Engine Heating and Cooling

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Description and Operation

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. DESCRIPTION AND OPERATION
4.

Cooling System Description and Operation

Cooling System

The cooling system maintains the engine operating temperature at the efficient level under any speed and operating condition. When the engine is cold, the cooling system cools the engine slowly or not at all. The slow cooling of the engine allows the engine to warm up quickly. The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, an oil cooler, a water pump and a water pump drive belt. The accessory belt drives the water pump. All components must function properly in order for the cooling system to operate. Before the coolant reaches operating temperature of the thermostat, the coolant circulates through water jackets in the engine block, the cylinder head, the heater core and the oil cooler. The coolant pump draws the coolant from the bypass pipe which the pipe receives returning floe form the engine and the heater core. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes to the radiator where it cools. This system directs some coolant through the hoses or pipes to the heater core and oil cooler. This provides for heating, defrosting and engine oil cooling. The surge tank is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The surge tank maintains the correct coolant level. The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the surge tank.

Water Pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley. The water pump is mounted on the front of the transverse-mounted engine and is driven by the accessory belt.

The impeller is supported by a completely sealed bearing. The water pump is serviced as an assembly and cannot be disassembled.

Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the rear of the cylinder head. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated through the radiator. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve. To provide fuel economy and low emission benefit during part load driving condition, the electric controlled thermostat enables changing the thermostat opening temperature. Basically, the thermostat begins to open at 105Â°â€‰C (221Â°â€‰F) and is fully open at 120Â°â€‰C (248Â°â€‰F) when the electric energy not assisted.

If a certain driving environment encountered that requiring better cooling performance, the ECM orders to put electric energy to the thermostat. The energized electric heater in the wax pellet gives thermal energy to the wax for assisting the wax expansion. Then the thermostat valve opens earlier than the specified coolant temperature. For this vehicle, the programmed temperature set value by the ECM is 105Â°â€‰C (221Â°â€‰F) for cold and part load driving mode and 90Â°â€‰C (194Â°â€‰F) for hot and full load driving mode.

Radiator

The radiator is a heat exchanger. It consists of a core and 2â€‰tanks. The aluminum core is a tube and fin cross-flow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

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

The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Surge Tank

The surge tank is a plastic tank with a threaded pressure cap. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system that allows the coolant to expand and contract. The surge tank provides a coolant fill point and a central air bleed location. During vehicle use, the coolant heats and expands. The increased coolant volume flows into the surge tank. As the coolant circulates, any air is allowed to bubble out. Coolant without air bubbles absorbs heat much better than coolant with bubbles.

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DESCRIPTION AND OPERATION
4.

Thermostat Heater Control System Description

A conventional thermostat valve is moved only by the coolant temperature. The temperature range at which the thermostat begins to open is fixed and cannot be adjusted. An electric thermostat valve is moved by the coolant temperature and the built-in heater that is controlled electrically by the ECM. The ECM controls the heater by providing a pulse width modulated (PWM) ground to the thermostat heater control circuit. In this system, a desired ECT can be achieved causing the vehicle better fuel consumption and reduced emissions in city driving or slow cruising.

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Diagnostic Information and Procedures

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

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

Diagnostic Instructions

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

DTC Descriptors

DTC P0480

Cooling Fan Relayâ€‰1 Control Circuit

DTC P0481

Cooling Fan Relayâ€‰2 Control Circuit

DTC P0691

Cooling Fan Relayâ€‰1 Control Circuit Low Voltage

DTC P0692

Cooling Fan Relayâ€‰1 Control Circuit High Voltage

DTC P0693

Cooling Fan Relayâ€‰2 Control Circuit Low Voltage

DTC P0694

Cooling Fan Relayâ€‰2 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Voltage Supply	â€”	P0480, P0481	â€”	â€”
Relay Switch B+	1	1	â€”	â€”
KR20Câ€‰Cooling Fan Low Speed Relay Control	P0691	P0480	P0692, 3	â€”
KR20Dâ€‰Cooling Fan High Speed Relay Control	P0694	P0481	P0694, 3	â€”
Relay Controlled Output	1	1	2	â€”
1. Fans inoperative without a DTC. 2. Fans always ON without a DTC. 3. The ECM must be commanding the relay ON in order for the DTC to set.				

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, 2â€‰relays, the engine control moduleâ€‰(ECM), and the associated wiring. The cooling fan assembly includes 1â€‰resistor mounted in the cooling fan shroud. This combination of components enables the ECM to operate the cooling fan at 2â€‰speeds using two fan control circuits. 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. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Conditions for Running the DTC

- The ignition voltage is 11â€“18â€‰volts.

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- The engine speed is 400â€‰RPM or greater.
- The ECM has commanded the output driver ON and OFF at least once during the ignition cycle.
- The DTCs run continuously when the conditions above are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTCs P0480, P0481, P0691, P0692, P0693, and P0694 are Typeâ€‰B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0480, P0481, P0691, P0692, P0693, and P0694 are Typeâ€‰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 Relayâ€‰1 operates the fan at low speed
    - Cooling Fan Relayâ€‰2 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

Master Electrical Component List

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.

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2. Verify an audible click is heard or felt from each cooling fan relay when commanding the cooling fan ON and OFF with a scan tool.
3.
    - **If a click is not heard or felt at each of the relays**
    - Refer to Circuit/System Testing.
4.
    - **If a click is heard or felt at each of the relays**
5. 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.
6. Verify the DTC does not set.
7.
    - **If the DTC sets**
    - Refer to Circuit/System Testing.
8.
    - **If the DTC does not set**
9. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the cooling fan relays listed below:
2.
    - KR20Câ€‰Cooling Fan Low Speed Relay
    - KR20Dâ€‰Cooling Fan High Speed Relay
3. Note**:**

   The following test must be performed on each of the relay coil ignition circuits.
4. Ignition ON, verify that a test lamp illuminates between ground and the relay coil ignition circuit terminal listed below:
5.
    - KR20Câ€‰Cooling Fan Low Speed Relay terminalâ€‰85
    - KR20Dâ€‰Cooling Fan High Speed Relay terminalâ€‰85
6.
    - **If the test lamp does not illuminate and the fuse is good**
7.
    1. Ignition OFF, and all vehicle systems OFF, it may take up to 2â€‰minutes for all vehicle systems to power down.
    2. Test for less than 2â€‰â„¦ in the ignition circuit of the appropriate cooling fan relay, end to end.
    3.
        - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
        - If less than 2â€‰â„¦, verify the fuse is not open and there is voltage at the fuse.
8.
    - **If the test lamp does not illuminate and the circuit fuse is open**
9.

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1. Ignition OFF, and all vehicle systems OFF, it may take up to 2â€‰minutes for all vehicle systems to power down.
2. Test for infinite resistance between the relay coil ignition circuits listed below and ground:
3.
    - KR20Câ€‰Cooling Fan Low Speed Relay terminalâ€‰85
    - KR20Dâ€‰Cooling Fan High Speed Relay terminalâ€‰85
4.
    - If less than infinite resistance, repair the short to ground in the circuit.
    - If infinite resistance, test all of the appropriate relays for a short and replace as necessary.

10.
    - **If the test lamp illuminates**

11. Ignition OFF, remove the test lamp, ignition ON.
12. Note**:**

    The following tests must be performed on the two fan relay control circuits.

13. Connect a DMM, set on the diode setting, between a control circuit terminal listed below and ground:
14.
    - KR20Câ€‰Cooling Fan Low Speed Relay terminalâ€‰86
    - KR20Dâ€‰Cooling Fan High Speed relay terminalâ€‰86

15. Verify the DMM reading is greater than 2.5â€‰V or displays O.L.
16.
    - **If 2.5â€‰V or less**

17.
    1. Ignition OFF, and all vehicle systems OFF, it may take up to 2â€‰minutes for all vehicle systems to power down. Disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module.
    2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
    3.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20â€‰Engine Control Module.

18.
    - **If greater than 2.5â€‰V or displays O.L.**

19. Note**:**

    The following test must be performed on the two fan relay circuits.

20. Verify the DMM reading is less than 1â€‰V when commanding the Cooling Fan Relays ON with a scan tool.
21.
    - **If 1â€‰V or greater**

22.
    1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
    2. Test for less than 1â€‰V between the appropriate KR20â€‰Cooling Fan Relay control circuit and ground.

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3.

- If 1â€‰V or greater, repair the short to voltage on the circuit.

4.

- If less than 1â€‰V.

5. Ignition OFF.
6. Test for less than 2â€‰â„¦ in the appropriate cooling fan relay control circuit end to end.
7.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, replace the K20â€‰Engine Control Module.

23.

- **If less than 1â€‰V**

24. Test or replace the appropriate cooling fan relay.

Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70â€“110â€‰â„¦ between terminalsâ€‰85/2 and 86/1.
4.

- **If less than 70â€‰â„¦ or greater than 110â€‰â„¦**
- Replace the cooling fan relay.

5.

- **If between 70â€“110â€‰â„¦**

6. Test for infinite resistance between following terminals:
7.

- 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 cooling fan relay.

-

  - **If infinite resistance**

8. Install a 20â€‰A fused jumper wire between relay terminalâ€‰85/2 and 12â€‰V.
9. Install a jumper wire between relay terminalâ€‰86/1 and ground.
10. Test for less than 2â€‰â„¦ between terminalsâ€‰30/3 and 87/5.
11.

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- **If 2â€‰â„¦ or greater**
- Replace the cooling fan relay.

12.

- **If less than 2â€‰â„¦**

13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Relay Replacement
- Control Module References for ECM replacement, programming, and setup

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

DTC P0597-P0599

Symptoms

Diagnostic Trouble Codes - P0598

Diagnostic Instructions

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

DTC Descriptors

DTCâ€‰P0597

Engine Coolant Thermostat Heater Control Circuit Malfunction

DTCâ€‰P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTCâ€‰P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0597, 1	P0597, 1	â€”	â€”
Control	P0598	P0598	P0597, P0599	â€”
1. Thermostat Heater Malfunction				

Circuit/System Description

The ECM controls the pulse width modulated (PWM) thermostat. The engine coolant thermostat heater controls coolant flow and regulates the engine operating temperature. The ignition relay supplies 12â€‰V to the thermostat through a fuse. The ECM controls the engine coolant thermostat heater by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTC

- The ignition is ON, or the engine is running.
- The ignition voltage is greater than 9â€‰V.
- DTCâ€‰P0597, P0598, and P0599 run continuously once the above conditions are met.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTCâ€‰P0597, P0598, P0599 are Type C DTCs.

Conditions for Clearing the DTC

DTCâ€‰P0597, P0598, P0599 are Type C DTCs.

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Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Master Electrical Component List

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. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.Loss of Coolant and Cooling System Draining and Filling
2.
    - **If the coolant level is not correct**
    - Repair as necessary.
3.
    - **If the coolant level is correct**
4. Ignition ON.
5. Verify the parameters listed below do not display Malfunction when commanding the Engine Coolant Thermostat Heater ON and OFF with a scan tool.
6.
    - Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status
    - Engine Coolant Thermostat Heater Control Circuit Open Test Status
    - Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status
    -

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- **If Malfunction is displayed**
- Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

7. 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.
8. Verify the DTC does not set.
9.
   - **If any DTC sets**
   - Refer to Circuit/System Testing.
10.
    - **If the DTC does not set**
11. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the E41â€‰Engine Coolant Thermostat Heater, Ignition ON.
2. Verify that a test lamp illuminates between the ignition circuit terminalâ€‰1 and ground.
3.
   - **If the test lamp does not illuminate and the circuit fuse is good**
4.
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2â€‰â„¦ in the ignition circuit end to end.
   3.
      - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
      - If less than 2â€‰â„¦ verify the fuse is not open and there is voltage at the fuse.
5.
   - **If the test lamp does not illuminate and the circuit fuse is open**
6.
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground
   3.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance, test all the components connected to fuse and replace as necessary.
7.
   - **If the test lamp illuminates**
8. Connect a test lamp between the ignition circuit terminalâ€‰1 and the control circuit terminalâ€‰2, command the Engine Coolant Thermostat Heater to Increase to 100â€‰% and Decrease to 0â€‰% with a scan tool.
9. Verify that a test lamp turns On and OFF.

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10.

- **If the test is always ON**

11.

1. Ignition OFF, disconnect the harness connector at the K20â€‰Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
3.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance, replace the K20â€‰Engine Control Module.
4.
   - **If the test lamp is always OFF**

12.

1. Ignition OFF, disconnect the harness connector at the K20â€‰Engine Control Module, ignition ON.
2. Test for less than 1â€‰V between the control circuit and ground.
3.
   - If 1â€‰V or greater, repair the short to voltage on the circuit.
4.
   - If less than 1â€‰V.

13.

1. Test for less than 2â€‰â„¦ in the control circuit end to end.
2.
   - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
   - If less than 2â€‰â„¦ replace the K20â€‰Engine Control Module

14.

- **If the test lamp turns On and OFF**

15. Test or replace the E41â€‰Engine Coolant Thermostat Heater.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Engine Coolant Thermostat Housing Replacement for E41â€‰engine coolant thermostat heater replacement.
- Control Module References for ECM replacement, programming and setup.

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

DTC P1484

Diagnostic Instructions

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

DTC Descriptor

DTCâ€‰P1484

Cooling Fan System Performance

Diagnostic Fault Information

Cooling Fan Low Speed Relay

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Relay Coil Ignition	P06910	P0691	P0480	â€”	â€”
Relay Switch B+	1	1	1	â€”	â€”
Relay Coil Control	P0691	P0691	P0480	P0692	P1484
Relay Output Control	1	1	1	2	â€”
1. Fan Malfunction Without a DTC. 2. Fan Always ON Without a DTC.					

Cooling Fan Medium Speed Relay

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Relay Coil Ignition	P0693	P0693	P0481	â€”	â€”
Relay Switch B+	1	1	1	â€”	â€”
Relay Coil Control	P0693	P0693	P0481	P0694	P1484
Relay Output Control	1	1	1	2	â€”
1. Fan Malfunction Without a DTC. 2. Fan Always ON Without a DTC.					

Cooling Fan High Speed Relay

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Relay Coil Ignition	P0695	P0695	P0482	â€”	â€”
Relay Switch B+	1	1	1	â€”	â€”
Relay Coil Control	P0695	P0695	P0482	P0696	P1484
Relay Output Control	1	1	1	2	â€”
1. Fan Malfunction Without a DTC. 2. Fan Always ON Without a DTC.					

Circuit/System Description

The ECM commands the fans ON in either high speed, medium speed, or low speed, depending on cooling requirements.

Low Speed

In low speed operation, the ECM applies ground to the coil side of the cooling fan low speed relay with the cooling fan relay 1 control circuit.

This energizes the relay coil. The low speed cooling fan relay supply power to the cooling fan motor through an internal fan resistor.

Medium Speed

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In medium speed operation, the ECM commands the medium speed fan relay on. This energizes the relay coil. The medium speed cooling fan relay supply power to the cooling fan motor through an internal fan resistor. The cooling fan is connected to a dedicated ground, and operates at medium speed.

High Speed

In high speed operation, the ECM applies a ground to the coil side of all the high speed cooling fan relay. When energized, the high speed relays apply voltage directly to the cooling fan through the switch side of the relay.

Conditions for Running the DTC

- The ignition voltage is between 8â€“18â€‰V.
- The engine is running greater than or equal to 400â€‰RPM.

Conditions for Setting the DTC

The ECM detects an over current at the output powerstage.

Action Taken When the DTC Sets

DTC P1484 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1484 is a Type A DTC.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

Master Electrical Component List

Description and Operation

Cooling System 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 that DTCs P0480, P0481, P0691, P0692, P0693 or P0694 are not set.
3.
    - **If DTC P0480, P0481, P0691, P0692, P0693, or P0694 is set**

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- If DTC is present, refer to DTC P0480, P0481, P0691, P0692, P0693, or P0694.

4.

- **If DTCâ€‰P0480, P0481, P0691, P0692, P0693 or P0694 is not set**

5. Verify that DTC P1484 is not set.

6.

- **If DTCâ€‰P1484 is set**
- Refer to Circuit/System Testing.

7.

- **If DTCâ€‰P1484 is not set**

8. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
9. Verify the DTC does not set.
10.

- **If the DTC sets**
- Refer to Circuit/System Testing

11.

- **If the DTC does not set**

12. Command the Cooling Fan Relay 1 ON and OFF with a scan tool. The cooling fan motor should turn ON at low speed and OFF when changing between the commanded states.
13.

- **If the cooling fan motor does not turn ON and OFF at low speed as commanded**
- Refer to Cooling Fan Always On, or to Cooling Fan Inoperative.

14.

- **If the cooling fan motor turns ON and OFF at low speed as commanded**

15. Command the Cooling Fan Relay 2 ON and OFF with a scan tool. The cooling fan motor should turn ON at medium speed and OFF when changing between the commanded states.
16.

- **If the cooling fan motor does not turn ON and OFF at medium speed as commanded**
- Refer to Cooling Fan Always On, or to Cooling Fan Inoperative.

17.

- **If the cooling fan motor turns ON and OFF at medium speed as commanded**

18. Command the Cooling Fan Relay 3 ON and OFF with a scan tool. The cooling fan motor should turn ON at high speed and OFF when changing between the commanded states.
19.

- **If the cooling fan motor does not turn ON and OFF at high speed as commanded**
- Refer to Cooling Fan Always On, or to Cooling Fan Inoperative.

20.

- **If the cooling fan motor turns ON and OFF at high speed as commanded**

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21. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect all cooling fan relays.
2. Note**:**

   The following tests must be performed on all fan relay circuits.
3. Ignition ON, command the Cooling Fan Low Speed Relay ON and OFF with a scan tool.
4. Verify the DTCâ€‰P1484 does not reset.
5.
   - **If DTCâ€‰P1484 is set**
6.
   1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module.
   2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
   3.
      - If less than infinite resistance, repair the short to ground on the circuit.
   4.
      - **If infinite resistance**
7. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
8. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
9.
   - **If 1â€‰V or greater**
10.
    1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
    2. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
    3.
       - If 1â€‰V or greater, repair the short to voltage on the circuit.
    4.
       - If less than 1â€‰V.
    5. Ignition OFF.
    6. Test for less than 2â€‰â„¦ in the appropriate cooling fan relay control circuit end to end.
    7.
       - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
       - If less than 2â€‰â„¦, replace the K20â€‰Engine Control Module.
    8.
       - **If less than 1â€‰V**
11. Ignition ON, command the Cooling Fan Medium Speed Relay ON and OFF with a scan tool.
12. Verify the DTCâ€‰P1484 does not reset.

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13.

- **If DTCâ€‰P1484 is set**

14.

1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module.
2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
3.
   - If less than infinite resistance, repair the short to ground on the circuit.
4.
   - **If infinite resistance**

15. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
16. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
17.

- **If 1â€‰V or greater**

18.

1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
2. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
3.
   - If 1â€‰V or greater, repair the short to voltage on the circuit.
4.
   - If less than 1â€‰V.
5. Ignition OFF.
6. Test for less than 2â€‰â„¦ in the appropriate cooling fan relay control circuit end to end.
7.
   - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
   - If less than 2â€‰â„¦, replace the K20â€‰Engine Control Module.
8.
   - **If less than 1â€‰V**

19. Ignition ON, command the Cooling Fan High Speed Relay ON and OFF with a scan tool.
20. Verify the DTCâ€‰P1484 does not reset.
21.

- **If DTCâ€‰P1484 is set**

22.

1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module.
2. Test for infinite resistance between the appropriate relay coil control circuit and ground.
3.
   - If less than infinite resistance, repair the short to ground on the circuit.

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4.

- **If infinite resistance**

23. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
24. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
25.

- **If 1â€‰V or greater**

26.

1. Ignition OFF, disconnect the X1â€‰harness connector at the K20â€‰Engine Control Module, ignition ON.
2. Test for less than 1â€‰V between the appropriate cooling fan relay control circuit and ground.
3.

- If 1â€‰V or greater, repair the short to voltage on the circuit.

4.

- If less than 1â€‰V.

5. Ignition OFF.
6. Test for less than 2â€‰â„¦ in the appropriate cooling fan relay control circuit end to end.
7.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, replace the K20â€‰Engine Control Module.

8.

- **If less than 1â€‰V**

27. Test or replace the X50Aâ€‰Fuse Block â€“ Underhood.

Component Testing

1. Ignition OFF.
2. Disconnect the appropriate cooling fan relay.
3. Test for 65â€“105â€‰â„¦ between terminalsâ€‰85 and 86.
4.

- **If less than 65â€‰â„¦ or greater than 105â€‰â„¦**
- Replace the appropriate cooling fan relay.

5.

- **If between 65â€“105â€‰â„¦**

6. Test for infinite resistance between the following terminals:
7.

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

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- OR
- 3 and 2
- 3 and 5
- 3 and 1
- 1 and 5

8.
   - **If less than infinite resistance**
   - Replace the appropriate cooling fan relay.

9.
   - **If infinite resistance**

10. Install a 20â€‰A fused jumper wire between relay terminalâ€‰85 and 12â€‰V.
11. Install a jumper wire between relay terminalâ€‰86 and ground.
12. Test for less than 2â€‰â„¦ between terminalsâ€‰30 and 87.
13.
   - **If 2â€‰â„¦ or greater**
   - Replace the appropriate cooling fan relay.

14.
   - **If less than 2â€‰â„¦**

15. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Relay Replacement
- Control Module References for Engine Control Module replacement, programming and setup.

