

Chapter 3 Cooling, heating and air conditioning systems

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Specifications

General

Coolant capacity	See Chapter 1
Radiator cap pressure rating	15 psi
Thermostat opening temperature	195-degrees F
Refrigerant type	
1993 and earlier	R-12
1994 and later	R-134a
Refrigerant capacity	
1993 and earlier	2.75 pounds
1994 and later	2.0 pounds

Torque specifications

Water pump-to-block bolts and studs	Ft-lbs
Thermostat housing bolts	25 to 35
	18 to 23

1 General information

Engine cooling system

The Corvette employs a pressurized engine cooling system with thermostatically controlled coolant circulation. An impeller type water pump mounted on the front of the block pumps coolant through the engine. The coolant flows around each cylinder and toward the rear of the engine. Cast-in coolant passages direct coolant around the intake and exhaust ports, near the spark plug areas and in close proximity to the exhaust valve guide inserts.

A wax pellet type thermostat is located in the front of the intake manifold, just beneath the throttle body on earlier models and located in the water pump housing on later models. During warm up, the closed thermostat prevents coolant from circulating through the radiator. When the engine reaches normal operating temperature, the thermostat opens and allows hot coolant to travel through the radiator, where it is cooled before returning to the engine.

The aluminum radiator is the crossflow type, with tanks on either side of the core.

The cooling system is sealed by a pressure type radiator cap. This raises the boiling point of the coolant and the higher boiling point of the

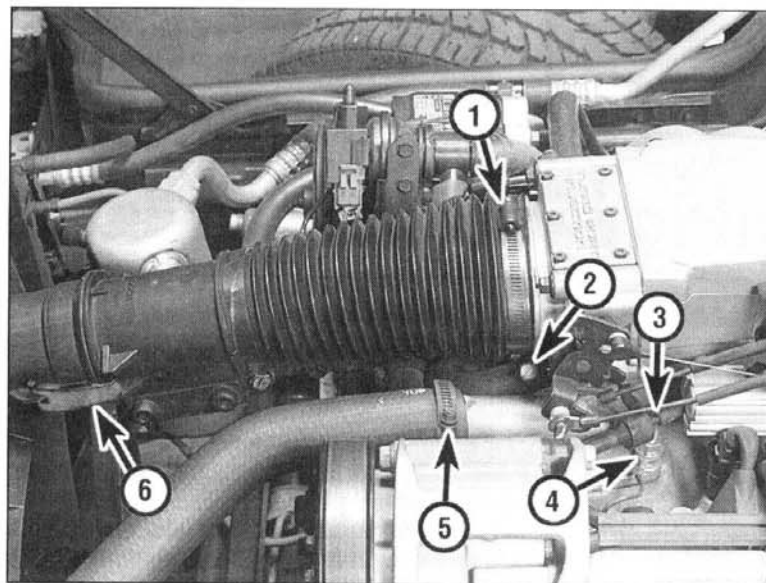
coolant increases the cooling efficiency of the radiator.

If the system pressure exceeds the cap pressure relief value, the excess pressure in the system forces the spring-loaded valve inside the cap off its seat and allows the coolant to escape through the overflow tube into a coolant reservoir. When the system cools the excess coolant is automatically drawn from the reservoir back into the radiator.

The coolant reservoir does double duty as both the point at which fresh coolant is added to the cooling system to maintain the proper fluid level and as a holding tank for overheated coolant. This type of cooling system is known as a closed design because coolant that escapes past the pressure cap is saved and reused.

Heating system

The heating system consists of a blower fan and heater core located under the dashboard, the inlet and outlet hoses connecting the heater core to the engine cooling system and the heater/air conditioning control head on the dashboard. Hot engine coolant is circulated through the heater core at all times. When the heater mode is activated, a flap door opens to expose the heater box to the passenger compartment. A fan switch on the control head activates the blower motor, which forces air through the core, heating the air.



3.3 Several items must be removed or disconnected before you can get to the thermostat housing

- | | |
|---|---|
| 1 Air intake duct hose clamp | 4 Ground wire connector from the thermostat housing stud |
| 2 Hose clamp on the smaller hose that is attached to the underside of the throttle body | 5 Radiator hose clamp |
| 3 Vacuum T-fitting from the vacuum hose under the throttle body | 6 Mass air flow sensor retaining clips (one on each side of the sensor) |

Air conditioning system

The air conditioning system consists of a condenser mounted in front of the radiator, an evaporator mounted under the dash, a compressor mounted on the engine, a filter-drier (accumulator) which contains a high pressure relief valve and the plumbing connecting all of the above.

