

COOLING SYSTEM

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GENERAL INFORMATION

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.

GENERAL INFORMATION (Continued)

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 (mechanical)
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler
- Coolant
- Water pump
- Hoses and hose clamps

COOLING SYSTEM CIRCULATION

For cooling system routings refer to (Fig. 1).

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system (Fig. 2) works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. It also provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure. This is done without removing the radiator pressure cap. The system also provides some reserve coolant to the radiator to cover minor leaks and evaporation or boiling losses.

As the engine cools, a vacuum is formed in the cooling system of both the radiator and engine. Coolant will then be drawn from the coolant tank and returned to a proper level in the radiator.

COOLANT

The cooling system is designed around the coolant. Coolant flows through the engine water jacket absorbing heat produced during engine operation. The coolant carries the heat to radiator and heater core. Here it is transferred to the 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.

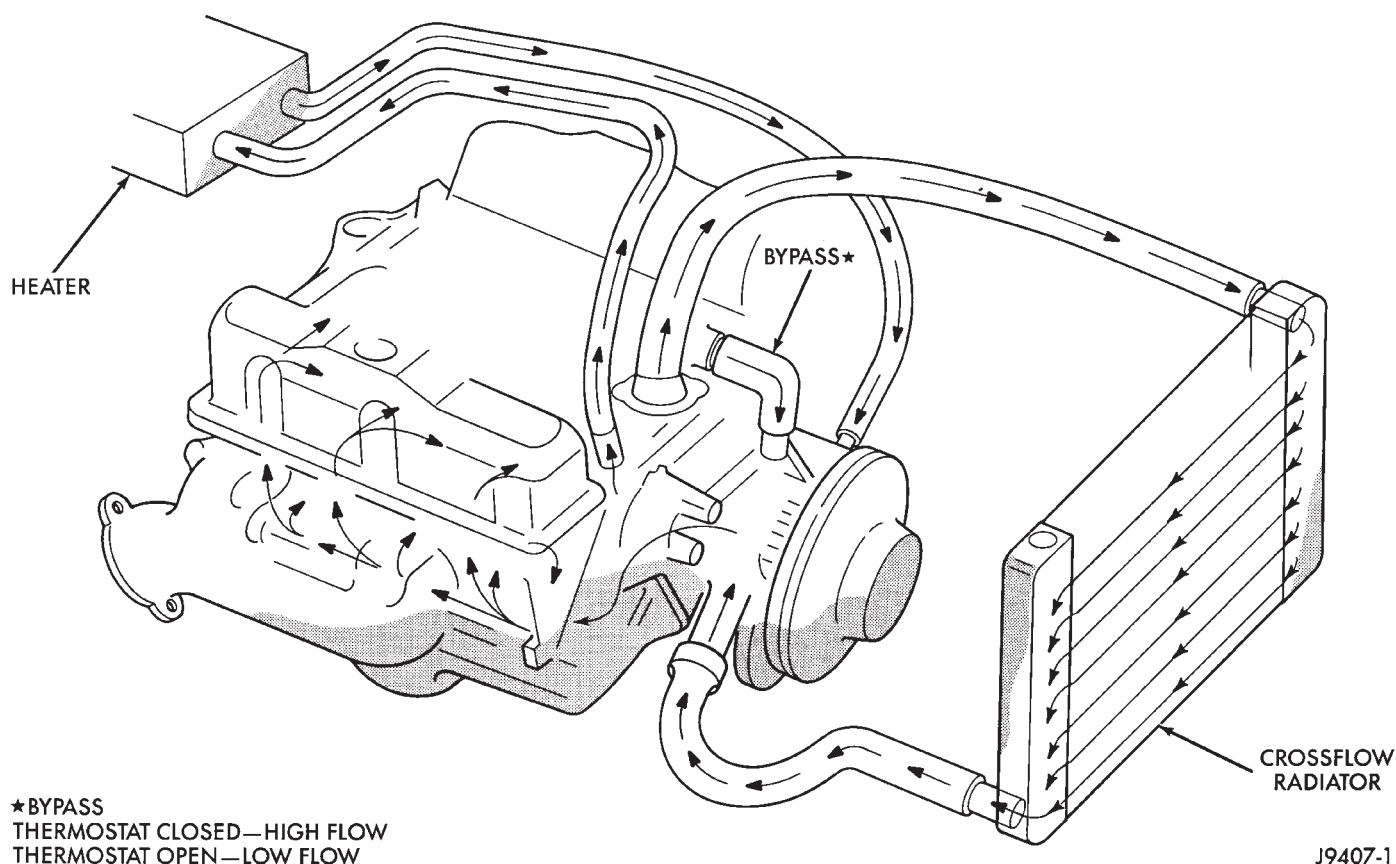


Fig. 1 Engine Cooling System—3.9L/5.2L/5.9L Engines—Typical

GENERAL INFORMATION (Continued)

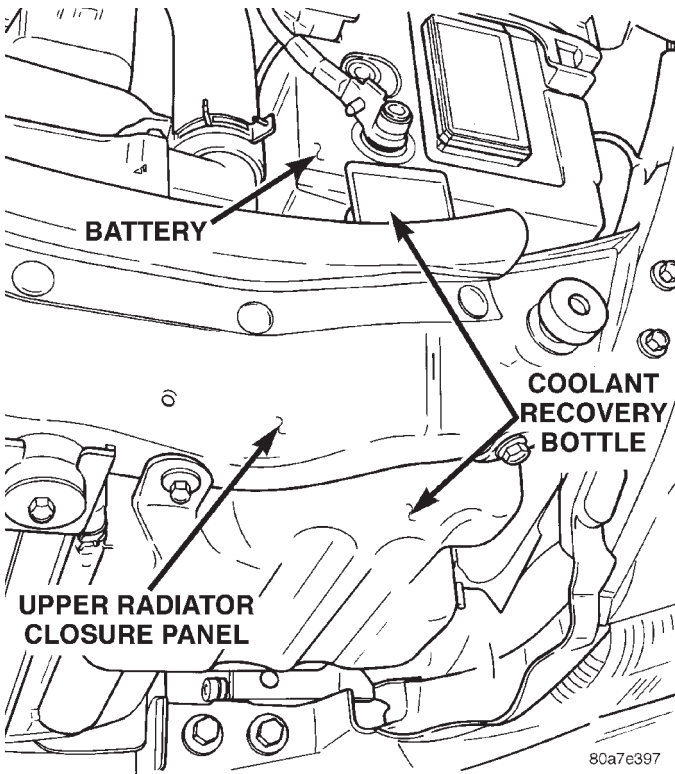


Fig. 2 Coolant Reserve/Overflow System

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

CAUTION: Do not use straight antifreeze as engine coolant, inadequate engine running temperatures can result. Do not operate vehicle without proper concentration of recommended ethylene glycol coolant, high running temperatures and cooling system corrosion can result.

The cooling system factory fill is a mixture of 50% Ethylene Glycol based antifreeze and 50% water.

Using a suitable hydrometer, measure antifreeze concentration in the radiator when the engine is cool. If the cooling system has recently been serviced, allow coolant to circulate for at least 20 minutes before taking hydrometer reading. Properly mixed coolant will protect the cooling system to -37°C (-35°F). If the freeze protection is above -28°C (-20°F), drain enough coolant from the cooling system to allow room to add antifreeze to achieve adequate protection.

Chrysler Corporation recommends Mopar Anti-freeze/Coolant or a high quality, ethylene glycol base antifreeze/coolant, with a silicate inhibitor.

RADIATOR PRESSURE CAP

Radiators are equipped with a pressure cap, which releases pressure at some point within a range of 97-124 kPa (14-18 psi). The pressure relief point (in pounds) is engraved on top of cap.

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. 3) contains a spring-loaded pressure relief valve that opens when system pressure reaches release range of 97-124 kPa (14-18 psi).

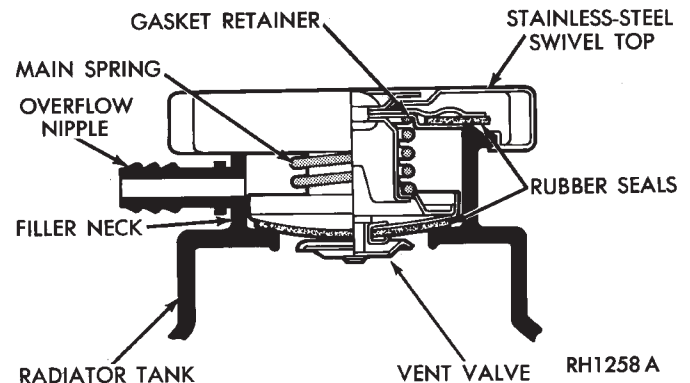


Fig. 3 Radiator Pressure Cap and Filler Neck

A vent valve in the center of cap allows a small coolant flow through 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 the cooling system. This causes the vacuum valve to open and coolant in the reserve/overflow tank to be drawn through its connecting hose into radiator. If the vacuum valve is stuck shut, the radiator hoses will collapse on cool-down. Clean the vent valve (Fig. 3).

A rubber gasket seals radiator filler neck to prevent leakage. This is done to keep system under pressure. It also maintains vacuum during coolant cool-down allowing coolant to return from reserve/overflow tank.

GENERAL INFORMATION (Continued)

THERMOSTAT

On 3.9L and 5.2L/5.9L engines, the thermostat is located beneath the thermostat housing at front of intake manifold (Fig. 4). This thermostat has an air bleed notch.

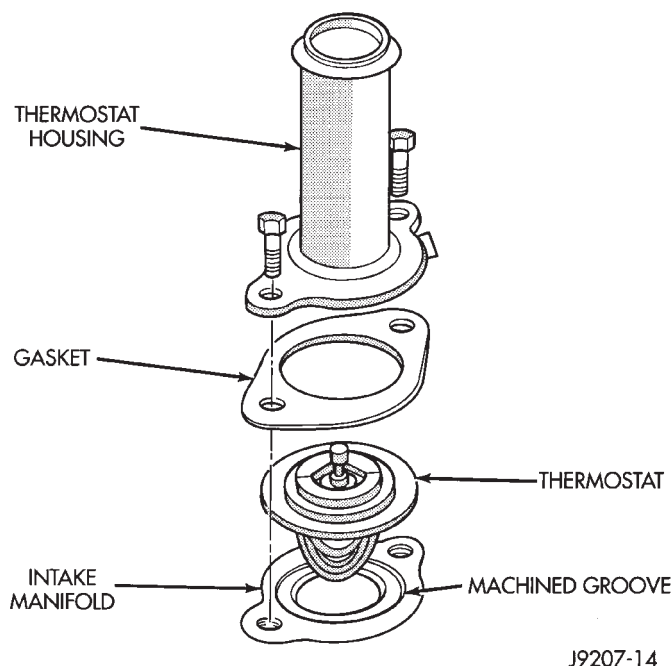


Fig. 4 Thermostat—3.9/5.2L/5.9L Engines

RADIATOR

The radiators used in the 3.9L/5.2L/5.9L models are of the cross-flow type (horizontal tubes) and have plastic side tanks. The radiator supplies sufficient heat transfer to cool engine.

CAUTION: Although plastic radiator tanks are stronger than brass, they are more susceptible to damage from impact or excessive hose clamp torque.

In the event of damage to a plastic radiator tank, the radiator should be replaced as an assembly.

WATER PUMP

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

3.9L/5.2L/5.9L ENGINES

The water pump on 3.9L and 5.2L/5.9L 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.

WATER PUMP BYPASS HOSE

A water pump bypass hose (Fig. 5) is used between the intake manifold and water pump on all 3.9/5.2L/5.9L engines. To test for leaks, refer to Testing Cooling System for Leaks in this group.

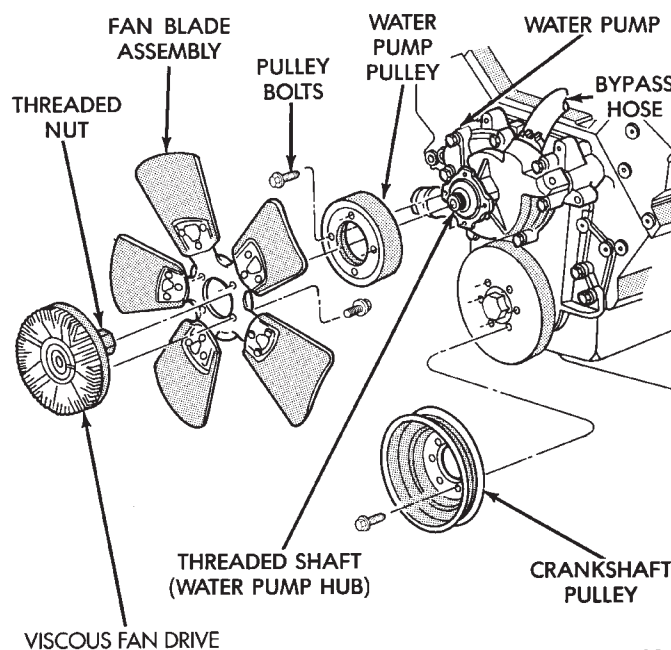


Fig. 5 Water Pump Bypass Hose—3.9L/5.2L/5.9L Engines

ACCESSORY DRIVE BELT TENSION

It is not necessary to adjust belt tension on 3.9L (V-6) or 5.2L/5.9L (V-8) engine. The engine is equipped with an automatic belt tensioner (Fig. 6). The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Automatic Belt Tensioner—3.9L/5.2L/5.9L Engine proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 3.9L/5.2L/5.9L engines.

DESCRIPTION AND OPERATION**THERMOSTAT**

Thermostats installed in the 3.9L/5.2L/5.9L engines are of the wax-pellet-driven, reverse-poppet-choke-type. The wax pellet is located in a sealed container at spring end of thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force valve to open.