Repair Verification

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

Ignition ON, verify with a scan tool that the ECM is not commanding fan activation. Ignition ON, observe that the fan is not activated.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

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

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- Terminal contact
- High circuit or component resistanceâ€"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:

- Engine Overheating
- Loss of Coolant
- Thermostat Diagnosis
- Engine Fails To Reach Normal Operating Temperature

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

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 provide an overview of each diagnostic category.

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing one electric cooling fan. The engine control moduleâ€‰(ECM) uses two fan control circuits and a series of two 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, the fan is turned ON at a reduced speed. High speed has the fan turned ON at full speed.

Diagnostic Aids

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

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

Master Electrical Component List

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.

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2. Verify that DTCâ€‰P0480 or P0481 is not set.
3.
   - **If any of the DTCs are set**
   - Refer to Diagnostic Trouble Code (DTC) List - Vehicle.
4.
   - **If none of the DTCs are set**
5. Verify the scan tool parameters listed below display OFF:
6.
   - Cooling Fan Relayâ€‰1 Command
   - Cooling Fan Relaysâ€‰2 Command
7.
   - **If a scan tool parameter displays ON**
   - Refer to Diagnostic Aids and Symptoms - Engine Cooling for further diagnosis.
8.
   - **If both scan tool parameters display OFF**
9. Verify that the fan is not activated.
10.
    - **If a fan is operating**
    - Refer to Circuit/System Testing.
11.
    - **If the fan is OFF**
12. All OK.

Circuit/System Testing

Cooling Fan Always ON

1. Ignition OFF, disconnect the KR20Câ€‰Cooling Fan Low Speed Relay and KR20Dâ€‰Cooling Fan High Speed Relay one at a time, ignition ON.
2. Verify that the cooling fan is OFF.
3.
   - **If the cooling fan is ON after both relays are removed**
4.
   1. Ignition OFF, disconnect the harness connector at the G10â€‰Cooling Fan Motor, ignition ON.
   2. Test for less than 1â€‰V between the appropriate output control circuit terminalâ€‰87 and ground.
   3.
      - If 1â€‰V or greater, repair the short to voltage in the circuit.
5.
   - **If the cooling fan is OFF after both relays are removed**
6. Test or replace the appropriate cooling fan relay.

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Component Testing

1. Ignition OFF.
2. Disconnect a cooling fan relay.
3. Test for 70â€“110â€‰â„¦ between terminalsâ€‰85/2 and 86/1.
4.
    - **If less than 70â€‰â„¦ or greater than 110â€‰â„¦**
    - Replace the cooling fan relay.
5.
    - **If between 70â€“110â€‰â„¦**
6. Test for infinite resistance between following terminals:
7.
    - 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 cooling fan relay.
    -
        - **If infinite resistance**
8. Install a 20â€‰A fused jumper wire between relay terminalâ€‰85/2 and 12â€‰V.
9. Install a jumper wire between relay terminalâ€‰86/1 and ground.
10. Test for less than 2â€‰â„¦ between terminalsâ€‰30/3 and 87/5.
11.
    - **If 2â€‰â„¦ or greater**
    - Replace the cooling fan relay.
12.
    - **If less than 2â€‰â„¦**
13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Relay Replacement

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Cooling Fan Inoperative

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system is composed of one cooling fan, 2â€‰relays, the engine control moduleâ€‰(ECM), and the associated wiring. The cooling fan assembly includes 1â€‰â€‰resistor mounted in the cooling fan shroud. The cooling fan resistor may be a stand alone component, or a part of the cooling fan motor and harness assembly. This combination of components enables the ECM to operate the cooling fan at 2â€‰speeds using two fan control circuits. 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. The ECM will operate the cooling fan at either Low or High speed based on the cooling requirements.

Diagnostic Aids

- The scan tool cooling fan output control operates as follows:
-
    - Cooling Fan Relayâ€‰1 operates the fan at a low speed
    - Cooling Fan Relayâ€‰2 operates the fan at a high speed
- When disconnecting or removing fuses and relays from a fuse block, always inspect the component electrical terminals for corrosion and the correct orientation in the fuse block. Test the mating electrical terminals for tightness.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

Master Electrical Component List

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.

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2. Verify that DTCâ€‰P0480, P0481, P0691, P0692, P0693, or P0694 is not set.
3.
   - **If a DTC is set**
   - Refer to DTC P0480, P0481, P0691, P0692, P0693, or P0694.
4.
   - **If no DTC is set**
5. Verify that the cooling fan operates at low and high speed, when commanding the appropriate cooling fan relays ON and OFF with a scan tool.
6.
   - **If the cooling fan does not operate at all speeds**
   - Refer to Circuit/System Testing.
7.
   - **If the cooling fan operates at all speeds**
8. All OK.

Circuit/System Testing

Inoperative in Both Speeds

1. Ignition OFF, disconnect the harness connector at the G10â€‰Cooling Fan Motor.
2. Verify that the test lamp illuminates between B+ and ground circuit terminalâ€‰2 of the G10â€‰Cooling Fan Motor.
3.
   - **If the test lamp does not illuminate**
4.
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2â€‰â„¦ in the ground circuit end to end.
   3.
      - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
      - If less than 2â€‰â„¦, repair the open/high resistance in the ground connection.
5.
   - **If the test lamp illuminates**
6. Disconnect the KR20Dâ€‰Cooling Fan Relay, ignition ON:
7. Verify a test lamp illuminates between the KR20Dâ€‰Cooling Fan High Speed Relay terminalâ€‰30 and ground.
8.
   - **If the test lamp does not illuminate and the circuit fuse is open**
9.
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the KR20Dâ€‰Cooling Fan High Speed Relay terminalâ€‰87 and ground:
   3.
      - If less than infinite resistance, repair the short to ground in the circuit.

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- If infinite resistance, test or replace the G10â€‰Cooling Fan Motor, replace the fuse as necessary.

10.

- **If the test lamp illuminates**

11. Ignition OFF, install the KR20Dâ€‰Cooling Fan Relay, Ignition ON.
12. Command the cooling fan ON at high speed with a scan tool.
13. Verify a test lamp illuminates between the G10â€‰Cooling Fan Motor terminals 1 and ground.
14.

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

15.

1. Ignition OFF, remove the test lamp.
2. Disconnect the KR20Dâ€‰Cooling Fan High Speed Relay.
3. Test for less than 2â€‰â„¦ between KR20Dâ€‰High Speed Relay terminalâ€‰87 and the G10â€‰Cooling Fan Motor terminalâ€‰1.
4.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.

16.

- **If the test lamp illuminates at each terminal**

17. Test or replace the G10â€‰Cooling Fan Motor.

Inoperative in Low Speed

1. Disconnect the KR20C Cooling Fan Low Speed relay, ignition ON:
2. Verify a test lamp illuminates between ground and the KR20Câ€‰Cooling Fan Low Speed Relay B+ circuit terminal 30.
3.

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

4.

1. Ignition OFF, remove the test lamp.
2. Test for less than 2â€‰â„¦ in the relay B+ circuit, end to end.
3.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, verify the fuse is not open and there is voltage at the fuse.

5.

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

6.

1. Ignition OFF, remove the test lamp and disconnect the R10â€‰Cooling Fan Resistor.
2. Test for infinite resistance between the relay circuit terminals listed below and ground:

7.

- KR20Câ€‰Cooling Fan Low Speed Relay terminalâ€‰87.
- KR20Câ€‰Cooling Fan Low Speed Relay terminalâ€‰30.

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8.

- If less than infinite resistance, repair the short to ground in the circuit. Replace the fuse as necessary.

9.

- **If the test lamp illuminates**

10. Ignition OFF, install the KR20Câ€‰relay. Disconnect R10â€‰Cooling Fan Resistor, Ignition ON.
11. Command the cooling fan ON at low speed with a scan tool.
12. Verify a test lamp illuminates between the R10â€‰Cooling Fan Resistor terminal X1â€“A and ground.
13.

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

14.

1. Ignition OFF, remove the test lamp.
2. Disconnect the KR20Câ€‰Cooling Fan Low Speed Relay.
3. Test for less than 2â€‰â„¦ between KR20Câ€‰Low Speed Relay terminalâ€‰87 and Cooling Fan Resistor terminalâ€‰X1â€‰A.

15.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, test or replace KR20Câ€‰Cooling Fan Low Speed Relay.

16.

- **If the test lamp illuminates**

17. Ignition OFF, reconnect the Cooling Fan Resistor and disconnect the harness connector at the G10â€‰Cooling Fan Motor.
18.

1. Ignition ON, Command the cooling fan ON at low speed with a scan tool.
2. Verify a test lamp illuminates between the G10â€‰Cooling Fan Motor terminal 1 and ground.
3.

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

4. Ignition OFF.
5. Test for less than 2â€‰â„¦ between the Cooling Fan Resister terminalâ€‰X2â€‰A and G10â€‰Cooling Fan terminalâ€‰1, end to end.
6.

   - If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.

19.

- **If the test lamp illuminates**

20. Replace the R10â€‰Cooling Fan Resistor.

Inoperative in High Speed

1. Disconnect the KR20Dâ€‰Cooling Fan High Speed Relay, ignition ON:
2. Verify a test lamp illuminates between the KR20Dâ€‰Cooling Fan High Speed Relay and ground.
3.

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

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

4.

1. Ignition OFF, remove the test lamp.
2. Test for less than 2â€‰â„¦ in the relay B+ circuit, end to end.
3.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, verify the fuse is not open and there is voltage at the fuse.

5.

- **If the test lamp illuminates**

6. Ignition OFF, install the KR20Dâ€‰Cooling Fan High Speed Relay. Disconnect the harness connector at the G10â€‰Cooling Fan Motor, ignition ON.
7. Command the cooling fan ON at high speed with a scan tool.
8. Verify a test lamp illuminates between the G10â€‰Cooling Fan Motor terminal 1 and ground.
9.

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

10.

1. Ignition OFF, remove the test lamp.
2. Disconnect the KR20Dâ€‰Cooling Fan High Speed Relay.
3. Test for less than 2â€‰â„¦ between KR20Dâ€‰High Speed Relay terminalâ€‰87 and G10â€‰Cooling Fan Motor terminalâ€‰1.

11.

- If 2â€‰â„¦ or greater, repair the open/high resistance in the circuit.
- If less than 2â€‰â„¦, test or replace the KR20D Cooling Fan High Speed Relay.

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

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 coolant pressure cap onto the ground while the engine is running.			
1	1. Inspect and fill the cooling system, as necessary. 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 Stepâ€‰2	â€”
2	1. Start the engine and allow the engine to run at approximately 1â€‰200â€‰RPM. 2. Use the Scan Tool in order to verify the overheat condition. Does the Scan Tool verify the engine overheat condition?	Go to Stepâ€‰3	Go to Engine Heating/Cooling Schematics
3	1. Verify that the cooling fans are operating correctly. 2. Repair the cooling fan system, as necessary. Does the engine still overheat?	Go to Stepâ€‰4	System OK
4	Perform the following inspections: • Inspect the radiator and the A/C condenser cooling fans for debris or any other obstruction • Inspect the drive belt system and the drive belt tensioner for correct operation in order to ensure that the water pump is rotating correctly. • Inspect for loose, damaged and/or missing air deflector(s). • Check for a pinched or kinked cooling system hose. • Repair the system if necessary. Does the engine still overheat?	Go to Stepâ€‰5	System OK
5	Inspect the thermostat for correct operation. Does the thermostat operating correctly? Thermostat Diagnosis	Go to Stepâ€‰7	Go to Stepâ€‰6
6	Replace the thermostat. Does the engine still overheat?	Go to Stepâ€‰7	System OK
7	Note: Excessive coolant freeze point protection MAY cause the coolant to boil at low temperatures. 1. Inspect for the correct coolant concentration (mixture). Correct the coolant concentration as necessary. 2. Remove the coolant pressure 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 Stepâ€‰8	Go to Stepâ€‰9

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Step	Action	Yes	No
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. • 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 Stepâ€‰1	System OK
9	The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Does the engine still overheat?	Go to Stepâ€‰10	System OK
10	Note: It is unlikely that the water pump is the cause of the overheat condition. If NONE of the cooling system passages are restricted, replace the water pump. Does the engine still overheat?	Go to Stepâ€‰1	System OK

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Loss of Coolant

Step	Action	Yes	No
DEFINITION: Loss of coolant in the coolant system internally or externally.			
1	Inspect the coolant level. Is the coolant at the correct level?	Go to Stepâ€‰6	Go to Stepâ€‰4
2	Fill the cooling system to the correct level. Is the action complete?	Go to Stepâ€‰5	â€”
3	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Stepâ€‰6	Repair the condition in which the engine cannot be cranked. Go to Engine Will Not Crank - Crankshaft Will Not Rotate
4	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Engine Overheating	Go to Stepâ€‰7
5	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed	Go to Stepâ€‰8
6	1. Idle the engine at the normal operation temperature. 2. Inspect for heavy white smoke coming out of the exhaust system. Is a heavy white smoke present from the exhaust pipe?	Go to Stepâ€‰9	Go to Stepâ€‰10
7	• 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?	Repair the engine internal coolant leak. Refer to Coolant in Engine Oil	Go to Stepâ€‰10
8	With the engine idling, inspect the coolant recovery reservoir. Does the coolant recovery system discharge coolant while the engine is idling?	Repair the engine internal coolant leak. Refer to Coolant in Engine Oil	Go to Stepâ€‰11

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Step	Action	Yes	No
9	Visually inspect the hoses and hose retaining clamps at the following locations: • Coolant bypass • Coolant reservoir • Heater core • Coolant bypass valve • Radiator Are any of the hoses leaking?	Repair or replace the leaking component. Refer to the appropriate repair.	Go to Stepâ€‰12
10	Visually inspect the following component: • Coolant pressure cap • Core plug • Cylinder head gasket • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Check for leaks at the following location of the listed components. • Sealing surfaces • Fittings or Joints • Cracked of damaged components Can you identify exact location of the leak?	Repair or replace any leaky part. Do partial repair according to the availability of subcomponents. For leak on thermostat housing, replace only the thermostat seal (O-ring). Refer toEngine Coolant Thermostat Replacement	Go to Stepâ€‰13
11	1. Pressure test the cooling system. 2. With the cooling system pressurized, visually inspect the components listed in stepsâ€‰11 andâ€‰12. Is there any leakage?	Repair or replace the leaking component.	Go to Stepâ€‰14
12	Pressure test the coolant pressure cap. Does the coolant pressure cap hold pressure?	Go to Stepâ€‰13	Replace the coolant pressure cap.
13	Inspect for the following conditions: • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. Is coolant present?	Replace the heater core.	Go to Stepâ€‰15

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Step	Action	Yes	No
14	Inspect the underside of the engine oil filler cap for a gray/white milky substance. Is there a milky substance on under the oil fill cap?	Repair the engine internal coolant leak. Refer to Coolant in Engine Oil	Replace the coolant pressure cap.
15	Inspect the engine oil level indicator for a gray/white milky substance. Is there a milky substance on the engine oil level indicator?	Repair the engine internal coolant leak. Refer to Coolant in Engine Oil	Replace the coolant pressure cap.

Related Part Information

Part Name	Catalog Name	Part Code
Engine Coolant	COOLANT,ENG	0050A
Engine Coolant	COOLANT,ENGINE	SS083

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Thermostat Diagnosis (LMU)

Figure is empty after load.

1. Step_1
2.
    - Ensure vehicle is having correct level of coolant and if coolant level is low, please fill coolant to the correct level (Coolant level should be between MAX to MIN marks)
    - Ensure coolant surge tank is properly tightened
    - If coolant level is low, check for any leakages in coolant hoses, hose joints, radiator, heater core, throttle body hoses, surge tank hoses, water pump, thermostat housing or thermostat sealing leak. Refer to Engine Coolant Thermostat Replacement for thermostat seal replacement.
    - Check and ensure the wiring harness connection to thermostat is in good condition. Check for proper voltage supply in the wiring harness
    - Check radiator fan for its operation
3. Step_2.
4.
    - Start engine and keep in idle for approximately 2 minutes and connect to GDS
    - Go to data display screen in the GDS
    - Note**:**

      In cold condition, Engine coolant temperature (ECT-1) always shows high compared to radiator coolant temperature (ECT -2)
    - Check Engine coolant temperature reading for ECT sensor 1 and 2.
    - Example for reference only (Actual temperatures may vary)
    -
        - ECT Sensor 1 : 85Â°C
        - ECT Sensor 2 : 37Â°C
5. Step_3
6.
    - Gradually increase the engine rpm and maintain at around 3500rpm till radiator fan start operating (Fan start operating at around ECT1 temperature 96Â°C). Take the vehicle out for a short drive about 30 minutes and check the below condition.
    - If temperature difference is more between ECT sensor 1 and ECT sensor 2, then suspect thermostat mechanical failure
    - Note**:**

      Temperature reading difference between ECT sensor 1 and ECT sensor 2 should be not more than Approximately 10Â°C, if thermostat is working normal. In this condition you can feel by hand / by touch clearly temperature difference between radiator out let hose and radiator inlet hose
7. Step_4
8.
    - Measure the thermostat electrical resistance
    -

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- Specification : 15.2 Â± 1.5â„¦ (If resistance is out of specification, suspect for thermostat electrical failure)

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Thermostat Diagnosis

1. Remove the thermostat from the vehicle. Refer to Engine Coolant Thermostat Replacement.
2. Make sure the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.
3. Suspend the thermostat and a thermometer in a pan of 50/50â€‰mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan because the uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
4. Heat the pan on a burner.
5. Use the thermometer to measure the temperature of the heated solution.
6. The thermostat should begin to open at 105Â°C (221Â°F) and it should be fully open at 120Â°C (248Â°F) and it should be fully close at 98Â°â€‰C (208.4Â°â€‰F). If it does not open or close at these temperature, replace the thermostat. Also, the thermostat rod's stroke from the initially open to the fully open should be 8â€‰mm (0.32â€‰in).

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
1	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine. 4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s). Is the electric cooling fan on?	Go to Stepâ€‰2	Go to Stepâ€‰3
2	1. Diagnose and repair the cooling fan system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Stepâ€‰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 Stepâ€‰5	Go to Stepâ€‰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 Stepâ€‰5	System OK
5	Inspect the thermostat for correct operation. Is the thermostat operating correctly?	System OK	Go to Stepâ€‰6
6	1. Replace the thermostat. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Stepâ€‰1	System OK

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Pressure Cap Testing

Special Tools

- *J-24460-A* Cooling System Pressure Tester
- *J-42401-1A* Radiator Cap / Surge Tank Test Adapter

Warning**:**

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

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



3. Click here for full size
4. Use the *J-24460-A* cooling system pressure tester (1) with *J-42401-1A* radiator cap / surge tank test adapter (2) in order to test the pressure cap.
5. Test the pressure cap for the following conditions:
6.
    - Pressure release when the *J-24460-A* 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.
7. Replace the pressure cap under the following conditions:
8.
    - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
    - The pressure cap does not hold the rated pressure.

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. DIAGNOSTIC INFORMATION AND PROCEDURES
4.

Cooling System Leak Testing

Special Tools

- *J-24460-A* Radiator Pressure Tester
- *J-42401-A* Radiator Cap and Surge Tank Test Adapter

For equivalent regional tools, refer to Special Tools.

Warning:

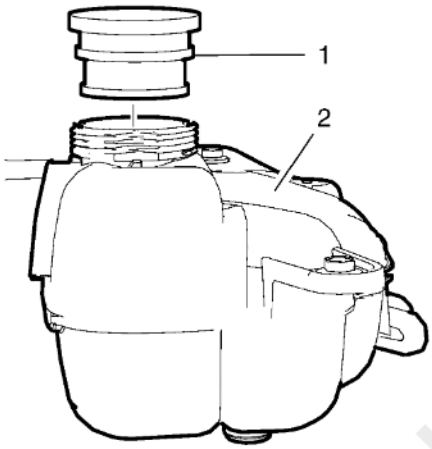
Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders,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

Warning:

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

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

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4. Click here for full size
5. Install the *J-42401-2* pressure test adapter (1) to the coolant recovery reservoirâ€‰(2) to plug the reservoir bleeder gallery.
6. Install the *J-42401-3* adapter to the coolant recovery reservoir.
7. Install the *J-24460-A* pressure tester to the *J-42401-3* adapter.

8. Note:

   Do NOT exceed the pressure cap rating.

9. Using the pressure tester apply pressure to the cooling system.
10. Observe the gage of the pressure tester for any loss.
11. The cooling system should hold the rated pressure for at least 2â€‰minutes.
12. If leak is detected on thermostat housing, replace only the thermostat seal (O-ring). Refer to Engine Coolant Thermostat Replacement.
13. Repair any leaks as required.

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Repair Instructions

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Cooling System Draining and Filling (LKY)

Draining Procedure

1. Warning**:**

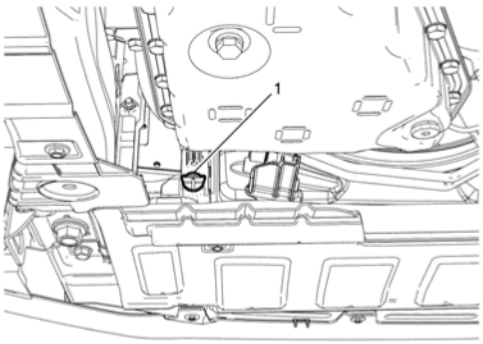
   To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

2. Remove the surge tank cap.

3. Raise the vehicle by its full height. Refer to Lifting and Jacking the Vehicle.

4. Place a drain pan under the drain cock.

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5. Click here for full size
6. Loosen the radiator coolant drain cock (1) on the radiator.
7. Drain the cooling system.
8. Lower the vehicle.
9. Inspect the coolant.
10. Follow the appropriate procedure based on the condition of the coolant.
11.
    - Normal in appearanceâ€”Follow the filling procedure.
    - Discoloredâ€”Follow the flush procedure. Refer to Coolant System Flushing.

