

ENGINE

Engine Heating and Cooling - Coupe And Wagon

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning (A/C) Condenser Bolt	6.5 N.m	58 lb in
Air Conditioning (A/C) Line Clip to Fan Shroud Screw	1 N.m	9 lb in
Auxiliary Cooling Fan Bolt	6.5 N.m	58 lb in
Brake Master Cylinder Nut	25 N.m	18 lb ft
Clutch Master Cylinder Bolt	50 N.m	37 lb ft
Coolant Air Bleed Pipe Cover Bolt (LSA)	12 N.m	106 lb in
Coolant Air Bleed Stud (LSA)	12 N.m	106 lb in
Coolant Pipe to Cylinder Head Bolt (3.0L/3.6L)	50 N.m	37 lb ft
Coolant Pipe to Generator Bracket Bolt (3.0L/3.6L)	10 N.m	89 lb in
Coolant Pipe to Thermostat Housing Bolt (3.0L/3.6L)	10 N.m	89 lb in
Electric Cooling Fan Blade Nut	7 N.m	62 lb ft
Coolant Recovery Reservoir Bolt	17 N.m	13 lb in
Electric Cooling Fan Motor Screw	5 N.m	44 lb in
Electric Cooling Fan Resistor Bolt	5.4 N.m	48 lb in
Electric Cooling Fan Shroud to Plenum Bolt	6.5 N.m	58 lb in
Electric Cooling Fan Shroud to Radiator Bolt	6.5 N.m	58 lb in
Engine Coolant Fan Motor Bolt	5 N.m	44 lb in
Engine Coolant Fan Resistor Bolt	5.4 N.m	48 lb in
Engine Coolant Fan Shroud Bolt	6.5 N.m	58 lb in
Engine Coolant Heater (LSA)	50 N.m	37 lb ft
Engine Coolant Heater Cord Fastener (LSA)	10 N.m	89 lb in
Engine Coolant Heater Ground Wire Bolt (3.0L/3.6L)	12 N.m	106 lb in
Fan Blade Nut	7 N.m	62 lb in
Front Compartment Splash Shield Bolt	6 N.m	53 lb in
Oil Level Indicator Tube Bolt	20 N.m	15 lb ft
Radiator Support Bracket Bolt	9 N.m	80 lb in
Radiator Surge Tank Bolt	9 N.m	80 lb in
Radiator Surge Tank Nut	9 N.m	80 lb in
Radiator Upper Mount Bracket Bolt	9 N.m	80 lb in
Thermostat Bolt (3.0L/3.6L)	10 N.m	89 lb in
Thermostat Housing Bolt (3.0L/3.6L)	20 N.m	15 lb ft

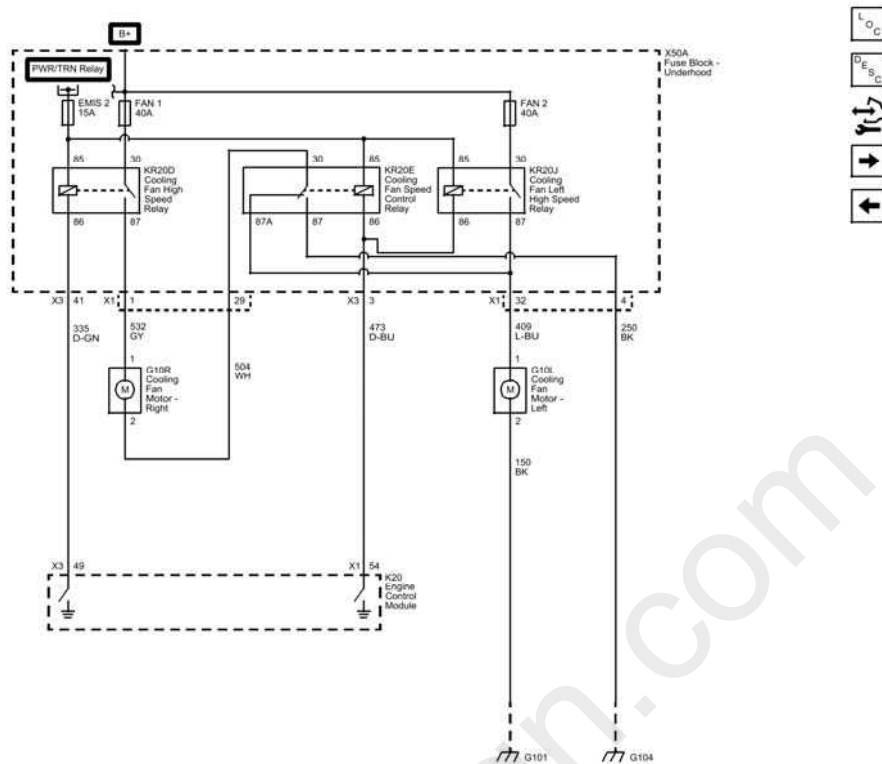


Fig. 2: Engine Cooling Fans (LSA)
Courtesy of GENERAL MOTORS COMPANY

Intercooler Coolant Pump (LSA)

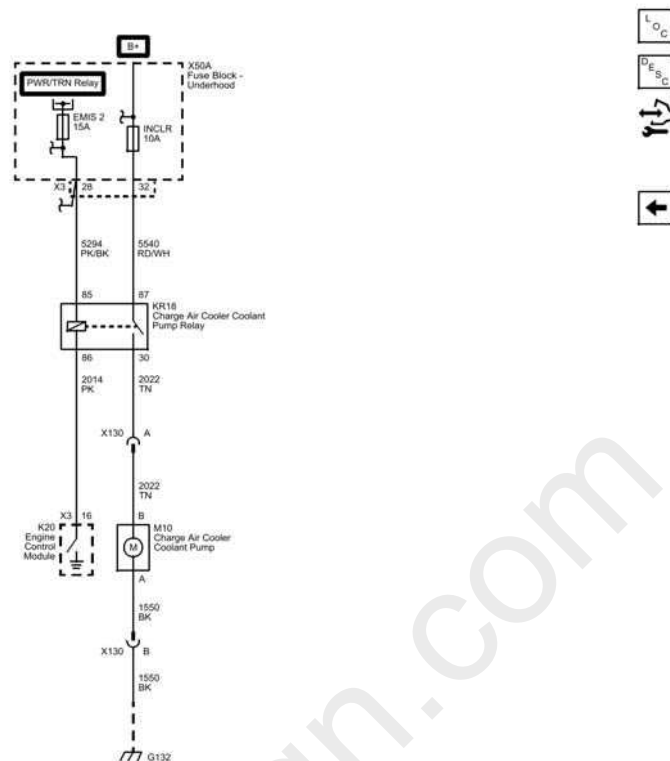


Fig. 3: Intercooler Coolant Pump (LSA)
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480 or P0481 (Dual Fan)	DTC P0480 Cooling Fan Relay 1 Control Circuit DTC P0481 Cooling Fan Relays 2 and 3 Control Circuit
DTC P0480, P0481, P0691, P0692, P0693, or P0694 (Single Fan)	DTC P0480 Cooling Fan Relay 1 Control Circuit DTC P0481 Cooling Fan Relays 2 and 3 Control Circuit DTC P0691 Cooling Fan Relay 1 Control Circuit Low Voltage DTC P0692 Cooling Fan Relay 1 Control Circuit High Voltage DTC P0693 Cooling Fan Relay 2 and 3 Control Circuit Low Voltage DTC P0694 Cooling Fan Relay 2 and 3 Control Circuit High Voltage
DTC P1258	DTC P1258 Engine Coolant Overtemperature - Protection Mode Active

DTC P0480 OR P0481 (DUAL FAN): COOLING FAN RELAY

Diagnostic Instructions

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

DTC Descriptors

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0480	P0480, P0481	-	-
Relay Switch B+	1	1	-	-
Low Speed Cooling Fan Relay Control	P0480	P0480	P0480	-
High Speed Cooling Fan Relay Control	P0481	P0481 or 1	P0481	-
Cooling Fan Speed Control Relay Control	P0481	P0481 or 1	P0481	-
Relay Controlled Output	1	1	2	-
1. Fan(s) inoperative without a DTC 2. Fan(s) always ON without a DTC				

Typical Scan Tool Data

Cooling Fan Relay 1 Control Circuit, and Cooling Fan Relays 2 and 3 Control Circuit Open, Short Gnd, and Short Volts Test Status with component OFF

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Short Gnd test and Not Run for Short Volts test • Component ON - Not Run for Open/Short Gnd test and OK for Short Volts test			
Ignition Voltage	Malfunction	Malfunction	-
Cooling Fan Relay 1 Control Circuit	Malfunction	Malfunction	-

Cooling Fan Relay 2 and 3 Control Circuit	Malfunction	Malfunction	Not Run
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Cooling Fan Relay 1 Control Circuit, and Cooling Fan Relays 2 and 3 Control Circuit Open, Short Gnd, and Short Volts Test Status with component ON

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Short Gnd test and Not Run for Short Volts test • Component ON - Not Run for Open/Short Gnd test and OK for Short Volts test			
Ignition Voltage	Not Run	Not Run	-
Cooling Fan Relay 1 Control Circuit	Not Run	Not Run	Malfunction
Cooling Fan Relay 2 and 3 Control Circuit	Not Run	Not Run	Malfunction

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing two electric cooling fans. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Conditions for Running the DTC

- The ignition voltage is greater than 11 volts.
- The engine speed is greater than 400 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTCs P0480 and P0481 run continuously when the conditions above are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTCs P0480 and P0481 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0480 and P0481 are Type B DTCs.

Diagnostic Aids

- The ECM has the capability of providing command to the fan relays even when a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates both fans at a low speed
 - Cooling Fan Relays 2 and 3 operates one fan at a high speed
 - Cooling Fan Relays 1, 2 and 3 operates both fans at a high speed

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify an audible click is heard or felt from each cooling fan relay when commanding the cooling fans ON and OFF with a scan tool.

- **If a click is not heard or felt at one or more of the relays**

Refer to Circuit/System Testing

- **If a click is heard or felt at each of the relays**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect all of the cooling fan relays. Ignition ON.

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

2. Verify that a test lamp illuminates between ground and a relay coil ignition circuit terminal listed below:

- KR20C Cooling Fan Low Speed Relay terminal 85/2
- KR20D Cooling Fan High Speed Relay terminal 85/2
- KR20E Cooling Fan Speed Control Relay terminal 85/2

- **If the test lamp does not illuminate**

1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
2. Test for less than 2 ohms in the ignition circuit of the appropriate cooling fan relay, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

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

1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
2. Test for infinite resistance between the appropriate cooling fan relay ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance test or replace the appropriate cooling fan relay.

- **If the test lamp illuminates**

3. Ignition ON.

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

4. Connect a DMM, set on the diode setting, between ground and a relay control circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 86/1
 - KR20D cooling fan high speed relay terminal 86/1
 - KR20E cooling fan speed control relay terminal 86/1
5. Verify the DMM reading is greater than 2.5 V or displays O.L with the cooling fan relays commanded OFF with a scan tool.
 - **If 2.5 V or less**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 2.5 V or displays O.L.**
6. Verify the DMM reading is less than 1 V when commanding the cooling fan relays ON with a scan tool.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the appropriate cooling fan relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
 4. Test for less than 2 ohms in the appropriate cooling fan relay control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 1 V**
7. Test or replace the appropriate cooling fan relay.

Component Testing

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

Replace the cooling fan relay.
 - **If between 70-110 ohms**
4. Test for infinite resistance between the following terminals:
 - 30 and 86

- 30 and 87
- 30 and 85
- 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the cooling fan relay.

- **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

- **If less than 2 ohms**

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

Replace the cooling fan relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

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

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

Diagnostic Instructions

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

DTC Descriptors

DTC P0480

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

DTC P0691

Cooling Fan Relay 1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relay 2 and 3 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relay 2 and 3 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Ignition	P0691, P0693	P0480, P0481	-	-
Relay Switch B+	1	1	-	-
Low Speed Cooling Fan Relay Control	P0691	P0480	P0692	-
High Speed Cooling Fan Relay Control	P0693	P0481 or 1	P0694	-
Cooling Fan Speed Control Relay Control	P0694	P0481 or 1	P0693	-
Relay Controlled Output	1	1	2	-

1. Fan(s) inoperative without a DTC
2. Fan(s) always ON without a DTC

Typical Scan Tool Data

Cooling Fan Relay 1 Control Circuit, and Cooling Fan Relays 2 and 3 Control Circuit Open, Short Gnd, and Short Volts Test Status with component OFF

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Short Gnd test and Not Run for Short Volts test • Component ON - Not Run for Open/Short Gnd test and OK for Short Volts test			
Ignition Voltage	Malfunction	Malfunction	-
Cooling Fan Relay 1 Control Circuit	Malfunction	Malfunction	-
Cooling Fan Relay 2 and 3 Control Circuit	Malfunction	Malfunction	Not Run

Cooling Fan Relay 1 Control Circuit, and Cooling Fan Relays 2 and 3 Control Circuit Open, Short Gnd, and Short Volts Test Status with component ON

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Short Gnd test and Not Run for Short Volts test • Component ON - Not Run for Open/Short Gnd test and OK for Short Volts test			
Ignition Voltage	Not Run	Not Run	-
Cooling Fan Relay 1 Control Circuit	Not Run	Not Run	Malfunction
Cooling Fan Relay 2 and 3 Control Circuit	Not Run	Not Run	Malfunction

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing one electric cooling fan. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Conditions for Running the DTC

- The ignition voltage is greater than 11 volts.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTCs P0480, P0481, P0691, P0692, P0693 and P0694 run continuously when the conditions above are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

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

Diagnostic Aids

- The ECM has the capability of providing command to the fan relays even when a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates both fans at a low speed
 - Cooling Fan Relays 2 and 3 operates one fan at a high speed
 - Cooling Fan Relays 1, 2 and 3 operates both fans at a high speed

Reference Information

Schematic Reference

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Connector End View Reference

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- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

- **Circuit Testing**

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

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

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

Circuit/System Testing

1. Ignition OFF, disconnect all of the cooling fan relays. Ignition ON.

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

2. Verify that a test lamp illuminates between ground and a relay coil ignition circuit terminal listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 85/2
 - KR20D Cooling Fan High Speed Relay terminal 86/1
 - KR20P Cooling Fan Speed Control Relay terminal 85/2
 - **If the test lamp does not illuminate**

1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
2. Test for less than 2 ohms in the ignition circuit of the appropriate cooling fan relay, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
2. Test for infinite resistance between the appropriate cooling fan relay ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance test or replace the appropriate cooling fan relay.
 - **If the test lamp illuminates**
3. Ignition ON.

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

4. Connect a DMM, set on the diode setting, between ground and a relay control circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 86/1
 - KR20D cooling fan high speed relay terminal 85/2
 - KR20P cooling fan speed control relay terminal 86/1
5. Verify the DMM reading is greater than 2.5 V or displays O.L with the cooling fan relays commanded OFF with a scan tool.
 - **If 2.5 V or less**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 2.5 V or displays O.L.**
6. Verify the DMM reading is less than 1 V when commanding the cooling fan relays ON with a scan tool.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the appropriate cooling fan relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
 4. Test for less than 2 ohms in the appropriate cooling fan relay control circuit end to end.

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

○ **If less than 1 V**

7. Test or replace the appropriate cooling fan relay.

Component Testing

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

Replace the cooling fan relay.

○ **If between 70-110 ohms**

4. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the cooling fan relay.

○ **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

○ **If less than 2 ohms**

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

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

- **If 2 ohms or greater**

Replace the cooling fan relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

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

DTC P1258: ENGINE COOLANT OVERTEMPERATURE - PROTECTION MODE ACTIVE

Diagnostic Instructions

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

DTC Descriptors

DTC P1258

Engine Coolant Overtemperature - Protection Mode Active

Circuit/System Description

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

Conditions for Running the DTC

V6

- The engine is operating for 10 seconds or greater.
- DTC P1258 runs continuously once the conditions above have been met.

V8

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

Conditions for Setting the DTC

V6

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

V8

The ECM detects that engine coolant temperature is warmer than 129°C (264°F) for 10 seconds or greater.

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

DTC P1258 is a Type A DTC.

Reference Information

Description and Operation

- **Cooling Fan Description and Operation**
- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (LFW, LFX or LSA) for scan tool information

Circuit/System Verification

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

- **If a DTC is set**

Refer to **DTC P0480 or P0481 (Dual Fan)**, or **DTC P0480, P0481, P0691, P0692, P0693, or P0694 (Single Fan)**.

- **If no DTCs is set**

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

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

- **Cooling fan does not operate**

Refer to **Cooling Fan Inoperative (Dual Fan)**, **Cooling Fan Inoperative (Single Fan)**.

- **Cooling fan operates**

4. Verify that the engine does not overheat.

- **Engine overheats**

Refer to **Engine Overheating (LFW, LFX, and LSA)**.

- **Engine does not overheat**

5. Operate the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Refer to **Symptoms - Engine Cooling**.

- **If the DTC does not set**

6. All OK

Circuit/System Testing

1. Test the thermostat for correct operation. Refer to **Thermostat Diagnosis (LP1, LY7)**, **Thermostat Diagnosis (LS2)**.
2. Test the engine cooling system for overheating. Refer to **Engine Overheating (LFW, LFX, and LSA)**.
3. Inspect the water pump and coolant flow for correct operation. Refer to **Water Pump Cleaning and Inspection**.
4. Inspect the engine mechanical for worn, leaking, cracked cylinder heads or engine block. Refer to **Coolant in Engine Oil**.

Repair Instructions

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

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

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

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to **Cooling Fan Description and Operation**, and **Cooling System Description and Operation (LSA)**, **Cooling System Description and Operation (LFW, LFX)**.

Visual/Physical Inspection

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

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

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

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

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

Identifying Intermittent Conditions

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

- Water intrusion in connectors, terminals, or components
- Poor connector mating
- Terminal contact
- High circuit or component resistance-High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness' that are routed too tight, or chaffed circuits
- High or low ambient temperatures
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in components or circuits due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surface
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of non-factory, aftermarket, or after factory add on accessories

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

Symptom List

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

- **Cooling Fan Always On (Dual Fan), Cooling Fan Always On (Single Fan)**
- **Cooling Fan Inoperative (Dual Fan), Cooling Fan Inoperative (Single Fan)**
- **Engine Overheating (LFW, LFX, and LSA)**
- **Loss of Coolant**
- **Thermostat Diagnosis (LP1, LY7), Thermostat Diagnosis (LS2)**
- **Engine Fails To Reach Normal Operating Temperature**

COOLING FAN ALWAYS ON (DUAL FAN)

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing two electric cooling fans. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates both fans at a low speed
 - Cooling Fan Relays 2 and 3 operates one fan at a high speed
 - Cooling Fan Relays 1, 2 and 3 operates both fans at a high speed
- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate Engine Controls subsection.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480 or P0481 are not set.
 - **If a DTC is set**

Refer to **DTC P0480 or P0481 (Dual Fan)**.

- **If no DTC is set**
3. Verify the scan tool parameters listed below display OFF:
 - Cooling Fan Relay 1 Command
 - Cooling Fan Relays 2 and 3 Command
 - **If a scan tool parameter displays ON**

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

- **If both scan tool parameters display OFF**
4. Verify that the fans are not activated.
 - **If a fan is operating**

Refer to Circuit/System Testing.

- **If both fans are OFF**
5. All OK

Circuit/System Testing

Both Cooling Fans Always ON

1. Ignition OFF, disconnect KR20C Cooling Fan Low Speed Relay, ignition ON.
2. Verify that both cooling fans are OFF.
 - **If the cooling fans are ON**
 1. Ignition OFF, disconnect the harness connector at the G10R Cooling Fan Motor-Right, ignition ON.
 2. Test for less than 1 V between KR20C Cooling Fan Low Speed Relay terminal 87/5 and ground.
 - If 1 V or greater, repair the short to voltage in the relay controlled output circuit.
 - **If the cooling fans are OFF**
3. Test or replace the KR20C Cooling Fan Low Speed Relay.

One Cooling Fan Always ON

1. Ignition OFF, disconnect the KR20D Cooling Fan High Speed Relay, ignition ON.
2. Verify the cooling fan is OFF.

- **If the cooling fan is ON**

1. Ignition OFF, disconnect the harness connector at the G10L Cooling Fan Motor-Left, ignition ON.
2. Test for less than 1 V between KR20D Cooling Fan High Speed Relay terminal 87/5 and ground.
 - If 1 V or greater, repair the short to voltage in the relay controlled output circuit.

- **If the cooling fan is OFF**

3. Test or replace the KR20D Cooling Fan High Speed Relay.

Component Testing

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

Replace the KR20 cooling fan relay.

- **If between 70-110 ohms**

4. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

- **If less than 2 ohms**

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

- **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

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

COOLING FAN ALWAYS ON (SINGLE FAN)

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing one electric cooling fans. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed, medium or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relays 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relays 1, 2 and 3 operates the fan at a high speed
- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate Engine Controls subsection.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON
- Electrical Center Identification Views

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Refer to **DTC P0480 or P0481 (Dual Fan)**.
 - **If no DTC is set**
3. Verify the scan tool parameters listed below display OFF:
 - Cooling Fan Relay 1 Command
 - Cooling Fan Relays 2 and 3 Command
 - **If a scan tool parameter displays ON**
 - Refer to Diagnostic Aids and **Symptoms - Engine Cooling** for further diagnosis.
 - **If both scan tool parameters display OFF**
4. Verify that the fans are not activated.
 - **If a fan is operating**

Refer to Circuit/System Testing.

- **If fan is OFF**

5. All OK

Circuit/System Testing

1. Ignition ON, disconnect each KR20 cooling fan relay one at a time.
2. Verify that the cooling fan is not activated.
 - **If the fan is not activated**
 - Test or replace the appropriate cooling fan relay.
 - **If the fan is active**
1. Test for less than 1 V between cooling fan terminal 1 and ground.
 - If 1 V or greater repair the short to voltage on the relay controlled output circuits.

Component Testing

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

Replace the KR20 cooling fan relay.

- **If between 70-110 ohms**

4. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

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

Replace the KR20 Cooling Fan Relay.

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

Repair Instructions

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

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

COOLING FAN INOPERATIVE (DUAL FAN)

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing two electric cooling fans. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Diagnostic Aids

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

- Cooling Fan Relay 1 operates both fans at a low speed
- Cooling Fan Relays 2 and 3 operates one fan at a high speed
- Cooling Fan Relays 1, 2 and 3 operates both fans at a high speed
- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fans ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate Engine Controls subsection.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480 or P0481 are not set.
 - **If a DTC is set**

Refer to **DTC P0480 or P0481 (Dual Fan)**.
 - **If no DTC is set**
3. Verify the scan tool parameters listed below display OFF:

- Cooling Fan Relay 1 Command
- Cooling Fan Relays 2 and 3 Command
 - **If a scan tool parameter displays ON**

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

- **If both scan tool parameters display OFF**
4. Verify that the fans are not activated.
 - **If a fan is operating**

Refer to Circuit/System Testing.

- **If both fans are OFF**
5. All OK

Circuit/System Testing

Both Cooling Fans Always ON

1. Ignition OFF, disconnect KR20C Cooling Fan Low Speed Relay, ignition ON.
2. Verify that both cooling fans are OFF.
 - **If the cooling fans are ON**
 1. Ignition OFF, disconnect the harness connector at the G10R Cooling Fan Motor-Right, ignition ON.
 2. Test for less than 1 V between KR20C Cooling Fan Low Speed Relay terminal 87/5 and ground.
 - If 1 V or greater, repair the short to voltage in the relay controlled output circuit.
 - **If the cooling fans are OFF**
3. Test or replace the KR20C Cooling Fan Low Speed Relay.

One Cooling Fan Always ON

1. Ignition OFF, disconnect the KR20D Cooling Fan High Speed Relay, ignition ON.
2. Verify the cooling fan is OFF.
 - **If the cooling fan is ON**
 1. Ignition OFF, disconnect the harness connector at the G10L Cooling Fan Motor-Left, ignition ON.
 2. Test for less than 1 V between KR20D Cooling Fan High Speed Relay terminal 87/5 and ground.
 - If 1 V or greater, repair the short to voltage in the relay controlled output circuit.
 - **If the cooling fan is OFF**
3. Test or replace the KR20D Cooling Fan High Speed Relay.

Component Testing

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

Replace the KR20 cooling fan relay.

- **If between 70-110 ohms**
4. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

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

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

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

COOLING FAN INOPERATIVE (SINGLE FAN)

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing one electric cooling fans. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed, medium or low speed, depending on cooling requirements. The ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. Each driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON**
- **Electrical Center Identification Views**

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Refer to **DTC P0480, P0481, P0691, P0692, P0693, or P0694 (Single Fan)**.

- **If no DTCs is set**
3. Verify that both cooling fans turn ON and OFF and operate at low and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.
 - **If a cooling fan does not operate**

Refer to Circuit/System Testing

- **If both cooling fans operate**
4. All OK.

Circuit/System Testing

Inoperative in All Speeds

1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor.
2. Verify a test lamp illuminates between the ground circuit terminal 2 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If the test lamp illuminates**

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

Low, Medium, or High Speed Inoperative

1. Ignition OFF.
2. Disconnect the following cooling fan relays, ignition ON:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
3. Verify a test lamp illuminates between ground and each of the cooling fan relay B+ circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay terminal 30
 - KR20P Cooling Fan Medium Speed Relay terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the appropriate relay B+ circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, disconnect the harness connector at the R10 Cooling Fan Resistor.
 2. Test for infinite resistance between the appropriate relay controlled output circuit terminal listed below and ground:
 - KR20C Cooling Fan Low Speed Relay terminal 87
 - KR20D Cooling Fan High Speed Relay terminal 30
 - KR20P Cooling Fan Medium Speed Relay terminal 87
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, test or replace the G10 Cooling Fan Motor, replace the fuse as necessary.
 - **If the test lamp illuminates**
4. Ignition OFF, install all of the previously removed cooling fan relays. Disconnect the harness connector at the R10 Cooling Fan Resistor, ignition ON.
5. Command the cooling fan ON at high speed with a scan tool.
6. Verify a test lamp illuminates between ground and each of the R10 Cooling Fan Resistor circuit terminals listed below:
 - R10 Cooling Fan Resistor low speed circuit terminal 4
 - R10 Cooling Fan Resistor medium speed circuit terminal 3
 - R10 Cooling Fan Resistor high speed circuit terminal 1
 - **If the test lamp does not illuminate at each terminal**
 1. Ignition OFF, remove the test lamp.

2. Disconnect the appropriate relay from the list below:
 - KR20C Cooling Fan Low Speed Relay
 - KR20D Cooling Fan High Speed Relay
 - KR20P Cooling Fan Medium Speed Relay
3. Test for less than 2 ohms in the relay controlled output circuit, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the relay.
 - **If the test lamp illuminates at each terminal**
7. Ignition OFF, Connect the R10 Cooling Fan Resistor.
8. Disconnect the G10 Cooling Fan Resistor.
9. Ignition ON, Command the cooling fan ON at low, medium, and high speed with a scan tool.
10. Verify a test lamp illuminates between G10 Cooling Fan terminal 1 and terminal 2 when commanding the cooling fans ON in all 3 speeds.
 - If the test lamp does not illuminate in all 3 speeds, replace the R10 Cooling Fan Resistor
 - If the test lamp illuminates in all 3 speeds
11. Test or replace the G10 Cooling Fan Motor.

Component Testing

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

Replace the KR20 cooling fan relay.

 - **If between 70-110 ohms**
4. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87

OR

- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5
- **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

NOTE: This test only applies to the speed control relay.

5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.
 - **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

- **If less than 2 ohms**

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

- **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Engine Coolant Fan Replacement (LSA)**, **Engine Coolant Fan Replacement (LFW or LFX)**
- **Engine Coolant Fan Motor Replacement (LFW, LFX)**, **Engine Coolant Fan Motor Replacement (LSA)**
- **Engine Coolant Fan Resistor Replacement (LFW, LFX)**

ENGINE OVERHEATING (LFW, LFX, AND LSA)

Engine Overheating (LFW, LFX, and LSA)

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			
1	Check the condenser, radiator, and auxiliary coolers for any obstructions or bent fins that would prevent air flow through the radiator. Is there any airflow obstruction or bent fins?	Go to Step 2	Go to Step 3
	1. Remove any debris that may cause an air flow obstruction.		

2	2. Remove or relocate aftermarket add-on components that block air flow to the radiator. Does the engine still overheat?	Go to Step 3	System OK
3	Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors?	Go to Step 4	Go to Step 5
4	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to Step 5	System OK
5	Check for an inoperative cooling fan. Refer to <u>Cooling Fan Inoperative (Dual Fan)</u> , <u>Cooling Fan Inoperative (Single Fan)</u> . Is the thermostat operating properly?	Go to Step 6	Go to Step 7
6	Repair or replace the cooling fan(s) as necessary. Refer to <u>Engine Coolant Fan Motor Replacement (LFW, LFX)</u> , <u>Engine Coolant Fan Motor Replacement (LSA)</u> . Does the engine still overheat?	Go to Step 7	System OK
7	Check for a loss of coolant. Refer to <u>Loss of Coolant</u> . Does the engine still overheat?	Go to Step 8	System OK
8	Check for kinked or pinched cooling hoses. Are any cooling hoses kinked or pinched?	Go to Step 9	Go to Step 10
9	1. Relieve any kinks by rerouting the hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to Step 10	System OK
10	Using J-26568 Coolant and Battery Fluid Tester , check the coolant concentration. Does the coolant concentration test correctly?	Go to Step 12	Go to Step 11
11	Replace the coolant, if necessary. Refer to <u>Loss of Coolant</u> . Does the engine still overheat?	Go to Step 12	System OK
12	Check for any blocked cooling system passages. Are there blocked cooling system passages?	Go to Step 13	Go to Step 14
13	Remove any obstructions by flushing the cooling system. Refer to <u>Flushing (Powertrain)</u> , <u>Flushing (Charge Air Cooling)</u> . Does the engine still overheat?	Go to Step 14	Go to Step 19
14	Inspect the accessory drive belt tensioner. Refer to <u>Drive Belt Tensioner Diagnosis</u> . Does the engine still overheat?	Go to Step 15	System OK
15	Check for a faulty thermostat. Refer to <u>Thermostat Diagnosis (LP1, LY7)</u> , <u>Thermostat Diagnosis (LS2)</u> .		

	Does the engine still overheat?	Go to Step 16	System OK
16	Replace the radiator. Refer to <u>Radiator Replacement (Heavy Duty Cooling)</u> , <u>Radiator Replacement (Standard Duty Cooling)</u> . Does the engine still overheat?	Go to Step 17	System OK
17	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to Step 18	-
18	Replace the water pump. Refer to <u>Water Pump Replacement (LFX)</u> , <u>Water Pump Replacement (LSA)</u> . Did you complete the repair?	Go to Step 19	-
19	Operate the system to verify the repair. Did you correct the condition?	System OK	-

LOSS OF COOLANT

Loss of Coolant

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Symptoms - Engine Cooling</u>
2	Repair any present DTCs. Refer to <u>Diagnostic System Check - Vehicle</u> . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level at the surge tank. 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 <u>Cooling System Draining and Filling (Static Fill LFW or LFX)</u> , <u>Cooling System Draining and Filling (Static Fill LSA)</u> , <u>Cooling System Draining and Filling (GE 47716 LFW or LFX)</u> , <u>Cooling System Draining and Filling (GE 47716 LSA)</u> . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 24
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 25	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 27	Go to Step 8
	Visually inspect the hoses, pipes and hose clamps at the following locations:		

8	• Surge tank • Auxiliary water pump • Water pump • Heater core • Radiator		
	Are any of the hoses, clamps or pipes leaking?	Go to Step 20	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Cylinder head gaskets • Cylinder heads • Engine block • Radiator • Thermostat housing • Water pump		
	Are any of the listed components leaking?	Go to Step 20	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 8 and 9.		
	Are any leaks present?	Go to Step 20	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 21
12	1. Apply the parking brake. 2. Ensure the vehicle is in PARK. 3. Start and idle the engine until it reaches normal operating temperature. 4. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 13	Go to Step 14
	• Coolant in the exhaust system creates a		

13	distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 26	Go to Step 14
14	WARNING: Refer to <u>Moving Parts and Hot Surfaces Warning</u> . With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling?	Go to Step 28	Go to Step 15
15	Inspect for the following conditions: - A coolant smell inside of the vehicle - Coolant in the HVAC module drain tube - Coolant on the vehicle floor covering near the HVAC module Is coolant present?	Go to Step 22	Go to Step 16
16	- Add 30 ml (1 oz) of Extended Life Coolant Leak Detection Dye GM P/N 89022219 (Canadian P/N 89022220) to the cooling system for each 15 liters (4 gallons) of coolant. Refer to <u>Approximate Fluid Capacities</u> . - Start the vehicle and allow the engine to reach normal operating temperature. - Shut the engine off. - Use J 42220 Universal 12V Leak Detection Lamp to visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 20	Go to Step 17
17	Use J 42220 to inspect for the following conditions: - Coolant dye in the HVAC module drain tube - Coolant dye on the vehicle floor covering near the HVAC module Is coolant dye present?	Go to Step 22	Go to Step 18
	Inspect the engine oil for a gray/white milky		

18	substance. Is there a milky substance in the engine oil ?	Go to Step 26	Go to Step 19
19	Inspect the transmission oil fluid for a gray/white milky substance. Does the transmission fluid contain a gray/white milky substance?	Go to Step 23	Go to Step 29
20	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 29	-
21	Replace the coolant pressure cap. Is the repair complete?	Go to Step 29	-
22	Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete?	Go to Step 29	-
23	1. Replace the radiator. Refer to <u>Radiator Replacement (Heavy Duty Cooling), Radiator Replacement (Standard Duty Cooling)</u> . 2. Service the transmission. Refer to <u>Coolant in Engine Oil</u> . Is the repair complete?	Go to Step 29	-
24	Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> . Is the repair complete?	Go to Step 29	-
25	Repair the engine overheating condition. Refer to <u>Engine Overheating (LFW, LFX, and LSA)</u> . Is the repair complete?	Go to Step 29	-
26	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> , <u>Coolant in Engine Oil</u> . Is the repair complete?	Go to Step 29	-
27	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> . Is the repair complete?	Go to Step 29	-
28	Repair the combustion pressure in the cooling system problem. Refer to <u>Cylinder Leakage Test</u> . Is the repair complete?	Go to Step 29	-
29	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS (LFW, LFX)

Tools Required

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

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

1. Use a tempilstick in order to find the opening and the closing temperatures of the thermostat.
 - **J 24731** 188 tempilstick melts at 87°C (188°F). The thermostat should begin to open at 90°C (194°F).
 - **J 24731** 206 tempilstick melts at 97°C (206°F). The thermostat should be fully open at 107°C (225°F).
2. Replace the thermostat if it does not operate properly between this temperature range.

THERMOSTAT DIAGNOSIS (LSA)

Tools Required

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

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

1. Use a tempilstick in order to find the opening and the closing temperatures of the coolant thermostat.
 - **J 24731** 188 tempilstick melts at 87°C (188°F). The thermostat should begin to open at 90°C (194°F).
 - **J 24731** 206 tempilstick melts at 97°C (206°F). The thermostat should be fully open at 107°C (225°F).
2. Replace the coolant thermostat if it does not operate properly between this temperature range.

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
1	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine. 4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s).		

	Is the electric cooling fan on?	Go to Step 2	Go to Step 3
2	1. Diagnose and repair the cooling fan system. Refer to <u>Cooling Fan Always On (Dual Fan)</u>, <u>Cooling Fan Always On (Single Fan)</u>. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 3	System OK
3	Install the Scan Tool to the DLC. Compare the Scan Tool coolant temperature reading to the I/P cluster coolant temperature. Is the I/P cluster coolant temperature close to the reading on the Scan Tool?	Go to Step 5	Go to Step 4
4	1. Diagnose and repair the coolant temperature gauge system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 5	System OK
5	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis (LFW, LFX)</u>, <u>Thermostat Diagnosis (LS2)</u>. Is the thermostat operating properly?	Go to Step 1	Go to Step 6
6	1. Replace the thermostat. Refer to <u>Engine Coolant Thermostat Replacement (LSA)</u>, <u>Engine Coolant Thermostat Replacement (LFW, LFX)</u>. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK

PRESSURE CAP TESTING

Special Tools

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

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

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

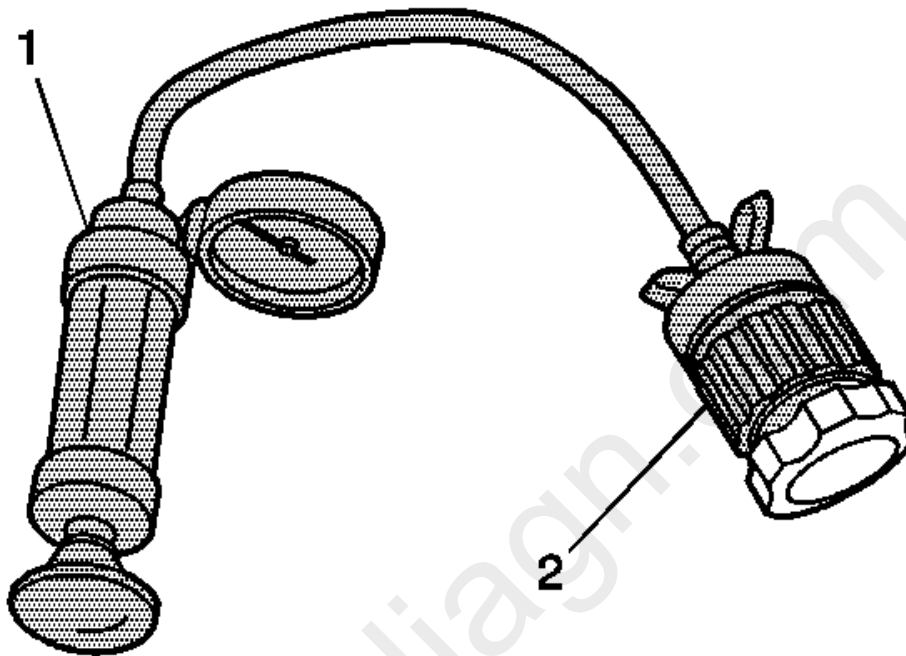


Fig. 4: Pressure Cap And Cooling System Pressure Tester
Courtesy of GENERAL MOTORS COMPANY

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

Note the rate of pressure loss.

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

- The pressure cap does not hold the rated pressure.

CHARGE AIR COOLING SYSTEM PRESSURE CAP TESTING

Special Tools

- **J 24460-01** Cooling System Pressure Tester
- **J 46143** Cooling System Adapter

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

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

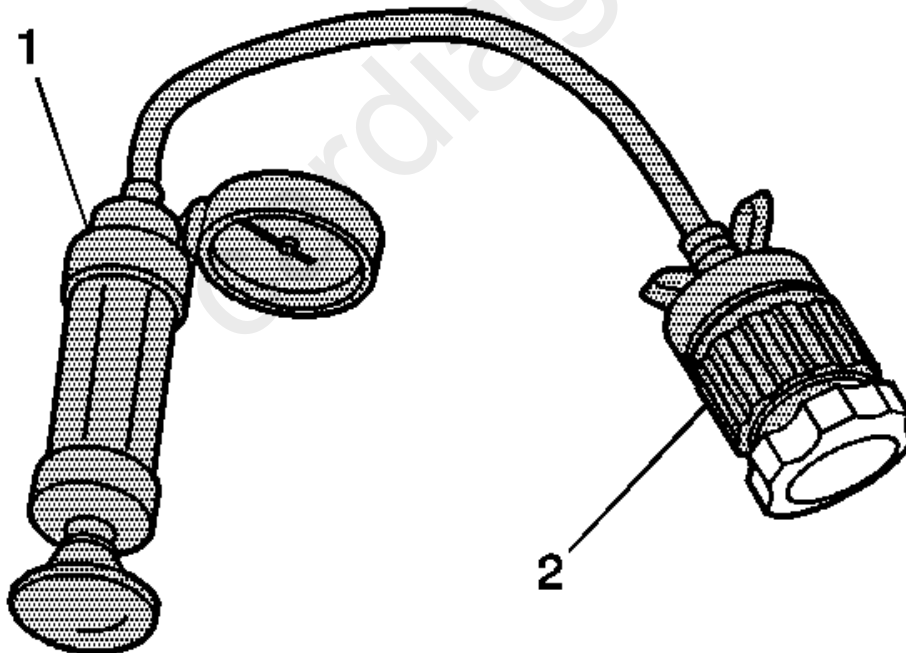


Fig. 5: Pressure Cap And Cooling System Pressure Tester
Courtesy of GENERAL MOTORS COMPANY

3. Use the **J 24460-01** cooling system pressure tester (1) with **J 46143** cooling system adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
 - Pressure release when the **J 24460-01** cooling system pressure tester exceeds the pressure rating of the pressure cap.
 - Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

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

COOLING SYSTEM LEAK TESTING

Special Tools

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

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

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

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

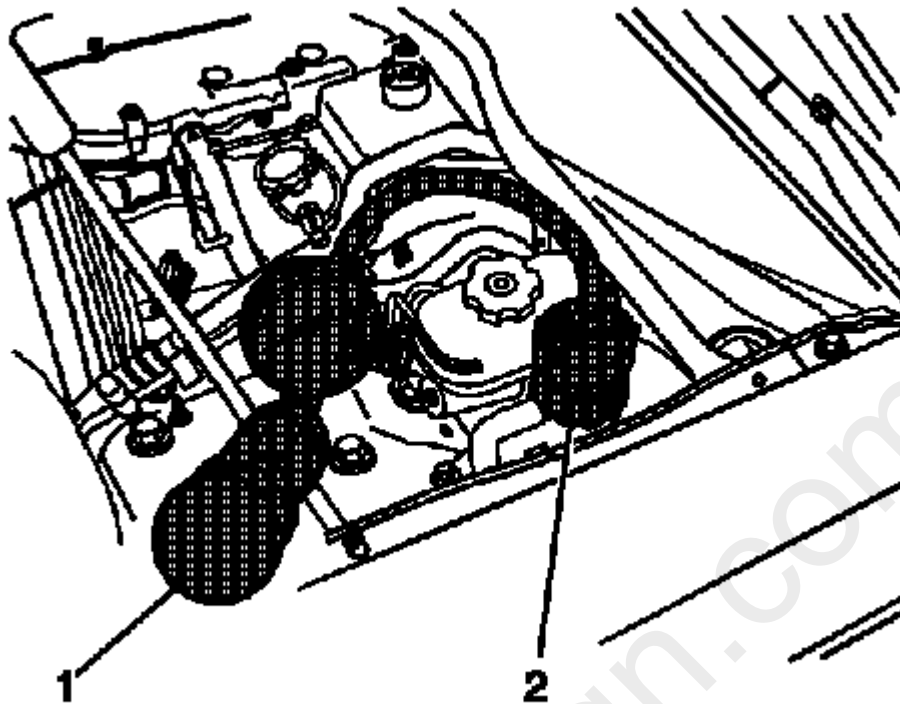


Fig. 6: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS COMPANY

4. Use the **J 24460-01** cooling system pressure tester (1) with **J 42401** radiator cap / surge tank test adapter (2) in order to apply pressure to the cooling system.

Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

6. Repair any leaks as required.

CHARGE AIR COOLING SYSTEM LEAK TESTING

Special Tools

- **J 24460-01** Cooling System Pressure Tester
- **J 46143** Cooling System Adapter

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

1. Remove the charge air coolant pressure cap.
2. Test the operation of the charge air coolant pressure cap. Refer to **Charge Air Cooling System Pressure Cap Testing.**
3. Wash the charge air coolant pressure cap mating surface with water.

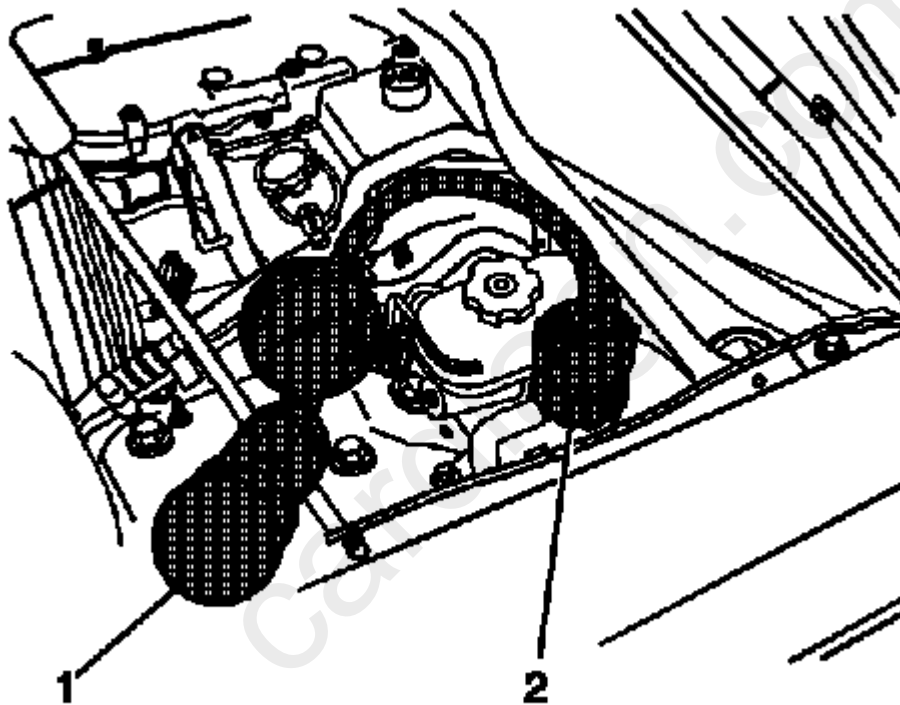


Fig. 7: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS COMPANY

4. Use the **J 24460-01** cooling system pressure tester (1) with **J 46143** cooling system adapter (2) in order to apply pressure to the charge air cooling system.

Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL LSA)

Special Tools

J 26568 Coolant and Battery Fluid Tester

Draining Procedure

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

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
4. Remove the air deflector. Refer to Front Air Deflector Replacement .
5. Place a drain pan under the radiator.
6. Remove the radiator outlet hose. Refer to Radiator Outlet Hose Replacement (LFX or LFW), Radiator Outlet Hose Replacement (LSA)

Fill Procedure

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

1. Install the radiator outlet hose. Refer to Radiator Outlet Hose Replacement (LFX or LFW), Radiator Outlet Hose Replacement (LSA)
2. Install the air deflector. Refer to Front Air Deflector Replacement .
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean drinkable water to the cooling system through the top of the surge tank opening. Refer to Approximate Fluid Capacities .
5. Slowly fill the cooling system until the coolant stabilizes at 25 mm (1 inch) above the FULL COLD mark on the surge tank.

6. Install the surge tank cap.
7. Start the engine.
8. Run the engine at 2,000-2,500 RPM until the engine reaches normal operating temperature.
9. Allow the engine to idle for 3 minutes.
10. Shut the engine OFF.
11. Allow the engine to cool.

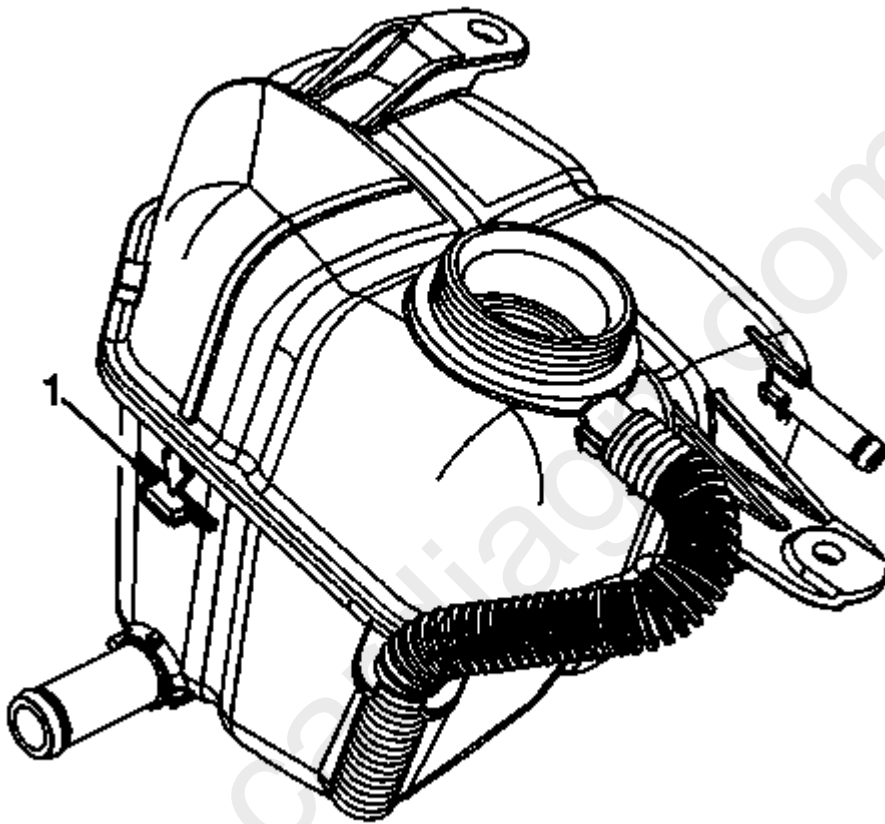


Fig. 8: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS COMPANY

12. Add or remove coolant as necessary from the surge tank until the level is stabilized at the FULL COLD mark (1).
13. Inspect the cooling system for leaks.
14. Using **J 26568** coolant and battery fluid tester inspect the concentration of the engine coolant .

COOLING SYSTEM DRAINING AND FILLING (GE 47716 LSA)

Special Tools

- **GE-47716** Vac N Fill Coolant Refill Tool

- **J 26568** Coolant and Battery Fluid Tester
- **J 42401** Radiator Cap / Surge Tank Test Adapter

Draining Procedure

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

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air deflector. Refer to **Front Air Deflector Replacement** .
5. Place a drain pan under the radiator.
6. Remove the radiator outlet hose. Refer to **Radiator Outlet Hose Replacement (LFX or LFW), Radiator Outlet Hose Replacement (LSA)**.

Vac N Fill Procedure

1. Install the radiator outlet hose. Refer to **Radiator Outlet Hose Replacement (LFX or LFW), Radiator Outlet Hose Replacement (LSA)**.
2. Install the **J 42401** radiator cap / surge tank test adapter onto the coolant surge tank.

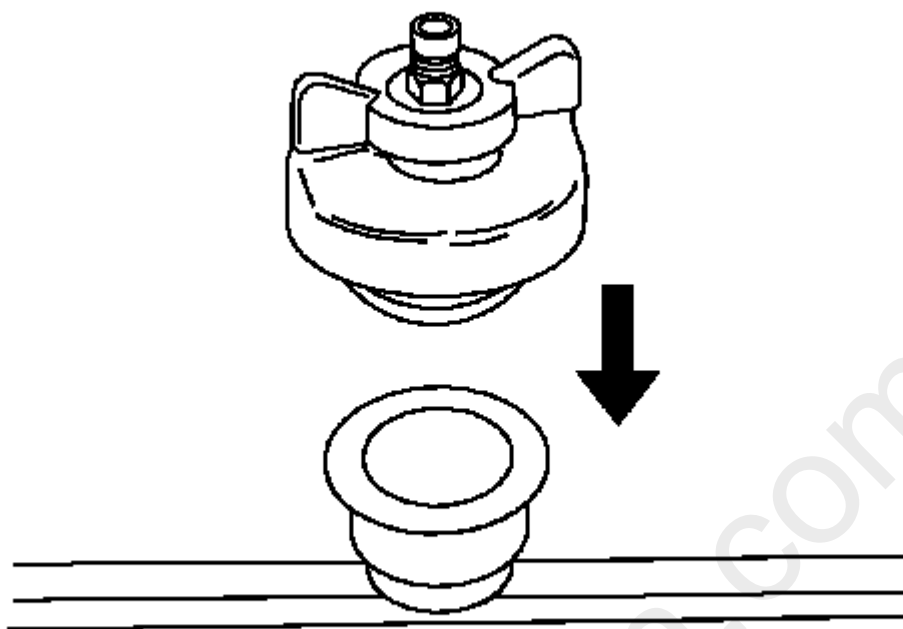


Fig. 9: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

3. Attach the Vac N Fill cap to the **J 42401** radiator cap / surge tank test adapter.

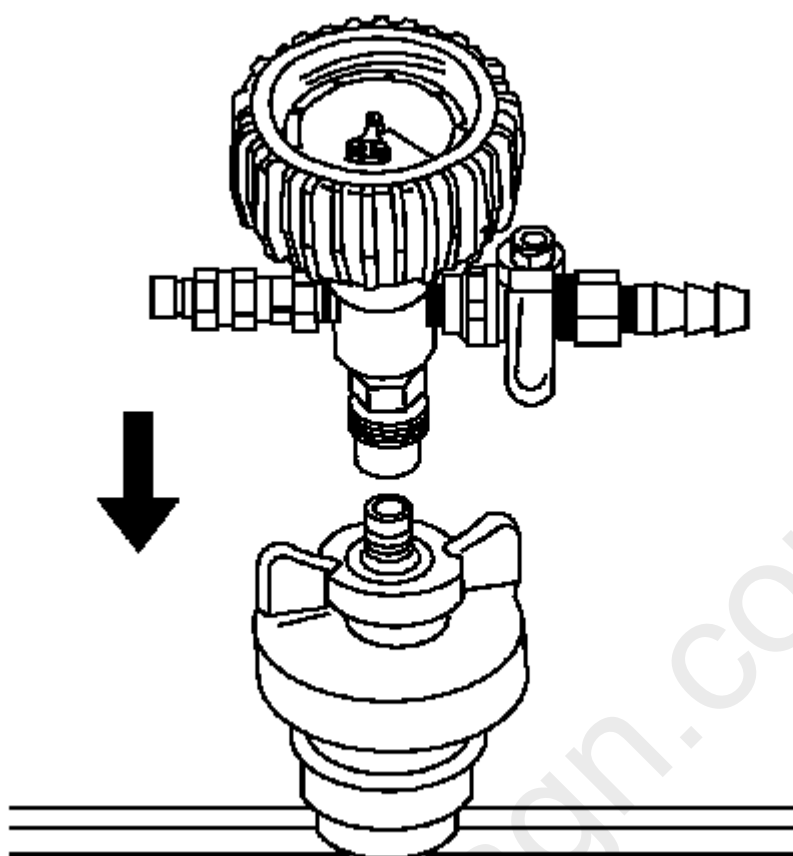


Fig. 10: Attaching The Vacuum Gage Assembly To The Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

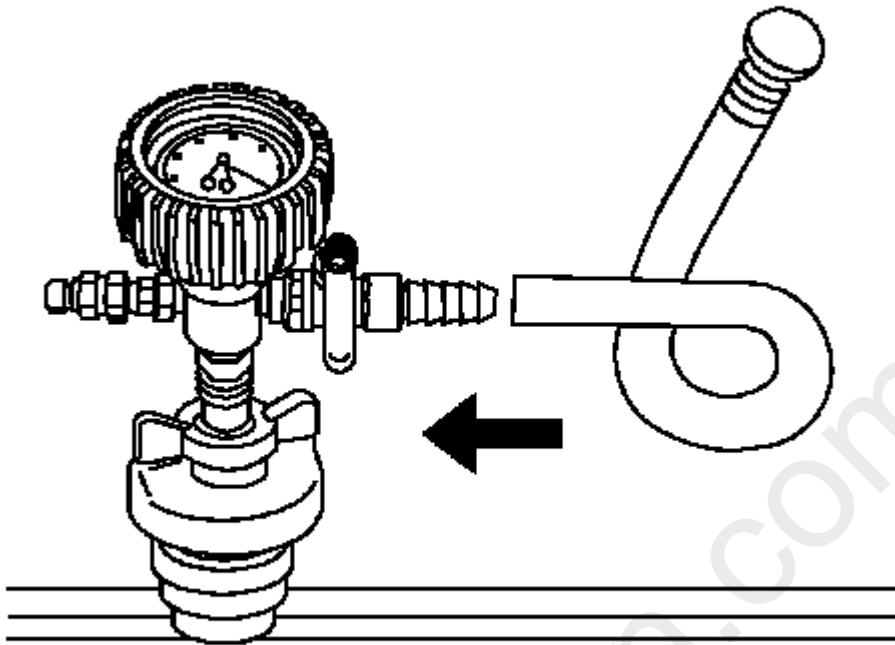


Fig. 11: Attaching Fill Hose To Barb Fitting On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure that the valve is closed.

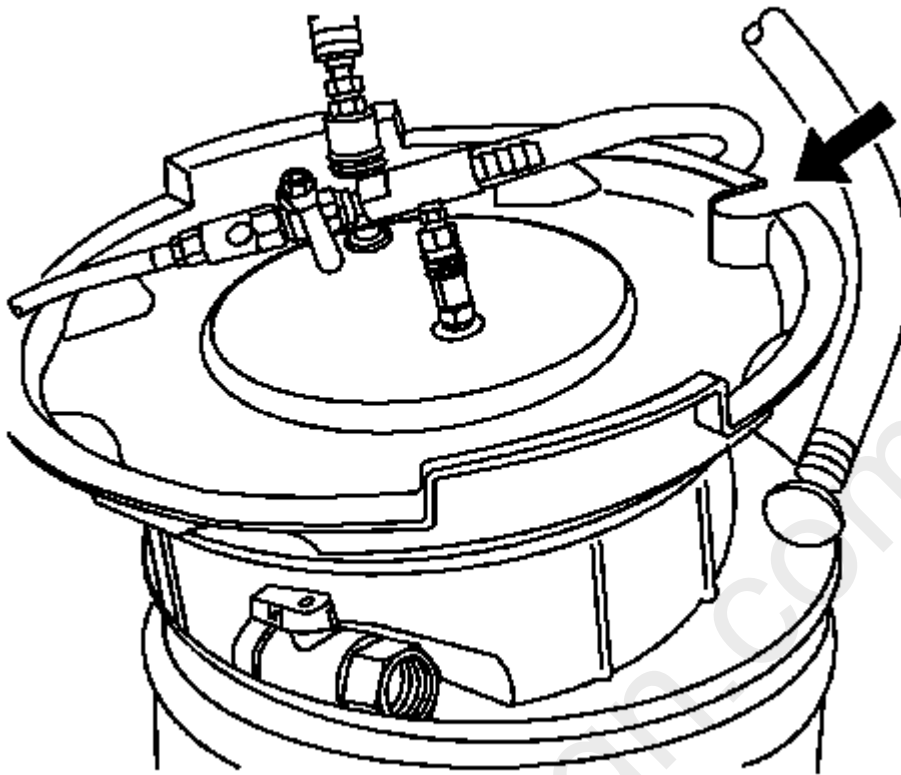


Fig. 12: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

NOTE:

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

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

NOTE:

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

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

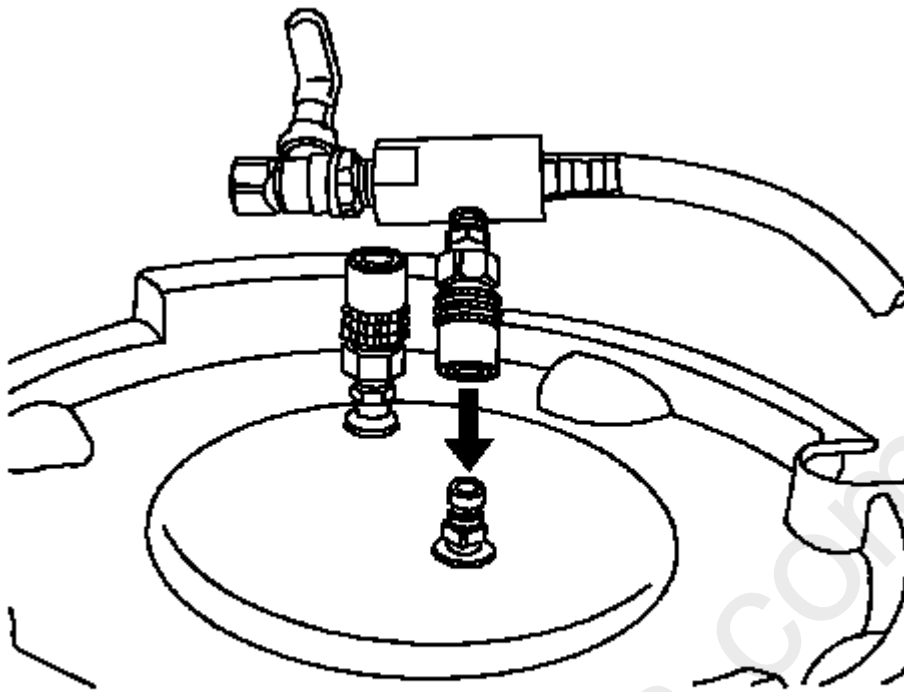


Fig. 13: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly to the vacuum tank.

