COOLING SYSTEM

CONTENTS

INDEX

GENERAL INFORMATION

Throughout this group, references are made to particular vehicle models by alphabetical designation or by the particular vehicle nameplate. A chart showing a breakdown of alphabetical designations is included in the Introduction section at the beginning of this manual.

COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

COOLING SYSTEM COMPONENTS

The cooling system consists of:

- A radiator
- Cooling fan
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (if equipped with an automatic transmission)
- Coolant
- Water pump
- Hoses and hose clamps

SYSTEM COOLANT ROUTING

For cooling system routings refer to (Figs. 1 or 2).

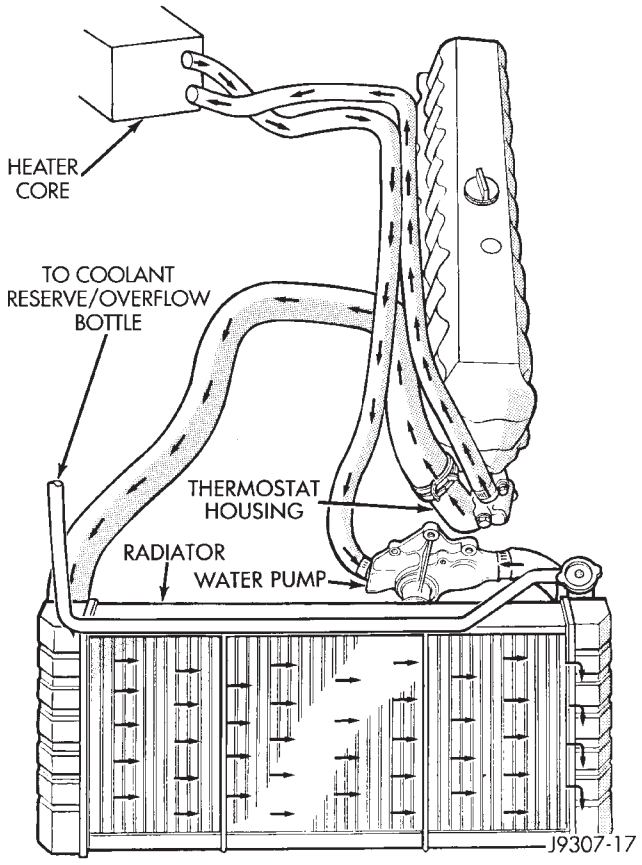

Fig. 1 Engine Cooling System—4.0L Engine—Typical

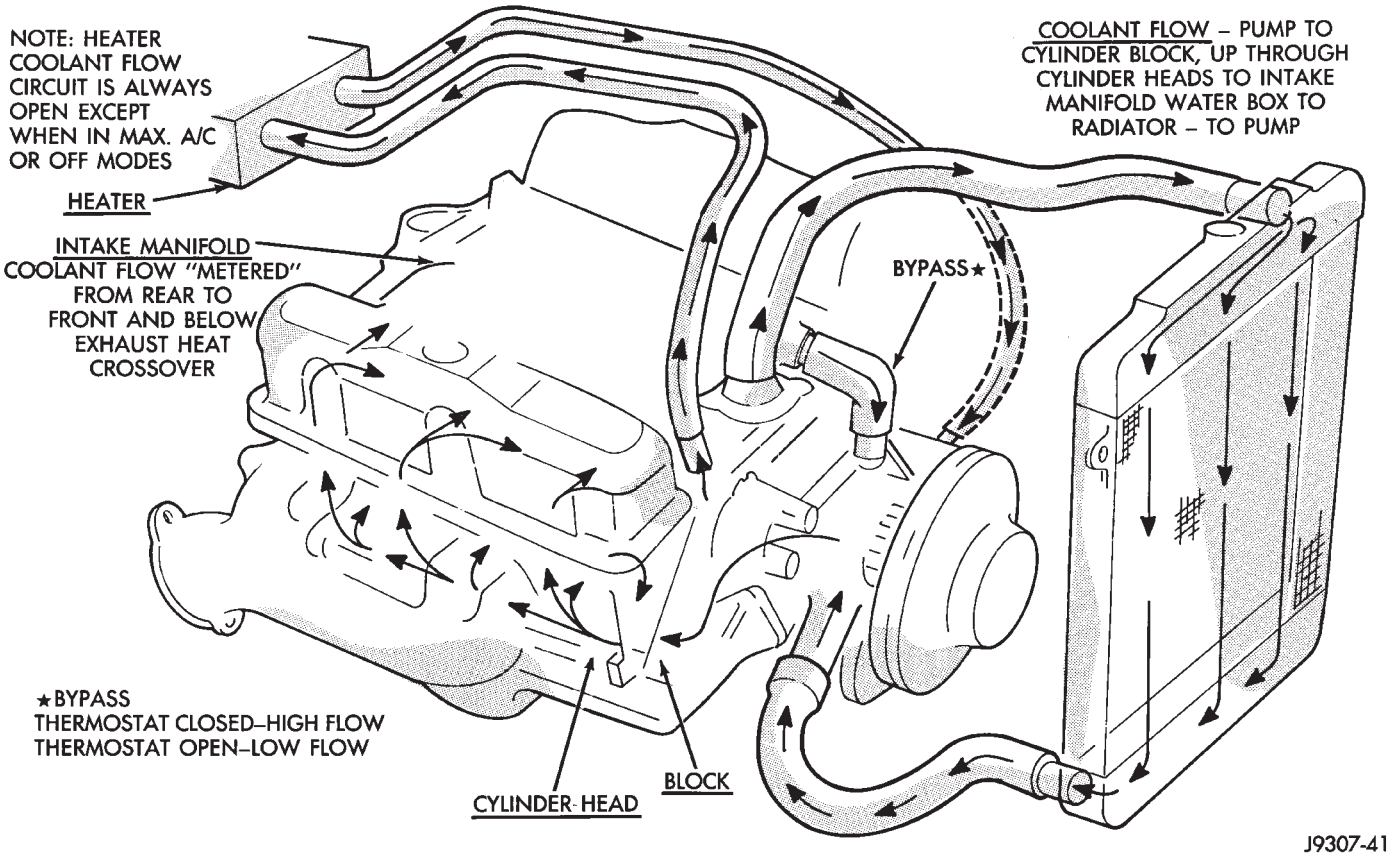

Fig. 2 Engine Cooling System—5.2L Engine—Typical

DIAGNOSIS

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause.

1. PROLONGED IDLE, VERY HIGH AMBIENT TEMPERATURE, SLIGHT TAIL WIND AT IDLE, SLOW TRAFFIC, TRAFFIC JAMS, HIGH SPEED, OR STEEP GRADES:

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

2. TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

3. AIR CONDITIONING; ADD-ON OR AFTER MARKET:

A maximum cooling package should have been ordered with vehicle if add-on or after market A/C is installed. If not, maximum cooling system components should be installed for model involved per manufacturer's specifications.

4. RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts (incorrect water pump rotating in wrong direction)
- Reconditioned radiator or cooling system refilling (possibly under-filled or air trapped in system).
- Rubber and foam air seals not properly installed to radiator or A/C condenser after a repair.

If investigation reveals none of the above as a cause for engine overheating complaint, refer to following Symptom and Action chart.

SYMPTOM AND ACTION—SEE PRELIMINARY CHECKS FIRST

Symptom	Action
Blinking Engine Temperature Warning Light Or High Gauge Indication-Without Coolant Loss	Normal with temporary operation with heavy load, towing a trailer, high outdoor temperatures, and/or on a steep grade.
Coolant Loss	Improper refilling procedures can result in trapped air in the system. Subsequent operation of the pressure cap and coolant reserve system will deaerate the cooling system. A low coolant level will then result in the Coolant Reserve/Overflow Bottle. Add coolant. If condition persists see System Diagnosis.
Hot Vehicle (Not Engine): **Heat Damage,** **Hot Carpet, Seat,** **Hot Catalytic Converter,** **Smoke, Burnt Odor**	Check heat shielding, exhaust system, engine emission controls, ignition timing, engine misfiring.
Hot Engine: **Crackling Noise** **Hot Smell** **Severe Local Hot Spots**	A moderate amount of sound from heating metal can be expected with any vehicle. However, a crackling sound from the thermostat housing, a hot smell and/or severe local hot spots on an engine can indicate; blocked coolant passages, bad casting, core sand deposits and subsequent blockage, cracked cylinder block or head, or blown cylinder head gasket.
Coolant Reserve Bottle: **Level Changes**	Level changes are to be expected as coolant volume fluctuates with engine temperature. During operation at higher temperatures and/or under heavy loads, the coolant level in the reserve/overflow bottle may increase above the FULL level indicated on the bottle. If the level in the bottle is between the ADD and FULL marks when the engine is at normal operating temperature, the level should return to within that range when the engine returns to normal operating conditions.
Coolant Not Returning To Radiator	Coolant will not return to the radiator if the radiator cap vent valve does not function, if an air leak destroys vacuum, or if the overflow passage is blocked or restricted. Inspect all portions of the overflow passage, pressure cap, filler neck nipple, hose, and passages within the bottle for vacuum leak only. Coolant return failure will be evident by a low level in the radiator. Reserve bottle level should increase during heat-up.

J9307-18

SYSTEM DIAGNOSIS

Condition	Possible Cause	Correction
NOISE	(1) Fan contacting shroud.	(1) Reposition shroud and inspect engine mounts.
	(2) Loose water pump impeller.	(2) Replace pump.
	(3) Glazed fan belt.	(3) Replace belt.
	(4) Loose fan belt.	(4) Adjust fan belt tension.
	(5) Rough surface on drive pulley.	(5) Replace pulley.
	(6) Water pump bearing worn.	(6) Remove belt to isolate. Replace pump.
	(7) Belt alignment.	(7) Check pulley alignment. Repair as necessary.
COOLANT LOSS— BOILOVER	**Refer to Overheating Causes in addition to the following items.**	
	(1) Overfilled cooling system.	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run.	(2) Allow engine to run at fast idle prior to shutdown.
	(3) Air in system, resulting in occasional "burping" of coolant.	(3) Purge system.
	(4) Insufficient antifreeze, allowing coolant boiling point to be too low.	(4) Add antifreeze to raise boiling point.
	(5) Antifreeze deteriorated because of age of contamination.	(5) Replace coolant.
	(6) Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator.	(6) Pressure test system to locate source of leak(s), then repair as necessary.
	(7) Faulty head gasket.	(7) Replace head gasket.
	(8) Cracked head, manifold, or block.	(8) Replace as necessary.
	(9) Faulty radiator cap.	(9) Replace cap.
COOLANT ENTRY INTO CRANKCASE OR CYLINDER(S)	(1) Low cylinder head bolt torque.	(1) Replace gasket, retorque head.
	(2) Faulty head gasket.	(2) Replace head gasket.
	(3) Crack in head, manifold or block.	(3) Replace as necessary.
COOLANT RESERVE SYSTEM INOPERATIVE	(1) Coolant level low.	(1) Replenish coolant to FULL mark.
	(2) Leak in system.	(2) Pressure test to isolate leak and repair as necessary.
	(3) Overflow tube clogged or leaking.	(3) Repair as necessary.
	(4) Recovery bottle vent restricted.	(4) Remove restriction.
LOW TEMPERATURE GAUGE INDICATION — UNDERCOOLING	(1) Thermostat stuck open.	(1) Replace thermostat.
	(2) Faulty gauge or sending unit.	(2) Repair or replace faulty component.

J9107-44

SYSTEM DIAGNOSIS (CONT.)

Condition	Possible Cause	Correction
HIGH TEMPERATURE GAUGE INDICATION — OVERHEATING	(1) Coolant level low.	(1) Replenish coolant.
	(2) Fan belt loose.	(2) Adjust fan belt tension.
	(3) Radiator hose(s) collapsed.	(3) Replace hose(s).
	(4) Radiator airflow blocked.	(4) Remove restriction (bug screen, fog lamps, etc.).
	(5) Faulty coolant expansion bottle cap.	(5) Replace coolant expansion bottle cap.
	(6) Air trapped in cooling system.	(6) Purge air.
	(7) Heavy-traffic driving.	(7) Operate at fast idle in neutral intermittently to cool engine.
	(8) Incorrect cooling system component(s) installed.	(8) Install proper component(s).
	(9) Faulty thermostat.	(9) Replace thermostat.
	(10) Water pump shaft broken or impeller loose.	(10) Replace water pump.
	(11) Radiator tubes clogged.	(11) Flush radiator.
	(12) Cooling system clogged.	(12) Flush system.
	(13) Casting flash in cooling passages.	(13) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.
	(14) Brakes dragging.	(14) Repair brakes.
	(15) Excessive engine friction.	(15) Repair engine.
	(16) Antifreeze concentration over 68%.	(16) Lower antifreeze concentration percentage.
	(17) Faulty gauge or sending unit.	(17) Repair or replace faulty component.
	(18) Loss of coolant flow caused by leakage or foaming.	(18) Repair or replace leaking component, replace coolant.
	(19) Faulty cooling fan operation.	(19) Check cooling fan operation.
NO COOLANT FLOW THROUGH HEATER CORE	(1) Restricted return inlet in water pump.	(1) Remove restriction.
	(2) Heater hose collapsed or restricted.	(2) Remove restriction or replace hose.
	(3) Restricted heater core.	(3) Remove restriction or replace core.
	(4) Restricted outlet in thermostat housing.	(4) Remove flash or restriction.
	(5) Intake manifold bypass hole in cylinder head restricted.	(5) Remove restriction.
	(6) Intake manifold coolant passage restricted.	(6) Remove restriction or replace intake manifold.
	(7) Heater valve controls not functioning.	(7) Repair controls (see Heating and Air Conditioning Group 24).

J9307-19

SERVICE PROCEDURES

INDEX

WATER PUMPS—GENERAL INFORMATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a single serpentine drive belt on all engines.

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

CAUTION: All 4.0L 6 cylinder engines are equipped with a reverse (counterclockwise) rotating water pump and thermal viscous fan drive assembly. REVERSE is stamped or imprinted on the cover of the viscous fan drive and inner side of the fan. The letter R is stamped into the back of the water pump impeller (Fig. 1). Engines from previous model years, depending upon application, may have been equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump or viscous fan drive will cause engine over heating.

A quick test to determine if the pump is working is to check if the heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

5.2L ENGINE: One of the heater hoses is connected to the water pump with a metal coolant return tube (Fig. 2). A rubber O-ring forms a seal at the water pump end of the tube.

WATER PUMP TESTS

LOOSE IMPELLER

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

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

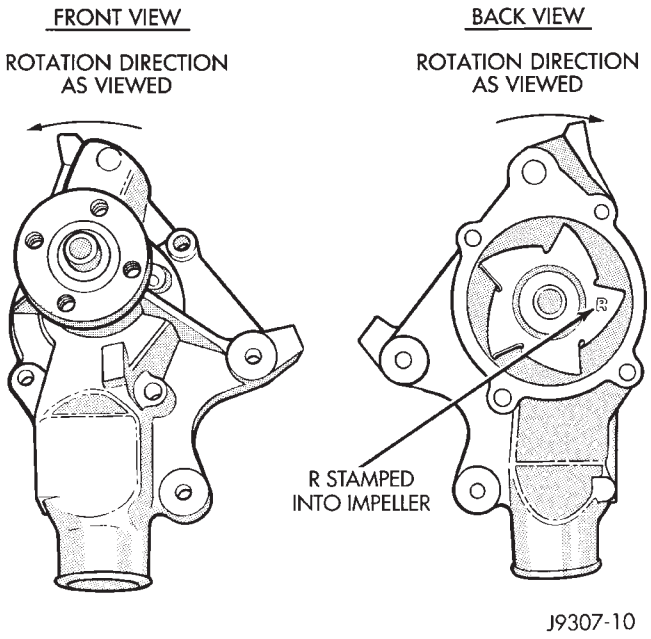

Fig. 1 Reverse Rotating Water Pump—4.0L 6 Cylinder

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

(2) Loosen the fan belt. Refer to Belt Service in the Engine Accessory Drive Belt section of this group.

(3) Disconnect the lower radiator hose from the water pump.

(4) Bend a stiff welding rod or similar device as shown in (Fig. 3). To prevent breakage of rod, minimum thickness should be 3/16 inch (.187 inches).

(5) Position the rod in the water pump inlet and attempt to hold the impeller while turning the fan pulley. If equipped with a thermal viscous fan drive, rotate the water pump shaft with a wrench attached to one of the fan pulley mounting nuts. If the impeller is loose and can be held with the rod while the fan blades are turning, the pump is defective. Do not

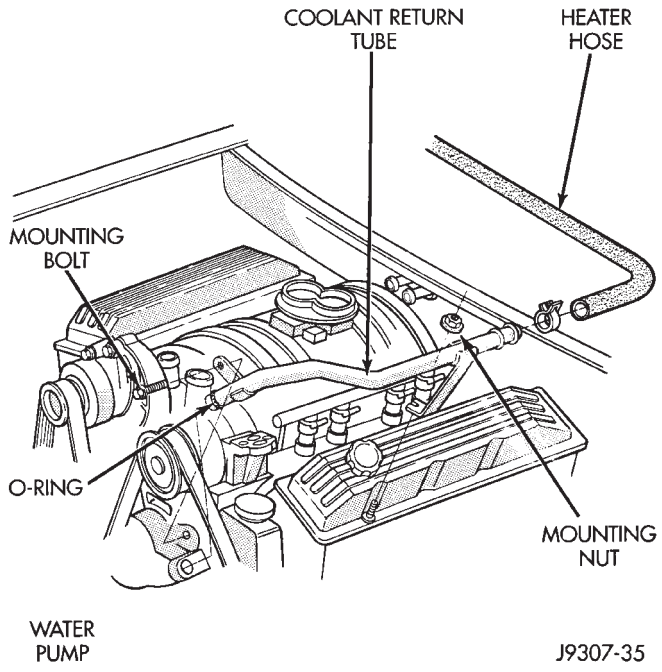

Fig. 2 Coolant Return Tube—5.2L Engine

use excessive force when rotating pump shaft. If the impeller turns, the pump is OK.

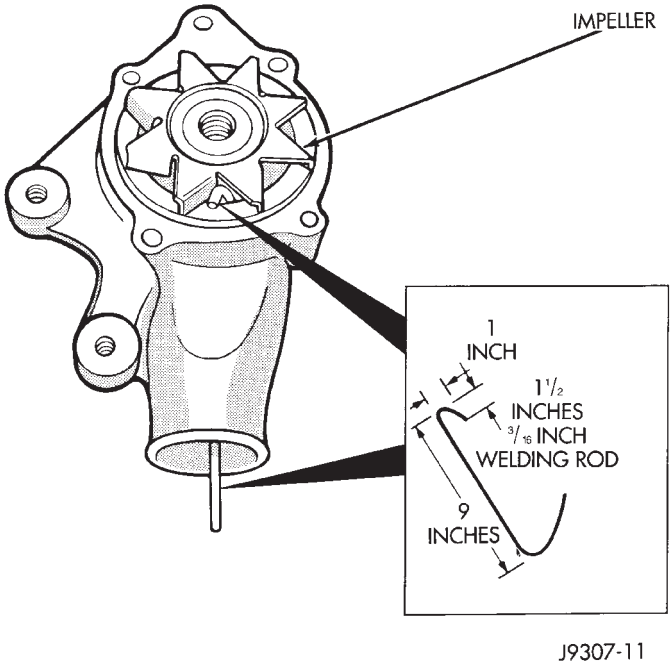

Fig. 3 Impeller Test—Typical

Connect the hose and install the coolant, or proceed with repairs.

INSPECTING FOR INLET RESTRICTIONS

Inadequate heater performance may be caused by a metal casting restriction in the water pump heater hose inlet.

DO NOT WASTE reusable coolant. If solution is clean, drain the coolant into a clean container for reuse.

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(1) Drain sufficient coolant from the radiator to decrease the level below the water pump heater hose inlet.

(2) Remove the heater hose.

(3) Inspect the inlet for metal casting flash or other restrictions.

Remove the pump from the engine before removing restriction to prevent contamination of the coolant with debris. Refer to Water Pump Removal in this group.

WATER PUMPS—REMOVAL/INSTALLATION

4.0L 6 CYLINDER ENGINE

REMOVAL

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

CAUTION: All 4.0L 6 cylinder engines have a reverse (counter-clockwise) rotating water pump. The letter R is stamped into the back of the water pump impeller (Fig. 1) to identify. Engines from previous model years, depending upon application, may be equipped with a forward (clockwise) rotating water pump. Installation of the wrong water pump will cause engine over heating.

The water pump impeller is pressed on the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

WARNING: DO NOT REMOVE THE BLOCK DRAIN PLUG(S) OR LOOSEN RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain coolant into a clean container for reuse.

(1) Disconnect negative battery cable at battery.

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

(3) Loosen (but do not remove at this time) the four fan hub-to-water pump pulley mounting nuts.