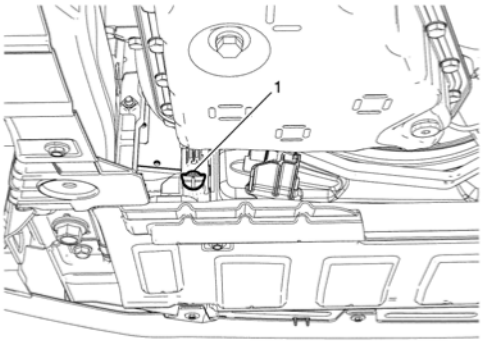
Filling Procedure

1. Caution:

   The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.
2. Raise and support the vehicle.
3. Caution:

   Refer to Fastener Caution.

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4. [Click here for full size]
5. Tighten the radiator drain cockâ€‰(1) to 2â€‰N-m (18â€‰lbâ€‰in).
6. Lower the vehicle.
7. Note:

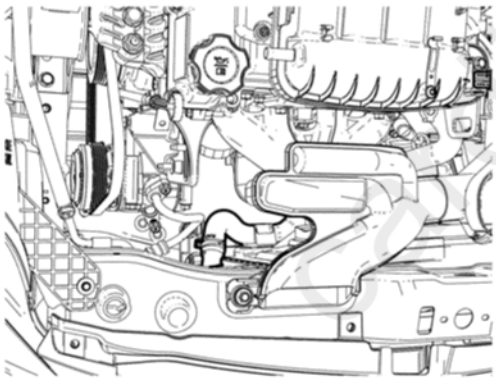
   Use a 50/50 mixture of DEX-COOL antifreeze and clean drinkable water.
8. Slowly fill the radiator with a 50/50 coolant mixture until the coolant level reaches the base of the radiator surge tank.
9. Allow 30 seconds for the coolant level to stabilize and continue to fill the coolant filler neck until the level stabilizes for at least 2 minutes.
10. Start the engine and allow the engine to idle in PARK or NEUTRAL with the parking brake engaged.
11. Slowly fill the coolant mixture until the level stabilizes at the base of the radiator surge tank.
12. Install the coolant pressure cap.

13. Raise the engine RPM to 2500â€‰â€‰RPM for 30â€“40 seconds.
14. Shut the engine OFF.
15. Allow the engine to cool, remove coolant fill cap and repeat steps 3â€“9 until the coolant level has completely stabilized within the radiator surge tank.
16. Inspect and if necessary, fill the coolant reservoir bottle as necessary.
17. Rinse away any excess coolant from the engine and the engine compartment.
18. Inspect the cooling system for leaks.
19. Top off the radiator surge tank if necessary.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Cooling System Draining and Filling (LMU)



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2. Warning**:**

   Do not remove the surge tank cap while the engine and the radiator are hot. Scalding fluid and steam may be blown out under pressure and cause bodily injury.

3. Remove the surge tank cap.
4. Place a pan below the vehicle to catch the draining coolant.
5. Remove the radiator outlet hose.
6. Catch the escaping fluid in a drain pan.
7. Warning**:**

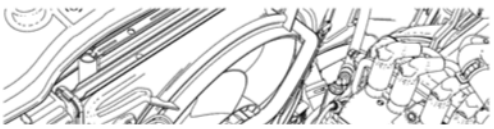
   Dispose of the used engine coolant properly. Store the used coolant in a used coolant holding tank awaiting proper disposal or recycling. Do not pour used coolant down the drain. Ethylene glycol antifreeze is a very toxic chemical. Disposal into the sewer system or into the ground water is both environmentally irresponsible and illegal.

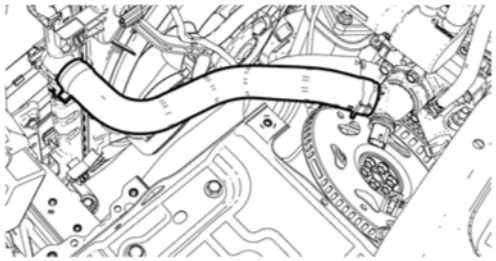
8. Note**:**

   Dispose the collected coolant to the designated area.

9. Remove all sludge and dirt from inside the surge tank.
10. Install the radiator outlet hose.
11. Fill the tank slowly so that the upper reservoir hose remains above the water line. This allows the air inside the cooling system to escape.

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12. [Click here for full size]

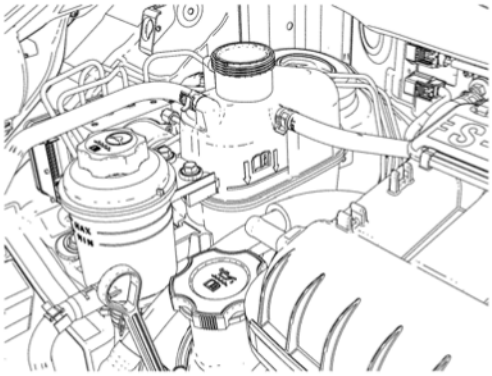
13. Start the engine.

14. Run the engine until the thermostat opens. You can tell the thermostat is open when both radiator hoses are hot to the touch.

15. Stop the engine.

16. Repeat stepsâ€‰1 throughâ€‰10 until the drained water is clear and free of coolant and rust.

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17. Click here for full size
18. Caution:

    Because the filled coolant is normal temperature, the electric controlled thermostat will be closed. After fill the coolant, the engine must be warming-up and then refill the coolant. If the coolant quantity is not enough based on the specifications, it would be damaged to engine performance.

19. Caution:

    To avoid damaging the vehicle, never use an antifreeze mixture more concentrated than 60 percent antifreeze to 40 percent water. The solution freezing point increases above this concentration.

20. Fill the cooling system through the surge tank with a mixture of ethylene glycol antifreeze and water. The mixture must be at least 50â€‰percent antifreeze, but not more than 60â€‰percent antifreeze for cold weather operation.

21. Fill the coolant above the minimum line mark on the outside of the tank.

1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Coolant System Flushing

Note**:**

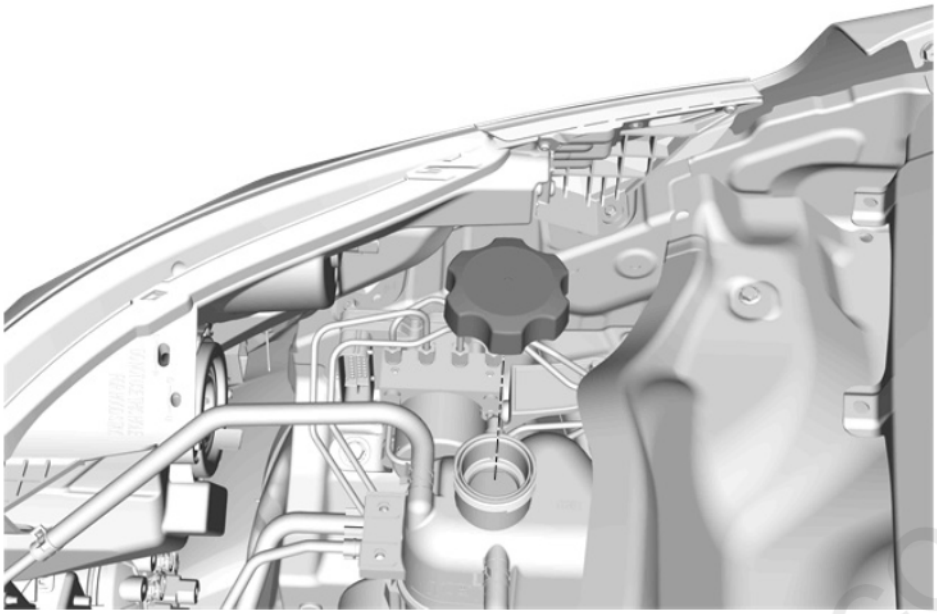
- Do not use a chemical flush.
- Store used coolant in the proper manner, such as in a used engine coolant holding tank.
- Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical.
- Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.
- Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufactures instruction. However, always remove the thermostat before back flushing the system.

1. Apply the parking brake.
2. Drain the coolant. Refer to Cooling System Draining and Filling.
3. Fill the cooling system with clean drinkable water. Refer to Cooling System Draining and Filling.
4. Start the engine and run at 2,000â€‰RPM until the thermostat opens.
5. Turn OFF the engine.
6. Drain the coolant system. Refer to Cooling System Draining and Filling.
7. Repeat the above procedure until the water from the coolant system is colorless.
8. Drain the coolant system. Refer to Cooling System Draining and Filling.
9. Repeat the above procedure until the water from the coolant system is colorless. Refer to Cooling System Draining and Filling.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Surge Tank Cap Replacement



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Callout	Component Name
1	Radiator Surge Tank Cap

Related Part Information

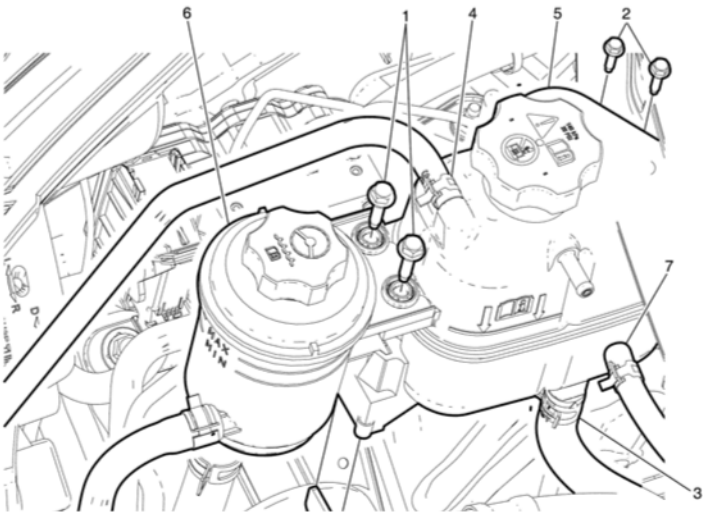
Part Name	Catalog Name	Part Code
Radiator Surge Tank Cap	CAP,RAD SURGE TK	0250A
Radiator Surge Tank Cap	CAP,RAD SURGE TK	0251A

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Surge Tank Replacement (LKY)

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Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling.	
1	Power Steering Fluid Reservoir Bolt (Qty:â€‰2) Caution: Refer to Fastener Caution. Tighten 8â€‰N-m (71â€‰lbâ€‰in)
2	Radiator Surge Tank Mounting Bolt (Qty:â€‰2) Tighten 8â€‰N-m (71â€‰lbâ€‰in)
3	Radiator Surge Tank Outlet Hose and Clamp
4	Radiator Surge Tank Inlet Hose and Clamp

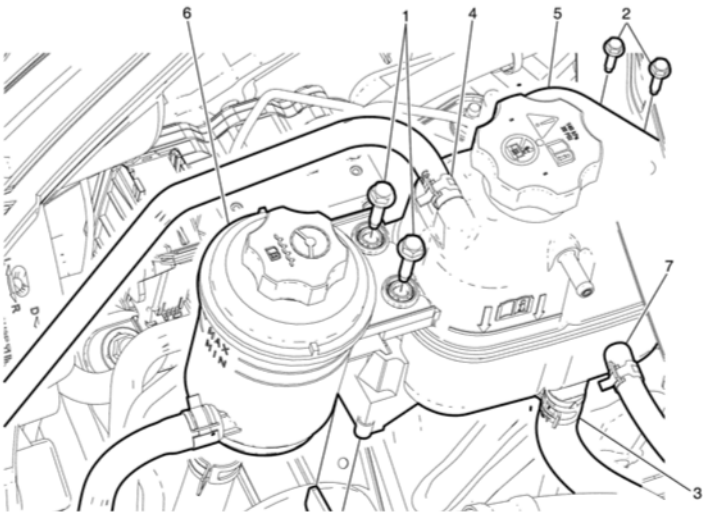
Callout	Component Name
5	Radiator Surge Tank
6	Power Steering Fluid Reservoir
7	Coolant Hose and Clamp

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Surge Tank Replacement (LC5, LMU)

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Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling.	
1	Power Steering Fluid Reservoir Bolt (Qty:â€‰2) Caution: Refer to Fastener Caution. Tighten 9â€‰N-m (80â€‰lbâ€‰in)
2	Radiator Surge Tank Mounting Bolt (Qty:â€‰2) Tighten 8â€‰N-m (71â€‰lbâ€‰in)
3	Radiator Surge Tank Outlet Hose Clip
4	Radiator Surge Tank Inlet Hose Clip

Callout	Component Name
5	Throttle Body Heater Outlet Hose Clip
6	Radiator Surge Tank

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Surge Tank Outlet Hose Replacement (LKY)

Special Tools

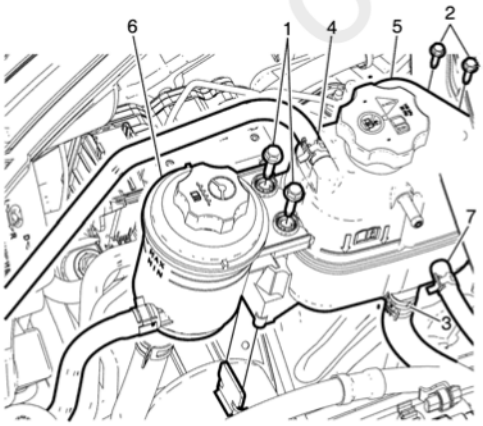
J-38185 Hose Clamp Pliers

For equivalent regional tools, refer to Special Tools.

Removal Procedure

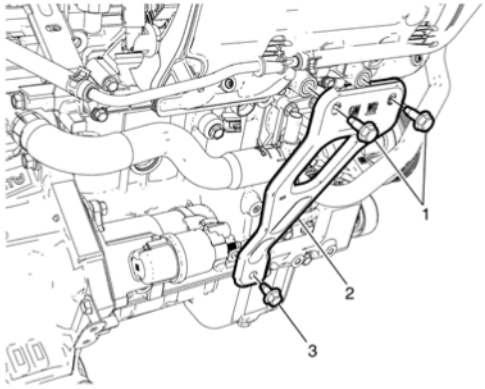
1. Drain the coolant. Refer to Cooling System Draining and Filling.

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3. Loosen the radiator surge tank outlet hose clampâ€‰(3) and remove the radiator surge tank outlet hoseâ€‰from the radiator surge tank.
4. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.

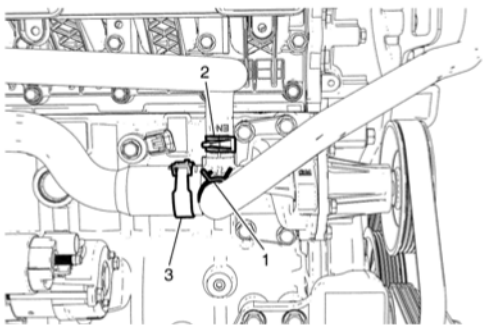
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5.
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6. Remove the 3 intake manifold bracket bolts (1).
7. Remove the intake manifold bracket (2).

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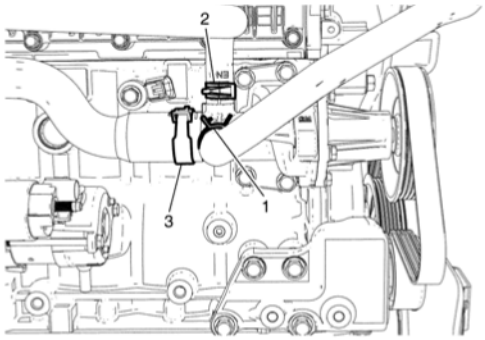


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9. Loosen the radiator surge tank outlet hose clampâ€‰(1) and remove the radiator surge tank outlet hoseâ€‰from the water pump.
10. Transfer parts as necessary.

Installation Procedure

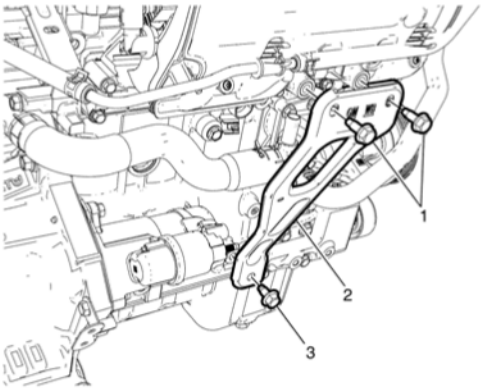
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1. Click here for full size
2. Install the radiator surge tank outlet hose with the radiator surge tank outlet hoseâ€‰clamp (1) to the water pump.

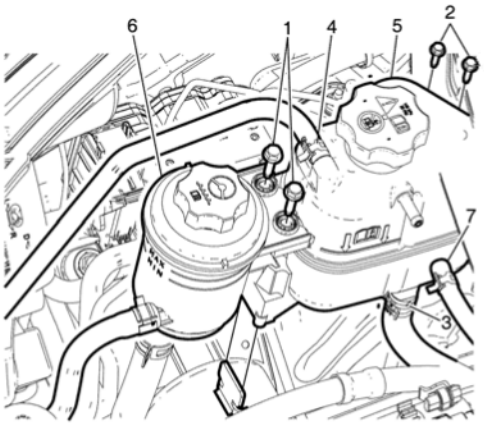
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3. Click here for full size
4. Install the intake manifold bracket (2).
5. Caution:

   Refer to Fastener Caution.
6. Install the 3 intake manifold bracket bolts (1) and tighten to 46â€‰N-m (34â€‰lbâ€‰ft).

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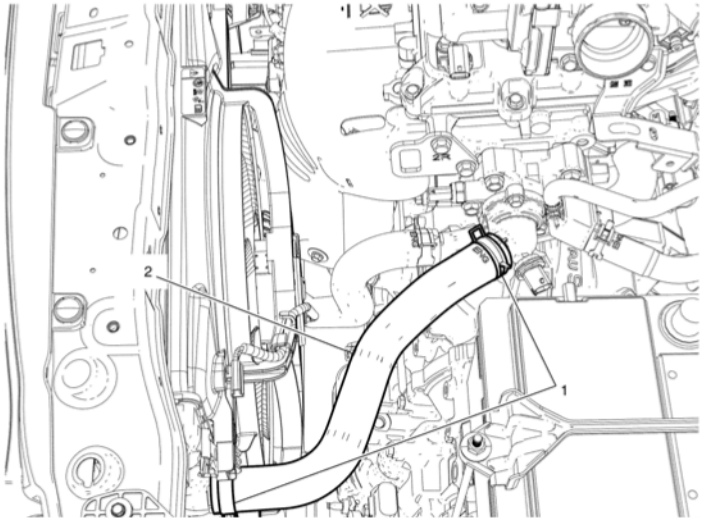
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7. Click here for full size
8. Lower the vehicle.
9. Install the radiator surge tank outlet hose with the radiator surge tank outlet hoseâ€‰clamp (3) to the radiator surge tank.
10. Fill the cooling system. Refer to Cooling System Draining and Filling.
11. Start the engine and check for coolant leaks.

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Inlet Hose Replacement (LKY)

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Callout	Component Name
	Preliminary Procedures 1. Open the hood. 2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection. 3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement. 4. Drain the cooling system. Refer to Cooling System Draining and Filling.
1	Radiator Inlet Hose Clamp (Qty:â€‰2) Procedure Loosen the radiator inlet hose clamp (1).
2	Radiator Inlet Hose

Related Part Information

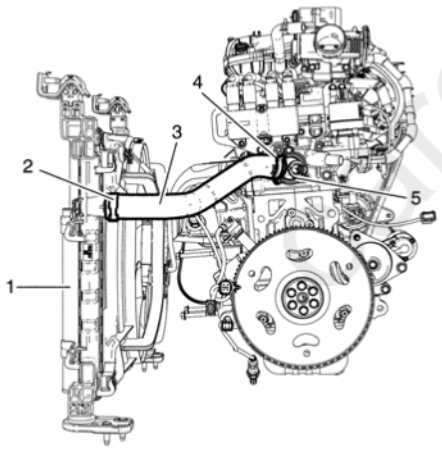
Part Name	Catalog Name	Part Code
Radiator Inlet Hose	HOSE,RAD INL	0050A
Radiator Inlet Hose	HOSE,RAD INL	0100A

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Inlet Hose Replacement (LC5, LMU)

Removal Procedure

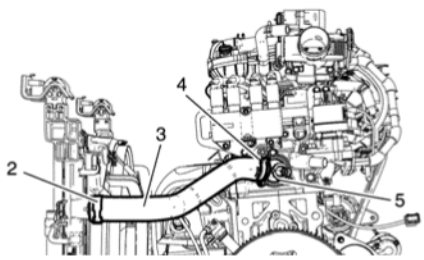


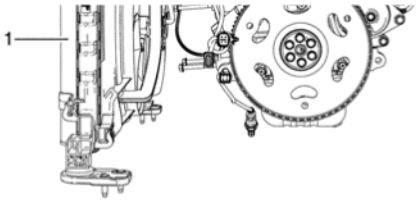
mitdiagn.com

1. Click here for full size
2. Open the hood.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
4. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.
5. Place a pan below the radiator outlet hose to catch the draining coolant.
6. Lower the vehicle.
7. Drain the cooling system. Refer to Cooling System Draining and Filling.
8. Loosen the radiator inlet hose clampâ€‰(2).
9. Remove the radiator inlet hoseâ€‰(3) from the radiatorâ€‰(1).
10. Loosen the radiator inlet hose clampâ€‰(4).
11. Loosen the radiator inlet hoseâ€‰(3) from the engine coolant thermostat housingâ€‰(5).

