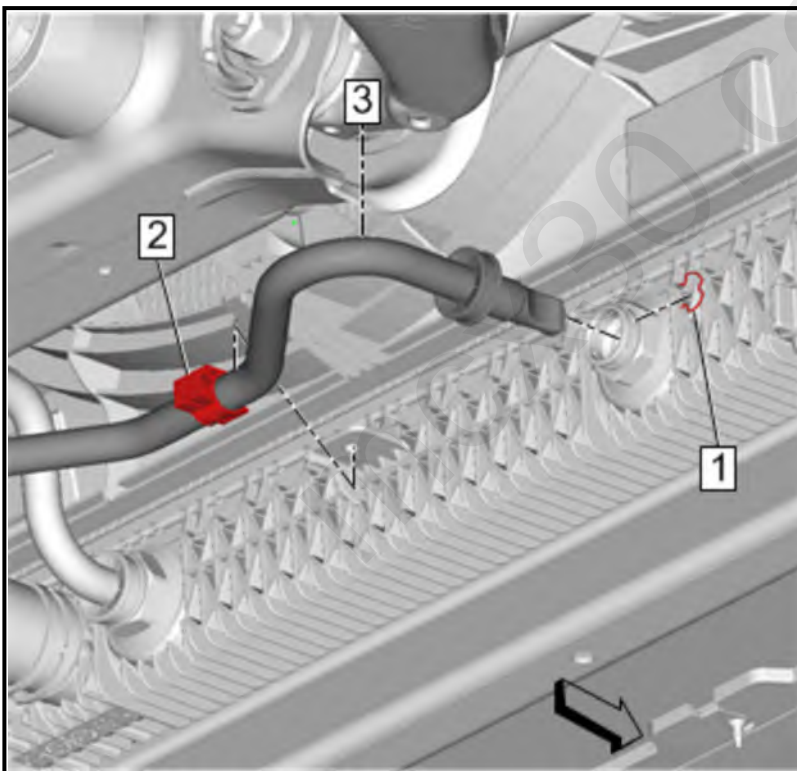
ENGINE OIL COOLER OUTLET PIPE REPLACEMENT (LGZ)

Removal Procedure

1. Underbody Splash Shield - Remove - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)
2. Engine Oil Cooler Pipe Clip (1) - Remove



3. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Remove



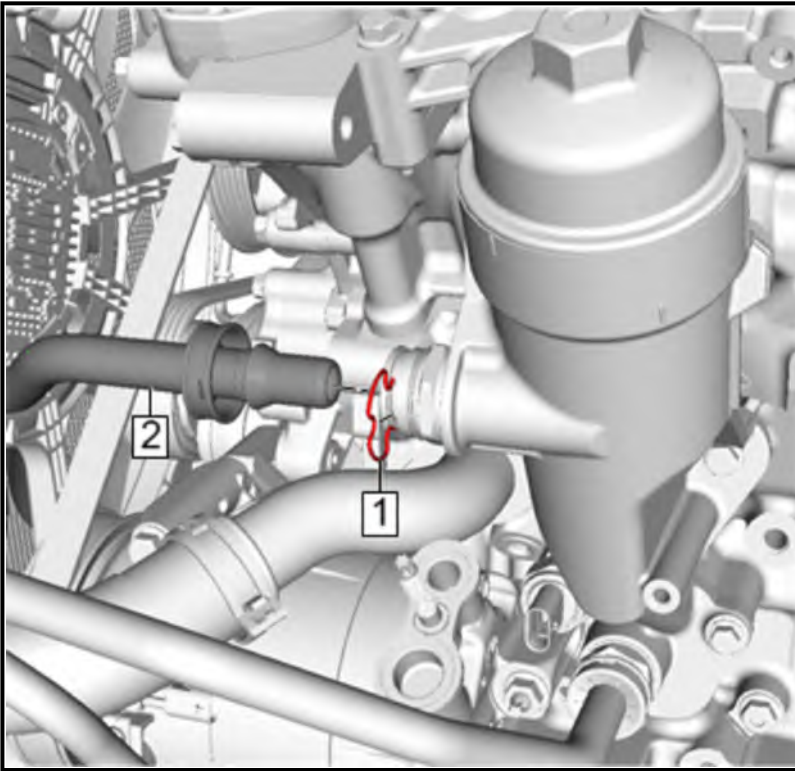
4. Engine Oil Cooler Pipe Clip (2) - Remove

5. Engine Oil Cooler Outlet Pipe (3) - Remove

NOTE: Removing the left front tire and wheel assembly will allow easier access to the engine oil cooler outlet pipe and retainer.

6. Remove the left front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

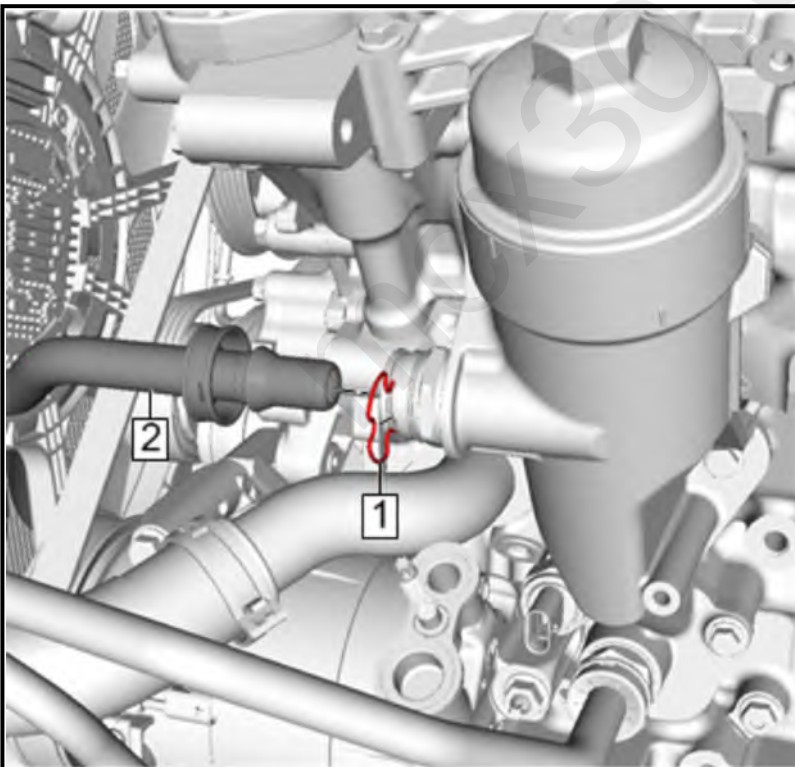
7. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Remove



8. Engine Oil Cooler Outlet Pipe (2) - Remove

Installation Procedure

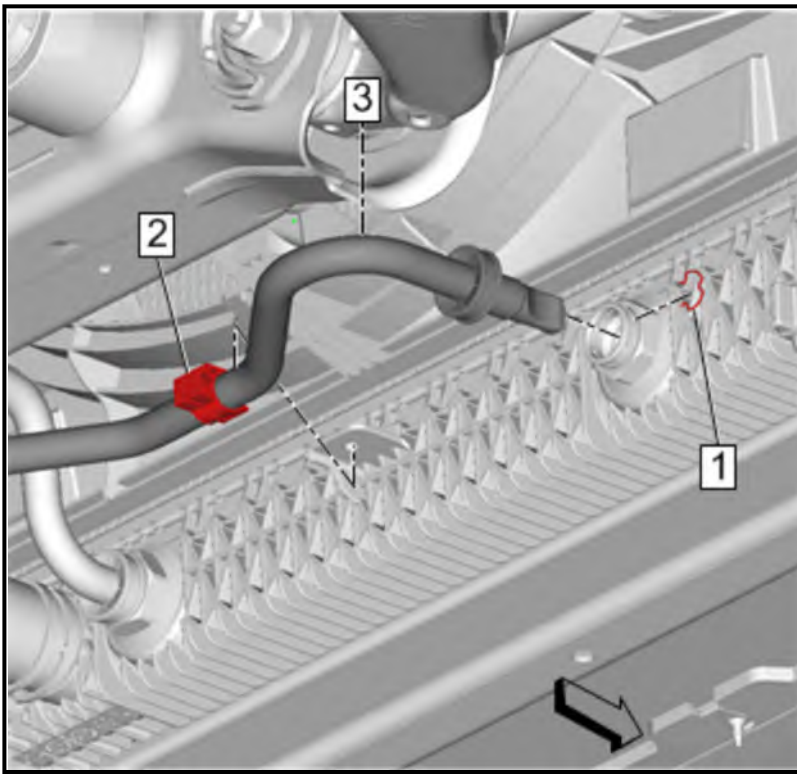
1. Engine Oil Cooler Outlet Pipe (2) - Install



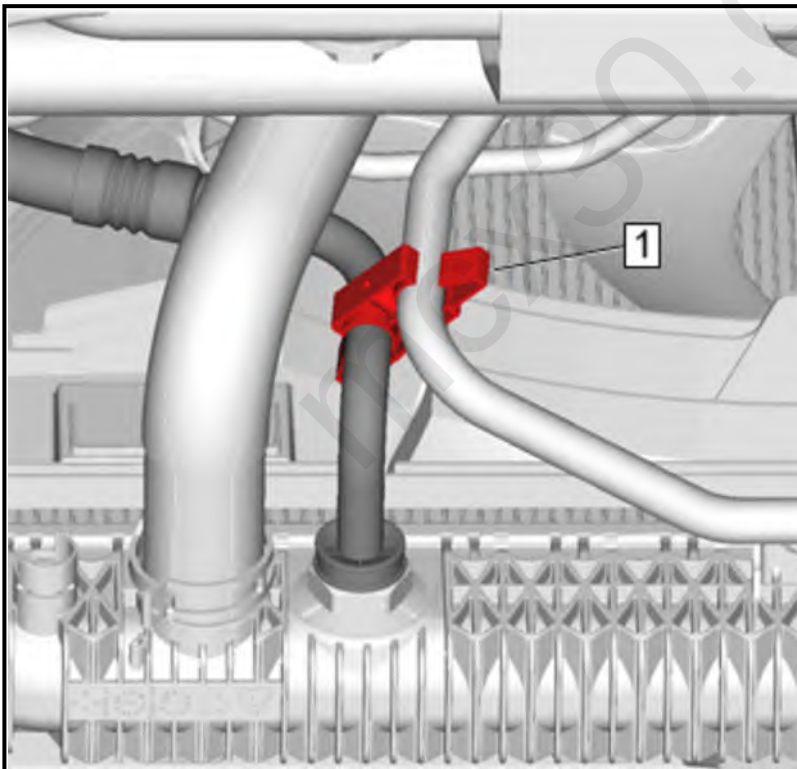
2. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install

3. Install the left front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

4. Engine Oil Cooler Outlet Pipe (3) - Install

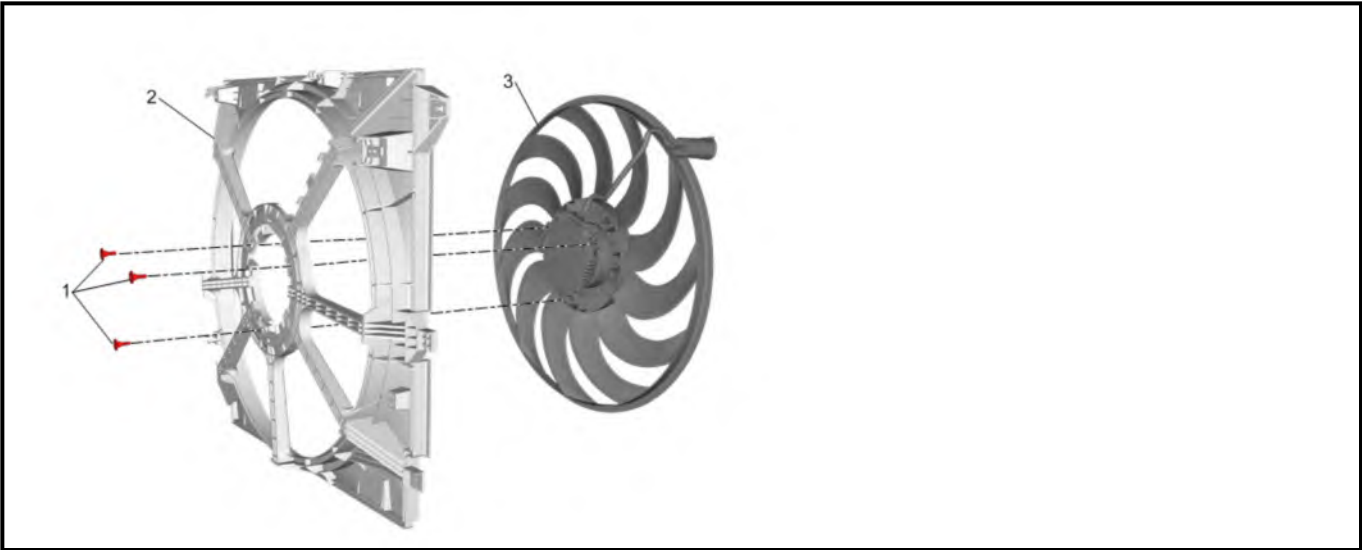


5. Engine Oil Cooler Pipe Clip (2) - Install
6. Engine Oil Cooler Pipe Quick Connect Retainer (1) - Install
7. Engine Oil Cooler Pipe Clip (1) - Install



8. Underbody Splash Shield - Install - [Underbody Splash Shield Replacement \(without ZR2\)](#) , or [Underbody Splash Shield Replacement \(with ZR2\)](#) , or [Underbody Splash Shield Replacement \(Bison\)](#)

FAN BLADE REPLACEMENT (LCV, LGZ)



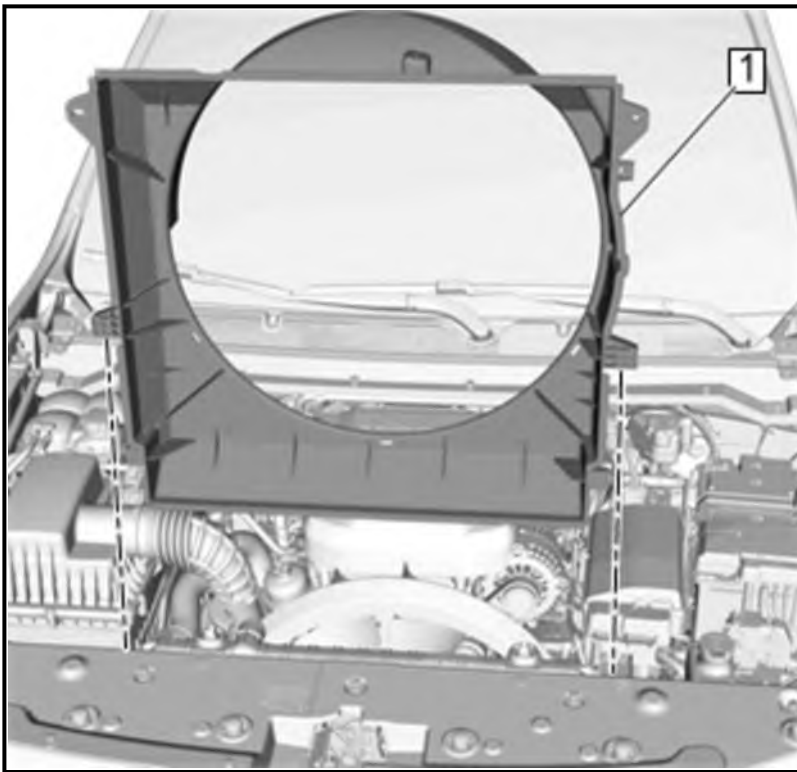
NOTE: Callouts in the following chart represent components shown in graphic above.

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

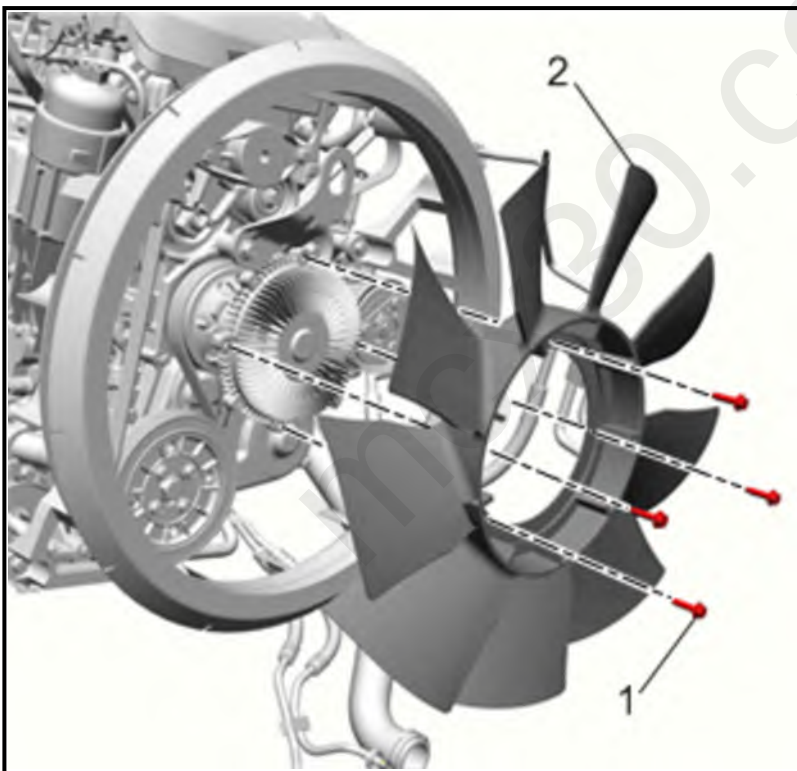
FAN BLADE REPLACEMENT (LWN)

Removal Procedure

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

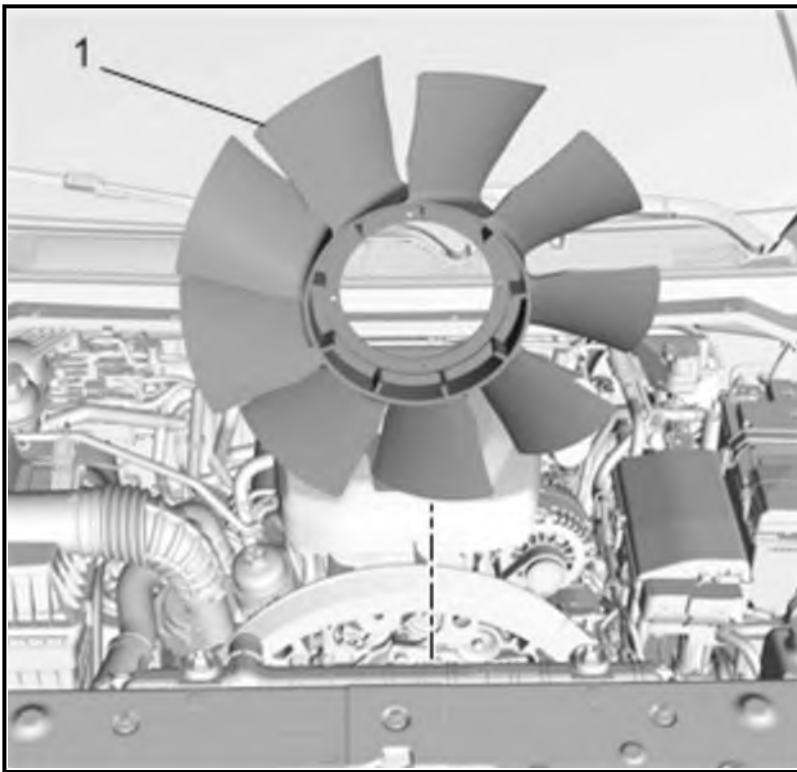


2. Fan Blade Bolt (1)[4x] - Remove



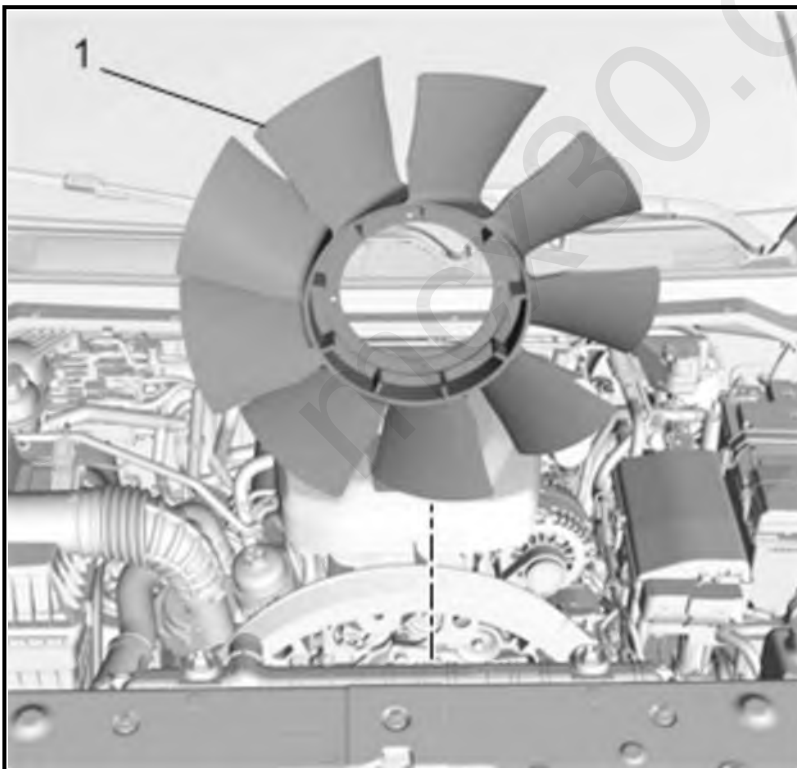
3. Fan Blade (2) @ Fan Blade Clutch - Remove

4. Fan Blade (1) - Remove

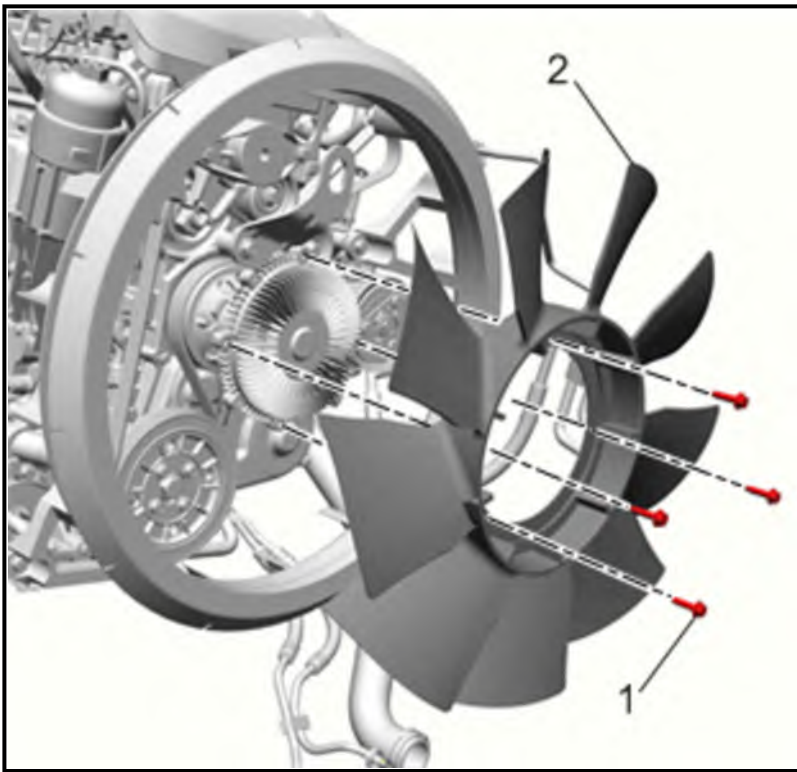


Installation Procedure

1. Fan Blade (1) - Install

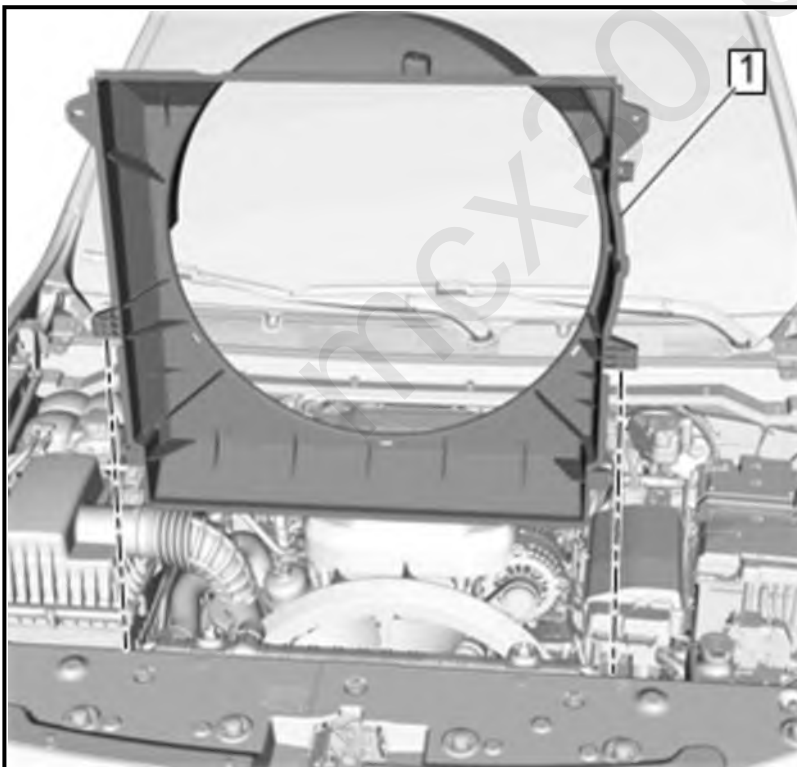


2. Fan Blade (2) @ Fan Blade Clutch - Install



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

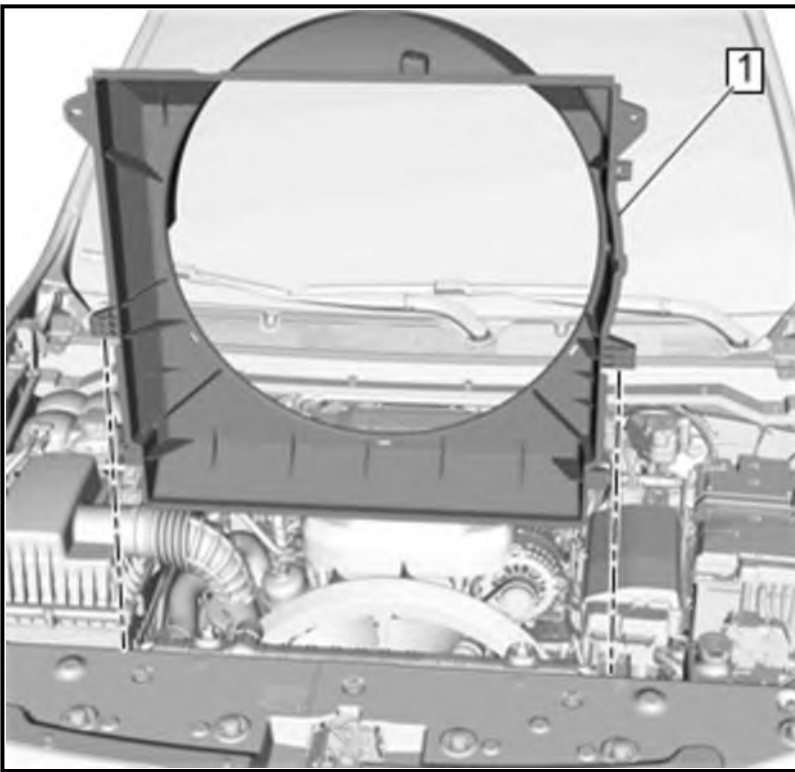
3. Fan Blade Bolt (1)[4x] - Install and tighten 10 N.m (89 lb in)
4. [Engine Coolant Fan Shroud Replacement \(LWN\)](#) (1) - Install



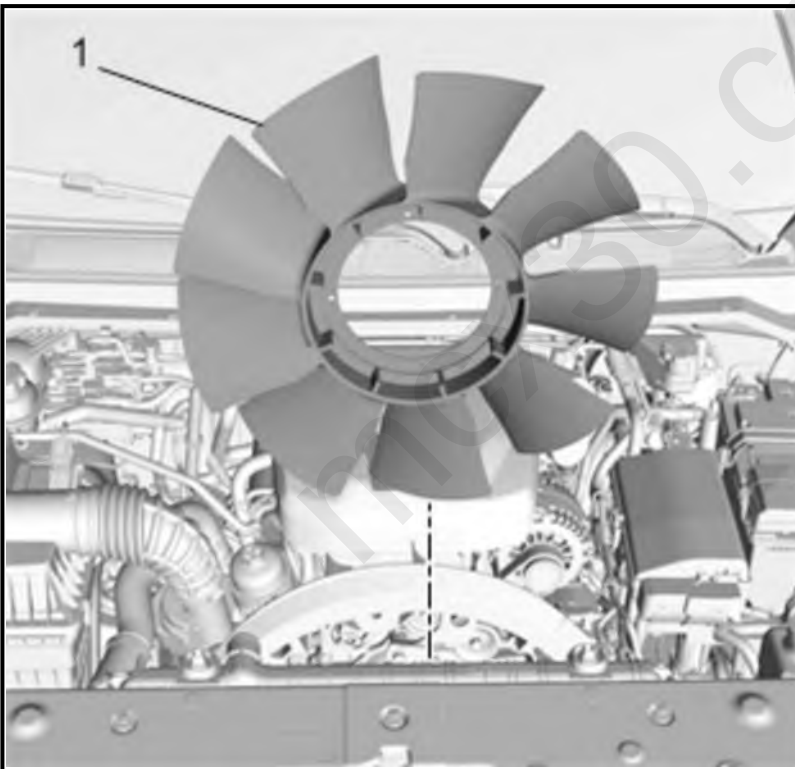
FAN BLADE CLUTCH REPLACEMENT (LWN)

Removal Procedure

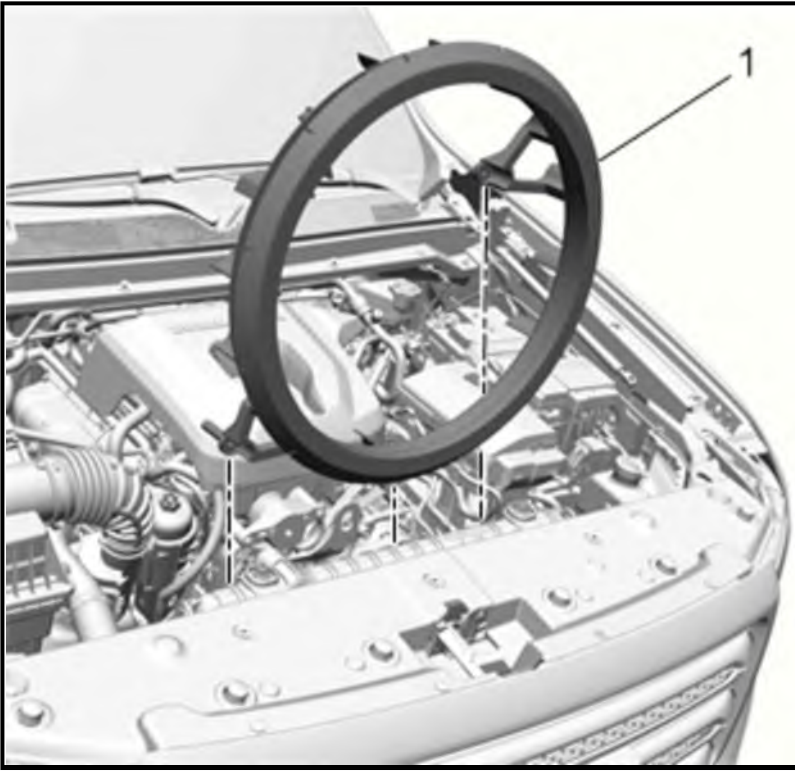
1. Engine Coolant Fan Shroud (1) - Remove - [Engine Coolant Fan Shroud Replacement \(LWN\)](#)



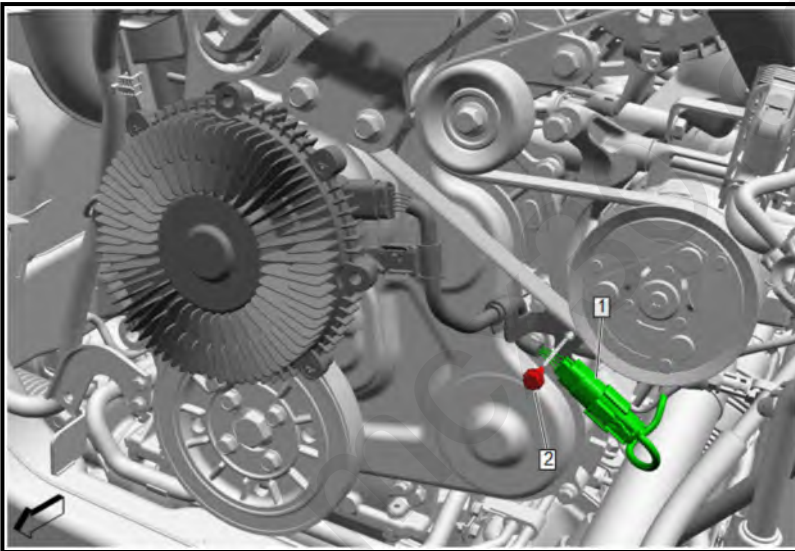
2. Fan Blade (1) - Remove - [Fan Blade Replacement \(LWN\)](#)



3. Engine Coolant Fan Rear Shroud (1) - Remove - [Engine Coolant Fan Rear Shroud Replacement \(LWN\)](#)

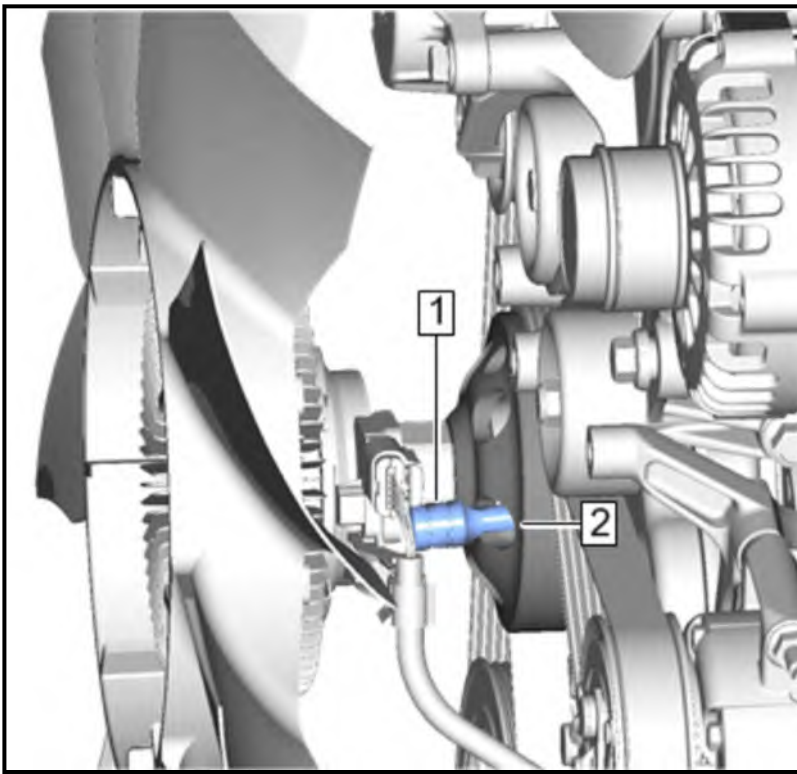


4. Electrical Connector (1) @ Fan Blade Clutch - Disconnect

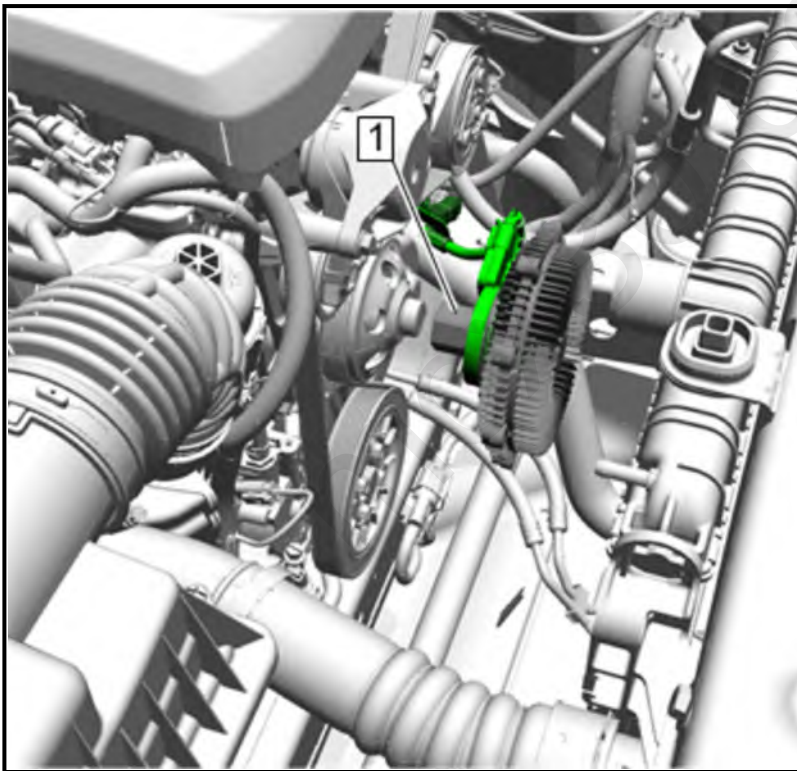


5. Remove the fan blade clutch bracket bolt (2).

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

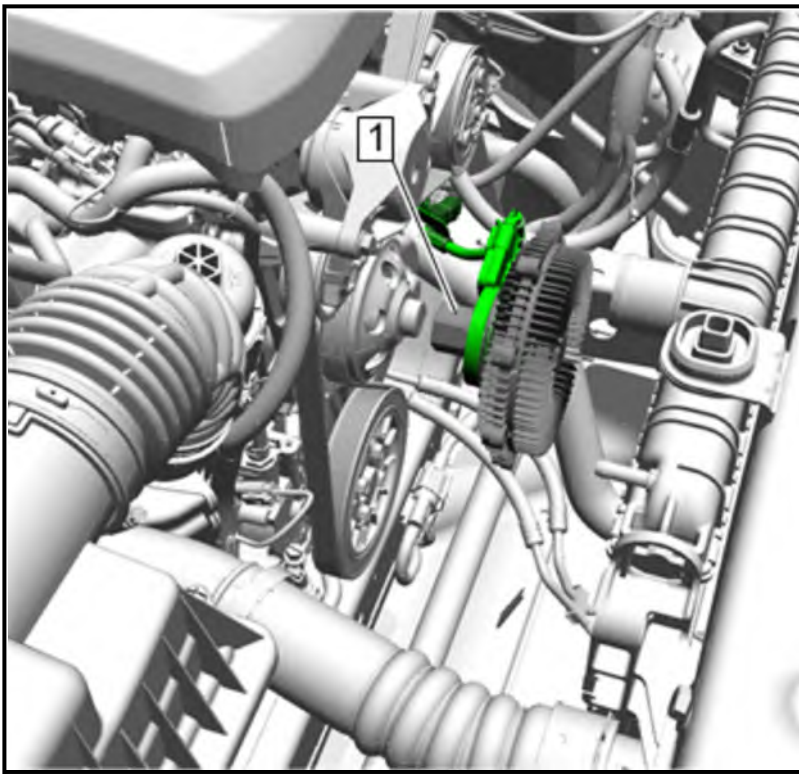


7. Fan Blade Clutch (1) @ Engine Coolant Fan Bracket Pulley - Remove



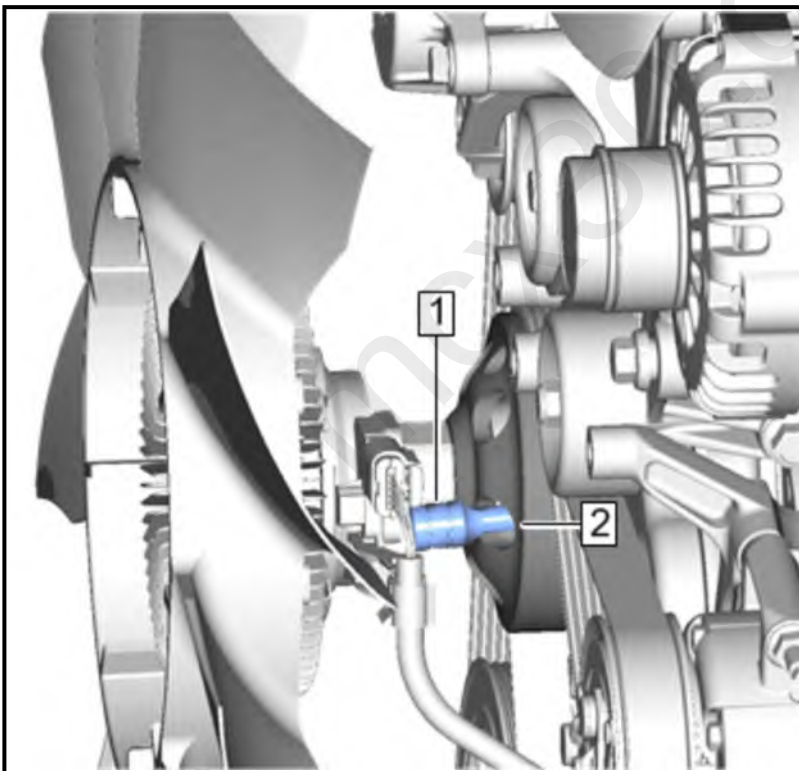
Installation Procedure

1. Fan Blade Clutch (1) @ Engine Coolant Fan Bracket Pulley - Install and tighten 100 N.m (74 lb ft)

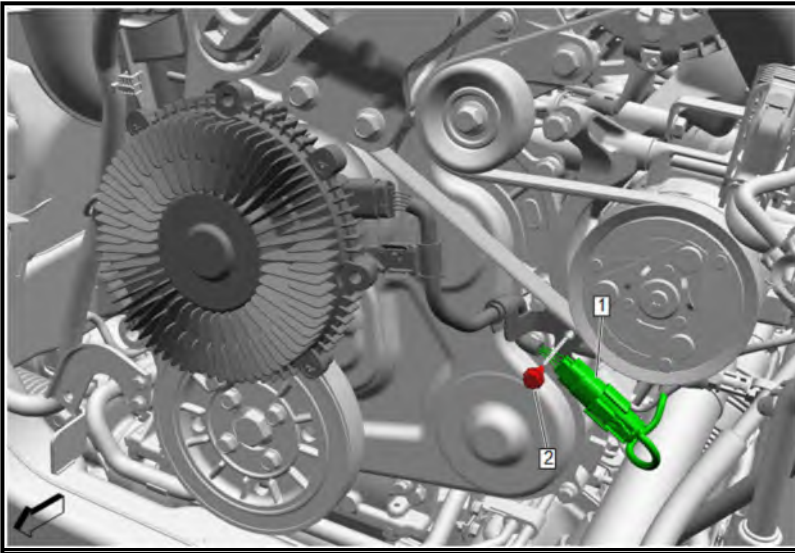


CAUTION: Refer to [Fastener Caution](#) .

2. Remove the suitable blunt ended tool (1) from the engine coolant fan bracket pulley (2).

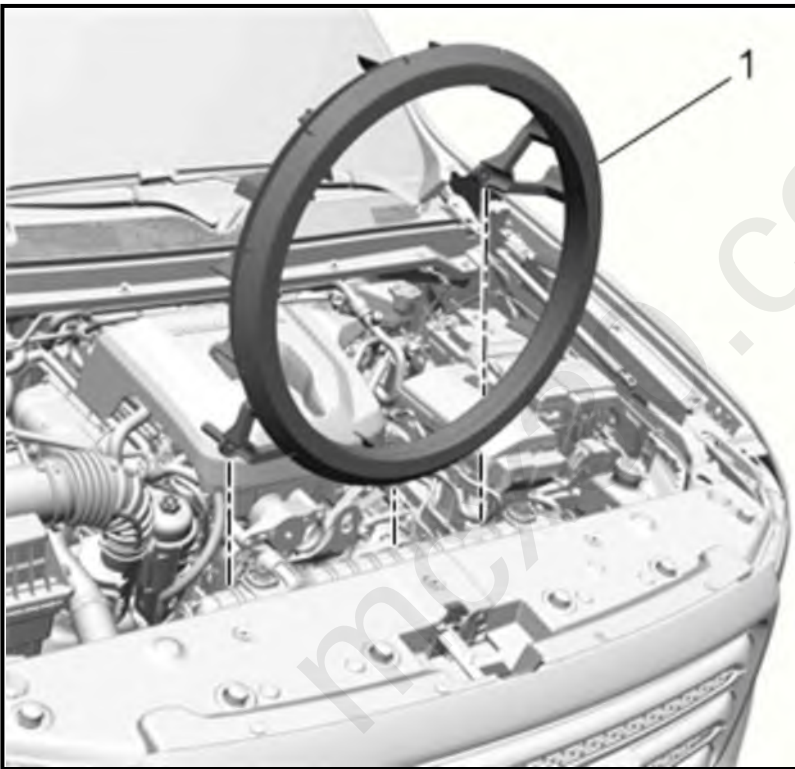


3. Install and tighten the fan blade clutch bracket bolt (2) to 9 N.m (80 lb in).

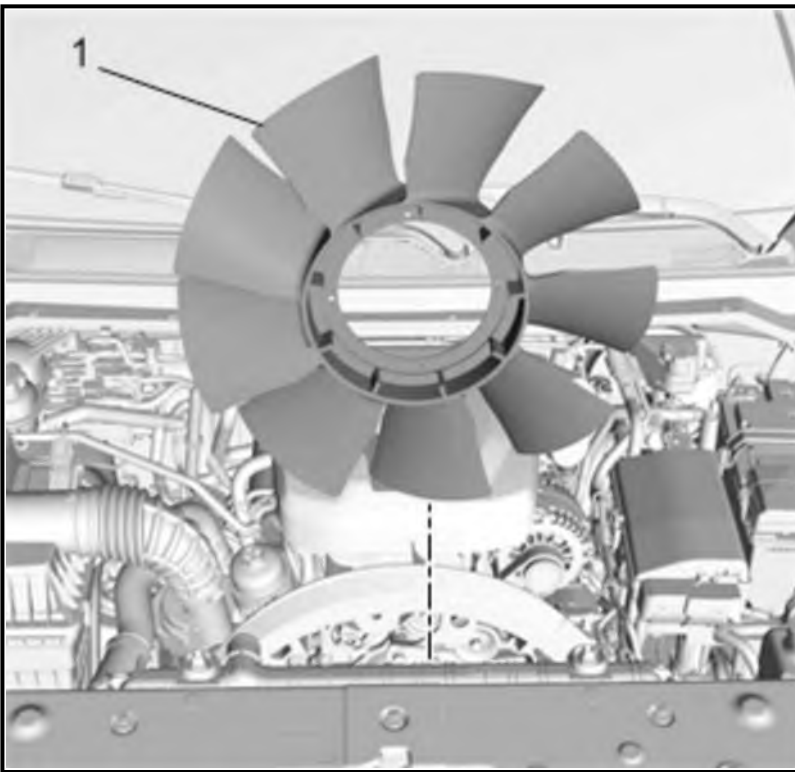


4. Electrical Connector (1) @ Fan Blade Clutch - Connect

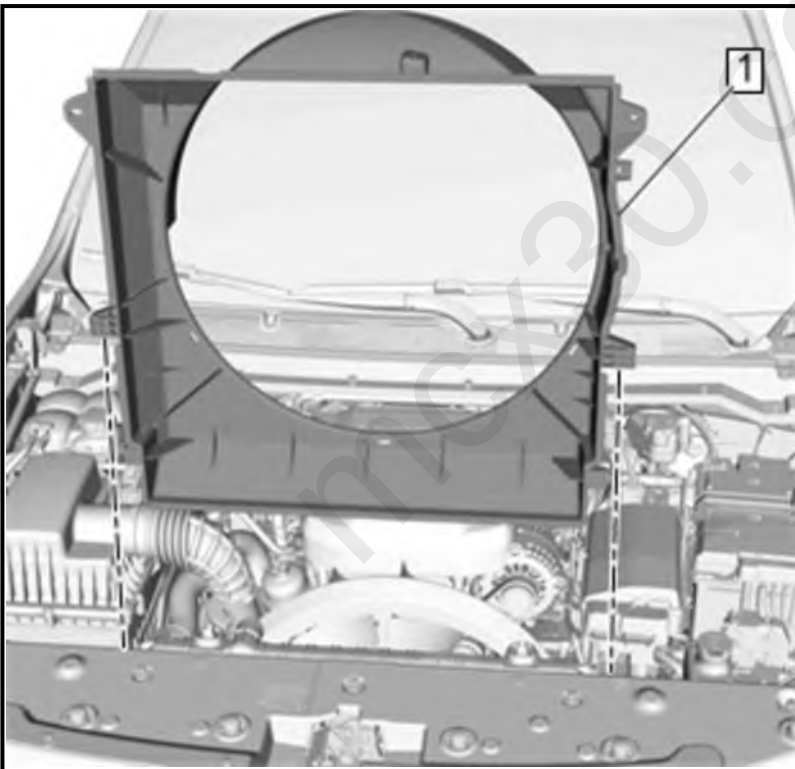
5. Engine Coolant Fan Rear Shroud (1) - Install - [Engine Coolant Fan Rear Shroud Replacement \(LWN\)](#)



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



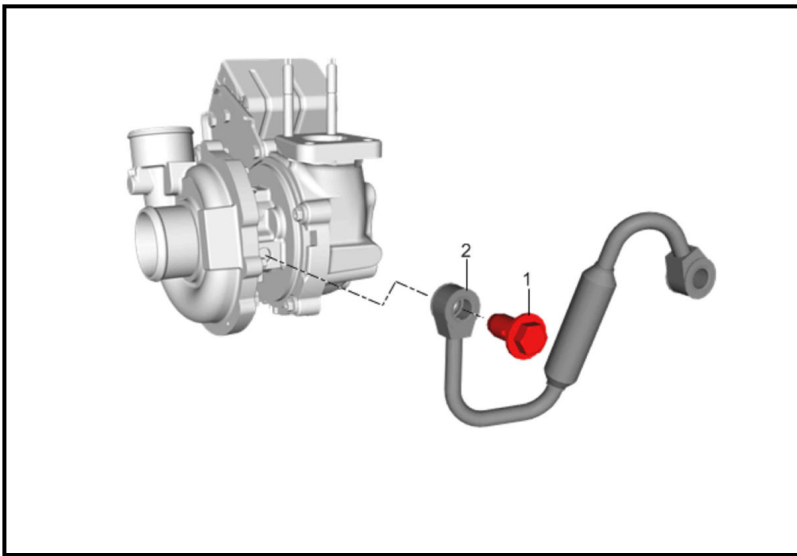
7. Engine Coolant Fan Shroud (1) - Install - [Engine Coolant Fan Shroud Replacement \(LWN\)](#)



TURBOCHARGER COOLANT FEED PIPE REPLACEMENT (LWN)

Removal Procedure

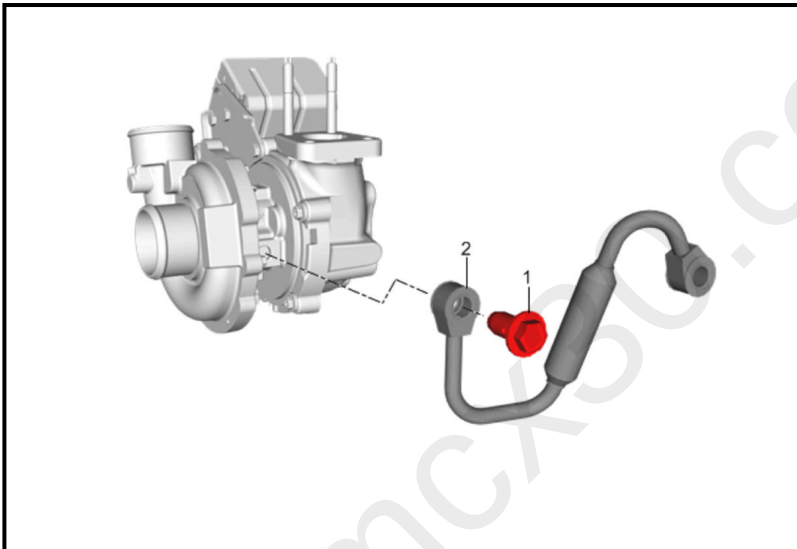
1. [Compressor Air Intake Turbocharger Replacement](#) - Remove
2. Turbocharger Coolant Feed Pipe Hollow Screw (1) - Remove



3. Turbocharger Coolant Feed Pipe (2) - Remove

Installation Procedure

1. Turbocharger Coolant Feed Pipe (2) - Install



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

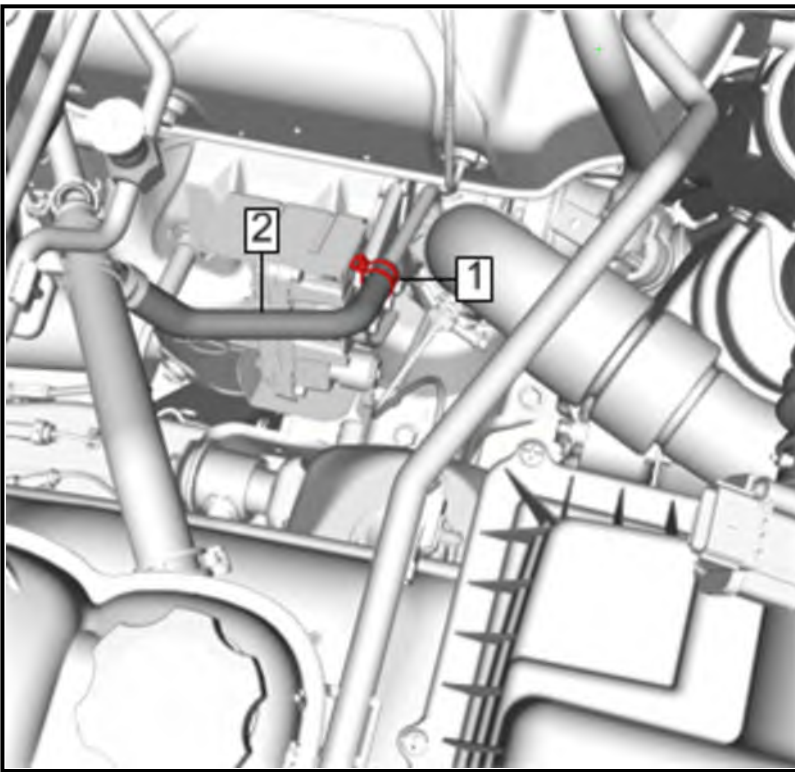
2. Turbocharger Coolant Feed Pipe Hollow Screw (1) - Install and tighten 35 N.m (26 lb ft)

3. [Compressor Air Intake Turbocharger Replacement](#) - Install

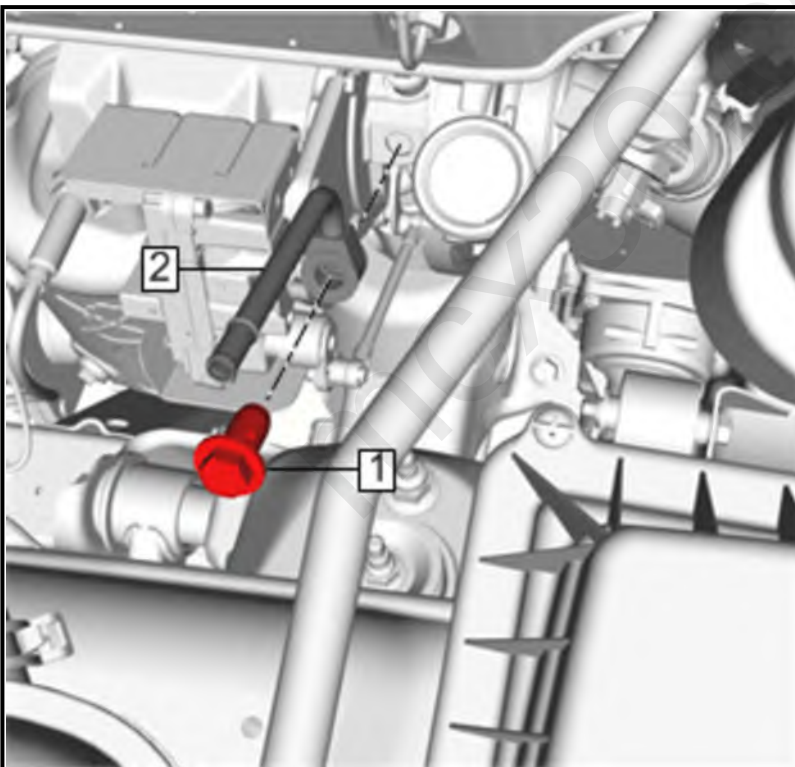
TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT (LWN)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Radiator Surge Tank Outlet Hose Clamp (1) - Reposition - [Hose Clamp Replacement Guidelines - Spring Type](#)



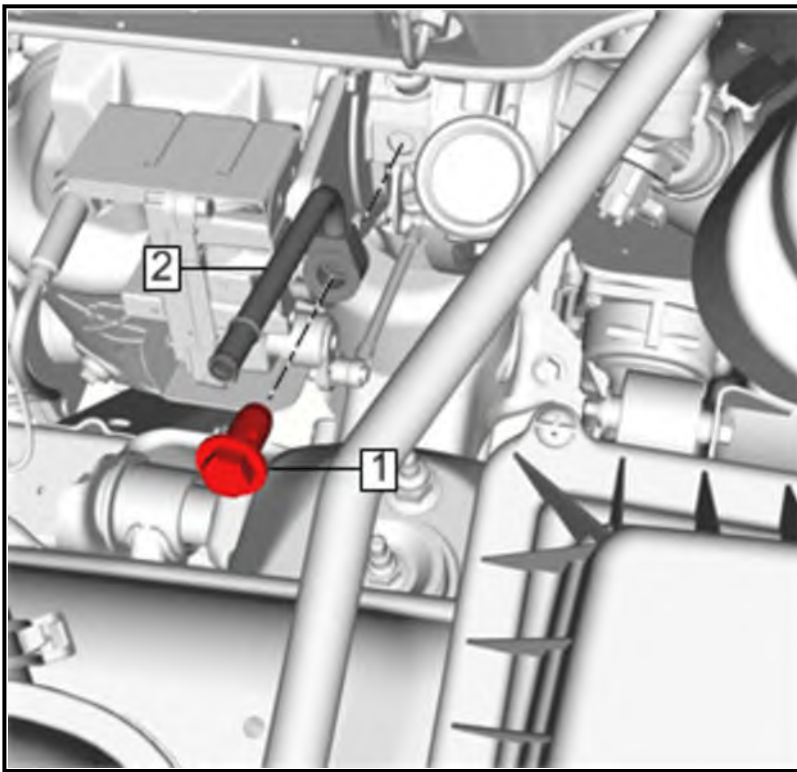
3. Radiator Surge Tank Outlet Hose (2) @ Turbocharger Coolant Return Pipe - Disconnect
4. Turbocharger Coolant Return Pipe Bolt (1) - Remove



5. Turbocharger Coolant Return Pipe (2) - Remove

Installation Procedure

1. Turbocharger Coolant Return Pipe (2) - Install



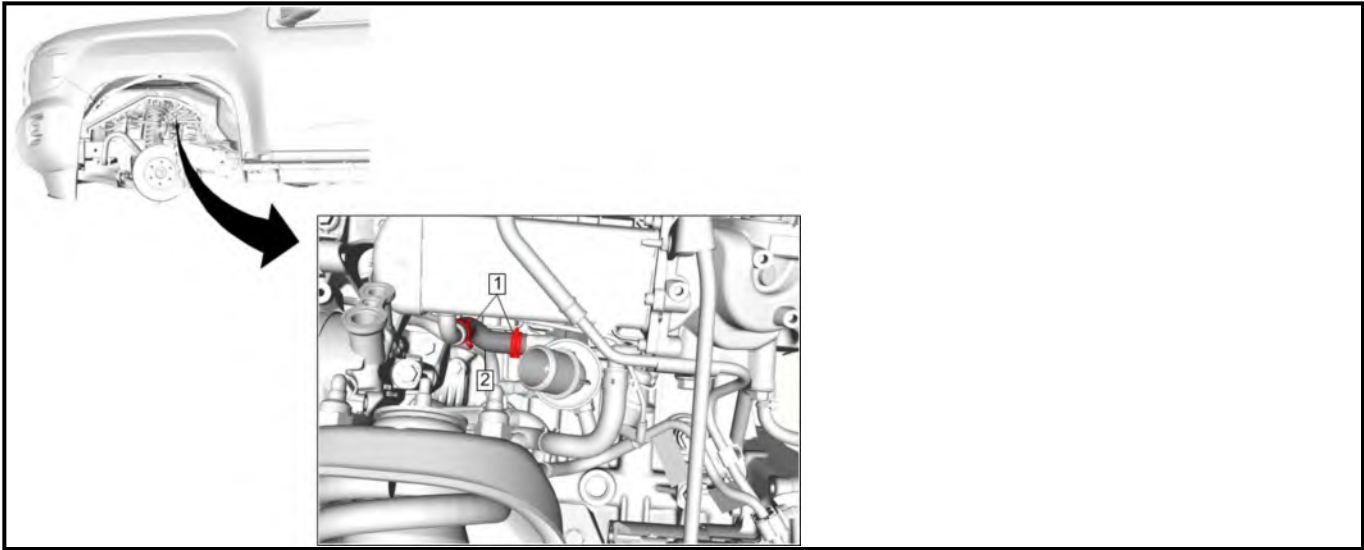
CAUTION: Refer to [Fastener Caution](#) .