The engine accessory drive belt must be removed prior to removing the fan.

(4) Remove engine drive belt as follows:

(a) Loosen two rear power steering pump mounting bolts A (Fig. 4).

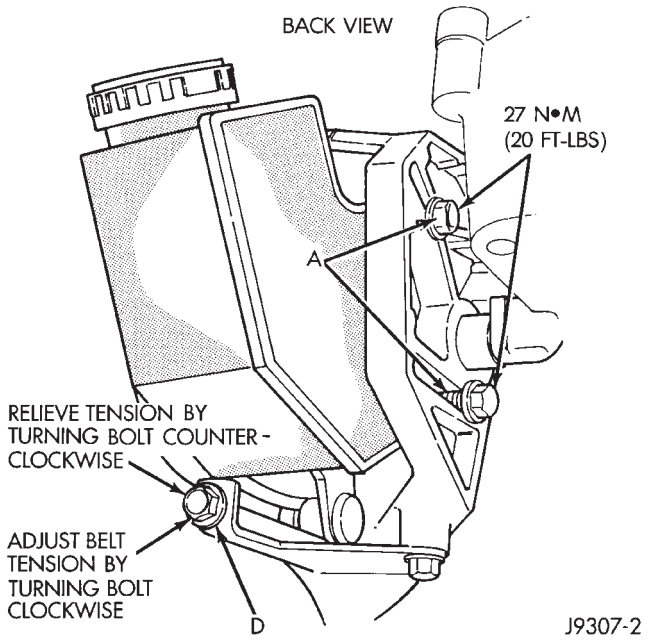

Fig. 4 P.S. Pump Rear Mounting Bolts—4.0L Engine

(b) Loosen upper pump pivot bolt B and lower lock nut C (Figs. 5 or 6).

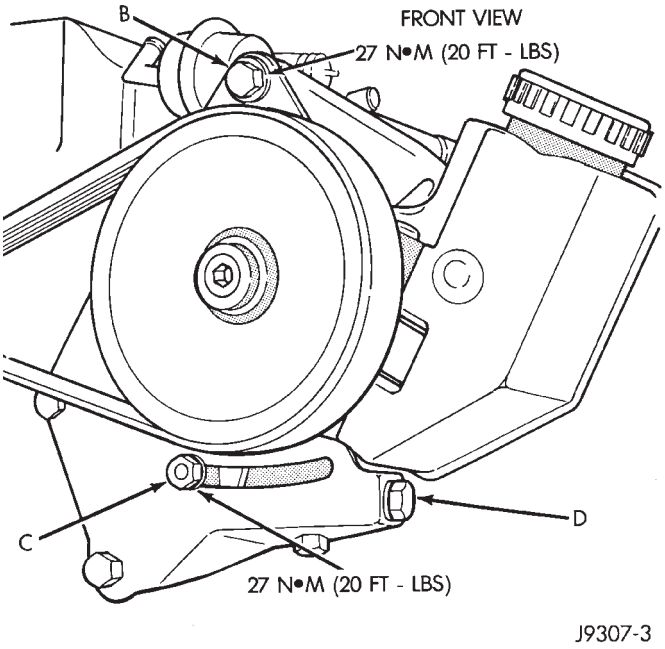

Fig. 5 P.S. Pump Front Mounting Bolt/Locknut—4.0L Engine

(c) Loosen pump adjusting bolt D (Fig. 4) until belt can be removed.

(d) Remove belt.

(5) Check condition of all pulleys.

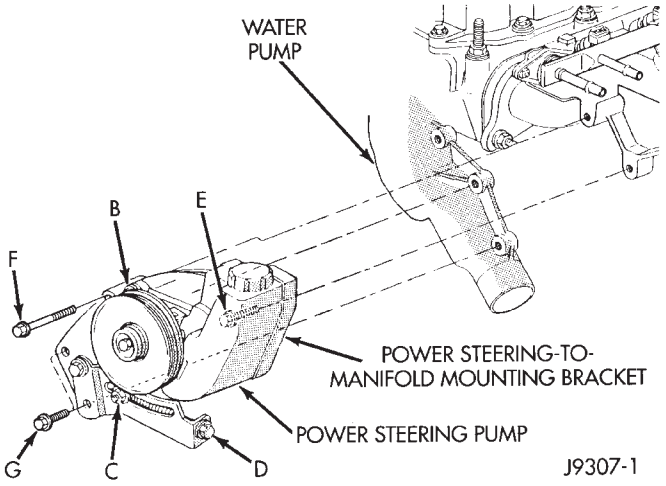

Fig. 6 Bracket Mounting Bolts—4.0L Engine

(6) The power steering pump must be removed from its cast mounting bracket to gain access to bolt E. Bracket mounting bolt E is located behind the power steering pump (Fig. 6).

(7) Remove two bolts A (Fig. 4).

(8) Remove locknut C and belt adjustment bolt D (Figs. 5 or 6).

(9) Remove bolt B (Fig. 5). Position power steering pump to the side. Hold pump in position with wire. Do not disconnect hydraulic lines from pump.

(10) Remove bolts E, F and G (Fig. 6) and remove pump mounting bracket.

(11) Remove idler pulley mounting bolt and remove idler pulley. This must be done to gain clearance for the water pump mounted heater hose fitting when water pump is being removed.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP.

(12) Remove lower radiator hose from water pump. Remove heater hose from water pump fitting. Miller Clamp Tool number 6094 (Fig. 7) may be used to remove the constant tension clamps.

(13) Remove the four fan hub-to-water pump pulley mounting nuts.

(14) Remove the two fan shroud-to-upper radiator crossmember attaching nuts (Fig. 8).

(15) Remove the fan assembly and fan shroud (together as one unit) from the vehicle.

(16) Remove the four pump mounting bolts (Fig. 9) and remove pump from vehicle. Discard old gasket. Note that one of the four bolts is longer than the other bolts.

(17) If pump is to be replaced, the heater hose fitting must be removed. Note position of fitting before removal.

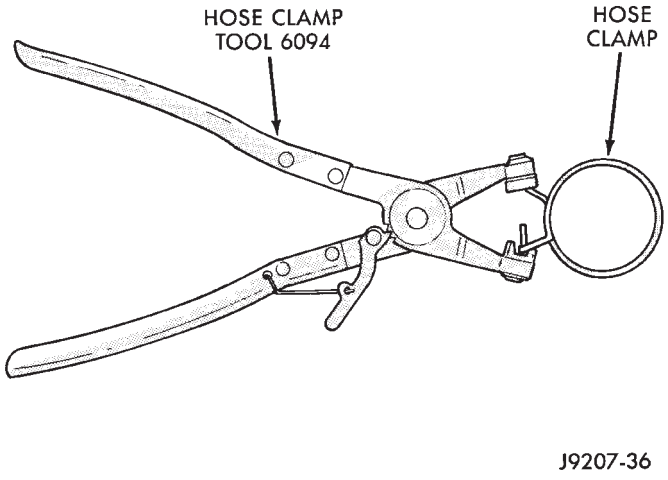

Fig. 7 Hose Clamp Tool

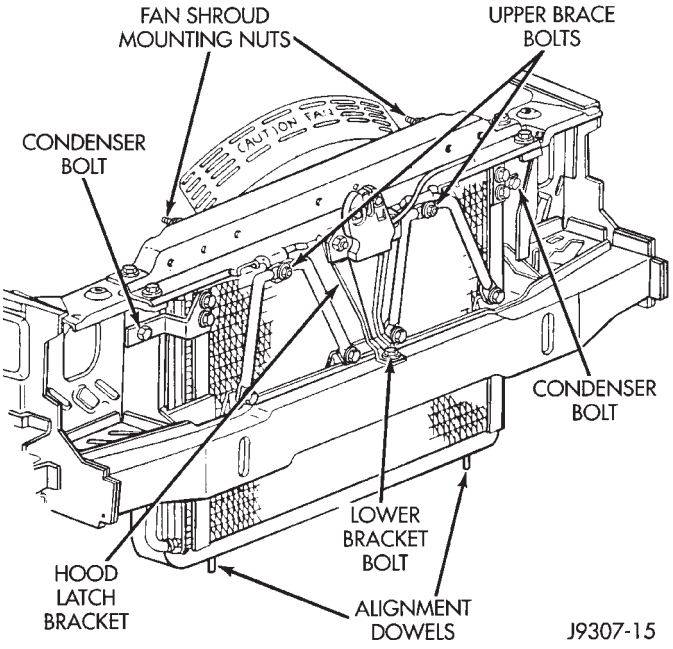

Fig. 8 Fan Shroud Mounting

INSTALLATION

(1) If pump is being replaced, install the heater hose fitting to the pump. Use a sealant on the fitting such as Mopar™ Thread Sealant With Teflon. Refer to the directions on the package.

(2) Clean the gasket mating surfaces. If the original pump is used, remove any deposits or other foreign material. Inspect the cylinder block and water pump mating surfaces for erosion or damage from cavitation.

(3) Install the gasket and water pump (the gasket is installed dry). Tighten mounting bolts to 30 N●m (22 ft. lbs.) torque. Rotate the shaft by hand to be sure it turns freely.

(4) Connect the radiator and heater hoses to the water pump.

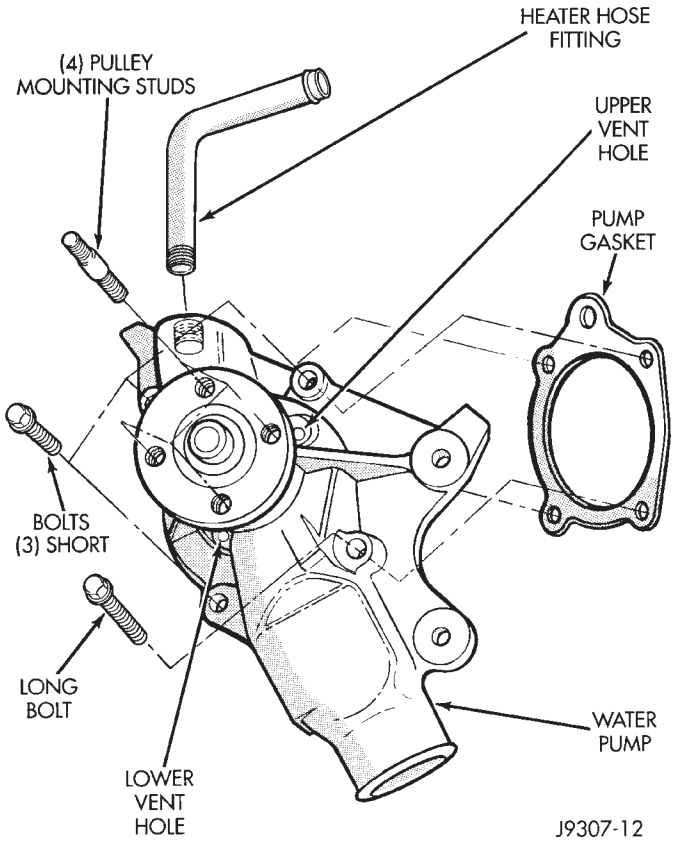

Fig. 9 Water Pump Remove/Install—4.0L 6 Cylinder Engine

(5) Position the fan assembly and fan shroud (together as one unit) to the engine.

(6) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator. Install and tighten the two fan shroud mounting nuts.

(7) Install fan assembly to water pump hub. Tighten fan drive mounting nuts to 24 N●m (18 ft. lbs.) torque. Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(8) Position power steering pump bracket to engine. Install bolts E, F and G (Fig. 6). Tighten bolts F and G to 38 N●m (28 ft. lbs.) torque. Tighten bolt E to 27 N●m (20 ft. lbs.) torque.

(9) Position power steering pump to mounting bracket. Install pivot bolt B (Fig. 5) finger tight. Install locknut C and adjustment bolt D (Figs. 5 or 6) finger tight.

(10) Install two adjustment bolts A (Fig. 4) finger tight.

(11) Install idler pulley.

CAUTION: When installing the serpentine engine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Fig. 10 for appropriate belt routing.

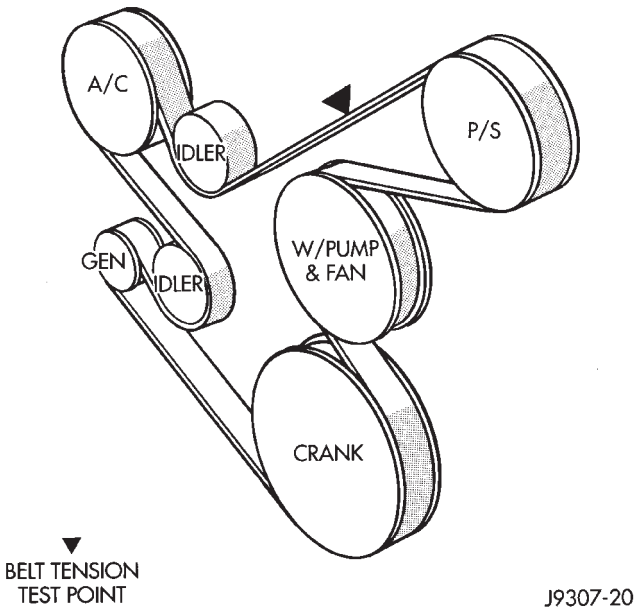

Fig. 10 Belt Routing—4.0L 6 Cylinder Engine

(12) Position drive belt to pulleys.

(13) Tighten belt adjustment bolt D (Fig. 4) to the proper tension. Refer to the Specifications section at the end of this group for belt tension.

(14) Tighten bolts A (Fig. 4) to 27 N•m (20 ft. lbs.) torque.

(15) Tighten pivot bolt B (Fig. 5) to 27 N•m (20 ft. lbs.) torque.

(16) Tighten locknut C (Fig. 5) to 27 N•m (20 ft. lbs.) torque.

(17) After the power steering pump has been tightened, recheck belt tension.

(18) Fill cooling system with coolant and check for leaks. Refer to Refilling Cooling System in this group.

(19) Connect battery cable to battery.

(20) Start and warm the engine. Check for leaks.

5.2L V-8 ENGINE

REMOVAL

The water pump on 5.2L engines is bolted directly to the engine timing chain case/cover.

A gasket is used as a seal between the water pump and timing chain case/cover.

If water pump is replaced because of bearing/shaft damage, or leaking shaft seal, the mechanical cooling fan assembly should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan if any of these conditions are found. Also check condition of the thermal Viscous Fan Drive. Refer to Viscous Fan Drive in this group.

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

(1) Disconnect negative battery cable from battery.

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

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) The thermal Viscous Fan Drive is attached (threaded) to the water pump hub shaft (Fig. 11). Remove fan/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 11) to prevent pulley from rotating. Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES.

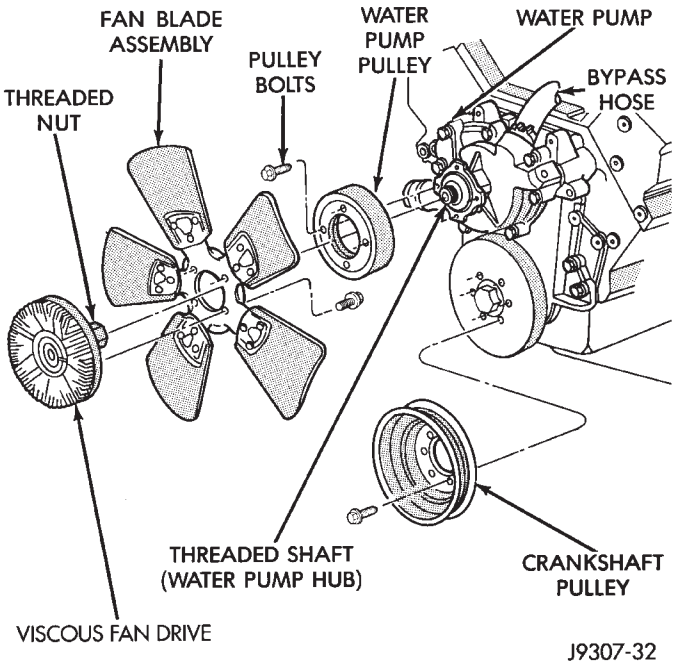

Fig. 11 Fan Blade and Viscous Fan Drive—5.2L Engine

WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP, SUCH AS MILLER TOOL 6094 (FIG. 12).

(4) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 11) from thermal viscous fan drive.

(5) Remove two fan shroud-to-radiator nuts (Fig. 13). Do not attempt to remove fan shroud at this time.

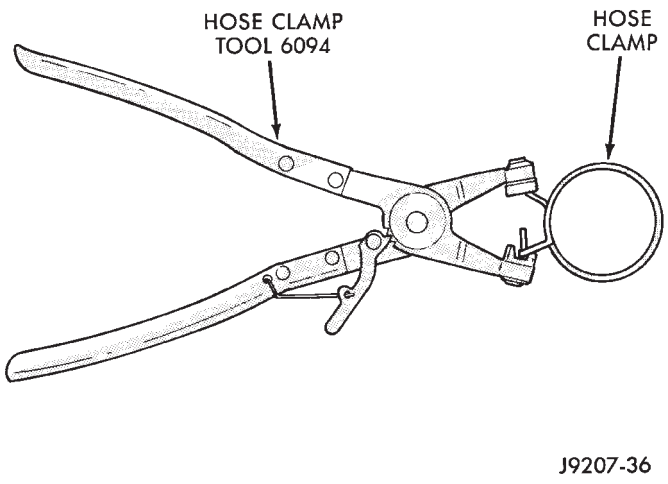

Fig. 12 Hose Clamp Tool

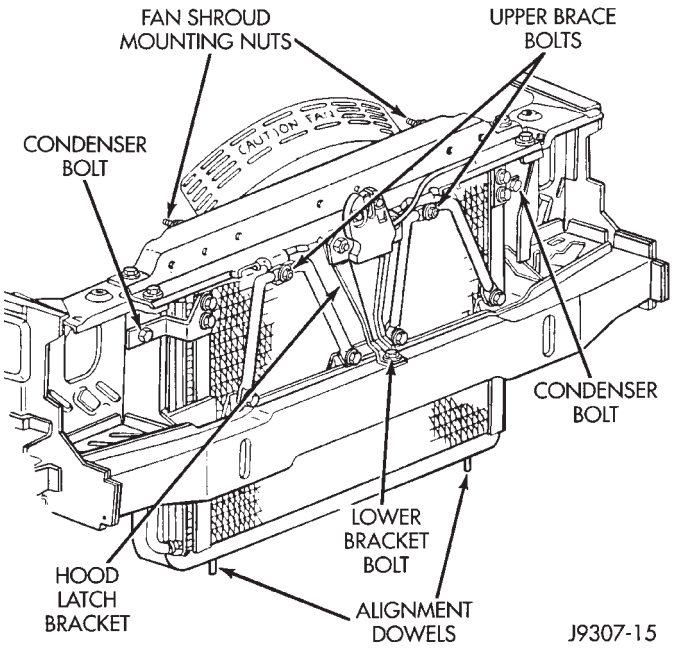

Fig. 13 Fan Shroud Nuts

(6) Remove fan shroud and fan blade/viscous fan drive assembly from vehicle as a complete unit.

After removing fan blade/viscous fan drive assembly, **do not** place thermal viscous fan drive in horizontal position. If stored horizontally, silicone fluid in viscous fan drive could drain into its bearing assembly and contaminate lubricant.

Do not remove water pump pulley bolts at this time.

(7) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic belt tensioner (Fig. 14). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 14). When all belt tension has been relaxed, remove accessory drive belt.

(8) Remove four water pump pulley-to-water pump hub bolts (Fig. 11) and remove pulley from vehicle.

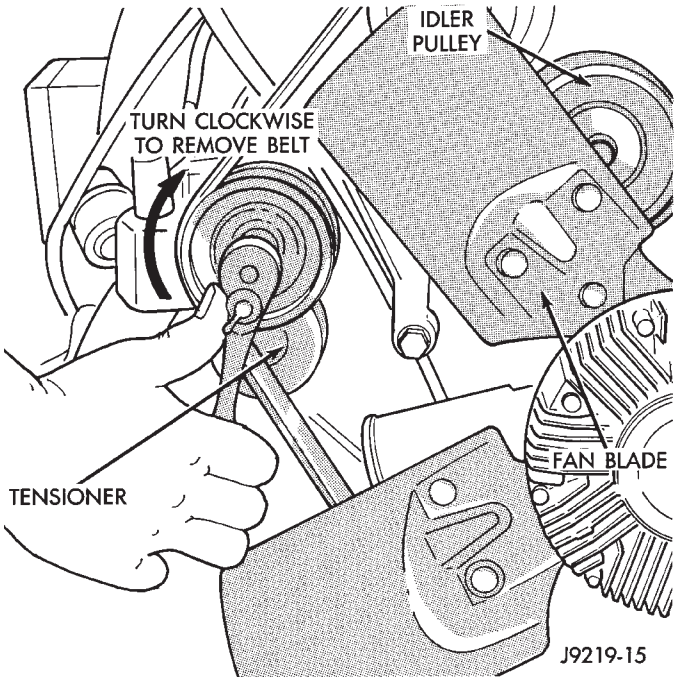

Fig. 14 Belt Tensioner Assembly—5.2L Engine

(9) Remove lower radiator hose clamp and remove lower hose at water pump.