Installation Procedure

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1. Click here for full size
2. Install the radiator inlet hoseâ€‰(3) to the engine coolant thermostat housingâ€‰(5).
3. Install the radiator inlet hose clampâ€‰(4).
4. Install the radiator inlet hoseâ€‰(3) to the radiatorâ€‰(1).
5. Install the radiator inlet hose clampâ€‰(2).
6. Fill the cooling system. Refer to Cooling System Draining and Filling.
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
8. Close the hood.

Related Part Information

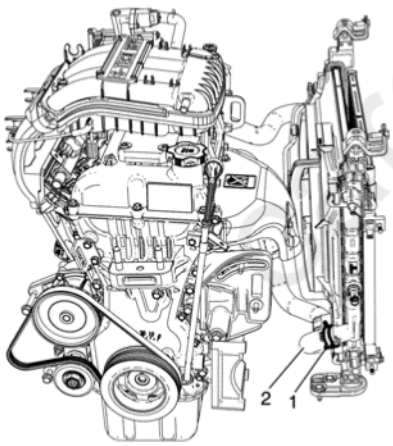
Part Name	Catalog Name	Part Code
Radiator Inlet Hose	HOSE,RAD INL	0050A
Radiator Inlet Hose	HOSE,RAD INL	0100A

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Outlet Hose Replacement (LC5, LMU)

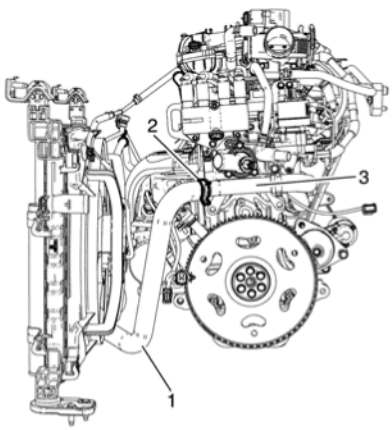
Removal Procedure



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1. Click here for full size
2. Open the hood.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
4. Raise the vehicle. Refer to Lifting and Jacking the Vehicle
5. Place a pan below the radiator outlet hose to catch the draining coolant.
6. Loosen the radiator outlet hose clampâ€‰(1).
7. Lower the vehicle.
8. Remove the radiator outlet hoseâ€‰(2) from the radiator.
9. Drain the cooling system. Refer to Cooling System Draining and Filling.

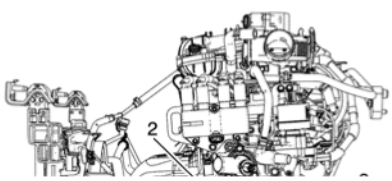
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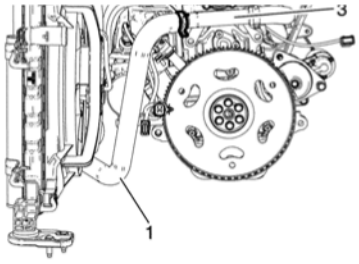
10.
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11. Loosen the radiator outlet hose clampâ€‰(2).
12. Remove the radiator outlet hoseâ€‰(1) from the water pump outlet pipeâ€‰(3).

Installation Procedure

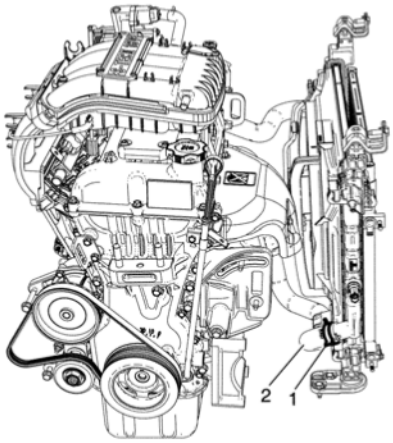


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1. Click here for full size
2. Install the radiator outlet hoseâ€‰(1) to the water pump outlet pipeâ€‰(3).
3. Install the radiator outlet hose clampâ€‰(2).
4. Raise the vehicle.

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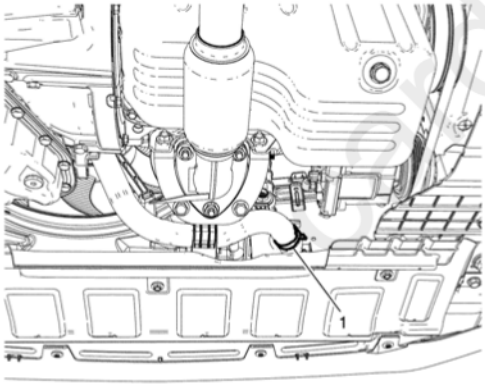
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5. Click here for full size
6. Install the radiator outlet hoseâ€‰(2) to the radiator.
7. Install the radiator outlet hose clampâ€‰(1).
8. Lower the vehicle.
9. Fill the cooling system. Refer to Cooling System Draining and Filling.
10. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Outlet Hose Replacement (LKY)

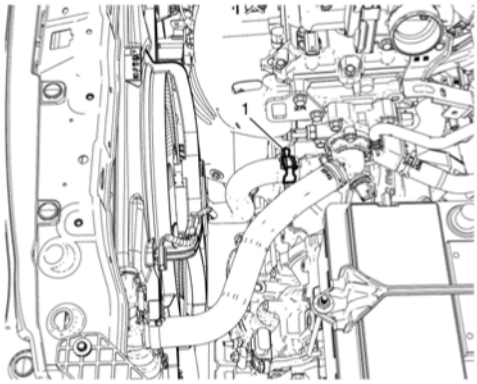
Removal Procedure



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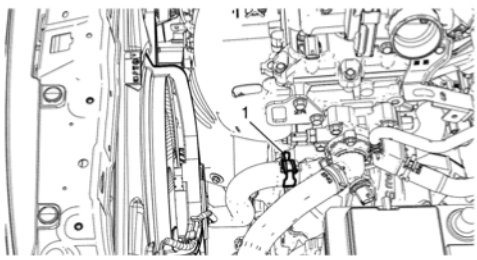
1. Click here for full size
2. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.
3. Drain the cooling system. Refer to Cooling System Draining and Filling.
4. Loosen the radiator outlet hose clampâ€‰(1).
5. Remove the radiator outlet hose from the radiator.
6. Lower the vehicle. Refer to Lifting and Jacking the Vehicle.
7. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.

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8. Click here for full size
9. Loosen the radiator outlet hose clampâ€‰(1).
10. Remove the radiator outlet hoseâ€‰from the water pump outlet pipe.

Installation Procedure

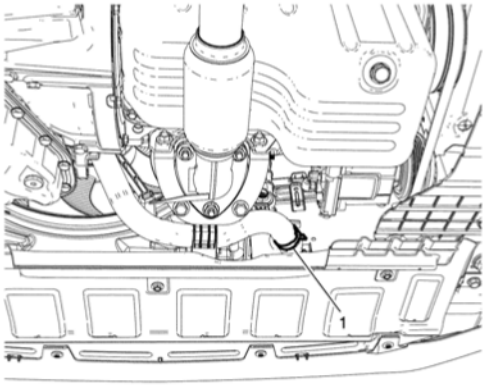


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1. Click here for full size
2. Install the radiator outlet hose to the water pump outlet pipe.
3. Install the radiator outlet hose clampâ€‰(1).
4. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
5. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.

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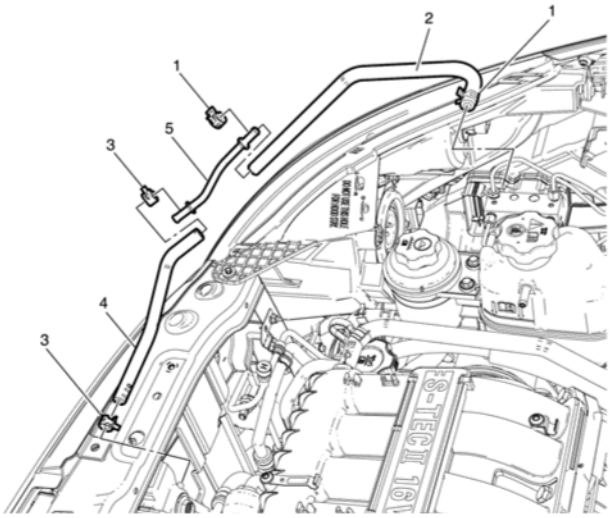
6. Click here for full size
7. Install the radiator outlet hose to the radiator.
8. Install the radiator outlet hose clampâ€‰(1).
9. Lower the vehicle. Refer to Lifting and Jacking the Vehicle.
10. Fill the cooling system. Refer to Cooling System Draining and Filling.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Inlet Pipe Replacement

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Callout	Component Name
Preliminary Procedure Drain the coolant from the cooling system, and add new coolant. Refer to Cooling System Draining and Filling.	
1	Engine Coolant Inlet Hose Clamp (Qty:â€‰2)
2	Engine Coolant Inlet Hose
3	Engine Coolant Inlet Hose Clamp (Qty:â€‰2)
4	Engine Coolant Inlet Hose
5	Engine Coolant Inlet Pipe

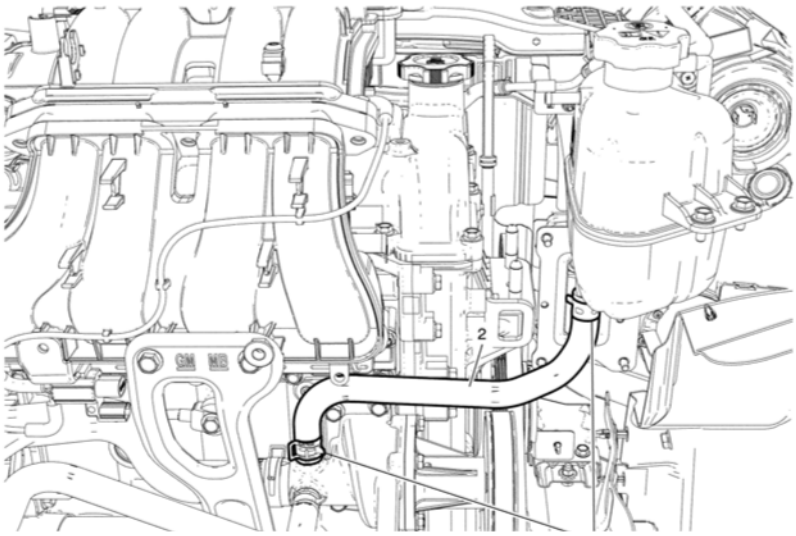
Related Part Information

Part Name	Catalog Name	Part Code
Engine Coolant Inlet Pipe	PIPE,ENG COOL INL	0515A

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Outlet Pipe Replacement

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Callout	Component Name
Preliminary Procedure Drain the coolant from the cooling system, and add new coolant. Refer to Cooling System Draining and Filling.	
1	Coolant Outlet Hose Clamp (Qty:â€‰2) Special Tools *BO-38185* Hose Clamp Pliers For equivalent regional tools, refer to Special Tools.
2	Coolant Outlet Hose

Related Part Information

Part Name	Catalog Name	Part Code
Engine Coolant Outlet Pipe	PIPE,ENG COOL OTLT	0530A
Engine Coolant Outlet Pipe	PIPE,ENG COOL OTLT	0530B

1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Mounting Stud Repair

Note**:**

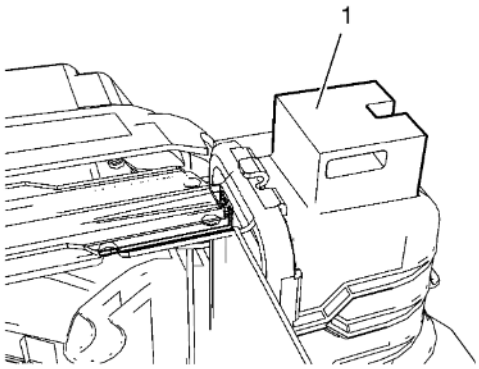
In this vehicle, mounting pin repair system is only applied to lower side of the radiator, not upper.

Note**:**

If the radiator is leaky, replace it. Refer to Radiator Replacement.

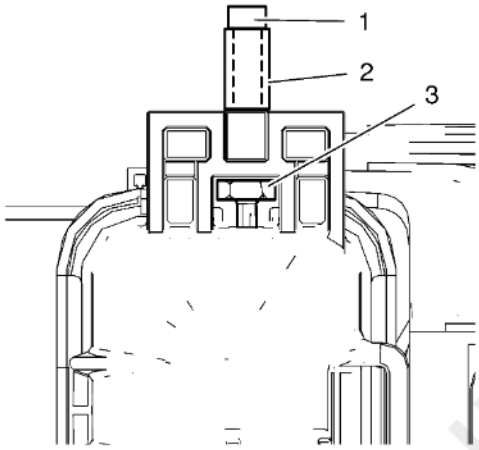
1. Pressure test the cooling system. Refer to Cooling System Leak Testing.

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



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6. Caution:

   Refer to Fastener Caution.

7. Note:

Bolt should not be longer than 35â€‰mm (1.38â€‰in).

8. Install the new radiator mounting pinâ€‰(2).
9. Install the nutâ€‰(3).

Related Part Information

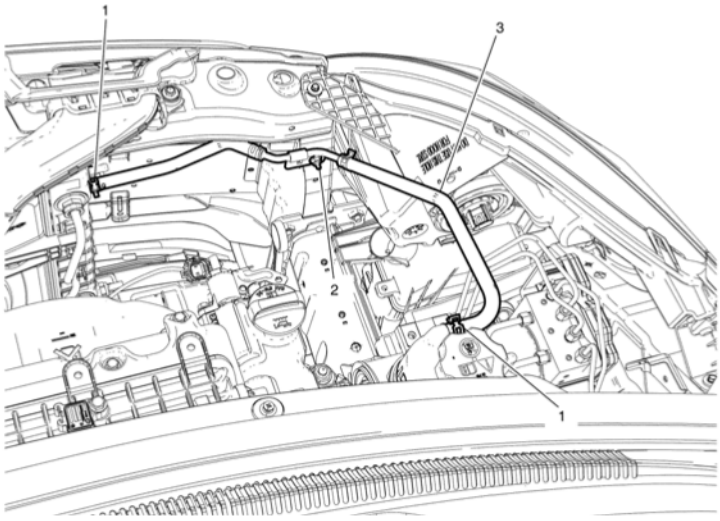
Part Name	Catalog Name	Part Code
Radiator Mounting Stud	STUD KIT,RAD MTG (RPR)	1905Z

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Overflow Hose Replacement (LKY)

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Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling.	
1	Radiator Overflow Hose Clamp (Qty:â€‰2)
2	Radiator Overflow Hose Bracket Nut Caution: Refer to Fastener Caution. Procedure Remove the radiator overflow hose bracket nut. Tighten 9â€‰N-m (80â€‰lbâ€‰ft)
3	Radiator Overflow Hose

Related Part Information

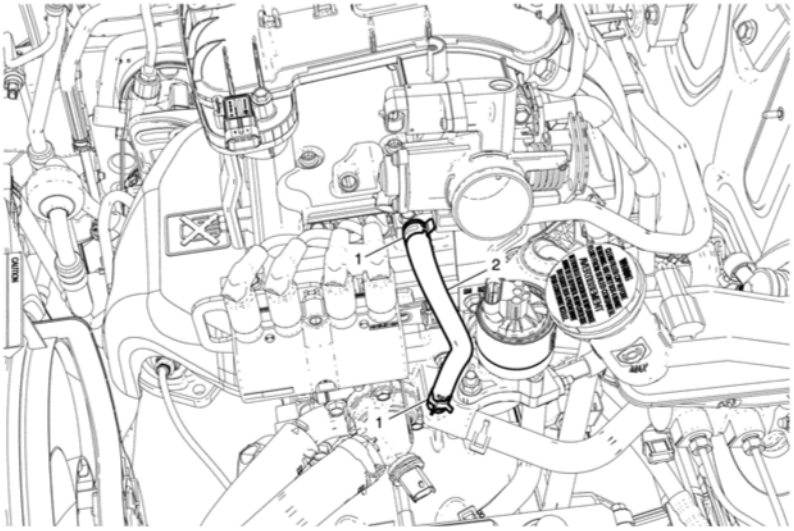
Part Name	Catalog Name	Part Code
Radiator Overflow Hose	HOSE KIT,RAD OVFL	0528Z
Radiator Overflow Hose	HOSE,RAD OVFL	0529A
Radiator Overflow Hose	HOSE,RAD OVFL	0530A

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Throttle Body Heater Inlet Hose Replacement

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Callout	Component Name
1	Throttle Body Heater Inlet Hose Clamp (Qty:â€‰2)
2	Throttle Body Heater Inlet Hose

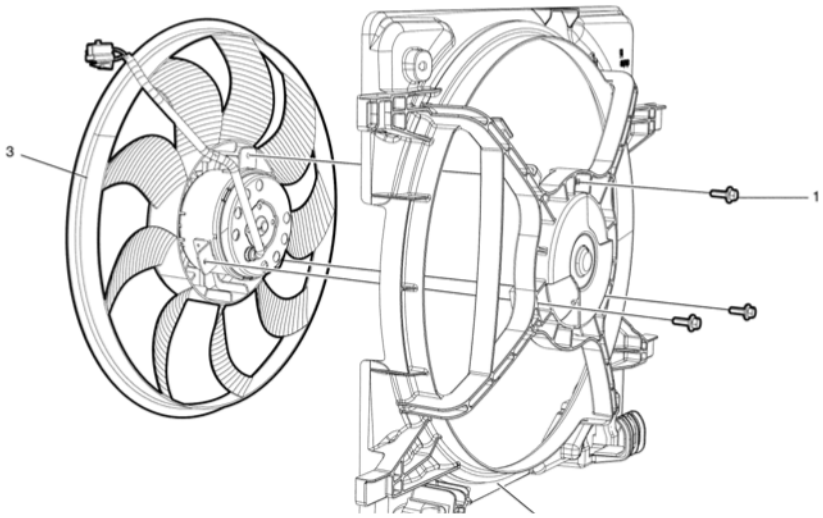
Related Part Information

Part Name	Catalog Name	Part Code
Throttle Body Heater Inlet Hose	HOSE,THROT BODY HTR INL	1788A
Throttle Body Heater Inlet Hose	HOSE,THROT BODY HTR INL	1788B

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Fan Replacement (LKY)

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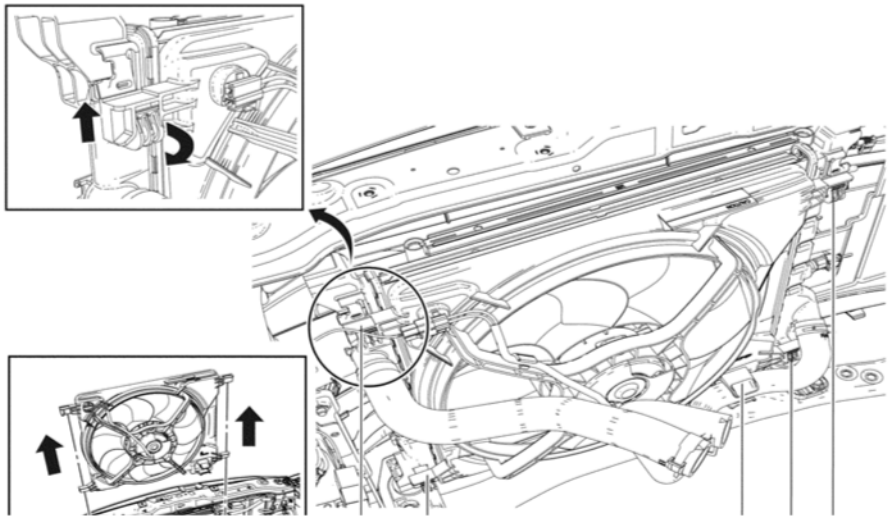
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Callout	Component Name
	Preliminary Procedures 1. Remove the engine coolant fan shroud. Refer to Engine Coolant Fan Shroud Replacement. 2. Disconnect the wiring harness plug of the engine cooling fan.
1	Engine Coolant Fan Bolt (Qty:â€‰3) Procedure Remove the engine coolant fan bolts. Tighten 10â€‰N-m (89â€‰lbâ€‰in)
2	Engine Coolant Fan Shroud
3	Engine Coolant Fan

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Fan Replacement (LC5, LMU)

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Callout	Component Name
	Preliminary Procedures 1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement. 2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection. 3. Disconnect the wiring harness plug of the engine cooling fan.
1	Radiator Outlet Hose Procedure Disconnect the radiator outlet hose from the engine coolant fan. .
2	Engine Coolant Fan Procedure Remove the engine coolant fan upward.

