

2011 Cadillac CTS

2011 ENGINE Engine Cooling - CTS

2011 ENGINE**Engine Cooling - CTS****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 (LLT)	50 N.m	37 lb ft
Coolant Pipe to Generator Bracket Bolt (LLT)	10 N.m	89 lb in
Coolant Pipe to Thermostat Housing Bolt (LLT)	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 (LLT)	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 (LLT)	10 N.m	89 lb in
Thermostat Housing Bolt (LLT)	20 N.m	15 lb ft
Thermostat Housing Bolt (LSA)	15 N.m	11 lb ft

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Water Outlet Housing Bolt (LLT)	10 N.m	89 lb in
Water Pump Bolt (LLT)	10 N.m	89 lb in
Water Pump Bolt (LSA)	30 N.m	22 lb ft
Water Pump Pulley Bolt (LLT)	12 N.m	106 lb in

SCHEMATIC WIRING DIAGRAMS

ENGINE COOLING WIRING SCHEMATICS

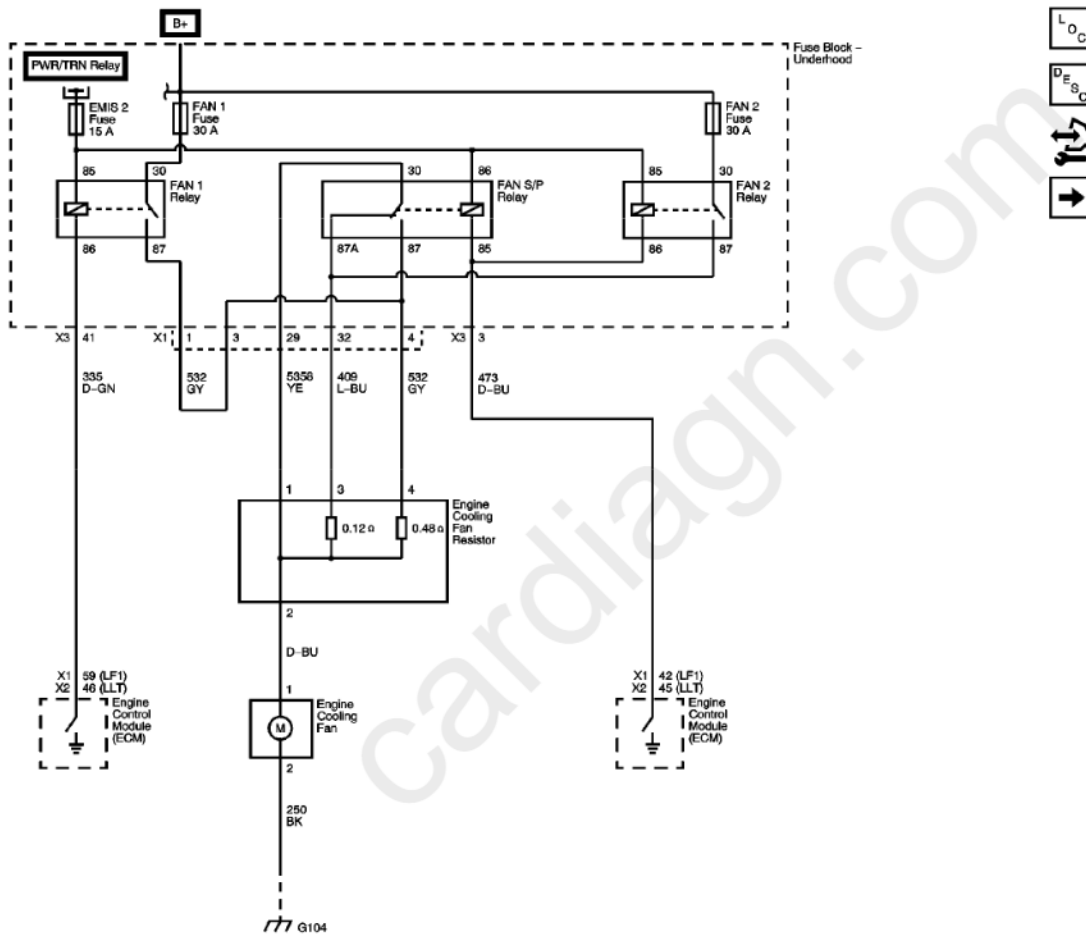


Fig. 1: LF1 or LLT Wiring Schematic
 Courtesy of GENERAL MOTORS CORP.

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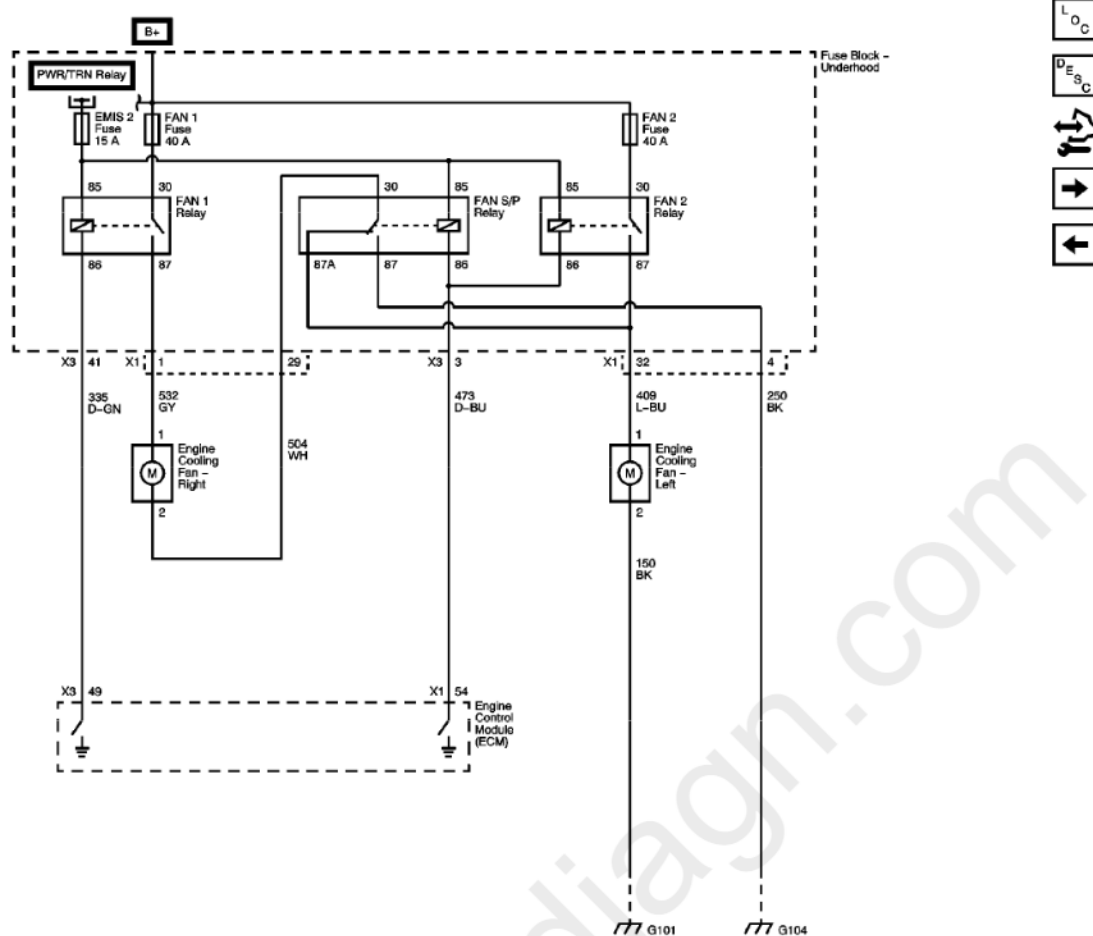


Fig. 2: LSA Wiring Schematic
Courtesy of GENERAL MOTORS CORP.

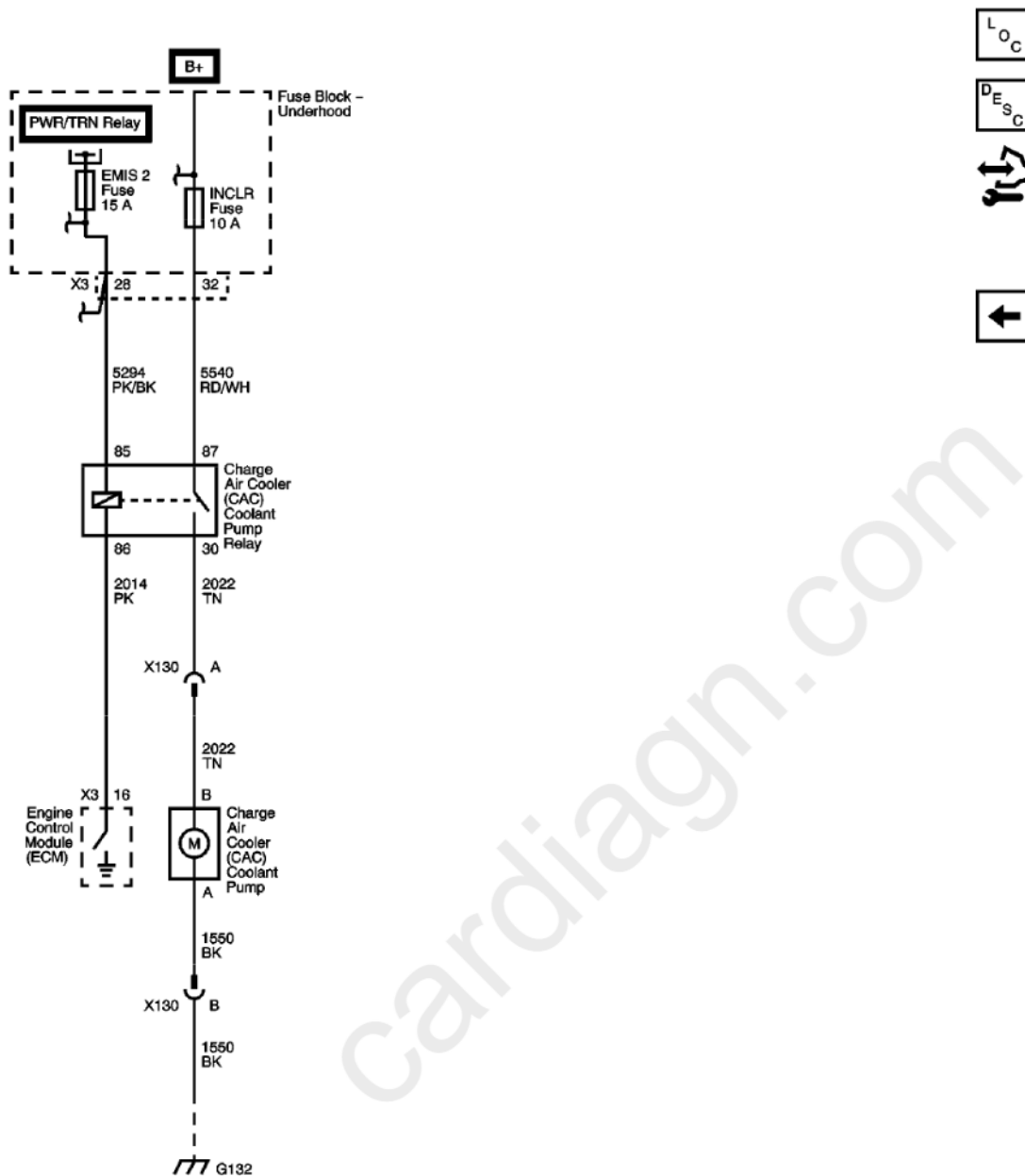


Fig. 3: Intercooler Coolant Pump (LSA) Wiring Schematic
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480 or P0481 (V8 and	P0480: Cooling Fan Relay 1 Control Circuit

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<u>V6-LF1, LGD - Dual Fan)</u>	P0481: Cooling Fan Relays 2 and 3 Control Circuit
<u>DTC P0480 or P0481 (V6-LF1)</u>	P0480: Cooling Fan Relay 1 Control Circuit P0481: Cooling Fan Relays 2 and 3 Control Circuit
<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/LLT)</u>	P0480: Cooling Fan Relay 1 Control Circuit P0481: Cooling Fan Relays 2 and 3 Control Circuit P0691: Cooling Fan Relay 1 Control Circuit Low Voltage P0692: Cooling Fan Relay 1 Control Circuit High Voltage P0693: Cooling Fan Relays 2 and 3 Control Circuit Low Voltage P0694: Cooling Fan Relays 2 and 3 Control Circuit High Voltage
<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/LLT and Dual Fan)</u>	P0480: Cooling Fan Relay 1 Control Circuit P0481: Cooling Fan Relays 2 and 3 Control Circuit P0691: Cooling Fan Relay 1 Control Circuit Low Voltage P0692: Cooling Fan Relay 1 Control Circuit High Voltage P0693: Cooling Fan Relays 2 and 3 Control Circuit Low Voltage P0694: Cooling Fan Relays 2 and 3 Control Circuit High Voltage
<u>DTC P1258</u>	P1258: Engine Coolant Overtemperature - Protection Mode Active

DTC P0480 OR P0481 (V8 AND V6-LF1, LGD - 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.

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, P0481	P0480, P0481	-	-
Relay Switch B+ Supply	1	1	-	-
Fan Relay 1 Control	P0480	P0480	P0480	-
Fan 2 and 3-S/P Relay Control	P0481	P0481	P0481	-
Relay Controlled Output	1	1	2	-

1. Fans inoperative without a DTC.

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- Fans always ON without a DTC.

Typical Scan Tool Data

FC Relay 1, and FC Relays 2 and 3 Ckt 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	Fault	Fault	-
Fan Relay 1 Control	Fault	Fault	-
Fan 2 and 3-S/P Relay Control	Fault	Fault	Not Run

FC Relay 1, and FC Relays 2 and 3 Ckt 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	-
Fan Relay 1 Control	Not Run	Not Run	Fault
Fan 2 and 3-S/P Relay Control	Not Run	Not Run	Fault

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. 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 between 11-18 V.
- The engine speed is greater than 400 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTC P0480 and P0481 run continuously when the conditions above are met.

Conditions for Setting the DTC**P0480**

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

P0481

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 scan tool cooling fan output control operates as follows:
 - Fan Relay 1 operates both fans at a low speed
 - Fan Relay 2 and 3 operates one fan at a high speed
 - Fan Relay 1, 2 and 3 operates both fans at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation**

Cooling Fan Description and Operation**Electrical Information Reference**

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

DTC Type Reference**Powertrain Diagnostic Trouble Code (DTC) Type Definitions****Scan Tool Reference****Control Module References** for scan tool information**Circuit/System Verification**

1. Engine operating, command the cooling fans ON and OFF at high speed while observing the scan tool circuit test status parameters listed below:
 - FC Relay 1 Ckt Open, Short Gnd, and Short Volts Test Status
 - FC Relay 2 and 3 Ckt Open, Short Gnd, and Short Volts Test Status

The parameters should display OK or Not Run in each of the commanded states.

2. Observe the DTC information with a scan tool. DTC P0480 and P0481 should not set.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect all of the KR20 cooling fan relays.

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

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 85
 - KR20D cooling fan high speed relay terminal 85
 - KR20E cooling fan speed control relay terminal 86
 - If the test lamp does not illuminate, test the relay coil ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay coil ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.

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

3. Connect the red lead of the DMM to a control circuit terminal listed below. Connect the black lead to ground. Set the DMM on the diode setting. The DMM should display OL.
 - KR20C cooling fan low speed relay terminal 86
 - KR20D cooling fan high speed relay terminal 86
 - KR20E cooling fan speed control relay terminal 85
 - If less than the specified range, test the appropriate relay coil control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.

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

4. Command the cooling fan relay ON and OFF with a scan tool. The DMM should transition from OL when commanded OFF to less than 1 V when commanded ON.
 - If the circuit voltage does not correspond to the specified values, test the control circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, test or replace the appropriate KR20 relay.

Component Testing

1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 70-110 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than the specified range, replace the KR20 cooling fan relay.
4. Test the KR20E relay for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Connect a 20 A fused jumper wire between relay terminal 85 and B+. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

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

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DTC P0480 OR P0481 (V6-LF1)**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, P0481	P0480, P0481	-	-
Relay Switch B+ Supply	1	1	-	-
Fan 1 Relay Control	P0480	P0480	P0480	-
Fan Relay 2 and Fan S/P Relay Control	P0481	P0481	P0481	-
Relay Controlled Output	1	1	2	-
1. Fans inoperative without a DTC. 2. Fans always ON without a DTC.				

Typical Scan Tool Data**FC Relay 1, and FC Relays 2 and 3 Ckt 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	Fault	Fault	-
Fan Relay 1 Control	Fault	Fault	-

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Fan Relay 2 and Fan S/P Relay Control	Fault	Fault	Not Run
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FC Relay 1, and FC Relays 2 and 3 Ckt 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	-
Fan Relay 1 Control	Not Run	Not Run	Fault
Fan Relay 2 and Fan S/P Relay Control	Not Run	Not Run	Fault

Circuit/System Description

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 resistor module is a self-contained unit providing a specific resistance through three individual circuits. To activate the fan, the ECM applies ground to the coil side of the applicable fan relays. 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.

Conditions for Running the DTC

- The ignition voltage is between 11-18 volts.
- The engine speed is greater than 400 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTC P0480 and P0481 run continuously when the conditions above are met.

Conditions for Setting the DTC

P0480

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

P0481

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 scan tool cooling fan output control operates as follows:
 - Fan Relay 1 operates the fan at a low speed
 - Fan Relay 2 and 3 operates the fan at a medium speed
 - Fan Relay 1, 2 and 3 operates the fan at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation****Cooling Fan Description and Operation****Electrical Information Reference**

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

DTC Type Reference**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine operating, observe the DTC information with a scan tool. DTC P0480 and P0481 should not set.
2. Command the cooling fans ON and OFF at high speed while observing the scan tool circuit test status parameters listed below:
 - FC Relay 1 Ckt Open, Short Gnd, and Short Volts Test Status
 - FC Relay 2 and 3 Ckt Open, Short Gnd, and Short Volts Test Status

The parameters should display OK or Not Run in each of the commanded states.

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

Circuit/System Testing

1. Ignition OFF, disconnect all of the KR20 cooling fan relays.

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

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 85
 - KR20D cooling fan high speed relay terminal 85
 - KR20E cooling fan speed control relay terminal 86
 - If the test lamp does not illuminate, test the relay coil ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay coil ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.

NOTE: The following test must be performed on all three fan relay control circuit terminals.

3. Connect the red lead of the DMM to a control circuit terminal listed below. Connect the black lead to ground. Set the DMM on the diode setting. The DMM should display OL.
 - KR20C cooling fan low speed relay terminal 86
 - KR20D cooling fan high speed relay terminal 86
 - KR20E cooling fan speed control relay terminal 85
 - If less than the specified range, test the appropriate relay coil control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.

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

4. Command the cooling fan relay ON and OFF with a scan tool. The DMM should transition from OL when commanded OFF to less than 1 V when commanded ON.
 - If the circuit voltage does not correspond to the specified values, test the control circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, test or replace the appropriate KR20 relay.

Component Testing

1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 70-110 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than the specified range, replace the KR20 cooling fan relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Connect a 20 A fused jumper wire between relay terminal 85 and B+. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

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

DTC P0480, P0481, P0691, P0692, P0693, OR P0694 (W/LLT)

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

2011 Cadillac CTS**2011 ENGINE Engine Cooling - CTS****DTC P0480**

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

DTC P0691

Cooling Fan Relay 1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relays 2 and 3 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relays 2 and 3 Control Circuit High Voltage

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+ Supply	1	1	-	-
Fan Relay 1 Control	P0691	P0480	P0692	-
Fan Relay 2 and Fan S/P Relay Control	P0693	P0481	P0694	-
Relay Controlled Output	1	1	2	-
1. Fans inoperative without a DTC. 2. Fans always ON without a DTC.				

Typical Scan Tool Data

FC Relay 1, and FC Relays 2 and 3 Ckt 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:			

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- 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	Fault	Fault	-
Fan Relay 1 Control	Fault	Fault	-
Fan Relay 2 and Fan S/P Relay Control	Fault	Fault	Not Run

FC Relay 1, and FC Relays 2 and 3 Ckt 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	-
Fan Relay 1 Control	Not Run	Not Run	Fault
Fan Relay 2 and Fan S/P Relay Control	Not Run	Not Run	Fault

Circuit/System Description

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 resistor module is a self-contained unit providing a specific resistance through three individual circuits. To operate the fan, the ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. 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.

Conditions for Running the DTC

- The ignition voltage is between 10-26 volts.
- The engine speed is greater than 80 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTC P0480, P0481, P0691, P0692, P0693, and P0694 run continuously when the conditions above are met.

Conditions for Setting the DTC

P0480

The ECM detects an open in the cooling fan relay 1 control circuit for greater than 1.5 S.

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P0481

The ECM detects an open in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

P0691

The ECM detects a short to ground in the cooling fan relay 1 control circuit for greater than 1.5 S.

P0692

The ECM detects a short to voltage in the cooling fan relay 1 control circuit for greater than 1.5 S.

P0693

The ECM detects a short to ground in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

P0694

The ECM detects a short to voltage in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

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 scan tool cooling fan output control operates as follows:
 - Fan Relay 1 operates the fan at a low speed
 - Fan Relay 2 and 3 operates the fan at a medium speed
 - Fan Relay 1, 2 and 3 operates the fan at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Cooling Schematics**Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation****Cooling Fan Description and Operation****Electrical Information Reference**

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

DTC Type Reference**Powertrain Diagnostic Trouble Code (DTC) Type Definitions****Scan Tool Reference****Control Module References** for scan tool information**Circuit/System Verification**

1. Engine operating, observe the DTC information with a scan tool. DTC P0480, P0481, P0691, P0692, P0693, or P0694 should not set.
2. Command the cooling fans ON and OFF at high speed while observing the scan tool circuit test status parameters listed below:
 - FC Relay 1 Ckt Open, Short Gnd, and Short Volts Test Status
 - FC Relay 2 and 3 Ckt Open, Short Gnd, and Short Volts Test Status

The parameters should display OK or Not Run in each of the commanded states.

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

Circuit/System Testing

1. Ignition OFF, disconnect all of the KR20 cooling fan relays.

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

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 85
 - KR20D cooling fan high speed relay terminal 85
 - KR20E cooling fan speed control relay terminal 86
 - If the test lamp does not illuminate, test the relay coil ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay coil ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.

NOTE:

- **The control circuits for the cooling fan relays are pulled-up to a voltage within the ECM, 2.6-4.6 volts on the control circuit is normal.**
- **The following test must be performed on all three fan relay control circuit terminals.**

3. Connect the red lead of the DMM to a control circuit terminal listed below. Connect the black lead to ground. Set the DMM on the diode setting. The DMM should display OL.
 - KR20C cooling fan low speed relay terminal 86
 - KR20D cooling fan high speed relay terminal 86
 - KR20E cooling fan speed control relay terminal 85
 - If less than the specified range, test the appropriate relay coil control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.

NOTE:

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

4. Command the cooling fan relay ON and OFF with a scan tool. The DMM should transition from OL when commanded OFF to less than 1 V when commanded ON.
 - If the circuit voltage does not correspond to the specified values, test the control circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, test or replace the appropriate KR20 relay.

Component Testing

1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 70-110 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than the specified range, replace the KR20 cooling fan relay.

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4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Connect a 20 A fused jumper wire between relay terminal 85 and B+. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

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

DTC P0480, P0481, P0691, P0692, P0693, OR P0694 (W/LLT AND 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.

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 Relays 2 and 3 Control Circuit Low Voltage

DTC P0694

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Cooling Fan Relays 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+ Supply	1	1	-	-
Fan Relay 1 Control	P0691	P0480	P0692	-
Fan Relay 2 and Fan S/P Relay Control	P0693	P0481	P0694	-
Relay Controlled Output	1	1	2	-
1. Fans inoperative without a DTC. 2. Fans always ON without a DTC.				

Typical Scan Tool Data**FC Relay 1, and FC Relays 2 and 3 Ckt 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	Fault	Fault	-
Fan Relay 1 Control	Fault	Fault	-
Fan Relay 2 and Fan S/P Relay Control	Fault	Fault	Not Run

FC Relay 1, and FC Relays 2 and 3 Ckt 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	-
Fan Relay 1 Control	Not Run	Not Run	Fault
Fan Relay 2 and Fan S/P Relay Control	Not Run	Not Run	Fault

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. To operate the fan, the ECM activates the applicable relay by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage. 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 between 10-26 volts.
- The engine speed is greater than 80 RPM.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTC P0480, P0481, P0691, P0692, P0693, and P0694 run continuously when the conditions above are met.

Conditions for Setting the DTC**P0480**

The ECM detects an open in the cooling fan relay 1 control circuit for greater than 1.5 S.

P0481

The ECM detects an open in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

P0691

The ECM detects a short to ground in the cooling fan relay 1 control circuit for greater than 1.5 S.

P0692

The ECM detects a short to voltage in the cooling fan relay 1 control circuit for greater than 1.5 S.

P0693

The ECM detects a short to ground in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

P0694

The ECM detects a short to voltage in the cooling fan relay 2 and 3 control circuit for greater than 1.5 S.

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 scan tool cooling fan output control operates as follows:
 - Fan Relay 1 operates both fans at a low speed
 - Fan Relay 2 and 3 operates one fan at a high speed
 - Fan Relay 1, 2 and 3 operates the fan at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation**

Cooling System Description and Operation (LF1, LLT) or Cooling System Description and Operation (LSA)

Electrical Information Reference

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

DTC Type Reference**Powertrain Diagnostic Trouble Code (DTC) Type Definitions****Scan Tool Reference**

Control Module References for scan tool information

Circuit/System Verification

1. Engine operating, observe the DTC information with a scan tool. DTC P0480, P0481, P0691, P0692, P0693, or P0694 should not set.
2. Command the cooling fans ON and OFF at high speed while observing the scan tool circuit test status parameters listed below:
 - FC Relay 1 Ckt Open, Short Gnd, and Short Volts Test Status
 - FC Relay 2 and 3 Ckt Open, Short Gnd, and Short Volts Test Status

The parameters should display OK or Not Run in each of the commanded states.

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

Circuit/System Testing

1. Ignition OFF, disconnect all of the KR20 cooling fan relays.

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

2. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
 - KR20C cooling fan low speed relay terminal 85
 - KR20D cooling fan high speed relay terminal 85
 - KR20E cooling fan speed control relay terminal 86
 - If the test lamp does not illuminate, test the relay coil ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay coil ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.

NOTE:

- The control circuits for the cooling fan relays are pulled-up to a voltage within the ECM, 2.6-4.6 volts on the control circuit is normal.
- The following test must be performed on all three fan relay control circuit terminals.

3. Connect the red lead of the DMM to a control circuit terminal listed below. Connect the black lead to ground. Set the DMM on the diode setting. The DMM should display OL.
 - KR20C cooling fan low speed relay terminal 86
 - KR20D cooling fan high speed relay terminal 86
 - KR20E cooling fan speed control relay terminal 85
 - If less than the specified range, test the appropriate relay coil control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.

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

4. Command the cooling fan relay ON and OFF with a scan tool. The DMM should transition from OL when commanded OFF to less than 1 V when commanded ON.
 - If the circuit voltage does not correspond to the specified values, test the control circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. If all circuits test normal, test or replace the appropriate KR20 relay.

Component Testing

1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 215-255 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than the specified range, replace the KR20 cooling fan relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Connect a 20 A fused jumper wire between relay terminal 85 and B+. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

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

DTC P1258

Diagnostic Instructions

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

DTC Descriptor

DTC P1258

Engine Coolant Overtemperature - Protection Mode Active

Circuit/System Description

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

Conditions for Running the DTC

- The engine is operating for greater than 30 seconds.
- DTC P0116, P0117, P0118, or P0128 is not set.

Conditions for Setting the DTC

- The ECM detects that engine coolant temperature is greater than 136°C (277°F) for greater than 1 second or a cumulative time of 10 seconds, for V6 applications.
- The ECM detects that the engine coolant temperature is greater than 131°C (267.8°F) for greater than 7 seconds, for V8 applications.

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 instrument panel (IP) will illuminate the coolant indicator lamp and the driver information center (DIC), if equipped, may display a message.

Conditions for Clearing the DTC

DTC P1258 is a Type A DTC.

Reference Information**Description and Operation**

Cooling System Description and Operation (LF1, LLT) or Cooling System Description and Operation (LSA)

DTC Type Reference**Powertrain Diagnostic Trouble Code (DTC) Type Definitions****Scan Tool Reference**

Control Module References for scan tool information

Circuit/System Verification

NOTE: If DTCs P0480, P0481, P0691, P0692, P0693, or P0694 is set, diagnose the DTC first.

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

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

4. Command the cooling fans in both low and high speed.
 - If the cooling fans do not operate in both speeds, refer to **Cooling Fan Inoperative (Single Fan)** or **Cooling Fan Inoperative (Dual Fan)**.
5. Test the thermostat for correct operation. Refer to **Thermostat Diagnosis (LP1, LY7)** or **Thermostat Diagnosis (LS2)**.
6. Test the engine cooling system for overheating. Refer to **Engine Overheating (LSA)** or **Engine Overheating (LF1, LLT)**.
7. Inspect the water pump and coolant flow for correct operation. Refer to **Water Pump Replacement (LF1/LLT)** or **Water Pump Replacement (LSA)**.
8. Inspect the engine mechanical for worn/leaking/cracked cylinder heads and engine block. Refer to **Coolant in Combustion Chamber** and **Coolant in Engine Oil**.

Repair Procedures

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

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

- Perform **Diagnostic System Check - Vehicle** and verify all of the following items:
 - Ensure that the engine control module (ECM) and indicator lamp are operating correctly.

- Ensure that there are no diagnostic trouble codes (DTCs) that are stored.
- Scan tool data is within a normal operating range.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this service information. 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 (LF1, LLT)** or **Cooling System Description and Operation (LSA)**.

Visual/Physical Inspection

CAUTION: Use the connector test adapter kit J 35616-A 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 areas:

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

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- Moisture and water intrusion in connectors, terminals, and components
- 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 temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit 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, and after factory add on accessories

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

Symptom List

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

- **Cooling Fan Always On (Dual Fan)** or **Cooling Fan Always On (Single Fan)**
- **Cooling Fan Inoperative (Single Fan)** or **Cooling Fan Inoperative (Dual Fan)**
- **Engine Overheating (LSA)** or **Engine Overheating (LF1, LLT)**
- **Loss of Coolant**
- **Thermostat Diagnosis (LP1, LY7)** or **Thermostat Diagnosis (LS2)**
- **Engine Fails To Reach Normal Operating Temperature**

LOW ENGINE COOLANT INDICATOR ALWAYS ON

Diagnostic Instructions

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

Diagnostic Fault Information

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

Circuit/System Description

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. The coolant level switch is mounted at the lowest point in the cooling system surge tank. If the amount engine coolant in the surge tank drops below the level of the switch, the coolant level switch opens. The coolant level switch signal circuit is monitored by the heating, ventilation, and air conditioning (HVAC) control module. If the HVAC control module detects an open circuit, or a high voltage condition on the signal circuit for greater than 10 seconds, a Class 2 message is sent to the radio, requesting display of the low coolant level message.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation (LF1, LLT) or Cooling System Description and Operation (LSA)

Electrical Information Reference

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

DTC Type Definitions

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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1. Ignition OFF, verify the radiator surge tank is filled to the correct level, with engine coolant.
2. Ignition ON, observe the scan tool coolant level parameter. The parameter should display OK.
3. The low engine coolant level message should not be displayed, with the engine coolant in the surge tank at the proper level.

Circuit/System Testing

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

1. Ignition OFF, disconnect the harness connector at the B33 coolant level switch.
2. Test for less than 5 ohms between the ground circuit terminal B and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the scan tool coolant level switch parameter displays LOW.
 - If not the specified value, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the K33 HVAC control module.
4. Install a 3 A fused jumper wire between the signal circuit terminal A and the ground circuit terminal B. Verify the scan tool coolant level parameter displays OK.
 - If not the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K33 HVAC control module.
5. If all circuits test normal, test or replace the B33 coolant level switch.

Repair Procedures

- **Instrument Cluster Replacement (Left Hand Drive)** or **Instrument Cluster Replacement (Right Hand Drive)**
- **Radiator Surge Tank Replacement**
- **Control Module References** for ECM replacement, setup, and programming

Repair Verification

Verify that the low coolant indicator is not displayed with the engine coolant at the correct level.

COOLING FAN ALWAYS ON (DUAL FAN)

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. 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 Relay 2 and 3 operates one fan at a high speed
- Cooling Fan Relay 1, 2 and 3 operates both fans at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0480 or P0481 is not set.
 - If a DTC is set, refer to **DTC P0480 or P0481 (V8 and V6-LF1, LGD - Dual Fan)** or **DTC P0480 or P0481 (V6-LF1)**.
2. Ignition ON, observe the scan tool FC Relay 1 and FC Relay 2 and 3 Command parameters. The parameters should display OFF.
3. Ignition ON, observe that the fan is not activated.

Circuit/System Testing

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

1. Ignition OFF, disconnect each KR20 cooling fan relay one at a time.
2. Ignition ON, observe that the cooling fans are not activated.
 - If the fans are activated, test for a short to voltage in the relay controlled output circuit.
 - If the fans are not activated, test or replace the appropriate KR20 cooling fan relay.

Component Testing

1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 70-110 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified range, replace the KR20 cooling fan relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Install a 20 A fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

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

COOLING FAN ALWAYS ON (SINGLE FAN)**Circuit/System Description**

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 resistor module is a self-contained unit providing a specific resistance through three individual circuits. To activate the fan, the ECM applies ground to the coil side of the applicable fan relays. 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.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation****Cooling Fan Description and Operation****Electrical Information Reference**

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

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

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0480, P0481, P0691, P0692, P0693, P0694 is not set.
 - If a DTC is set, refer to **DTC P0480 or P0481 (V8 and V6-LF1, LGD - Dual Fan)** or **DTC P0480 or P0481 (V6-LF1)** for V8 or V6 LF1, or **DTC P0480, P0481, P0691, P0692, P0693, or P0694**

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(w/LLT) or DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/LLT and Dual Fan) for V6 LLT.

2. Ignition ON, observe the scan tool FC Relay 1 and FC Relay 2 and 3 Command parameters. The parameters should display OFF.
3. Ignition ON, observe that the fan is not activated.

Circuit/System Testing

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

1. Ignition OFF, disconnect each KR20 cooling fan relay one at a time.
2. Ignition ON, observe that the cooling fan is not activated.
 - If the fan is activated, test for a short to voltage in the relay controlled output circuits.
 - If the fans is not activated, test or replace the appropriate cooling fan relay.

Component Testing

1. Ignition OFF, disconnect the appropriate cooling fan relay.
2. Test for 200-240 ohms between terminals 85 and 86 of the relay.
 - If not within the specified range, replace the relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the relay.
5. Install a 20 A fused jumper wire between B+ and relay terminal 85. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the cooling fan relay.

Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

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

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 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 resistor module is a self-contained unit providing a specific resistance through three individual circuits. To activate the fan, the ECM applies ground to the coil side of the applicable fan relays. 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.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
 - Cooling Fan Relay 1 operates the fan at a low speed
 - Cooling Fan Relay 2 and 3 operates the fan at a medium speed
 - Cooling Fan Relay 1, 2 and 3 operates the fan at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation****Cooling Fan Description and Operation****Electrical Information Reference**

- **Circuit Testing**
- **Connector Repairs**

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0480, P0481, P0691, P0692, P0693 or P0694 is not set.
 - If a DTC is set, refer to **DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/LLT)** or **DTC P0480, P0481, P0691, P0692, P0693, or P0694 (w/LLT and Dual Fan)**.
2. Ignition ON, command the fan relays ON and OFF with a scan tool. Verify that the fan operates at low, medium and high speed.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the R10 cooling fan resistor.
2. Test for less than 5 ohms between the cooling fan motor ground circuit terminal 2 and ground.
 - If greater than the specified range, test the ground circuit for and open/high resistance.
3. Connect a test lamp between the G10 cooling fan motor voltage supply circuit terminal 4 and ground. Command the FC relay 1 ON and OFF with a scan tool. The test lamp should respond to the scan tool commands.
 - If the test lamp remains OFF all of the time, test the voltage supply circuit for an open/high resistance or a short to ground. If the circuit tests normal, test or replace the KR20C relay.
4. Connect a test lamp between the G10 cooling fan motor voltage supply circuit terminal 3 and ground. Command the FC relay 2 and 3 ON and OFF with a scan tool. The test lamp should respond to the scan tool commands.
 - If the test lamp remains OFF all of the time, test the voltage supply circuit for an open/high resistance or a short to ground. If the circuit tests normal, test or replace the KR20D relay.
5. Connect a test lamp between the G10 cooling fan motor voltage supply circuit terminal 1 and ground. Command the FC relay 2 and 3 ON and OFF with a scan tool. The test lamp should remain OFF.
 - If the test lamp illuminates, test or replace the KR20E relay.
6. Connect a test lamp between the G10 cooling fan motor voltage supply circuit terminal 1 and ground. Command the FC relay 1, 2 and 3 ON and OFF with a scan tool. The test lamp should respond to the scan tool commands.
 - If the test lamp remains OFF all of the time, test the voltage supply circuit for an open/high resistance or a short to ground. If the circuit tests normal, test or replace the KR20E relay.
7. Connect the harness connector at the R10 cooling fan resistor. Disconnect the harness connector at the G10 cooling fan motor.
8. Connect a test lamp between the voltage supply circuit terminal 1 and the ground circuit terminal 2. Command the cooling fans ON in all 3 speeds. Verify the test lamp illuminates in all 3 speeds.

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- If the test does not illuminate in all 3 speeds, replace the R10 cooling fan resistor.
- 9. If all circuits/connections test normal, replace the G10 cooling fan motor.

Component Testing

1. Ignition OFF, disconnect the appropriate KR20 cooling fan relay.
2. Test for 200-240 ohms between terminals 85 and 86 of the relay.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Test for infinite resistance between the terminals listed below.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Install a 20 A fused jumper wire between B+ and relay terminal 85. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

Repair Procedures

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Engine Coolant Fan Motor Replacement (LF1, LLT)** or **Engine Coolant Fan Motor Replacement (LSA)**
- **Engine Coolant Fan Resistor Replacement (LF1, LLT)**

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. 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 Relay 2 and 3 operates one fan at a high speed
 - Cooling Fan Relay 1, 2 and 3 operates both fans at a high speed
- KR20 cooling fan relay identification:
 - KR20C cooling fan low speed FAN 1 Relay
 - KR20D cooling fan high speed FAN 2 Relay
 - KR20E cooling fan speed control FAN 3 or S/P Relay
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information**Schematic Reference****Engine Cooling Schematics****Connector End View Reference****COMPONENT CONNECTOR END VIEWS - INDEX****Description and Operation****Cooling Fan Description and Operation****Electrical Information Reference**

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

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

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0480, P0481, P0691, P0692, P0693, or P0694 is not set.

- If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
- 2. Ignition ON, command the appropriate fan relay ON and OFF with a scan tool. Verify that the fans turn ON and OFF when changing between the commanded states.

Circuit/System Testing

1. Ignition OFF, disconnect the KR20 cooling fan relays.

NOTE: **The jumper wire completes the FAN 1 ground circuit. Leave this jumper in place for the remainder of the procedure.**

2. Connect a 40 A fused jumper between the KR20E S/P or FAN 3 relay switch circuit terminal 30 and the ground circuit terminal 87.

NOTE: **The following test must be performed on both the high speed fan relay circuit and the low speed fan relay circuit.**

3. Ignition ON, verify that a test lamp illuminates between ground and the relay switched ignition circuit terminal listed below:
 - KR20C low speed FAN 1 relay terminal 87
 - KR20D high speed FAN 2 relay terminal 87
 - If the test lamp does not illuminate, test the appropriate relay switch B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay switch B+ circuit fuse is open, test the relay controlled output circuit for a short to ground. If the circuit tests normal, test or replace the appropriate KR20 relay.

NOTE: **The following test must be performed first on the high speed fan relay circuit and next on the low speed fan relay circuit. Leave the jumper connected to the low speed FAN 1 relay circuit for the next test.**

4. Connect a 40 A fused jumper between the KR20 cooling fan relay circuit terminals listed below. Verify the appropriate fan is activated.
 - KR20D high speed FAN 2 relay terminals 87 and 30
 - KR20C low speed FAN 1 relay terminals 87 and 30
 - If the corresponding cooling fan does not activate, test the relay controlled output circuit and the cooling fan ground circuit for an open/high resistance. If the circuits tests normal, replace the appropriate G10 cooling fan motor.
 - If the corresponding cooling fan activates, replace the appropriate KR20 cooling fan relay.
5. Install the KR20E S/P or FAN 3 relay. Verify both fans activate at low speed.
 - If both fans do not activate, test the relay controlled output circuit terminal 87A of the KR20E fan relay for a short to ground or an open/high resistance.
6. If the circuits test normal, test or replace the KR20E cooling fan speed control relay.

Component Testing

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1. Ignition OFF, disconnect the KR20 cooling fan relay.
2. Test for 70-110 ohms between terminals 85 and 86.
 - If not within the specified range, replace the KR20 cooling fan relay.
3. Measure the resistance between the terminals listed below. The DMM should display OL.
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than the specified range, replace the KR20 cooling fan relay.
4. Test the KR20E relay for less than 2 ohms between terminals 30 and 87A.
 - If greater than the specified range, replace the KR20E cooling fan relay.
5. Connect a 20 A fused jumper wire between relay terminal 85 and B+. Connect a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR20 cooling fan relay.

G10L and G10R Engine Cooling Fan

1. Ignition OFF, disconnect the harness connector at the G10 engine cooling fan assembly.
2. Connect a jumper wire between ground and the G10 ground circuit terminal 2.
3. Connect an appropriately fused jumper wire between B+ and the G10 B+ supply circuit terminal 1. The cooling fan should operate at a High speed:
 - If the cooling fan does operate, replace the G10 engine cooling fan.

Repair Procedures

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Engine Coolant Fan Motor Replacement (LF1, LLT)** or **Engine Coolant Fan Motor Replacement (LSA)**

ENGINE OVERHEATING (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		

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2	obstruction. 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 Cooling Fan Inoperative (Single Fan) or Cooling Fan Inoperative (Dual Fan). 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 Engine Coolant Fan Motor Replacement (LF1, LLT) or Engine Coolant Fan Motor Replacement (LSA). Does the engine still overheat?	Go to Step 7	System OK
7	Check for a loss of coolant. Refer to Loss of Coolant. 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 Loss of Coolant. 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 Flushing (Charge Air Cooling) or Flushing (Powertrain). Does the engine still overheat?	Go to Step 14	Go to Step 19
14	Inspect the accessory drive belt tensioner. Refer to Drive Belt Tensioner Diagnosis. Does the engine still overheat?	Go to Step 15	System OK
	Check for a faulty thermostat. Refer to Thermostat		

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15	<u>Diagnosis (LP1, LY7) or Thermostat Diagnosis (LS2).</u> Does the engine still overheat?	Go to Step 16	System OK
16	Replace the radiator. Refer to <u>Radiator Replacement (Standard Duty Cooling)</u> or <u>Radiator Replacement (Heavy 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 (LF1/LLT)</u> or <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	-

ENGINE OVERHEATING (LF1, LLT)

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. Special Tools: J-26568: Coolant and Battery Fluid Tester			
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
2	1. Remove any debris that may cause an air flow obstruction. 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 (Single Fan)</u> or <u>Cooling Fan Inoperative (Dual Fan)</u> . Is the thermostat operating properly?	Go to Step 6	Go to Step 7

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6	Repair or replace the cooling fan(s) as necessary. Refer to <u>Engine Coolant Fan Motor Replacement (LF1, LLT)</u> or <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 (Charge Air Cooling)</u> or <u>Flushing (Powertrain)</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> or <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 (Standard Duty Cooling)</u> or <u>Radiator Replacement (Heavy 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 (LF1/LLT)</u> or <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	-

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LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level 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 Cooling System Draining and Filling (Static Fill LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA) . 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
8	Visually inspect the hoses, pipes and hose clamps at the following locations: • 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
	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Cylinder head gaskets • Cylinder heads		

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9	• 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 <u>Cooling System Leak Testing</u>. 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 <u>Pressure Cap Testing</u> . 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
13	• Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. • Condensation in the exhaust system can cause an odorless white smoke during engine warm up.		
	Does the white smoke have a burning coolant type odor?	Go to Step 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		

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	HVAC module		
	Is coolant present?	Go to Step 22	Go to Step 16
16	1. 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> . 2. Start the vehicle and allow the engine to reach normal operating temperature. 3. Shut the engine off. 4. 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
18	Inspect the engine oil for a gray/white milky 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 (Standard Duty Cooling)</u> or <u>Radiator Replacement (Heavy Duty Cooling)</u>. 2. Service the transmission. Refer to <u>Coolant in Engine Oil</u> .		

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	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 (LSA)</u> or <u>Engine Overheating (LF1, LLT)</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 (LP1, LY7)**Tools Required**

- **J 24731** 188 Tempilstick. See **Special Tools**.
- **J 24731** 206 Tempilstick. See **Special Tools**.

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). See **Special Tools**.
 - **J 24731** 206 tempilstick melts at 97°C (206°F). The thermostat should be fully open at 107°C (225°F). See **Special Tools**.
2. Replace the thermostat if it does not operate properly between this temperature range.

THERMOSTAT DIAGNOSIS (LS2)**Tools Required**

- **J 24731** 188 Tempilstick. See **Special Tools**.

- **J 24731** 206 Tempilstick. See **Special Tools**.

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.

COOLANT HEATER INOPERATIVE

Diagnostic Instructions

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

Circuit/System Description

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

Reference Information

Electrical Information Reference

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

Circuit/System Testing

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

1. Test the engine coolant heater for an open or short to ground.

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- If open or shorted, replace the heater.
- 2. If the heater tests normal, replace the coolant heater power cord.

Repair Procedures

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

- **Coolant Heater Replacement (LF1/LLT)** or **Coolant Heater Replacement (LSA)**
- **Coolant Heater Cord Replacement (LF1/LLT)** or **Coolant Heater Cord Replacement (LSA - 110 Volt)** or **Coolant Heater Cord Replacement (LSA - 240 Volt)**

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> or <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 (LP1, LY7)</u> or <u>Thermostat Diagnosis (LS2)</u> . Is the thermostat operating properly?	Go to Step 1	Go to Step 6

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6	1. Replace the thermostat. Refer to <u>Engine Coolant Thermostat Replacement (LF1/LLT)</u> or <u>Engine Coolant Thermostat Replacement (LSA)</u>. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK
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PRESSURE CAP TESTING

Special Tools

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

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.

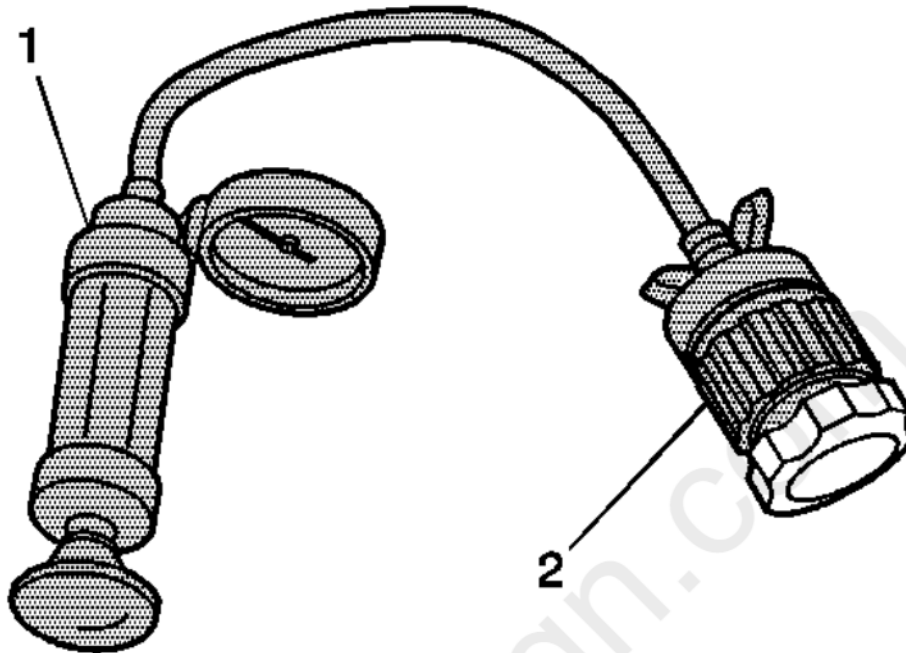


Fig. 4: Identifying Pressure Cap Testing Tool J 42401
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** (1) with **J 42401** (2) in order to test the pressure cap. See **Special Tools**.
4. Test the pressure cap for the following conditions:
 - Pressure release when the **J 24460-01** exceeds the pressure rating of the pressure cap. See **Special Tools**.
 - 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. See Special Tools.
- J 42401 Radiator Cap / Surge Tank Test Adapter. See Special Tools.

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

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

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

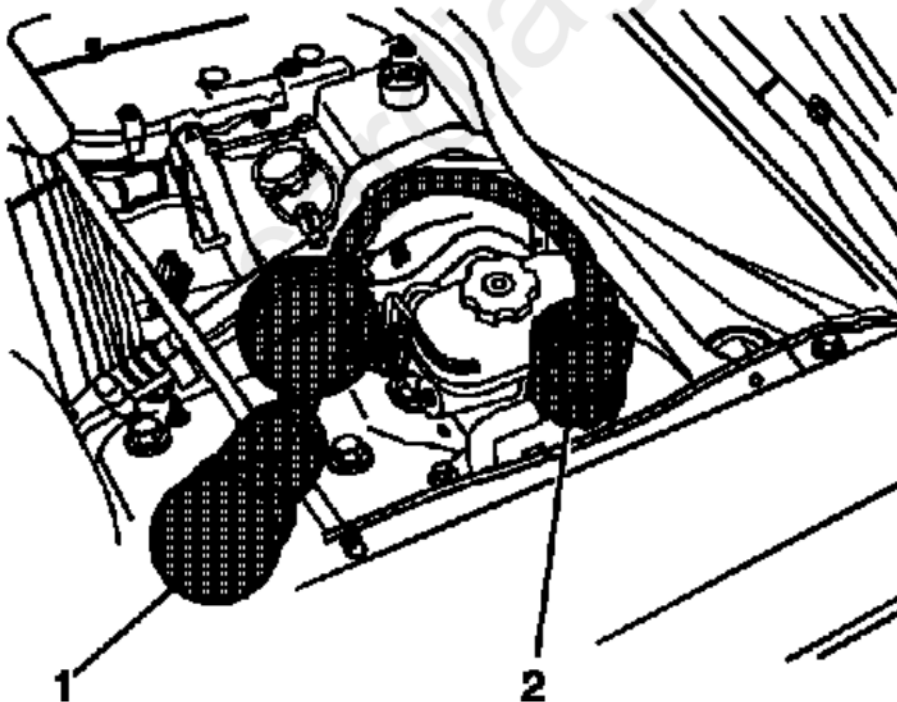


Fig. 5: View Of Testing Cooling System Pressure Using Special Tools J 24460-01 & J 42401
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 24460-01** (1) with **J 42401** (2) in order to apply pressure to the cooling system. See **Special Tools**.

Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL LF1, LLT)

Special Tools

J 26568 Coolant and Battery Fluid Tester. See **Special Tools**.

Draining Procedure

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

1. 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 (Charge Air Cooling) Flushing (Powertrain)**.
 - 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.

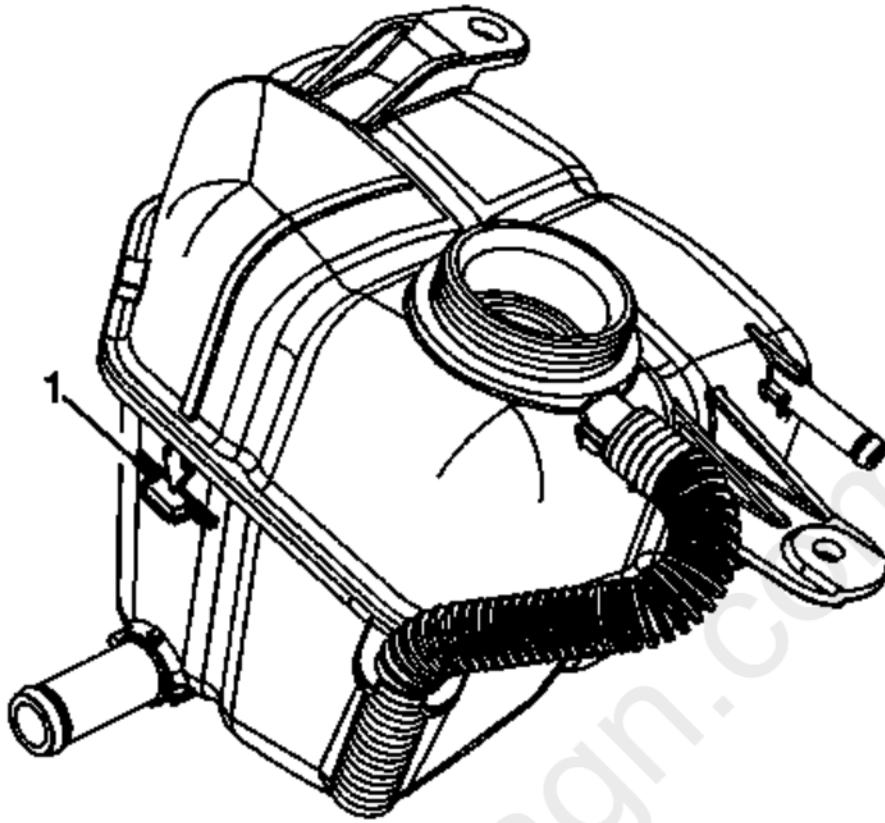


Fig. 6: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS CORP.