(10) Remove heater hose clamp (Fig. 15) and heater hose from heater hose coolant return tube.

(11) Loosen heater hose coolant return tube mounting bolt and nut (Fig. 15) and remove tube from water pump. Discard the old tube O-ring.

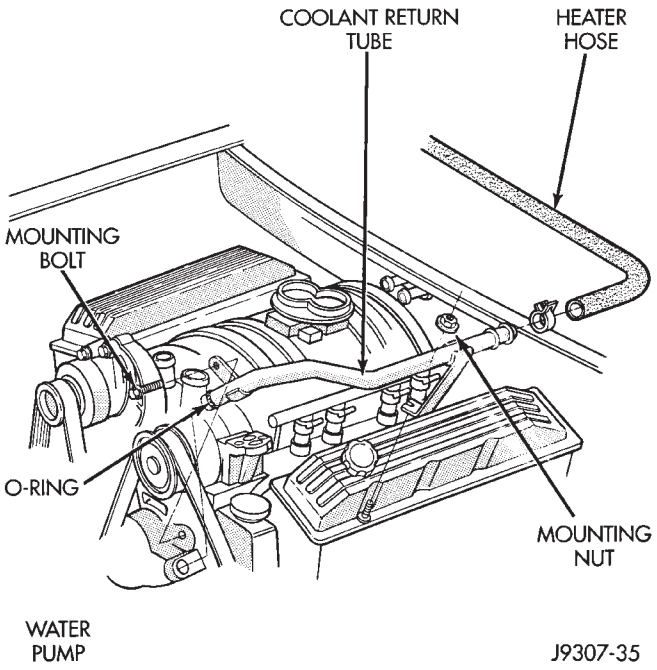

Fig. 15 Coolant Return Tube—5.2L Engine

(12) Remove seven water pump mounting bolts (Fig. 16).

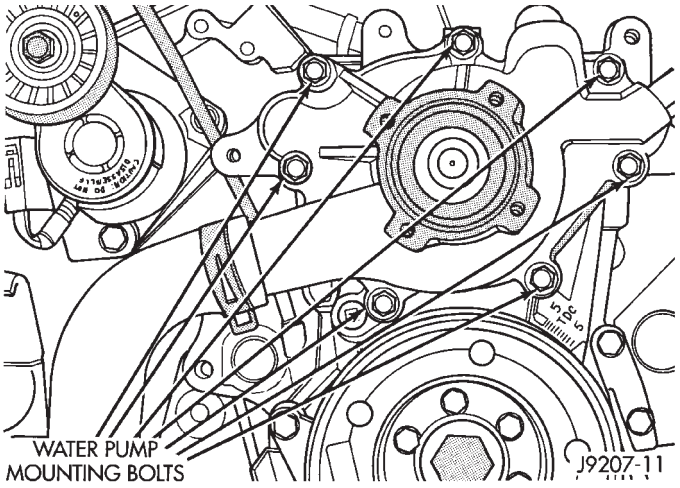

Fig. 16 Water Pump Bolts—5.2L Engine—Typical

(13) Loosen clamp at water pump end of bypass hose (Fig. 11). Slip bypass hose from water pump while removing pump from vehicle. Discard old gasket.

CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

INSPECTION

Replace water pump assembly if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from shaft seal. This is evident by traces of coolant below vent hole
- Loose or rough turning bearing. Also inspect viscous fan drive
- Impeller rubs either the pump body or timing chain case/cover

INSTALLATION

(1) Clean gasket mating surfaces.

(2) Using a new gasket, install water pump to engine as follows: Guide water pump nipple into bypass hose as pump is being installed. Install water pump bolts (Fig. 16). Tighten water pump mounting bolts to 40 N●m (30 ft. lbs.) torque.

(3) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.

(4) Install a new O-ring to the heater hose coolant return tube (Fig. 15). Coat the new O-ring with antifreeze before installation.

(5) Install coolant return tube to engine (Fig. 15). Be sure the slot in tube bracket is bottomed to the mounting bolt. This will properly position return tube.

(6) Connect radiator lower hose to water pump.

(7) Connect heater hose and hose clamp to coolant return tube.

(8) Install water pump pulley. Tighten bolts to 27 N●m (20 ft. lbs.) torque. Place a bar or screwdriver between water pump pulley bolts (Fig. 11) to prevent pulley from rotating.

(9) Relax tension from belt tensioner (Fig. 14). Install drive belt.

CAUTION: When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 17) for correct belt routing. The correct belt with correct length must be used.

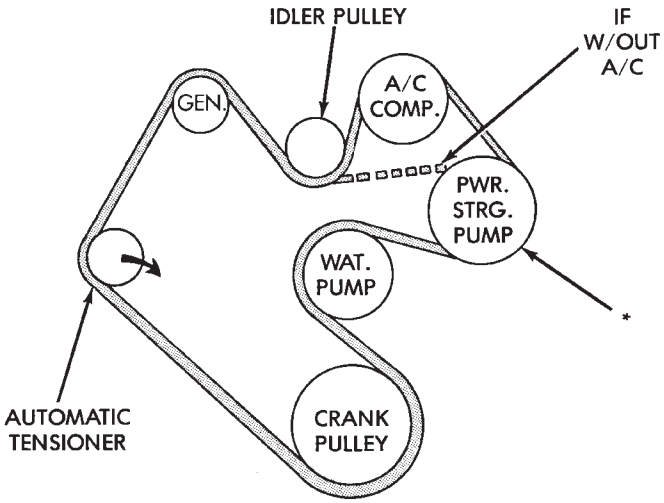

Fig. 17 Belt Routing—5.2L Engine

(10) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(11) Install two fan shroud-to-radiator nuts (Fig. 13).

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(12) Install fan blade/viscous fan drive assembly to water pump shaft.

(13) Fill cooling system. Refer to Refilling the Cooling System in this group.

(14) Connect negative battery cable.

(15) Start and warm the engine. Check for leaks.

WATER PUMP BYPASS HOSE—5.2L ENGINE

A water pump bypass hose (Fig. 18) is used between the intake manifold and water pump on all 5.2L V-8 engines. To test for leaks, refer to Testing Cooling System for Leaks in this group.

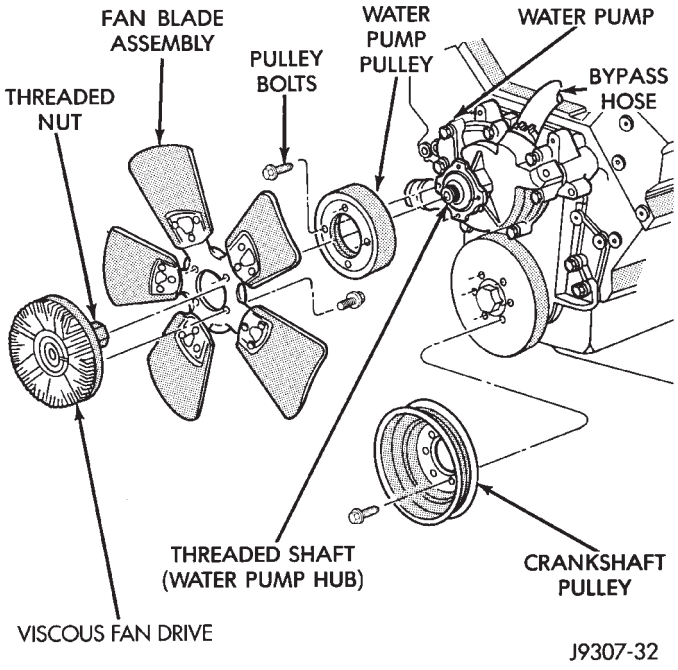

Fig. 18 Water Pump Bypass Hose—5.2L Engine

WITHOUT AIR CONDITIONING (A/C)

REMOVAL

(1) Partially drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON ALL COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP SUCH AS MILLER CLAMP TOOL 6094 (FIG. 19).

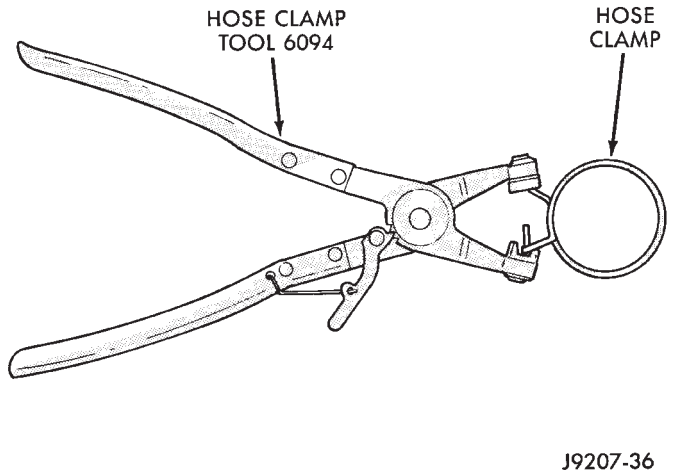

Fig. 19 Hose Clamp Tool

(2) Loosen both bypass hose clamps (Fig. 19) and position to center of hose. Remove hose from vehicle.

INSTALLATION

(1) Position bypass hose clamps (Fig. 19) to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 19).

(4) Fill cooling system. Refer to Refilling the Cooling System in this group.

(5) Start and warm the engine. Check for leaks.

WITH AIR CONDITIONING (A/C)

REMOVAL

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 20) must be partially removed. Removing generator or A/C compressor from their mounting bracket is not necessary. Also, discharging A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

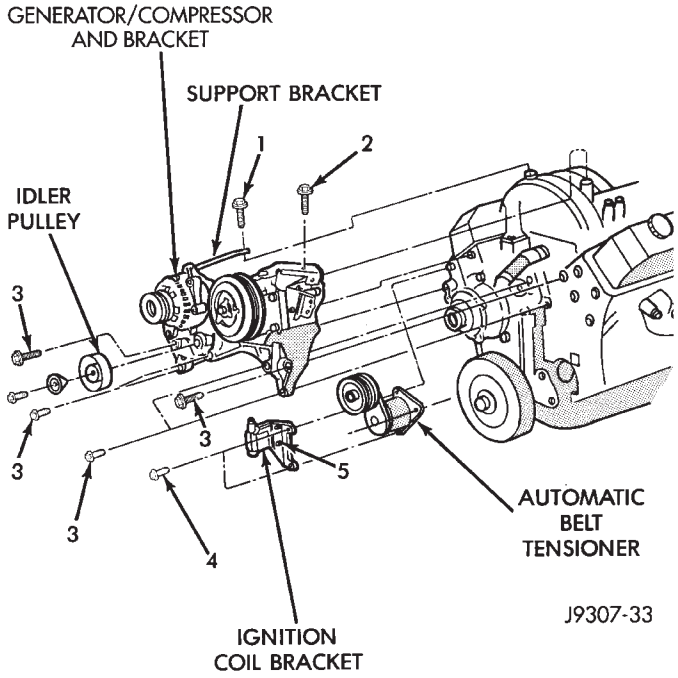

Fig. 20 Generator—A/C Compressor Mounting Bracket—5.2L Engine

WARNING: THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING.

(1) Disconnect negative battery cable from battery.

(2) Partially drain cooling system. Refer to Draining Cooling System in this group.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove upper radiator hose clamp (Fig. 19) and hose at radiator.

(4) Unplug wiring harness from A/C compressor.

(5) Remove air duct at throttle body.

(6) Disconnect A/C lines from clip at intake manifold.

(7) Remove heater hose coolant return tube mounting bolt and nut (Fig. 21). Remove tube from engine and discard the old tube O-ring.

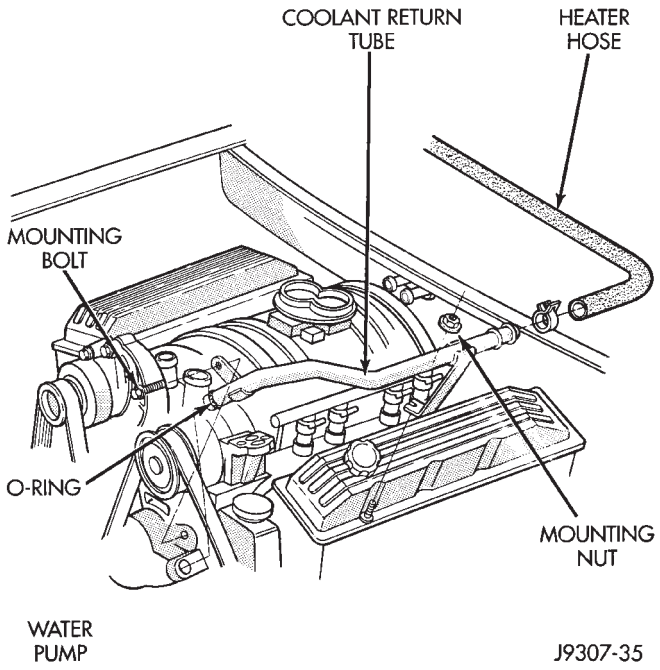

Fig. 21 Coolant Return Tube—5.2L Engine

(8) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic belt tensioner (Fig. 22). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 22). When all belt tension has been relaxed, remove accessory drive belt.

(9) The drive belt idler pulley must be removed to gain access to one of A/C compressor/generator bracket mounting bolts. Remove idler pulley bolt and remove idler pulley (Fig. 20).

(10) Remove oil dipstick tube mounting bolt at side of A/C-generator mounting bracket.

(11) Disconnect speed control cable and throttle cable at throttle body. Refer to Accelerator Pedal and Throttle Cable in Group 14, Fuel System for throttle cable removal and installation. Refer to Group 8H for removal and installation of speed control cable.

(12) Remove bracket-to-intake manifold bolts (number 1 and 2—Fig. 20).

(13) Remove six bracket bolts (number 3—Fig. 20).

(14) Lift and position generator and A/C compressor (along with their common mounting bracket) to gain access to bypass hose. A block of wood may be used to hold assembly in position.

(15) Loosen and position both hose clamps to center of bypass hose. Remove hose from vehicle.

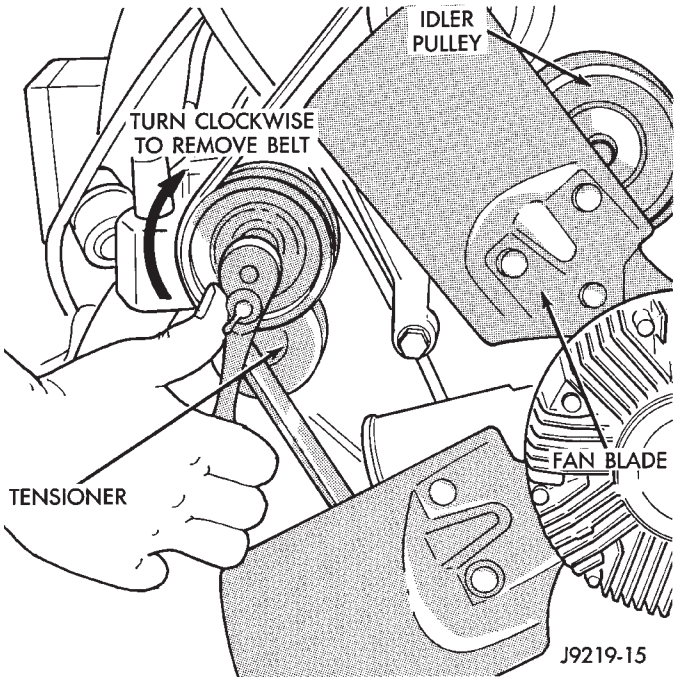

Fig. 22 Belt Tensioner Assembly—5.2L Engine

INSTALLATION

(1) Position bypass hose clamps to center of hose.

(2) Install bypass hose to engine.

(3) Secure both hose clamps (Fig. 19).

(4) Install generator-A/C mounting bracket assembly to engine. Tighten bolts (number 1 and 2—Fig. 20) to 54 N●m (40 ft. lbs.) torque. Tighten bolts (number 3—Fig. 20) to 40 N●m (30 ft. lbs.) torque.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 21). Coat the new O-ring with antifreeze before installation.

(6) Install coolant return tube to engine (Fig. 21).

Be sure the slot in tube bracket is bottomed to the mounting bolt. This will properly position return tube.

(7) Connect throttle body control cables.

(8) Install oil dipstick mounting bolt.

(9) Install idler pulley. Tighten pulley bolt to 54 N●m (40 ft. lbs.) torque.

(10) Relax tension from belt tensioner (Fig. 22). Install drive belt.

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 23) for correct belt routing. The correct belt with correct length must be used.

(11) Install air duct to throttle body.

(12) Install upper radiator hose to radiator.

(13) Connect wiring harness to A/C compressor.

(14) Connect A/C lines to clip at intake manifold.

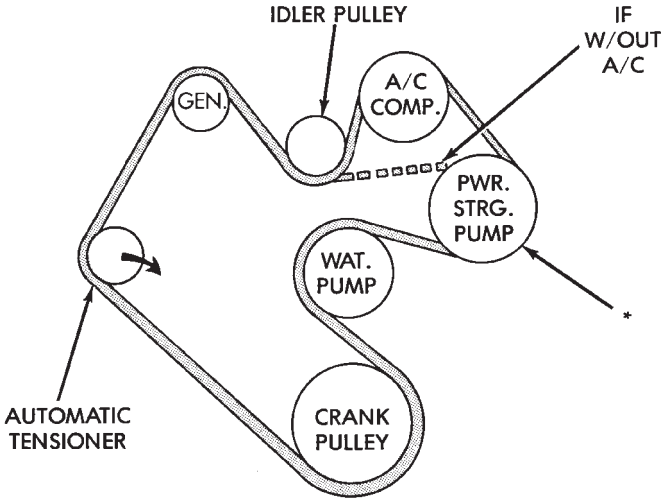

Fig. 23 Belt Routing—5.2L Engine

(15) Fill cooling system. Refer to Refilling the Cooling System in this group.

(16) Start and warm the engine. Check for leaks.

THERMOSTAT

DESCRIPTION AND OPERATION

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control.

An arrow, plus the word **UP** is stamped on the front flange next to the air bleed. The words **TO RAD** are stamped on one arm of the thermostat. They indicate the proper installed position.

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation. This condensation can result in sludge formation.

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The more common type of thermostat failure, usually found on high milage vehicles, is a thermostat failed in the shut position. The temperature gauge (if equipped) will give an indication of this condition. Depending upon length of time that vehicle is operated, pressure cap may vent. This will expel steam and coolant to coolant reserve/overflow tank and to surface below vehicle. Refer to the Diagnosis section of this group.

ON-BOARD DIAGNOSTICS

All models are equipped with On-Board Diagnostics. If the Powertrain Control Module (PCM) computer detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC). The code number for low coolant temperature is 17. For other DTC numbers, refer to On-Board Diagnostics in the General Diagnosis section of Group 14, Fuel Systems.

REMOVAL—4.0L 6 CYLINDER ENGINE

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Drain the coolant from the radiator until the level is below the thermostat housing.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP.

(2) Remove radiator upper hose and heater hose at thermostat housing. Miller Clamp Tool number 6094 (Fig. 24) may be used to remove the constant tension clamps.

(3) Disconnect wiring connector at engine coolant temperature sensor.

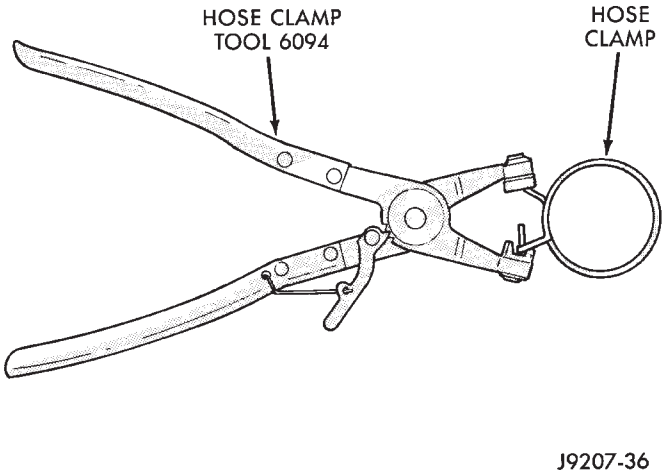

Fig. 24 Hose Clamp Tool

(4) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 25). Discard old gasket.

