Component Procedures: Radiator Cooling Fan

Table of Contents

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Parts and Labor (itype_189)

Parts

Qualifier	Part #	Name	Price	Note
Cooling Fan > Right	22762583	11 - Cooling Fan	55.69	
Cooling Fan > Left	22762584	11 - Cooling Fan	55.28	

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Cooling Fan > Fan Blade, R&R > One	B	1.1	0.8
Remove & Replace	Cooling Fan > Fan Blade, R&R > Both	B	1.3	0.9
Remove & Replace	Cooling Fan > Fan Motor, R&R > One	B	1.1	0.8
Remove & Replace	Cooling Fan > Fan Motor, R&R > Both	B	1.3	0.9
Remove & Replace	Cooling Fan > Fan Relay, R&R	B	0.3	0.0
Remove & Replace	Cooling Fan > Fan Shroud, R&R	C	1.3	0.9

Cooling Fan (Article 11806)

The engine cooling fan system consists of 2 electric cooling fan s and 3 fan relay s. The relays are arranged in a series/parallel (S/P) configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds. The cooling fan s receive positive voltage from the cooling fan relay s which receive battery positive voltage from the underhood fuse block.

In low speed operation, the ECM applies ground to the coil side of the cooling fan low speed relay. This energizes the coil and applies voltage directly to the right cooling fan through the switch side of the low speed relay. The right cooling fan is connected in series to the left cooling fan through the de-energized series/parallel (S/P) cooling fan speed control relay. The series circuit operates both fans at low speed.

In high speed operation, the ECM applies a ground to the coil side of the cooling fan low speed relay, the S/P cooling fan speed control relay, and the cooling fan high speed relay . When energized, the high speed fan relay applies voltage directly to the left cooling fan through the switch side of the relay. Simultaneously, the low speed fan relay and the S/P speed control relay provide ignition voltage and a direct path to ground for the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

Cooling System Electronic Component Description and Operation

Coolant Heater

The coolant heater operates using 110 V AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. The coolant heater also helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Engine or Radiator Coolant Temperature Sensor

The engine coolant temperature (ECT) sensor or radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine or radiator coolant. The ECM supplies 5 V to the sensor signal circuit and a ground for the low reference circuit.

Engine Coolant Thermostat Heater

The ECM controls the pulse width modulated (PWM) thermostat heater circuit. The engine coolant thermostat heater helps control coolant flow and regulates the engine operating temperature. The ignition relay supplies 12 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.

Electronic Coolant Pump

The switchable water pump is always ON in the default position. When commanded, an actuator disengages a clutch that decouples the pump from the engine. An Engine Material Sensor has been introduced on the engine head for the switchable water pump control and engine protection purposes. The engine metal temperature (EMT) sensor is present only if the switchable water pump is present in the specific application.

Engine Metal Temperature Sensor / Cylinder Head Temperature Sensor

The cylinder head temperature sensor is a variable resistor that measures the temperature of the cylinder head . The engine control module (ECM) supplies 5 V to the cylinder head temperature sensor signal circuit and a

ground for the low reference circuit.
Electro-Viscous (EV) Fan Clutch
The ECM controls the EV fan clutch operation. The ECM regulates a 12-volt pulse width modulated signal (PWM) to the cooling fan relay. The PWM signal determines the ON time of the relay. As the ECM command increases, so does the ON time of the relay. The relay ON time directly controls the amount of time the solenoid, which is internal to the fan clutch, is energized. When the solenoid in the fan clutch is energized, it opens the spring loaded valve and allows fluid to flow from the storage chamber to the fluid coupling of the cooling fan clutch, which increases the fan speed. When the solenoid is de-energized, the spring loaded valve closes, and allows the fluid in the coupling of the fan clutch to drain back to the storage chamber, which reduces fan speed. The rapid modulation of the fan clutch solenoid valve gives the ECM the ability to precisely control the amount of fluid that remains in the fluid coupler, allowing more effective regulation of the fan speed and powertrain cooling requirements.

