

# COOLING

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## GENERAL INFORMATION

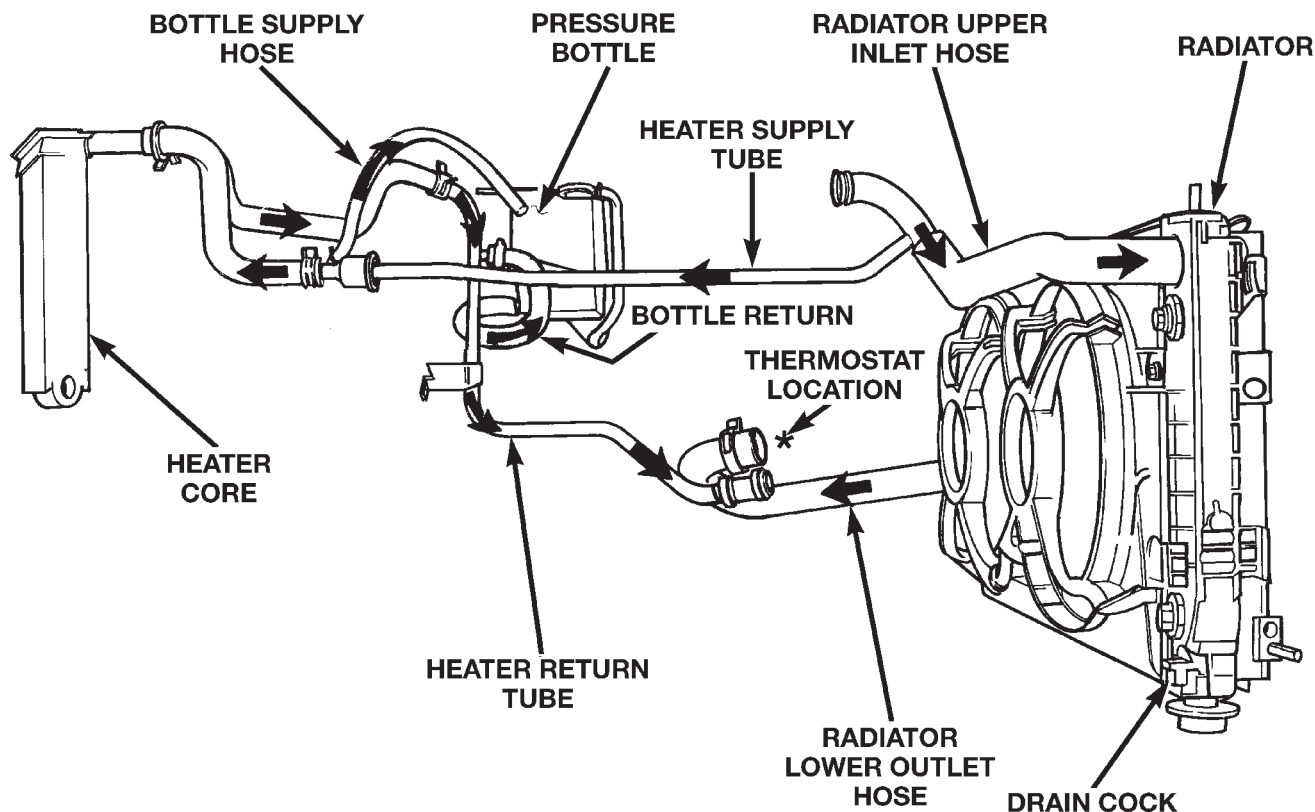
### COOLING SYSTEM

The cooling system consists of an engine cooling module, pressure cap, coolant bottle, thermostat (inlet), coolant, and a water pump to circulate the coolant. The engine cooling module consist of a radiator, electric fan motors, shroud, internal transmis-

sion oil cooler, internal engine oil cooler (if equipped), air conditioning condenser, receiver drier, and a auxiliary transmission oil cooler (if equipped).

- When Engine is cold: Thermostat is closed, cooling system has no flow through the radiator. The coolant flows through the engine heater core, coolant bottle and an internal engine by-pass.

## GENERAL INFORMATION (Continued)



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**Fig. 1 Cooling System Flow**

- When Engine is warm: Thermostat is open, coolant flows through the radiator, heater core, coolant bottle and by-pass (no by-pass 2.7L).

The cooling systems primary purpose is to maintain engine temperature in a range that will provide satisfactory engine performance and emission levels under all expected driving conditions. It also provides hot coolant for heater, and cooling for automatic transmission fluid. It does this by transferring heat from engine metal to coolant, moving this heated coolant to the radiator, and then transferring this heat to the ambient air.

The coolant flow circuit is shown in (Fig. 1).

**ACCESSORY DRIVE BELTS**

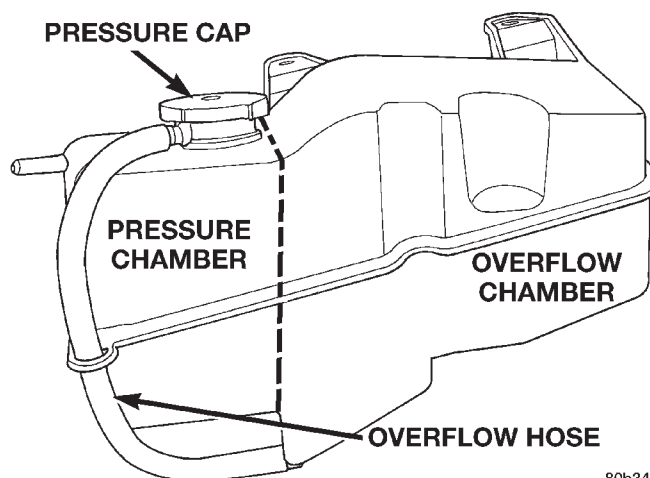
The accessory drive system on 2.7L and 3.2L engines utilizes two different belts. A conventional V-belt drives the air conditioning compressor on 3.2L engine; Poly-V belt on the 2.7L engine. The generator and power steering pump on all engines are driven by a Poly-V belt.

**COOLANT BOTTLE**

The coolant bottle consists of two chambers (Fig. 2). The pressure chamber keeps the coolant free of trapped air, provides a volume for expansion and contraction, and provides a convenient and safe method

for checking and adjusting coolant level at atmospheric pressure. It also provides some reserve coolant to cover minor leaks, evaporation or boiling losses. The overflow chamber allows coolant recovery in case of an overheat. An overflow hose connects the pressure chamber to the overflow chamber.

**NOTE:** Coolant will normally be in the pressure chamber side of the coolant bottle. The overflow chamber should normally be empty



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**Fig. 2 Coolant Pressure/Recovery Bottle**

## GENERAL INFORMATION (Continued)

Refer to Coolant Level Service, Pressure Cap sections for operation and service.

### ENGINE THERMOSTAT

The thermostat on the 2.7L and 3.2L engines are located on the lower left side of engine, near the front (Fig. 3) and (Fig. 4). The thermostat on both engines are on the inlet side of the water pump. The thermostats have an air bleed located in the thermostat flange.

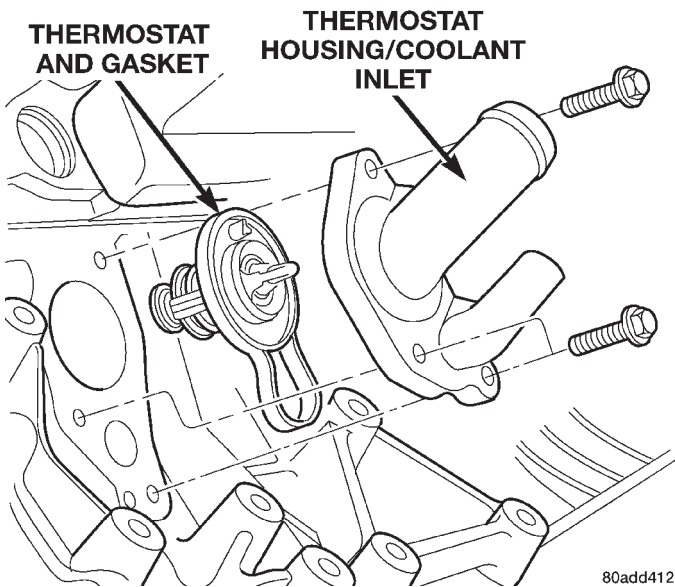


**Fig. 3 Thermostat and Housing—2.7L Engine**

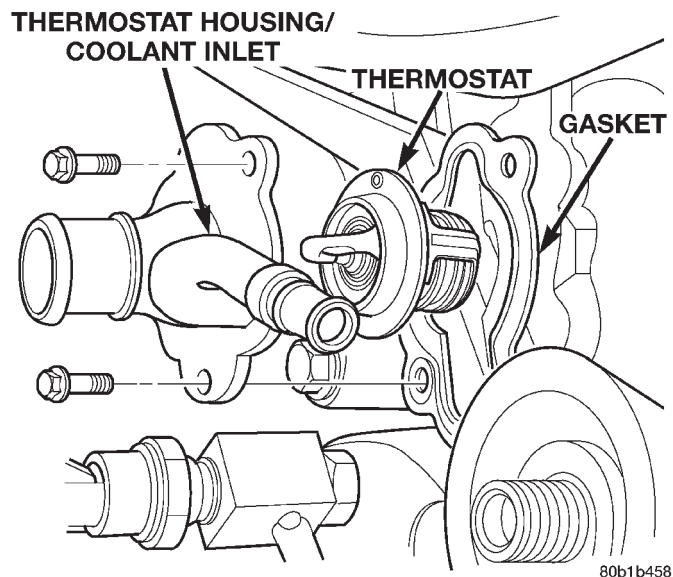


**Fig. 4 Thermostat and Housing—3.2L Engine**

### WATER PUMP

#### WATER PUMP—2.7L ENGINE

The 2.7L pump has a die cast aluminum body and a plastic swept vane impeller. It bolts directly to the

cylinder block, behind the timing chain cover (Fig. 5). The water pump is driven by the back side of the engine primary timing chain.

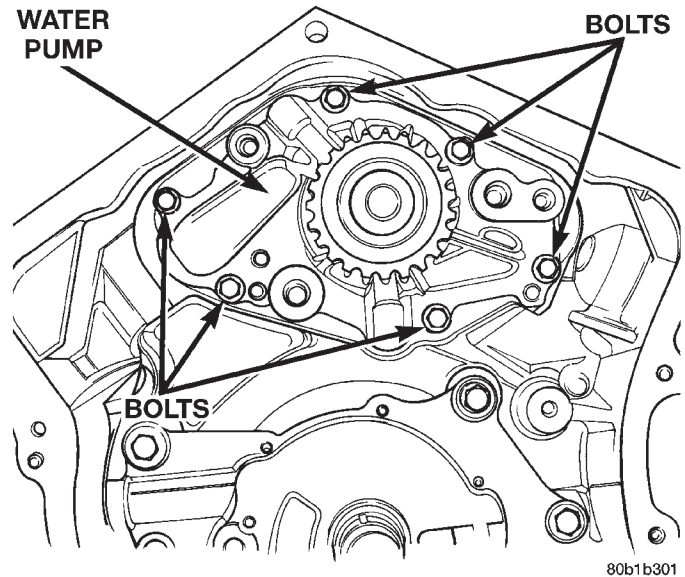


**Fig. 5 Water Pump—2.7L Engine**

#### WATER PUMP—3.2L ENGINE

The 3.2L pump has a plastic swept vane impeller. The housing bolts directly to the right rear timing belt cover, using a O-ring gasket for pump to cover sealing (Fig. 6). The pump is driven by the engine timing belt.

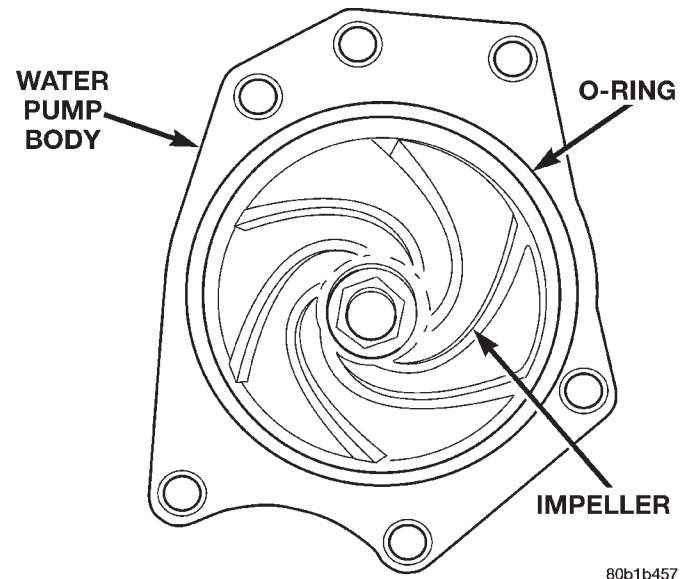


**Fig. 6 Water Pump—3.2L Engine**

### COOLANT

**CAUTION:** Use of Propylene Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.

## GENERAL INFORMATION (Continued)

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then carry this heat to the radiator where the tube/fin radiator can give it up to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Extended Life Coolant (orange in color) or the equivalent ethylene glycol base coolant with corrosion inhibitors (called OAT, for Organic Additive Technology) is recommended for best engine cooling without corrosion, when mixed only to a freeze point of -37°C (-35°F) to -59°C (-50°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed solution.

**WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.**

## RADIATOR

The radiators are cross-flow types (horizontal tubes) with design features that provide greater strength as well as sufficient heat transfer capabilities to keep the engine satisfactorily cooled.

**CAUTION: Plastic tanks, while stronger than brass are subject to damage by impact, such as wrenches, or heat from torch.**

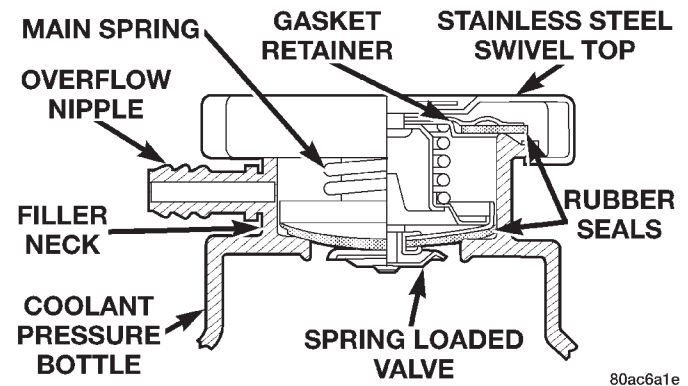
## COOLANT PRESSURE BOTTLE CAP

The Coolant bottle is equipped with a pressure cap which releases pressure at some point within a range of 110 kPa  $\pm$  14 kPa (16 psi  $\pm$  2 psi) (Fig. 7).