DESCRIPTION AND OPERATION (Continued)

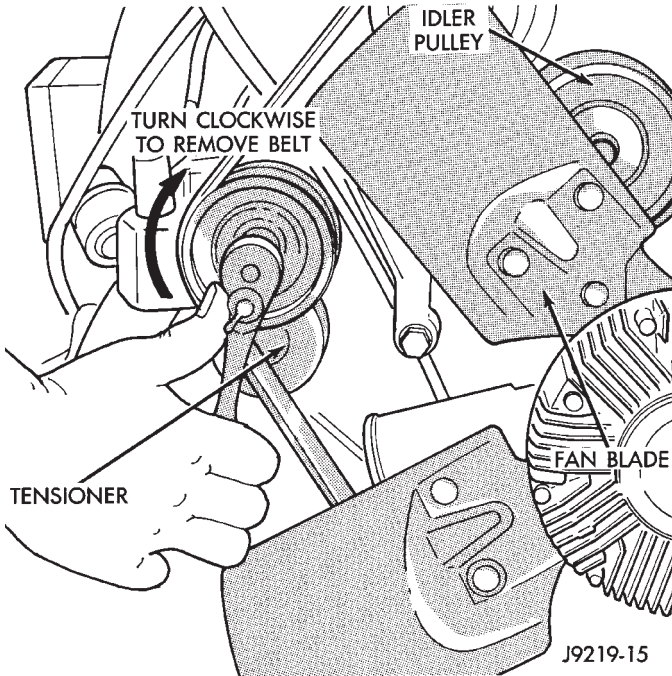


Fig. 6 Automatic Belt Tensioner—3.9L/5.2L/5.9L Engine

Coolant leakage into pellet container will cause thermostat to fail in open position. Do not attempt to free a sticking thermostat with a prying device.

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to radiator. On all engines, the thermostat is closed below 88°C (192°F). When coolant reaches this temperature, thermostat begins to open allowing coolant flow to radiator. This provides quick engine warm-up and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature range of from 88 to 93°C (192 to 199°F). The thermostat should be fully open for maximum coolant flow during operation in hot ambient temperatures of approximately 104°C (220°F). Above 104°C (220°F), coolant temperature is controlled by radiator, fan and ambient temperature.

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

The same thermostat is used for winter and summer seasons.

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

An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, unreliable warmup performance, increased

exhaust emissions and crankcase condensation that can result in sludge formation.

AUTOMATIC TRANSMISSION OIL COOLER

The automatic transmission oil is cooled when it passes through a cooler in radiator outlet tank (Fig. 7). This cooler is only to be serviced by radiator replacement.

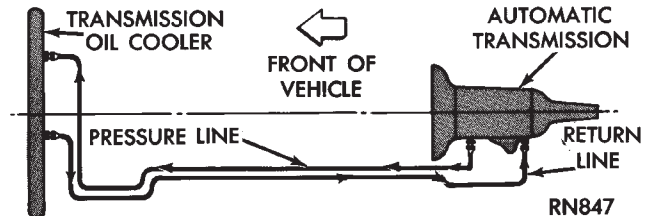


Fig. 7 Oil Flow to Cooler—Top View (Typical)

CAUTION: If transmission oil cooler is leaking, engine coolant may enter cooler, or transmission oil may enter engine cooling system. Both engine cooling system and transmission oil circuit should be drained, flushed, and inspected.

AUXILIARY OIL-TO-AIR COOLER

Oil-to-air (auxiliary) transmission coolers are mounted ahead of radiator (Fig. 8). They operate in conjunction with main cooler located in radiator side tank. The transmission oil is routed through main cooler in radiator side tank first. It is then routed through auxiliary cooler before returning to transmission.

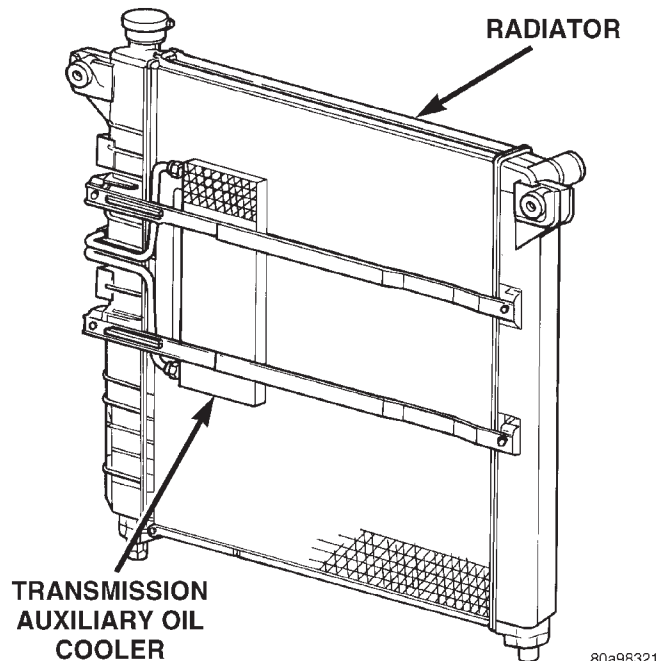


Fig. 8 Transmission Oil Auxiliary Cooler—Typical

DESCRIPTION AND OPERATION (Continued)

TENSIONER (AUTO)—ACCESSORY DRIVE BELT

Correct accessory drive belt tension is required to be sure of optimum performance of belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate and greatly reduced belt life.

Drive belts on both 3.9L and 5.2L/5.9L engines are equipped with a spring loaded automatic belt tensioner. This belt tensioner will be used with all belt configurations. Such as with or without power steering or air conditioning.

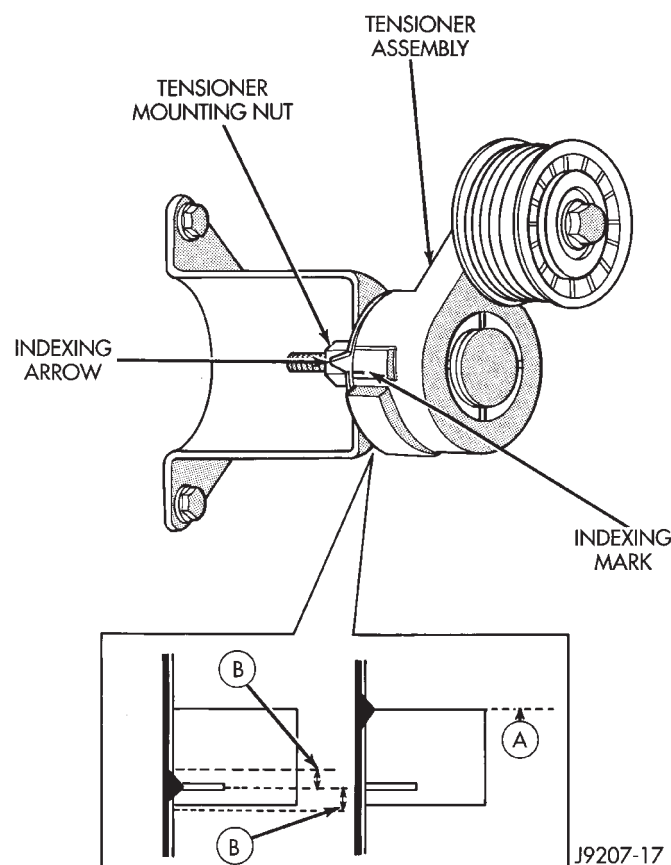


Fig. 9 Automatic Belt Tensioner/Pulley Assembly—3.9L/5.2L/5.9L Engine

BLOCK HEATER

An optional engine block heater is available 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.

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.

COOLANT PERFORMANCE

ETHYLENE-GLYCOL MIXTURES

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The recommended mixture of 50/50 ethylene-glycol and water will provide protection against freezing to -37 deg. C (-35 deg. F). The anti-freeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7 deg. C (-90 deg. F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water.

100 Percent Ethylene-Glycol—Should Not Be Used in Chrysler Vehicles

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149 deg. C (300 deg. 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 deg. C (-8 deg. F).

Propylene-glycol Formulations—Should Not Be Used in Chrysler Vehicles

Propylene-glycol formulations do not meet Chrysler coolant specifications. Its overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32 deg. C (-26 deg. F), 5 deg. C higher than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125 deg. C (257 deg. F) at 96.5 kPa (14 psi), compared to 128 deg. C (263 deg. F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up in Chrysler vehicles, which are designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This

DESCRIPTION AND OPERATION (Continued)

can increase cylinder head temperatures under certain conditions.

Propylene-glycol/Ethylene-glycol Mixtures—Should Not Be Used in Chrysler Vehicles

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

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

COOLANT SELECTION AND ADDITIVES

The presence of aluminum components in the cooling system requires strict corrosion protection. Maintain coolant at specified level with a mixture of ethylene-glycol based antifreeze and water. Chrysler Corporation recommends Mopar Antifreeze or equivalent. If coolant becomes contaminated or loses color, drain and flush cooling system and fill with correctly mixed solution.

A 0.25 percent emulsifiable oil is added to the radiator at the factory to prevent solder corrosion.

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

COOLING SYSTEM HOSES AND CLAMPS

Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

Inspect hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed, or swell excessively when system is pressurized. The use of molded replacement hoses is recommended. When performing a hose inspection, inspect radiator lower hose for proper position and condition of spring.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 10). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

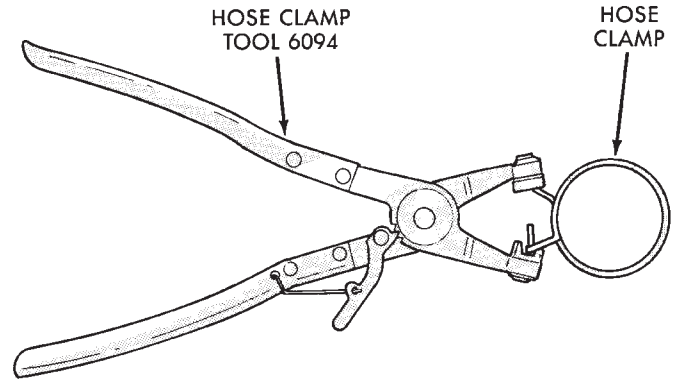


Fig. 10 Hose Clamp Tool—Typical

J9207-36

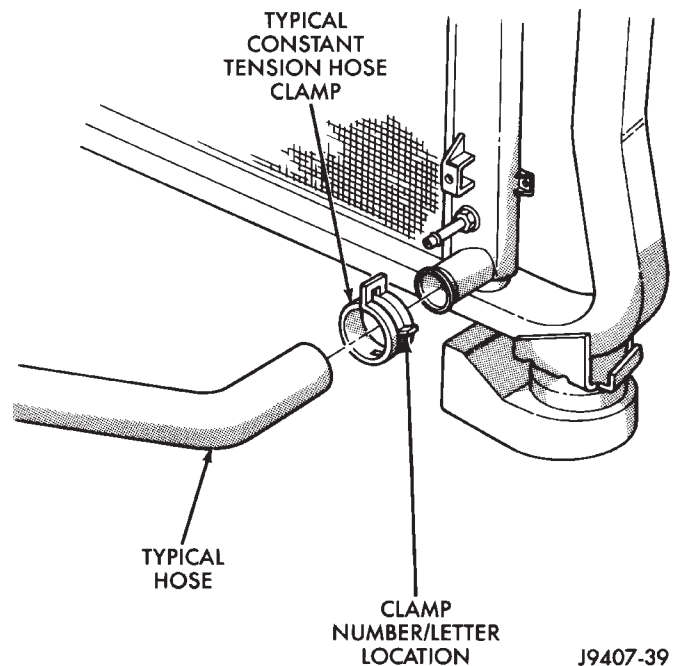


Fig. 11 Clamp Number/Letter Location

J9407-39

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 11). If replacement is necessary, use only an original equipment clamp with matching number or letter.

WATER PUMP

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 drive belt.

The water pump impeller is pressed onto the rear of a shaft that rotates in a bearing pressed into the water pump body. The body has a small hole for ventilation. The water pump seals are lubricated by anti-freeze in the coolant mixture. Additional lubrication is not necessary.

DESCRIPTION AND OPERATION (Continued)

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

The water pump is bolted directly to the engine timing case/cover. A gasket is used as a seal between the water pump and timing chain case/cover.

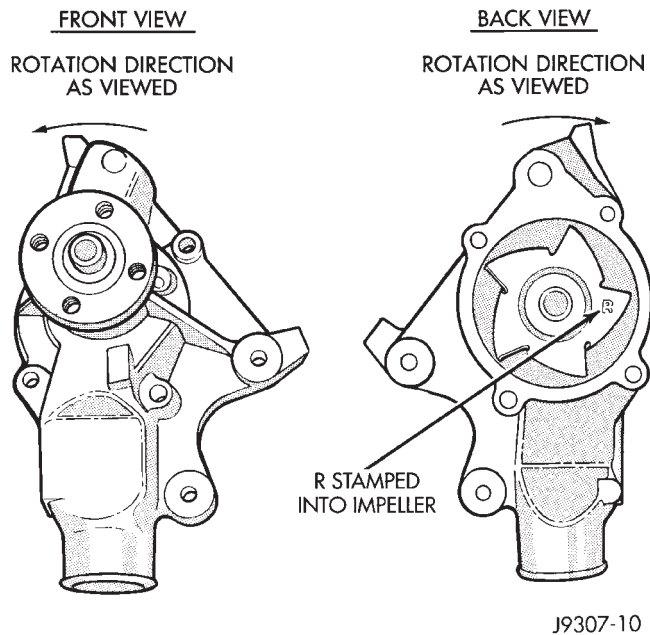


Fig. 12 Reverse Rotating Water Pump—Typical

VISCOUS FAN/DRIVE

The thermal viscous fan drive (Fig. 13)(Fig. 14) is a silicone-fluid- filled coupling used to connect the fan blades to the water pump shaft. 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 the fan to a predetermined maximum level at higher engine speeds.

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (Fig. 14). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the 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 engage. This is when the air flowing through the radiator core causes a reaction to 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.

