2008 ENGINE

Engine Cooling - Cab & Chassis Sierra, Cab & Chassis Silverado, Sierra & Silverado

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Air Cleaner Outlet Duct Clamp	4 N.m	35 lb in
Coolant Air Bleed Pipe Bolts	12 N.m	9 lb ft
Coolant Heater	50 N.m	37 lb ft
Coolant Heater Cord Bolt	8 N.m	71 lb in
Cooling Fan Motor Bolts	10 N.m	89 lb in
Cooling Fan Shroud Bolts	9 N.m	80 lb in
Differential Carrier Bolts	100 N.m	74 lb ft
Fan Clutch Bolts	23 N.m	17 lb ft
Fan Clutch Bolts	56 N.m	41 lb ft
Oil Cooler Hose Adapter Bolt	12 N.m	106 lb in
Oil Cooler Hose Bracket Bolt	25 N.m	18 lb ft
Oil Pan Skid Plate Bolts	20 N.m	15 lb ft
Radiator Bolt	25 N.m	18 lb ft
Surge Tank Bolt/Nut	10 N.m	89 lb in
TCM Cover Bolts	9 N.m	80 lb in
TCM Electrical Connector Bolts	8 N.m	71 lb in
Transmission Cooling Line Bolts	4 N.m	35 lb in
Water Pump		
• First Pass	15 N.m	11 lb ft
• Final Pass	30 N.m	22 lb ft
Water Pump Inlet Bolt	15 N.m	11 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

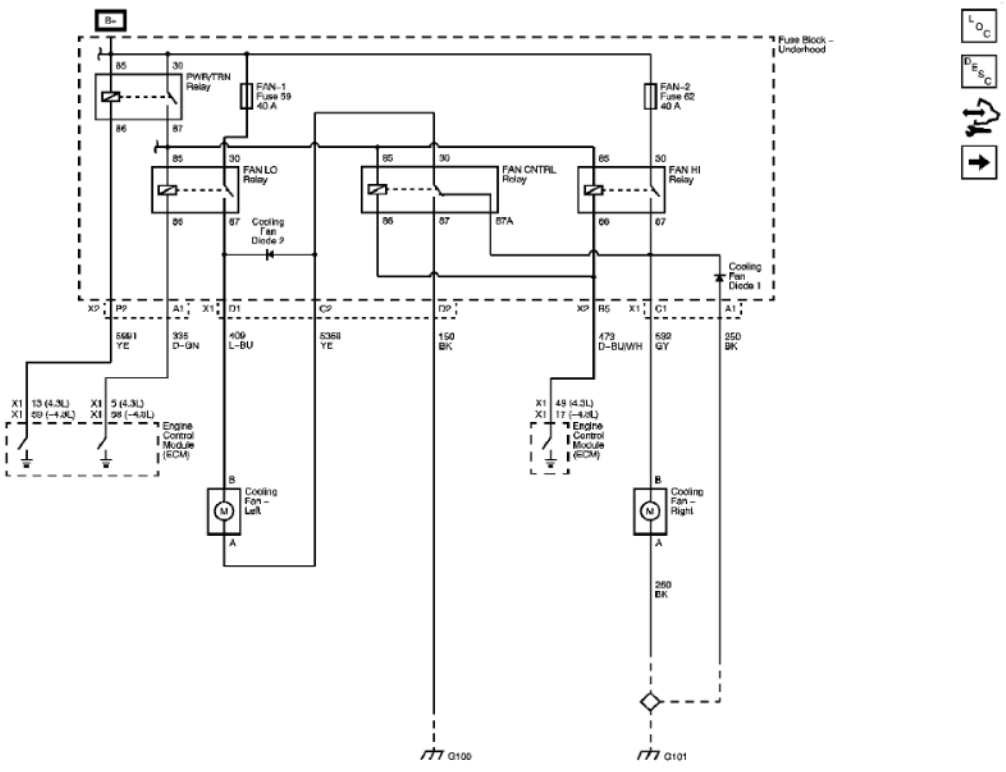


Fig. 1: Engine Cooling Schematic - Gas
Courtesy of GENERAL MOTORS CORP.

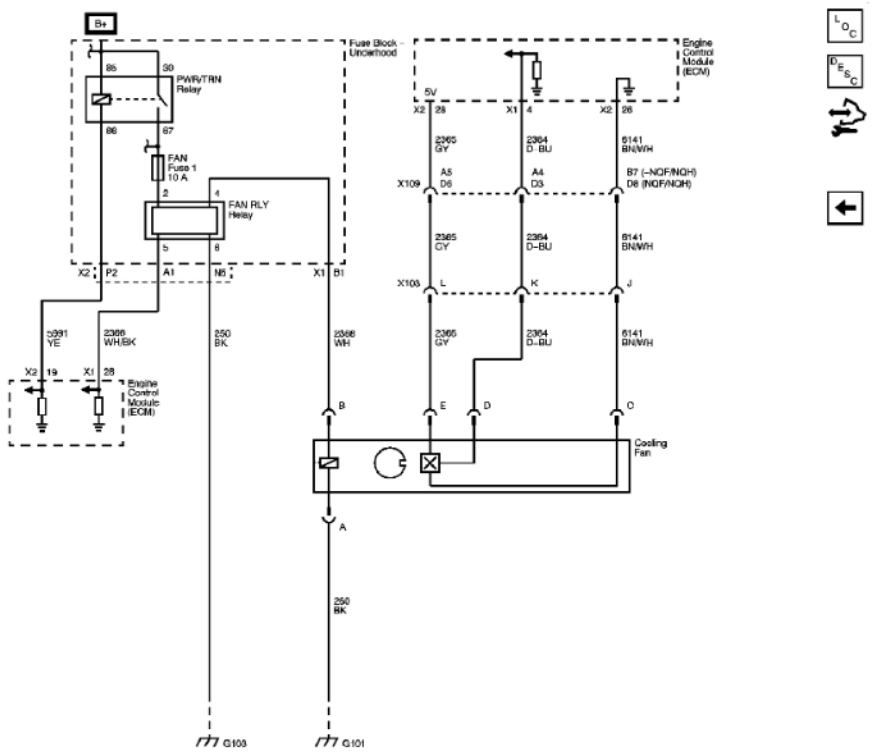


Fig. 2: Engine Cooling Schematic - Diesel
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480 or P0481	P0480: Cooling Fan Relay 1 Control Circuit P0481: Cooling Fan Relay 2 Control Circuit
DTC P1258	P1258: Engine Coolant Over temperature - Protection Mode Active

DTC P0480 OR P0481

Diagnostic Instructions

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

- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptor

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relay 2 Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage
Low Speed Cooling Fan Relay Control Circuit	P0480	P0480	P0480	P0480
High Speed Cooling Fan Relay Control Circuit	P0481	P0481	P0481	P0481

Circuit/System Description

The engine control module (ECM) commands the fans ON in either high speed or low speed, depending on cooling requirements. In low speed, the fans are configured in series. In high speed, the fans are configured in parallel.

In low speed operation, the ECM applies ground to the coil side of the fan low relay. Voltage is applied directly to the left cooling fan through the switch side of the fan low relay, which is fed by the fan 1 fuse. The right fan is connected in series to the left fan through the de-energized fan control relay so that both operate at low speed.

In high speed operation, the ECM applies a ground to the coil side of the fan low relay, the fan control relay, and the fan high relay. Voltage is applied directly to the right cooling fan through the switch side of the relay, which is fed by the fan 2 fuse. The left cooling fan obtains voltage through the fan low relay and ground through the fan control relay.

The ECM monitors the low and high speed cooling fan relay control circuits for the following conditions:

- Short to ground

- Short to voltage
- An open circuit

If the ECM detects an improper voltage level on the low or high speed ECM driver circuits, then DTC P0480 or P0481 will set and the affected ECM driver will be disabled.

Conditions for Running the DTC

- The battery voltage is between 9-18 volts.
- The engine speed is greater than 400 RPM.

Conditions for Setting the DTC

- The commanded state of the output driver module (ODM) and the actual state of the control circuit do not match.
- The condition is present for more than 5 seconds.

Action Taken When the DTC Sets

DTCs P0480 and P0481 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0480 and P0481 are Type B DTCs.

Diagnostic Aids

- This test procedure requires that the vehicle battery has passed a load test and is completely charged. Refer to **Battery Inspection/Test** .
- When disconnecting electrical connectors or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the mating electrical terminals for tightness.
- Use the **J 35616** for any test that requires probing the underhood fuse block terminals, component wire harness terminals, or the ECM wire harness connector terminals.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

- **Component Connector End Views**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation (w/o LFA)

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

Special Tools Required

- **J 43244** Relay Puller Pliers
- **J 35616** GM Approved Terminal Test Kit

Circuit/System Verification

1. Ignition ON, command the cooling fan relay 1 ON and OFF several times using the scan tool output control function. You should hear both fans turn ON and OFF. Both should run on low speed when turned ON.
2. Ignition ON, command the cooling fan relays 2 and 3 ON and OFF several times using the scan tool output control function. When turned ON, the right fan should run on high and the left fan should remain OFF.
3. Ignition ON, command the cooling fan relays 1, 2, and 3 ON and OFF several times using the scan tool output control function. When turned ON, both fans should run on high speed.

Circuit/System Testing

P0480

1. Ignition OFF, disconnect the cooling fan low relay from the underhood fuse block.
2. Ignition ON, verify that a test lamp illuminates between the fan low relay coil voltage supply circuit and ground.
    - If the test lamp does not illuminate, test the fan low relay coil voltage supply circuit for and open/high resistance.
3. Connect a test lamp between the fan low relay coil supply voltage circuit and the fan low relay coil control circuit. With a scan tool, command the fan relay 1 ON and OFF. Verify that the test lamp turns ON and OFF with each command.
    - If the test lamp remains illuminated with each command, test the relay coil control circuit for a short to ground. If the circuit tests normal, replace the control module.
    - If the test lamp does not illuminate, test the relay coil control circuit for and open or a short to voltage. If the circuit tests normal, replace the control module.
4. If the circuits test normal, replace the fan low relay.

P0481

1. Ignition OFF, disconnect the cooling fan high relay from the underhood fuse block.
2. Ignition ON, verify that a test lamp illuminates between the fan high relay coil voltage supply circuit and ground.
    - If the test lamp does not illuminate, test the fan high relay coil voltage supply circuit for and open/high resistance.
3. Connect a test lamp between the fan high relay coil supply voltage circuit and the fan high relay coil control circuit. With a scan tool, command the fan relays 2 and 3 ON and OFF. Verify that the test lamp turns ON and OFF with each command.
    - If the test lamp remains illuminated with each command, remove the fan control relay and retest. If the test lamp now turns ON and OFF with the fan control relay removed, replace the fan control relay. If the test lamp still remains illuminated when commanded ON and OFF, test the fan high relay coil control circuit for a short to ground. If the circuit tests normal, replace the control module.
    - If the test lamp does not illuminate, test the fan high relay coil control circuit for and open or a short to voltage. If the circuit tests normal, replace the control module.
4. If all circuits test normal, replace the fan high relay.

Repair Procedures

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

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

DTC P1258

Diagnostic Instructions

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

DTC Descriptor

DTC P1258

Engine Coolant Over temperature - Protection Mode Active

Circuit/System Description

The engine control module (ECM) uses the engine coolant temperature (ECT) sensor to monitor the engine for an over-termperature condition. This condition occurs when the coolant temperature is above a calibrated value for a calibrated length of time. The ECM will disable half of the cylinders by turning OFF the fuel injectors. By disabling half of cylinders, the ECM is able to reduce the temperature of the coolant.

Conditions for Running the DTC

- The engine is running.
- DTC P0117 or P0118 are not set.

Conditions for Setting the DTC

Coolant temperature more than 132°C (270°F) for greater than 10 seconds.

Action Taken When the DTC Sets

- DTC P1258 is a Type A DTC.
- The engine will operate in the Overheated Engine Protection Operating Mode.
- The engine coolant temperature indicator lamp, if equipped, will illuminate.

- The driver information center (DIC), if equipped, may display a message.

Conditions for Clearing the DTC

DTC P1258 is a Type A DTC.

Reference Information

Description and Operation

- **Cooling System Description and Operation**
- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Audible Warnings Description and Operation**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

IMPORTANT: If DTC P1482 is set, diagnose that DTC first.

1. Observe the engine coolant level. The engine coolant level should be within operating range. Refer to Capacities - Approximate Fluid, and Engine Coolant in the Owner's Manual.
2. Ensure that the vehicle has the correct engine coolant, with correct concentration, and is not old, contaminated or contains additives. Refer to Recommended Fluids and Lubricants in the Owner's Manual.
3. Inspect the cooling system for the following:
   - Leaks
   - Kinked or pinched hoses, especially at the radiator
   - Loose, missing, or damaged radiator air seals or deflectors
   - The radiator and A/C condenser for any air flow obstructions or bent fins-Refer to **Symptoms - Engine Cooling**.

IMPORTANT: A small delay occurs before the ECM changes the cooling fan speed.

4. Command the cooling fan speed from 0% to 100% with a scan tool.
    - If the fan speed does not transition with the commanded states, refer to **Cooling Fan Inoperative**.

Circuit/System Testing

1. Test the thermostat for correct operation. Refer to **Thermostat Diagnosis**.
2. Test the engine cooling system for overheating. Refer to **Engine Overheating**.
3. Inspect the water pump and coolant flow for correct operation. Refer to **Water Pump Replacement (LU3)** or **Water Pump Replacement (LY6, L76 and L92)** or **Water Pump Replacement (LH6, LY2, LY5, and LMG)** or **Water Pump Replacement (LMM)**.
4. Inspect the engine for worn/leaking/cracked cylinder heads and engine block. Refer to **Coolant in Combustion Chamber** and **Coolant in Engine Oil** .

Repair Procedures

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

SYMPTOMS - ENGINE COOLING

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions. Refer to the following:

- **Cooling System Description and Operation**
- **Cooling Fan Description and Operation (w/o LFA)**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to

Testing for Intermittent Conditions and Poor Connections .

Symptom List

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

- **Cooling Fan Always On**
- **Cooling Fan Inoperative**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis**
- **Engine Fails To Reach Normal Operating Temperature**

LOW ENGINE COOLANT INDICATOR ALWAYS ON

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Level Switch Signal	Indicator OFF	Indicator ON	-	-
Ground	-	Indicator ON	-	-

Circuit/System Description

The low engine coolant level indicator is controlled by the HVAC control module. The normal state of the engine coolant level switch is closed when in contact with coolant.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Cooling System Description and Operation

Electrical Information Reference

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

Circuit/System Verification

The low coolant indicator should be OFF with the engine coolant at the proper level.

Circuit/System Testing

IMPORTANT: Circuit/System Verification must be performed before performing the Circuit/System Testing.

1. Ignition OFF, disconnect the harness connector at the coolant level switch.
2. Install a 3A fused jumper wire between the signal circuit terminal and ground.
3. Engine running, verify the low coolant indicator turns OFF.
    - If the indicator does not turn OFF, test the signal circuit for an open/high resistance.
    - If the indicator turns OFF, test the ground circuit for an open/high resistance.
4. If all circuits test normal, replace the coolant level switch.

Repair Procedures

- **Radiator Surge Tank Replacement (Non-HP2)**
- **Control Module References**
- **Instrument Cluster Replacement (without RPO SLT)**

Repair Verification

Verify that the low coolant indicator is OFF with the engine coolant at the proper level.

COOLING FAN ALWAYS ON

Diagnostic Instructions

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

Circuit/System Description

The engine control module (ECM) commands the fans ON in either high speed or low speed, depending on cooling requirements. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

In low speed operation, the ECM applies ground to the coil side of the fan low relay. This energizes the coil and applies voltage directly to the left cooling fan through the switch side of the fan low relay, which is fed by the fan 1 fuse. The right fan is connected in series to the left fan through the de-energized fan control relay so that both operate at low speed.

In high speed operation, the ECM applies a ground to the coil side of the fan low relay, the fan control relay, and the fan high relay. On the fan high relay, the energized coil closes the switch side of the relay and applies voltage directly to the right cooling fan through the switch side of the relay, which is fed by the fan 2 fuse. At the same time, the ECM energizes fan control relay pulling the switch side over, providing a direct path to ground for the left cooling fan, which has voltage applied through the energized fan low relay. In high speed mode, the fans are operated as a parallel circuit with full voltage applied to each.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Cooling Fan Description and Operation (w/o LFA)

Electrical Information Reference

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

Circuit/System Verification

1. If DTCs P0480 or P0481 are set, perform those diagnostics first.
2. Ignition ON, verify with a scan tool that the control module is not commanding fan activation.
3. Ignition ON, observe that the fans are not activated.

Circuit/System Testing

1. Ignition OFF, disconnect the fan high relay.
2. Ignition ON, observe that both fans are now OFF.
    - If both fans are OFF, replace the fan high relay. If either fan is still activated, remove the fan low relay. If both fans are now OFF replace the fan low relay. If either fan is still activated, test for a short to voltage in the fan voltage supply circuit.

Repair Verification

1. Ignition ON, verify with a scan tool that the control module is not commanding fan activation.
2. Ignition ON, observe that the fans are not activated.

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 control module (ECM) commands the fans ON in either high speed or low speed, depending on cooling requirements. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

In low speed operation, the ECM applies ground to the coil side of the fan low relay. This energizes the coil and applies voltage directly to the left cooling fan through the switch side of the fan low relay, which is fed by the fan 1 fuse. The right fan is connected in series to the left fan through the de-energized series/parallel relay, which is the fan control relay so that both operate at low speed.

In high speed operation, the ECM applies a ground to the coil side of the fan low relay, the fan control relay, and the fan high relay. On the fan high relay, the energized coil closes the switch side of the relay and applies voltage directly to the right cooling fan through the switch side of the relay, which is fed by the fan 2 fuse. At the same time, the ECM energizes fan control relay pulling the switch side over, providing a direct path to ground for the left cooling fan, which has voltage applied through the energized fan low relay. In high speed mode, the fans are operated as a parallel circuit with full voltage applied to each.

Diagnostic Aids

The ECM has the capability of providing command to the fan relays even while a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.

Reference Information

Schematic Reference

Engine Cooling Schematics

Description and Operation

Cooling Fan Description and Operation (w/o LFA)

Connector End View Reference

- **Electrical Center Identification Views**
- **Component Connector End Views**

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify that the following DTCs are not set: P0480 or P0481.
   - If either of the DTCs is set, repair the DTC first.
2. Ignition ON, command high and low speed fans ON and OFF with a scan tool. Observe to verify that the fans turn ON and OFF when changing between the commanded states.

Circuit/System Testing

IMPORTANT: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF, disconnect the series/parallel fan relay.
2. Ignition ON, activate the cooling fan relay 1 with a scan tool. The fan should be OFF.
   - If the fan is activated, test the left fan ground circuit for a short to ground.
3. Ignition OFF, disconnect the remaining fan relays.
4. Connect a 30A fused jumper between the normally-open switch contact terminals at the fan control relay connector in order to complete the left fan ground circuit. Leave this jumper in place for the remainder of this procedure.
5. One at a time, connect a 30A fused jumper between the positive terminal at the battery and the fan voltage supply circuit terminal at each relay connection and verify the appropriate fan activation.
   - If the appropriate fan does not activate, test the fan voltage supply circuit for a short to ground or open/high resistance. If the circuit tests normal, test the fan ground circuit for open/high resistance. If the circuits test normal, replace the fan.
6. Ignition ON, connect a 30A fused jumper between the relay switch voltage supply circuit terminal and the fan voltage supply circuit terminal at the low speed and then the high speed relay connections and verify the appropriate fan activation.
   - If the appropriate fan does not activate, test the relay switch voltage supply circuit for a short to ground or high resistance.
7. If the circuits and fans test normal, replace the relay.

Repair Procedures

- **Engine Coolant Fan Motor Replacement (Non-HP2)**

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

Repair Verification

Ignition ON, command the fan relay ON and OFF with a scan tool. Observe to verify that the appropriate fan turns ON and OFF with each command.

ENGINE OVERHEATING

Step	Action	Yes	No
1	Inspect for a missing or damaged radiator side or upper baffle and/or radiator air deflector. Is the baffle and/or deflector missing or damaged?	Go to **Step 8**	Go to **Step 2**
2	Inspect for a loss of coolant. Is there a loss of coolant?	Go to **Step 3**	Go to **Step 4**
3	Fill the system to the specified level. Does the engine overheat?	Go to **Step 4**	System OK
4	Inspect for low temperature protection. Is the coolant to the correct concentration?	Go to **Step 5**	Go to **Step 8**
5	Inspect for a loss of cooling system pressure. Is there a loss of system pressure?	Go to **Step 8**	Go to **Step 6**
6	Inspect for a faulty engine coolant temperature (ECT) sensor. Refer to **DTC P0117 or P0118** . Is the sensor operating properly?	Go to **Step 7**	Go to **Step 8**
7	Inspect for the following: • Damaged coolant surge tank • Leaking hose • Bad/incorrect surge tank or radiator cap Were any of the above found?	Go to **Step 8**	Go to **Step 3**
8	Repair or install new parts as necessary, then retest. Does the engine overheat?	Go to **Step 9**	System OK
9	Inspect for incorrect drive belt tension. Is the belt tension correct?	Go to **Step 10**	Go to **Step 8**

10	1. Remove the water pump. Refer to **Water Pump Replacement (LU3)** or **Water Pump Replacement (LY6, L76 and L92)** or **Water Pump Replacement (LH6, LY2, LY5, and LMG)** or **Water Pump Replacement (LMM)**. 2. Inspect for a damaged water pump shaft/hub. Is the water pump driveshaft damaged or is the seal leaking?	Go to **Step 8**	Go to **Step 11**
11	Inspect for obstructed radiator air flow or bent radiator fins. Is the radiator air flow obstructed?	Go to **Step 8**	Go to **Step 12**
12	Inspect for blocked cooling system passages. Are the cooling system passages blocked?	Go to **Step 8**	Go to **Step 13**
13	Inspect the thermostat. Refer to **Thermostat Diagnosis**. Is the thermostat stuck in the closed position?	Go to **Step 15**	Go to **Step 16**
14	Replace the thermostat. Refer to **Engine Coolant Thermostat Housing Replacement (LY2, LH6, LY5, LMG, LY6)**. Does the engine overheat?	Go to **Step 16**	System OK
15	Inspect the radiator cooling capacity. Is the proper sized radiator being used on the vehicle?	Go to **Step 3**	Go to **Step 17**
16	Consult the current parts catalog and replace the radiator. Refer to **Radiator Replacement (4.3, 4.8, 5.3, and 6.0L)** or **Radiator Replacement (LLM)**. Is the repair complete?	System OK	-

LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is loosing coolant either internally or externally.			
1	Were you sent here from Symptoms, or another diagnostic table?		Go to **Symptoms - Engine**

		Go to **Step 2**	**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 (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. Is the action complete?	Go to **Step 5**	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to **Step 19**	Go to **Step 6**
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to **Step 7**	Go to **Step 8**
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. 2. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to **Step 20**	Go to **Step 8**
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to **Step 21**	Go to **Step 9**
	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs		

9	• Throttle body • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to **Step 21**	Go to **Step 10**
10	1. Pressure test the cooling system. Refer to **Cooling System Leak Testing**. 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8. Are any leaks present?	Go to **Step 21**	Go to **Step 11**
11	Pressure test the coolant pressure cap. Refer to **Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 12**	Go to **Step 16**
12	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering near the HVAC module Is coolant present?	Go to **Step 21**	Go to **Step 13**
13	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to **Step 14**	Go to **Step 15**
14	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to **Step 17**	Go to **Step 15**
	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky		

15	substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to **Step 18**	Go to **Step 22**
16	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 22**	-
17	1. Replace the radiator. Refer to **Radiator Replacement (4.3, 4.8, 5.3, and 6.0L)** or **Radiator Replacement (LLM)**. 2. Replace the oil and filter. Refer to **Engine Oil and Oil Filter Replacement** Is the repair complete?	Go to **Step 22**	-
18	1. Replace the radiator. Refer to **Radiator Replacement (4.3, 4.8, 5.3, and 6.0L)** or **Radiator Replacement (LLM)**. 2. Service the automatic transmission. Refer to the following: **Engine Coolant/Water in Transmission** . Is the repair complete?	Go to **Step 22**	-
19	Repair the engine overheating condition. Refer to **Engine Overheating**. Is the repair complete?	Go to **Step 22**	-
20	Repair the engine internal coolant leak. Refer to **Coolant in Combustion Chamber** or, **Coolant in Engine Oil** . Is the repair complete?	Go to **Step 22**	-
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

THERMOSTAT DIAGNOSIS

Tools Required

J 24731 Tempil Stick

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

Thermostat Test Procedure Using Tempil Sticks

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

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

Thermostat Test Procedure Using Glycol

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

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

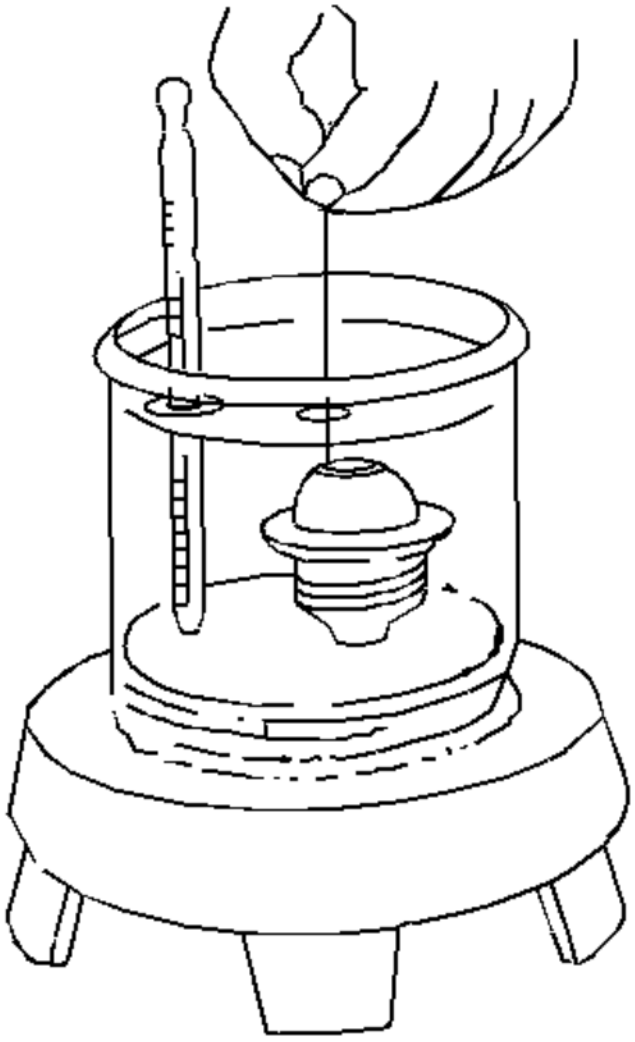


Fig. 3: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS CORP.

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

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

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

COOLANT HEATER INOPERATIVE (GASOLINE)

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

Reference Information

Electrical Information Reference

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

Circuit/System Testing

IMPORTANT: The power supply cord will read open due to an internal thermal switch if the ambient temperature is above -18°C (0°F).

1. Test the engine coolant heater for an open or short to ground.
    - If open or shorted, replace the heater.
2. If the heater tests normal, replace the coolant heater power cord.

Repair Procedures

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

- **Coolant Heater Replacement (LH6, LY2, LMG, LY5, and LY6)** or **Coolant Heater Replacement (L76, L92)**
- **Coolant Heater Cord Replacement (L76 and L92)** or **Coolant Heater Cord Replacement (LH6, LMG, LY2 and LY5)** or **Coolant Heater Cord Replacement (LY6)**

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Step	Action	Yes	No
1	Did you review the Symptoms - Engine Cooling diagnostic information and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Engine Cooling**
2	Verify that the engine does not reach normal operating temperature. Does the engine reach normal operating temperature?	System OK	Go to **Step 3**
3	Inspect the coolant level. Is the coolant level below the add mark?	Go to **Step 4**	Go to **Step 5**
4	1. Add coolant as necessary. 2. Perform a cooling system pressure test. Does the cooling system hold pressure?	System OK	Go to **Step 5**
5	Inspect for a stuck open, missing, or incorrect thermostat. Refer to **Thermostat Diagnosis**. Is the thermostat operating properly?	System OK	Go to **Step 6**
6	Install the correct replacement thermostat. Refer to **Engine Coolant Thermostat Housing Replacement (LY2, LH6, LY5, LMG, LY6)**. Is the repair complete?	Go to **Step 7**	-
7	Run the engine in order to verify the repair. Does the engine fail to reach normal operating temperature?	-	System OK

PRESSURE CAP TESTING

Tools required

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

Pressure Cap Testing

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

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

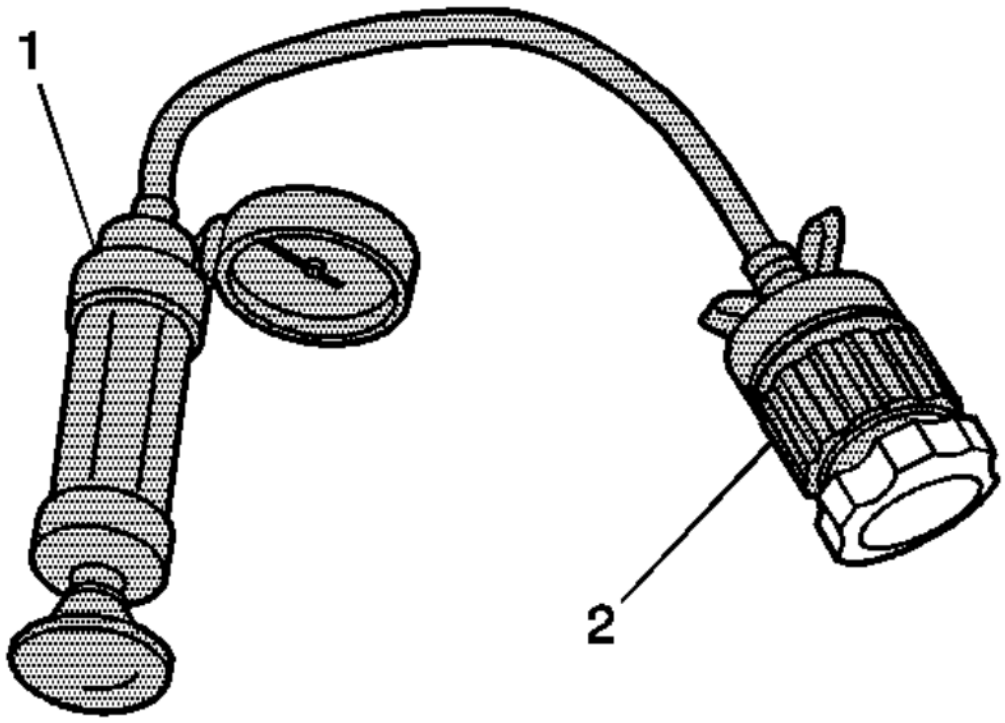


Fig. 4: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

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

3. Use the **J 24460-01** (1) with **J 42401** (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
   - Pressure release when the **J 24460-01** exceeds the pressure rating of the pressure cap.
   - Maintain the rated pressure for at least 10 seconds.

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

COOLING SYSTEM LEAK TESTING

Tools Required

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

Testing

CAUTION: 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.

CAUTION: In order to help avoid being burned, do not remove the

radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

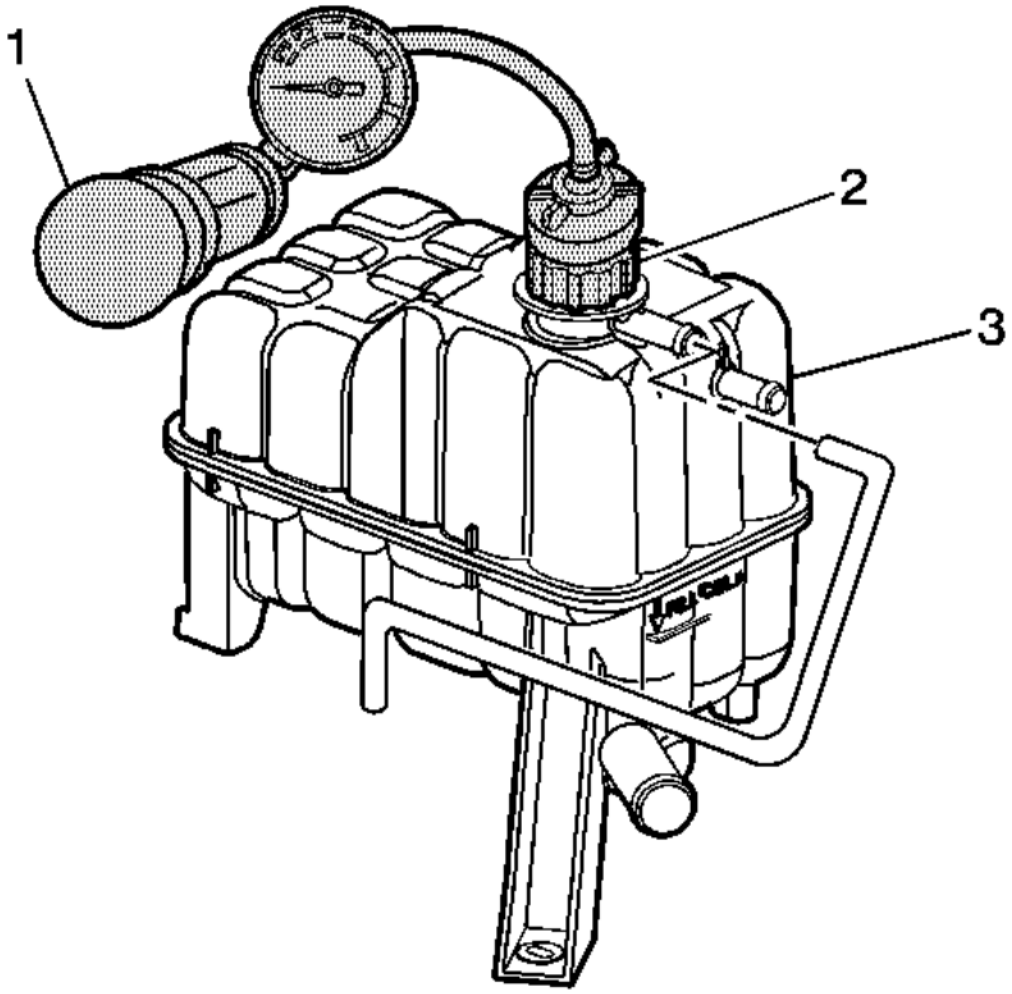


Fig. 5: Applying Pressure To Cooling System Using J 42401
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 24460-01** with the**J 42401** in order to apply pressure to the cooling system.

   Do not exceed the pressure cap rating.

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

   Observe the gage for any pressure loss.

6. Repair any leaks as required.

FAN CLUTCH DIAGNOSIS

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - Engine Cooling**
2	Is there excessive fan air noise?	Go to **Step 3**	Go to **Step 4**
3	Fan air noise is normal during cold engine start up. Does the fan noise go away at normal engine operating temperature?	Go to **Step 13**	Go to **Step 4**
4	**IMPORTANT:** **The engine must be turned OFF and the engine temperature should be cold.** Rotate the fan clutch.Does the fan clutch rotate?	Go to **Step 5**	Go to **Step 14**
5	Visually inspect the fan blades for cracks, looseness or damage. Are the fan blades in good condition?	Go to **Step 6**	Go to **Step 15**
6	Visually inspect the fan clutch for signs of silicone leakage. • Slight silicone leakage may not effect the fan clutch engagement. • Excess leakage will prevent the fan clutch from engaging. Is the silicone fluid leakage excessive?	Go to **Step 14**	Go to **Step 7**

7	Inspect the fan clutch for proper installation. 1. Move the fan blade back and forth in a lateral motion. 2. Inspect for fan blade to fan clutch movement. Is the fan blade loose at the fan clutch?	Go to **Step 10**	Go to **Step 8**
8	Inspect the fan clutch for wear. 1. Move the fan blade back and forth in a lateral motion. **IMPORTANT:** **Approximately 6.5 mm (1/4 in) movement at the tip of the fan blade is normal.** 2. Inspect for fan clutch lateral movement. Is the fan clutch lateral movement excessive?	Go to **Step 14**	Go to **Step 9**
9	The fan clutch should have more turning resistance when the engine is at or above normal operating temperature. Does the fan clutch have more resistance when the engine temperature is raised?	Go to **Step 11**	Go to **Step 14**
10	Tighten the fan. Refer to **Fastener Tightening Specifications**. Is the repair complete?	Go to **Step 16**	-
	Perform a fan clutch engagement test. 1. Ensure the engine coolant level is full. 2. Ensure the cooling fan drive belt tension is correct and not slipping. 3. Position and secure a thermometer between the fan clutch and the radiator. 4. Ensure the cooling fan is disengaged before starting this test.		

11	5. Sufficiently cover the radiator grille to restrict the air flow. **IMPORTANT:** **Do not allow engine temperature to exceed 121℃ (250℉).** 6. Start the engine. 7. Turn the A/C ON, if equipped. 8. Operate the engine at approximately 2,000 RPM. 9. Inspect the thermometer reading when the fan clutch engages. 10. Do not continue this test if the fan clutch does not engage between 85-96°C (185-205°F). Fan clutch engagement will be indicated by an increase in fan air noise, fan speed, and a drop of about 3-10°C (5-15°F) on the thermometer reading. Did the fan clutch engage between 85-96°C (185-205°F)?	Go to **Step 12**	Go to **Step 14**
12	Once the fan clutch engages, perform the following steps: 1. Uncover the radiator grille. 2. Turn the A/C OFF, if equipped. 3. Operate the engine at approximately 2,500 RPM to reduce the engine operating temperature. 4. Remove the thermometer. Did the engine return to normal operating temperature?	Go to **Step 13**	-
	As the engine temperature returns to normal, the		

13	fan clutch will disengage, indicated by a reduction in fan air noise and fan speed. Did the fan clutch disengage?	Go to **Step 16**	Go to **Step 14**
14	Replace the fan clutch. Refer to **Fan Clutch Replacement (Diesel)**. Is the repair complete?	Go to **Step 16**	-
15	Replace the fan blades. Refer to **Fan Replacement (Diesel)** or **Fan Replacement (Mechanical)**. Is the repair complete?	Go to **Step 16**	-
16	Operate the fan clutch to verify proper operation. Did you find and correct the condition?	System OK	Go to **Step 2**

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (VAC-N-FILL)

Tools Required

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

Draining Procedure

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

1. Park the vehicle on a level surface.
2. Remove the coolant pressure cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

4. Place a drain pan under the drain cock.
5. Open the radiator drain cock.
6. Drain the cooling system.
7. If a complete engine block drain is required, remove the engine block drain plug.
8. Inspect the coolant.
9. Follow the appropriate procedure based on the condition of the coolant.
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Vac-N-Fill Procedure

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

1. Install the **J 42401** .

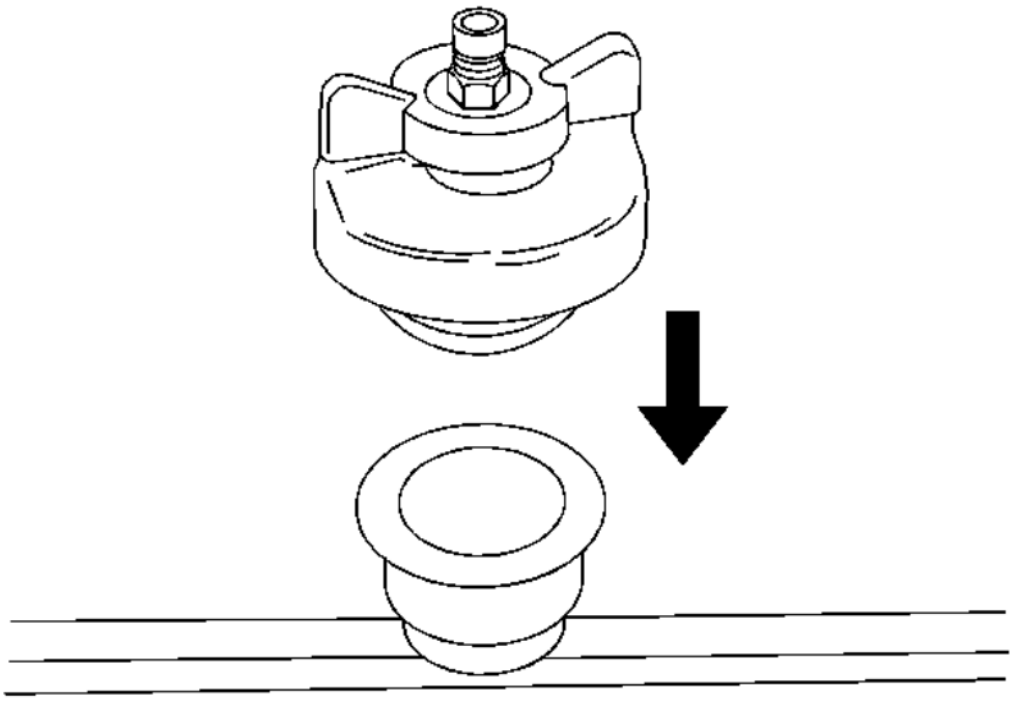


Fig. 6: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS CORP.

2. Attach the Van-N-Fill cap to the vehicles coolant fill port.

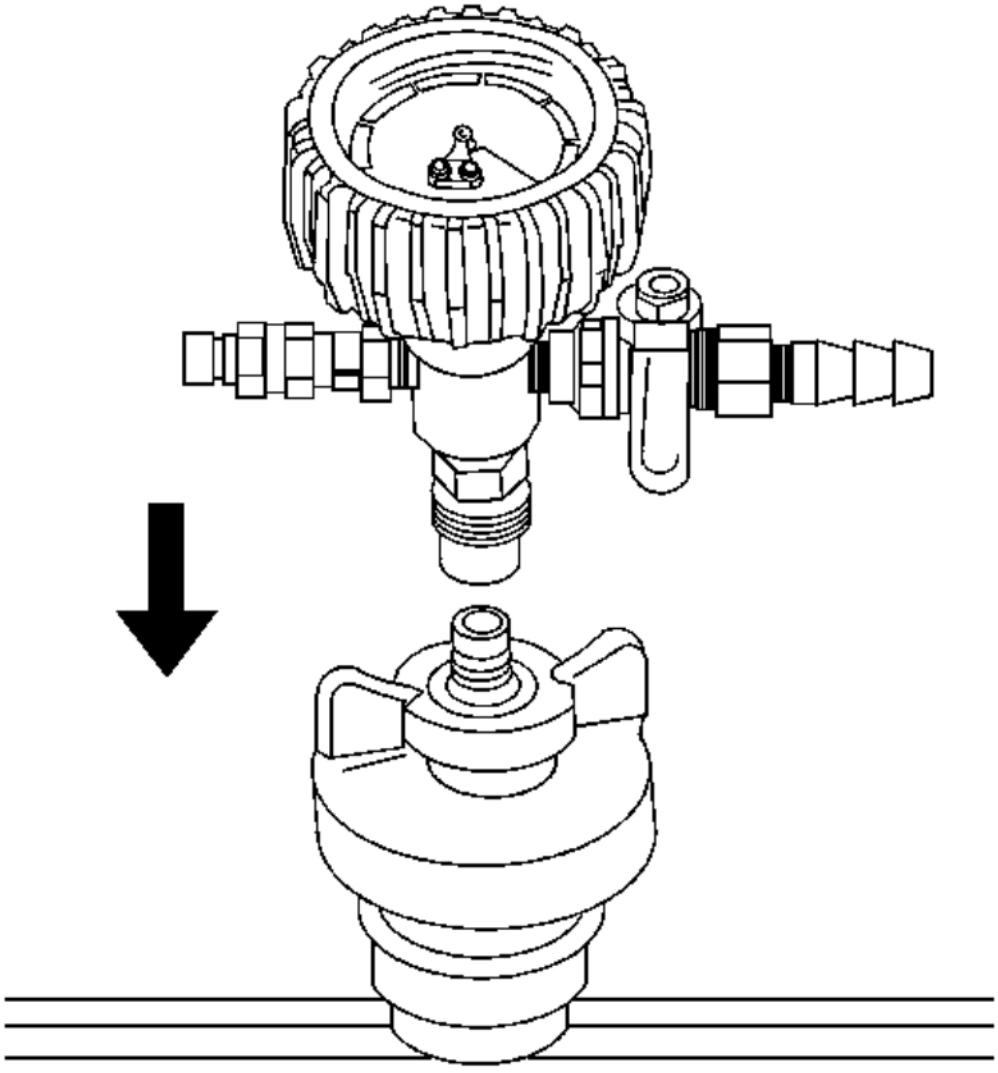


Fig. 7: Attaching Vacuum Gage Assembly To Vac-N-Fill Cap
Courtesy of GENERAL MOTORS CORP.

3. Attach the vacuum gage assembly to the Vac-N-Fill cap.

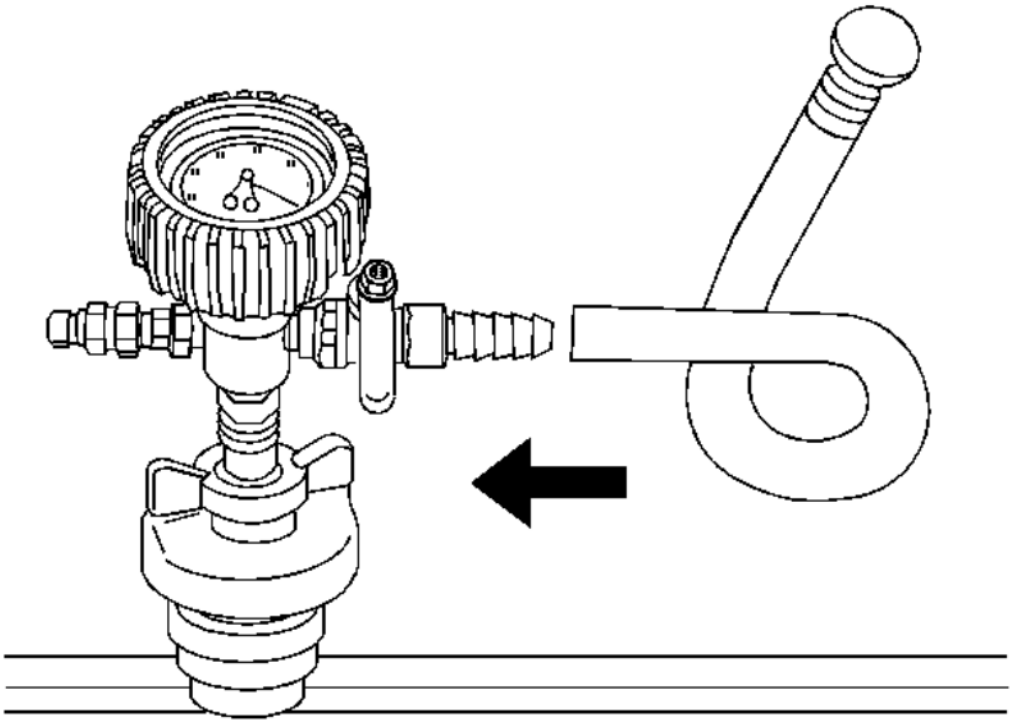


Fig. 8: Attaching Fill Hose To Barb Fitting On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gage assembly.

   Ensure that the valve is closed.

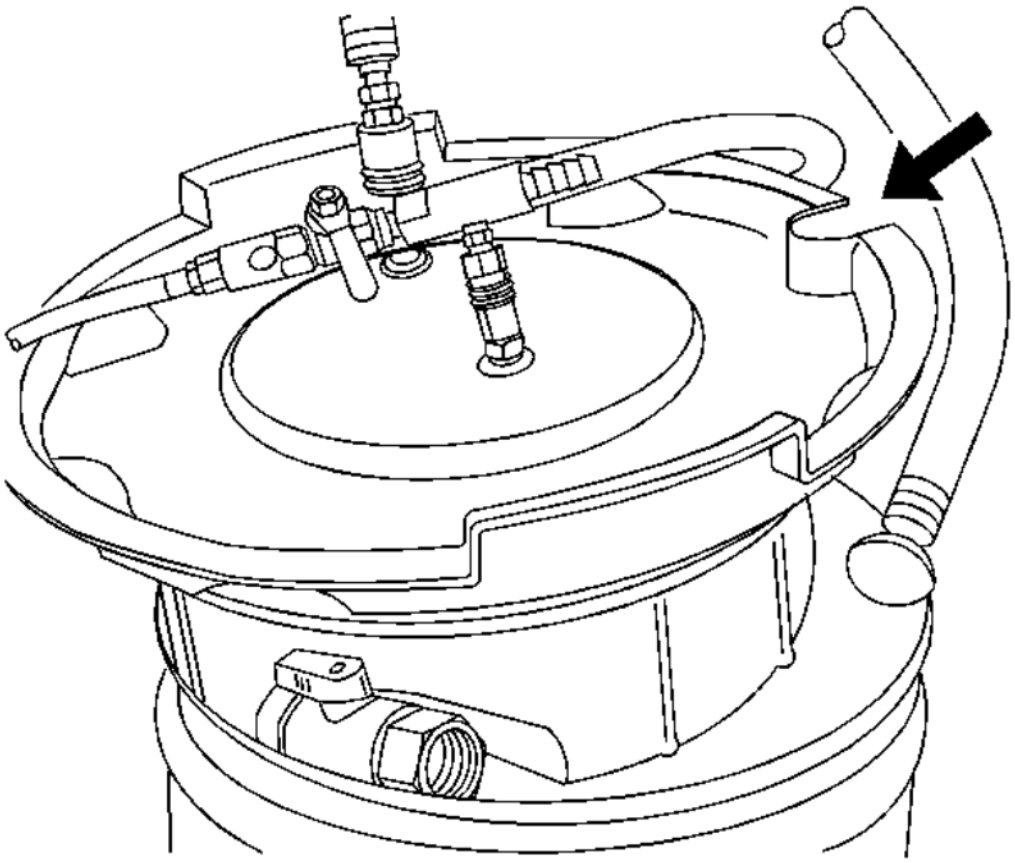


Fig. 9: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: 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.

5. Pour the coolant mixture into the graduated reservoir.
6. Place the fill hose in the graduated reservoir.

IMPORTANT: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom

of the tank is closed.

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

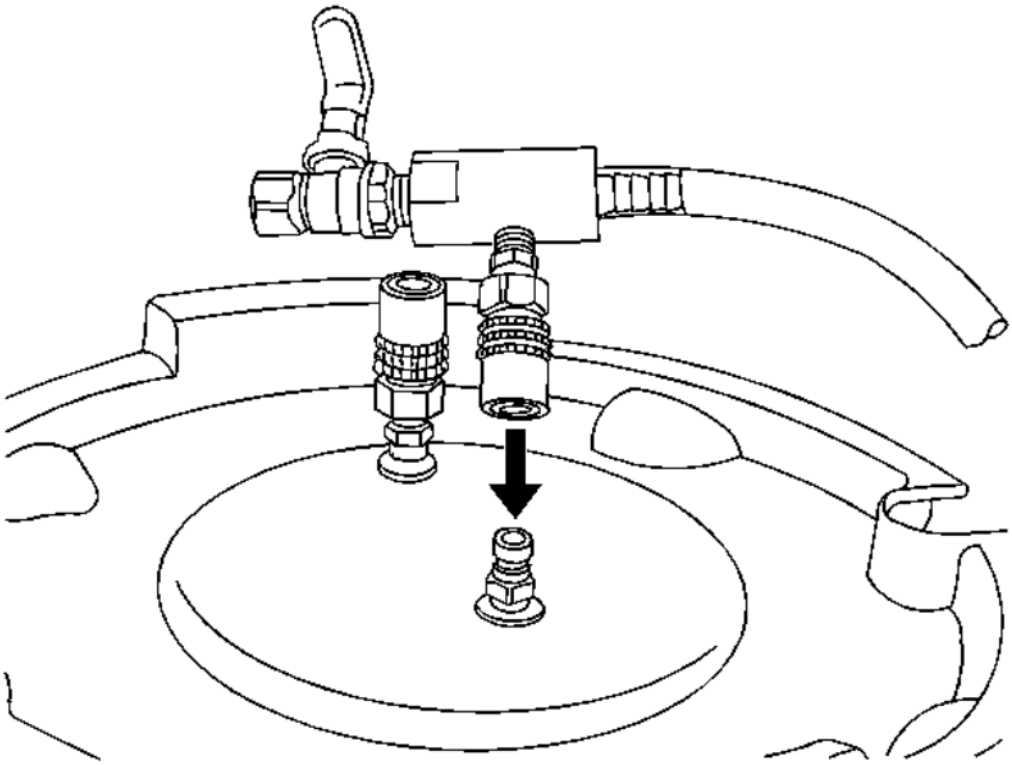


Fig. 10: Connecting Venturi Assembly To Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

8. Attach the venture assembly to the vacuum tank.

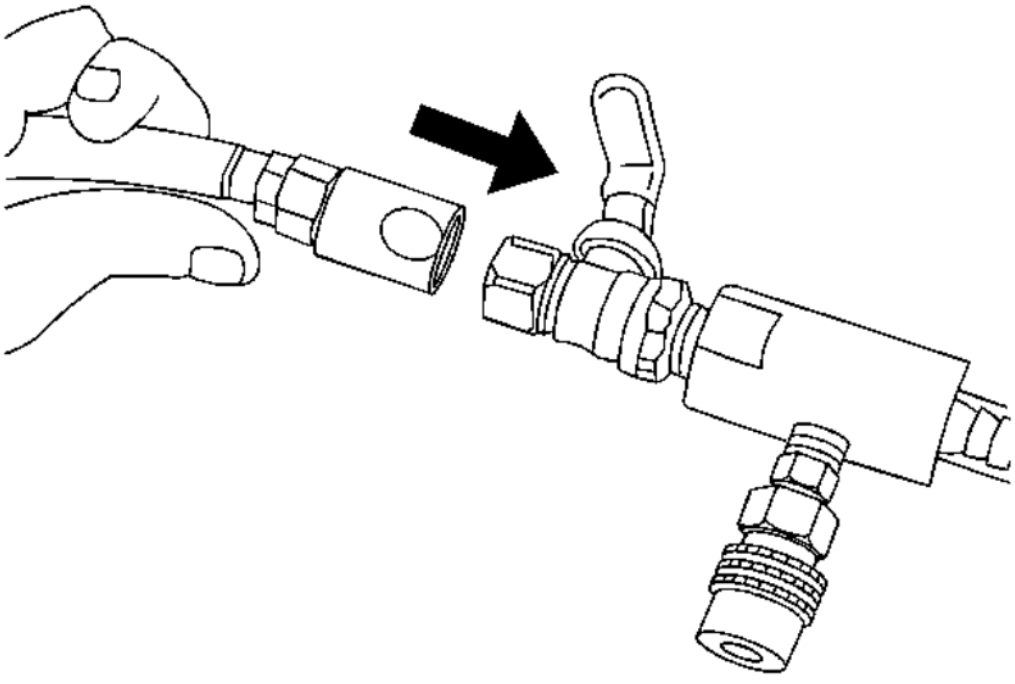


Fig. 11: Attaching Shop Air Hose To Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

9. Attach a shop air hose to the venture assembly.

   Ensure the valve on the venture assembly is closed.

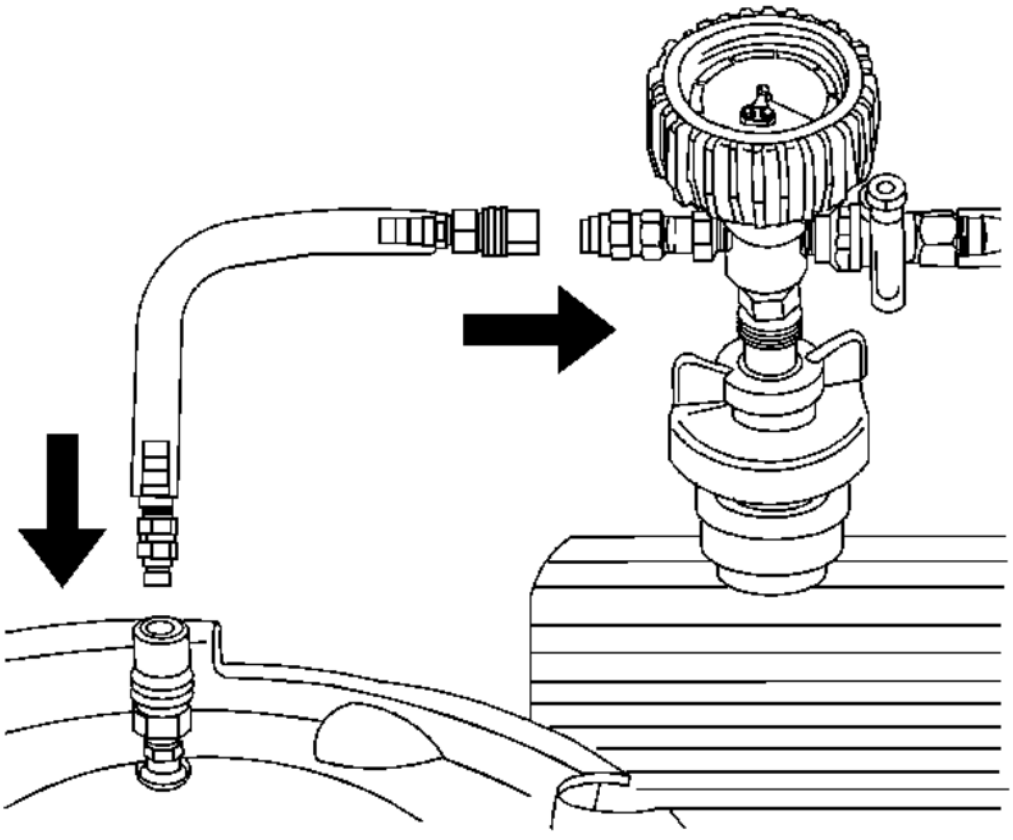


Fig. 12: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

10. Attach the vacuum hose to the vacuum gage assembly and the vacuum tank.
11. Clamp off the overflow hose.

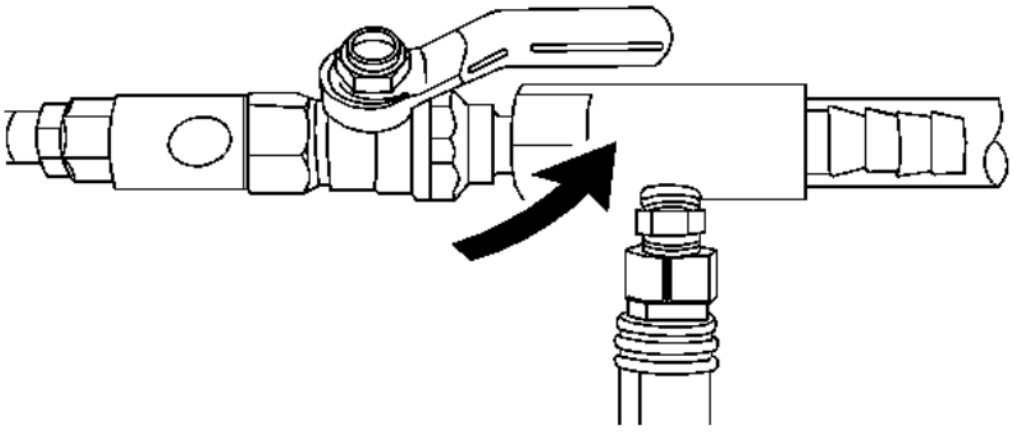


Fig. 13: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

12. Open the valve on the venture assembly. The vacuum gage will begin to rise and a hissing noise will be present.

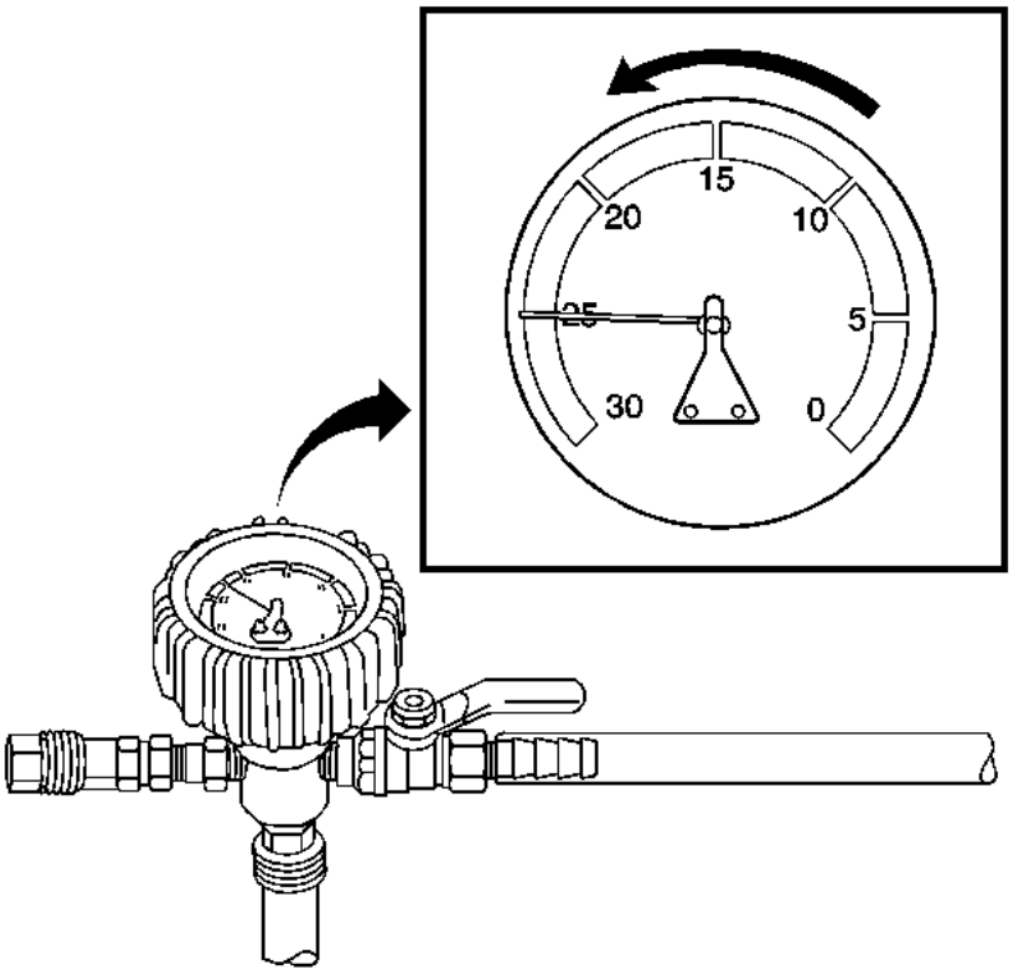


Fig. 14: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

13. 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.

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

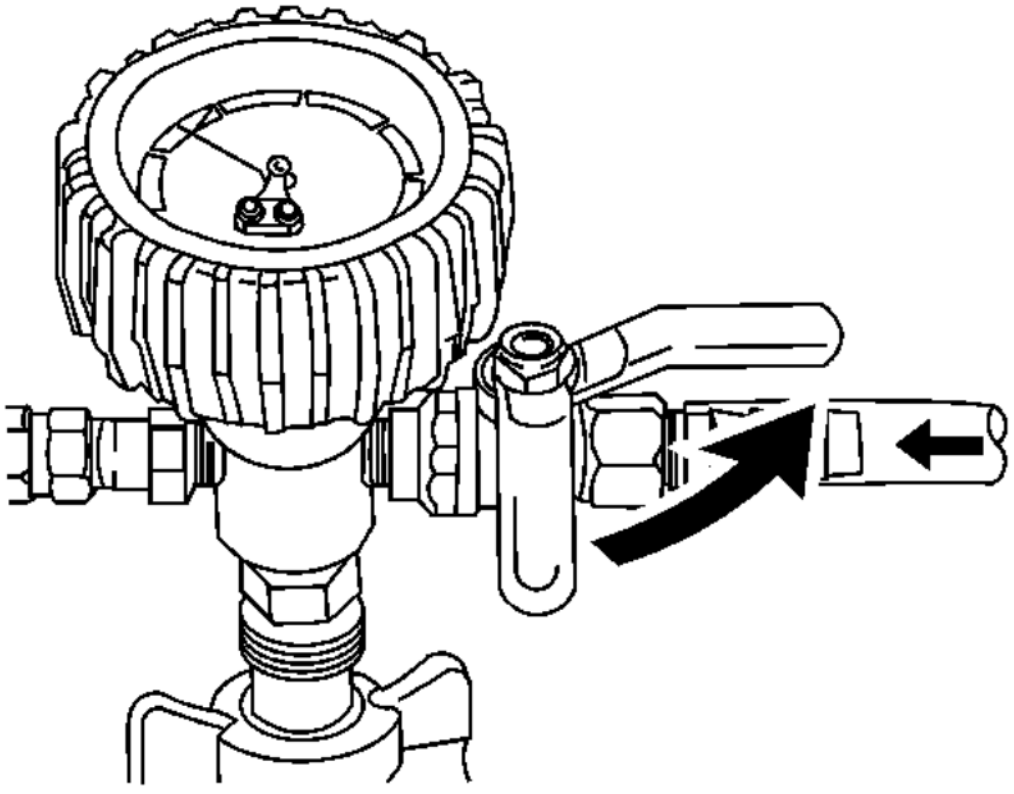


Fig. 15: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

15. Slowly open the valve on the vacuum gage assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
16. Close the valve on the venture assembly.
17. 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**.

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

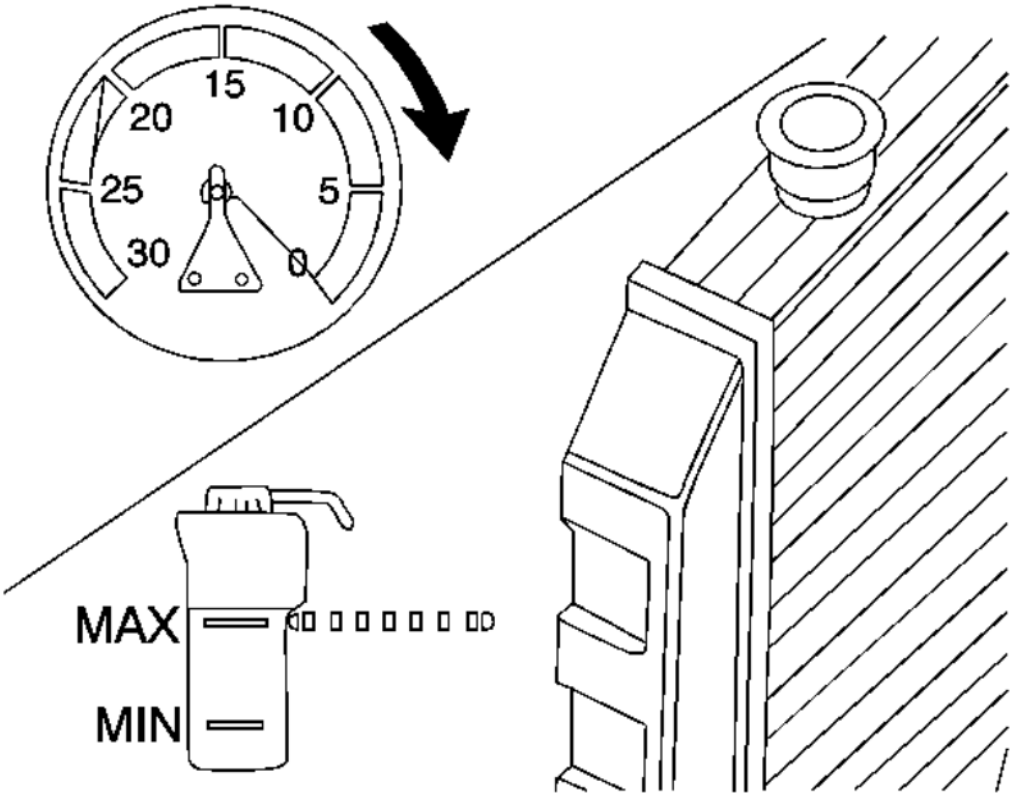


Fig. 16: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

19. Once the vacuum gage reaches zero, close the valve on the vacuum gage assembly and repeat steps 11-17.
20. Remove the **J 42401** .
21. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
22. Add coolant to the system as necessary.
23. Inspect the concentration of the coolant mixture using **J 26568** .

IMPORTANT: 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 form the vacuum gage assembly.

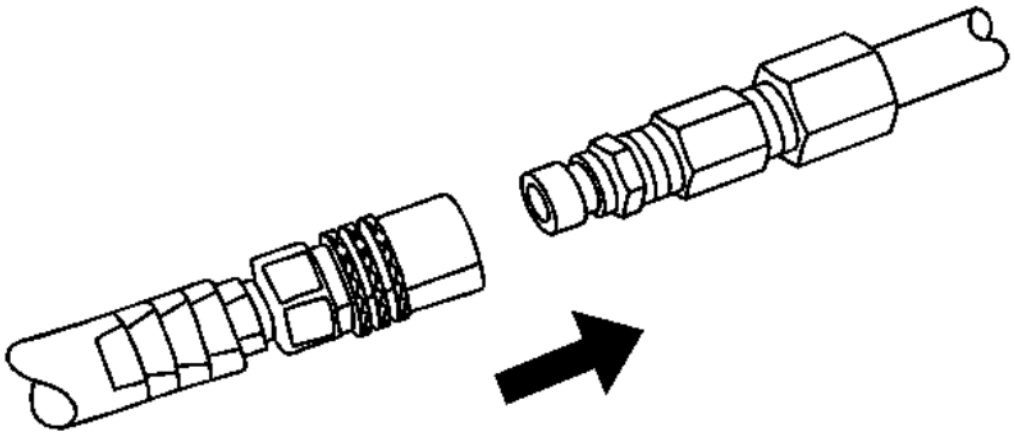


Fig. 17: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

25. Attach the extraction hose to the vacuum hose.

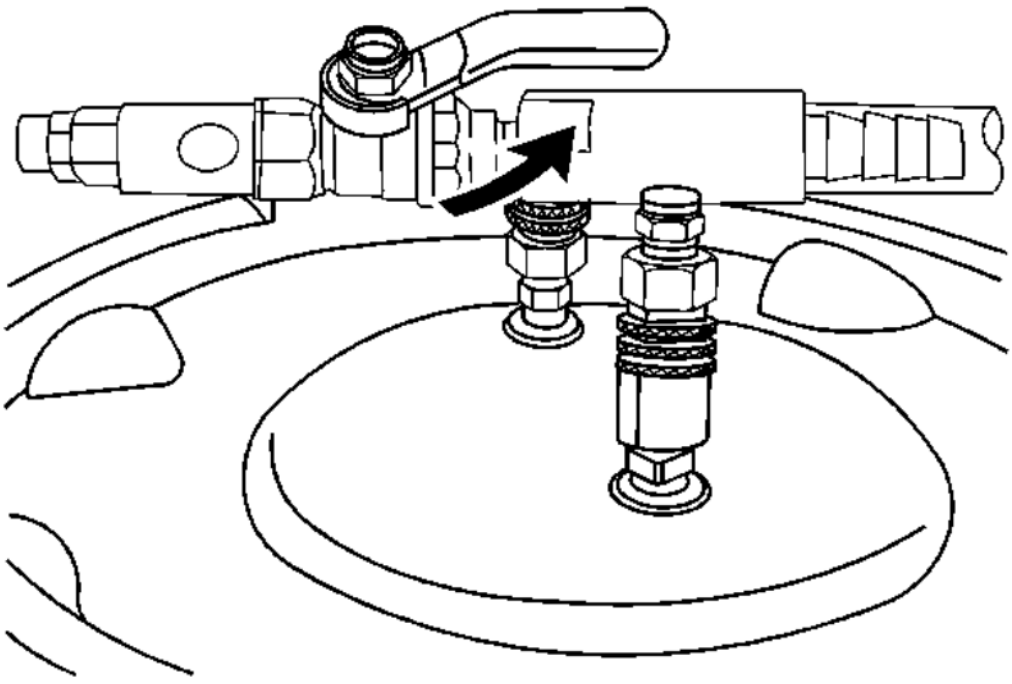


Fig. 18: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

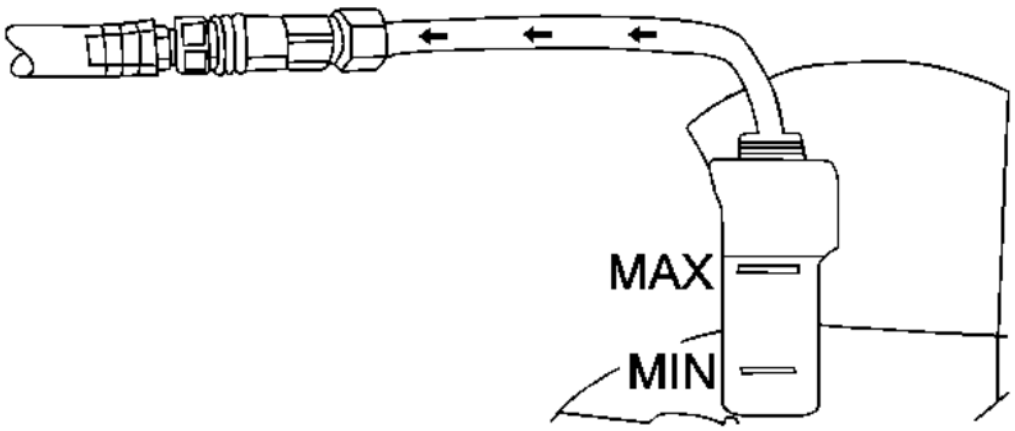


Fig. 19: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS CORP.

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

- **J 26568** Coolant and Battery Tester
- **J 38185** Hose Clamp Pliers

Draining Procedure

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

1. Follow the steps below in order to remove the surge tank fill cap:
    1. Slowly rotate the cap counterclockwise.

2. Stop rotating and allow the hissing to stop.
3. After all the hissing stops, continue turning counterclockwise in order to remove the cap.

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Place a drain pan under the lower radiator hose.
4. Using the **J 38185** , reposition the lower radiator hose clamp.
5. Remove the lower radiator hose from the radiator.
6. Drain the cooling system.

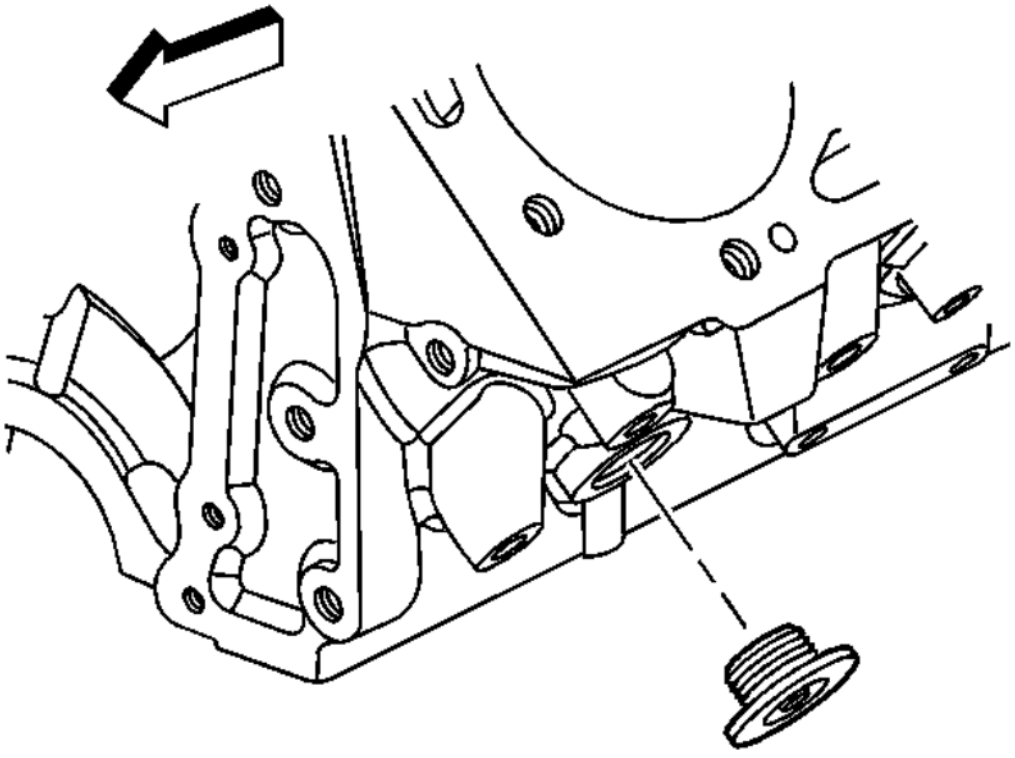


Fig. 20: View Of Engine Coolant Drain Hole Plug
Courtesy of GENERAL MOTORS CORP.

7. If a complete engine block drain is required, remove the left and right engine block coolant drain plugs.

8. Remove the engine block coolant heater, if equipped. Refer to **Coolant Heater Replacement (LH6, LY2, LMG, LY5, and LY6)** or **Coolant Heater Replacement (L76, L92)**.
9. Inspect the coolant.
10. Follow the appropriate procedure based on the condition of the coolant:
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. Refer to **Flushing** .

Filling Procedure

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

1. Install the lower radiator hose to the radiator.
2. Using the **J 38185** , reposition the lower radiator hose clamp.

NOTE: Refer to Fastener Notice .

3. If the left and right engine block coolant drain plugs were removed, perform the following:
    1. Apply pipe sealer to the drain plugs.
    2. Install the drain plugs.

    Tighten: Tighten the drain plugs to 60 N.m (44 lb ft).

4. Install the engine block coolant heater, if equipped. Refer to **Coolant Heater Replacement (LH6, LY2, LMG, LY5, and LY6)** or **Coolant Heater Replacement (L76, L92)**.
5. Lower the vehicle.

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

6. Slowly fill the cooling system with a 50/50 coolant mixture. Refer to **Approximate Fluid Capacities** .
7. Install the coolant pressure cap.
8. Start the engine.

9. Run the engine at 2,000-2,500 RPM until the engine reaches normal operating temperature.

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

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

FLUSHING

IMPORTANT:

- **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 manufacturer's instructions. However, always remove the thermostat before back flushing the system.**

1. **Block the drive wheels.**
2. **Place the transmission in park (P) or neutral (N).**
3. **Engage the park brake.**
4. **Run the engine until the thermostat opens.**
5. **Stop the engine.**
6. **Follow the drain and fill procedure unsing only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. Refer to Cooling System Draining and Filling (Vac-N-Fill) or Cooling System Draining and Filling (Static Fill).**

7. **Fill the coolant reservoir to the FULL HOT mark.**
8. **Fill the cooling system. Refer to Cooling System Draining and Filling (Vac-N-Fill) or Cooling System Draining and Filling (Static Fill).**

RADIATOR CLEANING

CAUTION: NEVER spray water on a hot radiator. The resulting steam could cause personal injury.

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

IMPORTANT: 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 (NON-HP2)

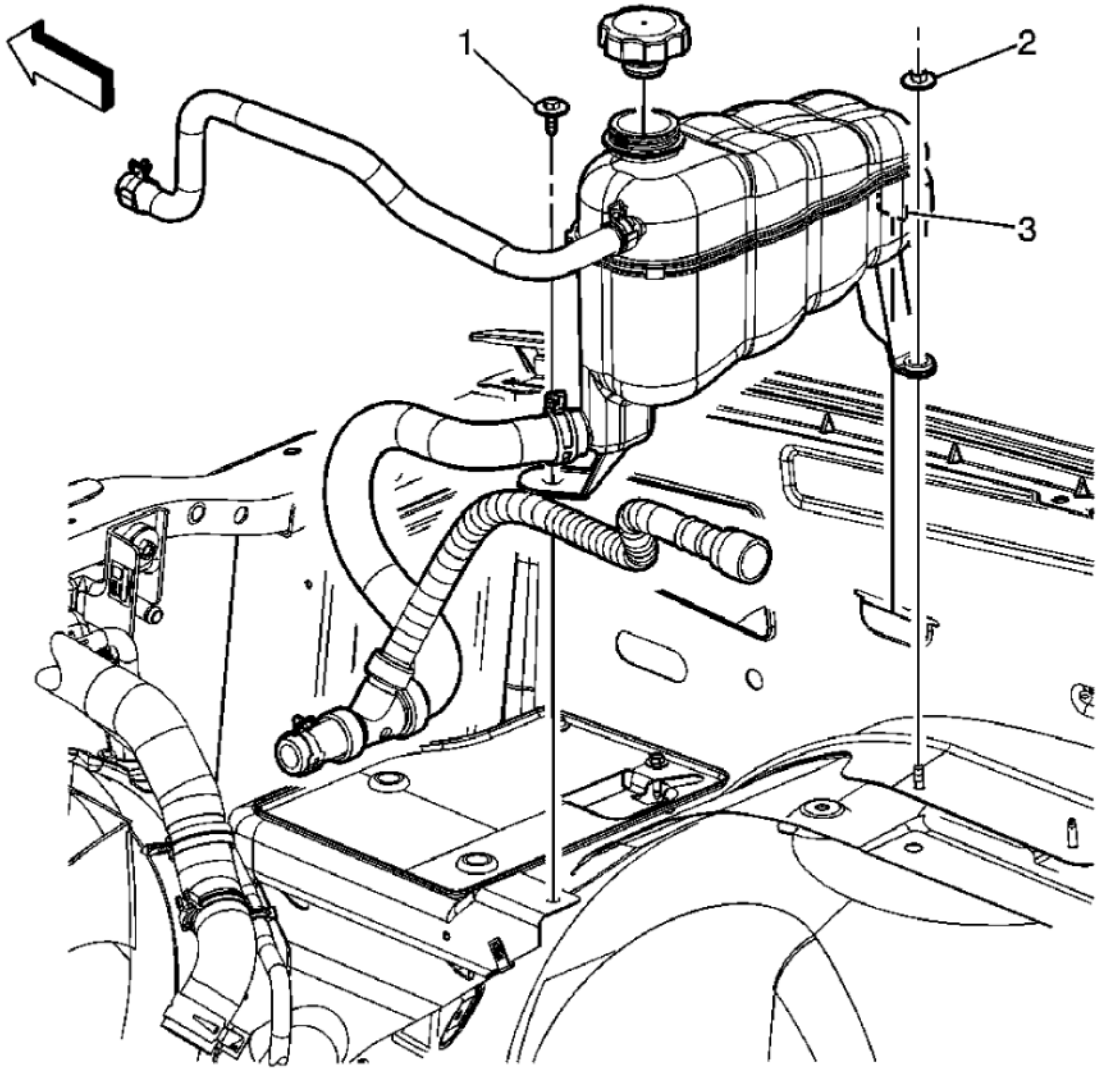


Fig. 21: Radiator Surge Tank (Non-HP2)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. 2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .	
1	Surge Tank Bolt **NOTE:**

	Refer to Fastener Notice . **Tighten:** 10 N.m (89 lb in)
2	Surge Tank Nut **Tighten:** 10 N.m (89 lb in)
3	Surge Tank **Tip:** Remove the surge tank hoses from the surge tank.

RADIATOR SURGE TANK INLET HOSE/PIPE REPLACEMENT (NON-HP2)

Removal Procedure

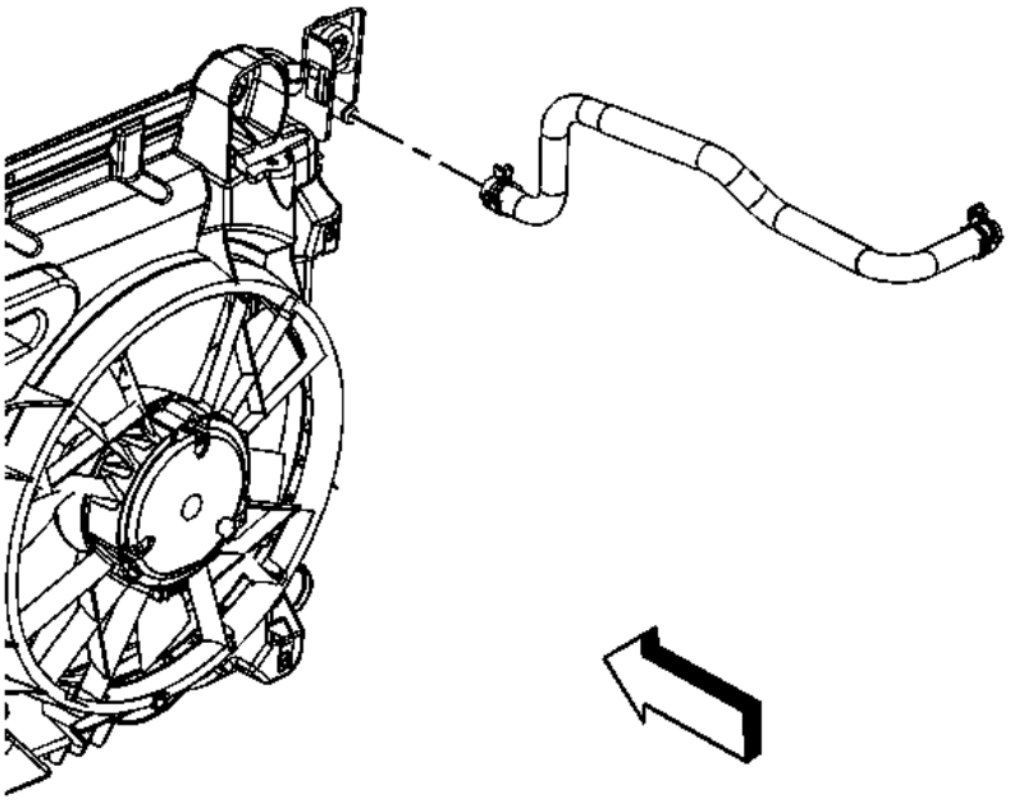


Fig. 22: View Of Surge Tank Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Reposition the surge tank inlet hose clamp from the radiator.
3. Remove the surge tank inlet hose from the radiator.

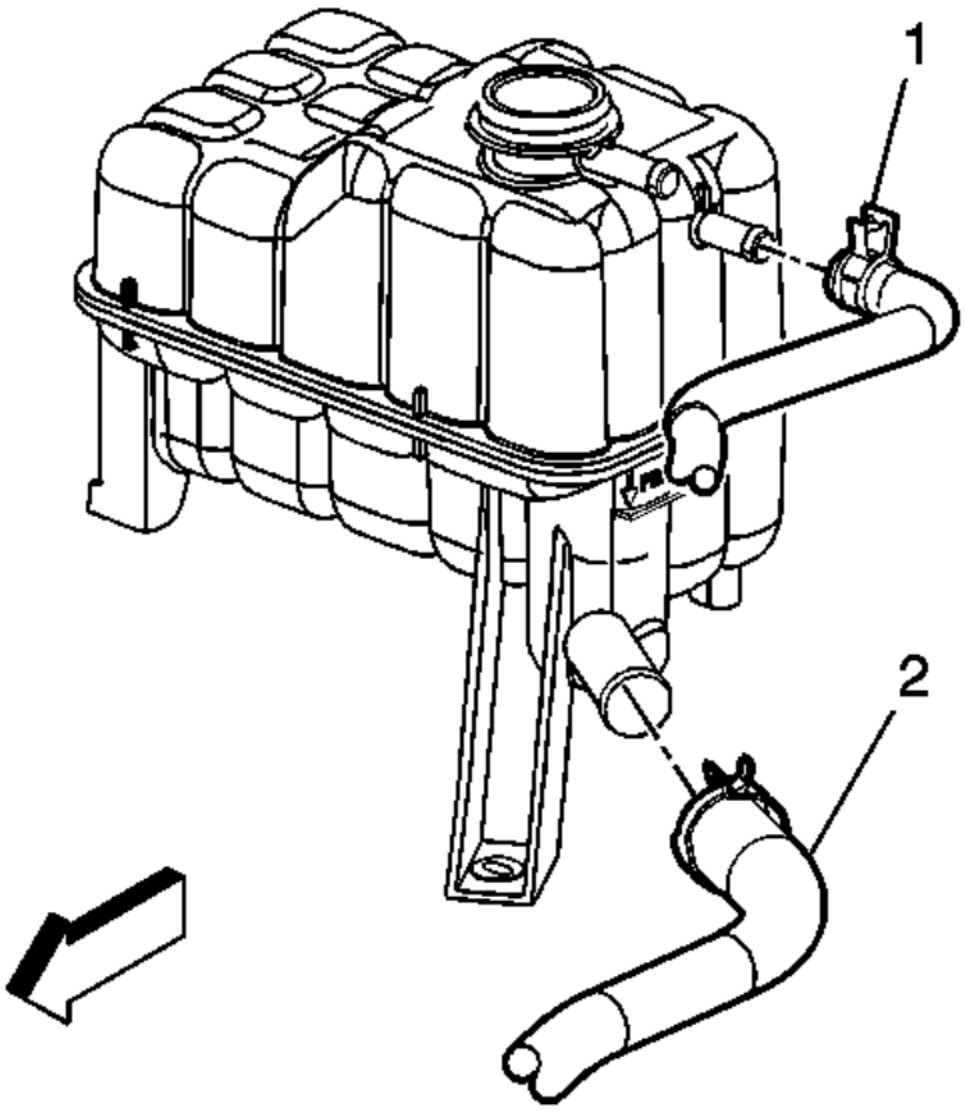


Fig. 23: View Of Surge Tank Outlet Hose & Surge Tank

Courtesy of GENERAL MOTORS CORP.

4. Reposition the surge tank inlet hose clamp at the surge tank.
5. Remove the surge tank inlet hose (1) from the surge tank.

Installation Procedure

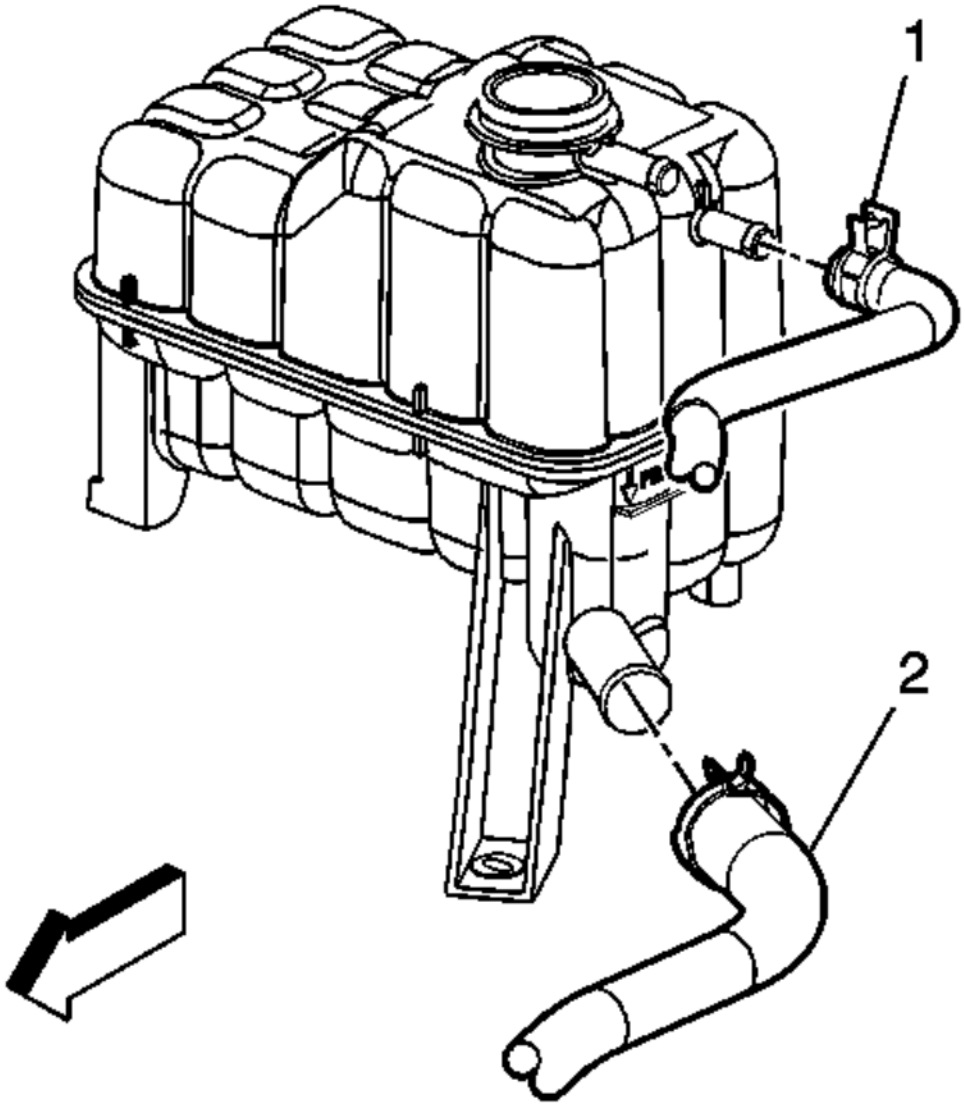


Fig. 24: View Of Surge Tank Outlet Hose & Surge Tank
Courtesy of GENERAL MOTORS CORP.

1. Install the surge tank inlet hose (1) to the surge tank.
2. Position the surge tank inlet hose clamp to the surge tank.

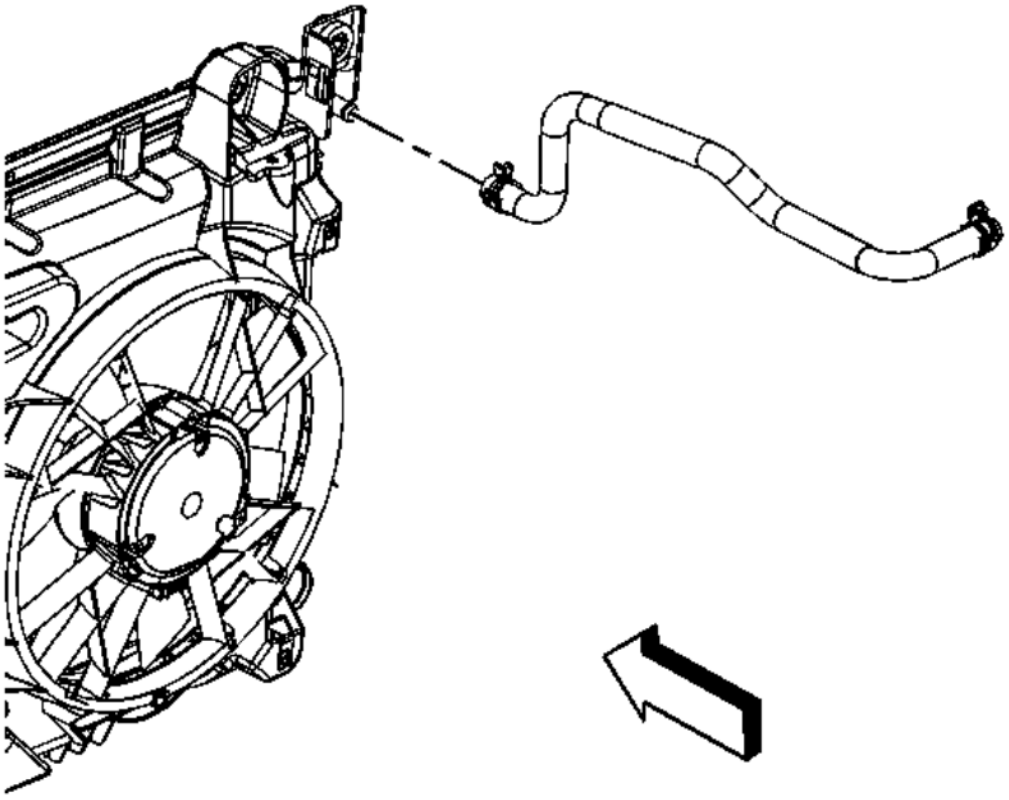


Fig. 25: View Of Surge Tank Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Install the surge tank inlet hose to the radiator.
4. Position the surge tank inlet hose clamp to the radiator.
5. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

RADIATOR INLET HOSE REPLACEMENT (NON-HP2)

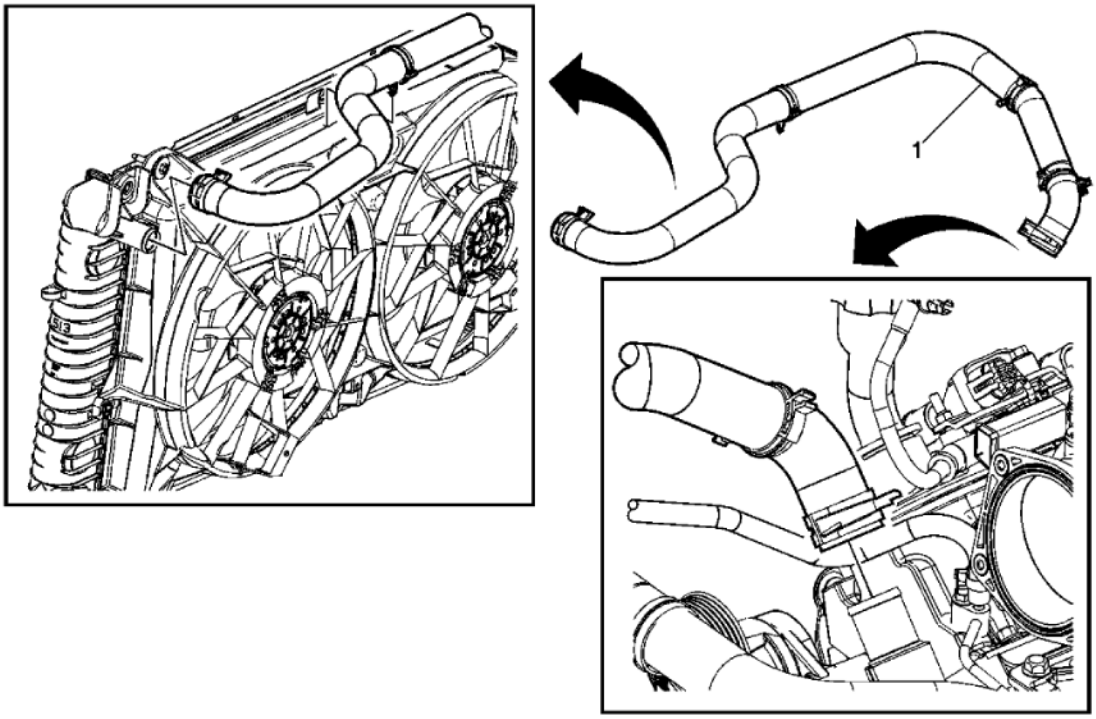


Fig. 26: Radiator Inlet Hose (Non-HP2)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .	
1	Radiator Inlet Hose **Tip:** • Remove the radiator vent hose from the radiator inlet hose clips. • Using **J 38185** reposition the radiator inlet hose clamps.

RADIATOR OUTLET HOSE REPLACEMENT (NON-HP2)

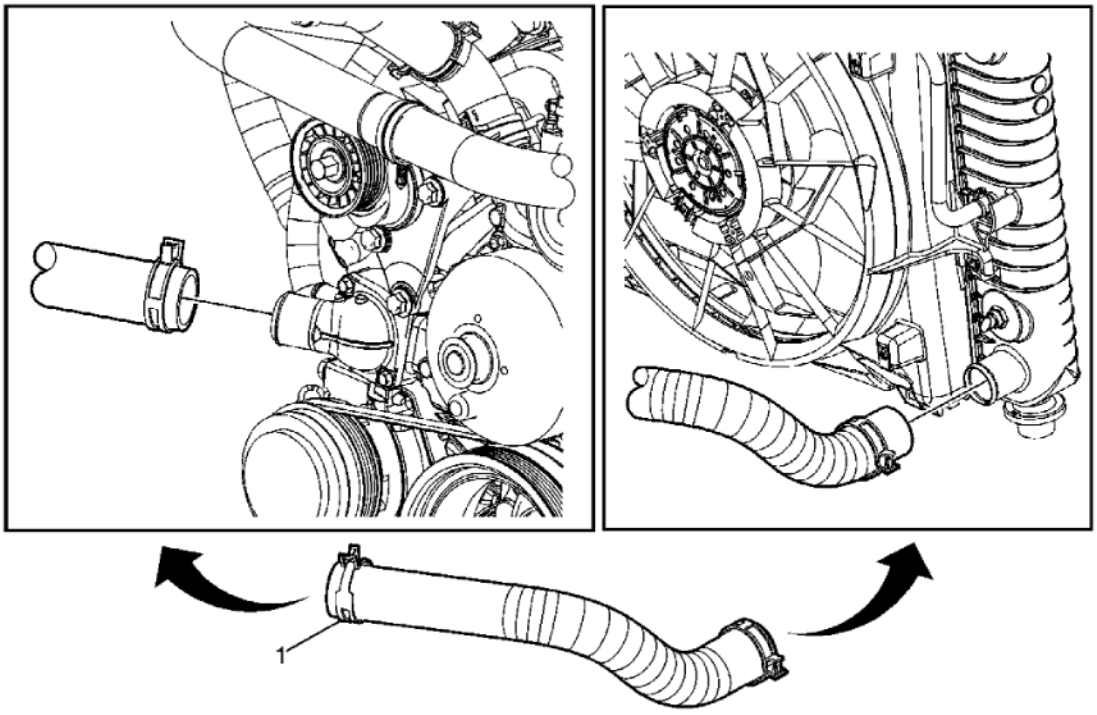


Fig. 27: Radiator Outlet Hose (Non-HP2)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** . 3. Remove air cleaner housing. Refer to **Air Cleaner Assembly Replacement**	
1	Radiator Outlet Hose **Tip:** Using **J 38185** reposition the radiator outlet hose clamps.

RADIATOR HOSE QUICK CONNECT FITTING

Removal Procedure

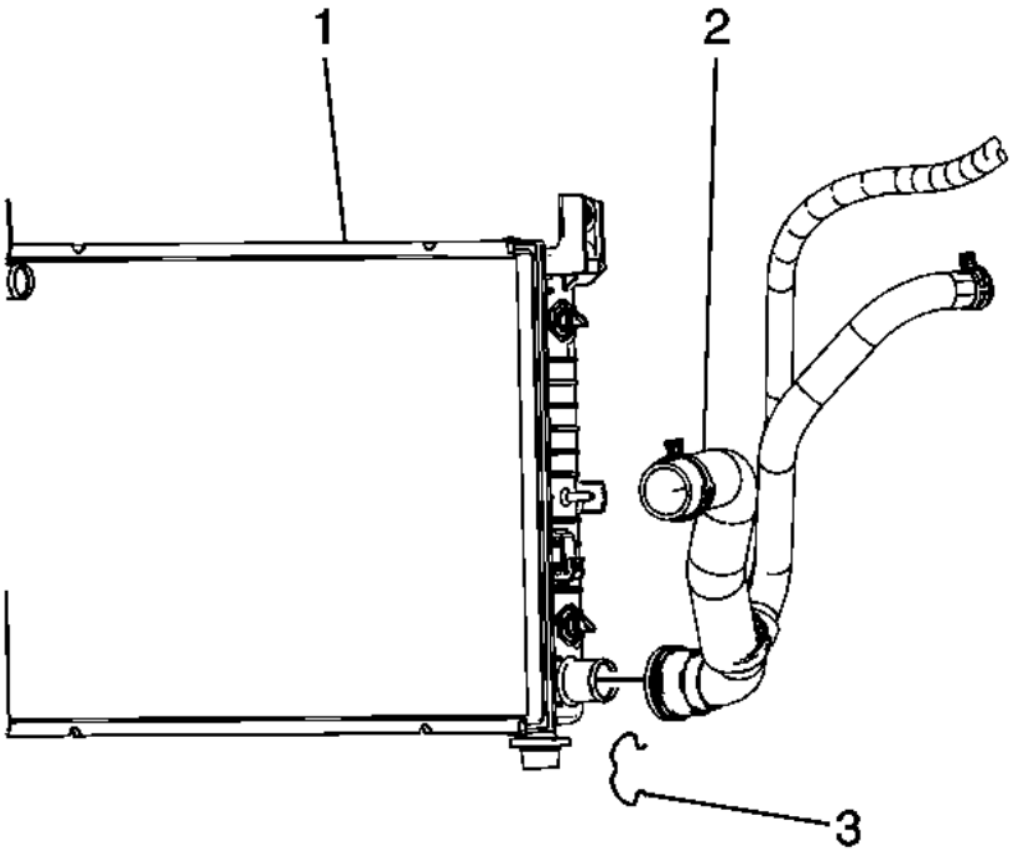


Fig. 28: Radiator Outlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

1. Using a bent-tip screwdriver or equivalent, pull on one of the open ends of the retaining ring in order to rotate the retaining ring.
2. Rotate the retaining ring (3) around the quick connector until the retaining ring is out of position and can be completely removed.
3. Remove the radiator outlet hose (2) from the quick connector fitting at the radiator (1).

Installation Procedure

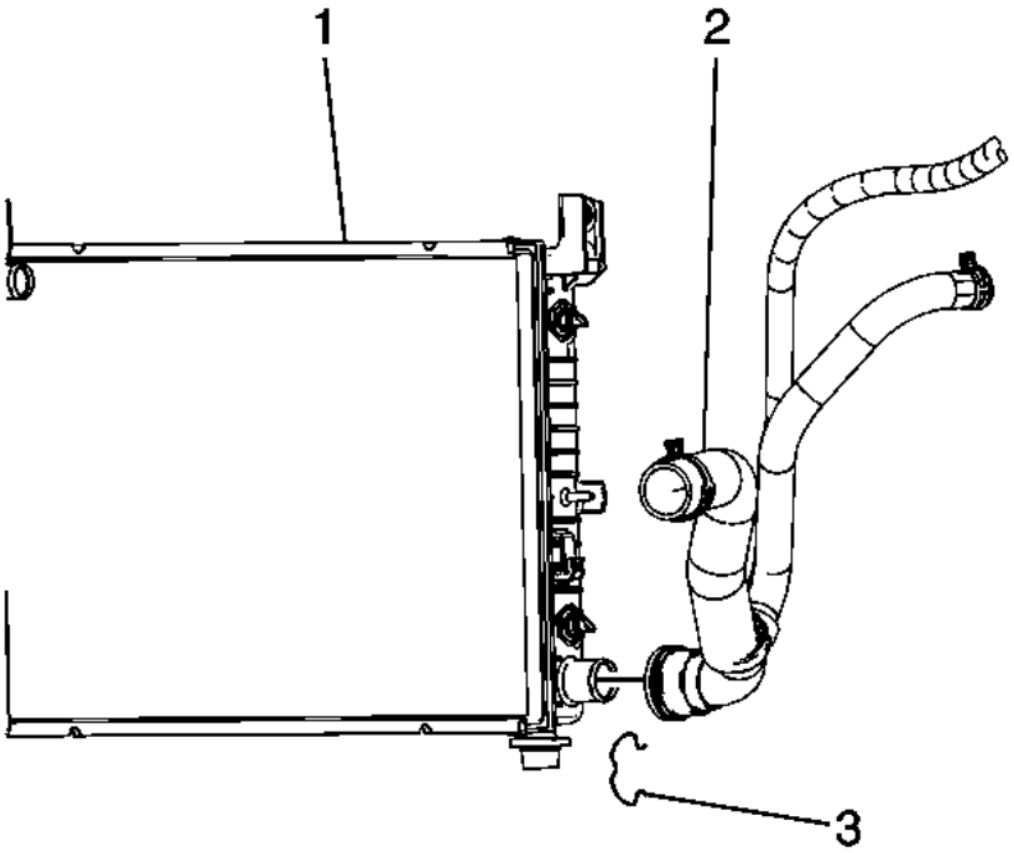


Fig. 29: Radiator Outlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not install the retaining ring (3) onto the fitting by pushing the retaining ring down over the fitting.

1. Hook one of the open ends of the retaining ring (3) in one of the slots in the quick connector.
2. Rotate the retaining ring (3) around the connector until the retaining ring is positioned with all 3 ears through the 3 slots.
3. Ensure the 3 retaining ring ears can be seen from the inside of the connector and the retaining ring can move freely in the slots.
4. Install the radiator outlet hose (2) onto the radiator quick connector fitting until a click is

heard or felt.

Pull back on the radiator outlet hose (2) to ensure a proper connection.

RADIATOR VENT INLET HOSE REPLACEMENT (NON-HP2)

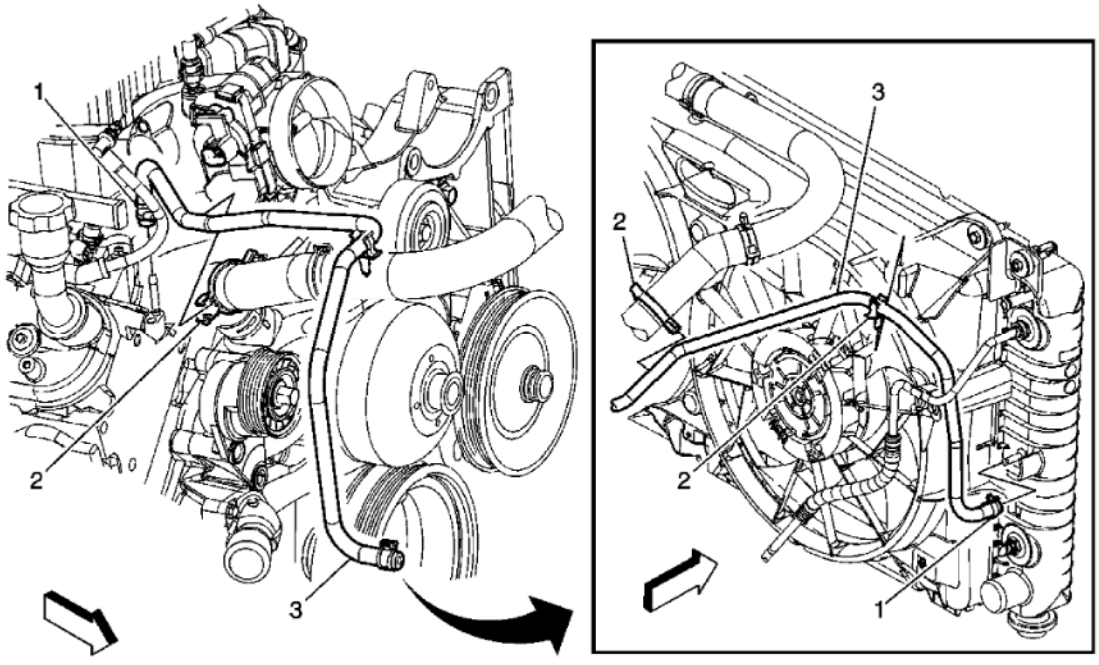


Fig. 30: Radiator Vent Inlet Hose (Non-HP2)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. 2. If necessary, remove the air cleaner resonator duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .	
1	Remove Radiator Vent Inlet Hose Clamp (Qty: 2)
2	Remove Radiator Vent Inlet Hose Support Clip (Qty: 2)
3	Radiator Vent Inlet Hose

ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING

Removal Procedure

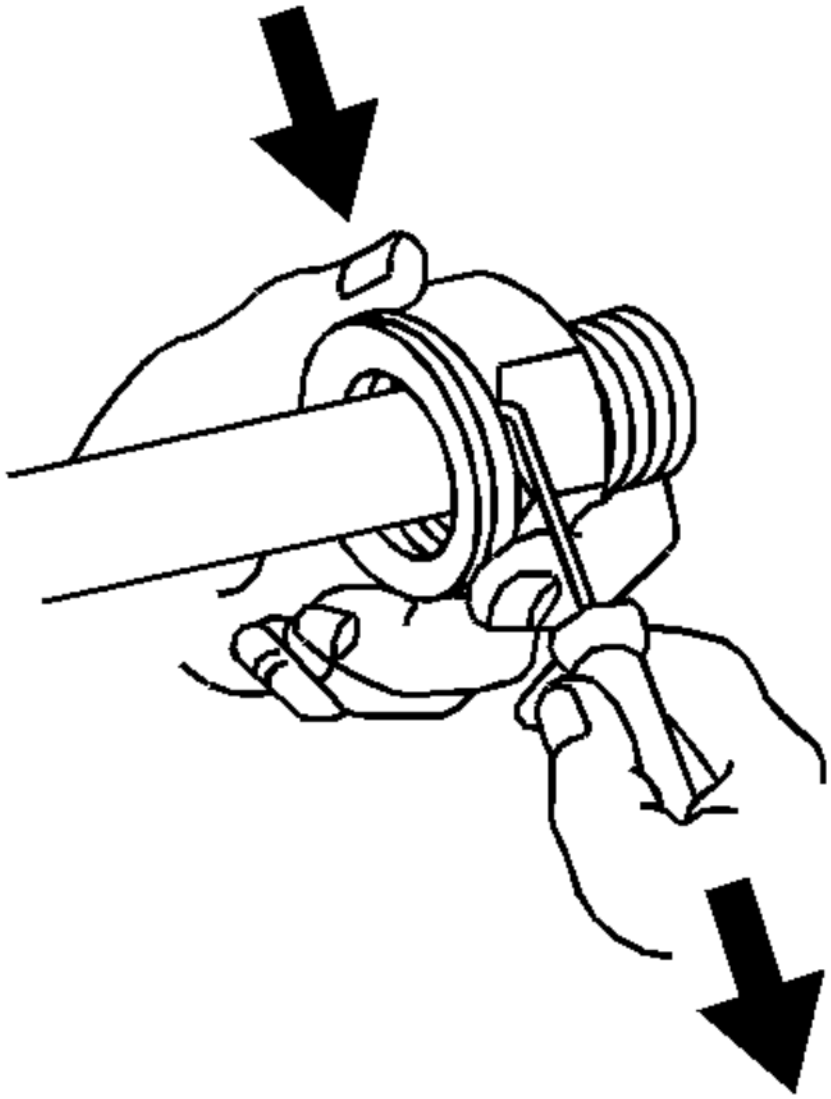


Fig. 31: Rotating Retaining Ring Using Screwdriver
Courtesy of GENERAL MOTORS CORP.

1. Disengage the plastic caps from the quick connect fittings. Pull the caps back along the pipe.
2. Using a bent-tip screwdriver or equivalent, pull on one of the open ends of the retaining ring

in order to rotate the retaining ring.

3. Rotate the retaining ring around the quick connector until the retaining ring is out of position and can be completely removed.

   Discard the retaining rings.