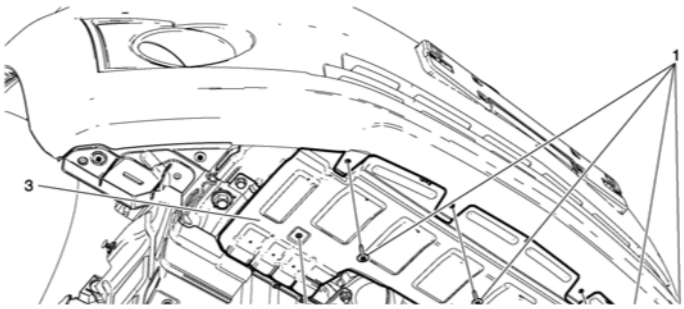
1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

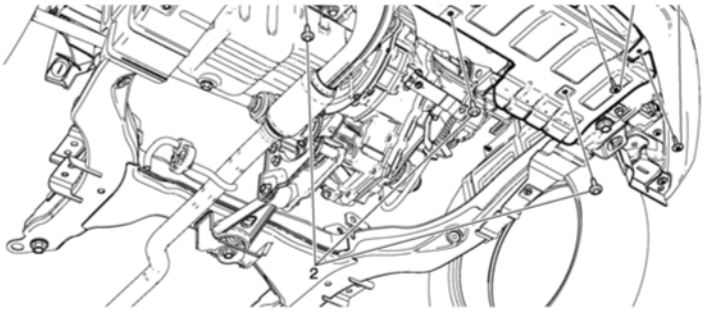
Water Pump Inlet Pipe Replacement

Removal Procedure

1. Open the hood.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Drain the coolant. Refer to Cooling System Draining and Filling.

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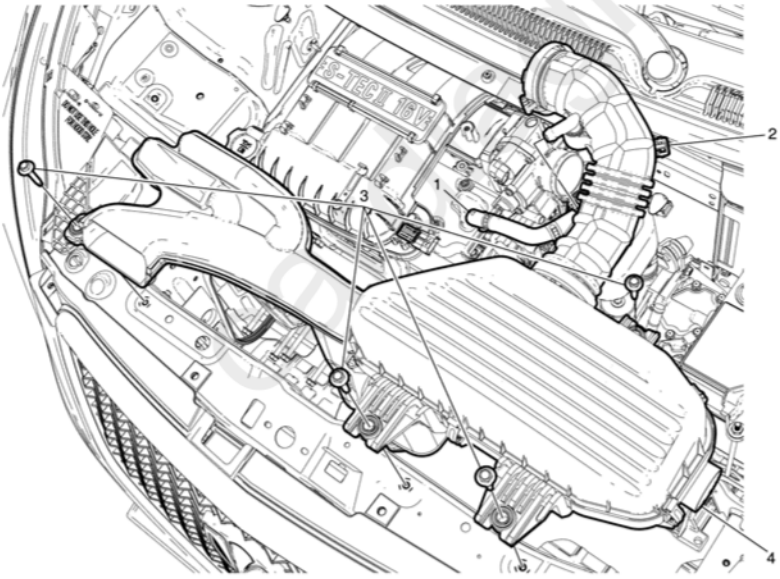




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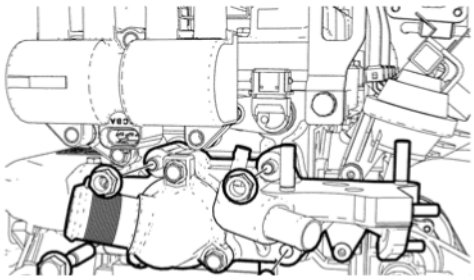
5. Remove the front bumper fascia opening lower cover (2). Refer to Front Bumper Fascia Opening Lower Cover Replacement.

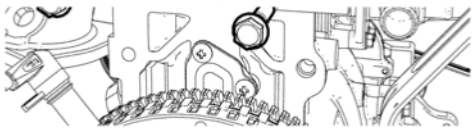

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7. Remove the air cleaner assembly (4). Refer to Air Cleaner Assembly Replacement.

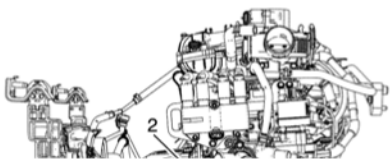
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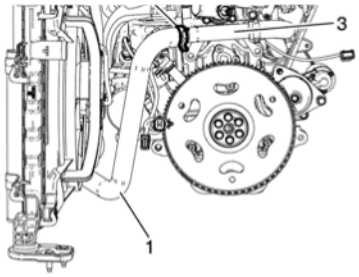


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9. Remove the engine coolant thermostat housing. Refer to Engine Coolant Thermostat Housing Replacement.

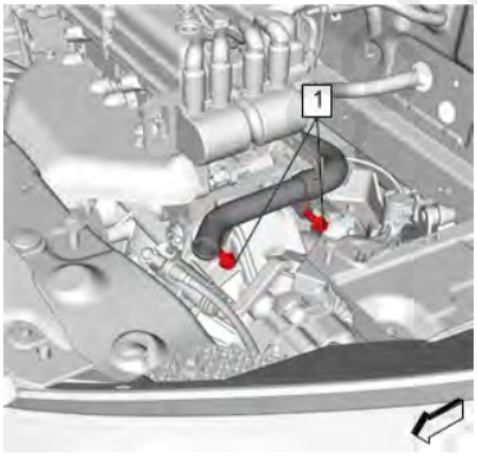


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10. Click here for full size

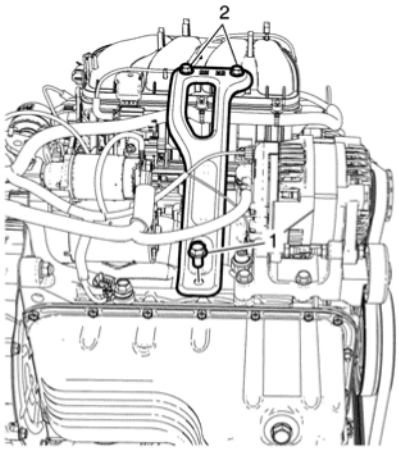
11. Remove the radiator outlet hose (1) from the water pump inlet pipe assembly (3). Refer to Radiator Outlet Hose Replacement.

12. 

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13. Remove the transmission upper bolts (1).

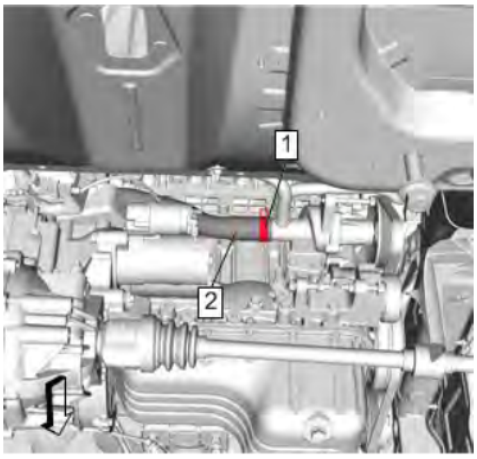
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14. Click here for full size

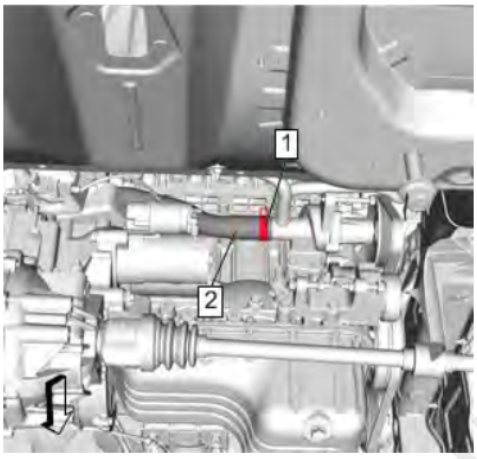
15. Remove the rear intake manifold brace. Refer to Lower Intake Manifold Replacement.

16. 

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17. Remove the water pump inlet pipe hose clamp (1).
18. Remove the water pump inlet pipe hose assembly (2) from the water pump.

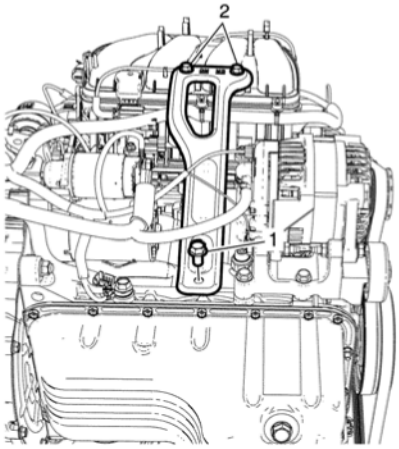
Installation Procedure

1. 

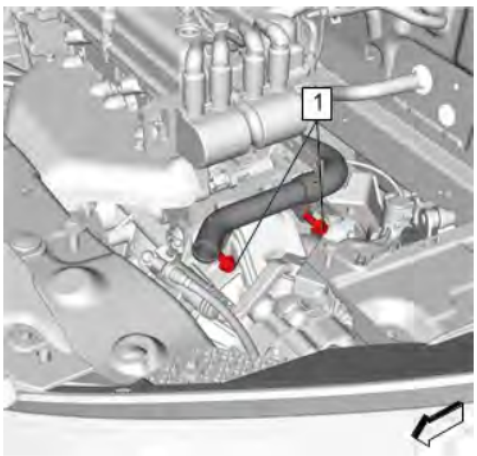
Click here for full size

2. Install the water pump inlet pipe hose assembly (2) to the water pump.
3. Install the water pump inlet pipe hose clamp (1).

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4. Click here for full size
5. Install the rear intake manifold brace. Refer to Lower Intake Manifold Replacement.

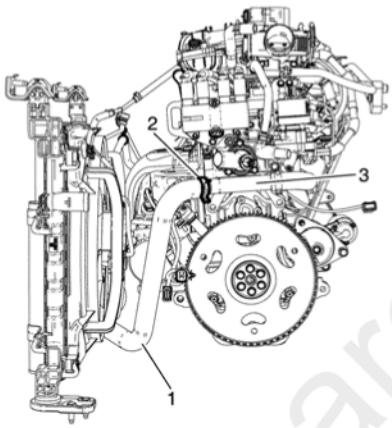


6. Click here for full size
7. Caution:

   Refer to Fastener Caution.

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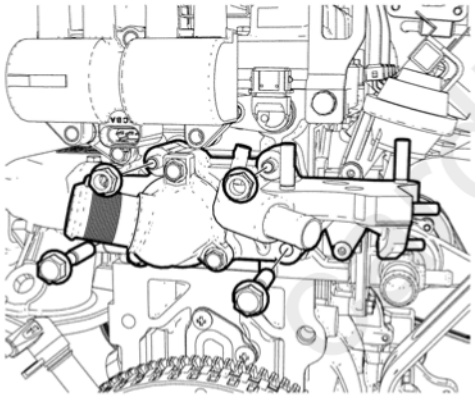
8. Install the transmission upper bolts (1) and tighten to 61â€‰N-m (44â€‰lbâ€‰ft).



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9.
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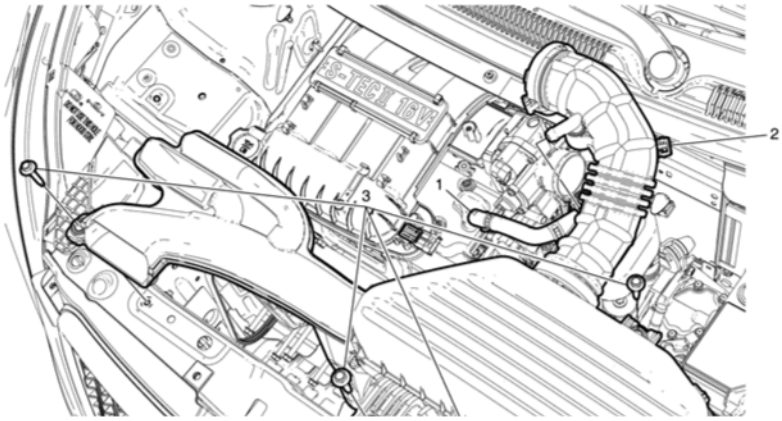
10. Install the radiator outlet hose (1) to the water pump inlet pipe (3). Refer to Radiator Outlet Hose Replacement .

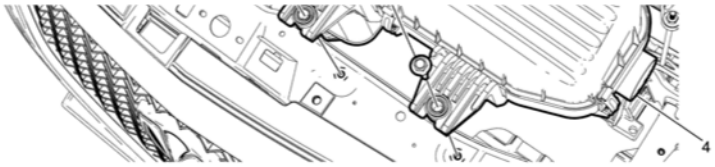


11.
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12. Install the engine coolant thermostat housing. Refer to Engine Coolant Thermostat Housing Replacement .

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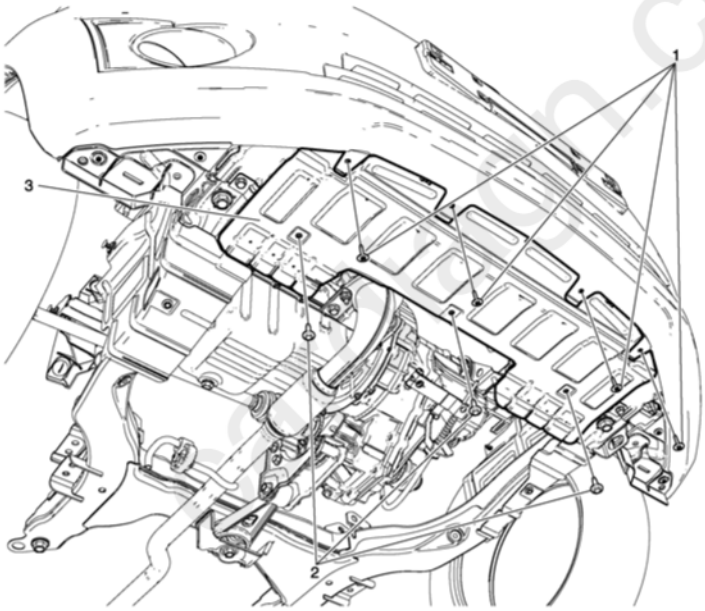




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13. Click here for full size

14. Install the air cleaner assembly (4). Refer to Air Cleaner Assembly Replacement .


1
3
2

15. Click here for full size

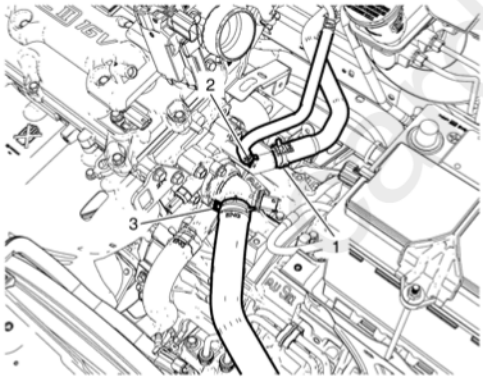
16. Install the front bumper fascia opening lower cover (2). Refer to Front Bumper Fascia Opening Lower Cover Replacement
17. Lower the vehicle.
18. Fill the cooling system. Refer to Cooling System Draining and Filling .
19. Connect the negative battery cable. Refer toBattery Negative Cable Disconnection and Connection .
20. Start the engine and check for coolant leaks.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Thermostat Housing Replacement (LKY)

Removal Procedure



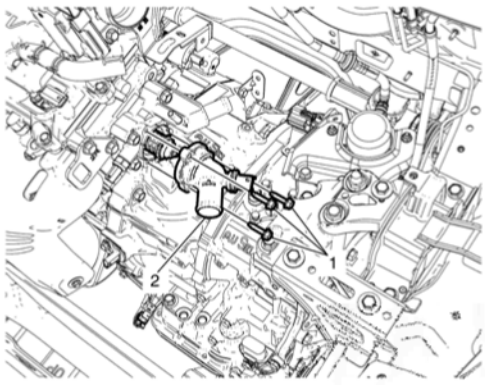
carDiagn.com

1.
   Click here for full size
2. Warning:

   In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.

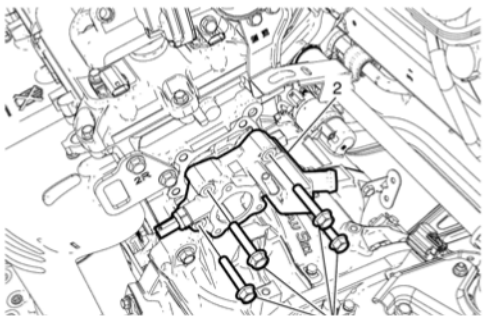
3. Drain the system. Refer to Cooling System Draining and Filling.
4. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
5. Disconnect the heater inlet hoseâ€‰and clamp (1).
6. Disconnect the coolant hose and clamp (2).
7. Disconnect the radiator inlet hose and clamp (3).

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8.
Click here for full size

9. Remove the engine coolant thermostat (2). Refer to Engine Coolant Thermostat Replacement.



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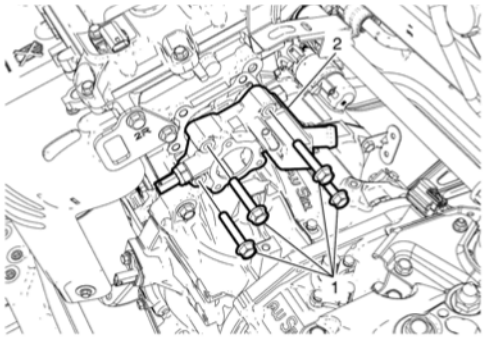


10. Click here for full size
11. Remove the engine coolant thermostat housing bolts (1).
12. Remove the engine coolant thermostat housing (2).

Installation Procedure

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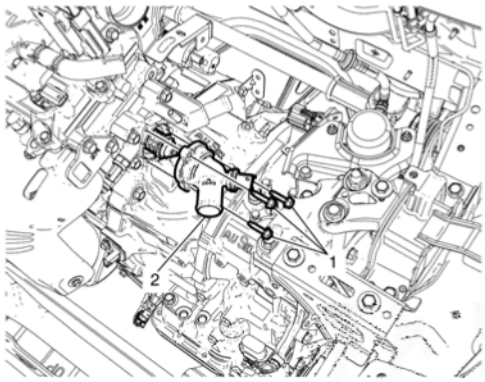




1. Click here for full size
2. Install the coolant thermostat housing (2).
3. Caution:

   Refer to Fastener Caution.
4. Install the engine coolant thermostat housing bolts (1) and tighten to 25â€‰N-m (18â€‰lbâ€‰ft).

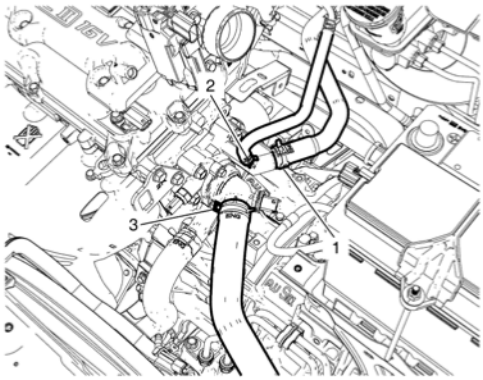
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5. Click here for full size

6. Install the engine coolant thermostat (2). Refer to Engine Coolant Thermostat Replacement.



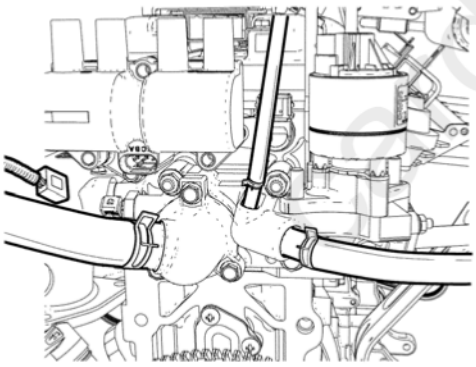
cardiagn.com

7. Click here for full size
8. Connect the radiator inlet hose and clamp (3).
9. Connect the coolant hose and clamp (2).
10. Connect the heater inlet hoseâ€‰and clamp (1).
11. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
12. Fill the cooling system. Refer to Cooling System Draining and Filling.
13. Start the engine and check for coolant leaks.

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Thermostat Housing Replacement

Removal Procedure



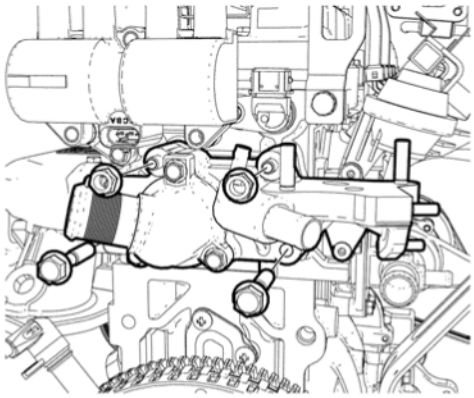
mydiagn.com

1. Click here for full size
2. Warning:

   In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.

3. Drain the system. Refer to Cooling System Draining and Filling.
4. Disconnect the coolant hoses.
5. Disconnect the engine coolant temperature sensor connector.
6. Disconnect the exhaust gas recirculation (EGR) pipe. Refer to Exhaust Gas Recirculation Valve Pipe Replacement.

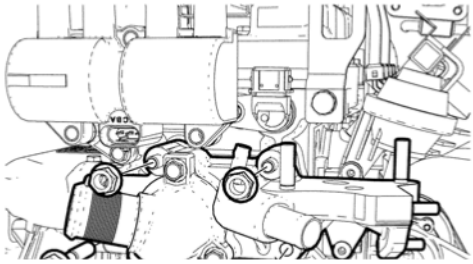
cardiagn.com

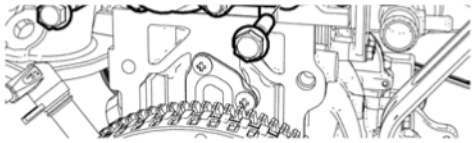


7. Click here for full size
8. Remove the coolant thermostat housing bolts and nuts.
9. Remove the coolant thermostat housing.