2. Turbocharger Coolant Return Pipe Bolt (1) - Install and tighten 35 N.m (26 lb ft)
3. Radiator Surge Tank Outlet Hose (2) @ Turbocharger Coolant Return Pipe - Connect



4. Radiator Surge Tank Outlet Hose Clamp (1) - Install - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
6. Start the engine and check for coolant leaks.

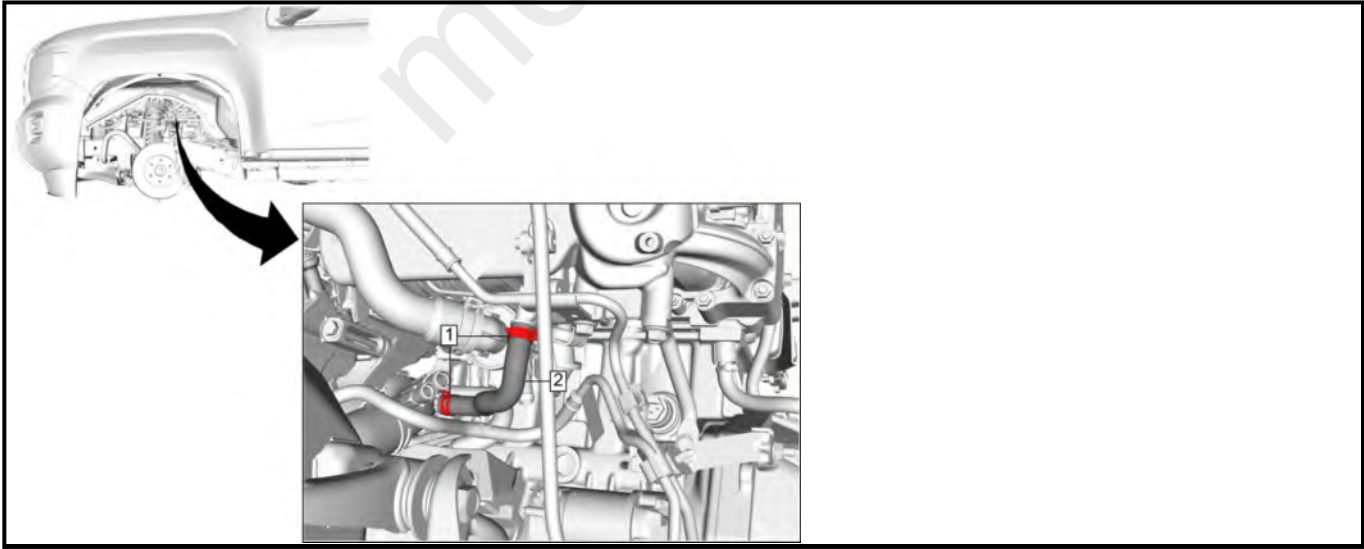
EXHAUST GAS RECIRCULATION MANIFOLD COOLING FEED HOSE REPLACEMENT (LWN)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	
1. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) 2. Front Wheelhouse Liner Replacement (Without ZR2) , or Front Wheelhouse Liner Replacement (With ZR2) , or Front Wheelhouse Liner Replacement (Bison)	
1	Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Exhaust Gas Recirculation Manifold Cooling Feed Hose

EXHAUST GAS RECIRCULATION MANIFOLD COOLING RETURN HOSE REPLACEMENT (LWN)

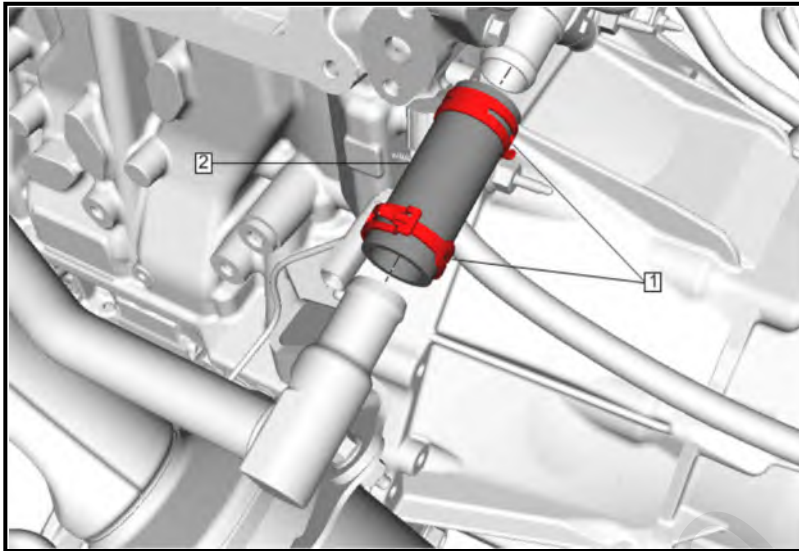


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	

Callout	Component Name
1.	Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill)
2.	Air Conditioning Compressor Bracket Replacement (LWN)
1	Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Exhaust Gas Recirculation Manifold Cooling Return Hose

THERMOSTAT BYPASS HOSE REPLACEMENT (LCV)



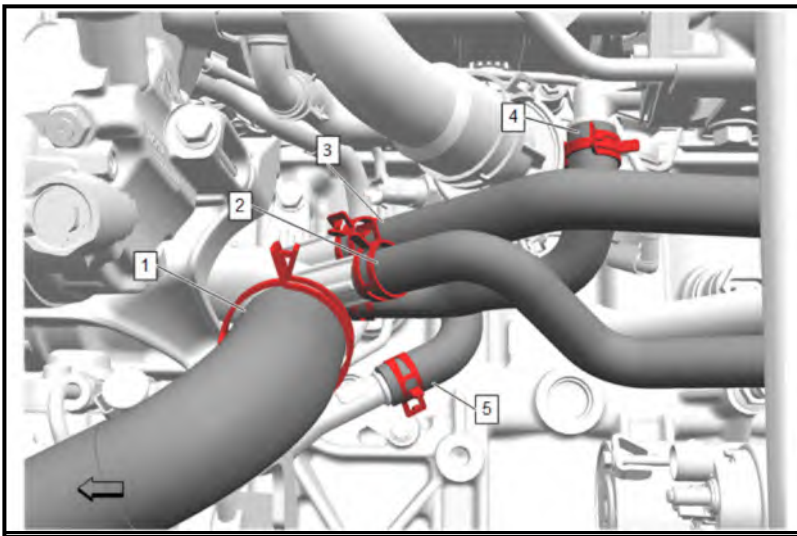
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure	
1.	Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill)
2.	Plenum Front Panel Replacement - Remove
3.	Thermostat Bypass Pipe Replacement (LCV) - Remove
1	Clamp [2X] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Thermostat Bypass Hose Procedure Check the cooling system for leaks.

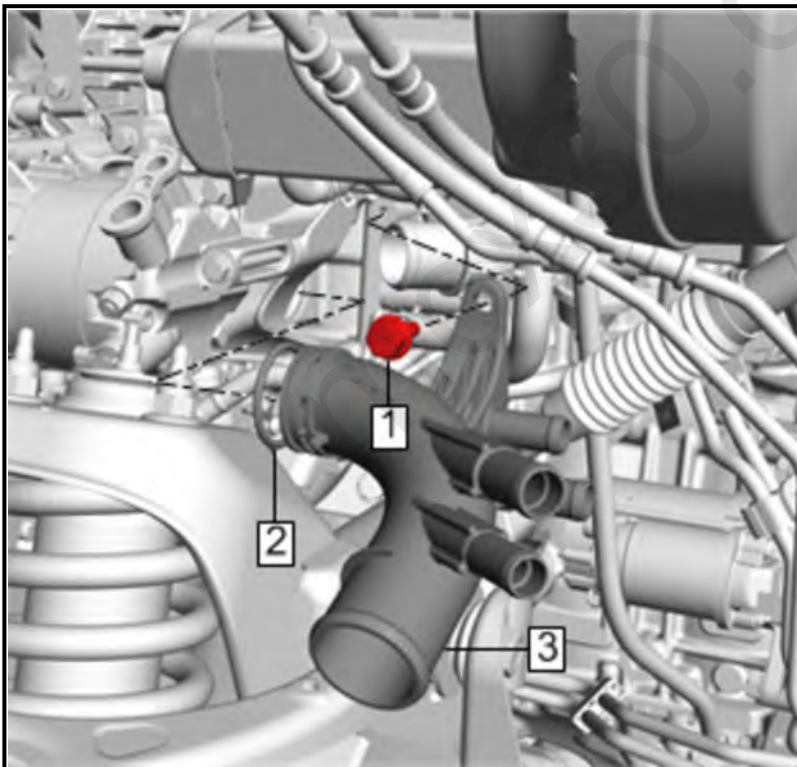
WATER PUMP INLET PIPE REPLACEMENT (LWN)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Air Conditioning Compressor Bracket - Remove - [Air Conditioning Compressor Bracket Replacement \(LWN\)](#)
3. Radiator Outlet Hose (1) - Disconnect - [Radiator Outlet Hose Replacement \(LWN\)](#)



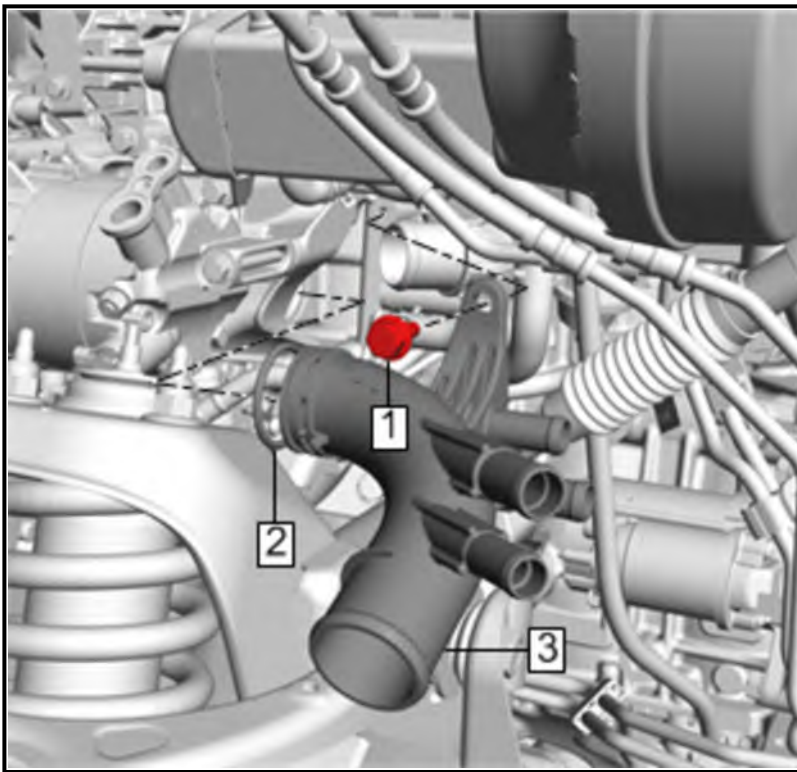
4. Heater Outlet Hose (2) - Disconnect - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).
5. Radiator Surge Tank Outlet Hose (3) - Disconnect - [Radiator Surge Tank Outlet Hose Replacement - Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe \(LWN\)](#).
6. Exhaust Gas Recirculation Manifold Cooling Return Hose (4) - Disconnect - [Exhaust Gas Recirculation Manifold Cooling Return Hose Replacement \(LWN\)](#).
7. Engine Oil Cooler Outlet Hose (5) - Disconnect - [Engine Oil Cooler Outlet Hose Replacement \(LWN\)](#).
8. Water Pump Inlet Pipe Bolt (1) - Remove



9. Water Pump Inlet Pipe (3) - Remove
10. Water Pump Inlet Pipe Seal (2) - Remove and DISCARD
11. Transfer components as necessary.

Installation Procedure

1. Water Pump Inlet Pipe Seal (2) - Install

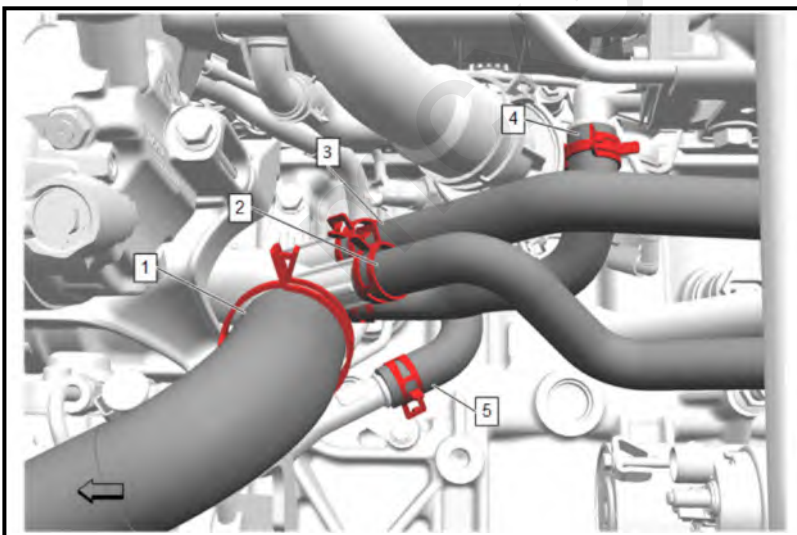


NOTE: Install a **NEW** seal.

2. Water Pump Inlet Pipe (3) - Install

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

3. Water Pump Inlet Pipe Bolt (1) - Install and tighten 25 N.m (18 lb ft)
4. Engine Oil Cooler Outlet Hose (5) - Connect - [Engine Oil Cooler Outlet Hose Replacement \(LWN\)](#).



5. Exhaust Gas Recirculation Manifold Cooling Return Hose (4) - Connect - [Exhaust Gas Recirculation Manifold Cooling Return Hose Replacement \(LWN\)](#).
6. Radiator Surge Tank Outlet Hose (3) - Connect - [Radiator Surge Tank Outlet Hose Replacement - Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe \(LWN\)](#).
7. Heater Outlet Hose (2) - Connect - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).
8. Radiator Outlet Hose (1) - Connect - [Radiator Outlet Hose Replacement \(LWN\)](#).
9. Air Conditioning Compressor Bracket - Install - [Air Conditioning Compressor Bracket Replacement \(LWN\)](#).

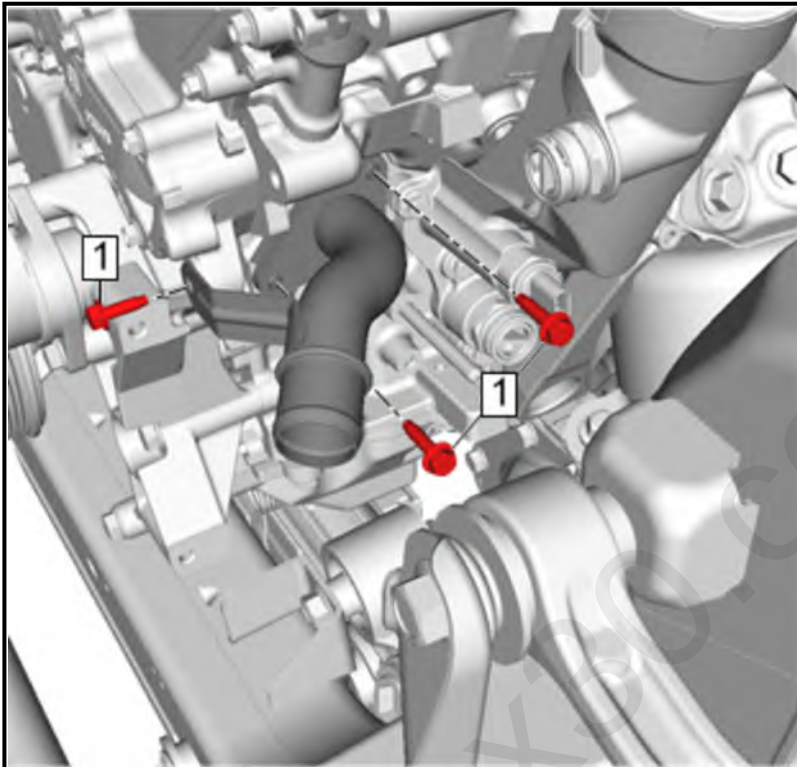
10. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).

11. Start the engine and check for coolant leaks.

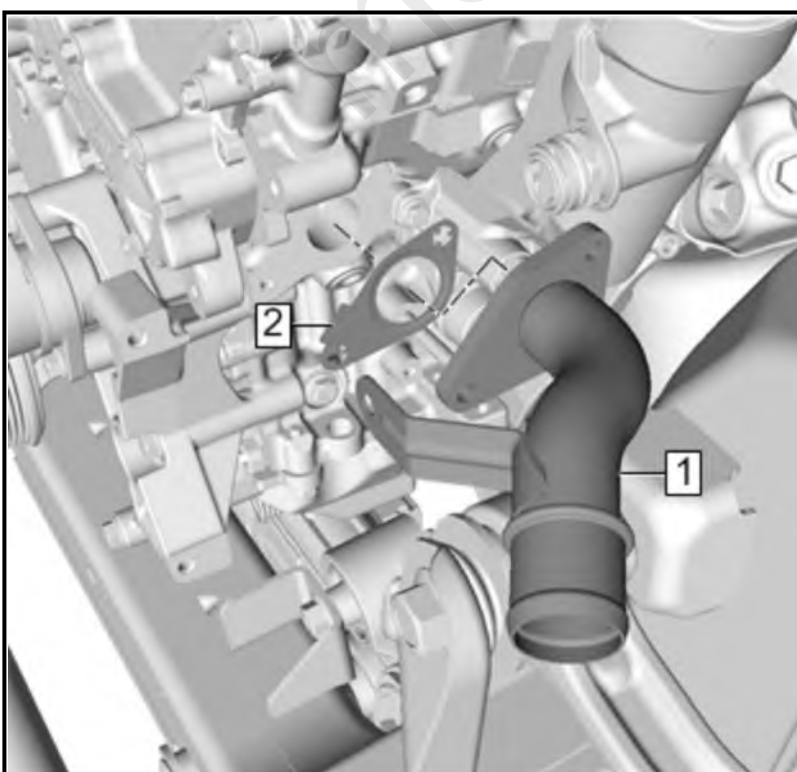
WATER PUMP INLET PIPE REPLACEMENT (LGZ)

Removal Procedure

1. Air Conditioning Compressor Bracket - Remove - [Air Conditioning Compressor Bracket Replacement \(LGZ\)](#)
2. Water Pump Inlet Pipe Bolt (1) - Remove [3x]



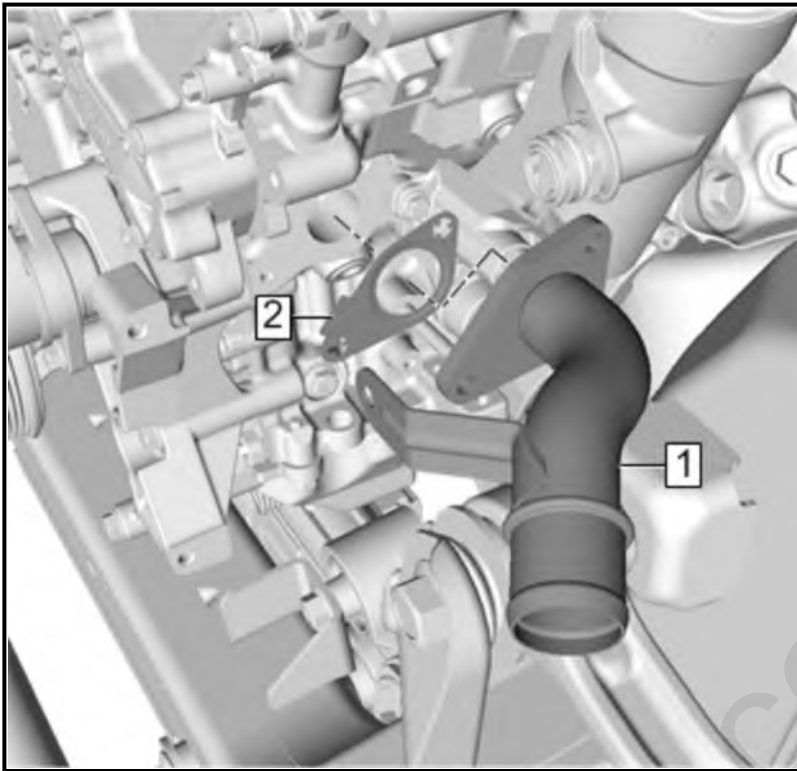
3. Water Pump Inlet Pipe (1) - Remove



4. Water Pump Inlet Pipe Seal (2) - Remove and DISCARD

Installation Procedure

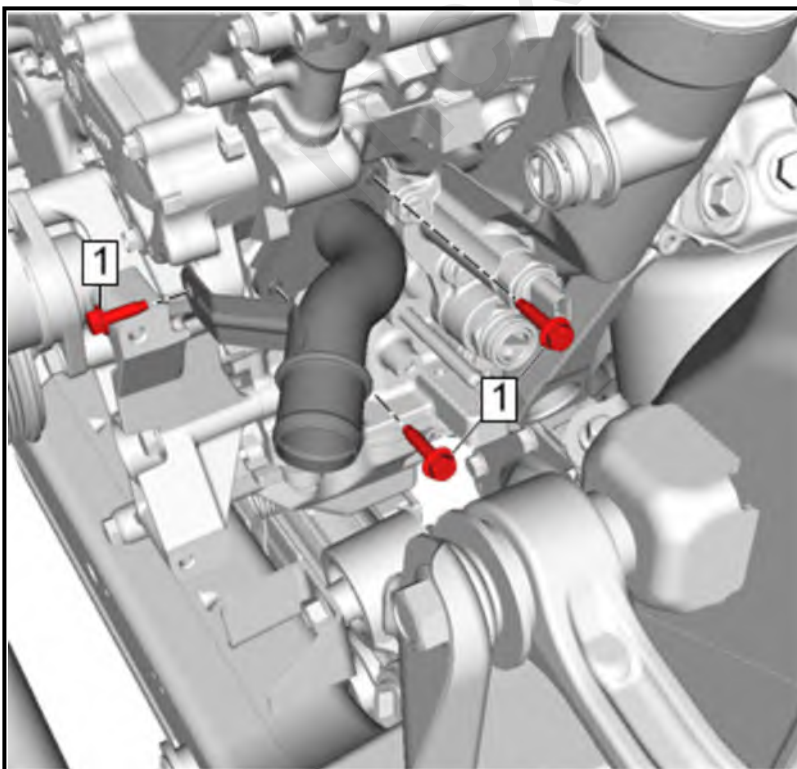
1. Water Pump Inlet Pipe Seal (2) - Install



NOTE: Install a **NEW** seal.

2. Water Pump Inlet Pipe (1) - Install

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

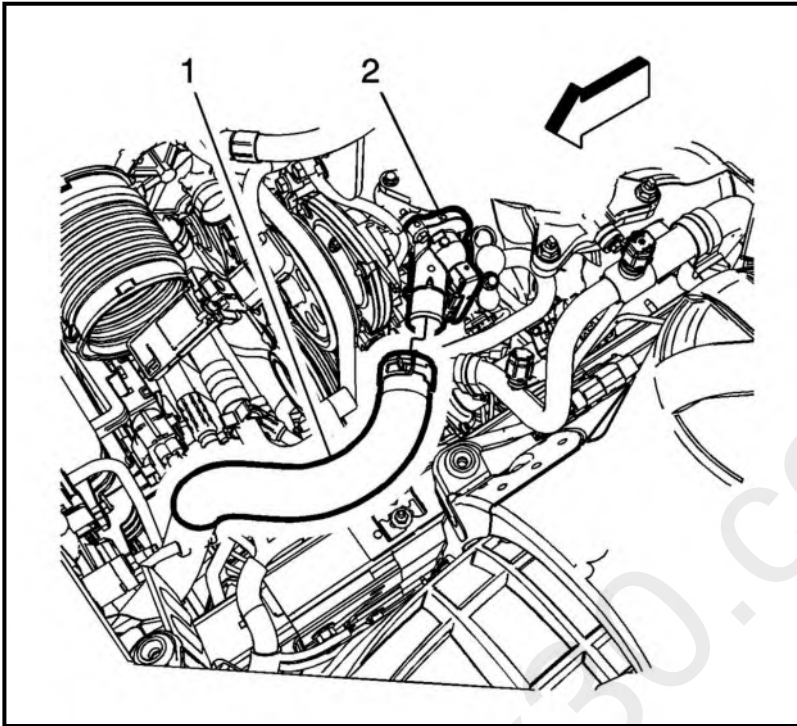


CAUTION: Refer to **Fastener Caution** .

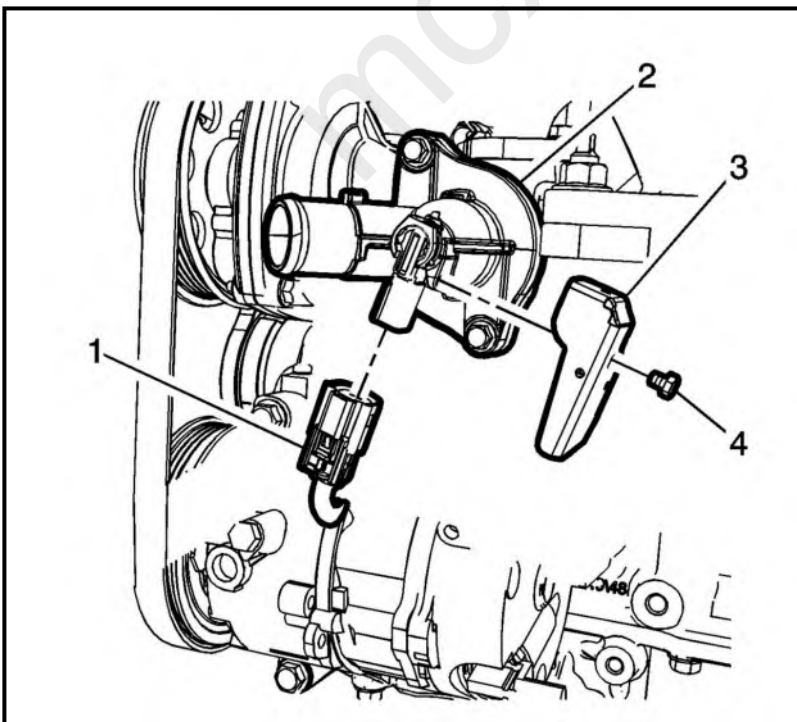
4. Air Conditioning Compressor Bracket - Install - [Air Conditioning Compressor Bracket Replacement \(LGZ\)](#)

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LCV)

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the exhaust manifold heat shield. [Exhaust Manifold Heat Shield Replacement \(LCV\)](#).
3. Disengage the hose clamp and remove the radiator outlet hose (1) from the engine coolant thermostat housing (2). [Hose Clamp Replacement Guidelines - Spring Type](#)

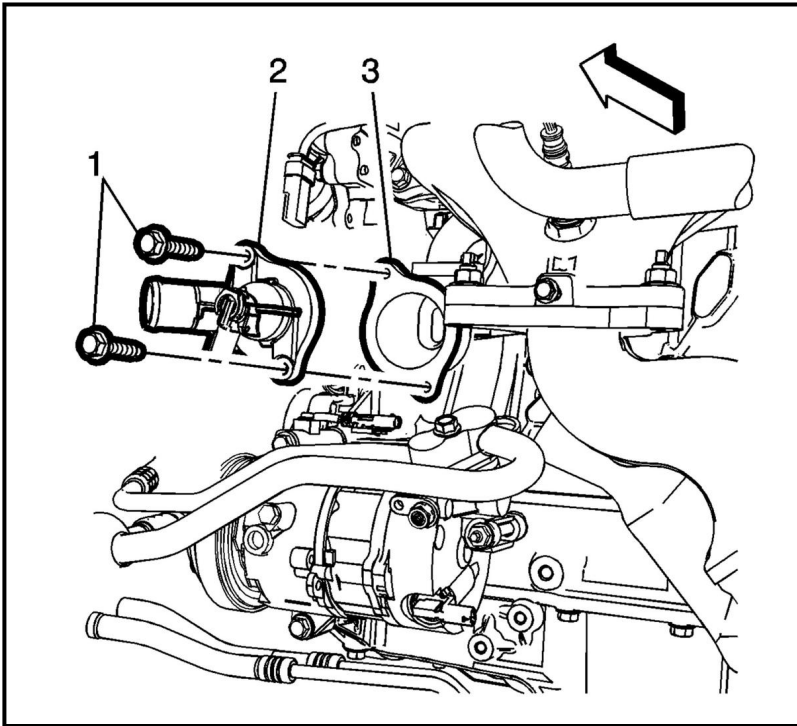


4. Remove the thermostat heater heat shield fastener (4) and remove the thermostat heater heat shield (3).



5. Disconnect the thermostat heater connector (1).

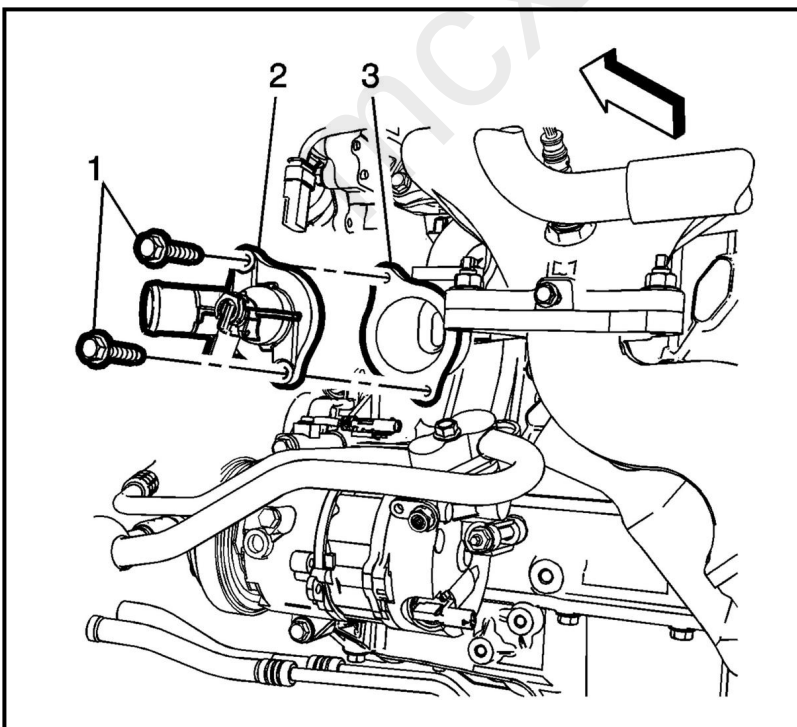
6. Remove the engine coolant thermostat housing fasteners (1) and remove the engine coolant thermostat housing (2).



7. Discard the engine coolant thermostat housing gasket (3).
8. Transfer the thermostat heater if replacing the thermostat housing with the thermostat.

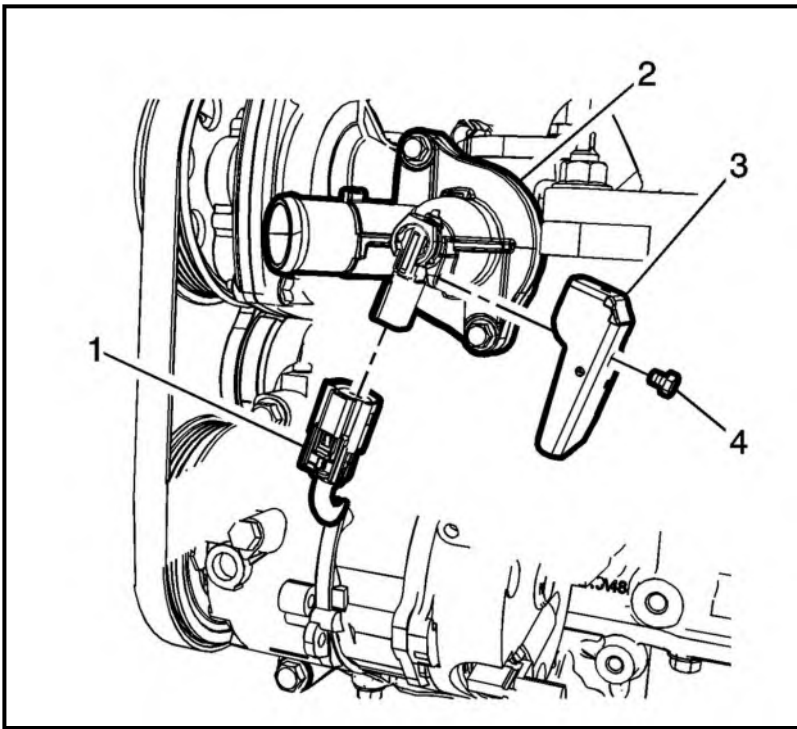
Installation Procedure

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

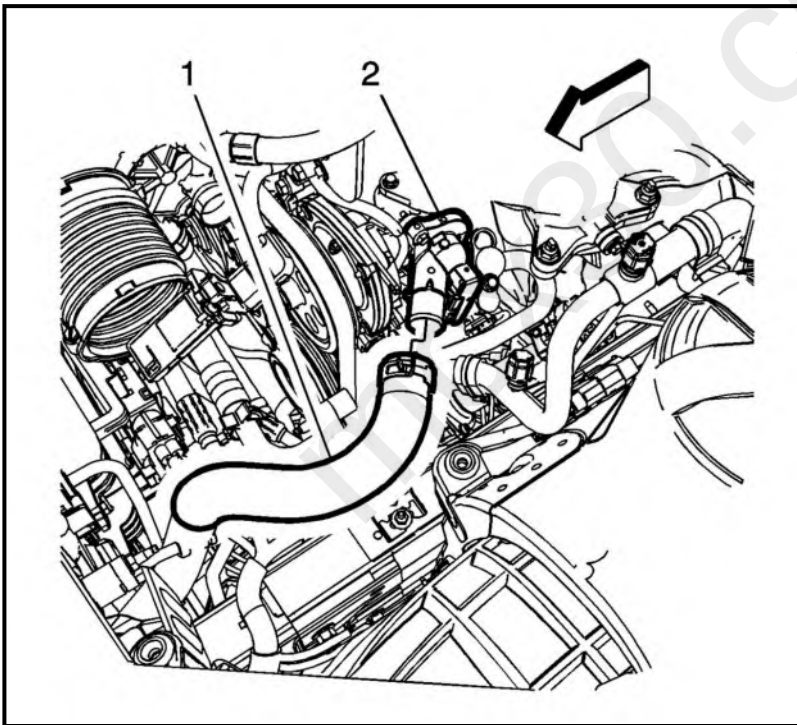


CAUTION: Refer to **Fastener Caution** .

3. Connect the thermostat heater connector (1).

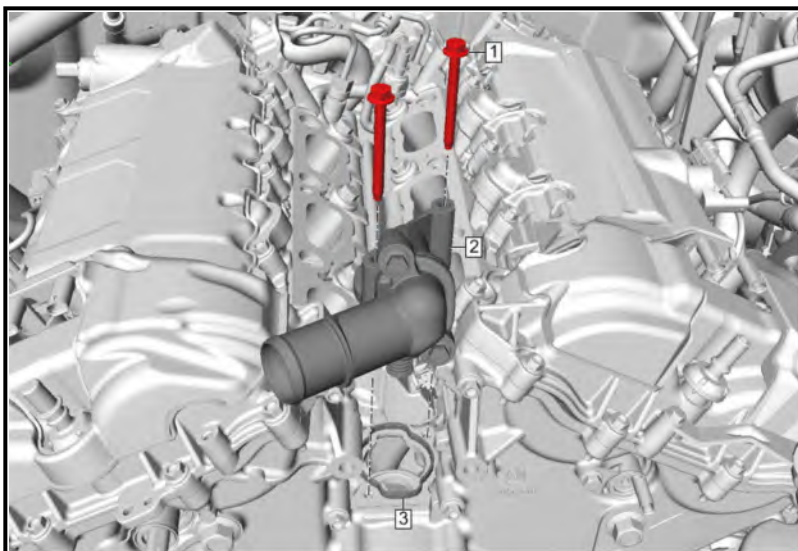


4. Install the thermostat heater shield (3) and tighten the fastener (4) to 5 N.m (44 lb in).
5. Install the radiator outlet hose (1) to the engine coolant thermostat housing (2). [Hose Clamp Replacement Guidelines - Spring Type](#)



6. Install the exhaust manifold heat shield. [Exhaust Manifold Heat Shield Replacement \(LCV\)](#)
7. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
8. Start the engine and check for coolant leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LGZ)



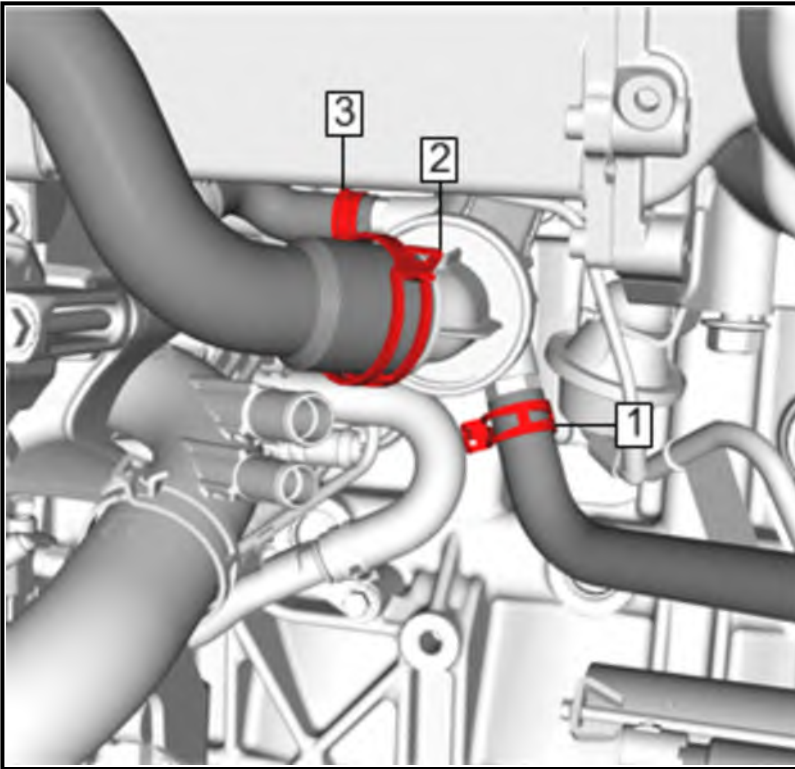
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Radiator Inlet Hose @ Engine Coolant Thermostat Housing - Reposition - Radiator Inlet Hose Replacement (LGZ). 2. Air Cleaner Outlet Duct Bracket Replacement 3. Fuel Injection Fuel Rail Noise Shield Replacement (Upper) , or Fuel Injection Fuel Rail Noise Shield Replacement (Lower). 4. Engine Coolant Air Bleed Pipe Replacement (LGZ).	
1	Engine Coolant Thermostat Housing Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Engine Coolant Thermostat Housing Procedure Transfer components as necessary.
3	Engine Coolant Thermostat Housing Seal Procedure Install a NEW seal.

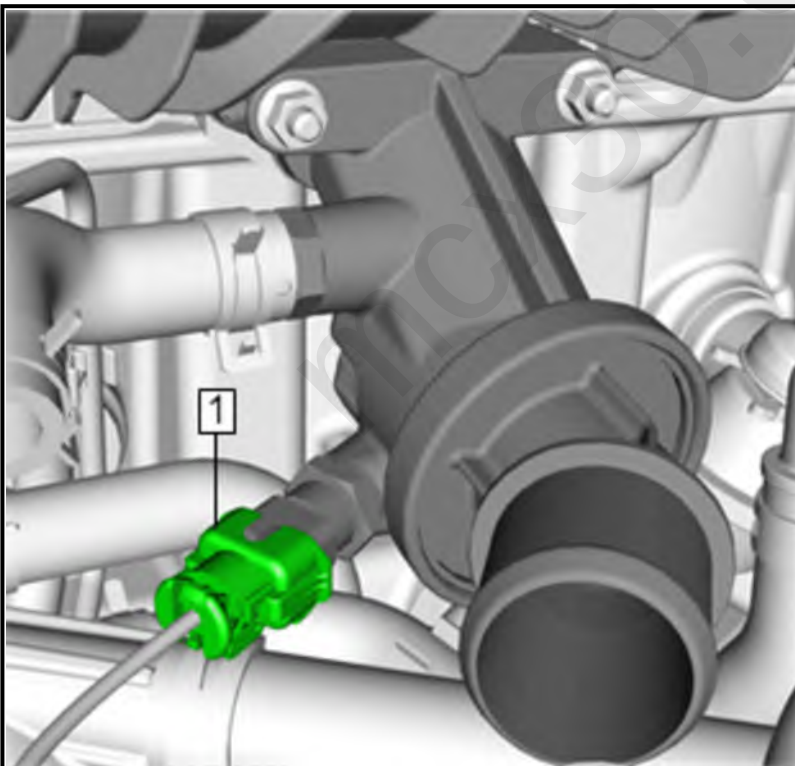
ENGINE COOLANT THERMOSTAT REPLACEMENT (LWN)

Removal Procedure

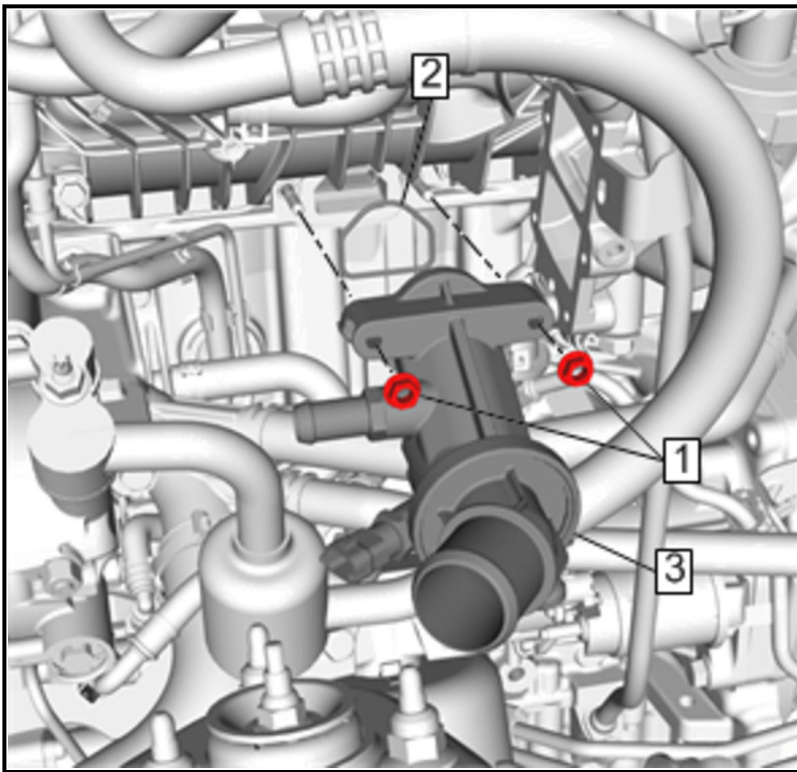
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Front Wheelhouse Liner - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).
3. Exhaust Gas Recirculation Valve - Remove - [Exhaust Gas Recirculation Valve Replacement](#)
4. Heater Inlet Hose (1) - Disconnect - [Hose Clamp Replacement Guidelines - Spring Type](#)



5. Radiator Inlet Hose (2) - Disconnect - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Exhaust Gas Recirculation Manifold Cooling Feed Hose (3) - Disconnect - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Engine Coolant Temperature Sensor Electrical Connector (1) - Disconnect



8. Engine Coolant Thermostat Nut (1) - Remove [2x]

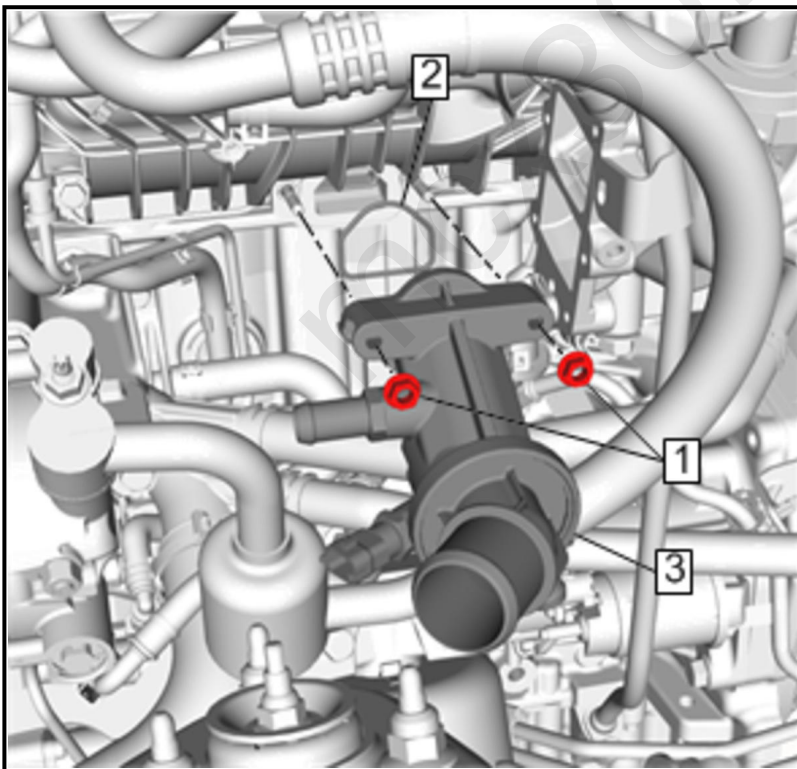


9. Engine Coolant Thermostat (3) - Remove

10. Engine Coolant Thermostat Seal (2) - Remove and DISCARD

Installation Procedure

1. Engine Coolant Thermostat Seal (2) - Install



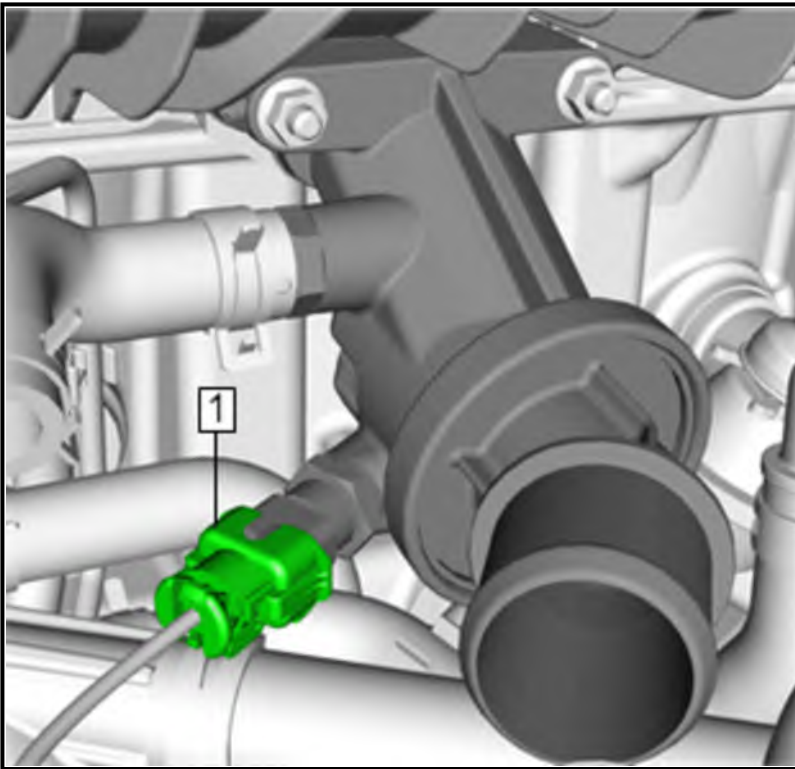
NOTE: Install a NEW seal.

2. Engine Coolant Thermostat (3) - Install

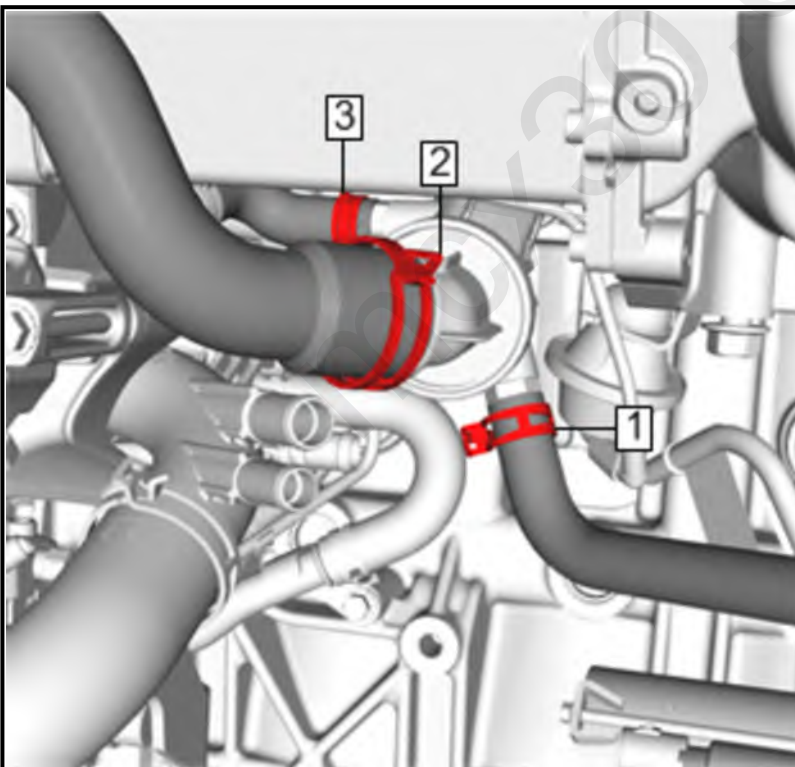
CAUTION: Refer to Fastener Caution .

3. Engine Coolant Thermostat Nut (1) - Install and tighten [2x] 9 N.m (80 lb in)

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



5. Exhaust Gas Recirculation Manifold Cooling Feed Hose (3) - Connect - [Hose Clamp Replacement Guidelines - Spring Type](#)



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

7. Heater Inlet Hose (1) - Connect - [Hose Clamp Replacement Guidelines - Spring Type](#)

8. Exhaust Gas Recirculation Valve - Install - [Exhaust Gas Recirculation Valve Replacement](#)

9. Front Wheelhouse Liner - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).

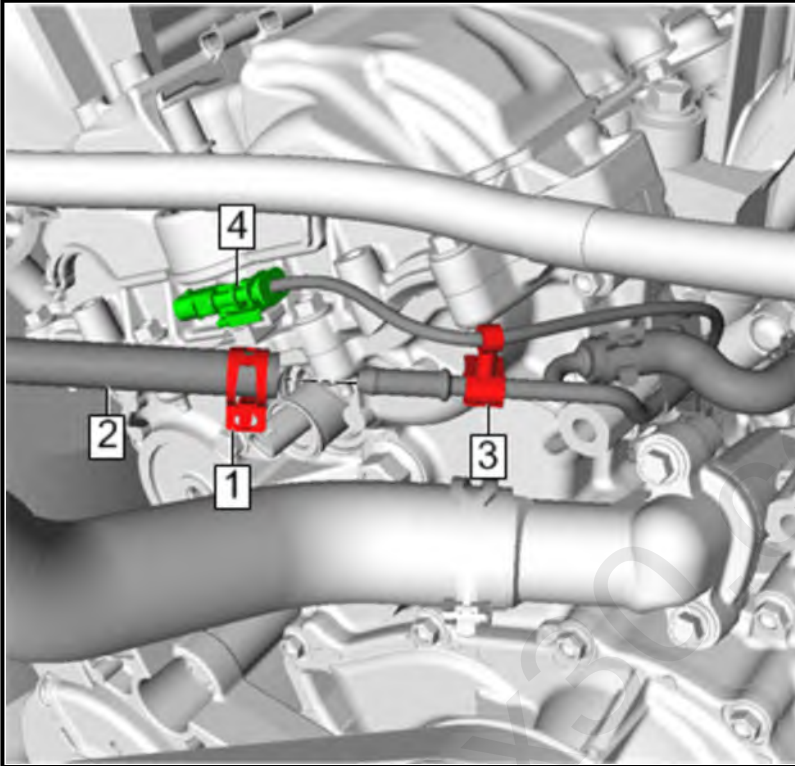
10. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).

11. Start the engine and check for coolant leaks.

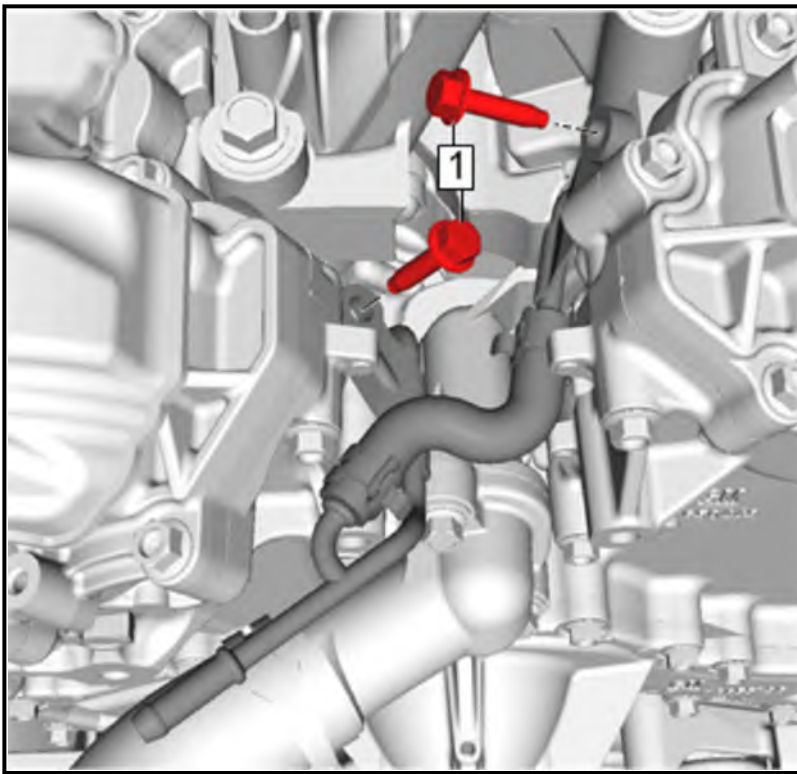
ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (LGZ)

Removal Procedure

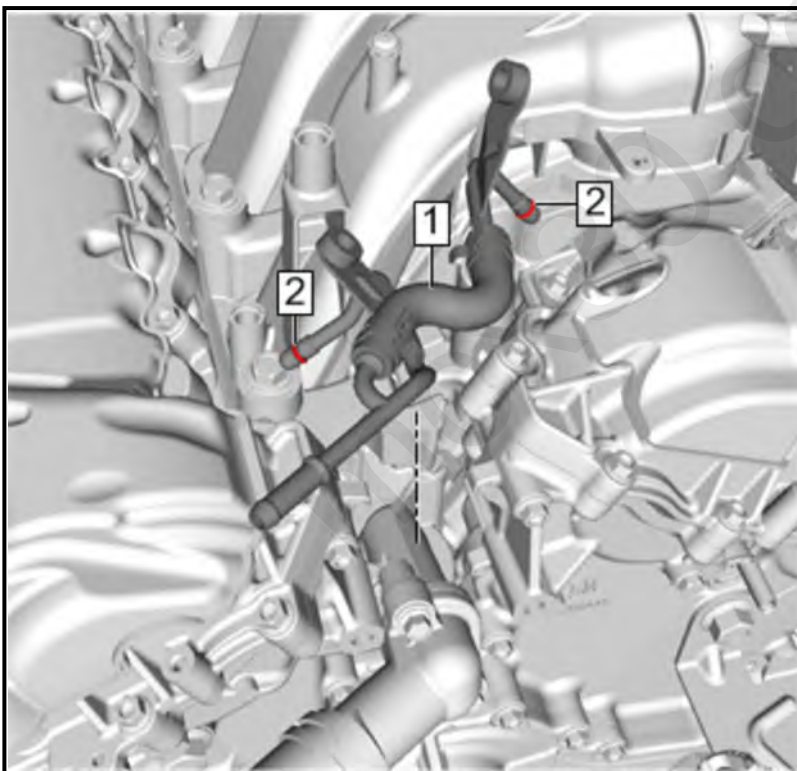
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Intake Manifold Cover - Remove - [Intake Manifold Insulator Replacement](#)
3. Coolant Recovery Reservoir Inlet Hose Clamp (1) - Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



4. Coolant Recovery Reservoir Inlet Hose (2) @ Engine Coolant Air Bleed Pipe - Disconnect
5. Disconnect the engine coolant temperature sensor wiring harness retainer (3).
6. Engine Coolant Air Bleed Pipe Bolt (1) - Remove [2x]



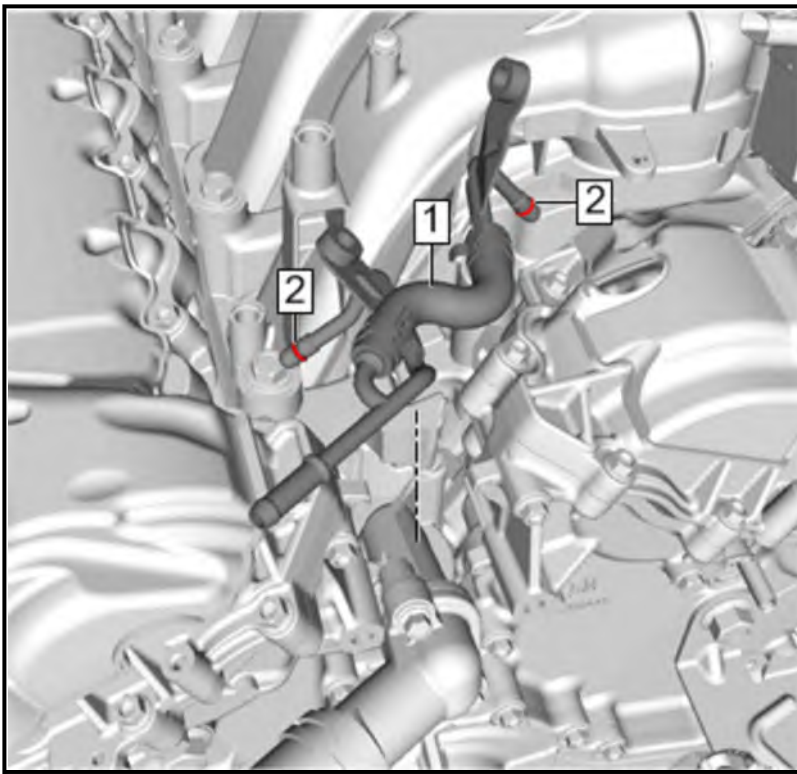
7. Engine Coolant Air Bleed Pipe (1) - Remove



8. Engine Coolant Air Bleed Pipe O-Ring (2) - Remove and DISCARD [2x]

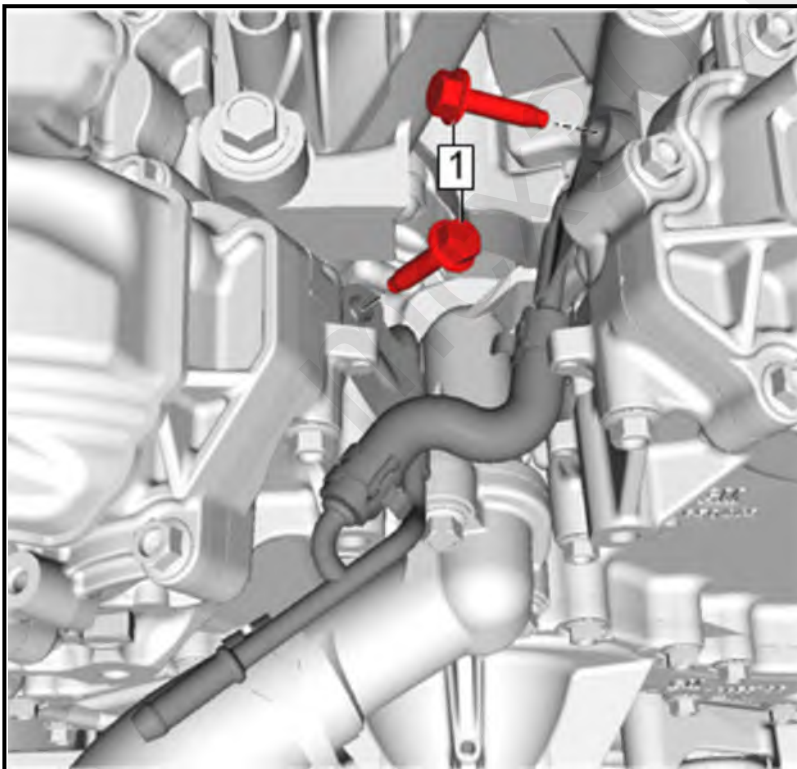
Installation Procedure

1. Engine Coolant Air Bleed Pipe O-Ring (2) - Install [2x]



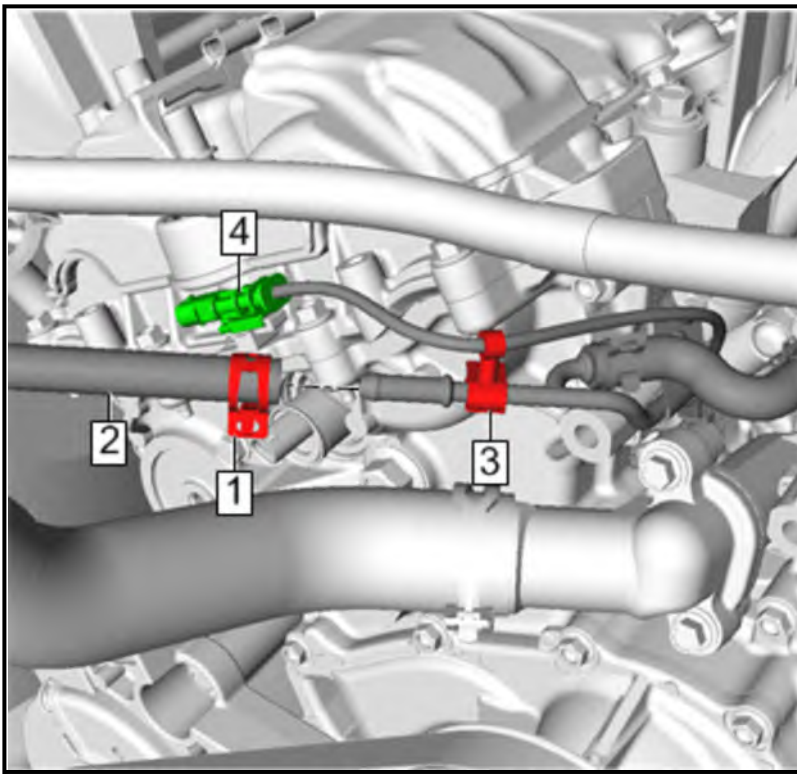
NOTE: Install a NEW O-ring seal.

