COOLING SYSTEM

CONTENTS

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 (when A/T equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

GENERAL INFORMATION (Continued)

COOLING SYSTEM COMPONENTS

The diesel engine cooling system consists of:

- Cross-flow radiator
- Belt driven water pump
- Belt driven mechanical cooling fan
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Vertically mounted thermostat
- Coolant reserve/recovery system
- Transmission oil cooler
- Coolant

COOLING SYSTEM CIRCULATION

Coolant is drawn from the radiator by the water pump. The coolant is then passed through the oil cooler cavity, cooling the engine oil that passes through the engine oil cooler element.

From the oil cooler cavity, the coolant travels through the engine block and circulates around each cylinder bore. The cylinder head gasket is orificed to regulate coolant flow through the cylinder head. Coolant entering the cylinder head on the right side of the block travels through the cylinder head lower cavity, across the valve seat area of the head.

It then joins the coolant entering the head on the left side of the block, which travels through the cylinder head upper cavity, cooling the valve bridges and injector bores. The coolant then travels down the exhaust manifold side of the engine, towards the thermostat. A tap point (fitting) in the cylinder head provides coolant to the cab heater core. This coolant returns from the heater core by way of a transfer pipe that delivers the coolant back to the water pump inlet.

When the engine is below operating temperature, the thermostat is closed, allowing coolant to by-pass the radiator and travel back to the water pump inlet through internal passages in the cylinder head and block.

When the engine reaches operating temperature, the thermostat opens, blocking the by-pass passage to the water pump, and allows coolant to circulate through the radiator.

Coolant flow circuits for the 5.9L diesel engine are shown in (Fig. 1).

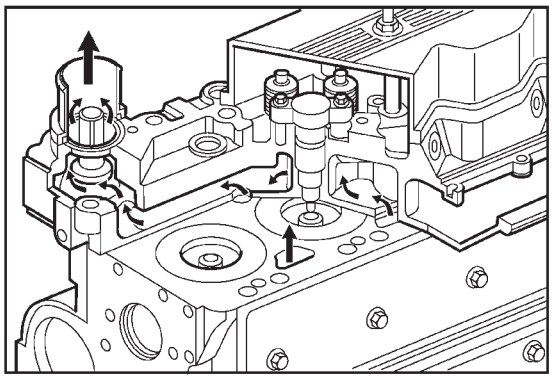
COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system 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. Refer to Description and Operation in this group for more information.

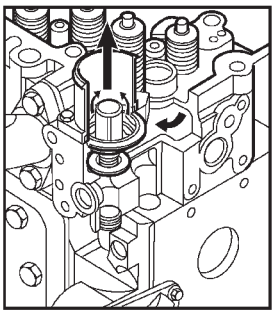
COOLANT

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.

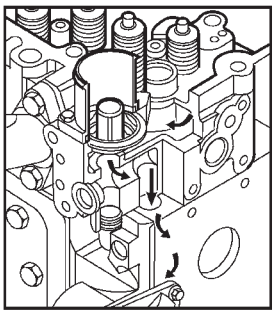
GENERAL INFORMATION (Continued)



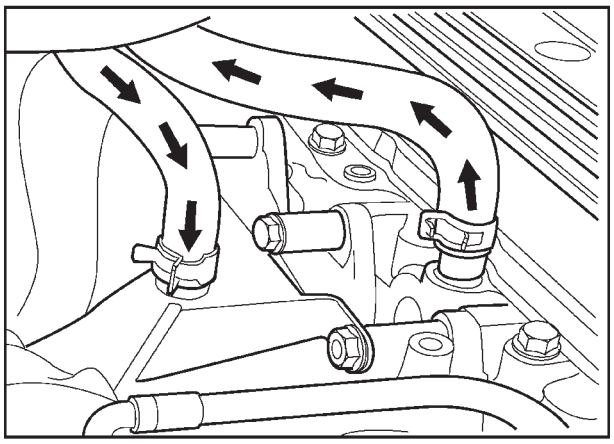
COOLANT FLOW THROUGH CYLINDER HEAD



THERMOSTAT OPEN BYPASS CLOSED



THERMOSTAT CLOSED BYPASS OPEN



HEATER CORE SUPPLY AND RETURN HOSES

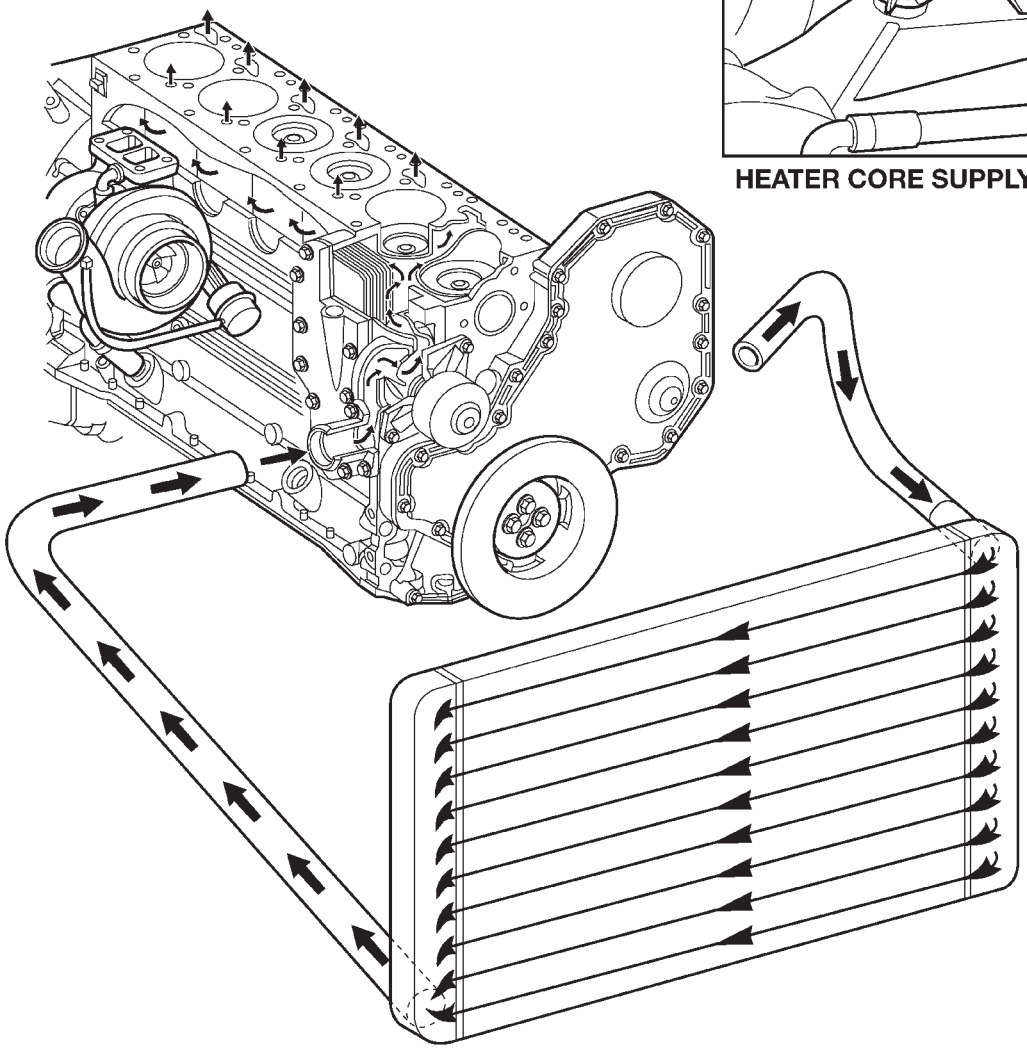


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Fig. 1 Cooling System Circulation

GENERAL INFORMATION (Continued)

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. See Description and Operation in this group for more information.

RADIATOR

The radiator used on the diesel engine is of a cross-flow design with horizontal tubes through the radiator core and vertical side tanks. The radiator consists of an aluminum core and uses brass side tanks.

The radiator supplies sufficient heat transfer to cool the engine and automatic transmission (if equipped).

THERMOSTAT

The thermostat of the 5.9L diesel engine is located in the front of the cylinder head, underneath the water outlet connector (Fig. 2).

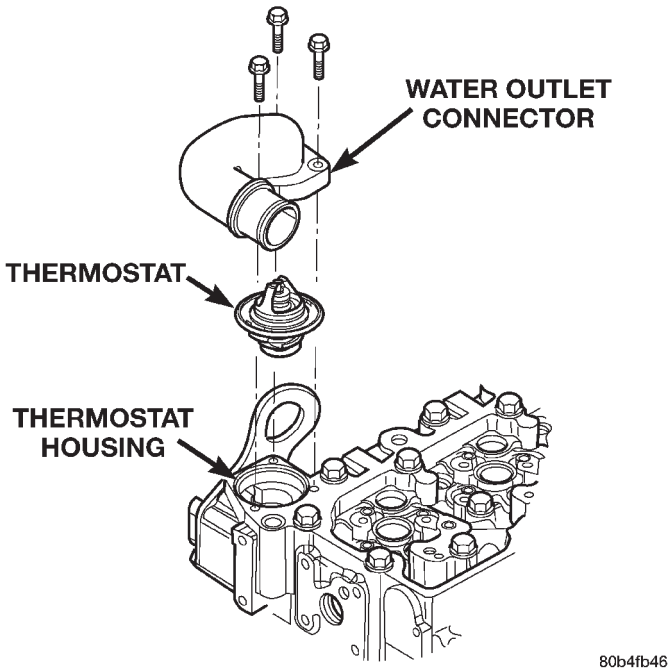

Fig. 2 Thermostat—5.9L Diesel—Typical

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

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing. An engine with the thermostat removed will operate in the radiator bypass mode, causing an overheat condition.

ACCESSORY DRIVE BELT AND TENSION

The accessory drive components are driven by a single, crankshaft driven, serpentine accessory drive belt on all engines. An automatic belt tensioner is also used to maintain correct belt tension at all times. This is used on all engines. Refer to Automatic Belt Tensioner proceeding in this group.

Correct accessory drive belt tension is required to be sure of optimum performance of belt driven engine accessories. If specific 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.

It is not necessary to adjust belt tension on the diesel engine because it is equipped with an automatic belt tensioner. The tensioner maintains correct belt tension at all times. For other tensioner information and removal/installation procedures, refer to Accessory Drive Belt Tensioner proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge to measure belt tension.

DESCRIPTION AND OPERATION

THERMOSTAT

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. When coolant temperature is below 83°C (181°F), the thermostat is closed (Fig. 3).

