

2013 ENGINE

Engine Cooling - Cruze

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

Temperature Versus Resistance

°C	°F	Sensor Resistance
Temperature vs Resistance Values (Approximate)		
100	212	155
90	194	208
80	176	283
70	158	392
60	140	552
50	122	793
45	113	958
40	104	1165
35	95	1425
30	86	1755
25	77	2176
20	68	2717
15	59	3428
10	50	4356
5	41	5578
0	32	7198
-5	23	9362
-10	14	12278
-15	5	16229
-20	-4	21653
-30	-22	39631
-40	-40	75532

FASTENER TIGHTENING SPECIFICATIONS (1.4L LUV)

Fastener Tightening Specifications (1.4L LUV)

Application	Specification	
	Metric	English
Air Conditioning Compressor And Condenser Hose Bolt	9 N.m	80 lb in
Air Conditioning Compressor And Condenser Hose Nut	19 N.m	14 lb ft
Air Conditioning Evaporator Hose Nut	19 N.m	14 lb ft

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Engine Coolant Thermostat Housing Bolt	8 N.m	71 lb in
Engine Oil Cooler Bolt	20 N.m	15 lb ft
Engine Oil Cooler Inlet Pipe Bolt	10 N.m	89 lb in
Engine Oil Cooler Outlet Pipe Bolt	10 N.m	89 lb in
Ground Cable Nut - Coolant Fan Wiring Harness	10 N.m	89 lb in
Oil Pressure Indicator Switch	20 N.m	15 lb ft
Radiator Lower Bracket Bolt	22 N.m	16 lb ft
Radiator Upper Bracket Bolt	22 N.m	16 lb ft
Turbocharger Coolant Return Pipe Bolt	10 N.m	89 lb in
Water Outlet Bolt	8 N.m	71 lb in
Water Pump Bolt	8 N.m	71 lb in
Water Pump Pulley Bolt	22 N.m	16 lb ft

FASTENER TIGHTENING SPECIFICATIONS (1.8L LUW AND LWE)**Fastener Tightening Specifications (1.8L LUW and LWE)**

Application	Specification	
	Metric	English
Engine Coolant Fan Motor Bolt	4 N.m	36 lb in
Engine Coolant Fan Resistor Bolt	4 N.m	36 lb in
Engine Coolant Thermostat Bolt	8 N.m	71 lb in
Engine Coolant Thermostat Bypass Pipe Bolt	8 N.m	71 lb in
Engine Coolant Thermostat Housing Bolt	8 N.m	71 lb in
Engine Coolant Thermostat Housing Retainer Nut	9 N.m	80 lb in
Engine Oil Cooler Bolt	8 N.m	71 lb in
Engine Oil Cooler Housing Bolt	25 N.m	19 lb ft
Engine Oil Cooler Pipe Bolt	8 N.m	71 lb in
Hood Hold Open Rod Retainer Bracket Bolt	22 N.m	17 lb ft
Radiator Bracket Bolt	25 N.m	18 lb ft
Radiator Support Bracket Bolt	22 N.m	17 lb ft
Water Pump Housing Bolt	8 N.m	71 lb in
Water Pump Pulley Bolt	20 N.m (1)	15 lb ft (1)
(1) Recut threads before re-use and insert bolts with screw locking compound. The installation time, including torque inspection, is a maximum of 10 minutes.		

ENGINE COOLING SYSTEM SPECIFICATIONS (1.4L LUV)**Engine Cooling System Specifications (1.4L LUV)**

Application	Specification	
	Metric	English
Cooling System		
• Water Pump Design	Rotary Pump	

• Cooling Filling Quantity	6.2 L	6.6 quart
Thermostat (Grid Controlled)		
• Thermostat Opening 0V	103°C	217°F
• Thermostat Opening 12V	80°C	176°F

ENGINE COOLING SYSTEM SPECIFICATIONS (1.8L LUW AND LWE)

Engine Cooling System Specifications (1.8L LUW and LWE)

Application	Specification	
	Metric	English
Cooling System		
Water Pump Design	Rotary Pump	
Flow (engine outlet 6000 min ⁻¹ , Thermostat fully open)	165 l/min	43.588 US gal
Coolant filling quantity	5.9L	5.917 quart
Thermostat		
Thermostat Opening- Electrical	90°C	194°F
Thermostat Opening- Thermic	105°C	221°F

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Wiring Schematics

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Callout	Component Name
CAV_86	86
CAV_87	87
CAV_30	30
CAV_85	85
CAV_86	86
CAV_87	87
CAV_30	30
CAV_85	85
CAV_30	30
CAV_85	85
CAV_86	86
CAV_87	87
CAV_30	30
CAV_85	85
CAV_86	86
CAV_87	87
CAV_86	86

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CAV_30	30
CAV_87	87
CAV_85	85
7625	Cooling Fan Motor Supply Voltage (4)
7625_GN	7625 GN
CAV_67	67
CAV_68	68
CONN_X1	X1
999_RD/WH	999 RD/WH
CAV_66	66
CAV_20	20
CONN_X1	X1
MH8	TRANSMISSION-AUTO 6 SPD, HMD, X23F
MH9	TRANSMISSION-AUTO 6 SPD, HMD, X24F
MF3	TRANSMISSION-MAN 6 SPD, OPEL, 76.5 MM, 4.273 1ST, 2.158 2ND, 1.302 3RD, 0.959 4TH, 0.744 5TH, 0.614 6TH, M32-6 WR
MZ0	TRANSMISSION-MAN 6 SPD, OPEL, 76.5 MM, 3.82 1ST, 0.74 6TH, (M32 WR)
473	High Speed Cooling Fan Relay Control
473_BN/YE	473 BN/YE
CAV_15	15
CONN_X3	X3
473_BN/YE	473 BN/YE
CAV_54	54
CONN_X1	X1
CAV_46	46
5358	Cooling Fan Motor Supply Voltage (3)
5358_YE	5358 YE
CAV_4	4
CAV_50	50
CONN_X1	X1
532	Cooling Fan Motor Supply Voltage (2)
532_GY	532 GY
CAV_3	3
CAV_46	46
2366	Cooling Fan Control Relay Speed Signal
2366_WH/BK	2366 WH/BK
CAV_43	43
CAV_34	34
409	Cooling Fan Motor Supply Voltage (1)
409_WH/BU	409 WH/BU

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CAV_2	2
CAV_47	47
5358_YE	5358 YE
532_GY	532 GY
409_WH/BU	409 WH/BU
1150	Ground
1150_BK	1150 BK
CAV_71	71
335	Low Speed Cooling Fan Relay Control
335_GN/VT	335 GN/VT
CAV_41	41
CONN_X1	X1
CAV_49	49
CONN_X3	X3
1250	Ground
1250_BK	1250 BK
CAV_1	1
X102	X102
CAV_1	1
CAV_2	2
CAV_3	3
G101	G101
G105	G105
F45UA	F45UA 60A
F45UA	F45UA 40A
F42UA	F42UA 30A
F46UA	F46UA 10A
X102	X102
KR20E	
KR20F	
K20	
X50A	
G10	
KR20C	
KR20P	
KR75	
K20	
KR20D	

DIAGNOSTIC INFORMATION AND PROCEDURES

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DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P00B3 or P00B4</u>	DTC P00B3 Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage DTC P00B4 Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage
<u>DTC P00B6</u>	DTC P00B6 Radiator Coolant Temperature (RCT)-Engine Coolant Temperature (ECT) Not Plausible
<u>DTC P00B7</u>	DTC P00B7 Engine Coolant Flow Insufficient
<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	DTC P0480 Cooling Fan Relay 1 Control Circuit DTC P0481 Cooling Fan Relays 2 and 3 Control Circuit DTC P0691 Cooling Fan Relay 1 Control Circuit Low Voltage DTC P0692 Cooling Fan Relay 1 Control Circuit High Voltage DTC P0693 Cooling Fan Relays 2 and 3 Control Circuit Low Voltage DTC P0694 Cooling Fan Relays 2 and 3 Control Circuit High Voltage
<u>DTC P0597-P0599</u>	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
<u>DTC P2181</u>	DTC P2181 Engine Cooling System Performance

DTC P00B3 OR P00B4

Diagnostic Instructions

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

DTC Descriptors

DTC P00B3

Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage

DTC P00B4

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Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	-	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

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

Circuit/System Description

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

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

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

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

Conditions for Running the DTC

P00B3

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

P00B4

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

Conditions for Setting the DTC

P00B3

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

P00B4

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

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

Action Taken When the DTC Sets

DTC P00B3 and P00B4 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTC P00B3 and P00B4 are Type B DTCs.

Diagnostic Aids

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

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

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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- **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 + 120°C (-38 to +248°F) and changes with engine run time.
 - **If not between -39 to + 120°C (-38 to +248°F) or does not change**

Refer to Circuit/System Testing below.

- **If between -39 to + 120°C (-38 to +248°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 below.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.

- **If less than 5 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F)**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
- 6. Verify the scan tool Radiator Coolant Temperature sensor parameter is warmer than 137°C (280°F).
 - **If colder than 137°C (280°F)**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If warmer than 137°C (280°F)**
- 7. Test or replace the B34B Engine Coolant Temperature Sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B34B Engine Coolant Temperature Sensor.
2. Test the RCT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the **Temperature Versus Resistance** table. The resistance values should be in range of the table values.
 - **If not within the specified range**
 - Replace the B34B Engine Coolant Temperature Sensor.
 - **If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
 - **If less than infinite resistance**

Replace the B34B Engine Coolant Temperature Sensor.
 - **If infinite resistance**

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4. All OK.

Repair Instructions

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

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

DTC P00B6

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 P00B6

Radiator Coolant Temperature (RCT)-Engine Coolant Temperature (ECT) Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Temperature Sensor Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	-	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

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

Circuit Description

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The engine coolant 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 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, P00B6, P0112, P0113, P0117, P0118, P0502, P0503 or P2610 are not set.
- The vehicle has been OFF for greater than 8 hours before vehicle ON.
- The vehicle is ON, or the engine is running.
- The intake air temperature (IAT) is warmer than -7°C (19°F).
- The fuel level is greater than 10 percent.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTC P00B6 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P00B6 is a Type B DTC.

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running, observe the DTC information with a scan tool. DTC P00B3, P00B4, P0117, P0118, P0597, P0598, or P0599 should not be set.
 - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.
2. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**, and **Loss of Coolant**.
3. Engine idling for 15 minutes with the A/C OFF.

NOTE: Depending on ambient temperature, it may take up to 4 minutes for the temperatures to equalize.

4. Command the engine coolant thermostat heater to 100 percent with a scan tool. Increase the engine speed to 3, 000 RPM. Observe the scan tool radiator coolant temperature sensor and ECT sensor parameters. The radiator coolant temperature sensor and the ECT sensor parameters should be within 20°C (68°F).
5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B34B engine coolant temperature sensor.
2. Vehicle OFF, all systems OFF. This may take up to 2 minutes for all vehicle systems to power down. Test for less than 5 ohms between the low reference circuit terminal 1 and ground.
 - If greater than the specified range, test the low reference circuit for an open/high resistance. If the

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circuit tests normal, replace the K20 engine control module.

3. Vehicle ON, verify the scan tool Radiator Coolant Temperature Sensor parameter is at -40°C (-40°F).
 - If warmer than the specified range, test the signal circuit terminal 2 for a short to ground. If the circuit tests normal, replace the K20 engine control module.

NOTE: **If the fuse in the jumper wire opens, the signal circuit is shorted to a voltage and the sensor may be damaged.**

4. Install a 1 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1. Verify the scan tool Radiator Coolant Temperature Sensor parameter is at 140°C (284°F).
 - If less than specified range, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 engine control module.
5. If all circuits test normal, test or replace the B34B engine coolant temperature sensor.

Component Testing

1. Vehicle OFF, remove the B34B engine coolant temperature sensor.

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

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

Repair Instructions

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

- **Engine Coolant Temperature Sensor Replacement (Radiator)** , **Engine Coolant Temperature Sensor Replacement (Water Outlet)**
- **Engine Control Module Replacement** for ECM replacement, setup, and programming

DTC P00B7

Diagnostic Instructions

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

DTC Descriptors

DTC P00B7

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Engine Coolant Flow Insufficient

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Temperature Sensor Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	P00B4*	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

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

Circuit Description

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

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0116, P0117, and P0118 are not set.
- The engine run time is greater than 5 m.

OR

- The engine coolant temperature is greater than 105°C (221°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

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

The ECM detects the difference between the RCT sensor and the ECT sensor is greater than 30°C (86°F) when the ECT sensor is warmer than 117°C (242°F) for greater than 5 s.

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Action Taken When the DTC Sets

DTC P00B7 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P00B7 is a Type B DTC.

Diagnostic Aids

- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 80°C (176°F). The mechanical thermostat will cycle from approximately 85°C (185°F) to approximately 102°C (215°F).
- A resistance condition in the RCT sensor circuits may cause this DTC. This condition results in a greater voltage on the RCT sensor signal circuit, which is interpreted by the ECM as a colder RCT.

Reference Information

Schematic Reference

Engine Controls Schematics

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running, observe the DTC information with a scan tool. DTC P00B3, P00B4, P00B6, P0117, P0118, P0597, P0598, and P0599 should not be set.
 - If a DTC is set, refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.
2. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill), and Loss of Coolant.
3. Verify the engine cooling fan operates. Refer to Cooling Fan Inoperative.

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

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

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

Circuit/System Testing

1. Vehicle OFF, inspect the cooling system for the conditions below. Refer to **Symptoms - Engine Cooling**.
 - Weak coolant solution
 - Obstructed radiator air flow or bent radiator fins
 - Blocked cooling system passages
 - Radiator hoses that are restricted, collapsed, or deteriorated
 - Damaged water pump and or belt
 - Loss of cooling system pressure
 - Leaking surge tank cap
 - Radiator hoses
 - Cylinder head or an engine block that is cracked or plugged
 - If you find any of the above conditions, repair as necessary.
2. If all conditions test normal, replace the E41 engine coolant thermostat heater.

Repair Instructions

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

Engine Coolant Thermostat Replacement

DTC P0480, P0481, P0691, P0692, P0693, OR P0694

Diagnostic Instructions

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

DTC Descriptors

DTC P0480

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Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

DTC P0691

Cooling Fan Relay 1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relays 2 and 3 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relays 2 and 3 Control Circuit High Voltage

Diagnostic Fault Information

KR20C Cooling Fan Low Speed Relay

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

KR20D Cooling Fan High Speed Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480, P0691	2	1	-
Relay Switch B+	2	2	-	-
Relay Control	P0481 or P0693	P0481	P0481 or P0694	-
Relay Controlled Output	2	2	3	-

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1. Medium speed fan replaced by high speed fan without a DTC.
2. High speed fan inoperative without a DTC.
3. High speed fan always ON without a DTC.

KR20E Cooling Fan Speed Control Relay

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

KR20F Cooling Fan Relay

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

KR20P Cooling Fan Medium Speed Relay

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

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

The commanded state of the ECM driver and the actual state of the control circuit do not match for greater than 5 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

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

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Refer to Circuit/System Testing below.

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

Refer to Circuit/System Testing below.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

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

- KR20D Cooling Fan High Speed Relay

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

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20F Cooling Fan Relay terminal 85
 - KR20P Cooling Fan Medium Speed Relay terminal 1
 - **If the test lamp does not illuminate and the fuse is good**
 1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 2. Test for less than 2 ohms in the ignition circuit of the appropriate KR20 Cooling Fan Relay, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 2. Test for infinite resistance between the relay coil ignition circuits listed below and ground:
 - KR20F Cooling Fan Relay terminal 85
 - KR20D Cooling Fan High Speed Relay terminal 1
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test all of the appropriate KR20 Cooling Fan Relays for a short and replace as necessary.
 - **If the test lamp illuminates**
3. Ignition OFF, remove the test lamp, ignition ON.

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

4. Connect a DMM, set on the diode setting, between a control circuit terminal listed below and ground:
 - KR20F Cooling Fan Relay terminal 86
 - KR20P Cooling Fan Medium Speed Relay terminal 2
 - KR20D Cooling Fan High Speed Relay terminal 2
5. Verify the DMM reading is greater than 2.5 V or displays O.L.
 - **If 2.5 V or less**
 1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the appropriate relay coil control circuit and ground.

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- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.
- **If greater than 2.5 V or displays O.L.**

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

6. Verify the DMM reading is less than 1 V when commanding the Cooling Fan Relays ON with a scan tool.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the appropriate KR20 Cooling Fan Relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Ignition OFF.
 4. Test for less than 2 ohms in the appropriate KR20 Cooling Fan Relay control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 1 V**
7. Test or replace the appropriate KR20 Cooling Fan Relay.

Component Testing

1. Ignition OFF.
2. Disconnect a KR20 Cooling Fan Relay.
3. Test for 70-110 ohms between terminals 85/2 and 86/1. 95-135 ohms for the KR20F Cooling Fan Relay.
 - **If less than or greater than the specified range**

Replace the KR20 Cooling Fan Relay.

- **If within the specified range**
- 4. Test for infinite resistance between the following terminals:
 - 30/3 and 86/1
 - 30/3 and 87/5
 - 30/3 and 85/2
 - 85/2 and 87/5
- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**
- 5. Install a 20 A fused jumper wire between relay terminal 85/2 and 12 V.

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6. Install a jumper wire between relay terminal 86/1 and ground.
7. Test for less than 2 ohms between terminals 30/3 and 87/5.
 - **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**
8. All OK.

Repair Instructions

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

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

DTC P0597-P0599

Diagnostic Instructions

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

DTC Descriptor

DTC P0597

Engine Coolant Thermostat Heater Control Circuit

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTC P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voltage	P0031, P0037, P0135, P0141, P0443, P0597,	P0031, P0037, P0135, P0141, P0443, P0597,	-	-

	P0598*, P0660, P0661	P0598, P0660, P0661		
Thermostat Control Circuit	P0458, P0598	P0597	P0599	-
*Opens the fuse that supplies voltage to the engine coolant thermostat				

Circuit/System Description

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

Conditions for Running the DTCs

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

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 15 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. **Loss of Coolant**, and **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**
 - **If the coolant level is not correct**

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

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

Refer to Circuit/System Testing below.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the E41 Engine Coolant Thermostat Heater, Ignition ON.
2. Verify that a test lamp illuminates between the ignition circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test all the components connected to fuse and replace as necessary.
 - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 2 and the control circuit terminal 1.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp, command the E41 Engine Coolant Thermostat Heater ON with a scan tool.
5. Verify the scan tool E41 Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status parameter displays OK.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 1 and the ignition circuit terminal 2.
7. Verify the scan tool Engine Coolant Thermostat Heater Circuit High Voltage Test Status parameter is displaying Malfunction when commanding the E41 Engine Coolant Thermostat Heater ON with a scan tool.

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- **If Malfunction is not displayed**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K20 Engine Control Module.

- **If Malfunction is displayed**

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

Repair Instructions

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

- **Engine Coolant Thermostat Replacement** for E41 engine coolant thermostat heater replacement.
- **Control Module References** for engine control module, replacement, programming, and setup.

DTC P2181

Diagnostic Instructions

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

DTC Descriptor

DTC P2181

Engine Cooling System Performance

Circuit/System Description

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

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, or P0118 are not set.
- The engine run time is between 70 s and 30 min.
- The engine coolant temperature (ECT) sensor at start-up is between -10°C to +59°C (14°F to 138°F).
- The intake air temperature (IAT) sensor is between -7°C to +60°C (-4°F to +140°F).
- The airflow into the engine is between 1 to 100 g/s.

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- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM detects the engine coolant thermostat is stuck open for at least 2.5 min.

Action Taken When the DTC Sets

DTC P2181 is a Type B DTC

Conditions for Clearing the DTC

DTC P2181 is a Type B DTC

Diagnostic Aids

- Insufficient vehicle interior heating is an indication of improper thermostat operation.
- The scan tool Desired ECT Sensor and the ECT Sensor parameters should be within 5°C (9°F) when the engine is at operating temperature.
- A resistance condition in the ECT sensor circuits may cause this DTC. This condition results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation (1.4L LUV), Cooling System Description and Operation (1.8L LUW and LWE)

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information**Circuit/System Verification**

1. Engine running, observe the DTC information with a scan tool. DTC P00B3, P00B4, P00B6, P0117, or P0118 should not be set.
 - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.
2. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**, and **Loss of Coolant**.

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

3. Engine idling for 15 min with the A/C OFF. Verify the engine cooling fan is not ON at all times.
4. Command the Engine Coolant Thermostat Heater to 0 % with a scan tool. Increase the engine speed to 3,000 RPM. Observe the scan tool ECT sensor parameter. The temperature should increase to greater than 102°C (215°F).
 - If less than the specified value, replace the E41 engine coolant thermostat heater.
5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

Repair Instructions

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

Engine Coolant Thermostat Replacement**SYMPTOMS - ENGINE COOLING****Important Preliminary Inspections Before Starting**

Before using the Symptom diagnosis, perform the following:

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

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to **Cooling Fan Description and Operation**, and **Cooling System Description and Operation (1.4L LUV)**, **Cooling System Description and Operation (1.8L LUW and LWE)**.

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 surge tank 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

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- 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 is detected, refer to **Testing for Intermittent Conditions and Poor Connections** for specific strategies in diagnosing intermittent conditions.

Symptom List

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

- **Cooling Fan Always On**
- **Cooling Fan Inoperative**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis (1.8L LUW and LWE), Thermostat Diagnosis (1.4L LUV)**
- **Engine Fails To Reach Normal Operating Temperature**

COOLING FAN ALWAYS ON

Diagnostic Instructions

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

Circuit/System Description

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

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed

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- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the Temperature Versus Resistance tables in the appropriate engine controls subsection.
- If the cooling fan operates at high speed when the ECM is requesting medium speed operation, test or replace the KR20E Cooling Fan Speed Control Relay.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that there are no cooling system DTCs set.
 - **If any DTCs are set**

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

- **If no DTCs are set**

3. Verify the scan tool parameters listed below display OFF.
 - Cooling Fan Relay 1 Command
 - Cooling Fan Relays 2 and 3 Command

- **If a scan tool parameter displays ON**

Refer to Diagnostic Aids and **Symptoms - Engine Cooling** for further diagnosis.

- **If both scan tool parameters display OFF**

4. Verify that the fan is not activated.

- **If the fan is operating**

Refer to Circuit/System Testing below.

- **If the fan is OFF**

5. All OK.

Circuit/System Testing

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

1. Ignition OFF, disconnect each KR20 cooling fan relay one at a time, in the order listed below, ignition ON:
 - KR20F Cooling Fan Relay
 - KR20C Cooling Fan Low Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
 - KR20D Cooling Fan High Speed Relay
2. Verify that the cooling fan is not activated after each relay is removed.
 - **If the cooling fan is ON with all of the listed relays removed**
 1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor, ignition ON.
 2. Test for less than 1 V between ground and the relay controlled output circuit terminal listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 87
 - KR20P Cooling Fan Medium Speed Relay terminal 5
 - KR20D Cooling Fan High Speed Relay terminal 3
 - If 1 V or greater, repair the short to voltage in the appropriate circuit.
 - **If the cooling fan is OFF after a listed relay is removed**
3. Replace the appropriate KR20 Cooling Fan Relay.

Component Testing

1. Ignition OFF.
2. Disconnect a KR20 Cooling Fan Relay.
3. Test for 70-110 ohms between terminals 85/2 and 86/1. 95-135 ohms for the KR20F Cooling Fan Relay.
 - **If less than or greater than the specified range**

Replace the KR20 Cooling Fan Relay.

- **If within the specified range**

4. Test for infinite resistance between the following terminals:

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

- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

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

- **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**

8. All OK.

Repair Instructions

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

Relay Replacement (Within an Electrical Center) , **Relay Replacement (Attached to Wire Harness)**

COOLING FAN INOPERATIVE

Diagnostic Instructions

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

Circuit/System Description

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

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:

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

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX
- Electrical Center Identification Views

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480, P0481, P0691, P0692, P0693, or P0694 is not set.
 - If a DTC is set

Refer to DTC P0480, P0481, P0691, P0692, P0693, or P0694.

- If no DTC is set
3. Verify that the cooling fan operates at low, medium, and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.

- **If the cooling fan does not operate at all speeds**

Refer to Circuit/System Testing below.

- **If the cooling fan operates at all speeds**

4. All OK.

Circuit/System Testing

Inoperative in All Speeds

1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor.
2. Verify a test lamp illuminates between the ground circuit terminal 1 and B+
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - 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.
 - **If the test lamp illuminates**
3. Test or replace the G10 Cooling Fan Motor. Replace the cooling fan fuses if necessary.

Low, Medium or High Speed Inoperative

1. Disconnect the following cooling fan relays, ignition ON:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20E Cooling Fan Speed Control Relay
 - KR20F Cooling Fan Relay
 - KR20P Cooling Fan Medium Speed Relay
2. Verify a test lamp illuminates between ground and each of the cooling fan relay B+ circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 30
 - KR20D Cooling Fan High Speed Relay terminal 5
 - KR20P Cooling Fan Medium Speed Relay terminal 3
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the appropriate relay B+ circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor.

2. Test for infinite resistance between the appropriate relay controlled output circuit terminal listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 87
 - KR20D Cooling Fan High Speed Relay terminal 3
 - KR20P Cooling Fan Medium Speed Relay terminal 5
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test or replace the G10 Cooling Fan Motor, replace the fuse as necessary.
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the KR20F Cooling Fan Relay output circuit terminal 87 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ground circuit, end to end.
 - 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.
 - **If the test lamp illuminates**
4. Ignition OFF, Install the KR20F Cooling Fan Relay, ignition ON.
5. Verify a test lamp illuminates between ground and each of the cooling fan relay terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 85
 - KR20E Cooling Fan Speed Control Relay terminal 86 and 30
 - **If the test lamp does not illuminate at each terminal**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the appropriate relay ignition circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates at each terminal**
6. Command the cooling fan ON at low speed with a scan tool.
7. Verify a test lamp illuminates between B+ and each of the KR20 Cooling Fan Relay terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 86
 - KR20E Cooling Fan Speed Control Relay terminal 85
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the KR20F Cooling Fan Relay.
 2. Test for less than 2 ohms between the KR20F Cooling Fan Relay terminal 30 and the relay control circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 86
 - KR20E Cooling Fan Speed Control Relay terminal 85
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

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- If less than 2 ohms, replace the KR20F Cooling Fan Relay.
- **If the test lamp illuminates**
- 8. Ignition OFF, install the KR20E Cooling Fan Speed Control Relay, Ignition ON.
- 9. Command the cooling fan ON at low speed with a scan tool.
- 10. Verify a test lamp illuminates between ground and the KR20D High Speed Relay ignition circuit terminal 1.
 - **If the test lamp does not illuminate**
 - 1. Ignition OFF, remove the test lamp and disconnect the KR20E Cooling Fan Speed Control Relay.
 - 2. Test for less than 2 ohms between the KR20D High Speed Relay terminal 1 and KR20E Cooling Fan Speed Control Relay 87
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the KR20E Cooling Fan Speed Control Relay.
 - **If the test lamp illuminates**
- 11. Ignition OFF, install all of the previously removed KR20 Cooling Fan Relays. Disconnect the harness connector at the G10 Cooling Fan Motor, ignition ON.
- 12. Command the cooling fan ON at high speed with a scan tool.
- 13. Verify a test lamp illuminates between ground and each of the G10 Cooling Fan Motor circuit terminals listed below:
 - G10 Cooling Fan low speed circuit terminal 2
 - G10 Cooling Fan medium speed circuit terminal 3
 - G10 Cooling Fan high speed circuit terminal 4
 - **If the test lamp does not illuminate at each terminal**
 - 1. Ignition OFF, remove the test lamp.
 - 2. Disconnect the appropriate relay from the list below:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
 - 3. Test for less than 2 ohms in the relay controlled output circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the relay.
 - **If the test lamp illuminate at each terminal**
- 14. Test or replace the G10 Cooling Fan Motor.

Component Testing

1. Ignition OFF.
2. Disconnect a KR20 Cooling Fan Relay.
3. Test for 70-110 ohms between terminals 85/2 and 86/1. 95-135 ohms for the KR20F Cooling Fan Relay.
 - **If less than or greater than the specified range**

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Replace the KR20 Cooling Fan Relay.

○ **If within the specified range**

4. Test for infinite resistance between the following terminals:

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

○ **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

○ **If infinite resistance**

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

○ **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

○ **If less than 2 ohms**

8. All OK.

Repair Instructions

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

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Engine Coolant Fan Replacement**

ENGINE OVERHEATING

Engine Overheating

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition.			
• The engine temperature gauge is in the red (overheat) zone and/or the engine temperature indicator is ON. • Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the ground while the engine is running.			
	1. Inspect and fill the cooling system, as necessary. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> , <u>Cooling</u>		

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1	<u>System Draining and Filling (GE-47716 Fill).</u> - Inspect the cooling system for leaks, as necessary. - Repair the cooling system leaks, as necessary. Has the inspection/repair been performed?	Go to Step 2	-
2	- Start the engine and allow the engine to run at approximately 1,200 RPM. - Use the Scan Tool in order to verify the overheat condition. Does the Scan Tool verify the engine overheat condition?	Go to Step 3	Go to <u>Diagnostic System Check - Vehicle</u>
3	- Verify that the cooling fans are operating properly. - Repair the cooling fan system, as necessary. Does the engine still overheat?	Go to Step 4	System OK
4	Perform the following inspections: - Inspect the radiator and the A/C condenser cooling fins for debris or any other obstruction. - Inspect the drive belt system and the drive belt tensioner for proper operation in order to ensure that the coolant pump is rotating properly. - Inspect for loose, damaged and/or missing air deflector(s). - Check for a pinched or kinked cooling system hose. - Repair the systems as necessary. Does the engine still overheat?	Go to Step 5	System OK
5	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis (1.8L LUW and LWE), Thermostat Diagnosis (1.4L LUV).</u> Is the thermostat operating properly?	Go to Step 7	Go to Step 6
6	Replace the thermostat. Refer to <u>Engine Coolant Thermostat Replacement.</u> Does the engine still overheat?	Go to Step 7	System OK

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7	NOTE: Excessive coolant freeze point protection MAY cause the coolant to boil at low temperatures. 1. Inspect for the proper coolant concentration (mixture). Correct the coolant concentration as necessary. 2. Remove the radiator cap. 3. Start the engine and inspect for a constant flow of air bubbles in the engine coolant. Is there a constant flow of air bubbles in the engine coolant?	Go to Step 8	Go to Step 9
8	The probable cause of the engine overheat is combustion chamber gasses leaking into the cooling system. This condition is usually caused by the following: • A worn or damaged cylinder head gasket • A worn or damaged cylinder head • A worn and/or damaged engine block Verify this condition by inspecting the spark plug electrodes and porcelain surrounding the spark plug electrode for signs of coolant. Replace and/or repair the engine internal component(s), as necessary, in order to repair the engine internal coolant leak. Does the engine still overheat?	Go to Step 1	System OK
9	The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Refer to Coolant System Flushing Does the engine still overheat?	Go to Step 10	System OK
10	NOTE: It is unlikely that the water pump is the cause of the overheat condition. If NONE of the cooling system passages are restricted, replace the coolant pump. Refer to Water Pump Replacement (1.8L LUW and LWE), Water Pump Replacement (1.4L LUV) Does the engine still overheat?	Go to Step 1	System OK

LOSS OF COOLANT

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Loss of Coolant

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally. Special Tools BO-42220 Universal 12V Leak Detection Lamp For equivalent regional tools, refer to Special Tools .			
1	Are you sent here from Symptoms?	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) , Cooling System Draining and Filling (GE-47716 Fill) . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 25
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 28	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 30	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 29	Go to Step 10
10	WARNING: Refer to Moving Parts and Hot Surfaces Warning . With the engine idling, inspect the coolant		

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	recovery system.Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • The coolant surge tank • The heater core • The radiator		
	Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 12
12	Visually inspect the following components: • The coolant pressure cap • The core plugs • The cylinder head gaskets • The engine block • The intake manifold • The radiator • The thermostat housing • The water pump		
	Are any of the listed components leaking?	Go to Step 21	Go to Step 13
13	1. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing</u>. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12.		
	Are any leaks present?	Go to Step 21	Go to Step 14
14	Pressure test the coolant pressure cap. Does the coolant pressure cap hold pressure?	Go to Step 15	Go to Step 22
15	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering near the HVAC module		
	Is coolant present?	Go to Step 23	Go to Step 16

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16	1. Add 30 ml (1 oz) of Extended Life Coolant Leak Detection Dye to the cooling system for each 15 L (4 gal) of coolant. Refer to <u>Approximate Fluid Capacities</u> . 2. Start the vehicle and allow the engine to reach normal operating temperature. 3. Shut the engine off. 4. Use BO 42220 detection lamp to visually inspect the components listed in steps 11 and 12.		
	Are any leaks present?	Go to Step 21	Go to Step 17
17	Use BO 42220 detection lamp to inspect for the following conditions: • Coolant dye in the HVAC module drain tube • Coolant dye on the vehicle floor covering near the HVAC module		
	Is coolant dye present?	Go to Step 23	Go to Step 18
18	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is a milky substance under the oil fill cap?	Go to Step 19	Go to Step 20
19	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is a milky substance on the engine oil fluid level indicator?	Go to Step 29	Go to Step 20
20	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 24	Go to Step 32
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 32	-
22	Replace the coolant pressure cap. Is the repair complete?	Go to Step 32	-
23	Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete?	Go to Step 32	-
	1. Remove the transmission oil cooler lines from the radiator.		

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24	2. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing</u> . 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to Step 25	Go to Step 26
25	1. Replace the radiator. Refer to <u>Radiator Replacement (1.4L LUV with Automatic Transmission)</u> , <u>Radiator Replacement (1.8L LUW and LWE)</u> , <u>Radiator Replacement (1.4L LUV with Manual Transmission)</u> . 2. Service the automatic transmission. Is the repair complete?	Go to Step 32	-
26	Install the cooler lines to the radiator. Is the action complete?	Go to Step 32	-
27	Repair the engine no crank condition. Is the repair complete?	Go to Step 32	-
28	Repair the engine overheating condition. Is the repair complete?	Go to Step 32	-
29	Repair the engine internal coolant leak. Is the repair complete?	Go to Step 32	-
30	Repair the engine knock. Is the repair complete?	Go to Step 32	-
31	Repair the combustion pressure in the cooling system problem. Is the repair complete?	Go to Step 32	-
32	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS (1.4L LUV)

Thermostat Diagnosis (1.4L LUV)

Step	Action	Values	Yes	No
1	1. Pressure test the cooling system and the cap for leaks. 2. Repair any leaks before proceeding. These engines use a 105°C (221°F) thermostat. The ambient temperatures should be within the specified range given. 3. Set the HVAC controls in the OFF position.	13-38°C (55-		

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	4. Run the cold engine at idle 20°C-21°C (68-70°F) for 15-20 minutes before checking the engine temperature. 5. Check the engine coolant temperature at idle with the scan tool. Is the engine coolant temperature (ECT) between 105-120°C (221-248°F)?	100°F)	System OK	Go to Step 2
2	Is the ECT below 105°C (221°F)?	-	Go to Step 3	Go to Step 4
3	The thermostat is opening early, or the thermostat seal is leaking. Replace the thermostat and the thermostat seal. Is the repair complete?	-	System OK	-
4	Is the ECT over 120°C (248°F)?	-	Go to Step 5	-
5	Is the radiator inlet hot?	-	Go to Step 6	Go to Step 7
6	1. Turn ON the heater. 2. Check if hot air is coming from the heater outlets. Is the air hot?	-	Go to Step 11	Go to Step 12
7	There may be air in the system. 1. Add coolant to the surge tank if the coolant level is low. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill). 2. Recheck the radiator inlet hose. Is the inlet hose hot?	-	Go to Step 6	Go to Step 8
8	Inspect for blockage in the following areas: • The cylinder head • The radiator • The radiator hoses Is there a blockage?	-	Go to Step 9	Go to Step 10
	1. Repair the blockage. 2. Recheck the coolant temperature with			

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9	the scan tool. Is the repair complete?	-	System OK	-
10	1. Replace the thermostat housing. Refer to <u>Engine Coolant Thermostat Housing Replacement (1.4L LUV), Engine Coolant Thermostat Housing Replacement (1.8L LUW and LWE).</u> 2. Recheck the coolant temperature with the scan tool. Is the repair complete?	-	System OK	-
11	Inspect for blockage in the radiator. Is there any blockage?	-	Go to Step 9	Go to Step 10
12	1. Accelerate the engine several times in order to remove any air from the system. 2. Inspect for blockage in the heater circuit. 3. Inspect for any pinched or buckled hoses. Is there any blockage?	-	Go to Step 9	Go to Step 13
13	Is the repair complete?		System OK	-

THERMOSTAT DIAGNOSIS (1.8L LUW AND LWE)

Thermostat Diagnosis (1.8L LUW and LWE)

Step	Action	Values	Yes	No
1	1. Pressure test the cooling system and the cap for leaks. 2. Repair any leaks before proceeding. These engines use a 90°C (194°F) thermostat. The ambient temperatures should be within the specified range given. 3. Set the HVAC controls in the OFF position. 4. Run the cold engine at idle (68-70°F) for 15-20 minutes before checking the engine temperature. 5. Check the engine coolant temperature at idle with the scan tool.	13-38°C (55-100°F)		

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	Is the engine coolant temperature (ECT) between 90-105°C (194-221°F)?		System OK	Go to Step 2
2	Is the ECT below 90°C (194°F)?	-	Go to Step 3	Go to Step 4
3	The thermostat is opening early, or the thermostat seal is leaking. Replace the thermostat and the thermostat seal. Is the repair complete?	-	System OK	-
4	Is the ECT over 105°C (221°F)?	-	Go to Step 5	-
5	Is the radiator inlet hot?	-	Go to Step 6	Go to Step 7
6	1. Turn ON the heater. 2. Check if hot air is coming from the heater outlets. Is the air hot?	-	Go to Step 11	Go to Step 12
7	There may be air in the system. 1. Add coolant to the surge tank if the coolant level is low. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> , <u>Cooling System Draining and Filling (GE-47716 Fill)</u> . 2. Recheck the radiator inlet hose. Is the inlet hose hot?	-	Go to Step 6	Go to Step 8
8	Inspect for blockage in the following areas: • The cylinder head • The radiator • The radiator hoses Is there a blockage?	-	Go to Step 9	Go to Step 10
9	1. Repair the blockage. 2. Recheck the coolant temperature with the the scan tool. Is the repair complete?	-	System OK	-
10	1. Replace the thermostat. Refer to <u>Engine Coolant Thermostat Replacement</u> . 2. Recheck the coolant temperature with the scan tool.	-		

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	Is the repair complete?		System OK	-
11	Inspect for blockage in the radiator. Is there any blockage?	-	Go to Step 9	Go to Step 10
12	1. Accelerate the engine several times in order to remove any air from the system. 2. Inspect for blockage in the heater circuit. 3. Inspect for any pinched or buckled hoses. Is there any blockage?	-	Go to Step 9	Go to Step 13
13	Is the repair complete?		System OK	-

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
1	Check the coolant level in the radiator surge tank. Refer to Cooling System Draining and Filling (Static Fill) , Cooling System Draining and Filling (GE-47716 Fill) . Is the coolant at the proper level?	Go to Step 3	Go to Step 2
2	Add coolant to the radiator surge tank as necessary. Does the engine still fail to reach normal operating temperatures?	Go to Step 3	System OK
3	Check for a blockage in the coolant passages. Are there any blockages in the coolant passages?	Go to Step 4	Go to Step 5
4	Flush the cooling system or flow check the radiator. Does the engine still fail to reach normal operating temperatures?	Go to Step 5	System OK
5	Check to see if the incorrect thermostat was installed or if it is stuck or sticks in the open position. Was the incorrect thermostat installed, or is it stuck or does it stick in the open position?	Go to Step 6	-
6	Replace the thermostat. Refer to Engine Coolant Thermostat Replacement . Does the engine still fail to reach normal operating temperature?	-	System OK

COOLING SYSTEM LEAK TESTING

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Special Tools

- **EN-471** Adapter
- **EN-6327-A** Cooling System Test Adapter

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

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

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

1. Detach the coolant expansion tank closure cap.

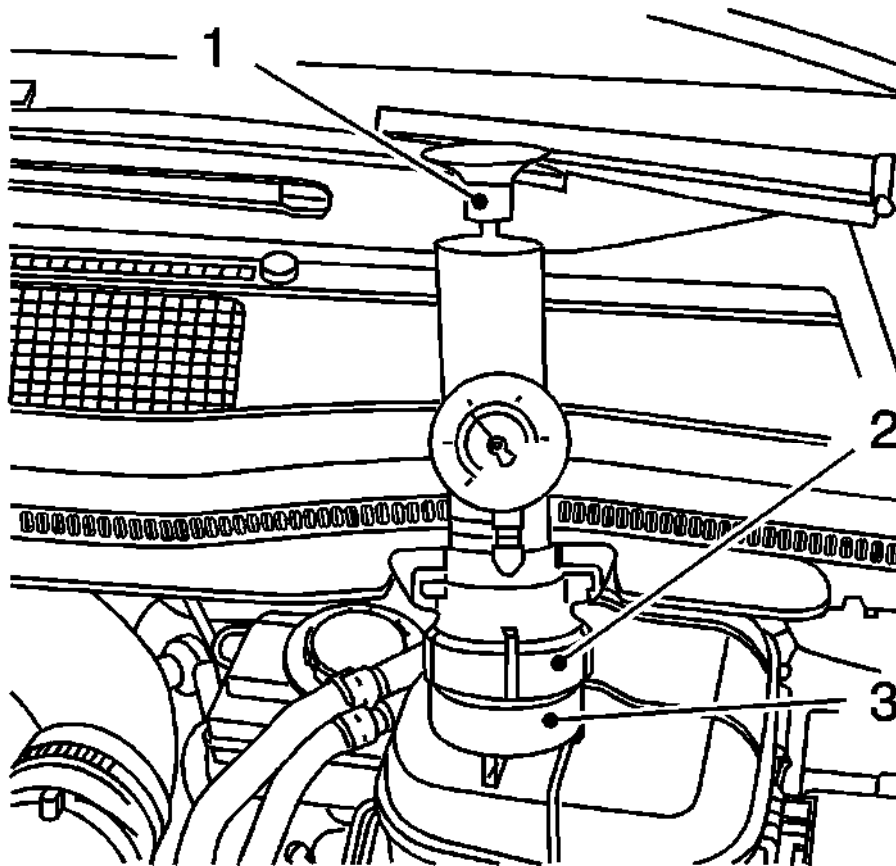


Fig. 2: View Of Coolant System Tester, KM-471 And KM-6327
Courtesy of GENERAL MOTORS COMPANY

2. Check the coolant level.

Top up the coolant to the COLD mark if necessary.

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

NOTE: Follow manufacturer instructions.

4. Attach the coolant system tester (1) with EN-471 adapter (2) and EN-6327-A adapter (3) to the coolant expansion tank.
5. Apply approximately 100 kPa (15 psi) to the cooling system.
6. Cooling system, check for leaks.
7. Detach the cooling system tester.
 - Release the pressure

- Detach the cooling system tester with **EN-471** adapter.
8. Attach the coolant expansion tank closure cap.
 9. Slide the coolant expansion tank onto the bracket.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (GE-47716 FILL)

Special Tools

- **GE-26568** Coolant and Battery Fluid Tester
- **GE-42401-A** Radiator Pressure Adapter
- **GE-47716** Vac N Fill Coolant Refill Tool

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

Draining Procedure

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

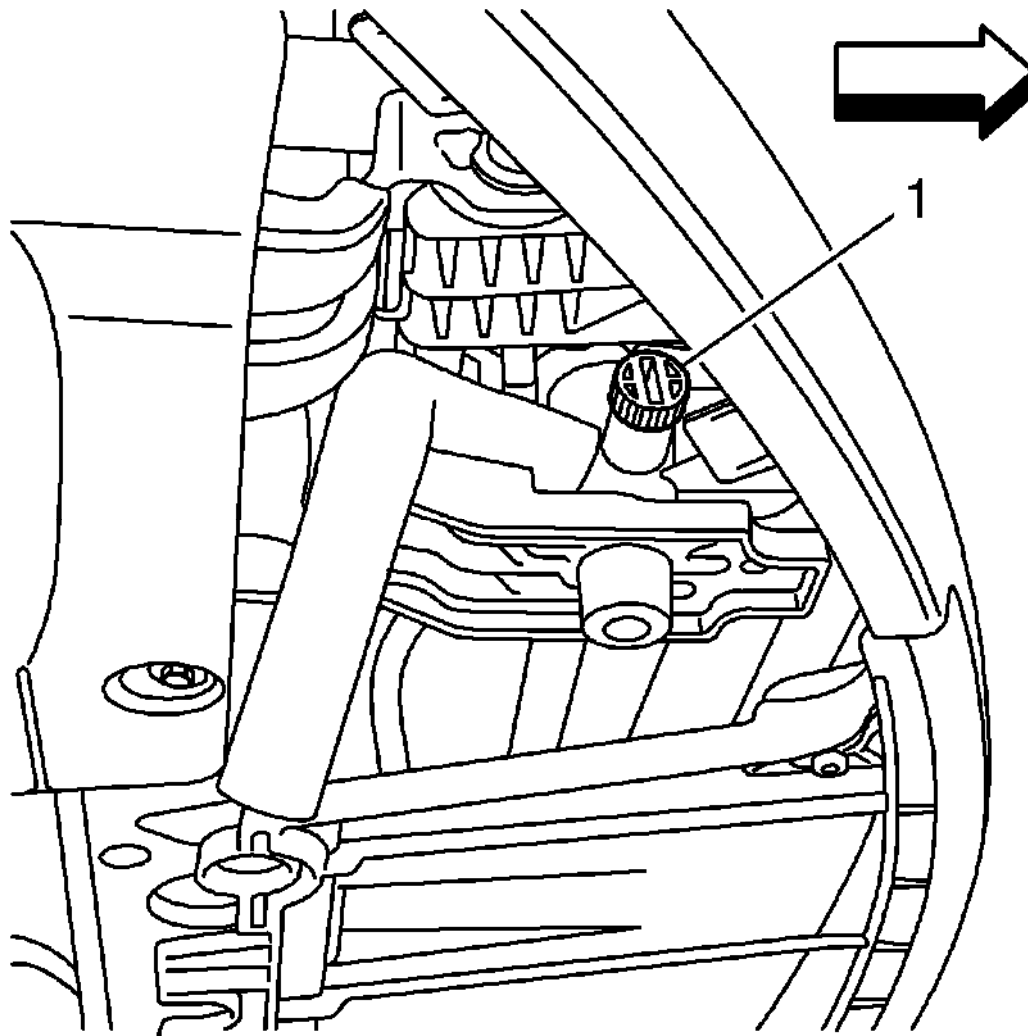


Fig. 3: Radiator Drain Plug

Courtesy of GENERAL MOTORS COMPANY

1. Unscrew the surge tank cap to remove vacuum when draining coolant.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**.
3. Place a container under the radiator drain.
4. Unscrew the radiator drain plug (1) until coolant flows out the radiator drain.
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 **Coolant System Flushing**.

Vac-N-Fill Procedure

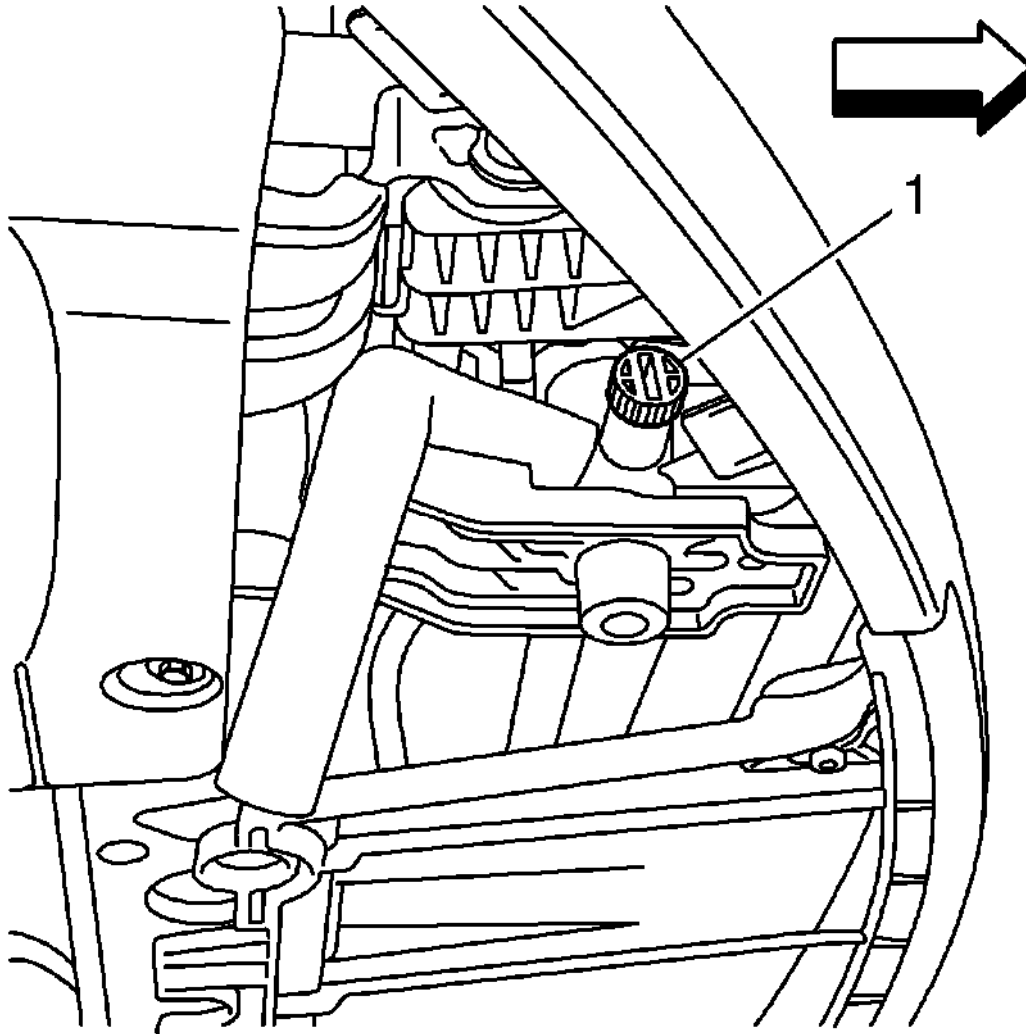


Fig. 4: Radiator Drain Plug

Courtesy of GENERAL MOTORS COMPANY

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

1. Close the radiator drain cock by hand.

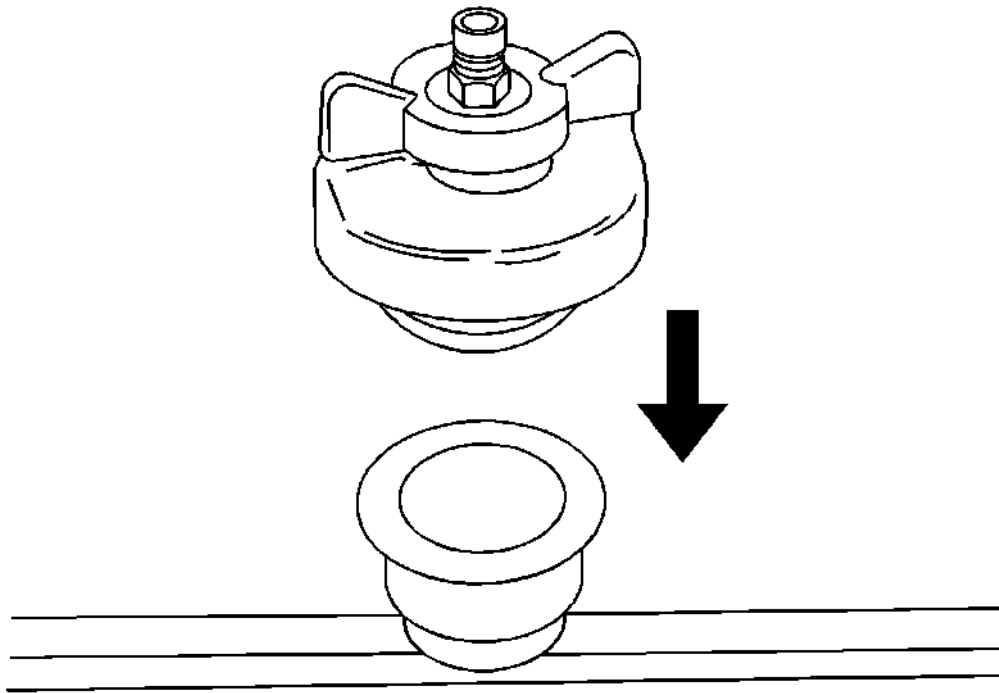


Fig. 5: Identifying Vac-N-Fill Cap

Courtesy of GENERAL MOTORS COMPANY

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

2. Install **GE-42401-2** adapter into the surge tank fill neck.
3. Install **GE-42401-3** adapter to the surge tank fill neck.
4. Attach the Vac N Fill cap to the **GE-42401-3** adapter.

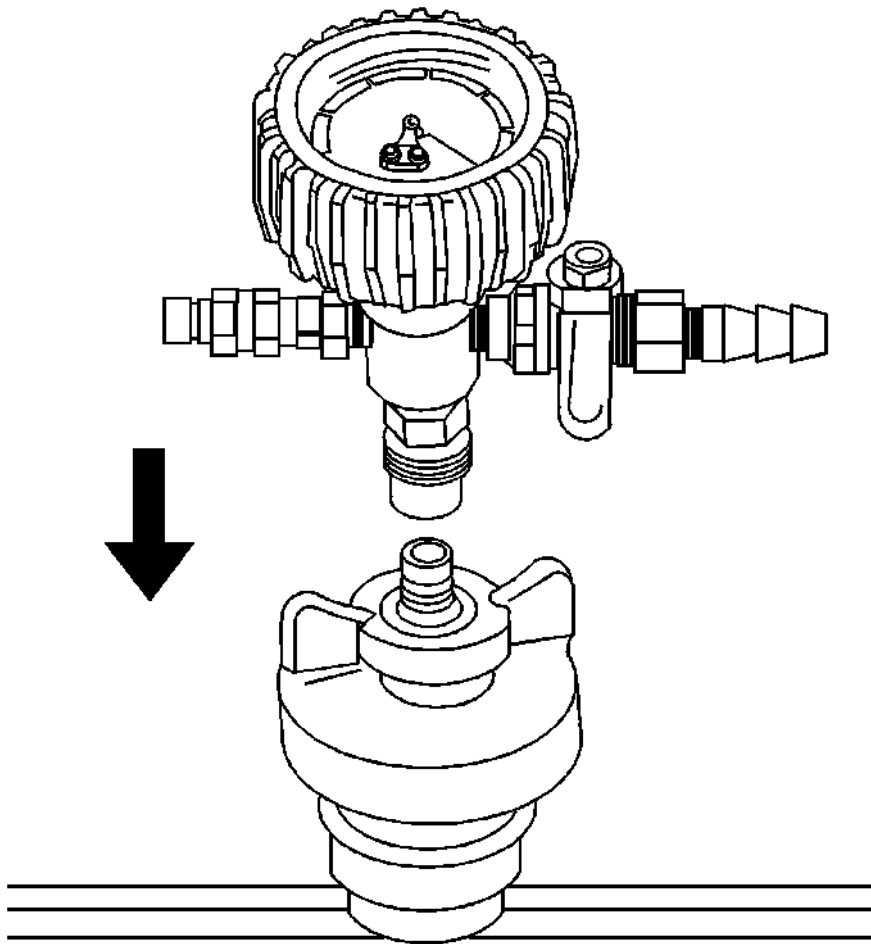


Fig. 6: Vacuum Gage & Vac N Fill cap

Courtesy of GENERAL MOTORS COMPANY

5. Attach the vacuum gauge assembly to the Vac N Fill cap.

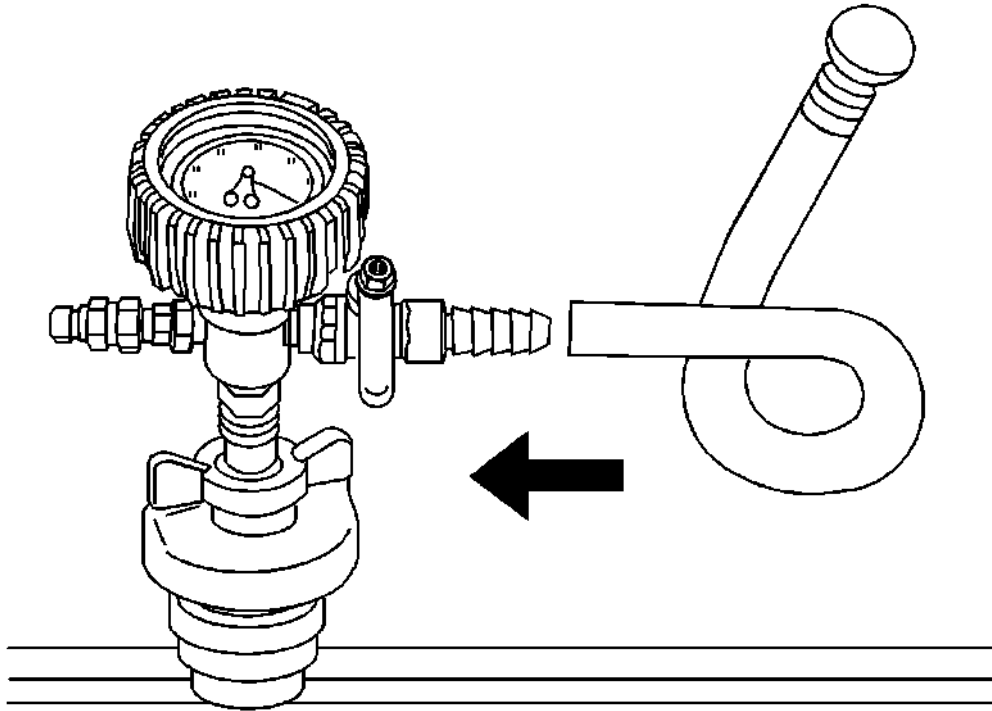


Fig. 7: View Of Fill Hose & Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Attach the fill hose to the barb fitting on the vacuum gauge assembly.

Ensure that the valve is closed.

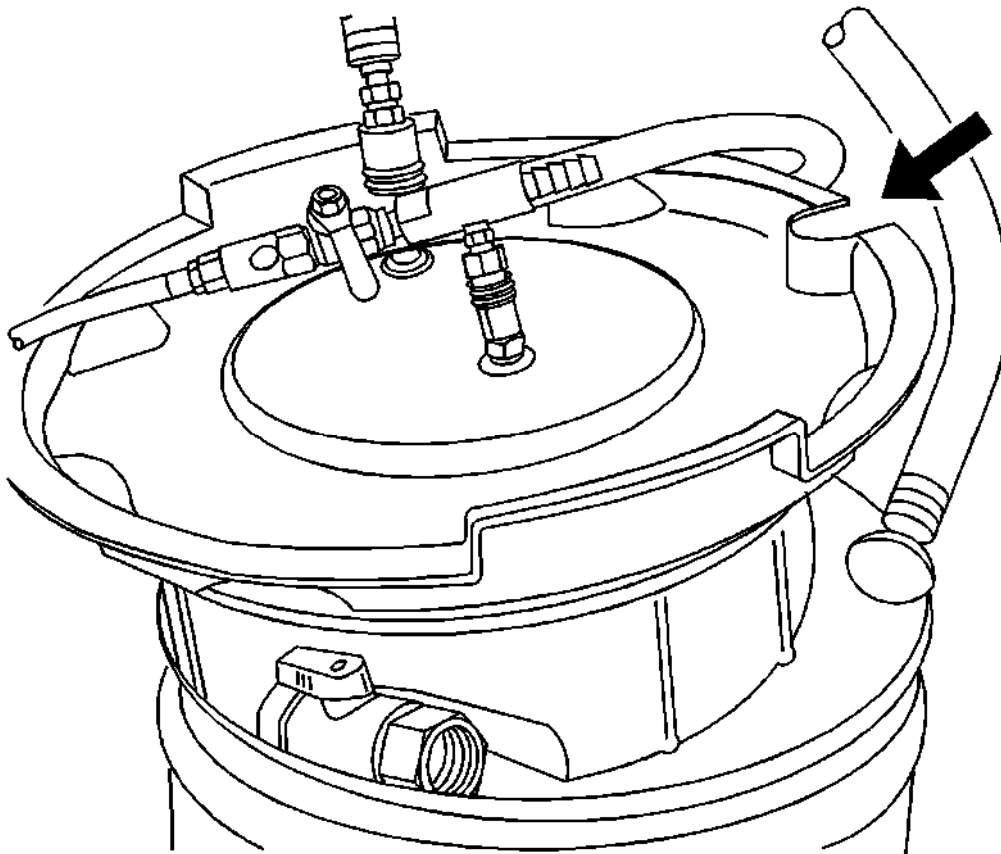


Fig. 8: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

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

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

7. Pour the coolant mixture into the graduated reservoir.
8. Place the fill hose in the graduated reservoir.

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.

9. Install the vacuum tank on the graduated reservoir with the fill hose routed through the cut-out area in the vacuum tank.

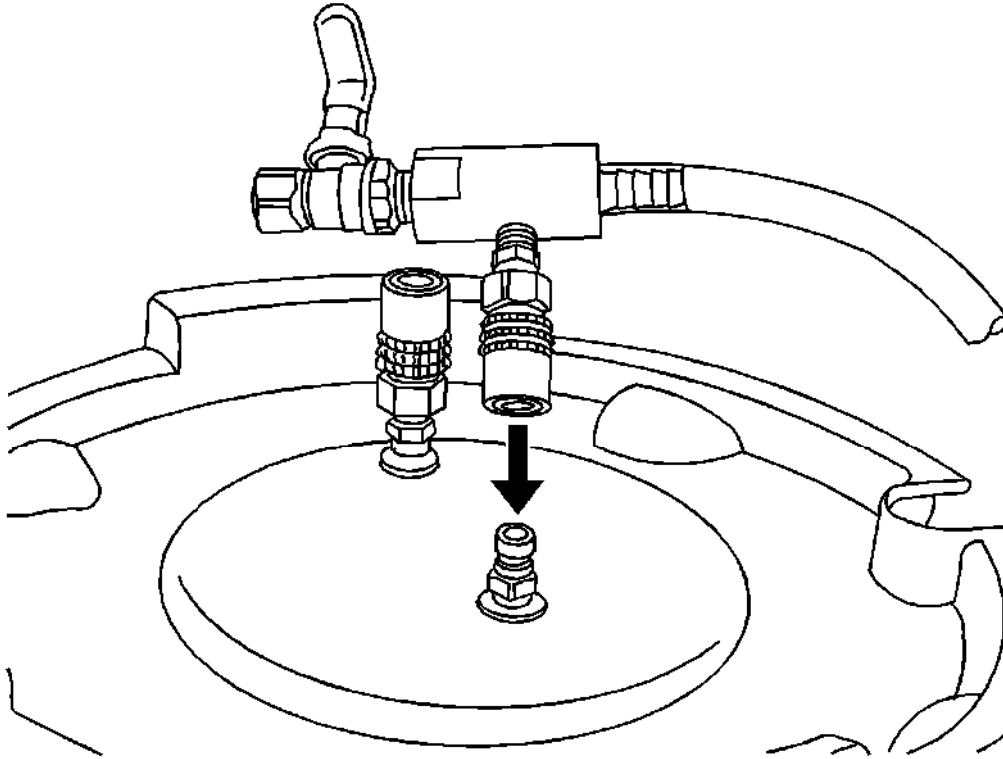


Fig. 9: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

10. Attach the venturi assembly to the vacuum tank.

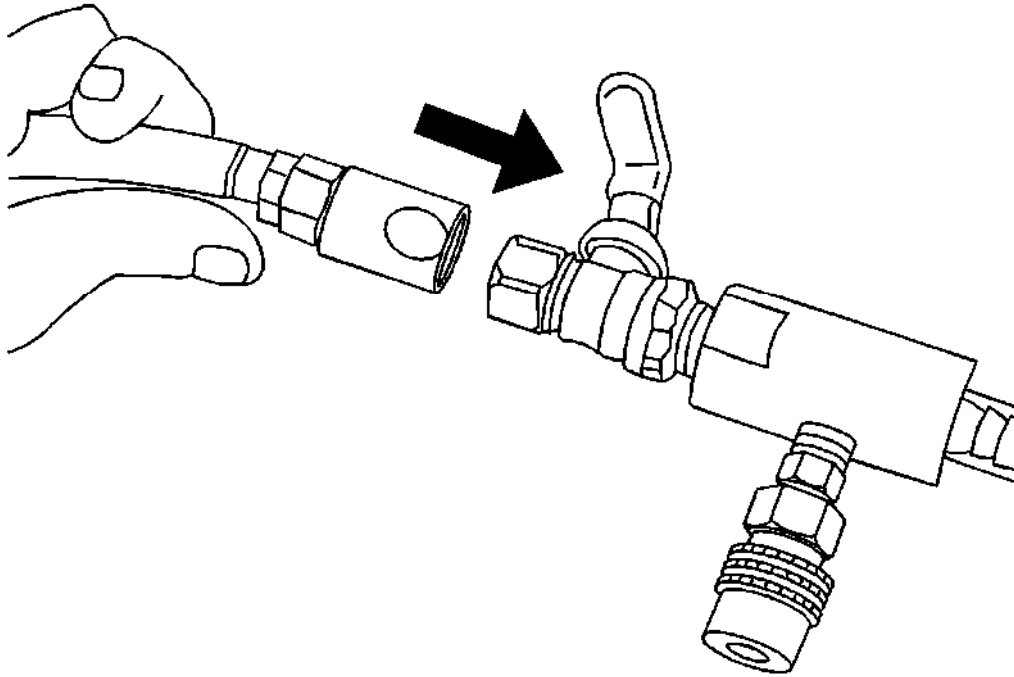


Fig. 10: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Attach a shop air hose to the venturi assembly.

Ensure the valve on the venturi assembly is closed.

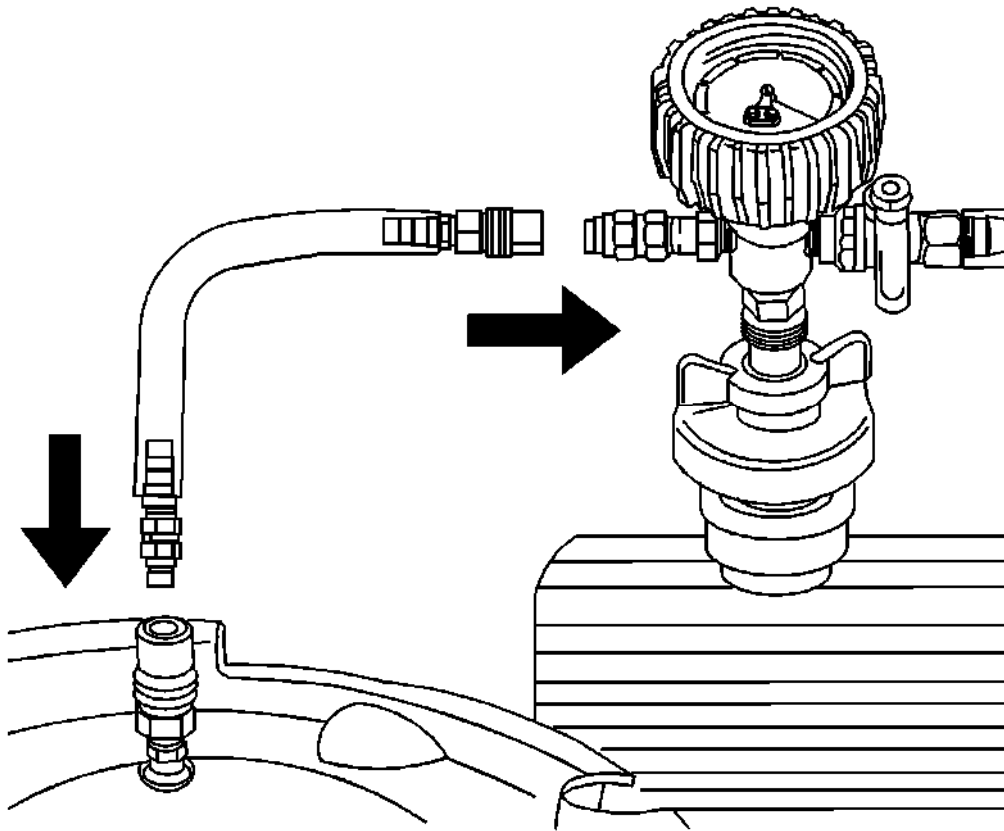


Fig. 11: Vacuum Gage Assembly And Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

12. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.

