

## SECTION 6B

# COOLING AND RADIATOR

**CAUTION:** This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to **CAUTIONS** in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow **CAUTIONS** could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

**NOTICE:** Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED**, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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## GENERAL DESCRIPTION

The engine cooling system consists of the radiator, radiator cap, coolant reservoir, coolant pipes/hoses, coolant pump, cooling fan, and thermostat (Figure 1). The radiator in this vehicle is a tube and fin type.

### RADIATOR

#### Core

A lightweight tube and fin aluminum radiator is used in this vehicle. The air circulating between the tubes is directed by the fins to lower the engine coolant temperature (ECT) as it flows through the tubes.

### Tanks

The radiator has upper and lower tanks. The upper tank is utilized to increase the capacity and ensure sufficient supply of coolant in the radiator to cool the engine as necessary. Transmission fluid cooler pipes run through the bottom tank of the radiator to cool the transmission fluid (automatic transmission equipped vehicles).

#### Drain Plug

The drain plug is located at the lower left of the radiator on the rear side. It is an open/close system which allows drainage of the engine coolant from the radiator.



## 6B-2 COOLING AND RADIATOR

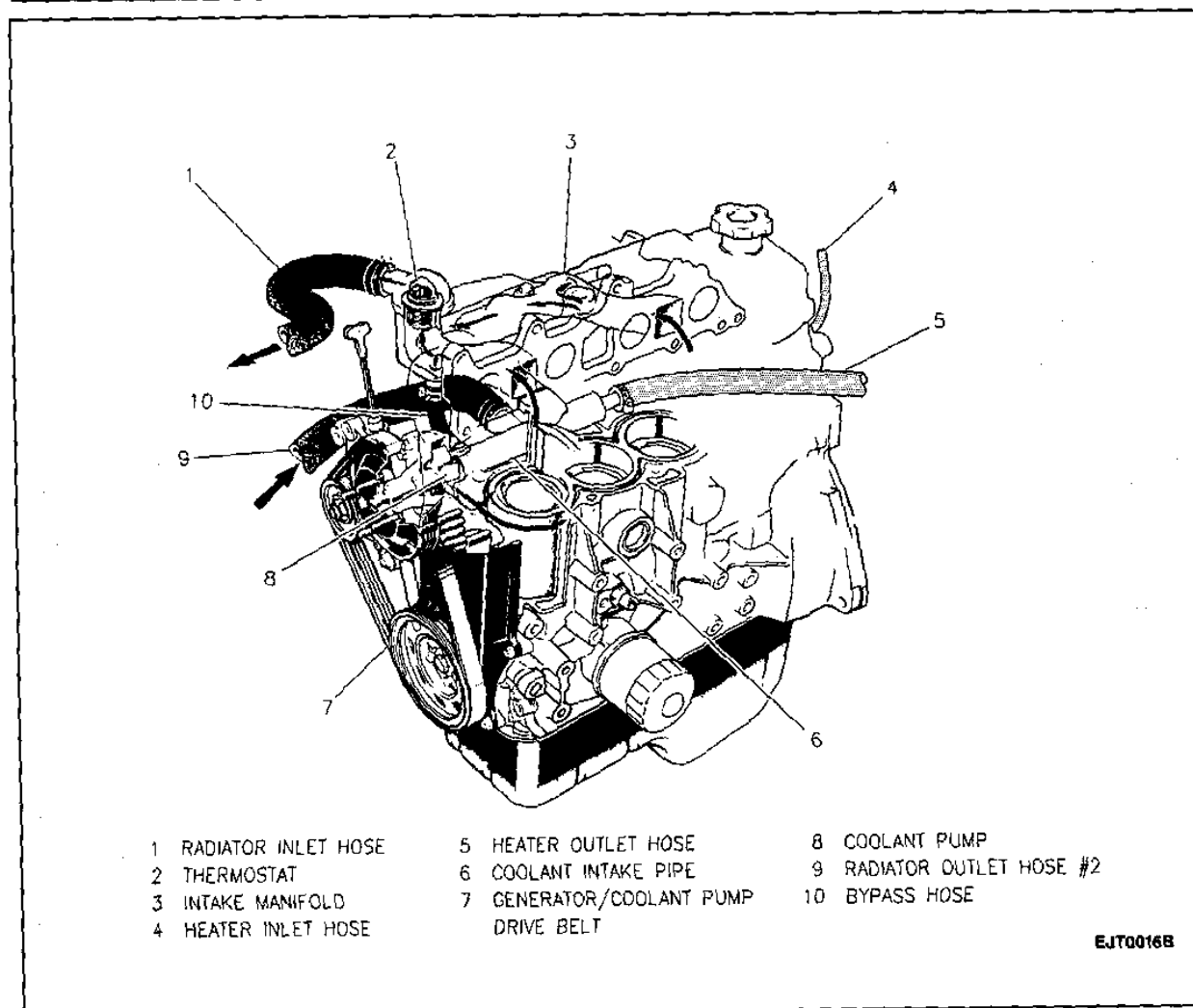


Figure 1—Cooling System

### Heater Core

The heater core is located inside the heater case in the passenger compartment. Engine coolant flows through the heater core, heating the air directed over the core, to provide warmed air flow to the vehicle's passenger compartment.

### RADIATOR CAP

#### Figure 2

A pressure vent cap is used on the radiator. The cap contains both a pressure relief valve and vacuum relief valve. The pressure valve is secured against its seat by a spring of predetermined strength that protects the cooling system by relieving the pressure when it rises above 90 kPa (13 psi). The vacuum valve is secured against its seat by a light spring which allows opening of the valve to relieve vacuum created in the cooling system. A see-through coolant reservoir is connected to the radiator by a rubber hose. The pressure/vacuum valve radiator cap allows two-way travel of coolant between the radiator and coolant reservoir (Figure 2).

### COOLANT RESERVOIR

When the coolant expands (when system temperature rises) the pressure valve in the radiator cap will open and coolant will flow to the reservoir. As the system temperature drops, a vacuum is created in the radiator. This opens the vacuum valve in the cap and pulls coolant from the reservoir back to the radiator. This system maintains a constant engine coolant level (ECL) in the radiator for cooling the engine.

ECL should be maintained between "FULL" and "LOW" marks on the coolant reservoir. Coolant should be added only through the coolant reservoir, never directly to the radiator.

### FAN CLUTCH

The cooling fan is connected to the coolant pump shaft by a fan clutch. The fan clutch regulates the speed of the cooling fan revolutions based on the air temperature at the clutch and provides slippage of the fan when cooling is not needed.

When the engine is at idle, regardless of the air temperature at the front of the clutch, the fan will rotate at the same speed as the coolant pump shaft.



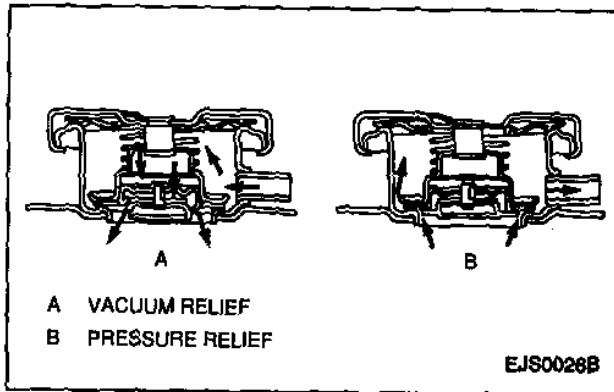


Figure 2—Pressure Vent Radiator Cap

When the air temperature at the front of the clutch approaches 55° C (131° F) and the engine speed increases gradually, the clutch slippage increases. Even when revolution speed of the water pump shaft increases, the revolutions of the cooling fan will not noticeably increase.

When the air temperature at the fan clutch exceeds 55° C (131° F) and the revolution speed of the coolant pump shaft exceeds 4,000 rpm, the cooling fan speed becomes constant at 3,100 rpm independent of the coolant pump shaft.

## ENGINE COOLANT TEMPERATURE (ECT) SENSOR

An ECT sensor is located in the intake manifold. This sensor operates the ECT gage in the instrument cluster.

## THERMOSTAT

### Figures 3 and 4

A wax pellet-type thermostat is used to control the flow of coolant through the cooling system (Figure 3). Mounted in the thermostat housing in the front of the intake manifold, the thermostat stops the flow of coolant from the engine to the radiator to provide faster warm-ups and to regulate coolant temperature.