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** inspect the concentration of the engine coolant. See **Special Tools**.

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL LSA)

Special Tools

J 26568 Coolant and Battery Fluid Tester. See **Special Tools**.

Draining Procedure

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

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

1. 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 (LF1, LLT)** or **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 (LF1, LLT)** or **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.

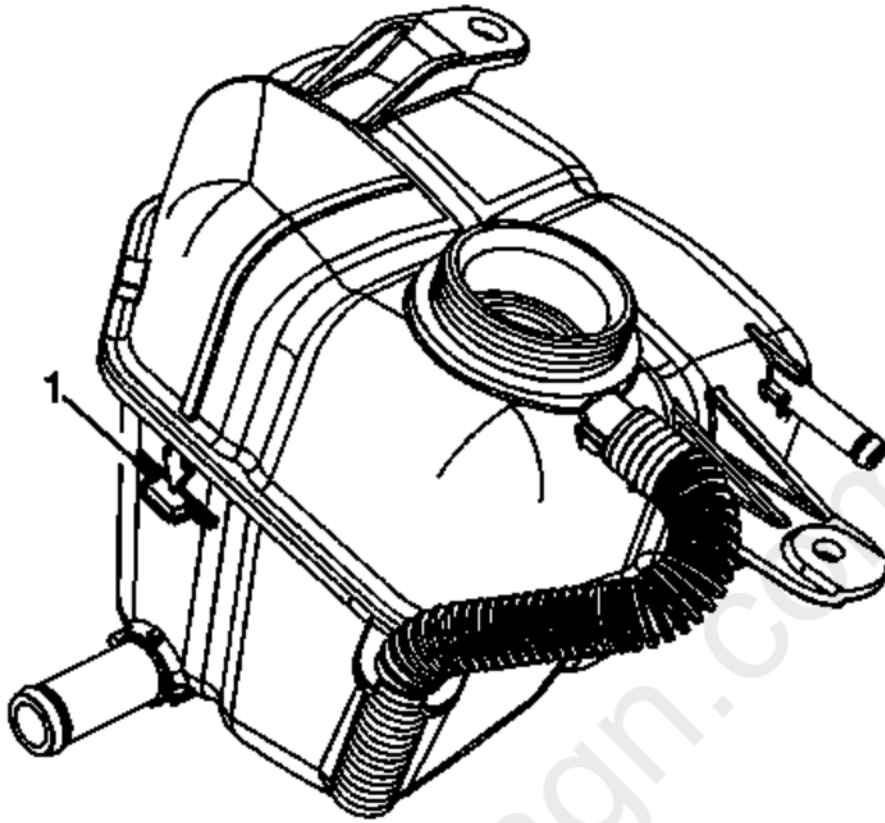


Fig. 7: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS CORP.

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** inspect the concentration of the engine coolant. See **Special Tools**.

COOLING SYSTEM DRAINING AND FILLING (GE 47716 LF1, LLT)

Special Tools

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

Draining Procedure

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

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

1. 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 (Charge Air Cooling)** or **Flushing (Powertrain)**.
 - Normal in appearance - Follow the Vac N Fill Procedure below.
9. Tighten the drain cock.

Vac N Fill Procedure

1. Install the **J 42401** onto the coolant surge tank. See **Special Tools**.

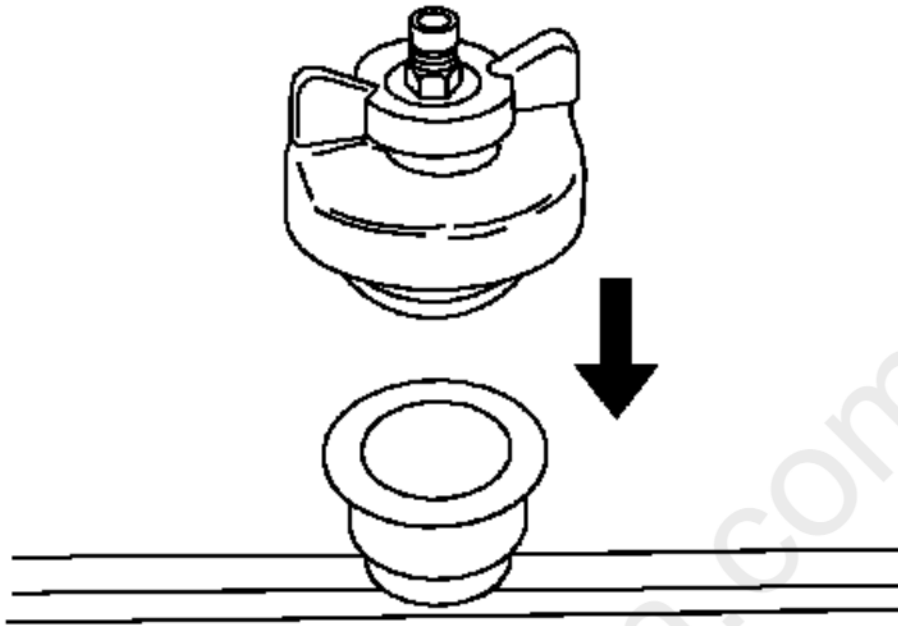


Fig. 8: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS CORP.

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 . See Special Tools.

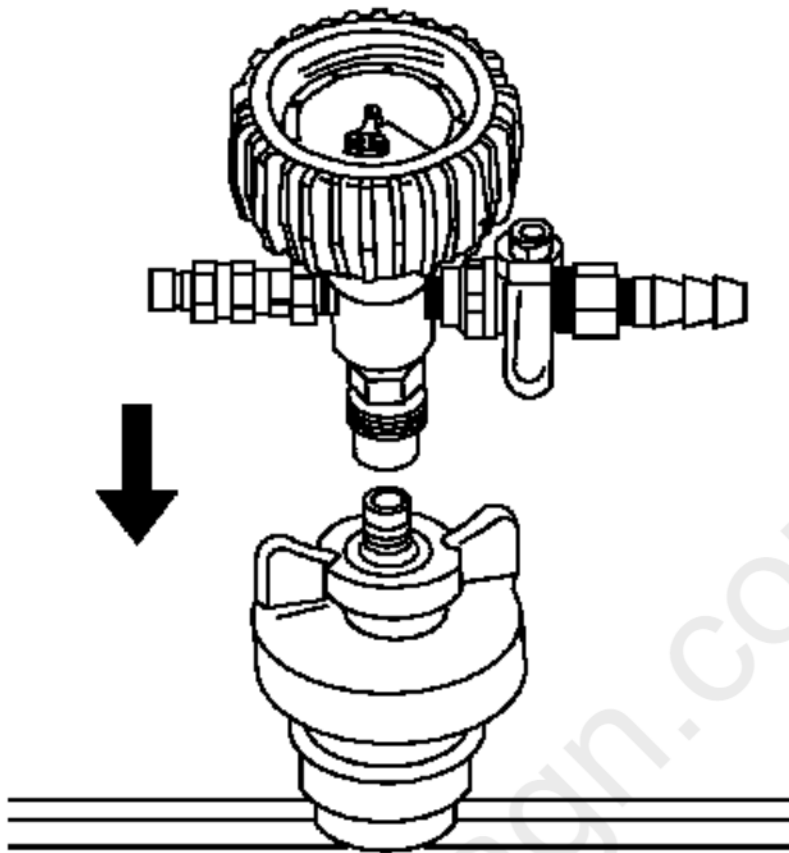


Fig. 9: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

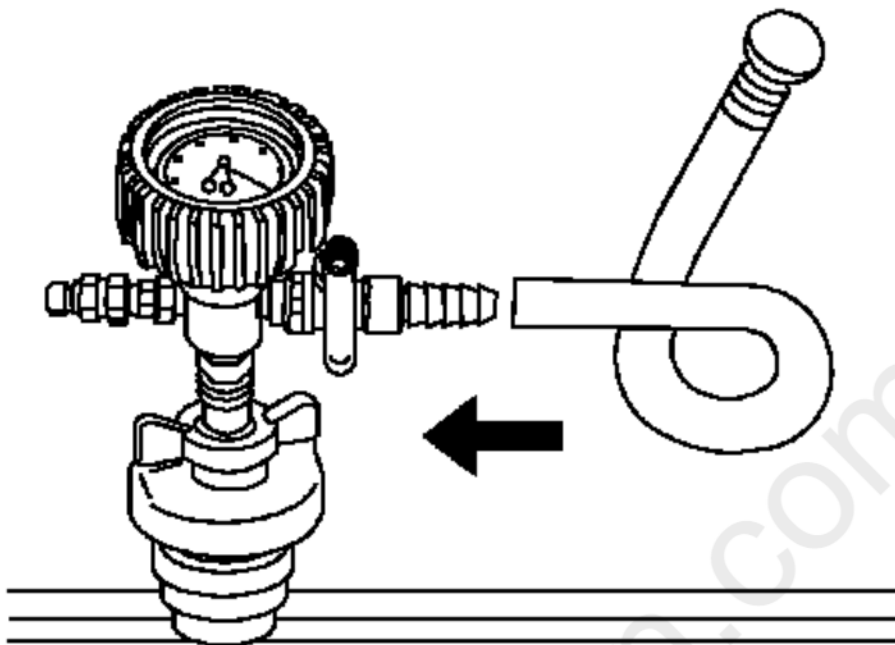


Fig. 10: Fill Hose & Barb Fitting
Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gauge assembly.
Ensure that the valve is closed.

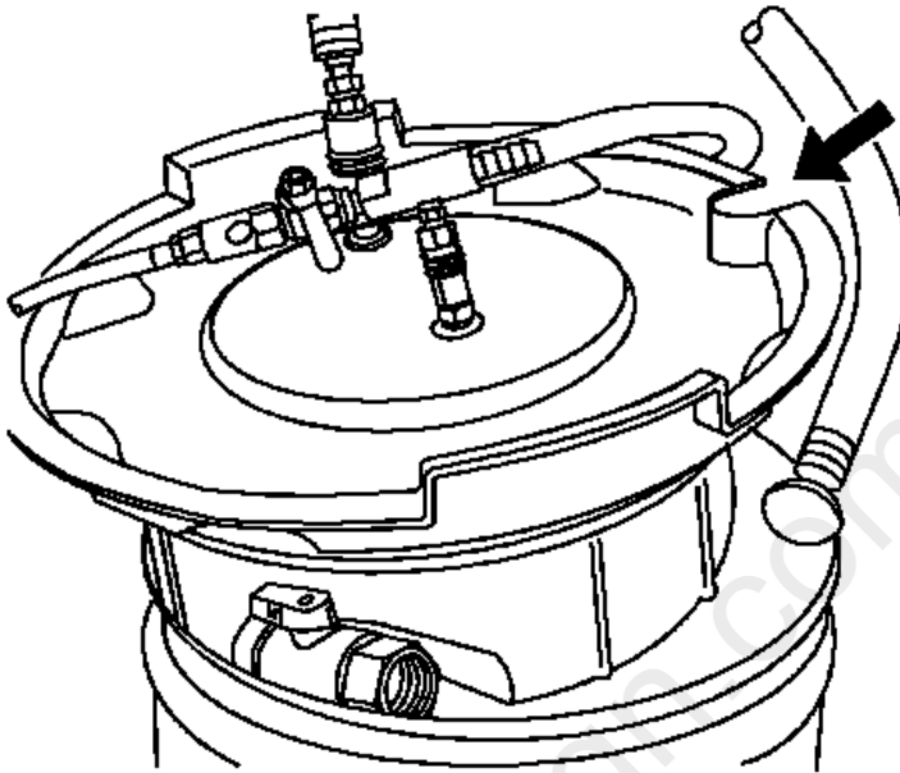


Fig. 11: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS CORP.

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.

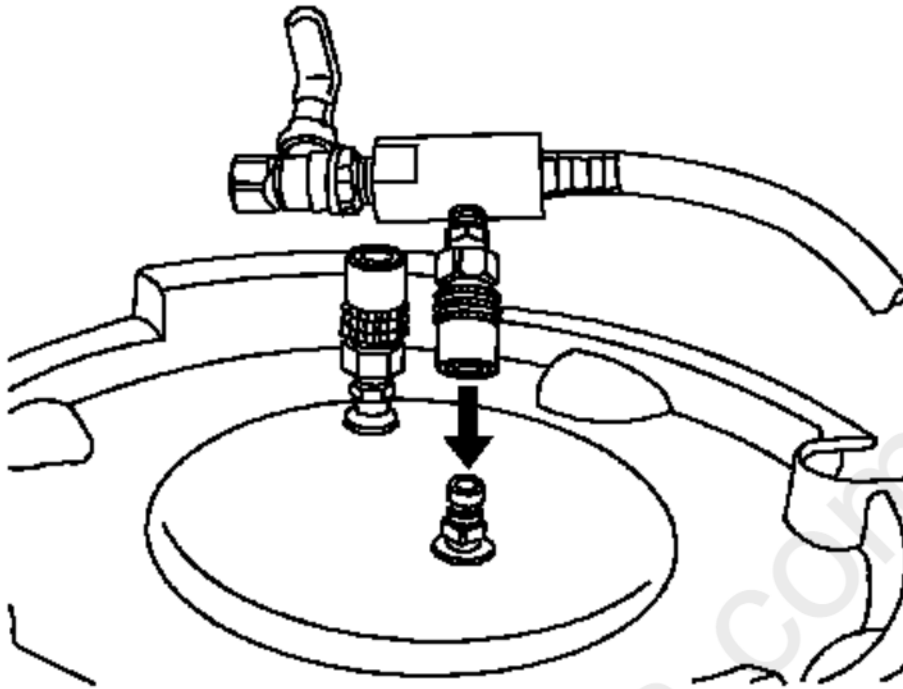


Fig. 12: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

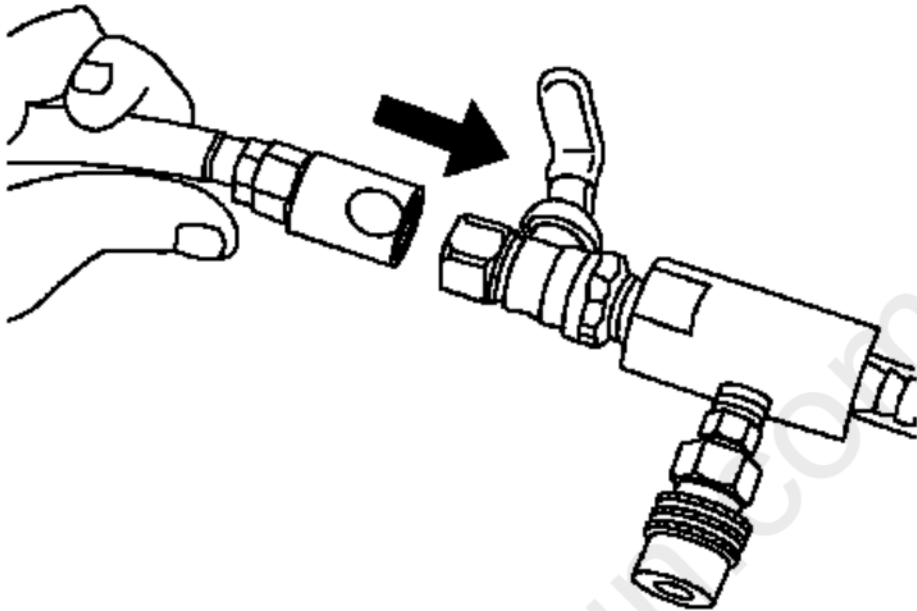


Fig. 13: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

Ensure the valve on the venturi assembly is closed.

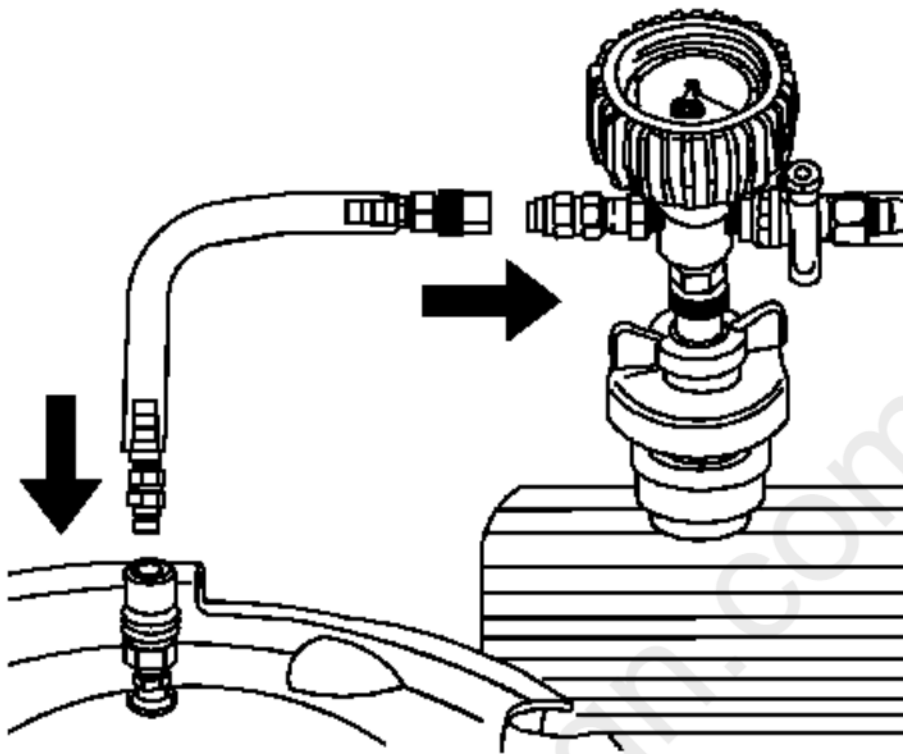


Fig. 14: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

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

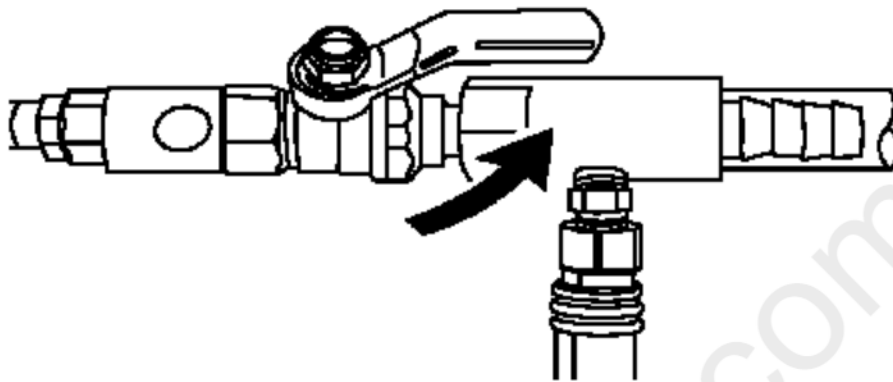


Fig. 15: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

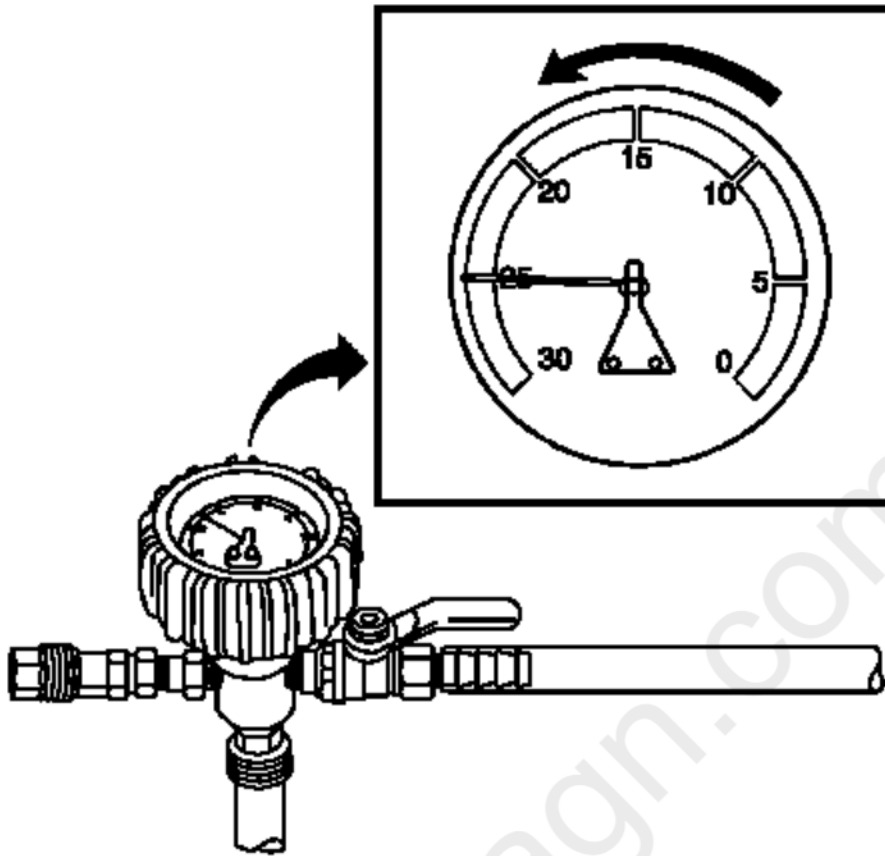


Fig. 16: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

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.

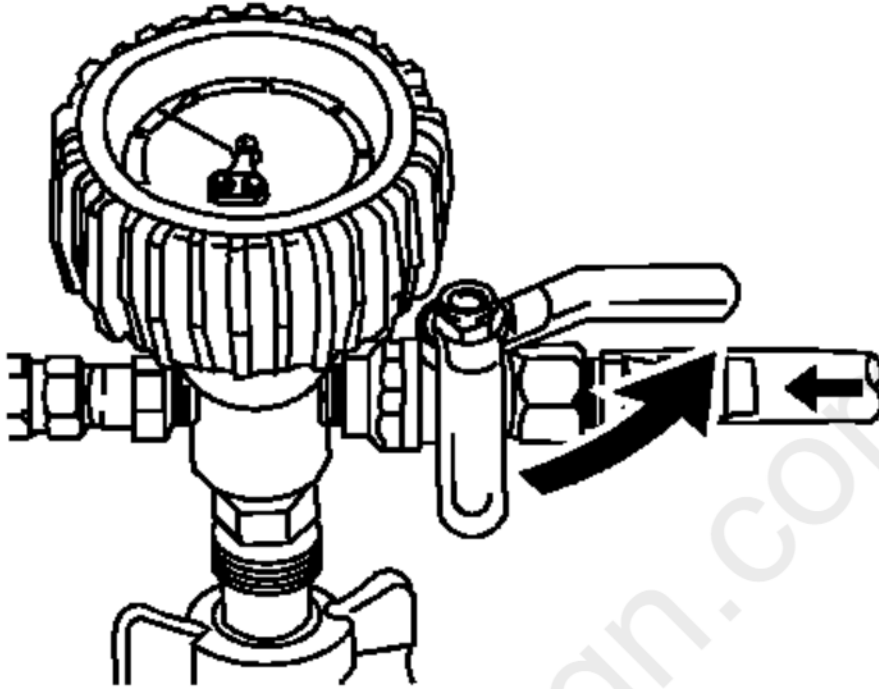


Fig. 17: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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.

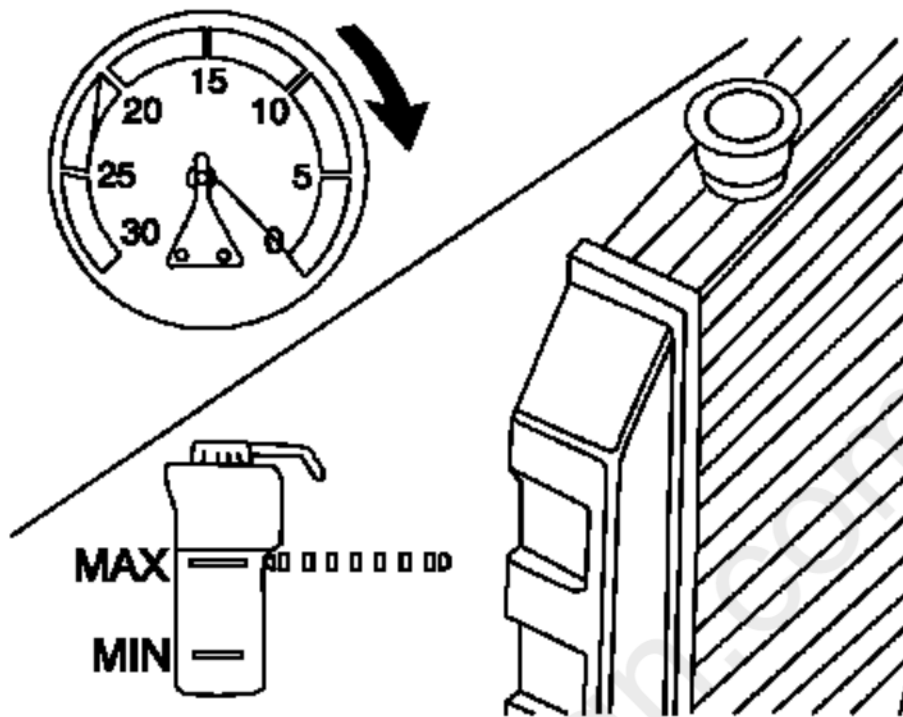


Fig. 18: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

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** . See **Special Tools**.
20. Remove the **J 42401** from the coolant surge tank. See **Special Tools**.

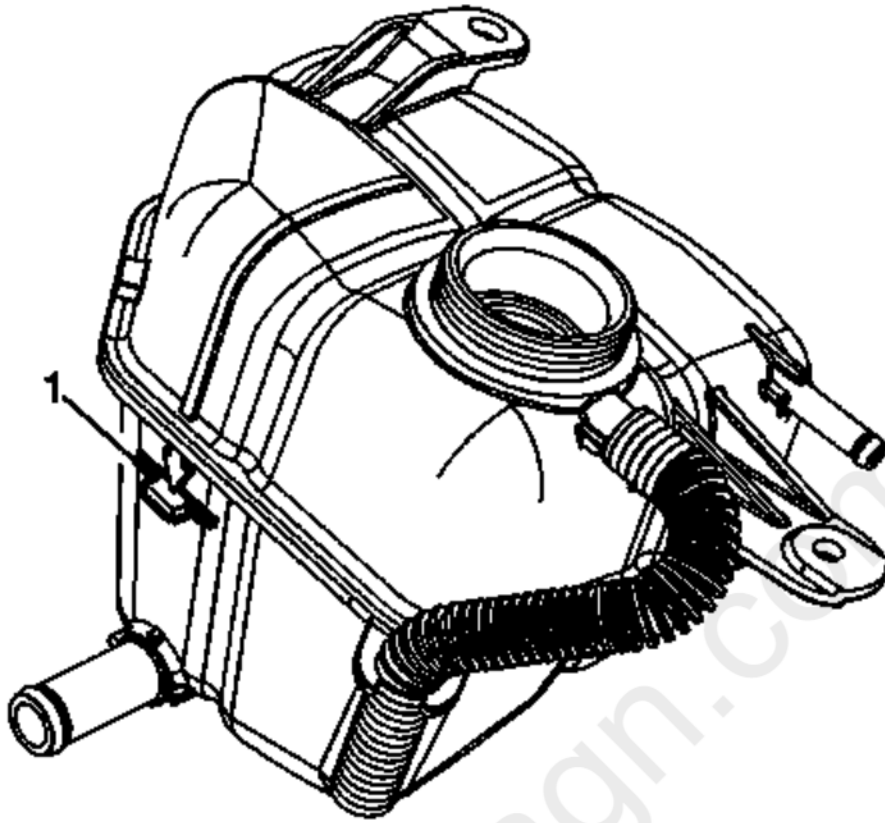


Fig. 19: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS CORP.

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** . See **Special Tools**.

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.

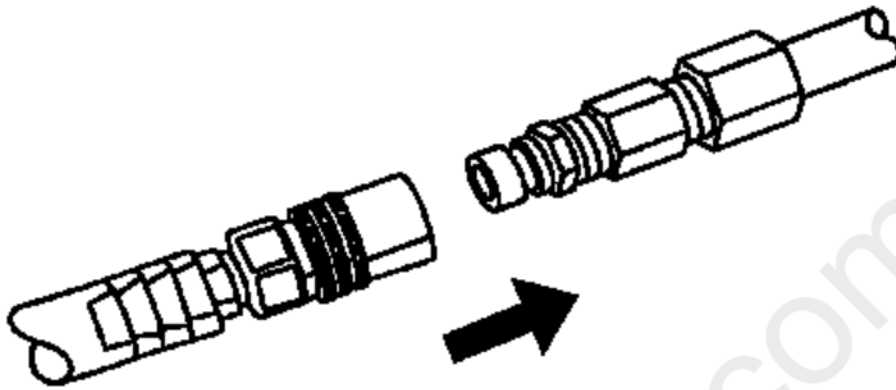


Fig. 20: Identifying Extraction Hose And Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

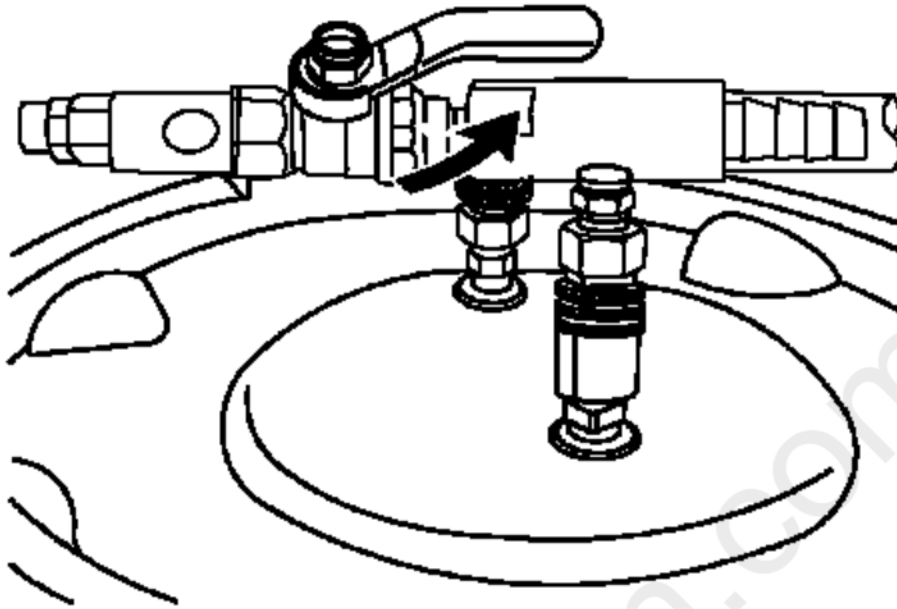


Fig. 21: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

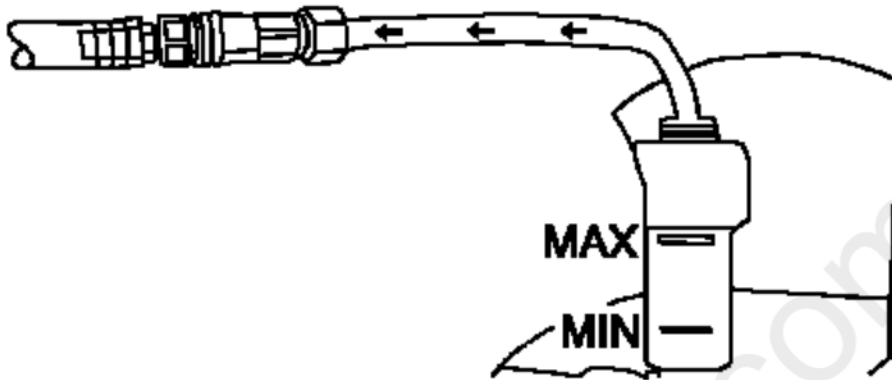


Fig. 22: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS CORP.

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.

COOLING SYSTEM DRAINING AND FILLING (GE 47716 LSA)

Special Tools

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

Draining Procedure

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

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

1. 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 (LF1, LLT) or Radiator Outlet Hose Replacement (LSA).

Vac N Fill Procedure

1. Install the radiator outlet hose. Refer to Radiator Outlet Hose Replacement (LF1, LLT) or Radiator Outlet Hose Replacement (LSA).
2. Install the **J 42401** onto the coolant surge tank. See Special Tools.

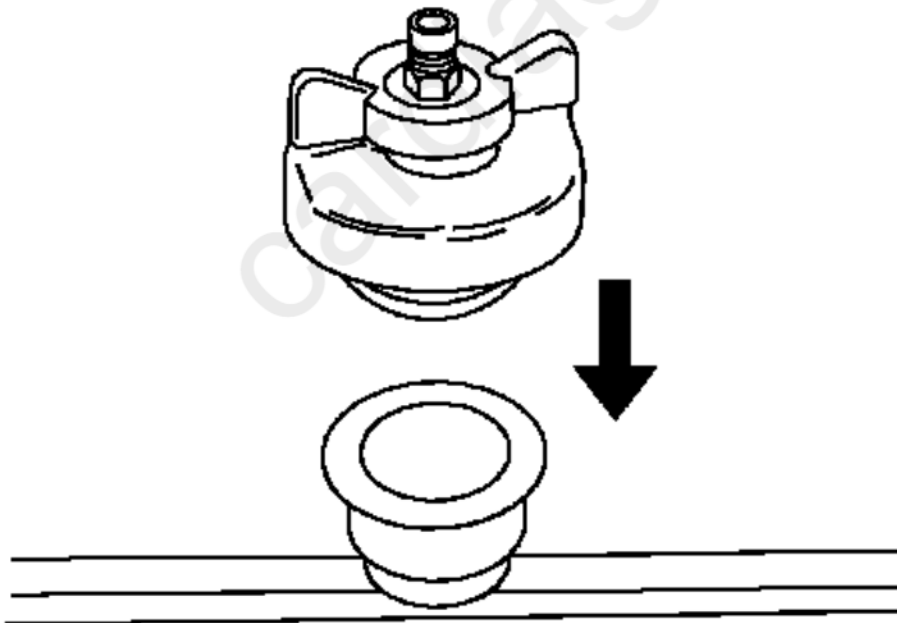


Fig. 23: Identifying Vac-N-Fill Cap

Courtesy of GENERAL MOTORS CORP.

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 . See Special Tools.

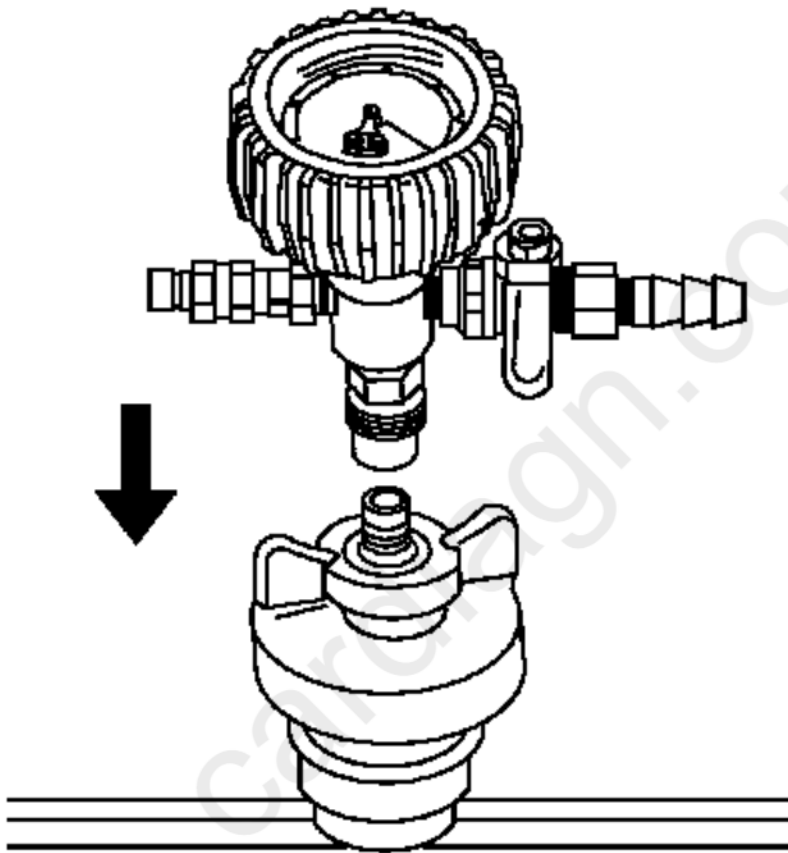


Fig. 24: Vacuum Gage Assembly

Courtesy of GENERAL MOTORS CORP.

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

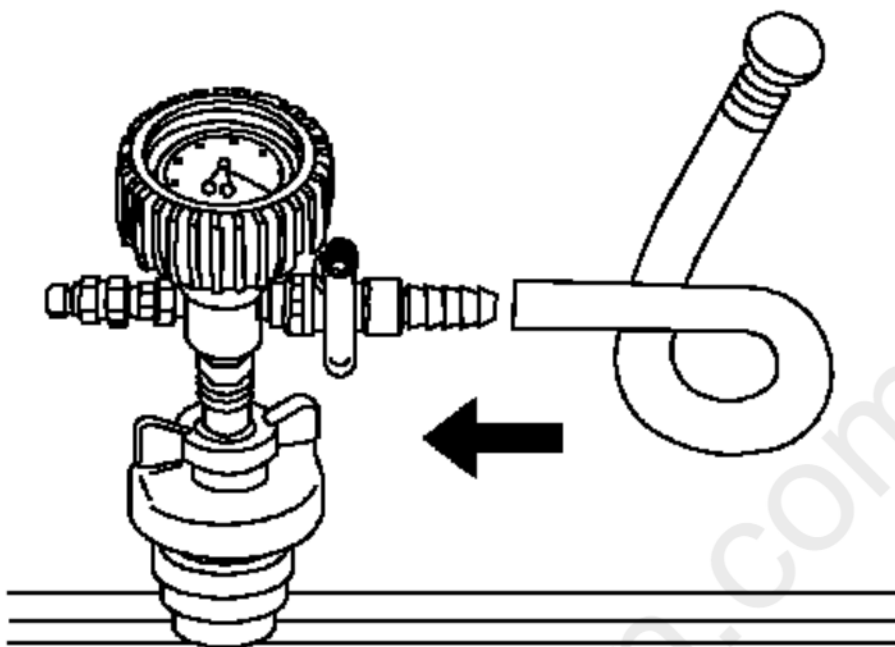


Fig. 25: Fill Hose & Barb Fitting
Courtesy of GENERAL MOTORS CORP.

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

Ensure that the valve is closed.

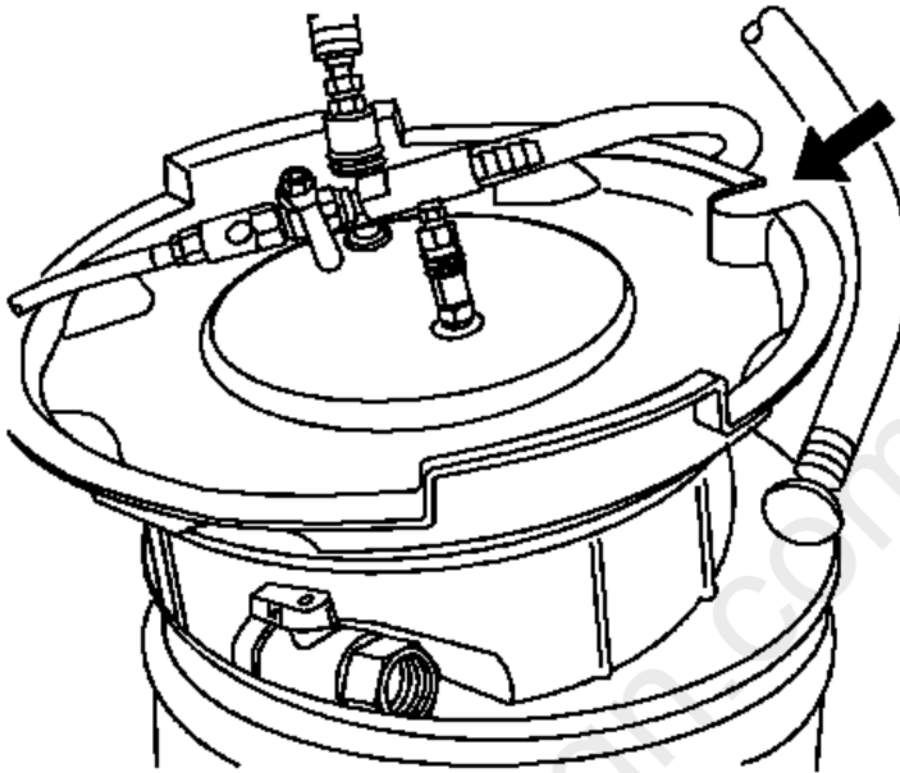


Fig. 26: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS CORP.

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.

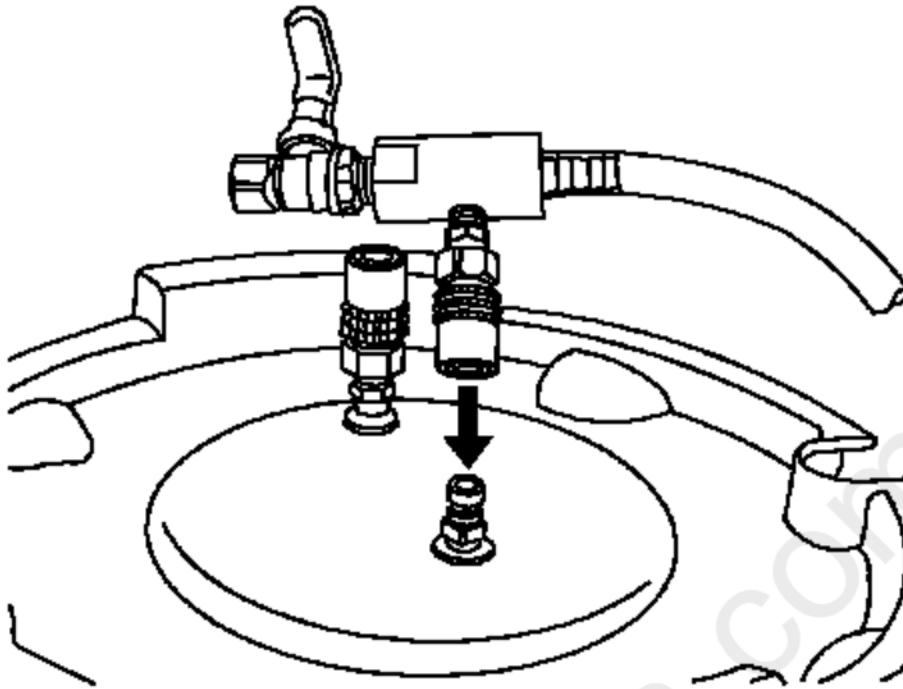


Fig. 27: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

9. Attach the venturi assembly to the vacuum tank.

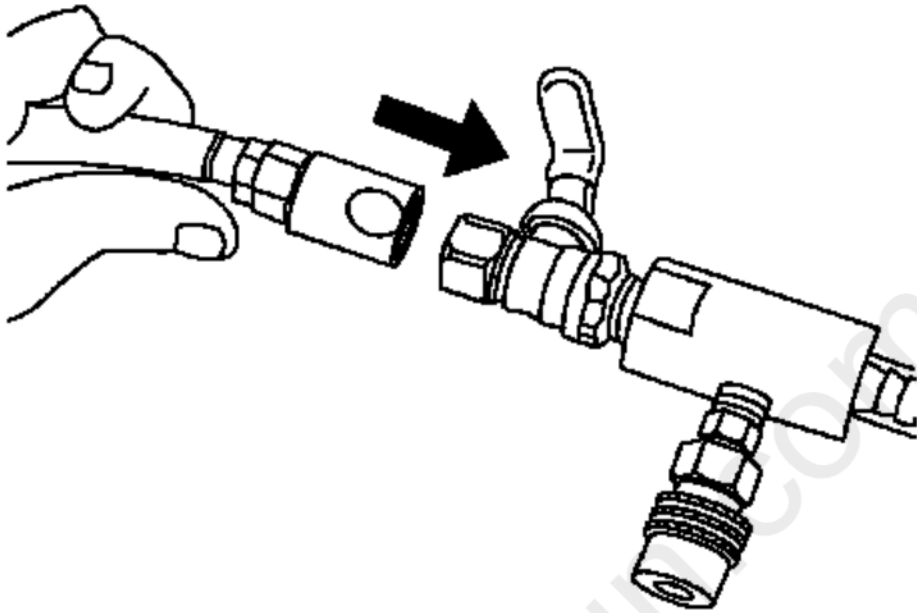


Fig. 28: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

Ensure the valve on the venturi assembly is closed.

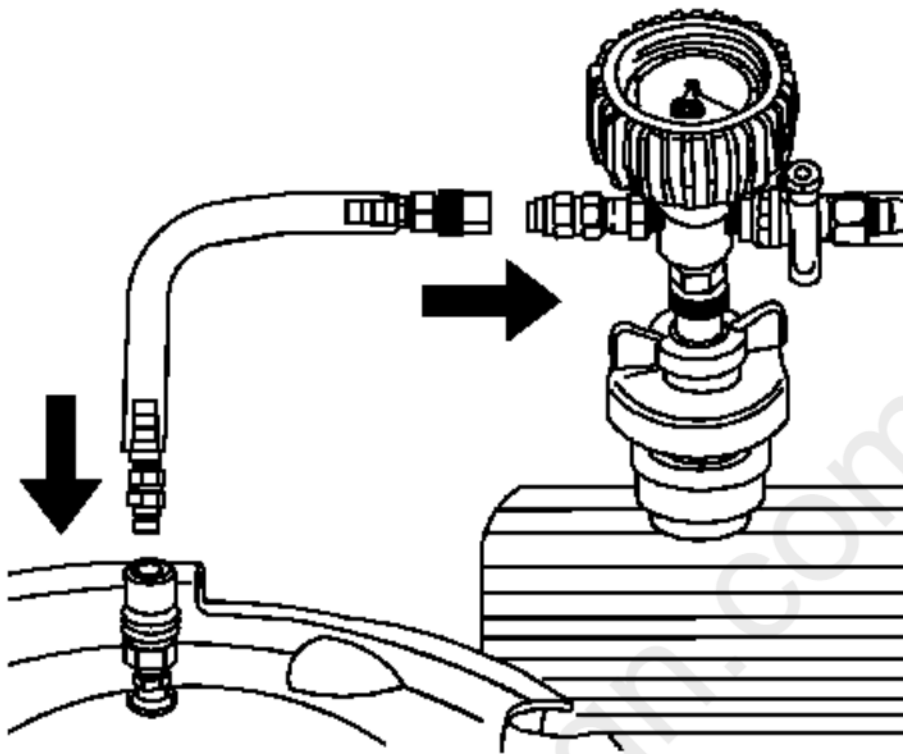


Fig. 29: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

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

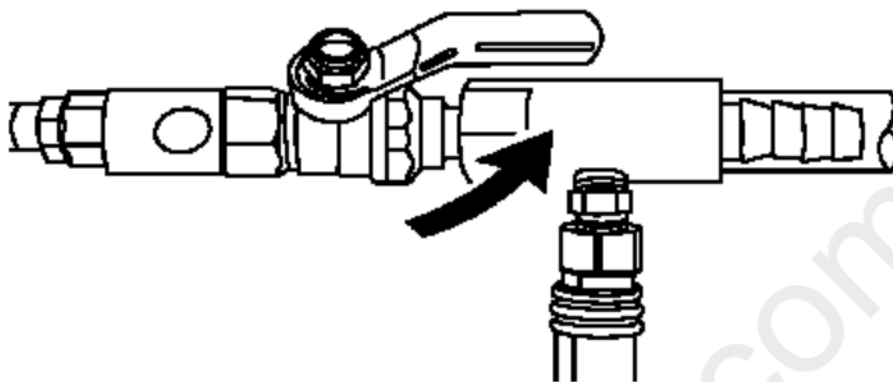


Fig. 30: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

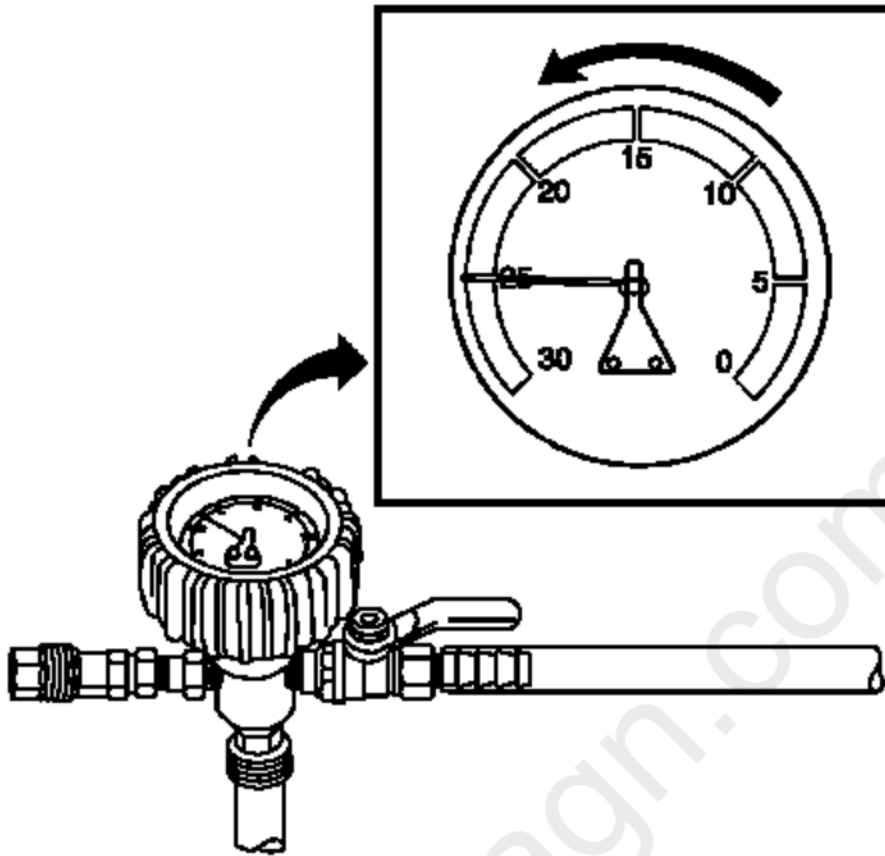


Fig. 31: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

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

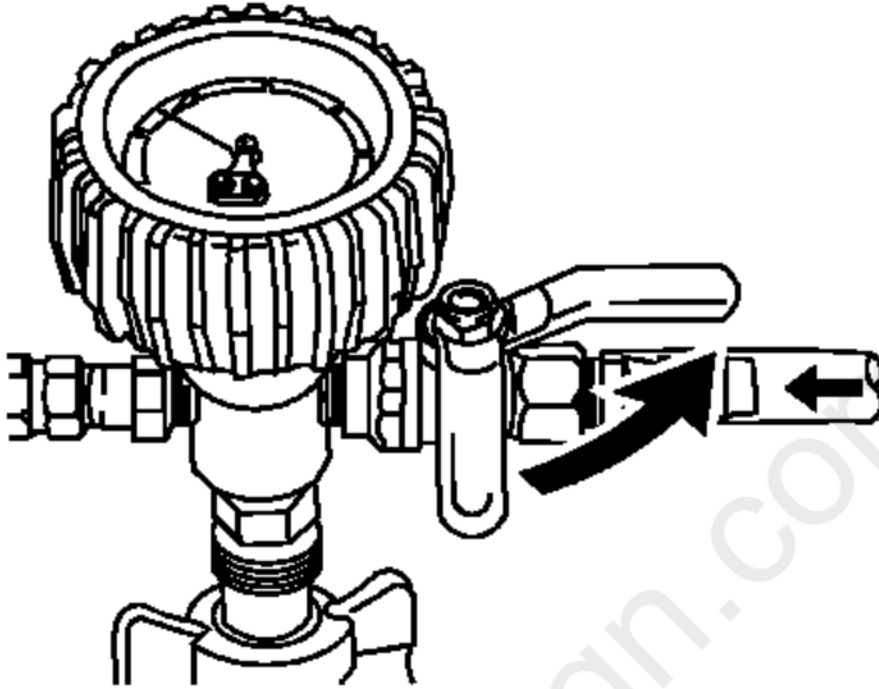


Fig. 32: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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.

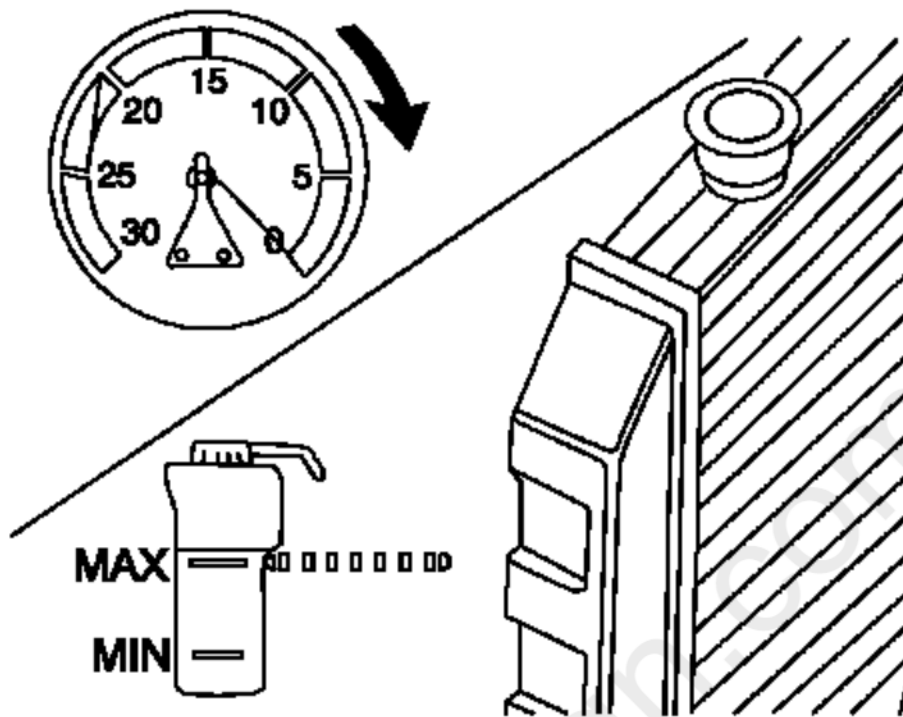


Fig. 33: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

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** . See **Special Tools**.
21. Remove the **J 42401** from the coolant surge tank. See **Special Tools**.