A blower fan forces the warmer air of the passenger compartment through the evaporator core (sort of a radiator-in-reverse), transferring the heat from the air to the refrigerant. The liquid refrigerant boils off into low pressure vapor, taking the heat with it when it leaves the evaporator.

Heat Vent Air Conditioning (HVAC) system

Both heating and air conditioning are integrated into one system. Air entering the vehicle passes through the air conditioning evaporator, then through or around the heater core. This design is known as a "reheat" or Heat Vent Air Conditioning (HVAC) system.

The HVAC system control components include an air conditioning control head assembly (controller), the programmer assembly, the blower power control module, the in-car temperature sensor, the outside air sensor and the air distribution assembly (the ducting) housing the air flow control valves, the evaporator and the heater core.

Electronic climate control

In the middle of 1986, an optional Electronic Climate Control (ECC) system became available. Although similar to the HVAC system, the ECC system also includes such features as a digital microprocessor (MPU) with a programmable memory, a diagnostic mode for self-diagnosis, both in-car and outside air temperature sensors signal for improved temperature compensation, a digital display, an English-metric conversion capability and a rear window defogger key pad switch.

While earlier HVAC systems use an electrically-operated, rheostat controlled motor to position the temperature door, the ECC HVAC system activates the Auto, Bi-level, Econ, Heat and Def modes through the use of vacuum routed through the programmer.

2 Antifreeze - general information

Warning: Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Flush contacted areas immediately with plenty of water. Do not store new coolant or leave old coolant lying around where it is easily accessible to children and pets, because they are attracted by its sweet taste. Ingestion of even a small amount can be fatal. Wipe up the garage floor and drip pan coolant spills immediately. Keep antifreeze containers covered and repair leaks in your cooling system immediately. Antifreeze is flammable - be sure to read the precautions on the container.

The cooling system should be filled with the recommended antifreeze solution which will prevent freezing down to at least -20-degrees F (see Chapter 1). It also provides protection against corrosion and increases the coolant boiling point.

The cooling system should be drained, flushed and refilled according to the maintenance schedule (see Chapter 1). The use of antifreeze solutions for periods of longer than recommended is likely to cause damage and encourage the formation of rust and scale in the system.

Before adding antifreeze to the system, check all hose connections. Antifreeze can leak through very minute openings.

The exact mixture of antifreeze to water which you should use depends on the relative weather conditions. The mixture should contain at least 50 percent antifreeze, but should never contain more than 70 percent antifreeze.

3 Thermostat - replacement

1991 and earlier models

Refer to illustrations 3.3, 3.7 and 3.12

1 Disconnect the cable from the negative terminal of the battery. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.

2 Drain the coolant (Chapter 1).

3 Loosen the hose clamp at the air intake duct and pop off the retaining clips on the side of the mass air flow sensor meter body (**see illustration**). Pull the air flow sensor away from the air cleaner housing enough to disconnect the electrical connection on the bottom of the sensor, then remove the air intake duct and mass air flow sensor and set them aside. **Caution:** The mass air flow sensor is delicate - handle it carefully.

4 Disconnect the radiator hose from the thermostat housing.

5 Disconnect the smaller coolant hose from the underside of the throttle body.

6 Disconnect the vacuum T-fitting from the vacuum hose under the throttle body.

7 Remove the thermostat housing bolt and stud. **Note:** Should the stud start to back out when the lock (upper) nut is loosened, put a pair of needle-nose locking-type pliers on the jam (lower) nut to prevent the stud from turning (**see illustration**).

8 Remove the thermostat housing.

9 Remove the thermostat. Note the shape of the top of the old thermostat to ensure that the new unit is installed right side up.

10 Remove all traces of old gasket material or sealant from the mating surfaces of the thermostat housing and the intake manifold.

11 Place the new thermostat in position.

12 Apply a bead of silicone sealant to the mating surface of the thermostat housing (**see illustration**).

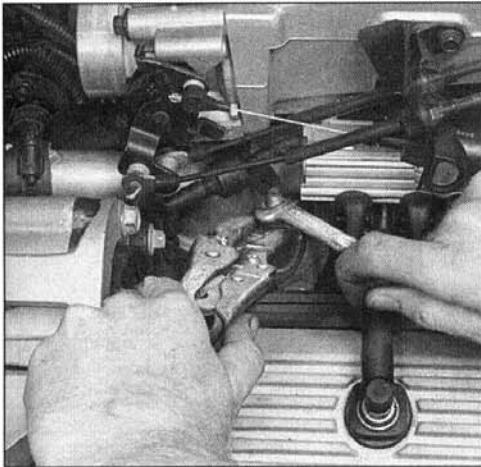
13 Install the thermostat housing and tighten the bolt and stud to the specified torque.