The wax pellet is hermetically sealed in a metal case. The wax element expands when heated and contracts when cooled. As the vehicle is driven and the engine warms up, the coolant temperature increases. When the coolant reaches a specified temperature, the wax pellet element expands and exerts pressure against a metal case, forcing the valve open. This allows coolant to flow through the system and cool the engine. As the pellet cools, the contraction allows a spring to close the valve.

The thermostat used in this vehicle is calibrated to begin opening at 82° C (179° F) and be fully open (more than 8 mm [0.31-inch] valve lift) at 95° C (203° F).

An air bleed valve is provided in the top portion of the thermostat to vent any gas or air which may have penetrated the cooling system (Figure 4).

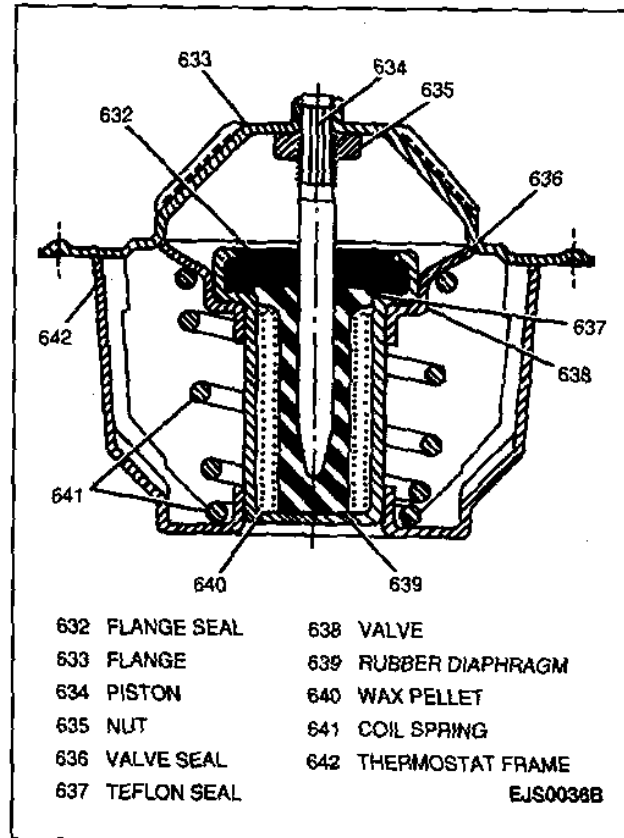


Figure 3—Typical Wax pellet Thermostat

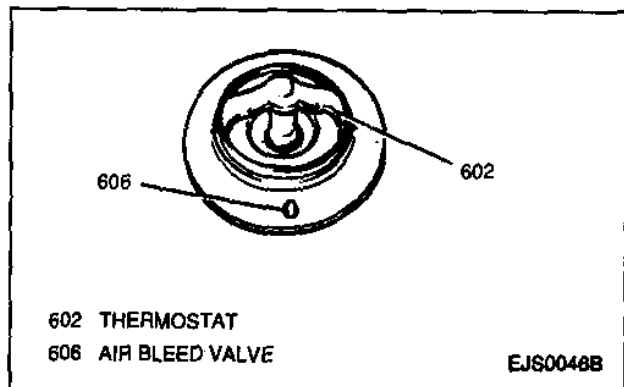


Figure 4—Thermostat

## COOLANT PUMP

A centrifugal-type coolant pump is used in the cooling system. It is driven by a drive belt shared with the generator. The pump impeller is supported by a totally sealed bearing. This pump is serviced as a complete unit and disassembly is not required.

## CYLINDER BLOCK PLUG

The cylinder block is equipped with one pressure fitted cylinder block plug for protection in extremely cold weather. If the coolant freezes inside the cylinder block, the expanding ice should drive out the cylinder block plug rather than cracking the block.



## 6B-4 COOLING AND RADIATOR

### MAINTENANCE RECOMMENDATIONS

**CAUTION:** To avoid the danger of being burned, do not remove the coolant reservoir cap when the coolant is boiling, and do not remove the radiator cap when the engine and radiator are still hot. Scalding coolant and steam can be blown out under pressure if radiator cap or reservoir cap is taken off when system is hot.

For maintenance recommendations and system capacities other than listed below, refer to SECTION 0B.

At least once per year, the front face of the radiator should be cleaned. In northern climates, spring is a good time of year to do this cleaning, as road salt residue on the radiator can cause corrosion. Insects, leaves and other debris can be removed by blowing compressed air through the radiator core from the back. Water can be used on both sides of the radiator.

**NOTICE:** Never spray cold water on a hot radiator.

**NOTICE:** The radiator fins are necessary for good heat transfer and should not be brushed to prevent damage to the fins.

### CHECKING ENGINE COOLANT LEVEL (ECL)

Visually check the ECL at the see-through coolant reservoir, located on the right side of the engine compartment. ECL should be near the "LOW" mark on the reservoir when the engine is cold. The ECL should increase somewhat as the vehicle is running. With the engine at normal running temperature, ECL should be between the "LOW" and "FULL" marks.

Should the ECL prove to be low, refill the cooling system through the coolant recovery reservoir with a mixture of 50% water and 50% ethylene glycol antifreeze meeting GM specification #1825-M.

**NOTICE:** To avoid possible damage to the cooling system, alcohol or methanol-based coolants or pure water should not be used at any time.

### COOLANT CONCENTRATION TESTERS

A hydrometer test will indicate whether ethylene glycol and/or water should be added to maintain the desired freezing point of the solution. The freezing point of the solution should give protection to an acceptable temperature of  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ), regardless of climatic conditions. This is also necessary to provide adequate corrosion protection.

Some devices used for testing solutions will indicate the correct freezing point only when tested at a specific temperature. Other testers provide thermometers and tables indicating freezing points

corresponding to readings made at various temperatures. Disregarding the temperature of the solution when testing may cause an error as large as  $15^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ) in determining freezing points.

Use of a refractometer is recommended, especially if the type of coolant is unknown. A J 26568 or J 23688 Coolant Tester (Centigrade and Fahrenheit scale, respectively) can be used to check the antifreeze protection of the coolant. Make sure the refractometer markings are correct. Unless the J 26568 or J 23688 has a provision for temperature correction, test at the temperature for which the tester was calibrated. If the coolant is warmer or cooler, the reading may be incorrect. Follow the manufacturer's directions when using a J 26568 or J 23688.

### TESTING COOLANT CONCENTRATION

Due to a worldwide shortage of ethylene glycol in 1988, some coolant manufacturers have started to mix other types of glycol in the coolant formulations; propylene glycol is the most common new ingredient. A hydrometer will not always provide a correct measurement of freeze protection when anything other than ethylene glycol and water is being tested. The degree of inaccuracy will vary depending on the proportion of other glycols present in the coolant.

All 1996 GEO vehicles are produced with coolant that can be accurately measured with a hydrometer; however, when the type and quality of coolant being measured is unknown, such as in a customer vehicle that has accumulated mileage, use of a refractometer is recommended.

### Testing Coolant

#### Figures 5 through 7

Tools Required:

- J 26568 Coolant Tester (Centigrade Scale)
- J 23688 Coolant Tester (Fahrenheit Scale)



#### Clean

- Before each use, swing the plastic cover at the slanted end of a J 26568 or J 23688, exposing the measuring window and the bottom of the plastic cover (Figure 5).
- Wipe dry with a tissue or a clean, soft cloth.
- Close the plastic cover.

