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 (if equipped). The cooling system is pressurized and uses a centrifugal water pump on all engines to circulate coolant throughout the system.

An optional factory installed maximum duty cooling package is available for some engines 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 AND FLOW—GAS ENGINES

The cooling system consists of:

- A cross-flow radiator
- Thermal viscous fan drive
- Fan shroud
- Radiator pressure cap
- Thermostat
- Coolant reserve/overflow system
- Transmission oil cooler (automatic transmission)
- Coolant
- Water pump (to circulate coolant)
- Hoses and hose clamps

Typical coolant flow circuits for gas powered engines are shown in (Fig. 1).

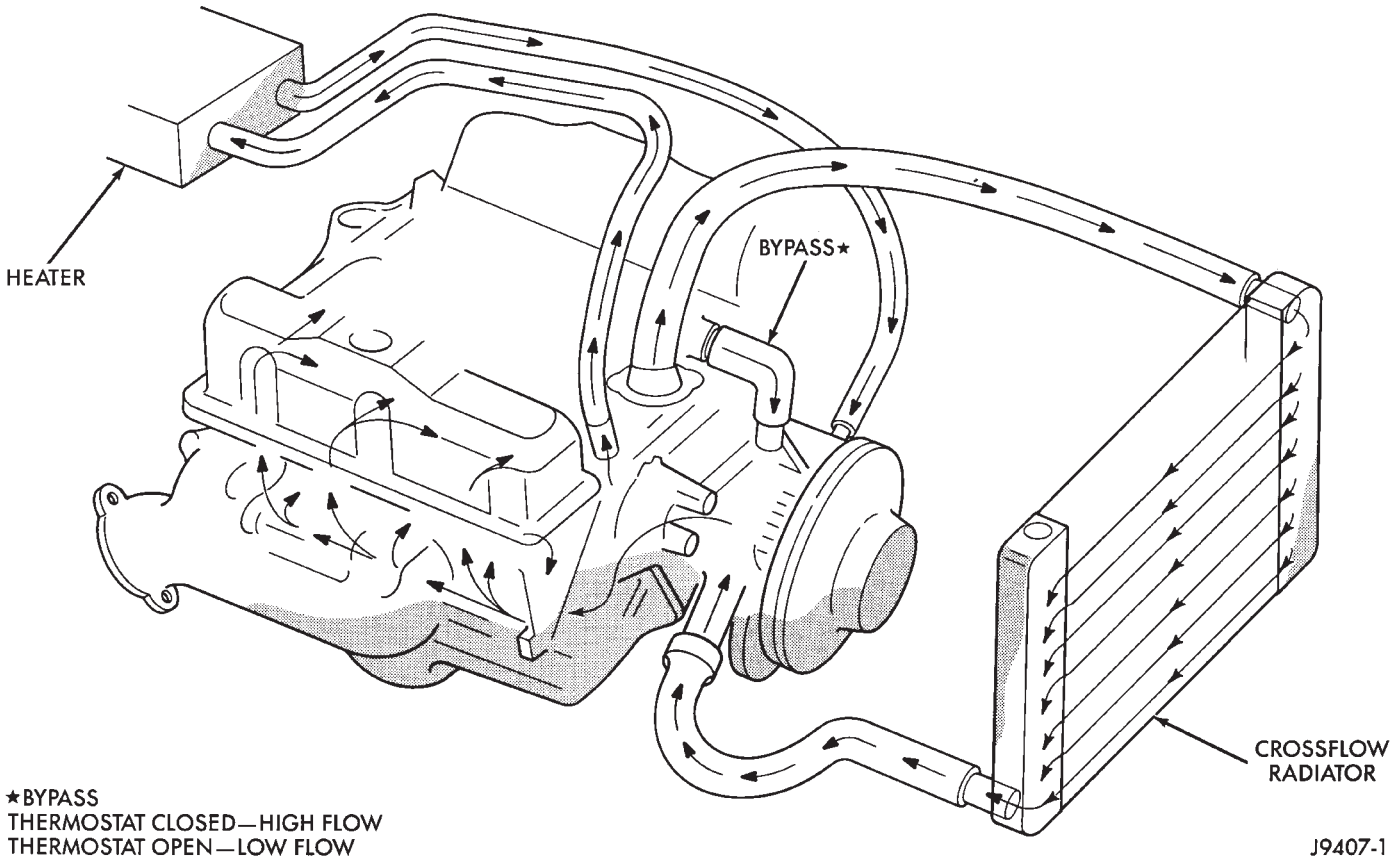


Fig. 1 Typical Cooling System Flow—Gas Powered Engines

GENERAL INFORMATION (Continued)

