

2014 ENGINE

Engine Heating and Cooling - Acadia, Enclave And Traverse

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Recovery Reservoir Bolt	5 N.m	44 lb in
Drain Plug	22 N.m	16 lb ft
Engine Oil Cooler Fitting	24 N.m	18 lb ft
Fan Shroud Mounting Bolt	10 N.m	89 lb in
Radiator Mounting Bolt	10 N.m	89 lb in
Thermostat Housing Bolt	10 N.m	89 lb in
Thermostat Housing Retainer Bolt	50 N.m	37 lb ft
Water Outlet Housing Bolt	10 N.m	89 lb in
Water Pump Bolt*		
• First Pass	10 N.m	89 lb in
• Second Pass	10 N.m	89 lb in
• Final Pass	Plus 45°	
Water Pump Pulley Bolt	10 N.m	89 lb in
*Use NEW fastener.		

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling

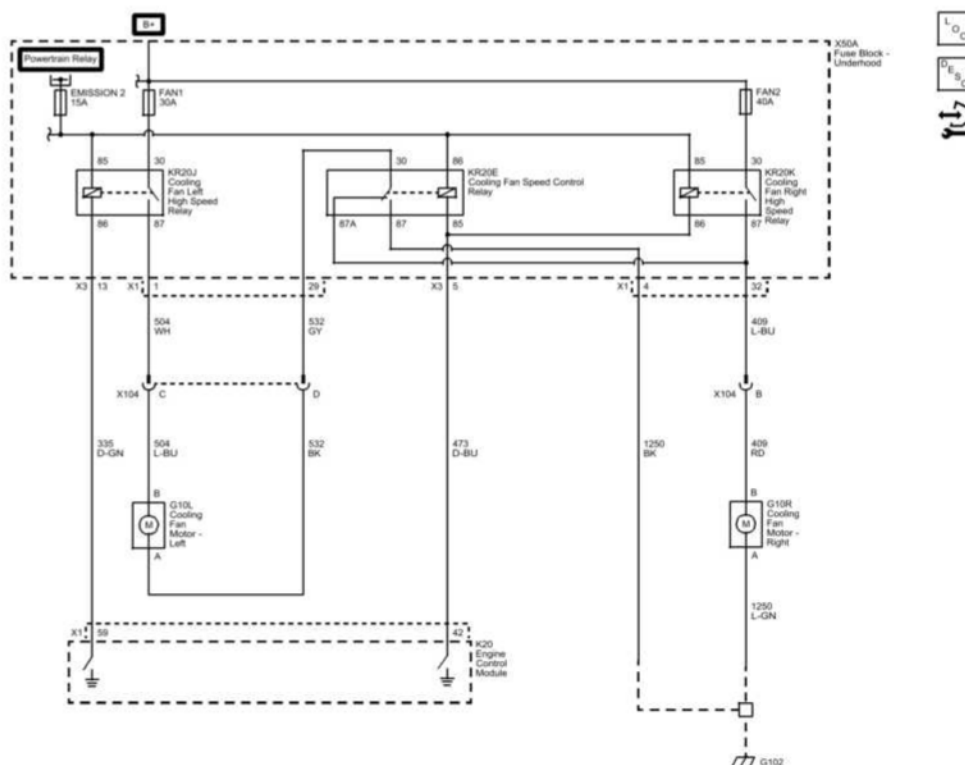


Fig. 1: Engine Cooling Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480, P0481, P0691, P0692, P0693 or P0694	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
DTC P1258	DTC P1258 Engine Coolant Overtemperature - Protection Mode Active

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

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors**DTC P0480**

Cooling Fan Relay 1 Control Circuit

DTC P0481

Cooling Fan Relays 2 and 3 Control Circuit

DTC P0691

Cooling Fan Relay 1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relay 1 Control Circuit High Voltage

DTC P0693

Cooling Fan 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	P0480	P0480, P0481	-	-
Relay Switch B+	1	1	-	-
Low Speed Cooling Fan Relay Control	P0691	P0480, P0691	P0692	-
High Speed Cooling Fan Relay Control	P0693	P0481 or 1	P0694	-
Cooling Fan Speed Control Relay Control	P0693	P0481 or 1	P0694	-
Relay Controlled Output	1	1	2	-
1. Fan(s) inoperative without a DTC 2. Fan(s) always ON without a DTC				

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

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

Diagnostic Aids

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

Reference Information**Schematic Reference****Engine Heating/Cooling Schematics**

Connector End View Reference

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

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify an audible click is heard or felt from cooling fan relays 1, 2 and 3 when commanding the cooling fans ON and OFF with a scan tool.
 - **If a click is not heard or felt at one or more of the relays**

Refer to **Circuit/System Testing**

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

Refer to **Circuit/System Testing**

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

Circuit/System Testing

1. Ignition OFF, disconnect all of the cooling fan relays. Ignition ON.
2. Verify that a test lamp illuminates between ground and a relay coil ignition circuit terminal listed below:

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

- KR20C Cooling Fan Low Speed Relay terminal 85/2
- KR20D Cooling Fan High Speed Relay terminal 86/1
- KR20E Cooling Fan Speed Control Relay terminal 86/1
- **If the test lamp does not illuminate**
 1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit of the appropriate cooling fan relay, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Remove the test lamp.
 2. Test for infinite resistance between the appropriate cooling fan relay ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance test or replace the appropriate cooling fan relay.
 - **If the test lamp illuminates**
- 3. Connect a DMM, set on the diode setting, between ground and a relay control circuit terminal listed below:

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

- KR20C cooling fan low speed relay terminal 86/1
- KR20D cooling fan high speed relay terminal 85/2
- KR20E cooling fan speed control relay terminal 85/2
- 4. Verify the DMM reading is greater than 2.5 V or displays O.L with the cooling fan relays commanded OFF with a scan tool.
 - **If 2.5 V or less**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 2.5 V or displays O.L.**
- 5. Verify the DMM reading is less than 1 V when commanding the cooling fan relays ON with a scan tool.

- **If greater than 1 V or displays OL.**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the appropriate cooling fan relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 2 ohms in the appropriate cooling fan relay control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.

- **If less than 1 V**

6. Test or replace the appropriate cooling fan relay.

Component Testing

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

Replace the cooling fan relay.

- **If between 70-110 ohms**

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

OR

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

Replace the cooling fan relay.

- **If infinite resistance**

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

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

- If 2 ohms or greater

Replace the KR20E Cooling Fan Speed Control Relay.

- If less than 2 ohms

6. Install a 10 A fused jumper wire between relay terminal 85 or 2 and 12 V.
7. Install a jumper wire between relay terminal 86 or 1 and ground.
8. Test for less than 2 ohms between terminals 3/30 and 5/87.

- If 2 ohms or greater

Replace the cooling fan relay.

- If less than 2 ohms

9. All OK.

Repair Instructions

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

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

DTC P1258: ENGINE COOLANT OVERTEMPERATURE - PROTECTION MODE ACTIVE

Diagnostic Instructions

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

DTC Descriptors

DTC P1258

Engine Coolant Overtemperature - Protection Mode Active

Circuit/System Description

The engine control module (ECM) uses the engine coolant temperature sensor to monitor the engine for an over-temperature condition. This condition occurs when the coolant temperature is above a calibrated value.

The ECM will alternately disable 2 groups of cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the ECM is able to reduce the temperature of the coolant.

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

DTC P1258 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information (LLT) for scan tool information

Circuit/System Verification

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

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

- **If no DTCs is set**

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

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

- **Cooling fan does not operate**

Refer to **Cooling Fan Inoperative.**

- **Cooling fan operates**

4. Verify that the engine does not overheat.

- **Engine overheats**

Refer to **Engine Overheating.**

- **Engine does not overheat**

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

- **If the DTC sets**

Refer to **Symptoms - Engine Cooling.**

- **If the DTC does not set**

6. All OK

Repair Instructions

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

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

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

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to **Cooling Fan Description and Operation** and **Cooling System Description and Operation**.

Visual/Physical Inspection

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

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

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

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

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

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement,

vibration or physical movement of a component. Refer to the following for a list to help isolate an intermittent condition:

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

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

Symptom List

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

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

COOLING FAN ALWAYS ON

Diagnostic Instructions

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

Circuit/System Description

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

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

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

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

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

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

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

Refer to **Circuit/System Testing.**

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

Circuit/System Testing**Both Cooling Fans Always ON**

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

One Cooling Fan Always ON

1. Ignition OFF, disconnect the KR20D Cooling Fan High Speed Relay, ignition ON.
2. Verify the cooling fan is OFF.
 - **If the cooling fan is ON**
 1. Ignition OFF, disconnect the harness connector at the G10L Cooling Fan Motor-Left, ignition ON.
 2. Test for less than 1 V between KR20D Cooling Fan High Speed Relay terminal 30/3 and ground.
 - If 1 V or greater, repair the short to voltage in the relay controlled output circuit.
 - **If the cooling fan is OFF**
3. Test or replace the KR20D Cooling Fan High Speed Relay.

Component Testing

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

Replace the KR20 cooling fan relay.
 - **If between 70-110 ohms**
4. Test for infinite resistance between the following terminals:
 - 30/3 and 86/1
 - 30/3 and 87/5
 - 30/3 and 85/2
 - 85/2 and 87/5
 - **If less than infinite resistance**

Replace the KR20 Cooling Fan Relay.
 - **If infinite resistance**
5. Test for less than 2 ohms between KR20E Cooling Fan Speed Control Relay terminals 30/3 and 87A/4.

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

- **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.
 - **If less than 2 ohms**
6. Install a 10 A fused jumper wire between relay terminal 85 or 2 and 12 V.
 7. Install a jumper wire between relay terminal 86 or 1 and ground.
 8. Test for less than 2 ohms between terminals 30/3 and 87/5.

- If 2 ohms or greater

Replace the KR20 Cooling Fan Relay.

- If less than 2 ohms

9. All OK.

Repair Instructions

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

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

COOLING FAN INOPERATIVE

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system 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 Relays 2 and 3 operates one fan at a high speed
 - Cooling Fan Relays 1, 2 and 3 operates both fans at a high speed

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Refer to **DTC P0480, P0481, P0691, P0692, P0693 or P0694.**
 - **If no DTCs is set**
3. Verify that both cooling fans turn ON and OFF and operate at low and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.
 - **If a cooling fan does not operate**

Refer to **Circuit/System Testing**
 - **If both cooling fans operate**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect all of the KR20 Cooling Fan Relays.
2. Ignition ON, verify a test lamp illuminates between ground and the B+ circuit terminals listed below:
 - KR20C Cooling Fan Low Speed Relay B+ circuit terminal 85/1
 - KR20C Cooling Fan Low Speed Relay B+ circuit terminal 30/3
 - KR20D Cooling Fan High Speed Relay B+ circuit terminal 87/5
 - KR20D Cooling Fan High Speed Relay B+ circuit terminal 86/2
 - KR20E Cooling Fan Speed Control Relay B+ circuit terminal 86/2
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Disconnect the appropriate cooling fan fuse or power source.
2. Test for less than 2 ohms between the fuse and the appropriate relay B+ circuit terminal, end to end.
 - If 2 ohms or greater, repair the open/high resistance in the B+ circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Connect a DMM to the appropriate relay B+ circuit terminal.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the B+ circuit.
 - If infinite resistance
3. Disconnect the harness connector at the appropriate G10 Cooling Fan Motor.
4. Test for infinite resistance between the appropriate relay controlled output circuit terminal and ground.
 - KR20C Cooling Fan Low Speed Relay output circuit terminal 87/5
 - KR20D Cooling Fan High Speed Relay output circuit terminal 30/3
 - KR20E Cooling Fan Speed Control Relay circuit terminal 30/3
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the appropriate G10 Cooling Fan Motor.
 - **If the test lamp illuminates**
3. Connect a DMM, set on the diode setting, between ground and a relay control circuit terminal listed below:

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

- KR20D Cooling Fan High Speed Relay terminal 85/2
 - KR20E Cooling Fan Speed Control Relay terminal 85/2
4. Verify the DMM reading is less than 1 V when commanding the cooling fan relays ON with a scan tool.
 - **If greater than 1 V or displays OL.**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the appropriate cooling fan relay control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
 4. Test for less than 2 ohms between the KR20E Cooling Fan Speed Control Relay terminal 85 and KR20D Cooling Fan High Speed Relay terminal 85.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.

- **If less than 1 V**
- 5. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the G10L Cooling Fan Motor - Left. It may take up to 2 minutes for all vehicle systems to power down.
- 6. Test for less than 5 ohms between the circuits listed below and ground:
 - G10L Cooling Fan Motor - Left terminal A
 - KR20E Cooling Fan Speed Control Relay terminal 87/5
- **If 5 ohms or greater**
- 1. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
- 2. Test for less than 2 ohms in the appropriate ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 5 ohms**
- 7. Connect the harness connector at the G10L Cooling Fan Motor - Left.
- 8. Connect a 50 A fused jumper between the KR20D Cooling Fan High Speed Relay terminals 30/3 and 87/5.
- 9. Ignition ON, verify the G10L Cooling Fan Motor - Left is activated at high speed.
 - **If the cooling fan does not activate or jumper fuse opens**
 - 1. Disconnect the harness connector at the G10L Cooling Fan Motor - Left.
 - 2. Test for less than 2 ohms in the circuit between KR20D Cooling Fan High Speed Relay terminal 30/3 and the G10L Cooling Fan Motor - Left terminal B.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G10L Cooling Fan Motor - Left.
- **If the cooling fan activates**
- 10. Ignition OFF, connect a fused jumper between the KR20E Cooling Fan Speed Control Relay switch circuit terminal 30/3 and the ground circuit terminal 87/5.
- 11. Connect a 40 A fused jumper between the KR20C Cooling Fan Low Speed Relay terminals 30/3 and 87/5.
- 12. Ignition ON, verify the G10R Cooling Fan Motor - Right is activated at high speed.
 - **If the cooling fan does not activate**
 - 1. Disconnect the harness connector at the G10R Cooling Fan Motor - Right.
 - 2. Test for less than 2 ohms in the circuit between KR20C Cooling Fan Low Speed Relay terminal 87/5 and the G10R Cooling Fan Motor - Right terminal B.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 - 3. Test for less than 2 ohms in the circuit between KR20E Cooling Fan Speed Control Relay terminal 30/3 and the G10R Cooling Fan Motor - Right terminal A.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the G10R Cooling Fan Motor - Right.

○ **If the cooling fan activates**

13. Ignition OFF, Install the KR20E Cooling Fan Speed Control Relay.

14. Ignition ON, verify both fan motors activate at low speed.

○ **If both cooling fans do not activate at low speed**

1. Disconnect both cooling fan motor harness connectors and the KR20E Cooling Fan Speed Control Relay.
2. Test for less than 2 ohms in circuit between KR20E Cooling Fan Speed Control Relay terminal 87A/4 and the G10L Cooling Fan Motor - Left terminal B.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
3. Test for infinite resistance between KR20E Cooling Fan Speed Control Relay terminal listed below and ground.
 - KR20E Cooling Fan Speed Control Relay terminal 30/3
 - KR20E Cooling Fan Speed Control Relay terminal 87A/4
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite, replace the KR20E cooling fan speed control relay.

○ **If both cooling fans activate**

15. Ignition OFF, test or replace the cooling fan relay listed below as appropriate:

- KR20C Cooling Fan Low Speed Relay
- KR20D Cooling Fan High Speed Relay

Component Testing

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

○ **If less than 70 ohms or greater than 110 ohms**

Replace the KR20 cooling fan relay.

○ **If between 70-110 ohms**

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

OR

- 3 and 2

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

Replace the KR20 Cooling Fan Relay.

- **If infinite resistance**

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

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

- **If 2 ohms or greater**

Replace the KR20E Cooling Fan Speed Control Relay.

- **If less than 2 ohms**

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

- **If 2 ohms or greater**

Replace the KR20 Cooling Fan Relay.

- **If less than 2 ohms**

9. All OK.

Repair Instructions

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

- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Cooling Fan and Shroud Replacement**

ENGINE OVERHEATING

Engine Overheating

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition.			
	• The engine temperature gauge is in the red (overheat) zone and/or the engine temperature indicator is ON. • Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the		

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ground while the engine is running.