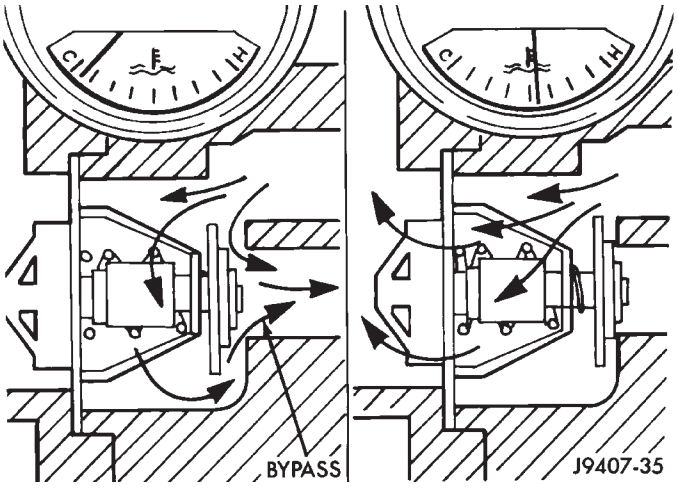

Fig. 3 Thermostat Operation—5.9L Diesel—Typical

DESCRIPTION AND OPERATION (Continued)

The thermostat is vertically mounted and uses caged vent balls (Fig. 4), which act as valves which bleed air from the system. They also quickly vent air when the system is being filled.

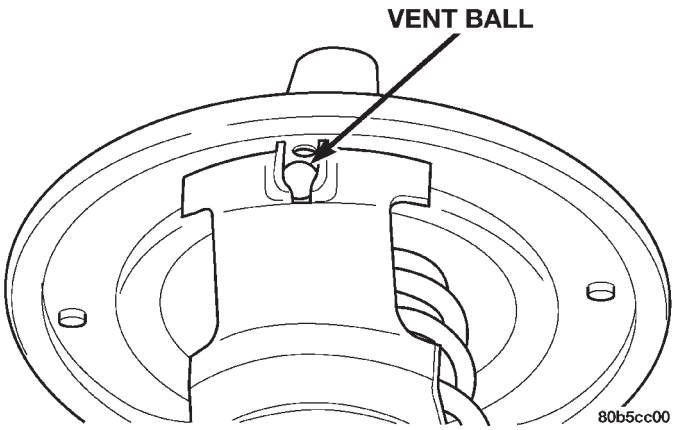

Fig. 4 Thermostat Vent Valve—Typical

When coolant temperature reaches 83°C (181°F), the thermostat begins to open allowing coolant flow to the radiator. This provides quick engine warm-up and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature of 83°C (181°F) and to be fully open for maximum coolant flow at approximately 95°C (203°F). Above 95°C (203°F), coolant temperature is controlled by the radiator, fan and ambient temperature.

AUTOMATIC TRANSMISSION OIL COOLERS

All diesel models equipped with an automatic transmission are equipped with both a main water-to-oil cooler and a separate air-to-oil cooler. Both coolers are supplied as standard equipment on diesel engine powered models when equipped with an automatic transmission.

Transmission oil is cooled when it passes through these coolers.

The main water-to-oil transmission oil cooler is mounted to a bracket on the turbocharger side of the engine (Fig. 5).

The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 6).

The diesel engine is not equipped with an internal radiator mounted oil cooler.

ACCESSORY DRIVE BELT TENSIONER

Drive belts on all engines are equipped with a spring loaded automatic belt tensioner (Fig. 7). This tensioner maintains constant belt tension at all times and requires no maintenance or adjustment. Refer to Diagnosis and Testing for accessory drive belt and tensioner diagnostic procedures.

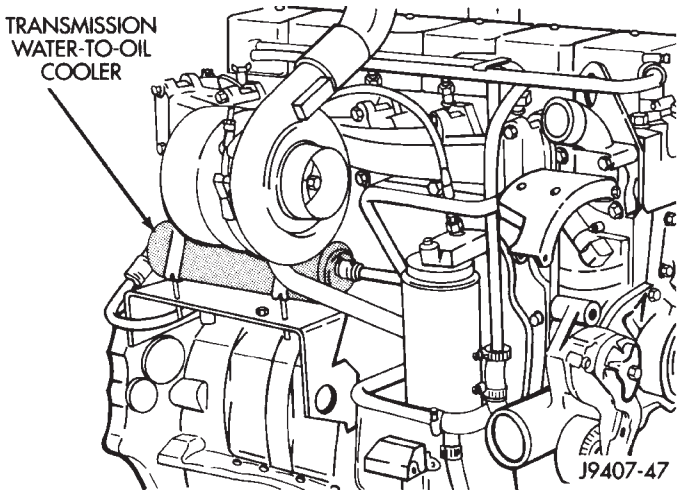

Fig. 5 Transmission Water-To-Oil Cooler—Diesel Engine—Typical

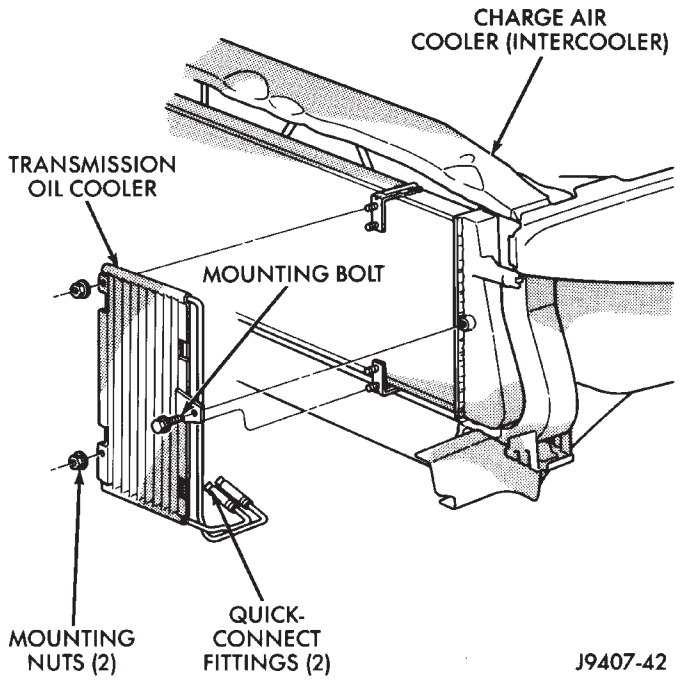

Fig. 6 Auxiliary Transmission Oil Cooler—Diesel Engine

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner.

BLOCK HEATER

An optional engine block heater is available on 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

DESCRIPTION AND OPERATION (Continued)

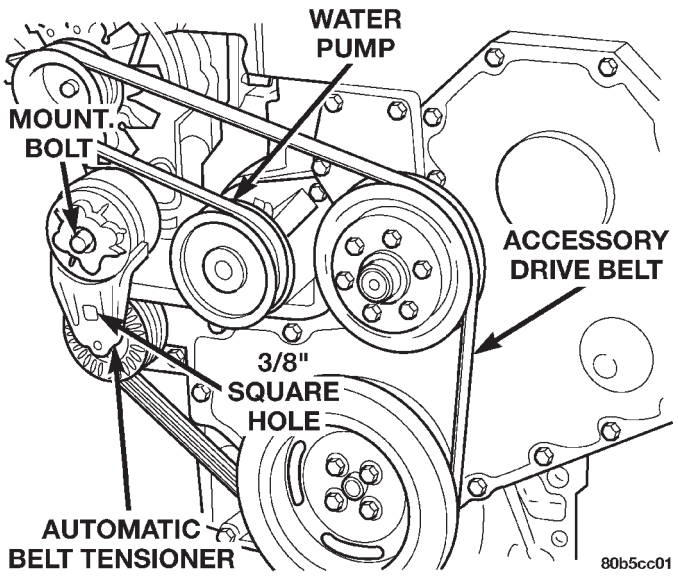

Fig. 7 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

coolant. Connect the 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.

The diesel engine block heater is located on the right side of the engine below the exhaust manifold, threaded into the block next to the oil cooler (Fig. 8).

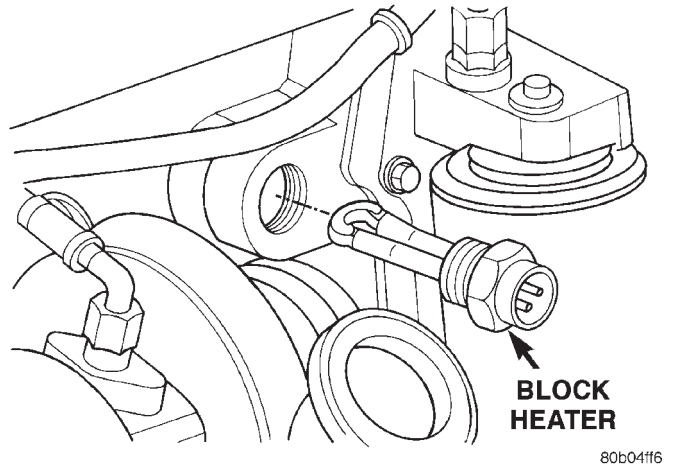

Fig. 8 Engine Block Heater—5.9L Diesel Engine

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 antifreeze 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. It's 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 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

DESCRIPTION AND OPERATION (Continued)

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-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. Only use an antifreeze containing ALUGARD 340-2 ™ such as Mopar Antifreeze. If coolant becomes contaminated or looses color, drain and flush cooling system and fill with correctly mixed solution.

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

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

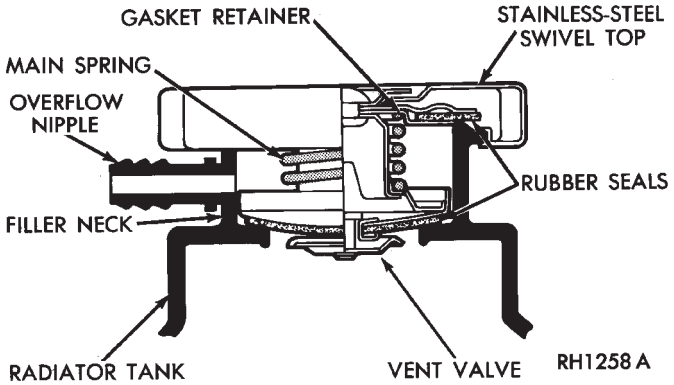

Fig. 9 Radiator Pressure Cap and Filler Neck—Typical

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. 9).

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.

WATER PUMP

The diesel engine water pump draws coolant from radiator outlet and circulates it through engine, heater core and back to radiator inlet. The crankshaft pulley drives the water pump with a serpentine drive belt (Fig. 10). An automatic belt tensioner (Fig. 10) is used to prevent the belt from slipping.

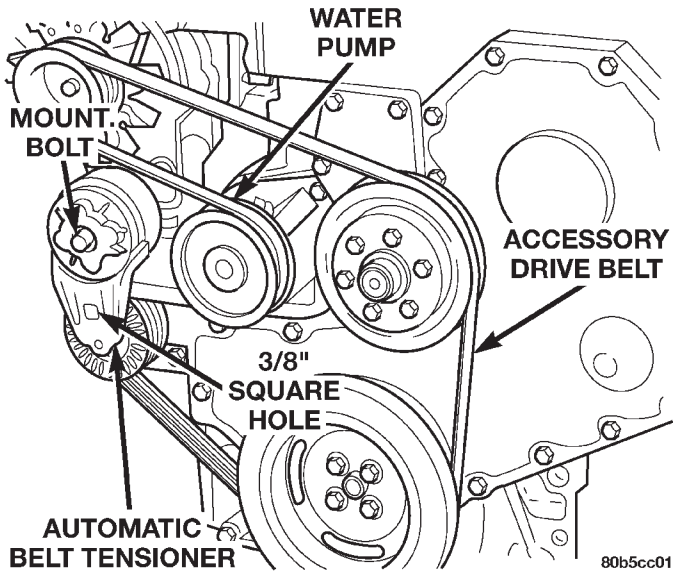

Fig. 10 Water Pump—5.9L Diesel—Typical (non-A/C shown)

COOLING SYSTEM HOSES AND CLAMPS

Rubber hoses route coolant to and from the radiator, intake manifold and heater core. Radiator lower hoses are spring-reinforced to prevent collapse from water pump suction at moderate and high engine speeds.