Installation Procedure

cardiagn.com

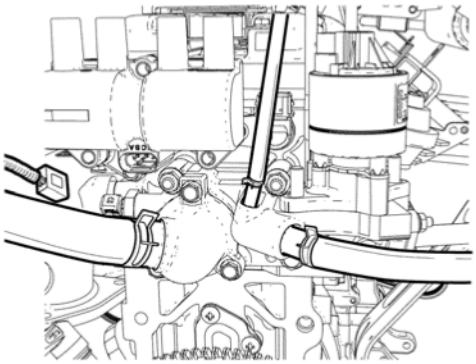




1. Click here for full size
2. Install the coolant thermostat housing.
3. Caution:

   Refer to Fastener Caution.
4. Install the engine coolant thermostat housing bolts and nuts and tighten to 20â€‰N-m (15â€‰lbâ€‰ft).
5. Install the EGR pipe. Refer to Exhaust Gas Recirculation Valve Pipe Replacement.

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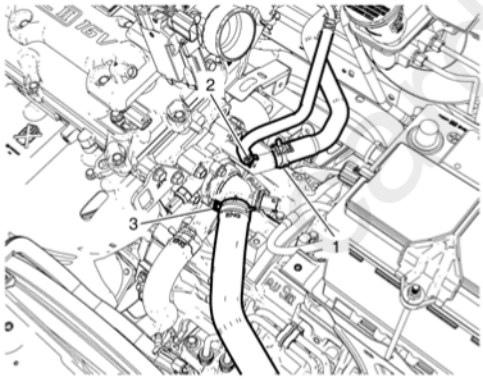
6. Click here for full size
7. Connect the engine coolant temperature sensor connector.
8. Connect the coolant hoses.
9. Replenish the cooling system. Refer to Cooling System Draining and Filling.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Thermostat Replacement (LKY)

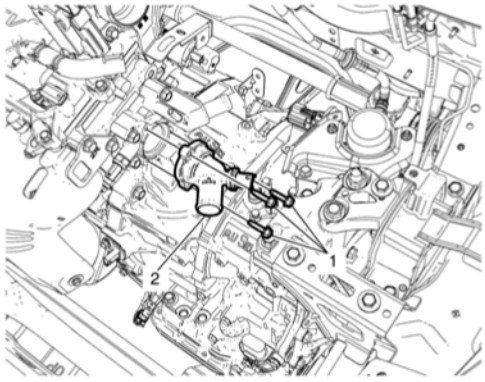
Removal Procedure



obdiagn.com

1. Click here for full size
2. Open the hood.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
4. Drain the cooling system. Refer to Cooling System Draining and Filling.
5. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
6. Disconnect the radiator inlet hose and clamp (3).
7. Disconnect the electrical connector from the engine coolant thermostat heater connector.

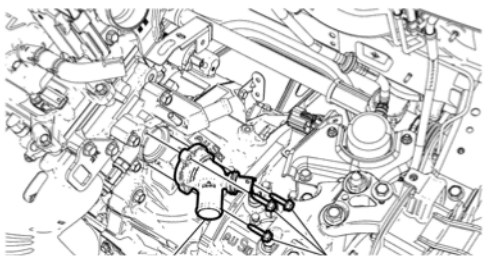
cardiagn.com



8. Click here for full size
9. Remove the engine coolant thermostat boltsâ€‰(1).
10. Remove the engine coolant thermostat assemblyâ€‰(2).

Installation Procedure

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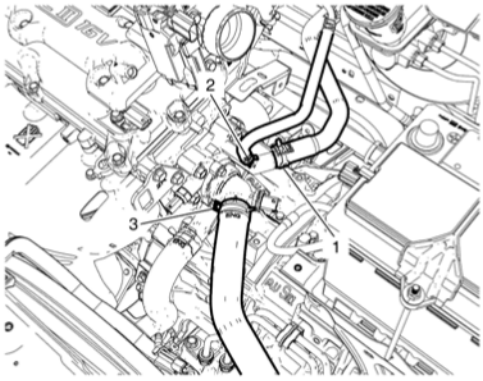




1. Click here for full size
2. Install the engine coolant thermostat assemblyâ€‰(2).
3. Caution:

   Refer to Fastener Caution.
4. Install the 3 engine coolant thermostat boltsâ€‰(1) and tighten to 10â€‰N-m (89â€‰lbâ€‰in).

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5. Click here for full size
6. Connect the electrical connector to the engine coolant thermostat heater connector.
7. Connect the radiator inlet hose and clamp (3).
8. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
9. Fill the cooling system. Refer to Cooling System Draining and Filling.
10. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
11. Start the engine and check for coolant leaks.
12. Close the hood.

Related Part Information

Part Name	Catalog Name	Part Code
Engine Coolant Thermostat	THERMOSTAT,ENG COOL(W/GSKT)	0399A
Engine Coolant Thermostat	THERMOSTAT,ENG COOL(W/WAT INL)	0399B
Engine Coolant Thermostat	THERMOSTAT,ENG COOL(W/WAT OTLT)	0399C
Engine Coolant Thermostat	THERMOSTAT,ENG COOL(W/WAT OTLT & RAD OTLT PIPE)	0399D
Engine Coolant Thermostat	THERMOSTAT KIT,ENG COOL	0399Z

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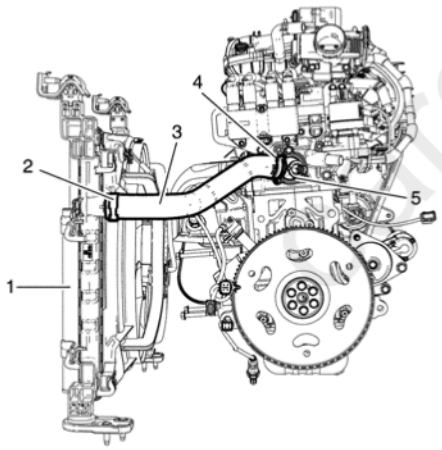
Part Name	Catalog Name	Part Code
Engine Coolant Thermostat	THERMOSTAT,ENG COOL	0400A
Engine Coolant Thermostat	THERMOSTAT,ENG COOL	SS129
Engine Coolant Thermostat	THERMOSTAT,ENG COOL	SJ267

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Thermostat Replacement (LC5, LMU)

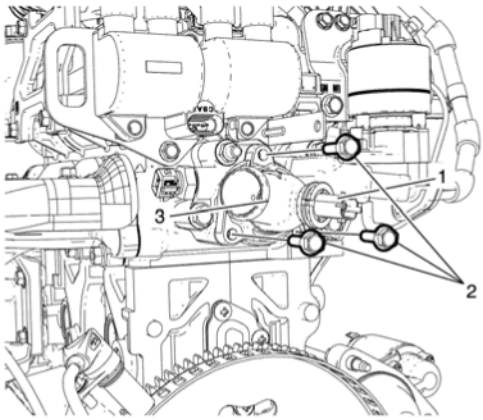
Removal Procedure



mitdiagn.com

1. Click here for full size
2. Open the hood.
3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
4. Raise the vehicle. Refer to Lifting and Jacking the Vehicle.
5. Place a pan below the vehicle to catch the draining coolant.
6. Drain the cooling system. Refer to Cooling System Draining and Filling.
7. Lower the vehicle.
8. Loosen the radiator inlet hose clampâ€‰(4).
9. Remove the radiator inlet hoseâ€‰(3) from the engine coolant thermostatâ€‰(5).

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10. Click here for full size
11. Disconnect the electrical connector from the engine coolant thermostat heater connectorâ€‰(1).
12. Remove the three engine coolant thermostat boltsâ€‰(2).
13. Remove the engine coolant thermostat assemblyâ€‰(3).
14. Check the thermostat seal visually. **IF THE THERMOSTAT SEAL IS OK, DO NOT REPLACE THE THERMOSTAT SEAL**
15. If thermostat seal is having coolant leakage or damaged, remove and **DISCARD** the seal. Replace with **NEW** thermostat seal as described in the seal installation steps below.

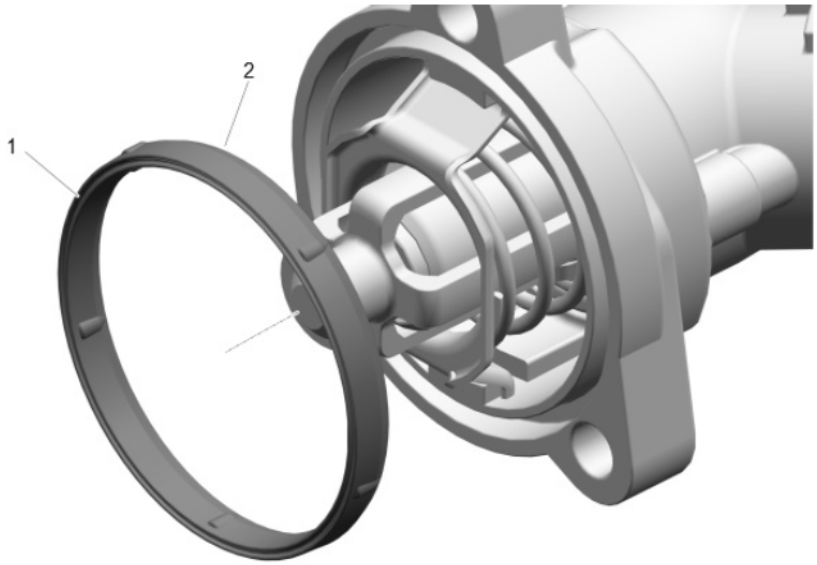
Installation Procedure

1. Note**:**

   Any presence of oil can damage the Seal
2. Check the Thermostat Seal for oil contamination
3. Note**:**

   Any dent, sealing surface damage, any surface scratch on the thermostat housing can lead to coolant leakage
4. Check the Thermostat Housing for oil contamination
5. If install the **NEW** seal, following the below procedure.
6.
   1. Any presence of oil can damage the seal. If any contamination is present, clean using pressurised air, before installing the thermostat seal

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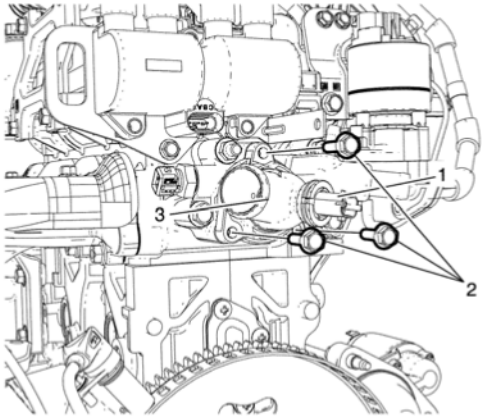


2. [Click here for full size]
3. Note:

   Thermostat seal should not be fitted in the reverse direction which may damage the seal and lead to leakages.

4. Mind the direction for two ribâ€‰(1) and one ribâ€‰(2) and fit the seal correctly.

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7. Click here for full size

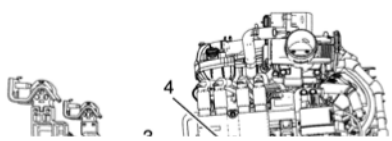
8. Install the engine coolant thermostat assemblyâ€‰(3).

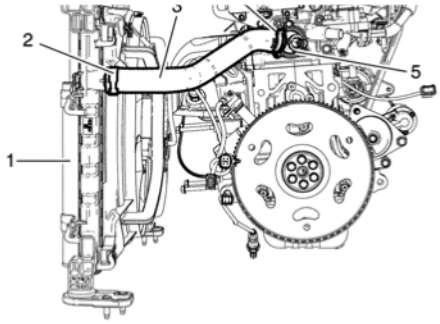
9. Caution:

   Refer to Fastener Caution.

10. Install the three engine coolant thermostat boltsâ€‰(2) and tighten to 10â€‰N-m (89â€‰lbâ€‰in).

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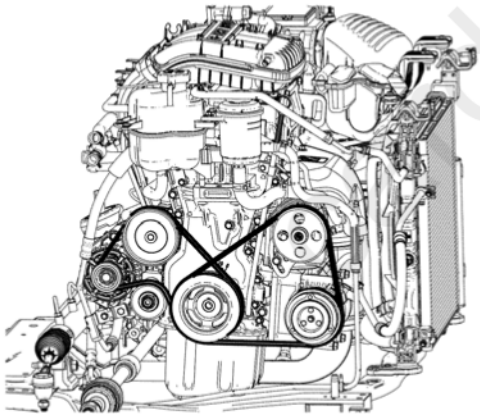
11. Click here for full size
12. Install the radiator inlet hoseâ€‰(3) to the engine coolant thermostatâ€‰(5).
13. Install the radiator inlet hose clampâ€‰(4).
14. Connect the electrical connector to the engine coolant thermostat heater connectorâ€‰(1).
15. Fill the cooling system. Refer to Cooling System Draining and Filling.
16. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
17. Close the hood.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Water Pump Replacement (LC5, LMU)

Removal Procedure



Diagn.com

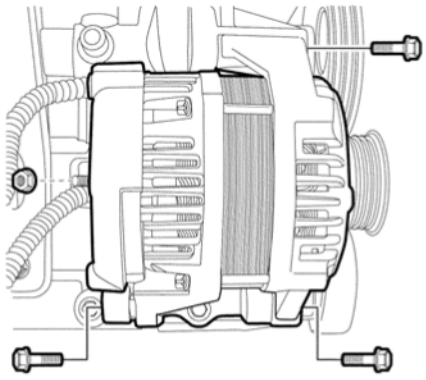
1. Click here for full size
2. Warning:

   In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.

3. Drain the coolant. Refer to Cooling System Draining and Filling.

4. Remove the drive belt. Refer to Drive Belt Replacement.

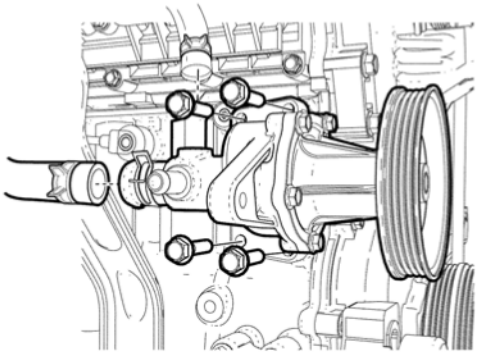
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5.
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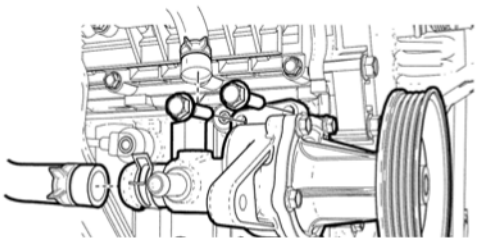
6. Remove the generator. Refer to Generator Replacement.

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7. Click here for full size
8. Disconnect the coolant hose(s) from the water pump.
9. Remove the water pump from engine block.

Installation Procedure



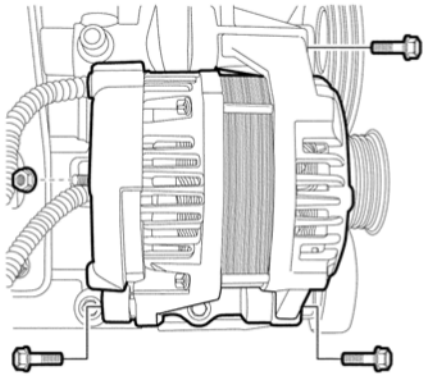
cardiagn.com



1. Click here for full size
2. Install the water pump to engine block.
3. Caution:

   Refer to Fastener Caution.
4. Install the three engine coolant thermostat bolts and tighten to 10â€‰N-m (89â€‰lbâ€‰in).

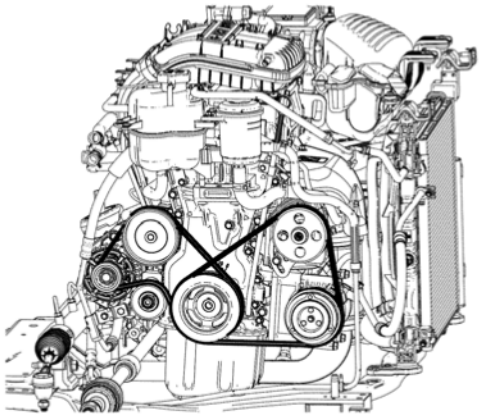
cardiagn.com



5. Click here for full size

6. Install the generator. Refer to Generator Replacement.

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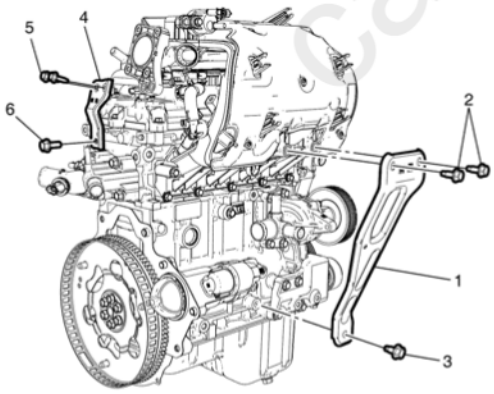
7. Click here for full size
8. Install the drive belt. Refer to Drive Belt Replacement.
9. Refill the engine cooling system. Refer to Cooling System Draining and Filling.

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Water Pump Replacement (LKY)

Removal Procedure

1. Drain the coolant. Refer to Cooling System Draining and Filling.
2. Remove the water pump and generator belt. Refer to Water Pump and Generator Belt Replacement.
3. Remove the generator. Refer to Generator Replacement.

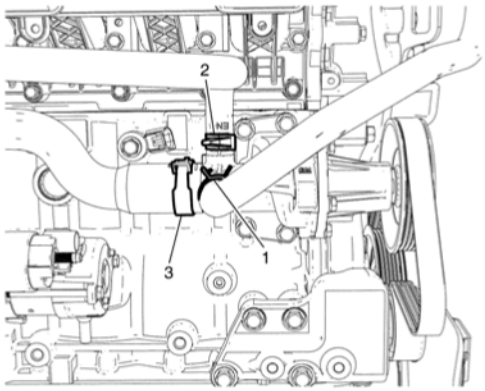


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4.
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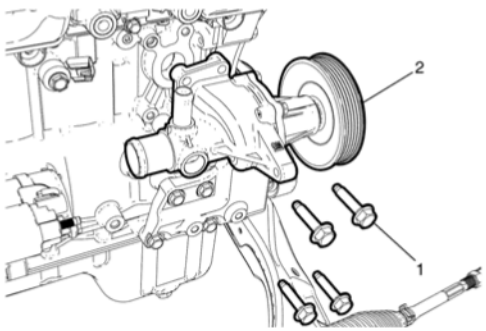
5. Remove the intake manifold rear bracket bolts (2, 3).
6. Remove the intake manifold rear bracket (1).

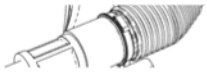
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7. Click here for full size
8. Disconnect the radiator surge tank outlet hose and clamp (1).
9. Disconnect the heater outlet hose â€‰and clamp (2).
10. Disconnect the water pipe hose and clamp (3).

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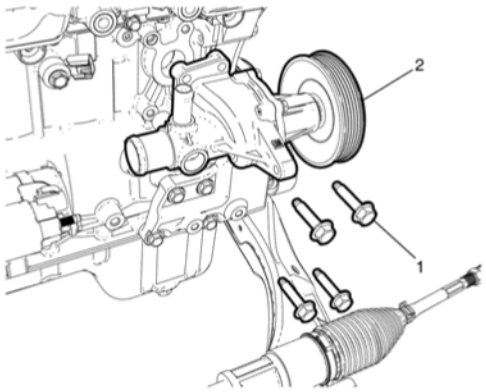


11. Click here for full size
12. Remove the 4 water pump bolts (1).
13. Remove the water pump assembly (2) from the engine block.
14. Remove the water pump oil seal ring.

Installation Procedure

1. Clean the water pump threads.
2. Insert a NEW water pump seal ring.

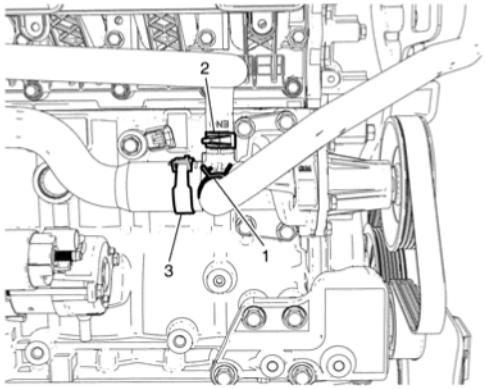
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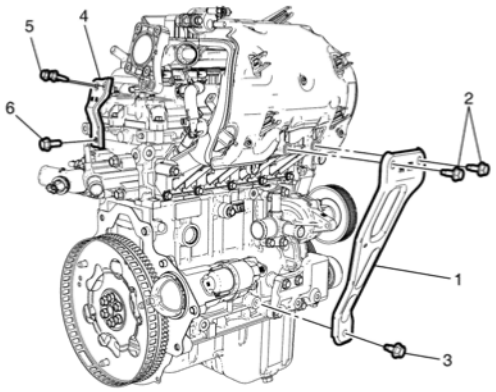
3. Click here for full size
4. Install the water pump assembly (2) to engine block.
5. Caution:

   Refer to Fastener Caution.
6. Install the 4 water pump bolts (1) and tighten to 25â€‰N-m (18â€‰lbâ€‰ft).