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

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

LOSS OF COOLANT

Loss of Coolant

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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 Starting Point - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill) , Cooling System Draining and Filling (Vac N Fill) . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into the cylinder, the coolant can hydraulically lock the cylinder. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 31
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 32	Go to Step 7
7	Extended engine operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 34	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 33	Go to Step 10
10	With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • The auxiliary heater core • The coolant reservoir • The heater core • The radiator		

	Are any of the hoses, clamps or pipes leaking?	Go to Step 24	Go to Step 12
12	Visually inspect the following components: • The block heater • The coolant pressure cap • The coolant reservoir • The core plugs • The cylinder head gaskets • The engine block • The intake manifold • The radiator • The thermostat • The water pump Are any of the listed components leaking?	Go to Step 24	Go to Step 13
13	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. Visually inspect the components listed in steps 11 and 12 again. Are any leaks present?	Go to Step 24	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 25
15	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 35	Go to Step 25
16	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module assembly drain tube • Coolant on the vehicle floor covering under the HVAC module assembly Is coolant present?	Go to Step 26	Go to Step 17
	If equipped with auxiliary heating, inspect for the following conditions:		

17	• A coolant smell inside of the vehicle • Coolant in the auxiliary HVAC module assembly drain tube • Coolant on the floor covering near the auxiliary HVAC module assembly		
	Is coolant present?	Go to Step 27	Go to Step 18
18	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 Approximate Fluid Capacities. 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 24	Go to Step 19
19	Use J 42220 universal 12V leak detection lamp to inspect for the following conditions: • Coolant dye in the HVAC module drain tube • Coolant dye on the vehicle floor covering near the HVAC module		
	Is coolant dye present?	Go to Step 26	Go to Step 20
20	Use J 42220 universal 12V leak detection lamp to inspect for the following conditions: • Coolant dye in the auxiliary HVAC module drain tube • Coolant dye on the vehicle floor covering near the auxiliary HVAC module		
	Is coolant dye present?	Go to Step 27	Go to Step 21
21	Inspect the underside of the oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to Step 22	Go to Step 23
	Inspect the engine oil fluid level indicator for a		

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22	gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to Step 33	Go to Step 23
23	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 28	Go to Step 36
24	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 36	-
25	Replace the coolant pressure cap. Is the repair complete?	Go to Step 36	-
26	Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete?	Go to Step 36	-
27	Replace the auxiliary heater core. Refer to <u>Auxiliary Heater Core Replacement</u> . Is the repair complete?	Go to Step 36	-
28	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing</u> . 3. Inspect the transmission oil cooler for coolant. Is coolant present in the transmission oil cooler?	Go to Step 29	Go to Step 30
29	1. Replace the radiator. Refer to <u>Radiator Replacement</u> . 2. Service the automatic transmission. Refer to <u>Engine Coolant/Water in Transmission</u> . Is the repair complete?	Go to Step 36	-
30	Install the cooler lines to the radiator. Is the action complete?	Go to Step 36	-
31	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 36	-
32	Repair the engine overheating condition. Refer to <u>Engine Overheating</u> . Is the repair complete?	Go to Step 36	-
33	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> or <u>Coolant in Engine Oil</u> . Is the repair complete?	Go to Step 36	-

34	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> . Is the repair complete?	Go to Step 36	-
35	Repair the combustion pressure in the cooling system problem. Refer to <u>Coolant in Combustion Chamber</u> . Is the repair complete?	Go to Step 36	-
36	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS

Tools Required

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

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

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

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

Reference Information

Electrical Information Reference

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

Circuit/System Testing

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

1. Ignition OFF, disconnect the coolant heater cord from the E19 Coolant Heater.
2. Test for 30-40 ohms between the terminals of the E19 Coolant Heater.
 - **If not within 30-40 ohms**
Replace the E19 Coolant Heater.
 - **If within 30-40 ohms**
3. Test for infinite resistance between each terminal of the E19 Coolant Heater and ground.
 - **If less than infinite resistance**
Replace the E19 Coolant Heater.
 - **If infinite resistance**
4. Test or replace the coolant heater cord.

Repair Instructions

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

- **Coolant Heater Replacement**
- **Coolant Heater Cord Replacement**

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE**Engine Fails To Reach Normal Operating Temperature**

Step	Action	Yes	No
	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine.		

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1	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 Cooling Fan Always On. 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 Thermostat Diagnosis. Is the thermostat operating properly?	Go to Step 1	Go to Step 6
6	1. Replace the thermostat. Refer to Engine Coolant Thermostat Replacement. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK

PRESSURE CAP TESTING

Special Tools

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

Pressure Cap Testing

1. Remove the pressure cap.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank

cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

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

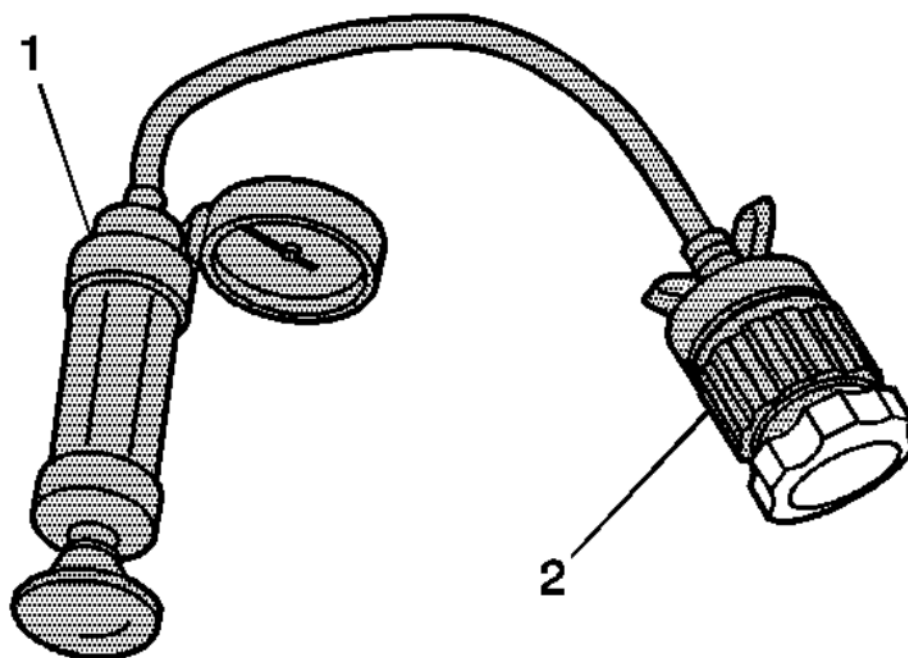


Fig. 2: Identifying Pressure Cap Testing Tool J 42401

Courtesy of GENERAL MOTORS COMPANY

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

4. Test the pressure cap for the following conditions:
 - Pressure release when the **J 24460-01** cooling system pressure tester exceeds the pressure rating of the pressure cap.

- Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:

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

COOLING SYSTEM LEAK TESTING

Special Tools

J-24460-01 Cooling System Pressure Tester

1. Remove the pressure cap.

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.

2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Use the **J-24460-01** tester in order to apply pressure to the cooling system.

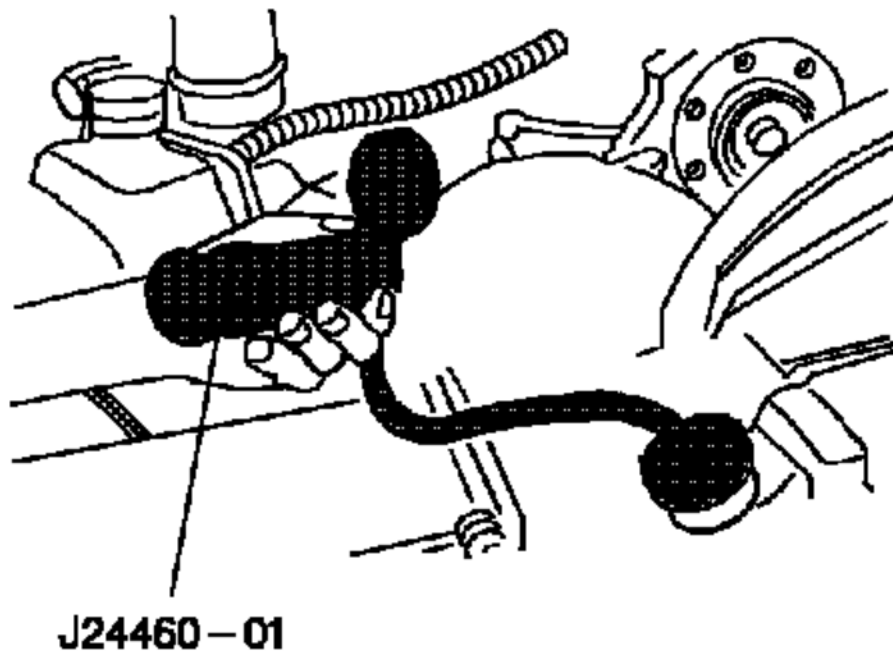


Fig. 3: Pressure Testing Cooling System Using J 24460-01
Courtesy of GENERAL MOTORS COMPANY

Do not exceed the pressure cap rating.

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

Observe the gauge for any pressure loss.

5. Repair any leaks as required.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Draining Procedure

Special Tools

J 26568 Coolant and Battery Tester

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. Place a drain pan under the radiator hose.

NOTE: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

2. Remove the radiator outlet hose from the engine. Refer to Radiator Outlet Hose Replacement.
3. Move down the end of the radiator hose to drain the radiator.
4. Drain the cooling system.
5. Remove the coolant pressure cap.
6. If a complete engine block drain is required, remove the engine drain plugs.
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.

Filling Procedure

1. Install the radiator outlet hose to the engine. Refer to Radiator Outlet Hose Replacement.

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

2. If the engine block drain plug was removed, perform the following:

CAUTION: Refer to Fastener Caution .

1. Apply pipe sealer to the drain plugs.
2. Install the drain plugs.

Tighten

Tighten the drain plug to 22 N.m (16 lb ft).

3. Lower the vehicle.
4. Slowly fill the cooling system with a 50/50 coolant mixture. Refer to Approximate Fluid Capacities .

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

5. Install the coolant pressure cap.
6. Start the engine.
7. Run the engine at 2,000-2,500 RPM until the engine reaches normal operating temperature.
8. Allow the engine to idle for 3 minutes.
9. Shut the engine OFF.
10. Allow the engine to cool.
11. Top off the coolant as necessary.
12. Inspect the concentration of the engine coolant, using the **J 26568** coolant and battery tester.
13. Rinse away any excess coolant from the engine and the engine compartment.

COOLING SYSTEM DRAINING AND FILLING (VAC N FILL)

Special Tools

- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **J 26568** Coolant and Battery Tester

Draining Procedure

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

1. Remove the radiator cap.
2. Attach the venturi assembly to the vacuum tank.

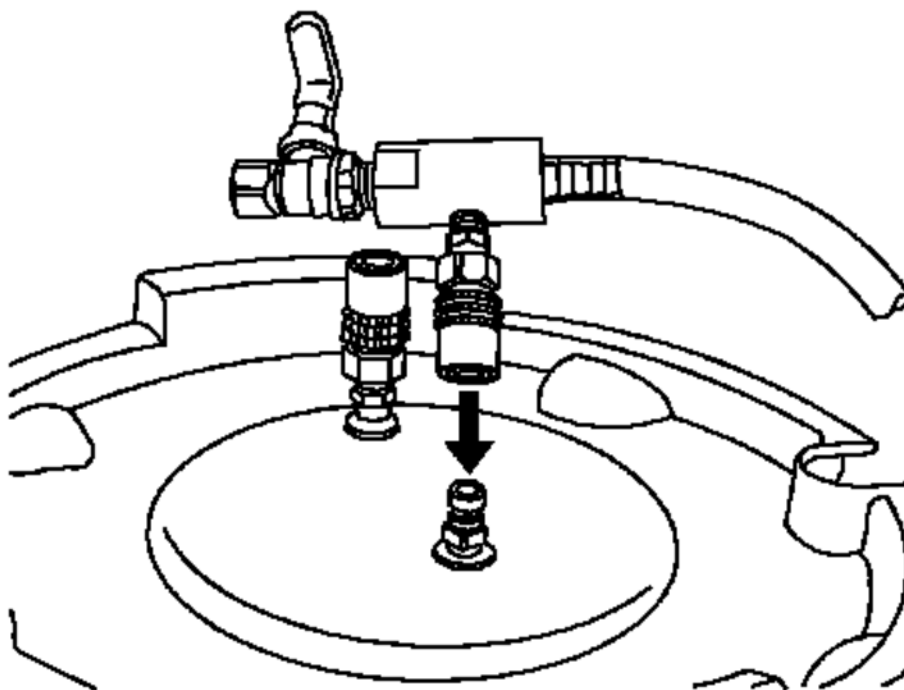


Fig. 4: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

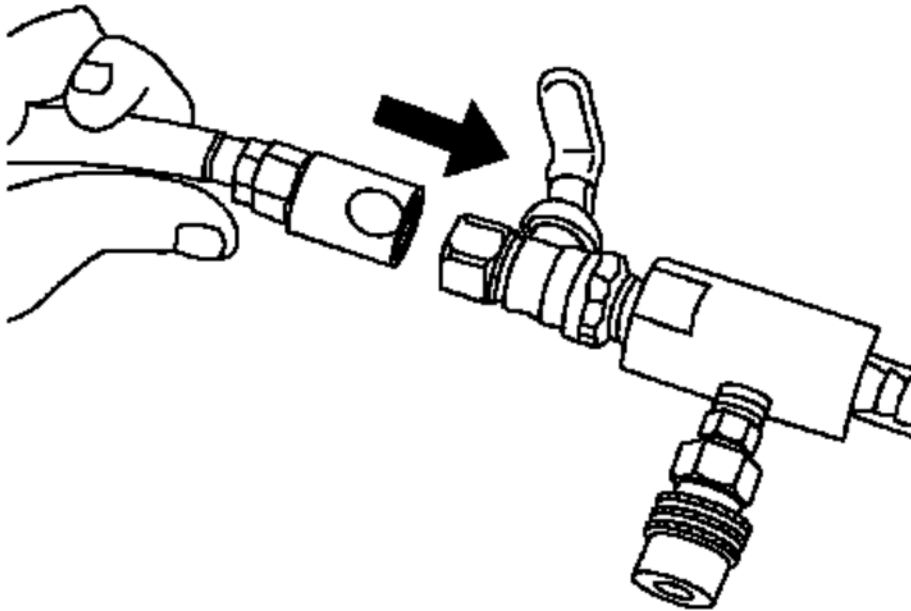


Fig. 5: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

Ensure the valve on the venturi assembly is closed.

4. Attach the vacuum hose to the vacuum tank.
5. Attach the extraction hose to the vacuum hose.

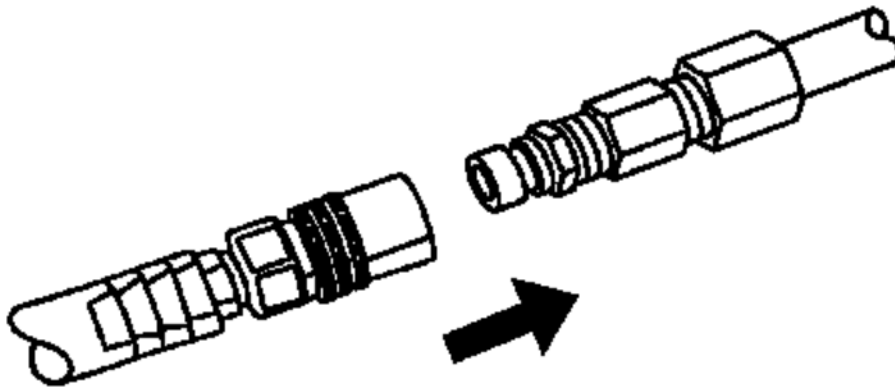


Fig. 6: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

6. Insert the extraction hose into the radiator cap opening and into the radiator until the extraction hose contacts the bottom of the radiator end tank.
7. Open the valve on the venturi assembly to start a vacuum draw.

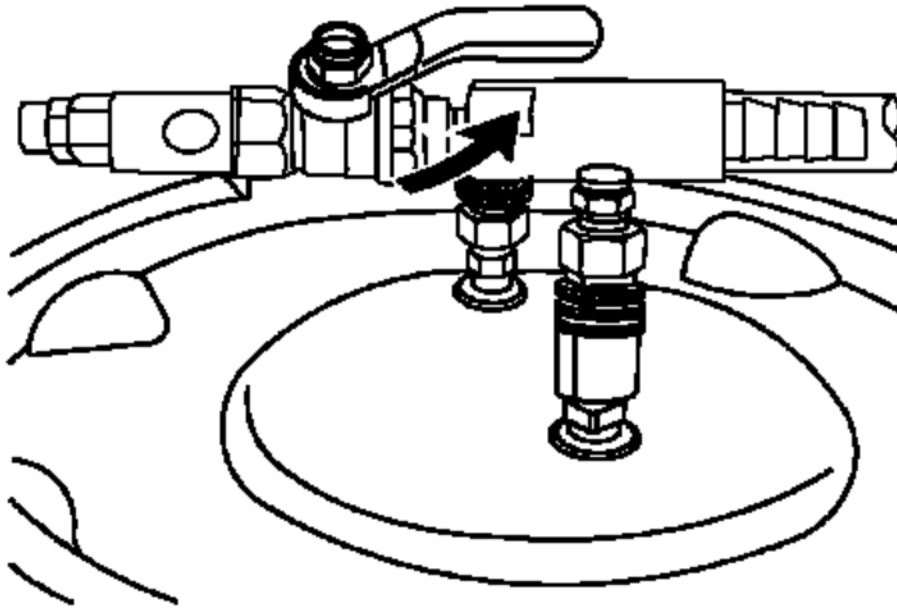


Fig. 7: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Use the extraction hose to draw out coolant until the radiator is empty.
9. 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.
10. If a complete engine block drain is required, remove the engine block drain plug.
11. Inspect the coolant.
12. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance-Follow the filling procedure.
 - Discolored-Follow the flush procedure. Refer to **Flushing**.