The system will operate at higher than atmospheric pressure which raises the coolant boiling point, thus allowing increased radiator cooling capacity.

There is a spring-loaded vent valve in the center of the cap that allows the system to pressurize and depressurize without creating a vacuum. If the valve is stuck open, coolant will escape to the overflow hose. There is also a gasket in the cap to seal to the top of the filler neck.

**CAUTION: Use only the pressure cap specified for this vehicle. Use of other pressure caps can lead to coolant loss and overheating.**



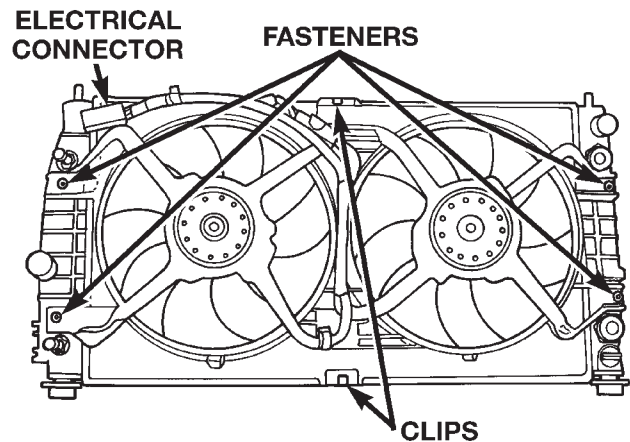
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Fig. 7 Pressure Cap and Bottle

## DUAL FAN MODULE

All models use electric motor driven fans. The fan modules include a motor support and shroud. The module is fastened to the radiator by screws with square nuts and retaining clips (Fig. 8).

The dual fan module is a combination of 2 fans mounted in a one piece shroud which operate at two speeds and are simultaneously activated. The dual fan system improves engine cooling and air conditioning performance in hot weather and severe driving conditions, while reducing fan noise and power consumption. Attempts to reduce high temperature gauge reading by increasing engine speed, can increase high temperature.



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Fig. 8 Fan Module

## GENERAL INFORMATION (Continued)

**FAN SHROUD**

All vehicles have fan shrouds to improve fan air flow efficiency. The shroud supports the electric fan motor and fan.

**AUTOMATIC TRANSMISSION OIL COOLER**

The transmission oil cooler circuit consists of a series connected internal cooler mounted inside the left radiator tank and an auxiliary external oil cooler mounted to the front of the air conditioning condenser (Fig. 9).

Steel tubes and rubber lines supply the oil from the transmission to the internal oil cooler and return the oil to the transmission from the auxiliary external oil cooler.

Use only approved transmission oil cooler hoses. Since these hoses are molded to fit space available, molded hoses are required. The steel tubes must be flared to ensure sealing of the hose. Torque oil cooler hose clamps to 2.5 N·m (22 in. lbs.).

**ENGINE OIL COOLER—3.2L**

The 3.2L engine uses an engine oil cooler that is mounted inside the right radiator tank. An oil cooler

pressure control valve is used to control pressure to the cooler. Engine oil travels from the control valve through the supply line and into the cooler. The engine oil exits the cooler through the oil return line and is returned to the engine oil pan (Fig. 10).

**ENGINE BLOCK HEATER**

On all models an engine block heater is available as an optional accessory. The heater, operated by ordinary house current (110 Volt A.C.) through a power cord and connector behind the radiator grill. This provides easier engine starting and faster warm-up when the vehicle is operated in areas having extremely low temperatures.

## DESCRIPTION AND OPERATION

**ENGINE THERMOSTAT**

The engine cooling thermostats are wax pellet driven, reverse poppet (3.2L), and dual poppet (2.7L) types. The thermostats are located in the inlet side of the engine to provide fast warm up and to optimize a constant temperature in the engine. The thermostats

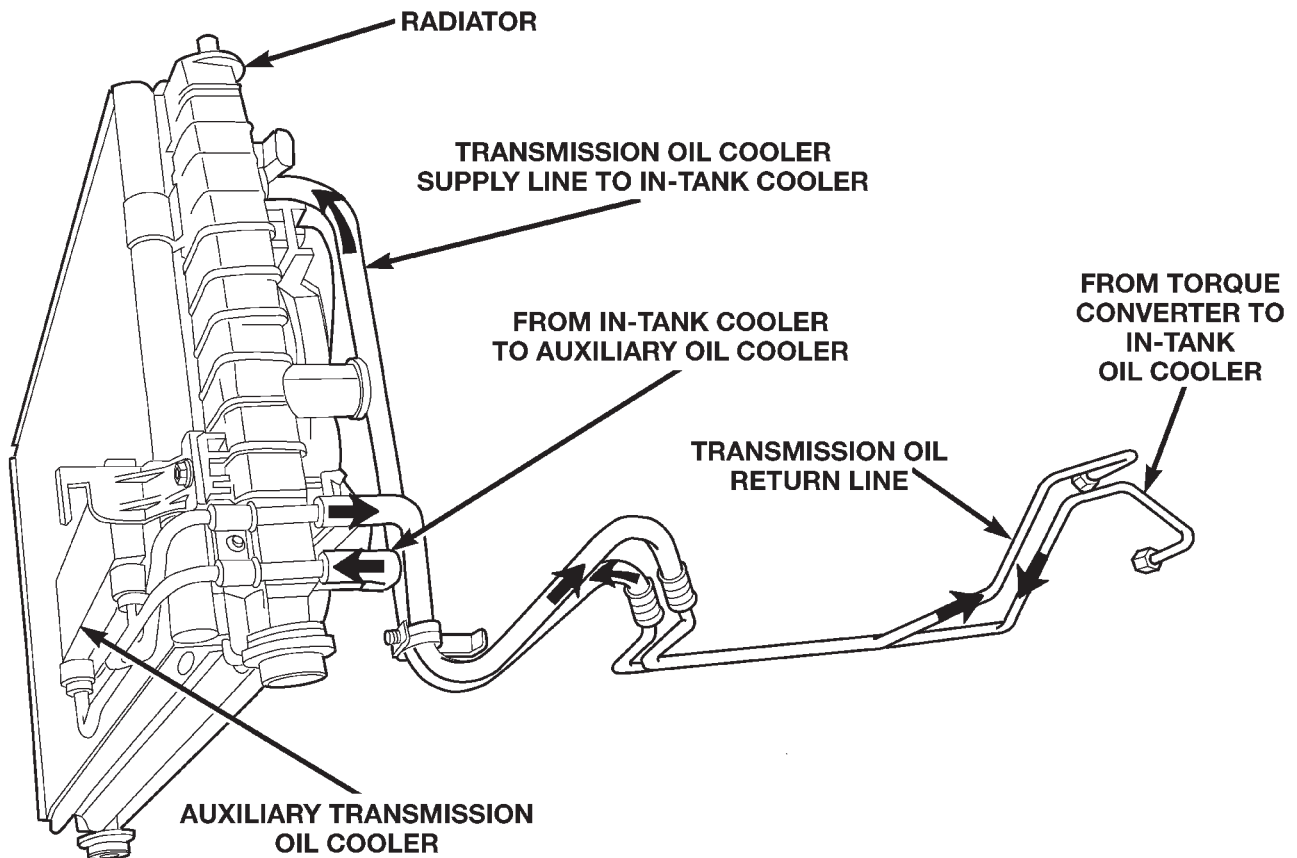
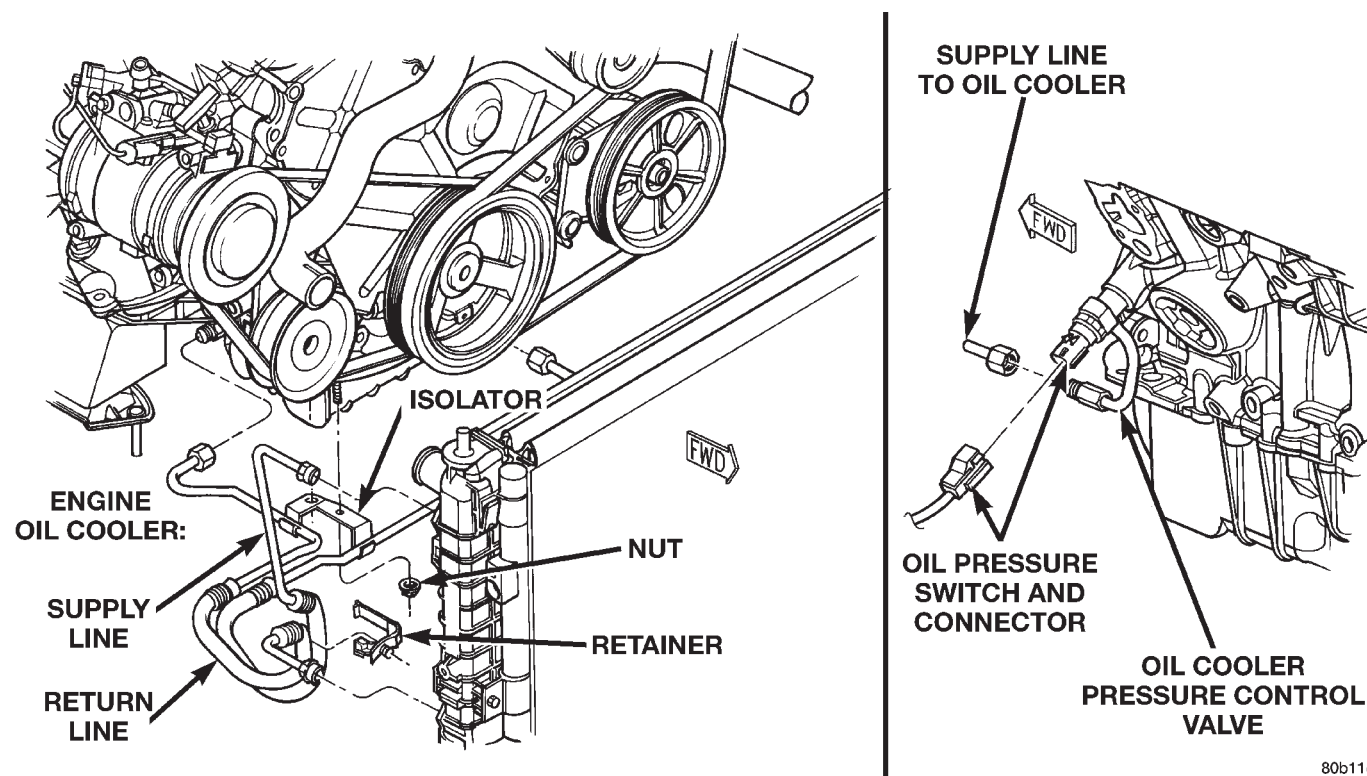


Fig. 9 Transmission Oil Cooler

## DESCRIPTION AND OPERATION (Continued)



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Fig. 10 Engine Oil Cooler—3.2L

are designed to prevent leakage through them and to guarantee a minimum engine operating temperature of 90°C (195°F). They also automatically reach wide open at a temperature of approximately 102°C (215°F) so they do not restrict flow to the radiator as temperature of the coolant rises in hot weather to around 104°C (220°F). Above 102°C (215°F) the coolant temperature is controlled by the radiator, fan, and ambient temperature, not the thermostat.

### COOLANT PERFORMANCE

Performance is measurable. For heat transfer, pure water absorbs 1 btu for each degree of temperature rise for each pound of water. This formula is altered when necessary additives to control boiling, freezing, and corrosion are added as follows:

- Pure Water (1 btu) boils at 100°C (212°F) and freezes at 0°C (32°F).
- 100 Percent ethylene glycol (.7 btu) can cause an engine to run hot, cause detonation, and will freeze at -22°C (-8°F).
- 50/50 Ethylene Glycol and Distilled Water (.82 btu) is the recommended combination that provides a freeze point of -37°C (-35°F). The radiator, water pump, engine water jacket, radiator pressure cap, thermostat, temperature gauge, coolant sensor and heater are all designed for 50/50 ethylene glycol.

Where required, a 56 percent glycol and 44 percent water mixture will provide a freeze point of -46°C (-50°F).

**NOTE:** Richer mixtures cannot be measured with field equipment and can lead to problems associated with 100 percent glycol. If there is doubt that the coolant mixture is too rich for field equipment to measure, put a sample in a clean container. Add exactly the same amount of water and retest. If the coolant in the vehicle is 100% antifreeze, the diluted sample will read 50%. If the coolant in the vehicle was 70% antifreeze and 30% water, the diluted sample will read as 35%, etc.

### SELECTION AND ADDITIVES

The use of aluminum cylinder blocks, cylinder heads, intake manifolds, and water pumps require special corrosion protection. Mopar® Extended Life Coolant (orange in color) or the equivalent is recommended for optimum engine cooling and protection against corrosion when mixed to a freeze point of -37°C (-35°F) to -59°C (-50°F). If it loses color or becomes contaminated; drain, flush, and replace with fresh properly mixed solution.

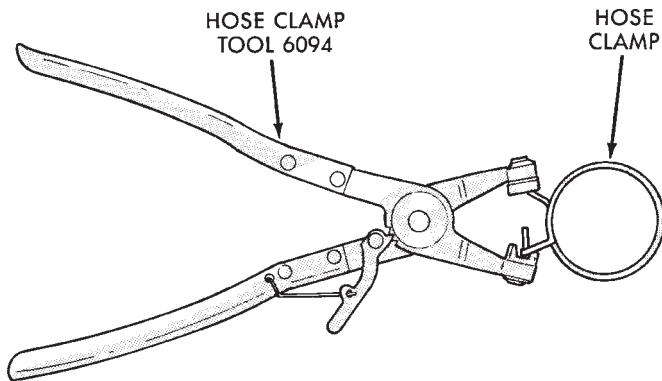
**CAUTION:** Do not use well water, or suspect water supply in cooling system. A 50/50 ethylene glycol and distilled water mix is recommended.