14 Reconnect the vacuum T-fitting to the vacuum hose.

15 Reattach the smaller coolant hose to the underside of the throttle body.

16 Reattach the radiator hose to the thermostat housing.

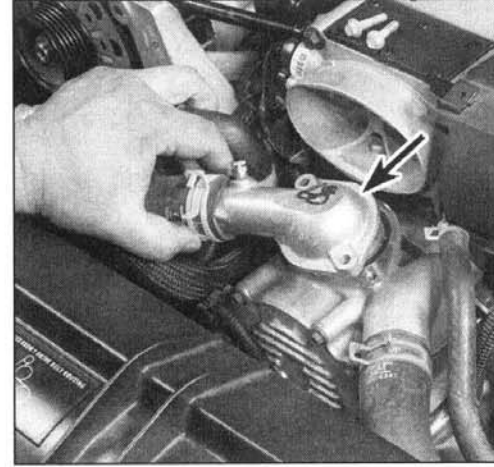
17 Place the intake air duct and mass air flow sensor assembly into



3.7 If the entire stud starts to back out when you start to loosen the locknut, hold the jam nut (the lower nut) with a pair of needle nose-type vise grip pliers



3.12 Apply a bead of silicone sealant on the mating surface of the thermostat housing



3.24 Thermostat cover location (arrow) - 1992 and later models

position and plug in the electrical connector to the bottom of the mass air flow sensor. Install the two retaining clips to the sides of the mass air flow sensor and tighten the air intake duct hose clamp securely.

18 Fill the cooling system.

19 Connect the cable to the negative terminal of the battery.

20 Start the engine, bring the cooling system up to operating temperature and check the thermostat housing and hoses for leaks.

1992 and later models

Refer to illustrations 3.24, 3.25 and 3.27

21 Drain coolant from the radiator, until the coolant level is below the thermostat housing (about 1 gallon).

22 Remove the air intake duct (see Chapter 4).

23 Disconnect the radiator hose from the thermostat cover. **Note:** Most models do not have a thermostat housing gasket, and it isn't necessary to remove the hose unless it is being replaced.

24 Remove the bolts and lift the cover off (see illustrations). It may be necessary to tap the cover with a soft-face hammer to break the gasket seal.

25 Note how it's installed, then remove the thermostat (see illustration). Be sure to use a replacement thermostat with the correct opening temperature (see this Chapter's Specifications).

26 Install the thermostat and make sure the correct end faces out - the spring is directed toward the engine.

27 A traditional gasket is not used, but rather a rubber ring around the thermostat. Replace this ring and install the thermostat cover

without gasket sealant (see illustration).

28 Carefully position the cover and install the bolts. Tighten them to the torque listed in this Chapter's Specifications - do not over-tighten the bolts or the cover may crack or become distorted.

29 Reattach the radiator hose to the cover and tighten the clamp - now may be a good time to check and replace the hoses and clamps (see Chapter 1).

30 Refer to Chapter 1 and refill the system, then run the engine and check carefully for leaks.

4 Electric cooling fan motor and circuit - testing

1984 models

Refer to illustrations 4.3, 4.5 and 4.6

1 The cooling fan temperature switch is located on the right cylinder head, just behind the dipstick. Disconnect the electrical connector from the switch.

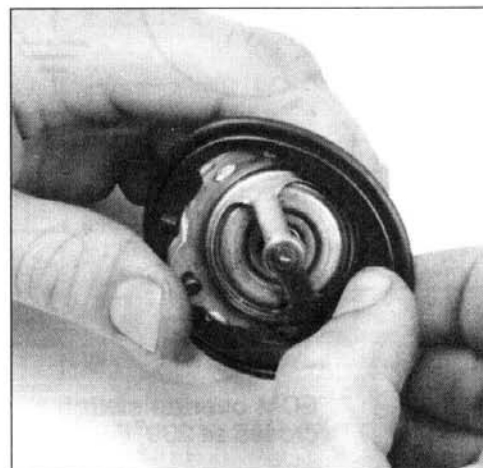
2 Turn the ignition key to the On position.