Vac-N-Fill Procedure

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

1. Attach the Vac-N-Fill cap to the vehicles coolant fill port.

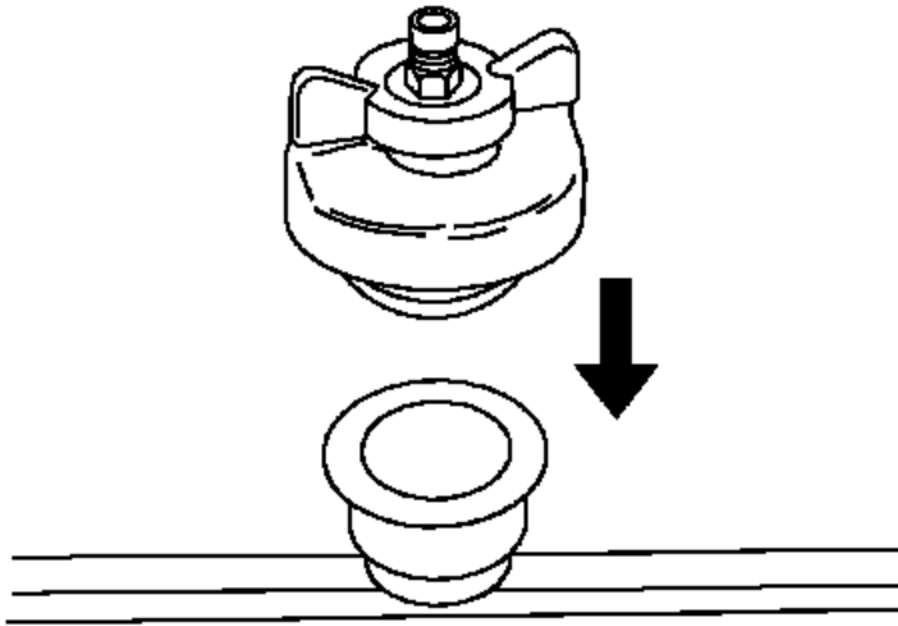


Fig. 8: Identifying Vac-N-Fill Cap

Courtesy of GENERAL MOTORS COMPANY

2. Install the extension hose.
3. Attach the vacuum gauge assembly to the Vac-N-Fill cap.

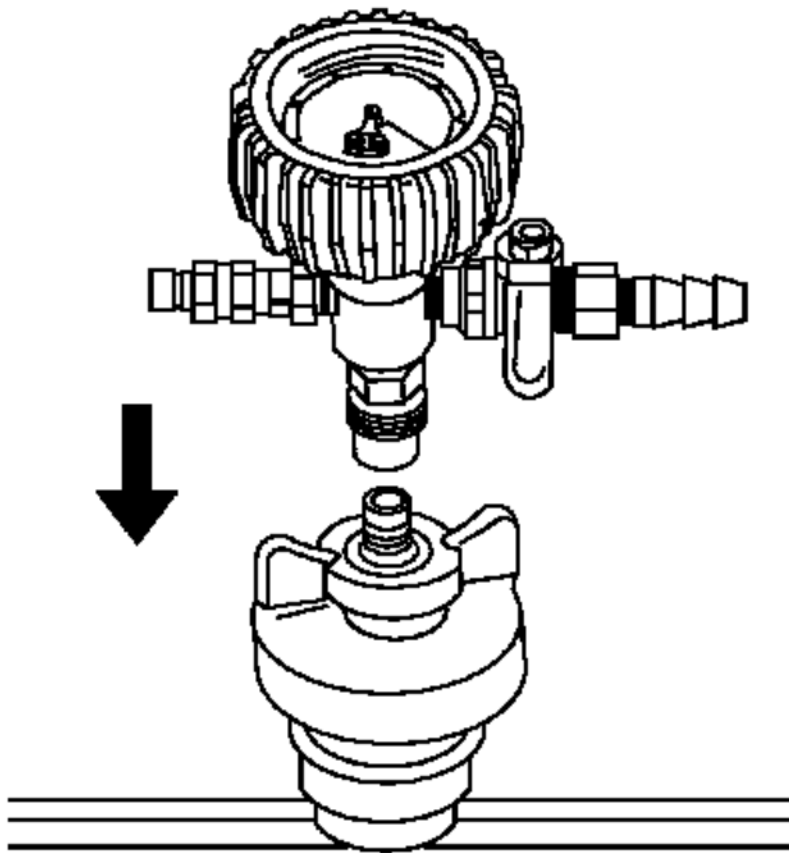


Fig. 9: Attaching Vacuum Gauge Assembly To Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

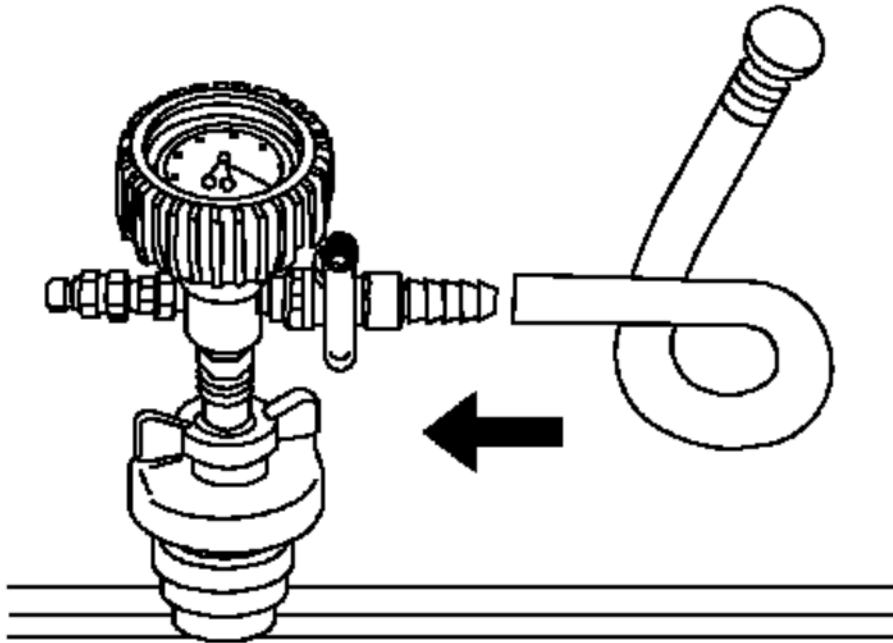


Fig. 10: Attaching Fill Hose To Barb Fitting On Vacuum Gauge Assembly
Courtesy of GENERAL MOTORS COMPANY

Ensure that the valve is closed.

5. Pour the coolant mixture into the graduated reservoir.

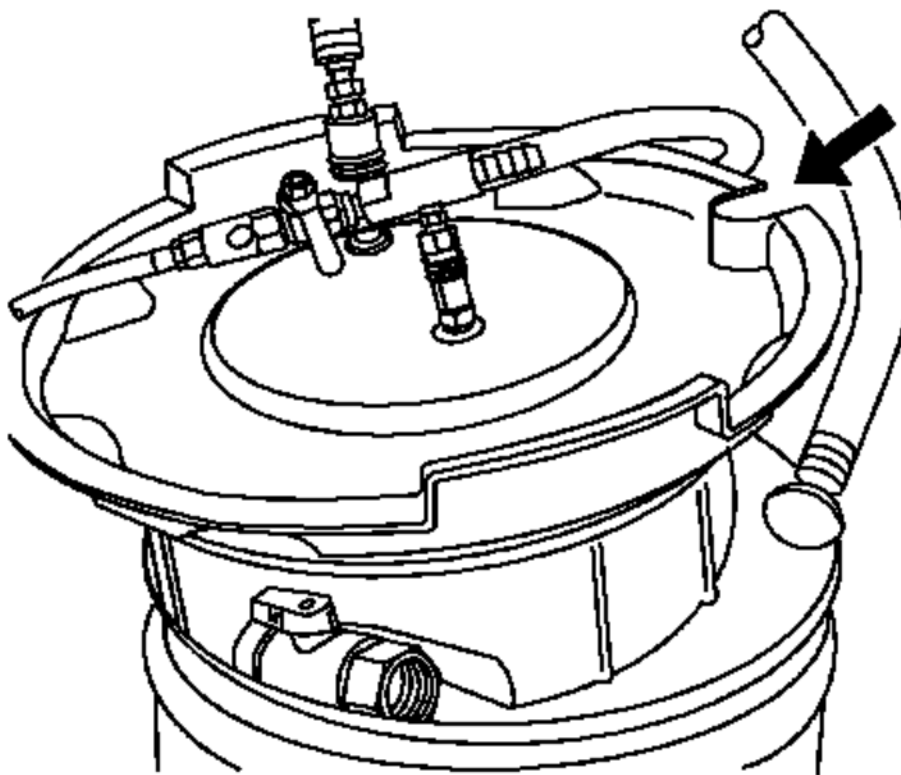


Fig. 11: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

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

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

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. Attach the venturi assembly to the vacuum tank.

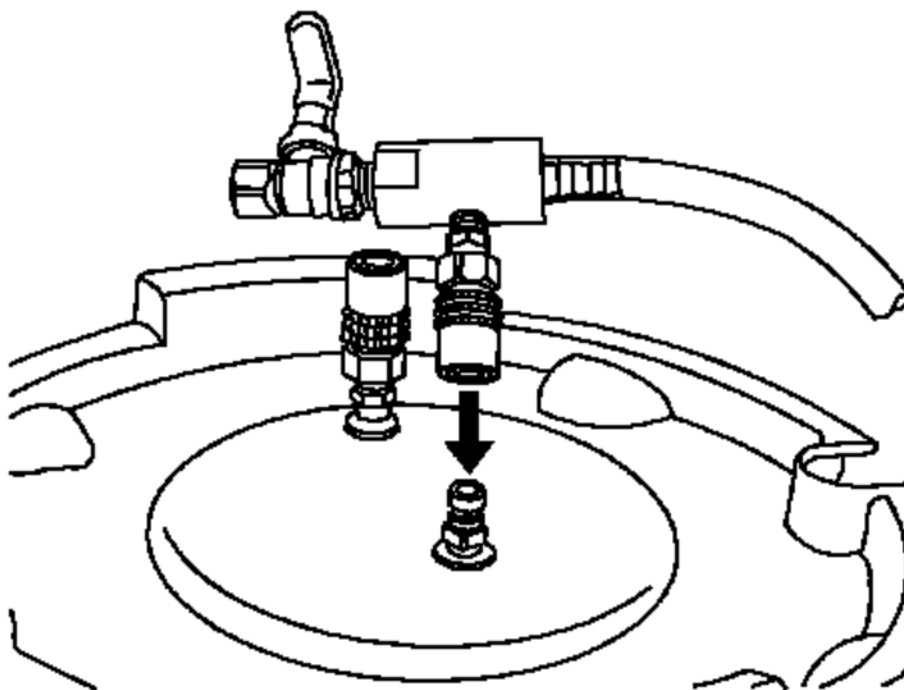


Fig. 12: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

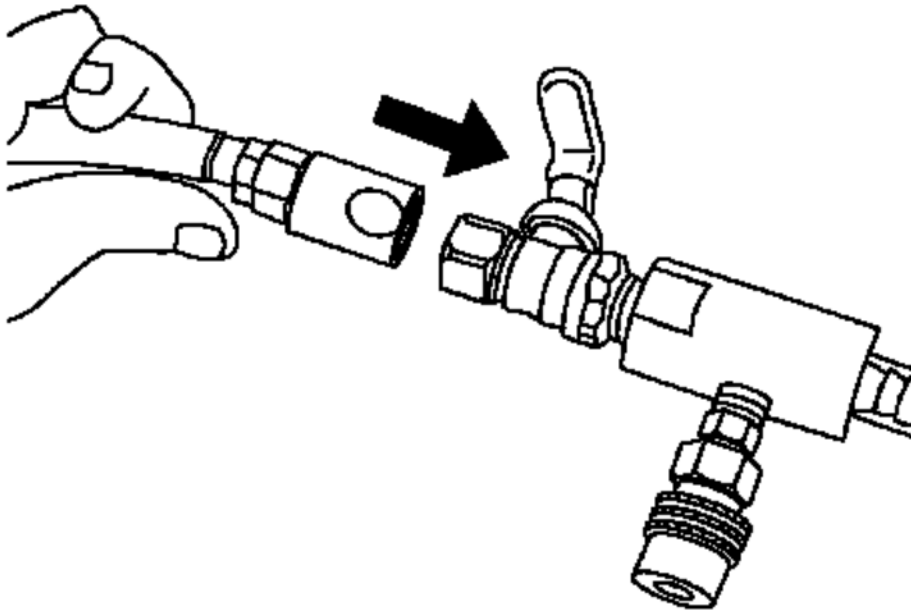


Fig. 13: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

Ensure the valve on the venturi assembly is closed.

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

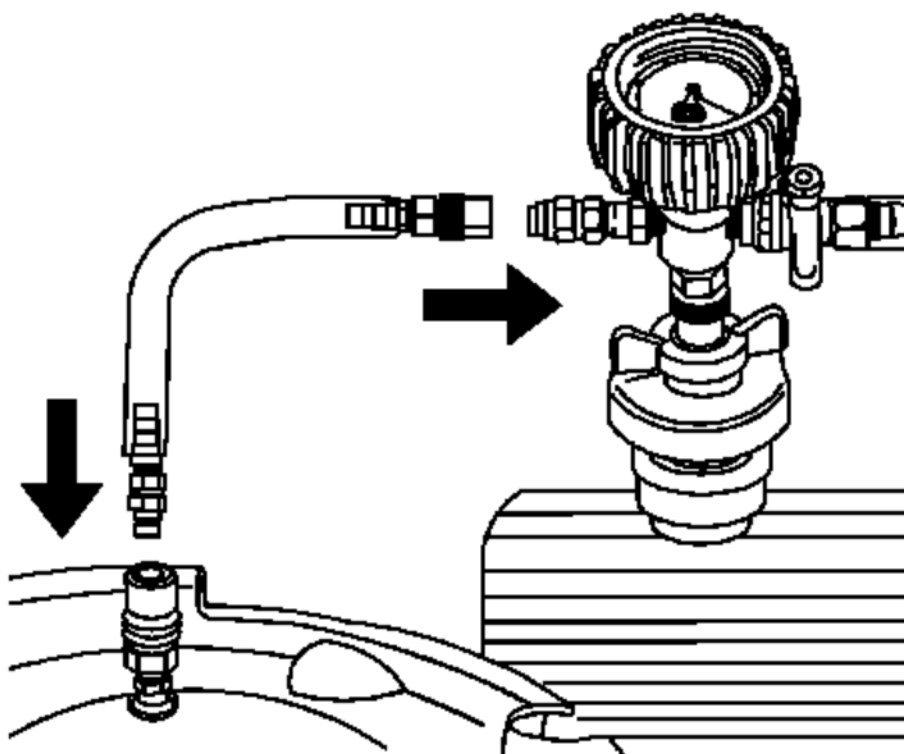


Fig. 14: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

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

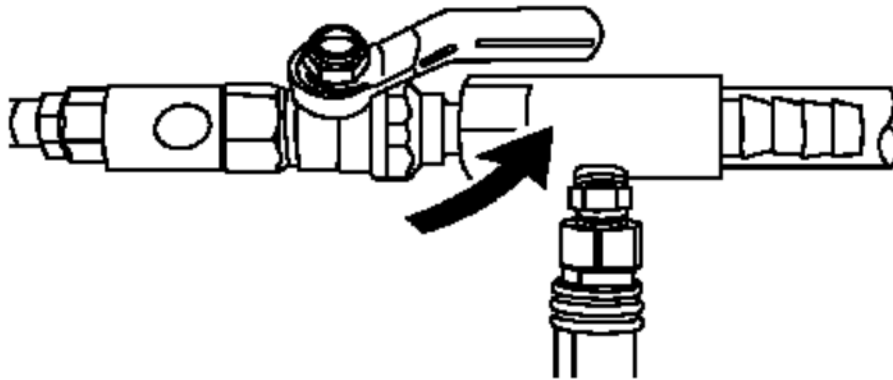


Fig. 15: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

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

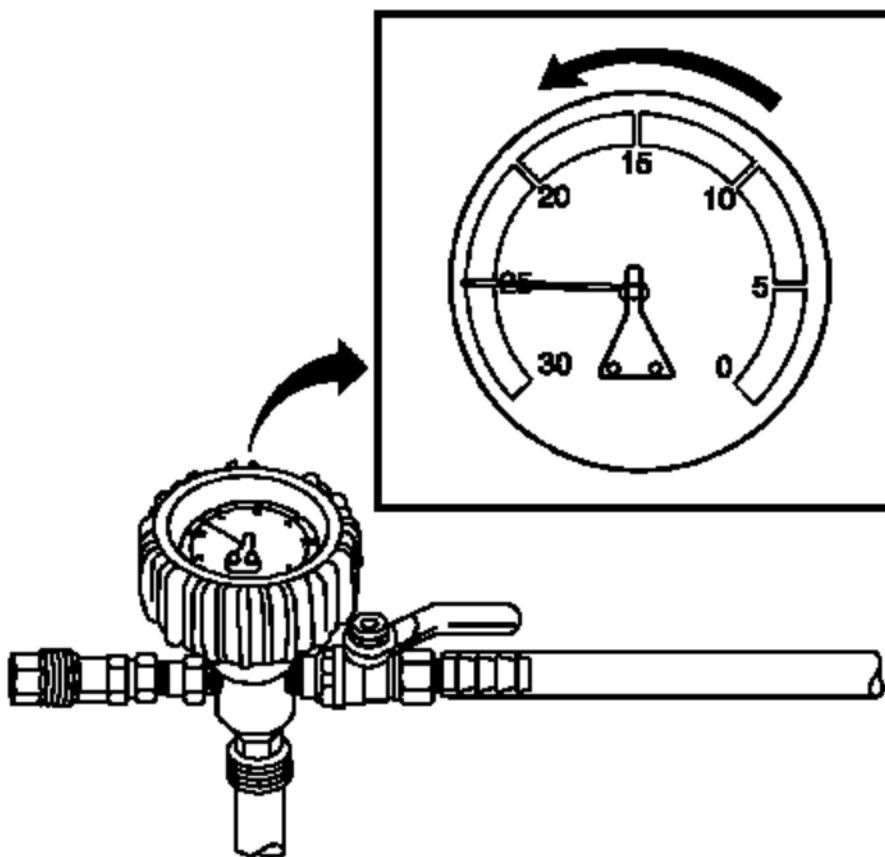


Fig. 16: View Of Vacuum Gauge

Courtesy of GENERAL MOTORS COMPANY

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.
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.