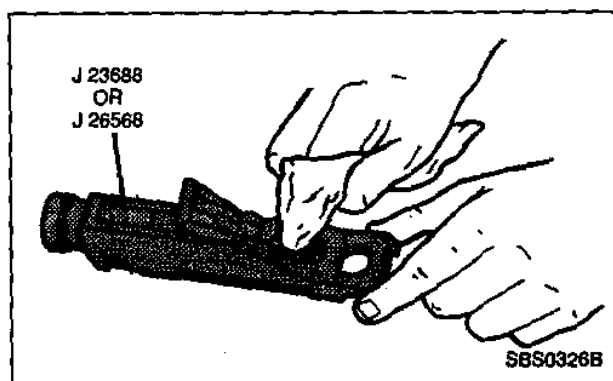


Figure 5—Cleaning Coolant Tester



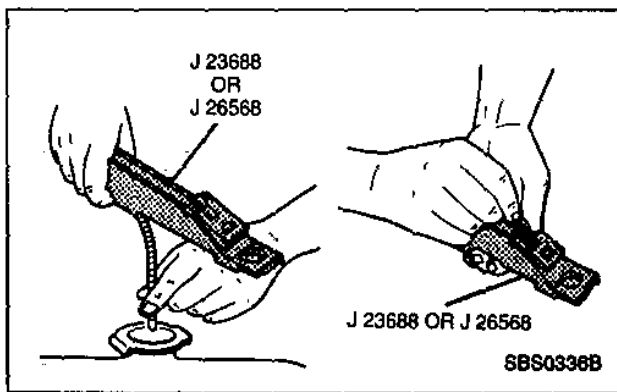


Figure 6—Collecting Coolant Samples

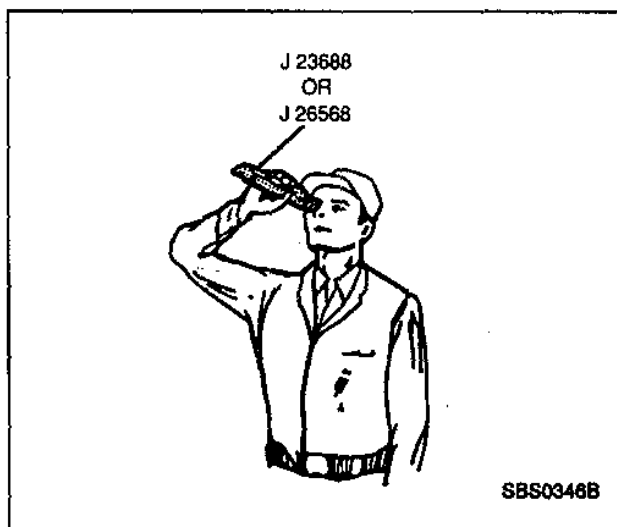


Figure 7—Reading the Coolant Tester



### Important

- Do not remove the clear plastic pump from the J 26568 or J 23688.
- 1. Release the tip of the pump from tester.
- 2. Insert the tip of the pump into the radiator filler neck. Make certain that the tip of the pump is below the level of the coolant (Figure 6).
- 3. Press the release bulb to get a sample.
- 4. Insert the tip of the pump into the cover plate opening.
- 5. Press the bulb and allow a few drops to fall onto the measuring surface.



### Important

- Do not open the plastic cover when taking readings because water evaporation can change the readings.
- 6. Point the J 26568 or J 23688 toward any light and look into the eyepiece (Figure 7).
- Coolant protection reading is at the point where the dividing line between light and dark crosses the scale (antifreeze protection is the scale on the right).

- Temperature scale is reversed from a standard thermometer scale; below zero readings are on the upper half of the scale.
- If the readings are not clear, the measuring surfaces were not wiped and properly dried. Wipe dry and conduct test again.

## HOSES AND CLAMPS INSPECTION

Inspect the condition of all hoses and clamps. Hoses should be flexible and show no signs of bulging. Inspect hoses for cracks, cuts, kinks and areas of possible leaks. Inspect for tracks from coolant leakage which has dried. Inspect the brackets, supports, ties and clamps. Tighten and adjust as needed.

## CLEANING

**CAUTION:** Under some conditions, the ethylene glycol in engine coolant is combustible. To help avoid being burned, do not spill antifreeze or coolant on the exhaust system or hot engine parts.

**CAUTION:** Do not remove the radiator cap when the radiator is warm. Removing the cap immediately lowers the boiling point of the coolant, and could cause a violent overflow, resulting in a large coolant loss and personal injury.

Every 30 months or 50 000 kilometers (30,000 miles) the cooling system should be serviced as follows:

1. Check coolant for proper level and freeze protection.
2. Check hose clamps for tightness and inspect all hoses. Replace cracked, swollen or deteriorated hoses.
3. Clean the front of the radiator and A/C condenser (if so equipped).
4. Every 30 months or 50 000 kilometers (30,000 miles), whichever comes first, the cooling system should be drained and refilled. Refer to "Draining and Refilling the Cooling System" later in this section.

**NOTICE:** If recommended quality antifreeze (GM specification #1825-M or equivalent) is used, supplemental inhibitors or additives claiming to provide increased cooling capability are not necessary. They may in fact be detrimental to the efficient operation of the system, and represent an unnecessary operating expense.



## 6B-6 COOLING AND RADIATOR

### DIAGNOSIS

#### THERMOSTAT TEST

Figure 8

This test requires that the thermostat be removed from the vehicle. Refer to "Thermostat" later in this section for removal and installation procedures.

1. Suspend the thermostat and a thermometer in a pan in a 50/50 mixture of ethylene glycol and water (Figure 8). Do not let the thermostat (or thermometer) rest on the bottom of the pan because of the uneven concentration of heat. This could result in inaccurate temperature measurements.
2. Place the pan on a burner; heat and measure the temperature of the solution using a thermometer.
3. The thermostat valve opening temperature should be 80 to 84° C (176 to 183° F). The valve lift should be 8 mm (0.31-inch) or more at 95° C (203° F). If either of these specifications are not met, replace the thermostat.
4. Make sure that the valve spring is tight when the thermostat is fully closed. If the spring is not tight, replace the thermostat.

#### RADIATOR CAP

**CAUTION:** Under some conditions, the ethylene glycol in engine coolant is combustible. To help avoid being burned, do not spill antifreeze or coolant on the exhaust system or hot engine parts.

**CAUTION:** Do not remove the radiator cap when the radiator is warm. Removing the cap immediately lowers the boiling point of the coolant and could cause a violent overflow, resulting in a large coolant loss and personal injury.

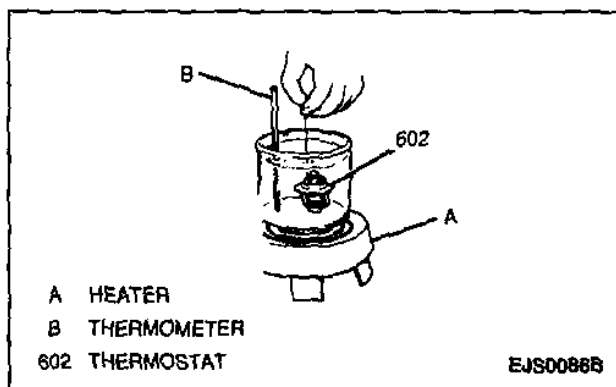


Figure 8—Checking Thermostat Valve Operation

#### Inspect

##### Tools Required:

J 24460-01 Cooling System Tester

J 33984-A Radiator Test Adapter

1. Cooling system for leaks and cracked pipes or hoses. Repair or replace pipes and/or hoses as necessary.
2. Coolant reservoir level and freeze protection.
3. Cooling system pressure capacity using a J 24460-01 and a J 33984-A. If cooling system does not maintain 90 kPa (13 psi) for two minutes, check for coolant leaks.
4. Radiator cap pressure using a J 24460-01 and a J 33984-A. If radiator cap does not maintain 90 kPa (13 psi) for two minutes, replace cap.

#### COOLING SYSTEM DIAGNOSTIC CHARTS

Figures 9 and 10

Refer to Figures 9 and 10 for cooling system problem diagnosis.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine overheats	Check coolant level and mixture	Add coolant
	Generator/coolant pump drive belt loose or missing	Adjust or replace belt
	Dirt, leaves, insects on front of radiator	Clean front of radiator
	Hoses, coolant pump, heater, thermostat housing, radiator, core plugs, or heads gasket leakage	Repair as necessary
	Thermostat faulty	Check thermostat
	Ignition timing retarded	Set timing. Refer to SECTION 6E2
	Improper cylinder head torque	Re-tighten the cylinder head bolts to specifications. Refer to SECTION 6A1. Replace the cylinder head gasket if required.



## COOLING AND RADIATOR 6B-7

CONDITION	POSSIBLE CAUSE	CORRECTION
	Leaking - intake manifold - cylinder head gasket - cylinder block plug - heater core - heater coolant valve, if equipped	Make repairs or replace components as necessary to correct the leak
Engine fails to reach normal operating temperature. Cool air from the heater	Thermostat stuck open or wrong type of thermostat Coolant is below the "ADD" mark Coolant pump faulty Radiator plugged or faulty cap Cylinder head or block cracked or plugged	Install a new thermostat of the correct type and heat range Add coolant Replace coolant pump Check radiator Repair as necessary

Figure 9 - Cooling System Diagnosis 1 of 2

T5478(Cont'd)

Loss of coolant	Leaking radiator Radiator cap faulty Leaking coolant recovery reservoir or hose Loose or damaged radiator or heater hoses or connections Coolant pump seal leaking Coolant pump gasket leaking	Inspect the radiator, repair as necessary Perform the radiator cap pressure test Replace the reservoir or hose Reseat the hoses; replace the hoses or clamps Replace the coolant pump Replace the gasket
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Figure 10 - Cooling System Diagnosis - 2 of 2

T5477

## ON-VEHICLE SERVICE

### DRAINING AND REFILLING THE COOLING SYSTEM

Figures 11 through 15

**CAUTION:** Under some conditions, the ethylene glycol in engine coolant is combustible. To help avoid being burned, do not spill antifreeze or coolant on the exhaust system or hot engine parts.