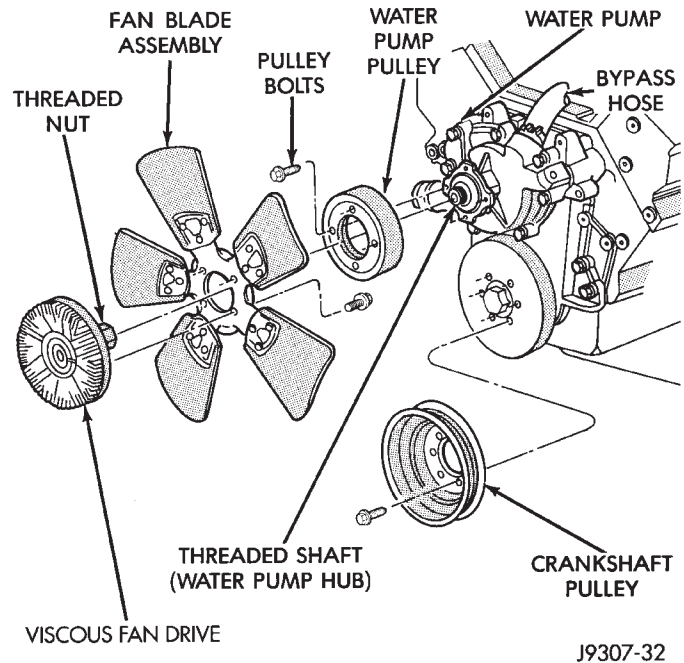


Fig. 13 Fan Blade/Viscous Fan Drive—3.9L/5.2L/5.9L Engine

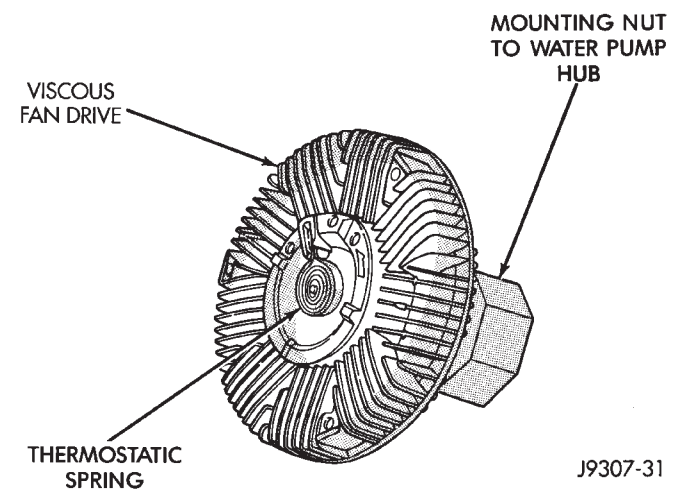


Fig. 14 Viscous Fan Drive—3.9L/5.2L/5.9L Engine—Typical

CAUTION: Engines equipped with 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 viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

DESCRIPTION AND OPERATION (Continued)

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

- The underhood temperature is above the engagement point for the viscous drive coupling. This may occur when ambient (outside air temperature) is very high.
- Engine loads and temperatures are high such as when towing a trailer.
- Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

DIAGNOSIS AND TESTING

ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The powertrain control module (PCM) has been programmed to monitor certain cooling system components:

- If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) can be set.
- If an open or shorted condition has developed in the relay circuit controlling the electric radiator fan, a Diagnostic Trouble Code (DTC) can be set.

If the problem is sensed in a monitored circuit often enough to indicated an actual problem, a DTC is stored. The DTC will be stored in the PCM memory for eventual display to the service technician. Refer to Group 25, Emission Control Systems for the correct procedures.

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, refer to Group 25, Emission Control Systems for the correct procedures.

ERASING TROUBLE CODES

After the problem has been repaired, use the DRB scan tool to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool.

DRB SCAN TOOL

For operation of the DRB scan tool, refer to the appropriate Powertrain Diagnostic Procedures service manual.

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:

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.
- If vehicle is equipped with a 3.9L V-6 or 5.2L/5.9L V-8 engine, increasing engine speed for more air flow is recommended.

(1) TRAILER TOWING:

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

(2) 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.

(3) 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, or pump rotating in wrong direction due to belt not correctly routed
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to following Cooling System Diagnosis charts.

These charts are to be used as a quick-reference only. Refer to the group text for information.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	<ol style="list-style-type: none">1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?2. Is the temperature sending unit connected?3. Is the temperature gauge operating OK?4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.5. Improper operation of internal heater doors or heater controls.	<ol style="list-style-type: none">1. Refer to Group 25, Emission Systems for On-Board Diagnostics and DTC information. Replace thermostat if necessary.2. Check the temperature sensor connector. Refer to Group 8E. Repair connector if necessary.3. Check gauge operation. Refer to Group 8E. Repair as necessary.4. Check coolant level in the coolant reserve/overflow tank and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and CAUTIONS associated with removing the radiator cap.5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	<p>1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.</p> <p>2. Is the temperature gauge reading correctly?</p> <p>3. Is the temperature warning illuminating unnecessarily?</p> <p>4. Coolant low in coolant reserve/overflow tank and radiator?</p> <p>5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.</p> <p>6. Poor seals at the radiator cap.</p> <p>7. Coolant level low in radiator but not in coolant reserve/overflow tank. This means the radiator is not drawing coolant from the coolant reserve/overflow tank as the engine cools</p> <p>8. Incorrect coolant concentration</p>	<p>1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-20).</p> <p>2. Check gauge. Refer to Group 8E. Repair as necessary.</p> <p>3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.</p> <p>4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this Group.</p> <p>5. Tighten cap</p> <p>6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.</p> <p>7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this Group. Replace cap if necessary. (b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator. (c) Check condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary. (d) Check coolant reserve/overflow tank and tanks hoses for blockage. Repair as necessary.</p> <p>8. Check coolant. Refer to Coolant section in this Group for correct coolant/water mixture ratio.</p>

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	9. Coolant not flowing through system	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine area of obstruction and repair as necessary.
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Remove insects and debris. Refer to Radiator Cleaning in this Group.
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Aftermarket A/C installed without proper radiator.	12. Install proper radiator.
	13. Fuel or ignition system problems.	13. Refer to Fuel and Ignition System Groups for diagnosis.
	14. Dragging brakes.	14. Check and correct as necessary. Refer to Group 5, Brakes for correct procedures.
	15. Bug screen or cardboard is being used, reducing airflow.	15. Remove bug screen or cardboard.
	16. Thermostat partially or completely shut.	16. Check thermostat operation and replace as necessary. Refer to Thermostats in this Group.
	17. Viscous fan drive not operating properly.	17. Check fan drive operation and replace as necessary. Refer to Viscous Fan Drive in this Group.
	18. Cylinder head gasket leaking.	18. Check for cylinder head gasket leaks. Refer to Cooling System-Testing For Leaks in this Group. For repair, refer to Group 9, Engines.
	19. Heater core leaking.	19. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	<ol style="list-style-type: none"> 1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly. 2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit. 3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running) 4. Gauge reading high after re-starting a warmed up (hot) engine. 5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late). 6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late. 7. Water pump impeller loose on shaft. 8. Loose accessory drive belt. (water pump slipping) 9. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late. 	<ol style="list-style-type: none"> 1. A normal condition. No correction is necessary. 2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel and Gauges. 3. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven. 4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation. 5. Check and correct coolant leaks. Refer to Cooling System-Testing for leaks in this group. 6. (a) Check for cylinder head gasket leaks. Refer to Cooling System-Testing for Leaks in this group. (b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary. 7. Check water pump and replace as necessary. Refer to water Pumps in this group. 8. Refer to Accessory Drive Belts in this group. Check and correct as necessary. 9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/OVERFLOW TANK	<ol style="list-style-type: none"> 1. Pressure relief valve in radiator cap is defective. 	<ol style="list-style-type: none"> 1. Check condition of radiator cap and cap seals. Refer to Radiator Caps in this group. Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT	<ol style="list-style-type: none"> 1. Coolant leaks in radiator, cooling system hoses, water pump or engine. 	<ol style="list-style-type: none"> 1. Pressure test and repair as necessary. Refer to Cooling System-Testing For Leaks in this group.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. Engine overheating. 2. Freeze point of coolant not correct. Mixture is too rich or too lean.	1. Check reason for overheating and repair as necessary. 2. Check coolant concentration. Refer to the Coolant section of this group and adjust ratio as required.
HOSE OR HOSES COLLAPSE WHILE ENGINE IS RUNNING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. Refer to Radiator Cap in this group. Replace if necessary (b) Hose between coolant reserve/overflow tank and radiator is kinked. Repair as necessary. (c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary. (d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VISCOUS FAN/DRIVE	<ol style="list-style-type: none"> 1. Fan blades loose. 2. Fan blades striking a surrounding object. 3. Air obstructions at radiator or air conditioning condenser. 4. Thermal viscous fan drive has defective bearing. 5. A certain amount of fan noise may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal. 	<ol style="list-style-type: none"> 1. Replace fan blade assembly. Refer to Cooling System Fans in this Group 2. Locate point of fan blade contact and repair as necessary. 3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser. 4. Replace fan drive. Bearing is not serviceable. Refer to Viscous Fan Drive in this group. 5. Refer to Viscous Fan Drive in this group for an explanation of normal fan noise.
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	<ol style="list-style-type: none"> 1. Has a Diagnostic trouble Code (DTC) been set? 2. Coolant level low 3. Obstructions in heater hose/ fittings 4. Heater hose kinked 5. Water pump is not pumping water to/through the heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly or the heater core may be plugged. Accessory drive belt may be slipping causing poor water pump operation. 	<ol style="list-style-type: none"> 1. Refer to Group 25, Emissions for correct procedures and replace thermostat if necessary 2. Refer to Cooling System-Testing For Leaks in this group. 3. Remove heater hoses at both ends and check for obstructions 4. Locate kinked area and repair as necessary 5. Refer to Water Pump in this group. If a slipping belt is detected, refer to Accessory Drive Belts in this group. If heater core obstruction is detected, refer to Group 24, Heating and Air Conditioning.
STEAM IS COMING FROM THE FRONT OF VEHICLE NEAR THE GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	<ol style="list-style-type: none"> 1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away. 	<ol style="list-style-type: none"> 1. Occasional steam emitting from this area is normal. No repair is necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. Refer to Coolant in this group for coolant concentration information. Adjust coolant mixture as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

RADIATOR COOLANT FLOW CHECK

Use the following procedure to determine if coolant is flowing through cooling system.

(1) Idle engine until operating temperature is reached. If upper radiator hose is warm to the touch, thermostat is opening and coolant is flowing to radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO FIRST STOP. ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from radiator until ends of radiator tubes are visible through filler neck. Idle engine at normal operating temperature. If coolant is flowing past exposed tubes, coolant is circulating.

COOLING SYSTEM—TESTING FOR LEAKS**ULTRAVIOLET LIGHT METHOD**

A leak detection additive is available through the parts department that can be added to cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into cooling system. Place heater control unit in HEAT position. Start and operate engine until radiator upper hose is warm to touch. Aim the commercially available black light tool at components to be checked. If leaks are present, black light will cause additive to glow a bright green color.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 15).

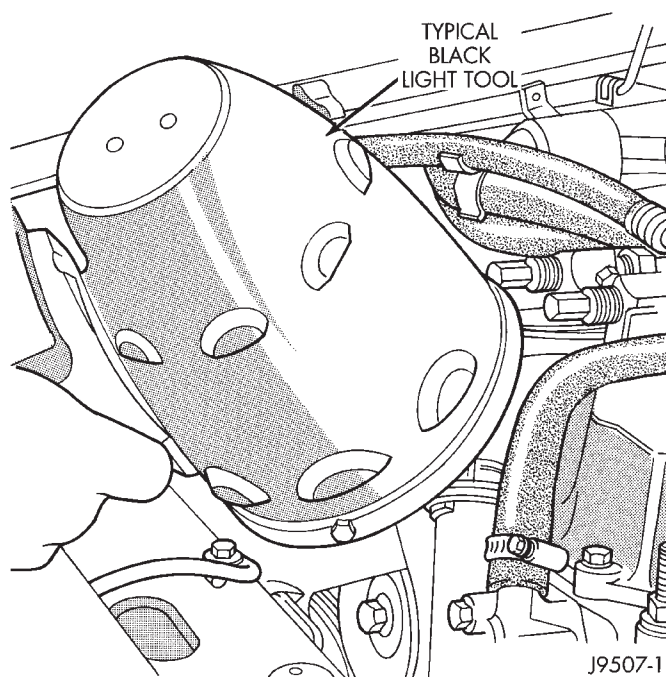


Fig. 15 Leak Detection Using Black Light—Typical PRESSURE TESTER METHOD

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

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

Carefully remove radiator pressure cap from filler neck and check coolant level. Push down on cap to disengage it from stop tabs. Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect radiator-to- reserve/overflow tank hose for internal

DIAGNOSIS AND TESTING (Continued)

obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Replace cap if cams are bent.

Attach pressure tester (7700 or an equivalent) to radiator filler neck (Fig. 16).

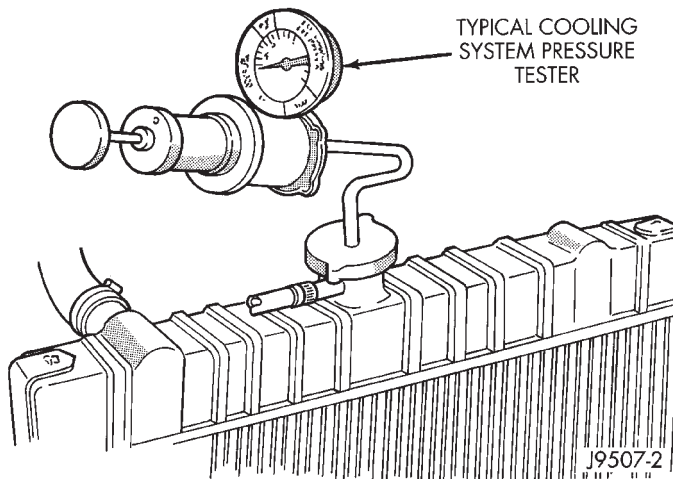


Fig. 16 Pressure Testing Cooling System—Typical

Operate tester pump to apply 103.4 kPa (15 psi) pressure to system. If hoses enlarge excessively or bulges while testing, replace as necessary. Observe gauge pointer and determine condition of cooling system according to following criteria:

Holds Steady: If pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage or perform Internal Leakage Test.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all connections for seepage or slight leakage with a flashlight. Inspect radiator, hoses, gasket edges and heater. Seal small leak holes with a Sealer Lubricant (or equivalent). Repair leak holes and inspect system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine system for external leakage. If leaks are not visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done,

remove engine dipstick and inspect for water globules. Also inspect transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: WITH RADIATOR PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 110 KPA (20 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE PRESSURE, ROCK TESTER FROM SIDE TO SIDE. WHEN REMOVING TESTER, DO NOT TURN TESTER MORE THAN 1/2 TURN IF SYSTEM IS UNDER PRESSURE.