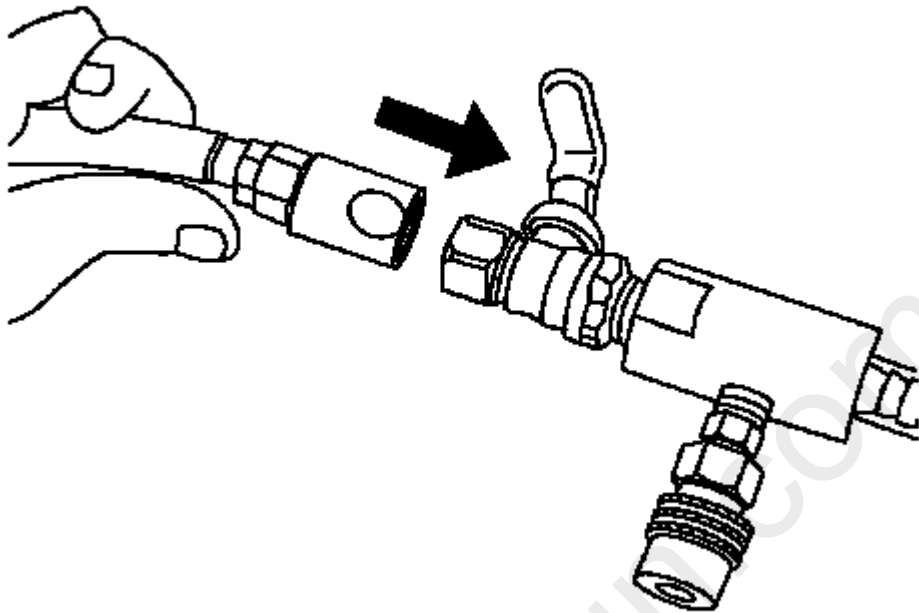


Fig. 14: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure the valve on the venturi assembly is closed.

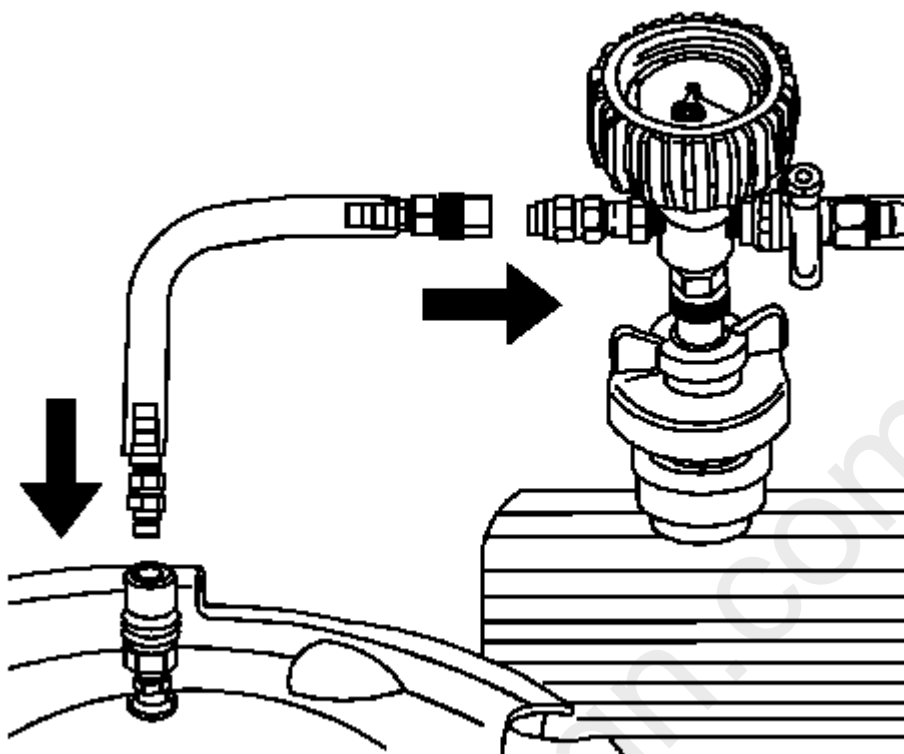


Fig. 15: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

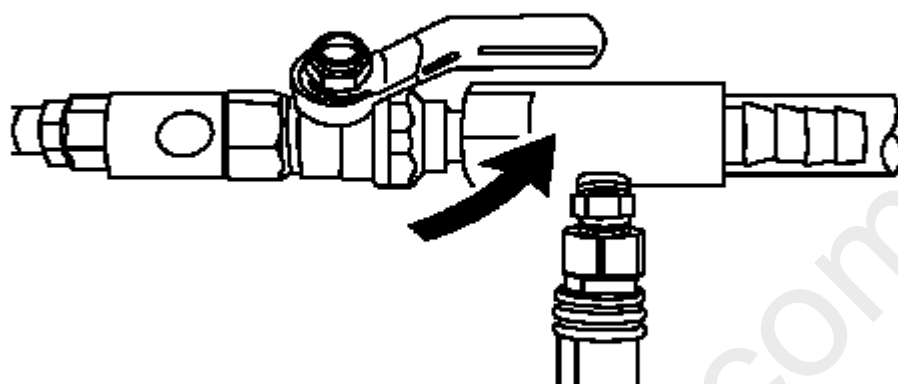


Fig. 16: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

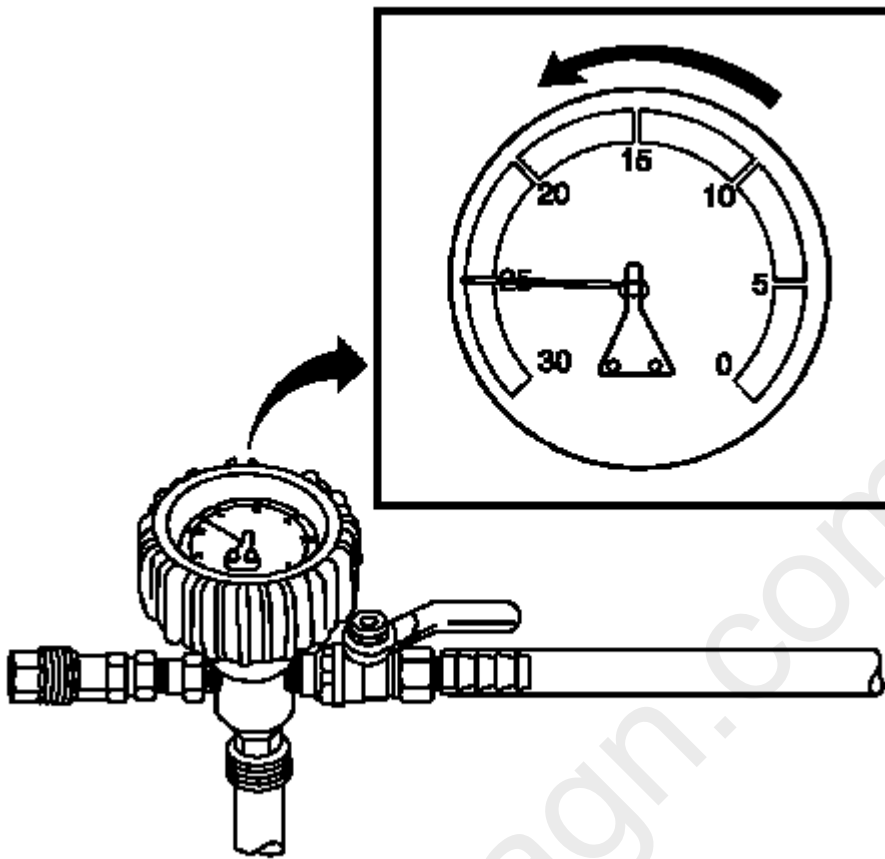


Fig. 17: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

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.

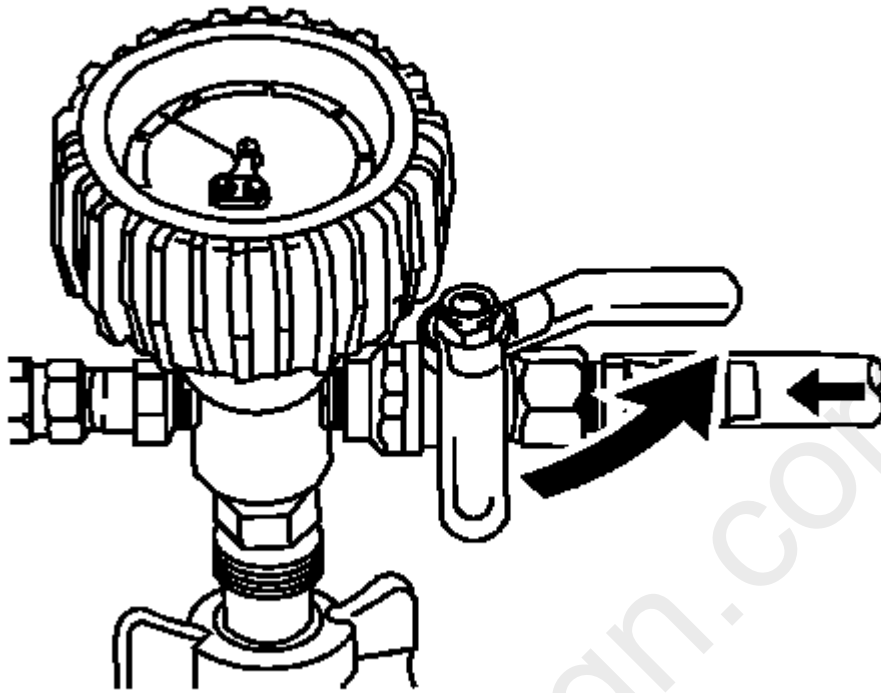


Fig. 18: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

15. Slowly open the valve on the vacuum gauge assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
16. Close the valve on the venturi 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 gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

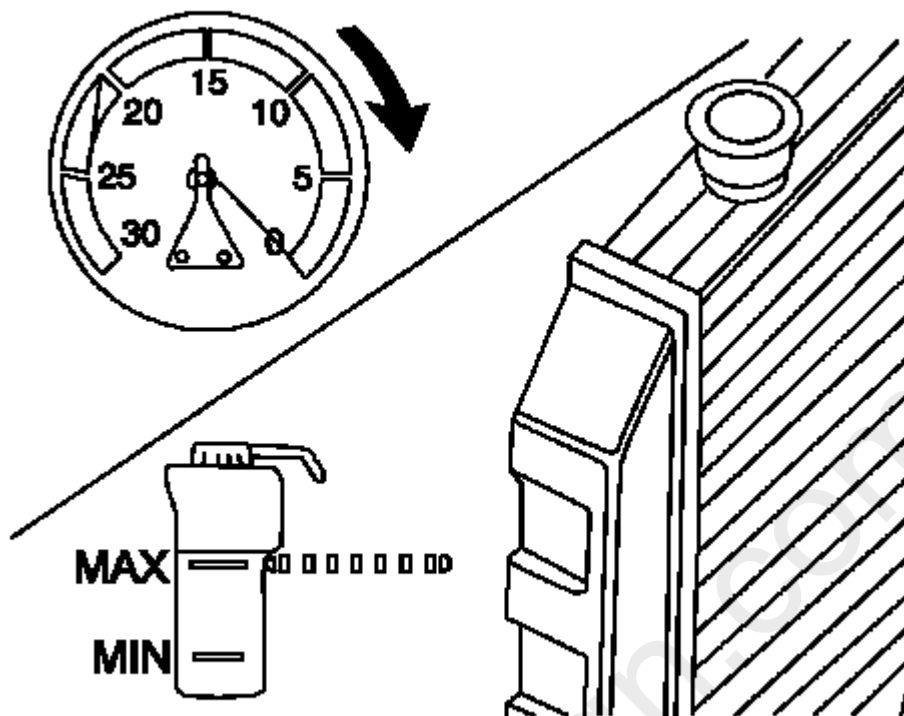


Fig. 19: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS COMPANY

19. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 11-17.
20. Detach the Vac N Fill cap from the **J 42401** radiator cap / surge tank test adapter.
21. Remove the **J 42401** radiator cap / surge tank test adapter from the coolant surge tank.

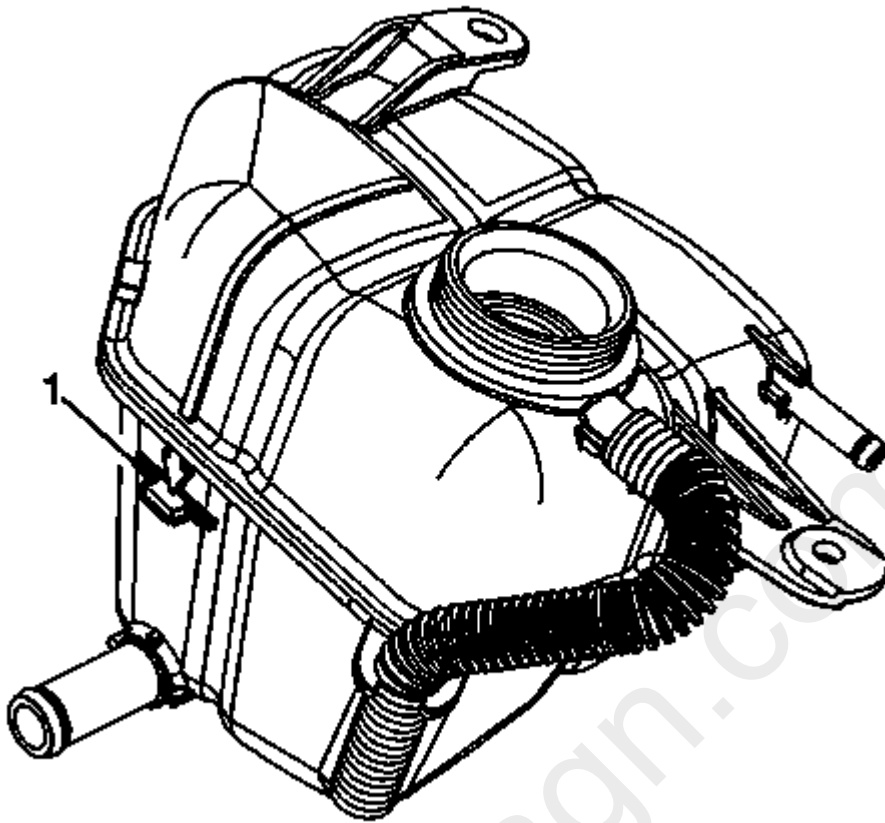


Fig. 20: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS COMPANY

22. Add coolant to the system as necessary until the level is at the cold fill mark (1).
23. Inspect the concentration of the coolant mixture using **J 26568** coolant and battery fluid tester.

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

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

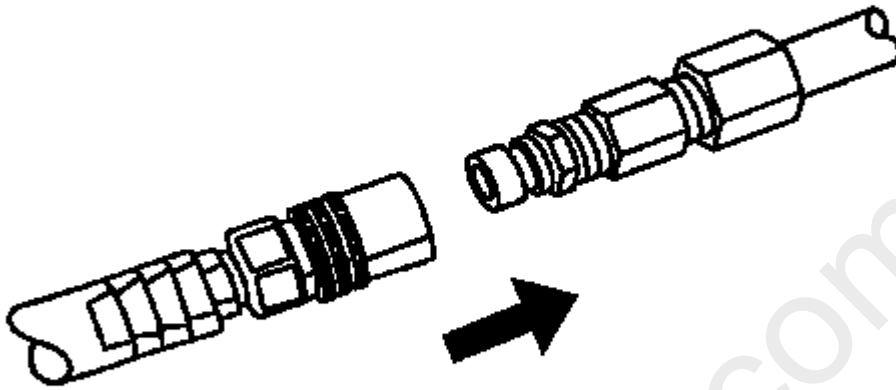


Fig. 21: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

25. Attach the extraction hose to the vacuum hose.

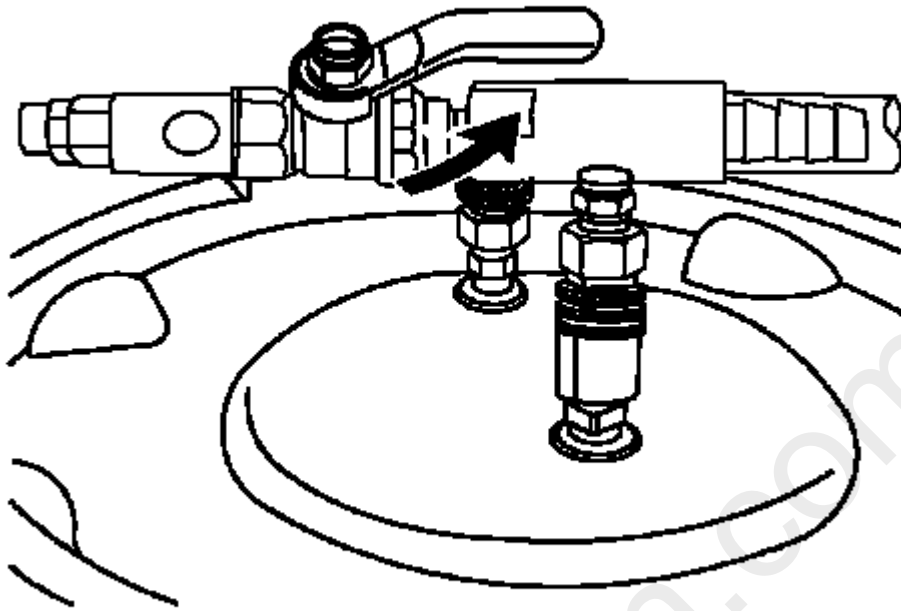


Fig. 22: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

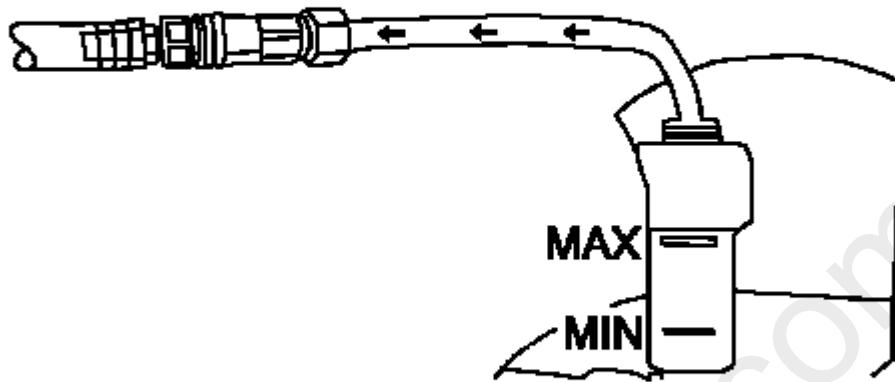


Fig. 23: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS COMPANY

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

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL LFW OR LFX)

Special Tools

J 26568 Coolant and Battery Fluid Tester

Draining Procedure

WARNING: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to

spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air deflector. Refer to **Front Air Deflector Replacement** .
5. Place a drain pan under the radiator.
6. Insert a piece of clean flexible hose through the access hole in the cradle onto the radiator mounting pin.
7. Slowly loosen the drain cock and drain the coolant into the drain pan. Do not completely remove the drain cock.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance - Follow the flush procedure. Refer to **Flushing (Powertrain), Flushing (Charge Air Cooling)**.
 - Normal in appearance - Follow the Fill Procedure below.

Fill Procedure

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

1. Close the radiator drain cock.
2. Install the air deflector. Refer to **Front Air Deflector Replacement** .
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean drinkable water to the cooling system through the top of the surge tank opening. Refer to **Approximate Fluid Capacities** .
5. Slowly fill the cooling system until the coolant stabilizes at 25 mm (1 inch) above the FULL COLD mark on the surge tank.
6. Install the surge tank cap.
7. Start the engine.
8. Run the engine at 2,000-2,500 RPM until the engine reaches normal operating temperature.
9. Allow the engine to idle for 3 minutes.
10. Shut the engine OFF.
11. Allow the engine to cool.

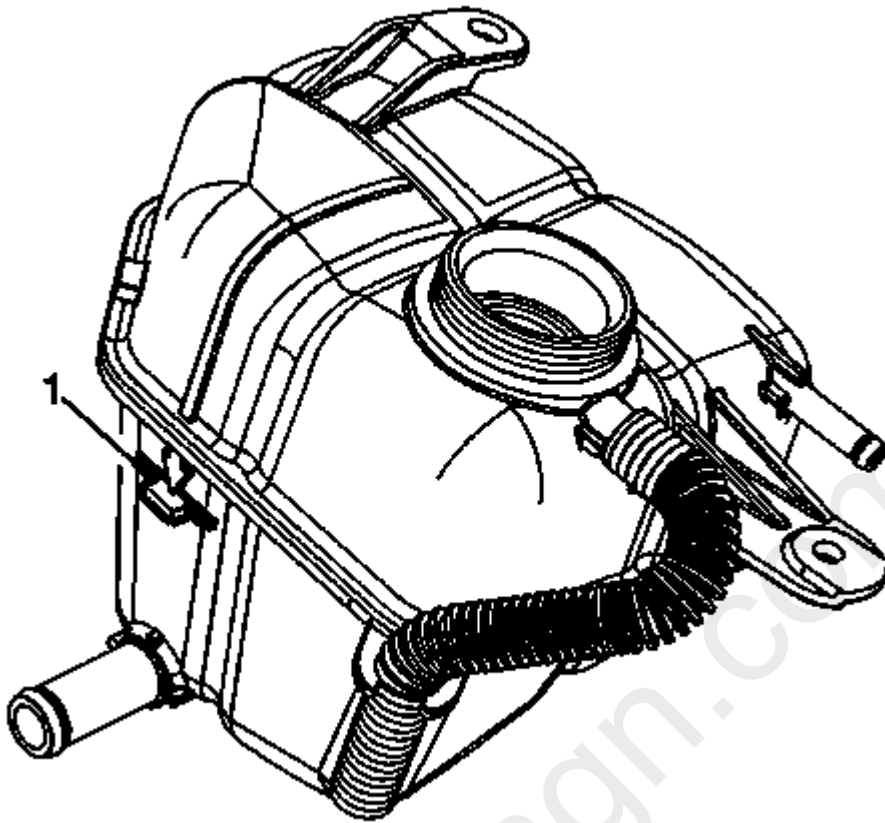


Fig. 24: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS COMPANY

12. Add or remove coolant as necessary from the surge tank until the level is stabilized at the FULL COLD mark (1).
13. Inspect the cooling system for leaks.
14. Using J 26568 coolant and battery fluid tester , inspect the concentration of the engine coolant .

COOLING SYSTEM DRAINING AND FILLING (GE 47716 LFW OR LFX)

Special Tools

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

Draining Procedure

WARNING: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the

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

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air deflector. Refer to **Front Air Deflector Replacement** .
5. Place a drain pan under the radiator.
6. Insert a piece of clean flexible hose through the access hole in the cradle onto the radiator mounting pin.
7. Slowly loosen the drain cock and drain the coolant into the drain pan. Do not completely remove the drain cock.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance - Follow the flush procedure. Refer to **Flushing (Powertrain)**, **Flushing (Charge Air Cooling)**.
 - Normal in appearance - Follow the Vac N Fill Procedure below.
9. Tighten the drain cock.

Vac N Fill Procedure

1. Install the **J 42401** radiator cap / surge tank test adapter onto the coolant surge tank.

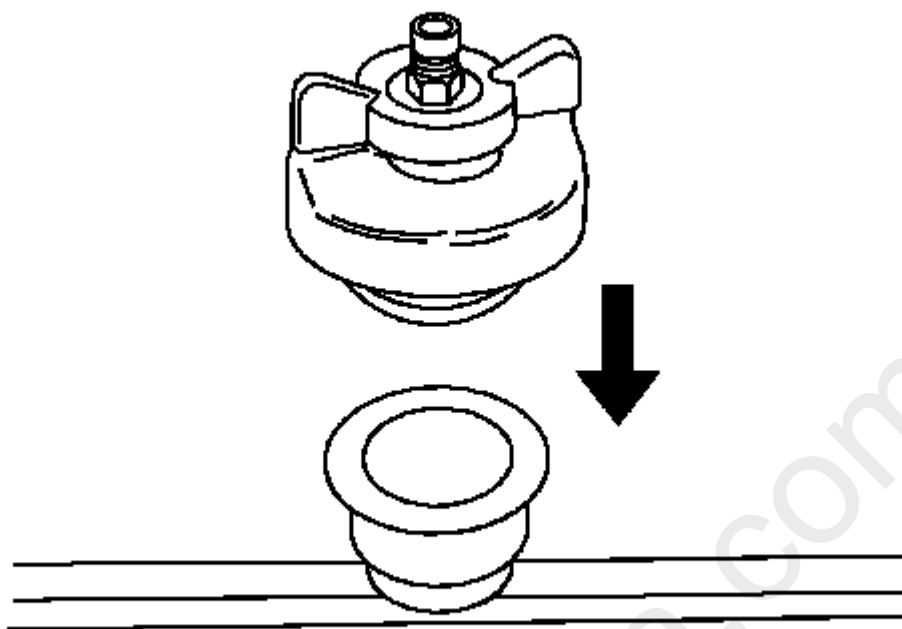


Fig. 25: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

2. Attach the Vac N Fill cap to the **J 42401** radiator cap / surge tank test adapter.

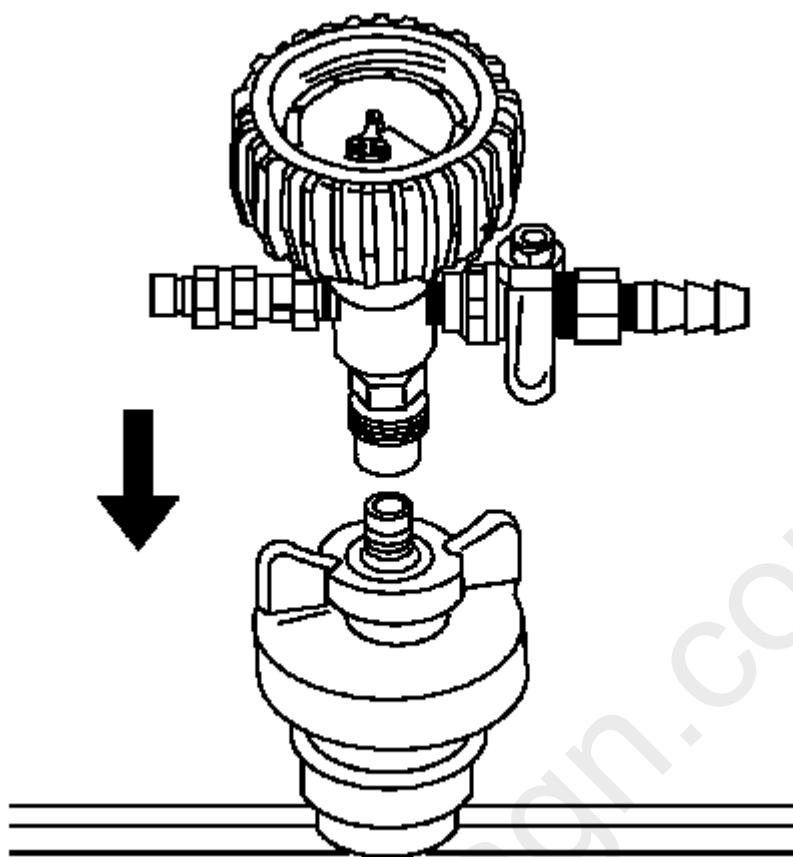


Fig. 26: Attaching The Vacuum Gage Assembly To The Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

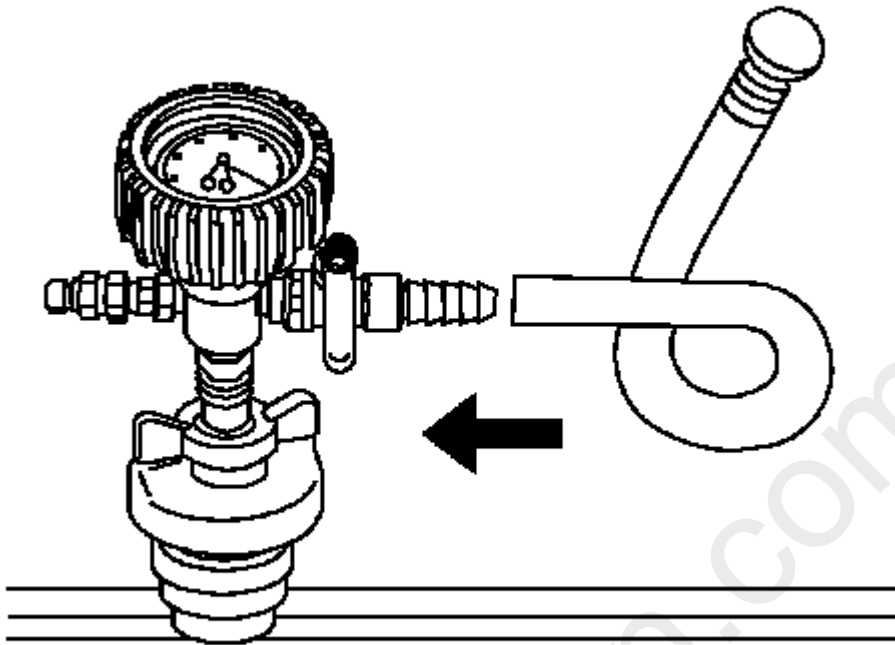


Fig. 27: Attaching Fill Hose To Barb Fitting On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure that the valve is closed.

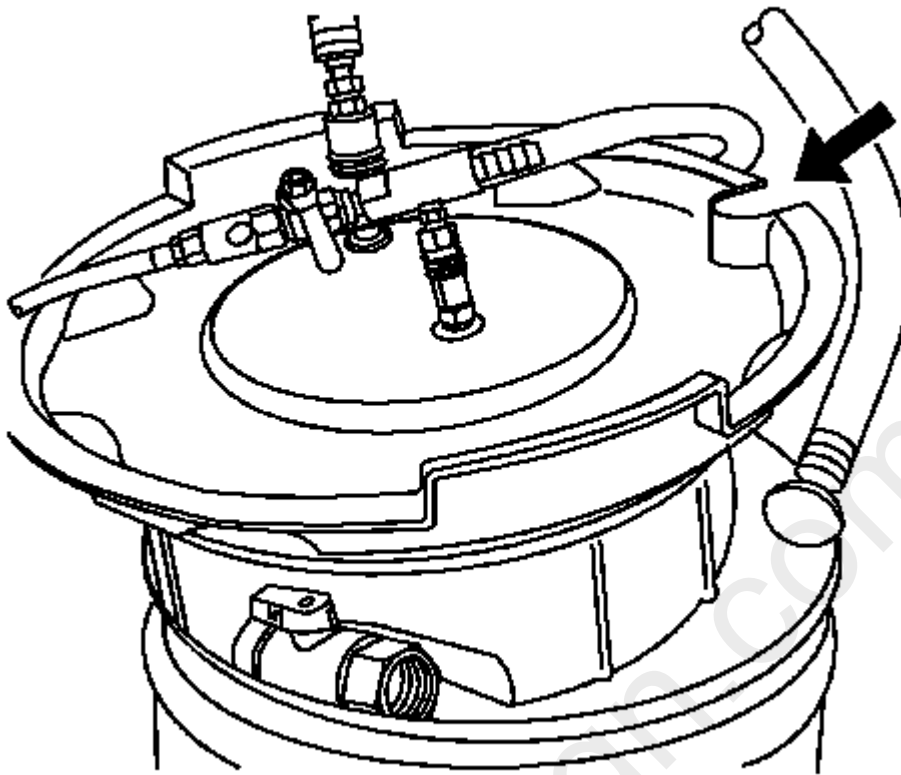


Fig. 28: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

NOTE:

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

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

NOTE:

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

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

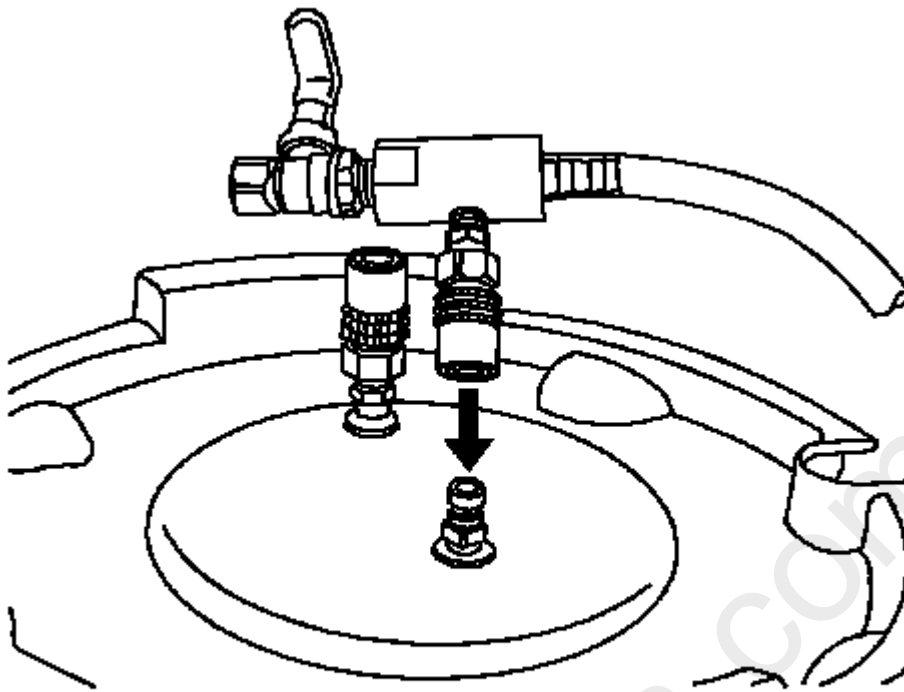


Fig. 29: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

8. Attach the venturi assembly to the vacuum tank.

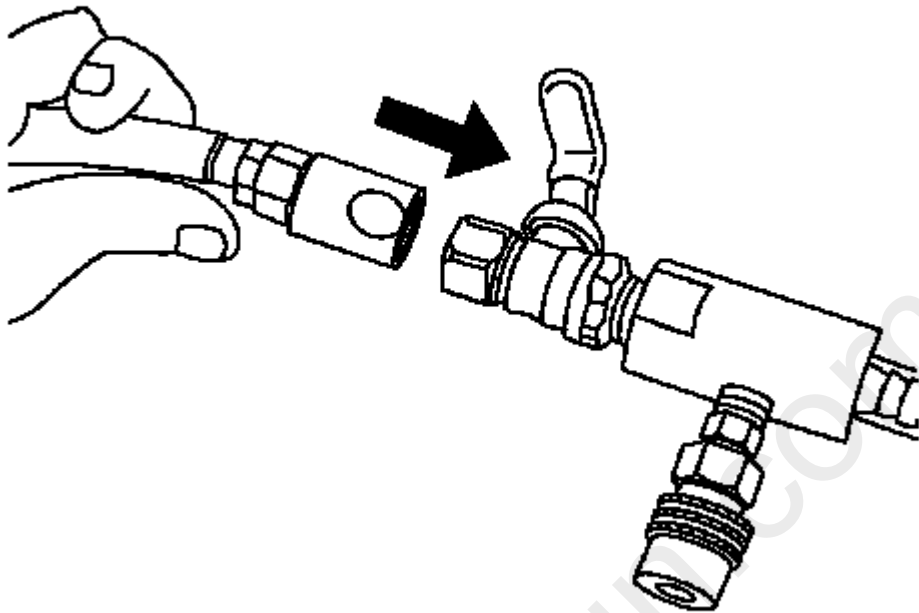


Fig. 30: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure the valve on the venturi assembly is closed.

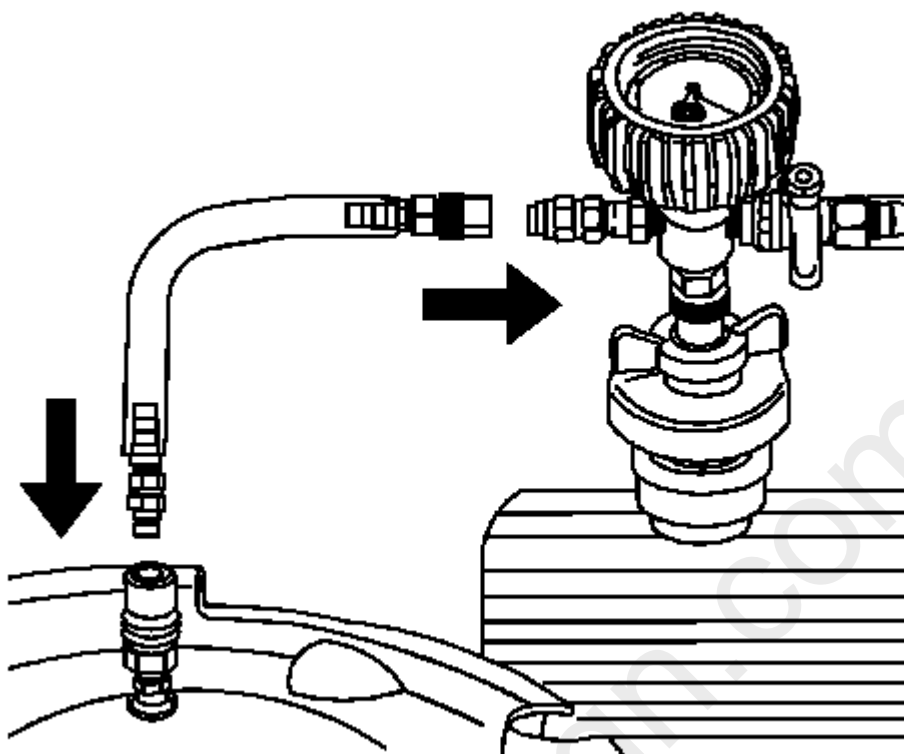


Fig. 31: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

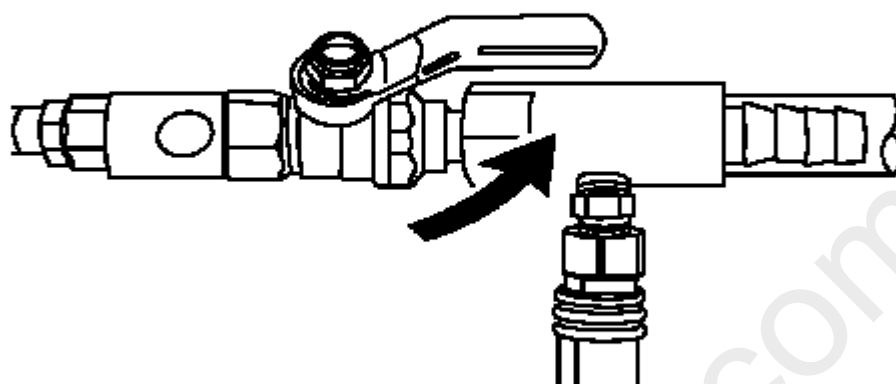


Fig. 32: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

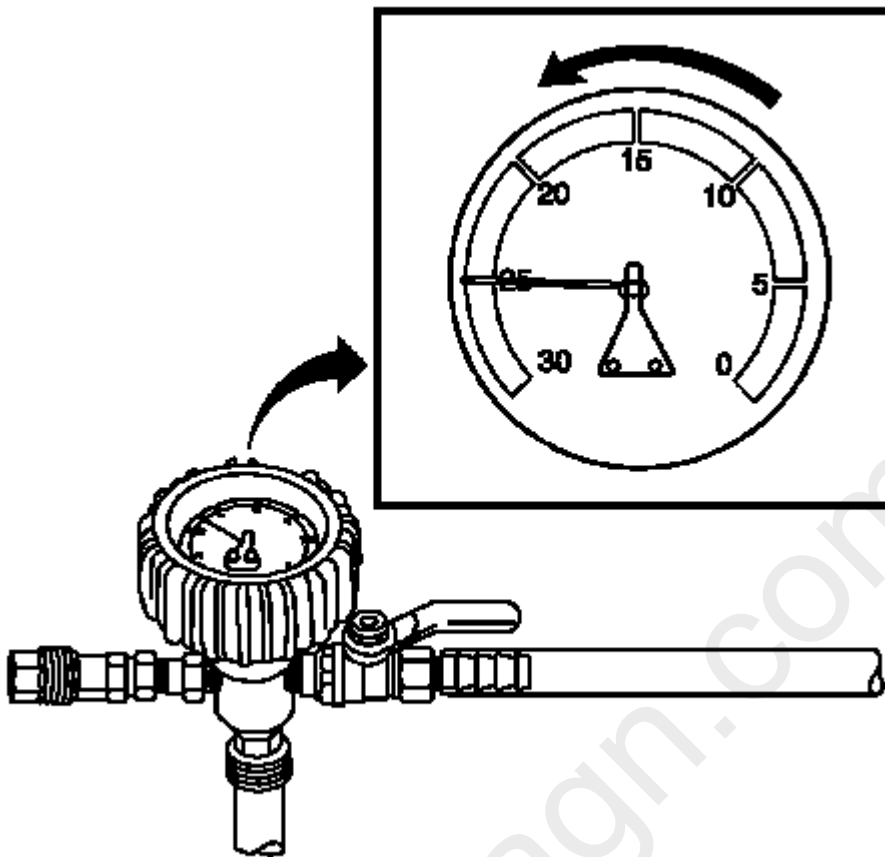


Fig. 33: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

12. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).
Cooling hoses may start to collapse. This is normal due to vacuum draw.
13. To aid in the fill process, position the graduated reservoir above the coolant fill port.

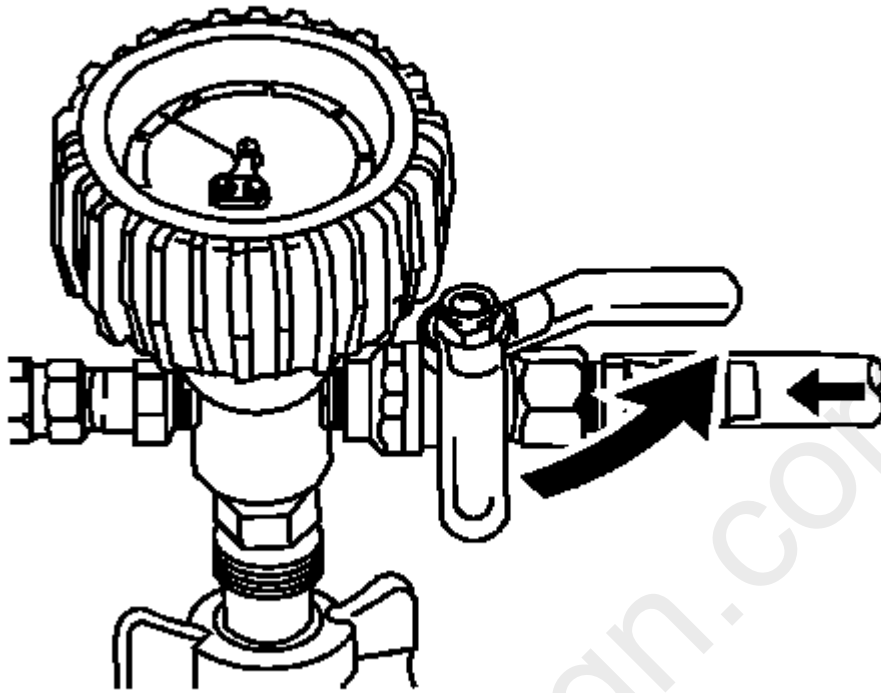


Fig. 34: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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

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

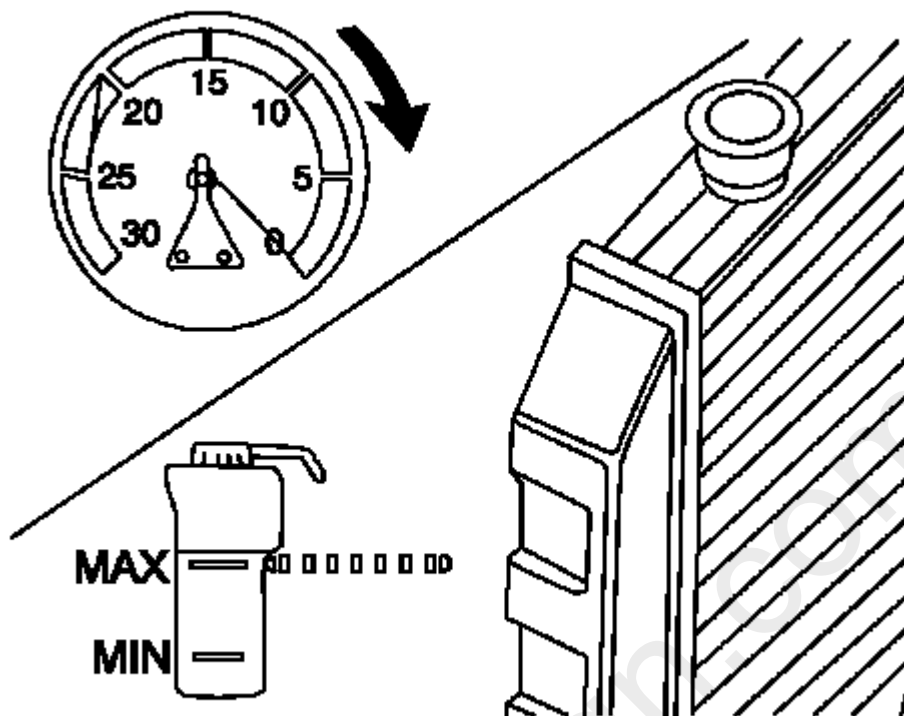


Fig. 35: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS COMPANY

18. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 11-17.
19. Detach the Vac N Fill cap from the **J 42401** radiator cap / surge tank test adapter.
20. Remove the **J 42401** radiator cap / surge tank test adapter from the coolant surge tank.

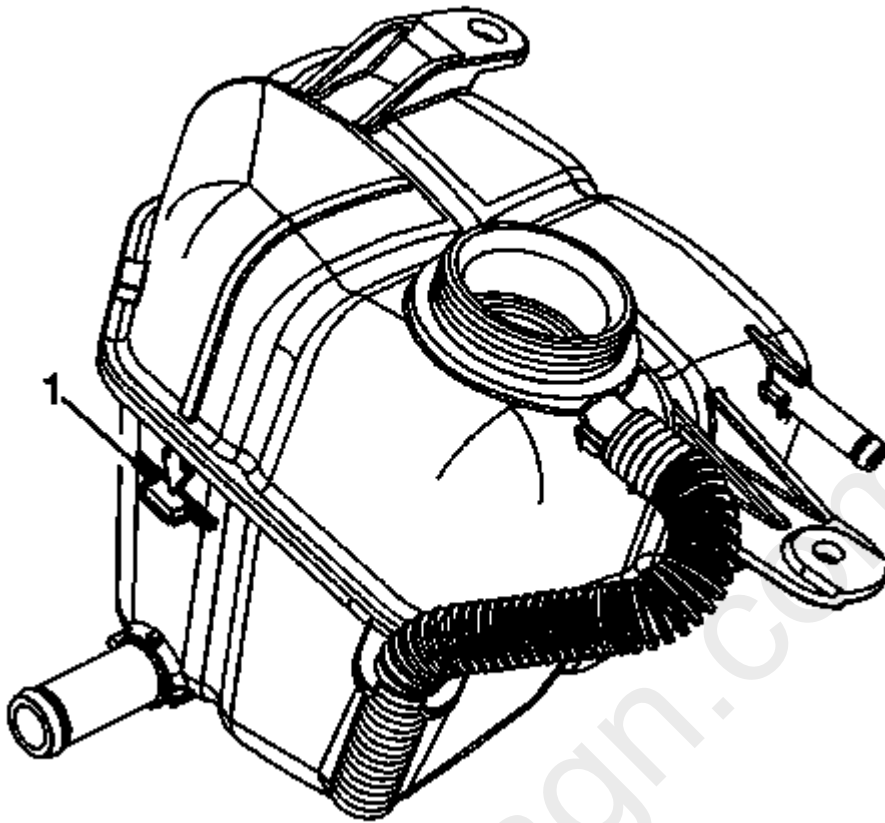


Fig. 36: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS COMPANY

21. Add coolant to the system as necessary until the level is at the cold fill mark (1).
22. Inspect the concentration of the coolant mixture using **J 26568** coolant and battery fluid tester.

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

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

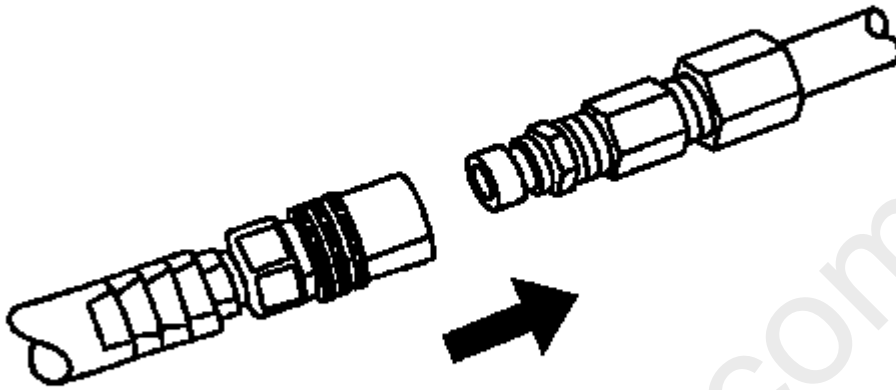


Fig. 37: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

24. Attach the extraction hose to the vacuum hose.

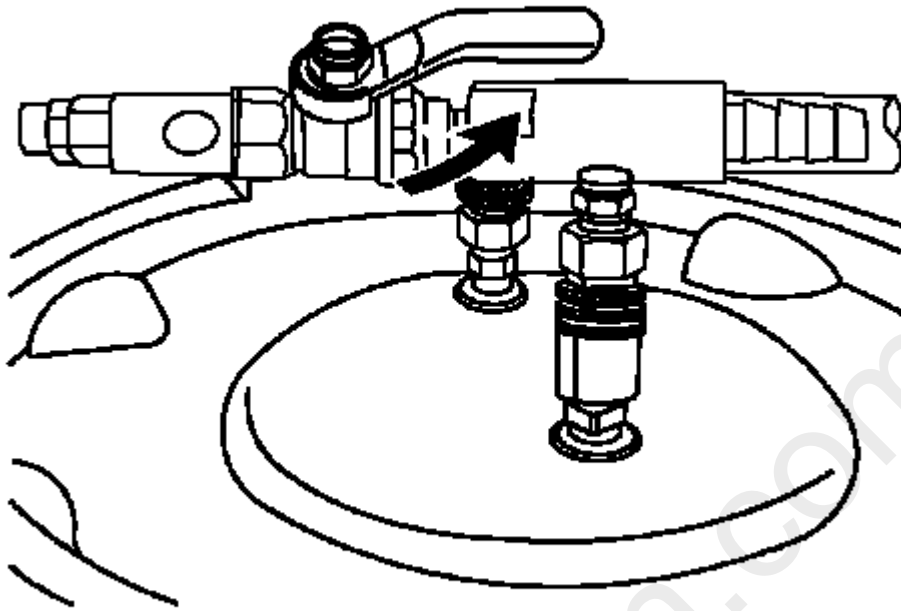


Fig. 38: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

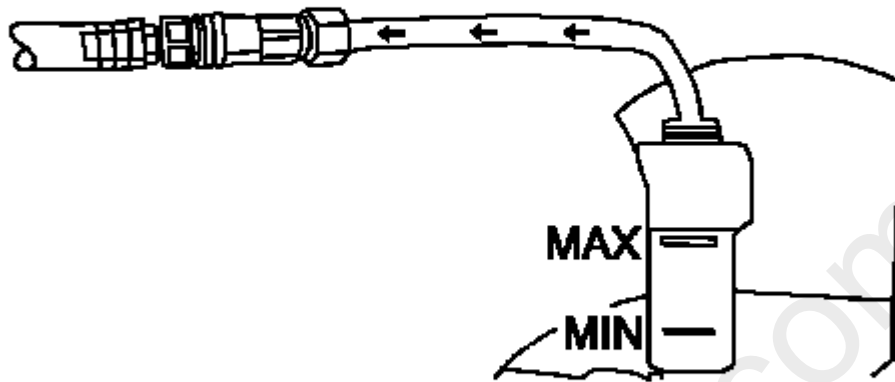


Fig. 39: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS COMPANY

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

CHARGE AIR COOLING SYSTEM COOLANT LEVEL INSPECTION

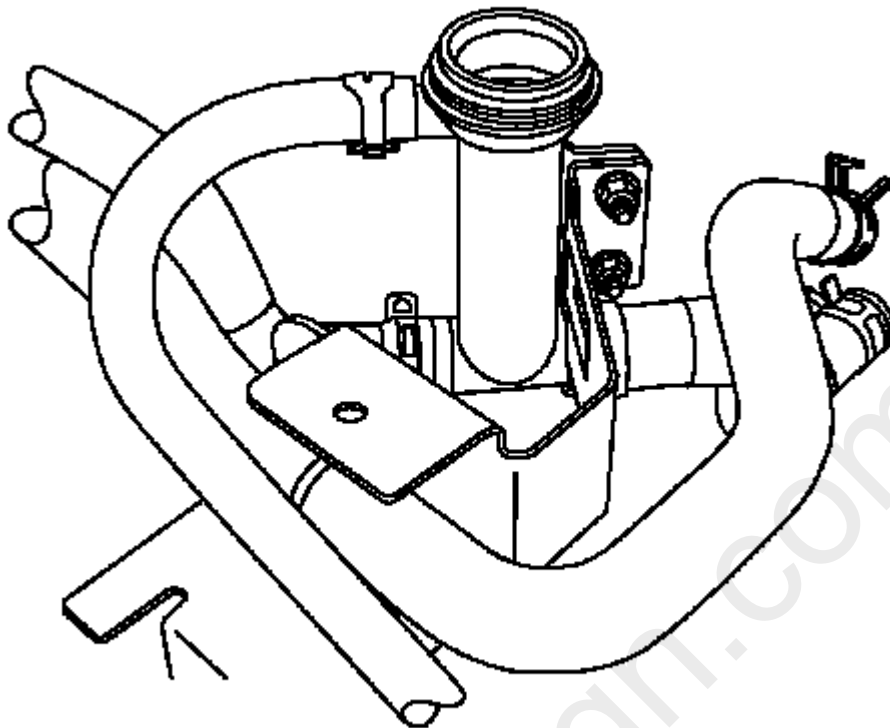


Fig. 40: View Of Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure the intercooler system is cool and the pump is not running

1. Remove the cap from the charge air cooler reservoir
2. Verify that the coolant is within the cold fill range on the charge air cooling system reservoir.

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

3. Add coolant as necessary to the fill neck and reservoir to bring the coolant level within the cold fill range.
4. Install the cap to the charge air cooler reservoir.

CHARGE AIR COOLING SYSTEM DRAINING AND FILLING (STATIC)

Special Tools

- **7000081** Tech 2 Kit
- **J 26568** Coolant and Battery Fluid Tester

Draining Procedure

WARNING: To avoid being burned, do not remove the charge air coolant cap while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

NOTE: Make sure the intercooler system is cool and the pump is not running.

1. Remove the cap from the charge air cooler reservoir.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
3. Remove the front air deflector. Refer to Front Air Deflector Replacement .
4. Place a drain pan under the charge air cooler radiator.

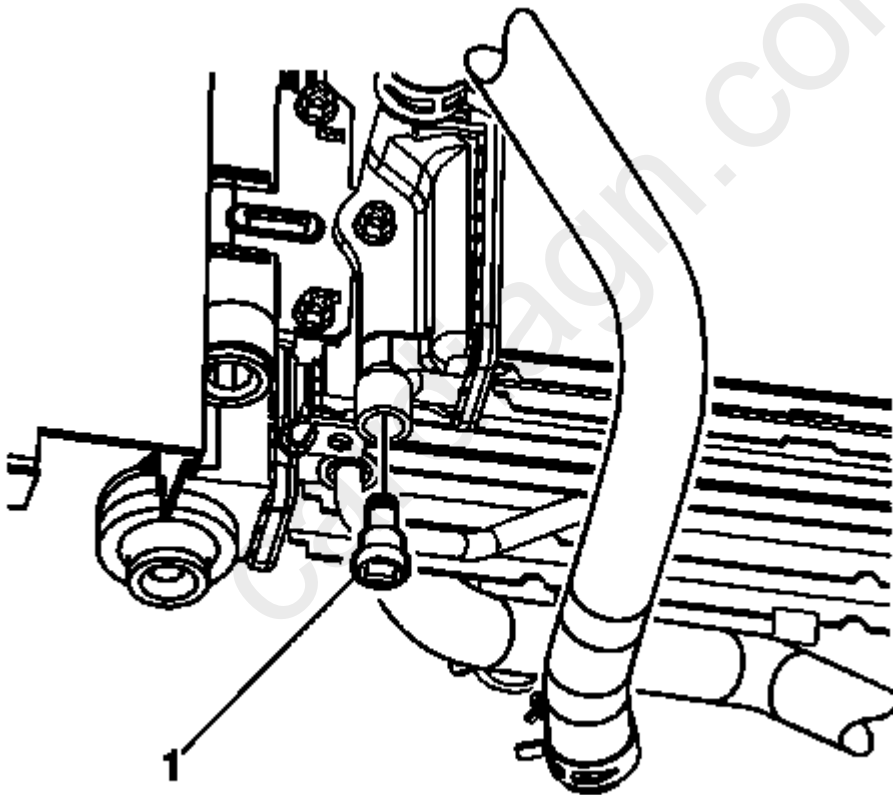


Fig. 41: Identifying Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS COMPANY

5. Remove the charge air cooler radiator drain plug (1) from the bottom passenger side of the charge air cooler.
6. Drain the charge air cooling system.