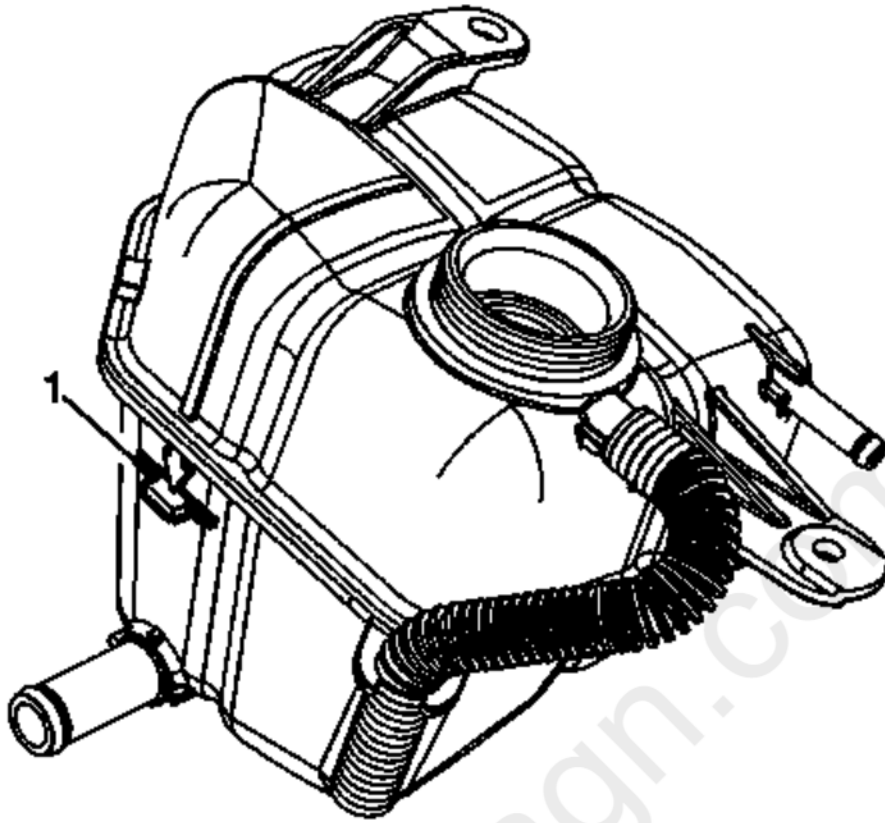


Fig. 34: Surge Tank FULL COLD Mark
Courtesy of GENERAL MOTORS CORP.

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** . See **Special Tools**.

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.

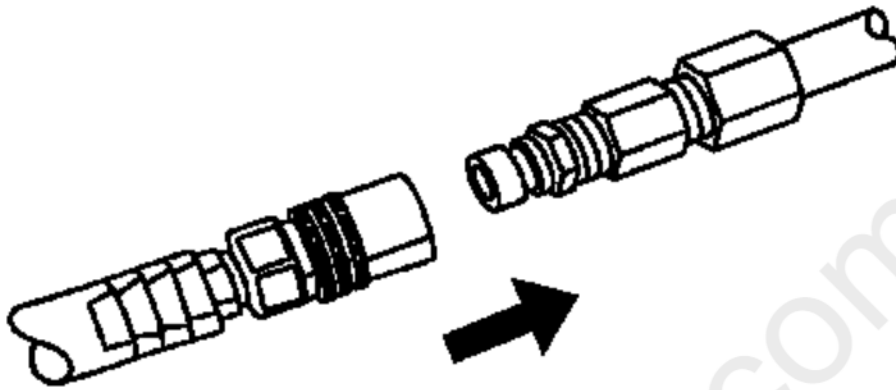


Fig. 35: Identifying Extraction Hose And Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

25. Attach the extraction hose to the vacuum hose.

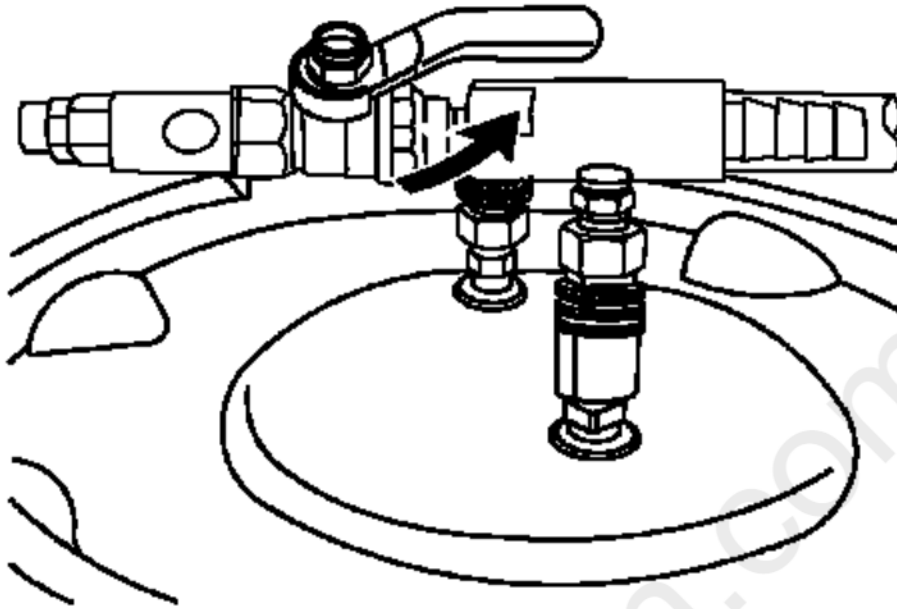


Fig. 36: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

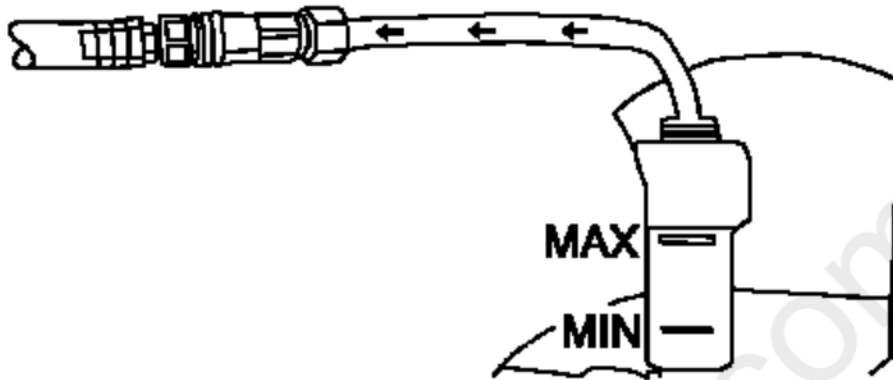


Fig. 37: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS CORP.

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

CHARGE AIR COOLING SYSTEM COOLANT LEVEL INSPECTION

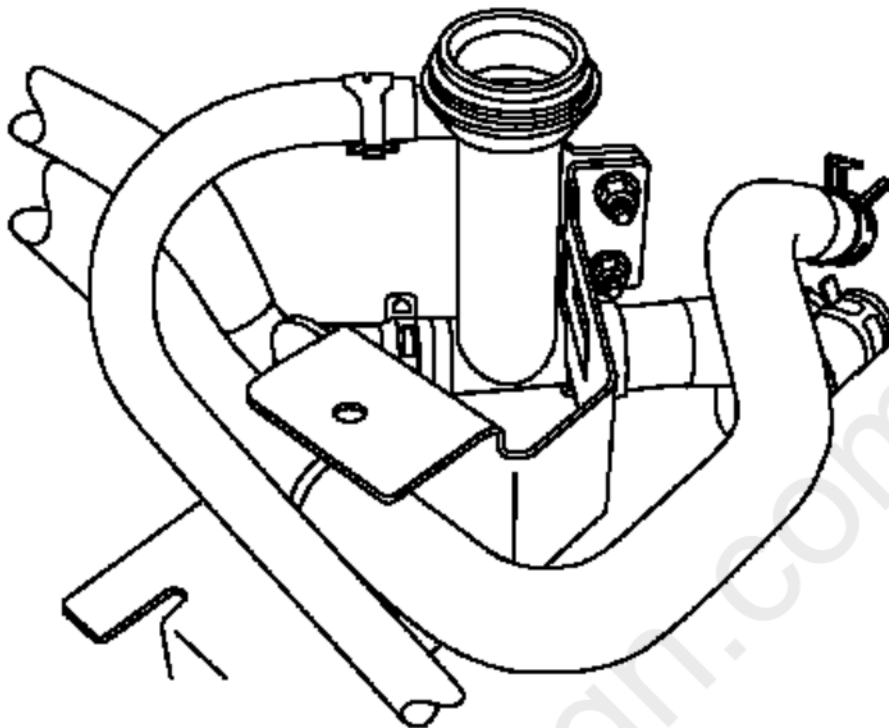


Fig. 38: View Of Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS CORP.

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.

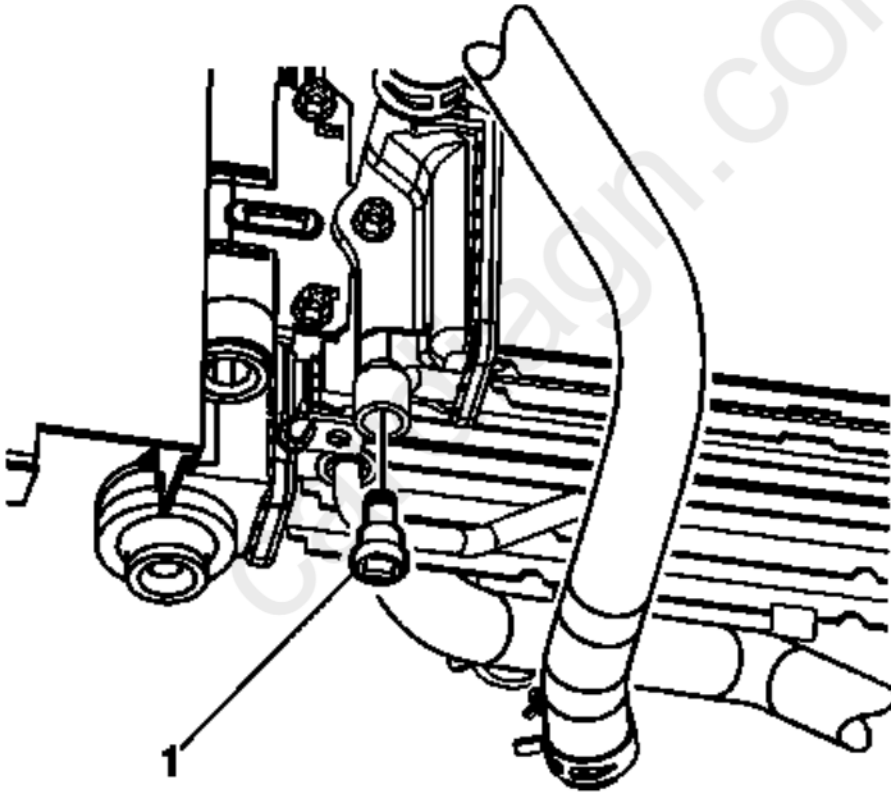


Fig. 39: Identifying Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS CORP.

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 (Charge Air Cooling) or Flushing (Powertrain).

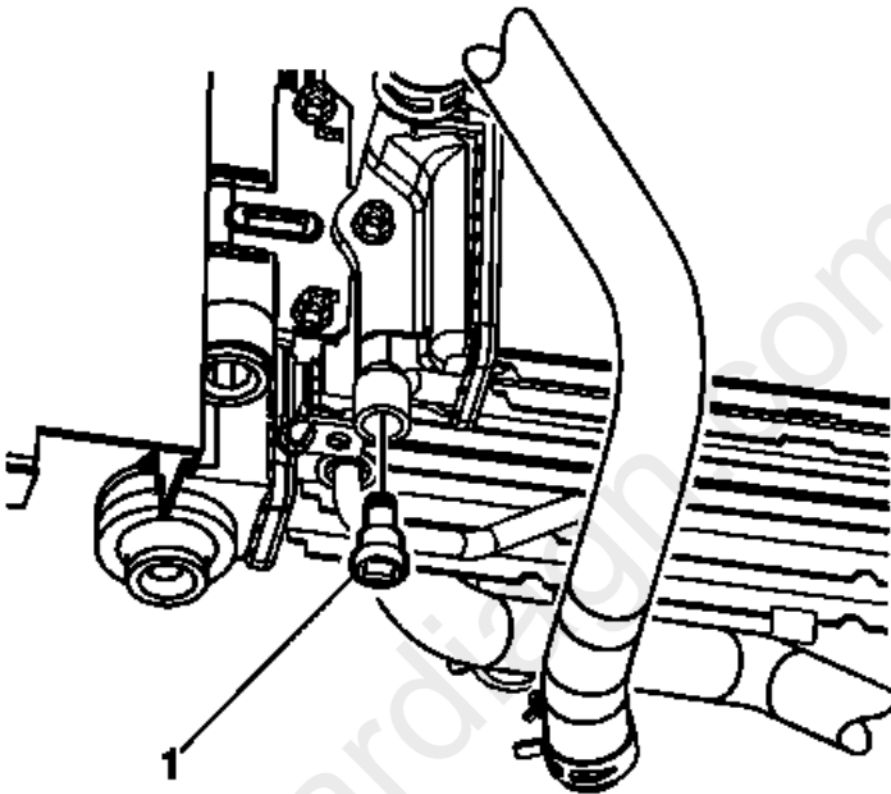


Fig. 40: Identifying Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to.

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.

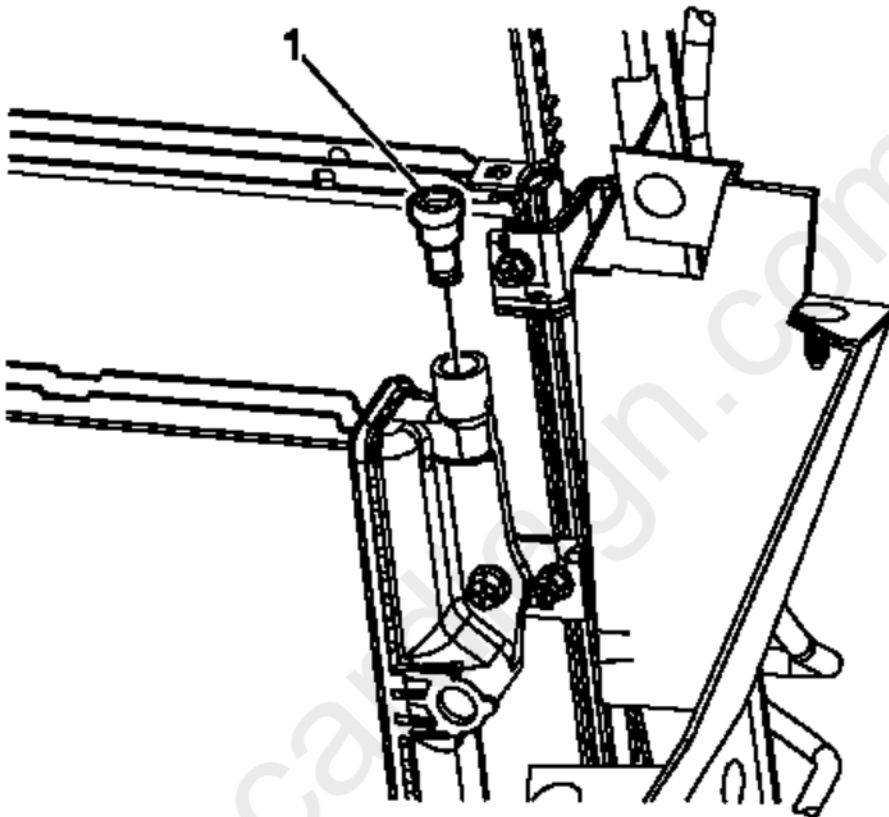


Fig. 41: Identifying Charge Air Cooler Bleeder Screw
Courtesy of GENERAL MOTORS CORP.

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).

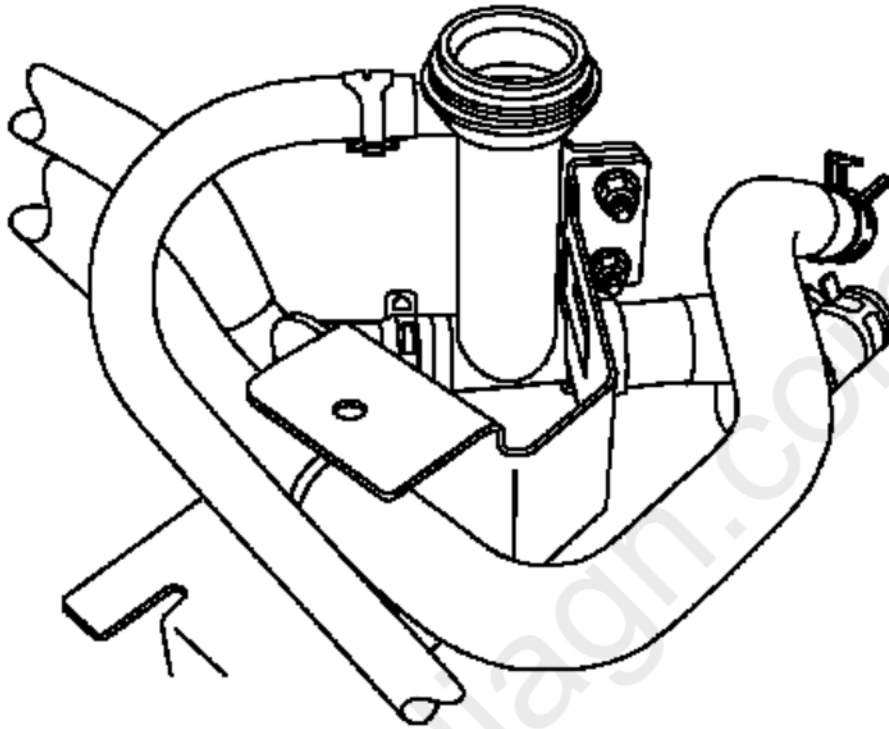


Fig. 42: View Of Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS CORP.

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.

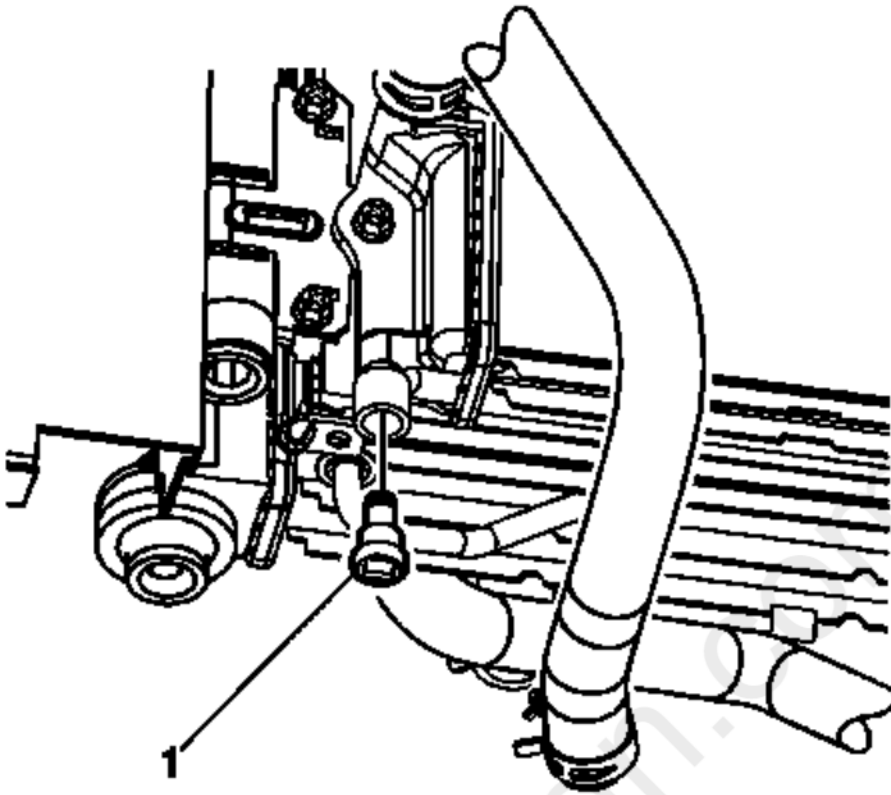


Fig. 43: Identifying Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS CORP.

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 (Charge Air Cooling)** or **Flushing (Powertrain)**.

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.

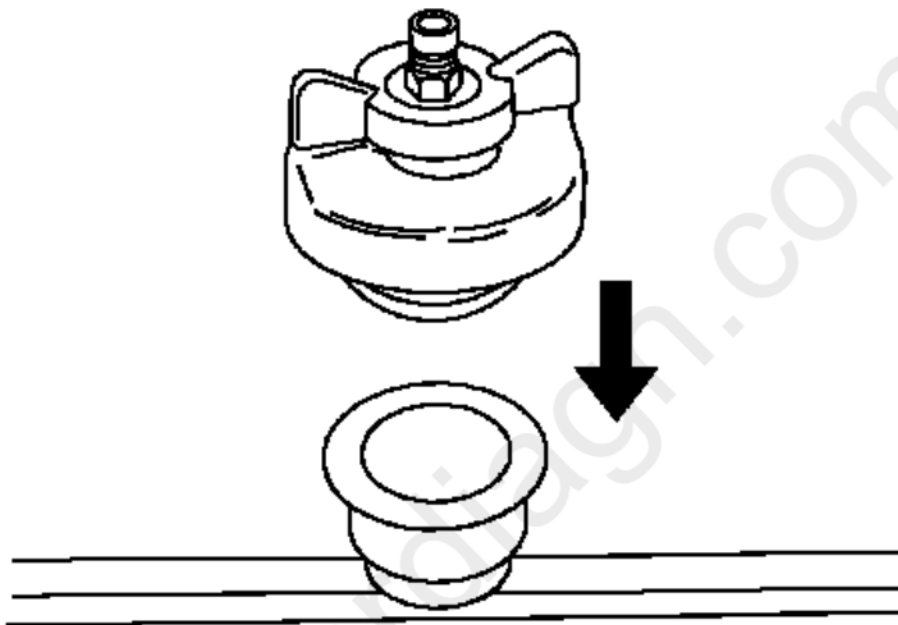


Fig. 44: Identifying Vac-N-Fill Cap
Courtesy of GENERAL MOTORS CORP.

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**.

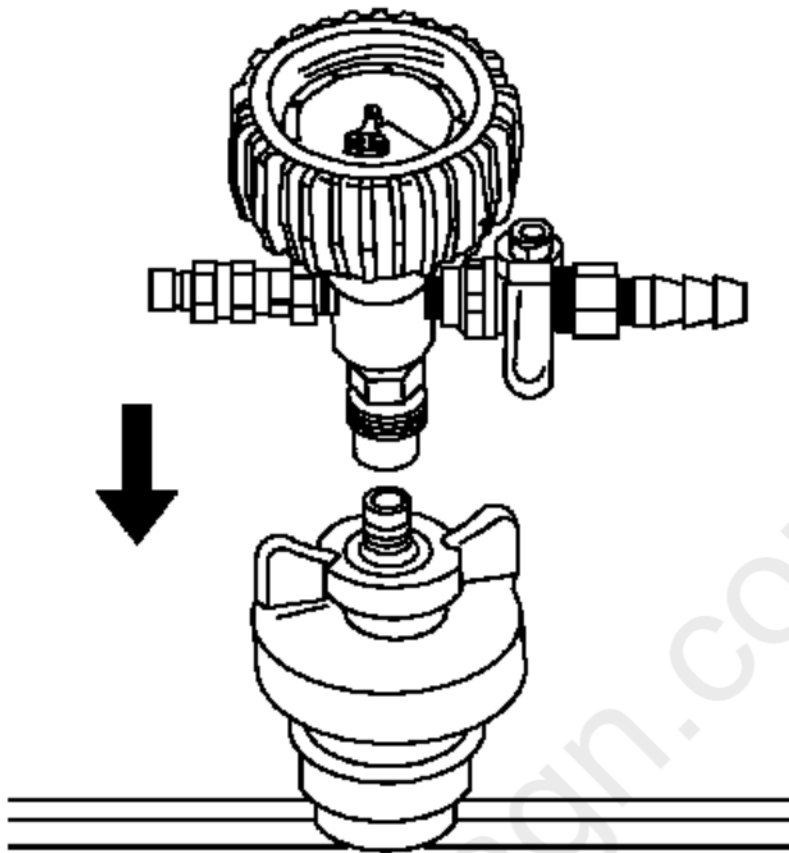


Fig. 45: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

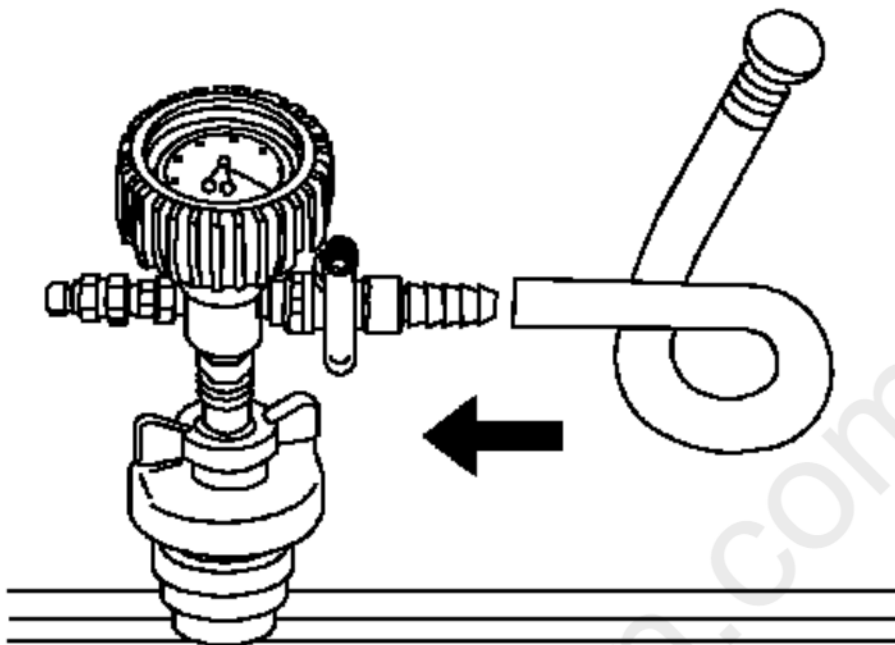


Fig. 46: Fill Hose & Barb Fitting
Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gauge assembly.
Ensure that the valve is closed.

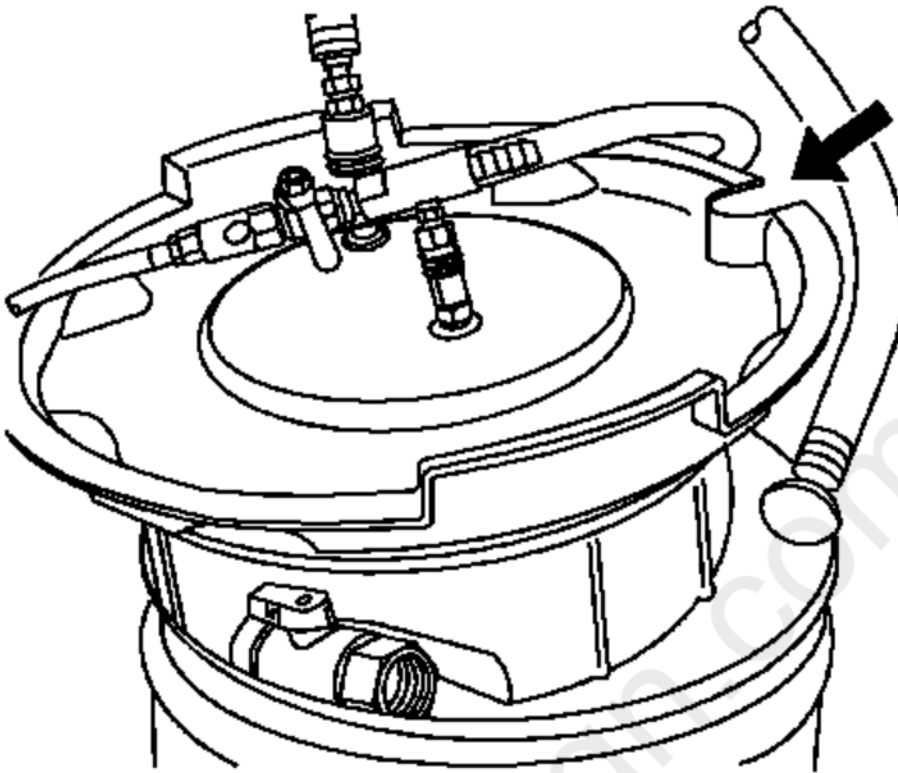


Fig. 47: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS CORP.

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.

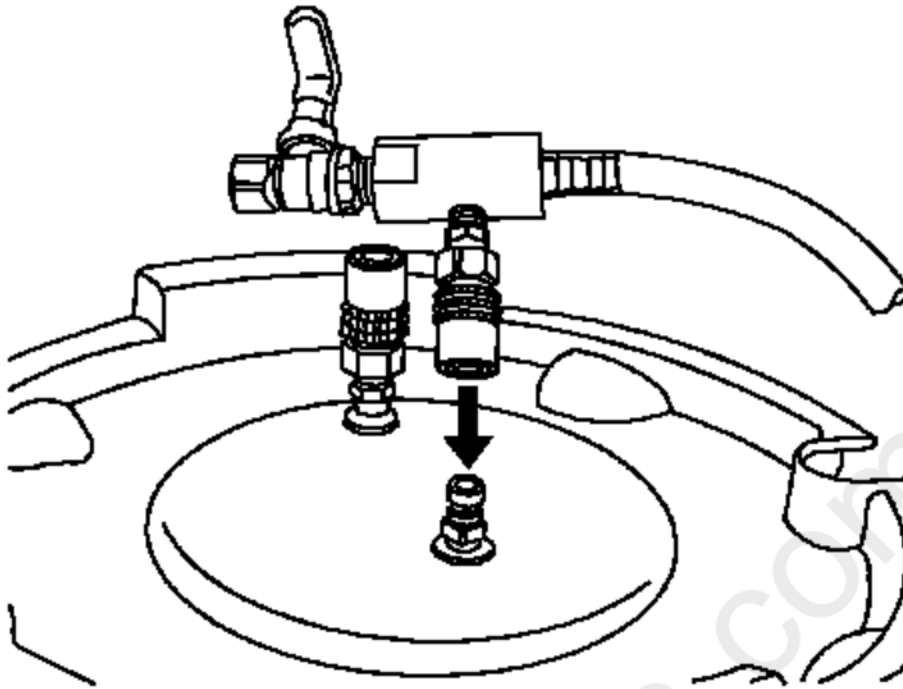


Fig. 48: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

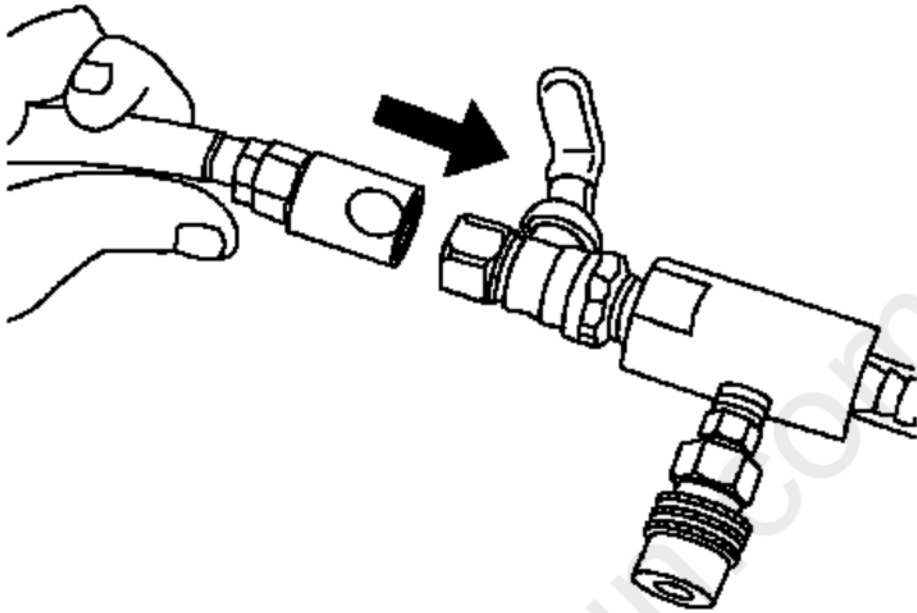


Fig. 49: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

Ensure the valve on the venturi assembly is closed.

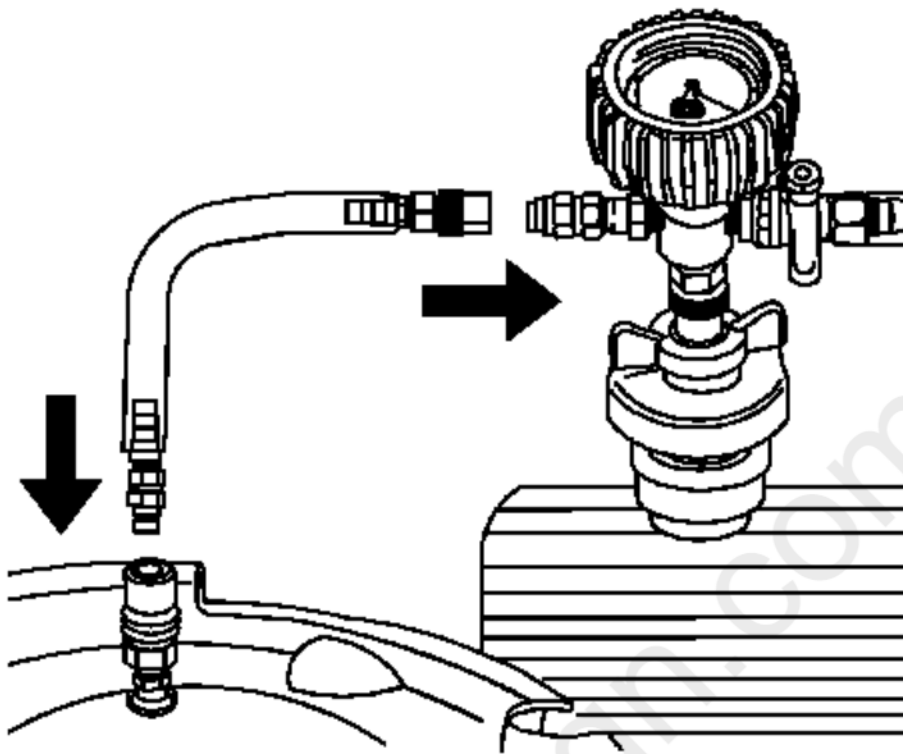


Fig. 50: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

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

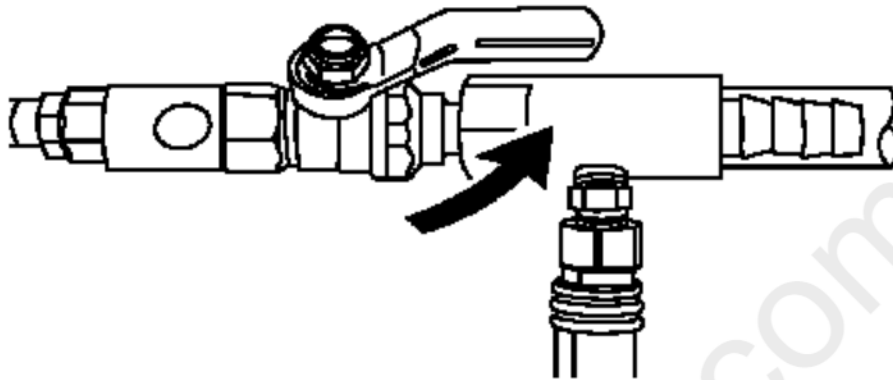


Fig. 51: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

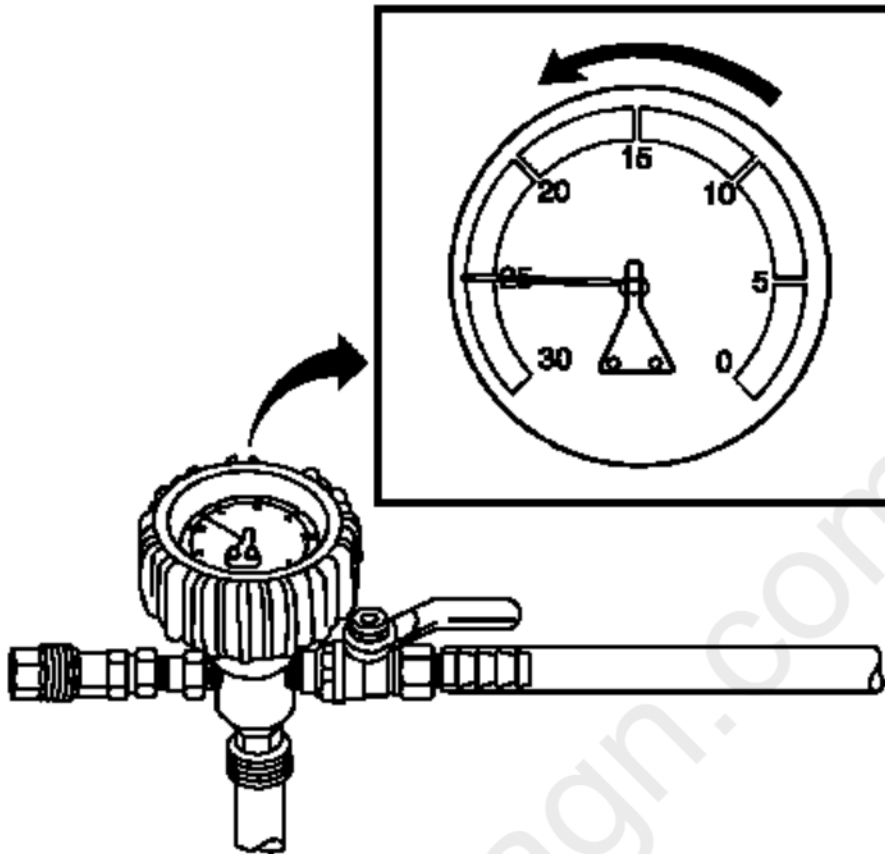


Fig. 52: View Of Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

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.

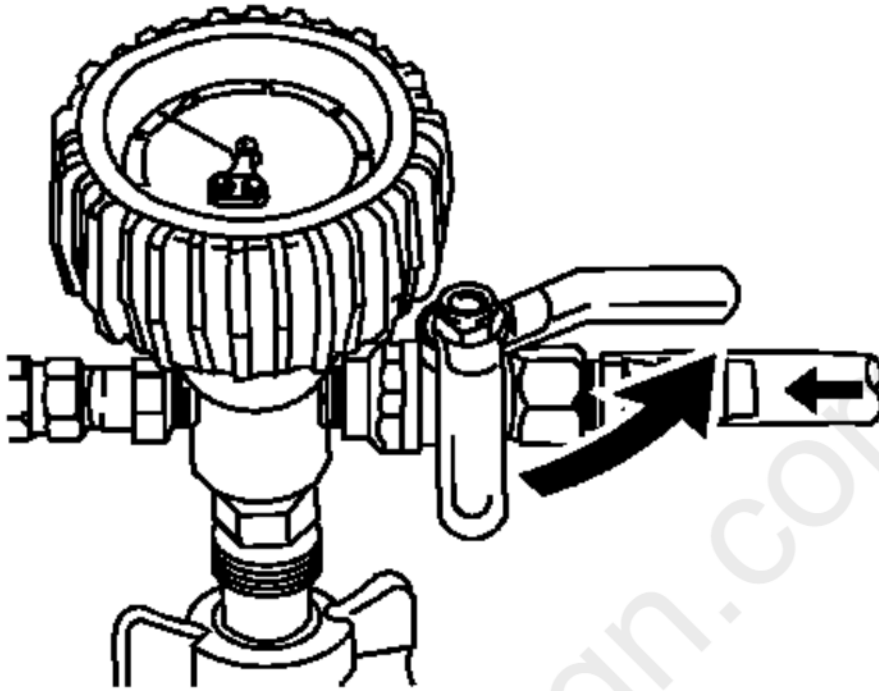


Fig. 53: Identifying Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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.

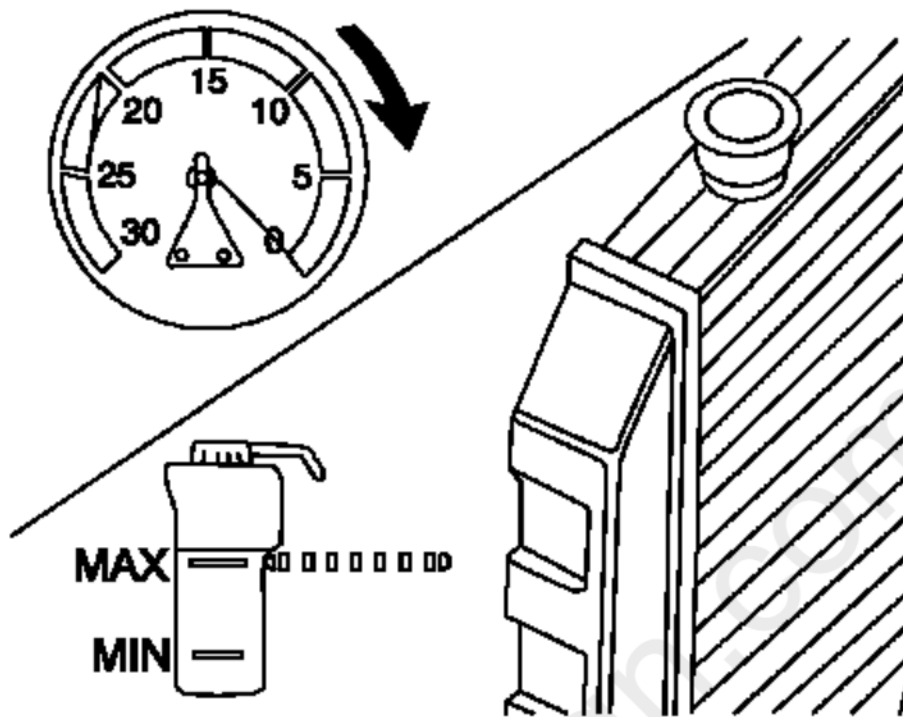


Fig. 54: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS CORP.

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.

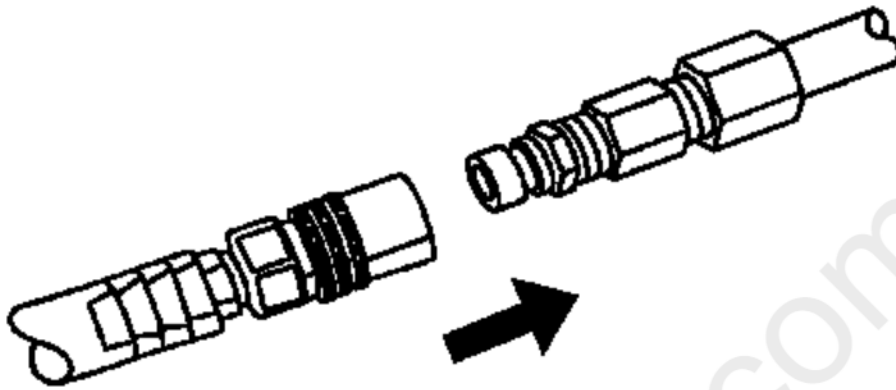


Fig. 55: Identifying Extraction Hose And Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

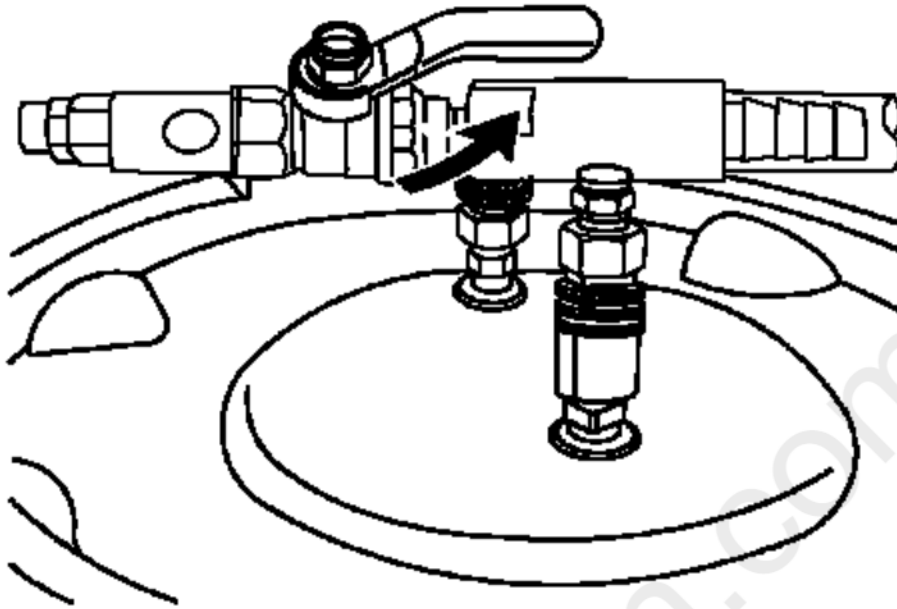


Fig. 56: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

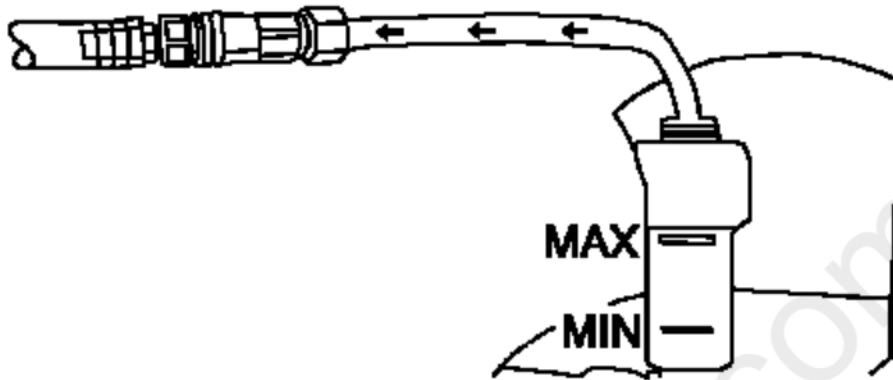


Fig. 57: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS CORP.

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 (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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or 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) or Charge Air Cooling System Draining and Filling (GE 47716).

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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or 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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).

RADIATOR CLEANING

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

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

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

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

RADIATOR SURGE TANK REPLACEMENT

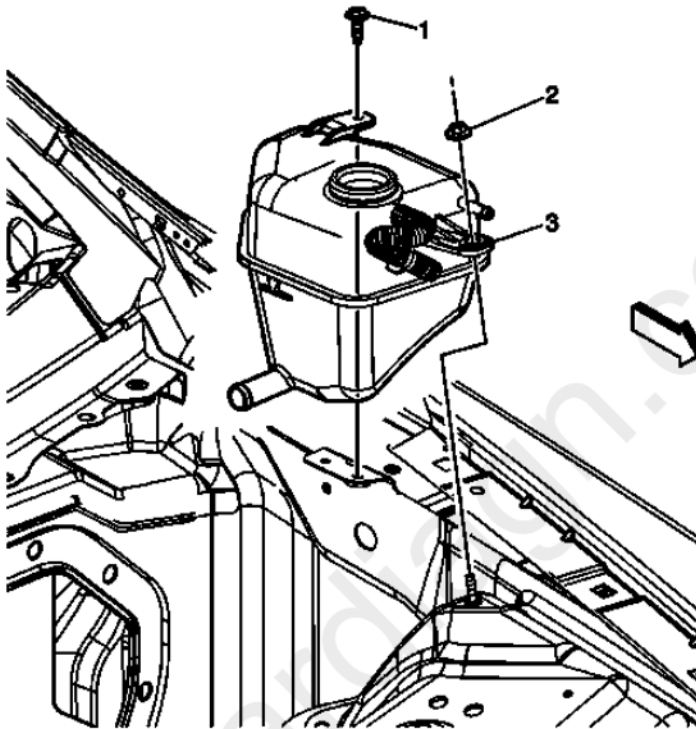


Fig. 58: Radiator Surge Tank
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1.	Drain the coolant. Refer to <u>Cooling System Draining and Filling (Static Fill LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <u>Cooling System Draining and Filling (GE 47716 LSA)</u> .
2.	Remove the surge tank inlet hose. Refer to <u>Radiator Surge Tank Inlet Hose/Pipe Replacement (LF1, LLT)</u> or <u>Radiator Surge Tank Inlet Hose/Pipe Replacement (LSA)</u> .
3.	Remove the surge tank engine hose. Refer to <u>Radiator Surge Tank Engine Hose Replacement (LF1, LLT)</u> or <u>Radiator Surge Tank Engine Hose Replacement (LSA)</u> .
	Surge Tank Bolt

1	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

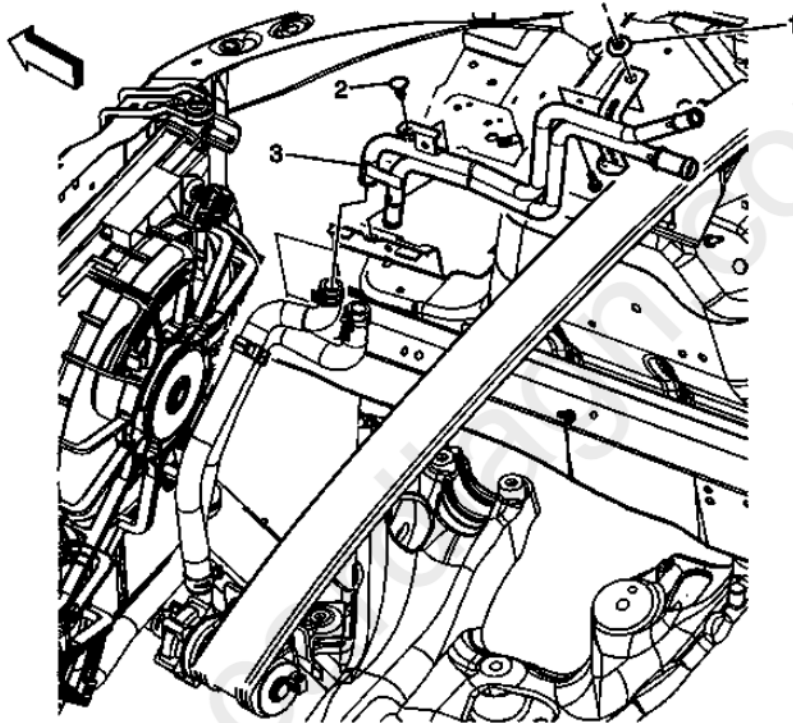


Fig. 59: Identifying Charge Air Cooler Coolant Pipe

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1.	Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> or <u>Charge Air Cooling System Draining and Filling (GE 47716)</u> .
2.	Remove the charge air cooler hose pipe to pump. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Pipe to Pump</u> .
3.	Remove the charge air cooler hose radiator to pipe. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Radiator to Pipe</u> .
4.	Remove the charge air cooler hose pipe to reservoir. Refer to <u>Charge Air Cooler Coolant Hose</u>

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

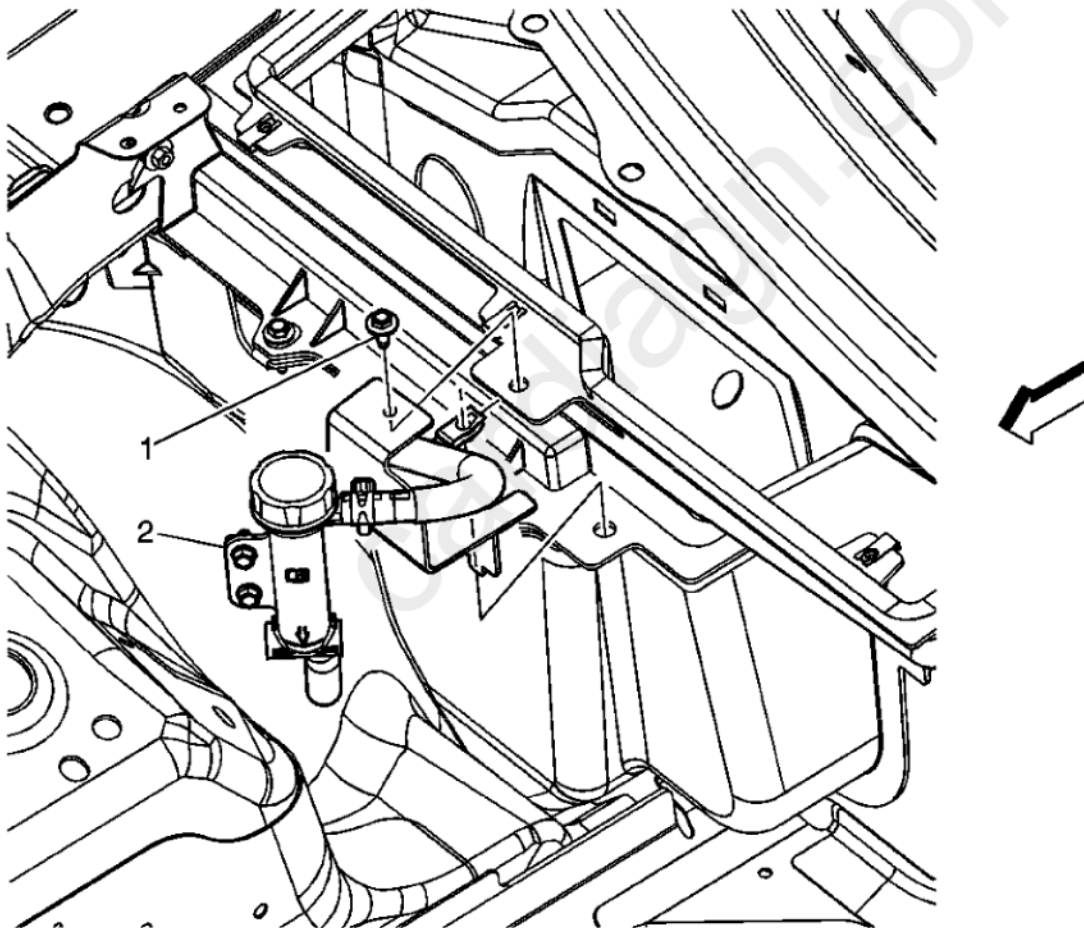
CHARGE AIR COOLER COOLANT RESERVOIR REPLACEMENT

Fig. 60: Identifying Charge Air Cooler Coolant Reservoir
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
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Preliminary Procedures

1. Drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (Static) or Charge Air Cooling System Draining and Filling (GE 47716).
2. Remove the charge air cooler coolant hose reservoir to pipe. Refer to Charge Air Cooler Coolant Hose Replacement - Reservoir to Pipe.
3. Remove the charge air cooler coolant hose reservoir to engine. Refer to Charge Air Cooler Coolant Hose Replacement - Engine to Reservoir.