## DESCRIPTION AND OPERATION (Continued)

**RADIATOR HOSES AND CLAMPS**

**WARNING:** IF VEHICLE HAS BEEN RUN RECENTLY, WAIT 15 MINUTES BEFORE WORKING ON VEHICLE. RELIEVE PRESSURE BY PLACING A SHOP TOWEL OVER THE CAP AND WITHOUT PUSHING DOWN ROTATE IT COUNTERCLOCKWISE TO THE FIRST STOP. ALLOW FLUIDS TO ESCAPE THROUGH THE OVERFLOW TUBE AND WHEN THE SYSTEM STOPS PUSHING OUT COOLANT AND STEAM AND PRESSURE DROPS.

The hoses are removed by using constant tension clamp pliers to compress hose clamp (Fig. 11).



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**Fig. 11 Hose Clamp Tool**

A hardened, cracked, swollen, severely abraded, or restricted hose should be replaced. Do not damage radiator inlet and outlet when loosening hoses.

Radiator hoses should be routed without any kinks and indexed as designed. The use of molded hoses is required.

Spring type hose clamps are used in all applications. If replacement is necessary replace with the original Mopar® equipment spring type clamp.

**CAUTION:** Use of general purpose pliers can bend the clamps to a out of round condition, Resulting in a loss of clamping strength.

**ENGINE BLOCK HEATER**

The engine block heater is mounted in the cylinder block, near the right rear corner. The block heater is a cylinder type design which transfers heat through the aluminum engine block without penetrating the cooling system. **The power cord must be secured in its retainer clips, and not positioned so it could contact linkages or exhaust manifolds and become damaged.**

**WATER PUMP**

The water pump body is made of aluminum with a plastic swept vane impeller. The water pump is bolted to the front of the timing cover, and driven by the timing belt on the 3.2L engine. On the 2.7L engine, the water pump attaches directly to the cylinder block and is driven by the back side of the primary timing chain. The water pump is the heart of the cooling system, pumping the coolant through the engine block, cylinder head, heater core, and radiator.

**NOTE:** The water pump on all models can be replaced without discharging the air conditioning system.

## DIAGNOSIS AND TESTING

## COOLING SYSTEM DIAGNOSIS

| CONDITION                                                                                                                                                                 | POSSIBLE CAUSES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CORRECTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC).                                                                                             | <ol style="list-style-type: none"> <li>1. During cold weather operation with the heater blower in the high position, the gauge reading may drop slightly. Fluctuation is also influenced by loads, outside temperature, and cycling of the air conditioning system.</li> <li>2. Temperature gauge or engine sending unit sensor defective or shorted. Also, corroded or loose wiring in this circuit.</li> <li>3. Gauge reading rise when vehicle is brought to a stop after heavy use (engine still running).</li> <li>4. Gauge reading high after restarting a warmed-up (hot) engine.</li> <li>5. Coolant level low (air will build up in the cooling system causing the thermostat to open late).</li> <li>6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late.</li> <li>7. Water pump impeller loose on shaft.</li> <li>8. Air leak on the suction side of water pump allows air to build up in cooling system causing thermostat to open late.</li> </ol> | <ol style="list-style-type: none"> <li>1. A normal condition. No correction is necessary.</li> <li>2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges.</li> <li>3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.</li> <li>4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.</li> <li>5. Check and correct coolant leaks. Refer to Testing Cooling System for Leaks in this group.</li> <li>6. (a) Check for cylinder head gasket leaks with a commercially available block leak tester. Repair as necessary. (b) Check for coolant in engine oil. Inspect for white steam emitting from exhaust system. Repair as necessary.</li> <li>7. Check water pump and replace as necessary. Refer to Water Pump Removal in this group.</li> <li>8. Locate leak and repair as necessary.</li> </ol> |
| PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/OVERFLOW TANK. | <ol style="list-style-type: none"> <li>1. Pressure relief valve in radiator cap is defective, or was not properly seated.</li> <li>2. Incorrect cap was installed.</li> <li>3. Incorrect coolant mixture.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ol style="list-style-type: none"> <li>1. Check condition of radiator cap and cap seal. Refer to Pressure Cap in this group. Replace cap as necessary.</li> <li>2. Replace cap as necessary.</li> <li>3. Make sure a 50% by volume mixture of coolant is used.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE IS READING HIGH OR HOT.                                                                                    | <ol style="list-style-type: none"> <li>1. Coolant leaks in radiator, cooling system hoses, water pump or engine.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"> <li>1. Pressure test and repair as necessary. Refer to Testing Cooling System for Leaks in this group.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## DIAGNOSIS AND TESTING (Continued)

## COOLING SYSTEM DIAGNOSIS

| CONDITION                                                                                  | POSSIBLE CAUSES                                                                                                                                                                                                                              | CORRECTION                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY NOT BE READING HIGH. | <ol style="list-style-type: none"> <li>1. Engine overheating.</li> <li>2. Freeze point of coolant not correct. Mixture too concentrated or too diluted.</li> <li>3. Wrong cooling system pressure cap.</li> </ol>                            | <ol style="list-style-type: none"> <li>1. Check reason for overheating and repair as necessary.</li> <li>2. Check freeze point of the coolant. Refer to Coolant General Info. in this group for test procedure. Adjust the ethylene glycol to water ratio as required.</li> <li>3. Install correct cap.</li> </ol>                                                                                                           |
| HOSE OR HOSES COLLAPSE AS ENGINE COOLS DOWN.                                               | <ol style="list-style-type: none"> <li>1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant bottle system.</li> </ol>                                                                               | <ol style="list-style-type: none"> <li>1. (a) Pressure cap relief valve stuck. Refer to Pressure cap in this group. Replace as necessary.<br/>(b) Hose between the pressure and overflow tank sections is kinked. repair as necessary.<br/>(c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary.<br/>(d) Reserve/overflow tank is internally blocked and repair as necessary.</li> </ol> |
| HOSE OR HOSES COLLAPSE WHEN ENGINE IS RUNNING.                                             | <ol style="list-style-type: none"> <li>1. Obstruction in cooling system hose.</li> </ol>                                                                                                                                                     | <ol style="list-style-type: none"> <li>1. Check hose for obstruction, repair as necessary.</li> </ol>                                                                                                                                                                                                                                                                                                                        |
| ELECTRIC RADIATOR FAN RUNS ALL THE TIME.                                                   | <ol style="list-style-type: none"> <li>1. Fan relay, Powertrain Control Module (PCM) or engine coolant temperature sensor defective.</li> <li>2. Check for low coolant level.</li> <li>3. A/C pressure transducer defective.</li> </ol>      | <ol style="list-style-type: none"> <li>1. Refer to appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool. Repair as necessary.</li> <li>2. Repair as necessary.</li> <li>3. Refer to appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool. Repair as necessary.</li> </ol>                                                                                |
| NOISY FAN                                                                                  | <ol style="list-style-type: none"> <li>1. Fan blade loose.</li> <li>2. Fan blade striking a surrounding object.</li> <li>3. Air obstructions at radiator or air conditioning condenser.</li> <li>4. Electric fan motor defective.</li> </ol> | <ol style="list-style-type: none"> <li>1. Replace fan module assembly. Refer to Cooling System Fans in this group.</li> <li>2. Locate point of fan blade contact and repair as necessary.</li> <li>3. Remove obstructions and/or clean debris.</li> <li>4. Replace fan motor. Refer to procedure outlined in this group.</li> </ol>                                                                                          |

## DIAGNOSIS AND TESTING (Continued)

| CONDITION                                                            | POSSIBLE CAUSES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CORRECTION                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INADEQUATE AIR CONDITIONER PERFORMANCE<br>(COOLING SYSTEM SUSPECTED) | <ol style="list-style-type: none"> <li>1. Radiator and/or A/C condenser is restricted, obstructed or dirty (insects, leaves etc.).</li> <li>2. Electric radiator fan not operating when A/C is operated.</li> <li>3. Engine is overheating (heat may be transferred from radiator to A/C condenser. High underhood temperatures due to engine overheating may also transfer heat to A/C components.</li> <li>4. All models are equipped with air seals at the radiator and/or A/C condenser. If these seals are missing or damaged, not enough air flow will be pulled through the radiator and A/C condenser.</li> </ol> | <ol style="list-style-type: none"> <li>1. Remove restriction and/or clean as necessary.</li> <li>2. Refer to appropriate Powertrain Diagnostic Procedures manual for test procedures. Repair as necessary.</li> <li>3. Correct overheating condition. Refer to procedures in Group 07, Cooling.</li> <li>4. Check for missing or damaged air seals and repair as necessary.</li> </ol>                                            |
| INADEQUATE HEATER PERFORMANCE                                        | <ol style="list-style-type: none"> <li>1. Has diagnostic trouble code (DTC) been set?</li> <li>2. Coolant level low.</li> <li>3. Obstructions in heater hose fitting at engine or at heater core.</li> <li>4. Heater hose kinked.</li> <li>5. Water pump is not pumping water to heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly.</li> </ol>                                                                                                                                                | <ol style="list-style-type: none"> <li>1. Refer to Refer to the appropriate Diagnostic manual.</li> <li>2. Refer to Testing Cooling System for Leaks in this section. Repair as necessary.</li> <li>3. Remove heater hoses at both ends and check for obstructions. Repair as necessary.</li> <li>4. Locate kinked area and repair as necessary.</li> <li>5. Refer to Water Pumps in the section. Repair as necessary.</li> </ol> |

## DIAGNOSIS AND TESTING (Continued)

## COOLING SYSTEM DIAGNOSIS

| CONDITION                                                                                                                                                                                                          | POSSIBLE CAUSES                                                                                                                                                                                                                                                                                                                                                                                                                                 | CORRECTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HEAT ODOR                                                                                                                                                                                                          | <ol style="list-style-type: none"> <li>1. Various heat shields are used at certain drive line components. One or more of these shields may be missing.</li> <li>2. Is temperature gauge reading above the normal range?</li> <li>3. Is cooling fan operating correctly?</li> <li>4. Has undercoating been applied to any unnecessary component?</li> <li>5. Engine may be running rich causing the catalytic converter to over heat.</li> </ol> | <ol style="list-style-type: none"> <li>1. Locate missing shields and replace or repair as necessary.</li> <li>2. Refer to the previous Temperature Gauge Reads High in these Diagnosis Charts. Repair as Necessary.</li> <li>3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary.</li> <li>4. Clean undercoating as necessary.</li> <li>5. Refer to appropriate Powertrain Diagnostic Procedures manual for operation of the DRB scan tool. Repair as necessary.</li> </ol> |
| POOR DRIVEABILITY (THERMOSTAT POSSIBLE STUCK OPEN). GAUGE MAY BE READING LOW.                                                                                                                                      | <ol style="list-style-type: none"> <li>1. For proper driveability, good vehicle emissions and for preventing buildup of engine oil sludge, the thermostat must be operating properly. Has a diagnostic trouble code (DTC) been set?</li> </ol>                                                                                                                                                                                                  | <ol style="list-style-type: none"> <li>1. Refer to On-Board Diagnostic in Group 25. DTC's may also be checked using the DRB scan tool. Refer to the proper Powertrain Diagnostic Procedure manual for checking the thermostat using the DRB scan tool. Replace thermostat if necessary.</li> </ol>                                                                                                                                                                                                      |
| STEAM IS COMING FROM FRONT OF VEHICLE NEAR GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING AND VEHICLE IS STATIONARY, OR VEHICLE HAS JUST BEEN SHUT OFF. TEMPERATURE GAUGE IS IN THE NORMAL RANGE. | <ol style="list-style-type: none"> <li>1. During wet weather, moisture (snow, ice, rain or condensation) on the radiator will evaporate when the thermostat opens. The thermostat opening allows heated coolant into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.</li> </ol>                                                    | <ol style="list-style-type: none"> <li>1. Occasional steam emitting from this area is normal. No repair is necessary.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                        |
| COOLANT COLOR                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.</li> </ol>                                                                                                                                                                                                                         | <ol style="list-style-type: none"> <li>1. Check the freeze point of the coolant. Refer to Coolant in the group for test procedure. Adjust the ethylene glycol to water ratio as necessary.</li> </ol>                                                                                                                                                                                                                                                                                                   |
| COOLANT LEVEL CHANGES IN COOLANT BOTTLE. TEMPERATURE GAUGE IS IN NORMAL RANGE.                                                                                                                                     | <ol style="list-style-type: none"> <li>1. Level changes are to be expected as coolant volume fluctuates with engine temperature. The coolant level will also drop as the system removes air from a fresh filling.</li> </ol>                                                                                                                                                                                                                    | <ol style="list-style-type: none"> <li>1. A normal condition. No repair is necessary.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                        |

## DIAGNOSIS AND TESTING (Continued)

## ENGINE THERMOSTAT

The thermostat is operated by a wax filled container (pellet) which is sealed so that when heated to a predetermined temperature, the wax expands enough to overcome the closing spring and water pump pressure, which forces the valve to open. Coolant leakage into the pellet will cause a thermostat to fail open. Do not attempt to free up a thermostat with a screwdriver.

The open too soon type failure mode is included in the on-board diagnosis. The check engine light will not be lit by an open too soon condition. If it has failed open, a DTC diagnostic trouble code will be set. Do not change a thermostat for lack of heat by gauge or heater performance, unless a code is present, see diagnosis for other probable causes. Failing shut is the normal long term mode of failure, and normally, only on high mileage vehicles. The temperature gauge will indicate this, Refer to diagnosis in this section.

## WATER PUMP DIAGNOSIS

A quick test to tell whether or not the pump is working is to see if the heater warms properly. A defective pump will not be able to circulate heated coolant through the long heater hose. **The water pump on all models can be replaced without discharging the air conditioning system.**

**NOTE:** It is normal for the water pump to weep a small amount of coolant from the weep hole (black stain on water pump body). Do not replace the water pump if this condition exists. Replace the water pump if a heavy deposit or a steady flow of green/brown engine coolant is evident on water pump body from the weep hole (shaft seal failure). Be sure to perform a thorough analysis before replacing water pump.

## RADIATOR FAN CONTROL

Fan control is accomplished two ways. A pressure transducer on the air conditioning compressor discharge line sends a signal to the Powertrain Control Module (PCM) which will activate both fans if necessary. In addition to this control, the fan is turned on based on coolant temperature sensor output to the (PCM). The PCM switches the fans on through the fan relays. Refer to Wiring Diagrams Manual for circuit and diagnostics.

Switching through the (PCM) provides fan control for the following conditions.

- Regardless of coolant temperature the fan will not run during cranking until the engine starts.
- Fans will run in accordance with following operation charts.