7. Inspect the coolant.
8. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance - follow the filling procedure
 - Discolored - follow the flush procedure. Refer to **Flushing (Powertrain), Flushing (Charge Air Cooling)**.

CAUTION: Refer to Fastener Caution .

9. Install the charge air cooler radiator drain plug (1) and tighten to 1.5 N.m (13 lb in).
10. Install the front air deflector. Refer to **Front Air Deflector Replacement** .
11. Lower the vehicle.

Filling Procedure

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

NOTE: The charge air cooling system is filled through the charge air cooler reservoir fill neck.

1. Remove the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement** .

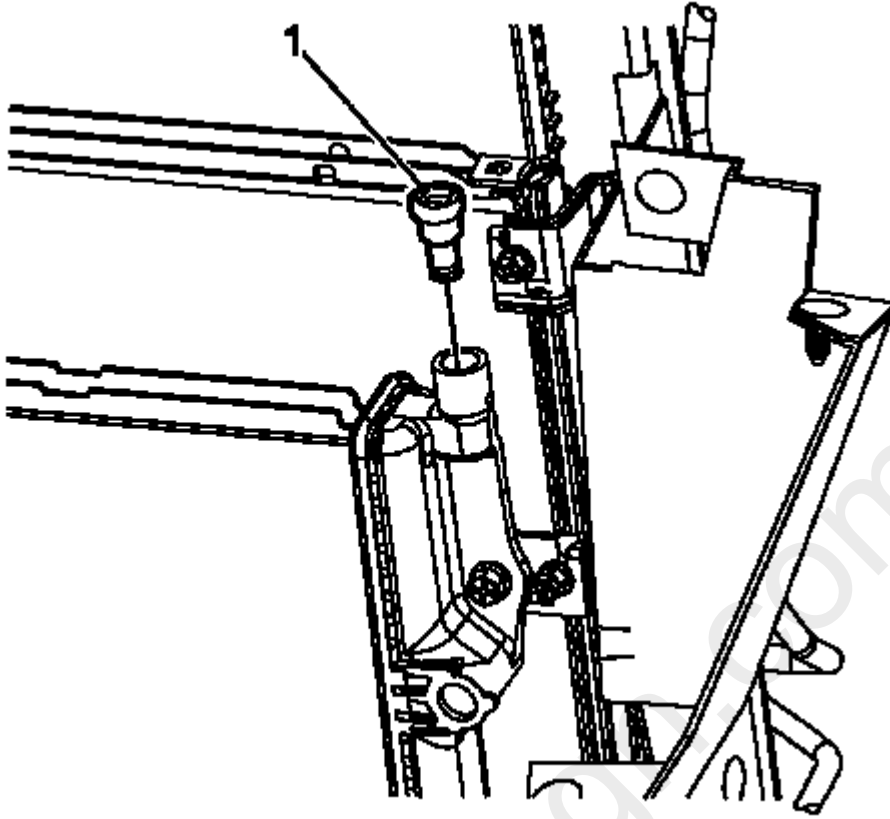


Fig. 42: Identifying Charge Air Cooler Bleeder Screw
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the bleeder screw (1) from the charge air cooler radiator on the top driver side of the charge air cooler.

NOTE: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water. It is necessary to maintain the coolant level within the cold fill level range on the charge air cooler reservoir to ensure all the air has been purged from the cooling system.

3. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean, drinkable water to the cooling system until the coolant level reaches the top of the charge air cooler radiator at the bleeder screw opening. Refer to **Approximate Fluid Capacities**.
4. Install the bleeder screw (1) and tighten to 1.5 N.m (13 lb in).

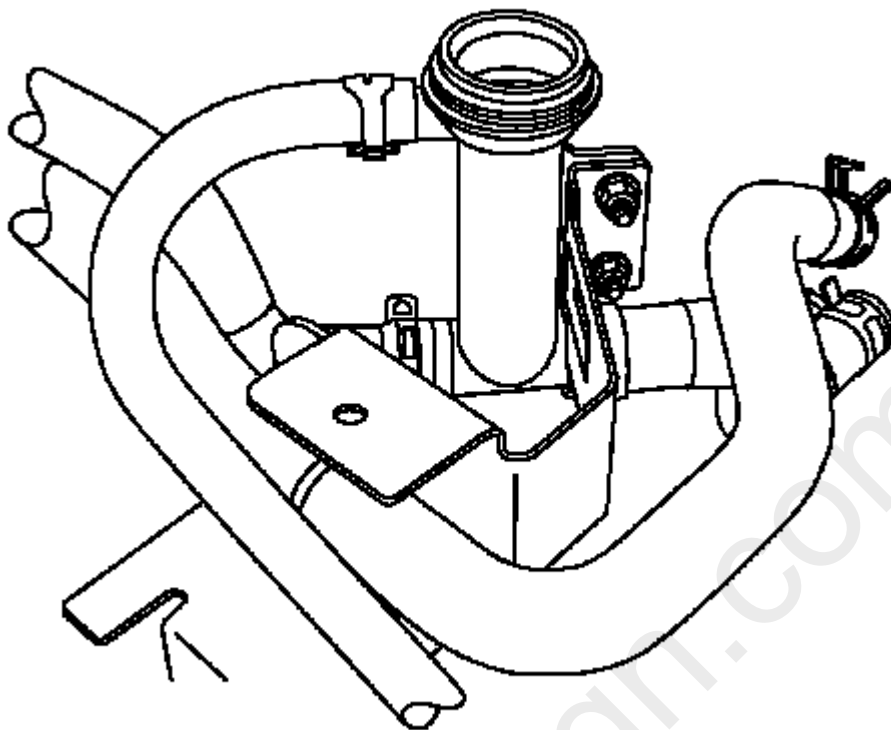


Fig. 43: View Of Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS COMPANY

5. Slowly add the coolant mixture to the charge air cooler reservoir until the coolant level is at the top of the cold fill level range on the reservoir.

NOTE: **Do not cycle the charge air coolant pump without the charge air cooling reservoir cap in place or loss of coolant will occur.**

6. Install the cap to the charge air cooler reservoir.
7. Using a Tech 2 Scan Tool, cycle the charge air coolant pump ON for 2 seconds.
8. Cycle the charge air coolant pump OFF.
9. Remove the charge air cooler reservoir cap, and wait for the air bubbles to travel up the charge air cooler reservoir hose to the reservoir.
10. Slowly add the coolant mixture to the charge air cooler reservoir until the coolant level is at the top of the cold fill level range on the reservoir.
11. Install the cap to the charge air cooler reservoir.
12. Repeat steps 7-11 until all of the air has been purged from the system and no air bubbles travel up the charge air cooler reservoir hose to the reservoir.
13. Install the charge air cooler reservoir cap and cycle the charge air coolant pump ON for 5 minutes.

14. Cycle the charge air coolant pump OFF.
15. Remove the charge air cooler reservoir cap and allow the vehicle to sit for 15 minutes.
16. Slowly add the coolant mixture to the charge air cooler reservoir until the coolant level is at the top of the cold fill level range on the reservoir.
17. Inspect the concentration of the charge air cooling system coolant using the **J 26568** Coolant and Battery Fluid Tester.
18. Install the charge air cooler reservoir cap.
19. Inspect the cooling system for leaks.
20. Install the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement** .
21. Rinse away any excess coolant from the engine and the engine compartment.

CHARGE AIR COOLING SYSTEM DRAINING AND FILLING (GE 47716)

Special Tools

- **GE-47716** Vac N Fill Coolant Refill Tool
- **J 26568** Coolant and Battery Fluid Tester
- **J 46143** Cooling System Adapter

Draining Procedure

WARNING: To avoid being burned, do not remove the charge air coolant cap while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

NOTE: Make sure the intercooler system is cool and the pump is not running.

1. Remove the cap from the charge air cooler reservoir.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .
4. Place a drain pan under the charge air cooler radiator.

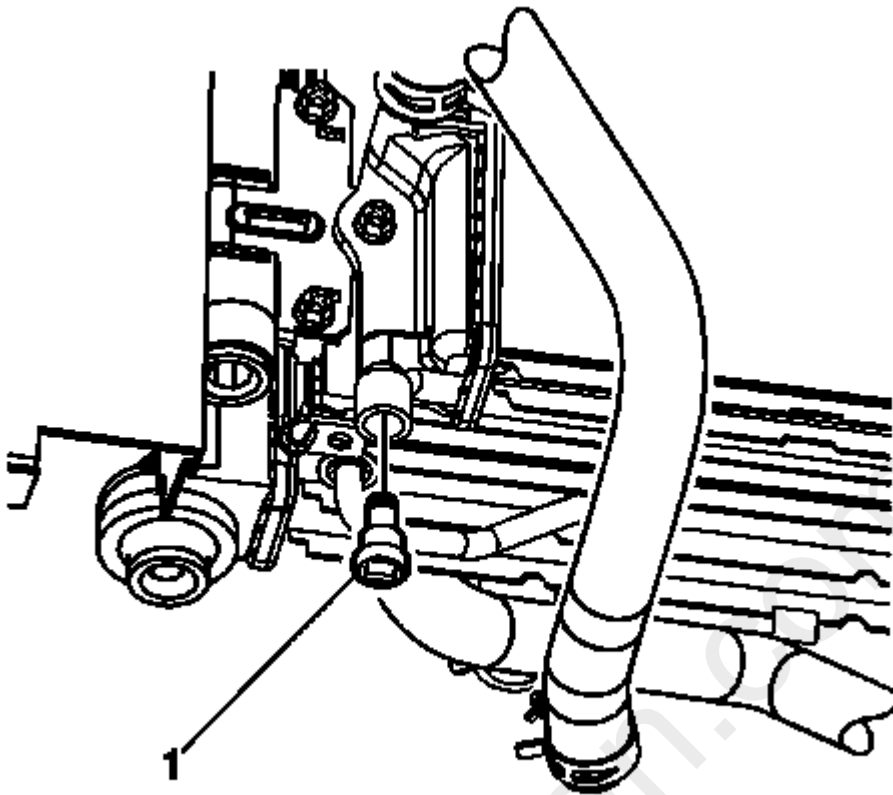


Fig. 44: Identifying Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS COMPANY

5. Remove the charge air cooler radiator drain plug (1) from the bottom passenger side of the charge air cooler.
6. Drain the charge air cooling system.
7. Inspect the coolant.
8. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance - follow the filling procedure
 - Discolored - follow the flush procedure. Refer to **Flushing (Powertrain)**, **Flushing (Charge Air Cooling)**.

CAUTION: Refer to Fastener Caution .

9. Install the charge air cooler radiator drain plug (1) and tighten to 1.5 N.m (13 lb in).
10. Install the front air deflector. Refer to **Front Air Deflector Replacement** .
11. Lower the vehicle.

Vac N Fill Procedure

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

1. Install the **J 46143** Cooling System Adapter onto the charge air cooler reservoir fill neck.

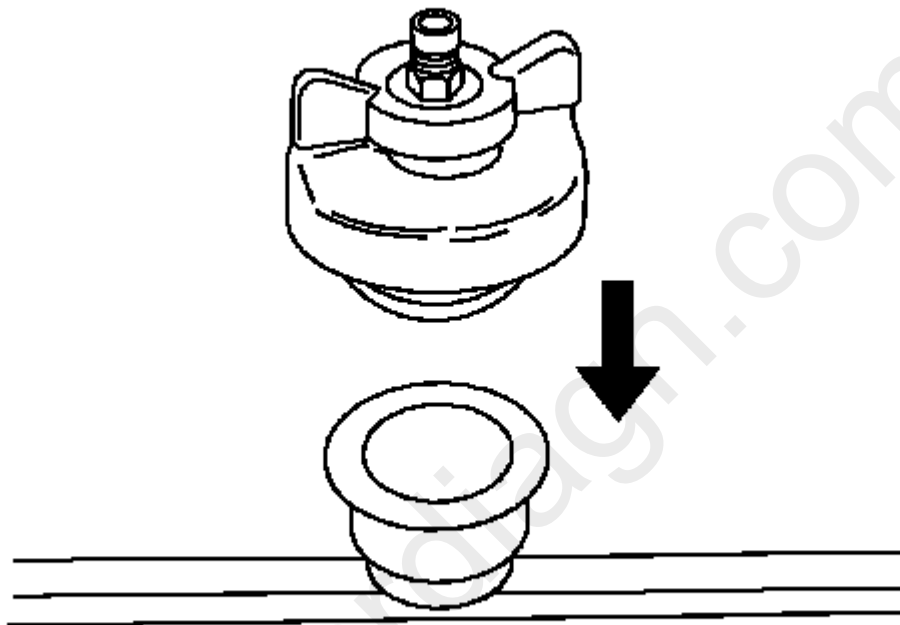


Fig. 45: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

WARNING: To avoid being burned, do not remove the charge air coolant cap while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

2. Attach the Vac N Fill cap to the **J 46143** Cooling System Adapter.

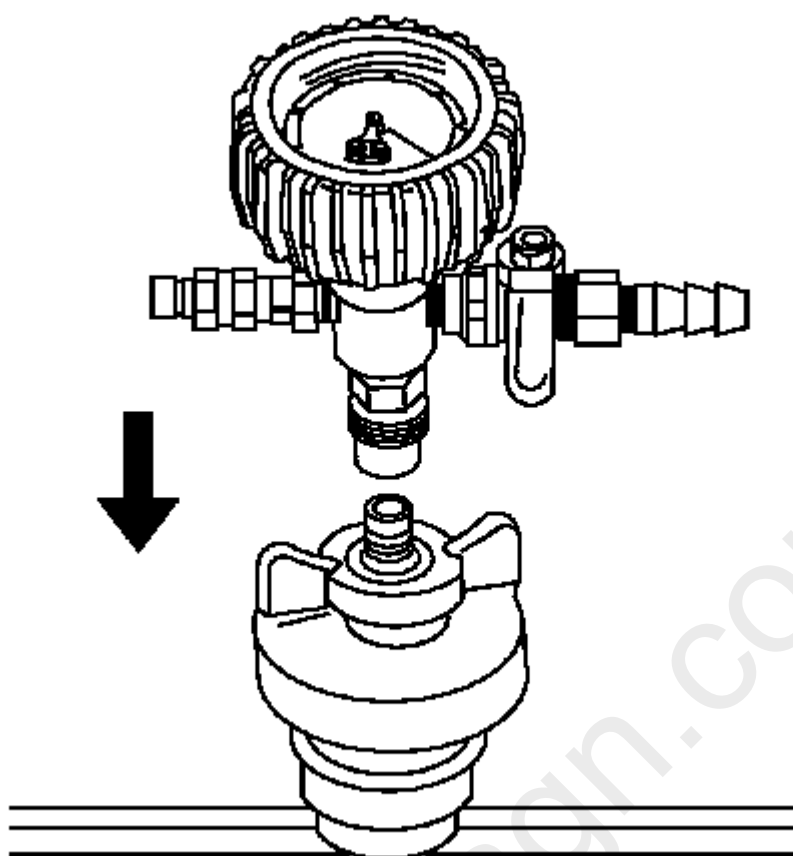


Fig. 46: Attaching The Vacuum Gage Assembly To The Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

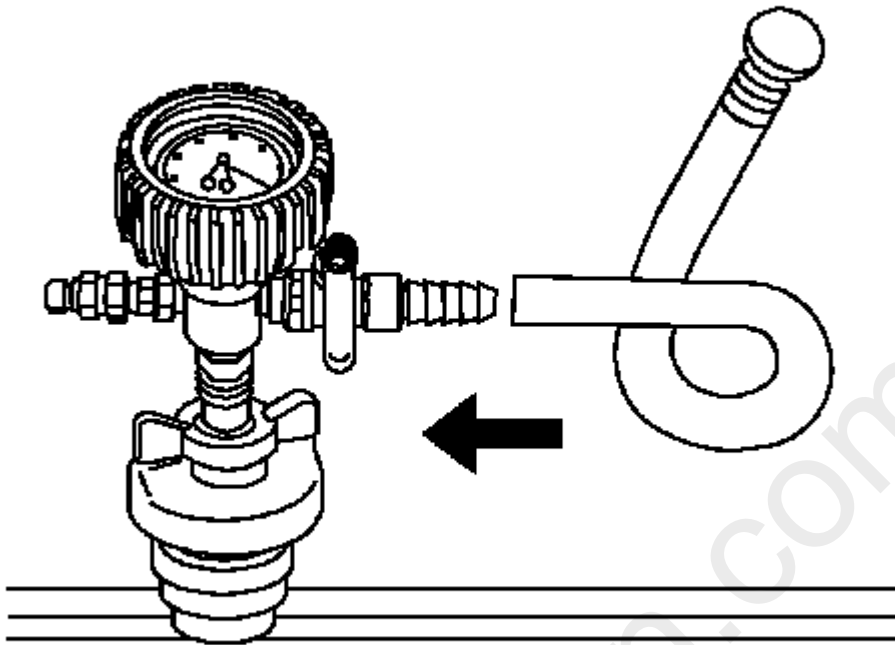


Fig. 47: Attaching Fill Hose To Barb Fitting On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure that the valve is closed.

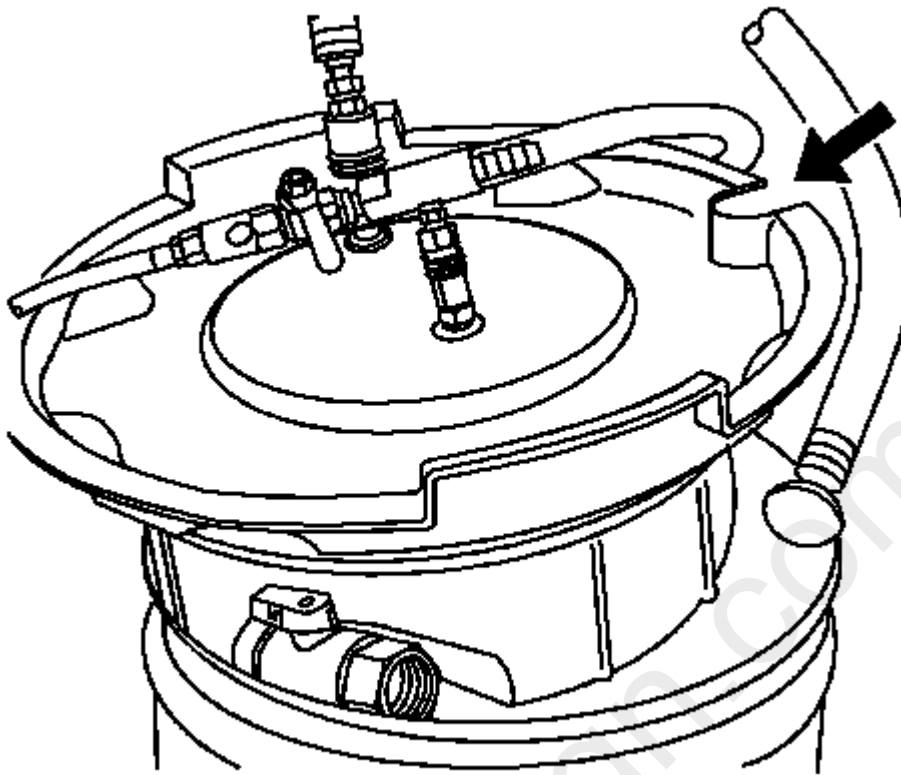


Fig. 48: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

NOTE:

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

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

NOTE:

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

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

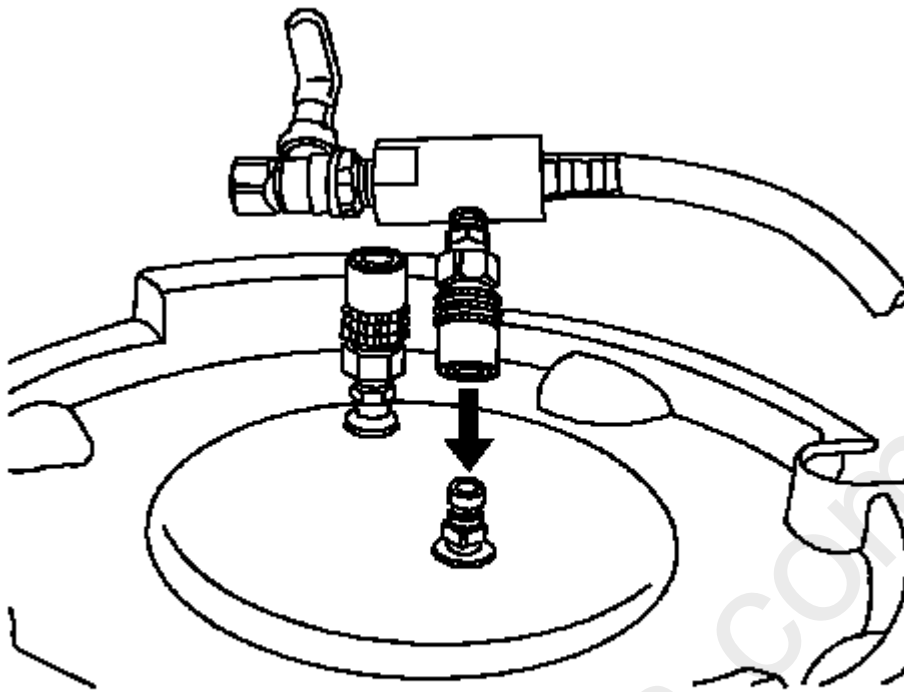


Fig. 49: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

8. Attach the venturi assembly to the vacuum tank.

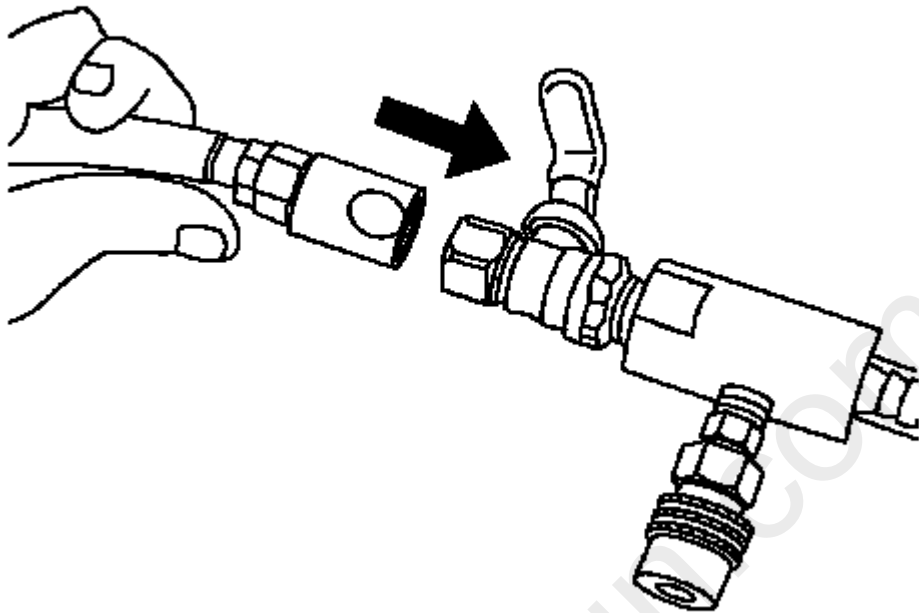


Fig. 50: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

Ensure the valve on the venturi assembly is closed.

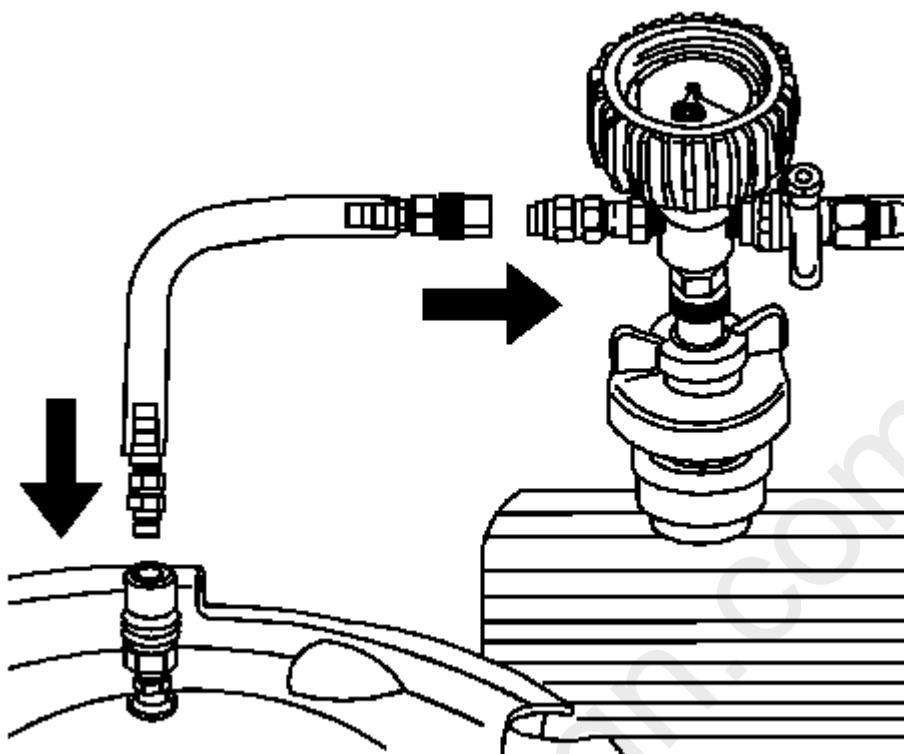


Fig. 51: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

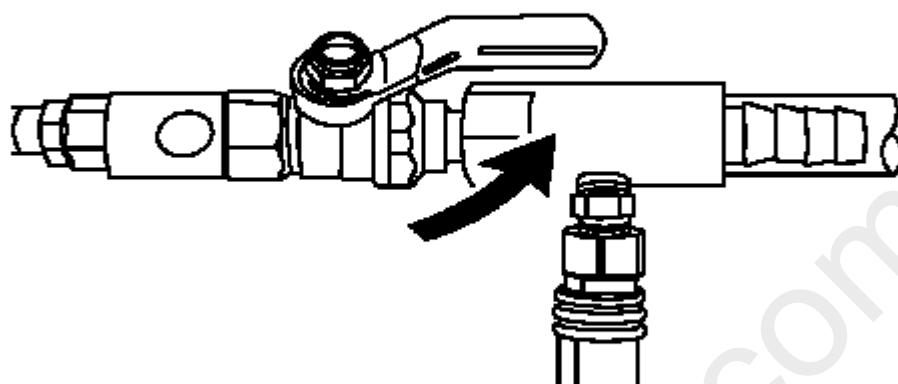


Fig. 52: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

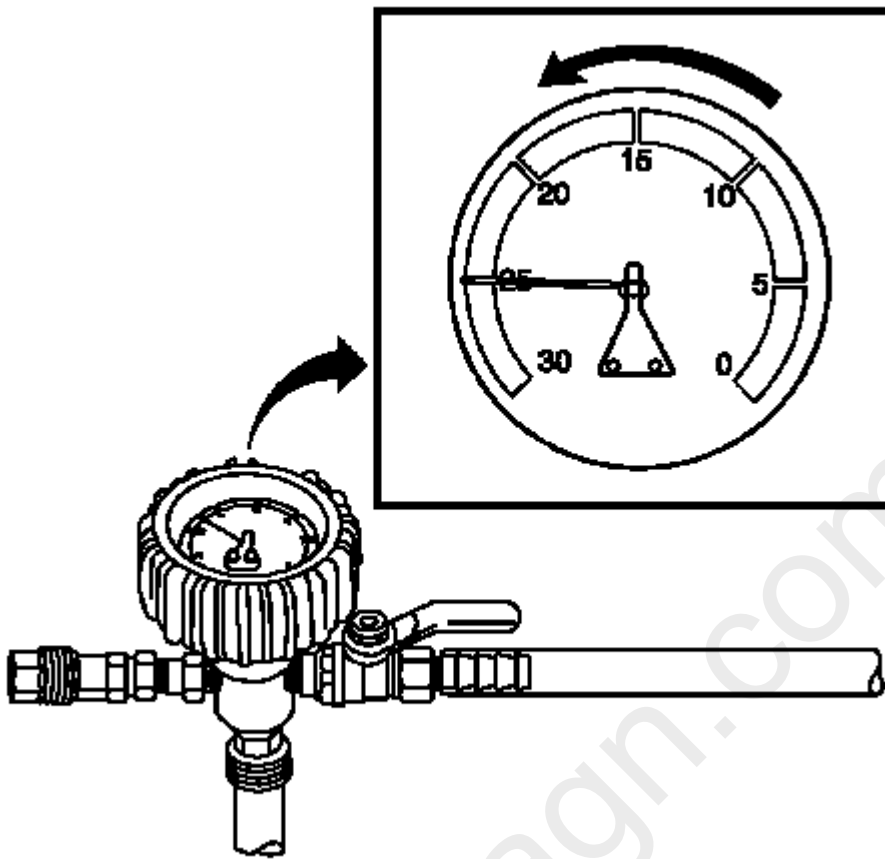


Fig. 53: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

12. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).
Cooling hoses may start to collapse. This is normal due to vacuum draw.
13. To aid in the fill process, position the graduated reservoir above the coolant fill port.

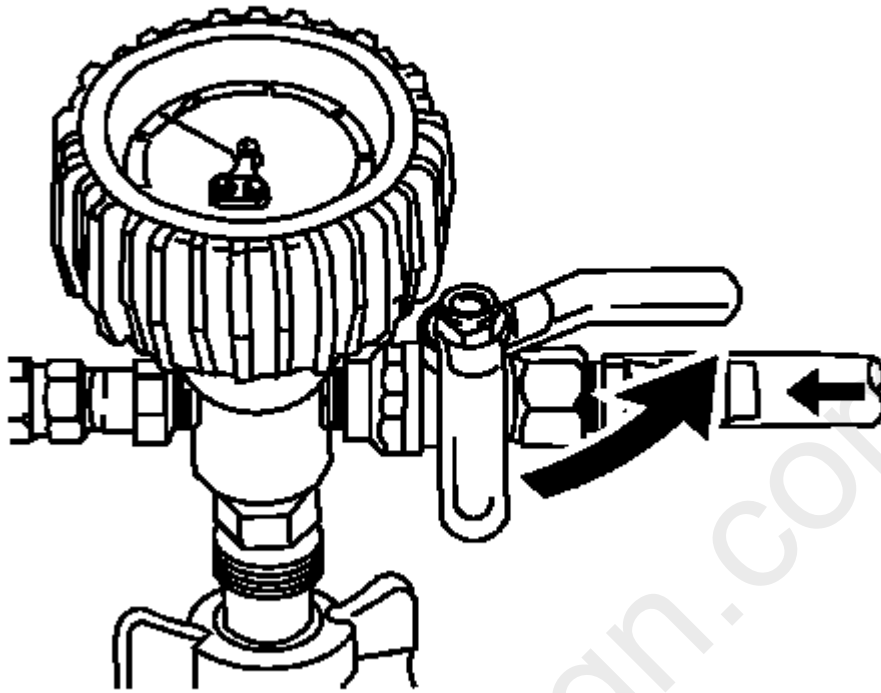


Fig. 54: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

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

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

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

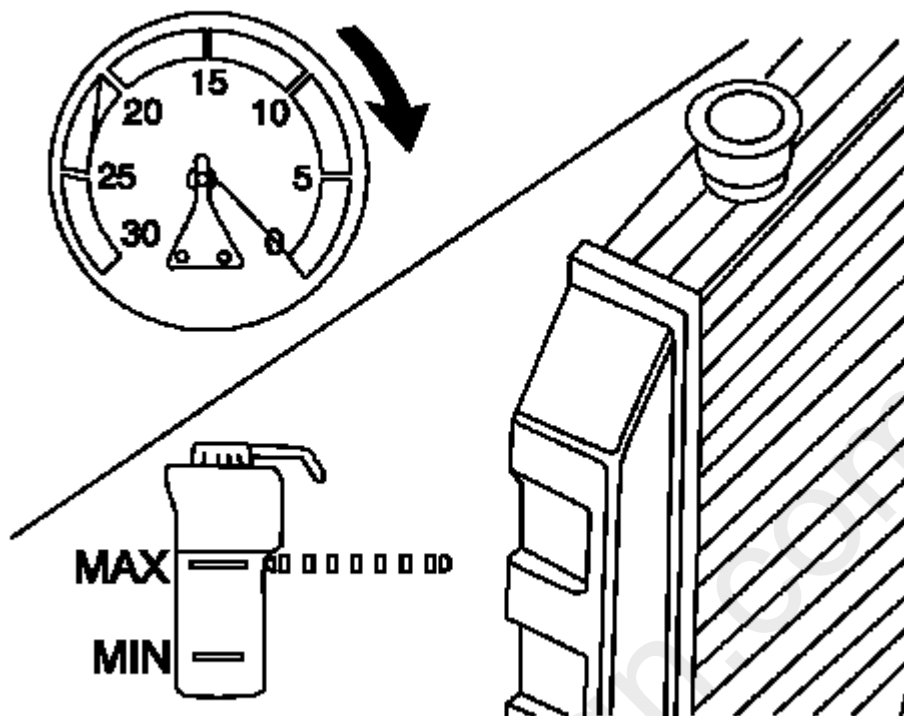


Fig. 55: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS COMPANY

18. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 11-17.
19. Detach the Vac N Fill cap from the **J 46143** Cooling System Adapter.
20. Remove the **J 46143** Cooling System Adapter from the coolant surge tank.
21. Add coolant to the system as necessary.
22. Inspect the concentration of the coolant mixture using **J 26568** Coolant and Battery Fluid Tester.

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

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

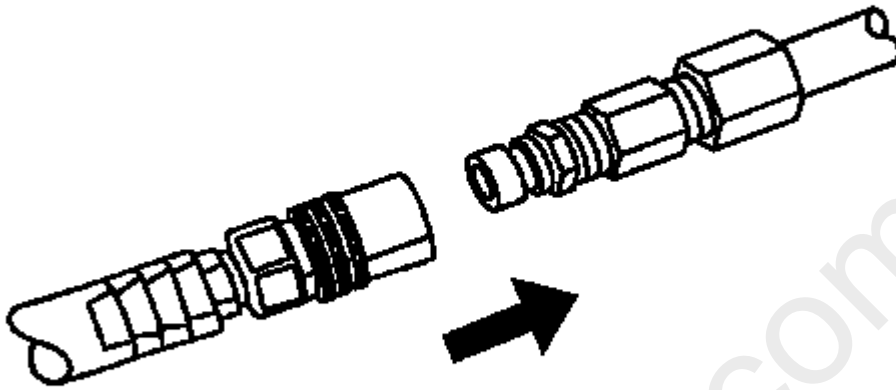


Fig. 56: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

24. Attach the extraction hose to the vacuum hose.

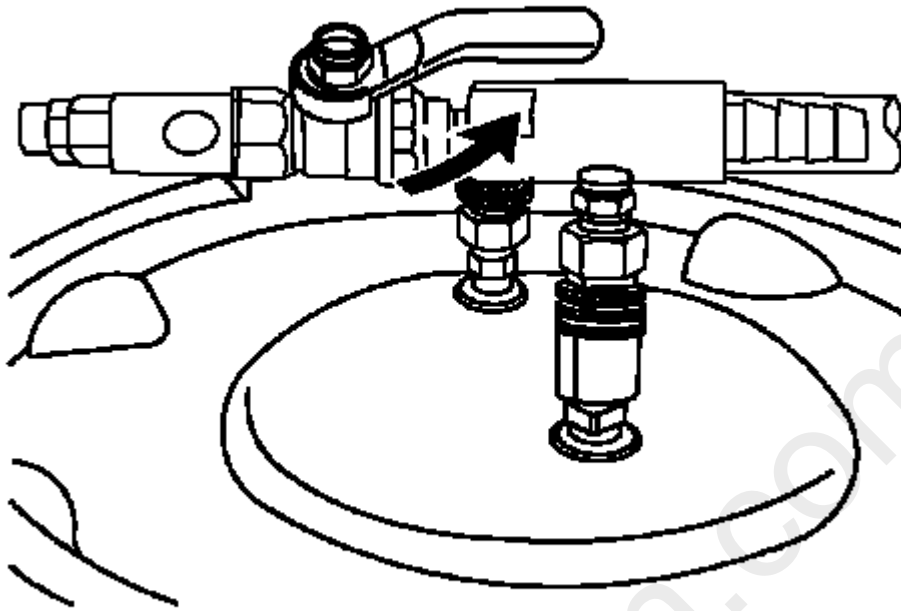


Fig. 57: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

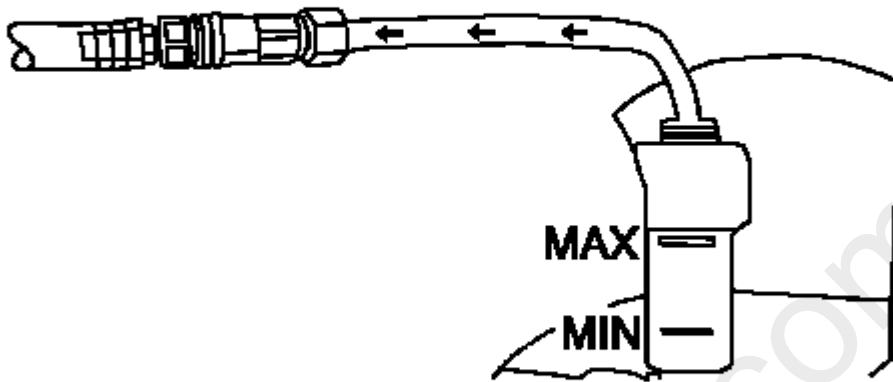


Fig. 58: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS COMPANY

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

FLUSHING (POWERTRAIN)

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 instruction. 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 using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LFW or LFX), Cooling System Draining and Filling (GE 47716 LSA).
7. Fill the coolant reservoir to the FULL COLD mark.
8. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LFW or LFX), Cooling System Draining and Filling (GE 47716 LSA).

FLUSHING (CHARGE AIR COOLING)

NOTE: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

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

1. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LFW or LFX), Cooling System Draining and Filling (GE 47716 LSA).
2. Fill the cooling system to specifications when flushing is complete. Refer to Charge Air Cooling System Draining and Filling (Static), Charge Air Cooling System Draining and Filling (GE 47716).

RADIATOR CLEANING

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

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

NOTE: Remove bugs, leaves, dirt and other debris by blowing compressed air

through the engine side of the radiator.

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

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

RADIATOR SURGE TANK REPLACEMENT

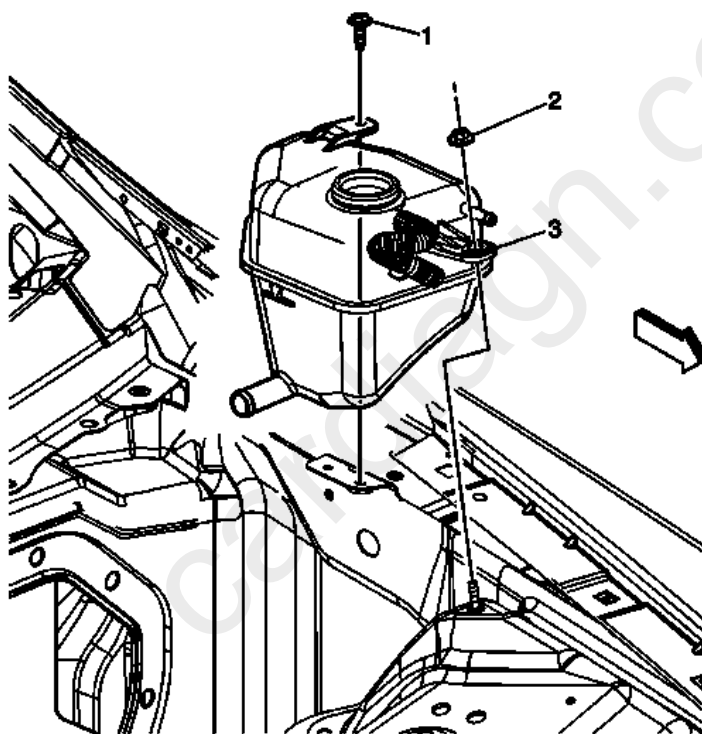


Fig. 59: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

Radiator Surge Tank Replacement

Callout	Component Name
Preliminary Procedures	
1.	Drain the coolant. Refer to <u>Cooling System Draining and Filling (Static Fill LFW or LFX)</u> , <u>Cooling System Draining and Filling (Static Fill LSA)</u> , <u>Cooling System Draining and Filling (GE 47716 LFW or LFX)</u> , <u>Cooling System Draining and Filling (GE 47716 LSA)</u> .

2. Remove the surge tank inlet hose. Refer to **Radiator Surge Tank Inlet Hose/Pipe Replacement (LSA), Radiator Surge Tank Inlet Hose/Pipe Replacement (LFX or LFW).**
3. Remove the surge tank engine hose. Refer to **Radiator Surge Tank Engine Hose Replacement (LFW or LFX), Radiator Surge Tank Engine Hose Replacement (LSA).**

1	Surge Tank Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Surge Tank Nut Tighten 9 N.m (80 lb in)
3	Surge Tank

CHARGE AIR COOLER COOLANT PIPE REPLACEMENT

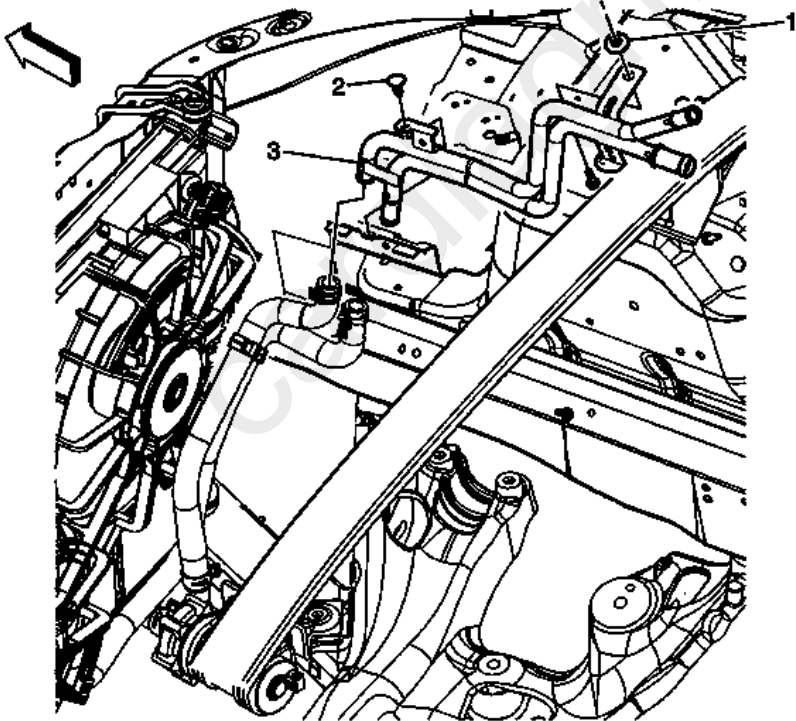


Fig. 60: Identifying Charge Air Cooler Coolant Pipe
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Pipe Replacement

Callout	Component Name

Preliminary Procedures

1. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Remove the charge air cooler hose pipe to pump. Refer to **Charge Air Cooler Coolant Hose Replacement - Pipe to Pump**.
3. Remove the charge air cooler hose radiator to pipe. Refer to **Charge Air Cooler Coolant Hose Replacement - Radiator to Pipe**.
4. Remove the charge air cooler hose pipe to reservoir. Refer to **Charge Air Cooler Coolant Hose Replacement - Reservoir to Pipe**.
5. Remove the charge air cooler hose pipe to engine. Refer to **Charge Air Cooler Coolant Hose Replacement - Engine to Pipe**.

1	Charge Air Cooler Pipe Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler Pipe Retainer
3	Charge Air Cooler Pipe Assembly

CHARGE AIR COOLER COOLANT RESERVOIR REPLACEMENT

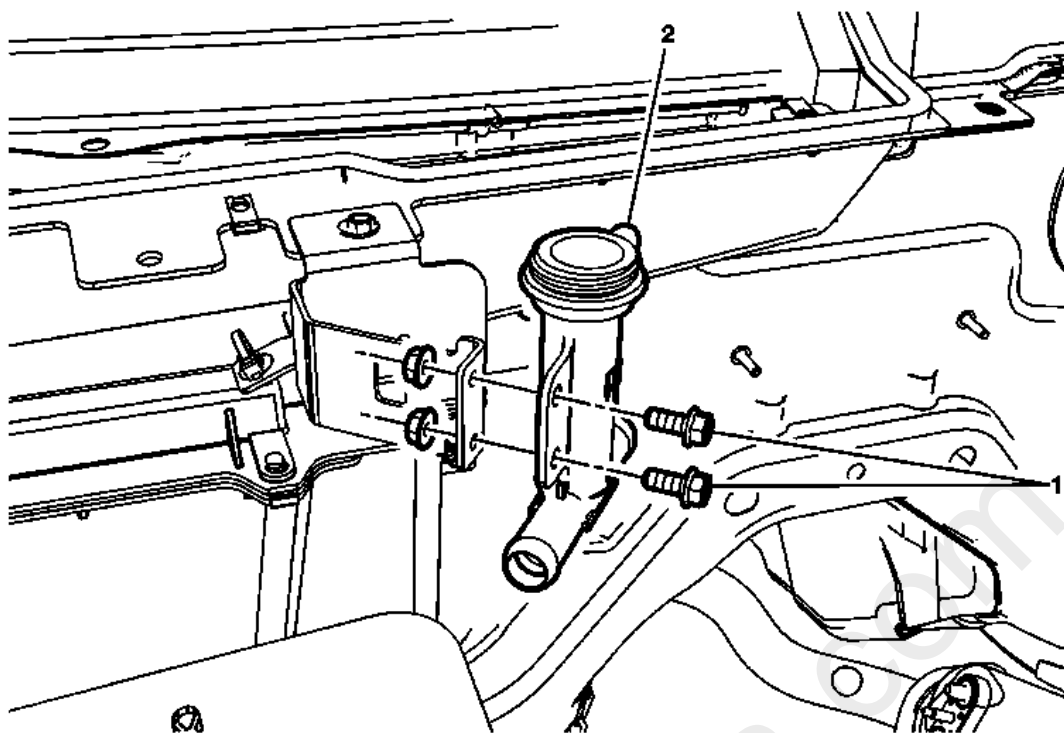


Fig. 61: Charge Air Cooler Coolant Reservoir & Fasteners
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Reservoir Replacement

Callout	Component Name
Preliminary Procedures 1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u>, <u>Charge Air Cooling System Draining and Filling (GE 47716)</u>. 2. Remove the charge air cooler coolant hose reservoir to pipe. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Reservoir to Pipe</u>. 3. Remove the charge air cooler coolant hose reservoir to engine. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Engine to Reservoir</u>. 4. Remove the air inlet grille panel. Refer to <u>Air Inlet Grille Panel Replacement</u>	
1	Charge Air Cooler Coolant Reservoir Fasteners (Qty 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler Coolant Reservoir TIP: Unclip hoses from bracket.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RESERVOIR TO PIPE

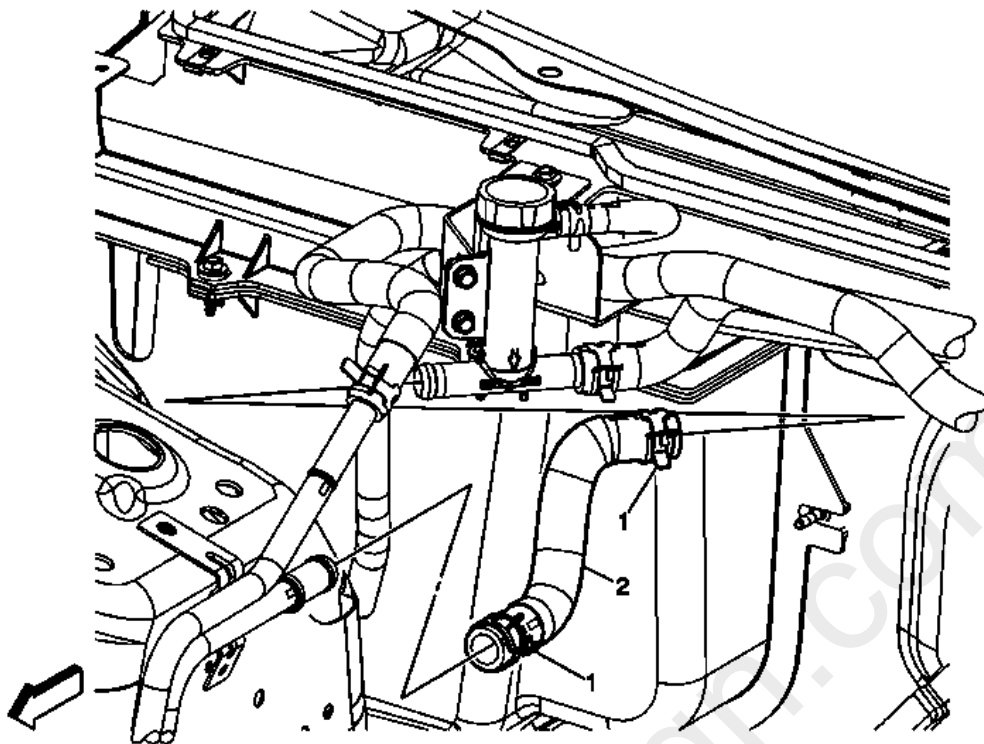


Fig. 62: Identifying Charge Air Cooler Coolant Hose - Reservoir to Pipe
Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Hose Replacement - Reservoir to Pipe

Callout	Component Name
Preliminary Procedures	
1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static), Charge Air Cooling System Draining and Filling (GE 47716)</u> .	
2. Remove the rear intake manifold cover. Refer <u>Intake Manifold Cover Replacement - Rear</u> .	
3. Remove the side compartment sight shield.	
1	Charge Air Cooler Hose Clamp (Qty: 2)
2	Charge Air Cooler Hose

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - PIPE TO PUMP

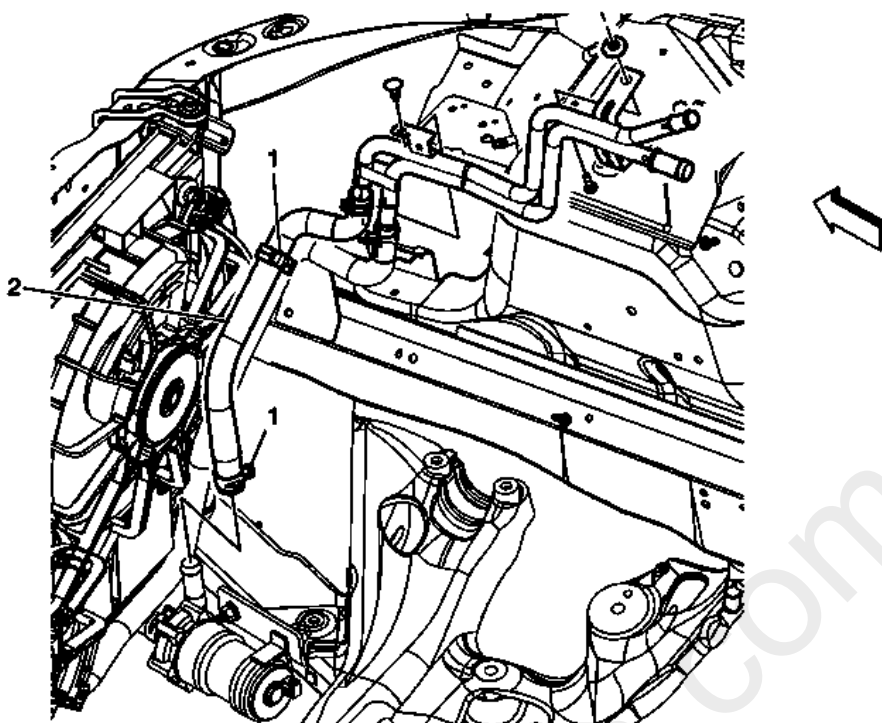


Fig. 63: Identifying Charge Air Cooler Coolant Hose - Pipe To Pump
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Hose Replacement - Pipe to Pump

Callout	Component Name
Preliminary Procedures	
1.	Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> , <u>Charge Air Cooling System Draining and Filling (GE 47716)</u> .
2.	Remove the right side compartment sight shield.
3.	Remove the front air deflector. Refer to <u>Front Air Deflector Replacement</u> .
1	Charge Air Cooler Hose Clamp (Qty: 2)
2	Charge Air Cooler Hose

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - ENGINE TO PIPE

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (Static), Charge Air Cooling System Draining and Filling (GE 47716).
2. Remove the rear intake manifold cover. Refer to Intake Manifold Cover Replacement - Rear

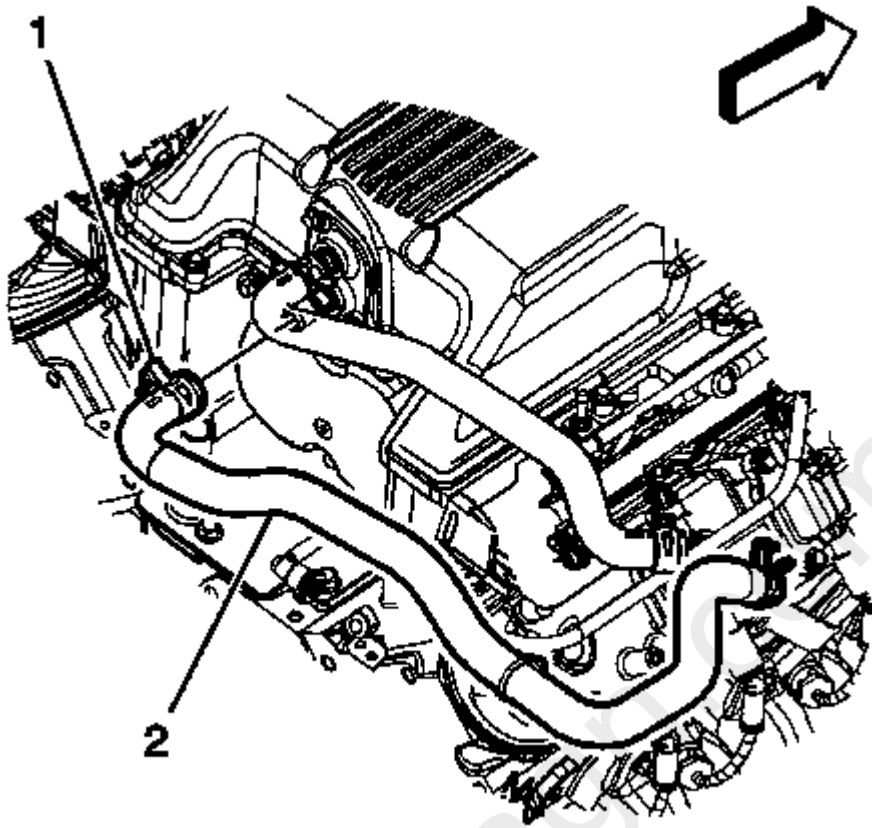


Fig. 64: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

3. Reposition the charge air cooler hose clamp (1) at engine using J 38185 Hose Clamp Pliers.
4. Remove the charge air cooler hose (2) from the engine.

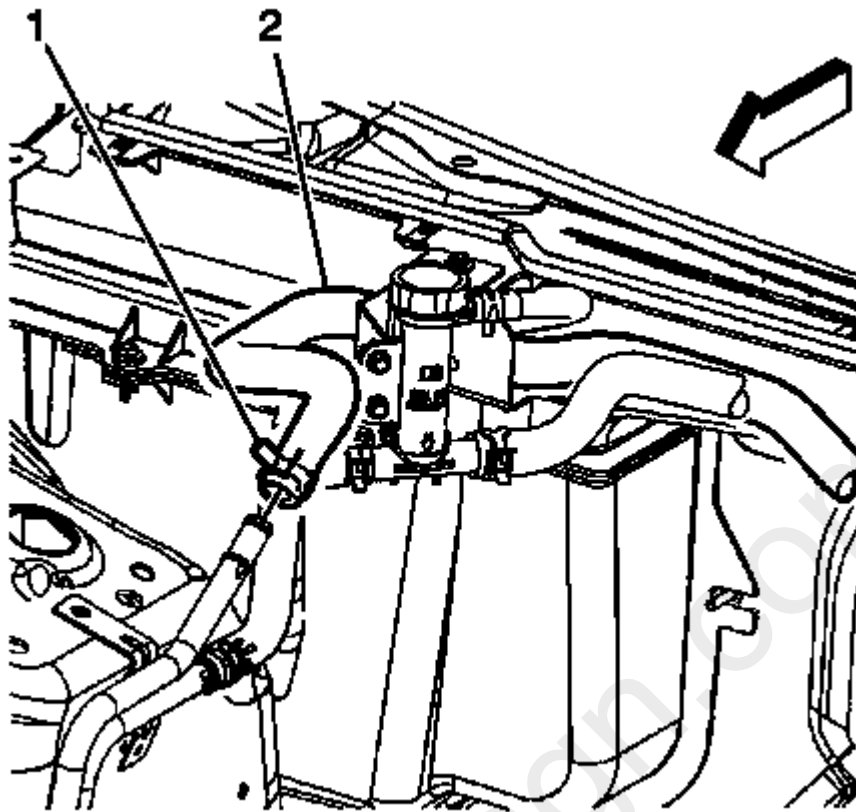


Fig. 65: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Pipe
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the charge air cooler hose clamp (1) at charge air cooler pipe using J 38185 Hose Clamp Pliers.
6. Remove the charge air cooler hose (2) from the charge air cooler pipe.
7. Unclip hose from bracket.
8. Remove the charge air cooler hose from the vehicle.

Installation Procedure

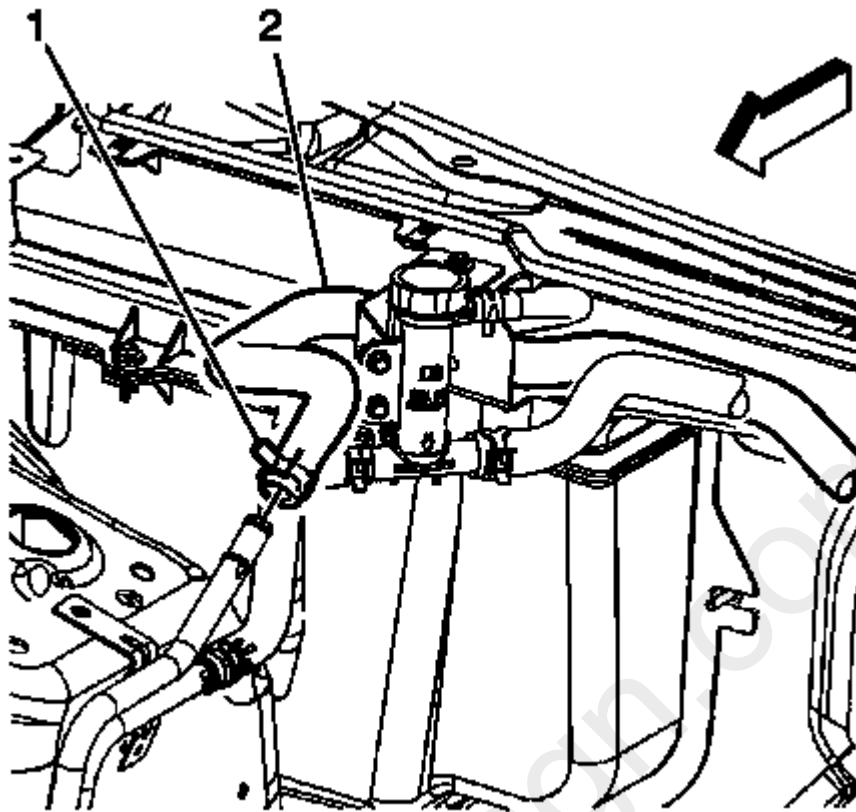


Fig. 66: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Pipe
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air cooler hose to the vehicle.
2. Clip hose from bracket.
3. Install the charge air cooler hose (2) to the charge air cooler pipe.
4. Reposition the charge air cooler hose clamp (1) at the charge air cooler pipe using **J 38185** Hose Clamp Pliers.