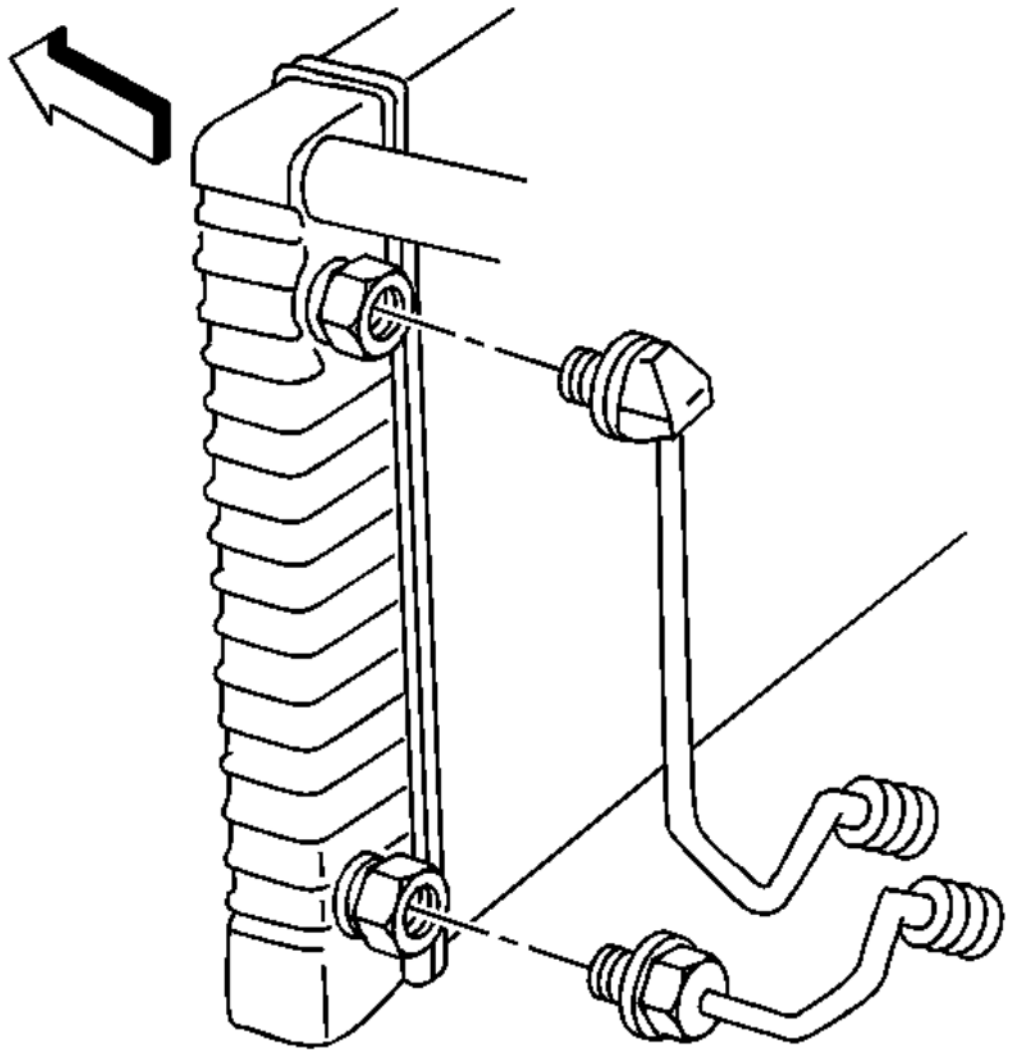


Fig. 32: View Of Engine Oil Cooler Line Connections
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil cooler line from the quick connector fitting at the radiator.

   Pull the lines straight out from the connectors.

5. Clean all of the components in a suitable solvent, and dry them with compressed air.
6. Inspect the fittings, the connectors, the cooler lines, and the cooler for damage, distortion, or restriction. Replace parts as necessary.

Installation Procedure

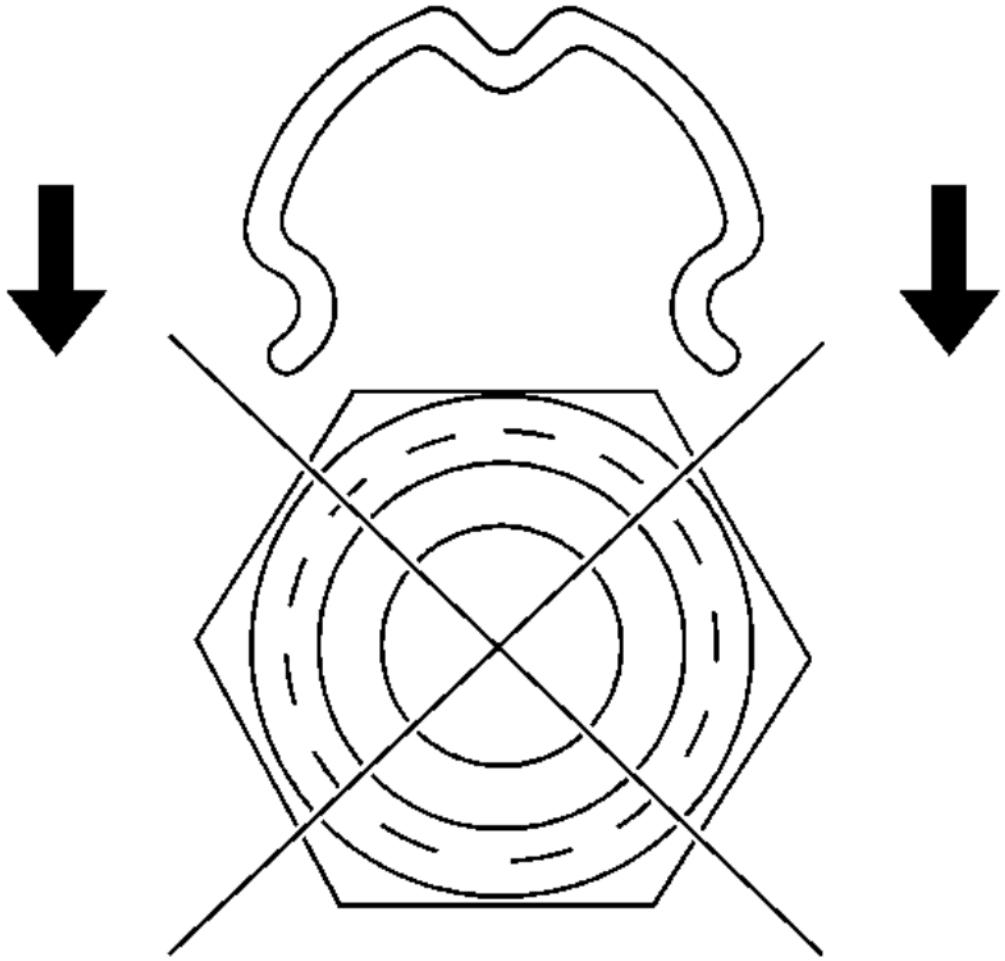


Fig. 33: View Of Retaining Ring & Quick Connector

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: When performing the following procedure, do not reuse the old retaining rings. Replace the old retaining rings with new ones.
Do not install the new retaining ring onto the fitting by pushing the retaining ring down over the fitting.

1. Install a new retaining ring into each quick connector fitting.

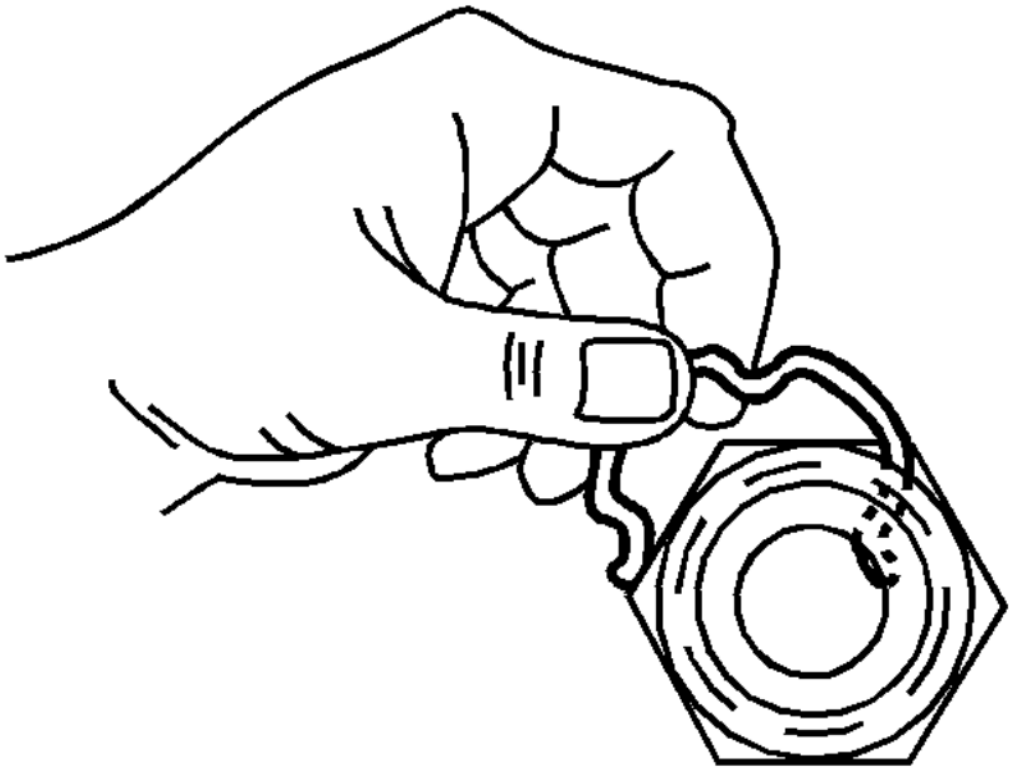


Fig. 34: Hooking Retaining Ring
Courtesy of GENERAL MOTORS CORP.

2. Hook one of the open ends of the retaining ring in one of the slots in the quick connector.

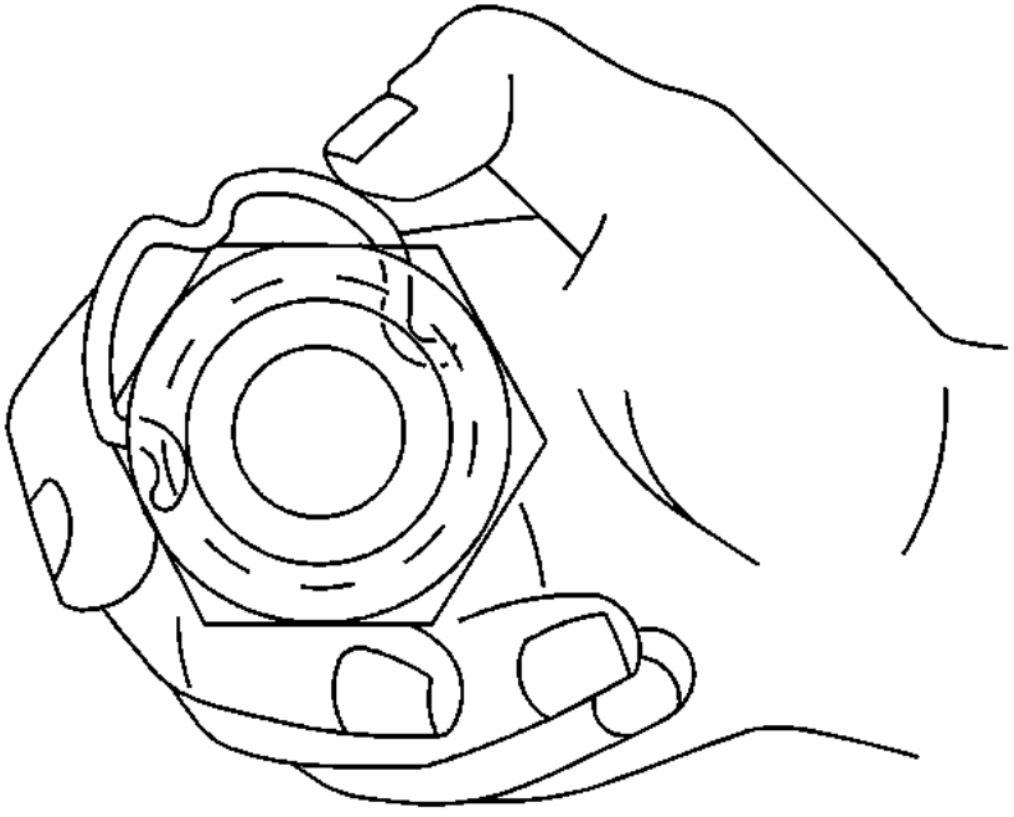


Fig. 35: View Of Retaining Ring & Connector
Courtesy of GENERAL MOTORS CORP.

3. Rotate the retaining ring around the connector until the retaining ring is positioned with all 3 ears through the 3 slots.

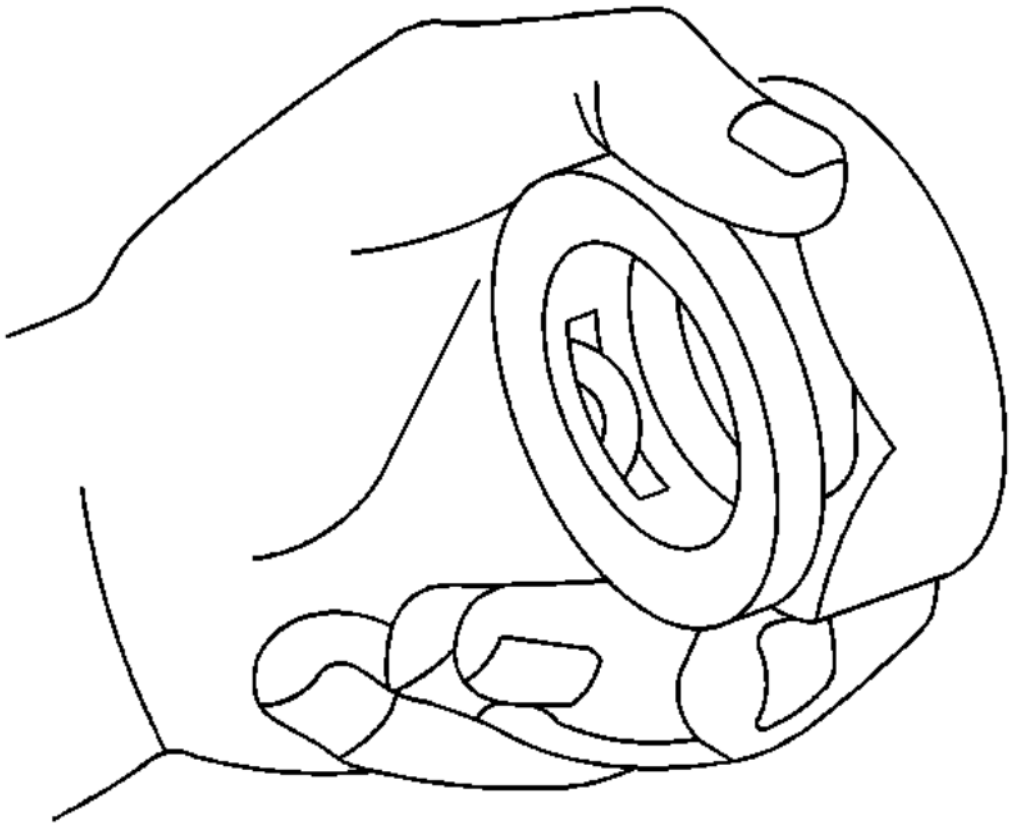


Fig. 36: View Of Retaining Ring Ears From Inside Of Connector
Courtesy of GENERAL MOTORS CORP.

4. Ensure the 3 retaining ring ears can be seen from the inside of the connector and the retaining ring can move freely in the slots.

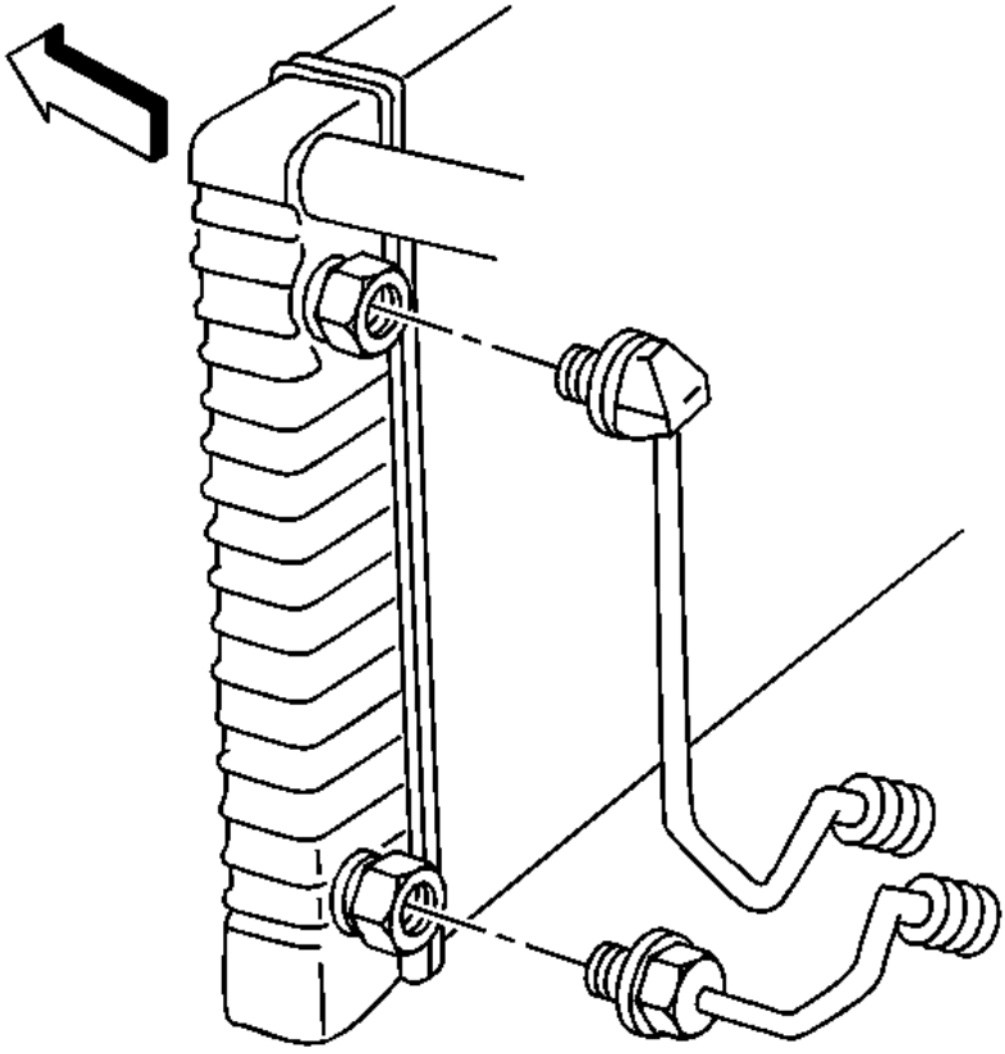


Fig. 37: View Of Engine Oil Cooler Line Connections
Courtesy of GENERAL MOTORS CORP.

5. Install the engine oil cooler line into the quick connector fitting until a click is heard or felt.

   Pull back on the engine oil cooler lines to ensure a proper connection.

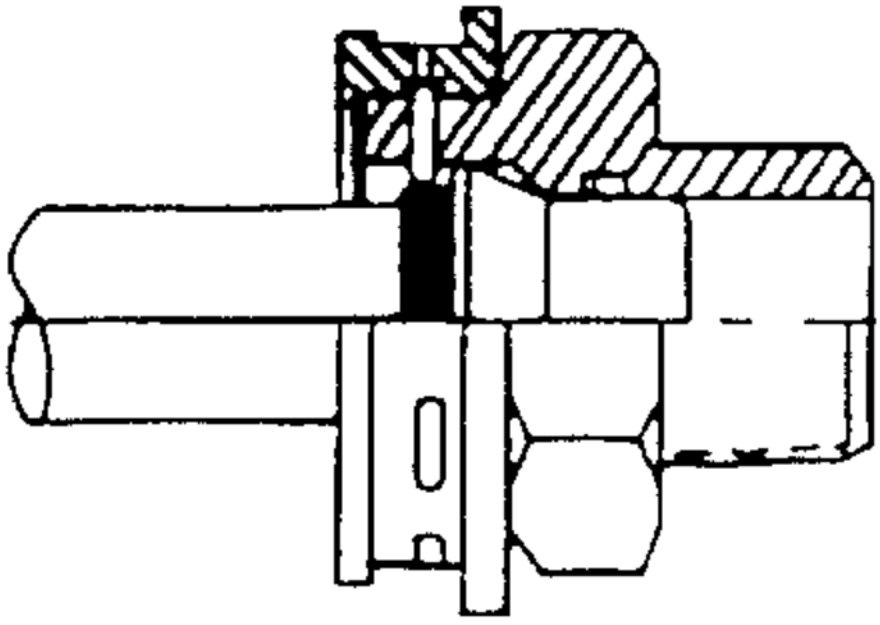


Fig. 38: View Of Cooler Line & Plastic Cap
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not manually depress the retaining clip when installing the plastic cap.

6. Snap the plastic cap onto the quick connect fitting.
7. Ensure that the plastic cap is fully seated against the fitting.

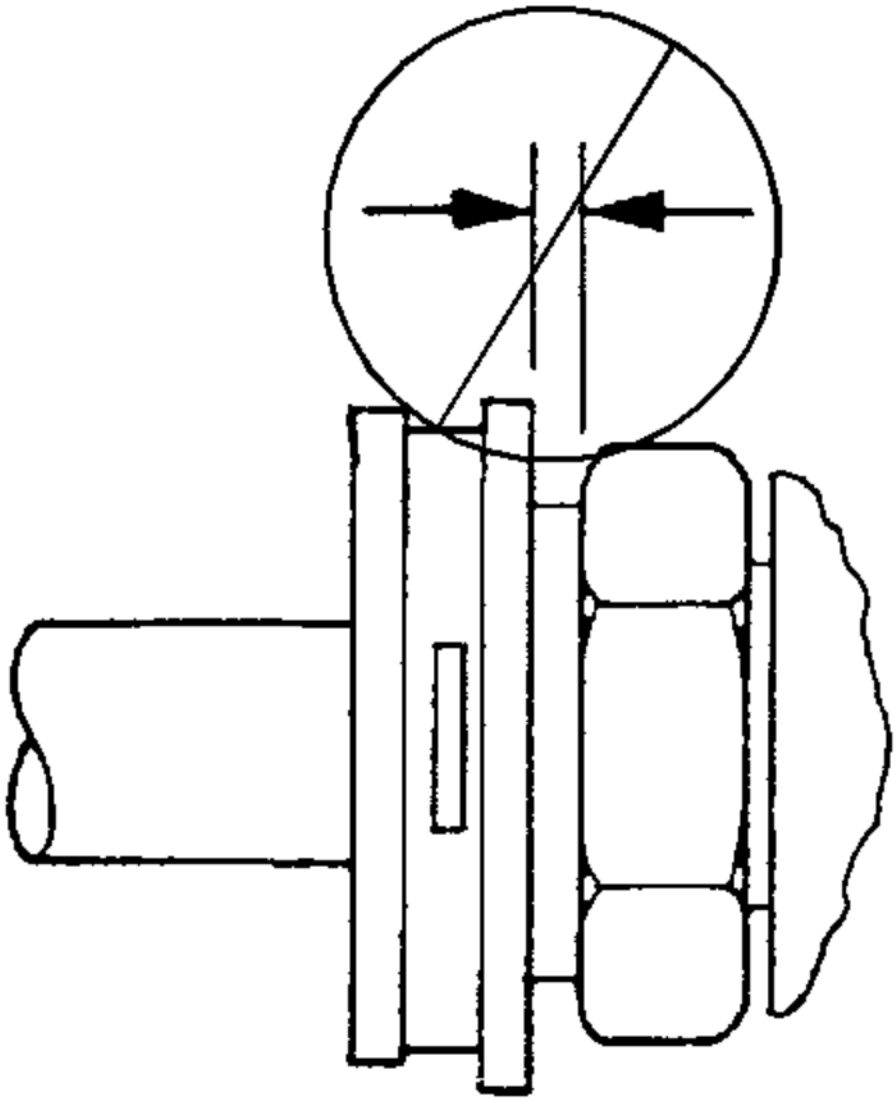


Fig. 39: Checking For Gap Between Cap & Fitting
Courtesy of GENERAL MOTORS CORP.

8. Ensure that no gap is present between the cap and the fitting.
9. Inspect and fill the engine oil to the proper level.

ENGINE OIL COOLER HOSE/PIPE REPLACEMENT

Removal Procedure

The optional oil cooler is either an integral part of the radiator or a separate unit placed in front of the radiator. The cooler lines and hoses are serviceable.

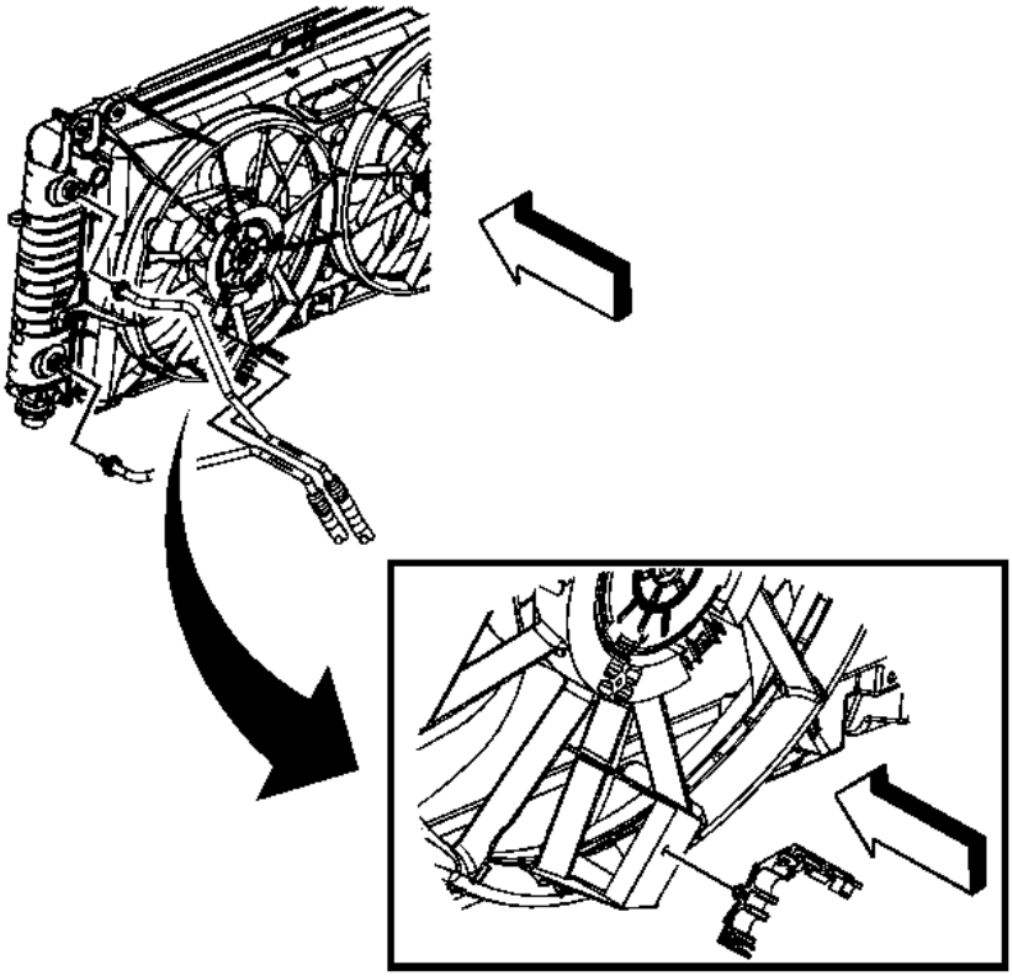


Fig. 40: Locating Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine oil cooler quick connect fittings. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
2. If equipped with regular production option (RPO) L76 (6.0L) engine, perform the

following.

1. Open the oil cooler hose clip located on the lower fan shroud.
2. Remove the oil cooler hoses from the clip.

3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

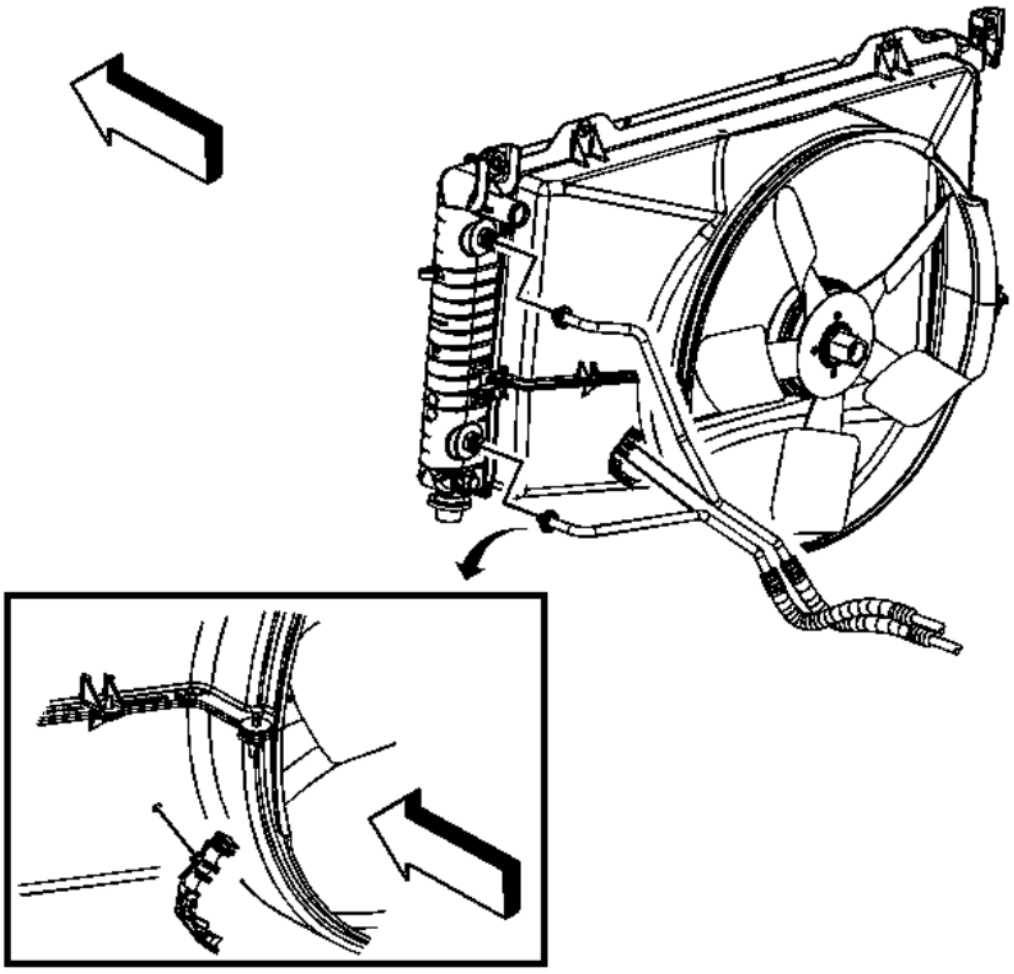


Fig. 41: View Of Oil Cooler Hoses & Clips
Courtesy of GENERAL MOTORS CORP.

4. If equipped with RPO LY6 (6.0L) engine, remove the oil cooler hoses from the clip.
5. Place a jack or utility stands at the rear of the vehicle.

6. If equipped, remove the engine protection shield. Refer to **Engine Shield Replacement** .

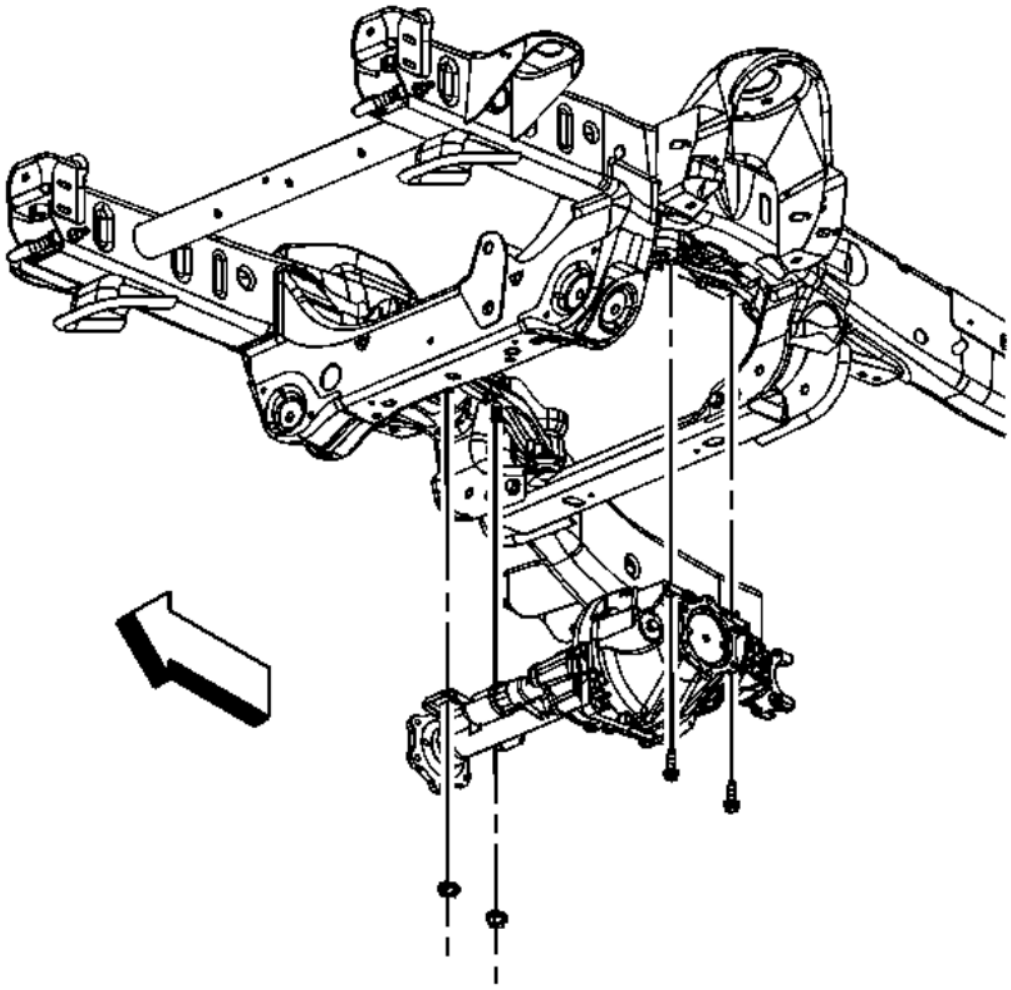


Fig. 42: Locating Differential Carrier Nuts
Courtesy of GENERAL MOTORS CORP.

7. For both 1500 and 2500 series, support the front differential carrier with a suitable adjustable jack.
8. For 1500 series vehicles, remove the differential carrier right side nuts.

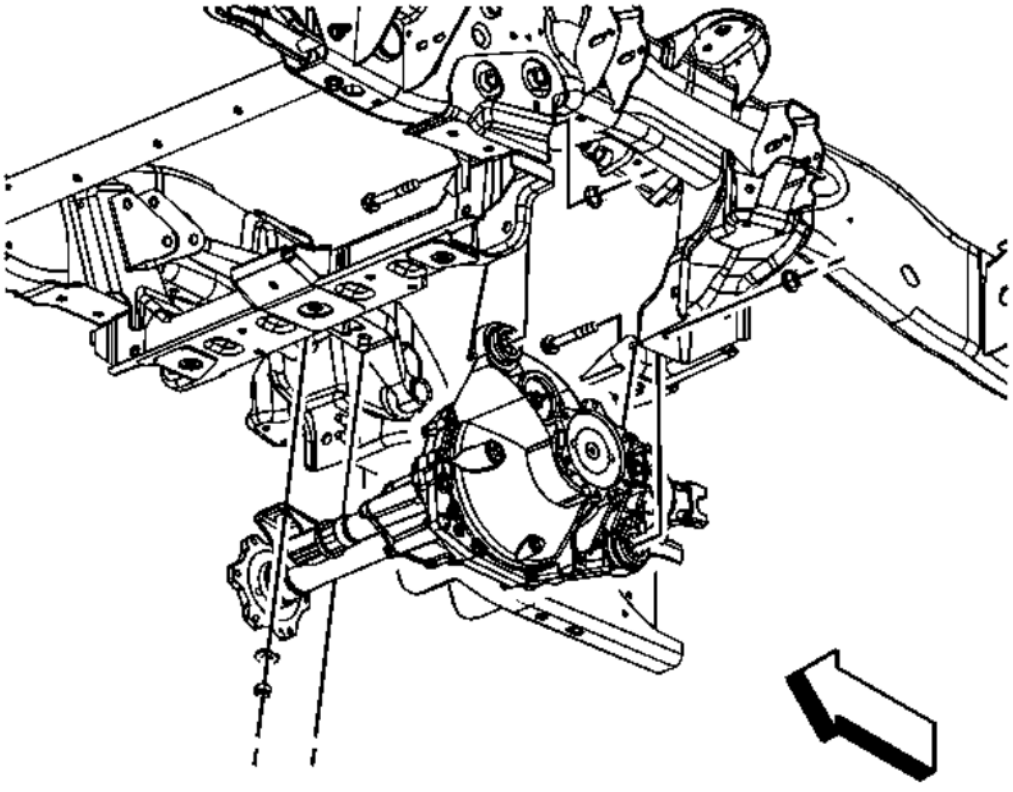


Fig. 43: View Of Differential Carrier Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the differential carrier left side bolts.
10. Lower the differential carrier.
11. For 2500 series vehicles, remove the differential carrier right side nuts.

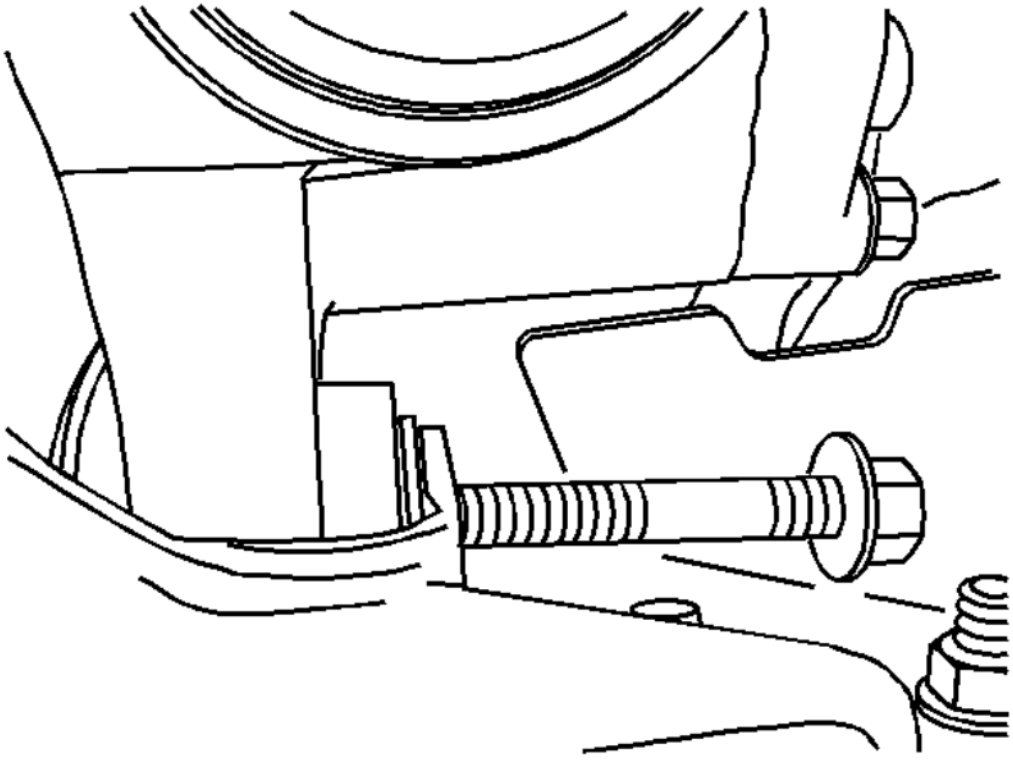


Fig. 44: View Of Differential Carrier Lower Mounting Bolt
Courtesy of GENERAL MOTORS CORP.

12. Remove the differential carrier upper mounting bolt and nut.
13. Remove the differential carrier lower mounting bolt and nut.

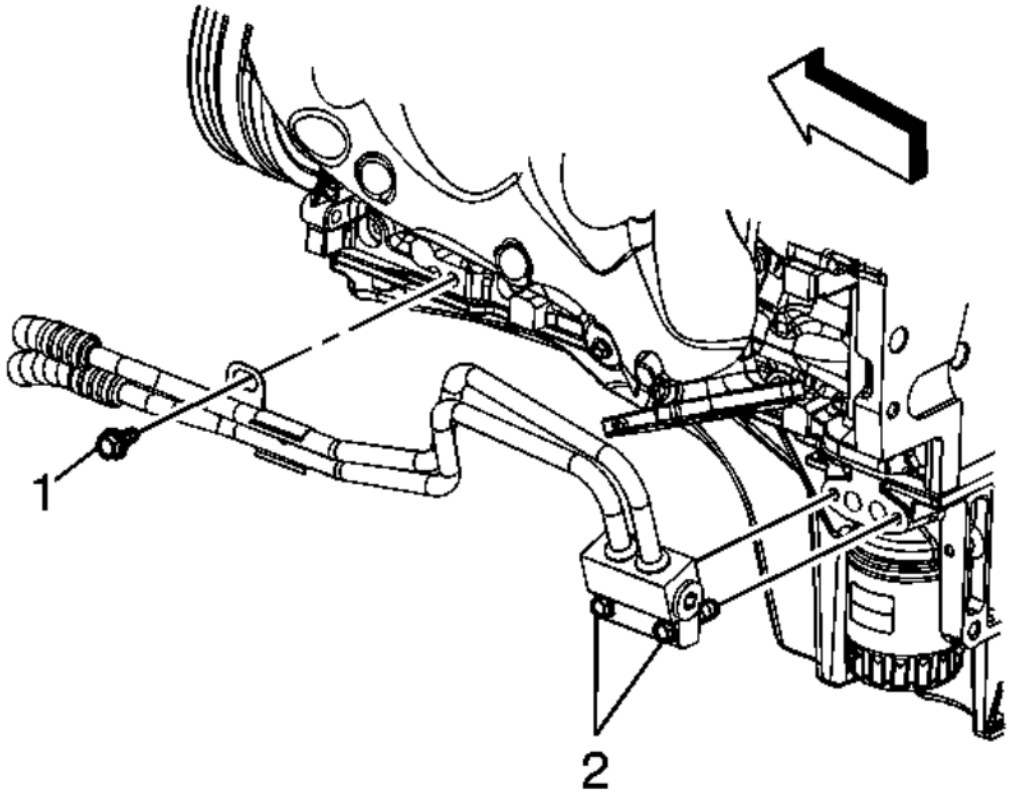


Fig. 45: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

14. If equipped with RPO L76 (6.0L) engine, perform the following:
    1. Lower the differential carrier.
    2. Remove the oil cooler hose adapter bolts (2).
    3. Remove the oil cooler hose assembly and gasket. Discard the gasket.
    4. Inspect the fittings, connectors, and cooler hoses for damage or distortion.

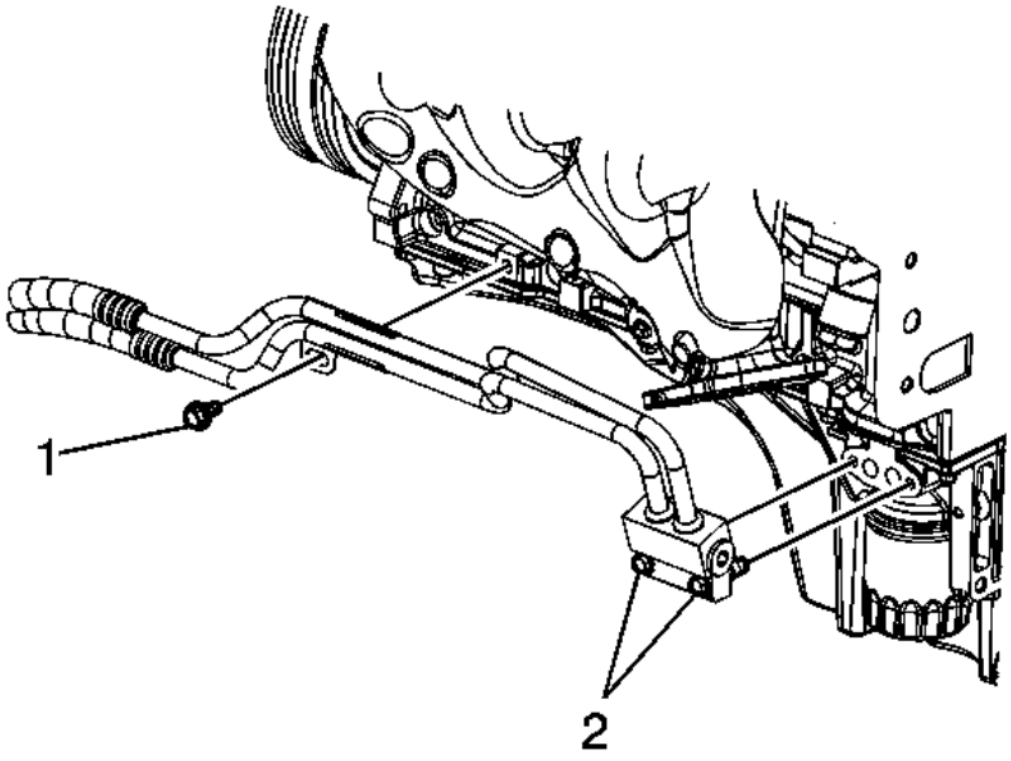


Fig. 46: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

15. If equipped with RPO LY6 (6.0L) engine, perform the following:
    1. Remove the oil cooler hose bracket bolt. (1)
    2. Remove the oil cooler hose adapter bolts. (2)
    3. Remove the oil cooler hose assembly. Discard the gasket.
    4. Inspect the fittings, connectors, and cooler hoses for damage or distortion.

Installation Procedure

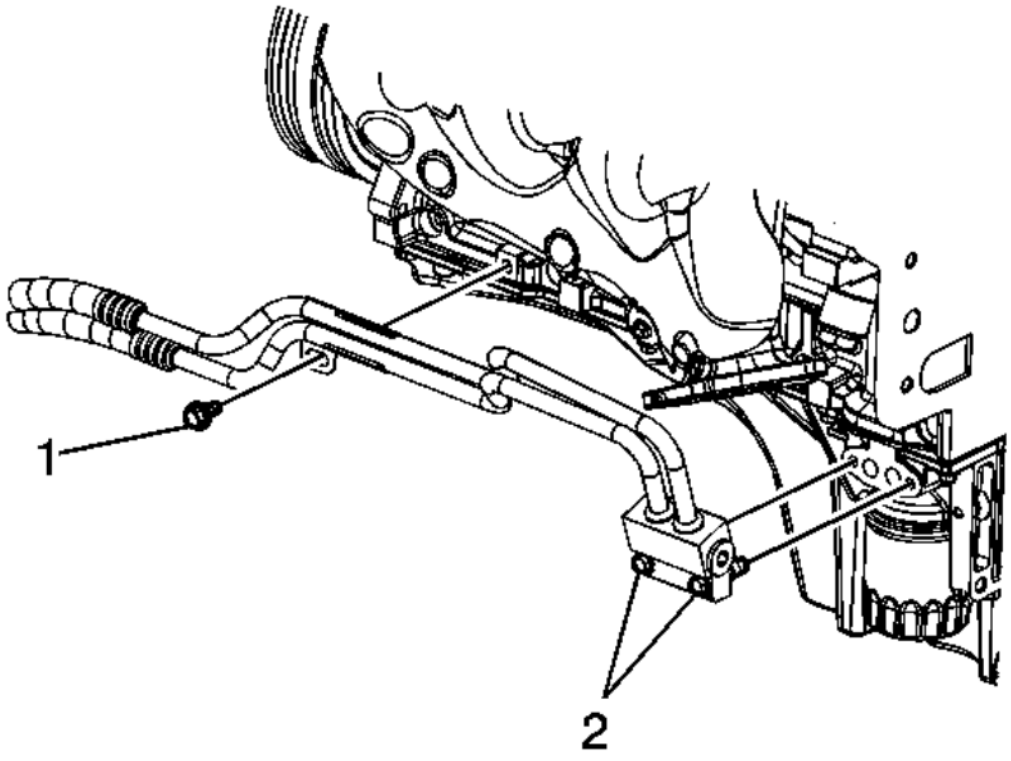


Fig. 47: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. If equipped with RPO LY6 (6.0L) engine, perform the following:
    1. Install the oil cooler hose assembly and a NEW gasket.
    2. Install the oil cooler hose adapter bolts (2).

       Tighten: Tighten the bolts to 12 N.m (106 lb in).

    3. Install the oil cooler hose bracket bolt.

       Tighten: Tighten the bolt to 25 N.m (18 lb ft).

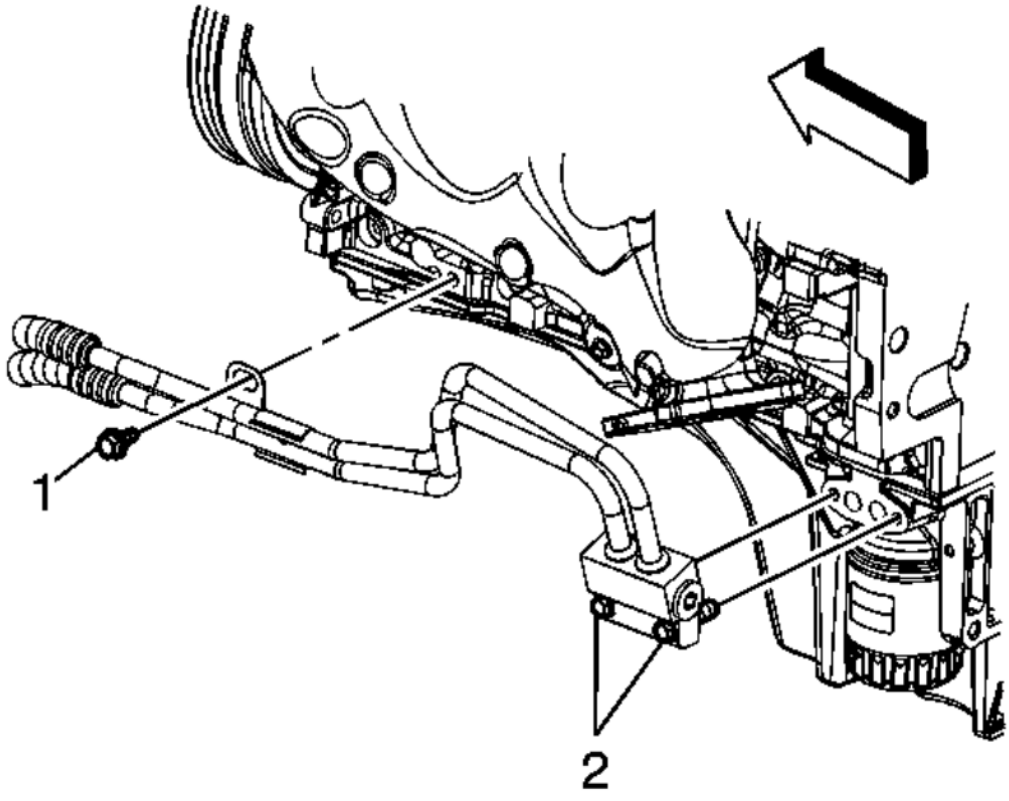


Fig. 48: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

2. If equipped with a RPO L76 (6.0L) engine, perform the following.
    1. Install the oil cooler hose assembly and a NEW gasket.
    2. Install the oil cooler hose adapter bolts (2).

       Tighten: Tighten the bolts to 12 N.m (106 lb in).

    3. Install the oil cooler hose bracket bolt (1).

       Tighten: Tighten the bolt to 25 N.m (18 lb ft).

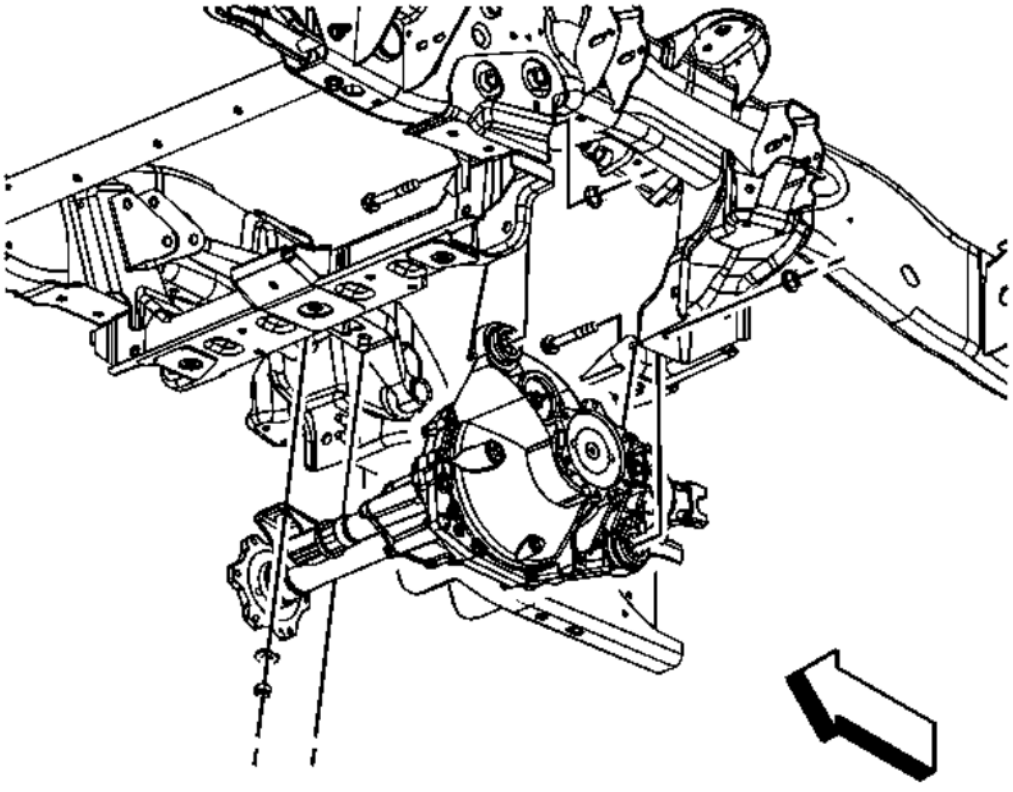


Fig. 49: View Of Differential Carrier Bolts
Courtesy of GENERAL MOTORS CORP.

3. For 2500 series vehicles, raise the differential carrier into position.
4. Install the differential carrier left side upper bolt and nut until snug.
5. Install the differential carrier left side lower bolt and nut until snug.
6. Install the differential carrier right side nuts.

Tighten: Tighten the bolt to 100 N.m (74 lb ft).

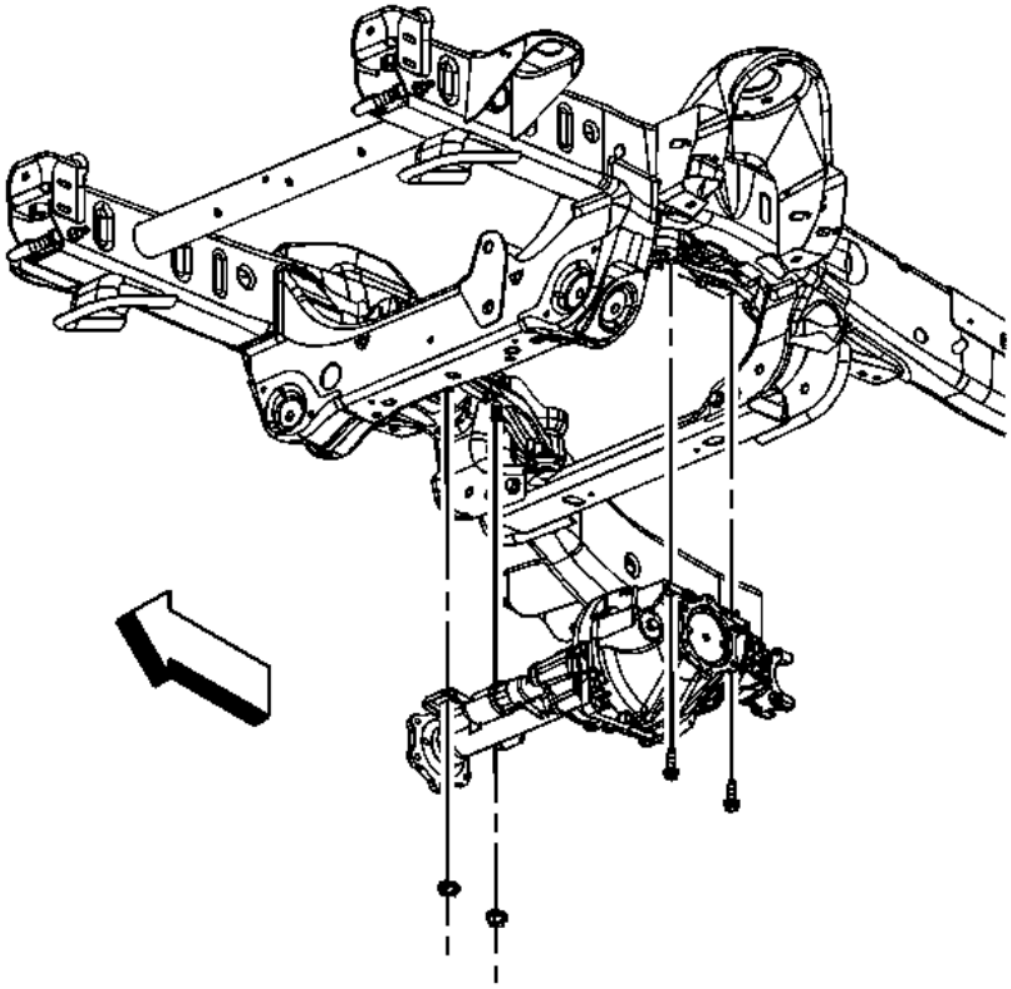


Fig. 50: Locating Differential Carrier Nuts
Courtesy of GENERAL MOTORS CORP.

7. For 1500 series vehicles, raise the differential carrier into position.
8. Install the differential carrier right side nuts.
9. Install the differential carrier left side bolts.

Tighten: Tighten the bolts/nuts to 100 N.m (74 lb ft).

10. If equipped, install the engine protection shield. Refer to **Engine Shield Replacement** .

11. Remove the jack or utility stand from the rear of the vehicle.
12. Lower the vehicle.

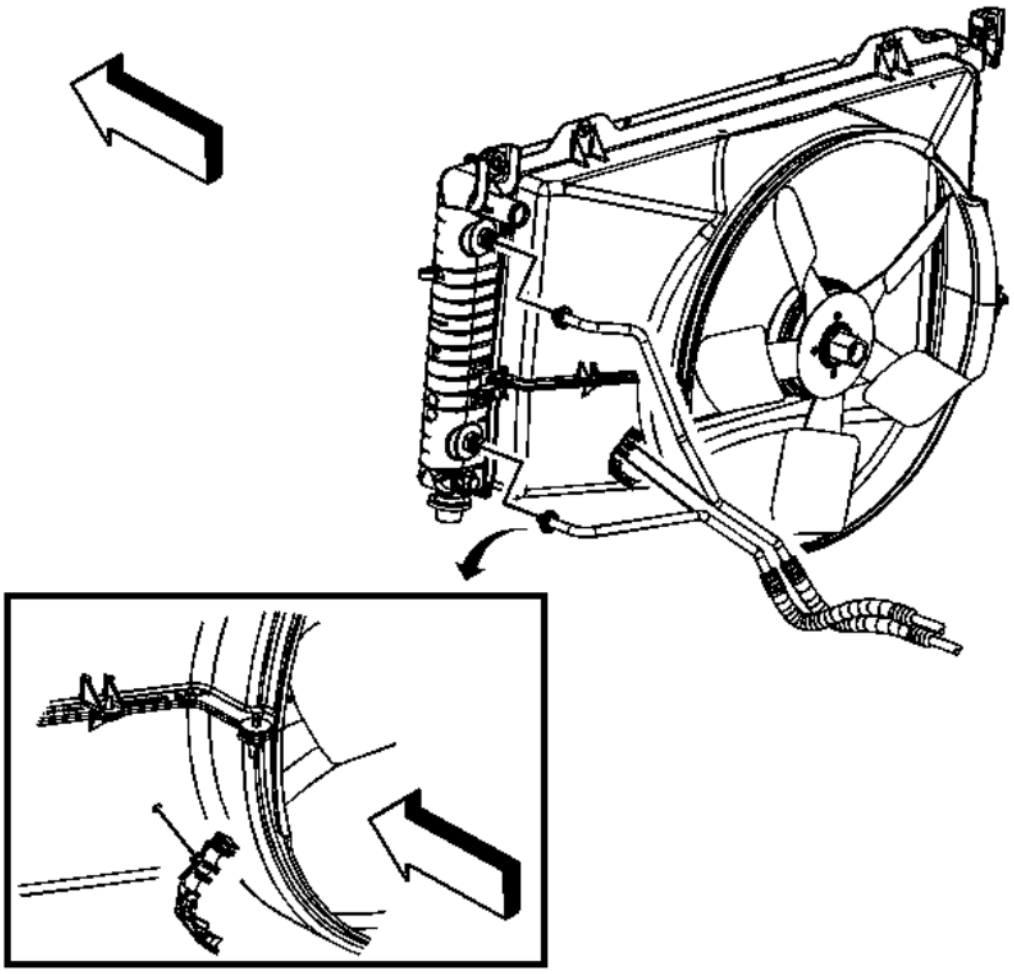


Fig. 51: View Of Oil Cooler Hoses & Clips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Ensure the oil cooler line being installed has a plastic cap on the end that connects to the quick connect fitting. If no plastic cap exists, or the plastic cap is damaged, obtain a new cap. Install the cap onto the cooler line**

prior cooler line installation.

- **Do not use the plastic cap in order to install the cooler line into the fitting.**

13. If equipped with RPO LY6 (6.0L) engine, install the oil cooler hoses to the clip.

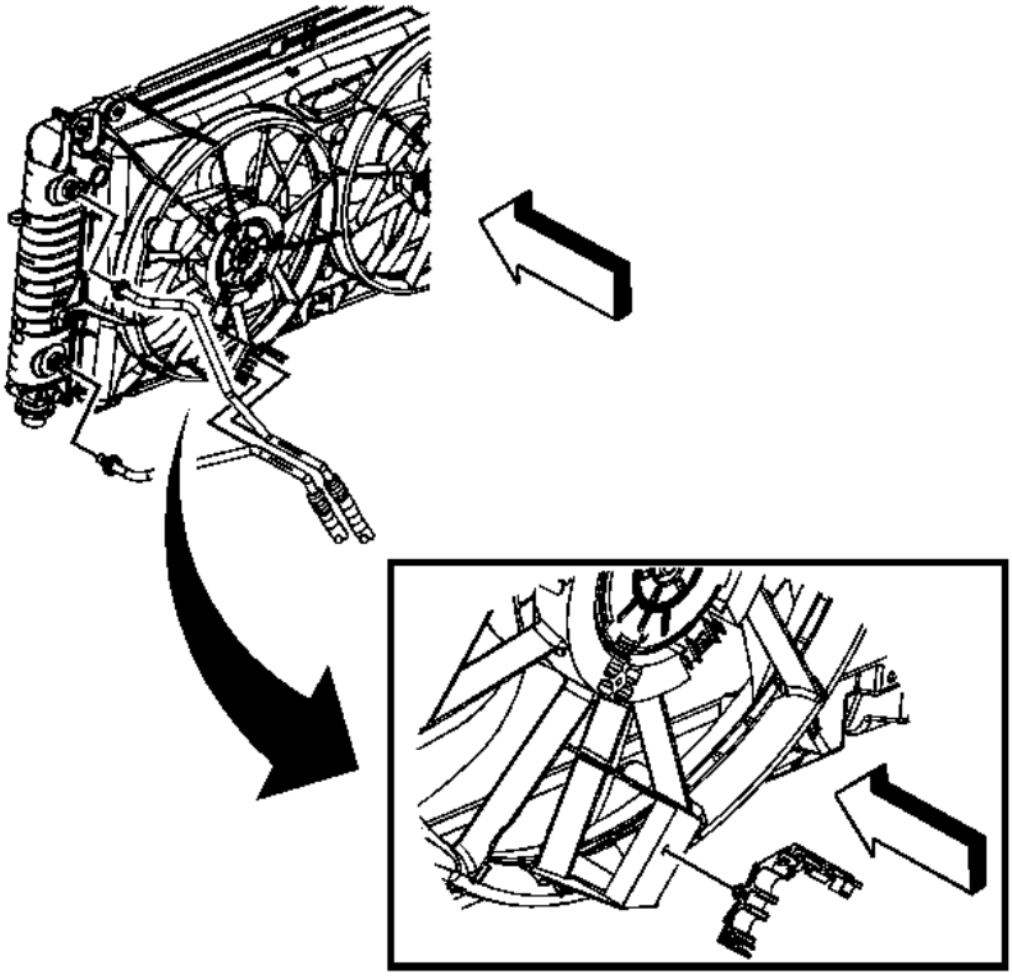


Fig. 52: Locating Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- **Ensure the oil cooler line being installed has a plastic**

cap on the end that connects to the quick connect fitting. If no plastic cap exists, or the plastic cap is damaged, obtain a new cap. Install the cap onto the cooler line prior cooler line installation.

- **Do not use the plastic cap in order to install the cooler line into the fitting.**

14. If equipped with RPO L76 (6.0L) engine, perform the following:
    1. Install the oil cooler hoses to the hose clip on the fan shroud.
    2. Snap the oil cooler hose clip shut.
15. Install the oil cooler lines to the radiator. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.

FAN REPLACEMENT (DIESEL)

Tools Required

J 41240-5A Fan Clutch Wrench

Removal Procedure

1. Remove the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.

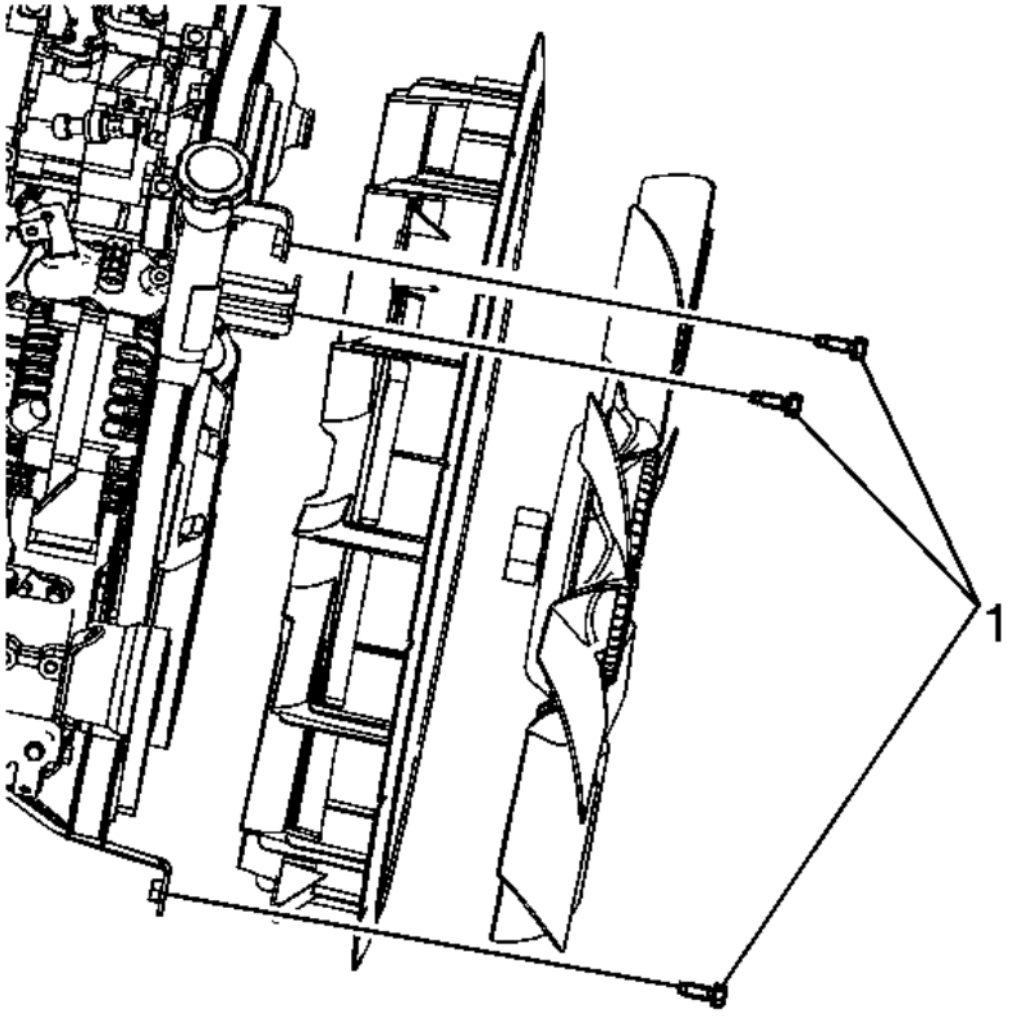


Fig. 53: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the 3 engine cooling fan shroud bolts (1).

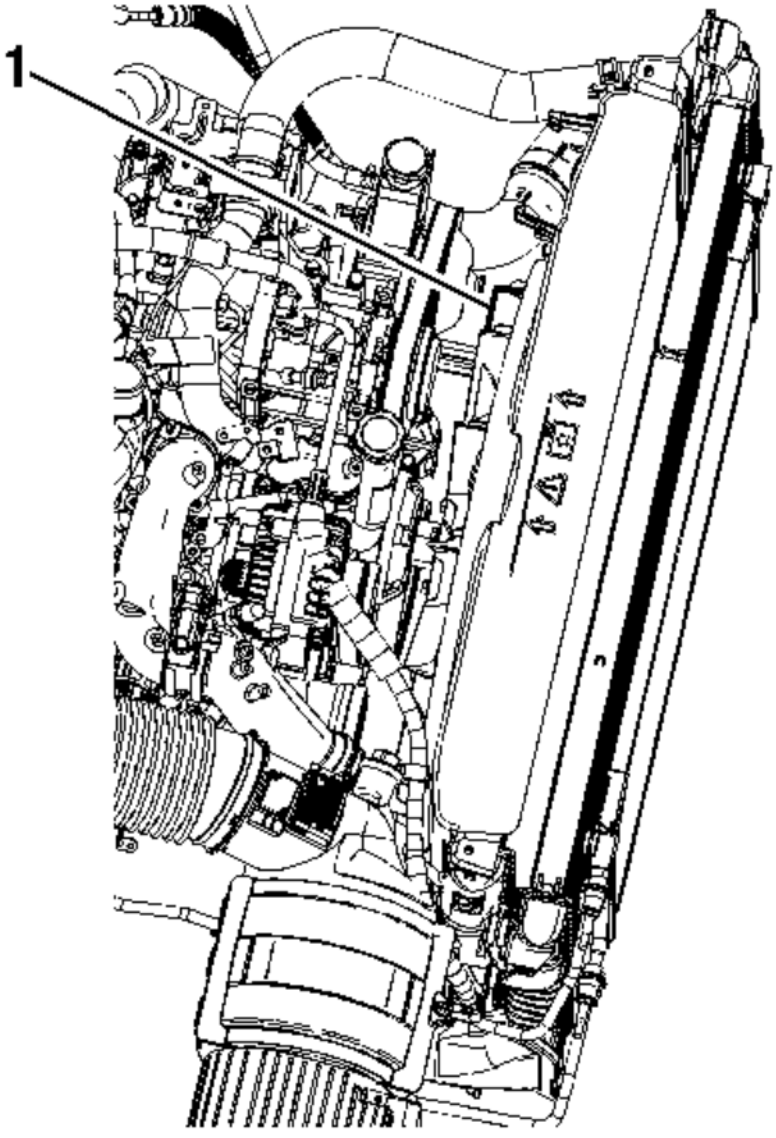


Fig. 54: View Of Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

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

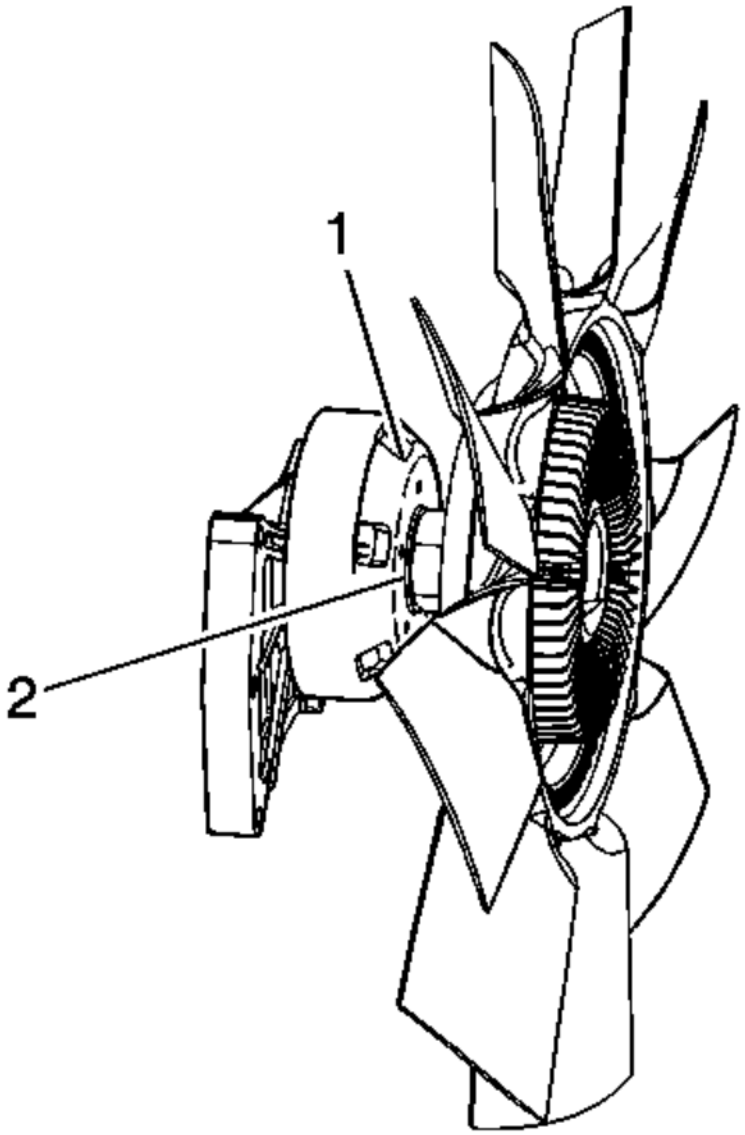


Fig. 55: View Of Fan Clutch Hub & Nut
Courtesy of GENERAL MOTORS CORP.

4. Install a long pin bar into the fan hub (1).
5. Use a **J 41240-5A** to remove the fan hub nut (2) from the hub in a counterclockwise rotation.

6. Remove the fan and the engine cooling fan shroud as an assembly.

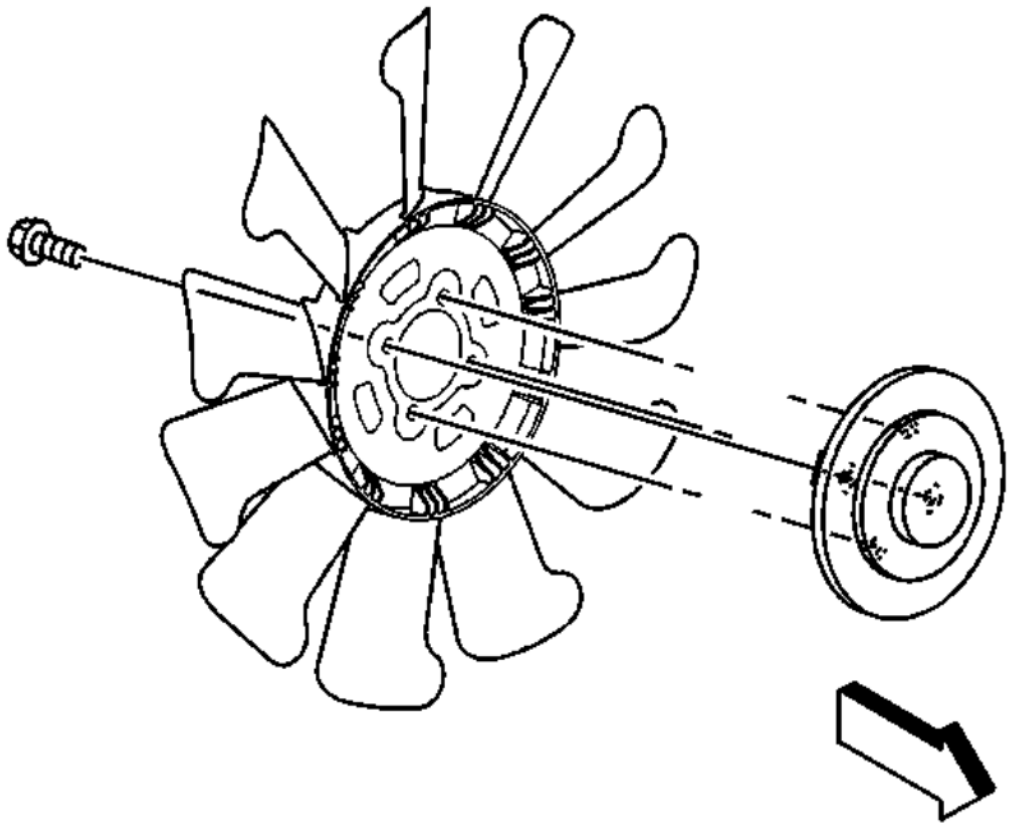


Fig. 56: View Of Fan Clutch & Fan Blade
Courtesy of GENERAL MOTORS CORP.

7. Remove the fan clutch bolts from the rear of the fan blade.
8. Separate the fan clutch from the fan blade.

Installation Procedure

CAUTION: Do not use or attempt to repair a damaged cooling fan assembly. Replace damaged fans with new assemblies. An unbalanced cooling fan could fly apart causing personal injury and property damage.

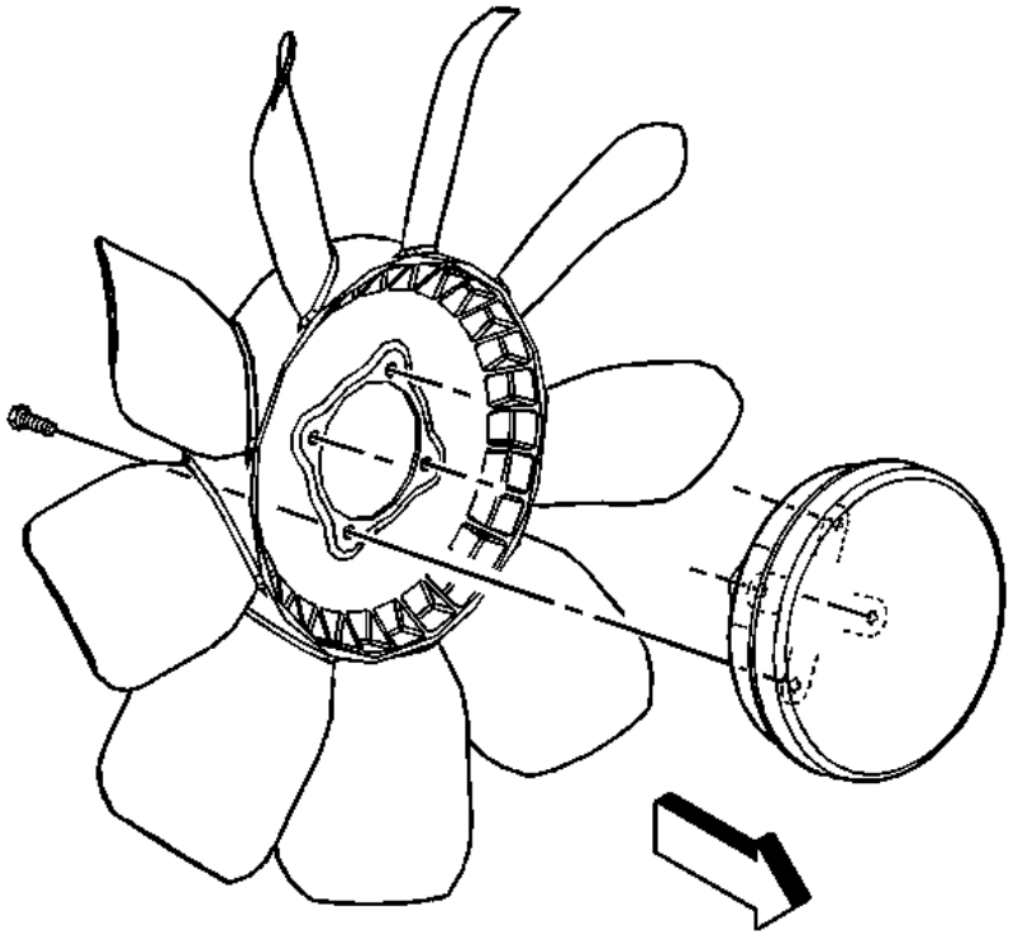


Fig. 57: View Of Fan Blade & Fan Clutch
Courtesy of GENERAL MOTORS CORP.

1. Install the fan clutch onto the fan blade.

NOTE: **Refer to Fastener Notice .**

2. Install the fan clutch bolts

Tighten: Tighten the bolts to 23 N.m (17 lb ft).

3. Install the fan and engine cooling fan shroud assembly to the fan hub.

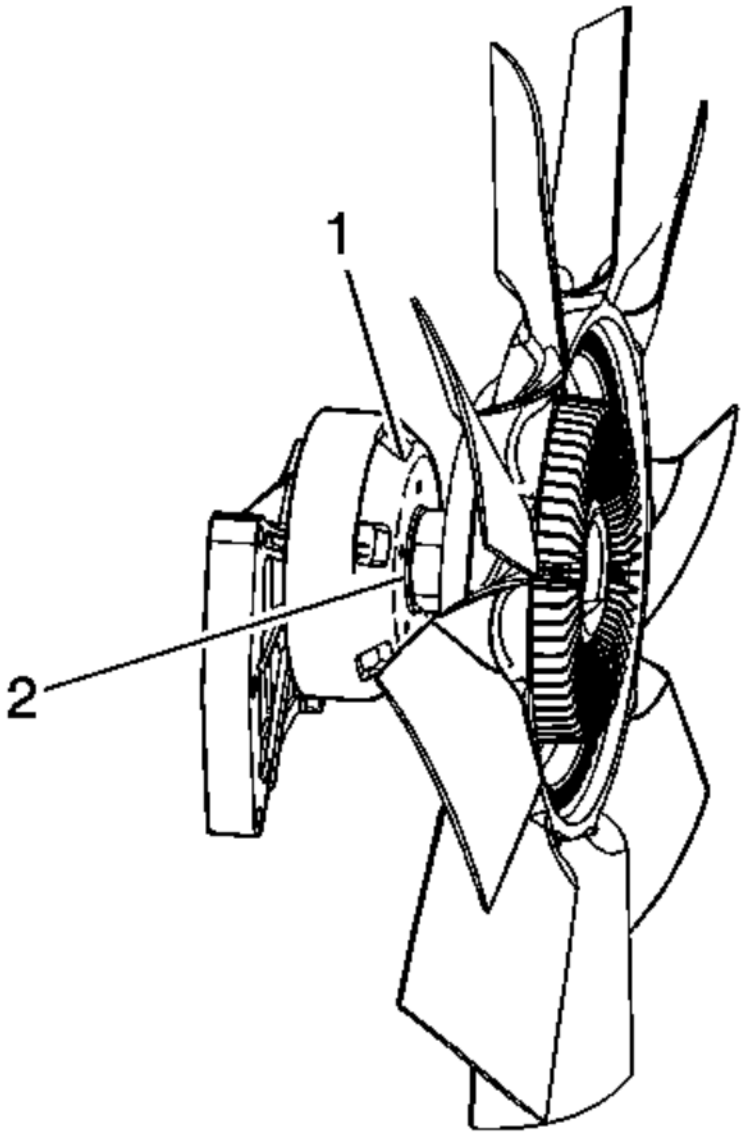


Fig. 58: View Of Fan Clutch Hub & Nut
Courtesy of GENERAL MOTORS CORP.

4. Use a **J 41240-5A** on the fan clutch hub nut (2) to install a long pry bar to the fan clutch hub (1).

Tighten: Tighten the nut clockwise to 56 N.m (41 lb ft).

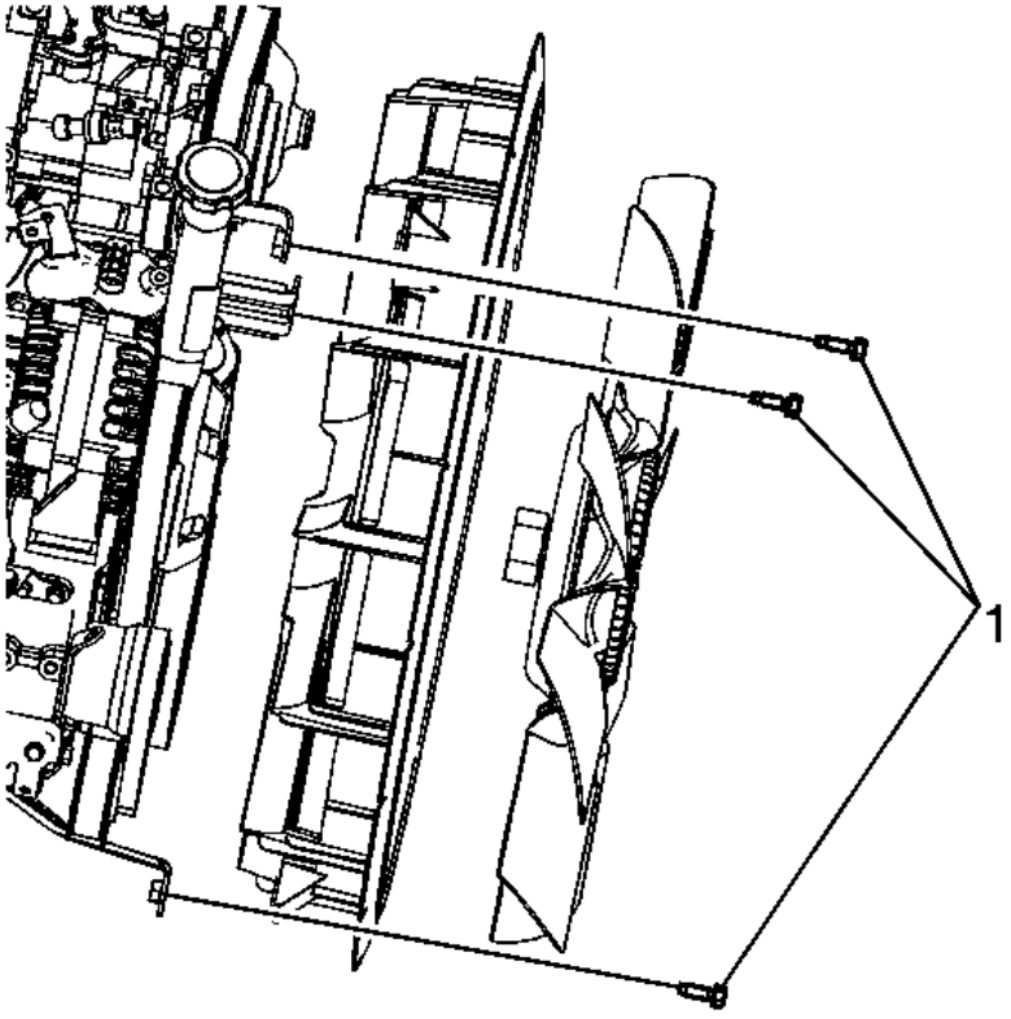


Fig. 59: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Position the engine cooling fan shroud on the 3 mounting brackets (1).
6. Install the bolts. Loosely tighten the top mounting bolt at the oil filler neck.

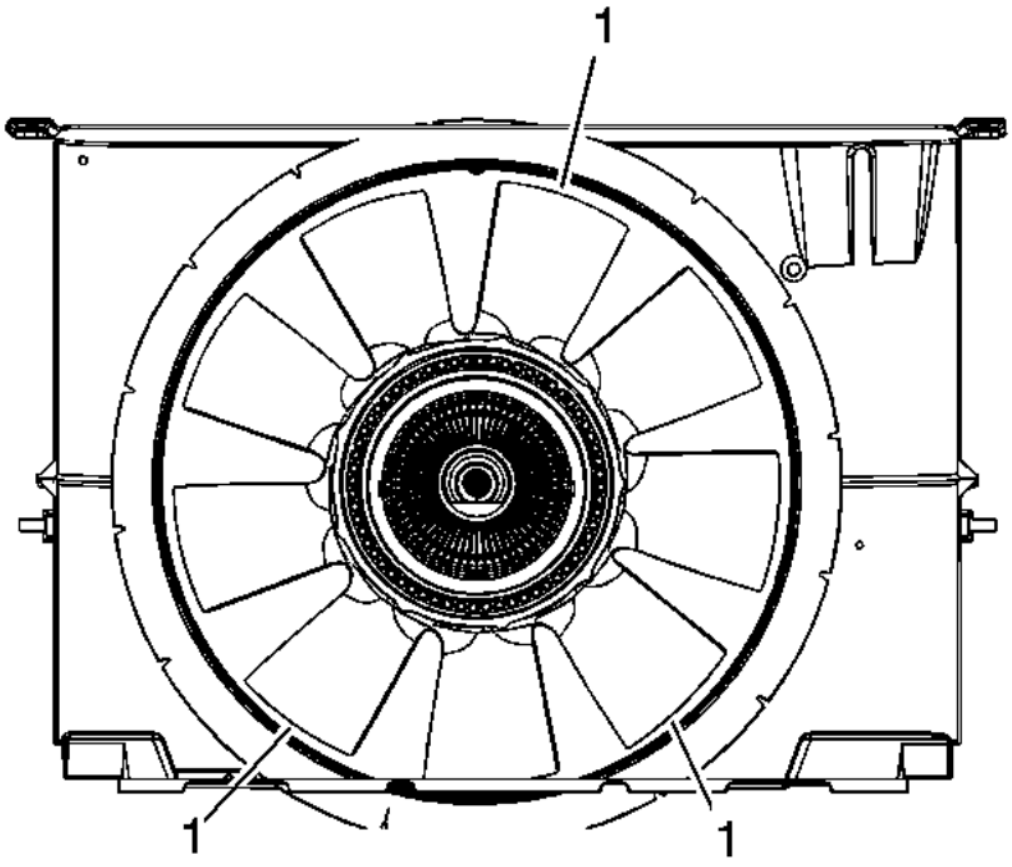


Fig. 60: View Of Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Maintain a 6 mm (0.25 in) minimum clearance at all 3 places.

7. Center the engine cooling fan shroud to the fan blade in 3 places (1).

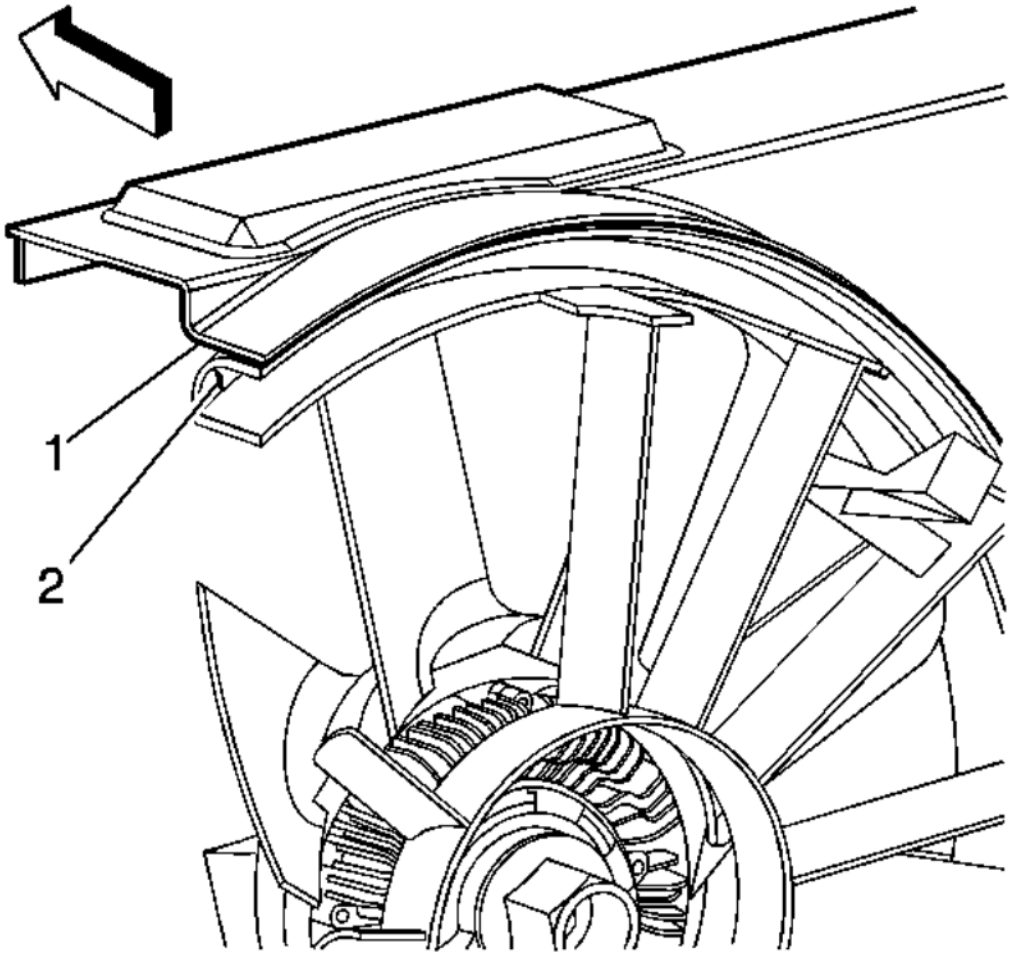


Fig. 61: Cooling Fan Shroud And Rubber Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Improper installation could cause damage to the fan and shroud while vehicle is in service.

8. Make sure the orientation of the cooling fan shroud (1) and rubber seal (2) are installed correctly

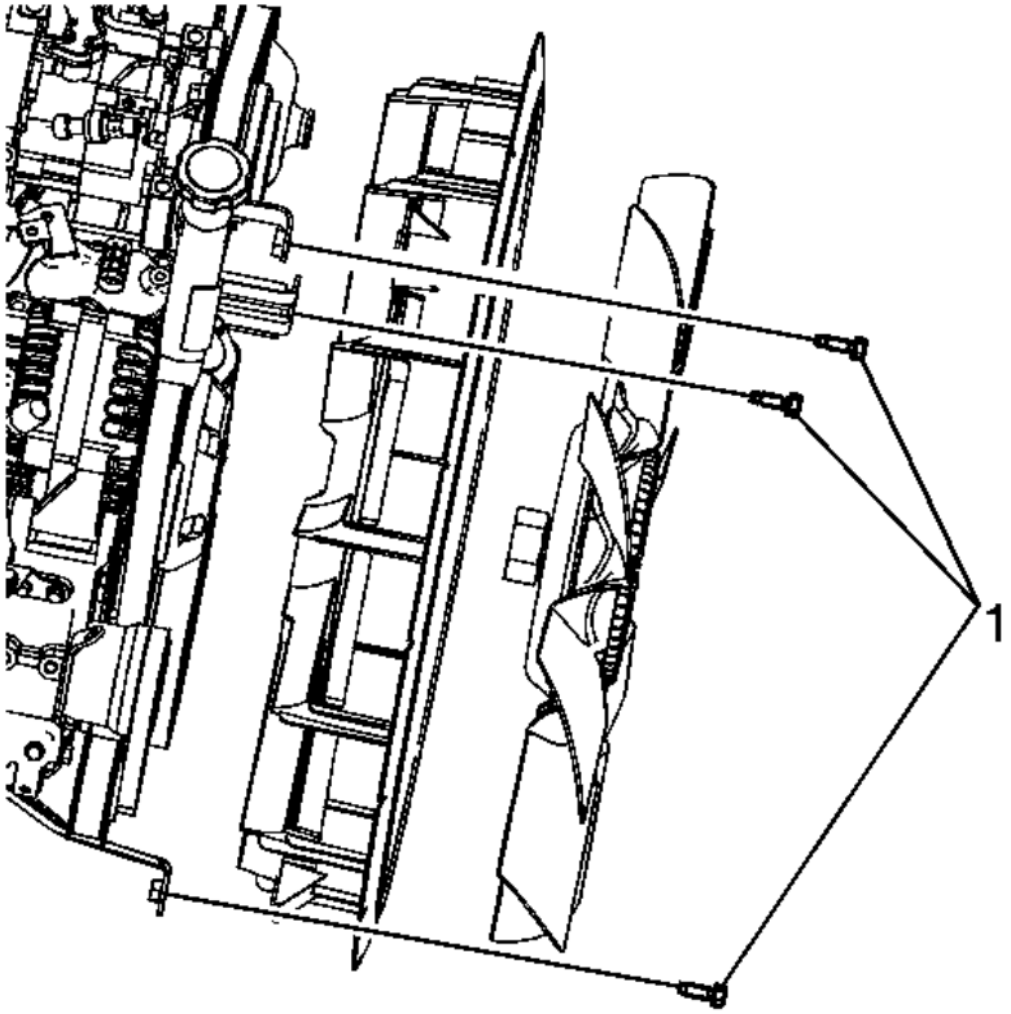


Fig. 62: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Fully tighten the 3 engine cooling fan shroud bolts (1).

   Tighten: Tighten the bolts to 8 N.m (71 lb in).

10. Install the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.

FAN REPLACEMENT (MECHANICAL)

Tools Required

J 46406 Fan Clutch Remover and Installer

Removal Procedure

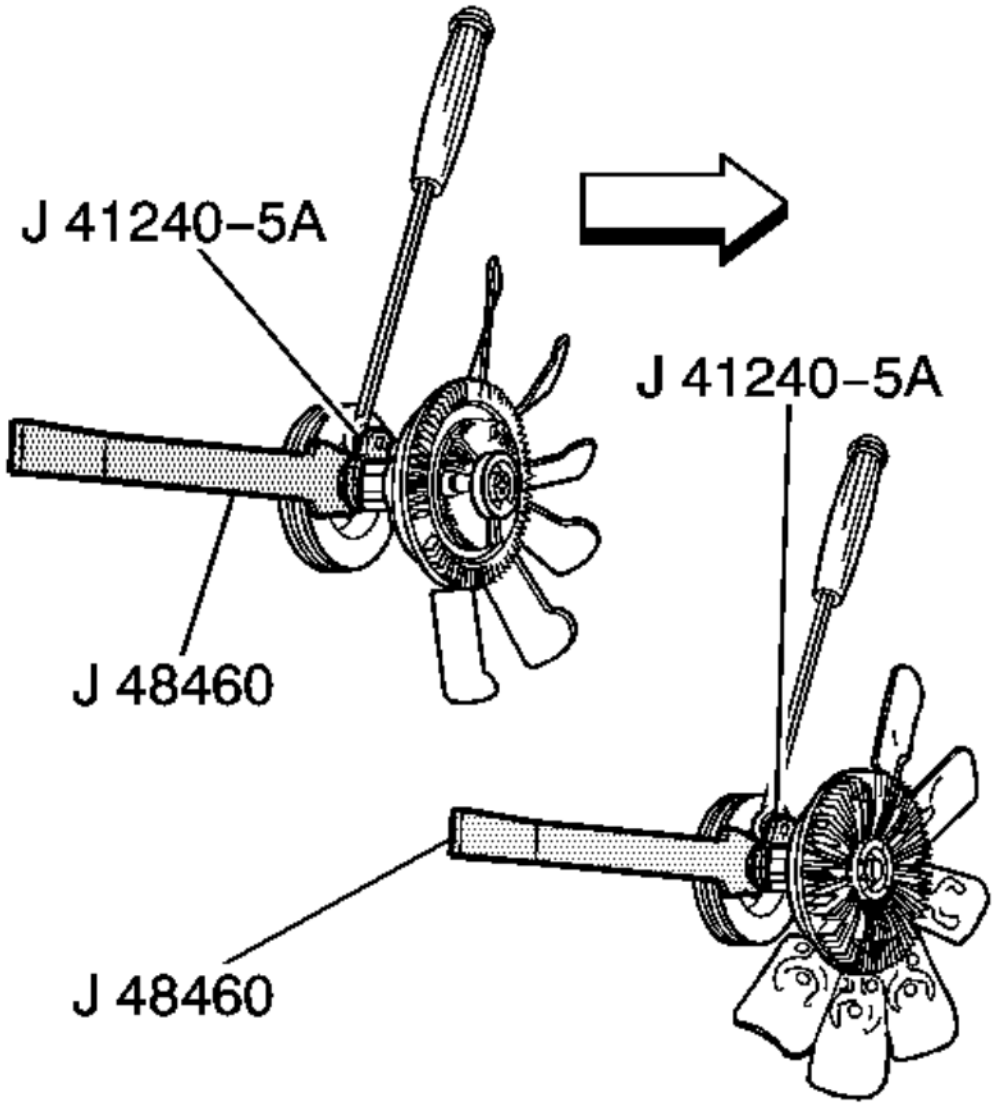


Fig. 63: Using Special Tools For Fan Clutch
Courtesy of GENERAL MOTORS CORP.

1. Remove the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.
2. Install the **J 46406** to the fan clutch.

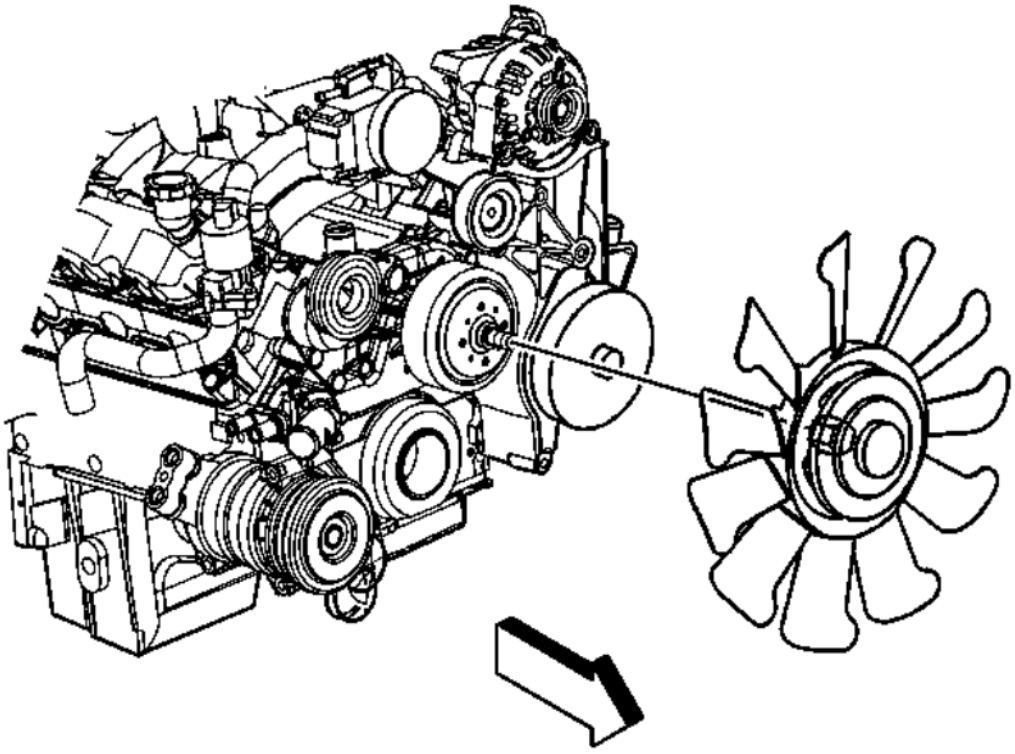


Fig. 64: View Of Fan Assembly Removed
Courtesy of GENERAL MOTORS CORP.

3. Remove the fan hub nut from the water pump in a counterclockwise rotation.

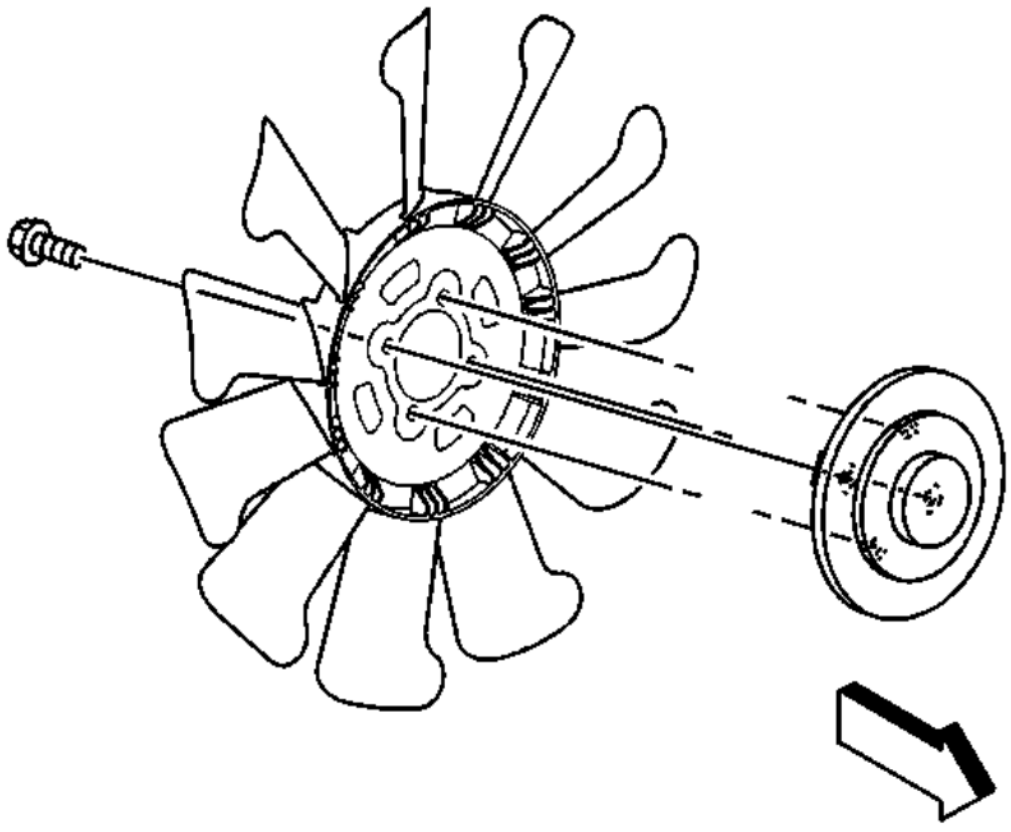


Fig. 65: View Of Fan Clutch & Fan Blade
Courtesy of GENERAL MOTORS CORP.

4. Remove the fan clutch bolts from the rear of the fan blade.
5. Separate the fan clutch from the fan blade.

Installation Procedure

CAUTION: Do not use or attempt to repair a damaged cooling fan assembly. Replace damaged fans with new assemblies. An unbalanced cooling fan could fly apart causing personal injury and property damage.

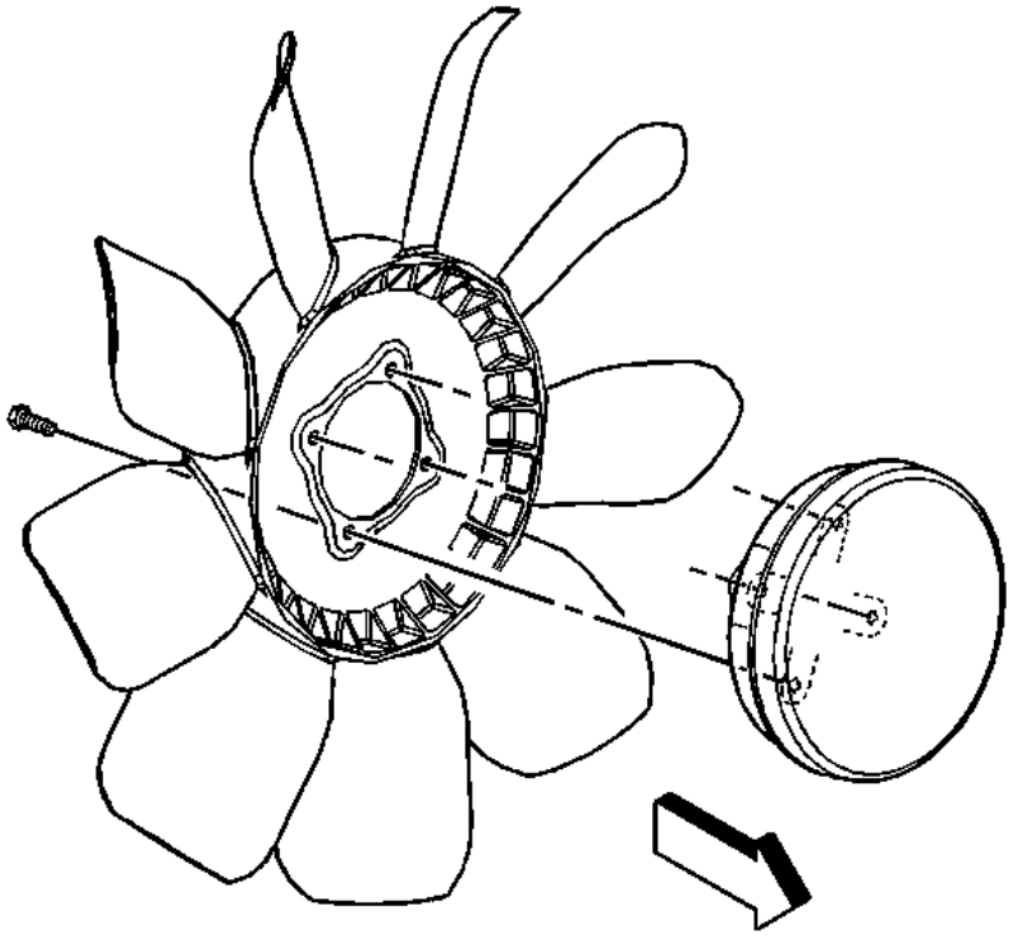


Fig. 66: View Of Fan Blade & Fan Clutch
Courtesy of GENERAL MOTORS CORP.

1. Install the fan clutch onto the fan blade.

NOTE: **Refer to Fastener Notice .**

2. Install the fan clutch bolts

Tighten: Tighten the bolts to 23 N.m (17 lb ft).

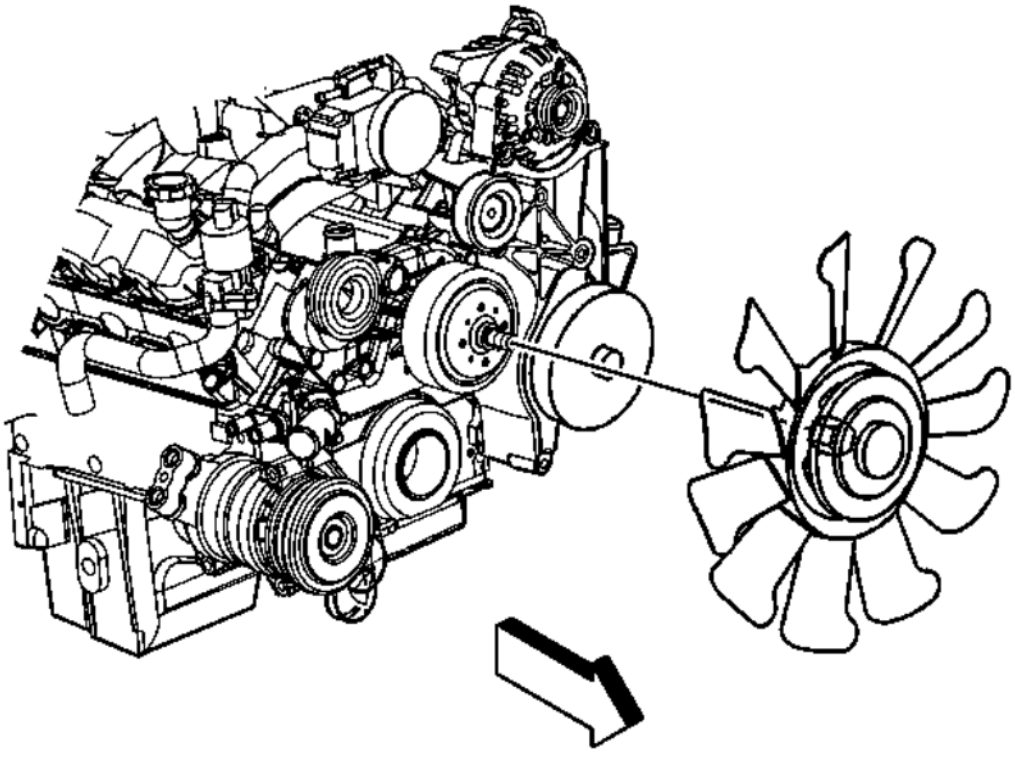


Fig. 67: View Of Fan Assembly Removed
Courtesy of GENERAL MOTORS CORP.