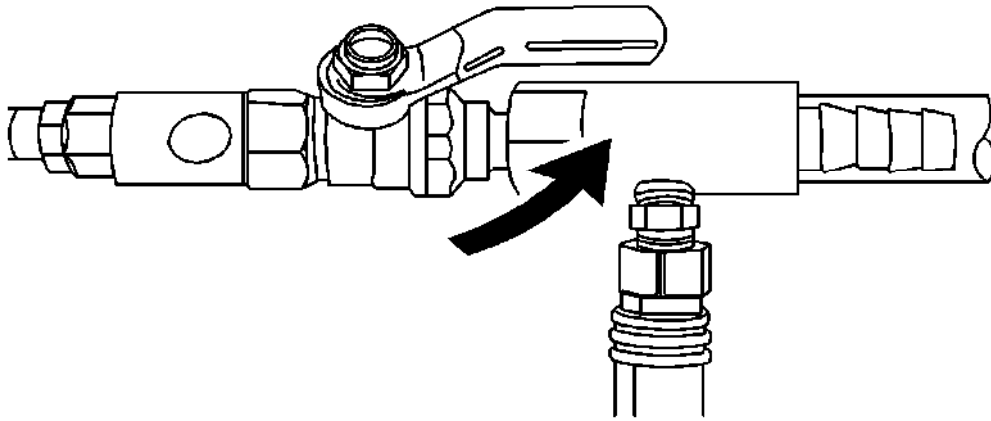


Fig. 12: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

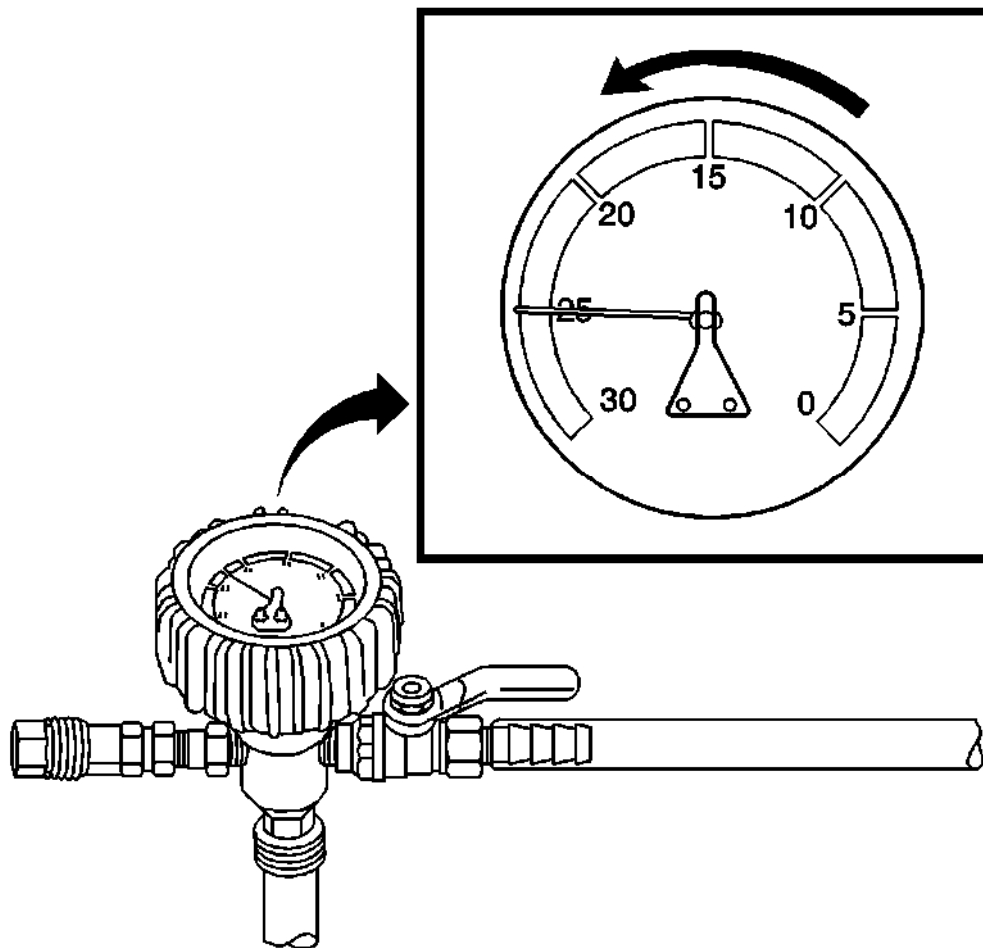


Fig. 13: View Of Vacuum Gauge

Courtesy of GENERAL MOTORS COMPANY

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

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

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

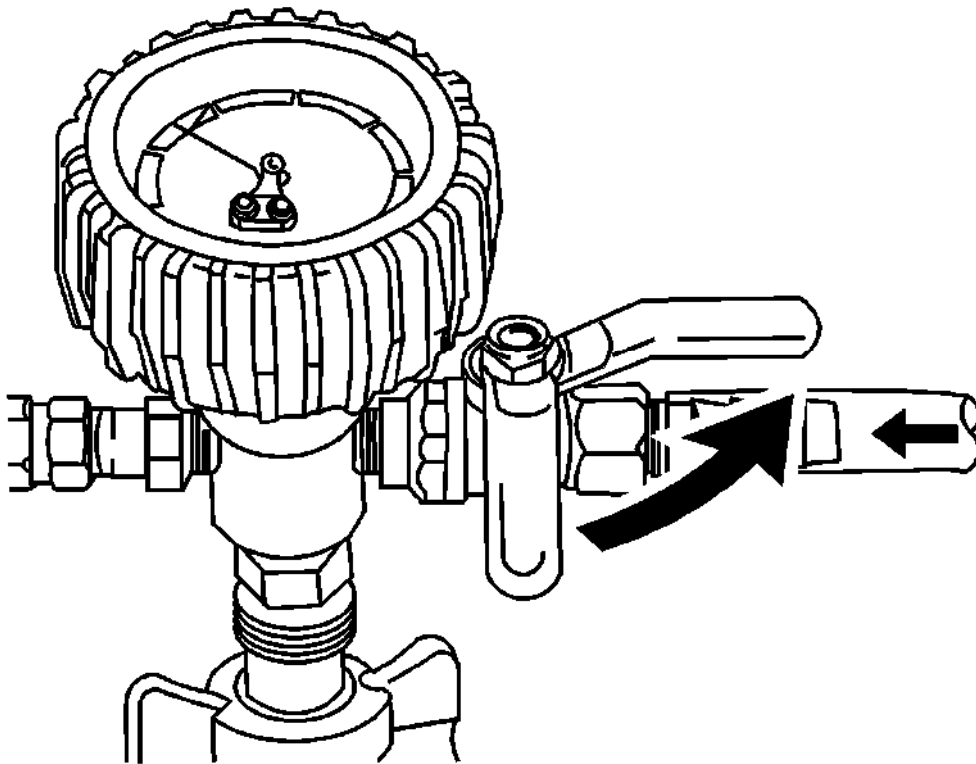


Fig. 14: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Slowly open the valve on the vacuum gauge assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
17. Close the valve on the venturi assembly.
18. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

If vacuum loss is observed, refer to **Loss of Coolant**.

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

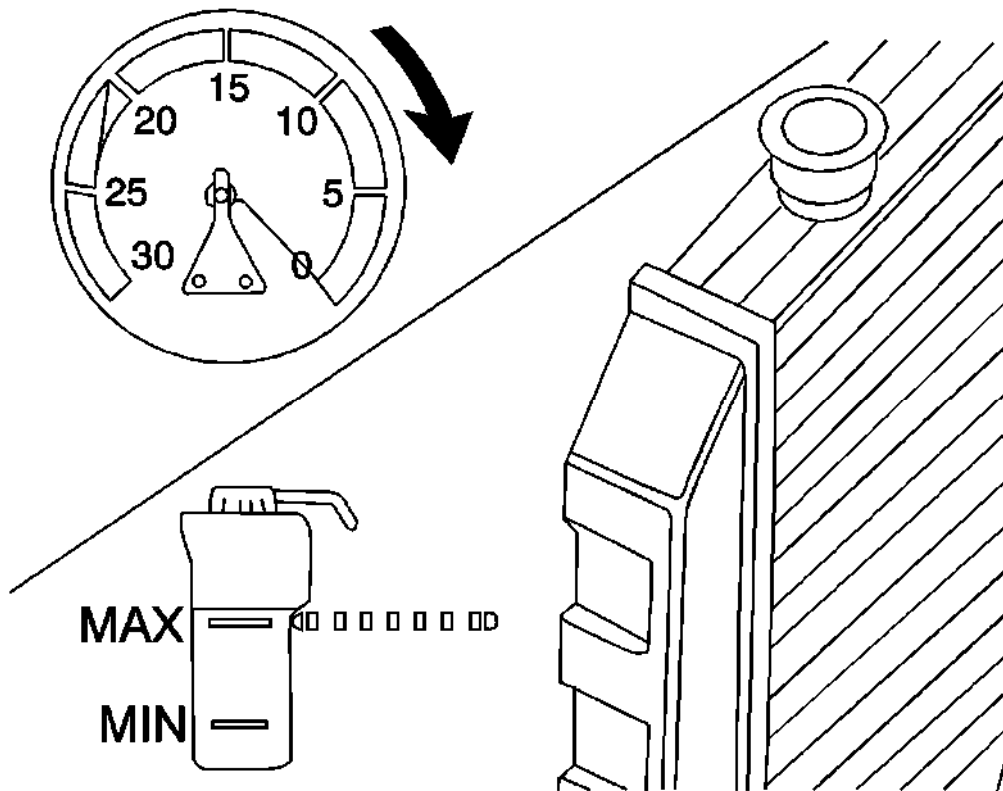


Fig. 15: View Of Vacuum Gauge & Radiator
 Courtesy of GENERAL MOTORS COMPANY

20. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 10-16.
21. Detach the Vac N Fill cap from the vehicle's coolant fill port.
22. Add coolant to the system as necessary.
23. Inspect the concentration of the coolant mixture, using the **GE-26568** tester.

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

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

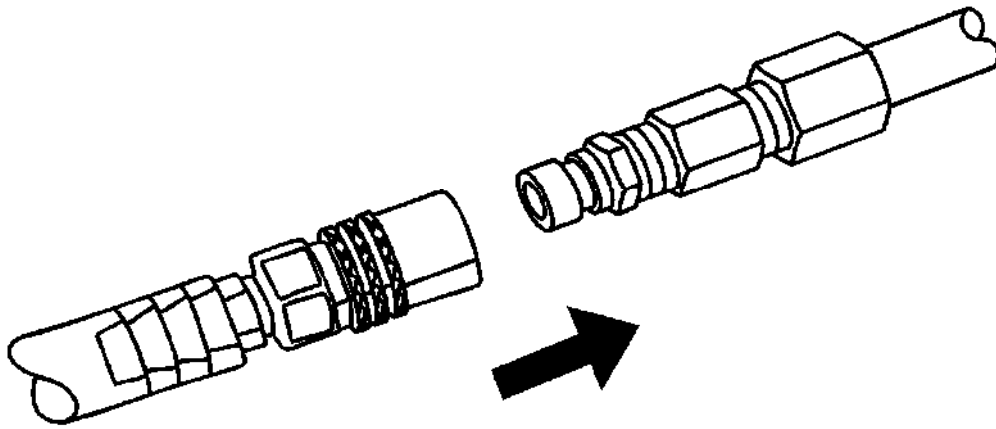


Fig. 16: Extraction Hose And Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

25. Attach the extraction hose to the vacuum hose.

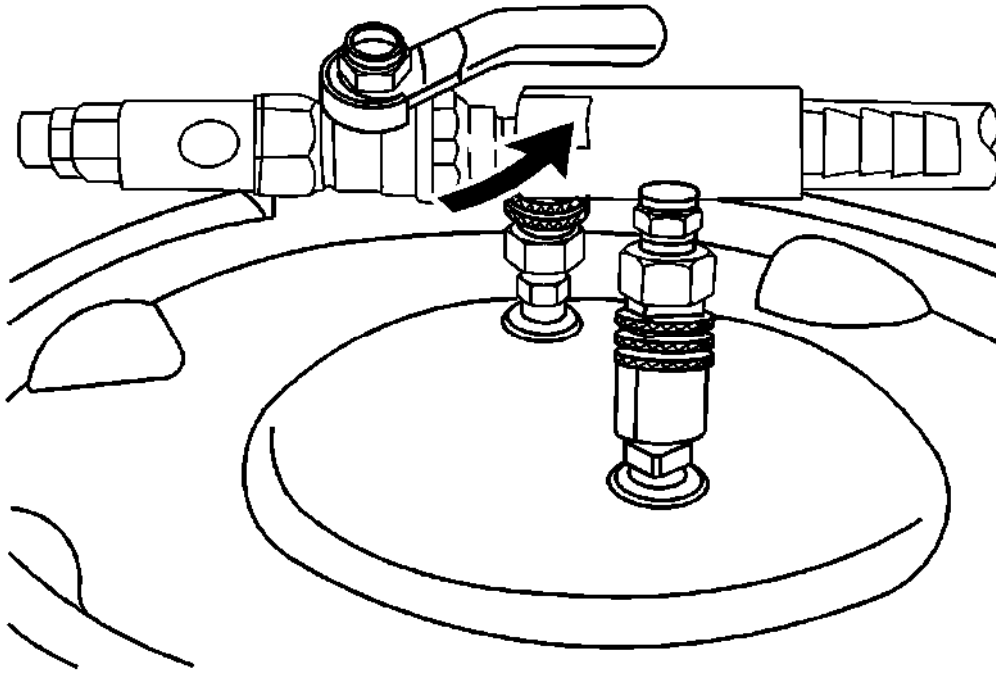


Fig. 17: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

26. Open the valve on the venturi assembly to start a vacuum draw.

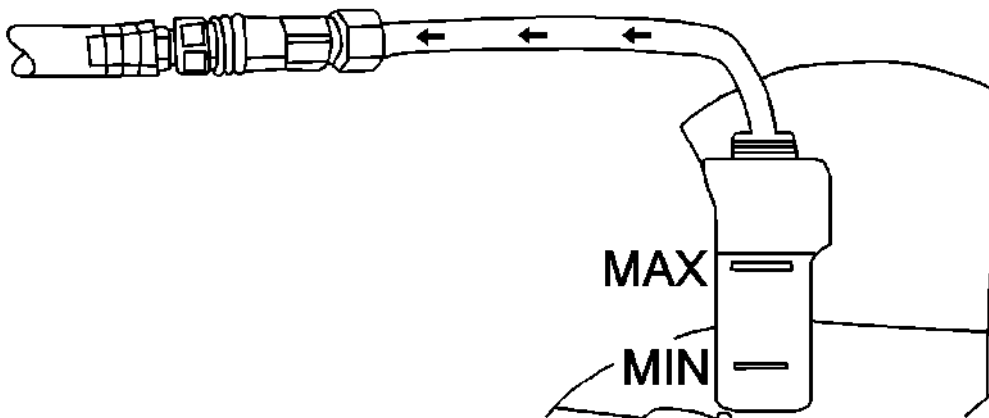


Fig. 18: Using Extraction Hose To Draw Out Coolant

Courtesy of GENERAL MOTORS COMPANY

27. Use the extraction hose to draw out coolant to the proper level.
28. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Special Tools

GE-26568 Coolant and Battery Fluid Tester

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

Draining Procedure

WARNING: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution

at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.

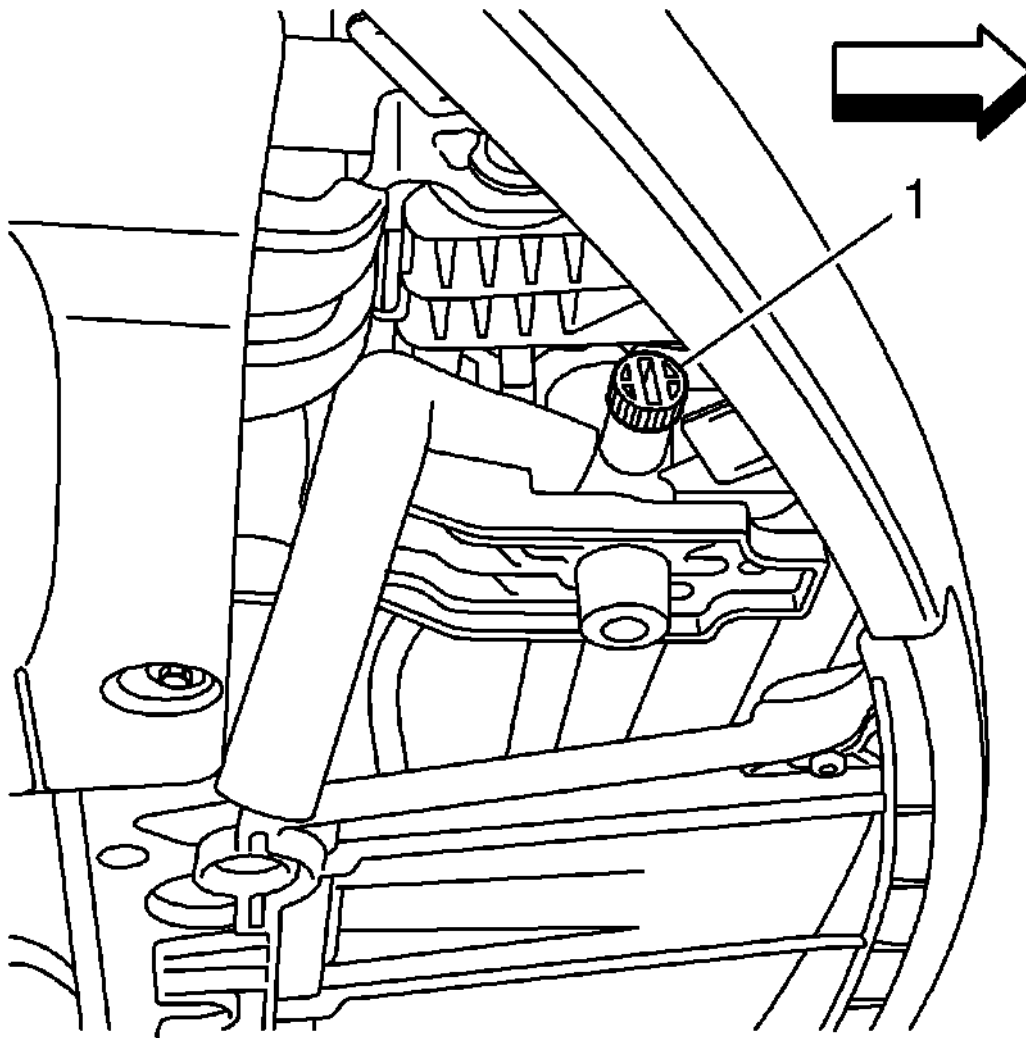


Fig. 19: Radiator Drain Plug

Courtesy of GENERAL MOTORS COMPANY

1. Unscrew the surge tank cap to remove vacuum when draining coolant.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**.
3. Place a container under the radiator drain.
4. Unscrew the radiator drain plug (1) until coolant flows out the radiator drain.
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 **Coolant System Flushing**.

Fill Procedure

1. Close the radiator drain plug.
2. Lower the vehicle.
3. Vehicle should be level.

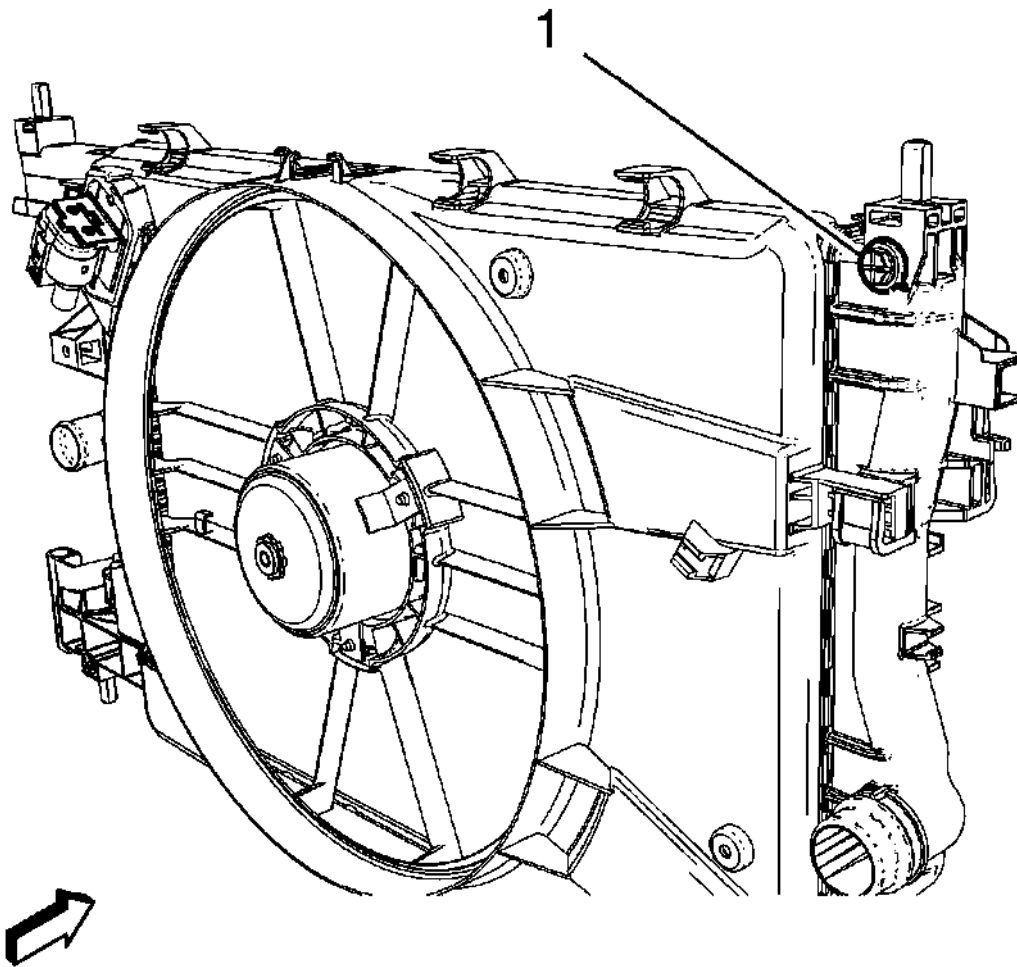
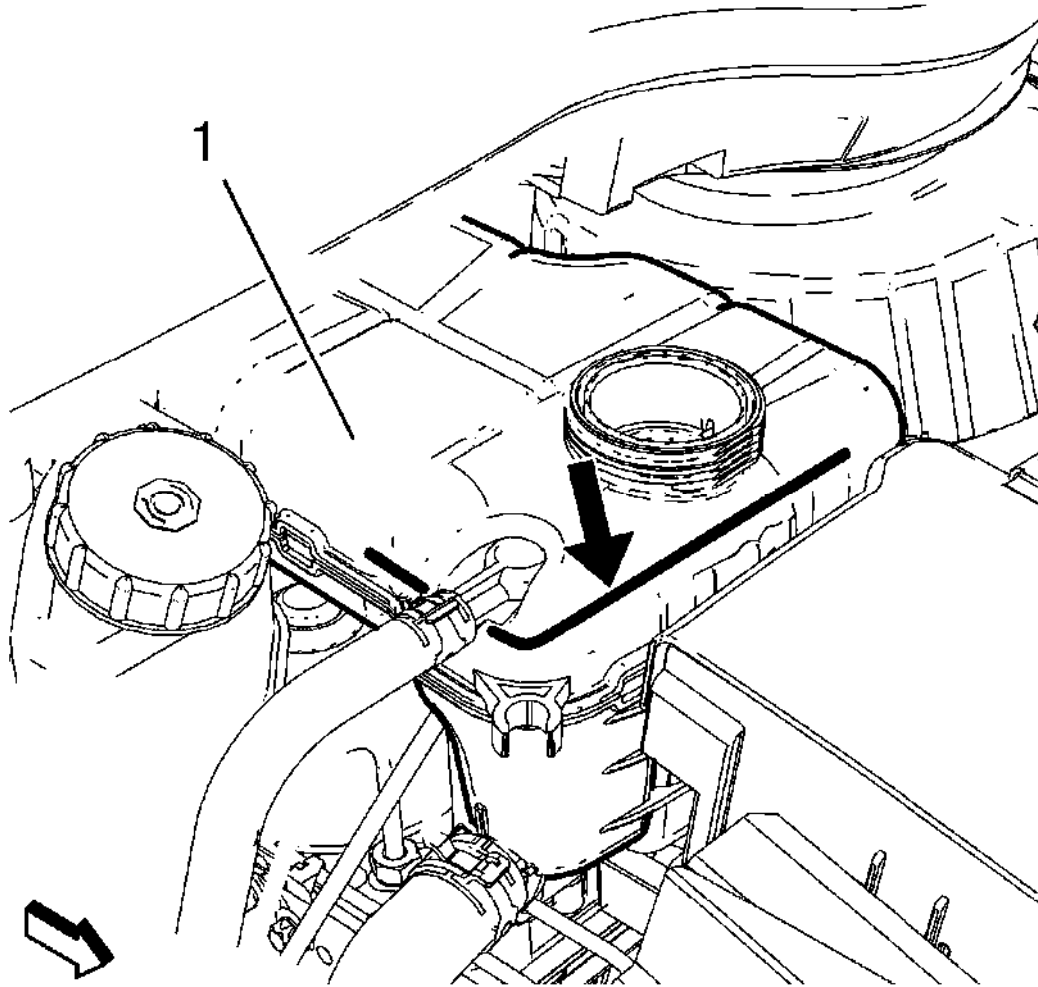


Fig. 20: Radiator Vent Screw

Courtesy of GENERAL MOTORS COMPANY

NOTE: Close vent screw when coolant begins to flow from the vent screw.

4. Loosen the vent screw (1) on the radiator.

**Fig. 21: Radiator Coolant Surge Tank**

Courtesy of GENERAL MOTORS COMPANY

5. Add a mixture of 50/50 DEX-COOL® antifreeze and clean drinkable water to the bottom line of the bleed nozzle on the coolant surge tank (1).

When the coolant level stabilizes, add enough coolant to reach the bottom line of the down pipe hole (black arrow).

6. Start the engine. After the engine starts, verify that the coolant level reaches the bottom line of the down pipe hole (black arrow).
7. Install the surge tank cap.
8. Warm up the engine.

NOTE: If the heater core has been replaced, let the engine run for 2 minutes at 2,000-2,500 RPM. This ensures complete venting of the cooling system.

Run at 2, 500 RPM until the engine cooling fan turns ON.

9. Turn the engine OFF and allow the engine to cool down.
10. Remove the surge tank cap.

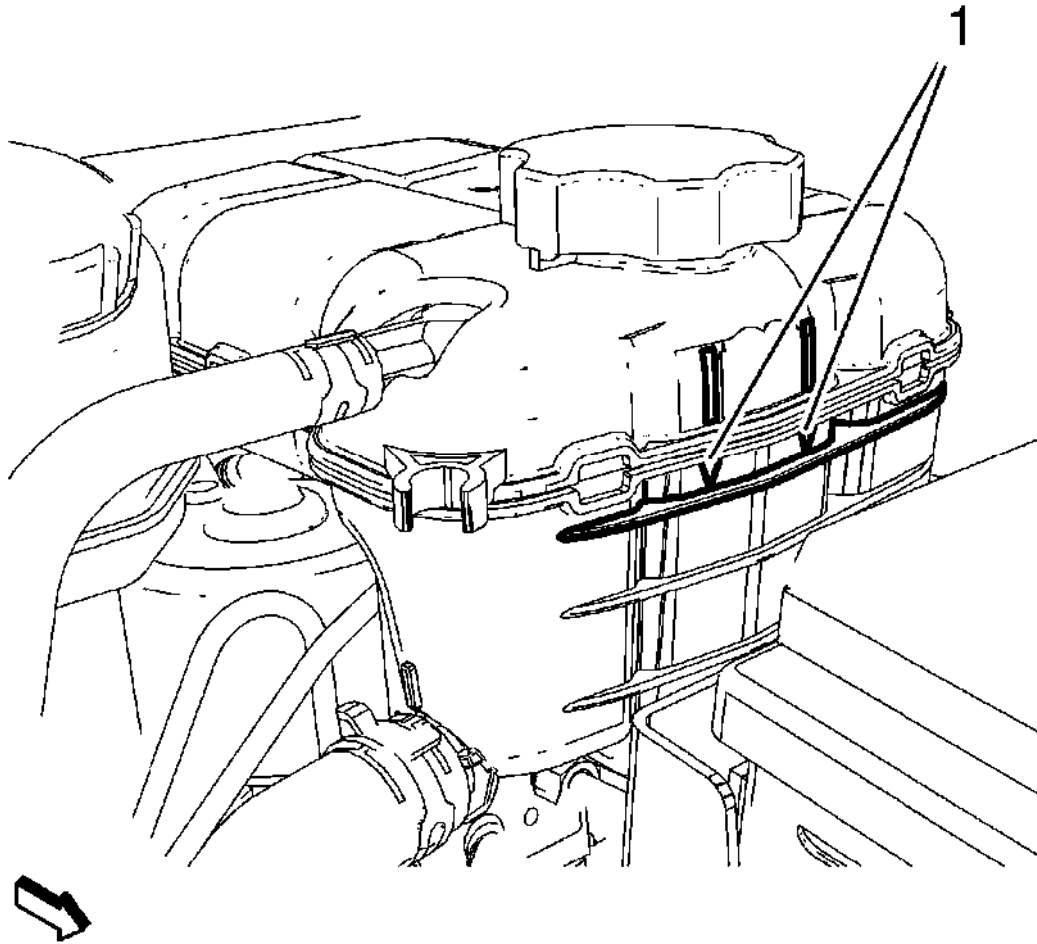


Fig. 22: Identifying Coolant Level Mark

Courtesy of GENERAL MOTORS COMPANY

NOTE: After a test drive let the engine cool down and check the coolant level again. Adjust the coolant level to the "COLD" mark if necessary.

11. Check the coolant level and fill to the "COLD" mark if necessary (1).
12. Inspect the concentration of the engine coolant, using **GE-26568** tester.
13. Install the surge tank cap.
14. Rinse away any excess coolant from the engine and the engine compartment.

COOLANT SYSTEM FLUSHING

NOTE: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank.

Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical.

Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufactures instruction. However, always remove the thermostat before back flushing the system.

1. Apply the park brake.
2. Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
3. Fill the coolant system with clean drinkable water. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
4. Start the engine and run at 2.000 RPM until the thermostat opens.
5. Turn OFF the engine.
6. Drain the coolant system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
7. Repeat the above procedure until the water from the coolant system is colorless.
8. Drain the coolant system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
9. Add 3.8 liters (1.0 gal) of concentrated antifreeze since there will be some water in the system.
10. Add a mixture of 50/50 antifreeze and clean drinkable water until the level stabilizes at the weld seam on the surge tank. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).

RADIATOR CLEANING

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

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

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

- Some conditions may require the use of warm water and a mild detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

RADIATOR SURGE TANK REPLACEMENT

Removal 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.

NOTE: Use only a GM released anti-freeze mixture and ensure a concentration of 50 percent water to 50 percent antifreeze. Antifreeze does not just prevent the cooling system from freezing up, it also protects all the components that are in contact with coolant from rust/limescale deposits. As a result, antifreeze should always be added, even in tropical countries.

In addition to the anti-freeze mixture, water quality also plays an important role. Potable tap water should normally suffice to fulfil this requirement. The quality of regenerated sea water is not suitable.

1. Open the cooling system by removing the radiator surge tank cap.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

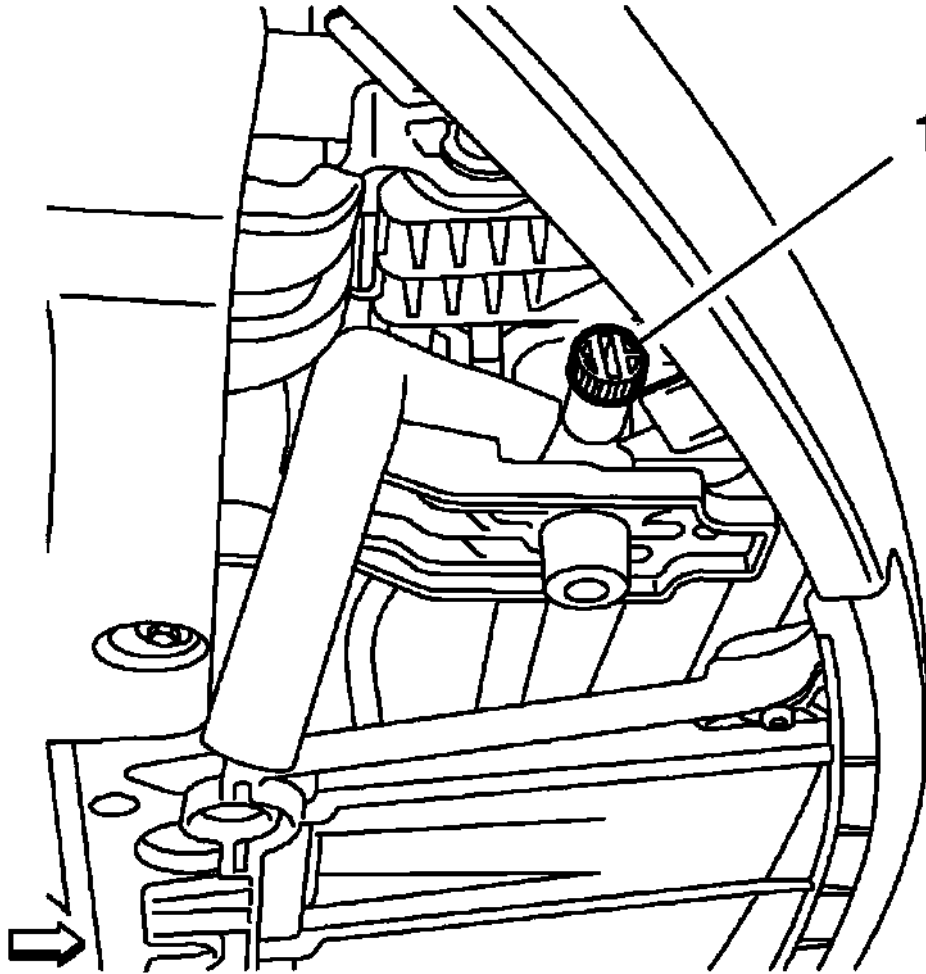


Fig. 23: Surge Tank Drain Screw

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT drain more than 1.5 liter (1.36 quarts) of coolant fluid to avoid necessity of the coolant system bleeding procedure.

3. Install a drain hose, slowly open the drain screw (1) and allow the to drain out max. 1.5 liter (1.36 quarts) coolant fluid into a clean measuring pincher.
4. Lower the vehicle.

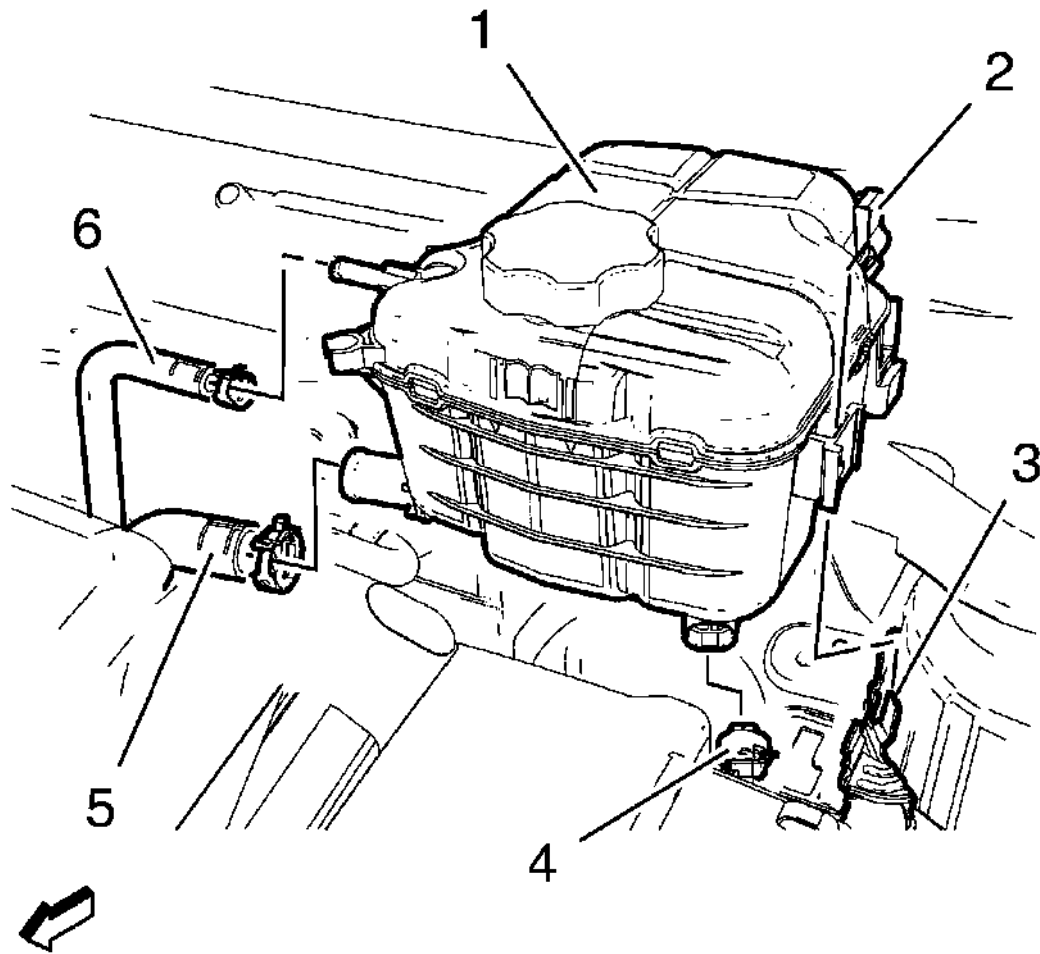


Fig. 24: Surge Tank And Components

Courtesy of GENERAL MOTORS COMPANY

5. Remove the engine coolant air bleed hose (6), remove the clamp.
6. Remove the radiator surge tank engine hose (5), remove the clamp.
7. Remove radiator surge tank clip (2).
8. Disconnect coolant level sensor wiring harness plug (4).
9. Remove the radiator surge tank (1), unclip from the bracket (3).

Installation Procedure

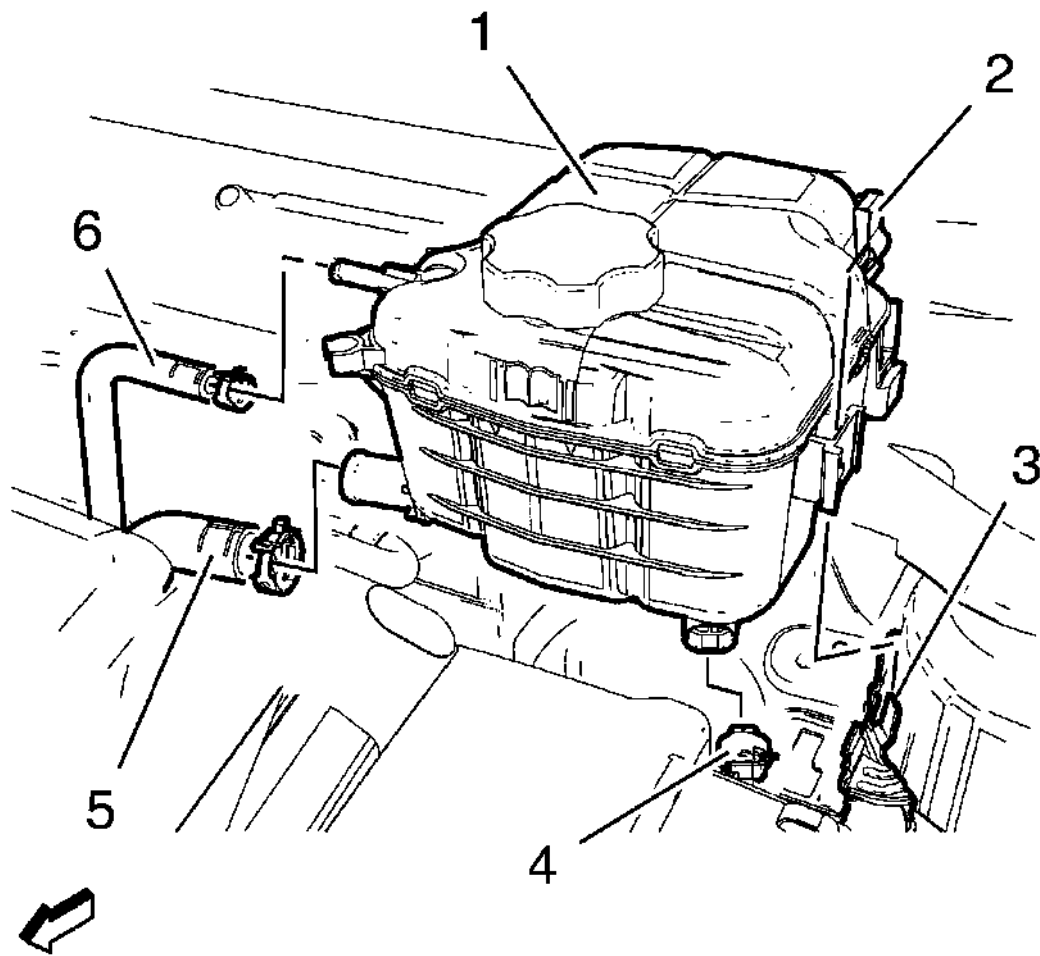


Fig. 25: Surge Tank And Components

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator surge tank (1) and clip into the bracket (3).
2. Connect coolant level sensor wiring harness plug (4).
3. Install radiator surge tank clip (2).
4. Install the radiator surge tank engine hose (5), install the clamp.
5. Install the engine coolant air bleed hose (6), install the clamp.
6. Refill the radiator surge tank with the coolant fluid, which has been drained out before.

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

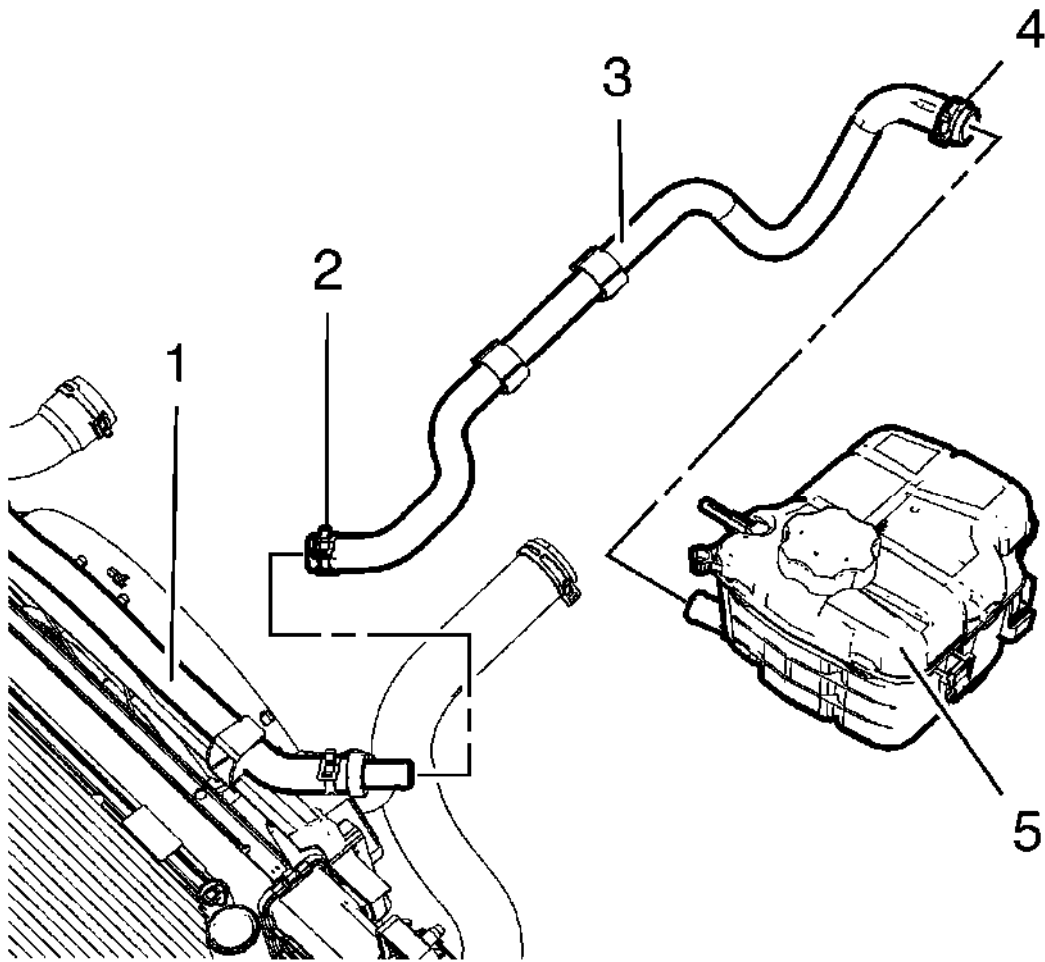


Fig. 26: Radiator Surge Tank, Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the hose clamp (4).
3. Remove the radiator surge tank hose (3) from the surge tank (5).
4. Loosen the clamp (2).
5. Remove the radiator surge tank hose (3) from the radiator outlet hose (1).

Installation Procedure

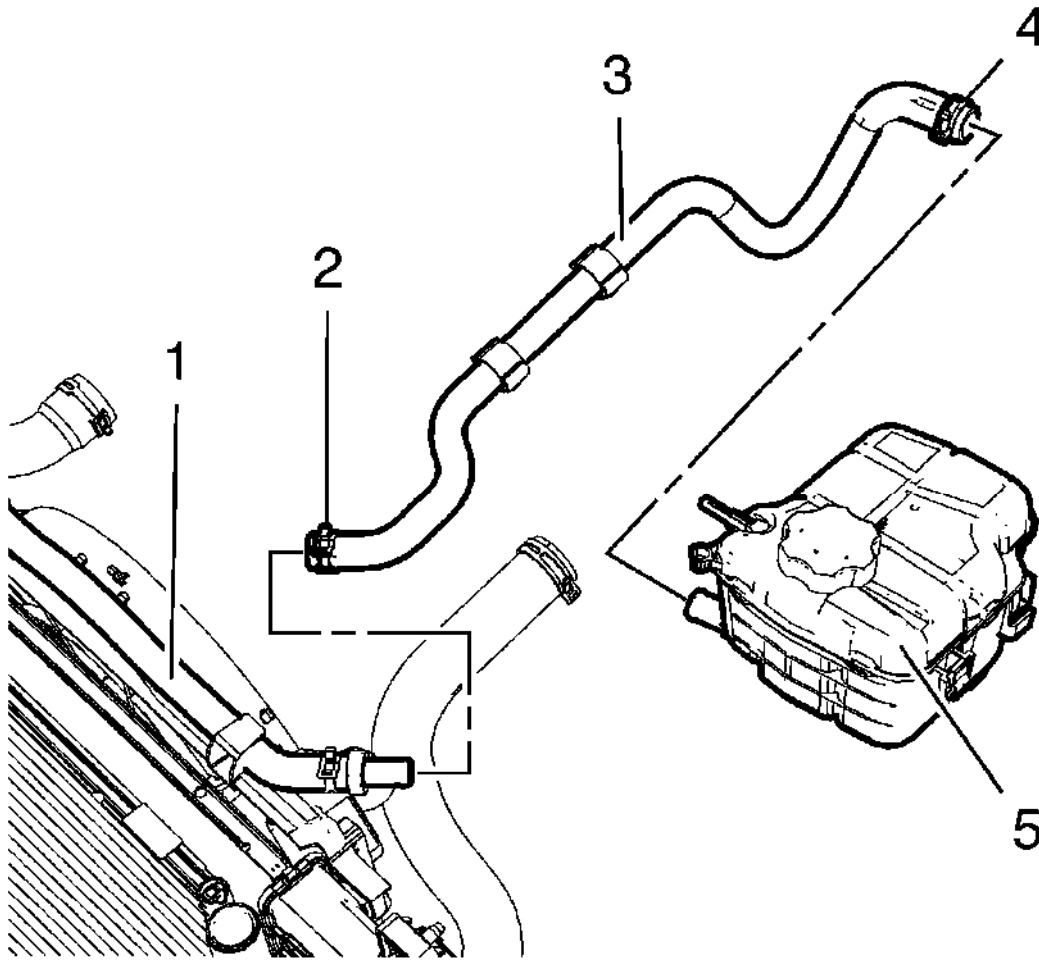
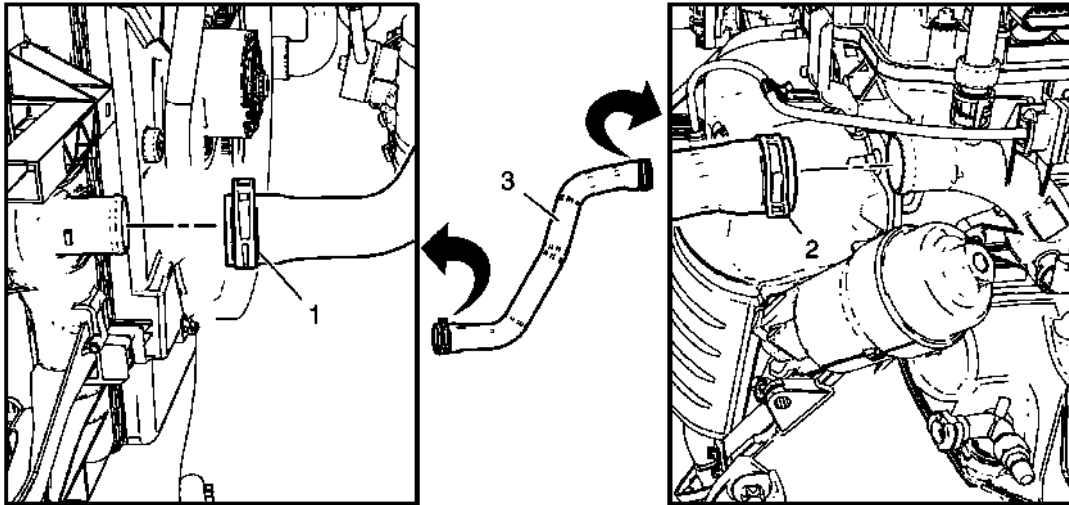


Fig. 27: Radiator Surge Tank, Hoses And Clamps

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator surge tank outlet hose (3) to the radiator outlet hose (1).
2. Install the clamp (2).
3. Install the radiator surge tank outlet hose (3) to the surge tank (5).
4. Install the clamp (4).
5. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

RADIATOR INLET HOSE REPLACEMENT (1.4L LUV)

**Fig. 28: Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

Radiator Inlet Hose Replacement (1.4L LUV)

Callout	Component Name
Preliminary Procedures Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> , <u>Cooling System Draining and Filling (GE-47716 Fill)</u> .	
1	Radiator Inlet Hose Clamp Procedure Place a drain pan below the vehicle.
2	Radiator Inlet Hose Clamp
3	Radiator Inlet Hose

RADIATOR INLET HOSE REPLACEMENT (1.8L LUW AND LWE)**Removal Procedure**

1. Disconnect the battery. Refer to Battery Negative Cable Disconnection and Connection .
2. Unclip the engine control module, if necessary.
3. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
4. Place a drain pan below the vehicle.
5. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).

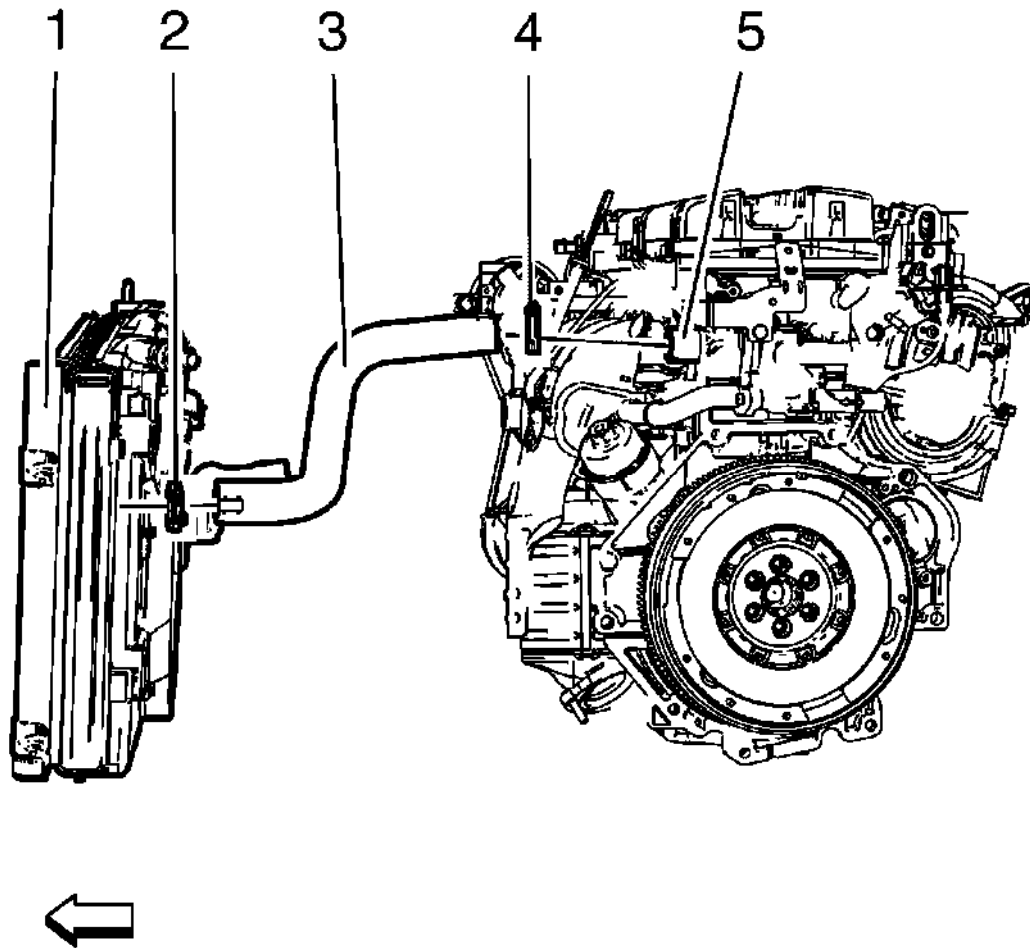


Fig. 29: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Loosen the radiator inlet hose clamp (2).
7. Remove the radiator inlet hose (3) from the radiator (1).
8. Loosen the radiator inlet hose clamp (4).
9. Remove the radiator inlet hose (3) from the thermostat housing (5).

Installation Procedure

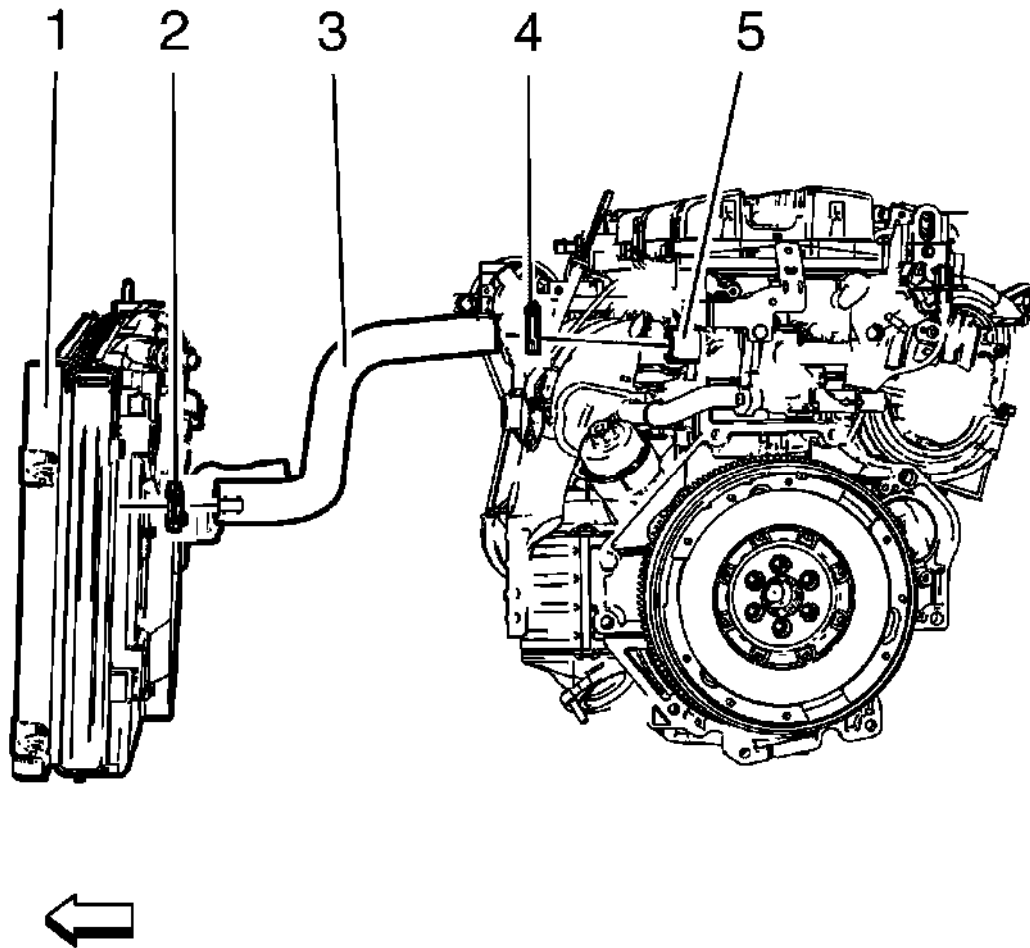
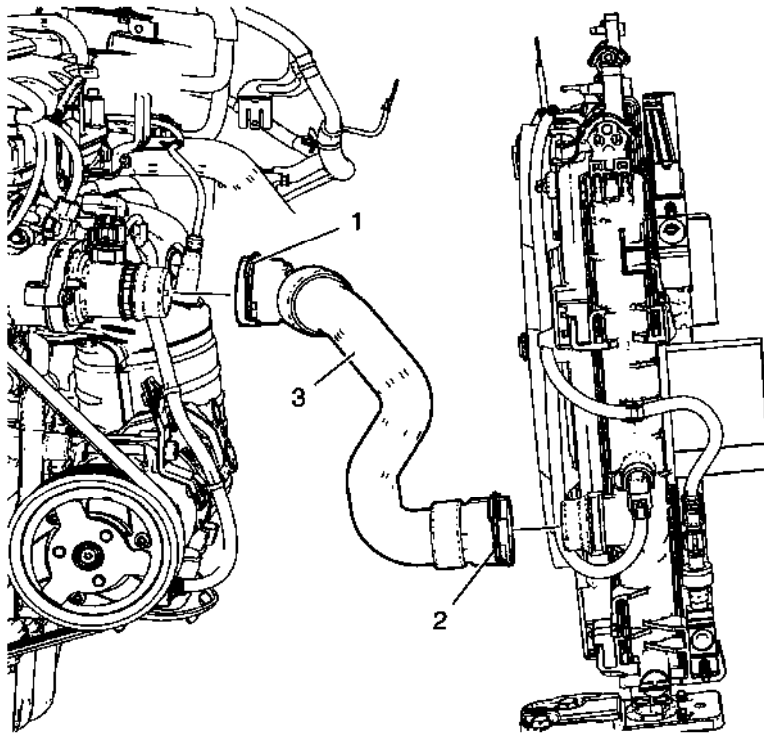


Fig. 30: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator inlet hose (3) to the thermostat housing (5).
2. Install the radiator inlet hose clamp (4).
3. Install the radiator inlet hose (3) to the radiator (1).
4. Install the radiator inlet hose clamp (2).
5. Lower the vehicle.
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
7. Clip in the engine control module, if necessary.
8. Connect the battery. Refer to **Battery Negative Cable Disconnection and Connection**.

RADIATOR OUTLET HOSE REPLACEMENT (1.4L LUV)

**Fig. 31: Radiator Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

Radiator Outlet Hose Replacement (1.4L LUV)

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill)</u> , <u>Cooling System Draining and Filling (GE-47716 Fill)</u> .	
1	Radiator Outlet Hose Connector Procedure 1. Place a drain pan below the vehicle. 2. Unlock radiator outlet hose connector.
2	Radiator Outlet Hose Connector Procedure Unlock the radiator outlet hose connector.
3	Radiator Outlet Hose

RADIATOR OUTLET HOSE REPLACEMENT (1.8L LUW AND LWE)**Removal Procedure**

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill)

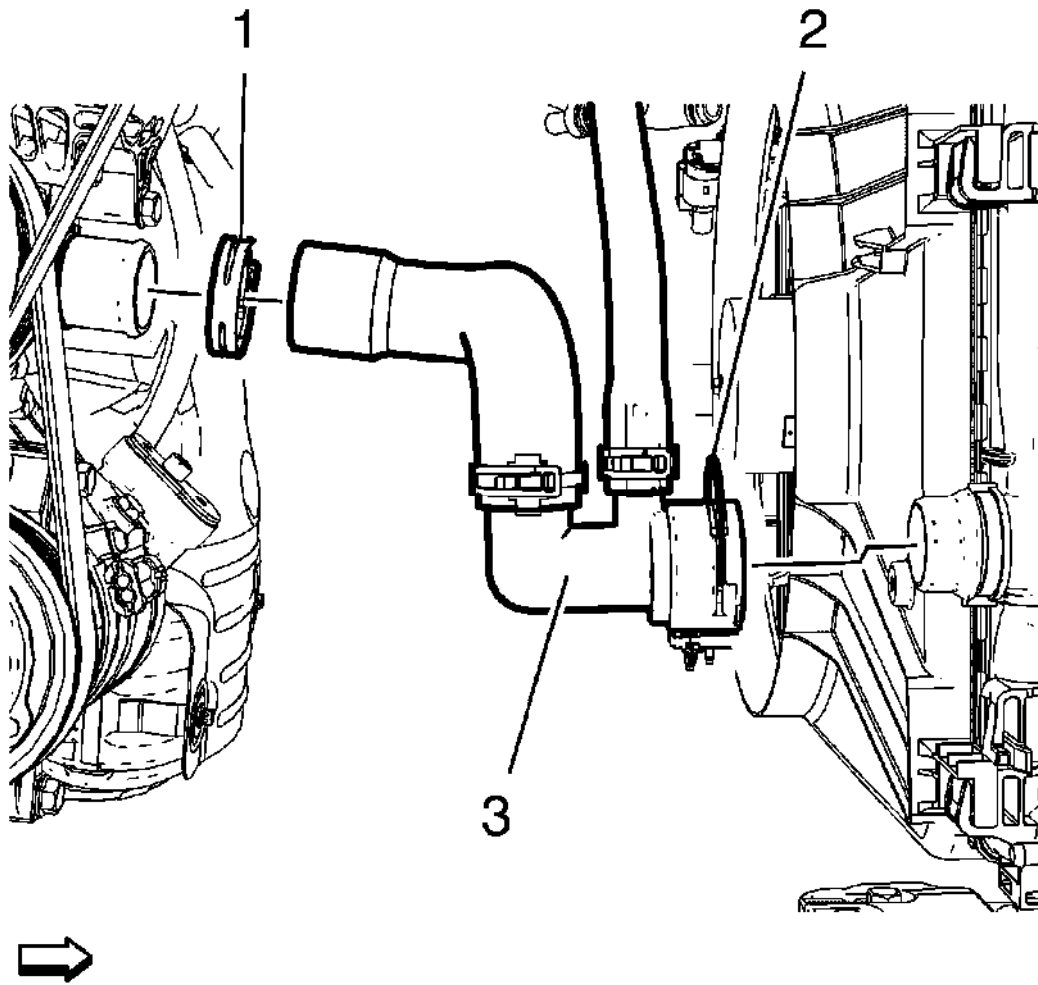


Fig. 32: Radiator Outlet Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the hose clamp (1).
3. Remove the radiator outlet hose assembly (3) from the water pump.
4. Unclip the clamp (2).
5. Remove the radiator outlet hose assembly (3) from the radiator.

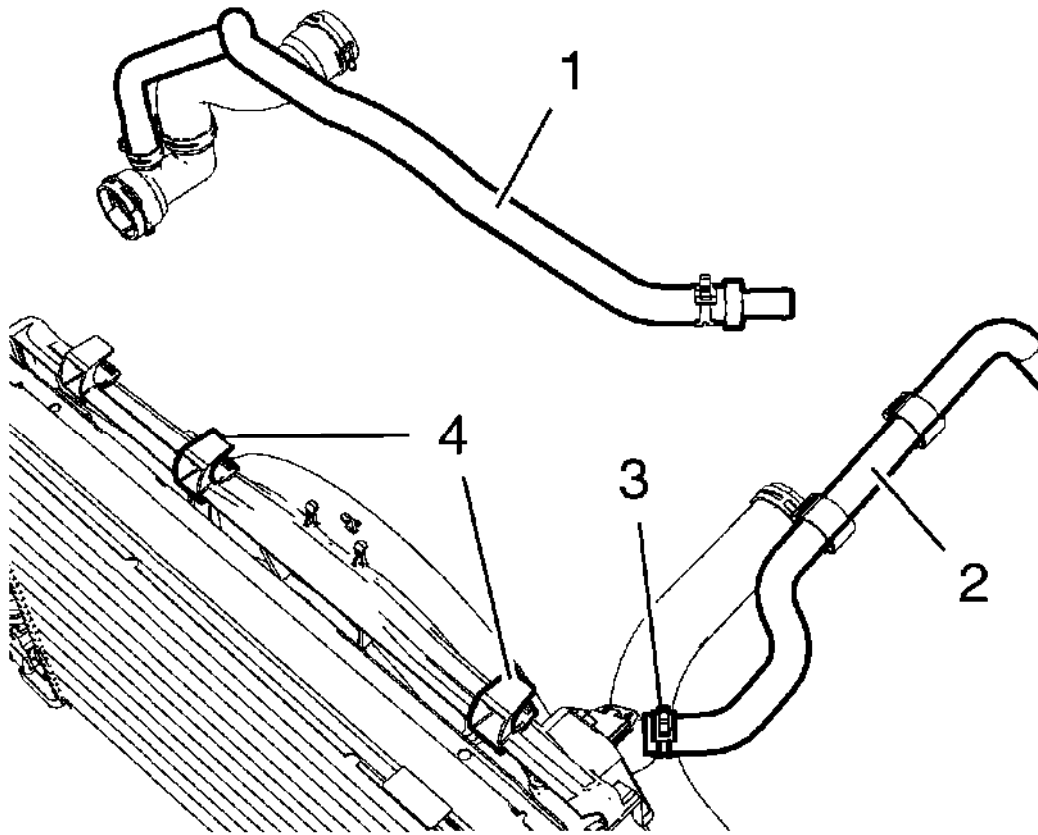


Fig. 33: Radiator Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Loosen the clamp (3).
7. Remove the radiator outlet hose (1) from the radiator surge tank outlet hose (2).
8. Unclip the radiator outlet hose (1) from the 2 clips (4).