**CAUTION:** Do not remove the radiator cap when the radiator is warm. Removing the cap immediately lowers the boiling point of the coolant, and could cause a violent overflow, resulting in a large coolant loss and personal injury.

The cooling system has been filled (by the manufacturer) with coolant that is a 50/50 mixture of water and ethylene glycol antifreeze. This coolant solution provides freezing protection to -36° C (-33° F) (Figures 11 through 14).

ANTI-FREEZE PROPORTIONING CHART			
For manual transmission model			
Freezing temperature	°C	-16	-36
	°F	3	-33
Anti-freeze/ Anti-corrosion coolant concentration	%	30	50
Ratio of compound to cooling water	ltr.	1.59/3.71	2.65/2.65
	US pt.	3.36/7.84	5.60/5.60
	Imp. pt.	2.80/6.53	4.66/4.66

Figure 11 - Antifreeze Chart for Manual Transmission

T5478

ANTI-FREEZE PROPORTIONING CHART			
For automatic transmission model			
Freezing temperature	°C	-16	-36
	°F	3	-33
Anti-freeze/ Anti-corrosion coolant concentration	%	30	50
Ratio of compound to cooling water	ltr.	1.56/3.64	2.60/2.60
	US pt.	3.30/7.69	5.49/5.49
	Imp. pt.	2.75/6.40	4.57/4.57

Figure 12 - Antifreeze Chart for Automatic Transmission

T5479



## 6B-8 COOLING AND RADIATOR

For manual transmission model	
COOLANT CAPACITY	
Engine, radiator and heater	4.7 liters (9.9/8.2 US/Imp pt.)
Reservoir tank	0.6 liters (1.3/1.1 US/Imp pt.)
Total	5.3 liters (11.2/9.3 US/Imp pt.)

Figure 13 - Coolant Capacity for Manual Transmission

T5480

For automatic transmission model	
COOLANT CAPACITY	
Engine, radiator and heater	4.6 liters (9.7/8.1 US/Imp pt.)
Reservoir tank	0.6 liters (1.3/1.1 US/Imp pt.)
Total	5.2 liters (11.0/9.20 US/Imp pt.)

Figure 14 - Coolant Capacity for Automatic Transmission

T5481

### ! Important

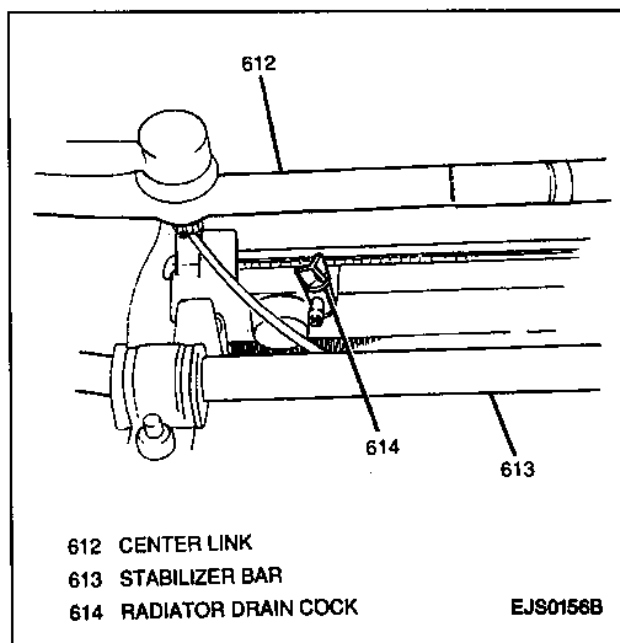
- Maintain cooling system protection at  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ) to ensure protection against corrosion and loss of coolant from boiling. This level of protection should be maintained even if extreme temperatures are not expected. Add ethylene glycol-based coolant to the coolant reservoir when the coolant level is low or to provide added protection against freezing temperatures lower than  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ).

**NOTICE:** Alcohol, methanol-based coolants or plain water alone should not be used in the cooling system at any time. Damage to the cooling system could result from their use.

1. Remove radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container (Figure 15).

### ! Important

- Dispose of used coolant in a proper fashion, i.e., in used coolant holding tank which is picked up along with used oil. **NEVER POUR USED COOLANT DOWN THE DRAIN.** Ethylene glycol antifreeze is a very toxic chemical; do not dispose of it into the sewer system or ground water.
4. Close the drain plug. Add water to fill the cooling system.
  5. Repeat Steps 2, 3 and 4 until the drained water is clean.
  6. Close radiator drain plug.



612 CENTER LINK  
613 STABILIZER BAR  
614 RADIATOR DRAIN COCK

EJS0156B

Figure 15—Radiator Drain Plug

7. Remove hose from reservoir cap and slide coolant reservoir from mounting bracket.

### ! Clean

- Inside of coolant reservoir with soap and water. Rinse thoroughly.
8. Install coolant reservoir to vehicle.
  9. Fill radiator with a 50/50 mixture of ethylene glycol coolant GM P/N 1052753, or equivalent, and water up to base of radiator filler neck and fill coolant reservoir up to "FULL" mark on reservoir.
  10. Install reservoir cap on reservoir and align marks on cap and reservoir.
  11. Install reservoir hose to reservoir cap.
  12. Start and run engine until coolant is at running temperature (both hoses feel warm and coolant is moving in radiator). Add coolant as necessary to radiator until coolant reaches radiator filler neck.
  13. Install radiator cap.

### ! Inspect

- Check radiator, coolant reservoir and all coolant pipe and hose connections for any signs of leaks. Tighten as necessary.

## Cooling System Flushing

Always remove the thermostat prior to flushing the cooling system. Various methods and equipment can be used for flushing. If using special equipment such as a back flusher, follow the manufacturer's instructions.



## THERMOSTAT

Figure 16

### Remove or Disconnect

1. Radiator cap.
2. Open drain plug and drain coolant into an appropriate container to a level below the thermostat.
3. Close drain plug.
4. Two bolts and thermostat cap from intake manifold (Figure 16).
5. Thermostat and gasket from thermostat housing.

### Clean

- Thermostat cap and intake manifold mating surfaces of gasket material, corrosion and debris.

### Inspect

- Refer to "Thermostat Test" earlier in this section.

### Install or Connect

#### Important

- Position air bleed valve toward front of vehicle (Figure 16).
1. Thermostat, with new thermostat gasket, and thermostat cap to intake manifold; secure cap with two bolts.

#### Tighten

- Thermostat cap bolts to 27 N.m (20 lb. ft.).
2. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

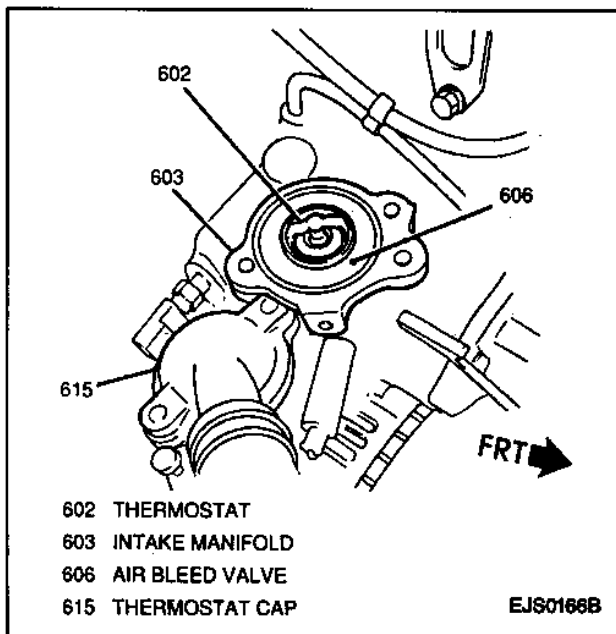


Figure 16—Thermostat and Thermostat Cap -Typical

### Inspect

- Remove radiator cap, start engine, bringing coolant to operating temperature (both hoses feel warm and coolant is flowing through radiator), and check for leaks in cooling system.
- Shut off engine and install radiator cap.