3. Install the fan assembly.

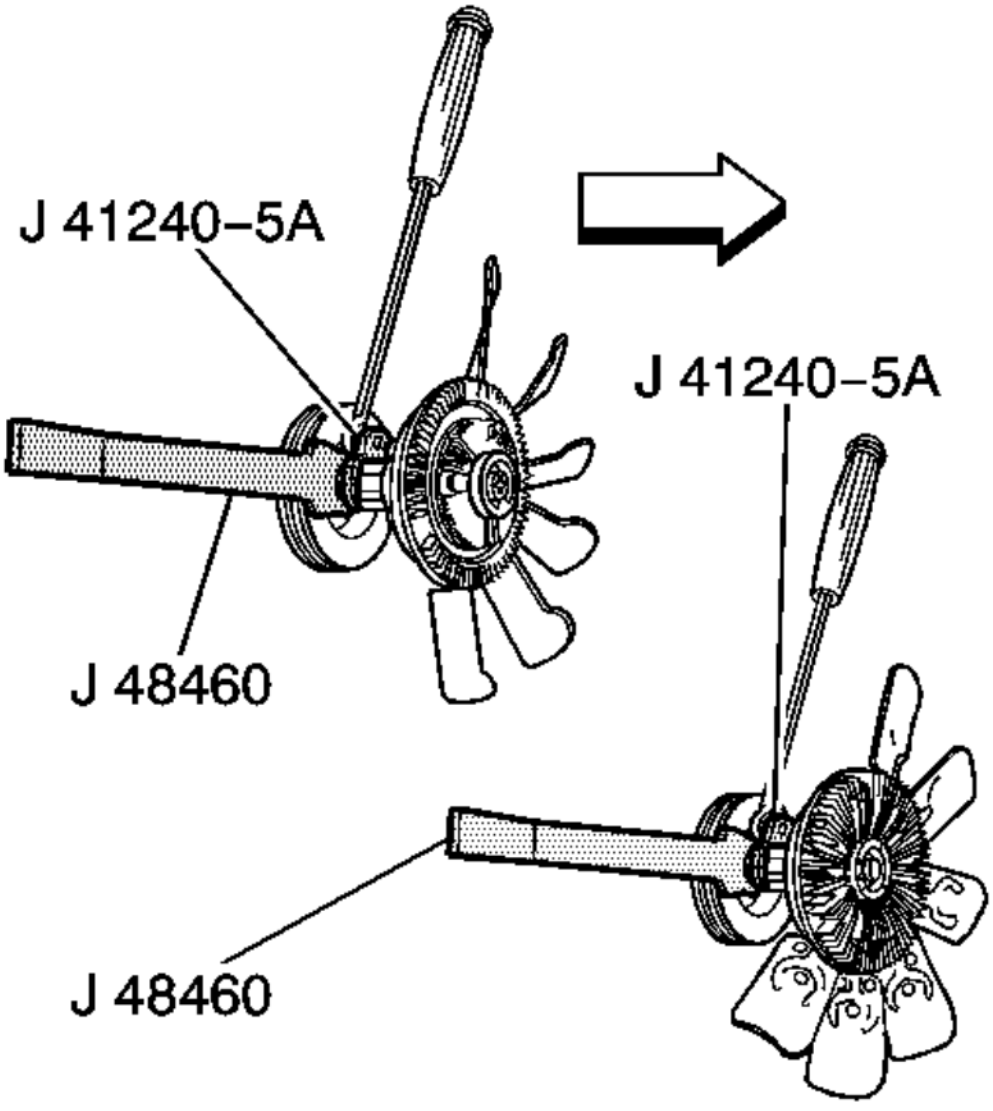


Fig. 68: Using Special Tools For Fan Clutch
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 46406** to the fan clutch.

   Tighten: Tighten the nut clockwise to 56 N.m (41 lb ft).

5. Install the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.

FAN CLUTCH REPLACEMENT (DIESEL)

Tools Required

J 41240-5A Fan Clutch Wrench

Removal Procedure

1. Remove the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.

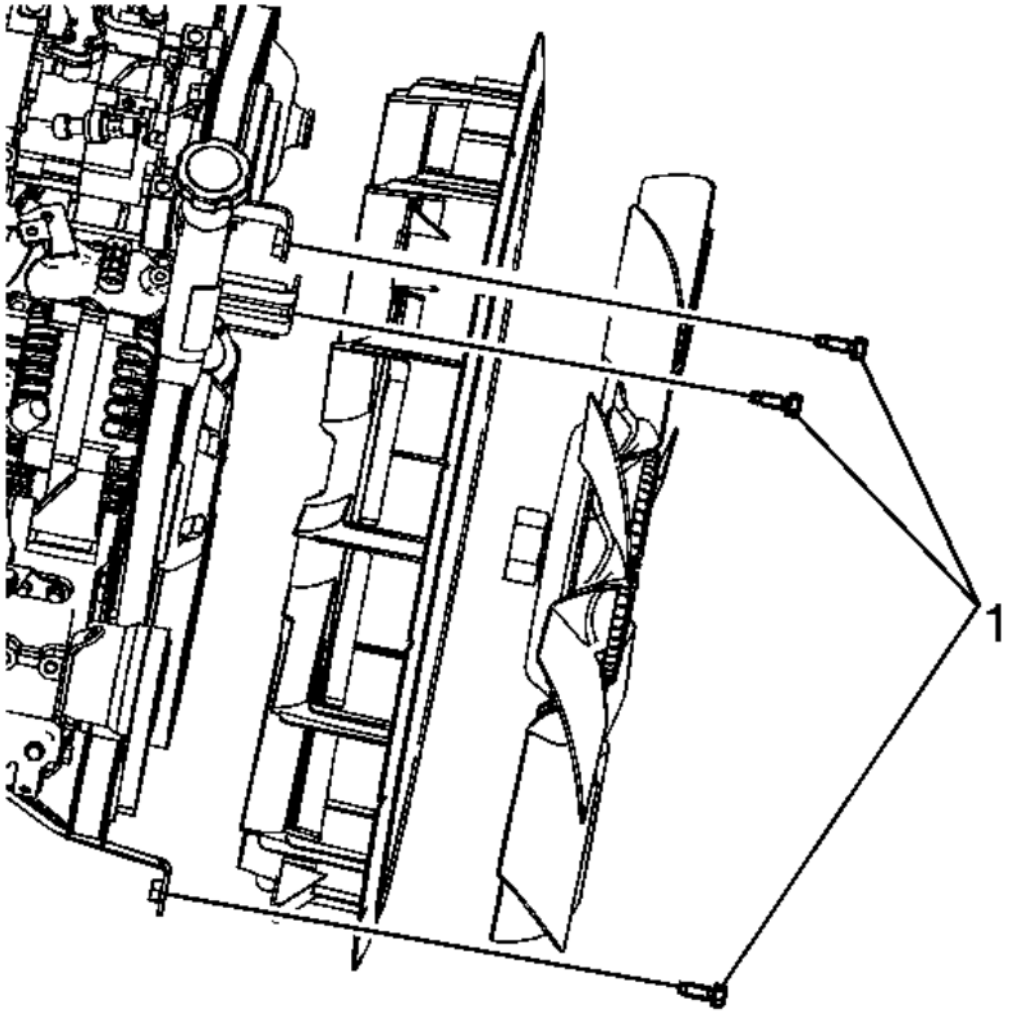


Fig. 69: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the 3 engine cooling fan shroud bolts (1).

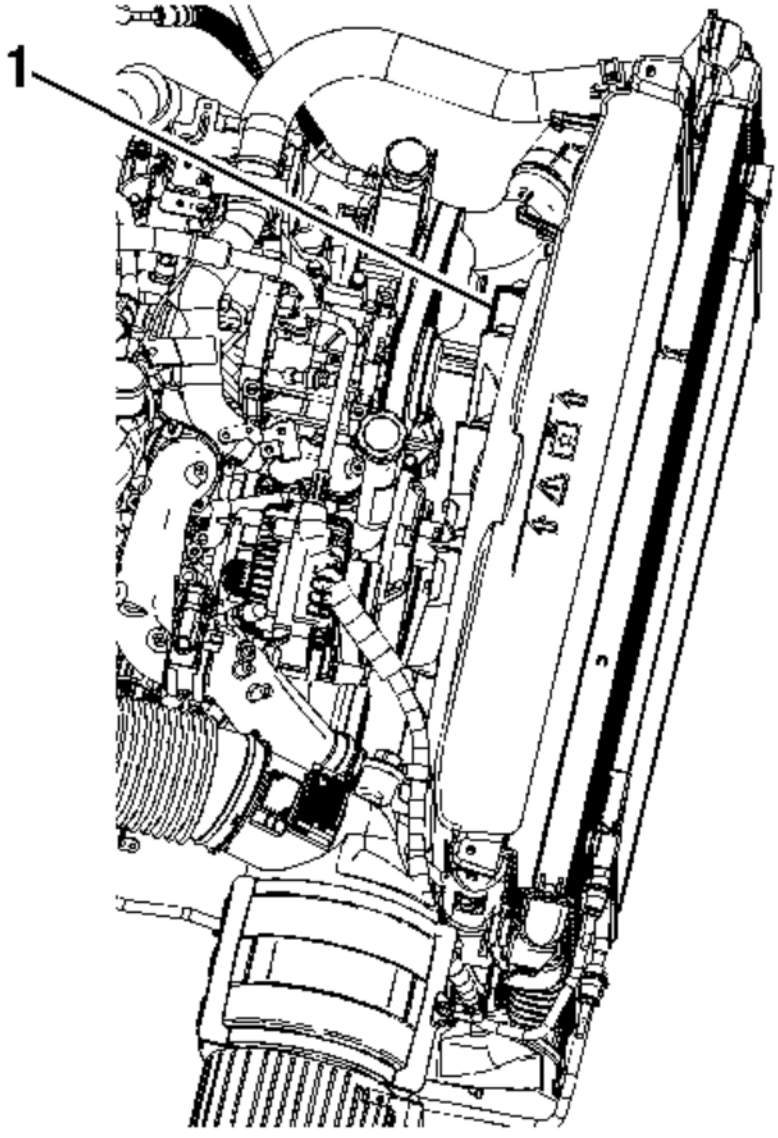


Fig. 70: View Of Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

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

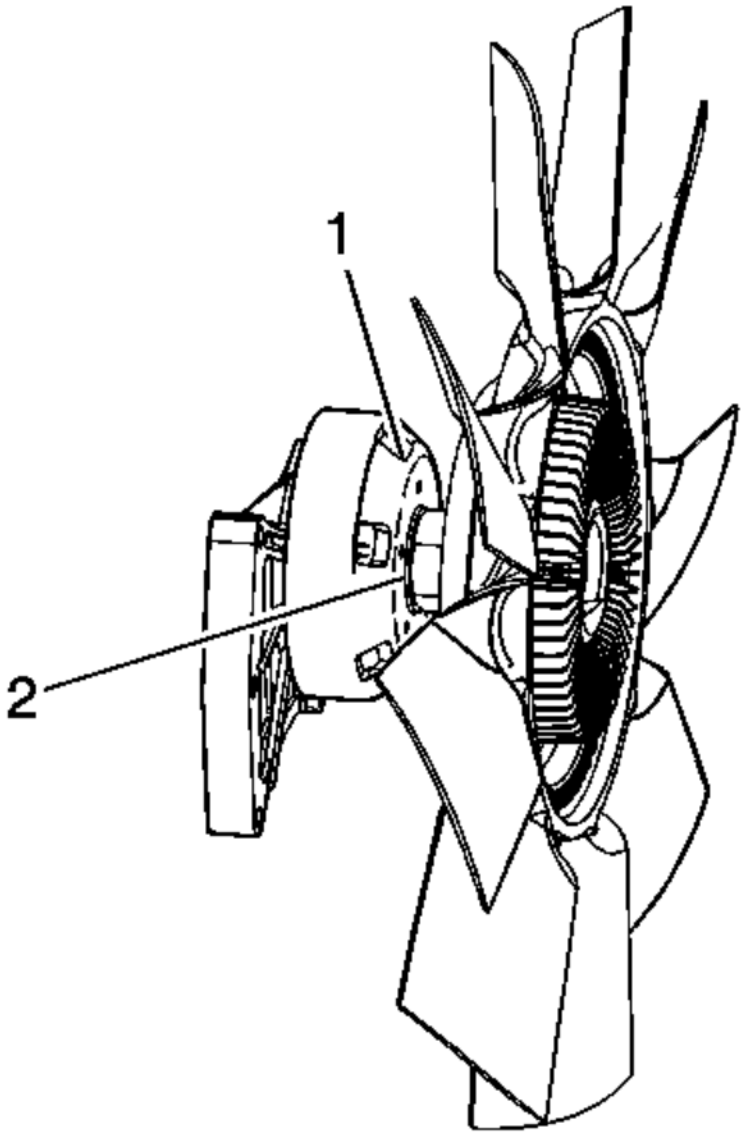


Fig. 71: View Of Fan Clutch Hub & Nut
Courtesy of GENERAL MOTORS CORP.

4. Install a long pin bar into the fan hub (1).
5. Use a **J 41240-5A** to remove the fan hub nut (2) from the hub in a counterclockwise rotation.

6. Remove the fan and the engine cooling fan shroud as an assembly.

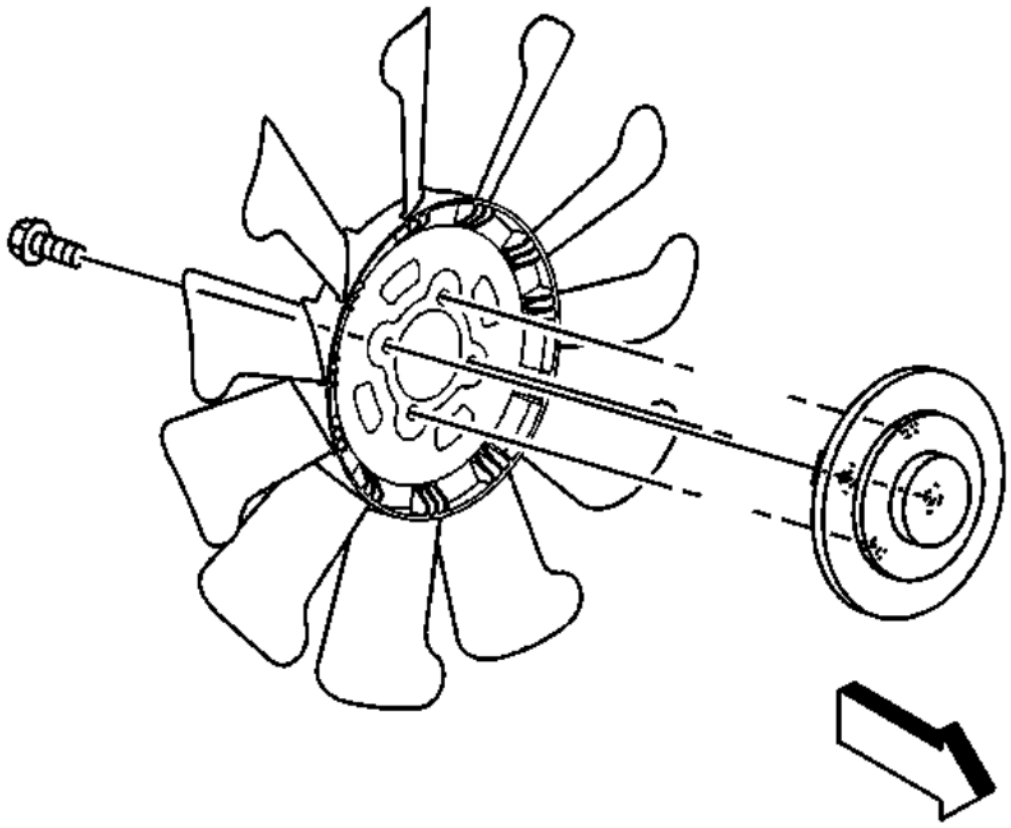


Fig. 72: View Of Fan Clutch & Fan Blade
Courtesy of GENERAL MOTORS CORP.

7. Remove the fan clutch bolts from the rear of the fan blade.
8. Separate the fan clutch from the fan blade.

Installation Procedure

CAUTION: Do not use or attempt to repair a damaged cooling fan assembly. Replace damaged fans with new assemblies. An unbalanced cooling fan could fly apart causing personal injury and property damage.

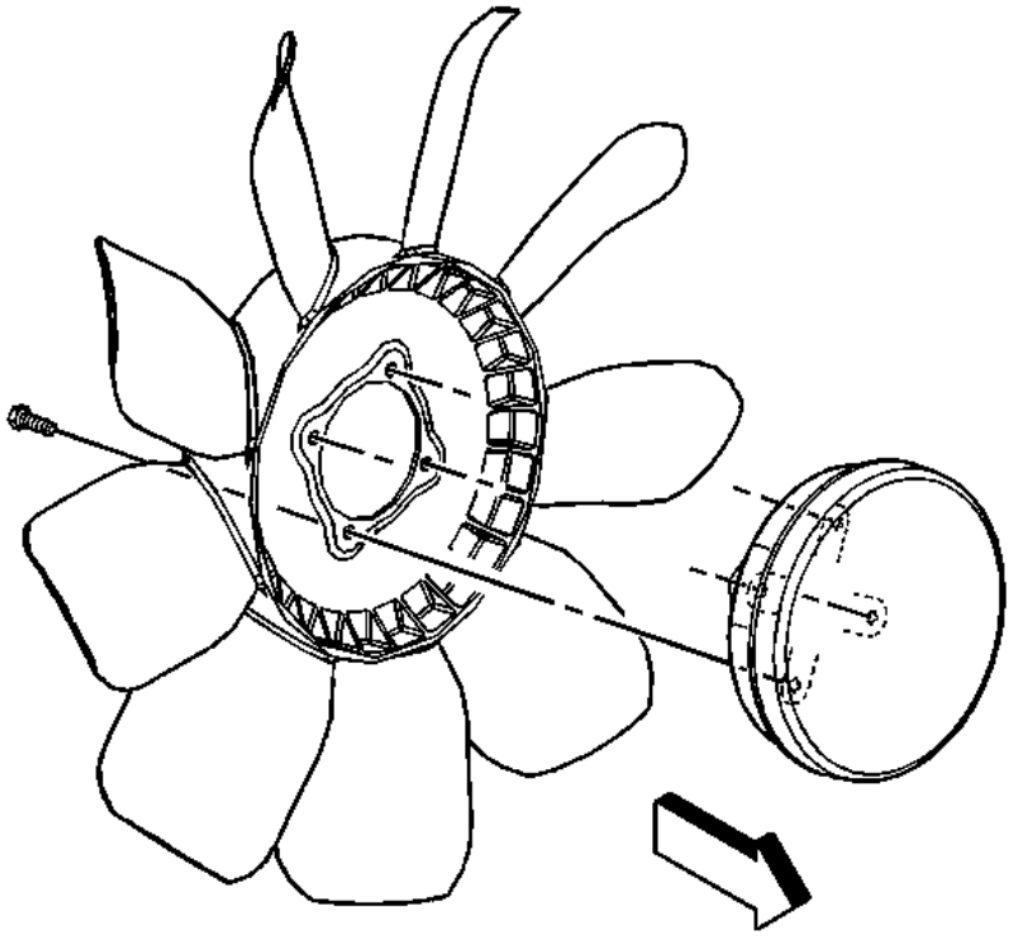


Fig. 73: View Of Fan Blade & Fan Clutch
Courtesy of GENERAL MOTORS CORP.

1. Install the fan clutch onto the fan blade.

NOTE: Refer to Fastener Notice .

2. Install the fan clutch bolts.

Tighten: Tighten the bolts to 23 N.m (17 lb ft).

3. Install the fan and engine cooling fan shroud assembly to the fan hub.

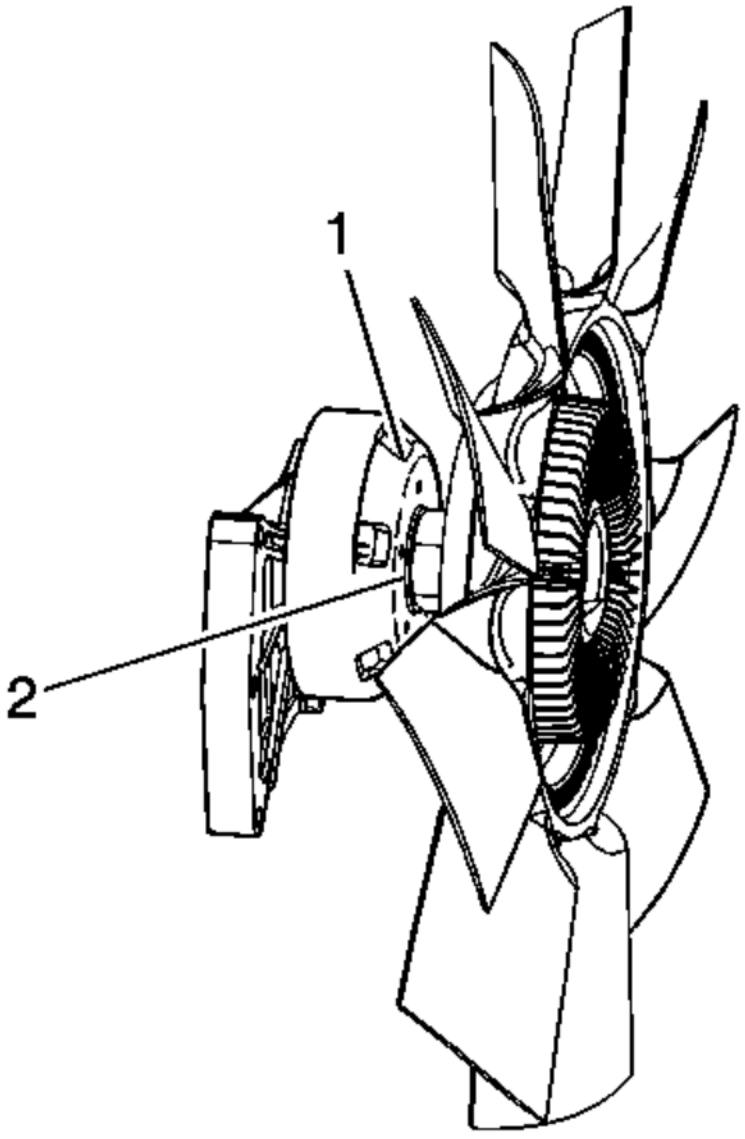


Fig. 74: View Of Fan Clutch Hub & Nut
Courtesy of GENERAL MOTORS CORP.

4. Use a **J 41240-5A** on the fan clutch hub nut (2) to install a long pry bar to the fan clutch hub (1).

Tighten: Tighten the nut clockwise to 56 N.m (41 lb ft).

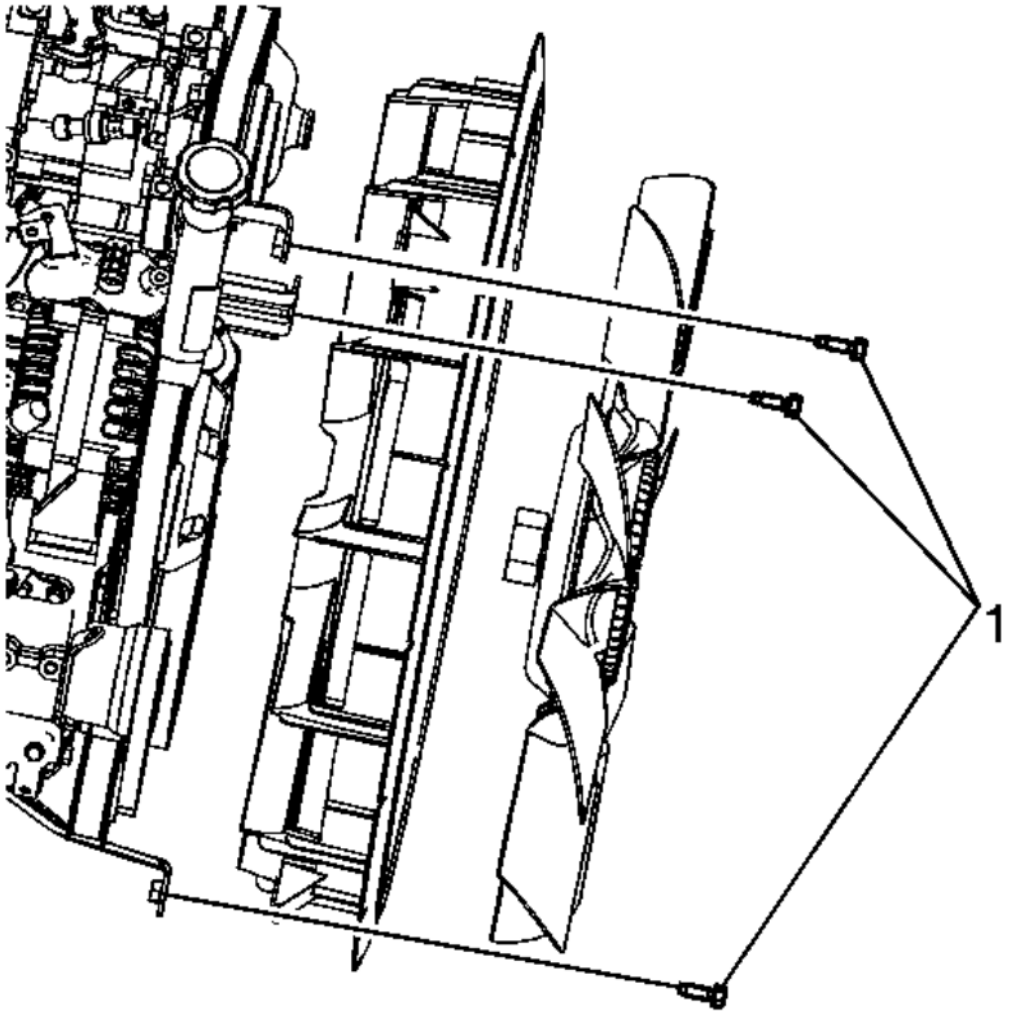


Fig. 75: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Position the engine cooling fan shroud on the 3 mounting brackets (1).
6. Install the bolts. Loosely tighten the top mounting bolt at the oil filler neck.

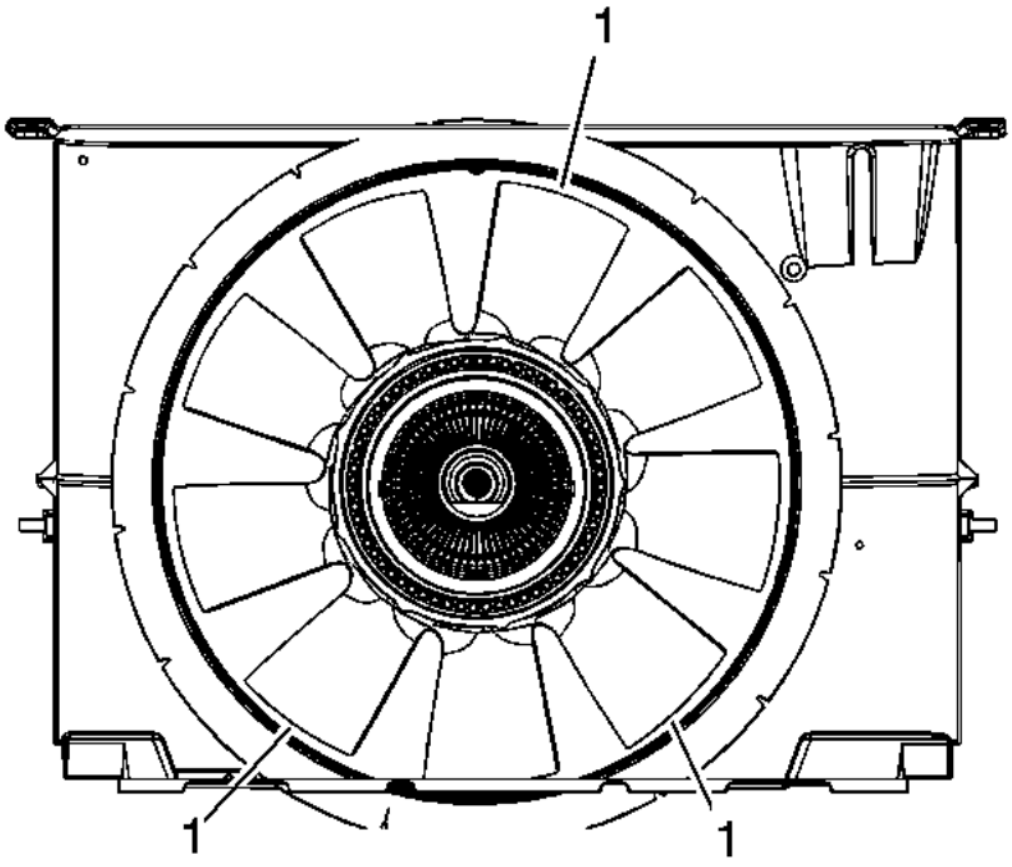


Fig. 76: View Of Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Maintain a 6 mm (0.25 in) minimum clearance at all 3 places.

7. Center the engine cooling fan shroud to the fan blade in 3 places (1).

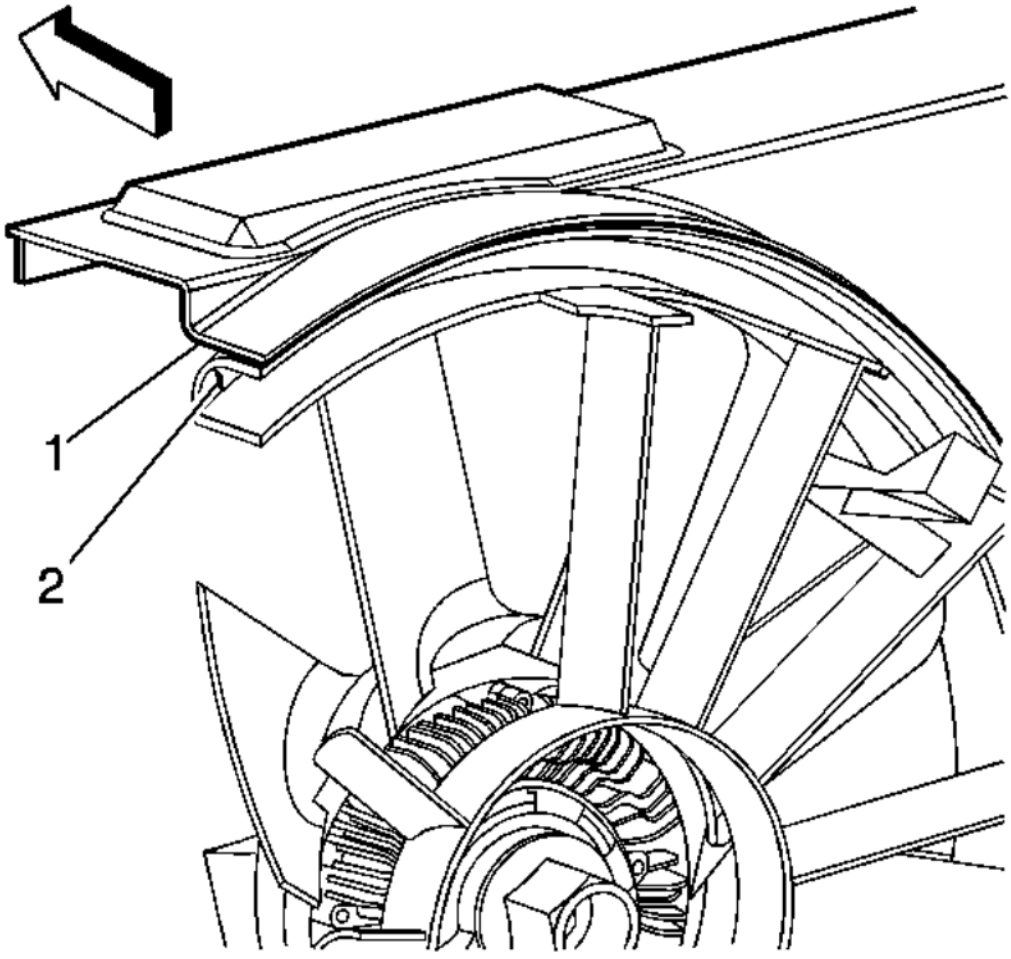


Fig. 77: Cooling Fan Shroud And Rubber Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Improper installation could cause damage to the fan and shroud while vehicle is in service.

8. Make sure the orientation of the cooling fan shroud (1) and rubber seal (2) are installed correctly

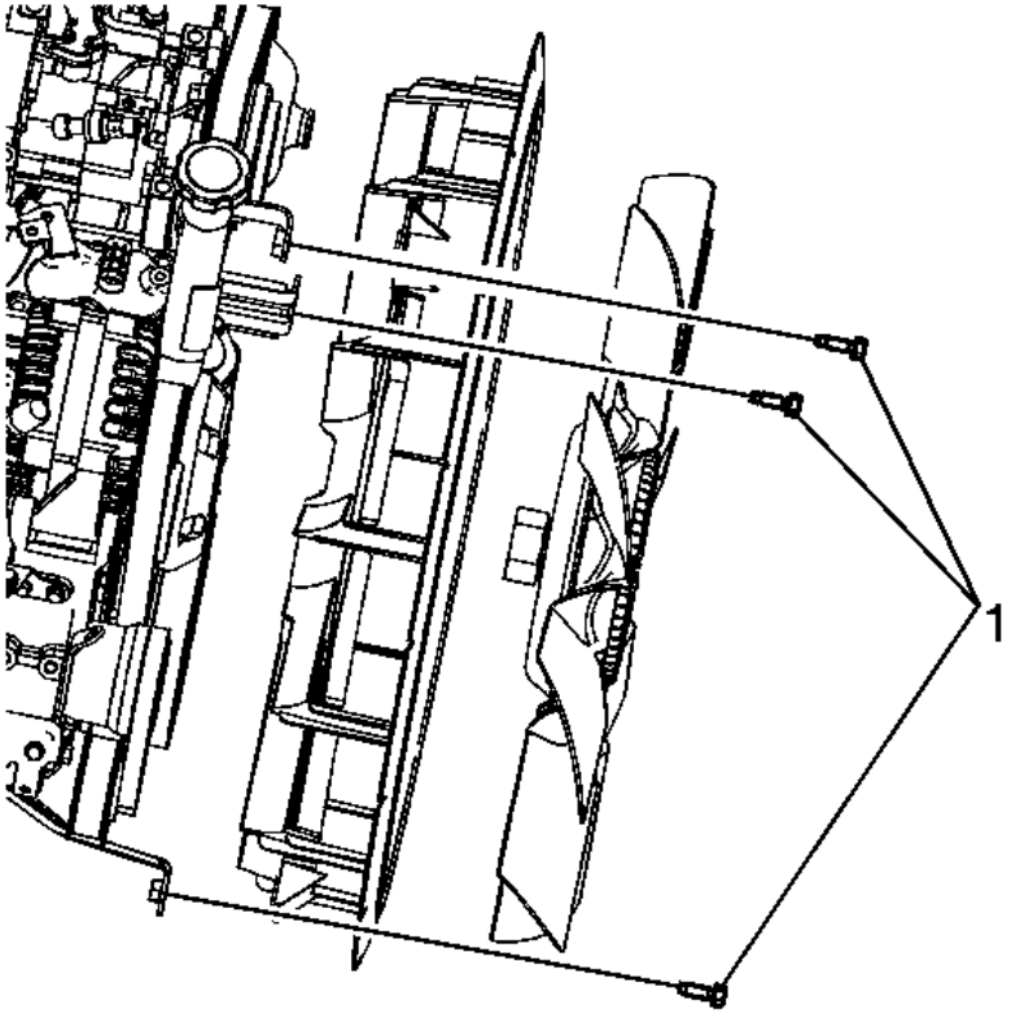


Fig. 78: Identifying Fan Shroud Mounting Brackets & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Fully tighten the 3 engine cooling fan shroud bolts (1).

   Tighten: Tighten the bolts to 8 N.m (71 lb in).

10. Install the upper fan shroud. Refer to **Engine Coolant Fan Upper Shroud Replacement (Mechanical)** or **Engine Coolant Fan Upper Shroud Replacement (Automatic Transmission - Diesel)**.

COOLING FAN PULLEY REPLACEMENT

Removal Procedure

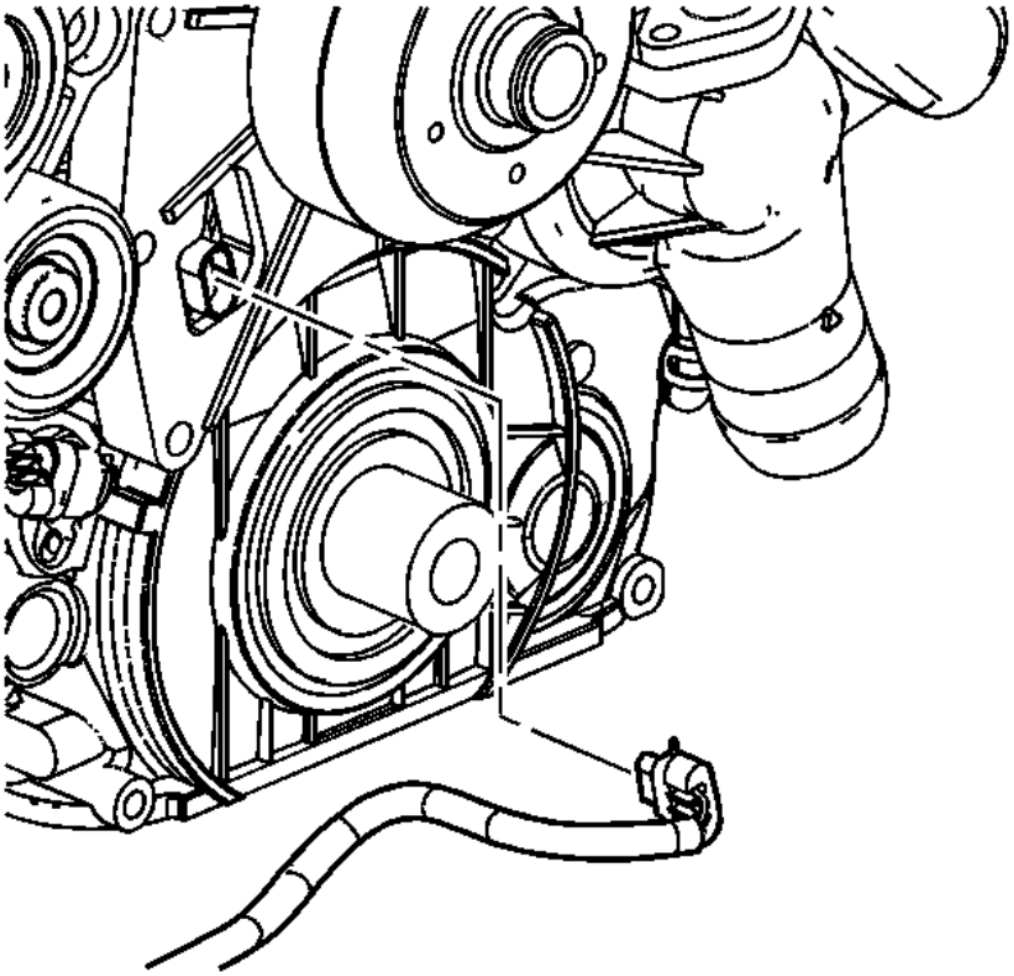


Fig. 79: View Of Camshaft Position Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement** .
2. Remove the fan clutch. Refer to **Fan Clutch Replacement (Diesel)**.
3. Disconnect the camshaft position (CMP) sensor electrical connector.

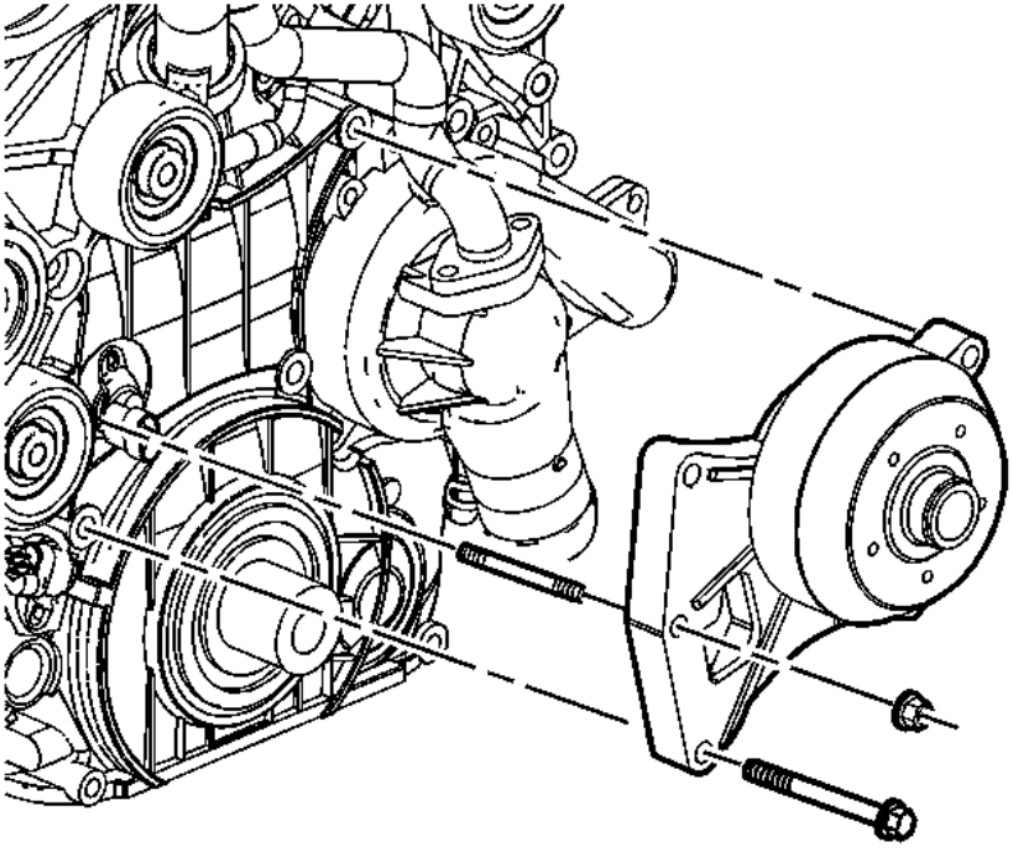


Fig. 80: View Of Cooling Fan Pulley
Courtesy of GENERAL MOTORS CORP.

4. Remove the fan pulley bolts/nuts.
5. Remove the fan pulley.

Installation Procedure

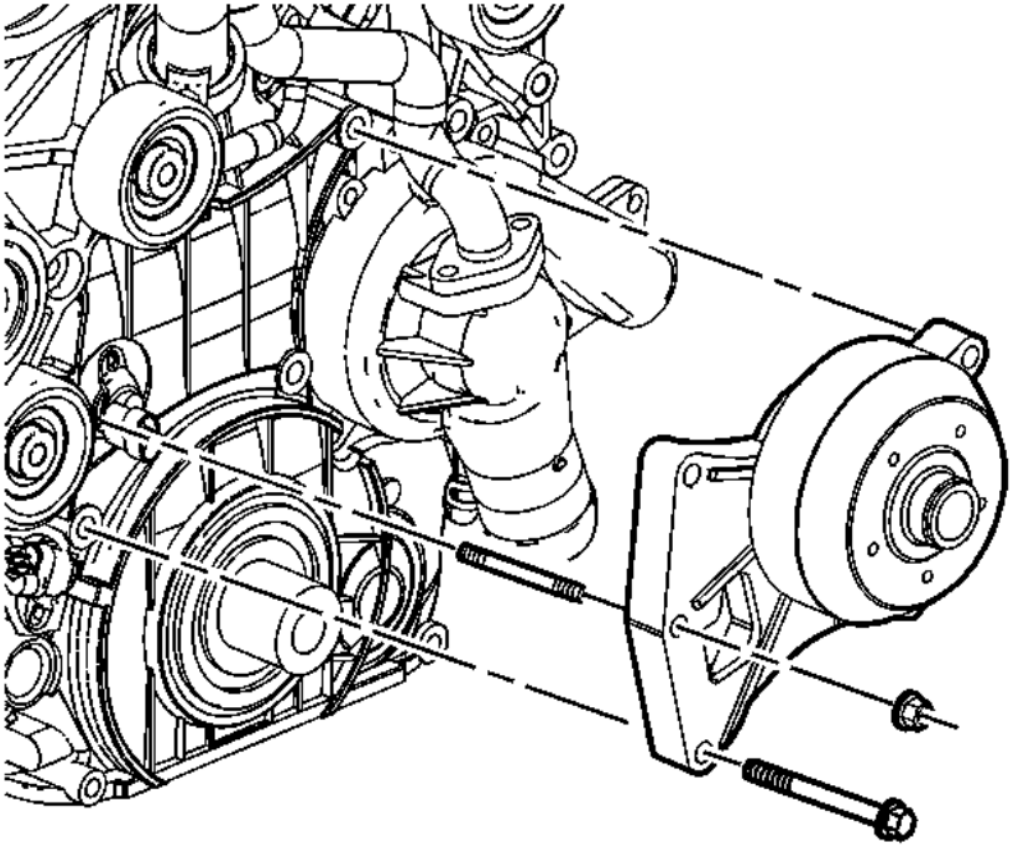


Fig. 81: View Of Cooling Fan Pulley
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the fan pulley.
2. Install the fan pulley bolts/nuts.

Tighten: Tighten the bolts/nuts to 41 N.m (30 lb ft).

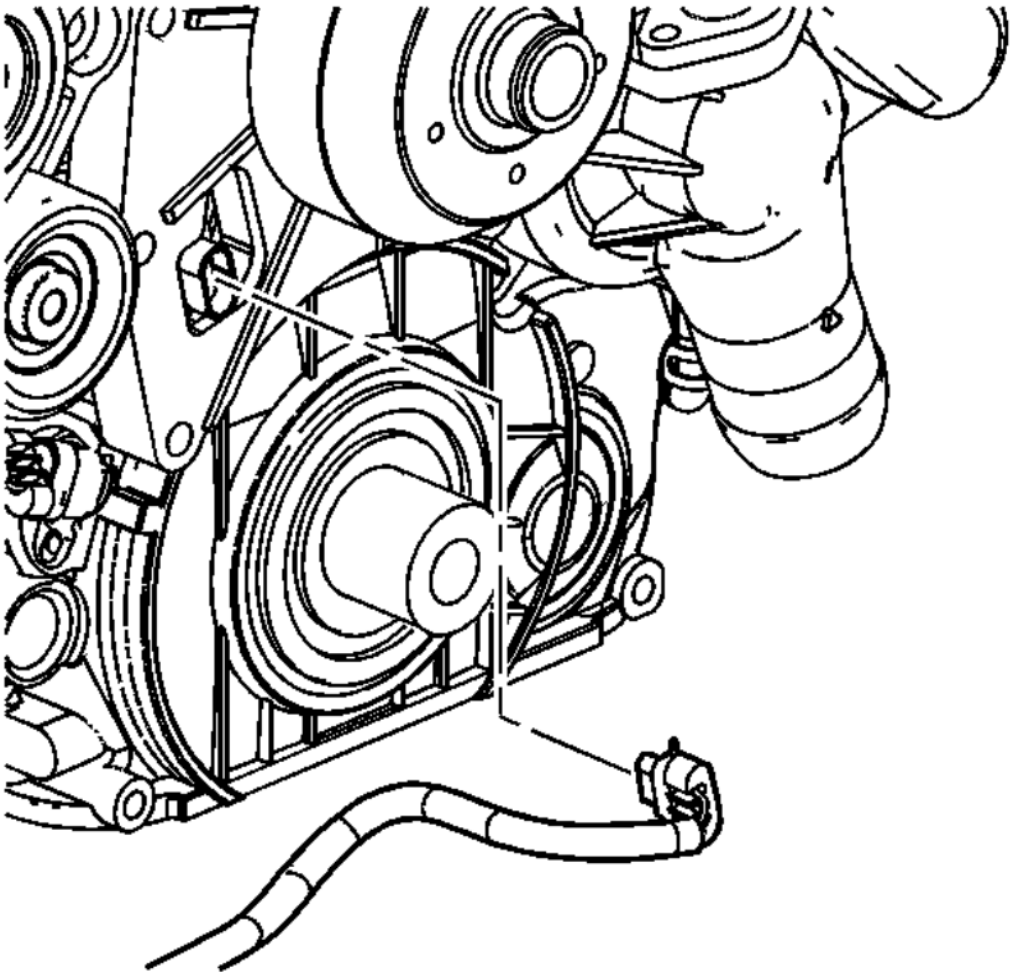


Fig. 82: View Of Camshaft Position Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the CMP sensor electrical connector.
4. Install the fan clutch. Refer to **Fan Clutch Replacement (Diesel)**.
5. Install the drive belt. Refer to **Drive Belt Replacement** .

ENGINE COOLING FAN REPLACEMENT (NON-HP2)

Removal Procedure

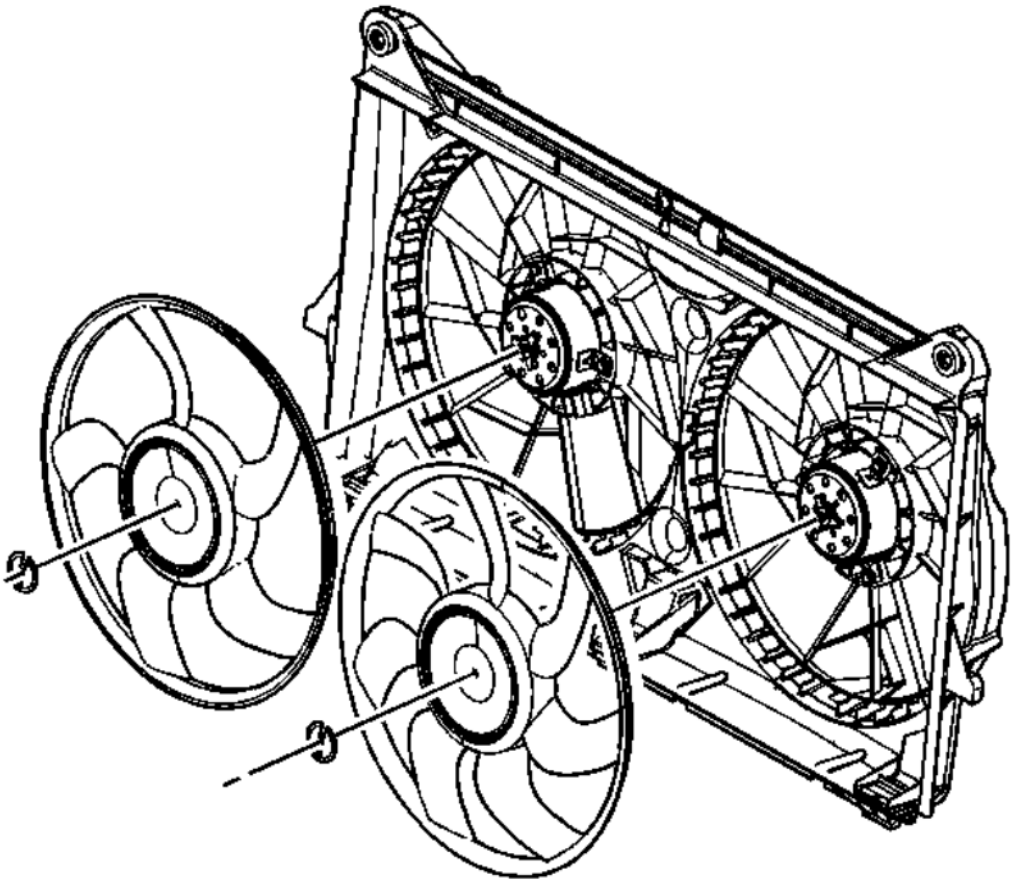


Fig. 83: Cooling Fan & Retainers
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling fan and shroud. Refer to **Cooling Fan and Shroud Replacement (Non-HP2)**.
2. Remove the cooling fan blade retainers.
3. Remove the cooling fan blades.

Installation Procedure

IMPORTANT: The electric cooling fan assembly uses a 5-blade fan and a 7-blade fan. It does not matter which side the fan blades are installed on. DO NOT install two 5-blade assemblies or two 7-

blade assemblies, as this would cause a noise issue.

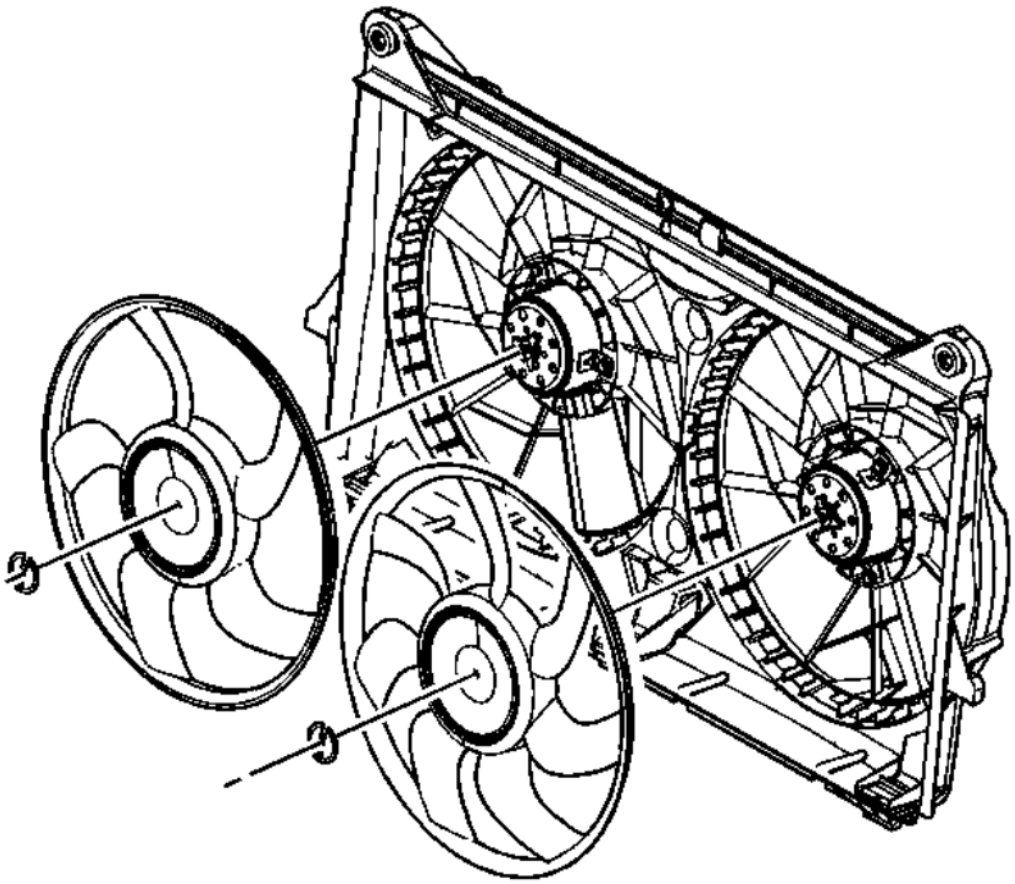


Fig. 84: Cooling Fan & Retainers
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan blades.
2. Install the cooling fan blade retainers.
3. Install the cooling fan and shroud. Refer to **Cooling Fan and Shroud Replacement (Non-HP2)**.

ENGINE COOLANT FAN MOTOR REPLACEMENT (NON-HP2)

Removal Procedure

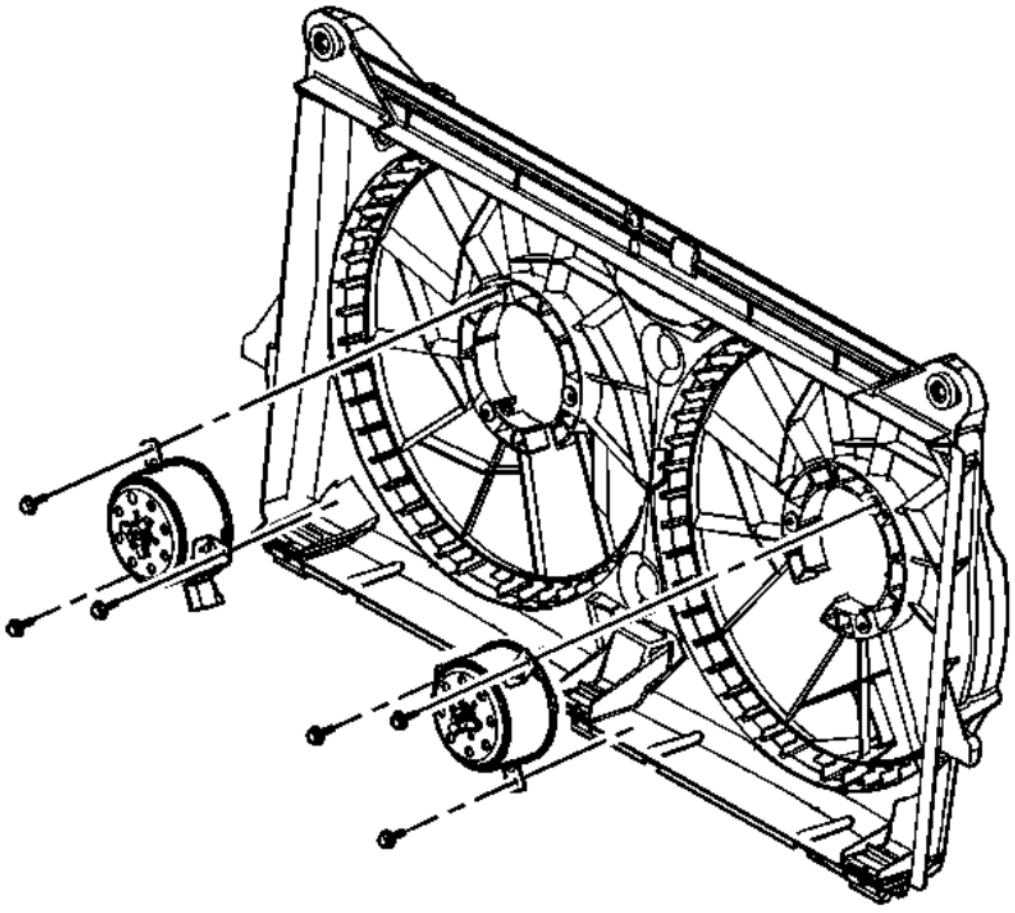


Fig. 85: Cooling Fan Motor & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling blade(s). Refer to **Engine Cooling Fan Replacement (Non-HP2)**.
2. Remove the cooling fan motor bolts.
3. Remove the cooling fan motor(s).

Installation Procedure

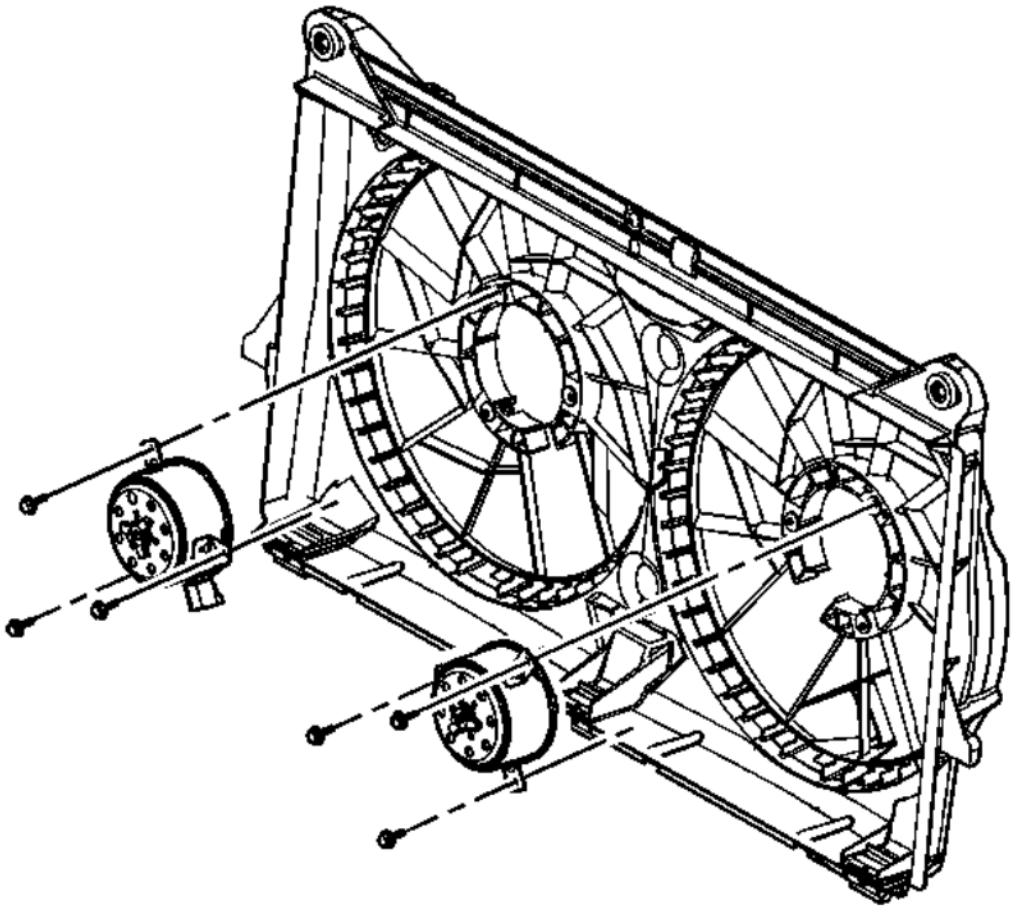


Fig. 86: Cooling Fan Motor & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the cooling fan motor(s).
2. Install the cooling fan motor bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

3. Install the cooling fan blades. Refer to **Engine Cooling Fan Replacement (Non-HP2)**.

COOLING FAN AND SHROUD REPLACEMENT (NON-HP2)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**
2. Remove air inlet duct.
3. Disconnect upper radiator hose from radiator.

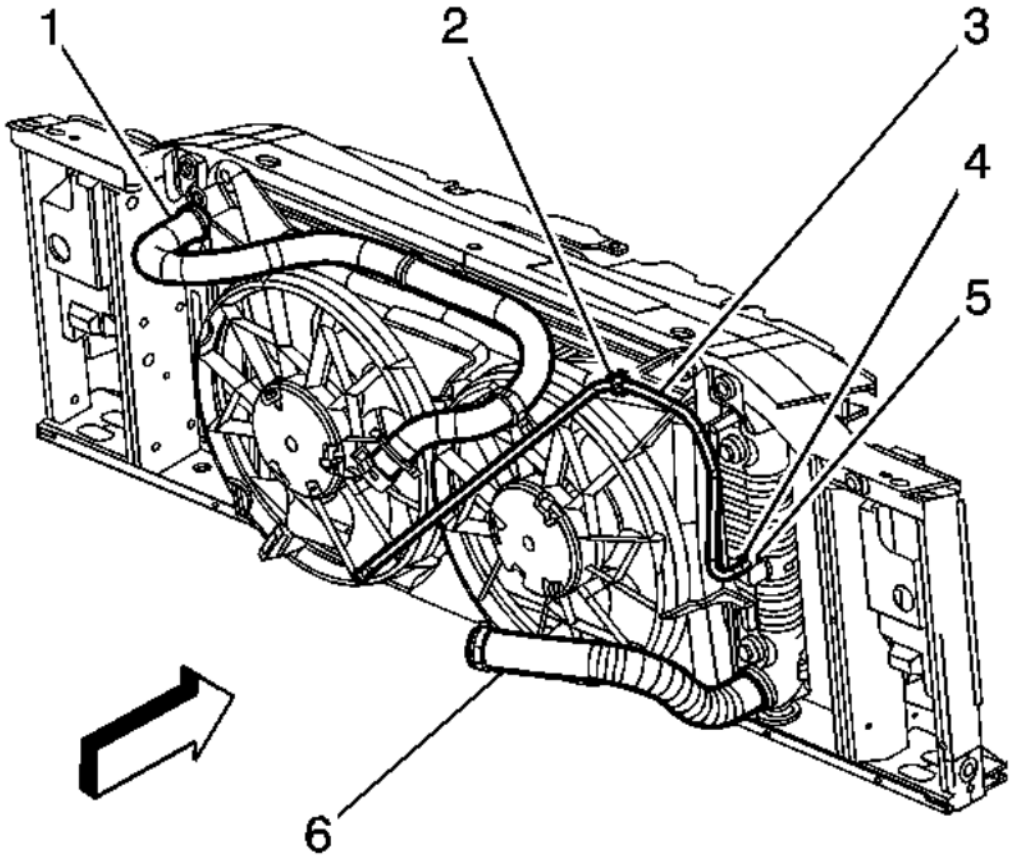


Fig. 87: Radiator, Inlet & Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

4. Disengage the radiator inlet hose clip (2) at the fan shroud.

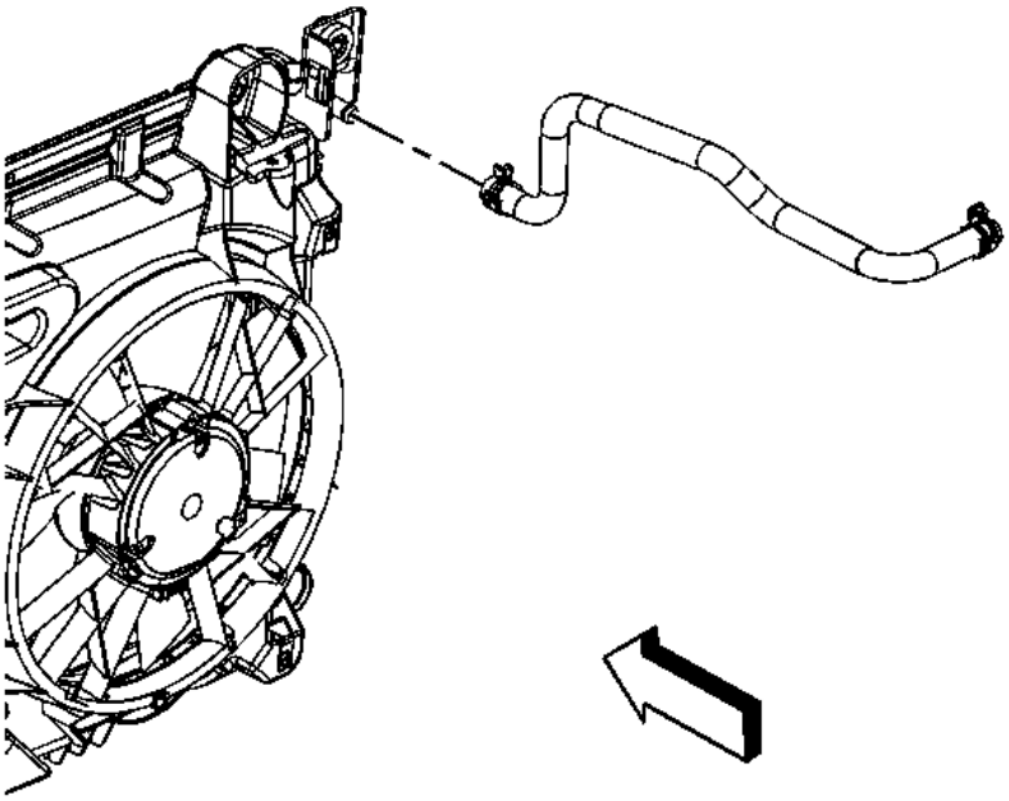


Fig. 88: View Of Surge Tank Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

5. If necessary, reposition the surge tank inlet hose clamp at the radiator.
6. If necessary, remove the surge tank inlet hose from the radiator.

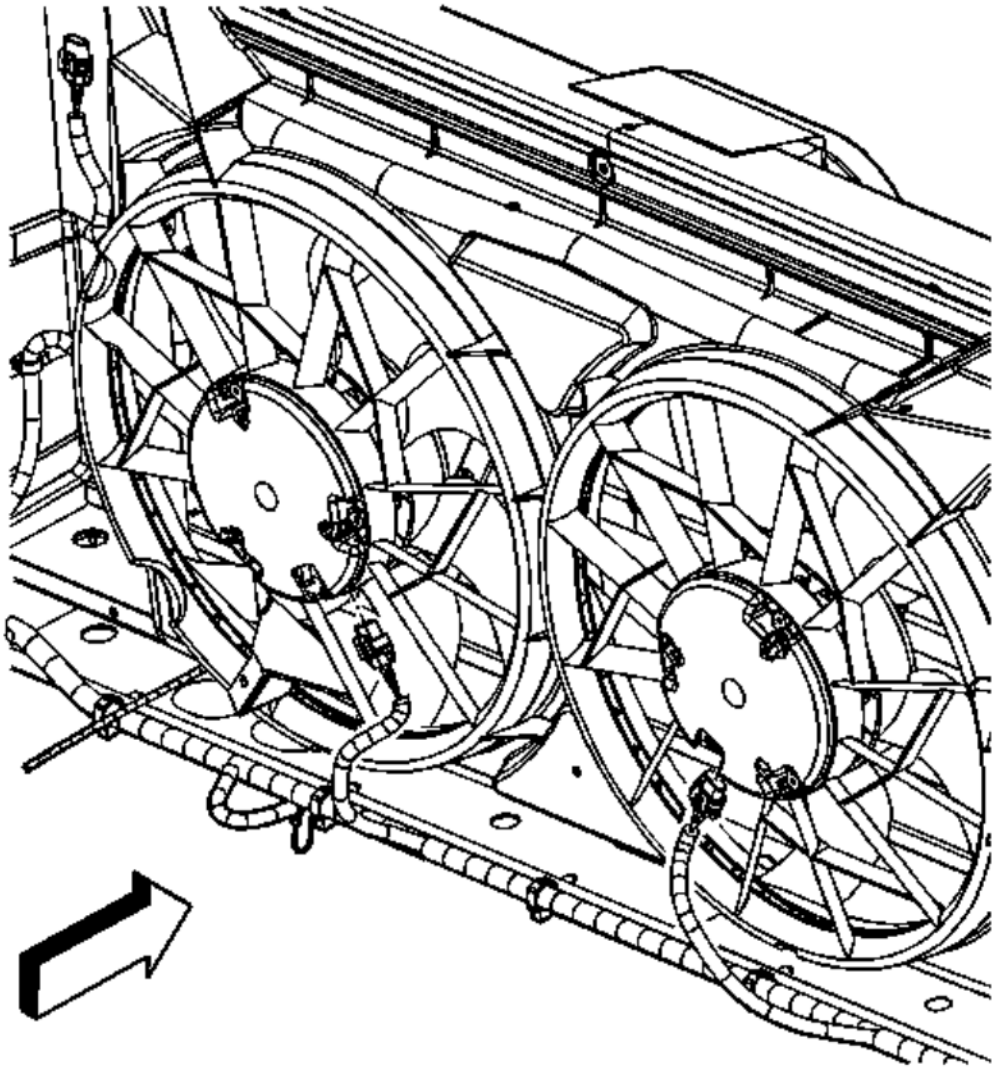


Fig. 89: Cooling Fan Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the electrical connectors from the cooling fans.
8. Remove the clip attaching the wiring harness to the shroud.
9. Remove transmission cooler lines bolts from fan shroud.

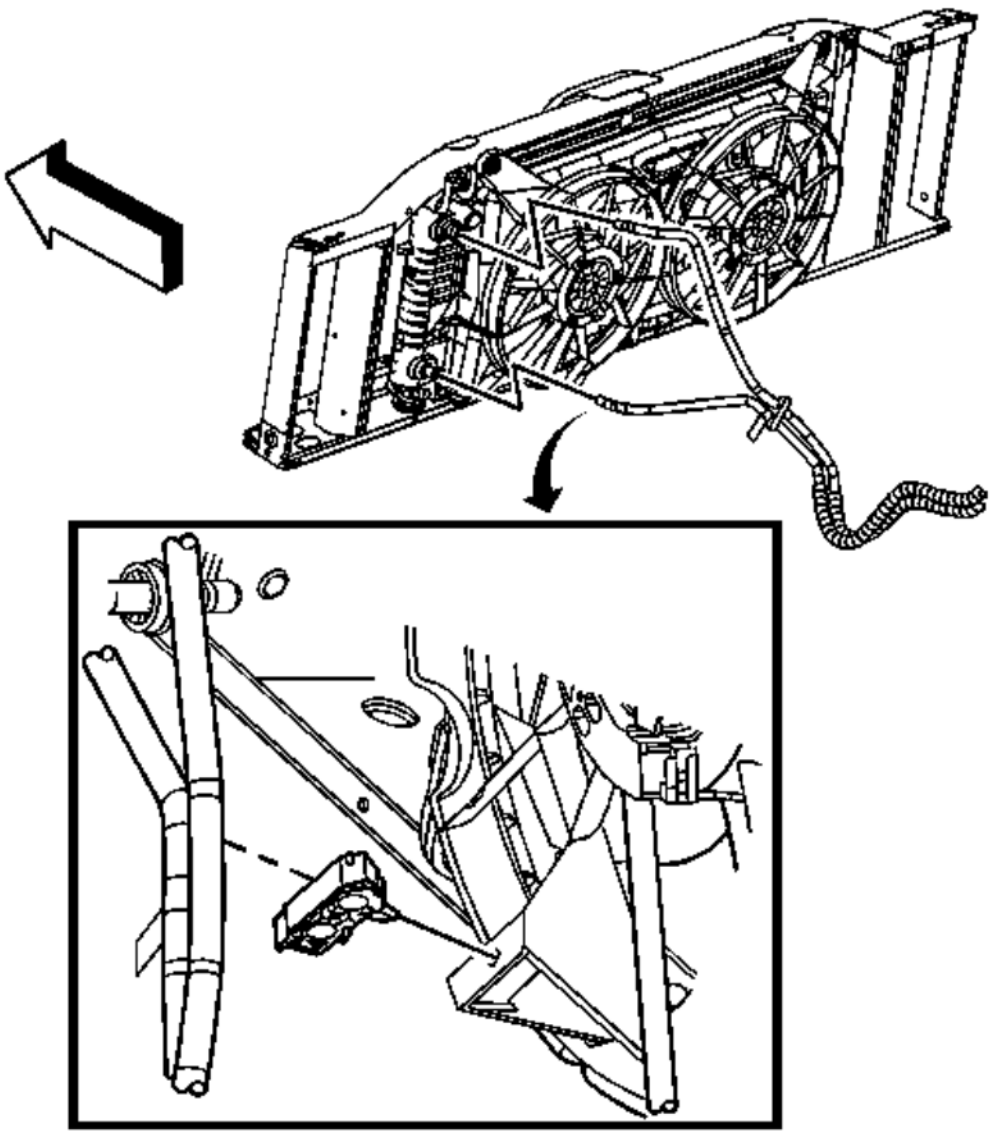


Fig. 90: Engine Oil Cooler Quick Connect Fittings
Courtesy of GENERAL MOTORS CORP.

10. If necessary, open the engine oil cooler line clip and remove the cooler lines from the clip.

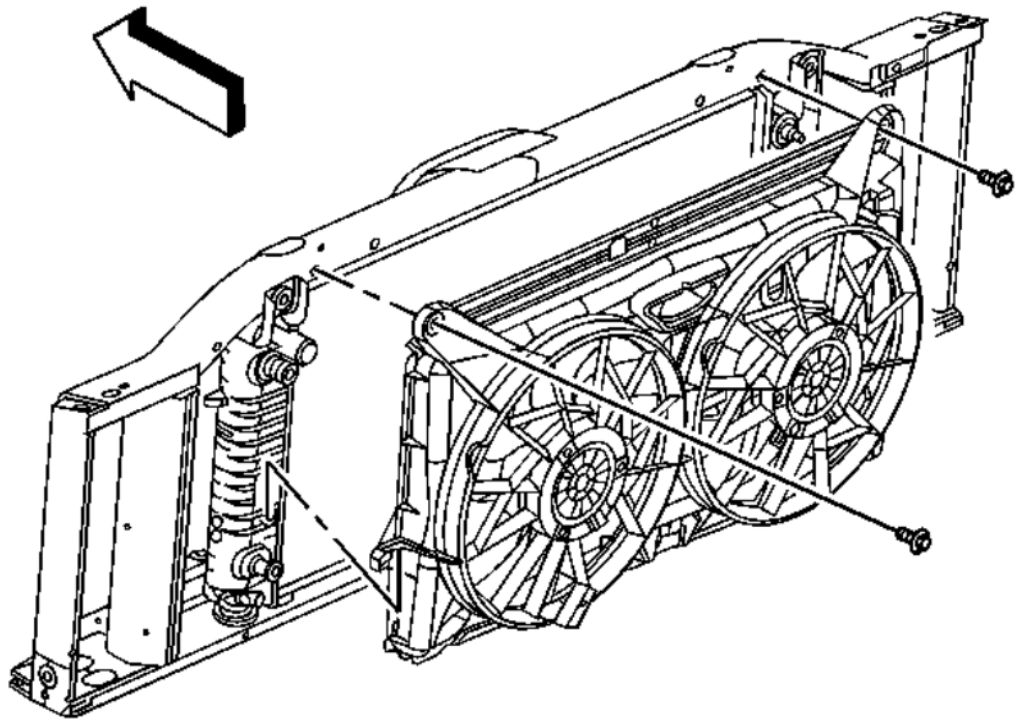


Fig. 91: Cooling Fan Shroud & Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the cooling fan shroud bolts.
12. Remove the cooling fan and shroud.

Installation Procedure

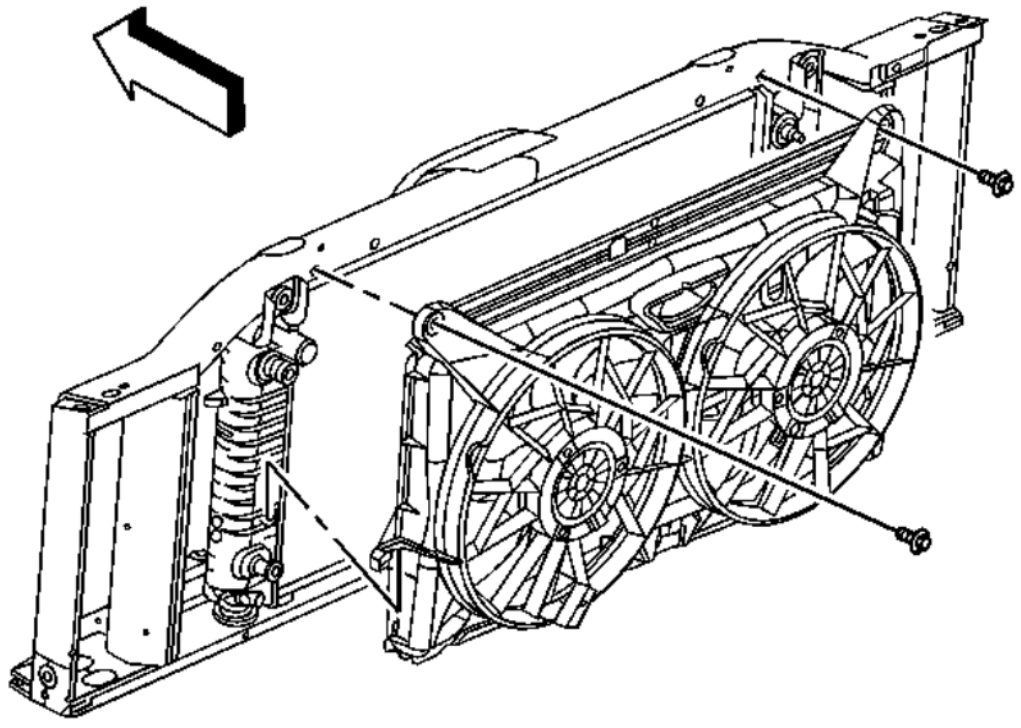


Fig. 92: Cooling Fan Shroud & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Insert the 3 lower tabs into the radiator support flange. Keeping the shroud parallel to the radiator will ensure the correct installation of the lower tabs.

1. Install the cooling fan and shroud.

   NOTE: Refer to Fastener Notice .

2. Install the cooling fan shroud bolts.

   Tighten: Tighten the bolts to 9 N.m (80 lb in).

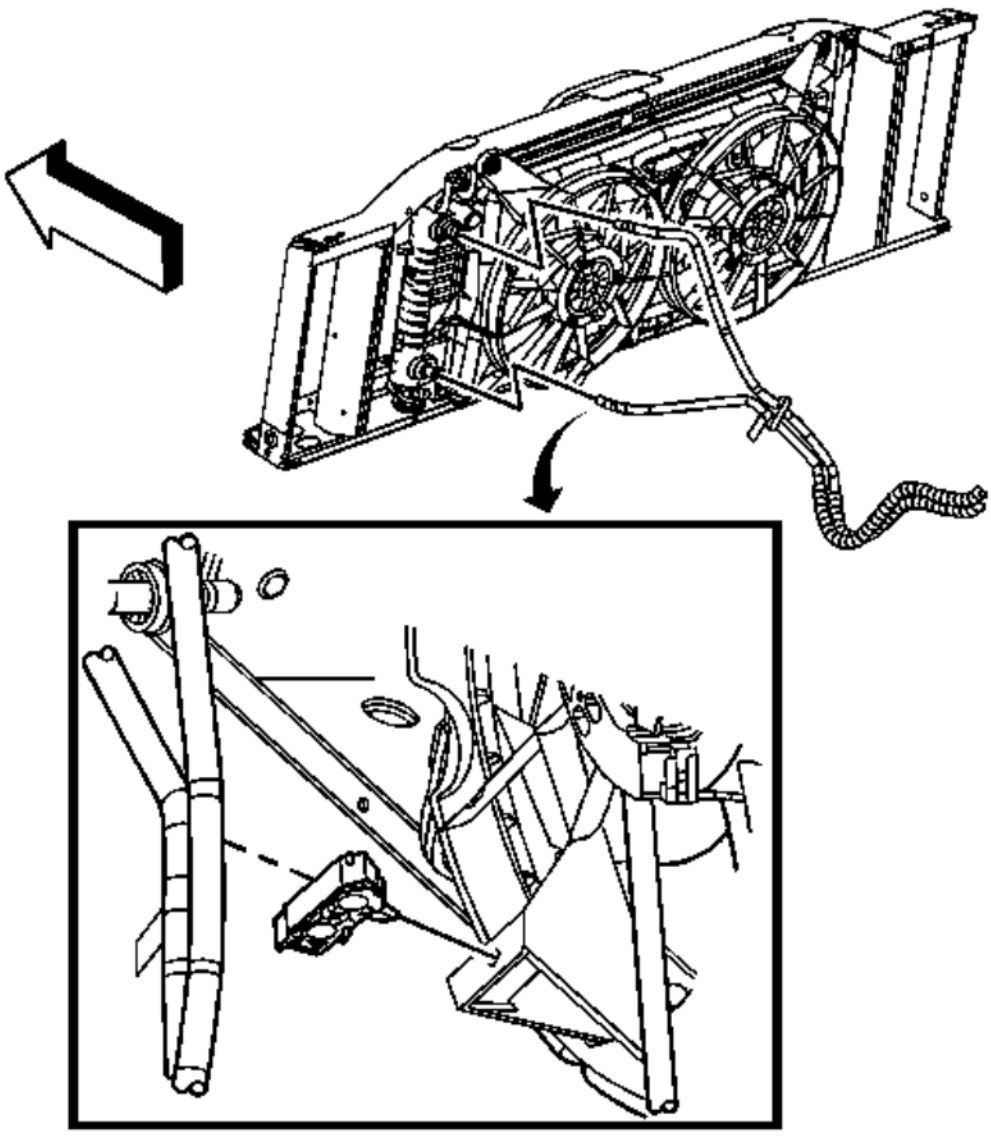


Fig. 93: Engine Oil Cooler Quick Connect Fittings
Courtesy of GENERAL MOTORS CORP.

3. If equipped, install the cooler lines to the clip and close the clip.

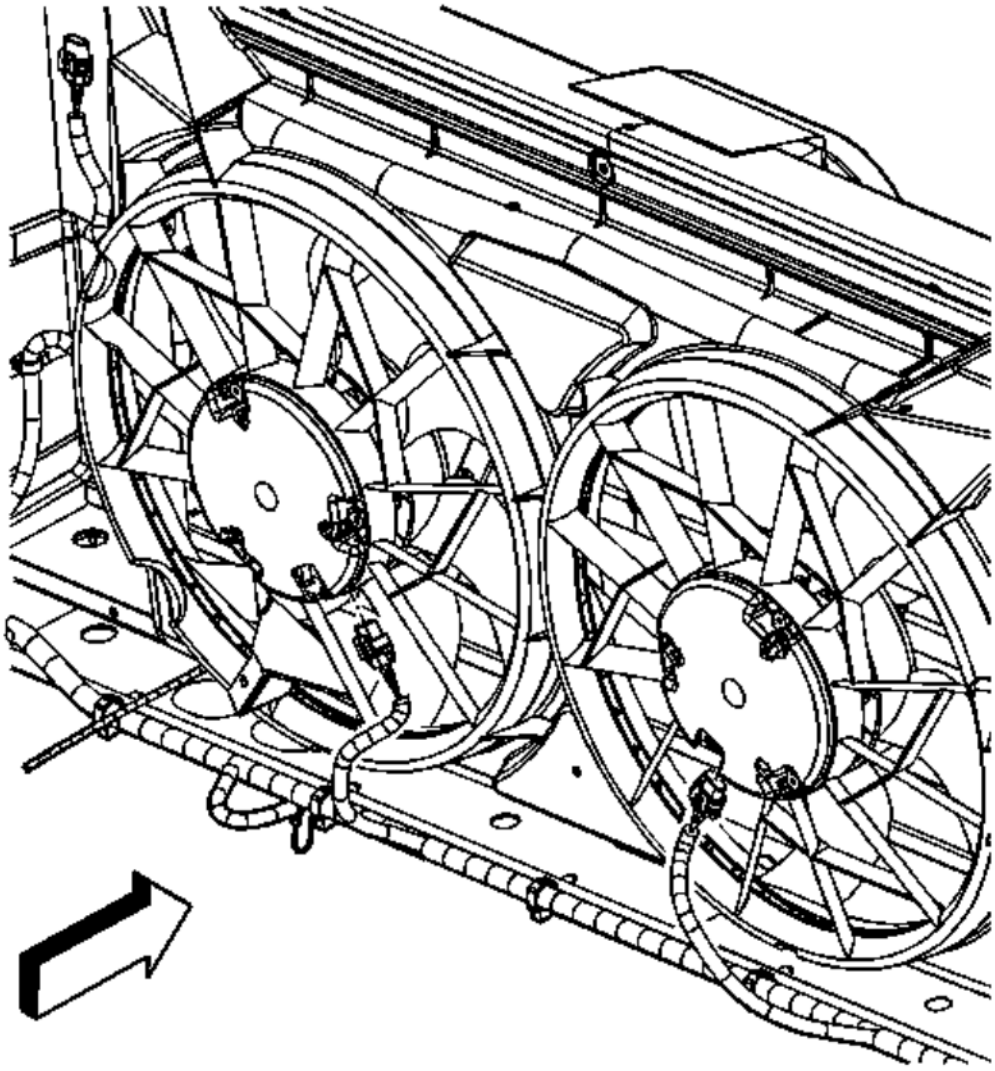


Fig. 94: Cooling Fan Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

4. Connect the electrical connectors to the cooling fans.
5. Install the clip attaching the wiring harness to the shroud.
6. Install the transmission cooling line bolts to fan shroud.

Tighten: Tighten the bolts to 4 N.m (35 lb in).

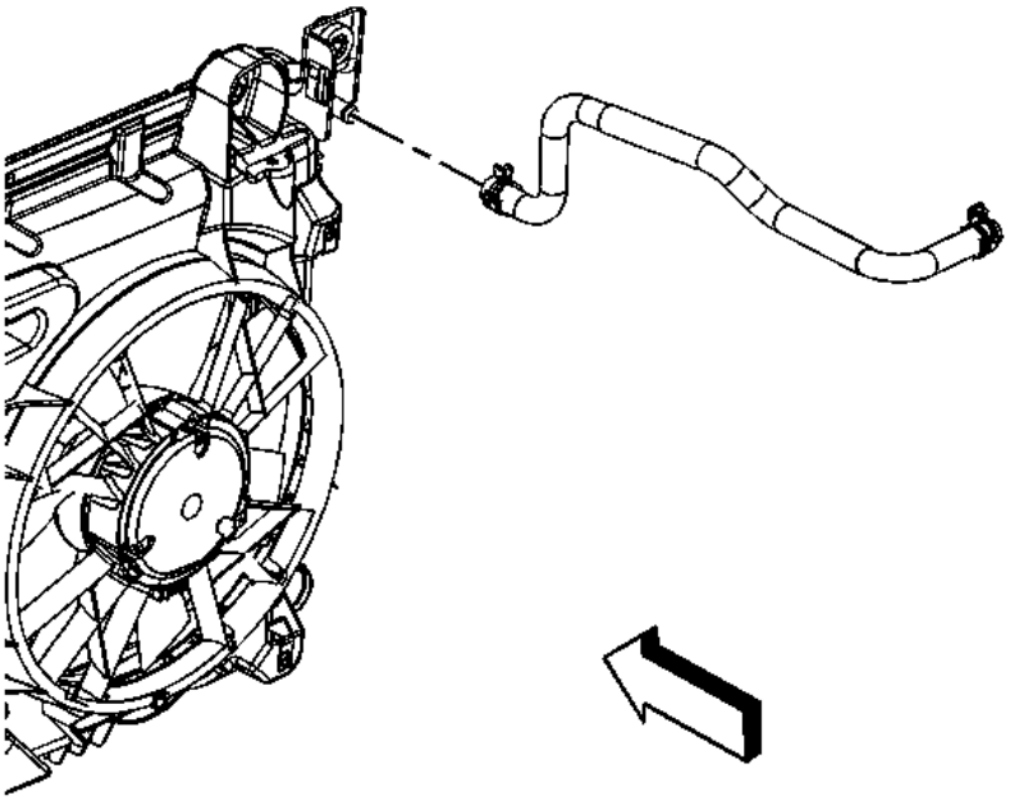


Fig. 95: View Of Surge Tank Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

7. If necessary, install the surge tank inlet hose to the radiator.
8. If necessary, reposition the surge tank inlet hose clamp at the radiator.

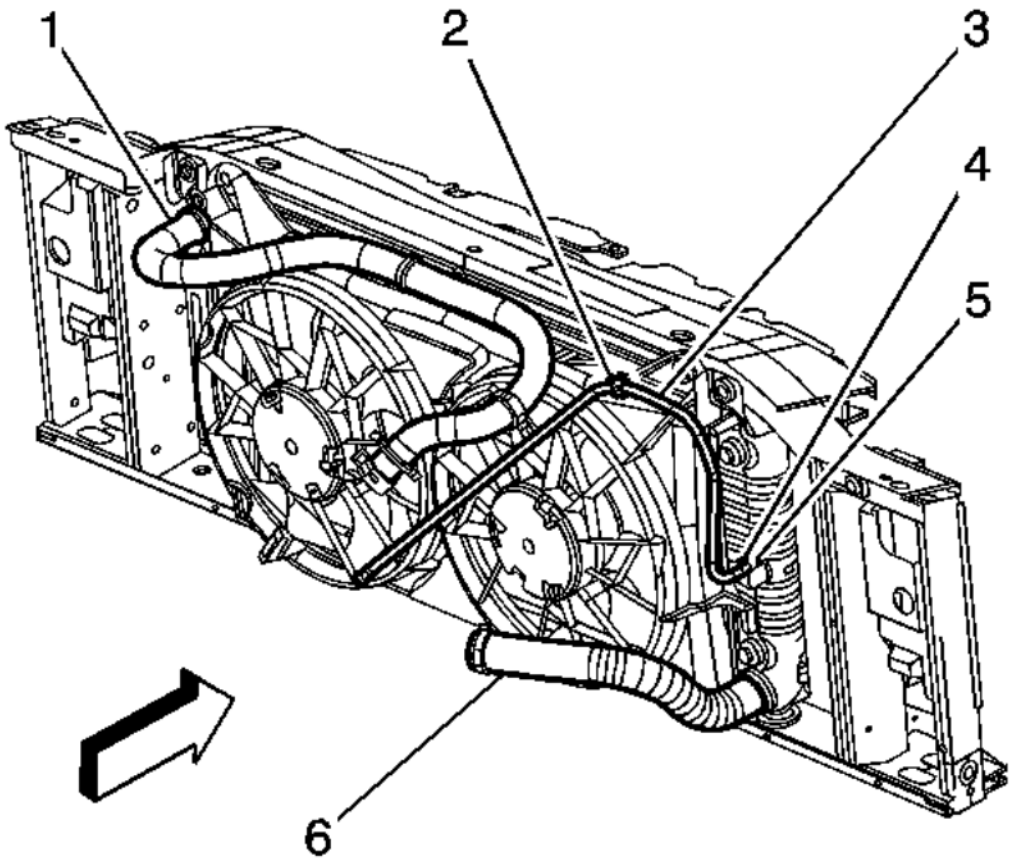


Fig. 96: Radiator, Inlet & Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

9. Engage the radiator inlet hose clip (2) at the fan shroud.
10. Connect upper radiator hose from radiator.
11. Install air inlet duct.
12. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**

TURBOCHARGER COOLANT BYPASS VALVE REPLACEMENT

Removal Procedure

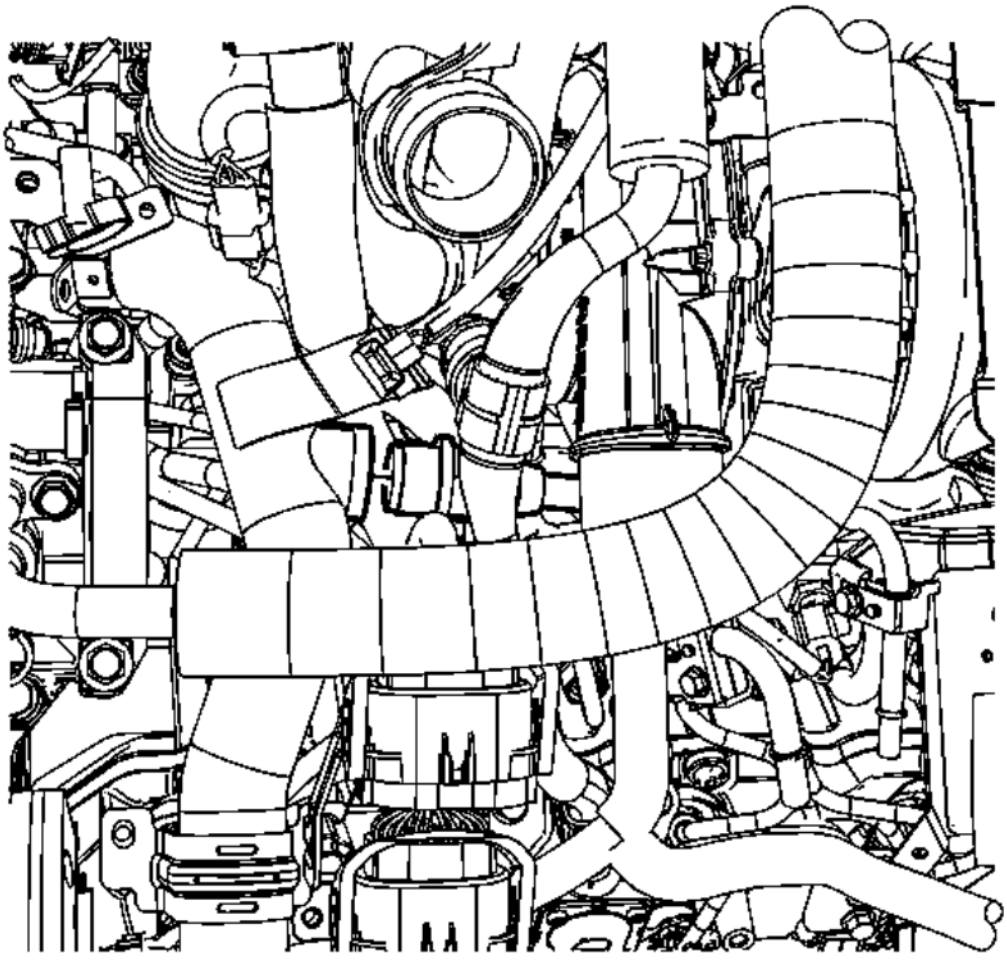


Fig. 97: View Of Turbocharger Coolant Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
3. Reposition the coolant inlet hose clamp.
4. Disconnect the turbocharger coolant inlet hose from the turbocharger bypass valve.

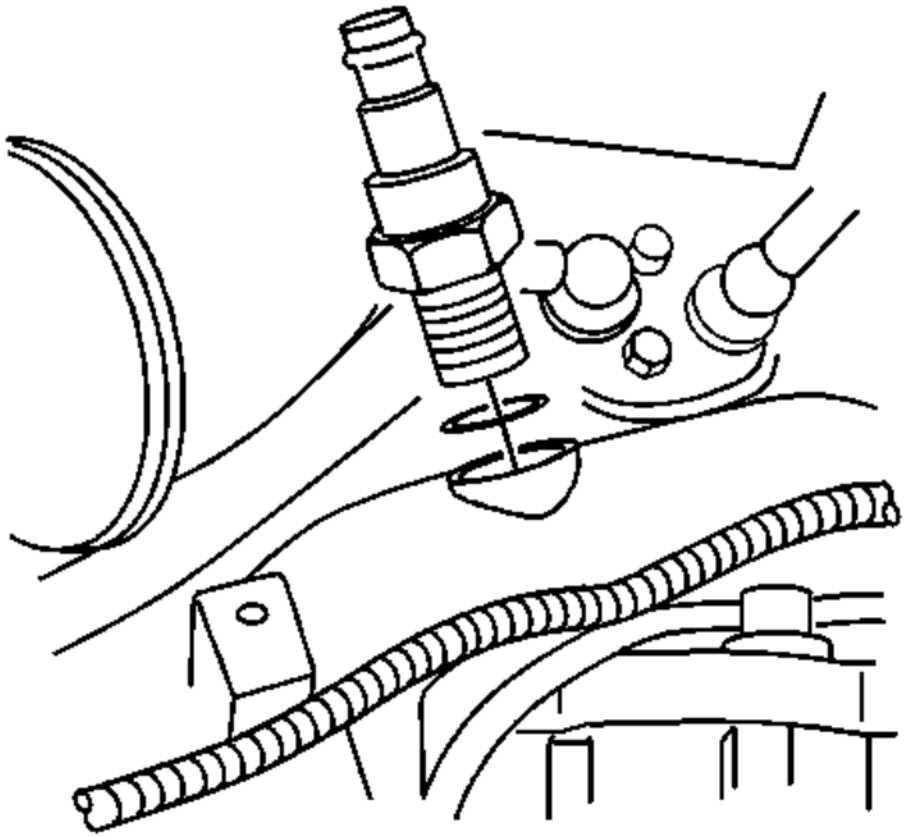


Fig. 98: View Of Turbocharger Bypass Valve & Washer
Courtesy of GENERAL MOTORS CORP.

5. Remove the turbocharger bypass valve and washer.

Installation Procedure

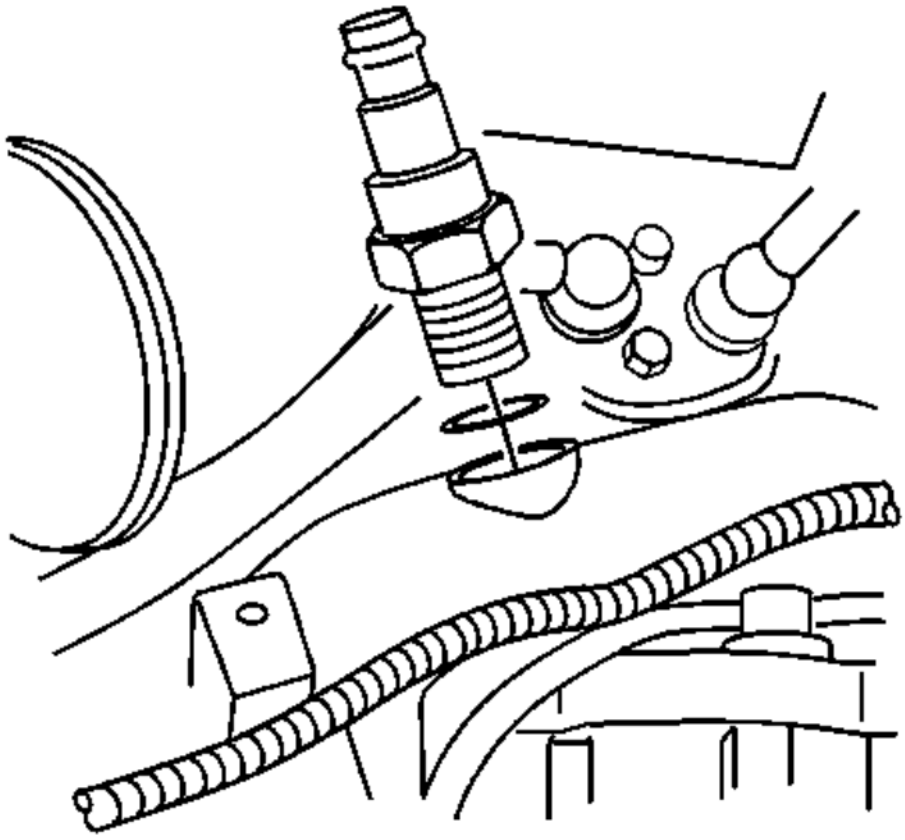


Fig. 99: View Of Turbocharger Bypass Valve & Washer
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the turbocharger bypass valve and washer.

   Tighten: Tighten the valve to 60 N.m (44 lb ft).

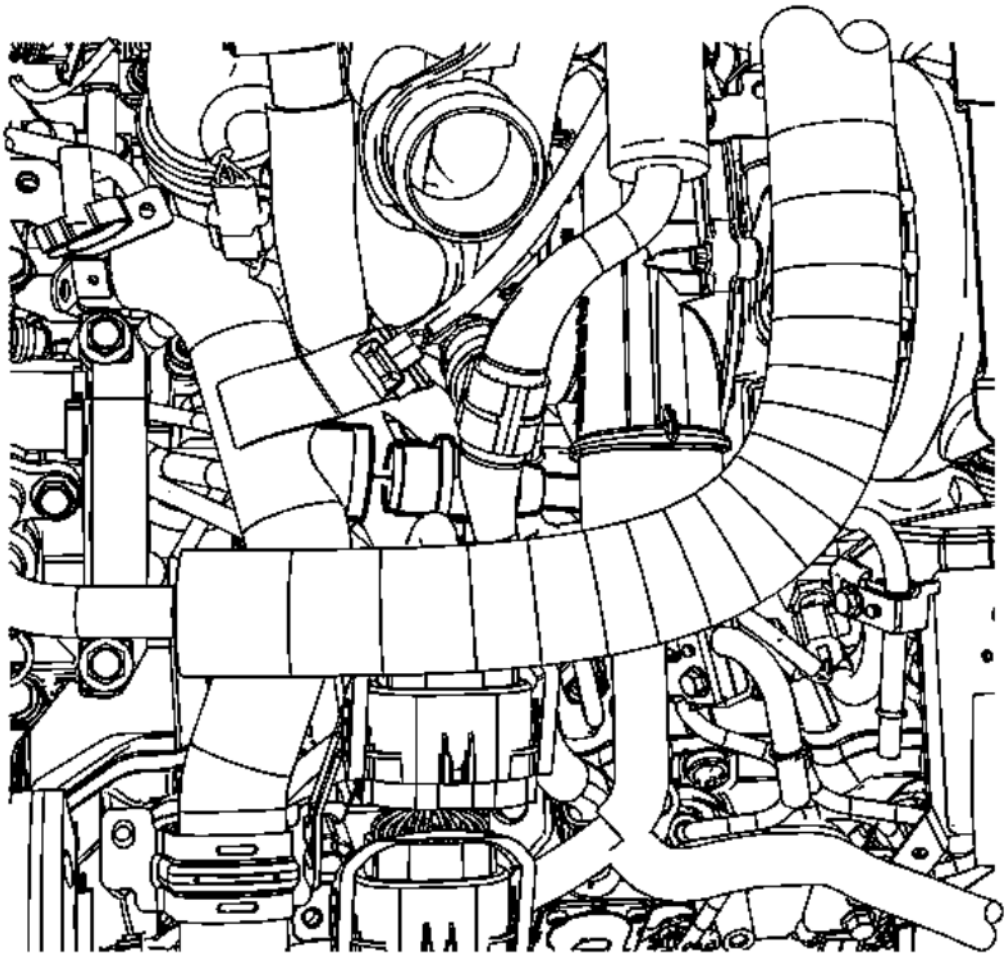


Fig. 100: View Of Turbocharger Coolant Inlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the turbocharger coolant inlet hose to the turbocharger bypass valve.
3. Position the coolant inlet hose clamp.
4. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .

TURBOCHARGER COOLANT HOSES/PIPES REPLACEMENT (LMM - INLET PIPE)

Removal Procedure

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
2. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

IMPORTANT: After removing the charged air cooler duct, cover the turbocharger opening with tape in order to prevent entry of objects.

4. Remove the charged air cooler outlet pipe from the turbocharger and the charged air cooler. Refer to **Charge Air Cooler Outlet Pipe Replacement** .

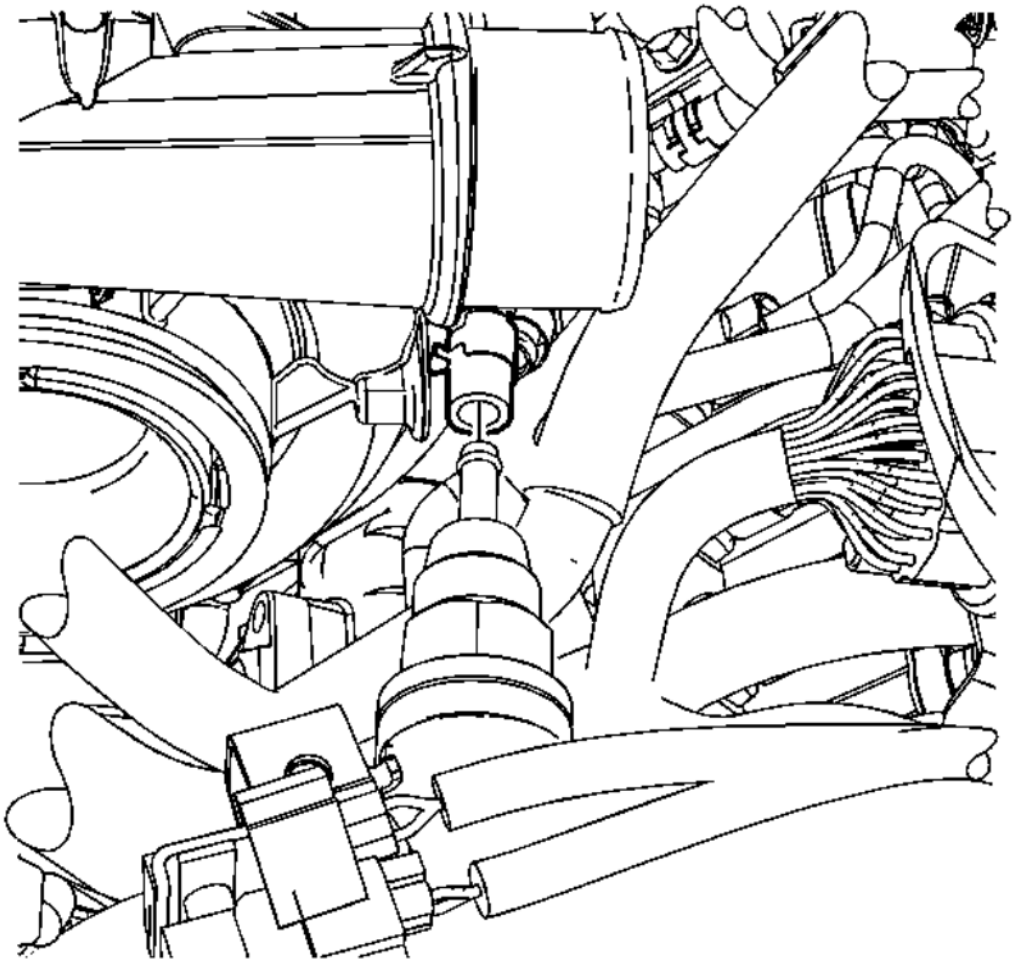


Fig. 101: Identifying Turbocharger Coolant Inlet Hose & Bypass Valve (6.6L, LMM)
Courtesy of GENERAL MOTORS CORP.

5. Reposition the turbocharger coolant inlet hose clamp at the bypass valve.

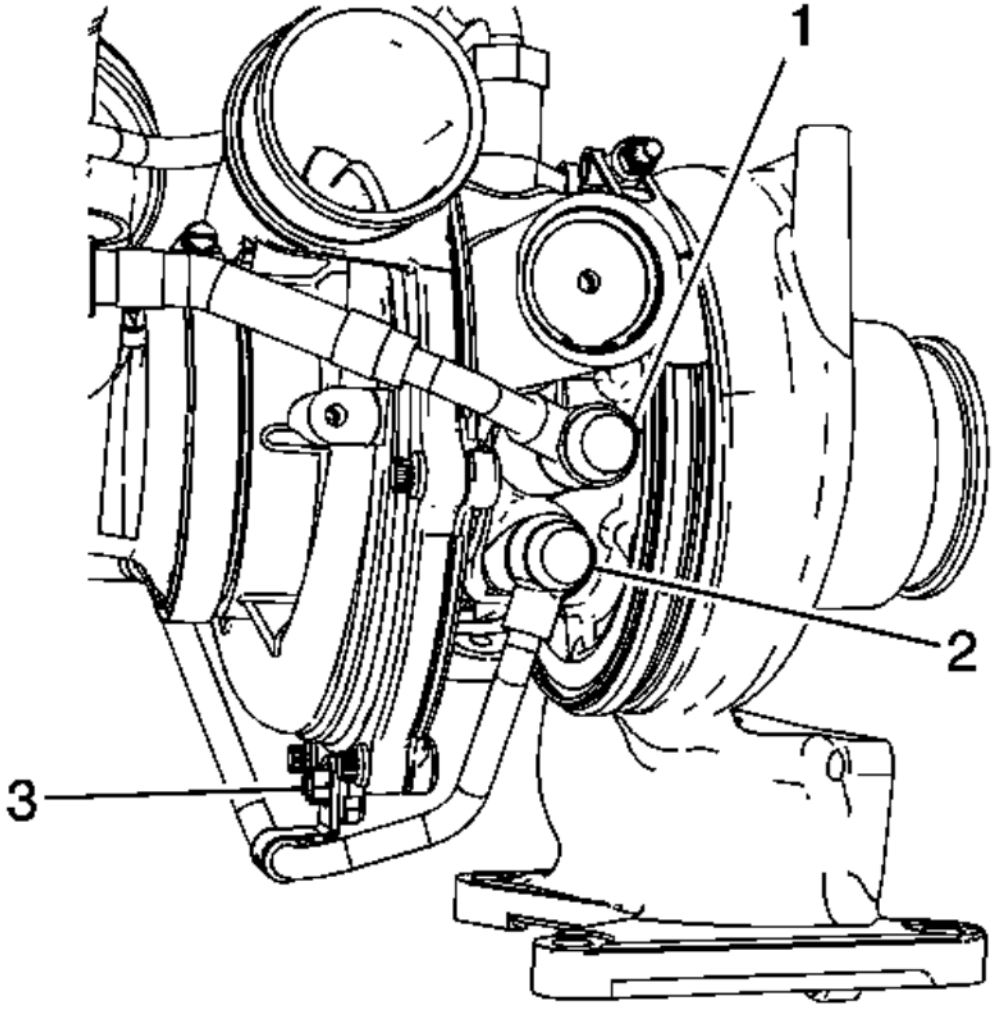


Fig. 102: View Of Turbocharger Coolant Inlet & Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

6. Remove the turbocharger coolant inlet hose banjo bolt (1).
7. Remove the inlet hose washer and inlet line.

Installation Procedure

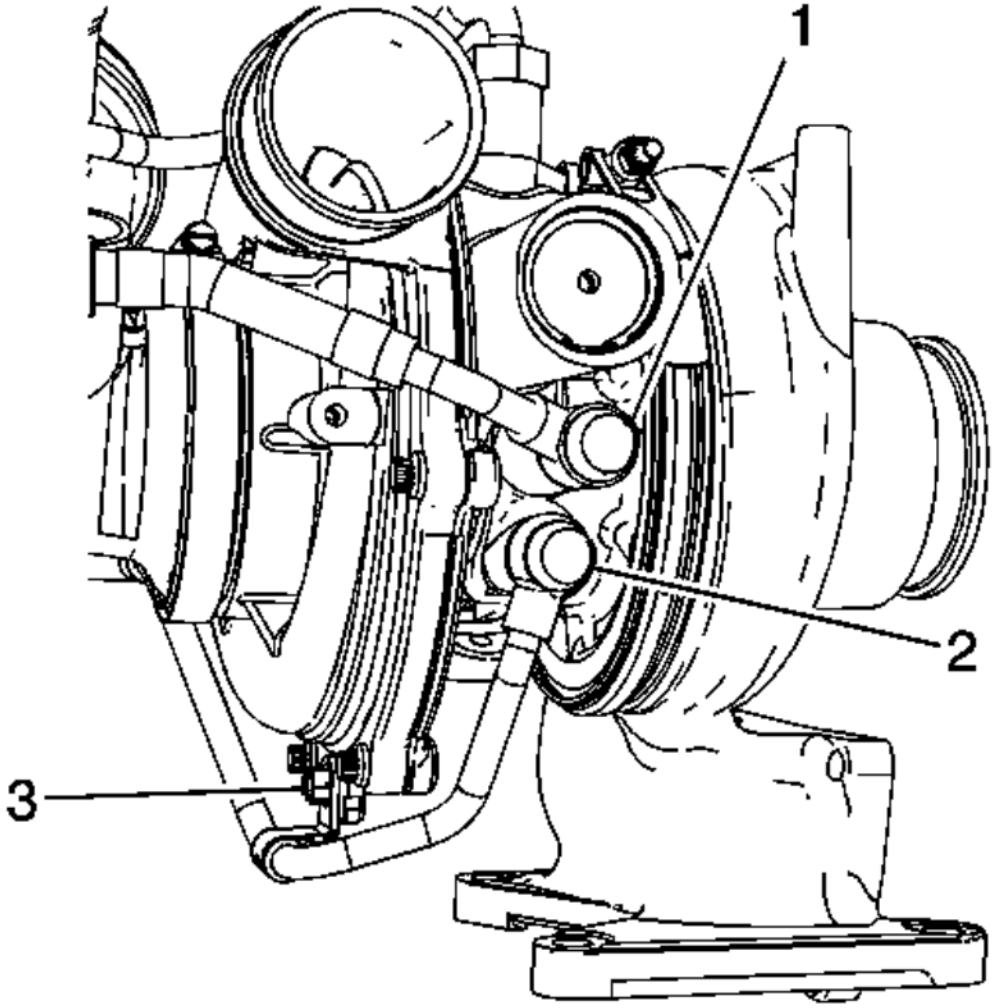


Fig. 103: View Of Turbocharger Coolant Inlet & Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the inlet hose washer and inlet line.
2. Install the turbocharger coolant inlet hose banjo bolt (1).