Operate engine without pressure cap on radiator until thermostat opens. Attach a Pressure Tester to filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the Pressure Tester. Do this until indicated pressure is within system range of 110 kPa (16 psi). Fluctuation of gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** remove spark plug cables or short out cylinders to isolate compression leak.

If the needle on dial of pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

A convenient check for exhaust gas leakage into cooling system is provided by a commercially available Block Leak Check tool. Follow manufacturers instructions when using this product.

COMBUSTION LEAKAGE TEST—WITHOUT PRESSURE TESTER

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

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

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

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

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open drain-cock immediately after test to eliminate boil over.

DIAGNOSIS AND TESTING (Continued)

Start engine and accelerate rapidly three times, to approximately 3000 rpm while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

VISCIOUS FAN DRIVE

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: 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 be sure that the air flow is blocked.

(5) Be sure that the air conditioner (if equipped) 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. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should have started to occur at between 74° to 82° C (165° to 180° F). Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan.

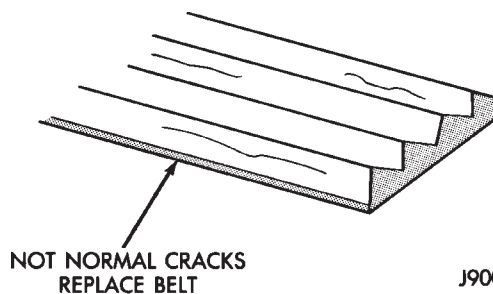
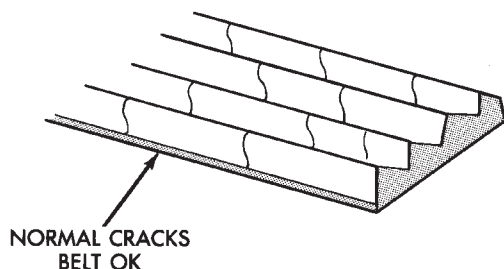
(7) When the air temperature reaches 88° C (190° F), remove the plastic sheet. Fan drive **disengagement** should have started to occur at between 57° to 79° C (135° to 175° F). A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

ACCESSORY DRIVE BELT DIAGNOSIS

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 17), 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. 17). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

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



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Fig. 17 Belt Wear Patterns

DIAGNOSIS AND TESTING (Continued)

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a

noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	<ol style="list-style-type: none"> 1. Foreign objects imbedded in pulley grooves. 2. Installation damage 	<ol style="list-style-type: none"> 1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	<ol style="list-style-type: none"> 1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated 	<ol style="list-style-type: none"> 1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	<ol style="list-style-type: none"> 1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol) 3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage 	<ol style="list-style-type: none"> 1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys 3. Replace faulty component or bearing 4. Replace belt.
LONGITUDAL BELT CRACKING	<ol style="list-style-type: none"> 1. Belt has mistracked from pulley groove 2. Pulley groove tip has worn away rubber to tensile member 	<ol style="list-style-type: none"> 1. Replace belt 2. Replace belt
"GROOVE JUMPING" (Belt does not maintain correct position on pulley)	<ol style="list-style-type: none"> 1. Incorrect belt tension 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken 	<ol style="list-style-type: none"> 1. Inspect/Replace tensioner if necessary 2. Replace pulley(s) 3. Remove foreign objects from grooves 4. Align component 5. Replace belt

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	<ol style="list-style-type: none"> 1. Incorrect belt tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure 	<ol style="list-style-type: none"> 1. Replace Inspect/Replace tensioner if necessary 2. Replace belt 3. Align pulley(s) 4. Replace defective component and belt
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	<ol style="list-style-type: none"> 1. Incorrect belt tension 2. Bearing noise 3. Belt misalignment 4. Belt to pulley mismatch 5. Driven component induced vibration 	<ol style="list-style-type: none"> 1. Inspect/Replace tensioner if necessary 2. Locate and repair 3. Align belt/pulley(s) 4. Install correct belt 5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	<ol style="list-style-type: none"> 1. Tension sheeting contacting stationary object 2. Excessive heat causing woven fabric to age 3. Tension sheeting splice has fractured 	<ol style="list-style-type: none"> 1. Correct rubbing condition 2. Replace belt 3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	<ol style="list-style-type: none"> 1. Incorrect belt tension 2. Belt contacting stationary object 3. Pulley(s) out of tolerance 4. Insufficient adhesion between tensile member and rubber matrix 	<ol style="list-style-type: none"> 1. Inspect/Replace tensioner if necessary 2. Replace belt 3. Replace pulley 4. Replace belt

THERMOSTAT—GAS ENGINES

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes. For other DTC numbers, refer to On-Board Diagnostics in the General Diagnosis section of Group 25, Emission Systems.

The DTC can also be accessed through the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures manual for diagnostic information and operation of the DRB scan tool.

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

The pressure cap upper gasket (seal) pressure relief can be tested by removing overflow hose from radiator filler neck nipple. Attach hose of pressure tester tool 7700 (or equivalent) to nipple. It will be necessary to disconnect hose from its adapter for filler neck. Pump air into radiator. The pressure cap upper gasket should relieve at 69-124 kPa (10-18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

DIAGNOSIS AND TESTING (Continued)

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

Do not remove radiator cap at any time **except** for the following purposes:

- (1) Check and adjust antifreeze freeze point.
- (2) Refill system with new antifreeze.
- (3) Conducting service procedures.
- (4) 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 CAP AND WITHOUT PUSHING CAP DOWN, ROTATE IT COUNTER-CLOCKWISE TO FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH THE COOLANT RESERVE/OVERFLOW HOSE INTO 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.

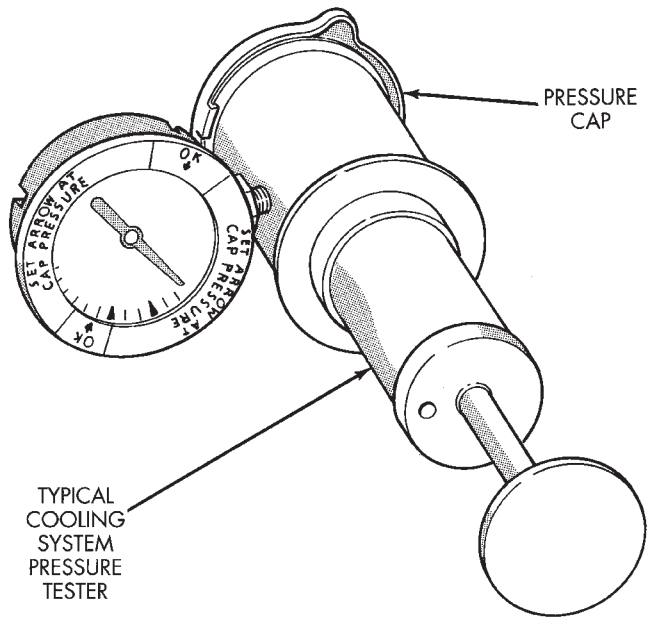
RADIATOR CAP—PRESSURE TESTING

Remove cap from radiator. Be sure that sealing surfaces are clean. Moisten rubber gasket with water and install cap on pressure tester 7700 or an equivalent (Fig. 18).

Operate tester pump to bring pressure to 104 kPa (15 psi) on gauge. If pressure cap fails to hold pressure of at least 97 kPa (14 psi) replace cap. Refer to following **CAUTION**.

The pressure cap may test properly while positioned on tool 7700 (or equivalent). It may not hold pressure or vacuum when installed on radiator. If so, inspect radiator filler neck and cap's top gasket for damage. Also inspect for dirt or distortion that may prevent cap from sealing properly.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks, which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.



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Fig. 18 Pressure Testing Radiator Cap—Typical COOLANT—LOW LEVEL AERATION

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

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

COOLING SYSTEM—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.

SERVICE PROCEDURES

COOLANT—ROUTINE LEVEL CHECK

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant recovery bottle (Fig. 19).

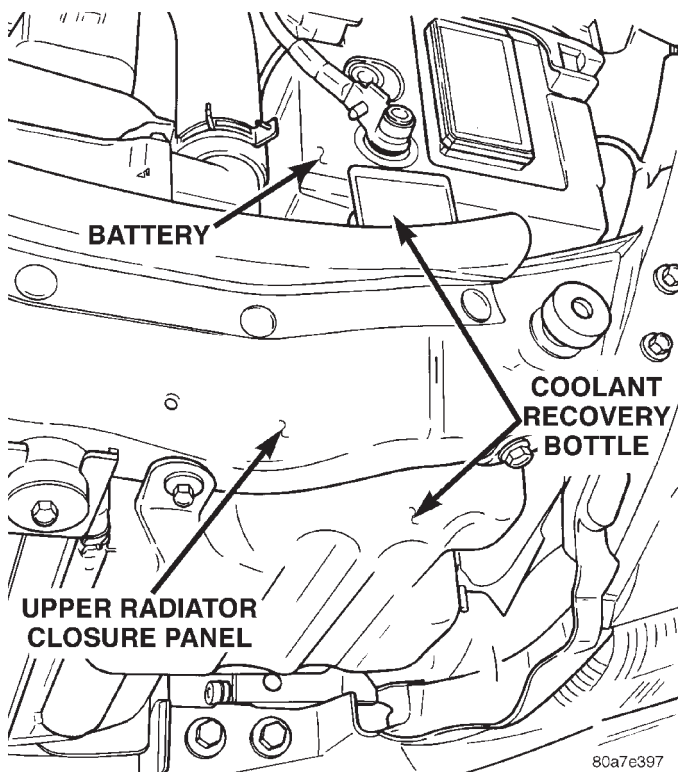


Fig. 19 Coolant Recovery Bottle Location

The coolant reserve/overflow system provides a quick method for determining coolant level without removing radiator pressure cap. With engine not running, open the coolant recovery bottle cap and remove coolant level indicator dipstick to observe coolant level in coolant recovery bottle. The coolant level should be between ADD and FULL marks. If the coolant level is at or below the ADD mark, fill the recovery bottle with a 50/50 mixture of antifreeze and water ONE QUART AT A TIME. Repeat this procedure until the coolant level is at the FULL mark.

COOLANT SERVICE

For cooling system flush and fill maintenance intervals, refer to Group 0, Lubrication and Maintenance.

COOLANT—ADDING ADDITIONAL

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 refill-

ing system after service. Removing cap unnecessarily can cause loss of coolant and allow air to enter system, which produces corrosion.

COOLANT LEVEL CHECK

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.

Remove radiator cap. The coolant level should be to top of radiator. If not, and if coolant level in coolant recovery bottle 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

COOLING SYSTEM—DRAINING AND FILLING

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

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

DRAINING

- (1) Remove radiator pressure cap.
- (2) Loosen radiator petcock.
- (3) Remove cylinder block drain plugs. Refer to (Fig. 20).

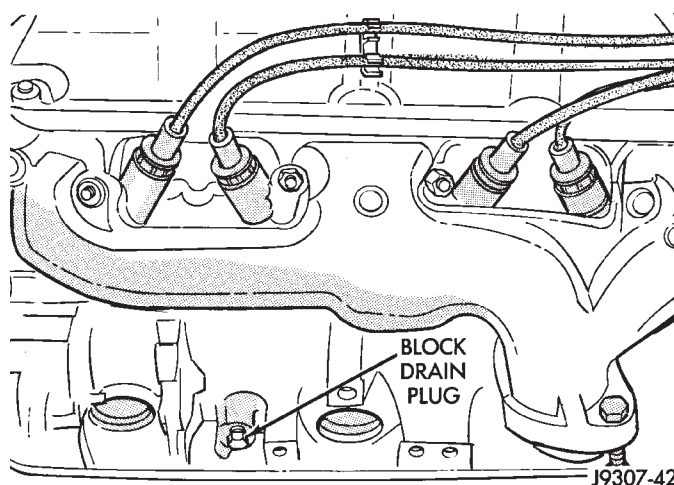


Fig. 20 Cylinder Block Drain Plug—3.9L/5.2L/5.9L Engines—Typical

SERVICE PROCEDURES (Continued)

REFILLING

Clean cooling system prior to refilling. Refer to Cooling System Cleaning section of this group.

(1) Install cylinder block drain plug(s). Coat the threads with Mopar® Thread Sealant with Teflon.

(2) Close radiator petcock.

(3) Fill cooling system with a 50/50 mixture of water and antifreeze. Be sure that antifreeze contains Alugard 340-2 TM as specified in Coolant section of this group.

(4) Fill coolant reserve/overflow tank to FULL mark on indicator stick.

(5) Start and operate engine until thermostat opens (upper radiator hose warm to touch).

(6) If necessary, add a 50/50 water and antifreeze mixture to the coolant reserve/overflow tank. This is done to maintain coolant level between the FULL and ADD marks. The level in the reserve/overflow tank may drop below the ADD mark after three or four warm-up and cool-down cycles.

COOLING SYSTEM—CLEANING/REVERSE FLUSHING

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

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

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

REVERSE FLUSHING ENGINE

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

CAUTION: On vehicles equipped with a heater water control valve, be sure heater control valve is closed (heat off). This will prevent coolant flow with scale and other deposits from entering heater core.

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

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

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 flushing operation.

CAUTION: Follow manufacturers instructions when using these products.

REMOVAL AND INSTALLATION

COOLANT RESERVE/OVERFLOW TANK

NOTE: Refer to **Coolant Level Check—Service, Deaeration and Radiator Pressure Cap** sections in this group for coolant reserve/overflow system operation and service.

Should the reserve/overflow tank become coated with corrosion or emulsifiable oil, it can be cleaned with detergent and water. Rinse tank thoroughly before refilling cooling system as described in the Coolant section of this group.

REMOVAL

- (1) Remove battery positive and negative cables and battery.
- (2) Remove upper radiator closure panel (Fig. 21).
- (3) Remove overflow hose at reserve/overflow tank.
- (4) Remove three (3) coolant recovery bottle screws and remove coolant recovery bottle from vehicle.