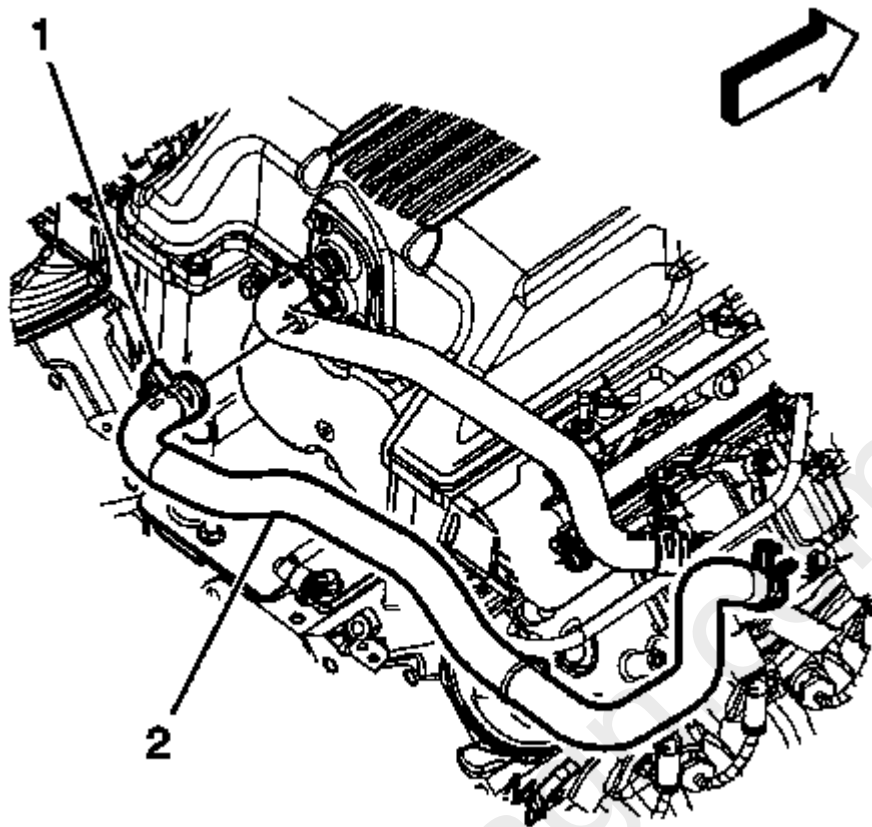


Fig. 67: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

5. Install the charge air cooler hose (2) to engine.
6. Reposition the charge air cooler hose clamp (1) at engine using **J 38185** Hose Clamp Pliers.
7. Install the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear**
8. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - ENGINE TO RESERVOIR

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Remove the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear**

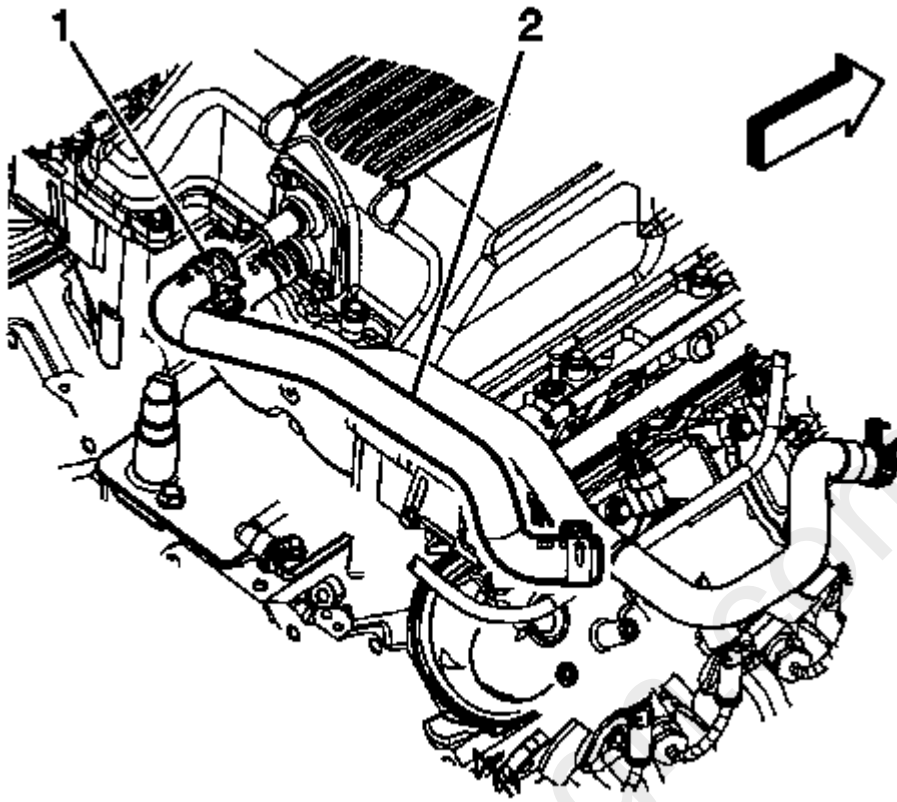


Fig. 68: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

3. Reposition the charge air cooler hose clamp (1) at engine using J 38185 Hose Clamp Pliers.
4. Remove the charge air cooler hose (2) from the engine.

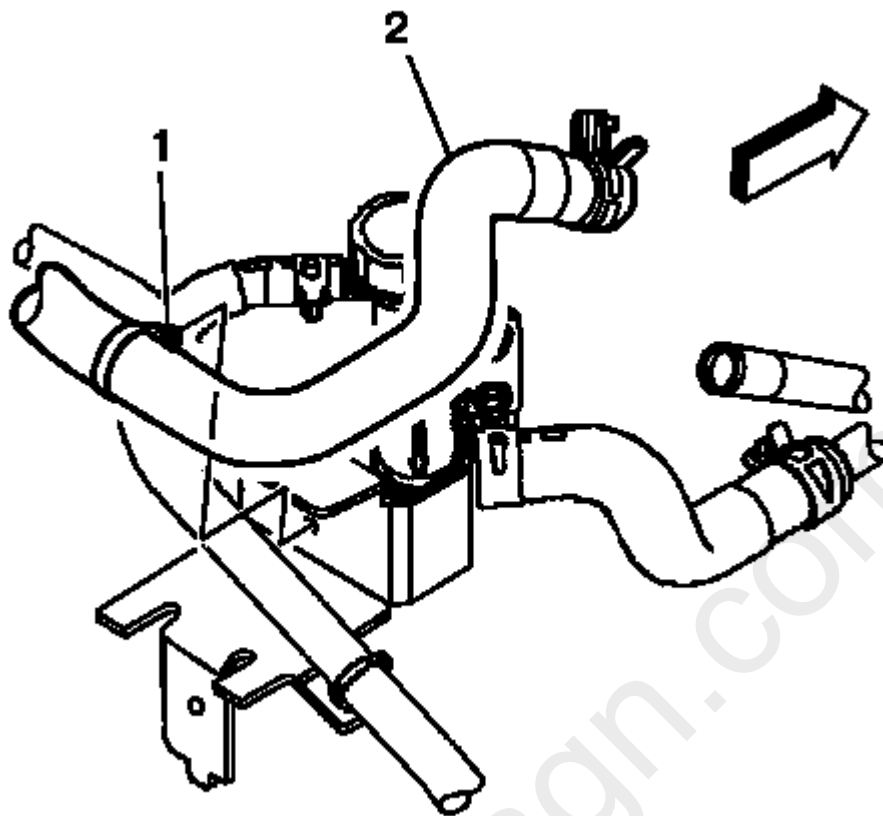


Fig. 69: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the charge air cooler hose clamp (1) at charge air cooler reservoir using J 38185 Hose Clamp Pliers.
6. Remove the charge air cooler hose (2) from the charge air cooler reservoir.
7. Remove the charge air cooler hose from the vehicle.

Installation Procedure

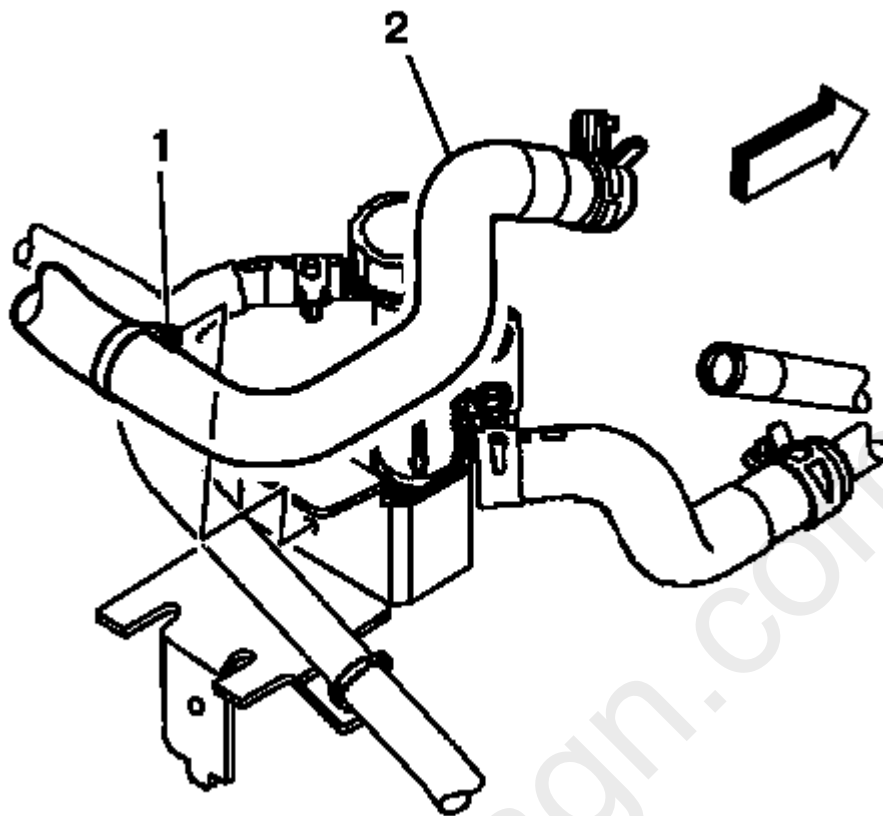


Fig. 70: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air cooler hose to the vehicle.
2. Install the charge air cooler hose (2) to the charge air cooler reservoir.
3. Reposition the charge air cooler hose clamp (1) at the charge air cooler reservoir using **J 38185** Hose Clamp Pliers.

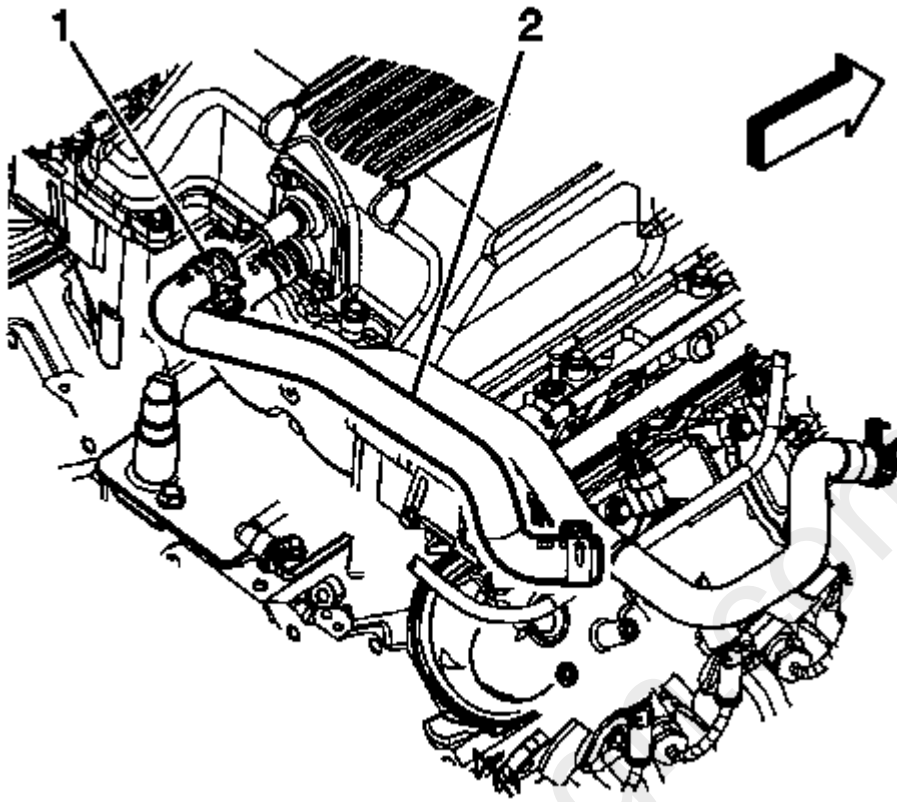


Fig. 71: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

4. Install the charge air cooler hose (2) to engine.
5. Reposition the charge air cooler hose clamp (1) at engine using **J 38185** Hose Clamp Pliers.
6. Install the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear**
7. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RADIATOR TO PIPE

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
3. Remove the front air deflector. Refer to **Front Air Deflector Replacement**

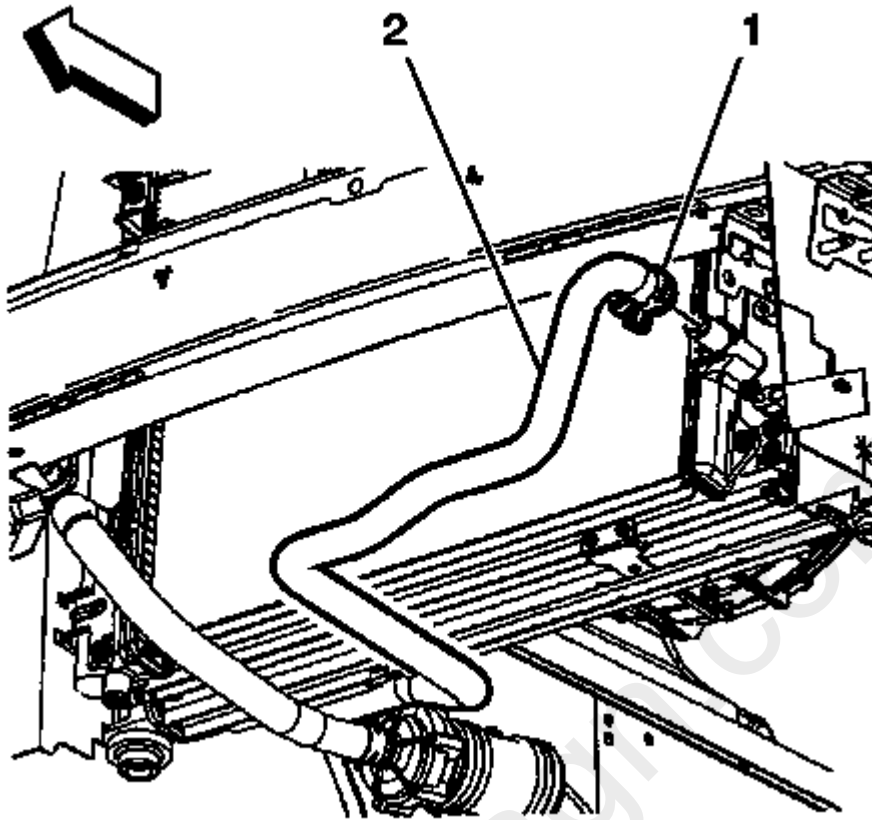


Fig. 72: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

4. Reposition the charge air cooler hose clamp (1) at the charge air cooler using **J 38185** Hose Clamp Pliers.
5. Remove the charge air cooler hose (2) from the charge air cooler.
6. Lower vehicle.
7. Remove right side compartment sight shield.

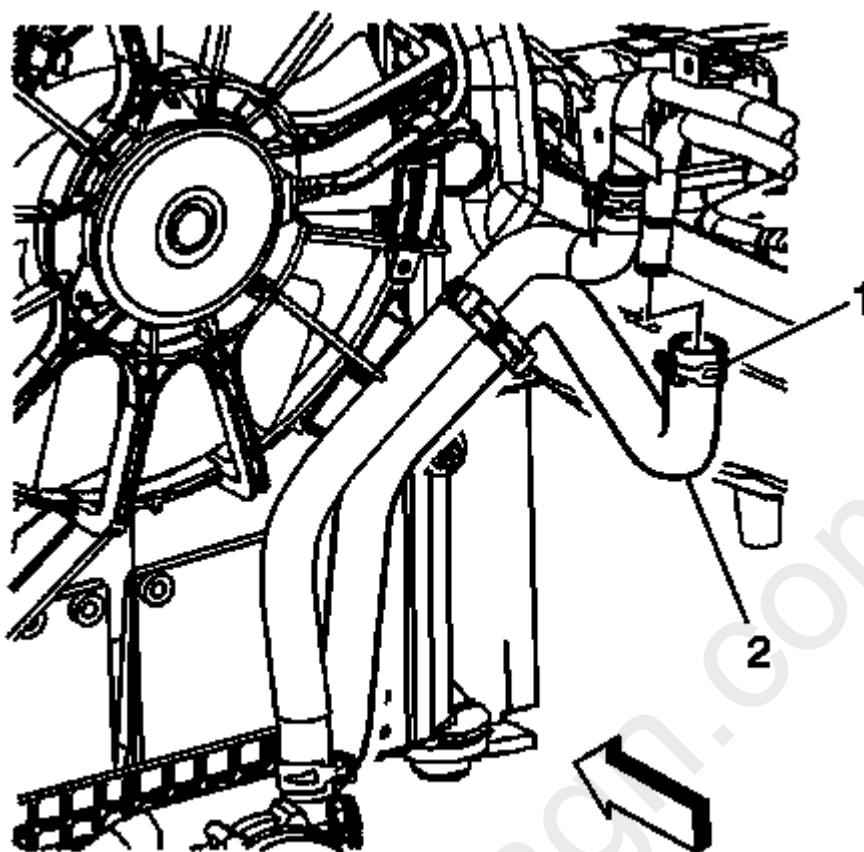


Fig. 73: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler Pipe Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Reposition the charge air cooler hose clamp (1) at charge air cooler pipe assembly using J 38185 Hose Clamp Pliers.
9. Remove the charge air cooler hose (2) from the charge air cooler pipe assembly.
10. Unclip charge air cooler hose and remove from vehicle.

Installation Procedure

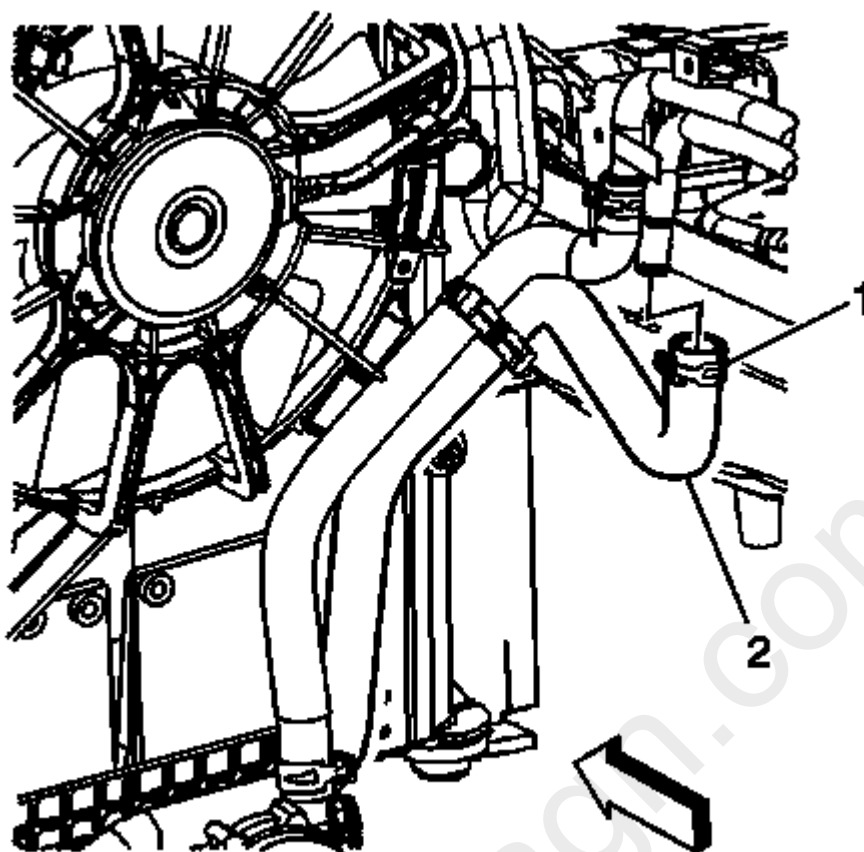


Fig. 74: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler Pipe Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air cooler hose to the vehicle and clip to hose.
2. Install the charge air cooler hose (2) to the charge air cooler pipe assembly.
3. Reposition the charge air cooler hose clamp (1) at the charge air cooler pipe assembly using **J 38185** Hose Clamp Pliers.
4. Install right side compartment sight shield.

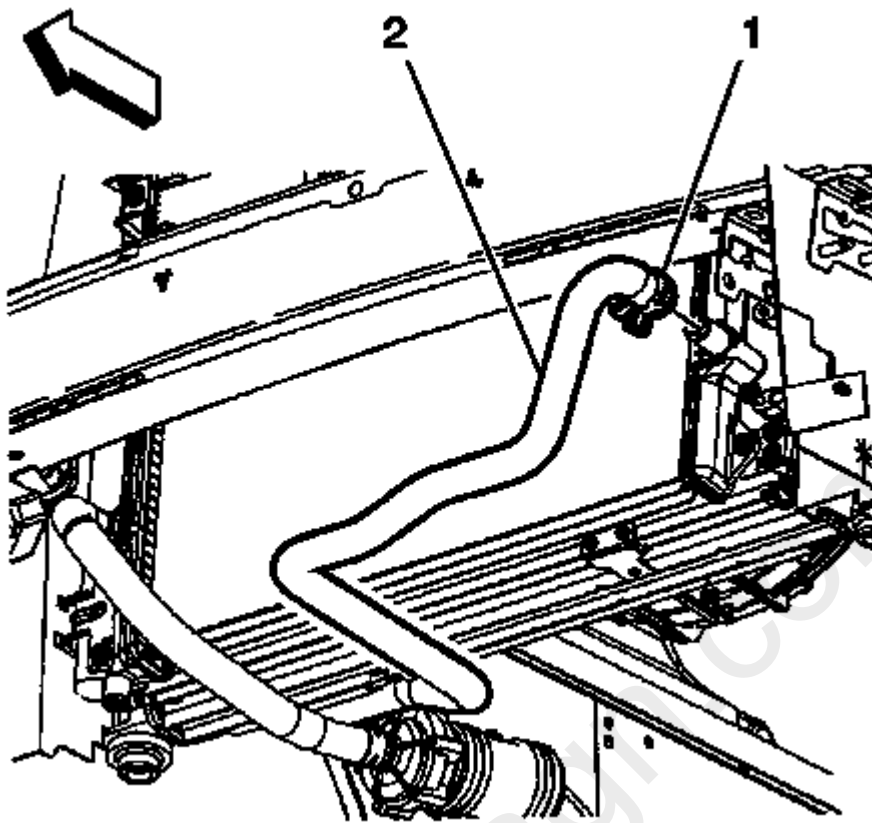


Fig. 75: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler
Courtesy of GENERAL MOTORS COMPANY

5. Install the charge air cooler hose (2) to the charge air cooler.
6. Reposition the charge air cooler hose clamp (1) at the charge air cooler using **J 38185** Hose Clamp Pliers.
7. Install the front air deflector. Refer to **Front Air Deflector Replacement**
8. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
9. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RADIATOR TO PUMP

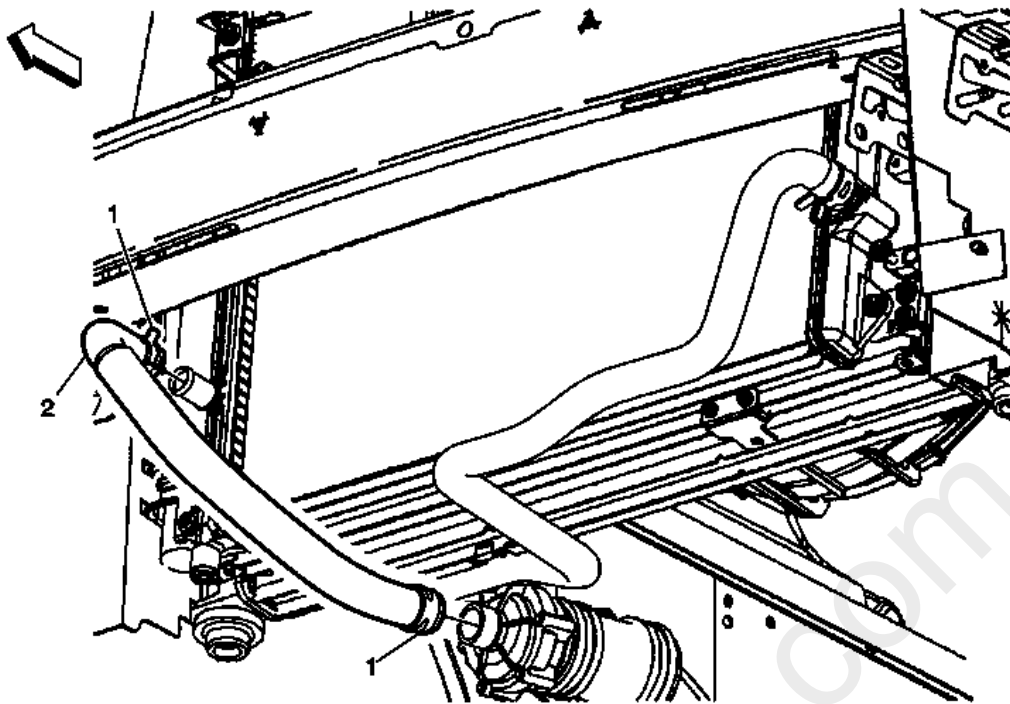


Fig. 76: Identifying Charge Air Cooler Coolant Hose - Radiator To Pump
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Hose Replacement - Radiator to Pump

Callout	Component Name
Preliminary Procedures	
1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> , <u>Charge Air Cooling System Draining and Filling (GE 47716)</u> .	
2. Remove the front air deflector. Refer to <u>Front Air Deflector Replacement</u> .	
1	Charge Air Cooler Hose Clamp (Qty: 2)
2	Charge Air Cooler Hose

RADIATOR SURGE TANK INLET HOSE/PIPE REPLACEMENT (LSA)

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LSA).
2. Remove the front compartment sight shield. Refer to Front Compartment Sight Shields Replacement
3. Remove the front compartment side sight shield. Refer to Front Compartment Side Sight Shield

Replacement

4. Remove the intake manifold cover front. Refer to **Intake Manifold Cover Replacement - Front**
5. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**

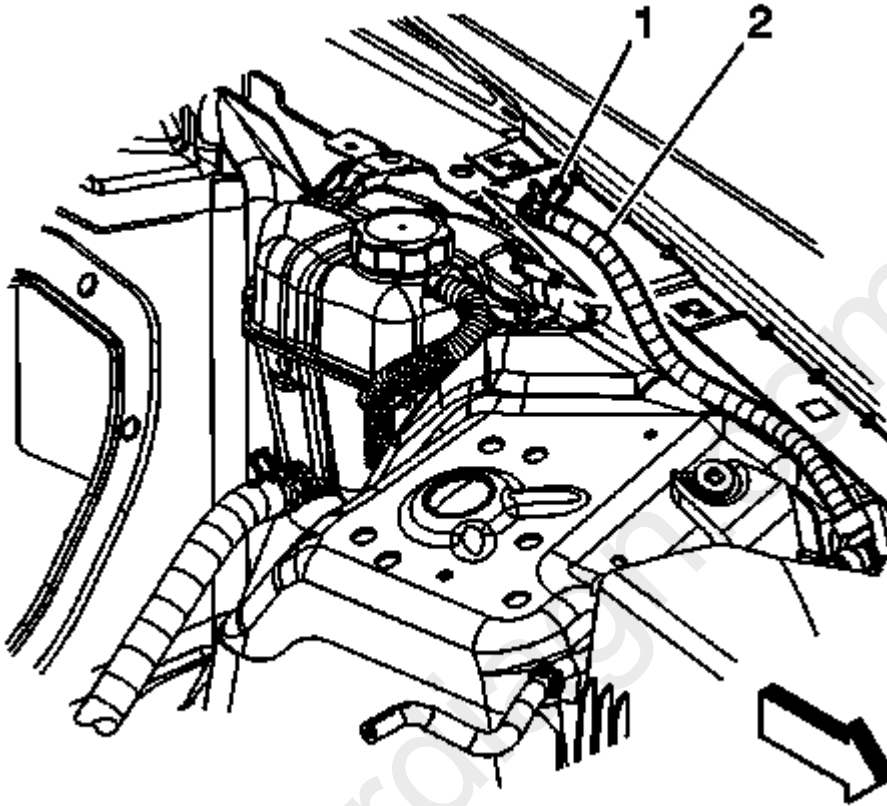


Fig. 77: Identifying Surge Tank Inlet Hose & Clamp At Surge Tank
Courtesy of GENERAL MOTORS COMPANY

6. Reposition the surge tank inlet hose clamp (1) at surge tank using **J 38185** Hose Clamp Pliers.
7. Remove the surge tank inlet hose (2) from the surge tank.

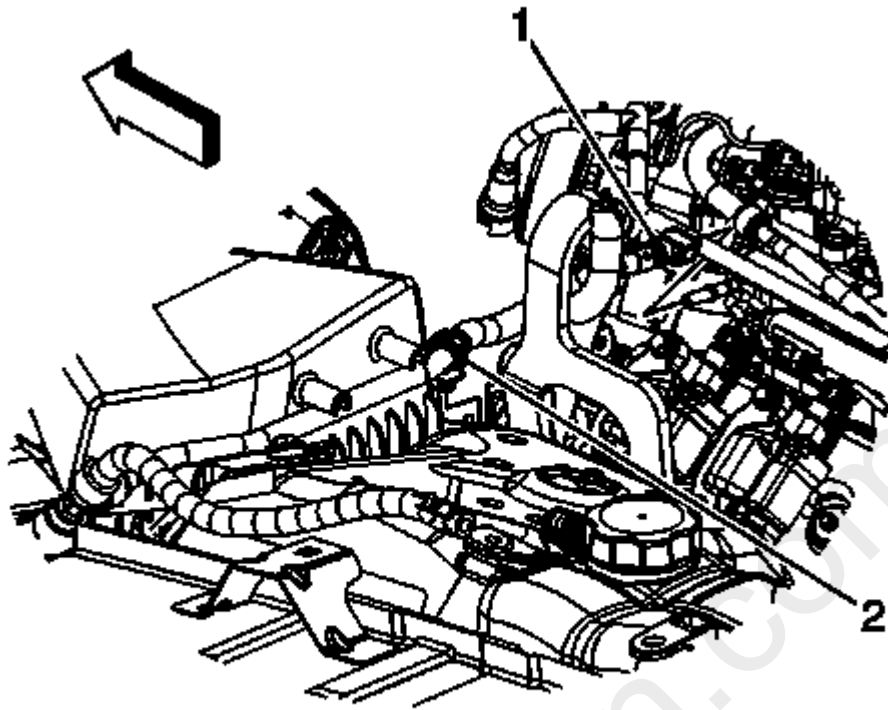


Fig. 78: Identifying Quick Connect Fitting & Clip At Air Cleaner Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the quick connect fitting (1) at the engine.
9. Disconnect the clip (2) at the air cleaner assembly.

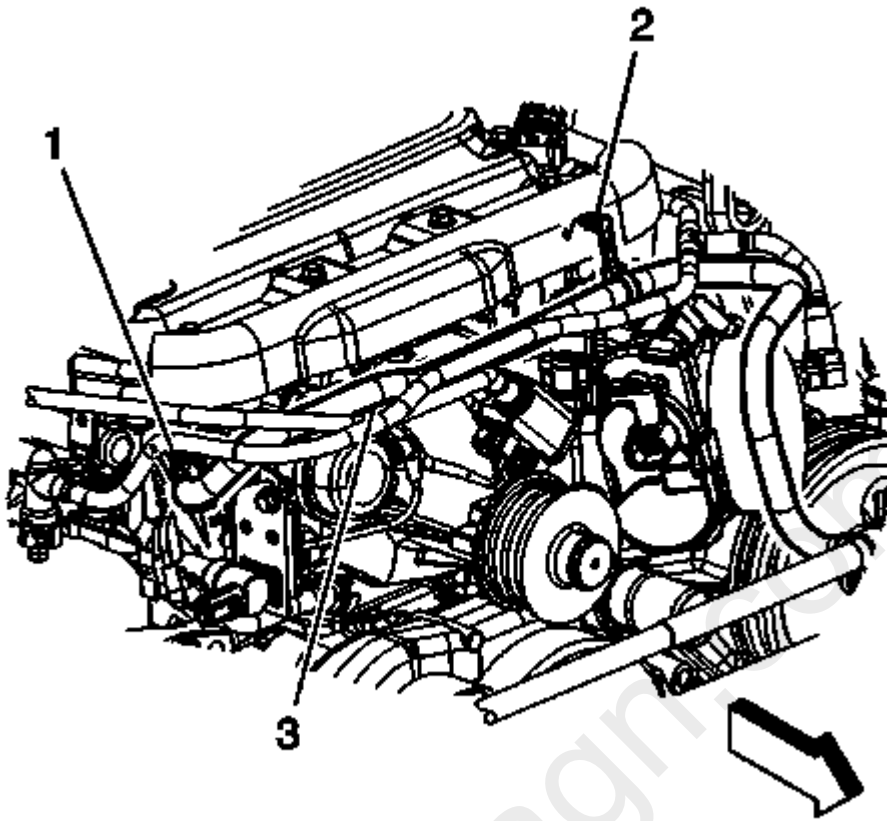


Fig. 79: Identifying Quick Connect Fitting & Clip At Engine
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the quick connect fitting (1) at the engine.
11. Disconnect the clip (2) at the engine.

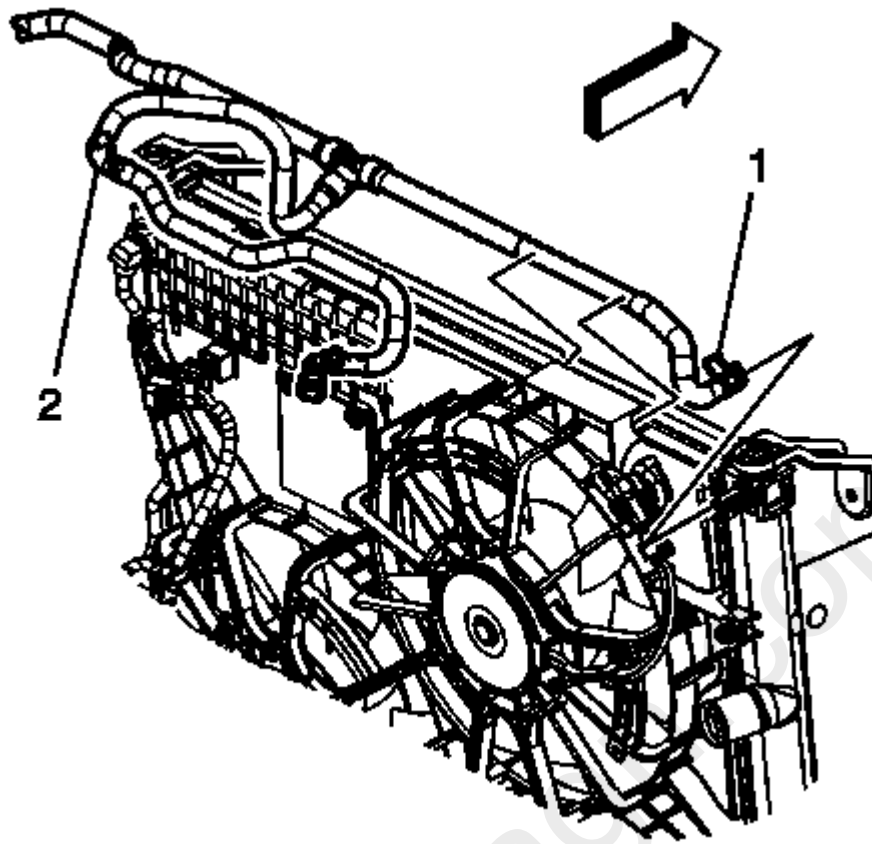


Fig. 80: Identifying Surge Tank Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

12. Reposition the surge tank inlet hose clamp (1) at radiator using J 38185 Hose Clamp Pliers.
13. Remove the surge tank inlet hose (2) from the radiator.
14. Remove the surge tank inlet hose from the vehicle.

Installation Procedure

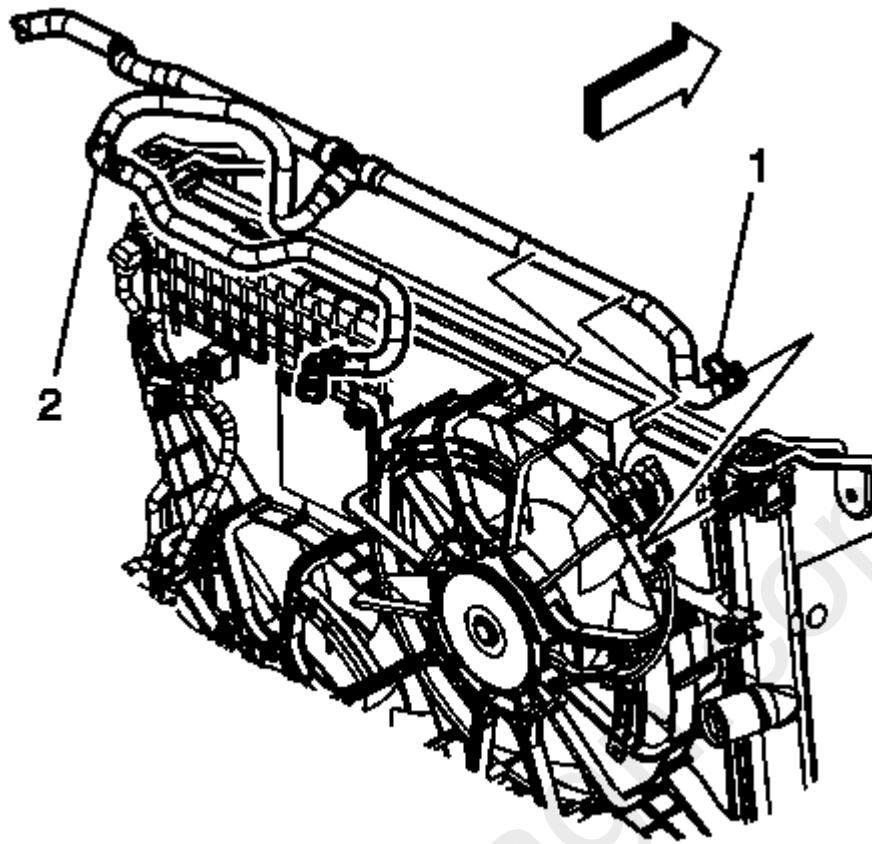


Fig. 81: Identifying Surge Tank Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Install the surge tank inlet hose to the vehicle.
2. Install the surge tank inlet hose (2) to the radiator.
3. Reposition the surge tank inlet hose clamp (1) at radiator using **J 38185** Hose Clamp Pliers.

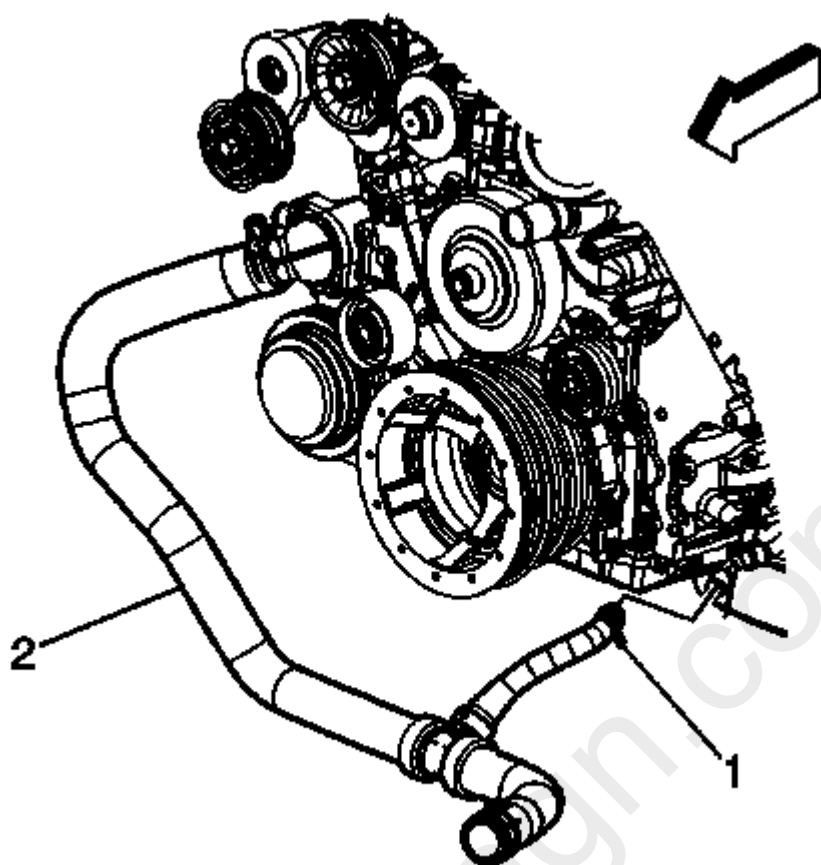


Fig. 82: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS COMPANY

4. Connect the quick connect fitting (1) at the engine.
5. Connect the clip (2) at the engine.

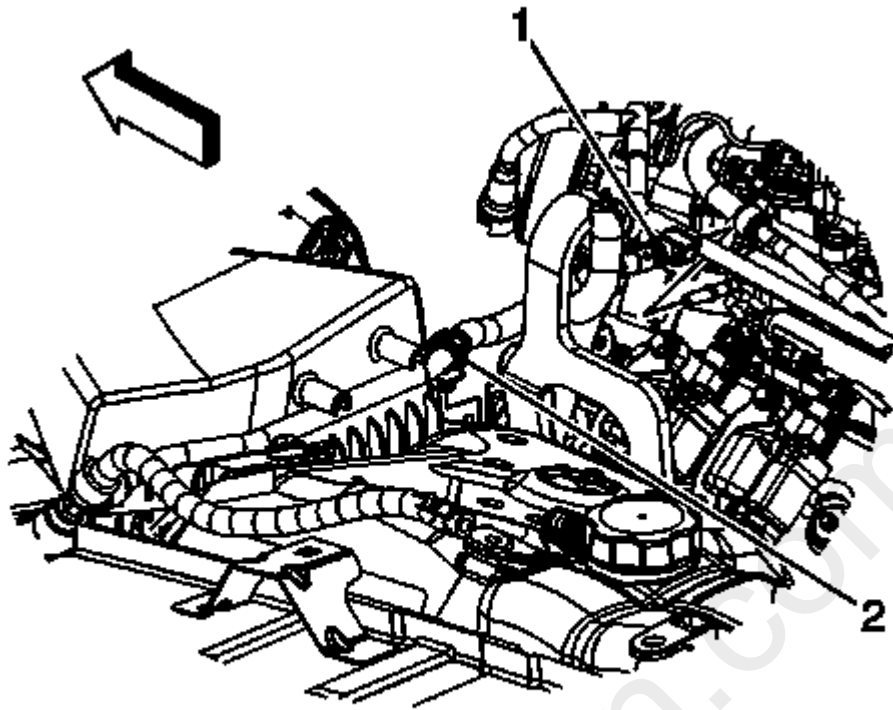


Fig. 83: Identifying Quick Connect Fitting & Clip At Air Cleaner Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Connect the quick connect fitting (1) at the engine.
7. Connect the clip (2) at the air cleaner assembly.

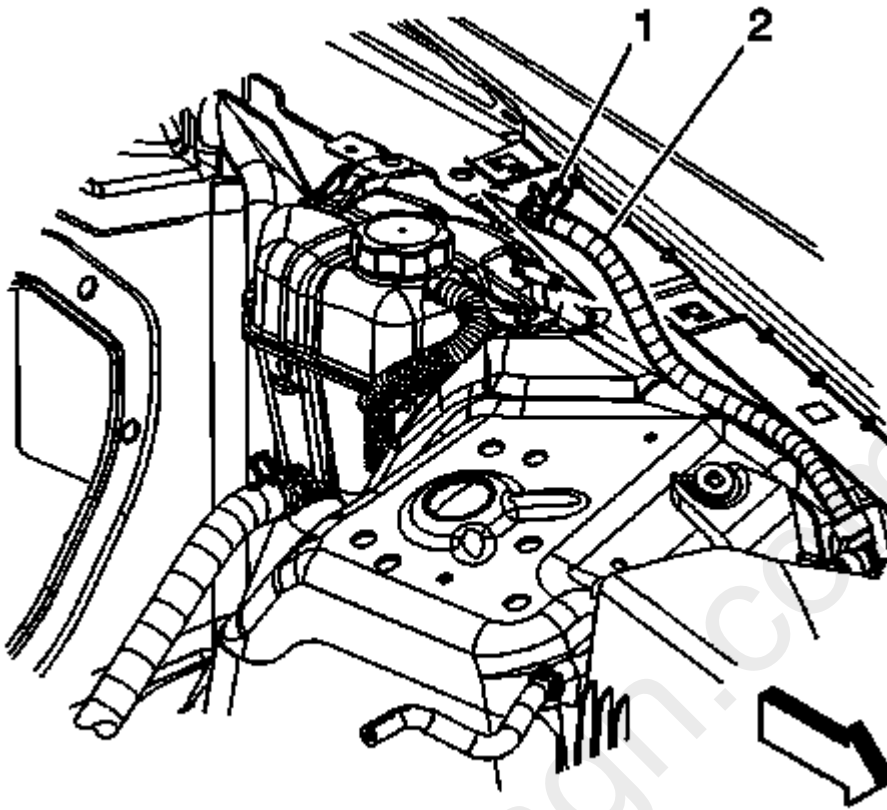


Fig. 84: Identifying Surge Tank Inlet Hose & Clamp At Surge Tank
 Courtesy of GENERAL MOTORS COMPANY

8. Install the surge tank inlet hose (2) to the surge tank.
9. Reposition the surge tank inlet hose clamp (1) at surge tank using **J 38185** Hose Clamp Pliers.
10. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**
11. Install the intake manifold cover front. Refer to **Intake Manifold Cover Replacement - Front**
12. Install the front compartment side sight shield. Refer to **Front Compartment Side Sight Shield Replacement**
13. Install the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement**
14. Fill the coolant. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR SURGE TANK INLET HOSE/PIPE REPLACEMENT (LFX OR LFW)

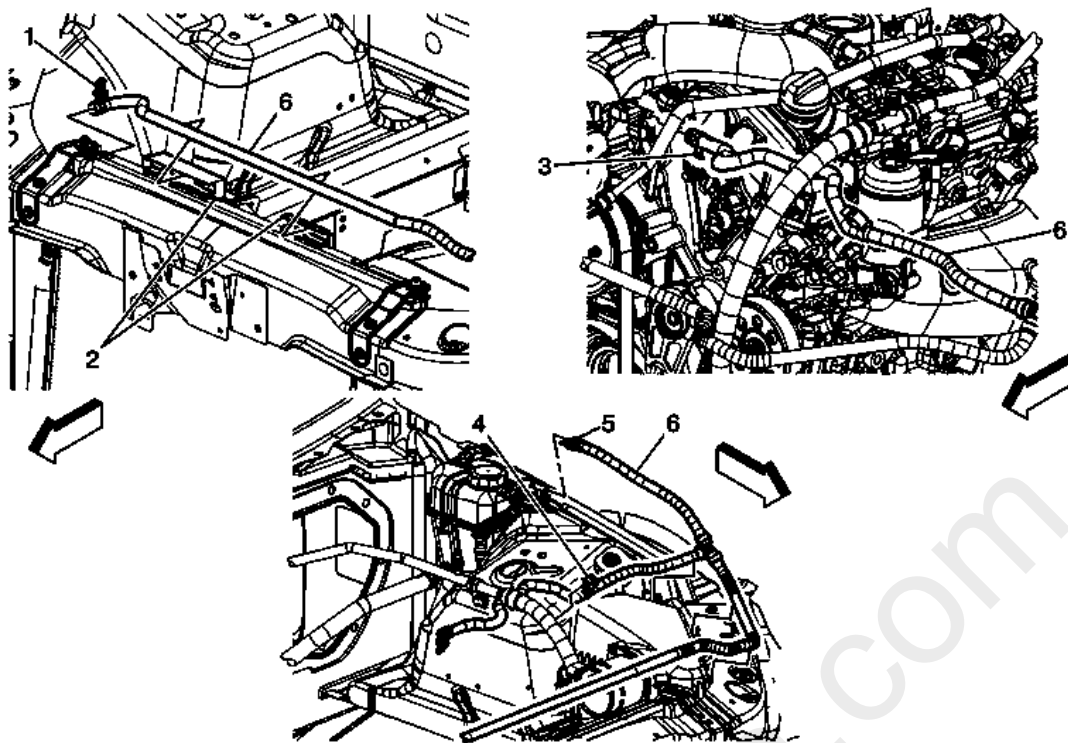


Fig. 85: Radiator Surge Tank Inlet Hose/Pipe Replacement
 Courtesy of GENERAL MOTORS COMPANY

Radiator Surge Tank Inlet Hose/Pipe Replacement (LFX or LFW)

Callout	Component Name
Preliminary Procedures	
1. Drain the coolant. Refer to <u>Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (GE 47716 LFW or LFX).</u> 2. Remove front compartment sight shield. Refer to <u>Front Compartment Sight Shields Replacement</u> .	
1	Surge Tank Inlet Hose Clamp Procedure Use J 38185 hose clamp pliers to reposition the surge tank inlet hose clamp. Special Tools J 38185 Hose Clamp Pliers
2	Radiator Bracket (Qty: 2)
3	Surge Tank Inlet Hose Clamp Procedure Use J 38185 hose clamp pliers to reposition the surge tank inlet hose clamp. Special Tools J 38185 Hose Clamp Pliers
4	Surge Tank Inlet Hose Clip
	Surge Tank Inlet Hose Clamp Procedure

5	Use J 38185 hose clamp pliers to reposition the surge tank inlet hose clamp. Special Tools J 38185 Hose Clamp Pliers
6	Surge Tank Inlet Hose

RADIATOR SURGE TANK ENGINE HOSE REPLACEMENT (LSA)

Special Tools

J 47622 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to , **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.
2. Remove cross vehicle brace. Refer to **Cross Vehicle Brace Replacement**

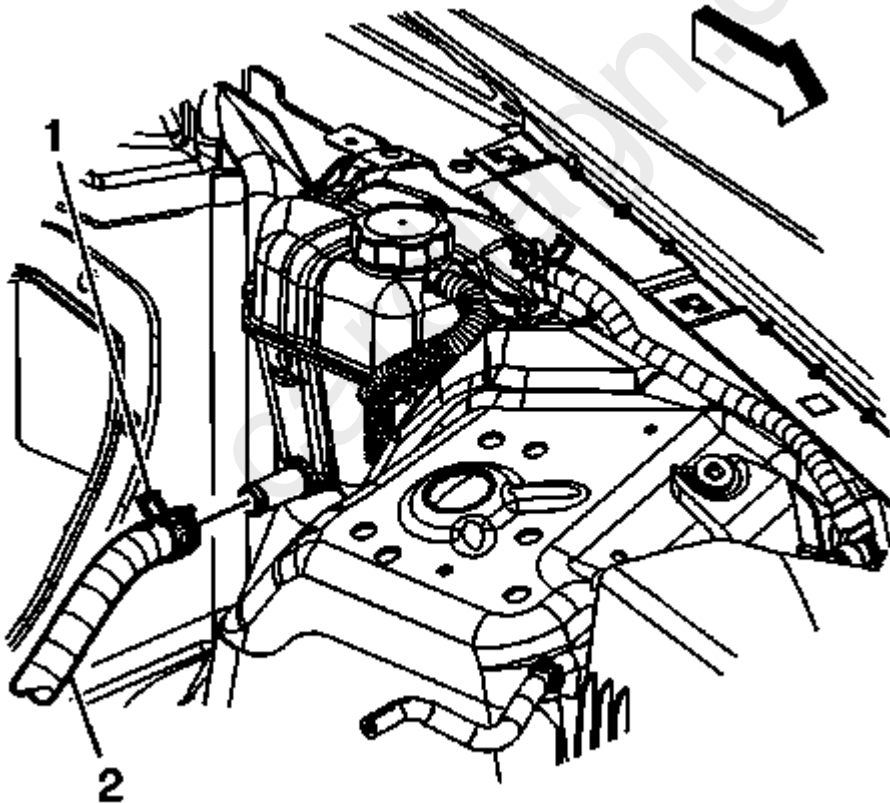


Fig. 86: Identifying Surge Tank Outlet Hose/Pipe & Clamp At Surge Tank
Courtesy of GENERAL MOTORS COMPANY

3. Reposition the surge tank engine hose clamp (1) at surge tank using **J 47622** Hose Clamp Pliers.

4. Remove the surge tank engine hose (2) from the surge tank.
5. Remove the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear** .

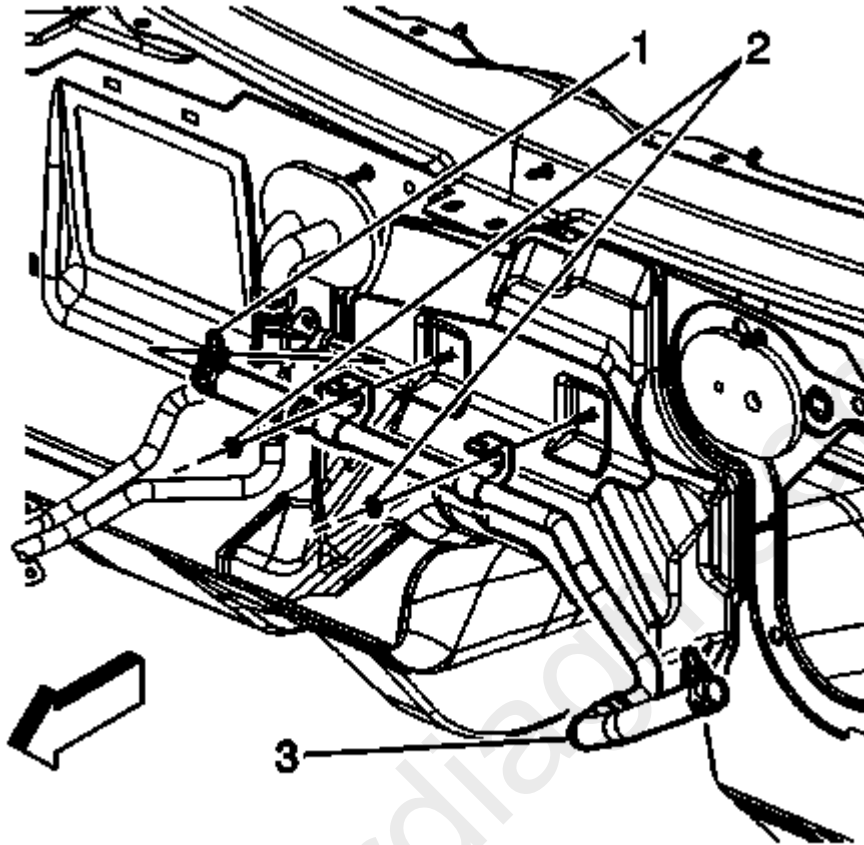


Fig. 87: Identifying Surge Tank Outlet Hose/Pipe Components
Courtesy of GENERAL MOTORS COMPANY

6. Reposition the surge tank engine hose clamp (1) at heater hose assembly using J 47622 Hose Clamp Pliers.
7. Remove the surge tank engine hose nuts (2).
8. Remove the surge tank engine hose (3) from the vehicle.

Installation Procedure

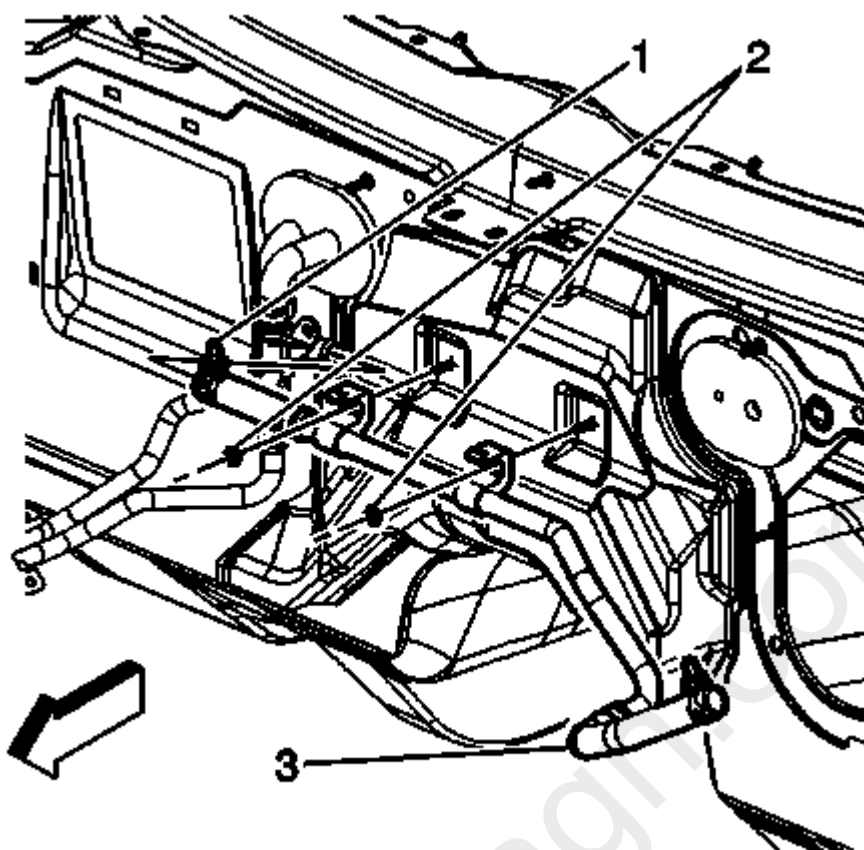


Fig. 88: Identifying Surge Tank Outlet Hose/Pipe Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the surge tank engine hose (3) to the vehicle.