Installation Procedure

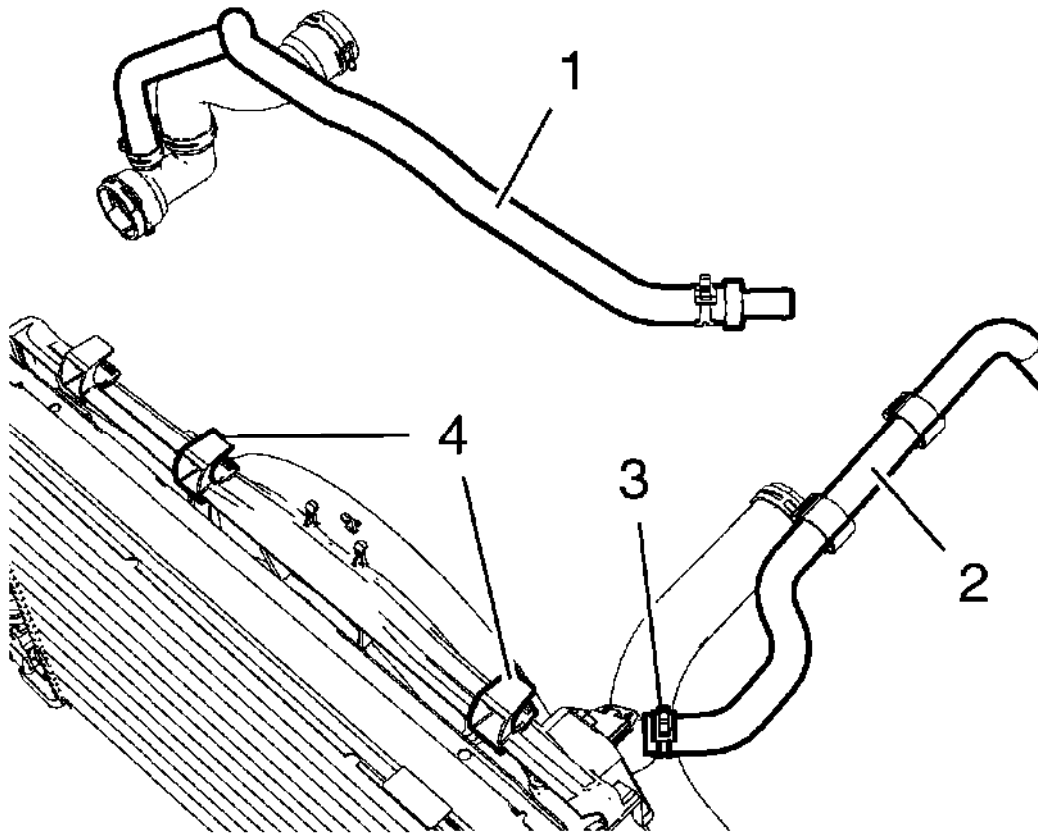


Fig. 34: Radiator Surge Tank Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Clip in the radiator outlet hose (1) into the 2 clips (4).
2. Install the radiator outlet hose (1) to the radiator surge tank outlet hose (2).
3. Install the clamp (3).

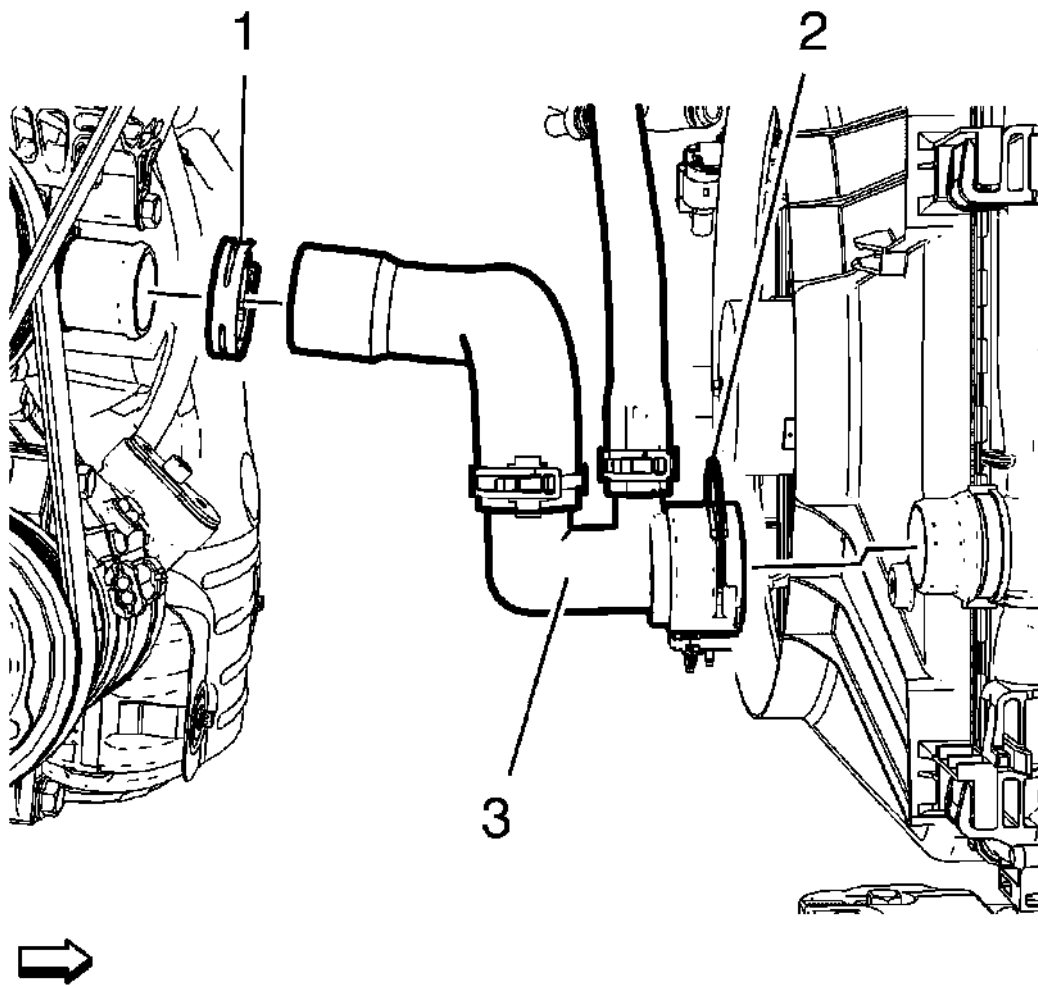


Fig. 35: Radiator Outlet Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator surge tank outlet hose assembly (3) to the radiator.
5. Clip in the clamp (2).
6. Install the radiator surge tank outlet hose assembly (3) to the water pump.
7. Install the hose clamp (1).
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**

RADIATOR MOUNTING STUD REPAIR

Repair Procedure

1. Pressure test the cooling system. Refer to **Cooling System Leak Testing**. If the radiator is not leaky, perform the following procedure.

2. Remove the radiator. Refer to **Radiator Replacement (1.4L LUV with Automatic Transmission)**, **Radiator Replacement (1.8L LUW and LWE)**, **Radiator Replacement (1.4L LUV with Manual Transmission)**.

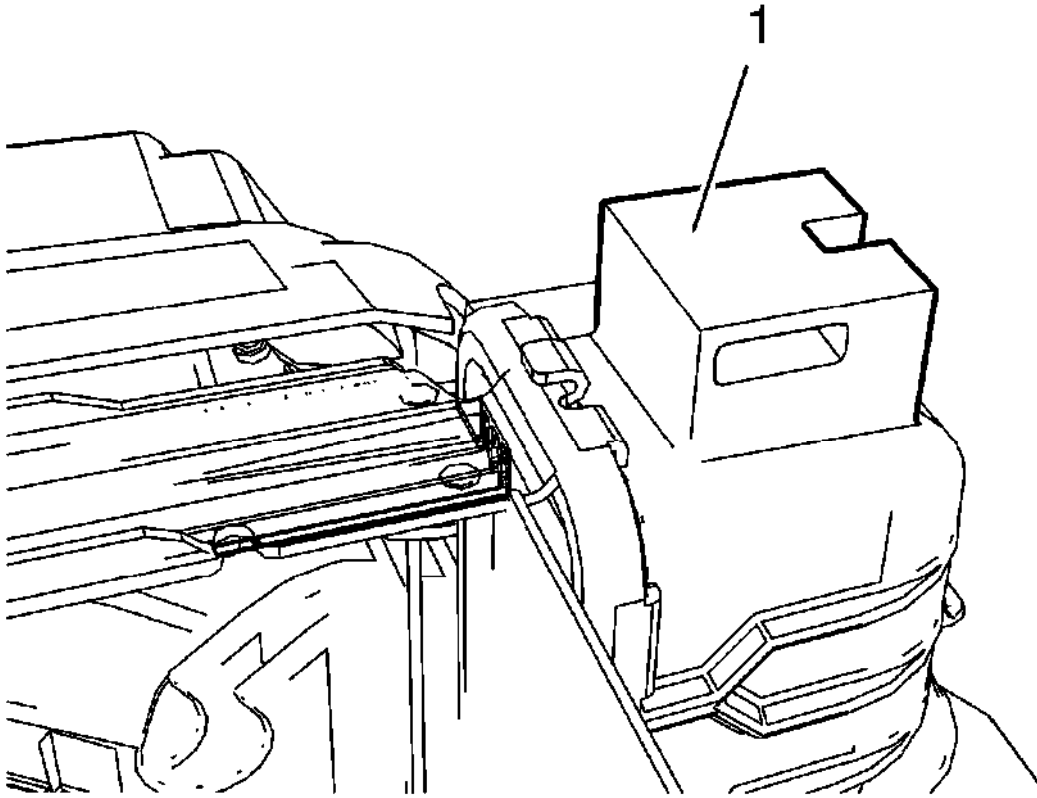


Fig. 36: Identifying Fracture Surface
Courtesy of GENERAL MOTORS COMPANY

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

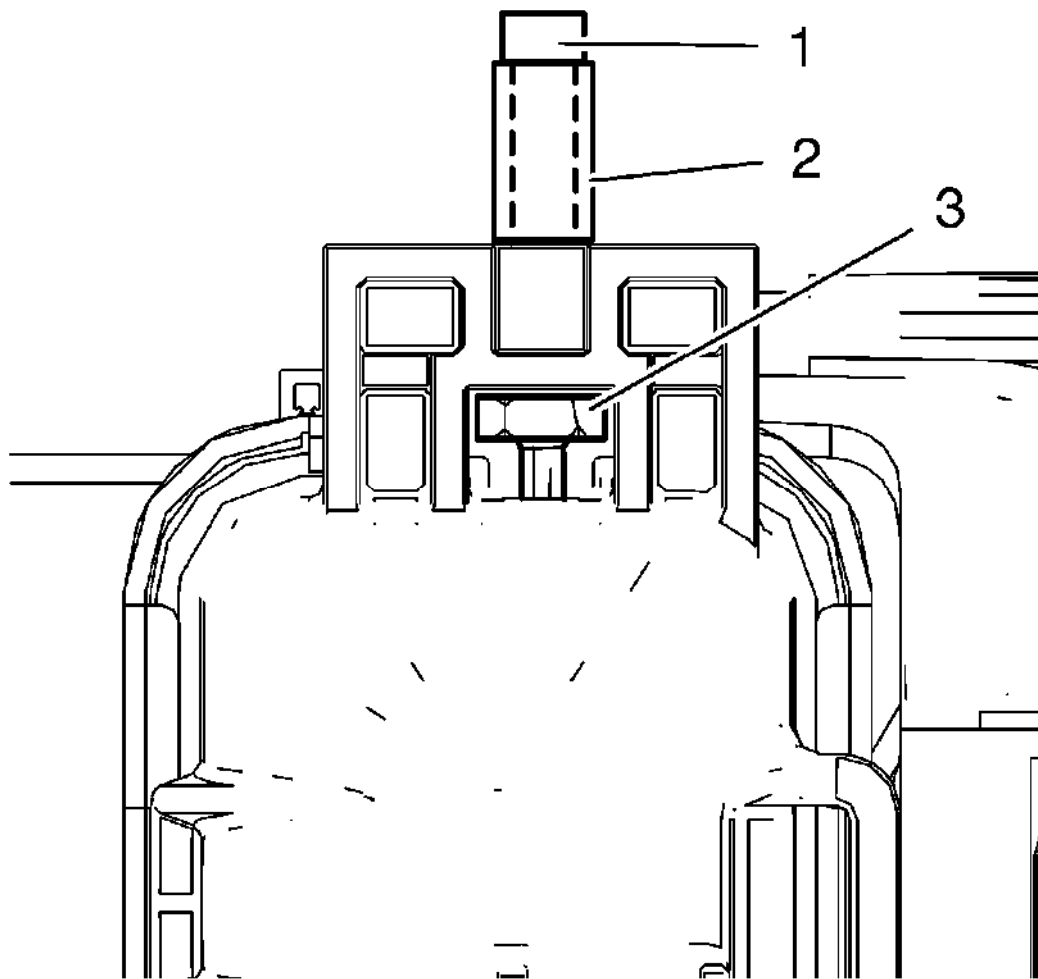


Fig. 37: Radiator Mounting Pin, Nut And Bolt
Courtesy of GENERAL MOTORS COMPANY

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

- Install the nut (3).

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

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

CAUTION: Refer to Fastener Caution .

6. Tighten the bolt 5 N.m (44 lb in).
7. Install the radiator. Refer to **Radiator Replacement (1.4L LUV with Automatic Transmission)**, **Radiator Replacement (1.8L LUW and LWE)**, **Radiator Replacement (1.4L LUV with Manual**

Transmission).

CHARGE AIR COOLER REPLACEMENT (AUTOMATIC TRANSMISSION)

Removal Procedure

1. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
3. Remove the radiator upper air seal.
4. Remove the left and right side radiator air baffles.
5. Remove the charge air cooler inlet air hose from the charge air cooler. Refer to **Charge Air Cooler Inlet Air Hose Replacement** .
6. Remove the charge air cooler outlet air hose from the charge air cooler. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .

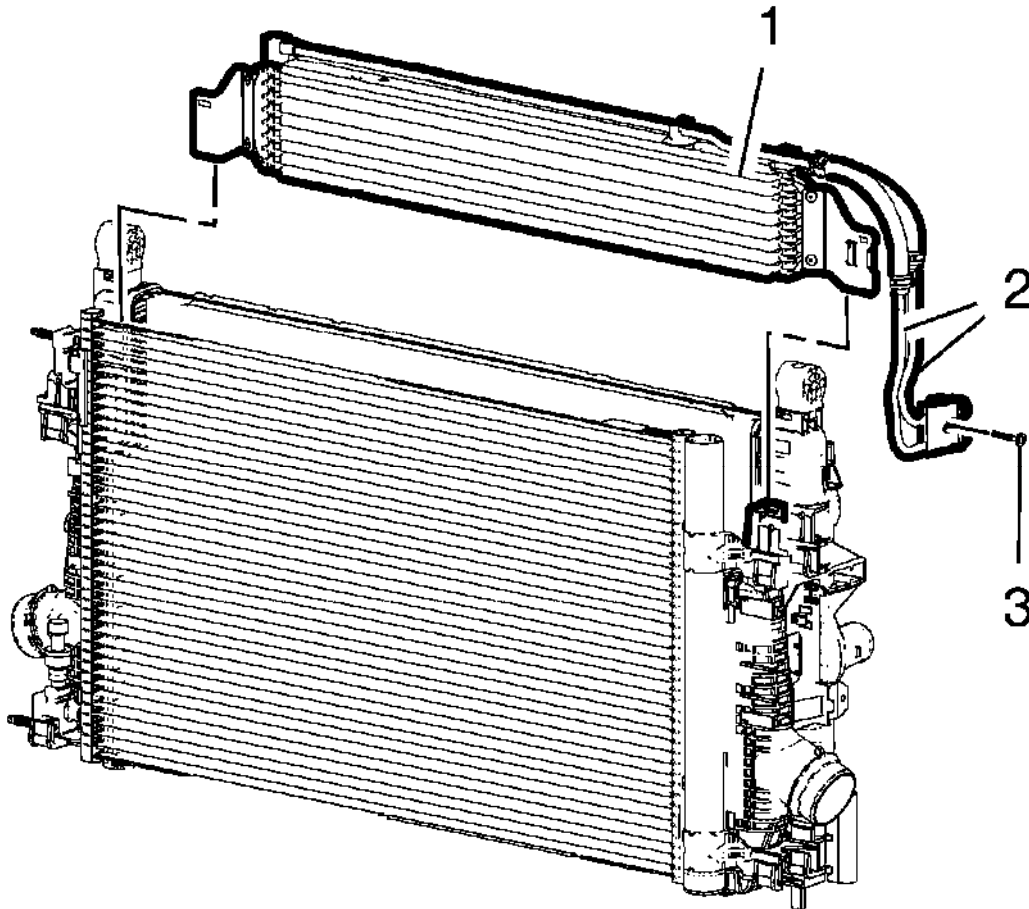


Fig. 38: Transmission Fluid Cooler

Courtesy of GENERAL MOTORS COMPANY

7. Unclip the transmission fluid cooler (1) from the radiator.
8. Reposition the transmission fluid cooler (1) away from the radiator and secure.

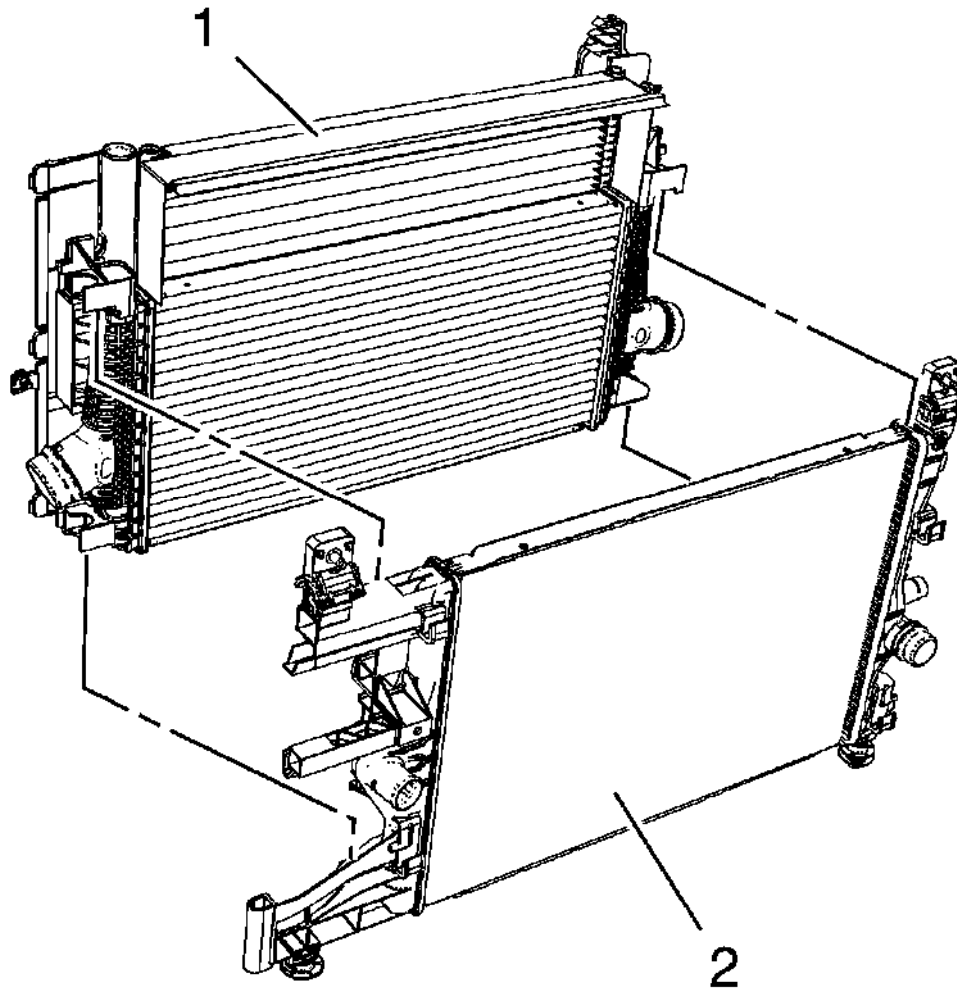


Fig. 39: Identifying Air Conditioning Condenser And Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

9. Unclip the air conditioning condenser (2) from the charge air cooler (1).
10. Reposition the air conditioning condenser (2) forward and below the front bumper impact bar.

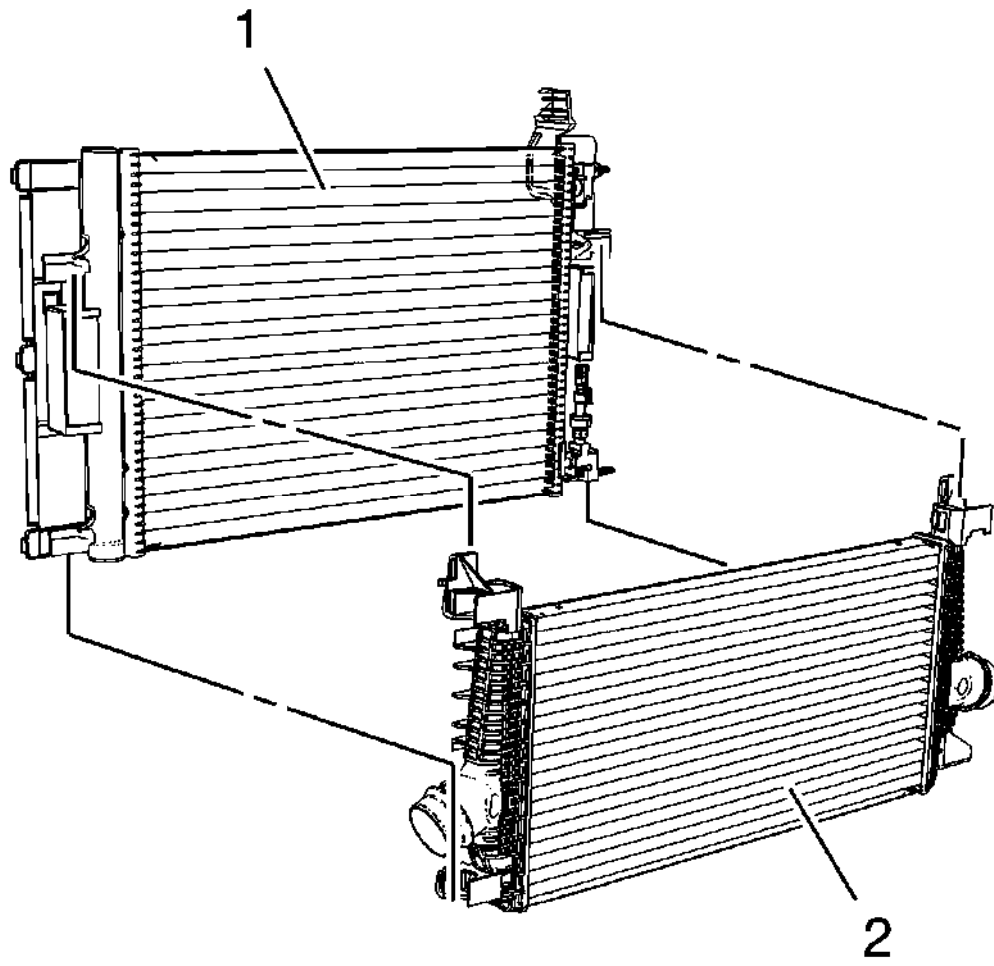


Fig. 40: Identifying Charge Air Cooler And Radiator
Courtesy of GENERAL MOTORS COMPANY

11. Unclip the charge air cooler (2) from the radiator (1).
12. Lift the charge air cooler (2) up and away from the radiator (1).

Installation Procedure

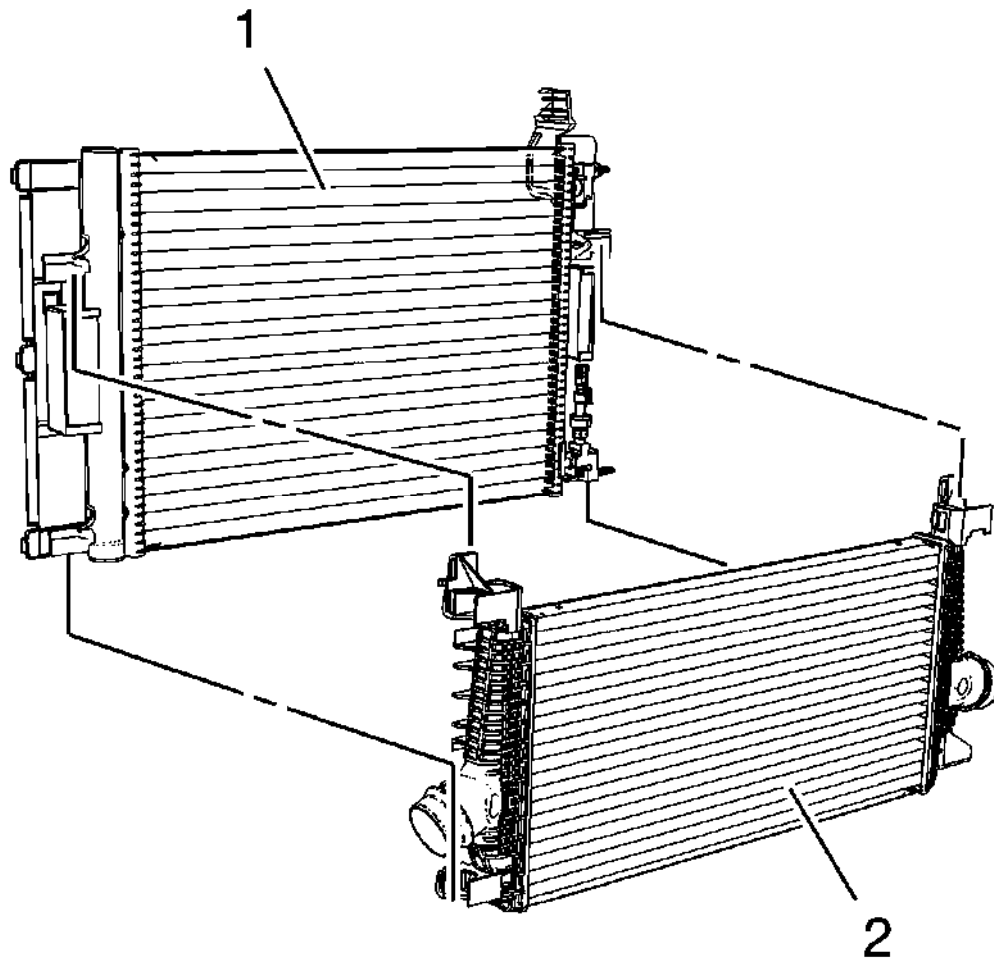


Fig. 41: Identifying Charge Air Cooler And Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Clip the charge air cooler (2) to the radiator (1).

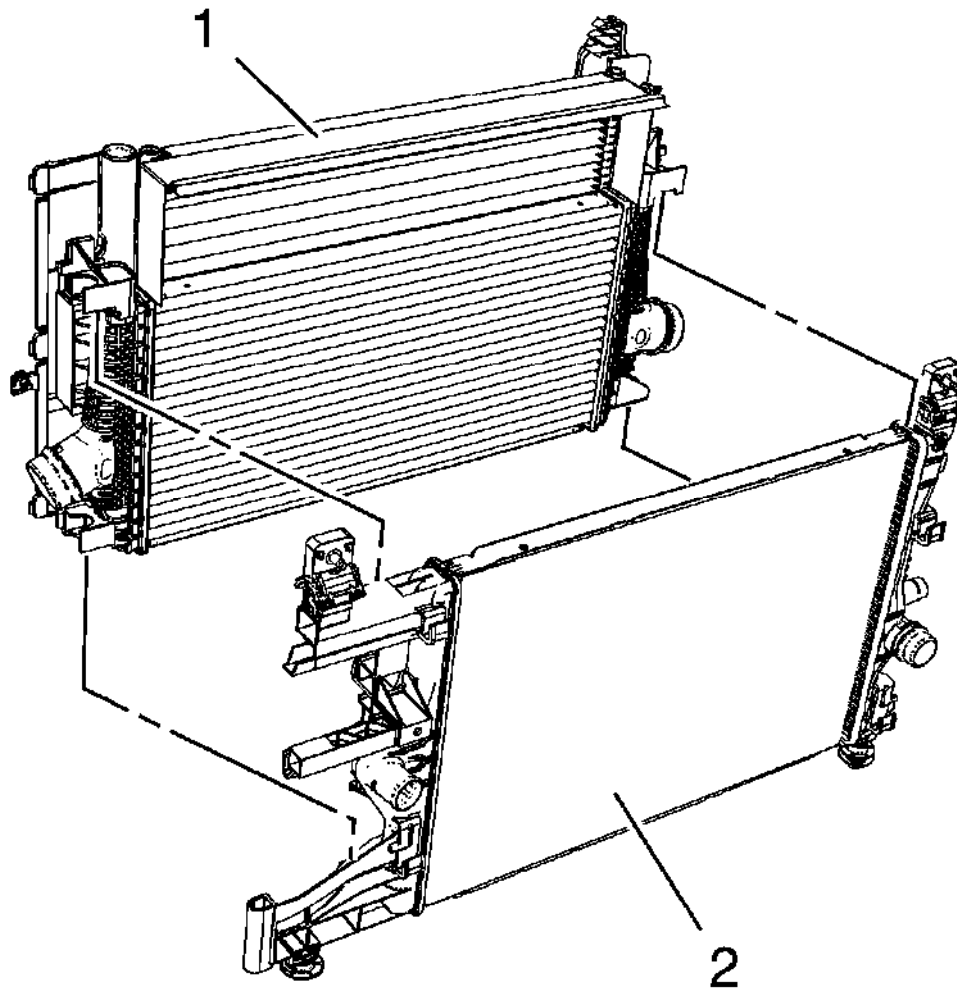


Fig. 42: Identifying Air Conditioning Condenser And Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

2. Clip the air conditioning condenser (2) to the charge air cooler (1).

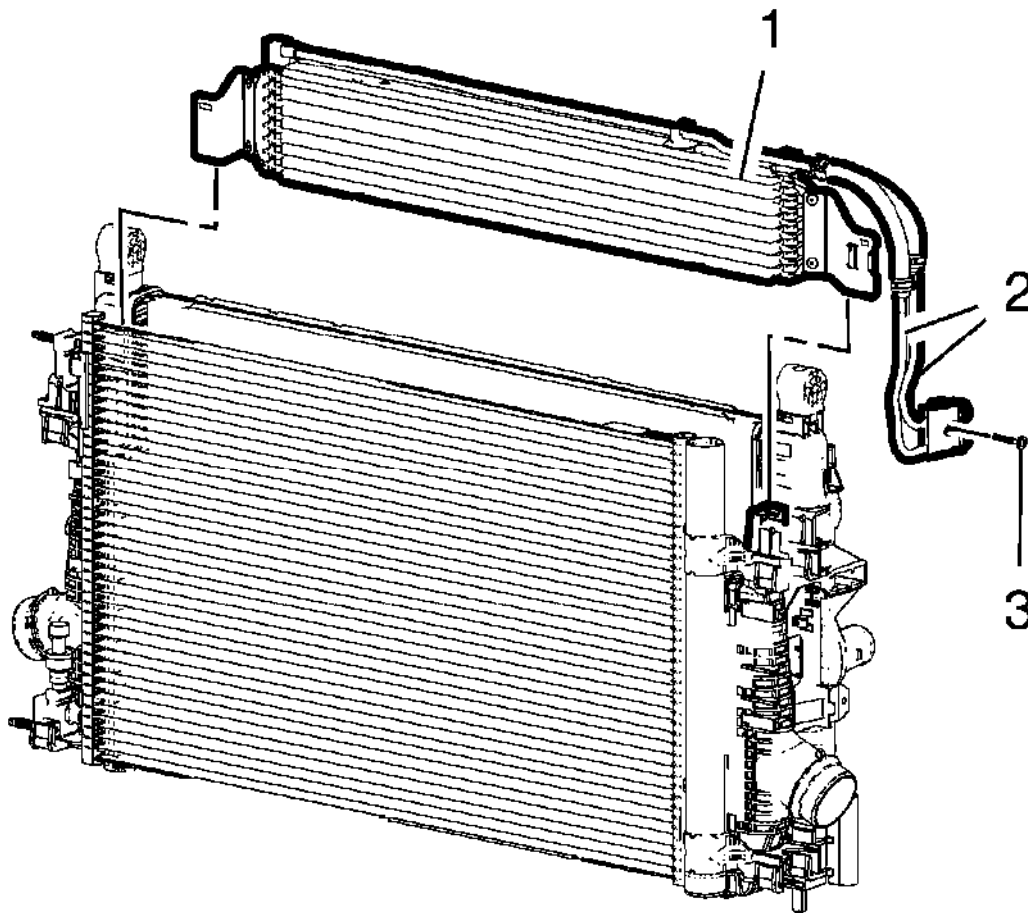


Fig. 43: Transmission Fluid Cooler
Courtesy of GENERAL MOTORS COMPANY

3. Clip the transmission fluid cooler (1) to the radiator.
4. Install the charge air cooler inlet air hose to the charge air cooler. Refer to **Charge Air Cooler Inlet Air Hose Replacement** .
5. Install the charge air cooler outlet air hose to the charge air cooler. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .
6. Install the left and right side radiator air baffles.
7. Install the radiator upper air seal.
8. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
9. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

CHARGE AIR COOLER REPLACEMENT (MANUAL TRANSMISSION)

Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
3. Remove the radiator upper air seal.
4. Remove the left and right side radiator air baffles.
5. Remove the charge air cooler inlet air hose from the charge air cooler. Refer to **Charge Air Cooler Inlet Air Hose Replacement** .
6. Remove the charge air cooler outlet air hose from the charge air cooler. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .

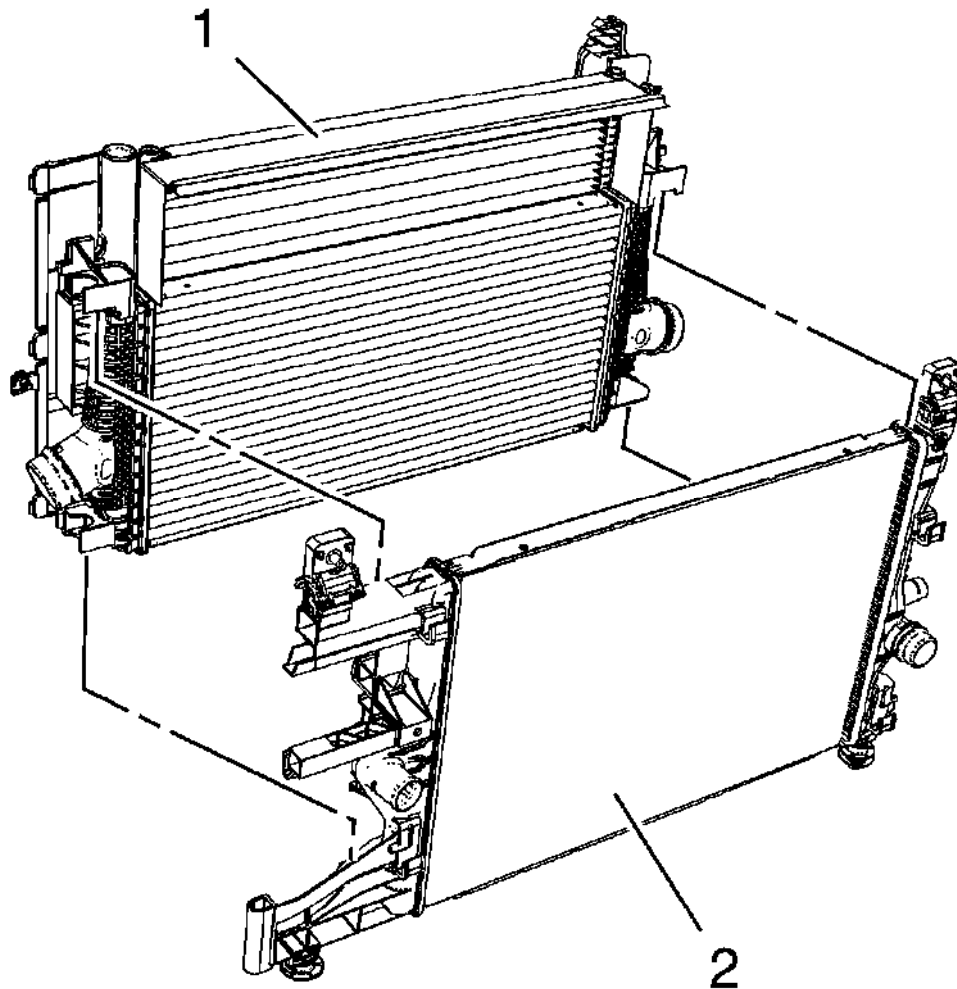


Fig. 44: Identifying Air Conditioning Condenser And Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

7. Unclip the air conditioning condenser (2) from the charge air cooler (1).
8. Reposition the air conditioning condenser (2) forward and below the front bumper impact bar.

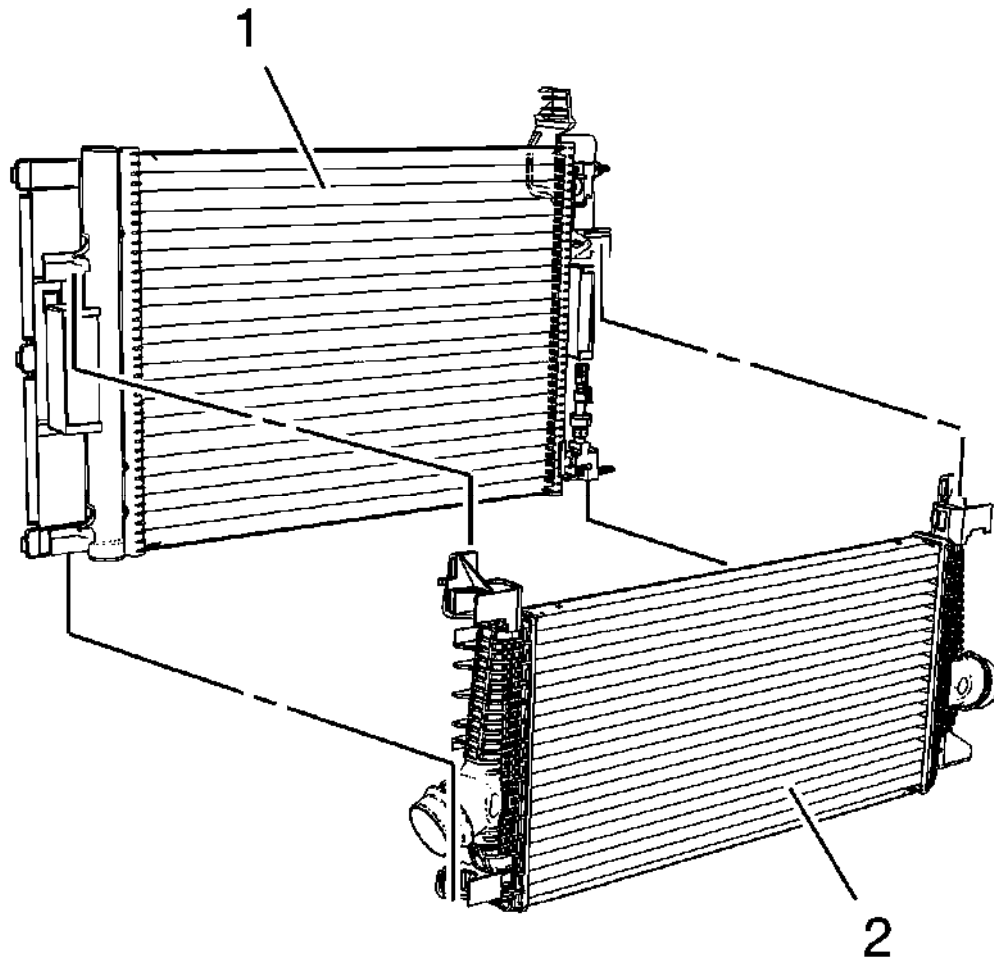


Fig. 45: Identifying Charge Air Cooler And Radiator
Courtesy of GENERAL MOTORS COMPANY

9. Unclip the charge air cooler (2) from the radiator (1).
10. Lift the charge air cooler (2) up and away from the radiator (1).

Installation Procedure

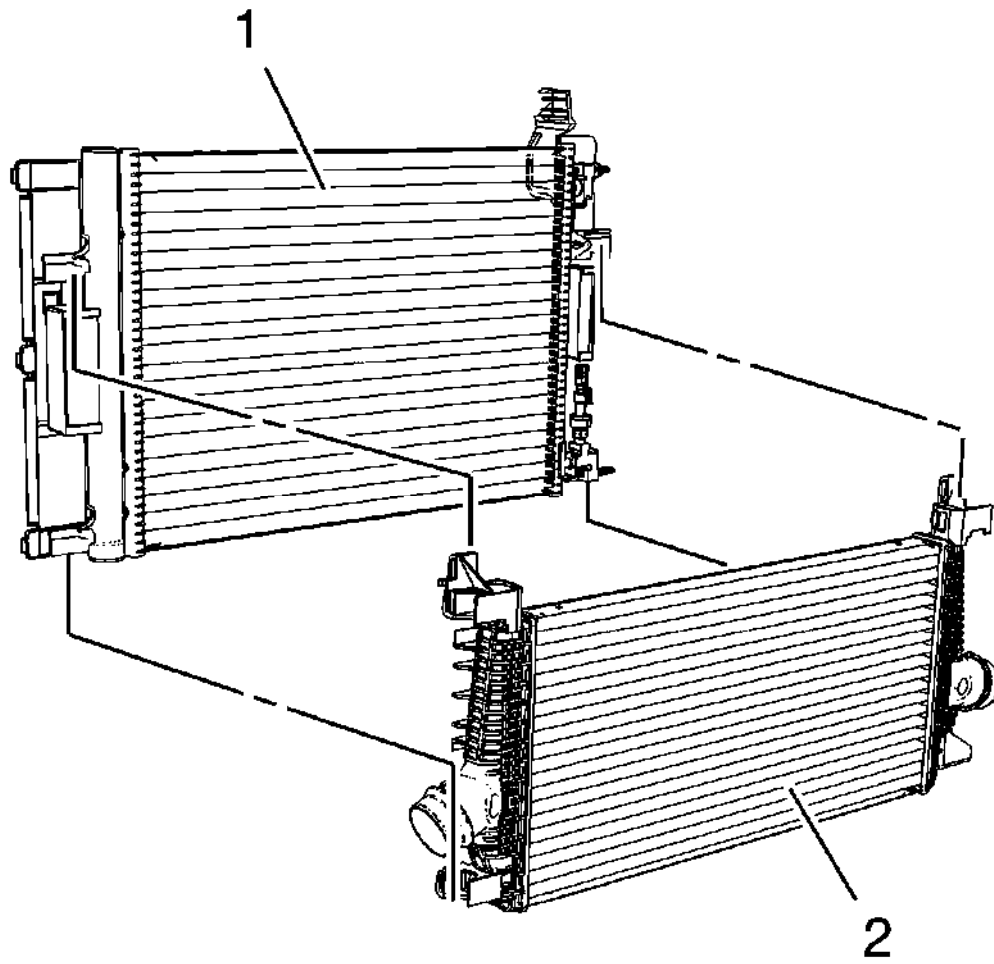


Fig. 46: Identifying Charge Air Cooler And Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Clip the charge air cooler (2) to the radiator (1).

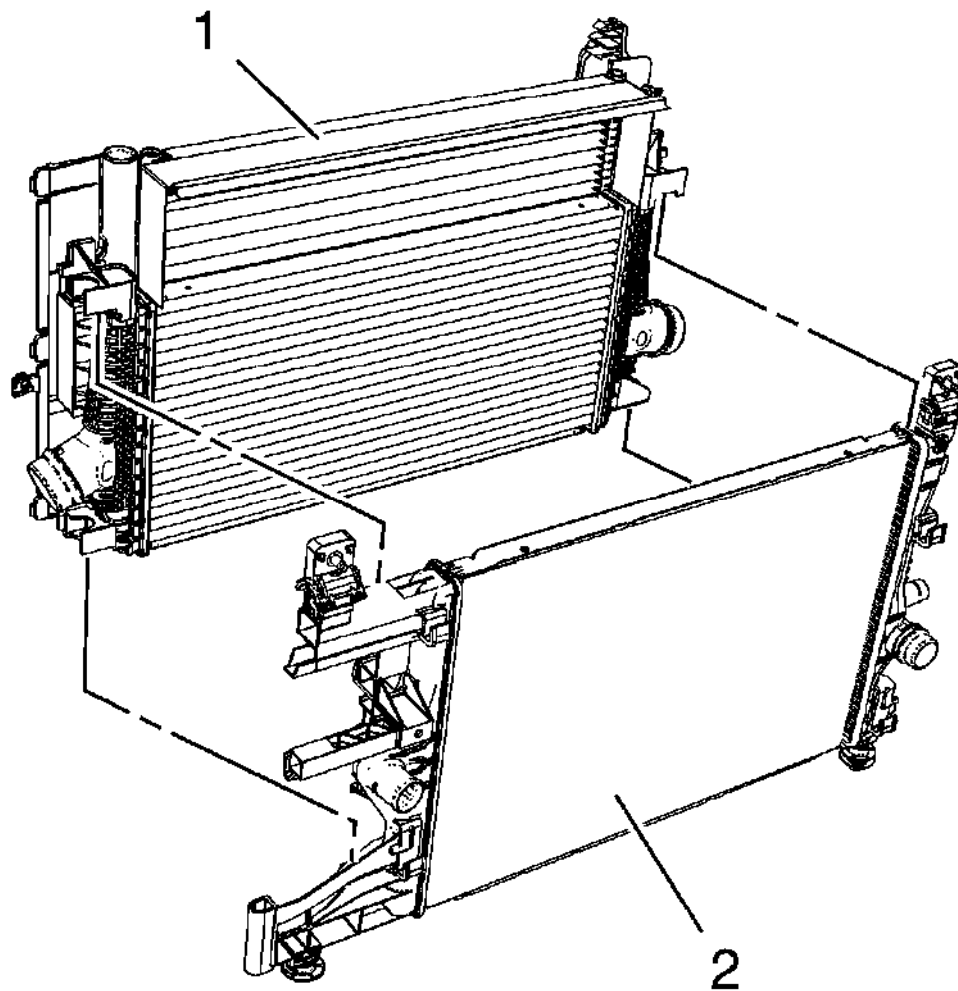


Fig. 47: Identifying Air Conditioning Condenser And Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

2. Clip the air conditioning condenser (2) to the charge air cooler (1).
3. Install the charge air cooler inlet air hose to the charge air cooler. Refer to **Charge Air Cooler Inlet Air Hose Replacement** .
4. Install the charge air cooler outlet air hose to the charge air cooler. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .
5. Install the left and right side radiator air baffles.
6. Install the radiator upper air seal.
7. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
8. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

RADIATOR AND CHARGE AIR COOLER BRACKET REPAIR

1. Remove the radiator. Refer to **Radiator Replacement (1.4L LUV with Automatic Transmission)**, **Radiator Replacement (1.8L LUW and LWE)**, **Radiator Replacement (1.4L LUV with Manual Transmission)**.

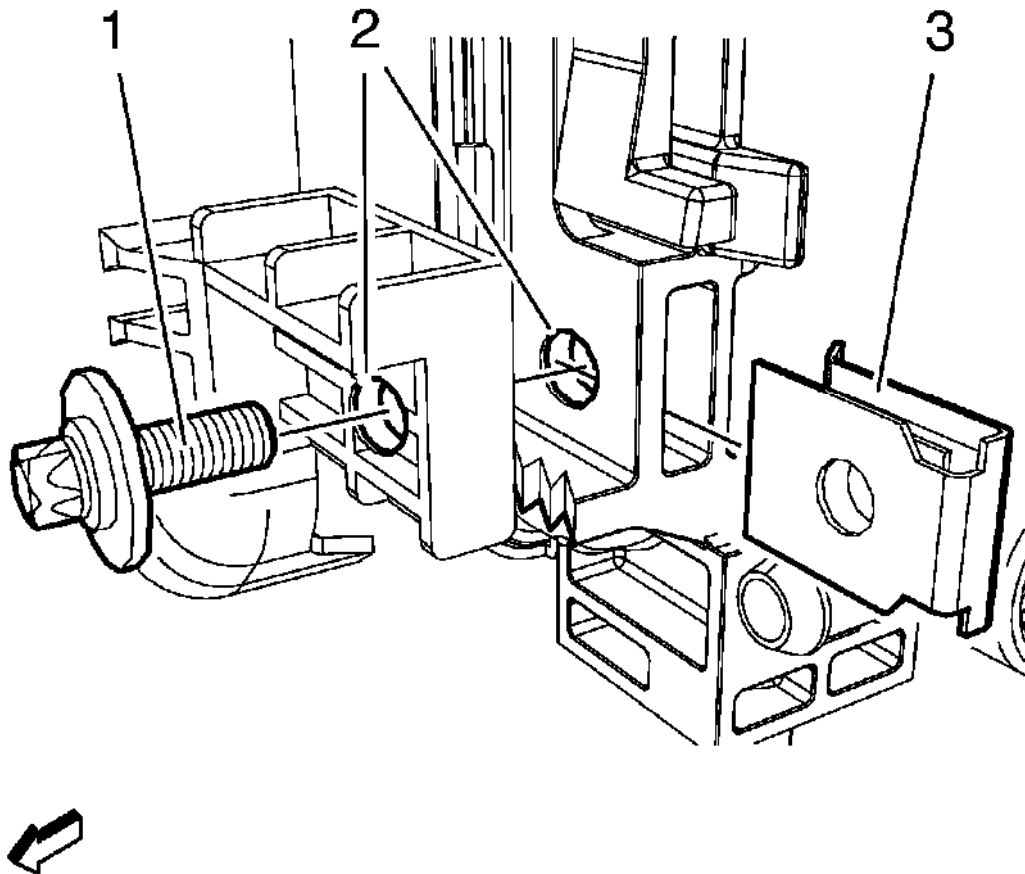


Fig. 48: Radiator Mounting Components
Courtesy of GENERAL MOTORS COMPANY

2. Drill hole in the charge air cooler bracket and radiator bracket (2) using a 7 mm (0.28 in) drill.
3. Install the j-clip (3) to the radiator.
4. Install the radiator. Refer to **Radiator Replacement (1.4L LUV with Automatic Transmission)**, **Radiator Replacement (1.8L LUW and LWE)**, **Radiator Replacement (1.4L LUV with Manual Transmission)**.

CAUTION: Refer to **Fastener Caution** .

5. Install the repair bolt (1) with locking compound and tighten to 5 N.m (45 lb in).

RADIATOR LOWER BRACKET REPLACEMENT

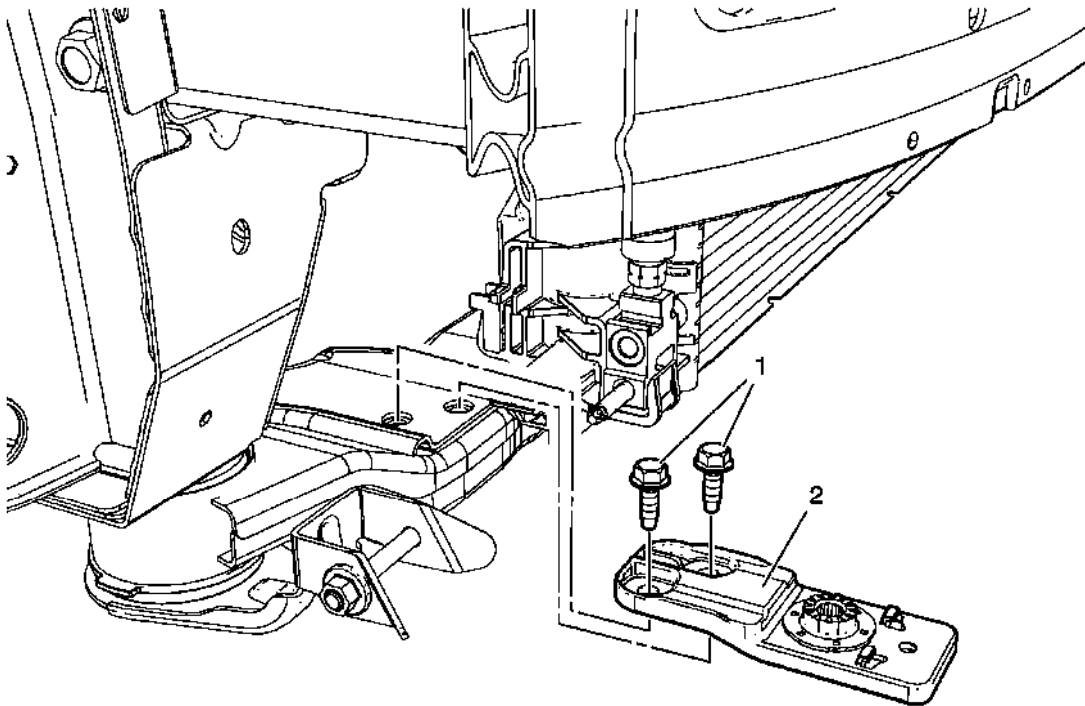


Fig. 49: Radiator Lower Bracket

Courtesy of GENERAL MOTORS COMPANY

Radiator Lower Bracket Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Radiator Lower Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Procedure Secure the radiator. Tighten 22 N.m (16 lb ft)
2	Radiator Lower Bracket

ENGINE COOLANT FAN RESISTOR MOUNT REPAIR

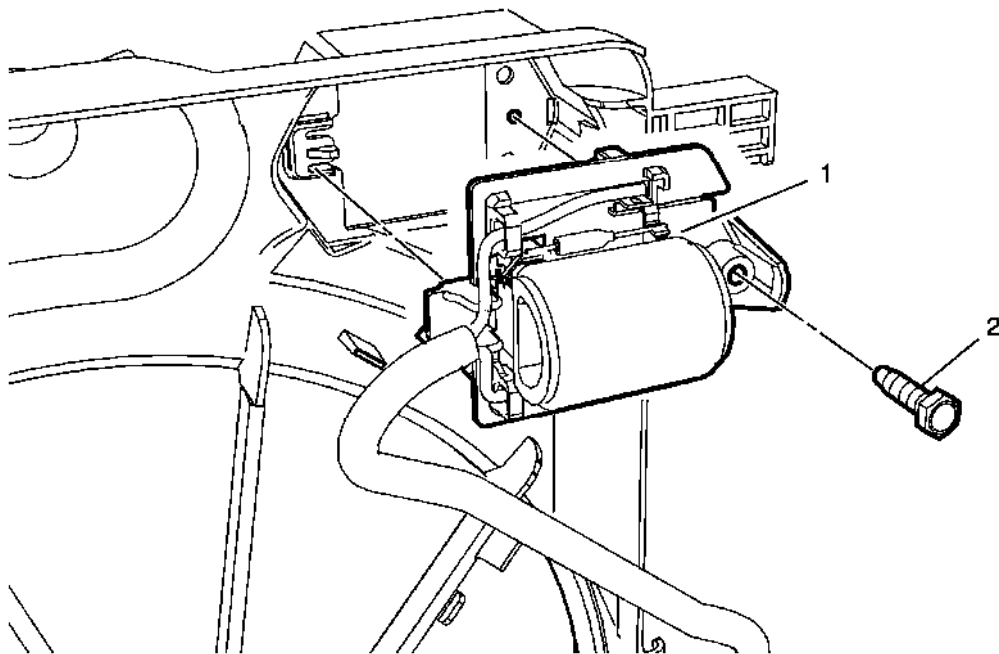


Fig. 50: Engine Coolant Fan Resistor Mount (Single Coolant Fan)

Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Resistor Mount Repair

Callout	Component Name
Preliminary Procedures	
Remove the engine cooling fan shroud. Refer to <u>Engine Coolant Fan Replacement</u> .	
1	Engine Coolant Fan Resistor Mount
2	Engine Coolant Fan Resistor Mount Bolt
	CAUTION: Refer to <u>Fastener Caution</u> .
	Procedure
	In case of a broken engine coolant fan resistor mount use this repair procedure.
	Tighten
	5 N.m (44 lb in)

THROTTLE BODY HEATER INLET HOSE REPLACEMENT

Removal Procedure

1. Open the hood.

2. Place a collection basin under the vehicle.

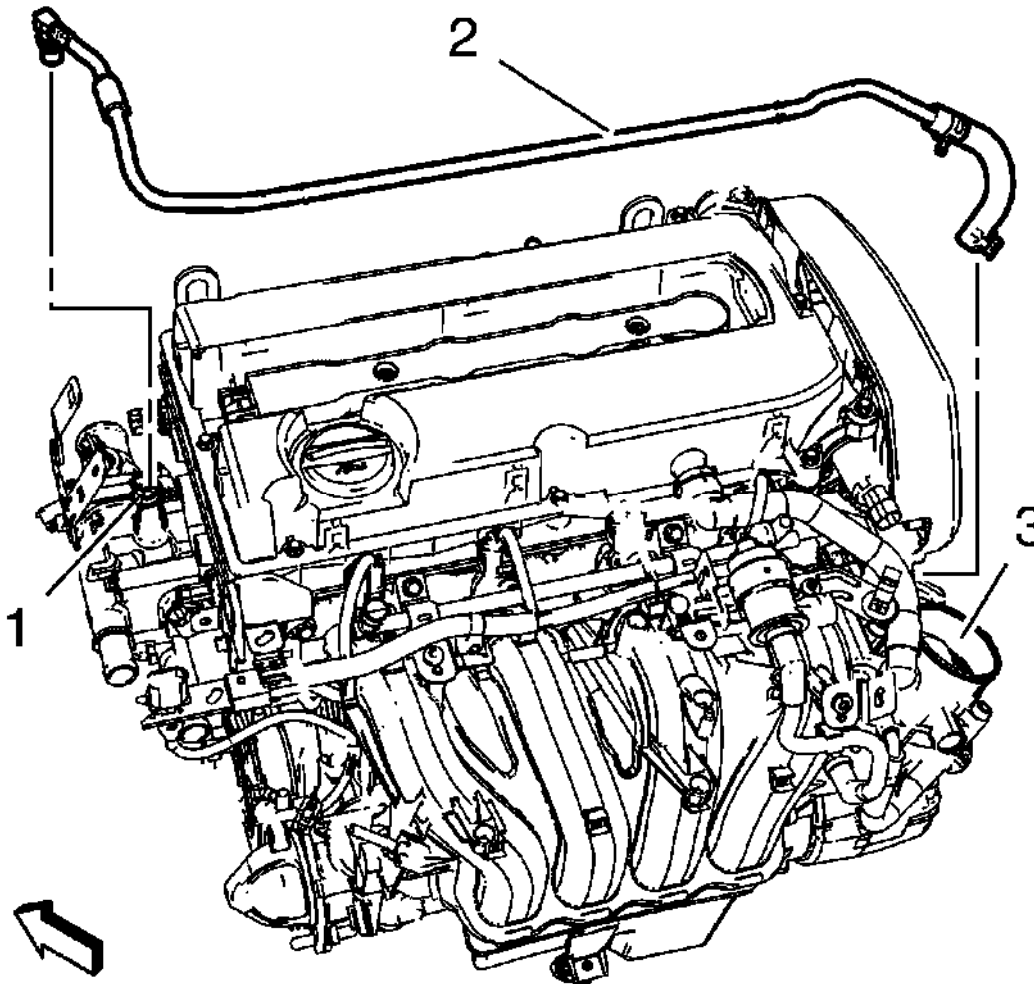


Fig. 51: Identifying Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the throttle body heater inlet hose connector from the engine coolant thermostat housing (1).
4. Loosen the clamp and disconnect the throttle body heater inlet hose connector from the throttle body (3).
5. Remove the throttle body heater inlet hose (2).

Installation Procedure

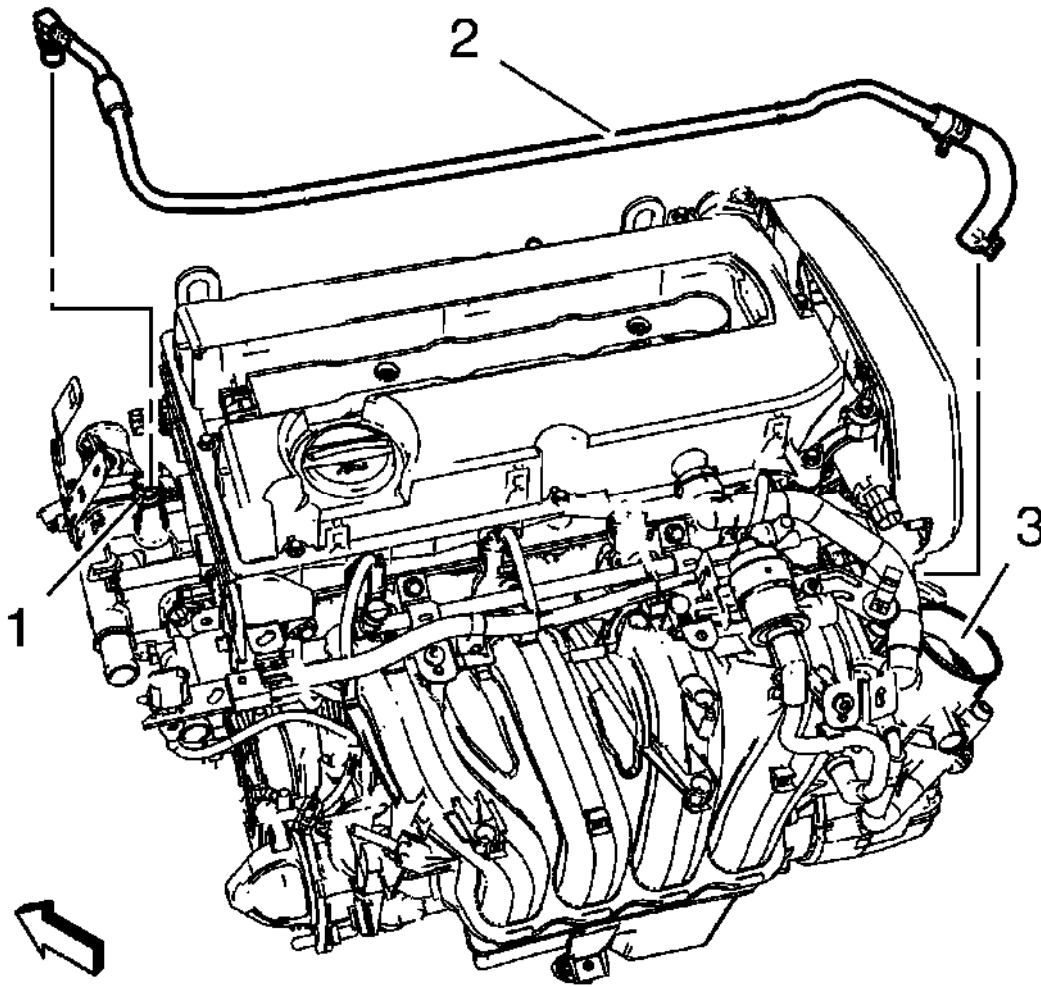


Fig. 52: Identifying Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

1. Install the throttle body heater inlet hose (2).
2. Connect the throttle body heater inlet hose to the throttle body (3) and install the clamp.
3. Connect the throttle body heater inlet hose (2) to the engine coolant thermostat housing (1).

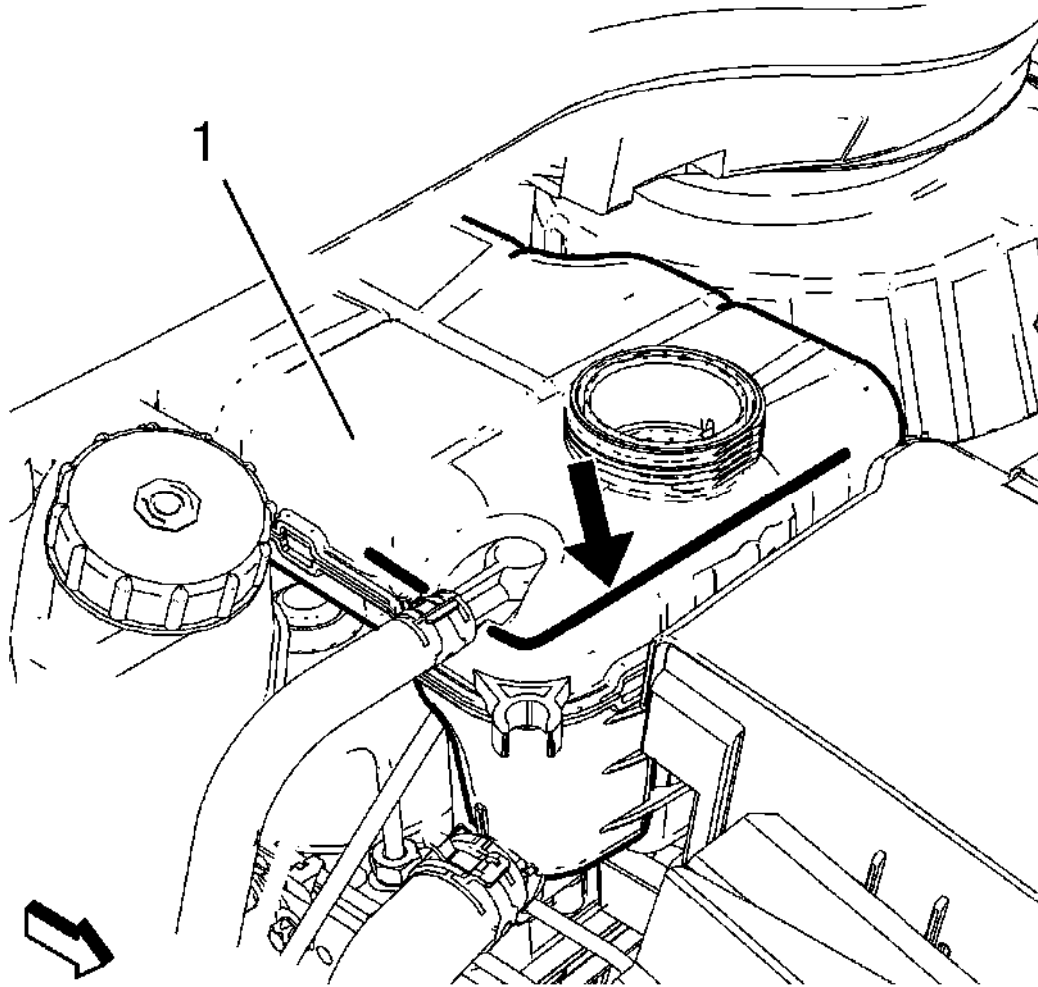


Fig. 53: Radiator Coolant Surge Tank
Courtesy of GENERAL MOTORS COMPANY

4. Top off the coolant by filling to the bottom line (black arrow) on the coolant surge tank (1) if necessary.
5. Close the hood.