2. Engine Coolant Air Bleed Pipe (1) - Install
3. Engine Coolant Air Bleed Pipe Bolt (1) - Install and tighten [2x] 10 N.m (89 lb in)



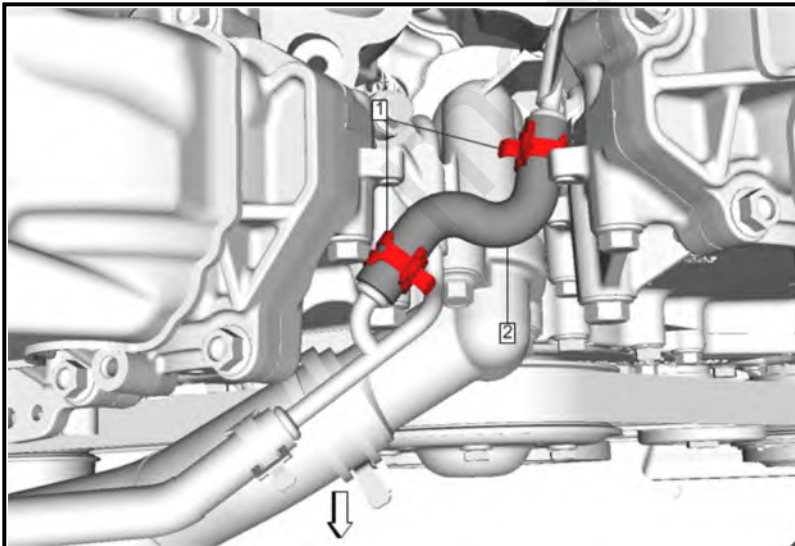
CAUTION: Refer to [Fastener Caution](#) .

4. Connect the engine coolant temperature sensor wiring harness retainer (3).



5. Coolant Recovery Reservoir Inlet Hose (2) @ Engine Coolant Air Bleed Pipe - Connect
6. Coolant Recovery Reservoir Inlet Hose Clamp (1) - Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Intake Manifold Cover - Install - [Intake Manifold Insulator Replacement](#)
8. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
9. Start the engine and check for leaks.

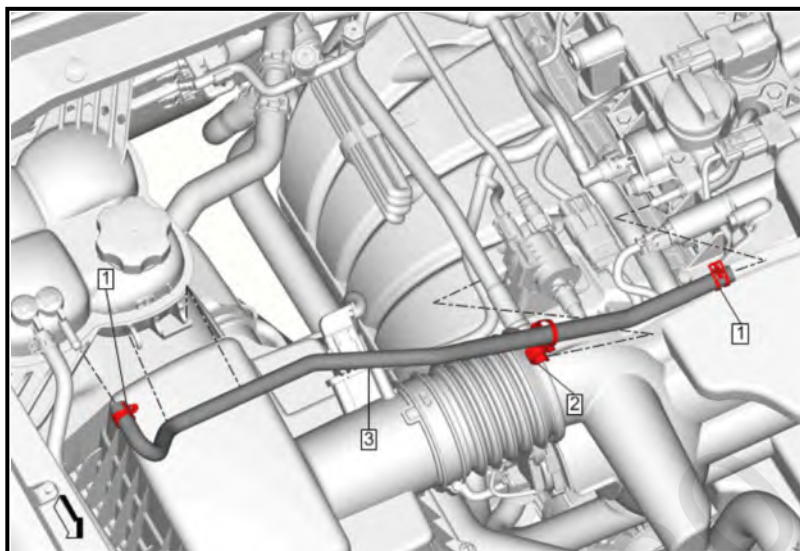
ENGINE COOLANT AIR BLEED HOSE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) 2. Air Cleaner Outlet Duct Bracket Replacement	
1	Engine Coolant Air Bleed Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Coolant Air Bleed Hose

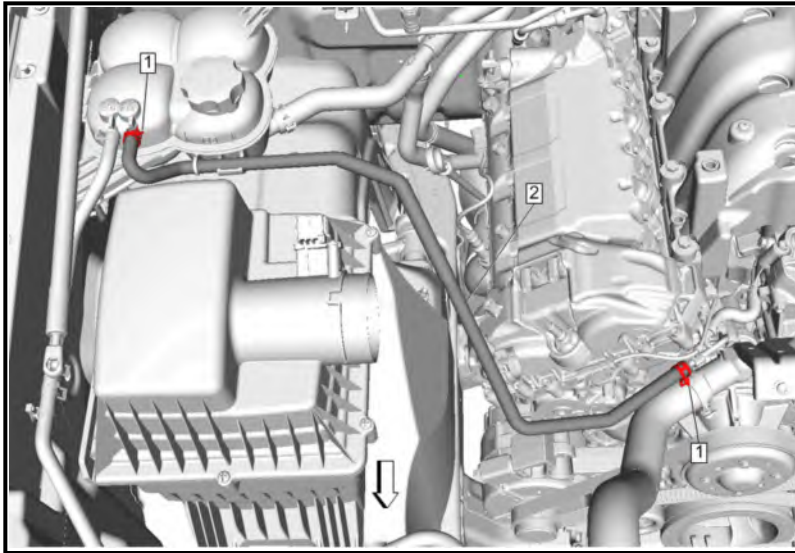
COOLANT RECOVERY RESERVOIR HOSE REPLACEMENT (LCV)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Intake Manifold Cover Replacement	
1	Coolant Recovery Reservoir Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Coolant Recovery Reservoir Hose Clip Procedure Unclip the coolant recovery reservoir hose from the positive crankcase ventilation tube.
3	Coolant Recovery Reservoir Hose Procedure 1. Unclip the coolant recovery reservoir hose from the radiator surge tank. 2. Check the engine coolant level and fill to the proper level if necessary. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill) .

COOLANT RECOVERY RESERVOIR HOSE REPLACEMENT (LGZ)



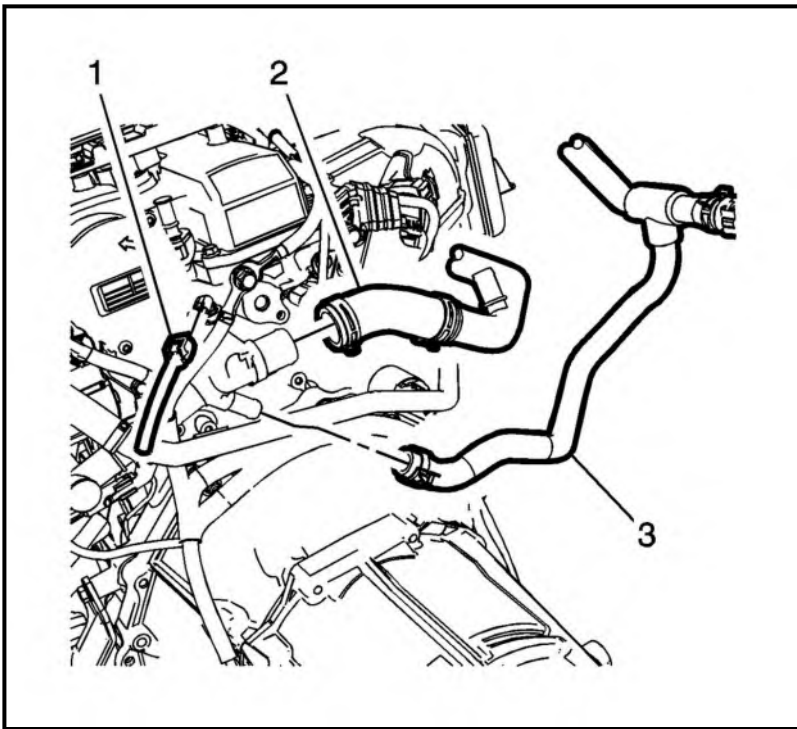
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	
1. Air Cleaner Outlet Duct Replacement	
1	Coolant Recovery Reservoir Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Coolant Recovery Reservoir Hose Procedure 1. Unclip the coolant recovery reservoir hose from the radiator surge tank. 2. Start the engine and check for coolant leaks.

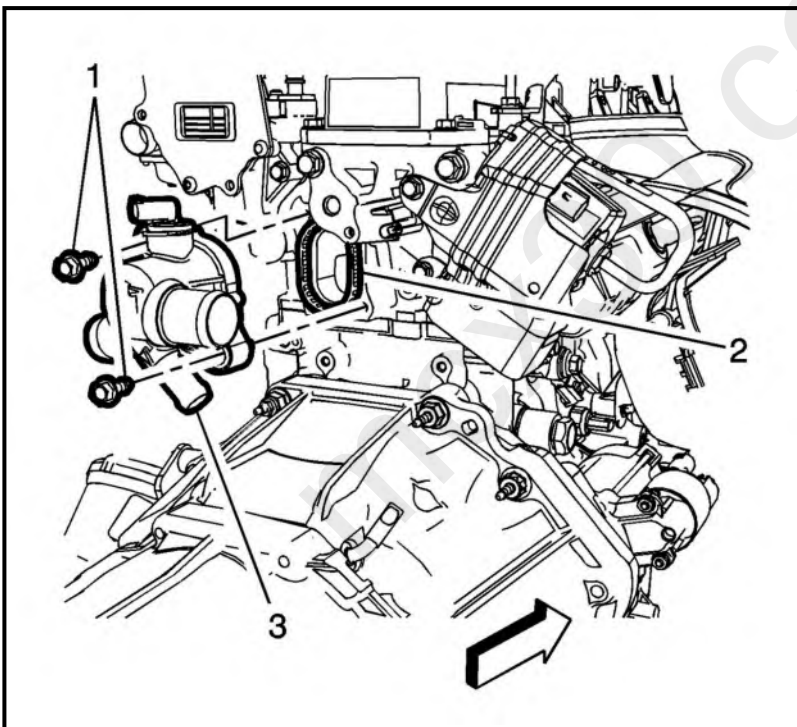
WATER OUTLET REPLACEMENT (LCV)

Removal Procedure

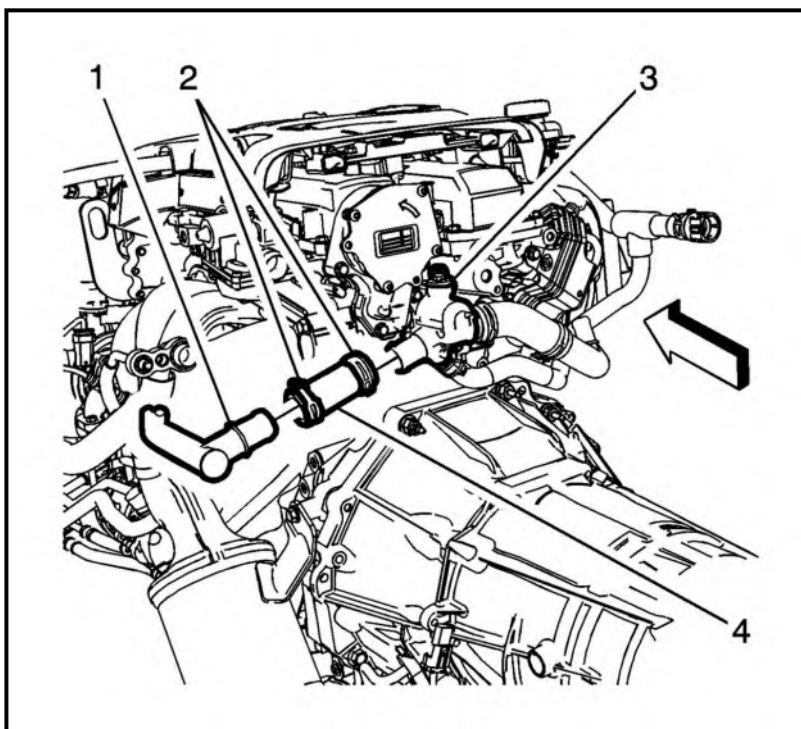
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the intake manifold cover. [Intake Manifold Cover Replacement](#)
3. Remove the plenum front panel. [Plenum Front Panel Replacement](#)
4. Remove the transmission mount bolts from the transmission support crossmember.
 - MY8 [Transmission Mount Replacement \(4WD\)](#) , or [Transmission Mount Replacement \(2WD\)](#)
5. Using a suitable jack stand, raise the rear of the transmission to allow additional clearance between the body and the water outlet.
6. Place a block of wood or a suitable spacer between the transmission mount and transmission support crossmember.
7. Remove the jack stand and lower the vehicle.
8. Disconnect the engine coolant temperature sensor electrical connector (1).



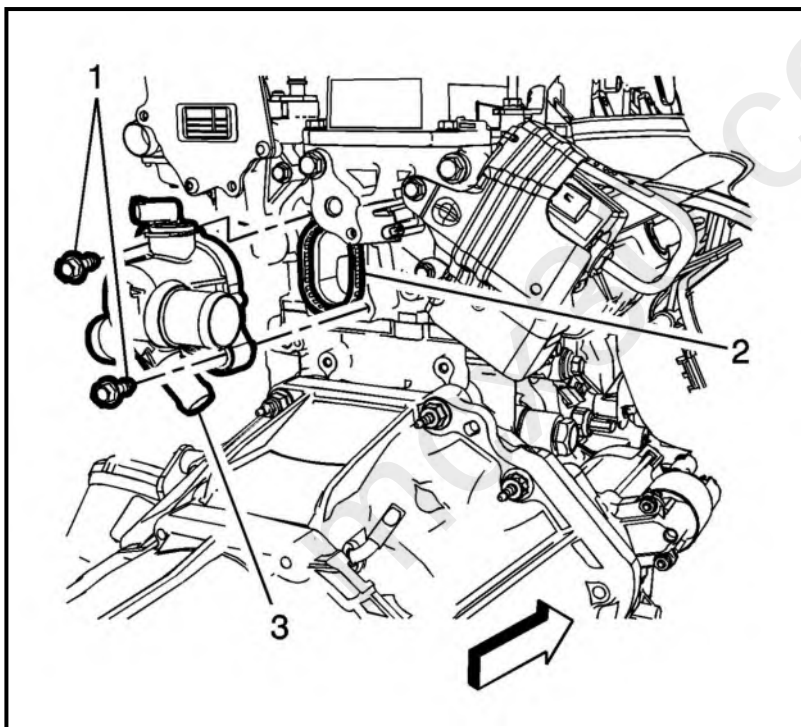
9. Remove the radiator inlet hose (2) and the heater outlet hose (3), from the water outlet.
10. Remove the 2 water outlet bolts (1).



11. Remove the water outlet (3) from the thermostat bypass hose (4).



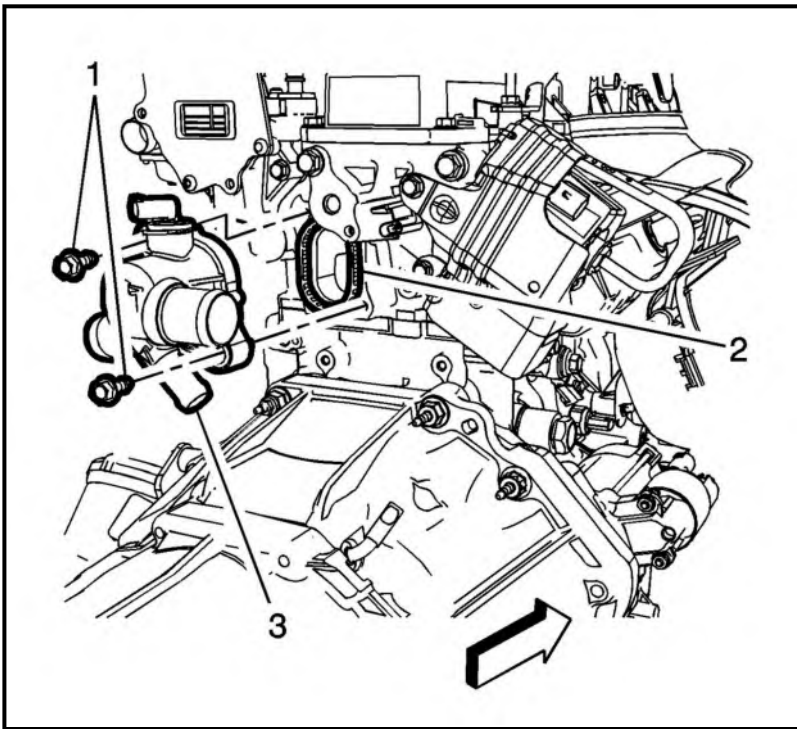
12. Remove the water outlet (3).



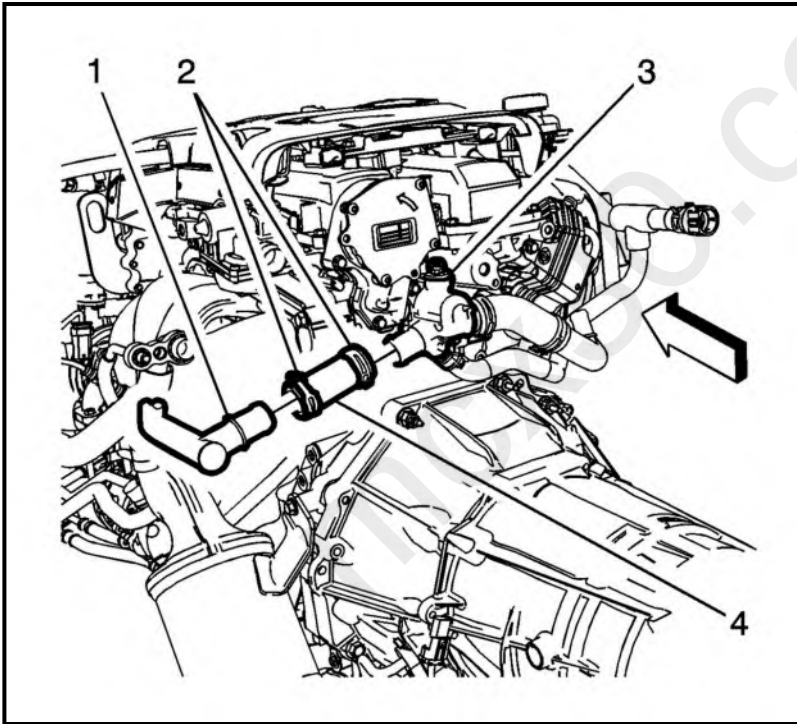
13. Remove and DISCARD the water outlet seal (2).

Installation Procedure

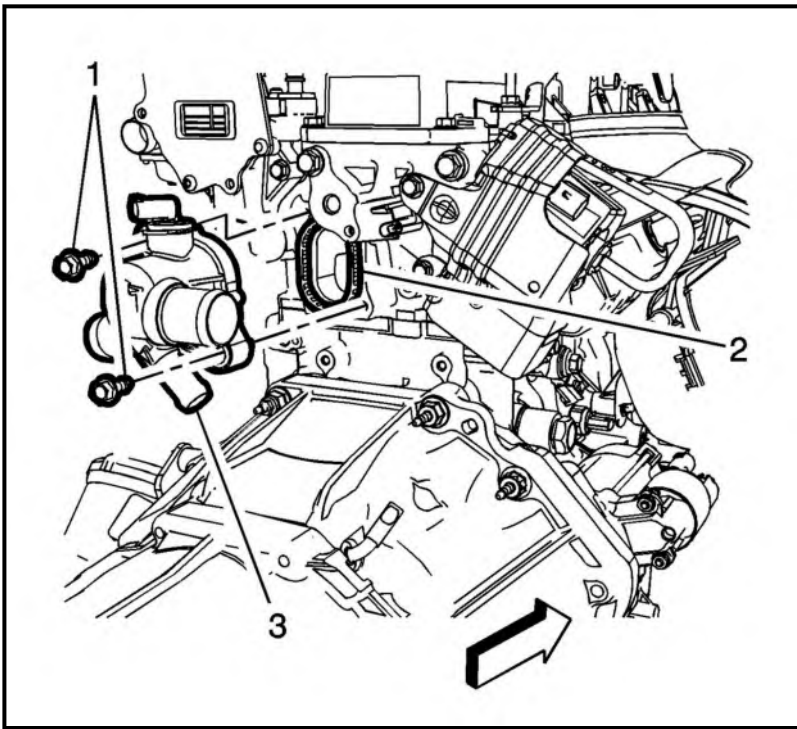
1. Install a NEW water outlet seal (2).



2. Install the water outlet (3) into the thermostat bypass hose (4) and position it to the cylinder head.

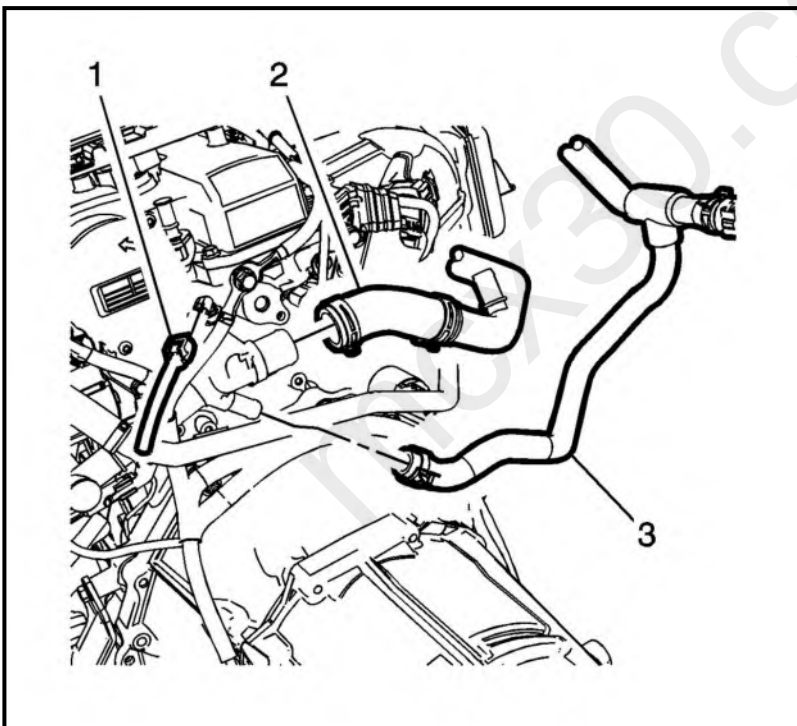


3. Install the 2 water outlet bolts (1). Tighten to 12 N.m (106 lb in).



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

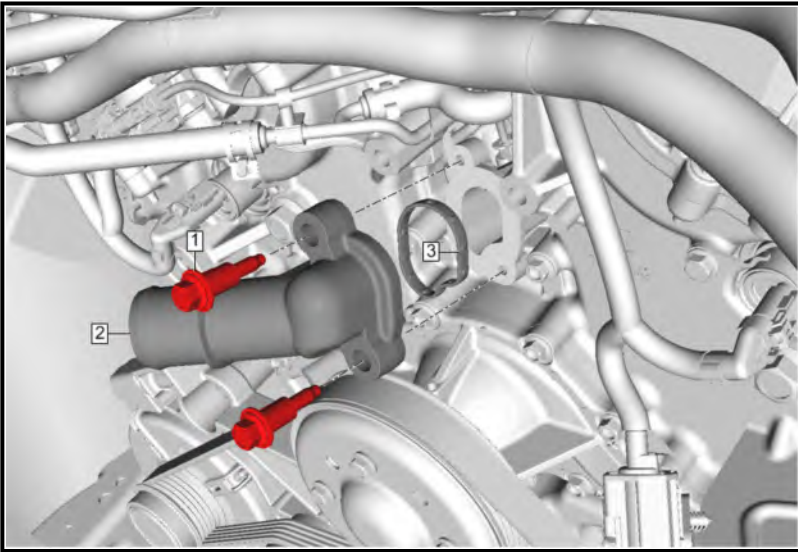
4. Install the heater outlet hose (3) and the radiator inlet hose (2) to the water outlet.



5. Connect the engine coolant temperature sensor electrical connector (1).
6. Raise the vehicle.
7. Install the jack stand and remove the wood block or spacer and lower the transmission onto the transmission support crossmember.
8. Install the transmission mount bolts.
 - MY8 [Transmission Mount Replacement \(4WD\)](#) , or [Transmission Mount Replacement \(2WD\)](#)
9. Install the plenum front panel. [Plenum Front Panel Replacement](#)
10. Install the intake manifold cover. [Intake Manifold Cover Replacement](#)
11. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)

12. Start the engine and check for coolant leaks.

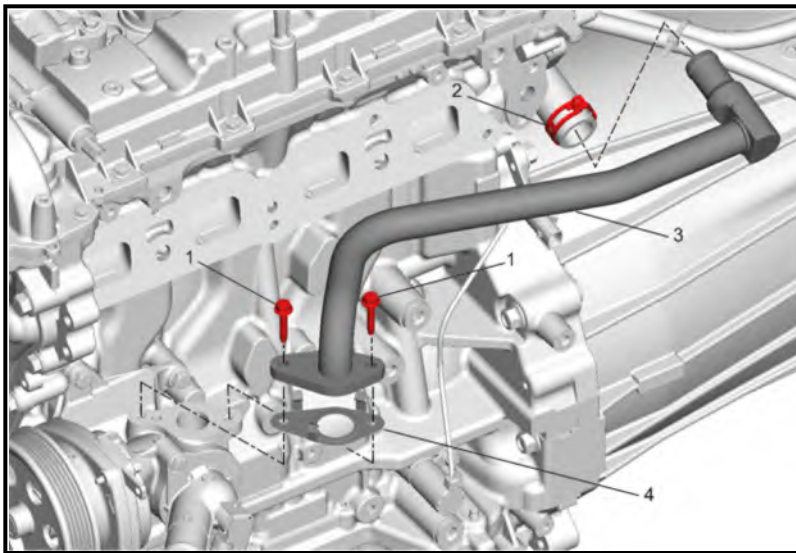
WATER OUTLET REPLACEMENT (LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. <u>Radiator Inlet Hose Replacement (LGZ)</u> 2. <u>Air Cleaner Outlet Duct Bracket Replacement</u>	
1	Water Outlet Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Water Outlet
3	Water Outlet Seal Procedure Install a NEW seal.

THERMOSTAT BYPASS PIPE REPLACEMENT (LCV)



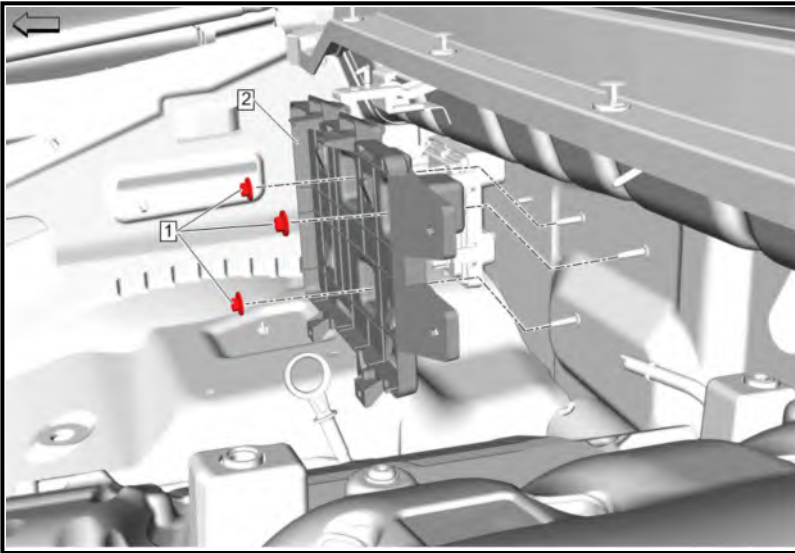
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Remove the exhaust manifold. Exhaust Manifold Replacement (LCV). 3. Remove the intake manifold cover. Intake Manifold Cover Replacement	
1	Thermostat Bypass Pipe Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten: 10 N.m (89 lb in)
2	Thermostat Bypass Pipe Hose Clamp Procedure Hose Clamp Replacement Guidelines - Spring Type
3	Thermostat Bypass Pipe
4	Thermostat Bypass Pipe Gasket Procedure Install a NEW gasket.

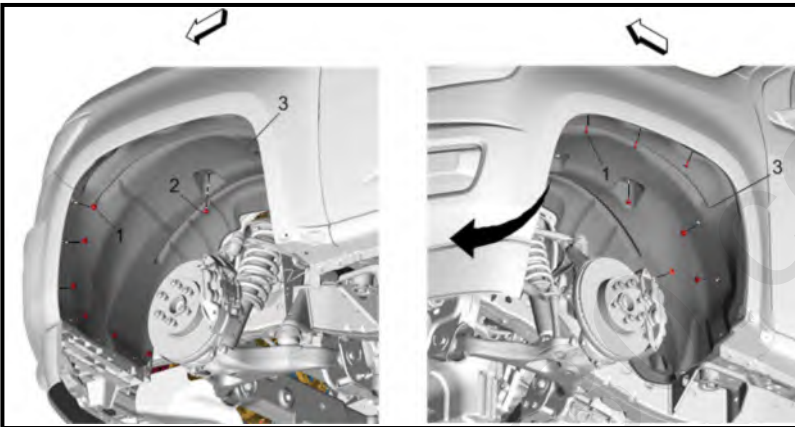
HEATER INLET AND OUTLET PIPE REPLACEMENT

Removal Procedure

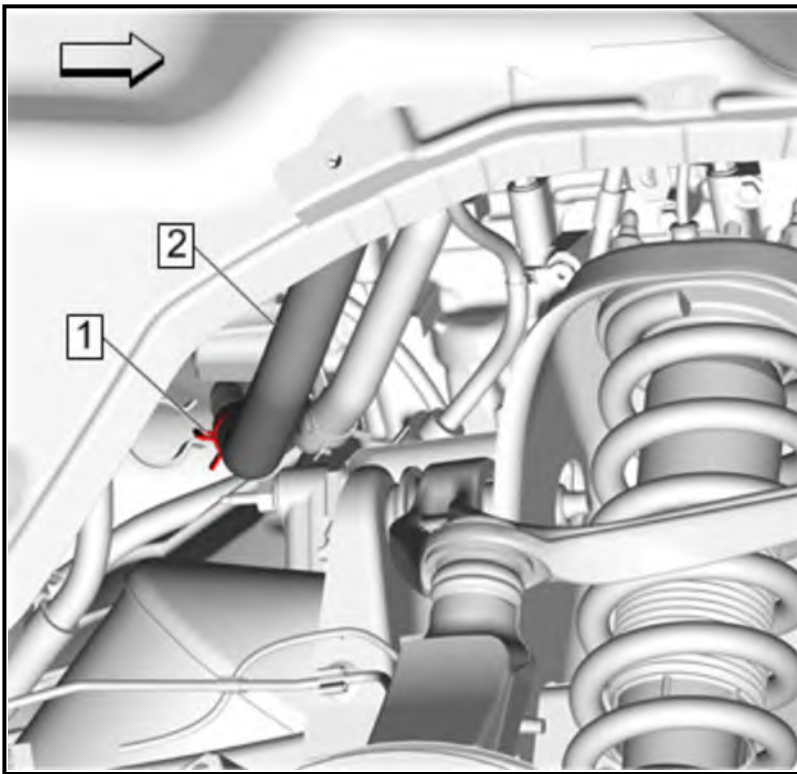
1. Engine Control Module Bracket (2) - Remove - [Engine Control Module Bracket Replacement](#)



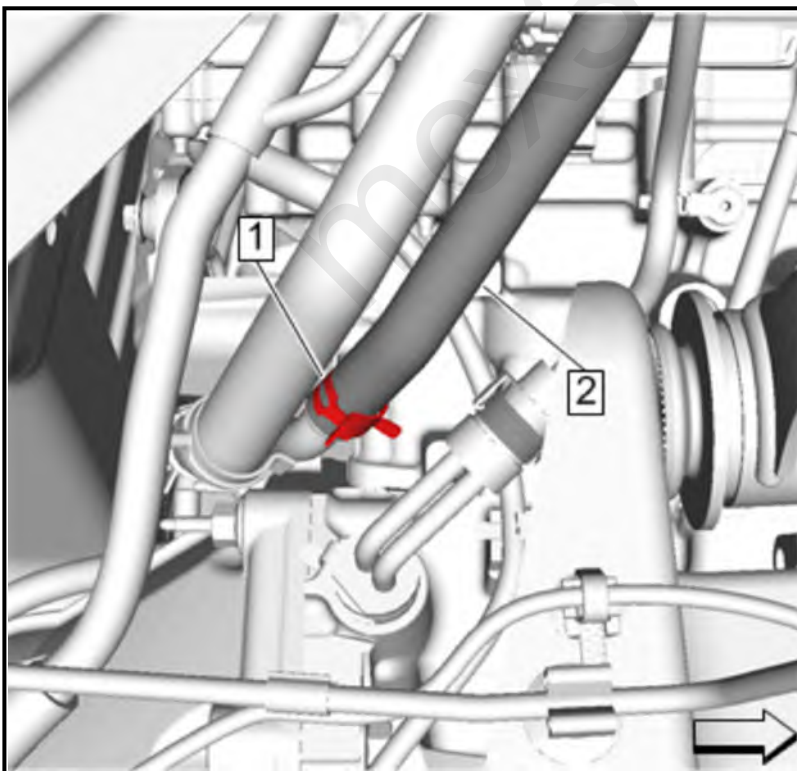
2. Front Wheelhouse Liner (3) @ Right Side - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)



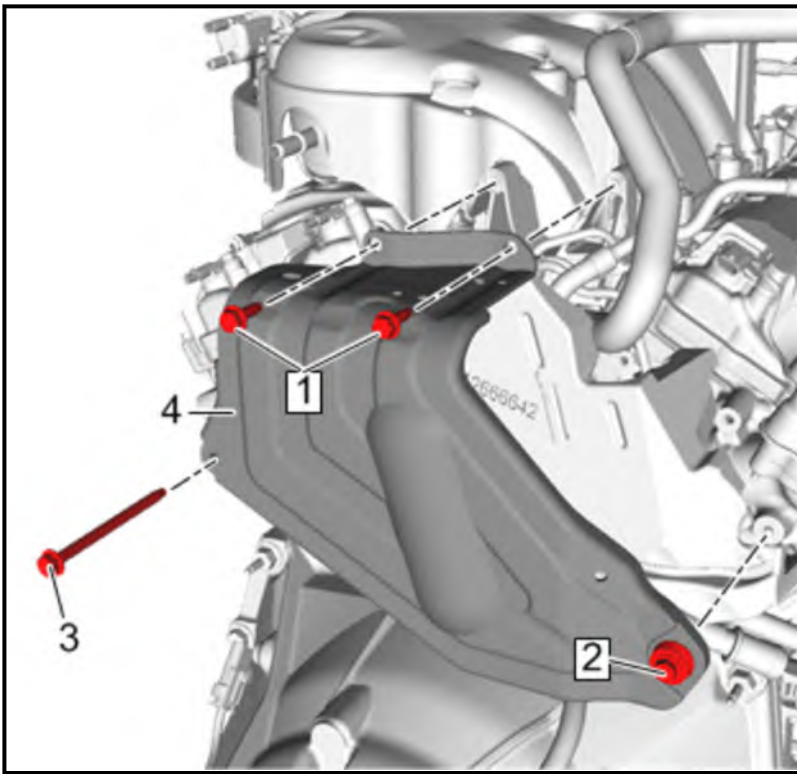
3. Heater Inlet Hose (2) @ Heater Inlet and Outlet Pipe - Remove - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(LGZ\)](#) , or [Heater Inlet Hose Replacement \(LCV\)](#)



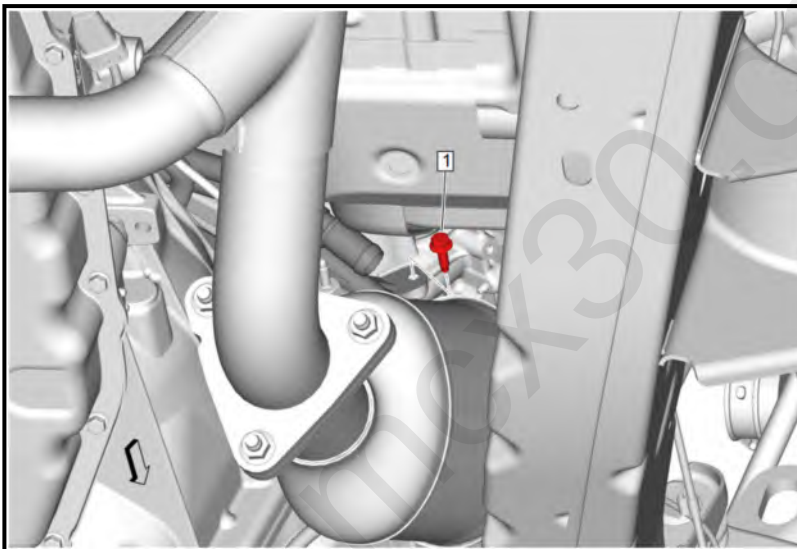
4. Heater Outlet Hose (2) @ Heater Inlet and Outlet Pipe - Remove - [Heater Outlet Hose Replacement \(Heater Outlet Hose Tee to Heater Core Tube LCV\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Tee to Water Outlet LCV\)](#) , or [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(LGZ Surge Tank to Connection\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Connector to Heater Core Tube LGZ\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Connector to Heater Inlet Outlet Pipe LGZ\)](#).



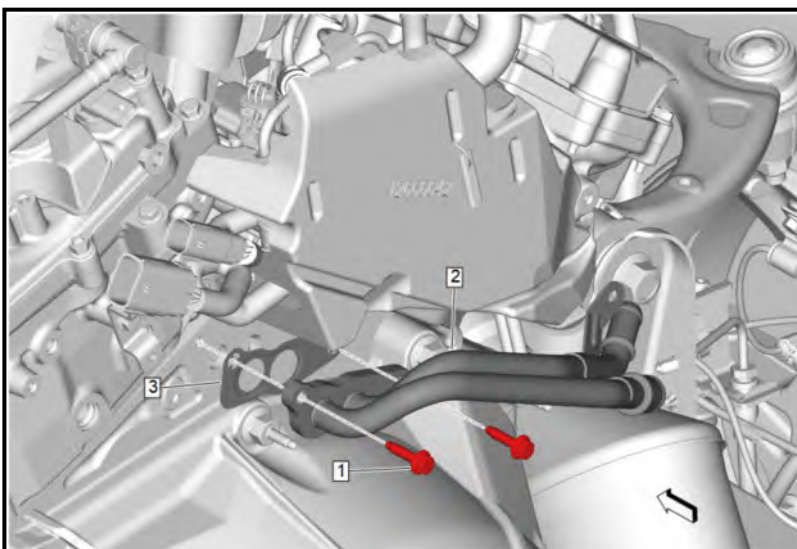
5. Fuel Pipe Shield (4) - Remove - [Fuel Pipe Shield Replacement](#)



6. Heater Inlet and Outlet Pipe Bolt (1) - Remove



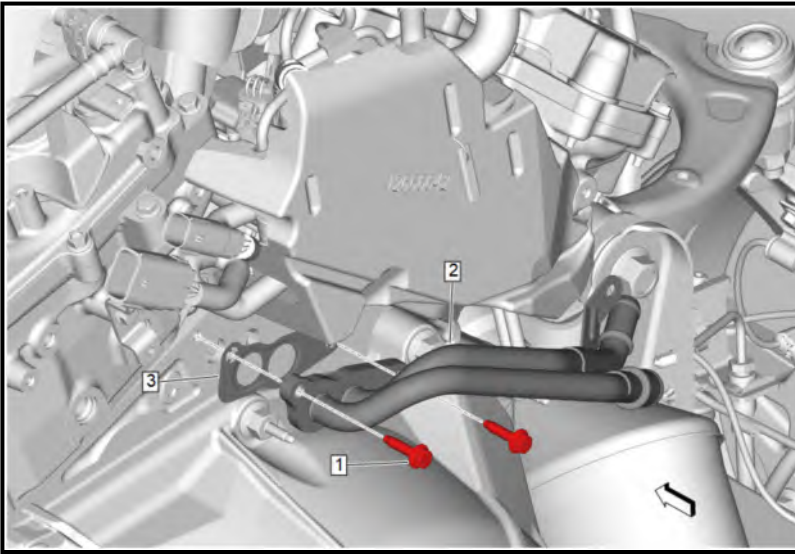
7. Heater Inlet and Outlet Pipe Bolt (1) - Remove [2x]



8. Heater Inlet and Outlet Pipe (2) - Remove
9. Heater Inlet and Outlet Pipe Gasket (3) - Remove and DISCARD

Installation Procedure

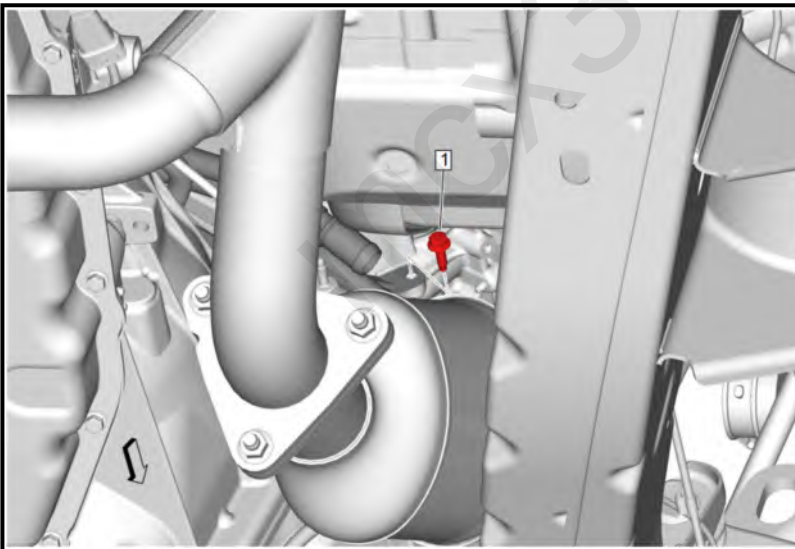
1. Heater Inlet and Outlet Pipe Gasket (3) - Install NEW



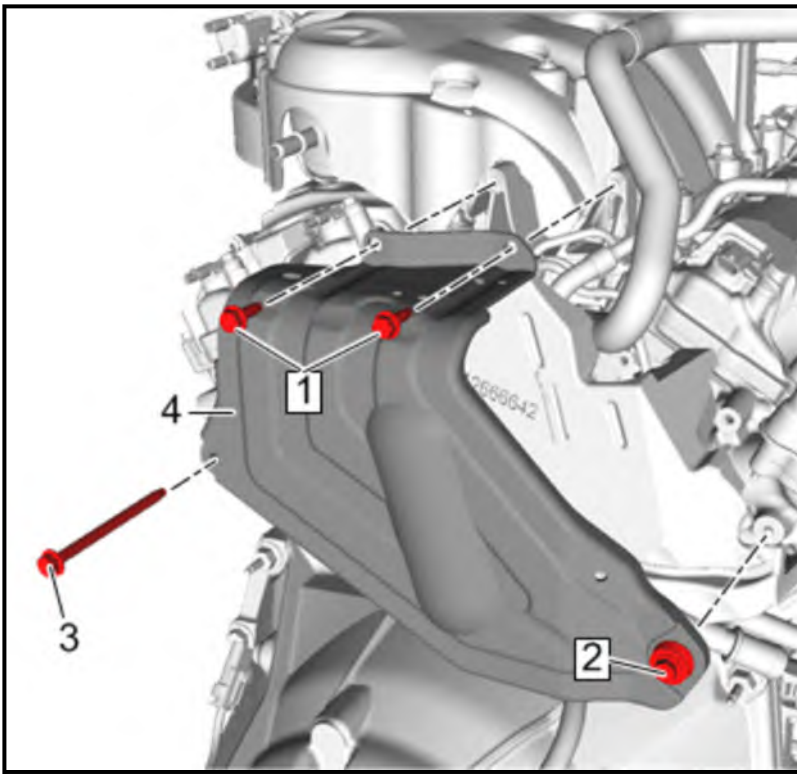
2. Heater Inlet and Outlet Pipe (2) - Install

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

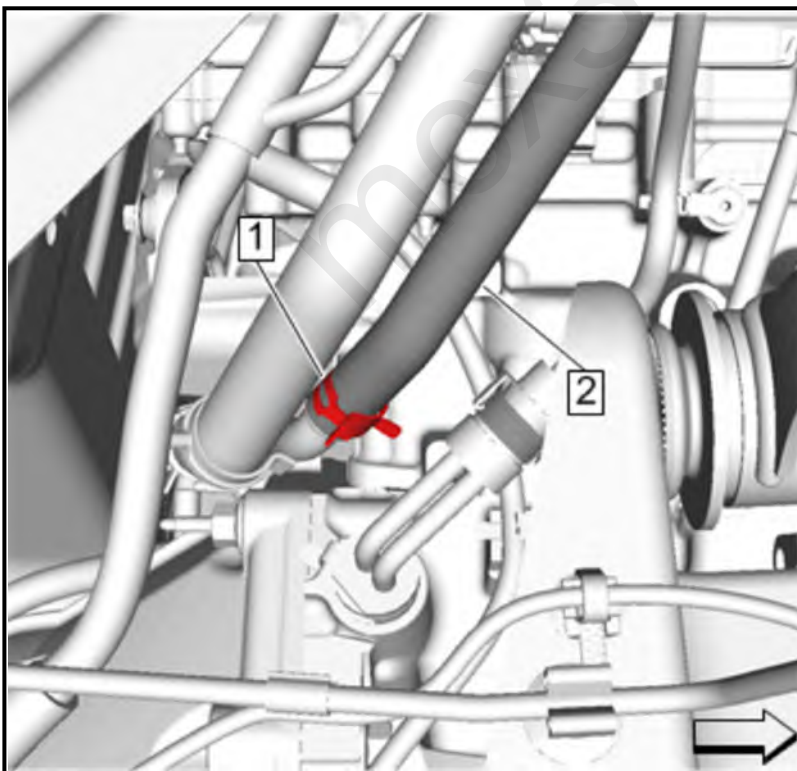
3. Heater Inlet and Outlet Pipe Bolt (1) - Install [2x] 9 N.m (80 lb in)
4. Heater Inlet and Outlet Pipe Bolt (1) - Install 9 N.m (80 lb in)



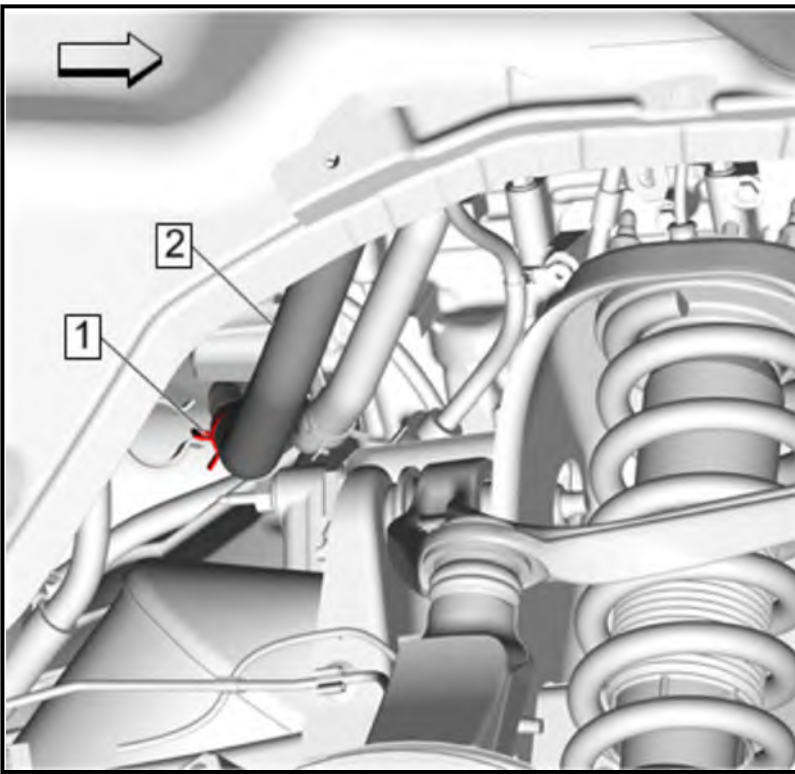
5. Fuel Pipe Shield (4) - Install - [Fuel Pipe Shield Replacement](#)



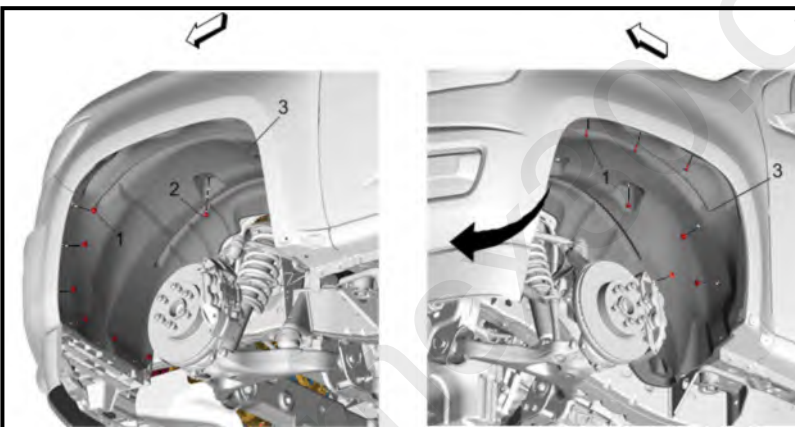
6. Heater Outlet Hose (2) @ Heater Inlet and Outlet Pipe - Install - [Heater Outlet Hose Replacement \(Heater Outlet Hose Tee to Heater Core Tube LCV\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Tee to Water Outlet LCV\)](#) , or [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(LGZ Surge Tank to Connection\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Connector to Heater Core Tube LGZ\)](#) , or [Heater Outlet Hose Replacement \(Heater Outlet Hose Connector to Heater Inlet Outlet Pipe LGZ\)](#).



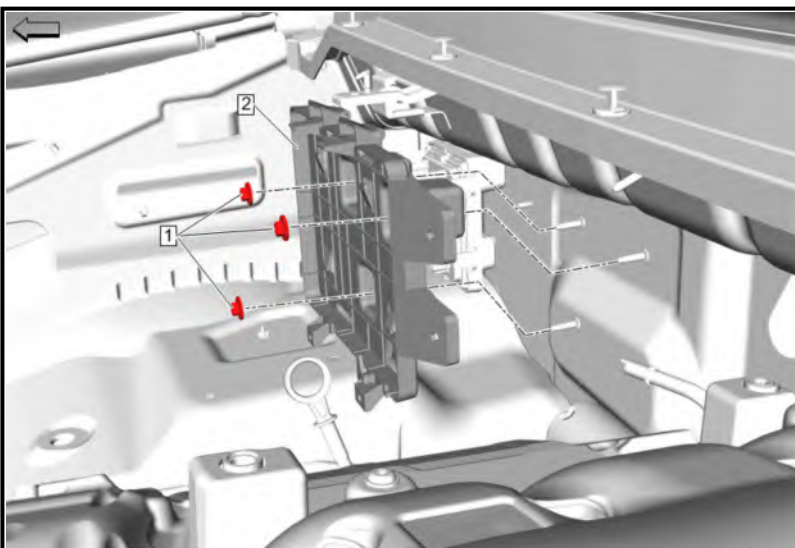
7. Heater Inlet Hose (2) @ Heater Inlet and Outlet Pipe - Install - [Heater Inlet Hose Replacement \(Heater Core Inlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(Engine Coolant Thermostat Assembly to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Inlet Hose Replacement \(LGZ\)](#) , or [Heater Inlet Hose Replacement \(LCV\)](#).



8. Front Wheelhouse Liner (3) @ Right Side - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)

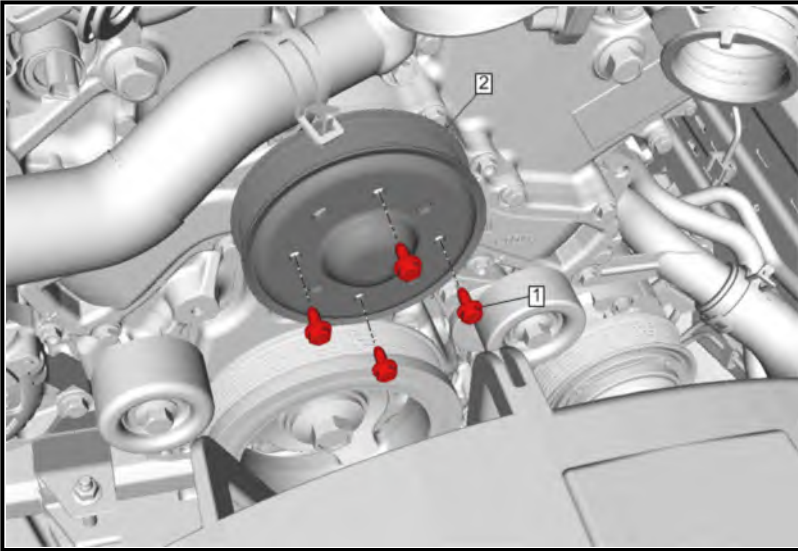


9. Engine Control Module Bracket (2) - Install - [Engine Control Module Bracket Replacement](#)



10. Start the engine and check for coolant leaks.

WATER PUMP PULLEY REPLACEMENT (LGZ)



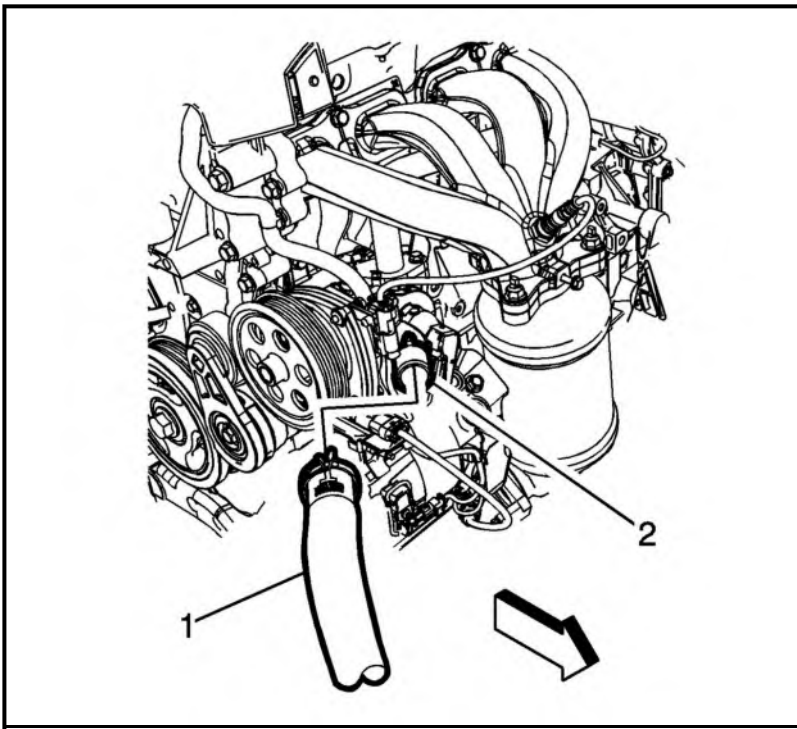
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Drive Belt Replacement</u>	
1	Water Pump Pulley Bolt [4X] CAUTION: Refer to <u>Fastener Caution</u> . 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 <u>Special Tools</u> .

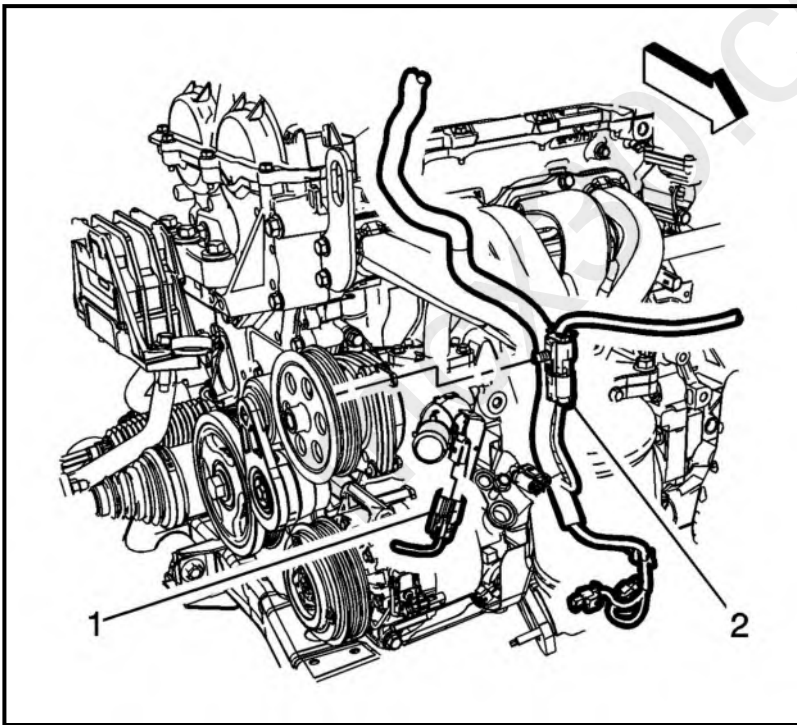
WATER PUMP REPLACEMENT (LCV)

Removal Procedure

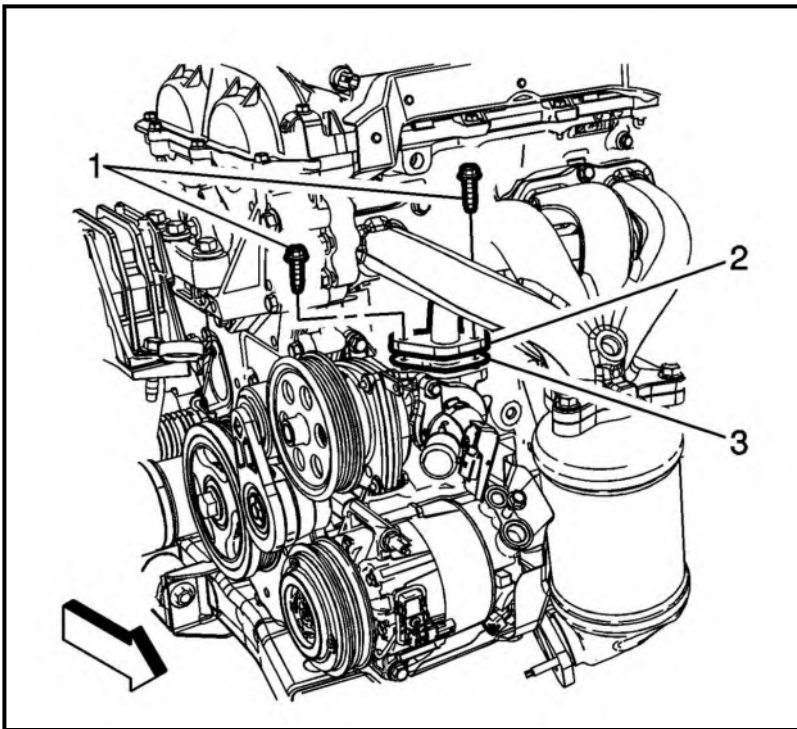
1. Drain the cooling system. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill).
2. Remove the drive belt. Drive Belt Replacement
3. Remove the radiator outlet hose (1) from the water outlet (2). Hose Clamp Replacement Guidelines - Spring Type



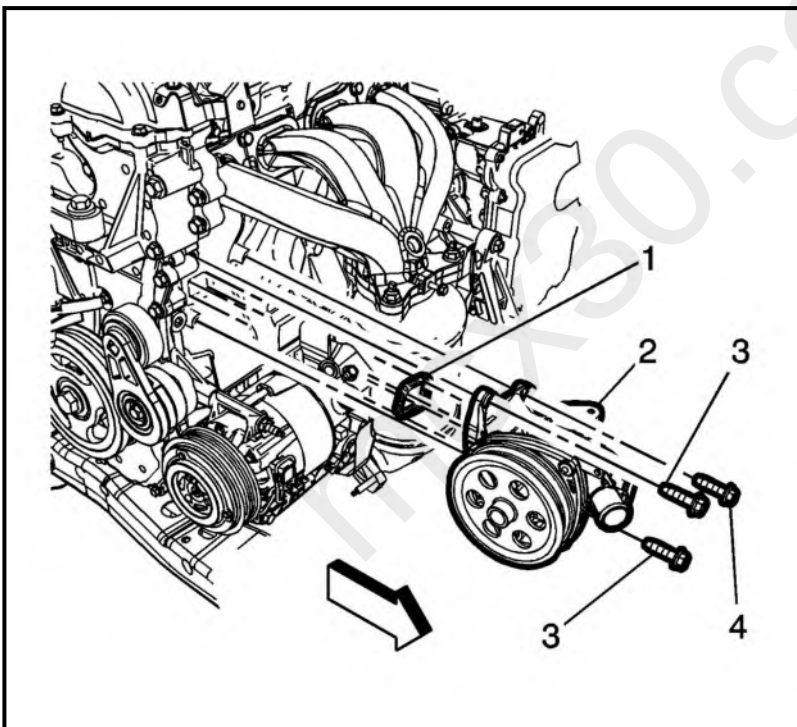
4. Remove the exhaust manifold heat shield. [Exhaust Manifold Heat Shield Replacement \(LCV\)](#)
5. Disconnect the thermostat housing connector (1) and remove the engine harness retainer (2) from the water pump.