CAUTION: Refer to Fastener Caution .

2. Install the surge tank engine hose (2) and tighten to 10 N.m (89 lb in)
3. Reposition the surge tank engine hose clamp (1) at heater hose assembly using J 47622 Hose Clamp Pliers.
4. Install the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear** .

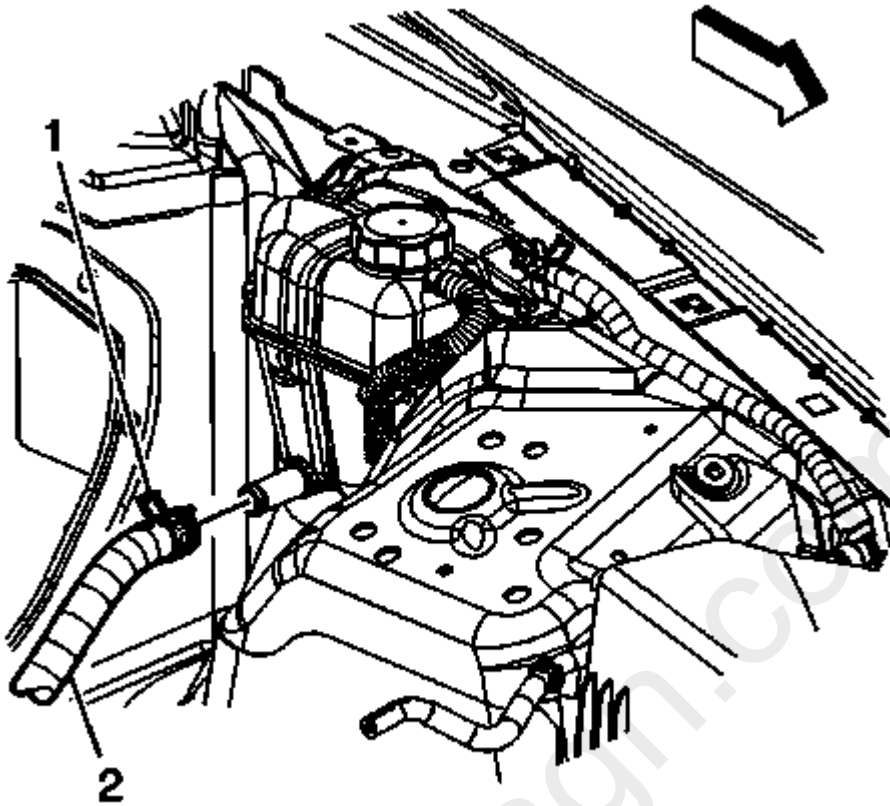


Fig. 89: Identifying Surge Tank Outlet Hose/Pipe & Clamp At Surge Tank
Courtesy of GENERAL MOTORS COMPANY

5. Install the surge tank engine hose (2) to the surge tank.
6. Reposition the surge tank engine hose clamp (1) at surge tank using **J 47622 Hose Clamp Pliers**.
7. Install cross vehicle brace. Refer to **Cross Vehicle Brace Replacement**
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR SURGE TANK ENGINE HOSE REPLACEMENT (LFW OR LFX)

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

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

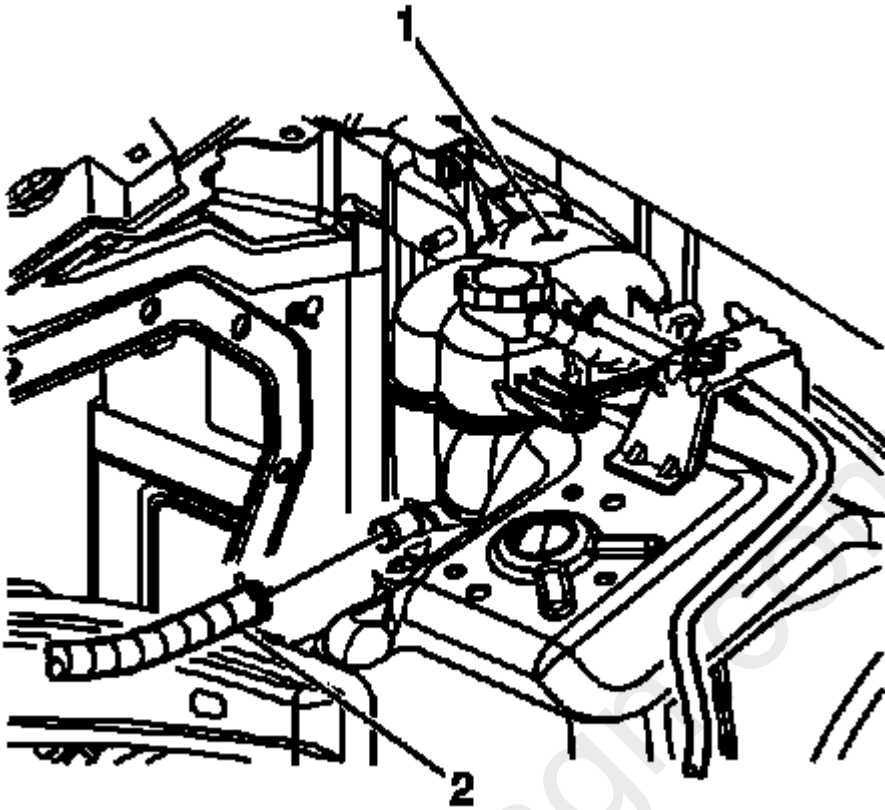


Fig. 90: Locating Surge Tank & Surge Tank Outlet Hose - LHD
Courtesy of GENERAL MOTORS COMPANY

2. Position **J 38185** hose clamp pliers to the clamp in order to remove the engine hose (2) from the surge tank (1).
3. Loosen the bolt on the bracket which secures the surge tank engine hose to the engine.
4. Remove the windshield wiper transmission. Refer to **Windshield Wiper Transmission Replacement** .
5. Position **J 38185** hose clamp pliers to the clamp in order to remove the surge tank engine hose from the thermostat assembly.
6. Remove the surge tank engine hose from the engine.

Installation Procedure

1. Position the surge tank engine hose to the engine.
2. Position **J 38185** hose clamp pliers to the clamp in order to connect the surge tank engine hose to the thermostat assembly.
3. Install the windshield wiper transmission. Refer to **Windshield Wiper Transmission Replacement** .

CAUTION: Refer to Fastener Caution .

4. Install the bolt to the bracket securing the surge tank engine hose to the engine and tighten to 9 N.m (80 lb in).

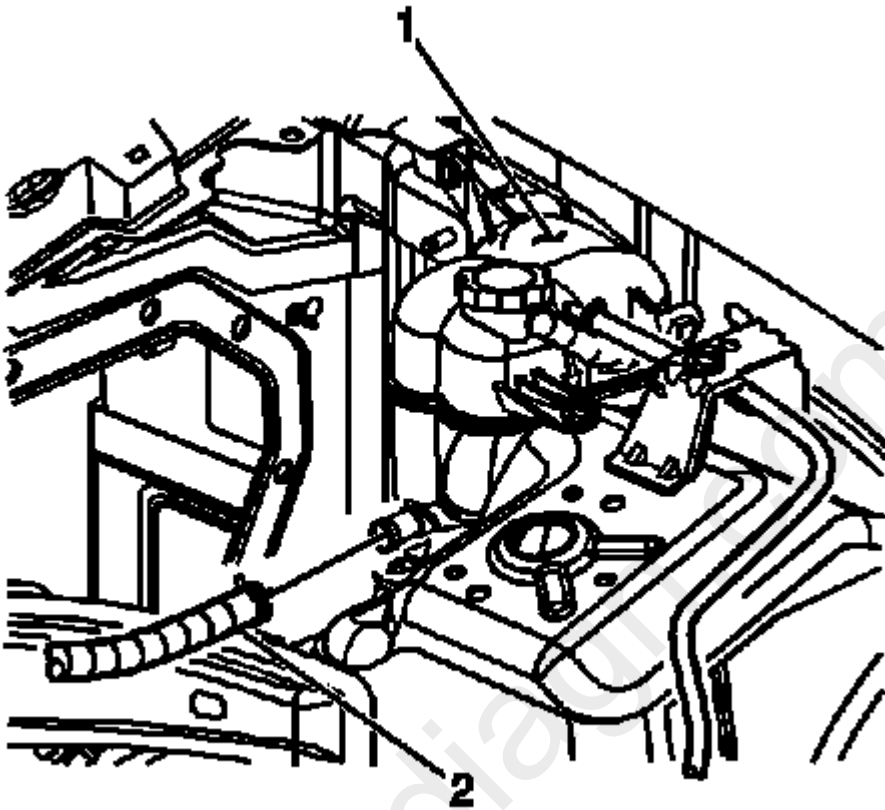


Fig. 91: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS COMPANY

5. Position **J 38185** hose clamp pliers to the clamp in order to connect the engine hose (2) to the surge tank (1).
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**.

RADIATOR INLET HOSE REPLACEMENT (LSA)

Special Tools

J 47622 Hose Clamp Pliers

Removal Procedure

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

2. Remove the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement**
3. Remove air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement**

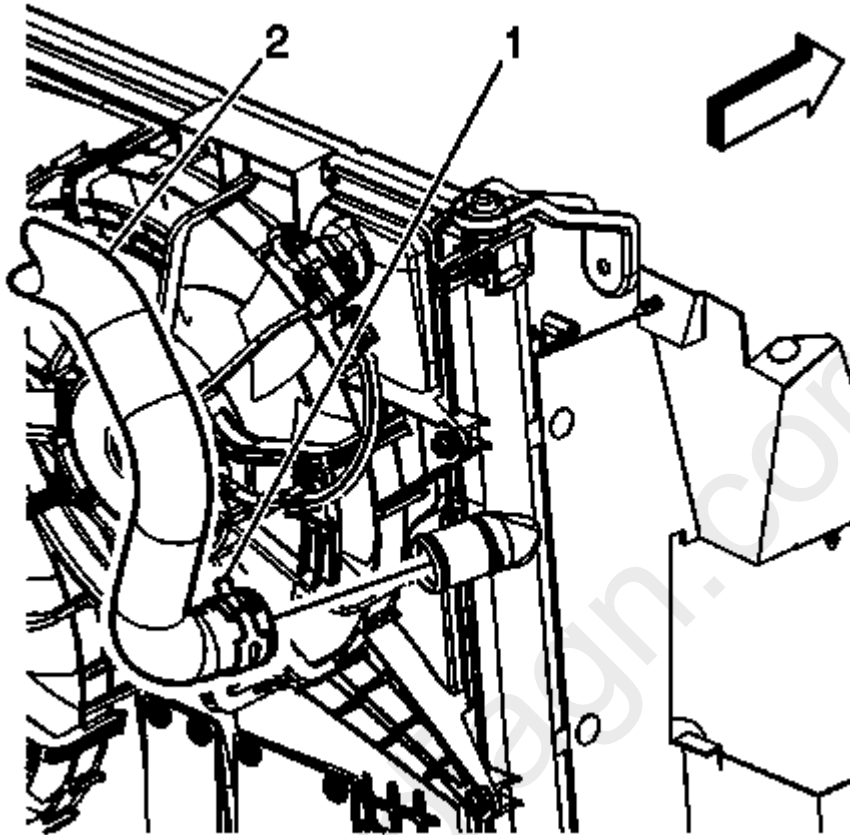


Fig. 92: Identifying Radiator Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

4. Reposition the radiator inlet hose clamp (1) at radiator using **J 47622** Hose Clamp Pliers.
5. Remove the radiator inlet hose (2) from the radiator.

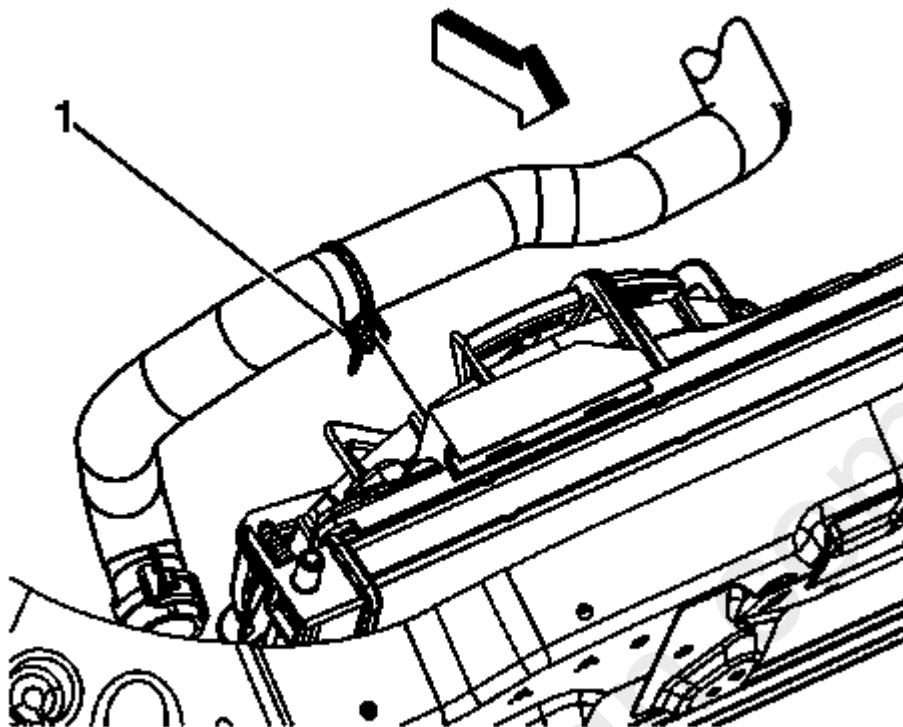


Fig. 93: Identifying Radiator Inlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Unclip the radiator inlet hose retainer (1) from the fan shroud.

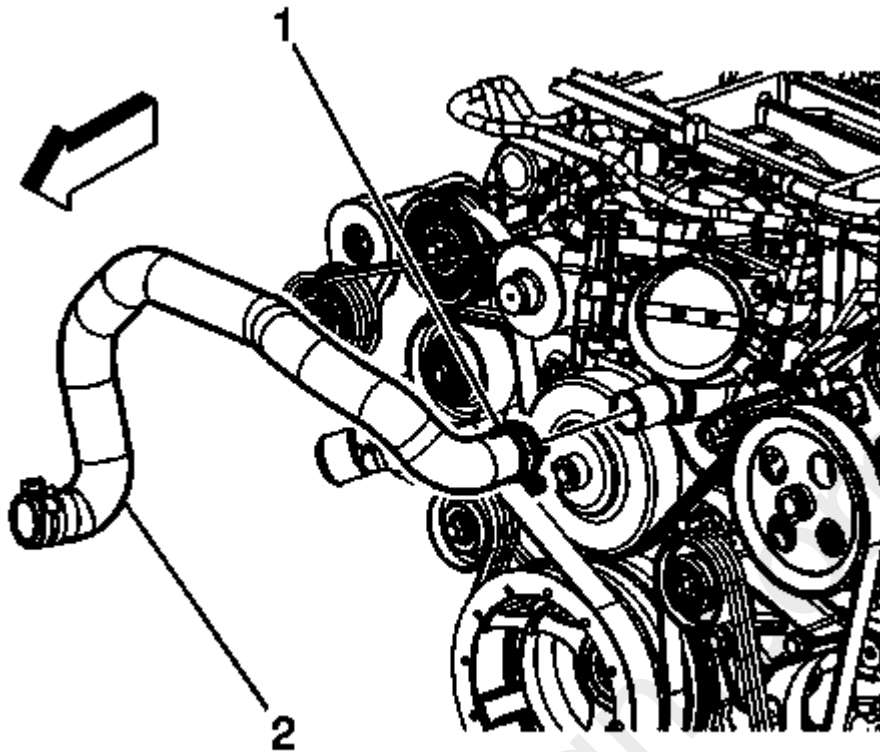


Fig. 94: Identifying Radiator Inlet Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

7. Reposition the radiator inlet hose clamp (1) at engine using J 47622 Hose Clamp Pliers.
8. Remove the radiator inlet hose (2) from the engine.
9. Remove the radiator inlet hose from the vehicle.

Installation Procedure

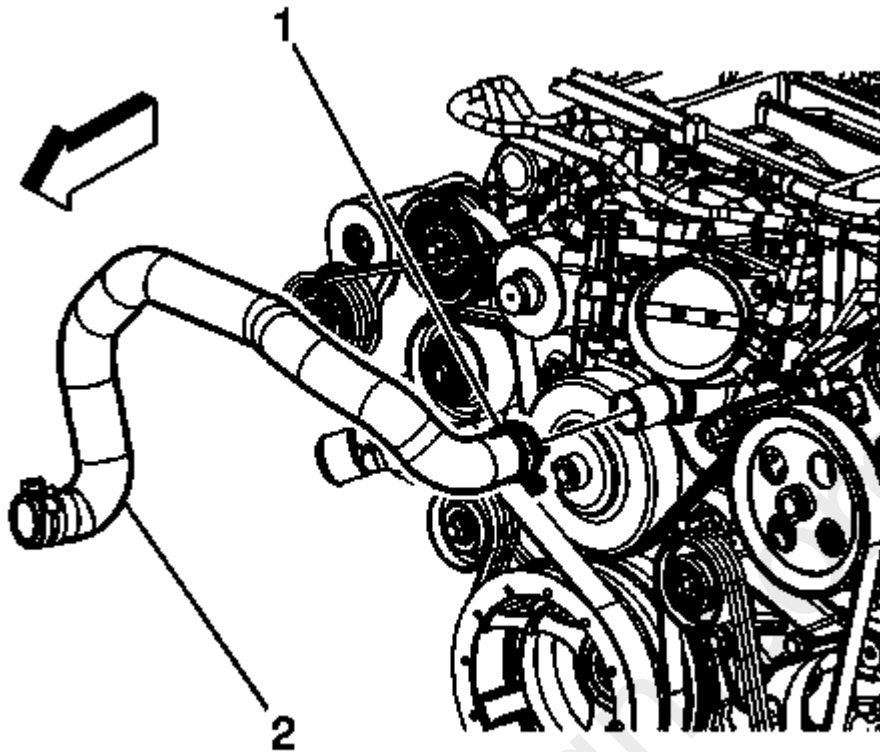


Fig. 95: Identifying Radiator Inlet Hose & Clamp At Engine
Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator inlet hose to the vehicle.
2. Install the radiator inlet hose (2) to the engine.
3. Reposition the radiator inlet hose clamp (1) at engine using J 47622 Hose Clamp Pliers.

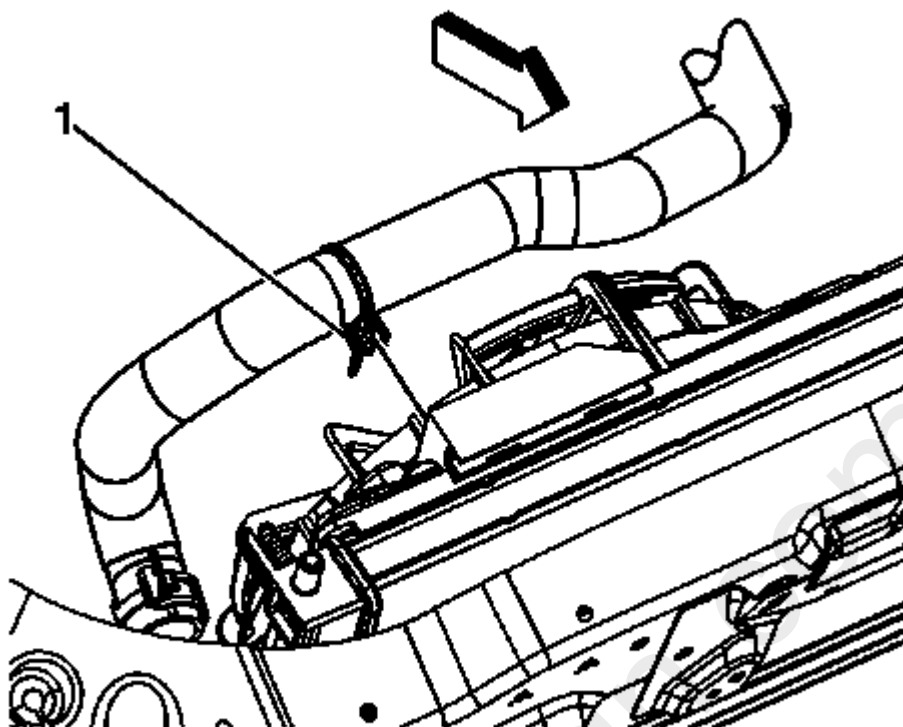


Fig. 96: Identifying Radiator Inlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Clip the radiator inlet hose retainer (1) to the fan shroud.

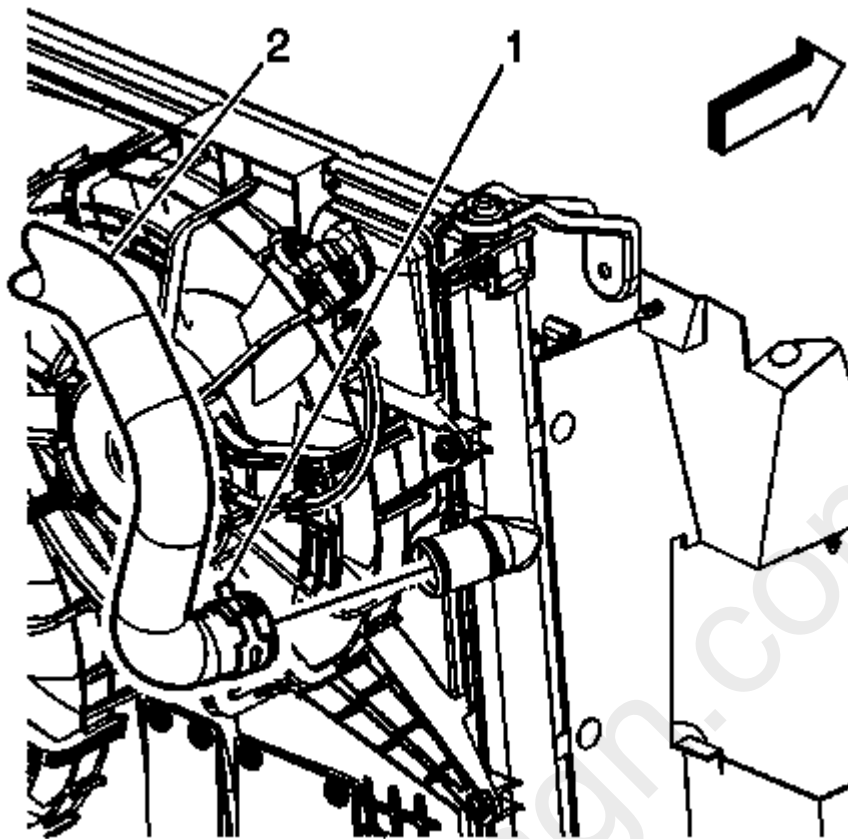


Fig. 97: Identifying Radiator Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

5. Install the radiator inlet hose (2) to the radiator.
6. Reposition the radiator inlet hose clamp (1) at radiator using **J 47622 Hose Clamp Pliers**.
7. Install air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement**
8. Install the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement**
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR INLET HOSE REPLACEMENT (LFW OR LFX)

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

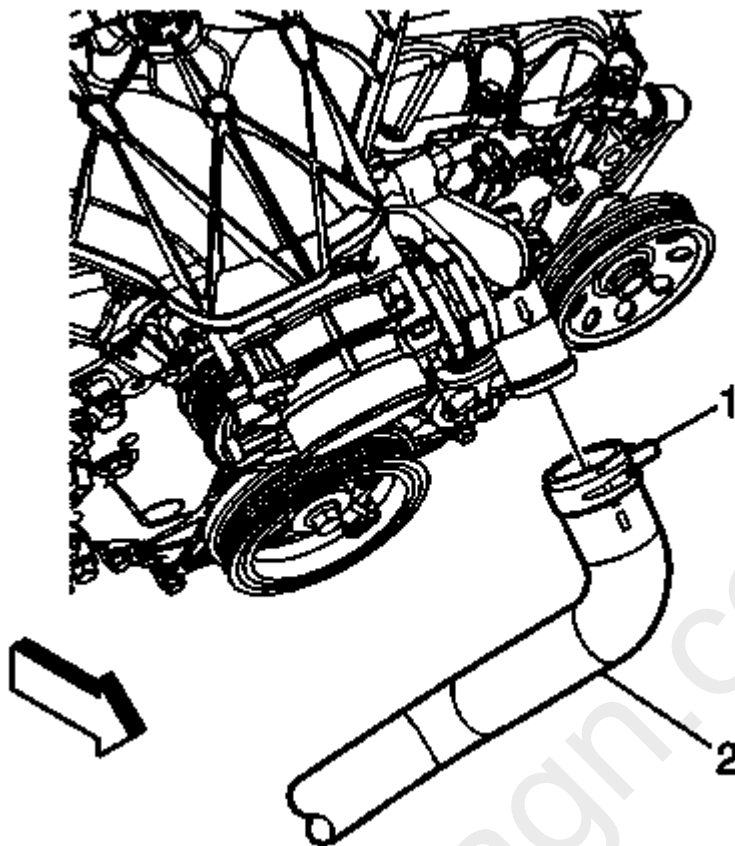


Fig. 98: Identifying Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS COMPANY

3. Reposition the radiator inlet hose clamp (1) at the engine using J 38185 Hose Clamp Pliers.
4. Remove the radiator inlet hose (2) from the engine.

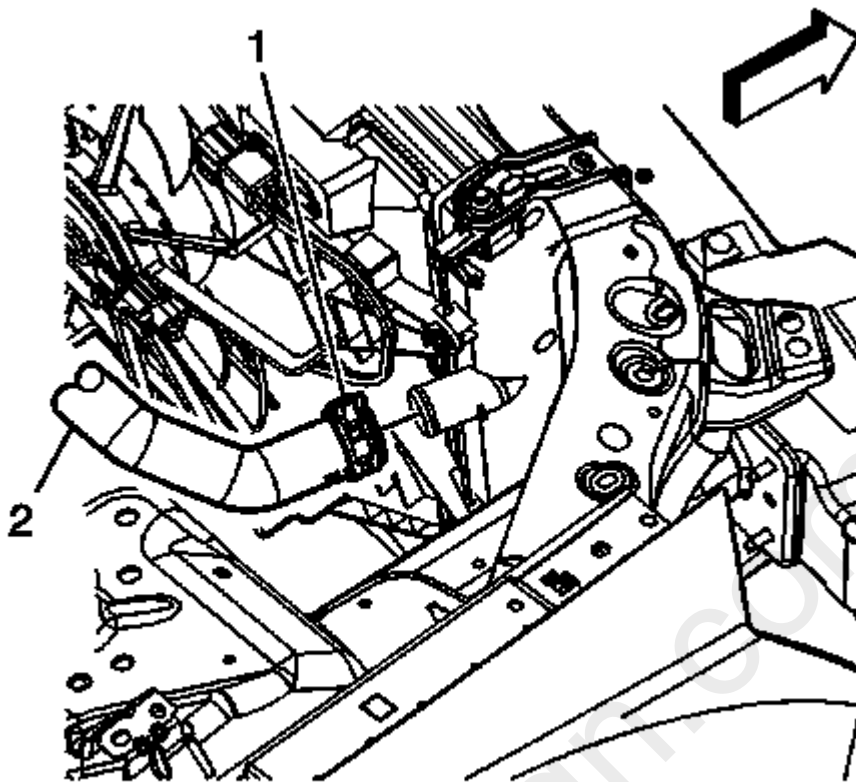


Fig. 99: View Of Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the radiator inlet hose clamp (1) at radiator using **J 38185** Hose Clamp Pliers.
6. Remove the radiator inlet hose (2) from the radiator.
7. Remove the radiator inlet hose from the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the vehicle.

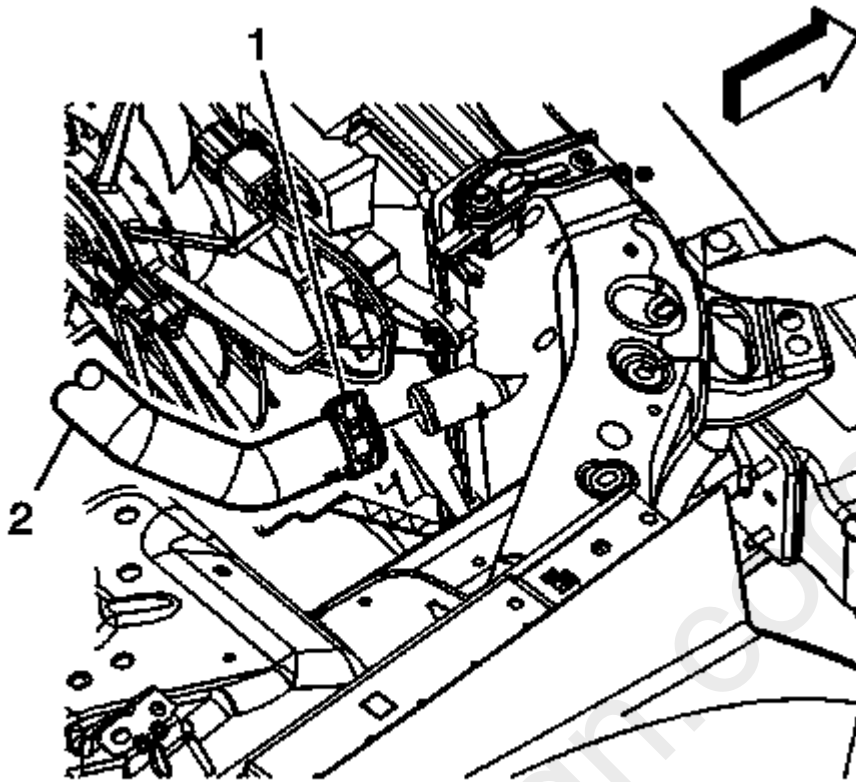


Fig. 100: View Of Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

2. Reposition the radiator outlet hose clamp (1) at radiator using **J 38185** Hose Clamp Pliers.
3. Install the radiator outlet hose (2) from the radiator.

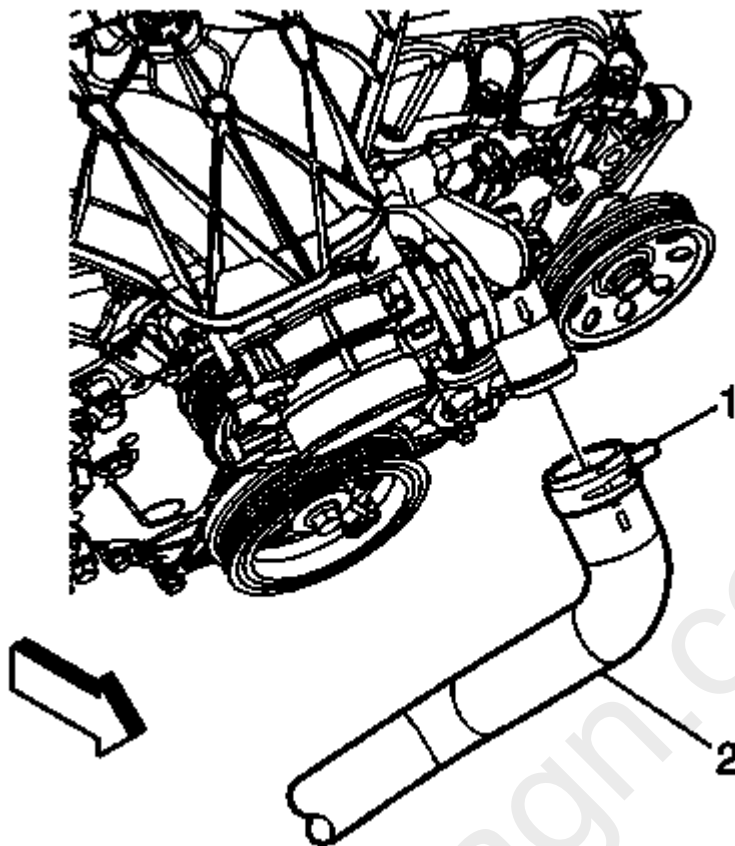


Fig. 101: Identifying Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator outlet hose (2) from the engine coolant inlet pipe.
5. Reposition the radiator outlet hose clamp (1) at the engine coolant inlet pipe using **J 38185** Hose Clamp Pliers.
6. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR OUTLET HOSE REPLACEMENT (LSA)

Special Tools

J 47622 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**

3. Remove the front air deflector. Refer to **Front Air Deflector Replacement**

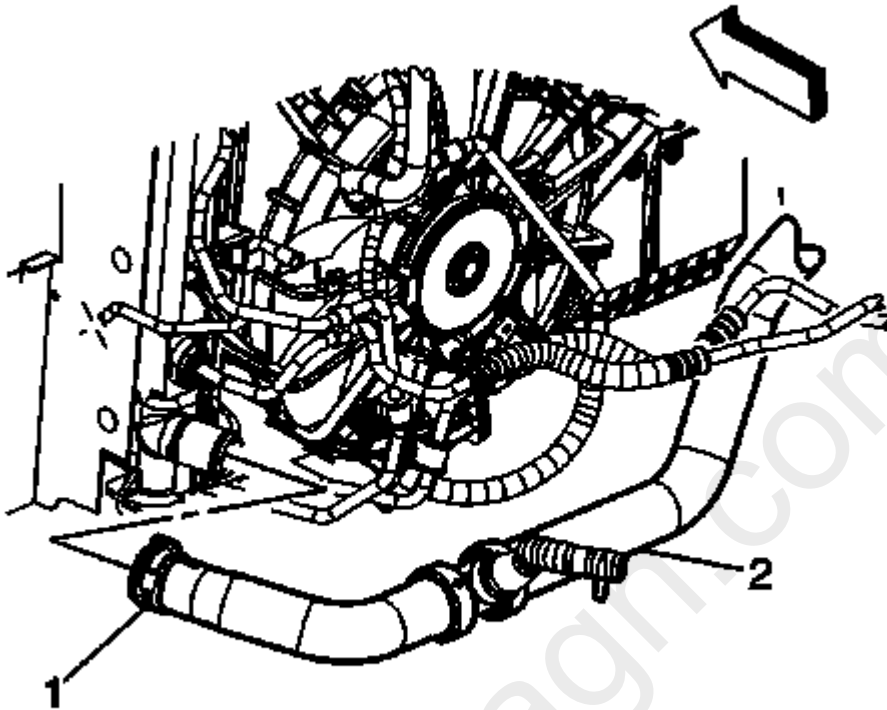


Fig. 102: Identifying Radiator Outlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

4. Reposition the radiator outlet hose clamp (1) at radiator using **J 47622** Hose Clamp Pliers.
5. Remove the radiator outlet hose (2) from the radiator.

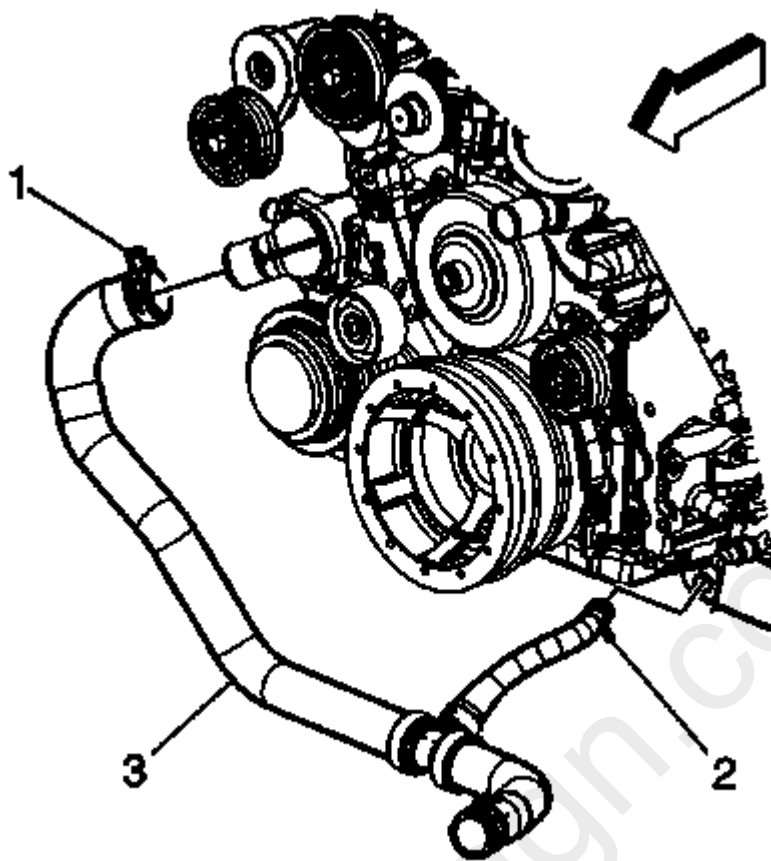


Fig. 103: Identifying Radiator Outlet Hose Components
Courtesy of GENERAL MOTORS COMPANY

6. Reposition the radiator outlet hose clamp (1) at engine oil cooler pipe using **J 47622** Hose Clamp Pliers.
7. Remove the radiator outlet hose (3) from the engine oil cooler pipe.
8. Reposition the radiator outlet hose clamp (2) at engine using **J 47622** Hose Clamp Pliers.
9. Remove the radiator outlet hose (3) from the engine.
10. Remove the radiator outlet hose (3) from the vehicle.

Installation Procedure

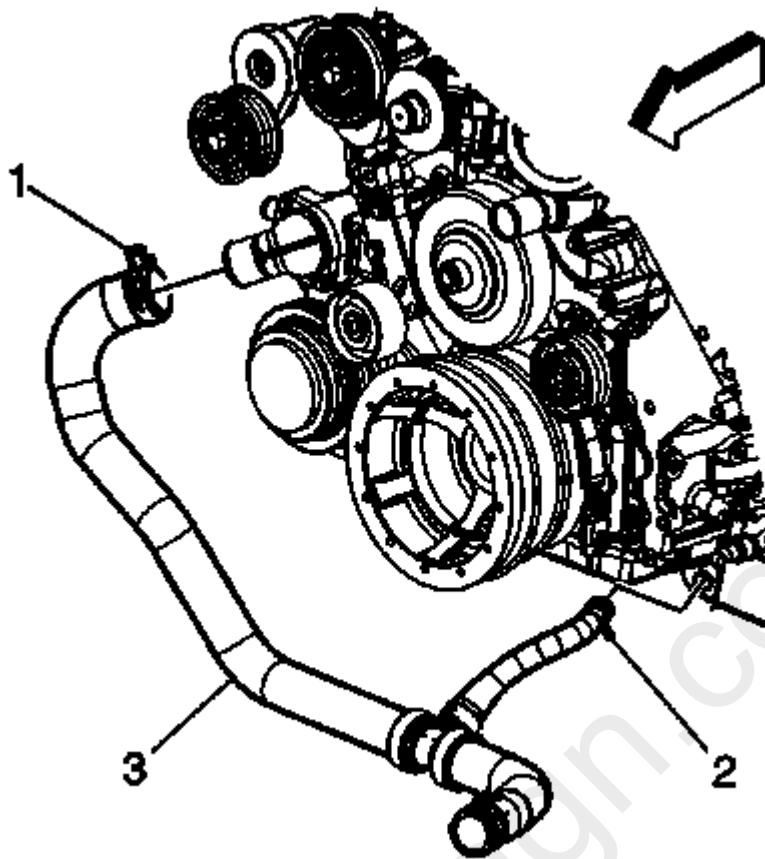


Fig. 104: Identifying Radiator Outlet Hose Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator outlet hose (3) to the vehicle.
2. Install the radiator outlet hose (3) to the engine.
3. Reposition the radiator outlet hose clamp (2) at engine using **J 47622** Hose Clamp Pliers.
4. Install the radiator outlet hose (3) to the engine oil cooler pipe.
5. Reposition the radiator outlet hose clamp (1) at engine oil cooler pipe using **J 47622** Hose Clamp Pliers.

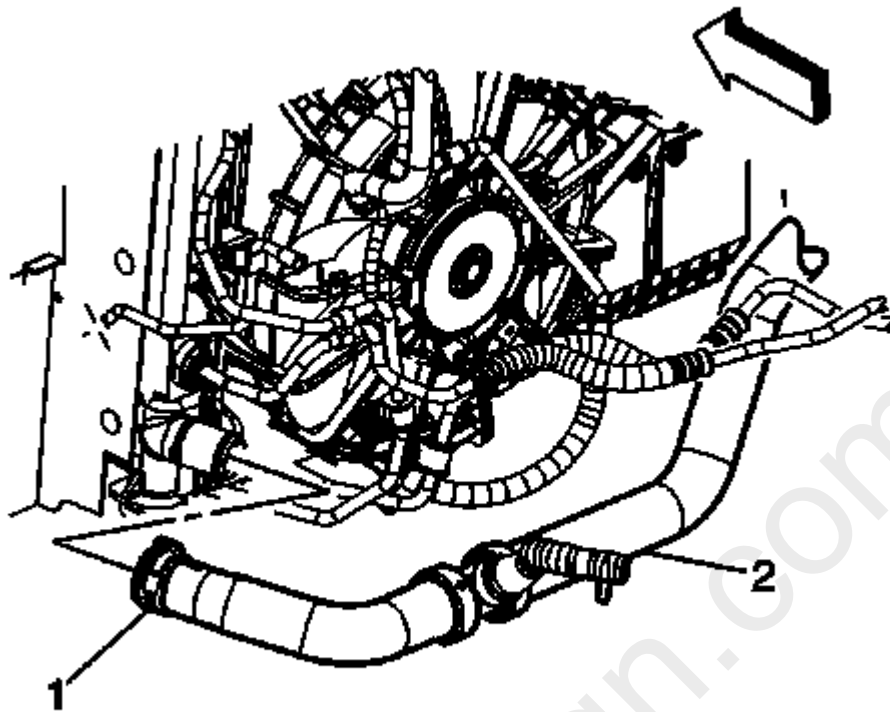


Fig. 105: Identifying Radiator Outlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS COMPANY

6. Install the radiator outlet hose (2) to the radiator.
7. Reposition the radiator outlet hose clamp (1) at radiator using **J 47622 Hose Clamp Pliers**.
8. Install the front air deflector. Refer to **Front Air Deflector Replacement**
9. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
10. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR OUTLET HOSE REPLACEMENT (LFX OR LFW)

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

3. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
4. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .

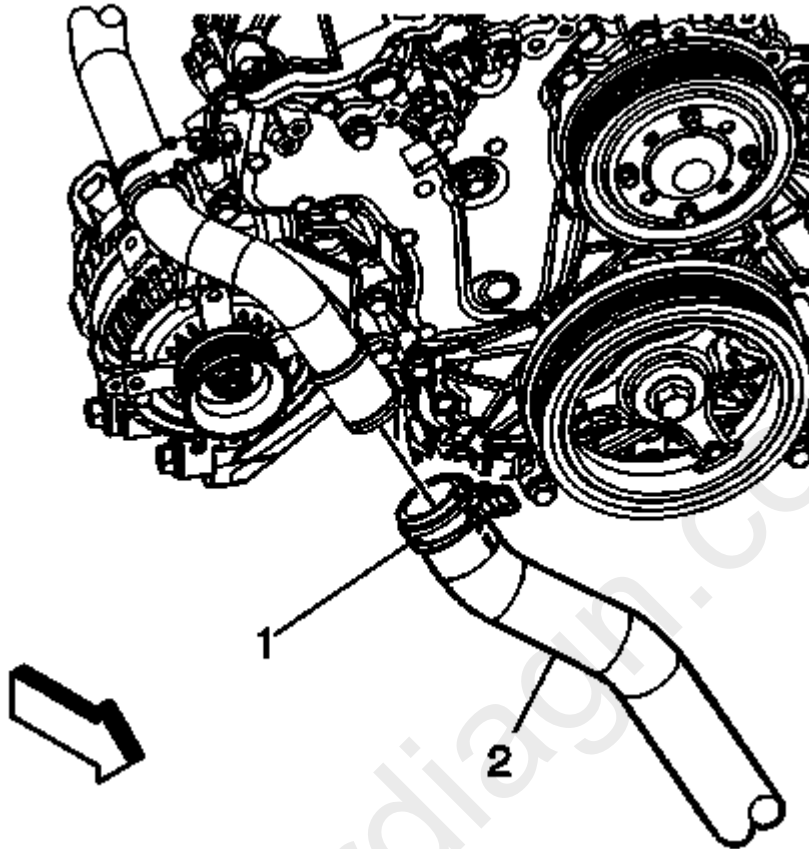


Fig. 106: View Of Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the radiator outlet hose clamp (1) at the engine coolant inlet pipe using **J 38185** Hose Clamp Pliers.
6. Remove the radiator outlet hose (2) from the engine coolant inlet pipe.

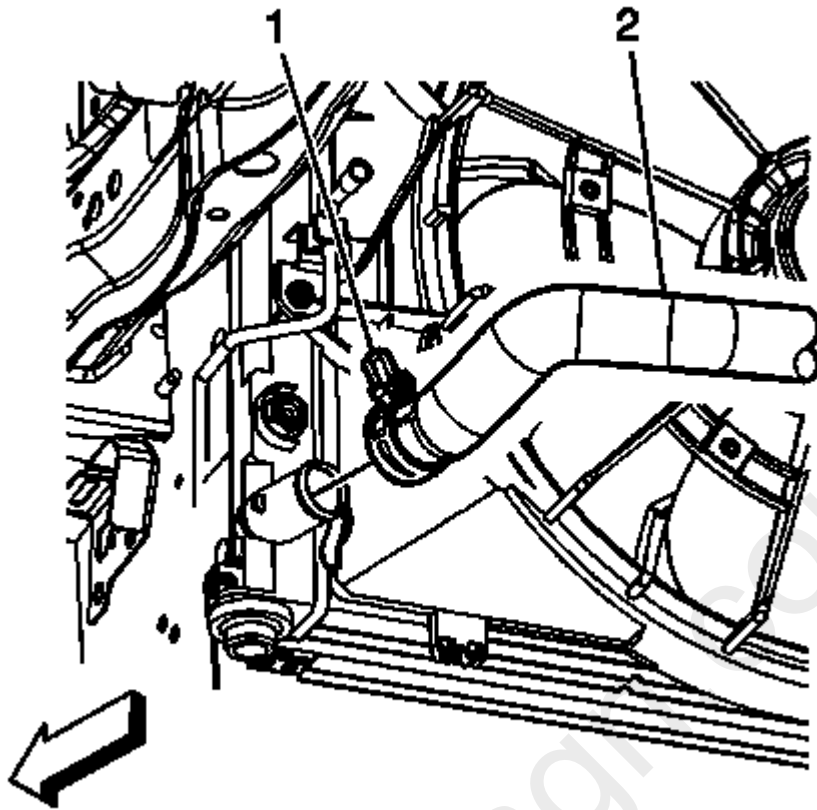


Fig. 107: Identifying Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Reposition the radiator outlet hose clamp (1) at radiator using J 38185 Hose Clamp Pliers.
8. Remove the radiator outlet hose (2) from the radiator.
9. Remove the radiator outlet hose from the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the vehicle.

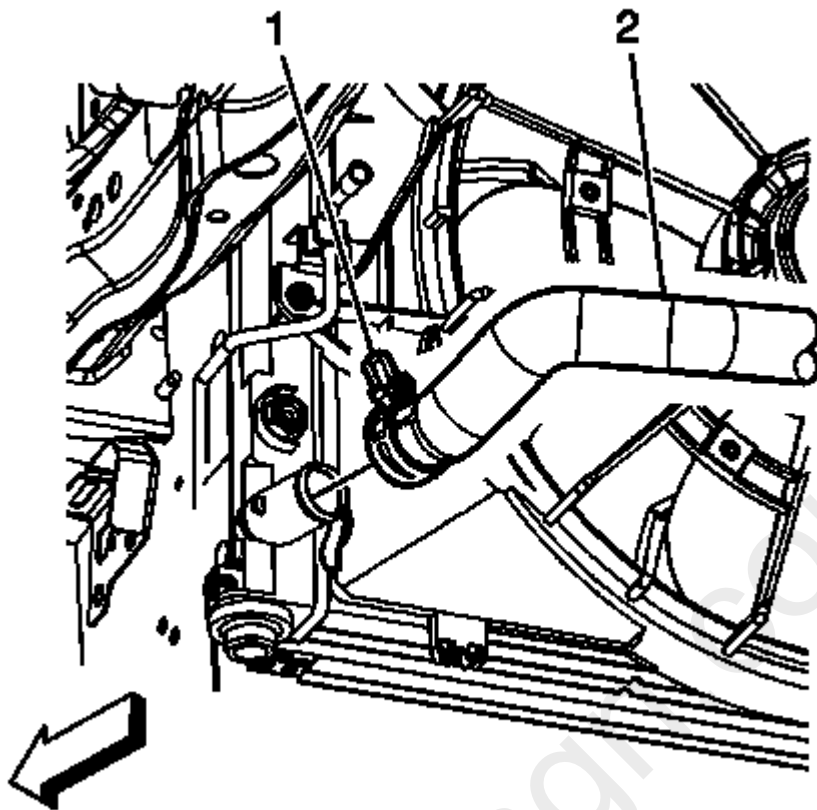


Fig. 108: Identifying Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

2. Reposition the radiator outlet hose clamp (1) at radiator using **J 38185** Hose Clamp Pliers.
3. Install the radiator outlet hose (2) from the radiator.

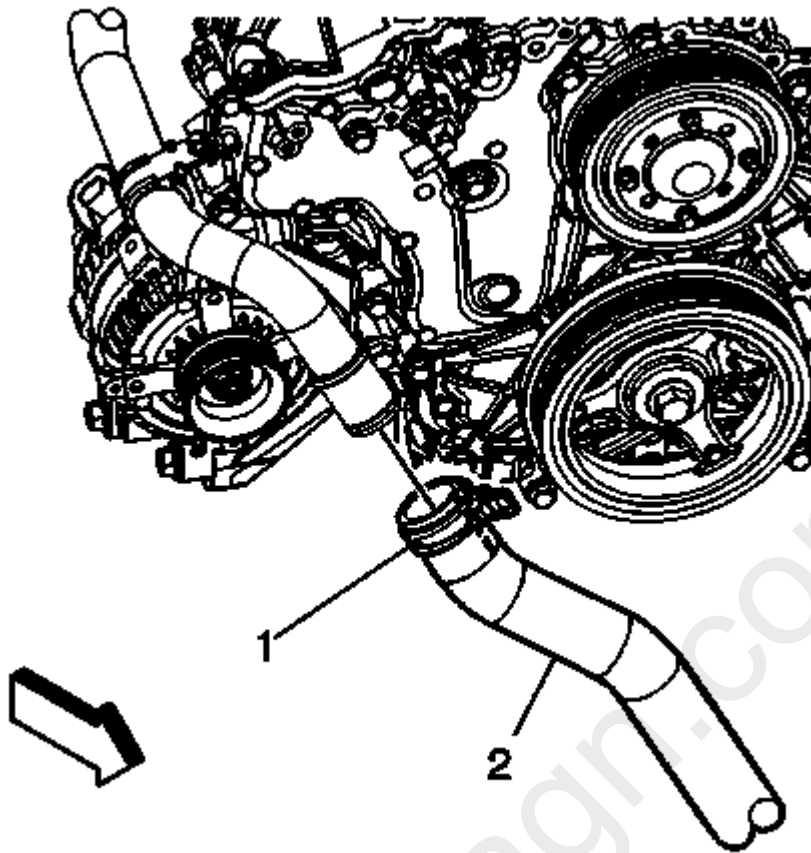


Fig. 109: View Of Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Install the radiator outlet hose (2) from the engine coolant inlet pipe.
5. Reposition the radiator outlet hose clamp (1) at the engine coolant inlet pipe using **J 38185** Hose Clamp Pliers.
6. Install the front air deflector. Refer to **Front Air Deflector Replacement** .
7. Lower the vehicle.
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**.

ENGINE COOLANT INLET PIPE REPLACEMENT

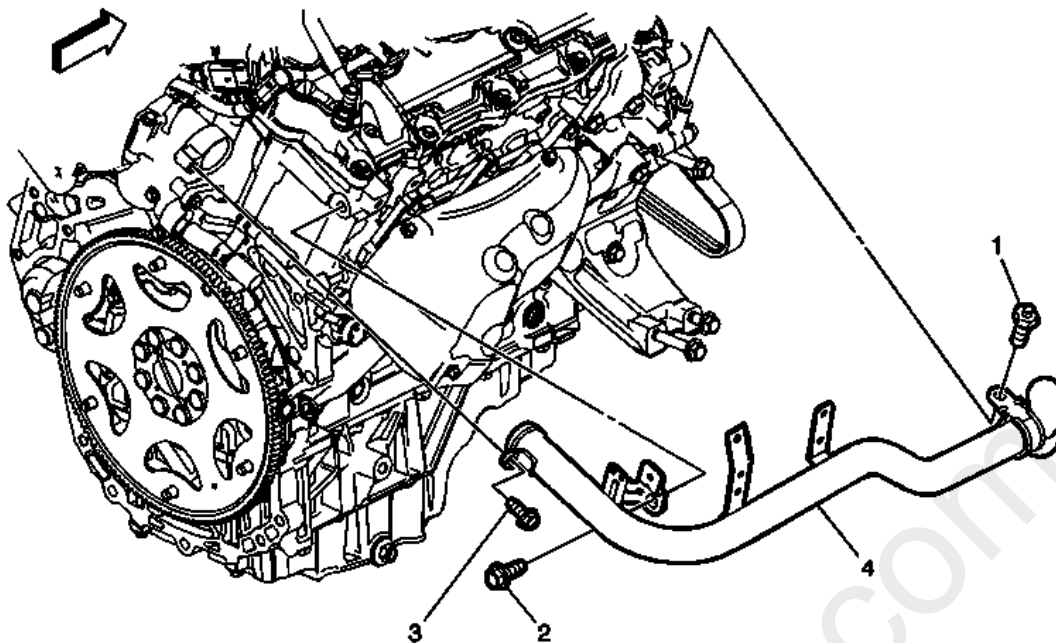


Fig. 110: Engine Coolant Inlet Pipe
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Inlet Pipe Replacement

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LFW or LFX)</u>, <u>Cooling System Draining and Filling (Static Fill LSA)</u>, <u>Cooling System Draining and Filling (GE 47716 LFW or LFX)</u>, <u>Cooling System Draining and Filling (GE 47716 LSA)</u>. 2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>. 3. Disconnect the radiator outlet hose from the coolant pipe. Refer to <u>Radiator Outlet Hose Replacement (LFX or LFW)</u>, <u>Radiator Outlet Hose Replacement (LSA)</u>. 4. Remove the passenger compartment air filter housing. Refer to <u>Passenger Compartment Air Filter Housing Replacement</u>.	
1	Radiator Outlet Pipe Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
	Radiator Outlet Pipe Bolt

2	Tighten 58 N.m (43 lb ft)
3	Radiator Outlet Pipe Bolt Tighten 22 N.m (16 lb ft)
4	Engine Coolant Inlet Pipe

CHARGE AIR COOLER COOLANT OUTLET PIPE REPLACEMENT

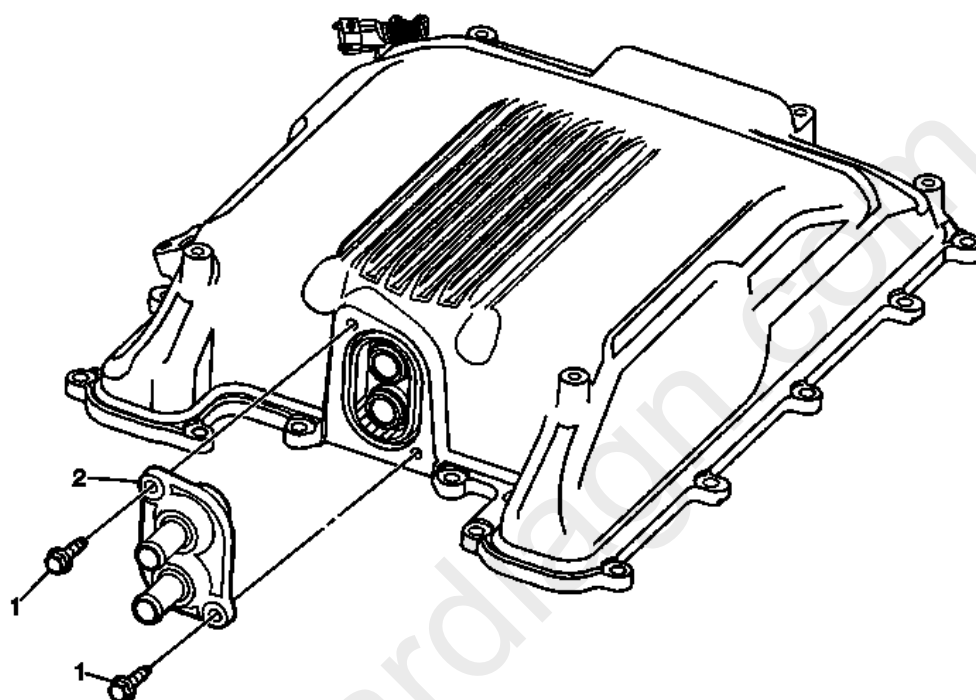


Fig. 111: Identifying Charge Air Cooler Coolant Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Outlet Pipe Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the charge air cooler inlet hose. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Engine to Pipe.</u> 2. Remove the charge air cooler outlet hose. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Engine to Reservoir.</u>	
1	Charge Air Cooler Coolant Outlet Pipe Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .

	Tighten 10 N.m (89 lb in)
2	Charge Air Cooler Coolant Outlet Pipe Procedure 1. Do not reuse the same gasket. 2. Transfer components as necessary.

ENGINE OIL COOLER REPLACEMENT

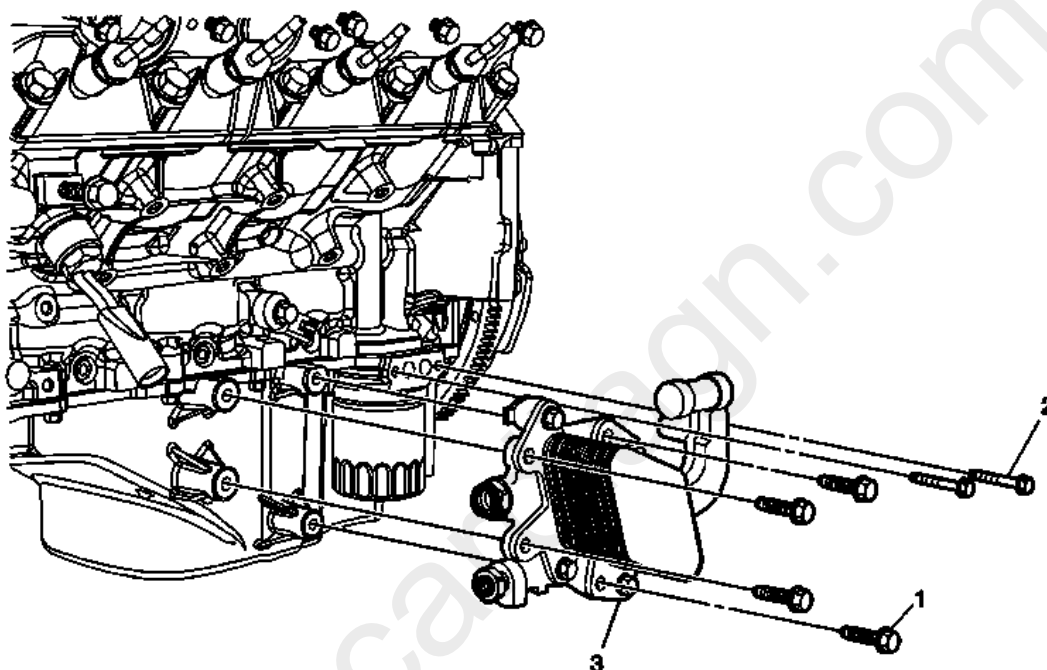


Fig. 112: Identifying Engine Oil Cooler
Courtesy of GENERAL MOTORS COMPANY

Engine Oil Cooler Replacement

Callout	Component Name
Preliminary Procedure Remove the engine oil cooler hose/pipe. Refer to <u>Engine Oil Cooler Hose/Pipe Replacement</u> .	
1	Engine Oil Cooler Fastener (Qty: 2) CAUTION: Refer to <u>Component Fastener Tightening Caution</u> .