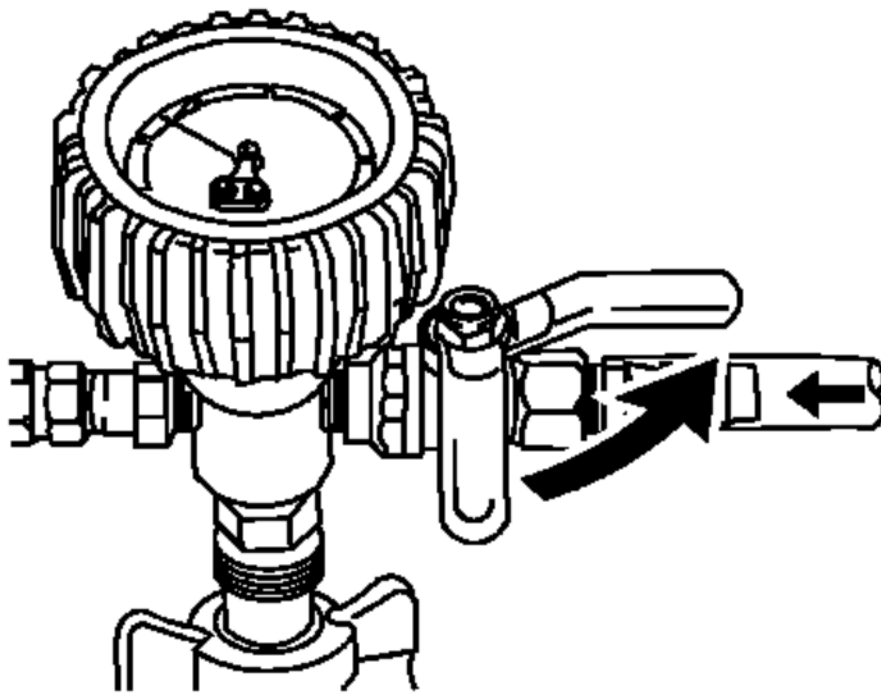


Fig. 17: Identifying Valve On Vacuum Gauge Assembly
Courtesy of GENERAL MOTORS COMPANY

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.
19. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 11-17.

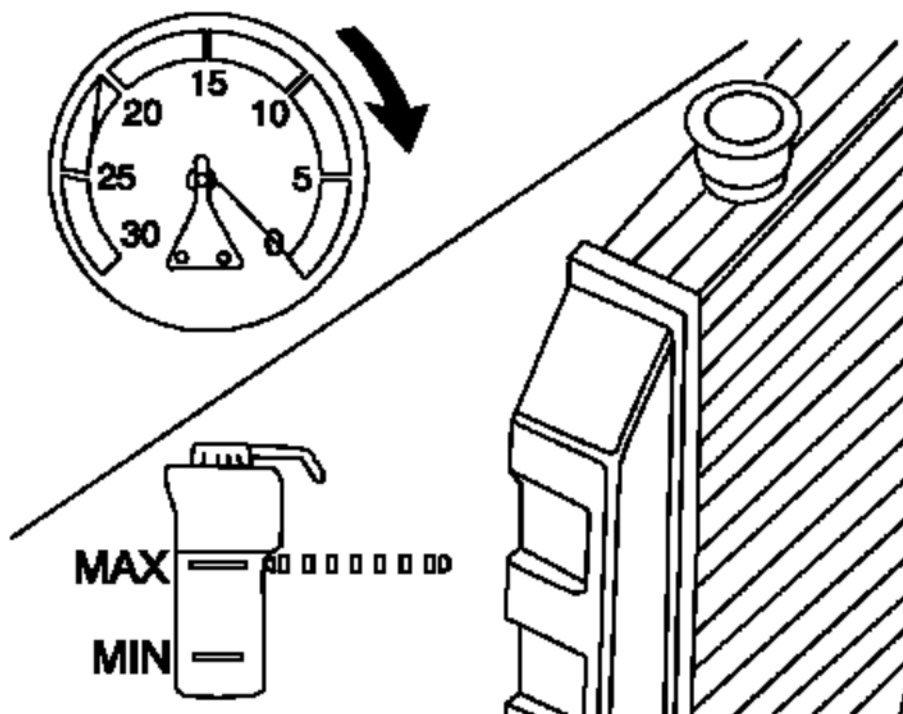


Fig. 18: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS COMPANY

Remove the extension hose.

20. Remove the **J 42401** radiator cap and surge tank test adapter.
21. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
22. Add coolant to the system as necessary.
23. Inspect the concentration of the coolant mixture using **J 26568** coolant and battery tester.
24. Detach the vacuum hose form the vacuum gauge assembly.

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

25. Attach the extraction hose to the vacuum hose.

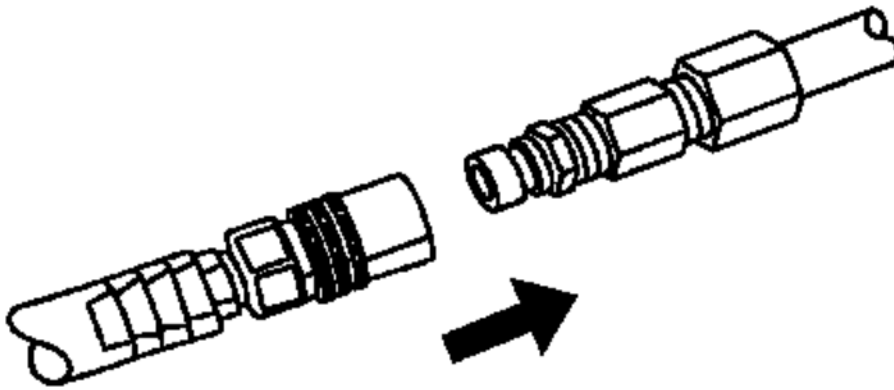


Fig. 19: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

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

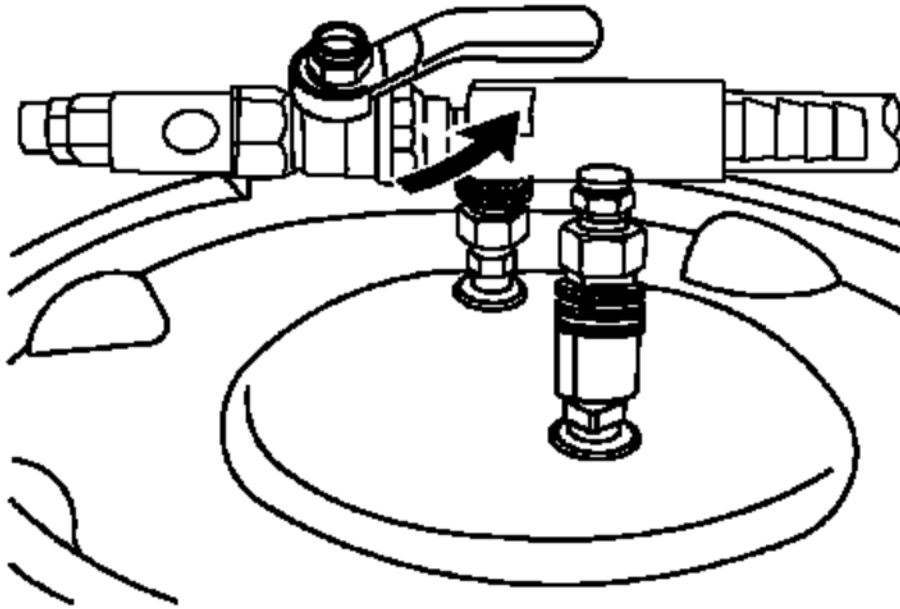


Fig. 20: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

27. Use the extraction hose to draw out coolant to the proper level.

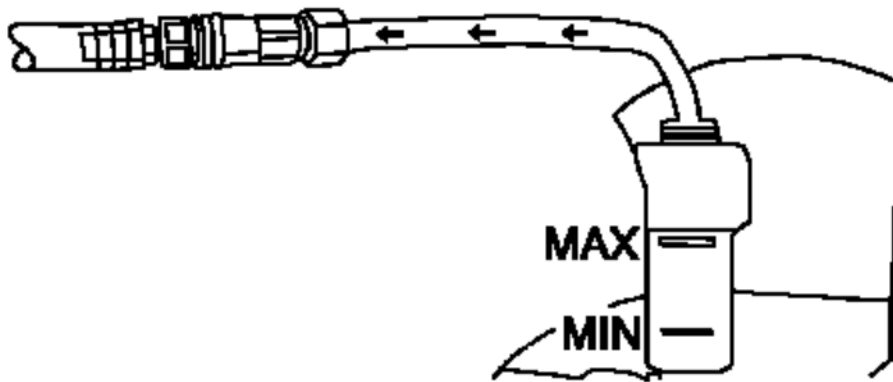


Fig. 21: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS COMPANY

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.

FLUSHING

IMPORTANT: Do not use a chemical flush.

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

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

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

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill).
2. Remove the coolant recovery reservoir. Refer to Coolant Recovery Reservoir Replacement.
3. Clean and flush the coolant recovery reservoir with clean, drinkable water.
4. Install the coolant recovery reservoir. Refer to Coolant Recovery Reservoir Replacement.
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill).
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill).
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill).

RADIATOR CLEANING

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

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

- Some conditions may require the use of warm water and a mild detergent.

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

- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

COOLANT RECOVERY RESERVOIR REPLACEMENT

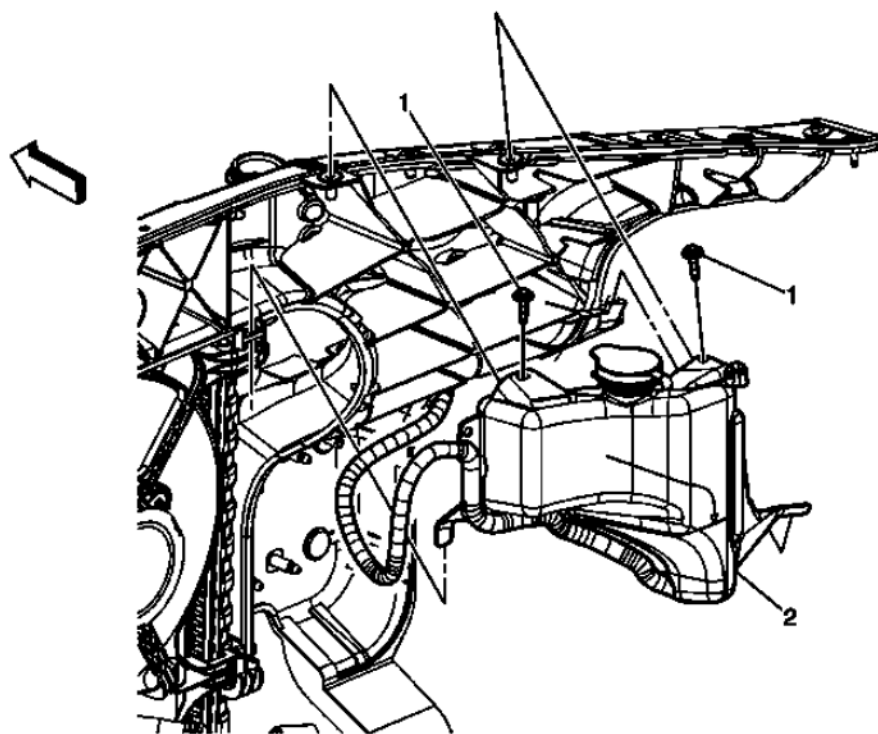


Fig. 22: View Of Coolant Recovery Reservoir
 Courtesy of GENERAL MOTORS COMPANY

Coolant Recovery Reservoir Replacement

Callout	Component Name
Preliminary Procedures 1. Drain the coolant from the recovery reservoir. 2. Remove the front compartment sight shield if necessary. Refer to Front Compartment Front Sight Shield Replacement (Enclave) , Front Compartment Front Sight Shield Replacement (Traverse) , Front Compartment Front Sight Shield Replacement (Acadia) .	
1	Coolant Recovery Reservoir Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 5 (44 lb in)
2	Coolant Recovery Reservoir Procedure Remove the overflow hose from the reservoir.

RADIATOR INLET HOSE REPLACEMENT

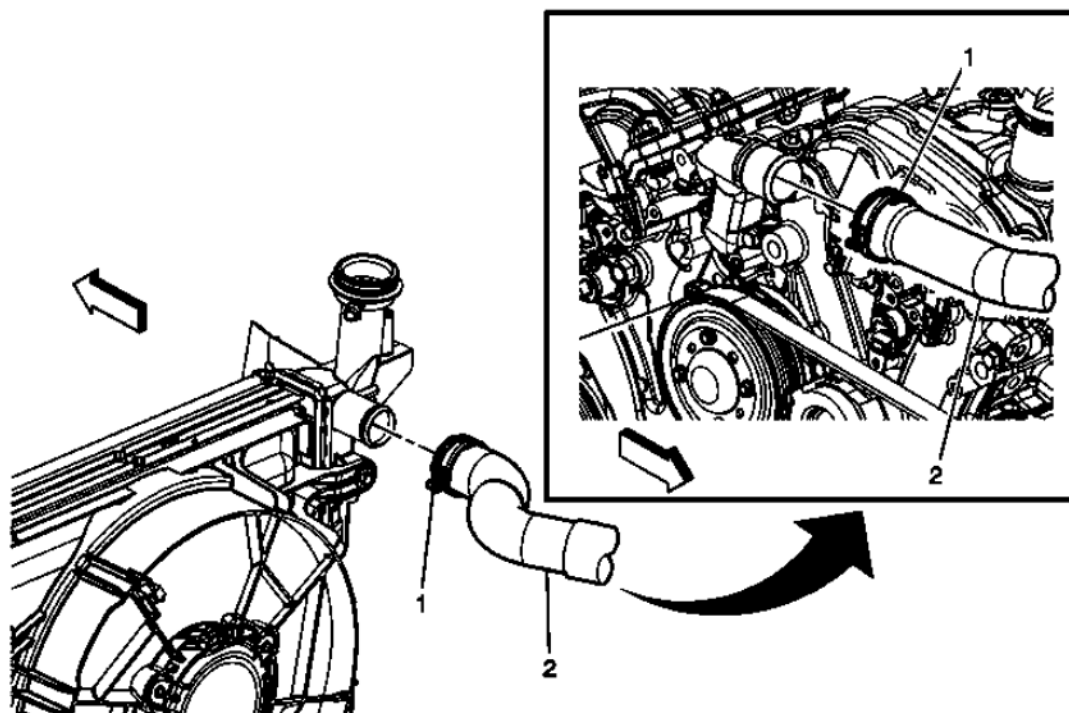


Fig. 23: Identifying Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Radiator Inlet Hose Replacement

Callout	Component Name
Preliminary Procedures	
1. Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill). 2. Remove the front compartment sight shield. Refer to Front Compartment Front Sight Shield Replacement (Enclave), Front Compartment Front Sight Shield Replacement (Traverse), Front Compartment Front Sight Shield Replacement (Acadia).	
1	Radiator Inlet Hose Clamp (Qty: 2) Procedure Using J 38185 hose clamp pliers reposition the radiator inlet hose clamps. Special Tools J 38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Inlet Hose

RADIATOR OUTLET HOSE REPLACEMENT

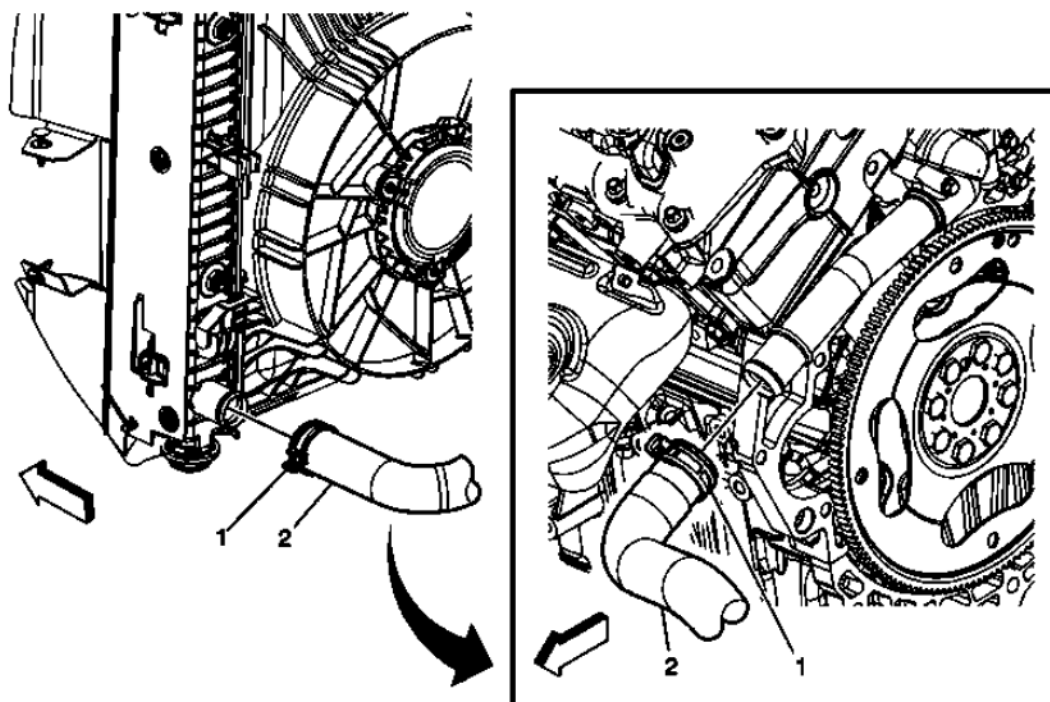


Fig. 24: Identifying Radiator Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Radiator Outlet Hose Replacement