## RADIATOR FAN OPERATION —ALL ENGINES

| Radiator Fan Control                                                  |                    |                  | A/C Pressure           |                        |
|-----------------------------------------------------------------------|--------------------|------------------|------------------------|------------------------|
| A/C Off                                                               | Low                | High             |                        |                        |
| Fan On:                                                               | 110°C<br>(230°F)   | 113°C<br>(235°F) |                        |                        |
| Fan Off:                                                              | 104°C<br>(219°F *) | 111°C<br>(231°F) |                        |                        |
| <b>*109°C (228°F) @ Vehicle speed greater than 12.8 Km/h (8 mph).</b> |                    |                  |                        |                        |
| A/C On                                                                | Low                | High             | Low                    | High                   |
| Fan On:                                                               | 105°C<br>(221°F)   | 110°C<br>(230°F) | 1,448 Kpa<br>(210 psi) | 1,717 Kpa<br>(249 psi) |
| Fan Off:                                                              | 102°C<br>(216°F)   | 106°C<br>(223°F) | 1207 Kpa<br>(175 psi)  | 1,579 Kpa<br>(229 psi) |

## RADIATOR COOLANT FLOW

To determine whether coolant is flowing through the cooling system, use the following procedure:

- If engine is cold, idle engine until normal operating temperature is reached. If the upper radiator hose is hot, coolant is circulating.

**WARNING: DO NOT REMOVE COOLANT PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

## ELECTRIC FAN MOTOR

Refer to Power Train Diagnostic Manual for procedure.

## TESTING SYSTEM FOR LEAKS

With engine not running, wipe the coolant bottle neck sealing seat clean.

Attach a radiator pressure tester to the coolant bottle, as shown in (Fig. 12) and apply 104 kPa (15 psi) pressure. If the pressure drops more than 2 psi in 2 minutes inspect all points for external leaks.

All hoses, radiator and heater, should be moved while at 15 psi since some leaks occur while driving due to engine rock, etc. If the cooling system will not pressurize easily and there is no coolant leaks, the cooling system is only partially filled. Refer to filling procedure in this section.

If there are no external leaks after the gauge dial shows a drop in pressure, detach the tester. Start engine and run the engine to normal operating temperature in order to open the thermostat and allow the coolant to expand. Reattach the tester. If the needle on the dial fluctuates it indicates a combustion leak, usually a head gasket leak.

## DIAGNOSIS AND TESTING (Continued)

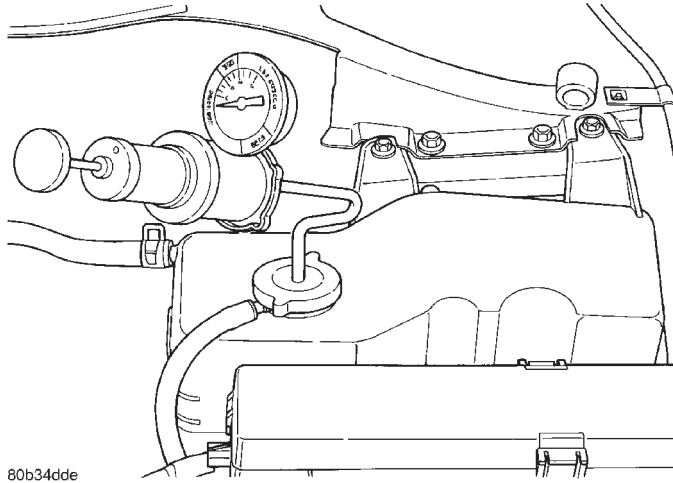


**Fig. 12 Pressure Testing Cooling System**

**WARNING: WITH TOOL IN PLACE PRESSURE BUILDS UP FAST. ANY EXCESSIVE AMOUNT OF PRESSURE BUILT UP BY CONTINUOUS ENGINE OPERATION MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).**

If the needle on the dial does not fluctuate, race the engine a few times. If an abnormal amount of coolant or steam is emitted from the tail pipe, it may indicate a faulty head gasket, cracked engine block or cylinder head.

There may be internal leaks which can be determined by removing the oil dipstick. If water globules appear intermixed with the oil it will indicate a internal leak in the engine. If there is an internal leak, the engine must be disassembled for repair.

### LOW COOLANT LEVEL

Low coolant level in a cross flow radiator will equalize in both tanks with engine off. With engine at running and at operating temperature, the high pressure inlet tank runs full and the low pressure outlet tank drops. If this level drops below the top of the transmission oil cooler, air will be drawn into the water pump:

- Transmission oil will become hotter.
- High reading shown on the temperature gauge.
- Air in the coolant will also cause loss of flow through the heater core.
- Water pump seal may run dry, increasing the risk of premature seal failure.
- Exhaust gas leaks into the coolant can also cause the same problems.

### DEAERATION

Air is removed from the system as it gathers in the coolant bottle and is released into the atmosphere through the pressure valve located in the pressure

cap when pressure reaches 96 - 124 kPa (14 - 18 psi). The air is replaced with coolant from the coolant bottle.

### TEMPERATURE GAUGE INDICATION

At idle the temperature gauge could rise slowly to about 1/2 gauge travel. The fan will come on and the gauge could drop to about 1/3 gauge travel, this is normal.

### ENGINE BLOCK HEATER

If unit does not operate, trouble can be in either the power cord or the heater element. Test power cord for continuity with a 110-volt voltmeter or 110-volt test light; test heater element continuity with an ohmmeter or 12-volt test light.

The power cord must be secured in its retainer clips, and not positioned so it could contact linkages or exhaust manifolds and become damaged.

## SERVICE PROCEDURES

### COOLANT SERVICE

Refer to Group 0, Lubrication and Maintenance for engine coolant service recommended schedule.

### COOLANT LEVEL CHECK

Do not remove coolant bottle pressure cap for routine coolant level inspections.

The coolant bottle provides a quick visual method for determining the coolant level without removing the pressure cap. With the engine cold, the level of the coolant in the coolant bottle (Fig. 13) should be between the MIN and MAX lines on the bottle.

### ADDING ADDITIONAL COOLANT

When additional coolant is needed, it should be added to the coolant pressure bottle. Use only 50/50 concentration of Mopar® Extended Life Coolant (orange in color) or the equivalent and distilled water. The Mopar® Extended Life Coolant must not be mixed with other (green in color) coolants. If this occurs, a reduction in the extended service interval will result. Refer to Group 0, Lubrication and Maintenance for service schedules.

**WARNING: DO NOT OPEN COOLING SYSTEM WHEN HOT AND UNDER PRESSURE BECAUSE PERSONAL INJURY AND SERIOUS BURNS FROM COOLANT CAN OCCUR. ALLOW ENGINE TO COOL BEFORE SERVICING COOLING SYSTEM.**

## SERVICE PROCEDURES (Continued)

## ACCESSORY DRIVE BELT DIAGNOSIS

| CONDITION                                          | POSSIBLE CAUSE                                                                                                                                                 | CORRECTION                                                                                                        |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| INSUFFICIENT ACCESSORY OUTPUT DUE TO BELT SLIPPAGE | 1. Belt too loose.<br>2. Belt excessively glazed or worn.                                                                                                      | 1. Adjust belt tension.<br>2. Replace and tighten as specified.                                                   |
| BELT SQUEAL WHEN ACCELERATING ENGINE               | 1. Belts too loose.<br>2. Belts glazed.                                                                                                                        | 1. Adjust belt tension.<br>2. Replace belts.                                                                      |
| BELT CHIRP AT IDLE                                 | 1. Belts too loose.<br>2. Foreign material imbedded in belt.<br>3. Non-uniform belt.<br>4. Misaligned pulley(s).<br>5. Non-uniform groove or eccentric pulley. | 1. Adjust belt tension.<br>2. Replace belt.<br>3. Replace belt.<br>4. Align accessories.<br>5. Replace pulley(s). |
| BELT ROLLED OVER IN GROOVE OR BELT JUMPS OFF       | 1. Broken cord in belt.<br>2. Belt too loose, or too tight.<br>3. Misaligned pulleys.<br>4. Non-uniform grooves or eccentric pulley.                           | 1. Replace belt.<br>2. Adjust belt tension.<br>3. Align accessories.<br>4. Replace pulley(s).                     |

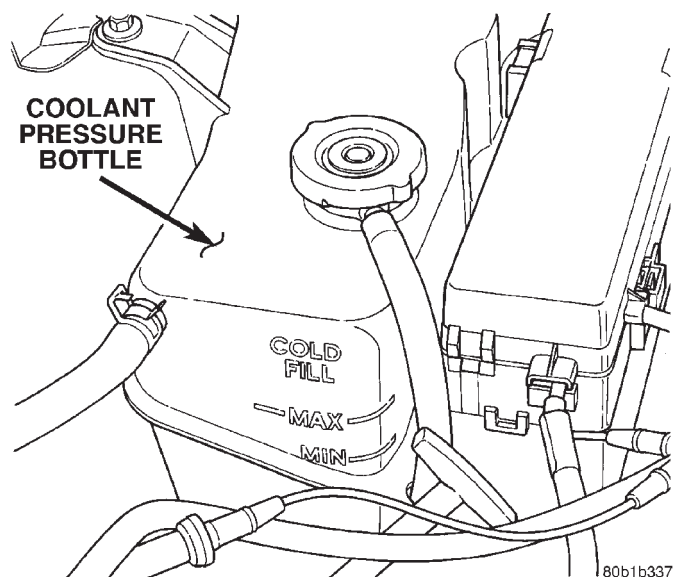


Fig. 13 Coolant Bottle Cold Fill Level

(1) Try squeezing the upper radiator hose to determine if the system is still pressurized.

(2) Place a shop towel over the pressure cap and turn to the first stop. Wait to see if any pressure is released. When no pressure is released, press down on the cap and turn to the second stop. Remove cap.

**NOTE:** If the coolant pressure is bottle completely empty, refer to Filling Cooling System in this section.

(3) If there is some coolant in coolant pressure bottle, slowly fill coolant pressure bottle.

**CAUTION:** Do not use well water, or suspect water supply in cooling system. A 50/50 ethylene glycol and distilled water mix is recommended.

## DRAINING COOLING SYSTEM

When servicing the cooling system, it is essential that coolant does not drip onto the drive belts and/or pulleys. Shield the belts with shop towels before working on the cooling system. If coolant contacts the belts or pulleys, flush both with clean water.

**WARNING:** DO NOT REMOVE HOSE CLAMPS OR HOSES, CYLINDER BLOCK DRAIN PLUGS, COOLANT BOTTLE CAP, OR OPEN THE RADIATOR DRAINCOCK, WHEN THE SYSTEM IS HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Open radiator drain located at the lower right side of radiator (Fig. 14). Drain takes place through the cooling module's lower right side insulator. **Do Not Use pliers to open draincock.**

(2) Remove coolant pressure bottle cap and open the thermostat bleed valve.

(3) Remove the cylinder block drain plug(s) located below each exhaust manifold.

**CAUTION:** The cooling system normally operates at 97-124 kPa (14-18 psi) pressure. Exceeding this pressure may damage the radiator or hoses.

## SERVICE PROCEDURES (Continued)

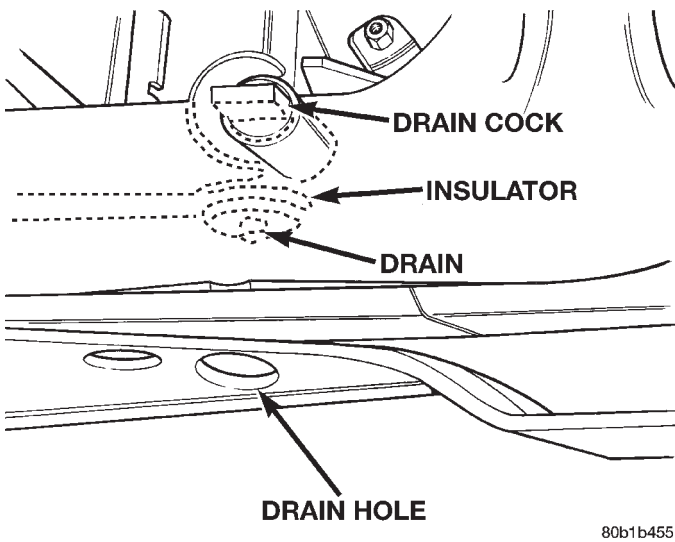


Fig. 14 Radiator Draincock Location

## COOLING SYSTEM—FILLING

**WARNING:** MAKE SURE ENGINE COOLING SYSTEM IS COOL BEFORE REMOVING PRESSURE CAP OR ANY HOSE. SEVERE PERSONAL INJURY MAY RESULT FROM ESCAPING HOT COOLANT. THE COOLING SYSTEM IS PRESSURIZED WHEN HOT.

**CAUTION:** Do not use well water, or suspect water supply in cooling system. A 50/50 mix of ethylene glycol and distilled water mix is recommended.

- (1) Close radiator drain. Hand tighten only.

**WARNING:** WHEN INSTALLING DRAIN HOSE TO AIR BLEED VALVE ON THERMOSTAT HOUSING, ROUTE HOSE AWAY FROM ACCESSORY DRIVE BELT, ACCESSORY DRIVE PULLEYS, AND ELECTRIC COOLING FAN MOTORS.

(2) Attach one end of a 6.35 mm (0.250 in.) ID clear hose that is approximately 1200 mm (48 in.) long, to the bleed valve in the outlet housing (Fig. 15). Route the hose away from the accessory drive belt, drive pulleys and electric cooling fan. Place the other end of hose into a clean container. The hose will prevent coolant from contacting the accessory drive belt when bleeding the system during the refilling operation.

- (3) Open the cooling system bleed valve:

- 2.7L: Located on the water outlet connector at the front of engine (Fig. 15).
- 3.2L: Located on the lower intake manifold, left of center and below the upper intake plenum (Fig. 15).

- (4) Attach Special Tool 8195, Filling Aid Funnel to pressure bottle filler neck (Fig. 16).

- (5) Use the supplied clip to pinch overflow hose that connects between the two chambers of the coolant bottle (Fig. 16).

**NOTE:** Use only Mopar® Extended Life Coolant or the equivalent. This coolant contains corrosion inhibitors (called OAT, for Organic Additive Technology) that permit extended drain intervals. Refer to Coolant Performance in this section for appropriate coolant mixture to use.