	Tighten 10 N.m (89 lb in)
2	Engine Oil Cooler Fastener (Qty: 5) Tighten 25 N.m (18 lb ft)
3	Engine Oil Cooler Procedure 1. Transfer components as necessary 2. Ensure the full oil level after installation.

ENGINE OIL COOLER HOSE/PIPE REPLACEMENT

Special Tools

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LFW or LFX), Cooling System Draining and Filling (GE 47716 LSA).
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle

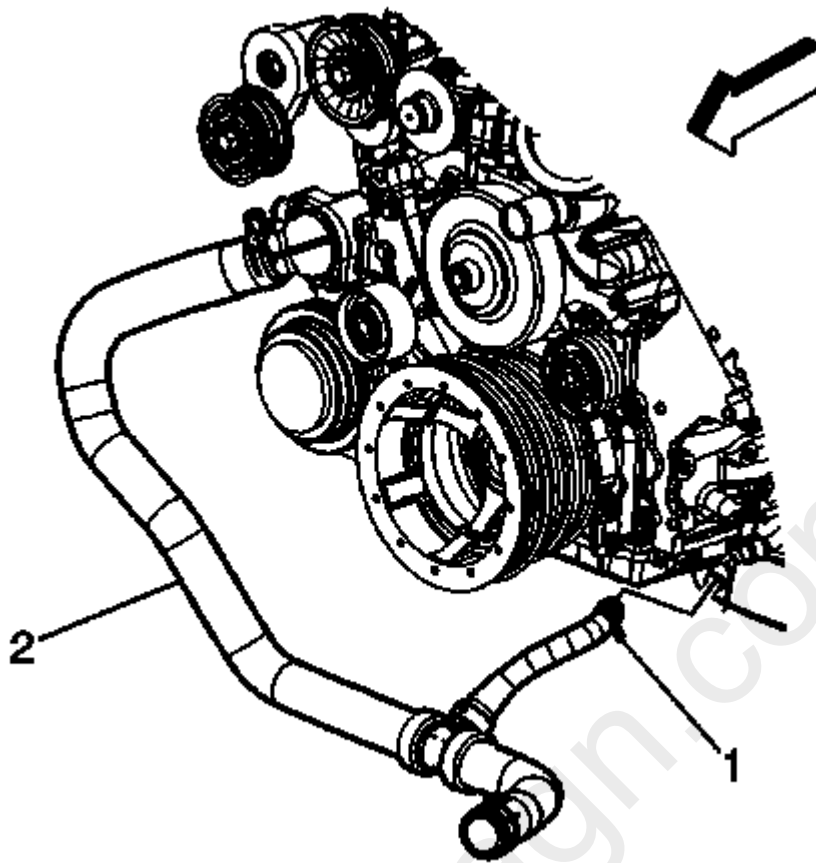


Fig. 113: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS COMPANY

3. Reposition the radiator hose clamp (1) at engine oil cooler hose using **J 38185** Hose Clamp Pliers.
4. Remove the radiator hose (2) from the engine oil cooler hose.
5. Remove the left engine splash shield.
6. Remove the air cleaner resonator outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement**
7. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement**

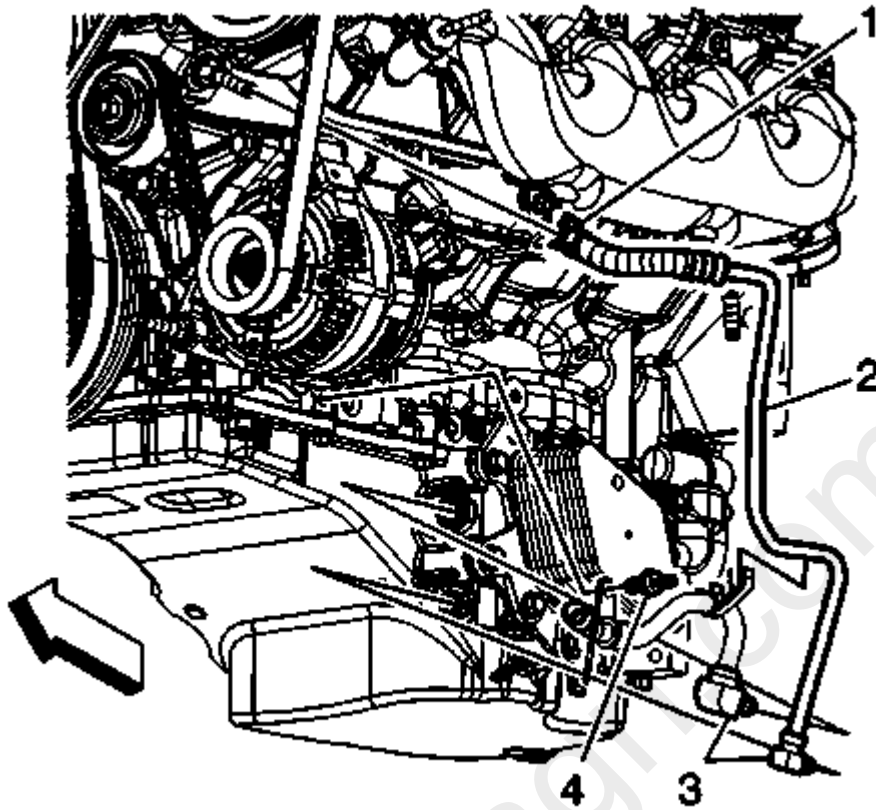


Fig. 114: Identifying Engine Oil Cooler Hose Components
Courtesy of GENERAL MOTORS COMPANY

8. Reposition the engine oil cooler hose clamp (1) at engine using J 38185 Hose Clamp Pliers.
9. Remove the engine oil cooler hose (2) from the engine.
10. Remove the engine oil cooler bolt (4) from the engine.
11. Disconnect the engine oil cooler hoses (3) from the engine.
12. Remove the engine oil cooler hoses from the vehicle.

Installation Procedure

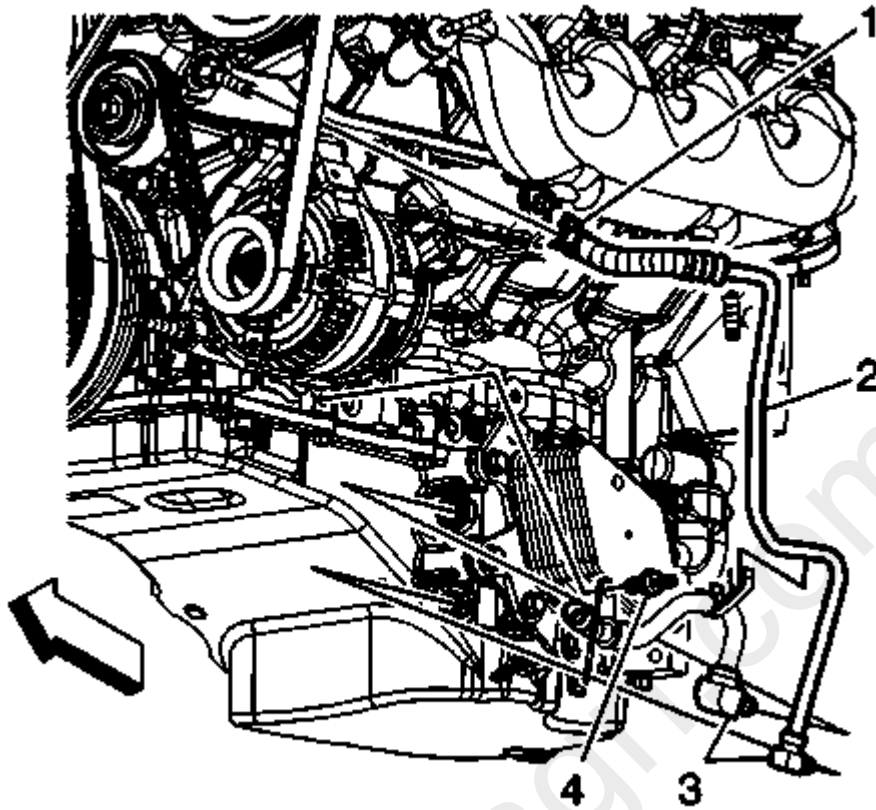


Fig. 115: Identifying Engine Oil Cooler Hose Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine oil cooler hoses to the vehicle.
2. Connect the engine oil cooler hoses (3) to the engine.
3. Install the engine oil cooler bolt (4) from the engine.
4. Install the engine oil cooler hose (2) to the engine.
5. Reposition the engine oil cooler hose clamp (1) at engine using **J 38185** Hose Clamp Pliers.

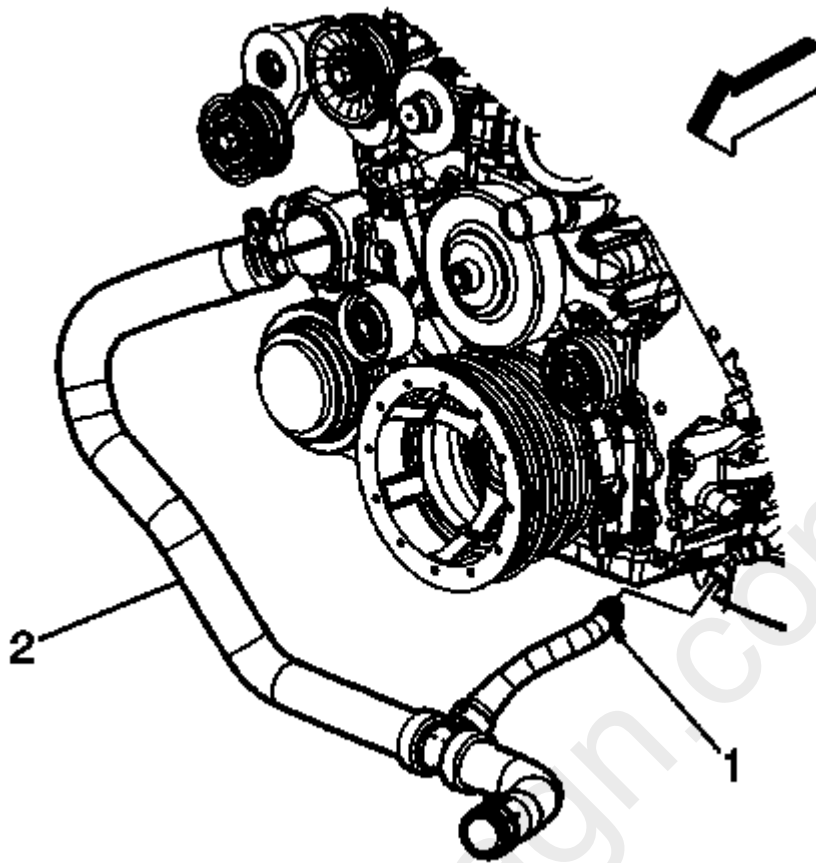


Fig. 116: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS COMPANY

6. Install the radiator hose (2) to the engine oil cooler hose.
7. Reposition the radiator hose clamp (1) at the engine oil cooler hose using **J 38185** Hose Clamp Pliers.
8. install the air cleaner. Refer to **Air Cleaner Assembly Replacement**
9. Install the air cleaner resonator outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement**
10. Install the left engine splash shield.
11. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
12. Fill the charge air cooler coolant. Refer to **Charge Air Cooling System Draining and Filling (Static)**, **Charge Air Cooling System Draining and Filling (GE 47716)**.

ENGINE COOLANT FAN REPLACEMENT (LSA)

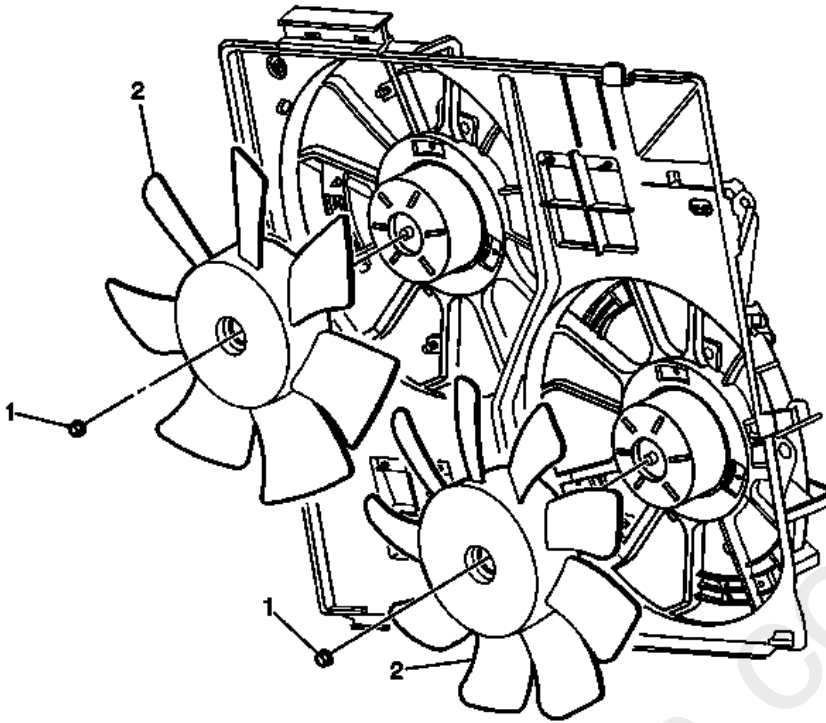


Fig. 117: Identifying Engine Coolant Fan (LSA)
Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Replacement (LSA)

Callout	Component Name
Preliminary Procedures 1. Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LSA)</u> 2. Remove the fan motor wire connector at the fan shroud retainers.	
1	Cooling Fan Retainer CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
2	Cooling Fan

ENGINE COOLANT FAN REPLACEMENT (LFW OR LFX)

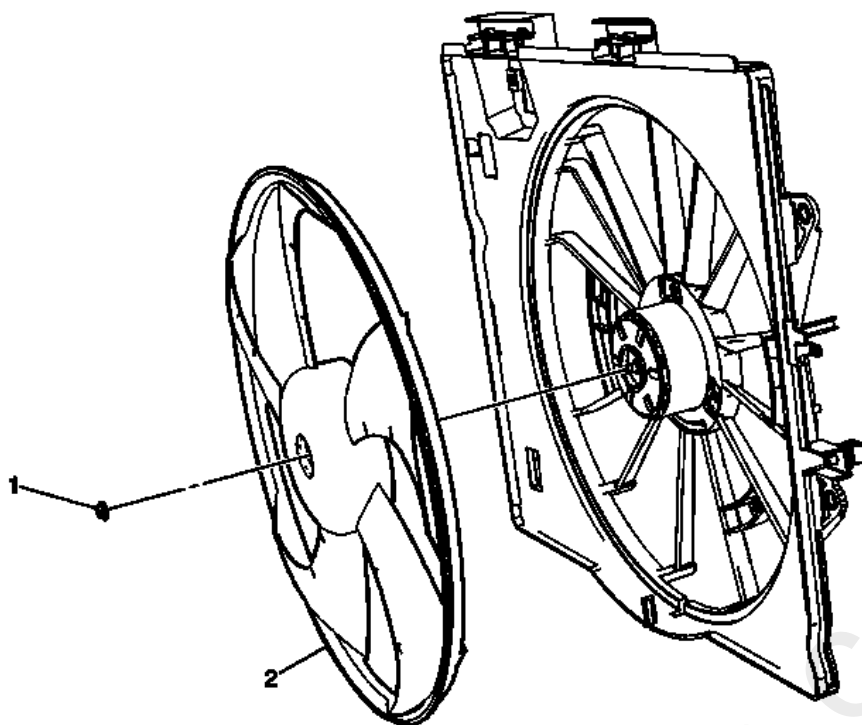


Fig. 118: Identifying Engine Coolant Fan
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Replacement (LFW or LFX)

Callout	Component Name
Preliminary Procedures	
Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LFW or LFX)</u>	
1	Cooling Fan Retainer CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
2	Cooling Fan

ENGINE COOLANT FAN MOTOR REPLACEMENT (LSA)

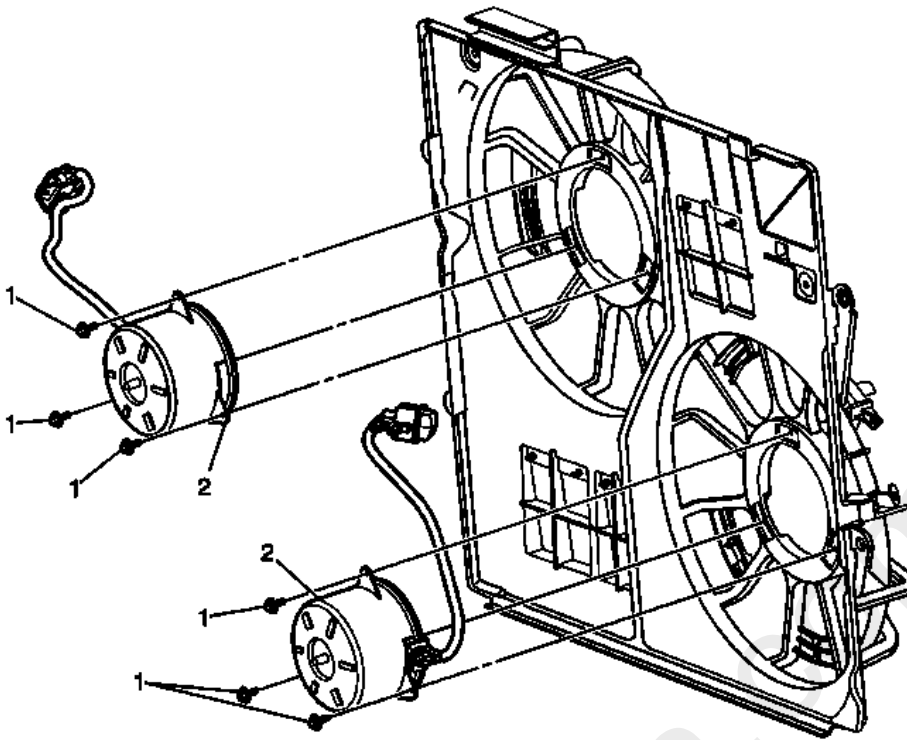


Fig. 119: Identifying Engine Coolant Fan Motor (LSA)

Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Motor Replacement (LSA)

Callout	Component Name
Preliminary Procedures	
1. Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LSA)</u> . 2. Remove the cooling fan. Refer to <u>Engine Coolant Fan Replacement (LSA)</u> .	
1	Cooling Fan Motor Retaining Screw (Qty: 6) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
2	Cooling Fan Motor

ENGINE COOLANT FAN MOTOR REPLACEMENT (LFW, LFX)

Removal Procedure

1. Remove the cooling fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LFW or LFX)**
2. Remove the cooling fan. Refer to **Engine Coolant Fan Replacement (LFW or LFX)**

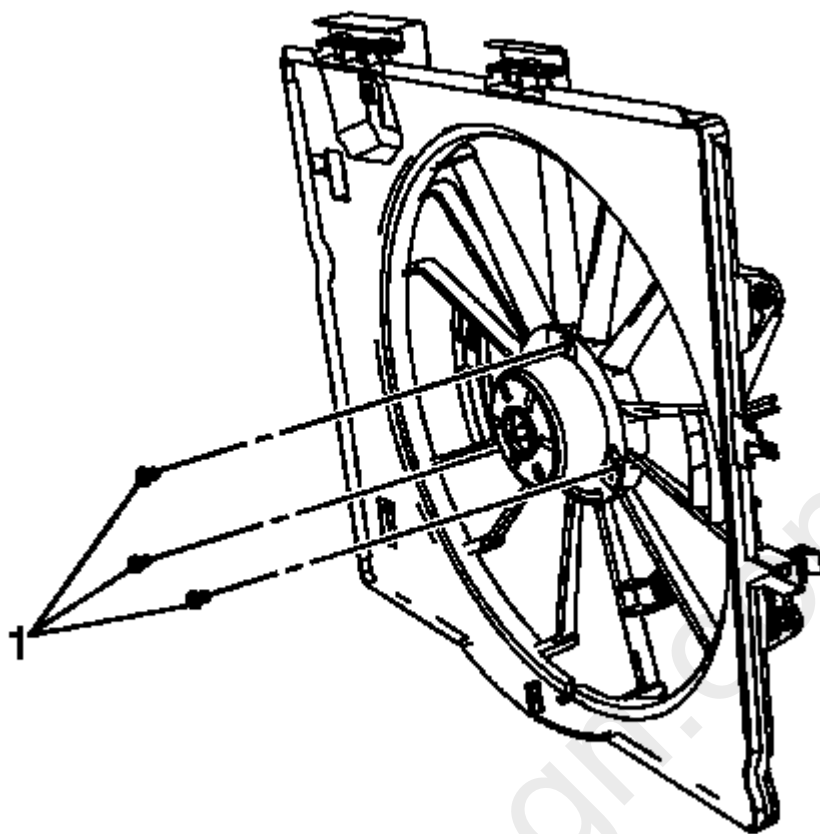


Fig. 120: Identifying Motor Retaining Screws
Courtesy of GENERAL MOTORS COMPANY

3. Remove the motor retaining screws (1).

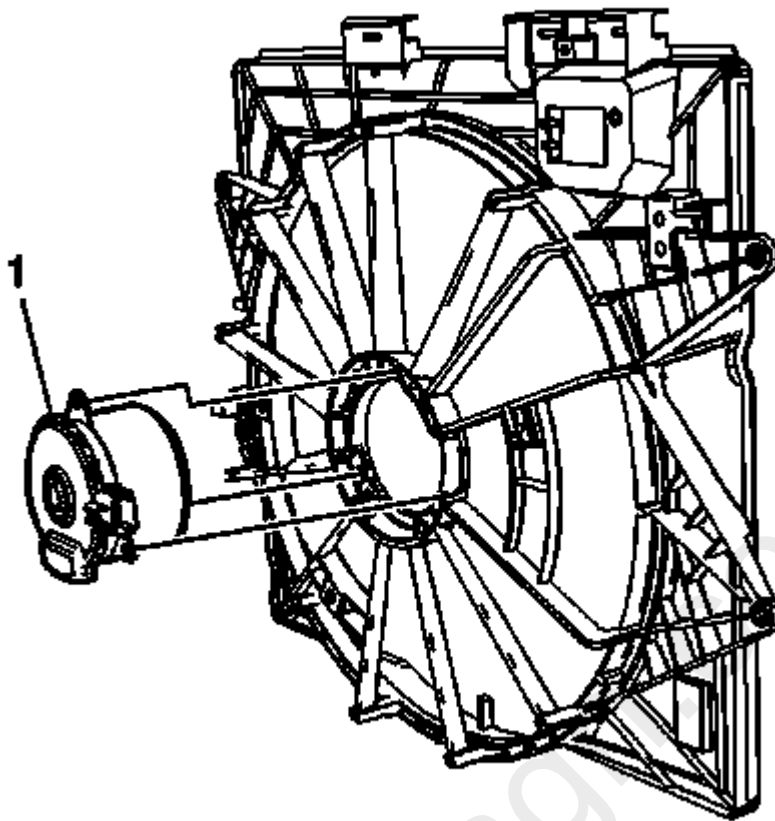


Fig. 121: Identifying Motor
Courtesy of GENERAL MOTORS COMPANY

4. Remove the motor from the shroud (1).

Installation Procedure

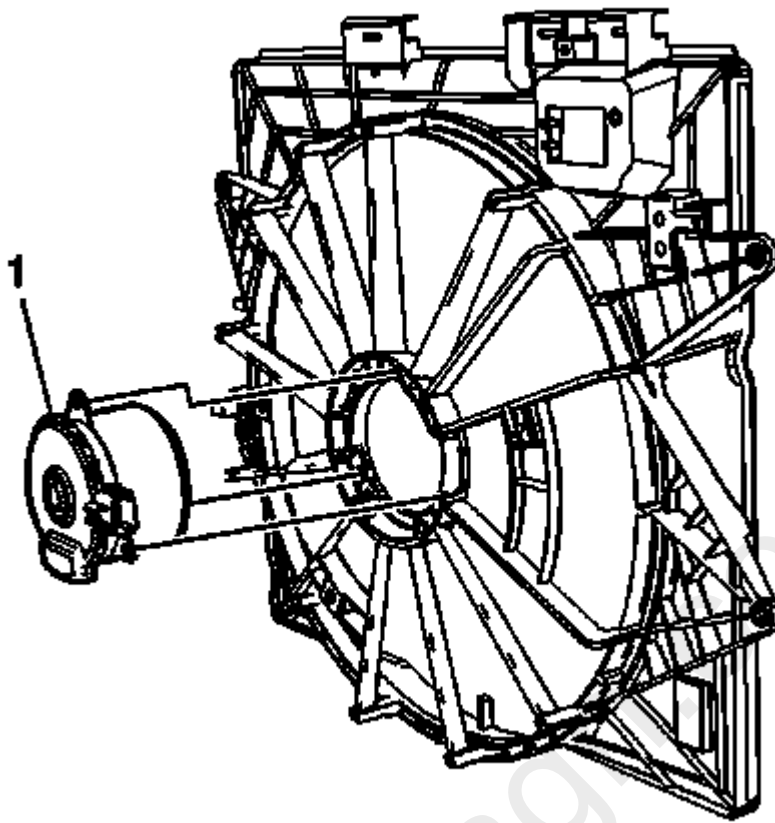


Fig. 122: Identifying Motor

Courtesy of GENERAL MOTORS COMPANY

1. Install the motor to the shroud (1).

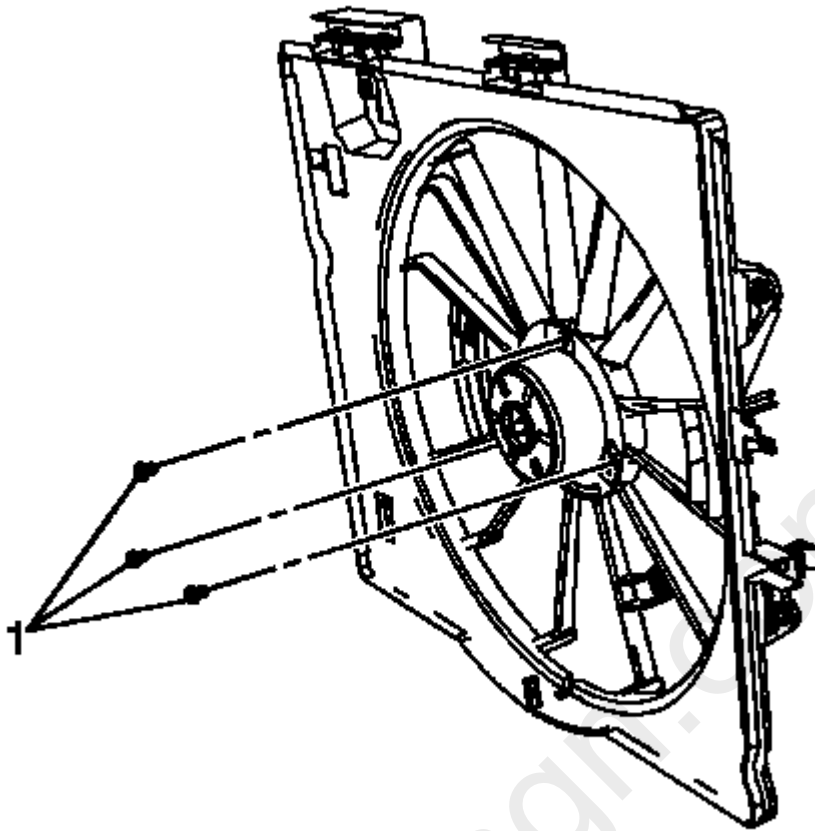


Fig. 123: Identifying Motor Retaining Screws
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the motor retaining screws (1) and tighten to 7 N.m (62 lb in).
3. Install the cooling fan. Refer to **Engine Coolant Fan Replacement (LFW or LFX)**
4. Install the cooling fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LFW or LFX)**

ENGINE COOLANT FAN RESISTOR REPLACEMENT (LFW, LFX)

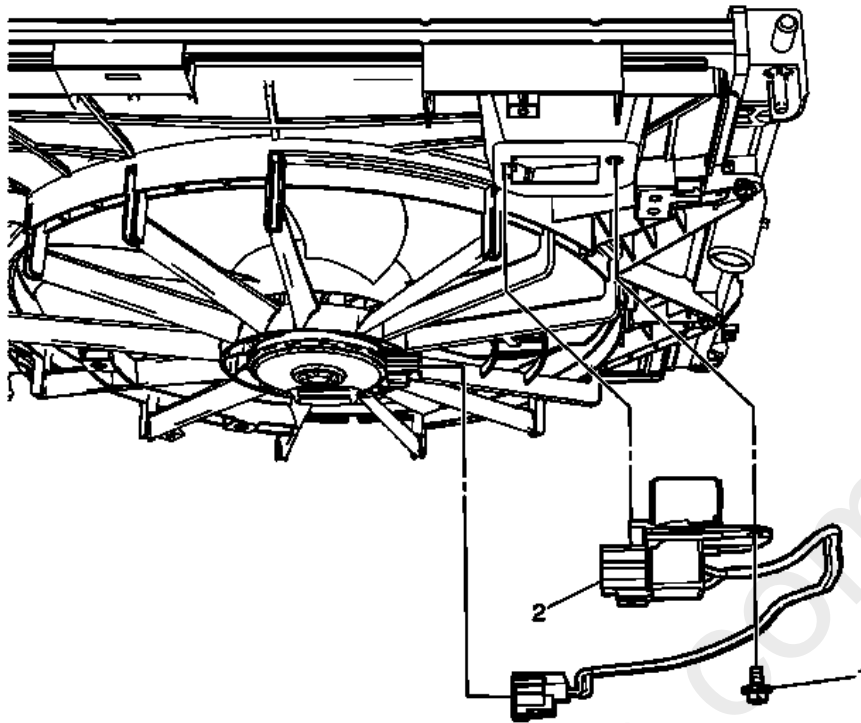


Fig. 124: Identifying Engine Coolant Fan Resistor
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Resistor Replacement (LFW, LFX)

Callout	Component Name
Preliminary Procedures 1. Disconnect the engine cooling fan resistor connector. 2. Disconnect the engine cooling fan electrical connector.	
1	Engine Cooling Fan Resistor Fasteners CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5.4 N.m (48 lb in)
2	Engine Cooling Fan Resistor

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LFW OR LFX)

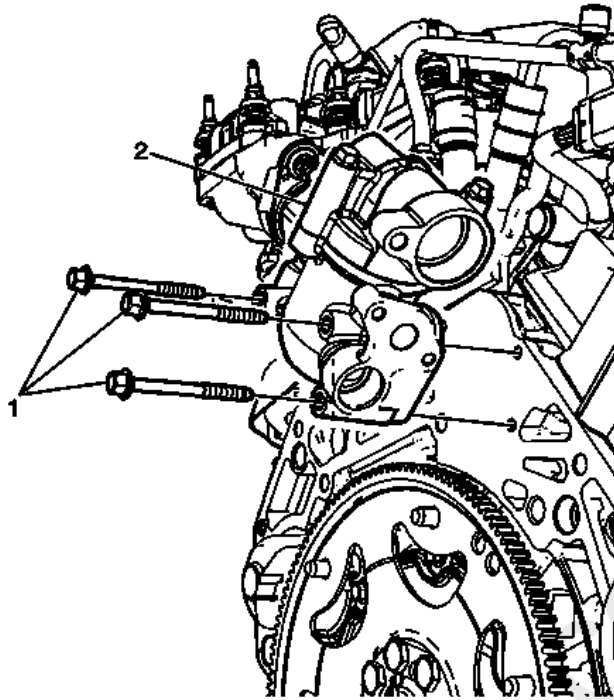


Fig. 125: Engine Coolant Thermostat Housing
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Thermostat Housing Replacement (LFW or LFX)

Callout	Component Name
Preliminary Procedures 1. Remove the fuel pipe shield. Refer to <u>Fuel Pipe Shield Replacement</u> . 2. Disconnect the engine coolant inlet pipe. Refer to <u>Engine Coolant Inlet Pipe Replacement</u>. 3. Disconnect the radiator inlet and outlet hoses. Refer to <u>Heater Inlet Hose Replacement</u> , and <u>Heater Outlet Hose Replacement</u> . 4. Disconnect the outlet pipe from the thermostat housing. Refer to <u>Radiator Surge Tank Engine Hose Replacement (LFW or LFX)</u>.	
1	Thermostat Housing Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT REPLACEMENT (LSA)

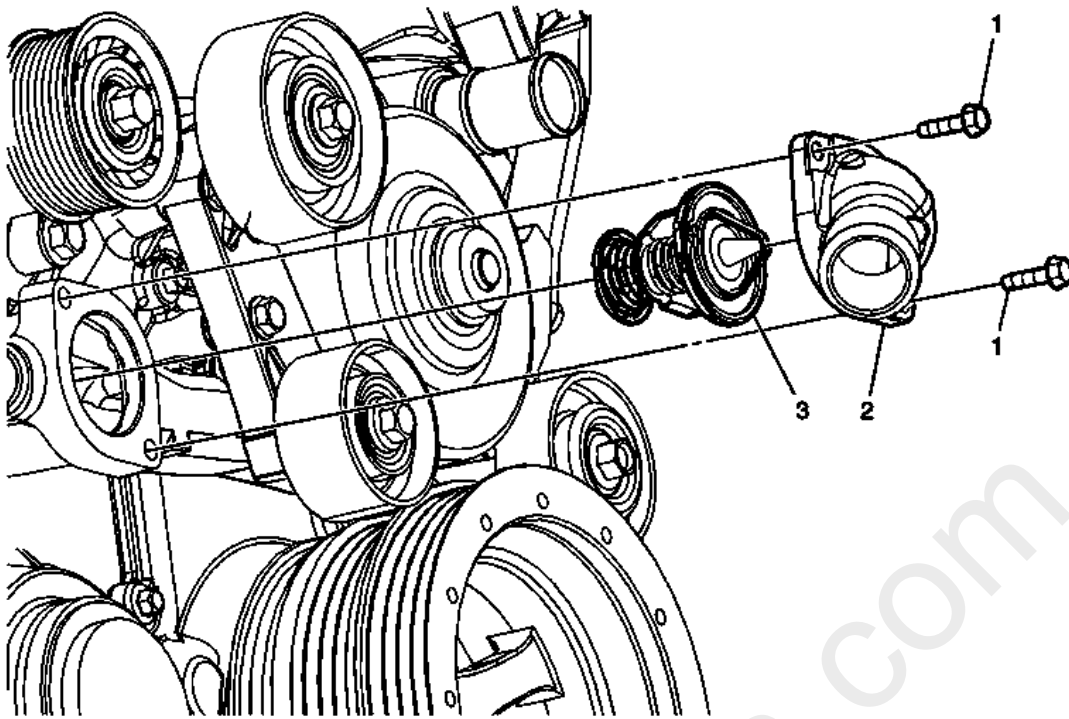


Fig. 126: Identifying Engine Coolant Thermostat (V8)
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Thermostat Replacement (LSA)

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LSA). 2. Remove the engine cooling fan. Refer to Engine Coolant Fan Replacement (LSA). 3. Disconnect the radiator inlet hose and position aside. Refer to Radiator Inlet Hose Replacement (LSA).	
1	Water Pump Inlet Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 15 N.m(11 lb ft)
2	Water Pump Inlet
3	Engine Coolant Thermostat • The thermostat mating surfaces must be clean and free of debris.

- Always install a NEW seal on the thermostat.

ENGINE COOLANT THERMOSTAT REPLACEMENT (LFW OR LFX)

Removal Procedure

1. Partially drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (GE 47716 LFW or LFX).
2. Remove the upper intake manifold. Refer to Intake Manifold Replacement.
3. Disconnect the surge tank outlet pipe from the thermostat. Refer to Radiator Surge Tank Engine Hose Replacement (LFW or LFX).

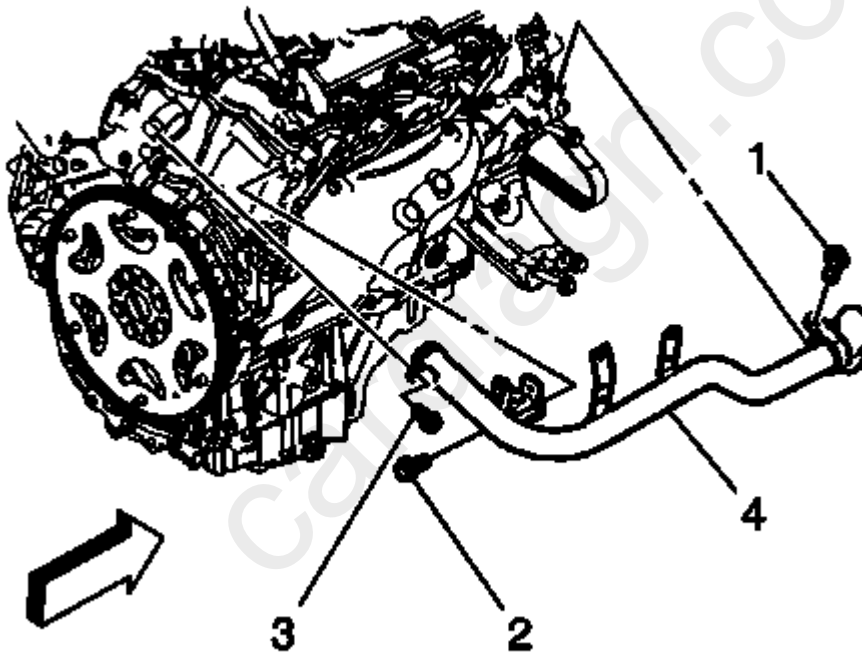


Fig. 127: Identifying Coolant Pipe/Thermostat Housing, Coolant Pipe Upper, And Coolant Inlet Pipe Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the coolant pipe/thermostat housing bolt (2).
5. Remove the coolant pipe upper bolt (3).
6. Remove the coolant inlet pipe (4) from the thermostat.

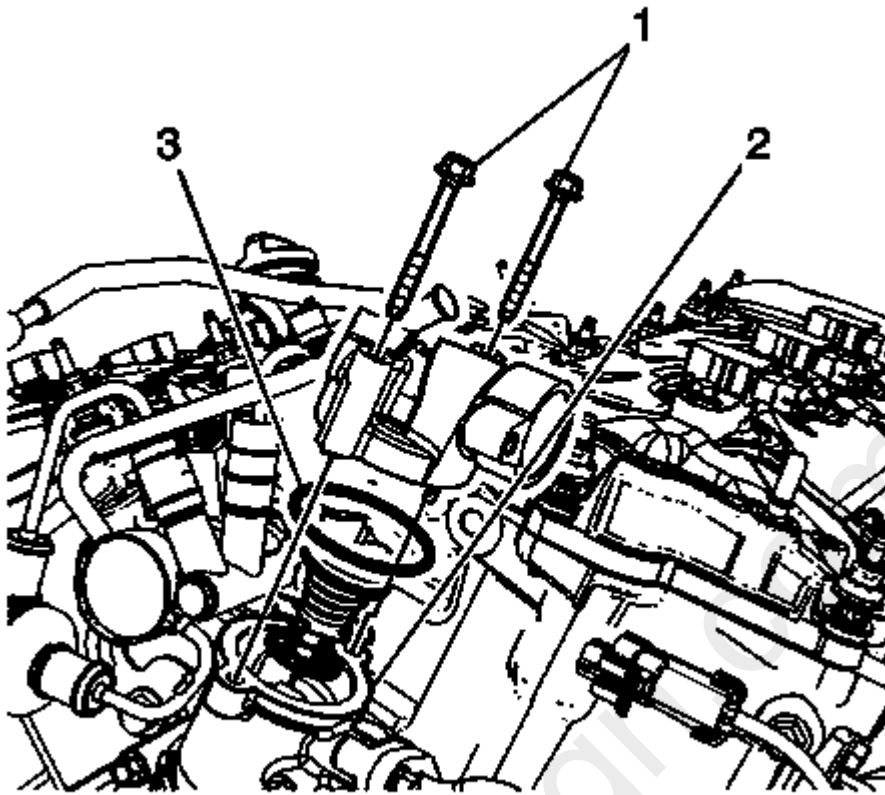


Fig. 128: View of Thermostat Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove the thermostat bolts (1).
8. Remove the thermostat (2) and discard the thermostat seal (3).

Installation Procedure

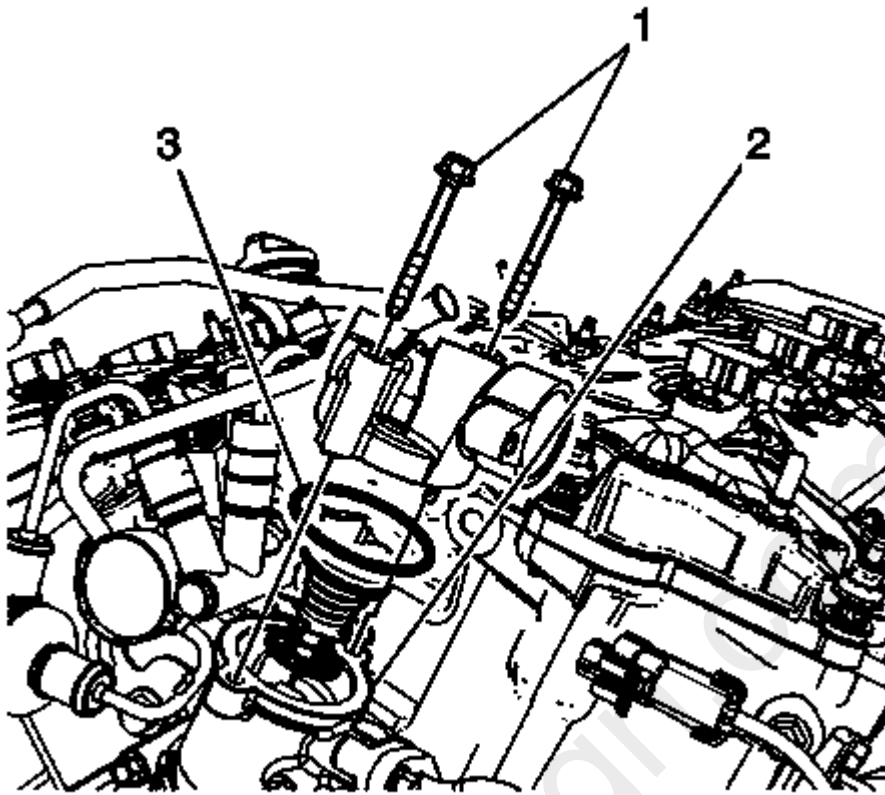


Fig. 129: View of Thermostat Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the thermostat (2) with a NEW thermostat seal (3).

CAUTION: Refer to Fastener Caution .

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

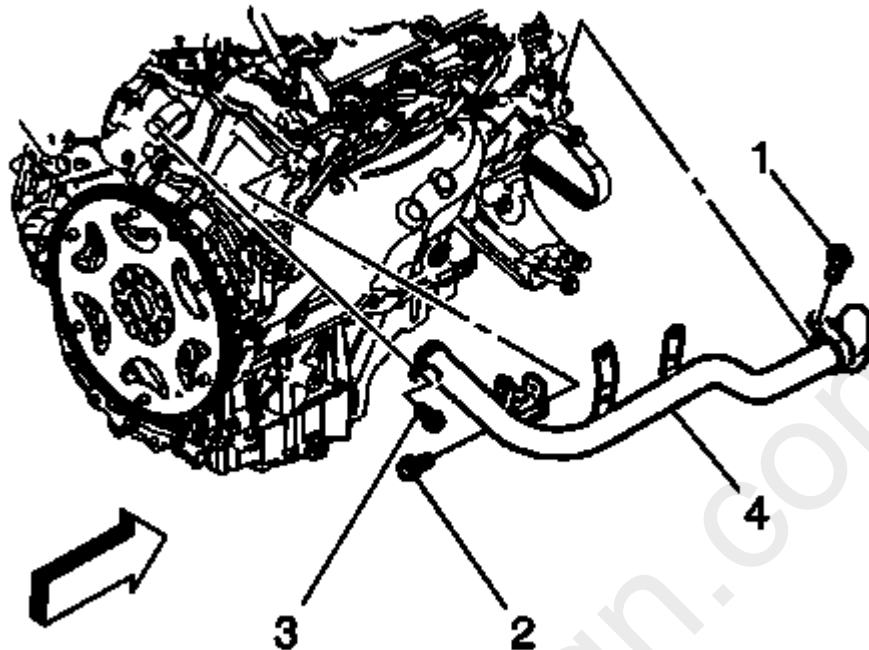


Fig. 130: Identifying Coolant Pipe/Thermostat Housing, Coolant Pipe Upper, And Coolant Inlet Pipe Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install the coolant pipe (4), NEW seal, and fasteners (2 and 3). Refer to **Engine Coolant Inlet Pipe Replacement**.
4. Connect the surge tank outlet pipe to the thermostat. Refer to **Radiator Surge Tank Engine Hose Replacement (LFW or LFX)**.
5. Install the upper intake manifold. Refer to **Intake Manifold Replacement**.
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**.

WATER OUTLET REPLACEMENT (LFW OR LFX)

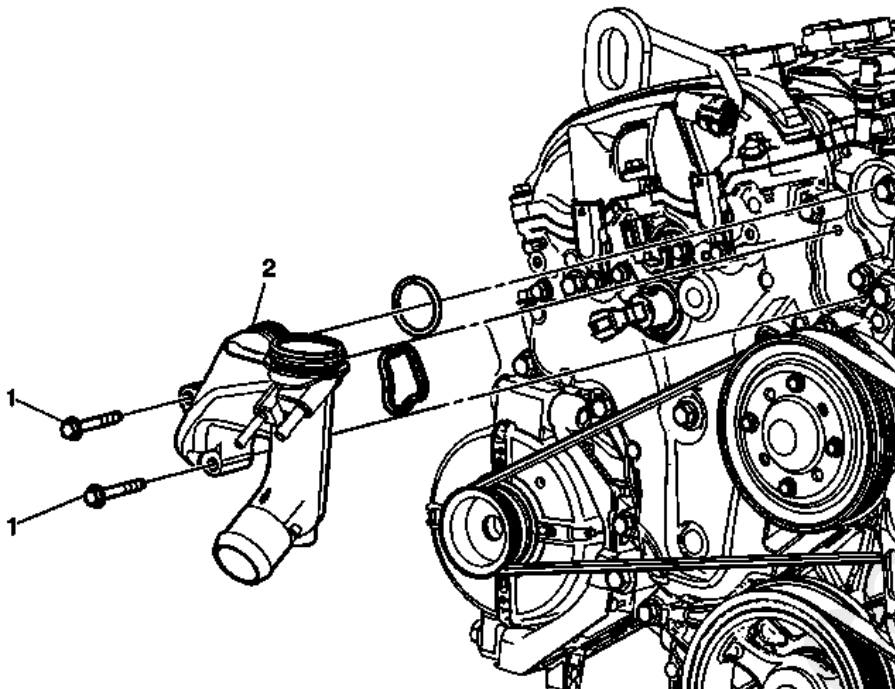


Fig. 131: Water Outlet
 Courtesy of GENERAL MOTORS COMPANY

Water Outlet Replacement (LFW or LFX)

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (GE 47716 LFW or LFX).</u> 2. Remove the intake manifold. Refer to <u>Intake Manifold Replacement</u>	
1	Bolt, Coolant Outlet Pipe (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Coolant Outlet Pipe Procedure 1. Disconnect the outlet radiator hose from the water outlet pipe 2. Disconnect the engine coolant air bleed hoses from the water outlet.

- | |
|------------------------------------|
| 3. Install NEW water outlet seals. |
|------------------------------------|

WATER PUMP REPLACEMENT (LSA)

Removal Procedure

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 (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LSA)**.
3. Remove the supercharger belt. Refer to **Supercharger Belt Replacement** .
4. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .
5. Remove the drive belt idler pulley. Refer to **Drive Belt Idler Pulley Replacement** .
6. Remove the supercharger belt idler pulley bracket. Refer to **Supercharger Belt Idler Pulley Bracket Replacement** .
7. Disconnect the radiator inlet hose from the water pump. Refer to **Radiator Inlet Hose Replacement (LSA)**.
8. Disconnect the radiator outlet hose from the water pump. Refer to **Radiator Outlet Hose Replacement (LSA)**.
9. Disconnect the heater inlet hose/pipe and heater outlet hose/pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement (LSA)** .

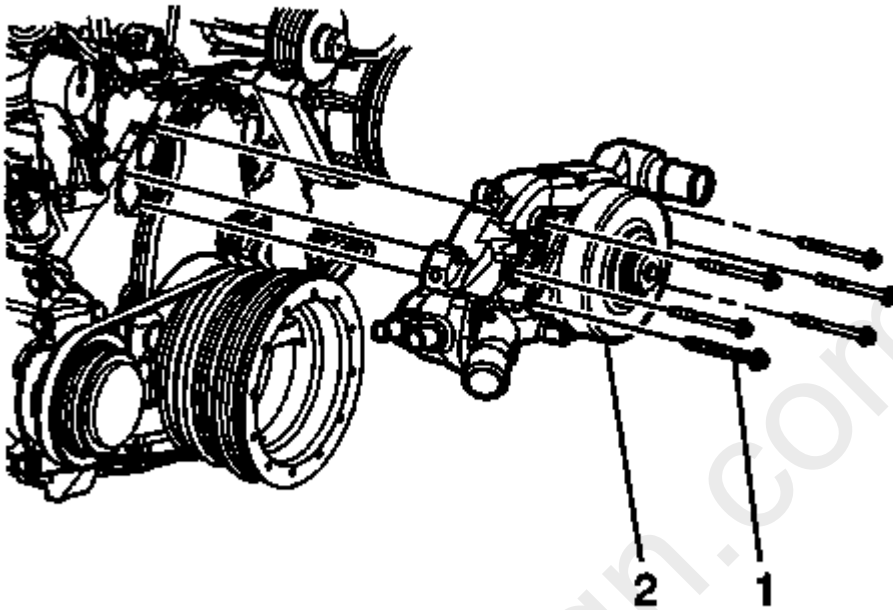


Fig. 132: Identifying Water Pump & Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the supercharger belt tensioner bracket. Refer to **Supercharger Belt Tensioner Bracket Replacement** .
11. Remove the water pump to block bolts (1).
12. Reposition pump to access oil cooler hose. Remove the clamp and pull pump away from the hose. Refer to **Engine Oil Cooler Hose/Pipe Replacement**.

NOTE: Always clean the water pump and engine block mating surfaces and discard the gaskets.

13. Remove the water pump (2).

Installation Procedure

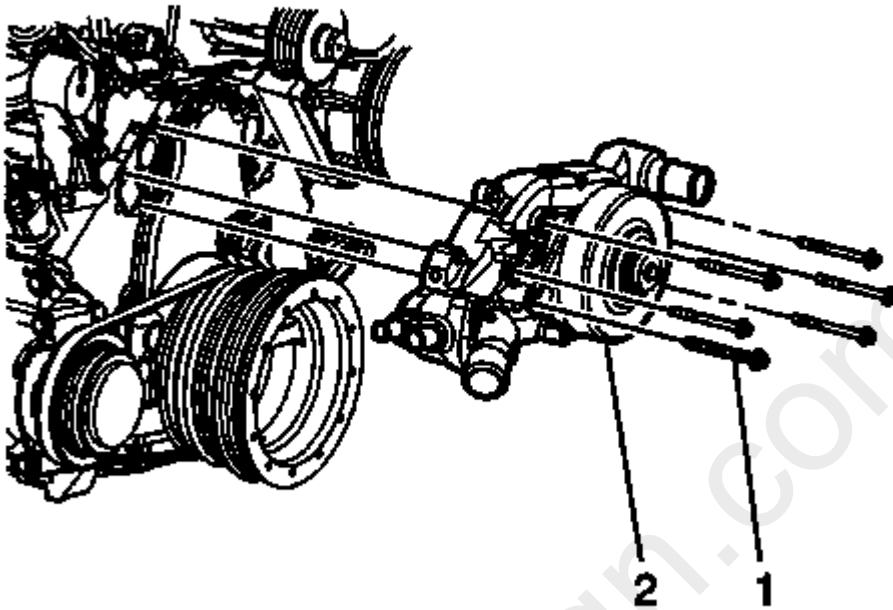


Fig. 133: Identifying Water Pump & Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: Always install a NEW water pump gasket.

1. Install the water pump to the engine block and tighten the bolts to 30 N.m (22 lb ft).
2. Install the supercharger belt tensioner bracket. Refer to **Supercharger Belt Tensioner Bracket Replacement** .
3. Install the heater inlet hose/pipe and heater outlet hose/pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement (LSA)** .
4. Install the supercharger belt idler pulley bracket. Refer to **Supercharger Belt Idler Pulley Bracket Replacement** .
5. Install the drive belt idler pulley. Refer to **Drive Belt Idler Pulley Replacement** .
6. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .
7. Install the supercharger belt. Refer to **Supercharger Belt Replacement** .
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling**

System Draining and Filling (GE 47716 LSA).

9. install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

WATER PUMP REPLACEMENT (LFX)

Special Tools

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (GE 47716 LFW or LFX).**
2. Remove the generator drive belt. Refer to **Drive Belt Replacement** .

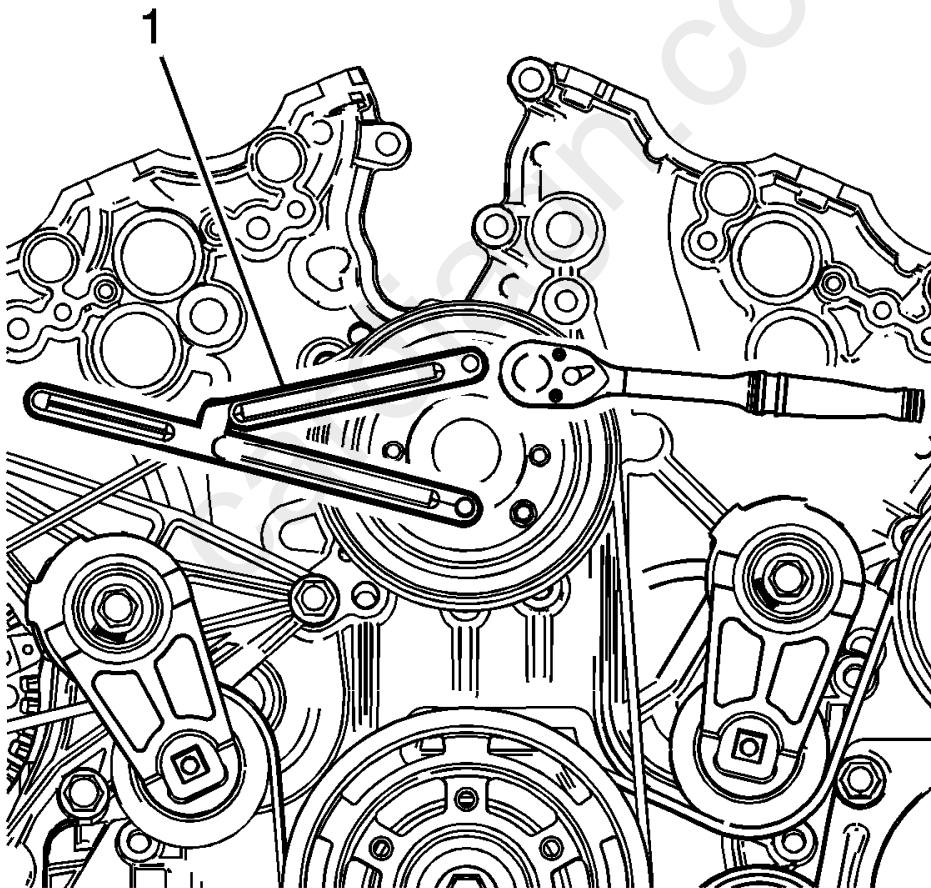


Fig. 134: Securing Water Pump Pulley With Water Pump Pulley Holder
Courtesy of GENERAL MOTORS COMPANY

3. Use the **EN 46104** water pump pulley holding tool (1) in order to retain the water pump pulley.

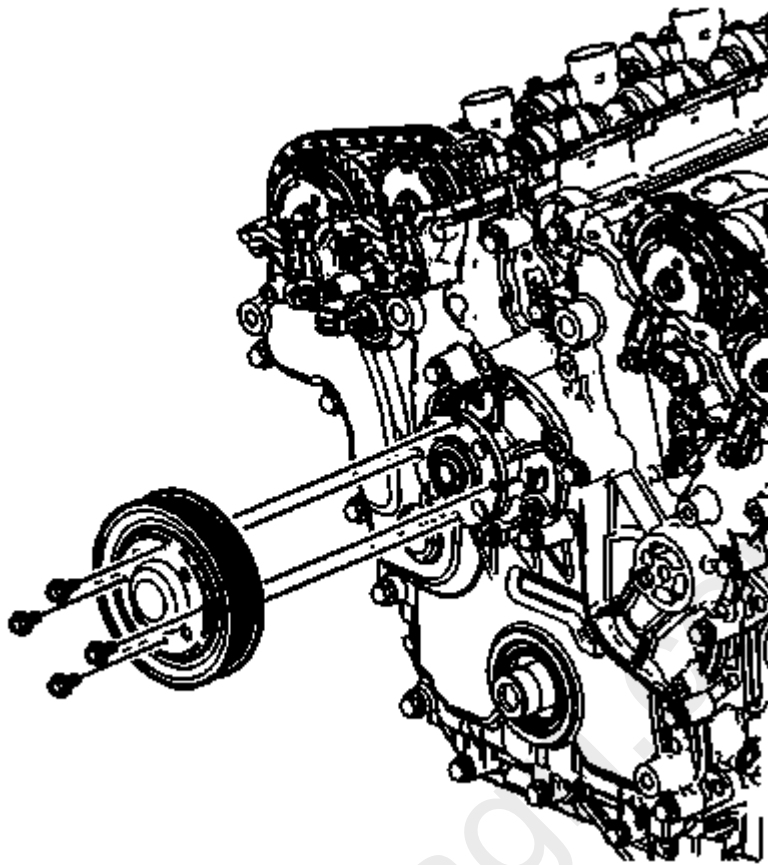


Fig. 135: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

4. Remove the water pump pulley bolts and DISCARD the bolts.

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

5. Remove the water pump pulley.

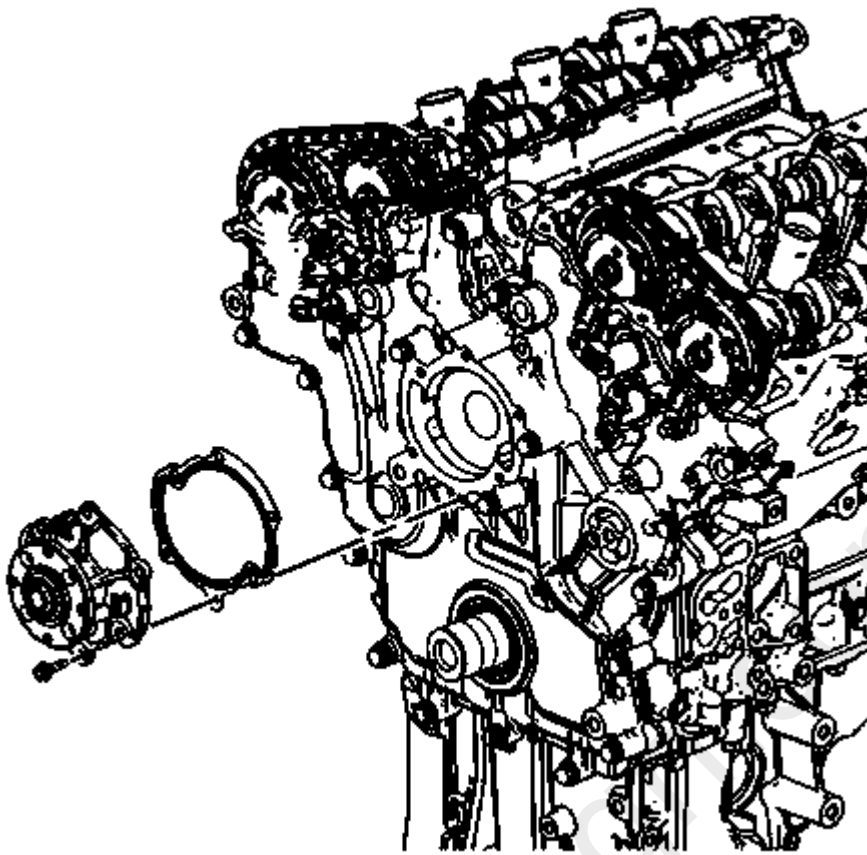


Fig. 136: View Of Water Pump
Courtesy of GENERAL MOTORS COMPANY

6. Remove the water pump bolts and DISCARD the bolts.
7. Remove the water pump.
8. Remove and DISCARD the water pump seal.
9. Carefully clean the water pump sealing surfaces.