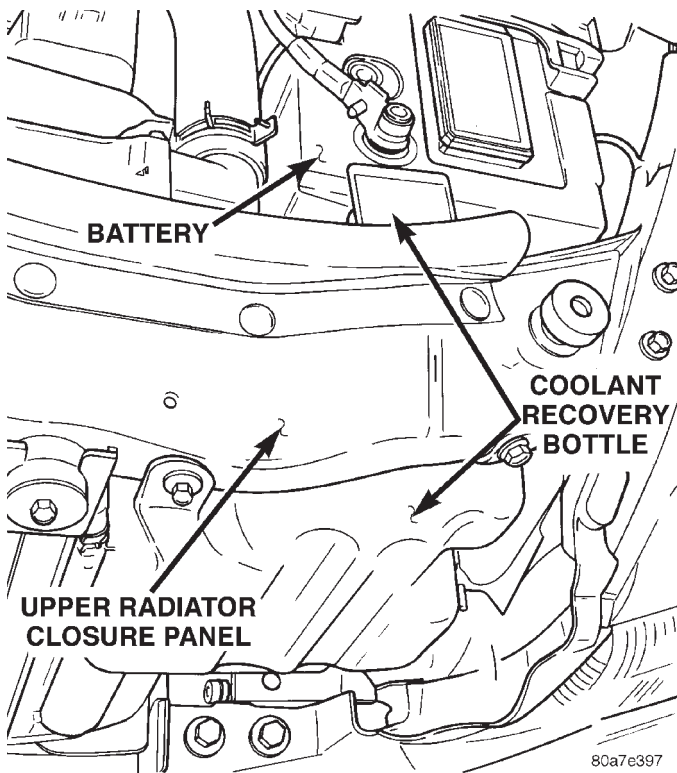


Fig. 21 Coolant Recovery Bottle

INSTALLATION

- (1) Install coolant recovery bottle and three (3) Screws.
- (2) Install overflow hose to tank.
- (3) Install upper radiator closure panel.
- (4) Install battery.
- (5) Add coolant (refer to coolant level checking procedure in this section).

WATER PUMP

REMOVAL

The water pump can be removed and installed without discharging the air conditioning system (if equipped).

- (1) Disconnect battery negative cable.
- (2) Drain cooling system. Refer to **Cooling System—Draining and Filling** in this group.
- (3) 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 MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with matching number or letter.

- (4) Remove upper radiator hose clamp and hose at radiator.

(5) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 22). 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. 22) to prevent pulley from rotating. Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

(6) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 22) from thermal viscous fan drive.

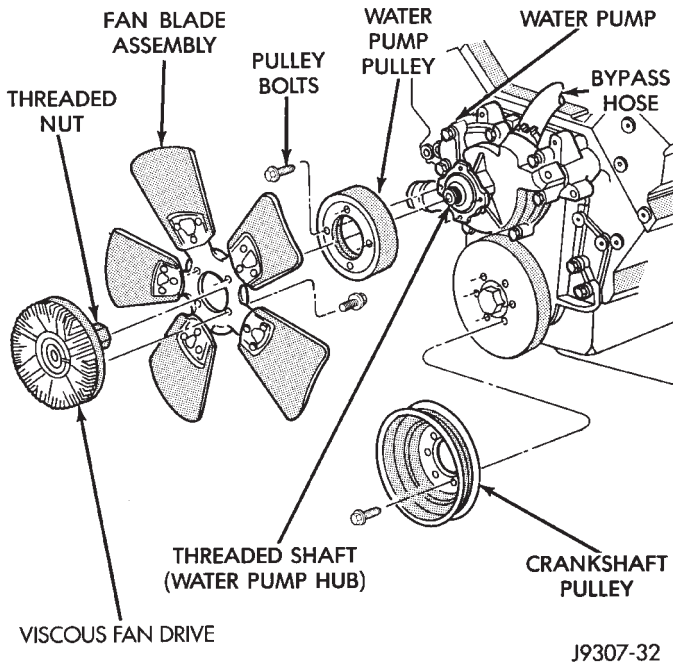
(7) Remove fan shroud attaching hardware (two bolts at bottom-two clips at top).

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

(9) 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.

(10) **Do not** remove water pump pulley bolts at this time.

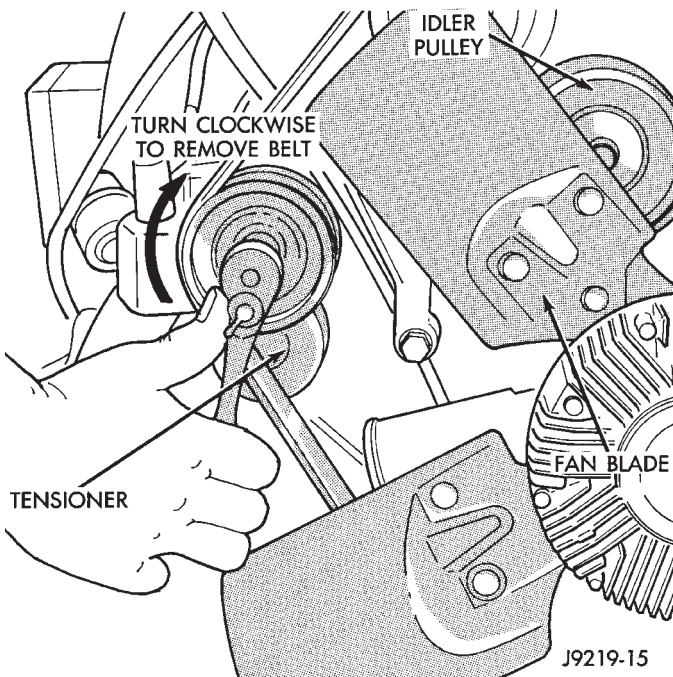
REMOVAL AND INSTALLATION (Continued)



J9307-32

Fig. 22 Fan Blade and Viscous Fan Drive—3.9L/5.2L/5.9L Engines

(11) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic tensioner (Fig. 23). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 23). When all belt tension has been relaxed, remove accessory drive belt.



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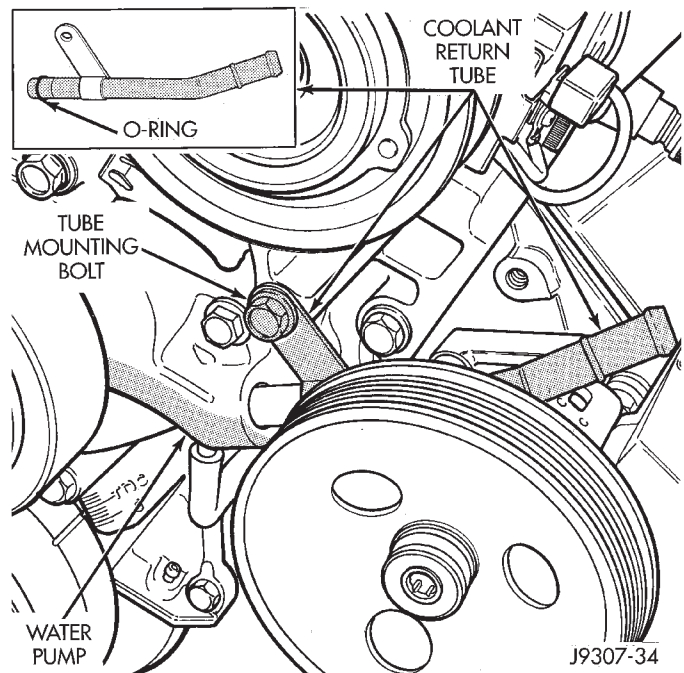
Fig. 23 Automatic Belt Tensioner Assembly—3.9L/5.2L/5.9L Engines

(12) Remove four water pump pulley-to-water pump hub bolts (Fig. 22) and remove pulley from vehicle.

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

(14) Remove heater hose clamp and heater hose from heater hose coolant return tube.

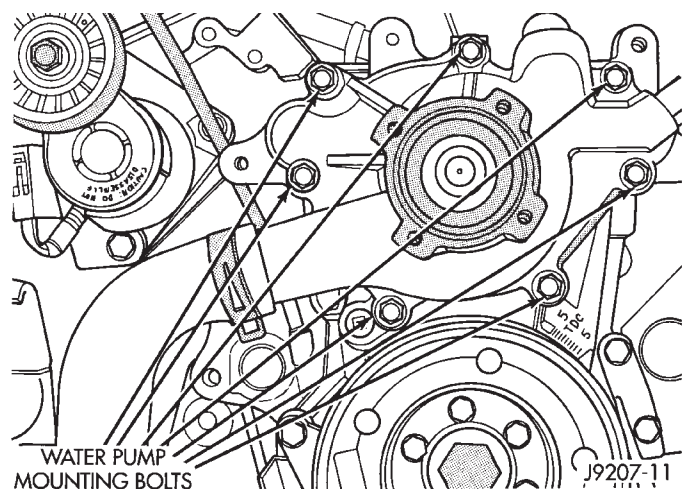
(15) Loosen heater hose coolant return tube mounting bolt (Fig. 24) and remove tube from water pump. Discard the old tube O-ring.



J9307-34

Fig. 24 Coolant Return Tube—3.9L/5.2L/5.9L Engines—Typical

(16) Remove seven water pump mounting bolts (Fig. 25).



J9207-11

Fig. 25 Water Pump Bolts—3.9L/5.2L/5.9L Engines

REMOVAL AND INSTALLATION (Continued)

(17) Loosen clamp at water pump end of bypass hose (Fig. 22). Slip bypass hose from water pump while removing pump from vehicle. Discard old gasket.

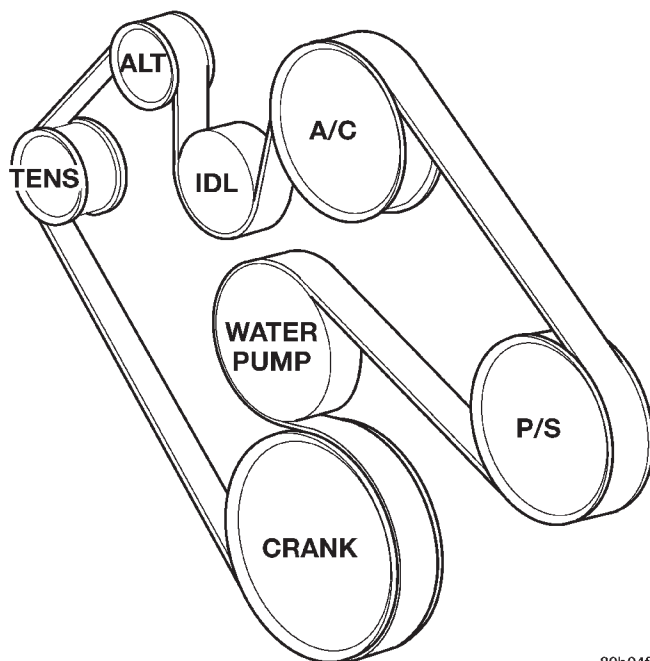
CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

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. 25). Tighten water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.
- (3) Position bypass hose clamp to bypass hose.
- (4) Spin water pump to be sure that pump impeller does not rub against timing chain case/cover.
- (5) Install a new O-ring to the heater hose coolant return tube (Fig. 24). Coat the new O-ring with anti-freeze before installation.
- (6) Install coolant return tube and its mounting bolt to engine (Fig. 24). Be sure the slot in tube bracket is bottomed to mounting bolt. This will properly position return tube.
- (7) Connect radiator lower hose to water pump.
- (8) Connect heater hose and hose clamp to coolant return tube.
- (9) 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. 22) to prevent pulley from rotating.
- (10) Relax tension from belt tensioner (Fig. 23). Install accessory drive belt.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 26) for correct belt routing. The correct belt with correct length must be used.

- (11) Position fan shroud and fan blade/viscous fan drive assembly to vehicle as a complete unit.
- (12) Install fan shroud.
- (13) Install fan blade/viscous fan drive assembly to water pump shaft.
- (14) Fill cooling system. Refer to Cooling System—Draining and Refilling in this group.
- (15) Connect battery negative cable.
- (16) Start and warm the engine. Check for leaks.



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Fig. 26 Belt Routing—3.9L/5.2L/5.9L Engines

WATER PUMP BYPASS HOSE

REMOVAL WITHOUT AIR CONDITIONING

(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 MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094) (Fig. 27). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps (Fig. 28). If replacement is necessary, use only an original equipment clamp with matching number or letter.

(2) Loosen both bypass hose clamps (Fig. 27) and position to center of hose. Remove hose from vehicle.

INSTALLATION

- (1) Position bypass hose clamps (Fig. 27) to center of hose.
- (2) Install bypass hose to engine.
- (3) Secure both hose clamps (Fig. 27).
- (4) Fill cooling system. Refer to Refilling the Cooling System in this group.
- (5) Start and warm the engine. Check for leaks.

REMOVAL AND INSTALLATION (Continued)

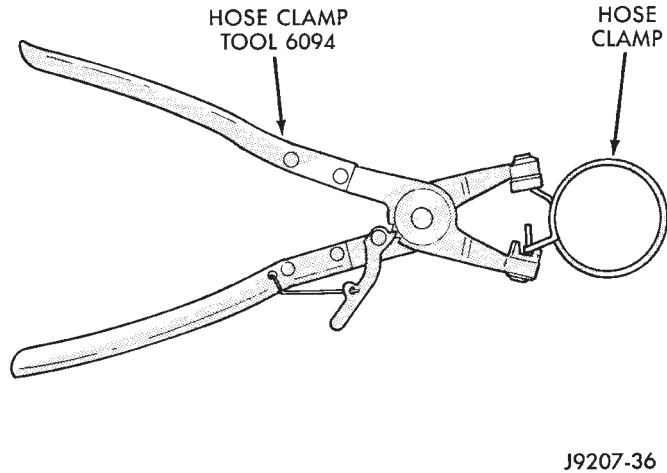


Fig. 27 Hose Clamp Tool—Typical

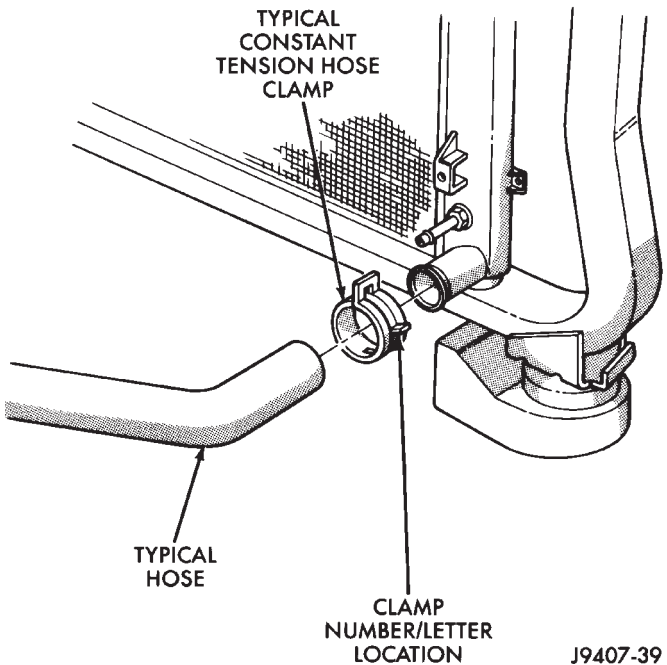


Fig. 28 Clamp Number/Letter Location

REMOVAL WITH AIR CONDITIONING

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 29) 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.