Inspect the 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.

DESCRIPTION AND OPERATION (Continued)

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. 11). 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. 12). If replacement is necessary, use only an original equipment clamp with a matching number or letter.

Ordinary worm gear type hose clamps (when equipped) can be removed with a straight screwdriver or a hex socket. **To prevent damage to hoses or clamps, the hose clamps should be tightened to 4 N·m (34 in. lbs.) torque. Do not over tighten hose clamps.**

For all vehicles: In areas where specific routing clamps are not provided, be sure that hoses are positioned with sufficient clearance. Check clearance from exhaust manifolds and pipe, fan blades, drive belts and sway bars. Improperly positioned hoses can be damaged, resulting in coolant loss and engine overheating.

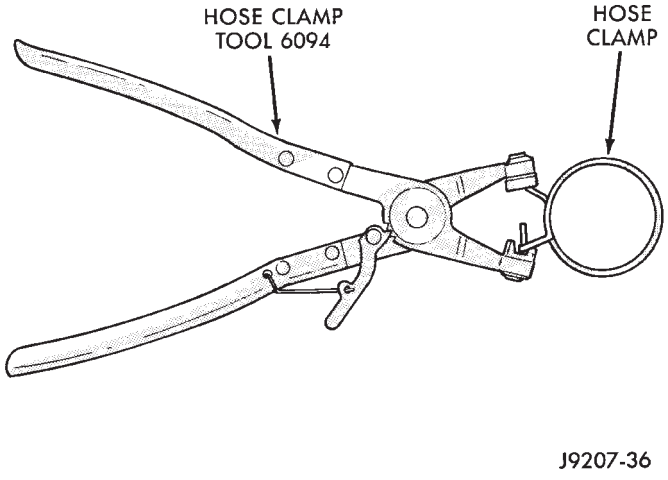

Fig. 11 Hose Clamp Tool—Typical

COOLANT RESERVE/OVERFLOW SYSTEM

The coolant reserve/overflow system 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

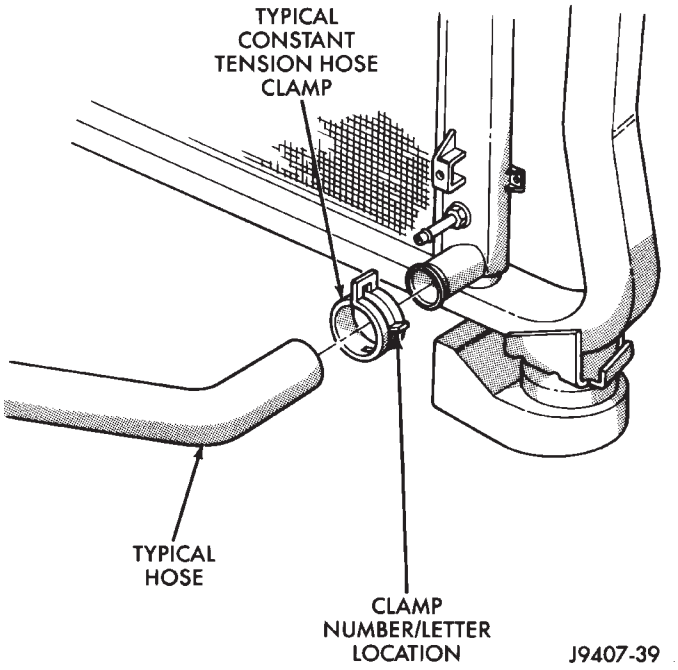

Fig. 12 Clamp Number/Letter Location

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.

On the 5.9L diesel engine, the coolant reserve/overflow tank is mounted to the side of the fan shroud (Fig. 13).

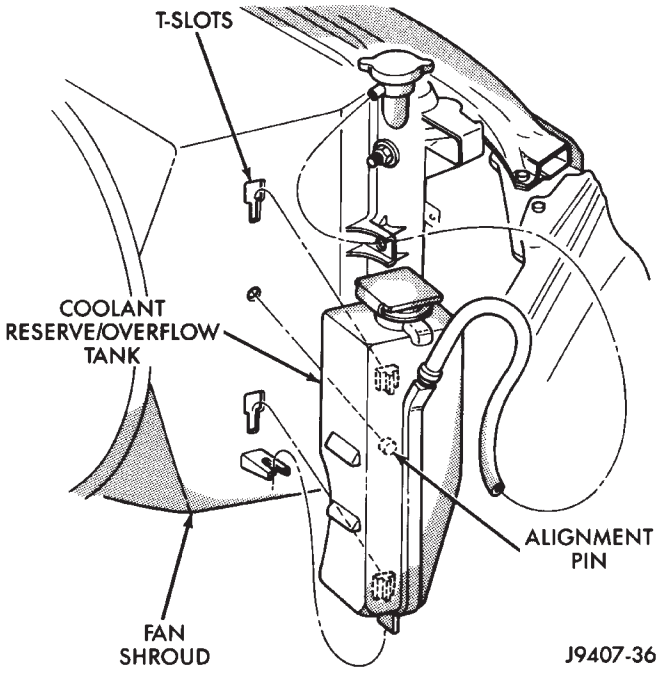

Fig. 13 Coolant Reserve/Overflow Tank

DESCRIPTION AND OPERATION (Continued)

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, it can be cleaned with detergent and water. Rinse tank thoroughly before refilling cooling system as described in the Coolant section of this group.

VISCOUS FAN DRIVE

The thermal viscous fan drive (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.

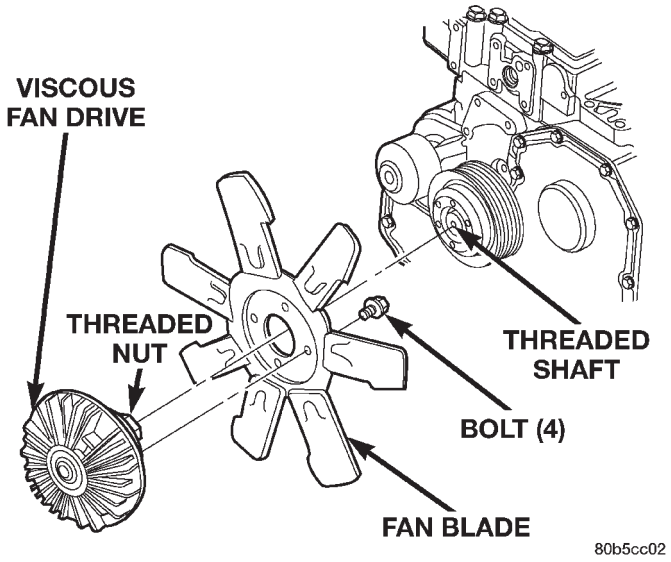

Fig. 14 Viscous Fan/Drive Assembly

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (a typical viscous unit is shown in (Fig. 15). 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.

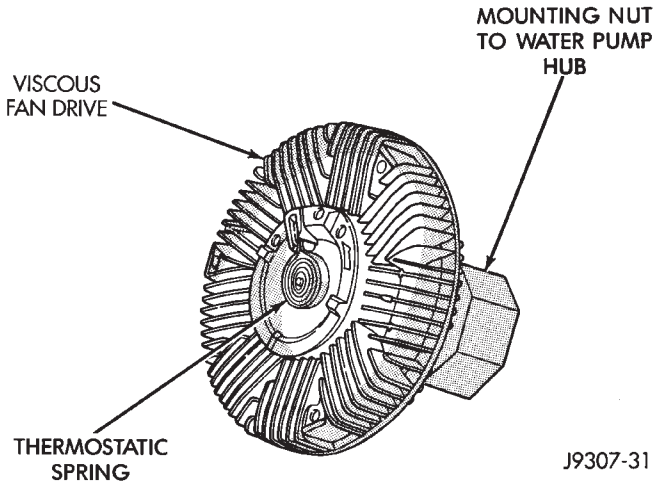

Fig. 15 Viscous Fan Drive—Typical

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.

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.

DIAGNOSIS AND TESTING

PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

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

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

Driving techniques that avoid overheating are:

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

(2) TRAILER TOWING:

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

(3) AIR CONDITIONING; ADD-ON OR AFTER MARKET:

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

(4) RECENT SERVICE OR ACCIDENT REPAIR:

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

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts. Incorrect water pump 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.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded.	1. The low gauge reading may be normal. Refer to thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine.
	2. Is the temperature gauge connected to the temperature gauge coolant sensor on the engine?	2. Check the engine temperature sensor connector in the engine compartment. Refer to Group 8E. Repair as necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. Refer to Group 8E. Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	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 precautions before removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. Refer to Group 24, Heating and Air Conditioning for procedures.
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM	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.	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 normal range, determine the cause for overheating and repair. Refer to POSSIBLE CAUSES (numbers 2 through 17).
	2. Is temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Coolant low in coolant reserve/overflow tank and radiator?	3. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System For Leaks in this group.
	4. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following step 5.	4. Tighten cap.
	5. Poor seals at radiator cap.	5. (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.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM COOLING SYSTEM - CONT.	6. 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. As the engine cools, a vacuum is formed in the cooling system of the engine and radiator. If radiator cap seals are defective, or cooling system has leaks, a vacuum can not be formed.	6. (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 the 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 tank hoses for blockage. Repair as necessary.
	7. Freeze point of antifreeze not correct. Mixture may be too rich.	7. Check antifreeze. Refer to Coolant section of this group. Adjust antifreeze-to-water ratio as required.
	8. Coolant not flowing through system.	8. 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 reason for lack of flow and repair as necessary.
	9. Radiator or A/C condenser fins are dirty or clogged.	9. Clean insects or debris. Refer to Radiator Cleaning in this group.
	10. Radiator core is corroded or plugged.	10. Have radiator re-cored or replaced.
	11. Aftermarket A/C installed without proper radiator.	11. Install proper radiator.
	12. Dragging brakes.	12. Check and correct as necessary. Refer to Group 5, Brakes in the manual text.
	13. Bug screen is being used reducing airflow.	13. Remove bug screen.
	14. Thermostat partially or completely shut. This is more prevalent on high mileage vehicles.	14. Check thermostat operation and replace as necessary. Refer to Thermostats in this group.
	15. Thermal viscous fan drive not operating properly.	15. Check fan drive operation and replace if necessary. Refer to Viscous Fan Drive in this group.
	16. Cylinder head gasket leaking.	16. Check for cylinder head gasket leaks. Refer to Testing Cooling System For Leaks in this group. For repair, refer to Group 9, Engines.
	17. Heater core leaking.	17. Check heater core for leaks. Refer to Group 24, Heating and Air Conditioning. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING IS INCONSISTENT (FLUCTUATES, CYCLES OR IS ERRATIC)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly. Fluctuation is also influenced by loads, outside temperature and extended idle time with diesel engines.	1. A normal condition. No correction is necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	2. Check operation of gauge and repair if necessary. Refer to Group 8E, Instrument Panel And Gauges.
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running).	3. A normal condition. No correction is necessary. Gauge reading should return to normal range after vehicle is driven.
	4. Gauge reading high after re-starting a warmed-up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. Refer to Testing Cooling System For Leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing thermostat to open late.	6. (a) Check for cylinder head gasket leaks with a commercially available Block Leak Tester. Repair as necessary. (b) Check for coolant in the engine oil. Inspect for white steam emitting from exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. Refer to Water Pumps in this group.
	8. Loose accessory drive belt (water pump slipping).	8. Refer to Engine Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of water pump allows air to build up in cooling system causing thermostat to open late.	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	1. Pressure relief valve in radiator cap is defective.	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 IS READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. Refer to Testing Cooling System For Leaks in this group.