**CAUTION:** Do not mix coolants. If coolant other than Mopar® Extended Life or equivalent is added, the mixed coolant will have a reduced service schedule. Refer to Group 0, Lubrication and Maintenance for scheduled maintenance.

- (6) Pour a 50/50 concentration of Mopar® Extended Life Coolant or equivalent and distilled water into the larger section of Filling Aid Funnel (the smaller section of Funnel is to allow air to escape). Slowly fill the cooling system until a steady stream of coolant flows from the hose attached to the bleed valve (Fig. 15). Close the bleed valve and continue filling system to the top of the Filling Funnel.

- (7) Remove clip from overflow hose (Fig. 16).

- (8) Allow the coolant in Filling Funnel to drain into overflow chamber of the pressure bottle.

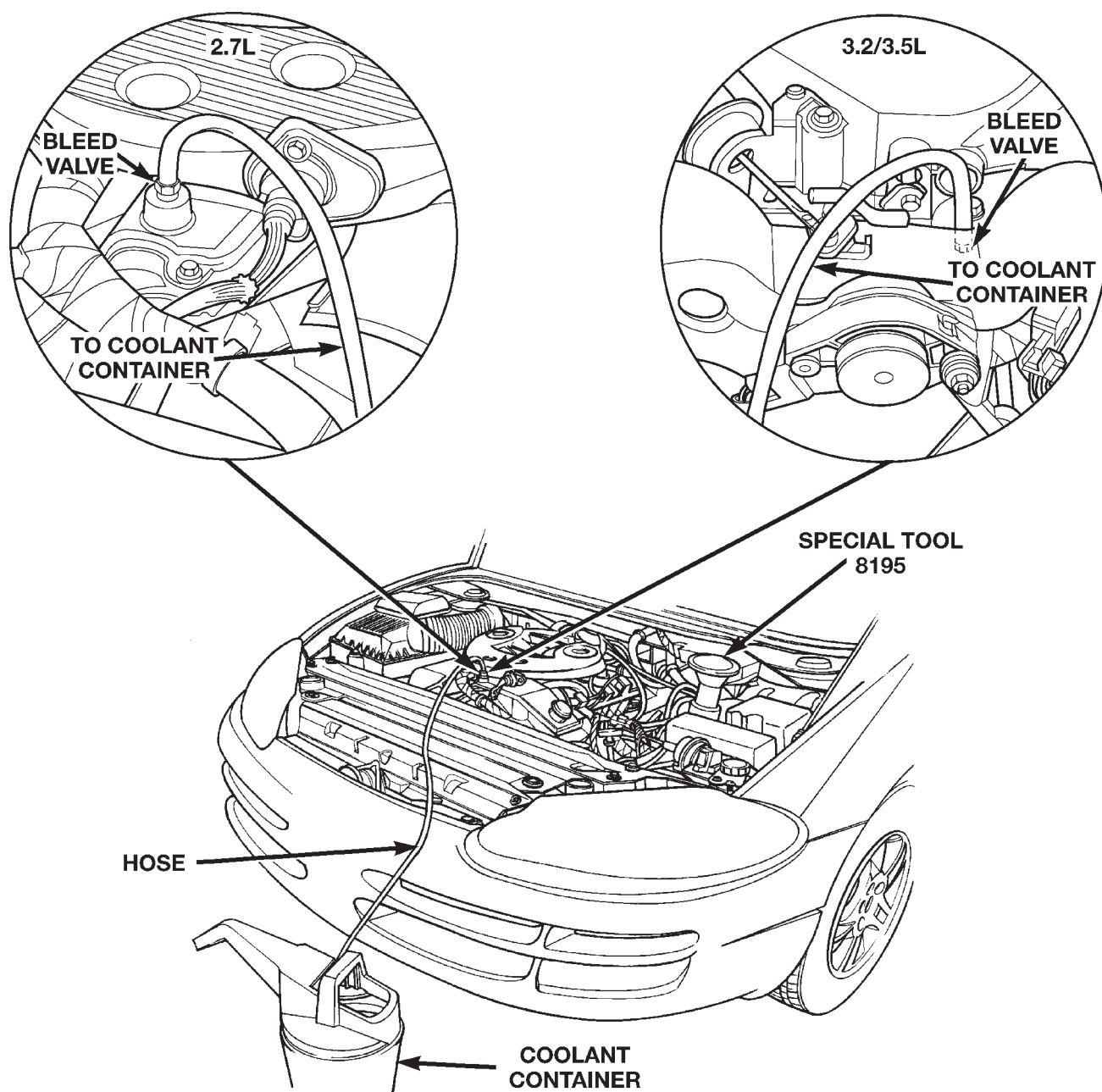
**NOTE:** The coolant bottle has two chambers. Coolant will normally only be in the inboard (smaller) of the two. The outboard chamber is only to recover coolant in the event of an overheat and should normally be empty. If there is coolant in the overflow side of the coolant bottle, disconnect the end of the overflow hose at the fill neck and lower it into a clean container. Allow coolant to drain into the container until emptied. Connect overflow hose to fill neck.

- (9) Remove Special Tool 8195, Filling Aid Funnel. Install cap on coolant pressure bottle.

- (10) Remove hose from bleed valve.

**NOTE:** The engine cooling system will push any remaining air into the coolant bottle within about an hour of normal driving. As a result, a drop in coolant level in the pressure bottle may occur.

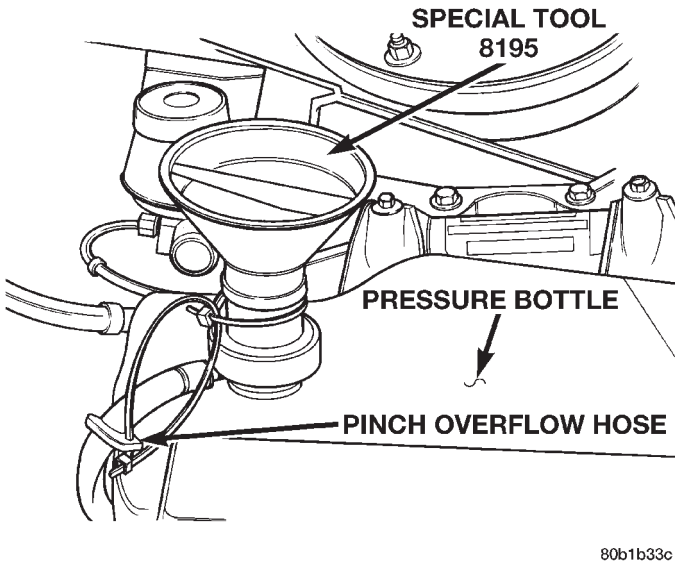
## SERVICE PROCEDURES (Continued)



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*Fig. 15 Cooling System Bleeding*

## SERVICE PROCEDURES (Continued)

**Fig. 16 Special Tool 8195**

**NOTE:** If the engine cooling system overheats and pushes coolant into the overflow flow side of the coolant bottle, this coolant will be sucked back into the cooling system **ONLY IF THE PRESSURE CAP IS LEFT ON THE BOTTLE**. Removing the pressure cap breaks the vacuum path between the two bottle sections and the coolant will not return to cooling system.

## REMOVAL AND INSTALLATION

**WATER PUMP—2.7L ENGINE****REMOVAL**

The water pump on all models can be replaced without discharging the air conditioning system.

**NOTE:** It is normal for the water pump to weep a small amount of coolant from the weep hole (black stain at weep passage). Do not replace the water pump if this condition exists. Replace the water pump if a heavy deposit or a steady flow of engine coolant is evident on side of the cylinder block from the weep hole passage (shaft seal failure). Be sure to perform a thorough analysis before replacing water pump.

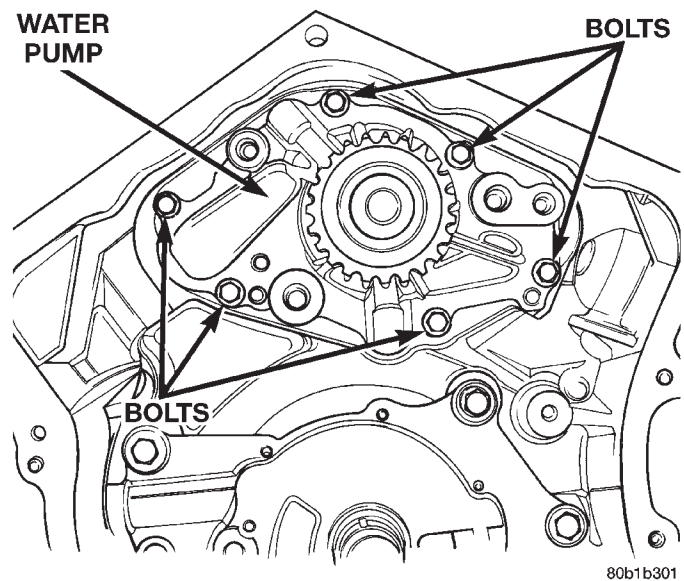
**WARNING: DO NOT REMOVE PRESSURE CAP WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN RESULT.**

(1) Drain cooling system. Refer to Cooling System Draining in this section.

- (2) Remove upper radiator crossmember. Refer to Group 23, Body for procedure.
- (3) Remove fan module.
- (4) Remove accessory and air conditioning drive belts.

**NOTE:** The water pump is driven by the primary timing chain.

- (5) Remove crankshaft damper, timing chain cover, primary timing chain, and all chain guides. Refer to Group 09, Engine for procedures.
- (6) Remove bolts attaching water pump to block (Fig. 17).
- (7) Remove water pump and gasket.

**Fig. 17 Water Pump—2.7L Engine****INSTALLATION**

- (1) Clean all sealing surfaces.
- (2) Install water pump and gasket. Tighten mounting bolts to 12 N·m (105 in. lbs.).
- (3) Install timing chain guides, timing chain, timing chain cover, and crankshaft damper.
- (4) Install air conditioning and accessory drive belts. Refer to procedure outlined in this section.
- (5) Install fan module and upper radiator crossmember.
- (6) Fill cooling system. Refer to Cooling System Refilling, in this section.

**WATER PUMP—3.2L ENGINE****REMOVAL**

The water pump on all models can be replaced without discharging the air conditioning system.

## REMOVAL AND INSTALLATION (Continued)

**WARNING: DO NOT REMOVE PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

**NOTE:** It is normal for the water pump to weep a small amount of coolant from the weep hole (black stain on water pump body). Do not replace the water pump if this condition exists. Replace the water pump if a heavy deposit or a steady flow of engine coolant is evident on water pump body from the weep hole (shaft seal failure). Be sure to perform a thorough analysis before replacing water pump.

(1) Drain cooling system. Refer to Cooling System Draining in this section.

(2) The water pump is driven by the timing belt. Refer to Timing Belt Removal in Group 09, Engine for component removal to provide access to water pump.

(3) Remove water pump mounting bolts (Fig. 18).

(4) Remove water pump body from engine (Fig. 18).

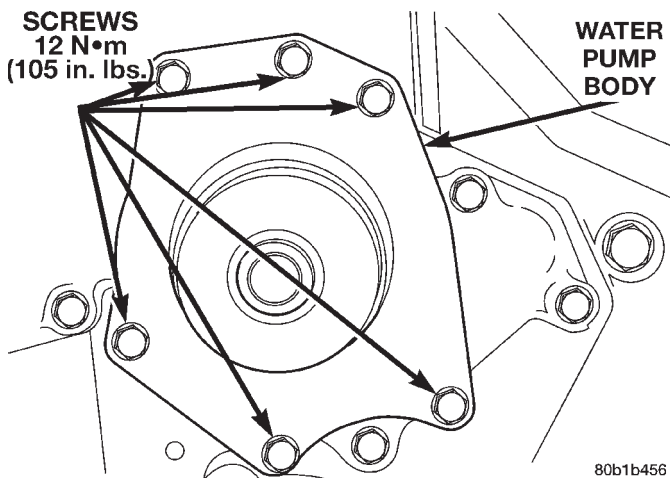


**Fig. 18 Water Pump—3.2L Engine**

## INSTALLATION

(1) Clean all O-ring surfaces on pump and cover.

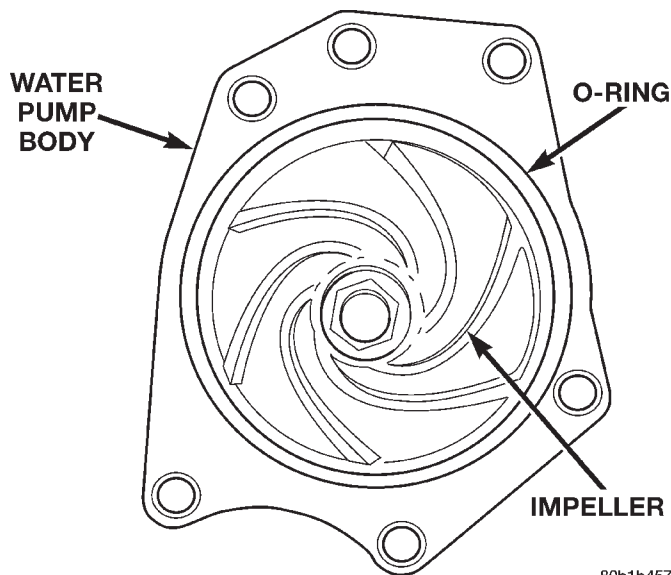
(2) Install new O-ring on water pump (Fig. 19). Wet the O-ring with water to facilitate assembly.

**CAUTION: Keep the O-ring free of oil or grease.**

(3) Install water pump to engine mounting bolts and tighten to 12 N·m (105 in. lbs.).

(4) Install timing belt. Refer to Group 09, Engine for procedures.

(5) Fill cooling system. Refer to Cooling System Refilling.



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**Fig. 19 Water Pump Body—3.2L Engine**

## WATER OUTLET CONNECTOR—2.7L

## REMOVAL

**WARNING: DO NOT REMOVE PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

(1) Drain cooling system. Refer to procedure in this section.

(2) Remove upper radiator crossmember. Refer to Group 23, Body for procedure.

(3) Remove upper intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedure.

(4) Disconnect upper radiator hose at outlet connector.

(5) Disconnect the heater hose quick-connect tee from the heater tube at rear of engine.

(6) Disconnect heater tube retaining clip at rear of engine.

(7) Disconnect electrical connector from coolant temperature sensor.

(8) Remove bolts attaching water outlet connector (Fig. 20). To remove outlet connector, move forward until heater tube clears cylinder heads.