Callout	Component Name
Preliminary Procedures	
1. Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill). 2. Remove the front compartment sight shield. Refer to Front Compartment Front Sight Shield Replacement (Enclave), Front Compartment Front Sight Shield Replacement (Traverse), Front Compartment Front Sight Shield Replacement (Acadia).	
1	Radiator Outlet Hose Clamp (Qty: 2) Procedure Using J 38185 hose clamp pliers reposition the radiator outlet hose clamps. Special Tools J 38185 Hose Clamp Pliers For equivalent regional tools, refer to Special Tools .
2	Radiator Outlet Hose

ENGINE OIL COOLER CONNECTOR REPLACEMENT

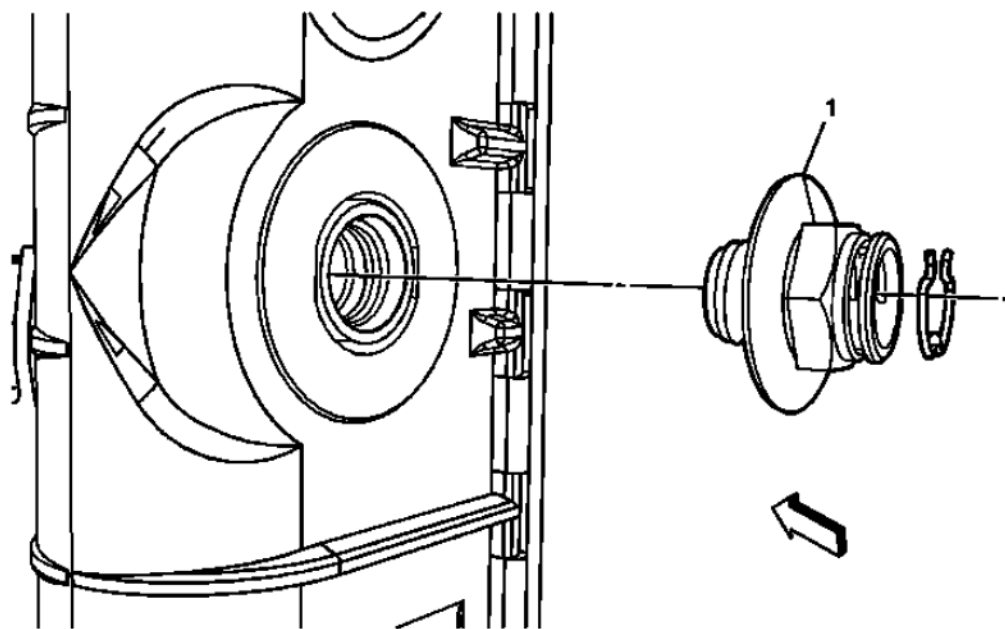


Fig. 25: View Of Engine Oil Cooler Connector
 Courtesy of GENERAL MOTORS COMPANY

Engine Oil Cooler Connector Replacement

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill). 2. Remove the engine oil cooler pipe from the oil cooler fittings on the radiator. Refer to Engine Oil Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.	
1	Engine Oil Cooler Fitting CAUTION: Refer to Fastener Caution . Procedure Remove the plastic caps from the quick connect fittings by pulling the caps back along the pipe before installation. • Do not remove the upper and lower engine oil cooler fittings from the radiator at the same time, otherwise the engine oil cooler may fall inside the radiator end tank. • The correct thread engagement is critical. Cross-threaded fittings can achieve proper

tightness and still leak.

Tighten

24 N.m (18 lb ft)

ENGINE OIL COOLER HOSE/PIPE QUICK-CONNECT FITTING DISCONNECTION AND CONNECTION**Special Tools**

- **DT-47731** 1/2 in. Cooler Line Quick Release Tool
- **J 28585** Universal Snap Ring Remover for the 5/8 in. Cooler Line

Removal Procedure

1. Remove the plastic caps from the quick connect fittings by pulling the caps back along the pipe before installation.
2. Install the **DT-47731** 1/2 in. cooler line quick release tool onto the transmission oil cooler (TOC) pipe or use the **J 28585** universal snap ring remover for the 5/8 in. cooler line.

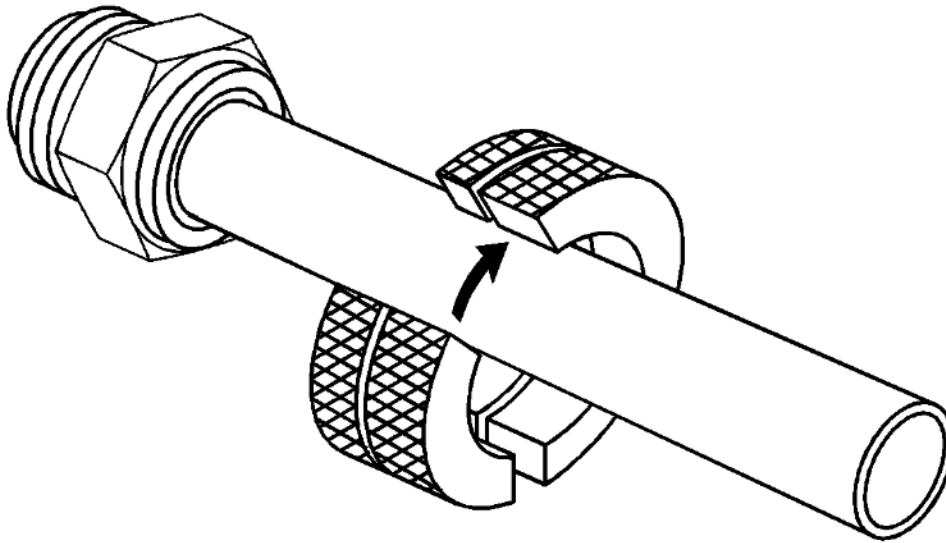


Fig. 26: View Of J 41623-B & Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

3. Slide the **DT-47731** 1/2 in. cooler line quick release tool toward the TOC pipe fitting or use the **J 28585** universal snap ring remover for the 5/8 in. cooler line.

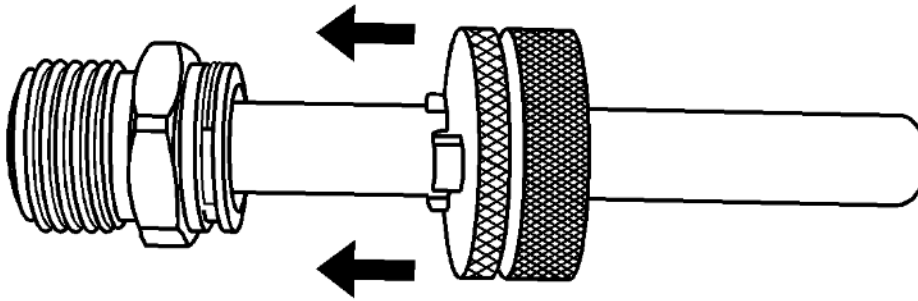


Fig. 27: Sliding J 41623-B Toward Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

4. Connect the **DT-47731** 1/2 in. cooler line quick release tool onto the TOC pipe fitting.

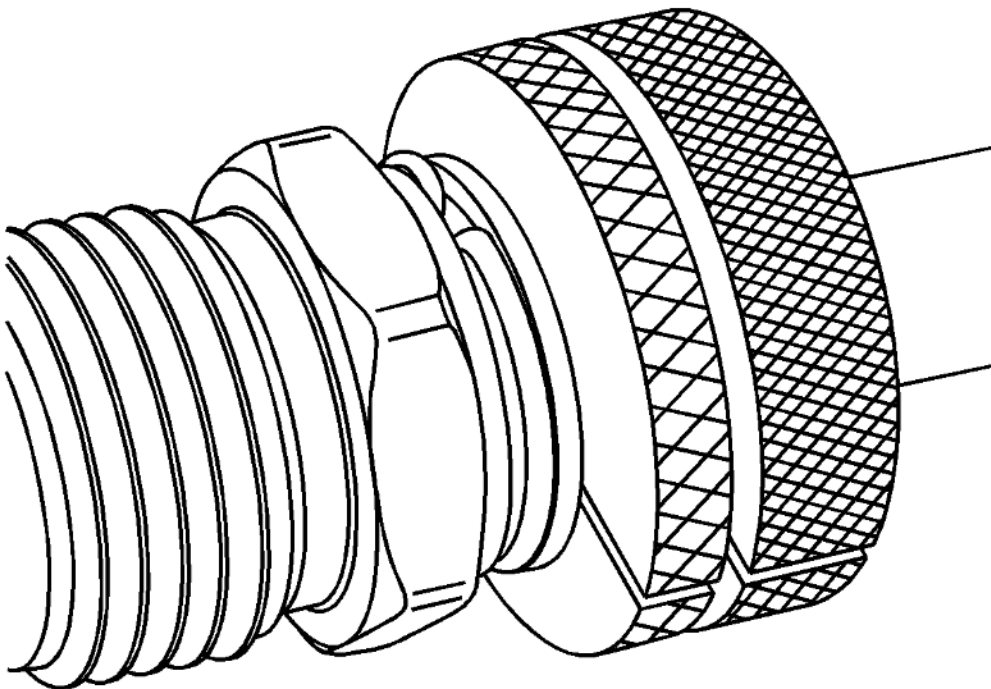


Fig. 28: Rotating Quick-Connect On Coolant Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Rotate the DT-47731 1/2 in. cooler line quick release tool to engage the TOC pipe fitting's retainer slots. The DT-47731 1/2 in. cooler line quick release tool should be nearly flush with the fitting.

5. Rotate the **DT-47731** 1/2 in. cooler line quick release tool or use the **J 28585** universal snap ring remover for the 5/8 in. cooler line until the retainer clip (1) rises above the fitting retainer seat.

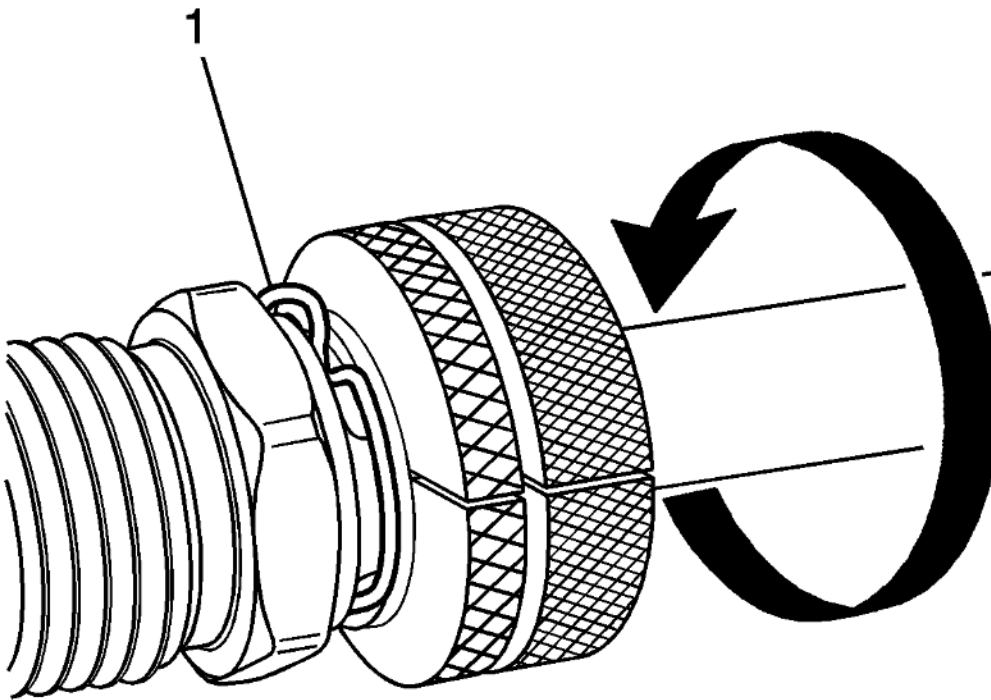


Fig. 29: Rotating Quick-Connect Until Retainer Clip Rises Above Fitting Retainer Seat
Courtesy of GENERAL MOTORS COMPANY

6. Pull back on the TOC pipe to disengage the pipe from the TOC pipe fitting.

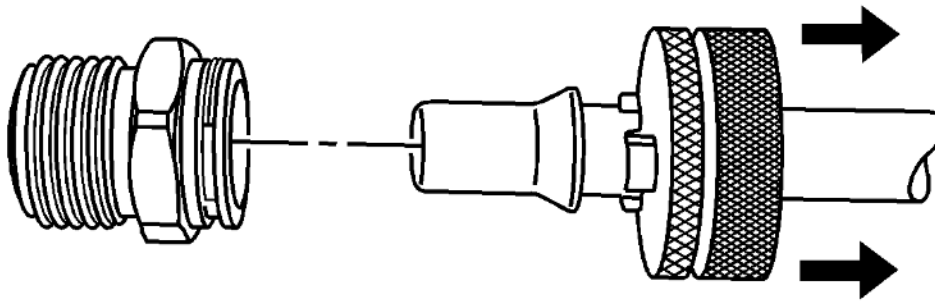


Fig. 30: View Of J 41623-B & Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

7. Remove the **DT-47731** 1/2 in. cooler line quick release tool or the **J 28585** universal snap ring remover for the 5/8 in. cooler line from the TOC pipe.

Installation Procedure

1. Install the TOC pipe into the TOC pipe fitting.

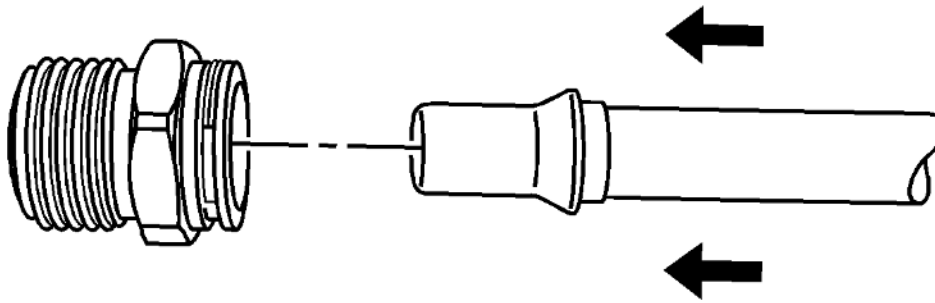


Fig. 31: View Of Generator Cooling Inlet Pipe & Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Discard the TOC retaining clip and install a new retaining clip.

A distinct snap should be heard or felt when assembling the TOC pipe to the fitting.

2. To ensure the cooler line is properly installed, give the cooler pipe a gentle pull.

COOLING FAN AND SHROUD REPLACEMENT

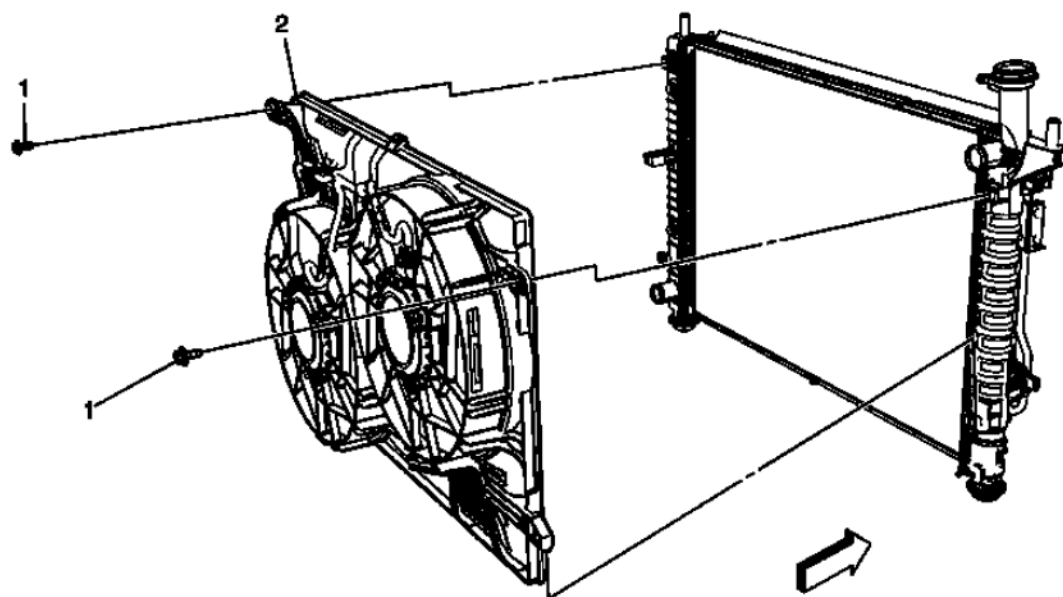


Fig. 32: View Of Cooling Fan & Shroud
 Courtesy of GENERAL MOTORS COMPANY

Cooling Fan and Shroud Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove front bumper impact bar. Refer to Front Bumper Impact Bar Replacement (Acadia). 2. Remove radiator inlet hose at radiator. Refer to Radiator Inlet Hose Replacement. 3. Disconnect electrical connector at fan shroud harness. 4. Remove front fascia upper support. Refer to Front Bumper Fascia Upper Support Replacement (Acadia, Enclave, Traverse). 5. Remove hood latch. Refer to Hood Primary and Secondary Latch Replacement. 6. Remove upper radiator mounting brackets and tip radiator forward for additional clearance.	
1	Fan Shroud Mounting Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Procedure Remove small pushpin retainers. Tighten

	10 N.m (89 lb in)
2	Fan Shroud Procedure Tilt fan shroud rearward and upward to remove. TIP: Reposition of radiator hoses may be necessary for removal.