3 Ground the cooling fan temperature switch connector (see illustration). The fan should come on. **Note:** If the fan comes on, but has not been coming on when the engine is operating at above normal temperature, the thermo switch is faulty.

4 If the fan does not come on, check the fan motor circuit fuse. Replace if necessary.



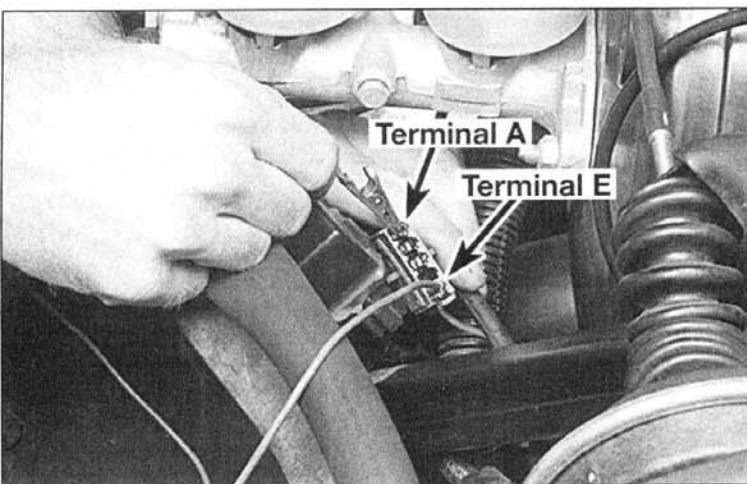
3.25 Note how the thermostat is installed, then remove the thermostat (the spring end points toward the engine)



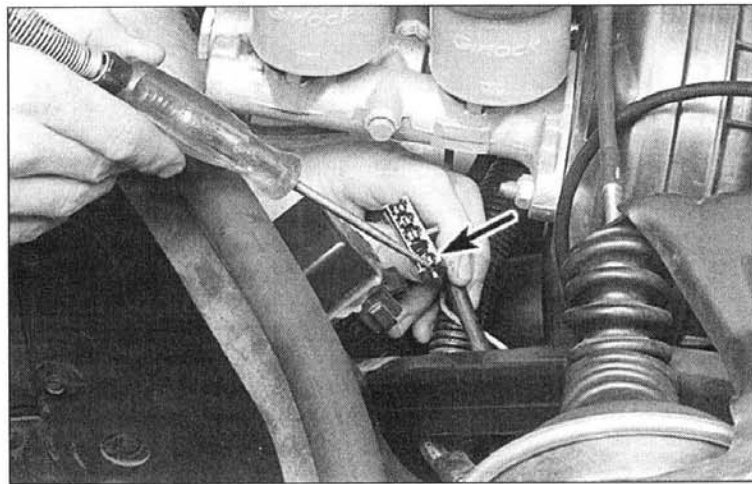
3.27 Install a new rubber seal around the thermostat



4.3 The cooling fan temperature switch is located in the right cylinder head just behind the engine oil dipstick. Unplug the electrical connector (arrow) and ground it and the fan should come on



4.5 The cooling fan motor relay is located just below the master cylinder



4.6 Check for battery voltage to the relay at terminal E (arrow) with a test light

5 If the fuse is okay, unplug the cooling fan relay, located just below the master cylinder. Jump terminal A (black/red wire) to terminal E (red wire) (**see illustration**). If the fan now comes on, the relay is faulty. Replace it.

6 If the fan does not come on after either test, check the battery voltage to the red wire with a test light (**see illustration**).

7 If battery voltage is present, either the fan motor is faulty, the wire between the relay and the fan motor is faulty or the wire between the motor and ground is broken or disconnected.

8 To check the wire between the relay and the fan motor, bypass the relay as in Step 5, attach a test light to ground and probe the black/red wire at the fan motor connector. If the light does not come on, there is an open in this wire. Repair or replace it.

9 To check the fan motor, connect a fused jumper wire from the battery directly to the fan motor hot terminal. If the motor does not come on, check the ground wire.

10 To check the fan motor ground wire, hook up a test light to a voltage source and probe the black wire at the fan motor connector. If the light does not come on, there is an open in the ground wire. Repair or replace it.

11 Aside from these checks, further diagnosis of the electric cooling

fan motor and circuit is beyond the scope of the home mechanic because the fan is ECM-controlled during operation of the air conditioning system.