## INSTALLATION

(1) Clean sealing surfaces. Inspect gasket for tears and cuts. Replace as necessary.

(2) Position outlet connector by inserting tube in-between cylinder heads (Fig. 20).

(3) Install attaching bolts and tighten to 12 N·m (105 in. lbs.) (Fig. 20).

## REMOVAL AND INSTALLATION (Continued)

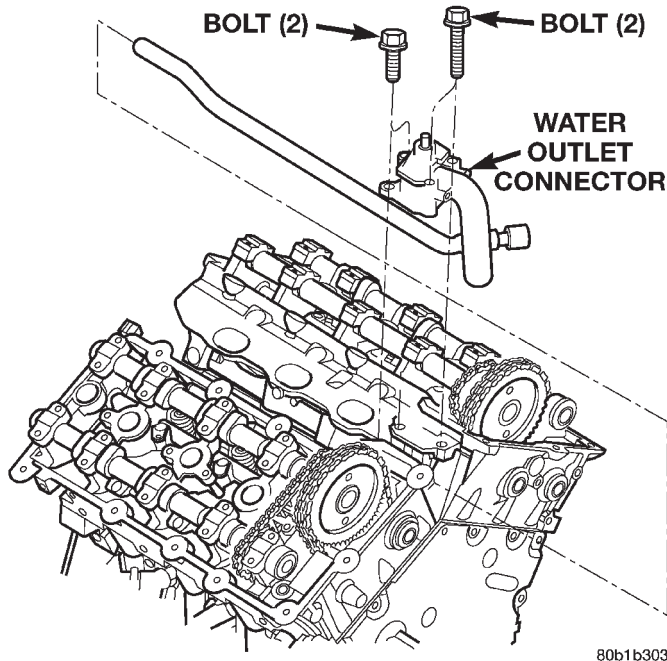


**Fig. 20 Water Outlet Connector—Removal and Installation**

- (4) Connect retaining clip and heater hose quick-connect tee to the heater tube at rear of engine.
- (5) Connect electrical connector to coolant temperature sensor.
- (6) Connect upper radiator hose to water outlet connector.
- (7) Install upper intake manifold and upper radiator support.
- (8) Fill cooling system. Refer to Cooling System Filling in this section.

### THERMOSTAT—2.7L

#### REMOVAL

- (1) Disconnect negative cable from remote jumper terminal.

**WARNING: DO NOT REMOVE PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

- (2) Drain cooling system.
- (3) Remove accessory drive belt for removal of the generator.
- (4) Raise vehicle on hoist.
- (5) Remove generator attaching bolts. Set generator aside for ease of access to thermostat.
- (6) Remove lower radiator and heater hoses from thermostat housing.
- (7) Remove thermostat housing bolts (Fig. 21).
- (8) Remove thermostat and housing.

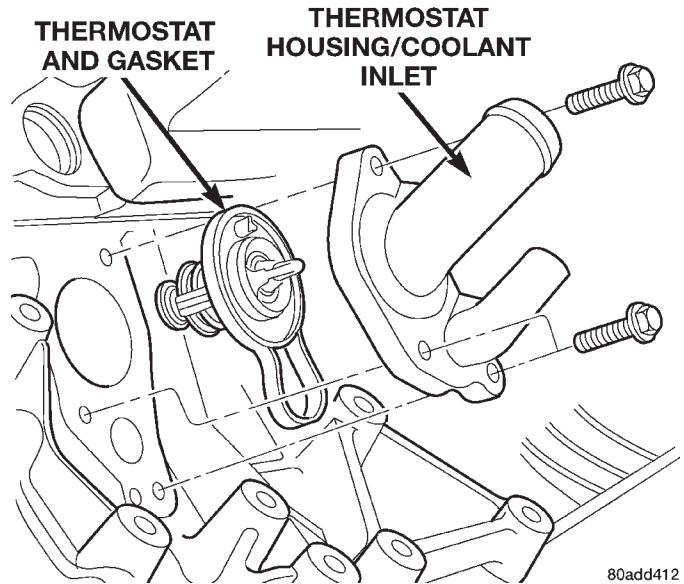


**Fig. 21 Thermostat and Housing—2.7L Engine**

#### INSTALLATION

- (1) Clean gasket sealing surfaces.

**NOTE: Install thermostat with the bleed valve located at the 12 o'clock position.**

- (2) Install thermostat and gasket into the thermostat housing.
- (3) Install thermostat and housing to cylinder block. Tighten attaching bolts to 12 N·m (105 in. lbs.) (Fig. 21).
- (4) Connect heater and lower radiator hoses. Install hose clamps.
- (5) Install generator and attaching bolts.
- (6) Lower vehicle.
- (7) Install accessory drive belt. Refer to procedure outlined in this section.
- (8) Refill cooling system (see **Cooling System Refilling**).
- (9) Connect negative cable to remote jumper terminal.

### THERMOSTAT—3.2L ENGINE

#### REMOVAL

**WARNING: DO NOT REMOVE PRESSURE CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

- (1) Disconnect negative cable from remote jumper terminal.
- (2) Drain cooling system.
- (3) Raise vehicle on hoist.
- (4) Disconnect electrical connectors from engine oil and power steering pressure switches.

## REMOVAL AND INSTALLATION (Continued)

(5) Disconnect radiator and heater hoses from thermostat housing.

(6) Remove thermostat housing bolts (Fig. 22).

(7) Remove housing, thermostat, and gasket.

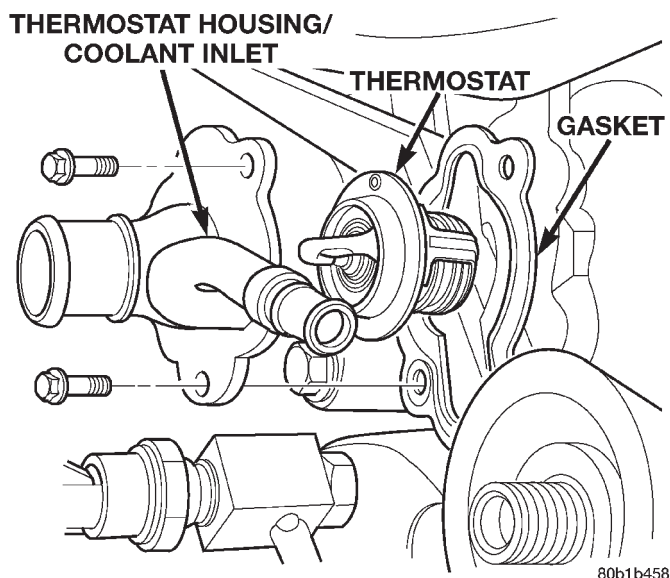


**Fig. 22 Thermostat and Housing—3.2L Engine**

## INSTALLATION

(1) Clean gasket sealing surfaces.

**NOTE:** Install thermostat with the bleed valve located at the 12 o'clock position.

(2) Install thermostat and gasket into thermostat housing. For ease of installation, install bolts in housing for thermostat and gasket retention.

(3) Install thermostat and housing to cylinder block. Tighten bolts to 12 N·m (105 in. lbs.).

(4) Connect heater and radiator hoses. Install hose clamps.

(5) Connect electrical connectors to engine oil and power steering pressure switches.

(6) Lower vehicle and connect negative cable to remote jumper terminal.

(7) Refill cooling system (see **Cooling System Refilling**).

## RADIATOR

## REMOVAL

**NOTE:** It is not necessary to discharge air conditioning system when removing the radiator.

(1) Disconnect negative cable from remote jumper terminal.

**WARNING:** DO NOT REMOVE THE CYLINDER BLOCK PLUG OR THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE

**BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

(2) Drain cooling system. Refer to Cooling System Draining in this section.

(3) Remove upper radiator crossmember.

(4) Remove hose clamps and hoses from radiator.

(5) Disconnect transmission hoses from cooler and plug off (Fig. 23).

(6) Disconnect engine oil cooler lines (if equipped) (Fig. 23).

(7) Disconnect the fan electrical connector (Fig. 24).

(8) Remove fan module (Fig. 24).

**CAUTION:** Avoid bending the condenser inlet tube. Care should be taken not to damage radiator or condenser cooling fins or water tubes during removal.

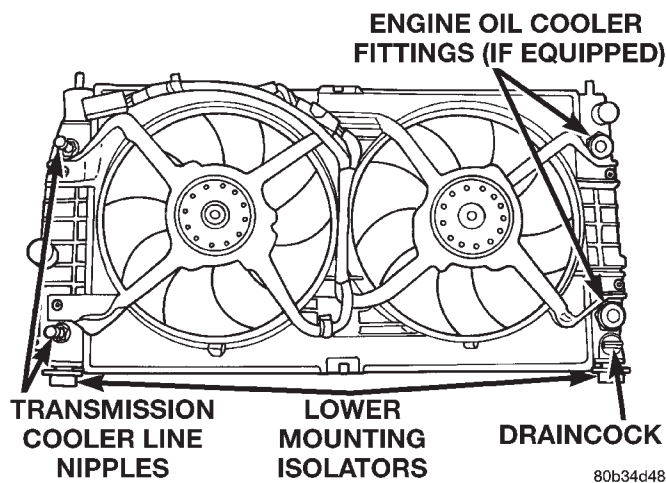


**Fig. 23 Radiator—Removal and Installation**

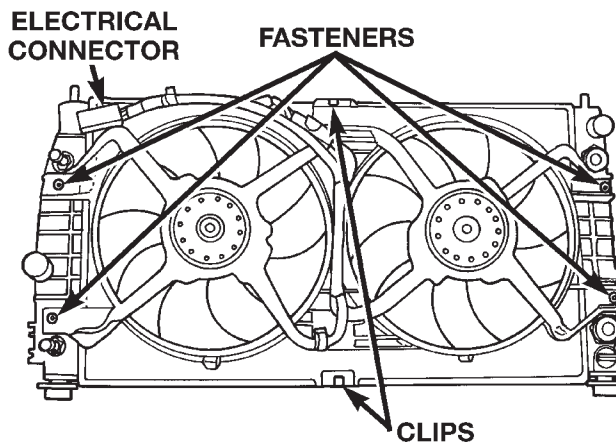
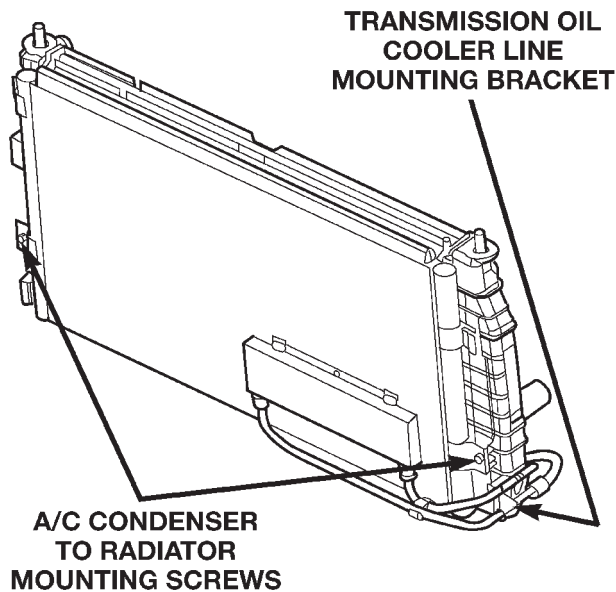


**Fig. 24 Fan Module—Removal and Installation**

(9) Remove the air conditioning condenser attaching screws located at the front of the radiator (Fig. 25).

## REMOVAL AND INSTALLATION (Continued)



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**Fig. 25 A/C Condenser To Radiator—Removal and Installation**

(10) Remove fastener attaching transmission cooler line bracket to left side of radiator (Fig. 25).

(11) Lift condenser upward, only enough to clear upper mounting clips; allow condenser to rest on lower radiator crossmember. It is not necessary to discharge the air conditioning system.

(12) Radiator can now be lifted free from engine compartment. **Care should be taken not to damage radiator cooling fins or water tubes during removal.**

**INSTALLATION**

(1) Slide radiator down into position; seat the radiator assembly lower rubber isolators in the mounting holes provided in lower radiator support (Fig. 23).

(2) Attach air conditioning condenser to mounting clips on radiator. Install mounting screws and tighten to 5 N·m (45 in. lbs.) (Fig. 25).

(3) Connect lower radiator hose and clamp.

(4) Install transmission cooler line bracket and attaching fastener. Connect automatic transmission hoses; torque hose clamps to 2.5 N·m (22 in. lbs.).

(5) Install fan module.

(6) Connect fan motor electrical connector.

(7) Connect engine oil cooler lines (if equipped).

(8) Install upper radiator hose. Align hose so it does not interfere with the accessory drive belt or engine. Position hose clamp so it will not interfere with the hood liner.

(9) Install upper radiator support crossmember.

(10) Connect negative cable to remote jumper terminal.

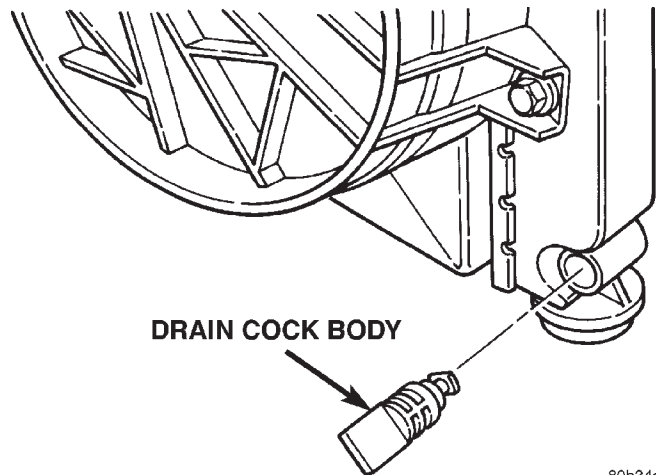
(11) Fill cooling system with coolant. Refer to Cooling System Filling in this section.

(12) Operate engine until it reaches normal operating temperature. Check cooling system and automatic transmission for correct fluid levels.

**RADIATOR DRAINCOCK****REMOVAL**

**WARNING: DO NOT REMOVE THE CYLINDER BLOCK PLUG OR THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.**

**CAUTION: Use of pliers on draincock is not recommended. Damage may occur to part. Draincock should not be removed unless leakage is observed.**



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**Fig. 26 Draincock**

(1) Turn the draincock stem counterclockwise to unscrew the stem. When the stem is unscrewed to the end of its threads, turn back 1/8 turn and pull the stem (Fig. 26) from the radiator tank.