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

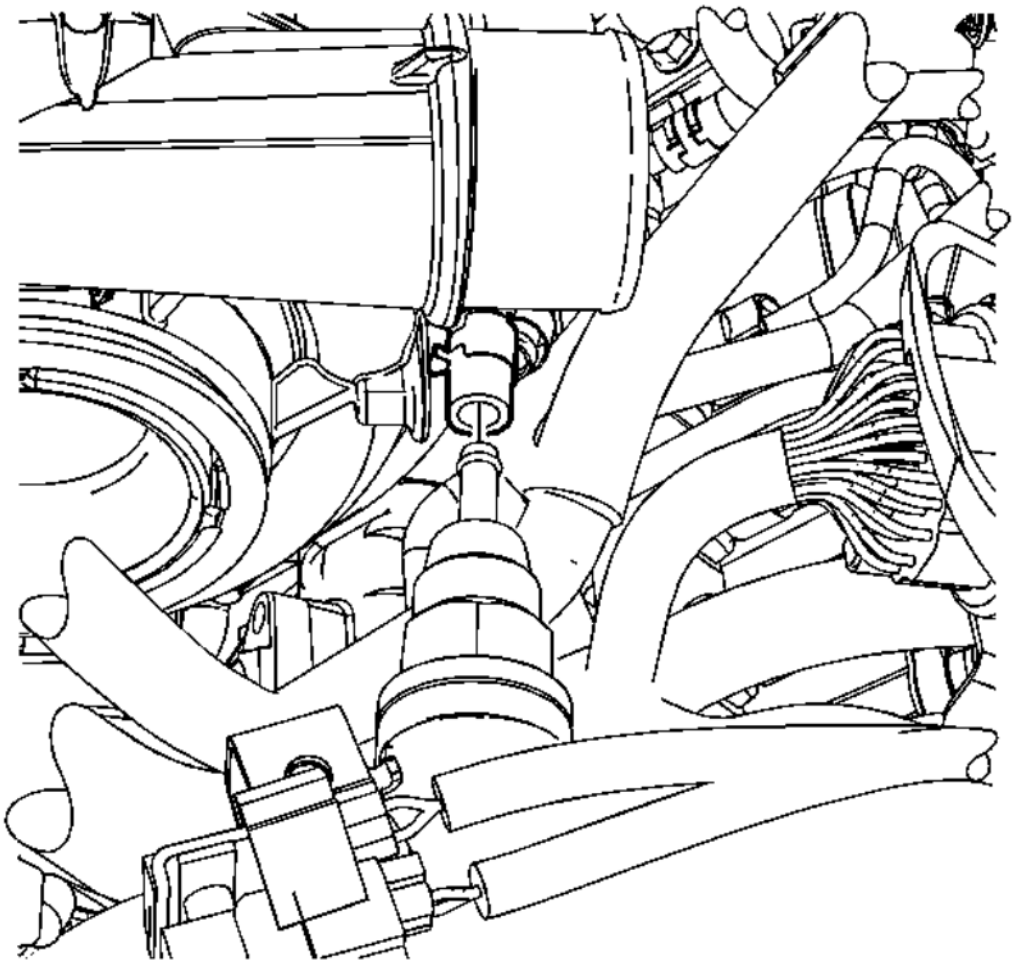


Fig. 104: Identifying Turbocharger Coolant Inlet Hose & Bypass Valve (6.6L, LMM)
Courtesy of GENERAL MOTORS CORP.

3. Position the turbocharger coolant inlet hose clamp at the bypass valve.
4. Remove the tape from the turbocharger openings.

IMPORTANT: Lubricate the end of the duct prior to installation.

5. Install the charged air cooler outlet pipe to the turbocharger and the charged air cooler. Refer to **Charge Air Cooler Outlet Pipe Replacement** .
6. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

7. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement** .
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

TURBOCHARGER COOLANT HOSES/PIPES REPLACEMENT (LMM - OUTLET PIPE)

Removal Procedure

1. Remove the turbocharger coolant inlet pipe. Refer to **Turbocharger Coolant Hoses/Pipes Replacement (LMM - Inlet Pipe)** or **Turbocharger Coolant Hoses/Pipes Replacement (LMM - Outlet Pipe)**.
2. Remove the generator mounting bracket. Refer to **Generator Bracket Replacement (4.3L)** or **Generator Bracket Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Generator Bracket Replacement (6.6L)** .
3. Remove the exhaust gas recirculation (EGR) cooler assembly. Refer to **Exhaust Gas Recirculation Valve Cooler Replacement** .
4. Remove the cooling fan clutch. Refer to **Fan Clutch Replacement (Diesel)**.

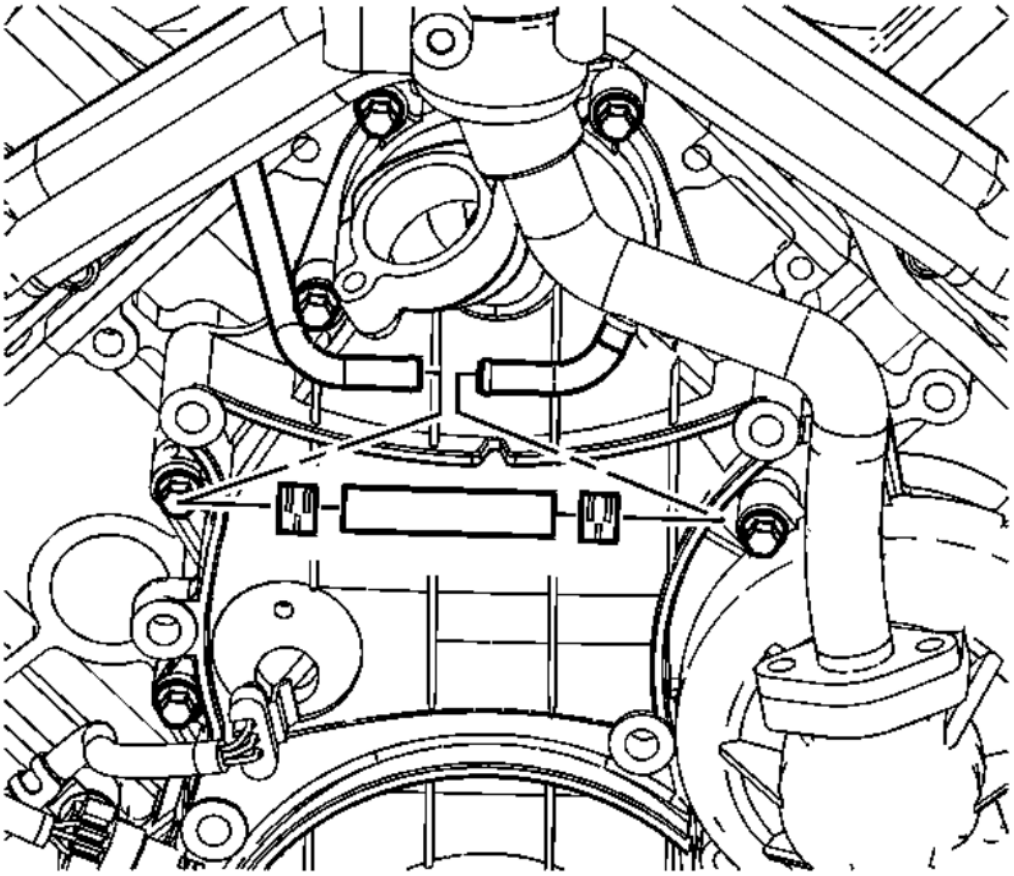


Fig. 105: View Of Turbocharger Coolant Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

5. Reposition the hose clamp at the bypass pipe.
6. Remove the turbocharger coolant outlet hose from the bypass pipe.

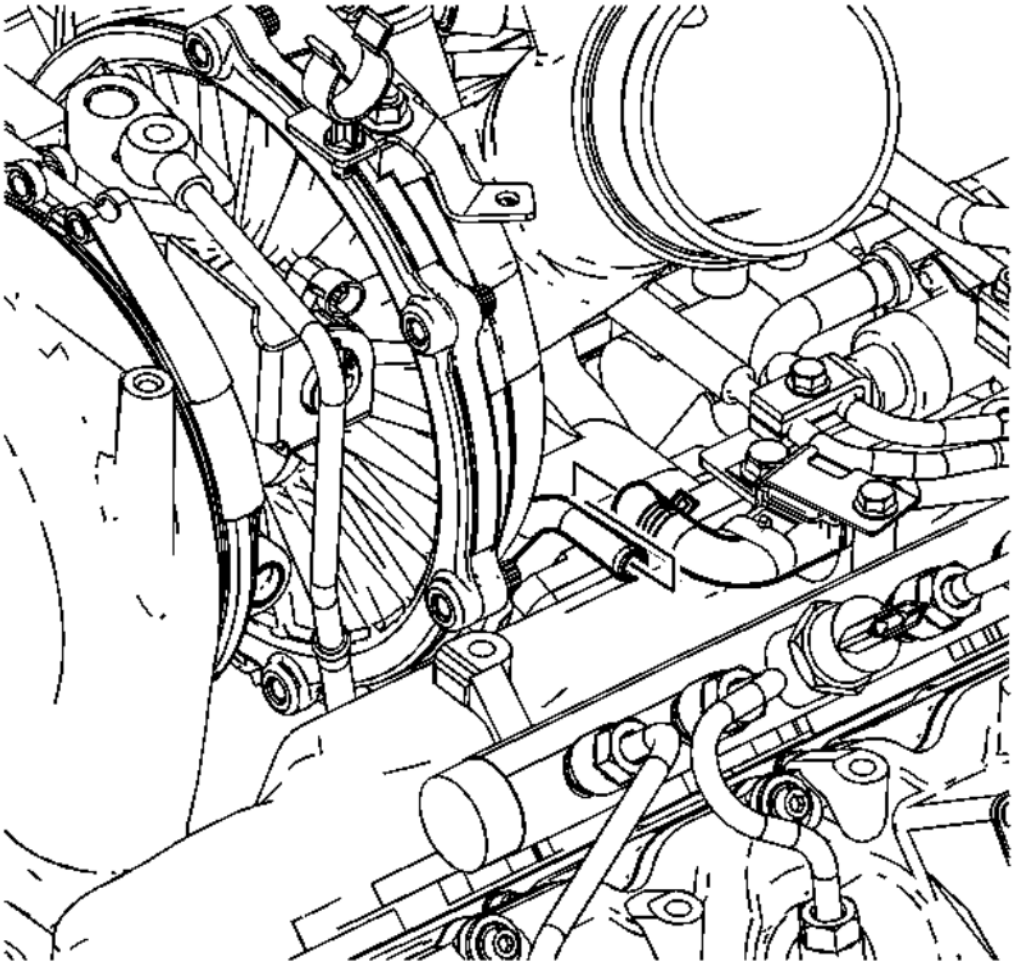


Fig. 106: View Of Turbocharger Outlet Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

7. Reposition the turbocharger coolant outlet hose clamp.
8. Remove the turbocharger coolant outlet hose from the pipe on the turbocharger.

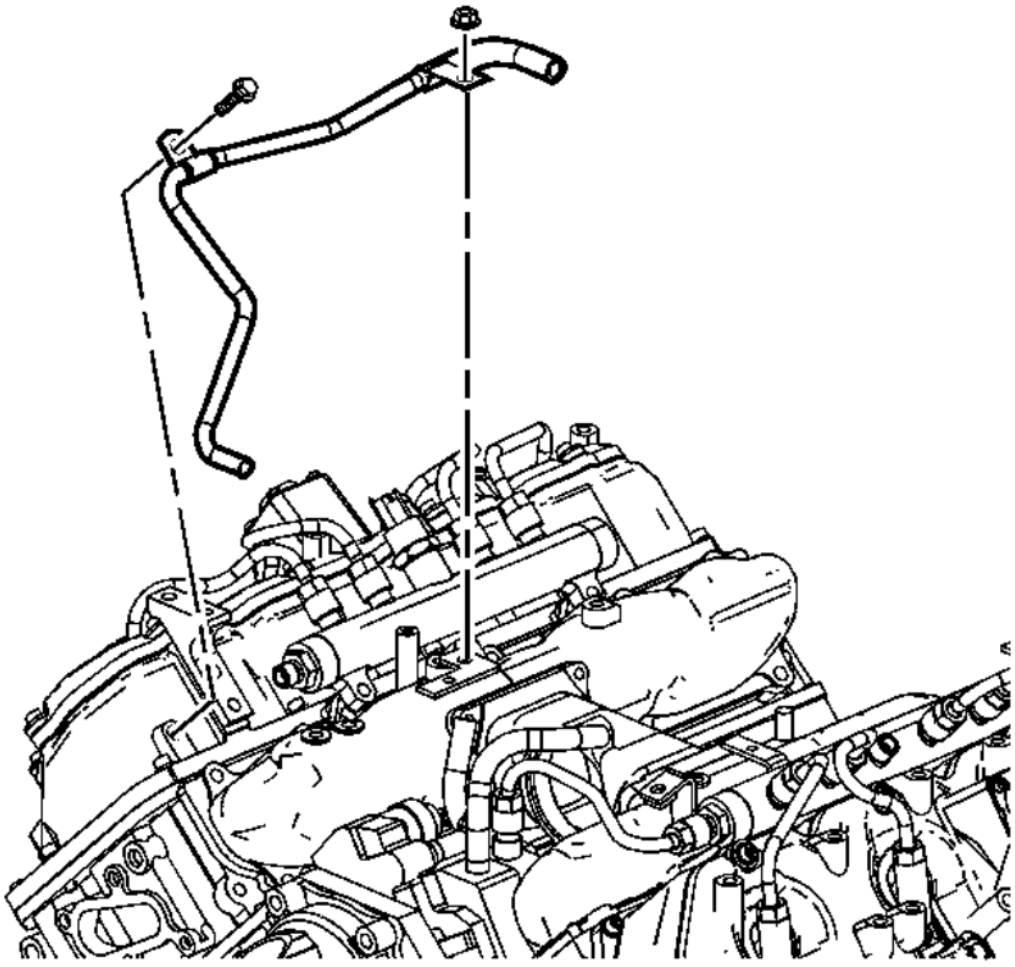


Fig. 107: View Of Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

9. Remove the turbocharger coolant outlet pipe bolt and nut.

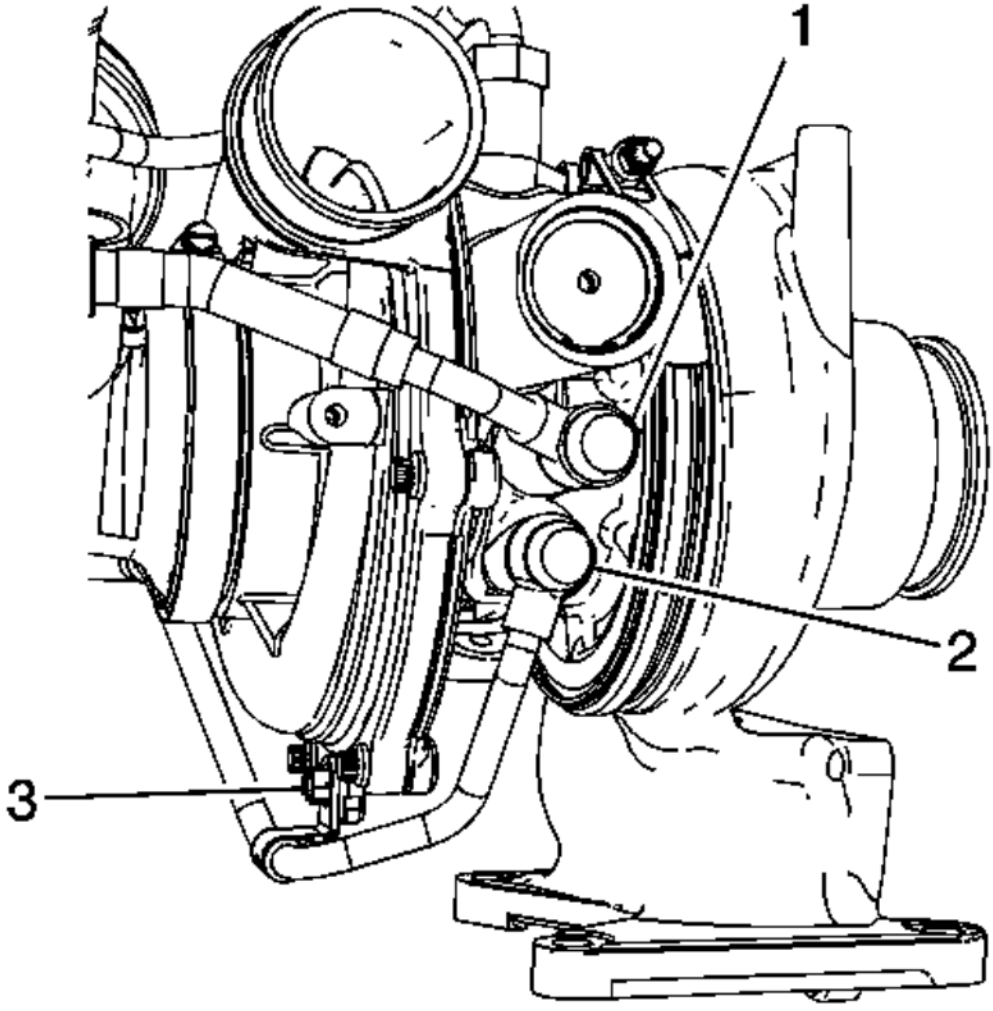


Fig. 108: View Of Turbocharger Coolant Inlet & Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

10. If necessary, remove the turbocharger. Refer to **Turbocharger Replacement** .
11. If necessary, remove the coolant outlet pipe clip bolt (3) from the turbocharger.
12. If necessary, remove the coolant outlet pipe.

Installation Procedure

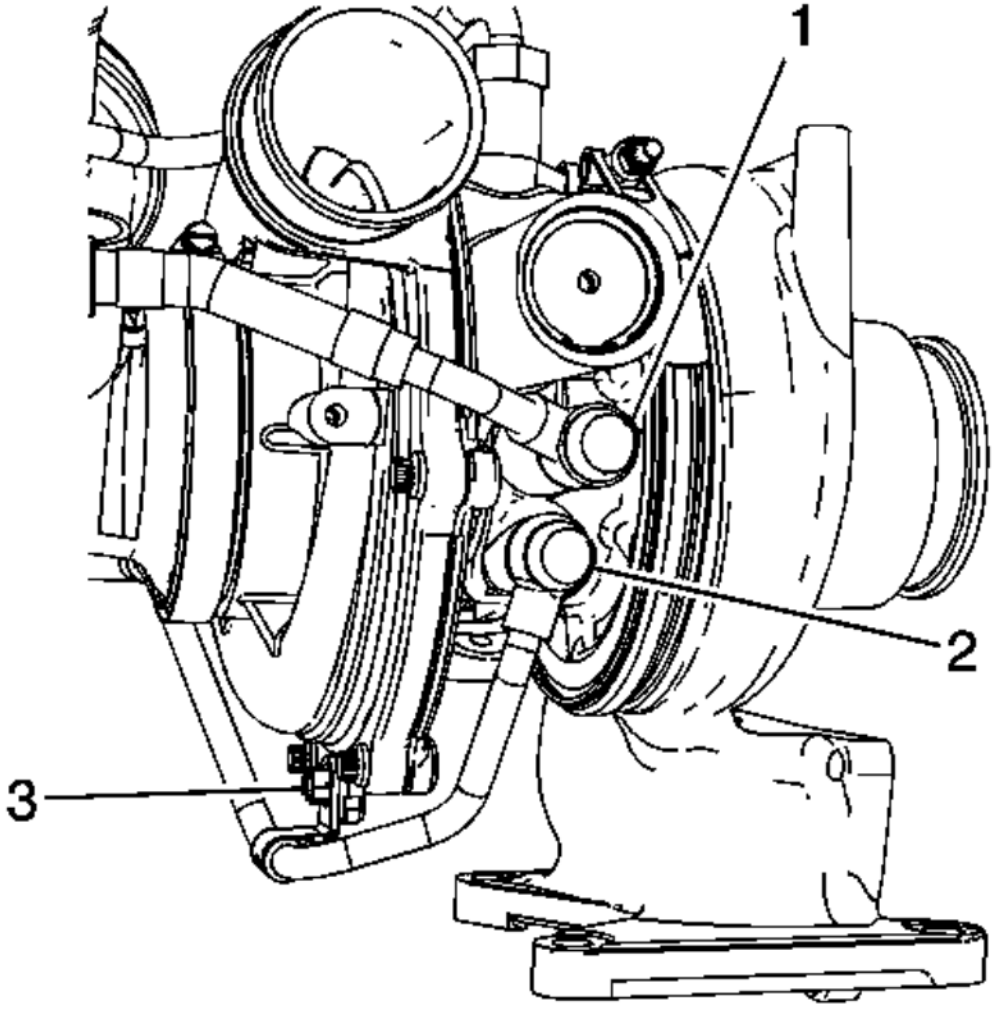


Fig. 109: View Of Turbocharger Coolant Inlet & Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

1. If necessary, install the coolant outlet pipe.

NOTE: Refer to Fastener Notice .

2. If necessary, install the coolant outlet pipe clip bolt (3) to the turbocharger.

Tighten: Tighten the bolt to 9 N.m (80 lb in).

3. If necessary, install the turbocharger. Refer to **Turbocharger Replacement** .

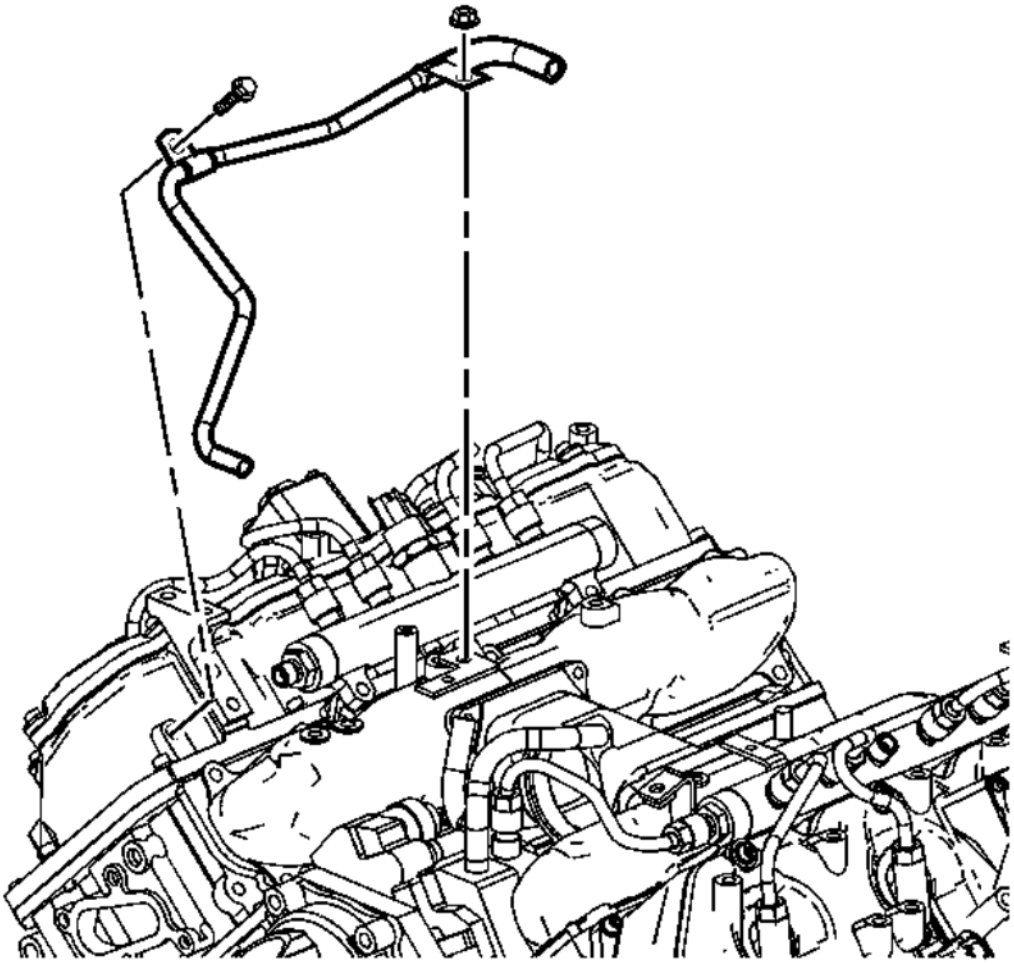


Fig. 110: View Of Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

4. Install the turbocharger coolant outlet pipe bolt and nut.

Tighten: Tighten the bolt/nut to 9 N.m (80 lb in).

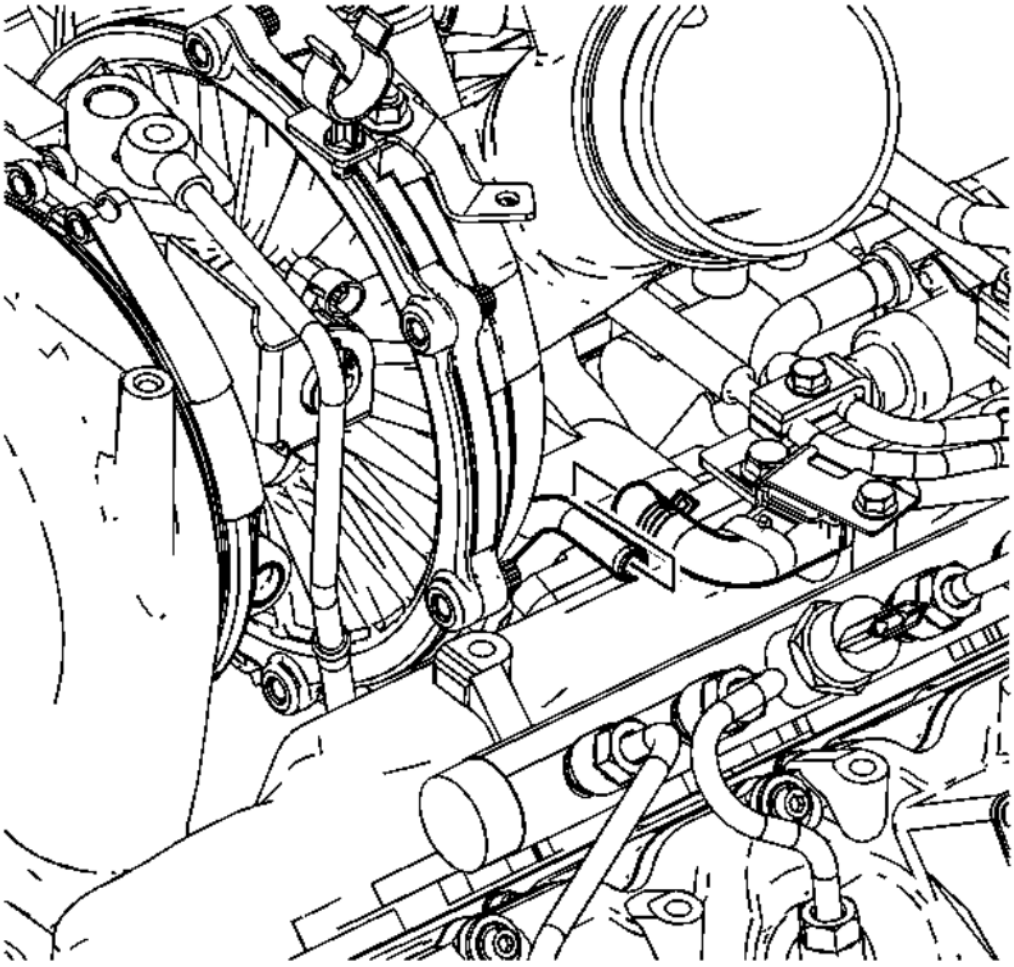


Fig. 111: View Of Turbocharger Outlet Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

5. Install the turbocharger coolant outlet hose to the pipe on the turbocharger.
6. Position the turbocharger coolant outlet hose clamp.

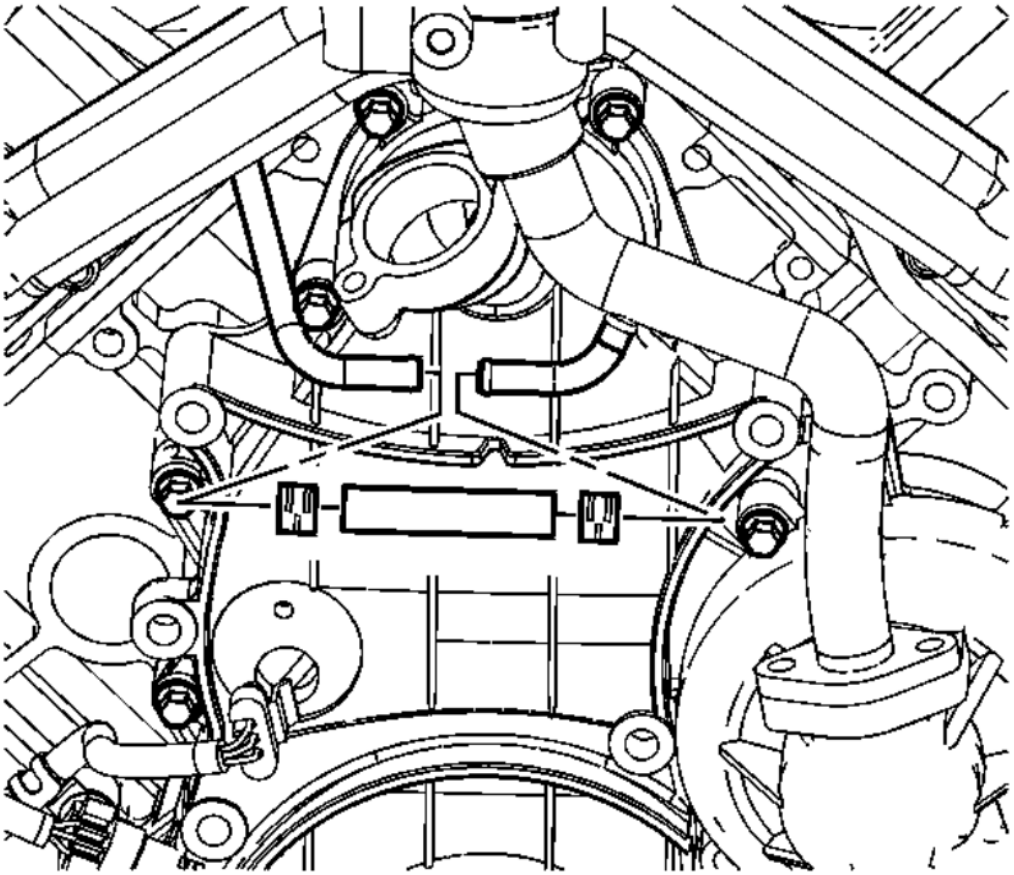


Fig. 112: View Of Turbocharger Coolant Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

7. Install the turbocharger coolant outlet hose to the bypass pipe.
8. Position the hose clamp at the bypass pipe.
9. Install the cooling fan clutch. Refer to **Fan Clutch Replacement (Diesel)**.
10. Install the EGR cooler assembly. Refer to **Exhaust Gas Recirculation Valve Cooler Replacement** .
11. Install the generator mounting bracket. Refer to **Generator Bracket Replacement (4.3L)** or **Generator Bracket Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Generator Bracket Replacement (6.6L)** .
12. Install the turbocharger coolant inlet pipe. Refer to **Turbocharger Coolant Hoses/Pipes**

Replacement (LMM - Inlet Pipe) or **Turbocharger Coolant Hoses/Pipes Replacement (LMM - Outlet Pipe)**.

EXHAUST GAS RECIRCULATION COOLING PIPE REPLACEMENT - LOWER (LMM)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

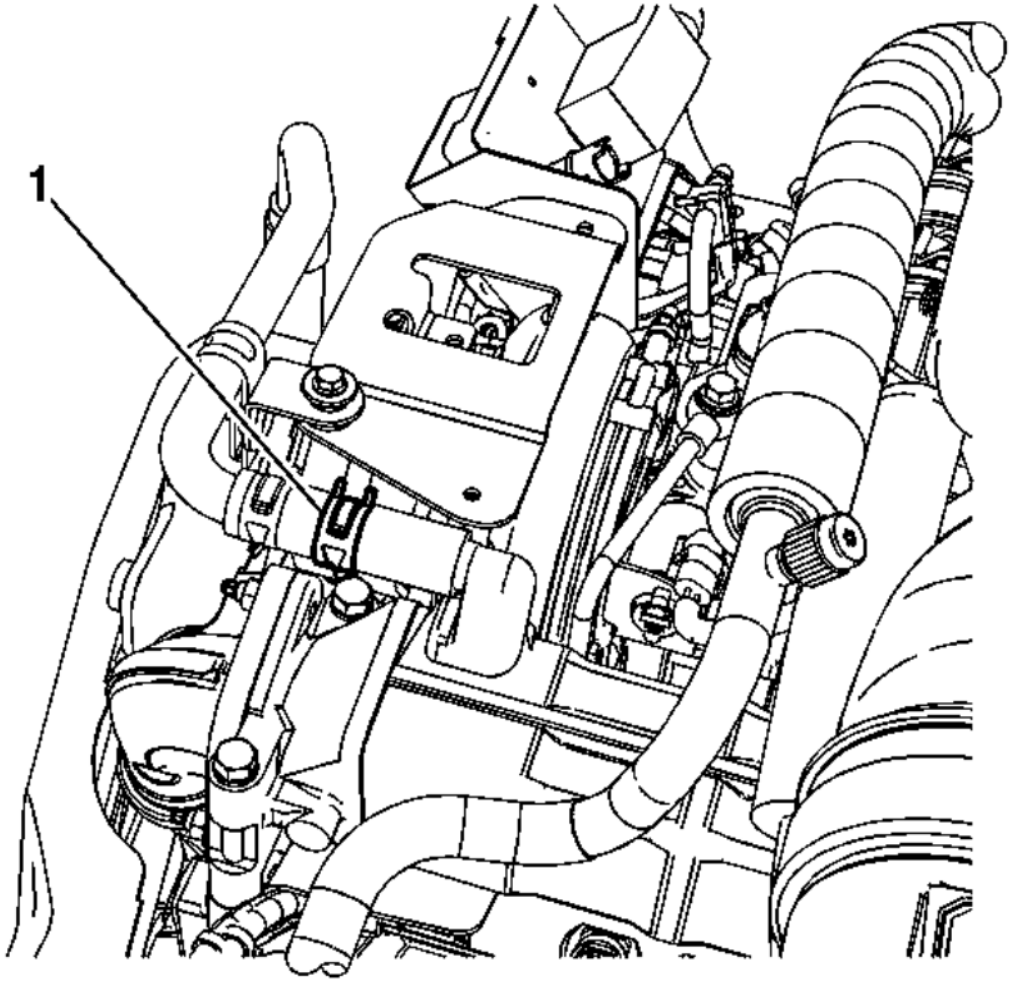


Fig. 113: View Of EGR Cooler Pipe Clamp

Courtesy of GENERAL MOTORS CORP.

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

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Reposition the EGR cooler pipe clamp (1) and remove the EGR cooler pipe hose from the EGR cooler tube.

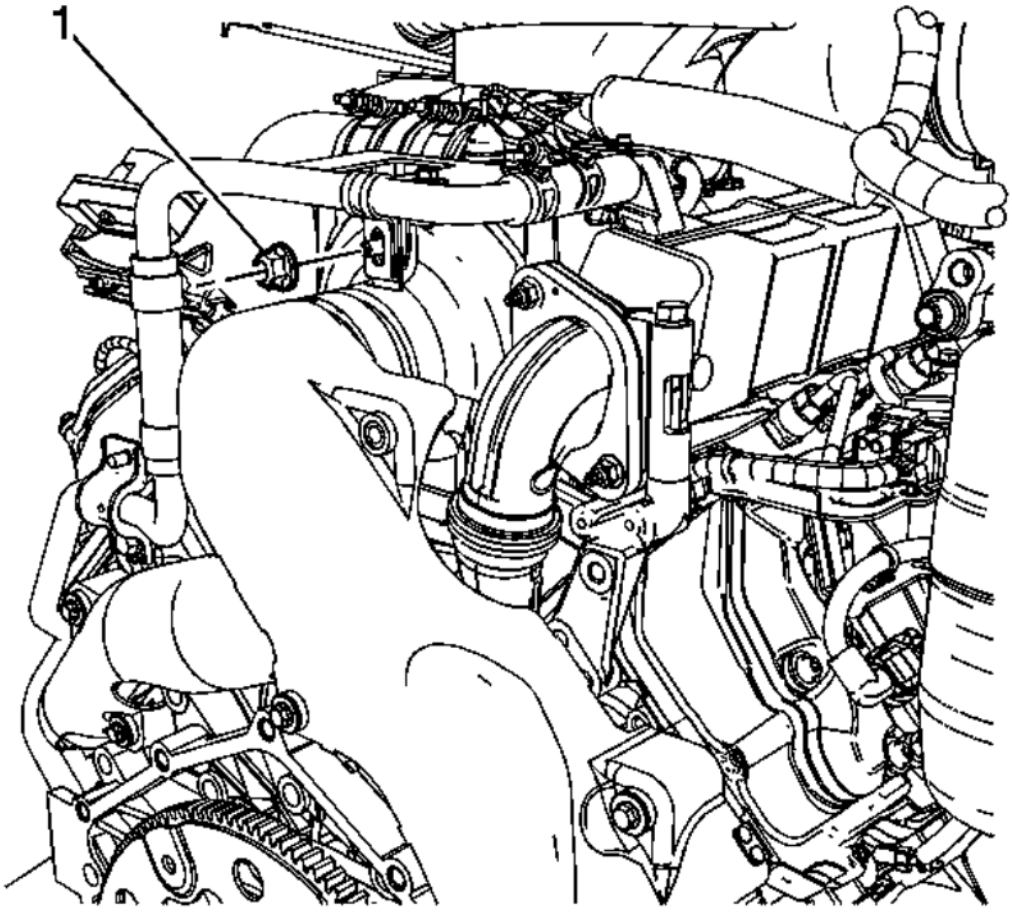


Fig. 114: View Of EGR Cooler Pipe Nut
Courtesy of GENERAL MOTORS CORP.

3. Remove the upper EGR cooler pipe nut (1).

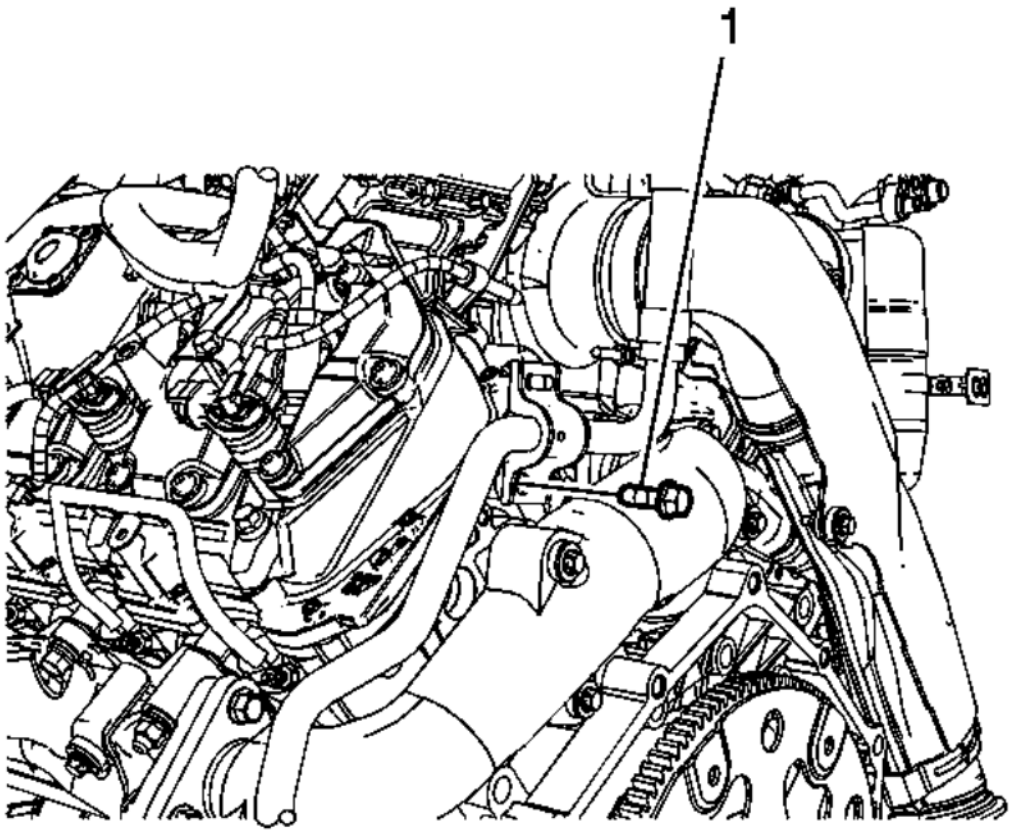


Fig. 115: View Of Lower EGR Cooler Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower EGR cooler pipe bolt (1).
5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

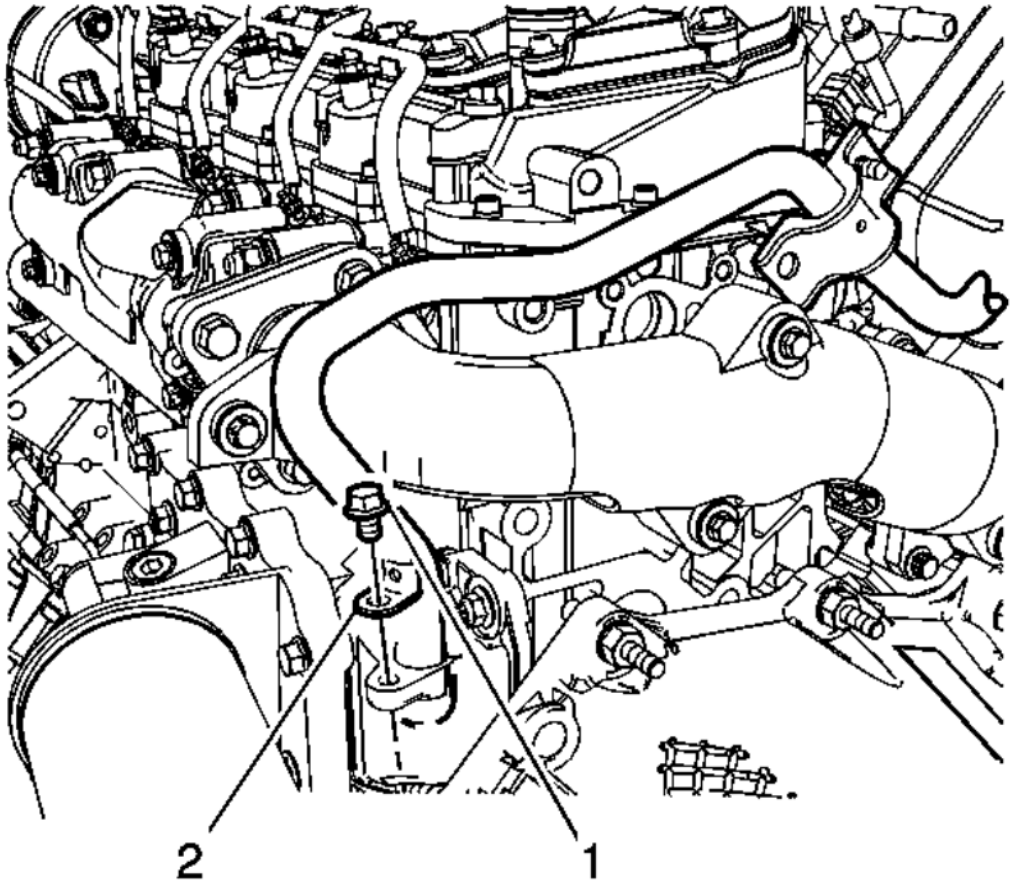


Fig. 116: Identifying EGR Cooler Pipe Bolt & Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the EGR cooler pipe bolt (1) and bracket (2).
7. Remove the EGR cooler pipe from the engine.

Installation Procedure

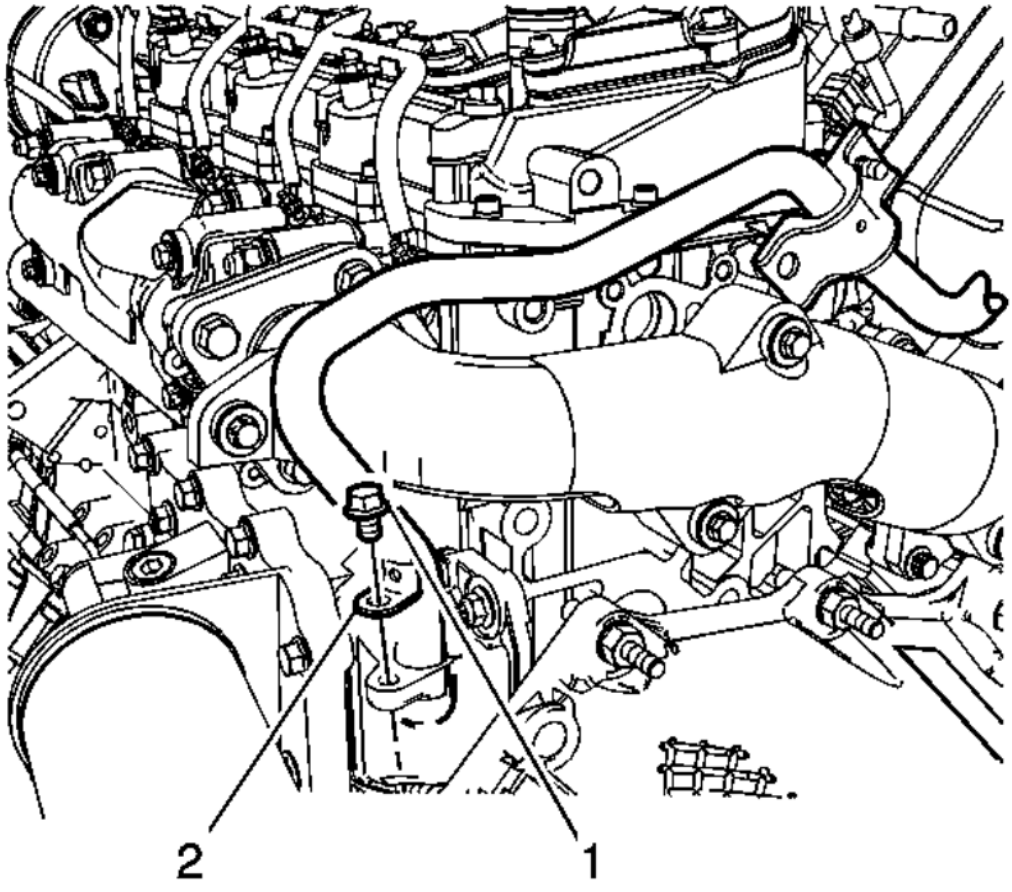


Fig. 117: Identifying EGR Cooler Pipe Bolt & Bracket
Courtesy of GENERAL MOTORS CORP.

1. Position the EGR cooler pipe to the engine.

NOTE: Refer to Fastener Notice .

2. Install the EGR cooler pipe bracket (2) and bolt (1).

Tighten: Tighten the bolt to 9 N.m (80 lb in).

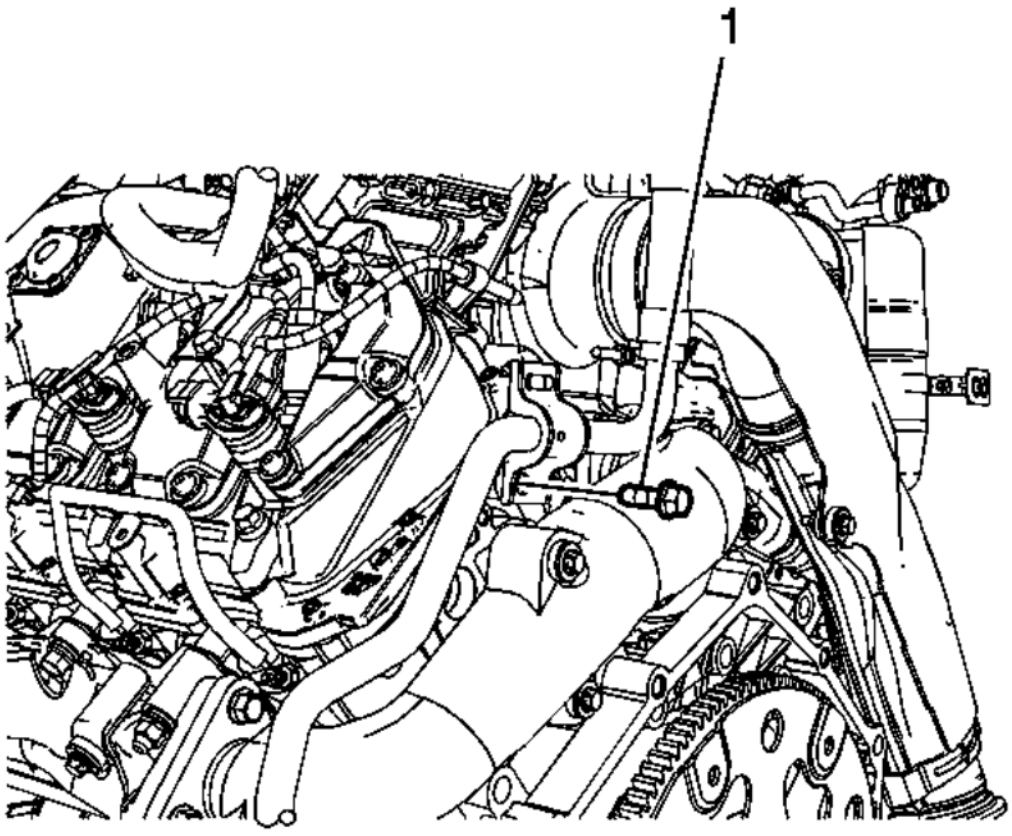


Fig. 118: View Of Lower EGR Cooler Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

3. Lower the vehicle.
4. Install the lower EGR cooler pipe bolt (1).

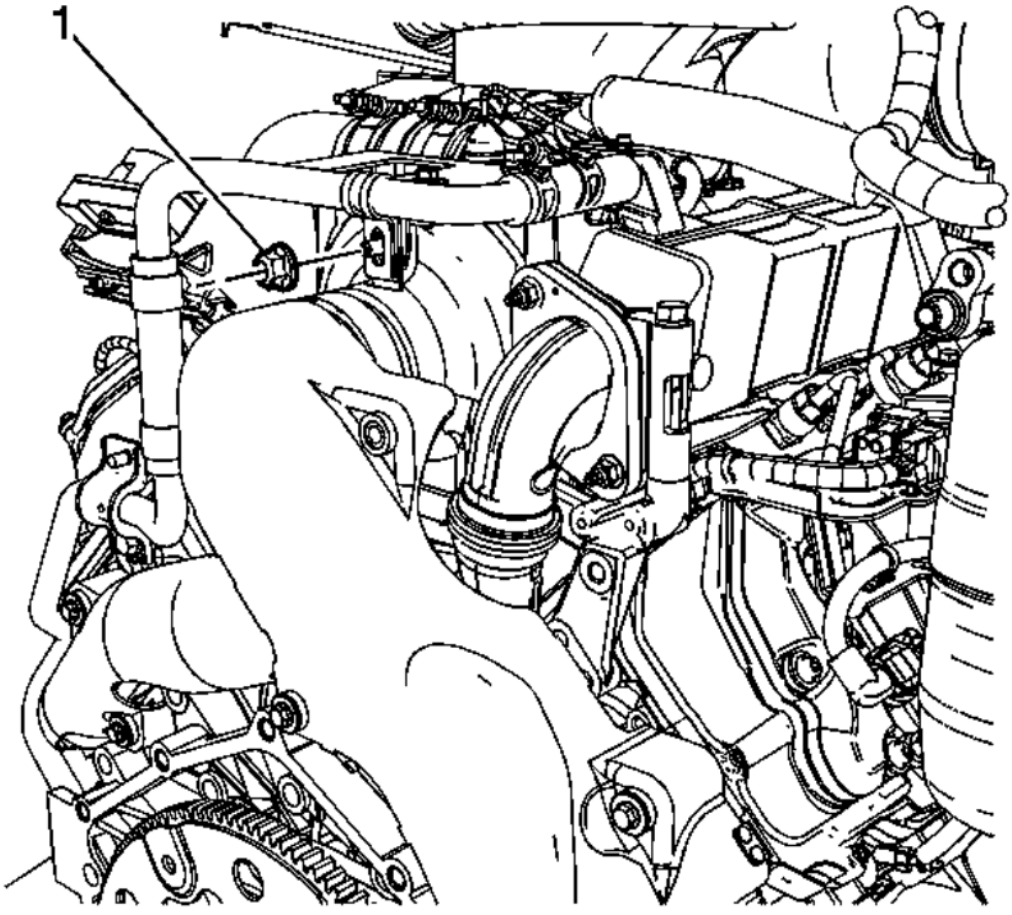


Fig. 119: View Of EGR Cooler Pipe Nut
Courtesy of GENERAL MOTORS CORP.

5. Install the upper EGR cooler pipe nut (1).

   Tighten: Tighten the bolt to 9 N.m (80 lb in).

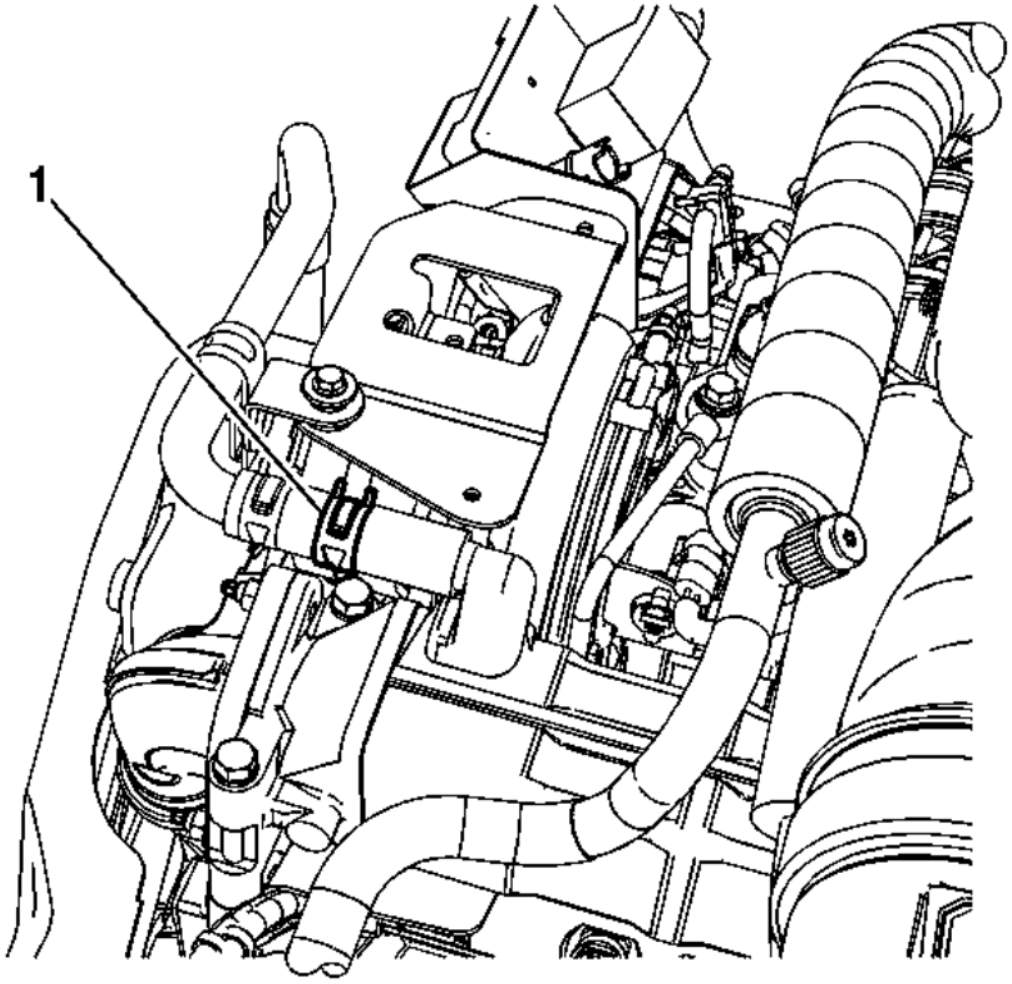


Fig. 120: View Of EGR Cooler Pipe Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the EGR cooler pipe hose to the EGR cooler tube and reposition the EGR cooler pipe clamp (1).
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

EXHAUST GAS RECIRCULATION COOLING PIPE REPLACEMENT - UPPER (LMM)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

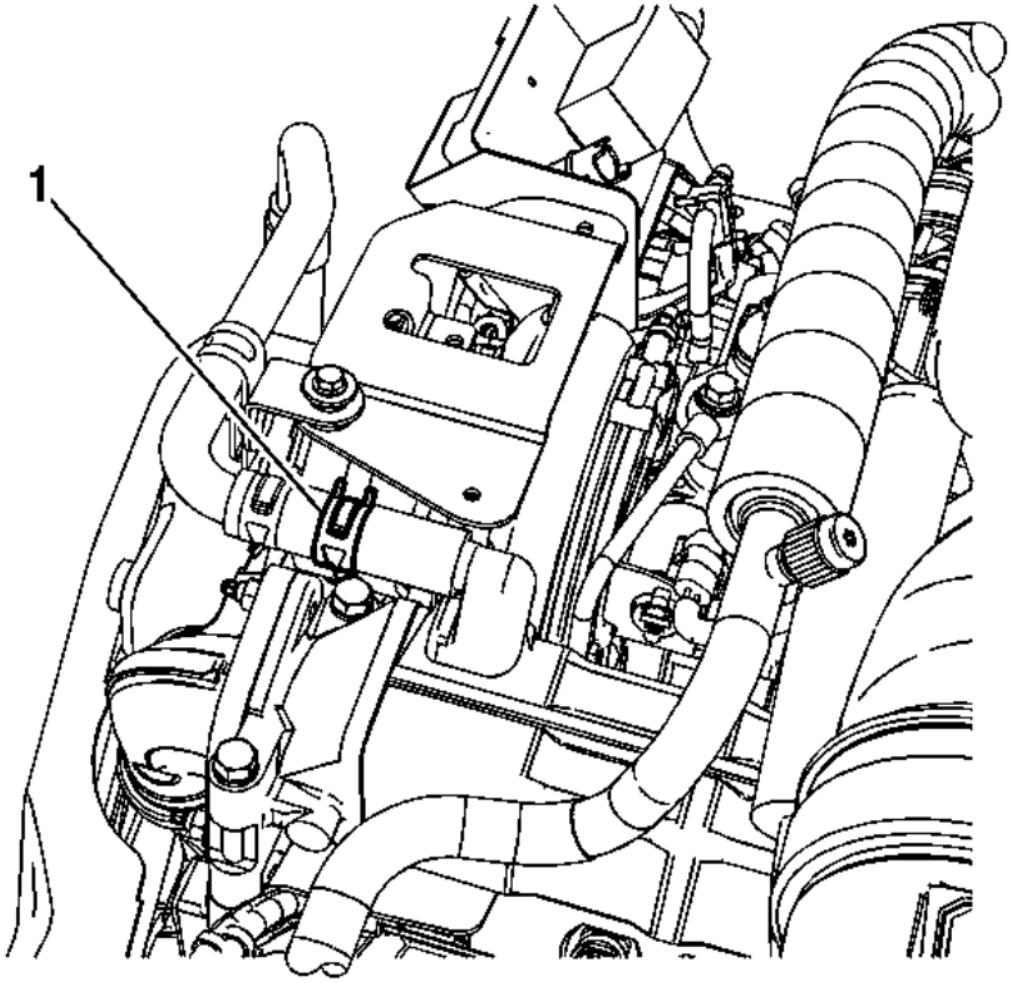


Fig. 121: View Of EGR Cooler Pipe Clamp
Courtesy of GENERAL MOTORS CORP.

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

while the engine and radiator are still hot.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Reposition the EGR cooler pipe clamp (1) and remove the EGR cooler pipe hose from the EGR cooler tube.

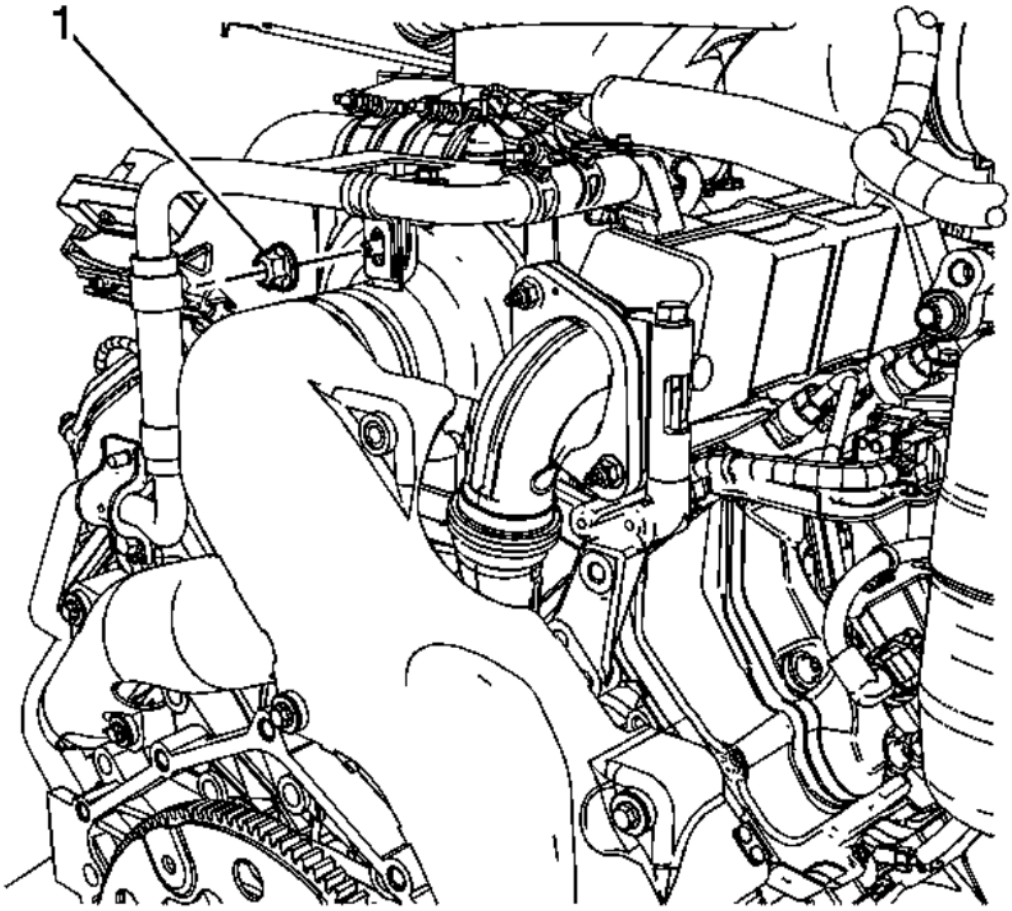


Fig. 122: View Of EGR Cooler Pipe Nut
Courtesy of GENERAL MOTORS CORP.

3. Remove the upper EGR cooler pipe nut (1).

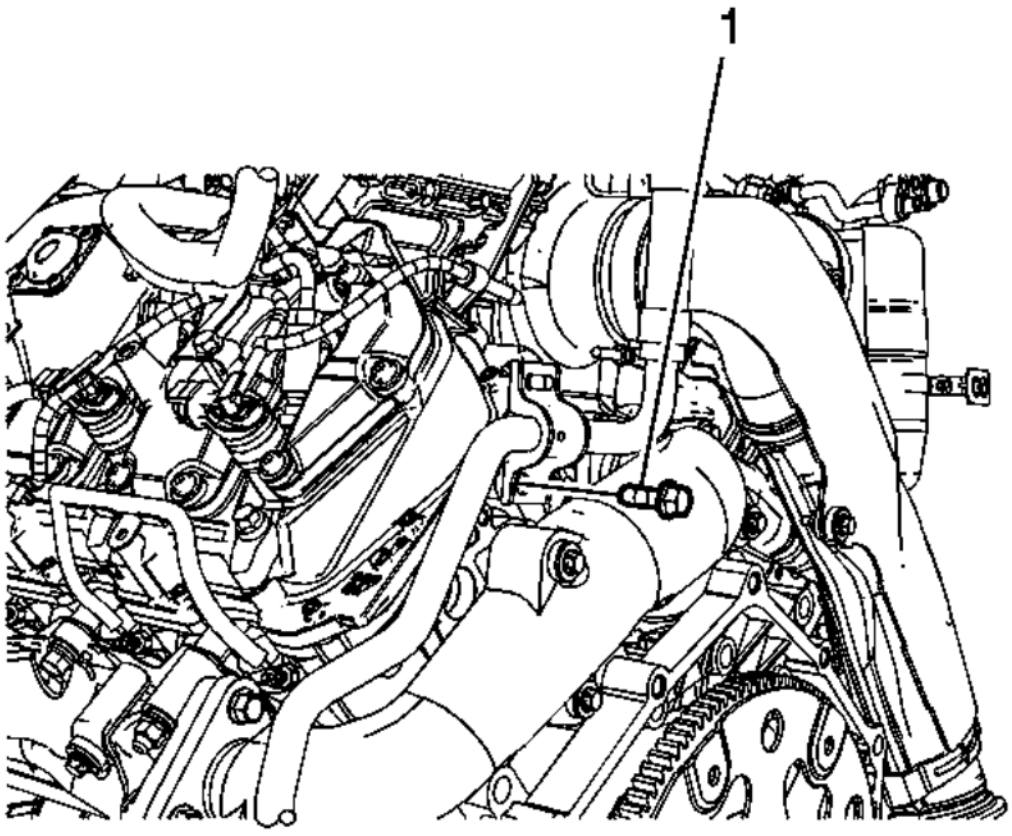


Fig. 123: View Of Lower EGR Cooler Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower EGR cooler pipe bolt (1).
5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .

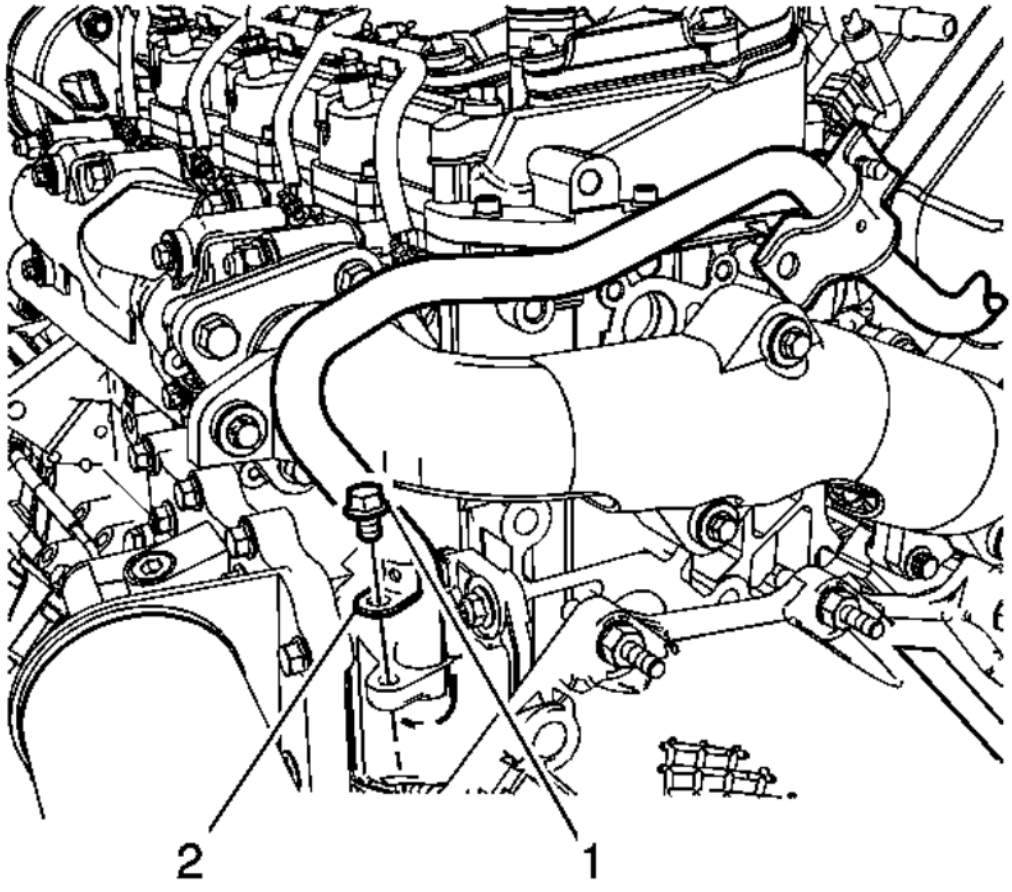


Fig. 124: Identifying EGR Cooler Pipe Bolt & Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the EGR cooler pipe bolt (1) and bracket (2).
7. Remove the EGR cooler pipe from the engine.

Installation Procedure

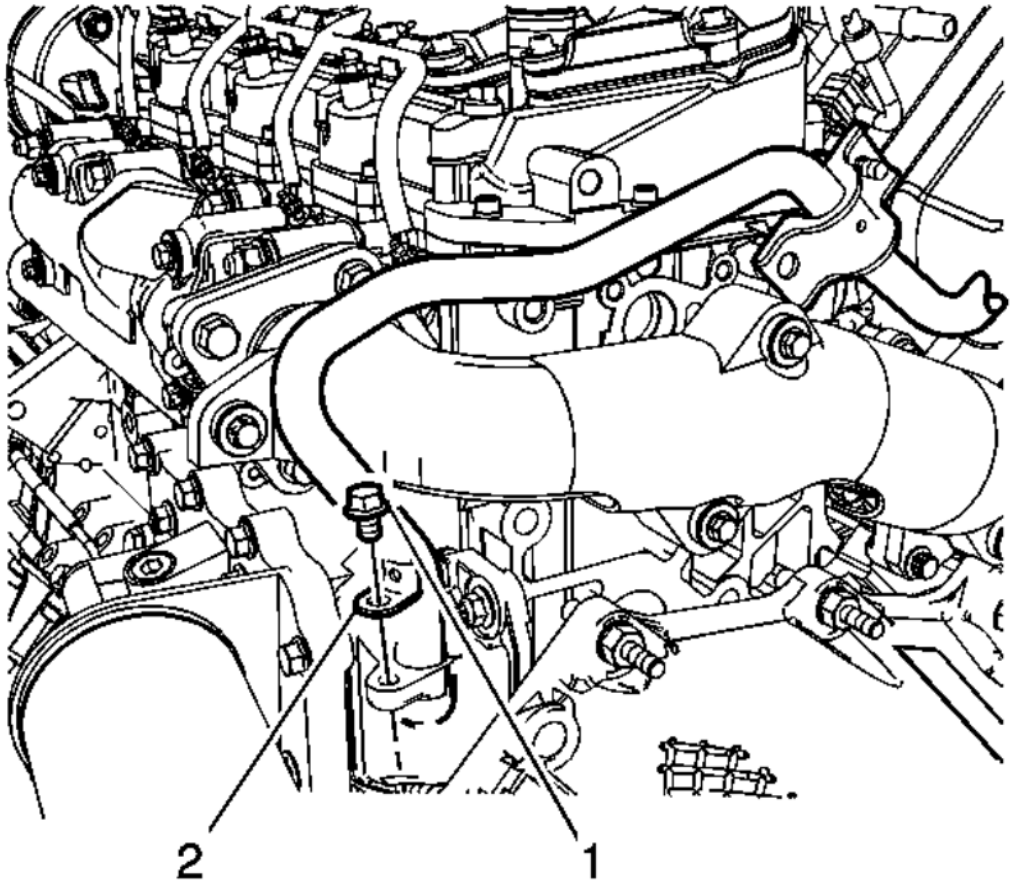


Fig. 125: Identifying EGR Cooler Pipe Bolt & Bracket
Courtesy of GENERAL MOTORS CORP.

1. Position the EGR cooler pipe to the engine.

NOTE: Refer to Fastener Notice .

2. Install the EGR cooler pipe bracket (2) and bolt (1).

Tighten: Tighten the bolt to 9 N.m (80 lb in).

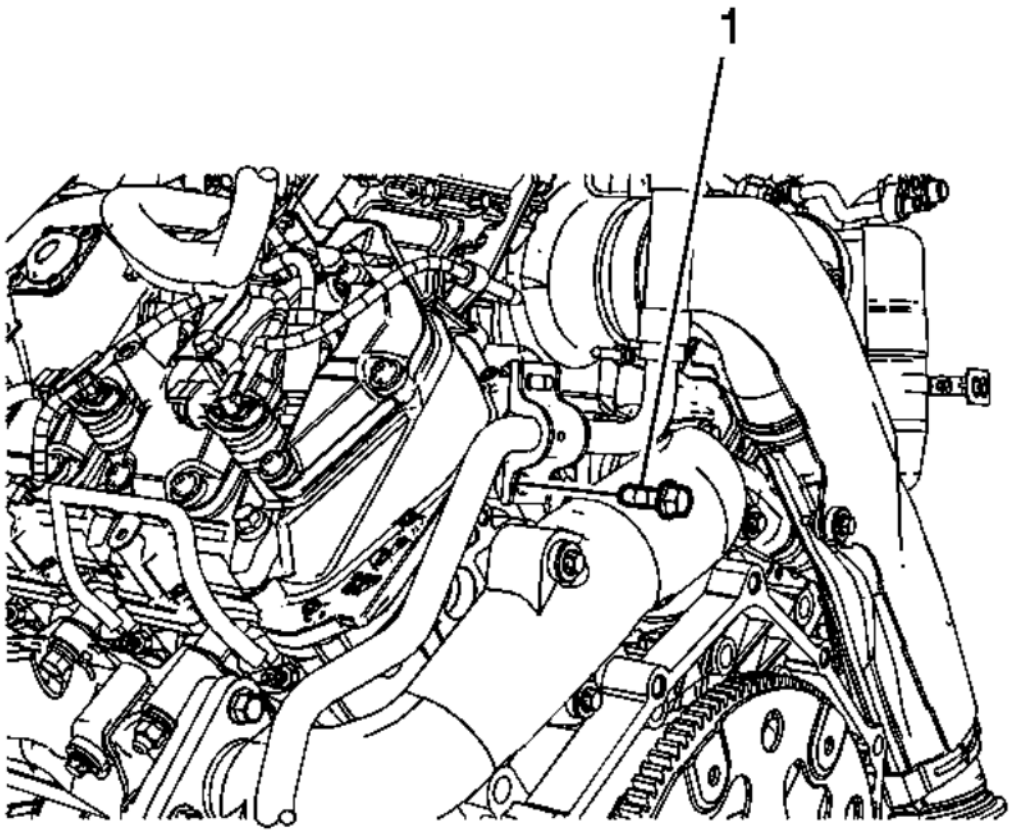


Fig. 126: View Of Lower EGR Cooler Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

3. Lower the vehicle.
4. Install the lower EGR cooler pipe bolt (1).

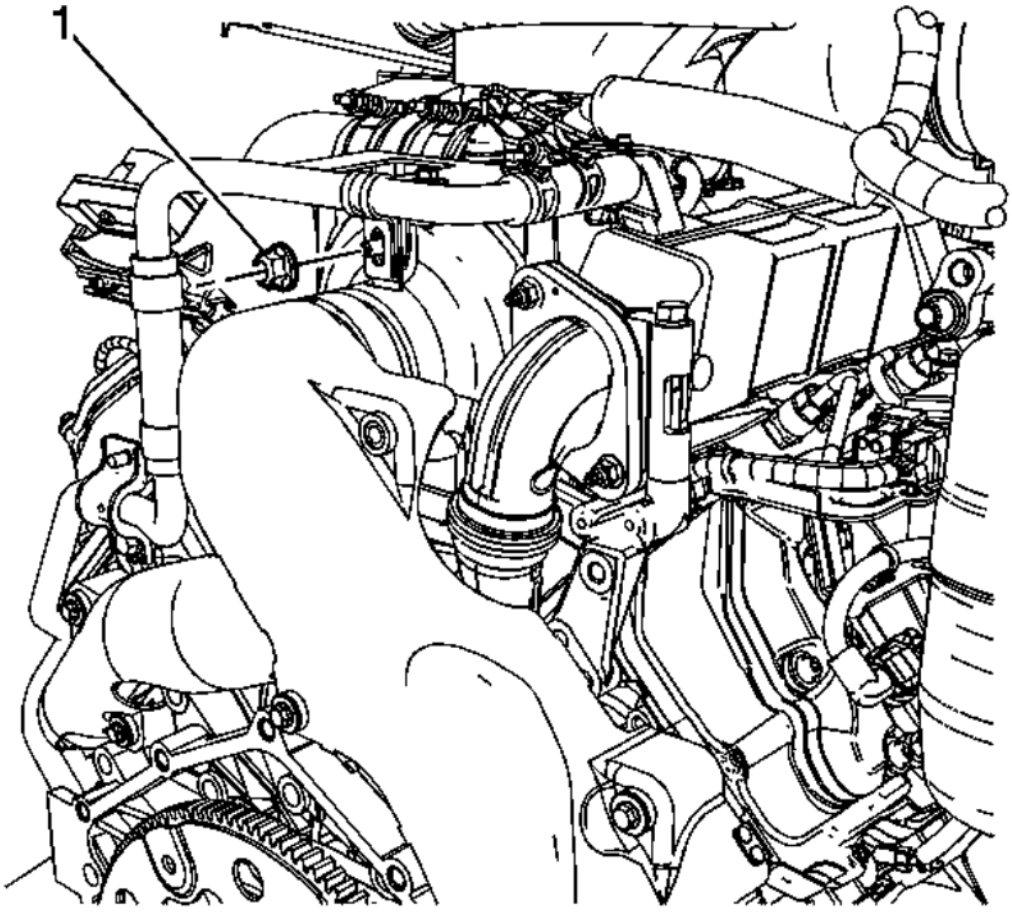


Fig. 127: View Of EGR Cooler Pipe Nut
Courtesy of GENERAL MOTORS CORP.

5. Install the upper EGR cooler pipe nut (1).

   Tighten: Tighten the bolt to 9 N.m (80 lb in).

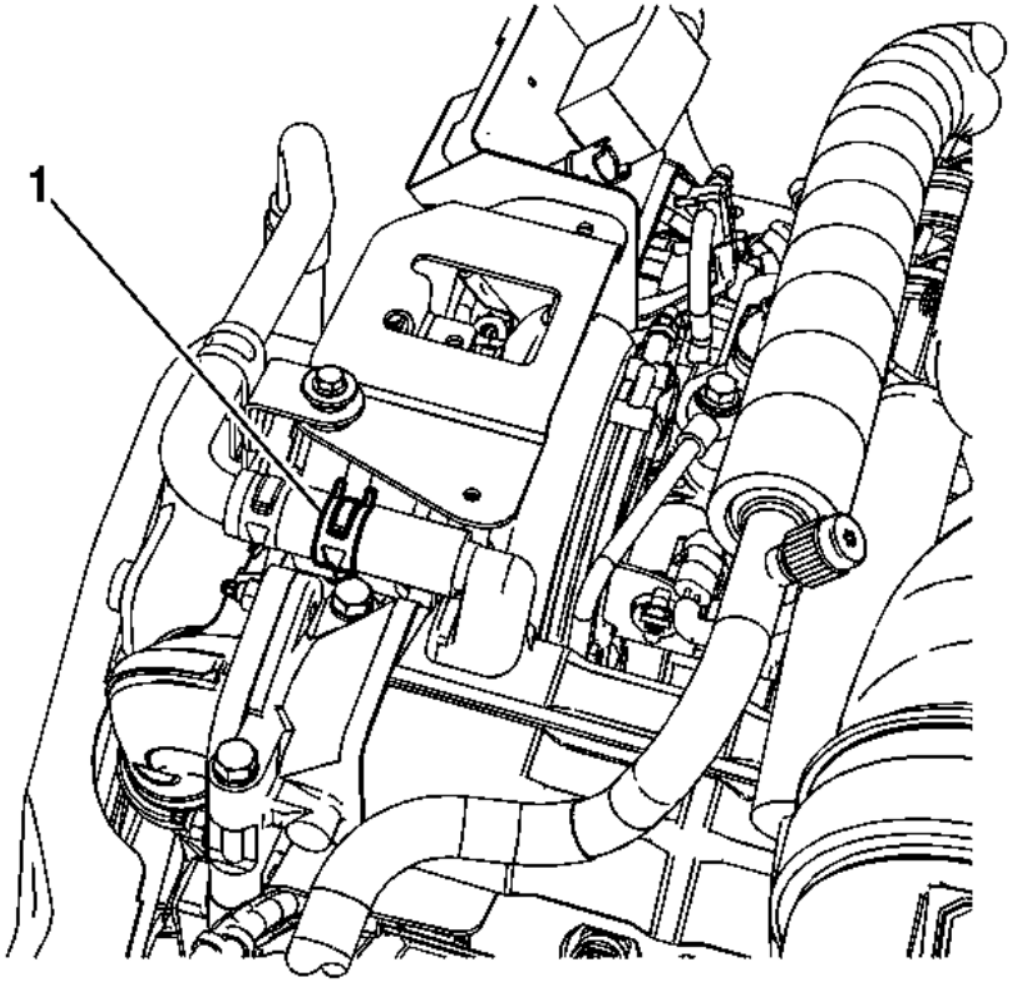


Fig. 128: View Of EGR Cooler Pipe Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the EGR cooler pipe hose to the EGR cooler tube and reposition the EGR cooler pipe clamp (1).
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

WATER OUTLET TUBE REPLACEMENT (LMM)

Removal Procedure

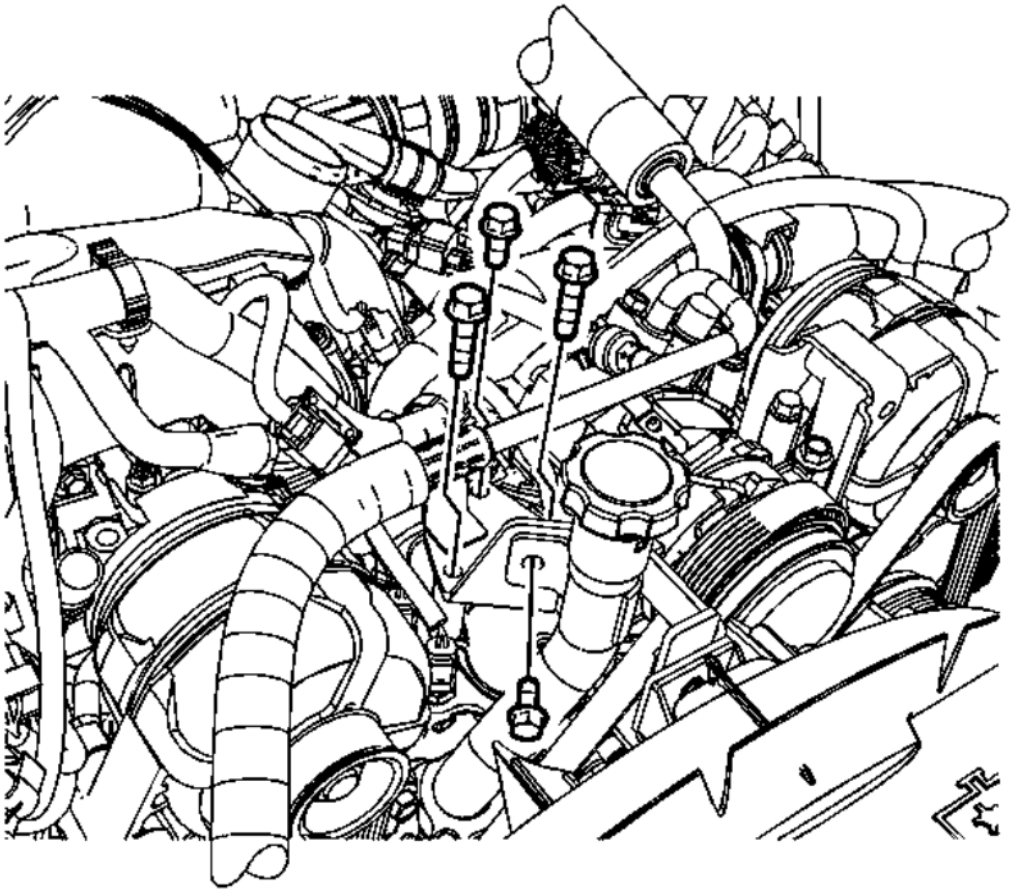


Fig. 129: View Of Wiring Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement (Non-HP2)**.
2. Remove the turbocharger coolant bypass valve. Refer to **Turbocharger Coolant Bypass Valve Replacement**.
3. Remove the bolts and wiring harness bracket at the thermostat housing.
4. Position the bracket and wiring harness aside.

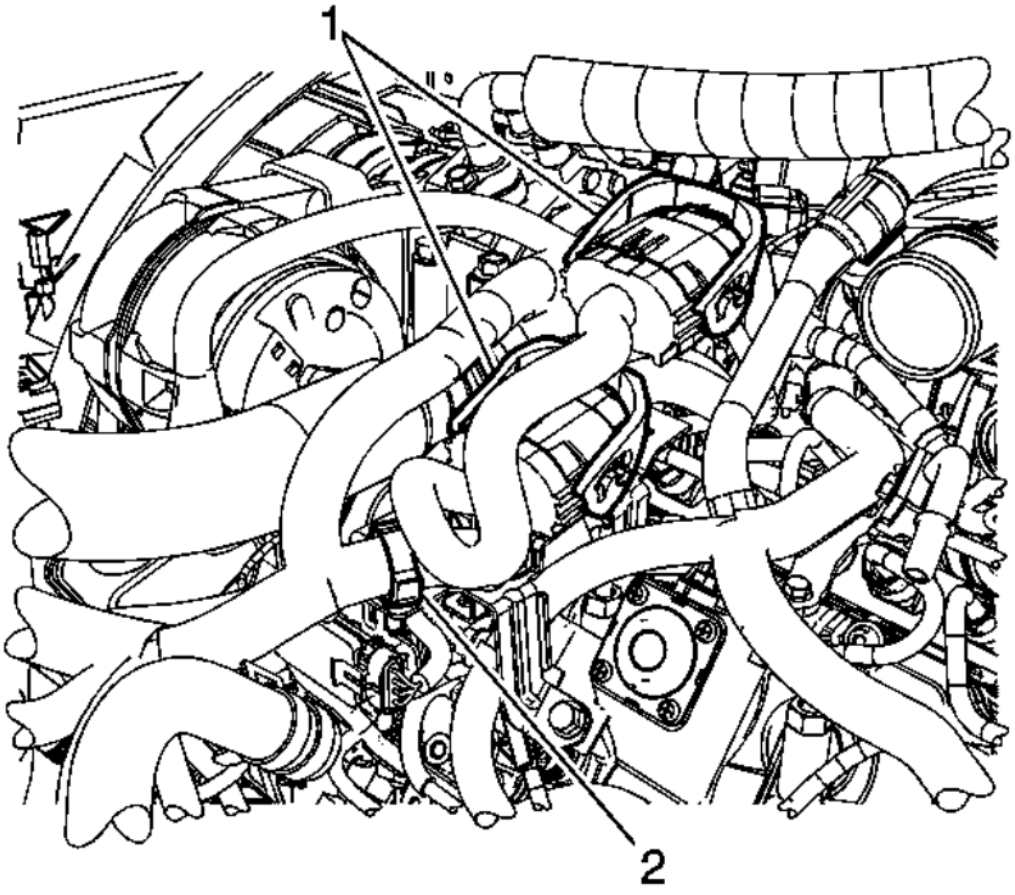


Fig. 130: View Of Main Engine Electrical Harness Connector Latches & Clips
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the main engine electrical harness connectors. Lift up on the latches (1) in order to disconnect the connectors.
6. Open the harness clip (2).
7. Remove the main engine electrical harness connectors.

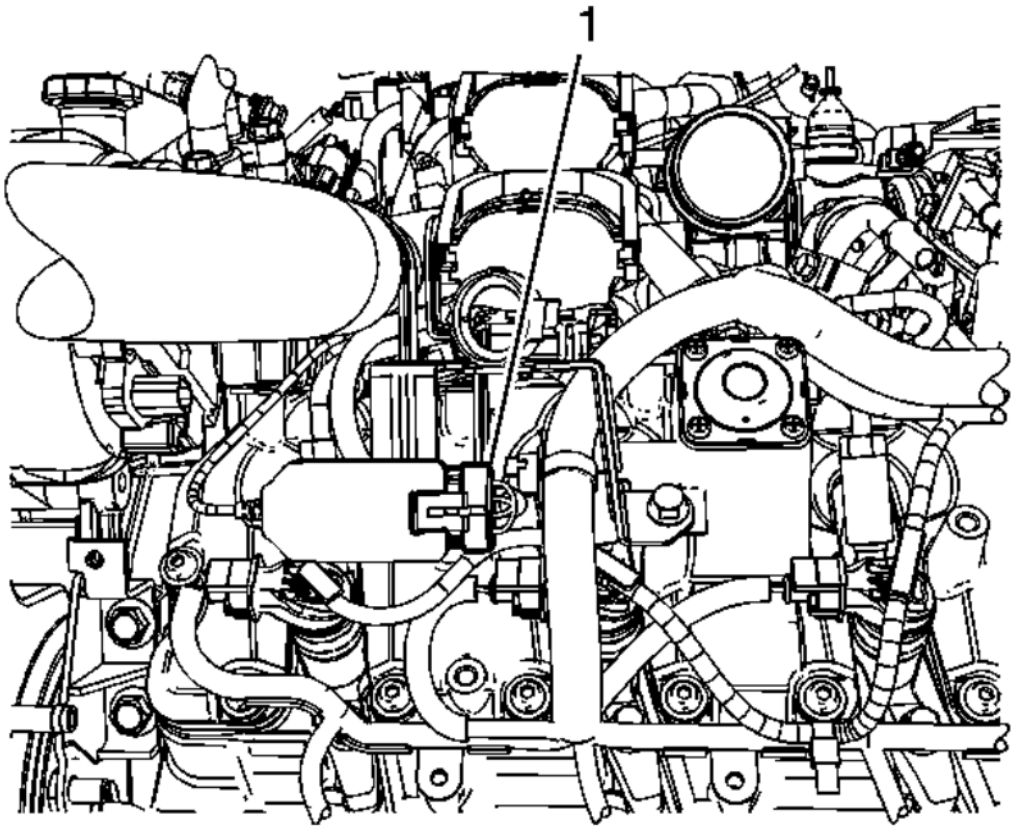


Fig. 131: View Of Turbocharger Vane Position Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the turbocharger vane position sensor electrical connector (1).

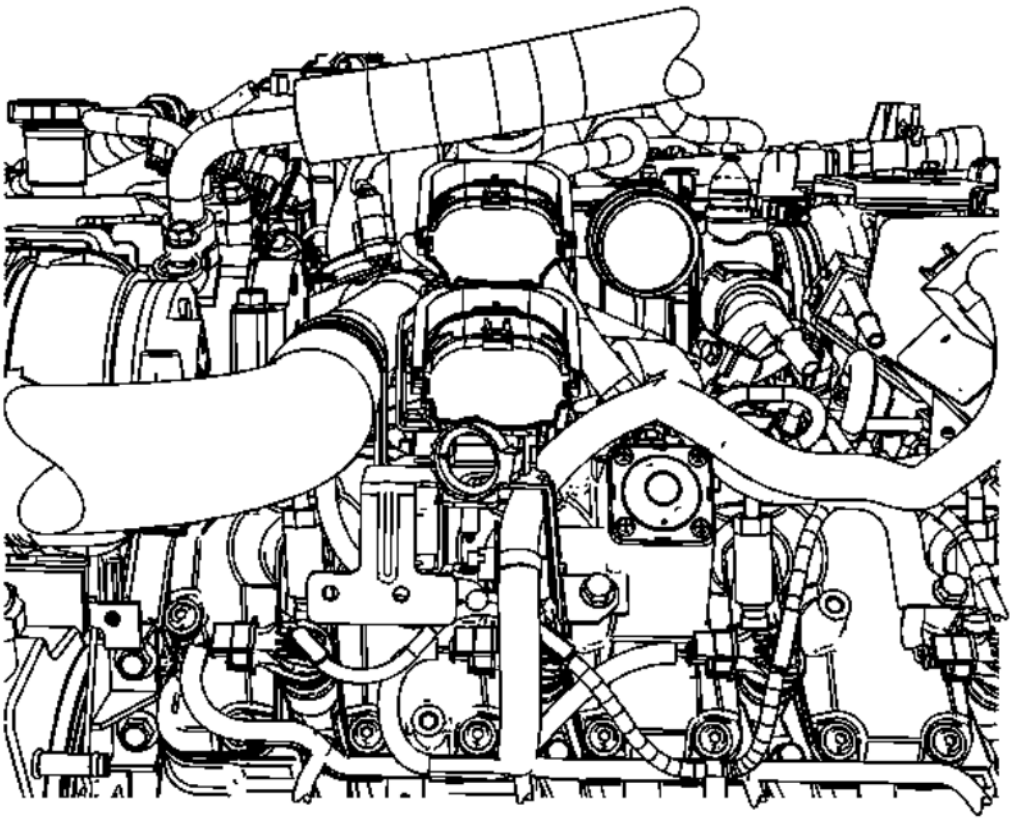


Fig. 132: View Of Main Engine Electrical Harness Connectors & Latches
Courtesy of GENERAL MOTORS CORP.

9. Unclip the main engine electrical harness connectors from the main electrical connector harness bracket.

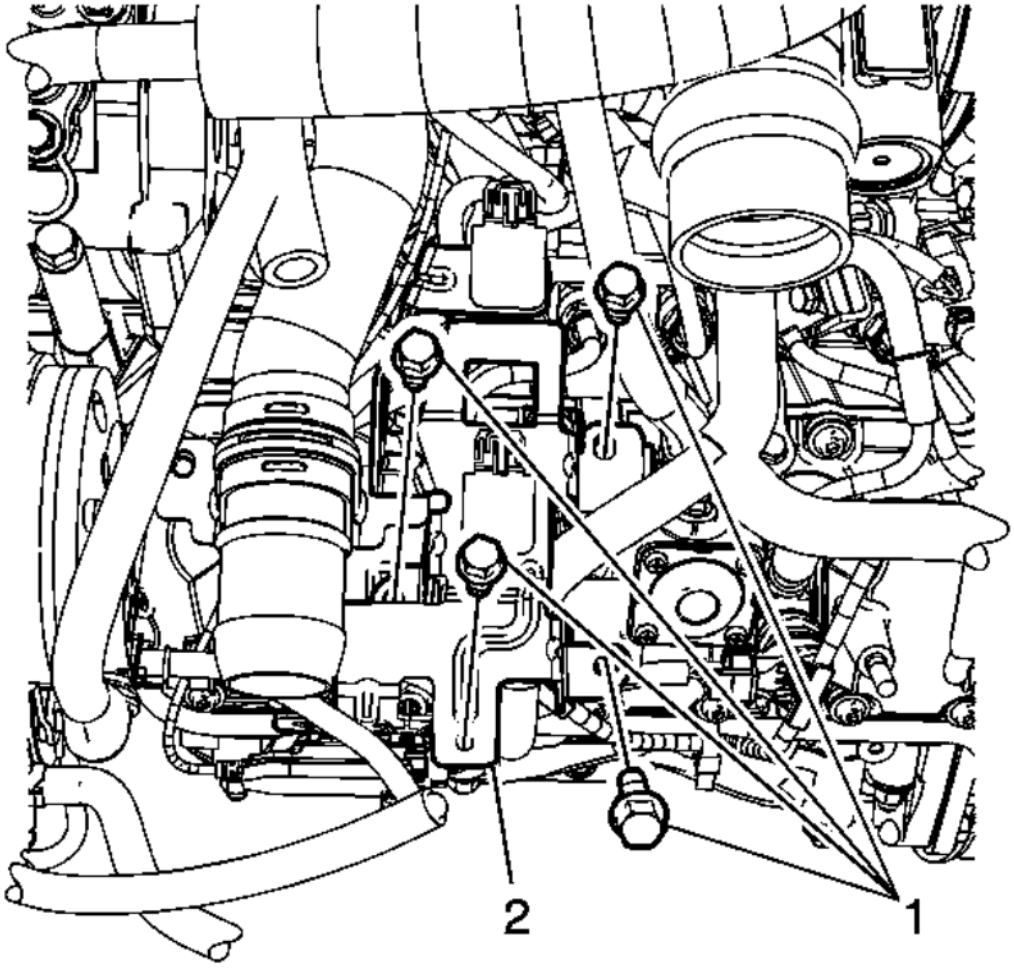


Fig. 133: View Of Main Electrical Connector Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the main electrical connector harness bracket bolts (1).
11. Remove the main electrical connector harness bracket (2) and position aside.

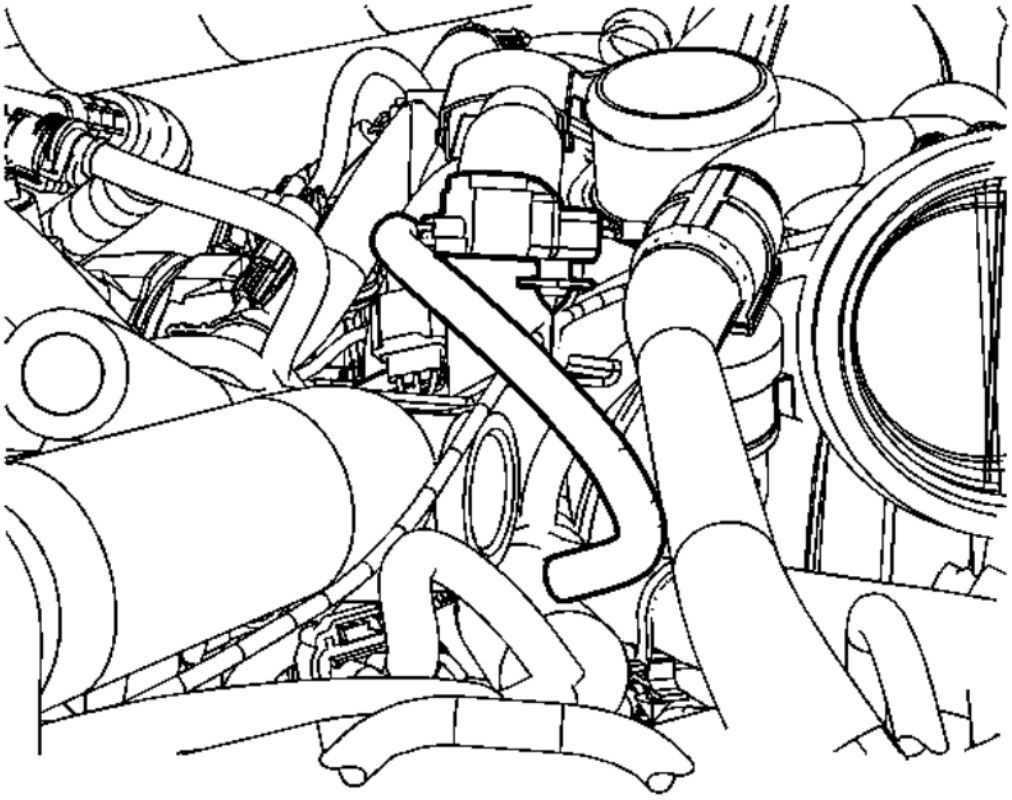


Fig. 134: View Of Manifold Intake Temperature Sensor Electrical Connector & Water Tube
Courtesy of GENERAL MOTORS CORP.

12. Remove the manifold intake temperature sensor electrical connector from the water tube bracket.

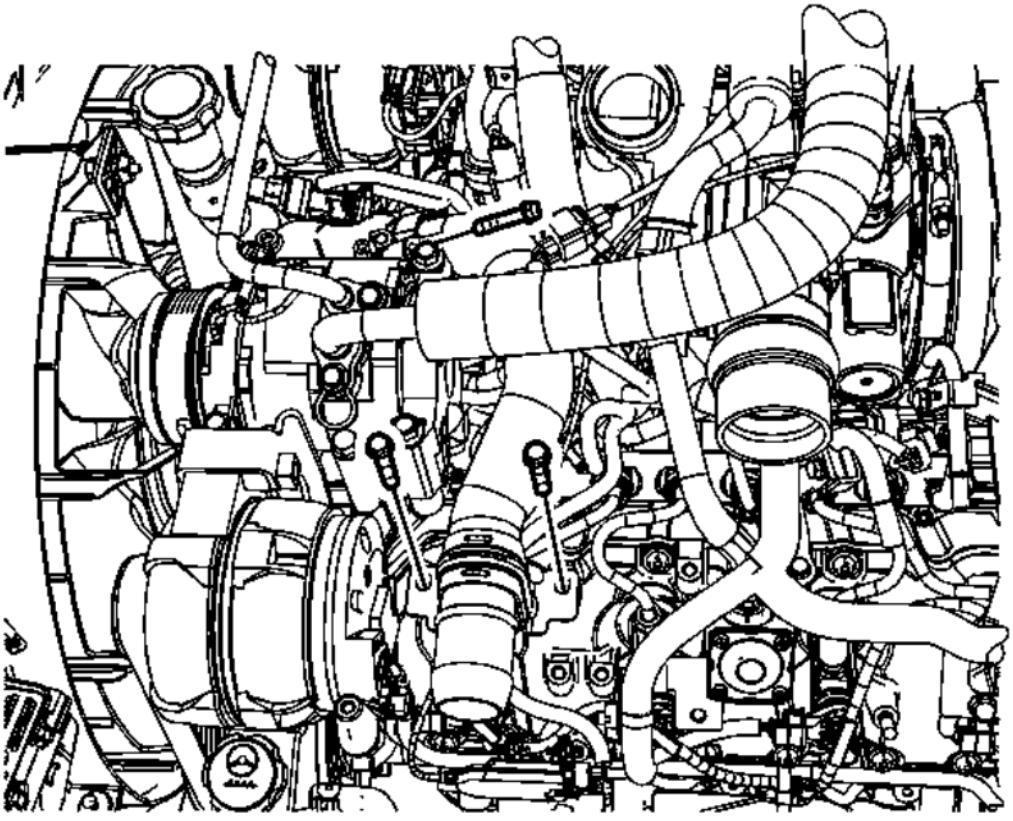


Fig. 135: Locating Water Outlet Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the water outlet bolts.

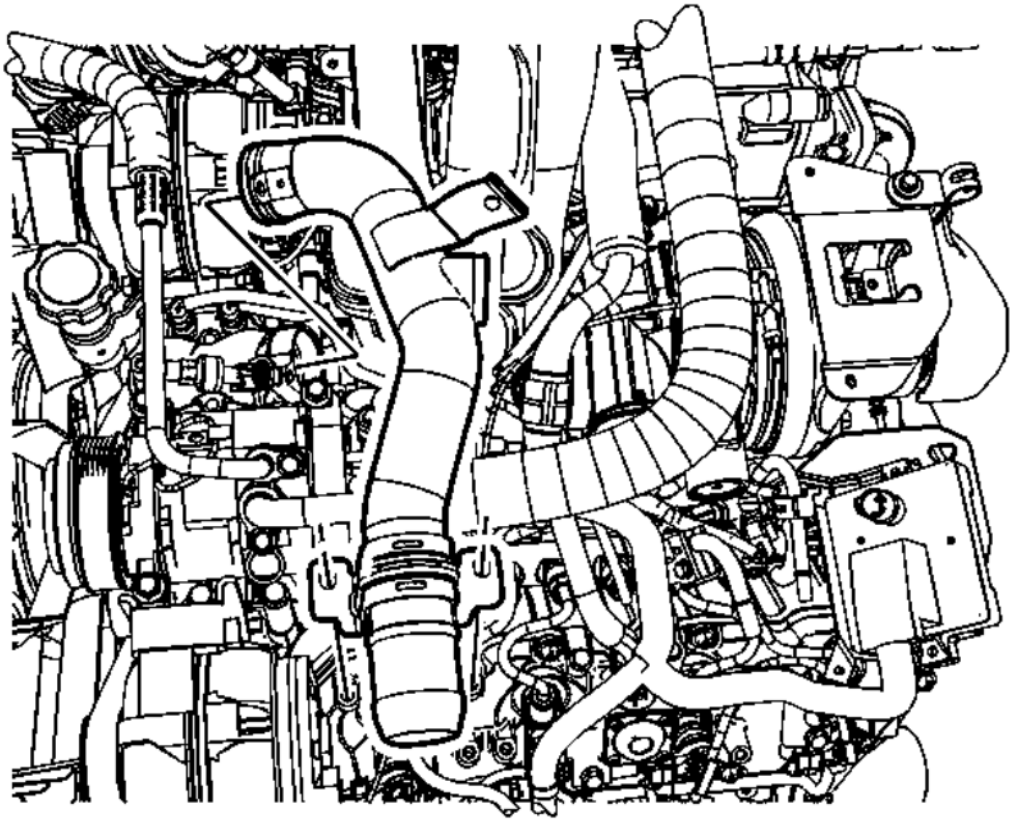


Fig. 136: View Of Water Outlet
Courtesy of GENERAL MOTORS CORP.

14. Remove the water outlet.
15. Remove and discard the O-ring seal.

Installation Procedure

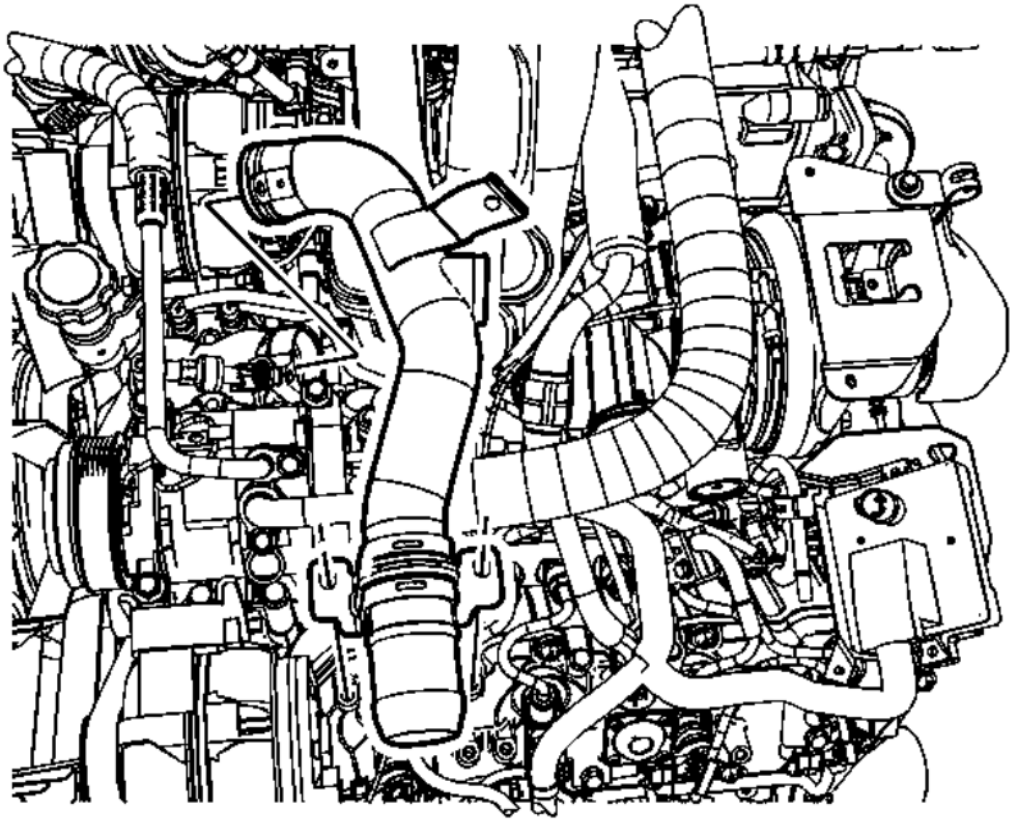


Fig. 137: View Of Water Outlet
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW O-ring seal to the water outlet.
2. Lubricate the O-ring seal with clean engine coolant.
3. Install the water outlet.

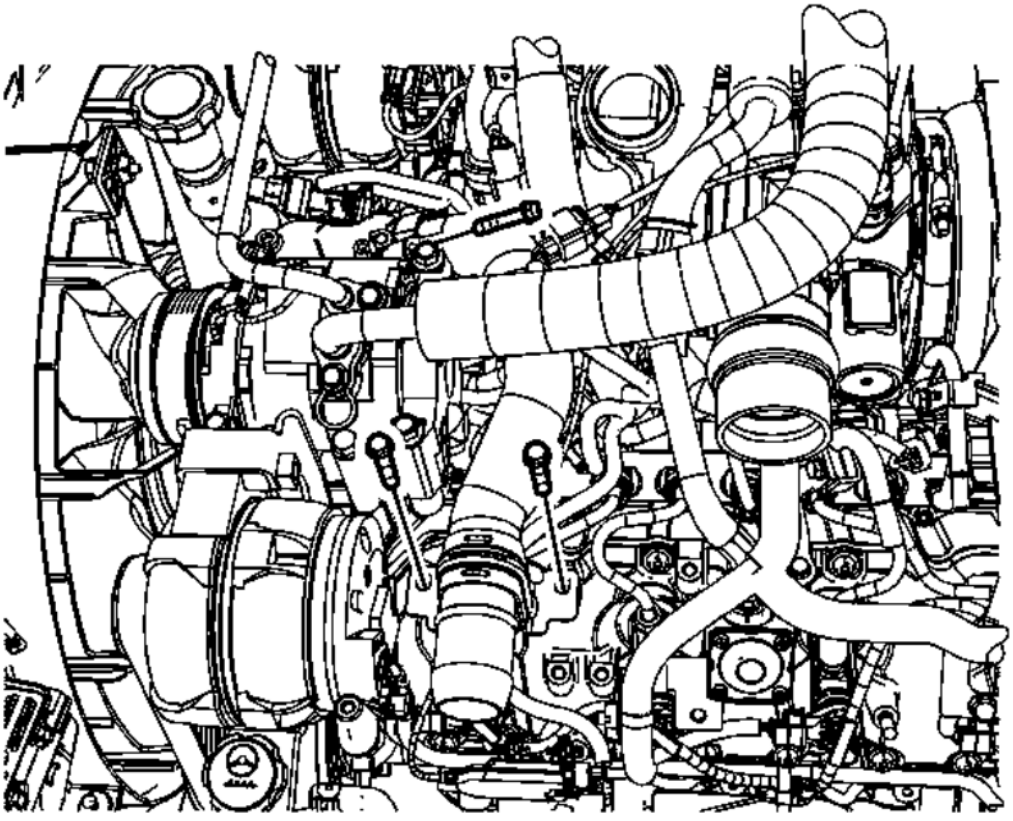


Fig. 138: Locating Water Outlet Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Install the water outlet bolts.

   Tighten: Tighten the bolts to 21 N.m (15 lb ft).

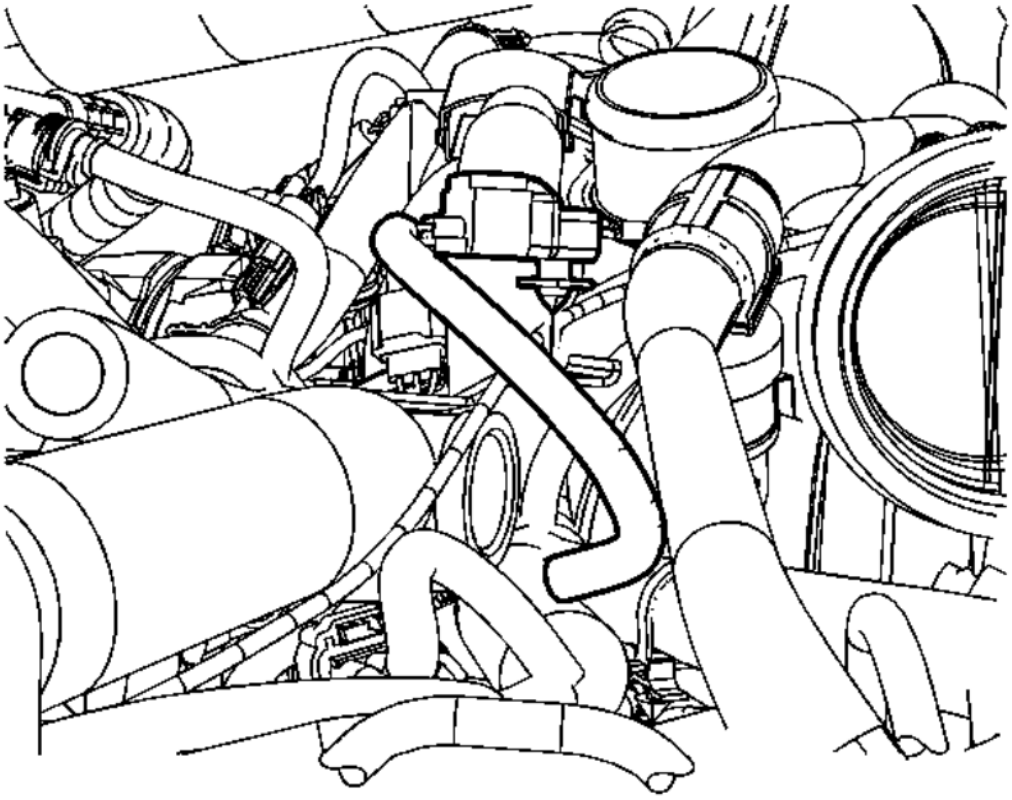


Fig. 139: View Of Manifold Intake Temperature Sensor Electrical Connector & Water Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the manifold intake temperature sensor electrical connector to the water tube bracket.