THROTTLE BODY HEATER OUTLET HOSE REPLACEMENT

Removal Procedure

1. Open the hood.
2. Place a collection basin under the vehicle.

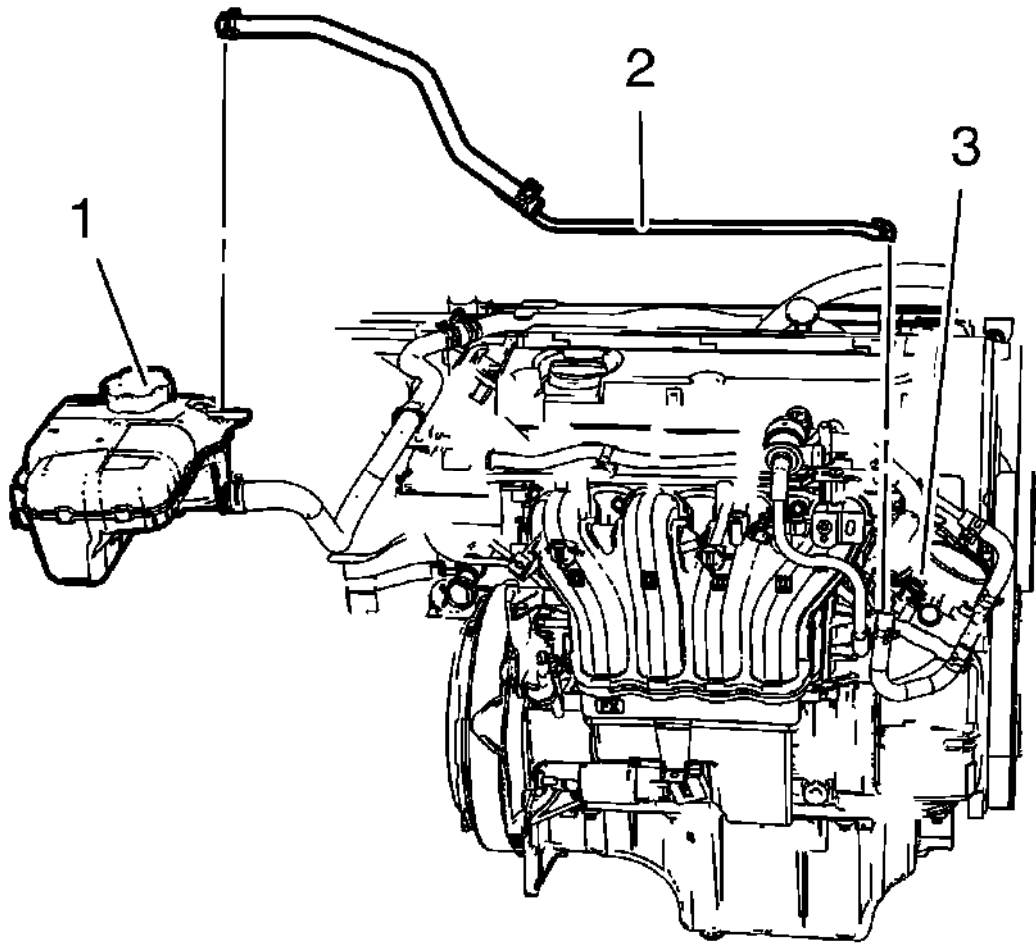


Fig. 54: Radiator Surge Tank, Throttle Body And Throttle Body Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Clip out the throttle body heater outlet hose from the intake manifold.
4. Loosen the clamp and disconnect the throttle body heater outlet hose (2) from the radiator surge tank (1).
5. Disconnect the throttle body heater outlet hose connector from the throttle body (3).
6. Remove the throttle body heater outlet hose (2).

Installation Procedure

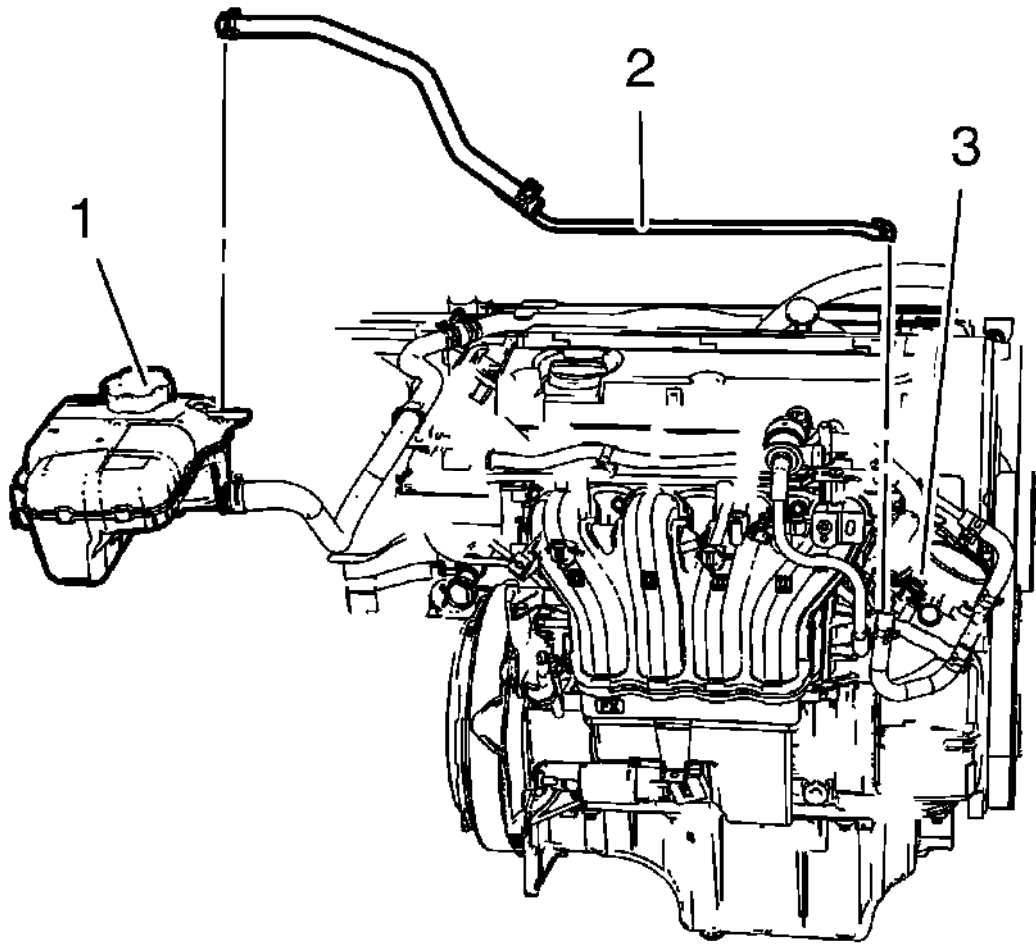


Fig. 55: Radiator Surge Tank, Throttle Body And Throttle Body Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install the throttle body heater outlet hose (2).
2. Connect the throttle body heater outlet hose connector to the throttle body (3)
3. Connect the throttle body heater outlet hose (2) to the radiator surge tank (1) and install the clamp.
4. Clip in the throttle body heater outlet hose to the intake manifold

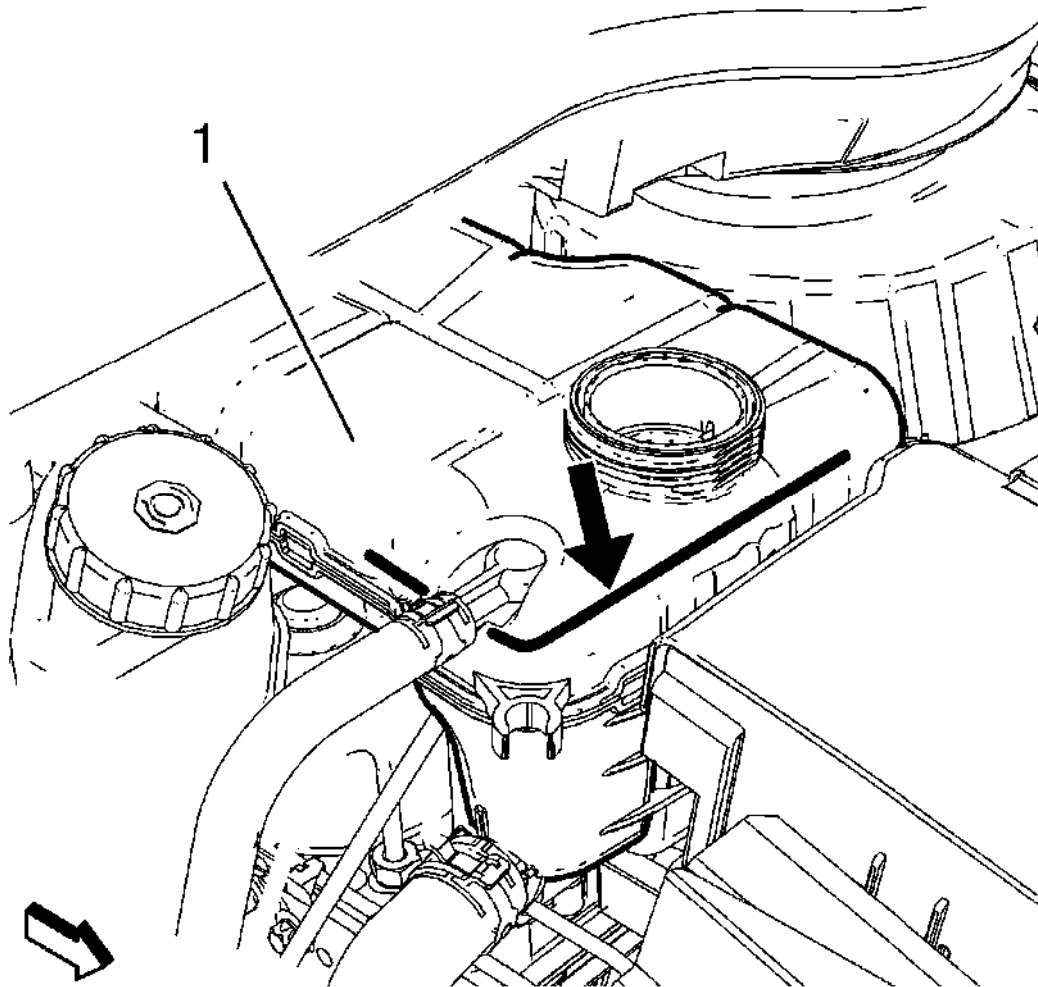


Fig. 56: Radiator Coolant Surge Tank
Courtesy of GENERAL MOTORS COMPANY

5. Top off the coolant by filling to the bottom line (black arrow) on the coolant surge tank (1), if necessary.
6. Close the hood.

ENGINE OIL COOLER REPLACEMENT (1.4L LUV)

Removal Procedure

1. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Drain engine coolant. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
3. Remove the turbocharger oil feed pipe. Refer to **Turbocharger Oil Feed Pipe Replacement**.
4. Remove the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement**.

5. Lower vehicle.
6. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .

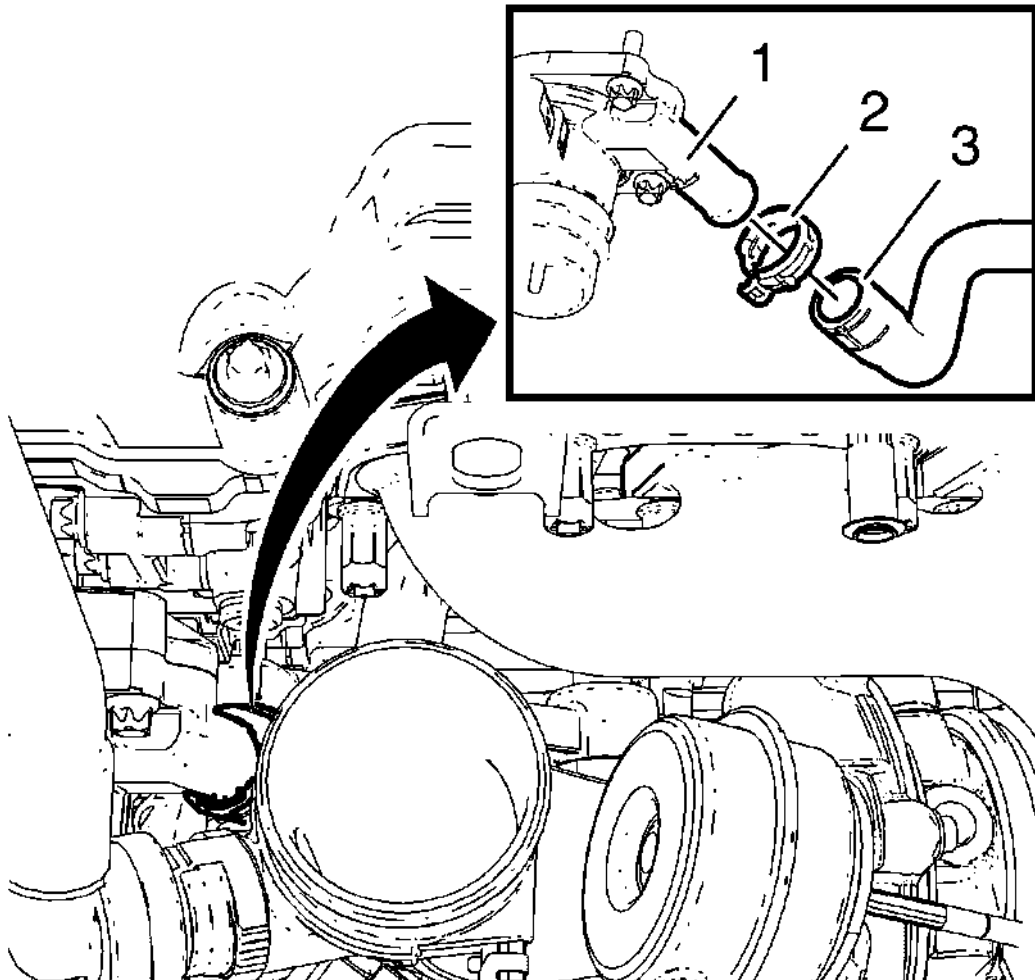


Fig. 57: Thermostat Housing And Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove the oil cooler outlet hose clamp (2).
8. Remove the oil cooler outlet hose (3) from the thermostat housing (1).

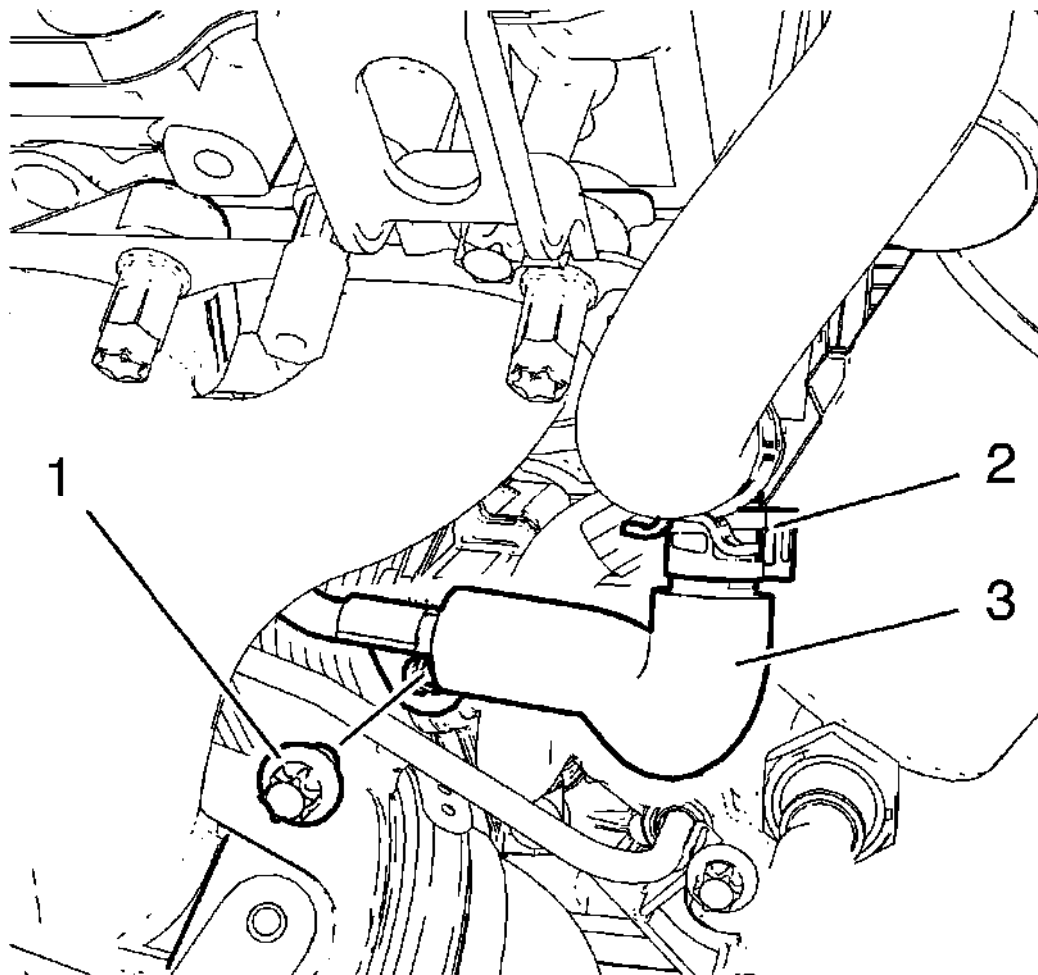


Fig. 58: Turbocharger Coolant Return Pipe Clamp And Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove the turbocharger coolant return pipe bolt (1) from the oil cooler housing.
10. Remove the turbocharger coolant return pipe clamp (2).

NOTE: Do not move the turbocharger coolant return pipe too much. An excessive moving of the turbocharger coolant return pipe could cause leakage.

11. Remove the turbocharger coolant return pipe (3) from the oil cooler inlet pipe.
12. Disconnect the oil pressure indicator switch wiring harness plug.

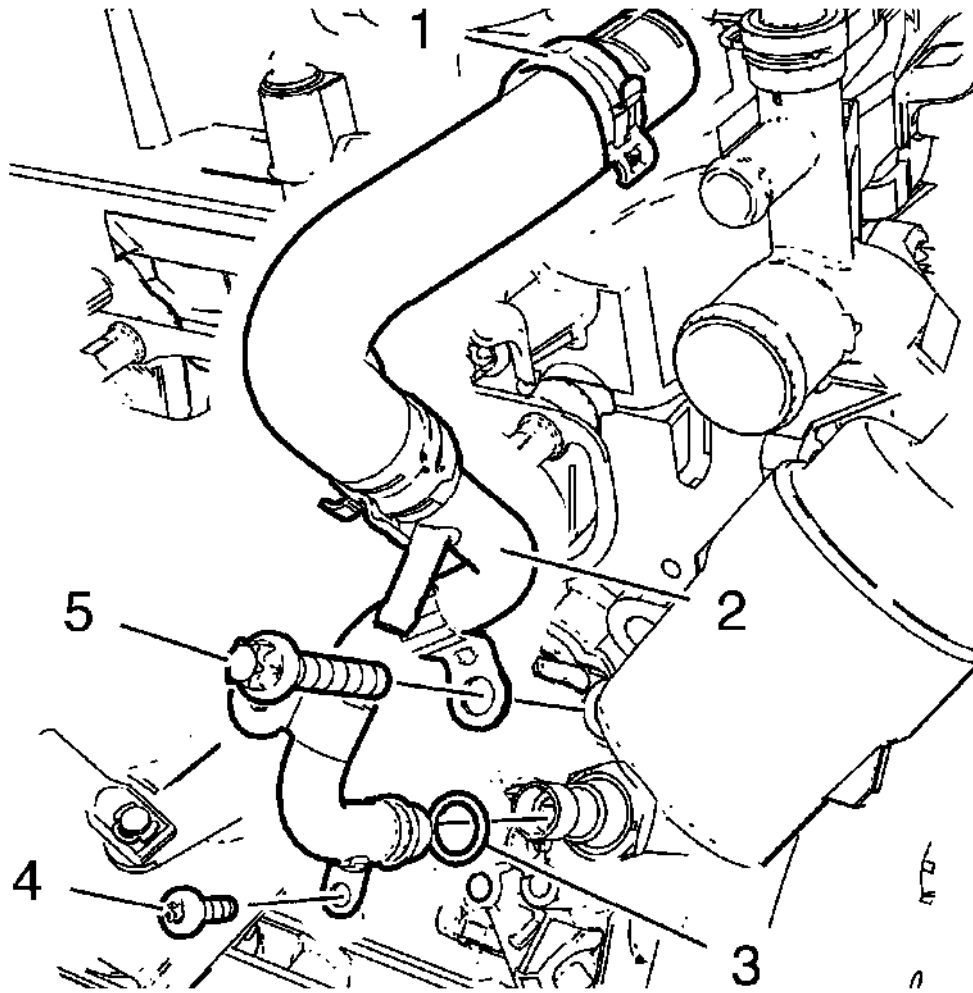


Fig. 59: Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

13. Remove the oil cooler inlet hose clamp (1) and remove the oil cooler inlet hose from the water outlet.
14. Remove the engine oil cooler bolt (5).
15. Remove the engine oil cooler inlet pipe bolt (4).
16. Remove the engine oil cooler inlet pipe (2) and the seal ring (3).
17. Raise vehicle.

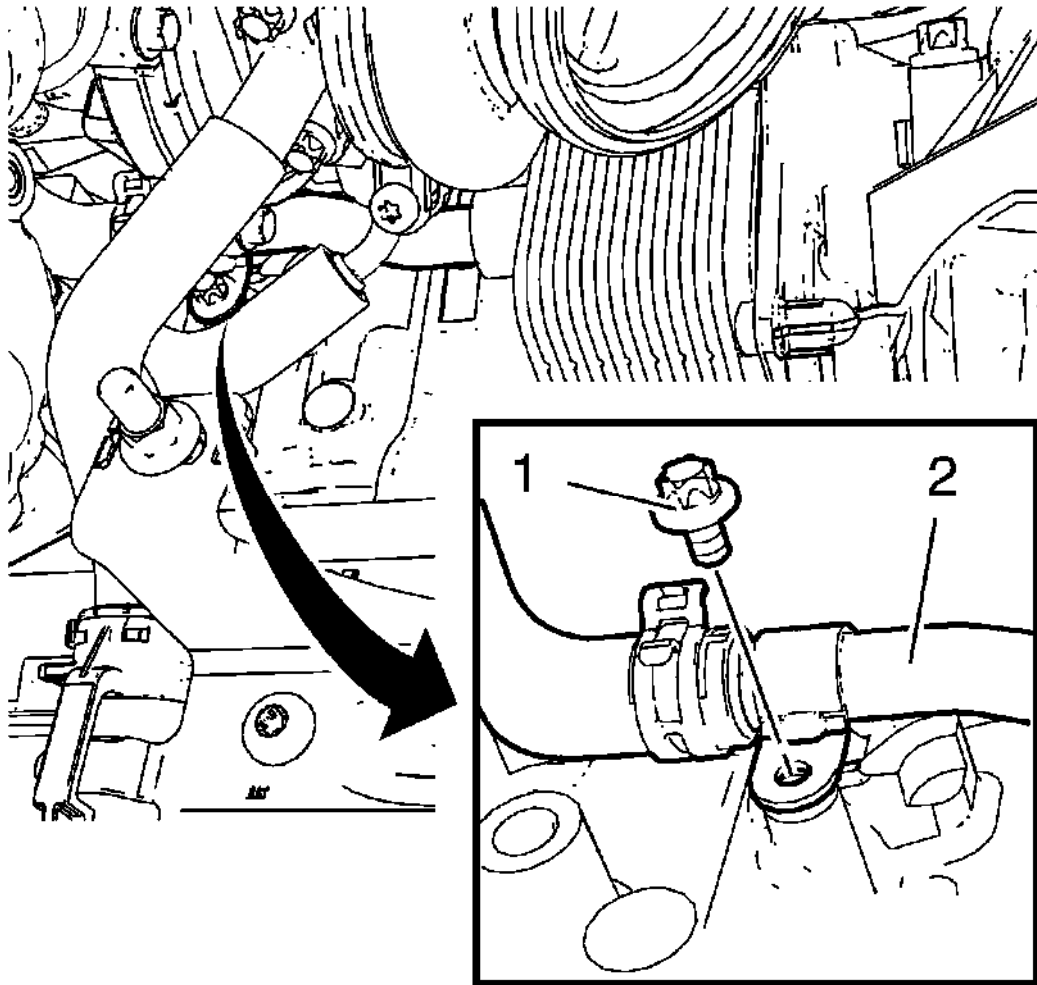


Fig. 60: Oil Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

18. Remove the oil cooler outlet pipe bolt (1) from the engine block.
19. Remove the oil cooler outlet pipe (2) in compound with the oil cooler outlet hose.
20. Lower vehicle.

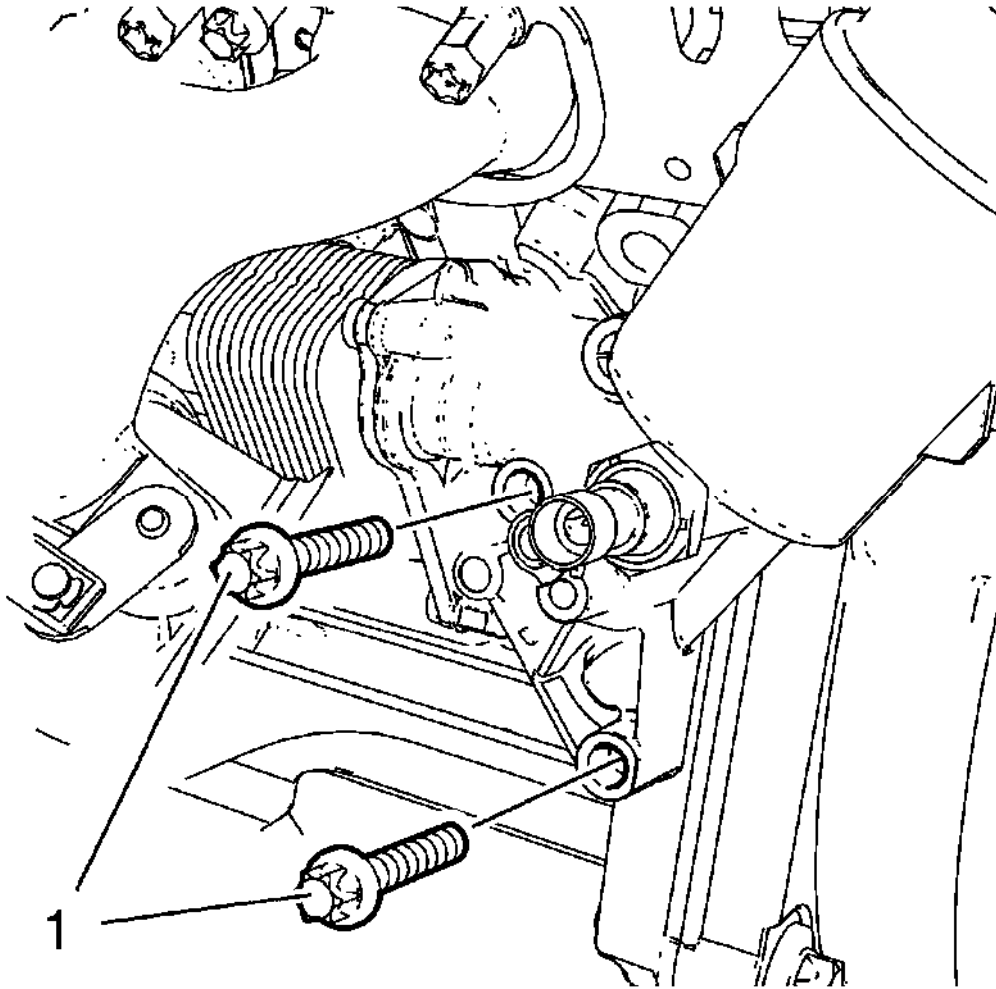


Fig. 61: Oil Cooler Bolts

Courtesy of GENERAL MOTORS COMPANY

21. Remove the 2 oil cooler bolts (1).
22. Raise vehicle.

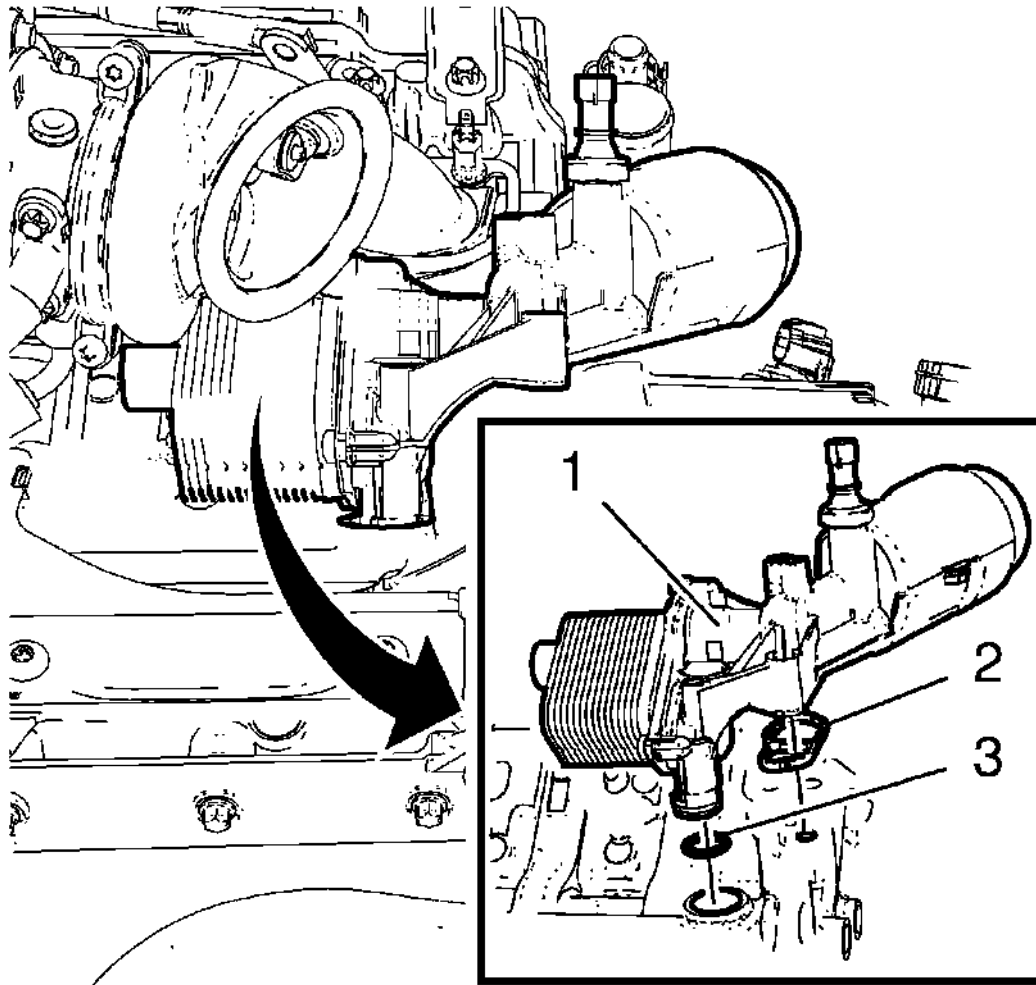


Fig. 62: Oil Cooler And Oil Cooler Gasket
Courtesy of GENERAL MOTORS COMPANY

23. Remove the oil cooler (1) in compound with the oil cooler gasket (2) and the seal ring (3).
24. Remove the oil pressure indicator switch from the oil cooler.

Installation Procedure

1. Install the oil pressure indicator switch to the oil cooler. Use a NEW seal ring.

CAUTION: Refer to Fastener Caution .

2. Tighten the oil pressure indicator switch to 20 N.m (15 lb ft).

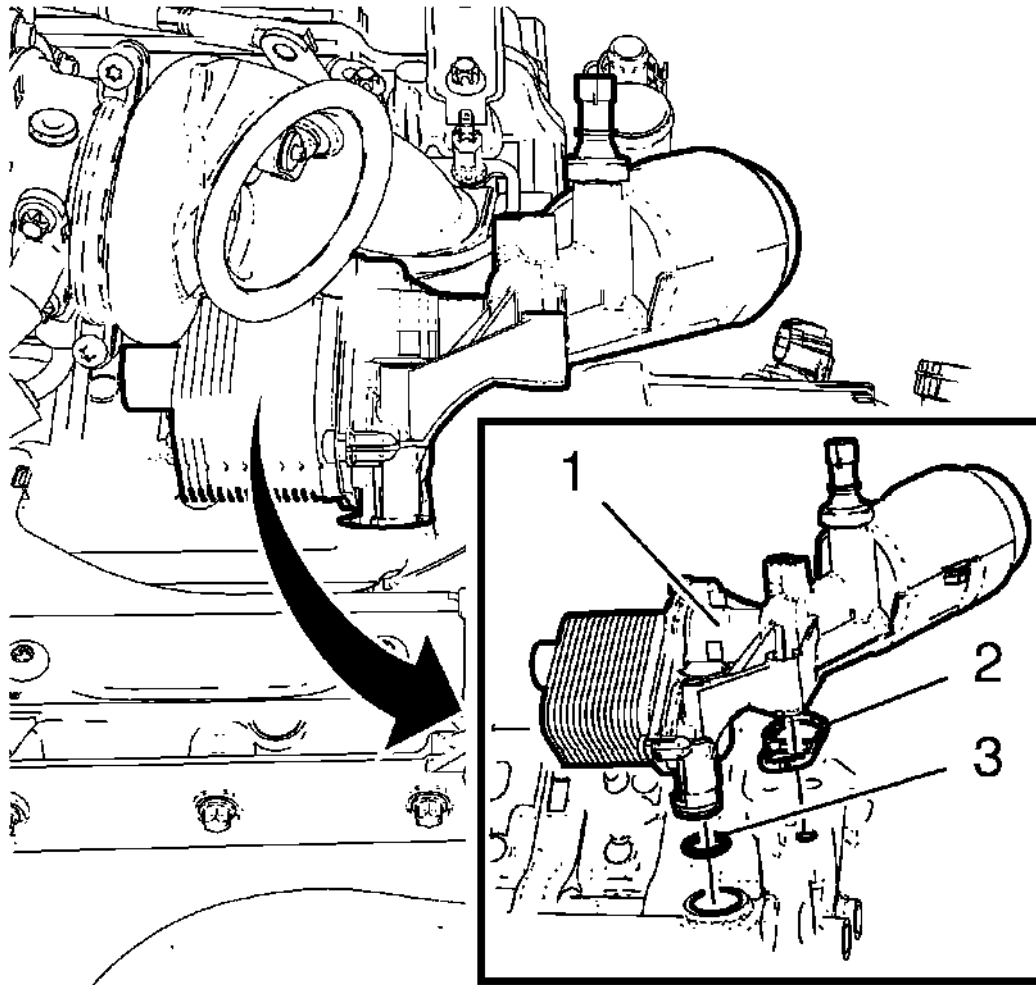


Fig. 63: Oil Cooler And Oil Cooler Gasket
Courtesy of GENERAL MOTORS COMPANY

3. Clean the sealing surfaces.
4. Install the oil cooler (1) in compound with a NEW oil cooler gasket (2) and a NEW seal ring (3).
5. Lower vehicle.

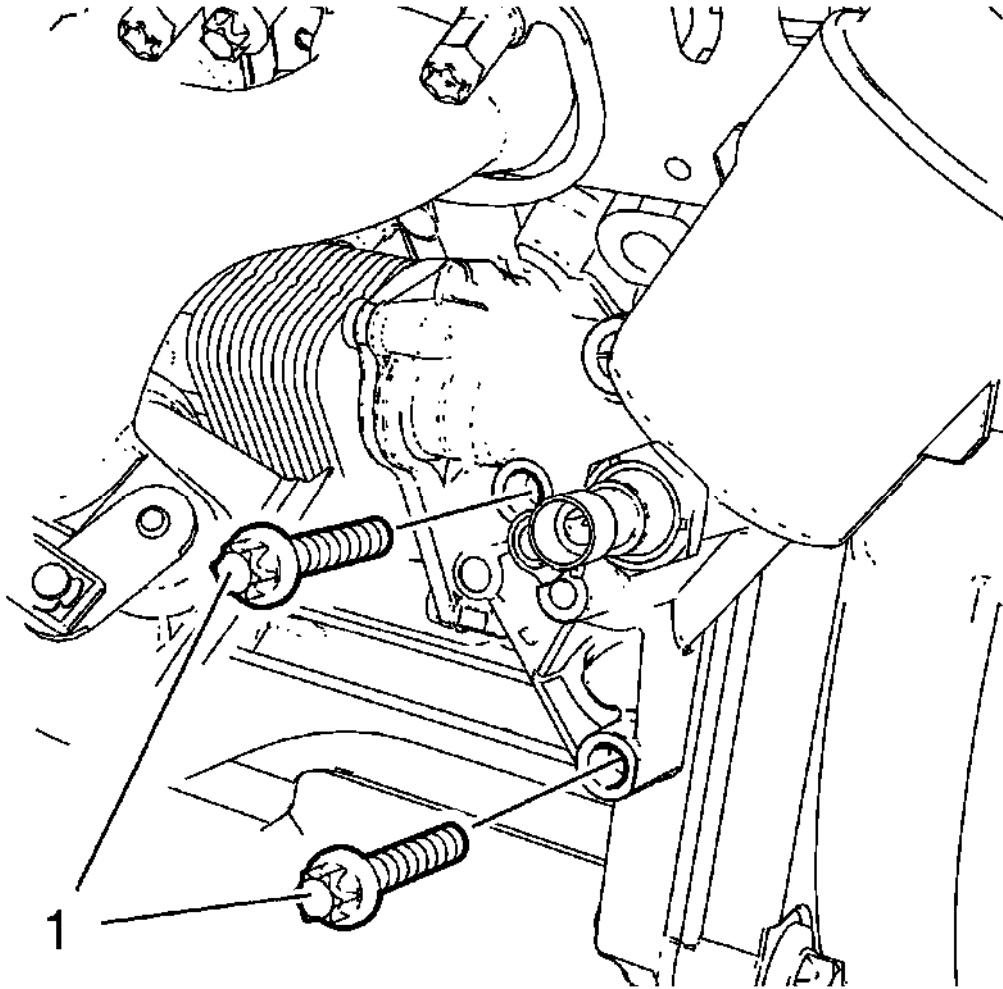


Fig. 64: Oil Cooler Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Install the 2 oil cooler bolts (1) and hand tighten.

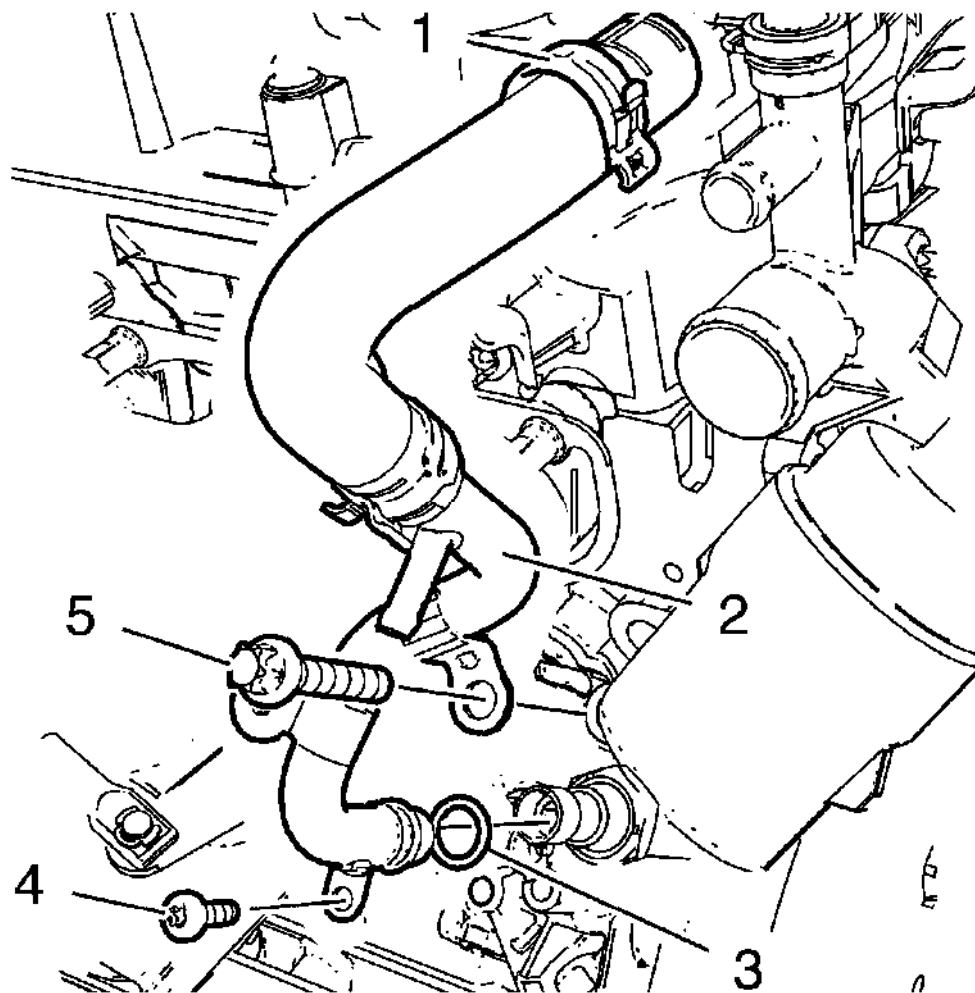


Fig. 65: Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Install the engine oil cooler inlet pipe (2) in compound with a NEW seal ring (3).
8. Install the oil cooler inlet hose to the water outlet and install the oil cooler inlet hose clamp (1).
9. Install the engine oil cooler bolt (5).
10. Install the engine oil cooler inlet pipe bolt (4) and tighten to 10 N.m (89 lb in).
11. Tighten the 3 engine oil cooler bolts to 20 N.m (15 lb ft).

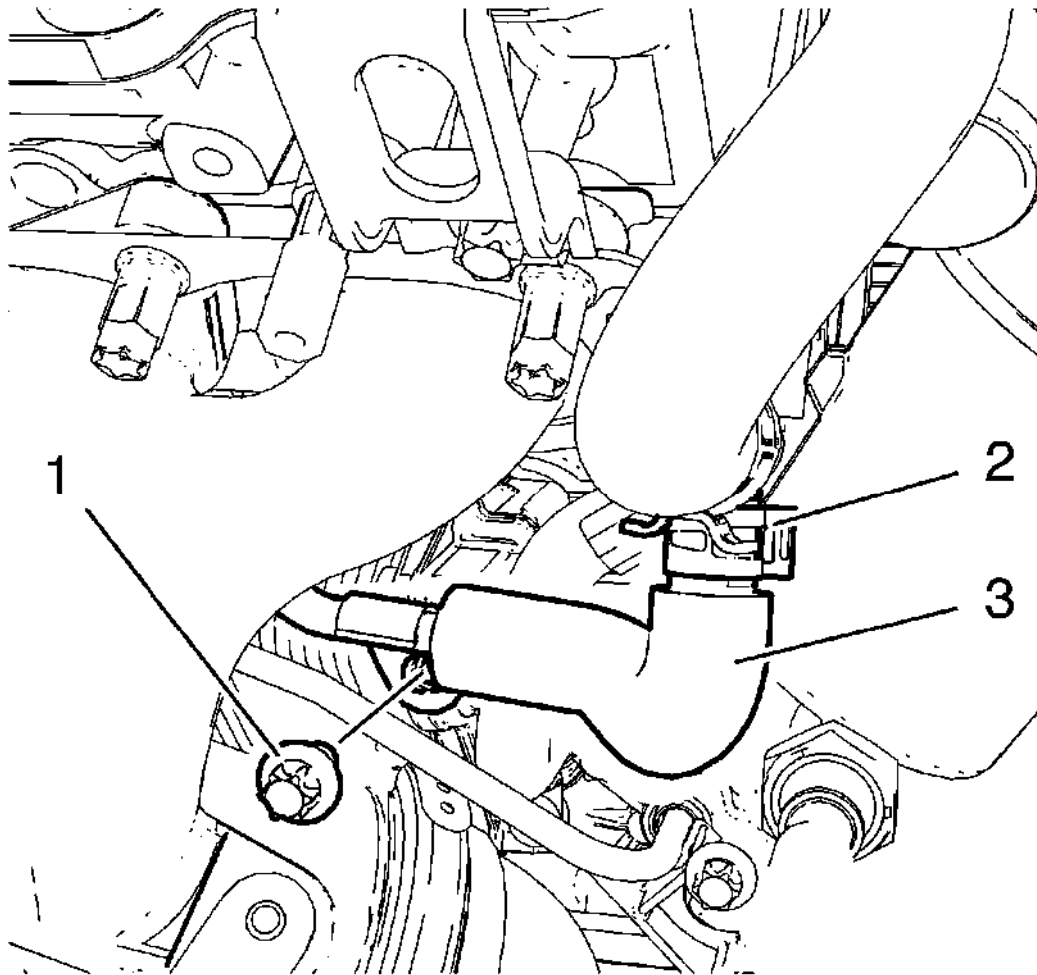


Fig. 66: Turbocharger Coolant Return Pipe Clamp And Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Install the turbocharger coolant return pipe (3) to the oil cooler inlet pipe.
13. Install the turbocharger coolant return pipe clamp (2).
14. Install turbocharger coolant return pipe bolt (1) and tighten to 10 N.m (89 lb in).
15. Connect the oil pressure indicator switch wiring harness plug.
16. Raise vehicle.

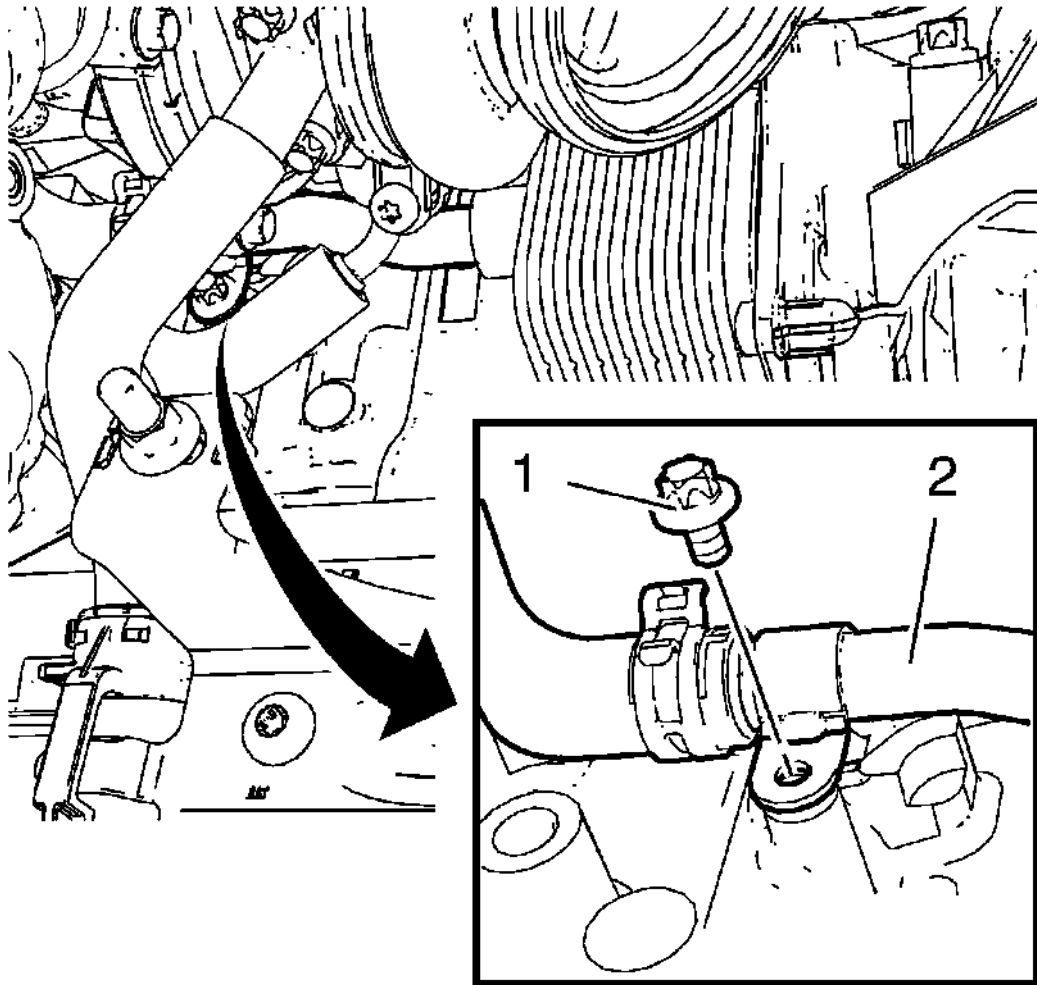


Fig. 67: Oil Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

17. Install the oil cooler outlet pipe (2) in compound with the oil cooler outlet hose to the oil cooler.
18. Install the oil cooler outlet pipe bolt (1) to the engine block and tighten to 10 N.m (89 lb in).
19. Install the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement** .

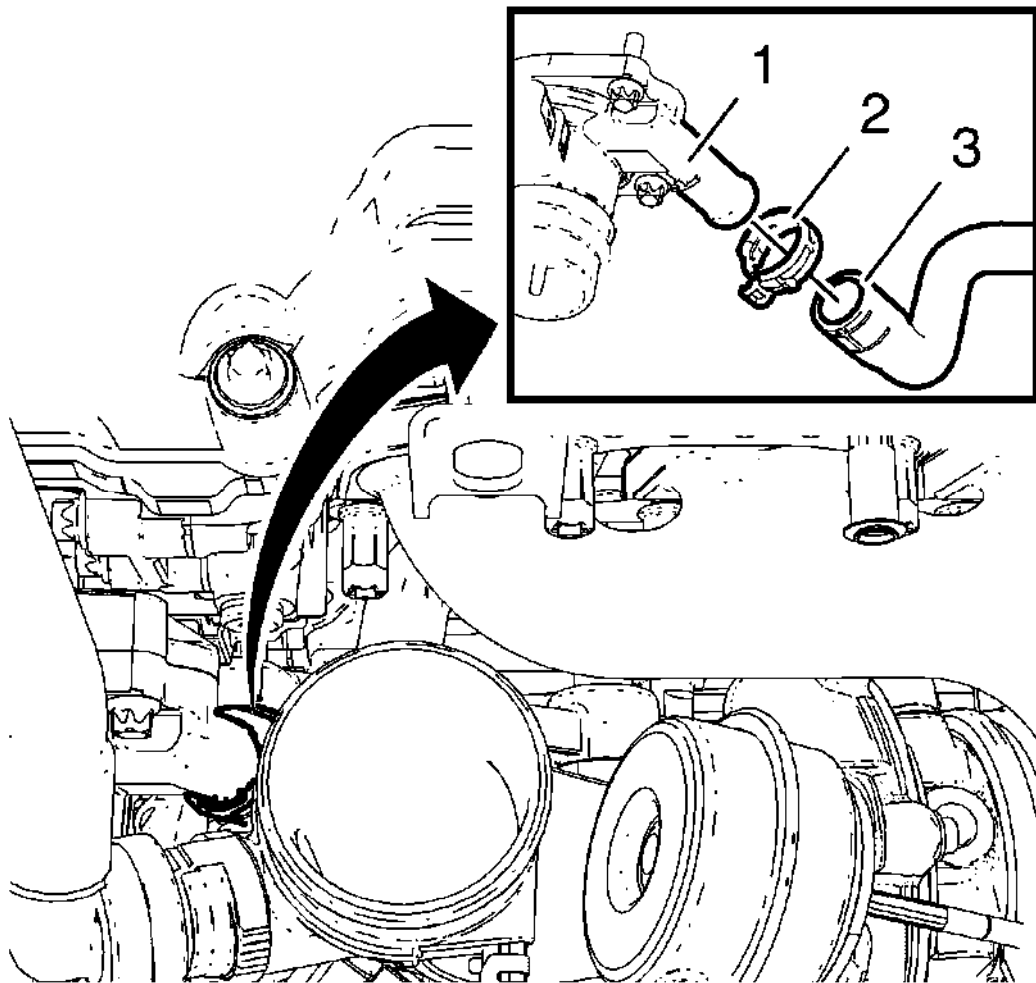


Fig. 68: Thermostat Housing And Oil Cooler Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

20. Install the oil cooler outlet hose (3) to the thermostat housing (1).
21. Install the oil cooler outlet hose clamp (2).
22. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
23. Install the turbocharger oil feed pipe and the exhaust manifold heat shield. Refer to **Turbocharger Oil Feed Pipe Replacement** .
24. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
25. Fill engine coolant. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

ENGINE OIL COOLER REPLACEMENT (1.8L LUW AND LWE)

1. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System**

Draining and Filling (GE-47716 Fill).

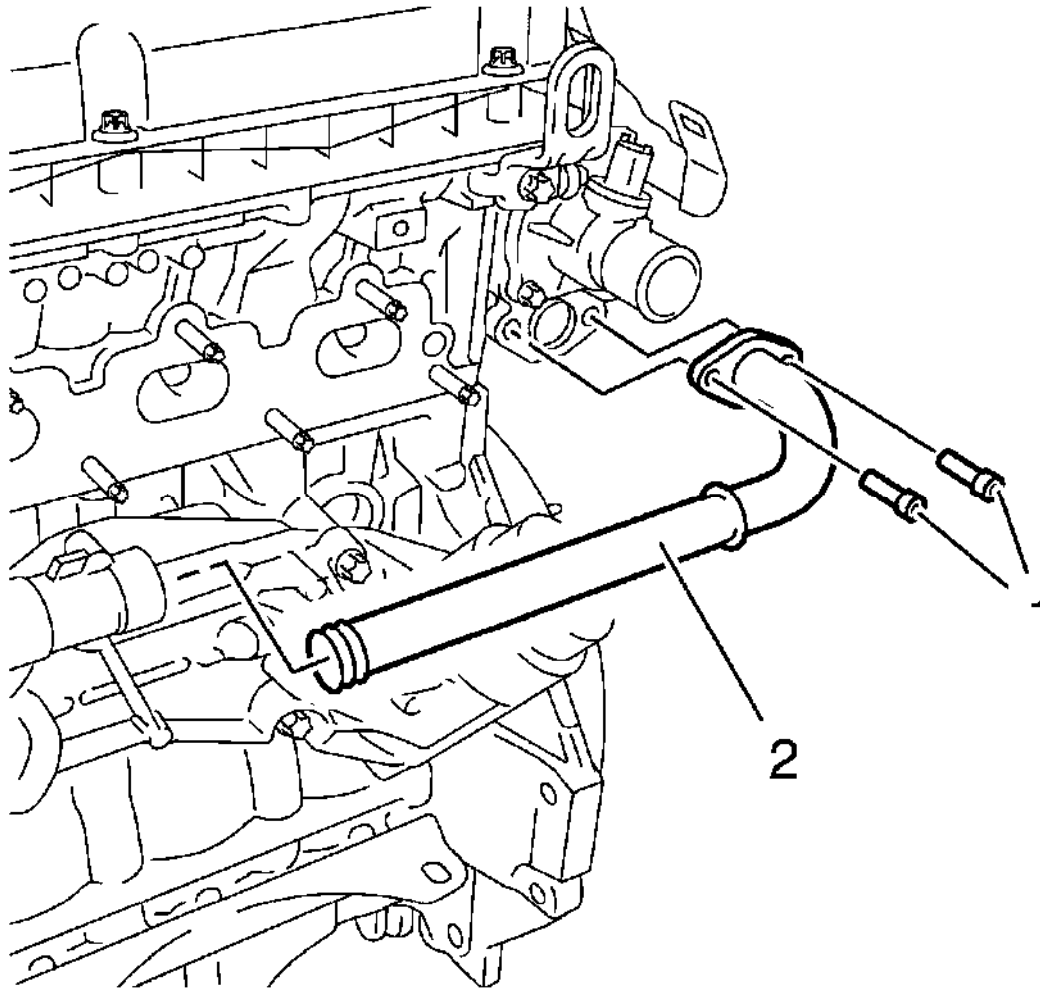


Fig. 69: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 engine oil cooler outlet pipe bolts (1).
4. Remove the engine oil cooler outlet pipe (2) from the engine oil cooler housing and the engine coolant thermostat housing.
5. Remove the 2 engine oil cooler outlet pipe gaskets.

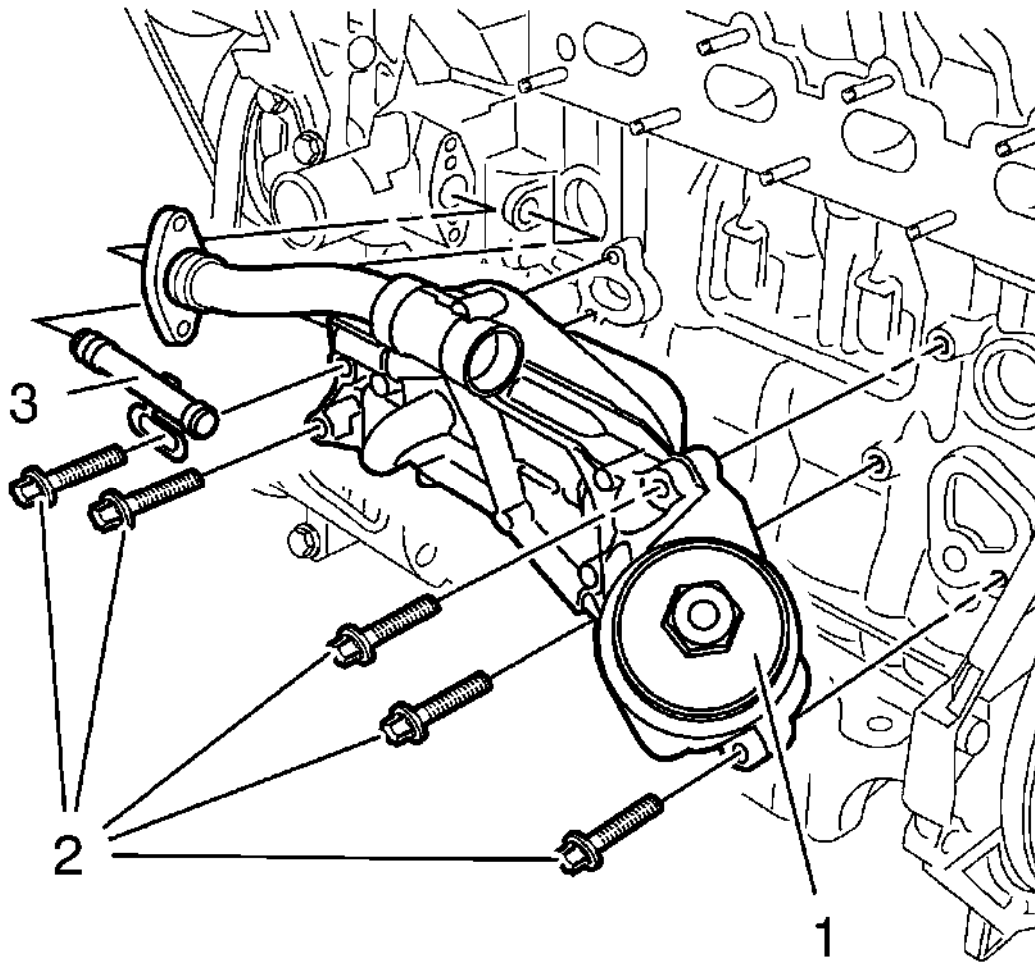


Fig. 70: Identifying Engine Oil Cooler Housing, Bolts And Engine Oil Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 5 engine oil cooler housing bolts (2).
7. Remove the engine oil cooler housing (1).
8. Remove the 2 engine oil cooler housing gaskets.
9. Remove the engine oil cooler inlet pipe (3).
10. Remove the 2 engine oil cooler inlet pipe gaskets.

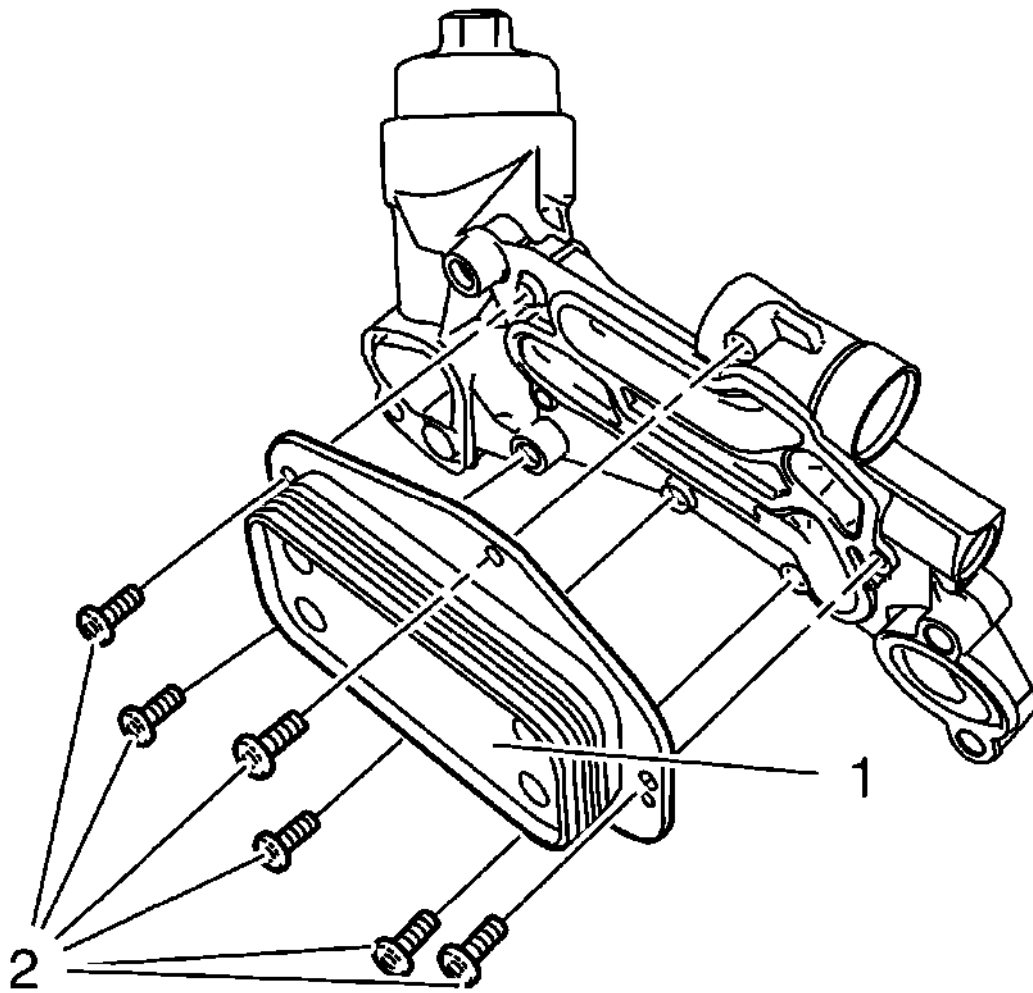


Fig. 71: Identifying Engine Oil Cooler And Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 6 engine oil cooler bolts (2) and the engine oil cooler (1) from the engine oil cooler housing.
12. Remove the engine oil cooler gasket.

Installation Procedure

1. Clean the engine oil cooler to engine oil cooler housing sealing surfaces.
2. Install a NEW engine oil cooler gasket.

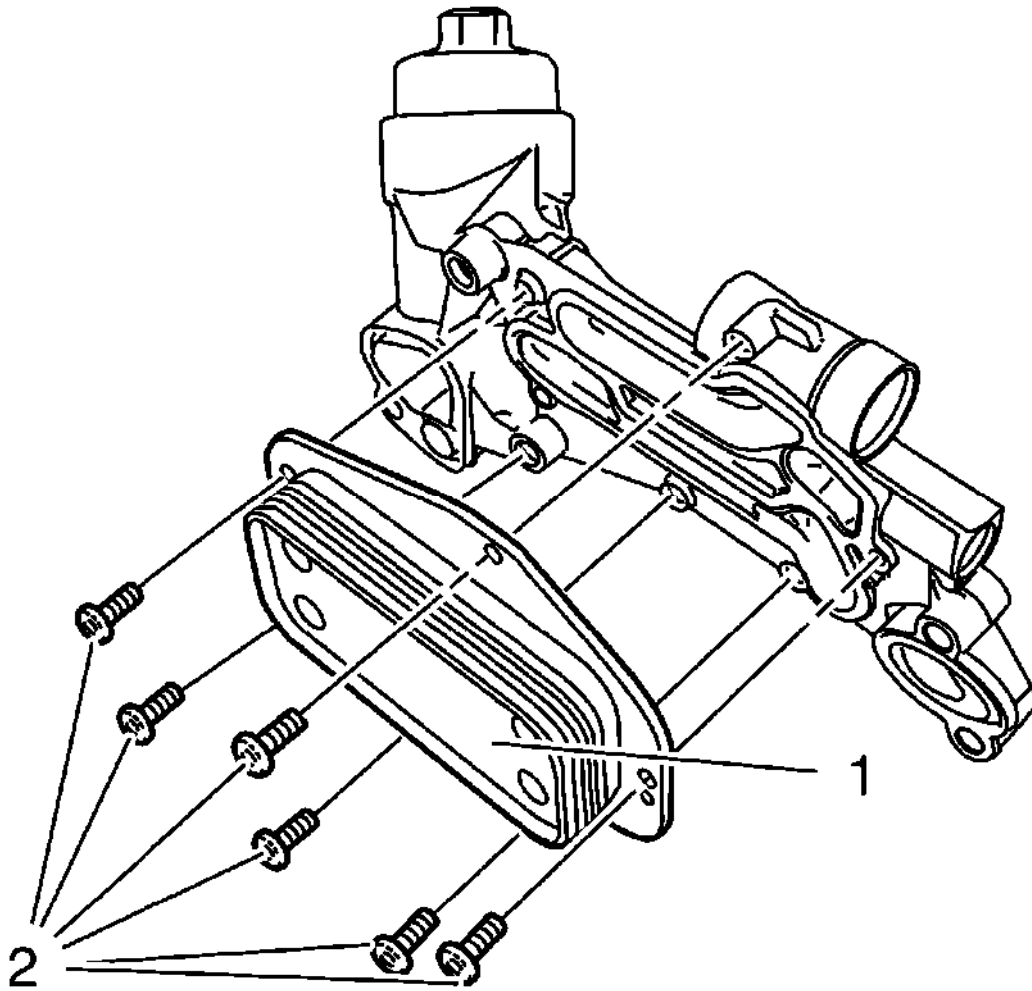


Fig. 72: Identifying Engine Oil Cooler And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the engine oil cooler (1) to the engine oil cooler housing.

CAUTION: Refer to Fastener Caution .

4. Install the 6 engine oil cooler bolts (2) and tighten to 8 N.m (71 lb in).

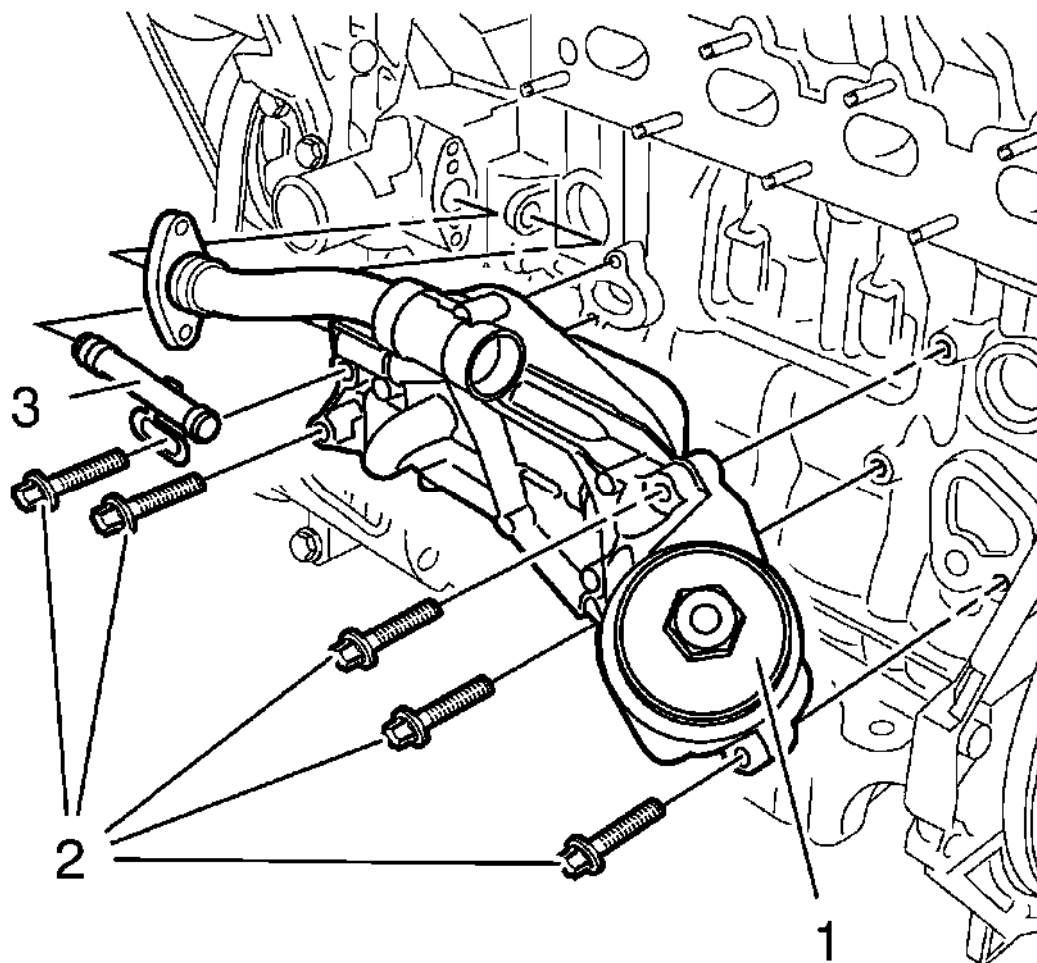


Fig. 73: Identifying Engine Oil Cooler Housing, Bolts And Engine Oil Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

5. Install the 2 NEW engine oil cooler inlet pipe gaskets.
6. Install the engine oil cooler inlet pipe (3).
7. Install the 2 NEW engine oil cooler housing gaskets.
8. Install the engine oil cooler housing (1).
9. Install the 5 engine oil cooler housing bolts (2) and tighten to 25 N.m (19 lb ft).