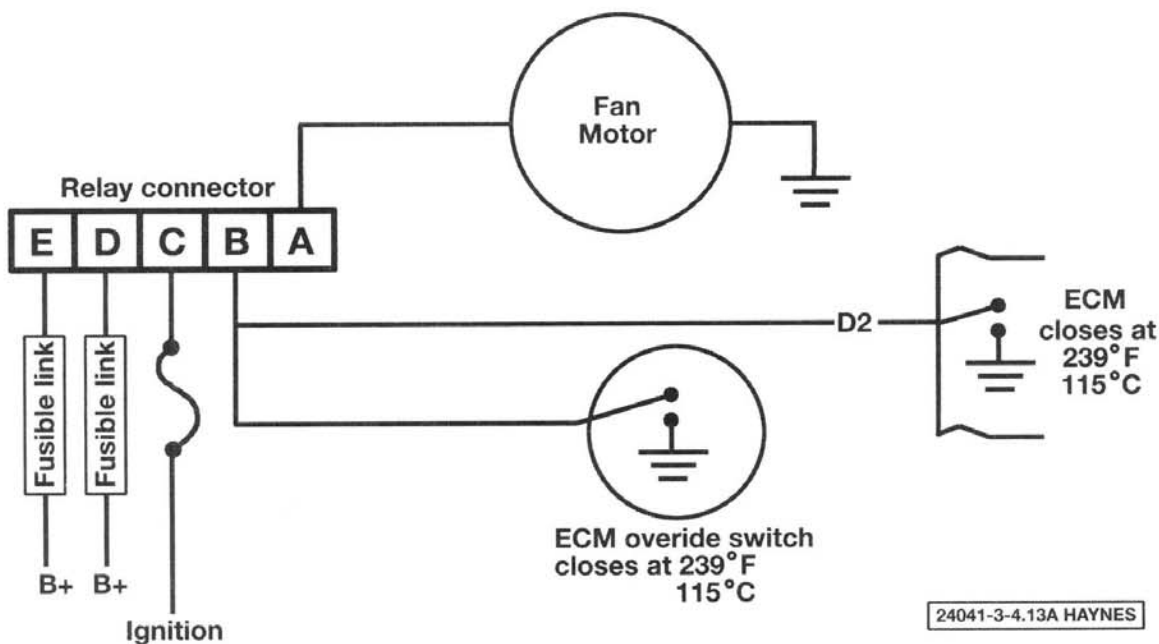
1985 through 1987 models

Refer to illustrations 4.13a, 4.13b and 4.15

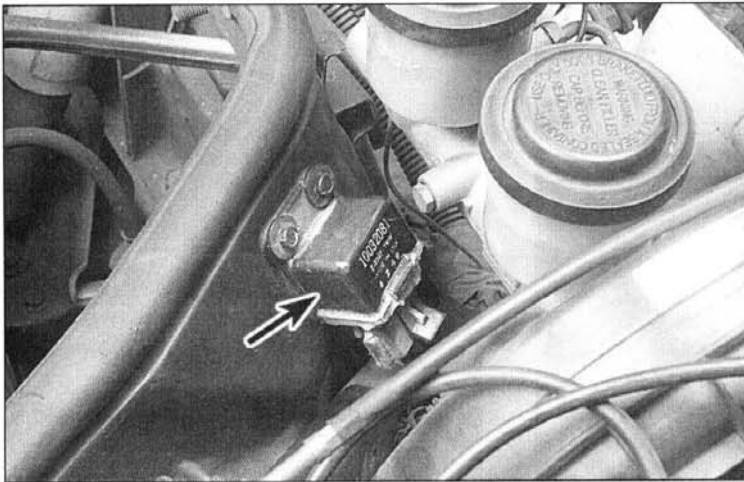
Note: Most models use an auxiliary cooling fan, typically mounted ahead of the radiator. The auxiliary cooling fan relay is usually mounted on the left side of the radiator shroud. The same procedure for diagnosing the primary cooling fan can be used to diagnose the auxiliary cooling fan.

12 Ground the ALCL terminals A to B, (chapter 6) turn the ignition on, engine not running. The cooling fan should be running.