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DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
HOSE OR HOSES COLLAPSE WHEN ENGINE IS COOLING	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.
NOISY FAN	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 (roaring) may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	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 AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED)	1. Radiator and/or A/C condenser is restricted, obstructed or dirty (insects, leaves etc.). 2. Thermal viscous fan drive is free-wheeling. 3. Engine is overheating (heat may be transferred from radiator to A/C condenser. High underhood temperatures due to engine overheating may also transfer heat to A/C components). 4. Some models with certain engines are equipped with air seals at the radiator and/or A/C condenser. If these seals are missing or damaged, not enough air flow will be pulled through the radiator and A/C condenser.	1. Remove restriction and/or clean as necessary. Refer to Radiator Cleaning in this group. 2. Refer to Viscous Fan Drive for diagnosis. Repair as necessary. 3. Correct overheating condition. Refer to text in Group 7, Cooling. 4. Check for missing or damaged air seals and repair as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. MAY BE ACCOMPANIED BY LOW GAUGE READING	1. Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded.	1. The low gauge reading may be normal. Refer to Thermostats in the manual text for information. See Thermostat Diagnosis - Diesel Engine.
	2. Coolant level low.	2. Refer to Testing Cooling System For Leaks in the manual text. Repair as necessary.
	3. Obstructions in heater hose fittings at engine.	3. Remove heater hoses at both ends and check for obstructions. Repair as necessary.
	4. Heater hose kinked.	4. Locate kinked area and repair as necessary.
	5. Water pump is not pumping water to heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly. The accessory drive belt may also be slipping causing poor water pump operation.	5. Refer to Water Pumps in this group. Repair as necessary. If a slipping belt is detected, refer to Engine Accessory Drive Belts in this group. Repair as necessary.
HEAT ODOR	1. Various heat shields are used at certain drive line components. One or more of these shields may be missing.	1. Locate missing shields and replace or repair as necessary.
	2. Is temperature gauge reading above the normal range?	2. Refer to the previous Temperature Gauge Reads High in these Diagnosis Charts. Repair as necessary.
	3. Is cooling fan operating correctly?	3. Refer to Cooling System Fan in this group for diagnosis. Repair as necessary.
	4. Has undercoating been applied to any unnecessary component?	4. Clean undercoating as necessary.

DIAGNOSIS AND TESTING (Continued)

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE—CONTINUED

Condition	Possible Causes	Correction
STEAM IS COMING FROM FRONT OF VEHICLE NEAR GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	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.	1. Occasional steam emitting from this area is normal. No repair is necessary.
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 antifreeze tests. Adjust antifreeze-to-water ratio 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 engine operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

DIAGNOSIS AND TESTING (Continued)

RADIATOR COOLANT FLOW TEST

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

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

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP. THIS WILL 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 the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes, the coolant is circulating.

TESTING COOLING SYSTEM FOR LEAKS

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 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).

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:

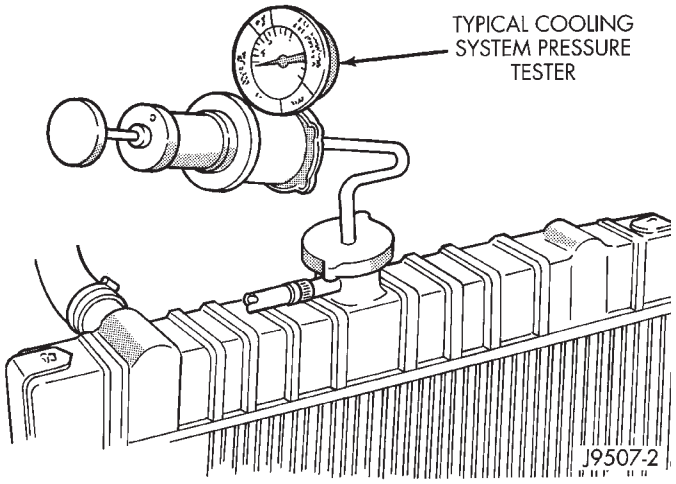


Fig. 16 Pressure Testing Cooling System—Typical

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.

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.

DIAGNOSIS AND TESTING (Continued)

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 17).

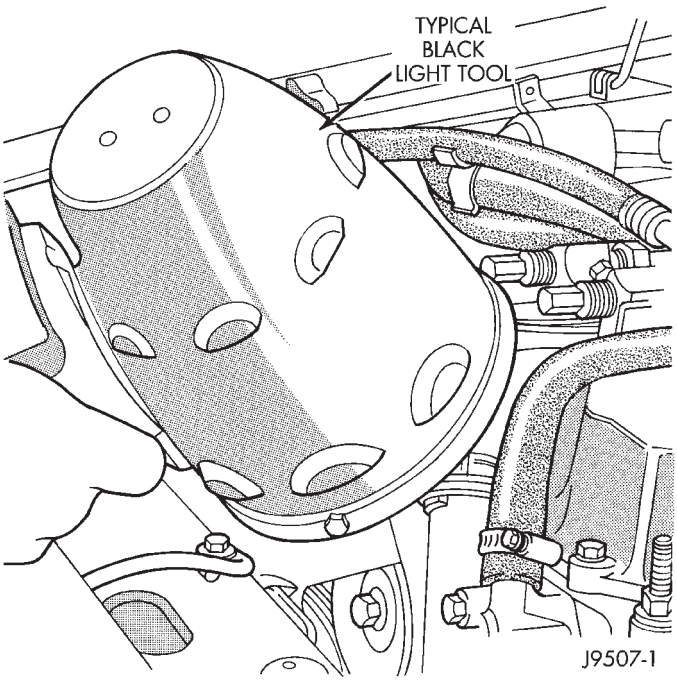


Fig. 17 Leak Detection Using Black Light—Typical

INTERNAL LEAKAGE TEST

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 COOLING SYSTEM 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 (non-diesel engines) 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 DRAINCOCK 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 draincock immediately after test to eliminate boil over.

Start engine and accelerate rapidly three times, to approximately 3000 rpm (2000 rpm for diesel) 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.

VISCOUS FAN DRIVE

NOISE

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.

DIAGNOSIS AND TESTING (Continued)

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.

TESTING

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. The timing light is to be used as a strobe light. This step cannot be used on the diesel engine.

(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 1500 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should start to occur at/between 71° to 82° C (160° to 179° 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 (non-diesel only).

(7) When viscous drive engagement is verified, remove the plastic sheet. Fan drive **disengagement** should start 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.

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.

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. 18), 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. 18). 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.

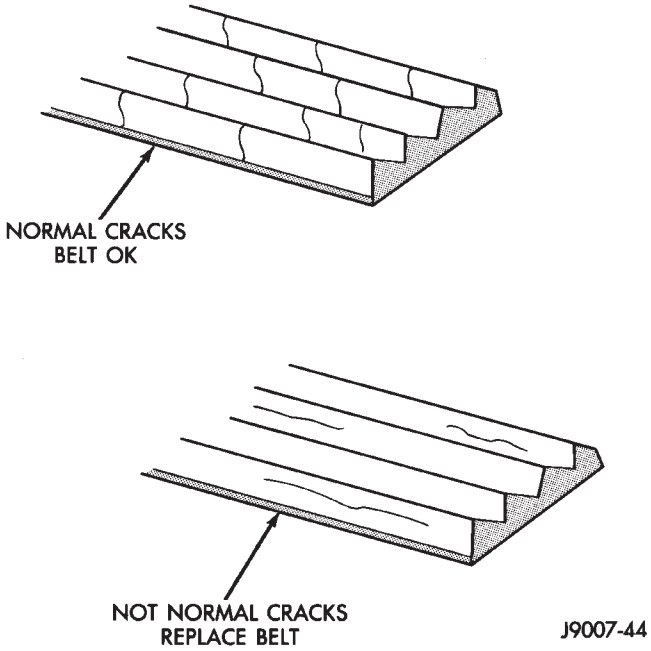


Fig. 18 Belt Wear Patterns

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.

DIAGNOSIS AND TESTING (Continued)

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves.	1. Remove foreign objects from pulley grooves. Replace belt.
	2. Installation damage	2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned	1. Align pulley(s)
	2. Abrasive environment	2. Clean pulley(s). Replace belt if necessary
	3. Rusted pulley(s)	3. Clean rust from pulley(s)
	4. Sharp or jagged pulley groove tips	4. Replace pulley. Inspect belt.
	5. Belt rubber deteriorated	5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension	1. Inspect/Replace tensioner if necessary
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	2. Replace belt and clean pulleys
	3. Driven component bearing failure (seizure)	3. Replace faulty component or bearing
	4. Belt glazed or hardened from heat and excessive slippage	4. Replace belt.
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Pulley(s) not within design tolerance	2. Replace pulley(s)
	3. Foreign object(s) in grooves	3. Remove foreign objects from grooves
	4. Pulley misalignment	4. Align component
	5. Belt cordline is broken	5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension	1. Replace Inspect/Replace tensioner if necessary
	2. Tensile member damaged during belt installation	2. Replace belt
	3. Severe misalignment	3. Align pulley(s)
	4. Bracket, pulley, or bearing failure	4. Replace defective component and belt

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (Objectional squeal, spueak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt

THERMOSTAT

The cooling system used with the diesel engine provides the extra coolant capacity and extra cooling protection needed for higher GVWR (Gross Vehicle Weight Rating) and GCWR (Gross Combined Weight Rating) vehicles.

This system capacity will not effect warm up or cold weather operating characteristics if the thermostat is operating properly. This is because coolant will be held in the engine until it reaches the thermostat "set" temperature.

Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. Because of this, lower temperature gauge readings for diesel versus gasoline engines may, at times be normal.

Typically, complaints of low engine coolant temperature are observed as low heater output when combined with cool or cold outside temperatures.