Cooling Fans (Article 10575)

Cooling Fan s
Page 1 of 1

Engine Coolant Fan Replacement (Article 11866)

Callout Component Name
Preliminary Procedures Remove engine coolant fan and shroud. Refer to Engine Coolant Fan Shroud Replacement
Preliminary Procedures
Remove engine coolant fan and shroud. Refer to Engine Coolant Fan Shroud Replacement
1 Engine Coolant Fan Nuts (Qty 2) Caution: Refer to Fastener Caution . Tighten 6 Nm (53 lb in)
6 Nm (53 lb in)
2 Engine Coolant Fan

Cooling Fan Always On (Article 11812)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.
Circuit/System Description
The engine cooling fan system consists of a cooling fan assembly containing two electric cooling fan s. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.
Reference Information
Schematic Reference
Engine Heating/Cooling Schematics
Connector End View Reference
Component Connector End Views
Description and Operation
Cooling Fan Description and Operation
Electrical Information Reference
- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
Scan Tool Reference
Control Module References for scan tool information
Circuit/System Verification
- Verify that DTC P0480, P0481, P0691, P0692, P0693 or P0694 is not set.
- If any cooling system DTCs are set, repair the DTCs first. Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- Ignition ON, verify with a scan tool that the ECM is not commanding fan activation.
- Ignition ON, observe that the fan is not activated.
Circuit/System Testing
- Ignition OFF, disconnect each KR20 cooling fan relay one at a time.
- Ignition ON, observe that the cooling fans are not activated.

- If the fans are activated, test for a short to voltage in the relay controlled output circuit.
- If the fans are not activated, test or replace the appropriate KR20 cooling fan relay.

Component Testing

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

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Electrical Relay Replacement

Cooling Fan Inoperative (Article 11813)

Diagnostic Instructions

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

Circuit/System Description

The engine cooling fan system consists of a cooling fan assembly containing two electric cooling fan s. The engine control module (ECM) uses two fan control circuits and a series of three relays to command the fans ON in either high speed or low speed, depending on cooling requirements. In low speed, both fans are turned ON at a reduced speed. High speed has both fans turned ON at full speed.

Diagnostic Aids

- The ECM has the capability of providing command to the fan relay s even when a scan tool output control is being used. Always refer to the fan control command parameters on the scan tool to know which fans are being commanded ON by the ECM.
- The scan tool cooling fan output control operates as follows:
- Cooling Fan Relay 1 operates both fans at a low speed
- Cooling Fan Relay 2 and 3 operates the left fan at a high speed
- Cooling Fan Relay 1, 2 and 3 operates both fans at a high speed
- KR20 cooling fan relay identification:
- The KR20C cooling fan low speed relay is COOL FAN LOW Relay K613
- The KR20E cooling fan speed control relay is COOL FAN CNTRL Relay K614
- The KR20D cooling fan high speed relay is COOL FAN HI Relay K612
- 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

Component Connector End Views

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Verify that DTC P0480, P0481, P0691, P0692, P0693 or P0694 is not set.
- If a DTC is set, refer to DTC P0480 or P0481 or DTC P0480, P0481, P0691, P0692, P0693, or P0694 .
- Ignition ON, command the appropriate fan relay ON and OFF with a scan tool. Verify that the fans turn ON and OFF when changing between the commanded states.

Circuit/System Testing

- Ignition OFF, disconnect the cooling fan relays.
- Connect a 30 A fused jumper between the KR20E relay K614 switch circuit terminal 30 and the ground circuit terminal 87. This completes the right side fan ground circuit. Leave this jumper in place for the remainder of this procedure.
- Ignition ON, verify that a test lamp illuminates between ground and the relay switched ignition circuit terminal listed below:
- KR20C Relay K613, terminal 87
- KR20D Relay K612, terminal 87
- If the test lamp does not illuminate, test the appropriate relay switch B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the relay switch B+ circuit fuse is open, test the relay controlled output circuit for a short to ground. If the circuit tests normal, test or replace the appropriate G10 cooling fan.
- Connect a 30 A fused jumper between the KR20 cooling fan relay circuit terminals listed below. Verify the appropriate fan is activated.
- KR20D Relay K612, terminals 87 and 30
- KR20C Relay K613, terminals 87 and 30
- If the corresponding cooling fan does not activate, test the relay controlled output circuit and the cooling fan ground circuit for an open/high resistance. If the circuits tests normal, replace the appropriate G10 cooling fan.
- If the corresponding cooling fan activates, replace the appropriate KR20 cooling fan relay.
- Install the KR20E relay K614. Verify both fans activate at low speed.
- If both fans do not activate, test the KR20E relay controlled output circuit terminal 87A, for a short to ground or an open/high resistance.
- If all circuits test normal, test or replace the KR20E cooling fan speed control relay.

Component Testing

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

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Electrical Relay Replacement
- Engine Coolant Fan Motor Replacement