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7. Click here for full size
8. Connect the water pipe hose and clamp (3).
9. Connect the heater outlet hoseâ€‰and clamp (2).
10. Connect the radiator surge tank outlet hose and clamp (1).



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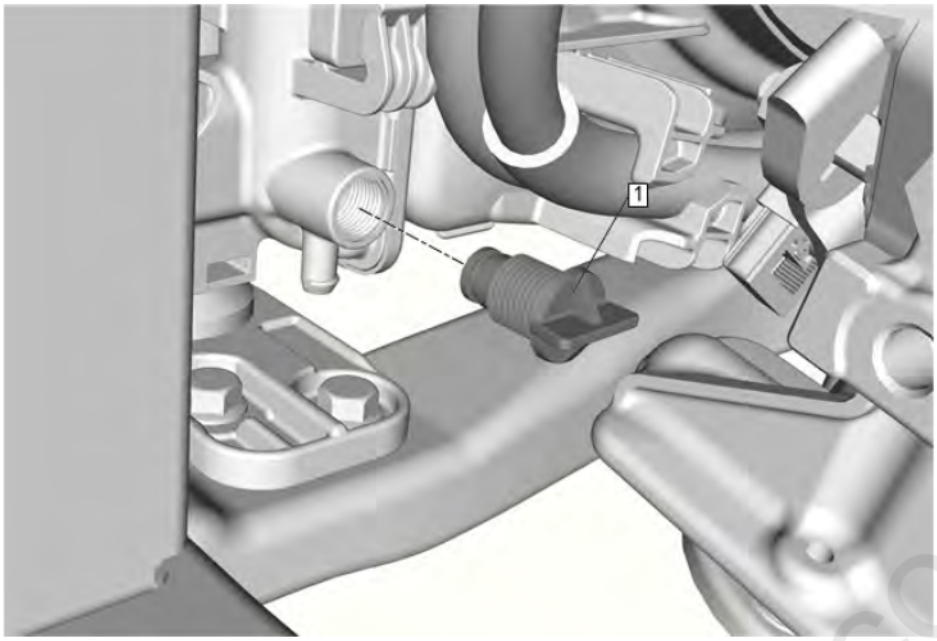
11. Click here for full size
12. Install the intake manifold rear bracket (1).
13. Install the intake manifold rear bracket bolts (2) and tighten to 25â€‰N-m (18â€‰lbâ€‰ft).

14. Install the intake manifold rear bracket bolt (3) and tighten to 46â€‰N-m (34â€‰lbâ€‰ft).
15. Install the generator. Refer to Generator Replacement.
16. Install the water pump and generator belt. Refer to Water Pump and Generator Belt Replacement.
17. Fill the engine cooling system. Refer to Cooling System Draining and Filling.
18. Start the engine and check for coolant leaks.

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Drain Cock Replacement



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Callout	Component Name
	Preliminary Procedures 1. Front Bumper Fascia Opening Lower Cover Replacement 2. Place a drain pan under the vehicle. 3. Attach a rubber hose to the radiator drain port to guide the coolant into the drain pan.
1	Radiator Drain Cock Caution: Refer to Fastener Caution. Procedures 1. Remove the drain pan. 2. Fill the cooling system. Cooling System Draining and Filling 3. Start the engine and check for coolant leaks.

Related Part Information

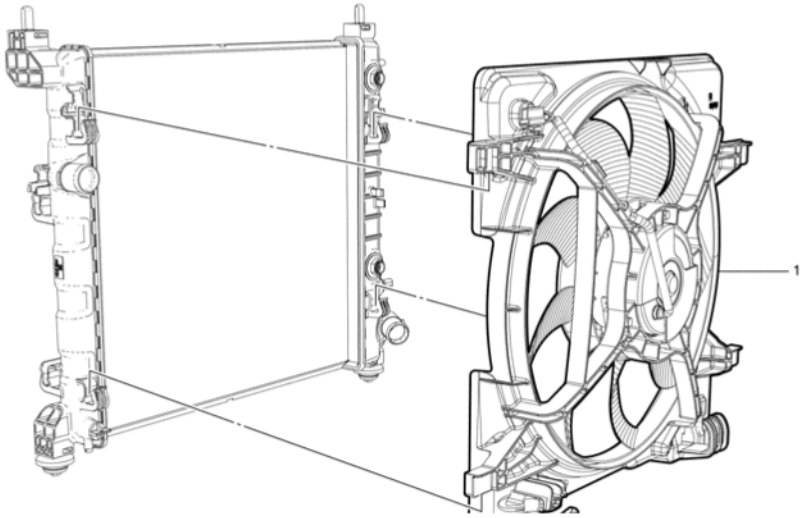
Part Name	Catalog Name	Part Code
Radiator Drain Cock	COCK,RAD DRN	0600A

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Engine Coolant Fan Shroud Replacement (LKY)

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Callout	Component Name
	Preliminary Procedures 1. Remove the radiator assembly. Refer to Radiator Replacement. 2. Disconnect any electrical connectors from the fan shroud.
1	Engine Coolant Fan Shroud Note: Unclip engine coolant fan shroud from radiator.

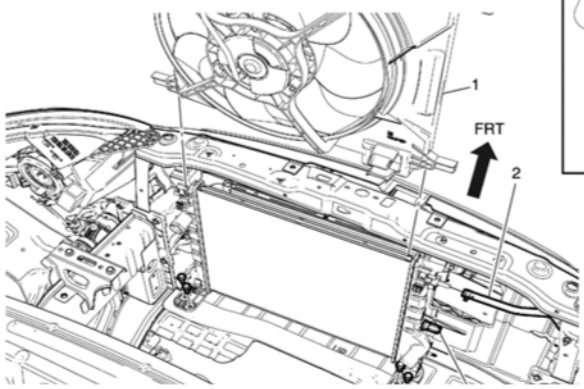
Related Part Information

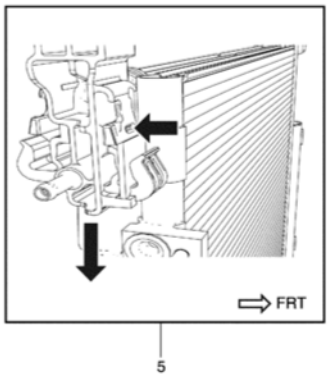
Part Name	Catalog Name	Part Code
Engine Coolant Fan Shroud	SHROUD,ENG COOL FAN	0050A
Engine Coolant Fan Shroud	SHROUD,ENG COOL FAN	0100A

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Replacement

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Callout	Component Name
	Preliminary Procedures 1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement. 2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection. 3. Drain the engine coolant and disconnect the radiator inlet/outlet hose from the radiator.
1	Engine Coolant Fan Engine Coolant Fan Replacement.
2	Engine Coolant Inlet Hose

Callout	Component Name
3	Engine Coolant Temperature Sensor Caution: Refer to Fastener Caution. Tighten 12.5â€‰N-m (9â€‰lbâ€‰ft)
4	Radiator Support Mounting Bolt Tighten 22â€‰N-m (16â€‰lbâ€‰ft)
5	Radiator Procedure Disconnect the condenser from radiator rotating, radiator support, and remove the radiator downward.

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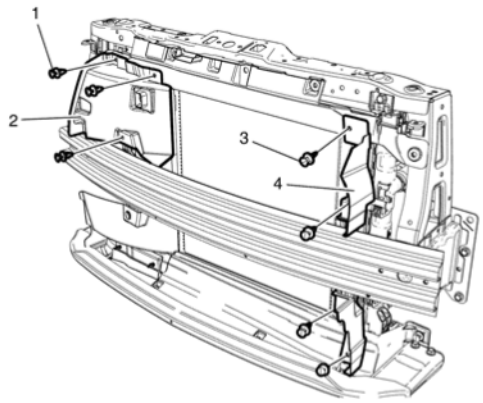
1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Replacement (LKY)

Removal Procedure

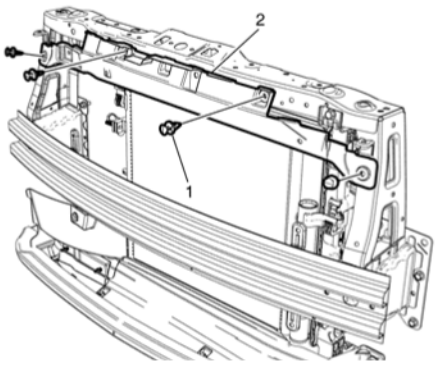
1. Drain the cooling system. Refer to Cooling System Draining and Filling.
2. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
4. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
5. Disconnect the radiator inlet hose from the radiator. Refer to Radiator Inlet Hose Replacement.
6. Disconnect the radiator outlet hose from the radiator. Refer to Radiator Outlet Hose Replacement.
7. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement.

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8. Click here for full size
9. Remove the 3 right side opening cover retainer (1) and right side opening cover (2).
10. Remove the 4 left side opening cover retainer (3) and left side opening cover (4).

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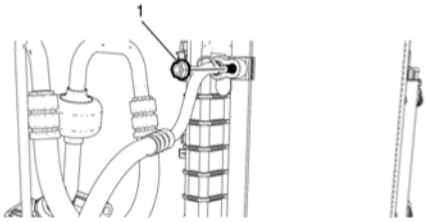


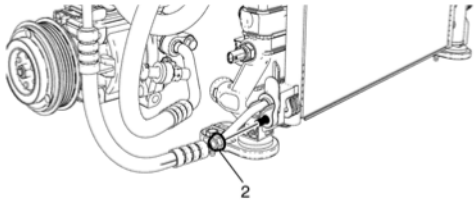


11.
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12. Remove the 4 upper opening cover retainer (1) and upper opening cover (2).

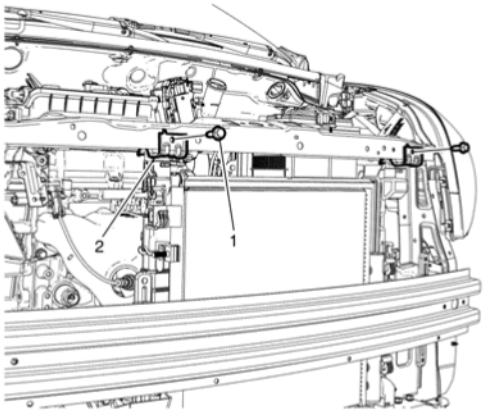
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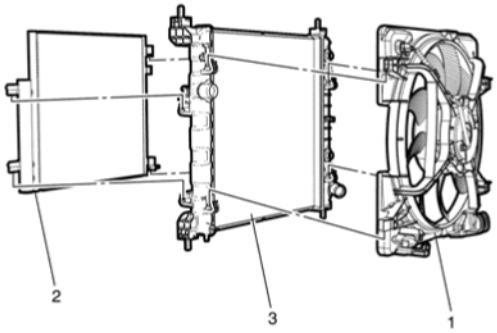
13. Click here for full size
14. Remove air conditioning compressor and condenser upper pipe nut â€‰(1).
15. Remove air conditioning compressor and condenser under pipe nut (2).
16. Remove air conditioning compressor and condenser pipe from the air conditioning condenser.

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17. Click here for full size
18. Remove the 2 radiator support bracket bolts (1).
19. Remove the 2 radiator support brackets (2).
20. Disconnect electrical connectors from the fan shroud.
21. Remove the radiator and air conditioning condenser and engine coolant fan shroud from the vehicle.

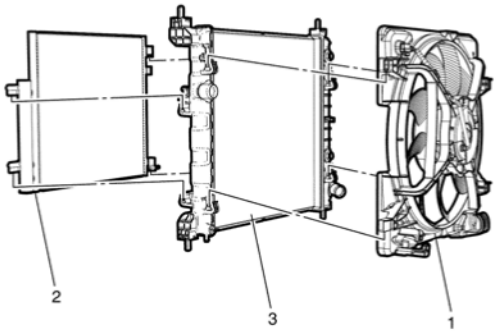
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22. Click here for full size
23. Unclip engine coolant fan shroud (1) from the radiator (3).
24. Unclip conditioning condenser (2) from the radiator (3).
25. Transfer parts as needed.

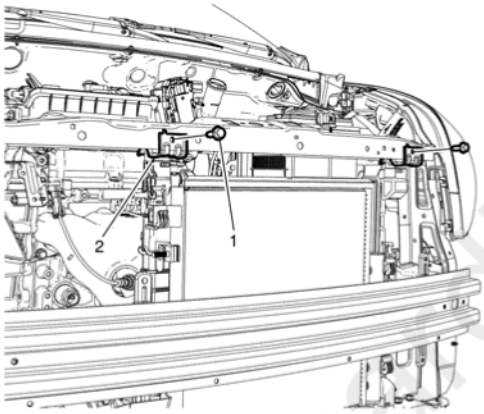
Installation Procedure



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1. Click here for full size
2. Clip the engine coolant fan shroudâ€‰ (1) to the radiator (3).
3. Clip the air conditioning condenser (2) to the radiator (3).

4. Install the radiator and air conditioning condenser and engine coolant fan shroud to the vehicle.



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5. Click here for full size

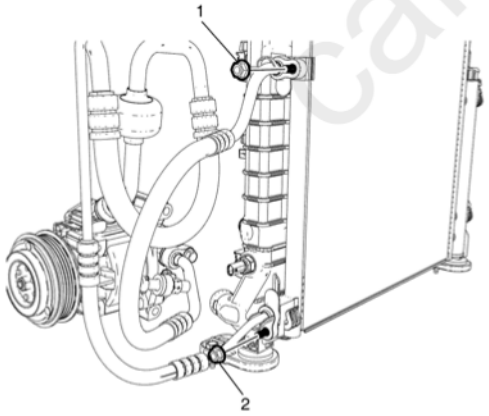
6. Install the 2 radiator support bracket (2).

7. Caution:

   Refer to Fastener Caution.

8. Install the 2 radiator support bracket bolt (1) and tighten to 22â€‰N-m (16â€‰lbâ€‰in).

9. Connect electrical connectors from the fan shroud.



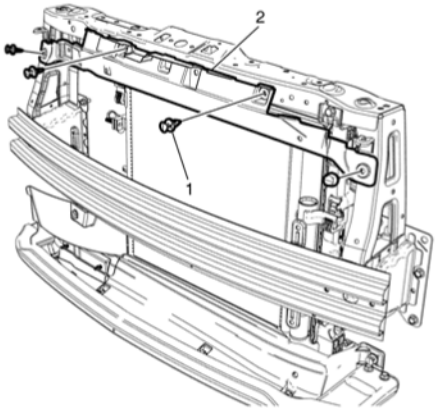
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10.
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11. Install air conditioning compressor and condenser pipe to the air conditioning condenser.
12. Caution:

    Refer to Fastener Caution.
13. Install air conditioning compressor and condenser upper pipe nutâ€‰ (1) and tighten to 22â€‰N-m (16â€‰lbâ€‰in).
14. Install air conditioning compressor and condenser under pipe nut (2) and tighten to 22â€‰N-m (16â€‰lbâ€‰in).

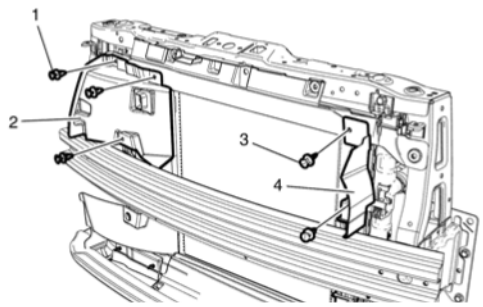
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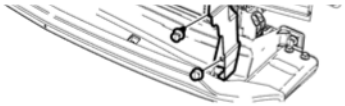


15.
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16. Install the upper opening cover (2) and 4 upper opening cover retainer (1).

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17. Click here for full size
18. Install the left side opening cover (4) and 4 left side opening cover retainer (3).
19. Install the right side opening cover (2) and 3 right side opening cover retainer (1).
20. Install the front bumper fascia. Refer to Front Bumper Fascia Replacement.
21. Connect the radiator outlet hose to the radiator. Refer to Radiator Outlet Hose Replacement.
22. Connect the radiator inlet hose to the radiator. Refer to Radiator Inlet Hose Replacement.
23. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
24. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
25. Fill the cooling system. Refer to Cooling System Draining and Filling.
26. Charge the refrigerant system. Refer to Refrigerant Recovery and Recharging.
27. Start the engine and check for coolant leaks.

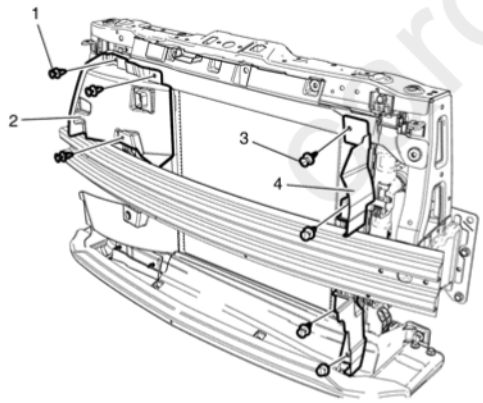
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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Support Bracket Replacement (LKY)

Removal Procedure

1. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement.

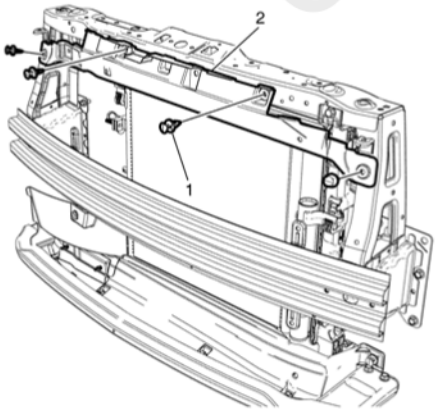


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2.
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3. Remove the 3 right side opening cover retainer (1) and right side opening cover (2).
4. Remove the 4 left side opening cover retainer (3) and left side opening cover (4).

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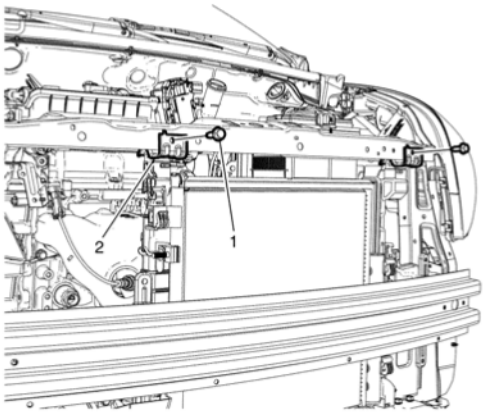


5.

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6. Remove the 4 upper opening cover retainer (1) and upper opening cover (2).

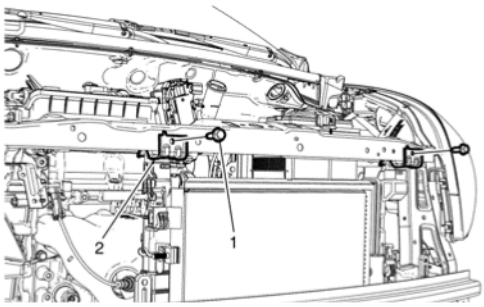
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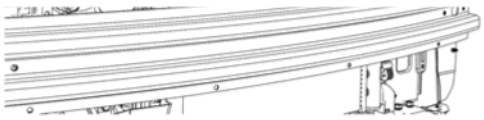
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8. Remove the 2 radiator support bracket bolt (1).
9. Remove the 2 radiator support bracket (2).

Installation Procedure



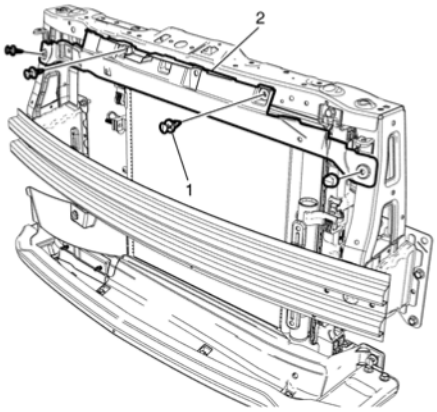
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1. Click here for full size
2. Install the 2 radiator support bracket (2).
3. Caution:

   Refer to Fastener Caution.
4. Install the 2 radiator support bracket bolts (1) and tighten to 22â€‰N-m (16â€‰lbâ€‰in).