Installation Procedure

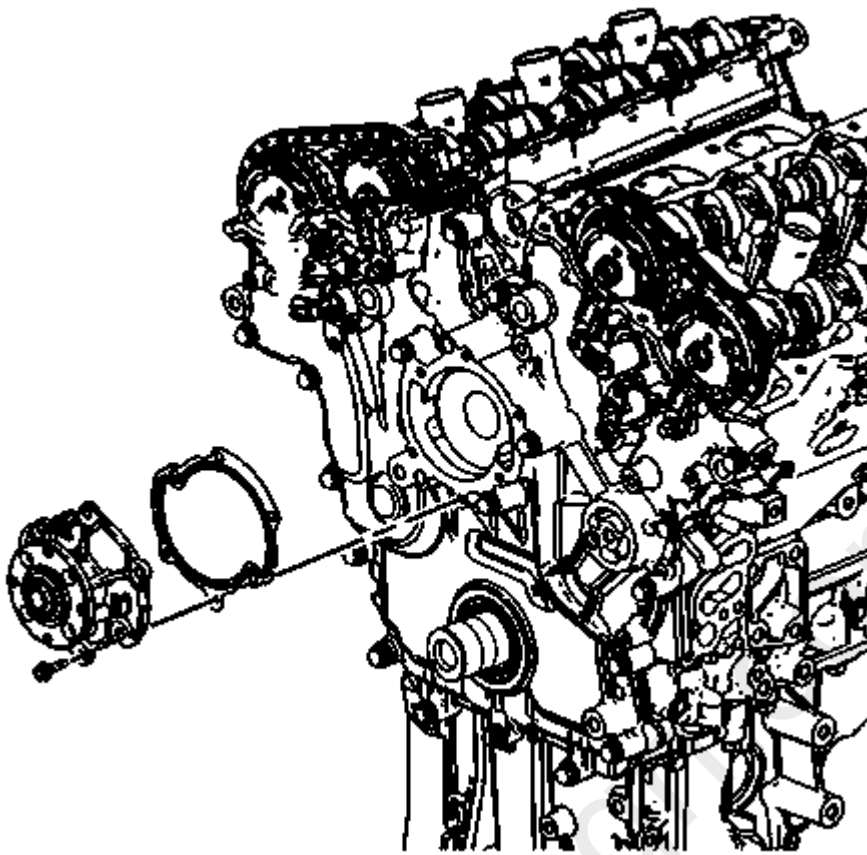


Fig. 137: View Of Water Pump

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW water pump seal.
2. Install the water pump.

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

CAUTION: Refer to Fastener Caution .

3. Install the NEW water pump bolts and hand tighten the water pump bolts.

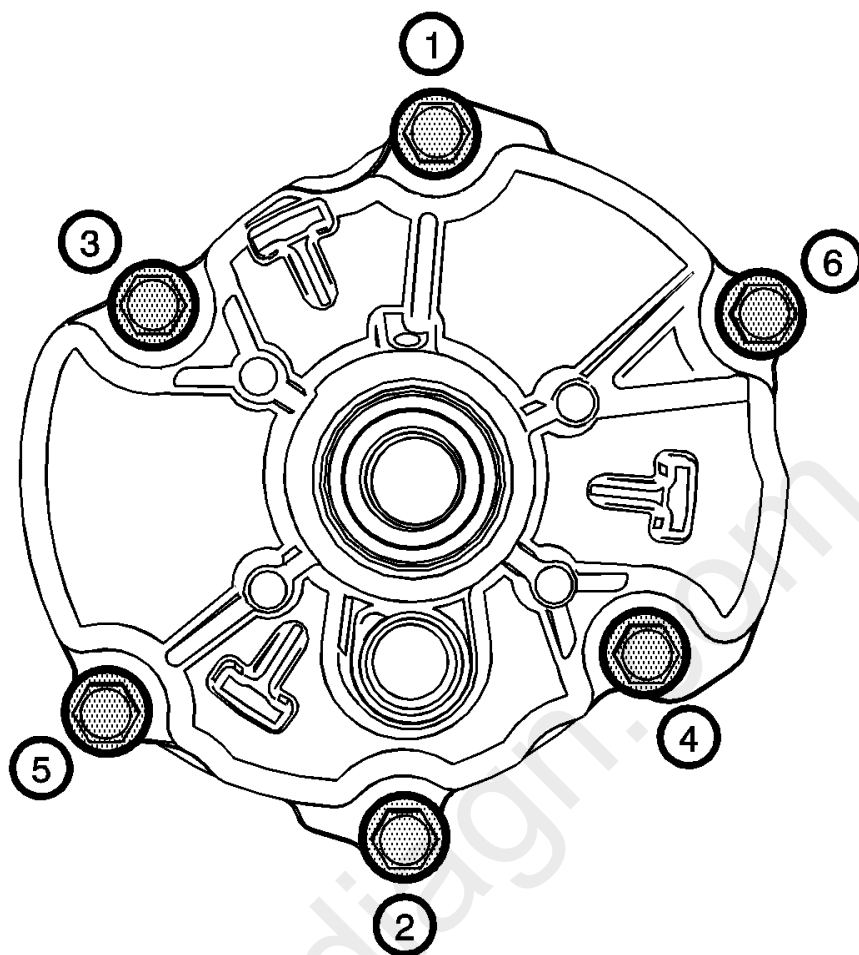


Fig. 138: Water Pump Bolts Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

4. Tighten the water pump bolts in sequence.
 1. On the initial pass, tighten the bolts in sequence to 10 (89 lb in).
 2. On the second pass, tighten the bolts in sequence to 10 (89 lb in).
 3. On the final pass, tighten the bolts in sequence shown an additional 45 degrees.

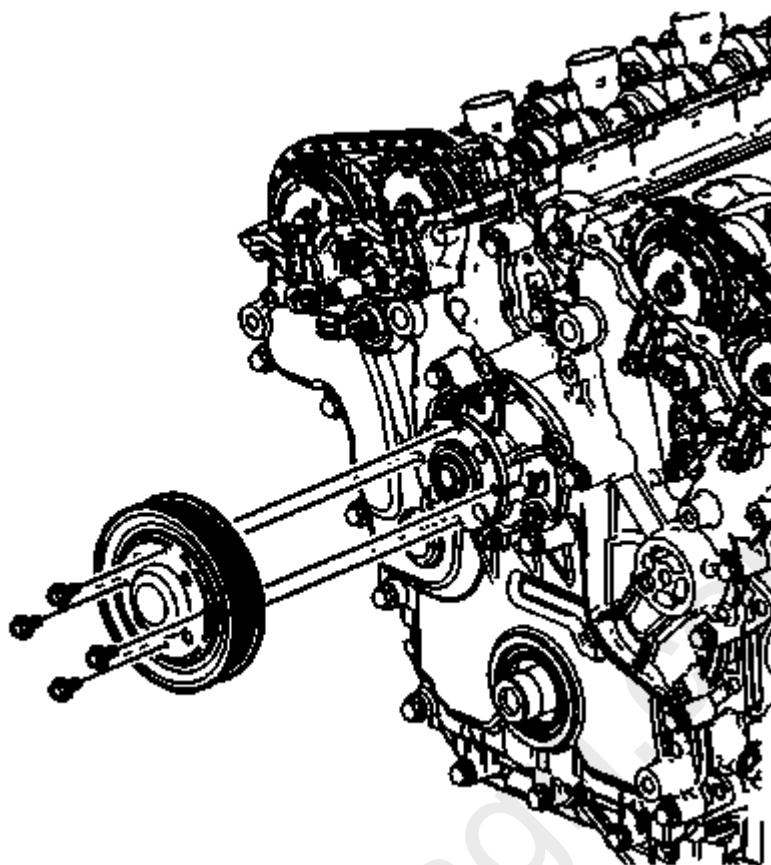


Fig. 139: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

5. Install the water pump pulley and the NEW water pump pulley bolts.

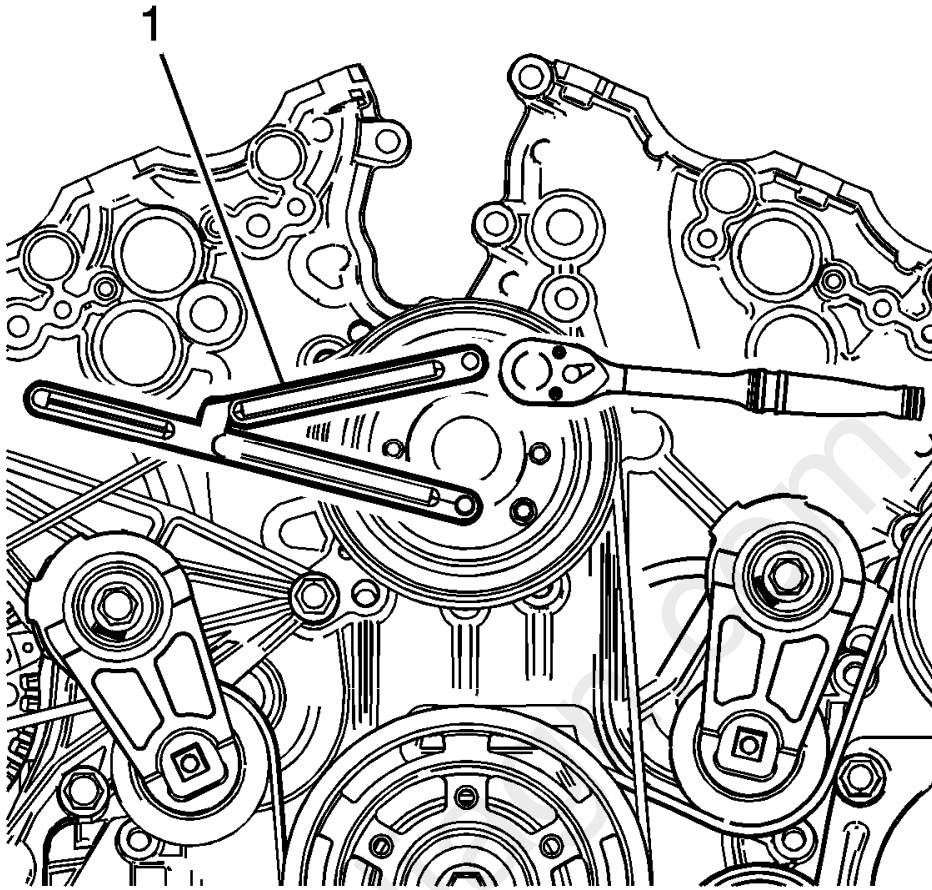


Fig. 140: Securing Water Pump Pulley With Water Pump Pulley Holder
Courtesy of GENERAL MOTORS COMPANY

6. Use the **EN 46104** water pump pulley holding tool (1) in order to retain the water pump pulley.
7. Install the water pump pulley bolts and tighten to 12 (106 lb in).
8. Install the generator drive belt. Refer to **Drive Belt Replacement** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX), Cooling System Draining and Filling (GE 47716 LFW or LFX).**

CHARGE AIR COOLER COOLANT PUMP REPLACEMENT

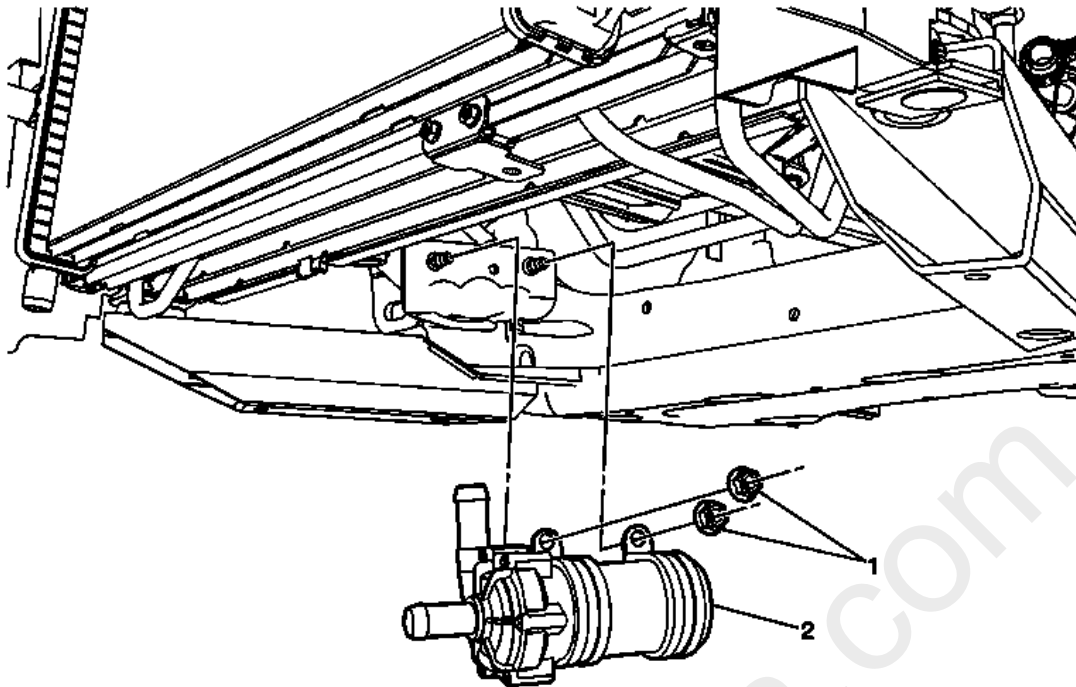
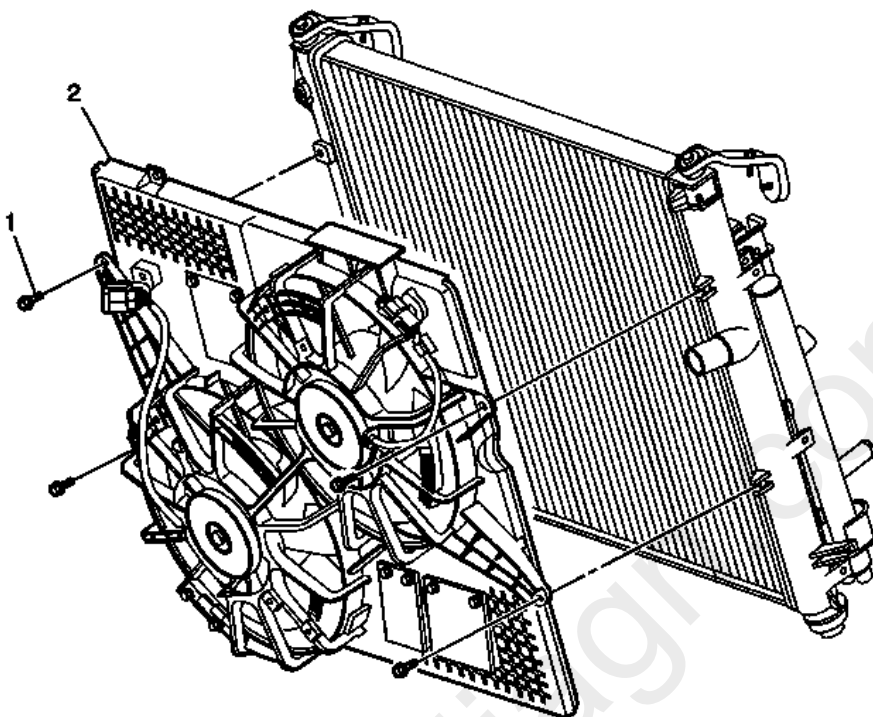


Fig. 141: Identifying Charge Air Cooler Coolant Pump
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Coolant Pump Replacement

Callout	Component Name
Preliminary Procedures 1. Drain the charged air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static), Charge Air Cooling System Draining and Filling (GE 47716)</u>. 2. Remove the front air deflector. Refer to <u>Front Air Deflector Replacement</u>. 3. Remove the charged air cooler coolant hose radiator to pump. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Radiator to Pump</u>. 4. Remove the charged air cooler coolant hose pipe to pump. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Pipe to Pump</u>. 5. Raise and support vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>.	
1	Charged Air Cooler Coolant Pump Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 16 N.m (12 lb ft)
	Charged Air Cooler Coolant Pump

ENGINE COOLANT FAN SHROUD REPLACEMENT (LSA)**Fig. 142: Identifying Engine Coolant Fan Shroud (LSA)**

Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Shroud Replacement (LSA)

Callout	Component Name
WARNING: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.	
Preliminary Procedures	
1. Remove the air cleaner. Refer to <u>Air Cleaner Assembly Replacement</u> .	
2. Remove the air cleaner resonator outlet duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u> .	
3. Remove the front compartment sight shield. Refer to <u>Front Compartment Sight Shields Replacement</u> .	
4. Remove the radiator inlet hose. Refer to <u>Radiator Inlet Hose Replacement (LSA)</u> .	
5. Disconnect the cooling fan electrical connectors.	
6. Remove the front air deflector. Refer to <u>Front Air Deflector Replacement</u> .	

	7. Remove any hoses or pipes. 8. Disconnect the condenser tube from the cooling fan shroud retainer clip. 9. Disengage the surge tank inlet hose from the retaining features on the cooling fan shroud and reposition aside.
1	Engine Cooling Fan Shroud Fastener (Qty: 4) CAUTION: Refer to Fastener Caution . TIP: Remove shroud/radiator clip. Tighten 5.4 N.m (48 lb in)
2	Engine Cooling Fan Shroud

ENGINE COOLANT FAN SHROUD REPLACEMENT (LFW OR LFX)

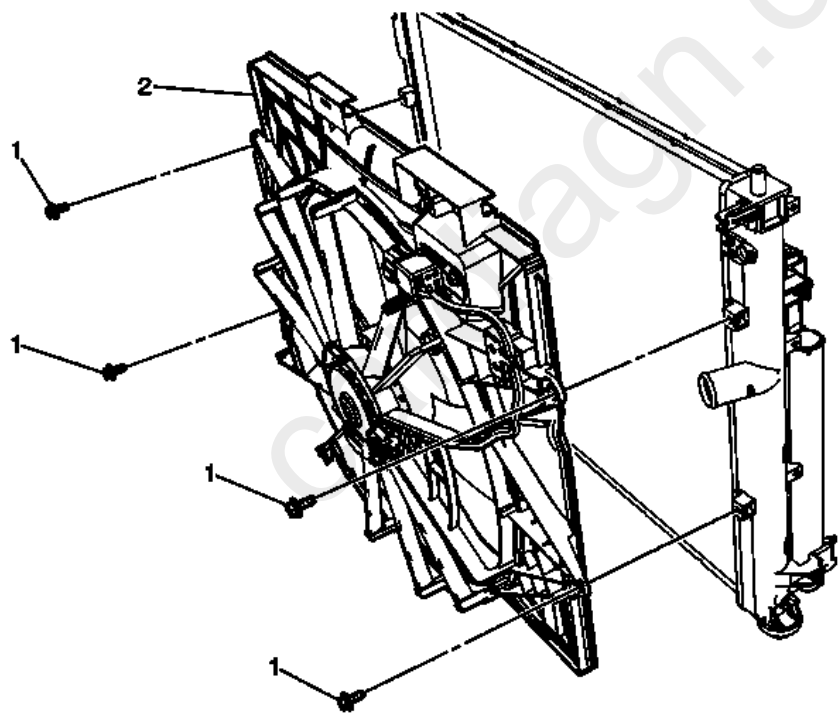


Fig. 143: Identifying Engine Coolant Fan Shroud
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Fan Shroud Replacement (LFW or LFX)

Callout	Component Name
Preliminary Procedures	

WARNING:

An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement**
2. Remove the front compartment sight shield. Refer to **Front Compartment Sight Shields Replacement**
3. Disconnect the cooling fan electrical connectors
4. Remove the auxiliary water pump and any hoses.
5. Remove any hoses or pipes.
6. Disconnect the condenser tube from the cooling fan shroud retainer clip.
7. Disengage the surge tank inlet hose from the retaining features on the cooling fan shroud and reposition aside.

1	Engine Cooling Fan Shroud Fasteners (Qty 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5.4 N.m (48 lb in)
2	Engine Cooling Fan Shroud

RADIATOR REPLACEMENT (STANDARD DUTY COOLING)**Special Tools**

- **J 38185** Hose Clamp Pliers Hose Clamp Pliers
- **J 38778** Door Trim Pad Clip Remover Door Trim Pad Clip Remover

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LSA)**.
2. Remove the electric cooling fan assembly. Refer to **Engine Coolant Fan Replacement (LSA)**, **Engine Coolant Fan Replacement (LFW or LFX)**.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

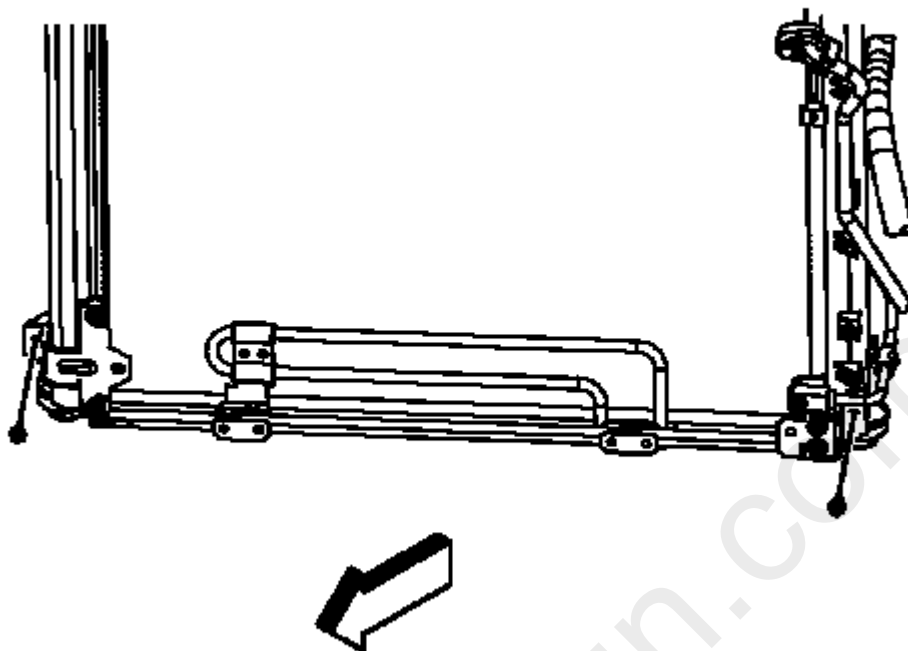


Fig. 144: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the lower condenser mounting bolts.

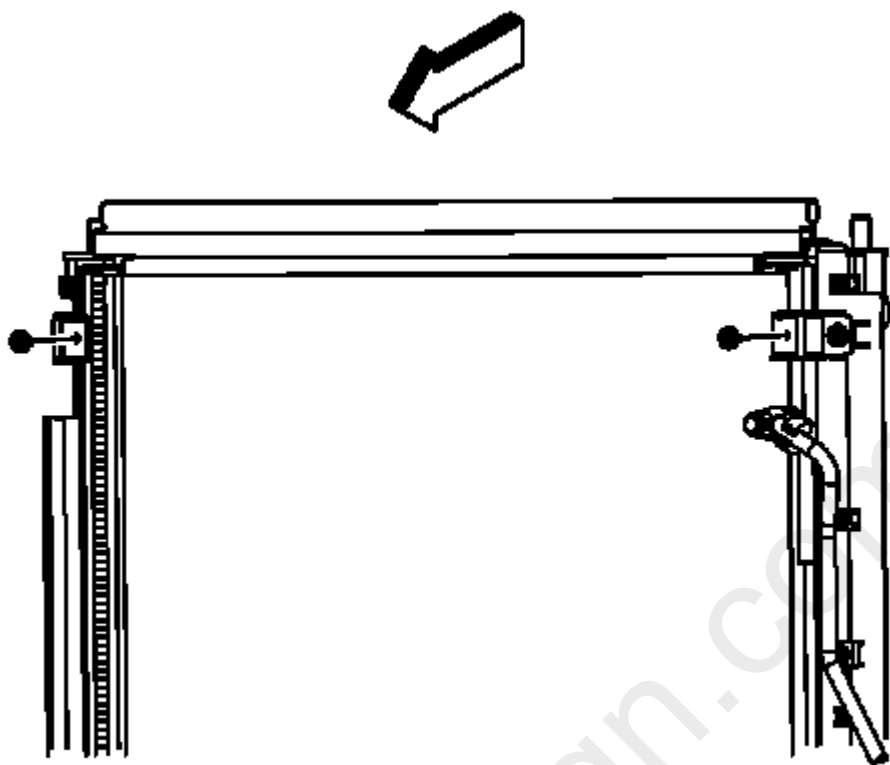


Fig. 145: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the upper condenser mounting bolts.

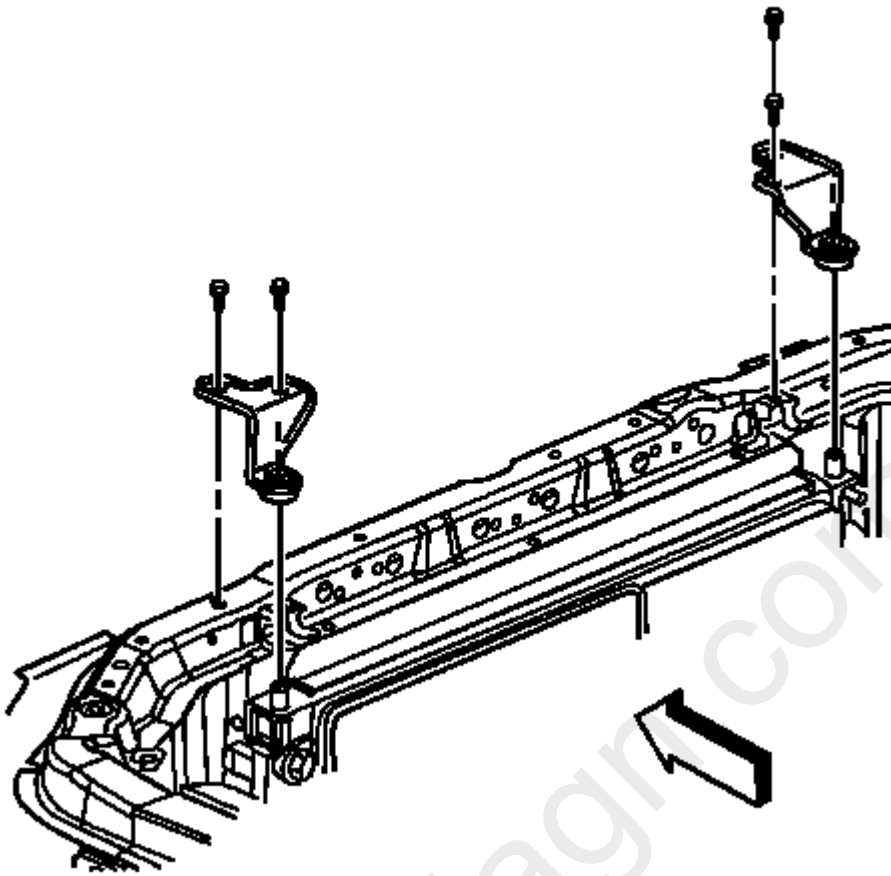


Fig. 146: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the lower retainer pins of the side air baffle from the radiator.
7. Lower the vehicle.
8. Remove the radiator support bracket bolts.
9. Remove the radiator support brackets.
10. Use **J 38778** door trim pad clip remover to remove the radiator/condenser upper support.

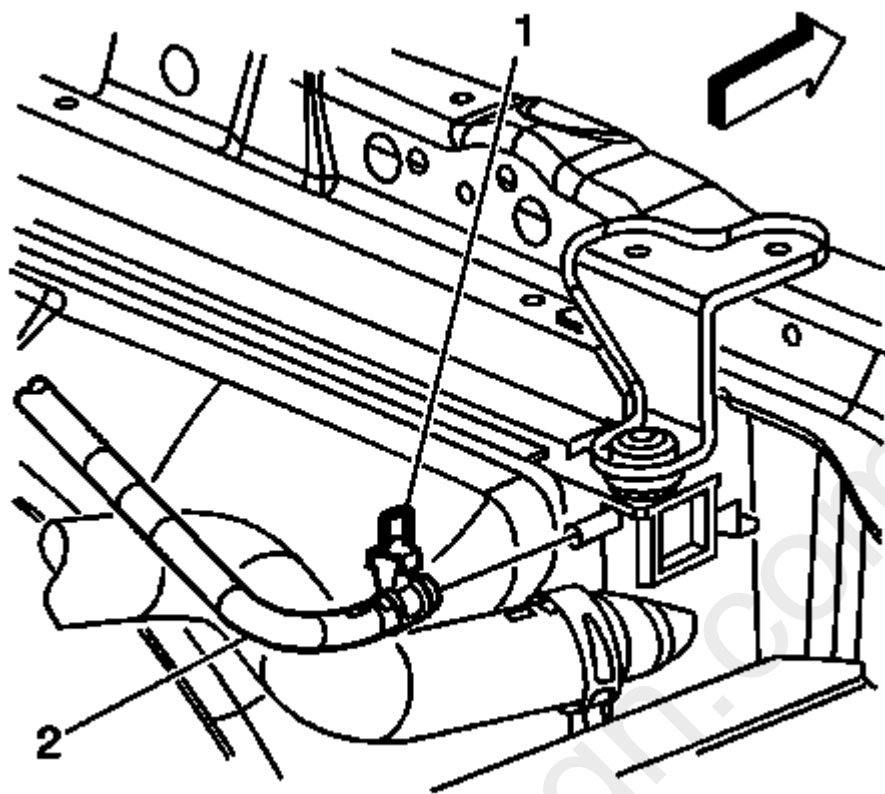


Fig. 147: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

11. Use J 38185 hose clamp pliers to disconnect the surge tank inlet hose from the radiator. Reposition the hose aside.

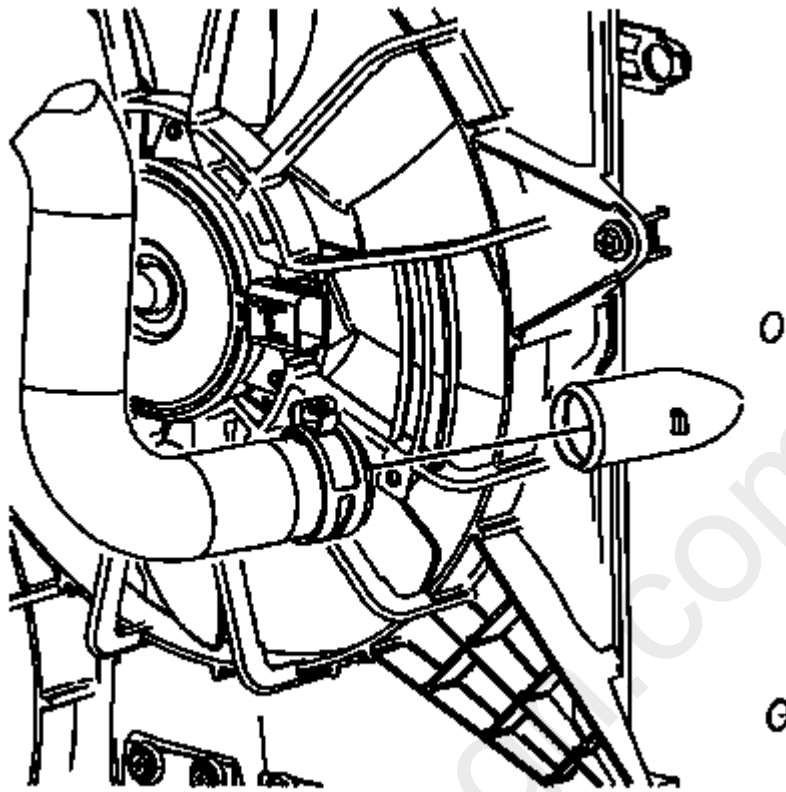


Fig. 148: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

12. Using **J 38185** hose clamp pliers , disengage tension on the radiator inlet hose clamp and disconnect the hose from the radiator.
13. Using **J 38185** hose clamp pliers , disengage tension on the radiator outlet hose clamp and disconnect the hose from the radiator.
14. Disconnect the upper retainer pins on the side air baffle from the radiator.
15. Remove the radiator.

Installation Procedure

1. Install the radiator.
2. Connect the upper retainer pins of the side air baffle to the radiator.
3. Connect the radiator outlet hose to the radiator. Use **J 38185** hose clamp pliers to position the radiator outlet hose clamp to secure the hose.

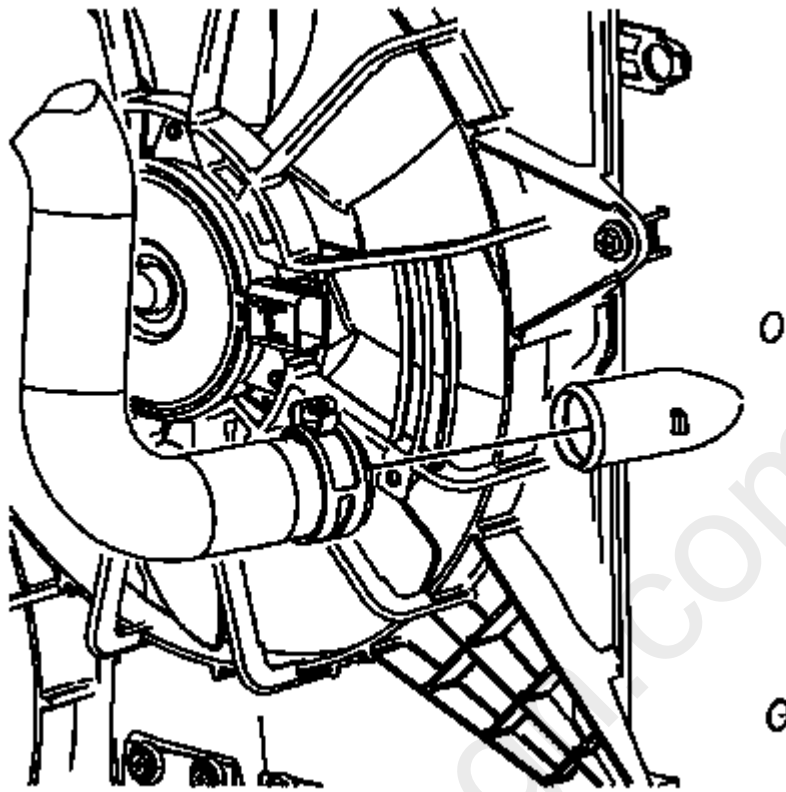


Fig. 149: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Connect the radiator inlet hose to the radiator. Use J 38185 hose clamp pliers to position the radiator inlet hose clamp to secure the hose.

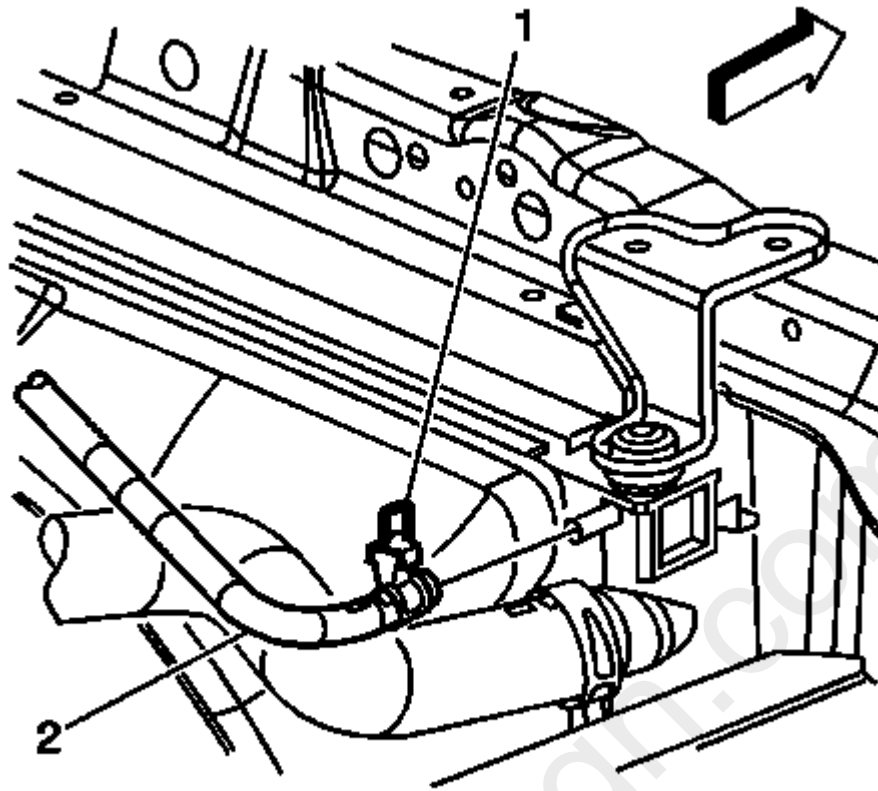


Fig. 150: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Connect the surge tank inlet hose to the radiator. Use J 38185 hose clamp pliers to position the hose clamp to secure the hose.
6. Install the radiator/condenser upper support.
7. Install the radiator support brackets.

CAUTION: Refer to Fastener Caution .

8. Install the radiator support bracket bolts and tighten to 9 (80 lb in).
9. Raise and support the vehicle.

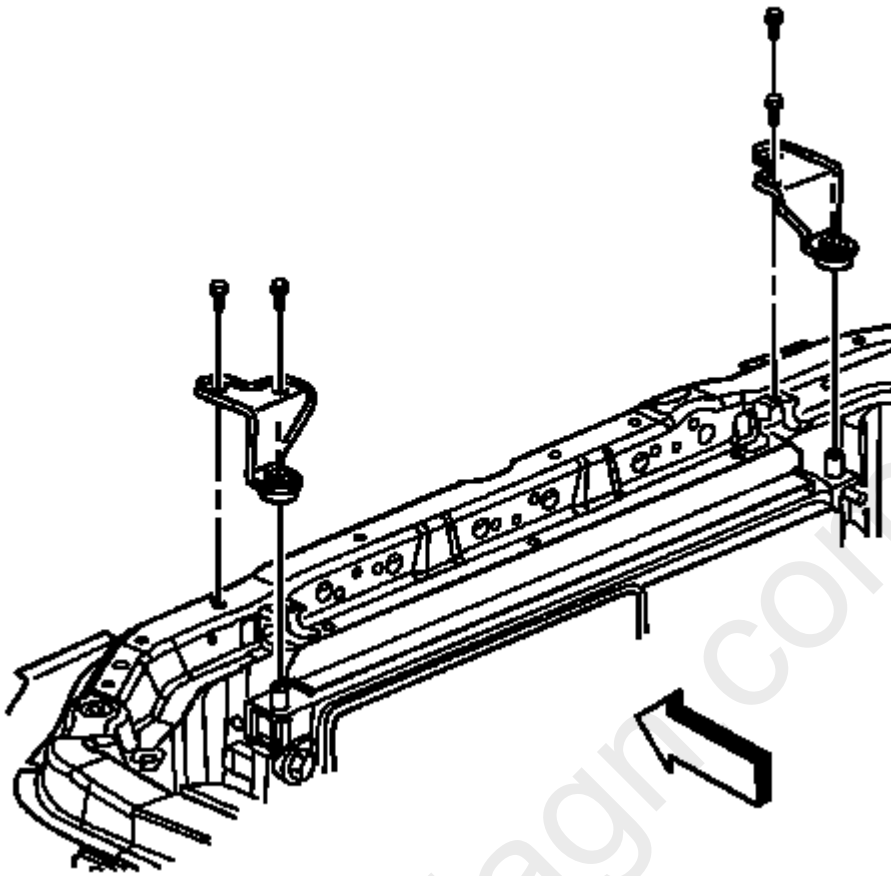


Fig. 151: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS COMPANY

10. Connect the lower retainer pins of the side air baffle to the radiator.

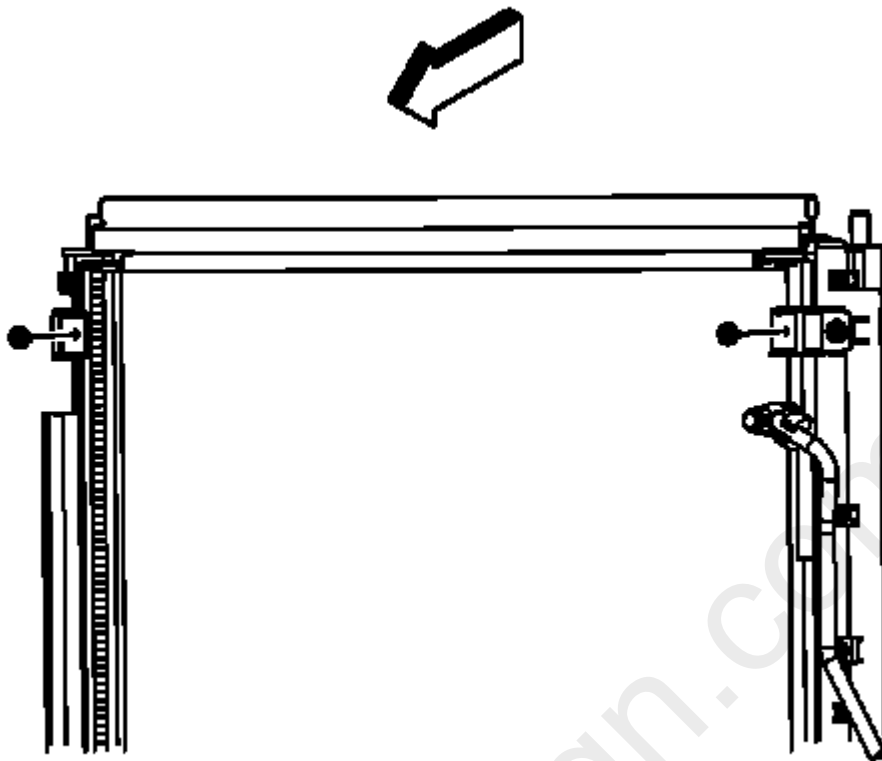


Fig. 152: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Install the upper condenser mounting bolts and tighten to 5.4 (48 lb in).

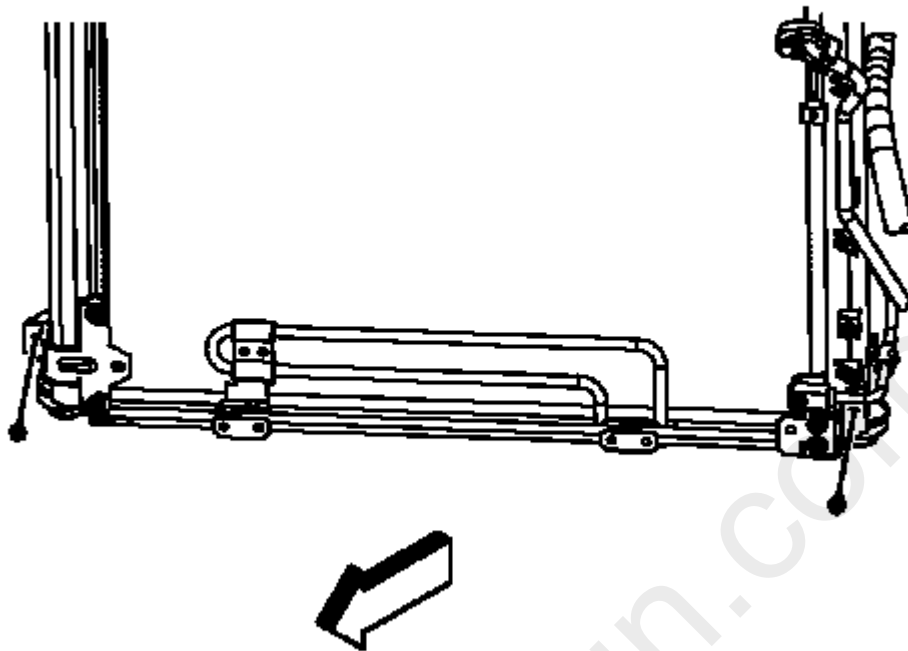


Fig. 153: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Install the lower condenser mounting bolts and tighten to 5.4 (48 lb in).
13. Lower the vehicle.
14. Install the electric cooling fan assembly. Refer to **Engine Coolant Fan Replacement (LSA)**, **Engine Coolant Fan Replacement (LFW or LFX)**.
15. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR REPLACEMENT (HEAVY DUTY COOLING)

Special Tools

- **J 38185** Hose Clamp Pliers
- **J 38778** Door Trim Pad Clip Remover

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling**

System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LFW or LFX), Cooling System Draining and Filling (GE 47716 LSA).

2. Remove the engine coolant fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LFW or LFX), Engine Coolant Fan Shroud Replacement (LSA).**
3. Disconnect transmission cooler lines at radiator.
4. Remove the front fascia. Refer to **Front Bumper Fascia Replacement .**
5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle .**

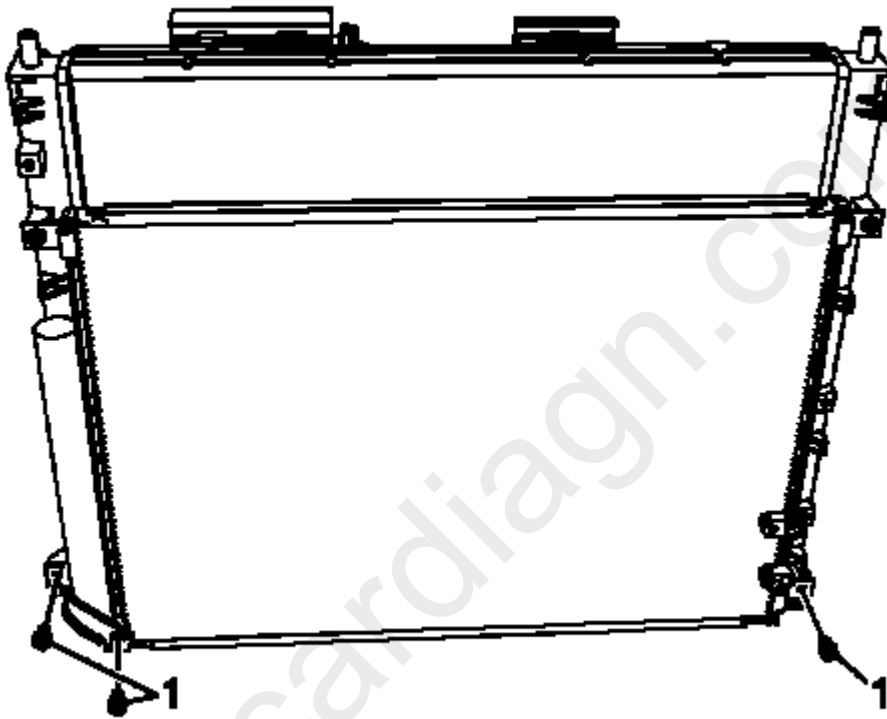


Fig. 154: View Of Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the lower condenser mounting bolts.

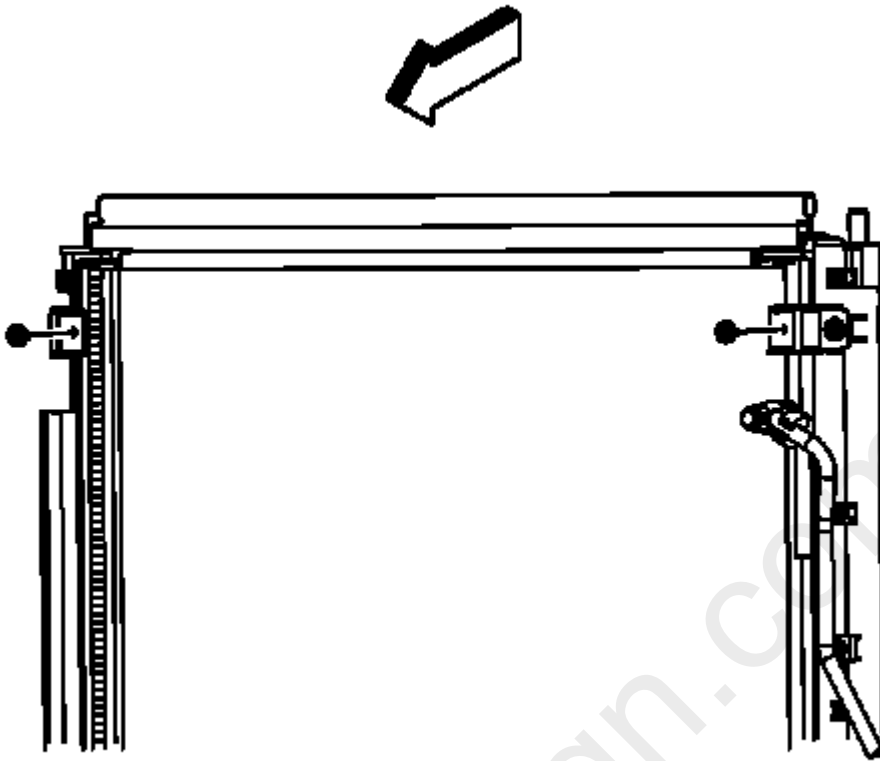


Fig. 155: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the upper condenser mounting bolts.
8. Disconnect transmission cooler lines at auxiliary transmission cooler.

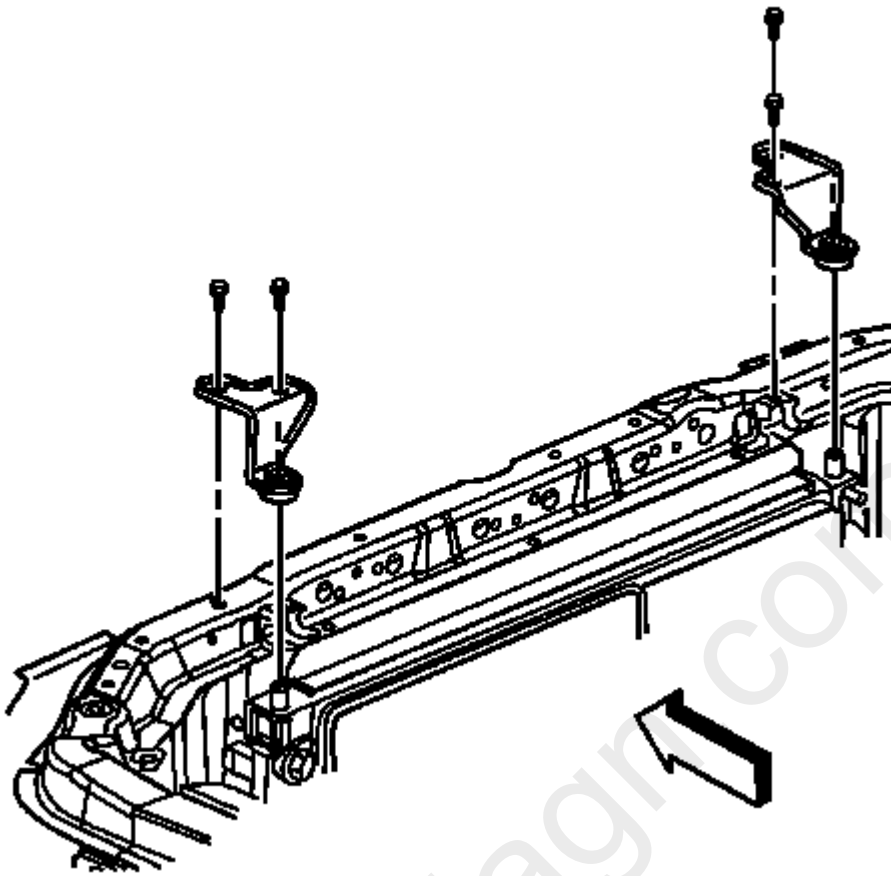


Fig. 156: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the lower retainer pins of the side air baffle from the radiator.
10. Lower the vehicle.
11. Remove the radiator support bracket bolts.
12. Remove the radiator support brackets.

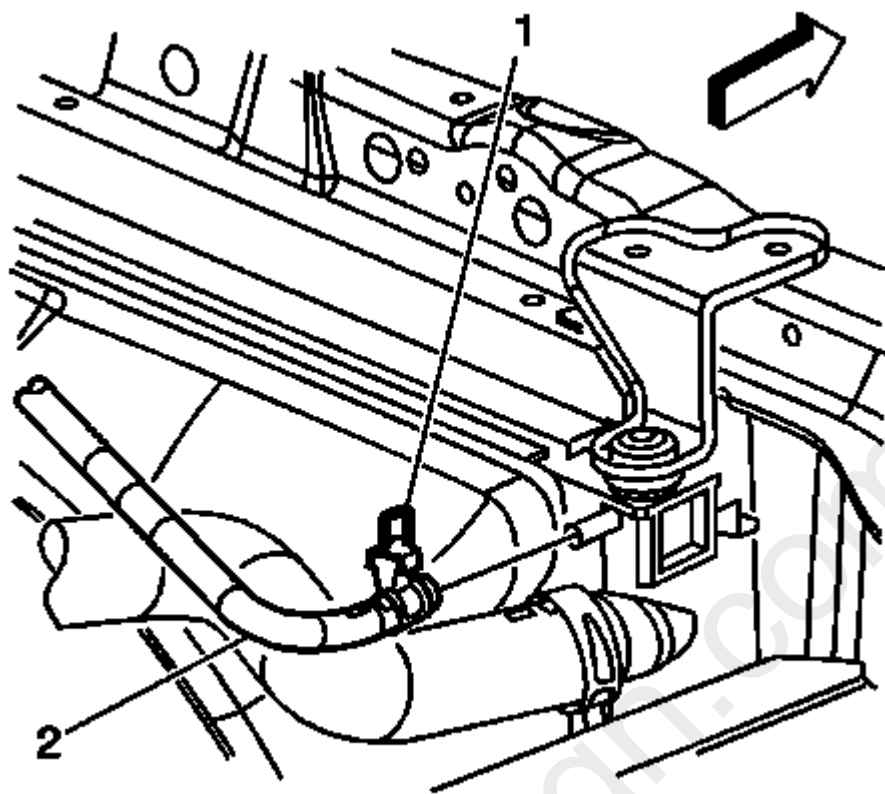


Fig. 157: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Use J 38185 hose clamp pliers to disconnect the surge tank inlet hose from the radiator. Reposition the hose aside.

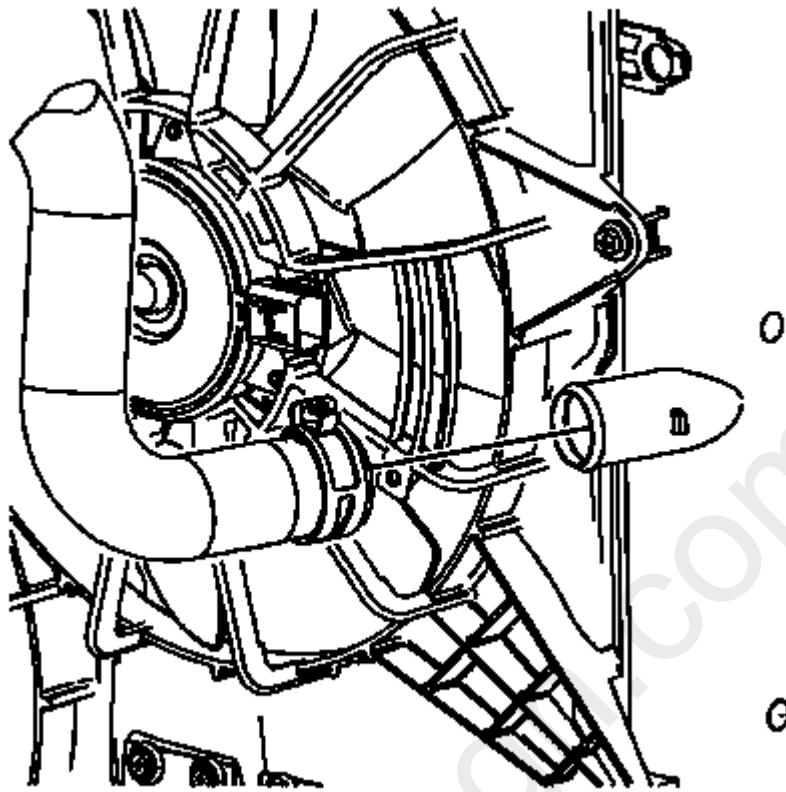


Fig. 158: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

14. Using **J 38185** hose clamp pliers disengage tension on the radiator inlet hose clamp and disconnect the hose from the radiator.
15. Using **J 38185** hose clamp pliers disengage tension on the radiator outlet hose clamp and disconnect the hose from the radiator.
16. Disconnect the upper retainer pins on the side air baffle from the radiator.
17. Remove the radiator, with the auxiliary transmission cooler attached.