## GENERATOR/COOLANT PUMP DRIVE BELT

Figure 17

### Remove or Disconnect

1. Air conditioning (A/C) compressor drive belt (if equipped). Refer to SECTION 1B.
2. Loosen tension on generator/coolant pump drive belt by loosening generator upper mounting bolt.
3. Generator/coolant pump drive belt from pulleys.

### Inspect

- Generator/coolant pump drive belt for wear or cracks. Replace as necessary.

### Install or Connect

1. Generator/coolant pump drive belt to pulleys.
2. A/C compressor drive belt to pulleys (if equipped). Refer to SECTION 1B.

### Adjust

- Air conditioner compressor drive belt (if equipped). Refer to SECTION 1B.
- Generator/coolant pump drive belt tension so the belt deflects 5 to 8 mm (0.20 to 0.32-inch) under 10 kg (22 lbs.) of applied pressure (Figure 17).

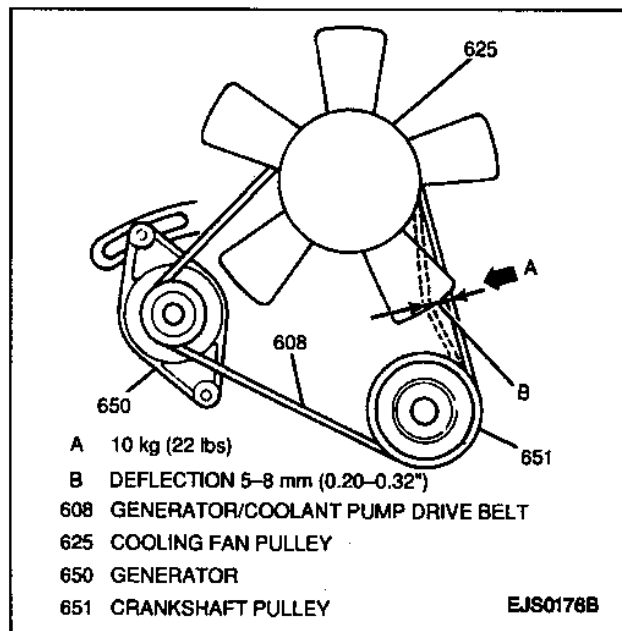


Figure 17—Generator/Coolant Pump Drive Belt Adjustment



## 6B-10 COOLING AND RADIATOR

### Tighten

- Generator upper mounting bolt to 27 N.m (20 lb. ft.) while holding generator/coolant pump drive belt tension.

## COOLANT PUMP

Figure 17

### Remove or Disconnect

1. Radiator cap.
2. Open drain plug and drain coolant into appropriate container.
3. Close drain plug.
4. Two bolts securing A/C flexible hose to radiator (if equipped); reposition to the rear.
5. Four bolts securing shroud to radiator and four fan clutch mounting nuts.
6. Shroud, fan clutch and cooling fan together.
7. Coolant pump pulley from coolant pump shaft, disengaging generator/coolant pump drive belt as pulley is removed.
8. Five bolts and crankshaft pulley from crankshaft.

### Important

- It is not necessary to remove the crankshaft pulley center bolt when removing the crankshaft pulley.
9. Timing belt. Refer to SECTION 6A1.
  10. Loosen A/C compressor drive belt (if equipped). Refer to SECTION 1B.
  11. One bolt and engine oil level indicator tube, with O-ring, from oil pump.
  12. Generator mounting bolt and bracket at coolant pump.
  13. Timing belt tensioner and pulley. Refer to SECTION 6A1.
  14. Five coolant pump mounting bolts and coolant pump with gasket and rubber seals from engine.

### Clean

- Mating surfaces on coolant pump and engine block of gasket material, corrosion and debris.

### Install or Connect

1. Coolant pump with new gasket to engine; secure with five bolts.

### Tighten

- Coolant pump bolts to 12 N.m (106 lb. in.).
2. Rubber seals between coolant pump and oil pump and between coolant pump and cylinder head.
  3. Engine oil level indicator tube to engine; secure with mounting bolt. Do not tighten fully.
  4. Generator mounting bracket to coolant pump; secure with mounting bolt. Do not tighten fully.

### Tighten

- Engine oil level indicator tube mounting bolt to 11 N.m (97 lb. in.).
5. Timing belt tensioner and pulley. Refer to SECTION 6A1.
  6. Timing belt. Refer to SECTION 6A1.
  7. Crankshaft pulley; secure with five bolts.

### Tighten

- Crankshaft pulley bolts to 16 N.m (12 lb. ft.).
8. Position generator/coolant pump drive belt on pulley before installing coolant pump pulley.
  9. Coolant pump pulley to coolant pump shaft.

### Important

- Fan clutch, cooling fan and radiator shroud must be installed together because of insufficient clearance to install in separate steps.
10. Fan clutch, cooling fan and shroud; secure with four fan clutch nuts and four shroud bolts.

### Tighten

- Fan clutch nuts to 11 N.m (97 lb. in.)
- Shroud bolts to 11 N.m (97 lb. in.)

### Adjust

- Air conditioner compressor drive belt (if equipped). Refer to SECTION 1B.
- Generator/coolant pump drive belt tension so the belt deflects 5 to 8 mm (0.20 to 0.32-inch) under 10 kg (22 lbs.) of applied pressure (Figure 17).

### Tighten

- Generator upper mounting bolt to 27 N.m (20 lb. ft.) while holding generator/coolant pump drive belt tension.
11. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.
  12. Radiator cap to radiator.
  13. Reposition A/C flexible hose to radiator (if equipped); secure with two bolts.

### Tighten

- Air conditioning flexible hose bolts to 15 N.m (11 lb. ft.).



## COOLANT RESERVOIR

Figures 18 and 19

### ↔ Remove or Disconnect

1. Two coolant overflow hoses from reservoir cap (Figure 18).
2. Slide reservoir from mounting bracket.

### → Install or Connect

1. Slide reservoir into mounting bracket.
2. Two coolant overflow hoses to reservoir cap.

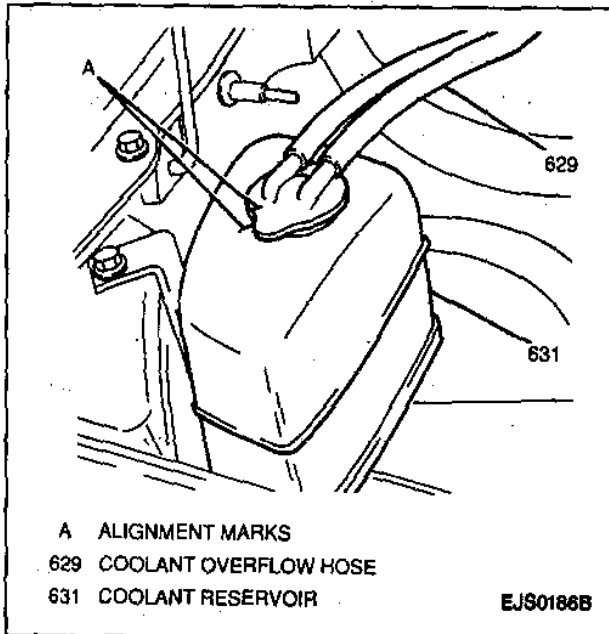


Figure 18—Coolant Reservoir Cap and Coolant Overflow Hoses - Typical

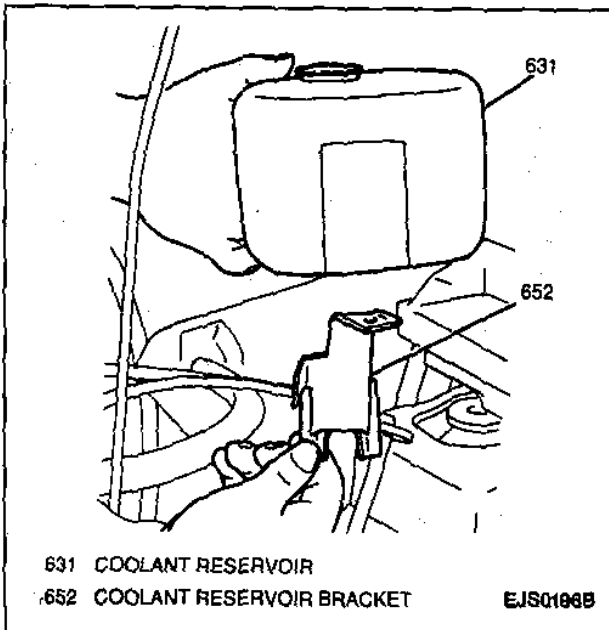


Figure 19—Coolant Reservoir - Typical

## RADIATOR

Figures 20, 21 and 22

### ↔ Remove or Disconnect

1. Radiator cap.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Open drain plug and drain radiator into appropriate container.
4. Close drain plug.
5. Place pan under radiator to catch any transmission fluid which may leak.
6. Hose clamps and transmission fluid cooler hoses from radiator (automatic transmission equipped vehicles) (Figure 20).
7. Two lower shroud bolts (Figure 20).