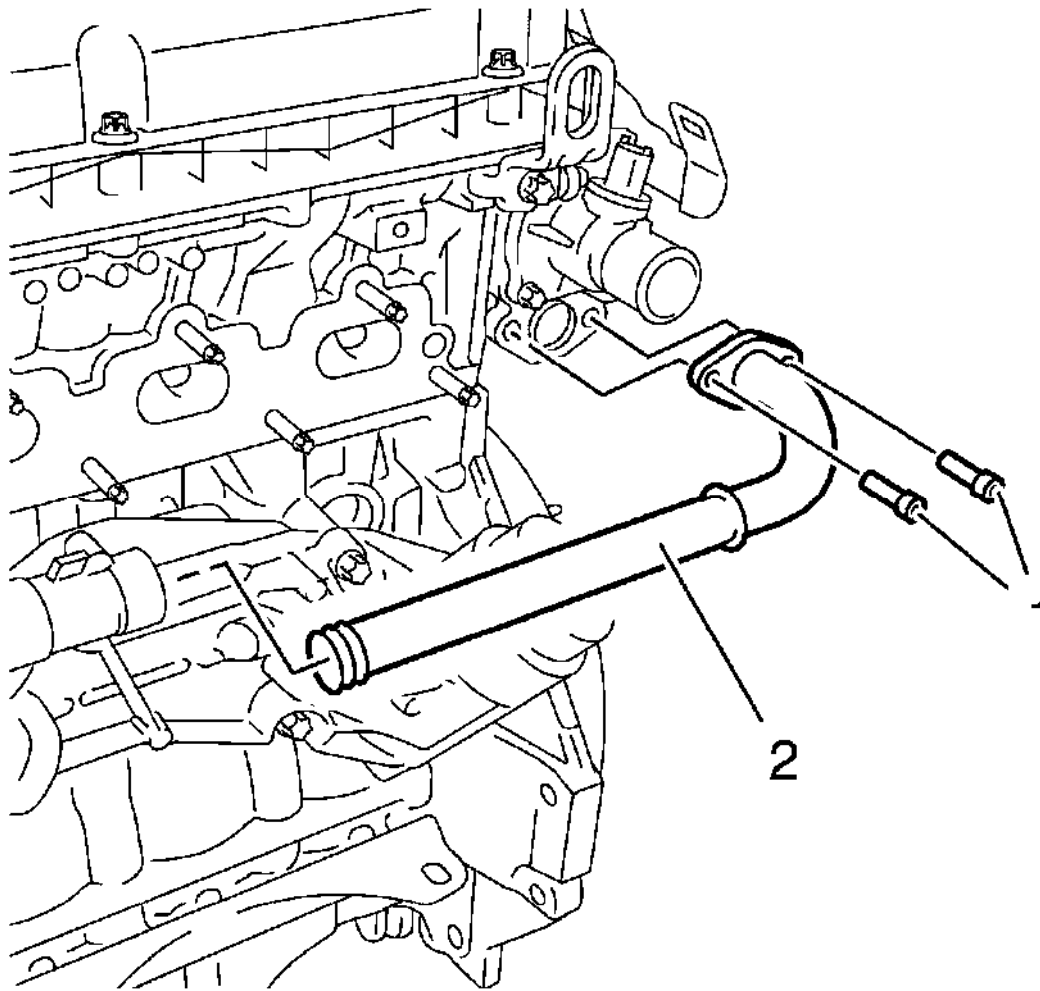


Fig. 74: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Clean the engine oil cooler outlet pipe sealing surfaces.
11. Install the 2 NEW engine oil cooler outlet pipe gaskets.
12. Install the engine oil cooler outlet pipe (2) to the engine oil cooler housing and the engine coolant thermostat housing.
13. Install the 2 engine oil cooler outlet pipe bolts (1) and tighten to 8 N.m (71 lb in).
14. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
15. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement**.

ENGINE OIL COOLER OUTLET HOSE REPLACEMENT

Removal Procedure

1. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
2. Drain engine coolant. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**
3. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**

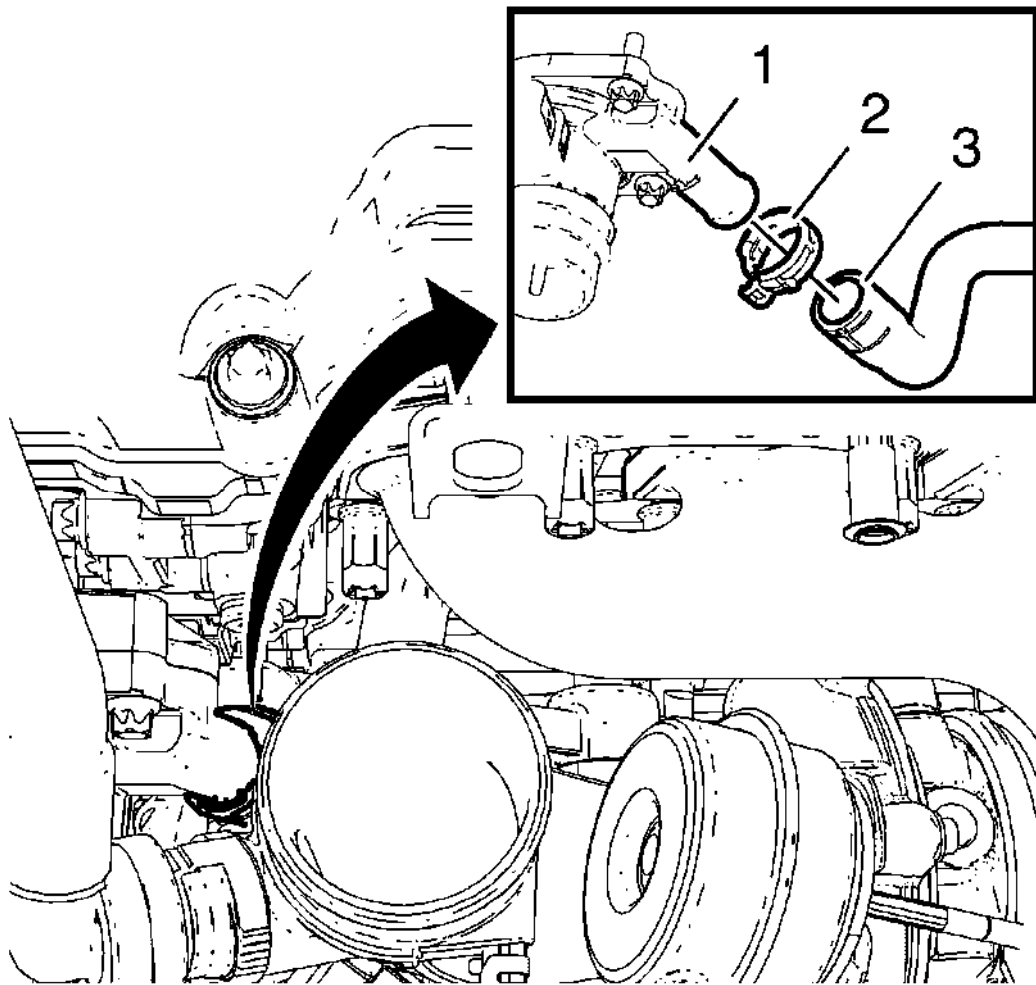


Fig. 75: Thermostat Housing And Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil cooler outlet hose clamp (2).
5. Remove the oil cooler outlet hose (3) from the thermostat housing (1).
6. Remove the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement**

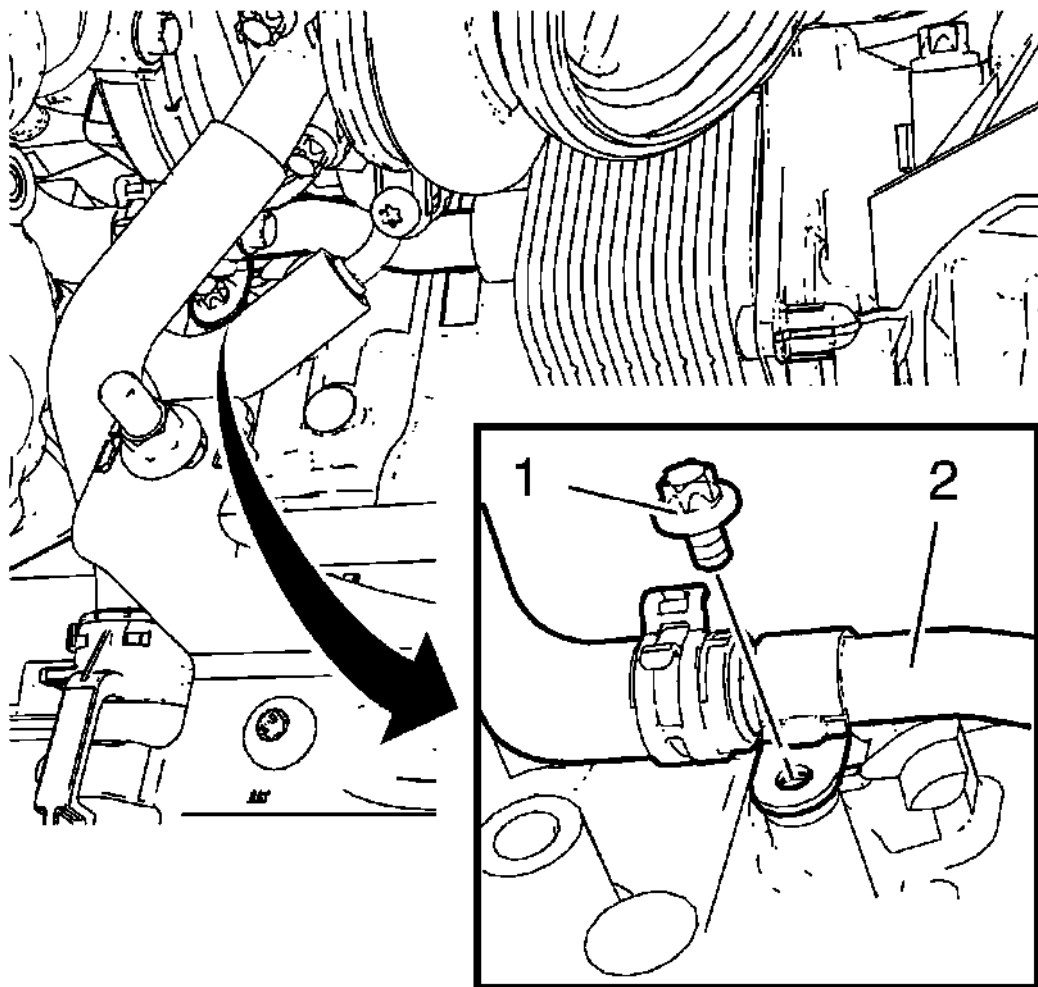


Fig. 76: Oil Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Remove the oil cooler outlet pipe bolt (1) from the engine block.
8. Remove the oil cooler outlet pipe (2) in compound with the oil cooler outlet hose.
9. Remove the oil cooler outlet hose clamp.
10. Remove the oil cooler outlet hose from the oil cooler outlet pipe.

Installation Procedure

1. Install the oil cooler outlet hose to the oil cooler outlet pipe.
2. Install the oil cooler outlet hose clamp.

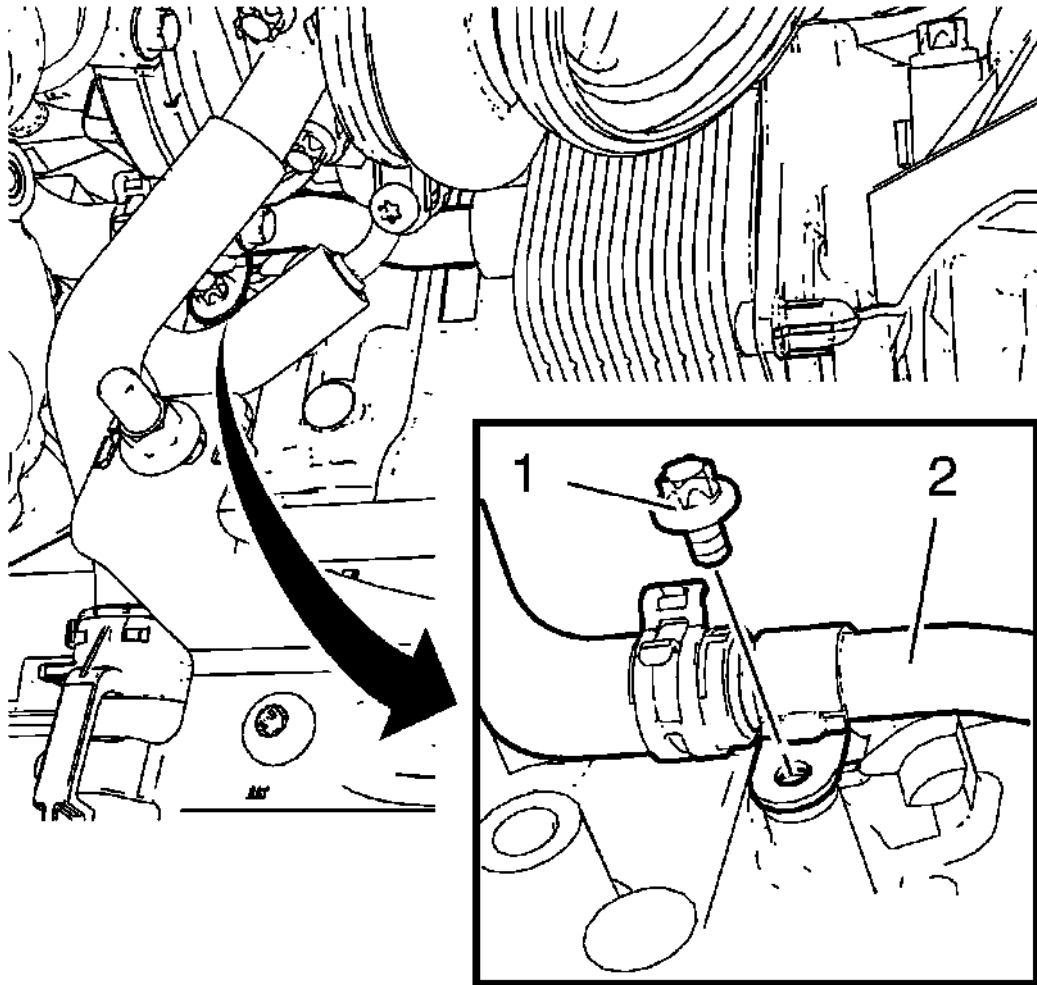


Fig. 77: Oil Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

3. Install the oil cooler outlet pipe (2) in compound with the oil cooler outlet hose to the oil cooler.
4. Install the oil cooler outlet pipe bolt (1) to the engine block and tighten to 10 N.m (89 lb in).
5. Install the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement**

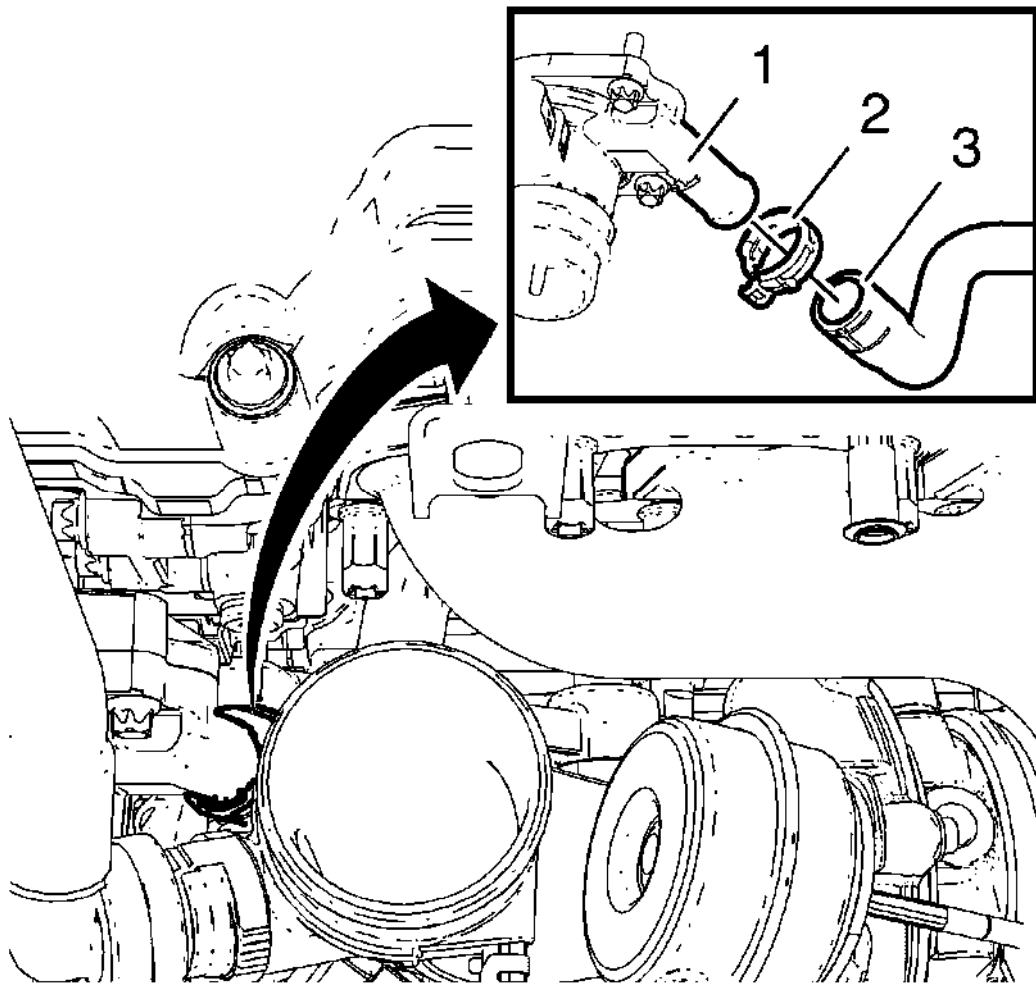


Fig. 78: Thermostat Housing And Oil Cooler Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Install the oil cooler outlet hose (3) to the thermostat housing (1).
7. Install the oil cooler outlet hose clamp (2).
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**
9. Install the turbocharger oil feed pipe and the exhaust manifold heat shield. Refer to **Turbocharger Oil Feed Pipe Replacement**
10. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
11. Fill engine coolant. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**

ENGINE OIL COOLER INLET HOSE REPLACEMENT

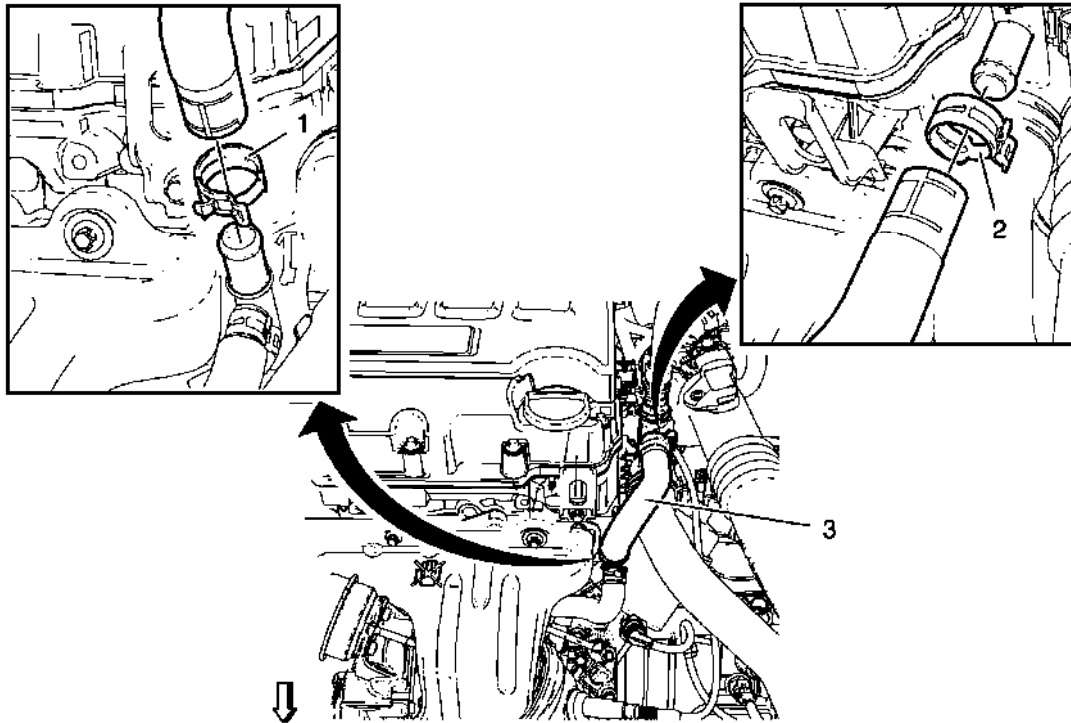


Fig. 79: Identifying Engine Oil Cooler Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

Engine Oil Cooler Inlet Hose Replacement

Callout	Component Name
Preliminary Procedure 1. Open the hood. 2. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).	
1	Oil Cooler Inlet Hose Clamp Procedure 1. Place a drain pan below the vehicle. 2. Remove / install engine coolant air bleed hose clamp.
2	Oil Cooler Inlet Hose Clamp Procedure 1. Place a drain pan below the vehicle. 2. Remove / install engine coolant air bleed hose clamp.
3	Oil Cooler Inlet Hose

ENGINE OIL COOLER INLET PIPE REPLACEMENT (1.4L LUV)**Removal Procedure**

1. Drain coolant fluid. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
2. Remove the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement**.
3. Remove the engine oil cooler inlet hose from the engine oil cooler inlet pipe. Refer to **Engine Oil Cooler Inlet Hose Replacement**.

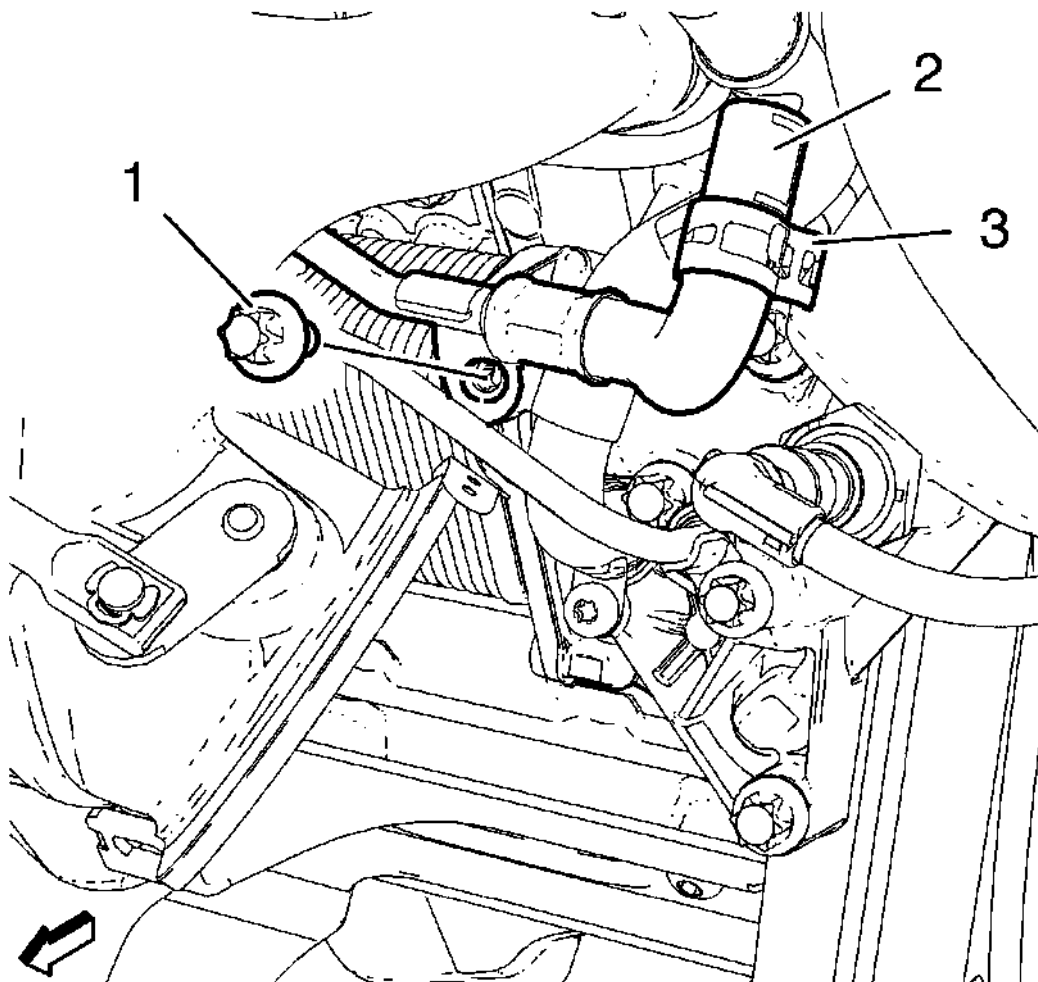


Fig. 80: Turbocharger Coolant Return Pipe Hose, Clamp And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the turbocharger coolant return pipe hose clamp (3).
5. Remove the turbocharger coolant return pipe hose (2) from the engine oil cooler inlet pipe.

NOTE: Do not move the turbocharger coolant return pipe too much. An excessive moving of the turbocharger coolant return pipe could cause leakage.

6. Remove the turbocharger coolant return pipe bolt (1).

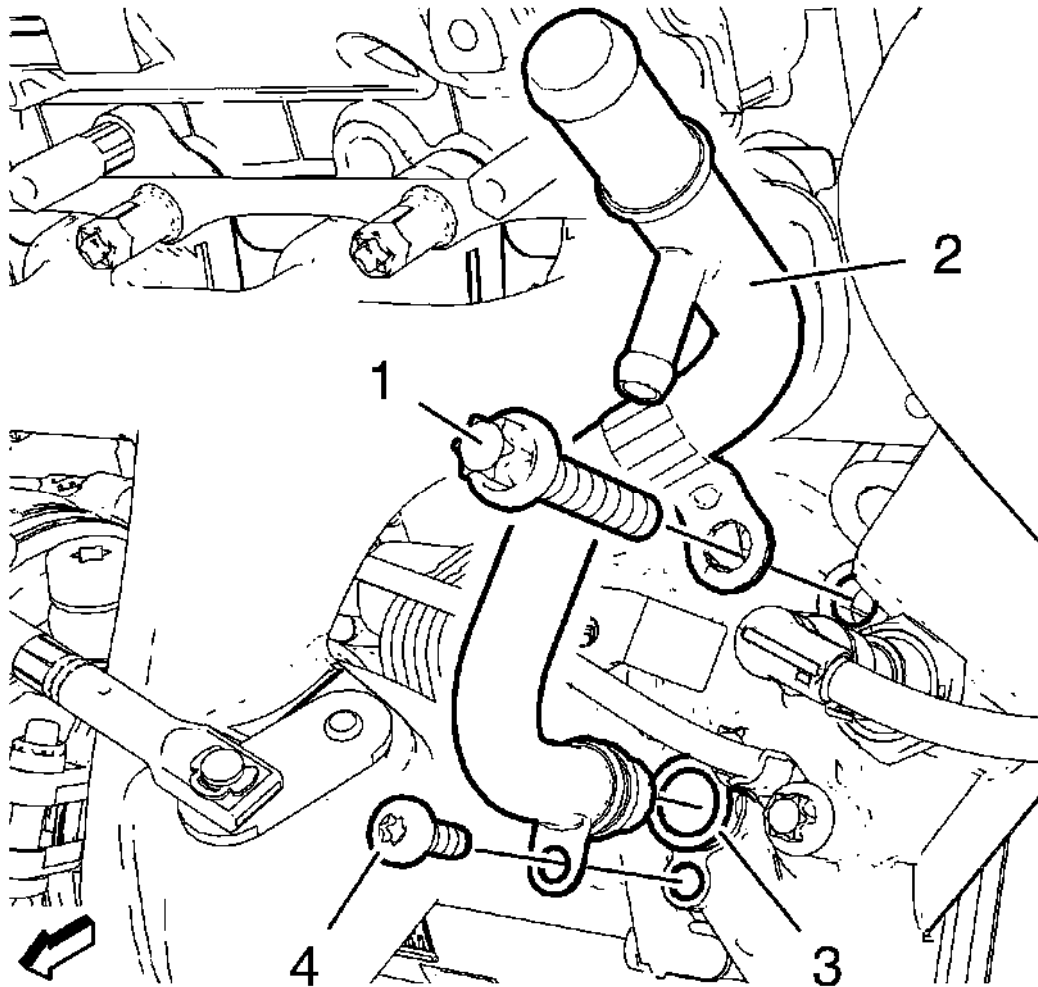


Fig. 81: Identifying Engine Oil Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine oil cooler bolt (1).
8. Remove the engine oil cooler inlet pipe bolt (4).
9. Remove the engine oil cooler inlet pipe (2) and the seal ring (3).

Installation Procedure

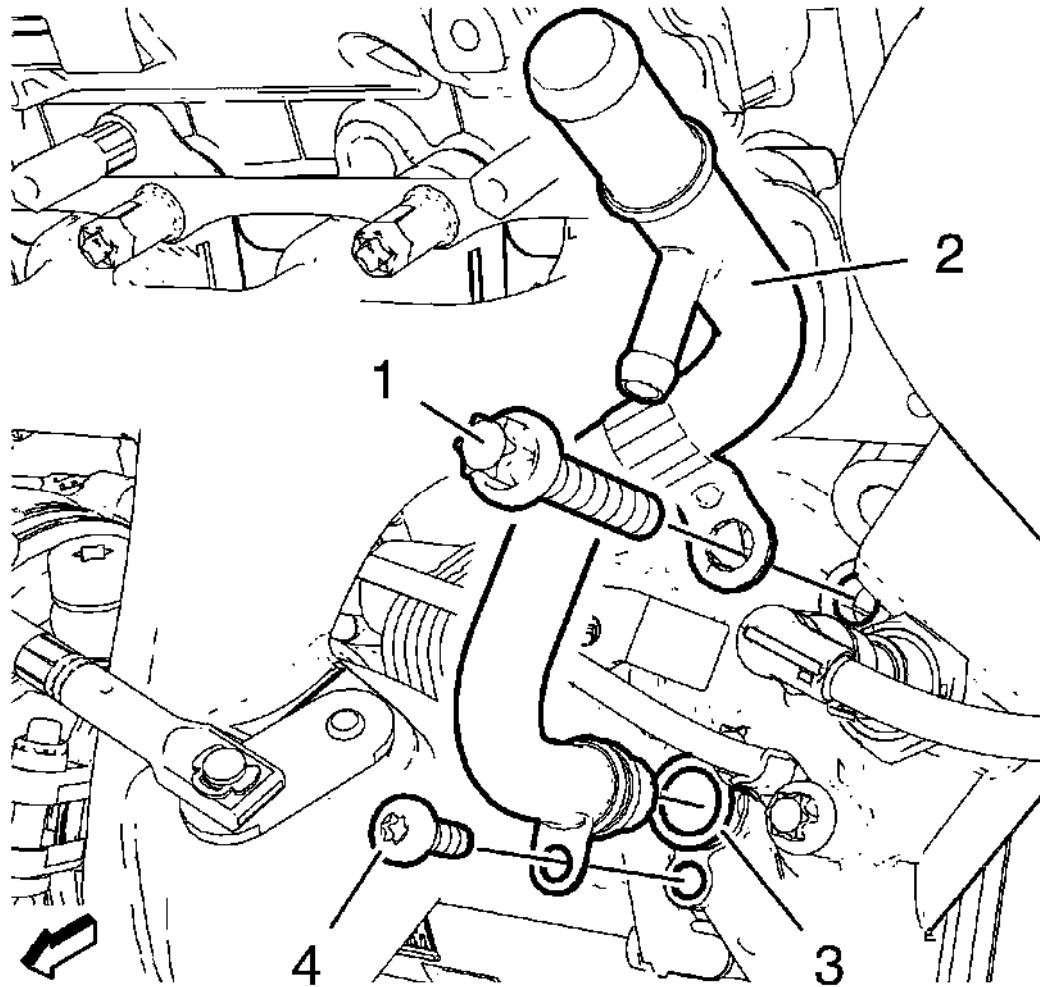


Fig. 82: Identifying Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Install the engine oil cooler inlet pipe (2) in compound with a NEW seal ring (3).
2. Install the engine oil cooler bolt (1).

CAUTION: Refer to Fastener Caution .

3. Install the engine oil cooler inlet pipe bolt (4) and tighten to 10 N.m (89 lb in).
4. Tighten the engine oil cooler bolt (1) to 20 N.m (15 lb ft).

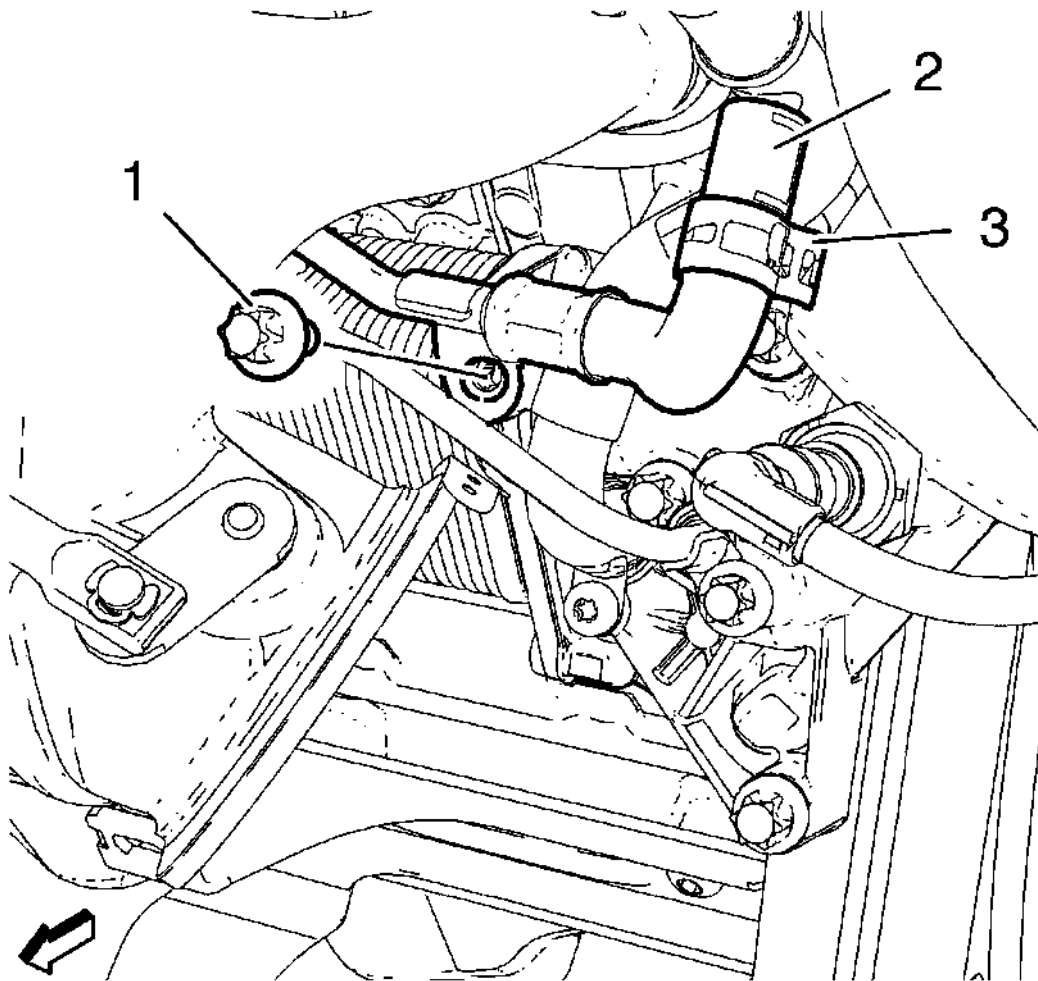


Fig. 83: Turbocharger Coolant Return Pipe Hose, Clamp And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install the turbocharger coolant return pipe hose (2) to the engine oil cooler inlet pipe.
6. Install the turbocharger coolant return pipe hose clamp (3).
7. Install turbocharger coolant return pipe bolt (1) and tighten to 10 N.m (89 lb in).
8. Install the engine oil cooler inlet hose to the engine oil cooler inlet pipe. Refer to **Engine Oil Cooler Inlet Hose Replacement**.
9. Install the warm up three way catalytic converter. Refer to **Warm Up Three-Way Catalytic Converter Replacement**.
10. Fill up coolant fluid. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

ENGINE OIL COOLER INLET PIPE REPLACEMENT (1.8L LUW AND LWE)

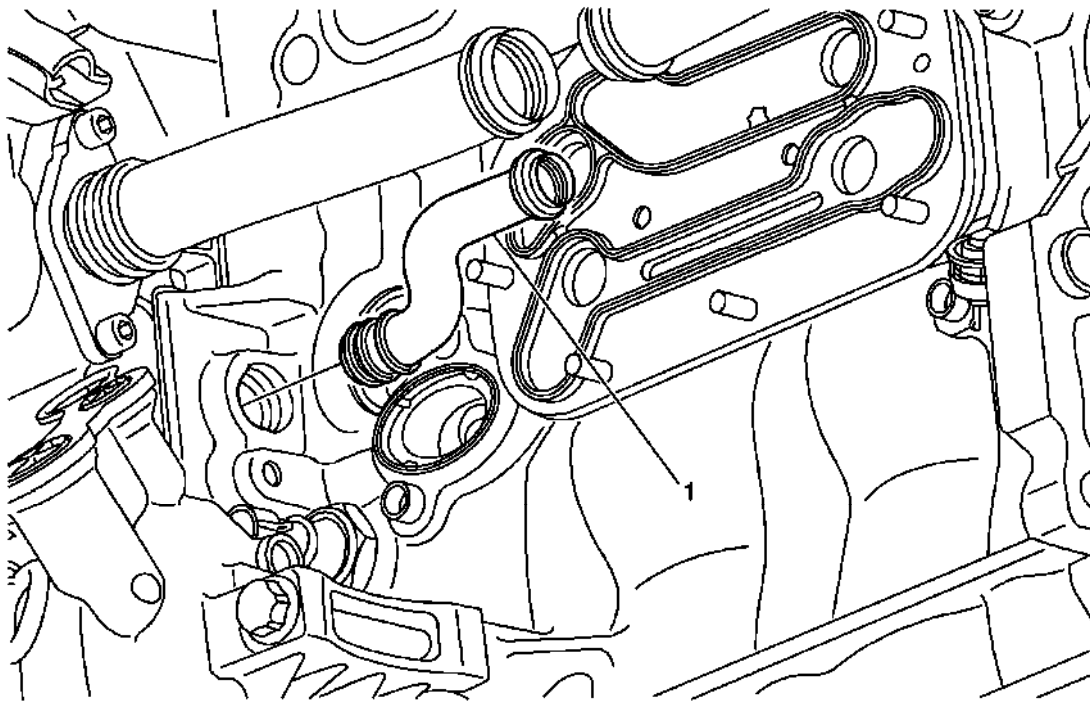


Fig. 84: Identifying Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

Engine Oil Cooler Inlet Pipe Replacement (1.8L LUW and LWE)

Callout	Component Name
Preliminary Procedure	
Remove the engine oil cooler housing. Refer to <u>Engine Oil Cooler Replacement (1.8L LUW and LWE)</u> , <u>Engine Oil Cooler Replacement (1.4L LUV)</u> .	
1	Engine Oil Cooler Inlet Pipe

ENGINE OIL COOLER OUTLET PIPE REPLACEMENT

Removal Procedure

1. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

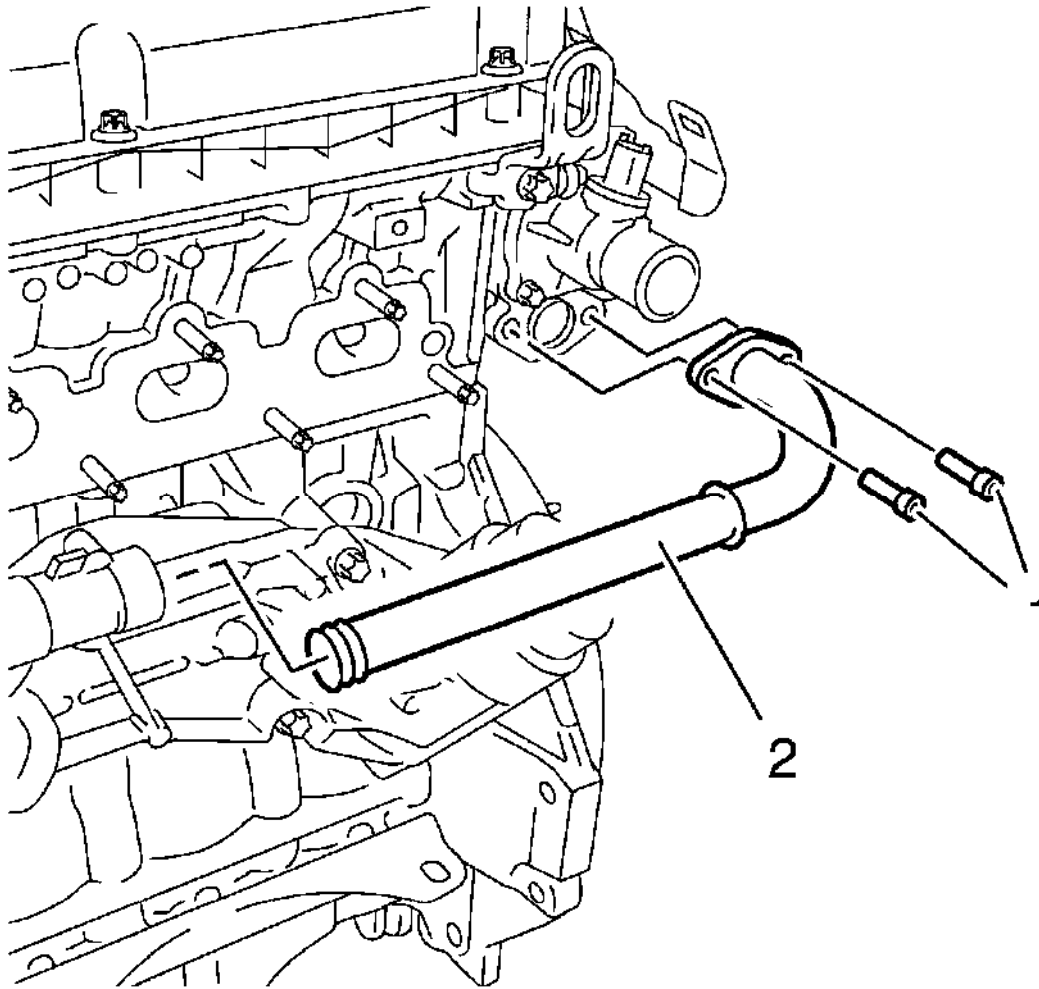


Fig. 85: Identifying Engine Oil Cooler Outlet Pipe And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 engine oil cooler outlet pipe bolts (1).
4. Remove the engine oil cooler outlet pipe (2) from the engine oil cooler housing and the engine coolant thermostat housing.
5. Remove the 2 engine oil cooler outlet pipe gaskets.

Installation Procedure

1. Clean the engine oil cooler outlet pipe sealing surfaces.
2. Install the 2 NEW engine oil cooler outlet pipe gaskets.

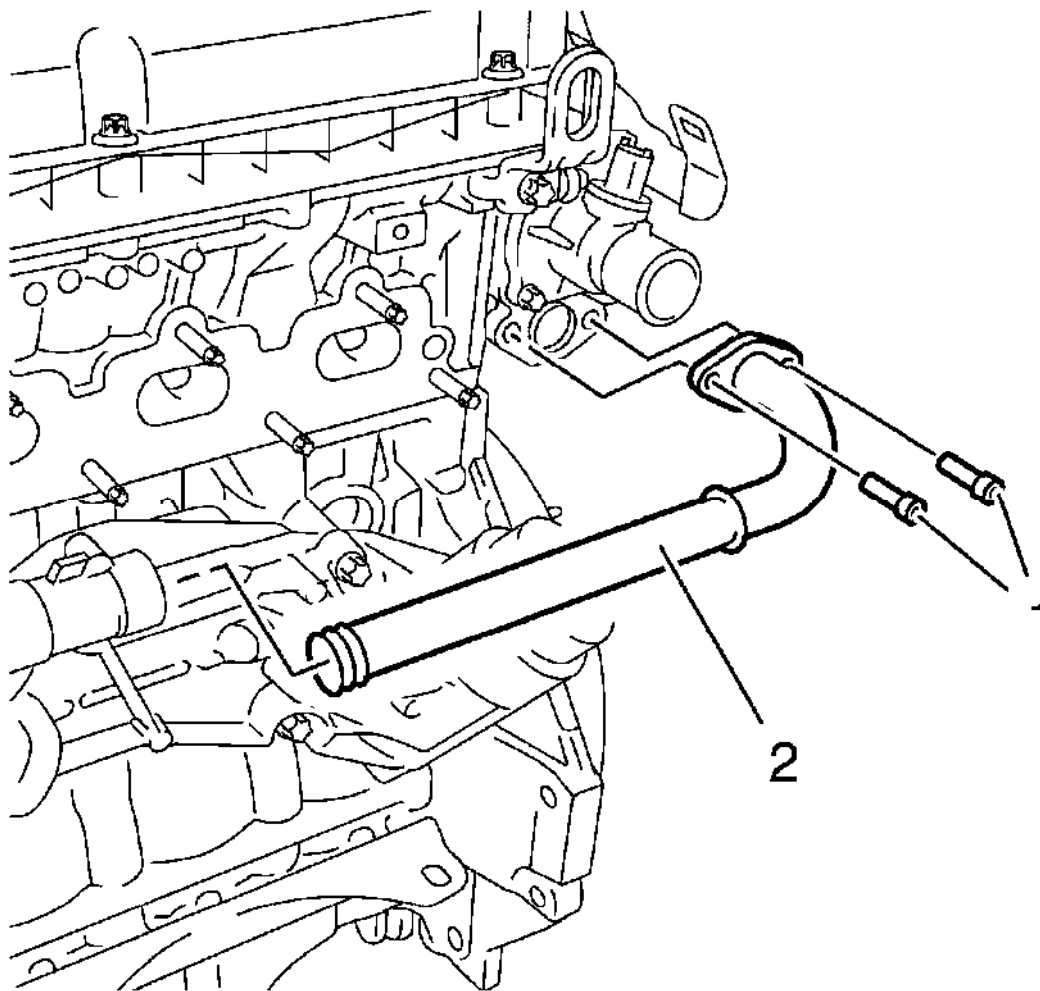


Fig. 86: Identifying Engine Oil Cooler Outlet Pipe And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install the engine oil cooler outlet pipe (2) to the engine oil cooler housing and the engine coolant thermostat housing.

CAUTION: Refer to Fastener Caution .

4. Install the 2 engine oil cooler outlet pipe bolts (1) and tighten to 8 N.m (71 lb in).
5. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
6. Install the exhaust manifold. Refer to Exhaust Manifold Replacement .

ENGINE COOLANT FAN REPLACEMENT

Removal Procedure

NOTE: It is not necessary to remove the hood latches and wiring clips from the front end upper tie bar for this procedure.

1. Remove and reposition the front end upper tie bar rearward. Refer to **Front End Upper Tie Bar Replacement** .
2. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the radiator upper air seal.
4. Remove the left and right side radiator air baffles.
5. Position the radiator assembly forward for engine coolant fan shroud access.

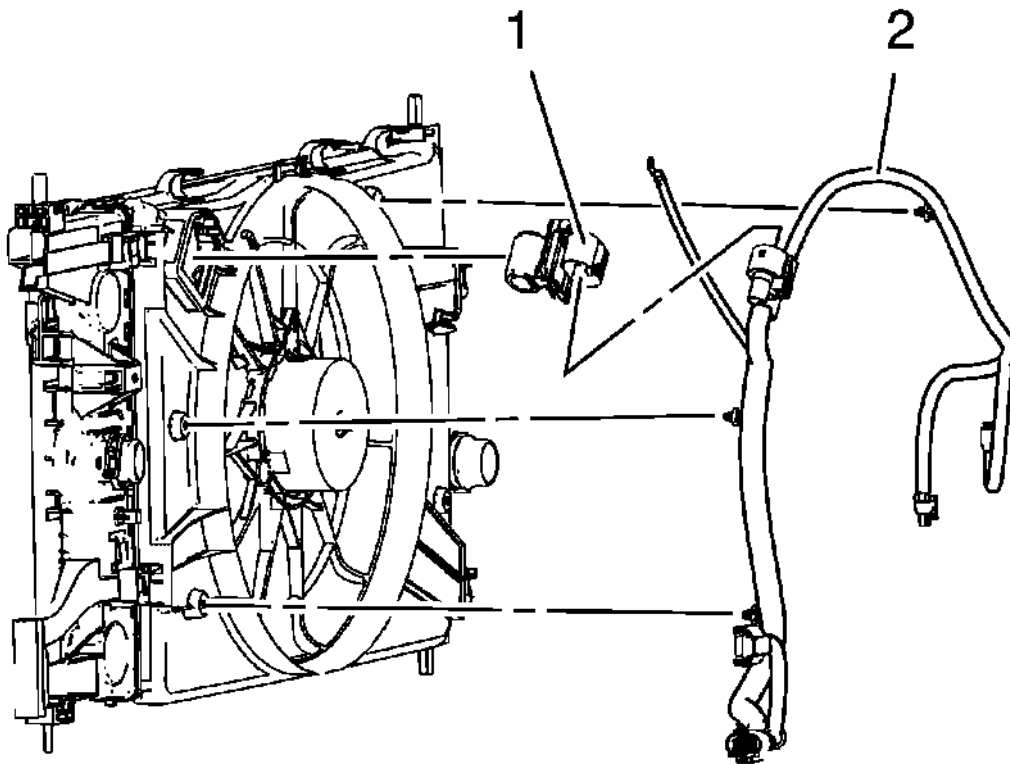


Fig. 87: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the engine coolant fan resistor wiring harness connector (1) and remove the ground cable nut.

7. Remove the wiring harness (3) and clips.

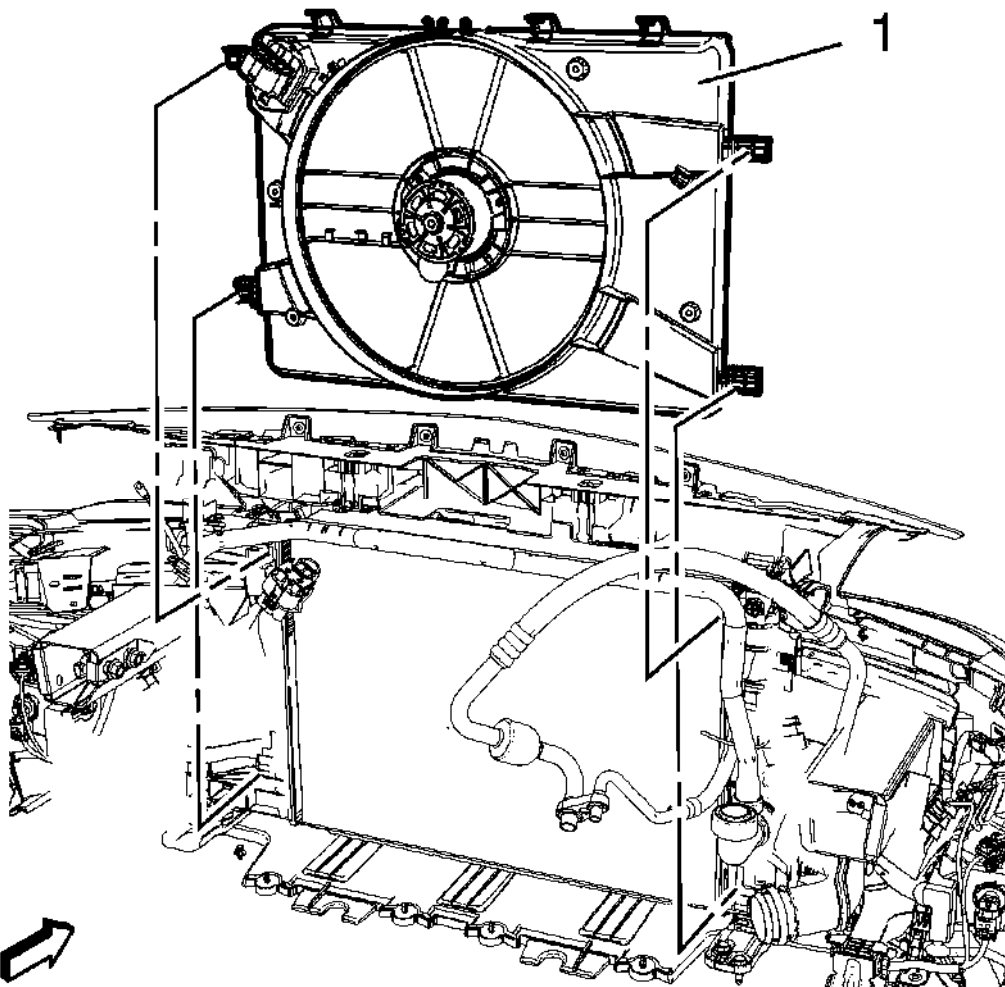


Fig. 88: Identifying Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

8. Unclip the engine coolant fan shroud (1) from the four mounting points shown.
9. Remove the engine coolant fan shroud (1).
 1. Slide the engine coolant fan shroud (1) toward the right side of the vehicle.
 2. Lift the left hand side of the engine coolant fan shroud (1) up.
 3. Remove the engine coolant fan shroud (1) from the vehicle.

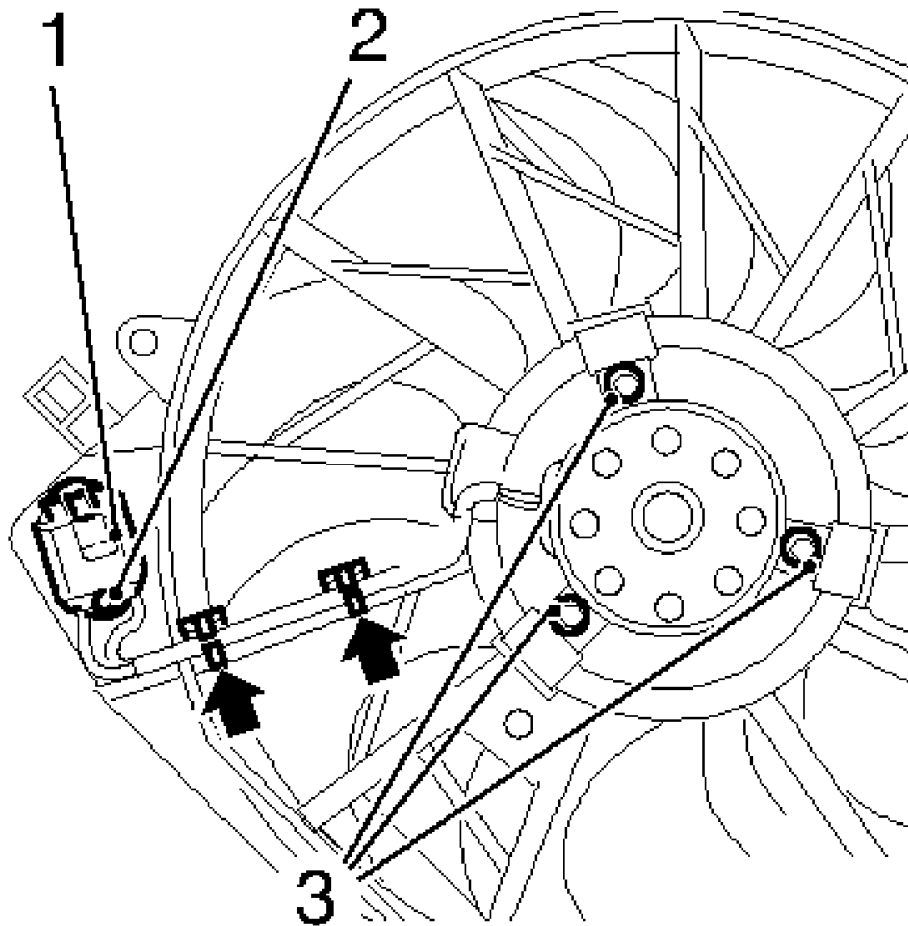


Fig. 89: Identifying Engine Coolant Fan Resistor
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine coolant fan resistor (1) by unclipping the retainer clip (2).
11. Unclip the engine coolant fan resistor wiring harness (arrows) from the shroud.
12. Remove the 3 engine coolant fan engine bolts (3) from the engine coolant fan.
13. Remove the engine coolant fan.

Installation Procedure

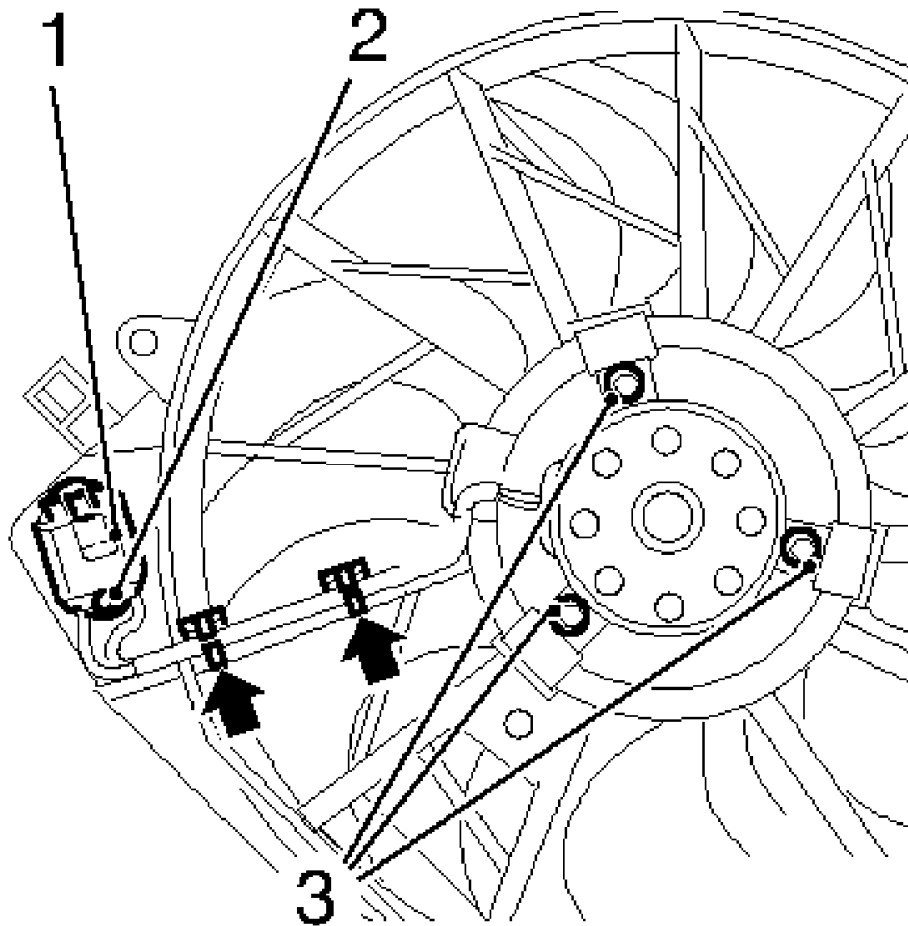


Fig. 90: Identifying Engine Coolant Fan Resistor
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant fan.

CAUTION: Refer to Fastener Caution

2. Install the 3 engine coolant fan engine bolts (3) to the engine coolant fan and tighten.
3. Clip in the engine coolant fan resistor wiring harness (arrows) to the shroud.
4. Install the engine coolant fan resistor (1) by clipping the retainer clip (2).

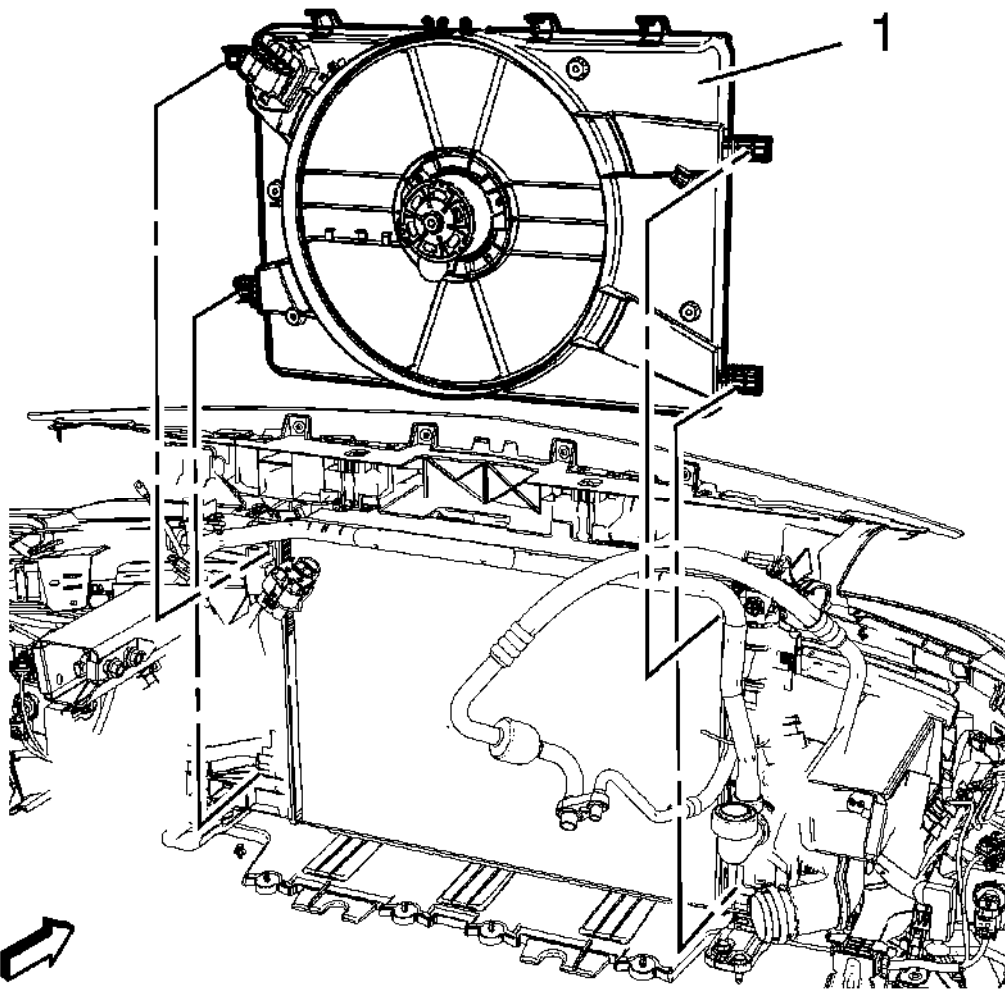


Fig. 91: Identifying Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

5. Install the engine coolant fan shroud (1).
 1. Lower the right hand side of the engine coolant fan shroud (1) behind the radiator.
 2. Slide the engine coolant fan shroud (1) toward the left side of the vehicle.
6. Clip in the engine coolant fan shroud (1) to the four mounting points shown.

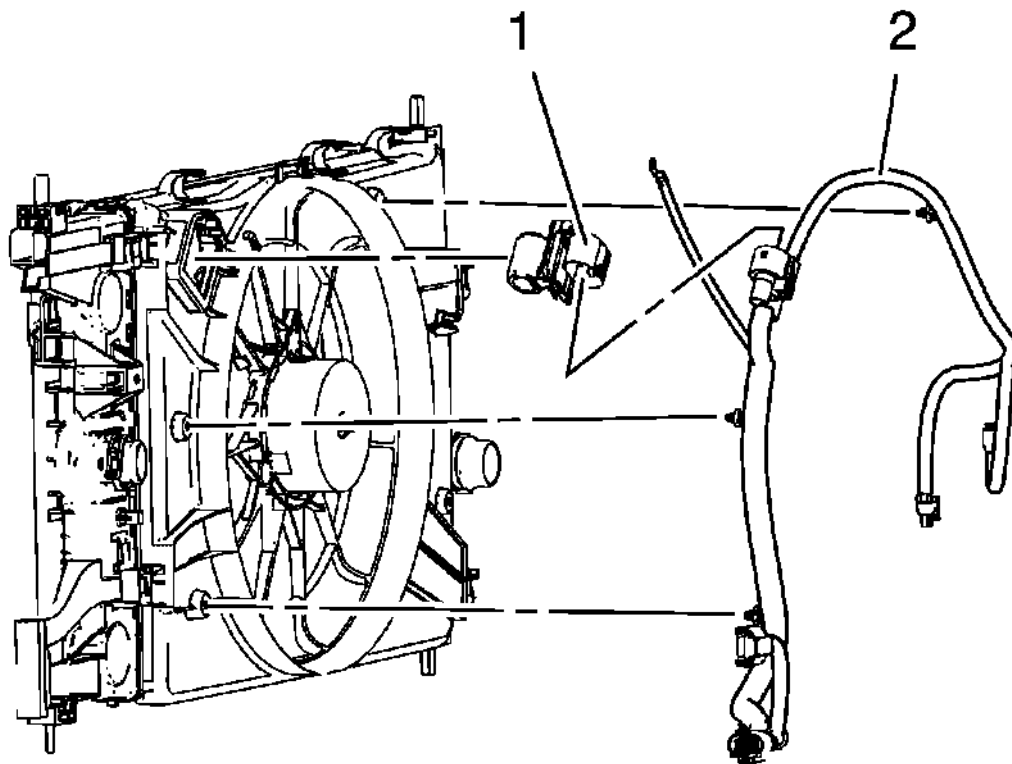


Fig. 92: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

7. Connect the engine coolant fan resistor wiring harness connector (1).
8. Install the wiring harness (3) and clips.
9. Install the front end upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
10. Install the left and right side radiator air baffles.
11. Install the radiator upper air seal.
12. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

ENGINE COOLANT FAN RESISTOR REPLACEMENT

Removal Procedure

1. Disconnect the negative cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection** .

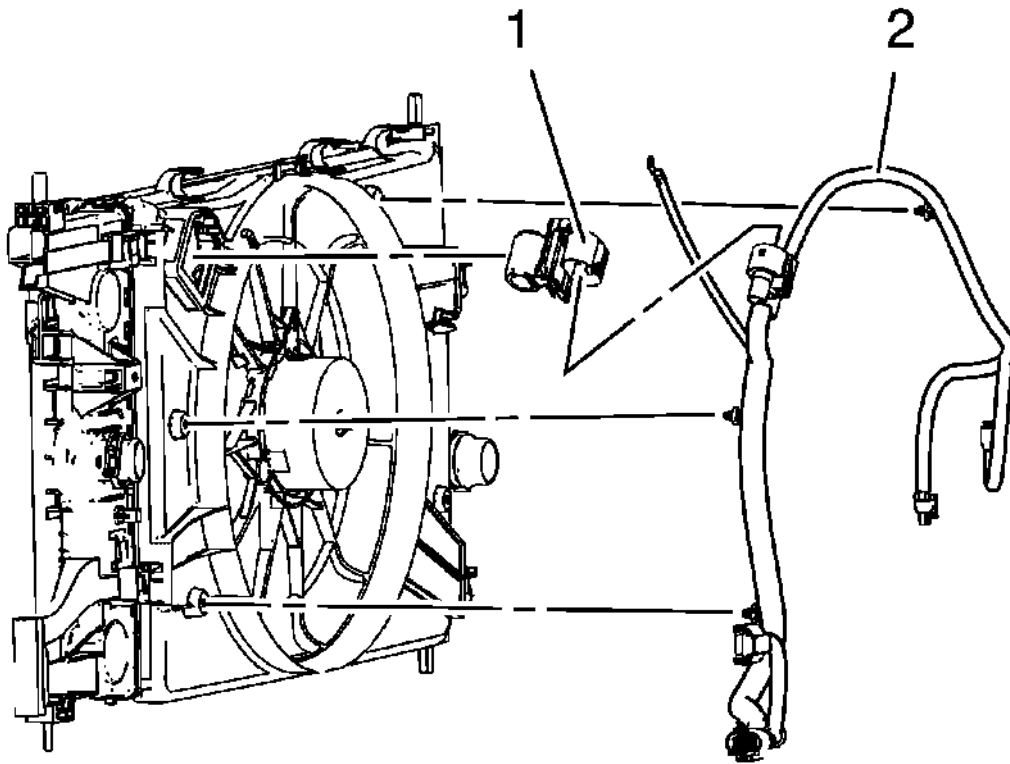


Fig. 93: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the engine coolant fan resistor wiring harness plug.
3. Remove the engine coolant fan resistor bolt (2).
4. Remove the engine coolant fan resistor (1).