To help promote faster engine warm-up, the electric engine block heater must be used with cool or cold outside temperatures. This will help keep the engine coolant warm when the vehicle is parked. Use the block heater if the outside temperature is below 4°C (40°F). **Do not use the block heater if the outside temperature is above 4°C (40°F).**

A "Cold Weather Cover" is available from the parts department through the Mopar® Accessories product line. This accessory cover is designed to block airflow entering the radiator and engine compartment to promote faster engine warm-up. It attaches to the front of the vehicle at the grill opening. **The cover is to be used with cool or cold temperatures only. If used with high outside temperatures, serious engine damage could result.** Refer to the literature supplied with the cover for additional information.

TESTING

The following test procedure is to be used for the **diesel engine only.**

(1) To determine if the thermostat is defective, it must be removed from the vehicle. Refer to Thermostats for removal and installation procedures.

(2) After the thermostat has been removed, examine the thermostat and inside of thermostat housing for contaminants. If contaminants are found, the thermostat may already be in a "stuck open" position. Flush the cooling system before replacing thermostat. Refer to Cooling System Cleaning/Reverse Flushing in this group for additional information.

(3) Place the thermostat into a container filled with water.

(4) Place the container on a hot plate or other suitable heating device.

(5) Place a commercially available radiator thermometer into the water.

DIAGNOSIS AND TESTING (Continued)

(6) Apply heat to the water while observing the thermostat and thermometer.

(7) When the water temperature reaches 83°C (181°F) the thermostat should start to open (valve will start to move). If the valve starts to move before this temperature is reached, it is opening too early. Replace thermostat. The thermostat should be fully open (valve will stop moving) at 95°C (203°F).

(7) If the valve is still moving when the water temperature reaches 203°, it is opening too late. Replace thermostat.

(7) If the valve refuses to move at any time, replace thermostat.

WATER PUMP

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.

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).

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:

- Check and adjust antifreeze freeze point
- Refill system with new antifreeze
- Conducting service procedures
- 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 CAPS—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. 19).

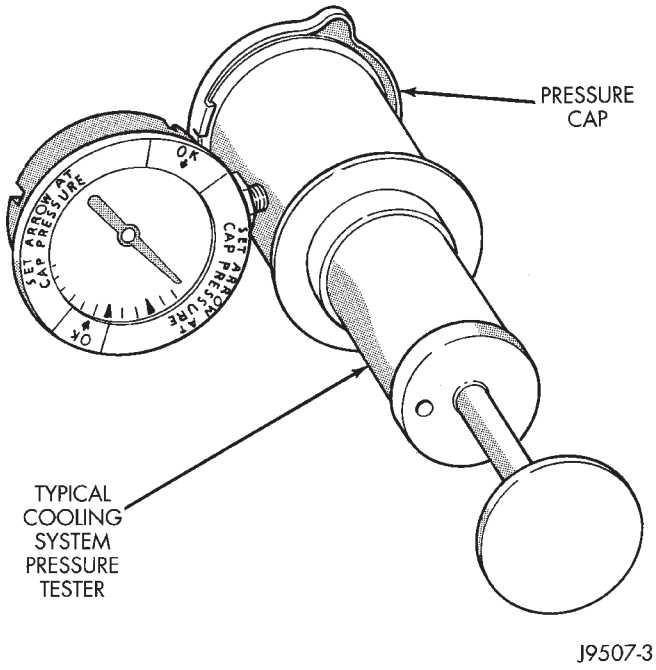


Fig. 19 Pressure Testing Radiator Cap—Typical Tester

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 **CAUTION** below.

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.

DIAGNOSIS AND TESTING (Continued)

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.

DEAERATION

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

SERVICE PROCEDURES

COOLANT LEVEL CHECK—ROUTINE

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

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

COOLANT SERVICE

Refer to your owner's manual for recommended coolant service intervals.

ADDING ADDITIONAL COOLANT—ROUTINE

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

COOLANT LEVEL CHECK—SERVICE

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

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

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

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

DRAINING COOLING SYSTEM

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

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

(1) Start the engine and place the heater control temperature selector in the Full-On position. Engine vacuum is needed to actuate the heater controls.

(2) Turn the ignition off.

(3) Do not remove radiator cap when draining coolant from reserve/overflow tank. Open radiator drain plug and when tank is empty, remove radiator cap. If the coolant reserve/overflow tank does not drain, refer to the Testing Cooling System for Leaks section in this group. The coolant need not be removed from tank unless the system is being refilled with fresh mixture.

(4) Remove radiator pressure cap and allow system to drain completely.

REFILLING COOLING SYSTEM

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

(1) Install the cylinder block drain plugs (Fig.).

(2) Close radiator drain plug.

(3) Fill the cooling system with a 50/50 mixture of water and antifreeze.

(4) Fill coolant reserve/overflow tank to the FULL mark.

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

SERVICE PROCEDURES (Continued)

(6) If necessary, add 50/50 water and antifreeze mixture to the coolant reserve/overflow tank to maintain coolant level. This level should be between the ADD and FULL 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 in the direction opposite 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—DIESEL

(1) Drain the cooling system.

(2) Disconnect the radiator lower hose from the water inlet connection.

(3) Remove the heater core inlet hose from cylinder head fitting. .

(4) Attach water supply hose to cylinder head fitting.

(5) Back-flush the engine until clean water exits the water pump inlet.

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

ACCESSORY DRIVE BELT

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label. This label is located in the engine compartment.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

Drive belts on diesel engines are equipped with a spring loaded automatic belt tensioner (Fig. 20). **(Fig. 20) displays the tensioner for vehicles without air conditioning.**

This belt tensioner will be used on all belt configurations, such as with or without air conditioning. For more information, refer to Automatic Belt Tensioner, proceeding in this group.

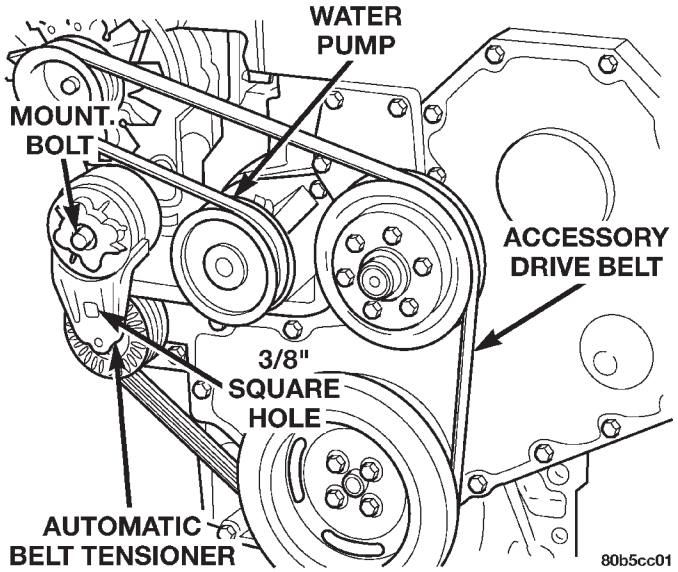


Fig. 20 Belt Tensioner—Typical (non-A/C shown)

REMOVAL

(1) A 3/8 inch square hole is provided in the automatic belt tensioner (Fig. 20). Attach a 3/8 inch drive-long handle ratchet to this hole.

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

REMOVAL AND INSTALLATION (Continued)

(3) Remove belt from water pump pulley first.
(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing the 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. 21) (Fig. 22) for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** water pump pulley.
(2) Attach a 3/8 inch ratchet to tensioner.
(3) Rotate ratchet and belt tensioner counterclockwise. Place belt over water pump pulley. Let tensioner rotate back into place. Remove ratchet. Be sure belt is properly seated on all pulleys.

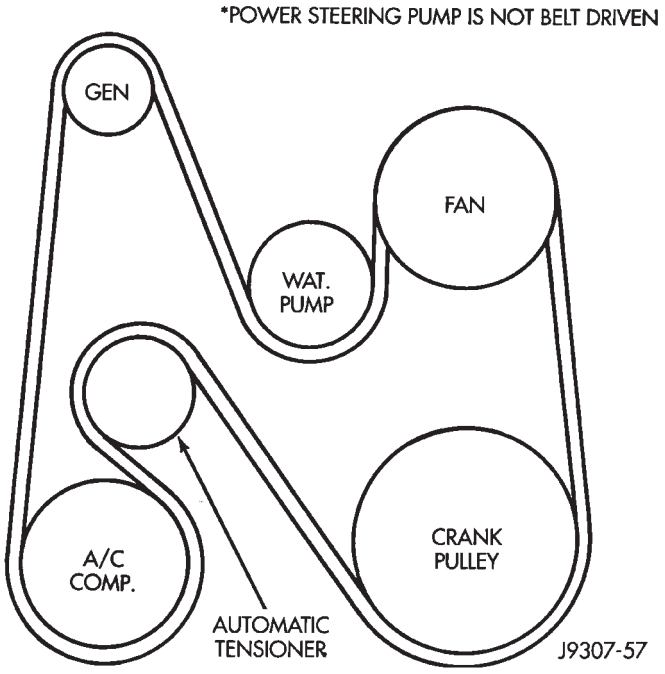


Fig. 21 Belt Routing—With A/C

ACCESSORY DRIVE BELT TENSIONER

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.
(2) Remove tensioner mounting bolt and remove tensioner (Fig. 23).

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

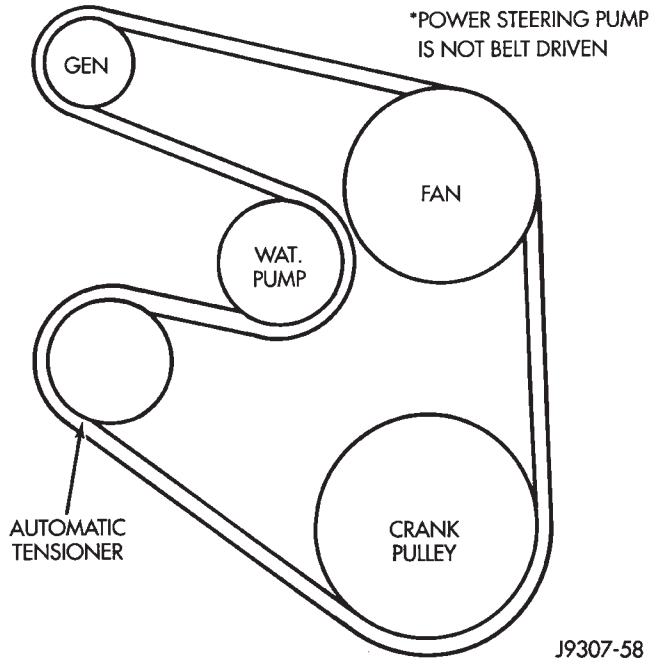


Fig. 22 Belt Routing—Without A/C

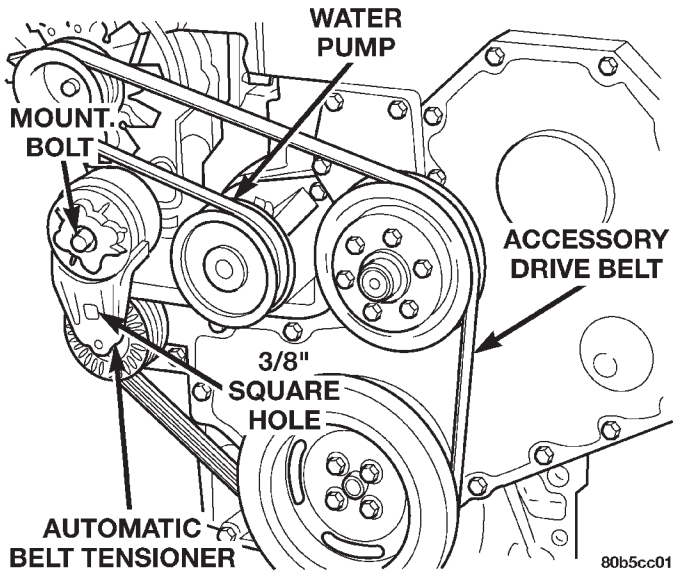


Fig. 23 Accessory Drive Belt Tensioner—Non A/C Shown

INSTALLATION

(1) Install tensioner assembly to mounting bracket. A dowel is located on back of tensioner. Align this dowel to hole in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.
(2) Install drive belt. Refer to Belt Removal/Installation in this group.