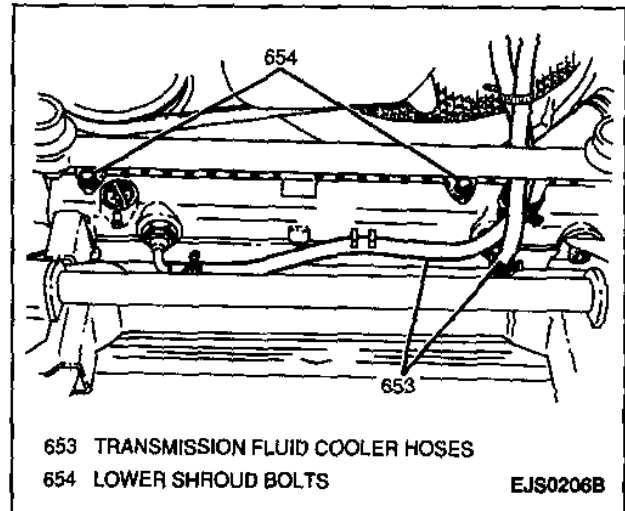


Figure 20—Transmission Fluid Cooler Hoses and Lower Shroud Bolts

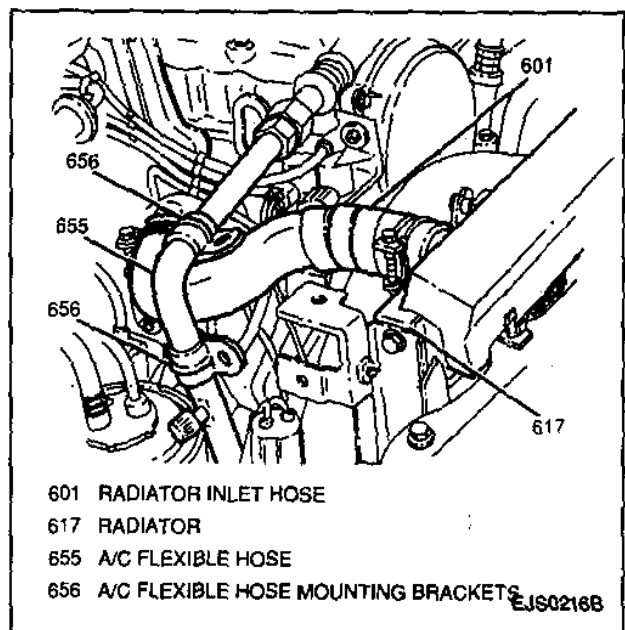


Figure 21—Repositioning A/C Flexible Hose



## 6B-12 COOLING AND RADIATOR

8. Loosen hose clamp and remove radiator outlet hose #1 from radiator.
9. Lower vehicle.
10. Two bolts and reposition A/C flexible hose to rear (if equipped) (Figure 21).
11. Two bolts and reposition power steering fluid reservoir (if equipped).
12. Two upper shroud bolts and reposition shroud to the rear.
13. Loosen hose clamp and remove radiator inlet hose from radiator.
14. Loosen hose clamp and remove radiator overflow hose from radiator filler neck.
15. Four bolts and radiator from vehicle (Figure 22).

### Install or Connect

1. Radiator to vehicle; secure with four bolts.

### Tighten

- Radiator bolts to 10 N.m (89 lb. in.).
2. Overflow hose to radiator filler neck; secure with hose clamp after positioning over filler neck flares.
  3. Radiator inlet hose to radiator; secure with hose clamp after positioning over radiator flares.
  4. Reposition shroud to radiator; secure with two bolts.

### Tighten

- Shroud bolts to 11 N.m (97 lb. in.).
5. Reposition A/C flexible hose to top of shroud (if equipped); secure with two bolts.

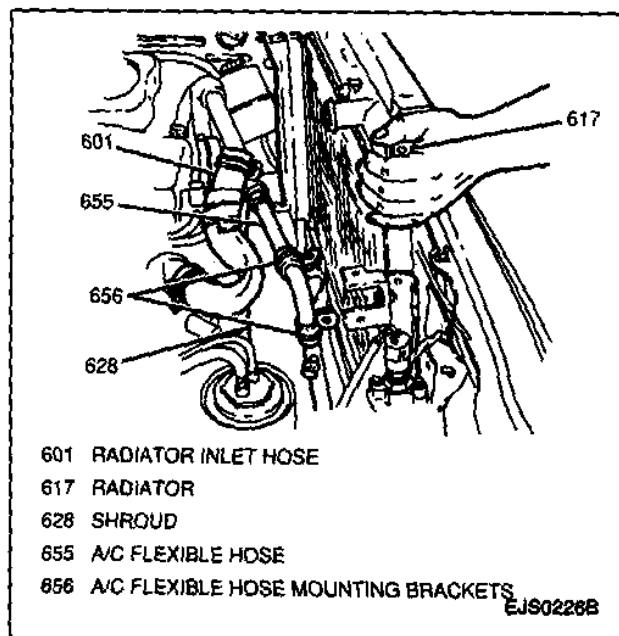


Figure 22—Removing Radiator

### Tighten

- Air conditioning flexible hose bolts to 15 N.m (11 lb. ft.).
6. Reposition power steering fluid reservoir (if equipped); secure with two bolts.

### Tighten

- Power steering fluid reservoir bolts to 15 N.m (11 lb. ft.).
7. Raise and suitably support vehicle. Refer to SECTION 0A.
  8. Transmission fluid cooler hoses to radiator (automatic transmission equipped vehicles); secure with hose clamps.
  9. Radiator outlet hose #1 to radiator; secure with hose clamp after positioning over radiator flares.
  10. Two lower shroud bolts.

### Tighten

- Shroud bolts to 11 N.m (97 lb. in.).
11. Lower vehicle.
  12. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.
  13. Radiator cap to radiator.

### Inspect

- Transmission fluid level (automatic transmission equipped vehicles). Refer to SECTION 7A.

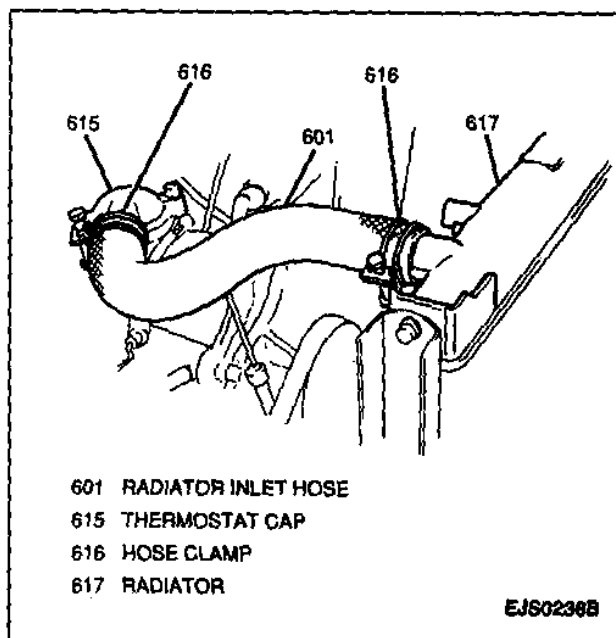


Figure 23—Radiator Inlet Hose



**COOLANT HOSES AND PIPES****Radiator Inlet Hose****Figure 23****Remove or Disconnect**

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen and reposition hose clamp on radiator inlet hose at radiator (Figure 23).
5. Loosen and reposition hose clamp on radiator inlet hose at thermostat cap.
6. Radiator inlet hose.