Installation Procedure

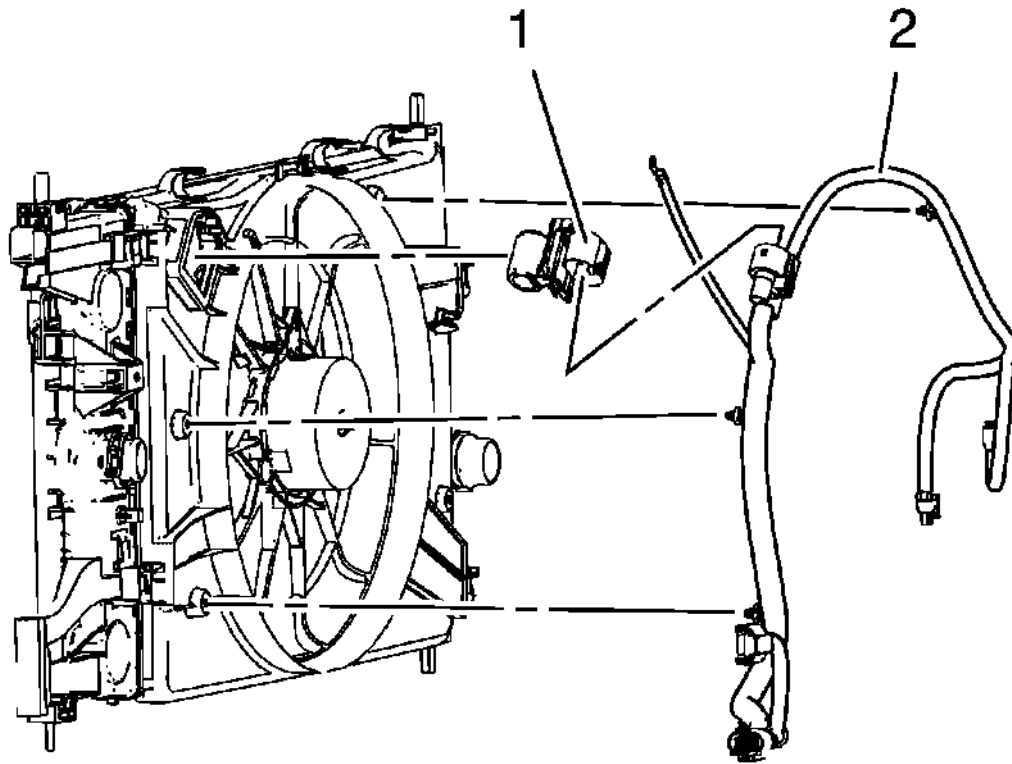


Fig. 94: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant fan resistor (1).

CAUTION: Refer to Fastener Caution .

2. Install the engine coolant fan resistor bolt (2) and tighten to 4 N.m (36 lb in).
3. Connect the engine coolant fan resistor wiring harness plug.
4. Connect the negative cable to the battery. Refer to Battery Negative Cable Disconnection and Connection .

ENGINE COOLANT LEVEL INDICATOR MODULE REPLACEMENT

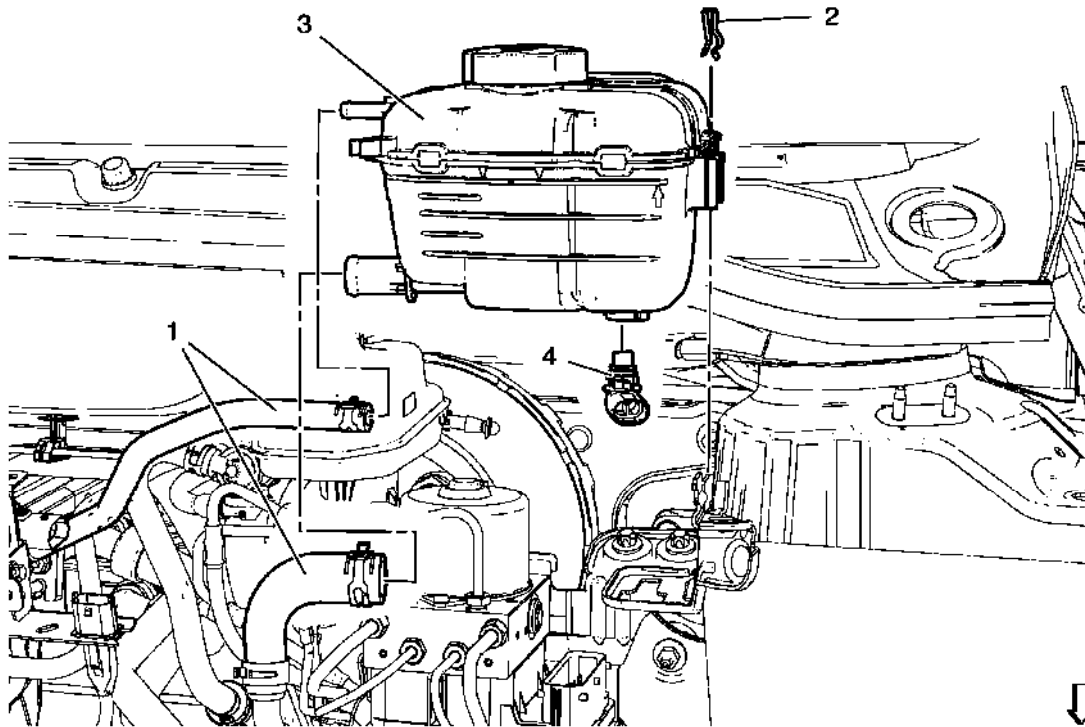


Fig. 95: Identifying Engine Coolant Level Indicator Module
Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Level Indicator Module Replacement

Callout	Component Name
Preliminary Procedure	
1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) , Cooling System Draining and Filling (GE-47716 Fill) .	
2. Remove the fuse block. Refer to Fuse Block Replacement .	
1	Coolant Hose (Qty: 2)
2	Radiator Surge Tank Clip
3	Radiator Surge Tank
4	Engine Coolant Level Indicator Module
Procedure	
Disconnect the electrical connector.	

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT

Removal Procedure

1. Remove the turbocharger. Refer to **Turbocharger Replacement**.
2. Remove the turbocharger coolant feed pipe from quick fitting connector. Refer to **Turbocharger Disassemble**.

Installation Procedure

1. Install the turbocharger coolant feed pipe to the quick fitting connector. Refer to **Turbocharger Assemble** .
2. Install the turbocharger. Refer to **Turbocharger Replacement** .

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT**Removal Procedure**

1. Remove the turbocharger. Refer to **Turbocharger Replacement** .
2. Remove the turbocharger coolant return pipe from quick fitting connector. Refer to **Turbocharger Disassemble** .
3. Replace the quick fitting connector. Refer to **Turbocharger Disassemble** .

Installation Procedure

1. Install the turbocharger coolant return pipe to the quick fitting connector. Refer to **Turbocharger Disassemble** .
2. Install the turbocharger. Refer to **Turbocharger Replacement** .

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (1.4L LUV)**Removal Procedure**

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
3. Disconnect the positive crankcase ventilation pipe from the turbocharger. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement** .
4. Remove the radiator outlet hose from the engine coolant thermostat housing. Refer to **Radiator Outlet Hose Replacement (1.8L LUW and LWE)**, **Radiator Outlet Hose Replacement (1.4L LUV)**.
5. Disconnect the engine coolant temperature sensor wiring harness connector.

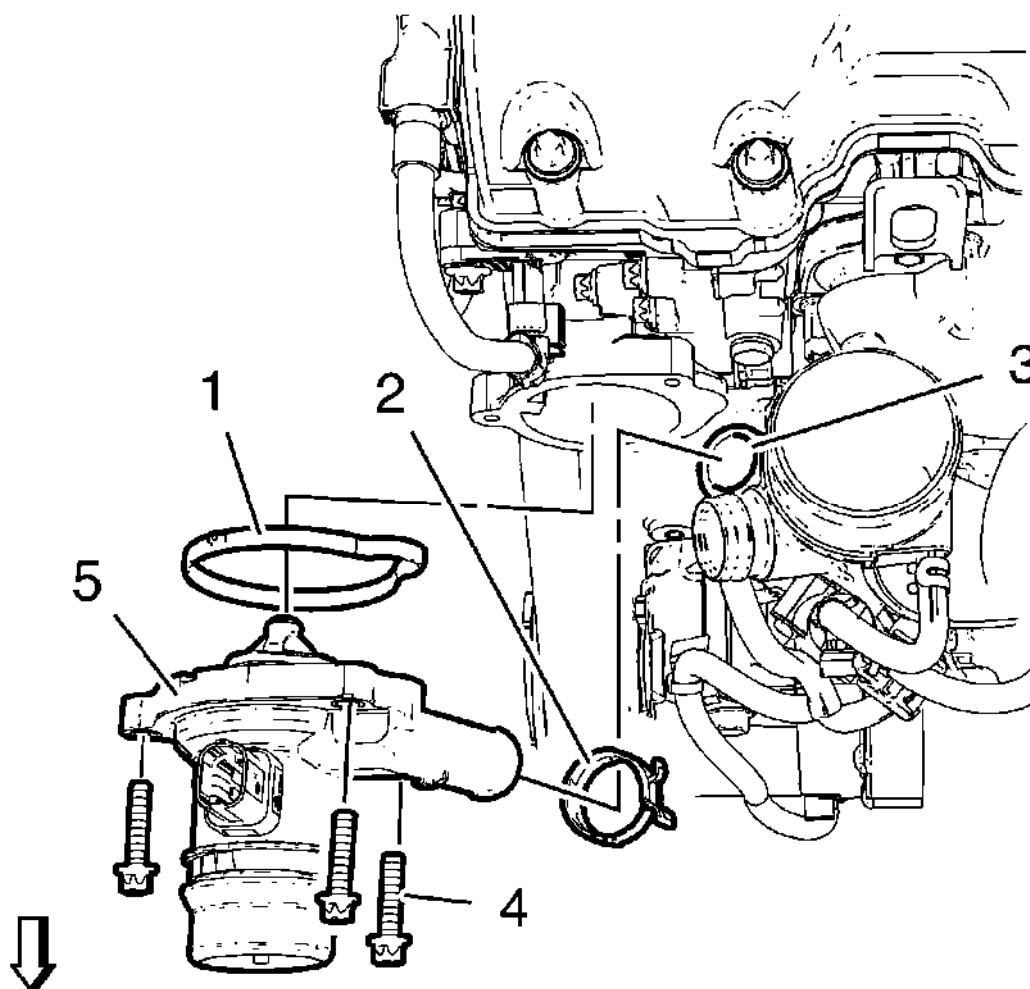


Fig. 96: Identifying Engine Coolant Thermostat Housing And Engine Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine oil cooler outlet hose clamp (2).
7. Remove the engine oil cooler outlet hose (3) from the engine coolant thermostat housing.
8. Remove the 3 engine coolant thermostat housing bolts (4).
9. Remove the engine coolant thermostat housing (5) and the seal ring (1).

Installation Procedure

1. Clean the sealing surfaces.

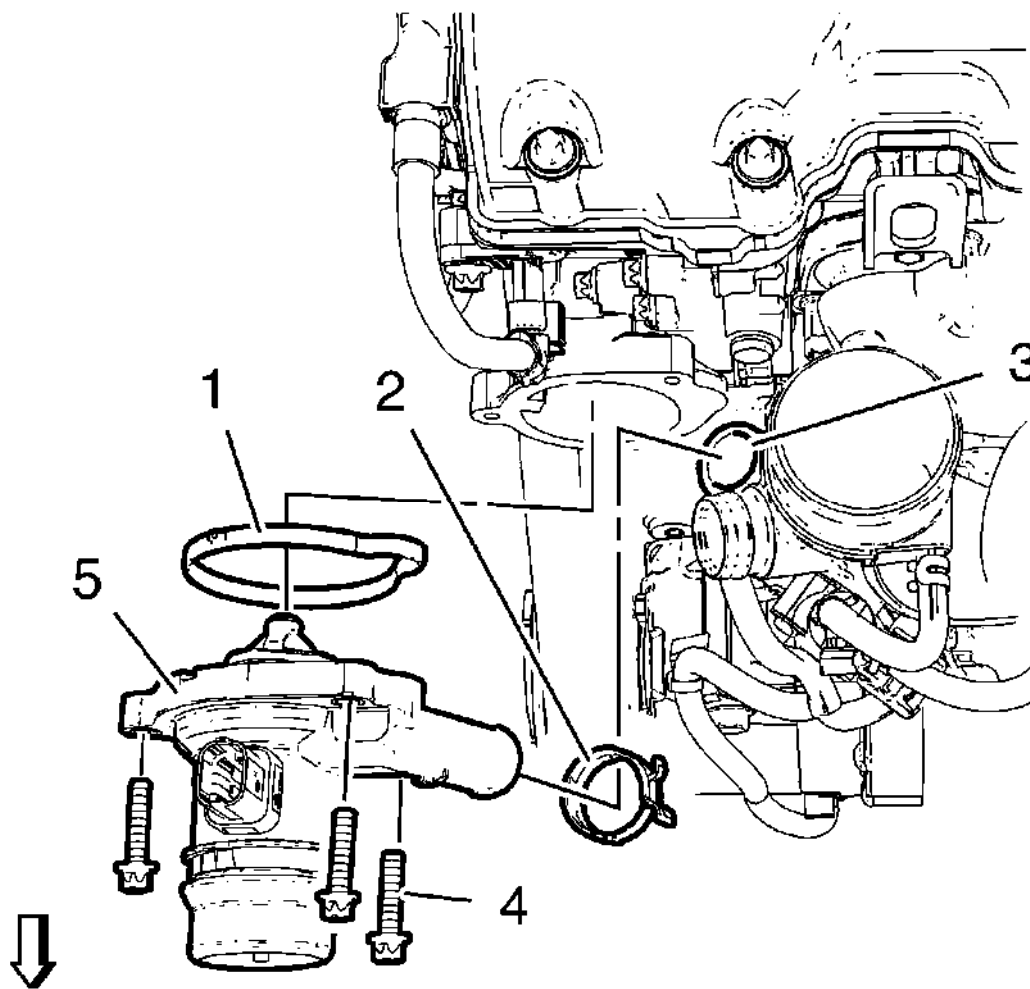


Fig. 97: Identifying Engine Coolant Thermostat Housing And Engine Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

2. Install the engine coolant thermostat housing (5) along with a NEW seal ring (1).

CAUTION: Refer to Fastener Caution .

3. Install the 3 engine coolant thermostat housing bolts (4) and tighten to 8 N.m(71 lb in).
4. Install the engine oil cooler outlet hose (3) to the engine coolant thermostat housing.
5. Install the engine oil cooler outlet hose clamp (2).
6. Connect the engine coolant temperature sensor wiring harness connector.
7. Install the radiator outlet hose to the engine coolant thermostat housing. Refer to Radiator Outlet Hose Replacement (1.8L LUW and LWE), Radiator Outlet Hose Replacement (1.4L LUV).
8. Connect the positive crankcase ventilation pipe to the turbocharger. Refer to Positive Crankcase

2013 Chevrolet Cruze

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Ventilation Hose/Pipe/Tube Replacement .

9. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement .**
10. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (1.8L LUW AND LWE)

Removal Procedure

CAUTION: Refer to **Engine Coolant Thermostat Housing Caution .**

1. Open the hood.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle .**
3. Place a drain pan below the vehicle.
4. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

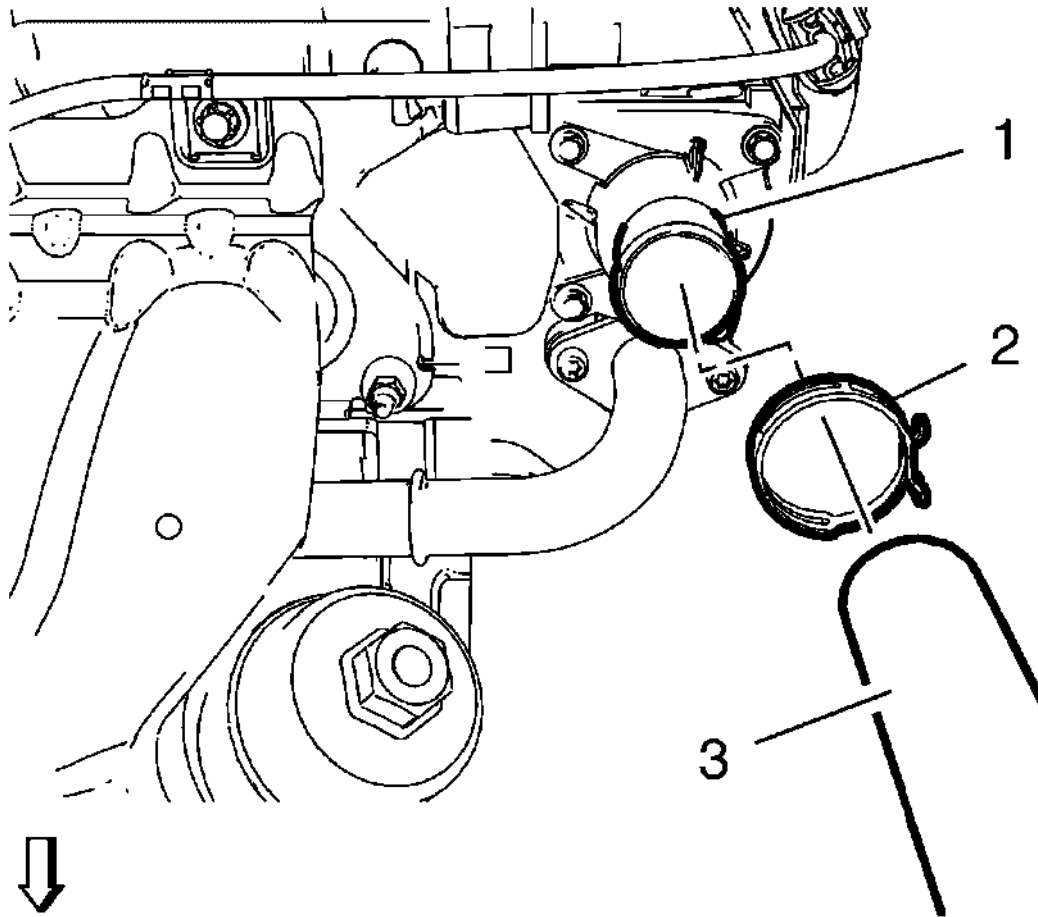


Fig. 98: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the radiator inlet hose clamp (2).
6. Remove the radiator inlet hose (3) from the engine coolant thermostat (1).

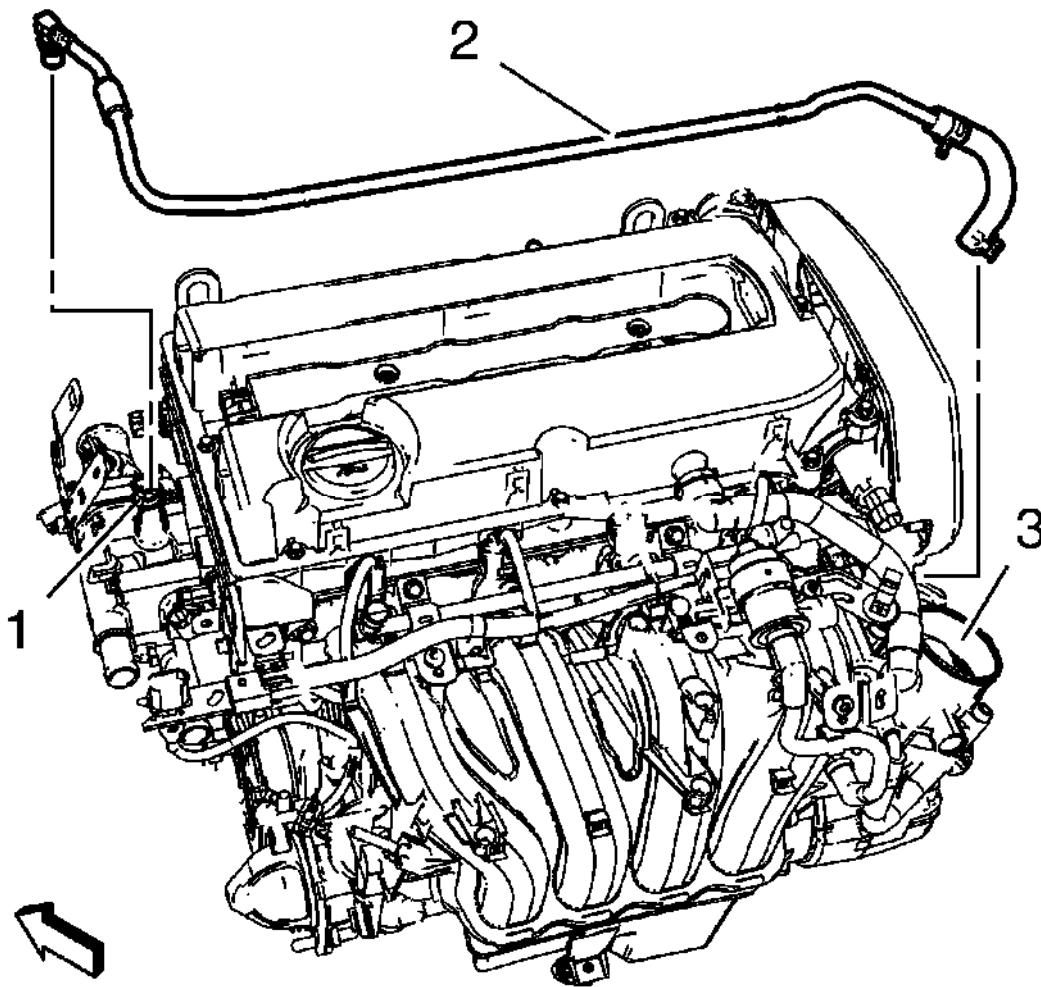


Fig. 99: Identifying Engine Coolant Thermostat Housing

Courtesy of GENERAL MOTORS COMPANY

7. Remove the throttle body heater inlet hose (2) from the engine coolant thermostat (1).
8. Remove the heater outlet hose from the engine coolant thermostat housing. Refer to **Heater Outlet Hose Replacement (1.8L LUW)** , **Heater Outlet Hose Replacement (1.4L LUV)** , **Heater Outlet Hose Replacement (1.8L LWE)** .
9. Remove the heater inlet hose from the engine coolant thermostat housing. Refer to **Heater Inlet Hose Replacement (1.8L LUW and LWE)** , **Heater Inlet Hose Replacement (1.4L LUV)** .
10. Remove the thermostat housing bracket nut.
11. Remove the thermostat housing bracket.

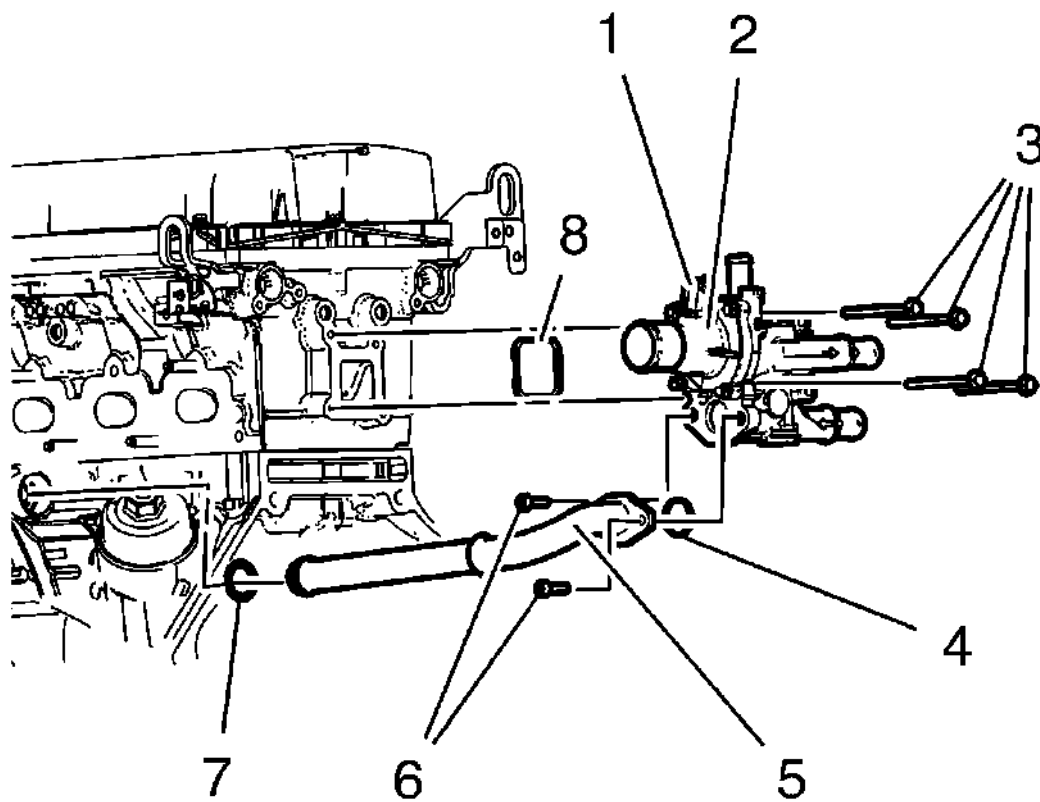


Fig. 100: Identifying Engine Coolant Temperature Sensor Connector, Engine Oil Cooler Pipe And Thermostat Housing

Courtesy of GENERAL MOTORS COMPANY

12. Disconnect the engine coolant temperature sensor connector (1).
13. Remove the 2 engine oil cooler pipe bolts (6).

NOTE: Pull the engine oil cooler pipe out of the engine oil cooler.

14. Remove the engine oil cooler pipe (5).
15. Remove the engine oil cooler pipe seals (4, 7).
16. Remove the 4 engine coolant thermostat housing bolts (3).
17. Remove the thermostat housing (2).
18. Remove the thermostat housing seal (8).

1. Clean sealing surface.

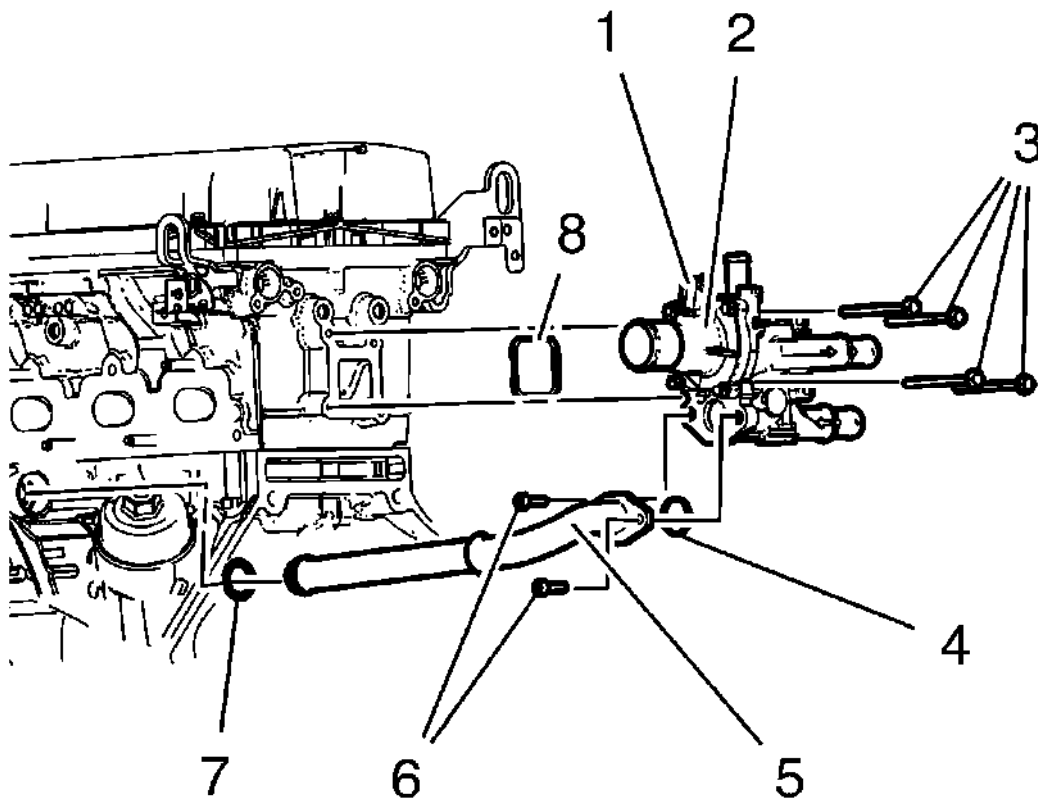


Fig. 101: Identifying Engine Coolant Temperature Sensor Connector, Engine Oil Cooler Pipe And Thermostat Housing

Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW engine coolant thermostat housing seal (8).
3. Install the engine coolant thermostat housing (2).

CAUTION: Refer to Fastener Caution .

NOTE: Partially install the 4 bolts until the engine coolant thermostat housing is in contact with the cylinder head.

4. Install the 4 engine coolant thermostat housing bolts (3) and tighten to 2 N.m (18 lb in).

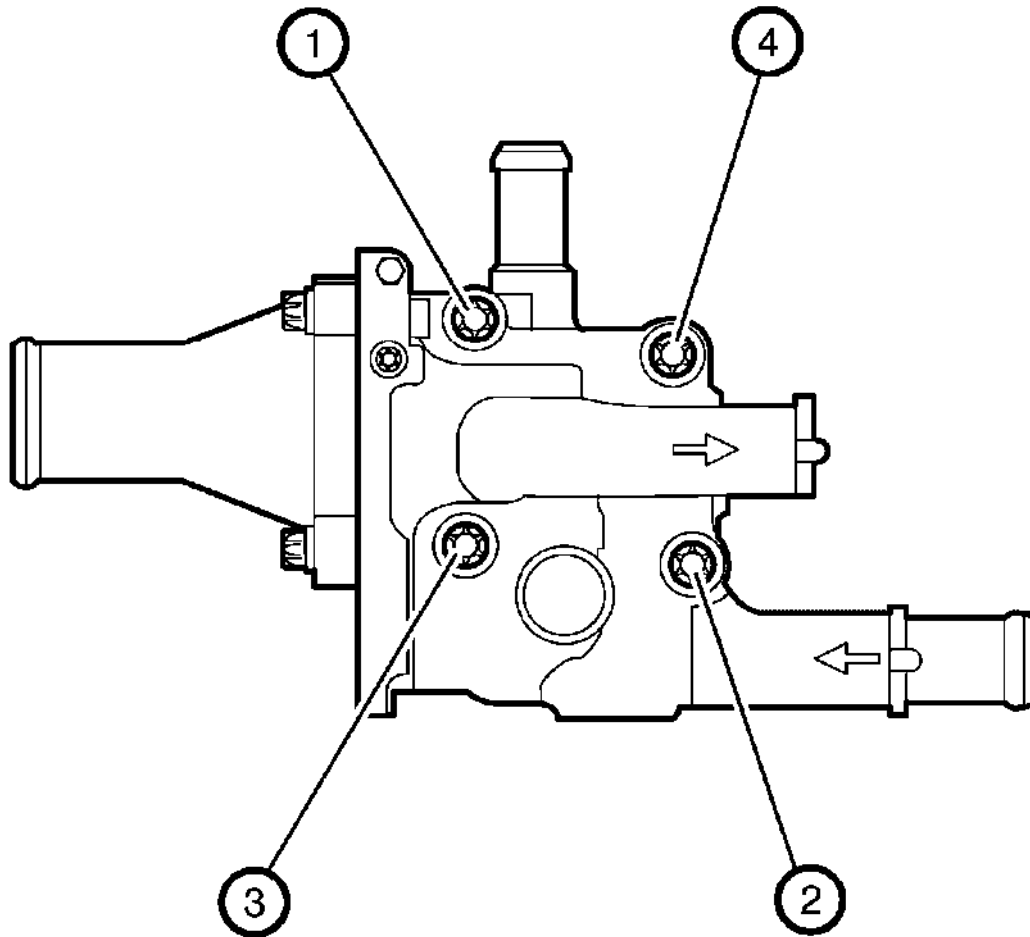


Fig. 102: Identifying Engine Coolant Thermostat Housing Bolts Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

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

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

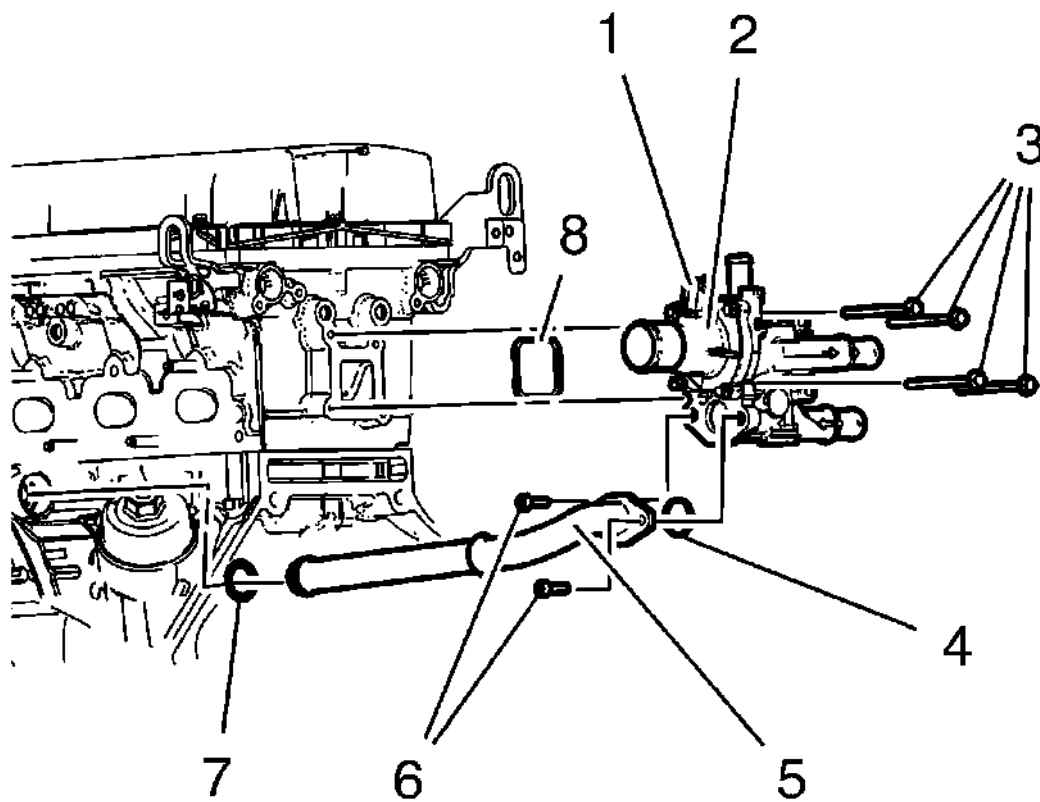


Fig. 103: Identifying Engine Coolant Temperature Sensor Connector, Engine Oil Cooler Pipe And Thermostat Housing

Courtesy of GENERAL MOTORS COMPANY

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

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

7. Install the engine oil cooler pipe (5).
8. Install the 2 engine oil cooler pipe bolts (6) and tighten to 8 N.m (71 lb in).
9. Install the heater inlet hose to the engine coolant thermostat housing. Refer to Heater Inlet Hose Replacement (1.8L LUW and LWE) , Heater Inlet Hose Replacement (1.4L LUV) .
10. Install the heater outlet hose to the engine coolant thermostat housing. Refer to Heater Outlet Hose Replacement (1.8L LUW) , Heater Outlet Hose Replacement (1.4L LUV) , Heater Outlet Hose Replacement (1.8L LWE) .
11. Connect the engine coolant temperature sensor connector (1).

12. Install the engine coolant thermostat housing bracket.
13. Install the engine coolant thermostat housing bracket nut and tighten to 6 N.m (53 lb in).

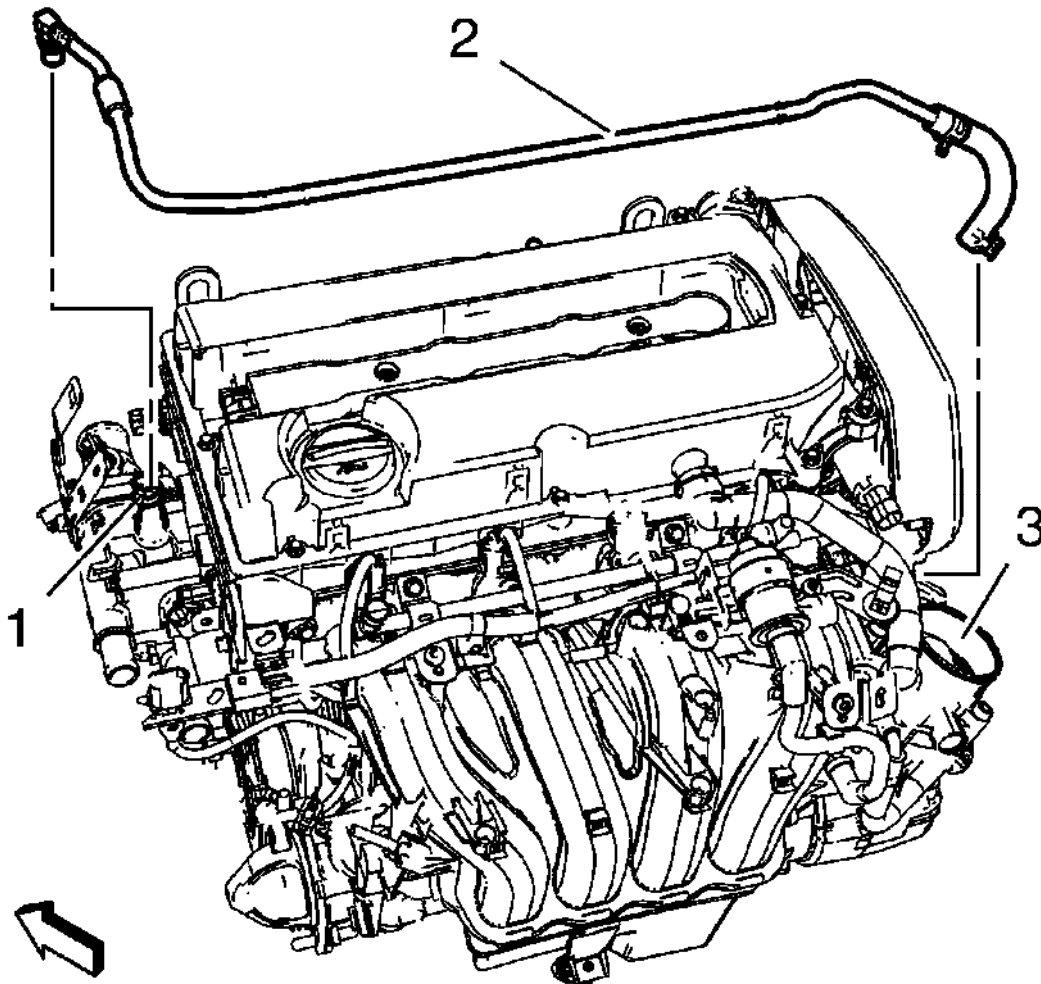


Fig. 104: Identifying Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

14. Install the throttle body heater inlet hose (2) to the engine coolant thermostat housing (1).

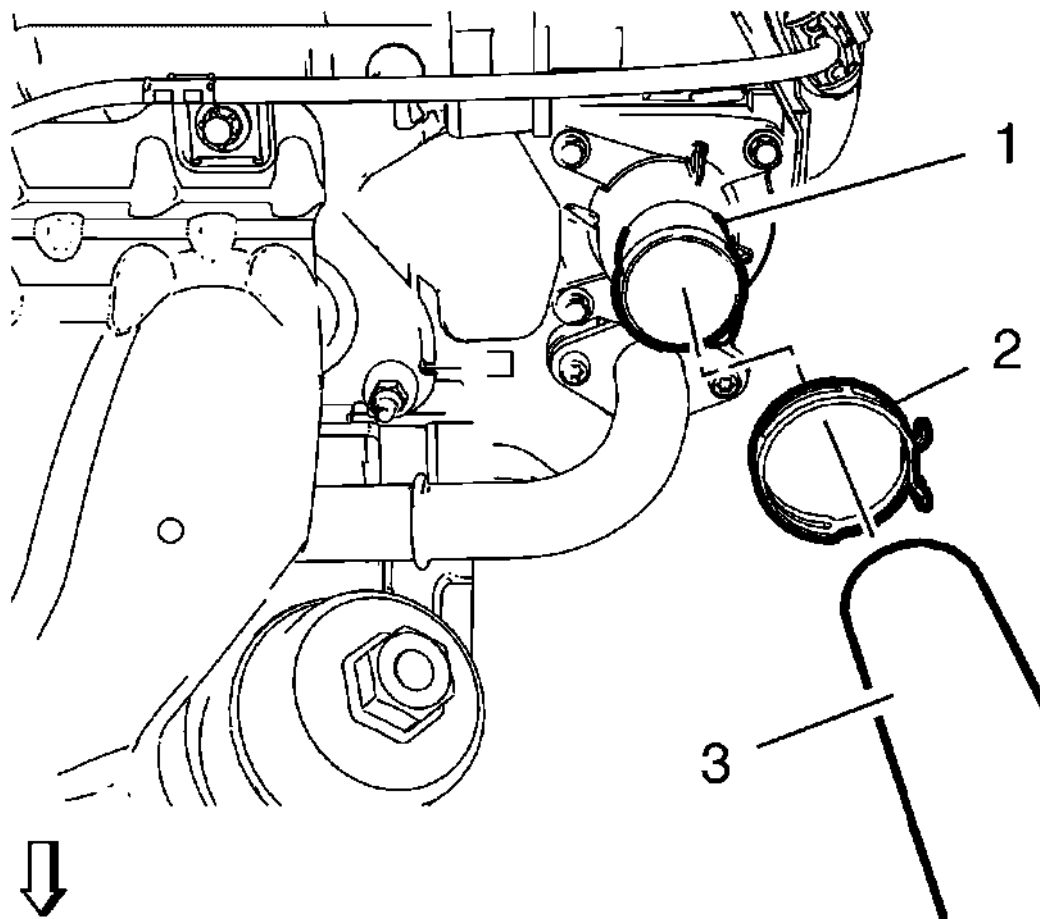


Fig. 105: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

15. Install the radiator inlet hose (3) with the radiator inlet hose clamp (2) to the engine coolant thermostat (1).
16. Lower the vehicle.
17. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).

ENGINE COOLANT THERMOSTAT REPLACEMENT

Removal Procedure

CAUTION: Refer to Engine Coolant Thermostat Housing Caution .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Place a drain pan below the vehicle.
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

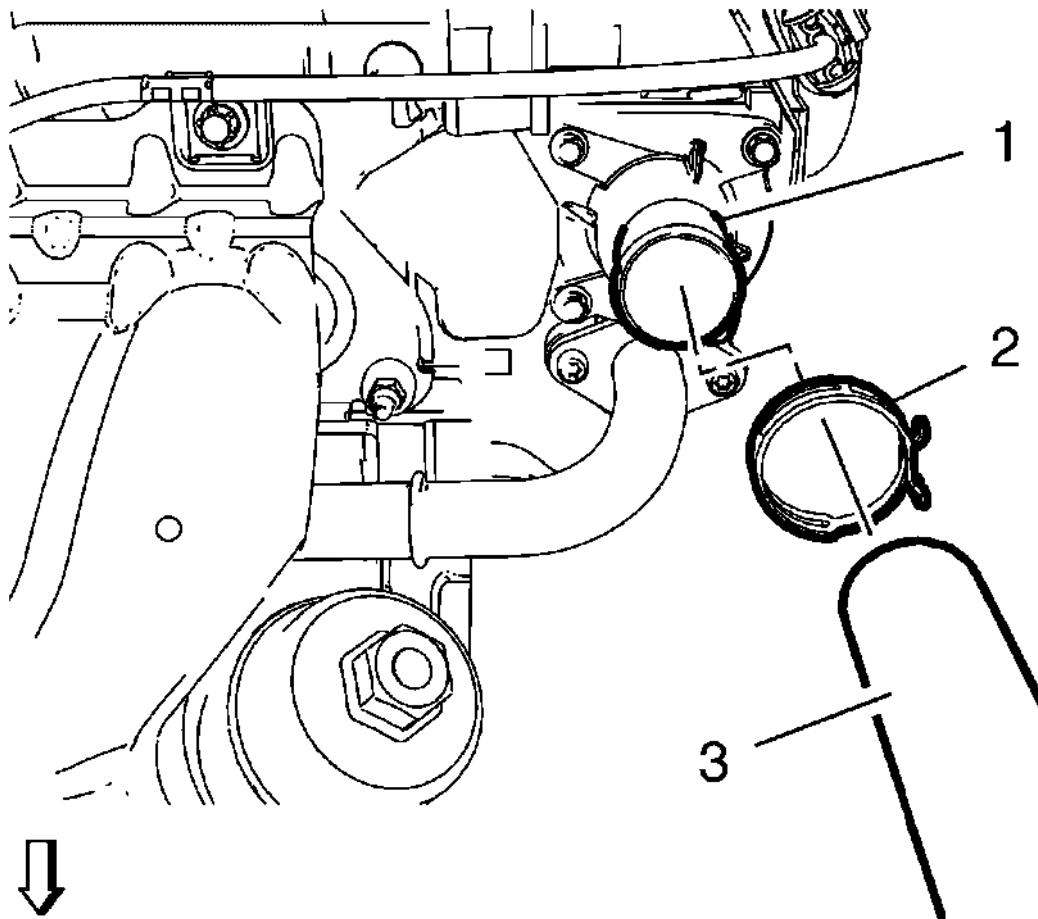


Fig. 106: Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Loosen the radiator inlet hose clamp (2).
5. Remove the radiator inlet hose (3) from the engine coolant thermostat (1).

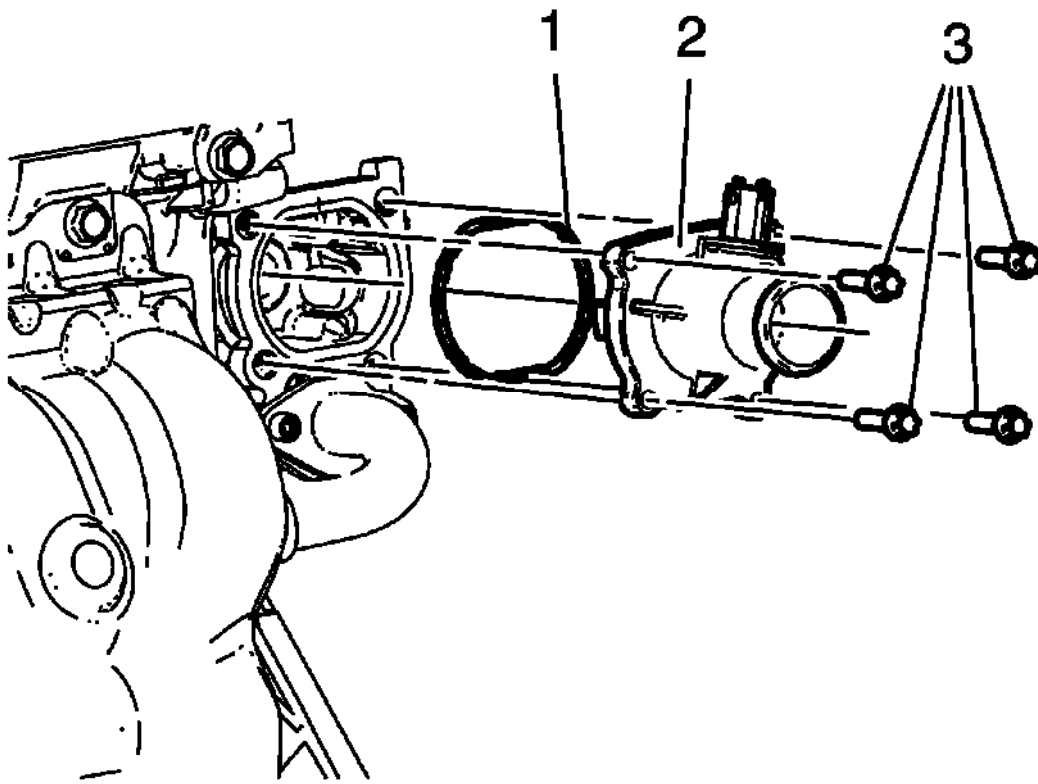


Fig. 107: Identifying Engine Coolant Thermostat Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 4 engine coolant thermostat bolts (3).
7. Remove the engine coolant thermostat assembly (2).
8. Remove the engine coolant seal (1).

Installation Procedure

1. Clean the engine coolant sealing surfaces.

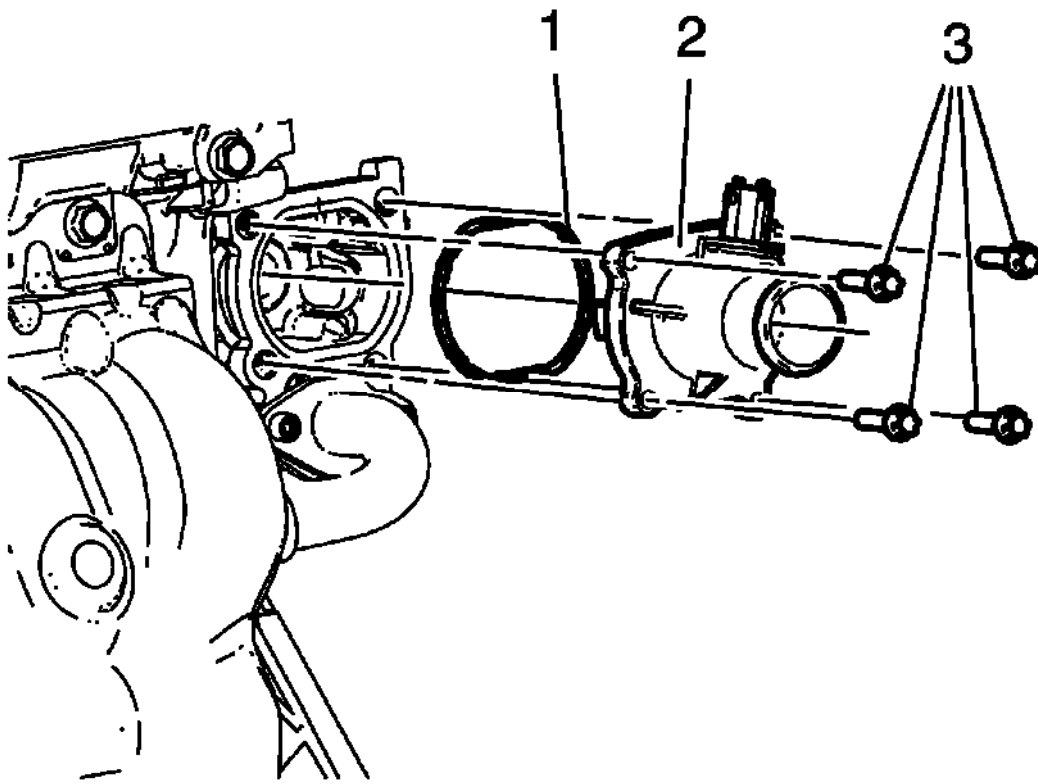


Fig. 108: Identifying Engine Coolant Thermostat Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Install the engine coolant seal (1).
3. Install the engine coolant thermostat assembly (2).

CAUTION: Refer to Fastener Caution .

4. Install the 4 engine coolant thermostat bolts (3) and tighten to 8 N.m (71 lb in).

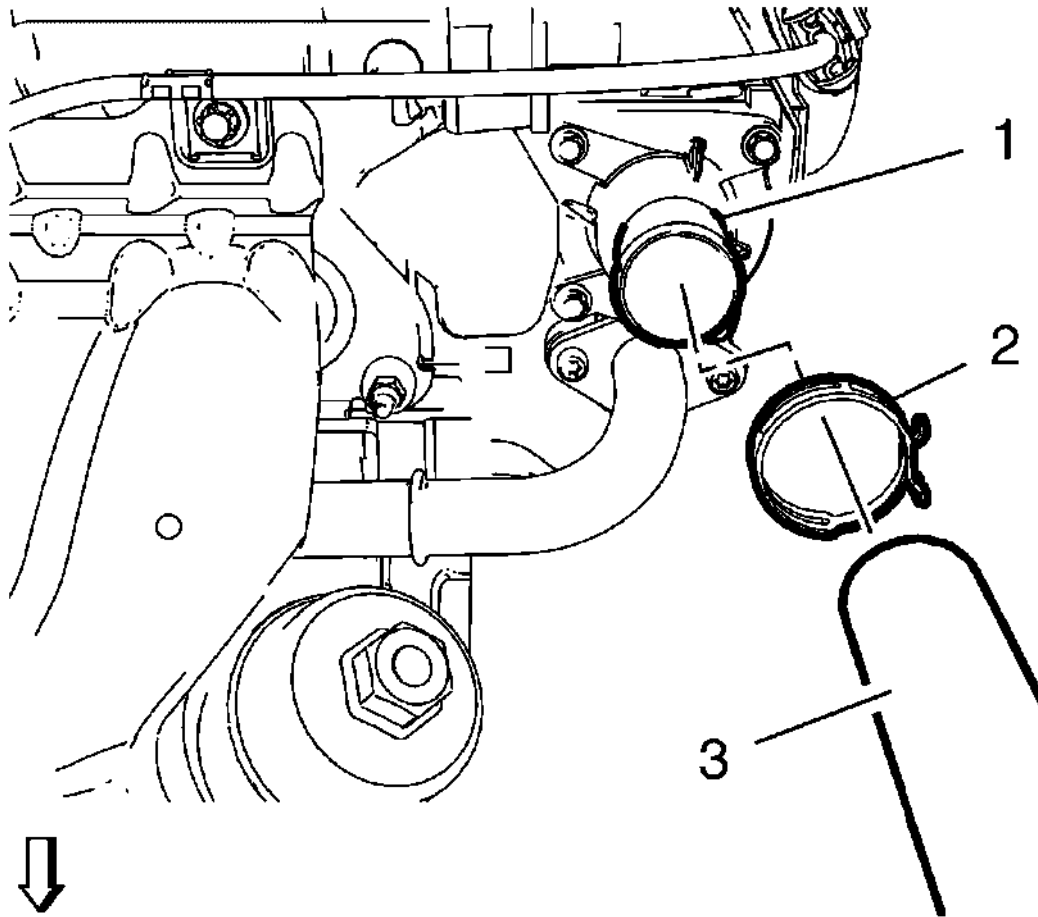


Fig. 109: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Install the radiator inlet hose (3) with the radiator inlet hose clamp (2) to the engine coolant thermostat (1).
6. Lower the vehicle.
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (1.4L LUV)

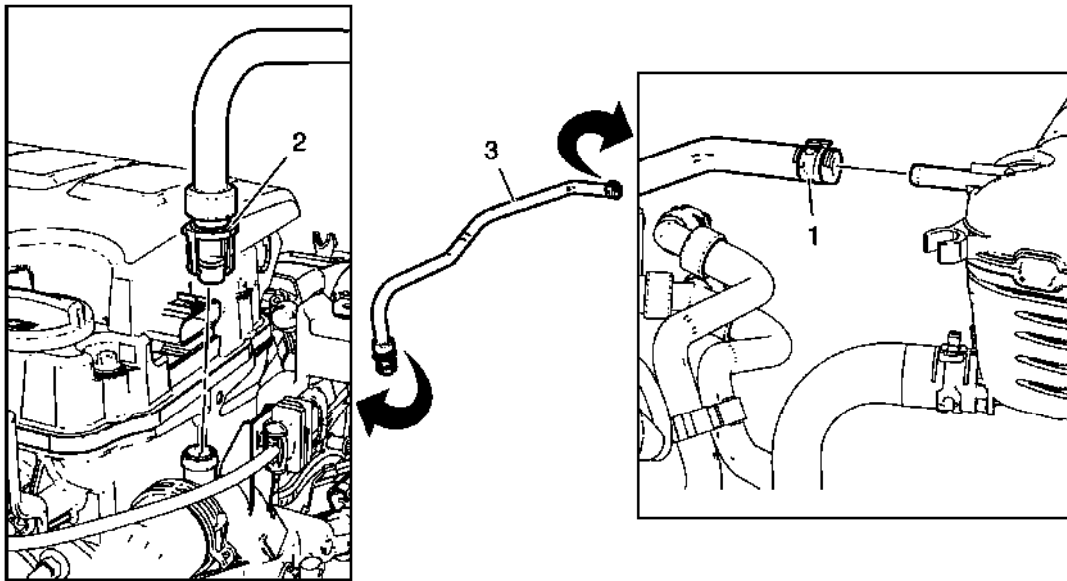


Fig. 110: Identifying Engine Coolant Air Bleed Hose
Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Air Bleed Hose Replacement (1.4L LUV)

Callout	Component Name
1	Engine Coolant Air Bleed Hose Clamp Procedure 1. Place a drain pan below the vehicle. 2. Remove / install engine coolant air bleed hose clamp.
2	Engine Coolant Air Bleed Hose Connector Procedure Unlock / lock engine coolant air bleed hose connector.
3	Engine Coolant Air Bleed Hose

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (1.8L LUW AND LWE)

NOTE: The engine coolant air bleed hose is the same part like the throttle body heater outlet hose.

Remove and install the engine coolant air bleed hose. Refer to **Throttle Body Heater Outlet Hose Replacement**.

WATER OUTLET REPLACEMENT**Removal Procedure**

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
2. Remove the charge air cooler outlet air hose from the throttle body. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .
3. Remove the engine coolant air bleed hose from the water outlet. Refer to **Engine Coolant Air Bleed Hose Replacement (1.8L LUW and LWE)**, **Engine Coolant Air Bleed Hose Replacement (1.4L LUV)**.
4. Remove the heater inlet hose from the water outlet. Refer to **Heater Inlet Hose Replacement (1.8L LUW and LWE)** , **Heater Inlet Hose Replacement (1.4L LUV)** .
5. Remove the radiator inlet hose from the water outlet. Refer to **Radiator Inlet Hose Replacement (1.4L LUV)**, **Radiator Inlet Hose Replacement (1.8L LUW and LWE)**.
6. Remove the engine oil cooler inlet hose from the water outlet. Refer to **Engine Oil Cooler Inlet Hose Replacement**.
7. Disconnect the engine coolant temperature sensor (water outlet) wiring harness connector.

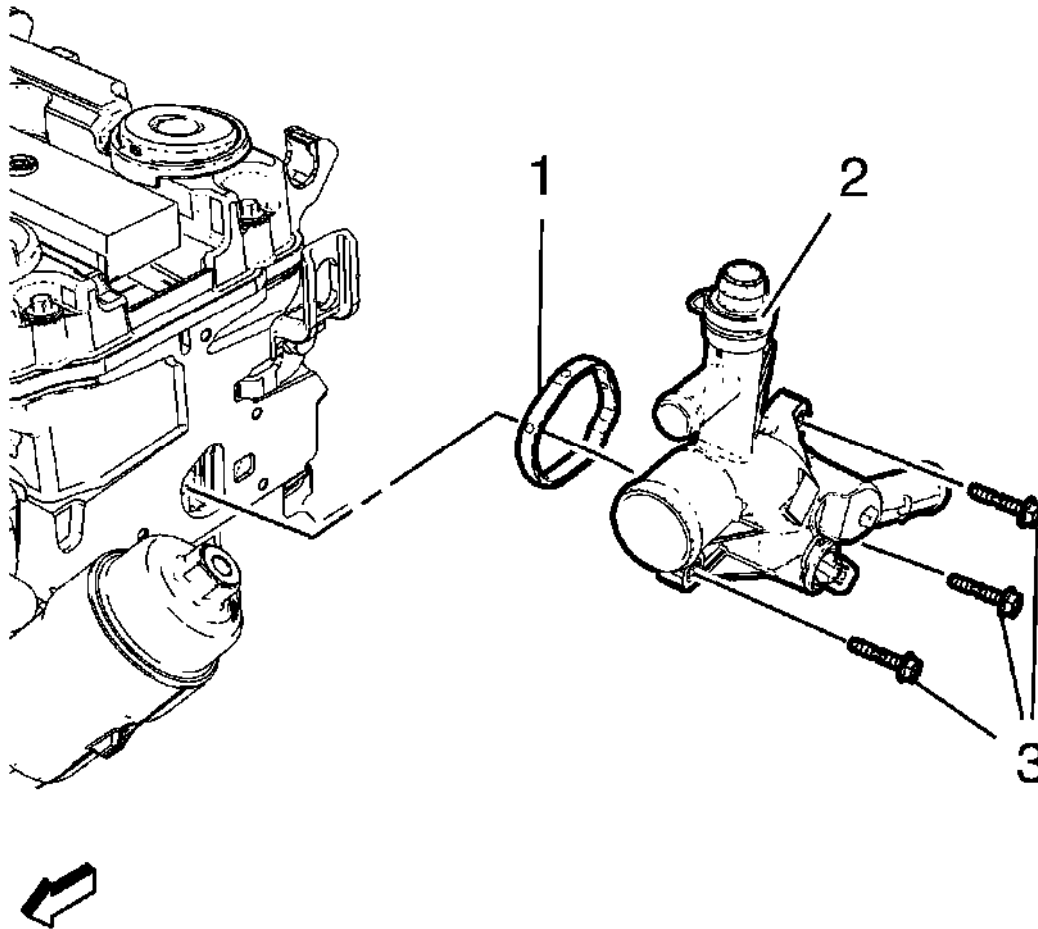


Fig. 111: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

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

Installation Procedure

1. Clean the sealing surfaces.

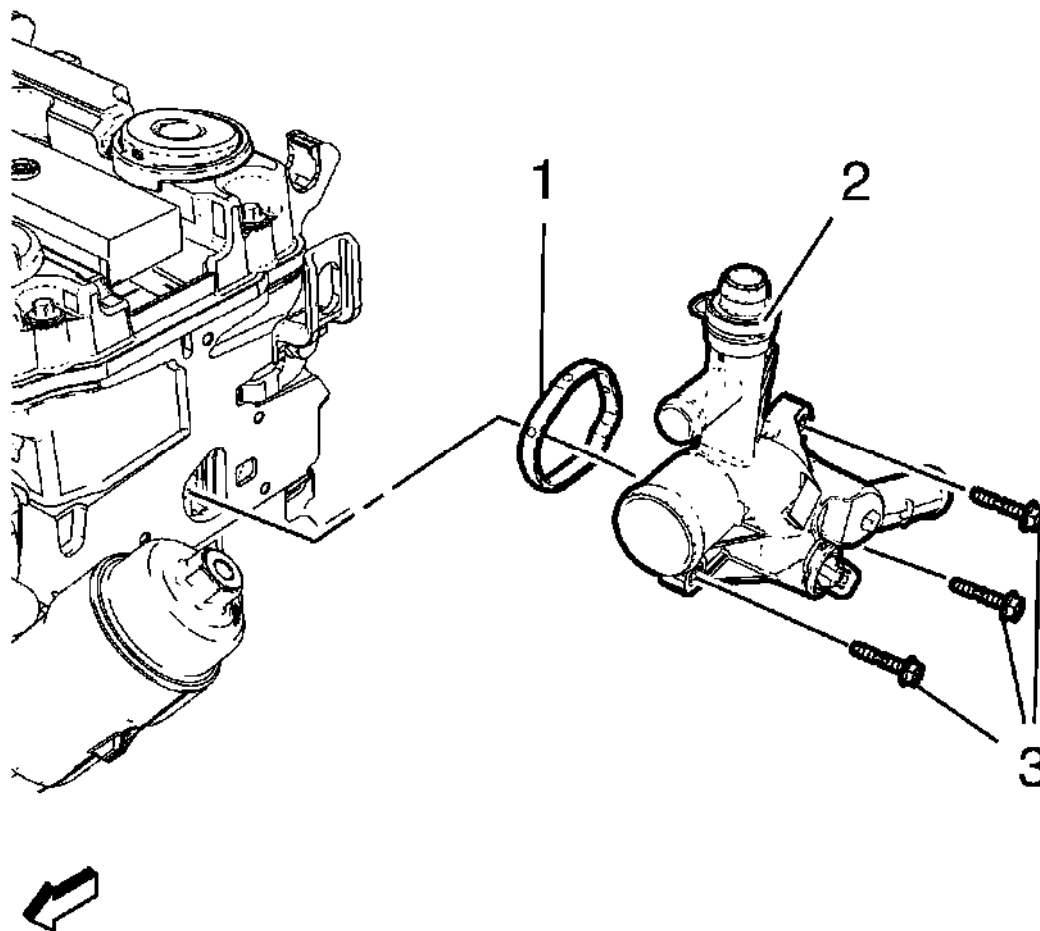


Fig. 112: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

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

CAUTION: Refer to Fastener Caution .

3. Install the 3 water outlet bolts (3) and tighten to 8 N.m (71 lb in).
4. Connect the engine coolant temperature sensor (water outlet) wiring harness connector.
5. Install the engine oil cooler inlet hose to the water outlet. Refer to Engine Oil Cooler Inlet Hose Replacement.
6. Install the radiator inlet hose to the water outlet. Refer to Radiator Inlet Hose Replacement (1.4L LUV), Radiator Inlet Hose Replacement (1.8L LUW and LWE).
7. Install the heater inlet hose to the water outlet. Refer to Heater Inlet Hose Replacement (1.8L LUW and LWE) , Heater Inlet Hose Replacement (1.4L LUV) .