REMOVAL AND INSTALLATION (Continued)

COOLANT RECOVERY BOTTLE

REMOVAL

(1) Remove overflow hose from radiator.

(2) Unsnap the coolant reserve/overflow tank from fan shroud. Lift straight up. The fan shroud is equipped with T-shaped slots (Fig. 24) to attach the tank. An alignment pin is located on the side of tank.

INSTALLATION

(1) Snap the tank into the two T-slots and the alignment pin on fan shroud.

(2) Connect overflow hose to radiator.

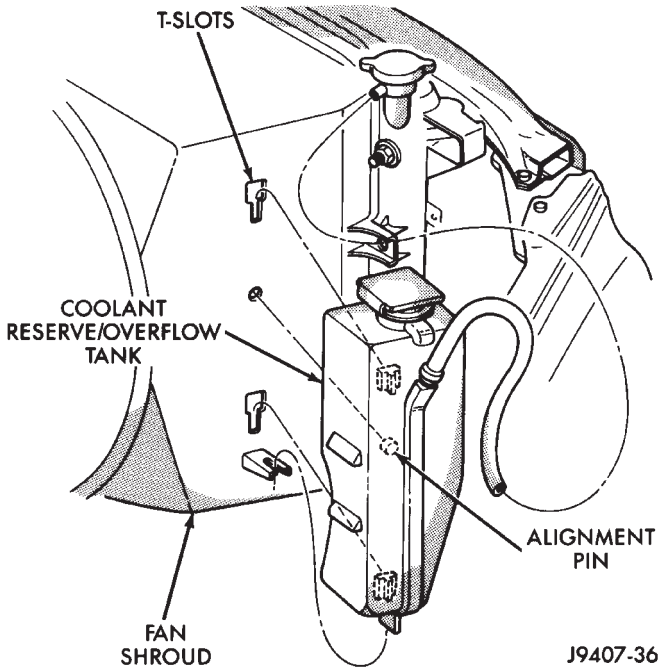


Fig. 24 Coolant Recovery Bottle

THERMOSTAT

REMOVAL

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

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

(1) Disconnect the battery negative cables.

(2) Remove accessory drive belt. Refer to procedure in this group.

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

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 a matching number or letter.

(4) Remove radiator hose clamp and hose from thermostat housing.

(5) Remove the three (3) water outlet-to-cylinder head bolts and remove the water outlet connector (Fig. 25).

(6) Clean the mating surfaces of the water outlet connector and clean the thermostat seat groove at the top of the thermostat housing (Fig. 25).

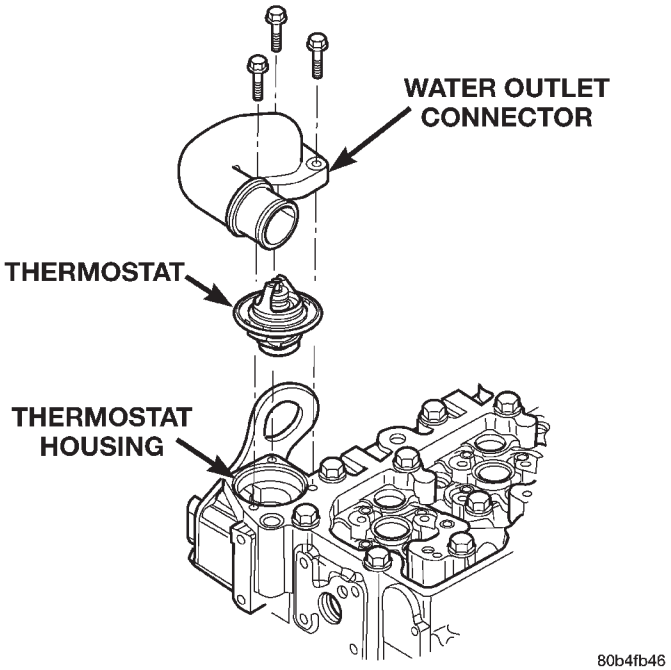


Fig. 25 Thermostat Removal/Installation

INSTALLATION

(1) Install the thermostat into the groove in the top of the thermostat housing (Fig. 25).

(2) Install the water outlet connector and bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Install the radiator upper hose and clamp.

(4) Fill the cooling system with coolant.

(5) Connect the battery negative cables.

(6) Start the engine and check for coolant leaks. Run engine to check for proper thermostat operation.

REMOVAL AND INSTALLATION (Continued)

COOLING FAN AND VISCOUS DRIVE

REMOVAL

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.

(1) Disconnect the battery negative cables.
(2) Remove the fan shroud mounting bolts. Position fan shroud towards engine.

CAUTION: Do not remove the fan pulley bolts. This pulley is under spring tension.

(3) The thermal viscous fan drive/fan blade assembly is attached (threaded) to the fan hub shaft (Fig. 26). Remove the fan blade/fan drive assembly from fan pulley by turning the mounting nut clockwise (as viewed from front). Threads on the viscous fan drive are **LEFT-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 the fan pulley bolts to prevent pulley from rotating.

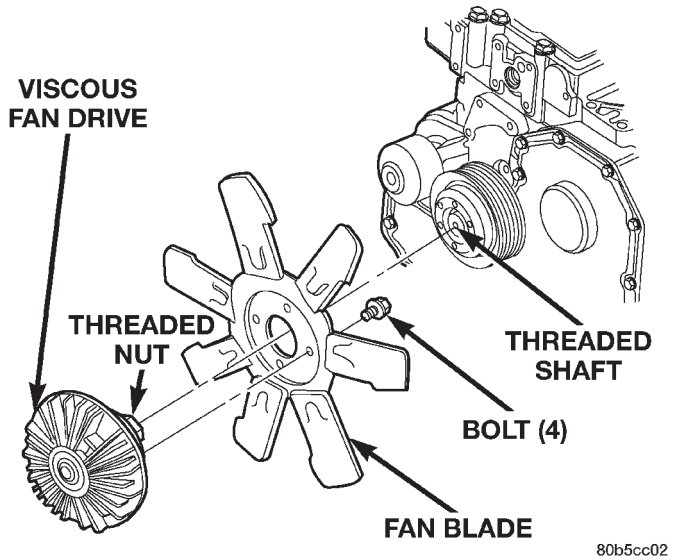


Fig. 26 Fan Blade/Viscous Fan Drive

(4) Remove the fan shroud and the fan blade/viscous drive as an assembly from vehicle.
(5) Remove fan blade-to-viscous fan drive mounting bolts.
(6) Inspect the fan for cracks, loose rivets, loose or bent fan blades.

CAUTION: Some engines equipped with serpentine 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.

INSTALLATION

(1) Install fan blade assembly to viscous fan drive. Tighten mounting bolts to 23 N·m (17 ft. lbs.) torque.
(2) Position the fan shroud and fan blade/viscous fan drive to the vehicle as an assembly.
(3) Install viscous fan drive assembly on fan hub shaft (Fig. 26). Tighten mounting nut to 57 N·m (42 ft. lbs.) torque.
(4) Install fan shroud bolts into position and tighten the mounting bolts to 6 N·m (50 in. lbs.) torque.
(5) Connect the battery negative cables.

NOTE: 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.

COOLING FAN SUPPORT/HUB

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove the cooling fan and viscous drive. Refer to procedure in this group.
(3) Remove the four (4) fan hub to block bolts (Fig. 27).
(4) If replacing the fan support/hub, transfer the pulley (Fig. 27) to the new component.

INSTALLATION

(1) If removed, install the fan drive pulley (Fig. 27) and tighten the bolts to 9 N·m (84 in. lbs.) torque.
(2) Install the support assy. to the block (Fig. 27), and tighten the bolts to 24 N·m (18. ft. lbs.) torque.
(3) Install the cooling fan and viscous drive. Refer to procedure in this group.
(4) Connect the battery negative cables.

WATER PUMP

REMOVAL

(1) Disconnect battery negative cables.
(2) Drain cooling system. Refer to Draining Cooling System in this section.

REMOVAL AND INSTALLATION (Continued)

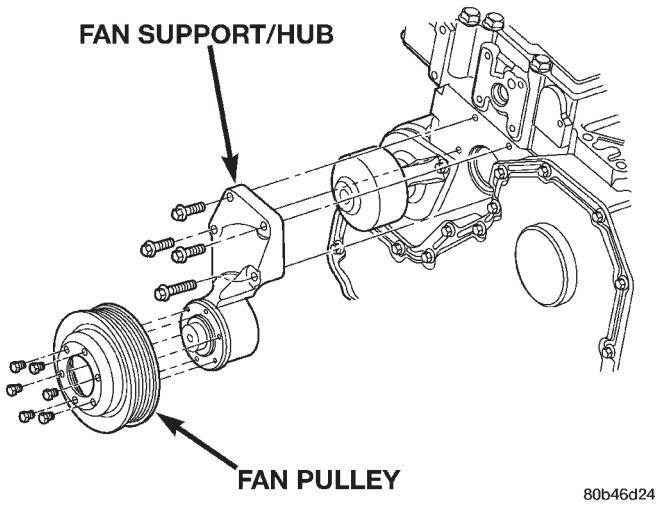


Fig. 27 Cooling Fan Support/Hub Assembly

(3) Remove the bolt retaining the wiring harness near the top of water pump. Position wire harness to the side.

(4) Remove the accessory drive belt. Refer to procedure in this group.

(5) Remove water pump mounting bolts (Fig. 28).