ENGINE COOLANT THERMOSTAT REPLACEMENT

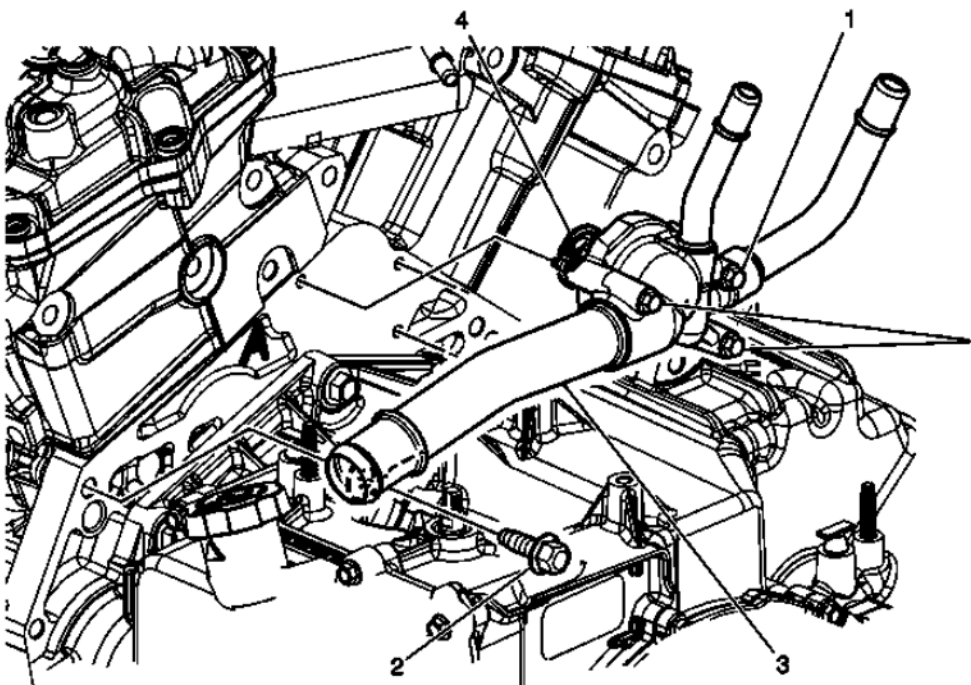


Fig. 33: View Of Thermostat Housing & Components
 Courtesy of GENERAL MOTORS COMPANY

Engine Coolant Thermostat Replacement

Callout	Component Name
Preliminary Procedures	
1.	Partially drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) , Cooling System Draining and Filling (Vac N Fill) .
2.	Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement .
3.	Remove the fuel pipe shield. Refer to Fuel Pipe Shield Replacement .
4.	Disconnect the radiator outlet hose from the thermostat housing. Refer to Radiator Outlet Hose Replacement .
5.	Remove the heater inlet and outlet hoses. Refer to Heater Inlet Hose Replacement and Heater Outlet Hose Replacement .

1	Thermostat Housing Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the thermostat housing bolts. Tighten 10 N.m (89 lb in)
2	Thermostat Housing Retainer Bolt Procedure Remove the thermostat housing retainer bolt. Tighten 50 N.m (37 lb ft)
3	Thermostat Housing
4	Thermostat Procedure 1. Remove the thermostat and discard the thermostat gasket. 2. Install a new thermostat gasket.

WATER OUTLET REPLACEMENT

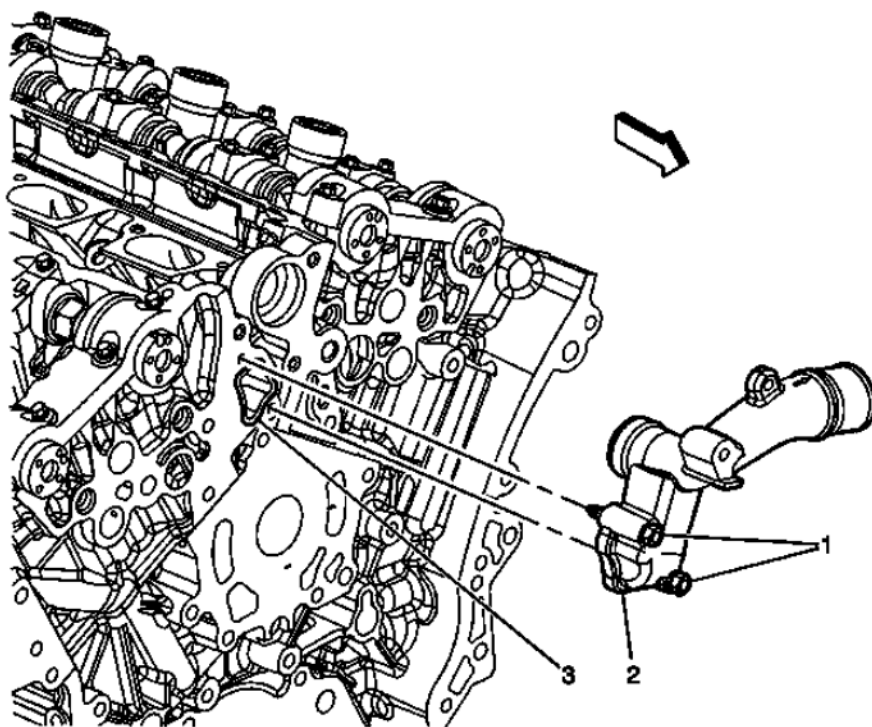


Fig. 34: Identifying Water Outlet Housing
 Courtesy of GENERAL MOTORS COMPANY

Water Outlet Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the radiator inlet hose. Refer to <u>Radiator Inlet Hose Replacement</u>. 2. Remove the right engine mount strut bracket. Refer to <u>Engine Mount Strut Bracket Replacement - Right Side</u>.	
1	Water Outlet Housing Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Procedure Remove the water outlet housing bolts. Tighten 10 N.m (89 lb in)
2	Water Outlet Housing
	Seal Procedure

3

1. Remove the water outlet housing seal. Discard the seal.
2. Install a new water outlet housing seal.

WATER PUMP REPLACEMENT

Special Tools

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill), Cooling System Draining and Filling (Vac N Fill).
2. Remove the drive belt. Refer to Drive Belt Replacement .
3. Remove the right engine strut mount. Refer to Engine Mount Strut Replacement - Right Side .
4. Remove the right engine mount strut bracket. Refer to Engine Mount Strut Bracket Replacement - Right Side .
5. Use the **EN 46104** tool in order to retain the water pump pulley.

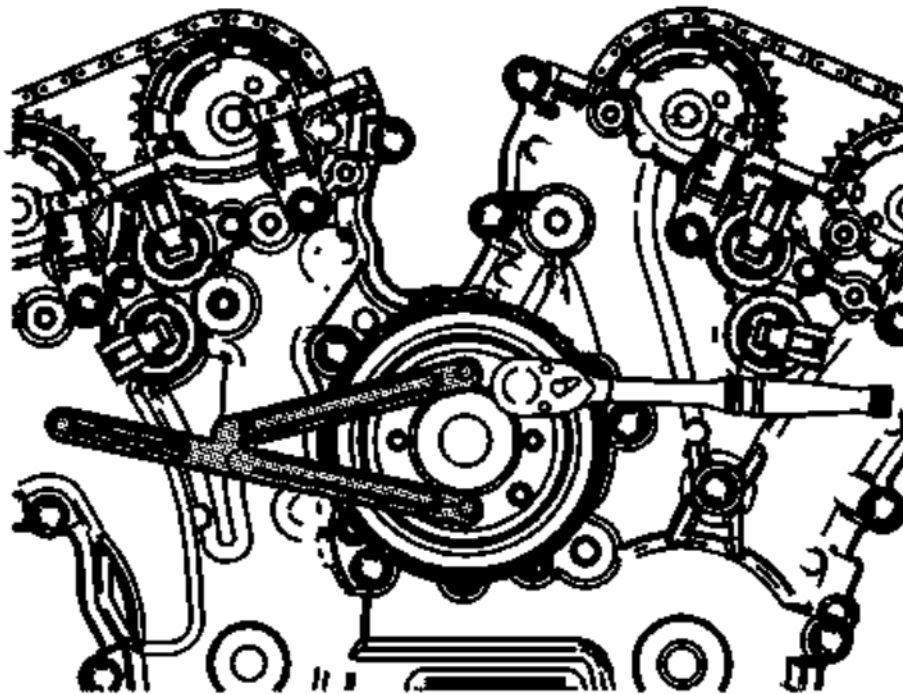


Fig. 35: View Of EN 46104 Installed On Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

6. Remove the water pump pulley bolts.

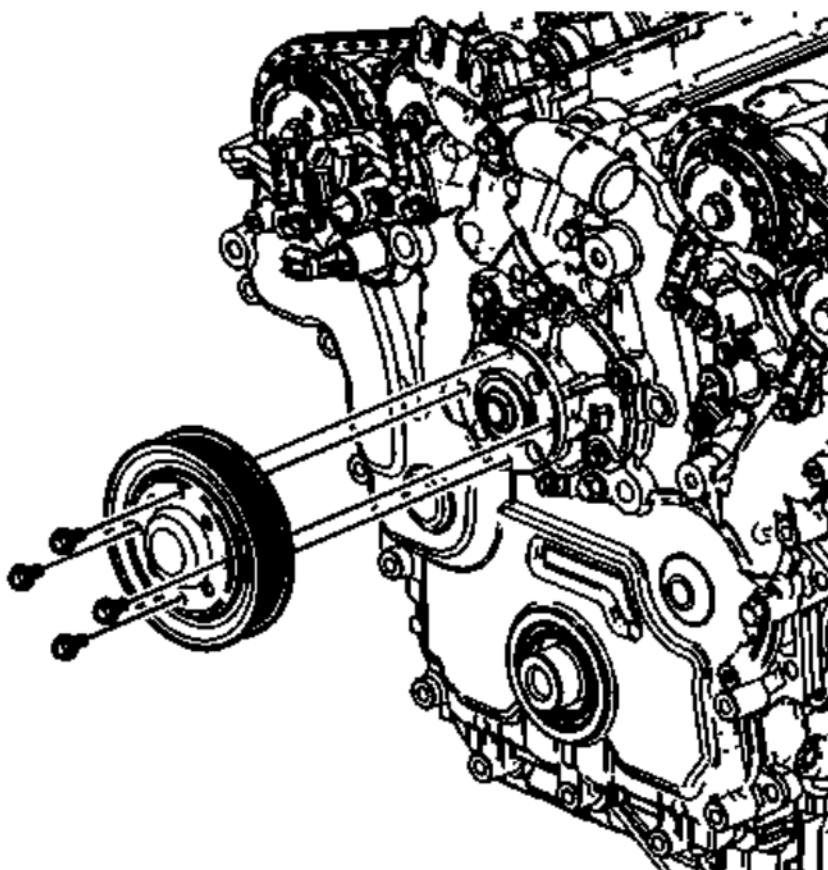


Fig. 36: Locating Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the water pump pulley.
8. Remove the water pump bolts and DISCARD the bolts.

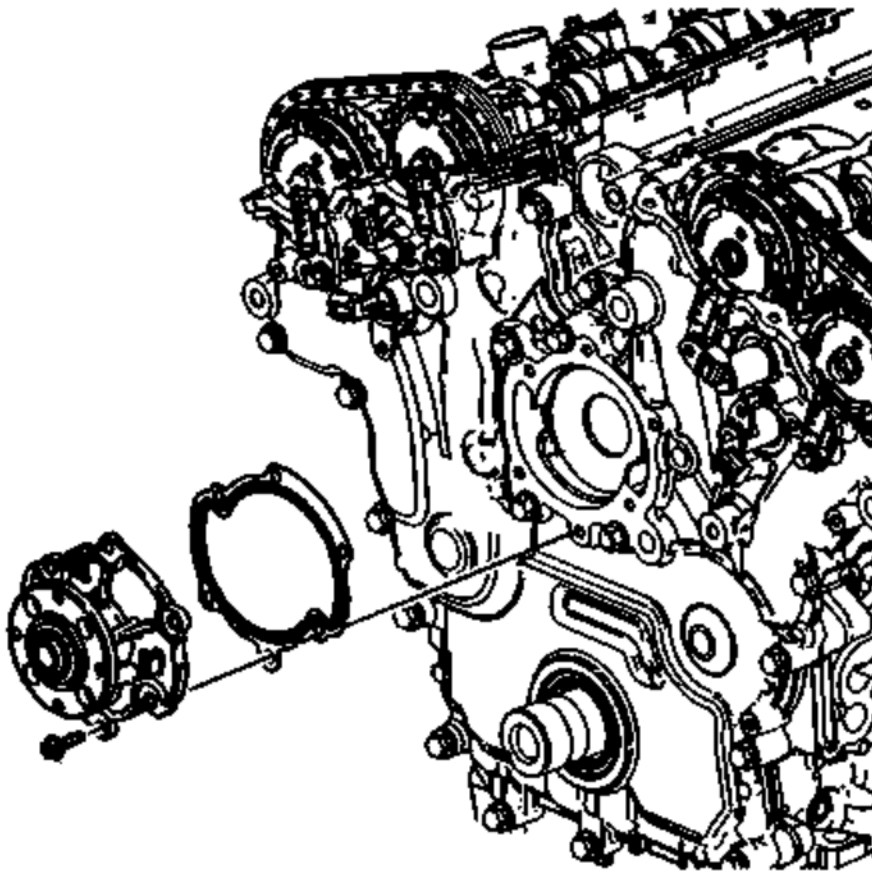


Fig. 37: Identifying Water Pump Components
Courtesy of GENERAL MOTORS COMPANY

9. Remove the water pump.
10. Remove and DISCARD the water pump seal.
11. Carefully clean the water pump sealing surfaces.

Installation Procedure

1. Install a NEW water pump seal.

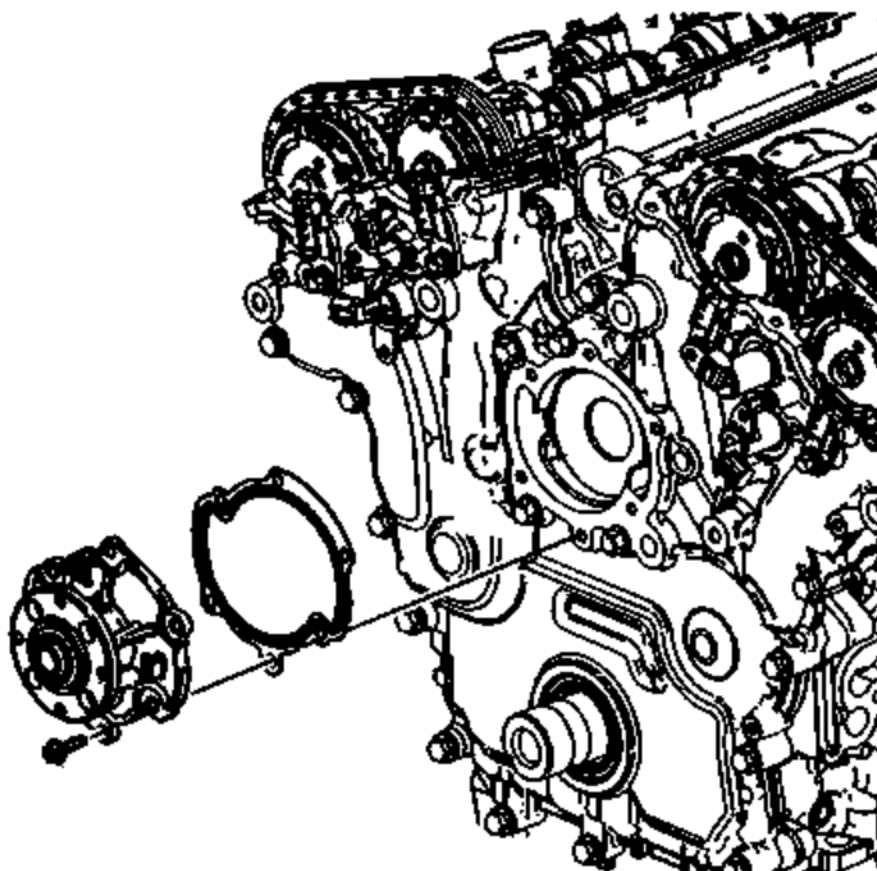


Fig. 38: Identifying Water Pump Components
Courtesy of GENERAL MOTORS COMPANY

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

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

CAUTION: Refer to Fastener Caution .