**INSTALLATION**

(1) Push the draincock assembly body into the tank opening until it snaps into place.

(2) Tighten the draincock stem by turning clockwise until it stops.

**COOLING FAN MODULE****REMOVAL**

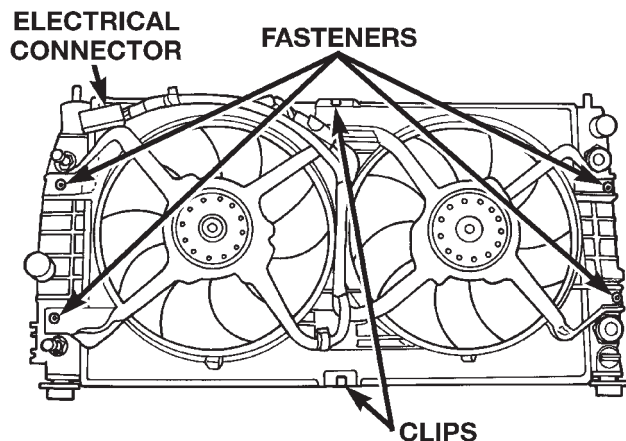
(1) Remove upper radiator crossmember. Refer to Group 23, Body for procedure.

(2) Disconnect fan electrical connector.

(3) Remove fan module attaching fasteners and clips (Fig. 27).

## REMOVAL AND INSTALLATION (Continued)

(4) Remove fan module by lifting upward to clear radiator.



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Fig. 27 Fan Module

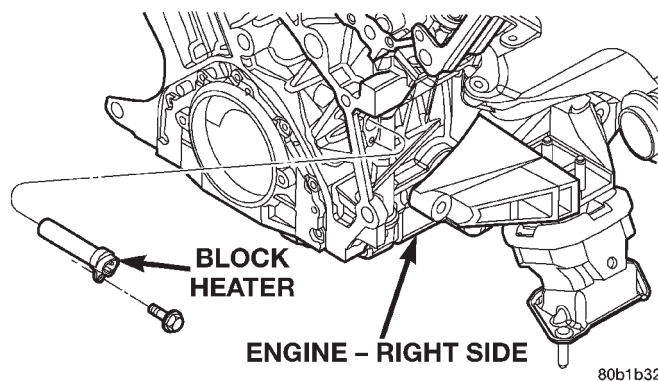
## INSTALLATION

- (1) Install fan module.
- (2) Install mounting clips and fasteners.
- (3) Connect fan module electrical connector.
- (4) Install upper radiator crossmember.

## ENGINE BLOCK HEATER

## REMOVAL

- (1) Raise vehicle on hoist.
- (2) Detach power cord plug from heater (Fig. 28).
- (3) Remove block heater attaching screw located below heater terminals.
- (4) Remove block heater from cylinder block.



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Fig. 28 Engine Block Heater

## INSTALLATION

- (1) Thoroughly clean cylinder block heater cavity.
- (2) Insert heater assembly into block such that mounting hole is located below heater terminals.
- (3) Install mounting screw and tighten to 12 N·m (105 in. lb.).
- (4) Attach power cord to heater.

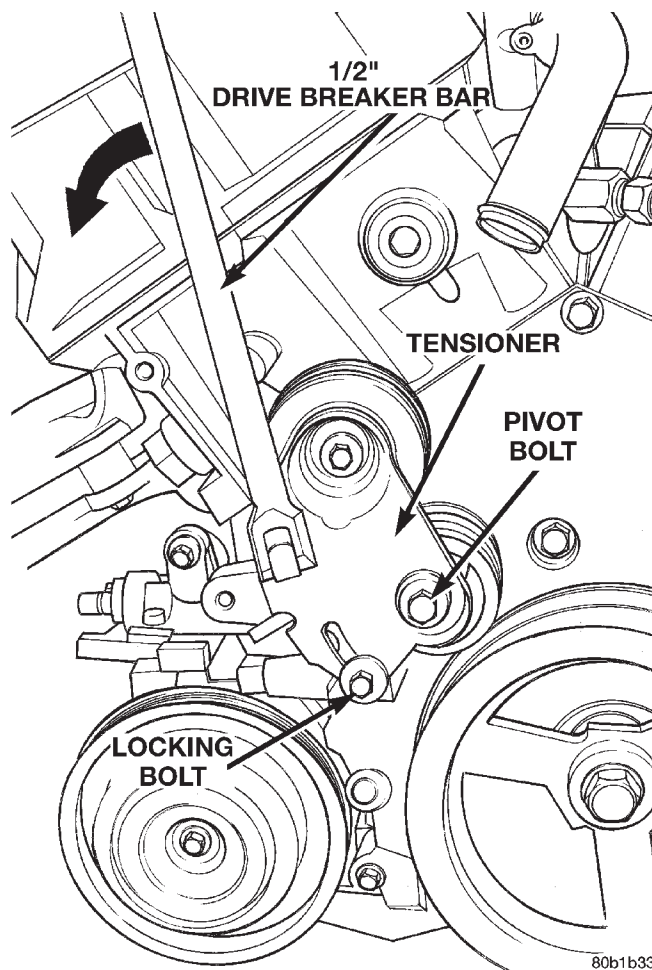
**CAUTION:** To prevent damage, the power cord must be secured in its retainer clips, and not positioned so it could contact linkages or exhaust manifolds.

- (5) Lower vehicle.

## AIR CONDITIONING BELT—2.7L

## REMOVAL

- (1) Remove accessory drive belt. Refer to procedure outlined in this section.
- (2) Loosen **BUT DO NOT REMOVE** tensioner locking bolt (Fig. 29).
- (3) Insert 1/2" drive breaker bar into square opening on belt tensioner. Rotate tensioner counterclockwise until belt can be removed from pulleys (Fig. 29).
- (4) Slowly rotate tensioner clockwise to relieve spring load.



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Fig. 29 Air Conditioning Drive Belt—Removal and Installation

## REMOVAL AND INSTALLATION (Continued)

## INSTALLATION

**WARNING: DO NOT REMOVE A/C BELT TENSIONER LOCKING BOLT WITHOUT FIRST HOLDING THE TENSIONER WITH A 1/2" DRIVE BREAKER BAR, AS PERSONAL INJURY COULD RESULT.**

## NEW BELT

**NOTE:** Verify that torsion spring position is in the new belt position before installing a NEW belt (Fig. 30). If torsion spring is not in the new belt position, follow steps 1 – 7 to change the tensioner spring from the USED belt position to the NEW belt position.

(1) Insert a 1/2" drive breaker bar into the square opening on the tensioner. Hold counterclockwise pressure on tensioner while removing the locking bolt (Fig. 29).

(2) Carefully release spring load of the torsion spring on the tensioner.

(3) Remove pivot bolt, tensioner, and spring from front timing cover.

(4) Insert spring arm into the NEW belt position on the tensioner (Fig. 30).

(5) Install torsion spring, tensioner, and pivot bolt.

(6) Tighten pivot bolt to 28 N·m (250 in. lbs.).

(7) Using a 1/2" drive breaker bar, apply counterclockwise pressure until locking bolt can be installed.

(8) Rotate tensioner counterclockwise until the NEW belt can be installed on pulleys. See (Fig. 31) for belt routing.

(9) Release tensioner and remove socket wrench. Belt is automatically adjusted with the tensioner's torsion spring.

(10) Tighten tensioner locking bolt to 28 N·m (250 in. lbs.) (Fig. 29).

(11) Install accessory drive belt.

## USED BELT

**NOTE:** A "used belt" is considered having more than 500 miles of service use.

**NOTE:** Perform steps 1 – 7 to change the tensioner spring from the NEW belt position, to the USED belt position.

(1) Insert a 1/2" drive breaker bar into the square opening on tensioner. Hold counterclockwise pressure on tensioner, while removing tensioner locking bolt (Fig. 29).

(2) Carefully release the tension of spring on tensioner.

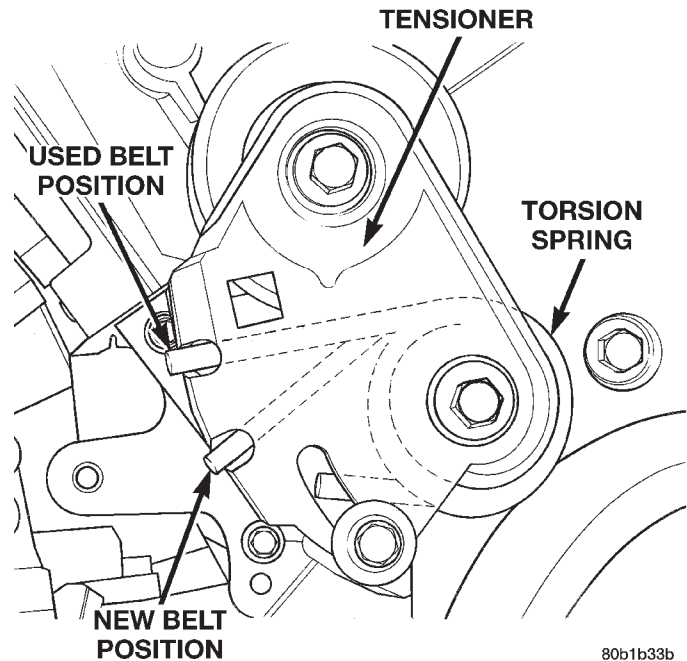


**Fig. 30 Air Conditioning Belt Tensioner Spring Position**

(3) Remove pivot bolt, tensioner, and spring from front cover.

(4) Insert spring into the used belt position on tensioner bracket (Fig. 30).

(5) Install spring, tensioner bracket, and pivot bolt.

(6) Tighten pivot bolt to 28 N·m (250 in. lbs.).

(7) Using a 1/2" drive breaker bar, apply counterclockwise pressure until locking bolt can be installed.

(8) Install the USED belt by rotating tensioner counterclockwise until belt can be installed on pulleys. See (Fig. 31) for belt routing.

(9) Tighten tensioner locking bolt to 28 N·m (250 in. lbs.).

(10) Install accessory drive belt.

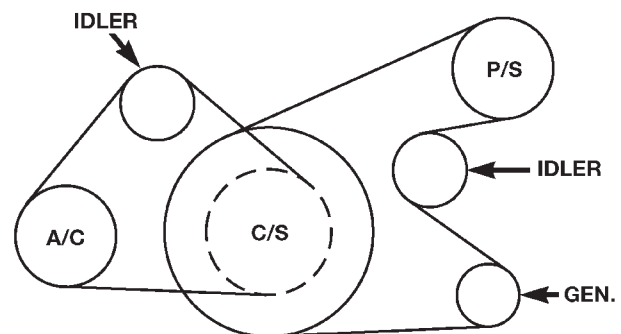
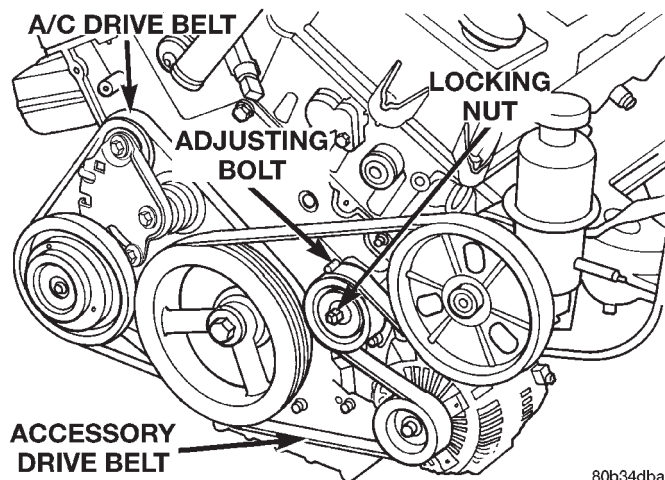


**Fig. 31 Belt Routing—2.7L Engine**

## REMOVAL AND INSTALLATION (Continued)

**ACCESSORY DRIVE BELT—2.7L****REMOVAL**

- (1) Loosen tensioner pulley locking nut (Fig. 32).
- (2) Loosen belt adjusting bolt (Fig. 32).
- (3) Remove accessory drive belt.

**Fig. 32 Accessory Drive Belt****INSTALLATION**

- (1) Install accessory drive belt on pulleys.
- (2) Tighten belt adjusting bolt to proper belt tension.
- (3) Tighten tensioner locking nut.

**NOTE:** See Belt Tension Chart for specifications.

**BELT TENSION CHART—2.7L**

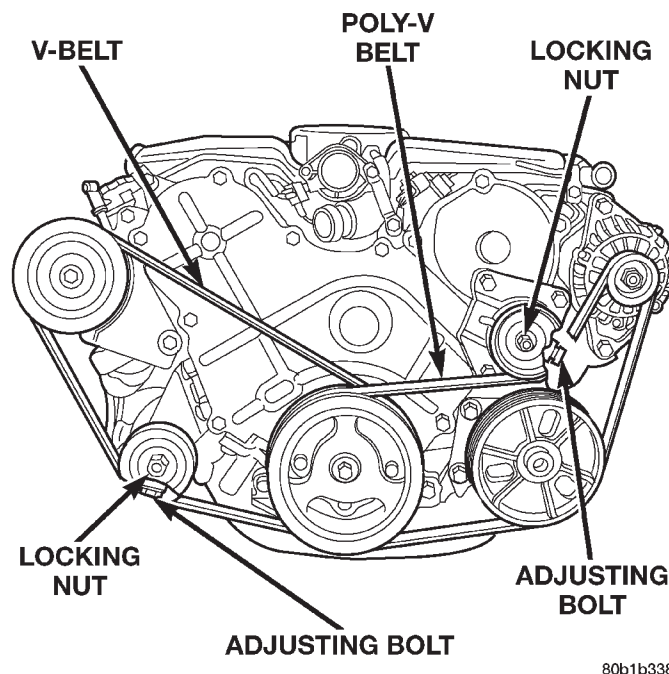
| POLY-V BELT          | GAUGE                                           |
|----------------------|-------------------------------------------------|
| Accessory Drive Belt | New Belt: 836 $\pm$ 44 N<br>(190 $\pm$ 10 lbs.) |
|                      | Used Belt: 534 N (120 lbs.)                     |

**AIR CONDITIONING BELT—3.2L ENGINE****REMOVAL**

- (1) Remove accessory drive belt to gain access to the air conditioning drive belt. Refer to procedure outlined in this section.
- (2) To remove air conditioning compressor drive belt, first loosen the tensioner pulley lock nut, then loosen the adjusting screw to the tensioner pulley assembly until the belt can be removed (Fig. 33).