8. Install the engine coolant air bleed hose to the water outlet. Refer to **Engine Coolant Air Bleed Hose Replacement (1.8L LUW and LWE)**, **Engine Coolant Air Bleed Hose Replacement (1.4L LUV)**.
9. Install the charge air cooler outlet air hose to the throttle body. Refer to **Charge Air Cooler Outlet Air Hose Replacement (Automatic Transmission)** , **Charge Air Cooler Outlet Air Hose Replacement (Manual Transmission)** .
10. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

WATER PUMP PULLEY REPLACEMENT (1.4L LUV)

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
2. Remove the engine mount bracket. Refer to **Engine Mount Bracket Replacement - Right Side** .
3. Remove the drive belt. Refer to **Drive Belt Replacement** .

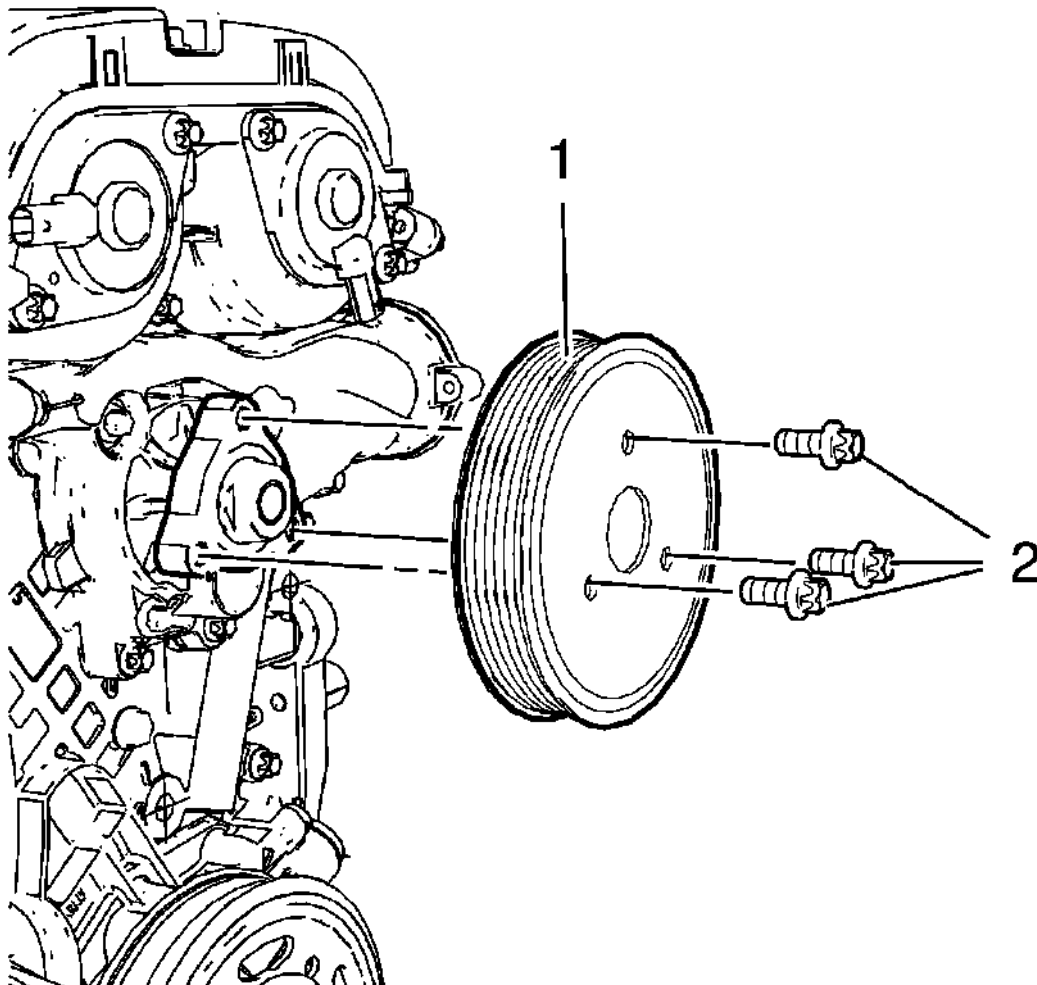


Fig. 113: Water Pump Pulley

Courtesy of GENERAL MOTORS COMPANY

4. Loosen the 3 water pump pulley bolts (2) while holding the water pump pulley hub with a wrench.
5. Remove the 3 water pump pulley bolts (2).
6. Remove the water pump pulley (1).

Installation Procedure

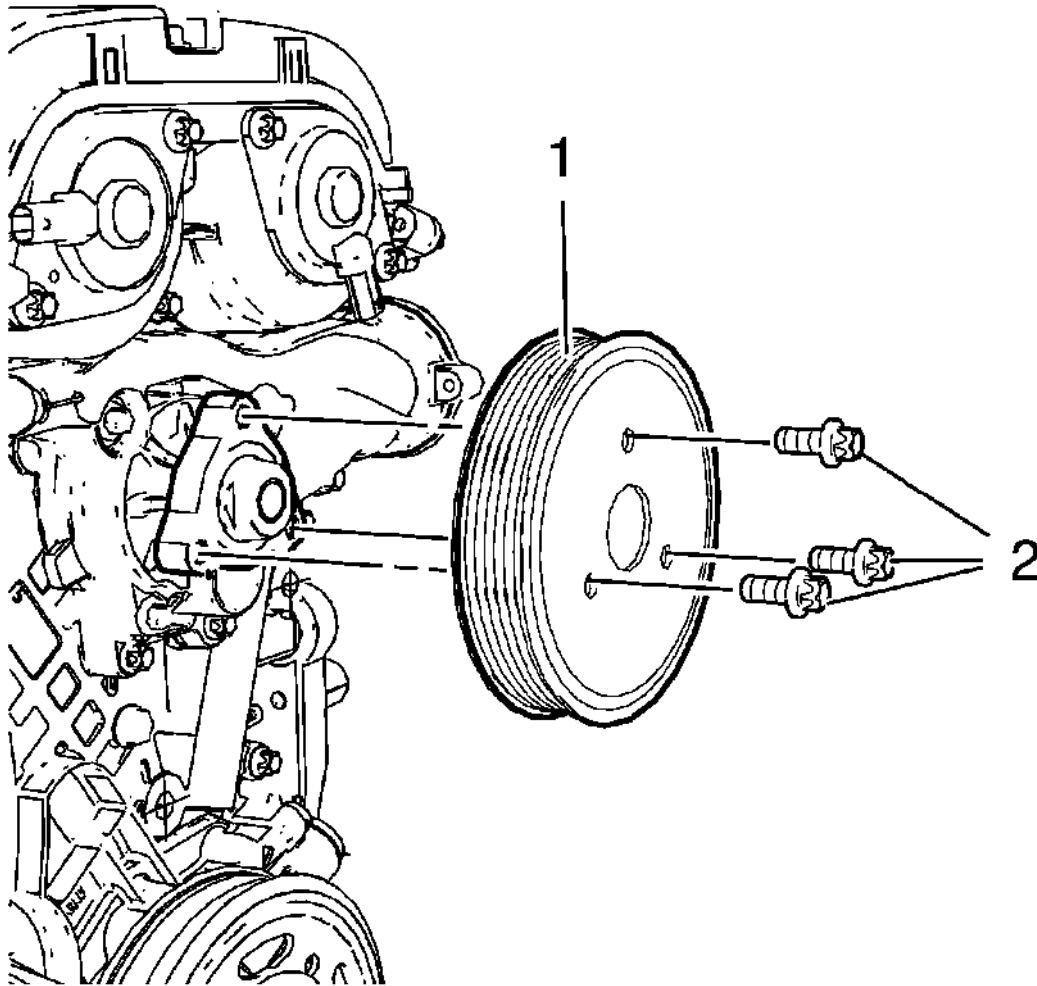


Fig. 114: Water Pump Pulley

Courtesy of GENERAL MOTORS COMPANY

1. Install the water pump pulley (1).
2. Install the 3 water pump pulley bolts (2).

CAUTION: Refer to Fastener Caution .

3. Tighten the 3 water pump pulley bolts to 22 N.m (16 lb ft) while holding the water pump pulley hub with a wrench.
4. Install the drive belt. Refer to **Drive Belt Replacement** .
5. Install the engine mount bracket. Refer to **Engine Mount Bracket Replacement - Right Side** .
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

WATER PUMP PULLEY REPLACEMENT (1.8L LUW AND LWE)

Removal Procedure

1. Remove the air cleaner housing. Refer to **Air Cleaner Assembly Replacement (1.8L LWE)** , **Air Cleaner Assembly Replacement (1.8L LUW)** .

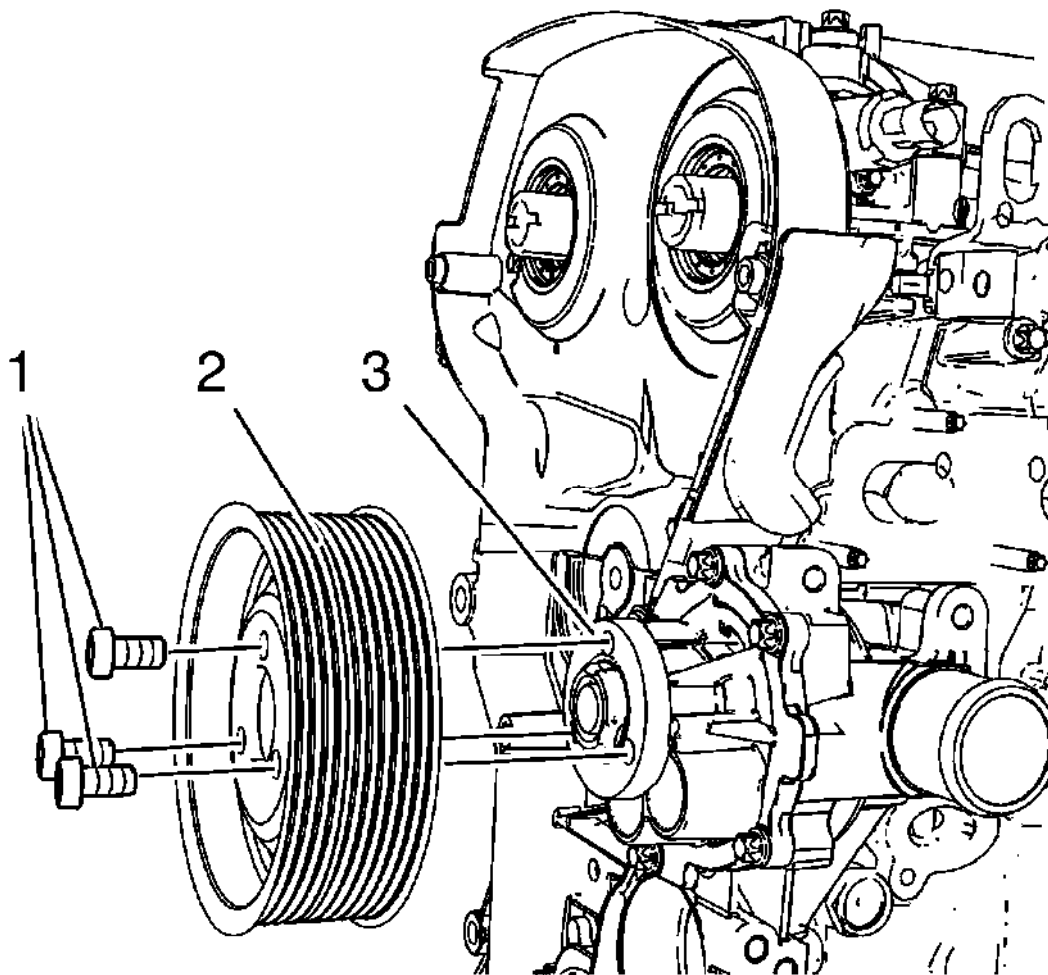


Fig. 115: Water Pump And Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

NOTE: Counterhold against crankshaft balancer bolt.

2. Loosen the 3 water pump pulley bolts (1).
3. Remove the drive belt. Refer to **Drive Belt Replacement** .
4. Remove the 3 water pump pulley bolts (1).
5. Remove the water pump pulley (2) from the water pump (3).

Installation Procedure

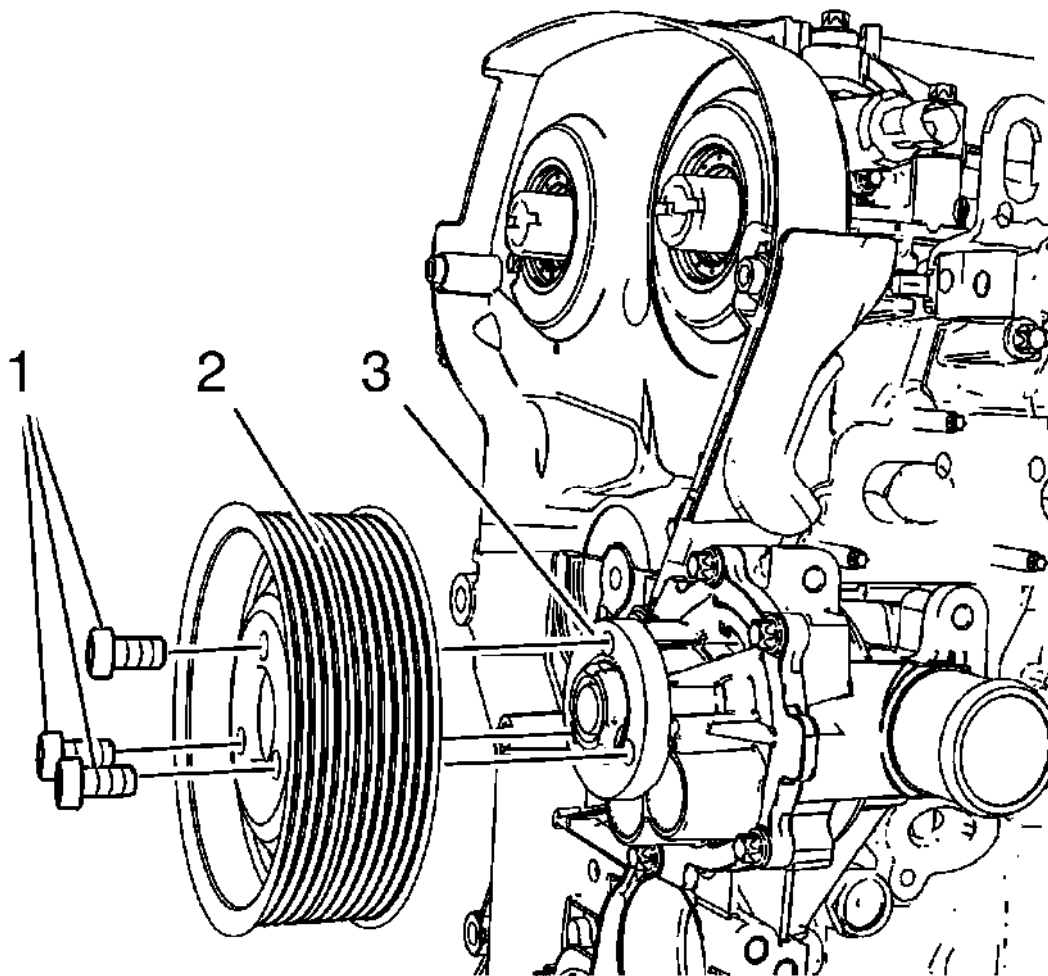


Fig. 116: Water Pump And Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

1. Install the water pump pulley (2) to the water pump (3).
2. Install the 3 water pump pulley bolts (1).
3. Install the drive belt. Refer to **Drive Belt Replacement** .

CAUTION: Refer to Fastener Caution .

NOTE: Counterhold against crankshaft balancer bolt.

4. Tighten the 3 water pump pulley bolts (1) to 20 N.m (15 lb ft).
5. Install the air cleaner housing. Refer to Air Cleaner Assembly Replacement (1.8L LWE) , Air Cleaner Assembly Replacement (1.8L LUW) .

WATER PUMP REPLACEMENT (1.4L LUV)

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
2. Remove the engine coolant thermostat housing from water pump. Refer to Engine Coolant Thermostat Housing Replacement (1.4L LUV), Engine Coolant Thermostat Housing Replacement (1.8L LUW and LWE).
3. Remove the water pump pulley. Refer to Water Pump Pulley Replacement (1.8L LUW and LWE), Water Pump Pulley Replacement (1.4L LUV).
4. Remove the heater outlet hose from the water pump. Refer to Heater Outlet Hose Replacement (1.8L LUW) , Heater Outlet Hose Replacement (1.4L LUV) , Heater Outlet Hose Replacement (1.8L LWE) .

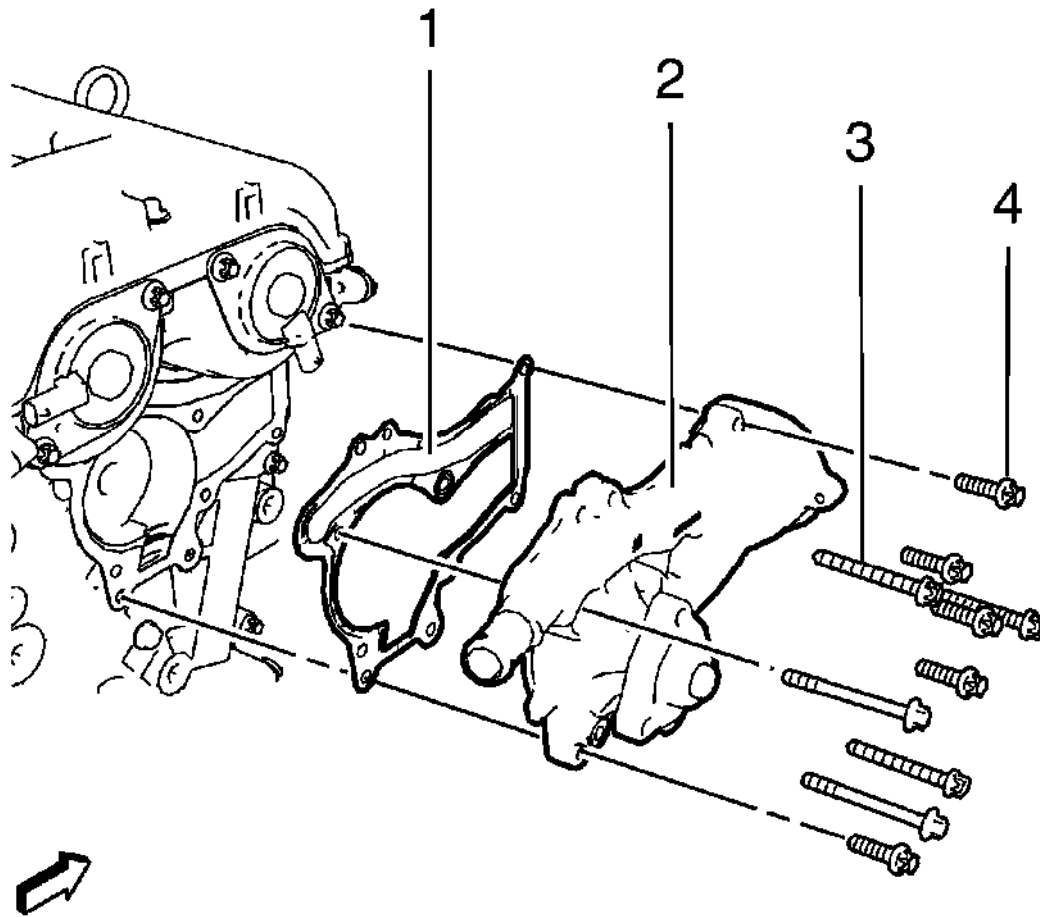


Fig. 117: Water Pump, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 5 water pump bolts (4) and the 5 long engine front cover bolts (3).
6. Remove the water pump (2).
7. Remove and DISCARD the water pump gasket (1).

Installation Procedure

1. Clean the sealing surfaces.

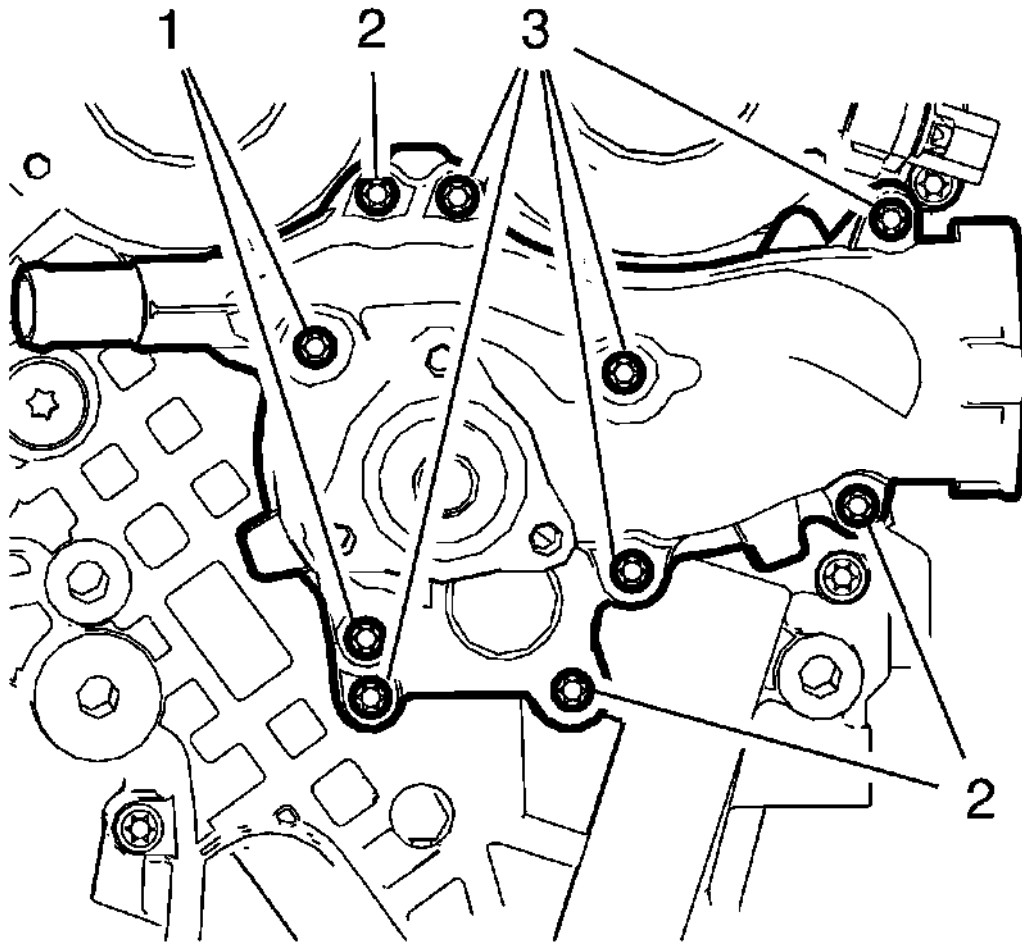


Fig. 118: Water Pump And Engine Front Cover Bolts

Courtesy of GENERAL MOTORS COMPANY

2. The water pump and engine front cover bolts are located as followed:
 - Engine front cover special bolt without cone end 60 mm (2.362 in) (1).
 - Engine front cover standard bolt with cone end 52 mm (2.047 in) (2).
 - Water pump bolt 25 mm (0.984 in) (3).

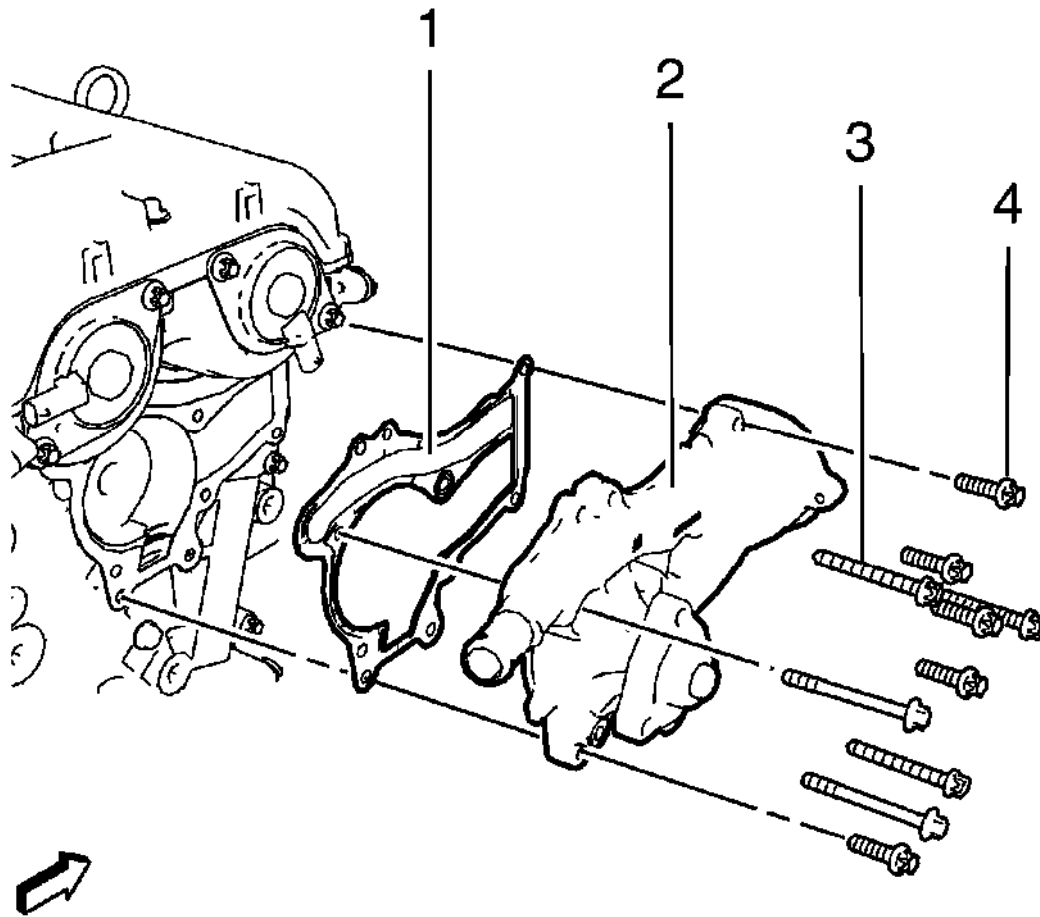


Fig. 119: Water Pump, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

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

CAUTION: Refer to Fastener Caution .

4. Install the 5 water pump bolts (4) and the 5 engine front cover bolts (3) and tighten in a cross sequence to 8 N.m (71 lb in).
5. Install the heater outlet hose from the water pump. Refer to Heater Outlet Hose Replacement (1.8L LUW) , Heater Outlet Hose Replacement (1.4L LUV) , Heater Outlet Hose Replacement (1.8L LWE) .
6. Install the water pump pulley. Refer to Water Pump Pulley Replacement (1.8L LUW and LWE), Water Pump Pulley Replacement (1.4L LUV).
7. Install the engine coolant thermostat housing to the water pump. Refer to Engine Coolant Thermostat

Housing Replacement (1.4L LUV), Engine Coolant Thermostat Housing Replacement (1.8L LUW and LWE).

8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).**

WATER PUMP REPLACEMENT (1.8L LUW AND LWE)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).**
2. Remove the water pump pulley. Refer to **Water Pump Pulley Replacement (1.8L LUW and LWE), Water Pump Pulley Replacement (1.4L LUV).**

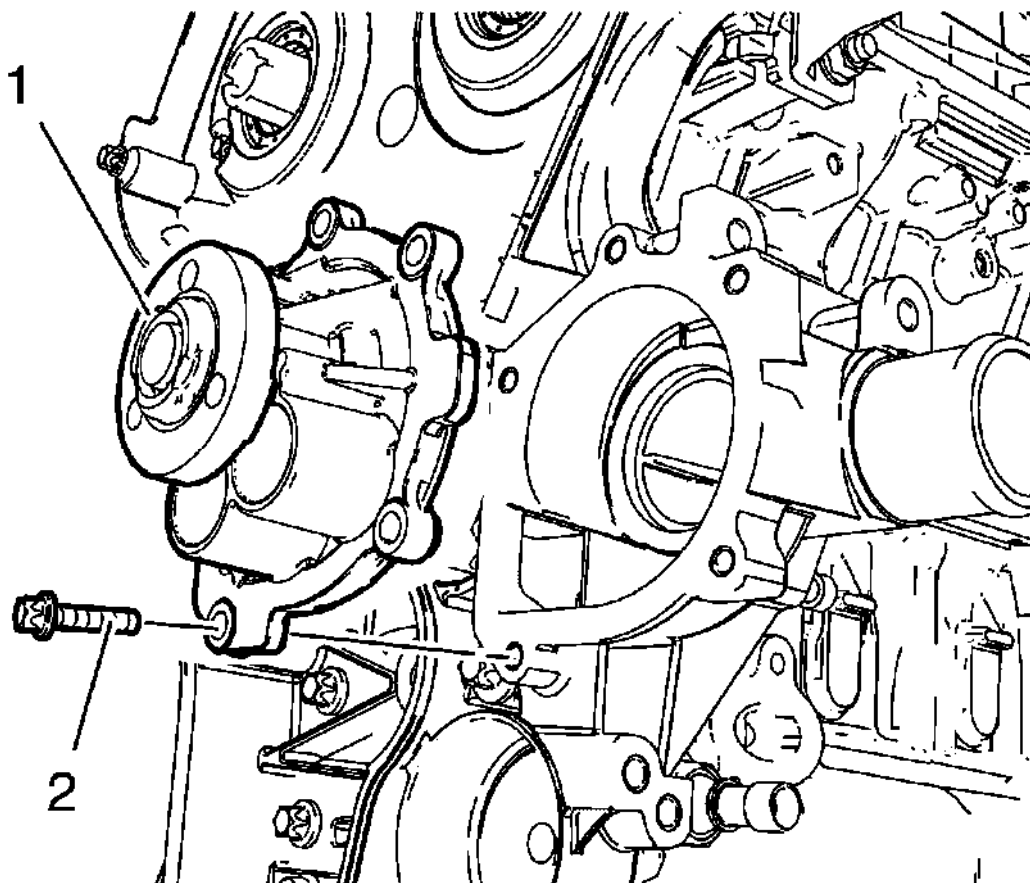


Fig. 120: Water Pump And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the 5 water pump bolts (2).
4. Remove the water pump (1).
5. Remove and DISCARD the water pump seal ring.

Installation Procedure

1. Clean the 5 water pump threads.
2. Clean the water pump sealing surface.
3. Insert a NEW water pump seal ring.

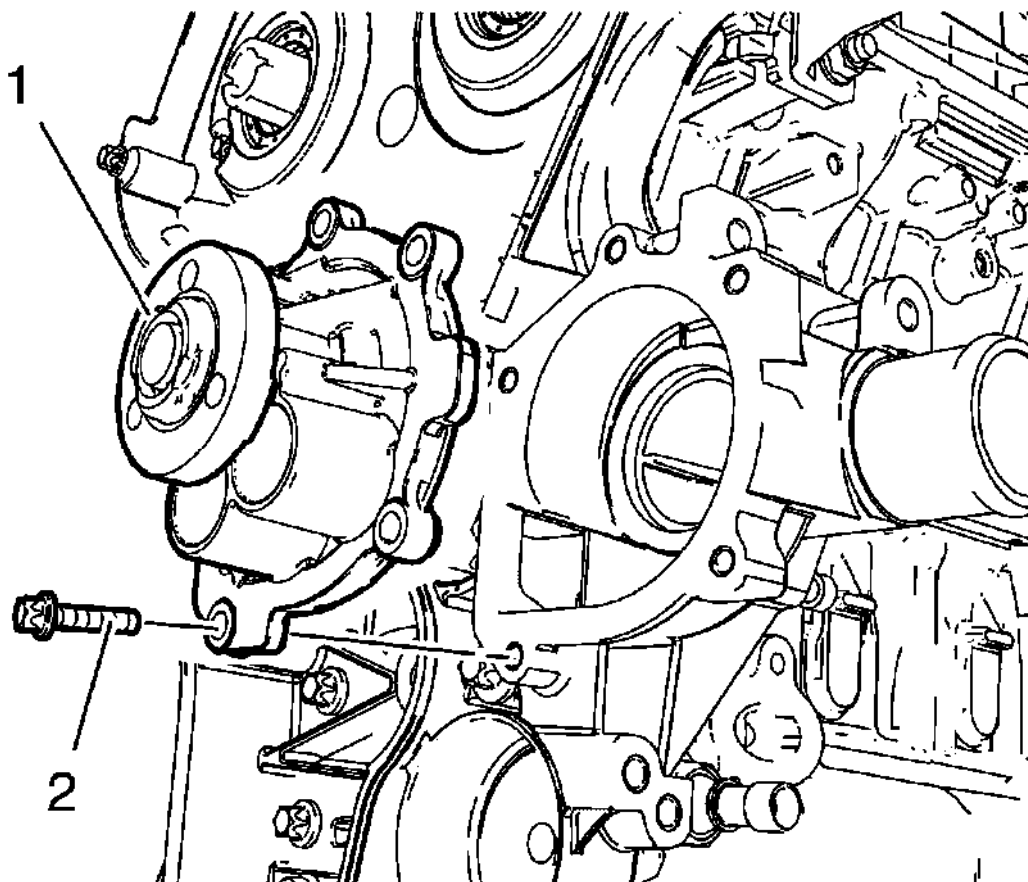


Fig. 121: Water Pump And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the water pump (1).

CAUTION: Refer to Fastener Caution .

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5. Install the 5 water pump bolts (2) and tighten to 8 N.m (71 lb in).
6. Install the water pump pulley. Refer to **Water Pump Pulley Replacement (1.8L LUW and LWE), Water Pump Pulley Replacement (1.4L LUV)**.
7. Refill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill)**.

ENGINE COOLANT FAN SHROUD REPLACEMENT

Removal Procedure

NOTE: It is not necessary to remove the hood latches and wiring clips from the front end upper tie bar for this procedure.

1. Remove and reposition the front end upper tie bar rearward. Refer to **Front End Upper Tie Bar Replacement** .
2. Disconnect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the radiator upper air seal.
4. Remove the left and right side radiator air baffles.
5. Position the radiator assembly forward for engine coolant fan shroud access.

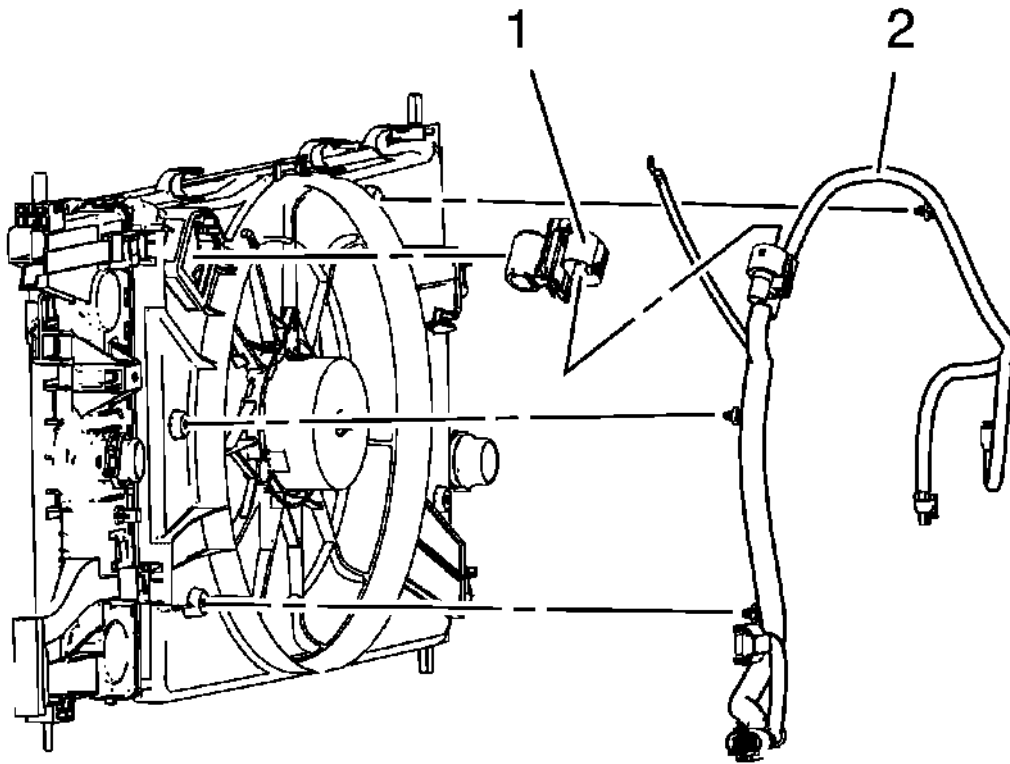


Fig. 122: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the engine coolant fan resistor wiring harness plug (1) and remove the ground cable nut.
7. Remove the wiring harness (3) and clips.

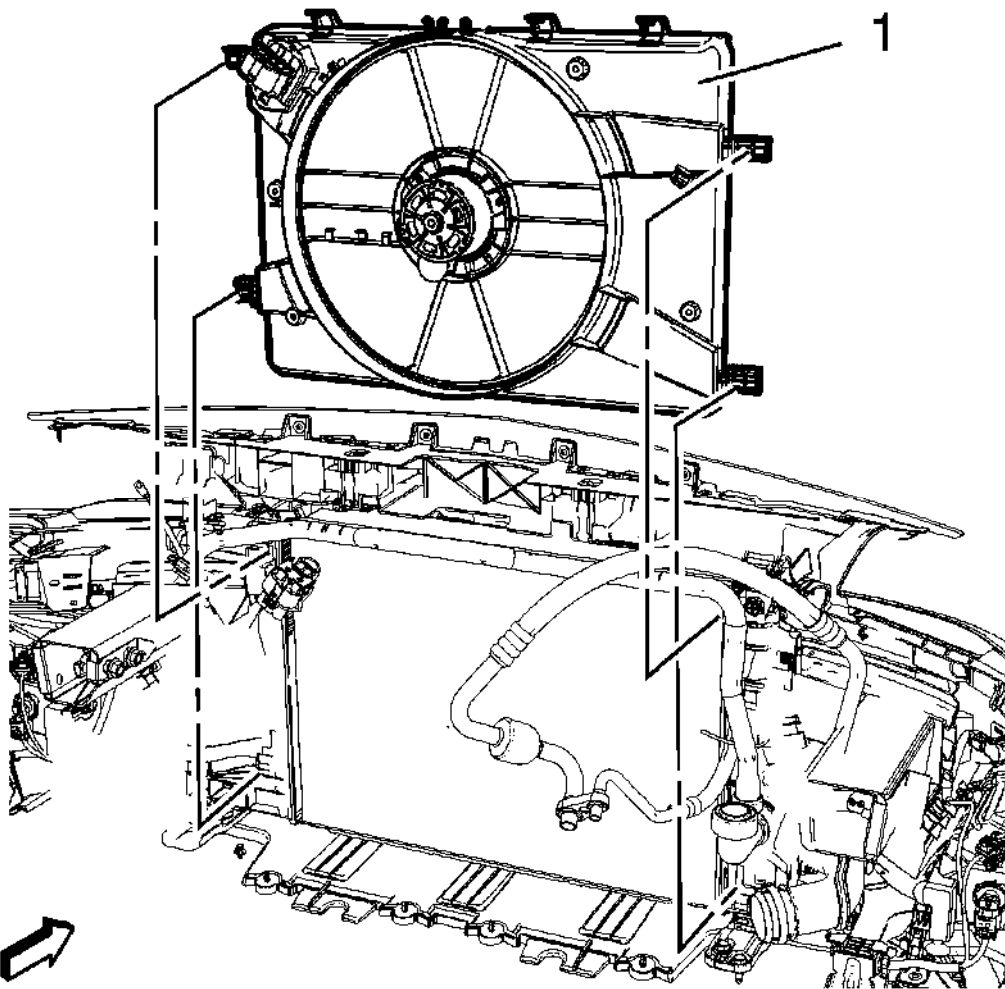


Fig. 123: Identifying Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

8. Unclip the engine coolant fan shroud (1) at the four mounting points shown.
9. Remove the engine coolant fan shroud (1).
 1. Slide the engine coolant fan shroud (1) toward the right side of the vehicle.
 2. Lift the left hand side of the engine coolant fan shroud (1) up.
 3. Remove the engine coolant fan shroud (1) from the vehicle.

Installation Procedure

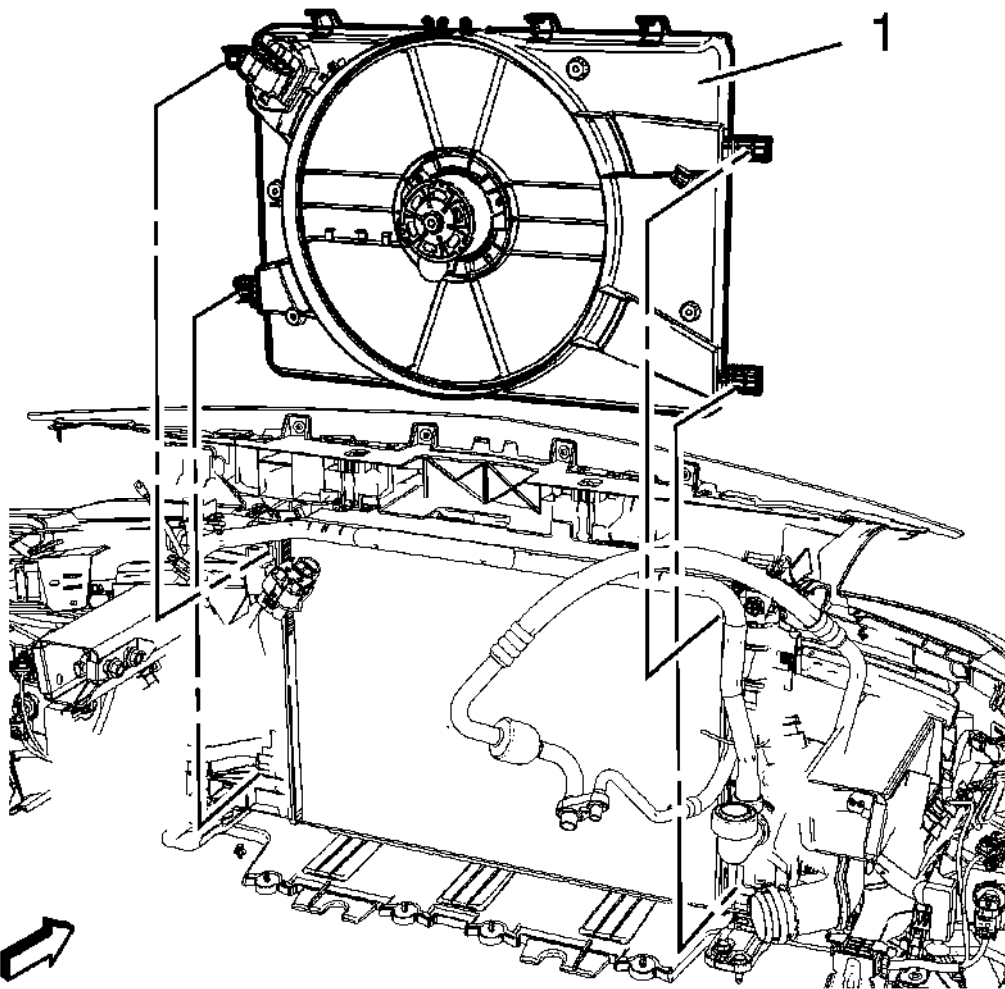


Fig. 124: Identifying Engine Coolant Fan Shroud

Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant fan shroud (1).
 1. Lower the right hand side of the engine coolant fan shroud (1) behind the radiator.
 2. Slide the engine coolant fan shroud (1) toward the left side of the vehicle.
2. Clip in the engine coolant fan shroud (1) at the four mounting points shown.

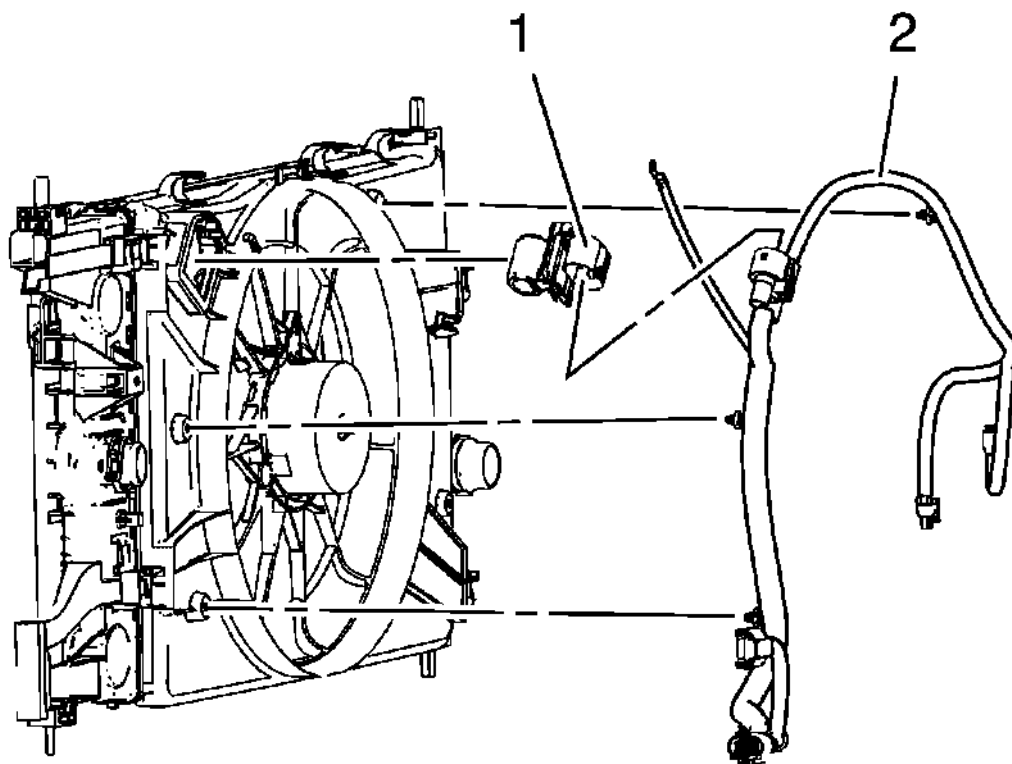


Fig. 125: Identifying Engine Coolant Fan Resistor Wiring Harness Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect the engine coolant fan resistor wiring harness connector (1).
4. Install the wiring harness (3) and clips.

CAUTION: Refer to Fastener Caution

5. Install the front end upper tie bar. Refer to **Front End Upper Tie Bar Replacement** .
6. Install the left and right side radiator air baffles.
7. Install the radiator upper air seal.
8. Connect battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .

RADIATOR REPLACEMENT (1.4L LUV WITH AUTOMATIC TRANSMISSION)

Removal Procedure

1. Remove the charge air cooler. Refer to **Charge Air Cooler Replacement (Automatic Transmission)**, **Charge Air Cooler Replacement (Manual Transmission)**.
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
3. Disconnect the radiator outlet hose and the radiator inlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement (1.8L LUW and LWE)**, **Radiator Outlet Hose Replacement (1.4L LUV)**, and **Radiator Inlet Hose Replacement (1.4L LUV)**, **Radiator Inlet Hose Replacement (1.8L LUW and LWE)**.
4. Remove the transmission fluid cooler inlet pipe from the radiator. Refer to **Transmission Fluid Cooler Inlet Pipe Replacement (1.4L LUV)**.
5. Remove the transmission fluid auxiliary cooler pipe. Refer to **Transmission Fluid Cooler Hose/Pipe Replacement**.
6. Use care and lay the transmission fluid cooler aside. Fix it in a suitable position so that the radiator is easy accessible.
7. Unclip the engine coolant fan shroud from the radiator.

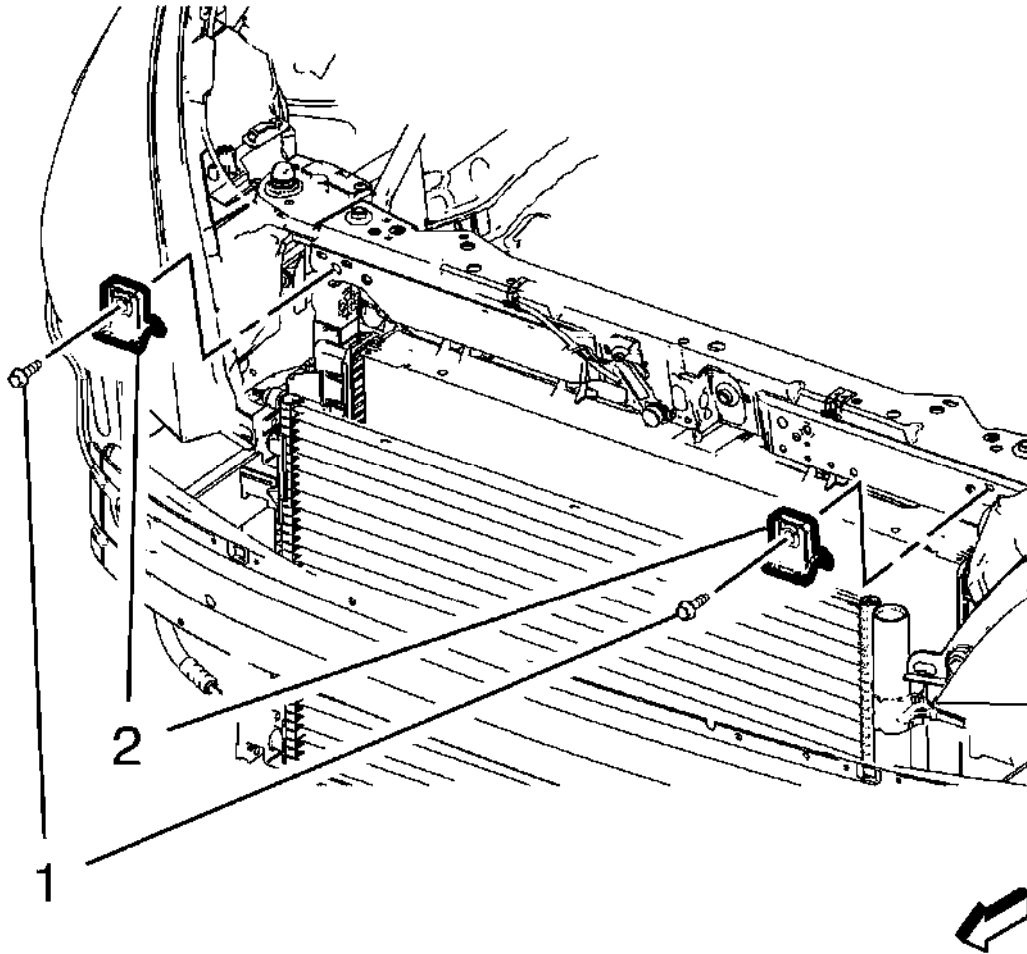


Fig. 126: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 radiator upper bracket bolts (1) and the 2 radiator upper brackets (2).

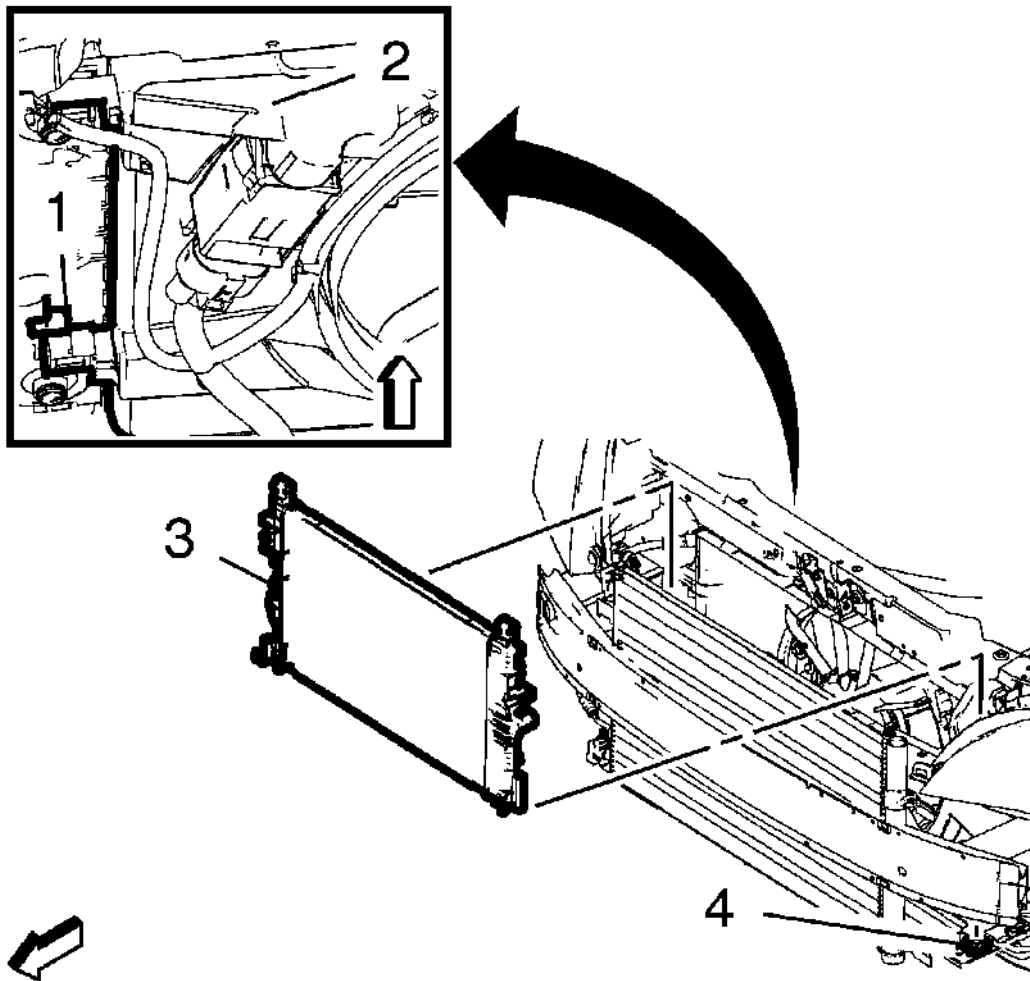


Fig. 127: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the radiator (1) from the 2 lower brackets (2).
10. Use care and rotate the radiator in order to gain more access for the removal.
11. Use care and lift the radiator up and away from the vehicle.

Installation Procedure

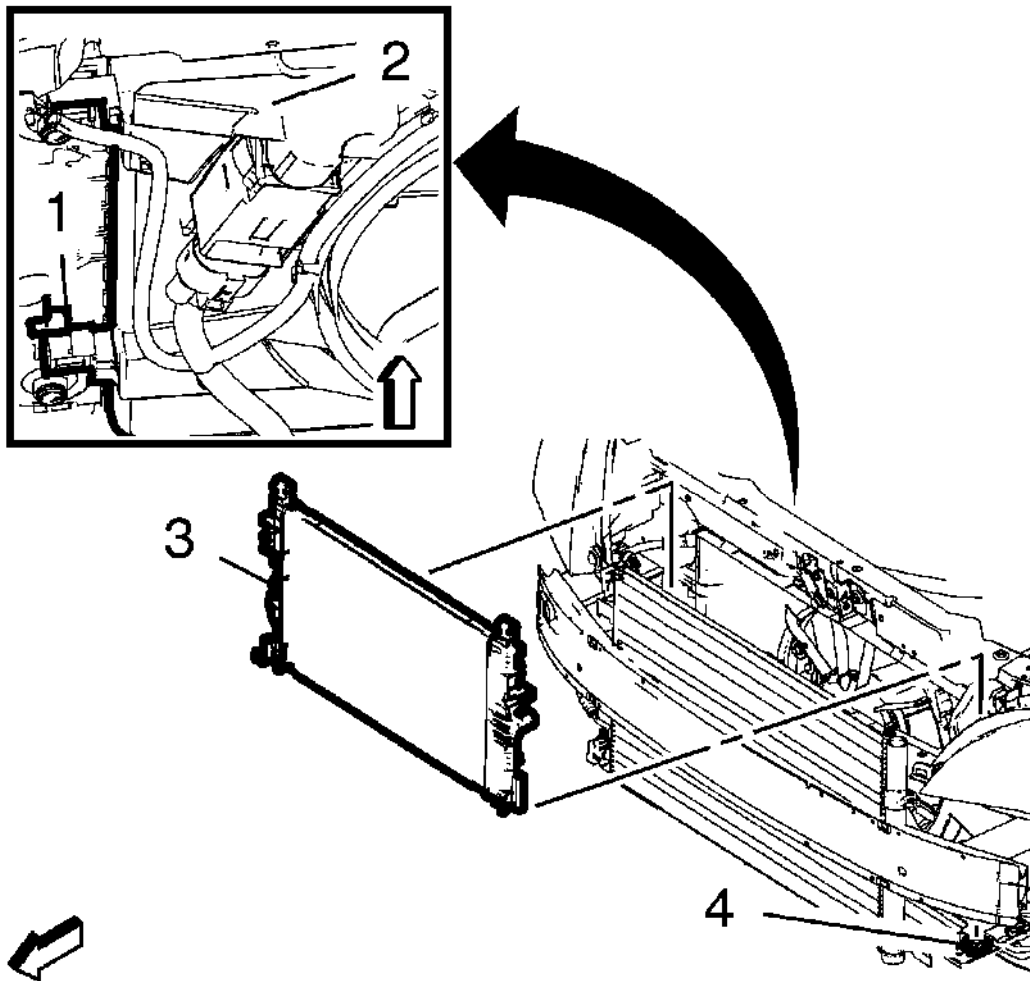


Fig. 128: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Use care and install the radiator (1).
2. Use care and rotate the radiator in order to get more access for the installation.
3. Install the radiator (1) to the 2 lower brackets (2).

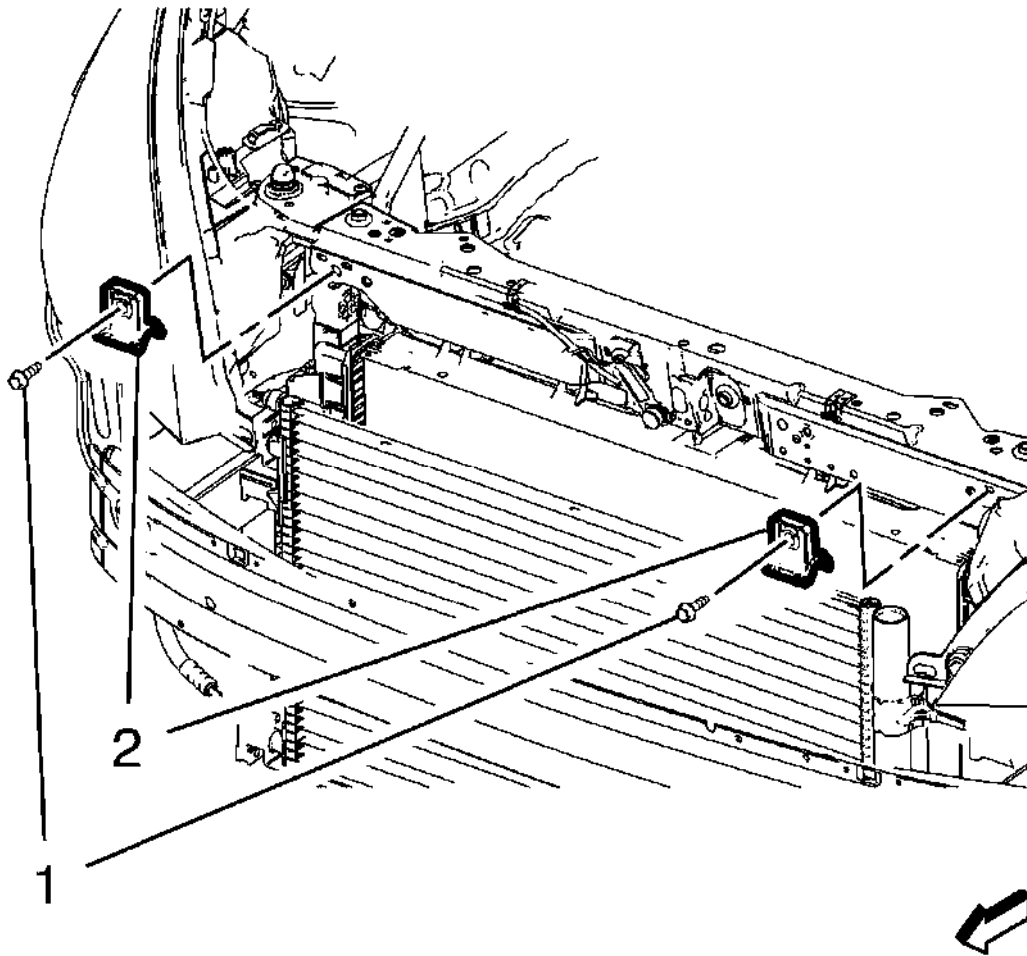


Fig. 129: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the 2 radiator upper brackets (2).

CAUTION: Refer to Fastener Caution .

5. Install the 2 radiator upper bracket bolts (1) and tighten to 22 N.m (16 lb ft).
6. Clip the engine coolant fan shroud to the radiator.
7. Install the transmission fluid auxiliary cooler pipe. Refer to Transmission Fluid Cooler Hose/Pipe Replacement .
8. Install the transmission fluid cooler inlet pipe to the radiator. Refer to Transmission Fluid Cooler Inlet Pipe Replacement (1.4L LUV) .
9. Connect the radiator outlet hose and the radiator inlet hose to the radiator. Refer to Radiator Outlet Hose Replacement (1.8L LUW and LWE), Radiator Outlet Hose Replacement (1.4L LUV), and Radiator

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Inlet Hose Replacement (1.4L LUV), Radiator Inlet Hose Replacement (1.8L LUW and LWE).

10. Fill and bleed the cooling system. Refer to **Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).**
11. Install the charge air cooler. Refer to **Charge Air Cooler Replacement (Automatic Transmission), Charge Air Cooler Replacement (Manual Transmission).**

RADIATOR REPLACEMENT (1.4L LUV WITH MANUAL TRANSMISSION)

Removal Procedure

1. Remove the charge air cooler. Refer to **Charge Air Cooler Replacement (Automatic Transmission), Charge Air Cooler Replacement (Manual Transmission).**
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).**
3. Disconnect the radiator outlet hose and the radiator inlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement (1.8L LUW and LWE), Radiator Outlet Hose Replacement (1.4L LUV), and Radiator Inlet Hose Replacement (1.4L LUV), Radiator Inlet Hose Replacement (1.8L LUW and LWE).**
4. Unclip the engine coolant fan shroud from the radiator.

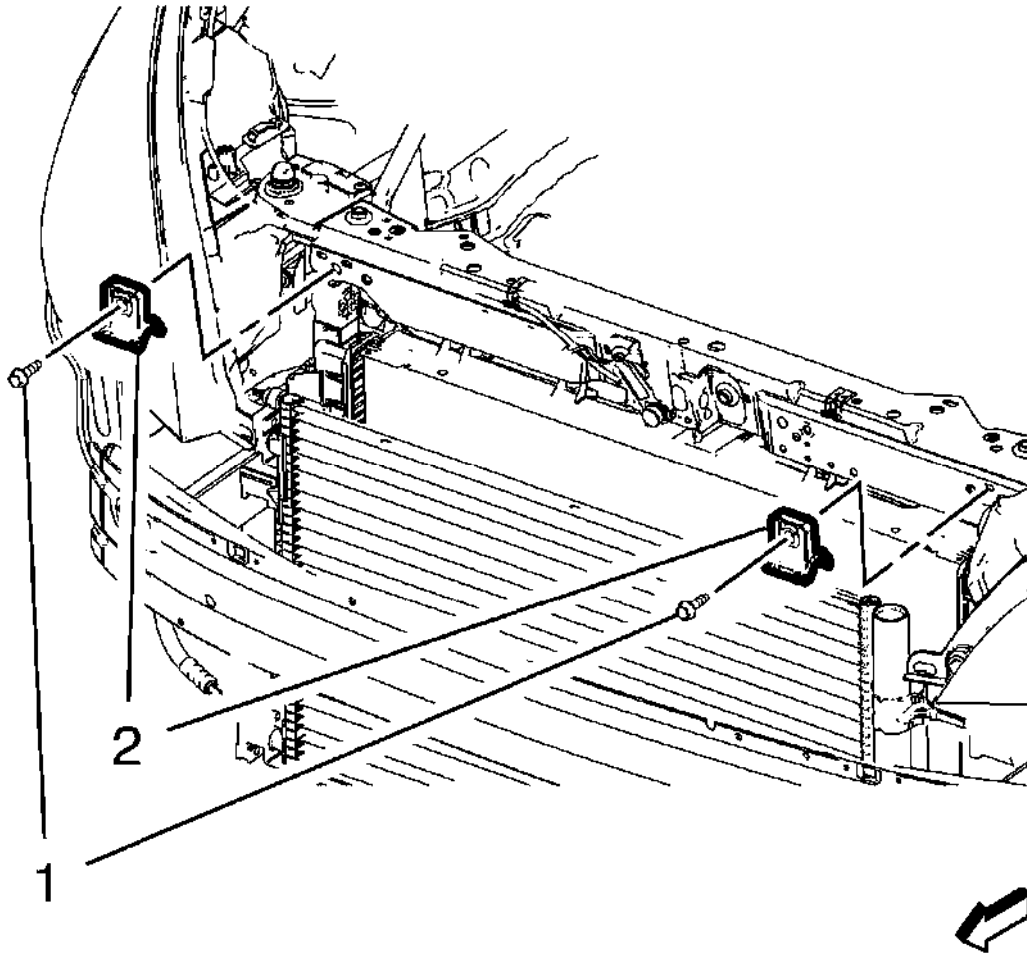


Fig. 130: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 radiator upper bracket bolts (1) and the 2 radiator upper brackets (2).

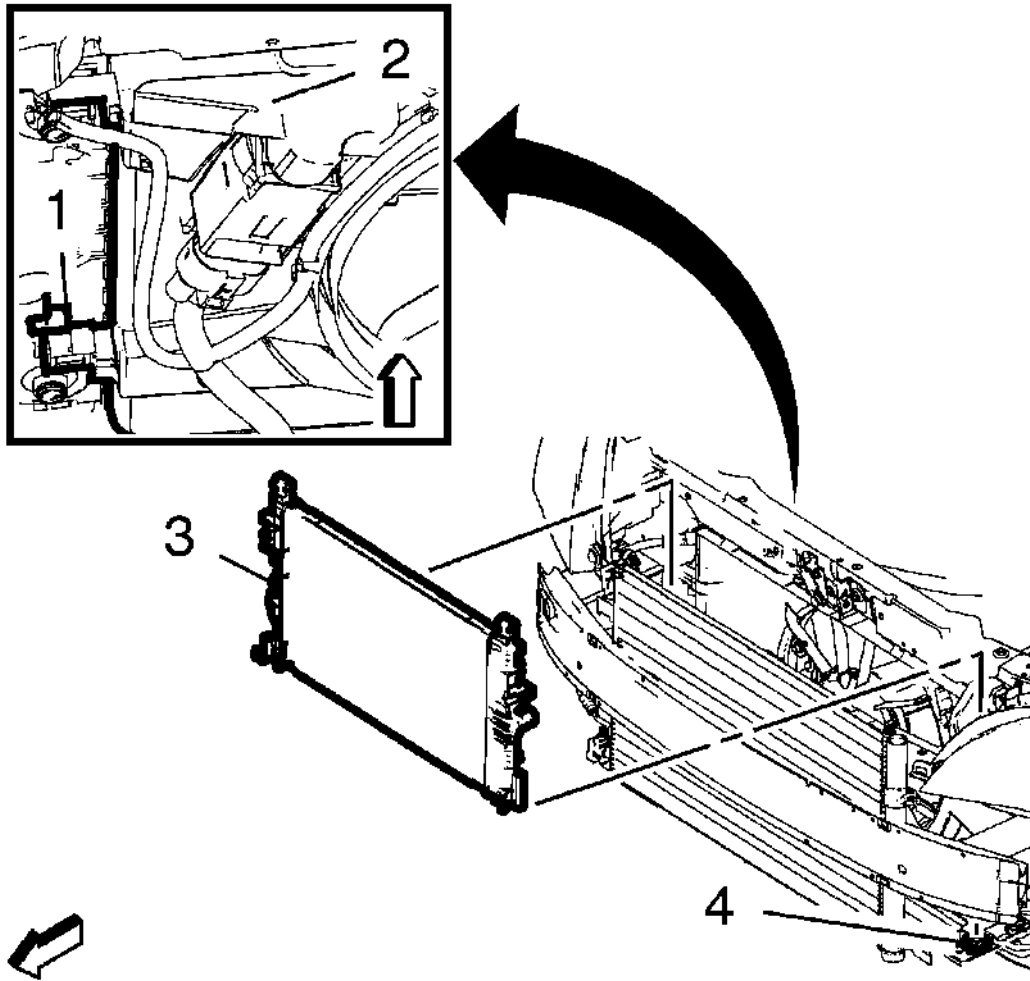


Fig. 131: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Remove the radiator (1) from the 2 lower brackets (2).
7. Use care and rotate the radiator in order to gain more access for the removal.
8. Use care and lift the radiator up and away from the vehicle.