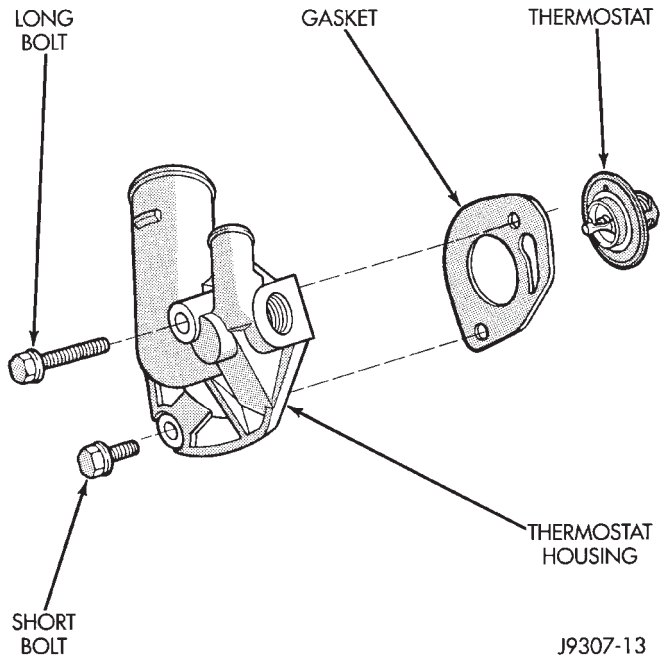

Fig. 25 Thermostat Removal/Installation—4.0L Engine

(5) Clean the gasket mating surfaces.

INSTALLATION—4.0L 6 CYLINDER ENGINE

(1) Install the replacement thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position.

(a) Observe the recess groove in the engine cylinder head (Fig. 26).

(b) Position thermostat in groove with arrow and air bleed hole on outer flange pointing up.

(2) Install replacement gasket and thermostat housing.

CAUTION: Tightening the thermostat housing unevenly or with the thermostat out of its recess, may result in a cracked housing.

(3) Tighten the housing bolts to 22 N●m (16 ft. lbs.) torque.

(4) Install hoses to thermostat housing.

(5) Install electrical connector to coolant temperature sensor.

(6) Be sure that the radiator draincock is tightly closed. Fill the cooling system to the correct level with the required coolant mixture. Refer to Refilling Cooling System in this group.

(7) Start and warm the engine. Check for leaks.

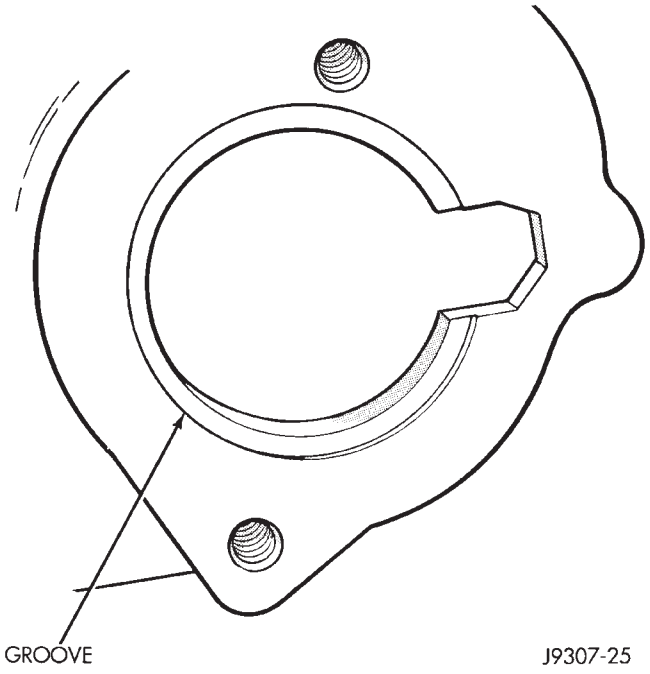

Fig. 26 Thermostat Recess—4.0L Engine

REMOVAL—5.2L V-8 ENGINE

WARNING: DO NOT LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

Factory installed thermostat housings on 5.2L engines are installed on a gasket with an anti-stick coating. This will aid in gasket removal and clean-up.

(1) Disconnect negative battery cable at battery.

(2) Drain cooling system until coolant level is below thermostat. Refer to Draining Cooling System in this group.

(3) Air Conditioned vehicles: Remove support bracket (generator mounting bracket-to-intake manifold) located near rear of generator (Fig. 27).

(4) On Air Conditioning equipped vehicles, the generator must be partially removed.

(a) Remove generator drive belt as follows: Drive belts on the 5.2L engine are equipped with a spring loaded automatic belt tensioner (Fig. 28).

(b) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 28).

(c) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(d) Remove belt from vehicle.

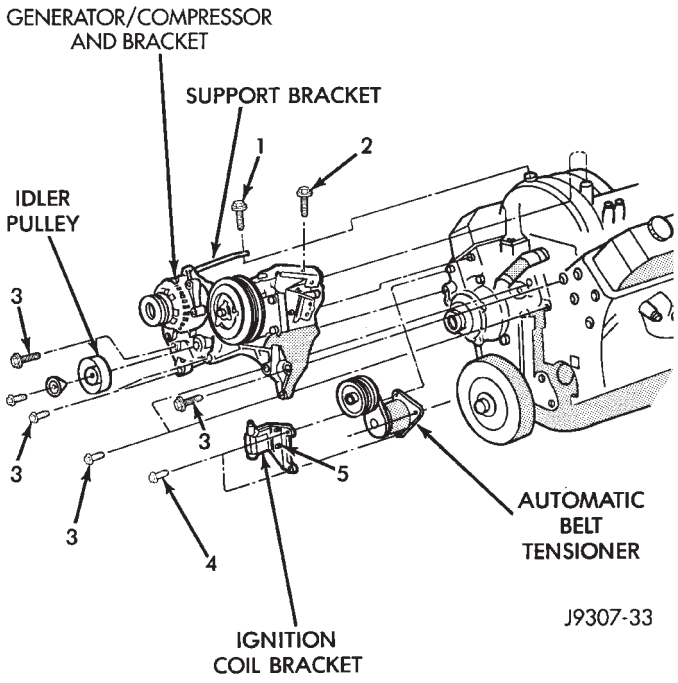

Fig. 27 Generator Support Bracket—5.2L Engine

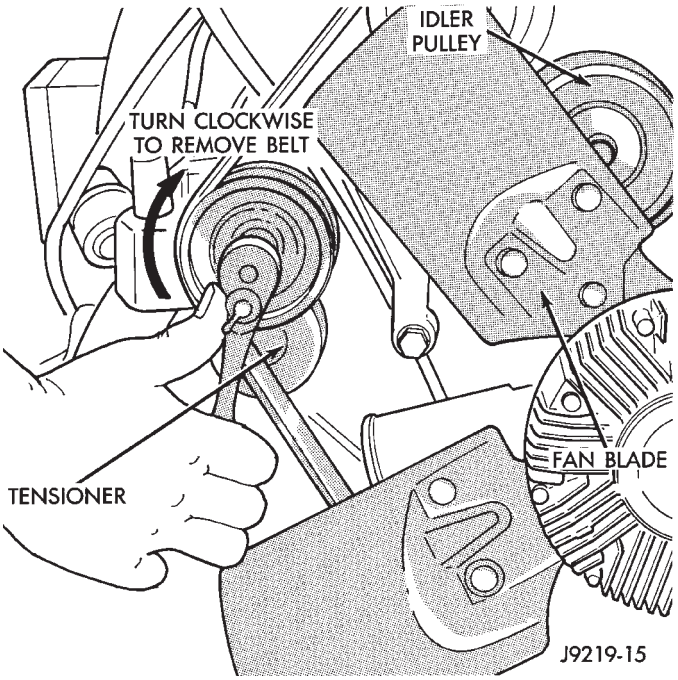

Fig. 28 Automatic Belt Tensioner—5.2L Engine

(e) Remove two generator mounting bolts. Do not remove any wiring at generator. If equipped with 4WD, unplug 4WD indicator lamp wiring harness (located near rear of generator).

(f) Remove generator. Position generator to gain access for thermostat gasket removal.

(5) Remove upper radiator hose clamp (Fig. 24) and upper radiator hose at thermostat housing.

(6) Position wiring harness (behind thermostat housing) to gain access to thermostat housing.

(7) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 29). Discard old gasket.

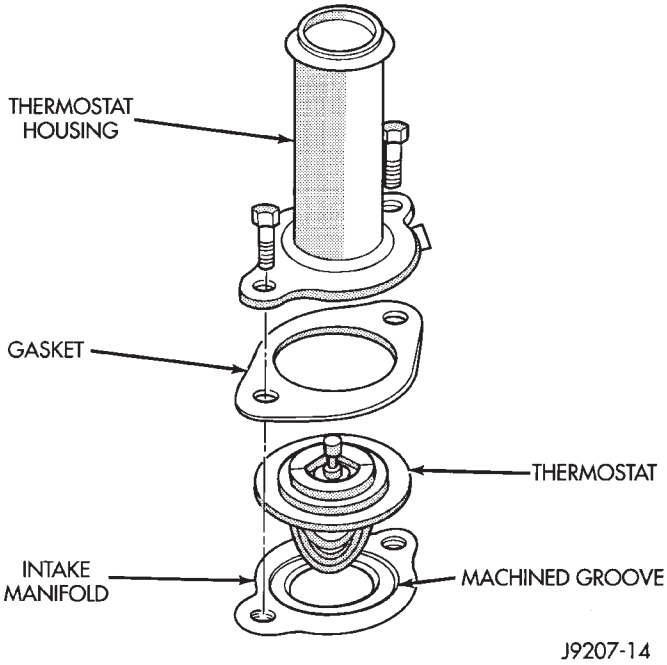

Fig. 29 Thermostat—5.2L Engine

INSTALLATION—5.2L V-8 ENGINE

(1) Clean mating areas of intake manifold and thermostat housing.

(2) Install thermostat (spring side down) into recessed machined groove on intake manifold (Fig. 29).

(3) Install gasket on intake manifold and over thermostat (Fig. 29).

(4) Position thermostat housing to intake manifold. Note the word FRONT stamped on housing (Fig. 30). For adequate clearance, this **must** be placed towards front of vehicle. The housing is slightly angled forward after installation to intake manifold.

(5) Install two housing-to-intake manifold bolts. Tighten bolts to 23 N●m (200 in. lbs.) torque.

CAUTION: Housing must be tightened evenly and thermostat must be centered into recessed groove in intake manifold. If not, it may result in a cracked housing, damaged intake manifold threads or coolant leak.

(6) Install upper radiator hose to thermostat housing.

(7) Air Conditioned vehicles:

(a) Install generator. Tighten bolts to 41 N●m (30 ft. lbs.).

(b) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 27). Tighten bolts to 54 N●m (40 ft. lbs.) torque.

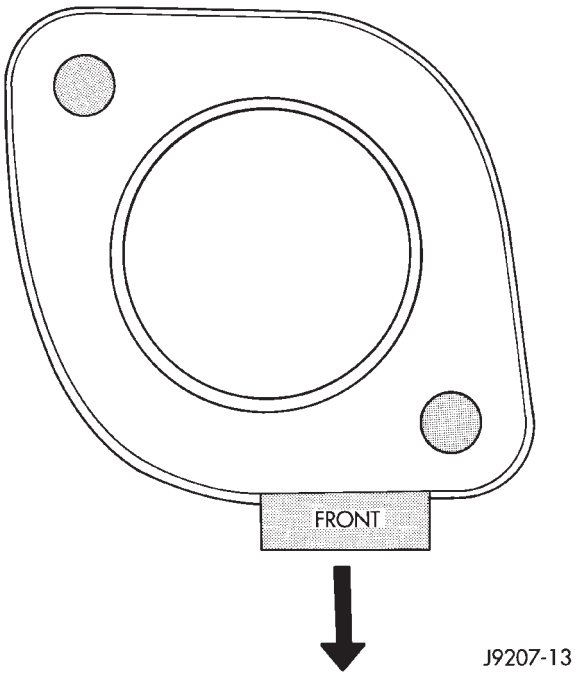

Fig. 30 Thermostat Position—5.2L Engine

CAUTION: When installing the serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 31) for correct 5.2L engine belt routing. The correct belt with correct length must be used.

(c) Position drive belt over all pulleys **except** idler pulley (located between generator and A/C compressor).

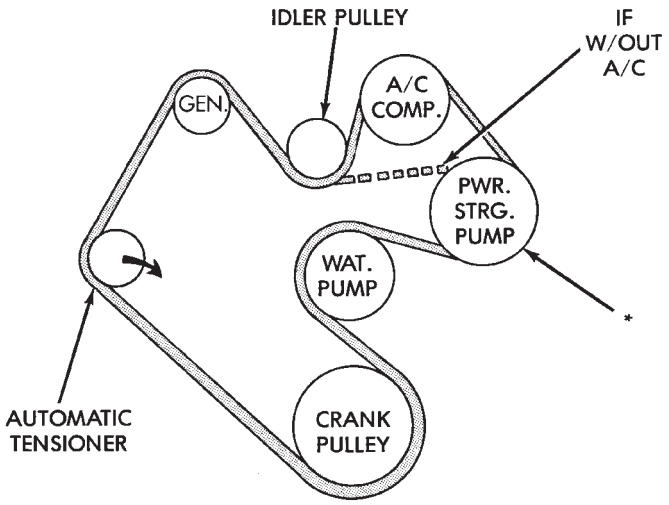

Fig. 31 Belt Routing—5.2L Engine

(d) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 28).

(e) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(8) Fill cooling system. Refer to Refilling Cooling System in this group.

(9) Connect negative battery cable to battery.

(10) Start and warm the engine. Check for leaks.

COOLANT

GENERAL INFORMATION

The cooling system is designed around the coolant. Coolant flows through the engine water jackets absorbing heat produced during engine operation. The coolant carries heat to the radiator and heater core. Here it is transferred to ambient air passing through the radiator and heater core fins. The coolant also removes heat from the automatic transmission fluid in vehicles equipped with an automatic transmission.

COOLANT PERFORMANCE

The required ethylene-glycol (antifreeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows:

Pure Water-Water can absorb more heat than a mixture of water and ethylene-glycol. This is for purpose of heat transfer only. Water also freezes at a higher temperature and allows corrosion.

100% Ethylene-Glycol-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at -22°C (-8°F).

50/50 Ethylene-Glycol and Water-Is the recommended mixture, it provides protection against freezing to -37°C (-35°F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. If percentage is lower, engine parts may be eroded by cavitation. Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7°C (-90°F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because specific heat of antifreeze is lower than that of water.

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

COOLANT SELECTION-ADDITIVES

Coolant should be maintained at the specified level with a mixture of ethylene glycol-based antifreeze and low mineral content water. Only use an antifreeze containing ALUGARD 340-2 ™.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

COOLANT SERVICE

It is recommended that the cooling system be drained and flushed at 84,000 kilometers (52,500 miles), or 3 years, whichever occurs first. Then every two years, or 48,000 kilometers (30,000 miles), whichever occurs first.

COOLANT LEVEL CHECK-ROUTINE

Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant reserve/overflow tank.

The coolant reserve/overflow system provides a quick visual method for determining coolant level without removing radiator pressure cap. With engine idling and at normal operating temperature, observe coolant level in reserve/overflow tank. The coolant level should be between ADD and FULL marks.

ADDING ADDITIONAL COOLANT-ROUTINE

Do not remove radiator cap to add coolant to system. When adding coolant to maintain correct level, do so at coolant reserve/overflow tank. Use a 50/50 mixture of ethylene-glycol antifreeze containing Alugard 340-2 ™ and low mineral content water. Remove radiator cap only for testing or when refilling system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system, which produces corrosion.

COOLANT LEVEL CHECK-SERVICE

The cooling system is closed and designed to maintain coolant level to top of radiator.

WARNING: DO NOT OPEN RADIATOR DRAINCOCK WITH ENGINE RUNNING OR WHILE ENGINE IS HOT AND COOLING SYSTEM IS UNDER PRESSURE.

When vehicle servicing requires a coolant level check in radiator, drain several ounces of coolant from radiator drain cock. Do this while observing coolant reserve/overflow system tank. The coolant level in reserve/overflow tank should drop slightly. If not, inspect for a leak between radiator and coolant reserve/overflow system connection. Remove radiator cap. The coolant level should be to top of radiator. If not and if coolant level in reserve/overflow tank is at ADD mark, check for:

- An air leak in coolant reserve/overflow tank or its hose
- An air leak in radiator filler neck
- Leak in pressure cap seal to radiator filler neck

LOW COOLANT LEVEL-AERATION

If the coolant level in radiator drops below top of radiator core tubes, air will enter cooling system.

Low coolant level can cause thermostat pellet to be suspended in air instead of coolant. This will cause thermostat to open later, which in turn causes higher coolant temperature. Air trapped in cooling system also reduces amount of coolant circulating in heater core resulting in low heat output.

DEAERATION

As the engine operates, any air trapped in cooling system gathers under the radiator cap. The next time the engine is operated, thermal expansion of coolant will push any trapped air past radiator cap into the coolant reserve/overflow tank. Here it escapes to the atmosphere into the tank. When the engine cools down the coolant, it will be drawn from the reserve/overflow tank into the radiator to replace any removed air.

DRAINING COOLING SYSTEM

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

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

DRAINING ENTIRE SYSTEM

Use this procedure if the entire cooling system is to be drained, such as for engine removal.

(1) DO NOT remove radiator cap first. With engine cold, raise vehicle on a hoist and locate radiator draincock.

- 4.0L Engine: Radiator draincock is located on the right/lower side of radiator facing to rear of vehicle.
- 5.2L Engine: Radiator draincock is located on the left/lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Open draincock and drain coolant from radiator. This will empty the coolant reserve/overflow tank. The coolant does not have to be removed from the tank unless the system

is being refilled with a fresh mixture. When tank is empty, remove radiator cap and continue draining cooling system.

To drain the 4.0L 6 cylinder engine of coolant, remove the cylinder block drain plug located on the side of cylinder block (Fig. 32).

To drain the 5.2L V-8 engine of coolant, remove the cylinder block drain plugs located on the sides of cylinder block above the oil pan rail (Fig. 33).

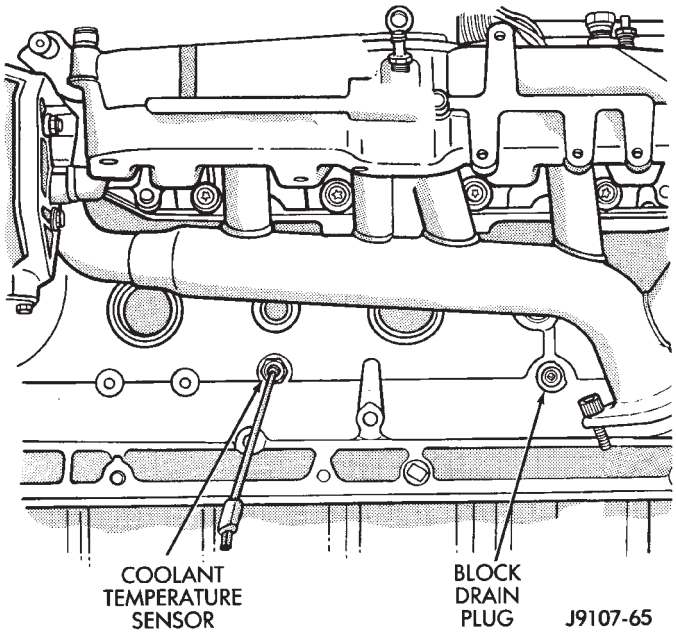

Fig. 32 Drain Plug—4.0L 6 Cylinder Engine

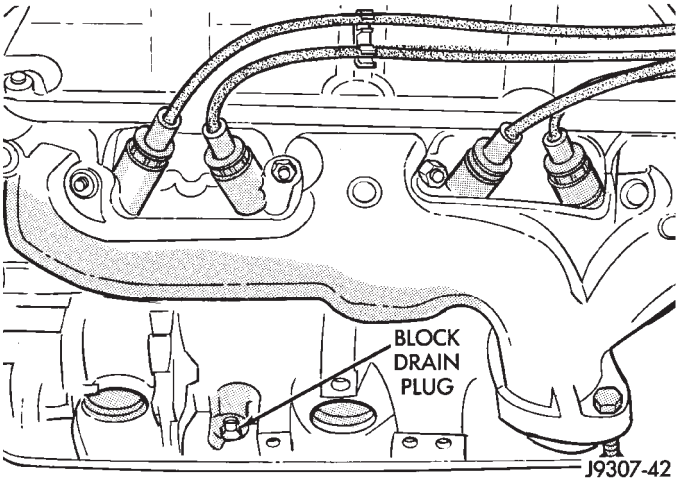

Fig. 33 Drain Plugs—5.2L V-8 Engine

PARTIAL DRAINING

Use this procedure if the coolant is to be partially drained, such as for engine thermostat removal.

(1) With engine cold, slowly remove the radiator cap. Raise vehicle on a hoist and locate radiator draincock.

• 4.0L Engine: Radiator draincock is located on the right/lower side of radiator facing to rear of vehicle.