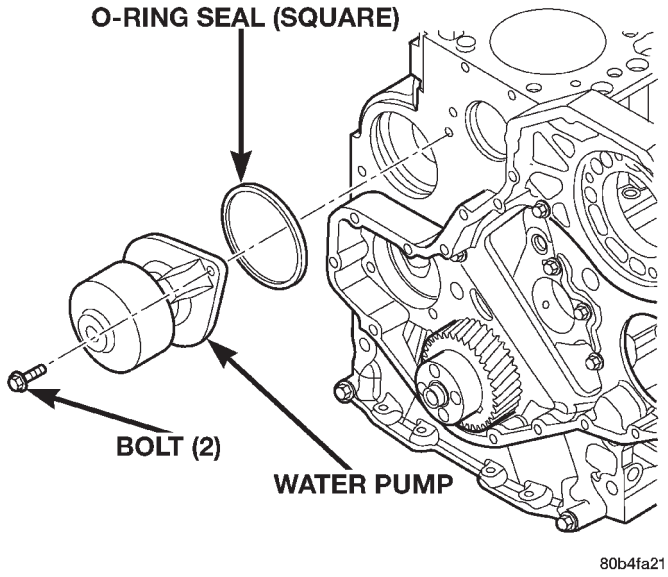


Fig. 28 Water Pump Removal/Installation

(6) Clean water pump sealing surface on cylinder block.

INSTALLATION

(1) Install new O-ring seal in groove on water pump (Fig. 29).

(2) Install water pump. Tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.

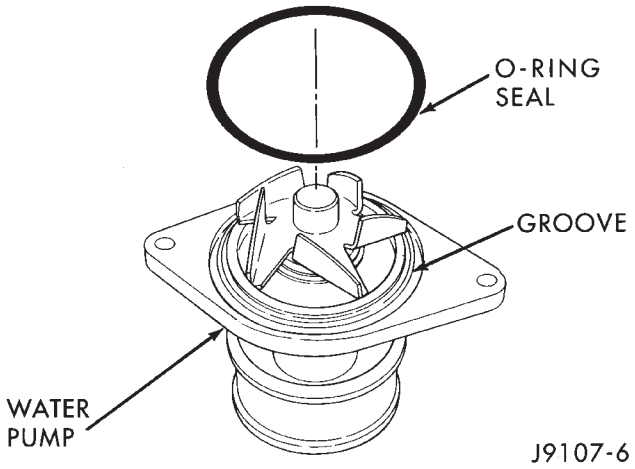


Fig. 29 Pump O-ring Seal

(3) Install accessory drive belt. Refer to procedure in this group.

(4) Install the bolt retaining the wiring harness near top of water pump.

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

(6) Connect both battery cables.

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

RADIATOR

REMOVAL

(1) Disconnect the battery negative cables.

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

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

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 a matching number or letter.

(3) Remove the radiator upper hose and clamps.

REMOVAL AND INSTALLATION (Continued)

(4) Disconnect the coolant recovery bottle hose from the radiator filler neck. Remove the coolant recovery bottle from the fan shroud (pull straight up). The tank slips into T-slots on the fan shroud. (Fig. 30).

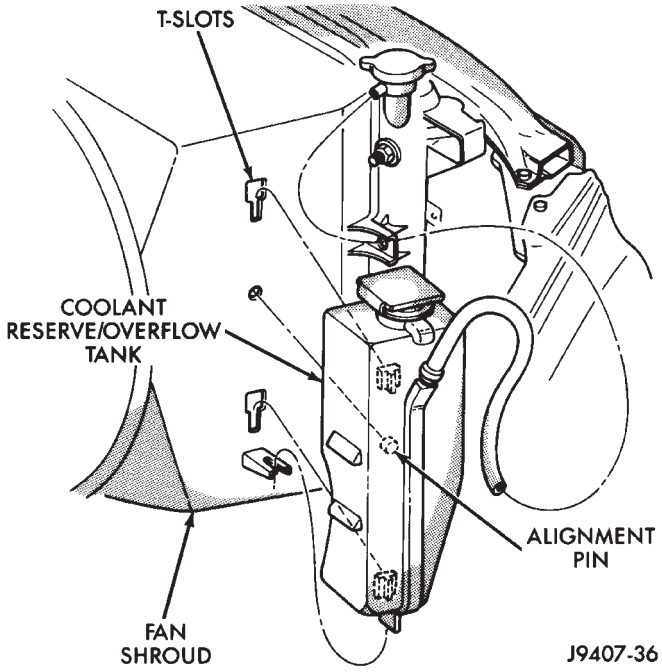


Fig. 30 Coolant Recovery Bottle

(5) Disconnect electrical connectors and supply hose from windshield washer bottle and remove tank. Refer to Group 8K, Windshield Wiper and Washer Systems for procedures.

(6) Remove the two metal clips retaining the upper part of fan shroud to the top of radiator.

(7) Remove the four fan shroud mounting bolts (Fig. 31). Position shroud rearward over the fan blades towards engine.

(8) Disconnect the radiator lower hose and clamp from the radiator.

(9) Remove the two radiator upper mounting bolts (Fig. 32).

(10) Lift radiator straight up and out of engine compartment. The bottom of the radiator is equipped with two alignment dowels that fit into holes in the lower radiator support panel (Fig. 32). Rubber biscuits (insulators) are installed to these dowels. Take care not to damage cooling fins or tubes on the radiator and air conditioning condenser when removing.

INSTALLATION

(1) Position fan shroud over the fan blades rearward towards engine.

(2) Install rubber insulators to alignment dowels at lower part of radiator.

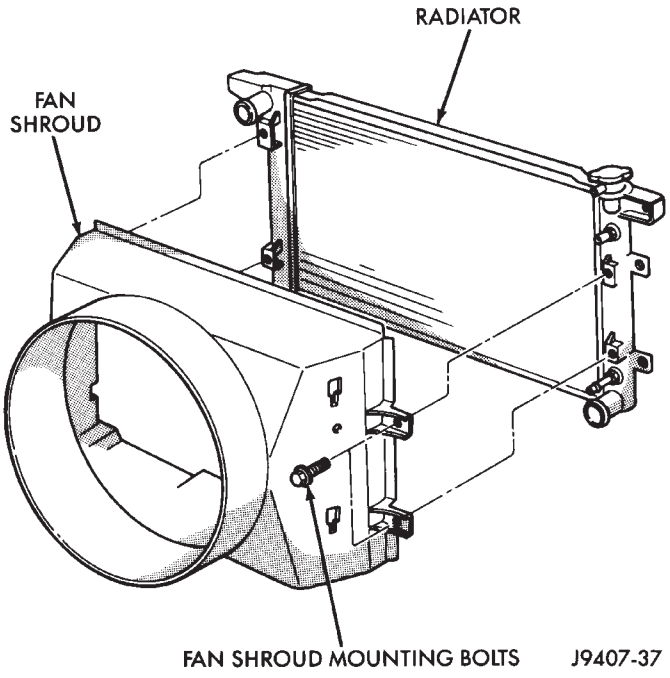


Fig. 31 Fan Shroud Mounting

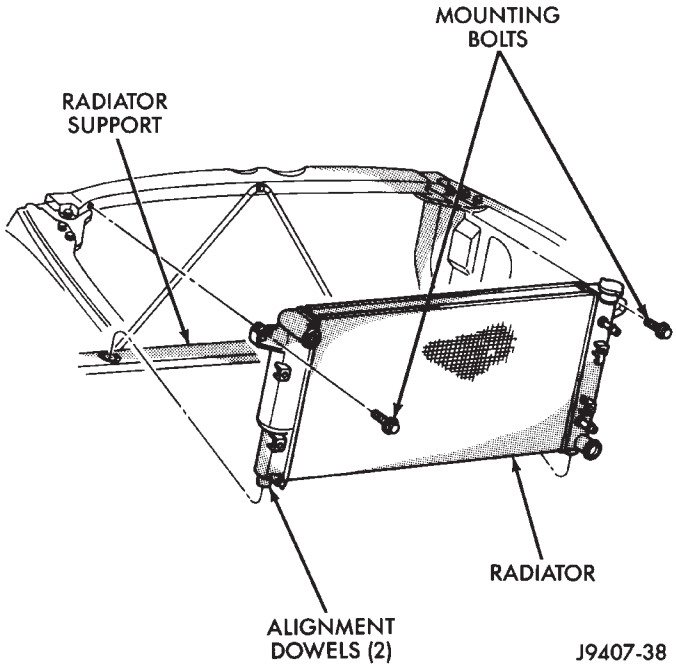


Fig. 32 Radiator Mounting

(3) Lower the radiator into position while guiding the two alignment dowels into lower radiator support (Fig. 32).

(4) Install two upper radiator mounting bolts. Tighten bolts to 11 N·m (95 in. lbs.) torque.

(5) Connect the radiator lower hose and clamp.

(6) Position fan shroud to flanges on sides of radiator. Install fan shroud mounting bolts (Fig. 31). Tighten bolts to 6 N·m (50 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(7) Install windshield washer reservoir tank. Refer to Group 8K. Connect electrical connections and supply hose.

(8) Install metal clips to top of fan shroud.

(9) Install coolant recovery bottle to fan shroud (Fig. 30).

(10) Install coolant recovery bottle hose to radiator filler neck nipple.

(11) Install the radiator upper hose and clamps.

(12) Connect the battery negative cables.

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

(14) Start engine and check for leaks.

BLOCK HEATER

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

REMOVAL

(1) Disconnect the battery negative cables.

(2) Drain coolant from radiator and cylinder block.

(3) Unscrew the power cord retaining cap and disconnect cord from heater element.

(4) Using a suitable size socket, loosen and remove the block heater element (Fig. 33).

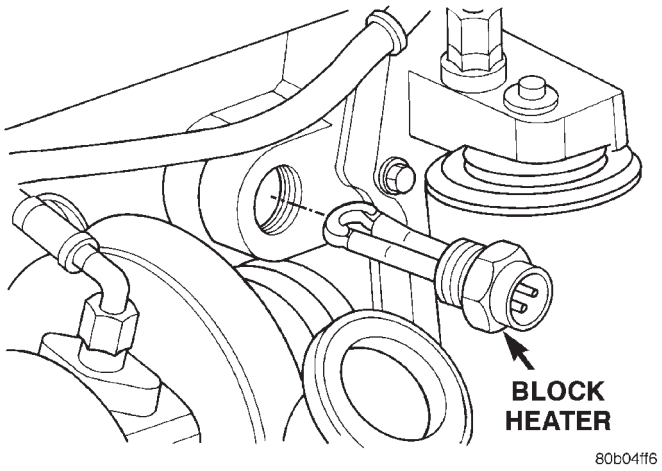


Fig. 33 Block Heater—Diesel Engine

INSTALLATION

(1) Clean and inspect the threads in the cylinder block.

(2) Coat heater element threads with Mopar® Thread Sealer with Teflon.

(3) Screw block heater into cylinder block and tighten to 43 N·m (32 ft. lbs.).

(4) Connect block heater cord and tighten retaining cap.

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

(6) Start and warm the engine.

(7) Check block heater for leaks.

WATER INLET CONNECTOR

REMOVAL

(1) Disconnect battery negative cables.

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

(3) Remove the accessory drive belt. Refer to procedure in this group.

(4) Remove the generator. Refer to Group 8C, Charging System, for the correct procedure.

(5) If A/C equipped, recover the refrigerant and remove the A/C compressor. Refer to Group 24, Heating and Air Conditioning for the correct procedures.

(6) Disconnect the heater core and transmission oil cooler return hoses at the water inlet connector.

(7) Remove the six (6) water inlet connector-to-block bolts. Remove connector and o-ring (Fig. 34).