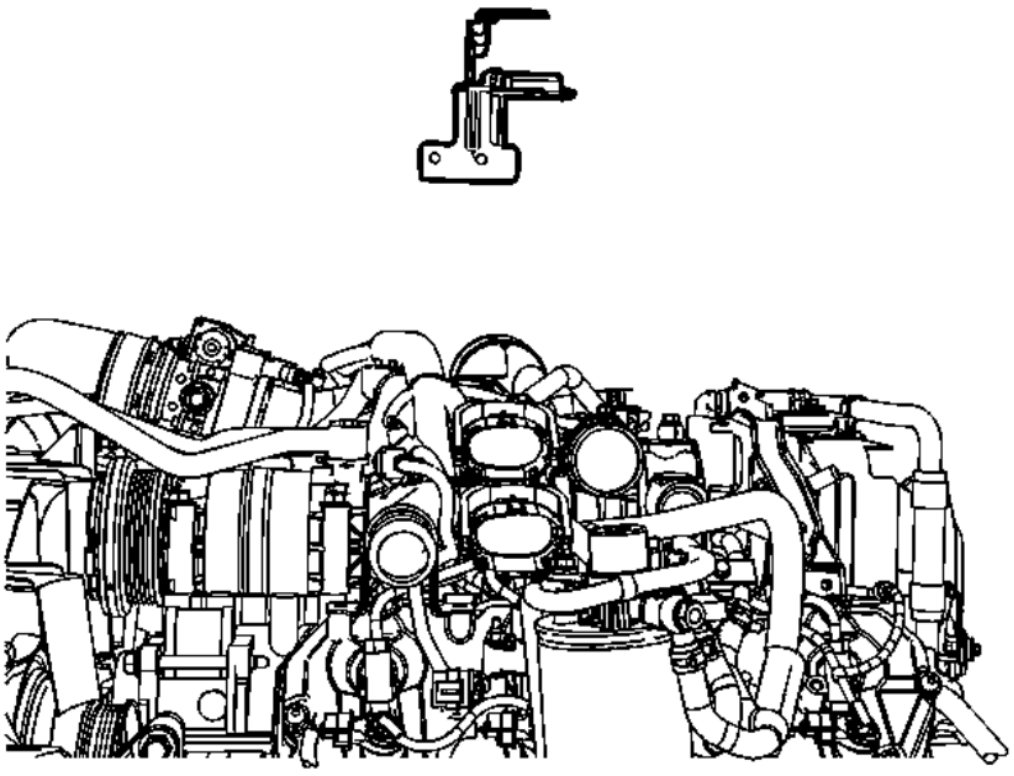


Fig. 140: View Of Main Electrical Connector Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the main electrical harness bracket.
7. Install the main electrical harness bracket bolts.

Tighten: Tighten the bolts to 21 N.m (15 lb ft).

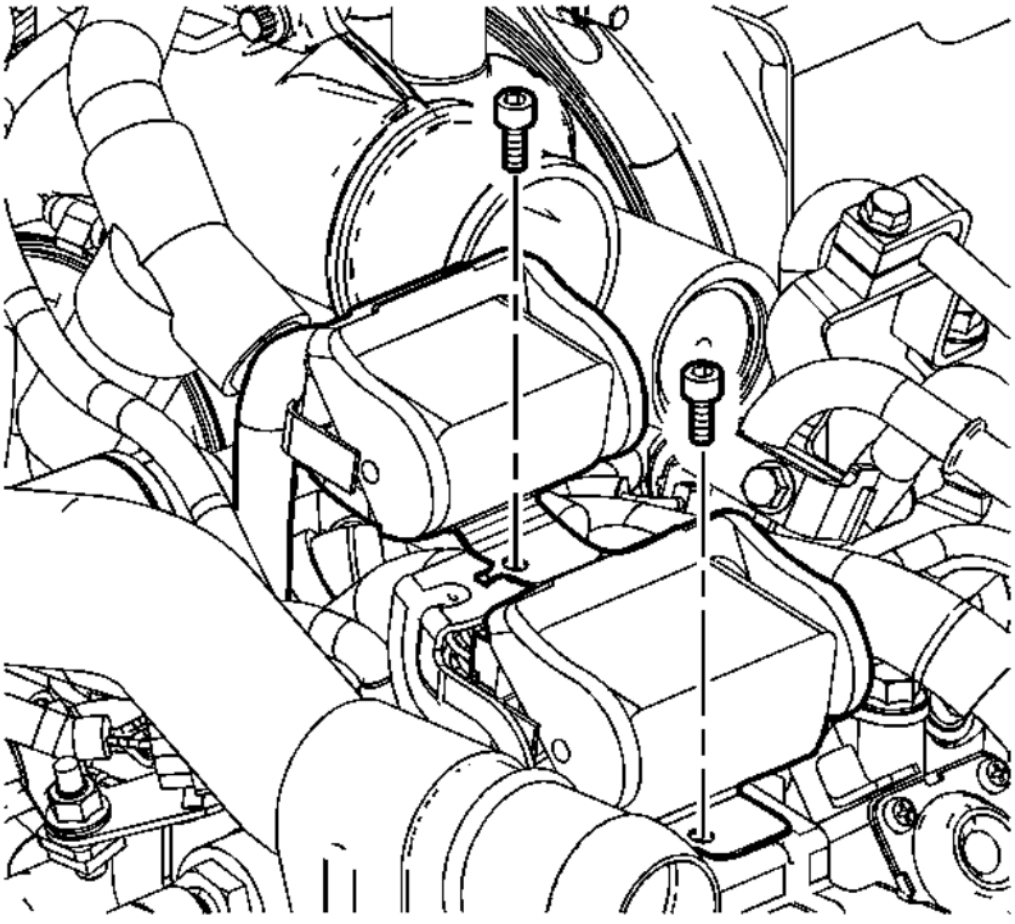


Fig. 141: View Of Main Engine Electrical Harness Connector Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the main engine electrical harness connector bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

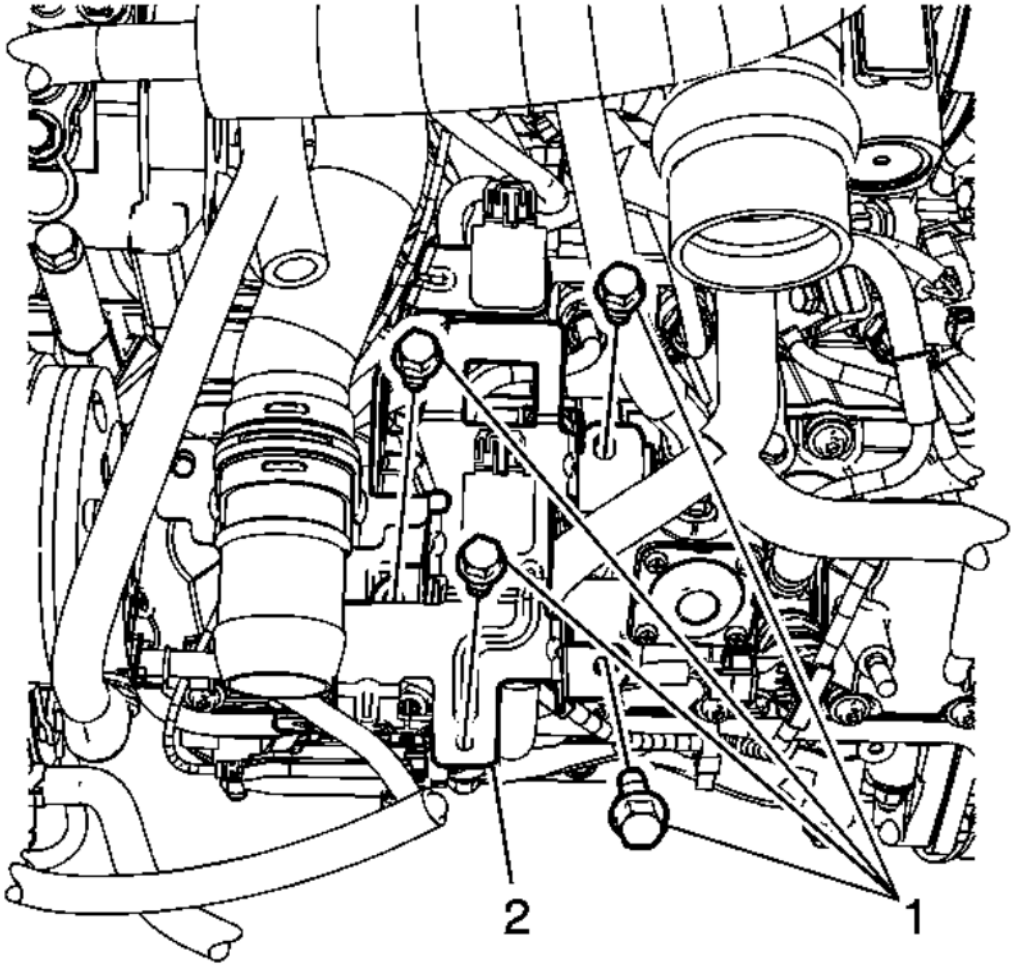


Fig. 142: View Of Main Electrical Connector Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the main electrical connector harness bracket (2).
10. Install the main electrical connector harness bracket bolts (1).

Tighten: Tighten the bolts to 21 N.m (15 lb ft).

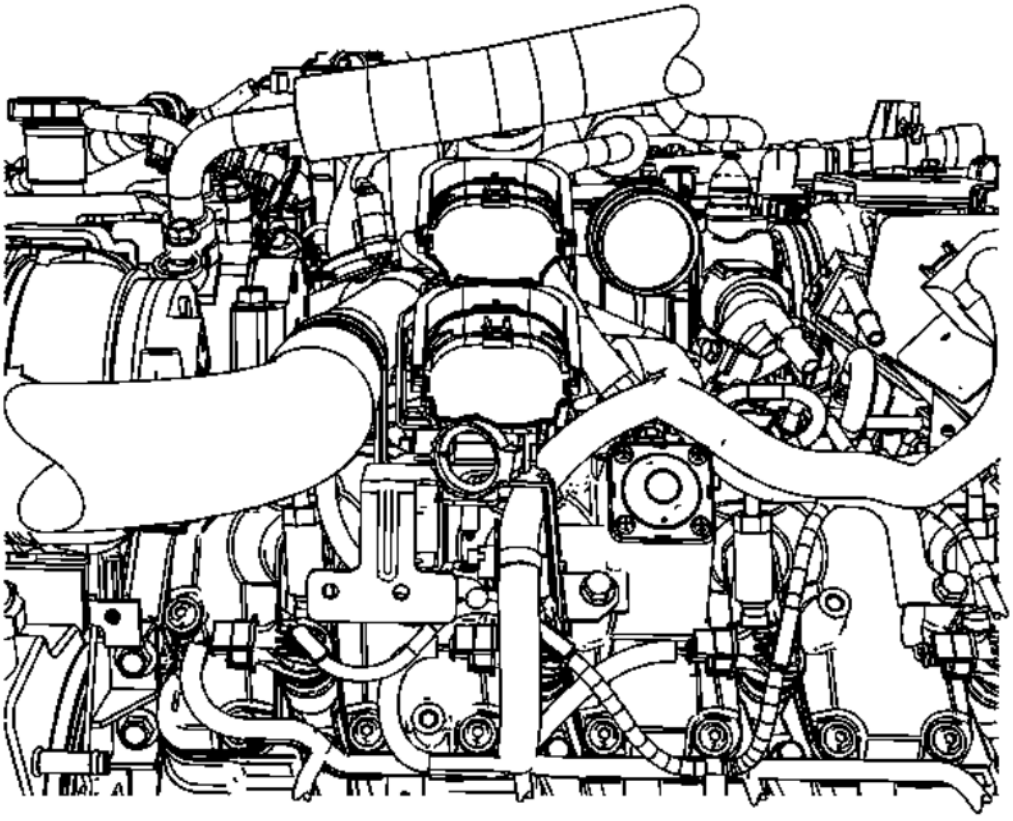


Fig. 143: View Of Main Engine Electrical Harness Connectors & Latches
Courtesy of GENERAL MOTORS CORP.

11. Clip the main engine electrical harness connectors to the main electrical connector harness bracket.

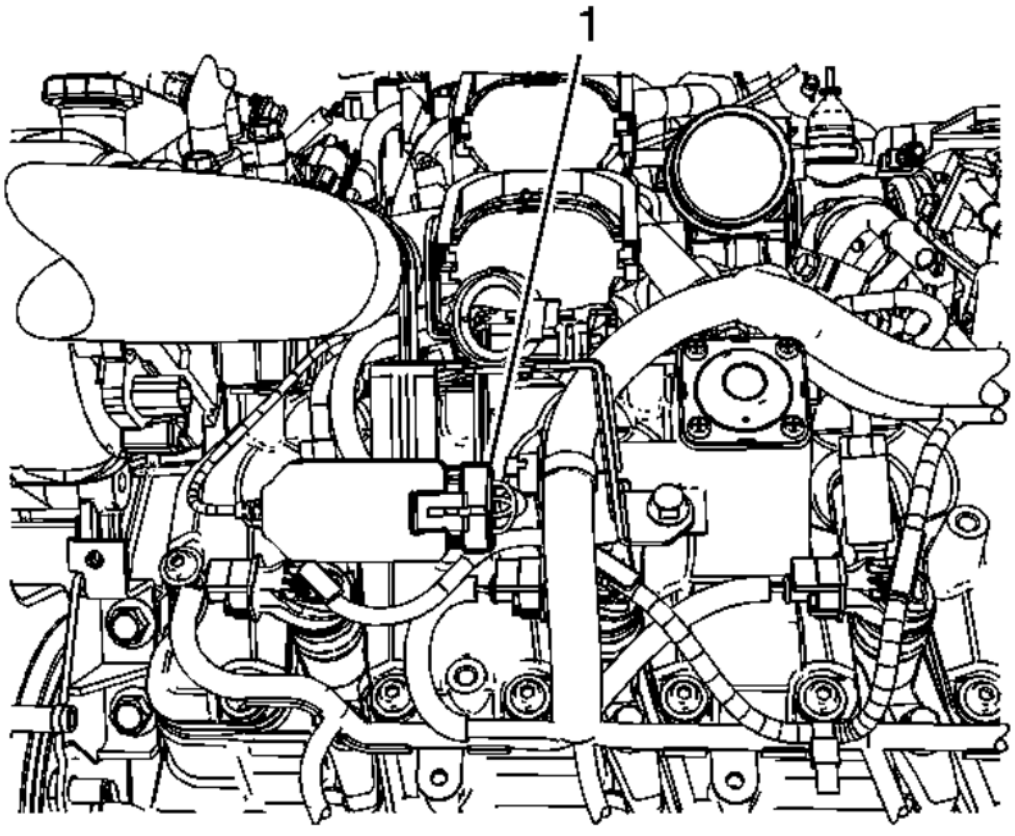


Fig. 144: View Of Turbocharger Vane Position Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Connect the turbocharger vane position sensor electrical connector (1).

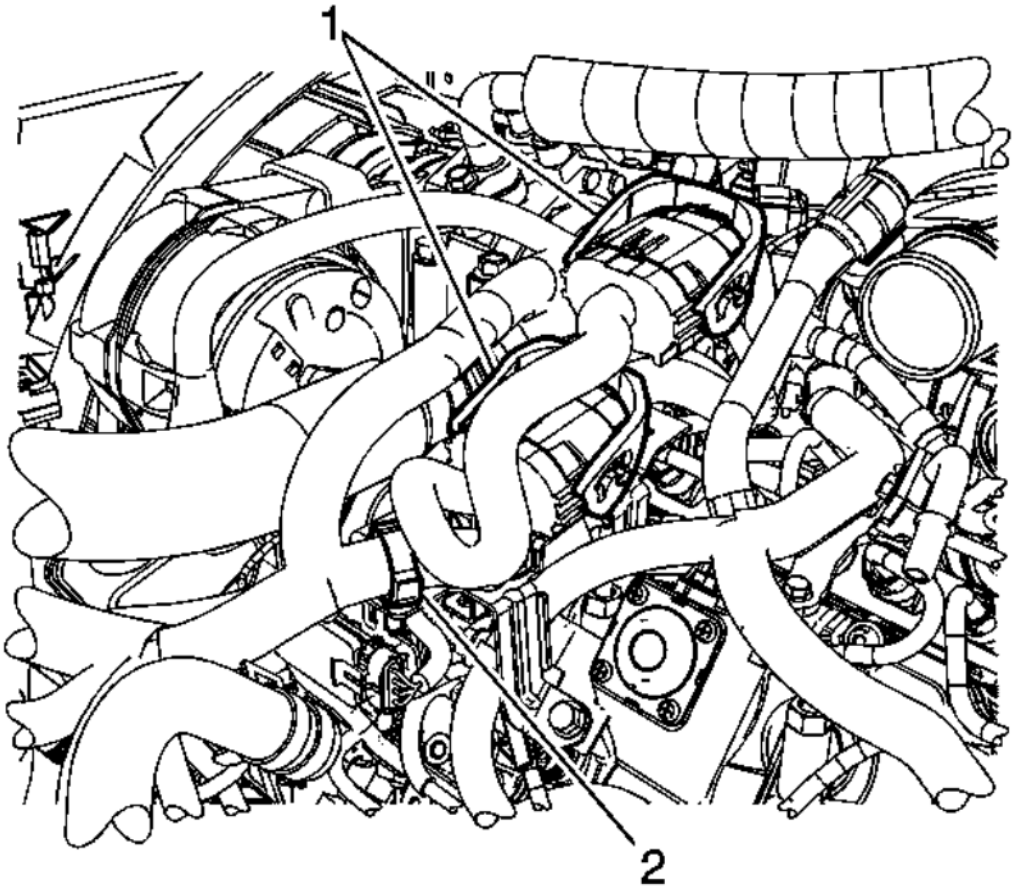


Fig. 145: View Of Main Engine Electrical Harness Connector Latches & Clips
Courtesy of GENERAL MOTORS CORP.

13. Connect the main engine electrical harness connectors.
14. Push down on the latches (1) in order to connect the connectors.
15. Close the harness clip (2).

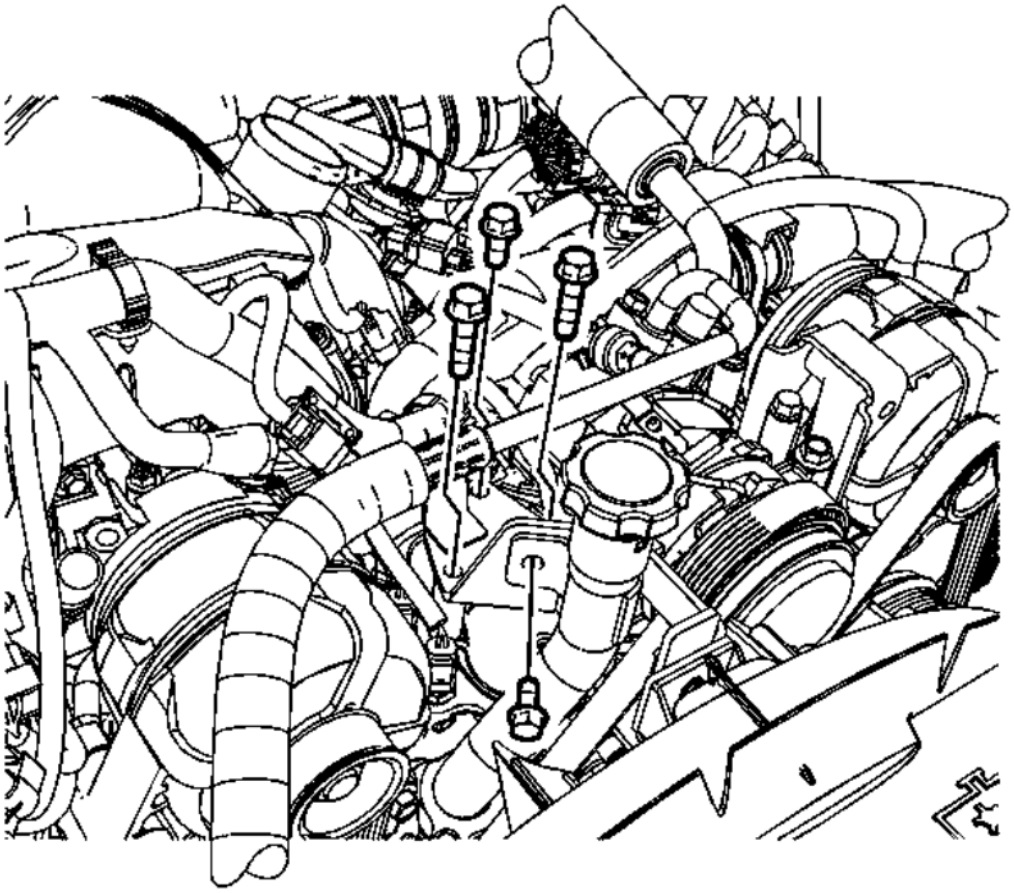


Fig. 146: View Of Wiring Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

16. Install the wiring harness bracket and bolts to the thermostat housing.

    Tighten: Tighten the bolts to 10 N.m (89 lb in).

17. Install the turbocharger coolant bypass valve. Refer to **Turbocharger Coolant Bypass Valve Replacement**.
18. Install the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement (Non-HP2)**.

WATER OUTLET TUBE REPLACEMENT (LU3)

Removal Procedure

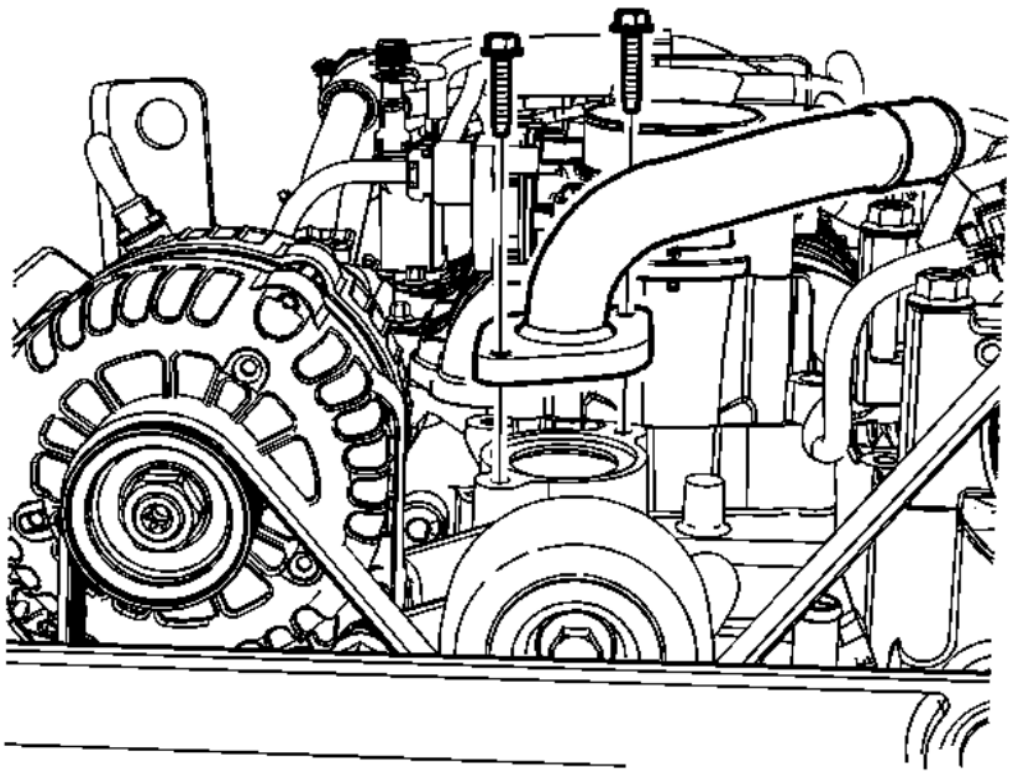


Fig. 147: View Of Water Outlet, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner outlet resonator duct. Refer to **Air Cleaner Outlet Resonator Replacement** .
2. Remove the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement (Non-HP2)**.
3. Remove the turbocharger coolant bypass valve. Refer to **Turbocharger Coolant Bypass Valve Replacement**.
4. Remove the water outlet bolts.
5. Remove the water outlet.
6. Remove and discard the gasket.

Installation Procedure

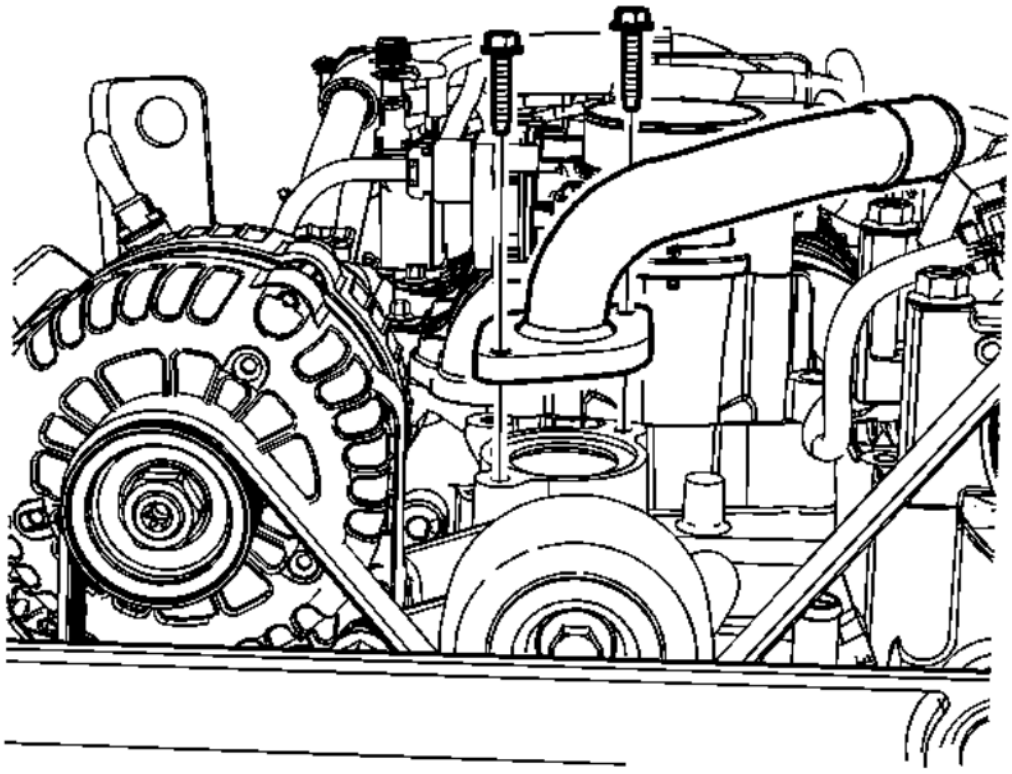


Fig. 148: View Of Water Outlet, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket to the water outlet.
2. Lubricate the O-ring seal with clean engine coolant.
3. Install the water outlet.

NOTE: Refer to Fastener Notice .

4. Install the water outlet bolts.

   Tighten: Tighten the bolts to 21 N.m (15 lb ft).

5. Install the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement (Non-HP2)**.
6. Install the air cleaner outlet resonator duct. Refer to **Air Cleaner Outlet Resonator**

Replacement .

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LY2, LH6, LY5, LMG, LY6)

Removal Procedure

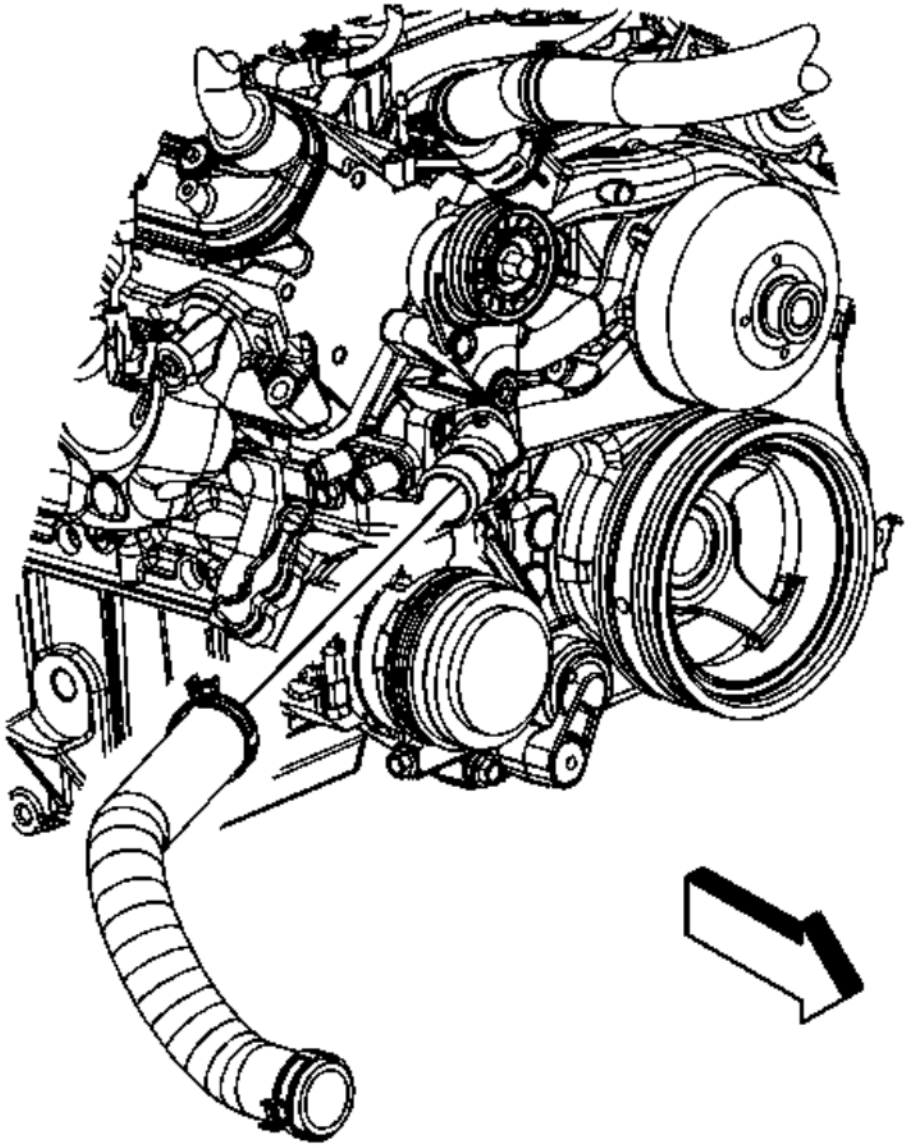


Fig. 149: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Reposition the radiator outlet hose clamp at the water pump inlet.
4. Remove the radiator outlet hose from the water pump inlet.

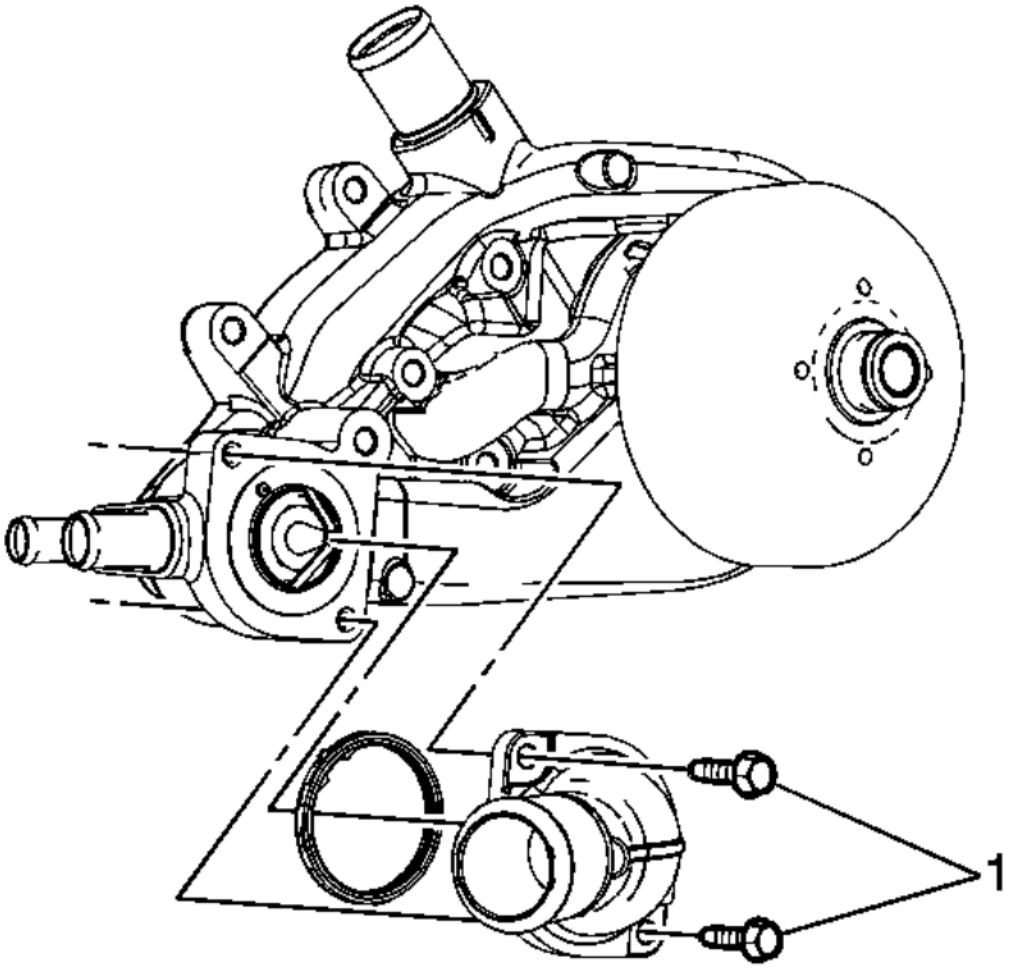


Fig. 150: View Of Water Pump Inlet Seal
Courtesy of GENERAL MOTORS CORP.

5. Remove the water pump inlet bolts.
6. Remove the water pump inlet from the water pump.
7. Remove and discard the water pump inlet seal.

Installation Procedure

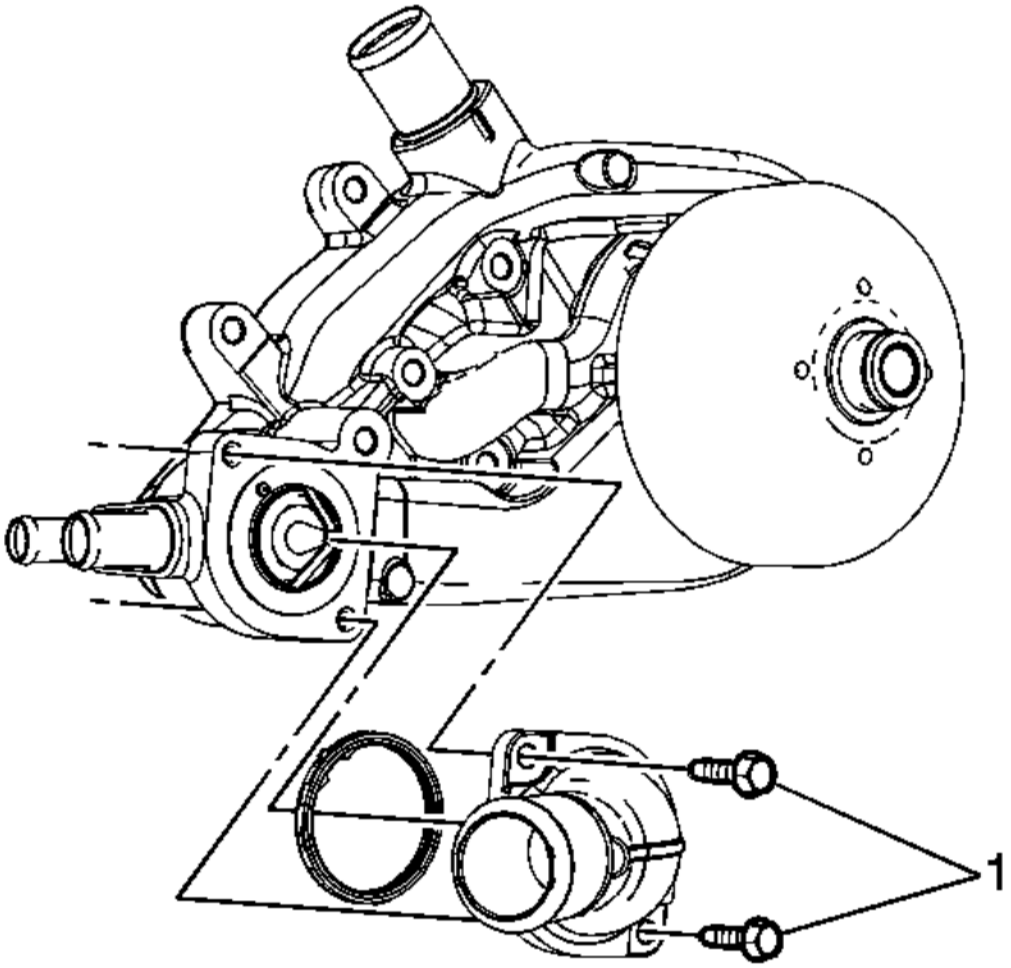


Fig. 151: View Of Water Pump Inlet Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW water pump inlet seal to the water pump inlet.
2. Position the water pump inlet to the water pump.

NOTE: Refer to Fastener Notice .

3. Install the water pump inlet bolts.

Tighten: Tighten the bolts to 15 N.m (11 lb ft).

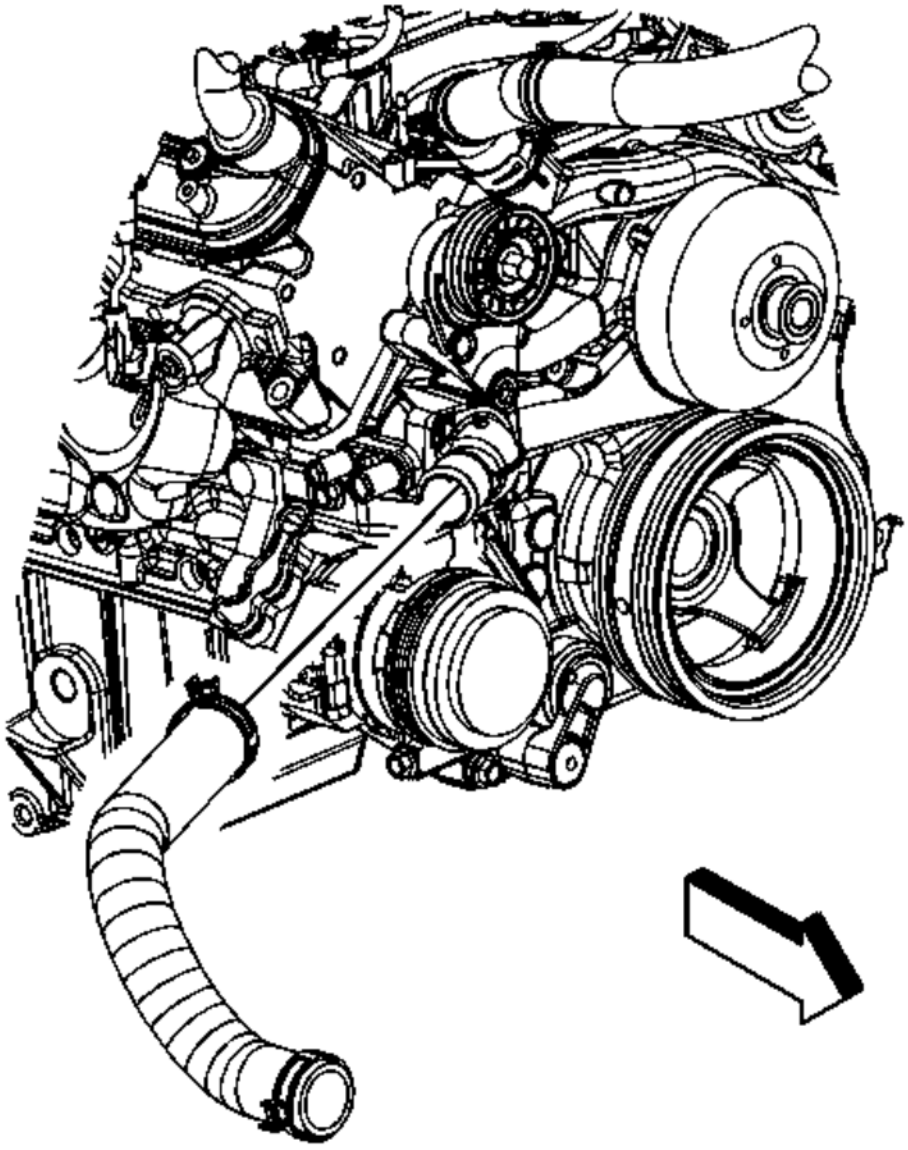


Fig. 152: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator outlet hose to the water pump inlet.
5. Position the radiator outlet hose clamp at the water pump inlet.

6. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

ENGINE COOLANT THERMOSTAT REPLACEMENT

Removal Procedure

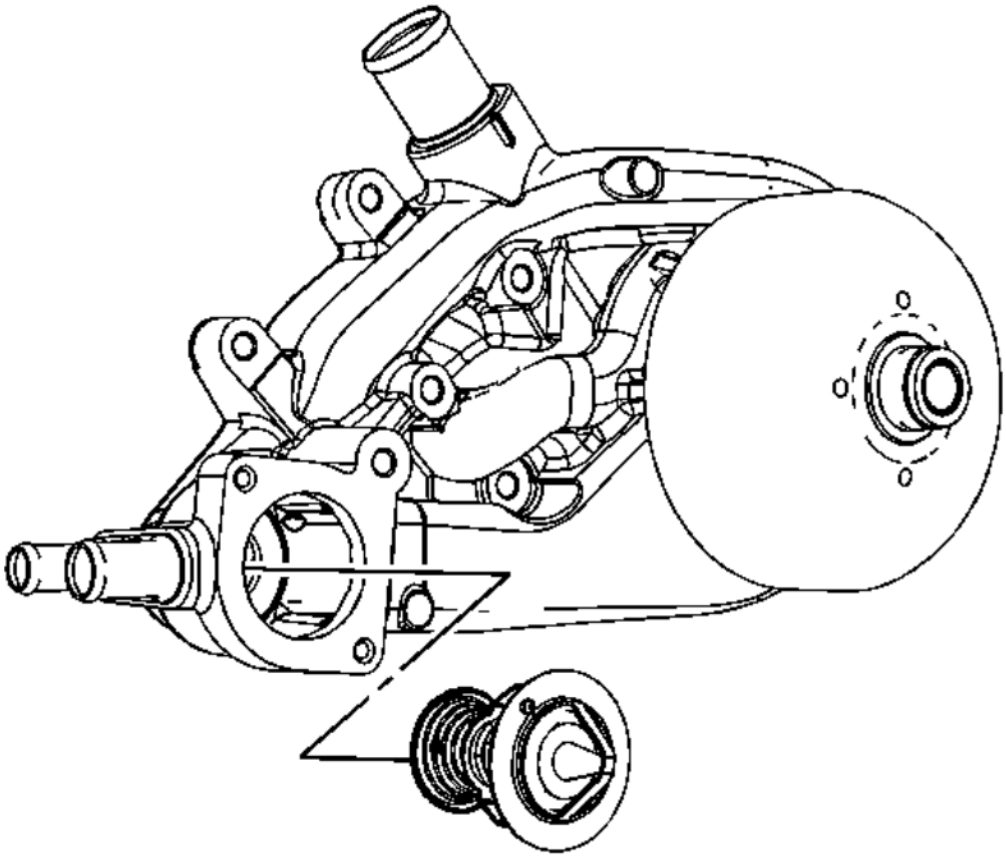


Fig. 153: View Of Thermostat & Housing
Courtesy of GENERAL MOTORS CORP.

1. Remove the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LY2, LH6, LY5, LMG, LY6)**.

2. Remove the thermostat.

Installation Procedure

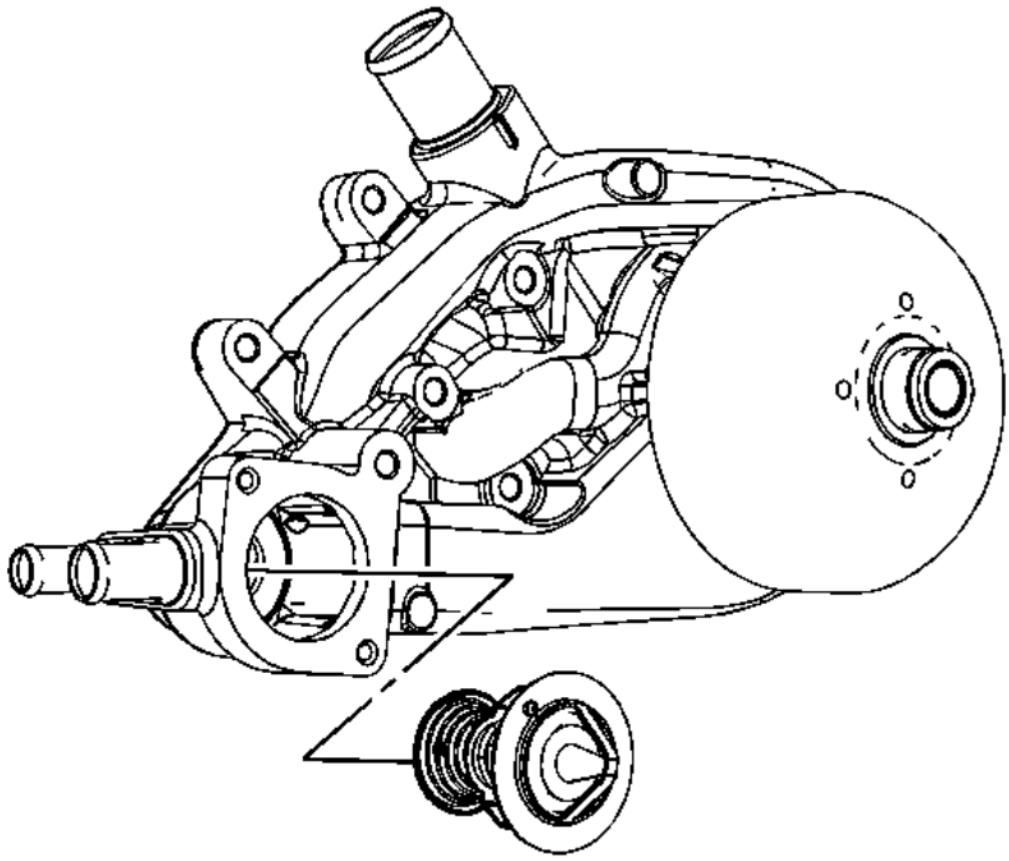


Fig. 154: View Of Thermostat & Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat.
2. Install the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LY2, LH6, LY5, LMG, LY6)**.

THERMOSTAT HOUSING CROSSOVER REPLACEMENT (LMM)

Removal Procedure

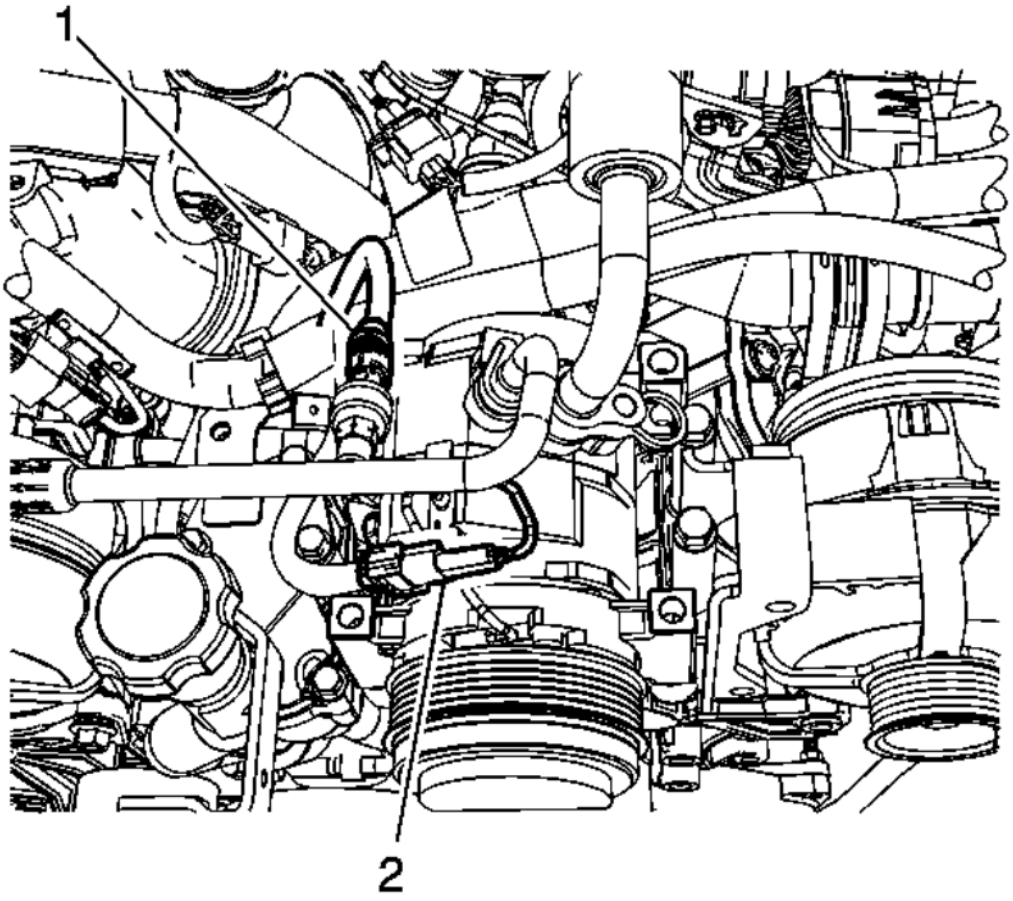


Fig. 155: View Of A/C Pressure Switch Electrical Connector & A/C Compressor Clutch Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
3. Disconnect the negative battery cables. Refer to **Battery Negative Cable Disconnection and Connection (w/Single Battery)** or **Battery Negative Cable Disconnection and Connection (w/Auxiliary Battery)** or **Battery Negative Cable Disconnection and Connection (w/Dual Batteries)** .
4. Remove the drive belt. Refer to **Drive Belt Replacement** .

5. Disconnect the air conditioning (A/C) pressure switch electrical connector (1).
6. Disconnect the A/C compressor clutch electrical connector (2).
7. Remove the generator bracket. Refer to **Generator Bracket Replacement (4.3L)** or **Generator Bracket Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Generator Bracket Replacement (6.6L)** .
8. Remove the front oil fill tube. Refer to **Oil Filler Tube Replacement** .

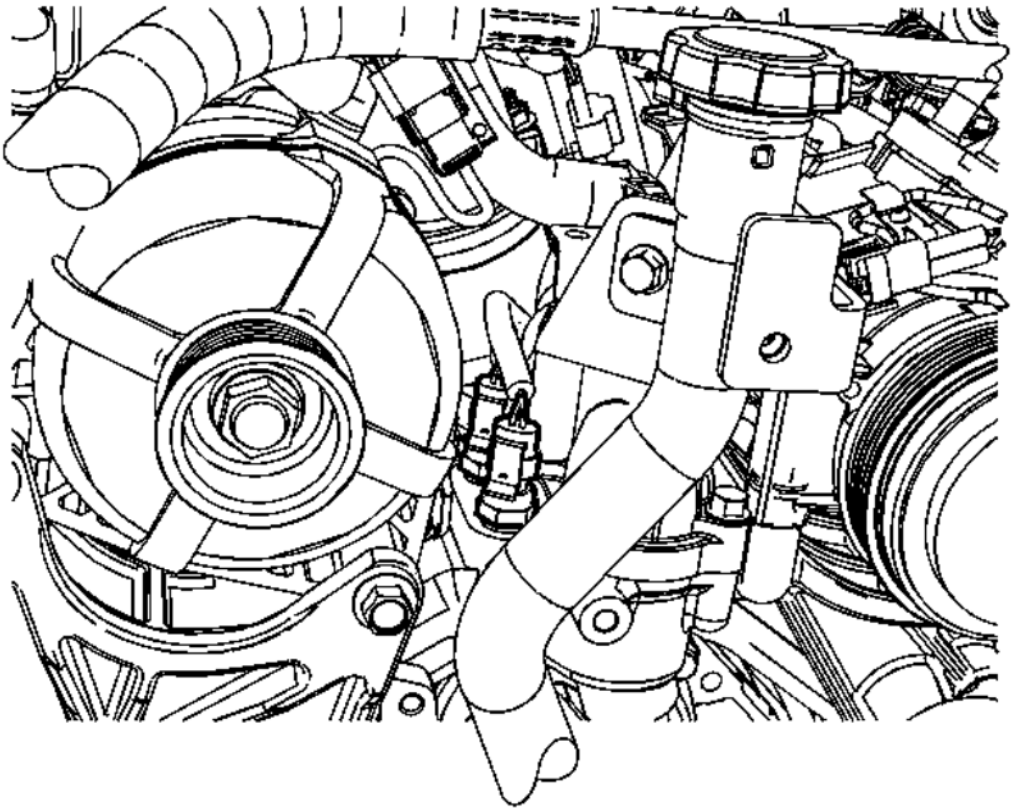


Fig. 156: View Of (ECT) Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the engine coolant temperature (ECT) sensor electrical connectors.
10. Remove the water outlet. Refer to **Water Outlet Tube Replacement (LMM)** or **Water Outlet Tube Replacement (LU3)**.
11. Without disconnecting the power steering hoses, remove the power steering pump bolts and

the power steering pump. Reposition the power steering pump and secure to the side. Refer to **Power Steering Pump Replacement (4.3L)** or **Power Steering Pump Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Power Steering Pump Replacement (6.6L)** .

12. Remove the power steering pump bracket. Refer to **Air Conditioning (A/C) Compressor and Power Steering Pump Bracket Replacement** .

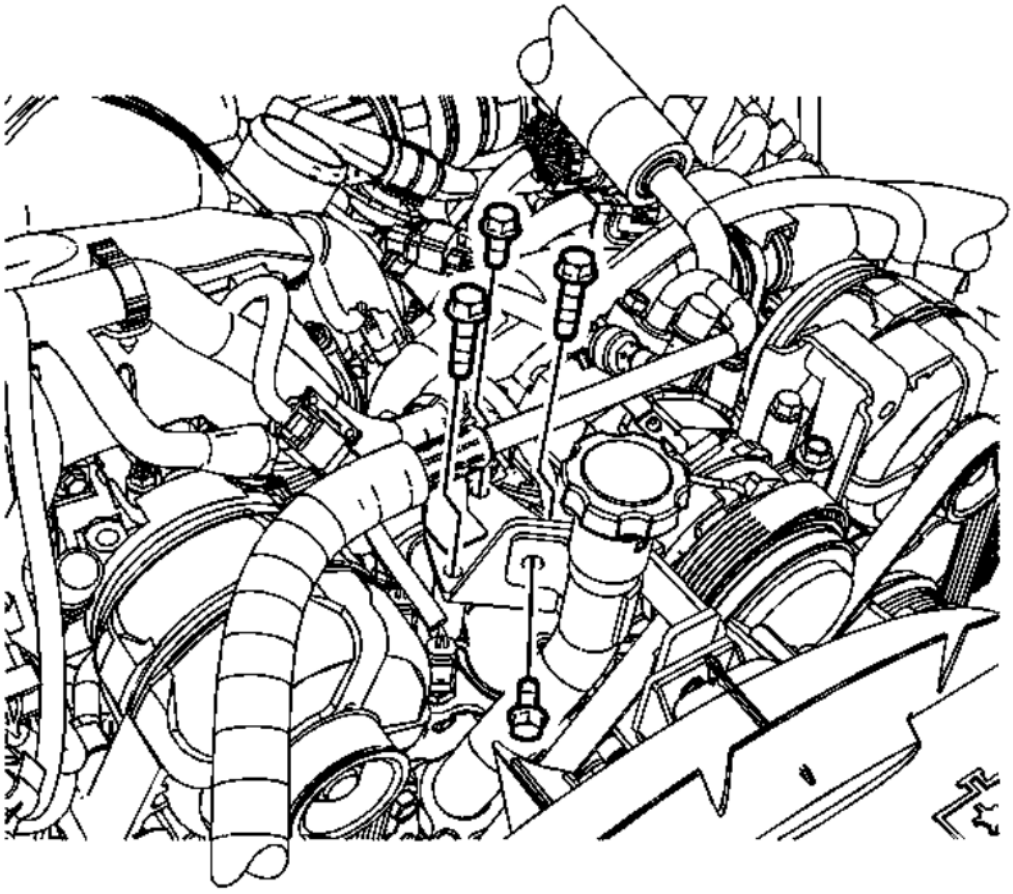


Fig. 157: View Of Wiring Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the bolts and wiring harness bracket at the thermostat housing.
14. Position the bracket and wiring harness aside.
15. Remove the cooling fan pulley. Refer to **Cooling Fan Pulley Replacement**.

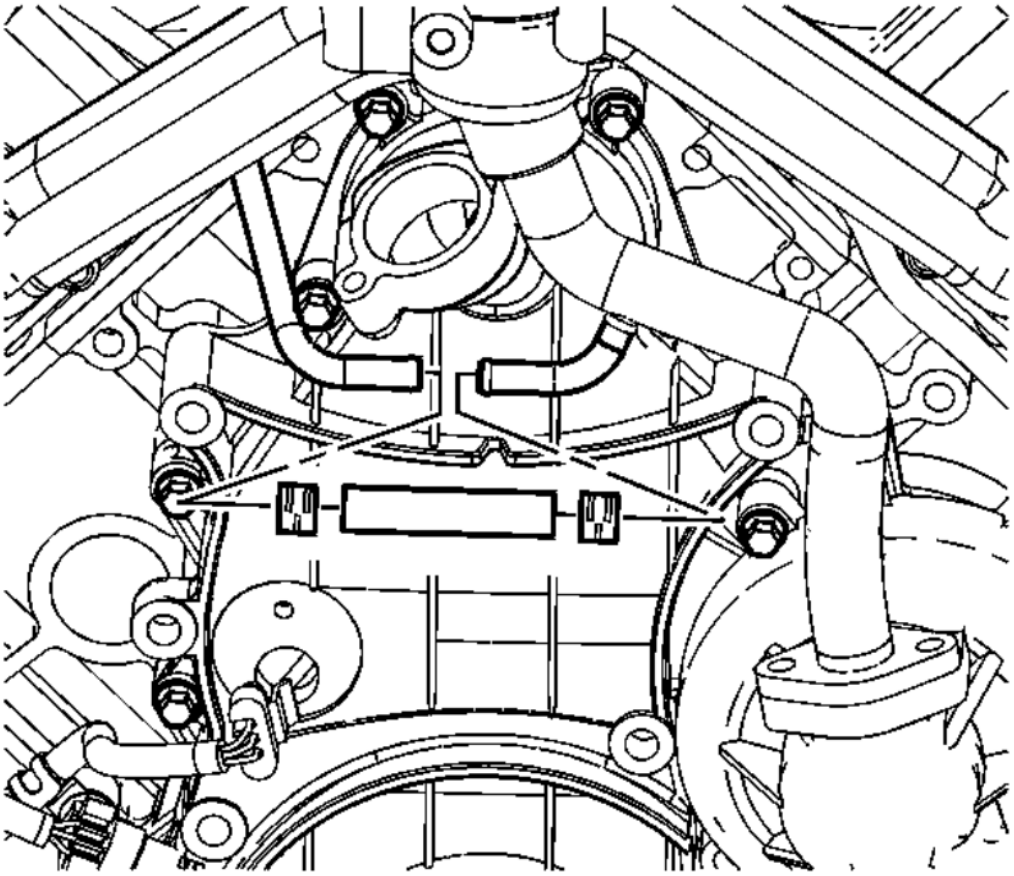


Fig. 158: View Of Turbocharger Coolant Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

16. Reposition the turbocharger coolant return pipe hose clamp.
17. Remove the turbocharger coolant return pipe hose.

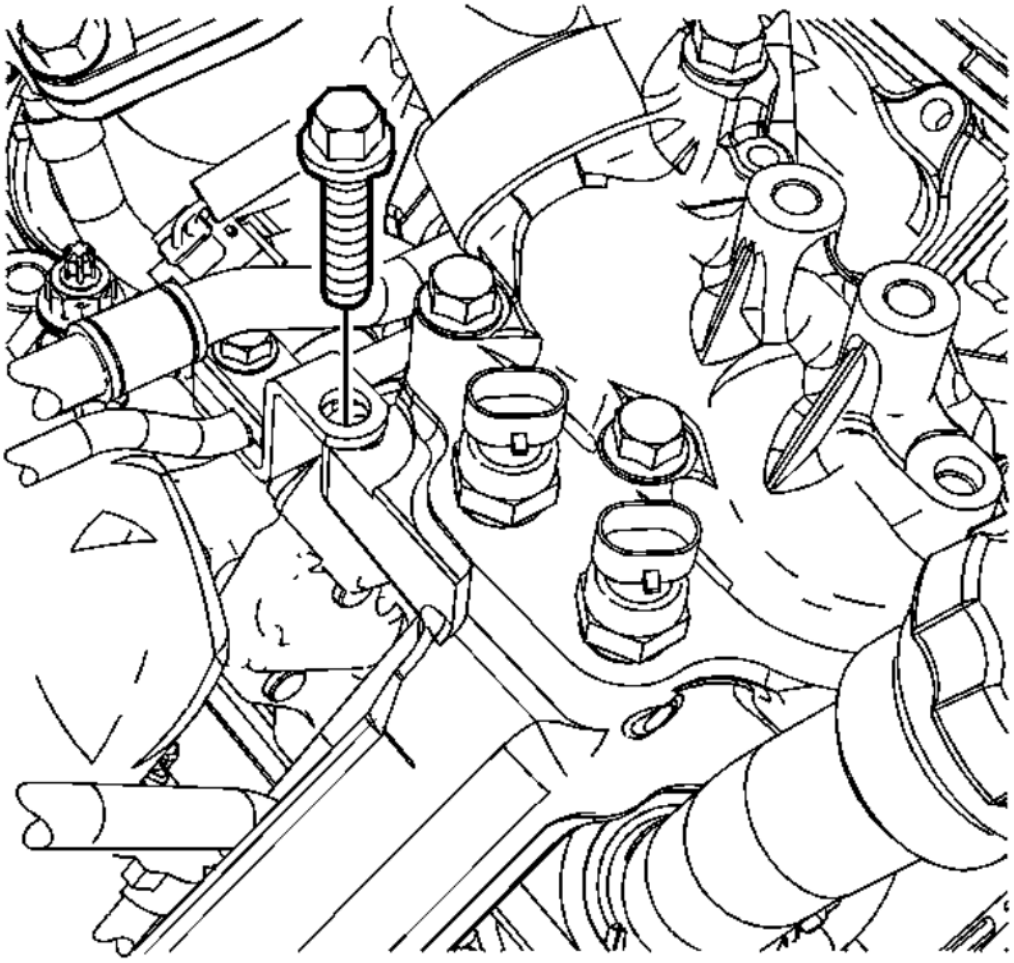


Fig. 159: View Of Fuel Line Bracket Bolt & Thermostat Housing Crossover (6.6L LMM)
Courtesy of GENERAL MOTORS CORP.

18. Remove the fuel line bracket bolt at the thermostat housing crossover.

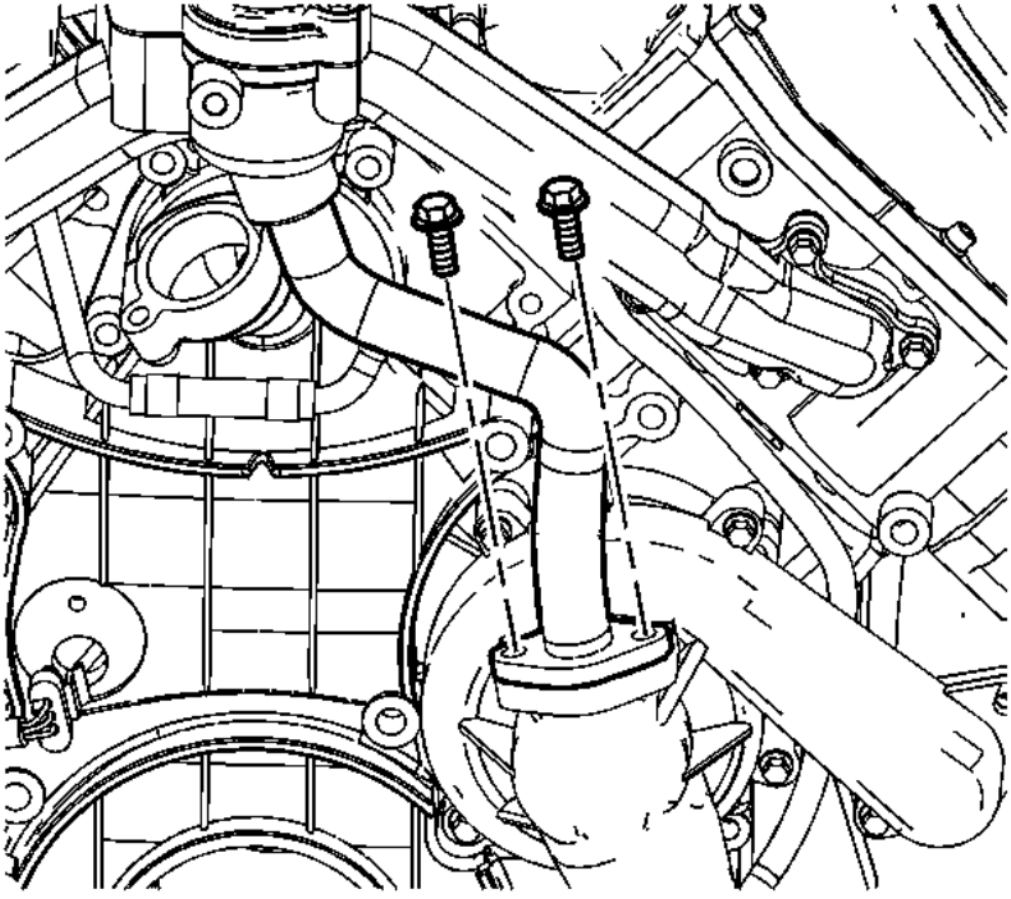


Fig. 160: View Of Water Pump Inlet Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

19. Remove the water pump inlet pipe bolts.

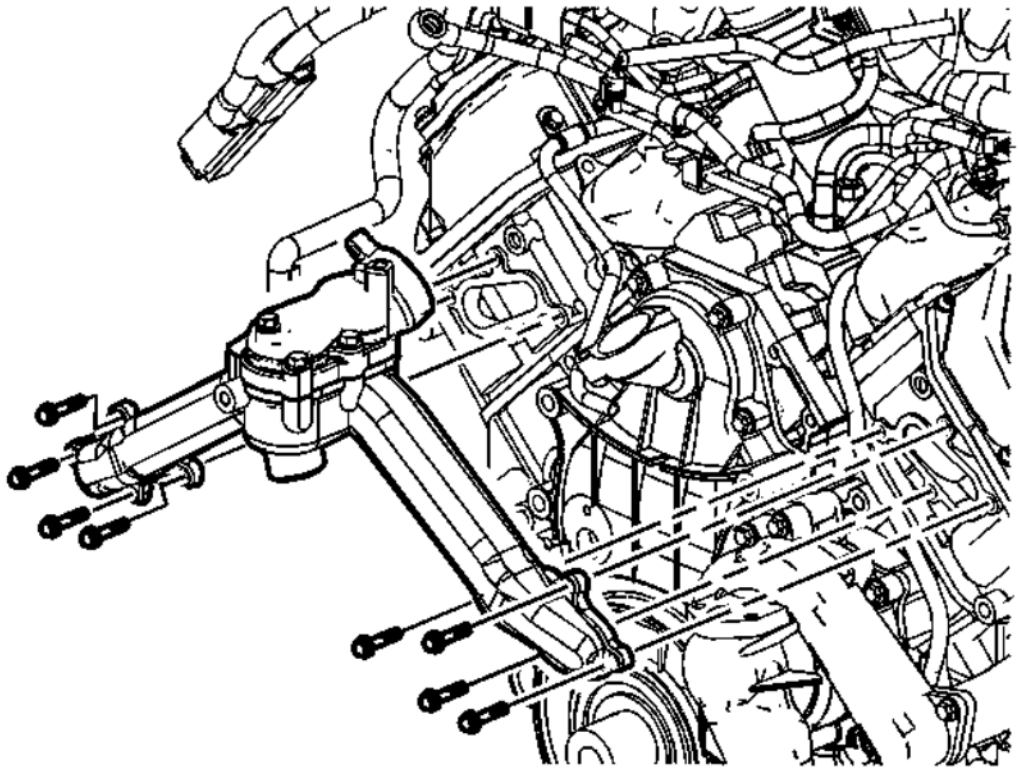


Fig. 161: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

20. Remove the thermostat housing crossover bolts and nuts.
21. Remove the thermostat housing crossover, with the bypass pipe.
22. Remove and discard the thermostat bypass pipe to water pump O-ring seal.
23. Remove and discard the thermostat housing crossover gaskets.
24. If necessary, perform the following:
    1. Remove the thermostat bypass pipe from the thermostat housing crossover.
    2. Remove and discard the thermostat bypass pipe O-ring seal.
    3. Remove the thermostat cover bolts and cover.
    4. Remove the thermostats.
    5. Remove and discard the thermostat seals.
25. If required, clean and inspect the thermostat housing. Refer to **Engine Coolant**

Thermostat Housing Cleaning and Inspection .

Installation Procedure

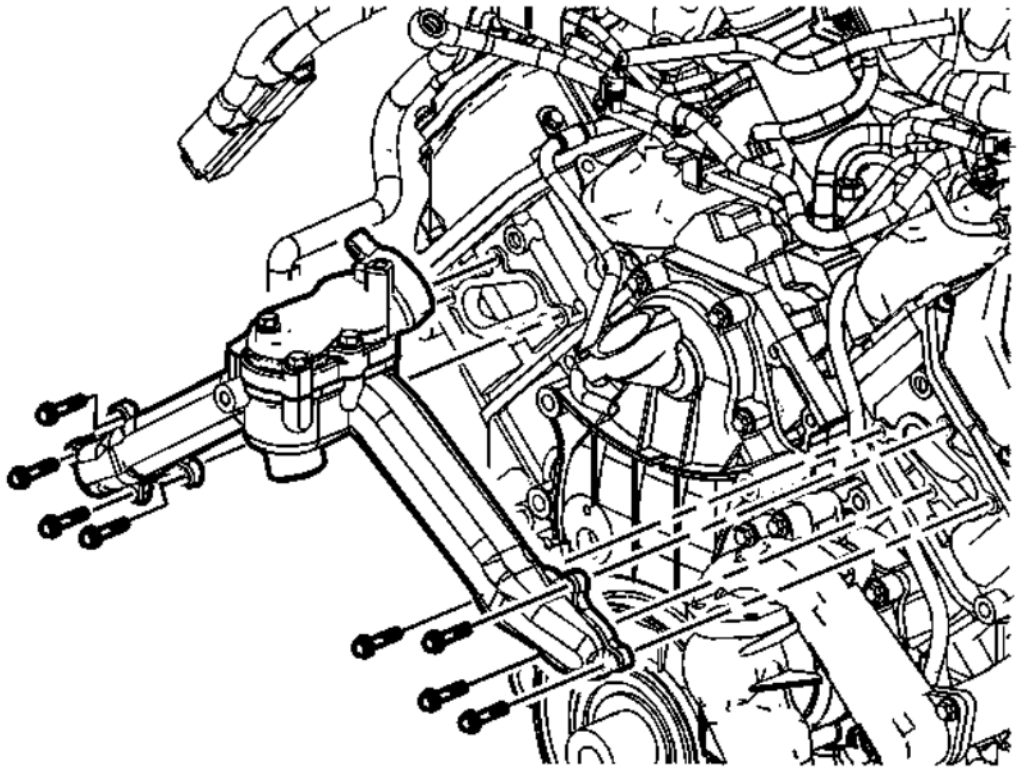


Fig. 162: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. If necessary, perform the following:
    1. Install NEW seals to the thermostats.
    2. Install the thermostats.
    3. Install the thermostat cover and bolts.

    Tighten: Tighten the bolts to 21 N.m (15 lb ft).

4. Install a NEW O-ring seal to the thermostat bypass pipe.
5. Install the thermostat bypass pipe to the thermostat housing.

2. Install a NEW thermostat bypass pipe to water pump O-ring seal.
3. Install the thermostat housing crossover using NEW gaskets.
4. Install the thermostat housing crossover bolts and nuts.

Tighten: Tighten the bolts/nuts to 21 N.m (15 lb ft).

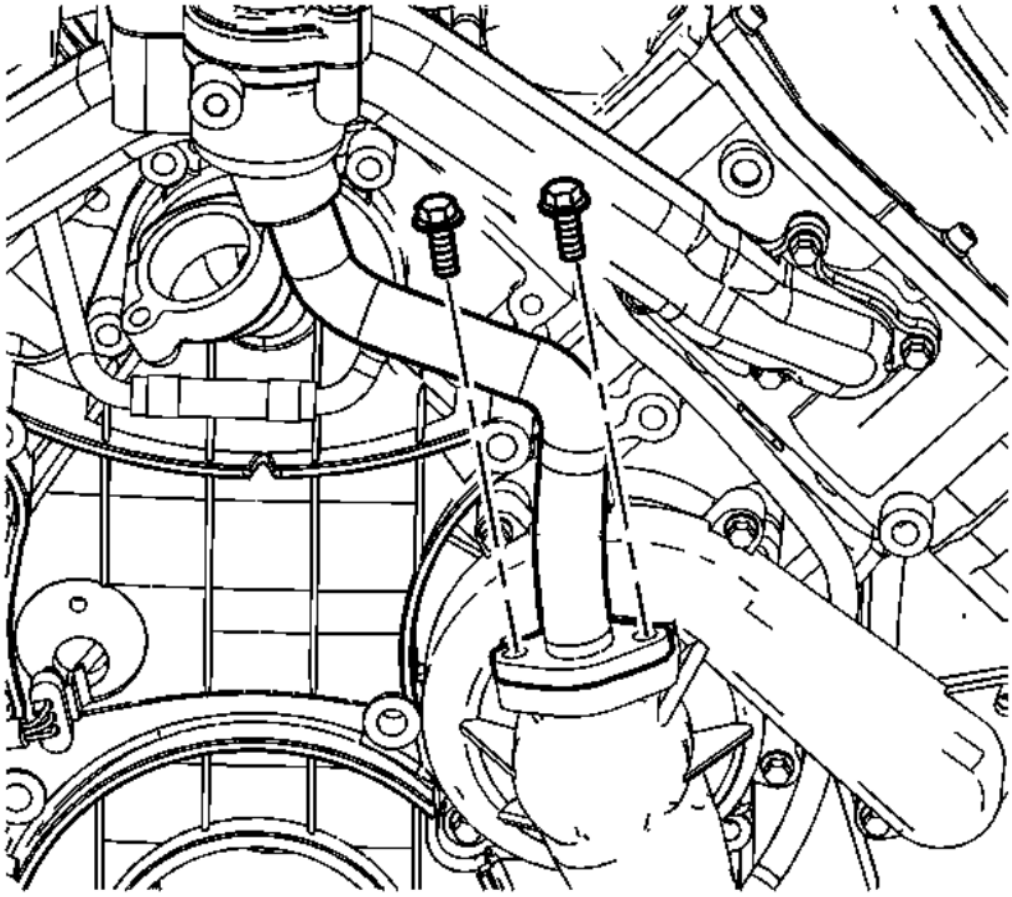


Fig. 163: View Of Water Pump Inlet Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the water pump inlet pipe bolts.

Tighten: Tighten the bolts to 21 N.m (15 lb ft).

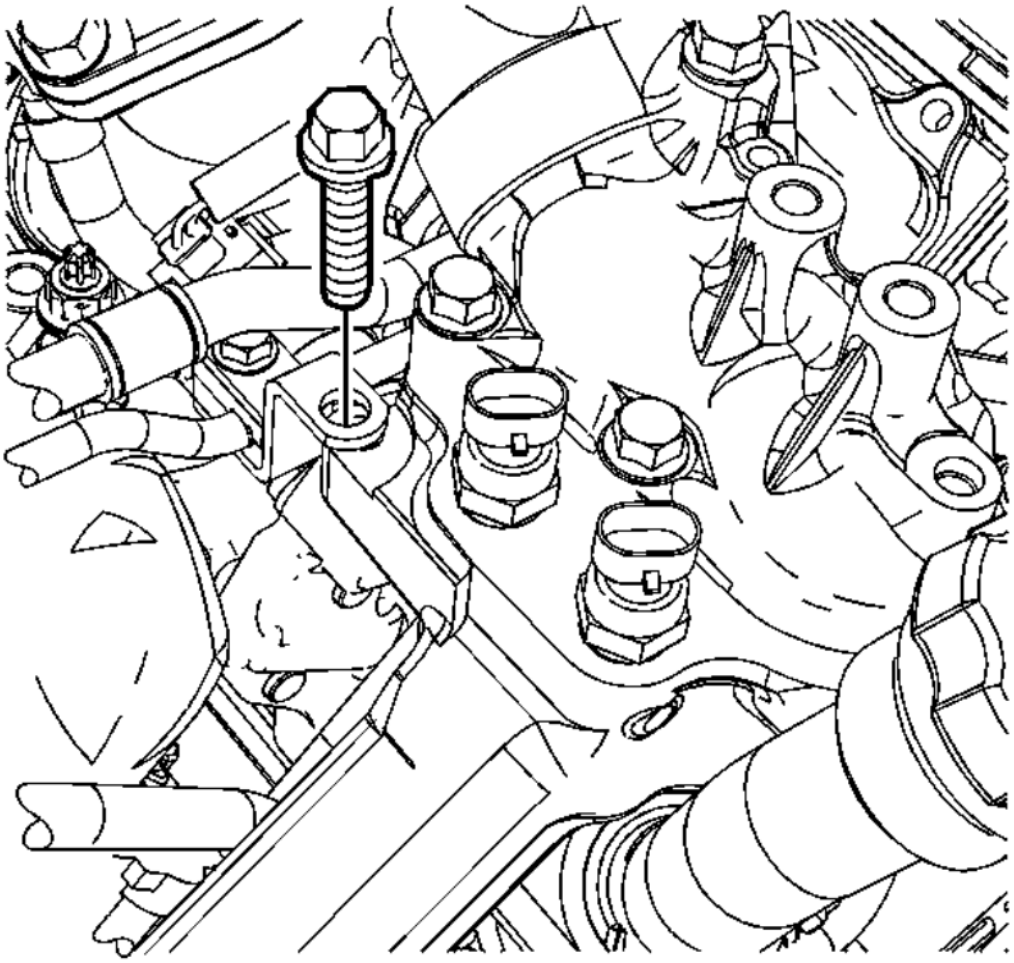


Fig. 164: View Of Fuel Line Bracket Bolt & Thermostat Housing Crossover (6.6L LMM)
Courtesy of GENERAL MOTORS CORP.

6. Install the fuel line bracket bolt at the thermostat housing crossover.

   Tighten: Tighten the bolt to 21 N.m (15 lb ft).

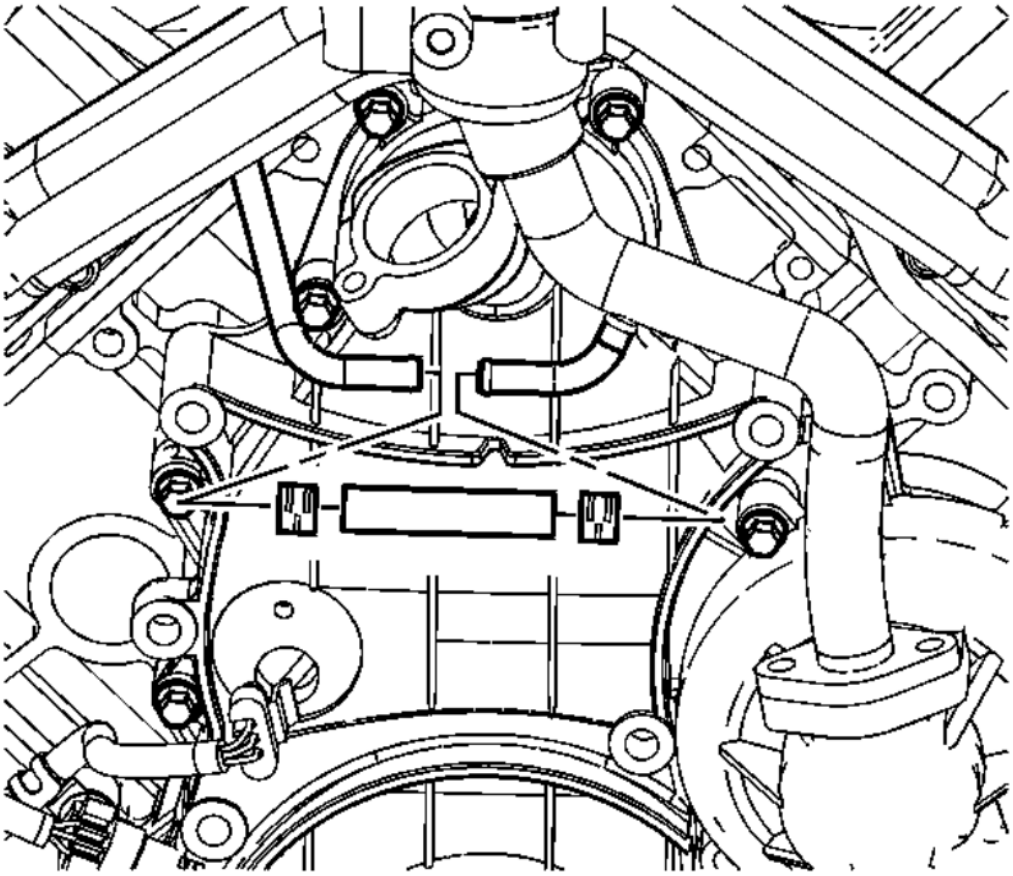


Fig. 165: View Of Turbocharger Coolant Outlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

7. Install the turbocharger coolant return pipe hose.
8. Position the turbocharger coolant return pipe hose clamp.

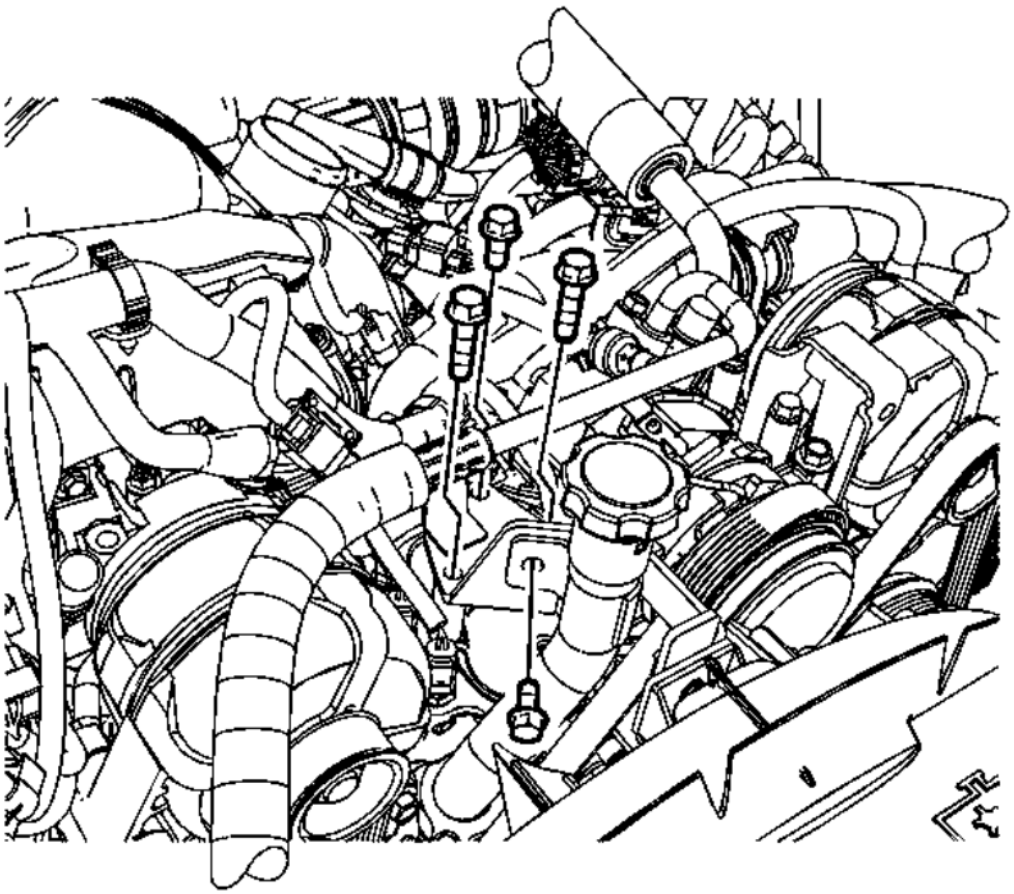


Fig. 166: View Of Wiring Harness Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the wiring harness bracket and bolts to the thermostat housing.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

10. Install the cooling fan pulley. Refer to **Cooling Fan Pulley Replacement**.
11. Install the power steering pump bracket. Refer to **Air Conditioning (A/C) Compressor and Power Steering Pump Bracket Replacement** .
12. Reposition the power steering pump and install the power steering pump bolts. Refer to **Power Steering Pump Replacement (4.3L)** or **Power Steering Pump Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Power Steering Pump Replacement (6.6L)** .

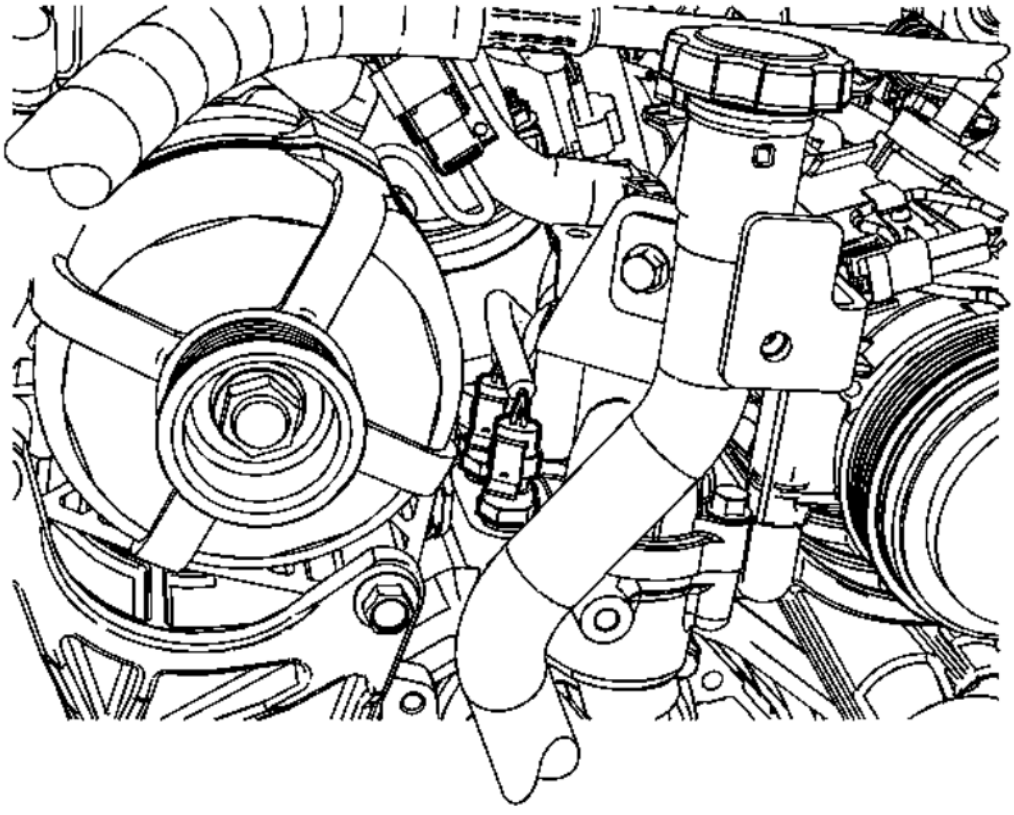


Fig. 167: View Of (ECT) Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

13. Install the water outlet. Refer to **Water Outlet Tube Replacement (LMM)** or **Water Outlet Tube Replacement (LU3)**.
14. Connect the ECT sensor electrical connectors.
15. Install the front oil fill tube. Refer to **Oil Filler Tube Replacement** .
16. Install the generator bracket. Refer to **Generator Bracket Replacement (4.3L)** or **Generator Bracket Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** or **Generator Bracket Replacement (6.6L)** .

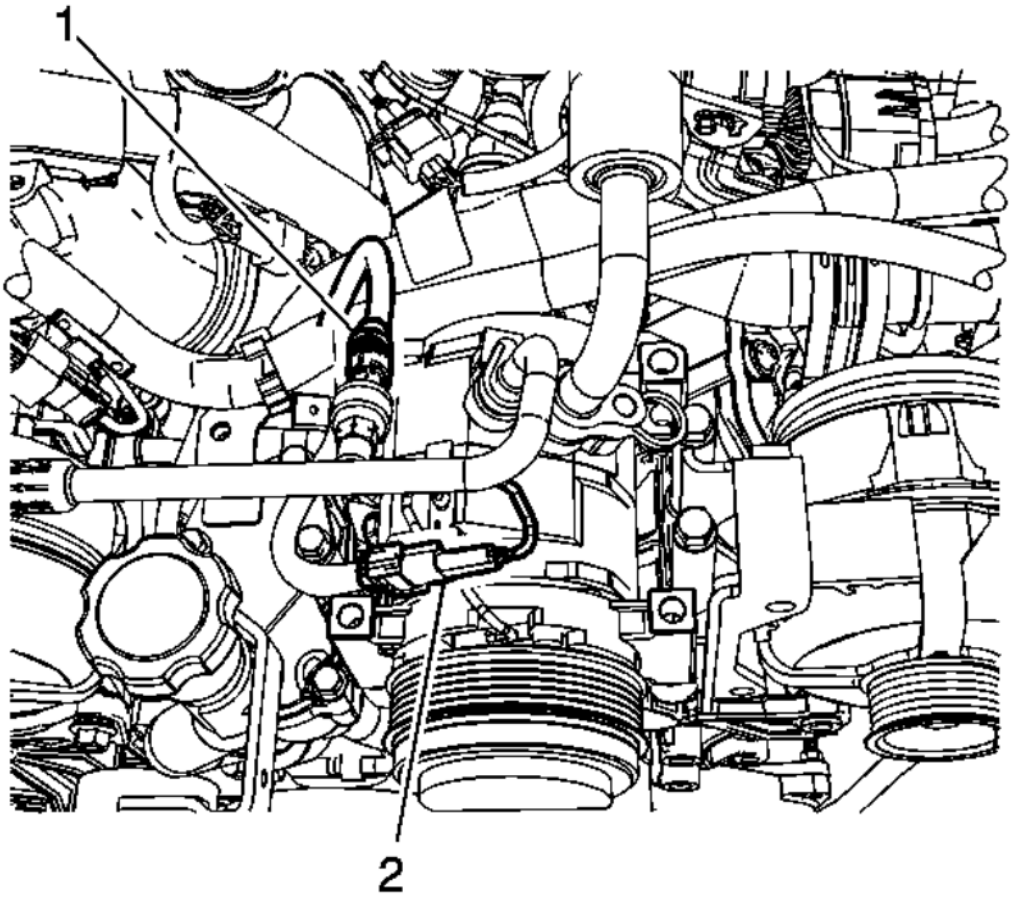


Fig. 168: View Of A/C Pressure Switch Electrical Connector & A/C Compressor Clutch Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Connect the A/C compressor clutch electrical connector (2).
18. Connect the A/C cut out switch electrical connector (1).
19. Install the drive belt. Refer to **Drive Belt Replacement** .
20. Connect the negative battery cables. Refer to **Battery Negative Cable Disconnection and Connection (w/Single Battery)** or **Battery Negative Cable Disconnection and Connection (w/Auxiliary Battery)** or **Battery Negative Cable Disconnection and Connection (w/Dual Batteries)** .
21. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or

Cooling System Draining and Filling (Static Fill).

22. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** .

COOLANT AIR BLEED PIPE ASSEMBLY REPLACEMENT (LH6, LY5, LMG, L76, L92)

Removal Procedure

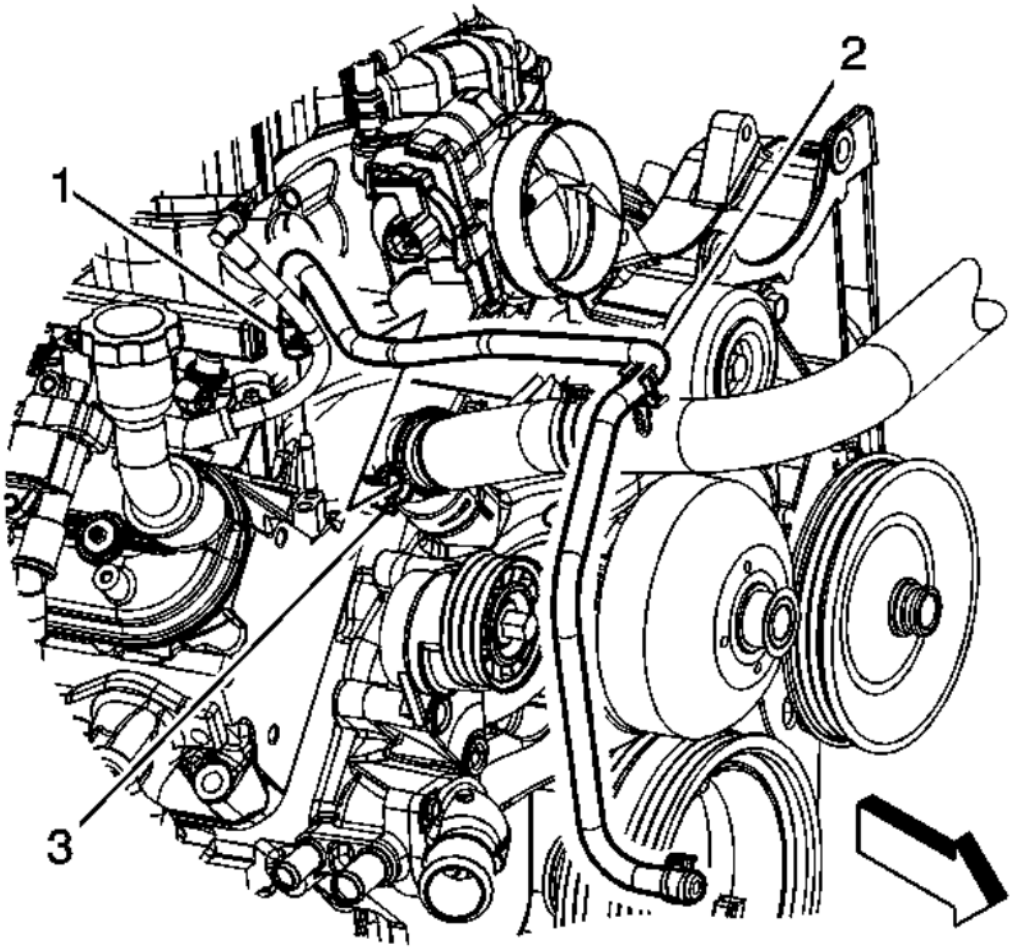


Fig. 169: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

1. If replacing the rear coolant air bleed covers, remove the intake manifold. Refer to **Intake Manifold Replacement (L92 - First Design)** or **Intake Manifold Replacement (L92 -**

Second Design) or **Intake Manifold Replacement (LY2 and LY6)** or **Intake Manifold Replacement (LH6, LMG, LY5 and L76)** . Otherwise proceed to the next step.

2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
4. Reposition the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
5. Remove the radiator vent inlet hose (2) from the coolant air bleed pipe fitting.

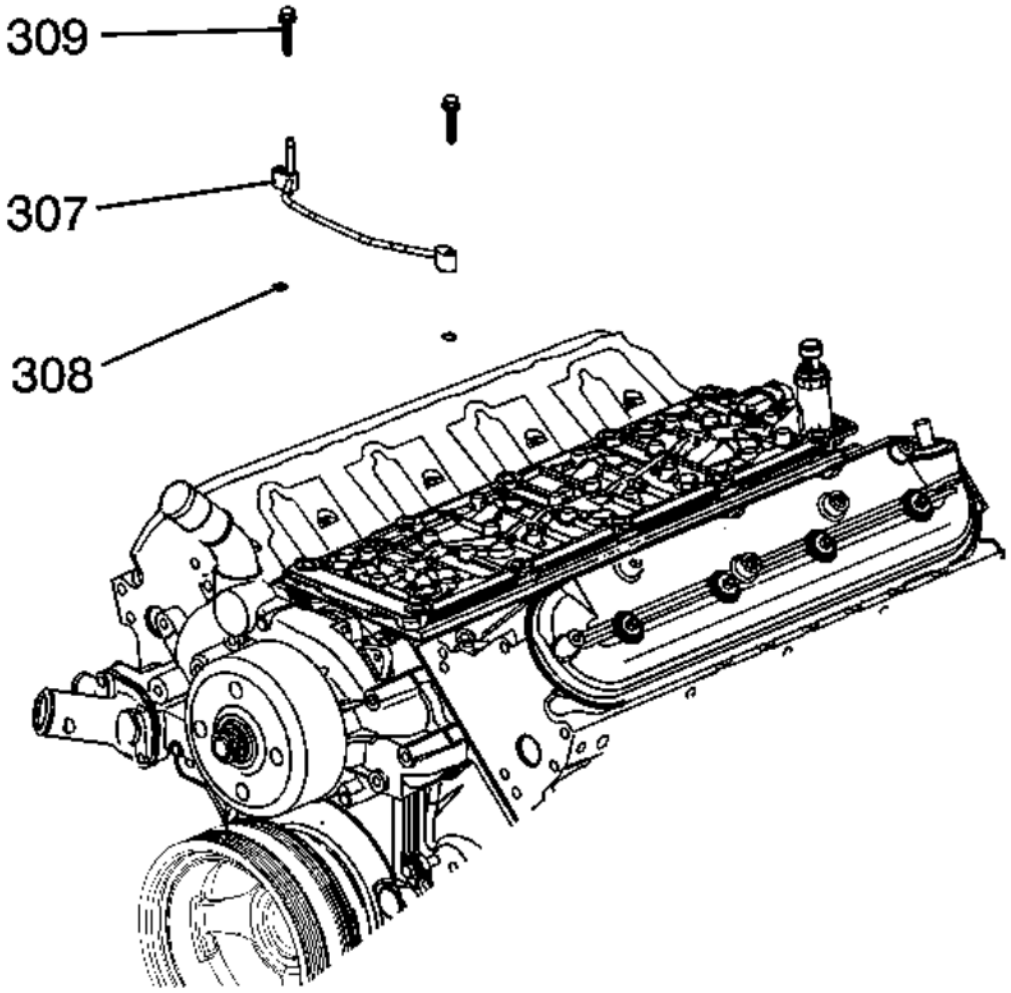


Fig. 170: Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS CORP.

6. Remove the coolant air bleed pipe bolts (309) (intake manifold shown removed for clarity).
7. Remove the coolant air bleed pipe (307) and seals (308).

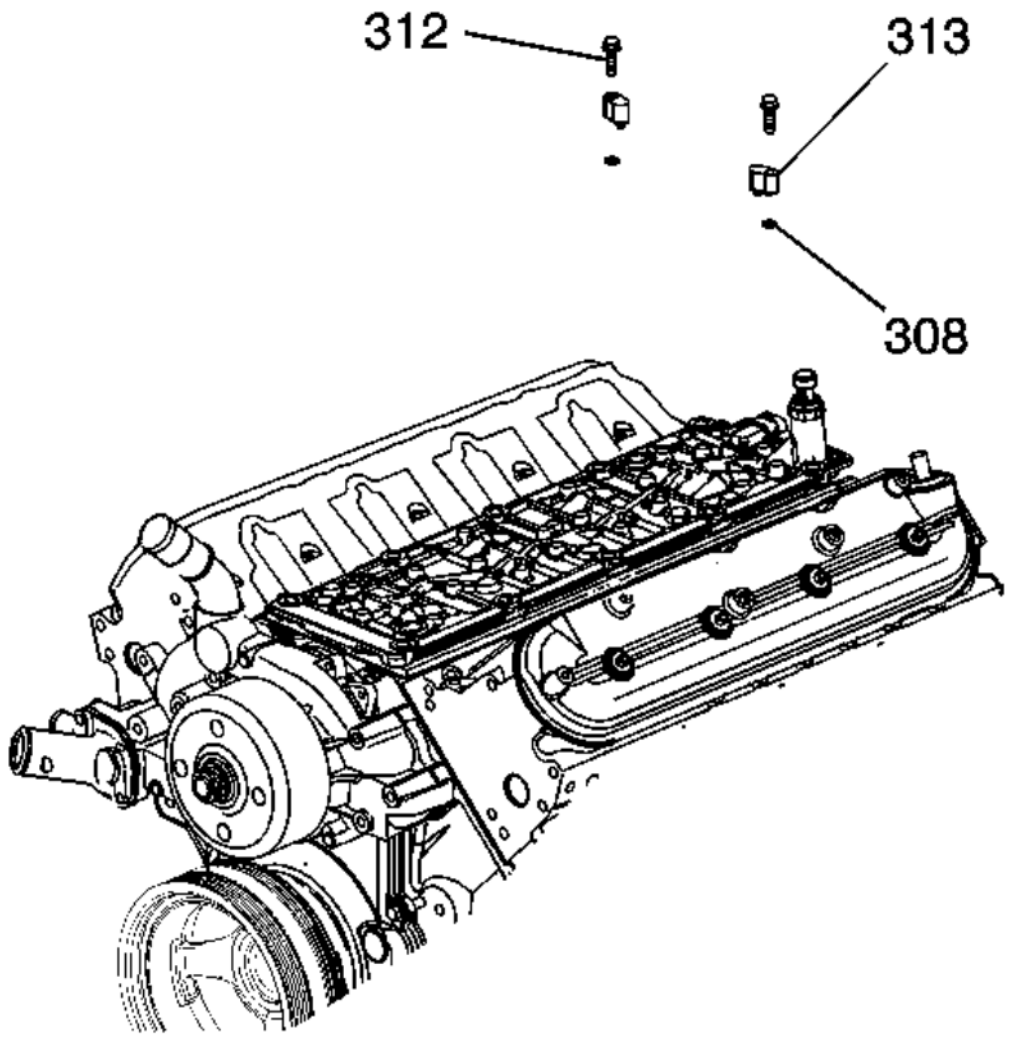


Fig. 171: Engine Coolant Air Bleed Cover Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the coolant air bleed cover bolts (312), if required.
9. Remove the coolant air bleed covers (313) and seals (308), if required.

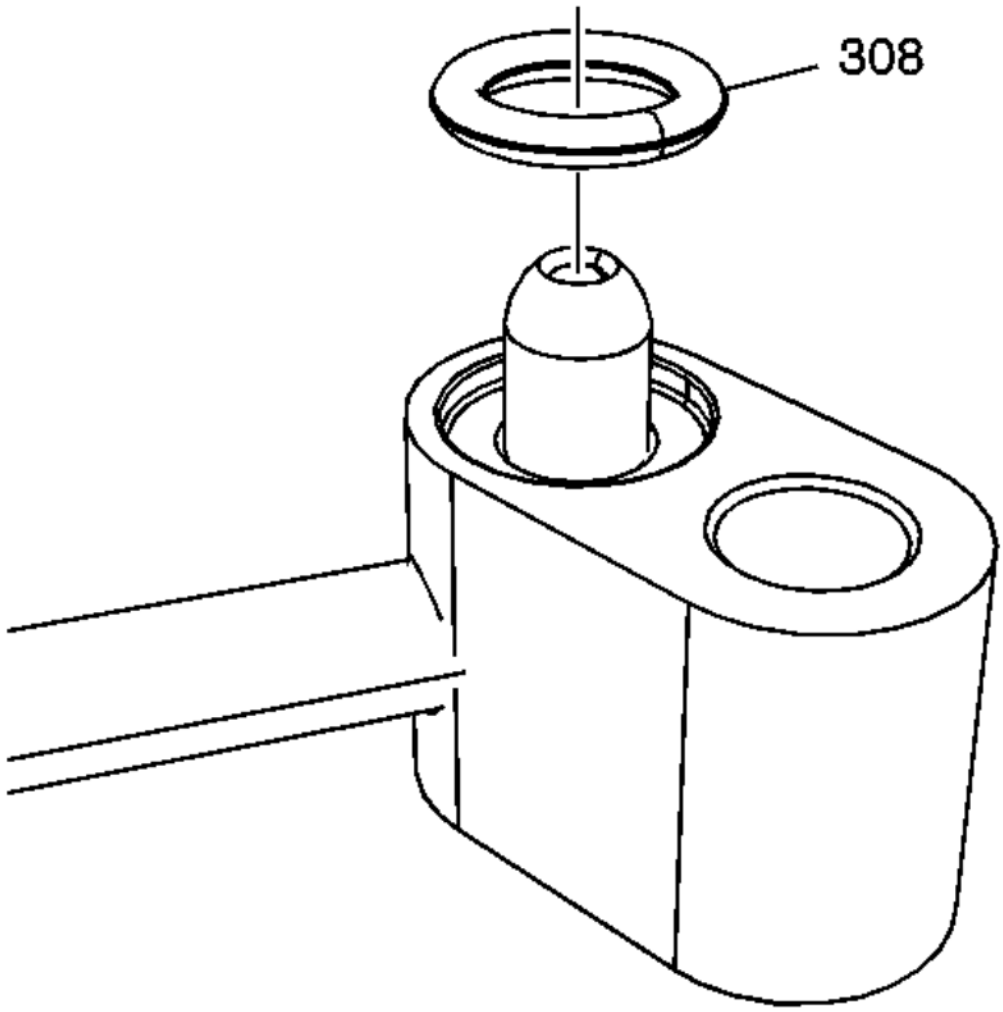


Fig. 172: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

10. Remove the seals (308) from the coolant air bleed pipe and/or covers.
11. Discard the seals.

Installation Procedure

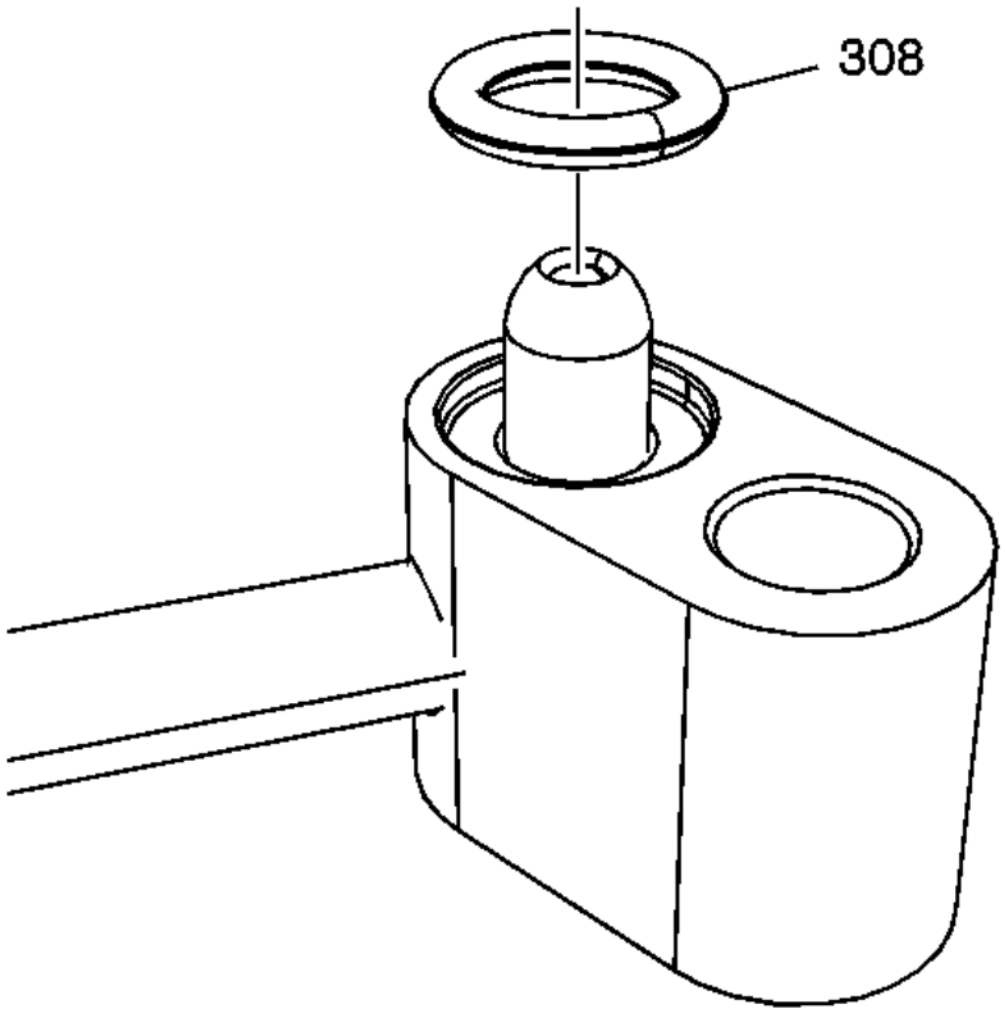


Fig. 173: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the O-ring seal (308) onto the nipple portion of the pipe.

1. Install the seals onto the coolant air bleed pipe and/or covers.

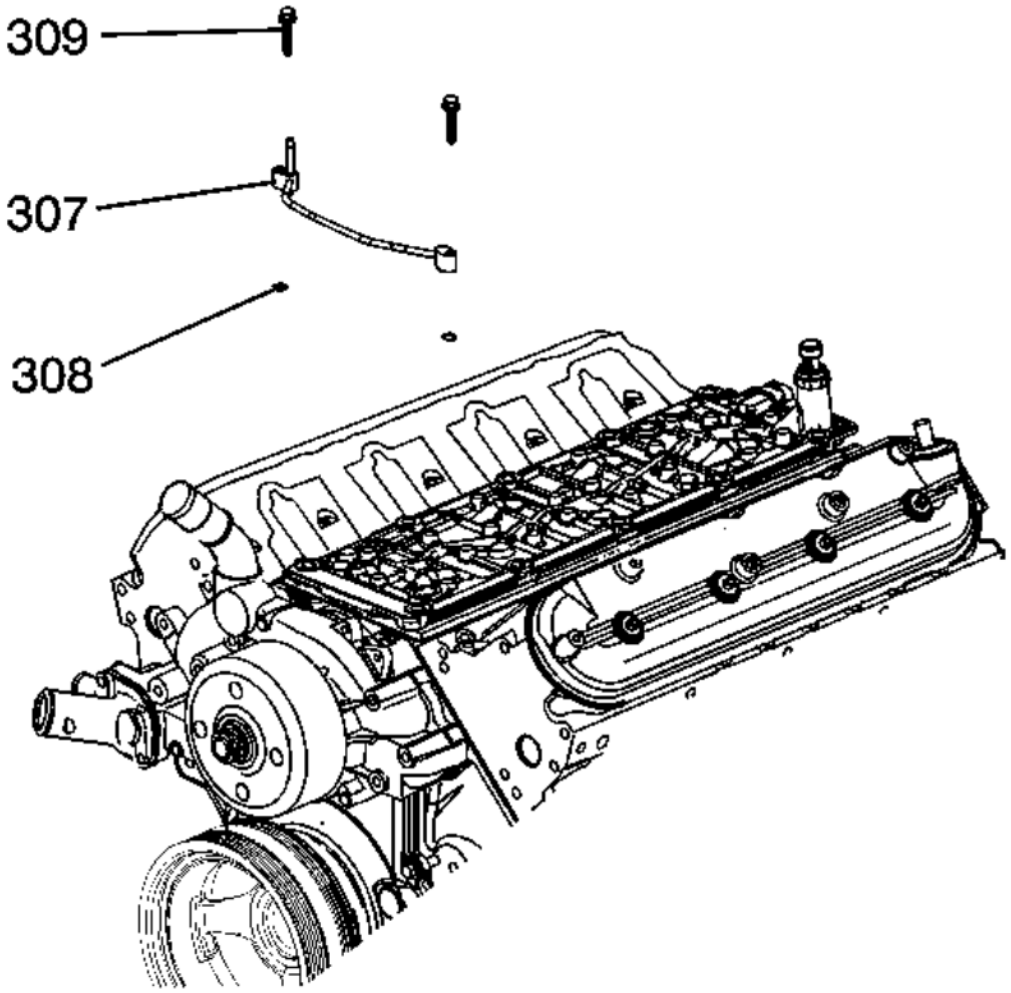


Fig. 174: Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS CORP.

2. Install the coolant air bleed pipe (307) and seals (308) onto the cylinder heads.

NOTE: Refer to Fastener Notice .

3. Install the coolant air bleed pipe bolts (309).

Tighten: Tighten the bolts to 12 N.m (106 lb in).

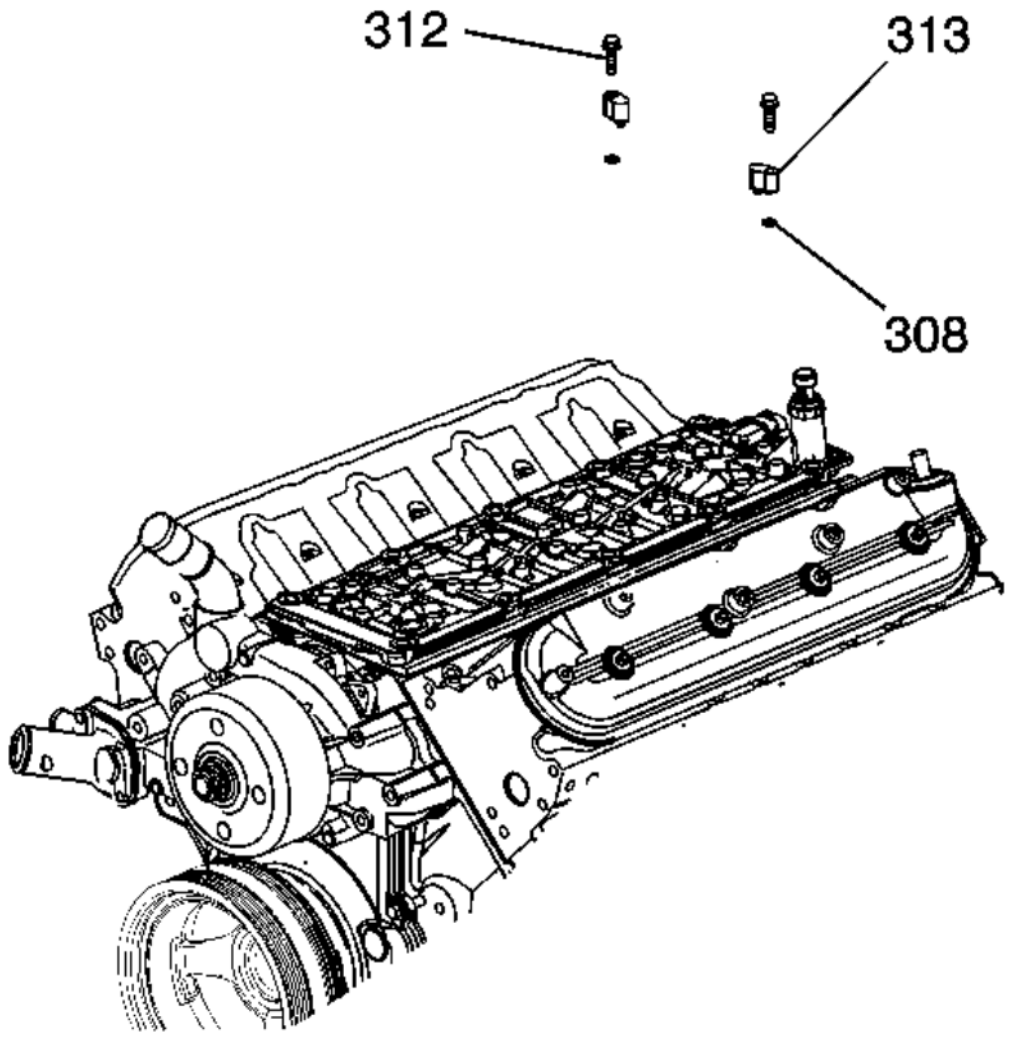


Fig. 175: Engine Coolant Air Bleed Cover Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the coolant air bleed covers (313) and seals (308), if required.
5. Install the coolant air bleed cover bolts (312), if required.