**Install or Connect**

1. Position a new hose clamp on each end of new radiator inlet hose before installation.
2. New radiator inlet hose to thermostat cap and radiator; secure with two hose clamps after positioning over thermostat and radiator flares.
3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

**Radiator Outlet Hose #1****Figure 24****Remove or Disconnect**

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen and reposition hose clamp on radiator outlet hose #1 at radiator (Figure 24).
5. Loosen and reposition hose clamp on radiator outlet hose #1 at radiator outlet pipe.
6. Radiator outlet hose #1.

**Install or Connect**

1. Position a new hose clamp on each end of new radiator outlet hose #1 before installation.
2. New radiator outlet hose #1 to outlet pipe and radiator; secure with hose clamps after positioning over outlet pipe and radiator flares.
3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

**Radiator Outlet Pipe****Figure 24****Remove or Disconnect**

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen and reposition radiator outlet hose clamp securing radiator outlet pipe to radiator outlet hose #1 (Figure 24).
5. Loosen and reposition radiator outlet hose clamp securing radiator outlet pipe to radiator outlet hose #2 (Figure 24).
6. One bolt and radiator outlet pipe from vehicle.

**Install or Connect**

1. Position new hose clamps on open ends of radiator outlet hoses #1 and #2 before installation of radiator outlet pipe.
2. Radiator outlet pipe to vehicle; secure with one bolt in outlet pipe support.

**Tighten**

- Outlet pipe support bolt to 11 N.m (97 lb. in.).
3. Radiator outlet hoses #1 and #2 to radiator outlet pipe; secure with hose clamps after positioning over coolant intake pipe flares.
  4. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

**Radiator Outlet Hose #2****Figure 24****Remove or Disconnect**

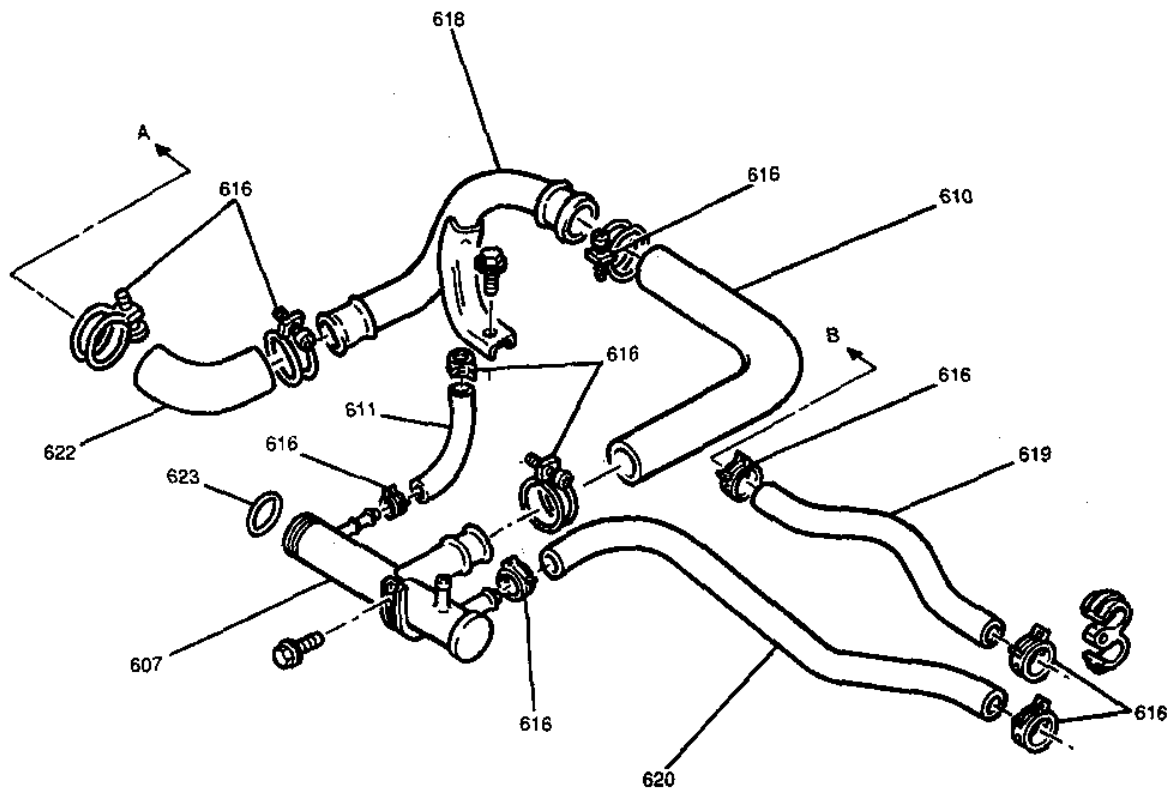
1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen two hose clamps on outlet hose #2 and remove hose from radiator outlet pipe and coolant intake pipe (Figure 24).

**Install or Connect**

1. Position new hose clamps on both ends of radiator outlet hose #2 before installation.
2. New radiator outlet hose #2 on radiator outlet pipe and opposite end on coolant intake pipe; secure with two hose clamps after positioning over coolant intake pipe and radiator outlet pipe flares.



## 6B-14 COOLING AND RADIATOR



- A RADIATOR OUTLET
- B COOLANT INTAKE
- 607 COOLANT INTAKE PIPE
- 610 RADIATOR OUTLET HOSE #2
- 611 BYPASS HOSE
- 616 HOSE CLAMP
- 618 RADIATOR OUTLET PIPE
- 619 HEATER CORE OUTLET HOSE
- 620 HEATER CORE INLET HOSE
- 622 RADIATOR OUTLET HOSE #1
- 623 O-RING SEAL

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Figure 24—Engine Coolant Pipes and Hoses -Typical



3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

### Coolant Intake Pipe

Figure 24

#### Remove or Disconnect

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen and reposition four hose clamps.
5. Two bypass hoses, radiator outlet hose #1 and heater core inlet hose from coolant intake pipe (Figure 24).
6. One bolt from coolant intake pipe support and coolant intake pipe from vehicle
7. O-ring seal from coolant intake pipe.

#### Install or Connect

1. Position new hose clamps on open ends of two bypass hoses, radiator outlet hose #1 and heater core inlet hose before installation of coolant intake pipe.
2. New O-ring seal to coolant intake pipe.
3. Coolant intake pipe to vehicle; secure with one bolt.

#### Tighten

- Coolant intake pipe bolt to 11 N.m (97 lb. in.).
4. Two bypass hoses, radiator outlet hose #1 and heater core inlet hose to coolant intake pipe; secure with four hose clamps after positioning over coolant intake pipe flares.
  5. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

### Coolant Bypass Hose

Figure 24

#### Remove or Disconnect

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen and reposition one hose clamp at intake manifold end and one hose clamp at coolant intake pipe end of coolant bypass hose (Figure 24).
5. Coolant bypass hose from vehicle.

#### Install or Connect

1. Position a new hose clamp on each end of coolant bypass hose before installation.
2. Coolant bypass hose to vehicle; secure with two coolant bypass hose clamps after positioning over coolant intake pipe and intake manifold flares.
3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

### Heater Core Inlet Hose

Figure 24

#### Remove or Disconnect

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen hose clamps at both ends of heater core inlet hose (Figure 24).
5. Heater core inlet hose from vehicle (Figure 24).

#### Install or Connect

1. Position a new hose clamp on each end of heater core inlet hose before installation.
2. Heater core inlet hose to vehicle; secure with two heater core inlet hose clamps after positioning over heater core and coolant intake pipe flares.
3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.
4. Radiator cap to radiator.

### Heater Core Outlet Hose

Figure 24

#### Remove or Disconnect

1. Radiator cap.
2. Start and run engine for 15 minutes.
3. Stop the engine and open the drain plug on the radiator to drain the coolant into a suitable container.
4. Loosen hose clamps at both ends of heater core outlet hose.
5. Heater core outlet hose from vehicle (Figure 24).

#### Install or Connect

1. Position a new hose clamp on each end of heater core outlet hose before installation.
2. Heater core outlet hose to vehicle; secure with two heater core outlet hose clamps after positioning over heater core and coolant intake flares.



## 6B-16 COOLING AND RADIATOR

3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

### COOLING FAN AND FAN CLUTCH

Figures 25 and 26

#### Remove or Disconnect

1. Radiator cap.
2. Open drain plug and drain coolant to level below thermostat.
3. Close drain plug.
4. Hose clamp and radiator inlet hose.
5. Four bolts securing shroud to radiator and four fan clutch mounting nuts.
6. Shroud, fan clutch and cooling fan together (Figures 25 and 26).