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



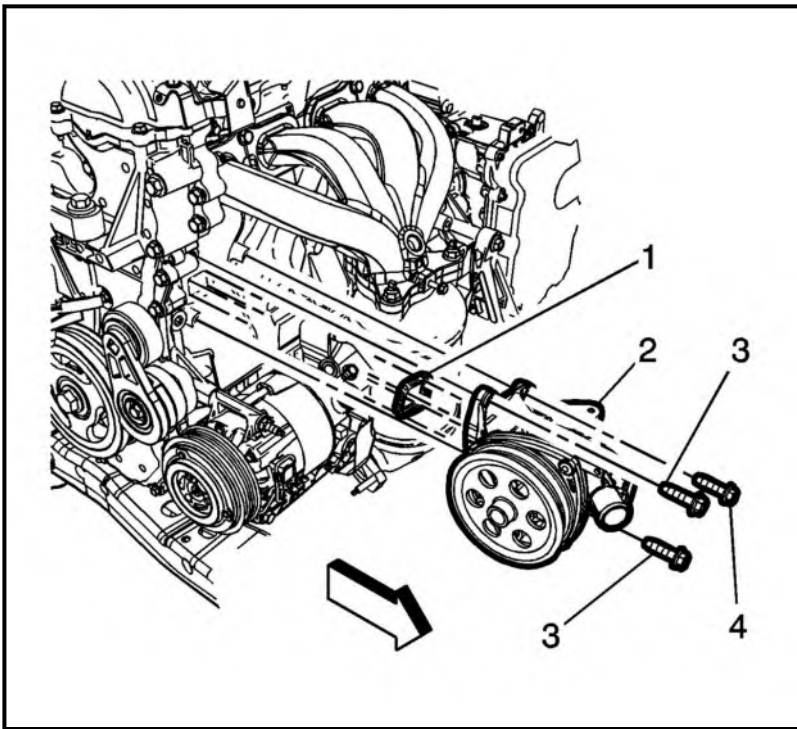
7. Discard the thermostat bypass pipe gasket (3).
8. Remove the water pump fasteners (3) and remove the water pump (2).



9. Discard the water pump seal (1).

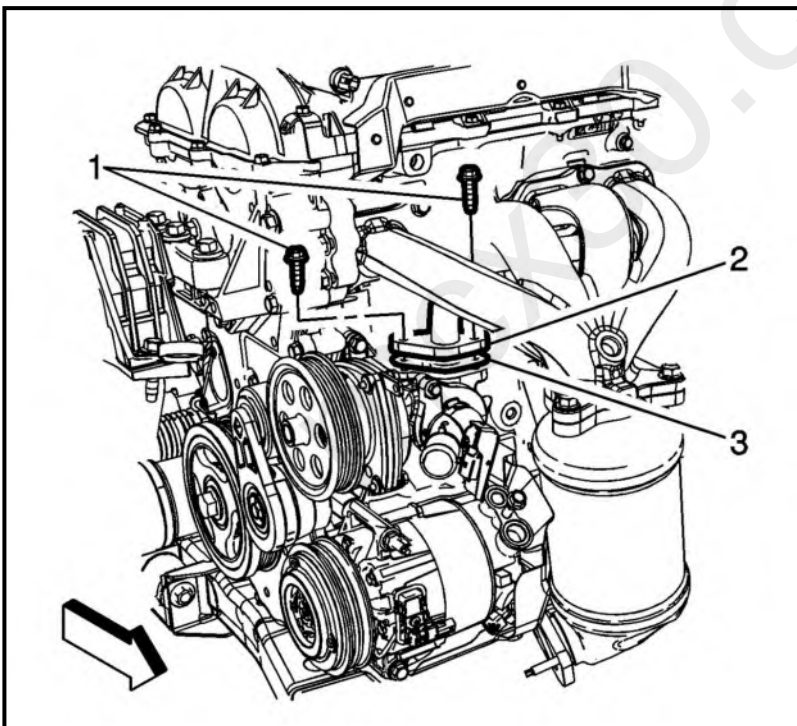
Installation Procedure

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

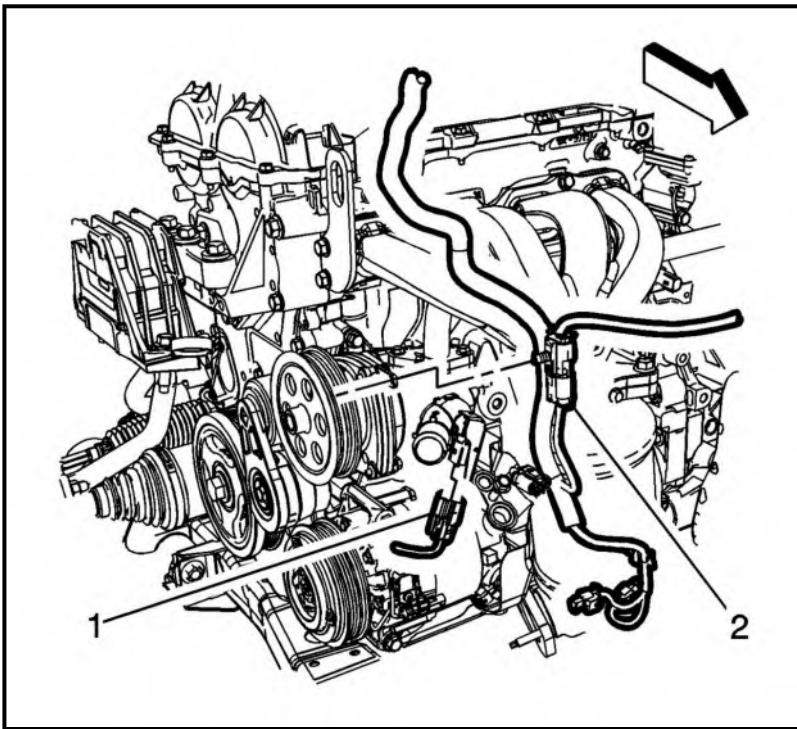


CAUTION: Refer to [Fastener Caution](#) .

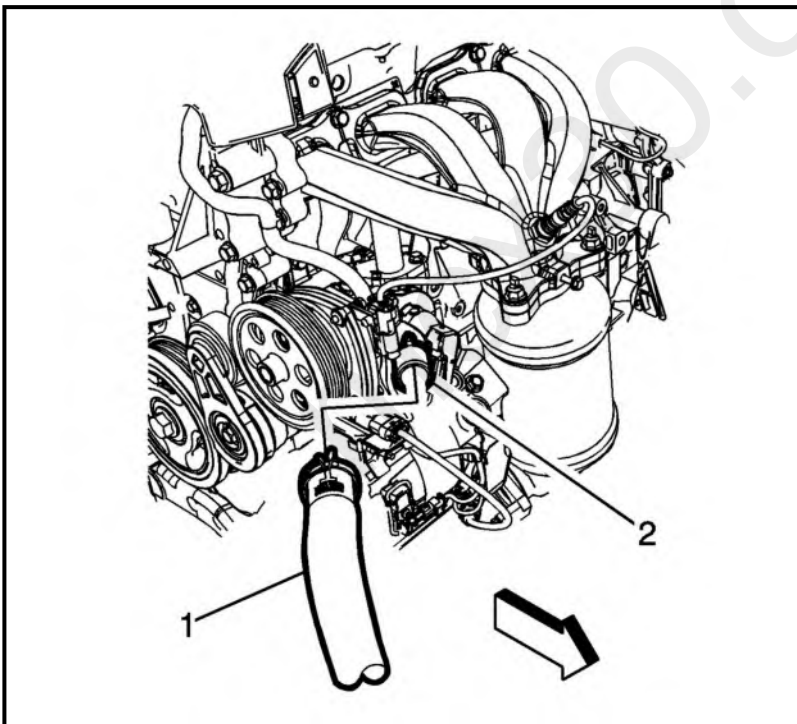
2. Install the thermostat bypass pipe (2) to the water pump with a NEW gasket (3) and tighten the fasteners (1) to 10 N.m (89 lb in).



3. Connect the connector (1) to the water outlet.



4. Install the exhaust manifold heat shield. [Exhaust Manifold Heat Shield Replacement \(LCV\)](#).
5. Install the engine wiring harness retainer (2) to the water pump.
6. Install the radiator outlet hose (1) to the water outlet (2). [Hose Clamp Replacement Guidelines - Spring Type](#)



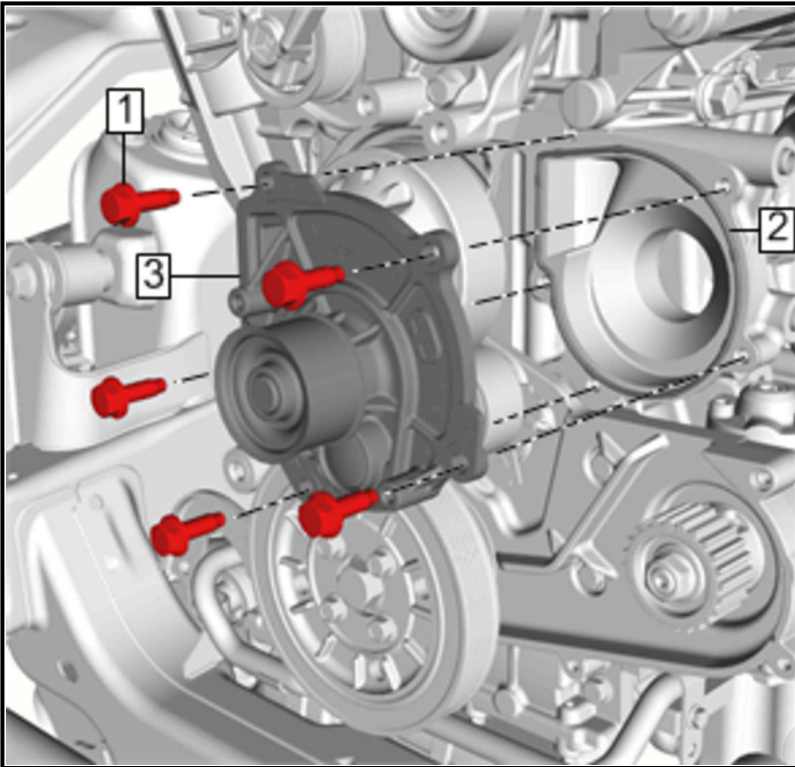
7. Install the drive belt. [Drive Belt Replacement](#)
8. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
9. Start the engine and check for coolant leaks.

WATER PUMP REPLACEMENT (LWN)

Removal Procedure

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

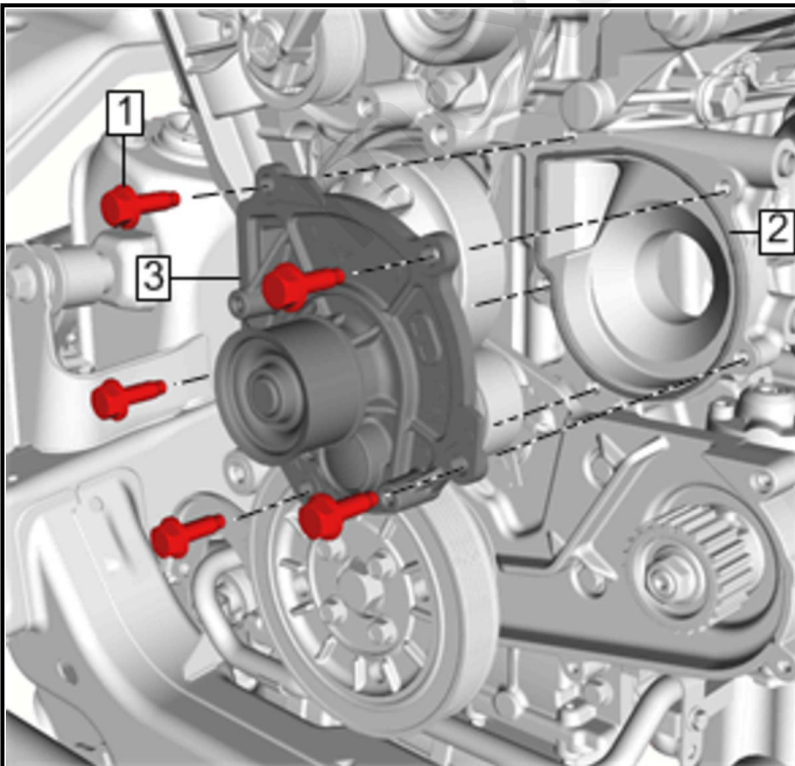
2. **Timing Belt Rear Cover Replacement** - Remove
3. Water Pump Bolt (1) - Remove [5x]



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

Installation Procedure

1. Water Pump Seal (2) - Install



NOTE: Install a NEW seal.

2. Water Pump (3) - Install

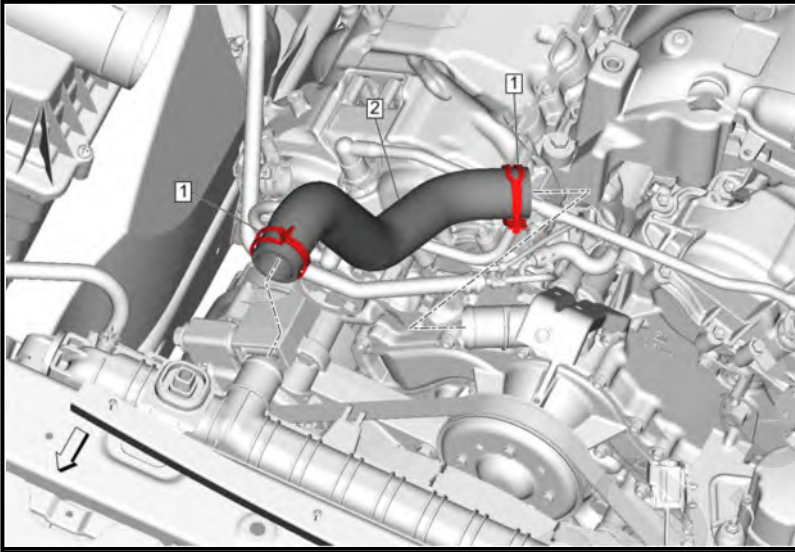
CAUTION: Refer to [Fastener Caution](#) .

3. Water Pump Bolt (1) - Install and tighten [5x] 25 N.m (18 lb ft)
4. [Timing Belt Rear Cover Replacement](#) - Install
5. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
6. Start the engine and check for coolant leaks.

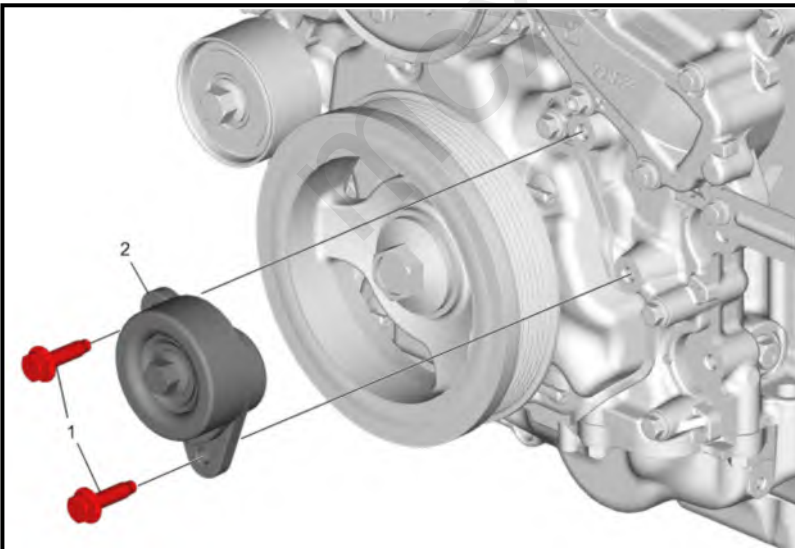
WATER PUMP REPLACEMENT (LGZ)

Removal Procedure

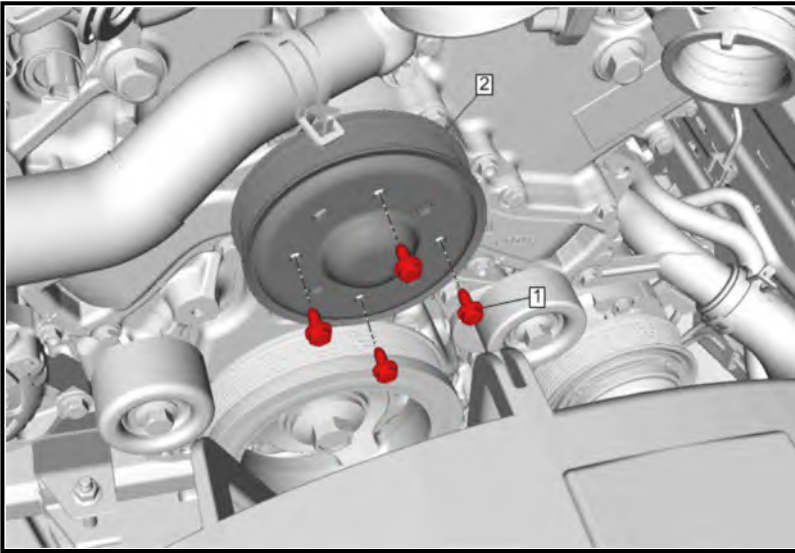
1. Radiator Inlet Hose (2) - Remove - [Radiator Inlet Hose Replacement \(LGZ\)](#).



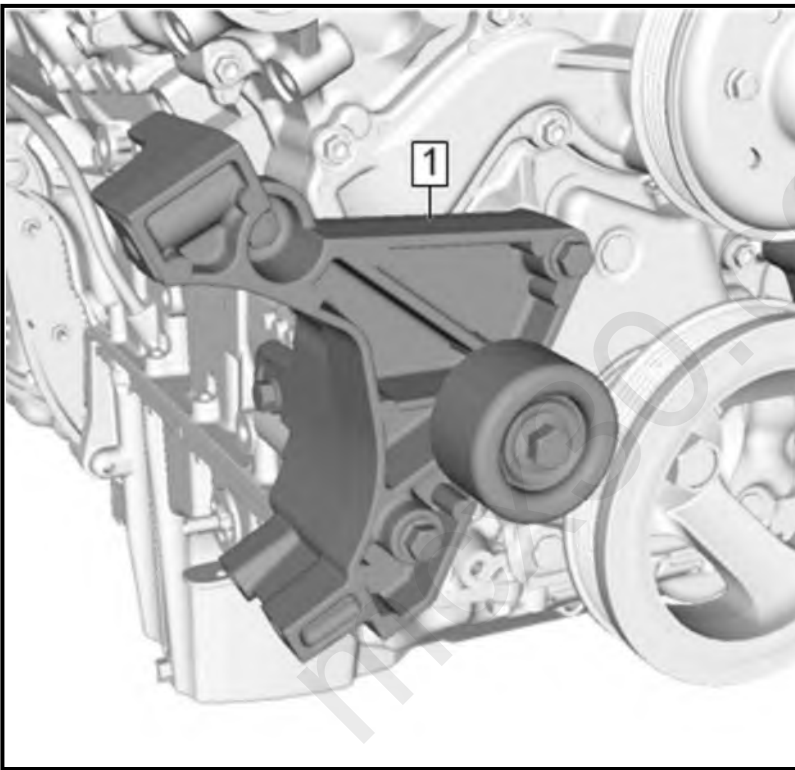
2. Drive Belt Tensioner (2) - Remove - [Drive Belt Tensioner Replacement](#)



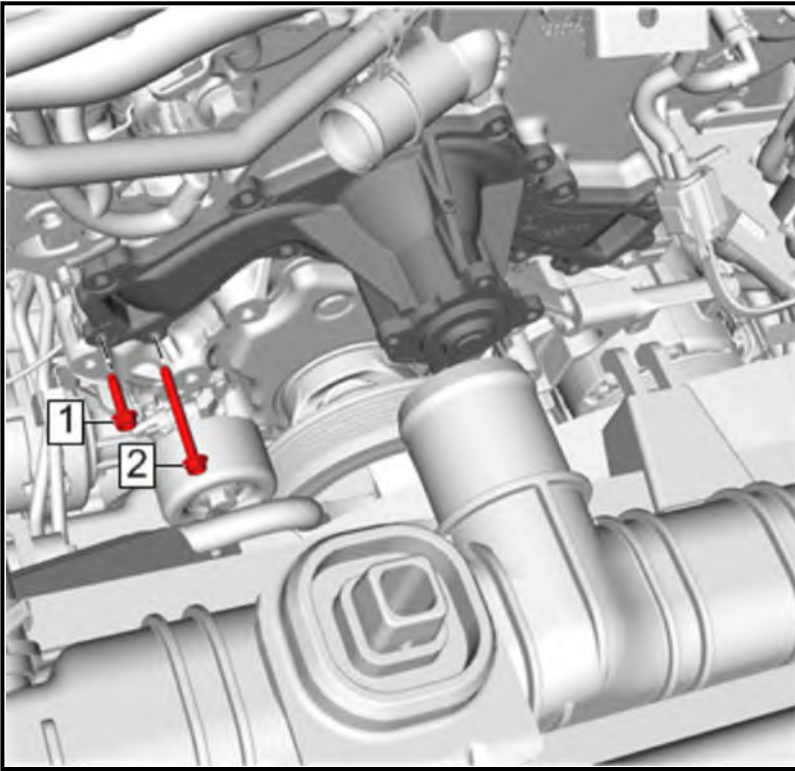
3. Water Pump Pulley (2) - Remove - [Water Pump Pulley Replacement \(LGZ\)](#).



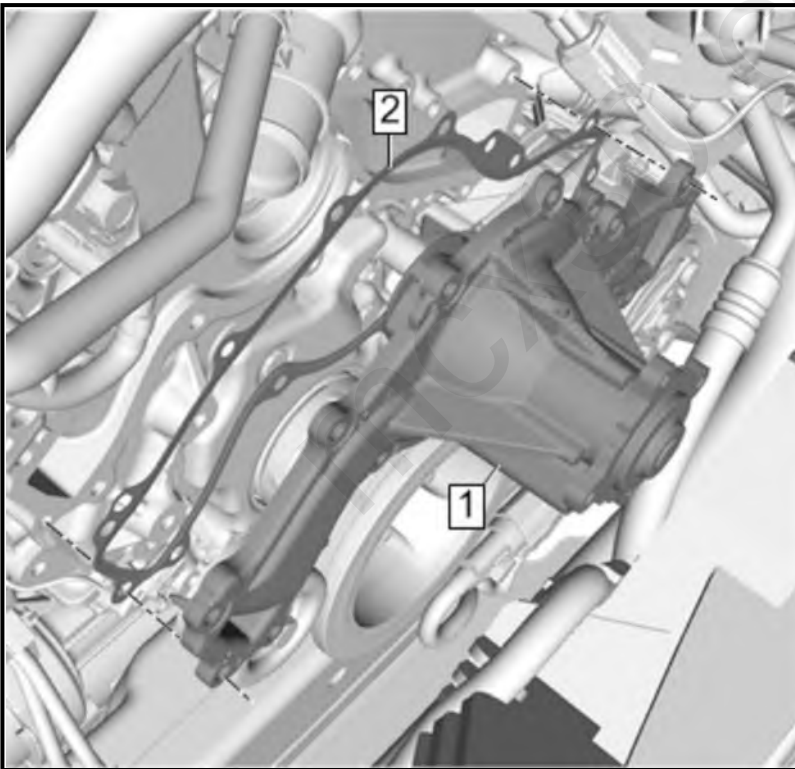
4. Generator and Drive Belt Tensioner Bracket (1) - Remove - **Generator and Drive Belt Tensioner Bracket Replacement**



5. Water Pump Bolt (1) - Remove and DISCARD [5x]



6. Engine Front Cover Bolt (2) - Remove and DISCARD [9x]
7. Water Pump (1) - Remove



8. Water Pump Gasket (2) - Remove and DISCARD

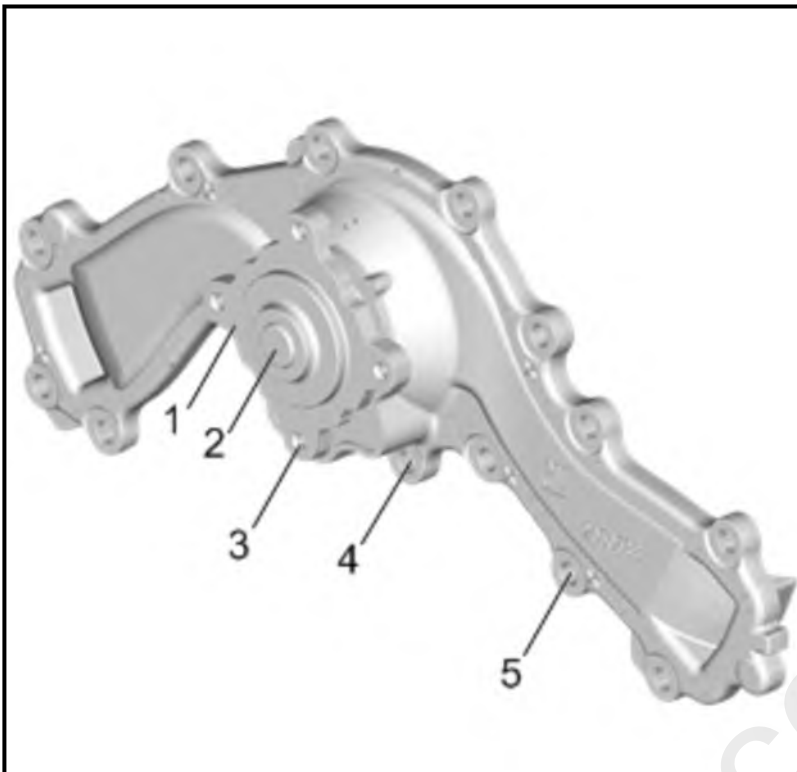
Cleaning Procedure

CAUTION: Do not immerse the water pump in solvent. The solvent may enter the water pump's permanently lubricated bearings and cause premature bearing failure.

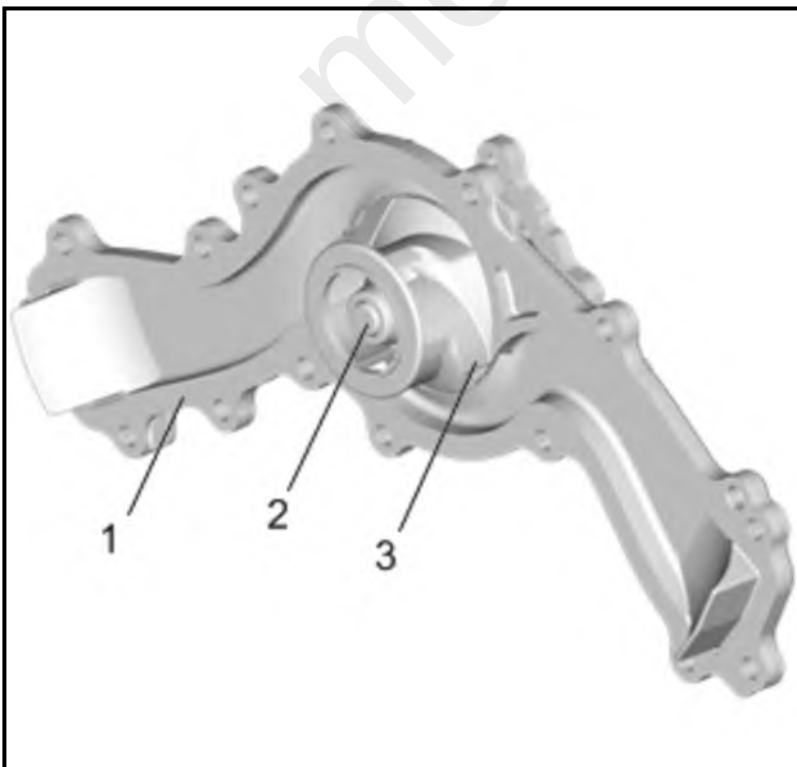
1. Remove the old gasket material from the water pump sealing surfaces.
2. Clean all excess dirt and debris from the water pump housing.

Inspection Procedure

1. Rotate the water pump hub (2). The water pump hub and impeller should turn straight and smoothly. If the hub wobbles, is noisy, or feels rough when rotated, replace the water pump.



2. Inspect the exterior of the water pump for the following:
 - Damage to the water pump hub mating surface (1) for the water pump pulley
 - Damage to the water pump hub bolt threads (3) for the water pump pulley
 - Damage to the water pump mounting tabs (4)
 - Damage to the water pump bolt holes (5)
3. Inspect the interior of the water pump for the following:

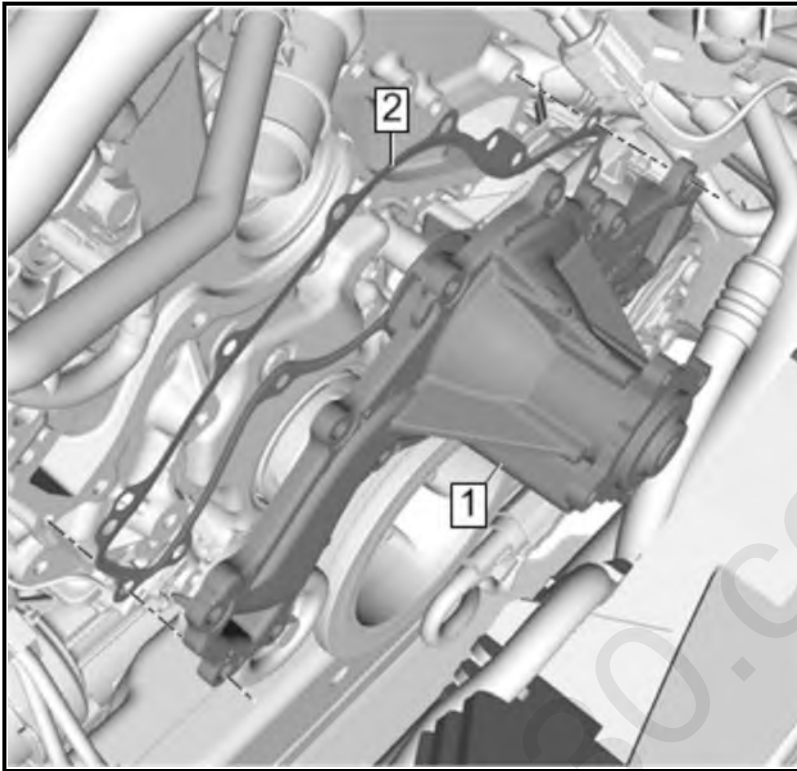


- Damage to the water pump gasket sealing surface (1)
- Damage, corrosion or restrictions to the water pump impeller (2)
- Damage, corrosion or restrictions to the coolant passages (3)

4. Repair or replace the water pump as necessary.

Installation Procedure

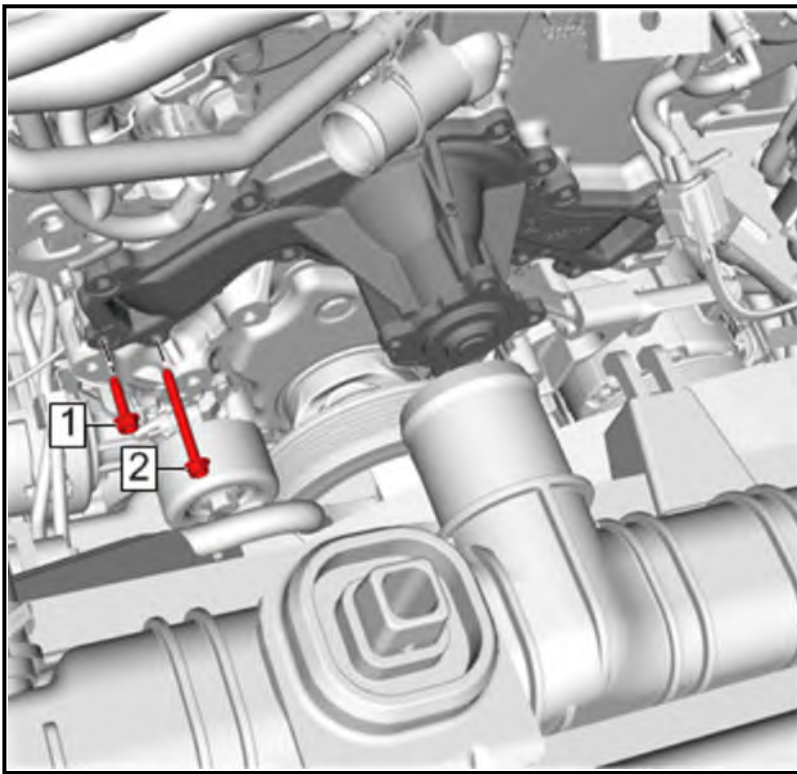
1. Water Pump Gasket (2) - Install



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

2. Water Pump (1) - Install

3. Engine Front Cover Bolt (2) - Install and hand tighten [9x]



CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

4. Water Pump Bolt (1) - Install and hand tighten [5x]
5. Tighten all bolts in the sequence shown to 15 N.m (11 lb ft)

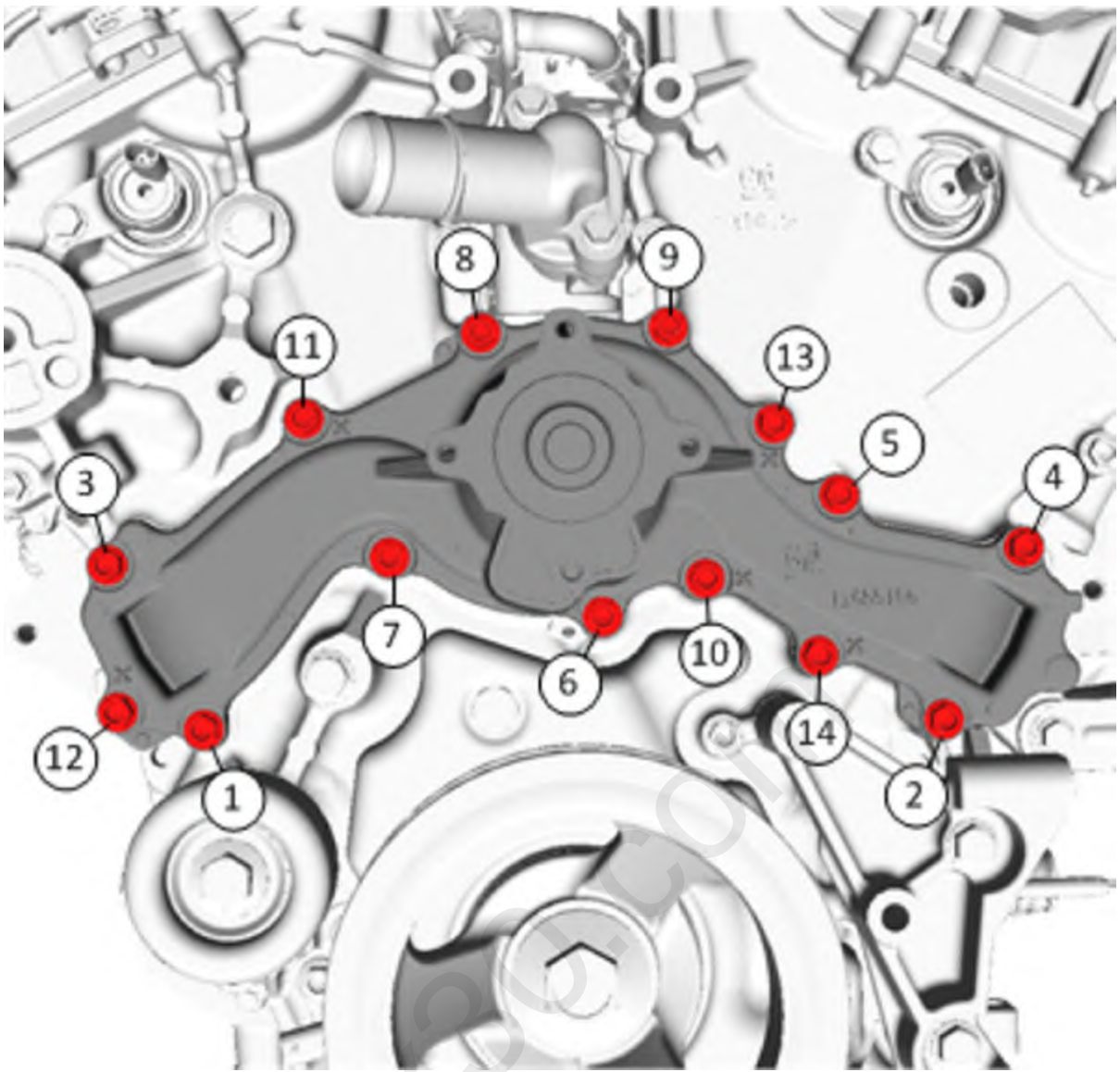
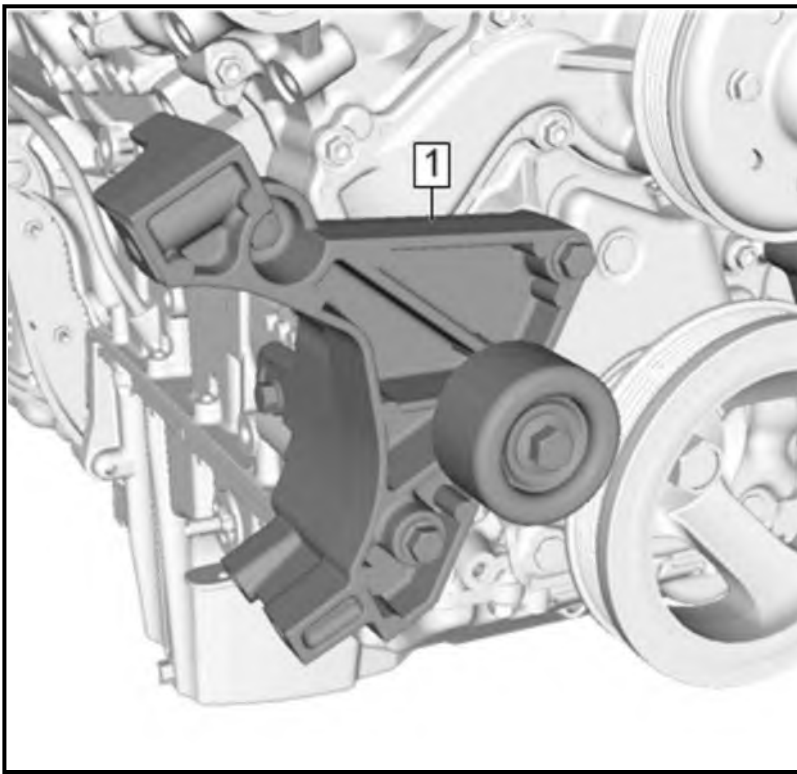


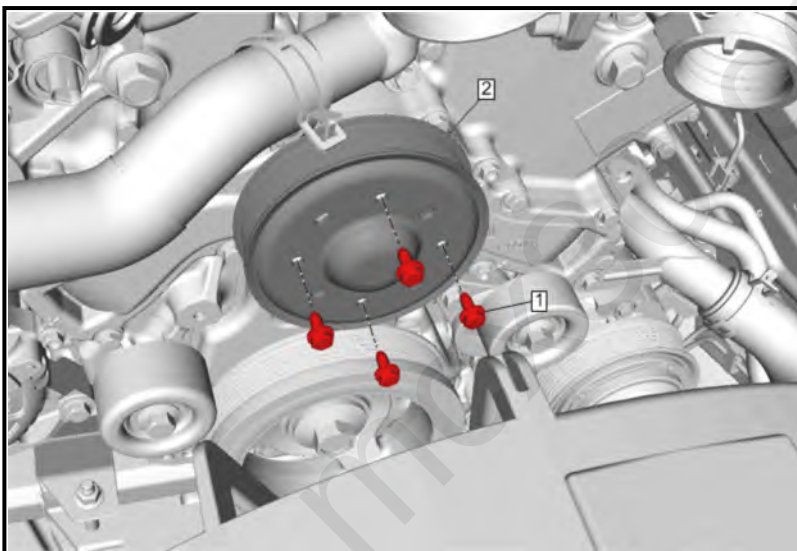
Fig. 1: Water Pump Bolts Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

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

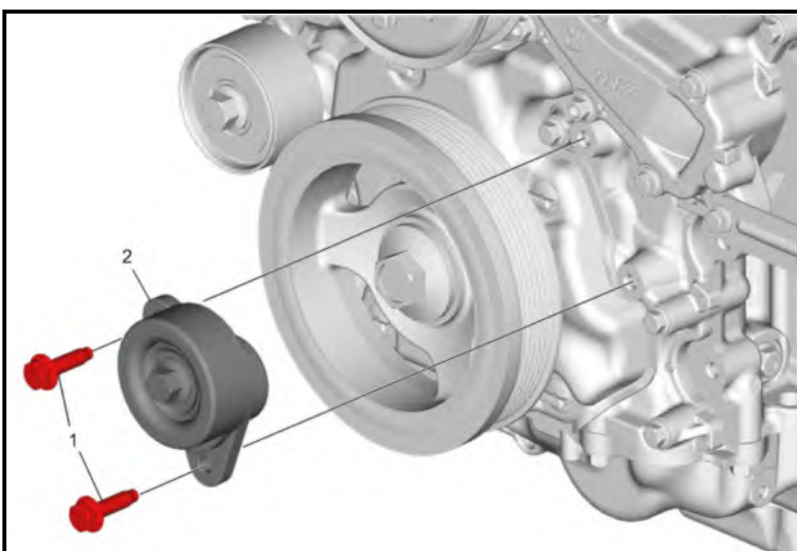
6. Generator and Drive Belt Tensioner Bracket (1) - Install - [Generator and Drive Belt Tensioner Bracket Replacement](#)



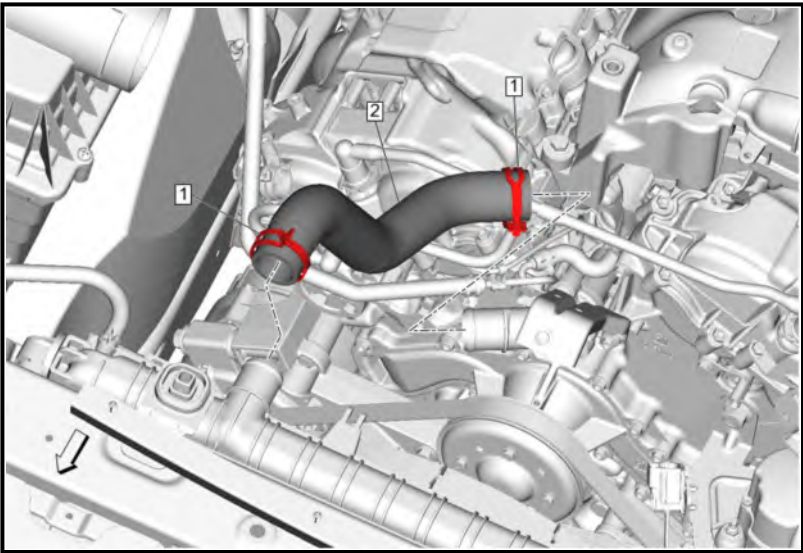
7. Water Pump Pulley (2) - Install - [Water Pump Pulley Replacement \(LGZ\)](#)



8. Drive Belt Tensioner (2) - Install - [Drive Belt Tensioner Replacement](#)

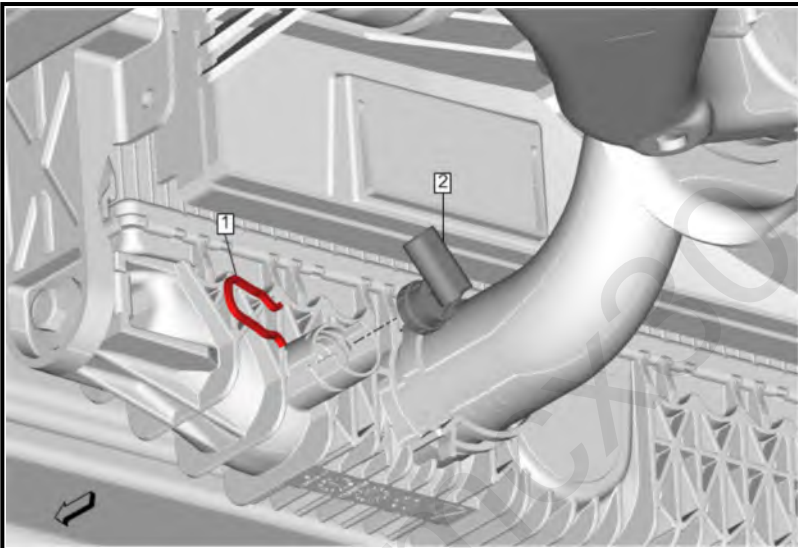


9. Radiator Inlet Hose (2) - Install - [Radiator Inlet Hose Replacement \(LGZ\)](#).



10. Start the engine and check for leaks.

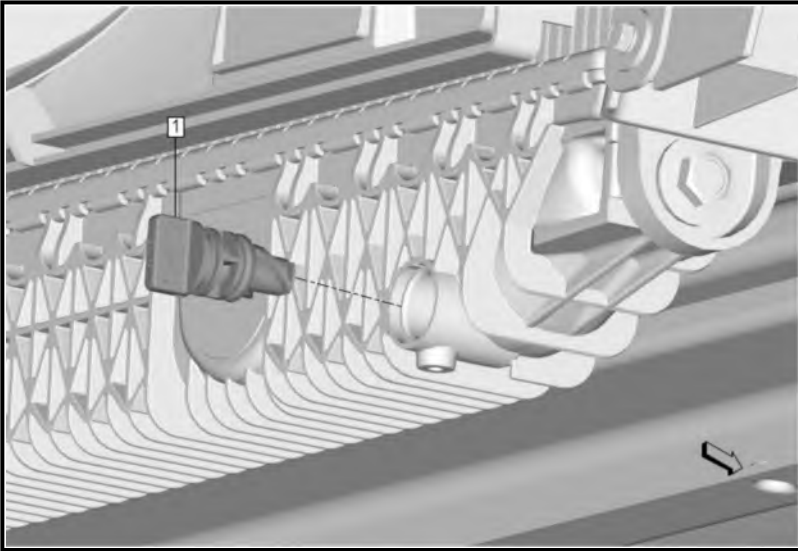
ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - RADIATOR (LCV)



NOTE: Callouts in the following chart represent components shown in graphic above.

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

RADIATOR DRAIN COCK REPLACEMENT (LCV, LWN, LGZ)



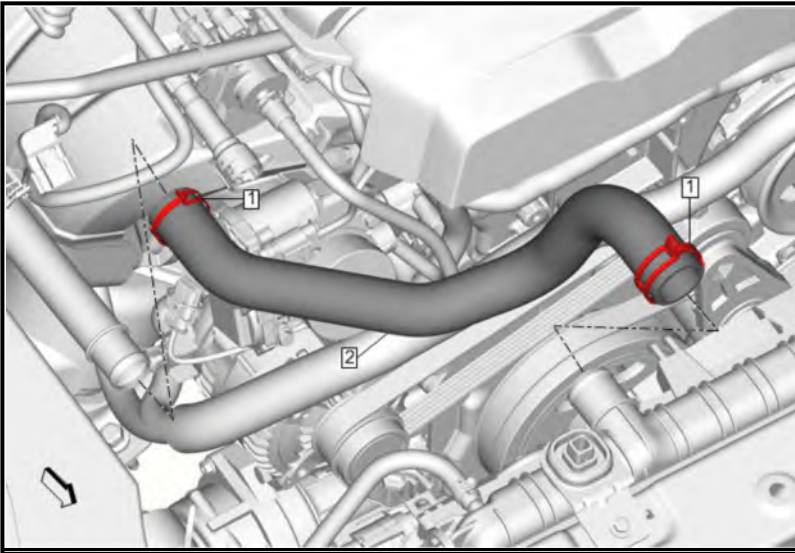
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure 1. <u>Underbody Splash Shield Replacement (without ZR2)</u> , or <u>Underbody Splash Shield Replacement (with ZR2)</u> , or <u>Underbody Splash Shield Replacement (Bison)</u> 2. Drain the cooling system. <u>Cooling System Draining and Filling (Static Fill)</u> , or <u>Cooling System Draining and Filling (Vac n Fill)</u>	
1	Radiator Drain Cock Procedure 1. Fill the cooling system. <u>Cooling System Draining and Filling (Static Fill)</u> , or <u>Cooling System Draining and Filling (Vac n Fill)</u> 2. Check the cooling system for leaks. <u>Cooling System Leak Testing</u>

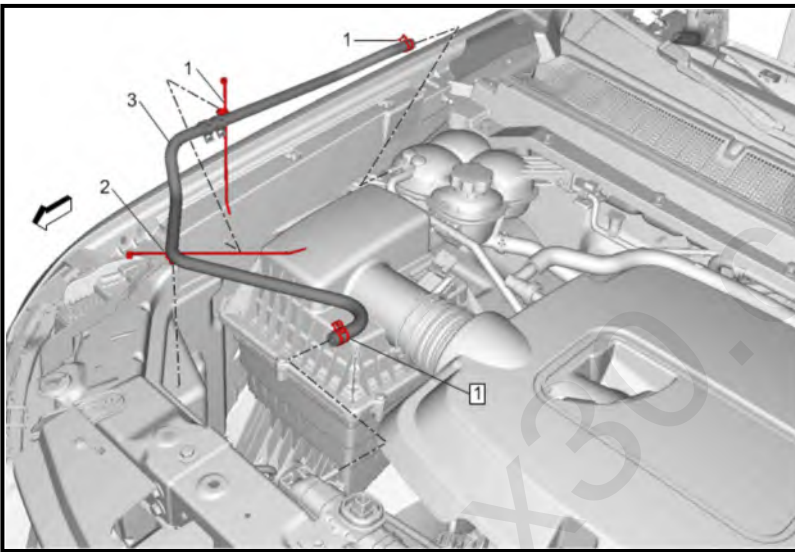
ENGINE COOLANT FAN SHROUD REPLACEMENT (LCV, LGZ)

Removal Procedure

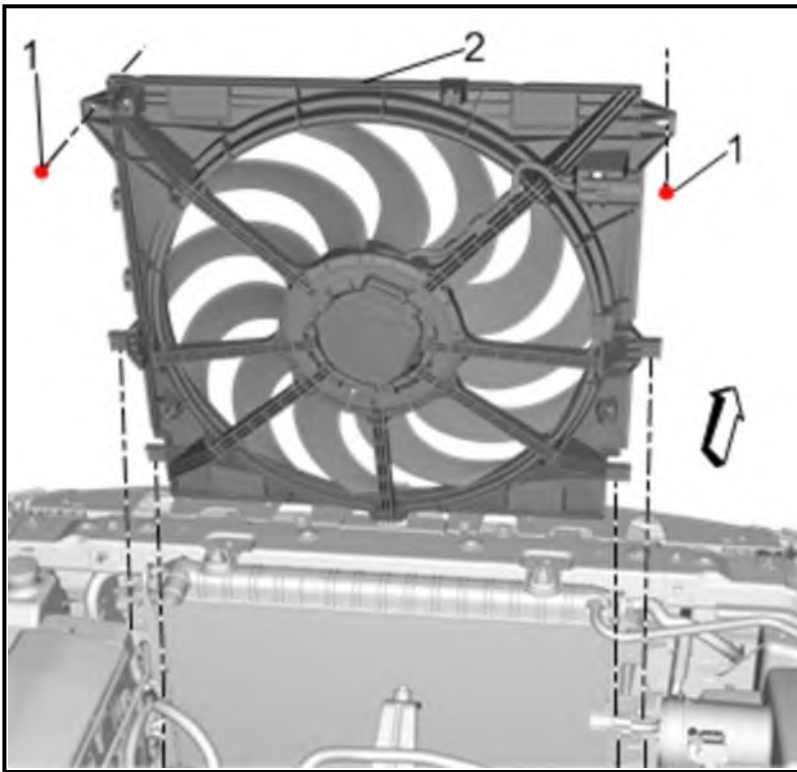
1. Radiator Inlet Hose (2) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#), or [Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#), or [Radiator Inlet Hose Replacement \(LGZ\)](#).



2. Radiator Vent Outlet Hose (3) @ Radiator - Remove - **Radiator Vent Outlet Hose Replacement (LCV, LGZ)**

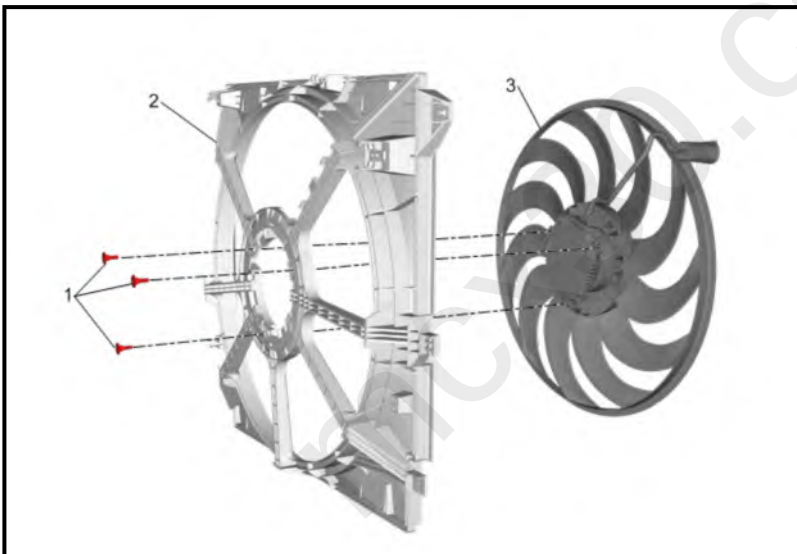


3. Disconnect the electrical connector.
4. Unclip the transmission fluid cooler inlet and outlet pipe from the engine coolant fan shroud if equipped.
5. Engine Coolant Fan Shroud Bolt (1) - Remove [2x]



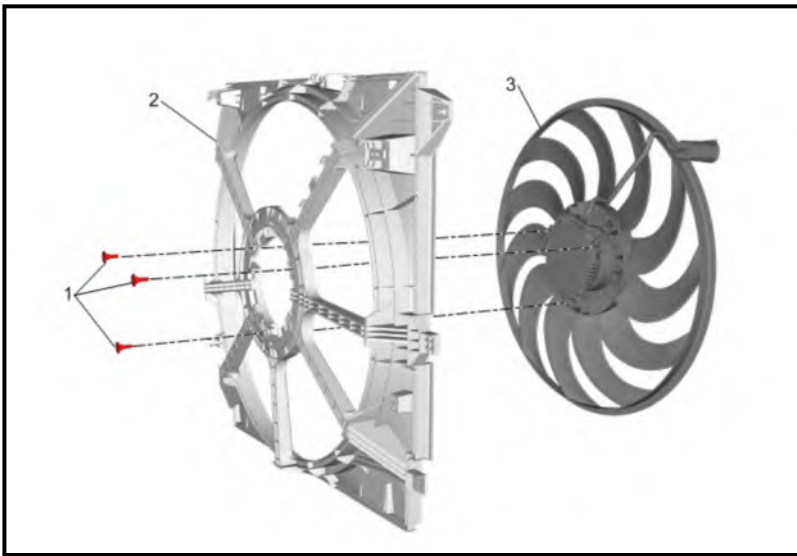
6. Engine Coolant Fan Shroud (2) - Remove

7. Fan Blade (3) - Remove - [Fan Blade Replacement \(LCV, LGZ\)](#) .

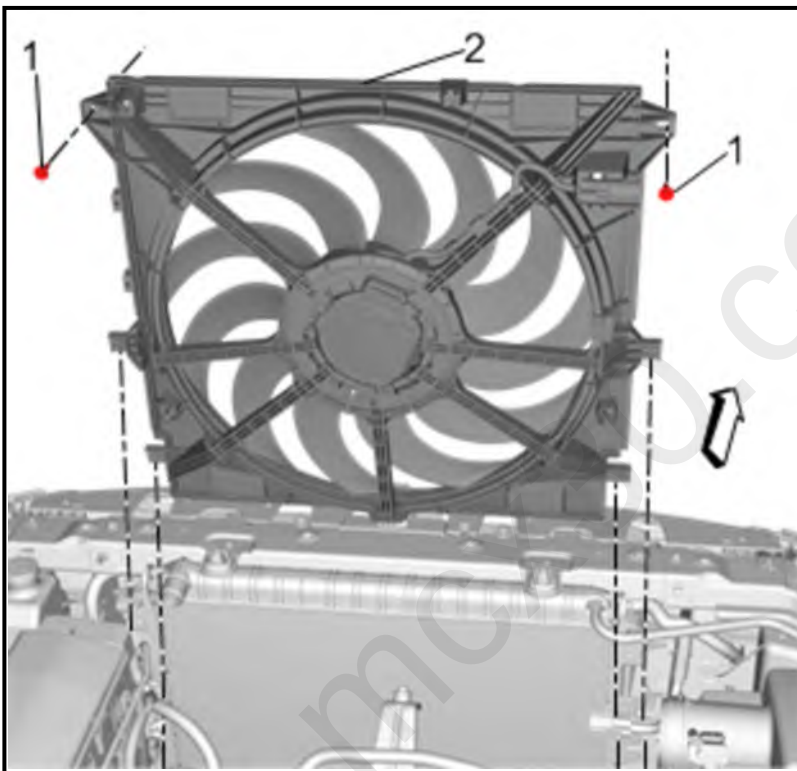


Installation Procedure

1. Fan Blade (3) - Install - [Fan Blade Replacement \(LCV, LGZ\)](#) .

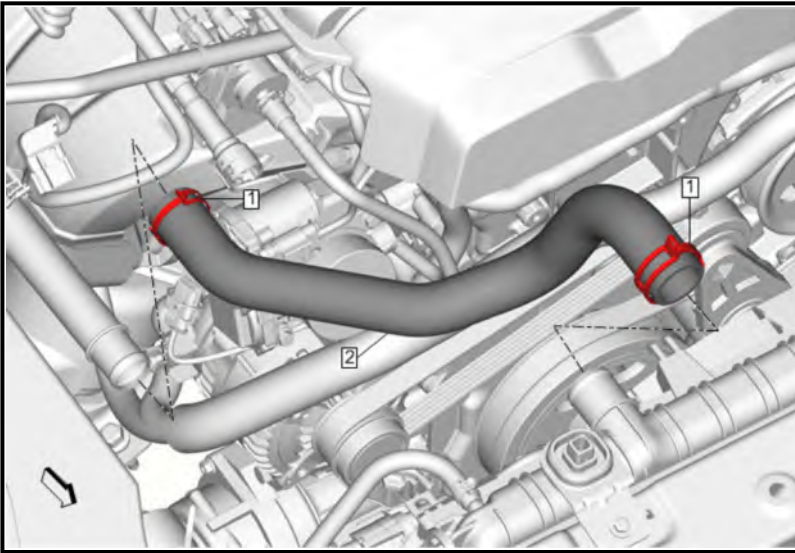


2. Engine Coolant Fan Shroud (2) - Install

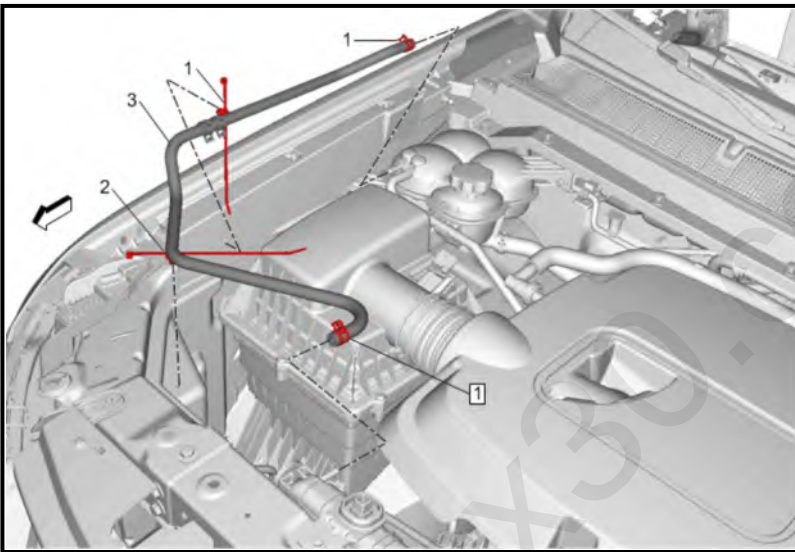


CAUTION: Refer to [Fastener Caution](#) .