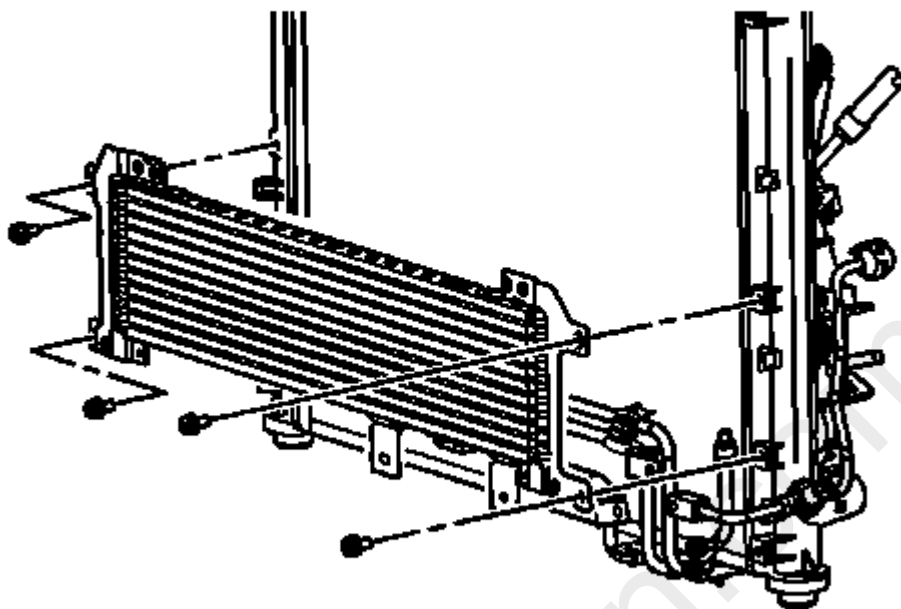


Fig. 159: View Of Transmission Oil Cooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Remove the auxiliary transmission cooler to radiator mounting bolts.
19. Remove the auxiliary transmission.

Installation Procedure

1. Install the auxiliary transmission.

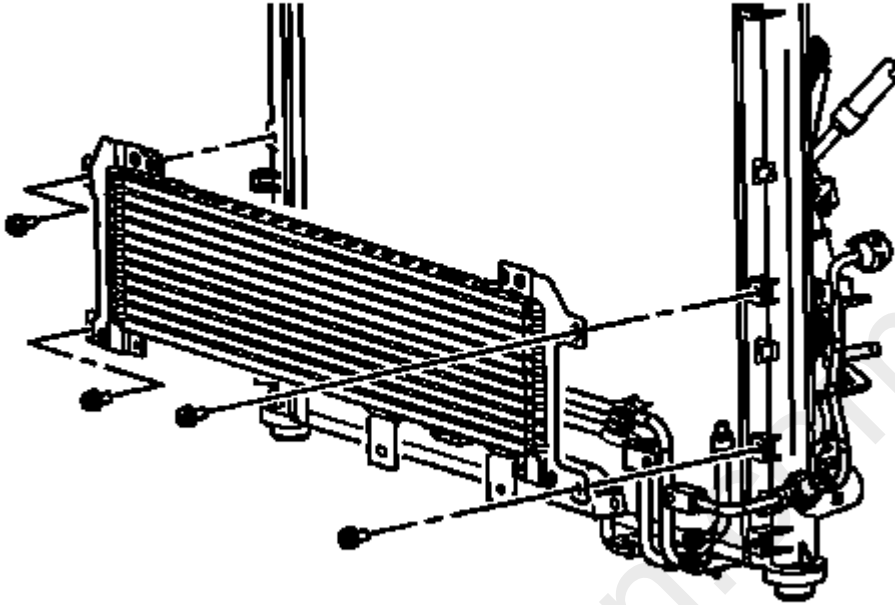


Fig. 160: View Of Transmission Oil Cooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the auxiliary transmission cooler to radiator mounting bolts and tighten to 5 (44 lb in).
3. Install the radiator, with the auxiliary transmission cooler attached.
4. Connect the upper retainer pins of the side air baffle to the radiator.
5. Connect the radiator outlet hose to the radiator. Use **J 38185** hose clamp pliers to position the radiator outlet hose clamp to secure the hose.

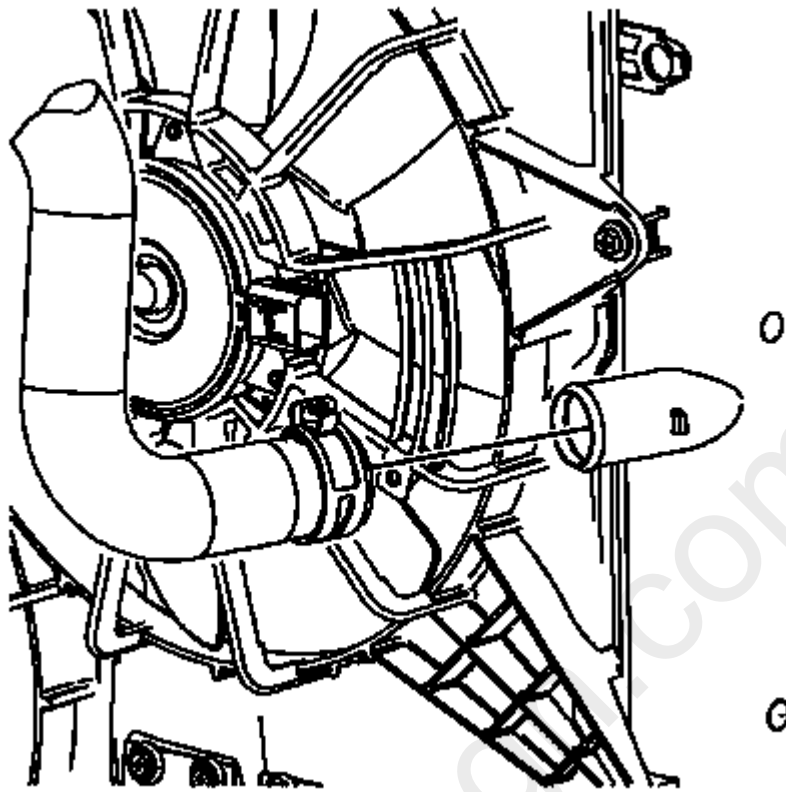


Fig. 161: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Connect the radiator inlet hose to the radiator. Use J 38185 hose clamp pliers to position the radiator inlet hose clamp to secure the hose.

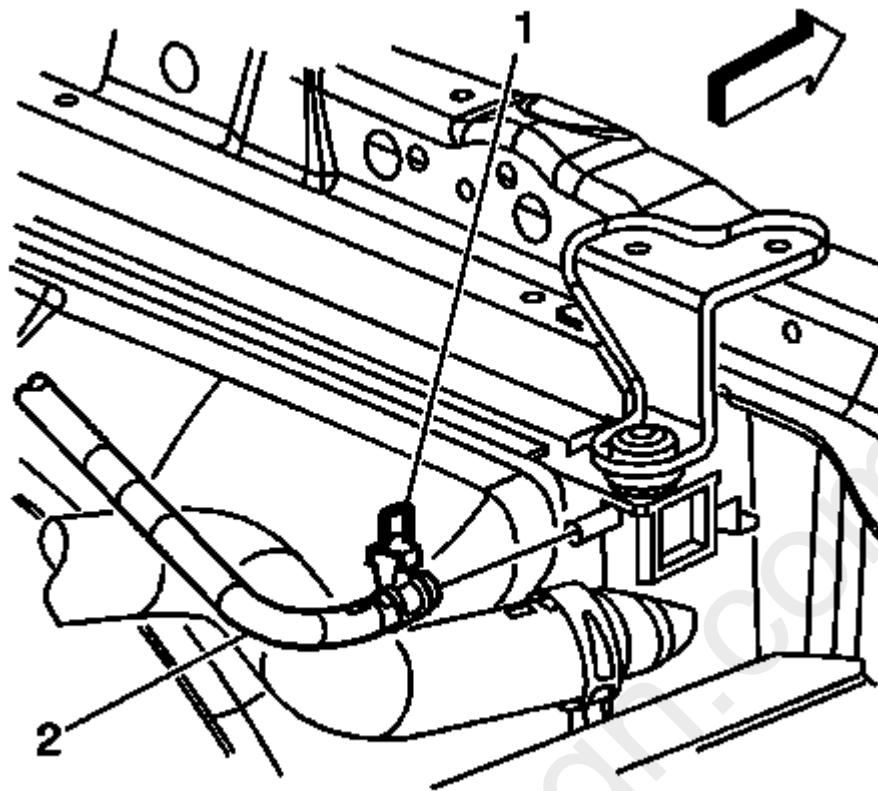


Fig. 162: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Connect the surge tank inlet hose to the radiator. Use J 38185 hose clamp pliers to position the hose clamp to secure the hose.
8. Install the radiator/condenser upper support.
9. Install the radiator support brackets.
10. Install the radiator support bracket bolts and tighten to 9 (80 lb in).
11. Raise and support the vehicle.

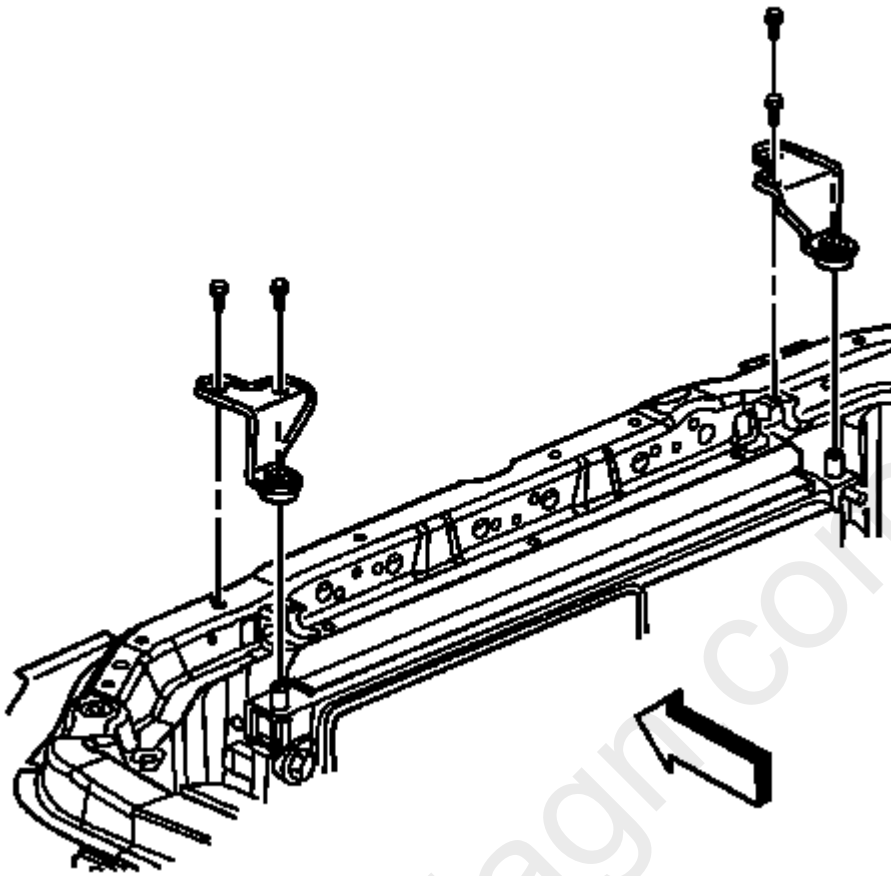


Fig. 163: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS COMPANY

12. Connect the lower retainer pins of the side air baffle to the radiator.
13. Connect transmission cooler lines at auxiliary transmission cooler.

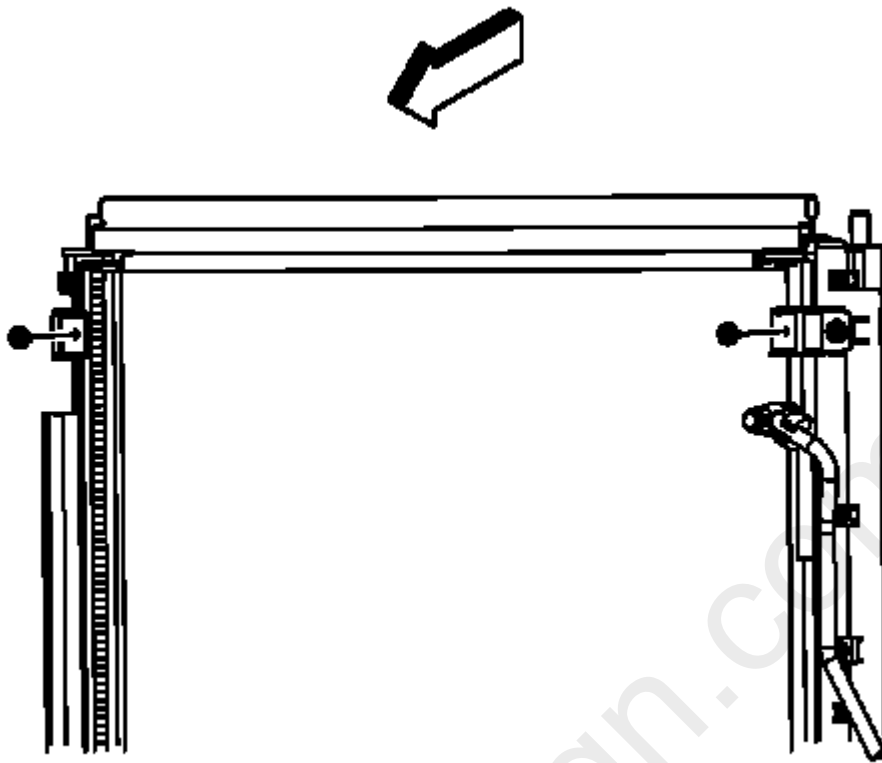


Fig. 164: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Install the upper condenser mounting bolts and tighten to 5.4 (48 lb in).

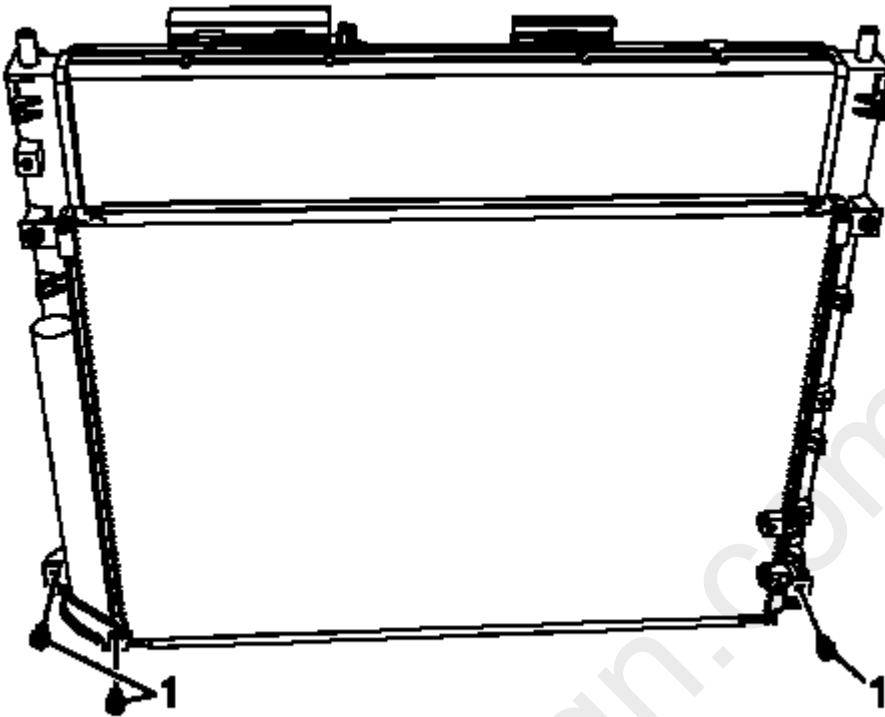


Fig. 165: View Of Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Install the lower condenser mounting bolts and tighten to 5.4 (48 lb in).
16. Lower the vehicle.
17. Install the engine coolant fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LFW or LFX)**, **Engine Coolant Fan Shroud Replacement (LSA)**.
18. Connect transmission cooler lines at radiator.
19. Install the front fascia. Refer to **Front Bumper Fascia Replacement**.
20. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)**, **Cooling System Draining and Filling (Static Fill LSA)**, **Cooling System Draining and Filling (GE 47716 LFW or LFX)**, **Cooling System Draining and Filling (GE 47716 LSA)**.

CHARGE AIR COOLER RADIATOR REPLACEMENT

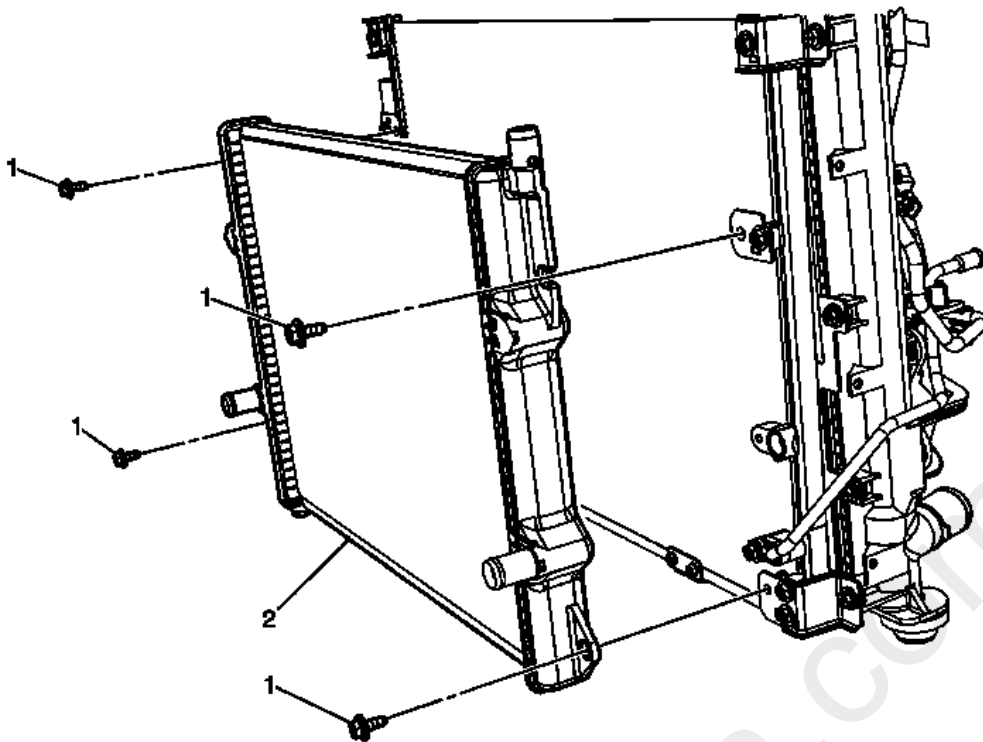


Fig. 166: Identifying Charge Air Cooler Radiator
 Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Radiator Replacement

Callout	Component Name
Preliminary Procedures 1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static), Charge Air Cooling System Draining and Filling (GE 47716)</u>. 2. Remove front air deflector. Refer to <u>Front Air Deflector Replacement</u>. 3. Remove the front bumper fascia. Refer to <u>Front Bumper Fascia Replacement</u>. 4. Remove the charged air cooler coolant hose radiator to pump. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Radiator to Pump</u>. 5. Remove the charged air cooler coolant hose radiator to pipe. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Radiator to Pipe</u>. 6. Remove the fluid cooler outlet hose. Refer to <u>Fluid Cooler Outlet Hose Replacement (LSA)</u>.	
1	Charged Air Cooler Coolant Radiator Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 16 N.m (12 lb ft)

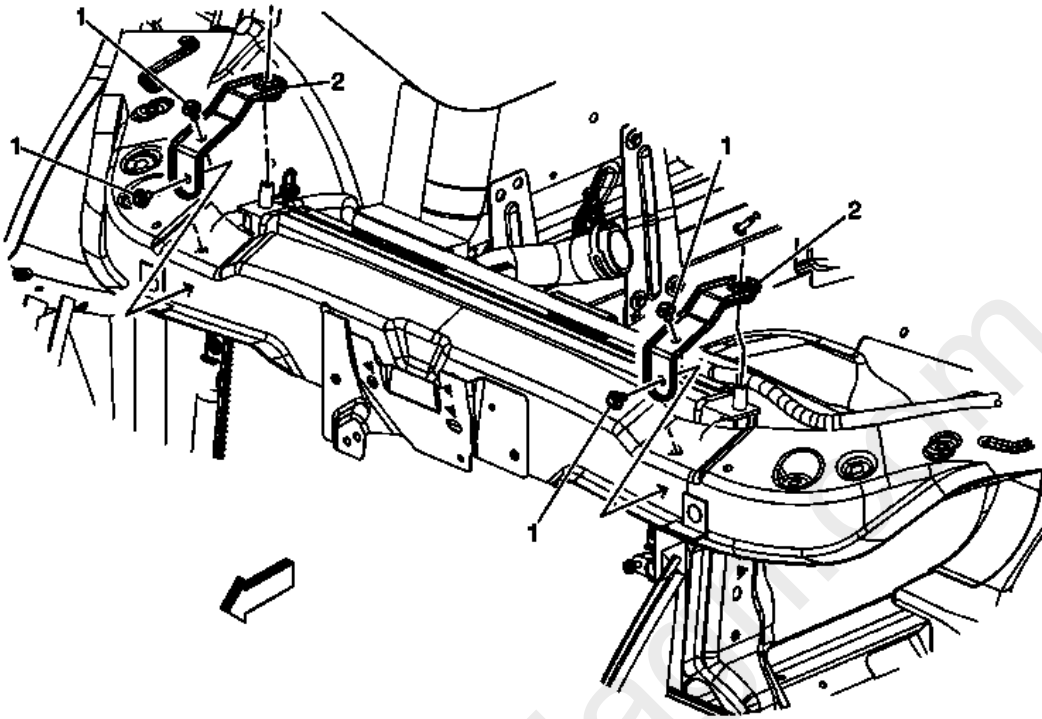
RADIATOR SUPPORT BRACKET REPLACEMENT

Fig. 167: Identifying Radiator Support Bracket
Courtesy of GENERAL MOTORS COMPANY

Radiator Support Bracket Replacement

Callout	Component Name
Preliminary Procedures	
Remove the front compartment sight shield. Refer to Front Compartment Sight Shields Replacement .	
1	Radiator Support Bracket Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Radiator Support Bracket (Qty: 2)

COOLANT HEATER REPLACEMENT (LFW/LFX)**Removal Procedure**

1. Turn the ignition OFF.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
3. Disconnect the coolant heater cord from the coolant heater.

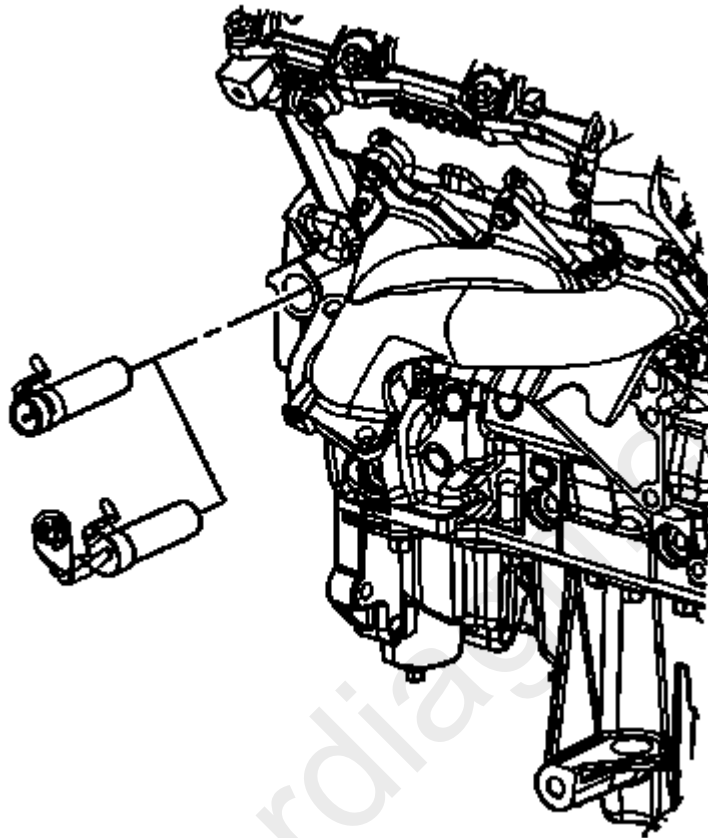


Fig. 168: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS COMPANY

4. Remove the coolant heater.

Installation Procedure

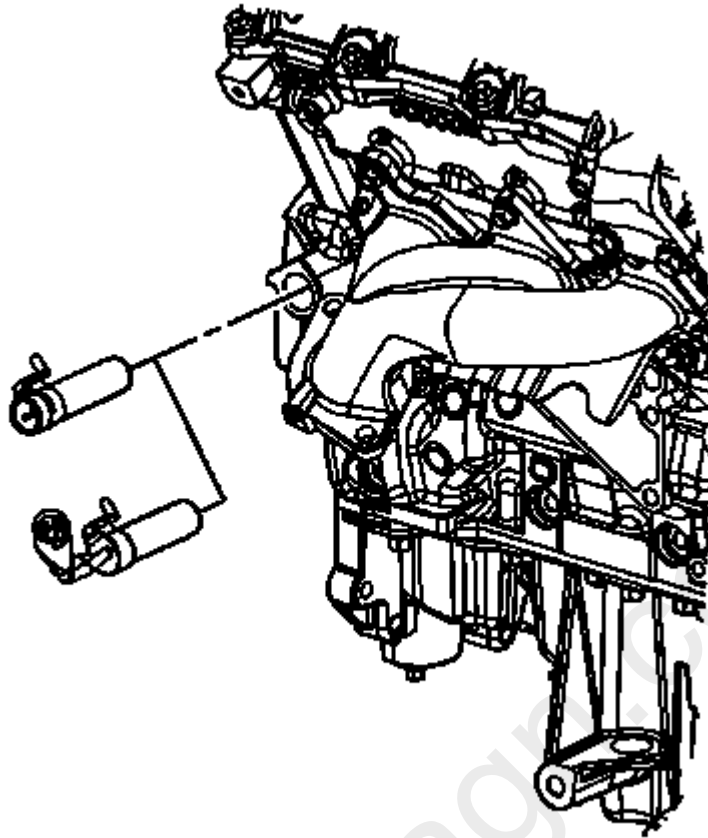


Fig. 169: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS COMPANY

1. Install the coolant heater.
2. Connect the coolant heater cord to the coolant heater.
3. Lower the vehicle.

COOLANT HEATER REPLACEMENT (LSA)

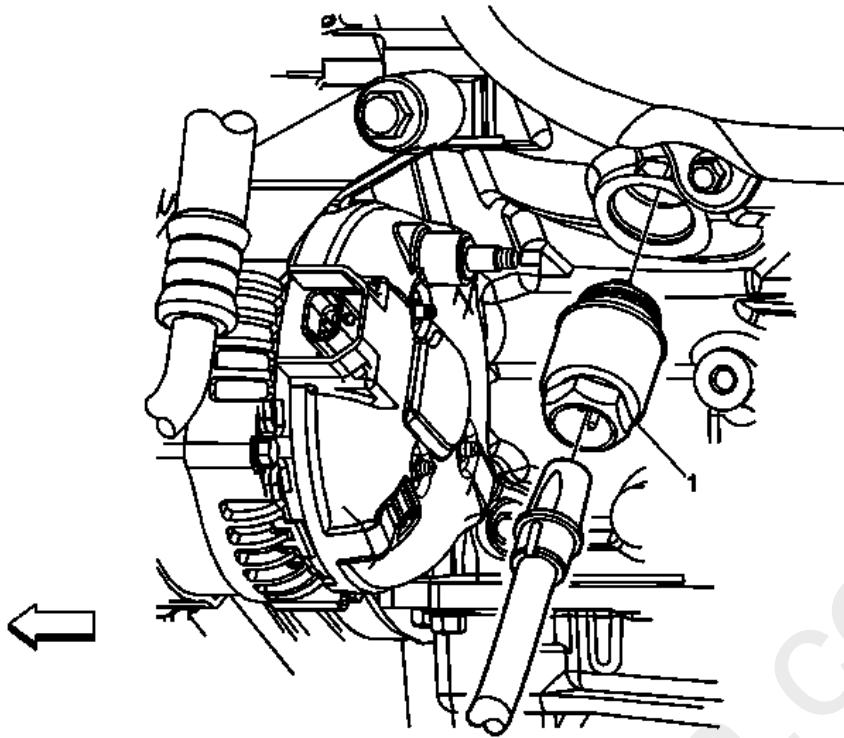


Fig. 170: Identifying Coolant Heater (V8)
 Courtesy of GENERAL MOTORS COMPANY

Coolant Heater Replacement (LSA)

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LSA), Cooling System Draining and Filling (GE 47716 LSA). 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 3. Remove the left front wheel. Refer to Tire and Wheel Removal and Installation.	
1	Coolant Heater CAUTION: Refer to Fastener Caution . Procedure Disconnect the coolant heater cord from the coolant heater. TIP: Work through the wheel well opening. Tighten 50 N.m (37 lb ft)

COOLANT HEATER CORD REPLACEMENT (LFW/LFX)

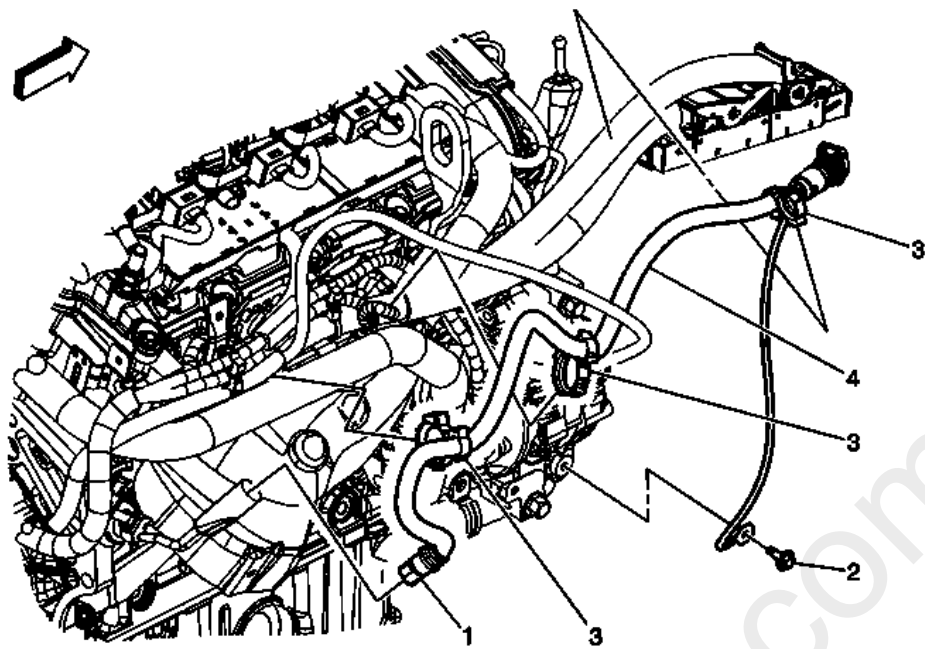


Fig. 171: Coolant Heater Cord Replacement
 Courtesy of GENERAL MOTORS COMPANY

Coolant Heater Cord Replacement (LFW/LFX)

Callout	Component Name
Preliminary Procedure	
Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Engine Heater Cord Female Connector
2	Ground Wire Bolt CAUTION: Refer to Fastener Caution . Tighten 12 N.m (106 lb in)
3	Plastic Clip (Qty: 3)
4	Coolant Heater Cord

COOLANT HEATER CORD REPLACEMENT (LSA - 110 VOLT)

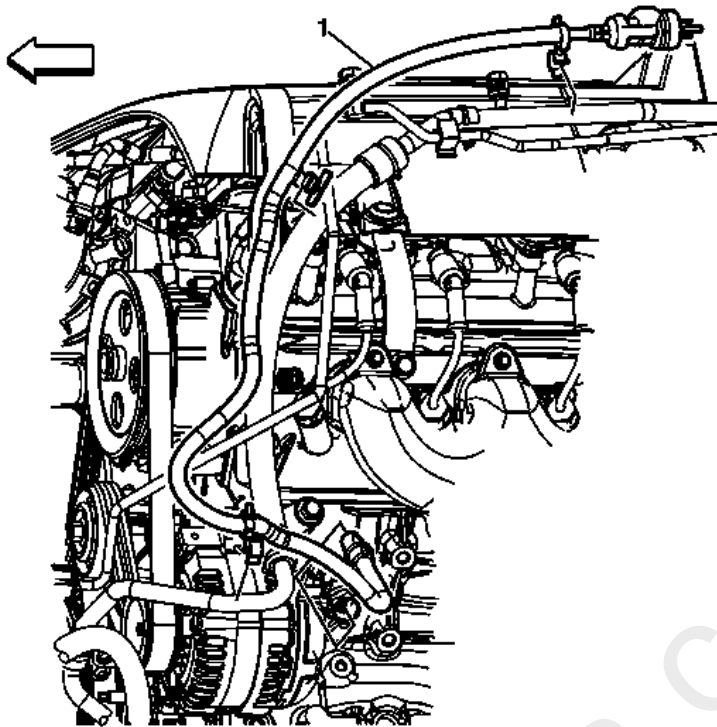


Fig. 172: Identifying Coolant Heater Cord (V8 With 110 Volt)
 Courtesy of GENERAL MOTORS COMPANY

Coolant Heater Cord Replacement (LSA - 110 Volt)

Callout	Component Name
Preliminary Procedure	
1. Remove the Air Cleaner Resonator outlet duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u> . 2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 3. Remove the left front wheel. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Coolant Heater Cord Procedure 1. Disconnect the coolant heater cord from the coolant heater. 2. Disconnect the three coolant heater cord retainers from the air conditioning compressor suction hose. 3. TIP: Work through the left wheel well opening.

COOLANT HEATER CORD REPLACEMENT (LSA - 240 VOLT)

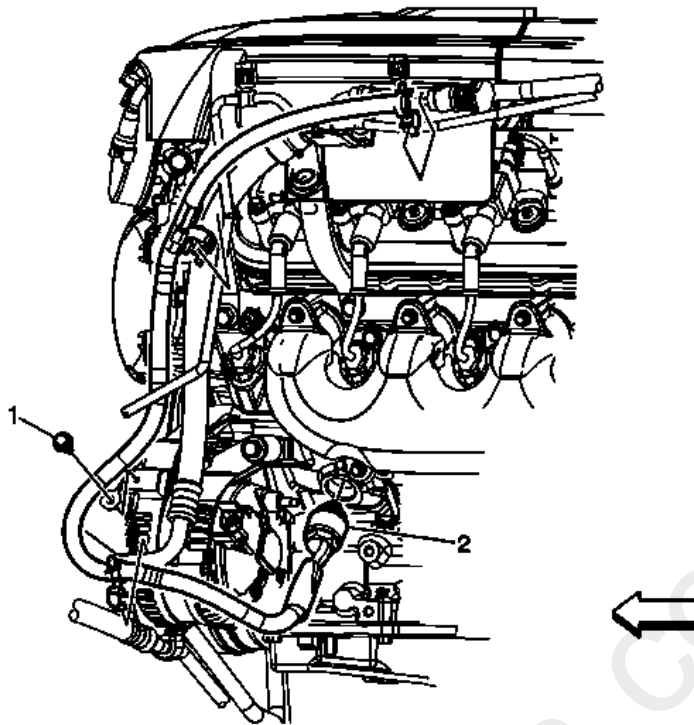


Fig. 173: Identifying Coolant Heater Cord (V8 With 240 Volt)
 Courtesy of GENERAL MOTORS COMPANY

Coolant Heater Cord Replacement (LSA - 240 Volt)

Callout	Component Name
Preliminary Procedure 1. Remove the Air Cleaner Resonator outlet duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u> . 2. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LSA)</u>, <u>Cooling System Draining and Filling (GE 47716 LSA)</u>. 3. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 4. Remove the left front wheel. Refer to <u>Tire and Wheel Removal and Installation</u> .	
1	Coolant Heater Cord fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
	Coolant Heater Cord Procedure

2

1. Disconnect the coolant heater cord from the coolant heater.
2. Disconnect the three coolant heater cord retainers from the air conditioning compressor suction hose.

TIP: Work through the left wheel well opening.

Tighten

50 N.m (37 lb ft)

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION

One Cooling Fan-3 Relays

System Overview

The engine cooling fan system consists of one electrical cooling fan, a serviceable resistor module mounted in the cooling fan shroud, and three fan relays. The relays are arranged in a series parallel (S/P) configuration that allows the engine control module (ECM) to operate the fan at low, medium, or high speeds, depending on cooling requirements. The cooling fan and fan relays receive battery voltage from the underhood fuse block. The ground path for the operation of the cooling fan is provided at G104.

Low Speed Operation

The ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The fan 1 relay coil closes the relay contacts to supply battery voltage from the FAN 1 fuse through the high resistance circuit of the cooling fan resistor module, and the fan motor supply voltage circuit to operate the cooling fan at low speed.

Medium Speed Operation

The ECM energizes the fan 2 and S/P relays by grounding the fan 2 relay control circuit. The energized fan 2 relay coil closes the relay contacts to supply battery voltage from the FAN 2 fuse. The voltage passes through the medium resistance circuit of the cooling fan resistor module, and the fan motor voltage supply circuit to operate the cooling fan at medium speed. At the same time, the energized S/P relay coil switches the dual pole contact position to prevent voltage from passing through the S/P relay to the low resistance circuit of the resistor module.

High Speed Operation

The ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The ECM also energizes the high speed fan 2 relay and the S/P fan relay by grounding the fan 2 relay control circuit. The energized S/P fan relay coil switches the dual pole contact position, allowing voltage from the FAN 1 fuse to pass through the S/P relay to the low resistance circuit of the cooling fan resistor module, and the motor voltage supply circuit to operate the cooling fan at high speed. The energized fan 2 relay also provides voltage from the FAN 2 fuse through the medium resistance circuit of the cooling fan resistor module. This provides a back up to high speed operation if a condition exists in the high speed cooling fan circuit.

Two Cooling Fans-3 Relays

System Overview

The engine cooling fan system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series parallel (S/P) configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds, depending on cooling requirements. The cooling fans and fan relays receive battery positive voltage from the underhood fuse block. The ground path is provided at G104 and G101.

Low Speed Operation

The ECM supplies the ground path for the low speed fan 1 relay through the fan 1 relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts, and supplies battery positive voltage from the FAN 1 fuse through the cooling fan motor supply voltage circuit to the right cooling fan. The ground path for the right cooling fan is through the cooling fan S/P relay and the left cooling fan. The result is a series circuit with both fans running at low speed.

High Speed Operation

The ECM supplies the ground path for the fan 1 relay through the fan 1 relay control circuit. After a 3 second delay, the ECM supplies a ground path for the high speed fan 2 relay and the fan S/P relay through the fan 2 relay control circuit. This energizes the fan S/P relay coil, closes the relay contacts, and provides a ground path for the right cooling fan. At the same time, the fan 2 relay coil is energized closing the relay contacts, and provides battery positive voltage from the FAN 2 fuse on the cooling fan motor supply voltage circuit, to the left 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.

COOLING SYSTEM DESCRIPTION AND OPERATION (LSA)

Coolant Warning Messages

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

Engine hot - A/C OFF, will be displayed if coolant temperature is above 117°C (243°F). For imports 115°C (239°F).

Engine coolant hot - idle engine, will be displayed if coolant temperature is above 118°C (245°F).

Engine overheated - stop engine, will be displayed if coolant temperature is above 123°C (253°F).

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the HVAC control module detects an open, or a high voltage level, on the coolant level indicator control circuit for at least 10 seconds, it will send a class 2 message to the radio requesting display of the low coolant level message. There is approximately a 10 second delay before the HVAC control module sends the class 2 message, to prevent the message from being displayed due to coolant sloshing in the surge

tank.

Coolant Heater

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

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

Thermostat

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

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

Engine Oil Heat Exchanger

The engine oil heat exchanger is mounted to the top of the engine block, under the intake manifold flange. Oil is pumped through the oil cooler inlet pipe to the heat exchanger, back through the oil cooler outlet pipe, and then to the oil passages in the engine for lubrication. The exchanger provides the following 2 functions:

- Engine coolant warms up faster than the engine oil. During cold operation, the coolant warms the oil and provides better flow during cold engine operation.
- After the engine reaches normal operating temperature, the engine oil temperature will exceed the engine coolant temperature. The coolant flowing through the engine oil cooler will absorb heat from the engine oil. Cooling the engine oil extends oil life and helps reduce internal engine wear.

Transmission Oil Cooler (with MG9)

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

The transmission oil cooler is a heat exchanger located in the end tank of the radiator. The transmission oil temperature is regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the cooler and back to the transmission.

Transmission Oil Cooler (with MYD)

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

There are two transmission oil coolers in a series in the heavy duty transmission oil cooler system. The initial transmission oil cooler is a heat exchanger located in the end tank of the radiator. The transmission oil temperature is partially regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the end tank cooler. The oil out of the cooler is plumbed to an air-to-oil cooler in between the A/C condenser and radiator. This cooler provides additional cooling for heavy duty trailering. The transmission oil is then directed back to the transmission.

Power Steering Oil Cooler

The power steering oil cooler is located on the rear side of the front bumper impact bar. This cooler transfers heat from the power steering system to the air passing through the grille. The cooler uses constant tension clamps on the hose connections to the cooler.

COOLING SYSTEM DESCRIPTION AND OPERATION (LFW, LFX)

Cooling Fan Control - One Fan System

The engine cooling fan system consists of one electrical cooling fan, a serviceable resistor module mounted in the cooling fan shroud, and three fan relays. The relays are arranged in a series parallel (S/P) configuration that allows the engine control module (ECM) to operate the fan at low, medium, or high speeds, depending on cooling requirements. The cooling fan and fan relays receive battery voltage from the underhood fuse block. The ground path for the operation of the cooling fan is provided at G104.

During low speed operation, the ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The fan 1 relay coil closes the relay contacts to supply battery voltage from the FAN 1 fuse through the high

resistance circuit of the cooling fan resistor module, and the fan motor supply voltage circuit to operate the cooling fan at low speed.

During medium speed operation, the ECM energizes the fan 2 and S/P relays by grounding the fan 2 relay control circuit. The energized fan 2 relay coil closes the relay contacts to supply battery voltage from the FAN 2 fuse. The voltage passes through the medium resistance circuit of the cooling fan resistor module, and the fan motor voltage supply circuit to operate the cooling fan at medium speed. At the same time, the energized S/P relay coil switches the dual pole contact position to prevent voltage from passing through the S/P relay to the low resistance circuit of the resistor module.

During high speed operation, the ECM energizes the fan 1 relay by grounding the fan 1 relay control circuit. The ECM also energizes the high speed fan 2 relay and the S/P fan relay by grounding the fan 2 relay control circuit. The energized S/P fan relay coil switches the dual pole contact position, allowing voltage from the FAN 1 fuse to pass through the S/P relay to the low resistance circuit of the cooling fan resistor module, and the motor voltage supply circuit to operate the cooling fan at high speed. The energized fan 2 relay also provides voltage from the FAN 2 fuse through the medium resistance circuit of the cooling fan resistor module. This provides a back up to high speed operation if a condition exists in the high speed cooling fan circuit.

Coolant Warning Messages

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

Engine hot - A/C OFF, will be displayed if coolant temperature is above 117°C (243°F). For imports 115°C (239°F).

Engine coolant hot - idle engine, will be displayed if coolant temperature is above 118°C (245°F).

Engine overheated - stop engine, will be displayed if coolant temperature is above 123°C (253°F).

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the HVAC control module detects an open, or a high voltage level, on the coolant level indicator control circuit for at least 10 seconds, it will send a class 2 message to the radio requesting display of the low coolant level message. There is approximately a 10 second delay before the HVAC control module sends the class 2 message, to prevent the message from being displayed due to coolant sloshing in the surge tank.

Coolant Heater

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

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

Thermostat

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

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

Transmission Oil Cooler (Without V03)

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

The transmission oil cooler is a heat exchanger located in the end tank of the radiator. The transmission oil temperature is regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the cooler and back to the transmission.

Transmission Oil Cooler (With V03)

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

There are two transmission oil coolers in a series in the heavy duty transmission oil cooler system. The initial transmission oil cooler is a heat exchanger located in the end tank of the radiator. The transmission oil temperature is partially regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the end tank cooler. The oil out of the cooler is plumbed to an air-to-oil cooler in between the A/C condenser and radiator. This cooler provides additional cooling for heavy duty trailering. The transmission oil is then directed back to the transmission.

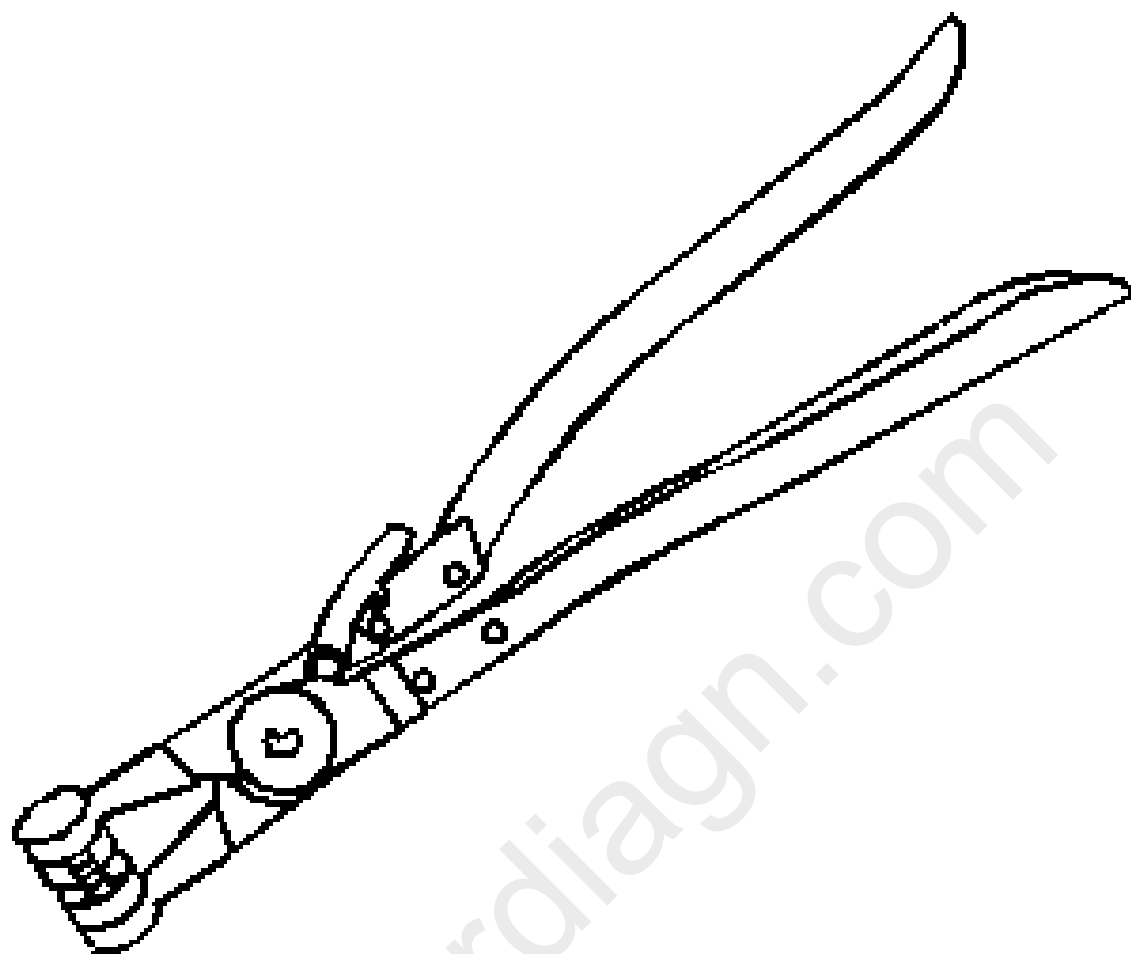
Power Steering Oil Cooler

The power steering oil cooler is located on the rear side of the front bumper impact bar. This cooler transfers heat from the power steering system to the air passing through the grille. The cooler uses constant tension clamps on the hose connections to the cooler.

SPECIAL TOOLS AND EQUIPMENT

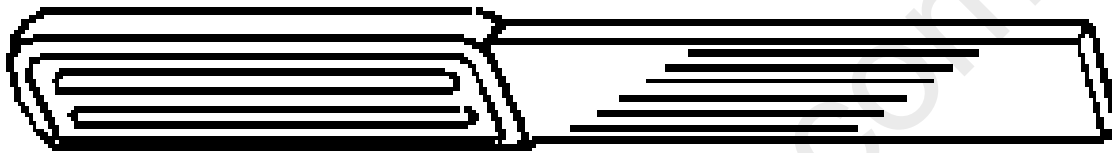
SPECIAL TOOLS

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



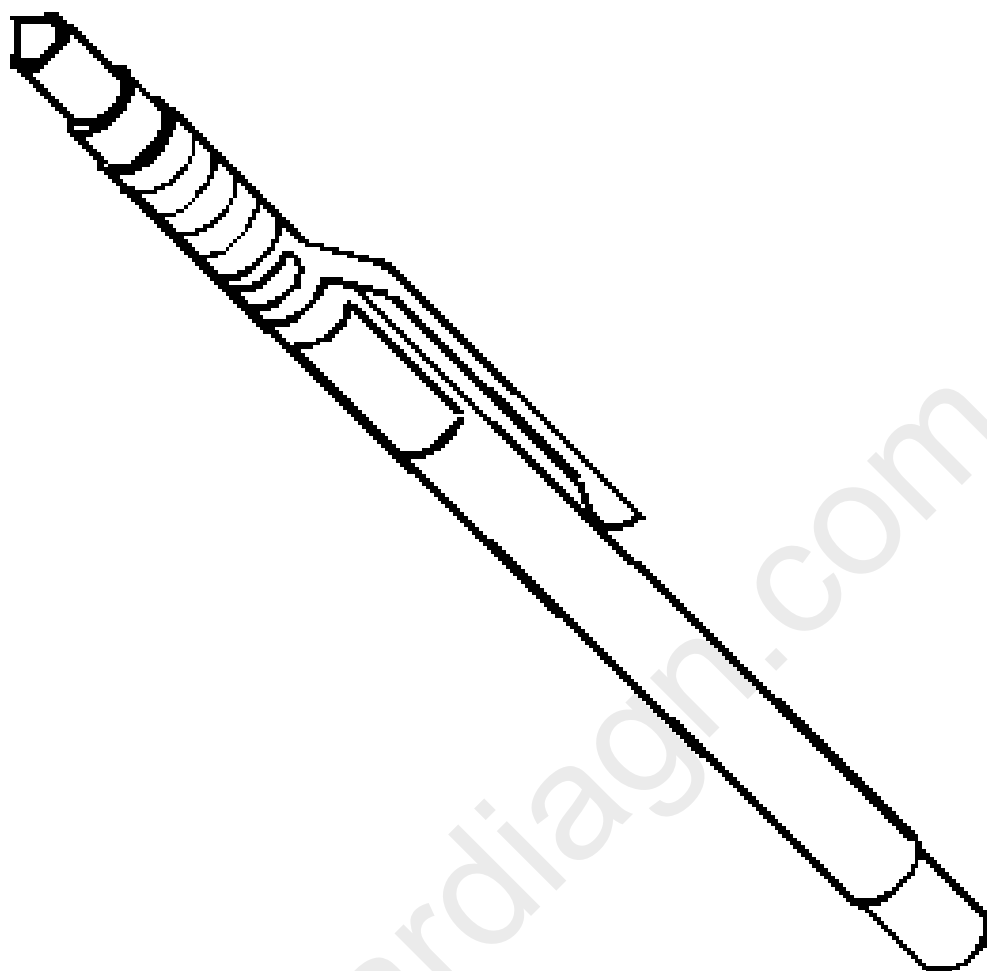
EN 24460-A
J 24460-01
Cooling
System
Pressure
Tester

EN 28410
J 28410
Gasket
Remover
(Aluminum
Components)



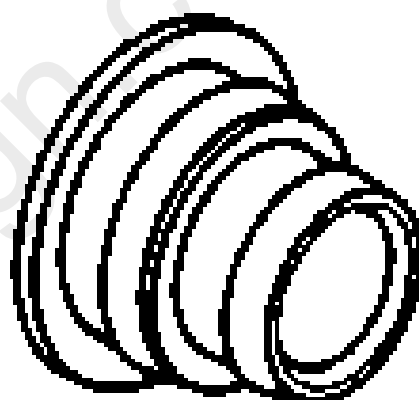
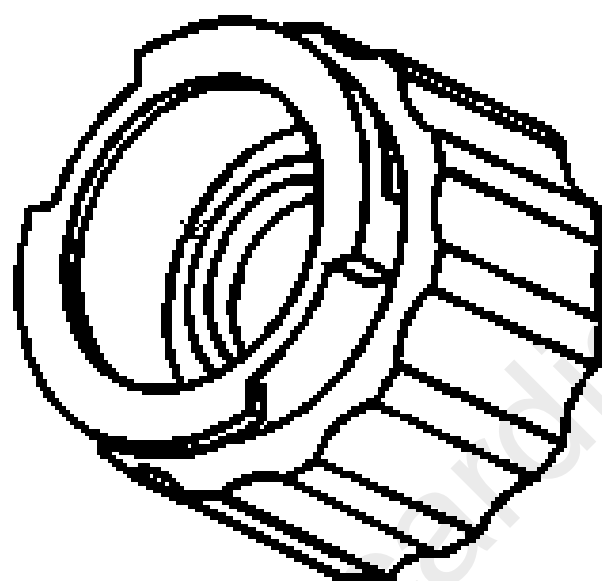
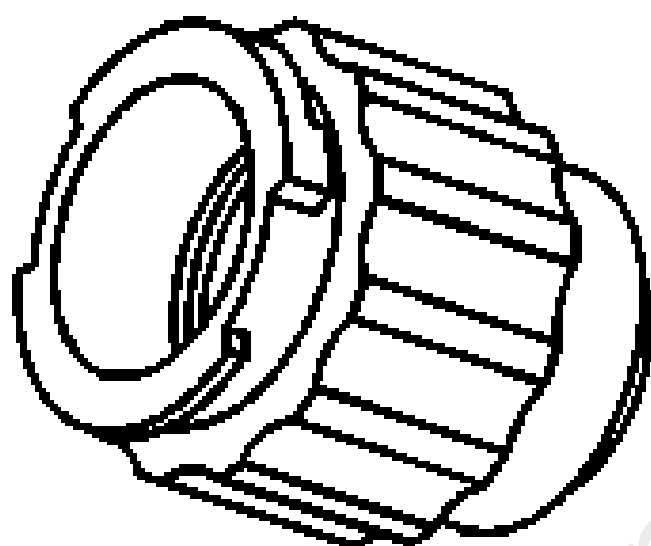
EN 46104
J 46104
Water Pump
Pulley
Holding
Tool

GE 24731
J 24731
Tempil Stick



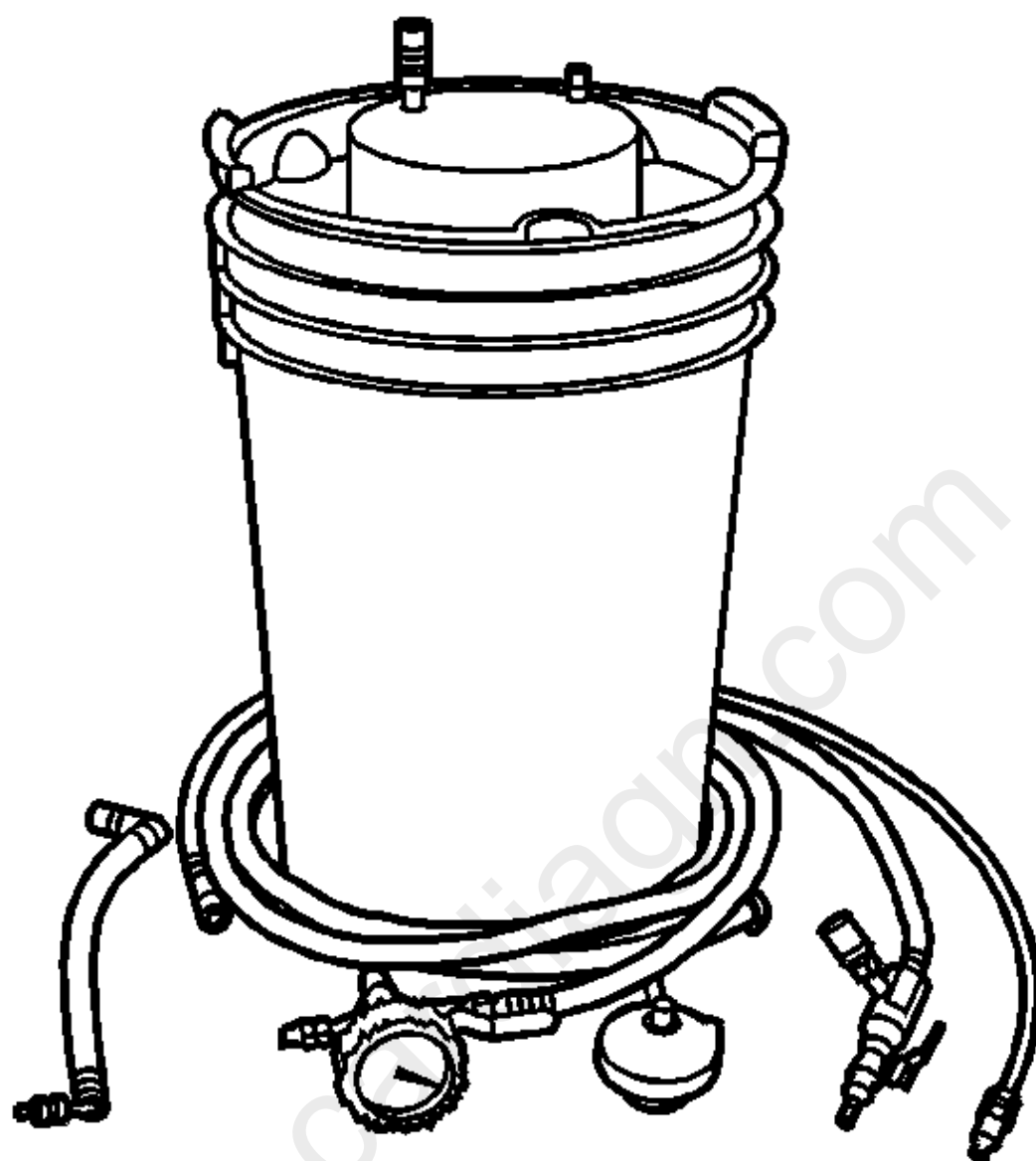
GE 26568
J 26568
Coolant and
Battery Fluid
Tester

GE 42401-A
J 42401
Radiator Cap
and Surge
tank Tester
Adapter



GE 46143
J 46143
Cooling
System
Adapter

GE 47716
Vac N Fill
Coolant
Refill Tool



J 37097-A
Heater Hose
Clamp Tool

J 44827
Transmission
Cooler
Quick
Disconnect