#### Disassemble

- Four nuts and washers from cooling fan and remove fan clutch.

#### Inspect

1. Cooling fan for cracks or broken blades. Replace if necessary.
2. Fan clutch for binding, cracks, or worn bearing. Replace as necessary.

#### Assemble

- Cooling fan to fan clutch; secure with four washers and nuts.

#### Tighten

- Cooling fan nuts to 11 N.m (97 lb. in.).

#### Install or Connect

#### Important

- Fan clutch, cooling fan and shroud must be installed together because of insufficient clearance to install in separate steps

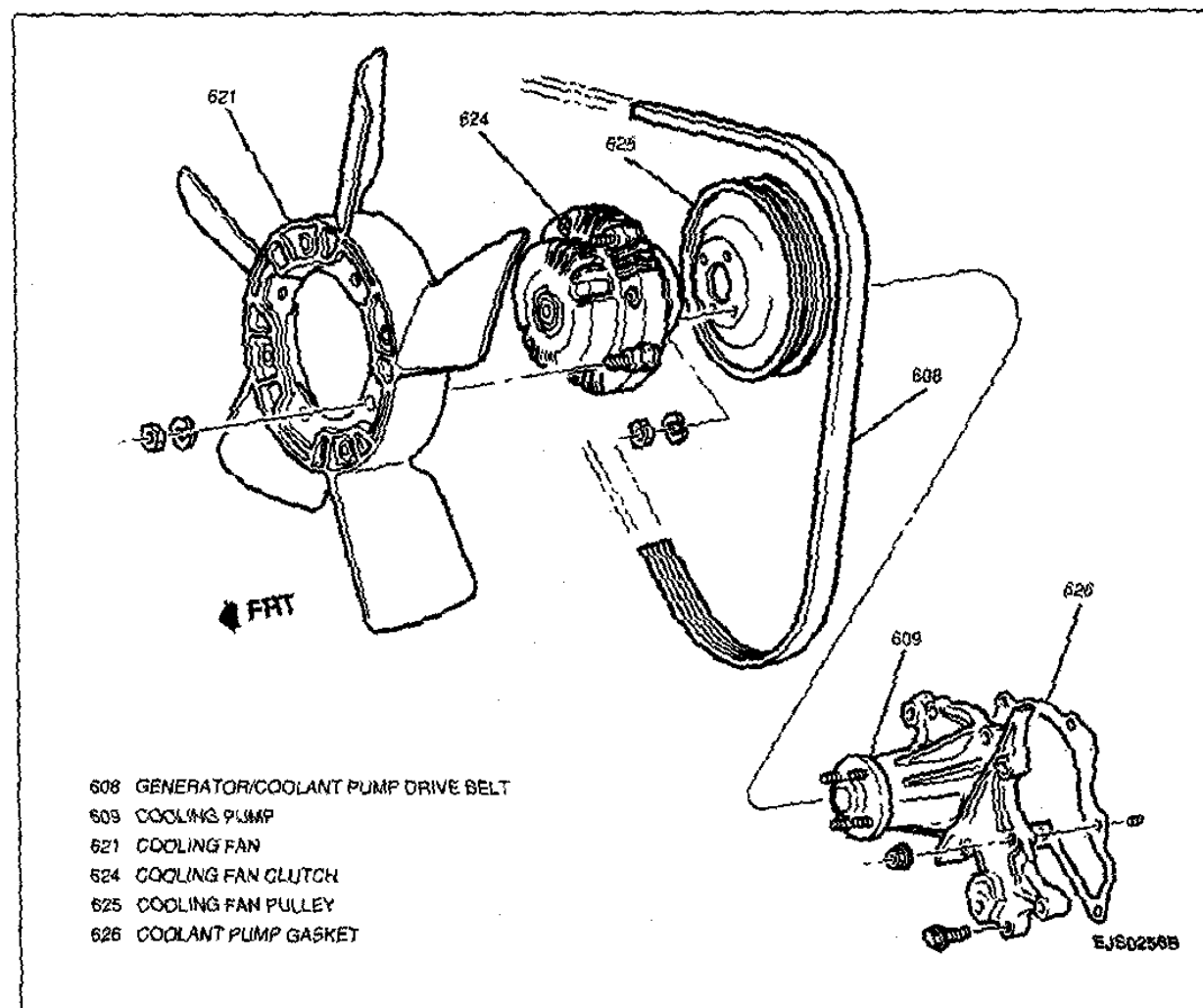


Figure 25—Cooling Fan, Fan Clutch, Coolant Pump and Pulley



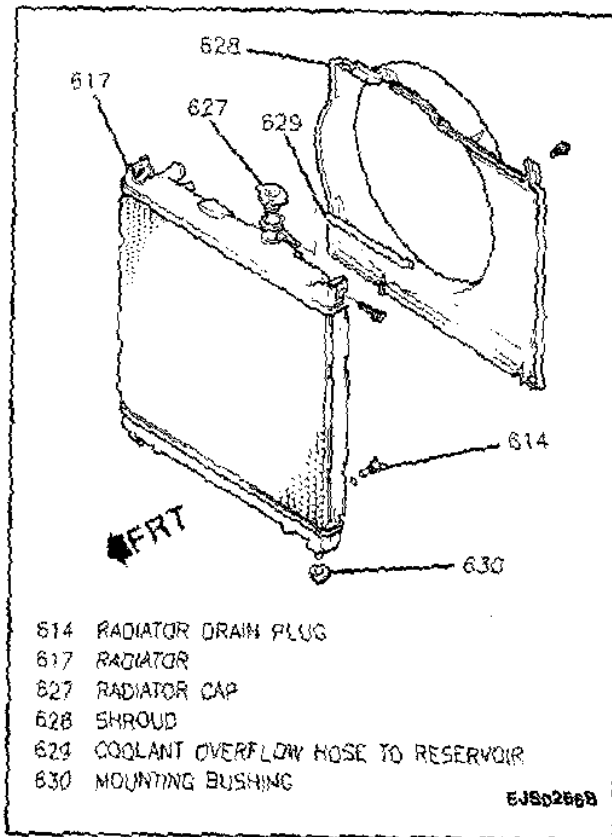


Figure 26—Radiator and Shroud

1. Fan clutch, cooling fan and shroud; secure with four fan clutch nuts and four shroud bolts.

### Tighten

- Fan clutch nuts to 11 N.m (97 lb. in.).
  - Shroud bolts to 11 N.m (97 lb. in.).
2. Radiator inlet hose; secure with hose clamp after positioning over radiator flange.
  3. Fill radiator with approved coolant. Refer to "Draining and Refilling the Cooling System" earlier in this section.

### Inspect

1. Remove radiator cap, start engine, bringing coolant to operating temperature (hoses warm to the touch and coolant flowing through radiator), and check for leaks in cooling system.
2. Shut off engine and install radiator cap.

## SPECIFICATIONS

### FASTENER TORQUES

Air Conditioning Flexible Hose Bolts	15 N.m (11 lb. ft.)
Cooling Fan Nuts	11 N.m (97 lb. in.)
Coolant Pump Bolts	12 N.m (106 lb. in.)
Crankshaft Pulley Bolts	16 N.m (12 lb. ft.)
Engine Oil Level Indicator Tube Mounting Bolt	11 N.m (97 lb. in.)
Fan Clutch Nuts	11 N.m (97 lb. in.)
Generator Mounting Bracket Bolt	23 N.m (17 lb. ft.)
Generator Upper Mounting Bolt	27 N.m (20 lb. ft.)
Coolant Intake Pipe Bolt	11 N.m (97 lb. in.)
Outlet Support Pipe Bolt	11 N.m (97 lb. in.)
Power Steering Fluid Reservoir Bolts	15 N.m (11 lb. ft.)
Radiator Bolts	10 N.m (89 lb. in.)
Shroud Bolts	11 N.m (97 lb. in.)
Thermostat Cap Bolts	27 N.m (20 lb. ft.)

### GENERAL SPECIFICATIONS

Thermostat Valve Opening Temperature	80-95° C (176-203° F)
Thermostat Valve Lift (Minimum)	8mm (0.31 in.) at 95° C (203° F)
Cooling System Pressure Capacity	90 kPa (13 psi)
Radiator Cap Pressure Capacity	90 kPa (13 psi)
Coolant Solution Protection Point	36° C (-33° F)
Generator/Coolant Pump Drive Bel Deflection	5-8 mm (0.20-0.32 in.) at 10 kg (22 lbs.) applied pressure



### SPECIAL TOOLS