3. Engine Coolant Fan Shroud Bolt (1) - Install [2x] 10 N.m (89 lb in)
4. Clip the transmission fluid cooler inlet and outlet pipe to the engine coolant fan shroud if equipped.
5. Connect the electrical connector.
6. Radiator Inlet Hose (2) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LCV Radiator to Inlet Pipe\)](#), or [Radiator Inlet Hose Replacement \(LCV Inlet Pipe to Water Outlet\)](#), or [Radiator Inlet Hose Replacement \(LGZ\)](#).



7. Radiator Vent Outlet Hose (3) @ Radiator - Install - [Radiator Vent Outlet Hose Replacement \(LCV, LGZ\)](#)

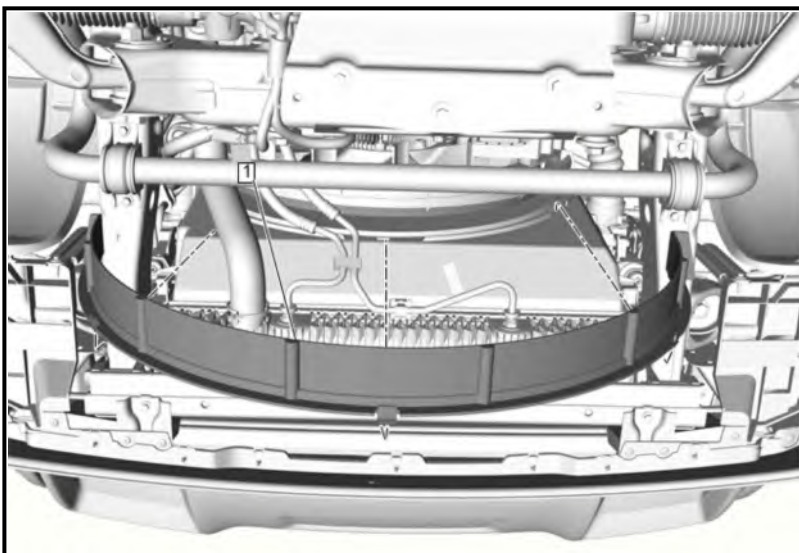


8. Fill the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
 9. Check the cooling system for leaks.

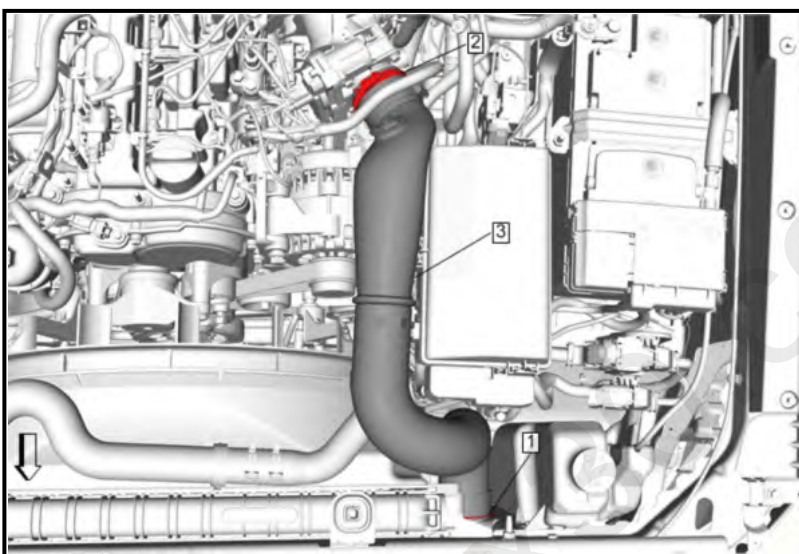
ENGINE COOLANT FAN SHROUD REPLACEMENT (LWN)

Removal Procedure

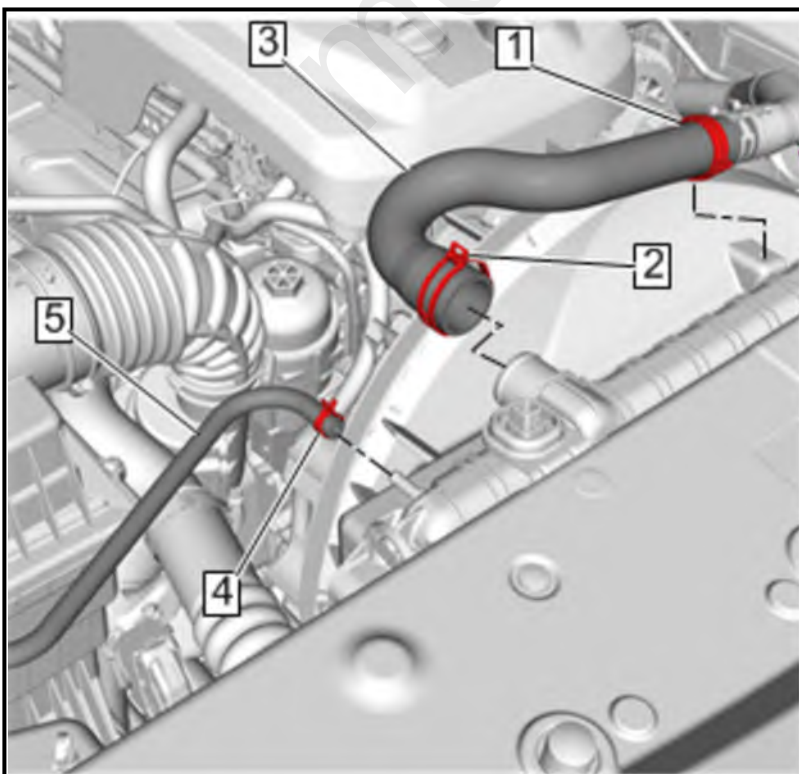
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Engine Coolant Fan Lower Shroud (1) - Remove - [Engine Coolant Fan Lower Shroud Replacement \(LWN\)](#).



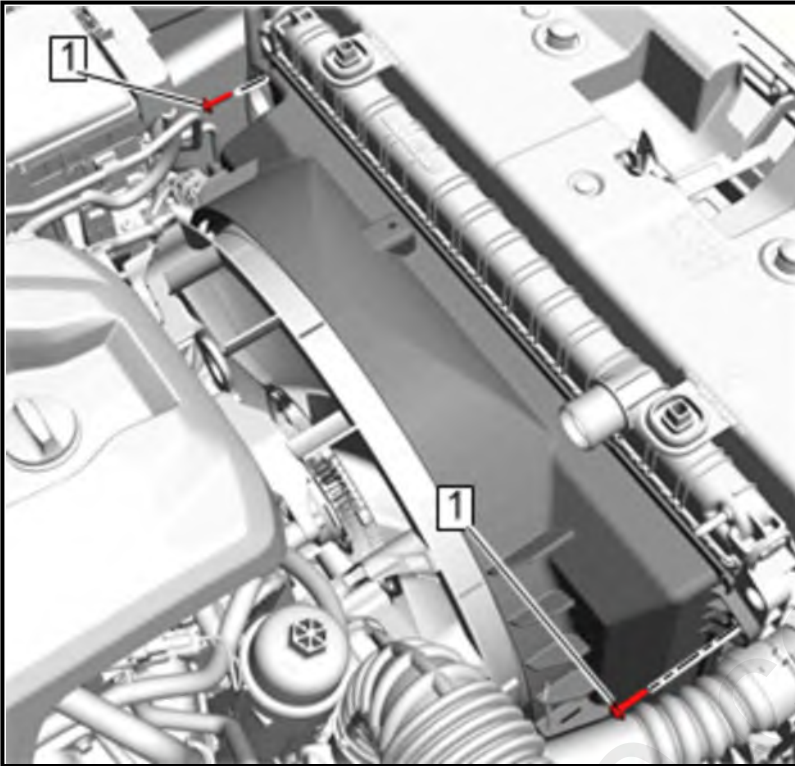
3. Charge Air Cooler Outlet Duct (3) - Remove - [Charge Air Cooler Outlet Duct Replacement](#)



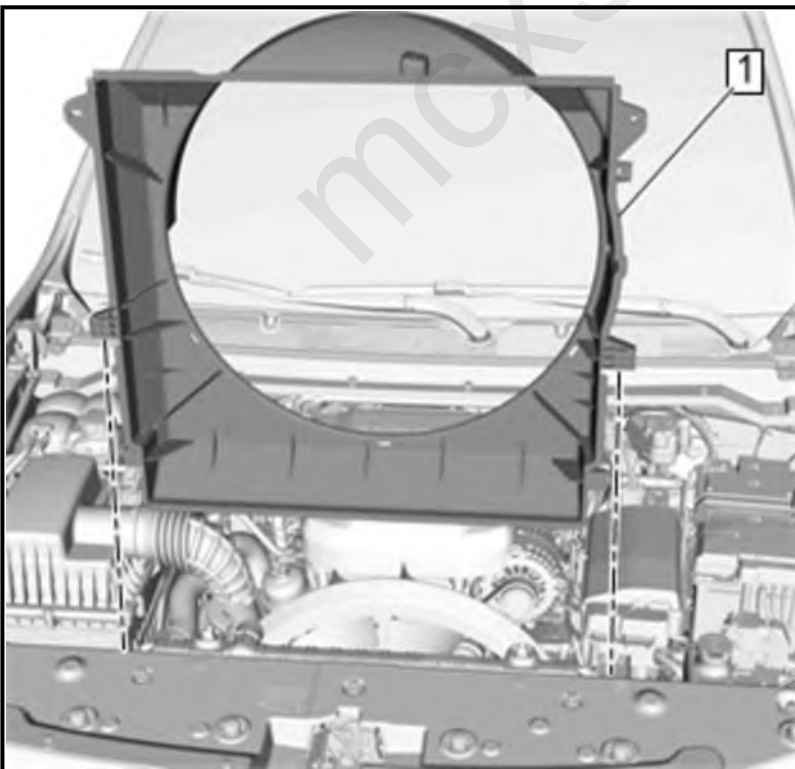
4. Radiator Inlet Hose Retainer (1) - Remove



5. Radiator Inlet Hose (3) @ Radiator Assembly - Remove - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#), or [Radiator Inlet Hose Replacement \(LWN Engine Side\)](#)
6. Radiator Vent Outlet Hose (5) @ Radiator Assembly - Remove - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)
7. Engine Coolant Fan Shroud Bolt (1) - Remove [2x]

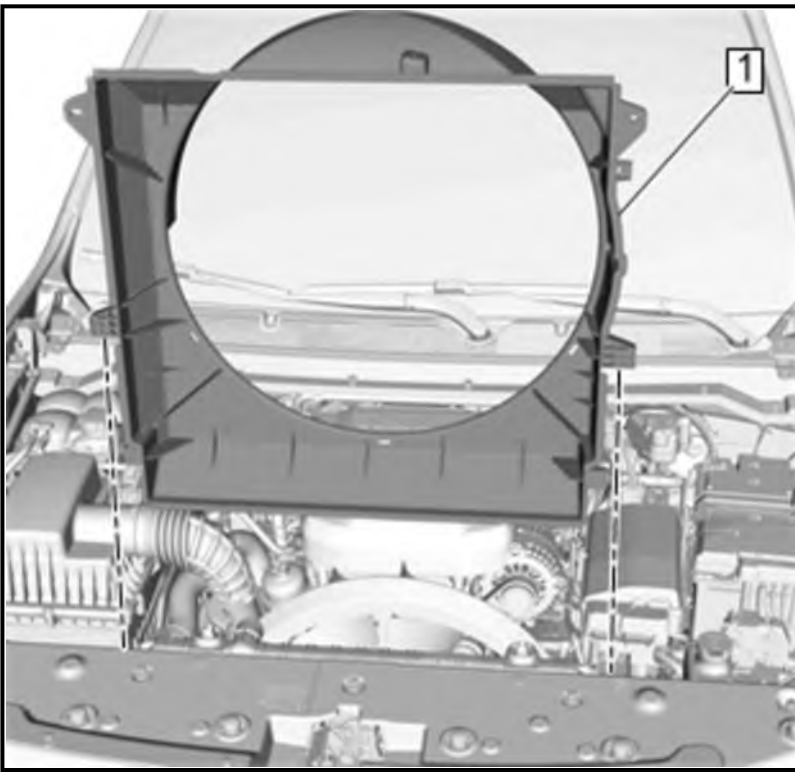


8. Wiring Harness Retainer @ Engine Coolant Fan Shroud - Remove
9. Engine Coolant Fan Shroud (1) - Remove

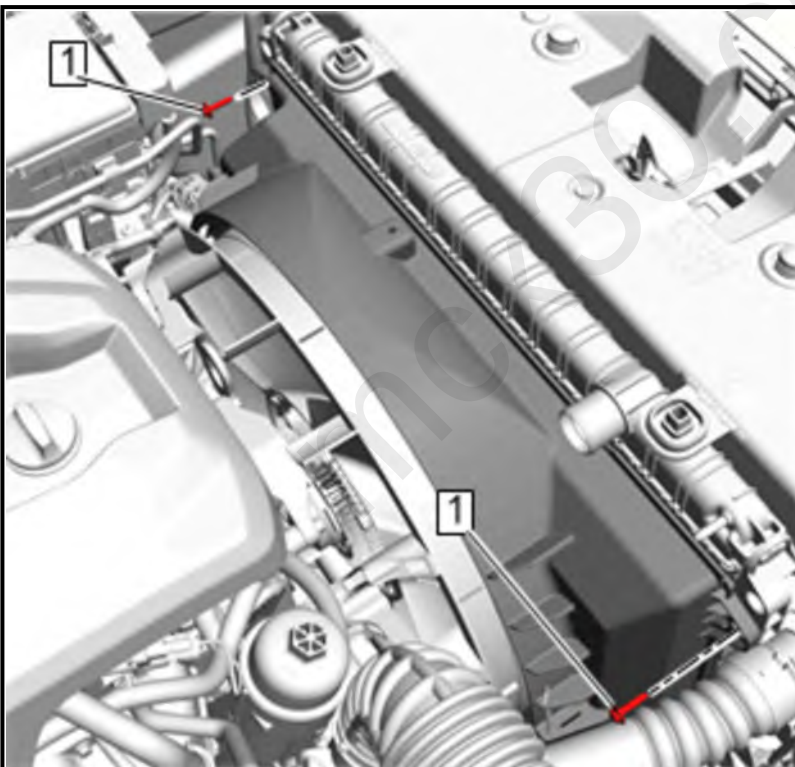


Installation Procedure

1. Engine Coolant Fan Shroud (1) - Install

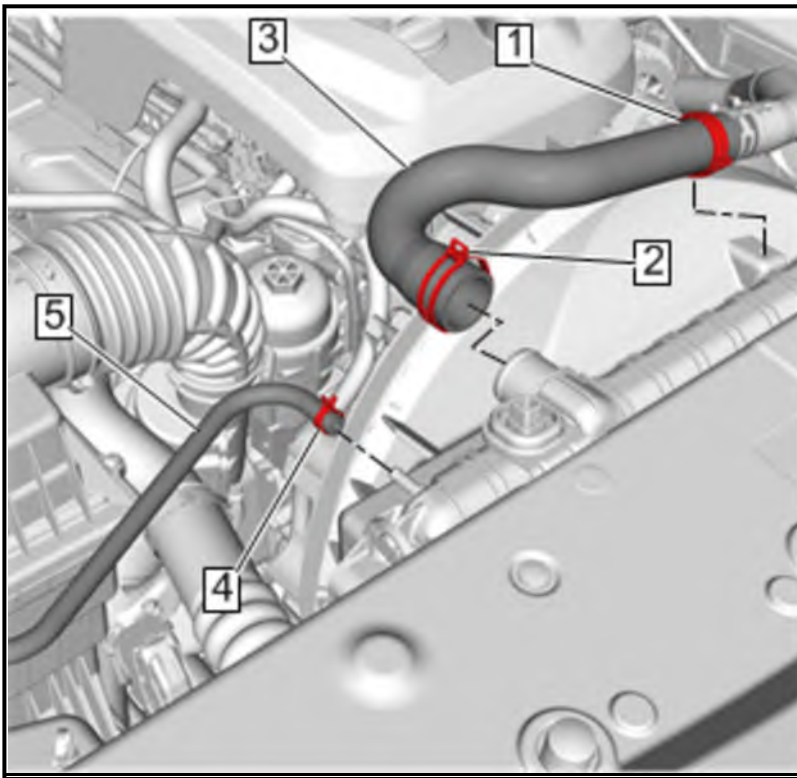


2. Wiring Harness Retainer @ Engine Coolant Fan Shroud - Install
3. Engine Coolant Fan Shroud Bolt (1) - Install and tighten [2x] 7 N.m (62 lb in)

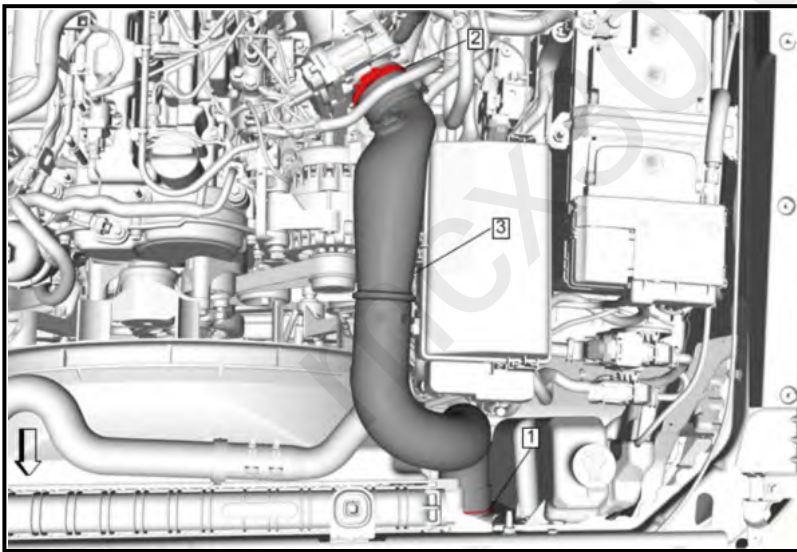


CAUTION: Refer to [Fastener Caution](#) .

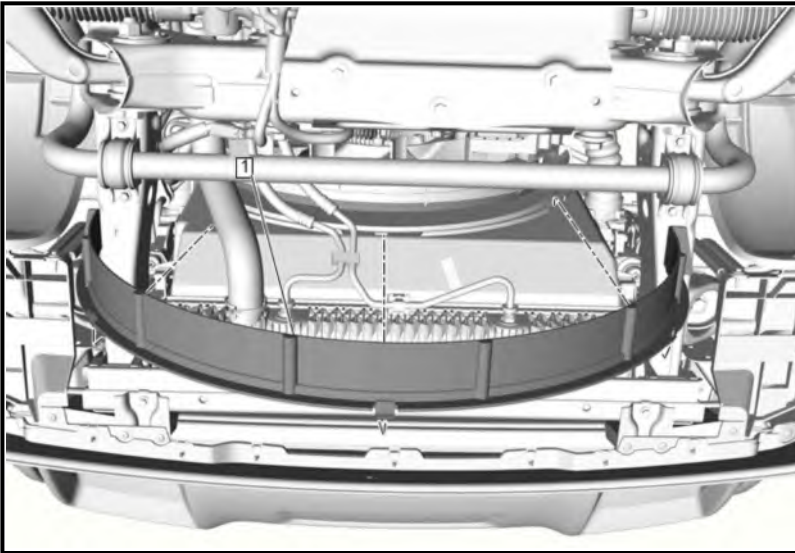
4. Radiator Vent Outlet Hose (5) @ Radiator Assembly - Install - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)



5. Radiator Inlet Hose (3) @ Radiator Assembly - Install - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#), or [Radiator Inlet Hose Replacement \(LWN Engine Side\)](#)
6. Radiator Inlet Hose Retainer (1) - Install
7. Charge Air Cooler Outlet Duct (3) - Install - [Charge Air Cooler Outlet Duct Replacement](#)

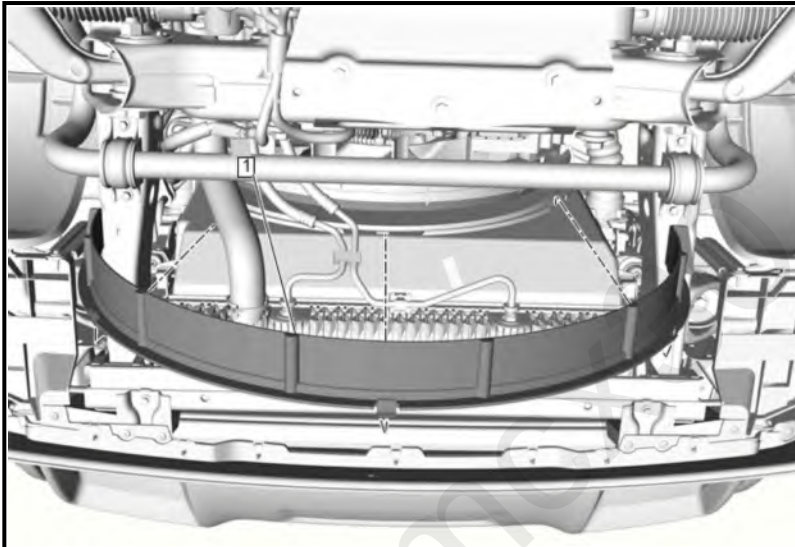


8. Engine Coolant Fan Lower Shroud (1) - Install - [Engine Coolant Fan Lower Shroud Replacement \(LWN\)](#)



9. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
10. Start the engine and check for coolant leaks.

ENGINE COOLANT FAN LOWER SHROUD REPLACEMENT (LWN)



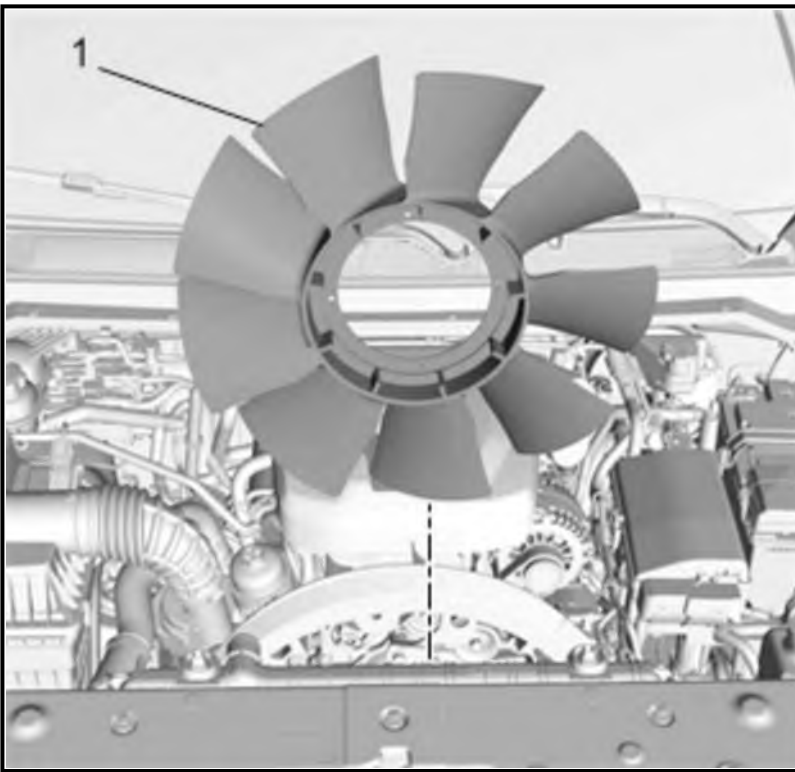
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Underbody Splash Shield Replacement (without ZR2) , or Underbody Splash Shield Replacement (with ZR2) , or Underbody Splash Shield Replacement (Bison)	
1	Engine Coolant Fan Lower Shroud Procedure Unclip the engine coolant fan lower shroud from the engine coolant fan shroud.

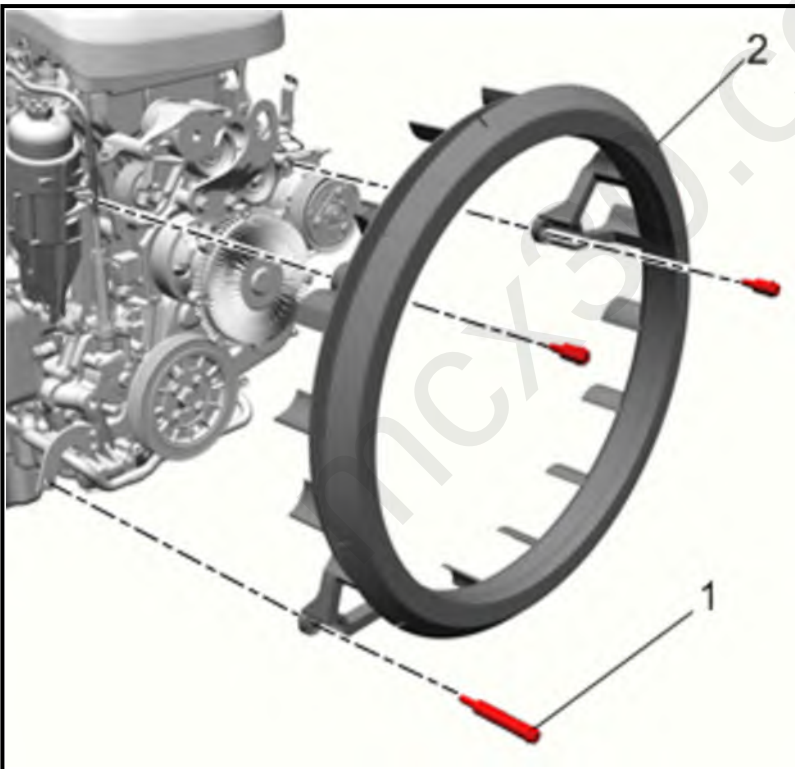
ENGINE COOLANT FAN REAR SHROUD REPLACEMENT (LWN)

Removal Procedure

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

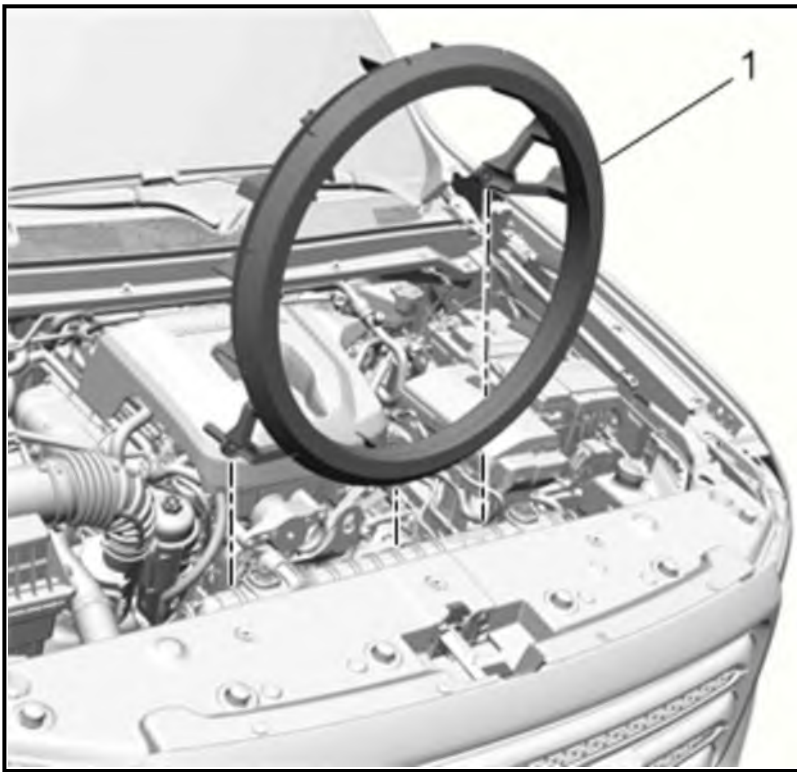


2. Engine Coolant Fan Rear Shroud Bolt (1)[3x] - Remove



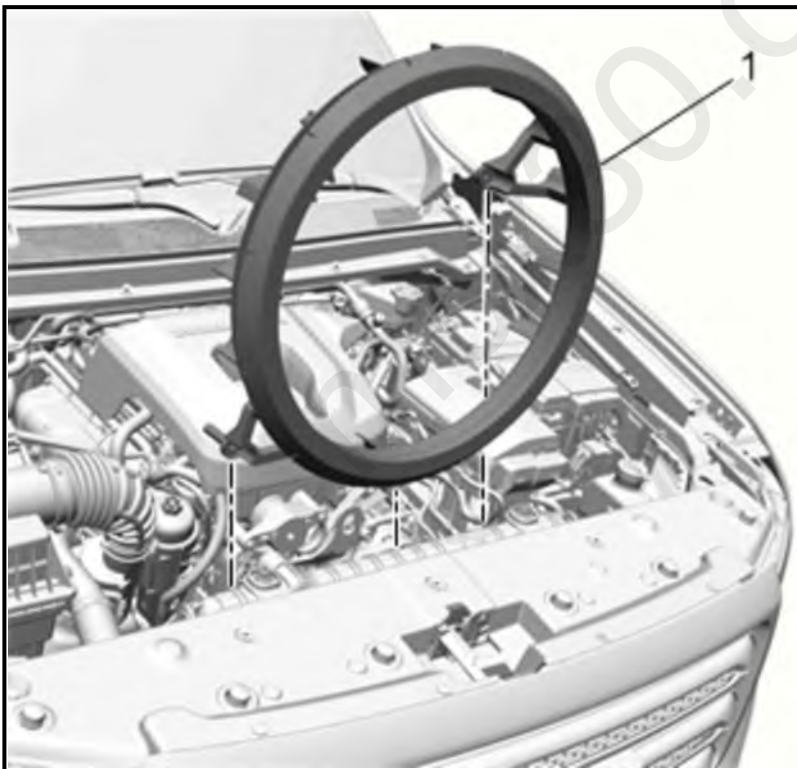
3. Engine Coolant Fan Rear Shroud (2) @ Engine Assembly - Remove

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

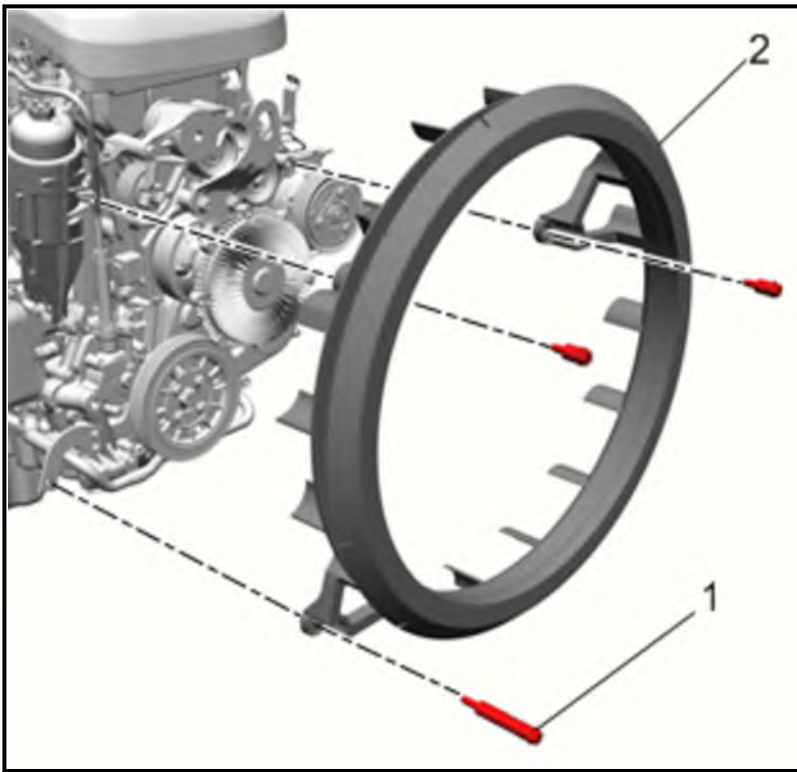


Installation Procedure

1. Engine Coolant Fan Rear Shroud (1) - Install on to Vehicle

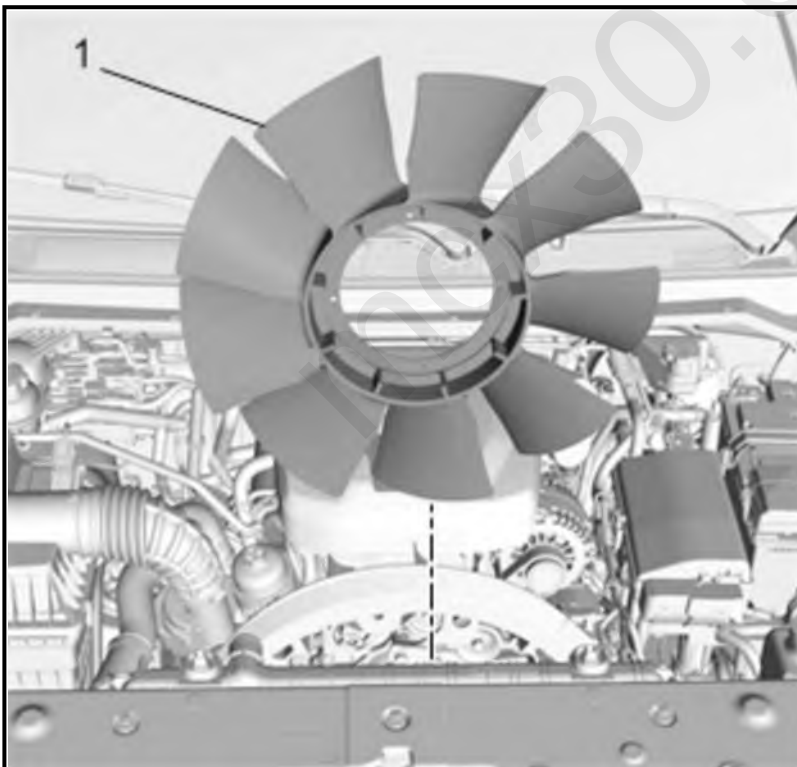


2. Engine Coolant Fan Rear Shroud (2) @ Engine Assembly - Install



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

3. Engine Coolant Fan Rear Shroud Bolt (1)[3x] - Install and tighten 22 N.m (16 lb ft)
4. [Fan Blade Replacement \(LWN\)](#) (1) - Install

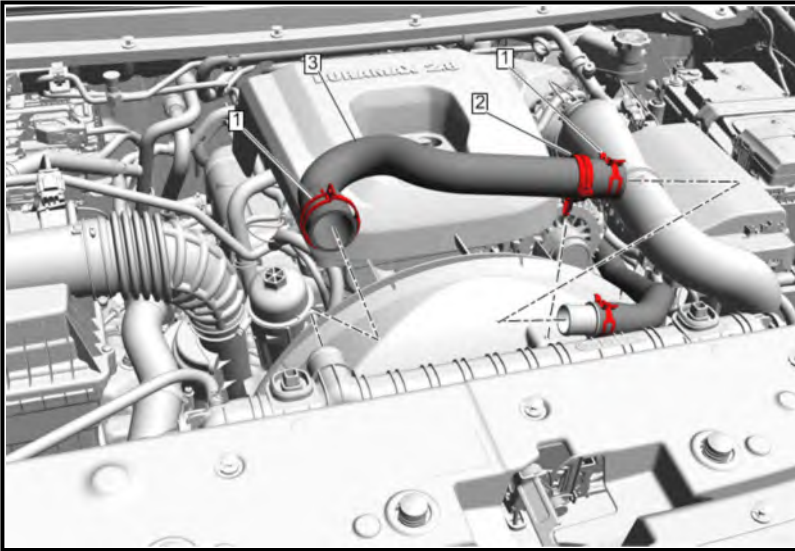


CONDENSER, FAN, AND RADIATOR ASSEMBLY REMOVAL AND INSTALLATION (LWN)

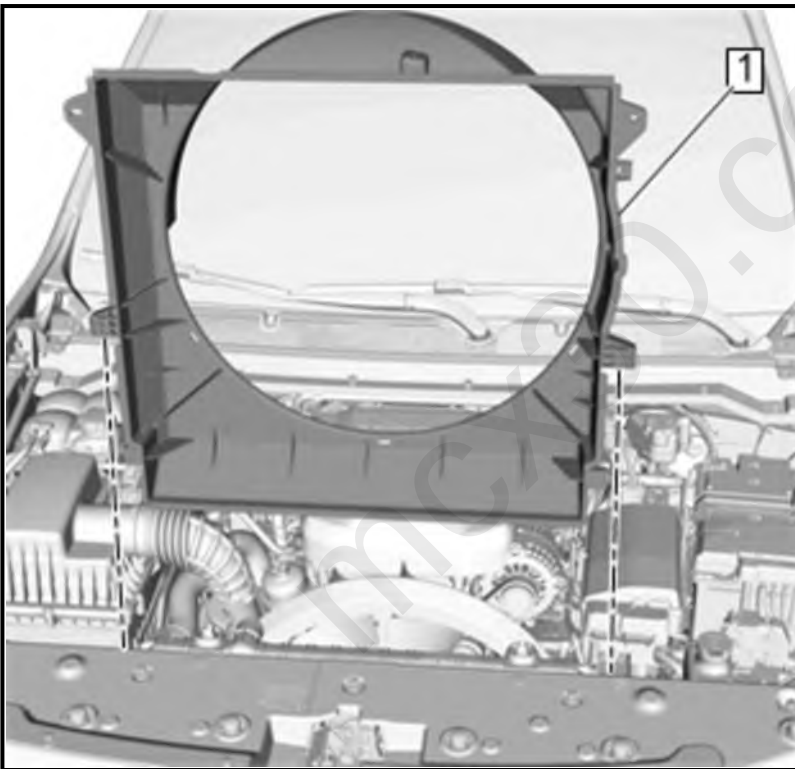
Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Recover the refrigerant. [Refrigerant Recovery and Recharging \(R-1234yf\)](#).

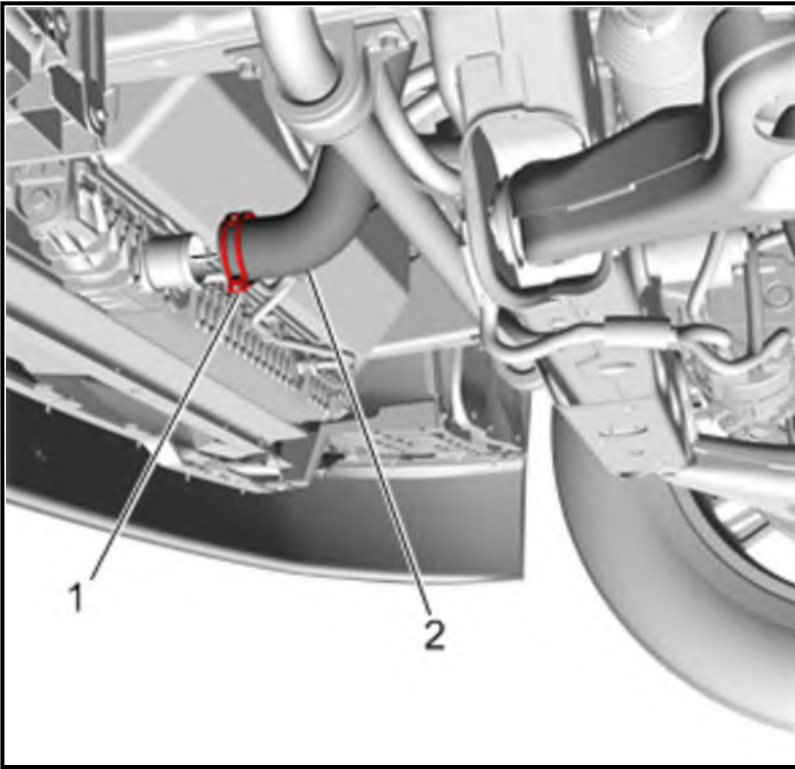
3. Radiator Inlet Hose (1) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#), or [Radiator Inlet Hose Replacement \(LWN Engine Side\)](#).



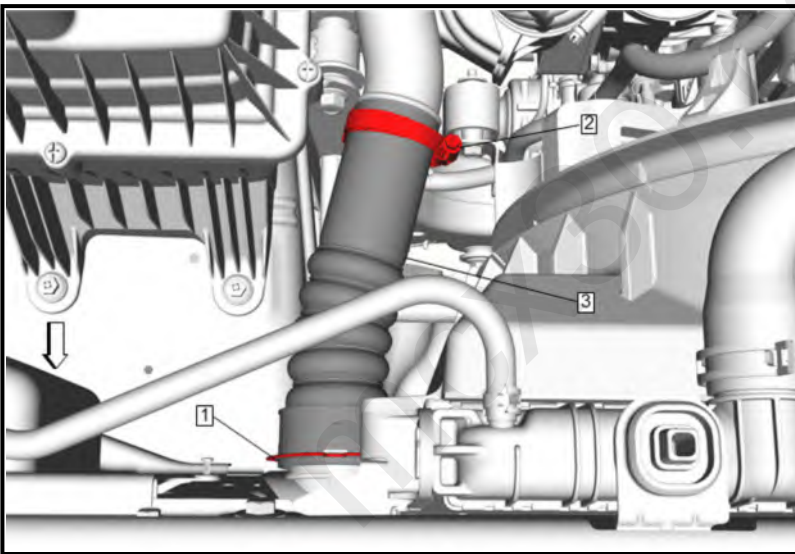
4. Engine Coolant Fan Shroud (1) - Remove - [Engine Coolant Fan Shroud Replacement \(LWN\)](#).



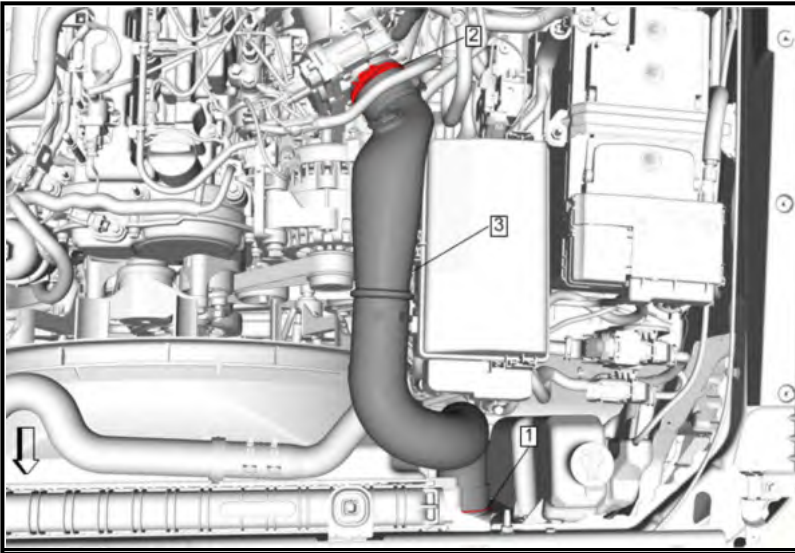
5. Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LWN\)](#).



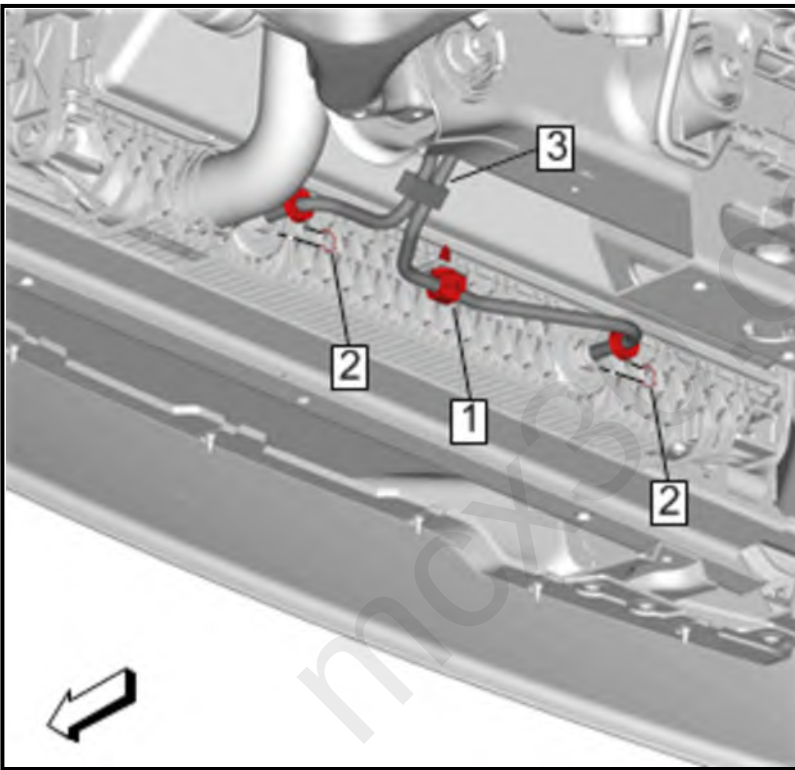
6. Charge Air Cooler Inlet Hose (3) @ Charge Air Cooler - Remove - [Charge Air Cooler Inlet Hose Replacement](#)



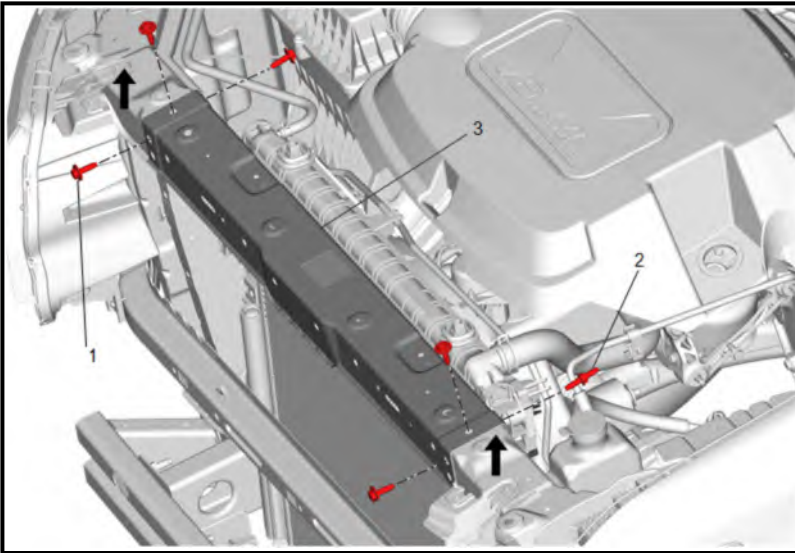
7. Charge Air Cooler Outlet Duct (3) @ Charge Air Cooler - Remove - [Charge Air Cooler Outlet Duct Replacement](#)



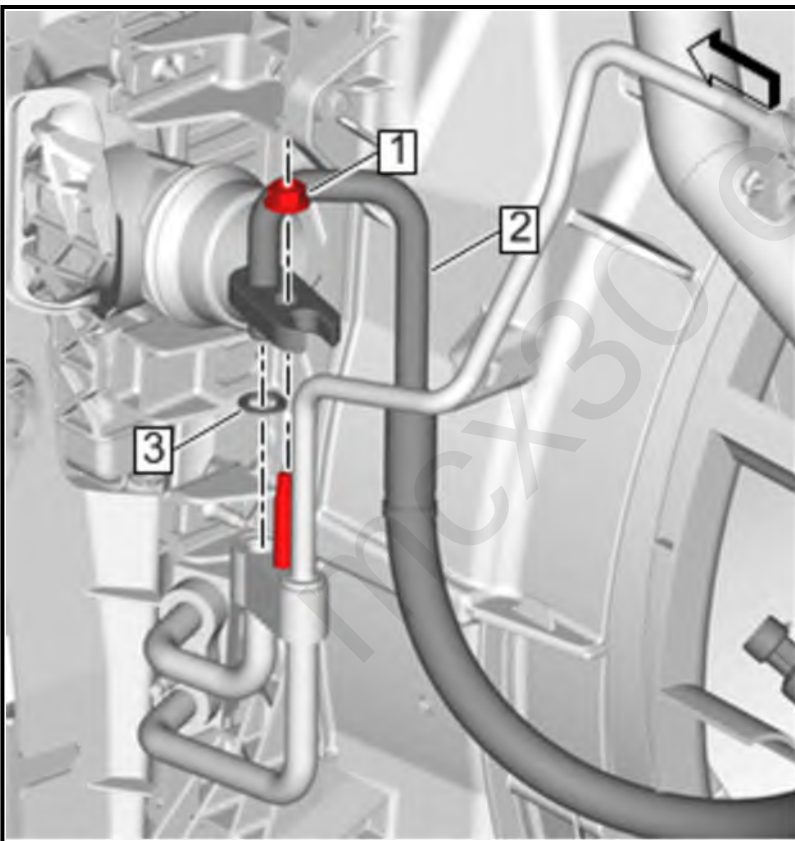
8. Transmission Fluid Cooler Inlet and Outlet Pipe (3) @ Radiator - Remove [2x] - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LWN\)](#).



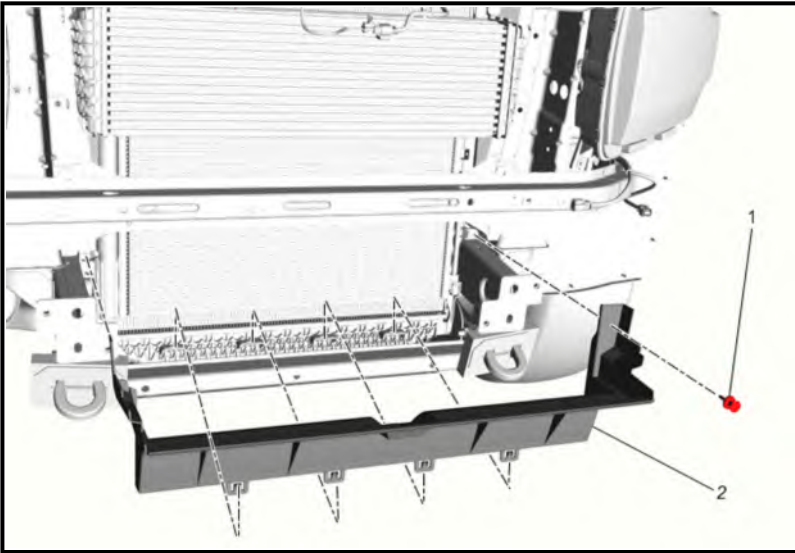
9. Front Bumper Fascia - Remove - [Front Bumper Fascia Replacement \(ZR2\)](#) , or [Front Bumper Fascia Replacement \(GMC\)](#) , or [Front Bumper Fascia Replacement \(Chevrolet\)](#).
10. Front End Upper Tie Bar (3) - Remove - [Front End Upper Tie Bar Replacement](#)



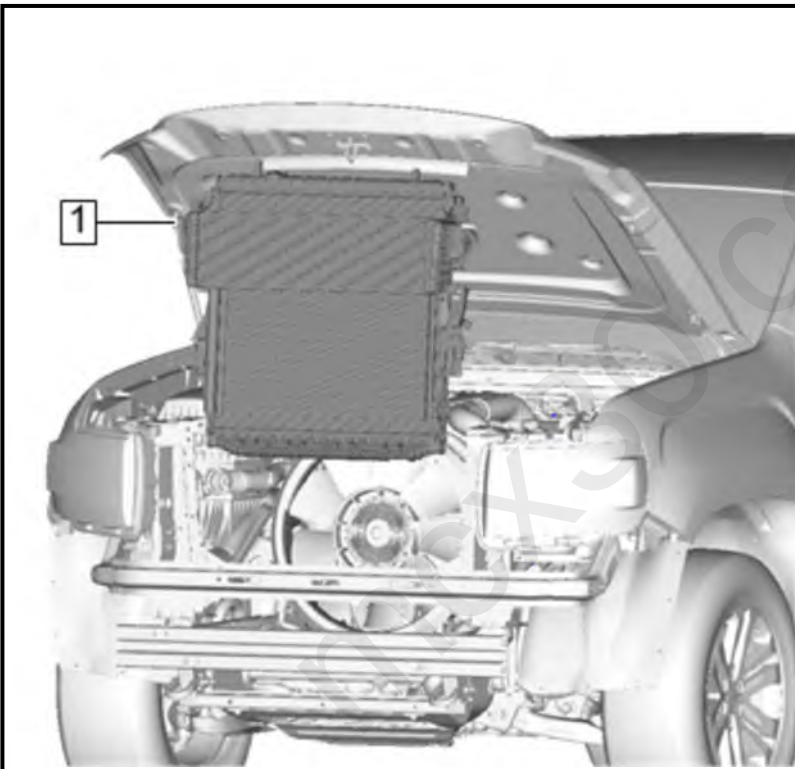
11. Upper and Lower Front Bumper Shutters - Remove - [Front Bumper Shutter Baffle Replacement \(Lower Without Bison\)](#) , or [Front Bumper Shutter Baffle Replacement \(Lower With Bison\)](#)
12. Air Conditioning Compressor Hose (2) @ Air Conditioning Condenser - Remove - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)



13. Radiator Air Lower Baffle (2) - Remove - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#)

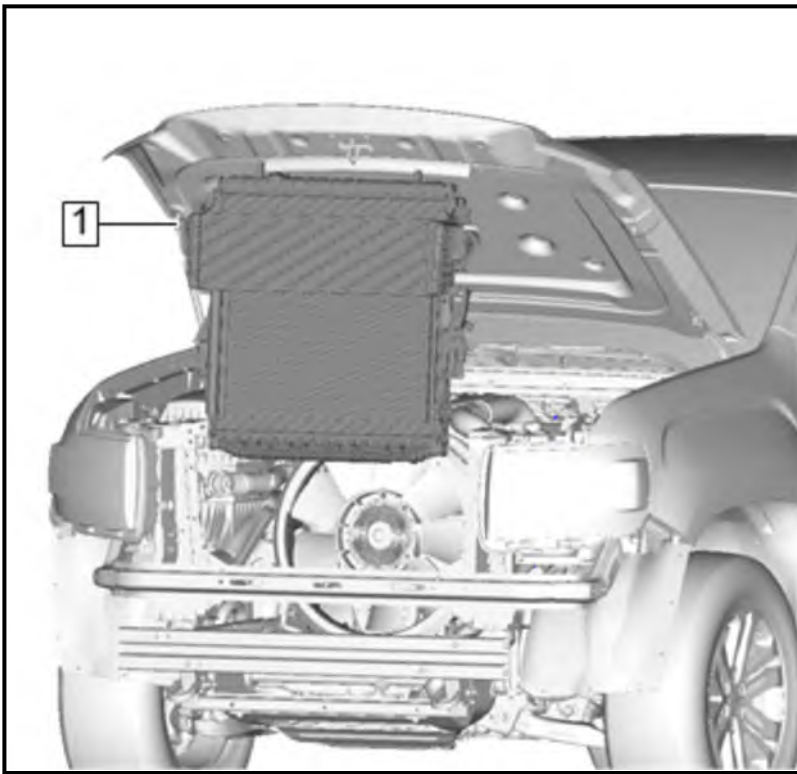


14. Radiator Vent Outlet Hose @ Radiator - Remove - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)
15. Radiator Assembly (1) - Remove

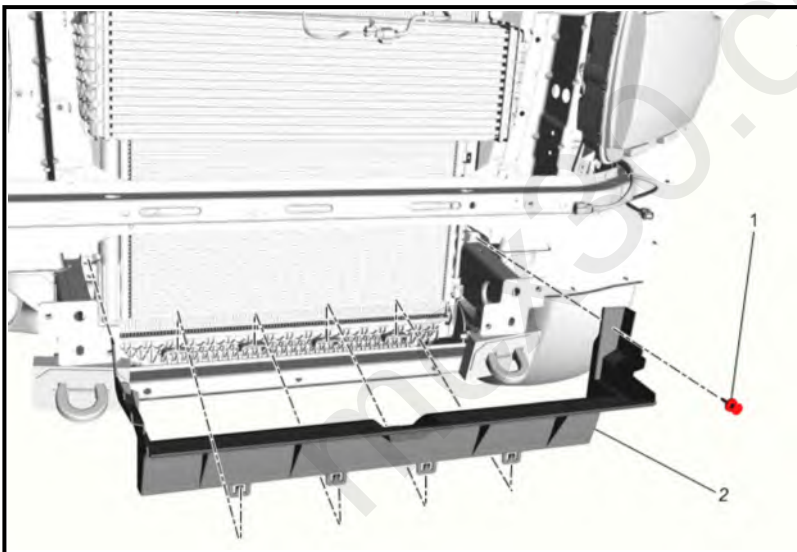


Installation Procedure

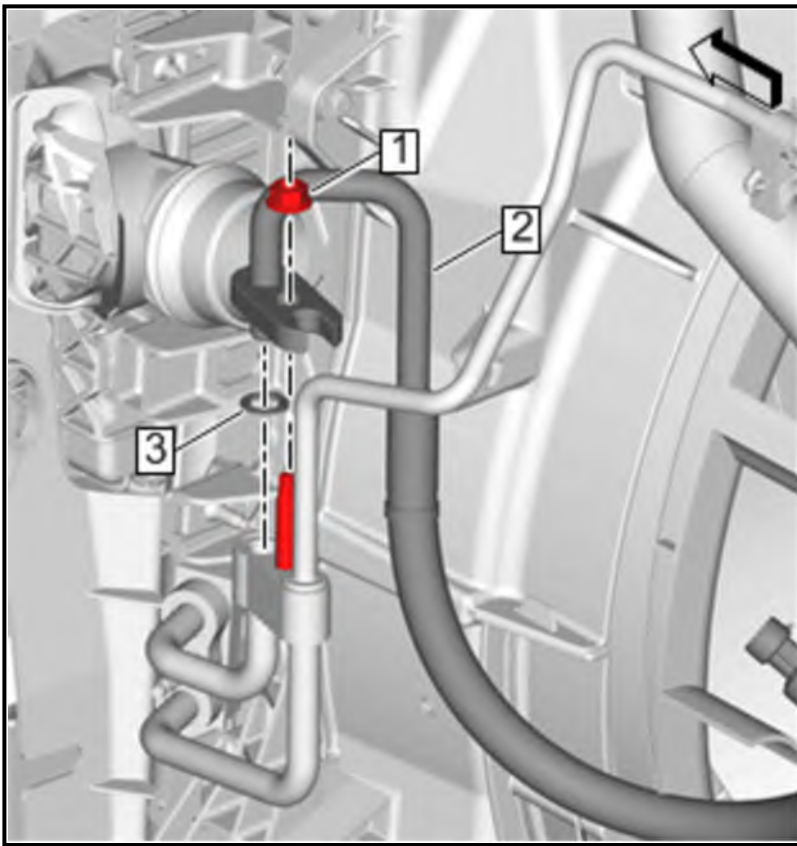
1. Radiator Assembly (1) - Install



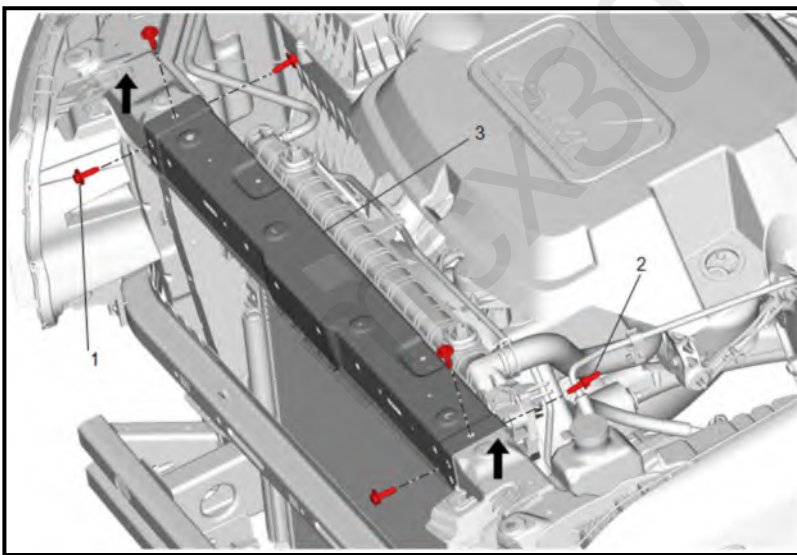
- 2. Radiator Vent Outlet Hose @ Radiator - Install - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)
- 3. Radiator Air Lower Baffle (2) - Install - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#)



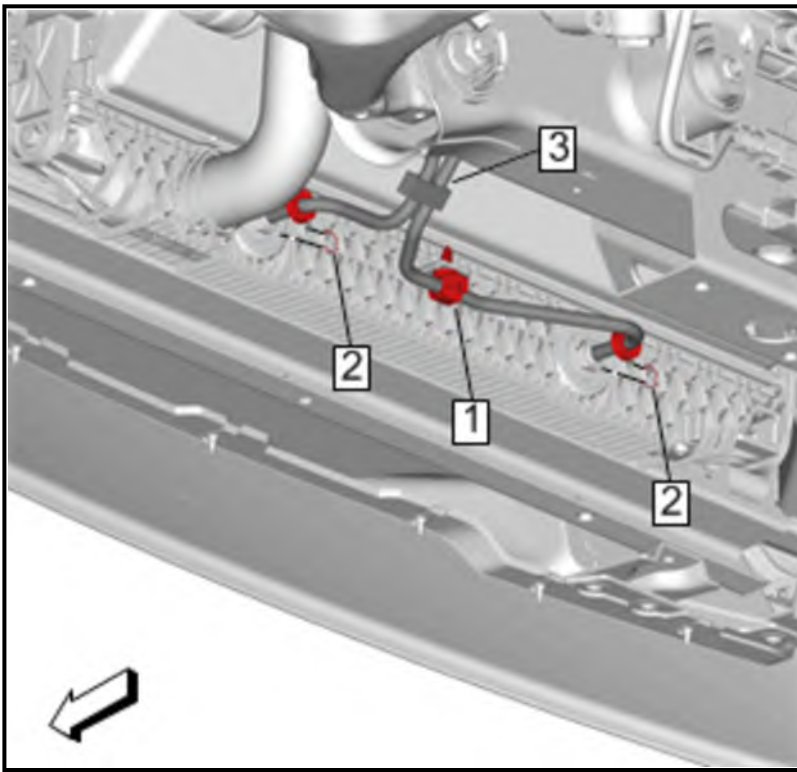
- 4. Air Conditioning Compressor Hose (2) @ Air Conditioning Condenser - Install - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)



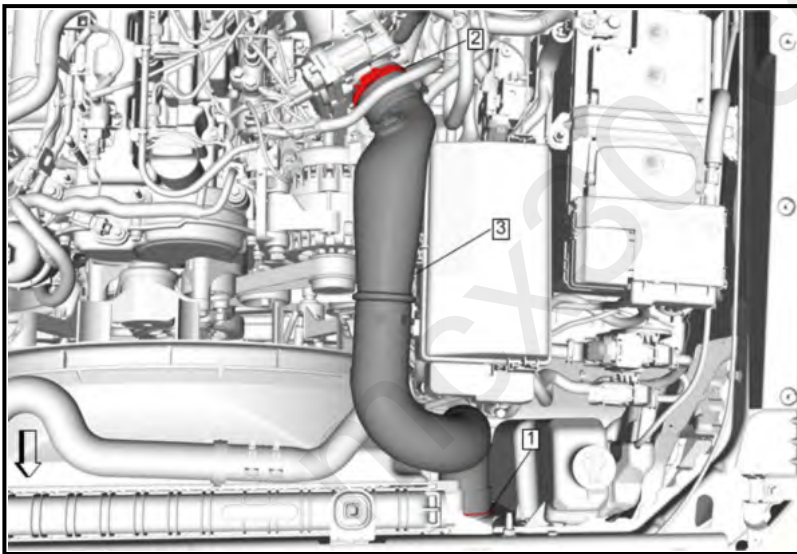
5. Upper and Lower Front Bumper Shutters - Install - [Front Bumper Shutter Baffle Replacement \(Lower Without Bison\)](#) , or [Front Bumper Shutter Baffle Replacement \(Lower With Bison\)](#).
6. Front End Upper Tie Bar (3) - Install - [Front End Upper Tie Bar Replacement](#)



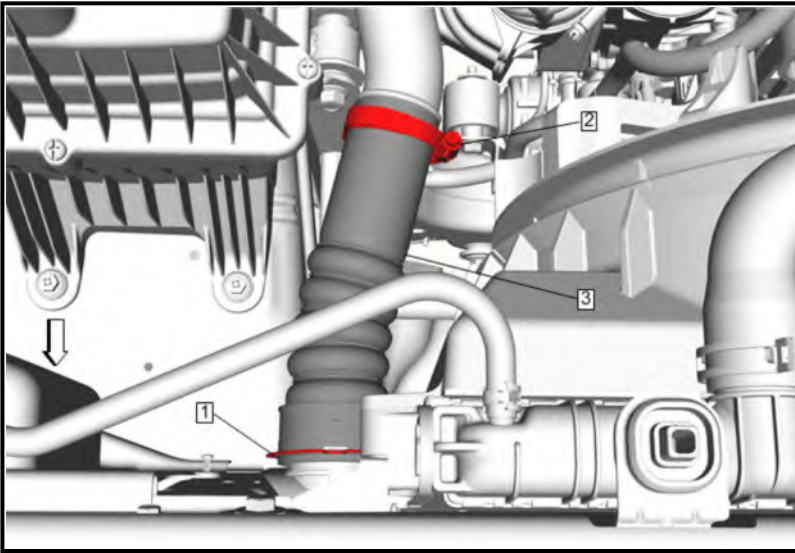
7. Front Bumper Fascia - Install - [Front Bumper Fascia Replacement \(ZR2\)](#) , or [Front Bumper Fascia Replacement \(GMC\)](#) , or [Front Bumper Fascia Replacement \(Chevrolet\)](#).
8. Transmission Fluid Cooler Inlet and Outlet Pipe (3) @ Radiator - Install [2x] - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LWN\)](#).