Tighten: Tighten the bolts to 12 N.m (106 lb in).

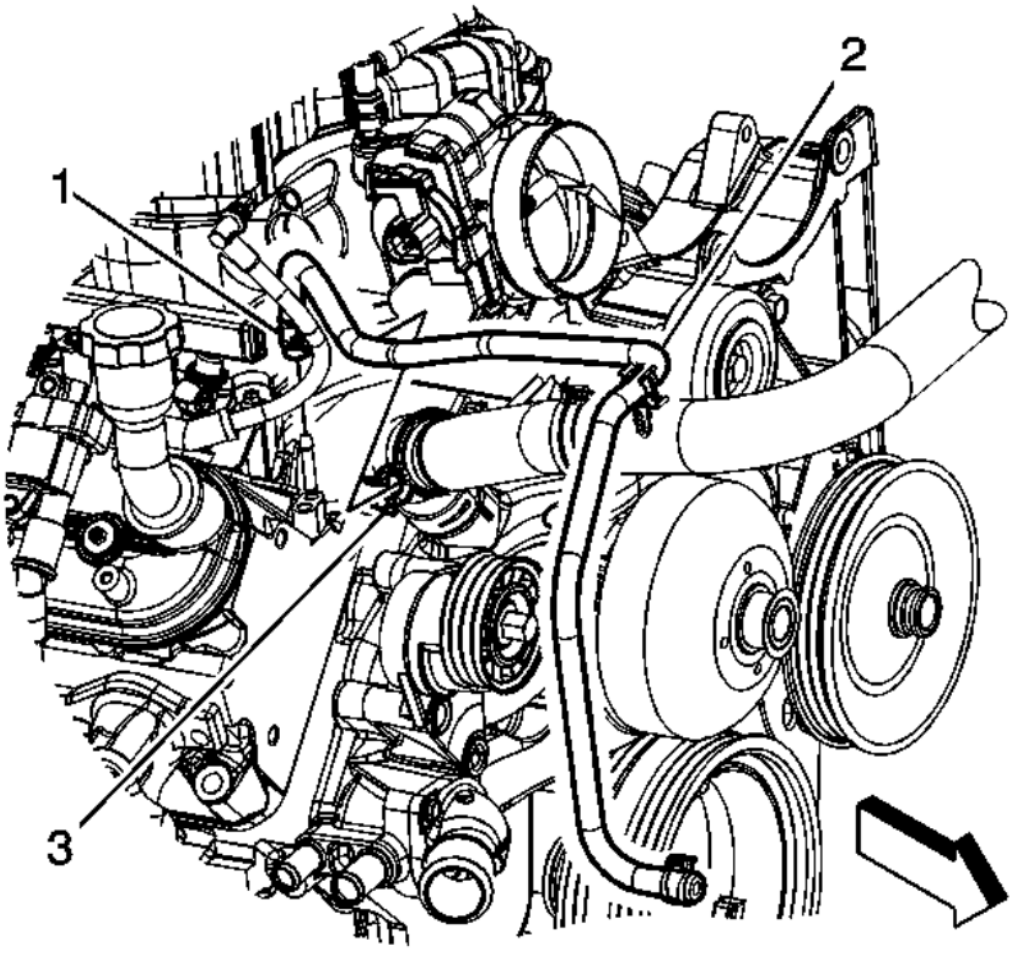


Fig. 176: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

6. Install the radiator vent inlet hose (2) to the coolant air bleed pipe fitting.
7. Position the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
10. If the rear coolant air bleed covers were replaced, install the intake manifold. Refer to **Intake Manifold Replacement (L92 - First Design)** or **Intake Manifold Replacement**

(L92 - Second Design) or **Intake Manifold Replacement (LY2 and LY6)** or **Intake Manifold Replacement (LH6, LMG, LY5 and L76)** .

COOLANT AIR BLEED PIPE ASSEMBLY REPLACEMENT (LY2, LY6)

Removal Procedure

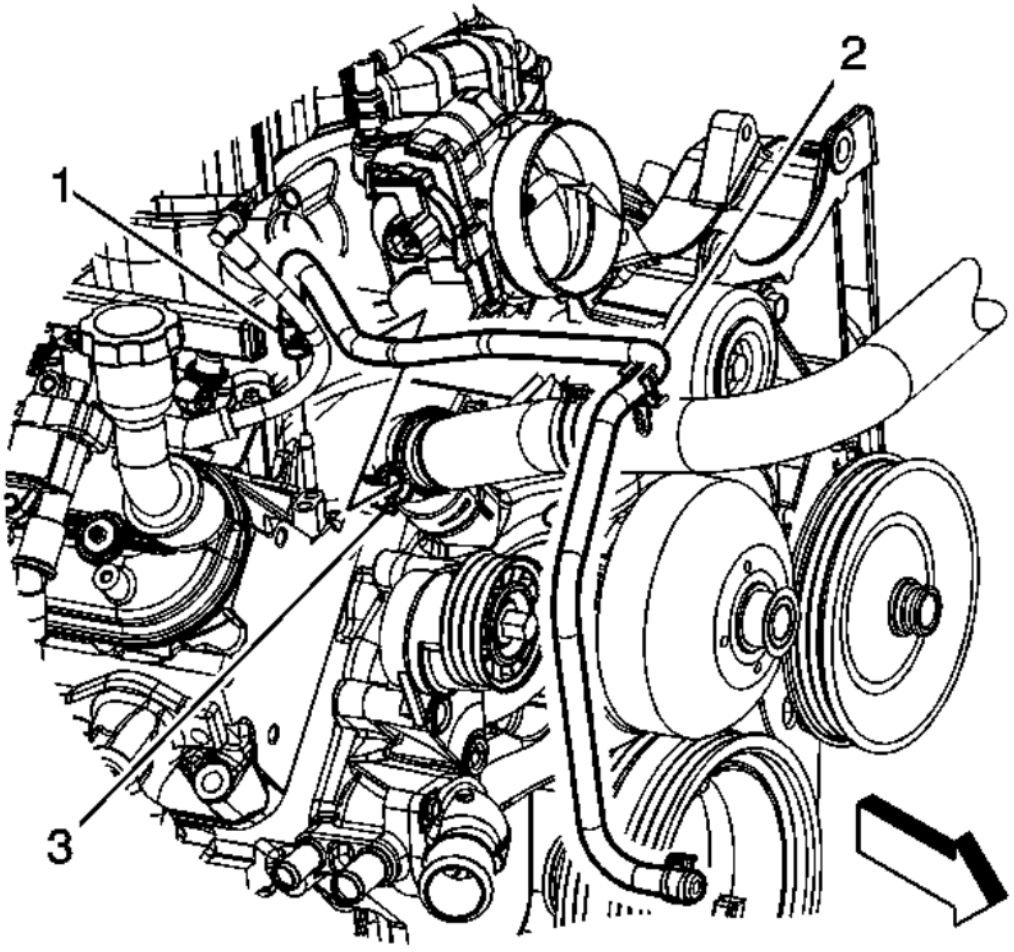


Fig. 177: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

1. If replacing the rear coolant air bleed covers, remove the intake manifold. Refer to **Intake Manifold Replacement (L92 - First Design)** or **Intake Manifold Replacement (L92 -**

Second Design) or **Intake Manifold Replacement (LY2 and LY6)** or **Intake Manifold Replacement (LH6, LMG, LY5 and L76)** . Otherwise proceed to the next step.

2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
4. Reposition the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
5. Remove the radiator vent inlet hose (2) from the coolant air bleed pipe fitting.

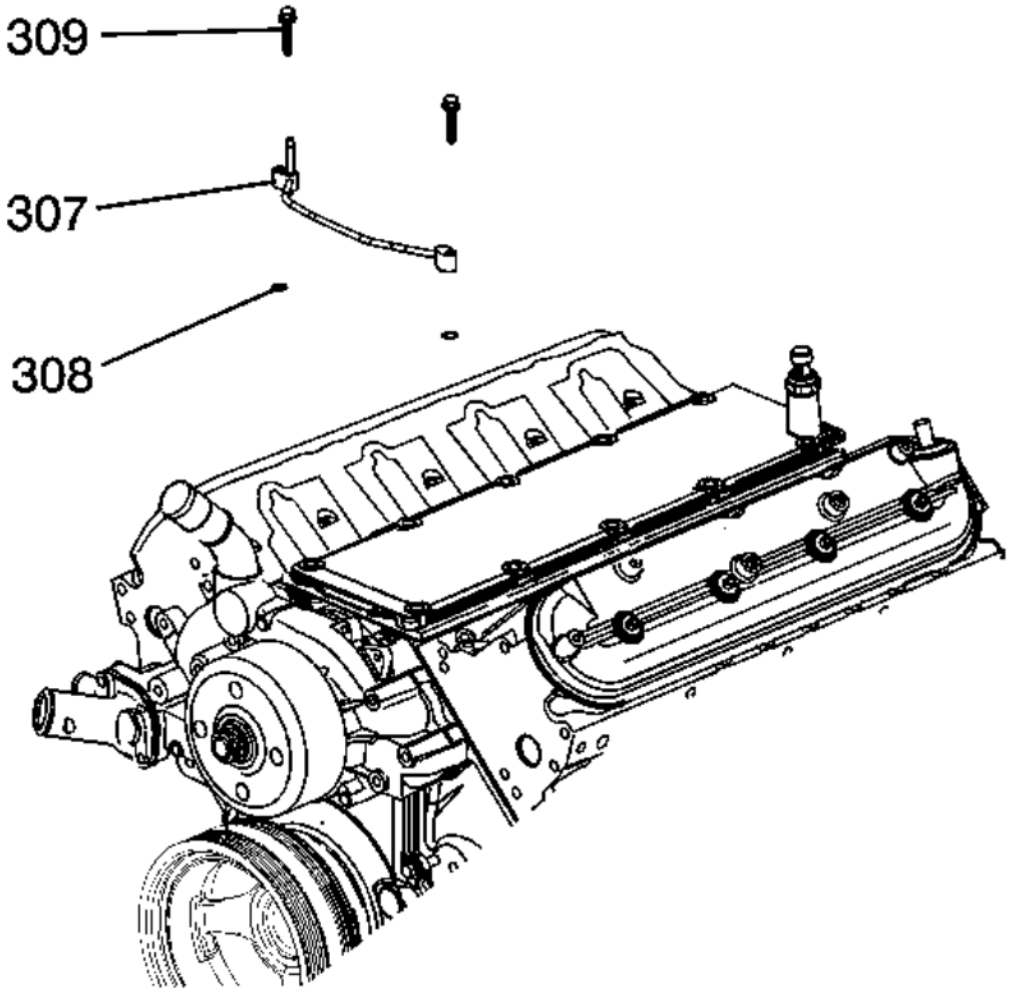


Fig. 178: Removing/Installing Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS CORP.

6. Remove the coolant air bleed pipe bolts (309) (intake manifold shown removed for clarity).
7. Remove the coolant air bleed pipe (307) and seals (308).

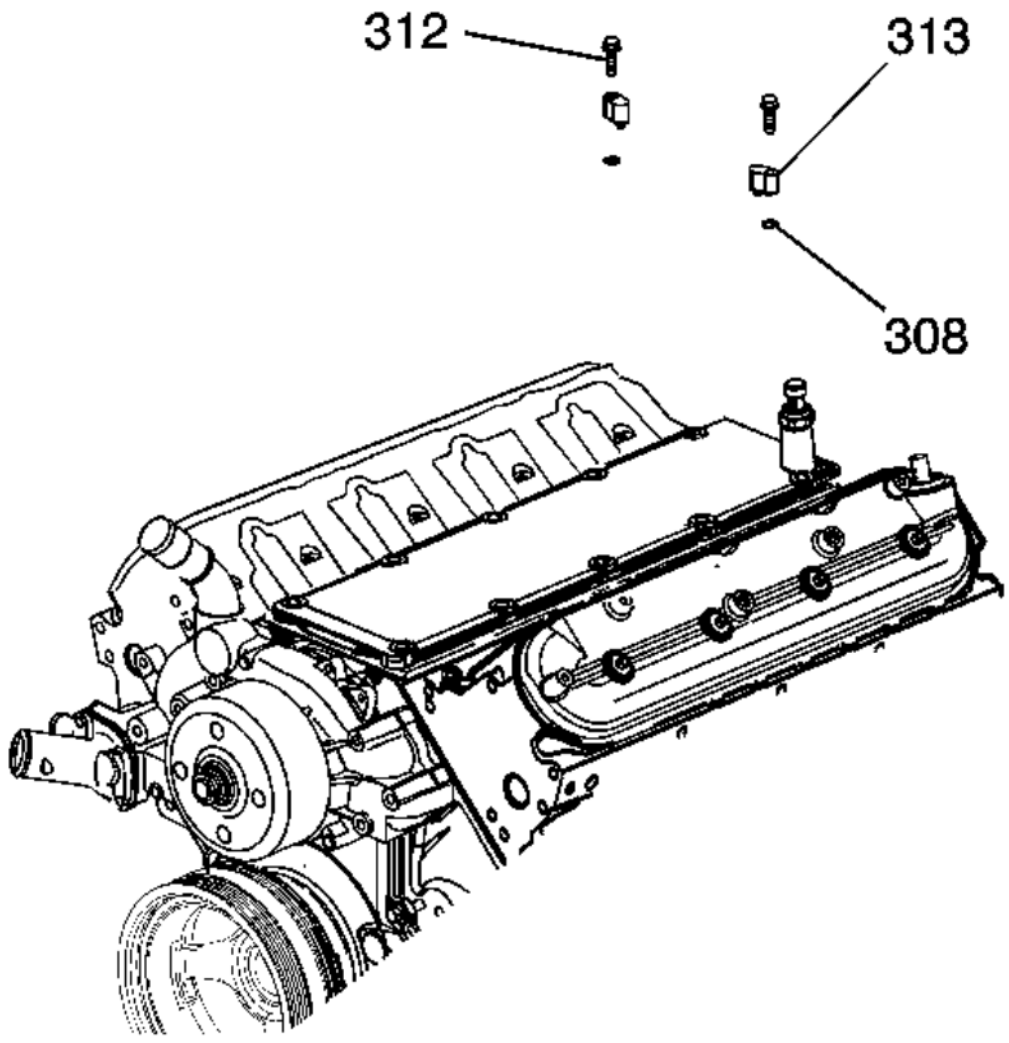


Fig. 179: Removing/Installing Coolant Air Bleed Cover Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the coolant air bleed cover bolts (312), if required.
9. Remove the coolant air bleed covers (313) and seals (308), if required.

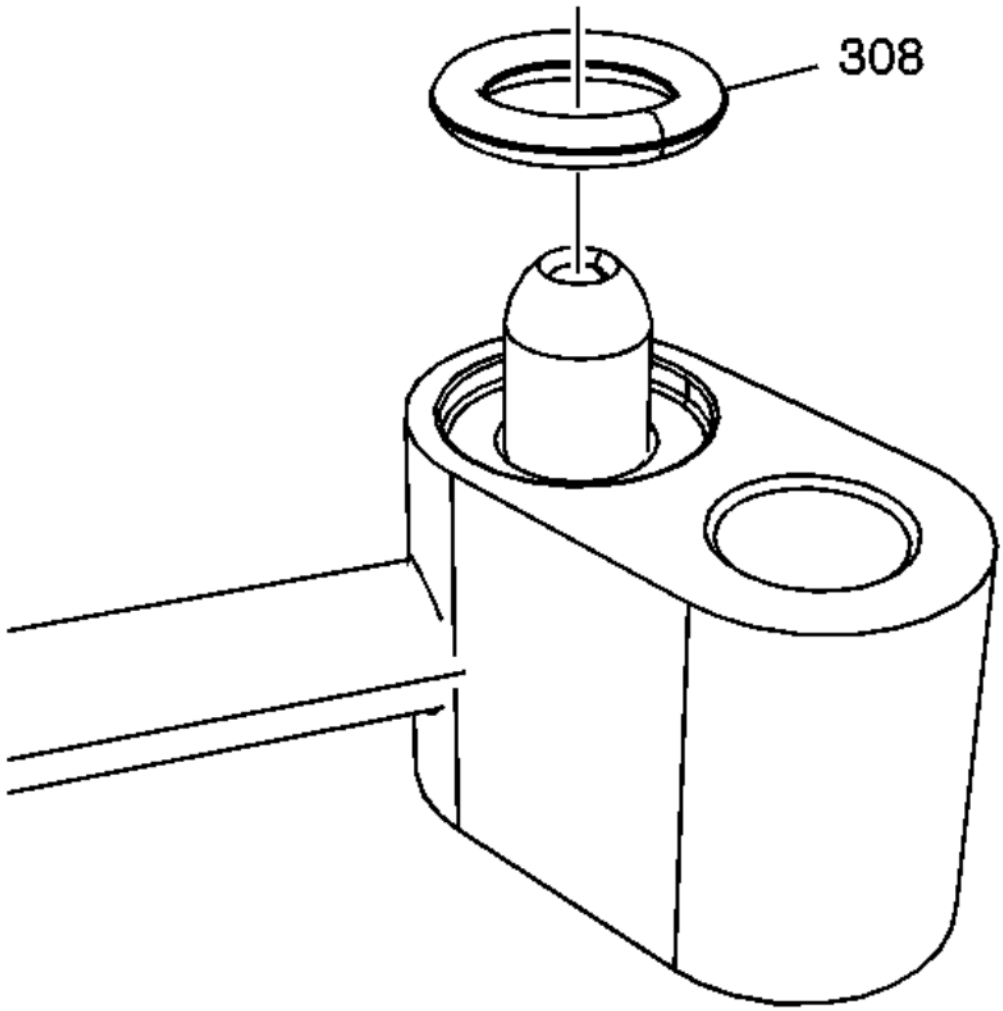


Fig. 180: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

10. Remove the seals (308) from the coolant air bleed pipe and/or covers.
11. Discard the seals.

Installation Procedure

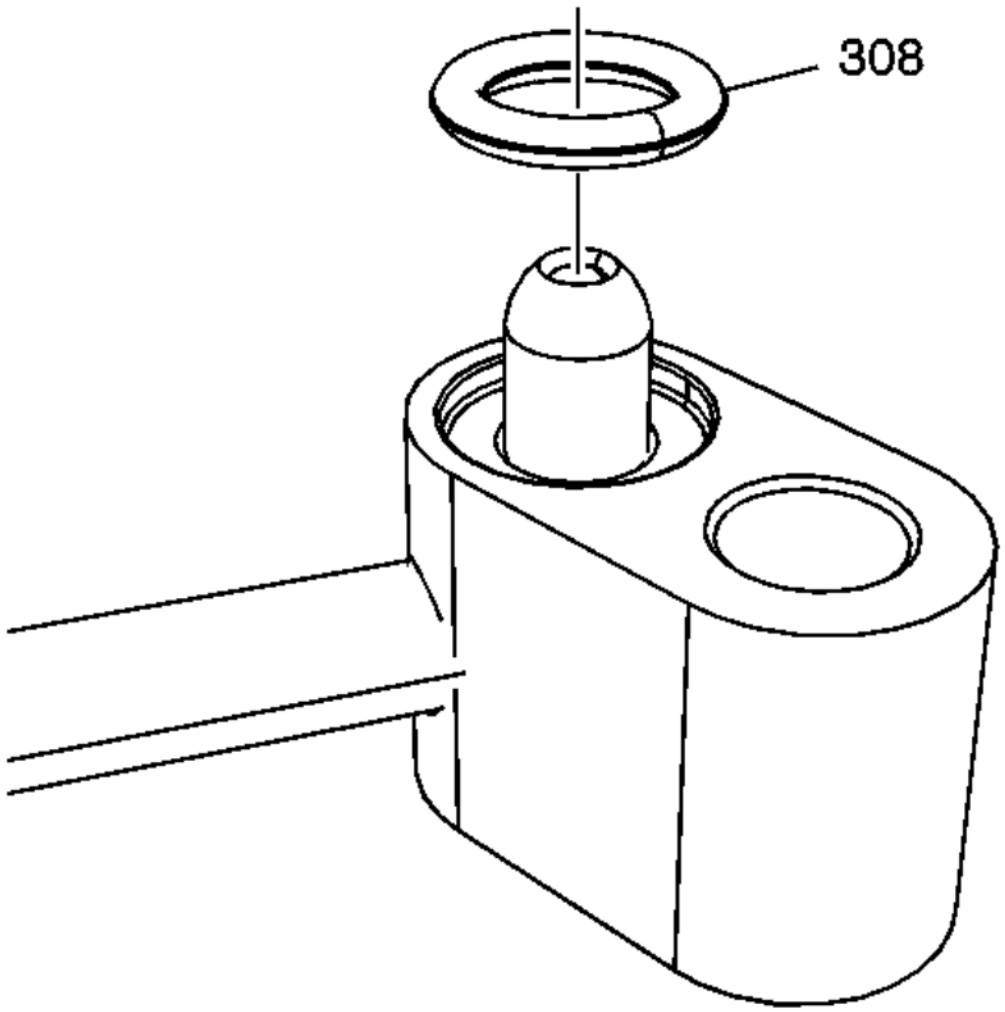


Fig. 181: View Of Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the O-ring seal (308) onto the nipple portion of the pipe.

1. Install the seals onto the coolant air bleed pipe and/or covers.

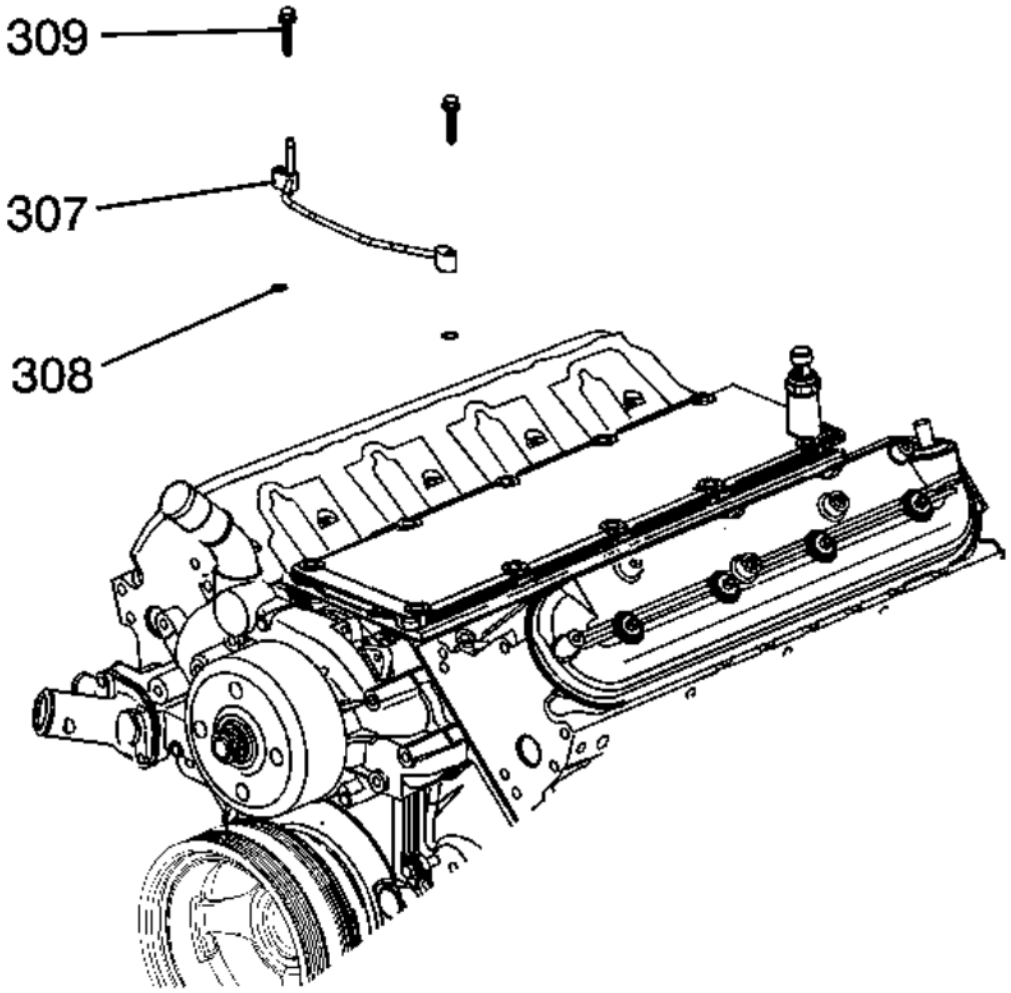


Fig. 182: Removing/Installing Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS CORP.

2. Install the coolant air bleed pipe (307) and seals (308) onto the cylinder heads.

NOTE: Refer to Fastener Notice .

3. Install the coolant air bleed pipe bolts (309).

Tighten: Tighten the bolts to 12 N.m (106 lb in).

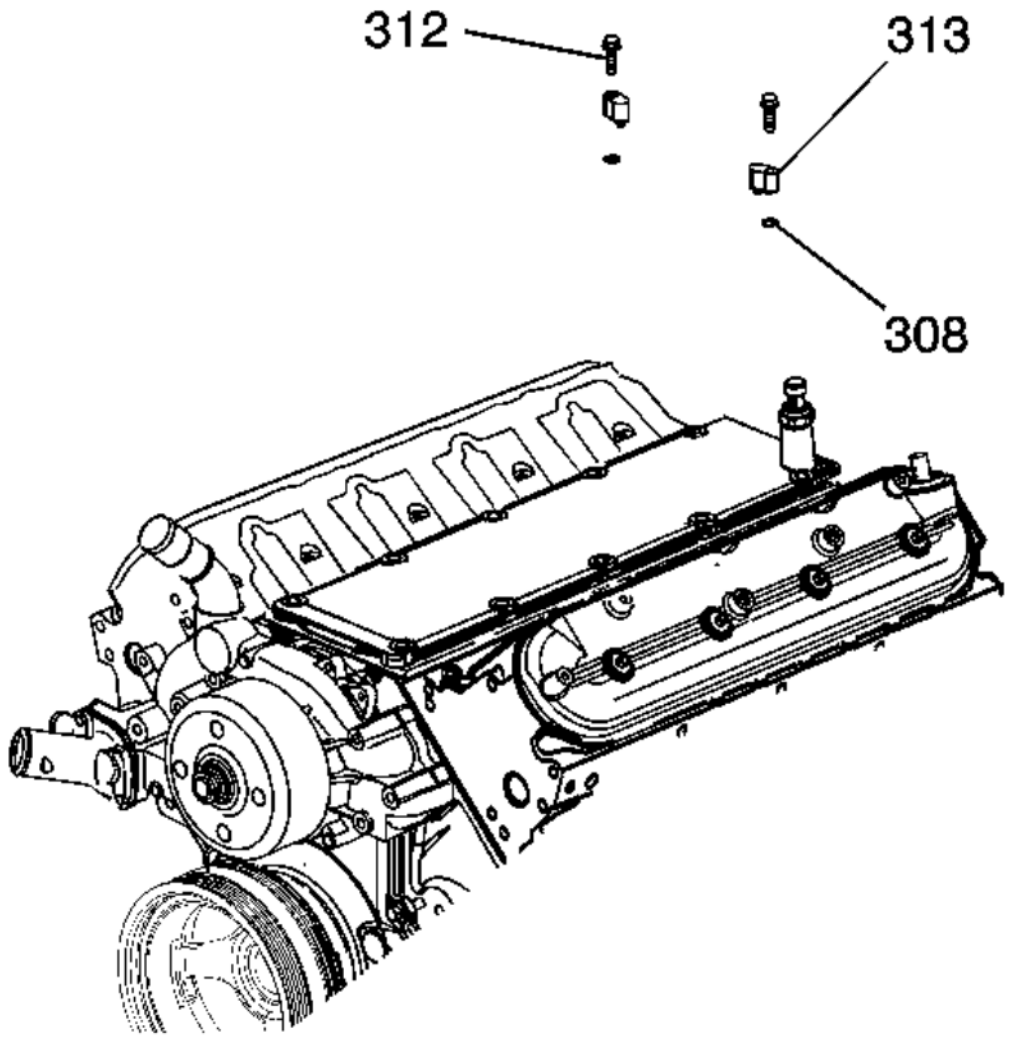


Fig. 183: Removing/Installing Coolant Air Bleed Cover Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the coolant air bleed covers (313) and seals (308), if required.
5. Install the coolant air bleed cover bolts (312), if required.

Tighten: Tighten the bolts to 12 N.m (106 lb in).

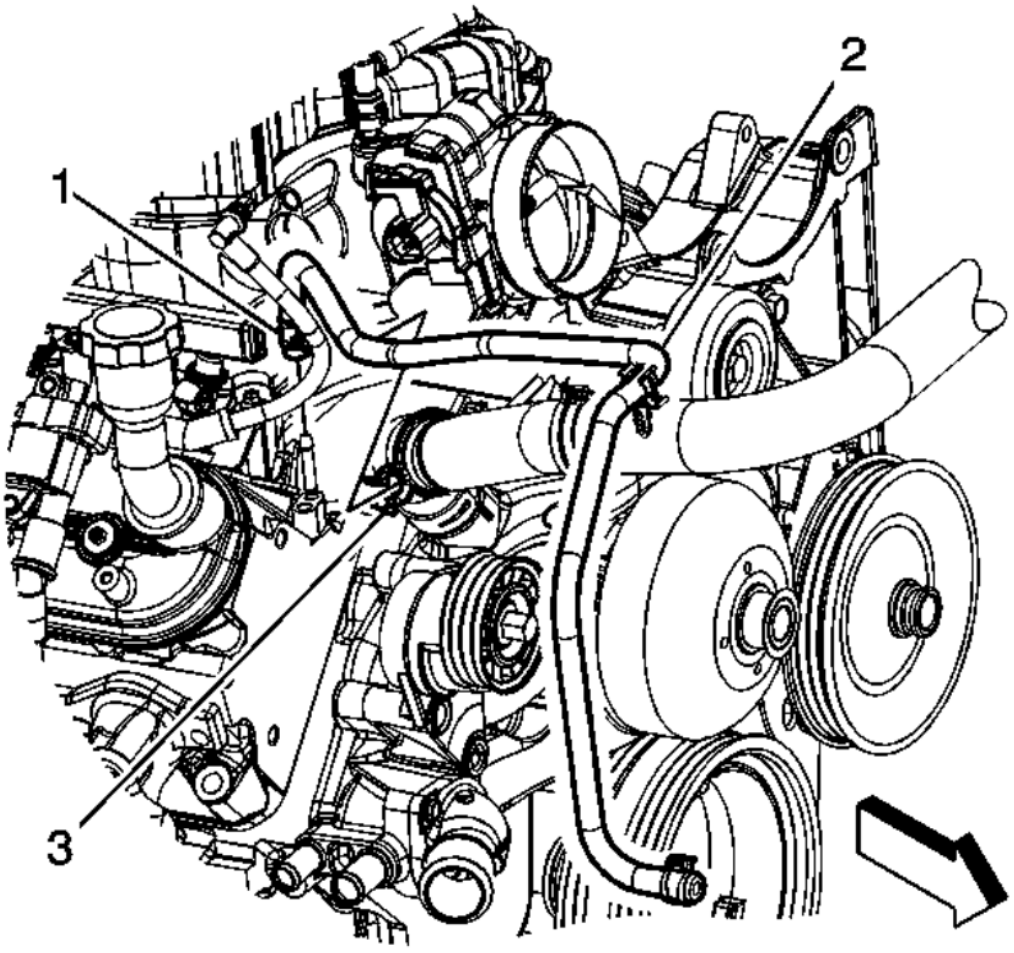


Fig. 184: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

6. Install the radiator vent inlet hose (2) to the coolant air bleed pipe fitting.
7. Position the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
10. If the rear coolant air bleed covers were replaced, install the intake manifold. Refer to **Intake Manifold Replacement (L92 - First Design)** or **Intake Manifold Replacement**

(L92 - Second Design) or **Intake Manifold Replacement (LY2 and LY6)** or **Intake Manifold Replacement (LH6, LMG, LY5 and L76)** .

WATER PUMP REPLACEMENT (LU3)

Tools Required

J 41240 Fan Clutch Remover and Installer

Removal Procedure

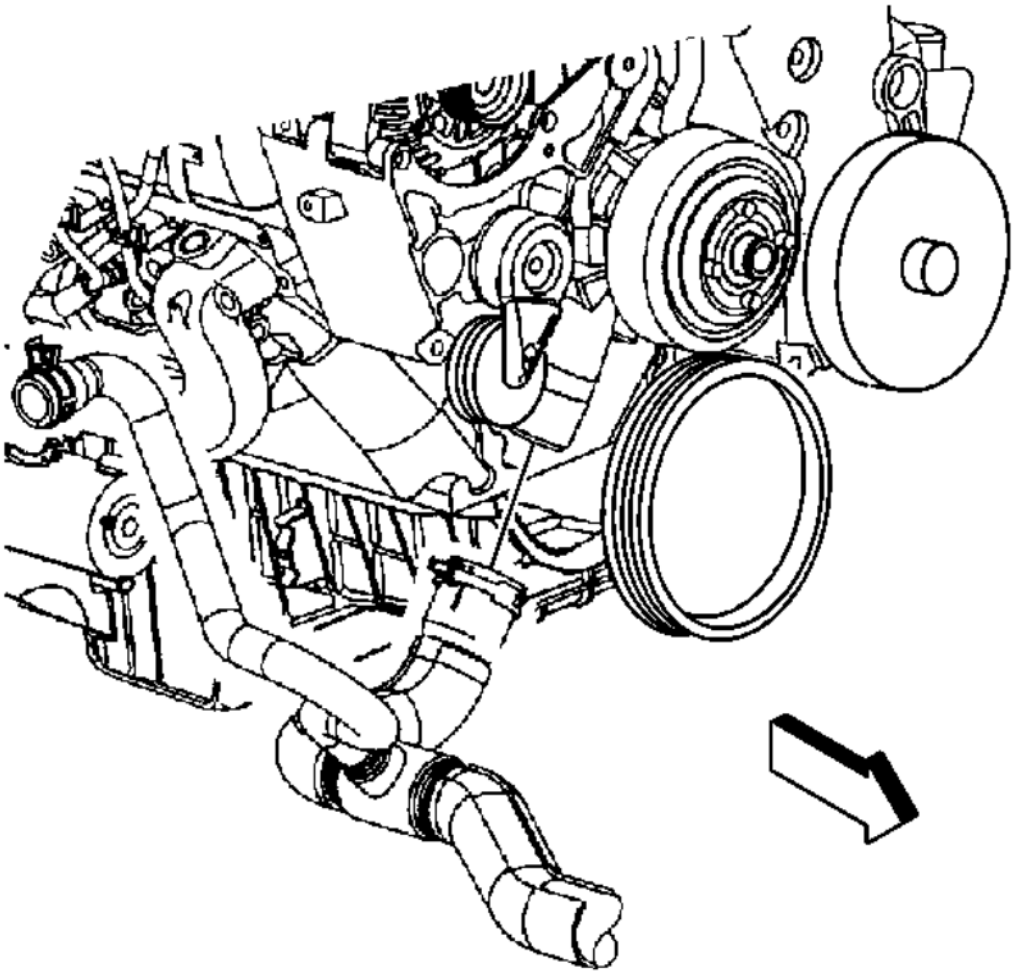


Fig. 185: View Of Radiator Outlet Hose

Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Resonator Replacement** .
2. Remove the drive belt. Refer to **Drive Belt Replacement** .
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
4. Reposition the radiator outlet hose clamps at the surge tank and water pump.
5. Remove the radiator outlet hose from the surge tank.
6. Remove the radiator outlet hose from the water pump.

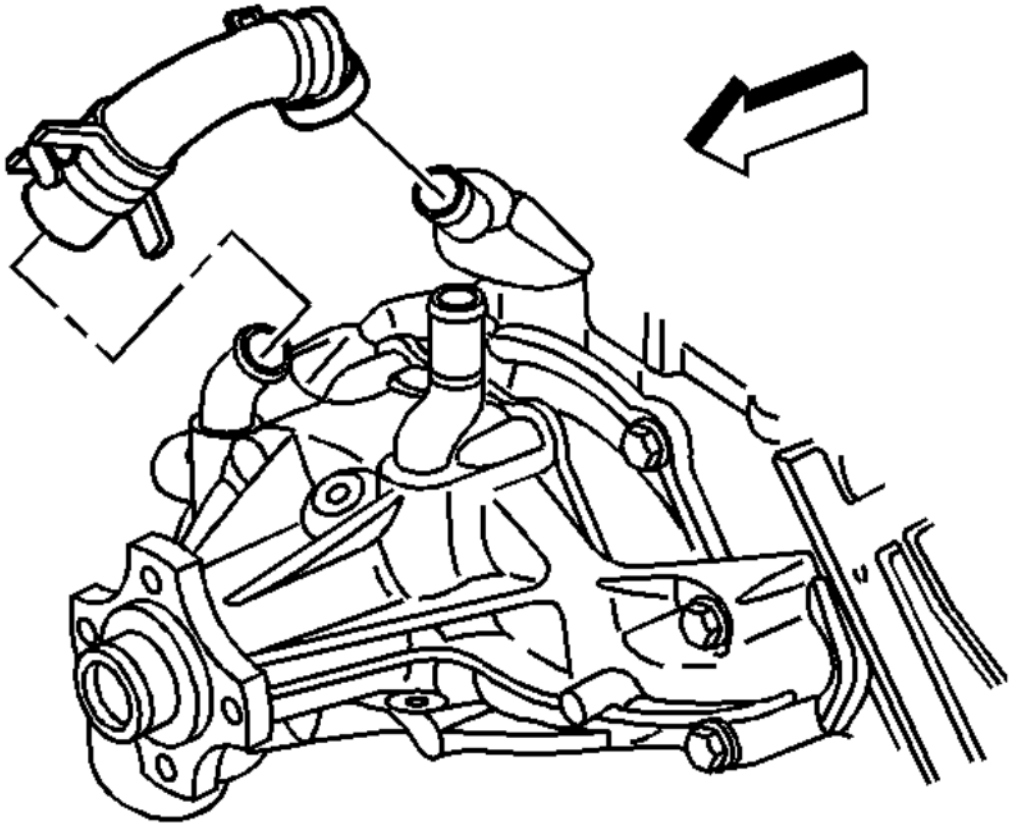


Fig. 186: View Of Water Pump Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

7. Reposition the water pump inlet hose clamps.
8. Remove the water pump inlet hose.

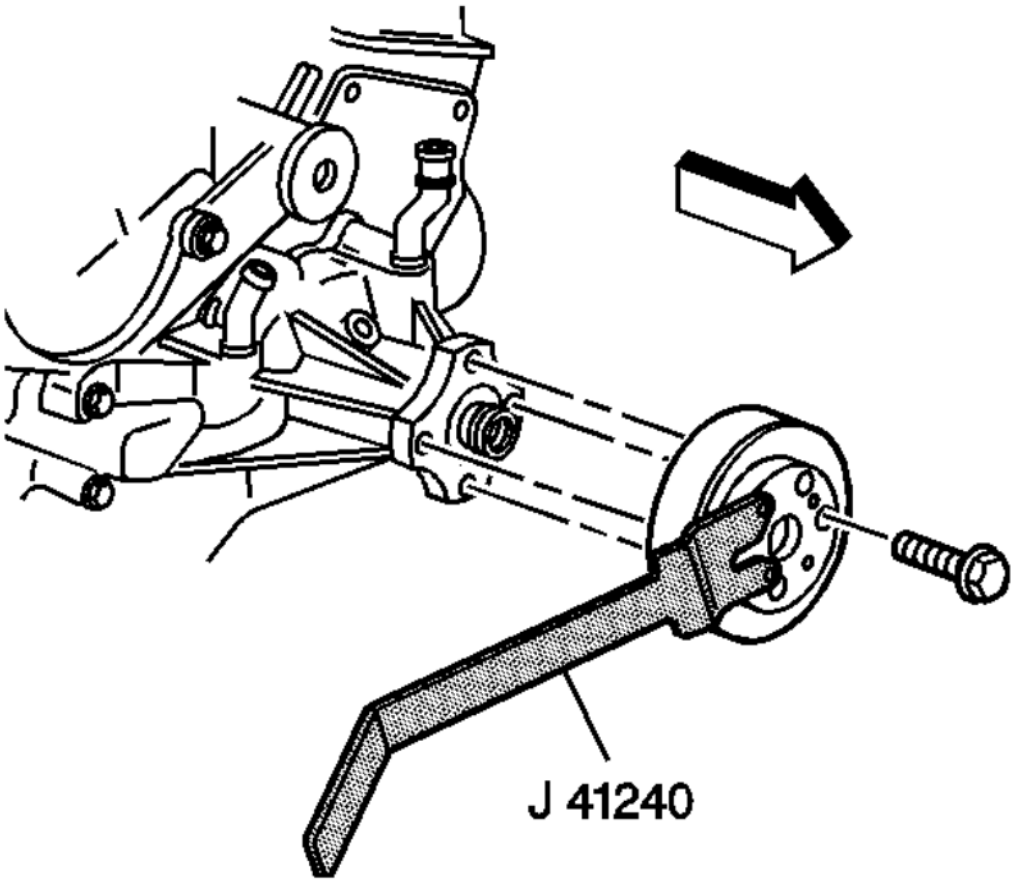


Fig. 187: View Of Fan, Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Using **J 41240** , hold the water pump pulley, remove the water pump pulley bolts.

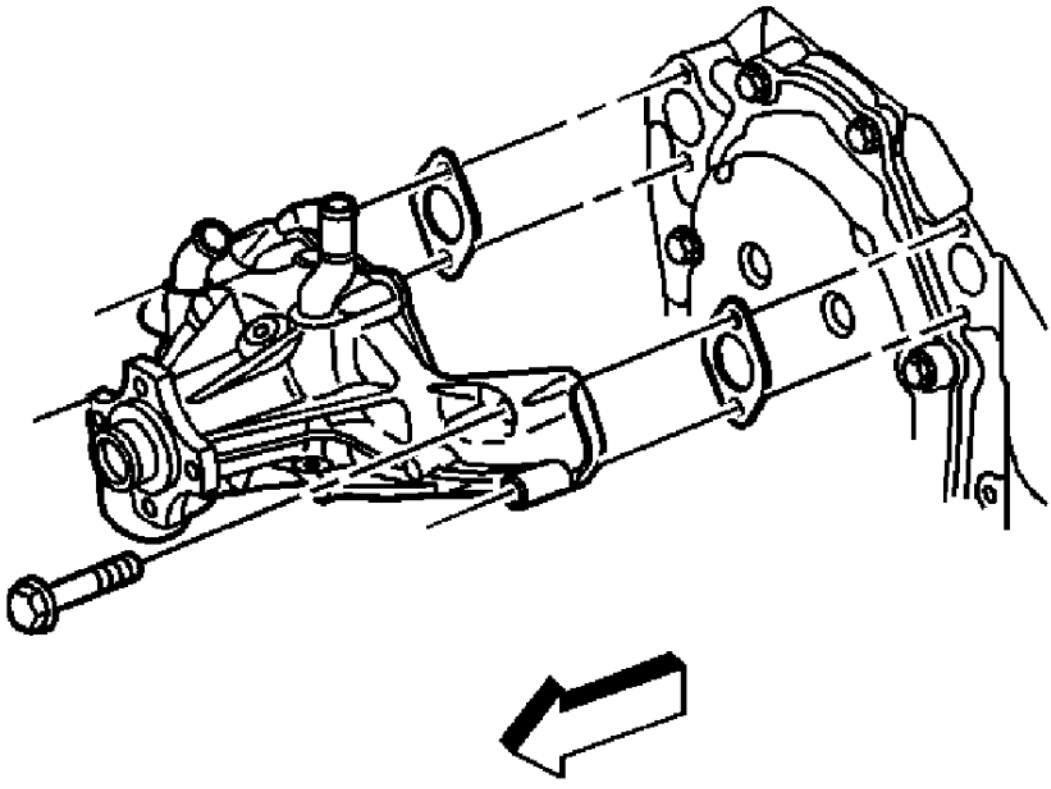


Fig. 188: View Of Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the water pump bolts.
11. Remove the water pump.
12. Remove and discard the water pump gaskets.
13. Clean and inspect the water pump, if necessary. Refer to **Water Pump Cleaning and Inspection** .

Installation Procedure

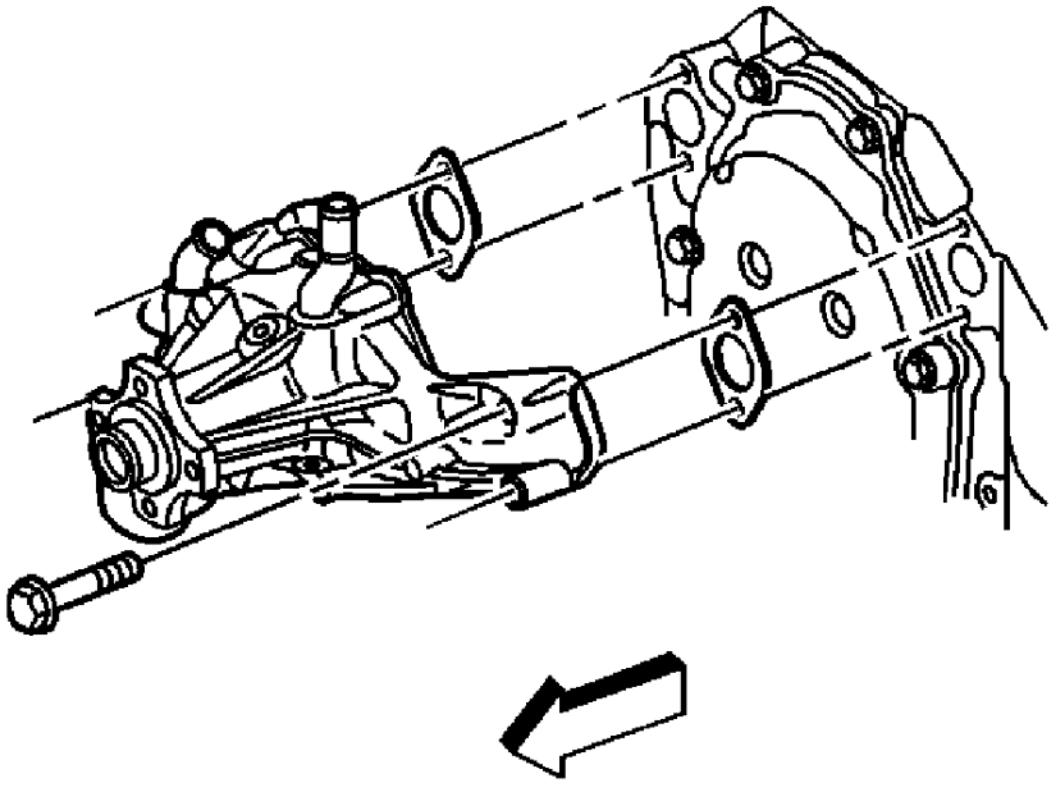


Fig. 189: View Of Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

1. If reusing the old fasteners, apply sealant GM P/N 12346004, (Canadian P/N 10953480), or equivalent to the threads of the water pump bolts.
2. Install NEW water pump gaskets and the water pump.

NOTE: Refer to Fastener Notice .

3. Install the water pump bolts.

Tighten: Tighten the bolts to 45 N.m (33 lb ft).

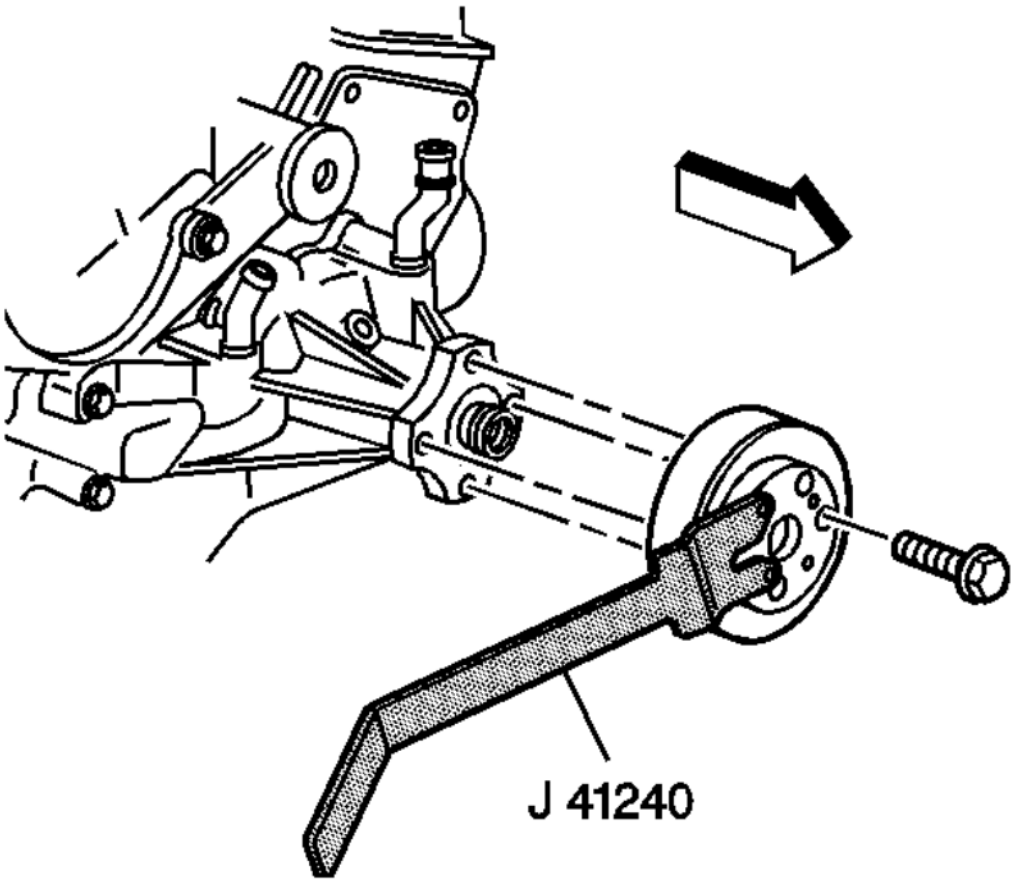


Fig. 190: View Of Fan, Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Using **J 41240** , hold the water pump pulley, install the water pump pulley bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

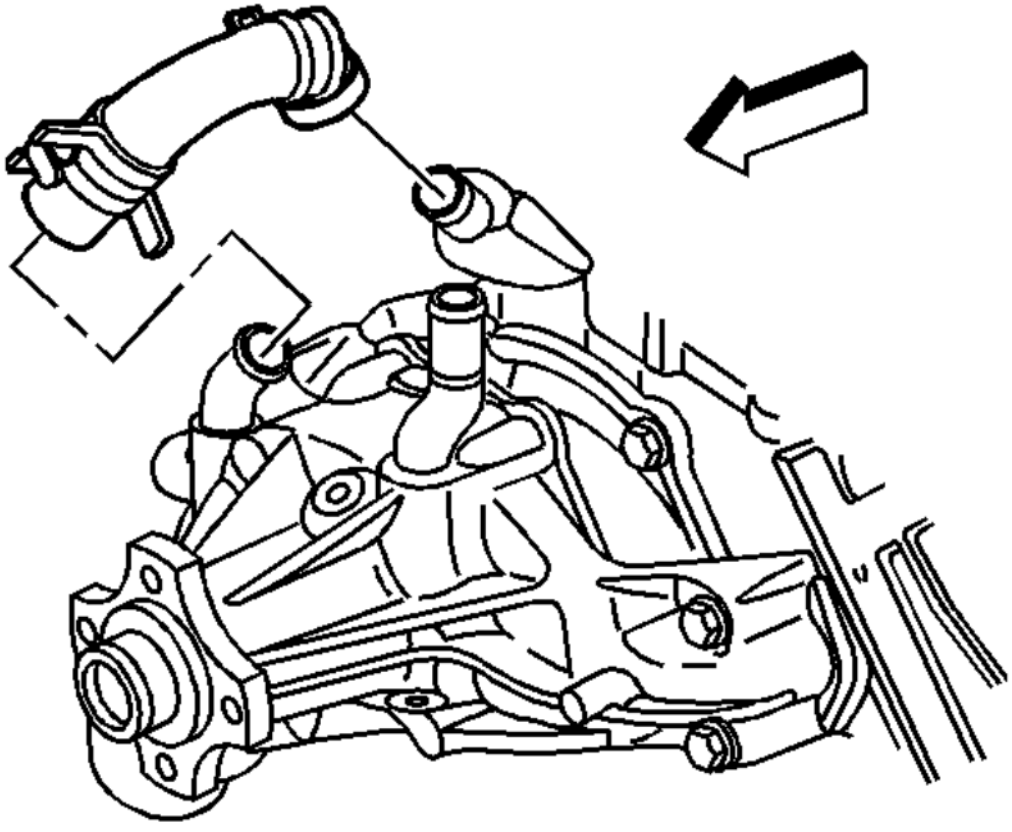


Fig. 191: View Of Water Pump Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: After assembly, the hose clamp tangs (water pump end) must point forward and the upper tang should be level with the outside diameter of the water pump inlet hose.

5. Install the water pump inlet hose.
6. Position the water pump inlet hose clamps.

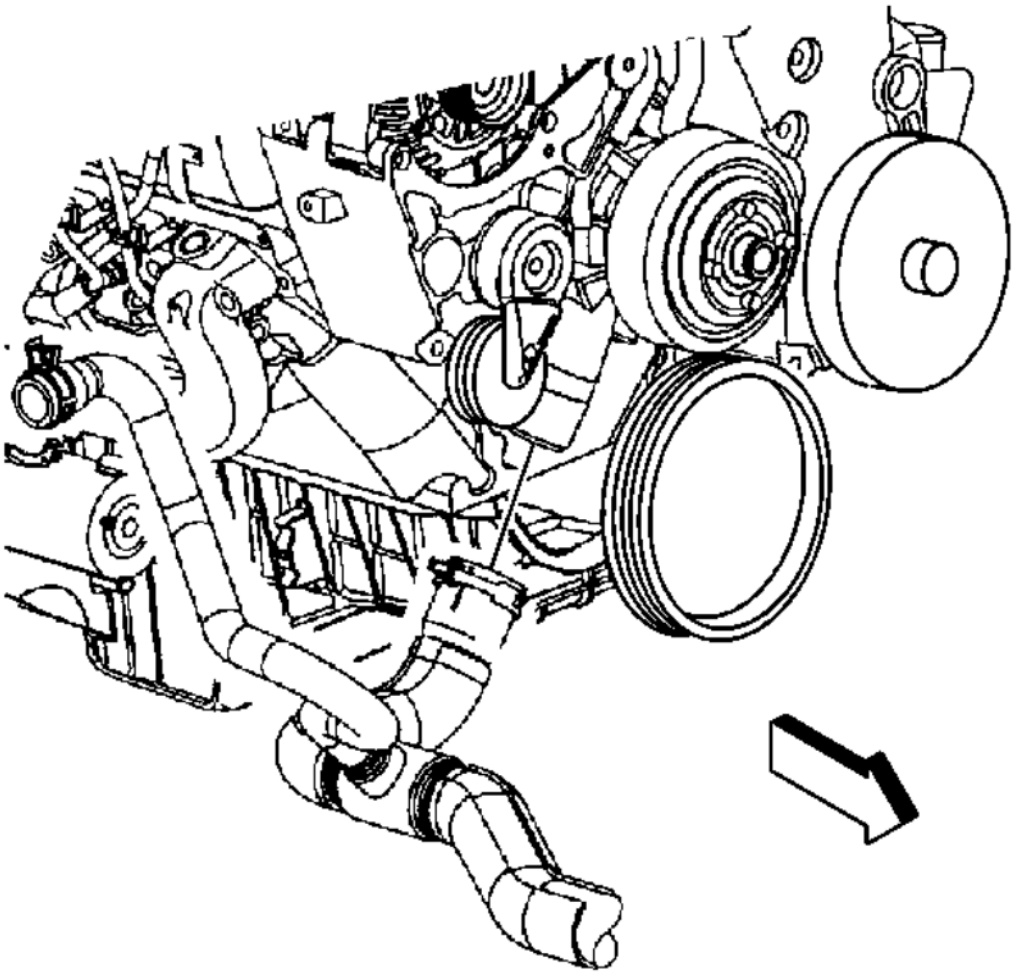


Fig. 192: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Install the radiator outlet hose to the water pump.
8. Install the radiator outlet hose to the surge tank.
9. Position the radiator outlet hose clamps at the surge tank and water pump.
10. Install the drive belt. Refer to **Drive Belt Replacement** .
11. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Resonator Replacement** .
12. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

13. Inspect the cooling system for leaks.

WATER PUMP REPLACEMENT (LY6, L76 AND L92)

Removal Procedure

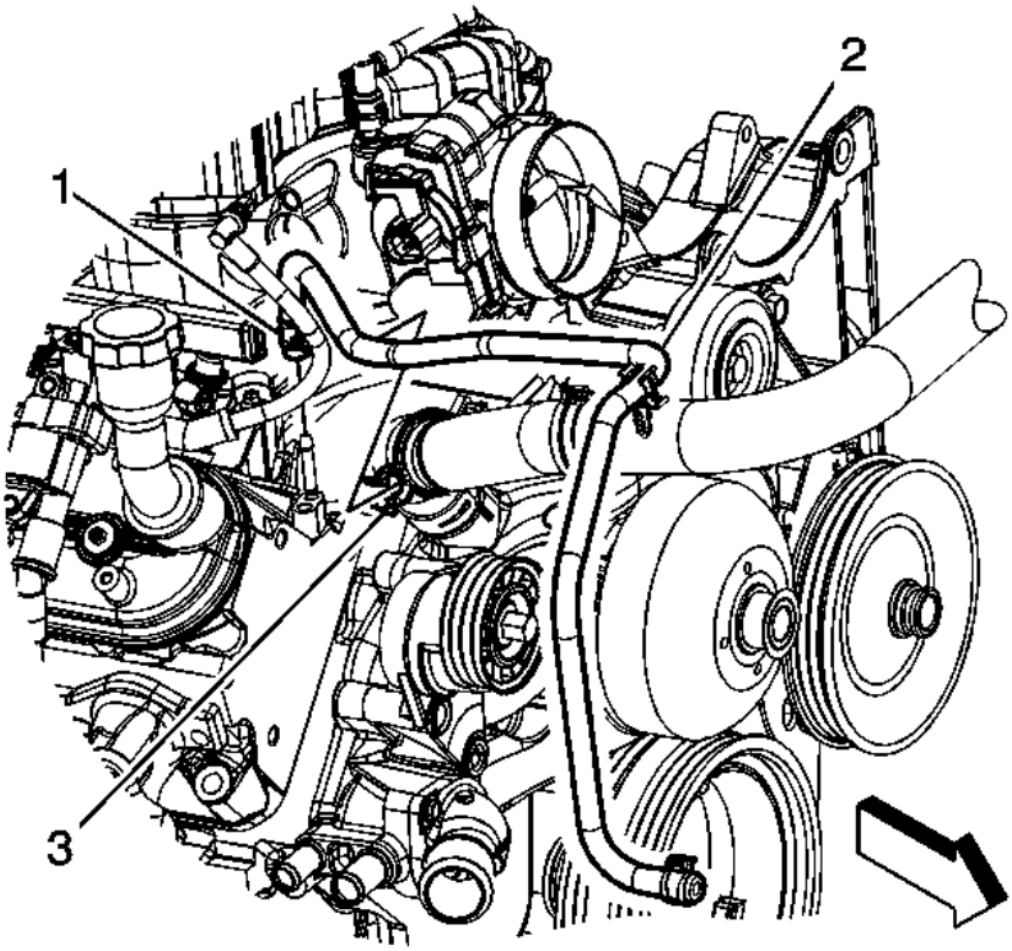


Fig. 193: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or

Cooling System Draining and Filling (Static Fill).

3. Reposition the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
4. Remove the radiator vent inlet hose (2) from the coolant air bleed pipe fitting.

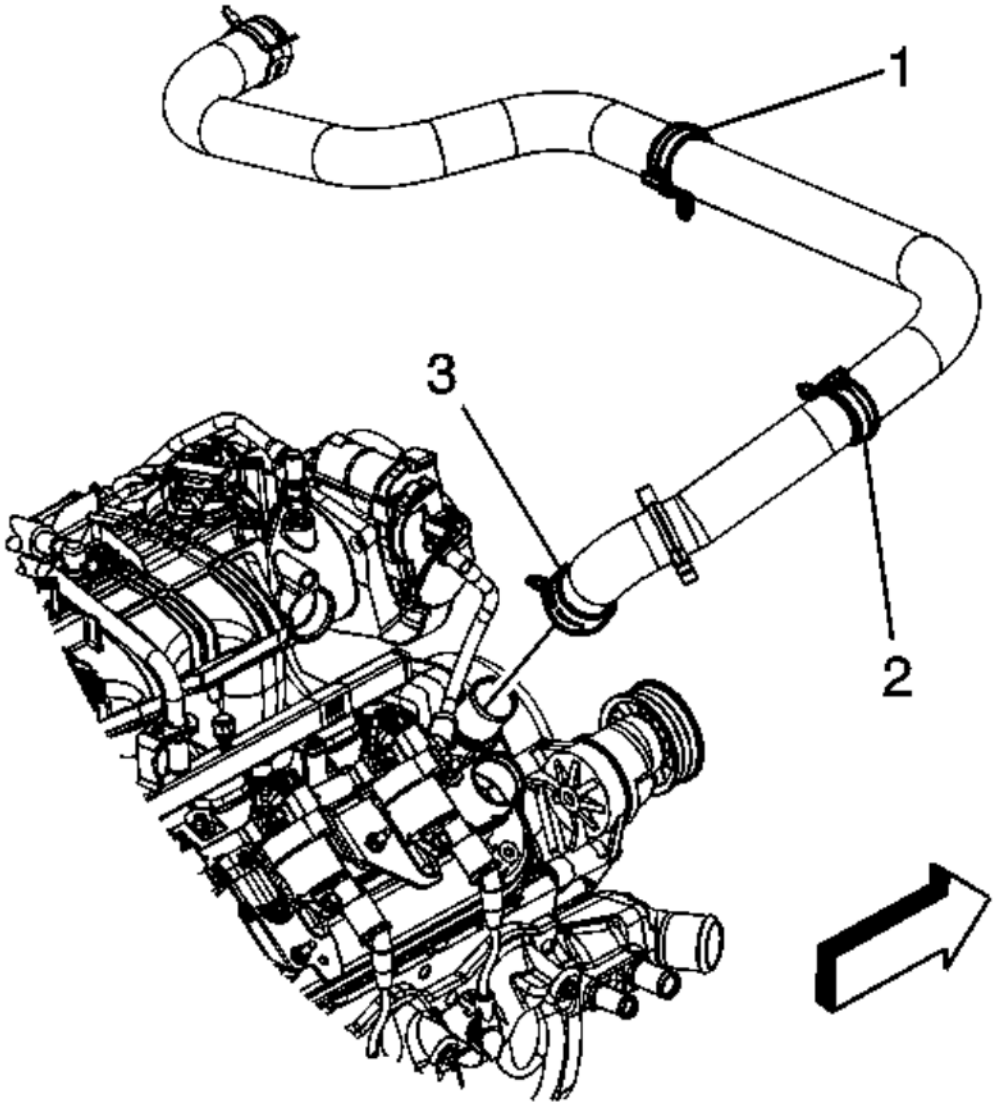


Fig. 194: View Of Radiator Vent Inlet Hose Clamp At Water Pump
Courtesy of GENERAL MOTORS CORP.

5. Reposition the radiator inlet hose clamp (3) at the water pump.
6. Remove the radiator inlet hose from the water pump.
7. Reposition the radiator inlet hose and vent inlet hose out of the way.
8. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .

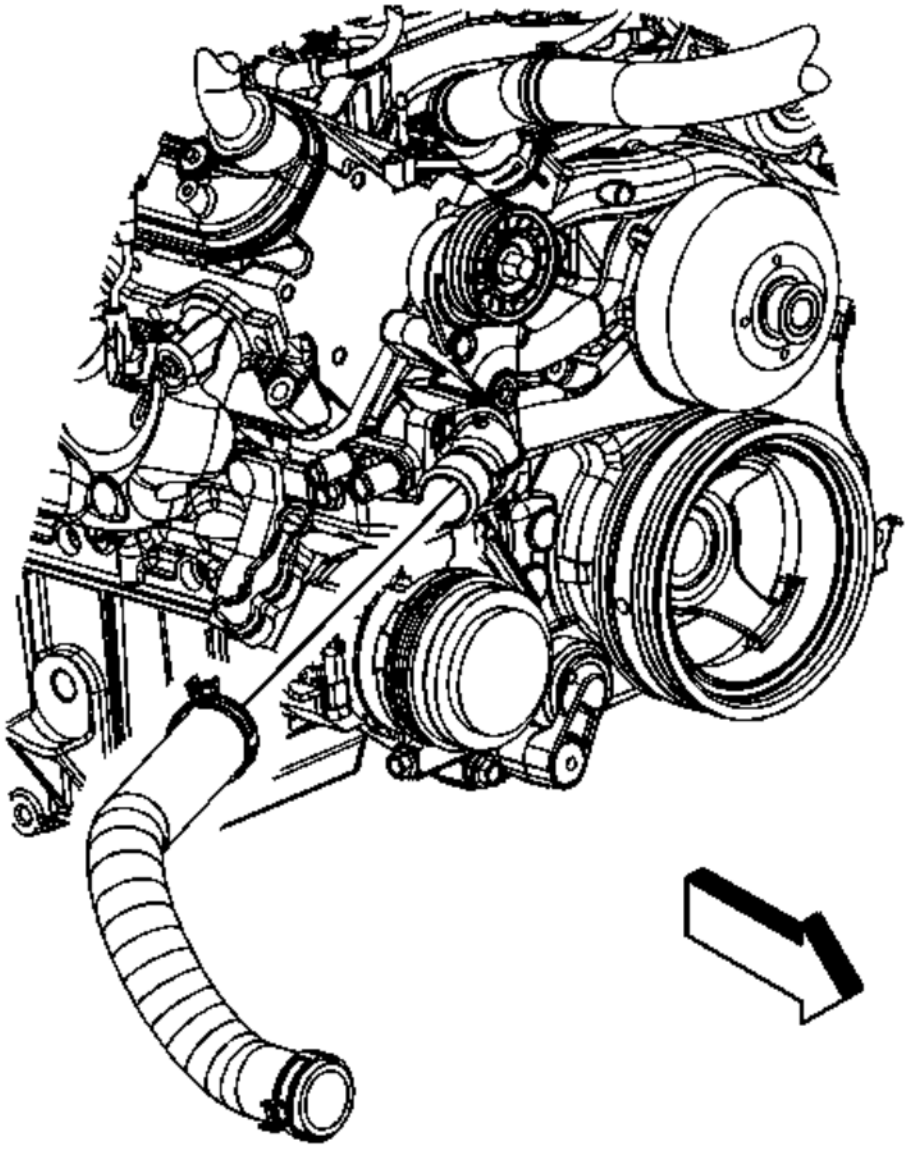


Fig. 195: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Reposition the radiator outlet hose clamp at the water pump.
10. Remove the radiator outlet hose from the water pump.
11. Reposition the outlet hose out of the way.

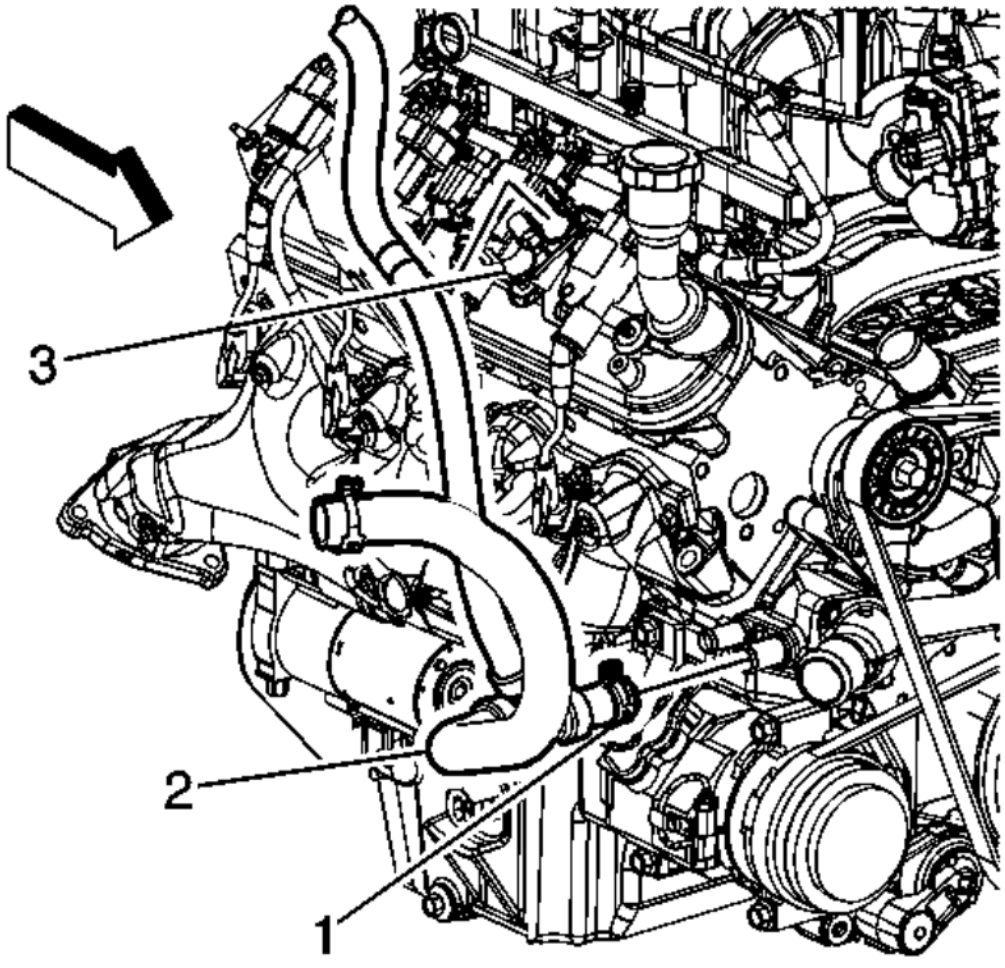


Fig. 196: View Of Radiator Surge Tank Outlet Hose, Clamp & Water Pump
Courtesy of GENERAL MOTORS CORP.

12. Reposition the radiator surge tank outlet hose clamp at the water pump (1).

13. Remove the radiator surge tank outlet hose (2) from the water pump.
14. Reposition the outlet hose out of the way.

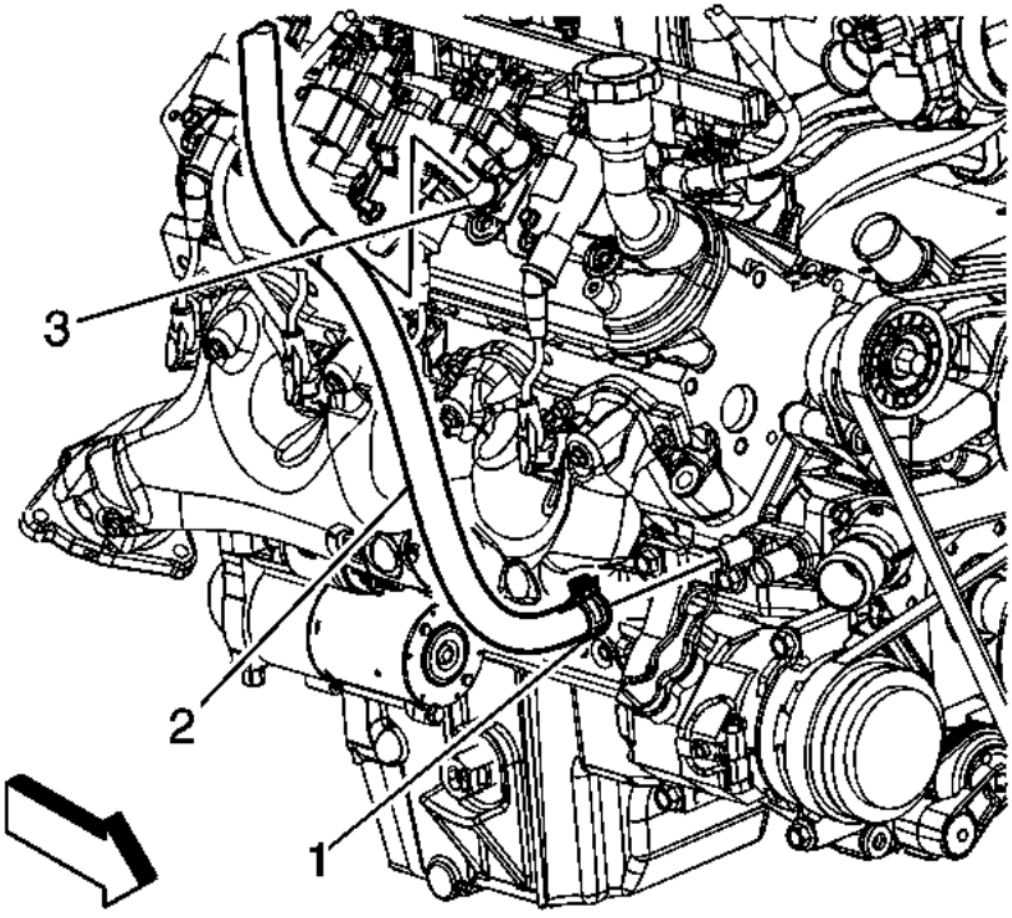


Fig. 197: View Of Heater Inlet Hose, Clamp & Waterpump
Courtesy of GENERAL MOTORS CORP.

15. Reposition the heater inlet hose clamp (1) at the water pump.
16. Remove the heater inlet hose (2) from the water pump.
17. Reposition the inlet hose out of the way.

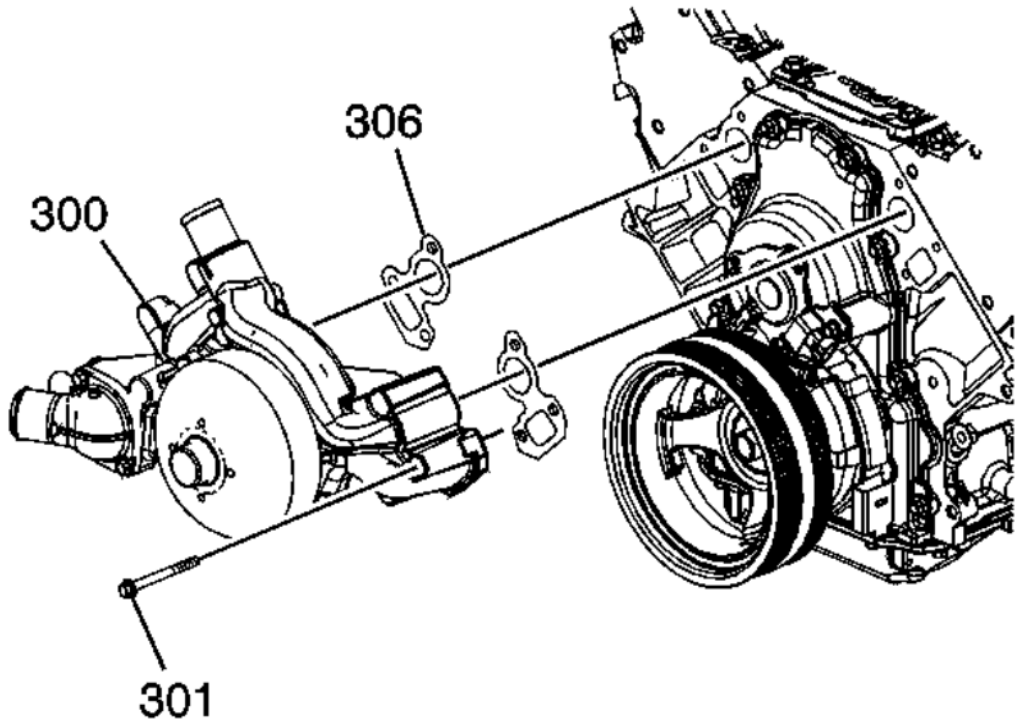


Fig. 198: View Of Water Pump, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

18. Remove the water pump bolts (301).
19. Remove the water pump (300) and gaskets (309). Discard the gaskets.

Installation Procedure

NOTE: DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.

IMPORTANT: All gaskets surfaces are to be free of oil or other foreign material during assembly.

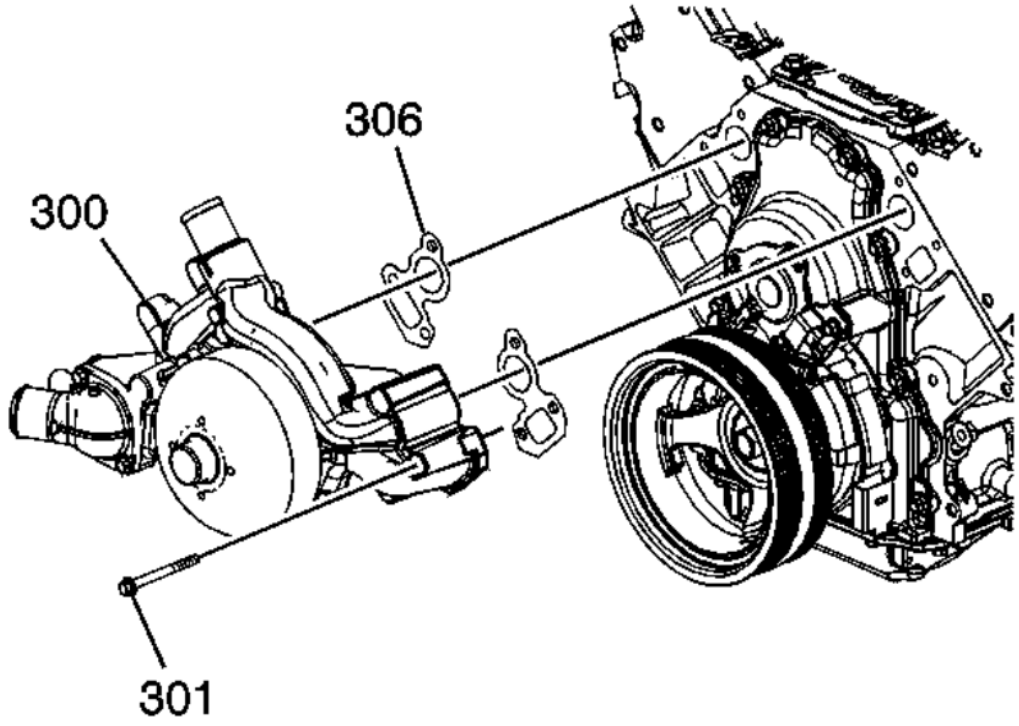


Fig. 199: View Of Water Pump, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Inspect the drained coolant for sand or other debris, flush the system as needed. Refer to **Flushing**.
2. Inspect and clear the radiator vent hose fitting, if necessary.

   There is a small 2.0 mm (0.080 in) orifice (vent hose fitting) in the neck of the radiator where the coolant vent hose from the engine attaches to the radiator.

3. Position the water pump (300) and NEW gaskets (306) to the engine block.

   NOTE: Refer to Fastener Notice .

4. Install the water pump bolts (301).

   Tighten:

1. Tighten the bolts a first pass to 15 N.m (11 lb ft).
2. Tighten the bolts a final pass to 30 N.m (22 lb ft).

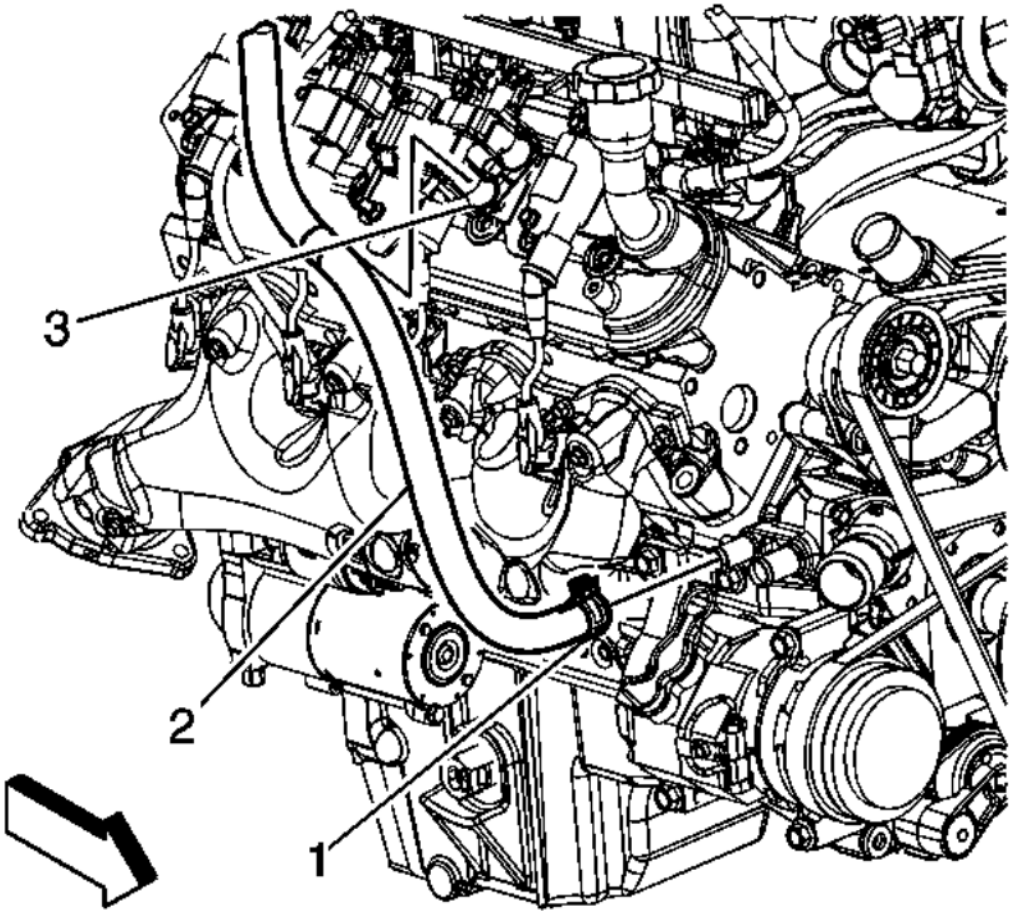


Fig. 200: View Of Heater Inlet Hose, Clamp & Waterpump
Courtesy of GENERAL MOTORS CORP.

5. Position and install the heater inlet hose (2) to the water pump.
6. Position the heater inlet hose clamp (1) at the water pump.

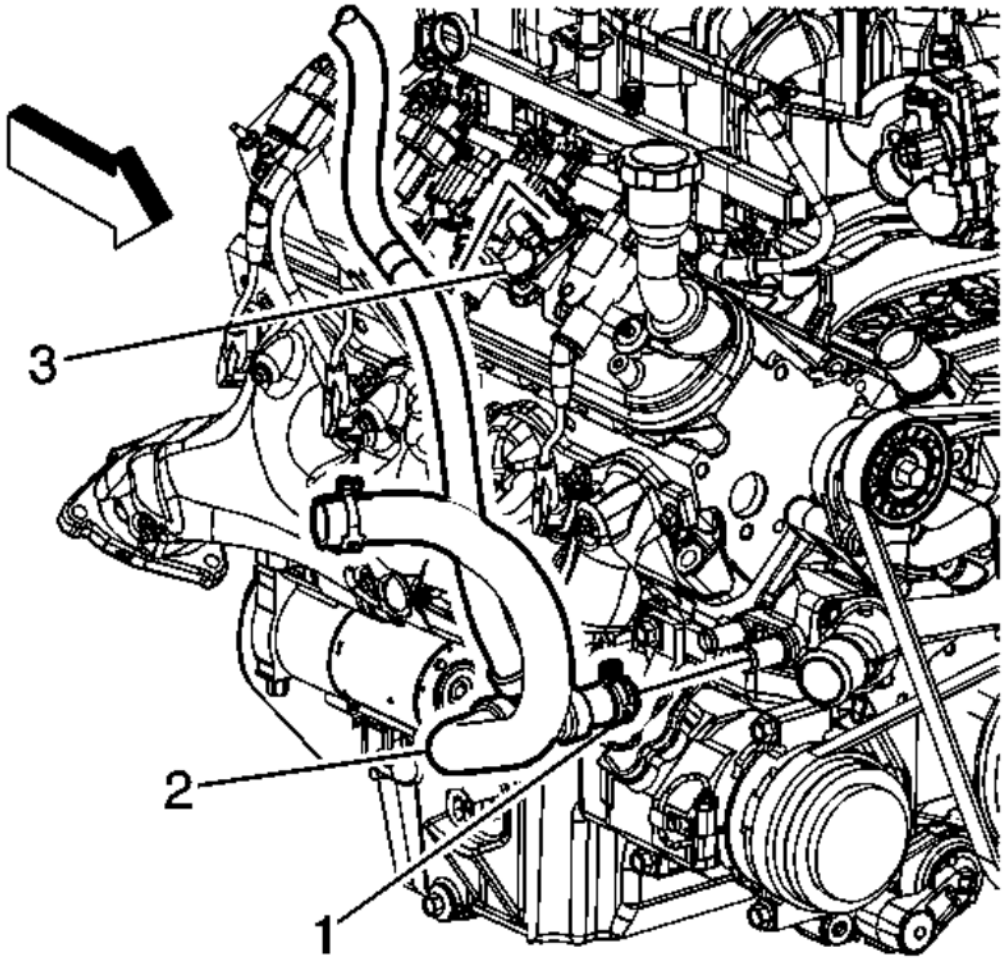


Fig. 201: View Of Radiator Surge Tank Outlet Hose, Clamp & Water Pump
Courtesy of GENERAL MOTORS CORP.

7. Position and install the radiator surge tank outlet hose (2) to the water pump.
8. Position the radiator surge tank outlet hose clamp at the water pump (1).

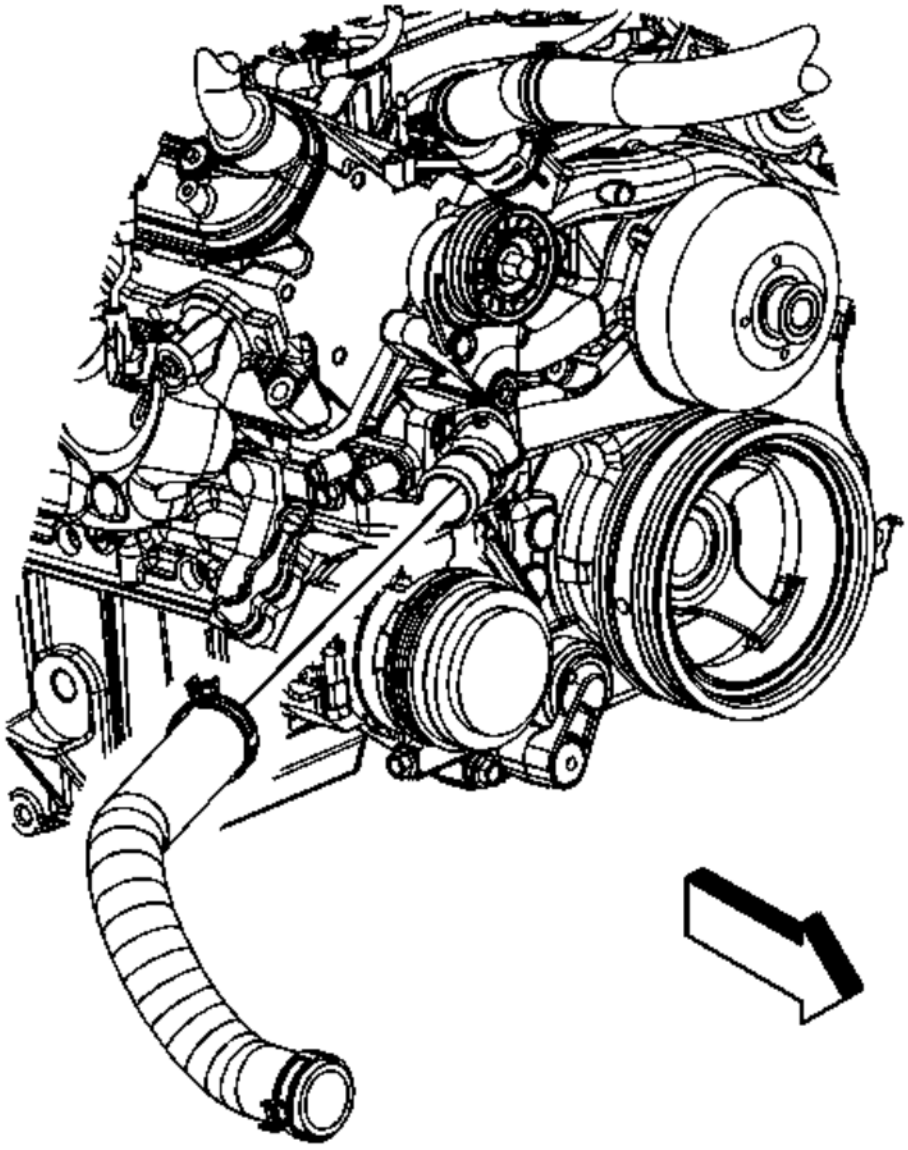


Fig. 202: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Position and install the radiator outlet hose to the water pump.
10. Position the radiator outlet hose clamp at the water pump.

11. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .

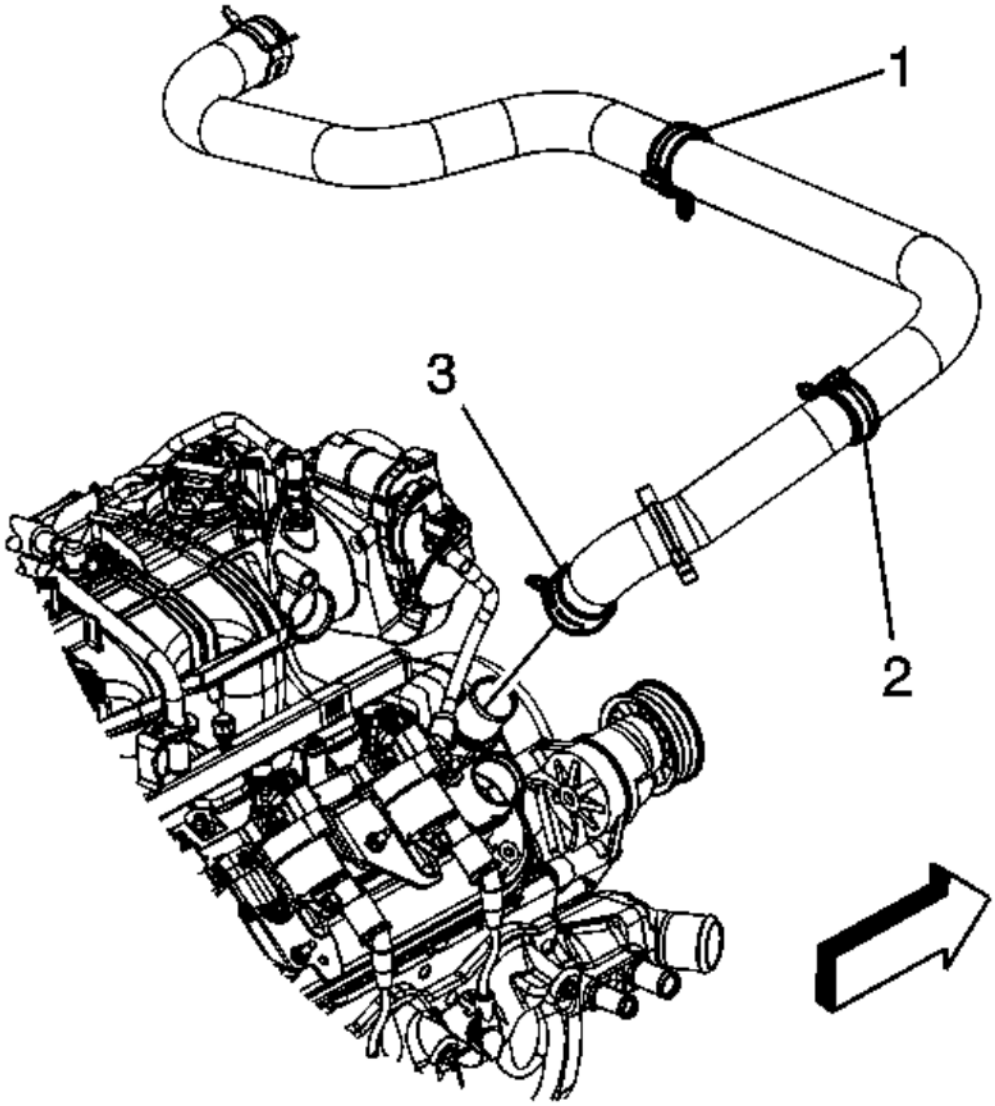


Fig. 203: View Of Radiator Vent Inlet Hose Clamp At Water Pump
Courtesy of GENERAL MOTORS CORP.

12. Position the radiator inlet hose and vent inlet hose to the correct position.
13. Install the radiator inlet hose to the water pump.

14. Position the radiator inlet hose clamp (3) at the water pump.

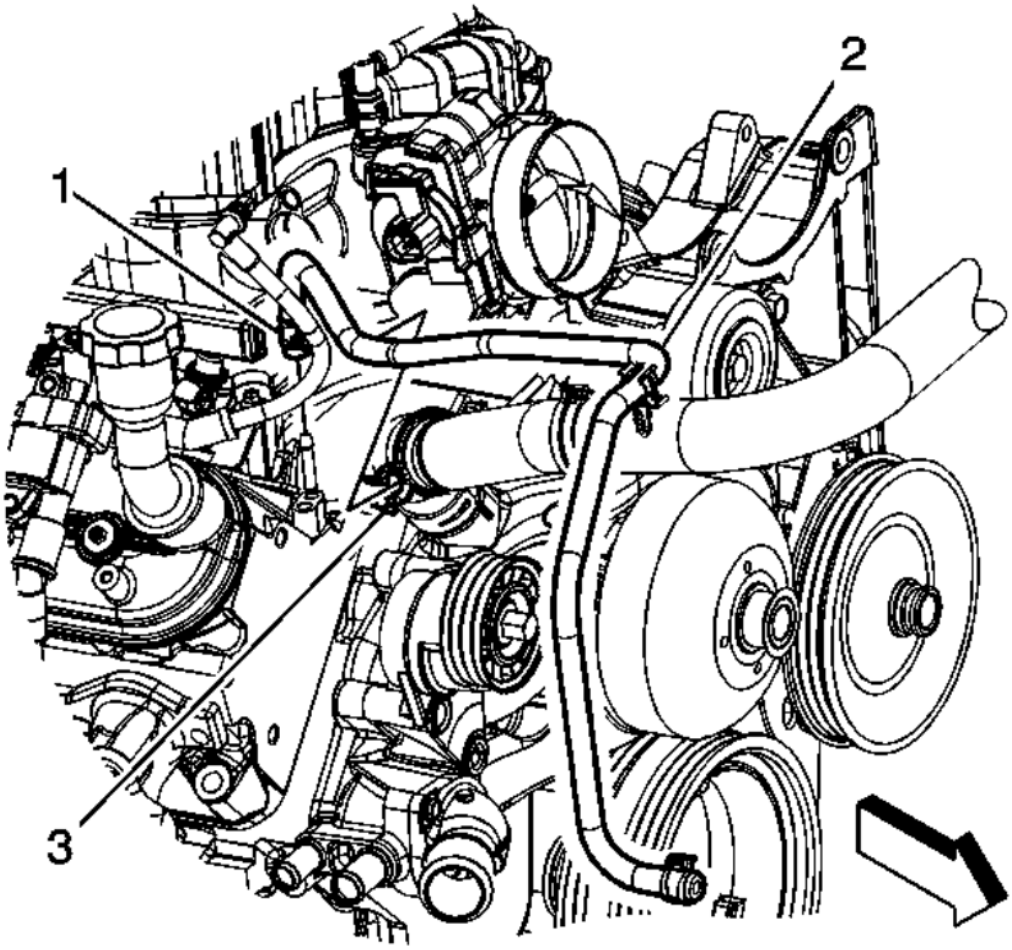


Fig. 204: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

15. Install the radiator vent inlet hose (2) to the coolant air bleed pipe fitting.
16. Position the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
17. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
18. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

WATER PUMP REPLACEMENT (LH6, LY2, LY5, AND LMG)

Removal Procedure

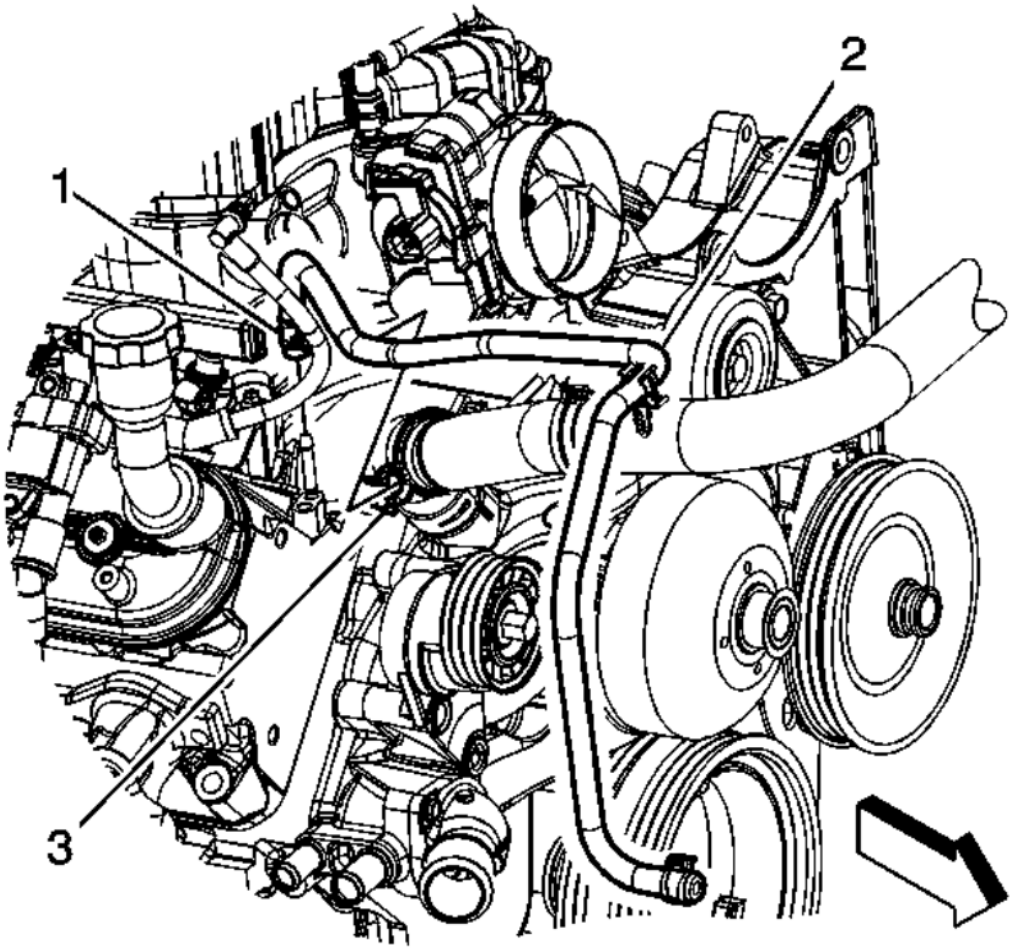


Fig. 205: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
3. Reposition the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.

4. Remove the radiator vent inlet hose (2) from the coolant air bleed pipe fitting.

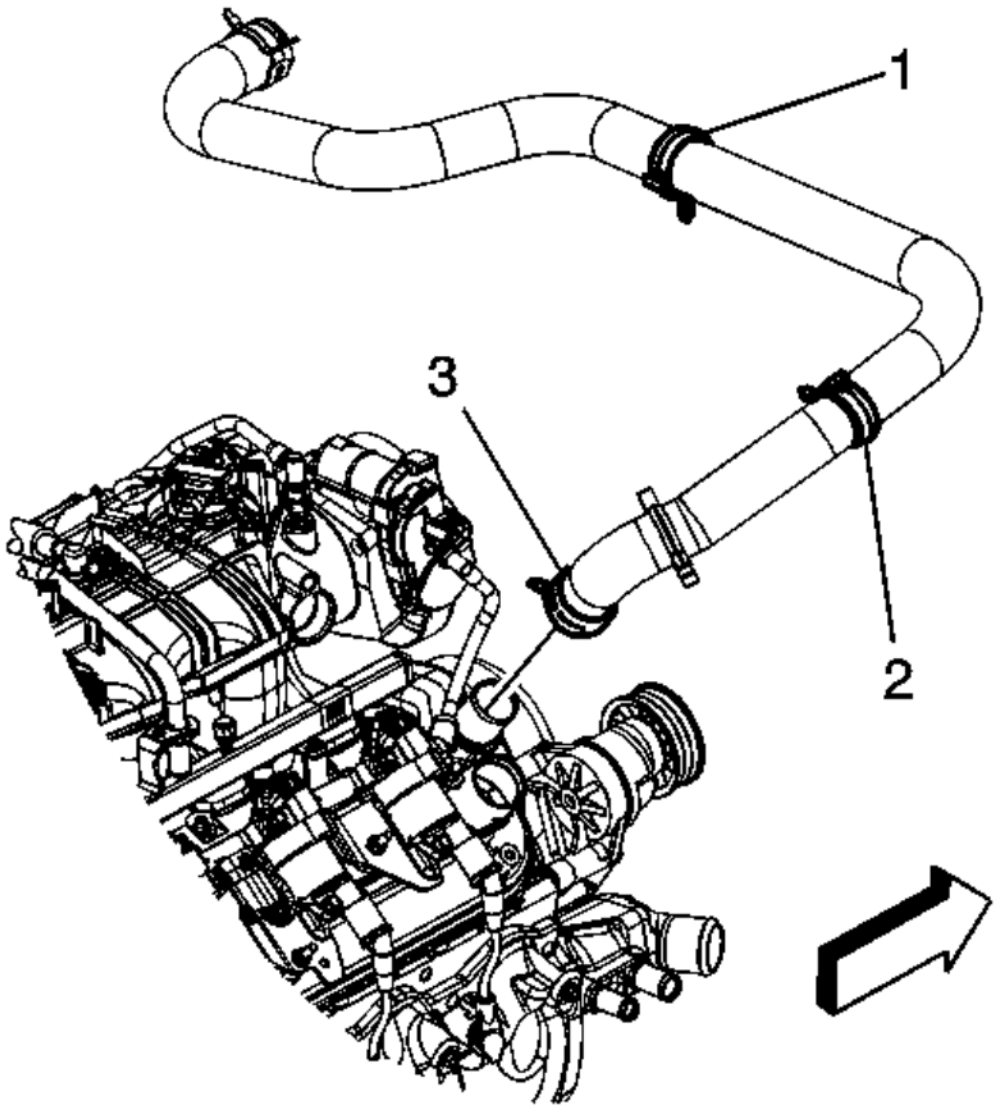


Fig. 206: View Of Radiator Vent Inlet Hose Clamp At Water Pump
Courtesy of GENERAL MOTORS CORP.

5. Reposition the radiator inlet hose clamp (3) at the water pump.
6. Remove the radiator inlet hose from the water pump.

7. Reposition the radiator inlet hose and vent inlet hose out of the way.
8. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .

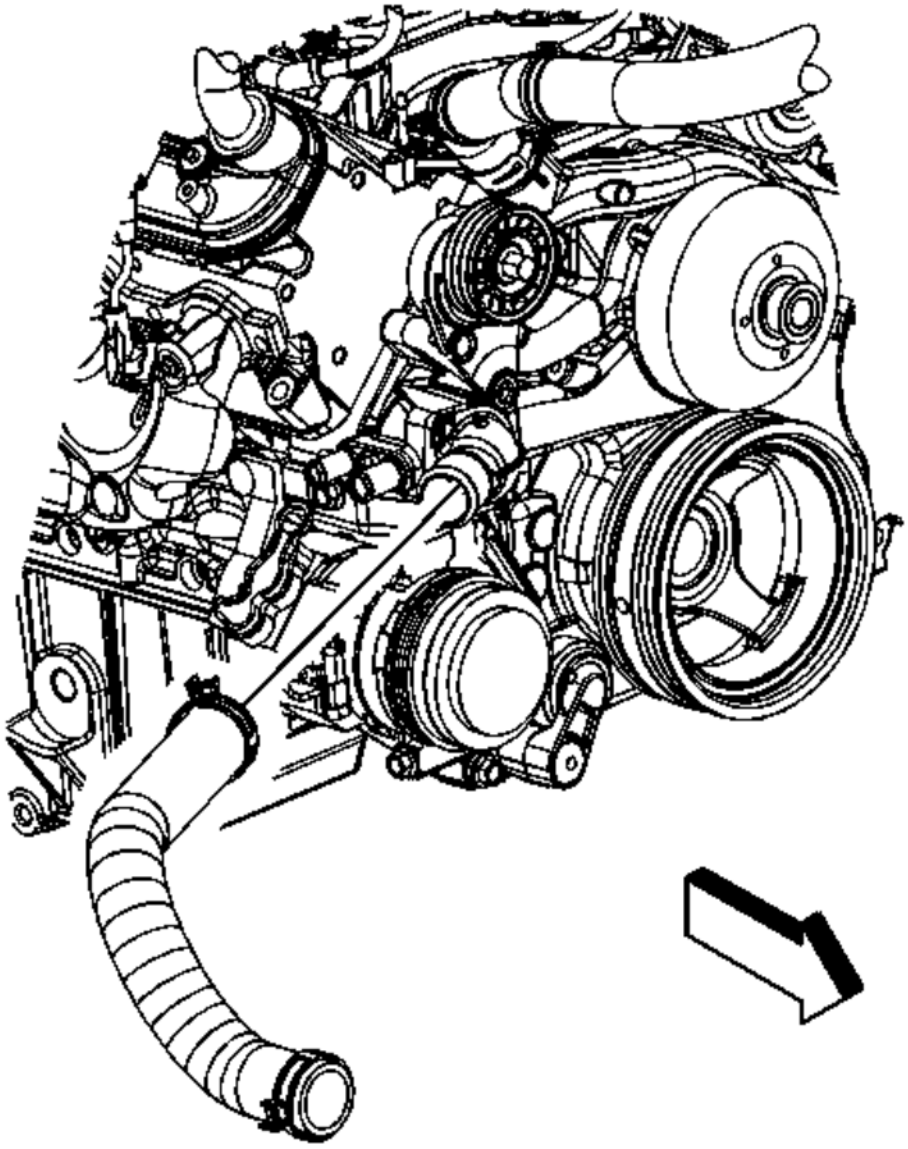


Fig. 207: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Reposition the radiator outlet hose clamp at the water pump.
10. Remove the radiator outlet hose from the water pump.
11. Reposition the outlet hose out of the way.

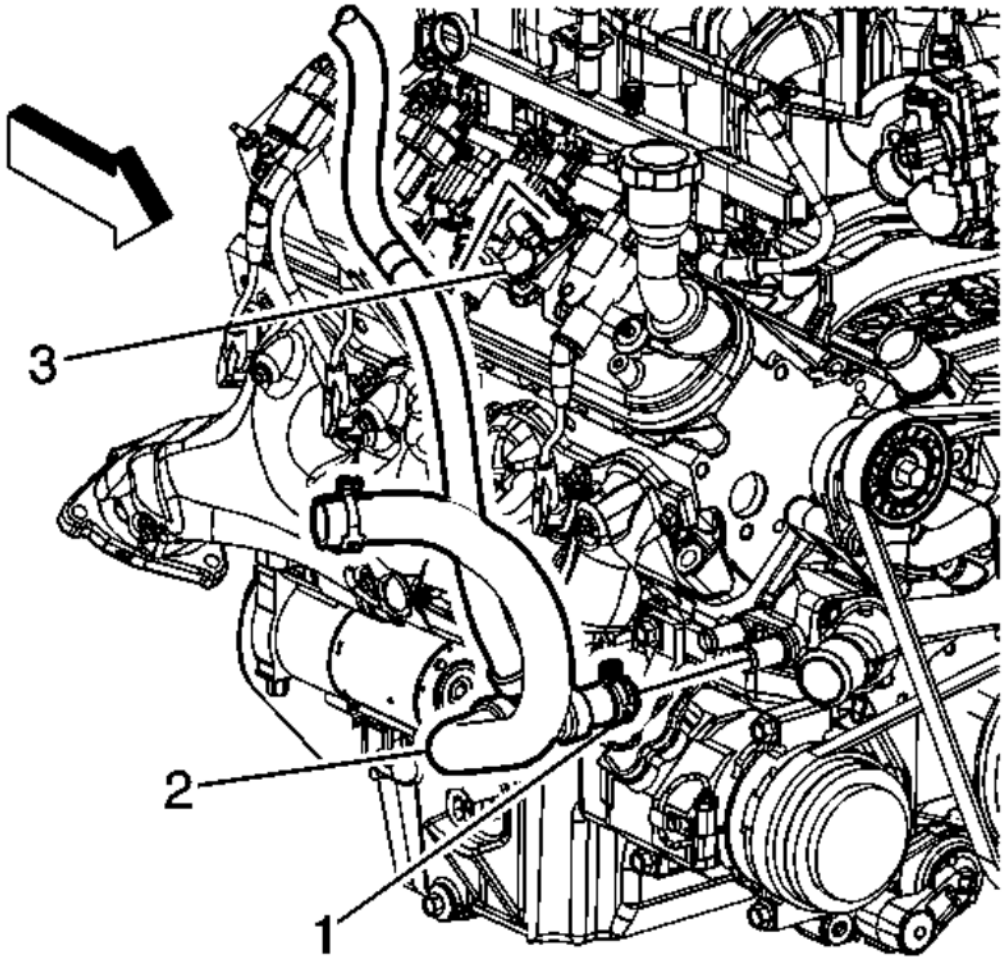


Fig. 208: View Of Radiator Surge Tank Outlet Hose, Clamp & Water Pump
Courtesy of GENERAL MOTORS CORP.

12. Reposition the radiator surge tank outlet hose clamp (1) at the water pump.
13. Remove the radiator surge tank outlet hose (2) from the water pump.
14. Reposition the outlet hose out of the way.

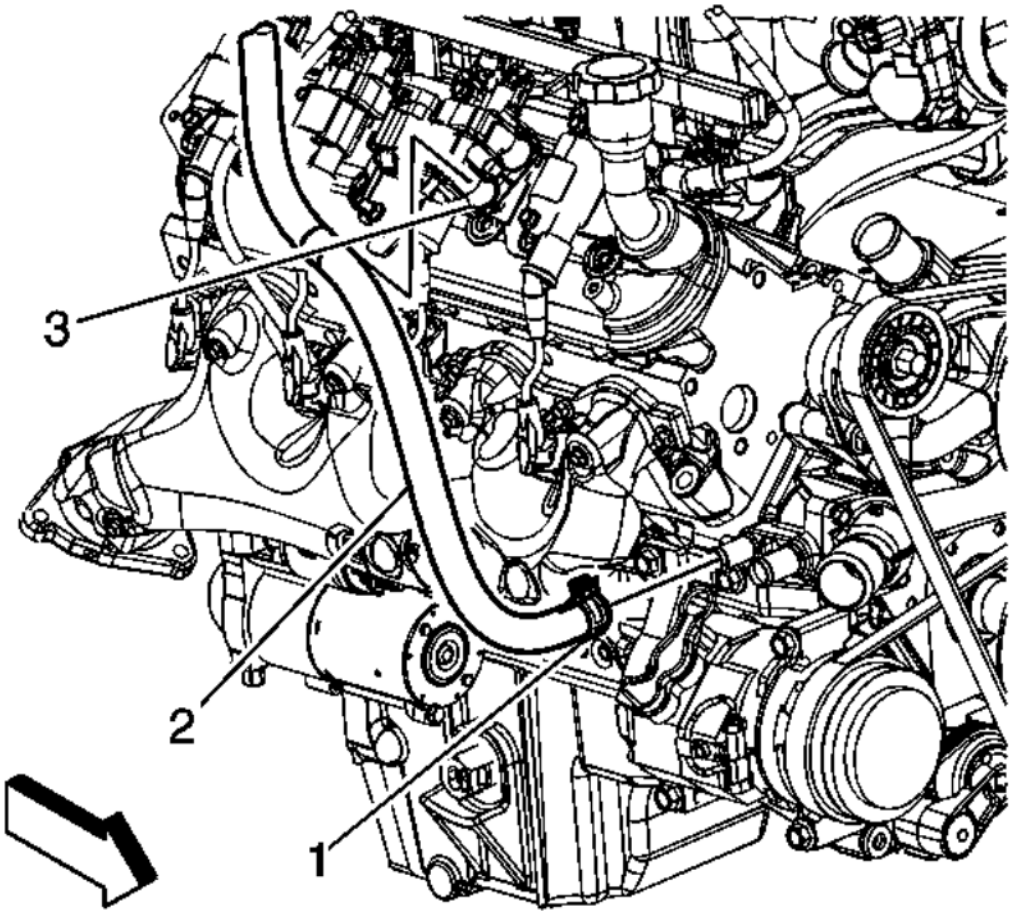


Fig. 209: View Of Heater Inlet Hose, Clamp & Waterpump
Courtesy of GENERAL MOTORS CORP.