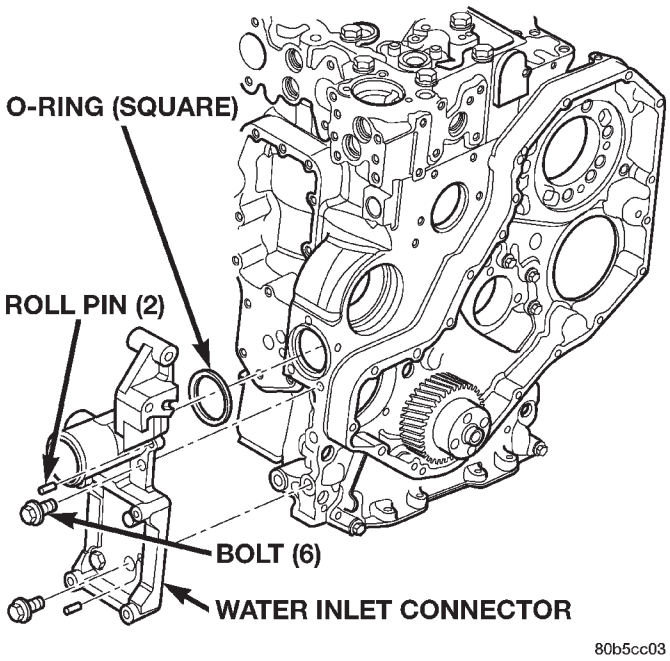


Fig. 34 Water Inlet Connector and O-ring

INSTALLATION

(1) Using a new o-ring, locate the water inlet connector on the roll pins (Fig. 34) and install and tighten all bolts to 24 N·m (18 ft. lbs.) torque.

(2) Install the heater core and transmission oil cooler return hoses and clamps to the connector.

(3) Install the A/C compressor. Refer to Group 24, Heating and Air Conditioning for the correct procedures.

REMOVAL AND INSTALLATION (Continued)

(4) Install the generator. Refer to Group 8C, Charging System for the correct procedures.
(5) Install the accessory drive belt. Refer to the procedure in this group.
(6) Add coolant. Refer to Refilling Cooling System in this group.
(7) Connect the battery negative cables.
(8) Start the engine and check for coolant leaks. Check and adjust the coolant level as necessary.

WATER-TO-OIL COOLER

REMOVAL

CAUTION: If a leak should occur in the water-to-oil cooler mounted to the side of the engine block, engine coolant may become mixed with transmission fluid. Transmission fluid may also enter engine cooling system. Both cooling system and transmission should be drained and inspected in case of oil cooler leakage.

(1) Disconnect both battery negative cables.
(2) Remove air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.
(3) Drain cooling system. Refer to Draining Cooling System in this group.
(4) Disconnect coolant lines from cooler.
(5) Disconnect transmission oil lines from cooler. Plug cooler lines to prevent oil leakage.
(6) Remove oil cooler mounting straps (Fig. 35).
(7) Lift oil cooler off of mounting bracket.
(8) If replacing cooler, make sure to transfer converter drain back valve to new cooler.

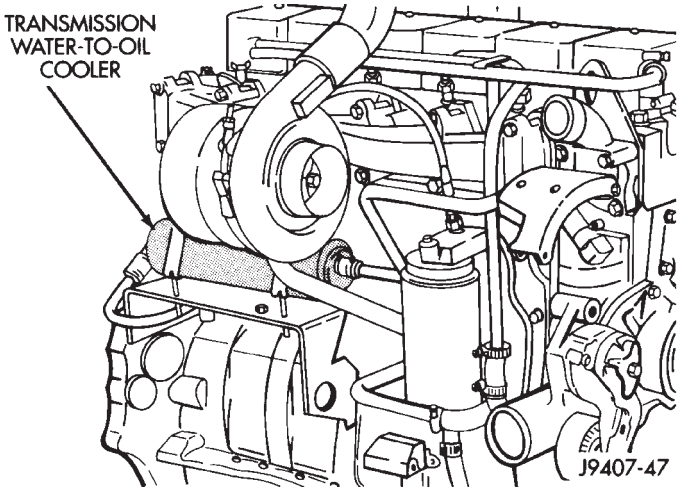


Fig. 35 Transmission Water-To- Oil Cooler—Diesel

INSTALLATION

(1) Position oil cooler on bracket.
(2) Install mounting straps.
(3) Connect transmission oil lines to cooler.
(4) Connect coolant hoses to cooler.
(5) Connect battery negative cables.
(6) Fill cooling system. Refer to Refilling Cooling System in this section.
(7) Check transmission oil level and fill as necessary.
(8) Install air cleaner assembly and air cleaner intake hoses. Refer to Group 14, Fuel System for procedures.

AUXILIARY TRANSMISSION OIL COOLER

REMOVAL

(1) Disconnect the battery negative cables.
(2) Remove front bumper. Refer to Group 13, Frame and Bumpers for the correct procedures.
(3) Place a drain pan under the oil cooler.
(4) Raise the vehicle.
(5) Using special tool #6931, disconnect the oil cooler quick-connect fittings from the transmission lines.
(6) Remove the charge air cooler-to-oil cooler bolt and the two mounting nuts (Fig. 36).

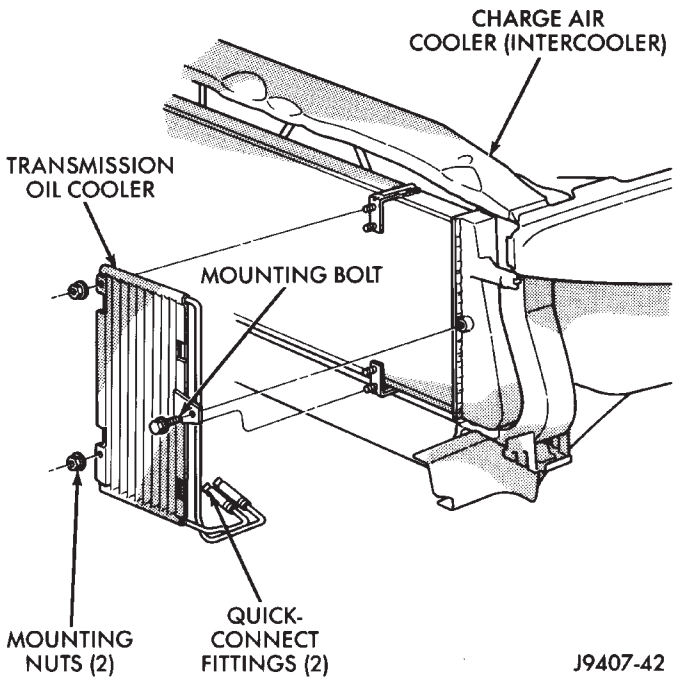


Fig. 36 Auxiliary Transmission Oil Cooler

(7) Remove the oil cooler and line assembly towards the front of vehicle. Cooler must be rotated and tilted into position while removing.

INSTALLATION

(1) Carefully position the oil cooler assembly to the vehicle.
(2) Install two nuts and one bolt (Fig. 36). Tighten to 11 N·m (95 in. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(3) Connect the quick-connect fittings to the transmission cooler lines. Push together until an audible "click" is heard. Verify by pulling outward on the connection.

(4) Install front bumper. Refer to Group 13, Frame and Bumpers for the correct procedures.

(5) Connect the battery negative cables.

(6) Start the engine and check all connections for leaks.

(7) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for for the correct procedures.

CLEANING AND INSPECTION

RADIATOR CLEANING

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.

COOLING FAN INSPECTION

The fan 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 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.

Also refer to the Viscous Fan Drive section for additional information.

RADIATOR CAP INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 37) at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

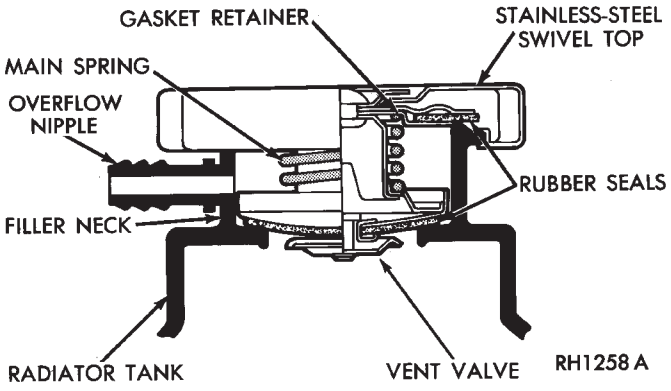


Fig. 37 Radiator Pressure Cap

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.

WATER PUMP INSPECTION

Visually inspect the water pump and replace if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from the shaft seal. This is evident by traces of coolant below the vent hole
- Loose or rough turning bearing. Also inspect thermal fan drive
- Impeller rubbing the pump body

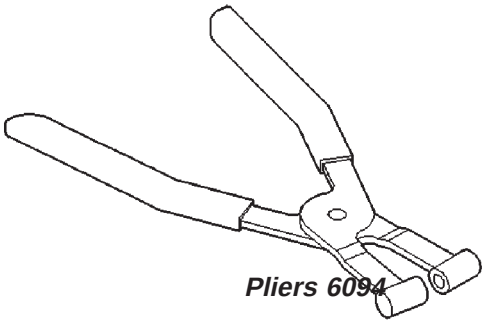
SPECIFICATIONS

TORQUE

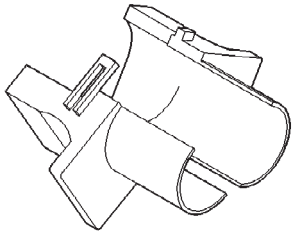
DESCRIPTION	TORQUE
Belt Tensioner	
Bolt	41 N·m (30 ft. lbs.)
Block Heater	
Hex	43 N·m (32 ft. lbs.)
Fan Blade-to-Viscous Drive	
Bolts	23 N·m (17 ft. lbs.)
Fan Drive Pulley-to-Fan Hub	
Bolts	9 N·m (84 in. lbs.)
Fan Shroud to Radiator Mounting	
Bolts	6 N·m (50 in. lbs.)
Fan Support/Hub Assy.	
Bolts	24 N·m (18 ft. lbs.)
Radiator Mounting	
Bolts	11 N·m (95 in. lbs.)
Thermal Viscous Fan-to-Hub	
Nut	57 N·m (42 ft. lbs.)
Water Inlet Connector-to-Block	
Bolts	24 N·m (18 ft. lbs.)
Water Outlet Connector (Therm. Housing)	
Bolts	24 N·m (18 ft. lbs.)
Water Pump-to-Block	
Bolts	24 N·m (18 ft. lbs.)

SPECIAL TOOLS

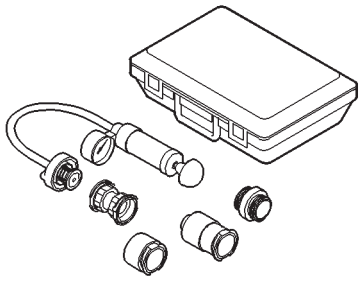
COOLING



Pliers 6094



1/2” Disconnect Tool—6931



Pressure Tester 7700–A