• 5.2L Engine: Radiator draincock is located on the left/lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container.

(3) Open draincock and drain desired amount of coolant from radiator.

REFILLING COOLING SYSTEM

(1) Tighten the radiator draincock and the cylinder block drain plug(s) (if removed).

(2) Fill system using a 50/50 mixture of water and antifreeze as described in the Coolant Section of this group. Fill radiator to top and install radiator cap. Add sufficient coolant to the reserve/overflow tank to raise level to FULL mark.

(3) With heater control unit in the HEAT position, operate engine with radiator cap in place.

(4) After engine has reached normal operating temperature, shut engine off and allow it to cool. When engine is cooling down, coolant will be drawn into the radiator from the reserve/overflow tank.

(5) Add coolant to reserve/overflow tank as necessary. **Only add coolant to the reserve/overflow tank when the engine is cold. Coolant level in a warm engine will be higher due to thermal expansion.** To purge the cooling system of all air, this heat up/cool down cycle (adding coolant to cold engine) must be performed three times. Add necessary coolant to raise tank level to the FULL mark after each cool down period.

COOLING SYSTEM CLEANING/REVERSE FLUSHING

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

CLEANING

Drain cooling system and refill with water. Run engine with radiator cap installed until upper radiator hose is hot. Stop engine and drain water from system. If water is dirty, fill system with water, run engine and drain system. Repeat until water drains clean.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator fittings. Attach a section of radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

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

Allow the radiator to fill with water. When radiator is filled, apply air in short blasts allowing radiator to refill between blasts. Continue this reverse flushing until clean water flows out through rear of radiator cooling tube passages. For more information, refer to operating instructions supplied with flushing equipment. Have radiator cleaned more extensively by a radiator repair shop.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump. Attach a lead away hose to the water pump inlet fitting.

Connect the water supply hose and air supply hose to the flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose. For more information, refer to operating instructions supplied with flushing equipment.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid the flushing operation.

CAUTION: Be sure instructions on the container are followed.

TESTING COOLING SYSTEM FOR LEAKS

ULTRAVIOLET LIGHT METHOD

All Jeep™ models have a leak detection additive added to the cooling system before they leave the factory. The additive is highly visible under ultraviolet light (black light). If the factory original coolant has been drained, pour one ounce of additive into the cooling system. The additive is available through the part's department. Place the heater control unit in HEAT position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the black light (tool 7138 or an equivalent), at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used along with a pressure tester to determine if any external leaks exist (Fig. 34).

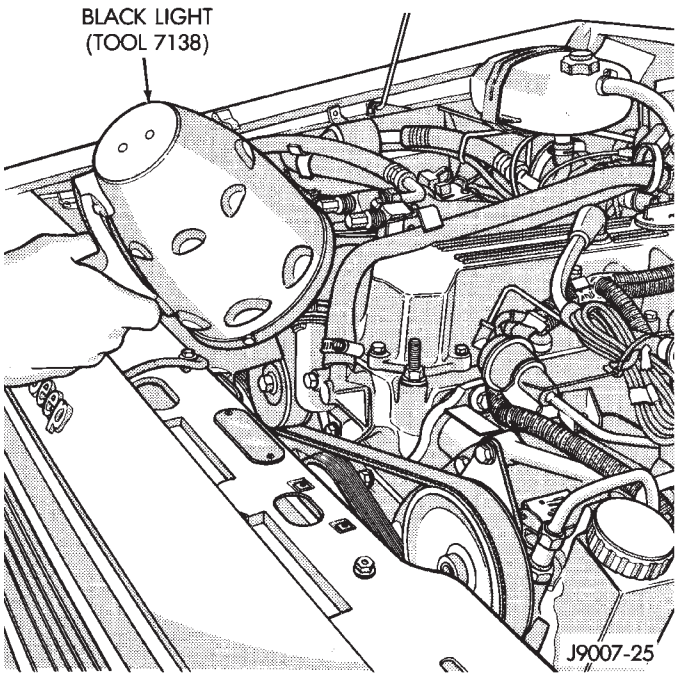

Fig. 34 Leak Detection Using Black Light—Typical

PRESSURE TESTER METHOD

The engine should be at the normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inner part of the filler neck and examine the lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the reserve/overflow tank tube for internal obstructions. Insert a wire through the tube to be sure it is not obstructed.

Inspect the cams on the outside part of the filler neck. If the cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully. Attach pressure tester 7700 or an equivalent to the radiator filler neck (Fig. 35).

Operate the tester pump to apply 124 kPa (18 psi) pressure to the system. If the hoses enlarge excessively or bulge while testing, replace as necessary.

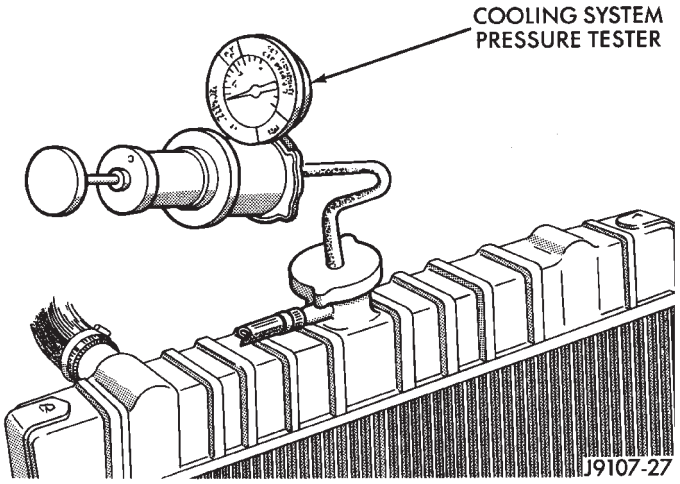

Fig. 35 Pressurizing System—Typical

Observe the gauge pointer and determine the condition of the cooling system according to the following criteria:

- Holds Steady: If the pointer remains steady for two minutes, there are no serious coolant leaks in the system. However, there could be an internal leak that does not appear with normal system test pressure. Inspect for interior leakage or do the Internal Leakage Test. Do this if it is certain that coolant is being lost and no leaks can be detected.
- Drops Slowly: Shows a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal any small leak holes with a Sealer Lubricant or equivalent. Repair leak holes and reinspect the system with pressure applied.
- Drops Quickly: Shows that a serious leakage is occurring. Examine the system for serious external leakage. If no leaks are visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the oil pan drain plug and drain a small amount of engine oil. Coolant, being heavier, will drain first, or operate engine to churn oil, then examine dipstick for water globules. Inspect the transmission dipstick for water globules. Inspect the transmission fluid cooler for leakage. Operate the engine without the pressure cap on the radiator until thermostat opens.

Attach a Pressure Tester to the filler neck. If pressure builds up quickly, a leak exists as result of a faulty cylinder head gasket or crack in the engine. Repair as necessary.

WARNING: DO NOT ALLOW PRESSURE TO EXCEED 124 KPA (18 PSI). TURN THE ENGINE OFF. TO RELEASE THE PRESSURE, ROCK THE TESTER FROM SIDE TO SIDE. WHEN REMOVING THE TESTER, DO NOT TURN THE TESTER MORE THAN 1/2 TURN IF THE SYSTEM IS UNDER PRESSURE.

If there is no immediate pressure increase, pump the Pressure Tester until the indicated pressure is within the system range. Vibration of the gauge pointer indicates compression or combustion leakage into the cooling system.

WARNING: DO NOT DISCONNECT THE SPARK PLUG WIRES WHILE THE ENGINE IS OPERATING.

CAUTION: Do not operate the engine with a spark plug shorted for more than a minute. The catalytic converter may be damaged.

Isolate the compression leak by shorting each spark plug to the cylinder block. The gauge pointer should stop or decrease vibration when spark plug for leaking cylinder is shorted. This happens because of the absence of combustion pressure.

COMBUSTION LEAKAGE TEST (WITHOUT PRESSURE TESTER)

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

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

Drain sufficient coolant to allow for thermostat removal. Refer to Thermostat Replacement. Disconnect the water pump drive belt.

Disconnect the upper radiator hose from the thermostat housing. Remove the housing and thermostat. Install the thermostat housing.

Add coolant to the radiator to bring the level to within 6.3 mm (1/4 in) of the top of the thermostat housing.

CAUTION: Avoid overheating. Do not operate the engine for an excessive period of time. Open the draincock immediately after the test to eliminate boil over of coolant.

Start the engine and accelerate rapidly three times (to approximately 3000 rpm) while observing the coolant. If internal engine combustion gases are leaking into the cooling system, bubbles will appear in the coolant. If bubbles do not appear, there is no internal combustion gas leakage.

COOLANT RESERVE/OVERFLOW SYSTEM

This system works along with the radiator pressure cap. This is done by using thermal expansion and contraction of the coolant to keep the coolant free of trapped air. It provides:

- A volume for coolant expansion and contraction.
- A convenient and safe method for checking/adjusting coolant level at atmospheric pressure. This is done without removing the radiator pressure cap.
- Some reserve coolant to cover minor leaks and evaporation or boiling losses.

The coolant reserve/overflow system has a radiator mounted pressurized cap, an overflow tube and a plastic coolant reserve/overflow tank (Fig. 36) mounted to the right inner fender.

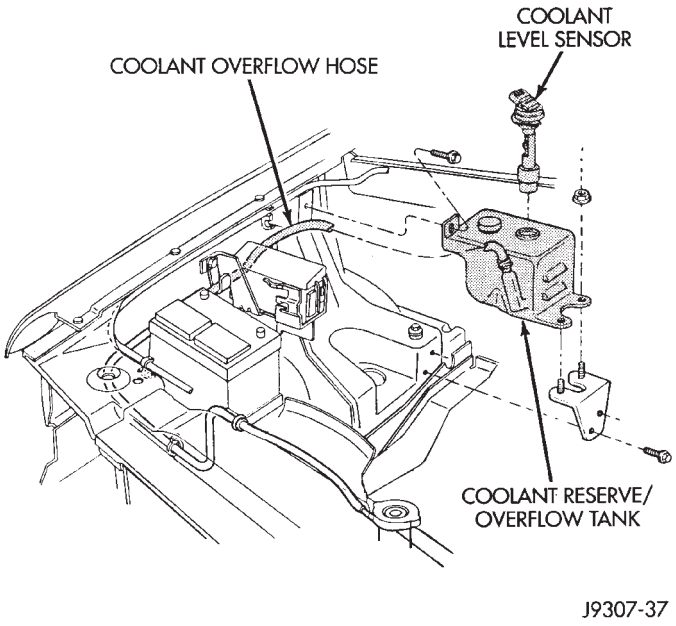

Fig. 36 Coolant Reserve/Overflow Tank—Typical

RADIATOR PRESSURE CAP

All radiators are equipped with a pressure cap. This cap releases pressure at some point within a range of 97-to-124 kPa (14-to-18 psi). The pressure relief point (in pounds) is engraved on top of the cap (Fig. 37).

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap (Fig. 37) contains a spring-loaded pressure relief valve. This valve opens when system pressure reaches the release range of 97-to-124 kPa (14-to-18 psi).

A vent valve in the center of the cap allows a small coolant flow through the cap when coolant is below boiling temperature. The valve is completely closed when boiling point is reached. As the coolant cools, it contracts and creates a vacuum in cooling system. This causes the vacuum valve to open and coolant in reserve/overflow tank to be drawn through connecting hose into radiator. If the vacuum valve is stuck shut, radiator hoses will collapse on cool-down.

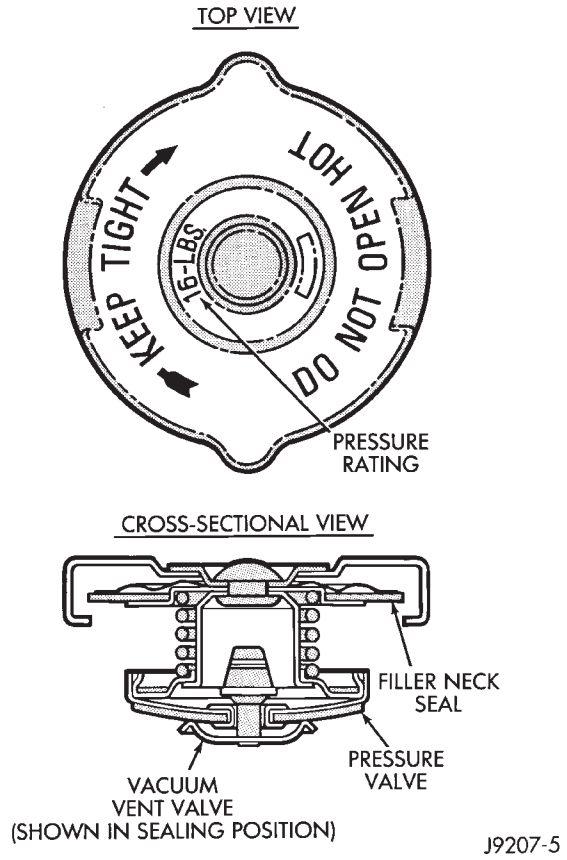

Fig. 37 Radiator Pressure Cap—Typical

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

RADIATOR CAP-TO-FILLER NECK SEAL—PRESSURE RELIEF CHECK

With radiator cap installed on filler neck, remove coolant reserve/overflow tank hose from nipple on filler neck. Connect a hand operated vacuum pump to nipple. Operate pump until a reading of 47-to-61 kPa (14-to-18 in. Hg) appears on gauge. If the reading stays steady, or drops slightly and then remains steady, the pressure valve seal is good. Replace radiator cap if reading does not hold.

WARNING: THE WARNING WORDS —DO NOT OPEN HOT— ON THE RADIATOR PRESSURE CAP (FIG. 37) ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, THE RADIATOR CAP SHOULD NOT BE REMOVED WHILE THE SYSTEM IS HOT AND/OR UNDER PRESSURE.

There is no need to remove the radiator cap **except** for the following purposes:

- To check and adjust antifreeze freeze point.
- To refill system with new antifreeze.
- For conducting service procedures.
- When checking for vacuum leaks.

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER THE CAP AND WITHOUT PUSHING DOWN, ROTATE CAP COUNTER-CLOCKWISE TO THE FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH OVERFLOW HOSE INTO COOLANT RESERVE/OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

PRESSURE TESTING RADIATOR CAPS

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install the cap on pressure tester (tool 7700 or an equivalent) (Fig. 38).

Operate the tester pump and observe the gauge pointer at its highest point. The cap release pressure should be 97-to-124 kPa (14-to-18 psi). The cap is satisfactory when the pressure holds steady. It is also good if it holds pressure within the 97-to-124 kPa (14-to-18 psi) range for 30 seconds or more. If the pointer drops quickly, replace the cap.

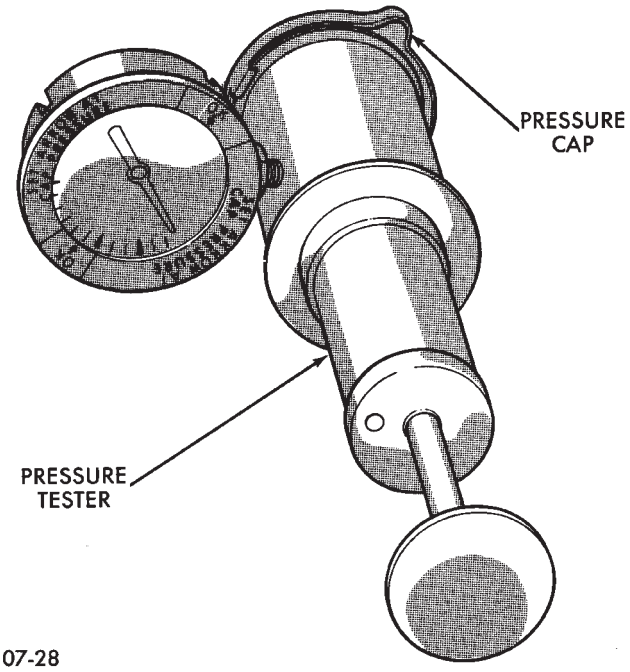

Fig. 38 Pressure Testing Radiator Pressure Cap

INSPECTION

Visually inspect the pressure valve gasket on the cap. Replace cap if the gasket is swollen, torn or worn. Inspect the area around radiator filler neck for white deposits that indicate a leaking cap.

RADIATOR

GENERAL INFORMATION

All vehicles are equipped with a cross flow type radiator with plastic side tanks.

Plastic tanks, while stronger than brass, are subject to damage by impact, such as from tools or wrenches. Handle radiator with care.

RADIATOR COOLANT FLOW CHECK

The following procedure will determine if coolant is flowing through the cooling system.

If engine is cold, idle engine until normal operating temperature is reached. Then feel the upper radiator hose. If hose is hot, the thermostat is open and water is circulating through cooling system.

REMOVAL

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR. REFER TO COOLING SYSTEM DRAINING IN THIS GROUP.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS CLAMP, SUCH AS MILLER TOOL 6094 (FIG. 39)

CAUTION: When removing the radiator or A/C condenser for any reason, note the location of all radiator-to-body and radiator-to-A/C condenser rubber air seals. To prevent overheating, these seals must be installed to their original positions.

(1) Disconnect the negative battery cable at battery.

(2) Observe the previous WARNINGS and CAUTIONS.

(3) Drain coolant from radiator. Refer to Draining Cooling System in this group.

(4) **4.0L Engine:** Remove the four fan hub-to-water pump pulley mounting nuts (Fig. 40). Carefully remove the fan assembly from the water pump pulley

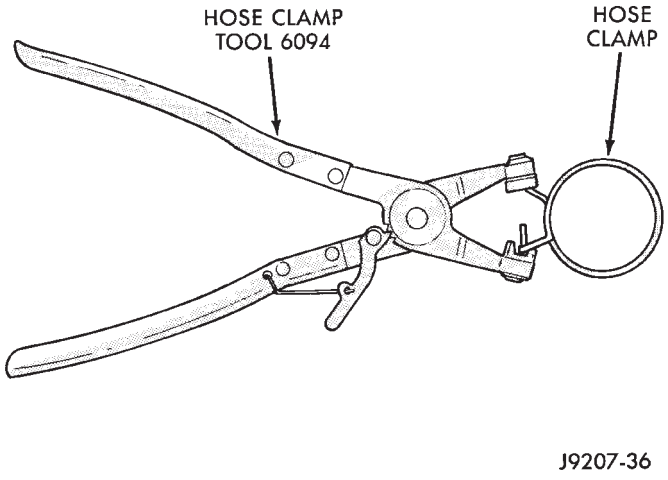

Fig. 39 Hose Clamp Tool

and position to center of fan shroud. Fan belt removal is not necessary as the water pump studs will hold the pump pulley in position.

Do not remove fan/viscous fan drive assembly from vehicle at this time.

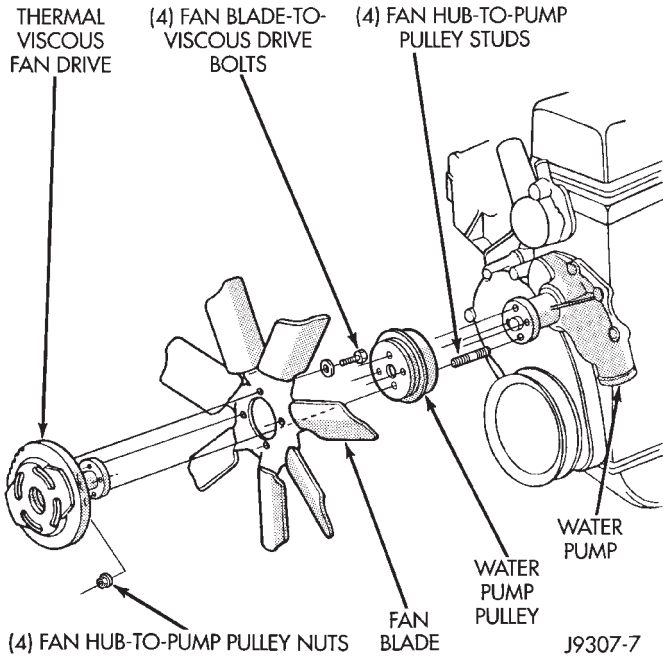

Fig. 40 Fan Mounting Nuts—4.0L Engine

5.2L Engine: The thermal Viscous Fan Drive is attached (threaded) to the water pump hub shaft (Fig. 41). Remove fan/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 41) to prevent pulley from rotating. Drive belt removal is not necessary for removal of fan drive.

Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

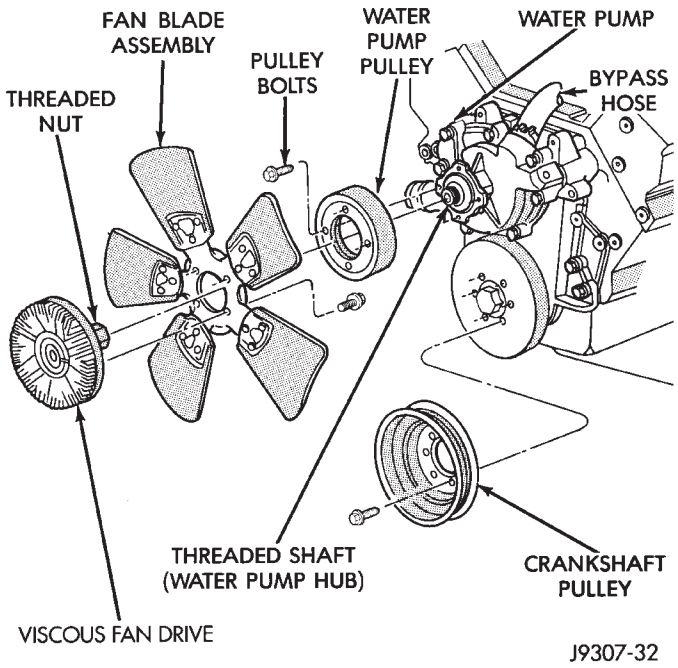

Fig. 41 Fan Blade and Viscous Fan Drive—5.2L Engine

(5) Remove the two fan shroud-to-upper radiator crossmember mounting nuts (Fig. 42).

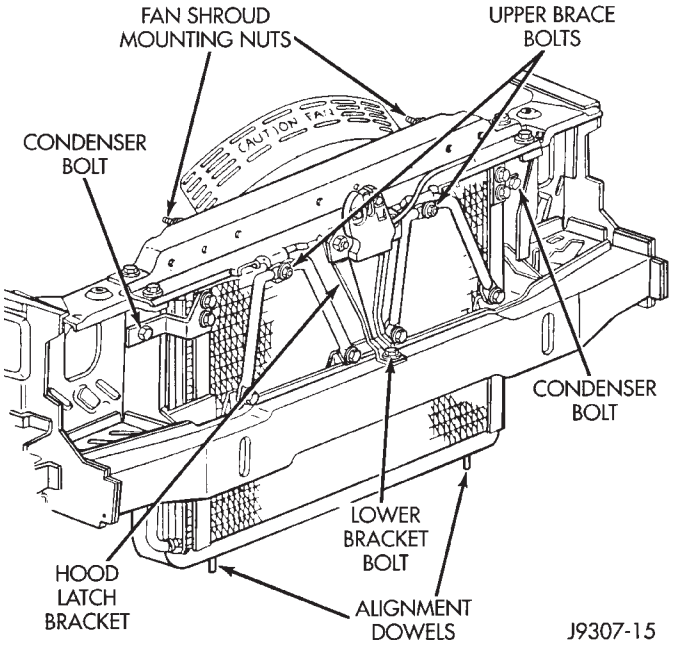

Fig. 42 Radiator—A/C Condenser Mounting

(6) Remove the fan assembly and fan shroud (as one unit) from vehicle.

(7) Special quick-connect fittings are used to join the transmission cooling lines to the radiator. Removal procedures are different between the 4.0L and 5.2L engine. Disconnect the cooling lines from the ra-

diator. Refer to Group 21 for transmission cooling line removal and installation.

(8) The radiator upper crossmember (Fig. 43) can be adjusted left or right through the use of slotted holes. Before removal, mark the original position of the crossmember.

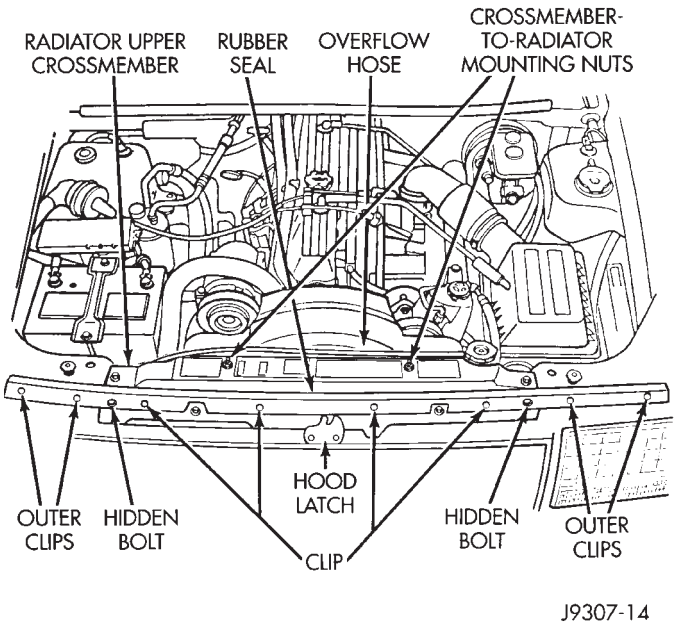

Fig. 43 Radiator Upper Crossmember—Typical

(9) Eight clips are used to retain a rubber seal (Fig. 43) to the body. Gently pry up the outboard clips (two per side) until rubber seal can be removed. Do not remove the clips entirely. Fold back the seal on both sides for access to (the hidden) grille opening reinforcement mounting bolts (Fig. 43). Remove these two bolts.

(10) Remove the grill. Refer to group 23, Body.

(11) Remove the upper brace bolt from each of the two radiator braces (Fig. 42).

(12) Remove the two crossmember-to-radiator mounting nuts (Fig. 43).

(13) Working through grill opening, remove the lower bracket bolt securing lower part of hood latch support bracket to lower frame crossmember (Fig. 42).

(14) Remove the remaining four bolts securing the radiator upper crossmember to the body. Do not remove the hood latch or hood latch cable from the crossmember. Lift the crossmember straight up and lay to the side.

(15) Equipped with air conditioning: Remove the two A/C condenser-to-radiator mounting bolts (Fig. 42). These two bolts are also used to retain the side mounted rubber air seals. These seals are compressed between the A/C condenser and the radiator. The lower part of the air seals are compressed between the radiator and the A/C condenser mounting brackets (Fig. 44).

Not equipped with air conditioning: Remove the two bolts retaining the side mounted rubber air seals to the radiator. The lower part of the air seals are compressed between the radiator and the radiator lower crossmember.

CAUTION: Note the location of all rubber air seals. To prevent overheating, they must be installed back to their original positions.

(16) Disconnect the coolant reserve/overflow tank hose (Fig. 43) at radiator.

(17) Remove upper radiator hose at radiator. Miller Clamp Tool number 6094 (Fig. 39) may be used to remove the constant tension hose clamps.

(18) 4.0L Engine Only: Remove the lower radiator hose at the water pump end.

(19) To gain access to lower radiator hose clamp at radiator, gently lift the radiator a slight amount. Remove hose clamp and hose.

The lower part of radiator is equipped with two alignment dowel pins (Figs. 42 or 44). They are located on the bottom of radiator tank and fit into rubber grommets. These rubber grommets are pressed into the radiator lower crossmember.

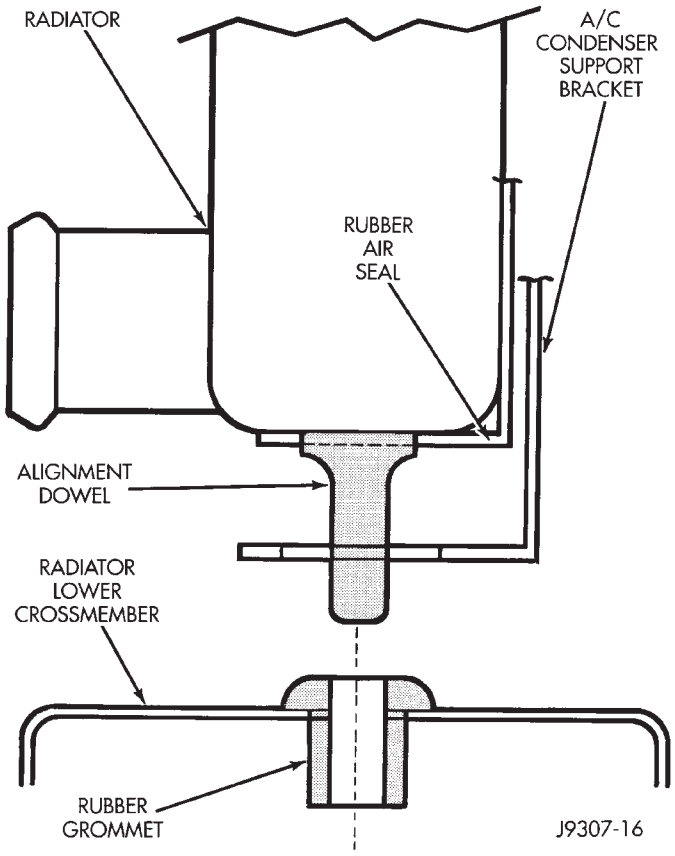

Fig. 44 Radiator Alignment Dowels

WARNING: THE AIR CONDITIONING SYSTEM (IF EQUIPPED) IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN GROUP 24, HEATING AND AIR CONDITIONING BEFORE HANDLING ANY AIR CONDITIONING COMPONENT.

(20) If equipped with an auxiliary automatic transmission oil cooler, use caution when removing radiator. The oil cooler lines are routed through a rubber air seal on the left side of radiator. Do not cut or tear this seal.

(21) Gently lift up and remove radiator from vehicle. Be careful not to scrape the radiator fins against any other component. Also be careful not to disturb the air conditioning condenser (if equipped).

INSTALLATION

(1) Equipped with air conditioning: Gently lower the radiator into the vehicle. Guide the two radiator alignment dowels through the holes in the rubber air seals first and then through the A/C support brackets (Fig. 44). Continue to guide the alignment dowels into the rubber grommets located in lower radiator crossmember (Fig. 44). The holes in the L-shaped brackets (located on bottom of A/C condenser) must be positioned between bottom of rubber air seals and top of rubber grommets.

Not equipped with air conditioning: Gently lower the radiator into the vehicle. Guide the two radiator alignment dowels through the holes in the rubber air seals. Continue to guide the alignment dowels into the rubber grommets located in lower radiator crossmember.

(2) Connect the lower radiator hose and hose clamp to radiator.

CAUTION: The tangs on the hose clamp must be positioned straight down.

(3) 4.0L Engine: Connect the lower radiator hose at the water pump.

(4) Connect the upper radiator hose at the radiator.

(5) Equipped with air conditioning: Install the two A/C condenser-to-radiator mounting bolts (Fig. 42). These two bolts are also used to retain the rubber air seal to the sides of radiator.

Not equipped with A/C: Install the two bolts retaining the rubber air seal to sides of radiator.

(6) Install coolant reserve/overflow tank hose at radiator.

(7) If radiator-to-upper crossmember rubber isolators were removed from radiator, install them. Tighten mounting nuts to 3 N•m (24-36 in. lbs.) torque. Position upper radiator crossmember to radiator.

(8) Working through grill opening, install and tighten the hood latch support bracket-to-lower frame crossmember bolt (Fig. 42).

(9) Install the four bolts securing the radiator upper crossmember to the body (Fig. 43).

(10) Install two nuts securing the radiator to the upper radiator crossmember (Fig. 43). Tighten nuts to 2 N•m (18-21 in. lbs.) torque.

(11) Install the upper bolt to each radiator brace (Fig. 42).

(12) Install the grill. Refer to group 23, Body.

(13) Install the rubber seal (Fig. 43) to the four (outer) seal mounting clips on vehicle body. Press down on clips until seated.

(14) Install the transmission cooler lines to radiator. Refer to Group 21 for installation.

(15) Position the fan assembly and fan shroud (as one unit) to the vehicle.

(16) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator.

(17) Install the two nuts securing the fan shroud to the upper radiator crossmember (Fig. 42).

(18) 4.0L Engine: Install the four nuts securing the fan assembly to the water pump (Fig. 40). Tighten nuts to 27 N•m (20 ft. lbs.) torque.

5.2L Engine: Install the fan/viscous fan drive assembly to the water pump.

(19) Rotate the fan blades (by hand) and check for interference at fan shroud.

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

(20) Fill cooling system. Refer to Refilling Cooling System in this group.

(21) Connect battery cable at battery.

(22) Start and warm engine. Check for leaks.

COOLING SYSTEM HOSES

Rubber hoses route coolant to and from the radiator, intake manifold and heater core.

The lower radiator hose is spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON ALL COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING THIS TYPE OF CLAMP, ONLY USE TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP SUCH AS MILLER CLAMP TOOL 6094 (FIG. 45)

Inspect the hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when the system is pressurized.

Be sure that the hoses are positioned with sufficient clearance from the exhaust system, fan blades, drive belts and sway bars. This should be done in areas where specific routing clamps are not provided. If

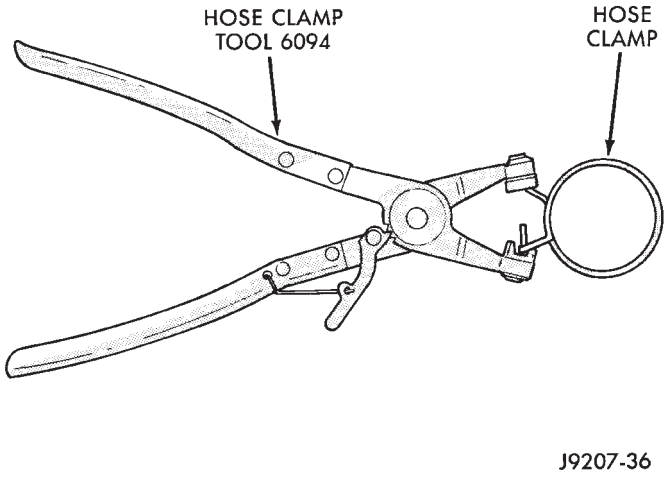

Fig. 45 Hose Clamp Tool

improperly positioned, the hoses will be damaged, resulting in coolant loss and overheating.

When performing a hose inspection, inspect the radiator lower hose for proper position and condition of the internal spring.

COOLING SYSTEM FAN

VISCOUS FAN DRIVE OPERATION

All models are equipped with a temperature controlled fan. The thermal Viscous Fan Drive is a torque-and-temperature sensitive clutch unit. It automatically increases or decreases fan speed to provide proper engine cooling.

The thermal Viscous Fan Drive is a silicone-fluid-filled coupling. It connects the fan assembly to the fan/water pump pulley (Figs. 46 or 47). The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of fan to a predetermined maximum level at higher engine speeds. A bimetallic spring coil is located on the front face. This spring coil reacts to the temperature of radiator discharge air. It engages the viscous fan drive for higher fan speed if air temperature from radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

Only when sufficient heat is present, will the viscous fan drive clutch engage. This is when the air flowing through the radiator core causes a reaction from the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

CAUTION: 4.0L 6 cylinder engines equipped with serpentine accessory drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or fan drive can result in engine overheating.

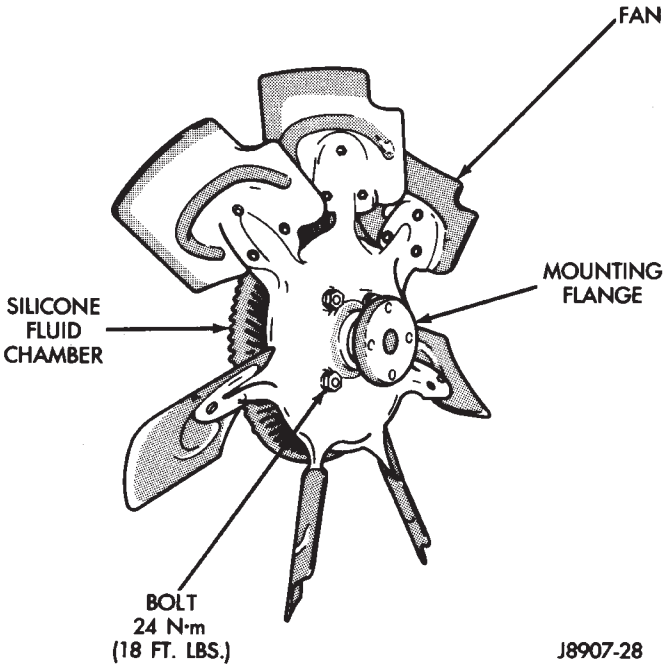

Fig. 46 Viscous Fan Drive—4.0L Engine—Typical

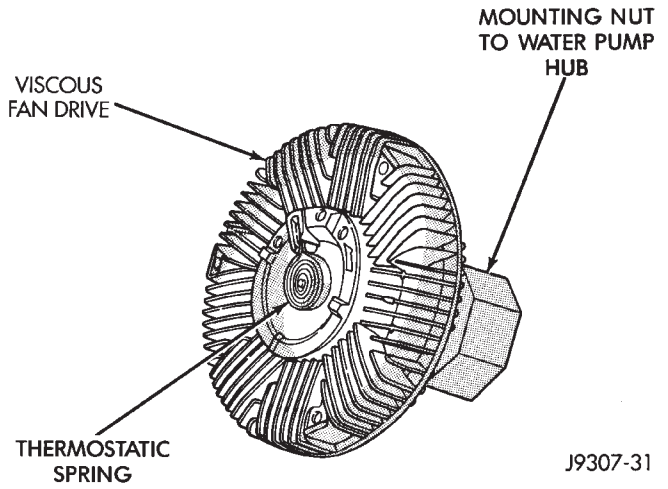

Fig. 47 Viscous Fan Drive—5.2L Engine—Typical

Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If the fan blade assembly is replaced because of mechanical damage, the water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

VISCOUS FAN DRIVE TEST

The cooling system must be in good condition. This is checked prior to performing the following test. It also will ensure against excessively high coolant temperature.

CAUTION: Be sure that there is adequate fan blade clearance before drilling.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light (timing light is to be used as a strobe light).

(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator (or air conditioner condenser). Use tape at the top to secure the plastic and ensure that the air flow is blocked.

(5) Be sure that the air conditioner is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 2400 rpm with the timing light (strobe light) aimed at the fan blades. Within ten minutes the air temperature (indicated on the dial thermometer) should be 88° C (190° F). Satisfactory operation of the fan drive requires that it engage before or at 88° C (190° F). Engagement is distinguishable by a definite increase in flow noise. The timing light also will indicate an increase in the speed of the fan.

(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Satisfactory operation of the viscous fan drive requires the air temperature to drop 20° F (11° C) or more. A definite decrease of audible-fan-air-flow-noise should be noticed. Replace defective fan assemblies.

VISCOUS FAN DRIVE REPLACEMENT

4.0L 6 CYLINDER ENGINE

REMOVAL

(1) Remove the four fan hub-to-water pump pulley mounting nuts (Fig. 48). Carefully remove the fan assembly from the water pump pulley and position to center of fan shroud. Fan belt removal is not necessary as the water pump studs will hold the pump pulley in position. Do not remove fan assembly from vehicle at this time.

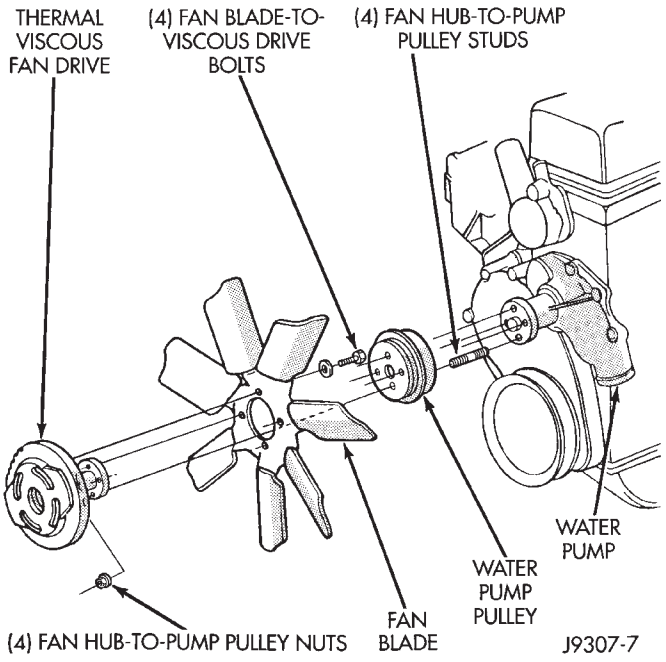

Fig. 48 Fan Mounting Nuts

(2) Remove the two fan shroud-to-upper radiator crossmember mounting nuts (Fig. 49).