1	Charge Air Cooler Coolant Reservoir Bolt 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.

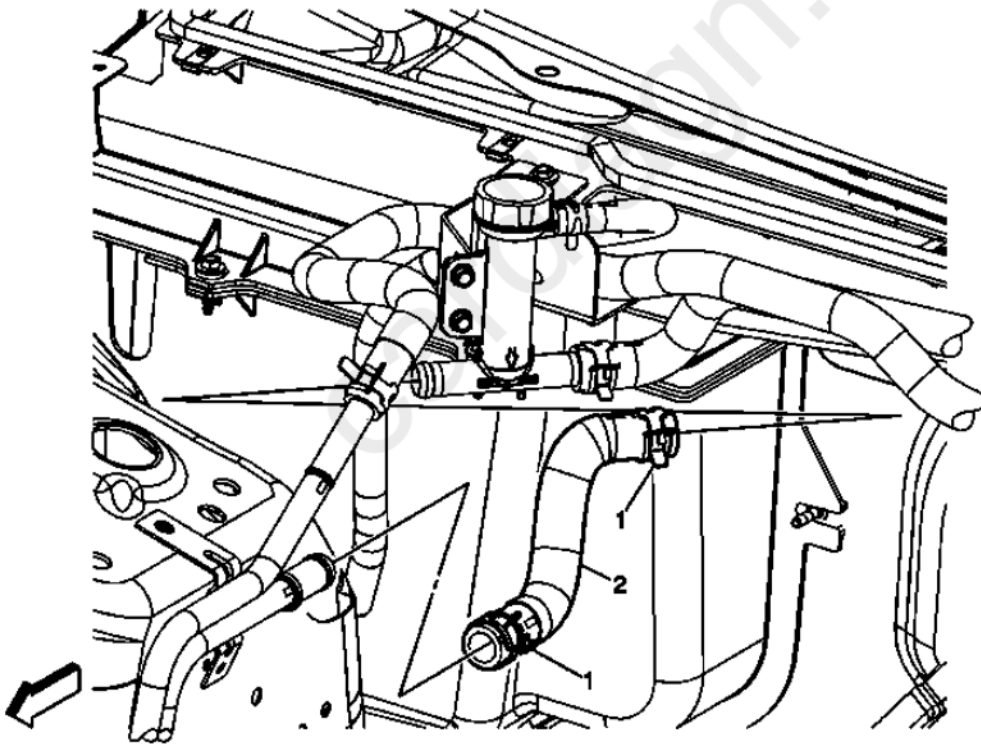
CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RESERVOIR TO PIPE

Fig. 61: Identifying Charge Air Cooler Coolant Hose - Reservoir to Pipe
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	

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

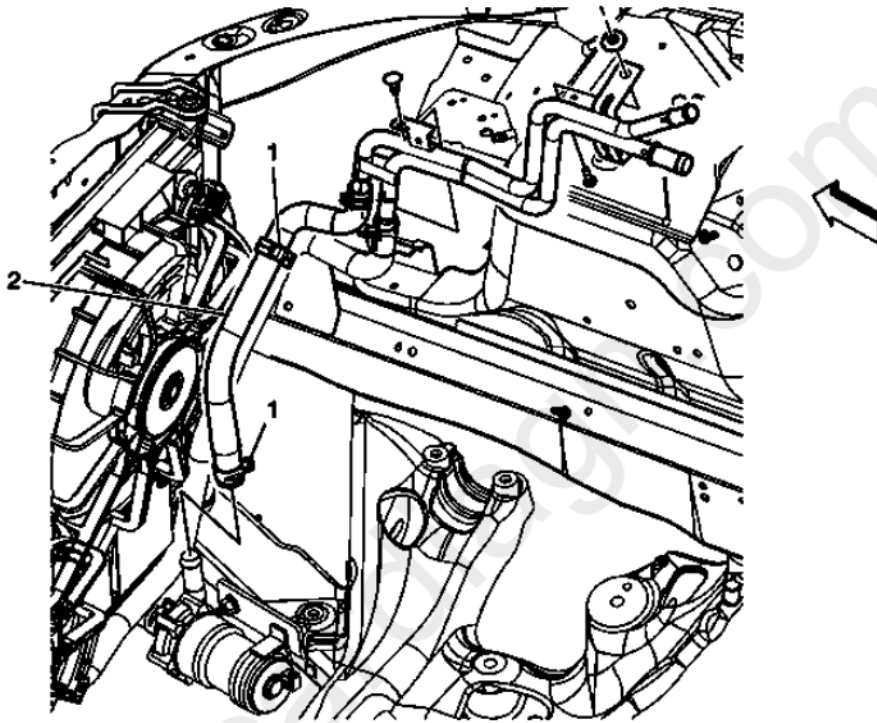


Fig. 62: Identifying Charge Air Cooler Coolant Hose - Pipe To Pump
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> or <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) or Charge Air Cooling System Draining and Filling (GE 47716).
2. Remove the rear intake manifold cover. Refer to Intake Manifold Cover Replacement - Rear

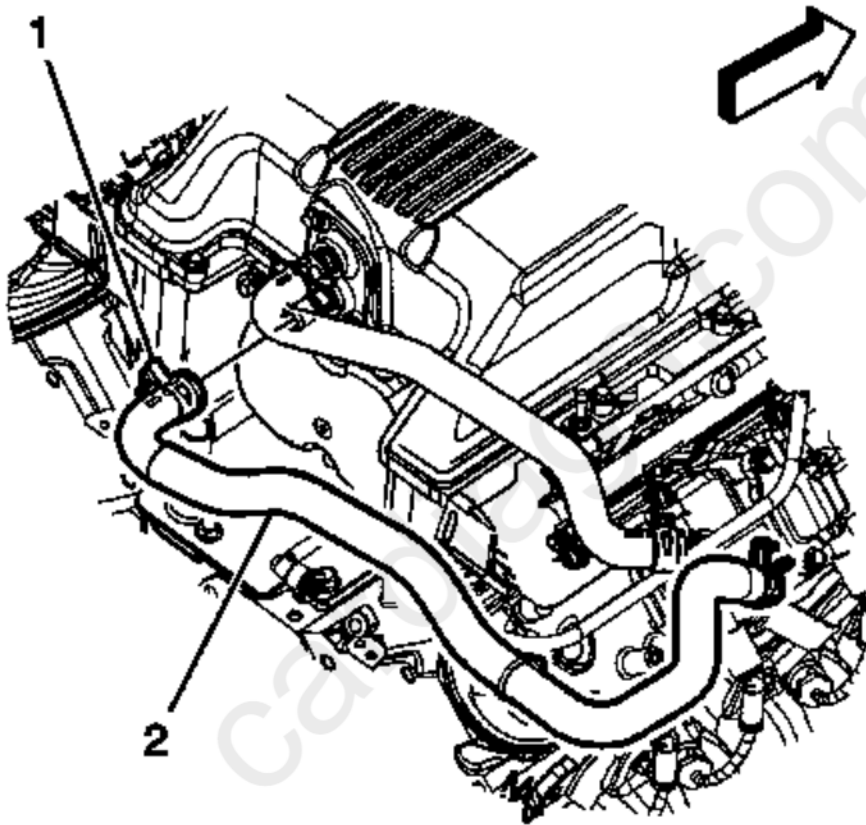


Fig. 63: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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.

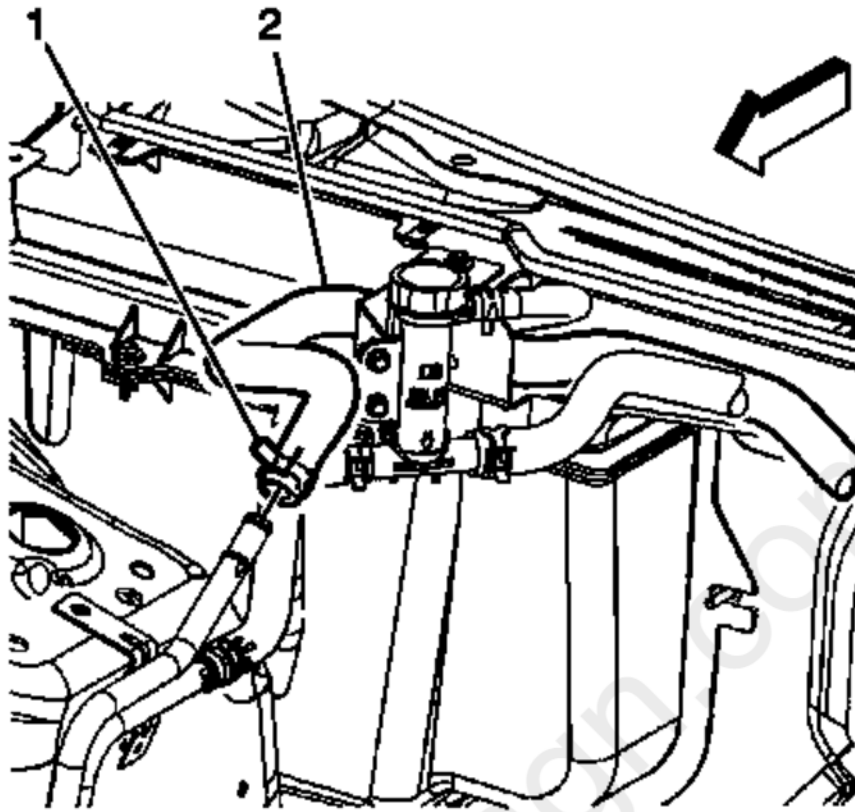


Fig. 64: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Pipe
Courtesy of GENERAL MOTORS CORP.

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

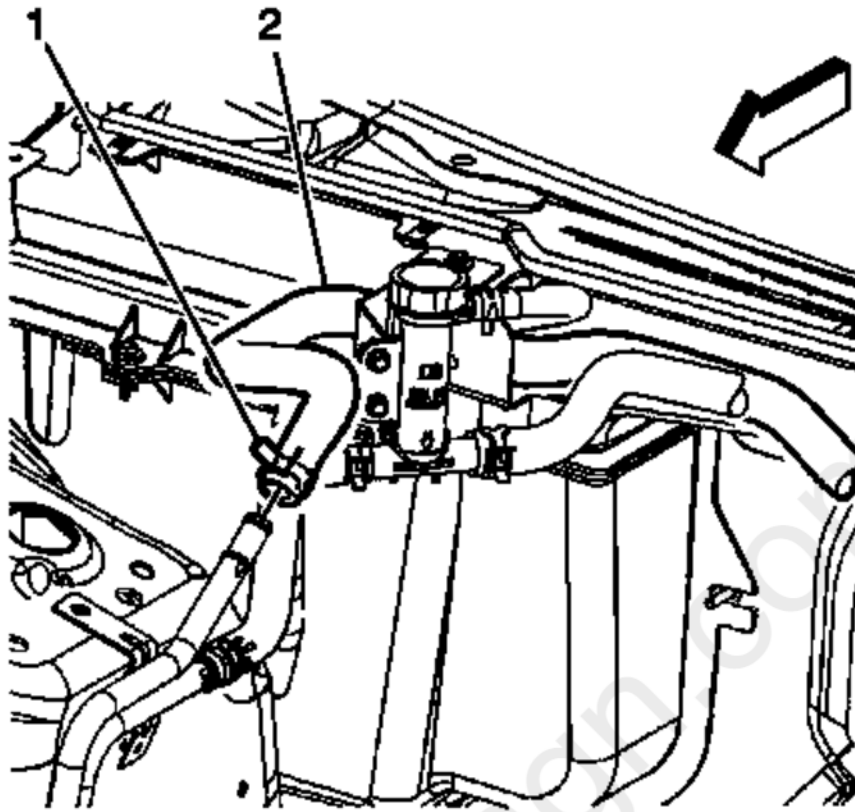


Fig. 65: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Pipe
Courtesy of GENERAL MOTORS CORP.

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**.

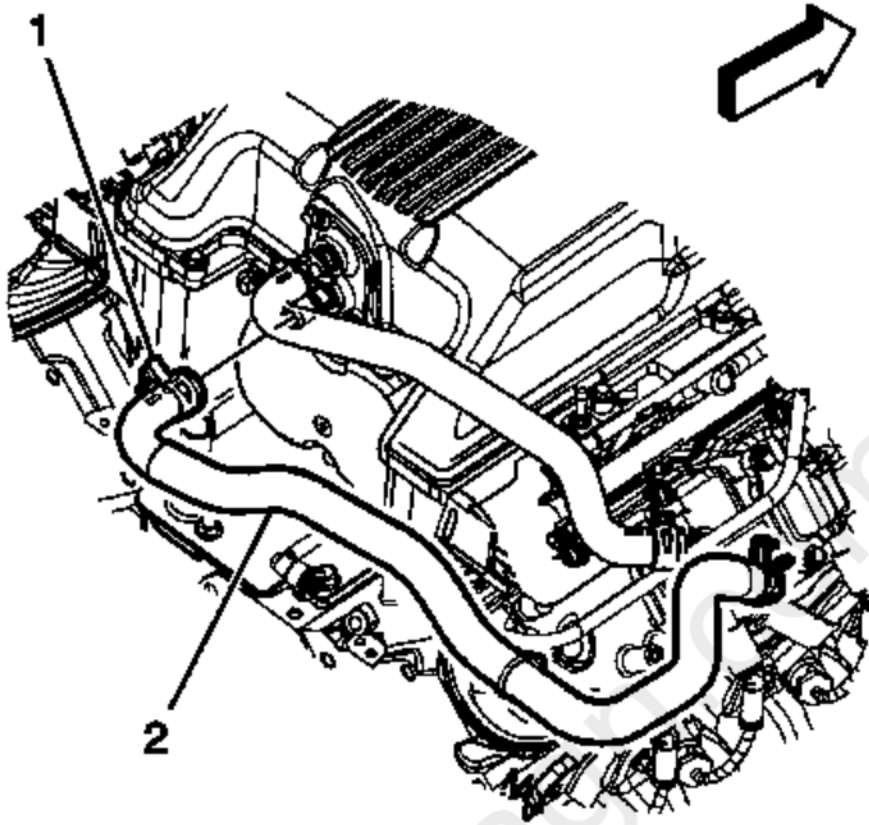


Fig. 66: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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)** or **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)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Remove the rear intake manifold cover. Refer to **Intake Manifold Cover Replacement - Rear**

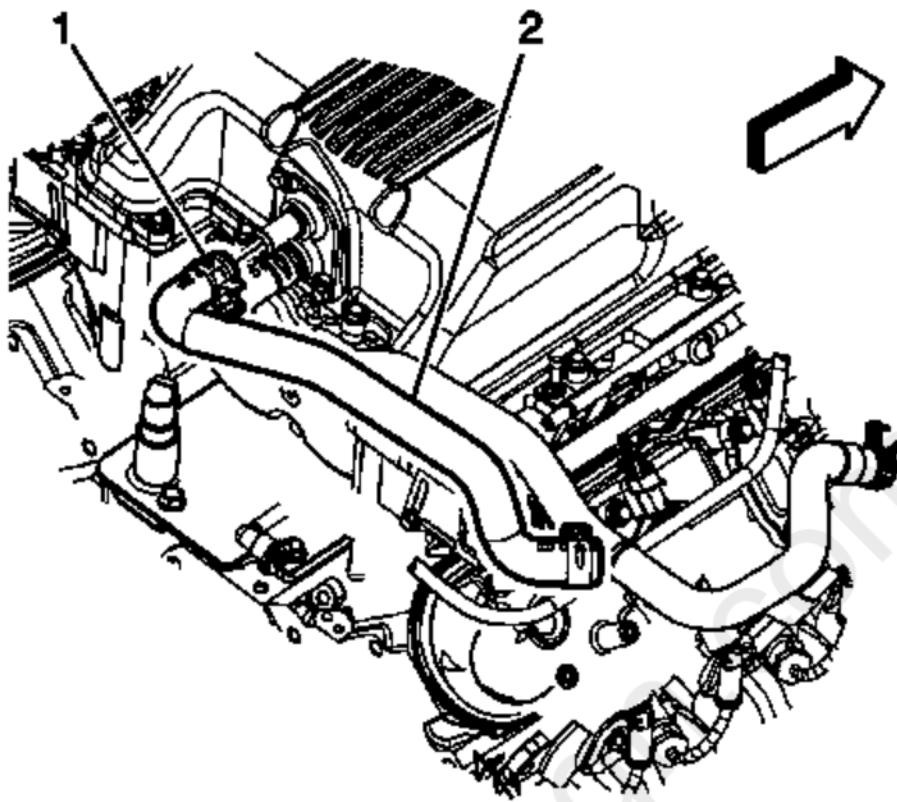


Fig. 67: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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.

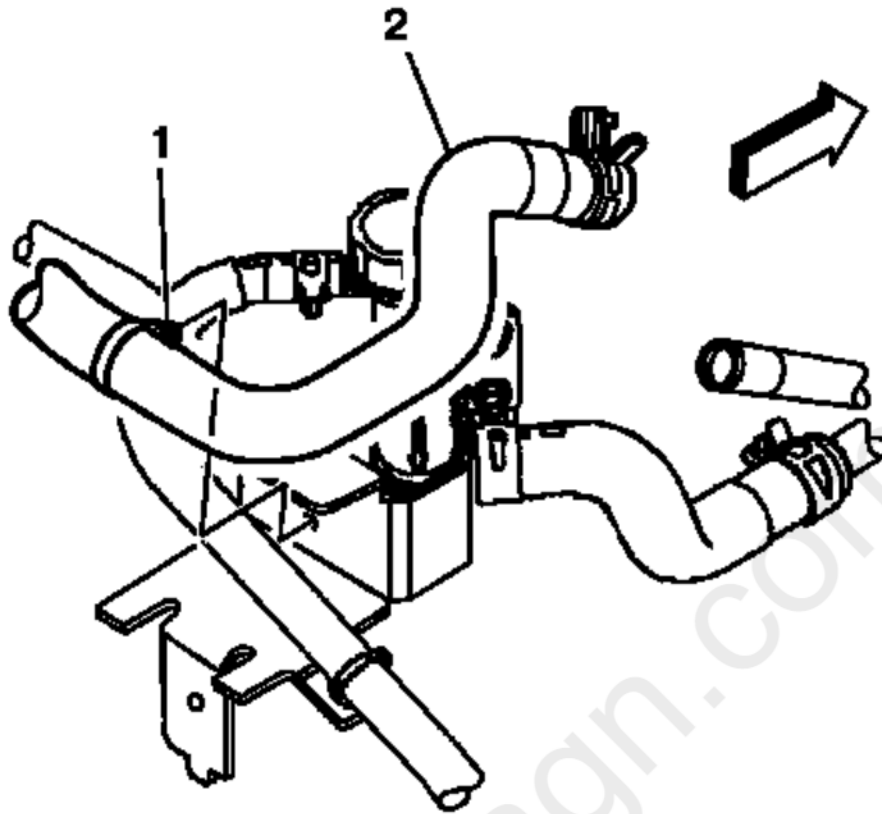


Fig. 68: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS CORP.

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

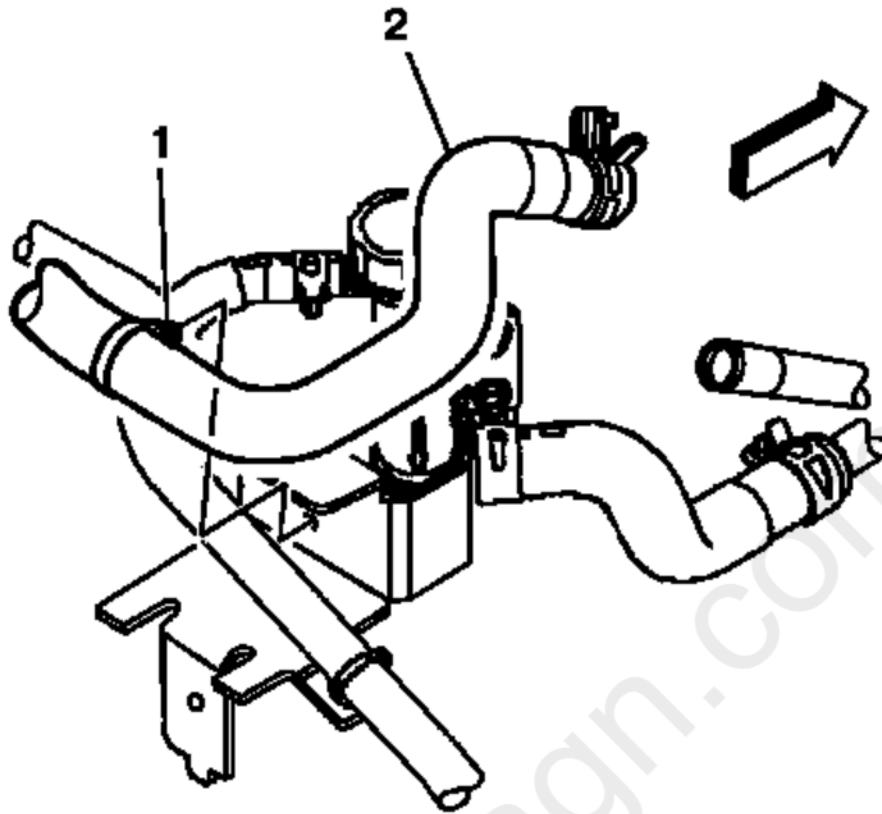


Fig. 69: Identifying Charge Air Cooler Hose & Clamp At Charge Air Cooler Reservoir
Courtesy of GENERAL MOTORS CORP.

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**.

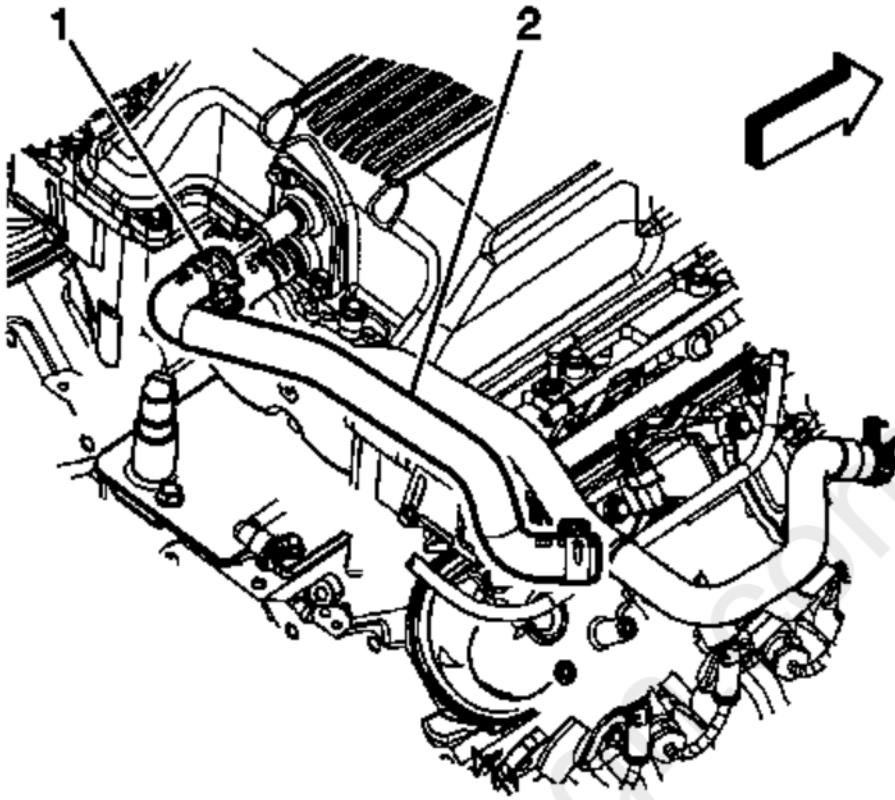


Fig. 70: Identifying Charge Air Cooler Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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)** or **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)** or **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**

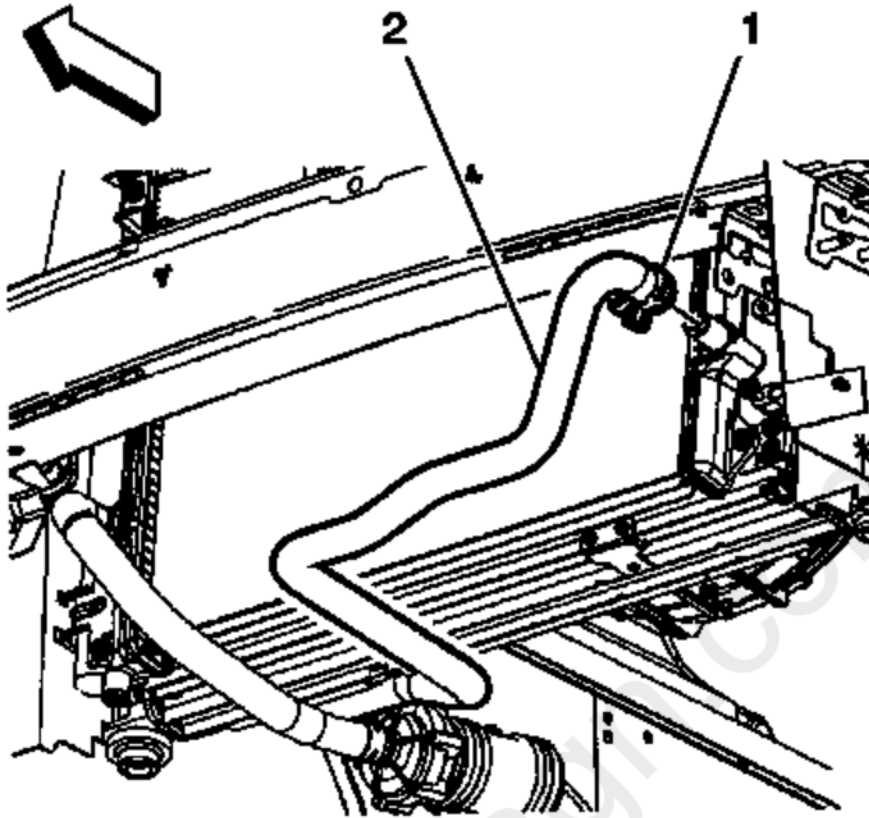


Fig. 71: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler
Courtesy of GENERAL MOTORS CORP.

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.

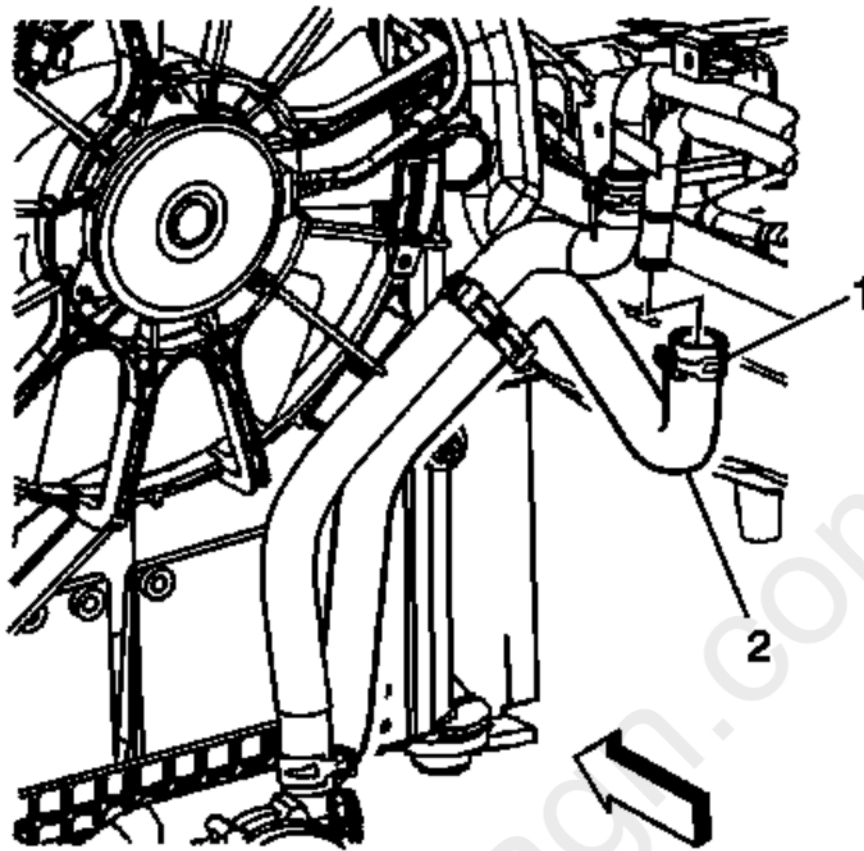


Fig. 72: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

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

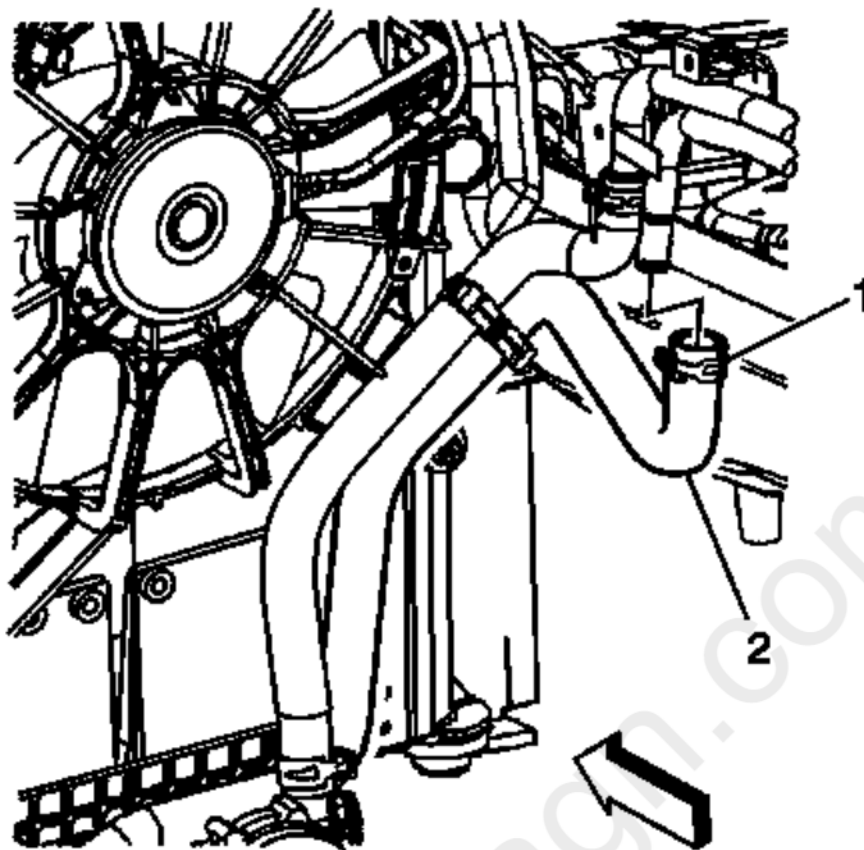


Fig. 73: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

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.

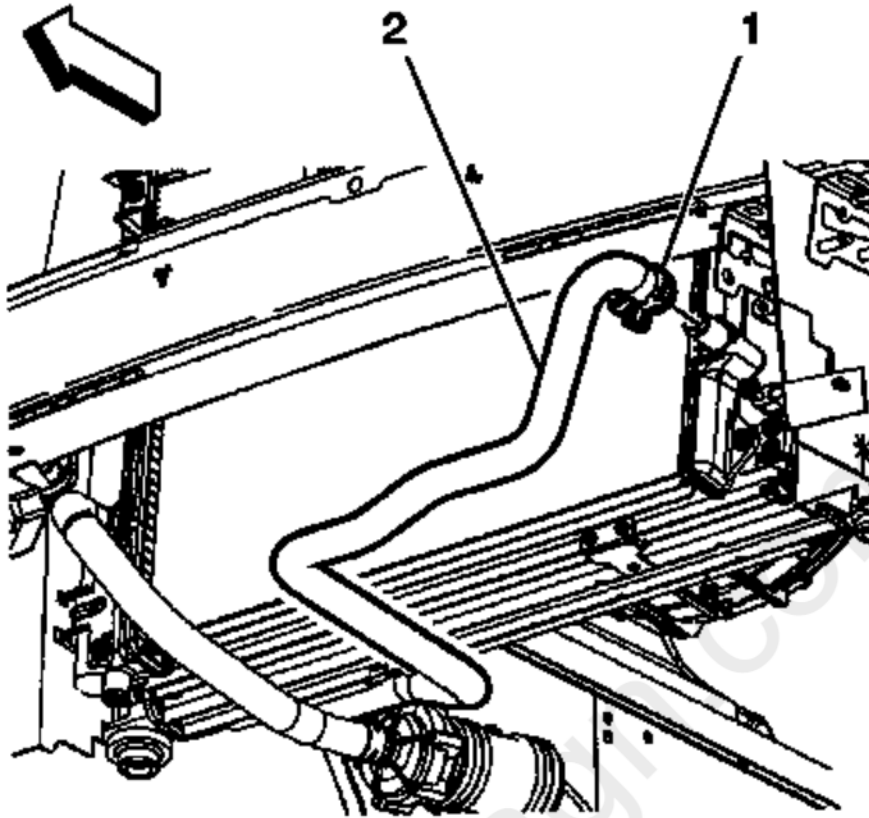


Fig. 74: Identifying Charge Air Cooler Hose Clamp At Charge Air Cooler
Courtesy of GENERAL MOTORS CORP.

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)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RADIATOR TO PUMP

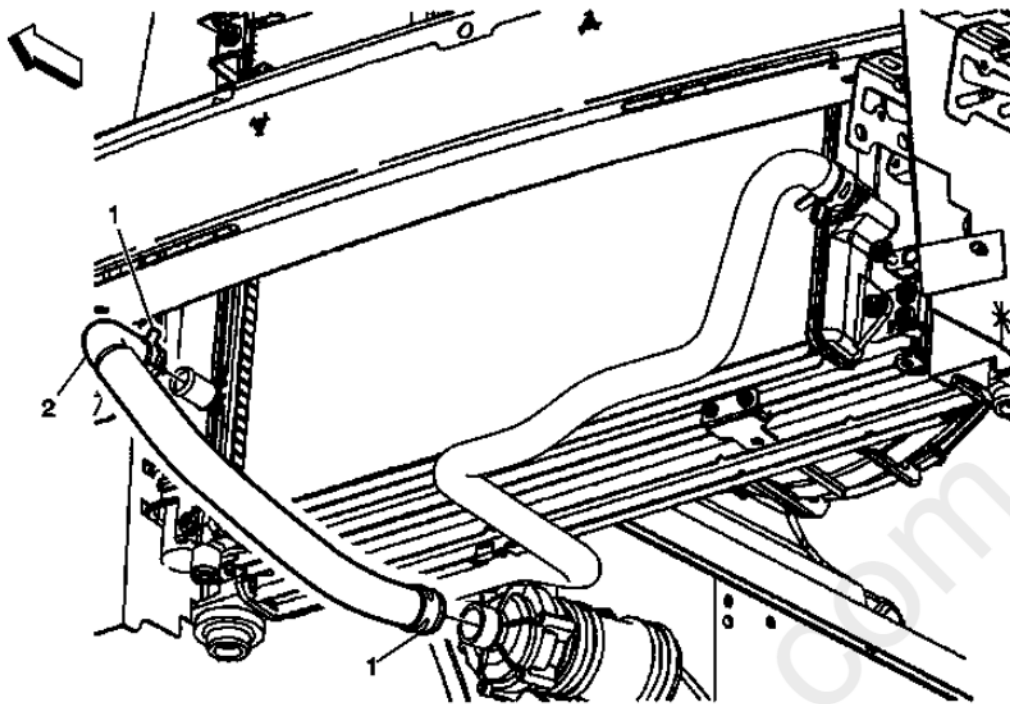


Fig. 75: Identifying Charge Air Cooler Coolant Hose - Radiator To Pump
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> or <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 (LF1, LLT)

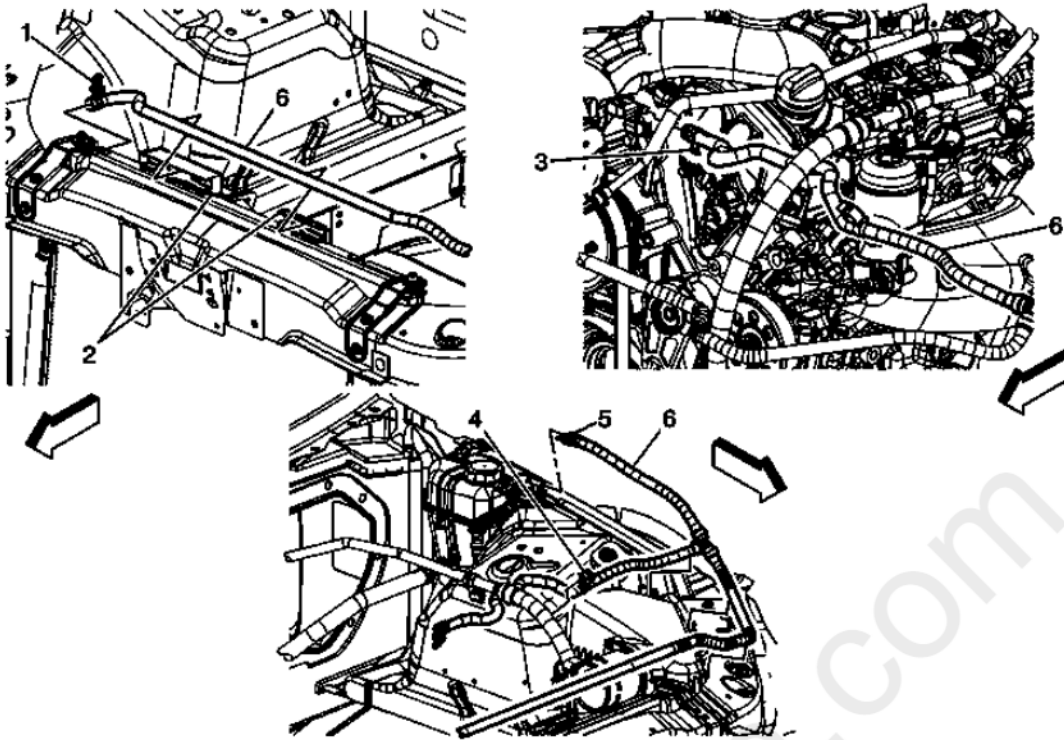


Fig. 76: Radiator Surge Tank Inlet Hose/Pipe
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Drain the coolant. Refer to <u>Cooling System Draining and Filling (Static Fill LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <u>Cooling System Draining and Filling (GE 47716 LSA)</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 to reposition the surge tank inlet hose clamp. See <u>Special Tools</u> . Special Tools: J 38185 Hose Clamp Pliers. See <u>Special Tools</u> .
2	Radiator Bracket (Qty: 2)
3	Surge Tank Inlet Hose Clamp Procedure: Use J 38185 to reposition the surge tank inlet hose clamp. See <u>Special Tools</u> . Special Tools: J 38185 Hose Clamp Pliers. See <u>Special Tools</u> .
4	Surge Tank Inlet Hose Clip
	Surge Tank Inlet Hose Clamp Procedure:

2011 Cadillac CTS

2011 ENGINE Engine Cooling - CTS

5	Use J 38185 to reposition the surge tank inlet hose clamp. See <u>Special Tools</u> . Special Tools: J 38185 Hose Clamp Pliers. See <u>Special Tools</u> .
6	Surge Tank Inlet 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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **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**

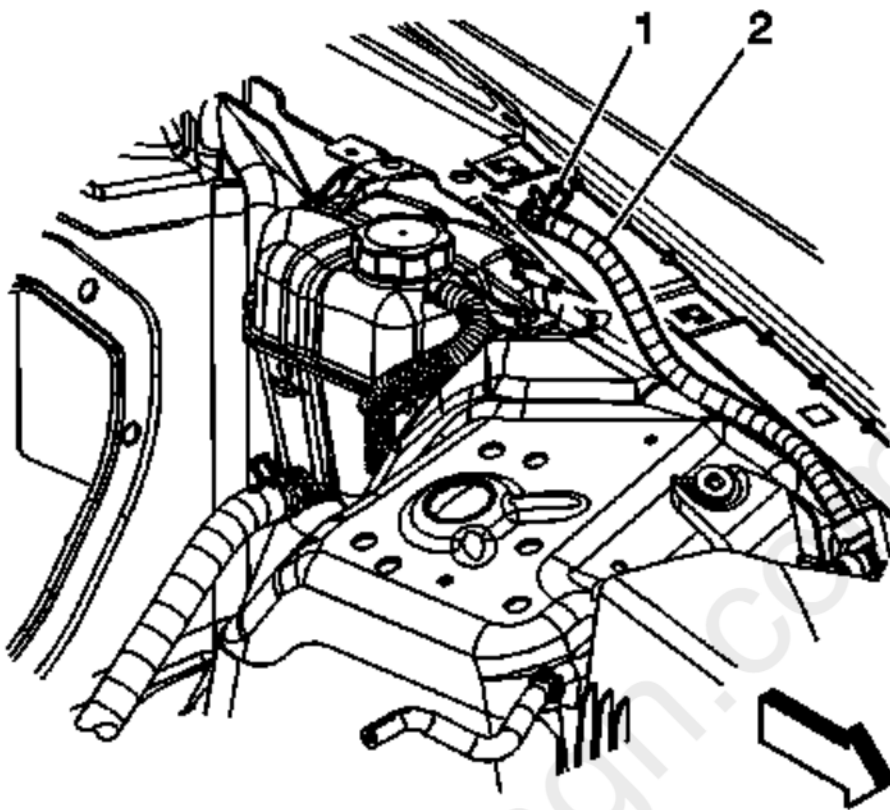


Fig. 77: Identifying Surge Tank Inlet Hose & Clamp At Surge Tank
Courtesy of GENERAL MOTORS CORP.

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.

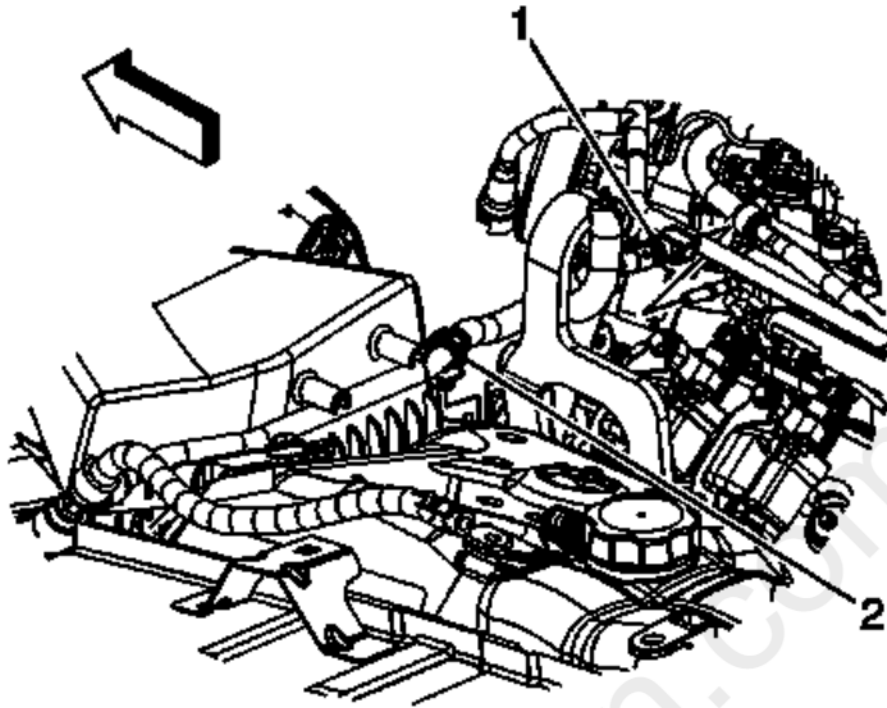


Fig. 78: Identifying Quick Connect Fitting & Clip At Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

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

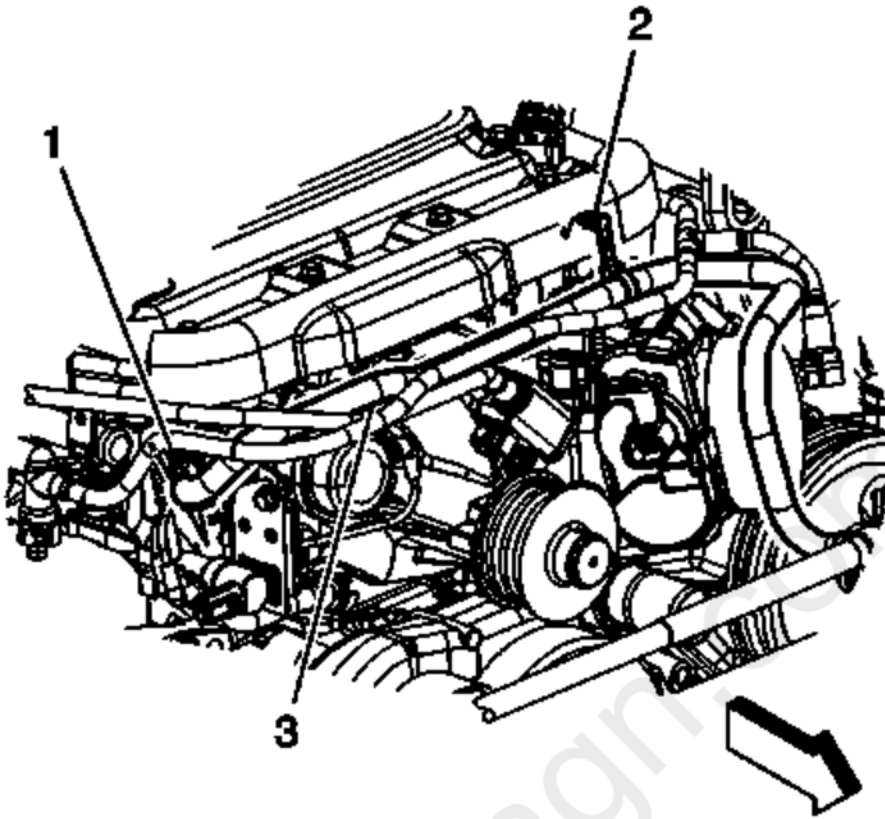


Fig. 79: Identifying Quick Connect Fitting & Clip At Engine
Courtesy of GENERAL MOTORS CORP.

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

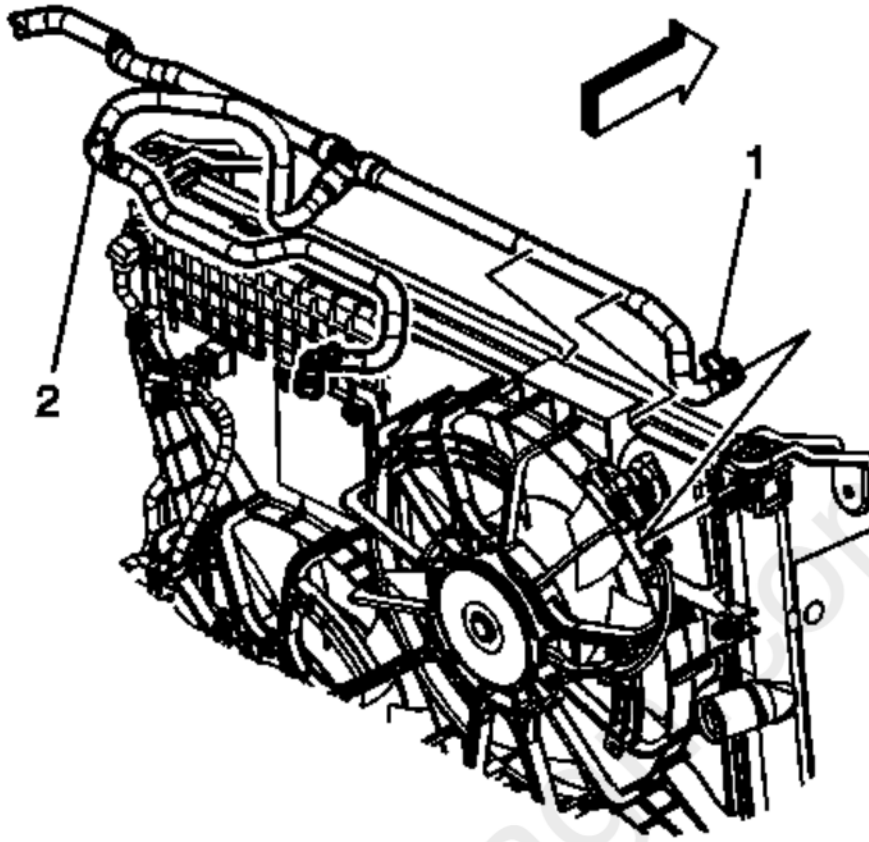


Fig. 80: Identifying Surge Tank Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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

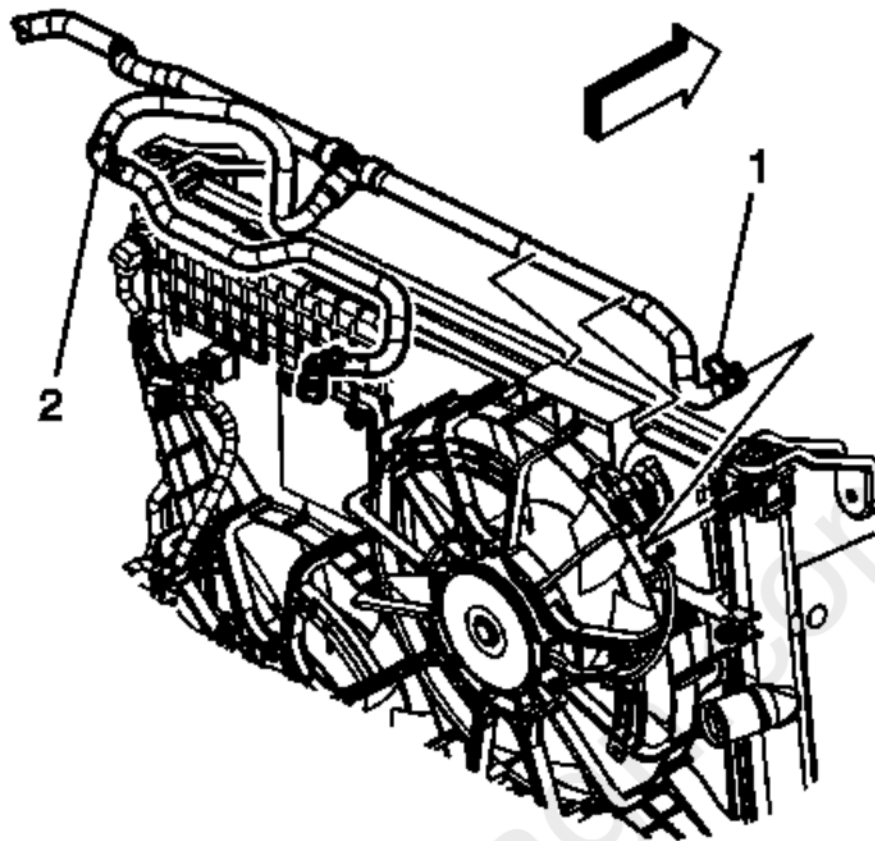


Fig. 81: Identifying Surge Tank Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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**.