15. Reposition the heater inlet hose clamp (1) at the water pump.
16. Remove the heater inlet hose (2) from the water pump.
17. Reposition the inlet hose out of the way.

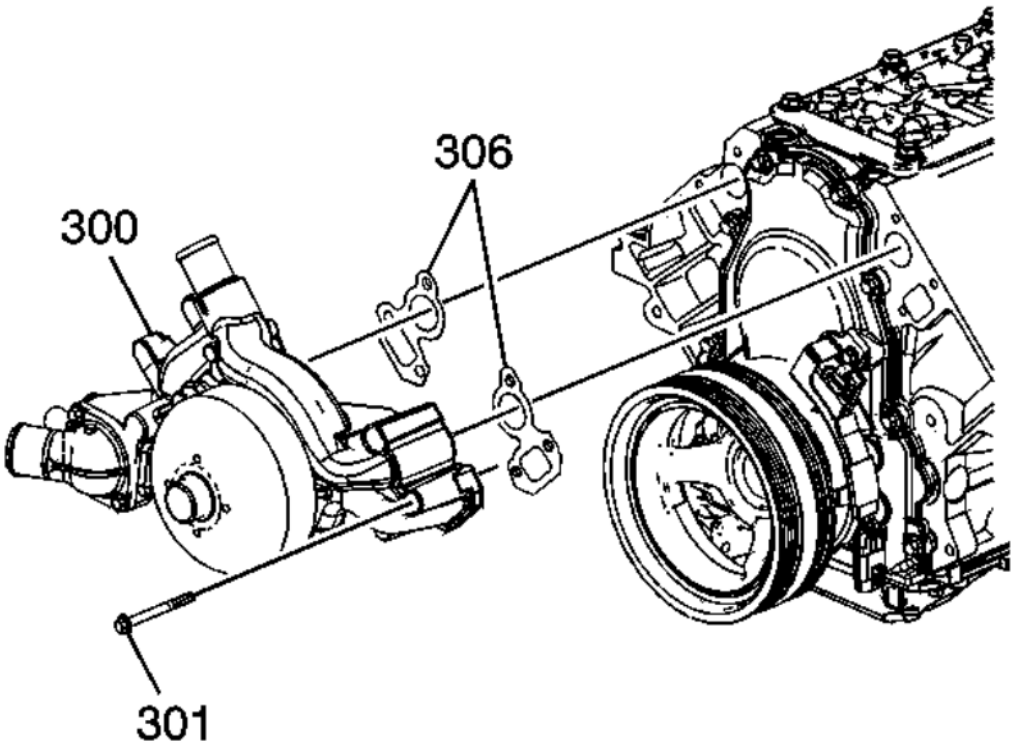


Fig. 210: View Of Water Pump, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

18. Remove the water pump bolts (301).
19. Remove the water pump (300) and gaskets (309). Discard the gaskets.

Installation Procedure

NOTE: DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.

IMPORTANT: All gaskets surfaces are to be free of oil or other foreign material

during assembly.

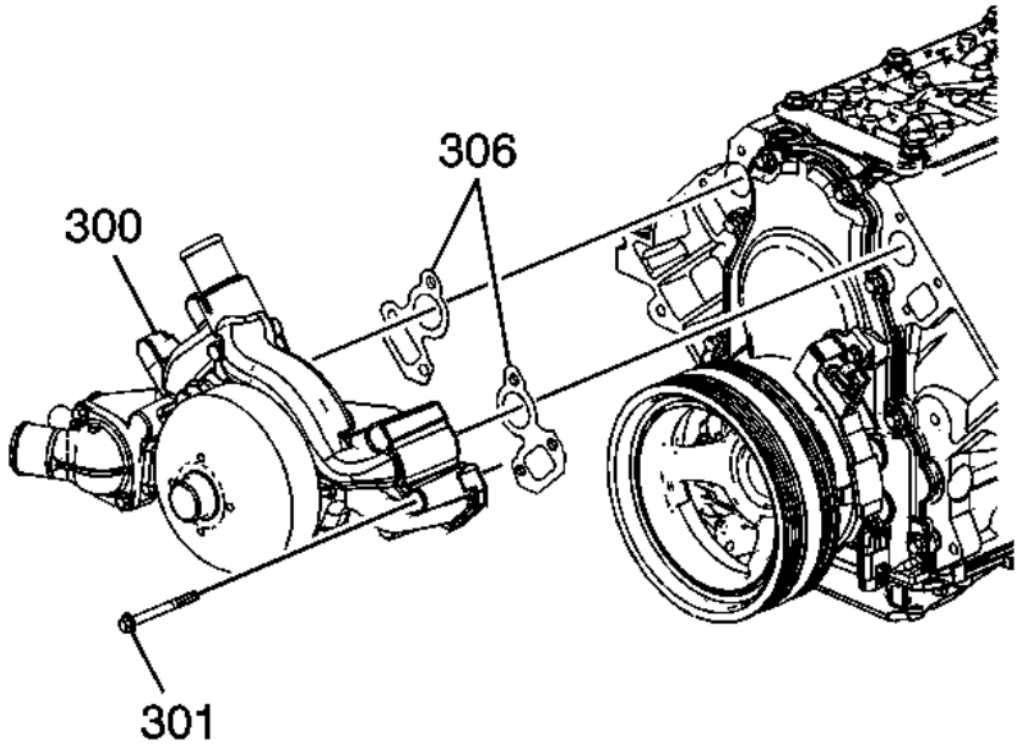


Fig. 211: View Of Water Pump, Bolts & Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Position the water pump (300) and NEW gaskets (306) to the engine block.

NOTE: Refer to Fastener Notice .

2. Install the water pump bolts (301).

Tighten:

1. Tighten the bolts a first pass to 15 N.m (11 lb ft).
2. Tighten the bolts a final pass to 30 N.m (22 lb ft).

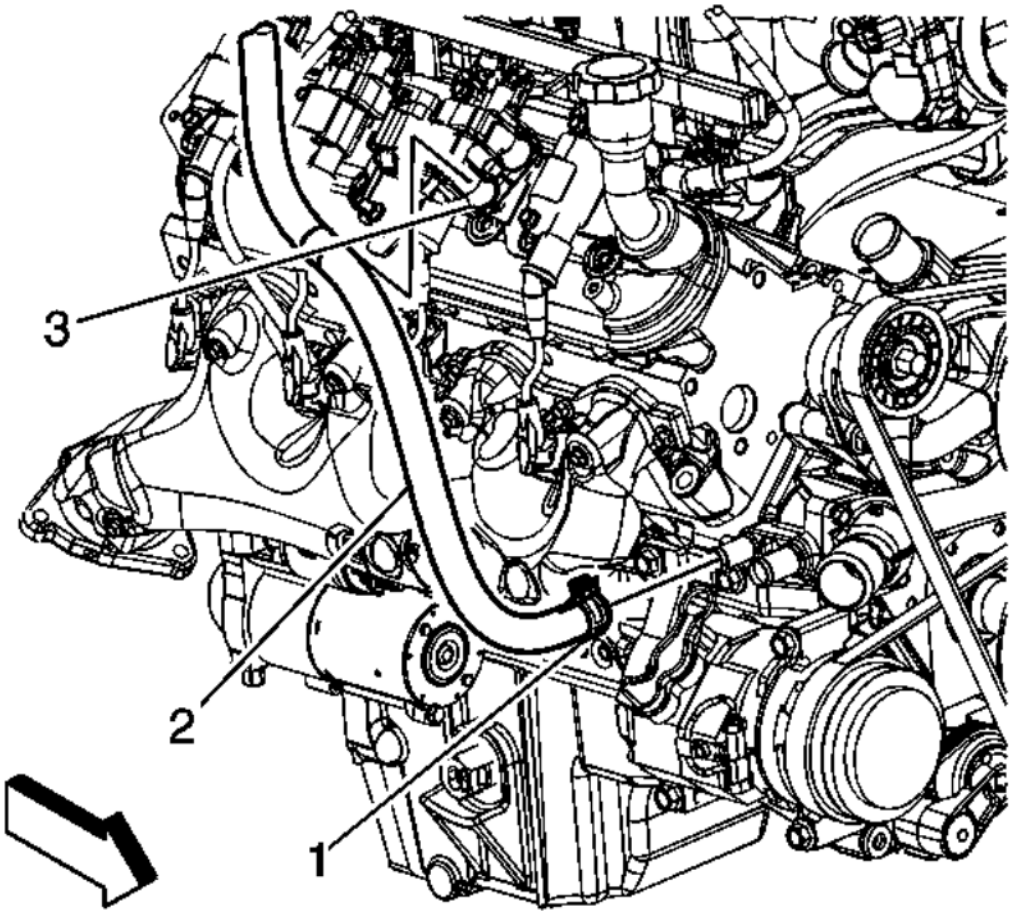


Fig. 212: View Of Heater Inlet Hose, Clamp & Waterpump
Courtesy of GENERAL MOTORS CORP.

3. Position and install the heater inlet hose (2) to the water pump.
4. Position the heater inlet hose clamp (1) at the water pump.

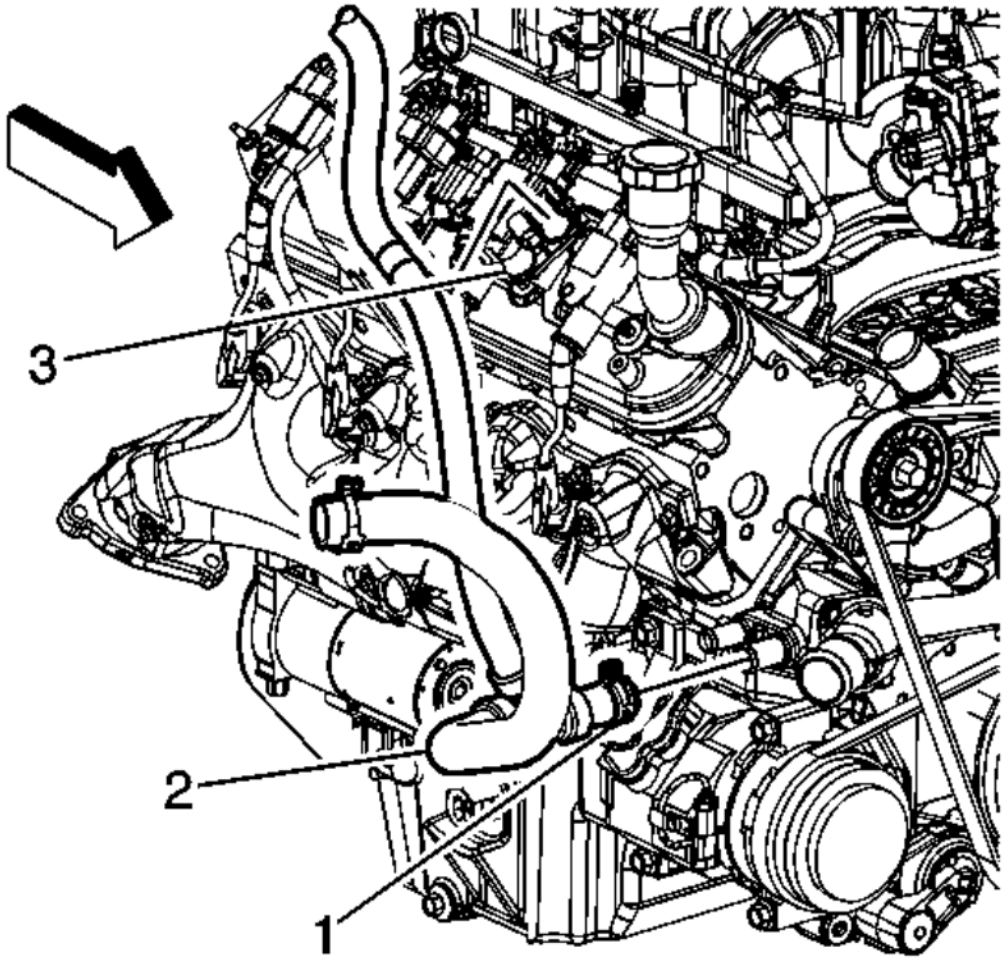


Fig. 213: View Of Radiator Surge Tank Outlet Hose, Clamp & Water Pump
Courtesy of GENERAL MOTORS CORP.

5. Position and install the radiator surge tank outlet hose (2) to the water pump.
6. Position the radiator surge tank outlet hose clamp (1) at the water pump.

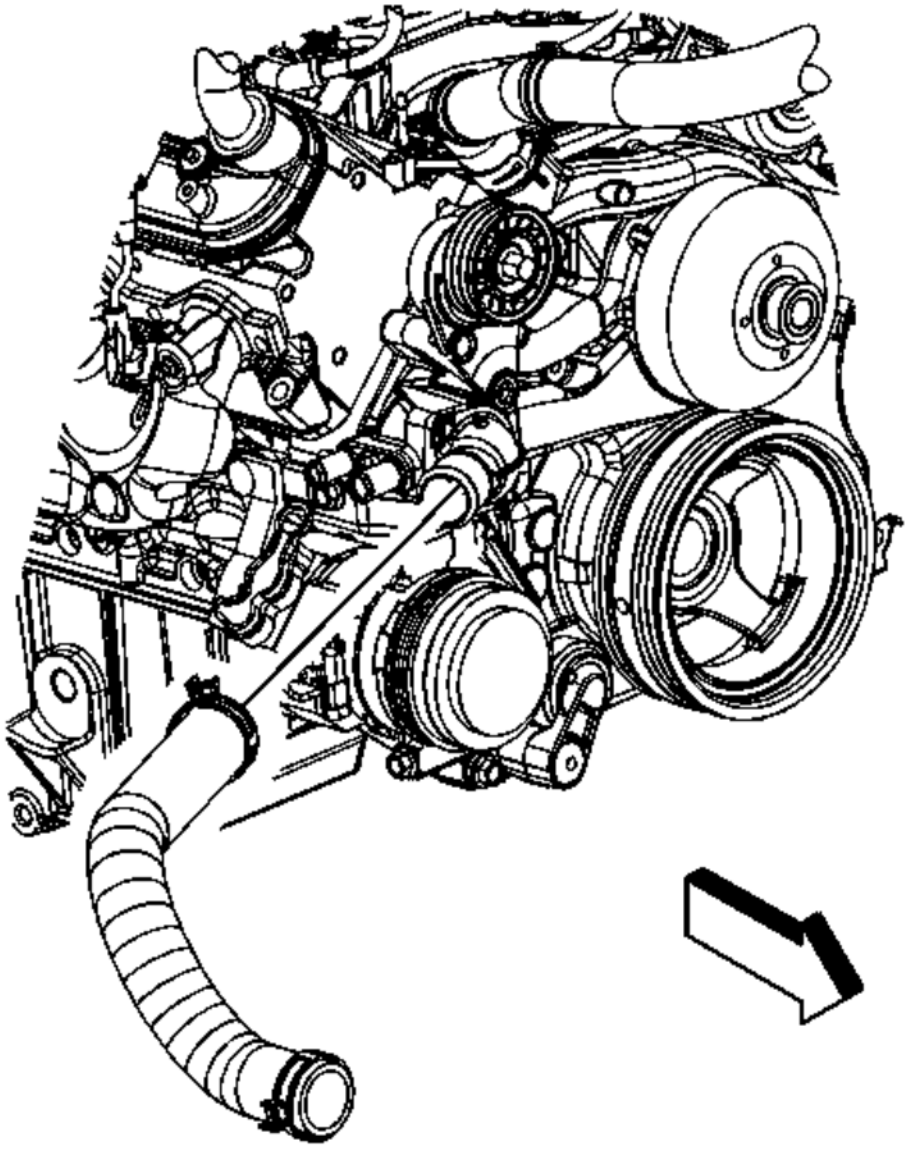


Fig. 214: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Position and install the radiator outlet hose to the water pump.
8. Position the radiator outlet hose clamp at the water pump.

9. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .

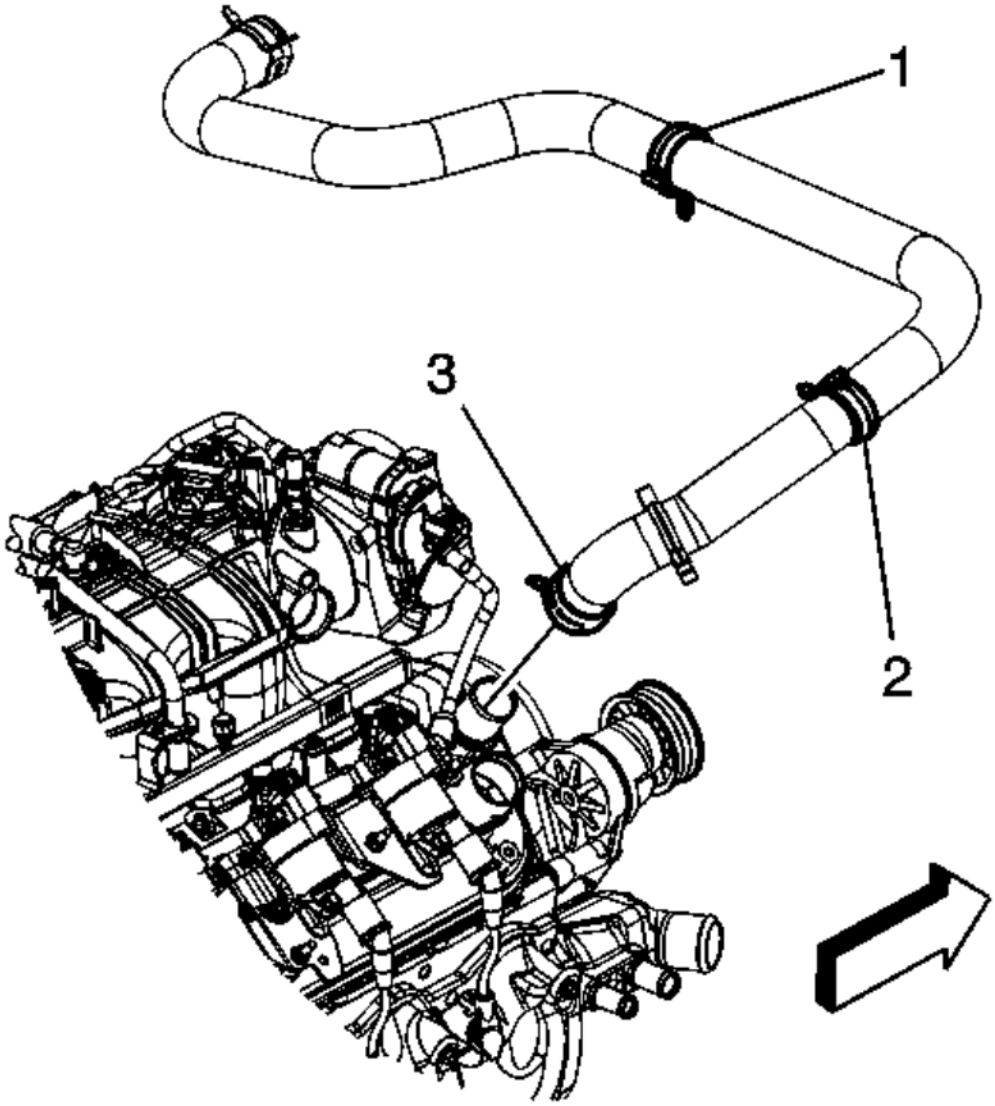


Fig. 215: View Of Radiator Vent Inlet Hose Clamp At Water Pump
Courtesy of GENERAL MOTORS CORP.

10. Position the radiator inlet hose and vent inlet hose to the correct position.
11. Install the radiator inlet hose to the water pump.

12. Position the radiator inlet hose clamp (3) at the water pump.

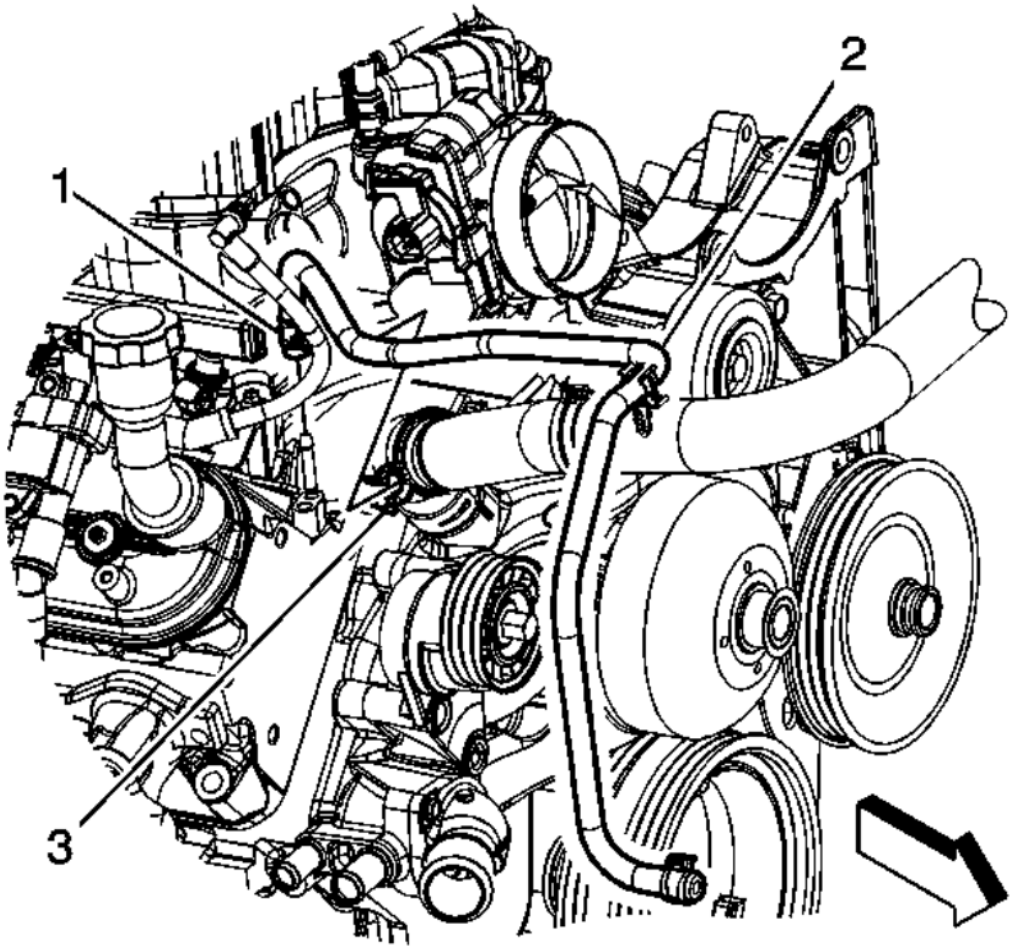


Fig. 216: View Of Radiator Vent Inlet Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

13. Install the radiator vent inlet hose (2) to the coolant air bleed pipe fitting.
14. Position the radiator vent inlet hose clamp (1) at the coolant air bleed pipe fitting.
15. Fill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
16. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

WATER PUMP REPLACEMENT (LMM)

Removal Procedure

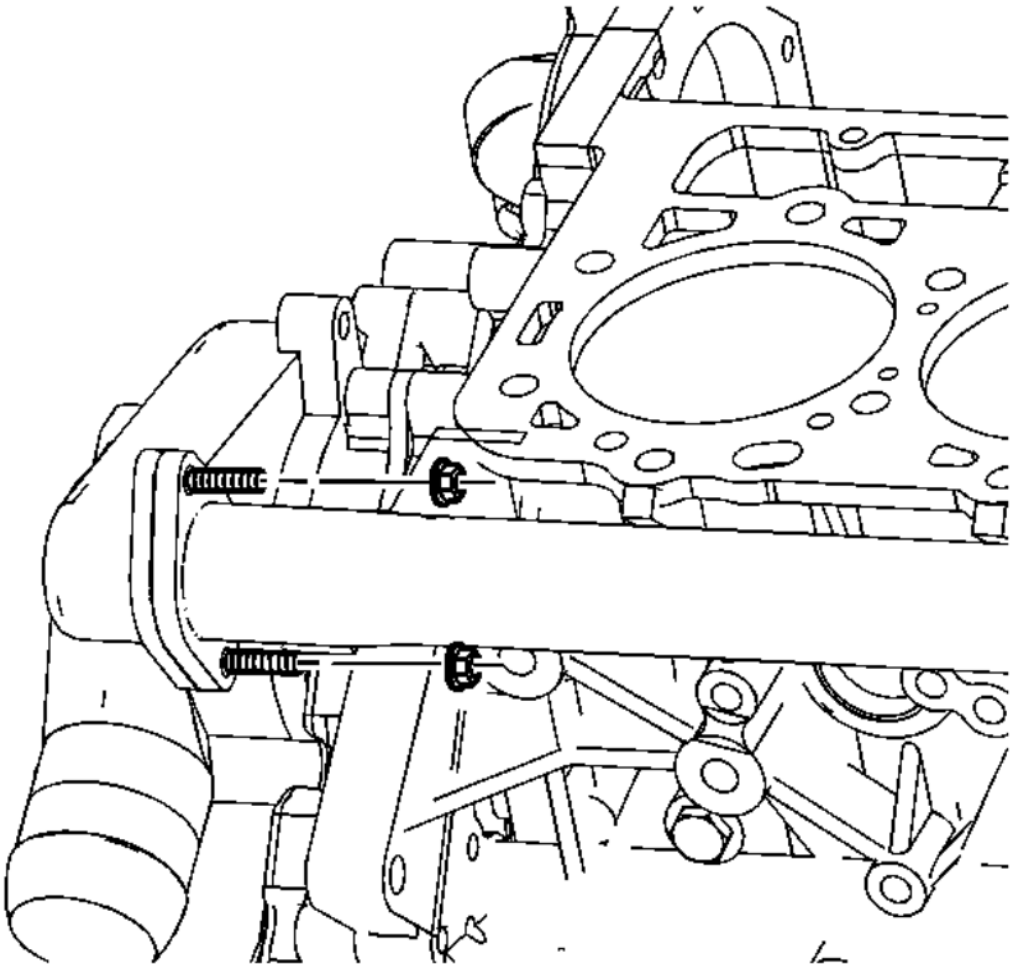


Fig. 217: View Of Water Pump Outlet Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the left wheelhouse inner panel. Refer to **Front Wheelhouse Liner Replacement - Left Side (Chevrolet)** or **Front Wheelhouse Liner Replacement - Left Side (GMC)** .
2. Remove the thermostat housing crossover. Refer to **Thermostat Housing Crossover Replacement (LMM)**.

3. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement** .
4. Remove the water pump to engine coolant pipe nuts.
5. Remove the engine wiring harness retainer from the inner stud.

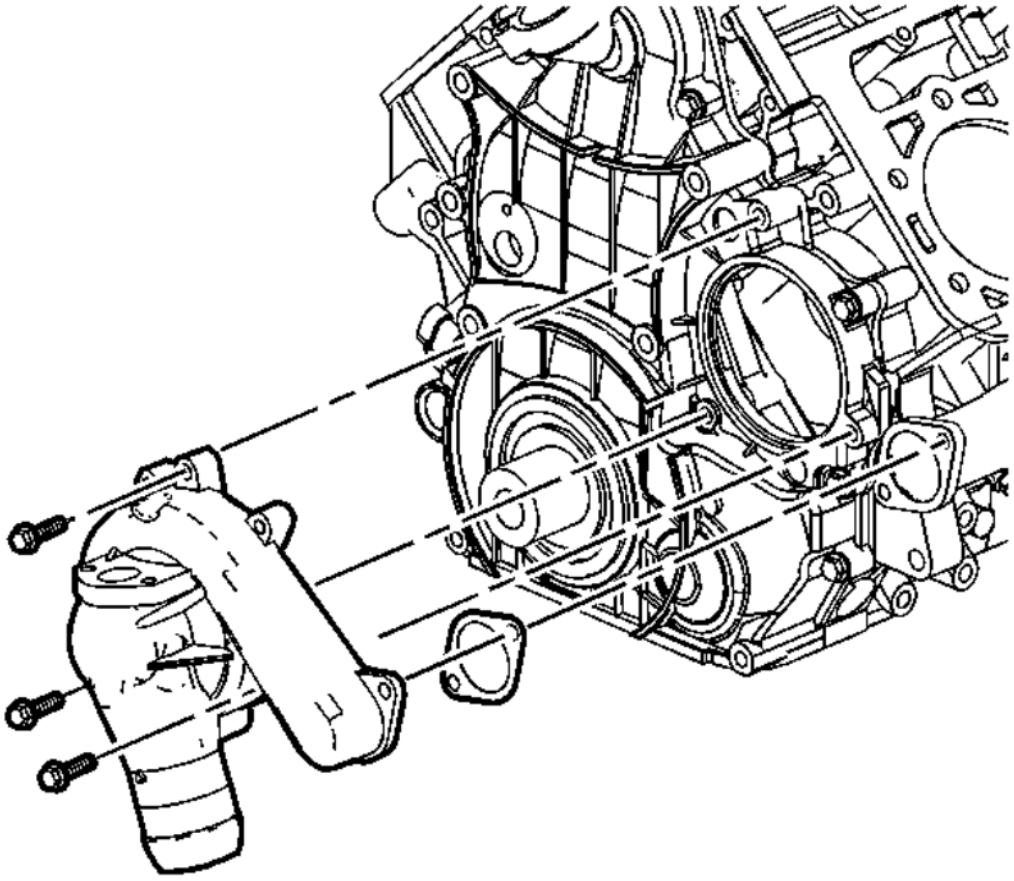


Fig. 218: View Of Engine Coolant Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

6. Remove the water pump bolts. Note the location of the bolts. The bolts are three different lengths.
7. Remove the water pump.
8. Remove and discard the water pump O-ring and coolant pipe gasket.
9. If required, clean and inspect the water pump. Refer to **Water Pump Cleaning and**

Inspection .

Installation Procedure

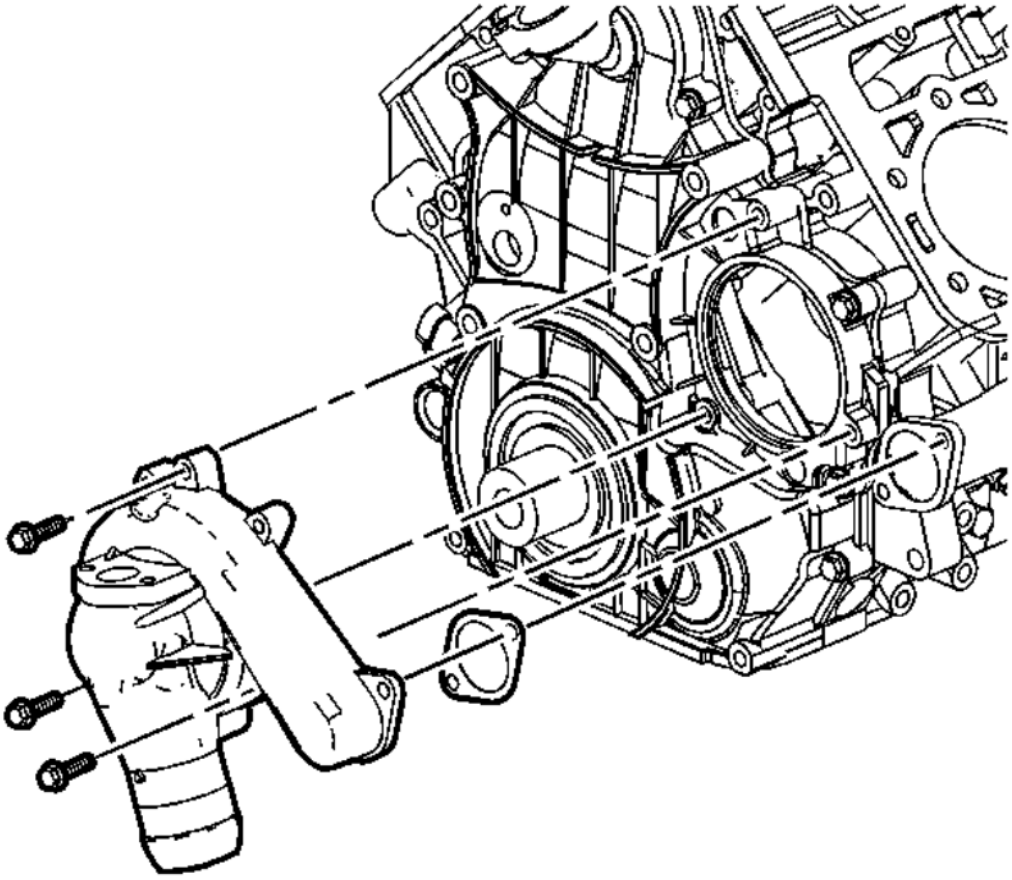


Fig. 219: View Of Engine Coolant Pipe & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the water pump O-ring with engine oil.
2. Install the engine coolant pipe gasket and water pump O-ring.
3. Install the water pump.

NOTE: Refer to Fastener Notice .

4. Install the water pump bolts. Ensure the correct length bolt is used in the proper location.

   Tighten: Tighten the bolts to 21 N.m (15 lb ft).

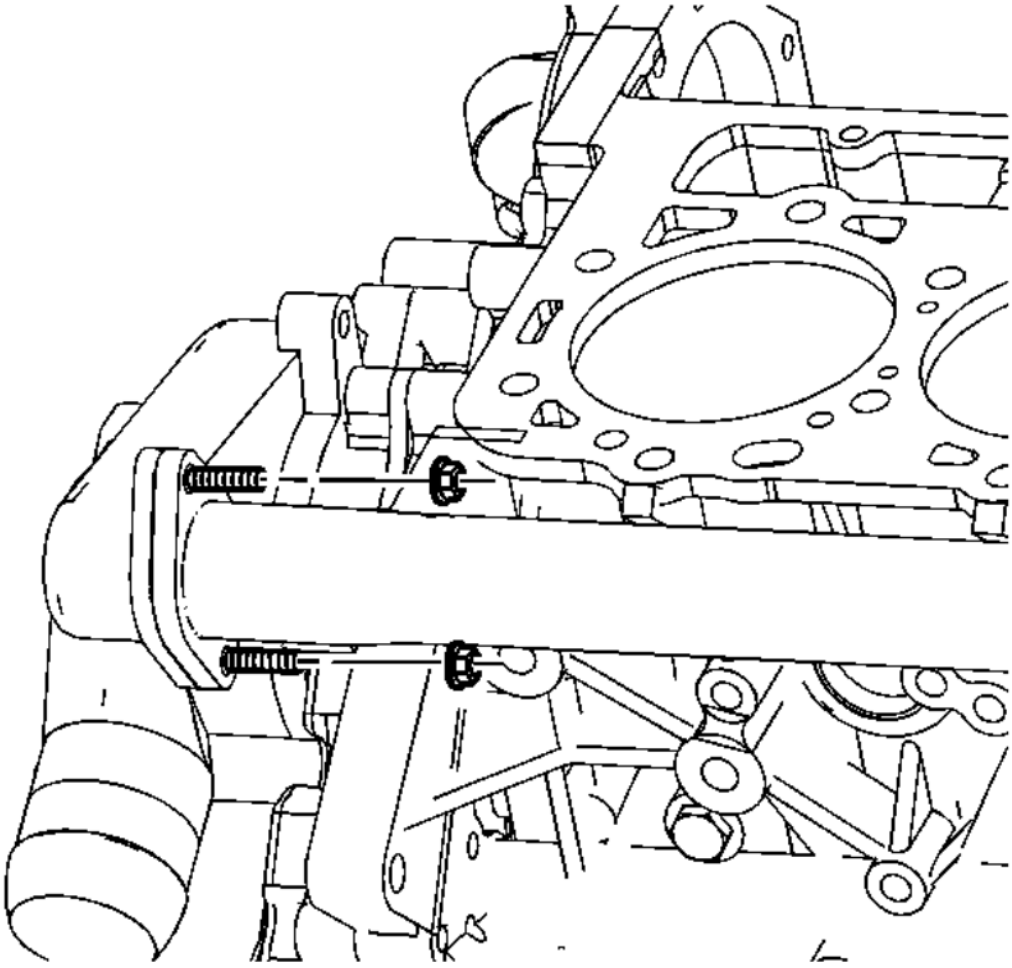


Fig. 220: View Of Water Pump Outlet Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

5. Install the engine wiring harness retainer on the water pump outlet pipe inner stud.
6. Install the water pump to engine coolant pipe nuts.

   Tighten: Tighten the nuts to 21 N.m (15 lb ft).

7. Install the thermostat housing crossover. Refer to **Thermostat Housing Crossover Replacement (LMM)**.
8. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement** .
9. Install the left wheelhouse inner panel. Refer to **Front Wheelhouse Liner Replacement - Left Side (Chevrolet)** or **Front Wheelhouse Liner Replacement - Left Side (GMC)** .

ENGINE COOLANT FAN UPPER SHROUD REPLACEMENT (MECHANICAL)

Removal Procedure

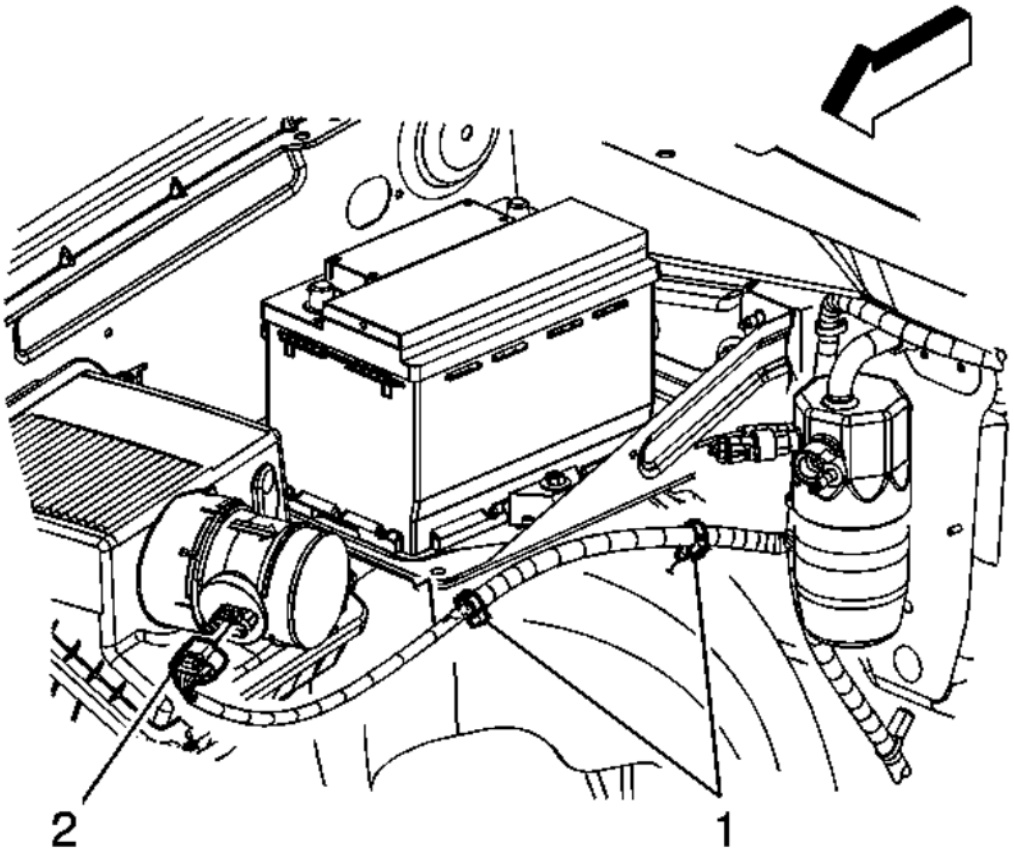


Fig. 221: View Of Throttle Body Heater Hose & Retainers
Courtesy of GENERAL MOTORS CORP.

1. Loosen the air cleaner outlet duct clamps from the throttle body.

2. Loosen the air cleaner outlet duct clamps from the mass airflow sensor(2).
3. Remove the air cleaner outlet duct.
4. If equipped remove the throttle body heater hose retainer from the fan shroud.
5. If equipped remove the inlet radiator hose retainer from the fan shroud.

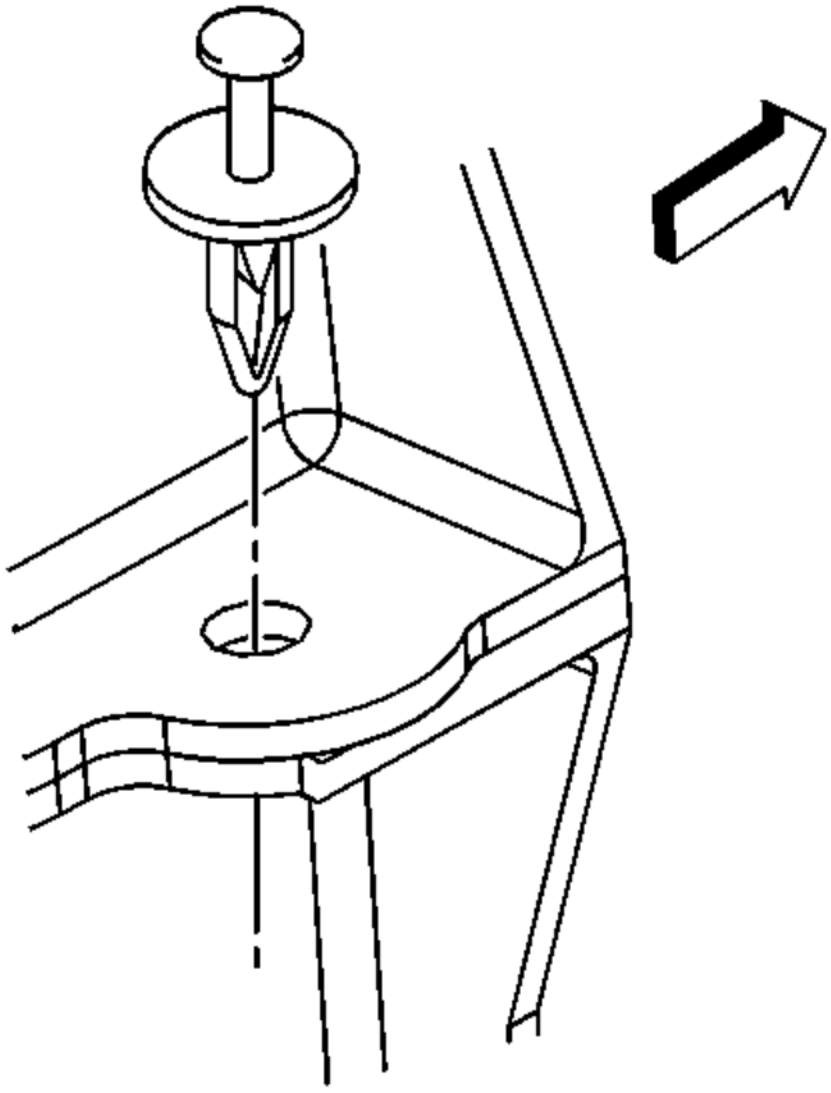


Fig. 222: View Of Fan Shroud Retainers

Courtesy of GENERAL MOTORS CORP.

6. Remove the fan shroud retainers.

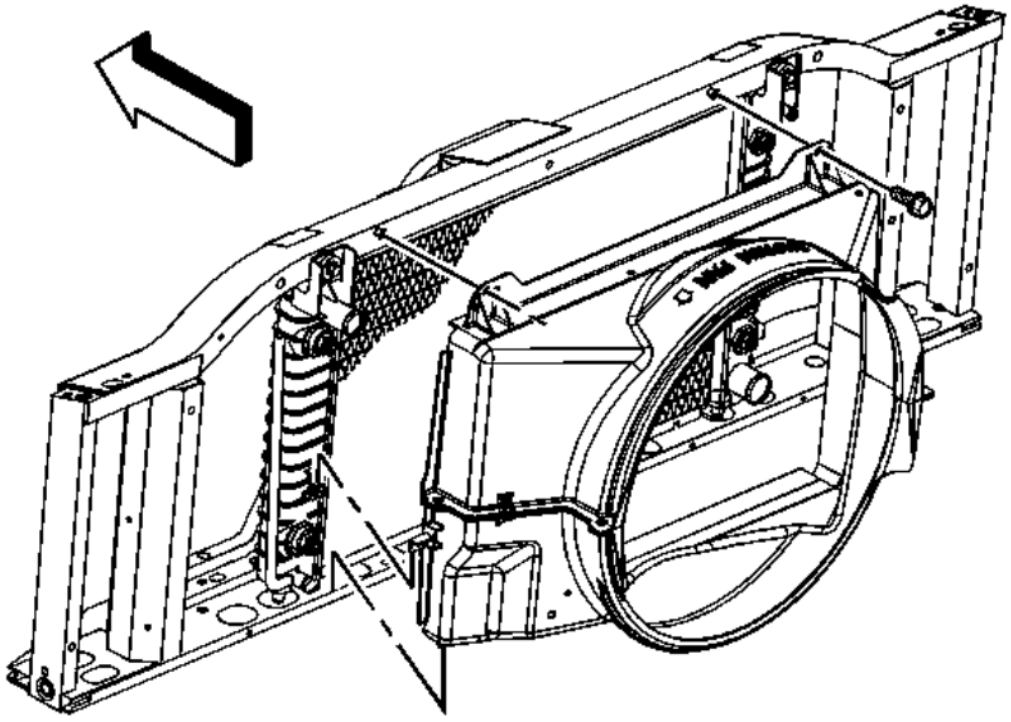


Fig. 223: View Of Fan Shroud & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the fan shroud bolts
8. Remove the upper fan shroud.

Installation Procedure

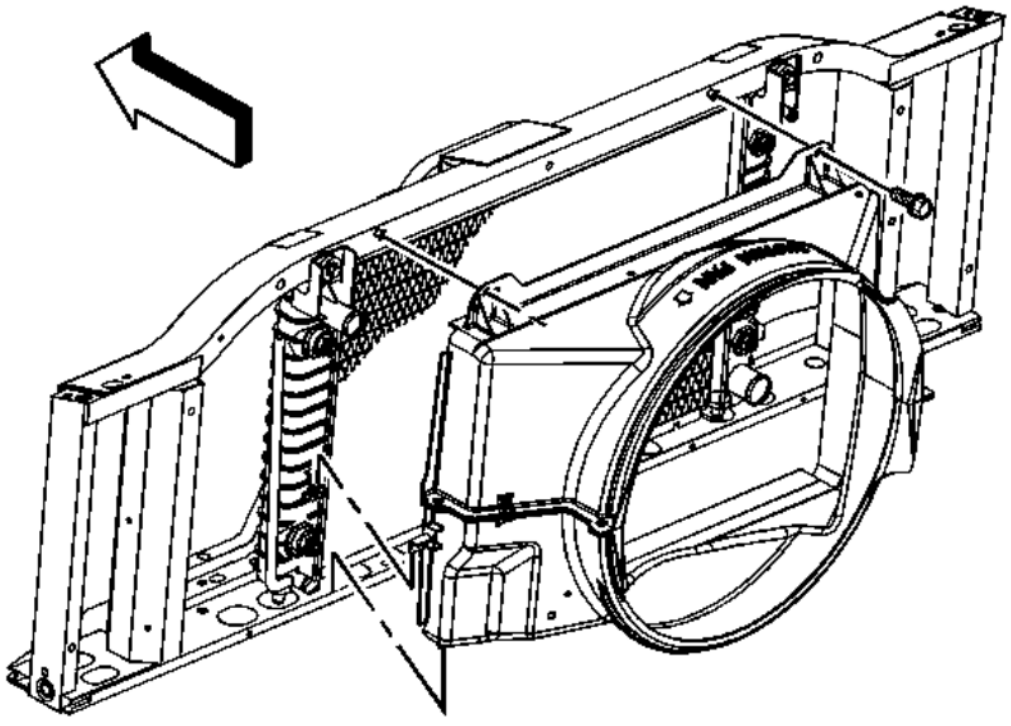


Fig. 224: View Of Fan Shroud & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the upper fan shroud.
2. Install the fan shroud bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

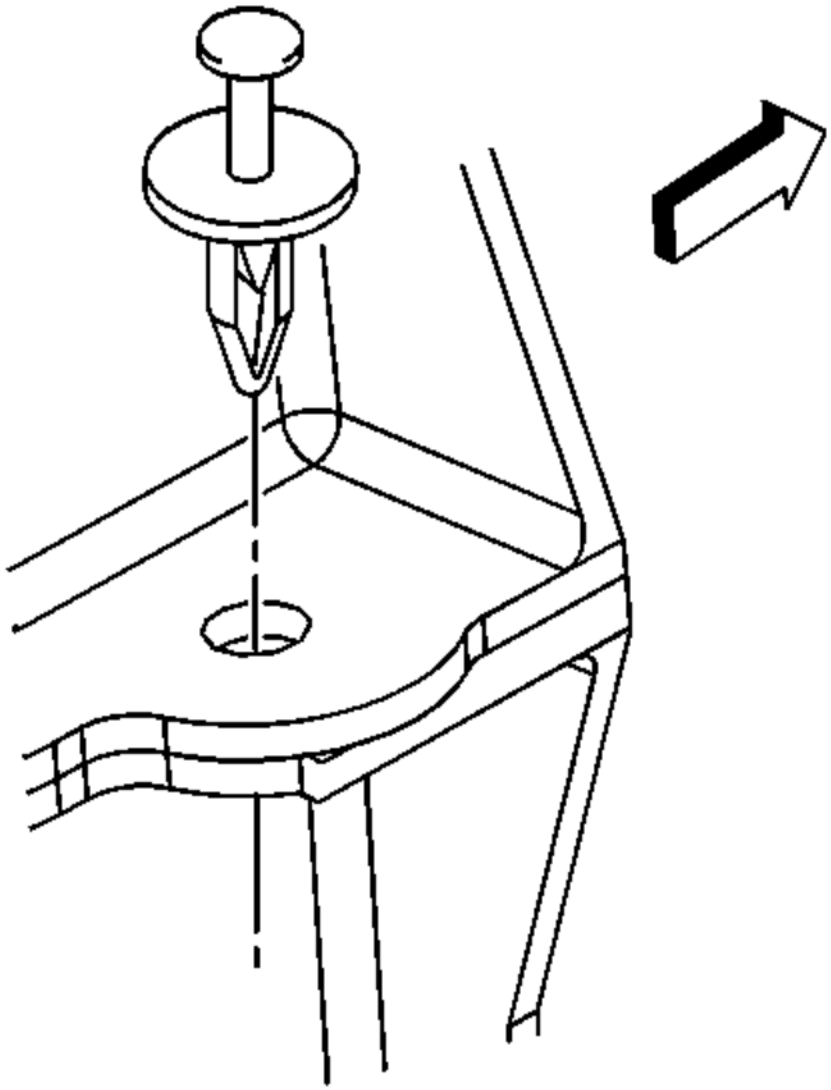


Fig. 225: View Of Fan Shroud Retainers
Courtesy of GENERAL MOTORS CORP.

3. Install the fan shroud retainers.
4. If equipped install the inlet radiator hose retainer to the fan shroud
5. If equipped install the throttle body heater hose retainer to the fan shroud.

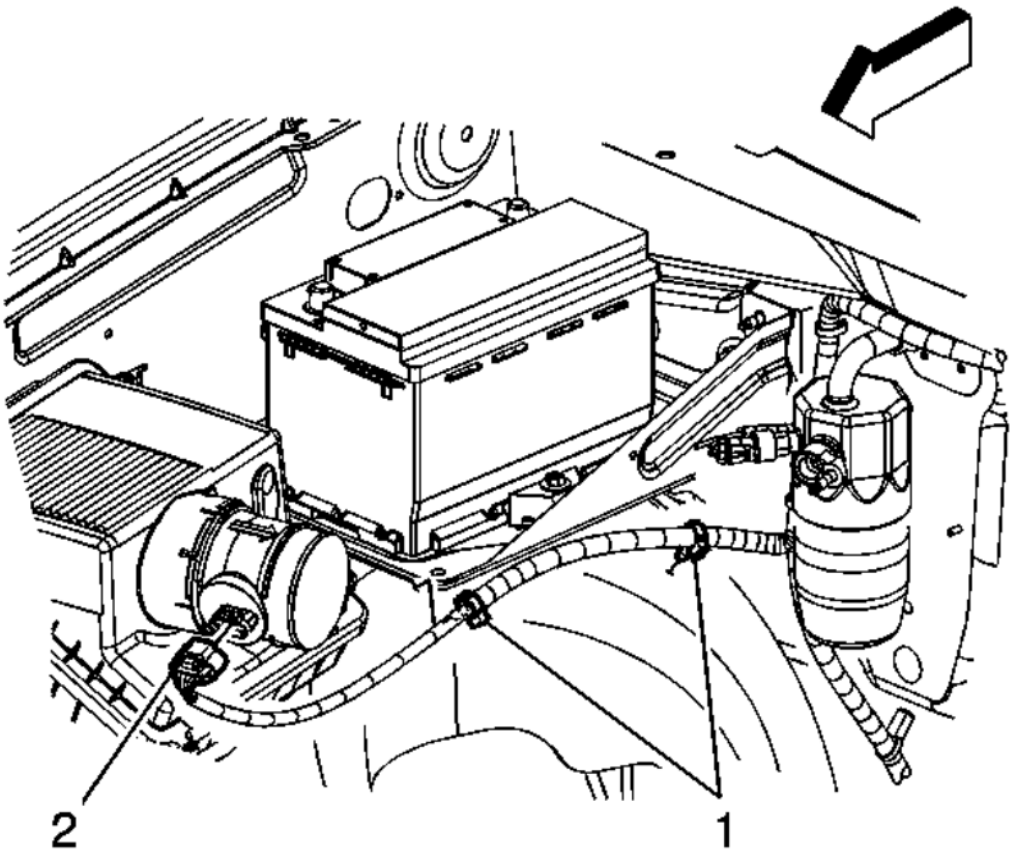


Fig. 226: View Of Throttle Body Heater Hose & Retainers
Courtesy of GENERAL MOTORS CORP.

6. Install the air cleaner outlet duct.
7. Tighten the air cleaner outlet duct clamp at the throttle body.

   Tighten: Tighten the clamp to 4 N.m (35 lb in).

8. Tighten the air cleaner outlet duct clamp at the mass airflow sensor(2).

   Tighten: Tighten the clamp to 4 N.m (35 lb in).

ENGINE COOLANT FAN UPPER SHROUD REPLACEMENT (AUTOMATIC TRANS TRANSMISSION - DIESEL)

Removal Procedure

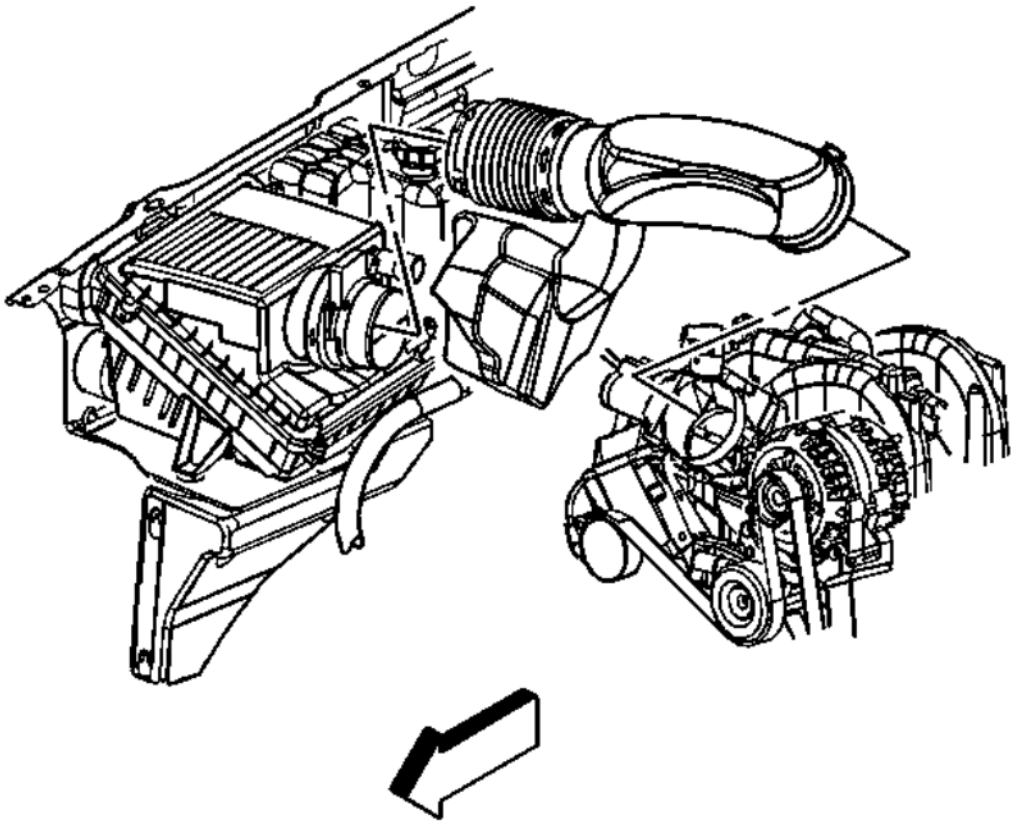


Fig. 227: View Of Air Cleaner Outlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Loosen the air cleaner outlet duct clamps from the throttle body.
2. Loosen the air cleaner outlet duct clamps from the mass airflow sensor.
3. Remove the air cleaner outlet duct.
4. Remove the A/C line retainer from the fan shroud.

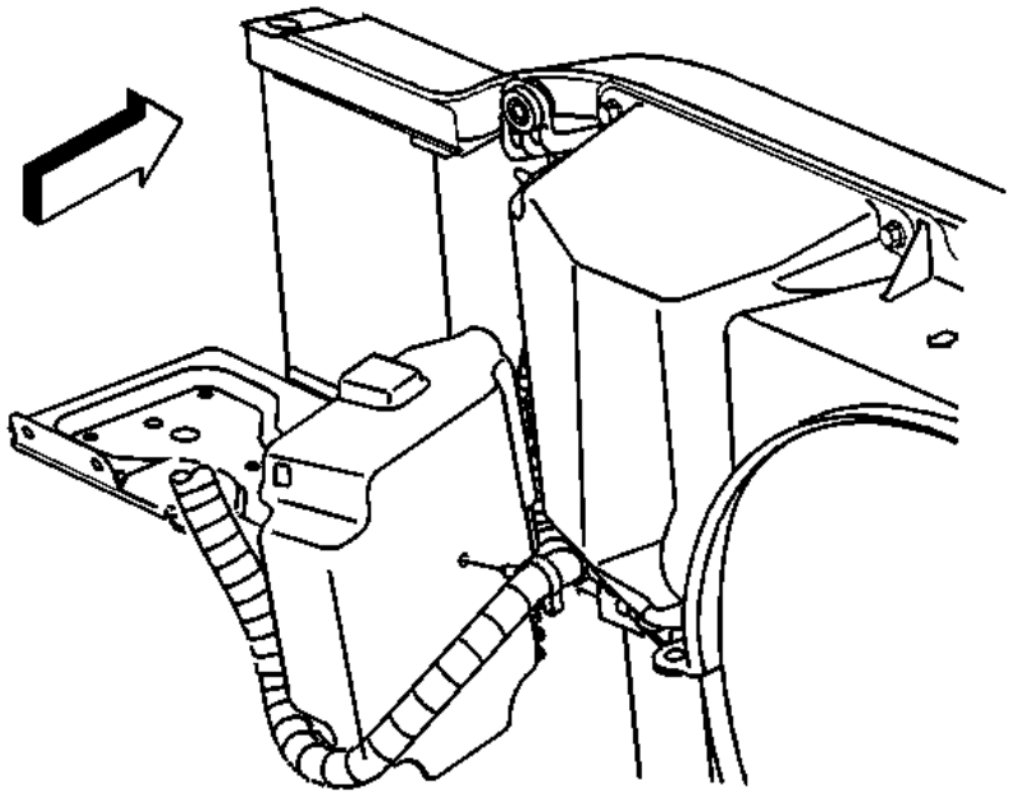


Fig. 228: View Of PCM Engine Harness Clip
Courtesy of GENERAL MOTORS CORP.

5. Remove the engine harness clip from the powertrain control module (PCM) cover.

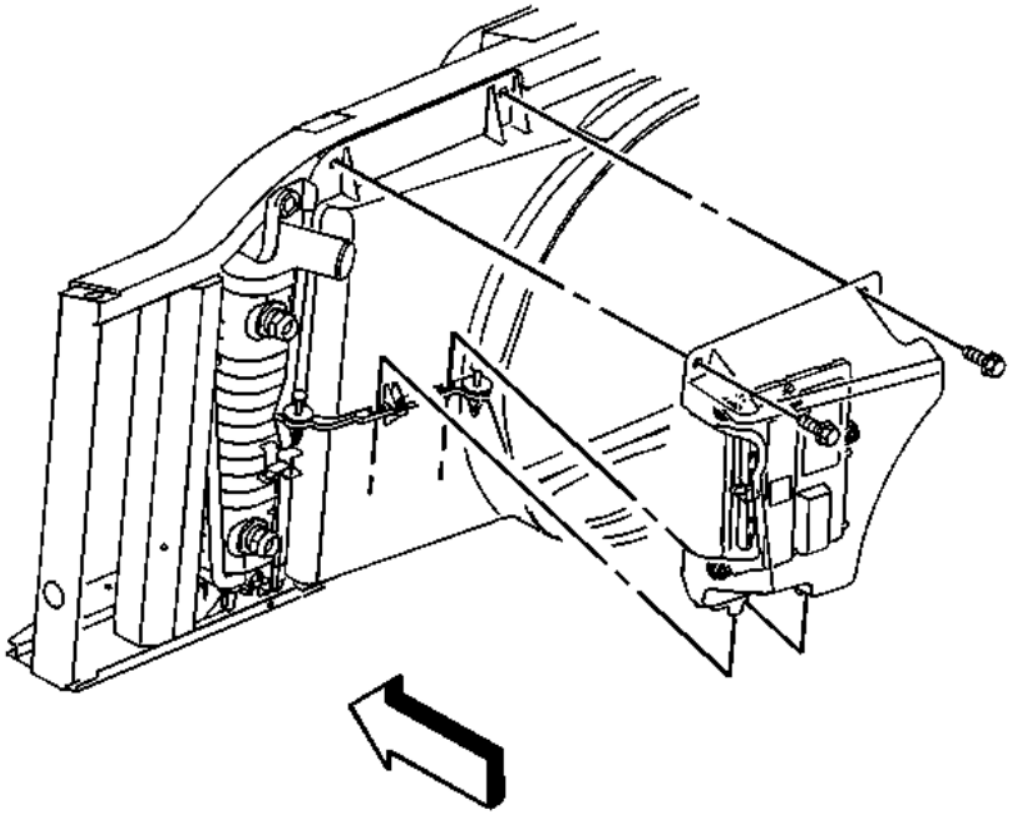


Fig. 229: View Of TCM Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the transmission control module (TCM) cover bolts.
7. Remove TCM cover from the fan shroud.

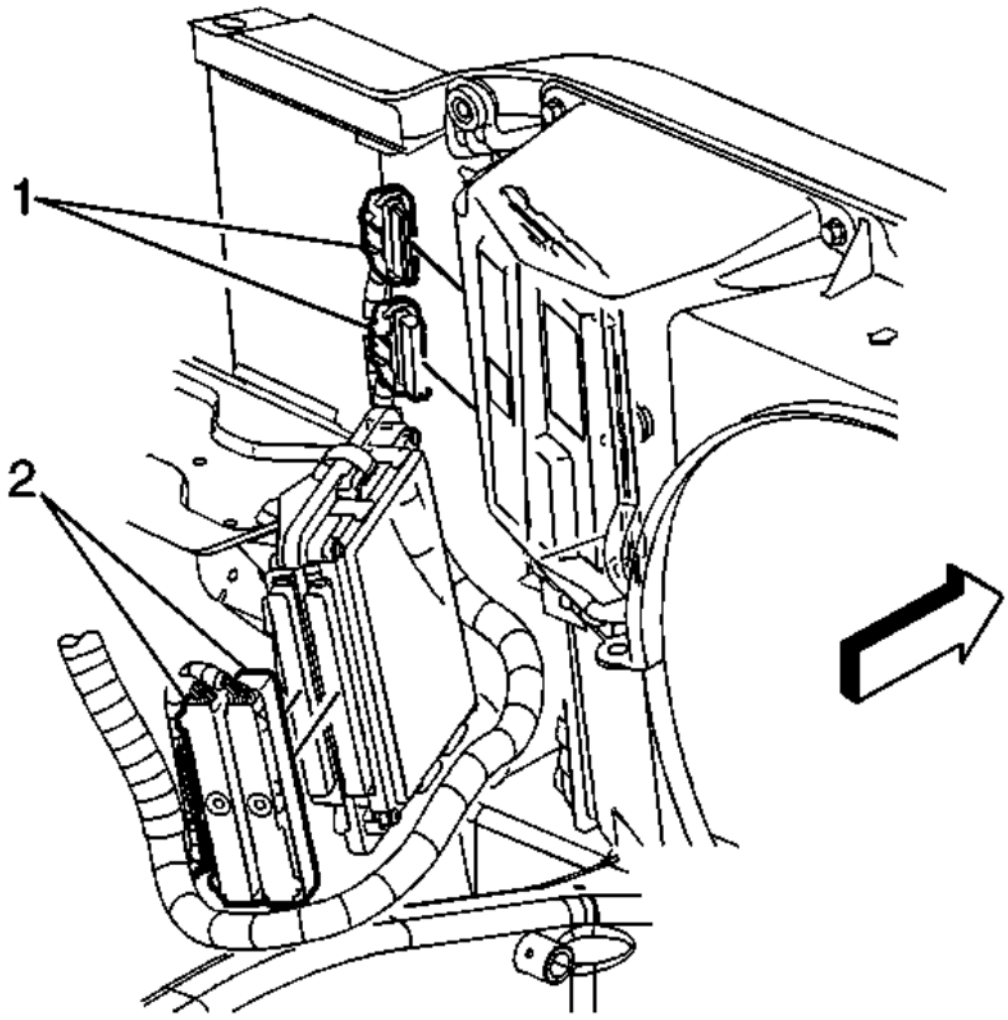


Fig. 230: View Of TCM Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

8. Loosen the TCM electrical connector bolts.
9. Disconnect the TCM electrical connectors (1).
10. Remove the TCM and cover.

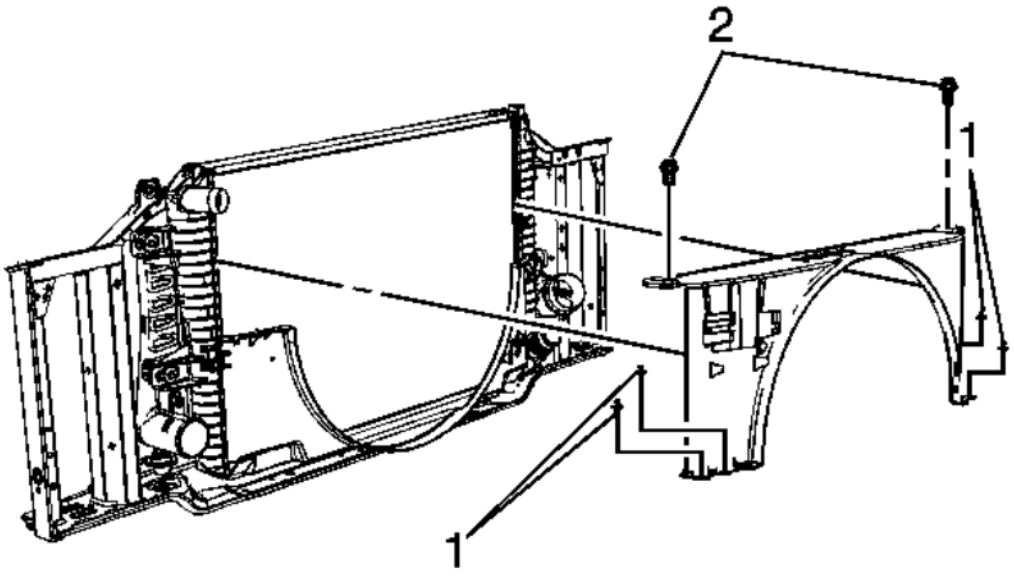


Fig. 231: View Of Fan Shroud Retainers
Courtesy of GENERAL MOTORS CORP.

11. Remove the fan shroud retainers (1).
12. Remove the fan shroud bolts (2).
13. Remove the upper fan shroud.

Installation Procedure

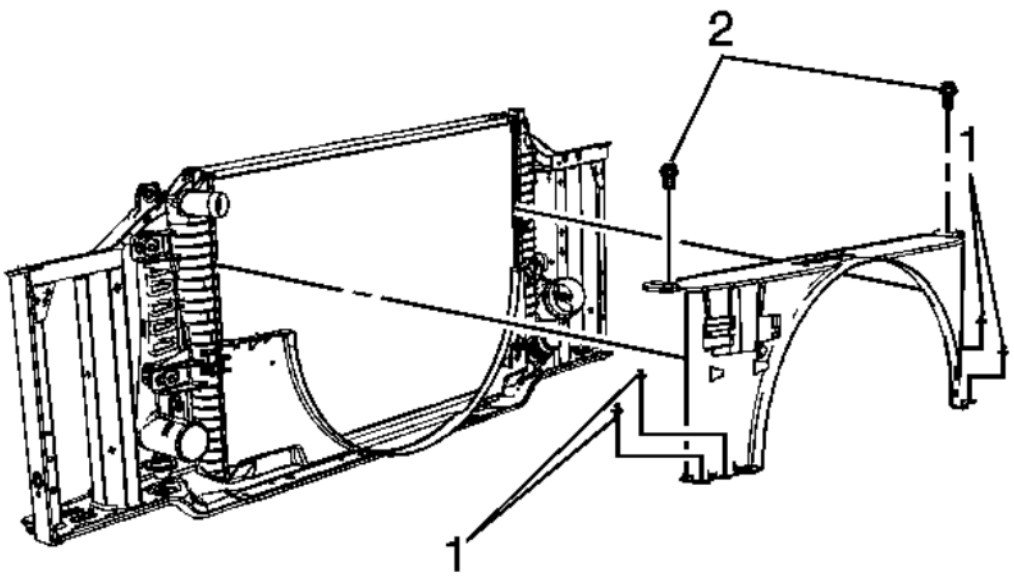


Fig. 232: View Of Fan Shroud Retainers
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the upper fan shroud.
2. Install the fan shroud retainers (1).
3. Install the fan shroud bolts (2).

Tighten: Tighten the bolts to 9 N.m (80 lb in).

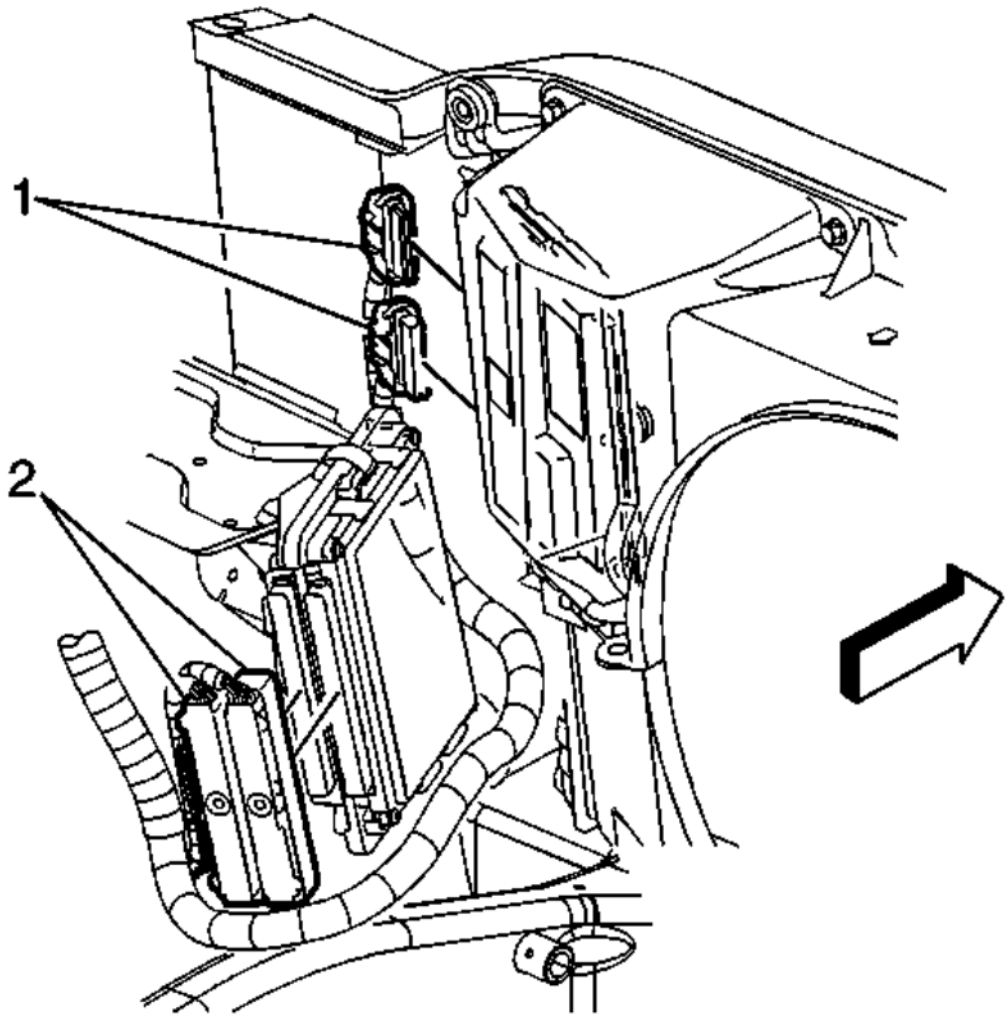


Fig. 233: View Of TCM Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

4. Connect the TCM electrical connectors (1).
5. Install the TCM and cover.
6. Tighten the TCM electrical connector bolts.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

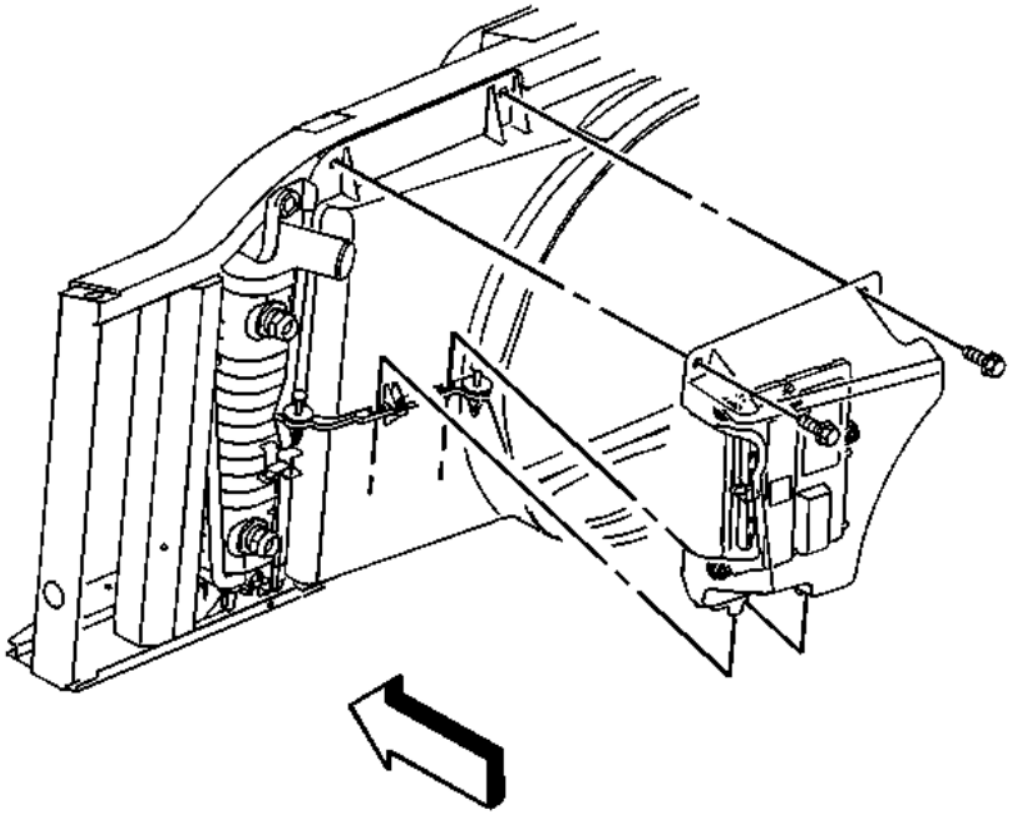


Fig. 234: View Of TCM Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Install the TCM cover to the fan shroud.
8. Install the TCM cover bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

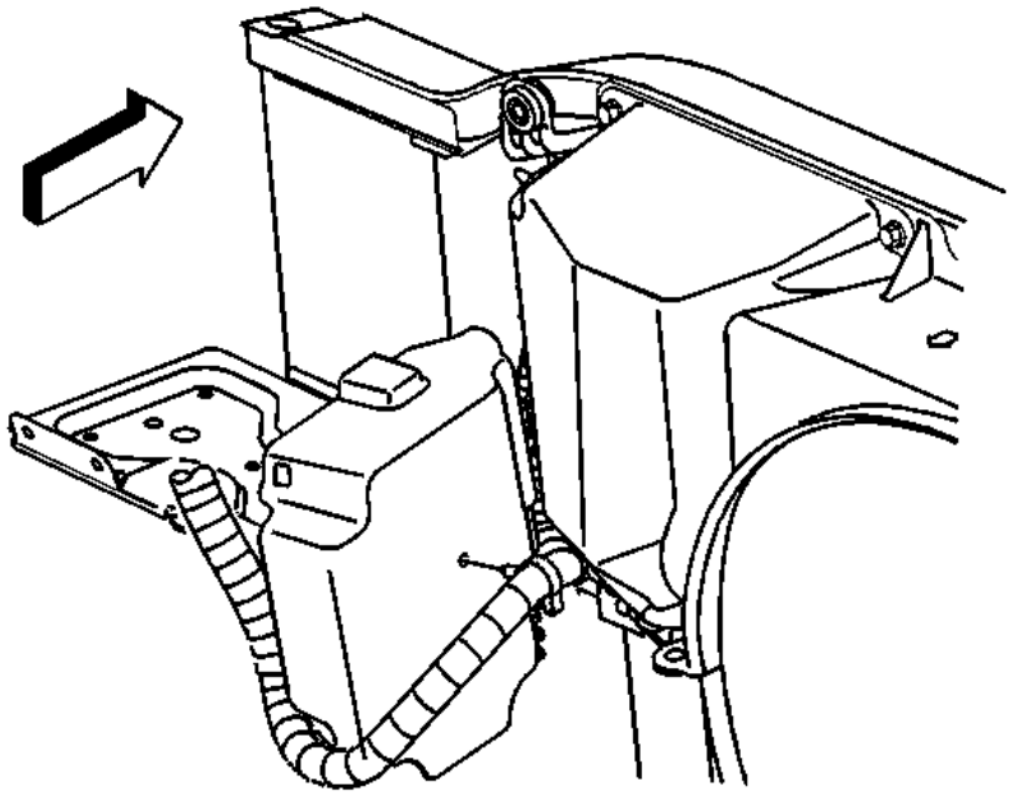


Fig. 235: View Of PCM Engine Harness Clip
Courtesy of GENERAL MOTORS CORP.

9. Install the engine harness clip to the PCM cover.
10. Install the A/C line retainer to the fan shroud.

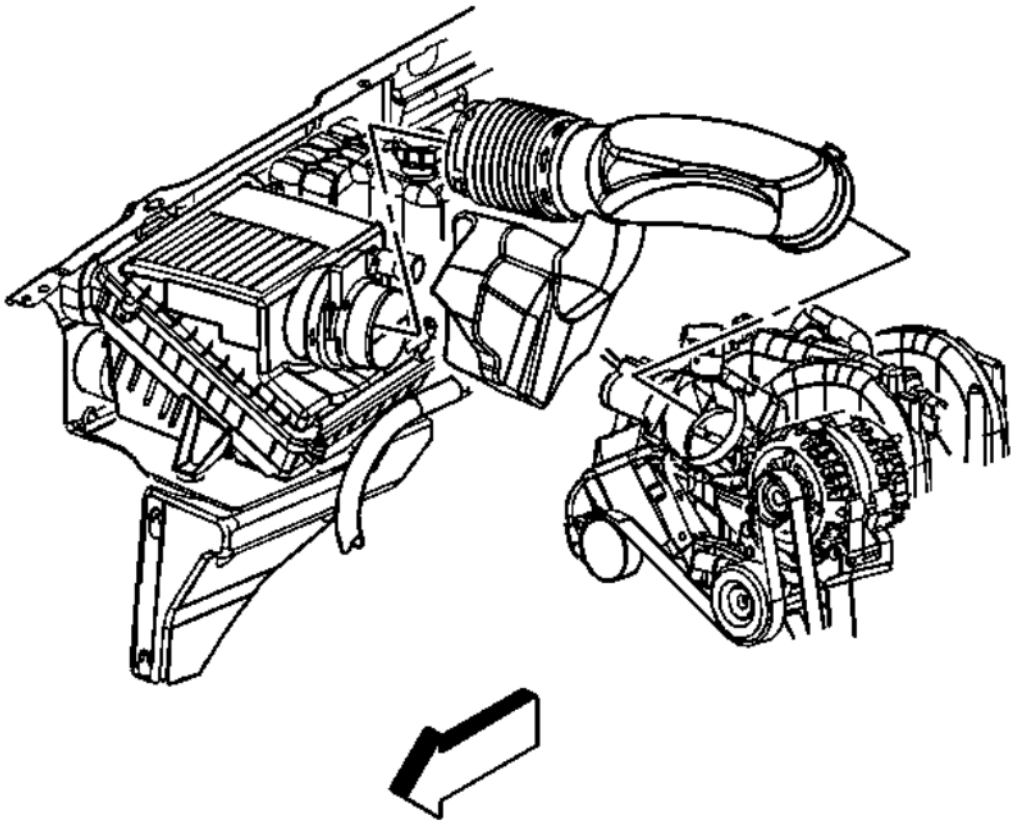


Fig. 236: View Of Air Cleaner Outlet Duct
Courtesy of GENERAL MOTORS CORP.

11. Install the air cleaner outlet duct.
12. Tighten the air cleaner outlet duct clamp at the throttle body.

    Tighten: Tighten the clamp to 4 N.m (35 lb in).

13. Tighten the air cleaner outlet duct clamp at the mass airflow sensor.

    Tighten: Tighten the clamp to 4 N.m (35 lb in).

ENGINE COOLANT FAN LOWER SHROUD REPLACEMENT (MECHANICAL)

Removal Procedure

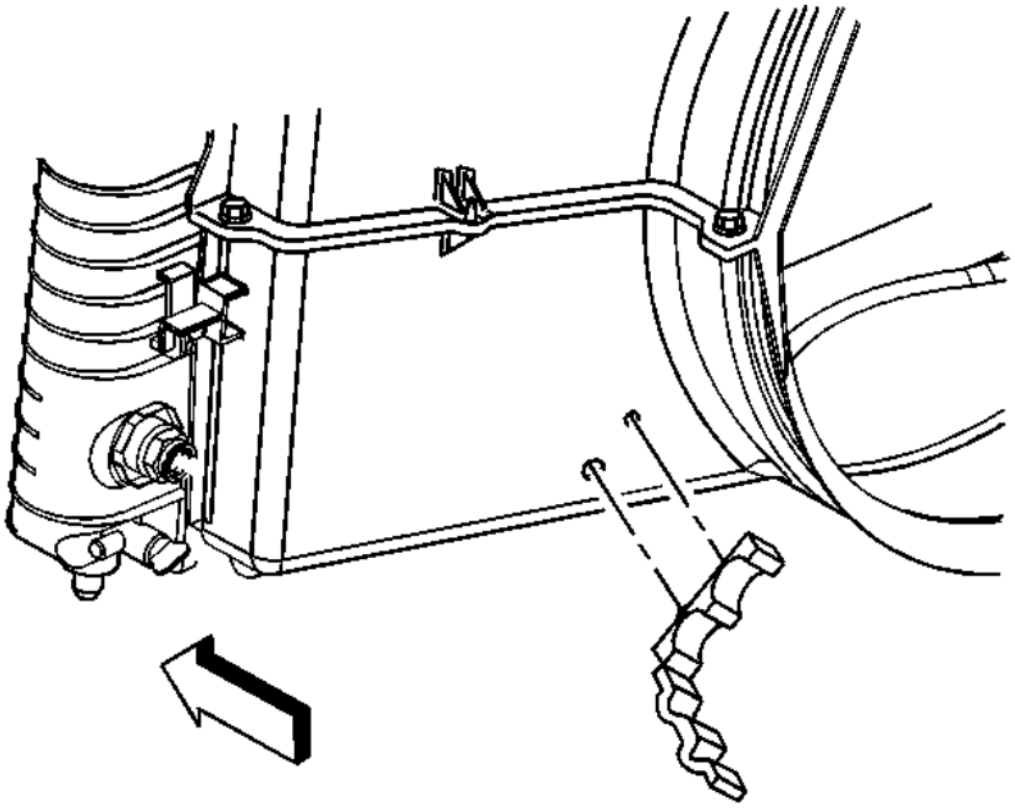


Fig. 237: View Of Oil Cooler Hose Clip At Lower Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling fan. Refer to **Fan Replacement (Diesel)** or **Fan Replacement (Mechanical)**.
2. If equipped with engine oil cooler, remove the oil cooler hose clip from the lower fan shroud.
3. Lift the lower fan shroud up in order to disengage the fan shroud from the retaining clips on the radiator.

Installation Procedure

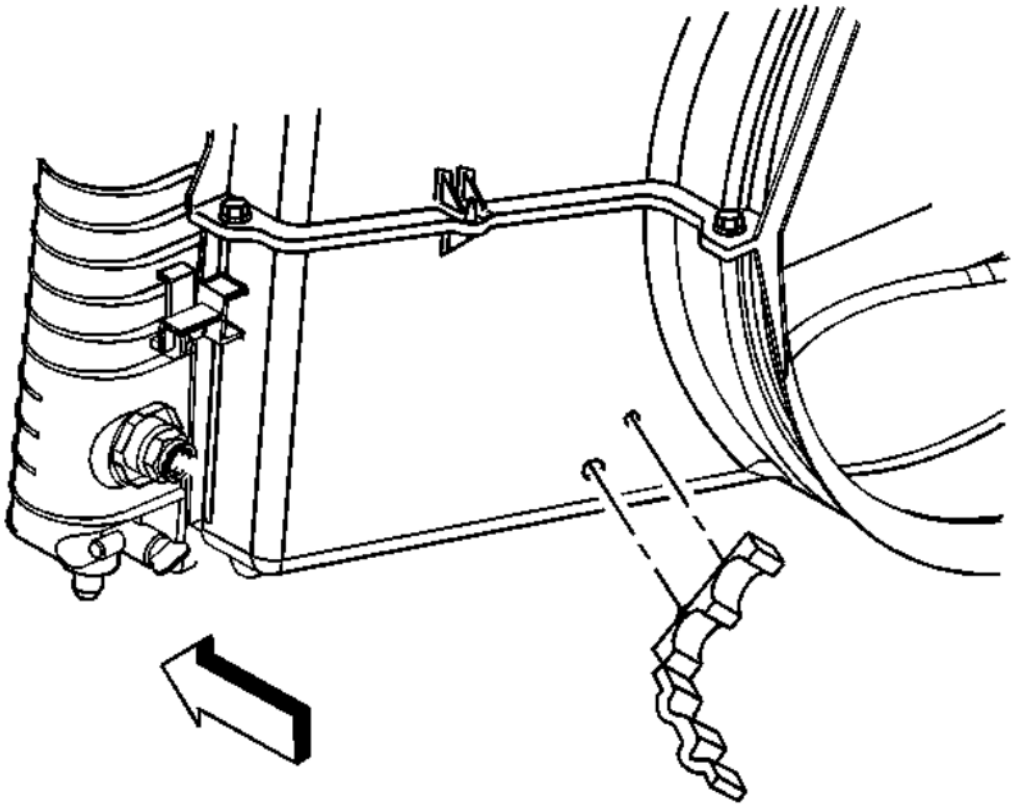


Fig. 238: View Of Oil Cooler Hose Clip At Lower Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the lower fan shroud and ensure it is centered over lower radiator support.
2. If equipped with the engine oil cooler, Install the oil cooler hose clip to the lower fan shroud.
3. Install the cooling fan. Refer to **Fan Replacement (Diesel)** or **Fan Replacement (Mechanical)**.

RADIATOR REPLACEMENT (4.3, 4.8, 5.3, AND 6.0L)

Removal Procedure

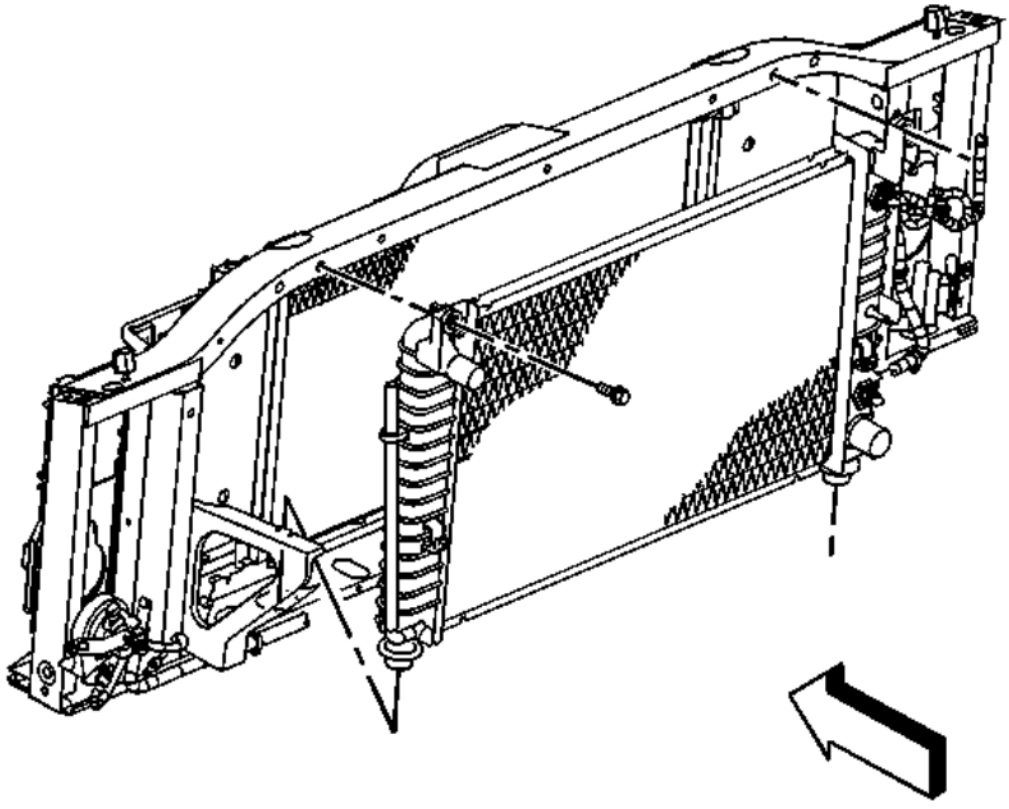


Fig. 239: View Of Radiator & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling fan and shroud. Refer to **Cooling Fan and Shroud Replacement (Non-HP2)**.
2. Remove the radiator outlet hose for the 4.3L engine, or the 4.8L, 5.3L and 6.0L engines. Refer to **Radiator Outlet Hose Replacement (Non-HP2)**.
3. Disconnect the engine oil cooler lines from the radiator, If Equipped. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
4. Disconnect the transmission oil cooler lines from the radiator, If Equipped. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .
5. Remove the radiator bolts.

6. Remove the radiator.

Installation Procedure

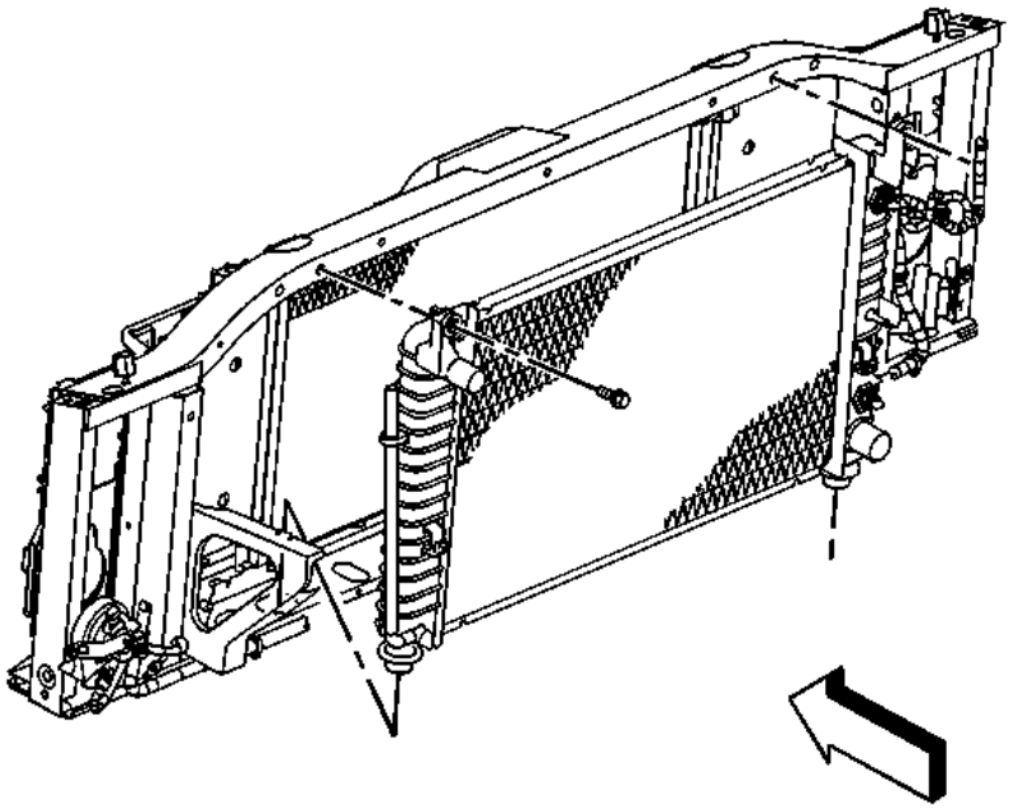


Fig. 240: View Of Radiator & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator.

NOTE: Refer to Fastener Notice .

2. Install the radiator bolts.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

3. Connect the transmission oil cooler lines to the radiator, If Equipped. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** .
4. Connect the engine oil cooler lines to the radiator, If Equipped. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
5. Install the radiator outlet hose for the 4.3L engine, or the 4.8L, 5.3L and 6.0L engines. Refer to **Radiator Outlet Hose Replacement (Non-HP2)**.
6. Install the cooling fan and shroud. Refer to **Cooling Fan and Shroud Replacement (Non-HP2)**.

RADIATOR REPLACEMENT (LLM)

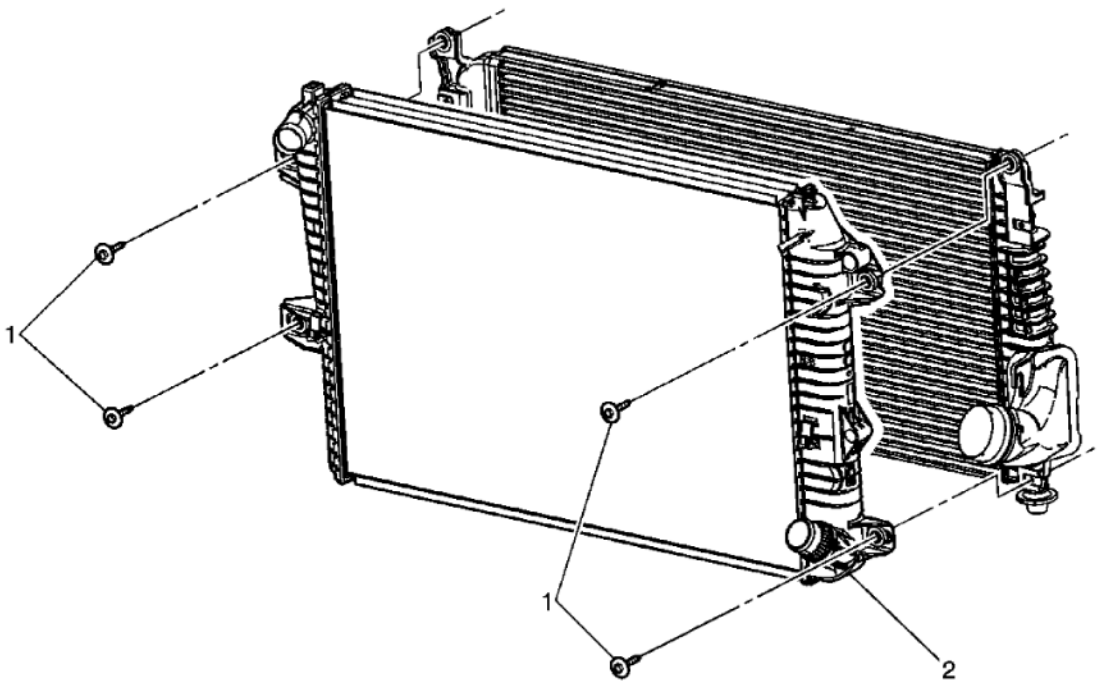


Fig. 241: View Of Radiator Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**. 2. If necessary, remove air cleaner resonator duct. Refer to **Air Cleaner Resonator**	

	Outlet Duct Replacement 3. Remove the surge tank inlet hose. Refer to **Exterior Trim Emblem Removal Notice** . 4. Remove the charge air cooler inlet and outlet pipes. Refer to **Charge Air Cooler Inlet Pipe Replacement** and **Charge Air Cooler Outlet Pipe Replacement** . 5. Remove the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement (Non-HP2)**. 6. Remove the radiator outlet hose. Refer to **Radiator Outlet Hose Replacement (Non-HP2)**.
1	Radiator Bolt (Qty: 4) **Tip:** Radiator is mounted to the charged air cooler.
2	Radiator Assembly

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT

Removal Procedure

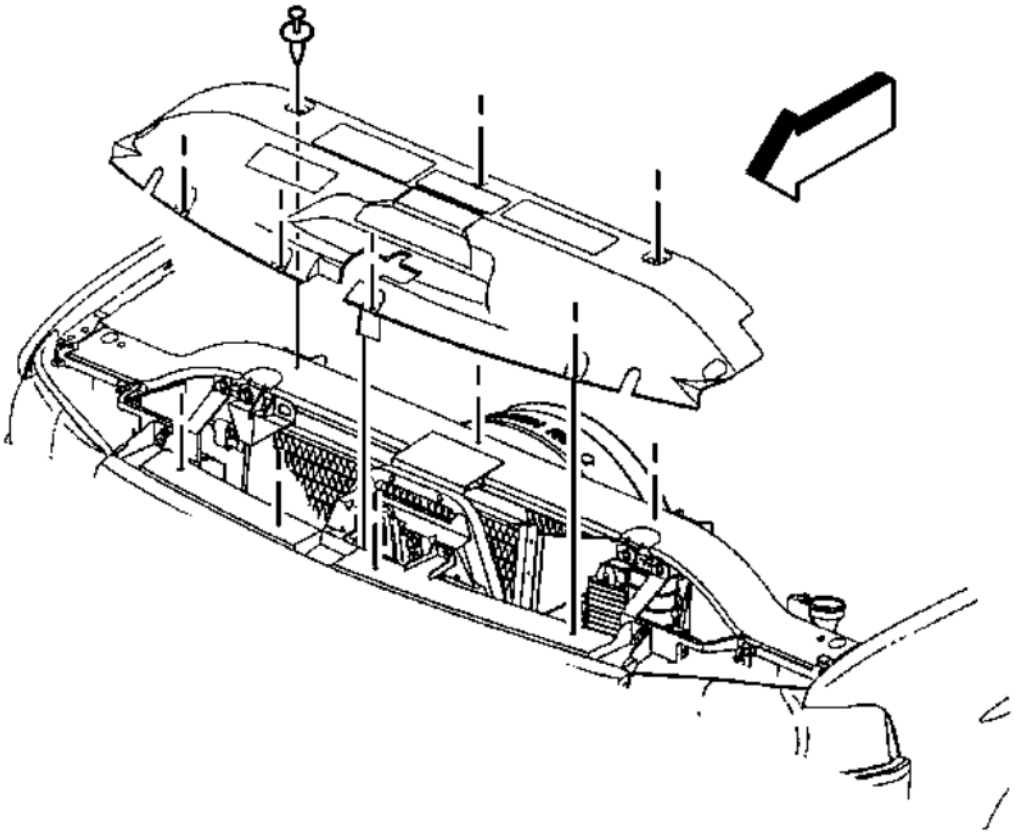


Fig. 242: View Of Upper Grille Baffle
Courtesy of GENERAL MOTORS CORP.

1. Remove the radiator air upper baffle retainers (Qty 8).
2. Remove the radiator air upper baffle.

Installation Procedure

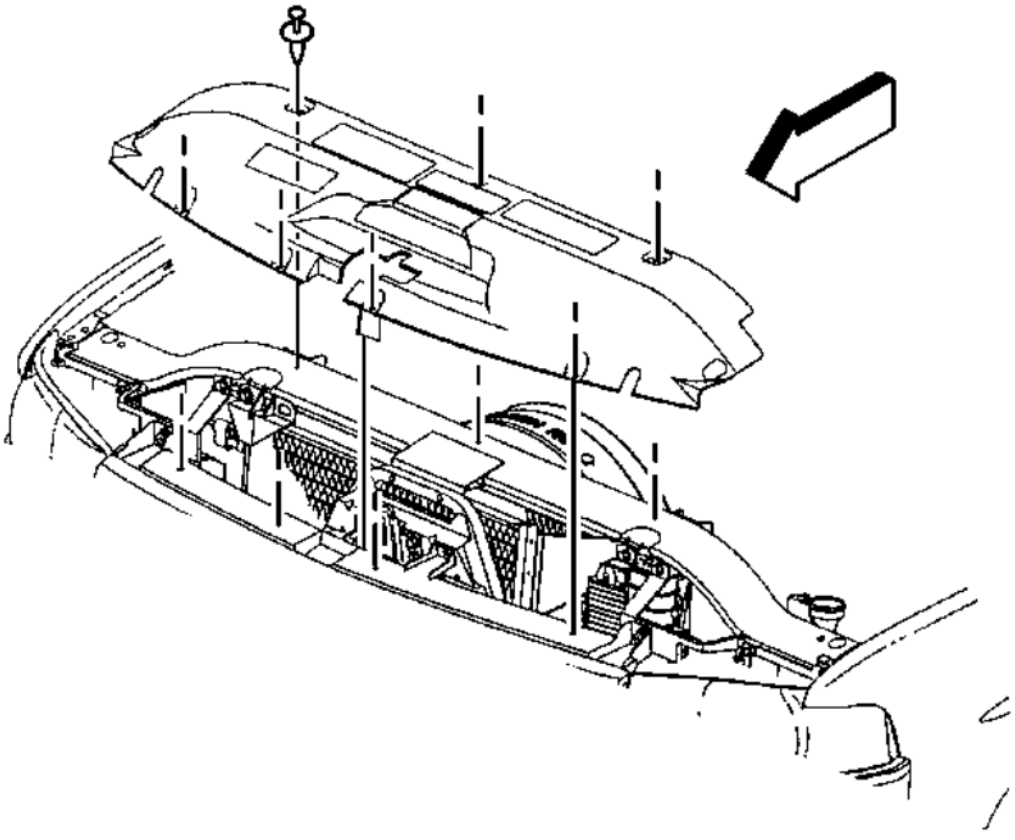


Fig. 243: View Of Upper Grille Baffle
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator air upper baffle.
2. Install the radiator air upper baffle retainers (Qty 8).

COOLANT HEATER REPLACEMENT (LH6, LY2, LMG, LY5, AND LY6)

Removal Procedure

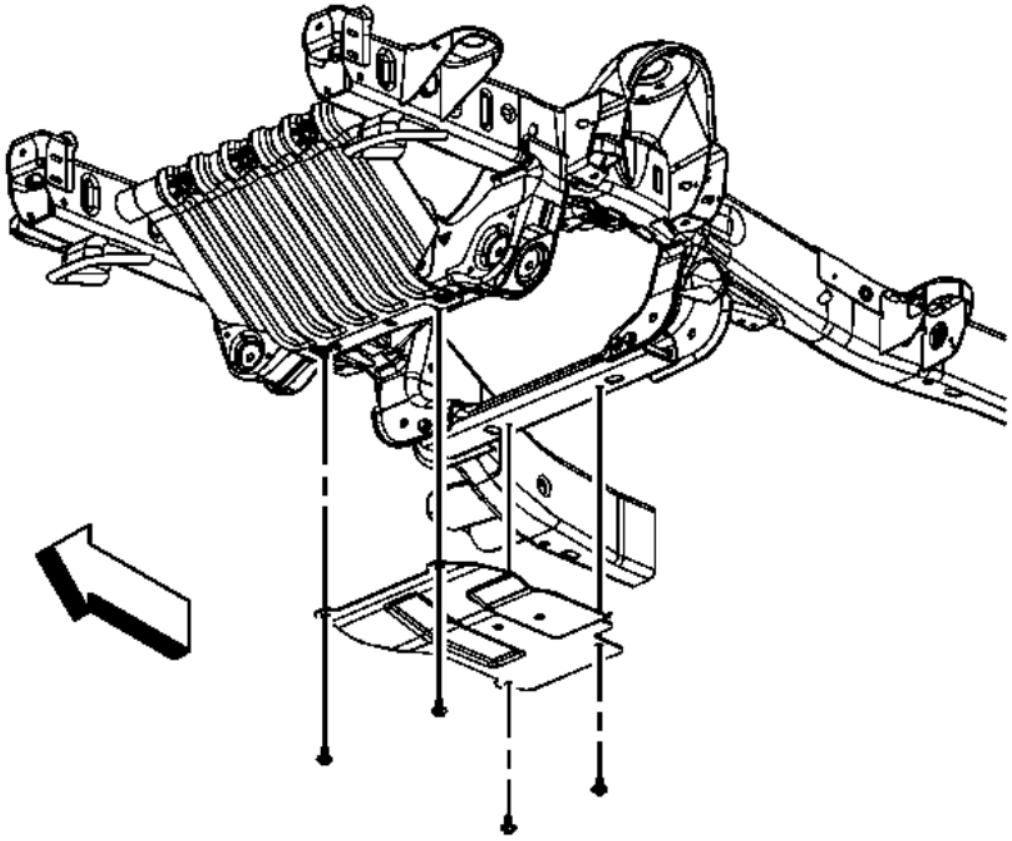


Fig. 244: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system/engine block. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. For 1500 series vehicles, remove the oil pan skid plate bolts and plate, if equipped.

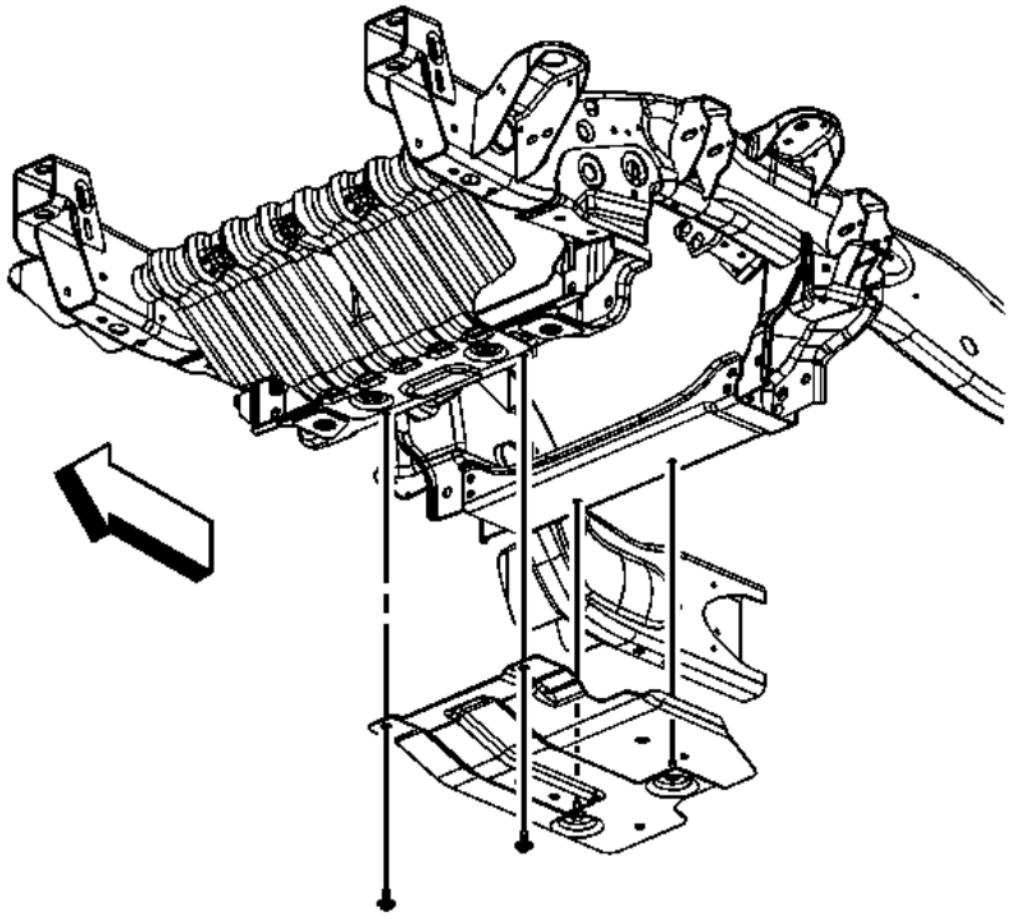


Fig. 245: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

4. For 2500 series vehicle, remove the front 2 oil pan skid plate bolts, loosen the 2 rear bolts and remove the skid plate, if equipped.

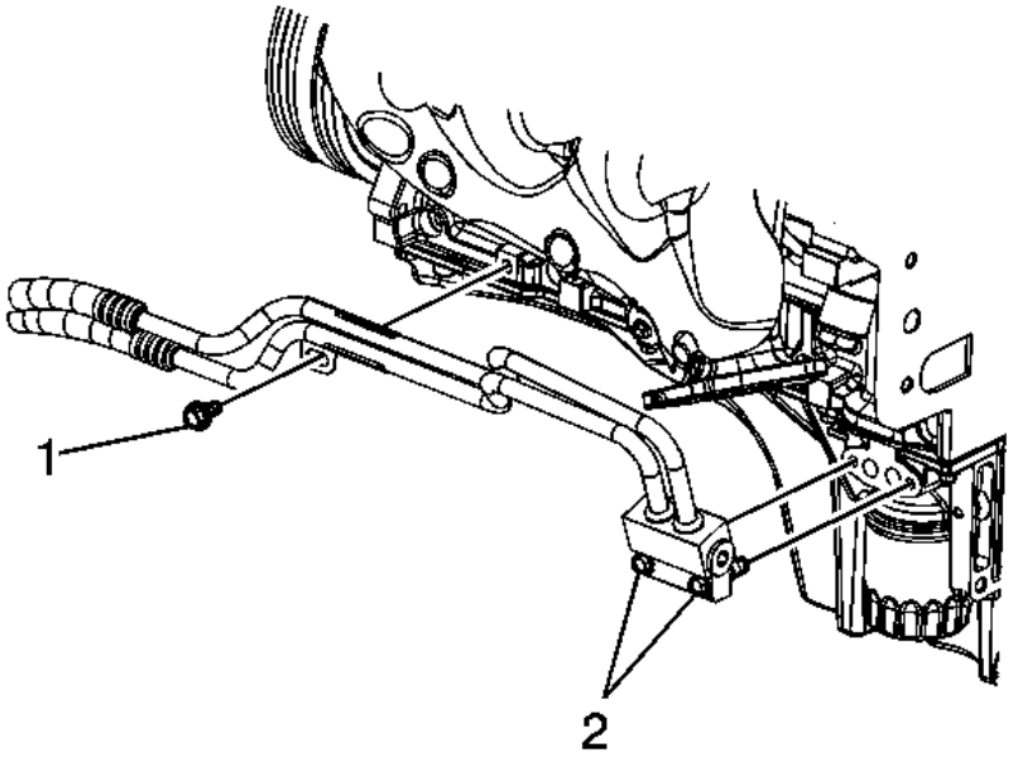


Fig. 246: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

5. For vehicles with regular production option (RPO) LY6 (6.0L) perform the following steps otherwise proceed to step 10.
6. Remove the oil cooler hose bracket bolt (1).
7. Remove the oil cooler hose adapter bolts (2).
8. Remove and discard the oil cooler hose adapter gasket.
9. Reposition the oil cooler hose adapter end out of the way.