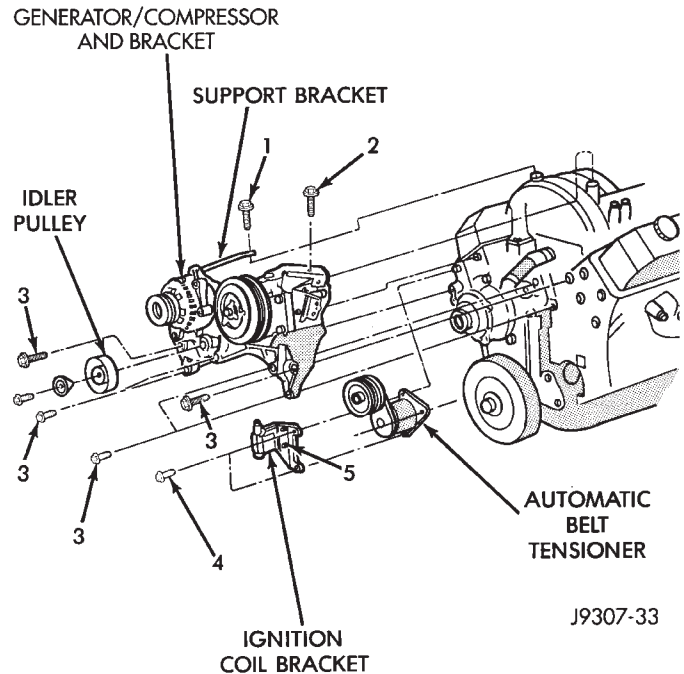


Fig. 29 Generator—A/C Compressor Mounting Bracket—3.9/5.2L/5.9L Engine

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 battery negative cable.
- (2) Partially drain cooling system. Refer to Cooling System—Draining and Filling 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. 27) and hose at radiator.
- (4) Unplug wiring harness from A/C compressor.
- (5) Remove air cleaner assembly.

REMOVAL AND INSTALLATION (Continued)

(6) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic tensioner (Fig. 30). Relax tension from belt by rotating tensioner clockwise (as viewed from front) (Fig. 30). When all belt tension has been relaxed, remove accessory drive belt.

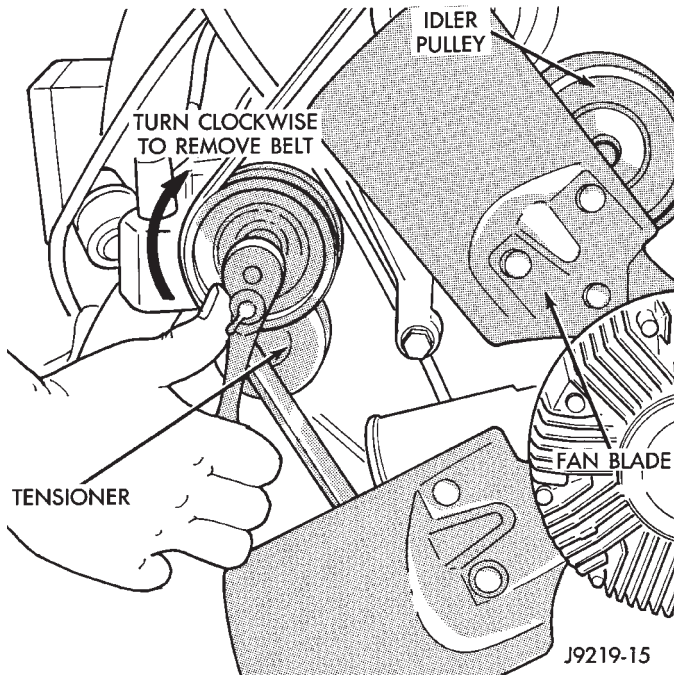


Fig. 30 Automatic Belt Tensioner Assembly

(7) 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. 29).

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

(9) Disconnect throttle body control cables. Refer to Accelerator Pedal and Throttle Cable in Group 14, Fuel System.

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

(11) Remove heater hose coolant return tube mounting bolt (Fig. 31) and remove tube from engine. Discard the old tube O-ring.

(12) Remove bracket-to-intake manifold bolts (number 1 and 2—(Fig. 29).

(13) Remove six bracket bolts (number 3—(Fig. 29).

(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.

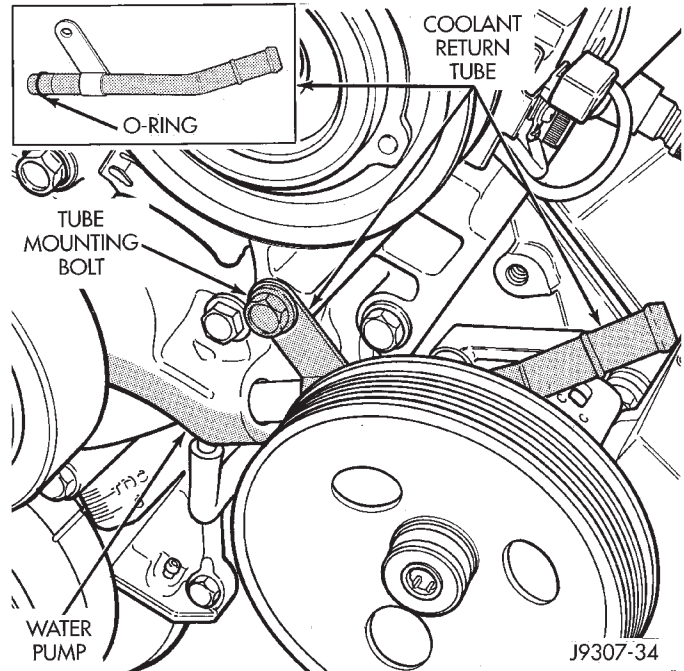


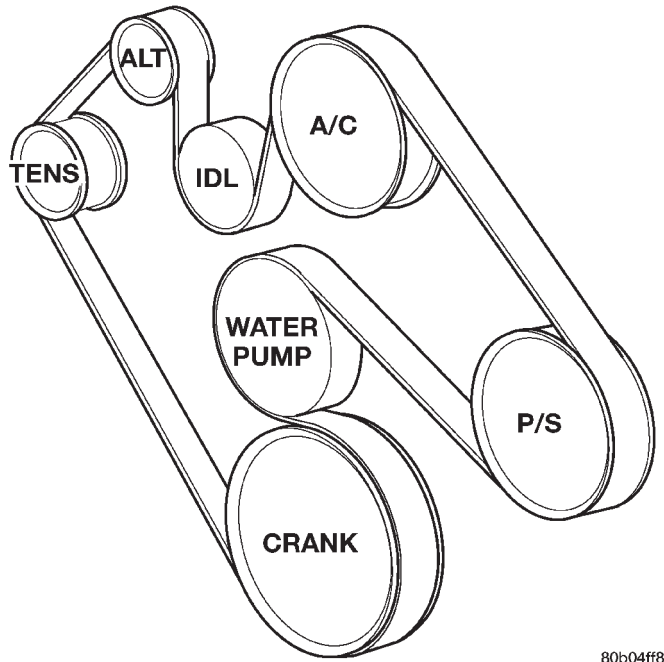
Fig. 31 Coolant Return Tube—3.9/5.2L/5.9L Engines—Typical

INSTALLATION

- (1) Position bypass hose clamps to center of hose.
- (2) Install bypass hose to engine.
- (3) Secure both hose clamps (Fig. 27).
- (4) Install generator-A/C mounting bracket assembly to engine. Tighten bolts (number 1 and 2—(Fig. 29) to 54 N·m (40 ft. lbs.) torque. Tighten bolts (number 3—(Fig. 29) to 40 N·m (30 ft. lbs.) torque.
- (5) Install a new O-ring to the heater hose coolant return tube (Fig. 31). Coat the new O-ring with anti-freeze before installation.
- (6) Install coolant return tube and its mounting bolt to engine (Fig. 31).
- (7) Connect throttle body control cables.
- (8) Install oil dipstick mounting bolt.
- (9) Install idler pulley. Tighten bolt to 54 N·m (40 ft. lbs.) torque.
- (10) Relax tension from belt tensioner (Fig. 30). Install drive belt.

REMOVAL AND INSTALLATION (Continued)

CAUTION: When installing serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 32) for correct belt routing. The correct belt with correct length must be used.



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Fig. 32 Belt Routing—3.9/5.2L/5.9L Engines

- (11) Install air cleaner assembly.
- (12) Install upper radiator hose to radiator.
- (13) Connect wiring harness to A/C compressor.
- (14) Connect battery negative cable.
- (15) Fill cooling system. Refer to Refilling the Cooling System in this group.
- (16) Start and warm the engine. Check for leaks.

THERMOSTAT

REMOVAL

WARNING: DO NOT LOOSEN RADIATOR DRAIN-
COCK 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.

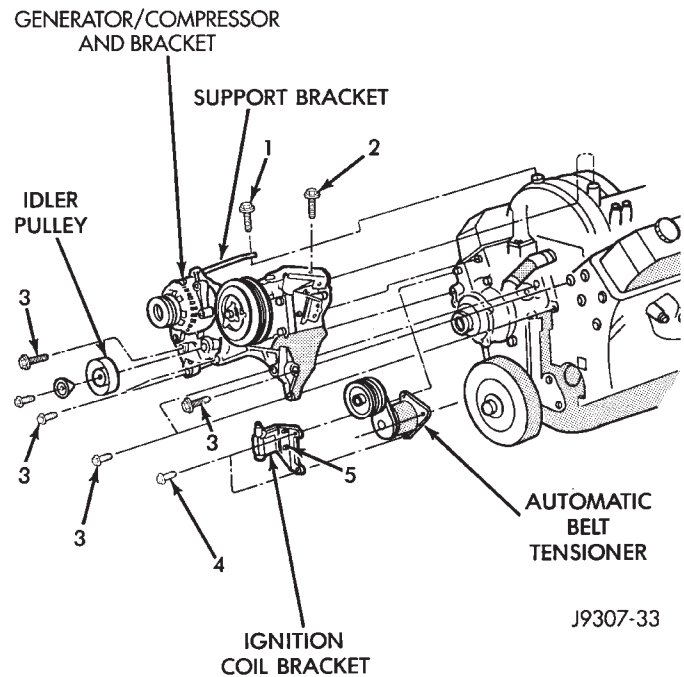
If thermostat is being replaced, be sure that replacement is specified thermostat for vehicle model and engine type.

Factory installed thermostat housings on 3.9L/5.2L/5.9L 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. 33).



J9307-33

Fig. 33 Generator Support Bracket—3.9L/5.2L/5.9L Engine

(4) On air conditioning equipped vehicles, the generator must be partially removed.

(a) Remove generator drive belt as follows: Drive belts on both 3.9L and 5.2L/5.9L engines are equipped with a spring loaded automatic belt tensioner (Fig. 34).

(b) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 34).

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

(d) Remove belt from vehicle.

(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).

REMOVAL AND INSTALLATION (Continued)

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

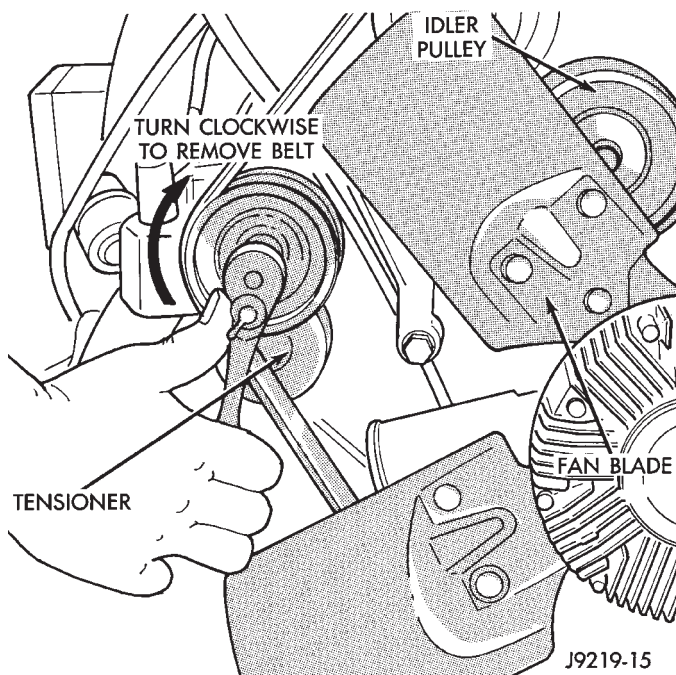


Fig. 34 Automatic Belt Tensioner—3.9L/5.2L/5.9L Engines

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with matching number or letter.

(5) Remove upper radiator hose clamp 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. 35). Discard old gasket.

INSTALLATION

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

(2) Install thermostat (spring side down) into recessed machined groove on intake manifold (Fig. 35).