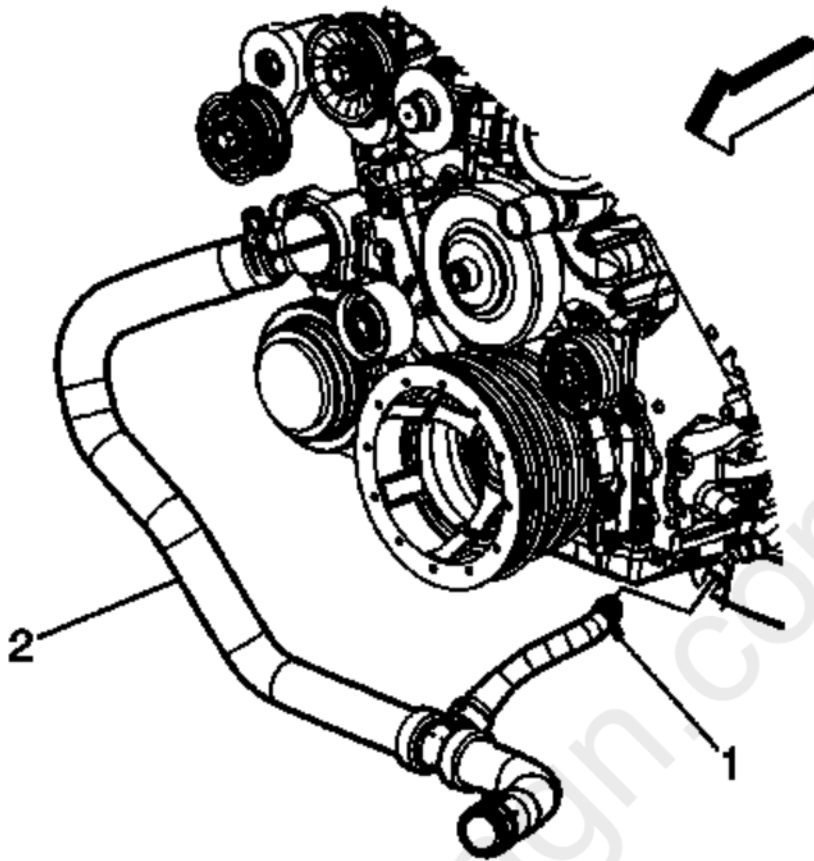


Fig. 82: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS CORP.

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

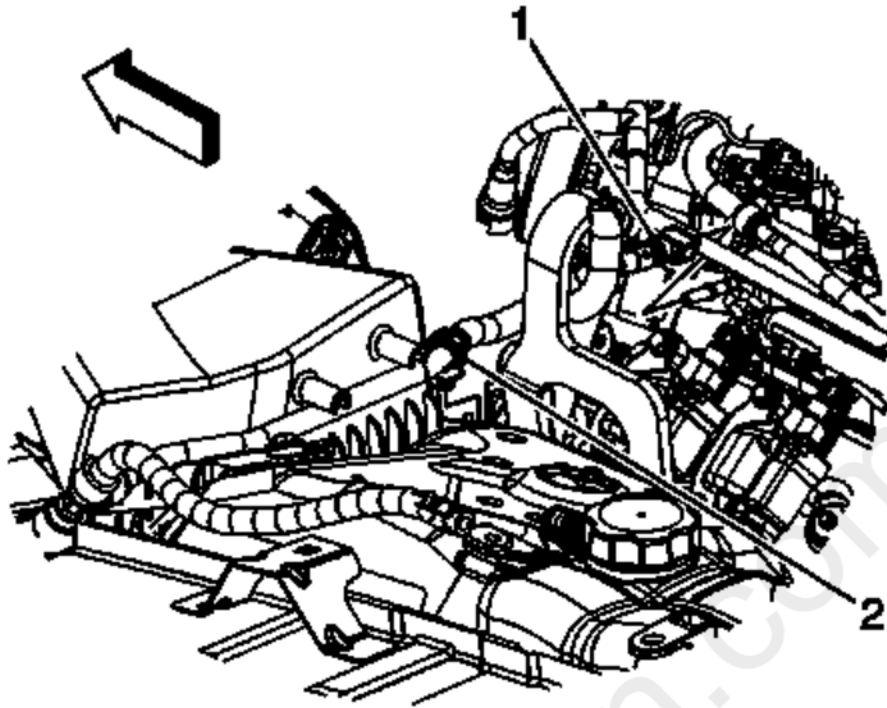


Fig. 83: Identifying Quick Connect Fitting & Clip At Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

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

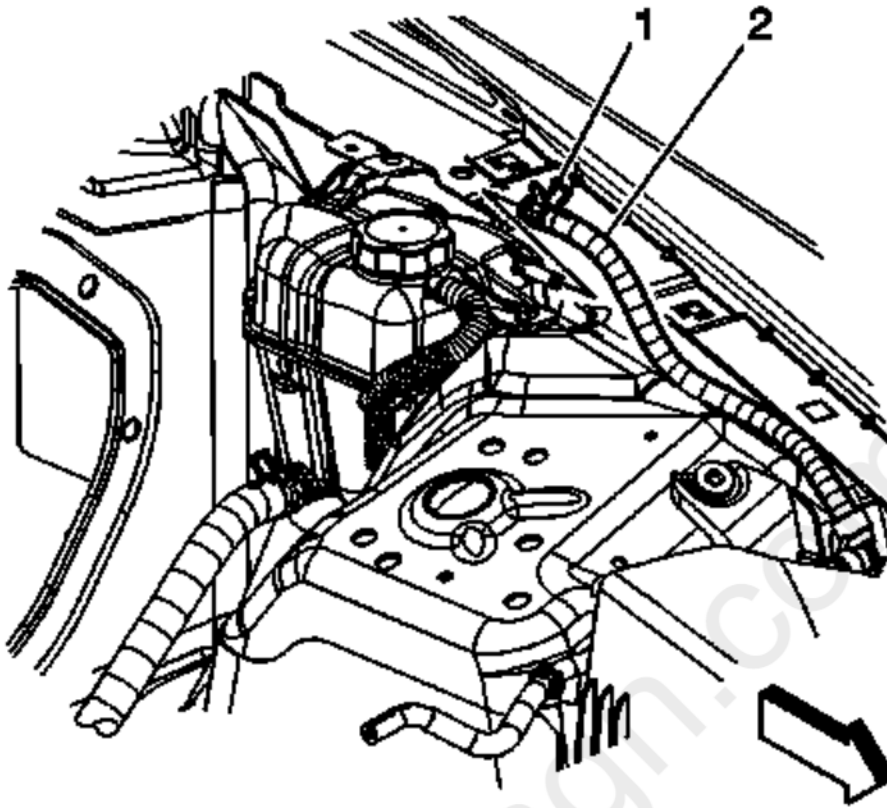


Fig. 84: Identifying Surge Tank Inlet Hose & Clamp At Surge Tank
Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR SURGE TANK ENGINE HOSE REPLACEMENT (LF1, LLT)

Special Tools

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).

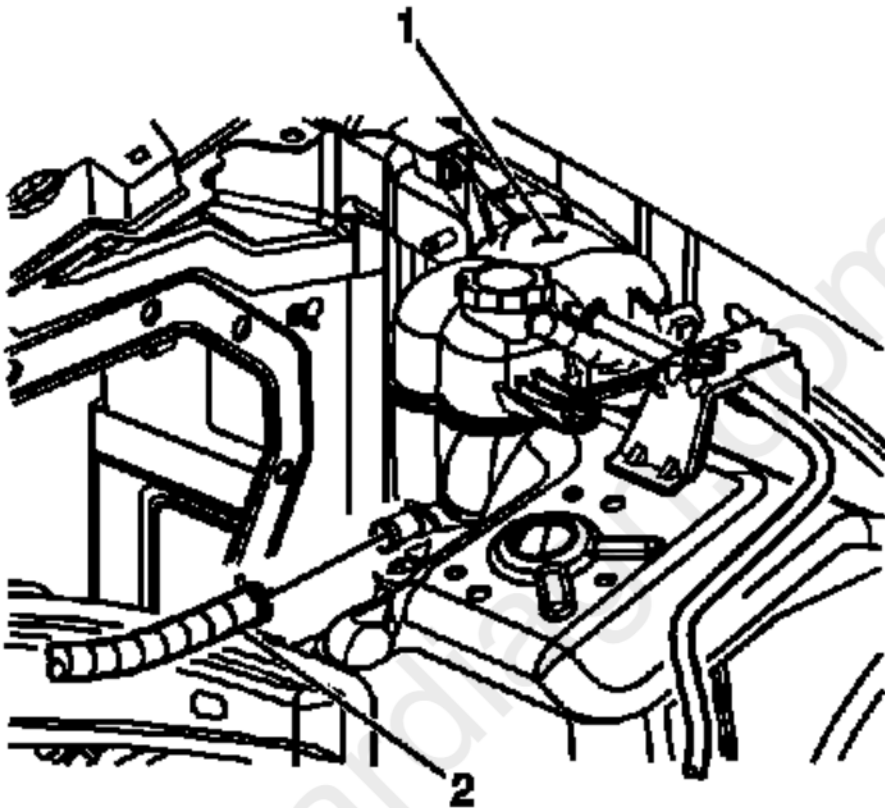


Fig. 85: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to remove the engine hose (2) from the surge tank (1). See **Special Tools**.
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** to the clamp in order to remove the surge tank engine hose from the thermostat assembly. See **Special Tools**.
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** to the clamp in order to connect the surge tank engine hose to the thermostat assembly.

See **Special Tools**.

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).

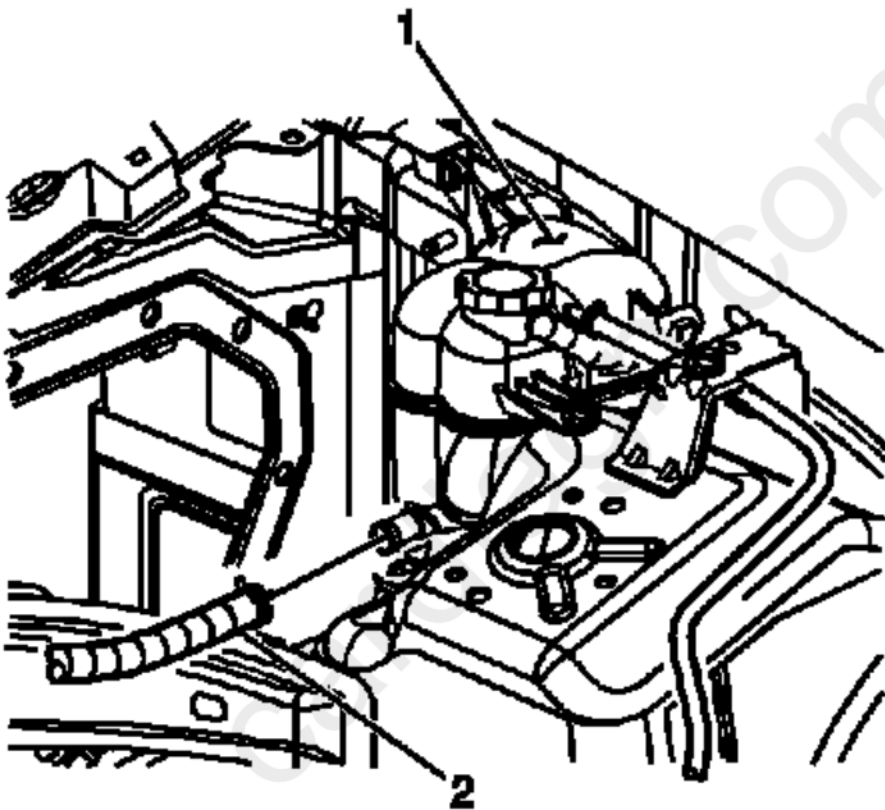


Fig. 86: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

5. Position **J 38185** to the clamp in order to connect the engine hose (2) to the surge tank (1). See **Special Tools**.
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).
2. Remove cross vehicle brace. Refer to Cross Vehicle Brace Replacement

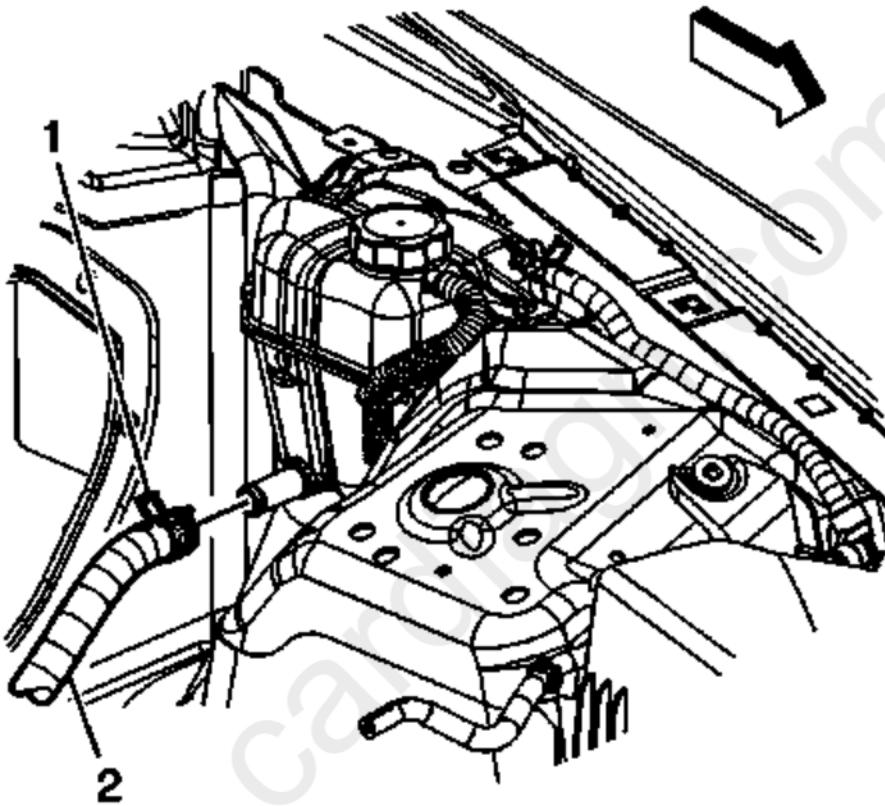


Fig. 87: Identifying Surge Tank Outlet Hose/Pipe & Clamp At Surge Tank
Courtesy of GENERAL MOTORS CORP.

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.

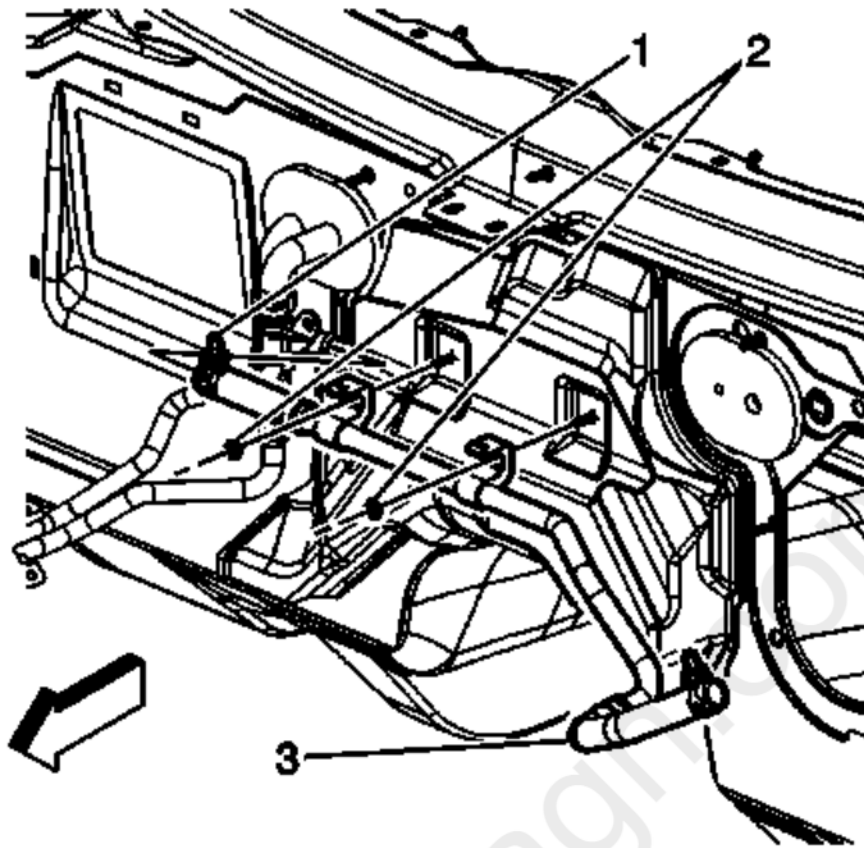


Fig. 88: Identifying Surge Tank Outlet Hose/Pipe Components
Courtesy of GENERAL MOTORS CORP.

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

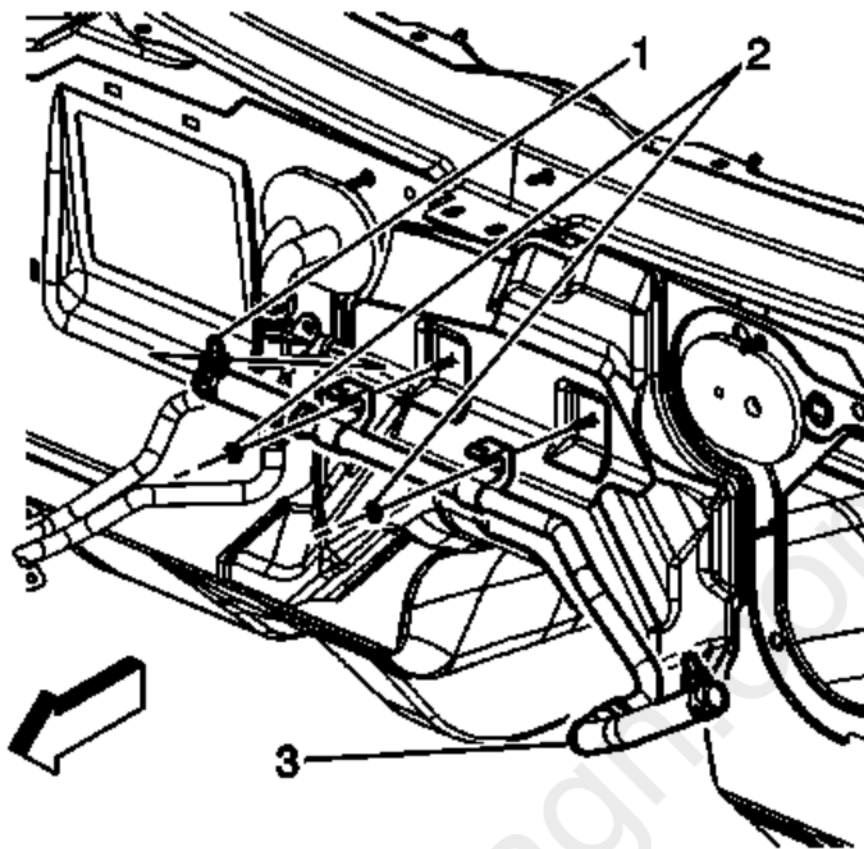


Fig. 89: Identifying Surge Tank Outlet Hose/Pipe Components
Courtesy of GENERAL MOTORS CORP.

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** .

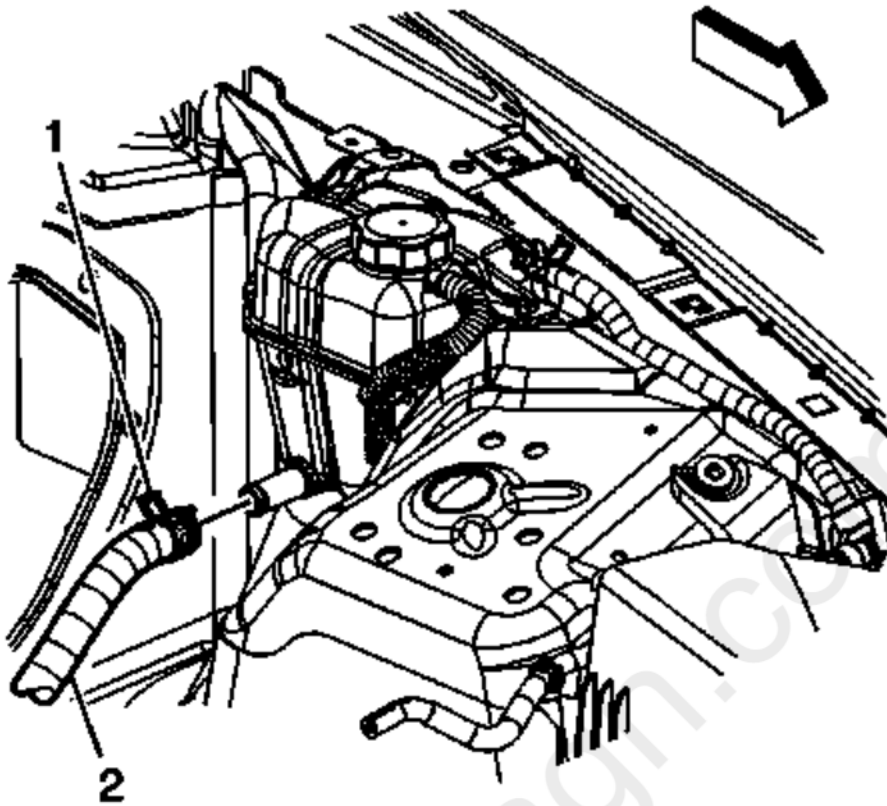


Fig. 90: Identifying Surge Tank Outlet Hose/Pipe & Clamp At Surge Tank
Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR INLET HOSE REPLACEMENT (LF1, LLT)

Special Tools

J 38185: Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

2. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement \(LF1\)](#) or [Air Cleaner Outlet Duct Replacement \(LLT\)](#).

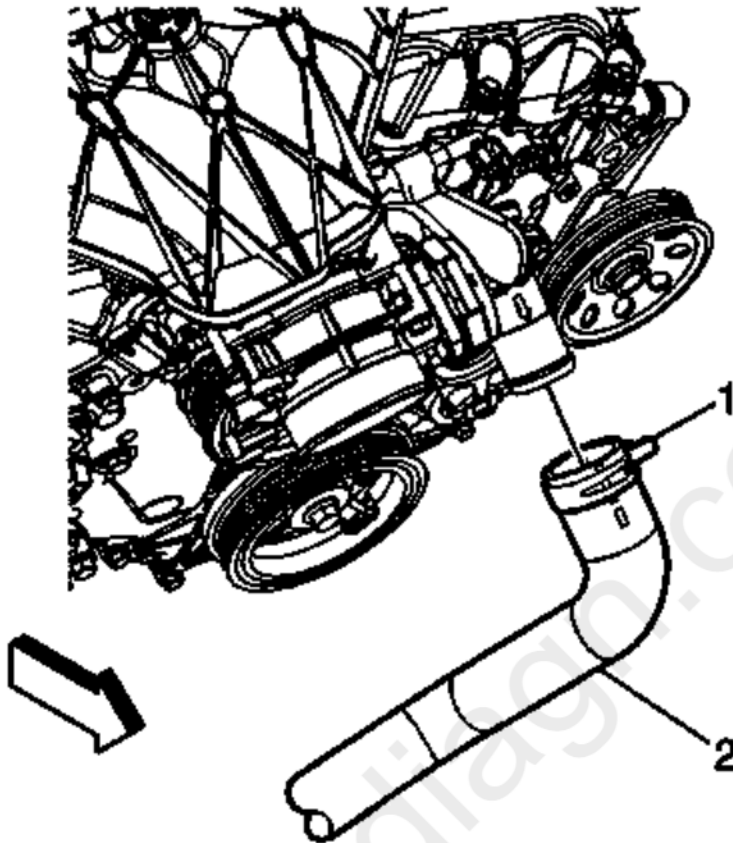


Fig. 91: Identifying Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS CORP.

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.

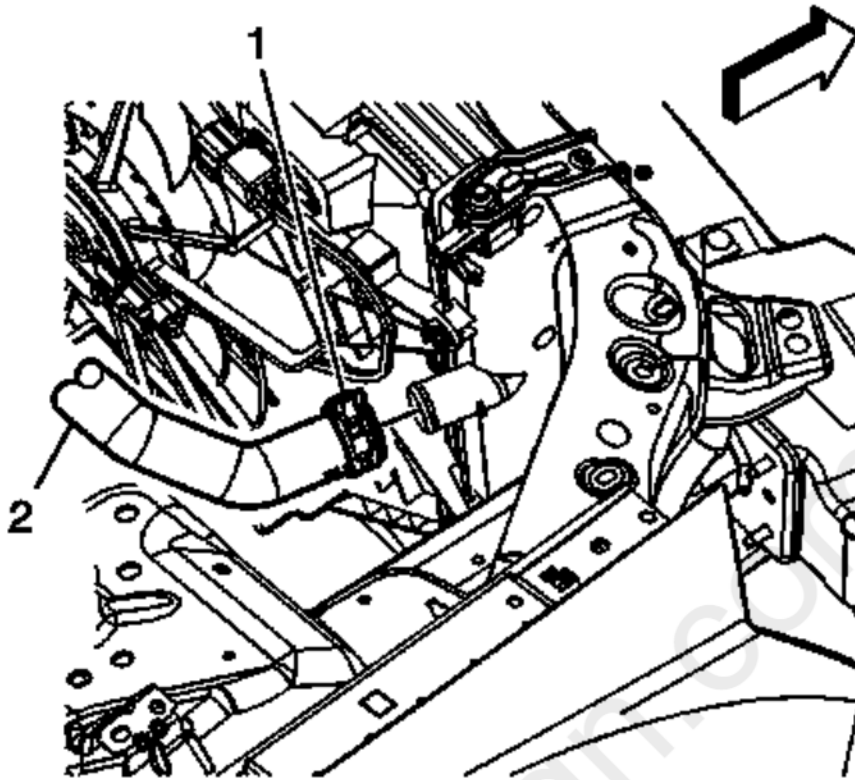


Fig. 92: View Of Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS CORP.

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.

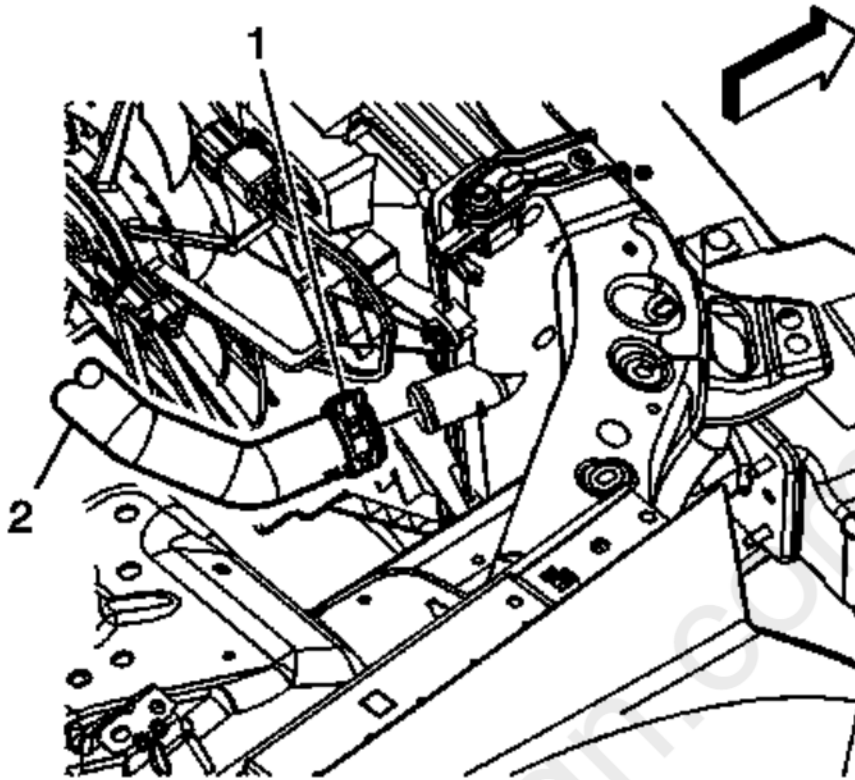


Fig. 93: View Of Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS CORP.

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.

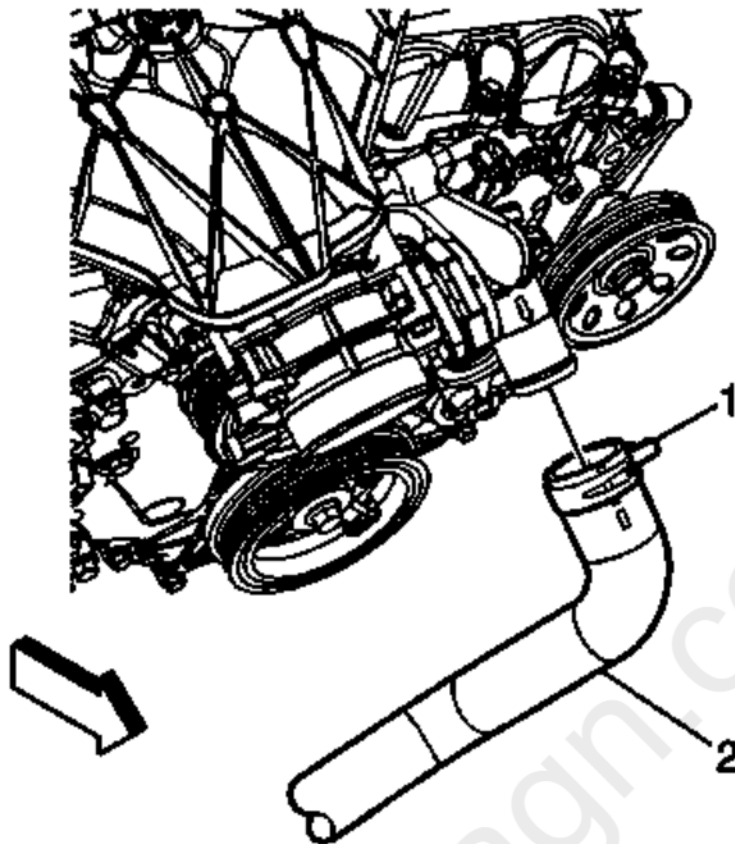


Fig. 94: Identifying Radiator Inlet Hose Clamp And Hose
Courtesy of GENERAL MOTORS CORP.

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 (LF1)** or **Air Cleaner Outlet Duct Replacement (LLT)**.
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

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 LF1, LLT)** or

Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or 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

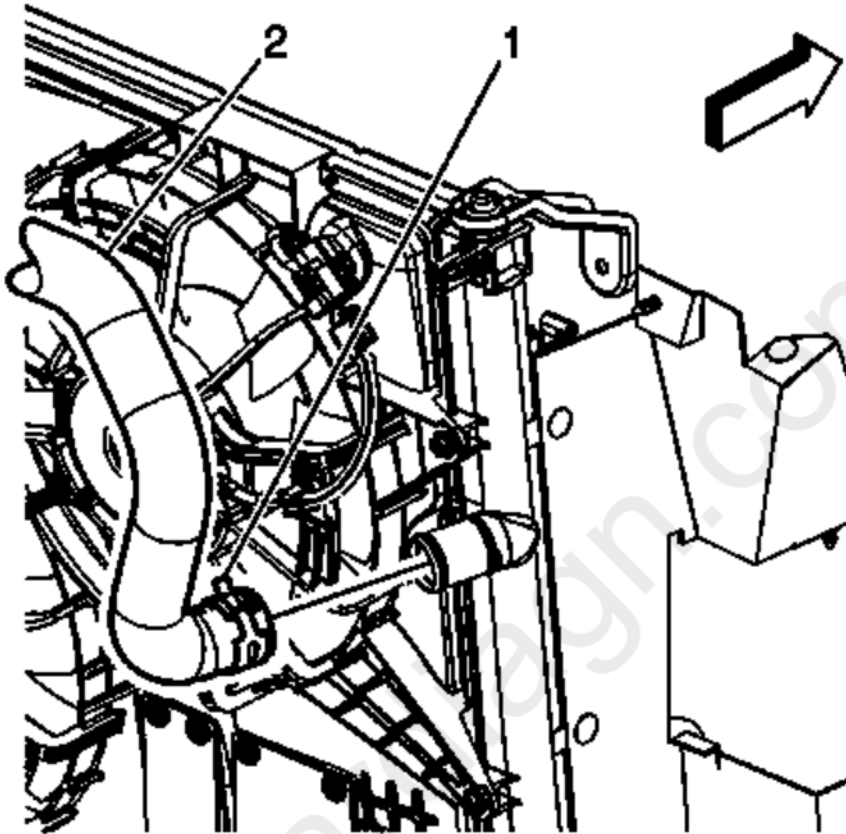


Fig. 95: Identifying Radiator Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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.

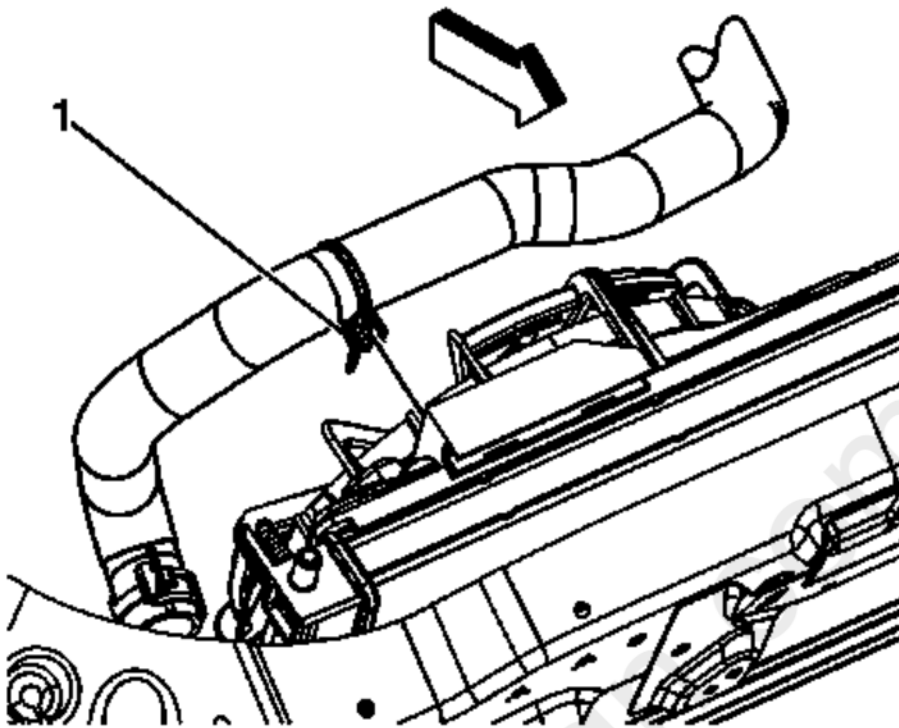


Fig. 96: Identifying Radiator Inlet Hose Retainer
Courtesy of GENERAL MOTORS CORP.

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

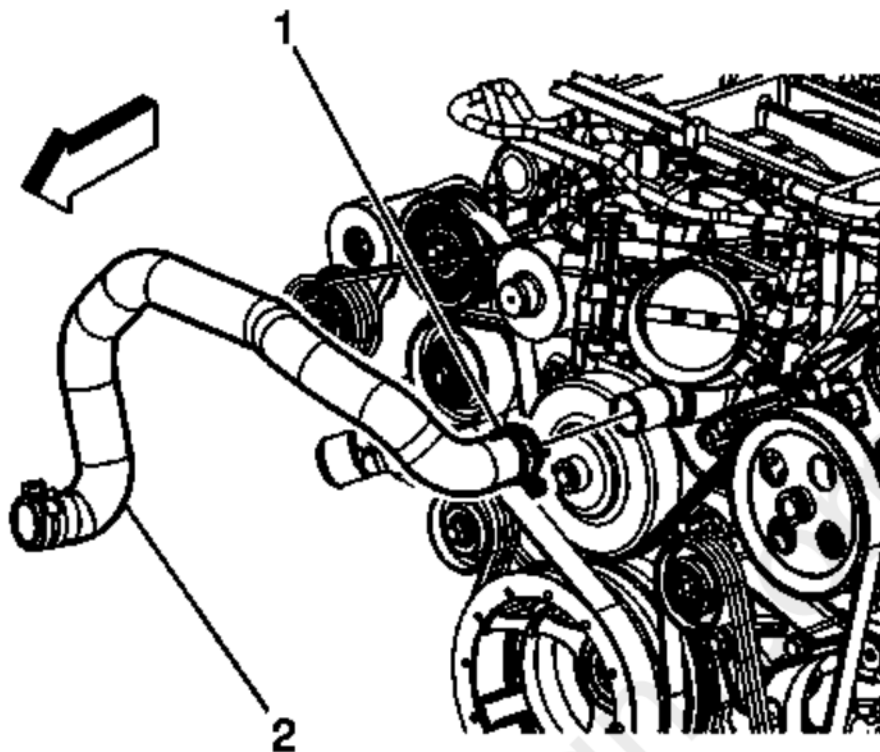


Fig. 97: Identifying Radiator Inlet Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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

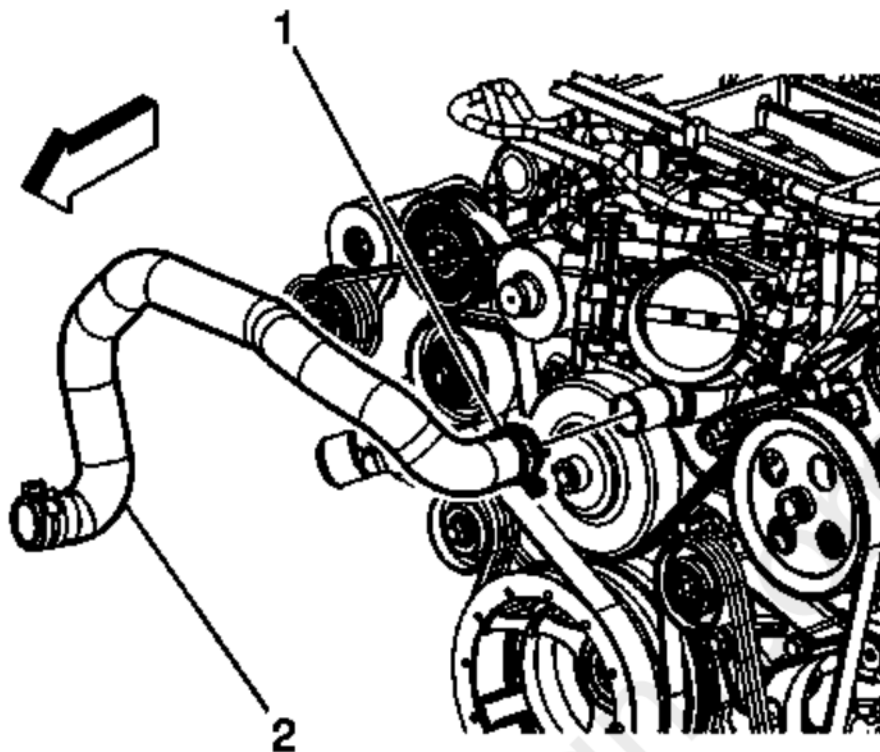


Fig. 98: Identifying Radiator Inlet Hose & Clamp At Engine
Courtesy of GENERAL MOTORS CORP.

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**.

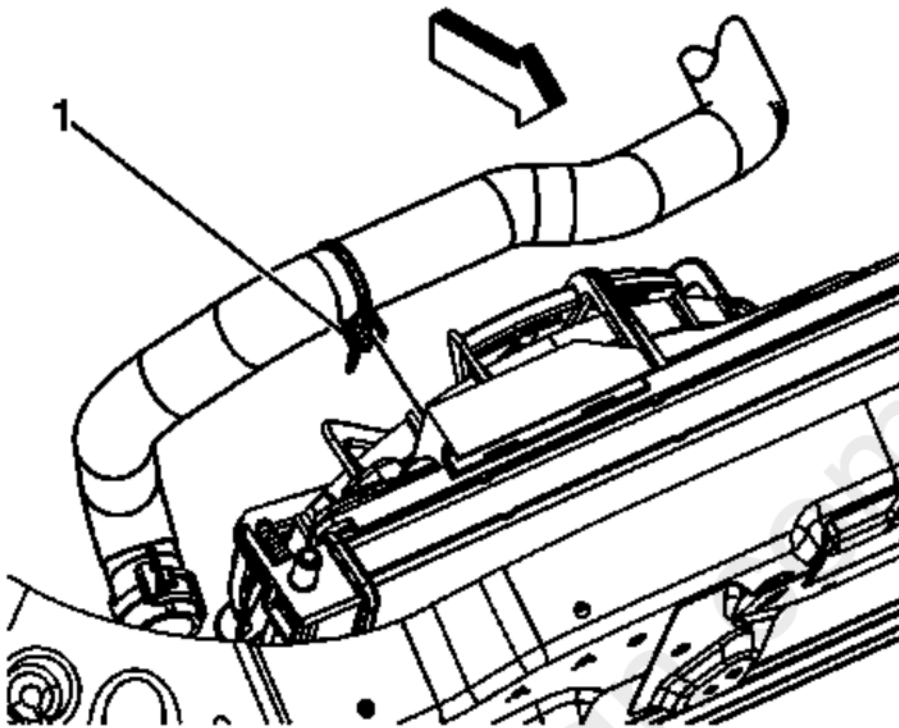


Fig. 99: Identifying Radiator Inlet Hose Retainer
Courtesy of GENERAL MOTORS CORP.

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

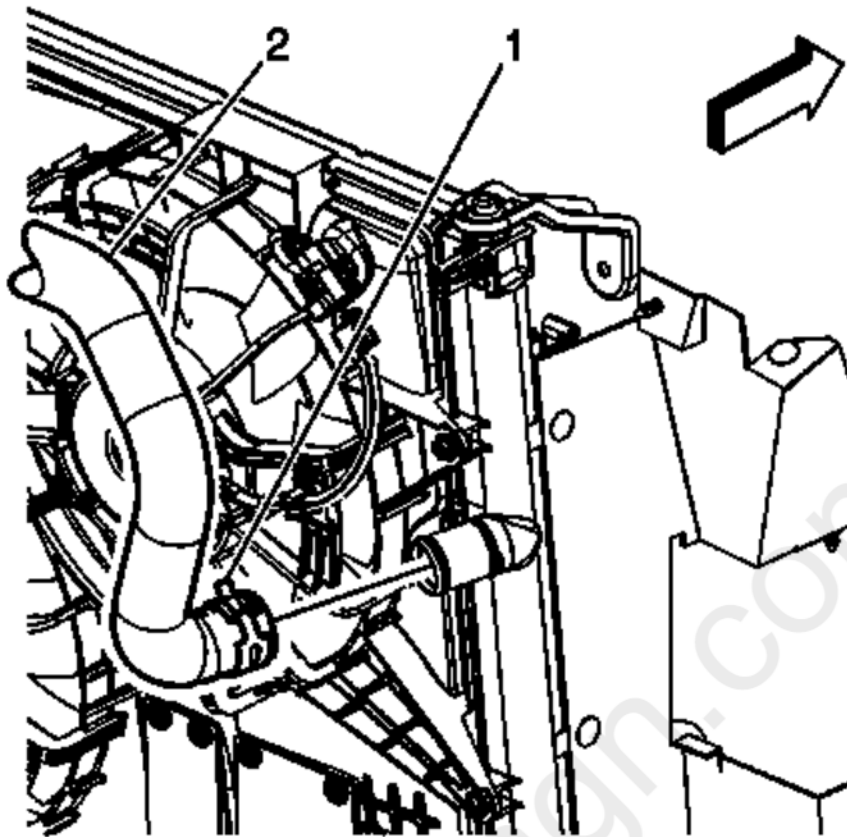


Fig. 100: Identifying Radiator Inlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR OUTLET HOSE REPLACEMENT (LF1, LLT)

Special Tools

J 38185: Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716**

LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).

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 (LF1) or Air Cleaner Outlet Duct Replacement (LLT)** .
4. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .

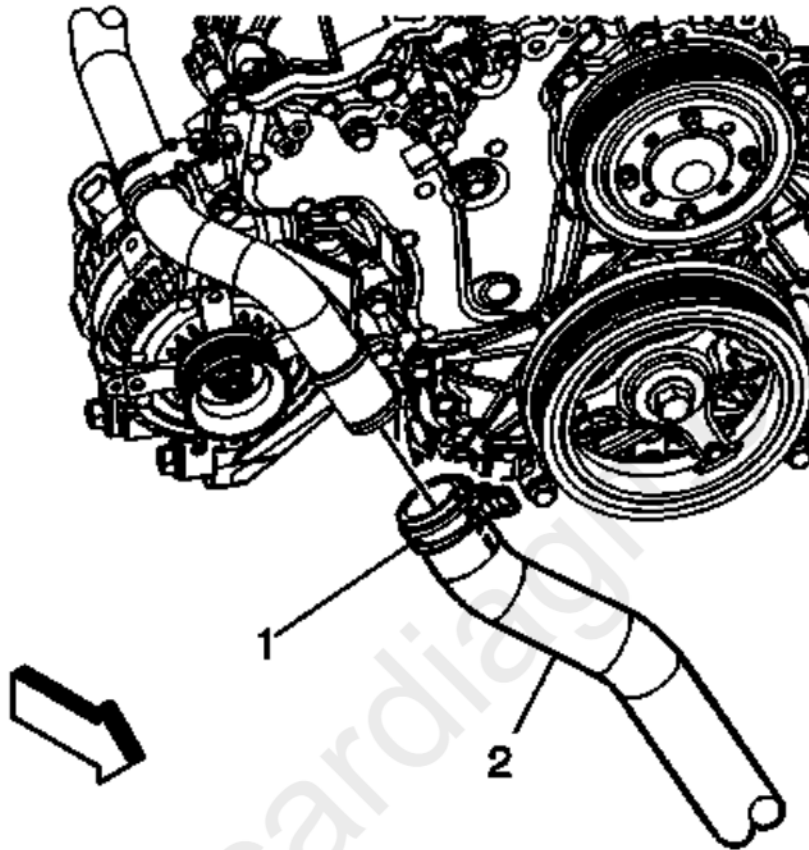


Fig. 101: View Of Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

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.

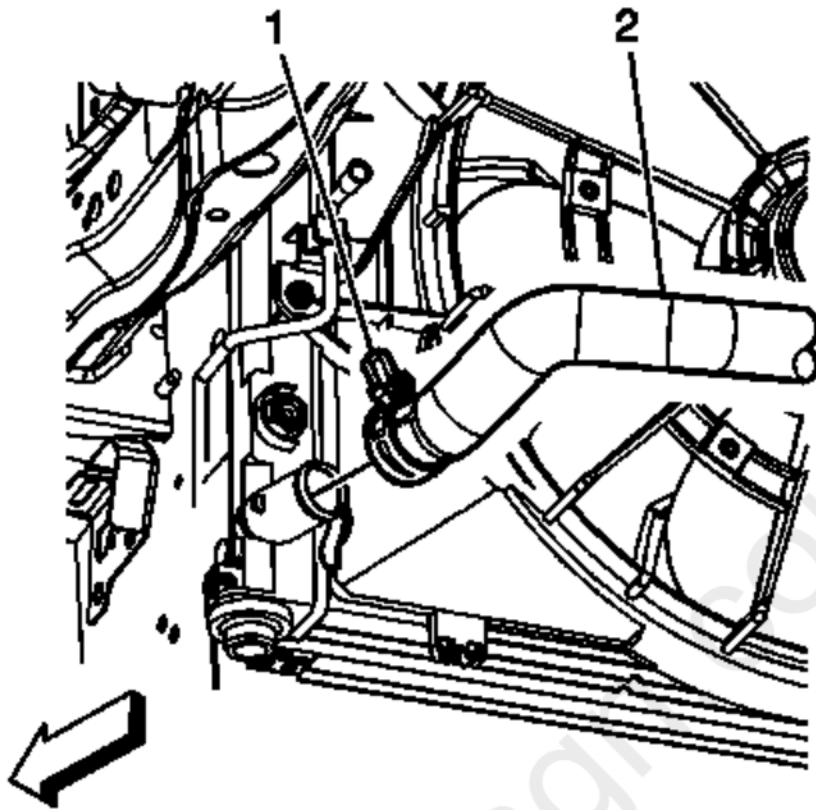


Fig. 102: Identifying Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

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.

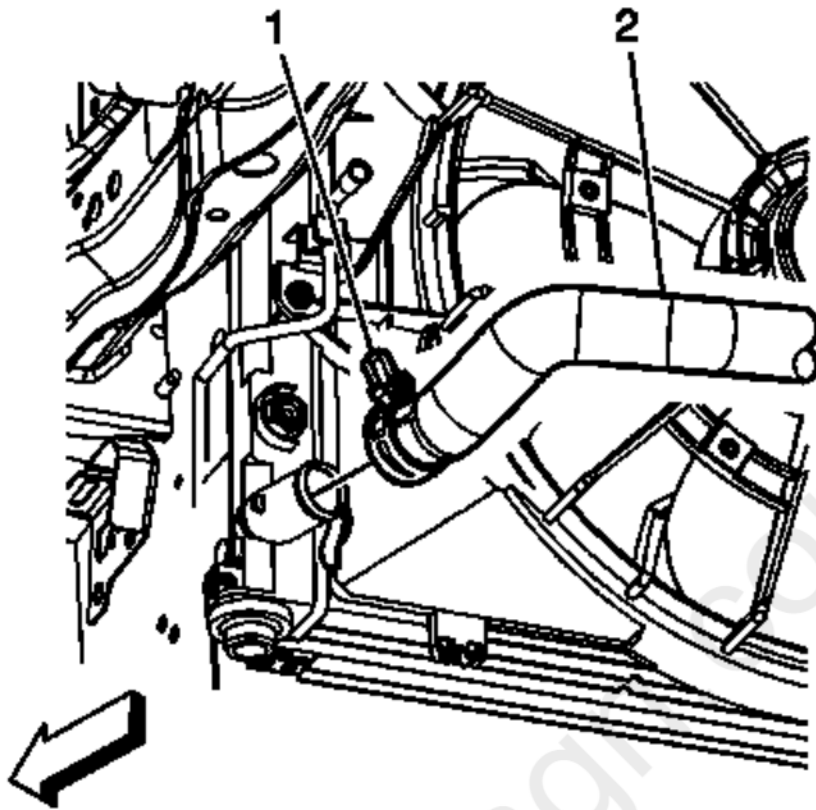


Fig. 103: Identifying Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

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.

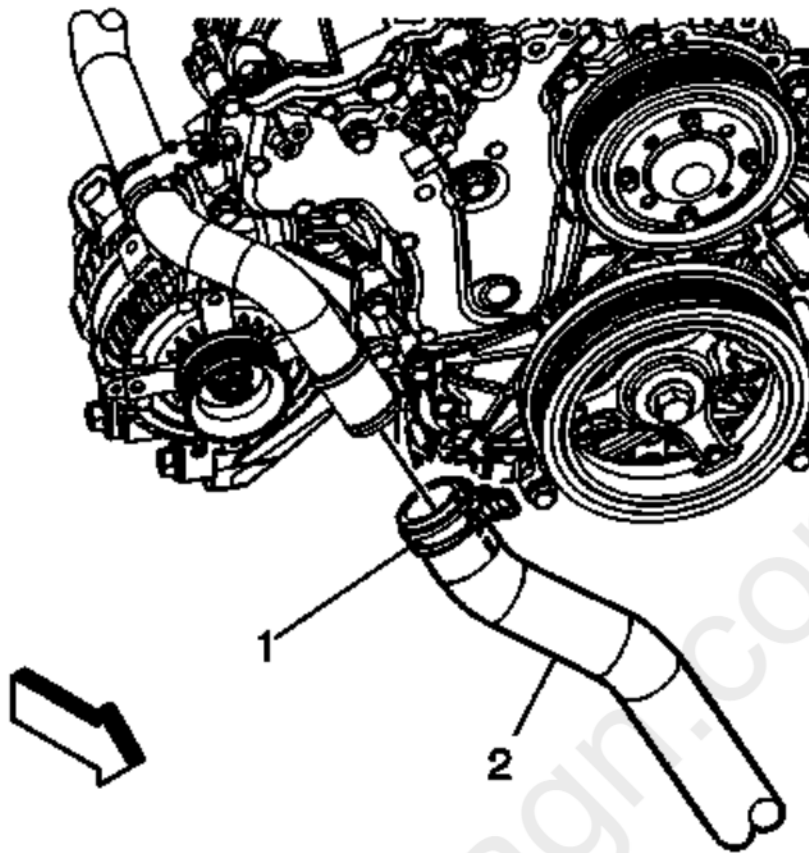


Fig. 104: View Of Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS CORP.

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 (LF1)** or **Air Cleaner Outlet Duct Replacement (LLT)** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or 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

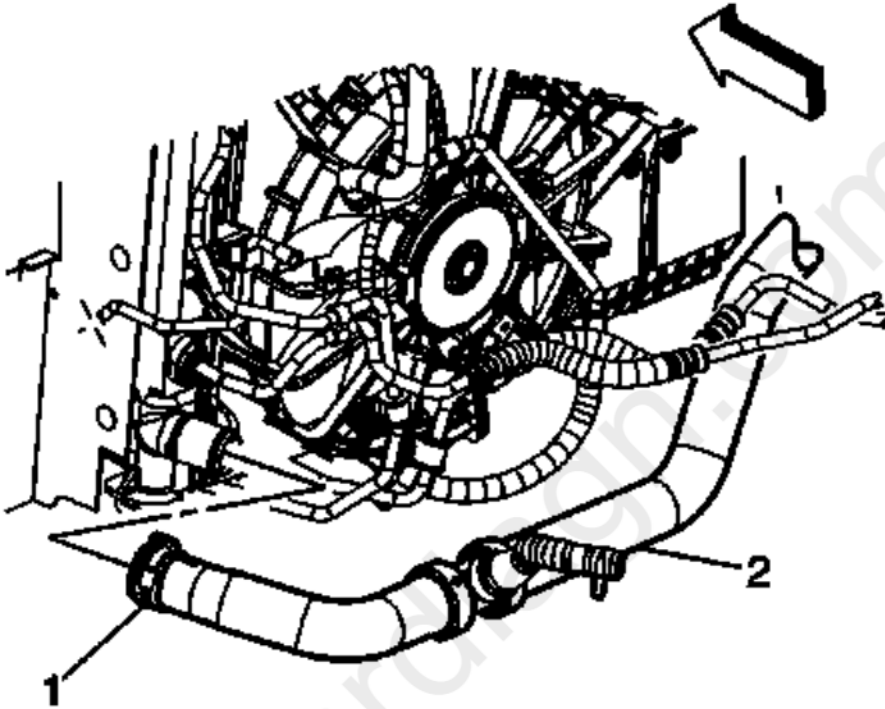


Fig. 105: Identifying Radiator Outlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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.