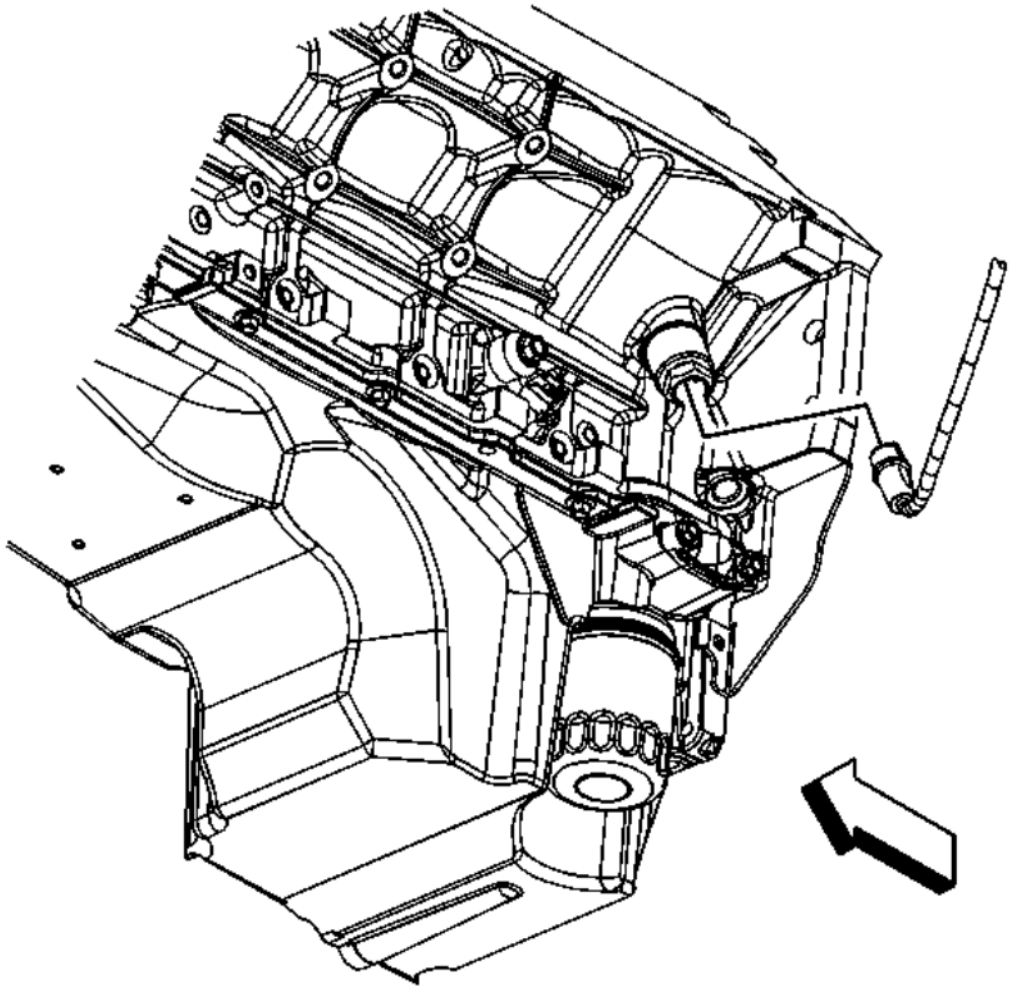


Fig. 247: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the coolant heater cord electrical connector.

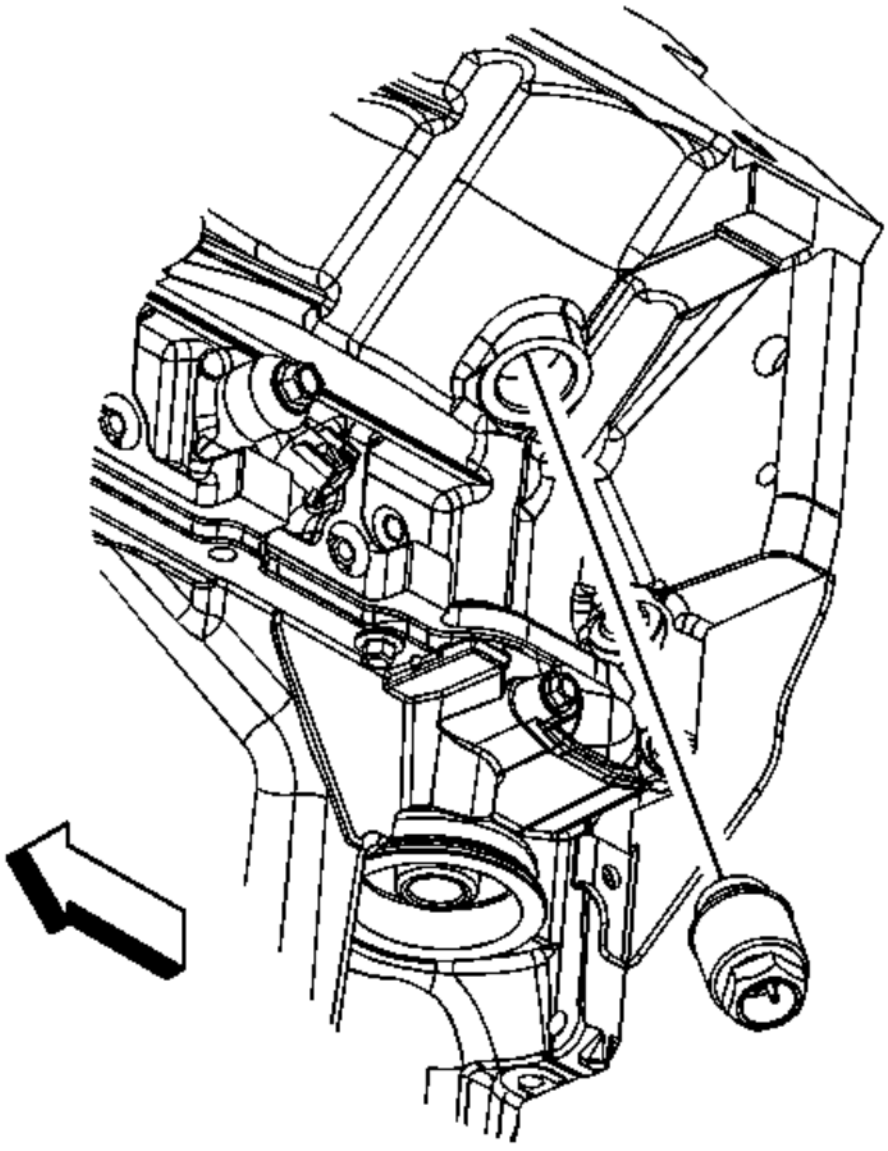


Fig. 248: Locating Coolant Heater
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not score the surface of the engine block hole when removing the coolant heater.

11. Remove the coolant heater from the engine block.
12. Remove any burrs, sealer, or other rough spots.

Installation Procedure

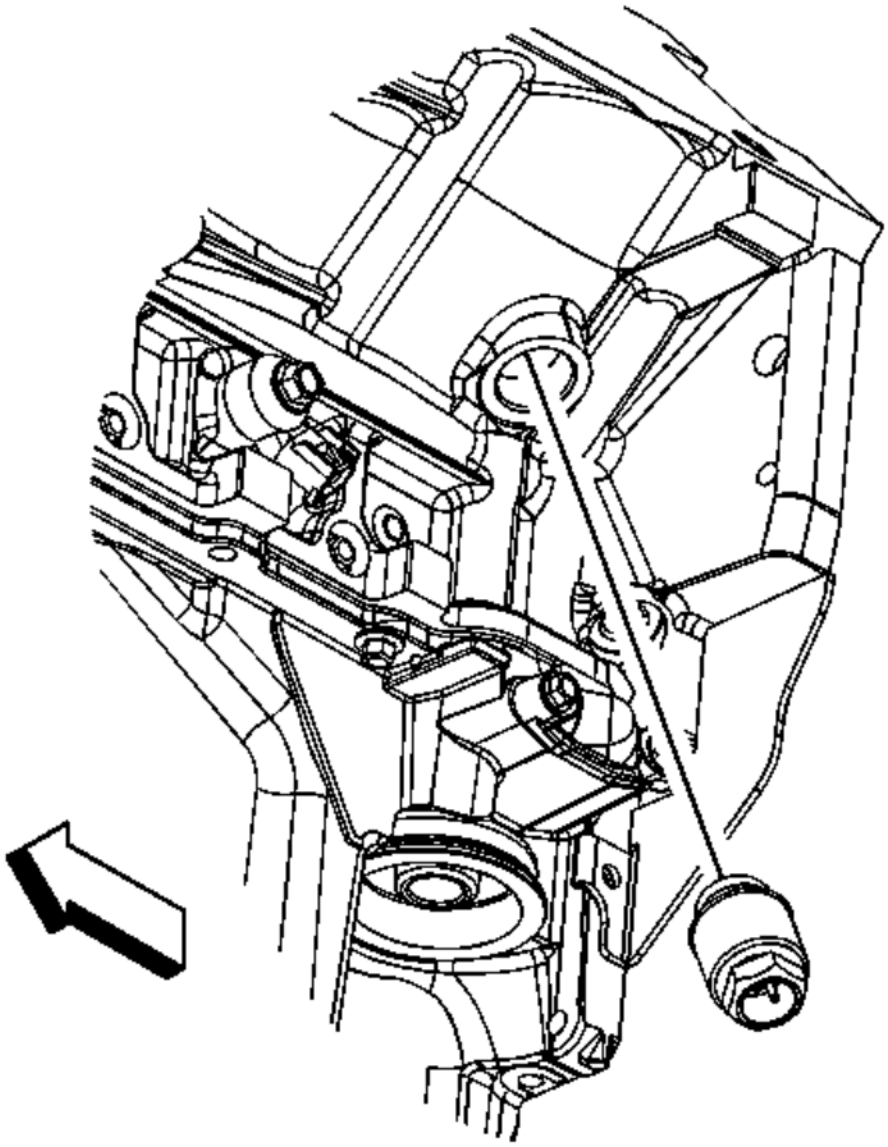


Fig. 249: Locating Coolant Heater

Courtesy of GENERAL MOTORS CORP.

1. If reusing the old coolant heater, apply thread sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the threads.

NOTE: **Refer to Fastener Notice .**

2. Install the coolant heater to the engine block.

Tighten: Tighten the coolant heater to 50 N.m (37 lb ft).

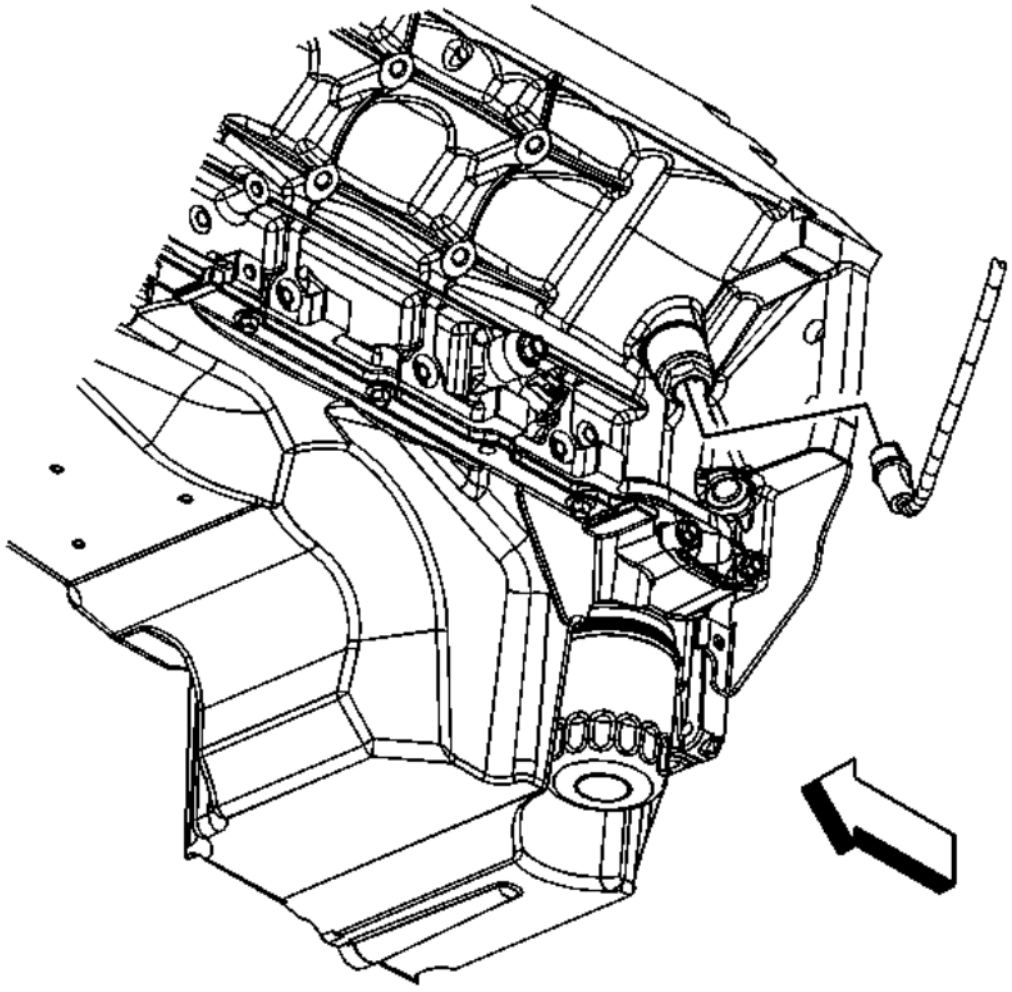


Fig. 250: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Connect the coolant heater cord electrical connector.

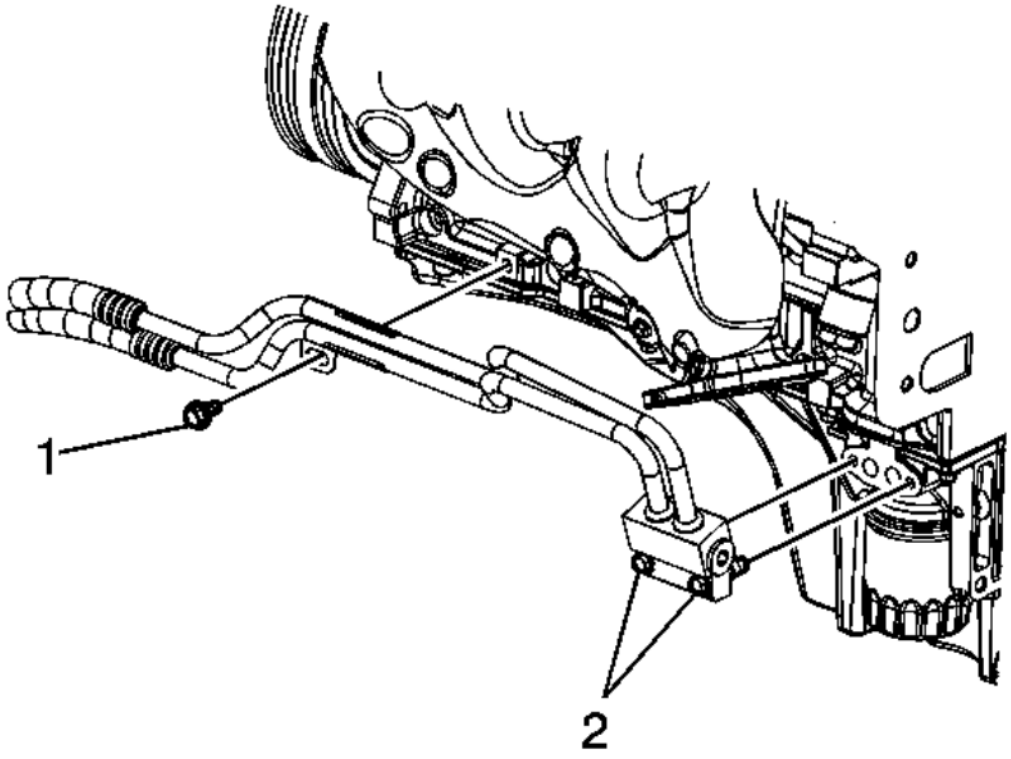


Fig. 251: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

4. For vehicles with RPO LY6 (6.0L) perform the following steps otherwise proceed to step 9.
5. Position the oil cooler hose adapter end.
6. Install a NEW oil cooler hose adapter gasket.
7. Install the oil cooler hose adapter bolts (2).

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

8. Install the oil cooler hose bracket bolt (1).

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

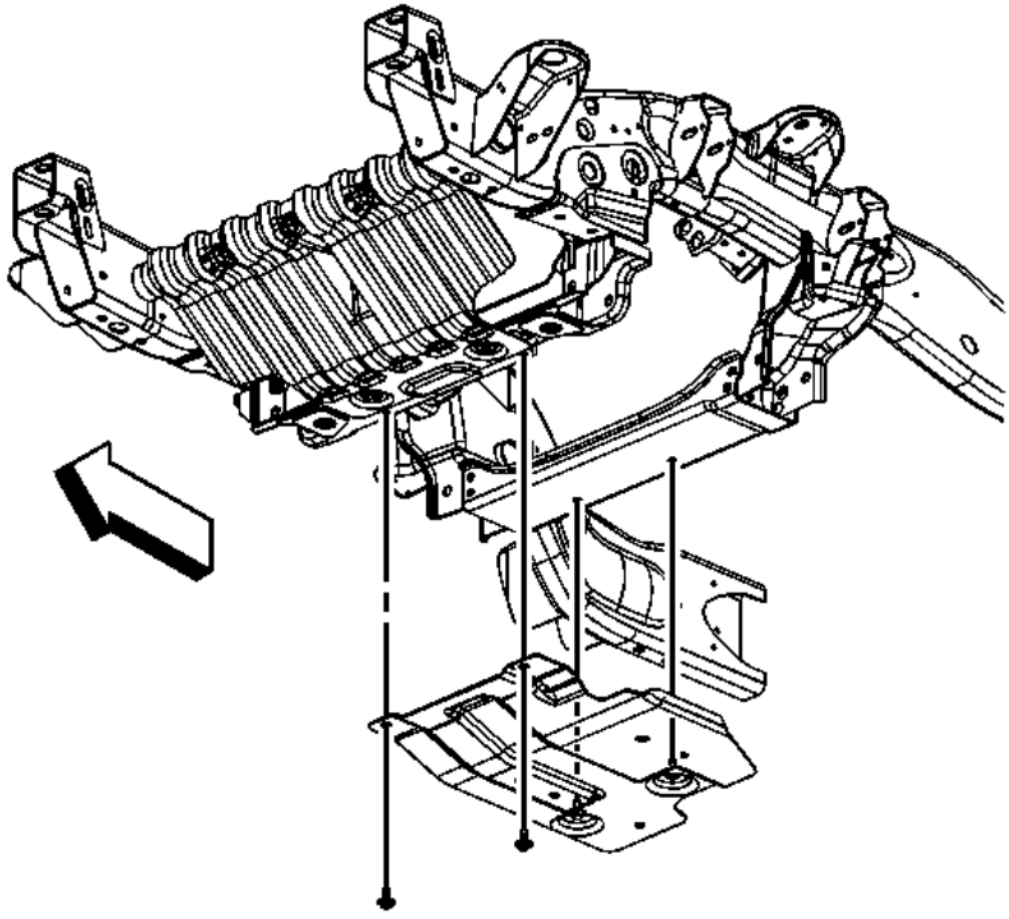


Fig. 252: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

9. For 2500 series vehicles, position the oil pan skid plate and install the 2 front bolts and tighten the 2 rear bolts, if equipped.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

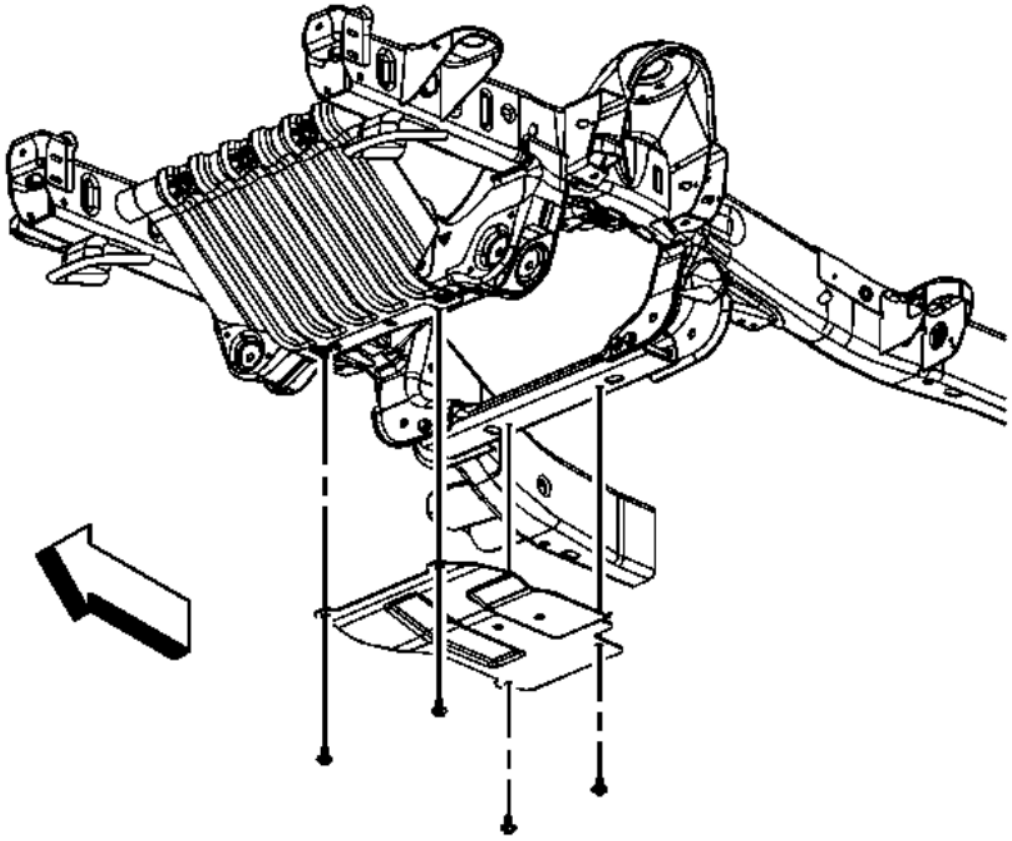


Fig. 253: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

10. For 1500 series vehicles position and install the oil pan skid plate and bolts, if equipped.

    Tighten: Tighten the bolts to 20 N.m (15 lb ft).

11. Lower the vehicle.
12. Fill the cooling system/engine block. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

COOLANT HEATER REPLACEMENT (L76, L92)

Removal Procedure

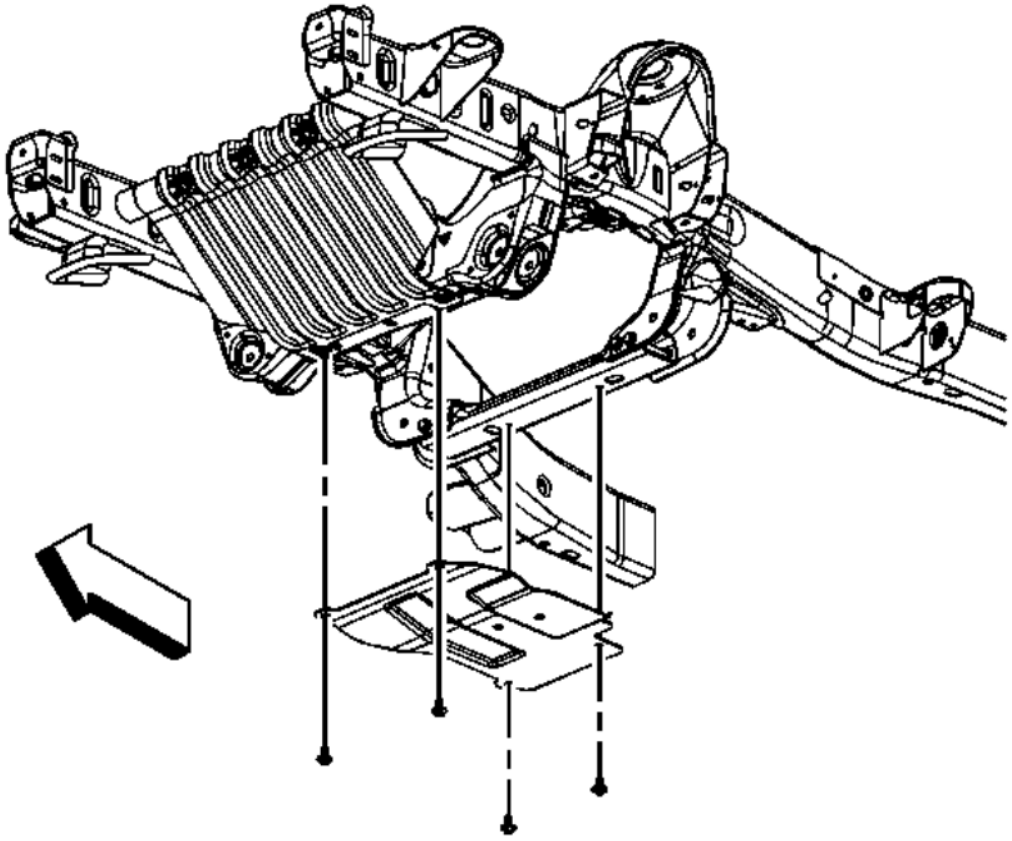


Fig. 254: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system/engine block. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the oil pan skid plate bolts and plate, if equipped.

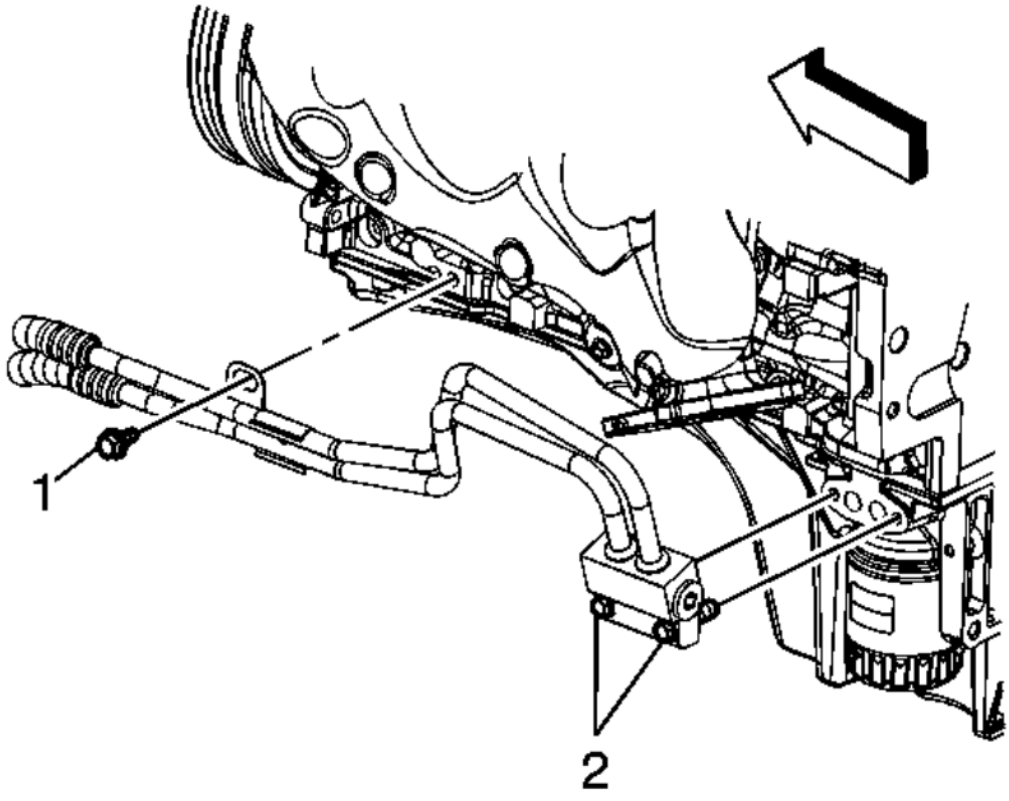


Fig. 255: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

4. For vehicles with regular production option (RPO) L76 (6.0L), perform the following steps. Otherwise, proceed to step 9.
5. Remove the oil cooler hose bracket bolt (1), if equipped.
6. Remove the oil cooler hose adapter bolts (2), if equipped.
7. Remove and discard the oil cooler hose adapter gasket, if equipped.
8. Position the oil cooler hose adapter end out of the way, if equipped.

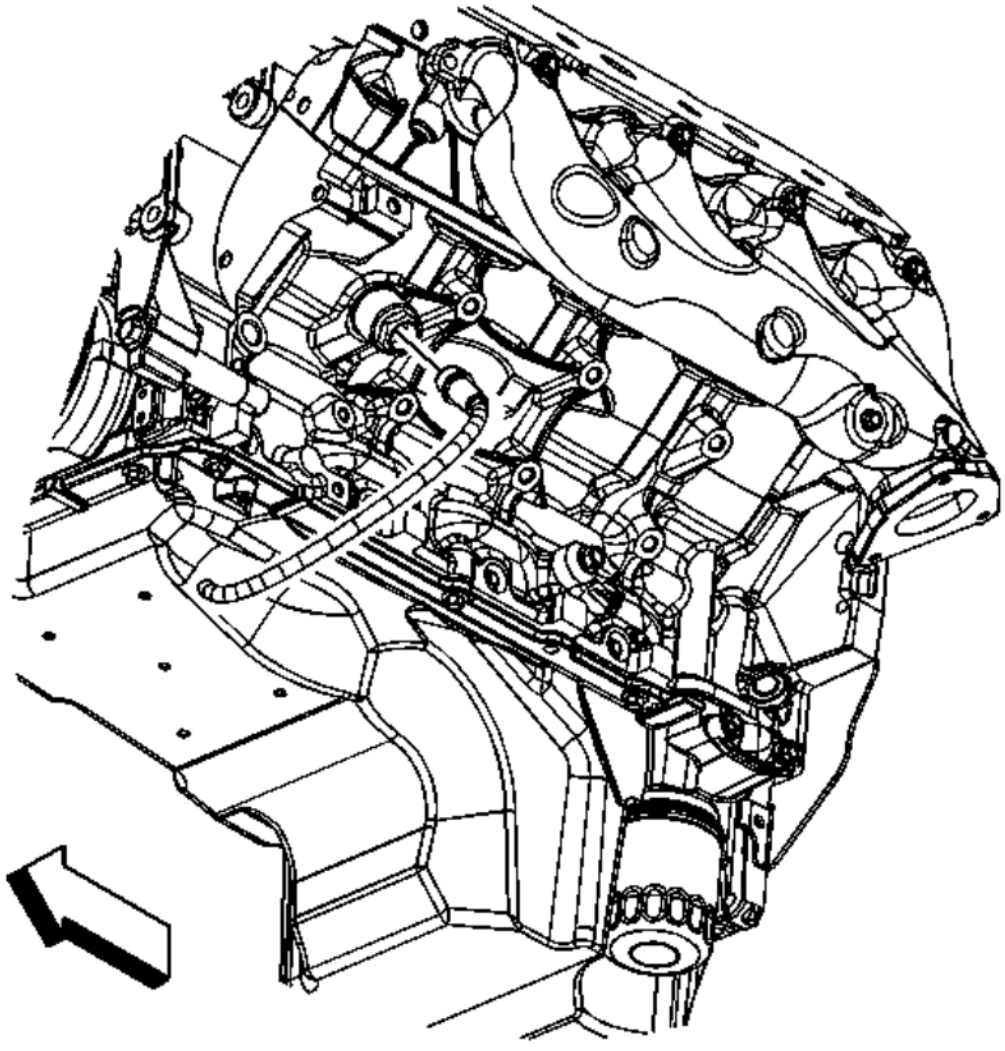


Fig. 256: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the coolant heater cord electrical connector.

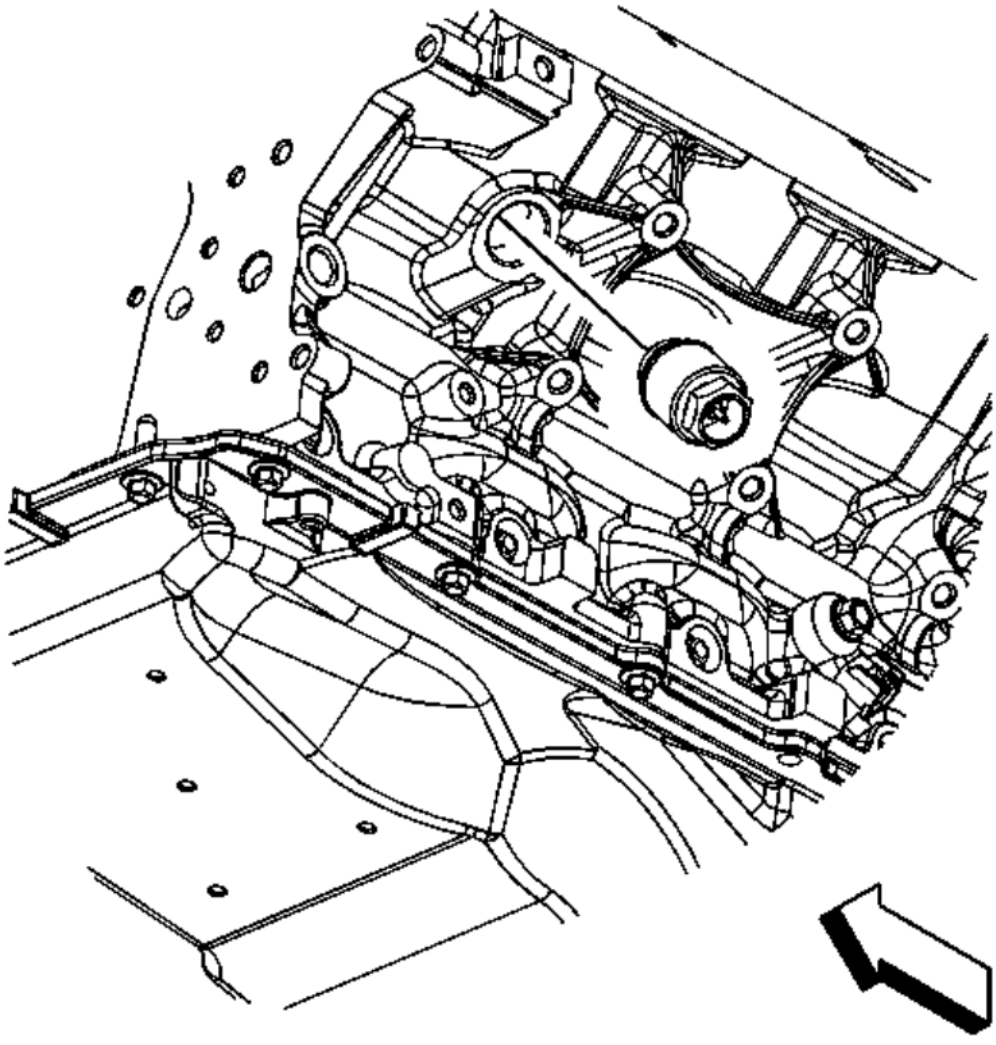


Fig. 257: Locating Coolant Heater
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not score the surface of the engine block hole when removing the coolant heater.

10. Remove the coolant heater from the engine block.
11. Remove any burrs, sealer, or other rough spots.

Installation Procedure

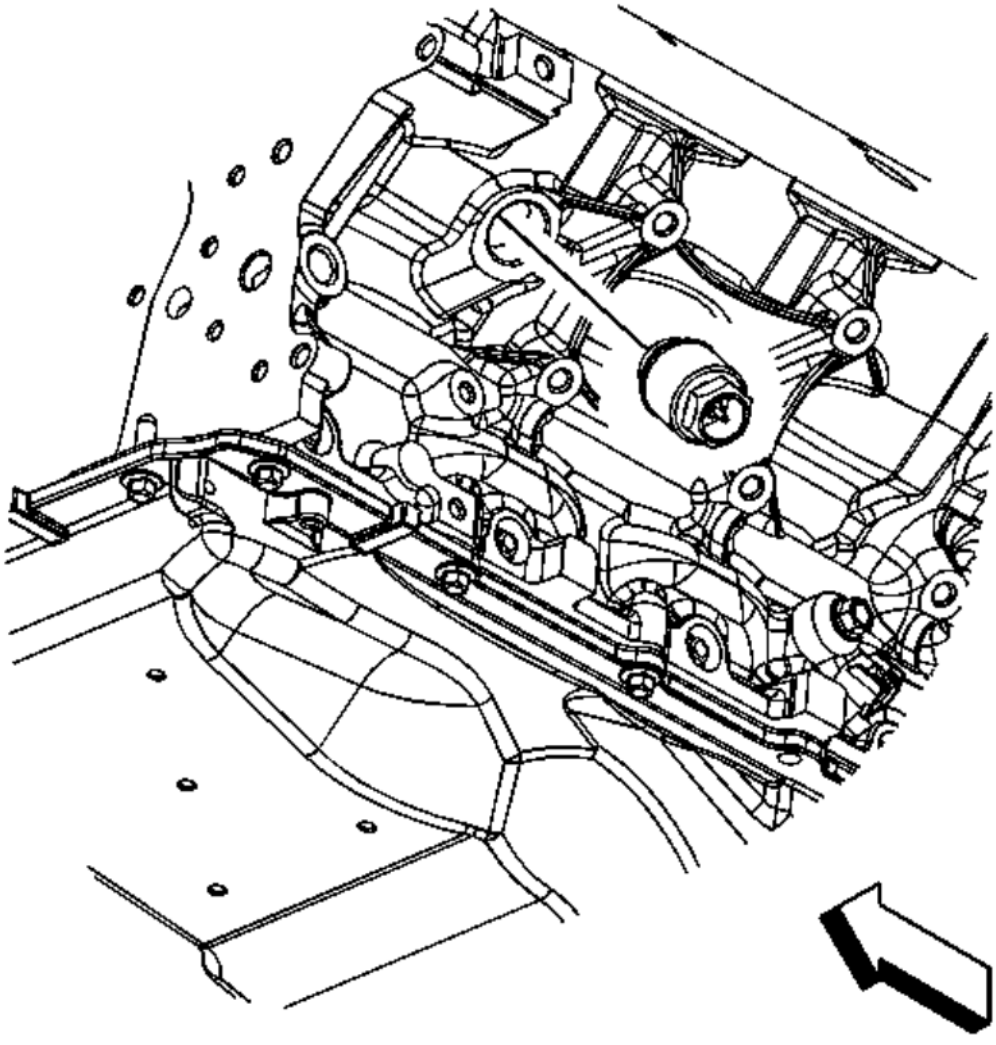


Fig. 258: Locating Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. If reusing the old coolant heater, apply thread sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent to the threads.

NOTE: **Refer to Fastener Notice .**

2. Install the coolant heater to the engine block.

   Tighten: Tighten the coolant heater to 50 N.m (37 lb ft).

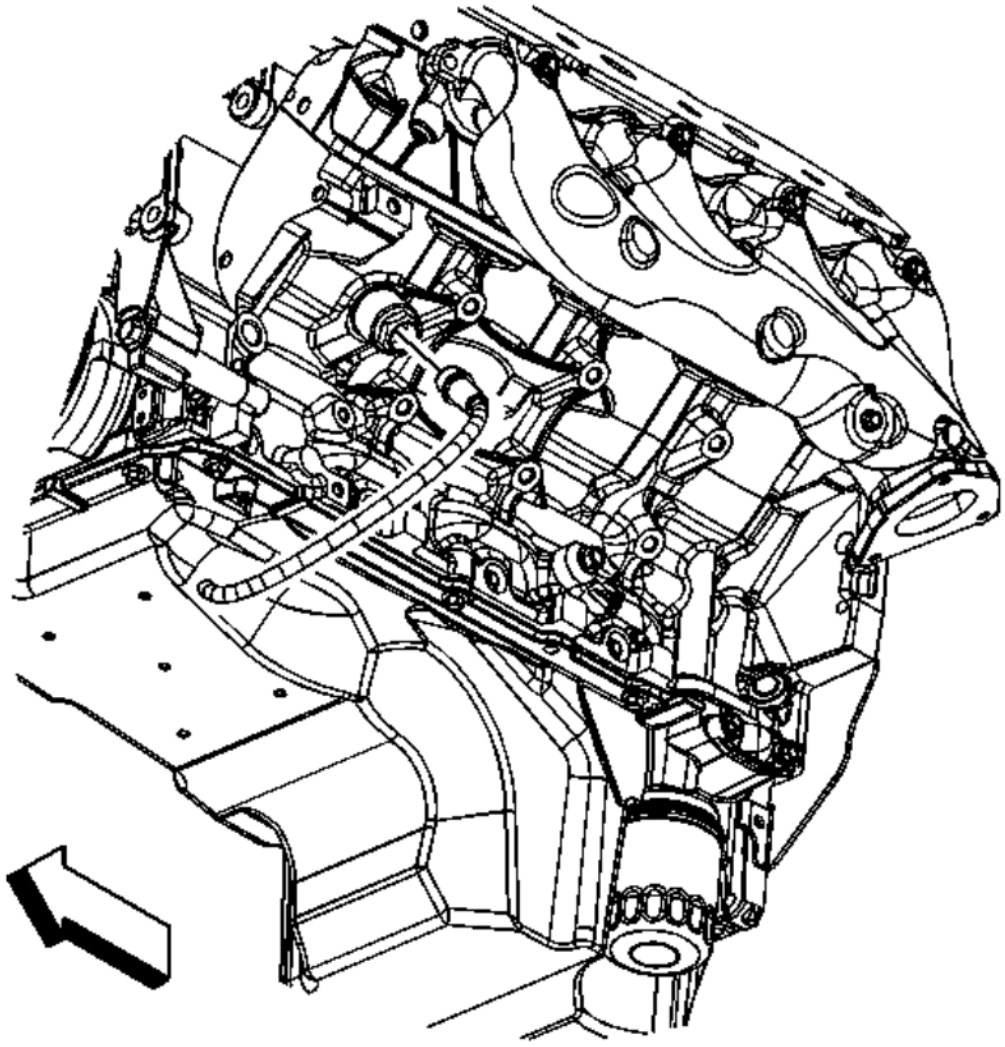


Fig. 259: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Connect the coolant heater cord electrical connector.

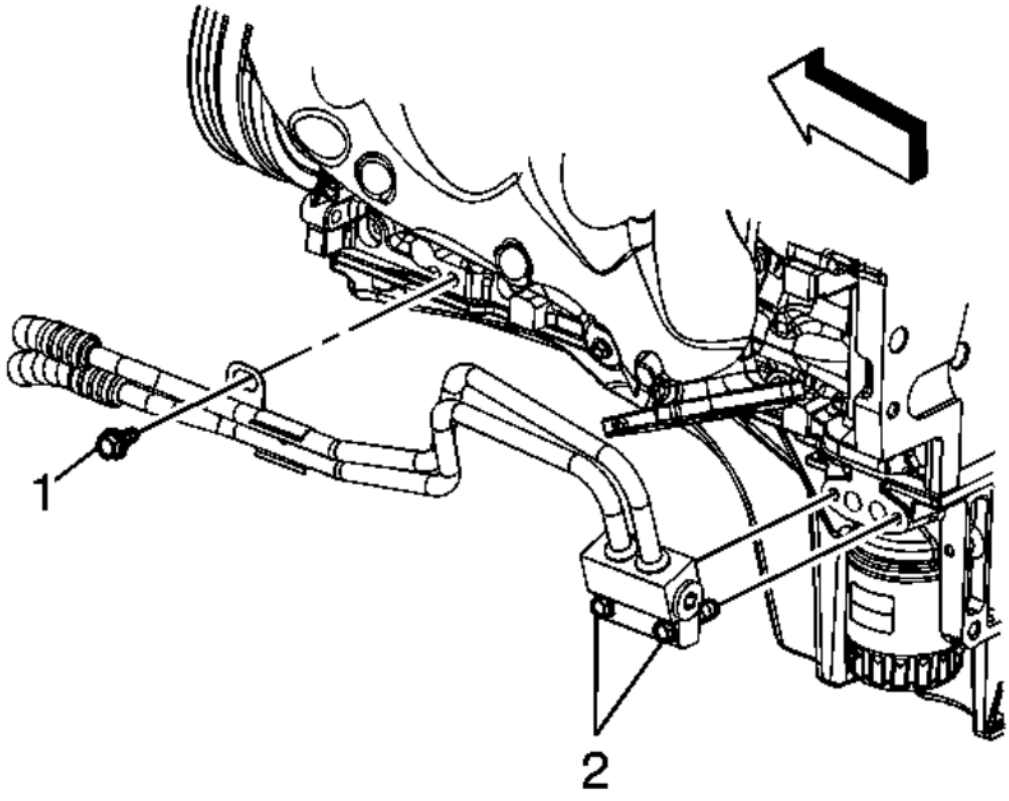


Fig. 260: Locating Oil Cooler Hose Bracket & Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

4. For vehicles with RPO L76 (6.0L) perform the following steps otherwise proceed to step 9.
5. Position the oil cooler hose adapter end, if equipped.
6. Install a NEW oil cooler hose adapter gasket, if equipped.
7. Install the oil cooler hose adapter bolts (2), if equipped.

   Tighten: Tighten the bolts to 12 N.m (106 lb in).

8. Install the oil cooler hose bracket bolt (1), if equipped.

   Tighten: Tighten the bolt to 25 N.m (18 lb ft).

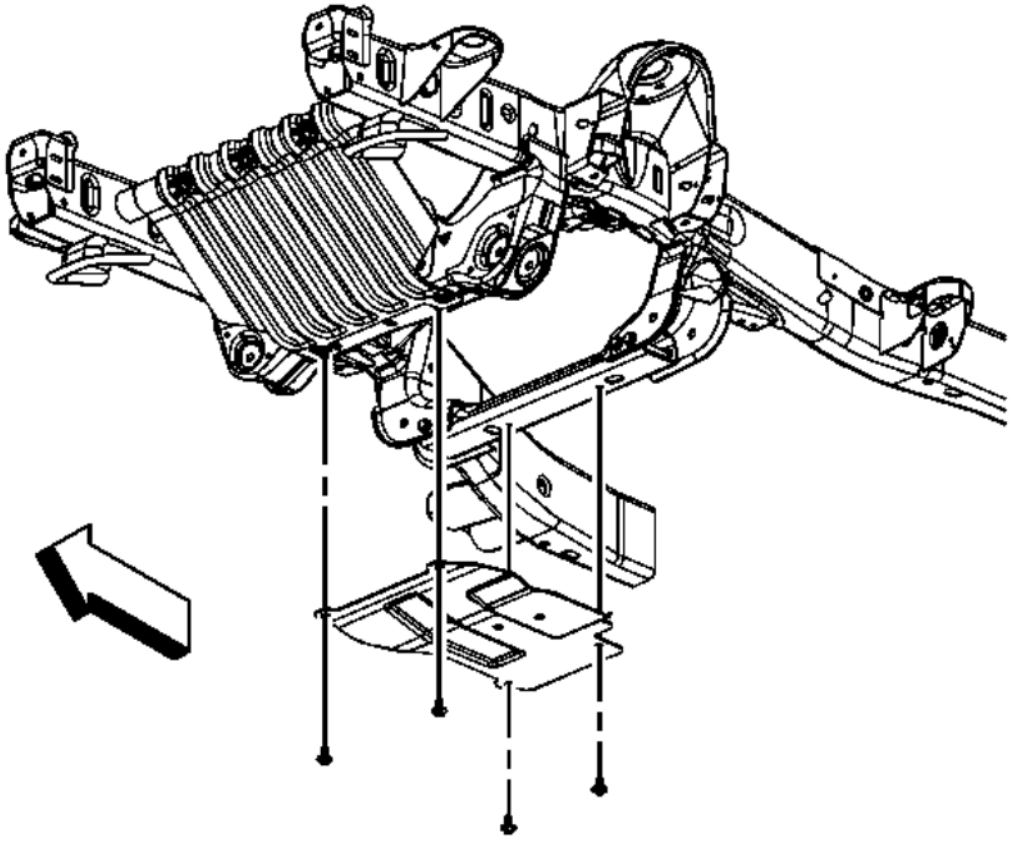


Fig. 261: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Position and install the oil pan skid plate and bolts, if equipped

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

10. Lower the vehicle.
11. Fill the cooling system/engine block. Refer to **Cooling System Draining and Filling (Vac-N-Fill)** or **Cooling System Draining and Filling (Static Fill)**.

COOLANT HEATER CORD REPLACEMENT (L76 AND L92)

Removal Procedure

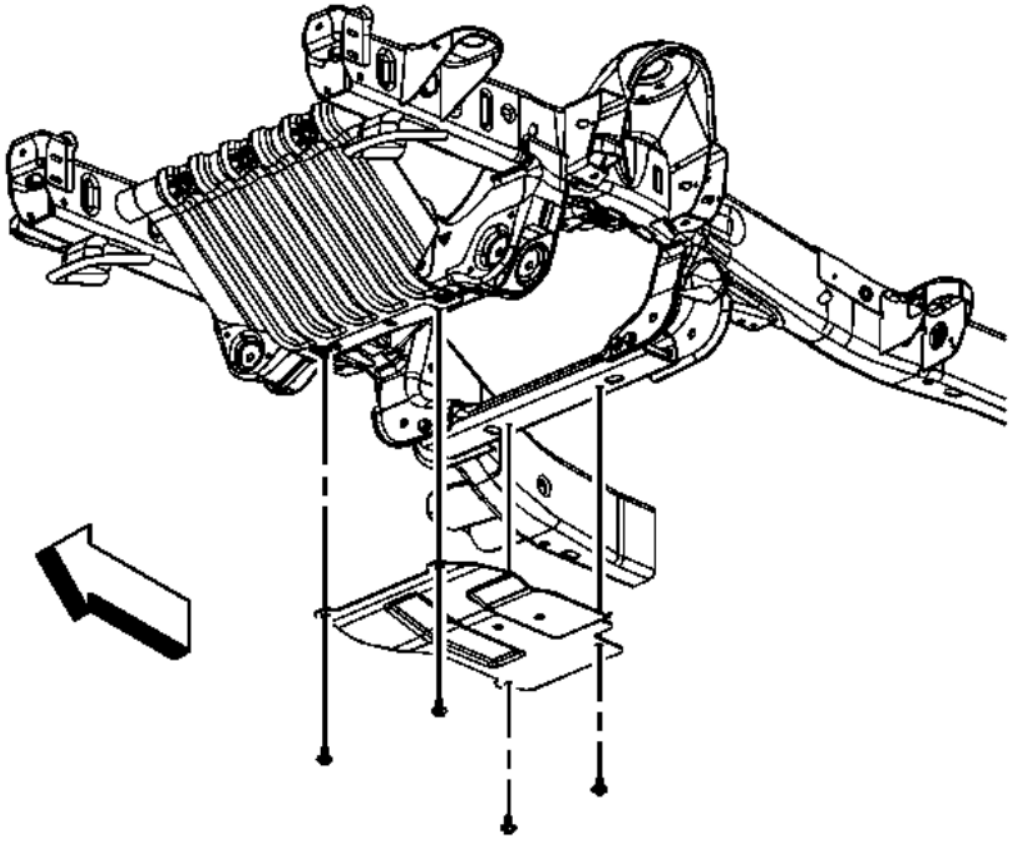


Fig. 262: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan skid plate bolts and plate, if equipped.

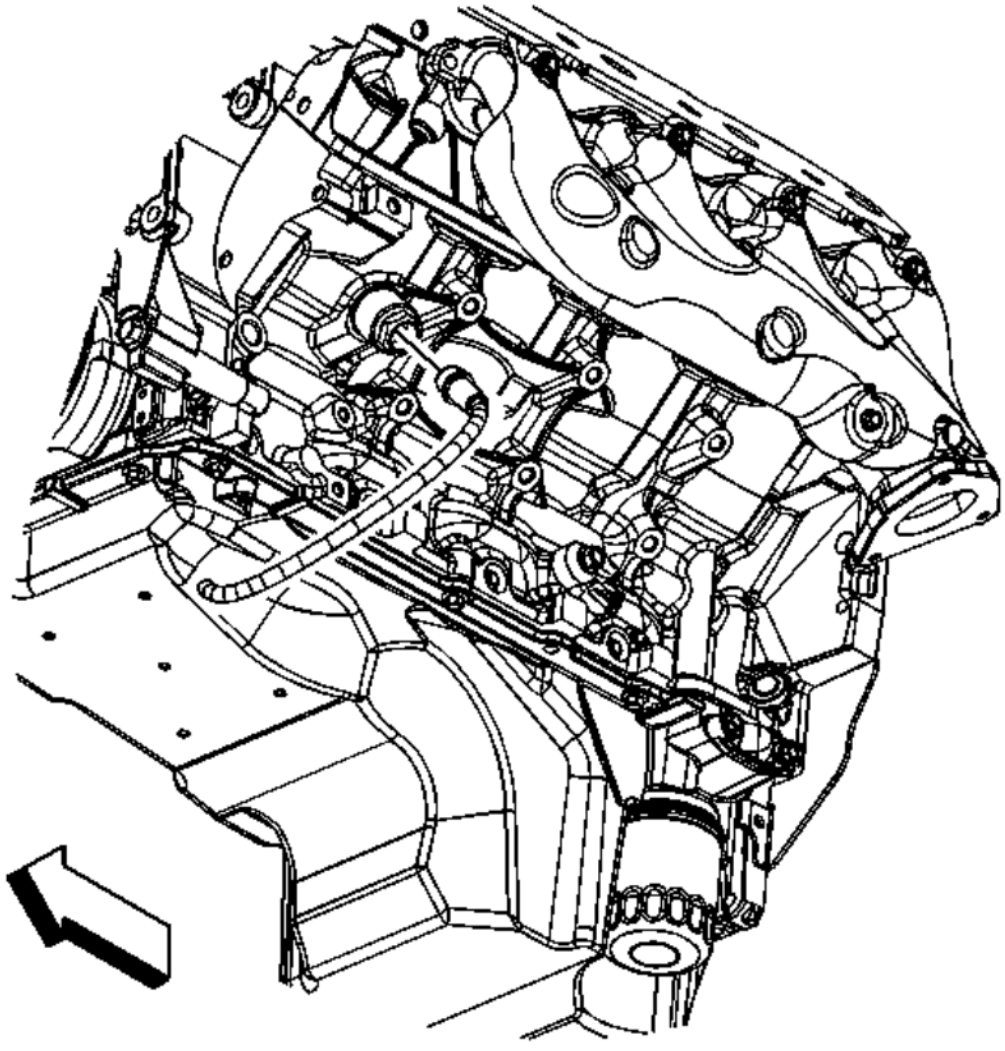


Fig. 263: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant heater cord electrical connector.

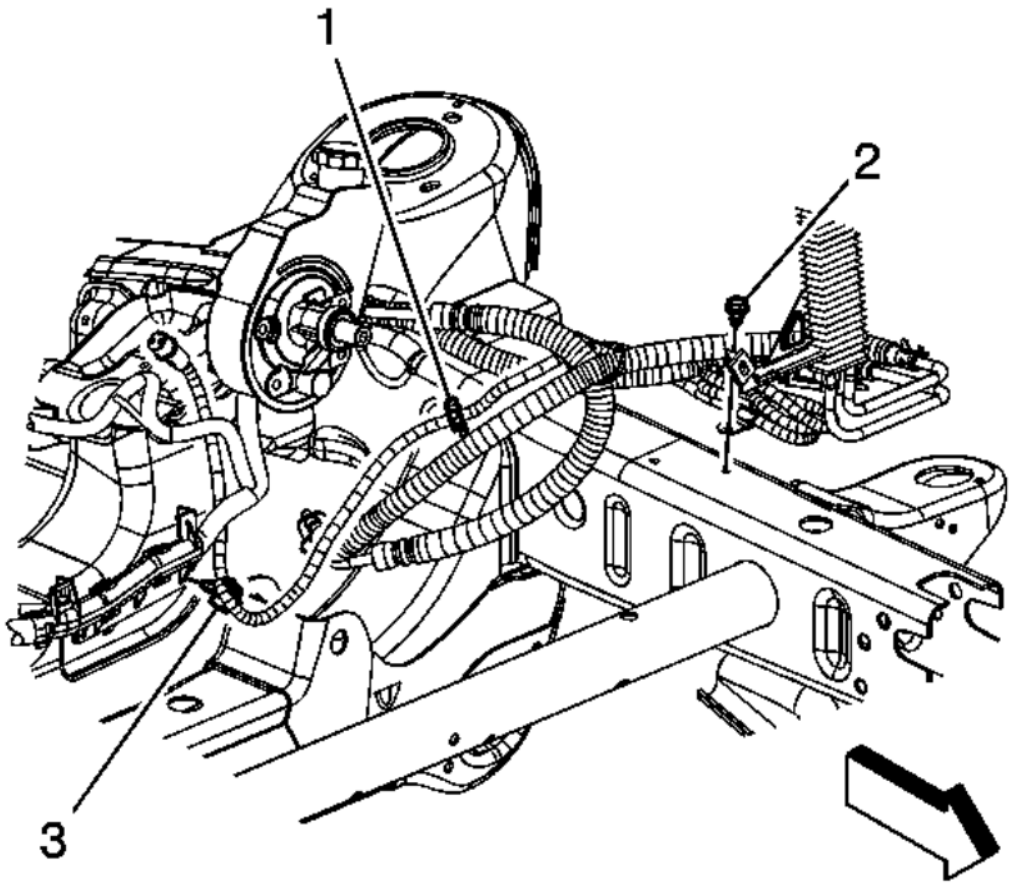


Fig. 264: View Of Coolant Heater Cord Clips & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater cord clip (3) from the engine harness channel.
5. Remove the coolant heater cord clip (1) from the power steering gear outlet hose.
6. Lower the vehicle.
7. Remove the coolant heater cord bolt (2) from the frame.
8. Remove the coolant heater cord from the vehicle.

Installation Procedure

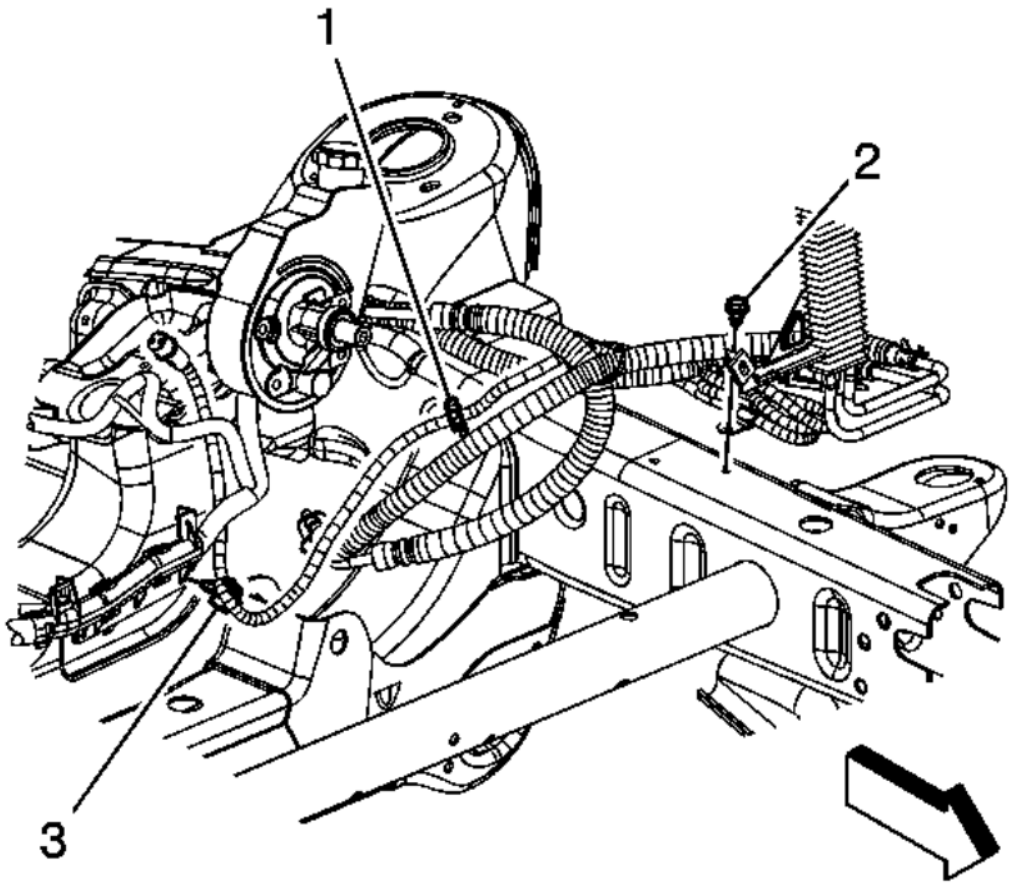


Fig. 265: View Of Coolant Heater Cord Clips & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater cord to the vehicle.

NOTE: Refer to Fastener Notice .

2. Position the coolant heater cord clip to the frame and install the coolant heater cord bolt (2).

Tighten: Tighten the bolt to 8 N.m (71 lb in).

3. Raise the vehicle.

4. Install the coolant heater cord clip (1) to the power steering gear outlet hose.
5. Install the coolant heater cord clip (3) to the engine harness channel.

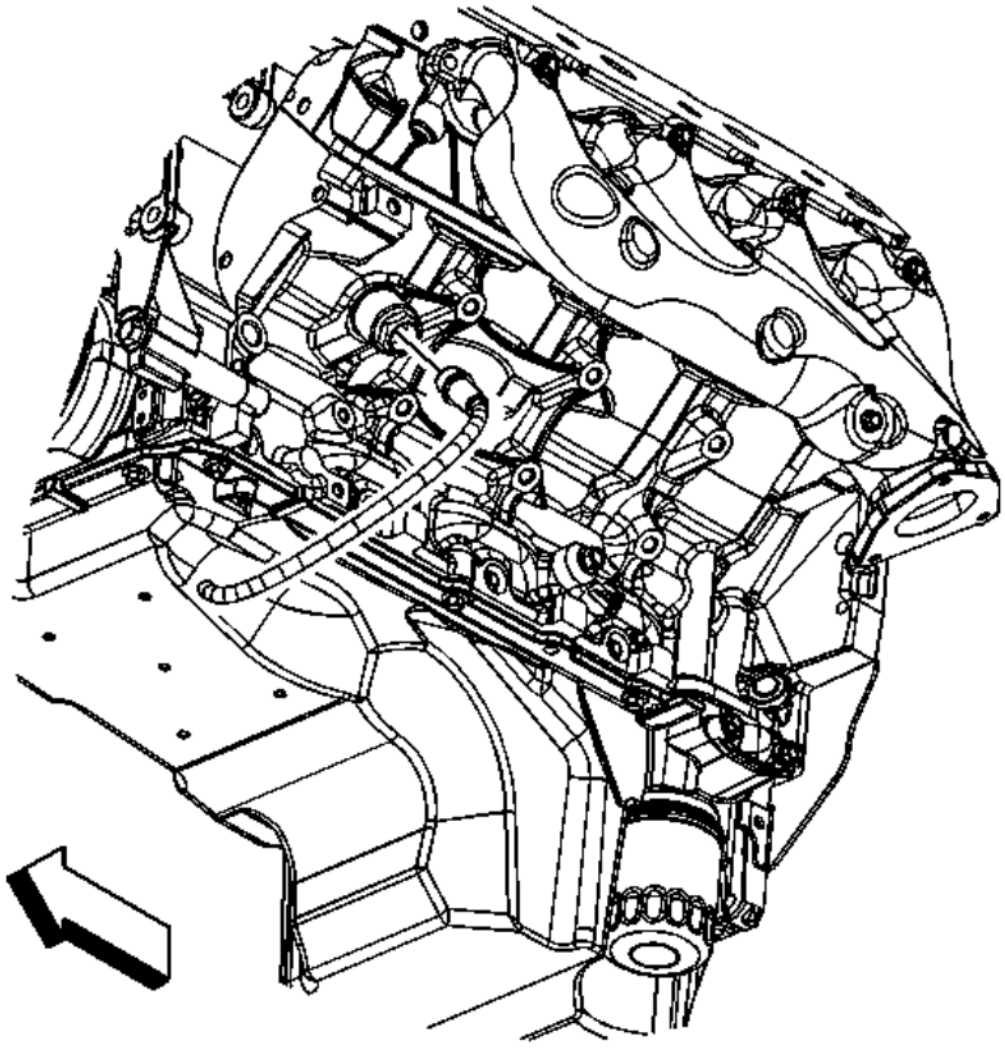


Fig. 266: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

6. Connect the coolant heater cord electrical connector.

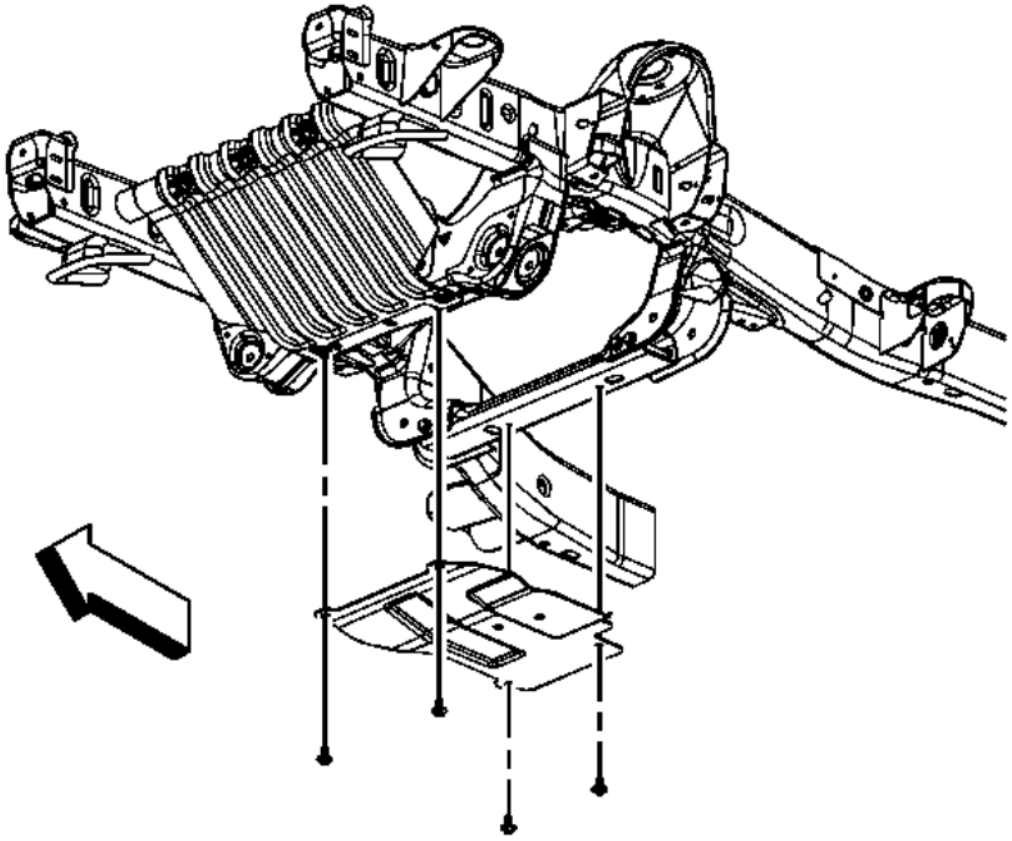


Fig. 267: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Position and install the oil pan skid plate and bolts, if equipped.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

8. Lower the vehicle.

COOLANT HEATER CORD REPLACEMENT (LH6, LMG, LY2 AND LY5)

Removal Procedure

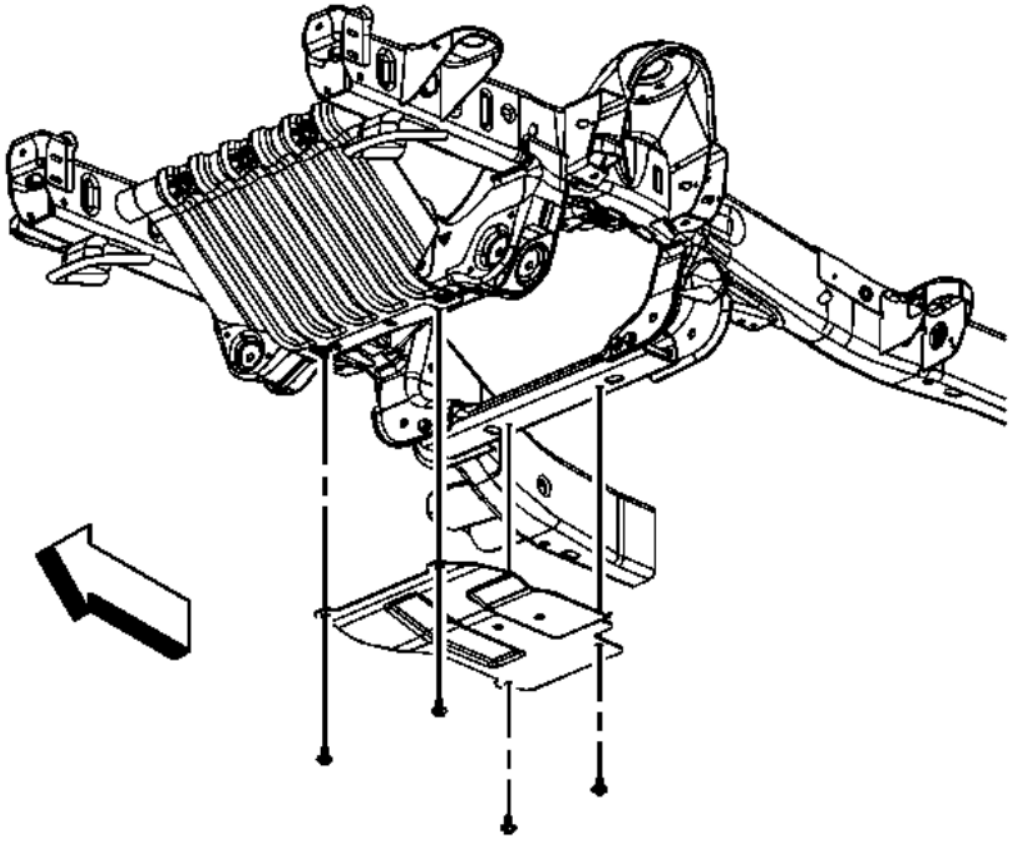


Fig. 268: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan skid plate bolts and plate, if equipped.

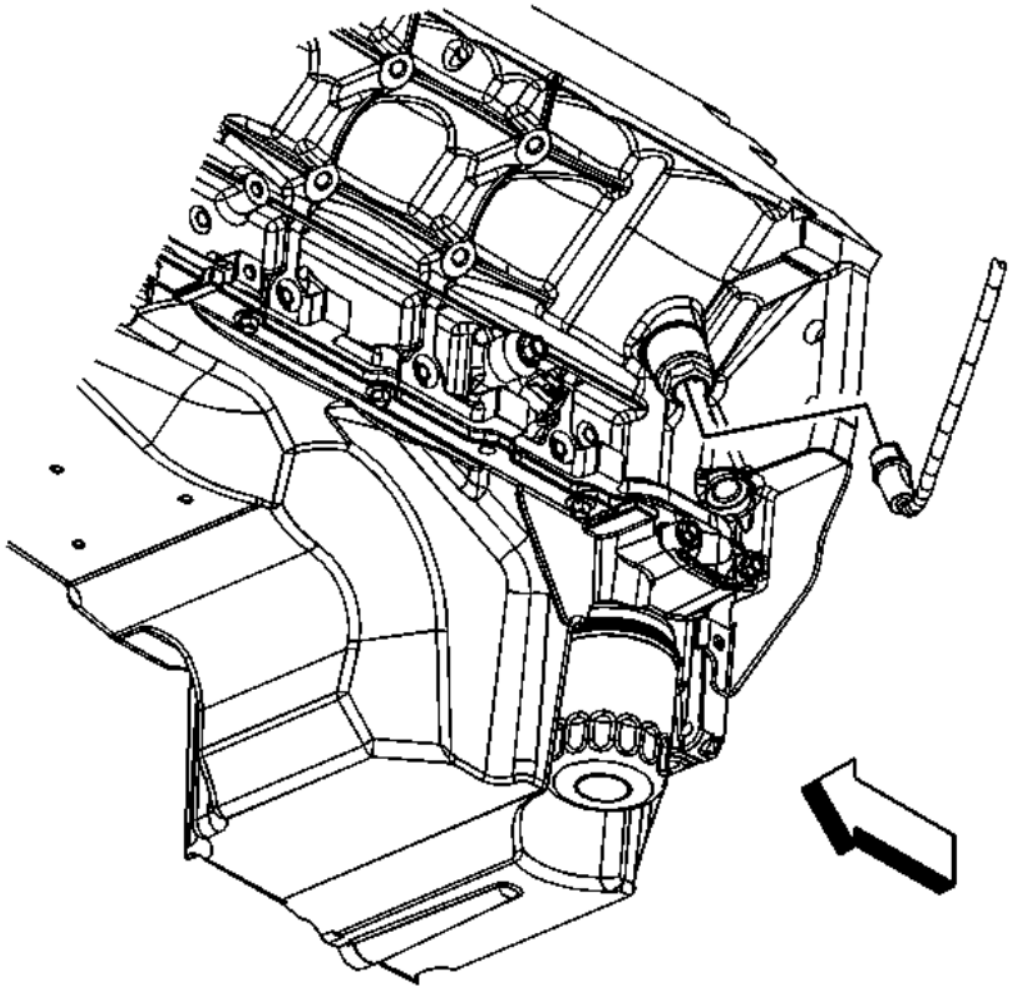


Fig. 269: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant heater cord electrical connector.

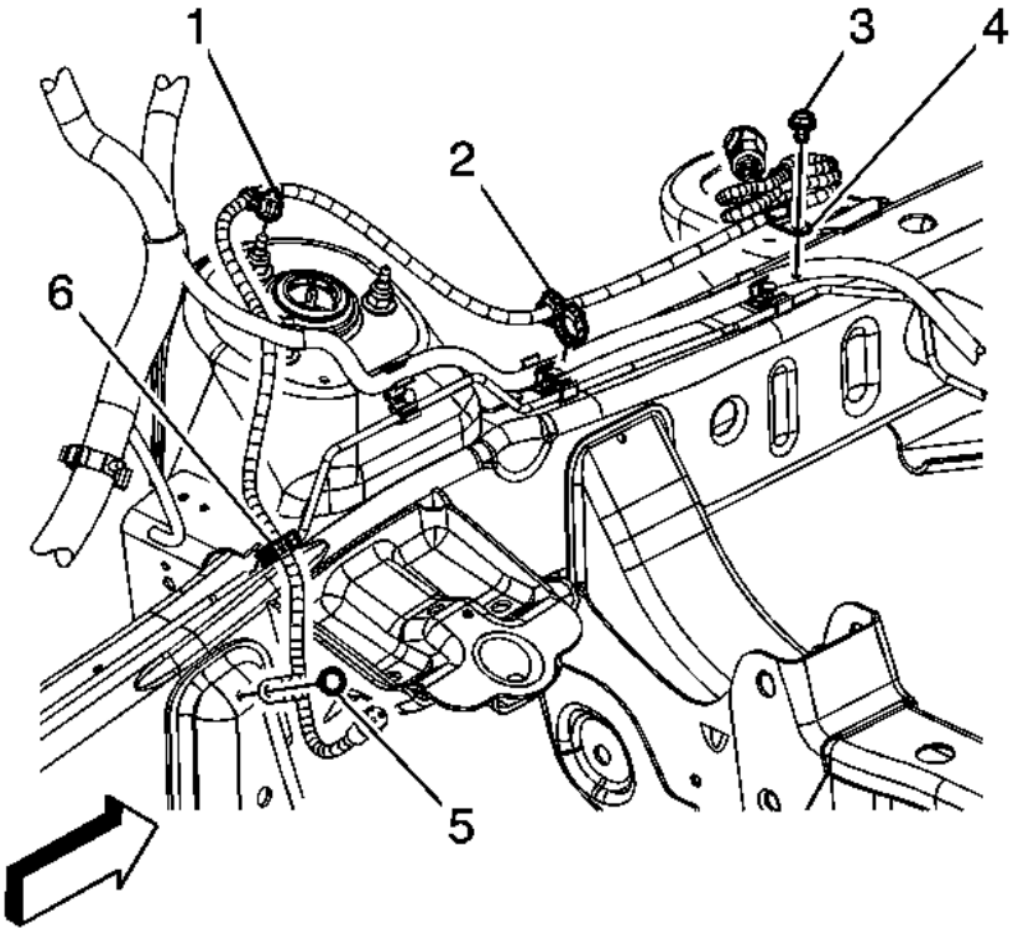


Fig. 270: View Of Coolant Heater Cord & Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater cord retainer (5) from the frame.
5. Remove the coolant heater cord clip (6) from the front brake front pipe.
6. Lower the vehicle.
7. Remove the coolant heater cord bolt (4) from the frame.
8. Remove the coolant heater cord clip (2) from the chassis harness.
9. Remove the coolant heater cord clip (1) from the front spring stud.
10. Remove the coolant heater cord from the vehicle.

Installation Procedure

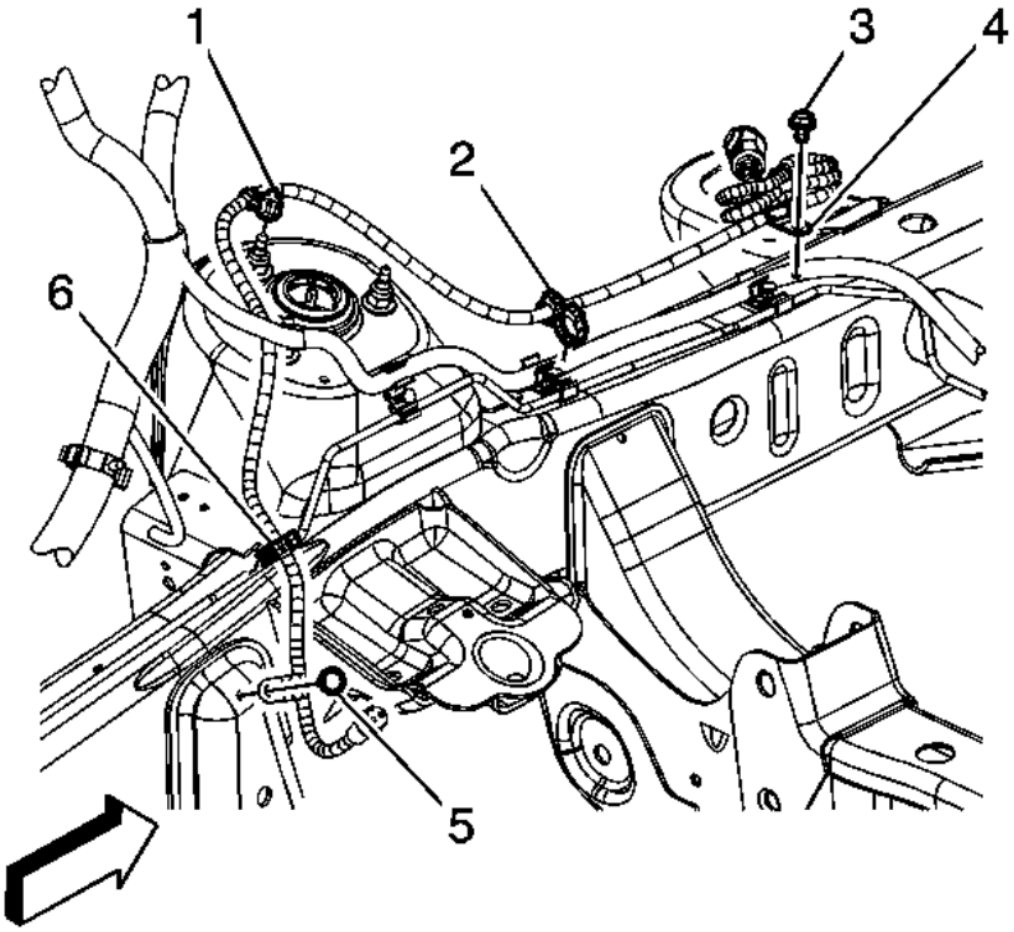


Fig. 271: View Of Coolant Heater Cord & Components
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater cord to the vehicle.
2. Install the coolant heater cord clip (1) to the front spring stud.
3. Install the coolant heater cord clip (2) to the chassis harness.

NOTE: Refer to Fastener Notice .

4. Position the coolant heater cord clip to the frame and install the coolant heater cord bolt

(4).

Tighten: Tighten the bolt to 8 N.m (71 lb in).

5. Raise the vehicle.
6. Install the coolant heater cord clip (6) to the front brake front pipe.
7. Position the coolant heater cord clip to the frame and install the coolant heater cord retainer (5).

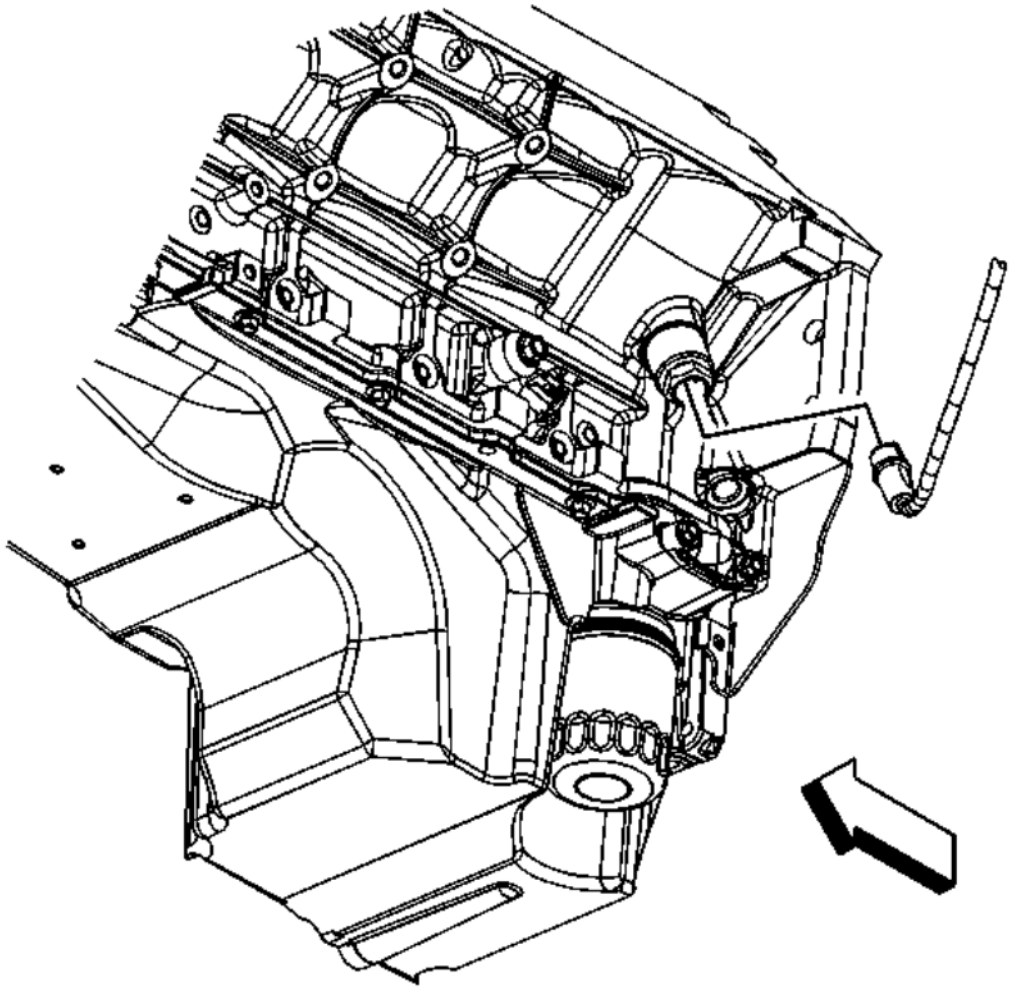


Fig. 272: View Of Coolant Heater Cord

Courtesy of GENERAL MOTORS CORP.

8. Connect the coolant heater cord electrical connector.

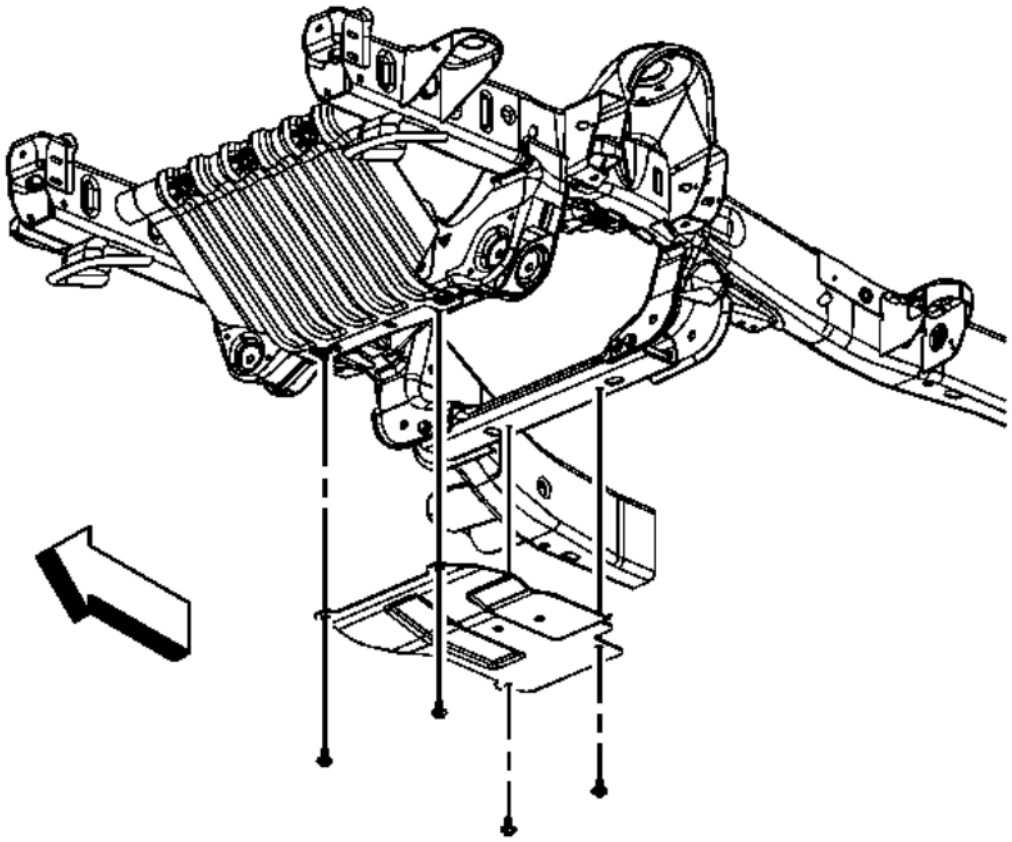


Fig. 273: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Position and install the oil pan skid plate and bolts, if equipped.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

10. Lower the vehicle.

COOLANT HEATER CORD REPLACEMENT (LY6)

Removal Procedure

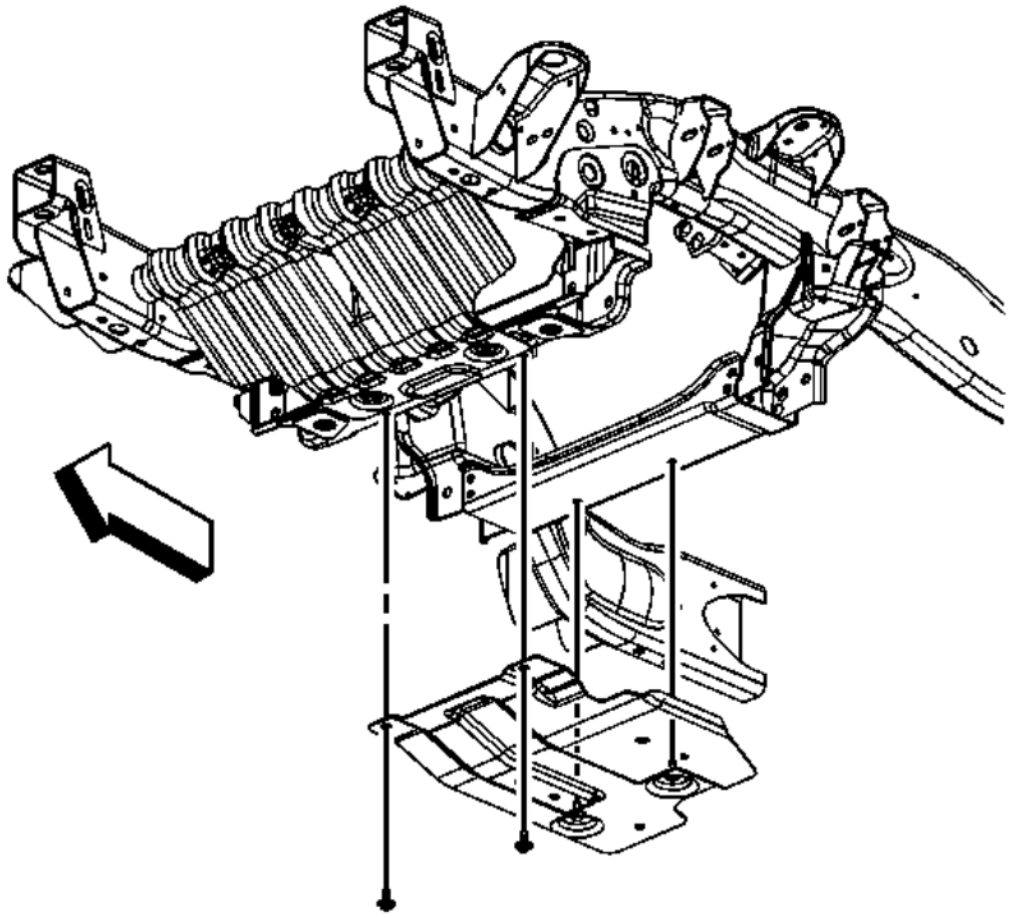


Fig. 274: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the front 2 oil pan skid plate bolts, loosen the 2 rear bolts and remove the skid plate, if equipped.

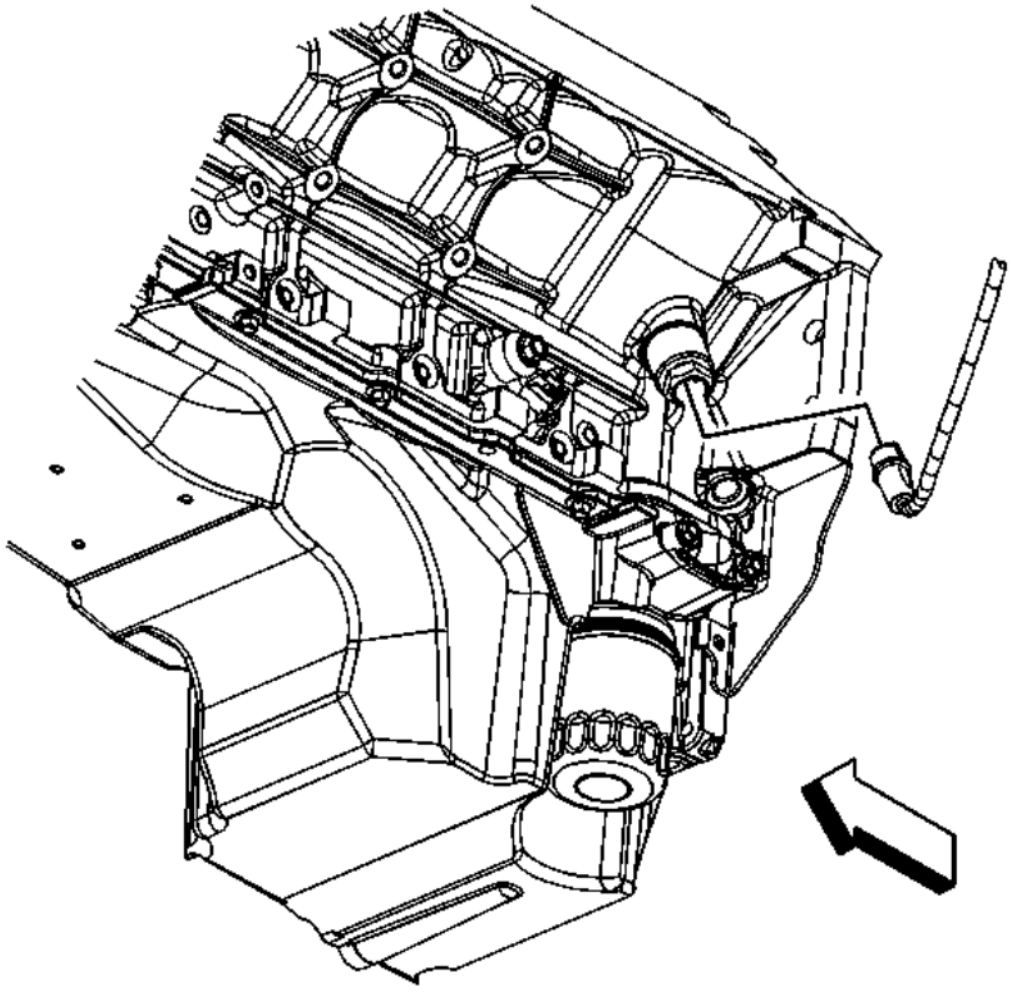


Fig. 275: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant heater cord electrical connector.

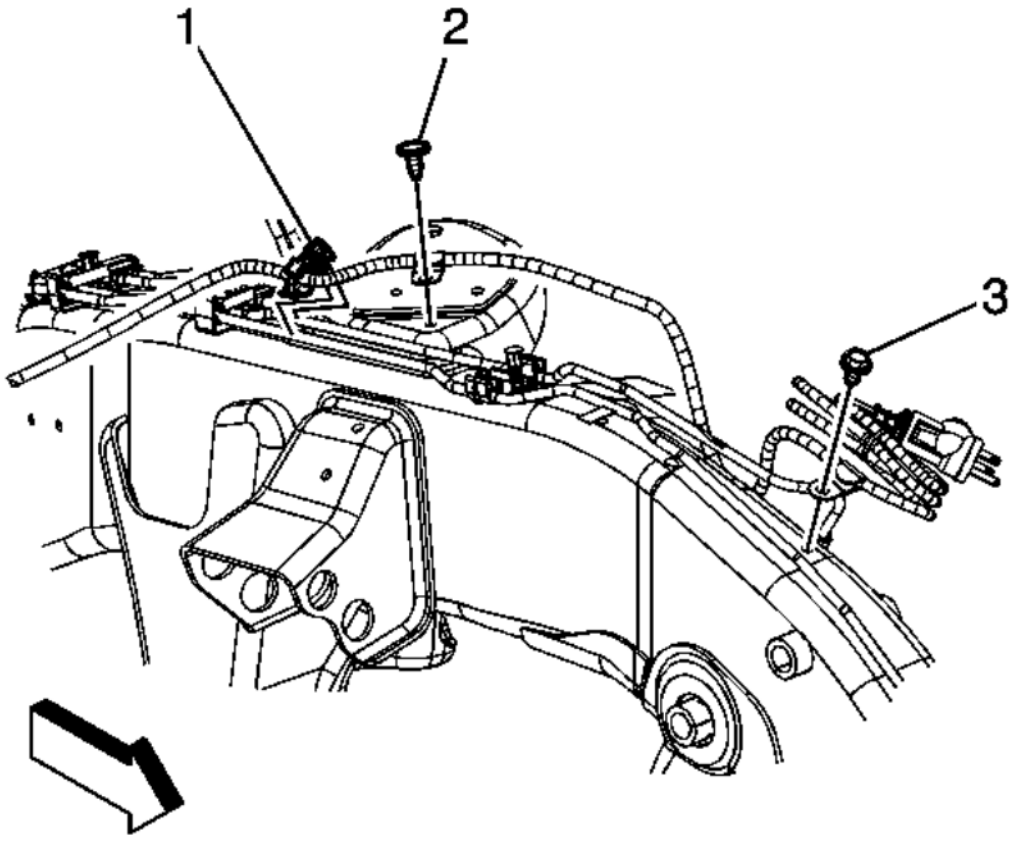


Fig. 276: View Of Coolant Heater Cord, Clip Retainer & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater cord clip (1) from the front brake front pipes.
5. Remove the coolant heater cord clip retainer (2) from the frame.
6. Lower the vehicle.
7. Remove the coolant heater cord bolt (3) from the frame.
8. Remove the coolant heater cord from the vehicle.

Installation Procedure

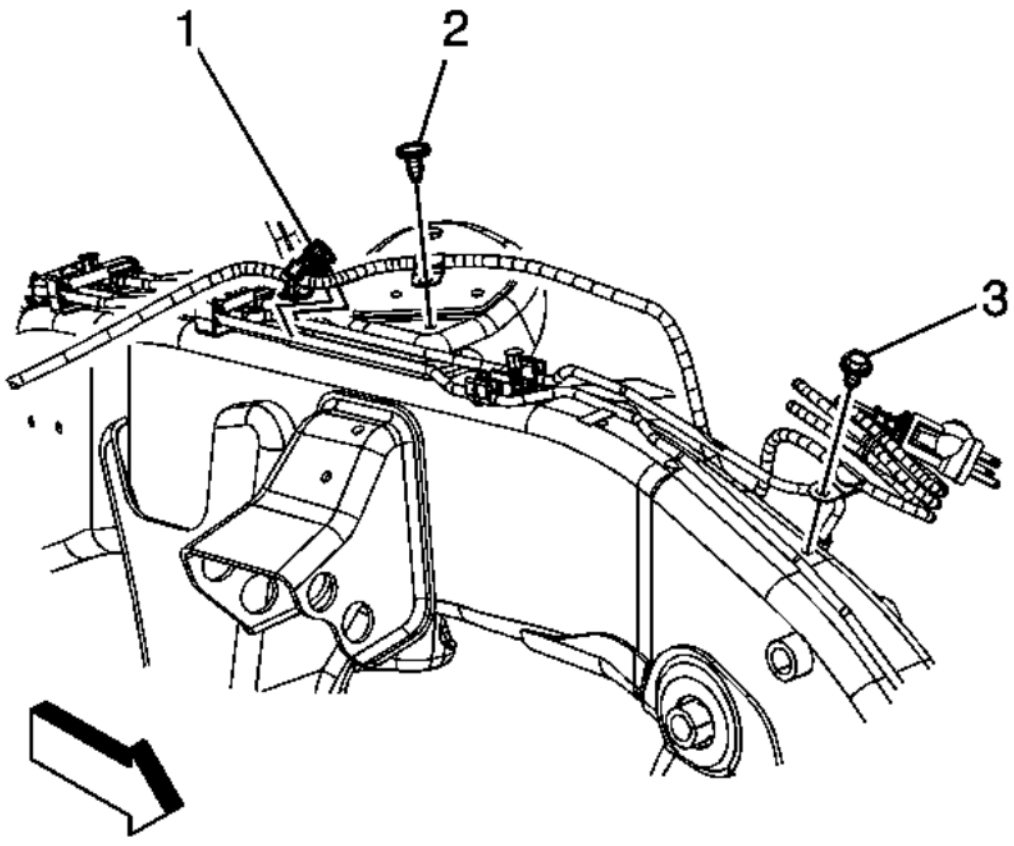


Fig. 277: View Of Coolant Heater Cord, Clip Retainer & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater cord to the vehicle.

NOTE: **Refer to Fastener Notice .**

2. Position the coolant heater cord clip to the frame and install the coolant heater cord bolt (3).

   Tighten: Tighten the bolt to 8 N.m (71 lb in).

3. Raise the vehicle.
4. Install the coolant heater cord clip retainer (2) to the frame.

5. Install the coolant heater cord clip (1) to the front brake front pipes.

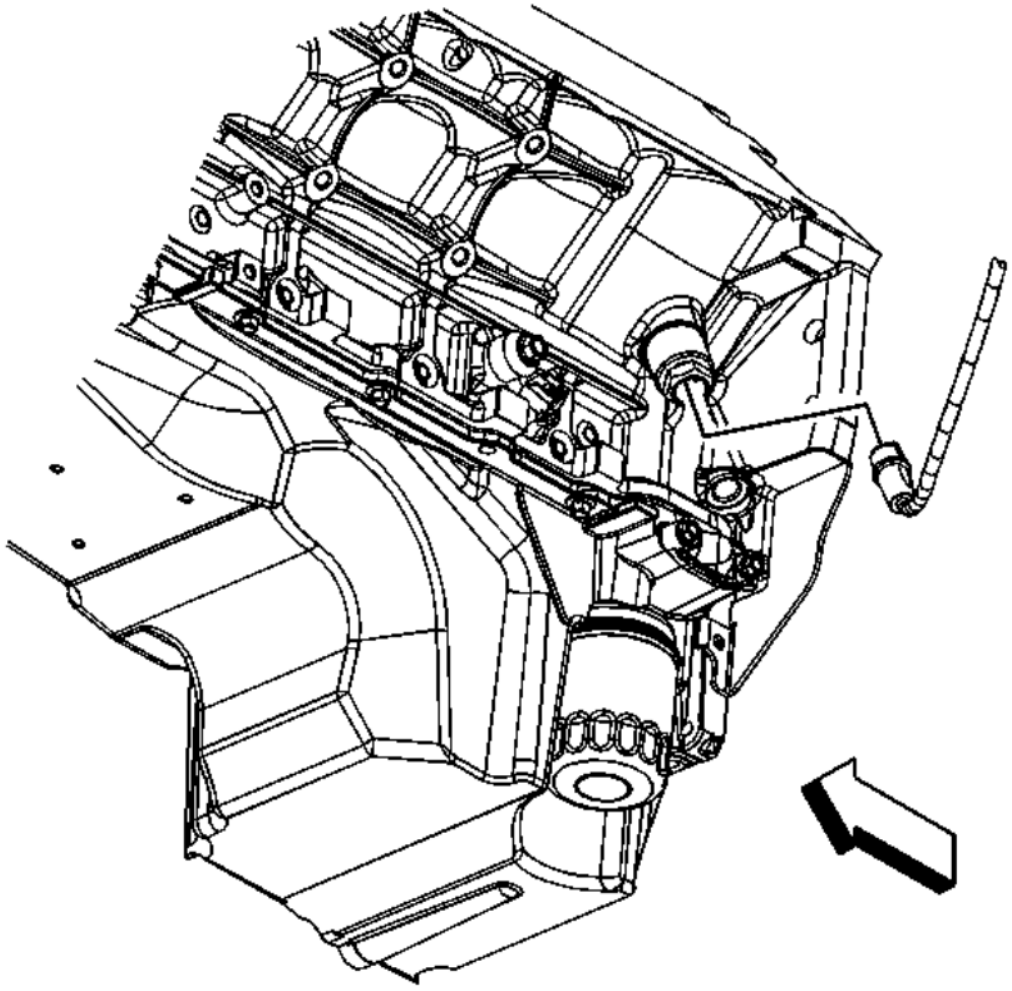


Fig. 278: View Of Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

6. Connect the coolant heater cord electrical connector.

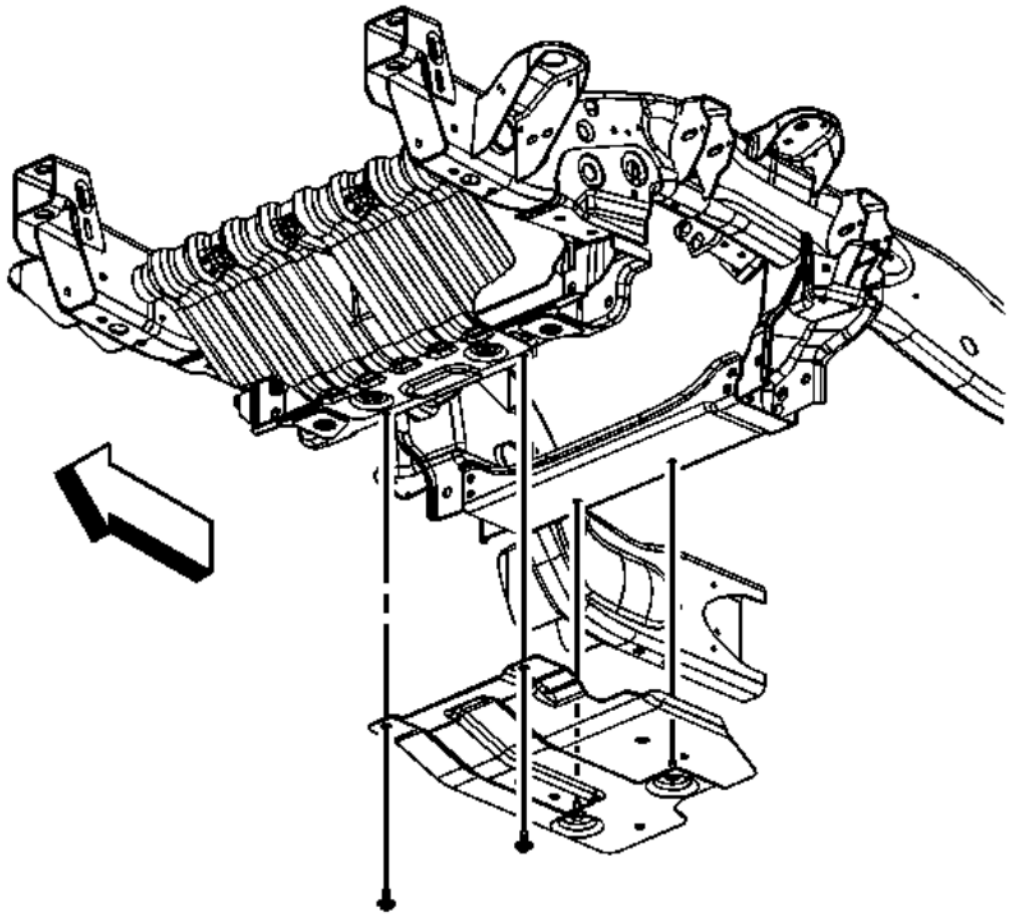


Fig. 279: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Position the oil pan skid plate and install the 2 front bolts and tighten the 2 rear bolts, if equipped.

   Tighten: Tighten the bolts to 20 N.m (15 lb ft).

8. Lower the vehicle.

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION (W/O LFA)

Cooling Fan Control - Two Fan System

The engine cooling fan system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds. The cooling fans receive positive voltage from the cooling fan relays which receive battery positive voltage from the underhood fuse block. The fan relay coils receive ignition 1 voltage from the powertrain relay.

During low speed operation, the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts, and supplies battery positive voltage from the low fan fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan series/parallel relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. The ECM grounds the high speed fan relay and the cooling fan series/parallel relay through the high speed cooling fan relay control circuit. This energizes the cooling fan control relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the high speed fan relay coil is energized closing the relay contacts and provides battery positive voltage from the high fan fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

Refer to **Engine Cooling Schematics**.

COOLING SYSTEM DESCRIPTION AND OPERATION

Engine Coolant Indicators

ENGINE COOLANT HOT

The instrument panel cluster (IPC) displays ENGINE COOLANT HOT message when the IPC receives a class 2 message from the powertrain control module (PCM) requesting illumination of this driver warning.

ENGINE OVERHEATED

The IPC displays ENGINE OVERHEATED message when the IPC receives a class 2 message from the PCM requesting illumination of this driver warning.

LOW COOLANT LEVEL B

The IPC displays LOW COOLANT LEVEL message when the IPC receives a class 2 message from the PCM requesting illumination of this driver warning.

REDUCED ENGINE POWER

The IPC displays REDUCED ENGINE POWER message when the IPC detects a reduced engine power condition from the PCM. The IPC receives a class 2 message from the PCM requesting illumination when the engine temperature reaches 132°C (270°F).

Cooling Fan Control - Two Fan System

The engine cooling fan system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the powertrain control module (PCM) to operate both fans together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood fuse block.

During low speed operation, the PCM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts, and supplies battery positive voltage from the low fan fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan s/p relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the PCM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. After a 3 second delay, the PCM supplies a ground path for the high speed fan relay and the cooling fan s/p relay through the high speed cooling fan relay control circuit. This energizes the cooling fan s/p relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the high speed fan relay coil is energized closing the relay contacts and provides battery positive voltage from the high fan fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have there own ground path. The result is a parallel circuit with both fans running at high speed.

IMPORTANT: The right and left cooling fan connectors are interchangeable. When servicing the fans be sure that the connectors are plugged into the correct fan.

The PCM commands the low speed cooling fans ON under the following conditions:

- Engine coolant temperature exceeds approximately 104.25°C (220°F).
- A/C refrigerant pressure exceeds 1447 kPa (210 psi).

- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 101°C (214°F) the low speed fans will run for a minimum of 60 seconds After 60 seconds, if the coolant temperature drops below 101°C (214°F) the fans will shut OFF. The fans will automatically shut OFF after 3 min. regardless of coolant temperature.

The PCM commands the high speed fans ON under the following conditions:

- Engine coolant temperature exceeds approximately 107.2°C (220°F).
- A/C refrigerant pressure exceeds approximately 1824 kPa (265 psi).
- When certain DTCs set.

At idle and very low vehicle speeds the cooling fans are only allowed to increase in speed if required. This insures idle stability by preventing the fans from cycling between high and low speed.

Coolant Level Control (If Equipped)

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a coolant loss. The powertrain control module (PCM) sends out a coolant loss signal over the coolant level switch signal circuit. When the engine coolant level switch reads a low coolant level in the fill tank, the switch opens. The message center receives its power from engine wiring harness junction block on the battery positive voltage circuit. Ground is provided by the ground circuits via the body wiring harness junction block and the engine wiring harness junction block. The cluster receives the class 2 message from the PCM indicating Low Coolant and displays the LOW COOLANT LEVEL message on the driver information center (DIC).

Coolant Heater

The optional engine coolant heater (RPO K05) operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather -18°C (0°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Auxiliary Coolant Pump (w/HP2)

The auxiliary coolant pump circulates coolant through the engine and heater core when HVAC requires heating and the engine is HOT and OFF. The HCM will turn on the auxiliary coolant pump when the HVAC control module commands it to do so by sending a class 2 signal to the HCM.

Cooling System

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

Cooling Cycle

Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. Coolant will then be pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders, where it absorbs heat.

Some coolant is also pumped from the water pump to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost.

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

Coolant is also directed to the throttle body. There it circulates through passages in the casting. During initial start up, the coolant assists in warming the throttle body. During normal operating temperatures, the coolant assists in regulating the throttle body temperature.

Cooling Cycle (6.6L Diesel Engine)

Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. The coolant flows to the heater core while the engine is running. This provides the passenger compartment with heat and defrost.

Coolant is then pumped through the water pump outlet and through the coolant pipe to the engine oil cooler. The coolant flows around the oil cooler element and to the rear engine cover. The rear engine cover distributes the coolant flow to both banks of the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

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

Coolant is also directed to the turbocharger. There it circulates through passages in the center housing. During engine warm-up cycle the bypass valve located in the turbocharger inlet hose at the outlet pipe prevents coolant flow. During normal operating temperatures, the coolant assists in keeping the turbocharger cool.

From the cylinder heads, the coolant flows to the thermostats. The coolant flows from the thermostat housing to the water pump through the bypass pipe until the enginereaches 85°C (185° F).

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

Coolant

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

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

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

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

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.

Pressure Cap

The pressure cap seals the cooling system. It contains a blow off or pressure relief valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling system pressure. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, might cause the radiator and/or coolant hoses to collapse.

The pressure cap allows cooling system pressure to build up as the temperature increases. As the pressure builds, the boiling point of the coolant increases. Engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat transfers from the radiator to the cooler, passing air.

The pressure in the cooling system can get too high. When the cooling system pressure exceeds the rating of the pressure cap, it raises the pressure valve, venting the excess pressure.

As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Cooling Fan and Clutch

The engine cooling fan and clutch are driven by the crankshaft via the drive belt. The cooling fan draws air through the radiator to improve the transfer of heat from the coolant to the atmosphere. As the fan blades spin, they pull cool, outside air past the radiator core. The fan clutch drives the cooling fan. The fan clutch controls the amount of torque that is transmitted from the crankshaft to the fan blades. The clutch allows more torque to engage on the fan when the engine operating temperature increases and/or the vehicle speed is low. As the torque increases, the fan turns more quickly. The fan clutch decreases the torque applied to the cooling fan when the engine temperature decreases and/or the vehicle speed is high. As the torque decreases, the fan speed decreases.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle and through the

radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser, and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is mounted on the pump shaft and consists of a series of flat or curved blades or vanes on a flat plate. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force.

The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

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

Water Pump (6.6L Diesel Engine)

The water pump is a centrifugal vane impeller type pump. The water pump is gear driven by the crankshaft gear. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by bearings. Splash of the engine oil lubricates the bearings. The bearings and shaft are sealed to prevent engine oil to mix with the coolant. If the seal fails, coolant will leak out the vent hole in the water pump housing.

The purpose of the water pump is to circulate coolant throughout the cooling system.

Thermostat

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

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up. After the coolant temperature reaches the rated thermostat opening

temperature, the thermostat valve will open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Thermostats (6.6L Diesel Engine)

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

The 6.6L diesel engine requires two thermostats for correct coolant flow. The front thermostat is a dual purpose thermostat. The front thermostat controls the coolant flow to the bypass port and to the water outlet. The rear thermostat only controls the coolant flow to the water outlet.

When the coolant temperature is below the rated thermostat opening temperature, the front thermostat valve remains closed to the water outlet and is opened to the bypass port. The bottom portion of the thermostat is raised off of the bypass port while at the same time the top portion closes the coolant flow to the water outlet. The rear thermostat also is closed to the water outlet during engine warm-up. This prevents circulation of the coolant to the radiator and allows the engine to warm up quickly. After the coolant temperature reaches 82°C (180°F) the front thermostat primary valve opening temperature, the front thermostat primary valve will start to open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. As the engine coolant reaches 85°C (185°F) and more coolant demand is required the front thermostat secondary valve begins to close the bypass port and the rear thermostat begins to open coolant flow to the water outlet. The thermostats will continue to control the coolant flow by opening and closing. The front thermostat will be fully open when the coolant temperature reaches 95°C (203°F) the rear thermostat will be fully open when the coolant temperature reaches 100°C (212°F). The thermostat also provides a restriction in the cooling system, even after the it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Engine Oil Cooler

The engine oil cooler is a heat exchanger. It is located inside the left side end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds

the oil cooler in the radiator.

The engine oil pump, pumps the oil through the engine oil cooler line to the oil cooler. The oil then flows through the cooler where the engine coolant absorbs heat from the oil. The oil is then pumped through the oil cooler return line, to the oil filter, to the engine block oil system.

Engine Oil Cooler (6.6L Diesel Engine)

The engine oil cooler is a heat exchanger. The engine oil cooler is mounted to the left lower corner of the engine. The oil filter is attached to the oil cooler housing. The engine coolant flows around the oil cooler element. The oil cooler element is a series of plates. The engine oil temperature is regulated by the temperature of the engine coolant that surrounds the oil cooler as the engine oil passes through the cooler.

The engine oil pump, pumps the oil through the engine oil feed line to the oil cooler. The oil then flows down through the cooler while the engine coolant absorbs heat from the oil. The oil is then pumped through the oil return line, to the oil filter, then to the main engine oil passage.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the right side end tank of the radiator. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator.

The transmission oil pump, pumps the fluid through the transmission oil cooler line to the transmission oil cooler. The fluid then flows through the cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

Turbocharger Bypass Valve (6.6L Diesel Engine)

The turbocharger bypass valve is a temperature control valve. The valve is located in the turbocharger coolant inlet hose at the water outlet tube.

The purpose of the valve is to close the coolant flow through the turbocharger. Closing off the coolant flow through the turbocharger avoids turbocharger overcooling.