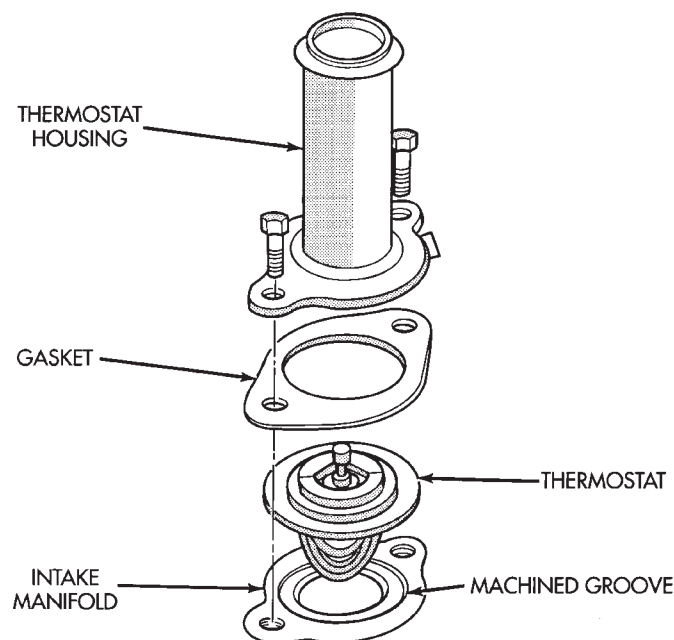


Fig. 35 Thermostat—3.9L/5.2L/5.9L Engines

(3) Install gasket on intake manifold and over thermostat (Fig. 35).

(4) Position thermostat housing to intake manifold. Note the word FRONT stamped on housing (Fig. 36). For adequate clearance, this **must** be placed towards front of vehicle. The housing is slightly angled forward after installation to intake manifold.

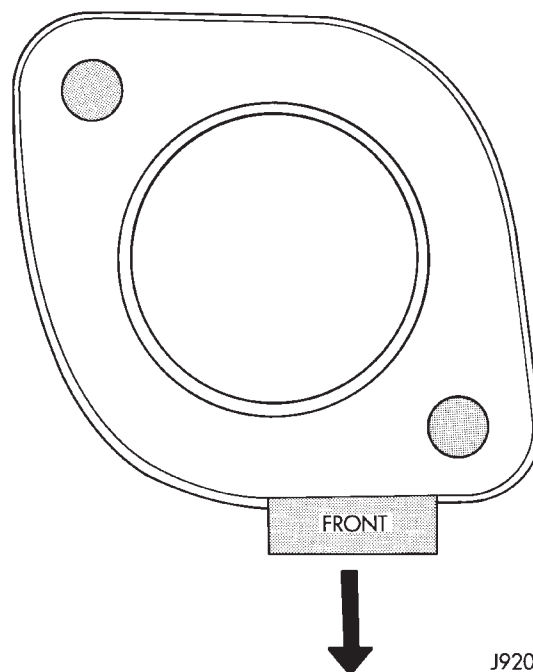


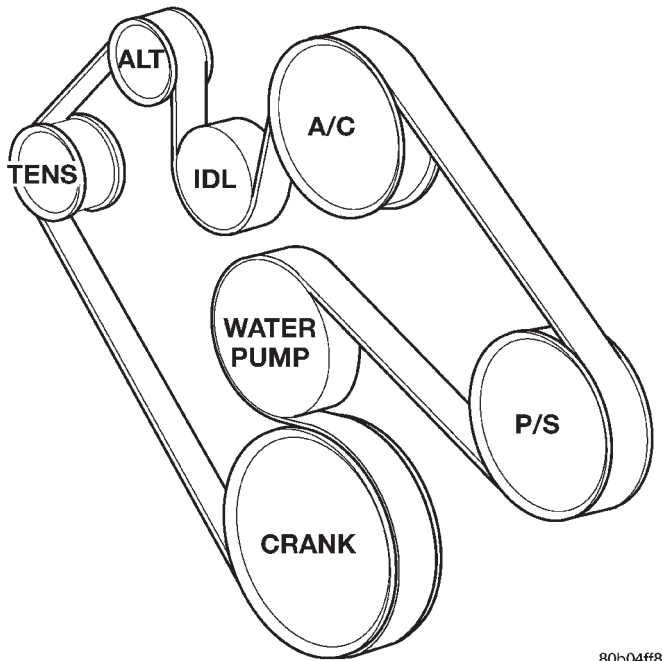
Fig. 36 Thermostat Position—3.9L/5.2L/5.9L Engines

REMOVAL AND INSTALLATION (Continued)

- (5) Install two housing-to-intake manifold bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.
- (6) Install upper radiator hose to thermostat housing.
- (7) Air Conditioned vehicles:

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 37) for correct 3.9/5.2L engine belt routing. The correct belt with correct length must be used.

- (a) Install generator. Tighten bolts to 41 N·m (30 ft. lbs.).
- (b) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 33). Tighten bolts to 54 N·m (40 ft. lbs.) torque.
- (c) Position drive belt over all pulleys **except** idler pulley (located between generator and A/C compressor).
- (d) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 34).
- (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.



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Fig. 37 Belt Routing—3.9L/5.2L/5.9L Engines

- (8) Fill cooling system. Refer to Refilling Cooling System in this group.
- (9) Connect battery negative cable.
- (10) Start and warm the engine. Check for leaks.

RADIATOR

REMOVAL

- (1) Disconnect battery negative cable.

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

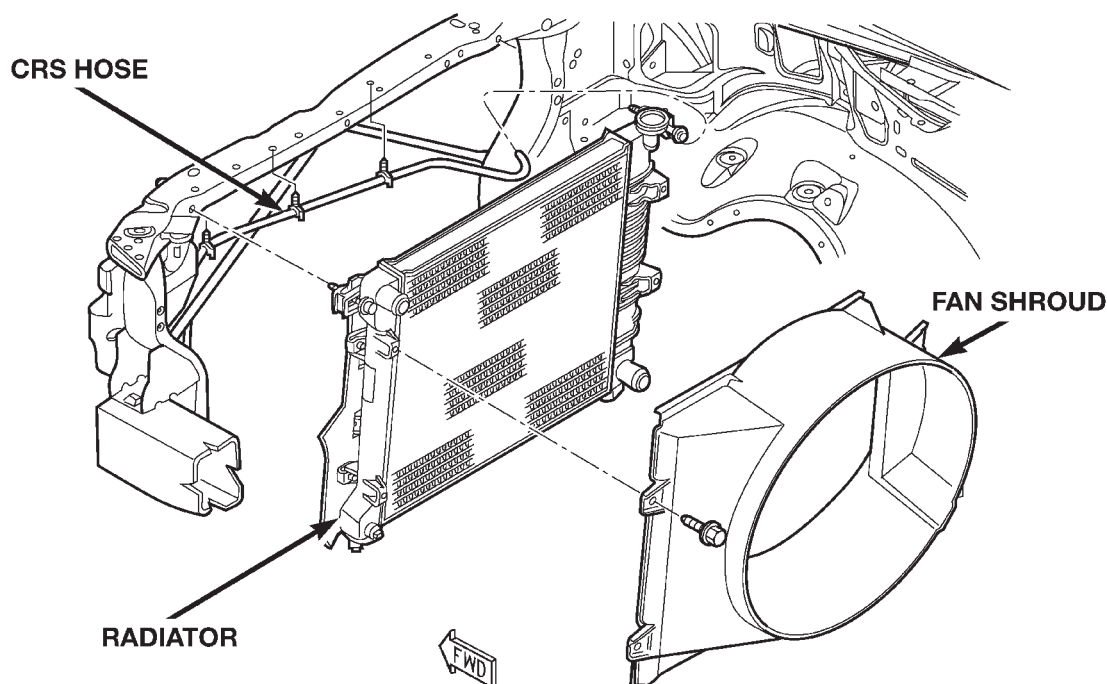
- (2) Drain cooling system. Refer to Cooling System—Draining and Filling in this group.
- (3) Remove fan shroud retaining hardware (Fig. 38).
- (4) Position fan shroud towards engine. Fan shroud does not have to be removed from vehicle.
- (5) Disconnect transmission cooler lines at radiator (Fig. 39). Use quick connect fitting release tool #6935.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

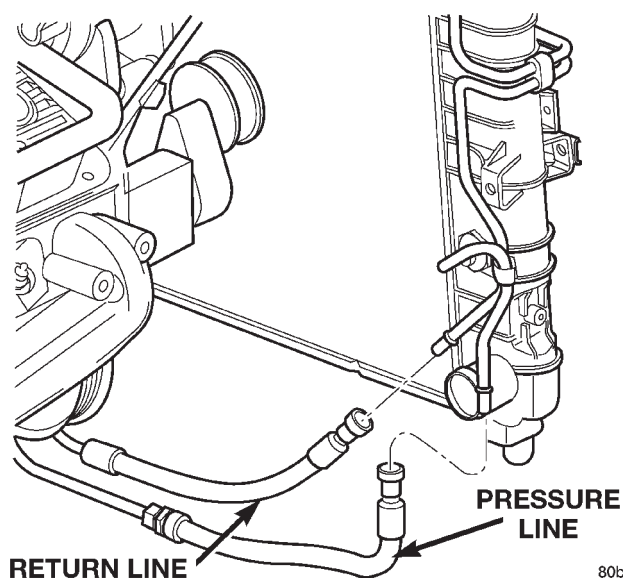
CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with matching number or letter.

- (6) Remove upper and lower radiator hose clamps (Fig.) and hoses at radiator.
- (7) Remove two upper radiator-to-radiator support bolts (Fig. 38). The radiator has two alignment pins to align lower part of radiator to lower radiator support.
- (8) Lift radiator up and out of engine compartment. Do not allow cooling fins of radiator to contact any other vehicle component. Radiator fin damage could result.
- (9) Remove transmission auxiliary cooler (Fig. 40) (if equipped).

REMOVAL AND INSTALLATION (Continued)



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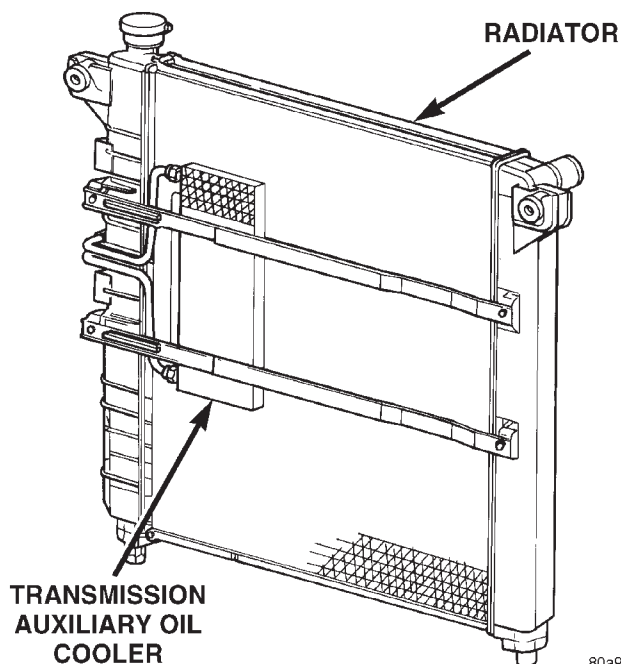
Fig. 38 Radiator Removal/Installation—Typical**Fig. 39 Transmission Oil Cooler Lines at Radiator INSTALLATION**

The radiator has two alignment pins on bottom of the side tanks. These fit into alignment holes in radiator lower support.

(1) If radiator is being replaced, transfer any components not included with replacement radiator.

(2) Install transmission auxiliary cooler (Fig. 40) (if equipped) and tighten fasteners to 10 N·m (90 in. lbs.)

(3) Lower radiator into engine compartment. Position alignment pins into alignment holes in radiator lower support.

**Fig. 40 Transmission Auxiliary Oil Cooler**

(4) Install two upper radiator bolts and tighten to 23 N·m (200 in. lbs.).

(5) Install transmission cooler lines (if equipped). Push connector together until an audible “click” is heard. Moderately pull connector apart to verify connection.

(6) Install both radiator hoses and hose clamps.

(7) Install fan shroud to radiator.

(8) Connect battery negative cable.

REMOVAL AND INSTALLATION (Continued)

(9) Fill cooling system. Refer to Cooling System—Draining and Filling section in this group.

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

(11) Check and adjust transmission fluid level. Refer to Group 21, Transmission and Transfer Case for the correct procedures.

BLOCK HEATER

REMOVAL

(1) Disconnect battery negative cable.

(2) Drain coolant from radiator and cylinder block. Refer to Cooling System—Draining and Filling in this group.

(3) Remove power cord from block heater (Fig. 41).

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

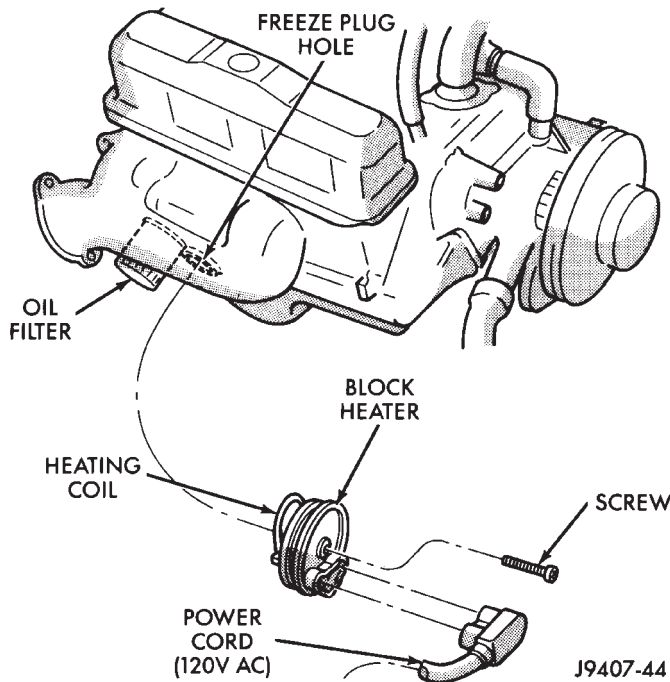


Fig. 41 Block Heater Removal/Installation

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 Cooling System—Draining and Filling section in this group.

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

ACCESSORY DRIVE BELT

REMOVAL

Drive belts on both 3.9L and 5.2L/5.9L engines are equipped with a spring loaded automatic belt tensioner (Fig. 42). 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—3.9/5.2L/5.9L Engines, proceeding in this group.