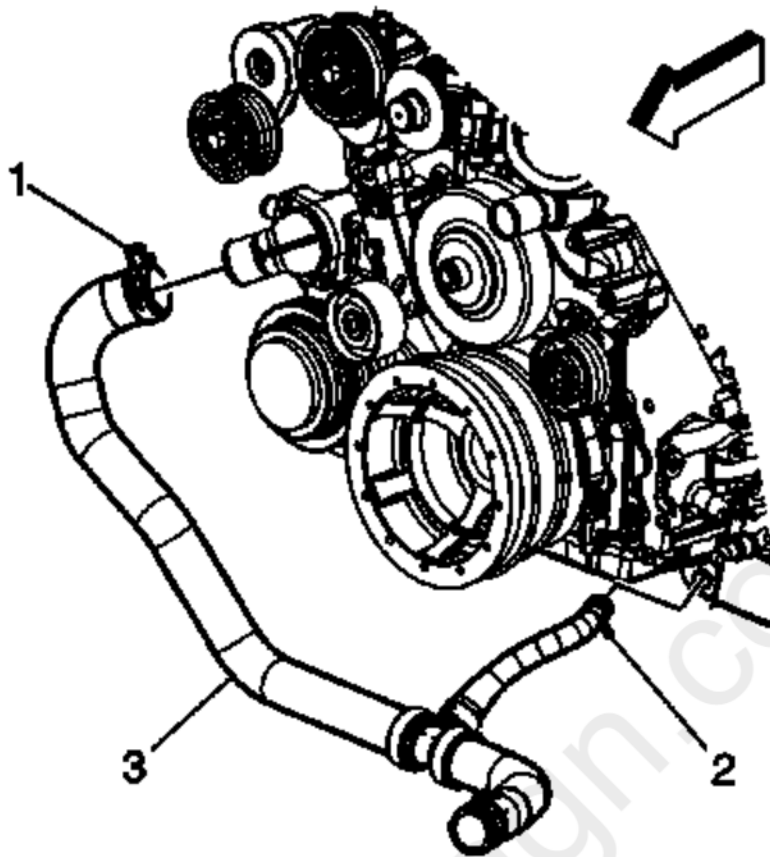


Fig. 106: Identifying Radiator Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

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

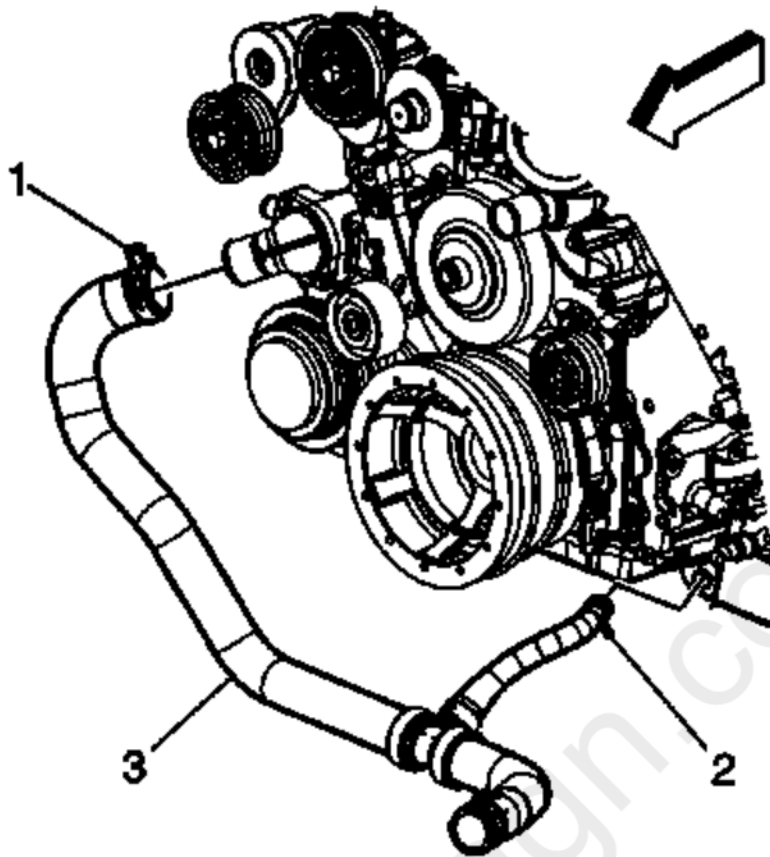


Fig. 107: Identifying Radiator Outlet Hose Components
Courtesy of GENERAL MOTORS CORP.

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**.

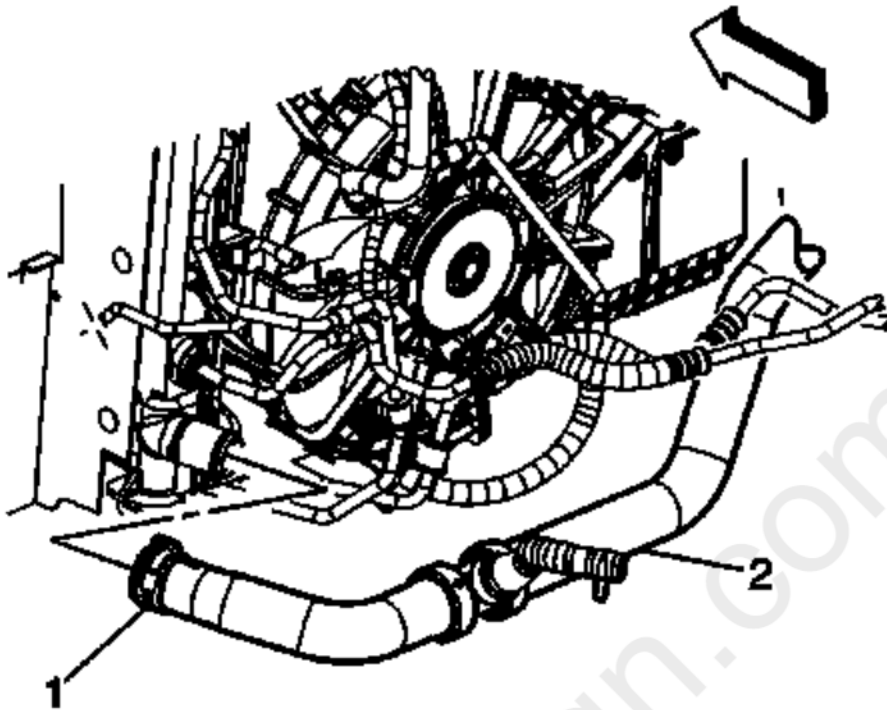


Fig. 108: Identifying Radiator Outlet Hose & Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

ENGINE COOLANT INLET PIPE REPLACEMENT

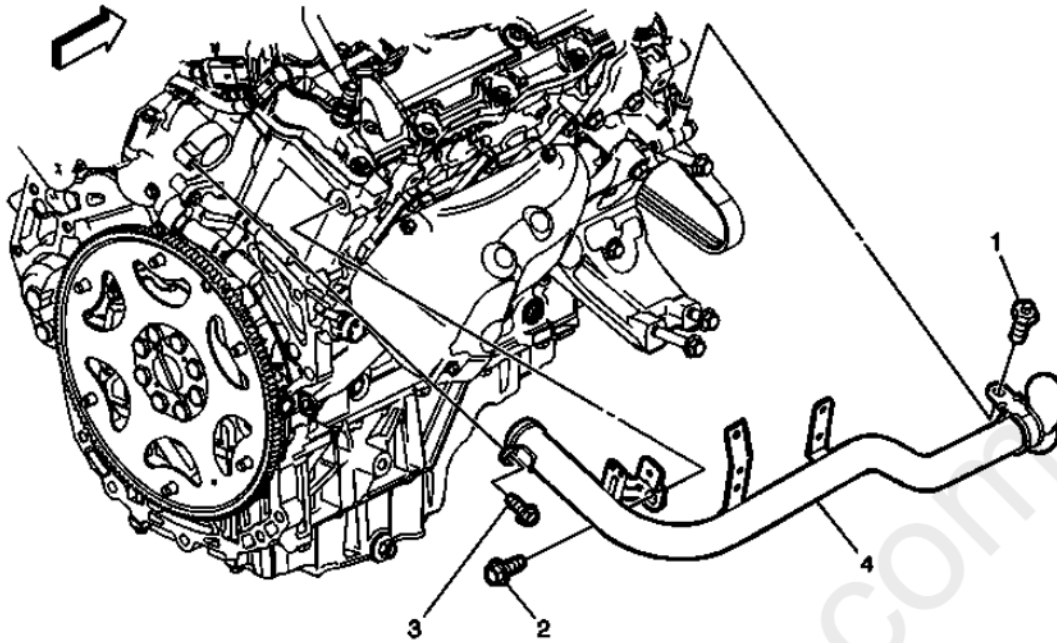


Fig. 109: Engine Coolant Inlet Pipe
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <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 (LF1, LLT)</u> or <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)
2	Radiator Outlet Pipe Bolt Tighten: 58 N.m (43 lb ft)
	Radiator Outlet Pipe Bolt

- | | |
|---|-----------------------------------|
| 3 | Tighten: 22 N.m (16 lb ft) |
| 4 | Engine Coolant Inlet Pipe |

CHARGE AIR COOLER COOLANT OUTLET PIPE REPLACEMENT

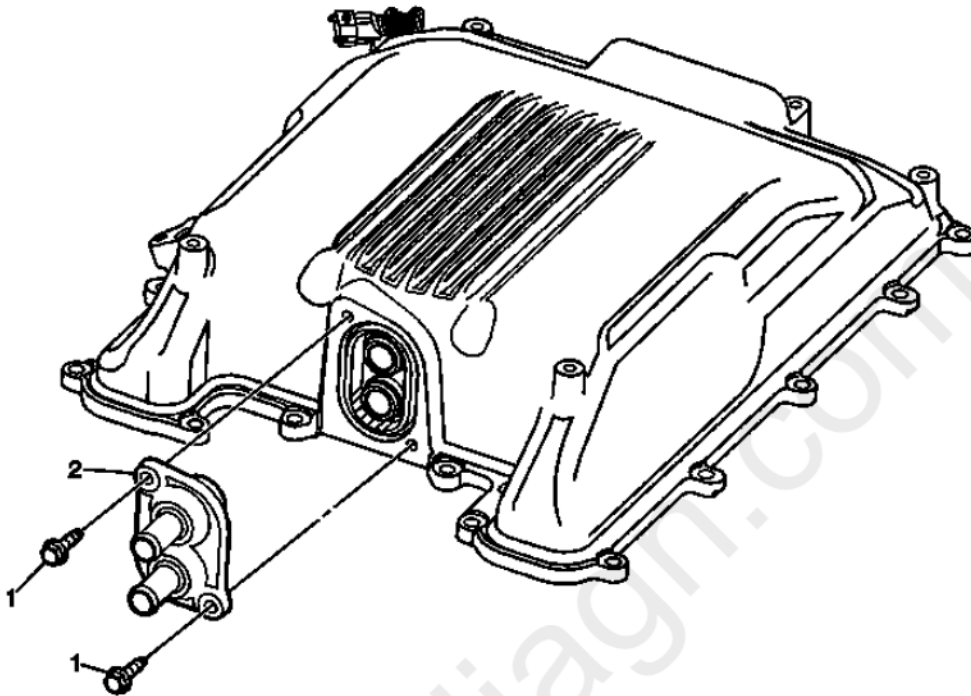


Fig. 110: Identifying Charge Air Cooler Coolant Outlet Pipe
Courtesy of GENERAL MOTORS CORP.

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)
	Charge Air Cooler Coolant Outlet Pipe Procedure

2

1. Do not reuse the same gasket.
2. Transfer components as necessary.

ENGINE OIL COOLER REPLACEMENT

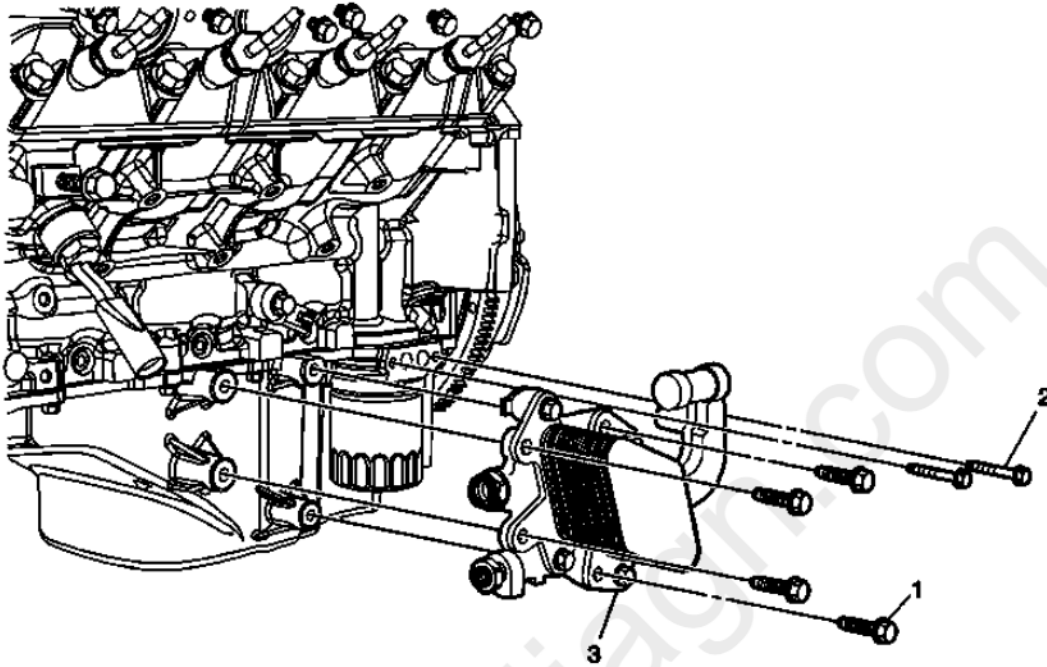


Fig. 111: Identifying Engine Oil Cooler
 Courtesy of GENERAL MOTORS CORP.

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>FASTENER 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 LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle

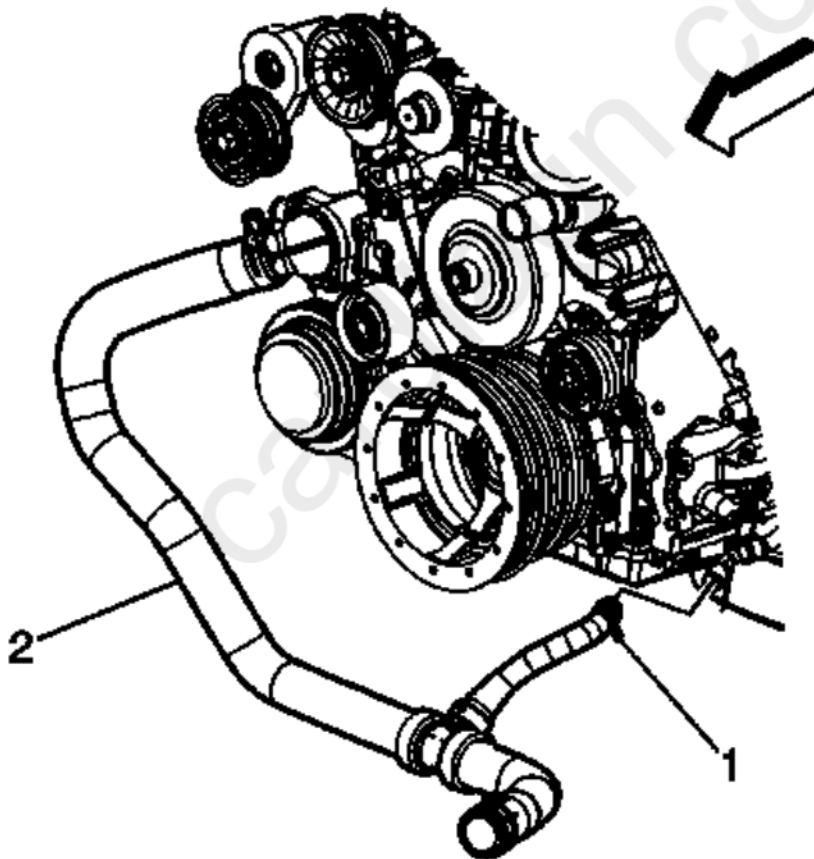


Fig. 112: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS CORP.

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](#)

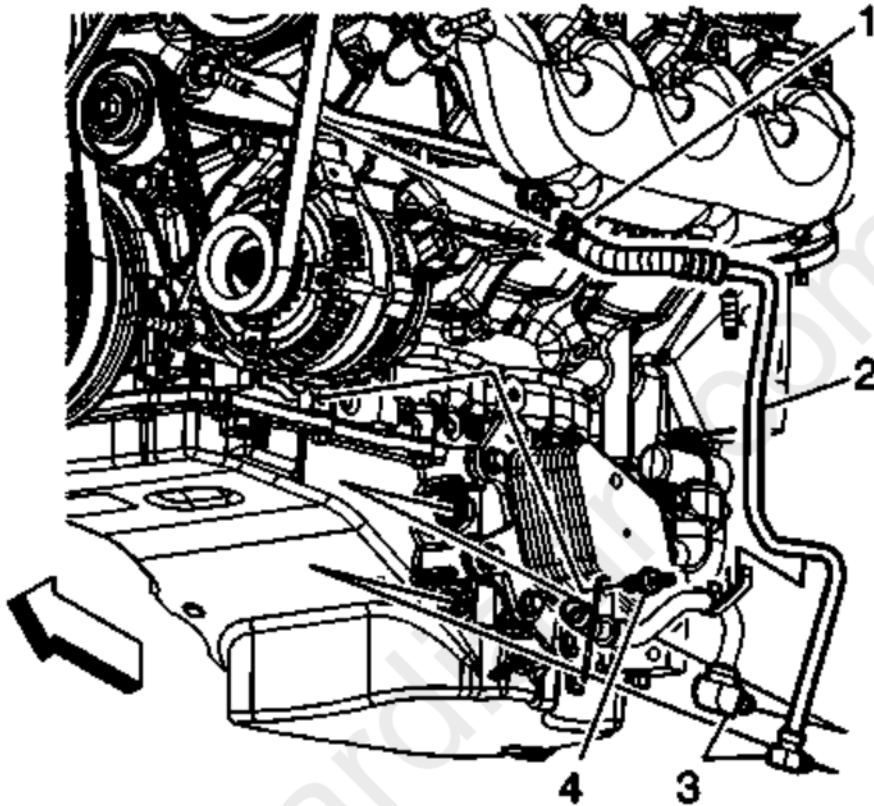


Fig. 113: Identifying Engine Oil Cooler Hose Components
Courtesy of GENERAL MOTORS CORP.

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

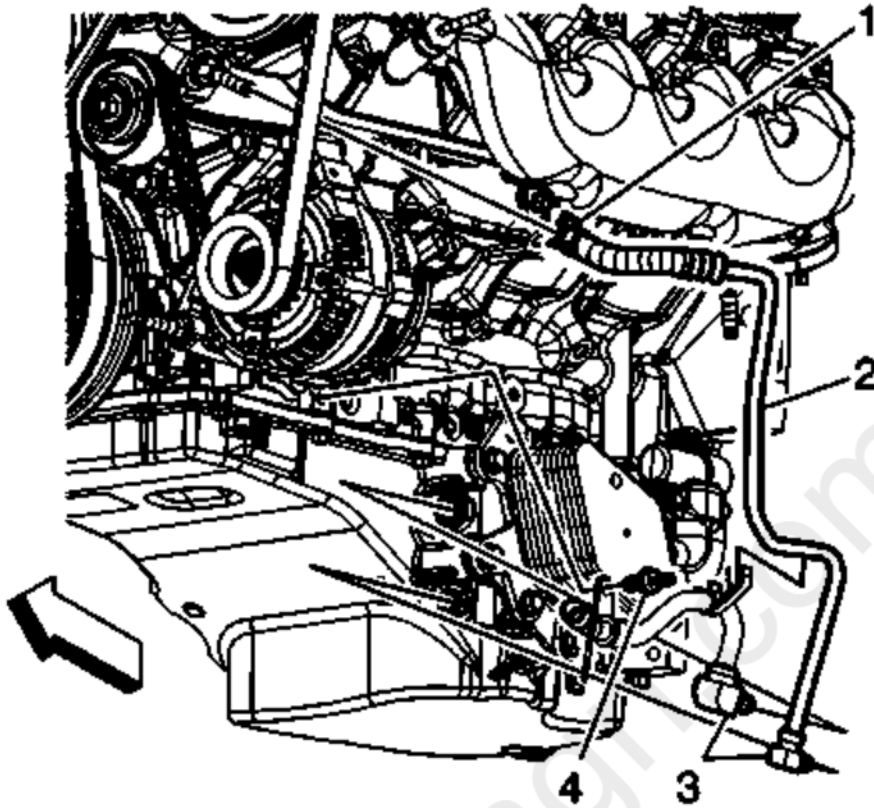


Fig. 114: Identifying Engine Oil Cooler Hose Components
Courtesy of GENERAL MOTORS CORP.

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**.

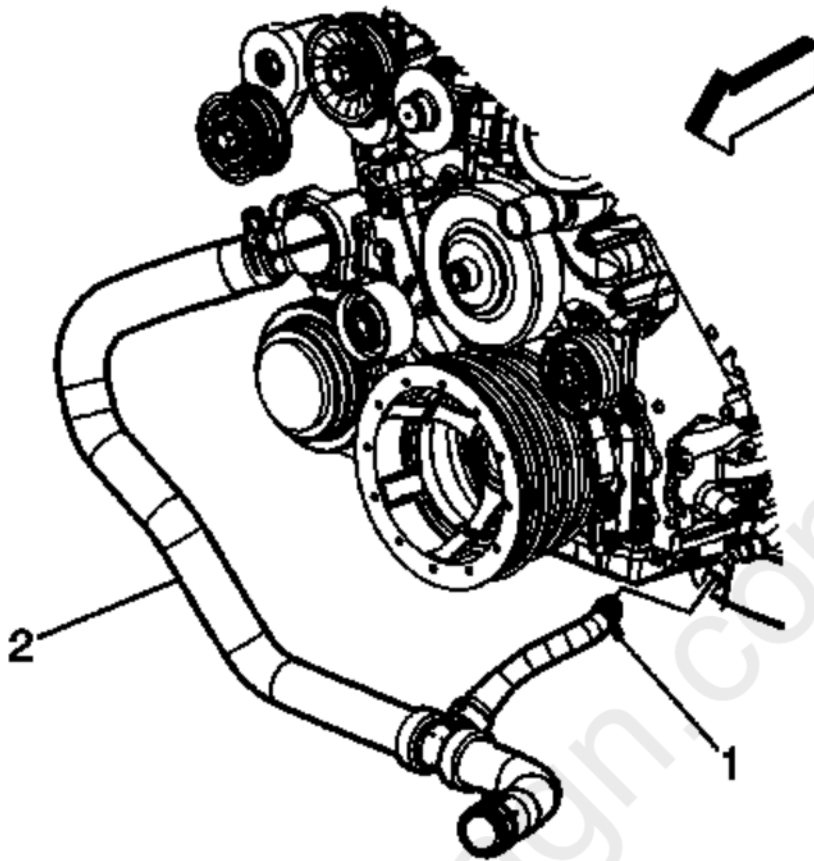


Fig. 115: Identifying Engine Oil Cooler Hose & Clamp At Radiator Hose
Courtesy of GENERAL MOTORS CORP.

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)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

ENGINE COOLANT FAN REPLACEMENT (LF1, LLT)

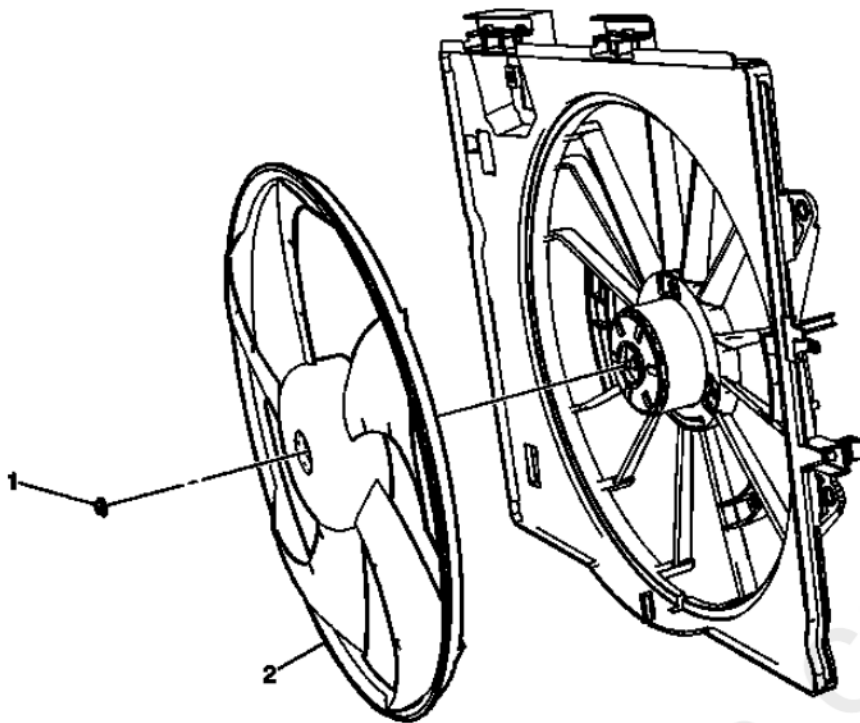


Fig. 116: Identifying Engine Coolant Fan (LLT, LP1, LY7)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures: Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LF1, LLT)</u> or <u>Engine Coolant Fan Shroud Replacement (LSA)</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 REPLACEMENT (LSA)

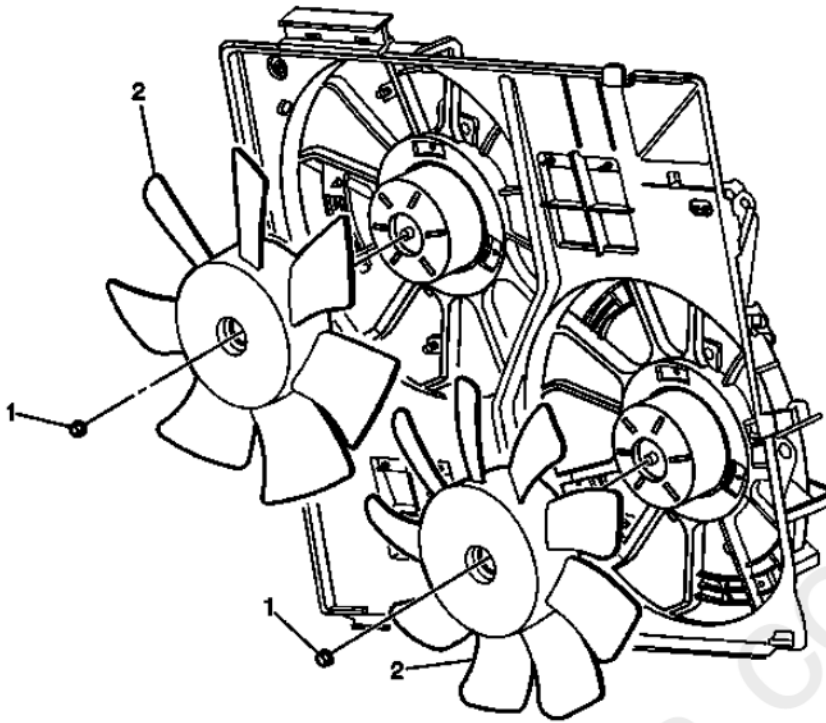


Fig. 117: Identifying Engine Coolant Fan (LSA)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures: Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LF1, LLT)</u> or <u>Engine Coolant Fan Shroud Replacement (LSA)</u>	
1	Cooling Fan Retainer CAUTION: Refer to Cooling Fan Retainer. Tighten: 7 N.m (62 lb in)
2	Cooling Fan

ENGINE COOLANT FAN MOTOR REPLACEMENT (LF1, LLT)

Removal Procedure

1. Remove the cooling fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LF1, LLT)** or **Engine Coolant Fan Shroud Replacement (LSA)**
2. Remove the cooling fan. Refer to **Engine Coolant Fan Replacement (LF1, LLT)** or **Engine Coolant Fan Replacement (LSA)**

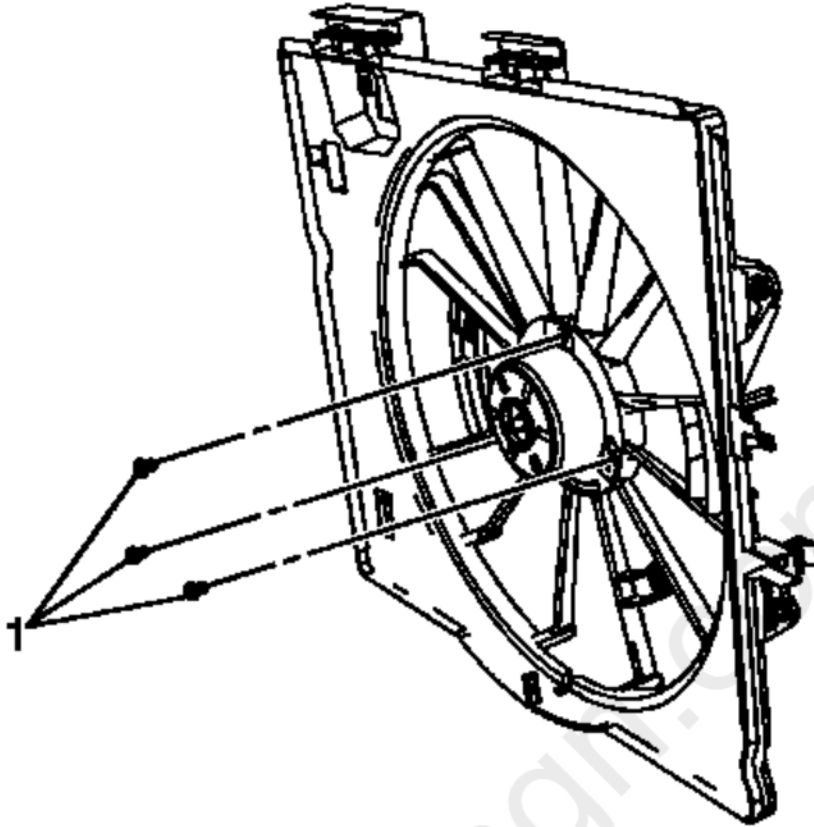


Fig. 118: Identifying Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

3. Remove the motor retaining screws (1).

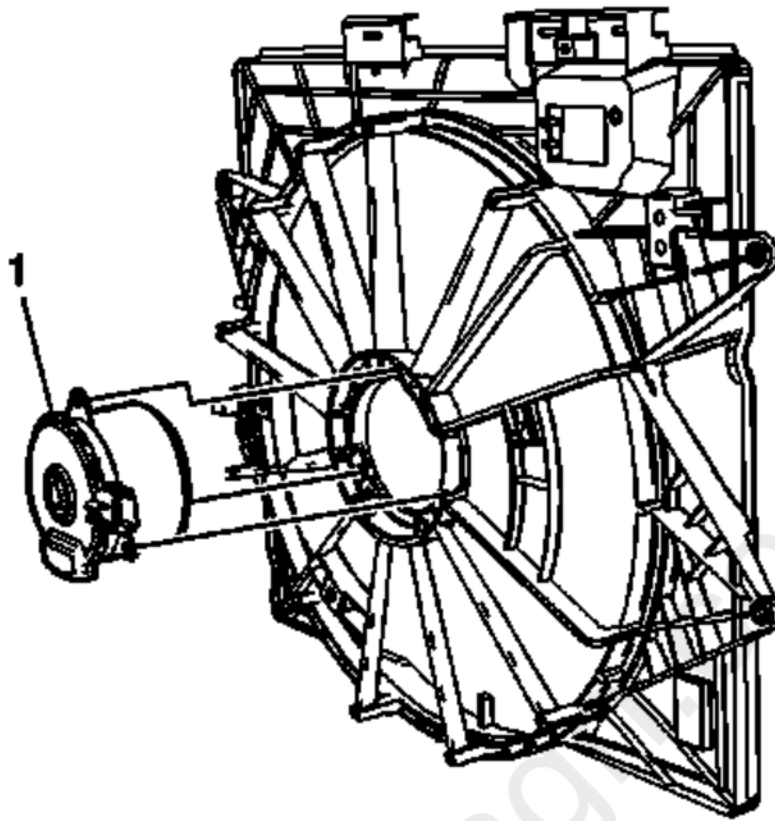


Fig. 119: Identifying Motor
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

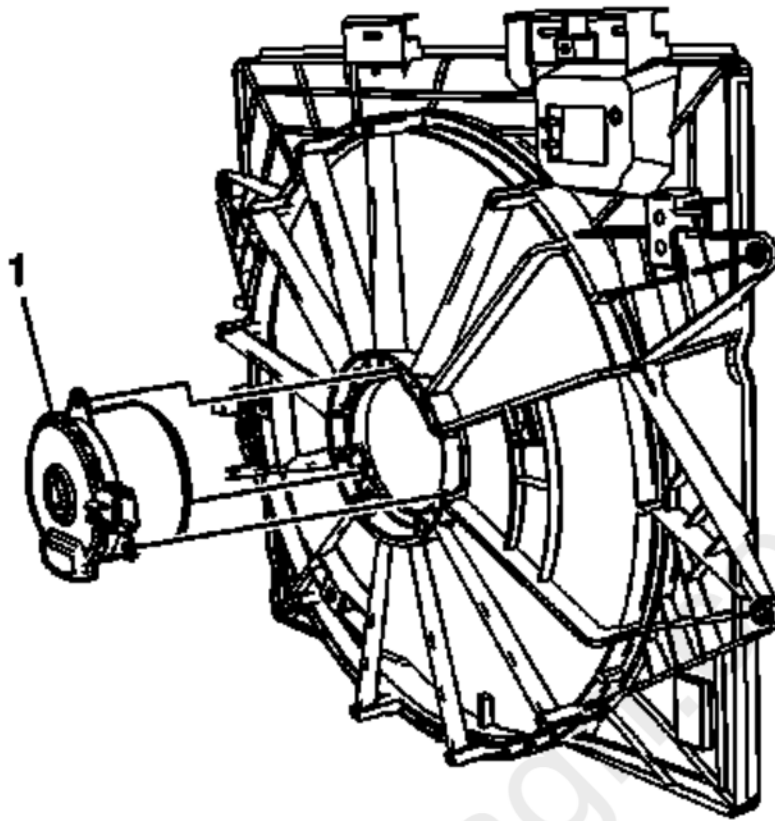


Fig. 120: Identifying Motor

Courtesy of GENERAL MOTORS CORP.

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

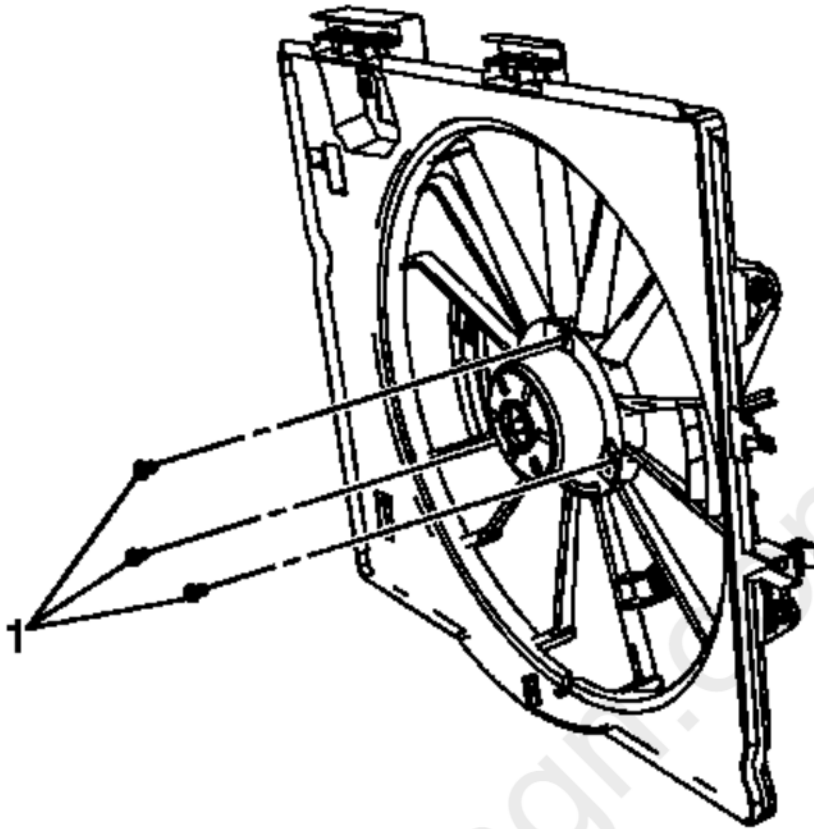


Fig. 121: Identifying Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Cooling Fan Retainer.

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 (LF1, LLT)** or **Engine Coolant Fan Replacement (LSA)**
4. Install the cooling fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LF1, LLT)** or **Engine Coolant Fan Shroud Replacement (LSA)**

ENGINE COOLANT FAN MOTOR REPLACEMENT (LSA)

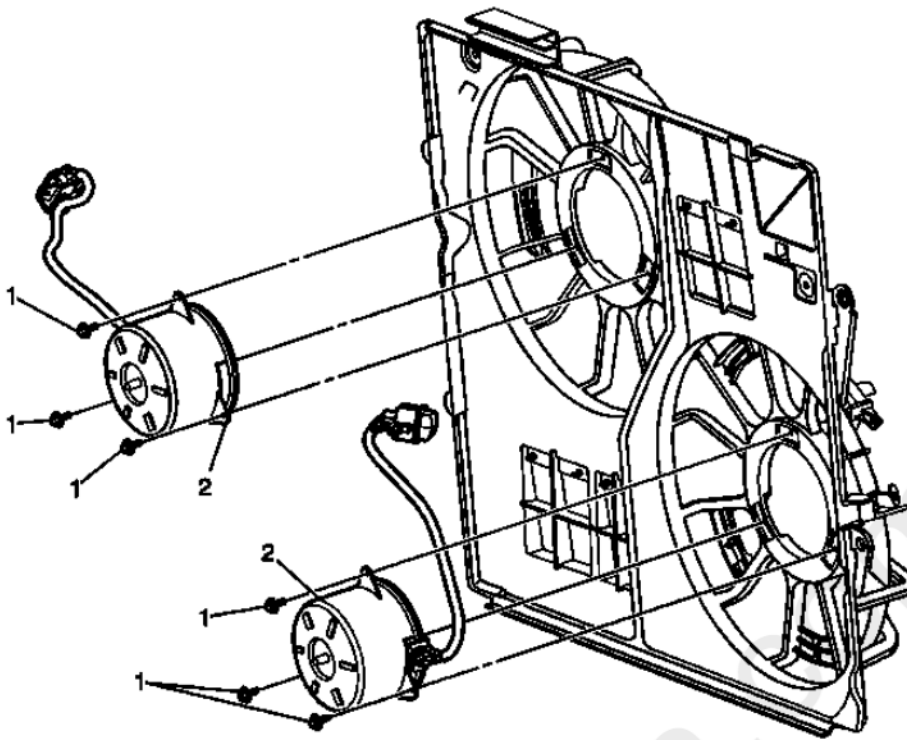


Fig. 122: Identifying Engine Coolant Fan Motor (LSA)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Remove the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LF1, LLT)</u> or <u>Engine Coolant Fan Shroud Replacement (LSA)</u>. 2. Remove the cooling fan. Refer to <u>Engine Coolant Fan Replacement (LF1, LLT)</u> or <u>Engine Coolant Fan Replacement (LSA)</u>.	
1	Cooling Fan Motor Retaining Screw (Qty: 6) CAUTION: Refer to Cooling Fan Retainer. Tighten: 7 N.m (62 lb in)
2	Cooling Fan Motor

ENGINE COOLANT FAN RESISTOR REPLACEMENT (LF1, LLT)

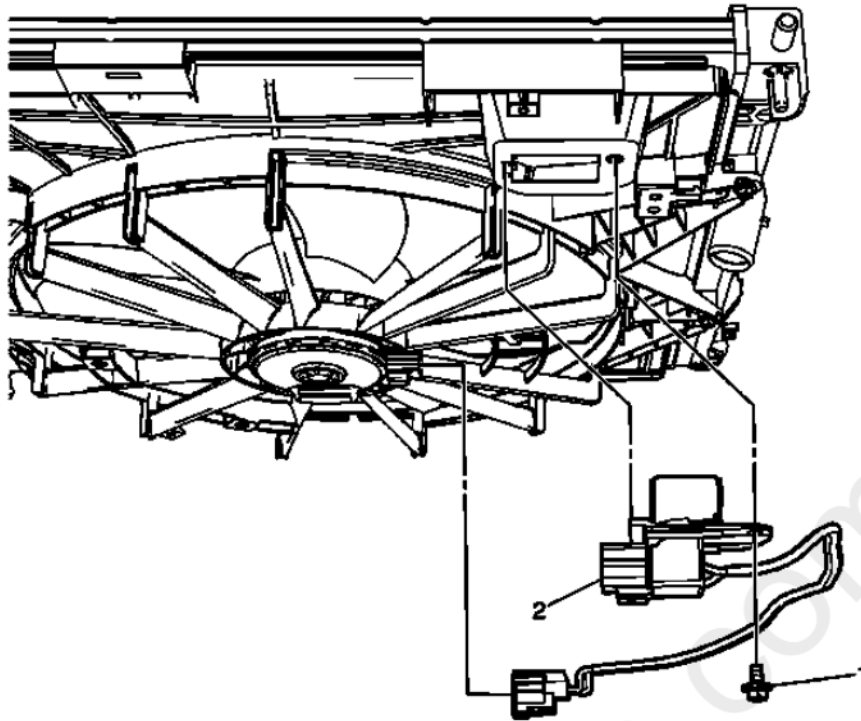


Fig. 123: Identifying Engine Coolant Fan Resistor (LLT, LP1, LY7)

Courtesy of GENERAL MOTORS CORP.

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 (LF1/LLT)

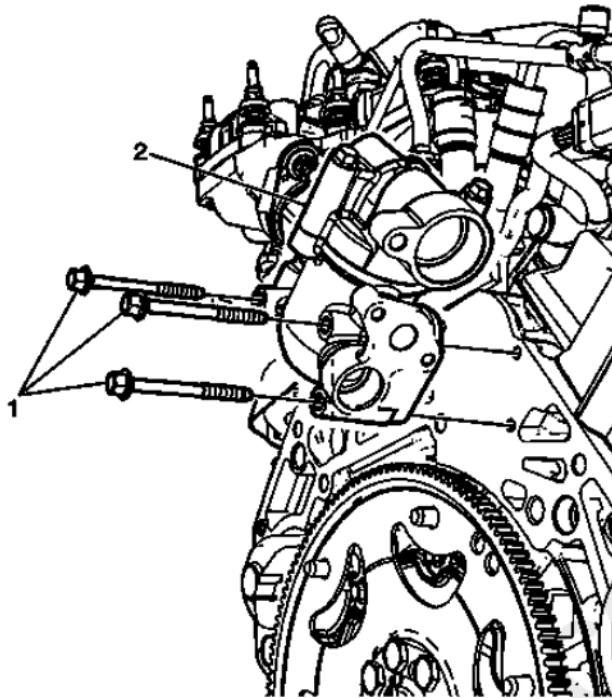


Fig. 124: Engine Coolant Thermostat Housing
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Remove the fuel pipe shield. Refer to <u>Fuel Pipe Shield Replacement (LF1)</u> or <u>Fuel Pipe Shield Replacement (LLT)</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 (LF1, LLT)</u> or <u>Radiator Surge Tank Engine Hose Replacement (LSA)</u>.	
1	Thermostat Housing Bolt (Qty: 3) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 20 N.m (15 lb ft)
2	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT REPLACEMENT (LF1/LLT)

Removal Procedure

1. Partially drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).
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 (LF1, LLT) or Radiator Surge Tank Engine Hose Replacement (LSA).

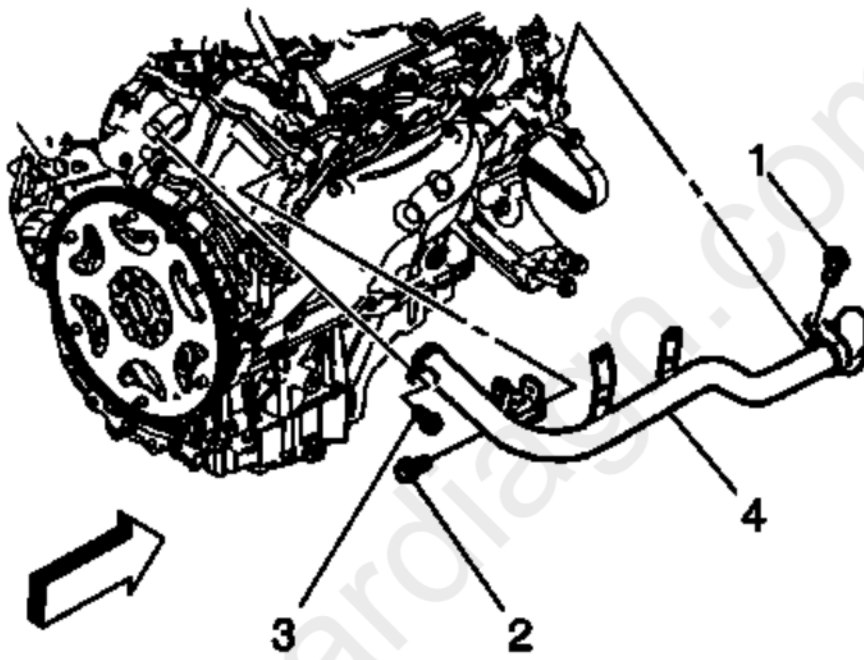


Fig. 125: Identifying Coolant Pipe/Thermostat Housing, Coolant Pipe Upper, And Coolant Inlet Pipe Bolts

Courtesy of GENERAL MOTORS CORP.

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.

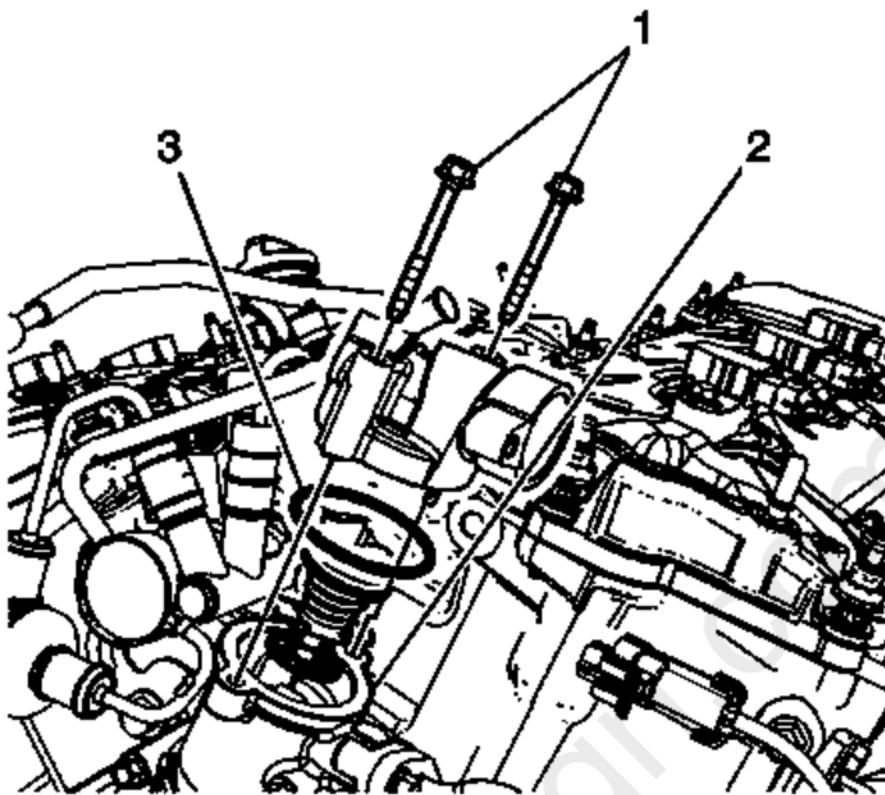


Fig. 126: View of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

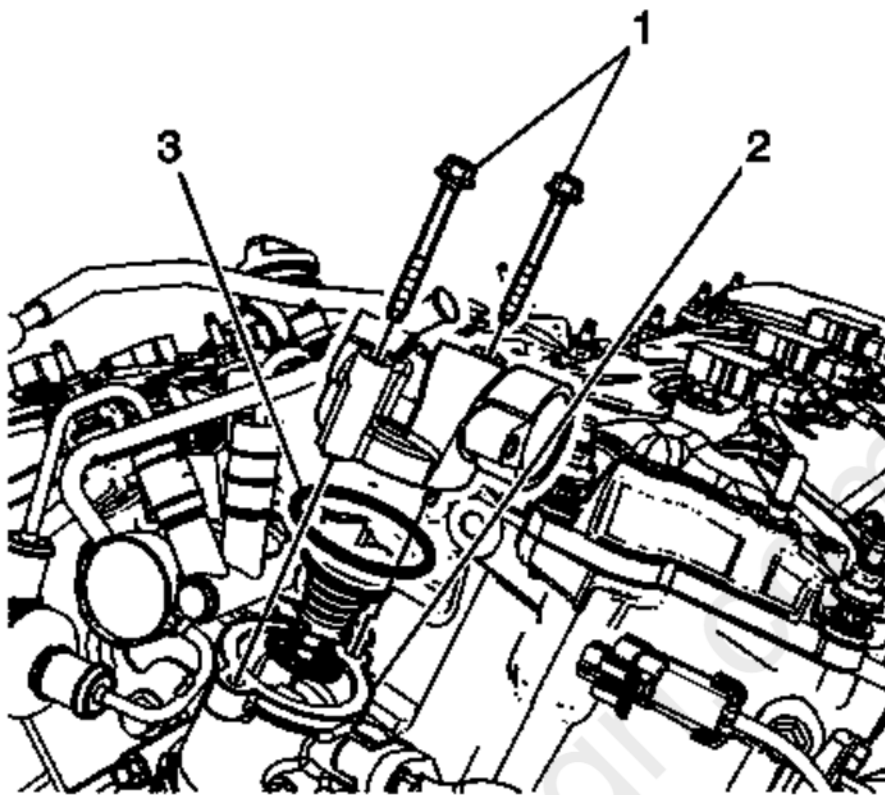


Fig. 127: View of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

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).

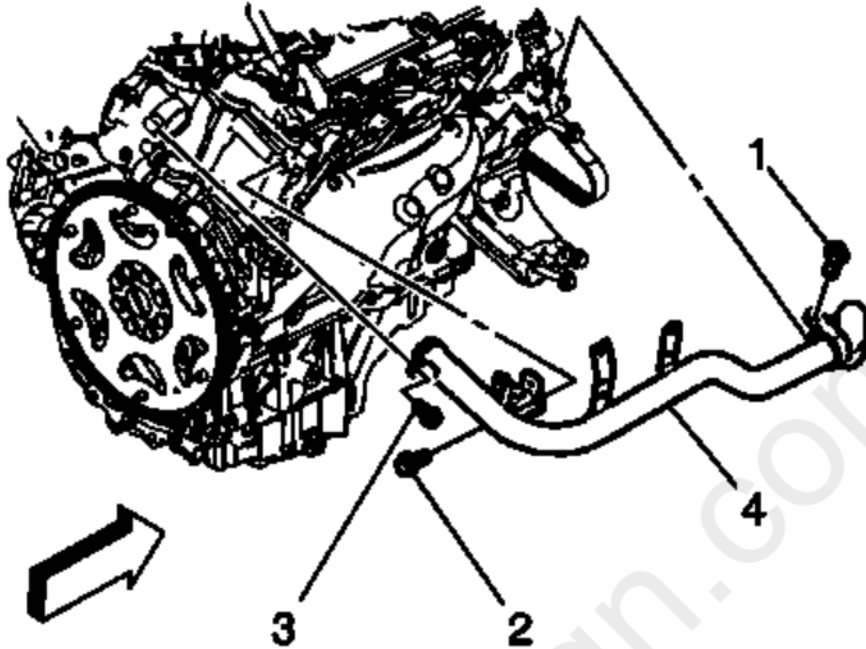


Fig. 128: Identifying Coolant Pipe/Thermostat Housing, Coolant Pipe Upper, And Coolant Inlet Pipe Bolts

Courtesy of GENERAL MOTORS CORP.