4. Tighten the water pump bolts in sequence.

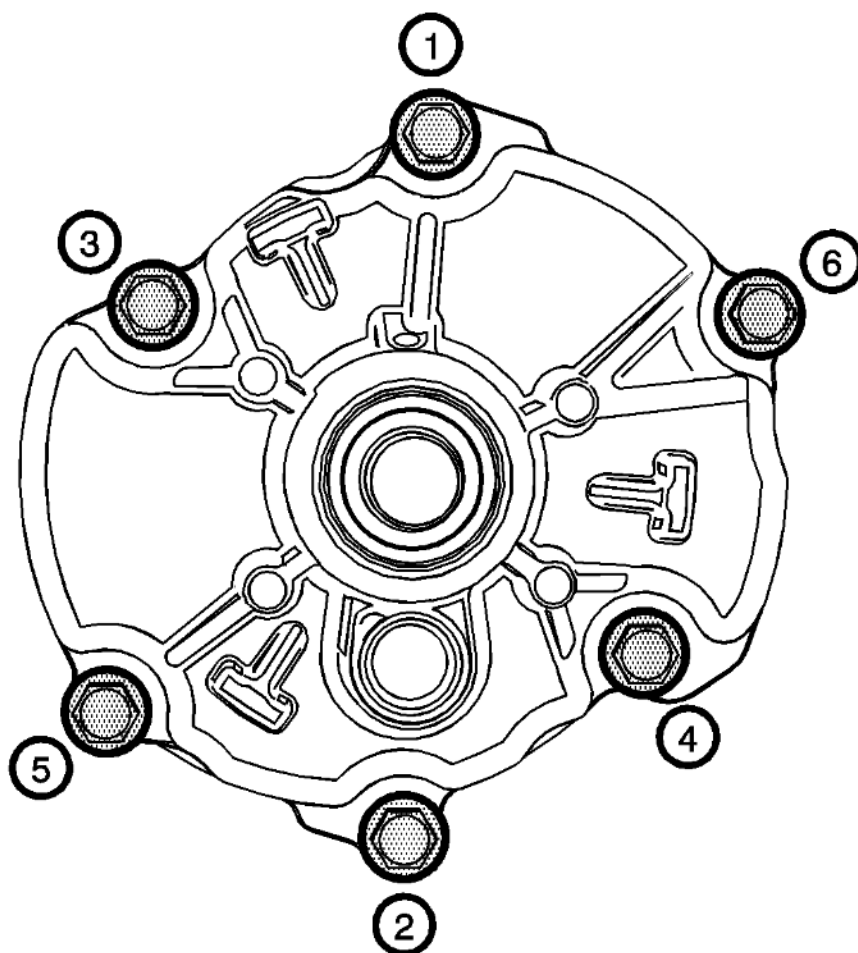


Fig. 39: Water Pump Bolts Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

1. On the initial pass, tighten the bolts in sequence to 10 (89 lb in).
2. On the second pass, tighten the bolts in sequence to 10 (89 lb in).
3. On the final pass, tighten the bolts in sequence shown an additional 45°.
5. Install the water pump pulley bolts.

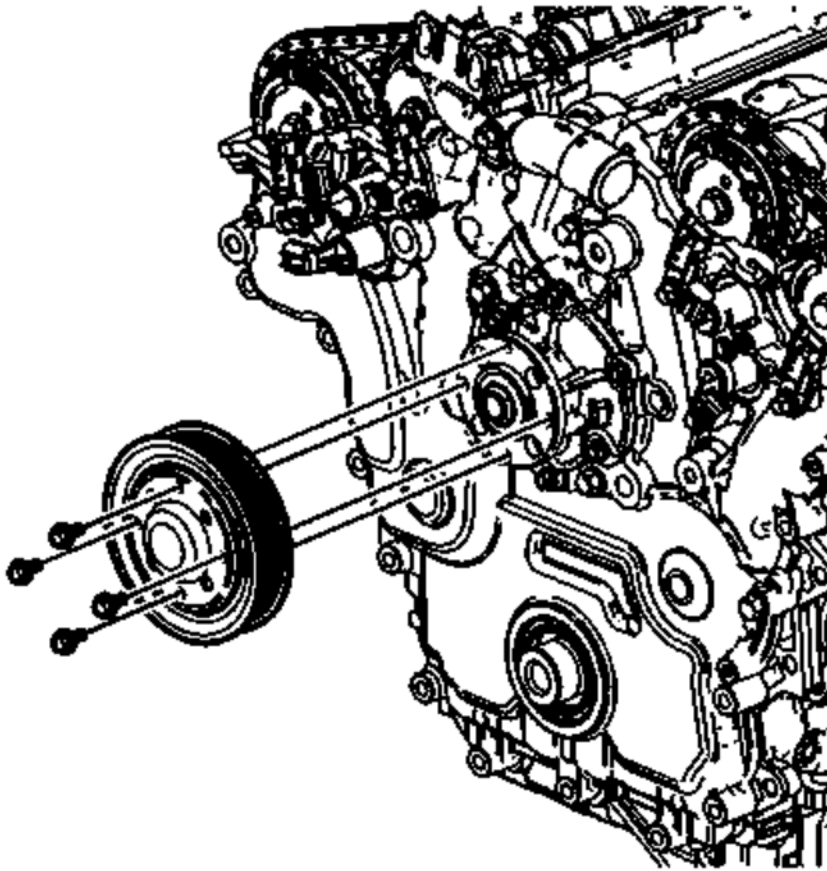


Fig. 40: Locating Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Use the **EN 46104** tool in order to retain the water pump pulley.

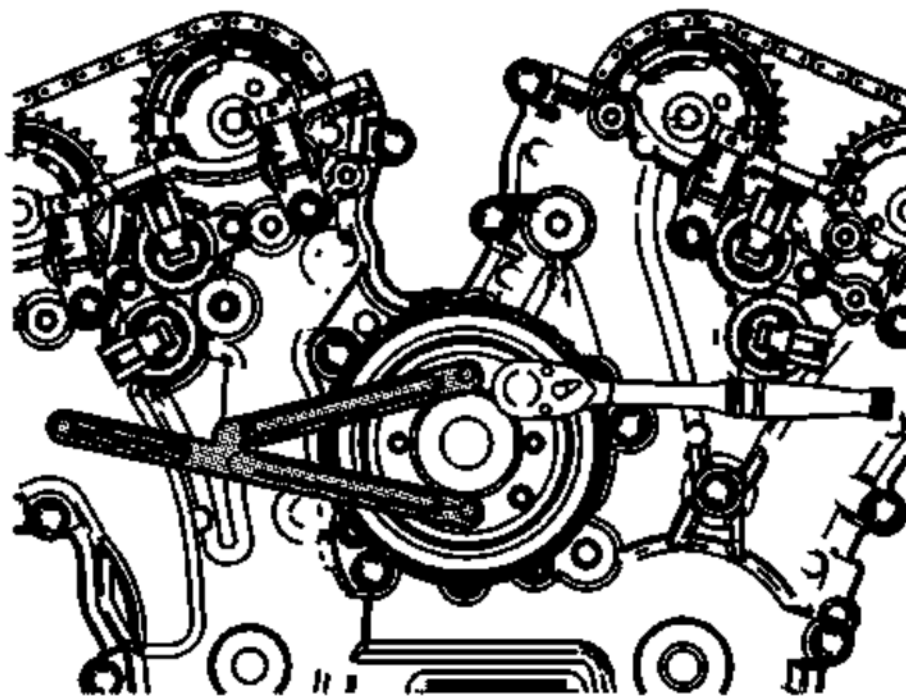
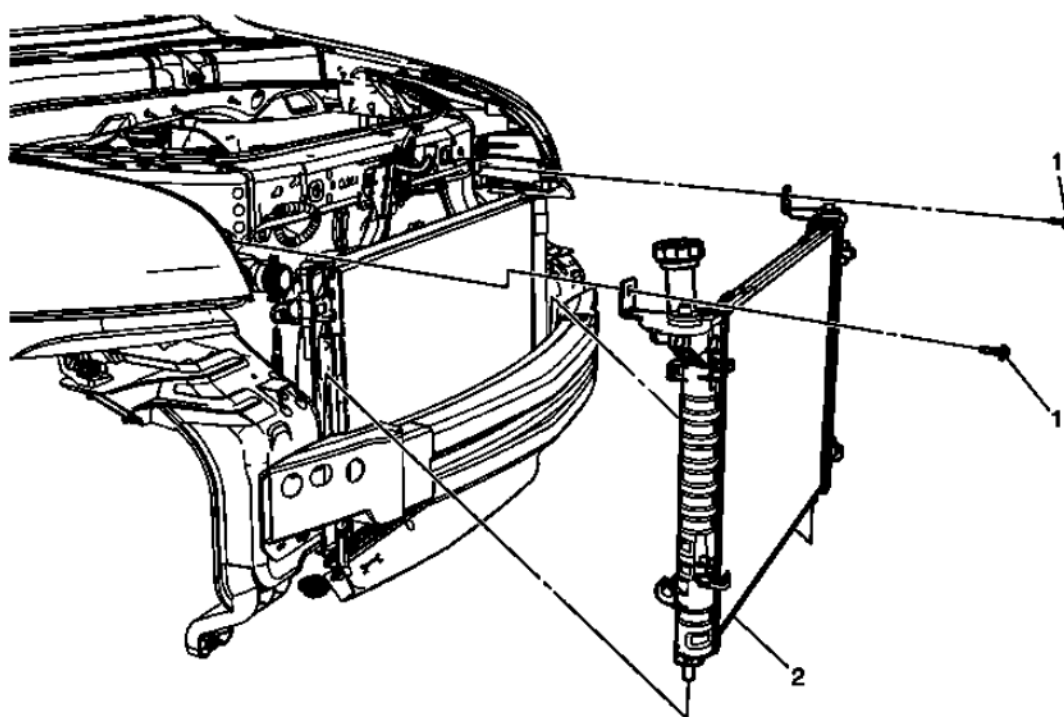


Fig. 41: View Of EN 46104 Installed On Water Pump Pulley
Courtesy of GENERAL MOTORS COMPANY

7. Install the water pump pulley bolts and tighten to 10 (89 lb in).
8. Install the right engine strut mount. Refer to **Engine Mount Strut Replacement - Right Side** .
9. Install the right engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Right Side** .
10. Install the drive belt. Refer to **Drive Belt Replacement** .
11. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)**, **Cooling System Draining and Filling (Vac N Fill)**.

RADIATOR REPLACEMENT

**Fig. 42: Identifying Radiator**

Courtesy of GENERAL MOTORS COMPANY

Radiator Replacement

Callout	Component Name
Preliminary Procedure	
1.	Drain the coolant. Refer to Cooling System Draining and Filling (Static Fill) , Cooling System Draining and Filling (Vac N Fill) .
2.	Remove radiator inlet hose. Refer to Radiator Inlet Hose Replacement .
3.	Remove radiator outlet hose. Refer to Radiator Outlet Hose Replacement .
4.	Remove fan shroud top mounting bolts and pushpin from radiator and position fan shroud rearward. Refer to Cooling Fan and Shroud Replacement .
5.	Remove transmission inlet cooling hose from radiator. Refer to Fluid Cooler Inlet Hose Replacement .
6.	Remove transmission outlet cooling hose from radiator. Refer to Fluid Cooler Outlet Hose Replacement .
7.	Remove coolant reservoir hose from radiator filler neck.
8.	Remove the front bumper fascia upper support. Refer to Front Bumper Fascia Upper Support Replacement (Acadia, Enclave, Traverse) .
9.	Pinch fastening tabs together at top of condenser to remove from radiator and position forward.
10.	Remove side rubber air deflectors from radiator tanks.
	Radiator Mounting Bolt (Qty: 2)

1	CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Radiator NOTE: • Bottom of condenser mounts into holding fixtures at bottom of radiator. • Radiator will slide out between the condenser and fan shroud.

RADIATOR AIR SIDE BAFFLE AND DEFLECTOR REPLACEMENT

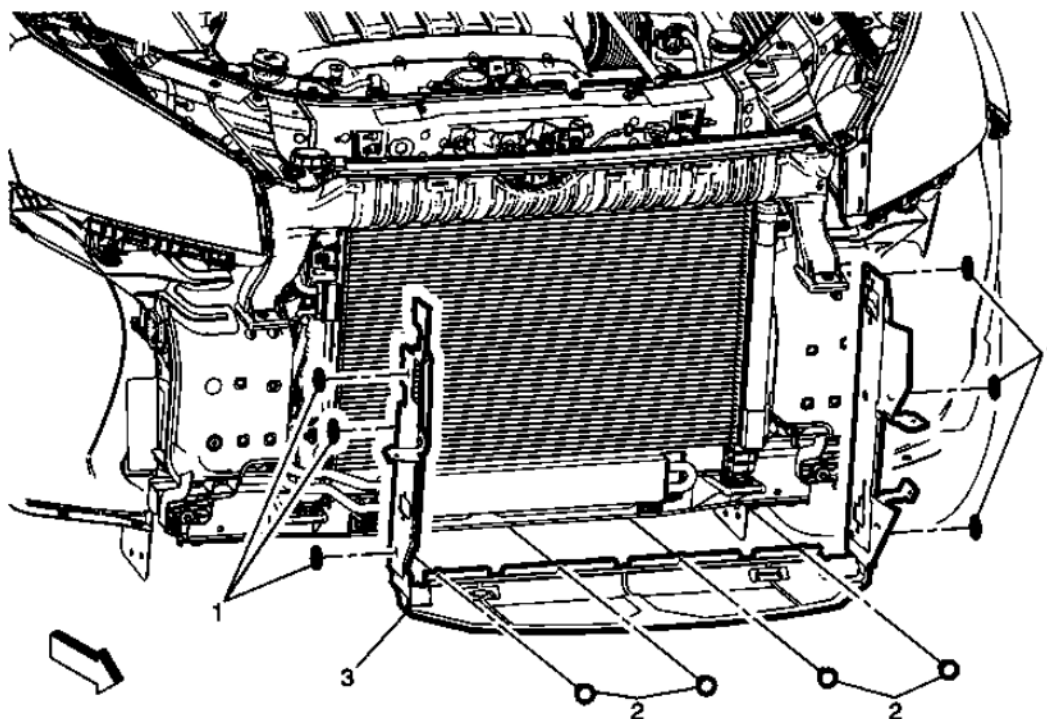


Fig. 43: Radiator Air Side Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

Radiator Air Side Baffle and Deflector Replacement

Callout	Component Name
Preliminary Procedure	
1.	Remove the front bumper impact bar. Refer to <u>Front Bumper Impact Bar Replacement (Acadia)</u> .

2. Reposition the power steering fluid cooler without disconnecting the lines. Refer to **Power Steering Fluid Cooler Replacement** .

1 Radiator Air Side Baffle and Deflector Retainer (Qty: 6)

2 Radiator Air Side Baffle and Deflector Retainer (Qty: 4)

3 Radiator Air Side Baffle and Deflector

Procedure

Pull the sides of the radiator air side baffle and deflector away from the radiator and lower to remove.

COOLANT HEATER REPLACEMENT

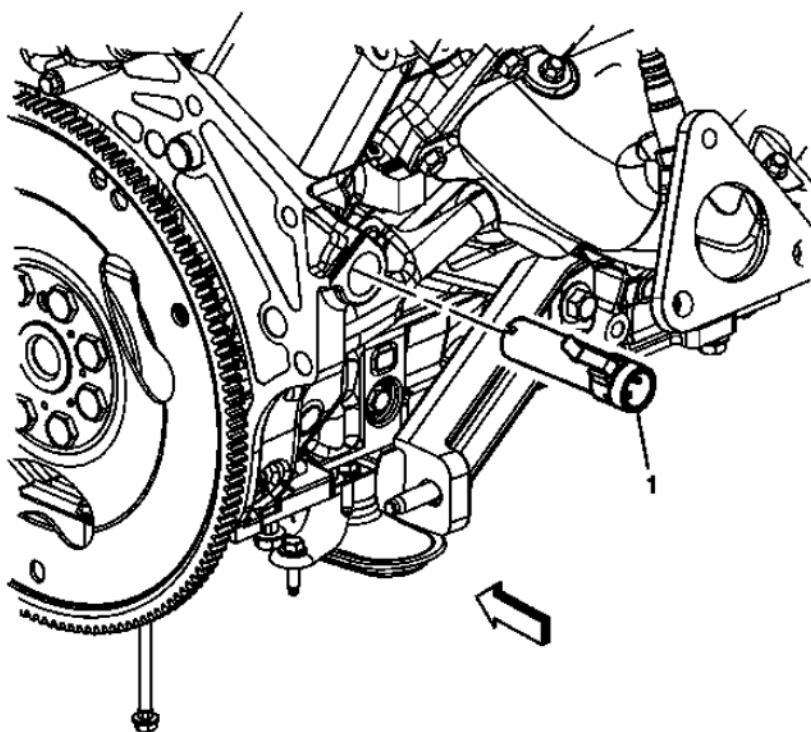


Fig. 44: View Of Coolant Heater

Courtesy of GENERAL MOTORS COMPANY

Coolant Heater Replacement

Callout	Component Name
Preliminary Procedure	
Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Coolant Heater Procedure 1. Disconnect the coolant heater cord from the coolant heater.

2. Remove the coolant heater.

COOLANT HEATER CORD REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.

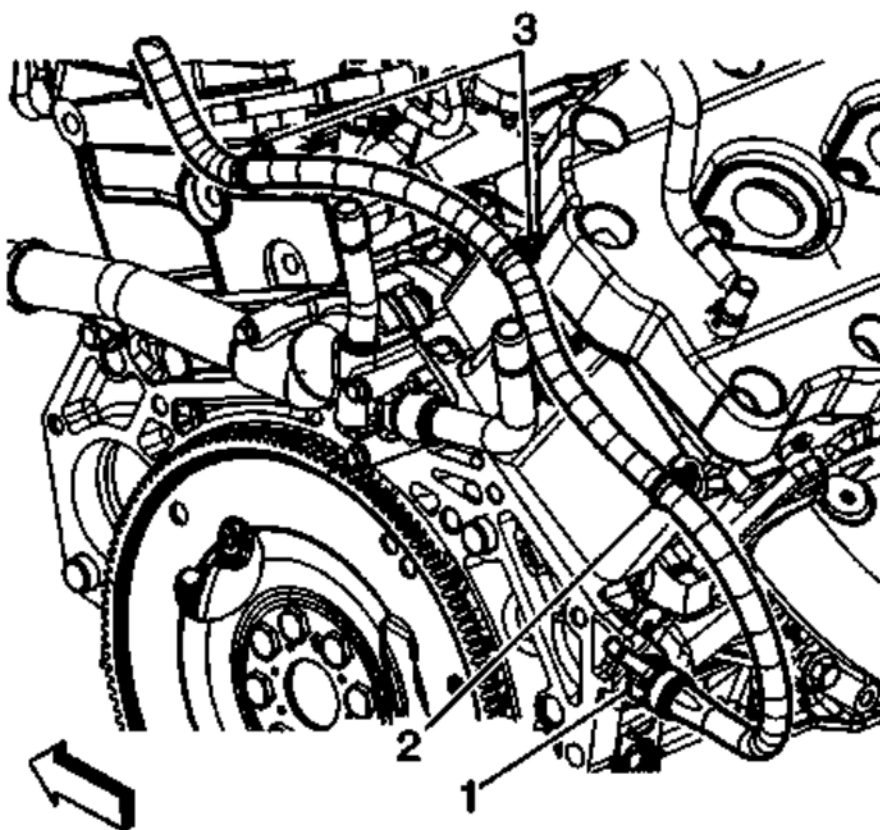


Fig. 45: Identifying Coolant Heater Cord Clips & Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the coolant heater power supply cord from the coolant heater.
3. Lower the vehicle.
4. Disconnect the coolant heater cord clips (3) from the cylinder heads.
5. Disconnect the coolant heater cord clip from the engine wiring harness.