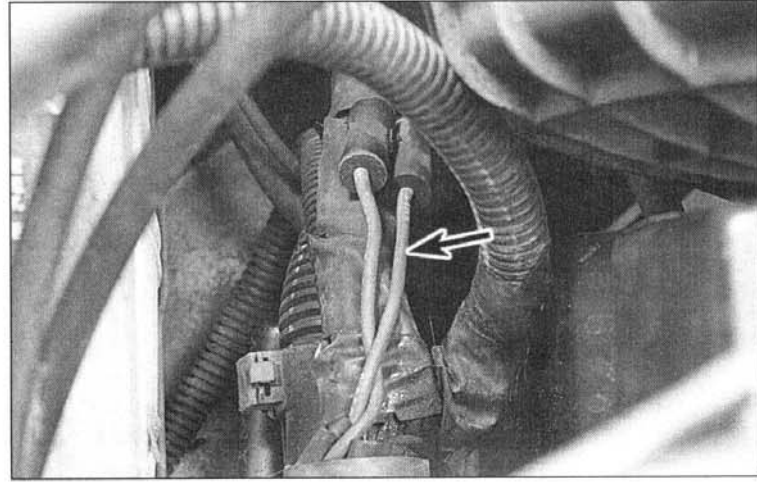
13 If the fan is inoperative Locate the cooling fan relay mounted at the left side of the engine compartment by the brake booster. With the ignition key in the ON position ground the cooling fan relay connector terminal "B" (**see illustrations**). If the fan operates the problem is in the ECM control circuit. Check the wire for opens, shorts and grounds. If the wiring appears to be OK the problem may be in the ECM itself and you may want to have a professional repair shop perform further diagnostics.



4.13a 1985 through 1987 Cooling fan wiring diagram - Some models use cavity E or D as the battery feed through the fusible link



4.13b 1985 through 1987 cooling fan relay location (arrow)



4.15 1985 through 1987 cooling fan fusible link location (arrow)

14 If the fan runs check for voltage and ground at the inoperative fan. If power and ground are OK replace the defective fan. **Caution:** The problem can be a poor connection at the cooling fan. the cooling fans may unexpectedly begin to run as you probe for power at the fan connectors. Keep hands and tools clear of the cooling fans at all times.

15 If there is no power at the inoperative fan(s). Remove the fan relay (located near the brake booster area) and check for battery voltage at the relay connector terminal "D" to ground. If there is less than battery voltage or no voltage, check the fusible links at the junction block located behind the battery and repair as necessary (see illustration).

16 If battery voltage is available at the relays check for battery voltage with the ignition key ON at the relay connector terminal "C" If no voltage check the ignition fuses and wiring and repair as necessary.

17 If the above checks are as specified, jump the cooling fan relay connector terminals "A" to "D", the fan should run. If it runs, replace the relay.

18 If cooling fan runs with the ignition off, replace the relay.

19 If the cooling fan problem hasn't been isolated it may be necessary to take the vehicle to a dealer or professional mechanic to diagnose the computer control of the cooling fan.