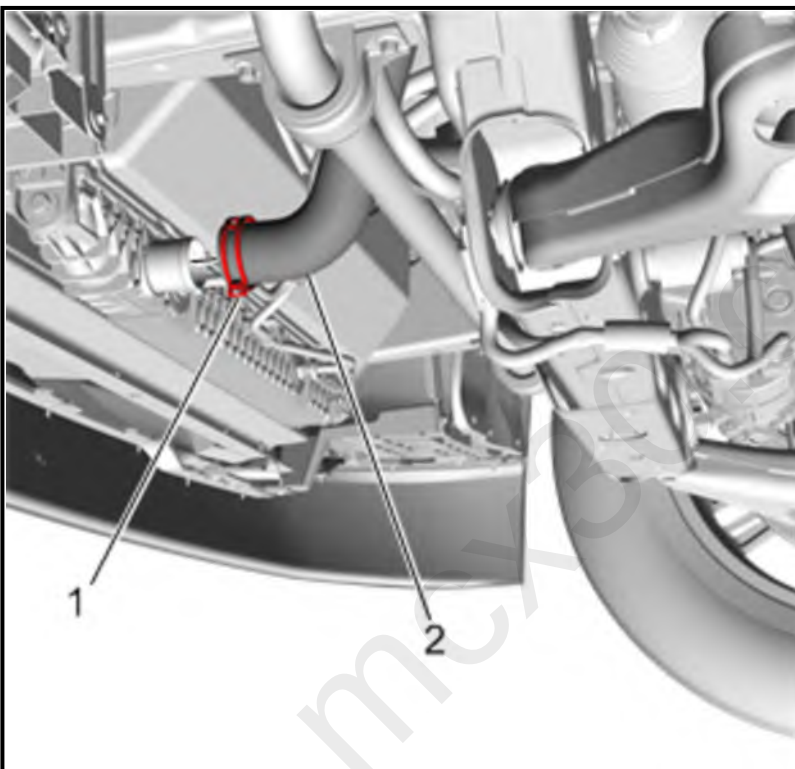
9. Charge Air Cooler Outlet Duct (3) @ Charge Air Cooler - Install - [Charge Air Cooler Outlet Duct Replacement](#)



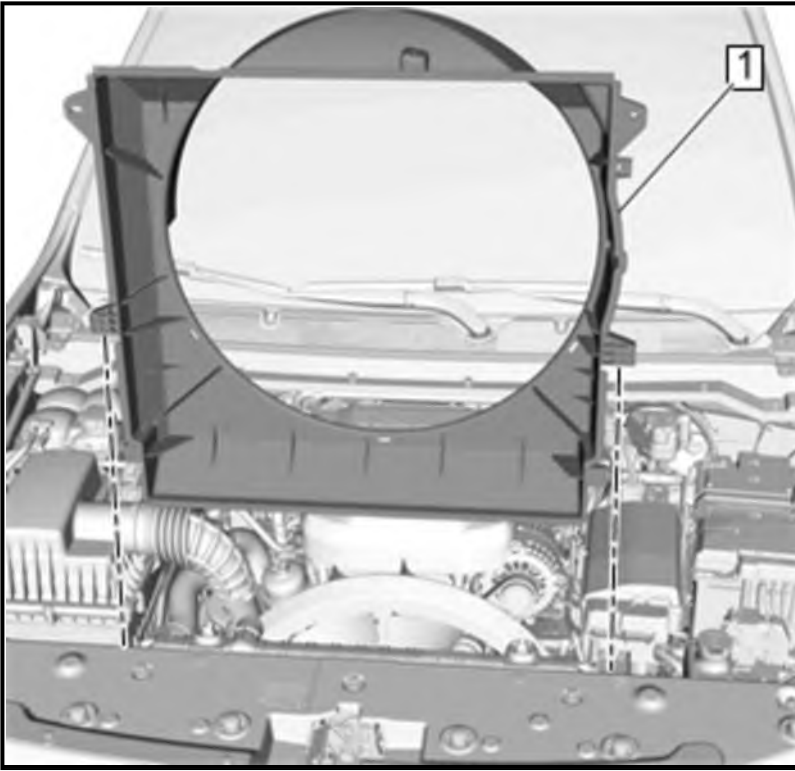
10. Charge Air Cooler Inlet Hose (3) @ Charge Air Cooler - Install - [Charge Air Cooler Inlet Hose Replacement](#)



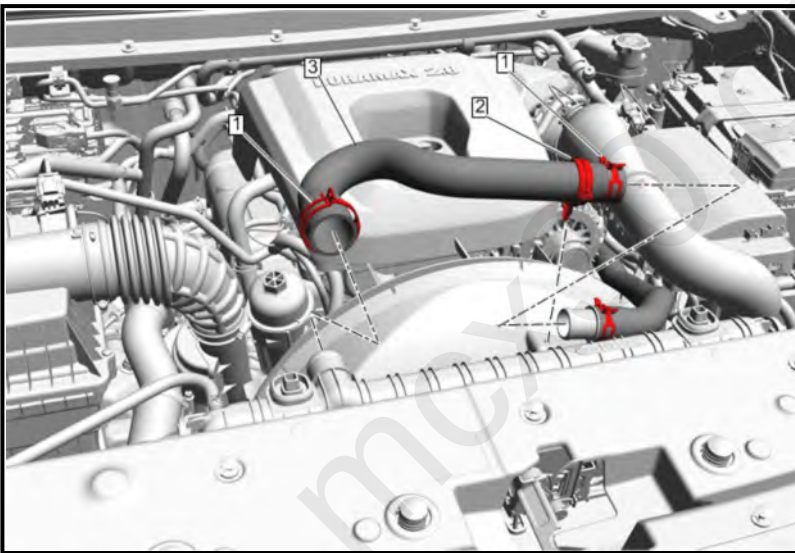
11. Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LWN\)](#).



12. Engine Coolant Fan Shroud (1) - Install - [Engine Coolant Fan Shroud Replacement \(LWN\)](#).



13. Radiator Inlet Hose (1) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#)



14. Recharge the refrigerant. [Refrigerant Recovery and Recharging \(R-1234yf\)](#)

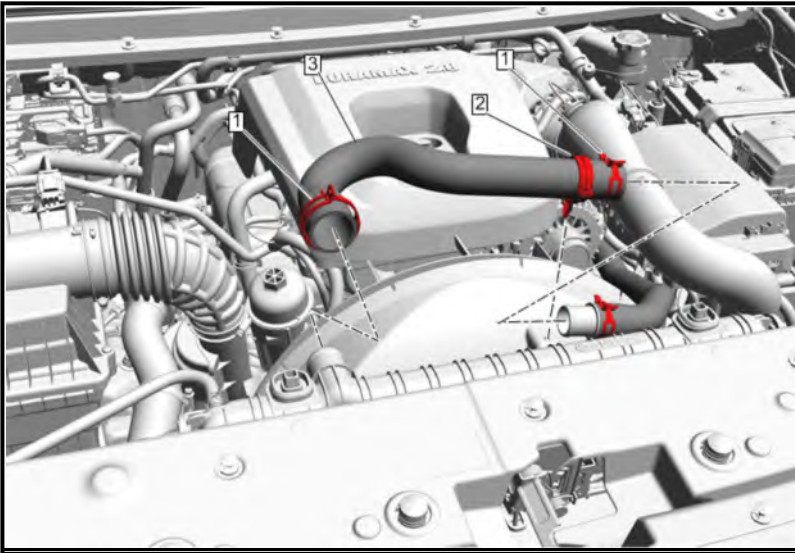
15. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)

16. Start the engine and check for coolant leaks.

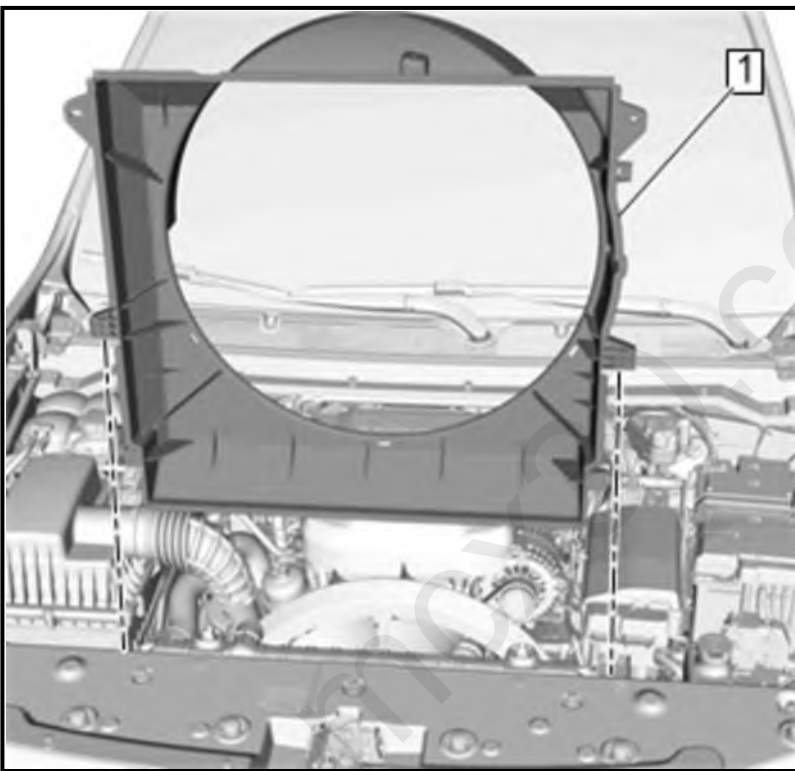
CONDENSER, FAN, AND RADIATOR ASSEMBLY REMOVAL AND INSTALLATION (LWN BISON)

Removal Procedure

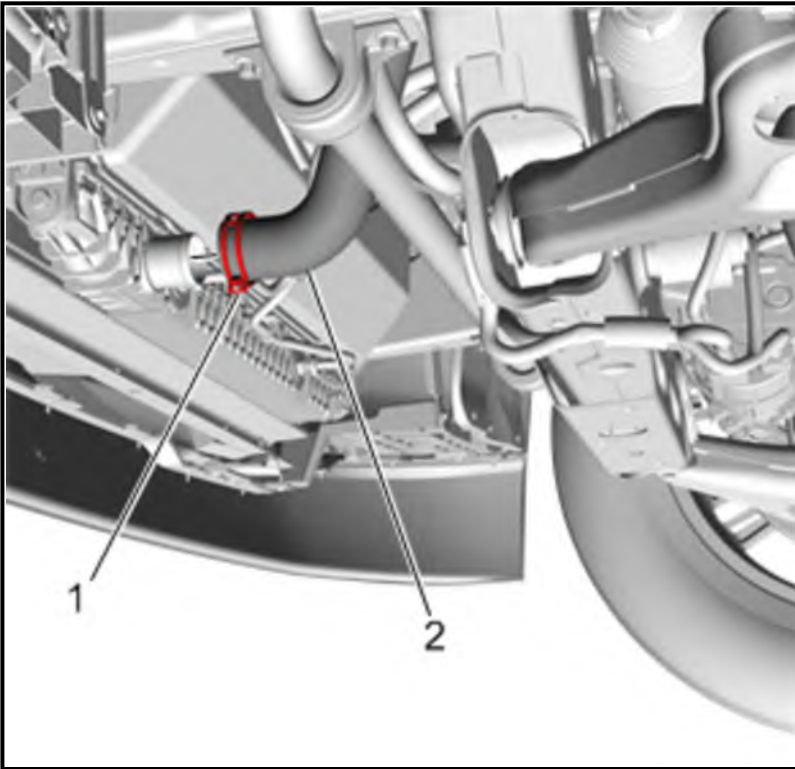
1. Drain the cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)
2. Recover the refrigerant. [Refrigerant Recovery and Recharging \(R-1234yf\)](#)
3. Radiator Inlet Hose (1) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#)



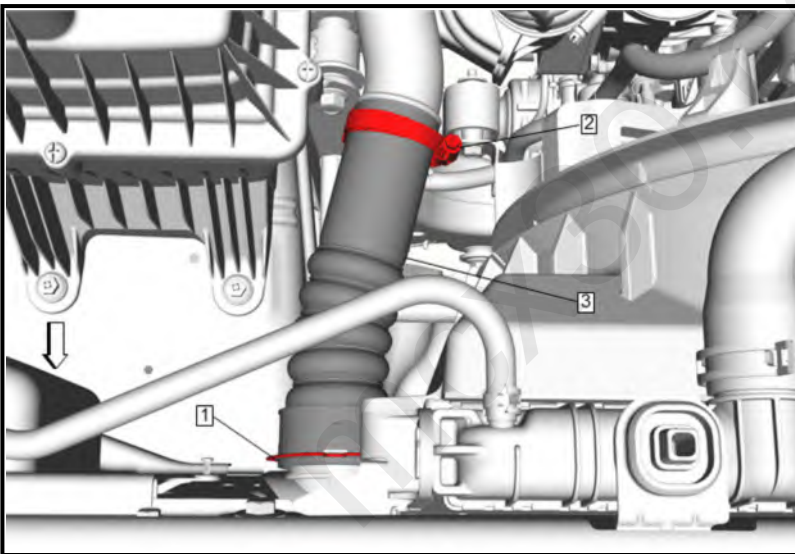
4. Engine Coolant Fan Shroud (1) - Remove - [Engine Coolant Fan Shroud Replacement \(LWN\)](#)



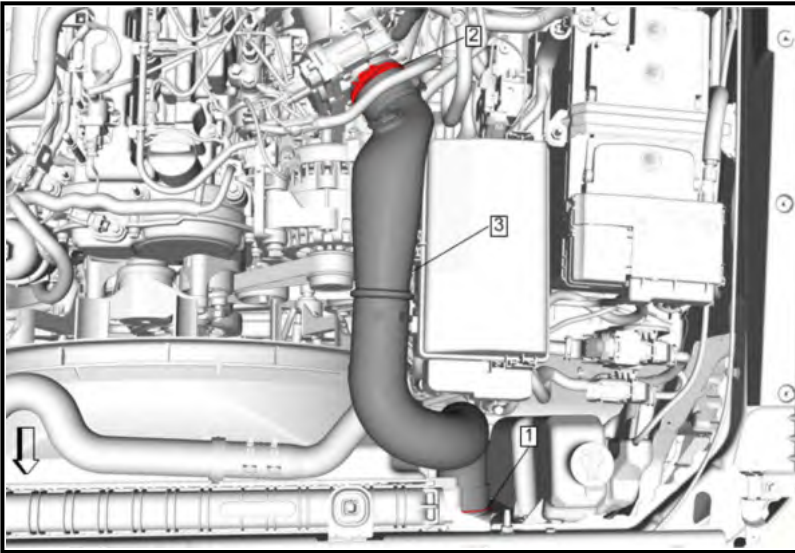
5. Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LWN\)](#)



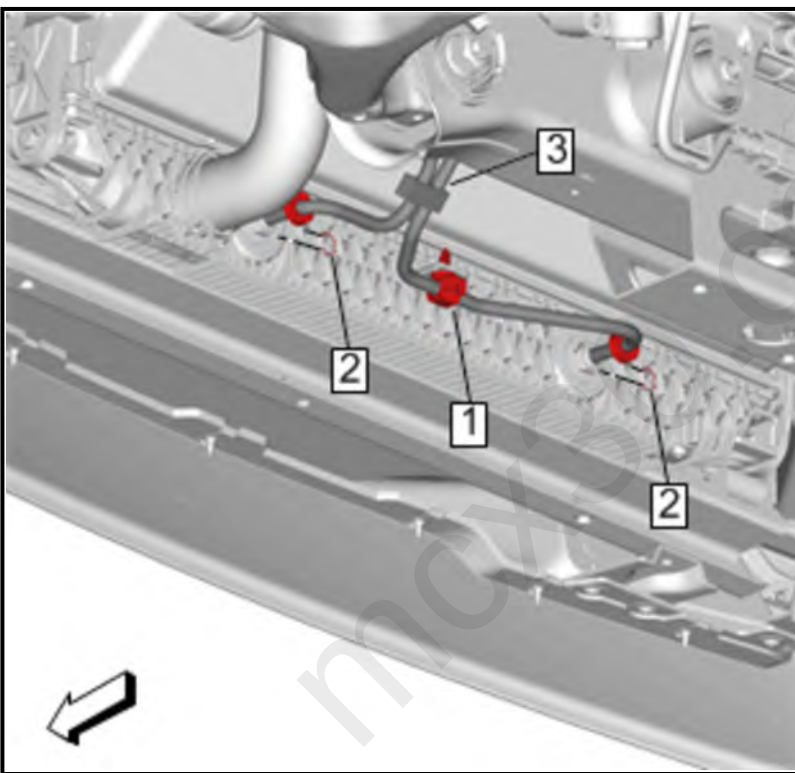
6. Charge Air Cooler Inlet Hose (3) @ Charge Air Cooler - Remove - [Charge Air Cooler Inlet Hose Replacement](#)



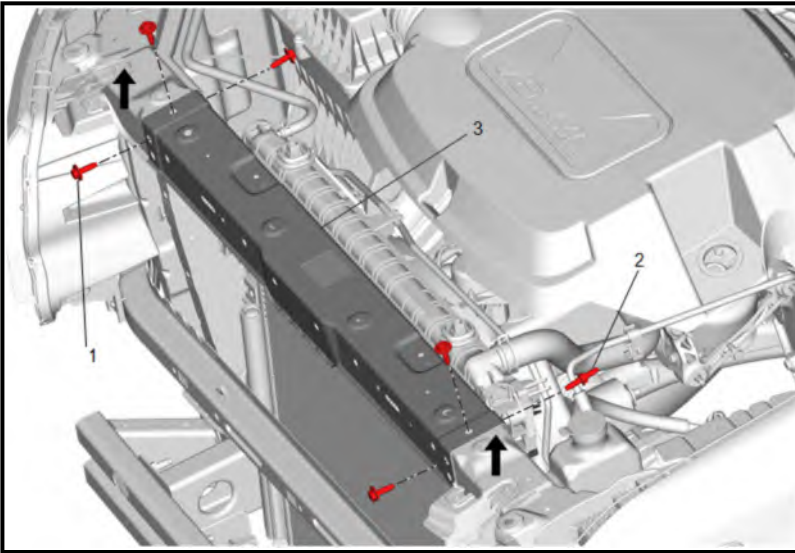
7. Charge Air Cooler Outlet Duct (3) @ Charge Air Cooler - Remove - [Charge Air Cooler Outlet Duct Replacement](#)



8. Transmission Fluid Cooler Inlet and Outlet Pipe (3) @ Radiator - Remove [2x] - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LWN\)](#)

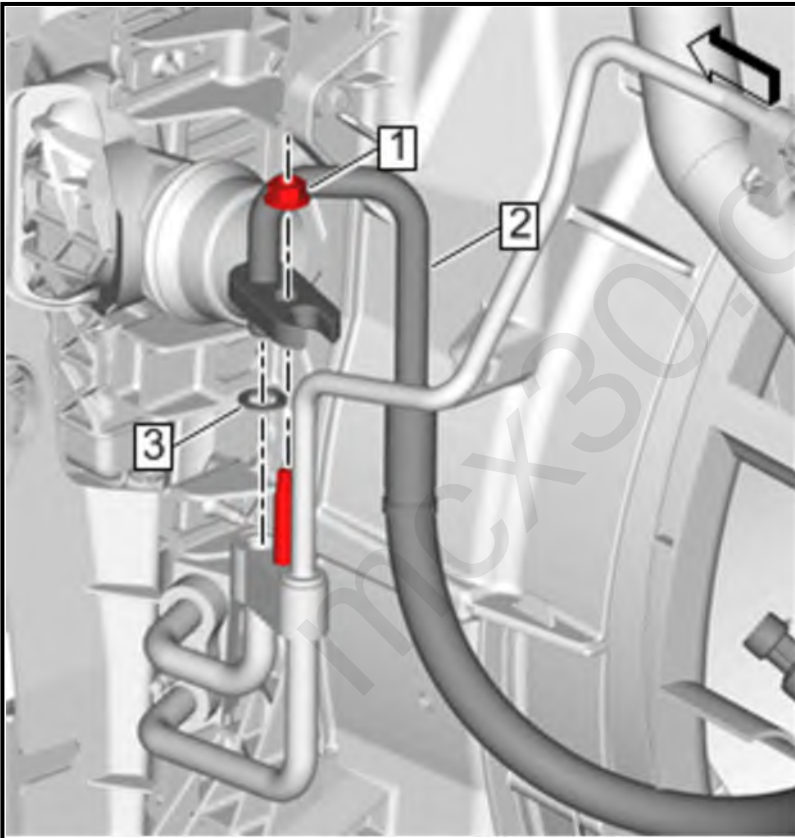


9. Front Bumper Upper Fascia - Remove - [Front Bumper Upper Fascia Replacement \(Bison\)](#)
 10. Front End Upper Tie Bar (3) - Remove - [Front End Upper Tie Bar Replacement](#)

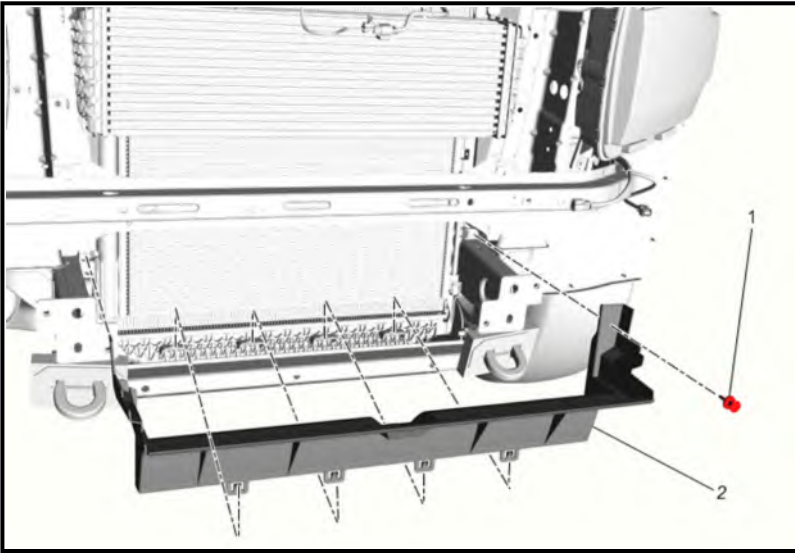


11. Front Bumper Shutter - Remove - [Front Bumper Shutter Replacement \(With Bison\)](#)

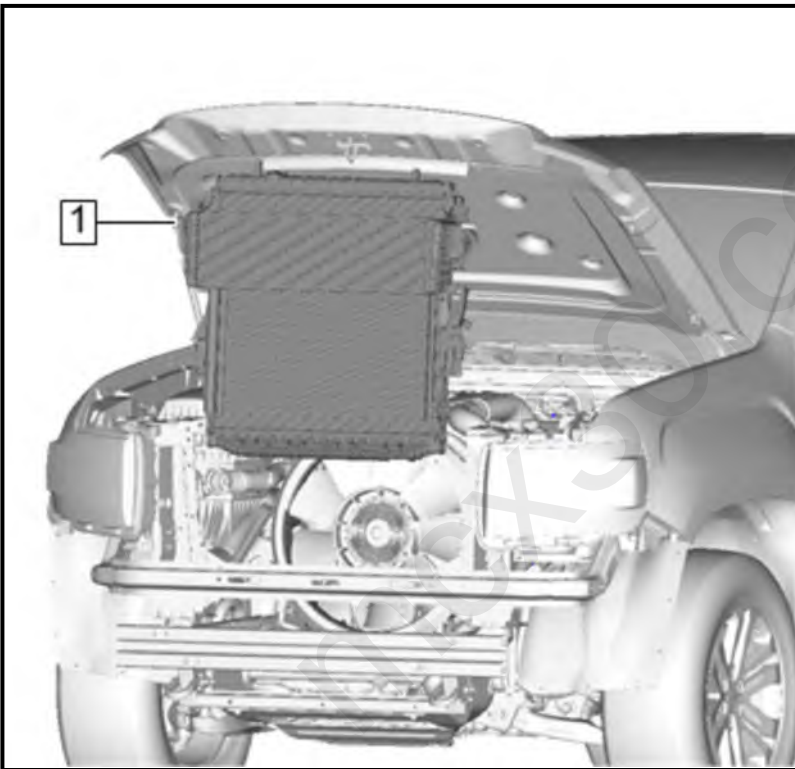
12. Air Conditioning Compressor Hose (2) @ Air Conditioning Condenser - Remove - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)



13. Radiator Air Lower Baffle (2) - Remove - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#)

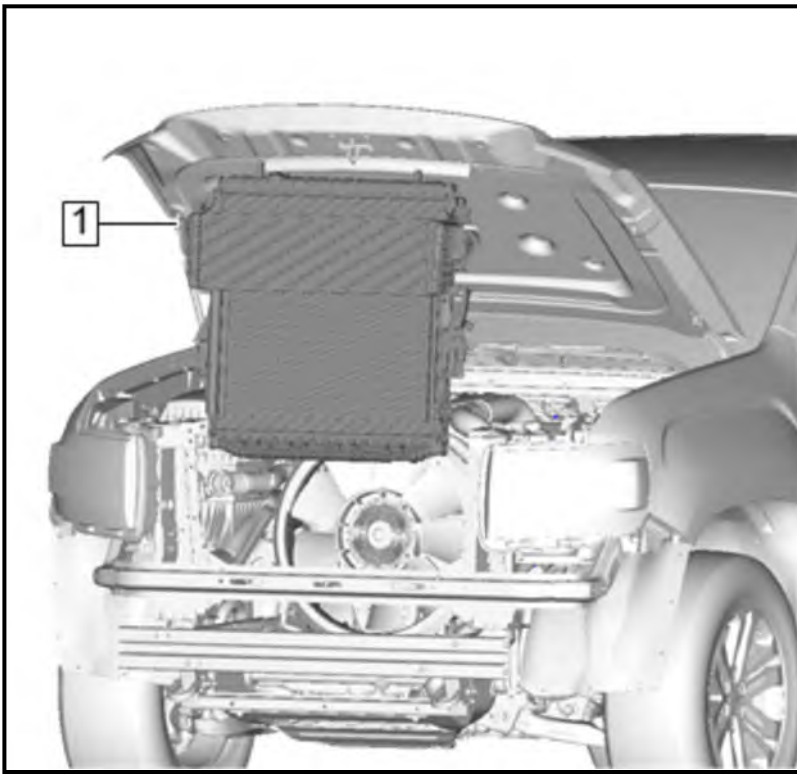


14. Radiator Vent Outlet Hose @ Radiator - Remove - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)
15. Radiator Assembly (1) - Remove

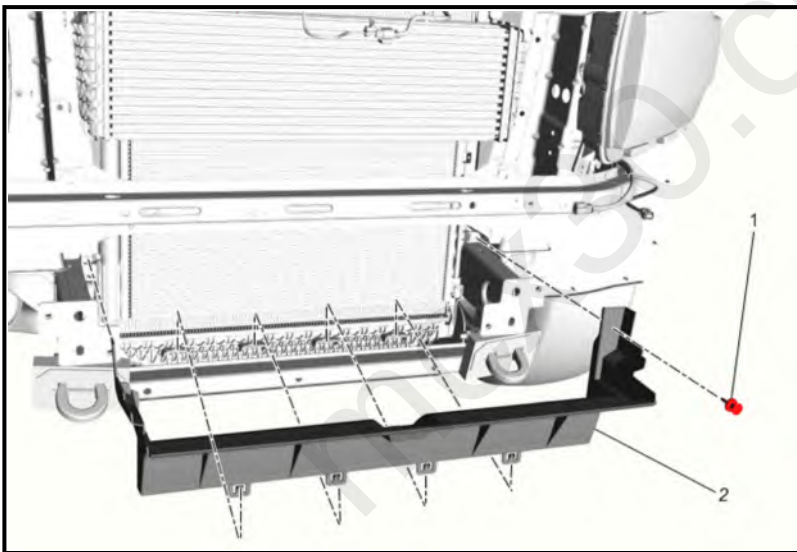


Installation Procedure

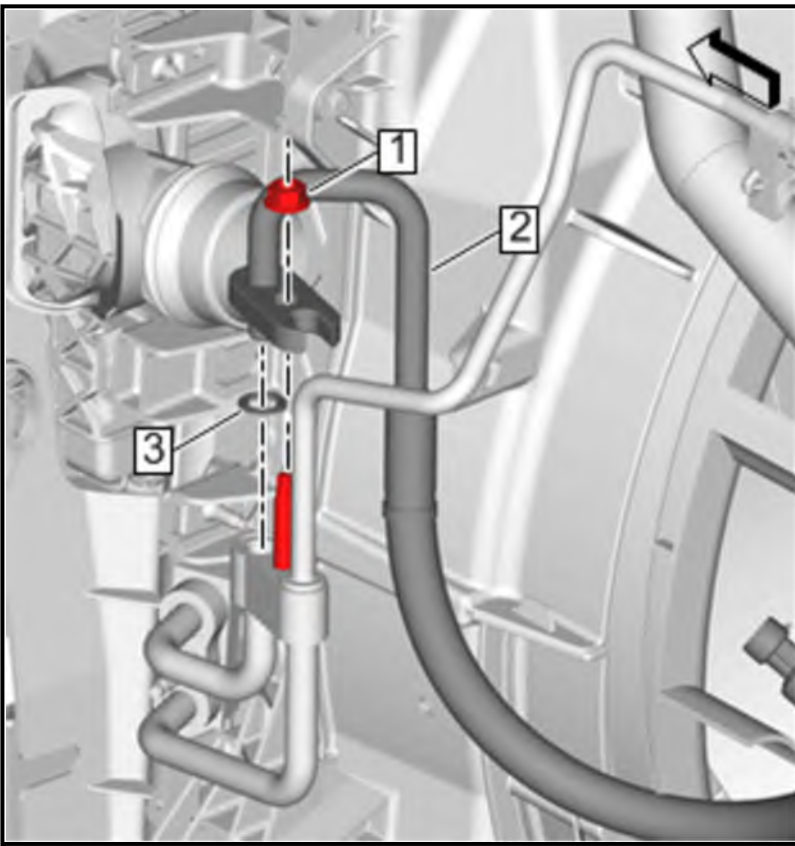
1. Radiator Assembly (1) - Install



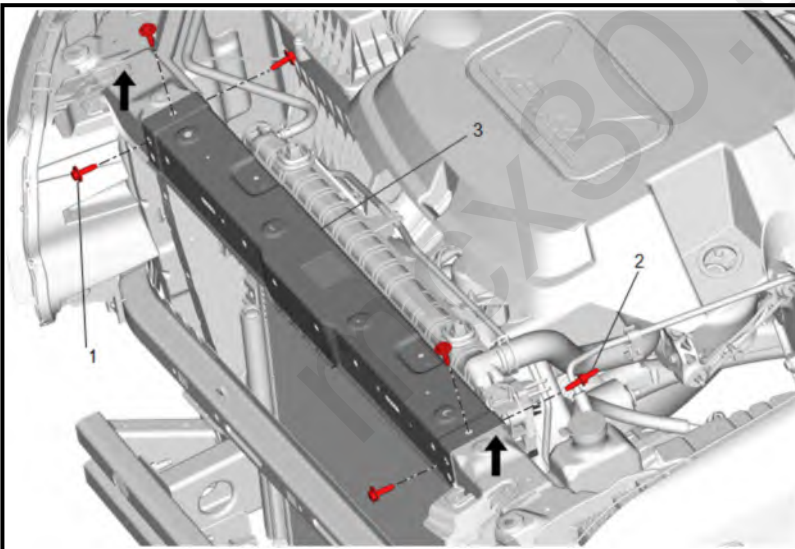
- 2. Radiator Vent Outlet Hose @ Radiator - Install - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)
- 3. Radiator Air Lower Baffle (2) - Install - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#)



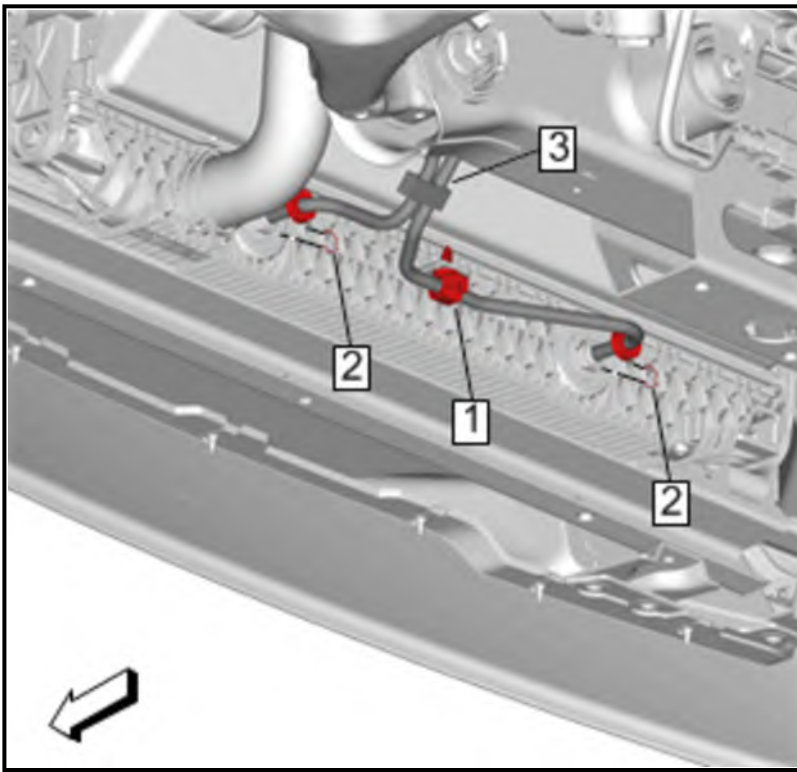
- 4. Air Conditioning Compressor Hose (2) @ Air Conditioning Condenser - Install - [Air Conditioning Compressor Hose Replacement \(LWN\)](#)



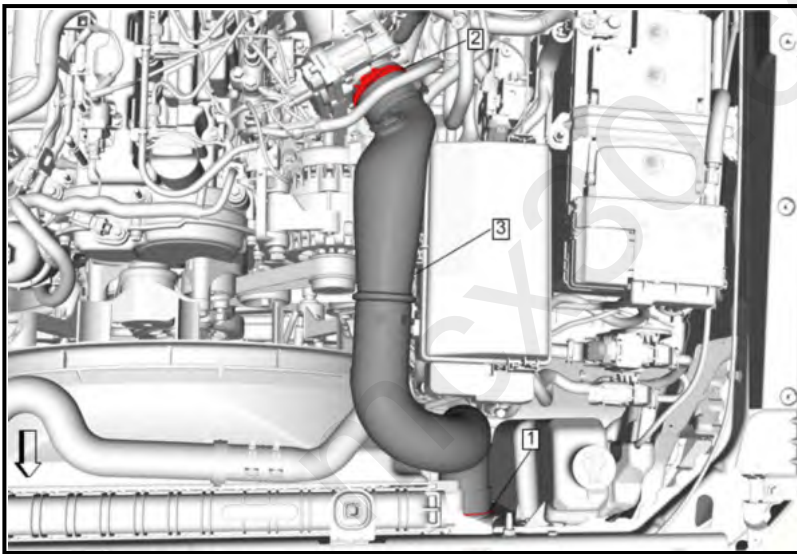
- 5. Front Bumper Shutter - Install - [Front Bumper Shutter Replacement \(With Bison\)](#)
- 6. Front End Upper Tie Bar (3) - Install - [Front End Upper Tie Bar Replacement](#)



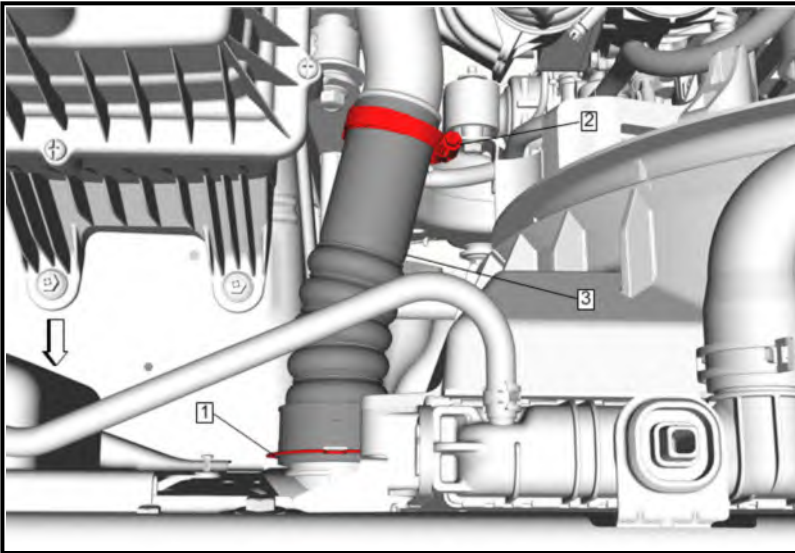
- 7. Front Bumper Upper Fascia - Install - [Front Bumper Upper Fascia Replacement \(Bison\)](#)
- 8. Transmission Fluid Cooler Inlet and Outlet Pipe (3) @ Radiator - Install [2x] - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LWN\)](#)



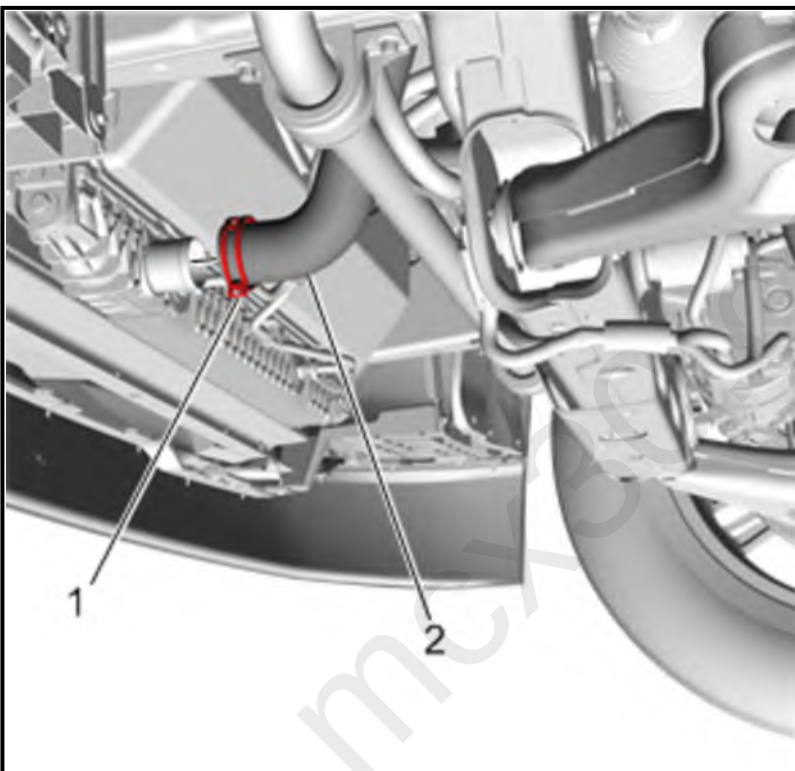
9. Charge Air Cooler Outlet Duct (3) @ Charge Air Cooler - Install - [Charge Air Cooler Outlet Duct Replacement](#)



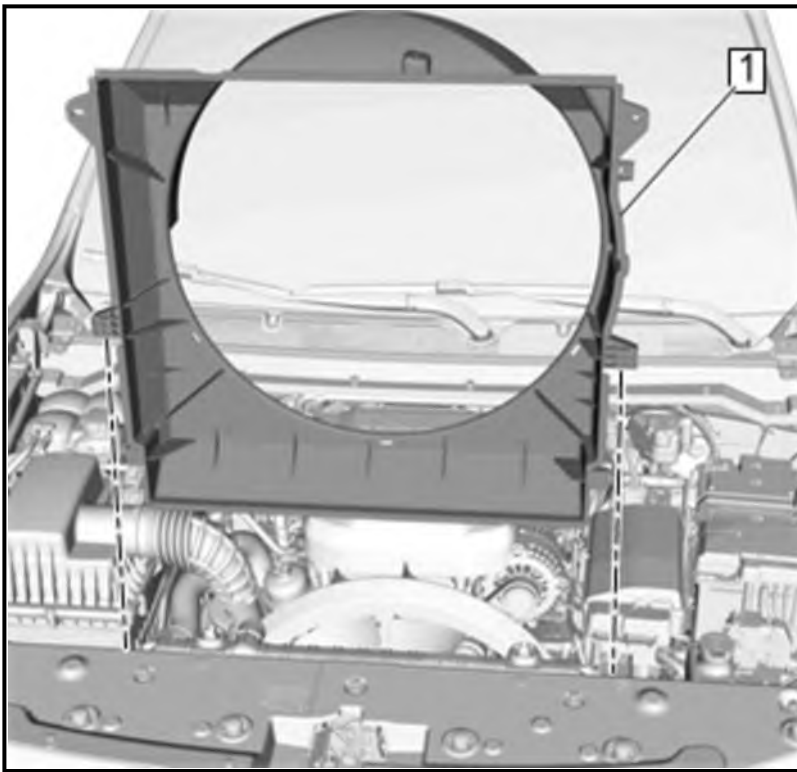
10. Charge Air Cooler Inlet Hose (3) @ Charge Air Cooler - Install - [Charge Air Cooler Inlet Hose Replacement](#)



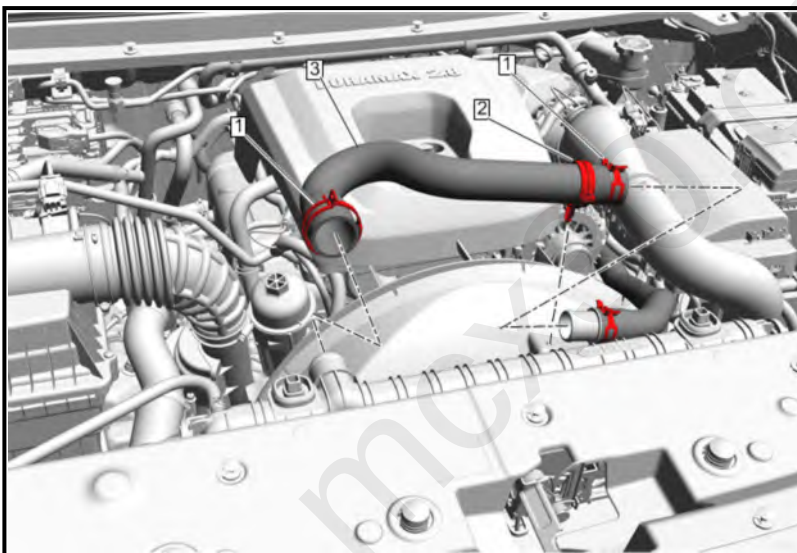
11. Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LWN\)](#)



12. Engine Coolant Fan Shroud (1) - Install - [Engine Coolant Fan Shroud Replacement \(LWN\)](#)



13. Radiator Inlet Hose (1) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LWN Radiator Side\)](#)



14. Recharge the refrigerant. [Refrigerant Recovery and Recharging \(R-1234yf\)](#)

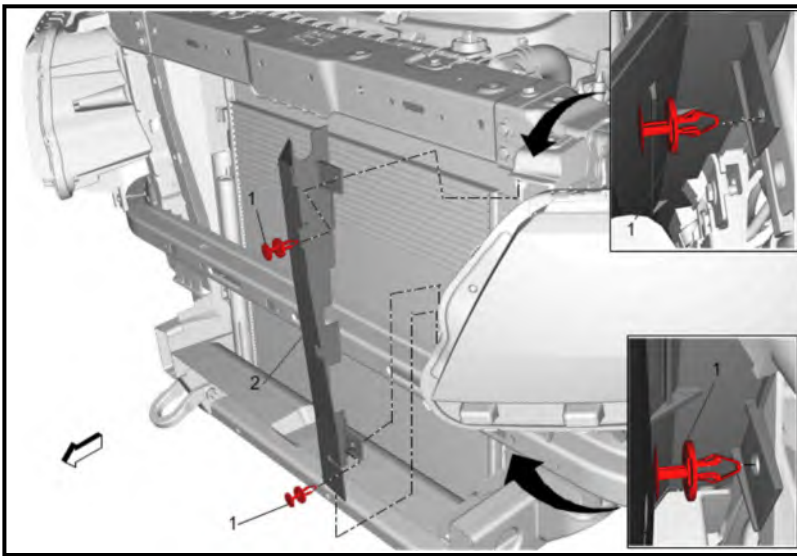
15. Fill the cooling system to the proper level. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#)

16. Start the engine and check for coolant leaks.

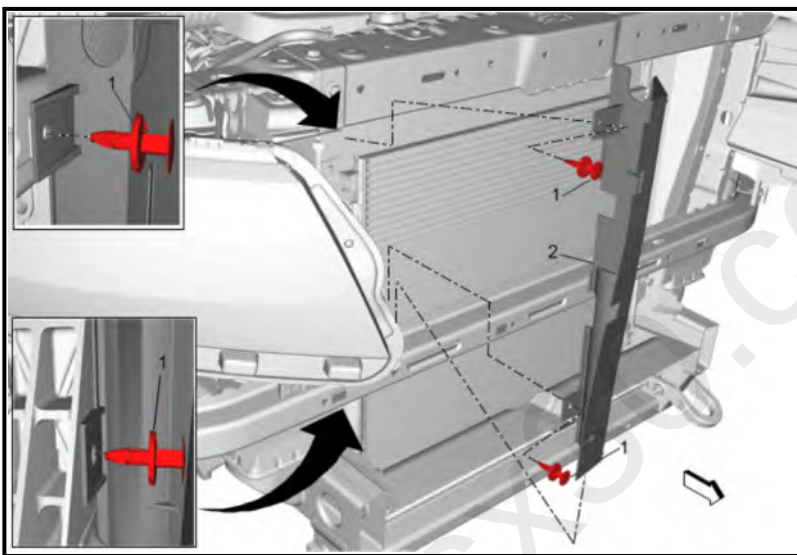
RADIATOR REPLACEMENT (LCV)

Removal Procedure

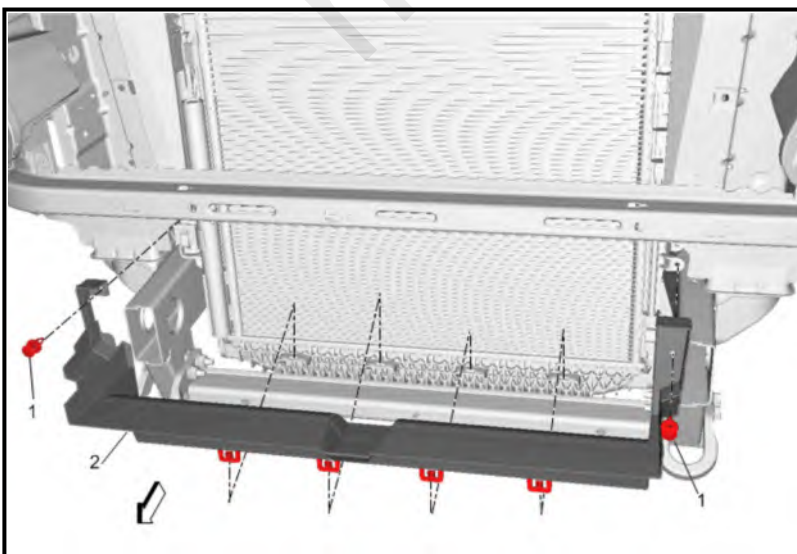
1. Drain the engine cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Remove the left side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Left Side \(LCV, LGZ\)](#).



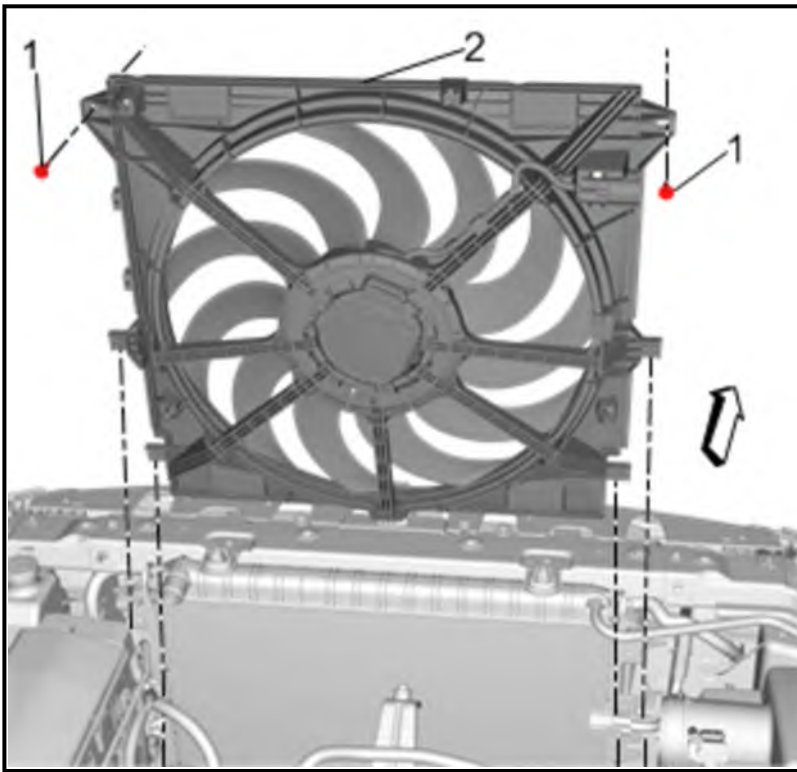
3. Remove the right side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Right Side \(LCV, LGZ\)](#) .



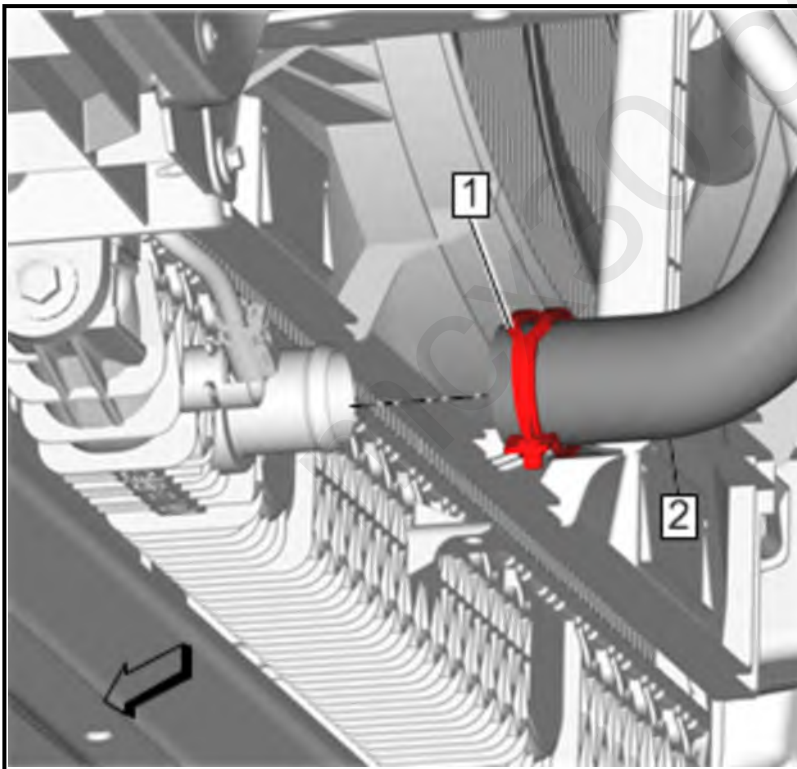
4. Remove the radiator air lower baffle (2). Refer to [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#) .



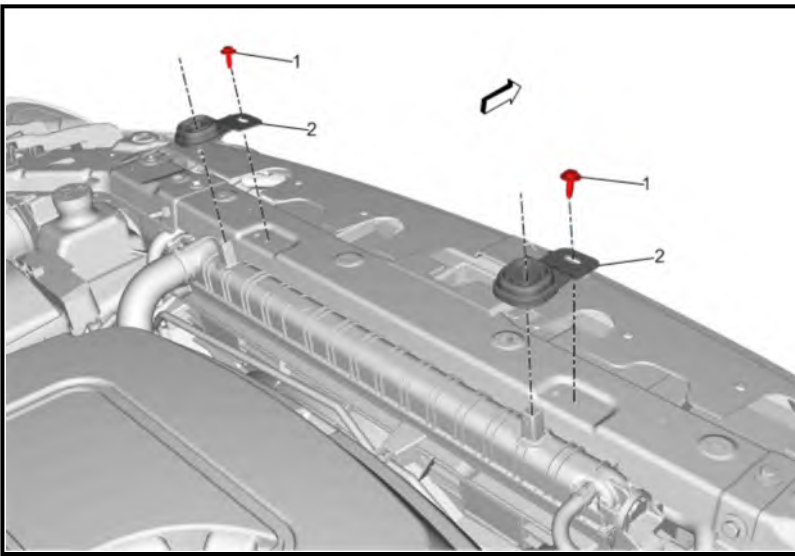
5. Remove the transmission fluid cooler inlet and outlet pipe from the air conditioning condenser if equipped. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LCV\)](#) .
6. Remove the engine coolant fan shroud (2) from the radiator. Refer to [Engine Coolant Fan Shroud Replacement \(LCV, LGZ\)](#) .



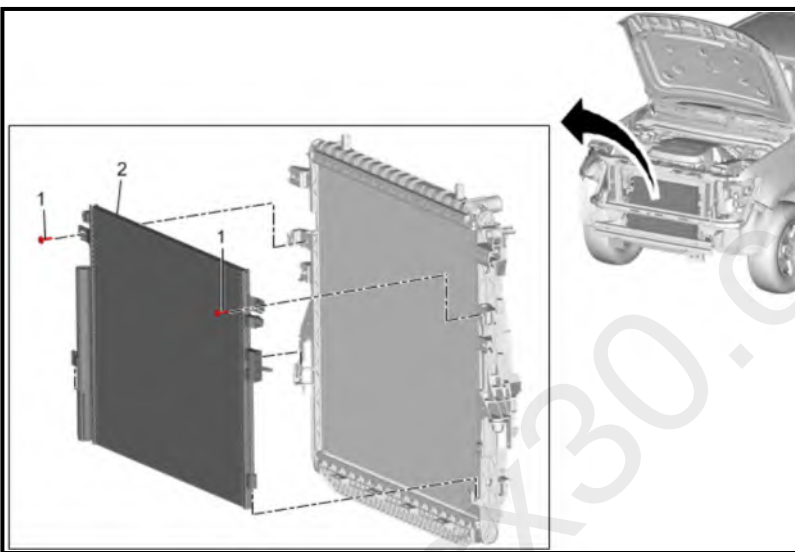
7. Remove the radiator outlet hose (2) from the radiator. Refer to [Radiator Outlet Hose Replacement \(LCV\)](#).



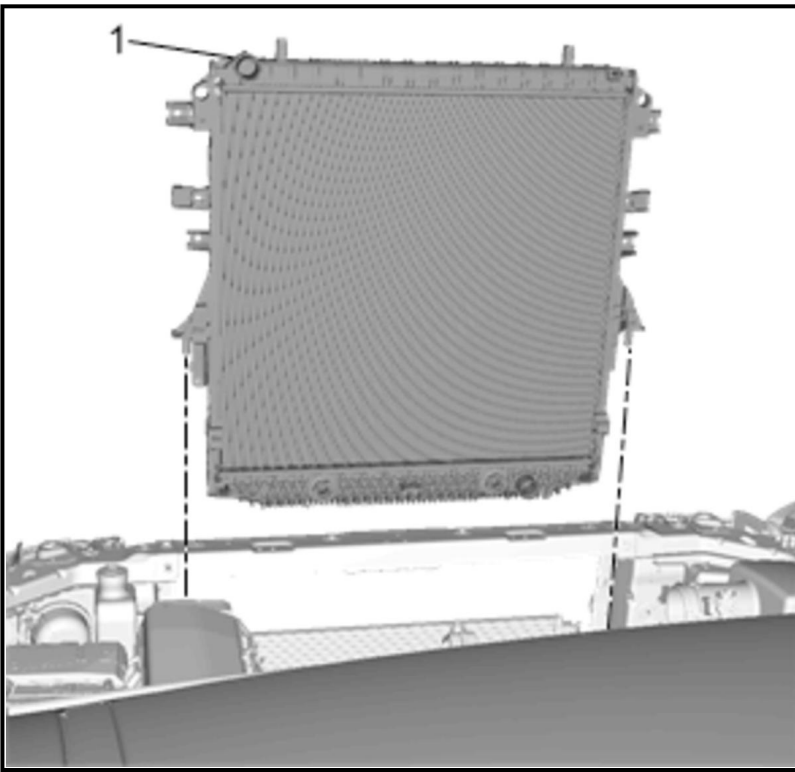
8. Remove the radiator upper brackets. Refer to [Radiator Upper Bracket Replacement](#).