**INSTALLATION**

- (1) Install air conditioning belt over drive pulleys. Tighten the tensioner adjusting bolt until the belt is at specified tension using a Belt Tension Gauge. Refer to Belt Tension Chart. Tighten tensioner pulley locking nut to 54 N·m (40 ft. lbs.).

**Fig. 33 Air Conditioning and Accessory Drive Belts**

- (2) Install accessory drive belt and adjust to specified tension.

**Air Conditioning Belt Tension Adjustment**

Loosen the tensioner pulley locking nut and adjust belt tension by tightening adjusting bolt. Use Belt Tension Gauge and refer to Belt Tension Chart for specifications. Torque pulley nut to 54 N·m (40 ft. lbs.) after adjustment.

**ACCESSORY DRIVE BELT—3.2L**

The Poly-V generator/power steering belt has an adjustable tensioner pulley located on the front timing belt cover.

**REMOVAL**

- (1) Loosen tensioner pulley locking nut.
- (2) Raise vehicle on hoist.
- (3) Remove the two (2) push clips attaching lower air shield to engine cradle. Remove air shield.
- (4) Loosen tensioner adjusting bolt until the accessory belt can be removed.

**INSTALLATION**

- (1) Install accessory drive belt.

**NOTE:** Use Special Tool 7198, Belt Tension Gauge to obtain proper tension on accessory drive belt. Refer to Belt Tension Chart.

## REMOVAL AND INSTALLATION (Continued)

- (2) Tighten adjusting bolt until the specified tension is obtained.
- (3) Install lower air shield and attaching push clips.
- (4) Lower vehicle.
- (5) Tighten tensioner pulley locking nut.

### BELT TENSION CHART—3.2L

| POLY-V BELT           | GAUGE                                           |
|-----------------------|-------------------------------------------------|
| Accessory Drive Belt  | New Belt: 836 $\pm$ 44 N<br>(190 $\pm$ 10 lbs.) |
|                       | Used Belt: 534 N (120 lbs.)                     |
| V-BELT                | GAUGE                                           |
| Air Conditioning Belt | New Belt: 667 $\pm$ 44 N<br>(150 $\pm$ 10 lbs.) |
|                       | Used Belt: 534 N (120 lbs.)                     |

## CLEANING AND INSPECTION

### WATER PUMP

Replace the water pump if it has any of the following defects.

- (1) Damage or cracks on the pump body.
- (2) Coolant leaks; if the seal is leaking, this will be evident by traces of thick deposits of dried glycol running down the pump body (3.2L), pump weep passage (2.7L) (Fig. 34), and components below. A thin black stain below pump weep hole/passage is considered normal operation.
- (3) Impeller rubs inside of cylinder block (2.7L) or timing belt cover (3.2L) engines.
- (4) Excessively loose or rough turning bearing.

**NOTE:** It is normal for the water pump to weep a small amount of coolant from the weep hole (black stain on water pump body). Do not replace the water pump if this condition exists. Replace the water pump if a heavy deposit or a steady flow of engine coolant is evident on water pump body (3.2L) or from the weep passage (2.7L) (Fig. 34). This indicates a shaft seal failure and pump must be replaced. Be sure to perform a thorough analysis before replacing water pump.

### ACCESSORY DRIVE BELT

Satisfactory performance of the belt driven accessories depends on belt condition and proper belt tension.

Belt replacement under any or all of the following conditions is required:

- (1) Excessive wear.
- (2) Frayed cords.
- (3) Severe glazing.

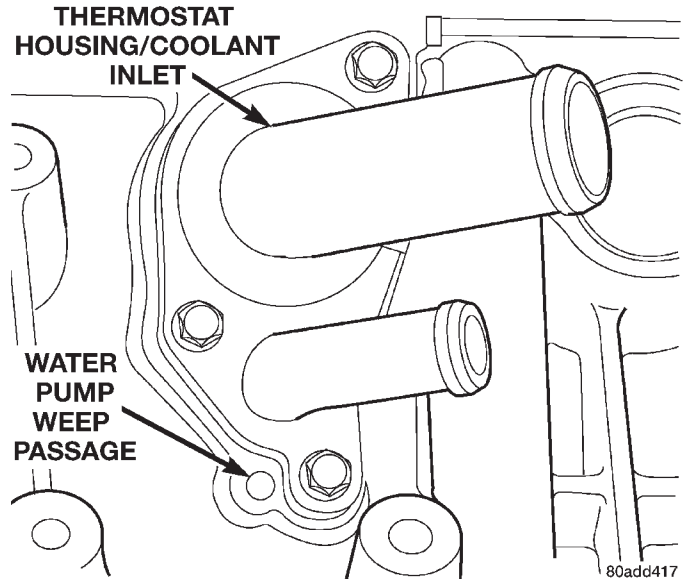


**Fig. 34 Water Pump Weep Passage—2.7L Engine**

V-Ribbed belt system with back drive pulley may develop minor cracks across the ribbed side (due to reverse bending). These minor cracks are considered normal and acceptable. Parallel cracks are not (Fig. 35).

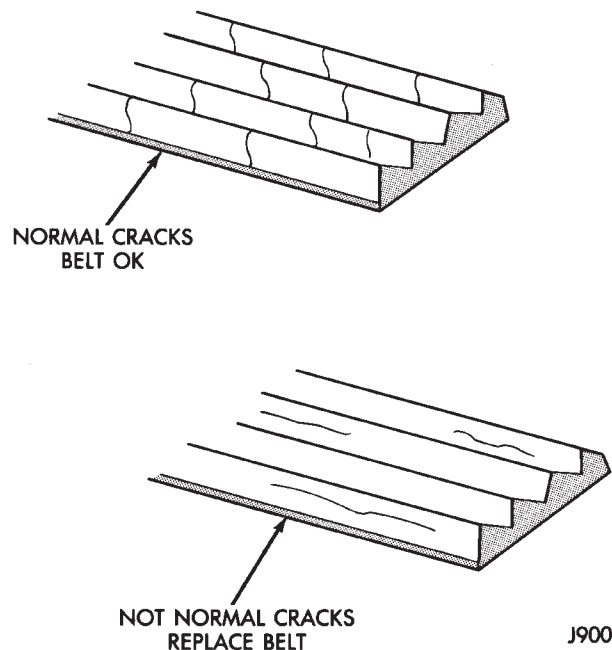
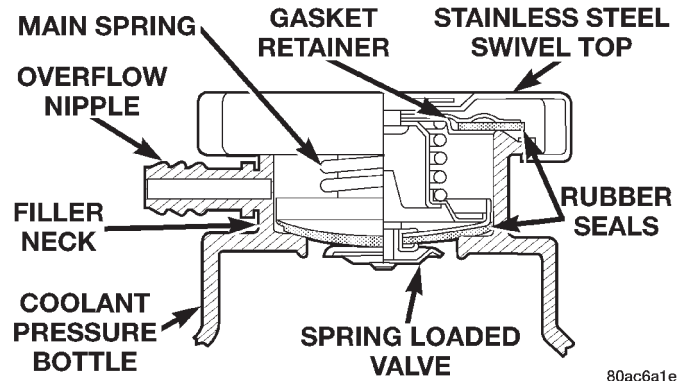


**Fig. 35 Drive Belt Inspection**

## CLEANING AND INSPECTION (Continued)

**COOLANT BOTTLE PRESSURE CAP**

The pressure cap upper gasket (seal) pressure relief can be checked by removing cap. Attach the Radiator Pressure Tool to the cap and pump air into the cap. Pressure cap upper gasket should relieve at 124 kPa (18 psi) and hold pressure at 110 kPa (16 psi) minimum.



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**Fig. 36 Pressure Cap**

Remove the pressure tester hold the cap in hand, **right side up** (Fig. 36). The vent valve at the bottom of the cap should not open. If the rubber gasket has swollen and prevents the valve from closing, replace the cap.

Hold the cleaned cap in hand **upside down**. If any light can be seen between vent valve and rubber gasket, replace cap.

**WARNING: THE WARNING WORDS DO NOT OPEN HOT ON THE COOLANT BOTTLE PRESSURE CAP IS A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, THE COOLANT BOTTLE PRESSURE CAP SHOULD NOT BE REMOVED WHILE THE SYSTEM IS HOT AND/OR UNDER PRESSURE.**

There is no need to remove the pressure cap at any time **except** for the following purposes:

- Checking and adjust antifreeze freeze point.
- Refilling system with new coolant.
- Conducting service procedures.
- Checking for vacuum leaks.

**WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT 15 MINUTES BEFORE REMOVING CAP. THEN PLACE A SHOP TOWEL OVER THE CAP AND WITHOUT PUSHING DOWN ROTATE IT COUNTERCLOCKWISE TO THE FIRST STOP. ALLOW FLUIDS TO ESCAPE THROUGH THE OVERFLOW TUBE AND WHEN THE SYSTEM STOPS PUSHING OUT COOLANT AND STEAM AND PRESSURE DROPS, REMOVE THE CAP COMPLETELY. SQUEEZING THE RADIATOR INLET HOSE WITH A SHOP TOWEL (TO CHECK PRESSURE) BEFORE AND AFTER TURNING TO THE FIRST STOP IS RECOMMENDED.**

**CLEANING COOLING SYSTEM**

Drain cooling system. Refer to Draining Cooling System in this section. Refill with clean distilled water. Refer to Refilling Cooling System in this section. Run engine with radiator cap installed until upper radiator hose is warm. Stop engine and drain water from system. If water is dirty, fill, run and drain system again until water runs clear.

**REVERSE FLUSHING COOLING SYSTEM**

Reverse flushing of the cooling system is the forcing of water through the cooling system, using air pressure in a direction opposite to that of the normal flow of water. This is only necessary with dirty systems or in case of partially plugged systems.

**RADIATOR**

Drain cooling system and remove radiator hoses from engine. Install suitable flushing gun in radiator lower hose. Fill radiator with clean water and turn on air in short blasts.

**CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result. Continue this procedure until water runs clear.**

**ENGINE**

Drain radiator. Refer to Draining Cooling System in this section. Remove hoses from radiator. Remove engine thermostat and reinstall thermostat housing. Install suitable flushing gun to thermostat housing hose. Turn on water, and when engine is filled, turn on air, but no higher than 138 kPa (20 psi) in short blasts. Allow engine to fill between blasts of air. Continue this procedure until water runs clean. Install thermostat using a new housing gasket. Fill cooling system. Refer to Refilling Cooling System in this section.

## ADJUSTMENTS

### BELT TENSION GAUGE METHOD

Use belt tension gauge, Special Tool 7198 for conventional V-belts and Poly-V belts.

Adjust the belt tension for **NEW** or **USED** belt tension applications. Refer to Belt Tension Chart.

#### BELT TENSION CHART—2.7 & 3.2L ENGINES

| POLY-V BELT                           | GAUGE                                           |
|---------------------------------------|-------------------------------------------------|
| Accessory Drive Belt<br>(all engines) | New Belt: 836 $\pm$ 44 N<br>(190 $\pm$ 10 lbs.) |
|                                       | Used Belt: 534 N (120 lbs.)                     |
| V-BELT                                | GAUGE                                           |
| Air Conditioning Belt<br>(3.2L only)  | New Belt: 667 $\pm$ 44 N<br>(150 $\pm$ 10 lbs.) |
|                                       | Used Belt: 534 N (120 lbs.)                     |

## SPECIFICATIONS

### COOLING SYSTEM CAPACITY

| ENGINE                                                | CAPACITIES |           |
|-------------------------------------------------------|------------|-----------|
| 2.7/3.2L                                              | 7.5 LITERS | 7.92 QTS. |
| CAPACITY: Includes Heater and Coolant Pressure Bottle |            |           |

## TORQUE

### DESCRIPTION TORQUE

#### Accessory Drive Belt Tensioner Pulley—2.7/3.2L

Nut . . . . .54 N·m (40 ft. lbs.)

#### Air Conditioning Belt Tensioner Pulley—3.2L

Nut . . . . .54 N·m (40 ft. lbs.)

#### Air Conditioning Belt Tensioner & Pulley—2.7L

Bolts . . . . .28 N·m (25 in. lbs.)

#### Fan Module To Radiator

Screws . . . . .5 N·m (45 in. lbs.)

#### Fan Blade To Motor

Nut . . . . .5 N·m (45 in. lbs.)

#### Condenser Inlet Tube Bracket

Screw . . . . .5 N·m (45 in. lbs.)

#### A/C Condenser to Radiator

Bolt . . . . .5 N·m (45 in. lbs.)

#### Fan Motor To Shroud

Screws . . . . .3 N·m (25 in. lbs.)

#### Thermostat Housing

Bolts . . . . .12 N·m (105 in. lbs.)

#### Water Pump Mounting

Bolts—2.7L . . . . .12 N·m (105 in. lbs.)

Bolts—3.2L . . . . .12 N·m (105 in. lbs.)

#### Thermostat Bleed

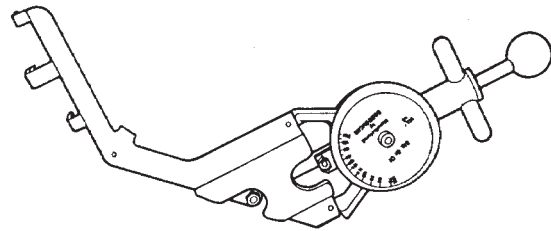
Screw . . . . .8 N·m (70 in. lbs.)

## SPECIAL TOOLS

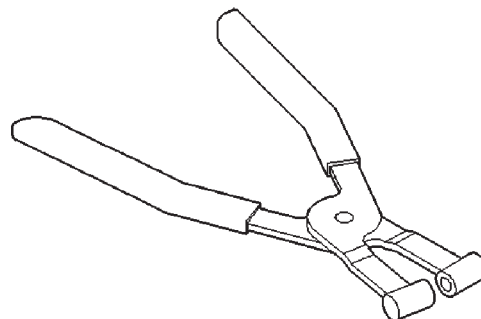
### COOLING



*Filling Aid Funnel 8195*



*Belt Tension Gauge 7198*



*Hose Clamp Pliers 6094*