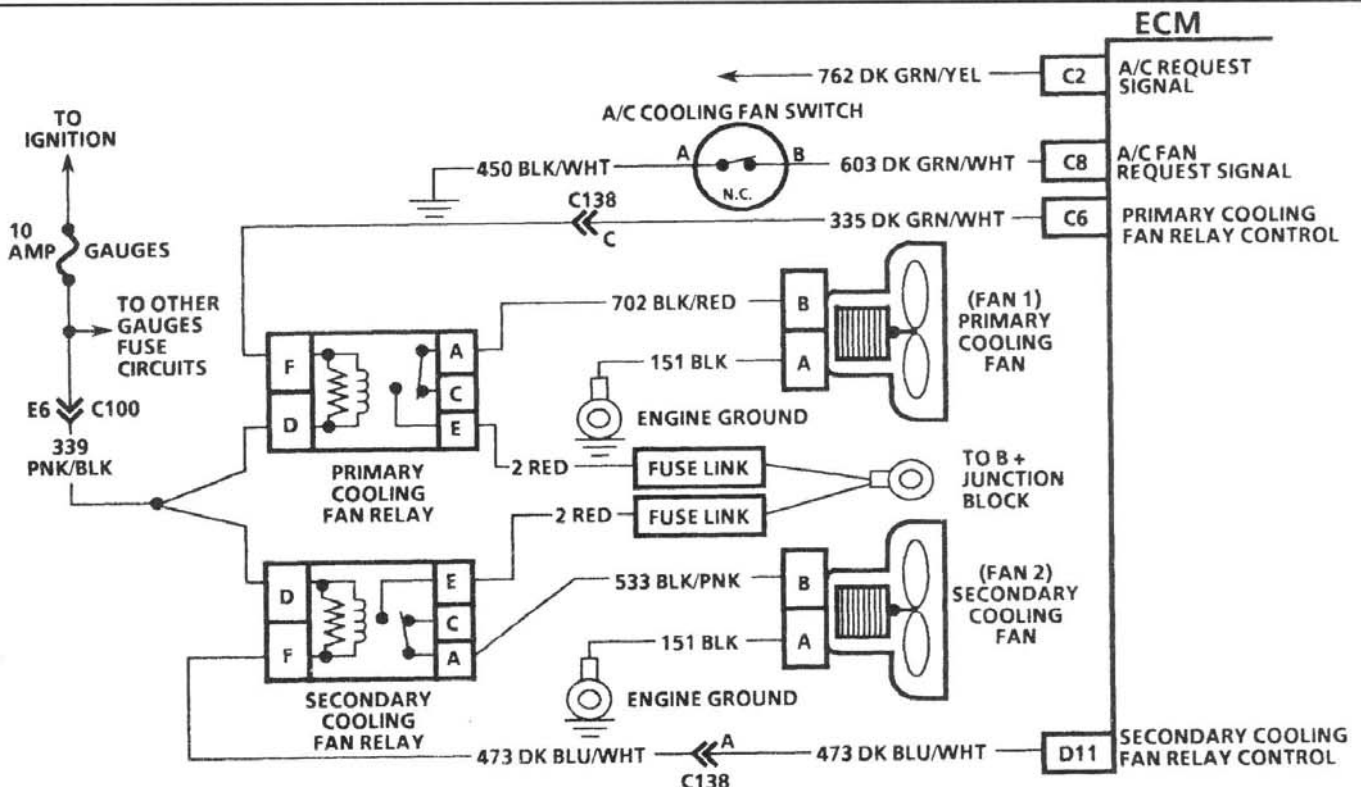
1988 and later models

Refer to illustrations 4.20, 4.22 and 4.24

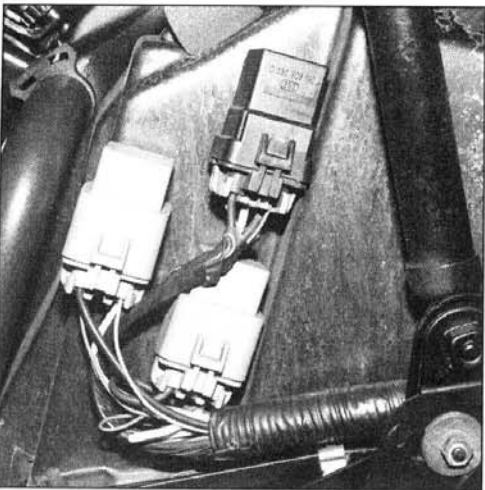
Note: 1995 and 1996 models utilize three cooling fan relays and use various combinations of these relays to obtain several cooling fan speeds. Due to the complexity of this circuitry the relay circuit must be diagnosed using equipment normally not available to the home mechanic. These vehicles should be diagnosed by a professional repair shop.

20 Most models use two cooling fans, a primary and a secondary. during normal operation the ECM will command the primary cooling fan on when engine coolant temperature reaches 226-degrees F, when the air conditioning is on or if a cooling system or coolant sensor diagnostic code is occurring. The ECM will command the secondary cooling fan on when the primary fan is running and the air conditioning is on if the vehicle speed is below 55 MPH, if the engine temperature exceeds 235-degrees F or if a cooling system or coolant sensor diagnostic code is occurring (see illustration).

21 Ground the ALCL terminals A to B, (see Chapter 6) turn the ignition on, engine not running. Both cooling fans should be running.



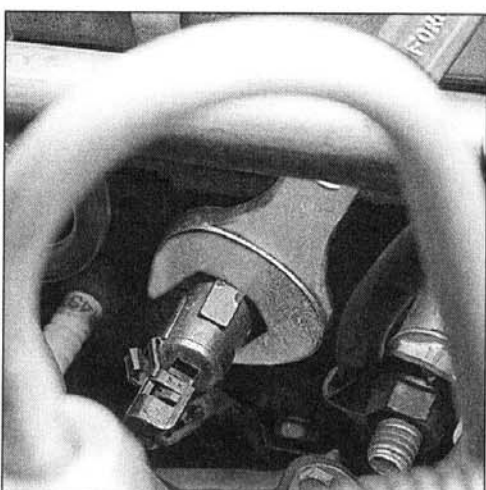
4.20 1988 and later primary and secondary cooling fan wiring diagram



4.22 On 1988 and later models, the cooling fan relays are located on the left side of the radiator shroud primary (arrow) secondary (arrow)