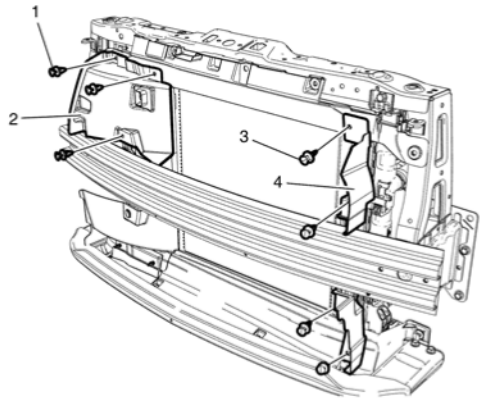
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5. Click here for full size

6. Install the upper opening cover (2) and 4 upper opening cover retainers (1).

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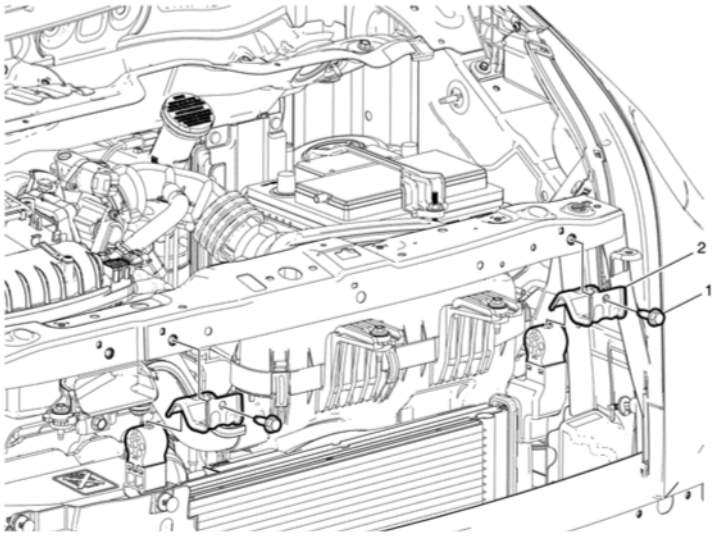
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7. Click here for full size
8. Install the left side opening cover (4) and 4 left side opening cover retainers (3).
9. Install the right side opening cover (2) and 3 right side opening cover retainers (1).
10. Install the front bumper fascia. Refer to Front Bumper Fascia Replacement.

1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Support Bracket Replacement

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Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement.	
1	Radiator Support Bracket Bolt Caution: Refer to Fastener Caution. Tighten 22â€‰N-m (16â€‰lbâ€‰ft)
2	Radiator Support Bracket Tip To easy access the bracket, remove the radiator support retaining bolt and loosen the radiator downward.

Related Part Information

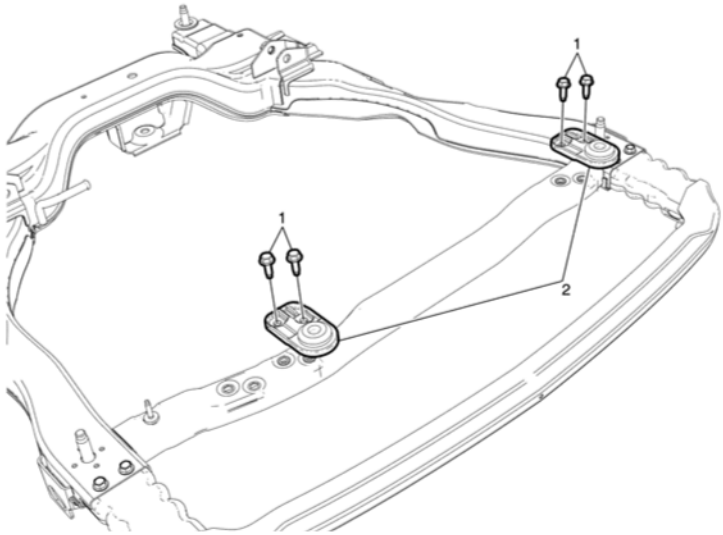
Part Name	Catalog Name	Part Code
Radiator Support Bracket	BRACKET,RAD SUPT	0949A
Radiator Support Bracket	BRACKET,RAD SUPT	0950A

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Support Replacement

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Callout	Component Name
Preliminary Procedure Disconnect the condenser from the radiator. Refer to Radiator Replacement.	
1	Radiator Support Mounting Bolt (Qty:â€‰4) Caution: Refer to Fastener Caution. Tighten 22â€‰N-m (16â€‰lbâ€‰ft)
2	Radiator Support Procedure Rotate the radiator support and disconnect it from the radiator.

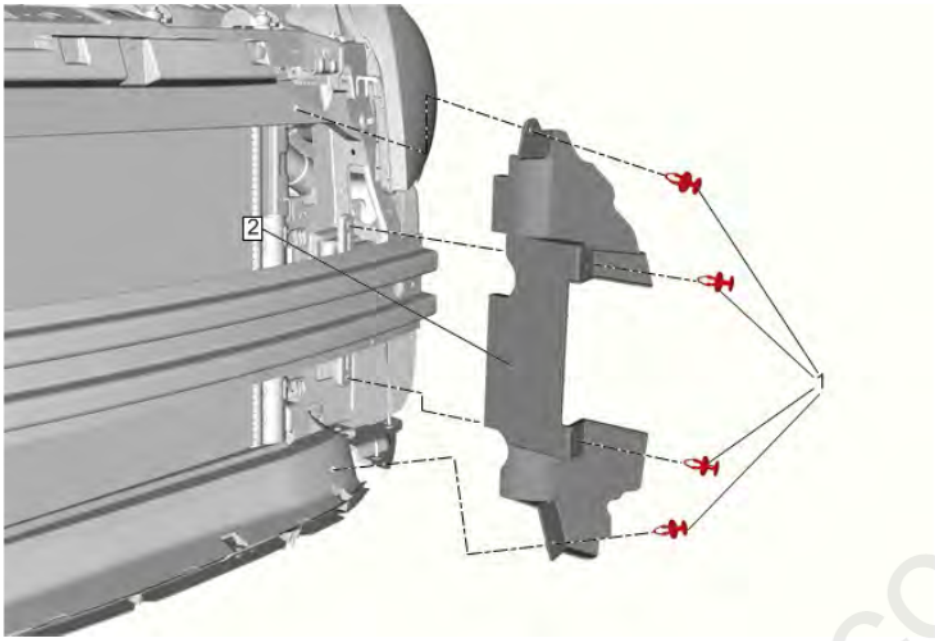
Related Part Information

Part Name	Catalog Name	Part Code
Radiator Support	SUPPORT KIT,RAD	0449Z
Radiator Support	SUPPORT,RAD	0450A
Radiator Support	SUPPORT,RAD	0500A

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Air Baffle Replacement



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Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement	
1	Radiator Air Baffle Retainer [4>x]
2	Radiator Air Baffle

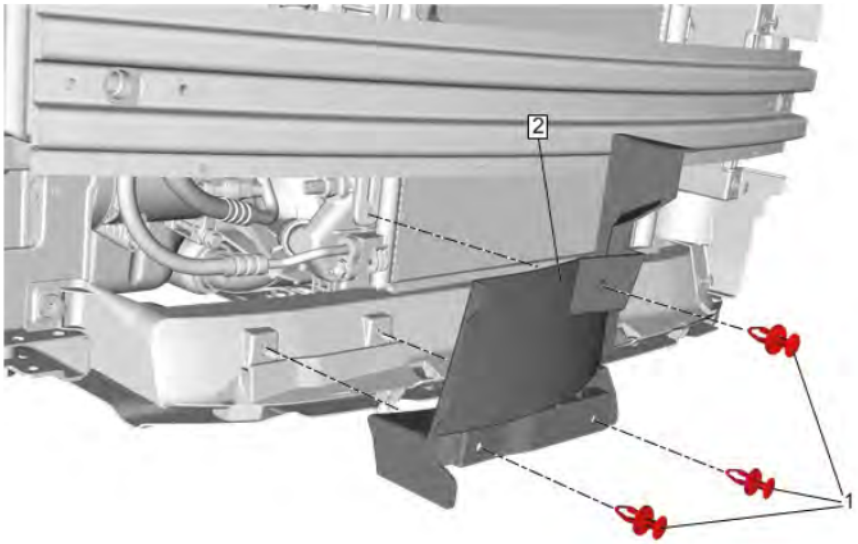
Related Part Information

Part Name	Catalog Name	Part Code
Radiator Air Baffle	BAFFLE,RAD AIR 2950A	

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Air Lower Baffle Replacement (LMU, LKY with MBN)



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Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement	
1	Radiator Air Lower Baffle Retainer [3>x]
2	Radiator Air Lower Baffle

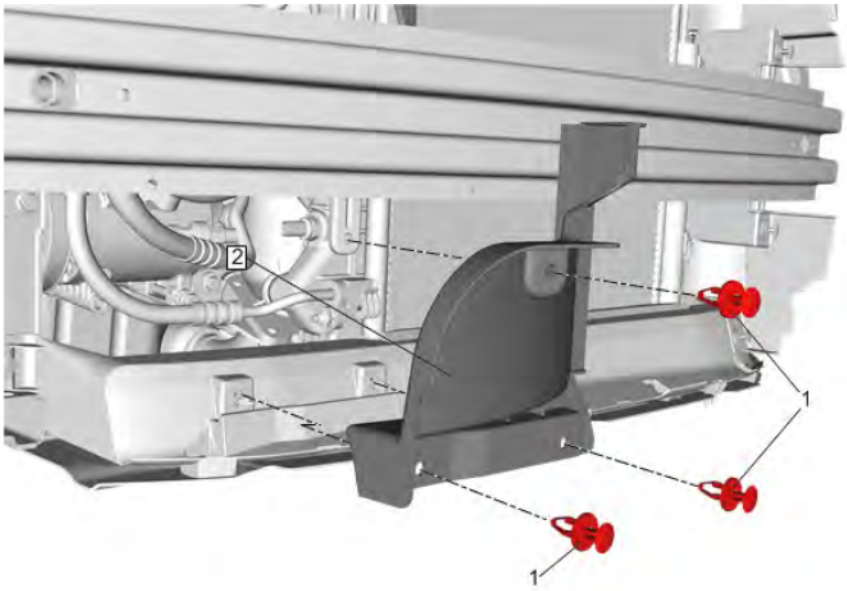
Related Part Information

Part Name	Catalog Name	Part Code
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3199A
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3200A
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3675A

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Air Lower Baffle Replacement (LKY with MBR)



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Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement	
1	Radiator Air Lower Baffle Retainer [3>x]
2	Radiator Air Lower Baffle

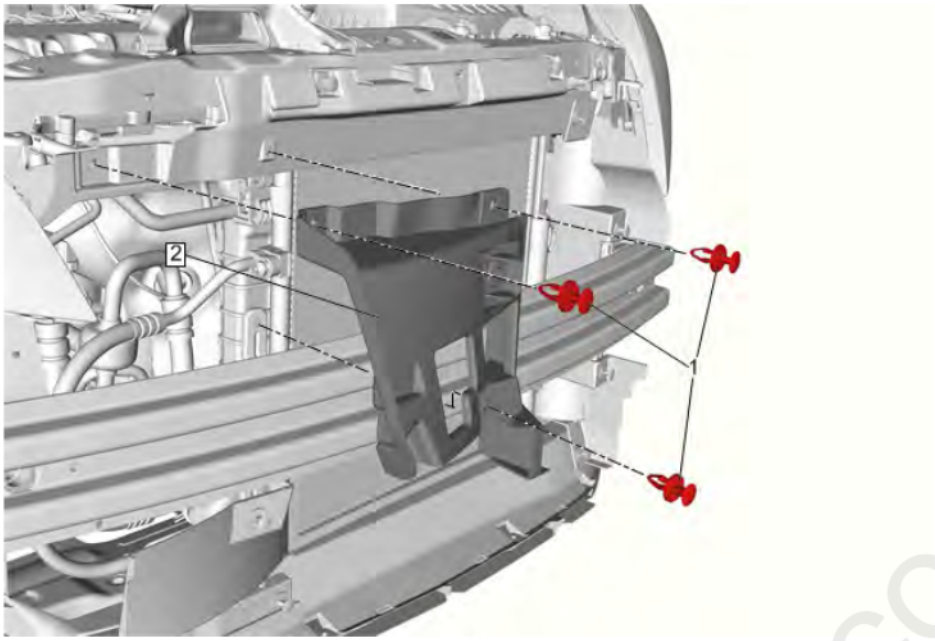
Related Part Information

Part Name	Catalog Name	Part Code
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3199A
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3200A
Radiator Air Lower Baffle	BAFFLE,RAD AIR LWR	3675A

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2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Air Upper Baffle Replacement (LMU, LKY with MBN)



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Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement	
1	Radiator Air Upper Baffle Retainer [3>x]
2	Radiator Air Upper Baffle

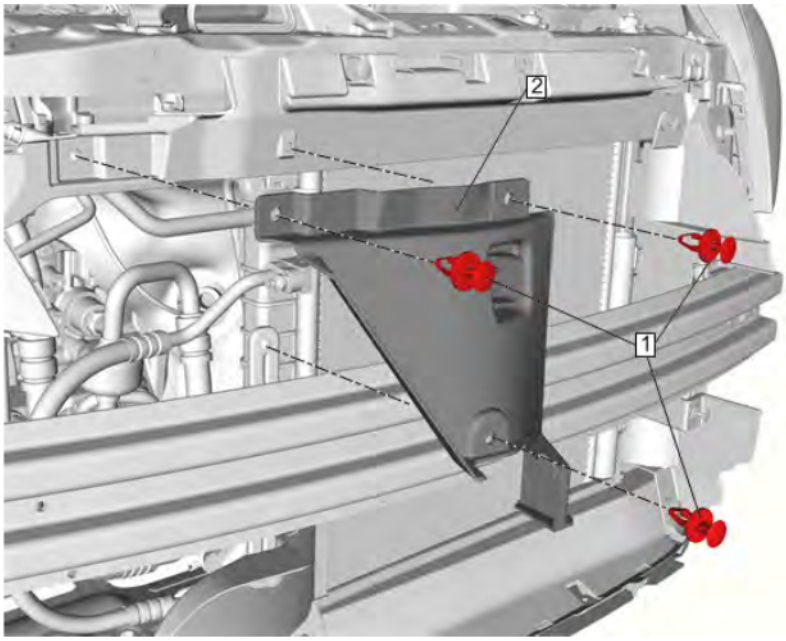
Related Part Information

Part Name	Catalog Name	Part Code
Radiator Air Upper Baffle	BAFFLE,RAD AIR UPR	3749A

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. REPAIR INSTRUCTIONS
4.

Radiator Air Upper Baffle Replacement (LKY with MBR)



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Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement	
1	Radiator Air Upper Baffle Retainer [3>x]
2	Radiator Air Upper Baffle

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Specifications

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1. **ENGINE/PROPULSION**
2. ENGINE CONTROLS AND FUEL - 1.0L, 1.19L, OR 1.2L
3. SPECIFICATIONS
4.

Temperature Versus Resistance

Temperature	Resistance
150Â°C (302Â°F)	42 to 44 Ω
140Â°C (284Â°F)	53 to 57 Ω
130Â°C (266Â°F)	68 to 72 Ω
120Â°C (248Â°F)	88 to 92 Ω
110Â°C (230Â°F)	114to 120thinsp;Ω
100Â°C (212Â°F)	151to 159thinsp;Ω
90Â°C (194Â°F)	203to 215thinsp;Ω
80Â°C (176Â°F)	275to 293thinsp;Ω
70Â°C (158Â°F)	379to 405thinsp;Ω
60Â°C (140Â°F)	532to 572thinsp;Ω
50Â°C (122Â°F)	762to 824thinsp;Ω
45Â°C (113Â°F)	921to 997thinsp;Ω
40Â°C (104Â°F)	1118o 1212hinsp;Ω
35Â°C (95Â°F)	1366o 1484hinsp;Ω
30Â°C (86Â°F)	1683o 1829hinsp;Ω
25Â°C (77Â°F)	2088o 2266hinsp;Ω
20Â°C (68Â°F)	2608o 2828hinsp;Ω
15Â°C (59Â°F)	3289o 3567hinsp;Ω
10Â°C (50Â°F)	4182o 4532hinsp;Ω
5>Â°C (41Â°F)	5356o 5800hinsp;Ω
0>Â°C (32Â°F)	6914o 7484hinsp;Ω
-5Â°C (23Â°F)	8994o 9732hinsp;Ω
-10Â°C (14Â°F)	11796 12762insp;Ω
-15Â°C (5>Â°F)	15589 16871insp;Ω
-20Â°C (-4Â°F)	20791 22517insp;Ω
-30Â°C (-22Â°F)	37991 41273insp;Ω
-40Â°C (-40Â°F)	72230 78834insp;Ω

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1. ENGINE/PROPULSION
2. ENGINE HEATING AND COOLING
3. SPECIFICATIONS
4.

Fastener Specifications (LKY)

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
Note: All fasteners listed in this table can be reused after removal.	
Air Conditioning Compressor and Condenser Under Pipe Nut	22N-m (16 lb ft)
Air Conditioning Compressor and Condenser Upper Pipe Nut	22N-m (16 lb ft)
Block Heater Connecting Plug Holder Bolt	8>N-m (71 lb in)
Engine Coolant Fan Bolt	10N-m (89 lb in)
Engine Coolant Thermostat Bolt	10N-m (89 lb in)
Engine Coolant Thermostat Housing Bolt	25N-m (18 lb ft)
Intake Manifold Bracket Bolt â€“ Lower	46â€‰N-m
Intake Manifold Bracket Bolt â€“ Upper	25N-m (18 lb ft)
Radiator Drain Cock	2>N-m (18 lb in)
Radiator Overflow House Bracket Nut	9>N-m (80 lb in)
Radiator Support Bracket Bolt	22N-m (16 lb ft)
Radiator Support Mounting Bolt	22N-m (16 lb ft)
Radiator Surge Tank Mounting Bolt	8>N-m (71 lb in)

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. SPECIFICATIONS
4.

Fastener Specifications (LC5, LMU)

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
Note: All fasteners listed in this table can be reused after removal.	
EGR Pipe Retaining Bolt	8>N-m (71 lb in)
EGR Pipe Retaining Nut	10N-m (89 lb in)
Engine Coolant Temperature Sensor (Radiator)	12.5N-m (111thinsp;lb in)
Engine Coolant Temperature Sensor (Thermostat)	18N-m (13 lb ft)
Engine Coolant Thermostat Housing Retaining Bolt	20N-m (15 lb ft)
Engine Coolant Thermostat Retaining Bolt	10N-m (89 lb in)
Power Steering Fluid Reservoir Bolt	9>N-m (80 lb in)
Radiator Support Bracket Bolt	22N-m (16 lb ft)
Radiator Support Mounting Bolt	22N-m (16 lb ft)
Radiator Surge Tank Mounting Bolt	8>N-m (71 lb in)

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. SPECIFICATIONS
4.

Approximate Fluid Capacities

Application	Specification	
	Metric	US English
Coolant System		
• Diesel	4.2â€‰liters	4.4â€‰quarts
• Gasoline	4.74â€‰liters	4.9â€‰quarts

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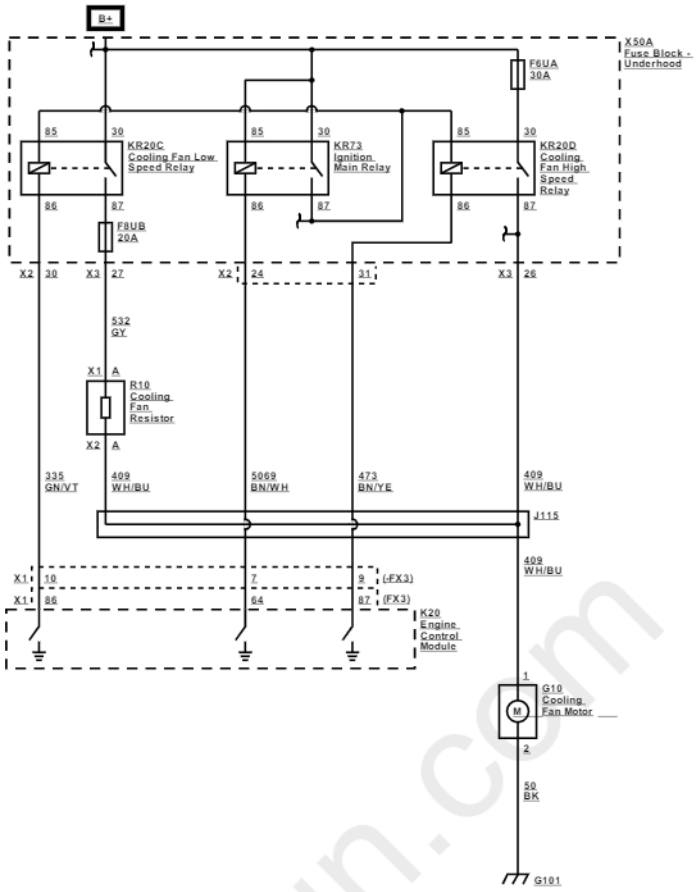
Schematic and Routing Diagrams

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Engine Heating|Cooling Schematics

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Engine Cooling



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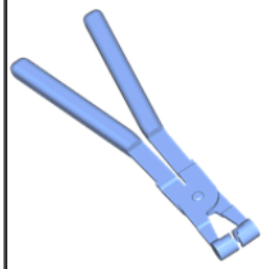
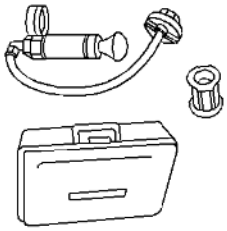
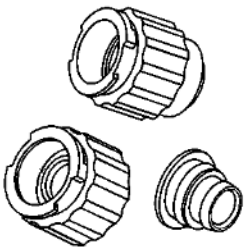
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Special Tools and Equipment

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1. **ENGINE/PROPULSION**
2. ENGINE HEATING AND COOLING
3. SPECIAL TOOLS AND EQUIPMENT
4.

Special Tools

Illustration	Tool Number / Description
 Click here for full size	BO-38185 J-38185 Hose Clamp Pliers
 Click here for full size	EN-24460-A J-24460-A Cooling System Pressure Tester
 Click here for full size	GE-42401-A J-42401-A Radiator Cap and Surge Tank Test Adapter

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