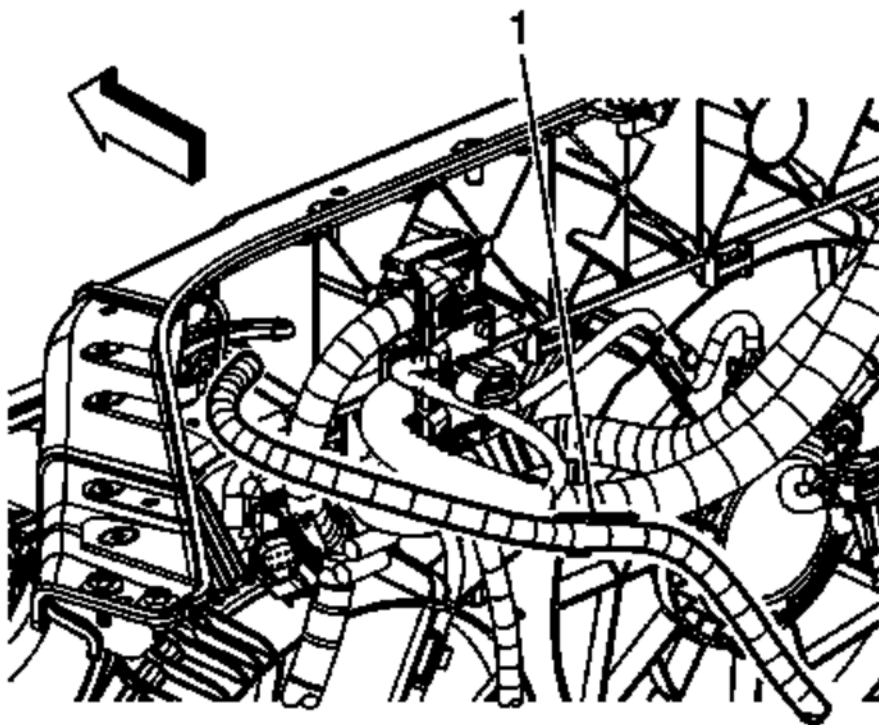


Fig. 46: Identifying Coolant Heater Cord
Courtesy of GENERAL MOTORS COMPANY

6. Remove the coolant heater cord (1) from the vehicle.

Installation Procedure

1. Position the coolant heater cord (1) to the engine harness.

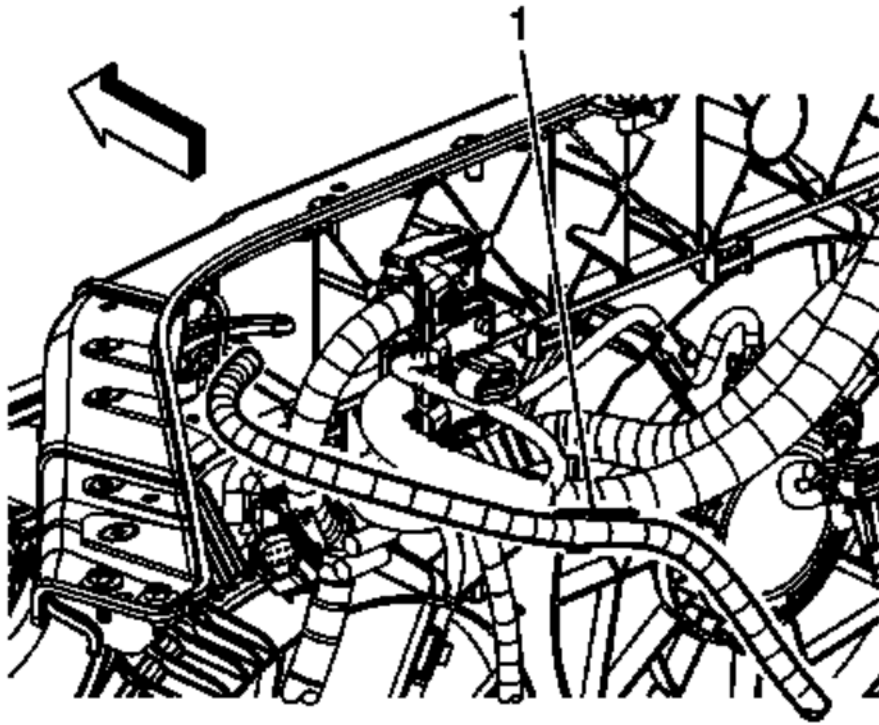


Fig. 47: Identifying Coolant Heater Cord

Courtesy of GENERAL MOTORS COMPANY

2. Connect the coolant heater cord clip to the engine wiring harness.
3. Connect the coolant heater cord clips (3) to the cylinder heads.

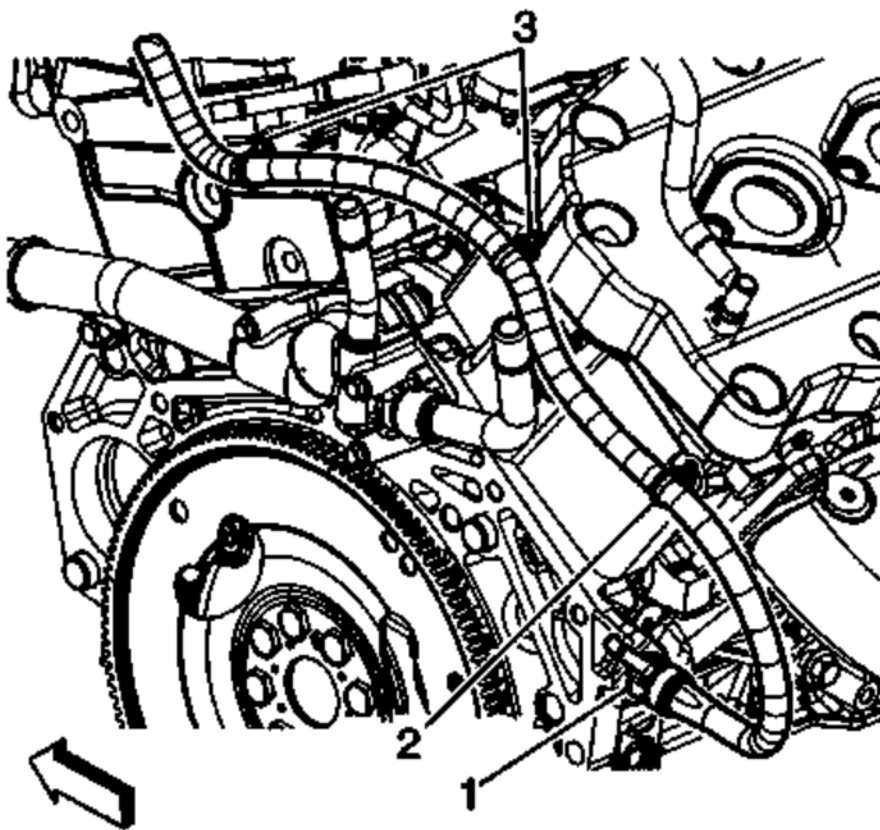


Fig. 48: Identifying Coolant Heater Cord Clips & Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Connect the coolant heater cord to the coolant heater.
6. Lower the vehicle.

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION

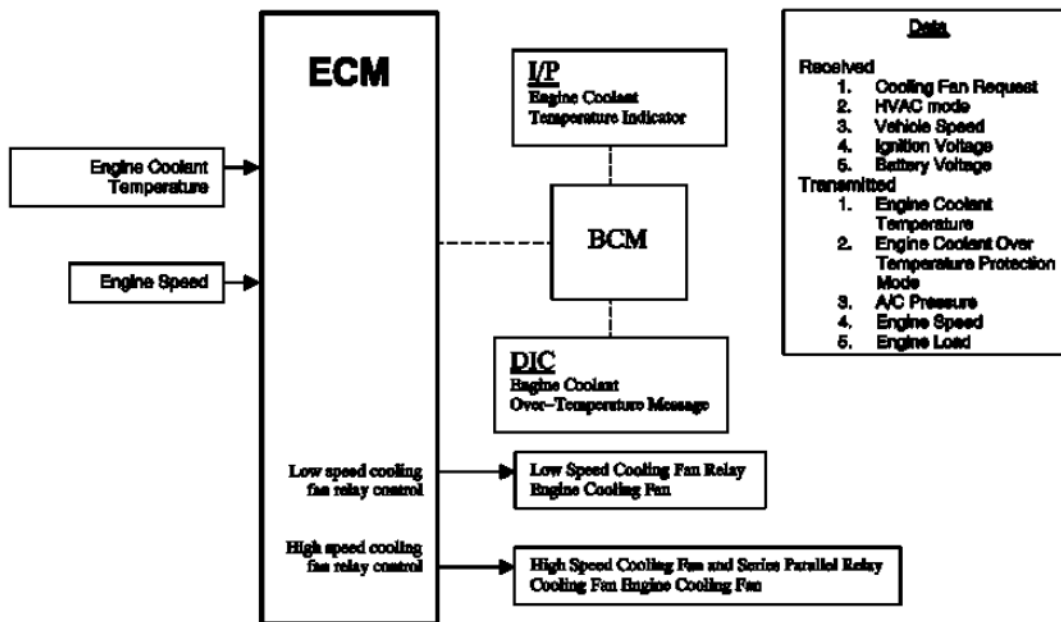


Fig. 49: Cooling Fan Description and Operation
 Courtesy of GENERAL MOTORS COMPANY

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. The cooling fans receive positive voltage from the cooling fan relays which receive battery positive voltage from the underhood fuse block.

During 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 fan 1 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 left engine cooling fan. The ground path for the left cooling fan is through the S/P fan 2 relay and the right engine cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the ECM continues to supply battery positive voltage for the right cooling fan by grounding the coil of the fan 1 relay. The ECM also grounds the high speed fan 3 relay and the S/P fan 2 relay through the fan 3 relay control circuit. This energizes the S/P fan 2 relay coil, closes the relay contacts and provides a direct ground path for the left engine cooling fan. At the same time the fan 3 relay coil is energized closing the relay contacts and providing battery positive voltage from the Fan 2 fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

COOLING SYSTEM DESCRIPTION AND OPERATION

The cooling systems function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat

produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant is drawn from the radiator outlet to the thermostat. The flow of coolant will be stopped at the thermostat until the engine is warmed; while the thermostat is closed the water pump circulates coolant through the engine block and heater core. Coolant is returned to the water pump through the engine bypass and the heater core outlet hose. This provides the passenger compartment with heat and defrost.

After the thermostat opens, the coolant is pumped through the water pump outlet and into the engine block and heater core. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

The coolant is then forced through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where it absorbs additional heat.

From the cylinder heads, the coolant is then forced into the radiator where it is cooled and the coolant cycle is completed.

Operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

Coolant

The engine coolant is a solution made up of a 50/50 mixture of DEX-COOL® and suitable drinking water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger consisting of a core and 2 tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

Heat is removed from the coolant as the coolant passes through the radiator. The fins on the core transfer heat from the coolant passing through the tubes. Air passing between the fins absorbs the heat and cools the coolant.

Pressure Cap

The pressure cap seals and pressurizes the cooling system. The cap contains a blow off or pressure valve and a vacuum or an atmospheric valve:

- The pressure valve is held against the seat by a spring that protects the radiator by relieving pressure that exceeds 15 psi.
- The vacuum valve is held against the seat by a spring that permits opening of the valve to relieve vacuum created when the cooling system cools. The vacuum, if not relieved, might cause the radiator to collapse.

The pressure cap allows the cooling system pressure to build up when the temperature increases. As the pressure builds, the boiling point of the coolant increases. Therefore, the engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant becomes, the faster the heat transfers from the radiator into the cooler air.

The pressure in the cooling system can get too high. When the pressure exceeds the strength of the spring, the pressure valve rises, venting the excess pressure.

As the engine cools, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open. This equalizes the pressure in the cooling system with the atmospheric pressure, preventing the radiator from collapsing.

Coolant Recovery System

The coolant recovery system consists of a plastic coolant recovery reservoir and overflow tube. The recovery reservoir is also called a recovery tank or expansion tank. This tank is partially filled with coolant and is connected to the radiator fill neck with the overflow tube. Coolant can flow back and forth between the radiator and the reservoir.

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure within the cooling system gets too high, the pressure valve in the pressure cap will open. This allows the coolant, which has expanded due to heat, to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is the elimination of almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle and through the radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

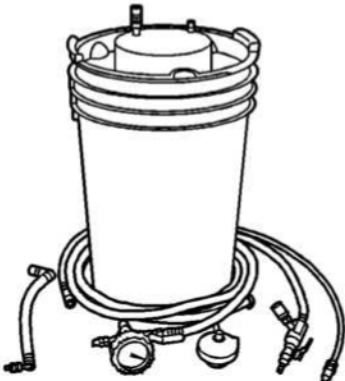
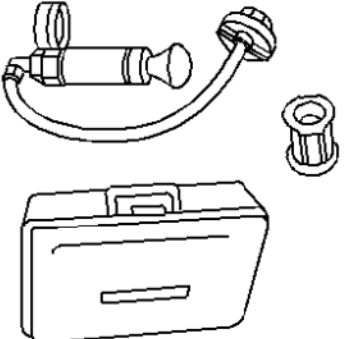
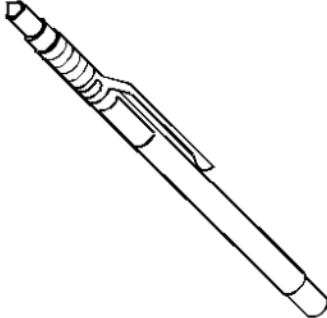
Transmission Oil Cooler

The transmission oil cooler is a heat exchanger that is located inside one of the radiator end tanks. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator. The oil pump pumps the fluid through the transmission oil cooler feed line to the oil cooler. The fluid flows through the

cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the oil cooler return line back to the transmission.

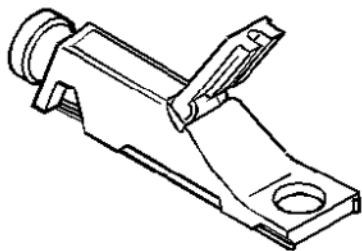
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	GE-47716 Vac N Fill Coolant Refill Tool
	EN-24460-A J-24460-01 Cooling System Pressure Tester
	GE-24731 J-24731 Tempilstick

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GE-26568
J-26568
Coolant and Battery Fluid Tester



DT-28585
J-28585
Universal Snap Ring Remover

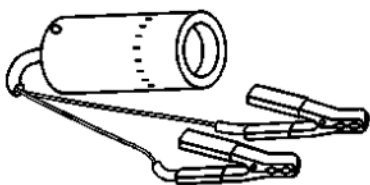
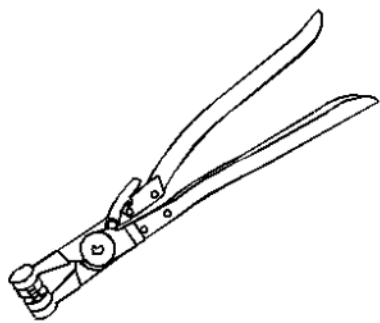


EL-35616-F
Connector Test Adapter Kit

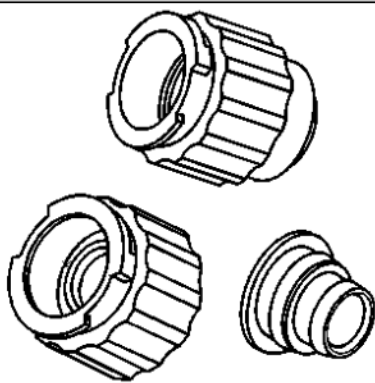
BO-38185
J-38185
Hose Clamp Pliers

2014 GMC Acadia Denali

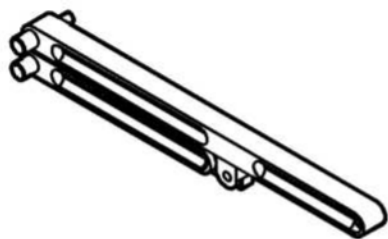
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GE-42220
J-42220
Universal 12V Leak Detection Lamp

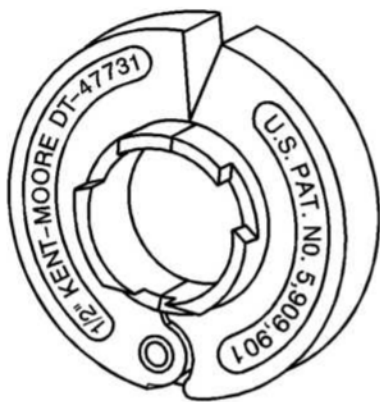


GE-42401-A
J-42401
Radiator Cap and Surge Tank Test Adapter



EN-46104
J-46104
Water Pump Pulley Holding Tool

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DT-47731
Cooler Line Quick Release Tool