4.24 1988 and later cooling fan fusible link location (arrow)



5.3 The cooling fan temperature switch is mounted in the right cylinder head, just behind the engine oil dipstick

- 22 If one or both fans are inoperative Locate the cooling fan relays mounted at the left side of the radiator shroud (**see illustration**). With the ignition key in the ON position ground the inoperative cooling fan relay connector terminal "F". If the fan operates the problem is in the ECM control circuit. Check the wire for opens, shorts and grounds. If the wiring appears to be OK the problem may be in the ECM itself and you may want to have a professional repair shop perform further diagnostics.
- 23 If no fans or only one fan runs check for voltage and ground at the inoperative fan(s). If power and ground are OK replace the defective fan. **Caution:** The problem can be a poor connection at the cooling fan. the cooling fans may unexpectedly begin to run as you probe for power at the fan connectors. Keep hands and tools clear of the cooling fans at all times.
- 24 If there is no power at the inoperative fan(s), remove the fan relays and check for battery voltage at the relay connector terminal "E" to ground. If there is less than battery voltage or no voltage, check the fusible links at the junction block located behind the battery and repair as necessary (**see illustration**).
- 25 If battery voltage is available at the relays check for battery voltage with the ignition key ON at the relay connector terminal "D". If there's no voltage check the ignition fuses and wiring and replace as necessary.
- 26 If the above checks are good, jump the cooling fan(s) relay connector terminals "A" to "E", the fans should run. If they do, replace the relay(s).
- 27 If either of the cooling fans run with the ignition off, replace the relays.
- 28 If the cooling fan problem hasn't been isolated it may be necessary to take the vehicle to a dealer or professional mechanic to diagnose the computer control of the cooling fans.

5 Cooling fan temperature switch - replacement

Refer to illustration 5.3

- 1 Disconnect the cable from the negative terminal of the battery.
- 2 Disconnect the electrical connector from the cooling fan temperature switch.
- 3 Remove the switch (**see illustration**).
- 4 Wrap the threads of the new switch with Teflon tape.
- 5 Install the new switch and tighten it securely.
- 6 Reconnect the electrical connector.
- 7 Reconnect the cable to the negative terminal of the battery.
- 8 Start the engine, warm it up to operating temperature and verify that the new switch is operating properly. That is, it is now turning on the fan motor when the cooling system overheats.

6 Electric cooling fan - removal and installation

Refer to illustration 6.4

- 1 Disconnect the cable from the negative terminal of the battery.
- 2 Loosen the hose clamp at the air intake duct and pop off the retaining clips on the side of the mass air flow sensor body. Pull the air flow sensor away from the air cleaner housing enough to disconnect the electrical connection on the bottom of the sensor, then remove the air intake duct and mass air flow sensor and set them aside. **Caution:** The mass air flow sensor is delicate - handle it carefully.
- 3 Remove the two locking knobs on the top of the air cleaner housing and remove the air cleaner housing.
- 4 Remove the four cooling fan motor frame-to-shroud bolts, lift the fan motor frame up far enough to disconnect the electrical connector from the underside of the fan motor and remove the fan motor frame assembly (**see illustration**).
- 5 Remove the fan retaining nut and remove the fan from the motor.
- 6 Remove the four motor-to-frame mounting bolts and remove the motor from the frame.
- 7 Installation of the new motor is the reverse of the removal procedure.

7 Radiator - removal and installation

Refer to illustrations 7.5 and 7.11

- 1 Disconnect the cable from the negative terminal of the battery.
- 2 Drain the coolant (Chapter 1).
- 3 Remove the fan motor frame assembly (see Section 6).
- 4 Disconnect the upper and lower radiator hoses and the overflow hose.
- 5 Disconnect the transmission cooler fittings (**see illustration**).
- 6 Remove the 12 bolts and 6 screws that attach the upper shroud to the lower one.
- 7 Remove the power steering reservoir-to-shroud bolt and loosen the rear bolt, then rotate the reservoir to the left far enough to clear the radiator shroud.
- 8 Pop the fan motor wire harness retaining clip loose from the shroud.
- 9 Push the accumulator bracket aside and lift the shroud from the engine compartment.
- 10 Lift the radiator straight up and remove it.
- 11 Installation is the reverse of the removal procedure. **Note:** Be sure to inspect the condition of the radiator rubber support blocks before installing the radiator (**see illustration**). Replace them if they are cracked or deteriorated.