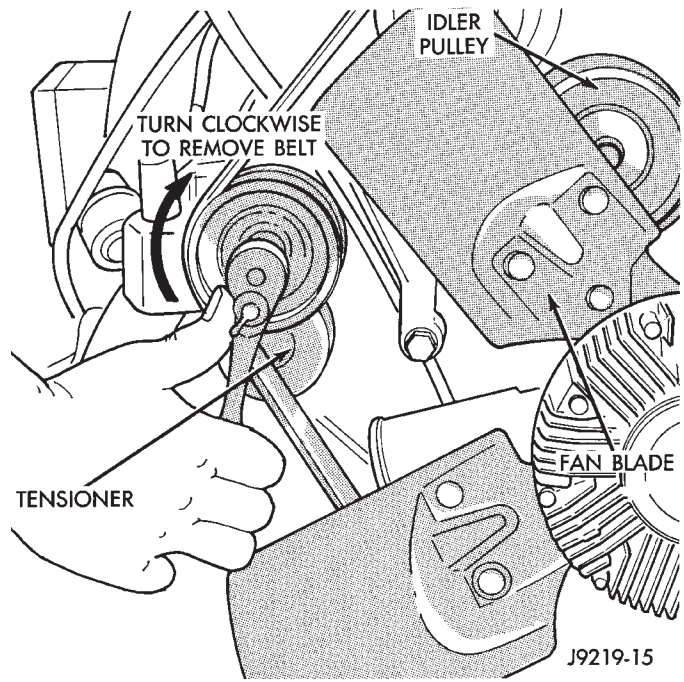


Fig. 42 Automatic Belt Tensioner—Belt Removal/Installation

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 42).

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

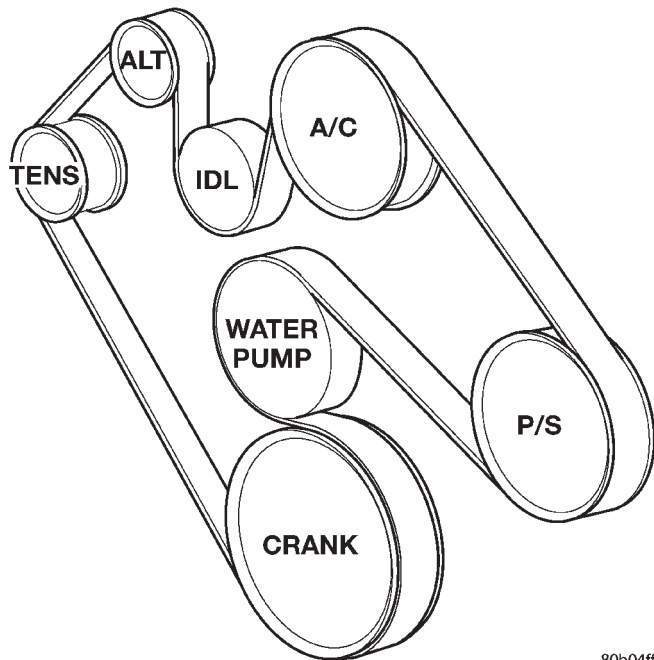
(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: When installing serpentine accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 43) for correct 3.9L/5.2L/5.9L engine belt routing. The correct belt with correct length must be used.



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Fig. 43 Belt Routing—3.9L/5.2L/5.9L Engine

(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 tensioner (Fig. 42).

(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 preceding Automatic Belt Tensioner—3.9L/5.2L/5.9L Engine for more belt information.

The tensioner is equipped with an indexing arrow (Fig. 9) 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. 9). 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. 43)

A used belt should be replaced if tensioner indexing arrow has moved beyond point A (Fig. 9).

AUTOMATIC BELT TENSIONER

REMOVAL

(1) Attach a socket/wrench to mounting bolt of automatic tensioner pulley bolt (Fig. 42).

(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. 9).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC 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, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 43) for correct 3.9L/5.2L/5.9L engine belt routing. The correct belt with correct length must be used

REMOVAL AND INSTALLATION (Continued)

(6) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 42).

(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.

RADIATOR DRAINCOCK

REMOVAL

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

(1) Unscrew draincock stem (counterclockwise rotation). When stem is completely unscrewed, pull it from radiator tank and draincock body (Fig. 44).

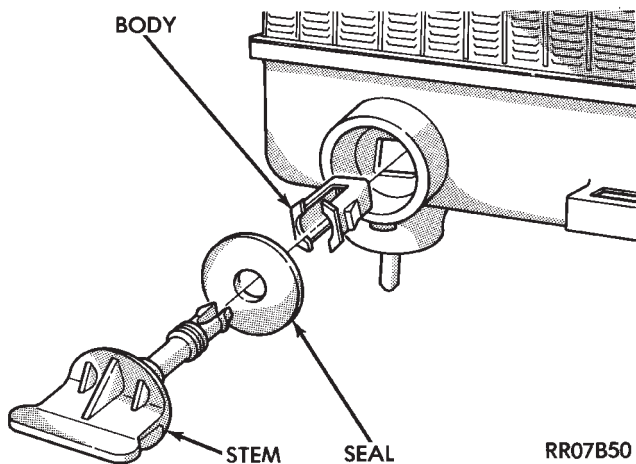


Fig. 44 Draincock Assembly

(2) Using a pair of needle nose pliers, compress draincock body and pull straight out of radiator (Fig. 45).

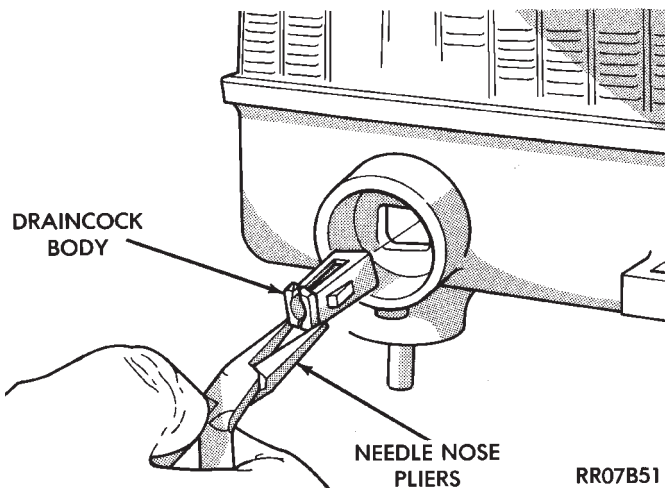


Fig. 45 Draincock Body Removal

INSTALLATION

(1) Install draincock stem loosely into body (Fig. 46). The draincock assembly cannot be installed if stem is threaded into the body.

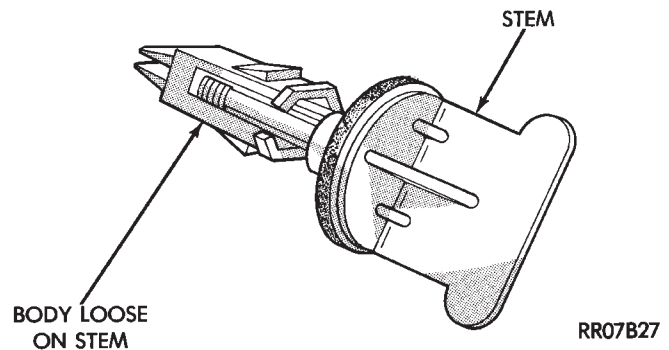


Fig. 46 Draincock Assembled for Installation

(2) Push draincock assembly into opening in radiator tank. It will snap into place when fully seated.

(3) Tighten draincock (clockwise) to 2.0 to 2.7 N·m (18-25 in. lbs.) torque.

VISCIOUS FAN/DRIVE

REMOVAL

For additional information, also refer to Viscous Fan Drive in this group.

(1) Disconnect battery negative cable.

(2) The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft (Fig. 47). 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. 47) to prevent pulley from rotating.

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

(4) Do not unbolt fan blade assembly (Fig. 47) from viscous fan drive at this time.

(5) Remove fan shroud attaching hardware (two bolts at bottom-two clips at top).

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

(7) 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. 47). This pulley is under spring tension.

REMOVAL AND INSTALLATION (Continued)

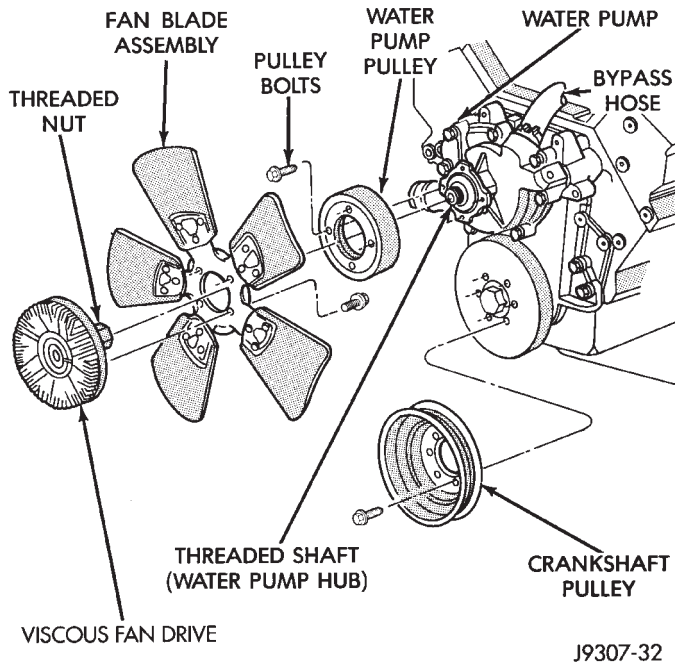


Fig. 47 Fan Blade/Viscous Fan Drive—3.9L/5.2L/5.9L Engine

(8) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 47).

INSTALLATION

- (1) Install fan blade assembly to viscous fan drive. Tighten bolts (Fig. 47) 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) Install fan shroud.
- (4) Install fan blade/viscous fan drive assembly to water pump shaft (Fig. 47) and tighten bolts to 27 N·m (20 ft. lbs.).
- (5) Connect battery negative cable.

Viscous Fan Drive Fluid Pump Out Requirement: After installing a **new** viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

CLEANING AND INSPECTION**RADIATOR CAP**

Hold cap at eye level, right side up. The vent valve (Fig. 29) at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

Hold cap at eye level, upside down. If any light can be seen between vent valve and rubber gasket, replace cap. **Do not use a replacement cap that has a spring to hold vent shut.** A replacement cap must be the type designed for a coolant reserve/overflow system with a completely sealed diaphragm

spring and a rubber gasket. This gasket is used to seal to radiator filler neck top surface. Use of proper cap will allow coolant return to radiator.

RADIATOR

The radiator and air conditioning fins should be cleaned when an accumulation of bugs, leaves etc. has occurred. Clean radiator fins are necessary for good heat transfer. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or A/C condenser of debris.

WATER PUMP**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

FAN BLADE

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

- (1) Remove fan blade and viscous fan drive as an assembly from the engine. Refer to preceding Removal procedure.
- (2) Remove fan blade assembly from viscous fan drive unit (four bolts).
- (3) Lay fan 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: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF FAN IS NOT WITHIN SPECIFICATIONS.

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

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

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

Engine	Capacity
3.9L V-6 Engine	*13.3L (14.0 Qts.)
5.2L V-8 Engine	*13.5L (14.3 Qts.)
5.9L V-8 Engine	*13.5L (14.3 Qts.)

*Nominal refill capacities are shown. A variation may be observed from vehicle due to manufacturing tolerances and refill procedures.

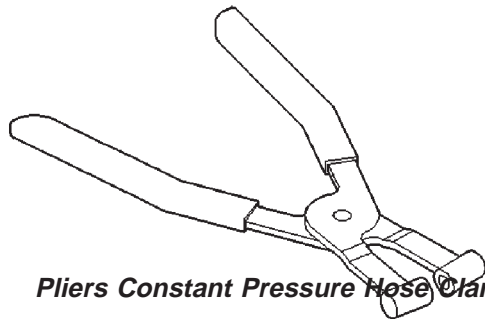
*Capacities shown include vehicles with air conditioning and/or heavy duty cooling systems.

COOLING SYSTEM

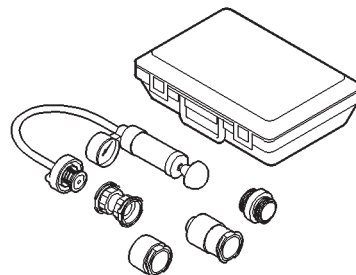
DESCRIPTION	TORQUE
A/C Compressor	
Bolts	27 N·m (20 ft. lbs.)
Automatic Belt Tensioner to Mounting Bracket	
Bolts	67 N·m (50 ft. lbs.)
Automatic Belt Tensioner to Block	
Bolts	41 N·m (30 ft. lbs.)
Automatic Belt Tensioner Pulley	
Bolt	61 N·m (45 ft. lbs.)
Block Heater	
Bolt	2 N·m (17 in. lbs.)
Bracket (Generator/Compressor Mounting)	
Bolts	41 N·m (30 ft. lbs.)
Coolant Recovery Bottle	
Bolts	12 N·m (105 in. lbs.)
Crankshaft Pulley	
Bolts	24 N·m (210 In. lbs.)
Fan Shroud	
Bolts	6 N·m (50 in. lbs.)
Generator	
Bolts/Nuts	41 N·m (30 ft. lbs.)
Idler Pulley (Acc. Drive)	
Bolt	41 N·m (30 ft. lbs.)
Radiator to Support	
Bolts	23 N·m (200 in. lbs.)
Thermostat Housing	
Bolts	20 N·m (15 ft. lbs.)
Transmission Auxiliary Oil Cooler	
Bolts	10 N·m (90 in. lbs.)
Upper Radiator Closure Panel	
Bolts	10 N·m (90 in. lbs.)
Water Pump	
Bolts	40 N·m (30 ft. lbs.)
Water Pump Pulley	
Bolts	24 N·m (210 In. lbs.)

SPECIAL TOOLS

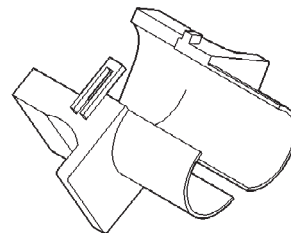
COOLING



Pliers Constant Pressure Hose Clamp—6094



Cooling System Pressure Tester—7700A



3/8" Disconnect Tool—6935