Installation Procedure

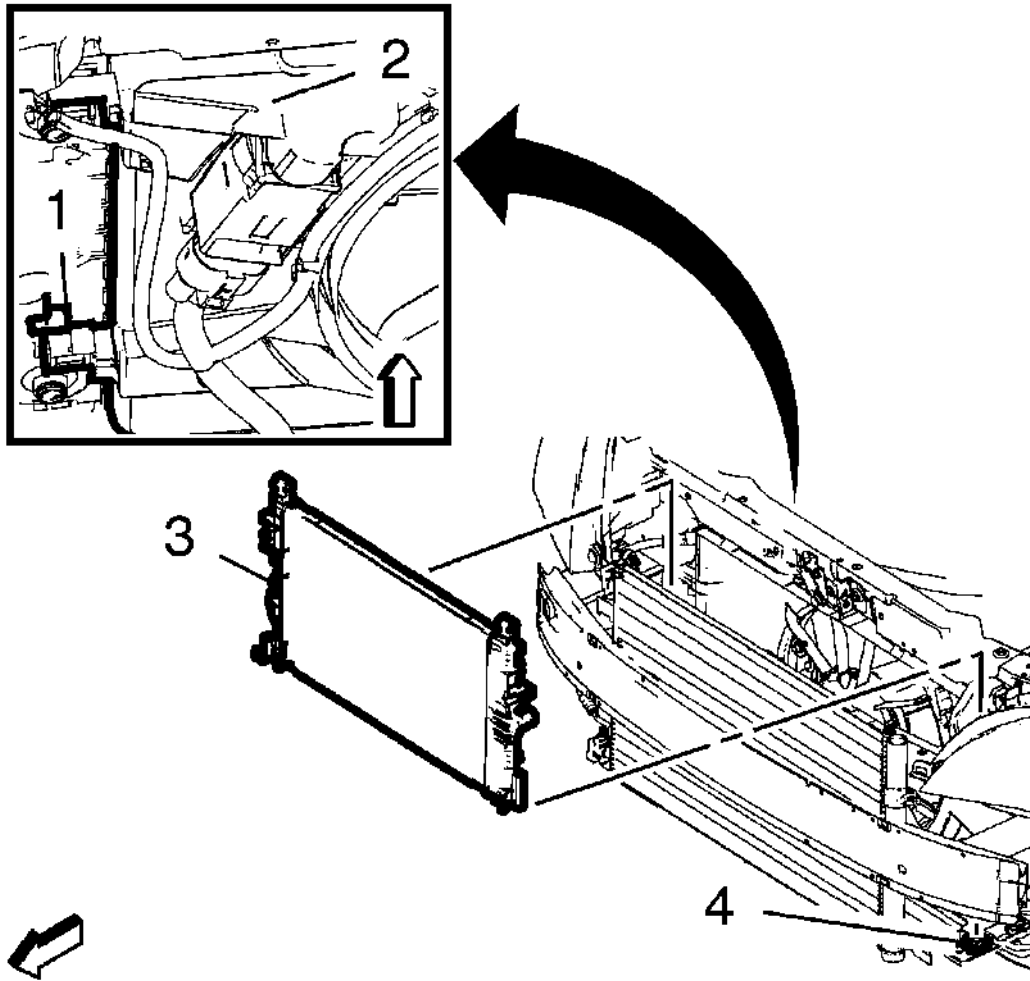


Fig. 132: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Use care and install the radiator (1).
2. Use care and rotate the radiator in order to get more access for the installation.
3. Install the radiator (1) to the 2 lower brackets (2).

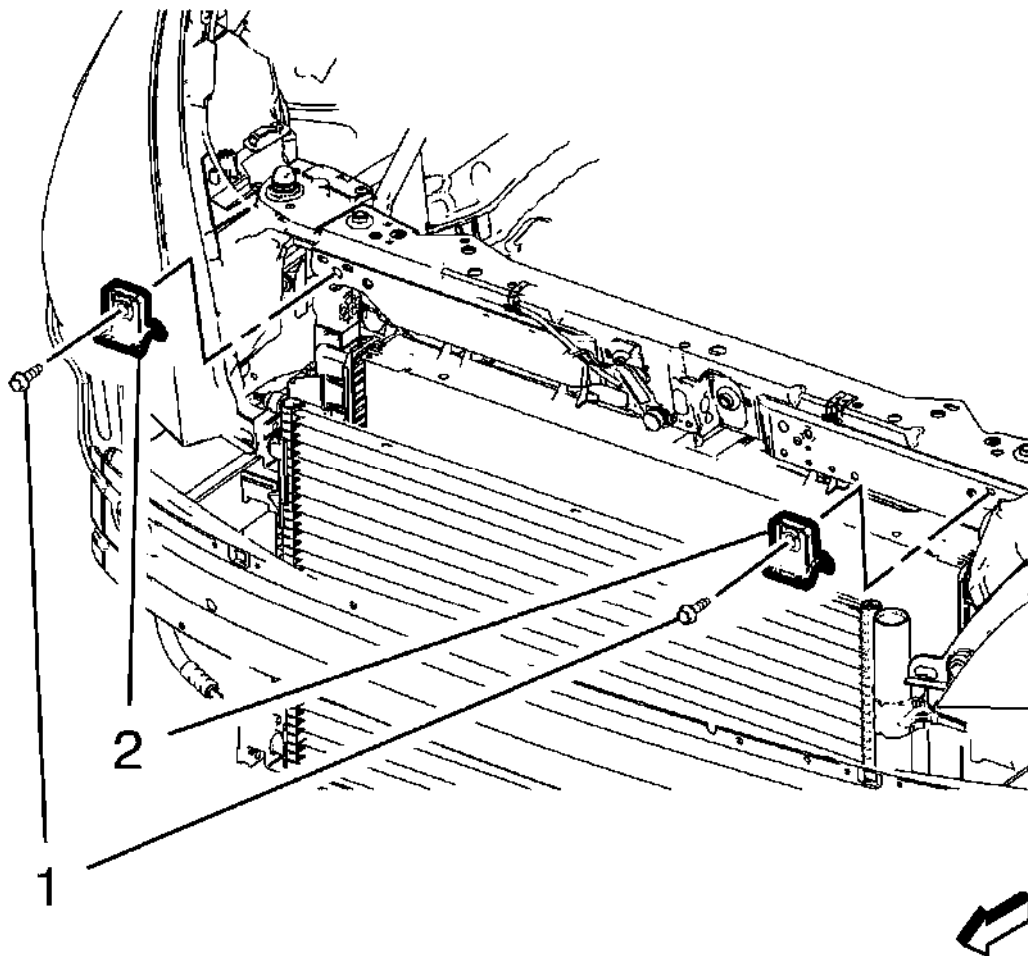


Fig. 133: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the 2 radiator upper brackets (2).

CAUTION: Refer to Fastener Caution .

5. Install the 2 radiator upper bracket bolts (1) and tighten to 22 N.m (16 lb ft).
6. Clip the engine coolant fan shroud to the radiator.
7. Connect the radiator outlet hose and the radiator inlet hose to the radiator. Refer to Radiator Outlet Hose Replacement (1.8L LUW and LWE), Radiator Outlet Hose Replacement (1.4L LUV), and Radiator Inlet Hose Replacement (1.4L LUV), Radiator Inlet Hose Replacement (1.8L LUW and LWE).
8. Fill and bleed the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (GE-47716 Fill).
9. Install the charge air cooler. Refer to Charge Air Cooler Replacement (Automatic Transmission).

Charge Air Cooler Replacement (Manual Transmission).

RADIATOR REPLACEMENT (1.8L LUW AND LWE)

Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.
4. Remove the front intake air duct deflector.

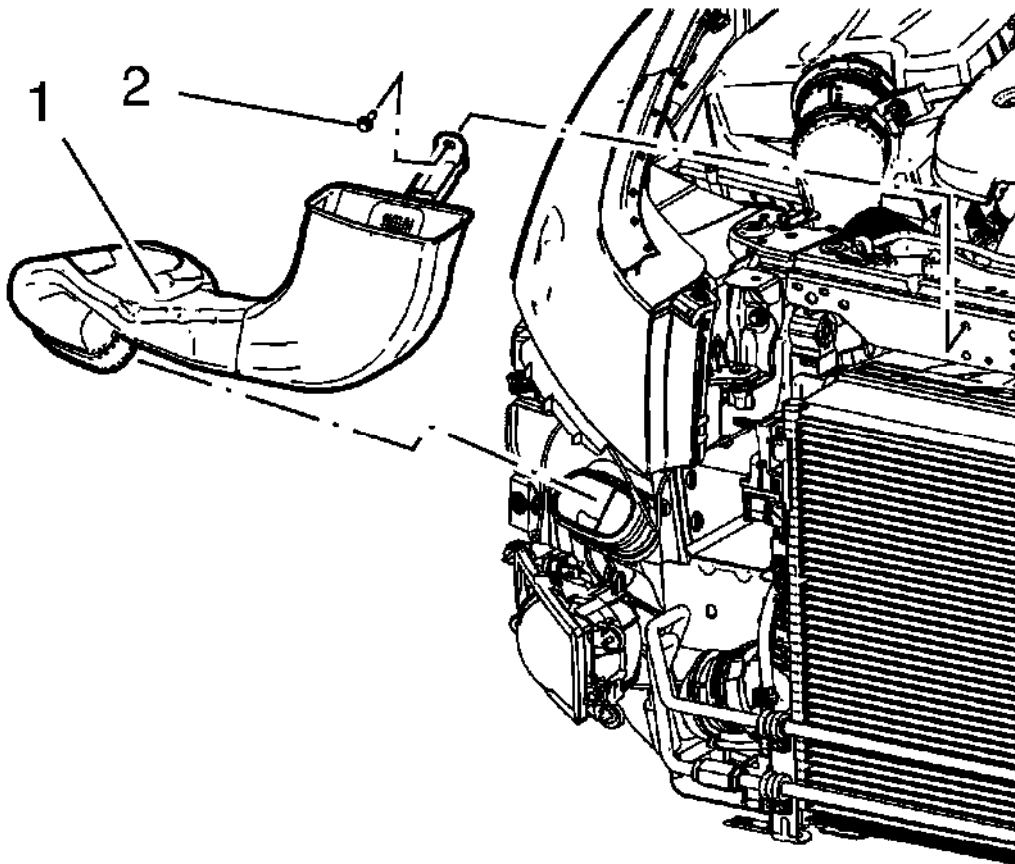


Fig. 134: Intake Air Duct And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the front intake air duct bolt (2).

6. Remove the front intake air duct (1).
7. Remove the radiator grill support. Refer to **Front Grille Support Replacement** .

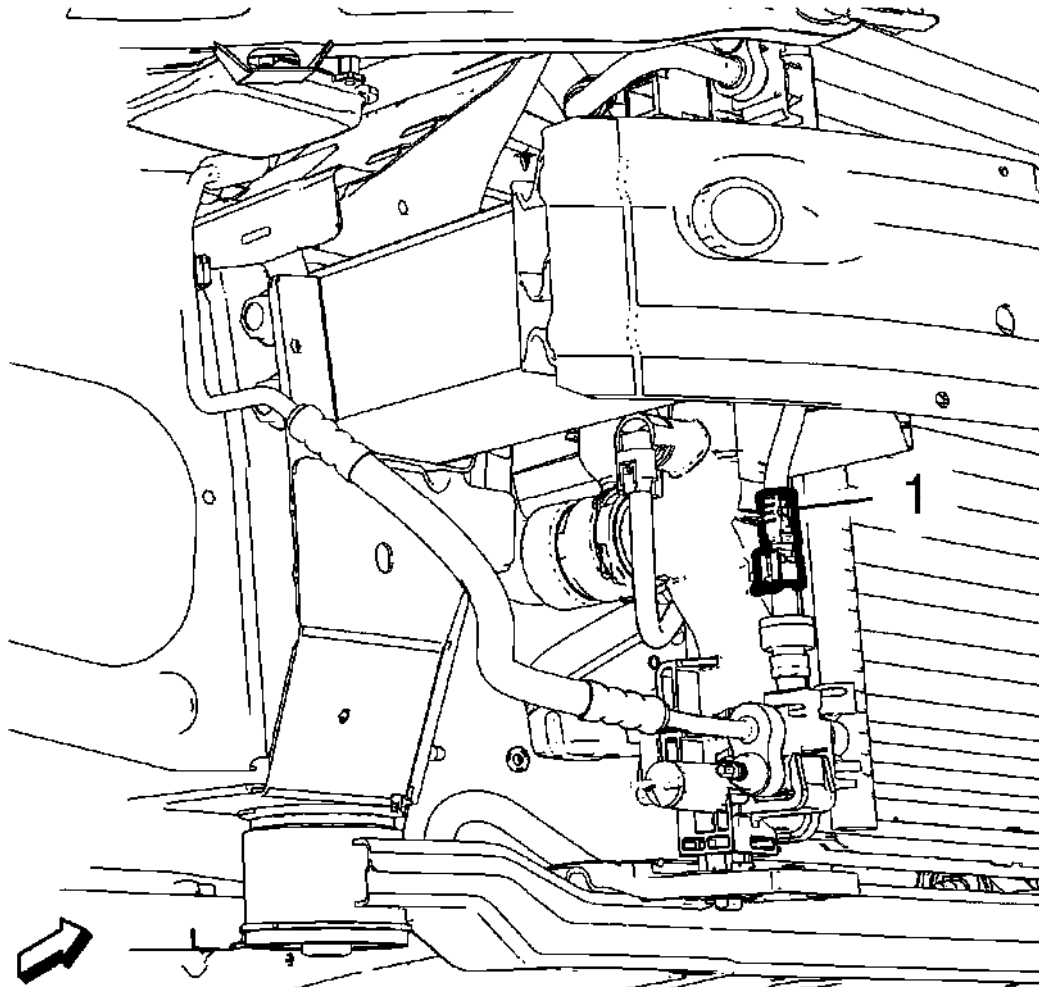


Fig. 135: A/C Pressure Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect and unclip the A/C pressure sensor wiring harness (1).

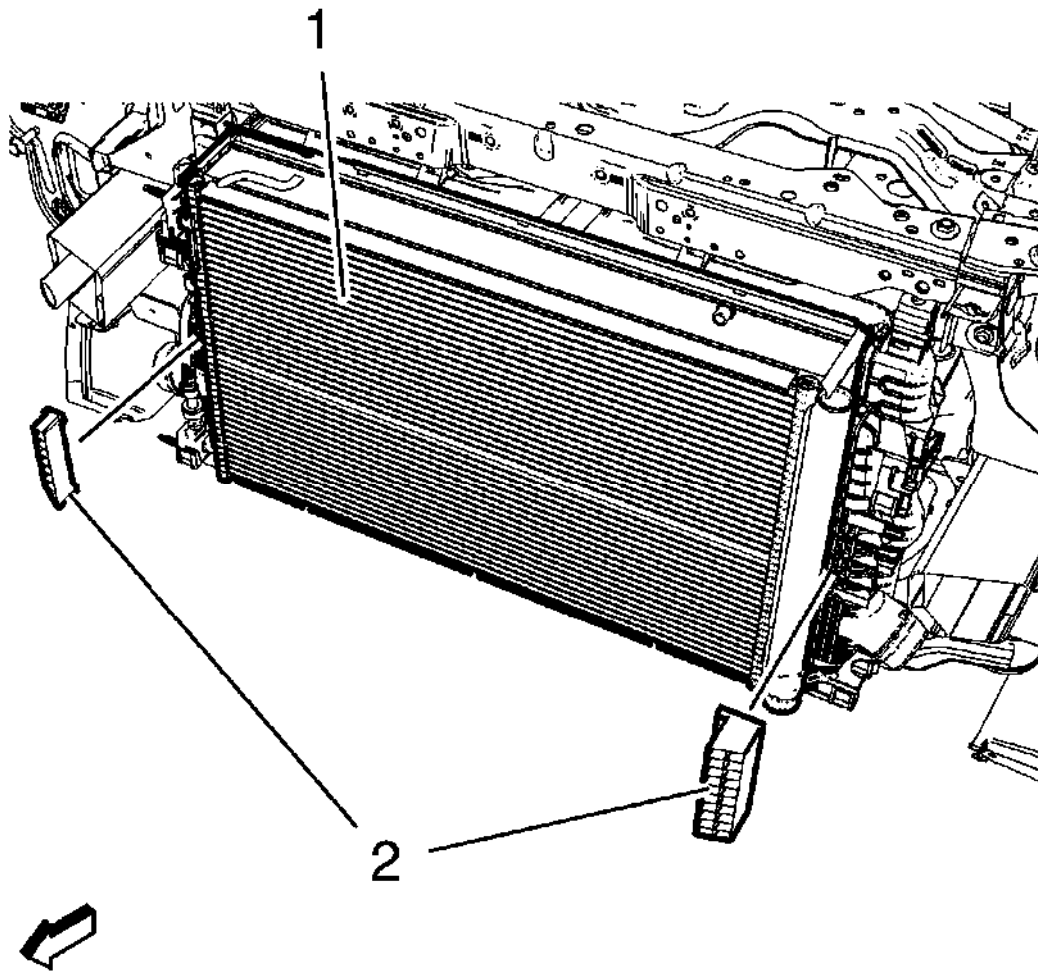


Fig. 136: Radiator Protector Fenders

Courtesy of GENERAL MOTORS COMPANY

9. Remove the 2 protector fenders (2) from the charge air cooler (1).
10. Disconnect the radiator outlet hose and the radiator inlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement (1.8L LUW and LWE)**, **Radiator Outlet Hose Replacement (1.4L LUV)**, and **Radiator Inlet Hose Replacement (1.4L LUV)**, **Radiator Inlet Hose Replacement (1.8L LUW and LWE)**.
11. If equipped, remove the transmission fluid cooler inlet pipe from the radiator. Refer to **Transmission Fluid Cooler Inlet Pipe Replacement (1.4L LUV)**.
12. If equipped, remove the transmission fluid cooler outlet pipe from the radiator. Refer to **Transmission Fluid Cooler Outlet Pipe Replacement (1.4L LUV)**.
13. Unclip the engine coolant fan shroud from the radiator.

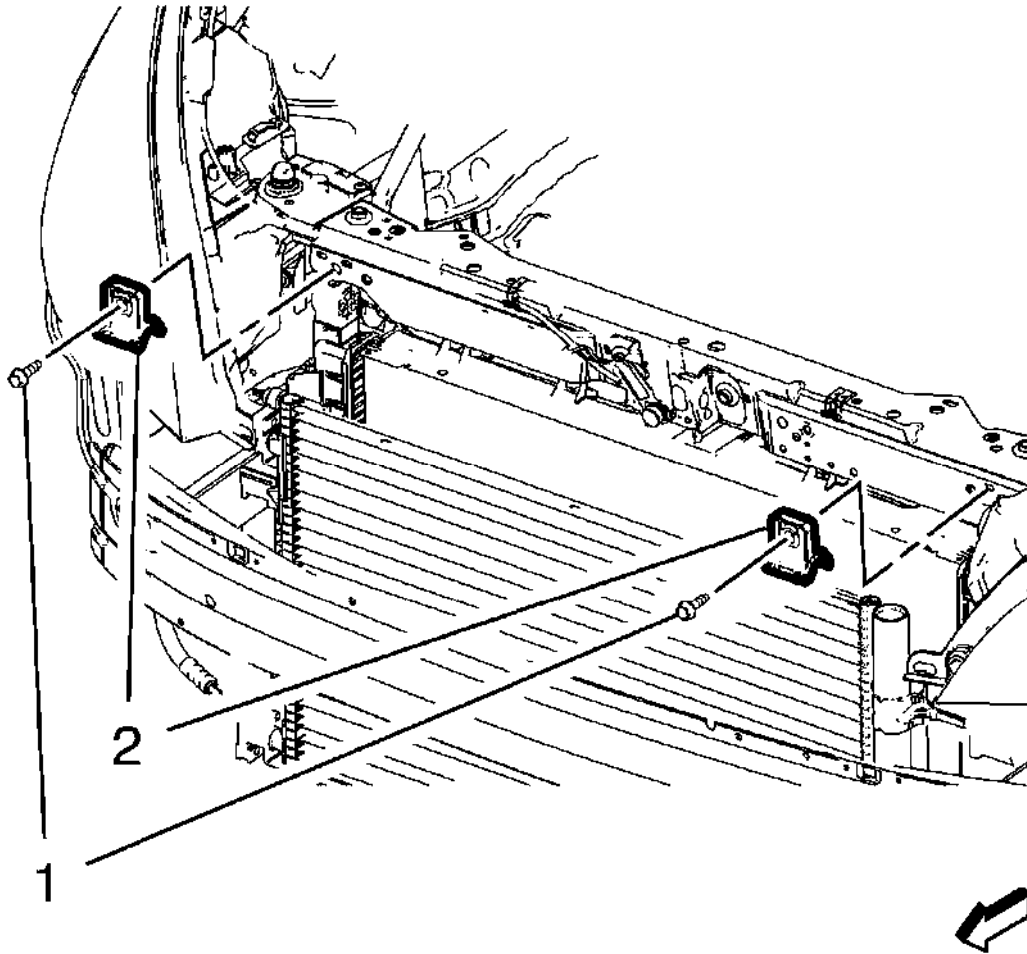


Fig. 137: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove the 2 radiator upper bracket bolts (1) and the 2 radiator upper brackets (2).

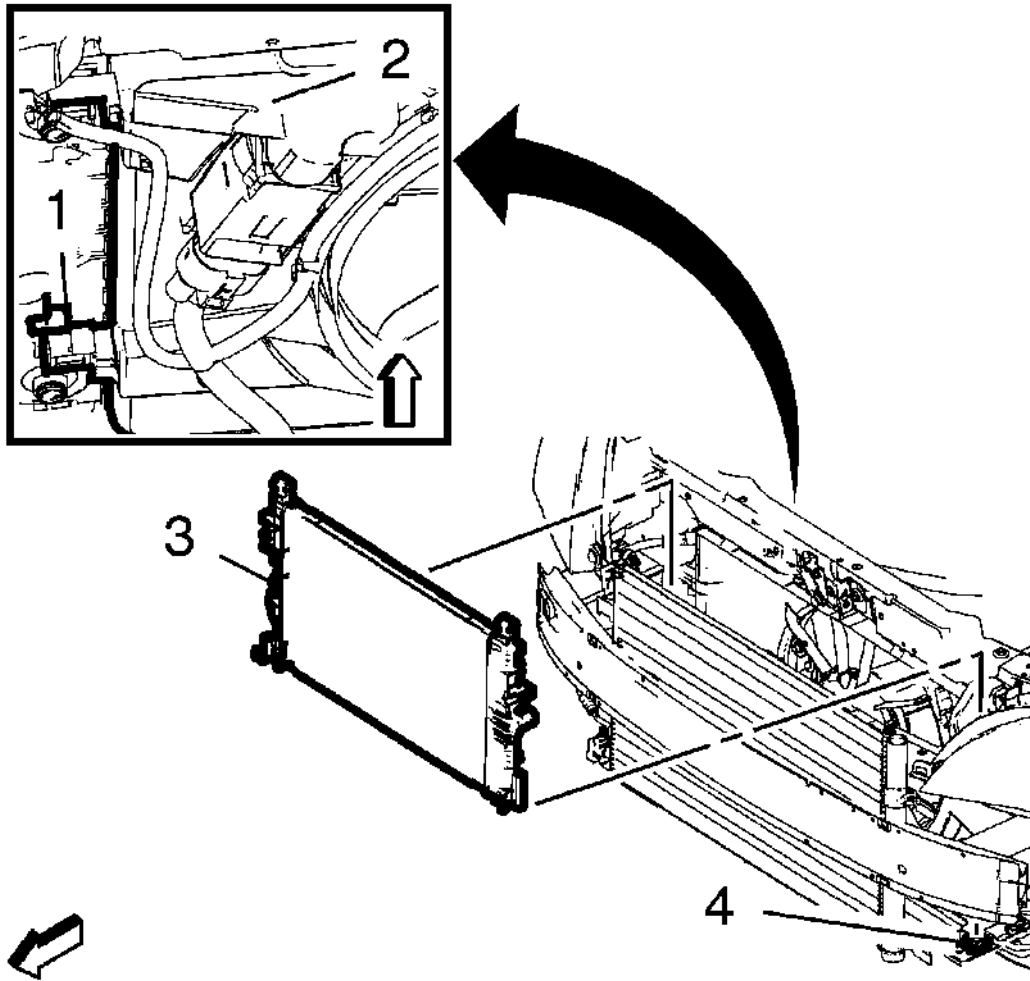


Fig. 138: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

15. Remove the radiator (1) from the 2 lower brackets (2).
16. Use care and rotate the radiator in order to gain more access for the removal.
17. Use care and lift the radiator up and away from the vehicle.

Installation Procedure

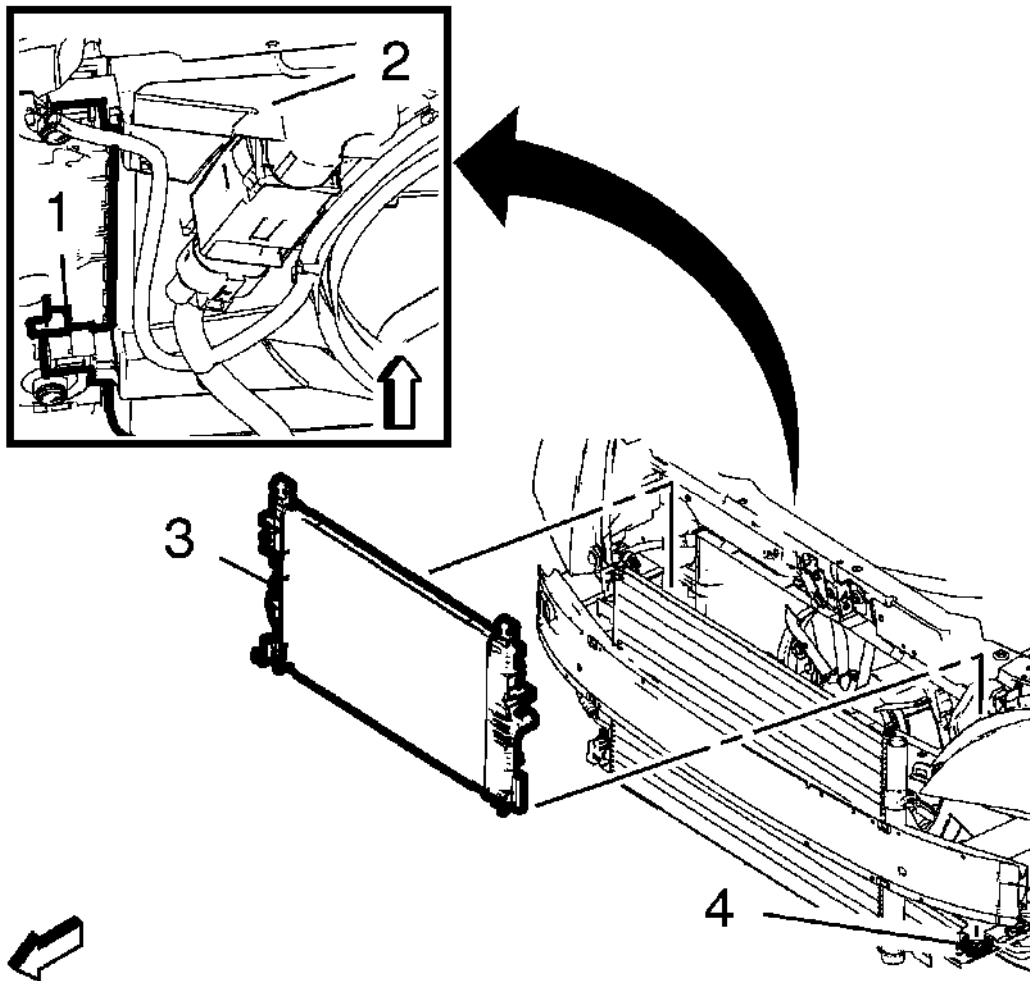


Fig. 139: Radiator And Lower Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Handle the radiator with care.

1. Use care and install the radiator (1).
2. Use care and rotate the radiator in order to get more access for the installation.
3. Install the radiator (1) to the 2 lower brackets (2).

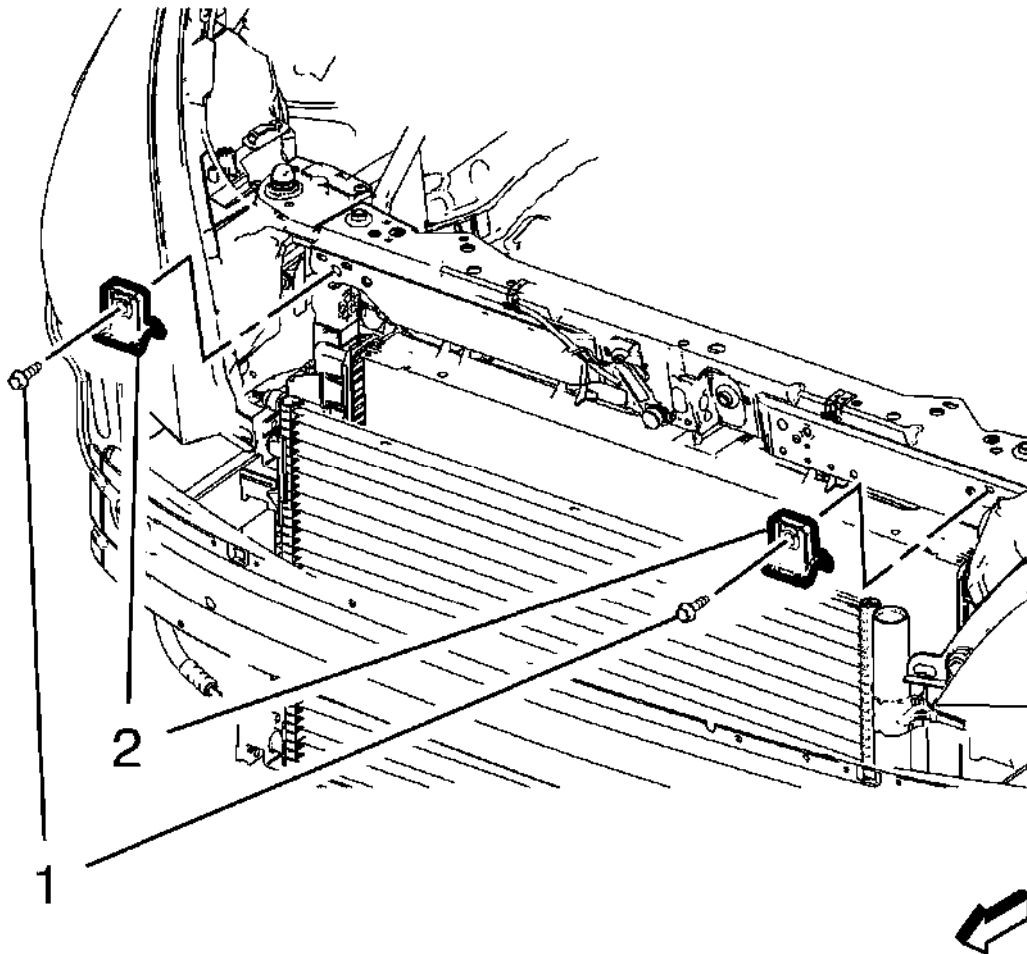


Fig. 140: Radiator Upper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the 2 radiator upper brackets (2).

CAUTION: Refer to Fastener Caution .

5. Install the 2 radiator upper bracket bolts (1) and tighten to 22 N.m (16 lb ft).
6. Clip the engine coolant fan shroud to the radiator.
7. Connect the radiator outlet hose and the radiator inlet hose to the radiator. Refer to Radiator Outlet Hose Replacement (1.8L LUW and LWE), Radiator Outlet Hose Replacement (1.4L LUV), and Radiator Inlet Hose Replacement (1.4L LUV), Radiator Inlet Hose Replacement (1.8L LUW and LWE).
8. If equipped, install the transmission fluid cooler inlet pipe to the radiator. Refer to Transmission Fluid Cooler Inlet Pipe Replacement (1.4L LUV) .
9. If equipped, install the transmission fluid cooler outlet pipe to the radiator. Refer to Transmission Fluid

Cooler Outlet Pipe Replacement (1.4L LUV) .

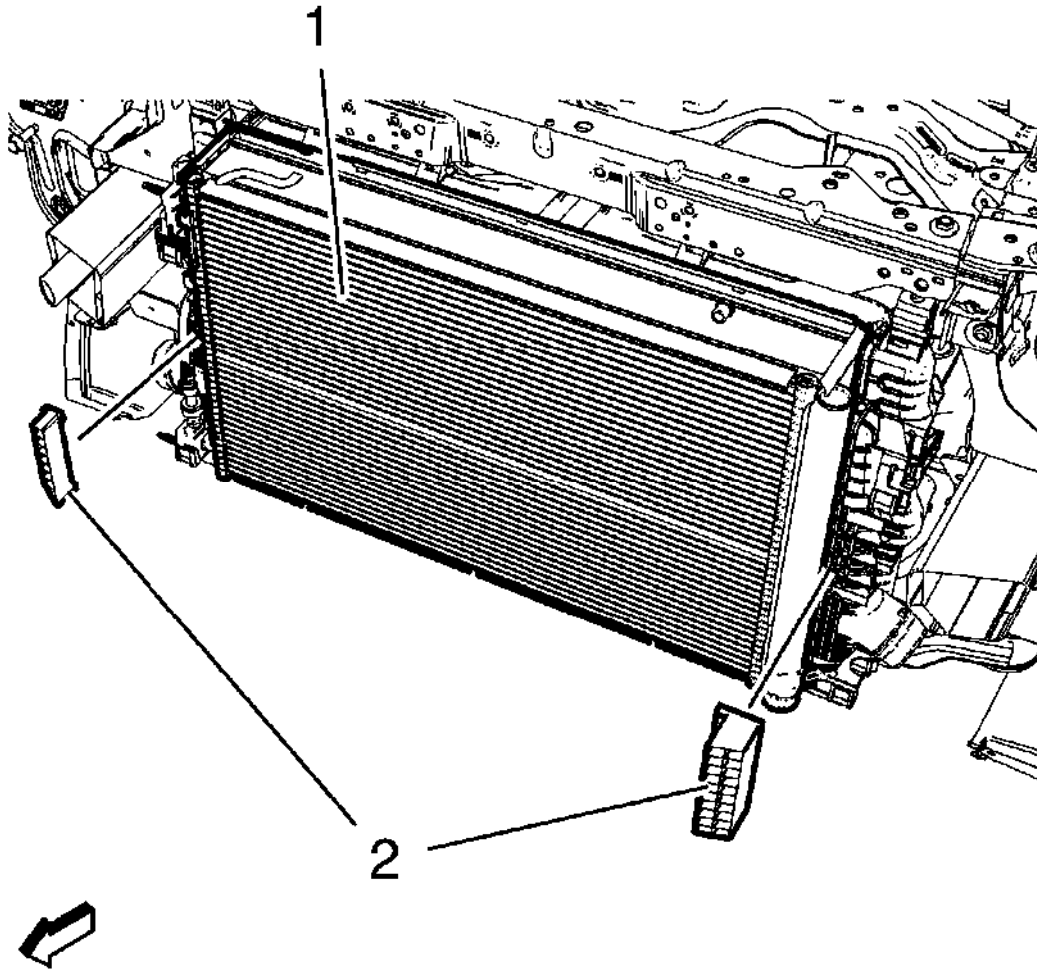


Fig. 141: Radiator Protector Fenders
Courtesy of GENERAL MOTORS COMPANY

10. Install the 2 protector fenders (2) to the charge air cooler (1).

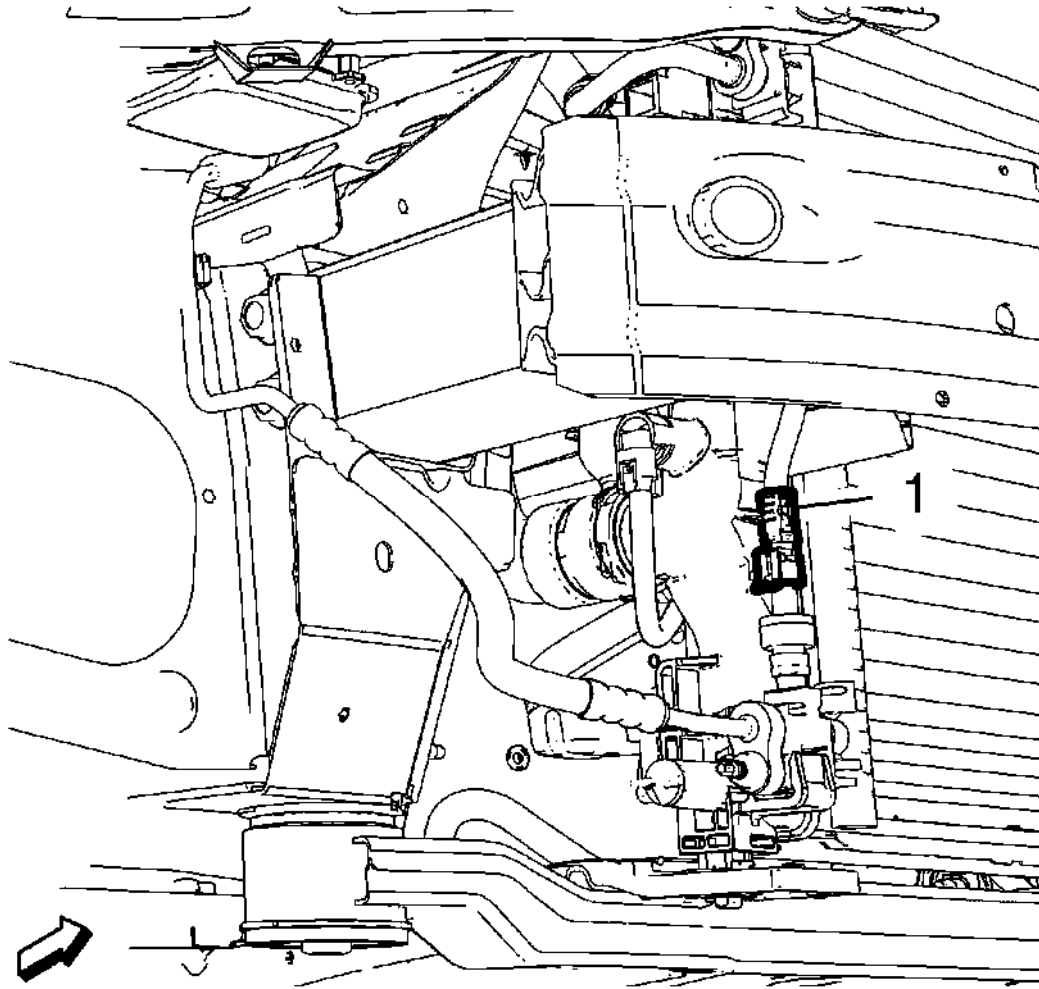


Fig. 142: A/C Pressure Sensor Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

11. Connect and clip in the A/C pressure sensor wiring harness (1).
12. Install the radiator grill support. Refer to **Front Grille Support Replacement** .

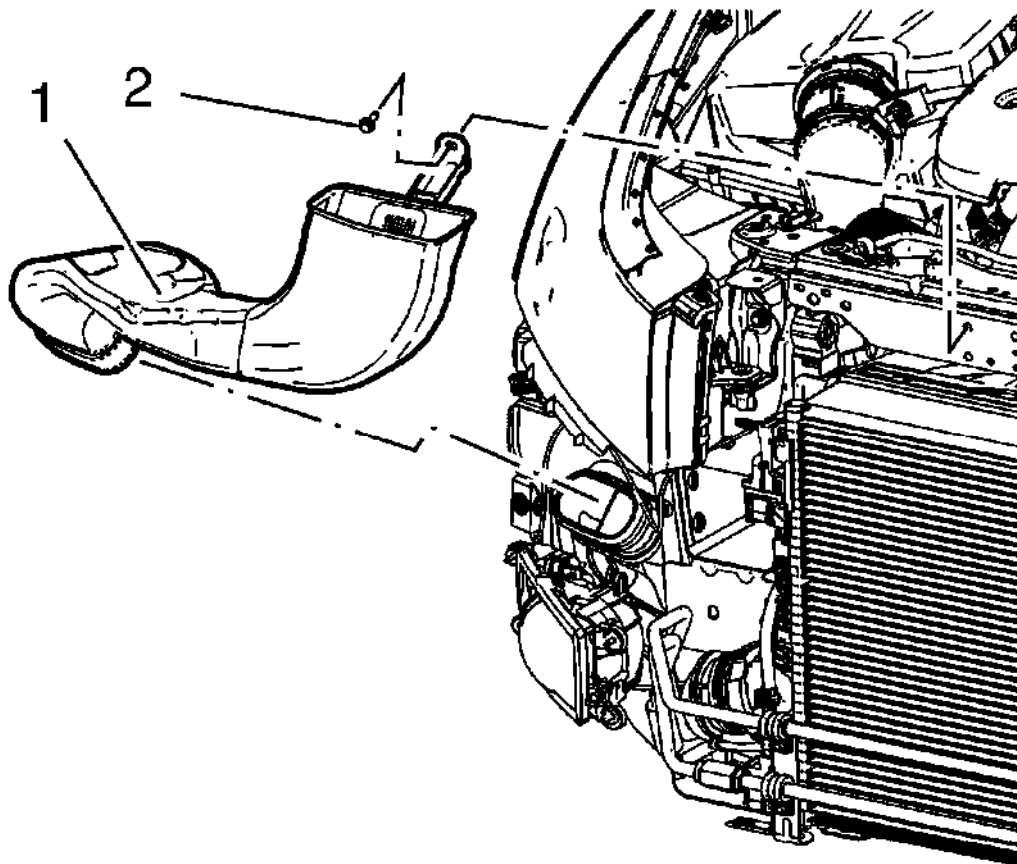
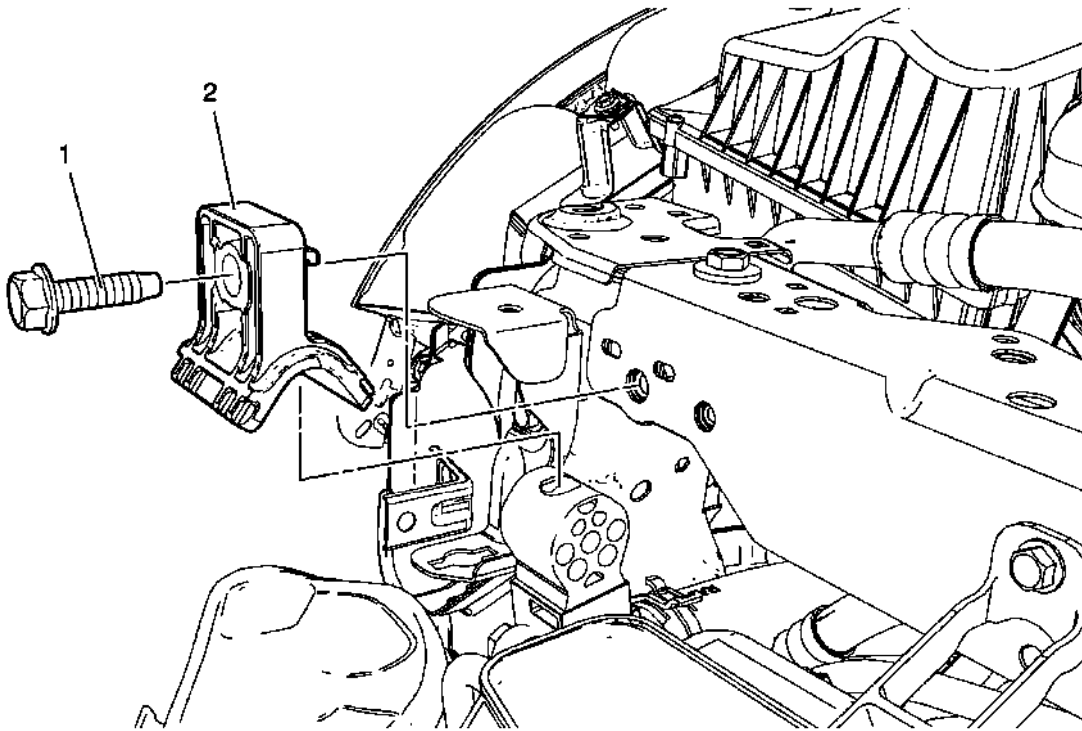


Fig. 143: Intake Air Duct And Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Install the front intake air duct (1).
14. Install the front intake air duct bolt (2).
15. Install the front intake air duct deflector.
16. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
17. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** .
18. Fill and bleed the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (GE-47716 Fill)**.

RADIATOR SUPPORT BRACKET REPLACEMENT

**Fig. 144: Radiator Support Bracket**

Courtesy of GENERAL MOTORS COMPANY

Radiator Support Bracket Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement .	
1	Radiator Support Bracket Bolt CAUTION: Refer to Fastener Caution . Tighten 22 N.m (17 lb ft)
2	Radiator Support Bracket Procedure Pull the radiator forward until the bracket is reachable.

DESCRIPTION AND OPERATION**COOLING FAN DESCRIPTION AND OPERATION**

The engine cooling fan system is composed of one cooling fan, a series of 5 relays, the engine control module (ECM), and the associated wiring. The cooling fan assembly includes two resistors. This combination of

components enables the ECM to operate the cooling fan at 3 speeds using two fan control circuits.

Low Speed Operation

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

Medium Speed Operation

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

High Speed Operation

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

COOLING SYSTEM DESCRIPTION AND OPERATION (1.4L LUV)

Cooling System

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

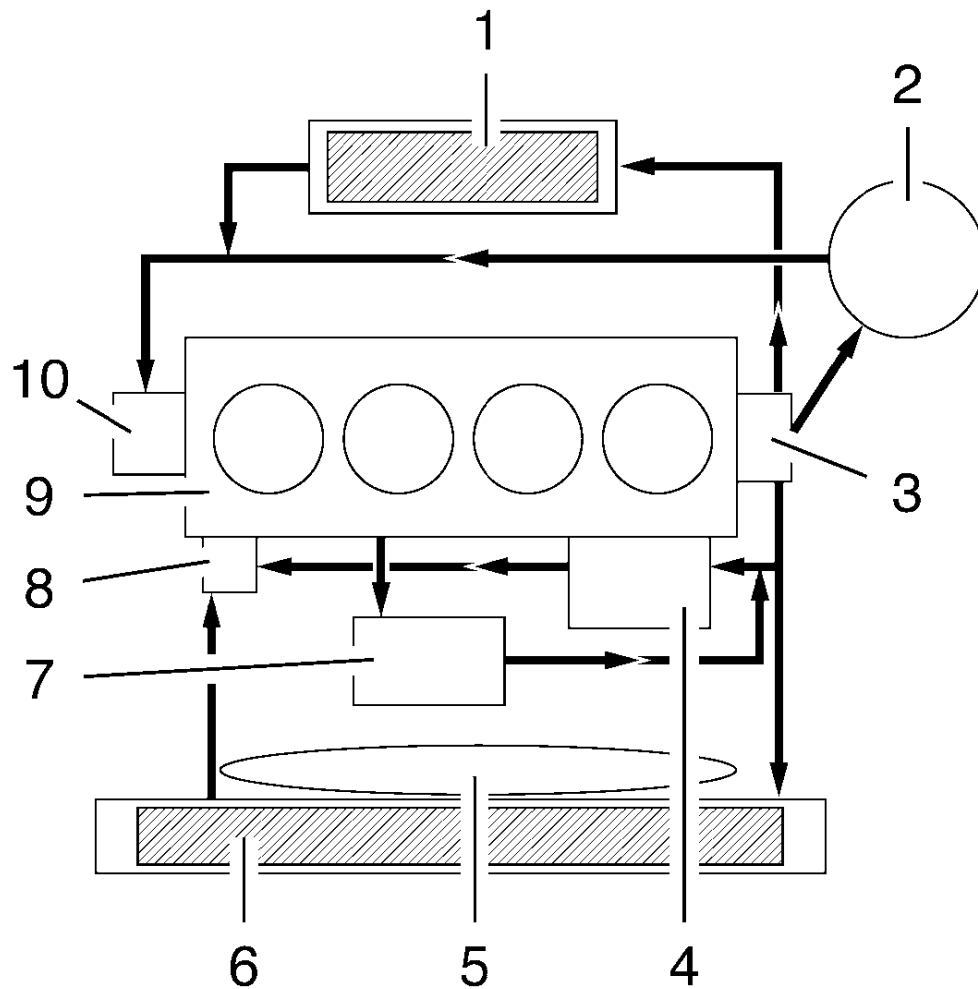


Fig. 145: Cooling System Flow Operation
Courtesy of GENERAL MOTORS COMPANY

NOTE: See arrows for coolant flow order.

The cooling system consists of the following components:

- Heater (1)
- Surge Tank (2)
- Water Outlet (3)
- Engine Oil Cooler (4)
- Cooling Fan (5)
- Radiator (6)
- Turbocharger (7)
- Engine Coolant Thermostat (8)

- Engine Block (9)
- Water Pump (10)

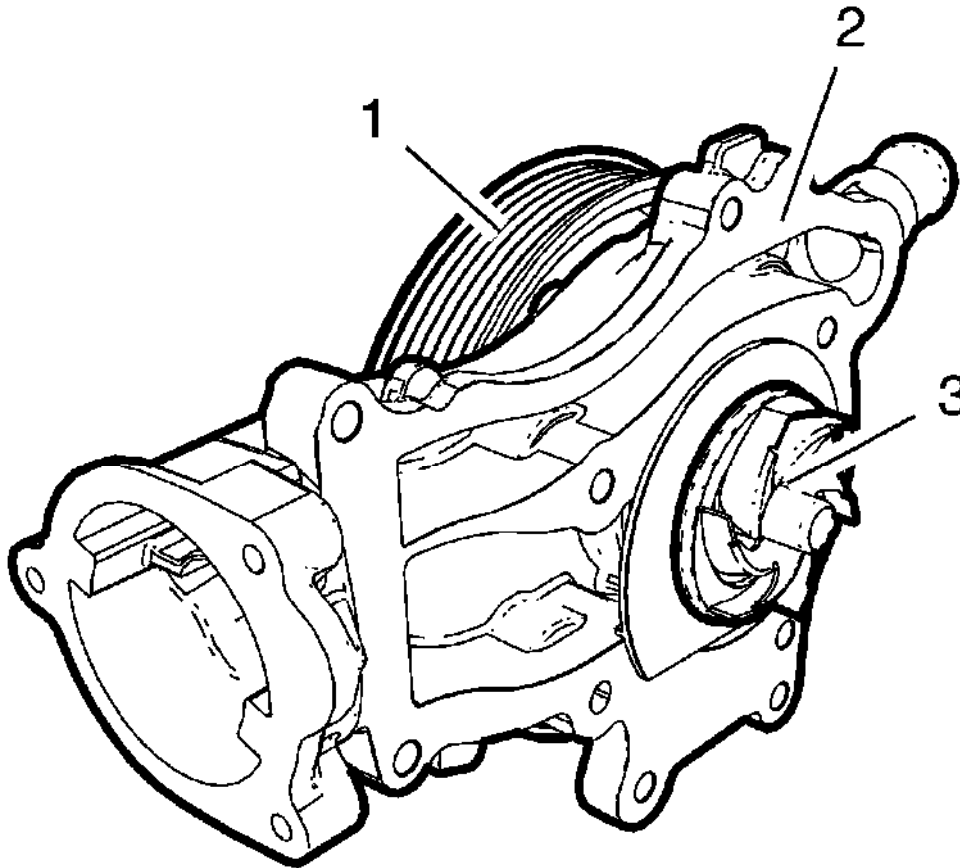
Water Pump

Fig. 146: Water Pump (1.4L LUJ)

Courtesy of GENERAL MOTORS COMPANY

Water pump is a component of the engine cooling system and circulated the coolant from each cooling circuit components. This water pump consists of sealing, bearing, pulley (1) and housing (2) and is driven by the drive belt to loose noise to water pump pulley. Water pump apply drain hole cup to cap to prevent coolant leakage for customers. Water pump is not open impeller type but closed plastic impeller type (3) to increase the cooling efficiency.

Thermostat

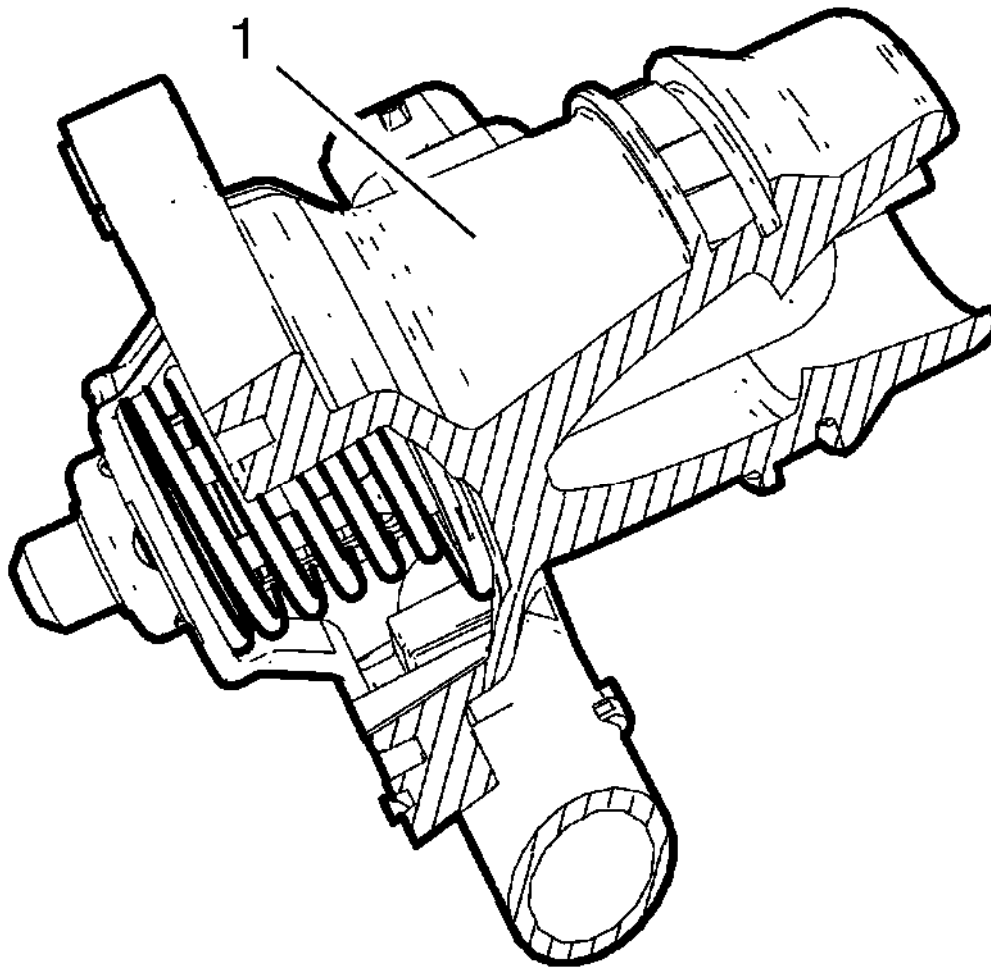


Fig. 147: Thermostat (1.4L LUJ)

Courtesy of GENERAL MOTORS COMPANY

The Thermostat is a regular part of the Thermostat Housing (1). The thermostat controls coolant flowing. It is a grid controlled electronic wax pellet type. By coolant temperature and / or applying current, the wax-pellet of the thermostat is molten what leads to the opening of the thermostat. That allows the coolant to flow through the radiator. The electronic heating of the thermostat is controlled by the engine control unit. The thermostat begins to open with 0V at 103°C (217°F) and with 12V at 80°C (176°F). It is fully open at 117°C (243°F). Whether the thermostat opening is supported by the electronic heating or not depends on load conditions which are defined as parameters in the grid.

Radiator

The radiator is a heat exchanger. It consists of a core and 2 tanks. The aluminum core is a tube and fin cross-flow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere. The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the

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core. The radiator also has a drain cock located in the bottom of the left hand tank. The drain cock unit includes the drain cock and drain cock seal. The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

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.

Cooling Fan

The cooling fan is mounted behind the radiator in the engine compartment. The engine cooling fan is driven by electric power. The cooling fan draws air through the radiator to improve the transfer of heat from the coolant to the atmosphere. As the fan blades spin, they increase the flow of air across the radiator core and across the condenser on air condition (A/C) equipped vehicles. This helps to speed cooling when the vehicle is at idle or moving at low speeds.

COOLING SYSTEM DESCRIPTION AND OPERATION (1.8L LUW AND LWE)

Cooling System

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

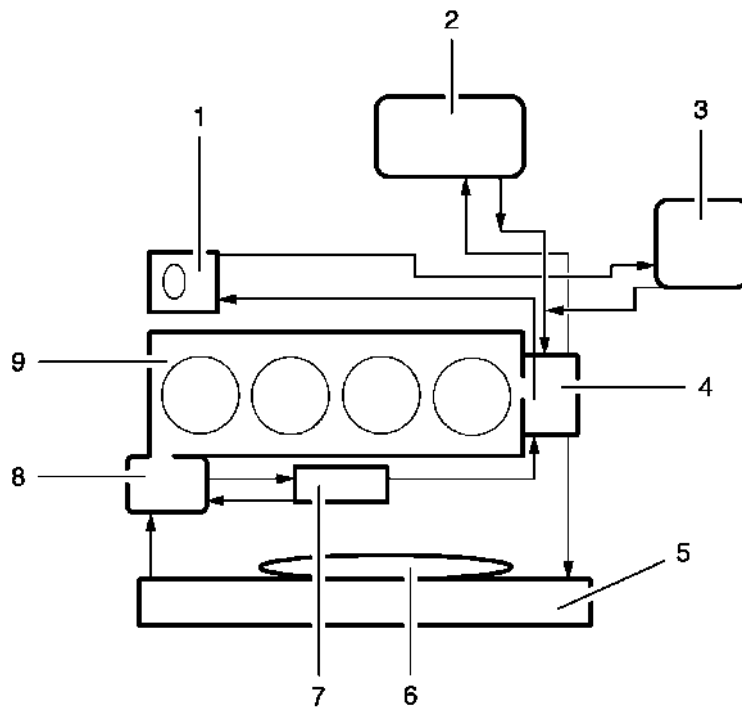


Fig. 148: Cooling System Flow Operation Diagram
Courtesy of GENERAL MOTORS COMPANY

NOTE: See arrows for coolant flow order. Notice the port between cylinder head and thermostat housing, as well as the port between cylinder block and water pump.

The cooling system consists of the following components:

- Throttle Body (1)
- Heater (2)
- Surge Tank (3)
- Engine Coolant Thermostat Housing (4)
- Radiator (5)
- Cooling Fan (6)
- Engine Oil Cooler Housing (7)
- Water Pump (8)
- Cylinder Head / Cylinder Block (9)

Water Pump

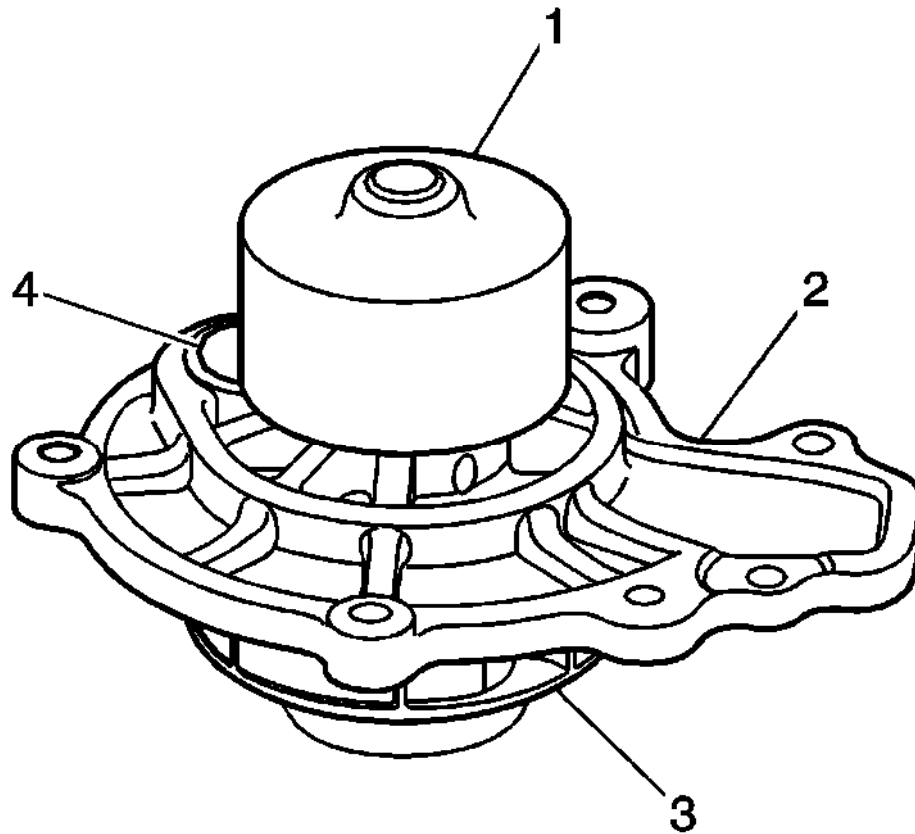


Fig. 149: Water Pump And Components

Courtesy of GENERAL MOTORS COMPANY

Water pump is a component of the engine cooling system and circulated the coolant from each cooling circuit components. This water pump consists of sealing, bearing, pulley (3) and housing (2) and is driven by the crankshaft with the back of timing belt to loose noise to water pump pulley. Water pump apply drain hole cup to cap to prevent coolant leakage for customers. Water pump is not open impeller type but closed plastic impeller type to increase the cooling efficiency.

Thermostat

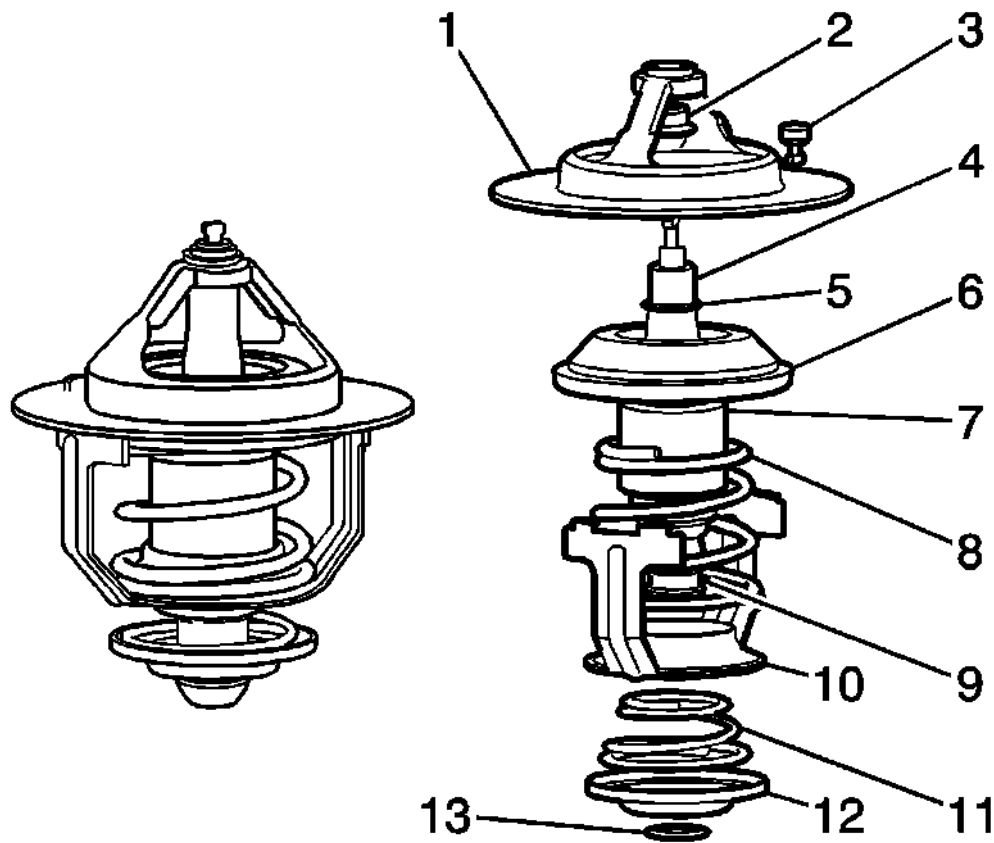


Fig. 150: View Of Thermostat And Components

Courtesy of GENERAL MOTORS COMPANY

Thermostat controls the flow of coolant and is mounted to the cylinder head. The thermostat contains a wax pellet (7) that expands and contracts based on the coolant temperature, which will mechanically move the main spring and a sealing disc to control the flow of coolant. The thermostat will begins to open electrically at 90°C (194°F) and will fully open mechanically at 105°C (221°F).

Radiator

The radiator is a heat exchanger. It consists of a core and 2 tanks. The aluminum core is a tube and fin cross-flow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere. The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock located in the bottom of the left hand tank. The drain cock unit includes the drain cock and drain cock seal. The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Surge Tank

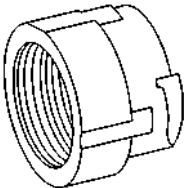
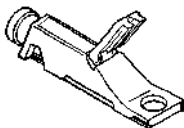
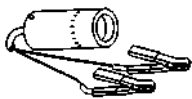
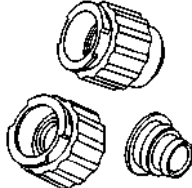
The surge tank is a plastic tank with a threaded pressure cap. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system that allows the coolant to expand and contract. The surge tank provides a coolant fill point and a central air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

Cooling Fan

The cooling fans are mounted behind the radiator in the engine compartment. The engine cooling fan is driven by electric power. The cooling fan draws air through the radiator to improve the transfer of heat from the coolant to the atmosphere. As the fan blades spin, they increase the flow of air across the radiator core and across the condenser on air condition (A/C) equipped vehicles. This helps to speed cooling when the vehicle is at idle or moving at low speeds.

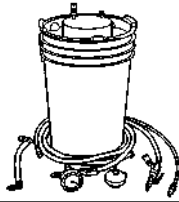
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

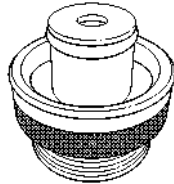
Illustration	Tool Number / Description
	EN-471 KM-471 GE-42401-A Adapter
	GE-26568 J 26568 Coolant and Battery Fluid Tester
	BO-42220 J-42220 Universal 12V Leak Detection Lamp
	GE-42401-A J 42401 Radiator Cap/Surge Tank Tester Adapter

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GE 47716
Vac N Fill Coolant Refill Tool



EN-6327-A
KM-6327-A
GE-42401-A
Cooling System Test Adapter