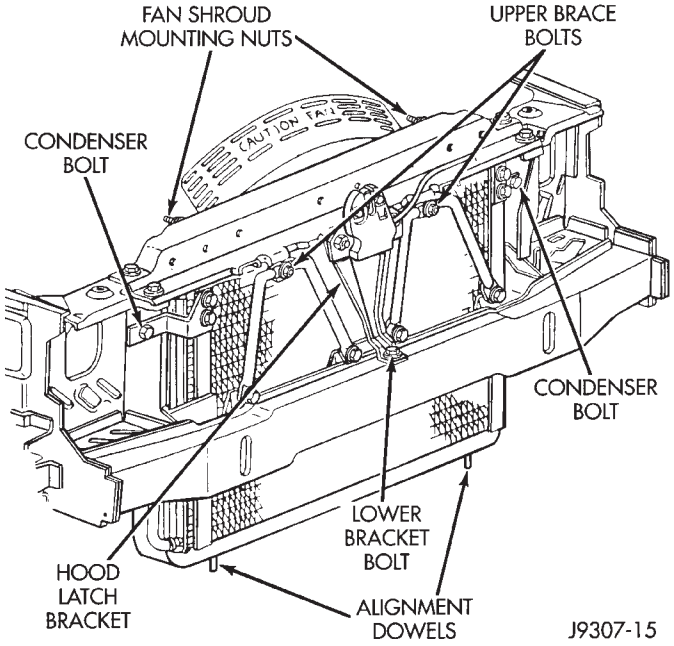

Fig. 49 Fan Shroud Mounting Nuts

(3) Remove fan, viscous fan drive and fan shroud as an assembly from the vehicle.

(4) Remove the four fan blade-to-viscous fan drive mounting bolts. Remove viscous fan drive from fan blades.

After removing fan blade/fan drive assembly **do not** place the thermal viscous fan drive in the horizontal position. If stored horizontally, the silicone fluid in the viscous fan drive could drain into the bearing assembly and contaminate the lubricant.

INSTALLATION

(1) Assemble fan blades to viscous fan drive. Tighten mounting bolts to 24 N●m (18 ft. lbs.) torque.

(2) Position fan, viscous fan drive and fan shroud to the engine as one assembly.

(3) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator.

(4) Position mounting flange of fan/viscous fan drive assembly onto water pump pulley. Install four nuts and tighten to 24 N●m (18 ft. lbs.) torque.

(5) Install two fan shroud mounting nuts.

Be sure of at least 25 mm (1.0 inches) between tips of fan blades and fan shroud.

5.2 L V-8 ENGINE

REMOVAL

(1) Disconnect negative battery cable from battery.

(2) The thermal Viscous Fan Drive/Fan Blade Assembly is attached (threaded) to water pump hub shaft (Fig. 50). Remove fan blade/viscous fan drive assembly from water pump by turning mounting nut counterclockwise as viewed from front. Threads on viscous fan drive are **RIGHT HAND**. A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between water pump pulley bolts (Fig. 50) to prevent pulley from rotating.

Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

Do not unbolt fan blade assembly (Fig. 50) from viscous fan drive at this time.

(3) Remove two fan shroud-to-upper crossmember nuts (Fig. 49).

(4) Remove fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

After removing fan blade/viscous fan drive assembly, **do not** place Viscous Fan Drive in horizontal position. If stored horizontally, silicone fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

CAUTION: Do not remove water pump pulley-to-water pump bolts (Fig. 50). This pulley is under spring tension.

(5) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 50).

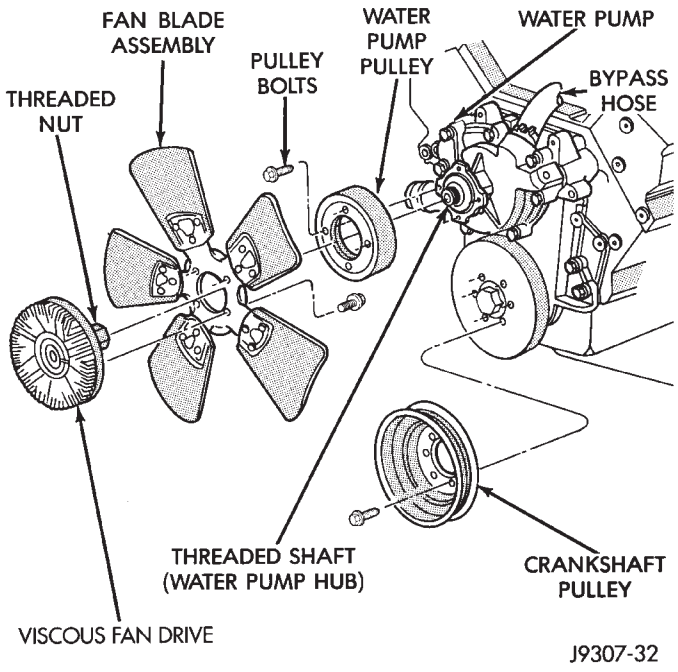

Fig. 50 Fan Blade/Viscous Fan Drive—5.2L Engine

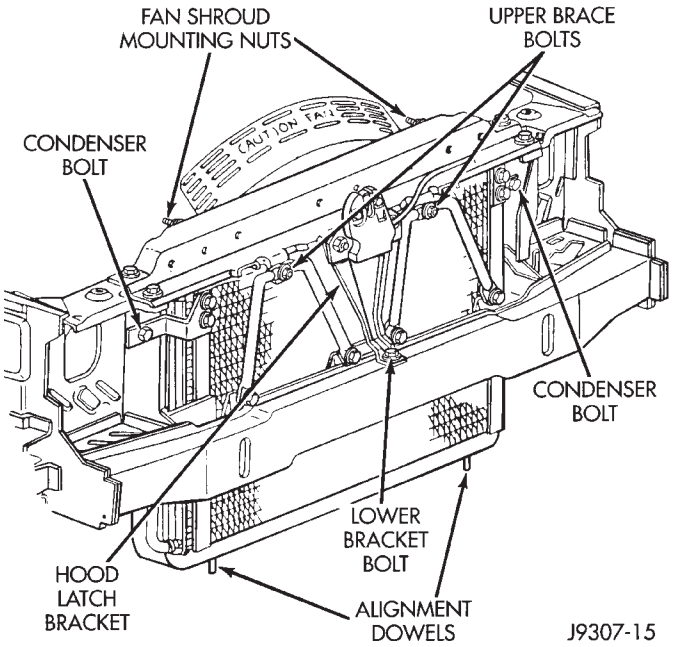

Fig. 51 Fan Shroud Mounting Nuts

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 50) to 23 N●m (17 ft. lbs.) torque.

(2) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.

(3) Position fan shroud to radiator. Be sure the alignment tabs at the lower part of shroud are placed into the slots near lower part of radiator. Install and tighten the two fan shroud-to-upper crossmember mounting nuts.

Be sure of at least 25 mm (1.0 inches) between tips

of fan blades and fan shroud.

(4) Install fan blade/viscous fan drive assembly to water pump shaft.

(5) Connect negative battery cable.

FAN BLADE INSPECTION

The fan blades cannot be repaired. If the fan is damaged, it must be replaced. Inspect the fan blades as follows:

Lay fan blade assembly on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

WARNING: IF FAN IS NOT WITHIN SPECIFICATIONS, DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN.

Inspect fan assembly for cracks, bends, loose rivets or broken welds. Replace fan if any damage is found.

CAUTION: If the Fan Blade Assembly is replaced because of mechanical damage, the Water Pump and Viscous Fan Drive should also be inspected. These components could have been damaged due to excessive vibration.

AUTOMATIC TRANSMISSION OIL COOLERS

There are two types of automatic transmission oil coolers:

- An oil-to-coolant type. This is supplied as standard equipment on vehicles with an automatic transmission. It is mounted in the radiator outlet tank.
- An external auxiliary oil-to-air cooler. This is supplied as optional equipment. It is mounted in front of the radiator and air conditioning condenser and behind the grille (Fig. 52).

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Remove the grill. Refer to Group 23, Body.

(3) Remove the bumper fascia. Refer to Group 23, Body.

(4) Remove the grill opening reinforcement panel. Refer to Group 23, Body.

(5) Remove two bracket bolts and three brace bolts (Fig. 52).

(6) Remove the retaining clip from the cooler lines (Fig. 52).

(7) Place a drain pan under the cooler.

(8) Disconnect the upper hose clamp at cooler line (Fig. 53). Separate the line from the rubber hose.

(9) Position the cooler to gain access to lower hose. The cooler lines are routed through a rubber seal located on the side of radiator. Be careful not to cut or tear this seal when positioning cooler for lower hose removal.

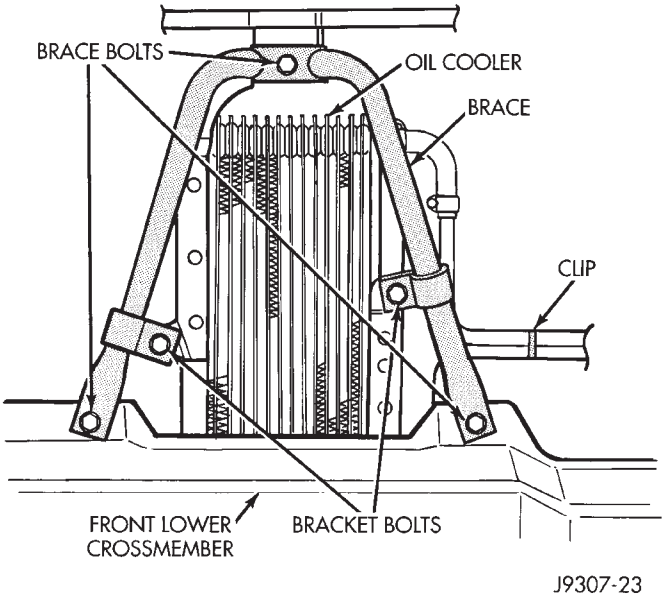

Fig. 52 Oil Cooler Mounting Brackets—Typical

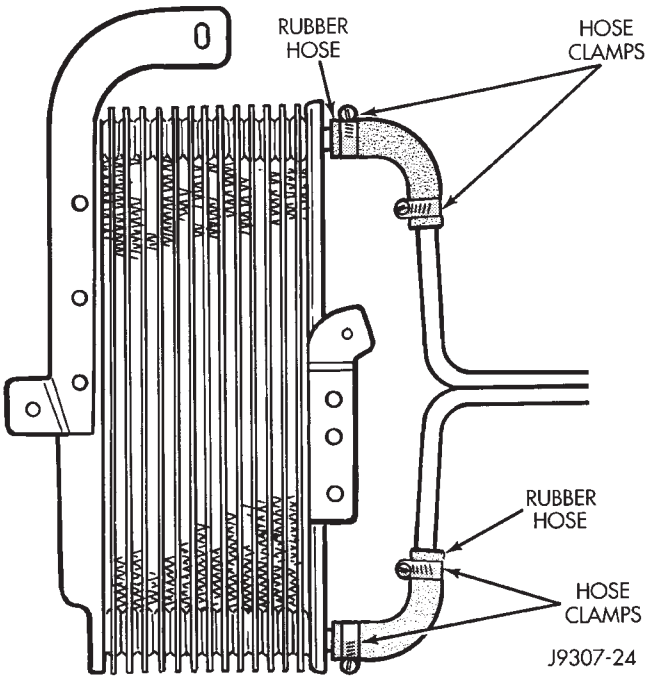

Fig. 53 Oil Cooler Hoses—Typical

(10) Remove lower hose clamp and hose from cooler.

(11) Remove cooler from vehicle.

INSTALLATION

(1) Position cooler to vehicle.

(2) Install lower hose and hose clamp to cooler. Hose clamp screws must be facing towards rear of vehicle. Tighten clamp to 2 N•m (18 in. lbs.) torque.

(3) Install upper hose and hose clamp at cooler. Hose clamp screws must be facing towards rear of vehicle. Tighten clamp to 2 N●m (18 in. lbs.) torque.

(4) Install brace and mounting bracket bolts (Fig. 52).

(5) Connect negative battery cable to battery.

(6) Add necessary transmission fluid. Refer to Group 21, Transmissions. Start engine and check for leaks.

(7) Install grill opening reinforcement panel, bumper fascia and grill. Refer to Group 23, Body.

ENGINE ACCESSORY DRIVE BELTS

INDEX

GENERAL INFORMATION

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to water pump rotating in wrong direction. Refer to the appropriate engine Belt Schematic in this Group for the correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment.

BELT DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 1), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 1). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to the Serpentine Accessory Drive Belt Diagnosis charts for further belt diagnosis.

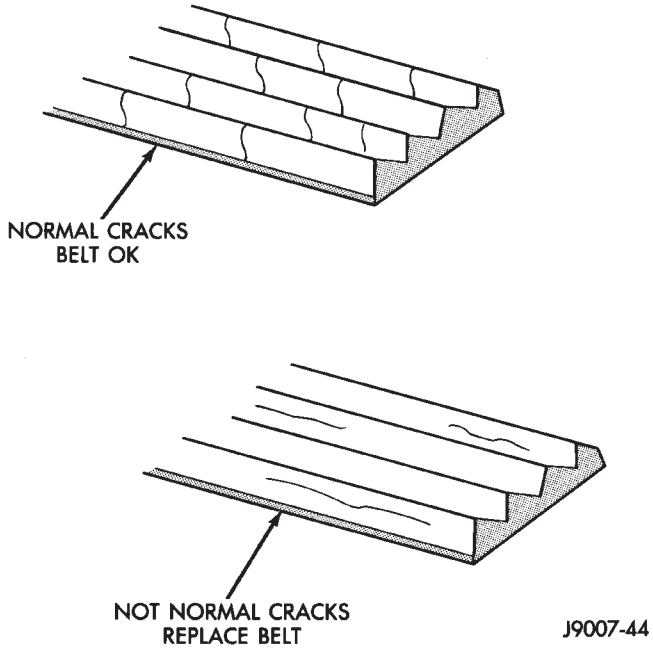

Fig. 1 Serpentine Belt Wear Patterns

SERPENTINE ACCESSORY DRIVE BELT DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	(1) Foreign objects imbedded in pulley grooves. (2) Installation damage.	(1) Remove foreign objects from pulley grooves. Replace belt. (2) Replace belt.
RIB OR BELT WEAR	(1) Pulley(s) misaligned. (2) Abrasive environment. (3) Rusted pulley(s). (4) Sharp or jagged pulley groove tips. (5) Rubber deteriorated.	(1) Align pulley(s). (2) Clean pulley(s). Replace belt if necessary. (3) Clean rust from pulley(s). (4) Replace pulley. (5) Replace belt.
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	(1) Belt has mistracked from pulley groove. (2) Pulley groove tip has worn away rubber to tensile member.	(1) Replace belt. (2) Replace belt.
BELT SLIPS	(1) Belt slipping because of insufficient tension. (2) Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction. (3) Driven component bearing failure. (4) Belt glazed and hardened from heat and excessive slippage.	(1) Adjust tension (4.0L). (1A) Check belt tensioner (5.2L). (2) Replace belt and clean pulleys. (3) Replace faulty component bearing. (4) Replace belt.
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY)	(1) Belt tension either too high or too low. (2) Pulley(s) not within design tolerance. (3) Foreign object(s) in grooves. (4) Pulley misalignment. (5) Belt cordline is broken.	(1) Adjust belt tension (4.0L). (1A) Check belt tensioner (5.2L). (2) Replace pulley(s). (3) Remove foreign objects from grooves. (4) Align pulley(s). (5) Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	(1) Excessive tension. (2) Tensile members damaged during belt installation. (3) Severe misalignment. (4) Bracket, pulley, or bearing failure.	(1) Replace belt. Adjust tension (4.0L). (1A) Check bent tensioner (5.2L). (2) Replace belt. (3) Align pulley(s). (4) Replace defective component and belt.

J9307-43

SERPENTINE ACCESSORY DRIVE BELT DIAGNOSIS—CONTINUED

CONDITION	POSSIBLE CAUSE	CORRECTION
NOISE (OBJECTIONABLE SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	(1) Belt slippage.	(1) Adjust belt (4.0L). (1A) Check belt tensioner (5.2L).
	(2) Bearing noise.	(2) Locate and repair.
	(3) Belt misalignment.	(3) Align belt/pulley(s).
	(4) Belt-to-pulley mismatch.	(4) Install correct belt.
	(5) Driven component induced vibration.	(5) Locate defective driven component and repair.
	(6) System resonant frequency induced vibration.	(6) Vary the belt tension within specs (4.0L). (6A) Check belt tensioner (5.2L).
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	(1) Tension sheeting contacting stationary object.	(1) Correct rubbing condition.
	(2) Excessive heat causing woven fabric to age.	(2) Replace belt.
	(3) Tension sheeting splice has fractured.	(3) Replace belt.
CORD EDGE FAILURE (TENSILE MEMBER EXPOSED AT EDGES OF BELT OR SEPARATED FROM BELT BODY)	(1) Excessive tension.	(1) Adjust belt tension (4.0L). (1A) Check belt tensioner (5.2L).
	(2) Belt contacting stationary object.	(2) Correct as necessary.
	(3) Pulley(s) out of tolerance.	(3) Replace pulley
	(4) Insufficient adhesion between tensile member and rubber matrix.	(4) Replace belt and adjust tension to specifications.

J9307-44

BELT TENSION—4.0L ENGINE

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. There are different types of adjustment gauges for checking either a serpentine or a V-type belt. Refer to the instructions supplied with the gauge. Use the correct gauge when checking belt tension. Place gauge in the middle of the section of belt being tested (between two pulleys) to check tension (Fig. 2). Do not allow the gauge (or gauge adapter) to contact anything but the belt.

BELT TENSION—5.2L ENGINE

It is not necessary to adjust belt tension on the 5.2L (V-8) engine. The engine is equipped with an automatic belt tensioner (Fig. 3). The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Automatic Belt Tensioner—5.2L En-

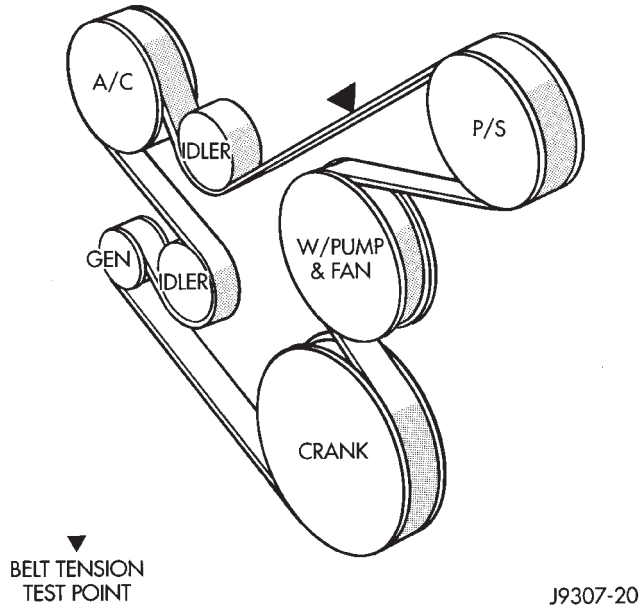

Fig. 2 Belt Routing—4.0L 6 Cylinder Engine

gine proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 5.2L (V-8) engines.

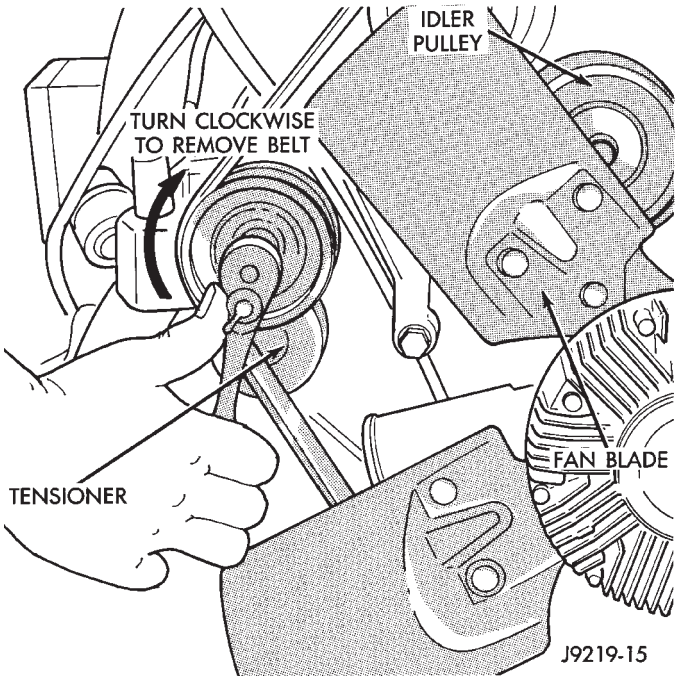

Fig. 3 Automatic Belt Tensioner—5.2L Engine

BELT TENSION SPECIFICATIONS

4.0L ENGINE

Proper belt tension for a new serpentine accessory drive belt is 800-900 N (180-200 lbs. force). For a used belt, the belt tension is 623-712 N (140-160 lbs. force). Belt tension is not adjustable on the 5.2L engine.