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 (LF1, LLT)** or **Radiator Surge Tank Engine Hose Replacement (LSA)**.
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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

ENGINE COOLANT THERMOSTAT REPLACEMENT (LSA)

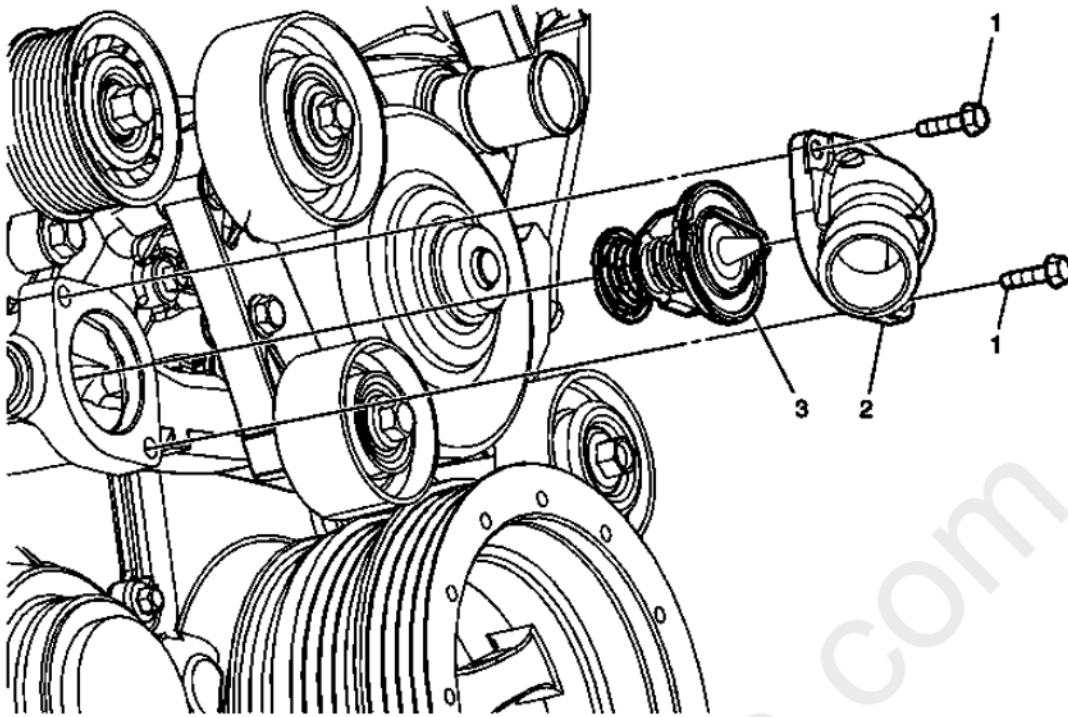


Fig. 129: Identifying Engine Coolant Thermostat (V8)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <u>Cooling System Draining and Filling (GE 47716 LSA)</u>. 2. Remove the engine cooling fan. Refer to <u>Engine Coolant Fan Replacement (LF1, LLT)</u> or <u>Engine Coolant Fan Replacement (LSA)</u>. 3. Disconnect the radiator inlet hose and position aside. Refer to <u>Radiator Inlet Hose Replacement (LF1, LLT)</u> or <u>Radiator Inlet Hose Replacement (LSA)</u>.	
1	Water Pump Inlet Bolt (Qty: 2) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 15 N.m(11 lb ft)
2	Water Pump Inlet
3	Engine Coolant Thermostat Tip: • The thermostat mating surfaces must be clean and free of debris.

- Always install a NEW seal on the thermostat.

WATER OUTLET REPLACEMENT (LF1/LLT)

Removal Procedure

1. Partially drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).
2. For the LLT engine, remove the throttle body. Refer to Throttle Body Assembly Replacement (LF1) or Throttle Body Assembly Replacement (LLT).
3. Remove the radiator hose from the water outlet. Refer to Radiator Inlet Hose Replacement (LF1, LLT) or Radiator Inlet Hose Replacement (LSA).

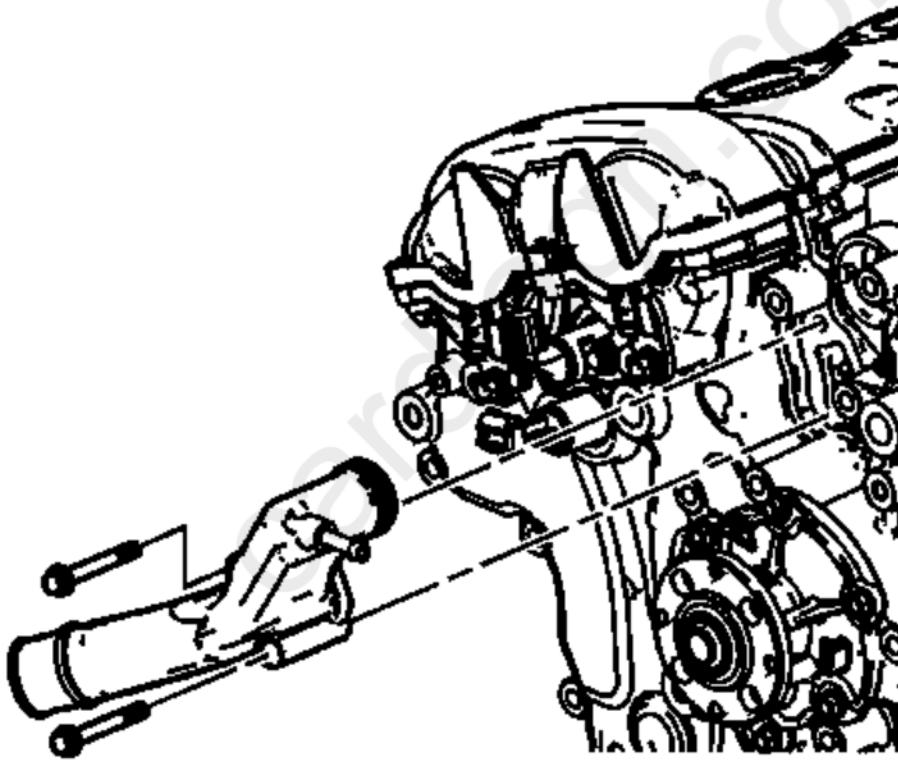


Fig. 130: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

4. Remove the water outlet housing bolts.
5. Remove the water outlet.
6. Remove and discard the water outlet seals.

7. Clean the water outlet housing sealing surfaces.

Installation Procedure

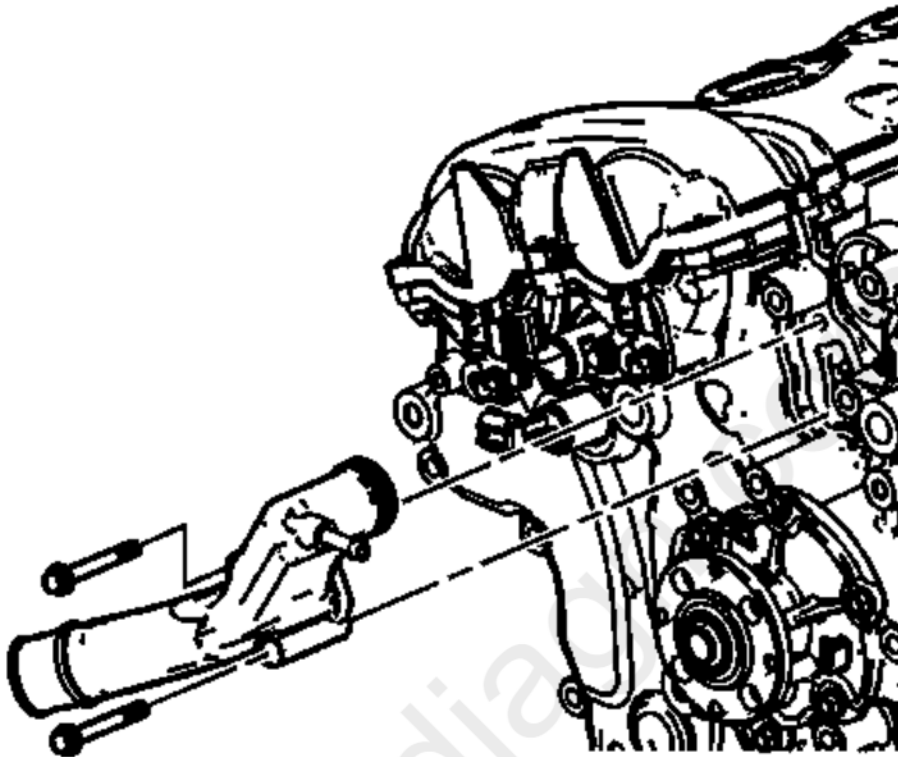


Fig. 131: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

1. Install NEW water outlet housing seals.
2. Install the water outlet.

CAUTION: Refer to **FASTENER CAUTION** .

3. Install the water outlet bolts and tighten to 10 N.m(89 lb in).
4. Install the radiator hose to the water outlet. Refer to **Radiator Inlet Hose Replacement (LF1, LLT)** or **Radiator Inlet Hose Replacement (LSA)**.
5. For the LLT engine, install the throttle body. Refer to **Throttle Body Assembly Replacement (LF1)** or **Throttle Body Assembly Replacement (LLT)** .
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE**

47716 LF1, LLT or **Cooling System Draining and Filling (GE 47716 LSA)**.

WATER PUMP REPLACEMENT (LF1/LLT)

Special Tools

EN 46104 Water Pump Pulley Holding Tool. See **Special Tools**.

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.
2. Remove the generator drive belt. Refer to **Water Pump and Generator Belt Replacement**.

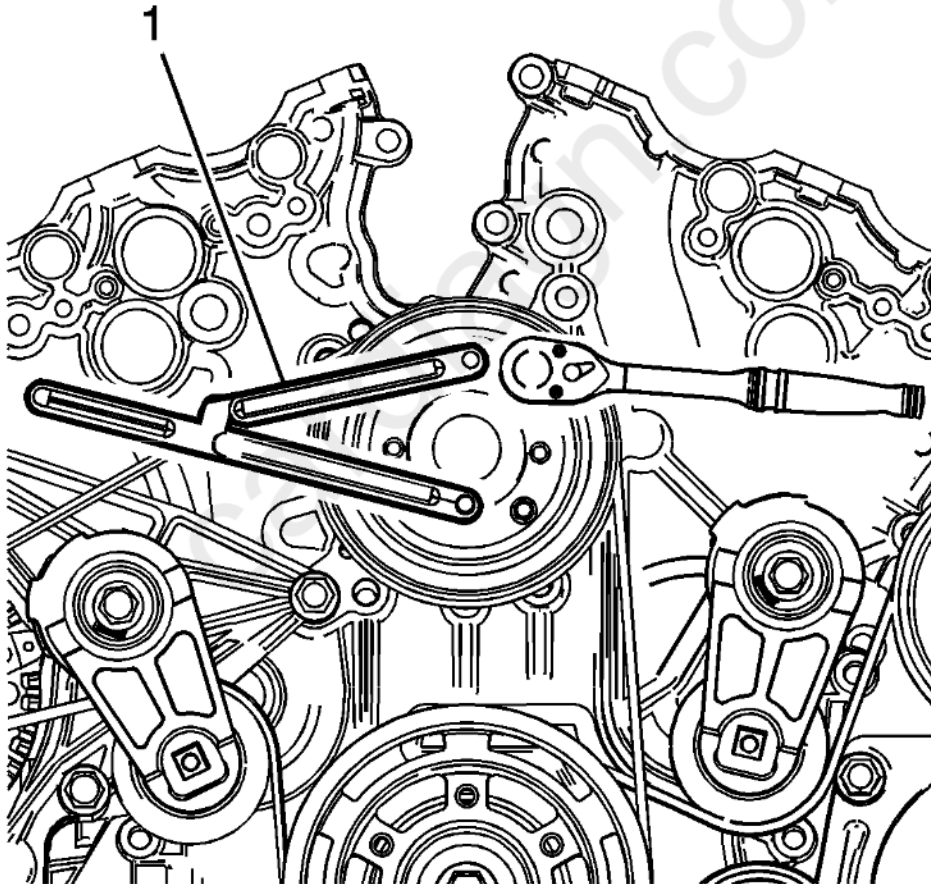


Fig. 132: Using EN 46104 On Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

3. Use the **EN 46104** (1) in order to retain the water pump pulley. See **Special Tools**.

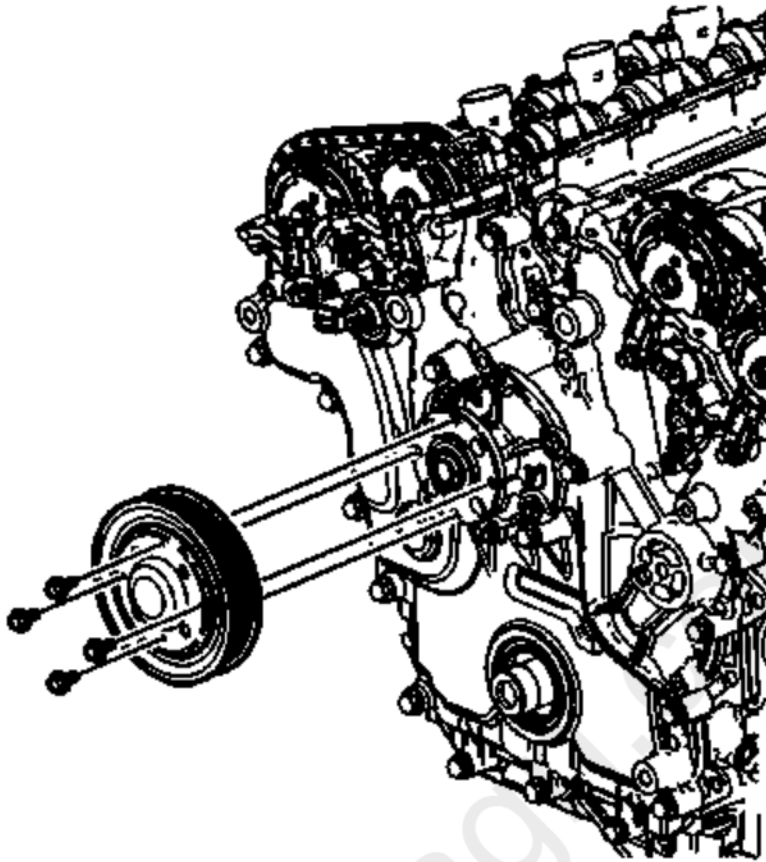


Fig. 133: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Remove the water pump pulley bolts.
5. Remove the water pump pulley.

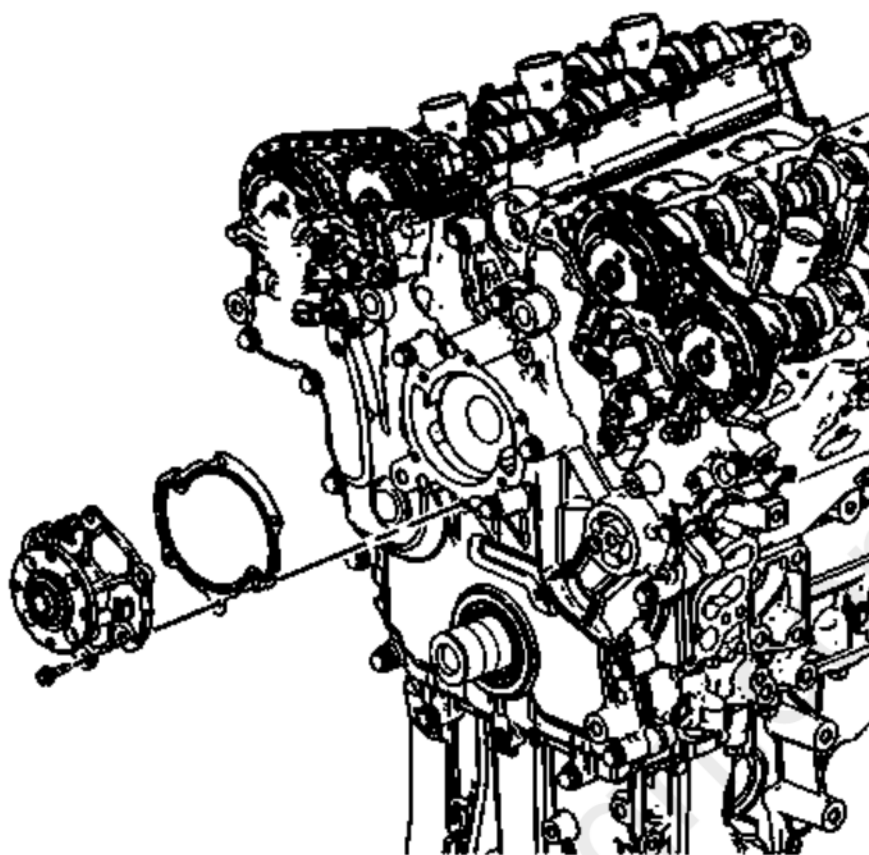


Fig. 134: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

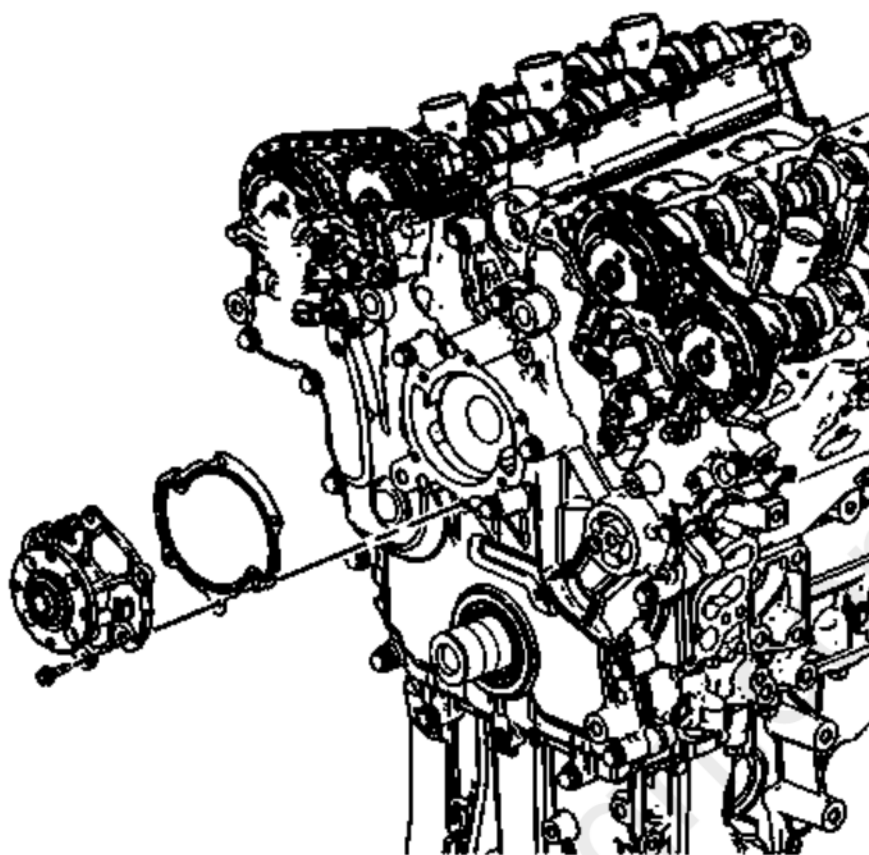


Fig. 135: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to **FASTENER CAUTION** .

3. Install the water pump bolts and tighten to 10 N.m (89 lb in).

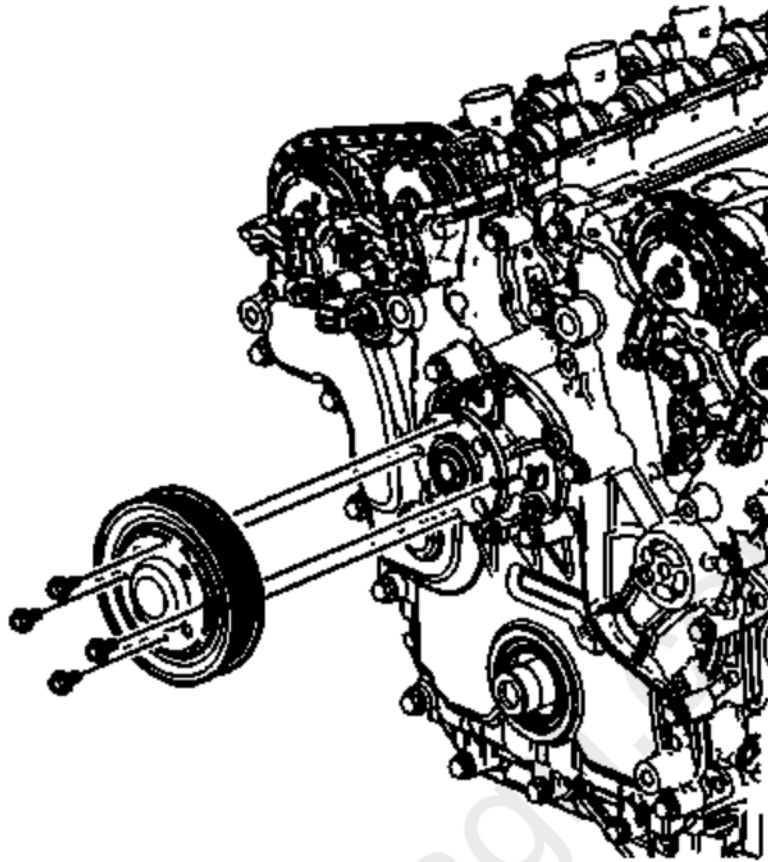


Fig. 136: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley and the water pump pulley bolts.

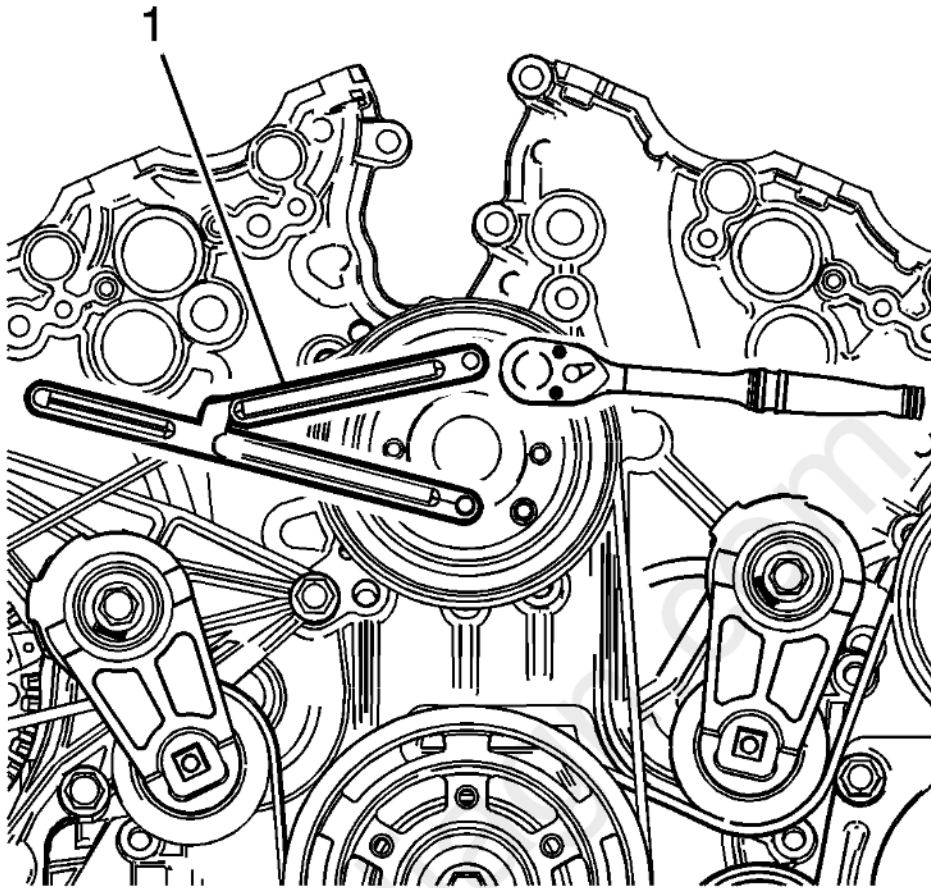


Fig. 137: Using EN 46104 On Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

5. Use the **EN 46104** (1) in order to retain the water pump pulley. See **Special Tools**.
6. Install the water pump pulley bolts and tighten to 12 N.m (106 lb in).
7. Install the generator drive belt. Refer to **Water Pump and Generator Belt Replacement**.
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **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 (LF1, LLT)** or **Radiator Inlet Hose Replacement (LSA)**.
8. Disconnect the radiator outlet hose from the water pump. Refer to **Radiator Outlet Hose Replacement (LF1, LLT)** or **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)** .

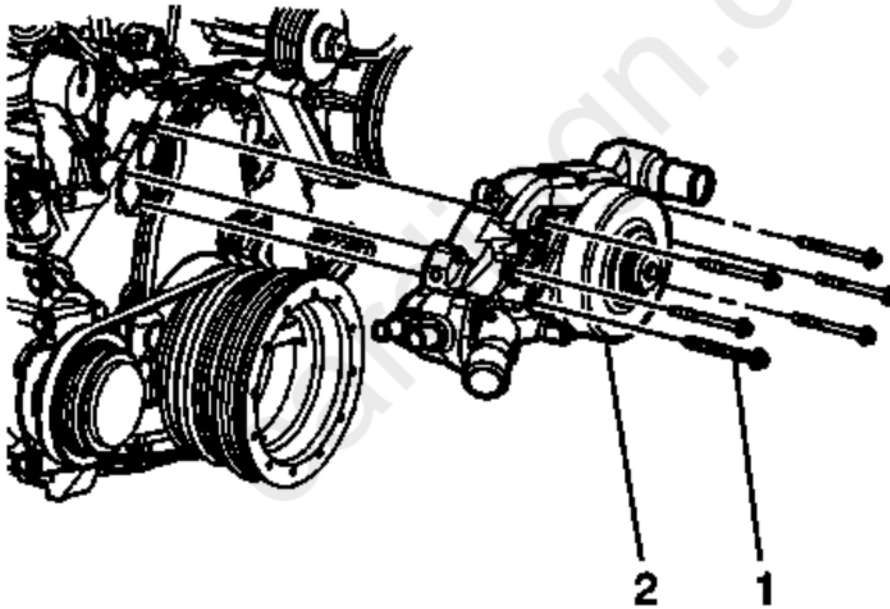


Fig. 138: Identifying Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

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

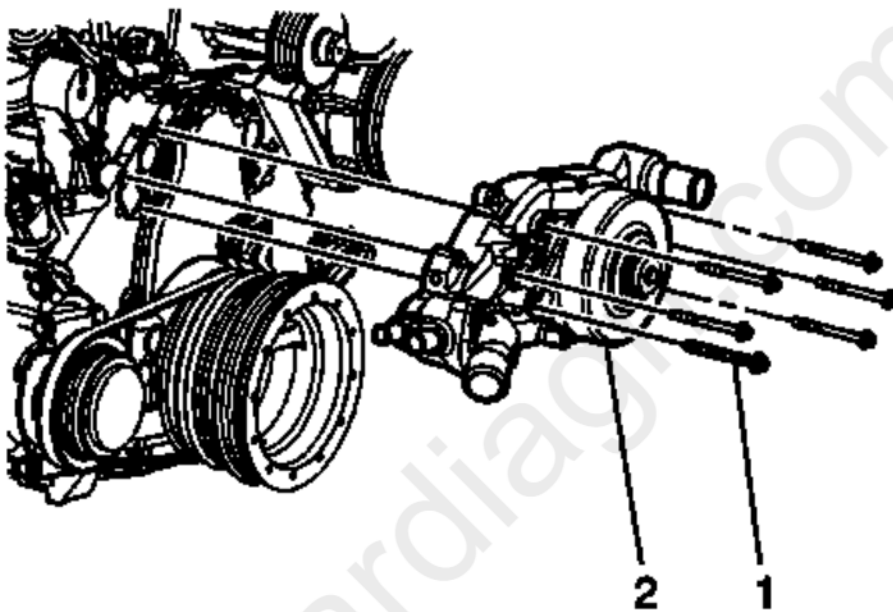


Fig. 139: Identifying Water Pump & Bolts

Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.
9. install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

CHARGE AIR COOLER COOLANT PUMP REPLACEMENT

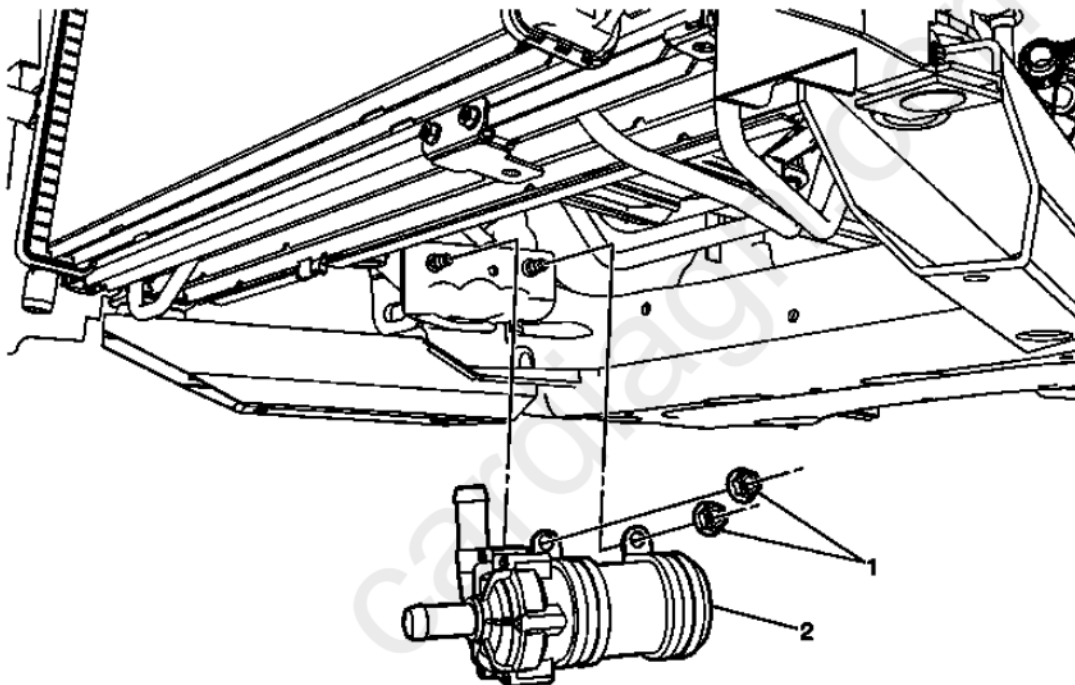


Fig. 140: Identifying Charge Air Cooler Coolant Pump
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1.	Drain the charged air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> or <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> .
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 **Charge Air Cooler Coolant Hose Replacement - Pipe to Pump**.
5. Raise and support vehicle. Refer to **Lifting and Jacking the Vehicle**.

1	Charged Air Cooler Coolant Pump Nut (Qty: 2) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 16 N.m (12 lb ft)
2	Charged Air Cooler Coolant Pump Procedure: Disconnect electrical connection

ENGINE COOLANT FAN SHROUD REPLACEMENT (LF1, LLT)

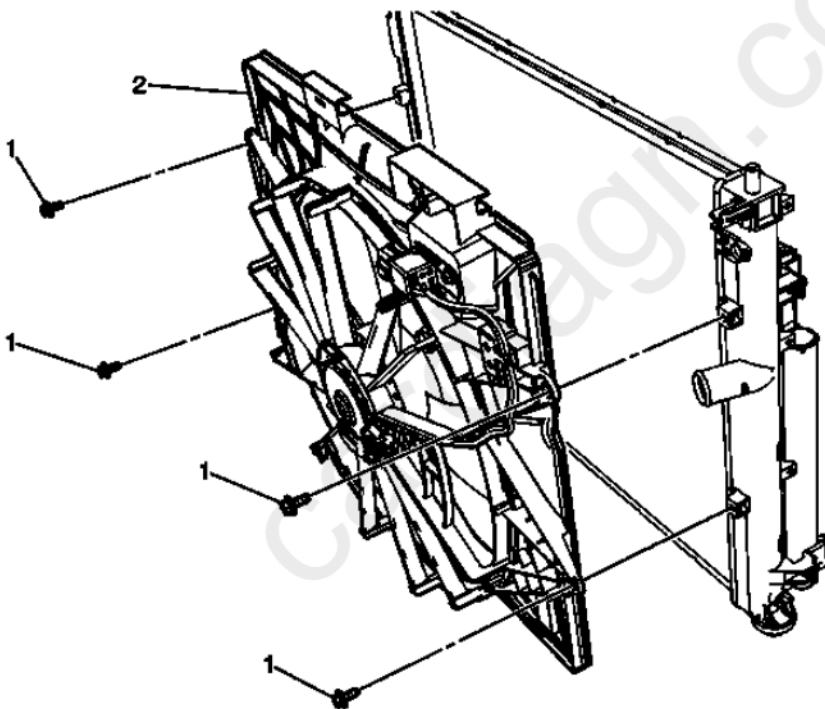


Fig. 141: Identifying Engine Coolant Fan Shroud (LLT, LP1, LY7)
 Courtesy of GENERAL MOTORS CORP.

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 (LF1)** or **Air Cleaner Assembly Replacement (LLT)**
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

ENGINE COOLANT FAN SHROUD REPLACEMENT (LSA)

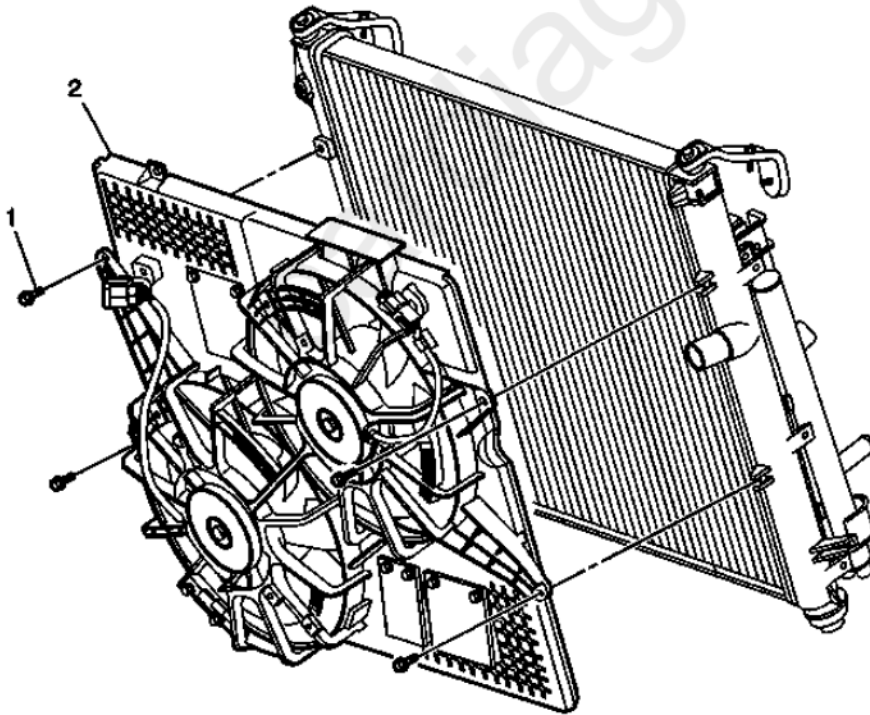


Fig. 142: Identifying Engine Coolant Fan Shroud (LSA)
 Courtesy of GENERAL MOTORS CORP.

2011 Cadillac CTS

2011 ENGINE Engine Cooling - CTS

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 <u>Air Cleaner Assembly Replacement (LF1)</u> or <u>Air Cleaner Assembly Replacement (LLT)</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 (LF1, LLT)</u> or <u>Radiator Inlet Hose Replacement (LSA)</u>. 5. Disconnect the cooling fan electrical connectors. 6. Remove any hoses or pipes. 7. Disconnect the condenser tube from the cooling fan shroud retainer clip. 8. 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 <u>FASTENER CAUTION</u> . Tip: Remove shroud/radiator clip. 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. See **Special Tools**.
- **J 38778** Door Trim Pad Clip Remover

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.
2. Remove the electric cooling fan assembly. Refer to **Engine Coolant Fan Replacement (LF1, LLT)** or

Engine Coolant Fan Replacement (LSA).

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

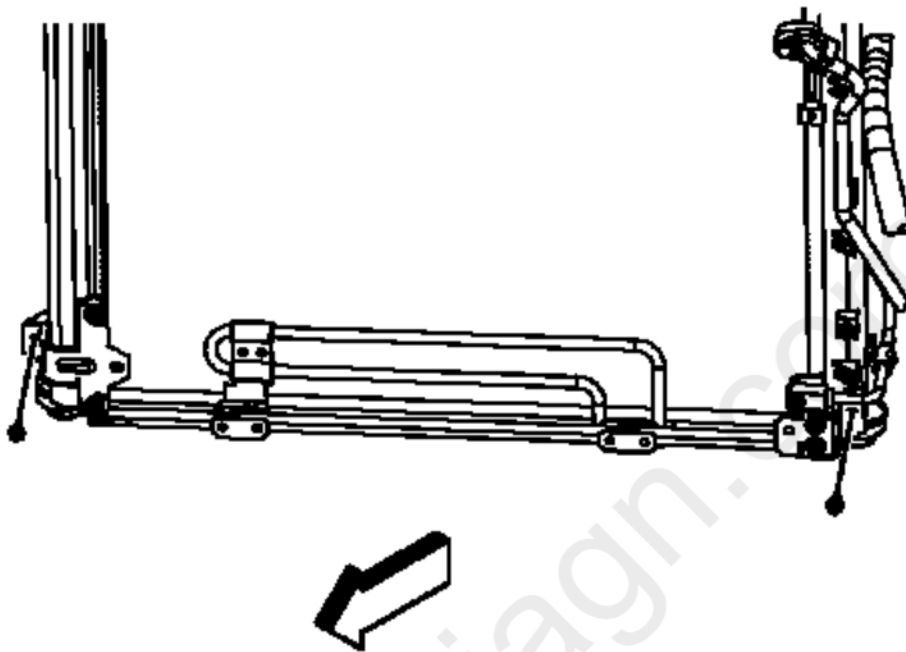


Fig. 143: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower condenser mounting bolts.

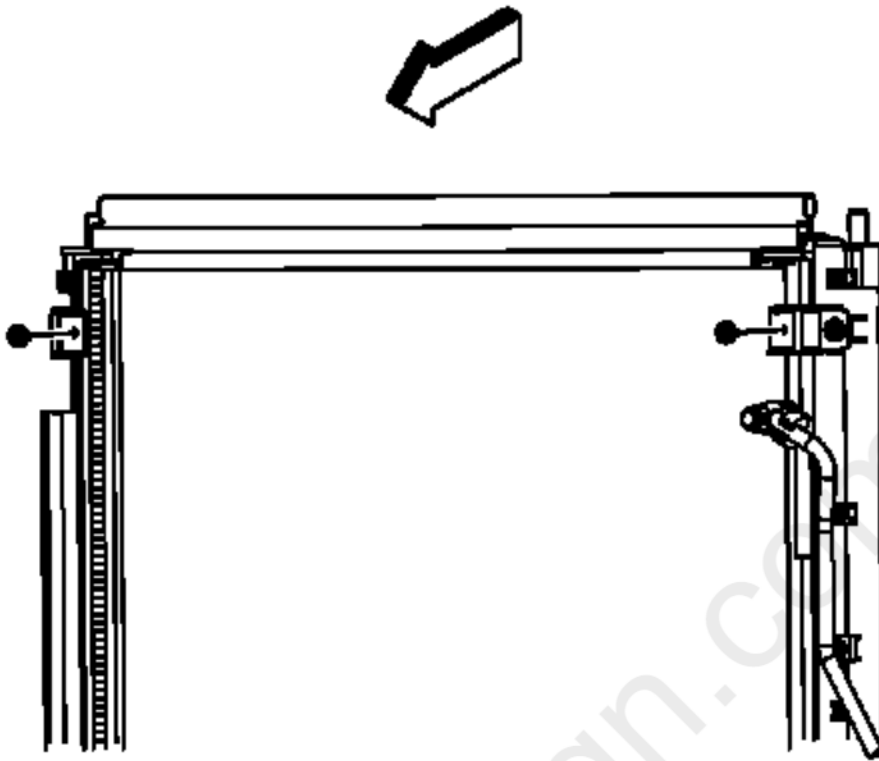


Fig. 144: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper condenser mounting bolts.

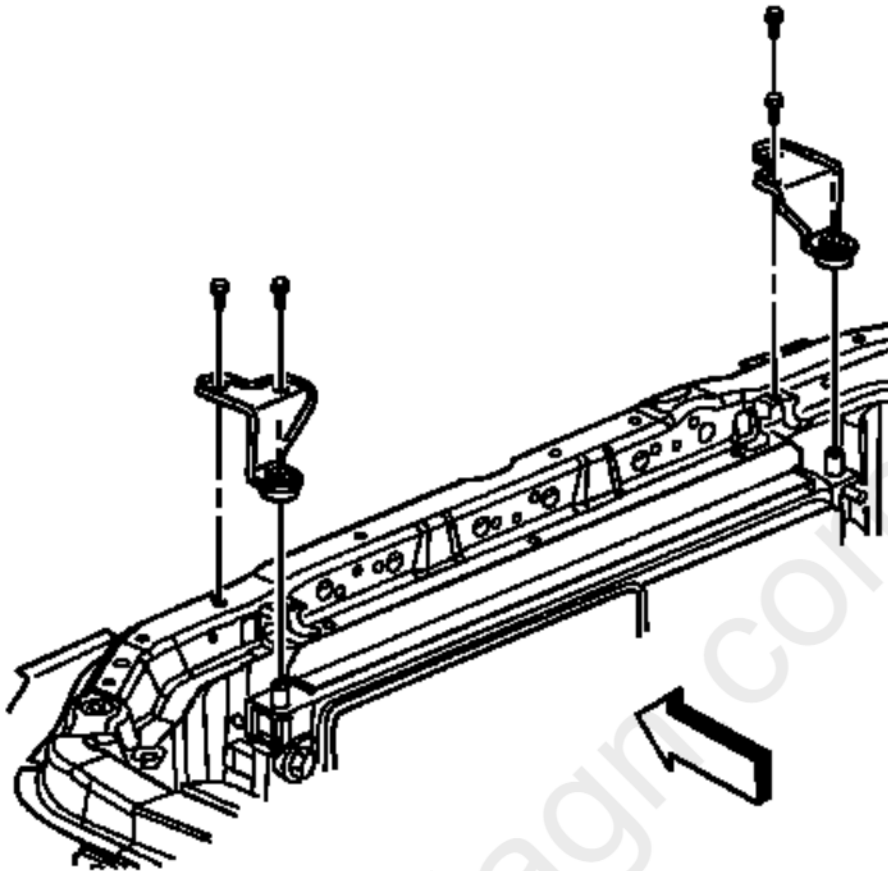


Fig. 145: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

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** to remove the radiator/condenser upper support.

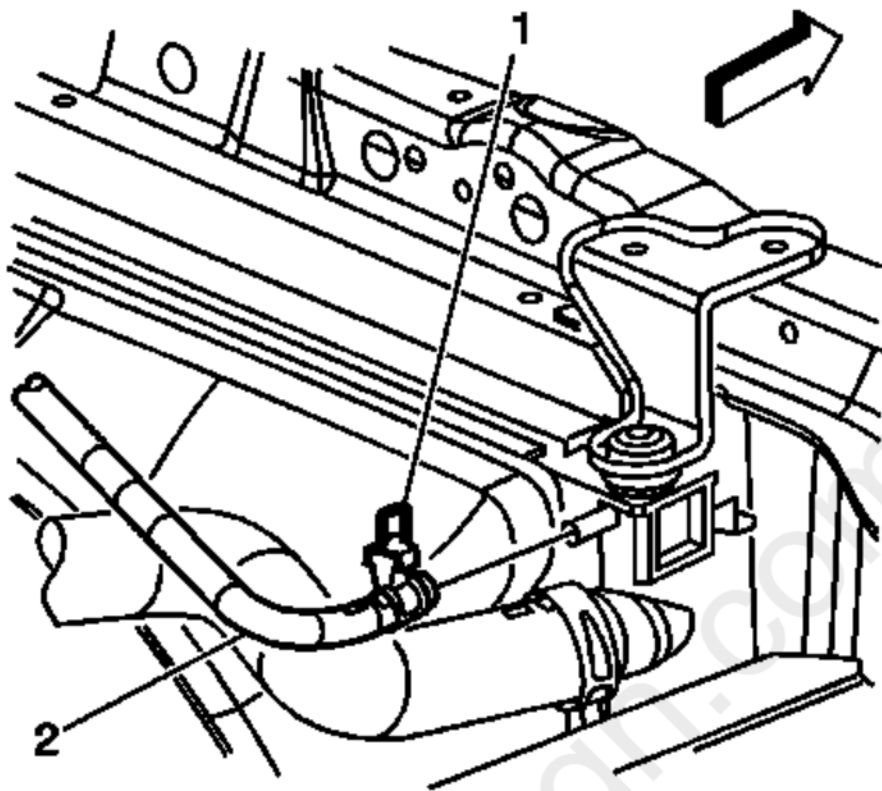


Fig. 146: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

11. Use **J 38185** to disconnect the surge tank inlet hose from the radiator. Reposition the hose aside. See **Special Tools**.

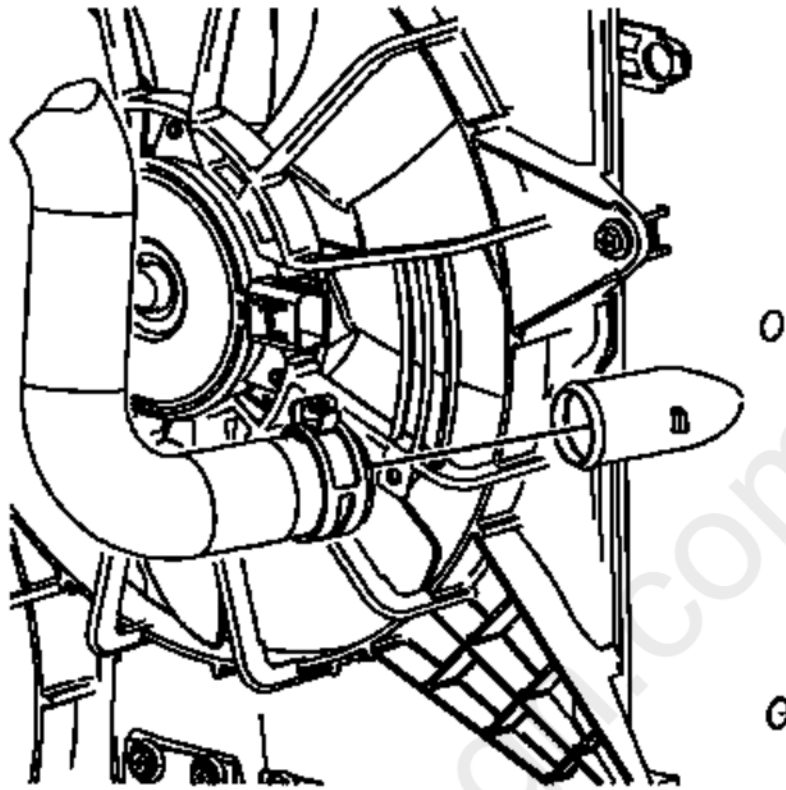


Fig. 147: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

12. Using **J 38185** disengage tension on the radiator inlet hose clamp and disconnect the hose from the radiator. See **Special Tools**.
13. Using **J 38185** disengage tension on the radiator outlet hose clamp and disconnect the hose from the radiator. See **Special Tools**.
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** to position the radiator outlet hose clamp to secure the hose. See **Special Tools**.

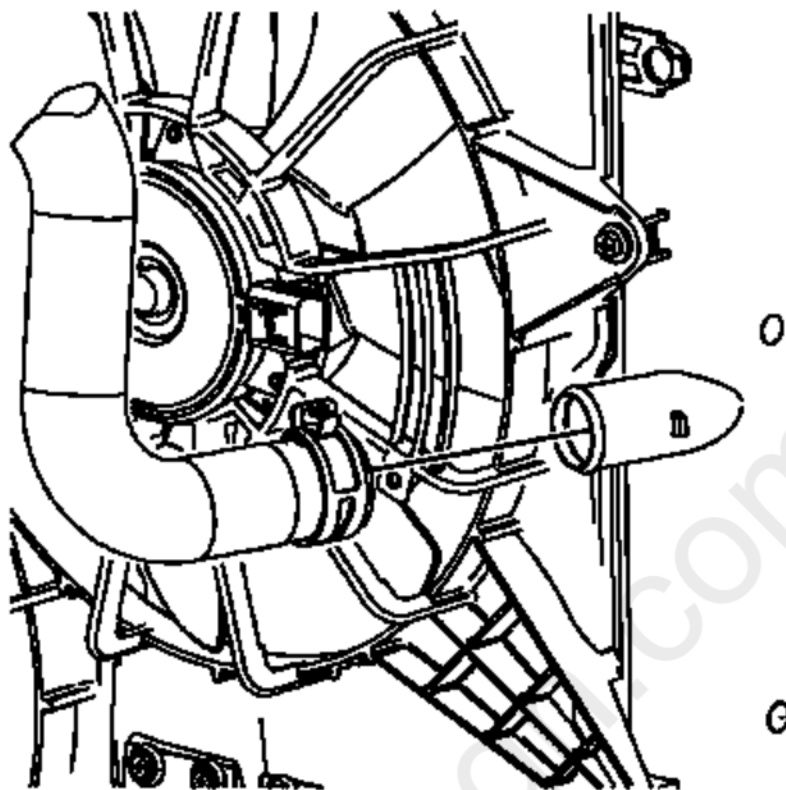


Fig. 148: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Connect the radiator inlet hose to the radiator. Use **J 38185** to position the radiator inlet hose clamp to secure the hose. See **Special Tools**.

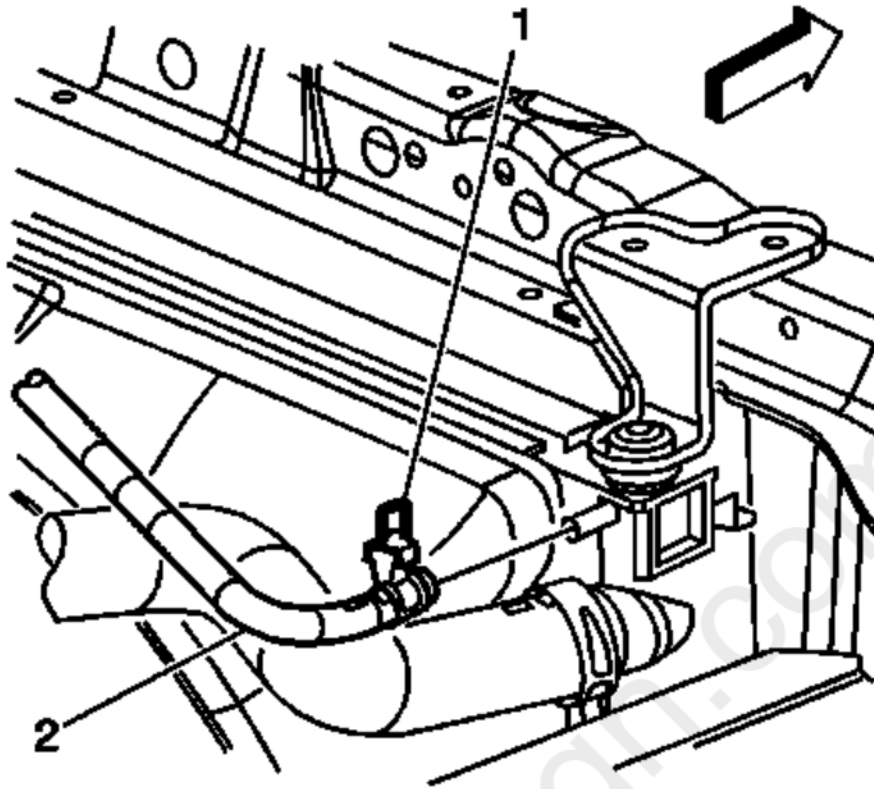


Fig. 149: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank inlet hose to the radiator. Use **J 38185** to position the hose clamp to secure the hose. See **Special Tools**.
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 N.m (80 lb in).
9. Raise and support the vehicle.