9. Remove the air conditioning condenser bolts (1). Refer to [Air Conditioning Condenser Replacement \(LCV, LGZ\)](#).



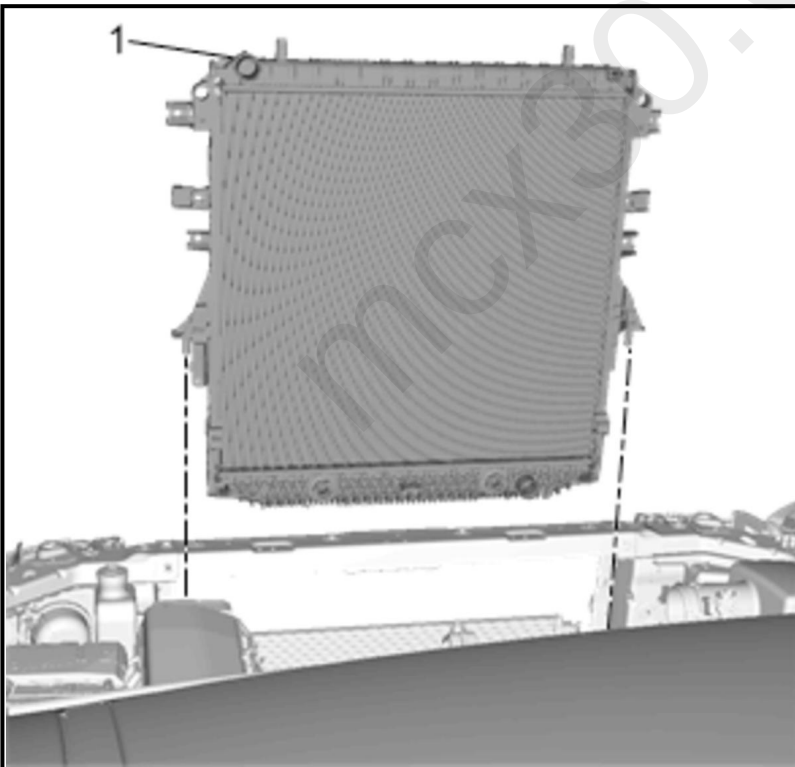
10. Without removing the air conditioning evaporative connector hose/tube and compressor and condenser hose, position the air conditioning condenser (2) forward off of the radiator.
11. Tilt the radiator assembly (1) back, and lift up to remove the radiator assembly from the vehicle.



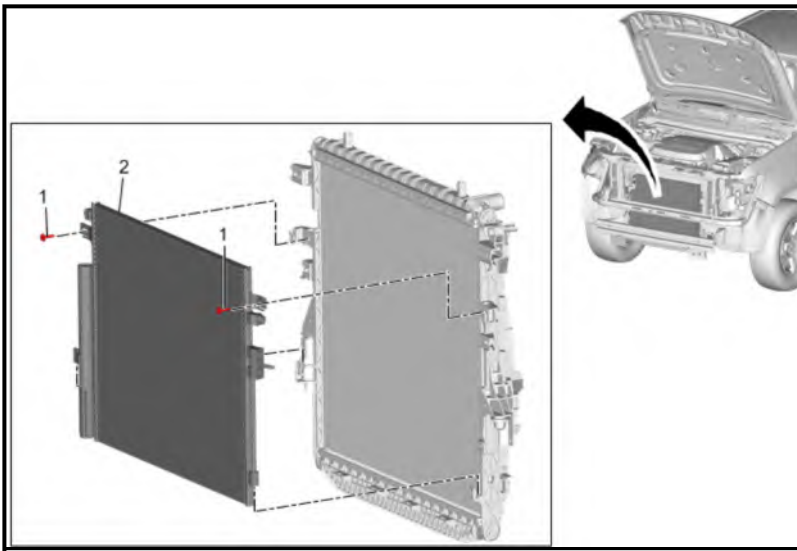
12. Transfer components as necessary.

Installation Procedure

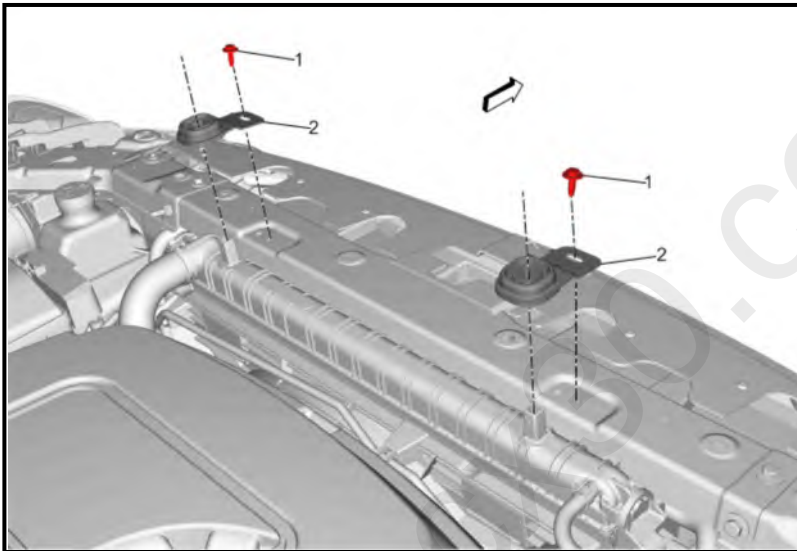
1. Install the radiator assembly (1) into the vehicle.



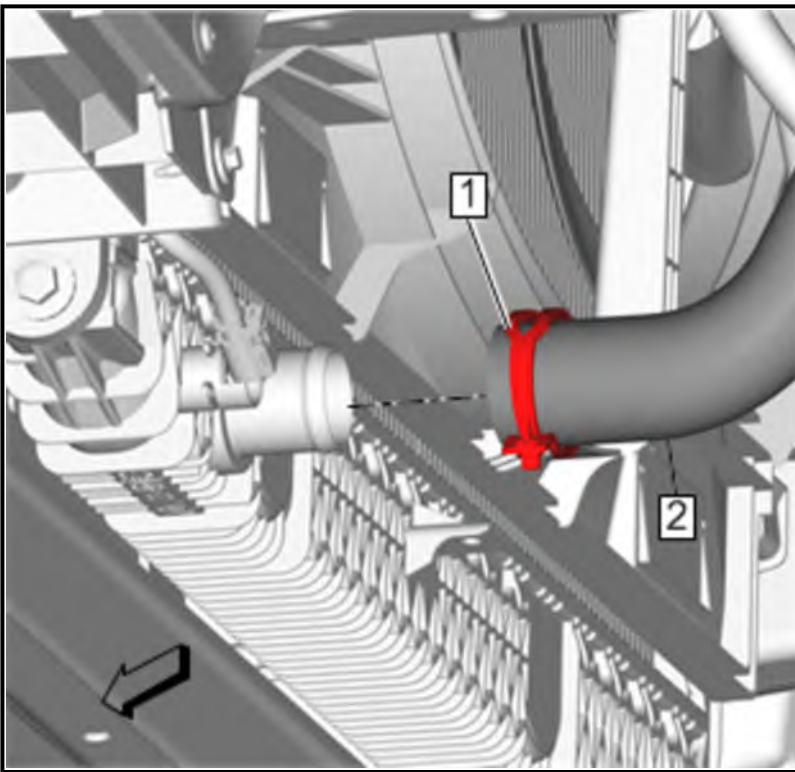
2. Position the air conditioning condenser (2) onto the radiator.



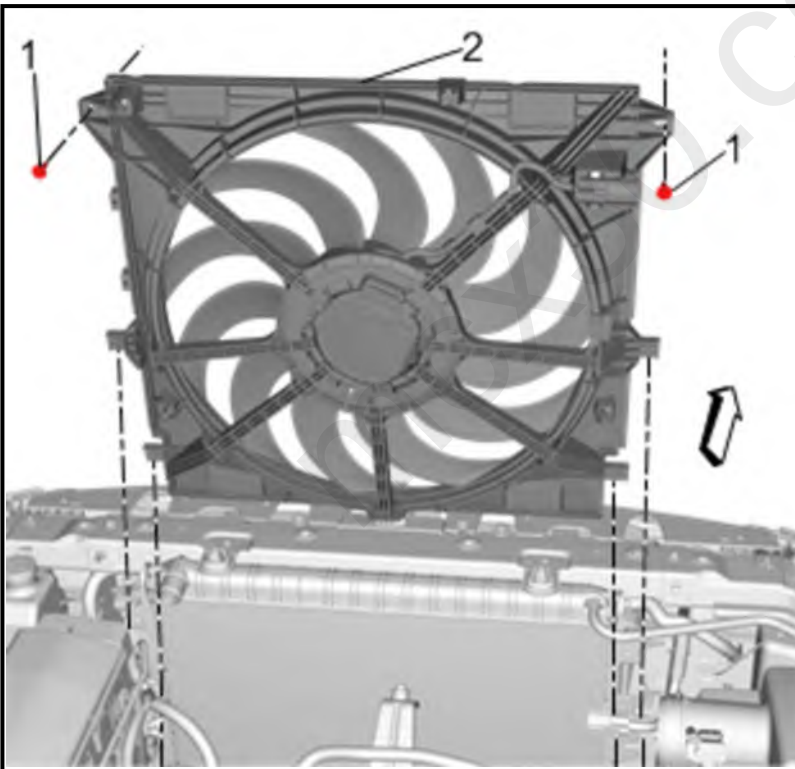
3. Install the air conditioning condenser bolts (1). Refer to [Air Conditioning Condenser Replacement \(LCV, LGZ\)](#).
4. Install the radiator upper brackets. Refer to [Radiator Upper Bracket Replacement](#).



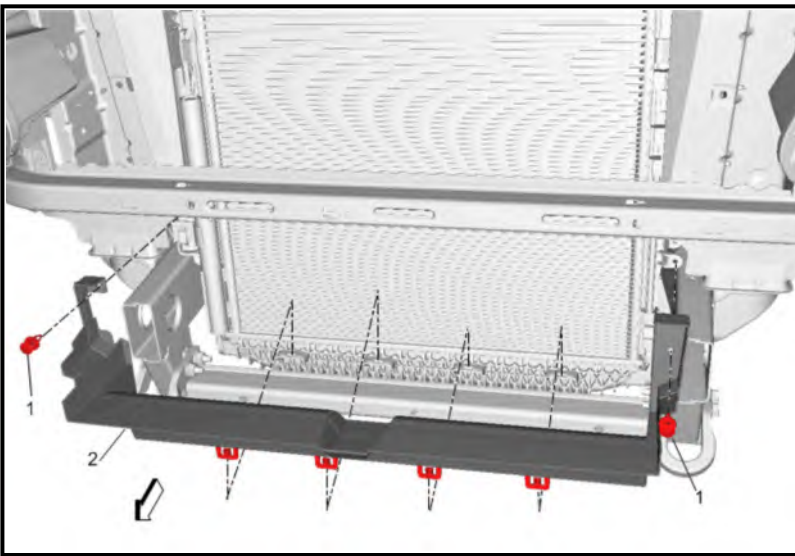
5. Install the radiator outlet hose (2) to the radiator. Refer to [Radiator Outlet Hose Replacement \(LCV\)](#).



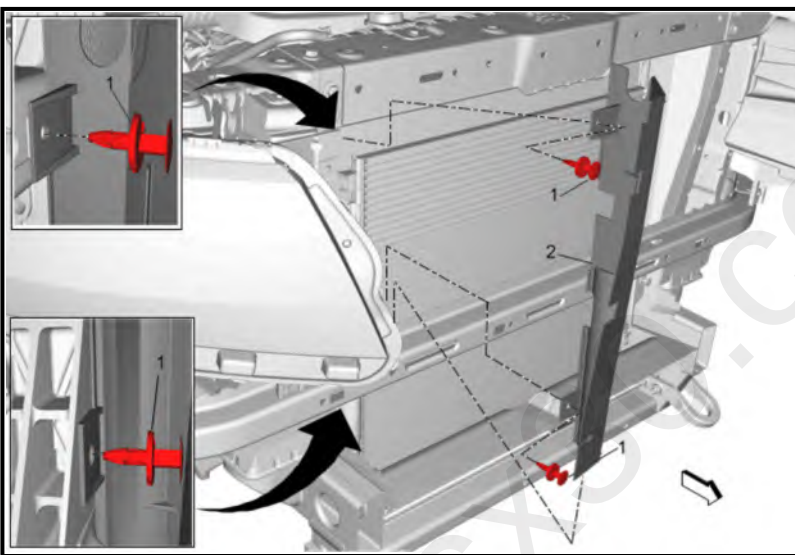
6. Install the engine coolant fan shroud (2) to the radiator. Refer to [Engine Coolant Fan Shroud Replacement \(LCV, LGZ\)](#).



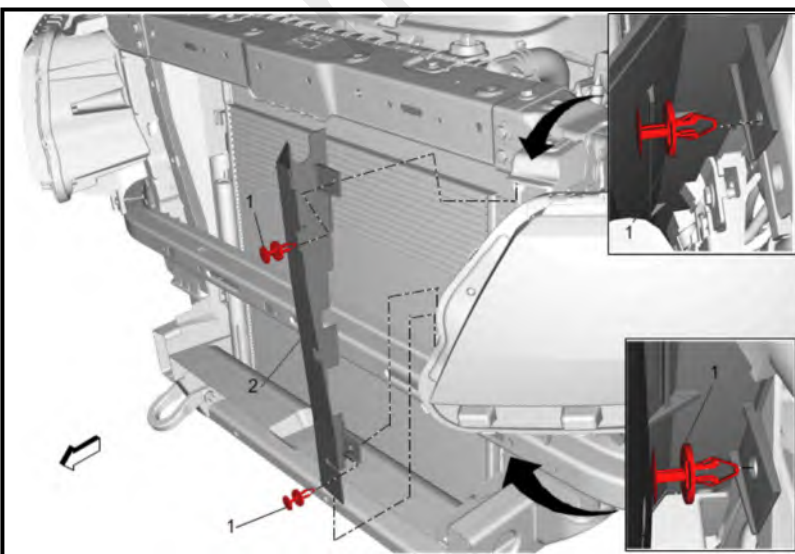
7. Install the transmission fluid cooler inlet and outlet pipe (2) to the air conditioning condenser if equipped. Refer to [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LCV\)](#).
8. Install the radiator air lower baffle (2). Refer to [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#).



9. Install the right side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Right Side \(LCV, LGZ\)](#).



10. Install the left side radiator air side baffle (2). Refer to [Radiator Air Side Baffle Replacement - Left Side \(LCV, LGZ\)](#).

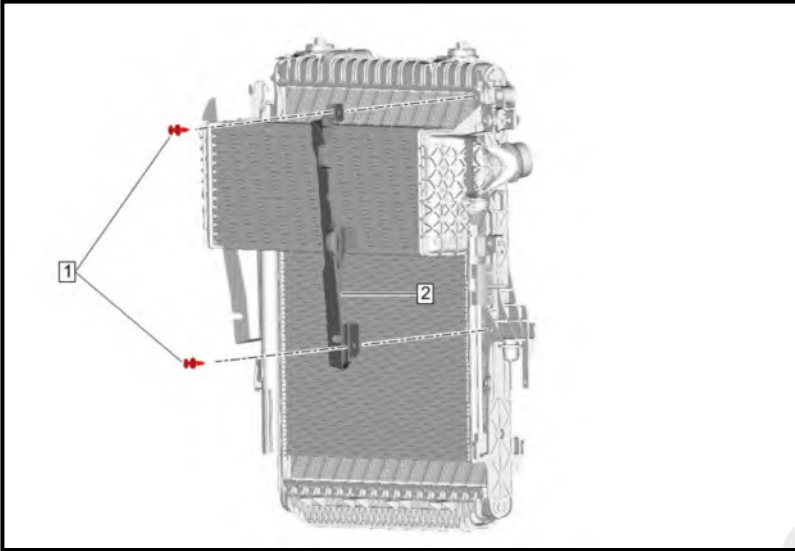


11. Fill the engine cooling system. Refer to [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
12. Inspect the cooling system for leaks.

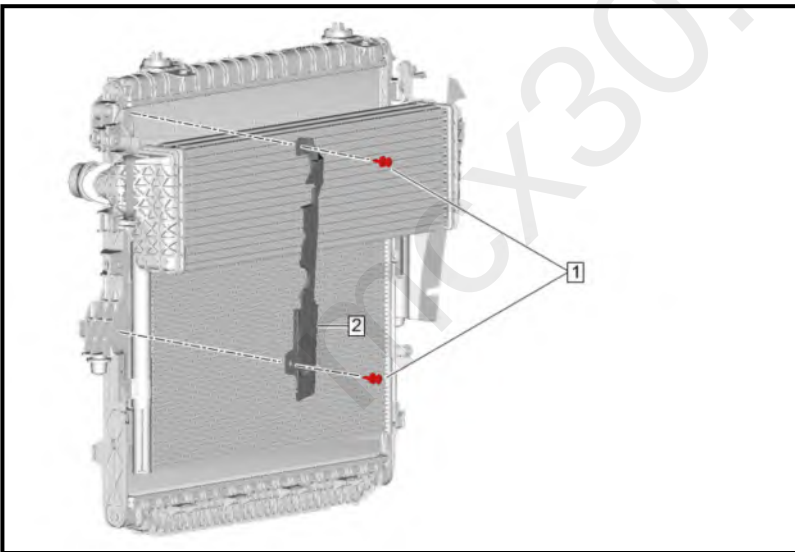
RADIATOR REPLACEMENT (LWN)

Removal Procedure

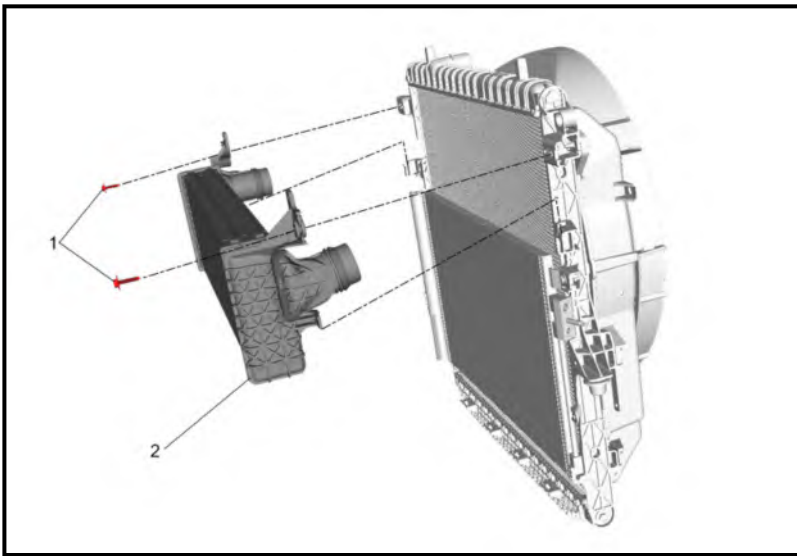
1. Radiator Assembly - Remove - [Condenser, Fan, and Radiator Assembly Removal and Installation \(LWN\)](#), or [Condenser, Fan, and Radiator Assembly Removal and Installation \(LWN Bison\)](#)-->
2. Radiator Air Side Baffle - Left Side (2) - Remove - [Radiator Air Side Baffle Replacement - Left Side \(LWN\)](#)



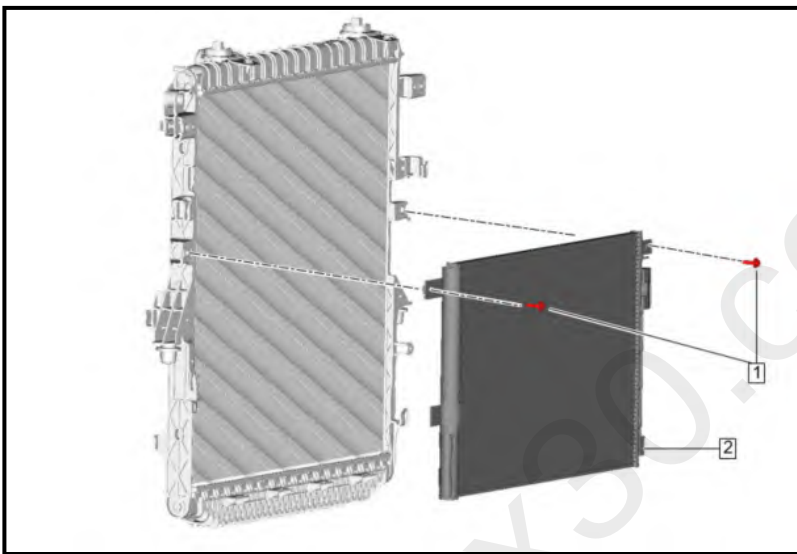
3. Radiator Air Side Baffle - Right Side (2) - Remove - [Radiator Air Side Baffle Replacement - Right Side \(LWN\)](#)



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



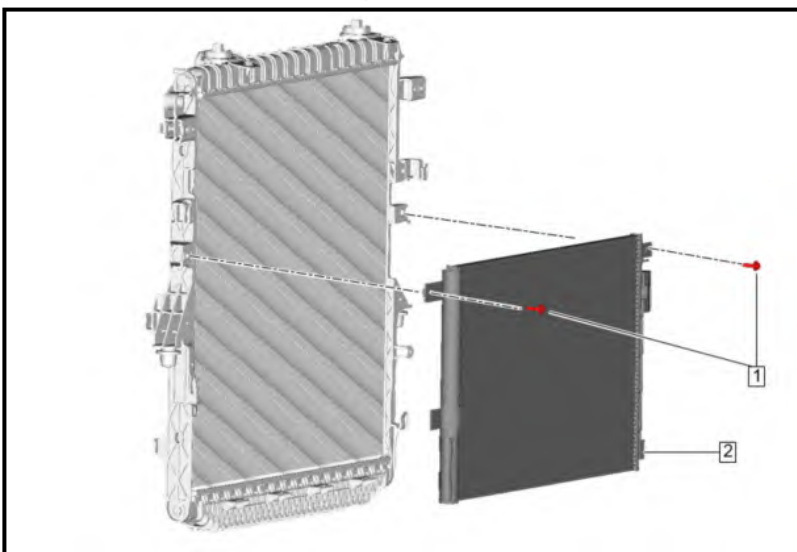
5. Air Conditioning Condenser (2) - Remove - [Air Conditioning Condenser Replacement \(LWN\)](#).



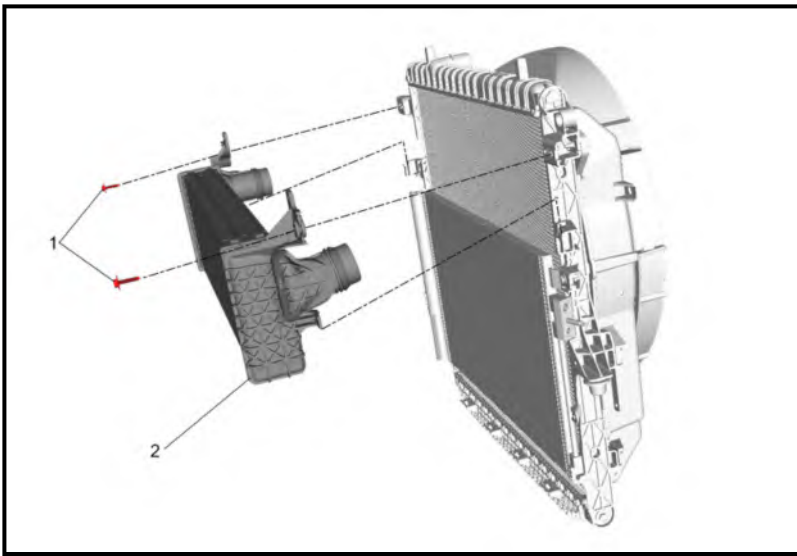
6. Transfer components as necessary.

Installation Procedure

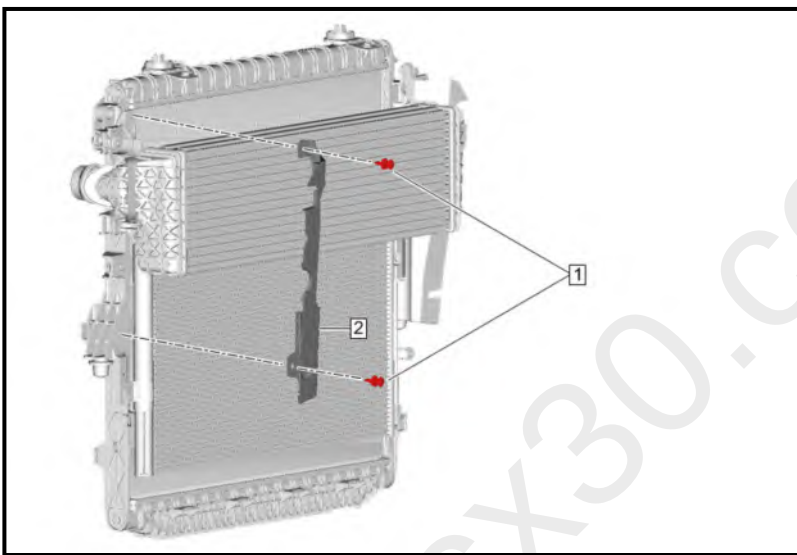
1. Air Conditioning Condenser (2) - Install - [Air Conditioning Condenser Replacement \(LWN\)](#).



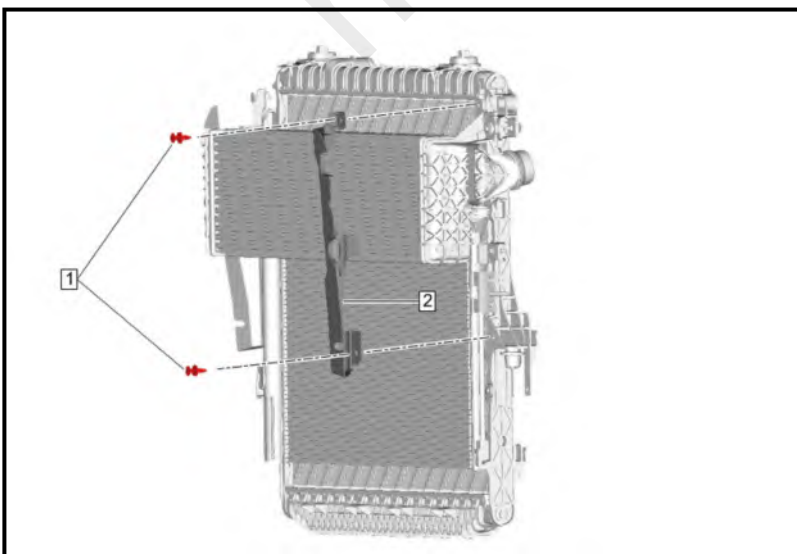
2. Charge Air Cooler (2) - Install - [Charge Air Cooler Replacement](#)



3. Radiator Air Side Baffle - Right Side (2) - Install - [Radiator Air Side Baffle Replacement - Right Side \(LWN\)](#)



4. Radiator Air Side Baffle - Left Side (2) - Install - [Radiator Air Side Baffle Replacement - Left Side \(LWN\)](#)

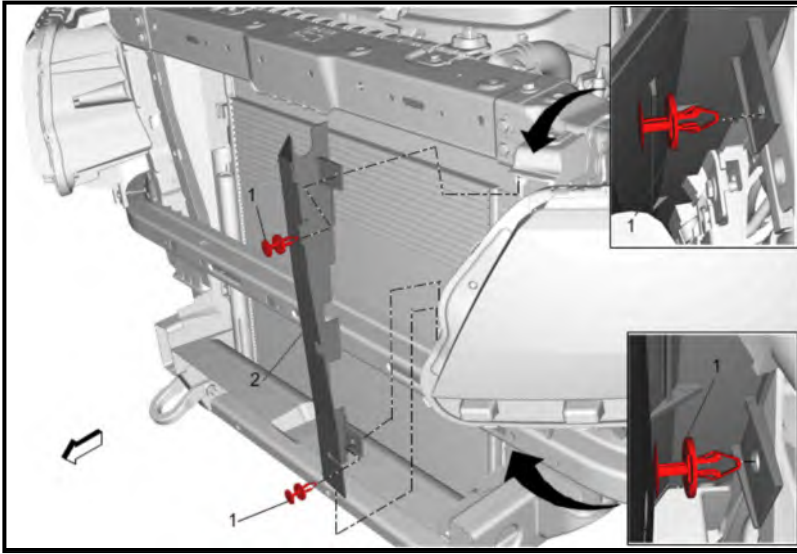


5. Radiator Assembly - Install - [Condenser, Fan, and Radiator Assembly Removal and Installation \(LWN\)](#), or [Condenser, Fan, and Radiator Assembly Removal and Installation \(LWN Bison\)](#)

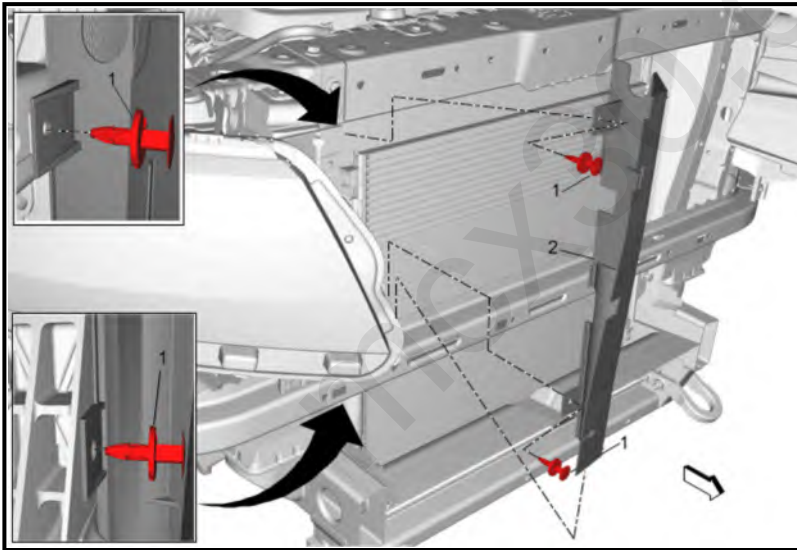
RADIATOR REPLACEMENT (LGZ)

Removal Procedure

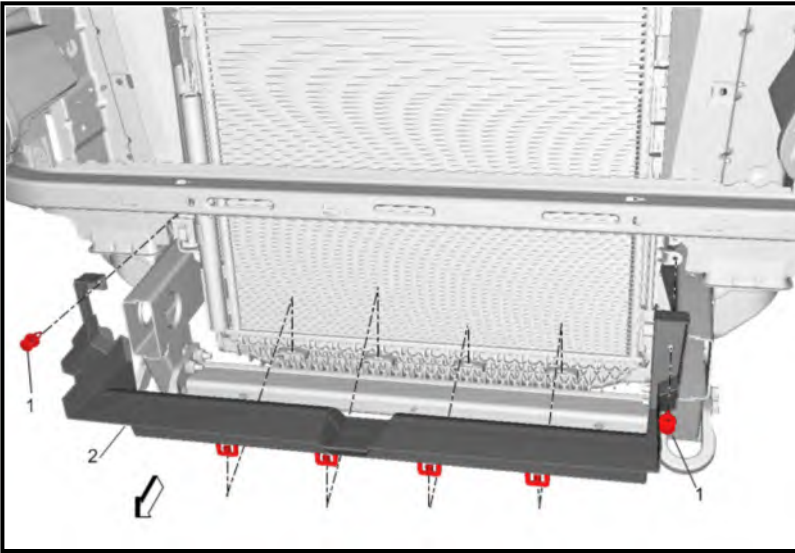
1. Drain the engine cooling system. [Cooling System Draining and Filling \(Static Fill\)](#), or [Cooling System Draining and Filling \(Vac n Fill\)](#).
2. Left Side Radiator Air Side Baffle (2) - Remove - [Radiator Air Side Baffle Replacement - Left Side \(LCV, LGZ\)](#).



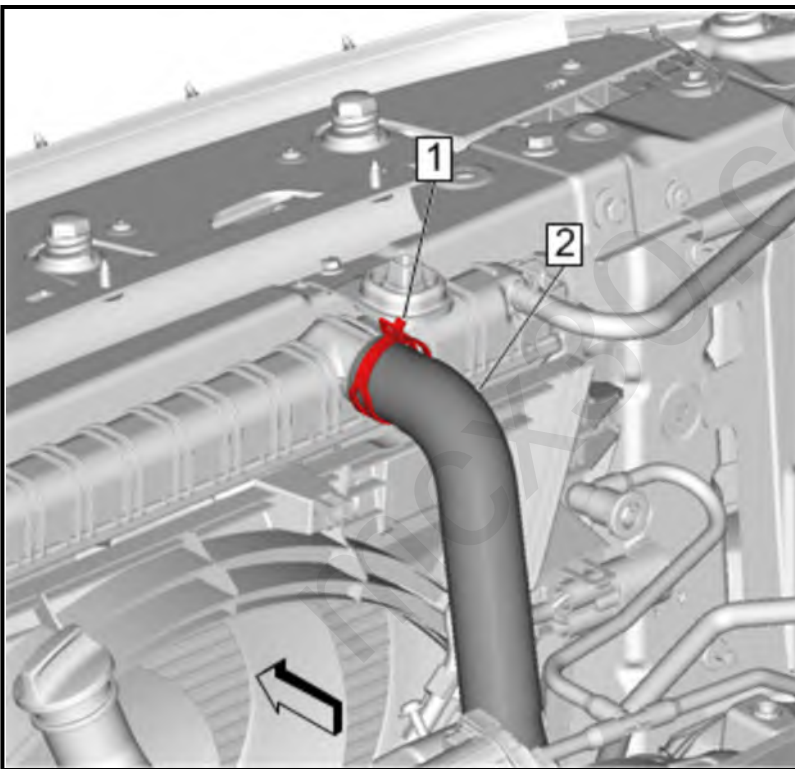
3. Right Side Radiator Air Side Baffle (2) - Remove - [Radiator Air Side Baffle Replacement - Right Side \(LCV, LGZ\)](#).



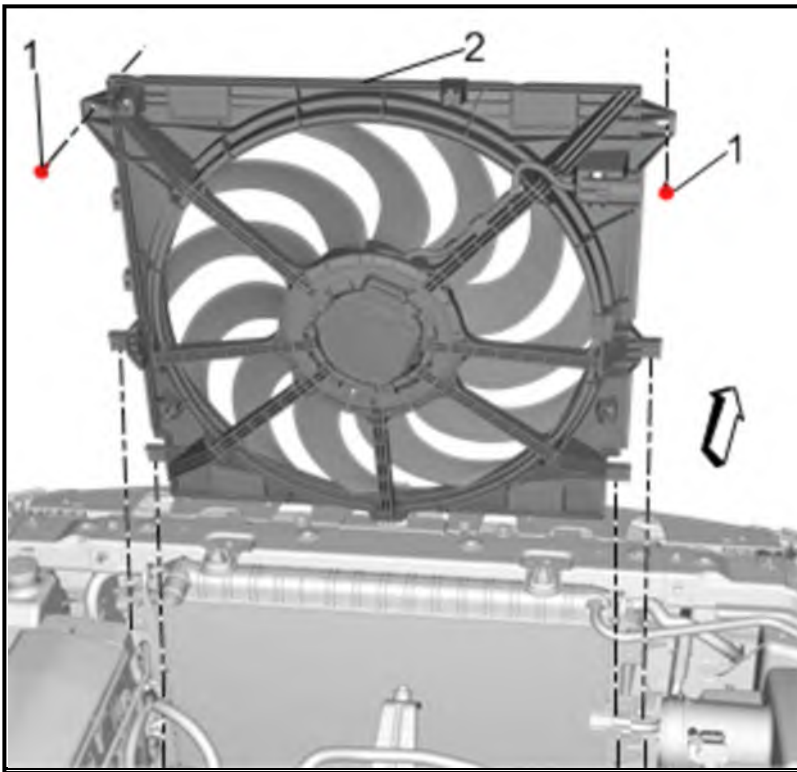
4. Radiator Air Lower Baffle (2) - Remove - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#).



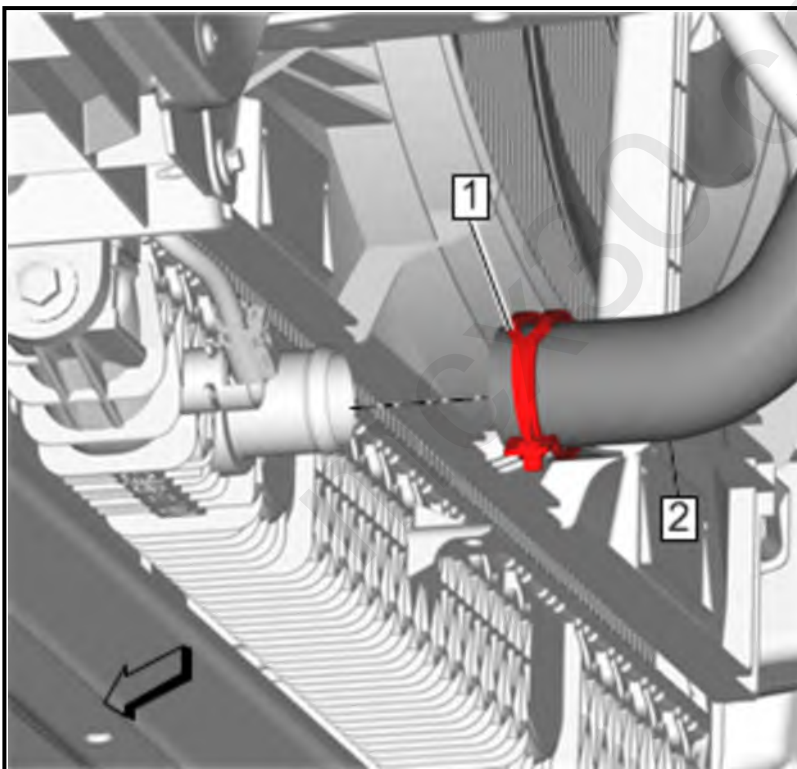
5. Transmission Fluid Cooler Inlet and Outlet Pipe @ Air Conditioning Condenser - Remove - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGZ With M5T and 4WD\)](#) , or [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGZ With M5T and 2WD\)](#)
6. Radiator Inlet Hose (2) @ Radiator - Remove - [Radiator Inlet Hose Replacement \(LGZ\)](#)



7. Engine Coolant Fan Shroud (2) @ Radiator - Remove - [Engine Coolant Fan Shroud Replacement \(LCV, LGZ\)](#)



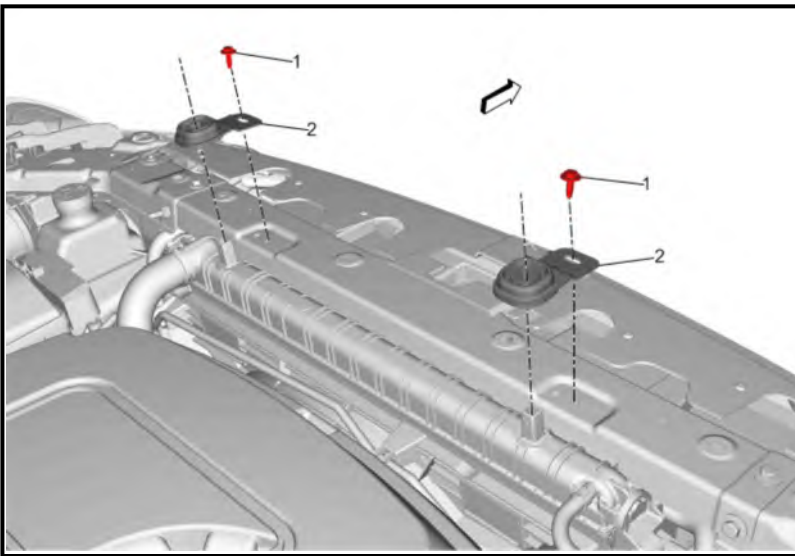
8. Radiator Outlet Hose (2) @ Radiator - Remove - [Radiator Outlet Hose Replacement \(LGZ\)](#)



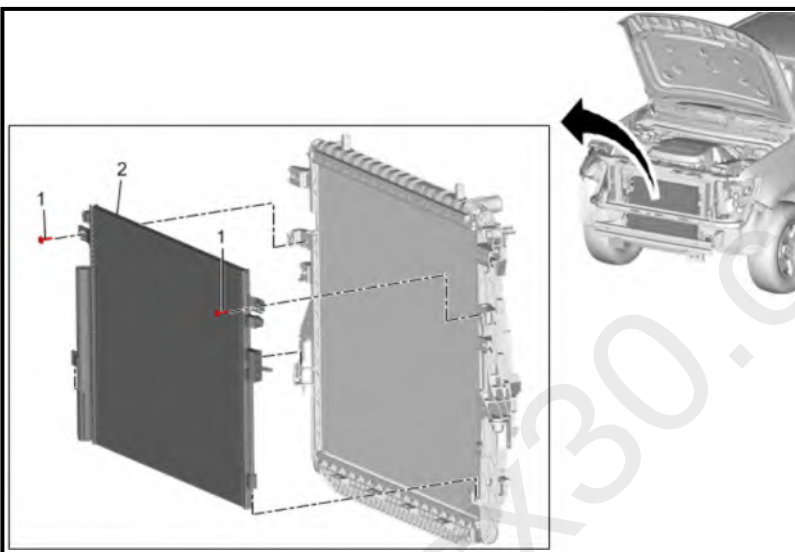
9. Engine Oil Cooler Inlet Pipe @ Radiator - Remove - [Engine Oil Cooler Inlet Pipe Replacement \(LGZ, 2WD\)](#), or [Engine Oil Cooler Inlet Pipe Replacement \(LGZ, 4WD\)](#)

10. Engine Oil Cooler Outlet Pipe @ Radiator - Remove - [Engine Oil Cooler Outlet Pipe Replacement \(LGZ\)](#)

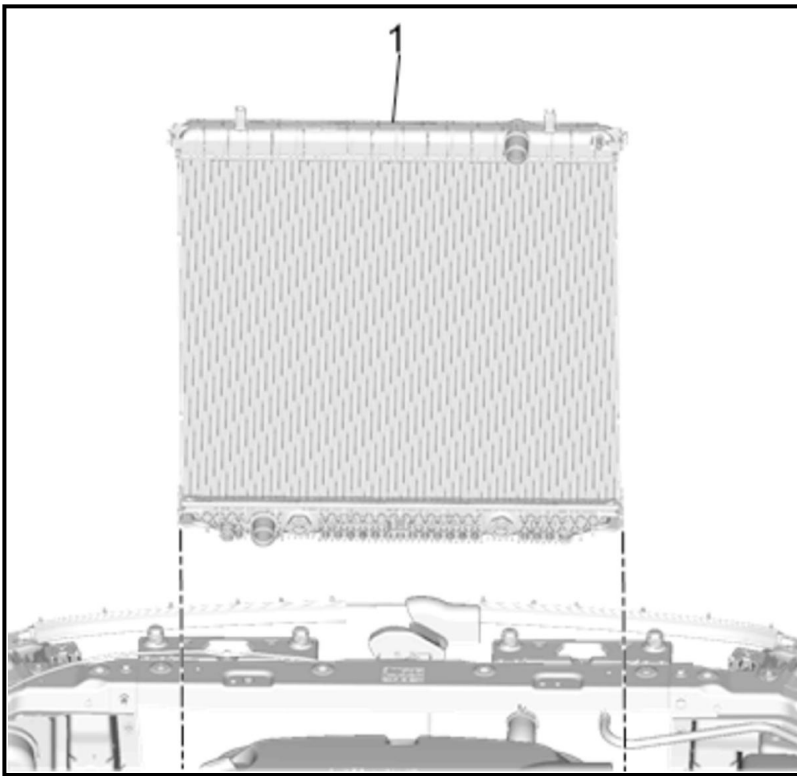
11. Radiator Upper Bracket (2) - Remove [2x] - [Radiator Upper Bracket Replacement](#)



12. Air Conditioning Condenser Bolt (1) - Remove [2x] - [Air Conditioning Condenser Replacement \(LCV, LGZ\)](#)



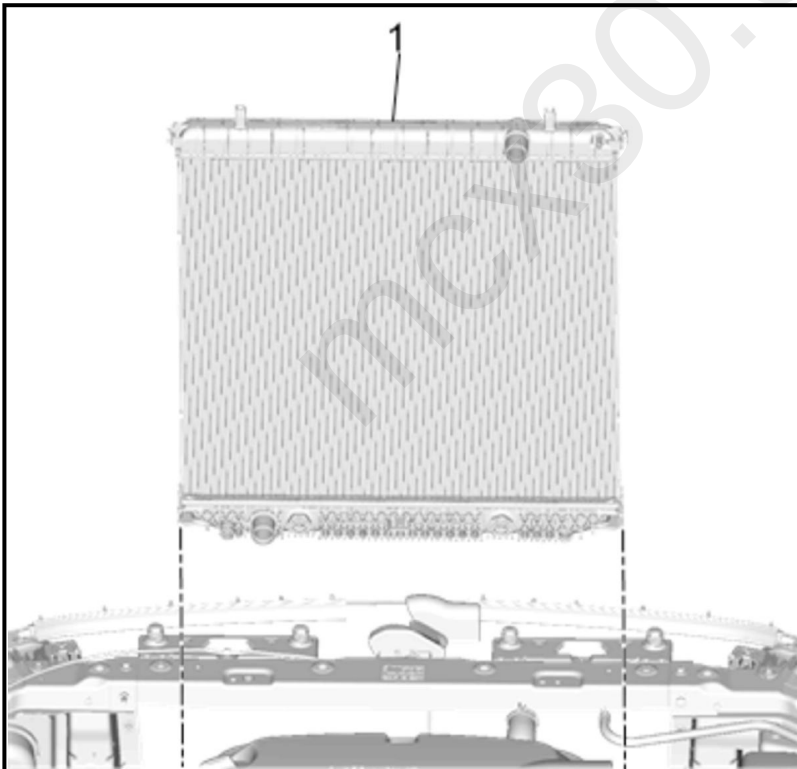
13. Without removing the air conditioning evaporative connector hose/tube and compressor and condenser hose, position the air conditioning condenser (2) forward off of the radiator.
14. Tilt the radiator assembly (1) back, and lift up to remove the radiator assembly from the vehicle.



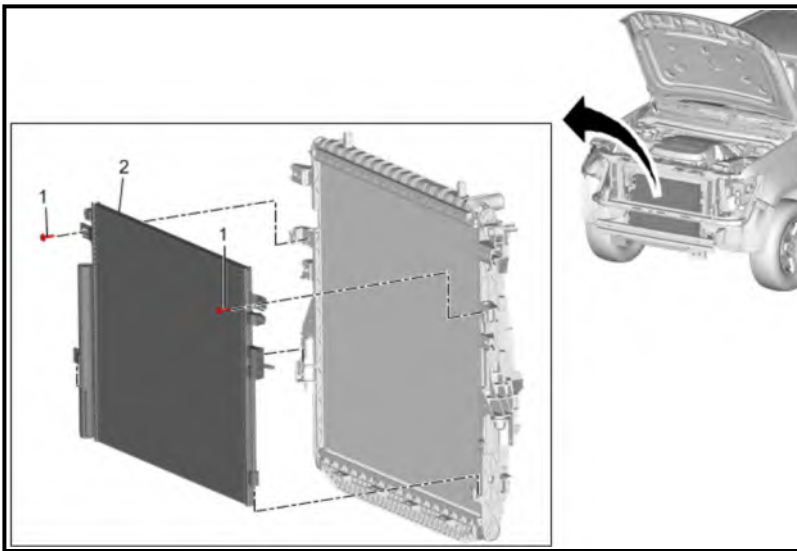
15. Transfer components as necessary.

Installation Procedure

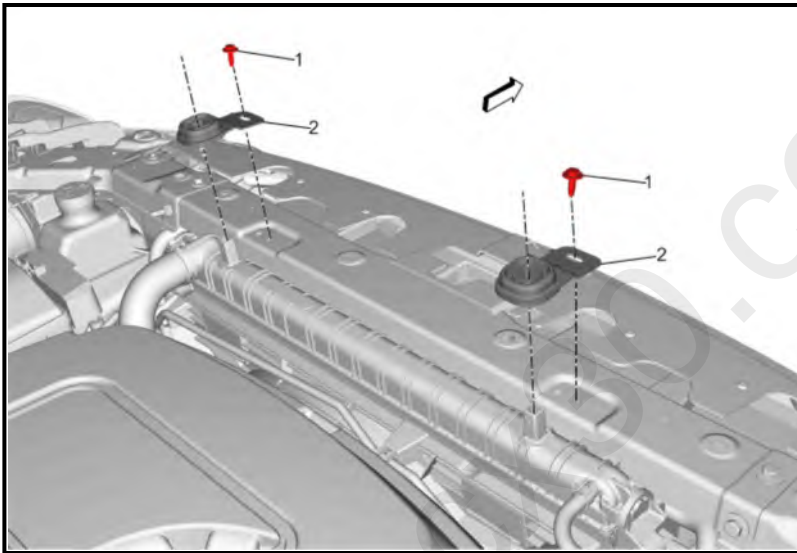
1. Radiator Assembly (1) - Install



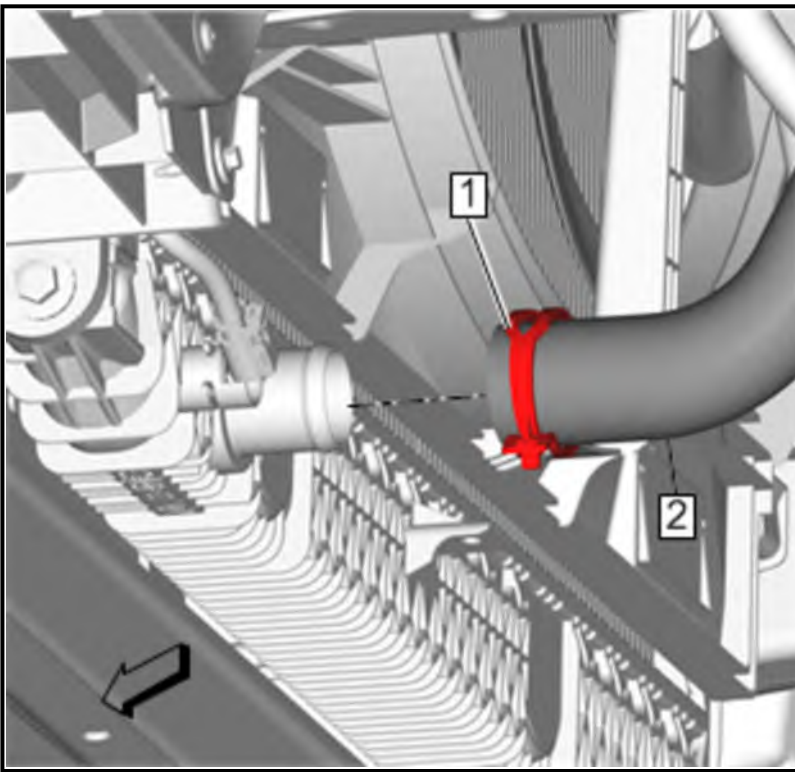
2. Position the air conditioning condenser (2) onto the radiator.



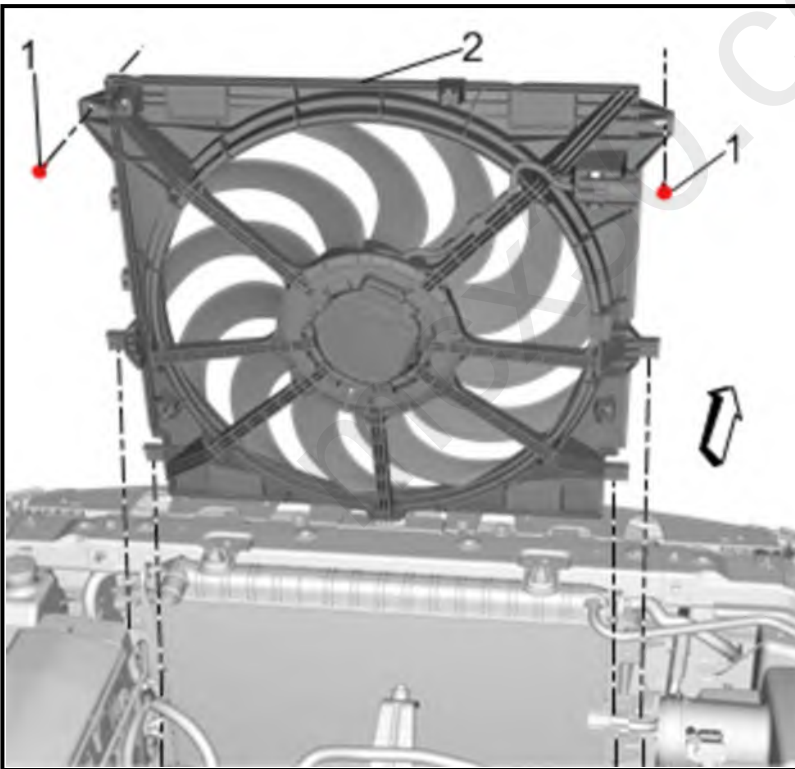
3. Air Conditioning Condenser Bolt (1) - Install [2x] - [Air Conditioning Condenser Replacement \(LCV, LGZ\)](#)
4. Radiator Upper Bracket (2) - Install [2x] - [Radiator Upper Bracket Replacement](#)



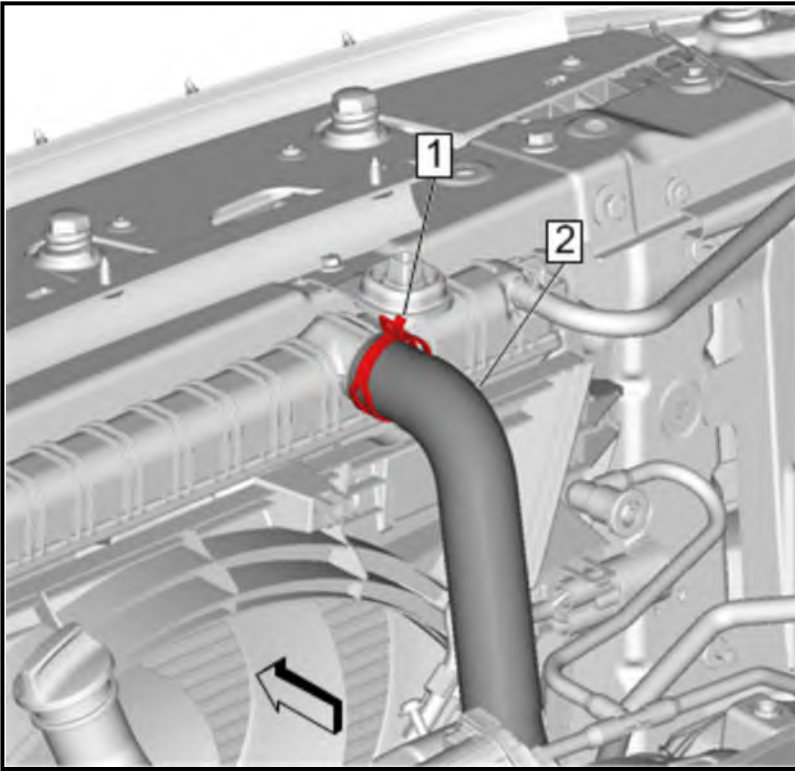
5. Engine Oil Cooler Inlet Pipe @ Radiator - Install - [Engine Oil Cooler Inlet Pipe Replacement \(LGZ, 2WD\)](#), or [Engine Oil Cooler Inlet Pipe Replacement \(LGZ, 4WD\)](#)
6. Engine Oil Cooler Outlet Pipe @ Radiator - Install - [Engine Oil Cooler Outlet Pipe Replacement \(LGZ\)](#)
7. Radiator Outlet Hose (2) @ Radiator - Install - [Radiator Outlet Hose Replacement \(LGZ\)](#)



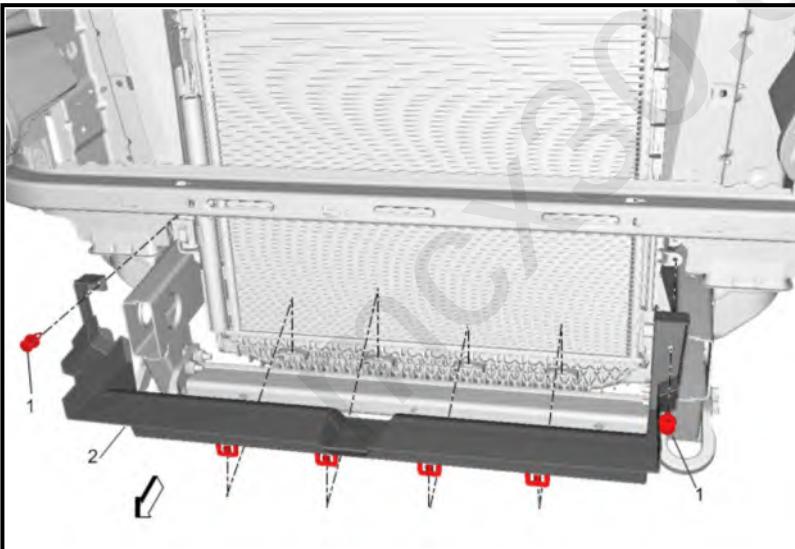
8. Engine Coolant Fan Shroud (2) @ Radiator - Install - [Engine Coolant Fan Shroud Replacement \(LCV, LGZ\)](#).



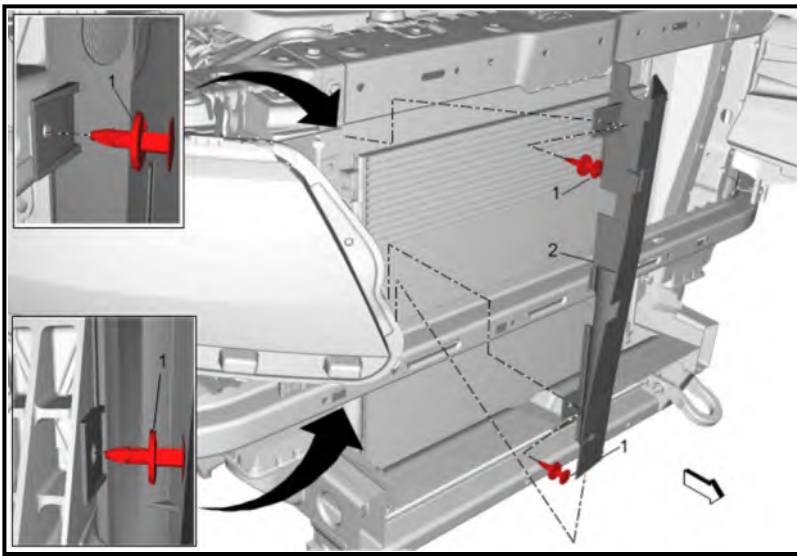
9. Radiator Inlet Hose (2) @ Radiator - Install - [Radiator Inlet Hose Replacement \(LGZ\)](#).



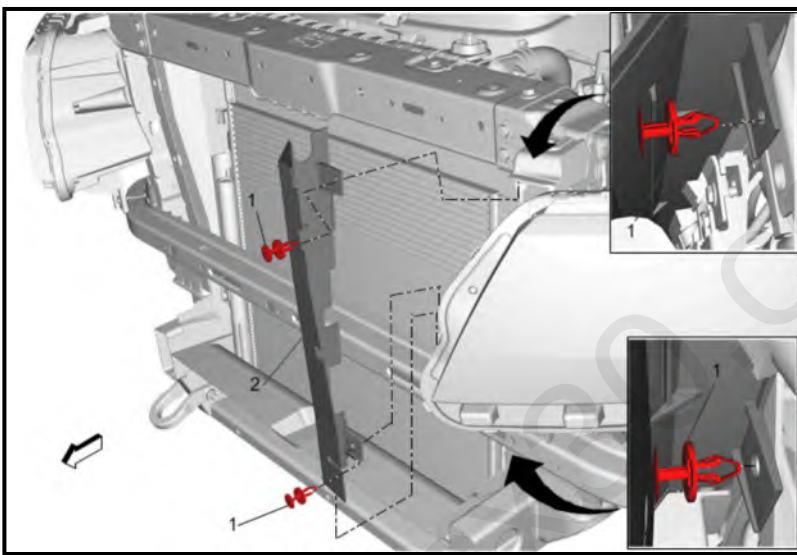
10. Transmission Fluid Cooler Inlet and Outlet Pipe @ Air Conditioning Condenser - Install - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGZ With M5T and 4WD\)](#) , or [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGZ With M5T and 2WD\)](#).
11. Radiator Air Lower Baffle (2) - Install - [Radiator Air Lower Baffle Replacement \(LCV, LGZ, LWN\)](#).



12. Right Side Radiator Air Side Baffle (2) - Install - [Radiator Air Side Baffle Replacement - Right Side \(LCV, LGZ\)](#).