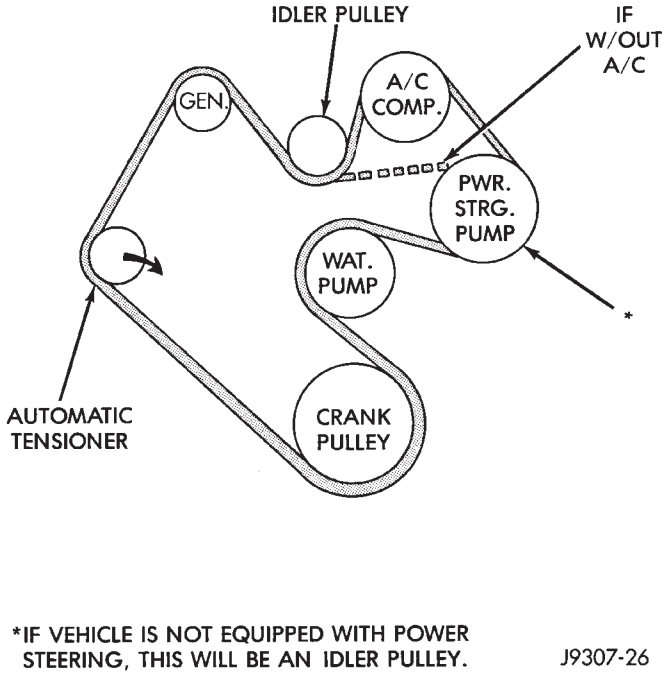

Fig. 4 Belt Routing—5.2 Engine

BELT SCHEMATICS

Refer to figures 2 or 4 for proper belt routing. Or, refer to the Belt Routing Label located in the vehicle engine compartment.

BELT SERVICE

REPLACEMENT/ADJUSTMENT—4.0L ENGINE

Belt tension is adjusted at the power steering pump (or idler pulley if not equipped with power steering). To adjust belt tension or to replace belt:

(1) Loosen two rear power steering pump mounting bolts A (Fig. 5).

(2) Loosen upper pump pivot bolt B and lower lock nut C (Fig. 6).

(3) Loosen pump adjusting bolt D (Fig. 5).

(4) If belt is to be adjusted, refer to Drive Belt Tension specifications at the end of this group for correct tension and proceed to step 7.

If belt is to be replaced, remove belt.

(5) Check condition of all pulleys.

CAUTION: When installing the serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 4) for correct belt routing.

(6) Install new belt. Refer to the end of this group for Drive Belt Tension specifications.

(7) Tighten pump adjusting bolt D (Fig. 5) to attain proper belt tension.

(8) Tighten rear pump mounting bolts, pivot bolt and lock nut to 27 N•m (20 ft. lbs.) torque.

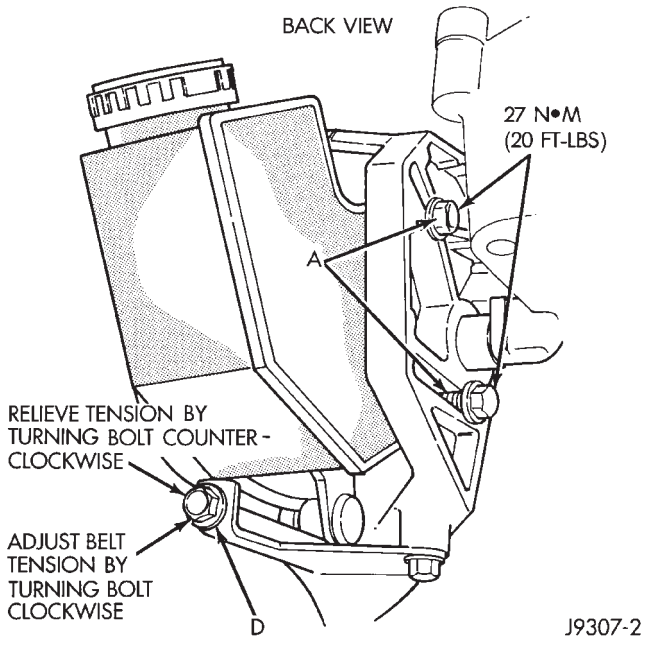

Fig. 5 P.S. Pump Rear Mounting Bolts—4.0L Engine

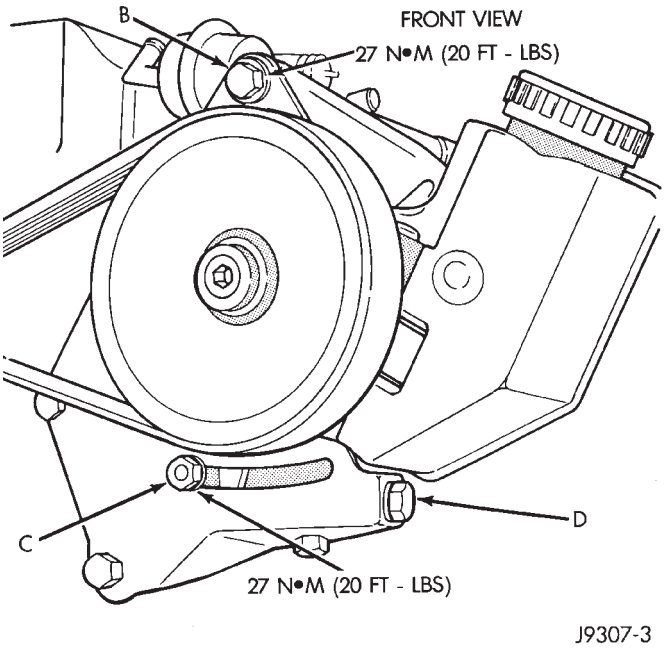

Fig. 6 P.S. Pump Front Mounting Bolt/Locknut—4.0L Engine

(9) After power steering pump has been tightened into position, recheck belt tension. Adjust if necessary.

REPLACEMENT—5.2L V-8 ENGINE

REMOVAL

Drive belts on the 5.2L V-8 engine are equipped with a spring loaded automatic belt tensioner (Fig. 7). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, refer to Automatic Belt Tensioner—5.2L Engines, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

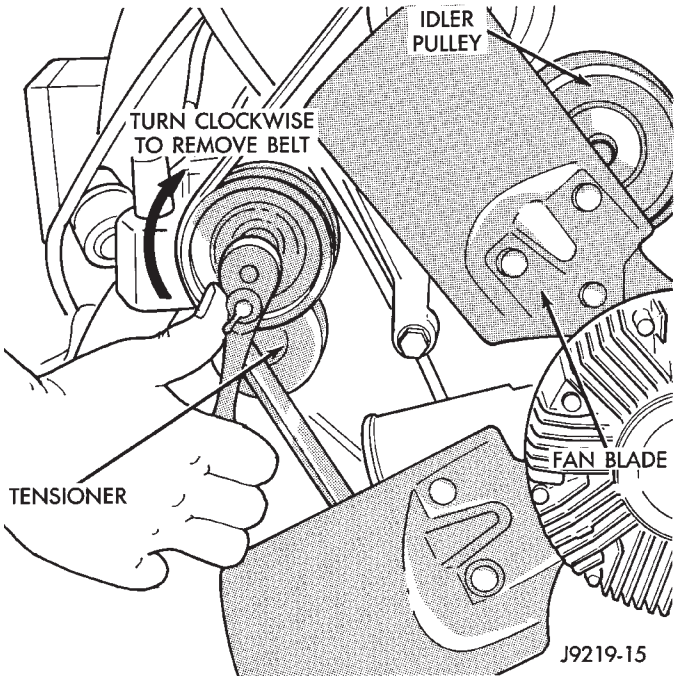

Fig. 7 Belt Tensioner—Belt Removal/Installation—5.2L Engine

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 4) for correct 5.2L V-8 engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** idler pulley. This pulley is located between generator and A/C compressor.

(2) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

(3) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(4) Check belt indexing marks. Refer to the proceeding Automatic Belt Tensioner—5.2L Engine for more belt information.

AUTOMATIC BELT TENSIONER—5.2L ENGINE

Drive belts on the 5.2L engine are equipped with a spring loaded automatic belt tensioner (Figs. 7 and 8). This belt tensioner will be used with all belt configurations. Such as with or without power steering or air conditioning.

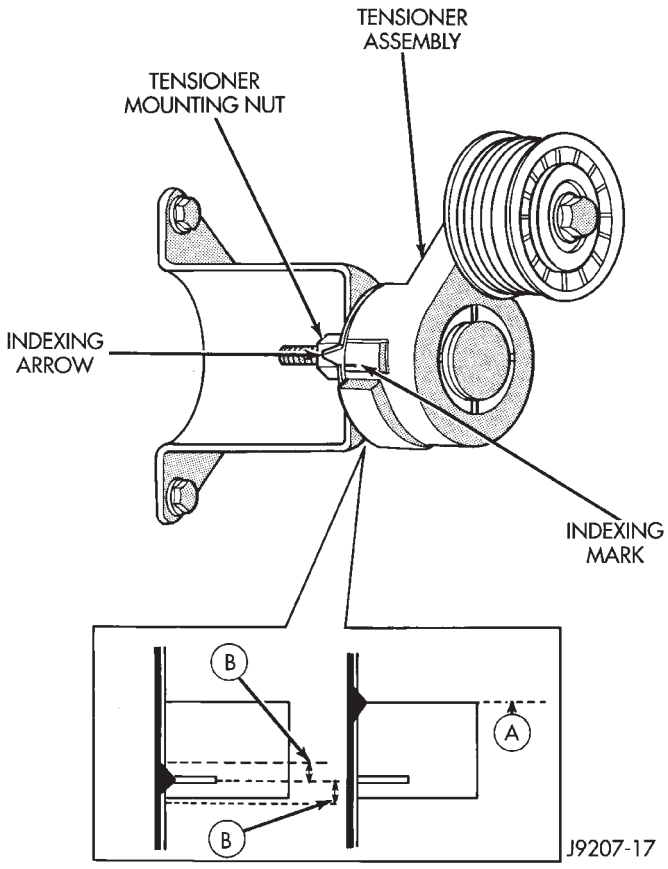

Fig. 8 Belt Tensioner/Pulley Assembly—5.2L Engine

The tensioner is equipped with an indexing arrow (Fig. 8) on back of tensioner and an indexing mark on tensioner housing. If a new belt is being installed, arrow must be within approximately 3 mm (1/8 in.) of indexing mark (Point B—Fig. 8). Belt is considered new if it has been used 15 minutes or less. If this specification cannot be met, check for:

- The wrong belt being installed (incorrect length/width)
- Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)
- A pulley on an engine accessory being loose
- Misalignment of an engine accessory
- Belt incorrectly routed. Refer to (Fig. 4)

A used belt should be replaced if tensioner indexing arrow has moved beyond point A (Fig. 8).

REMOVAL

(1) Attach a socket/wrench to mounting bolt of automatic belt tensioner pulley bolt (Fig. 7).

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from other pulleys.

(5) Disconnect wiring and secondary cable from ignition coil.

(6) Remove ignition coil from coil mounting bracket (two bolts). Do not remove coil mounting bracket from cylinder head.

(7) Remove tensioner assembly from mounting bracket (one nut) (Fig. 8).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC BELT TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(8) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N•m (45 ft. lbs.).

(2) Install tensioner assembly to mounting bracket. An indexing tab is located on back of tensioner. Align this tab to slot in mounting bracket. Tighten nut to 67 N•m (50 ft. lbs.).

(3) Connect all wiring to ignition coil.

(4) Install coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N•m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N•m (50 in. lbs.) torque.

CAUTION: To prevent damage to coil case, coil mounting bolts must be torqued.

(5) Position drive belt over all pulleys **except** idler pulley (located between generator and A/C compressor).

CAUTION: When installing serpentine accessory drive belt, belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 4) for correct 5.2L engine belt routing. The correct belt with correct length must be used

(6) Attach a socket/wrench to pulley mounting bolt of automatic belt tensioner (Fig. 7).

(7) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(8) Check belt indexing marks.

ENGINE BLOCK HEATER

DESCRIPTION AND OPERATION

An optional engine block heater (Figs. 1 or 2) is available with for all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block in place of a freeze plug with the heating element immersed in engine coolant. Connect power cord to a grounded 110-120 volt AC electrical outlet with a grounded, three wire extension cord.

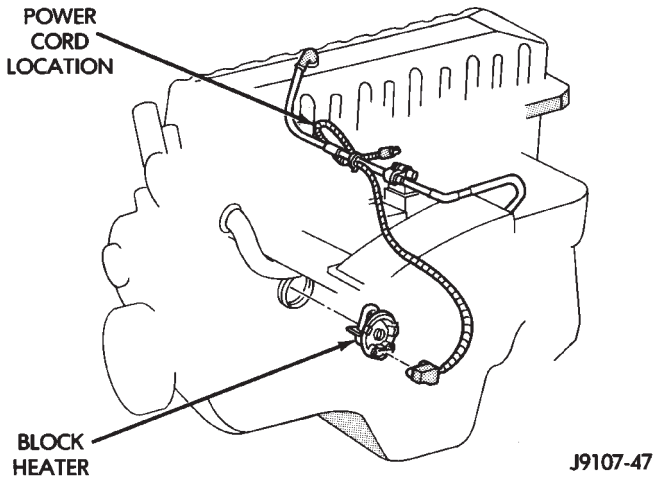

Fig. 1 Block Heater—4.0L Engine

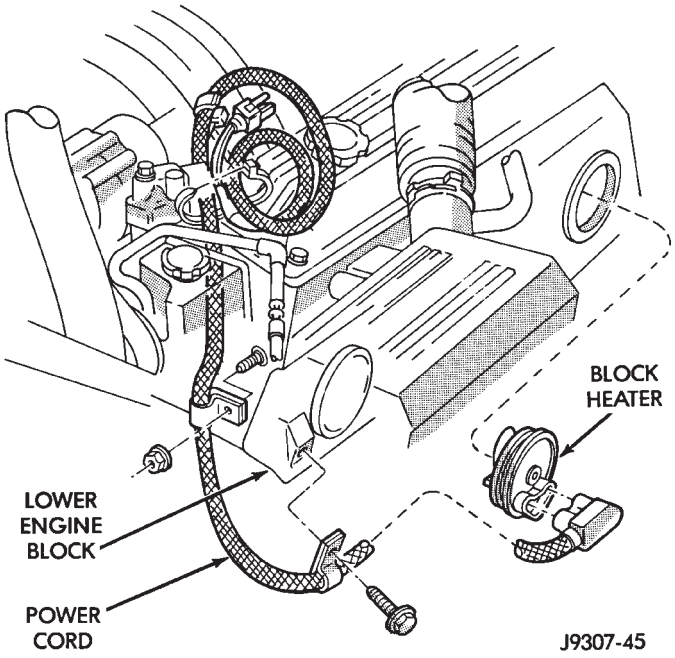

Fig. 2 Block Heater—5.2L Engine

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

REMOVAL

(1) Disconnect negative battery cable from battery.

(2) Drain coolant from radiator. Refer to Draining Cooling System in this group.

(3) Raise vehicle.

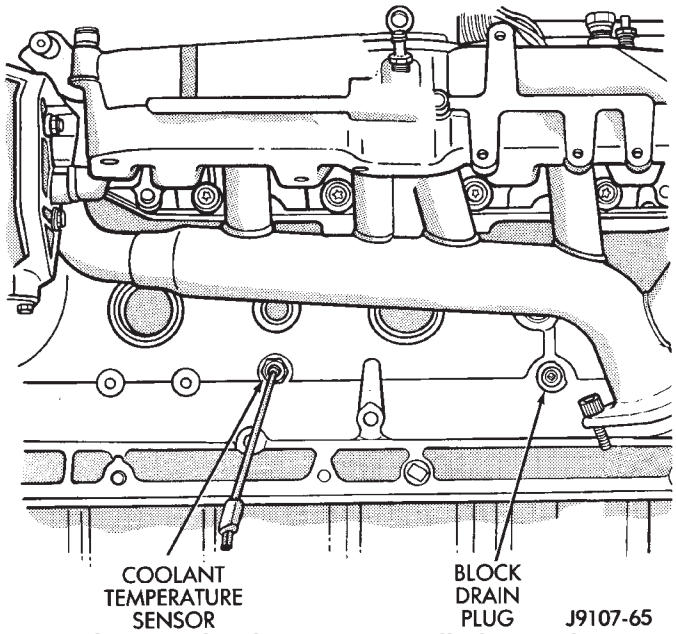

Fig. 3 Drain Plug—4.0L 6 Cylinder Engine

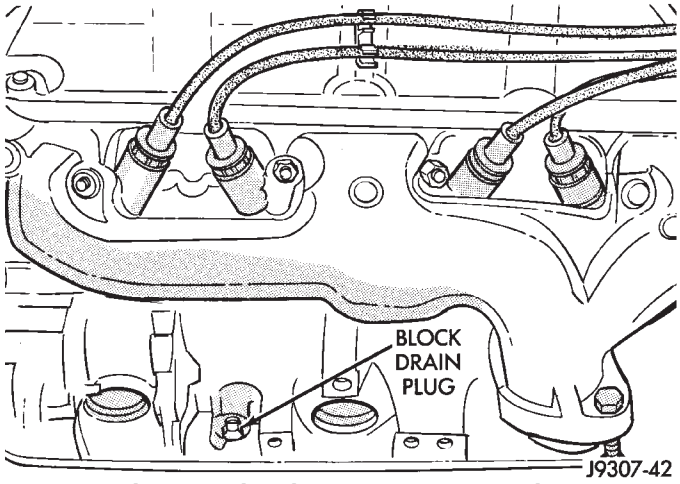

Fig. 4 Drain Plugs—5.2L V-8 Engine

(4) Remove engine cylinder block drain plug(s) located on the sides of cylinder block above the oil pan rail (Figs. 3 or 4).

(5) Remove power cord from block heater (Figs. 1 or 2).

(6) Loosen screw at center of block heater. Remove heater assembly.

INSTALLATION

(1) Thoroughly clean cylinder block core hole and block heater seat.

(2) Insert block heater assembly with element loop pointing down.

(3) With block heater fully seated, tighten center screw to 2 N•m (17 in. lbs.) torque.

(4) Fill cooling system with recommended coolant. Refer to Refilling Cooling System section in this group.

(5) Start and warm the engine. Check for leaks.

SPECIFICATIONS

GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. **If anything differs between the specifications found on the Vehicle Emission Control Information (VECI) label and the following specifications, use specifications on VECI label.** The VECI label is located in the engine compartment. Refer to Group 25, Emission System for more information on the VECI label.

COOLING SYSTEM CAPACITIES

4.0L (6 cylinder engine)—
(a) with standard cooling system
8.5L (9.0 qts.)

4.0L (6 cylinder engine)—
(a) (b) with heavy duty cooling system
9.5L (10.0 qts.)

5.2L (V-8) engine
(a) All systems
14.1L (14.9 qts.)

(a) Nominal refill capacities are shown. A variation may be observed due to manufacturing tolerances and refill procedures.

(b) The heavy duty cooling system can be identified by the use of an auxiliary transmission oil cooler located in front of the radiator.

J9307-47

DRIVE BELT TENSION

4.0L (6 cylinder) engine—
* (With new serpentine belt)
800-900 N (180-200 lbs. force)

4.0L (6 cylinder) engine—
* (With used serpentine belt)
623-712 N (140-160 lbs. force)

5.2L (V-8) engine—
Do not attempt to check belt tension with a tension gauge. Belt is equipped with an automatic tensioner. Refer to Automatic Belt Tensioner in Group 7, Cooling System.

* Specifications for use with a belt tension gauge. Refer to operating instructions supplied with gauge.

J9307-46

TORQUE

DESCRIPTION	TORQUE
Generator Pivot Bolt (4.0L)	27 N•m (20 ft. lbs.)
Generator Rear Adj. Bolt (4.0L Engine)	27 N•m (20 ft. lbs.)
Automatic Belt Tensioner-To Mounting Bracket (5.2L)	67 N•m (50 ft. lbs.)
Automatic Belt Tensioner Pulley Bolt (5.2L)	61 N•m (45 ft. lbs.)
Auto. Trans. Auxiliary Oil Cooler Mtg. Screws	10 N•m (90 in. lbs.)
Block Htr. Mounting Screw	4 N•m (32 in. lbs.)
Fan Blade Assy.-to-Viscous Drive	24 N•m (18 ft. lbs.)
Fan/Drive Assy.-to-Water Pump (4.0L Engine)	27 N•m (20 ft. lbs.)
Fan Shroud Mtg. Bolts	3 N•m (20 in. lbs.)
Radiator Upper Isolator-to-Crossmember Mounting Nuts	3 N•m (20 in. lbs.)
Radiator Upper Isolator-to-Radiator Mounting Nuts	4 N•m (36 in. lbs.)
Radiator Brace Bolts	10 N•m (90 in. lbs.)
Thermostat Housing	22 N•m (16 ft. lbs.)
Upper Radiator Crossmember-to-Body Mounting Bolts	10 N•m (90 in. lbs.)
Water Pump Bolts (4.0L)	30 N•m (22 ft. lbs.)
Water Pump Bolts (5.2L)	40 N•m (30 ft. lbs.)
Water Pump Pulley (5.2L)	27 N•m (20 ft. lbs.)

J9307-48