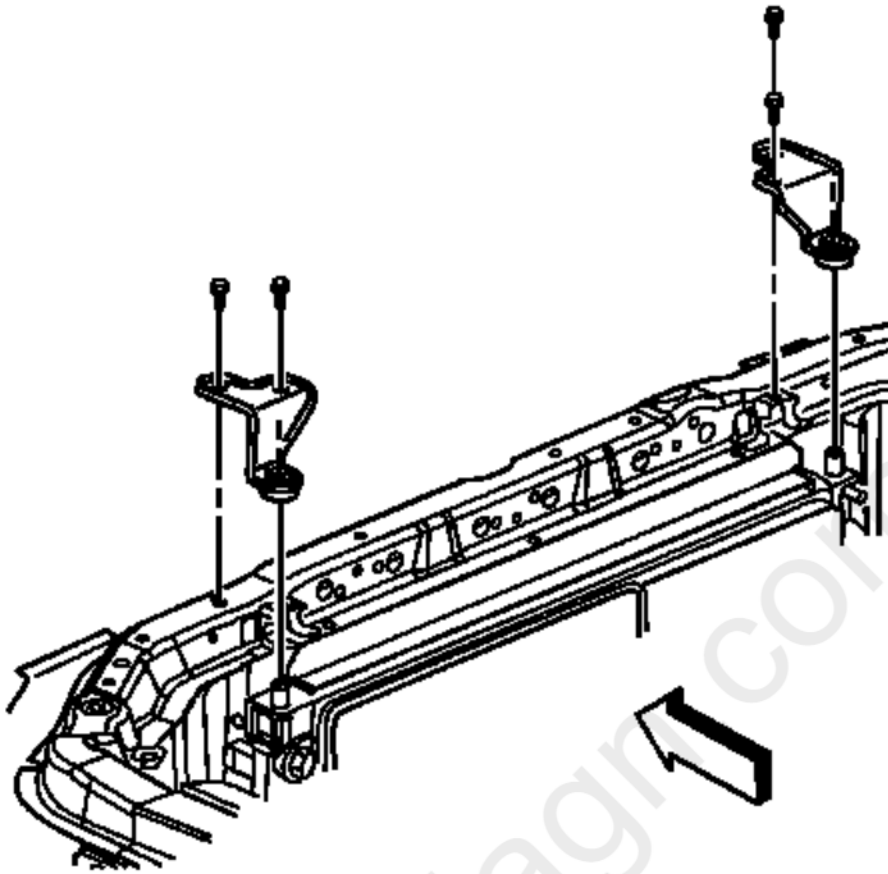


Fig. 150: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

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

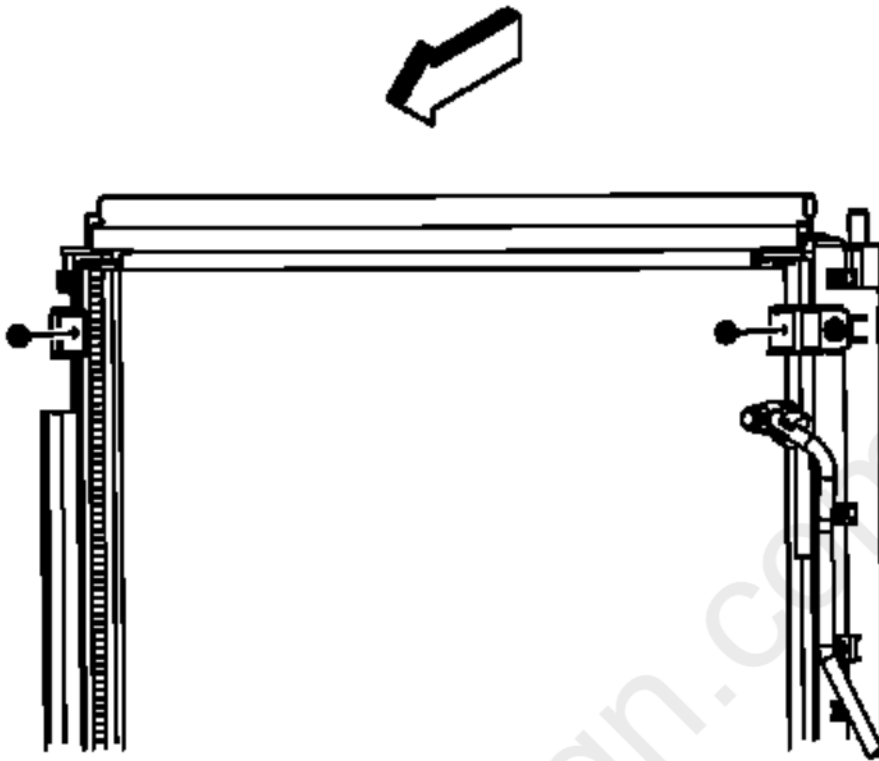


Fig. 151: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

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

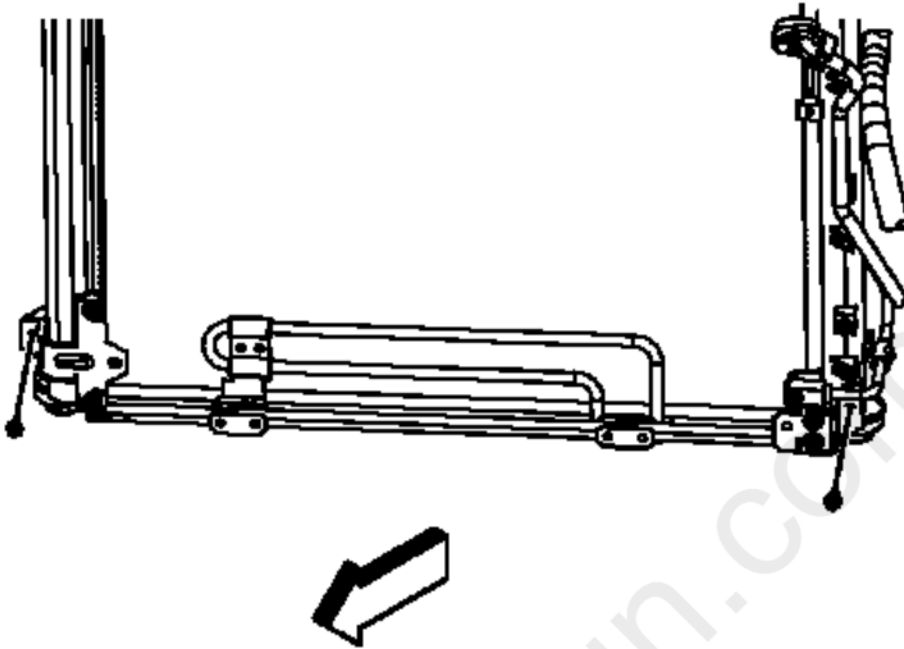


Fig. 152: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the lower condenser mounting bolts and tighten to 5.4 N.m (48 lb in).
13. Lower the vehicle.
14. Install the electric cooling fan assembly. Refer to **Engine Coolant Fan Replacement (LF1, LLT)** or **Engine Coolant Fan Replacement (LSA)**.
15. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

RADIATOR REPLACEMENT (HEAVY DUTY COOLING)

Special Tools

- **J 38185** Hose Clamp Pliers. See **Special Tools**.
- **J 38778** Door Trim Pad Clip Remover

Removal Procedure

1. Drain the coolant. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling**

System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA).

2. Remove the engine coolant fan shroud. Refer to Engine Coolant Fan Shroud Replacement (LF1, LLT) or Engine Coolant Fan Shroud Replacement (LSA).
3. Remove the front fascia. Refer to Front Bumper Fascia Replacement
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

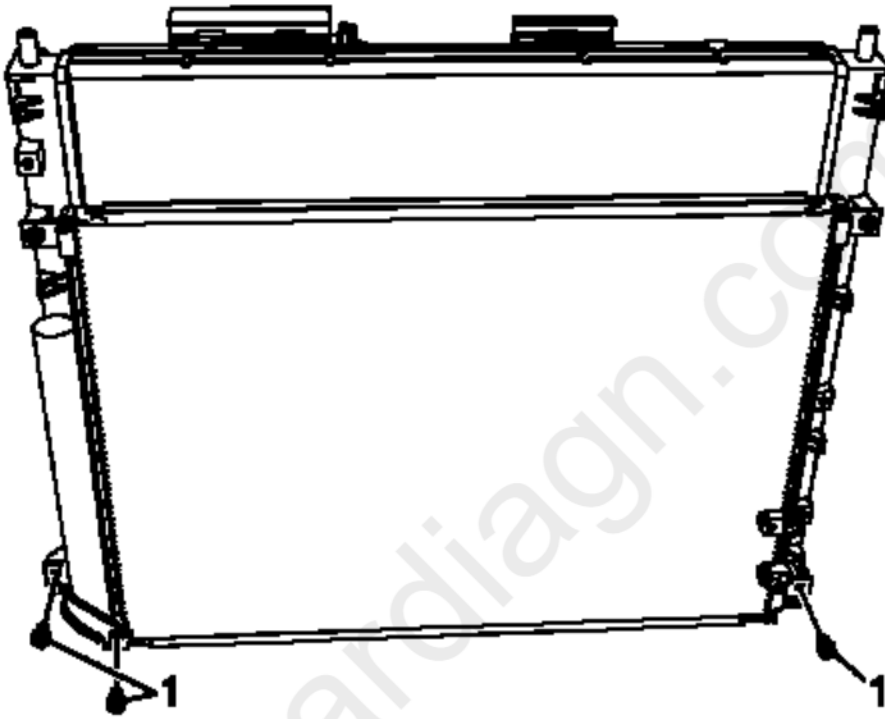


Fig. 153: View Of Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower condenser mounting bolts.

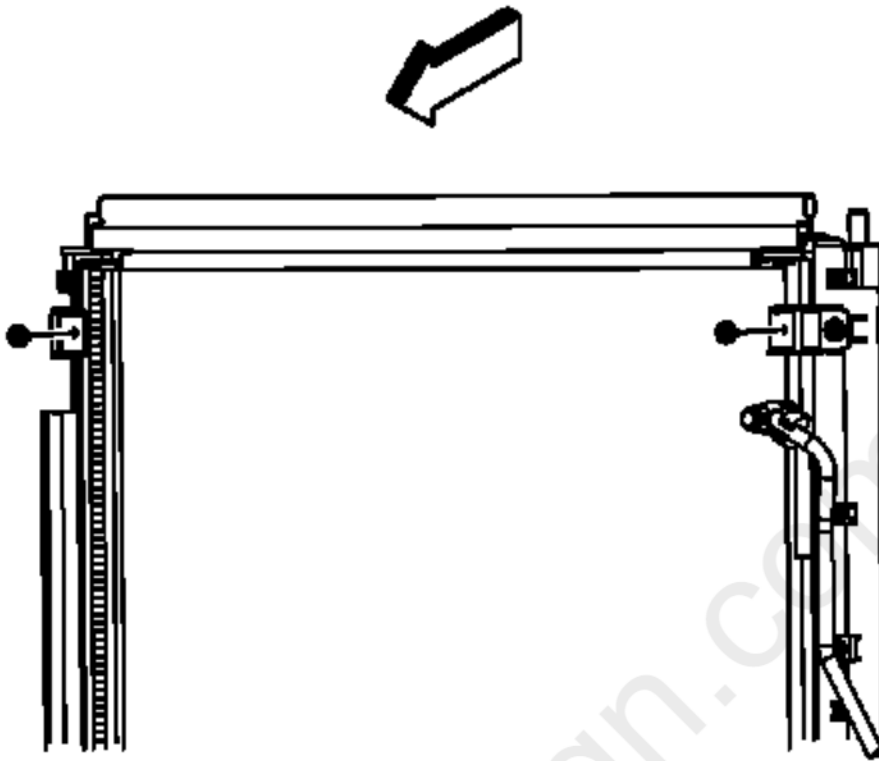


Fig. 154: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the upper condenser mounting bolts.

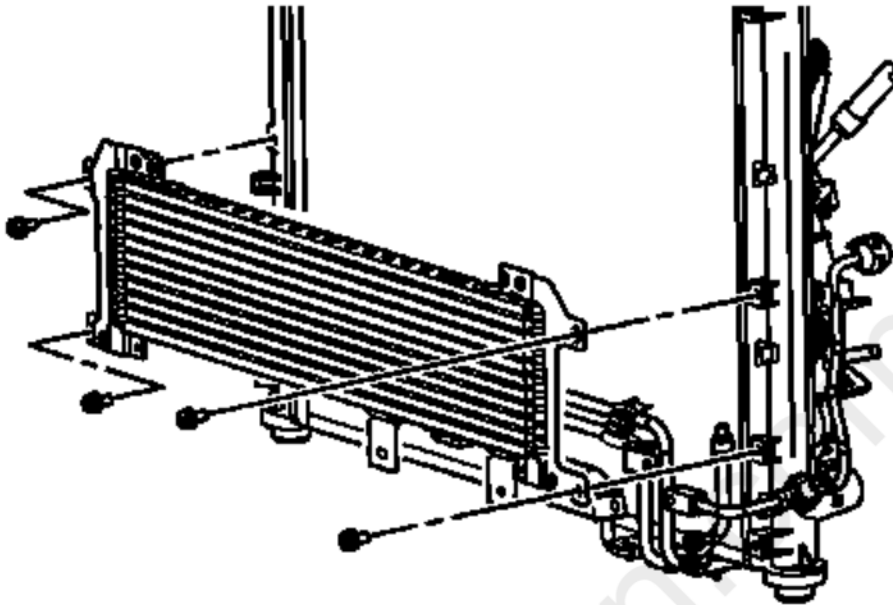


Fig. 155: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Reposition the condenser to access the transmission oil cooler mounting bolts.

7. Remove the transmission oil cooler mounting bolts.

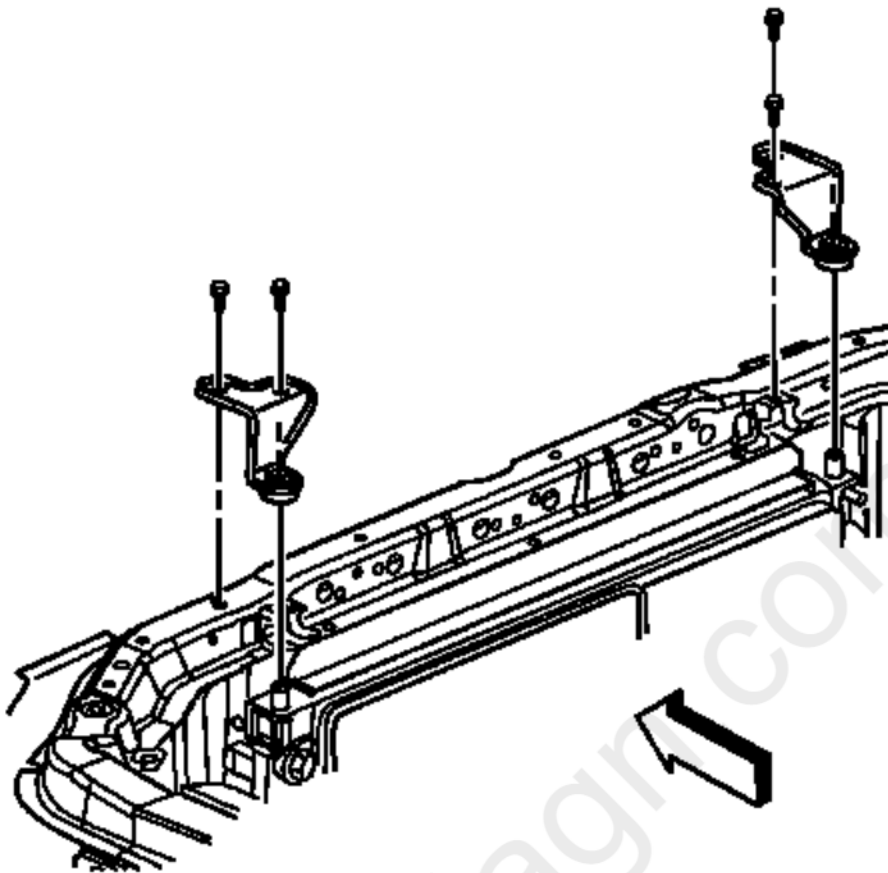


Fig. 156: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the lower retainer pins of the side air baffle from the radiator.
9. Lower the vehicle.
10. Remove the radiator support bracket bolts.
11. Remove the radiator support brackets.
12. Use **J 38778** to remove the radiator/condenser upper support.

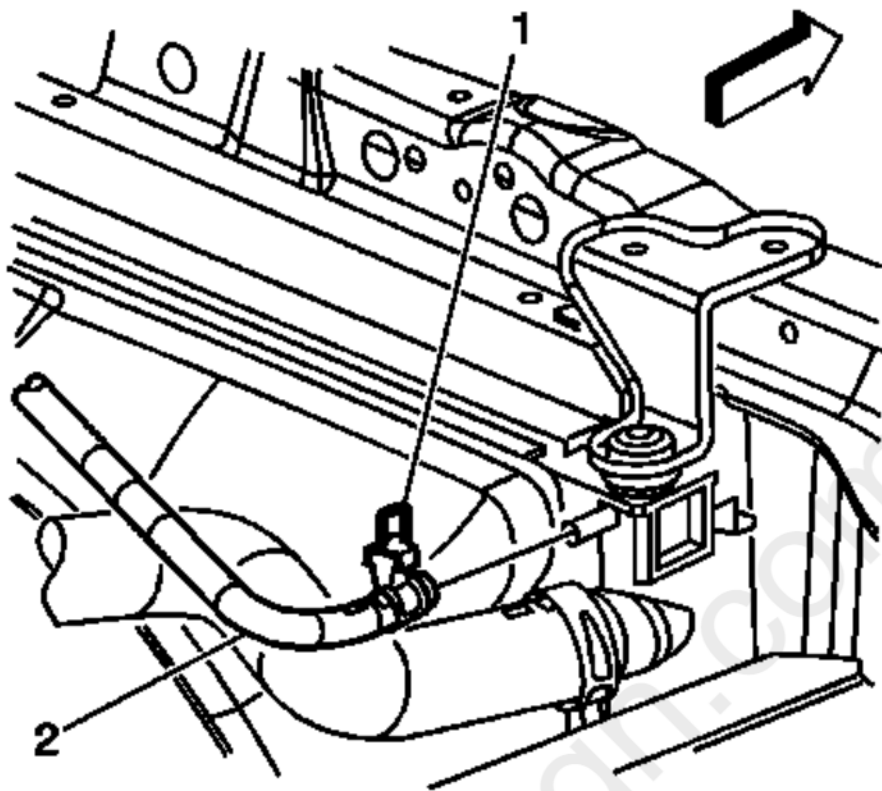


Fig. 157: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

13. Use **J 38185** to disconnect the surge tank inlet hose from the radiator. Reposition the hose aside. See **Special Tools**.

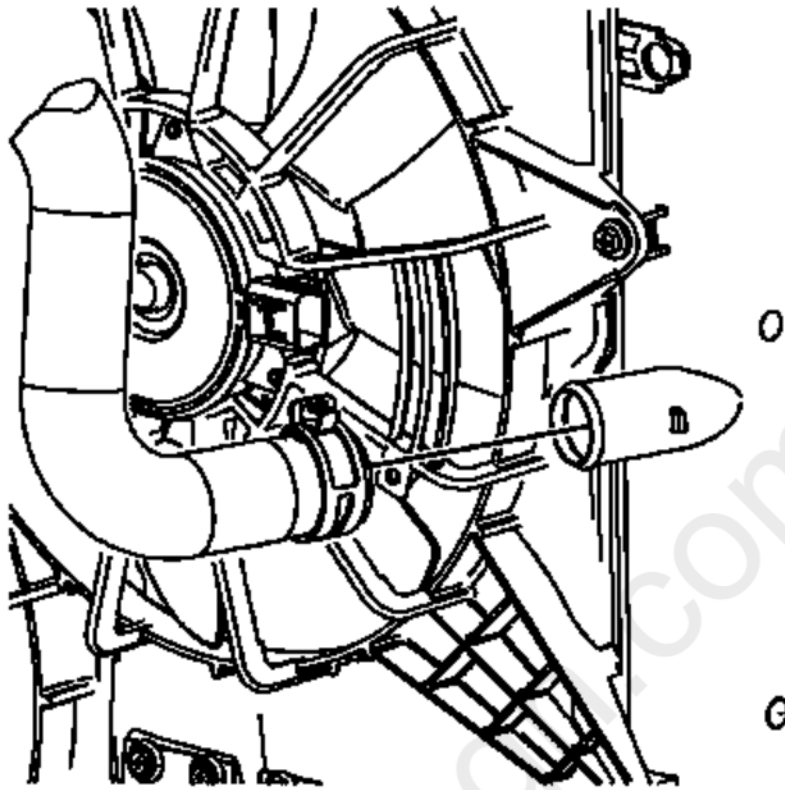


Fig. 158: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

14. Using **J 38185** disengage tension on the radiator inlet hose clamp and disconnect the hose from the radiator. See **Special Tools**.
15. Using **J 38185** disengage tension on the radiator outlet hose clamp and disconnect the hose from the radiator. See **Special Tools**.
16. Disconnect the upper retainer pins on the side air baffle from the radiator.
17. 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** to position the radiator outlet hose clamp to secure the hose. See **Special Tools**.

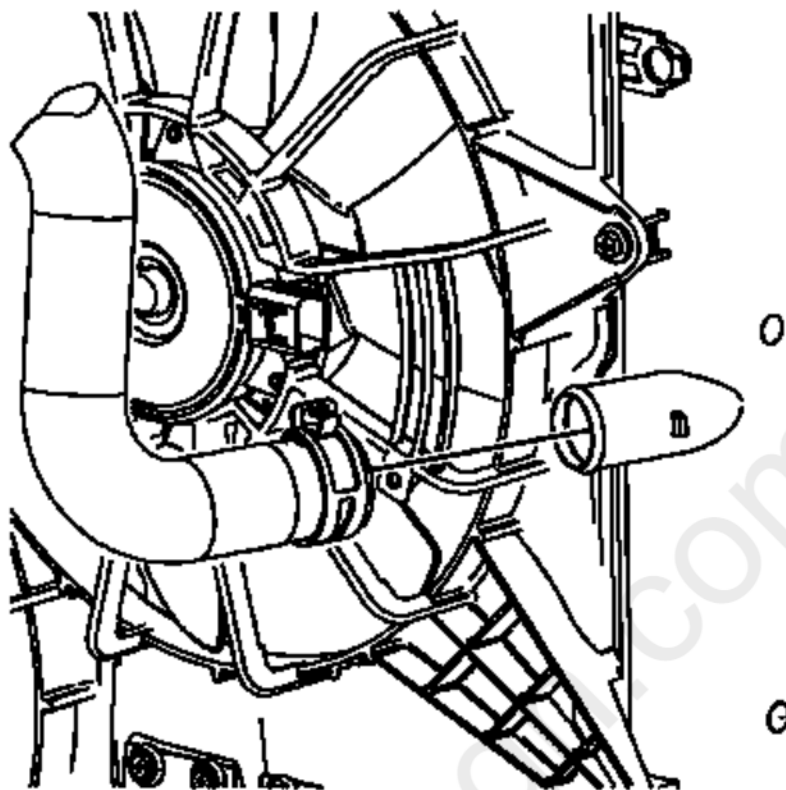


Fig. 159: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Connect the radiator inlet hose to the radiator. Use **J 38185** to position the radiator inlet hose clamp to secure the hose. See **Special Tools**.

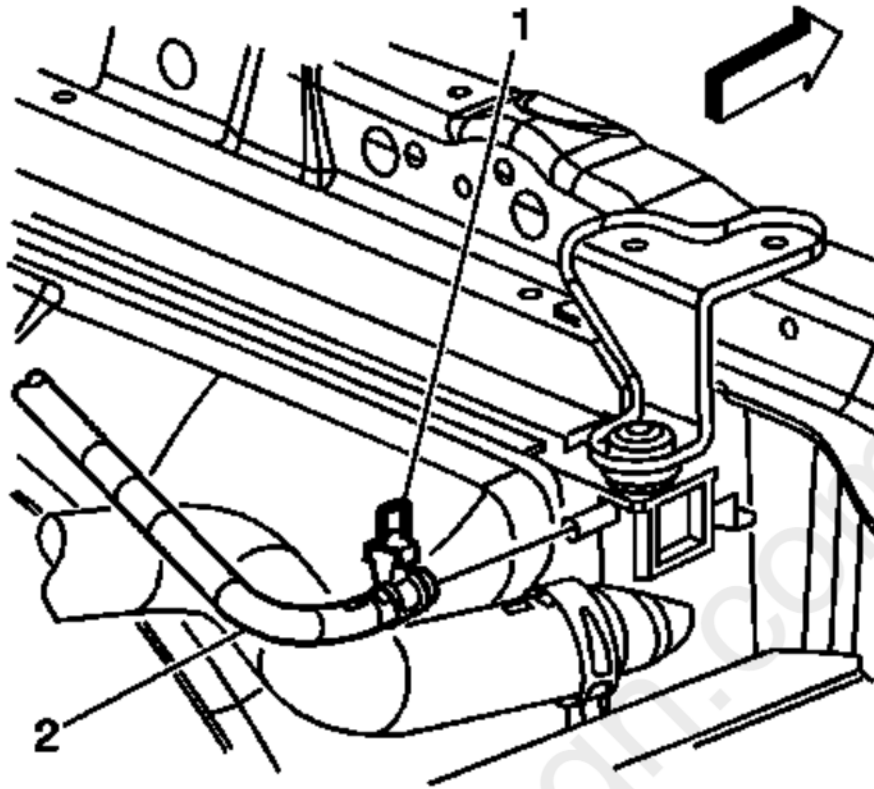


Fig. 160: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank inlet hose to the radiator. Use **J 38185** to position the hose clamp to secure the hose. See **Special Tools**.
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 N.m (80 lb in).
9. Raise and support the vehicle.

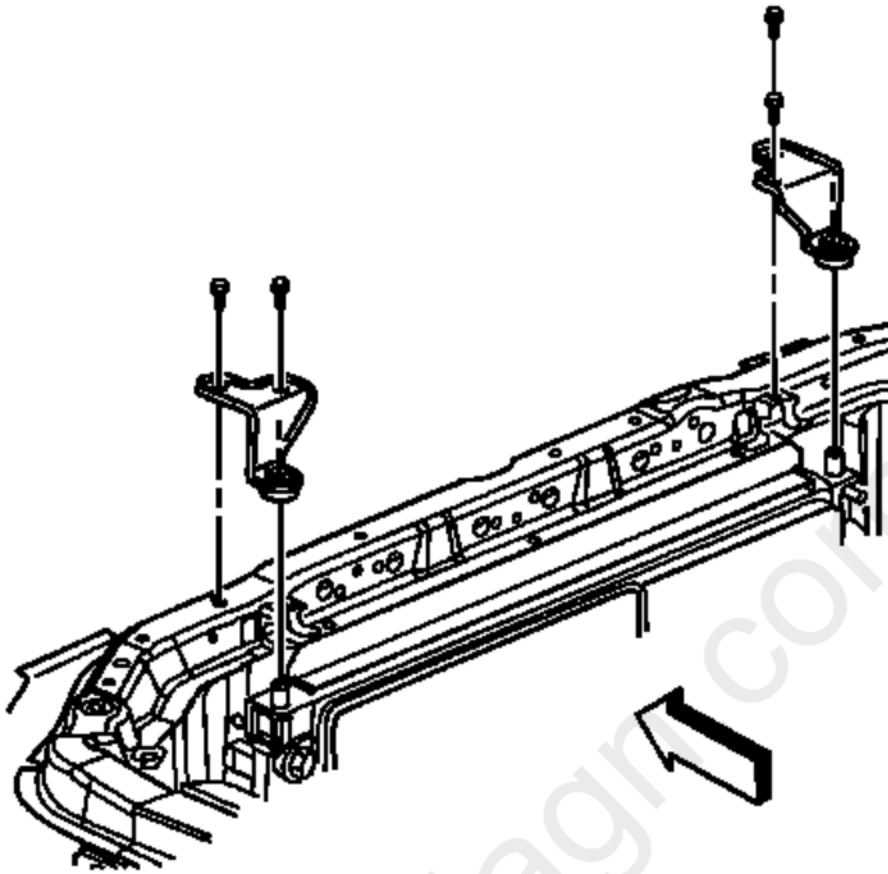


Fig. 161: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

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

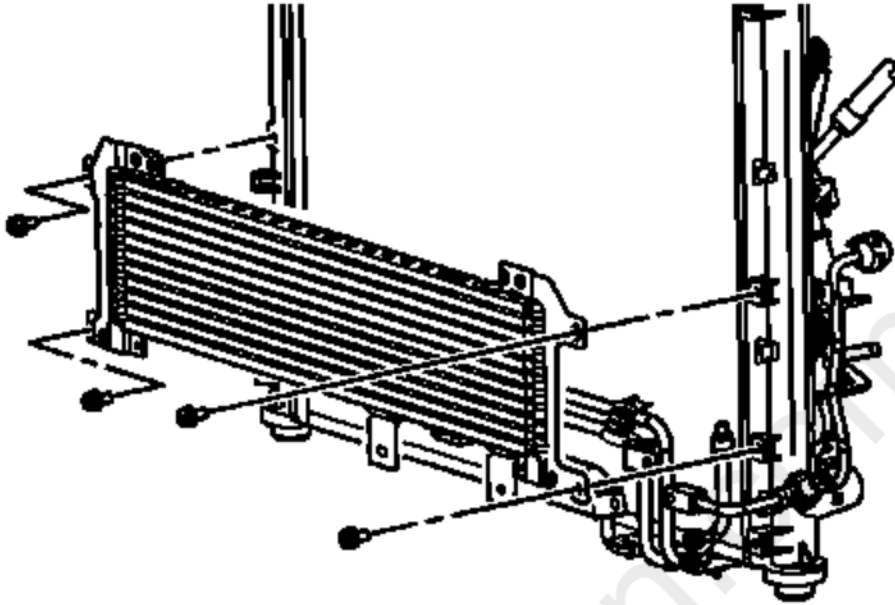


Fig. 162: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the transmission oil cooler mounting bolts and tighten to 5 N.m (44 lb in).

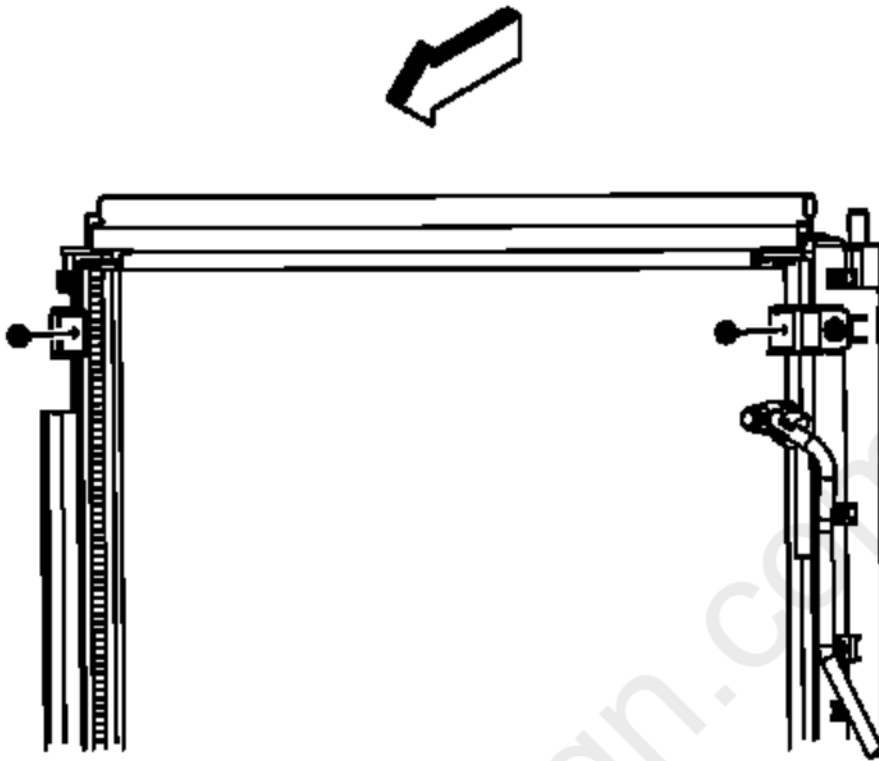


Fig. 163: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

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

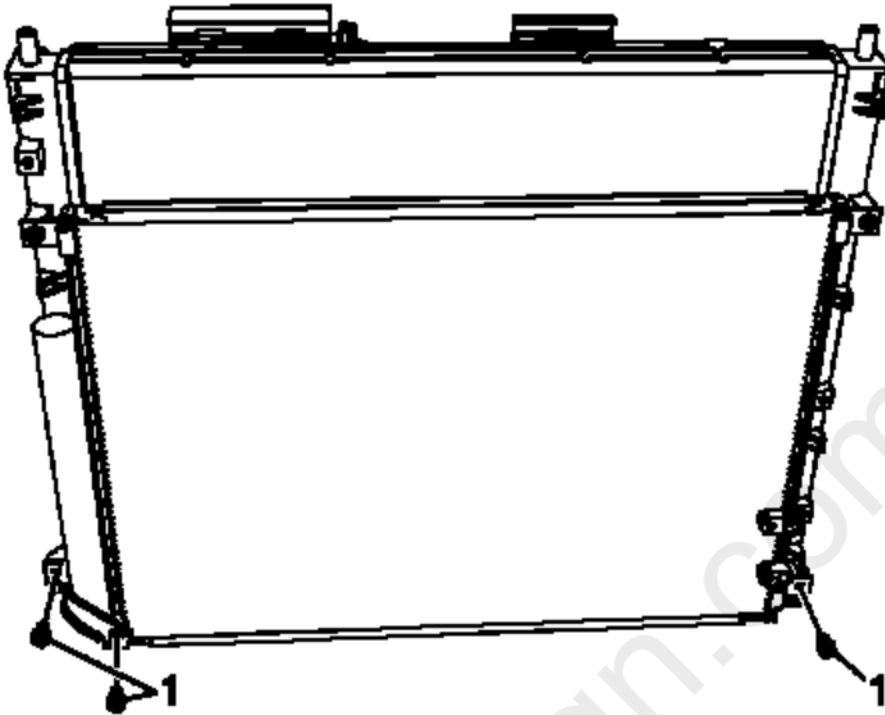


Fig. 164: View Of Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the lower condenser mounting bolts and tighten to 5.4 N.m (48 lb in).
14. Lower the vehicle.
15. Install the engine coolant fan shroud. Refer to **Engine Coolant Fan Shroud Replacement (LF1, LLT)** or **Engine Coolant Fan Shroud Replacement (LSA)**.
16. Install the front fascia. Refer to **Front Bumper Fascia Replacement**
17. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling (Static Fill LSA)** or **Cooling System Draining and Filling (GE 47716 LF1, LLT)** or **Cooling System Draining and Filling (GE 47716 LSA)**.

CHARGE AIR COOLER RADIATOR REPLACEMENT

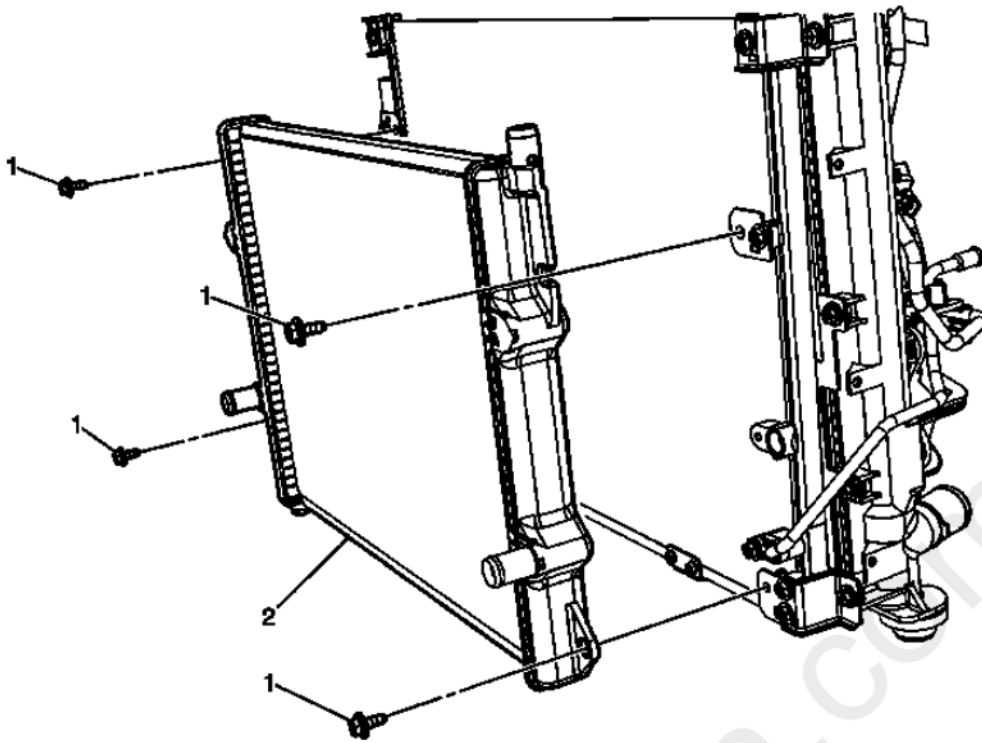


Fig. 165: Identifying Charge Air Cooler Radiator
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Drain the charge air cooling system. Refer to <u>Charge Air Cooling System Draining and Filling (Static)</u> or <u>Charge Air Cooling System Draining and Filling (GE 47716)</u>. 2. Remove the front bumper fascia. Refer to <u>Front Bumper Fascia 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 radiator to pipe. Refer to <u>Charge Air Cooler Coolant Hose Replacement - Radiator to Pipe</u>.	
1	Charged Air Cooler Coolant Radiator Bolt (Qty: 4) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 16 N.m (12 lb ft)
2	Charged Air Cooler Coolant Radiator

RADIATOR SUPPORT BRACKET REPLACEMENT

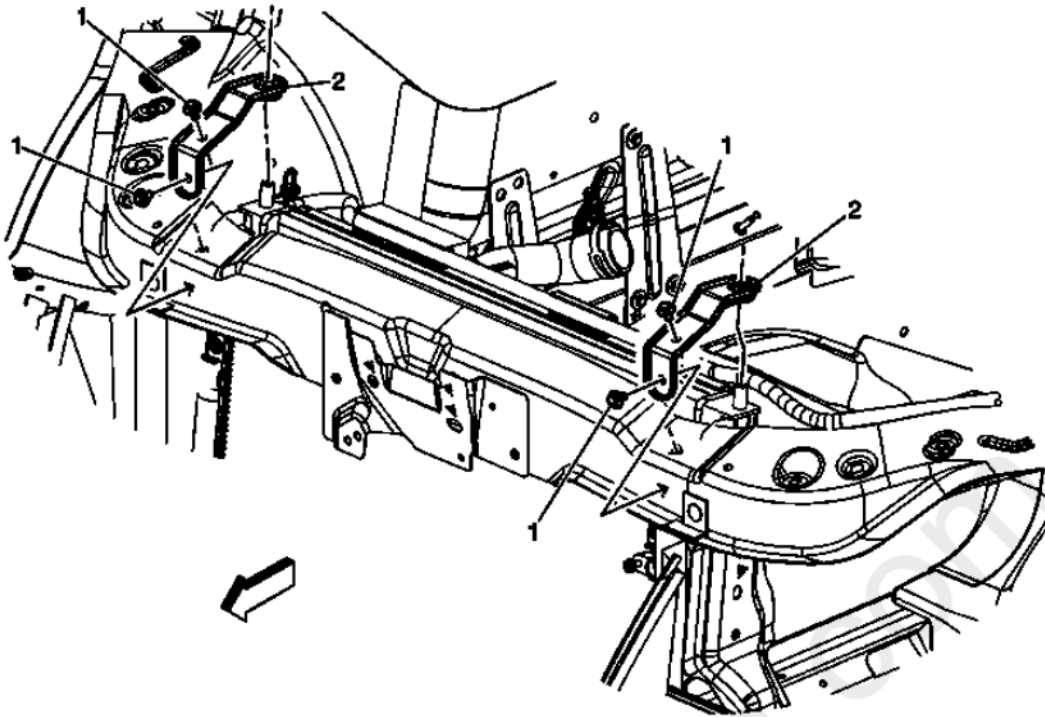


Fig. 166: Identifying Radiator Support Bracket
 Courtesy of GENERAL MOTORS CORP.

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

COOLANT HEATER REPLACEMENT (LF1/LLT)

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.

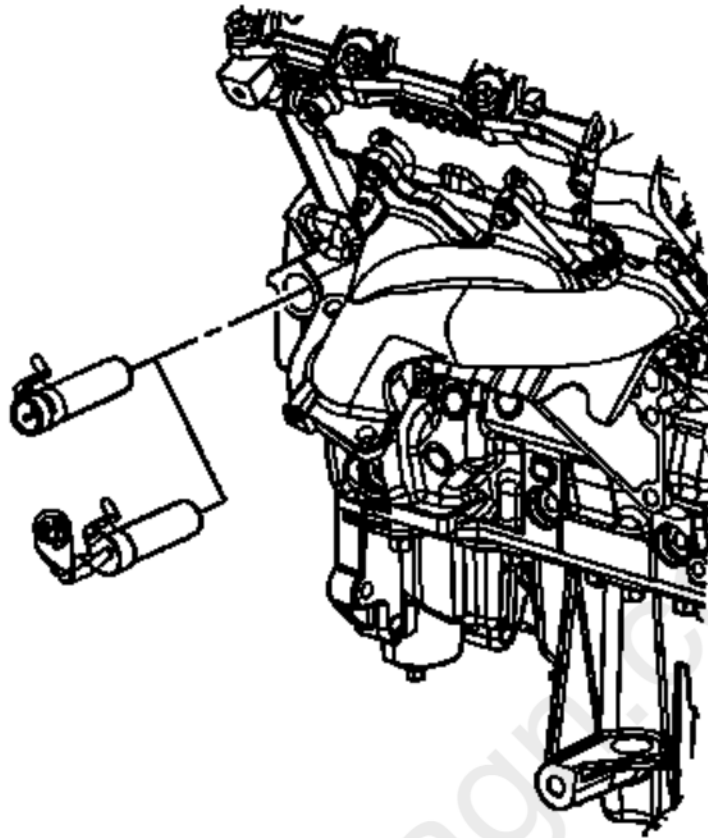


Fig. 167: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater.

Installation Procedure

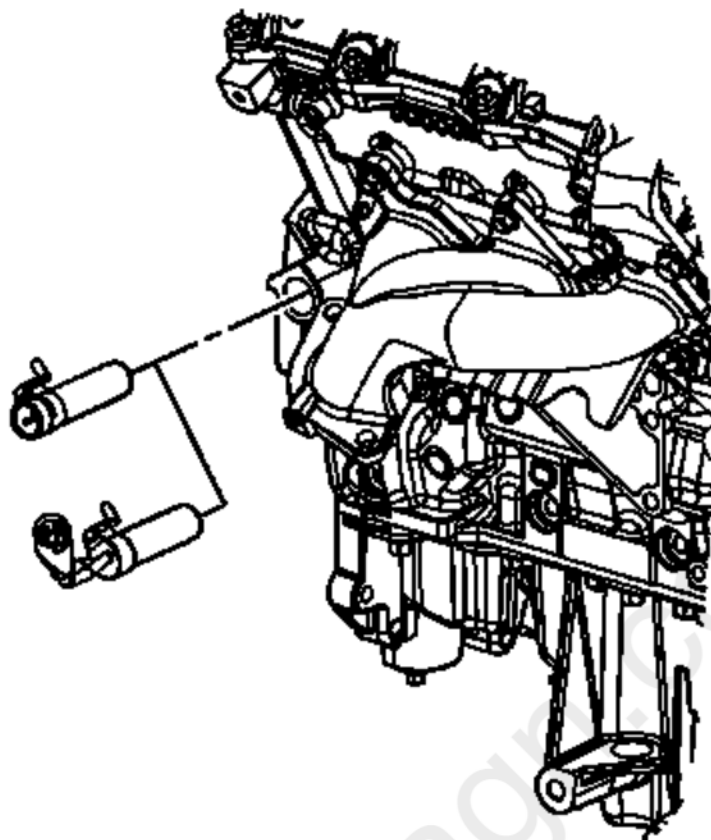


Fig. 168: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

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

COOLANT HEATER REPLACEMENT (LSA)

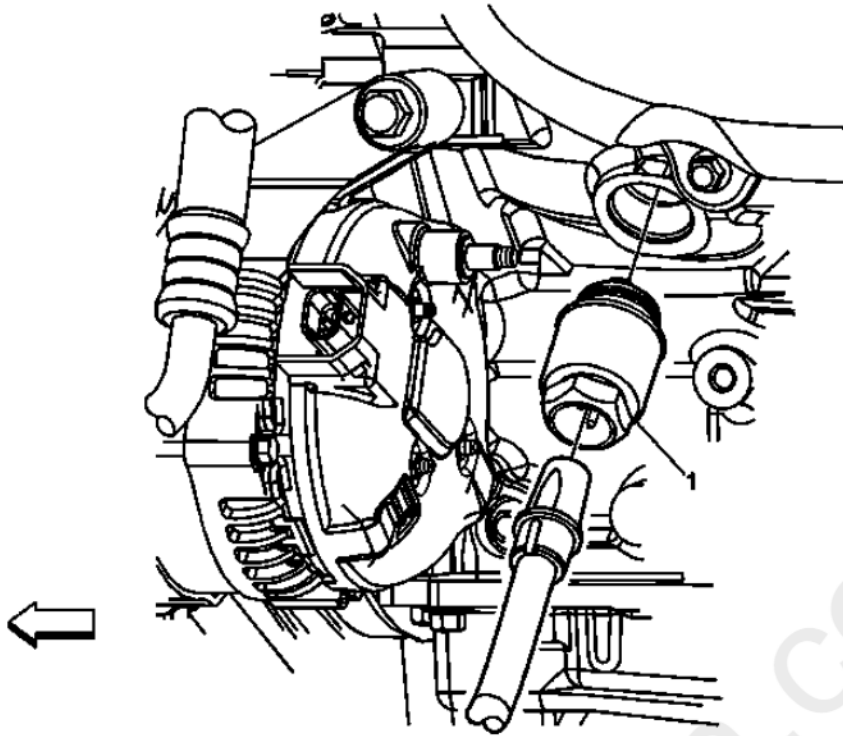


Fig. 169: Identifying Coolant Heater (V8)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to <u>Cooling System Draining and Filling (Static Fill LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <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. Remove the left front wheel. Refer to <u>Tire and Wheel Removal and Installation</u>.	
1	Coolant Heater CAUTION: Refer to <u>FASTENER CAUTION</u> . 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 (LF1/LLT)

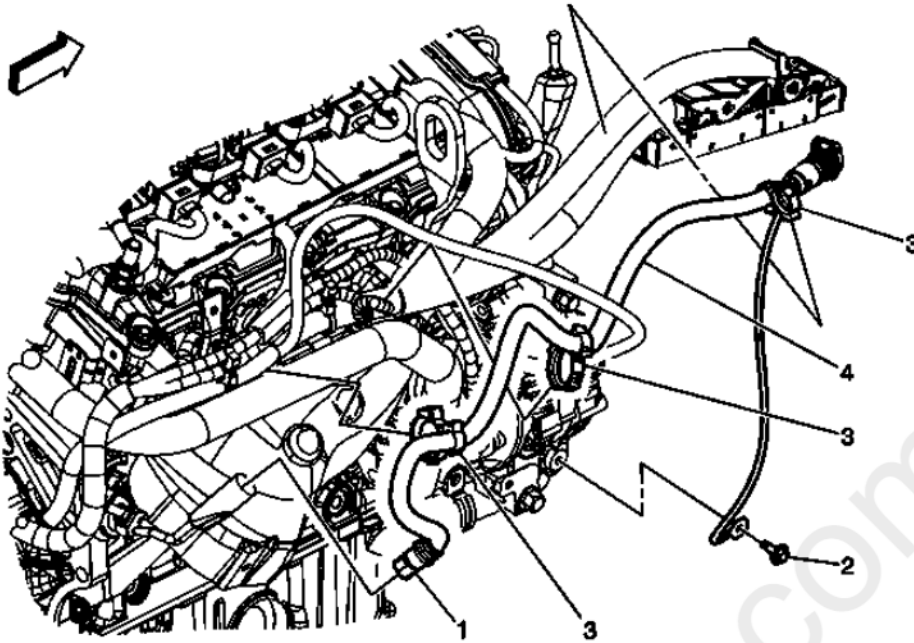


Fig. 170: Coolant Heater Cord (LF1/LLT)
 Courtesy of GENERAL MOTORS CORP.

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

COOLANT HEATER CORD REPLACEMENT (LSA - 110 VOLT)

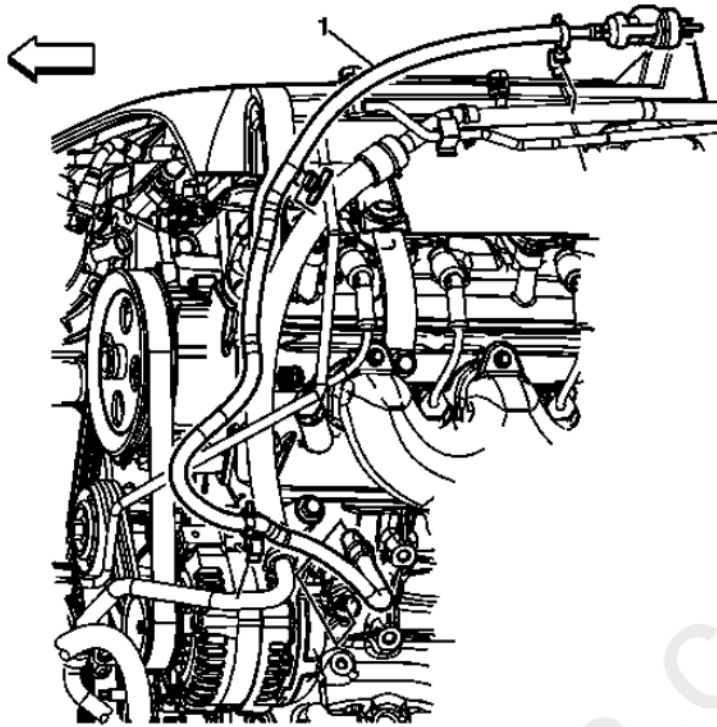


Fig. 171: Identifying Coolant Heater Cord (V8 With 110 Volt)
 Courtesy of GENERAL MOTORS CORP.

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> .	
	Coolant Heater Cord
1	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)

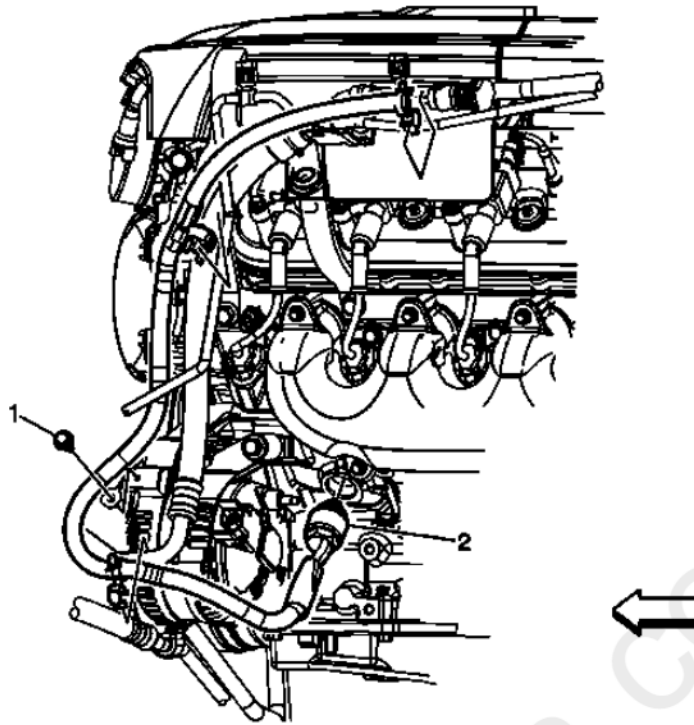


Fig. 172: Identifying Coolant Heater Cord (V8 With 240 Volt)
 Courtesy of GENERAL MOTORS CORP.

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 LF1, LLT)</u> or <u>Cooling System Draining and Filling (Static Fill LSA)</u> or <u>Cooling System Draining and Filling (GE 47716 LF1, LLT)</u> or <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 1. Disconnect the coolant heater cord from the coolant heater.

2

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 (LF1, LLT)**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.

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2011 ENGINE Engine Cooling - CTS

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)

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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 (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).

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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.

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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

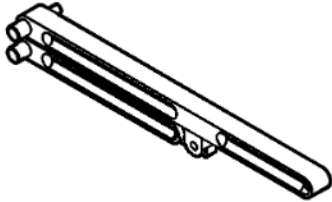
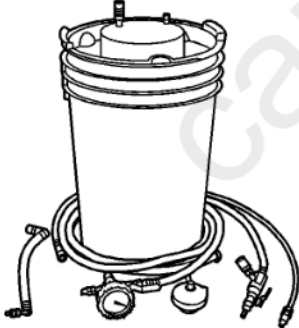
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Power Steering Oil Cooler

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.

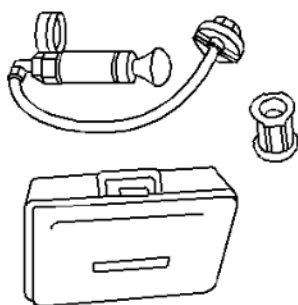
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

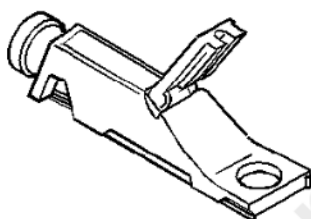
Illustration	Tool Number / Description
	EN 46104 Water Pump Pulley Holding Tool
	GE 47716 Vac N Fill Coolant Refill Tool
	J 24460-01 Cooling System Pressure Tester

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J 24731
Tempil Stick



J 26568
Coolant and Battery Fluid Tester



J 28410
Gasket Remover (Aluminum Components)

J 37097-A

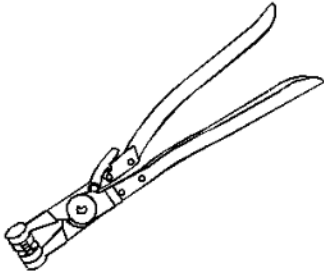
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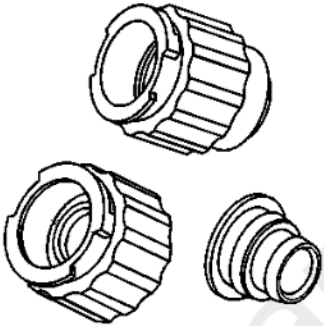
Heater Hose Clamp Tool



J 38185
Hose Clamp Pliers



J 42401
Radiator Cap and Surge tank Tester Adapter



J 44827
Transmission Cooler Quick Disconnect