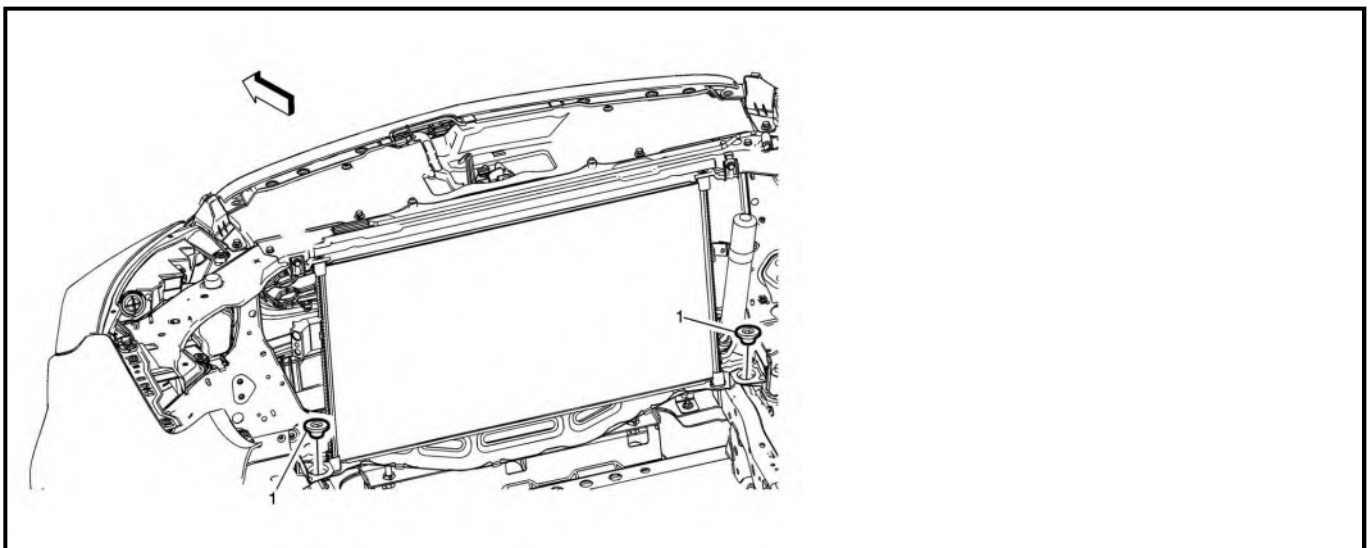
13. Left Side Radiator Air Side Baffle (2) - Install - [Radiator Air Side Baffle Replacement - Left Side \(LCV, LGZ\)](#)



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

15. Inspect the cooling system for leaks.

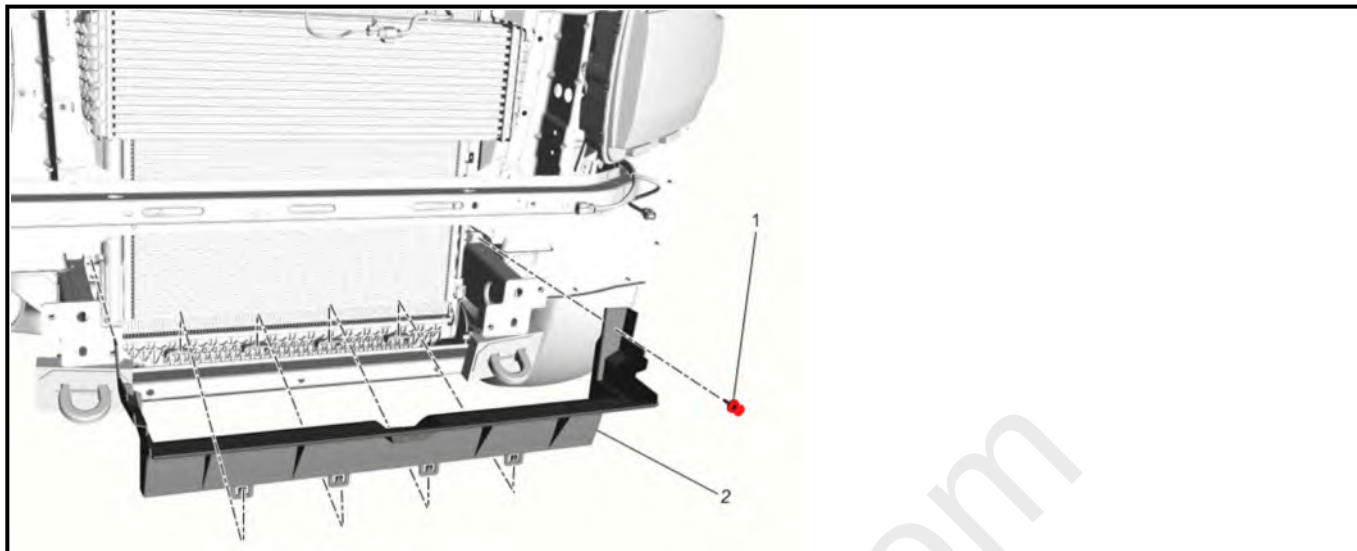
RADIATOR LOWER INSULATOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Remove radiator. Refer to Radiator Replacement (LCV) , or Radiator Replacement (LWN) , or Radiator Replacement (LGZ) .	
1	Radiator Lower Insulator/Mount (Qty: 2)

RADIATOR AIR LOWER BAFFLE REPLACEMENT (LCV, LGZ, LWN)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Front Bumper Shutter Replacement (Without Bison) , or Front Bumper Shutter Replacement (With Bison) 2. Front Bumper Impact Bar Replacement (Without Bison) , or Front Bumper Impact Bar Replacement (With Bison)	
1	Radiator Air Lower Baffle Push Pin
2	Radiator Air Lower Baffle

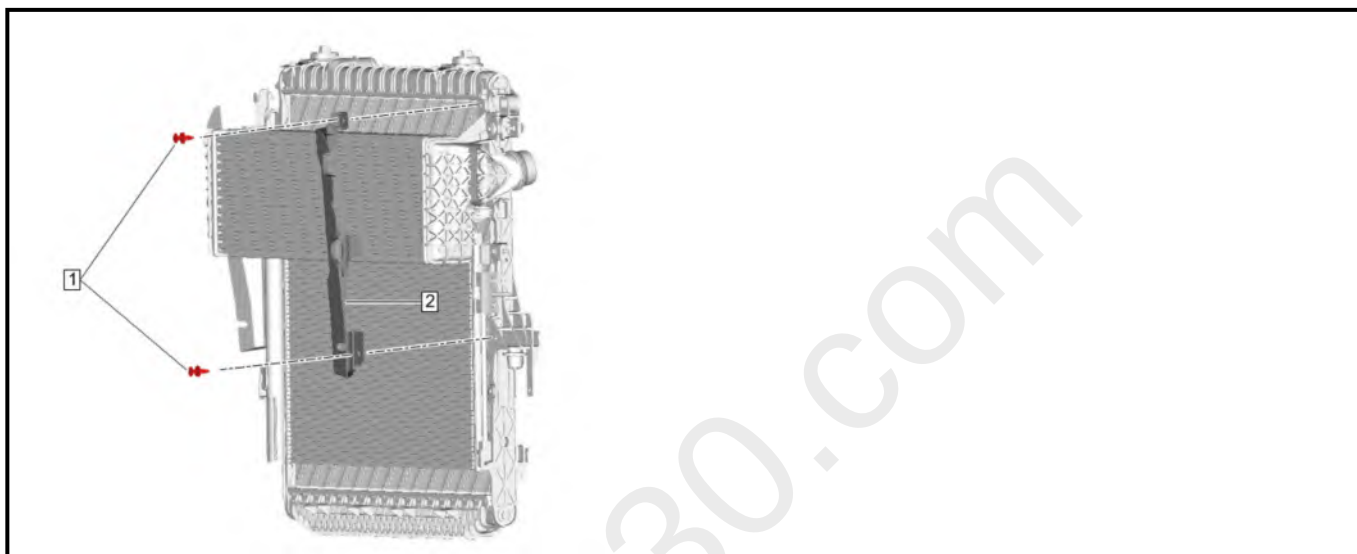
RADIATOR AIR SIDE BAFFLE REPLACEMENT - LEFT SIDE (LCV, LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. <u>Front Bumper Shutter Replacement (Without Bison)</u> , or <u>Front Bumper Shutter Replacement (With Bison)</u> 2. <u>Front End Sheet Metal Diagonal Brace Replacement</u> - Left Side	
1	Radiator Air Side Baffle Retainer (Qty: 2) Procedure Fold back flexible portion of radiator air side baffle to gain access to the radiator air side baffle retainers.
2	Radiator Air Side Baffle

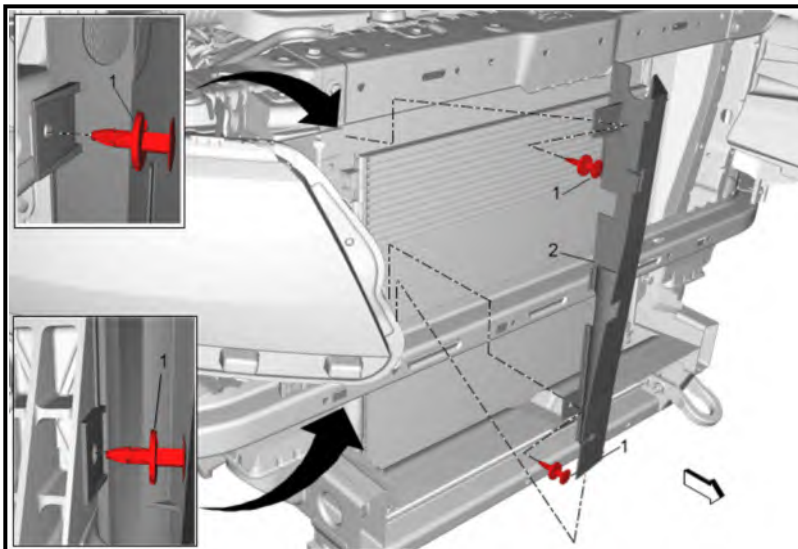
RADIATOR AIR SIDE BAFFLE REPLACEMENT - LEFT SIDE (LWN)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN)</u> , or <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN Bison)</u>	
1	Push Pin (1)[2x]
2	Radiator Air Side Baffle - Left Side

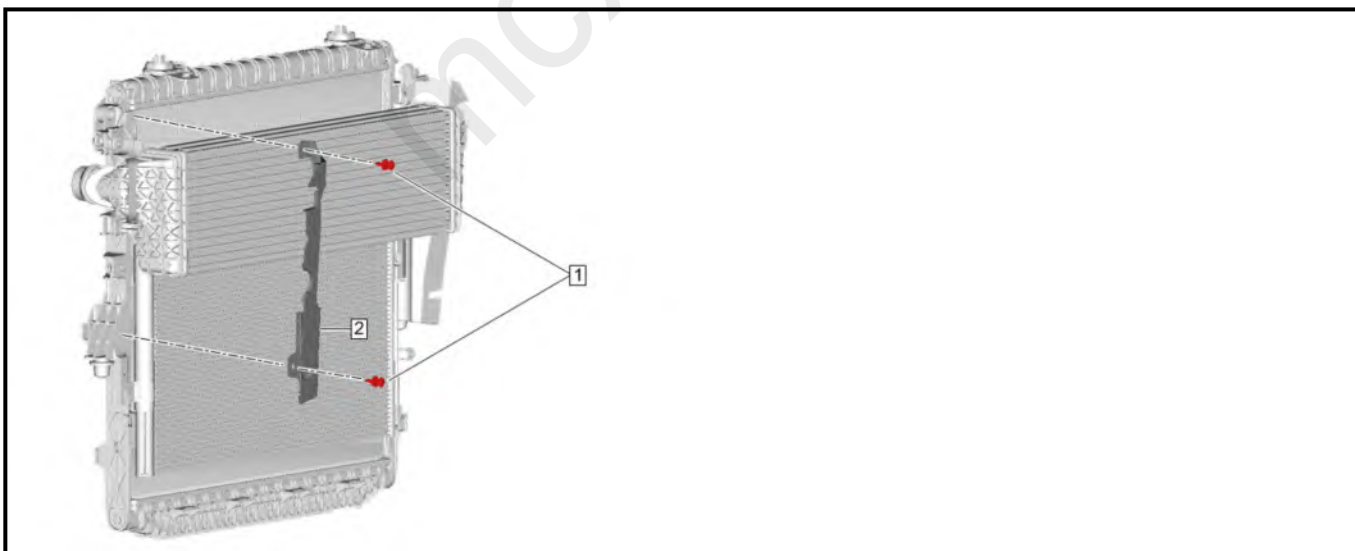
RADIATOR AIR SIDE BAFFLE REPLACEMENT - RIGHT SIDE (LCV, LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures <u>Front Bumper Shutter Replacement (Without Bison)</u> , or <u>Front Bumper Shutter Replacement (With Bison)</u> <u>Front End Sheet Metal Diagonal Brace Replacement</u> - Right Side	
1	Radiator Air Side Baffle Retainer (Qty: 2) Procedure Fold back flexible portion of radiator air side baffle to gain access to the radiator air side baffle retainers.
2	Radiator Air Side Baffle

RADIATOR AIR SIDE BAFFLE REPLACEMENT - RIGHT SIDE (LWN)

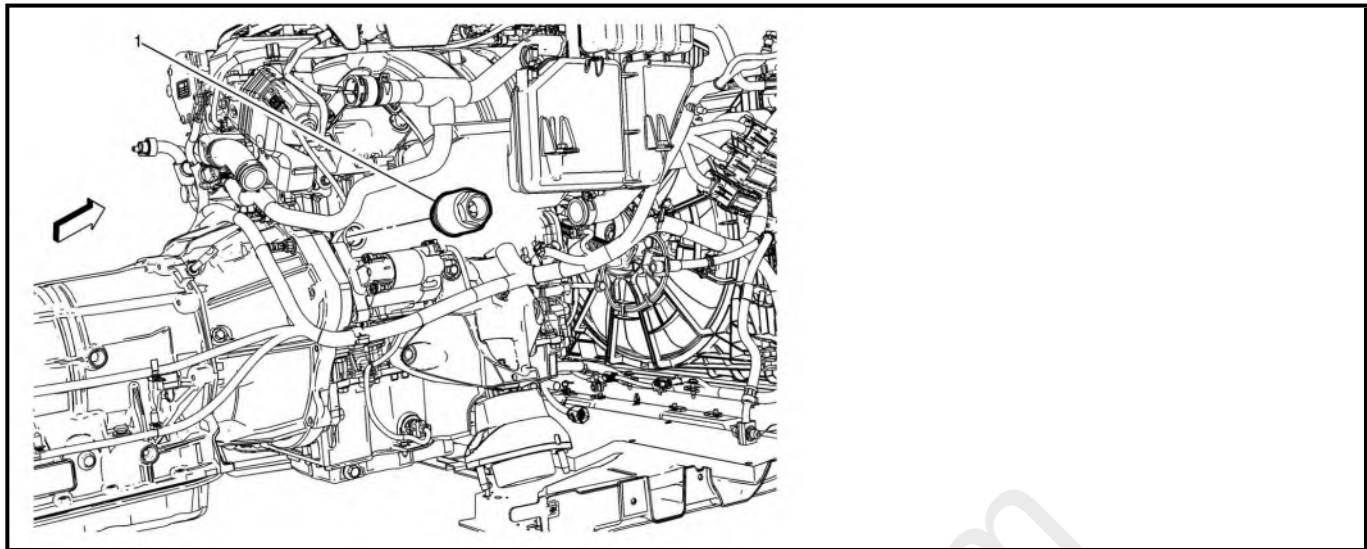


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN)</u> , or <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN Bison)</u>	

Callout	Component Name
1	Push Pin (1)[2x]
2	Radiator Air Side Baffle - Right Side

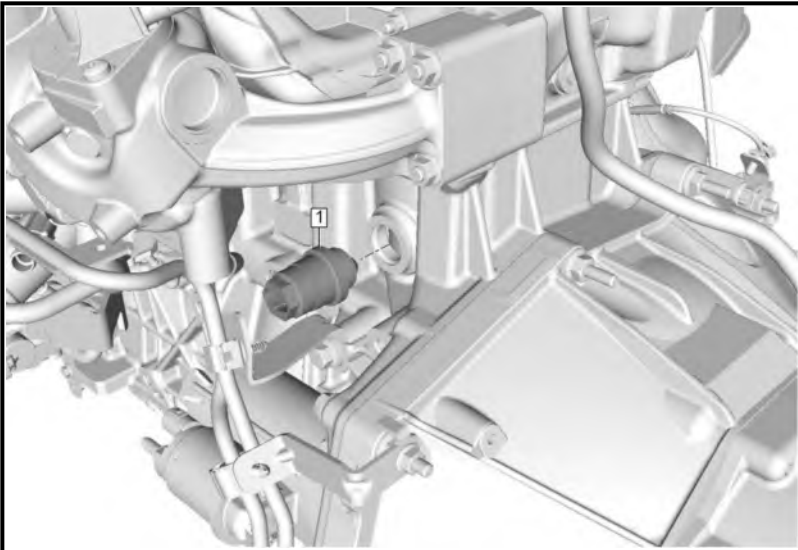
COOLANT HEATER REPLACEMENT (LCV)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Drain the cooling system. Cooling System Draining and Filling (Static Fill) , or Cooling System Draining and Filling (Vac n Fill)	
1	Engine Coolant Heater CAUTION: Refer to Fastener Caution . Procedure Disconnect the engine coolant heater cord. Tighten 50 N.m (37 lb ft)

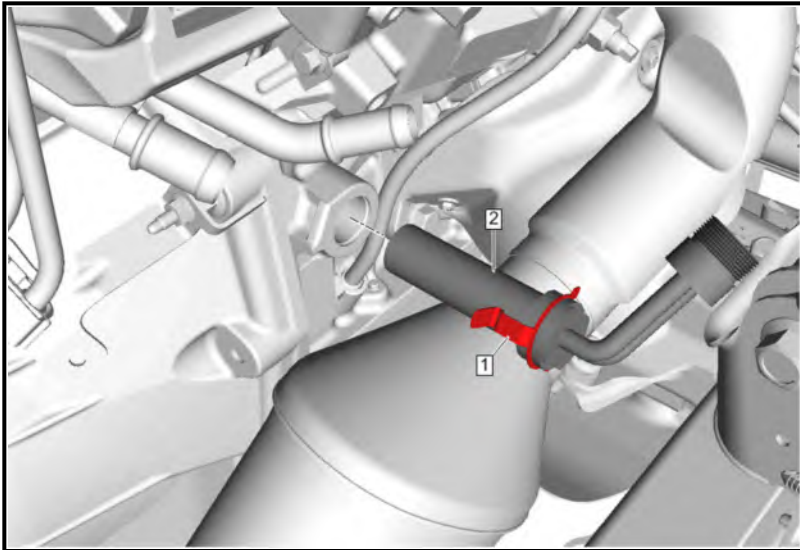
COOLANT HEATER REPLACEMENT (LWN)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Drain the coolant. <u>Cooling System Draining and Filling (Static Fill)</u> , or <u>Cooling System Draining and Filling (Vac n Fill)</u> . 2. Fuel Pump Fuel Feed Hose - Reposition - <u>Fuel Pump Fuel Feed Hose Replacement</u> 3. Fuel Pump Fuel Return Hose - Reposition - <u>Fuel Pump Fuel Return Hose Replacement</u> 4. Coolant Heater Cord - Disconnect - <u>Coolant Heater Cord Replacement (LWN)</u>	
1	Coolant Heater CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Tighten 50 N.m (37 lb ft)

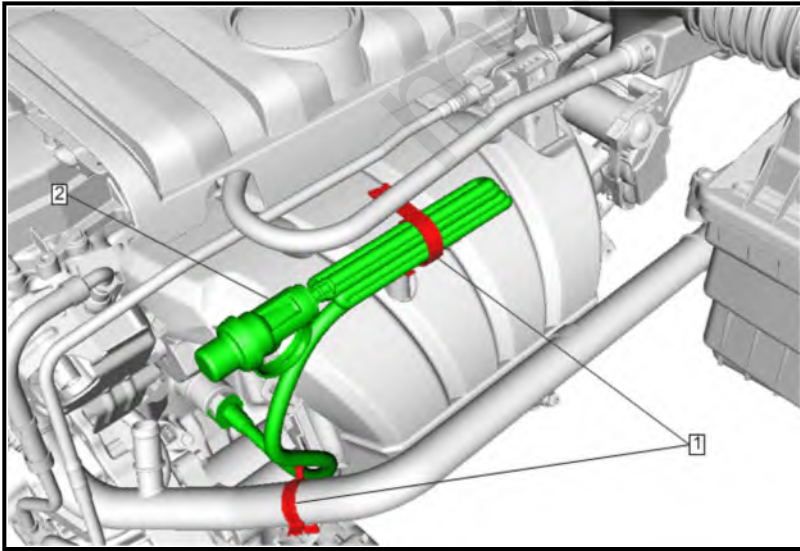
COOLANT HEATER REPLACEMENT (LGZ)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Drain the coolant. Cooling System Draining and Filling (Static Fill), or Cooling System Draining and Filling (Vac n Fill). 2. Front Wheelhouse Liner - Remove - Front Wheelhouse Liner Replacement (Without ZR2) , or Front Wheelhouse Liner Replacement (With ZR2) , or Front Wheelhouse Liner Replacement (Bison). 3. Coolant Heater Cord - Disconnect - Coolant Heater Cord Replacement (LGZ).	
1	Coolant Heater Retainer
2	Coolant Heater

COOLANT HEATER CORD REPLACEMENT (LCV)

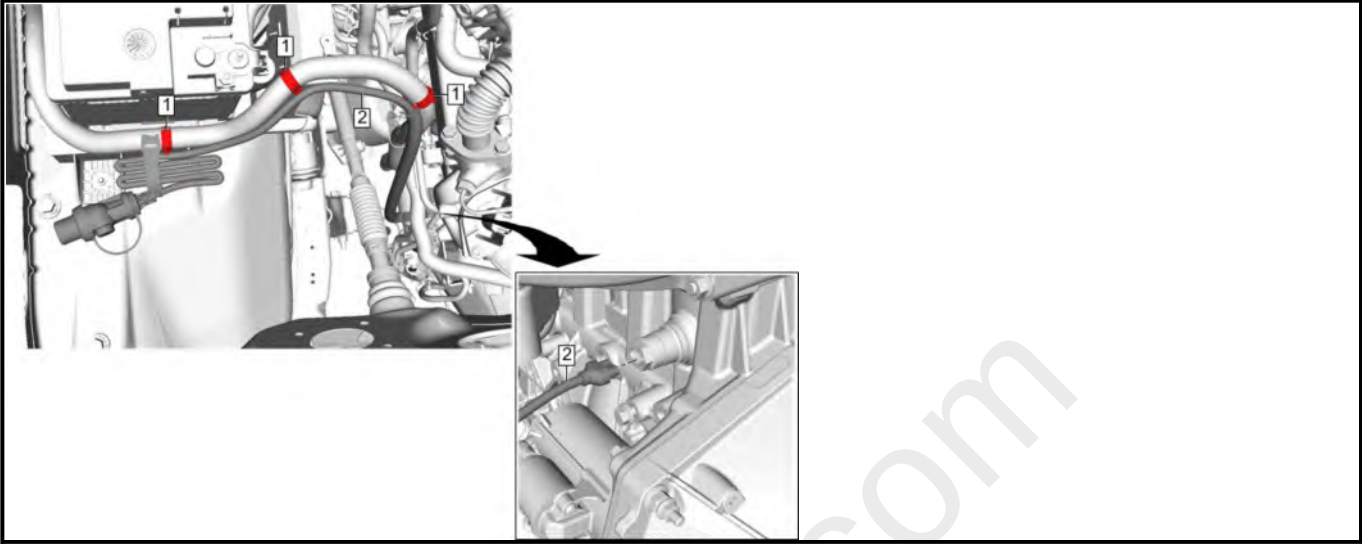


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	

Callout	Component Name
1	Coolant Heater Cord Procedure Disconnect the coolant heater cord from the coolant heater.
2	Coolant Heater Cord Retainer Procedure Disconnect the coolant heater cord retainers.

COOLANT HEATER CORD REPLACEMENT (LWN)



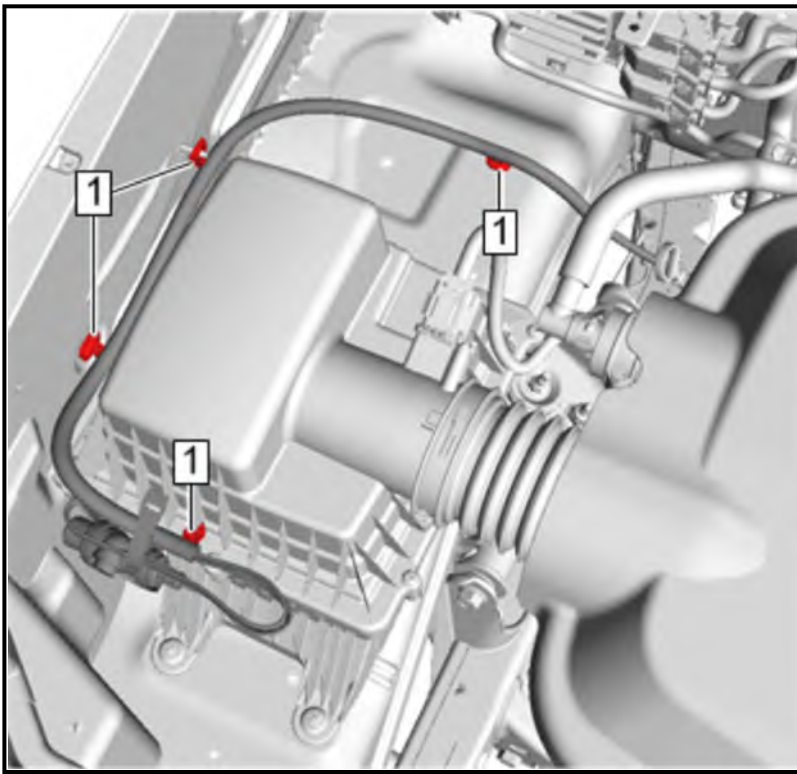
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Fuel Pump Fuel Feed Hose Replacement	
1	Coolant Heater Cord Clip [3x]
2	Coolant Heater Cord

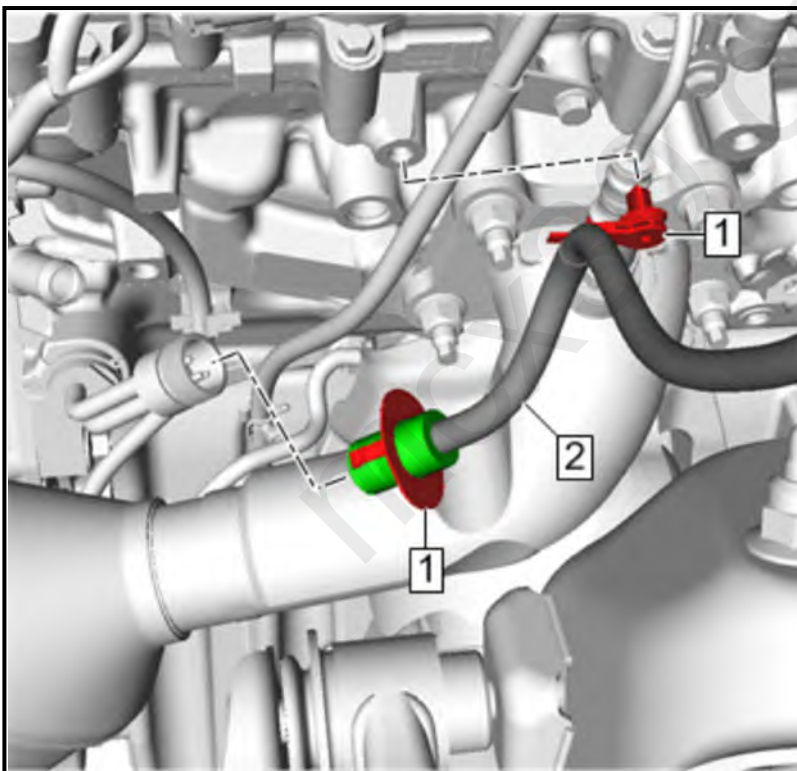
COOLANT HEATER CORD REPLACEMENT (LGZ)

Removal Procedure

1. Front Wheelhouse Liner - Remove - **Front Wheelhouse Liner Replacement (Without ZR2)** , or **Front Wheelhouse Liner Replacement (With ZR2)** , or **Front Wheelhouse Liner Replacement (Bison)**.
2. Coolant Heater Cord Clip (1) - Remove [4x]



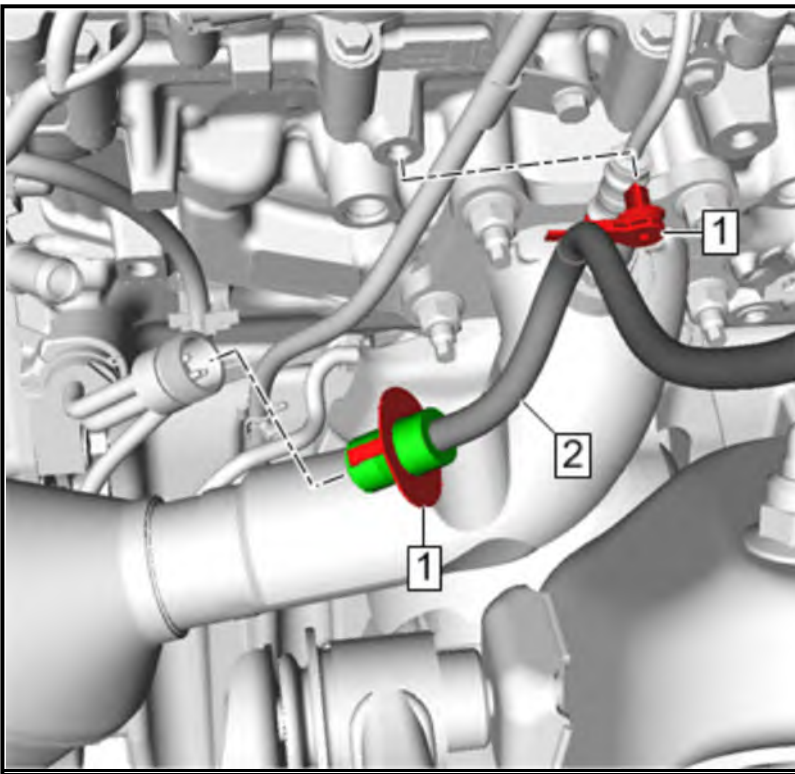
3. Coolant Heater Cord Clip (1) - Remove [2x]



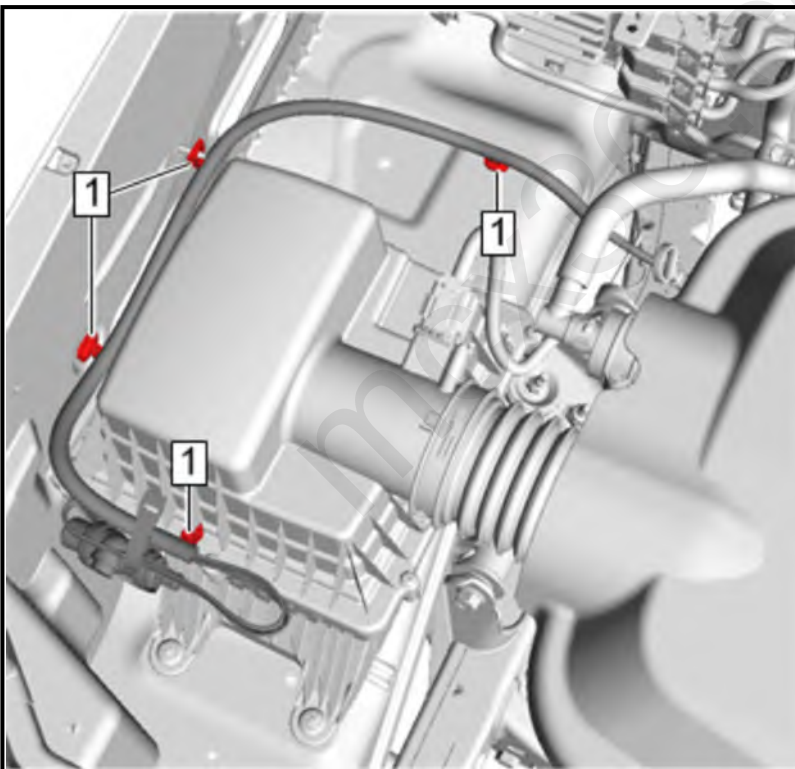
4. Coolant Heater Cord (2) - Remove

Installation Procedure

1. Coolant Heater Cord (2) - Install



2. Coolant Heater Cord Clip (1) - Install [2x]
3. Coolant Heater Cord Clip (1) - Install [4x]



4. Front Wheelhouse Liner - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION (WITH LWN)

Cooling Fan Control

The purpose of the electro-viscous (EV) fan clutch is to maintain powertrain cooling requirements. The engine control module (ECM) monitors the following sensors to regulate the fan speed:

- Engine coolant temperature sensor
- A/C refrigerant pressure sensor
- Vehicle speed sensor
- Intake air temperature sensor
- Transmission fluid temperature sensor
- Ambient air temperature sensor
- Cooling fan speed sensor

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.

The fan clutch supplies a feedback signal to the ECM, as an actual fan speed input. The fan speed sensor is a hall effect sensor which is internal to the fan clutch. The ECM supplies a 5-volt reference and a low reference to the hall effect sensor. The hall effect sensor returns a signal pulse through the cooling fan speed signal circuit in response to the reluctor track passing by the magnetic field of the hall effect sensor.

The scan tool can operate the cooling fan clutch. This is done through the controls function menu screen. Cooling fan clutch engagement can take up to 2 minutes with a 100 percent command and the engine speed at 2, 000 RPM. The lower the engine speed, the longer it will take for the fan to engage. Cooling fan disengagement can take up to 2 minutes with the engine speed at 2, 000 RPM. The lower the engine speed, the longer it will take to disengage. In lower ambient air temperatures the cooling fan will engage in less time, however, it will take longer to disengage due to the properties of the fluid vs. temperature.

Under certain conditions the cooling fan may be engaged at engine start. The cooling fan may have been engaged at the time the engine was turned off. Or, fluid may bleed from the storage chamber into the fluid coupling of the cooling fan clutch while the engine is off. Although the fan clutch is commanded off during a cold start, this is the most likely time a vehicle driver will notice that the fan noise is excessive in comparison to engine starts when the fan clutch is disengaged.

COOLING FAN DESCRIPTION AND OPERATION (WITH LCV, LGZ)

Cooling Fan Control

The engine cooling fan system is composed of 1 electric cooling fan and an integral cooling fan control module. The cooling fan control module communicates with the engine control module (ECM) via a local interconnect network (LIN). The ECM controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module over a serial data circuit or (LIN Buss). 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 actual commanded cooling fan speed is based on a number of inputs from the ECM, and cooling fan requests from other modules, such as the BCM, TCM, and HPCM, if equipped. When multiple cooling fan speed requests are received, the ECM operates the fan at the highest of speed requests. The scan tool output control is only capable of operating the cooling fan in increments, between 10 - 90 percent. 90 percent is considered high speed fan. The ECM commands the fans ON under the following conditions:

- The engine coolant temperature is warmer than a predetermined value

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

COOLING SYSTEM DESCRIPTION AND OPERATION (LGZ, LWN)

Cooling System

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

Cooling Cycle

Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. Some coolant will then be pumped from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost.

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

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

From the cylinder heads, the coolant is then forced to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine is warmed, or it will flow through the thermostat and into the radiator where it is cooled and the coolant cycle is completed.

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

Coolant

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

Thermostat

The thermostat has a valve which controls coolant flow to the radiator. Attached to the valve is a 'pellet' or 'element' which contains a carefully formulated wax. The design of the thermostat housing ensures that coolant flow washes the element at all times. As the coolant warms up the wax temperature also goes up. Eventually the wax begins to melt and change in volume. This volume expansion drives the valve open allowing flow to the radiator. As the engine operates, changes in coolant temperature will result in more or less valve opening which maintain temperature in a desired range. In this specific thermostat type, there is also an electric heater within the element. The engine control system can partially 'override' the influence of the coolant temperature alone by energizing the heater. The result is a broader range of controlled operating temperatures than found in a traditional (unheated) thermostat. At very high engine loads and very high ambient temperature, the thermostat reaches its limit of control and the coolant temperature depends on the radiator air flow determined by vehicle speed and the fans.

Radiator

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

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

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

Pressure Cap

The pressure cap is a cap that seals and pressurizes the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring and protects the radiator by relieving pressure if it exceeds 20 psi. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, could cause the radiator hoses to collapse.

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

Engine Coolant Bypass Valve {If equipped}

The engine coolant bypass valve opens at around 4, 000 RPM. All coolant is circulated through the heater core when the RPM is below 4, 000 RPM and while the engine thermostat is fully closed during engine warm up. The engine coolant bypass valve opens at around 4, 000 RPM and above, which stops increase of flow rate to the heater core and forces some portion of coolant through a heater bypass loop in order to protect the heater core from excessive coolant pressure. In rare cases, the engine coolant bypass valve may be stuck open, causing a lack of cabin heat.

Surge Tank

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

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

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

Air Baffles and Seals

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

Engine Oil Cooler

The engine oil cooler is a heat exchanger located inside the lower end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds the oil cooler in the radiator.

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

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. The air conditioning condenser is a multi-cooler that contains the transmission oil cooler heat exchanger. The transmission fluid temperature is regulated by the temperature of the air passing through the heat exchanger.

The transmission oil pump, pumps the fluid through the transmission oil cooler feed line to the oil cooler. The fluid then flows through the cooler while the passing through the heat exchanger absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

COOLING SYSTEM DESCRIPTION AND OPERATION (LCV)

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions.

Cooling Circuit

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

From the cylinder heads, there are several return paths for the coolant.

Some coolant will circulate to the heater core and then back to the water pump. This provides the passenger compartment with heat and defrost.

Some coolant will flow through a bypass valve at the engine outlet and return directly to the water pump.

The coolant returning from the heater core is mixed with the bypass flow and together flows past or 'washes' the thermostat. The thermostat is located directly upstream or in front of the water pump. When the heater and bypass flow becomes warm enough, the thermostat begins to open and allows flow from the radiator to return to the pump and engine. The thermostat regulates the 'cold' flow from the radiator such that the temperature of the coolant entering the pump and engine is maintained at an optimum.

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

Coolant

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

Radiator

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

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Engine Coolant Bypass Valve

The LCV engine water outlet assembly includes an engine coolant bypass valve, which opens at around 4,000 RPM. All coolant is circulated through the heater core when the RPM is below 4,000 RPM and while the engine thermostat is fully closed during engine warm up. The engine coolant bypass valve opens at around 4,000 RPM and above, which stops increase of flow rate to the heater core and forces some portion of coolant through a heater bypass loop in order to protect the heater core from excessive coolant pressure. In rare cases, the engine coolant bypass valve may be stuck open, causing a lack of cabin heat.

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Thermostat

The thermostat has a valve which controls coolant flow to the radiator. Attached to the valve is a 'pellet' or 'element' which contains a carefully formulated wax. The design of the thermostat housing ensures that coolant flow washes the element at all times. As the coolant warms up the wax temperature also goes up. Eventually the wax begins to melt and change in volume. This volume expansion drives the valve open allowing flow to the radiator. As the engine operates, changes in coolant temperature will result in more or less valve opening which maintain temperature in a desired range. In this specific thermostat type, there is also an electric heater within the element. The engine control system can partially 'override' the influence of the coolant temperature alone by energizing the heater. The result is a broader range of controlled operating temperatures than found in a traditional (unheated) thermostat. At very high engine loads and very high ambient temperature, the thermostat reaches its limit of control and the coolant temperature depends on the radiator air flow determined by vehicle speed and the fans.

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The transmission oil cooler is a heat exchanger. The air conditioning condenser is a multi-cooler that contains the transmission oil cooler heat exchanger. The transmission fluid temperature is regulated by the temperature of the air passing through the heat exchanger.

The transmission oil pump, pumps the fluid through the transmission oil cooler feed line to the oil cooler. The fluid then flows through the cooler while the passing through the heat exchanger absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

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

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

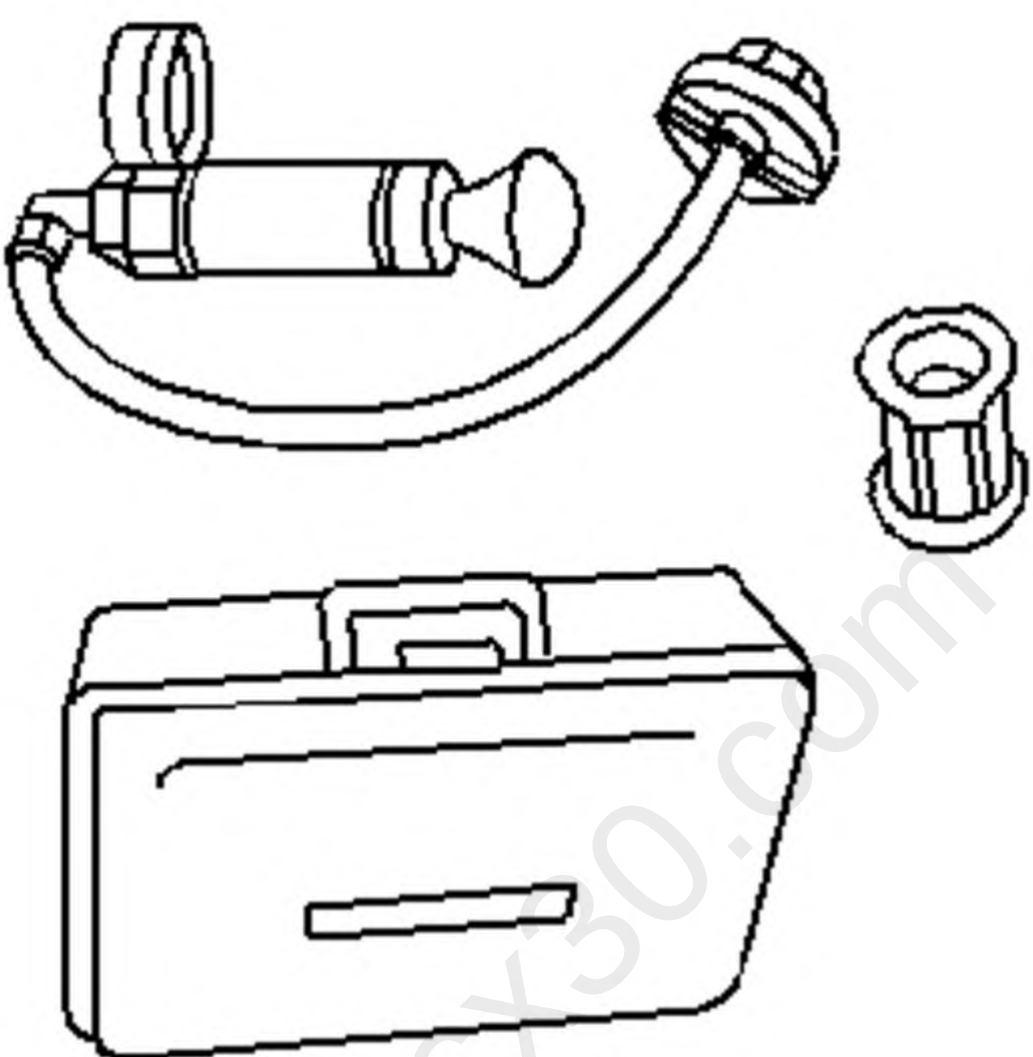
Illustration	Tool Number/ Description
 The illustration shows a cooling system pressure tester kit. It consists of a main gauge unit with a handle and a hose, a separate pressure gauge, and a carrying case. The main gauge unit has a handle on the left and a hose on the right. The separate pressure gauge is located to the right of the main unit. The carrying case is a rectangular box with a handle on top and a latch on the front. A large, faint watermark 'mcx30.com' is visible across the center of the illustration.	EN-24460-A J-24460-01 Cooling System Pressure Tester

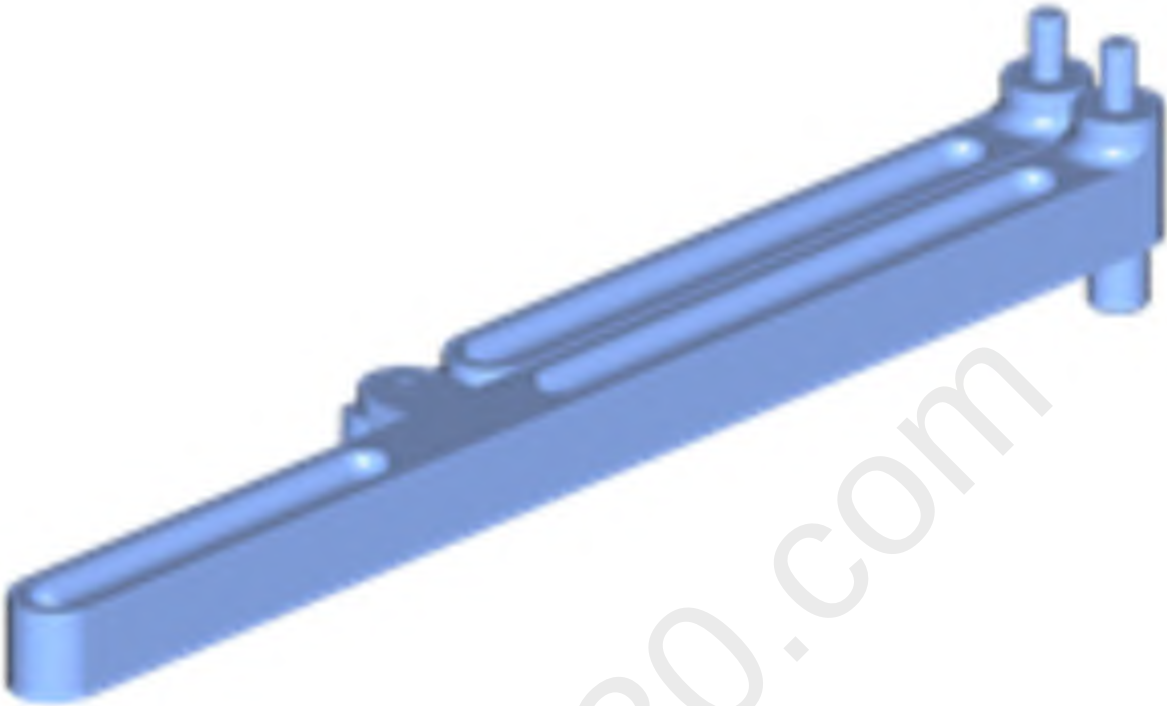
Illustration	Tool Number/ Description
	EN-46104 J-46104 Water Pump Pulley Holding Tool

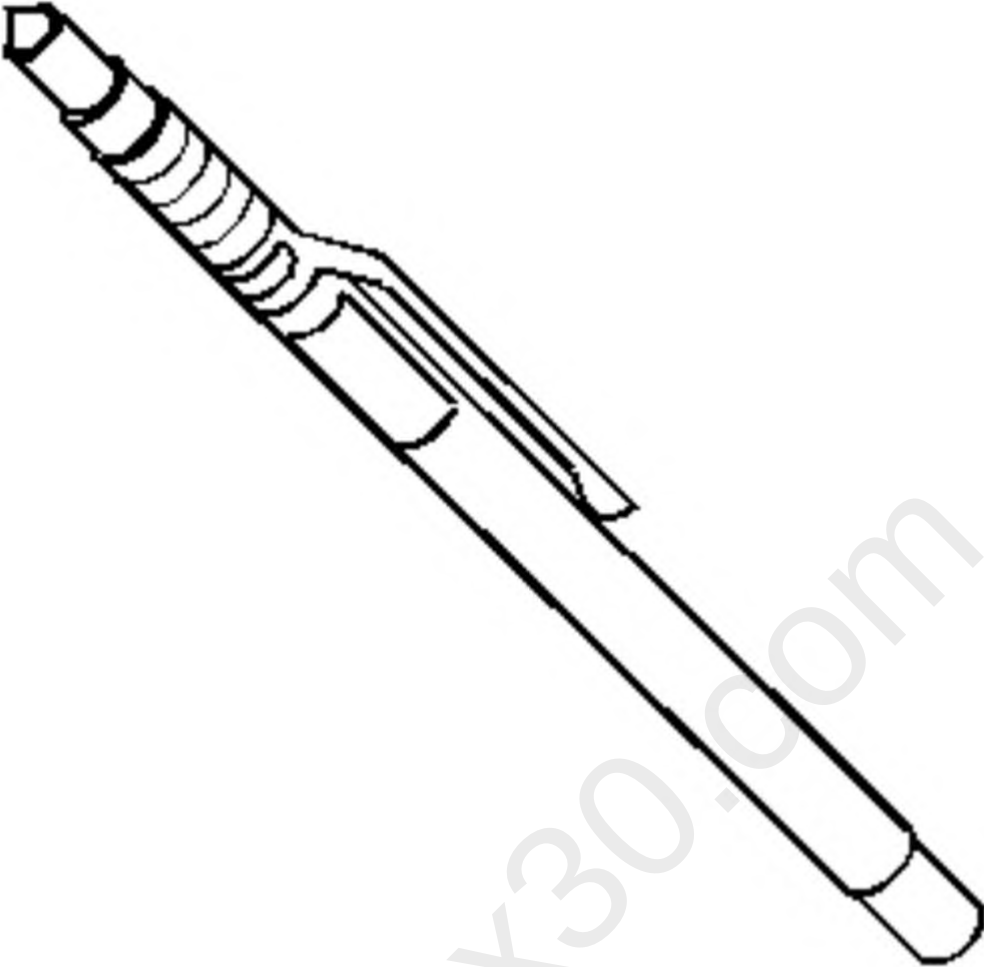
Illustration	Tool Number/ Description
	GE-24731 J-24731 Tempilstick

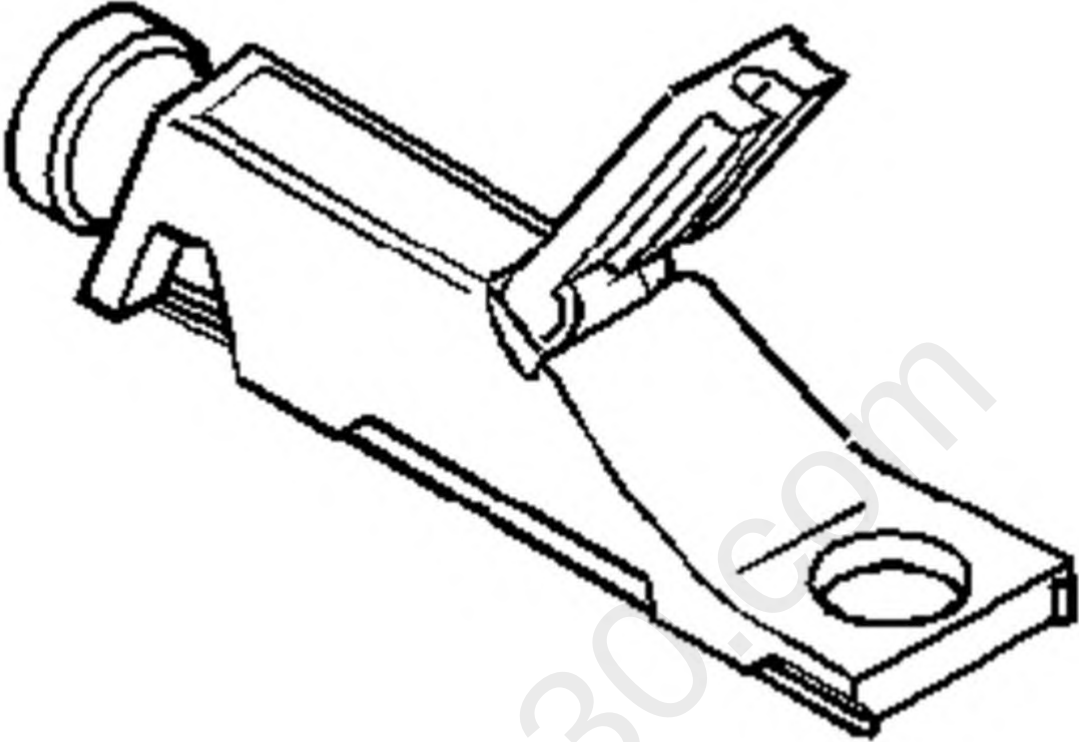
Illustration	Tool Number/ Description
	GE-26568 J-26568 Coolant and Battery Fluid Tester

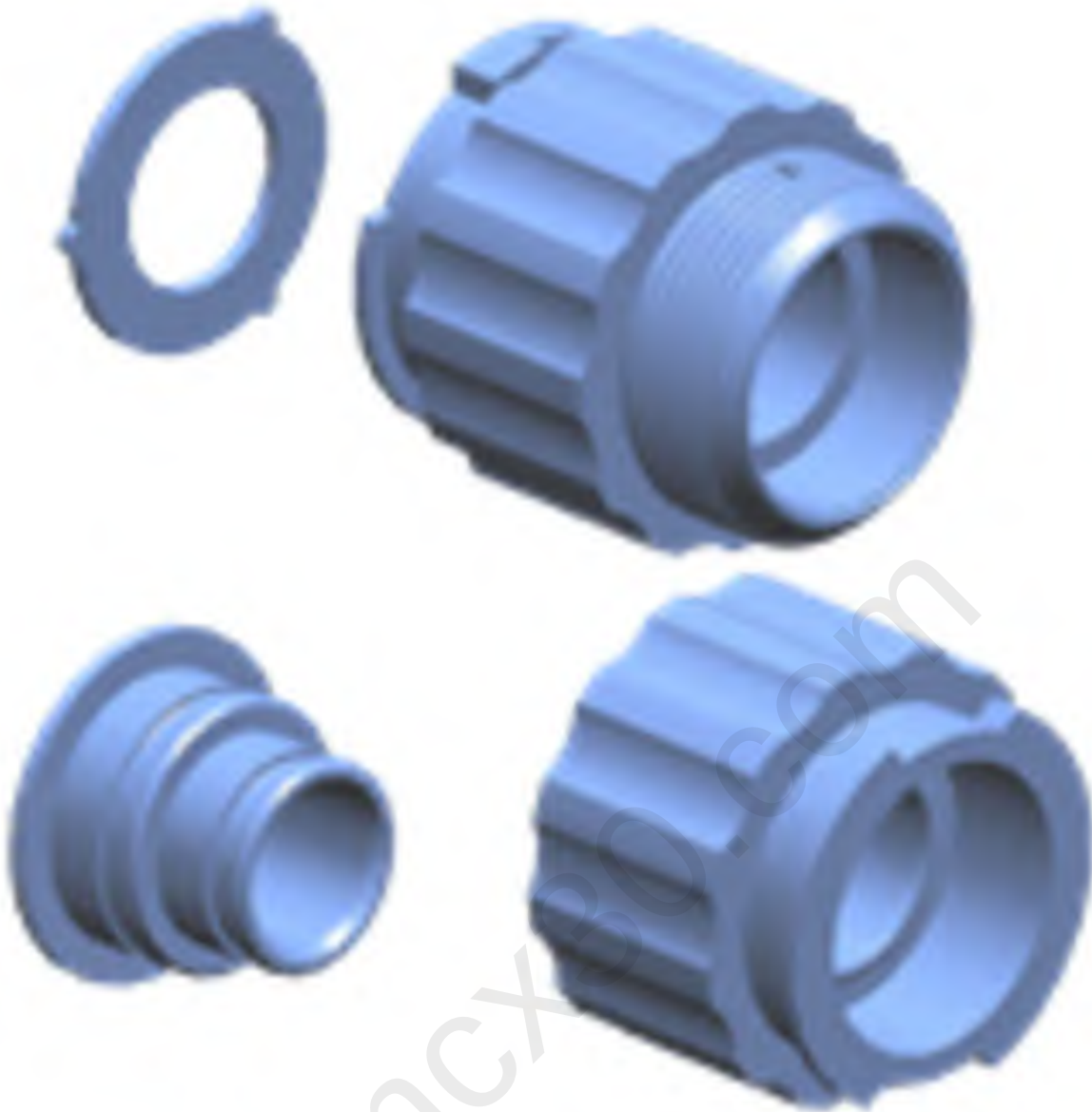
Illustration	Tool Number/ Description
	GE-42401-A J-42401 Adapter Cooling System

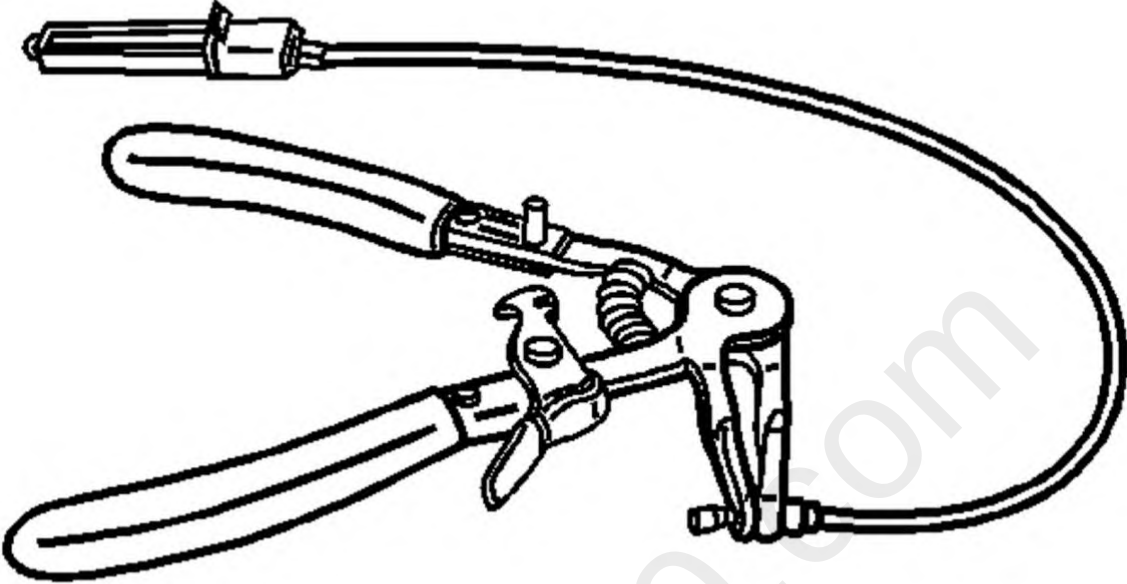
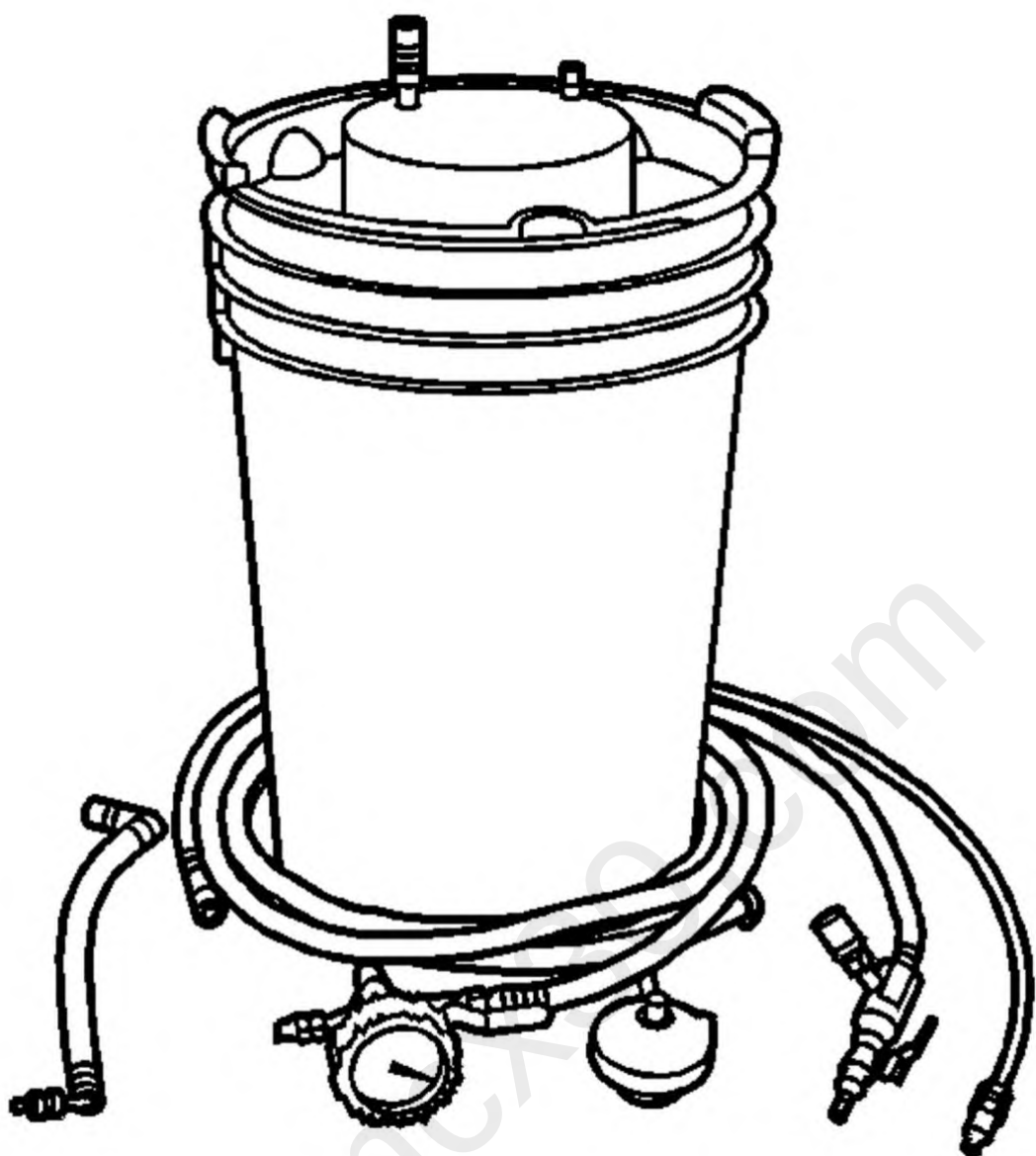
Illustration	Tool Number/ Description
	GE 47622 Hose Clamp Pliers

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