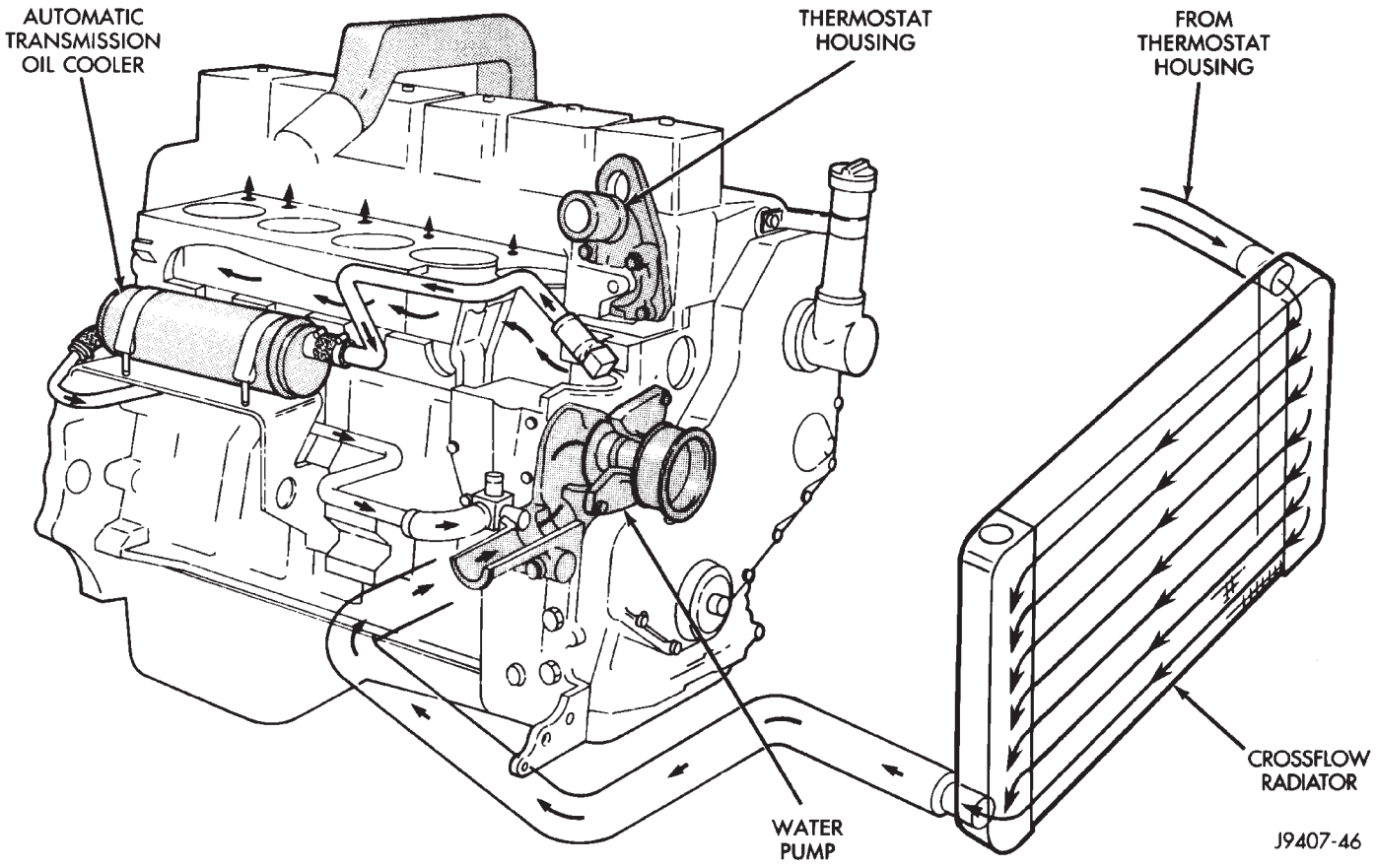


Fig. 2 Typical Cooling System Flow—Diesel Powered Engine

COOLING SYSTEM COMPONENTS AND FLOW—DIESEL

Coolant flow circuits for the 5.9L diesel engine are shown in (Fig. 2).

The diesel cooling system consists of: a cross-flow radiator, engine driven cooling fan, thermal viscous fan drive, fan shroud, radiator pressure cap, thermostat, a vertically mounted one-way check valve (jiggle pin) at cylinder head, a bypass hose at thermostat, coolant reserve/overflow system, transmission oil cooler (if equipped with an automatic transmission), coolant, water pump, hoses and hose clamps.

Coolant is drawn from radiator into the water pump. Water pump output is directed to the engine oil cooler cavity of the cylinder block (Fig. 3).

From the oil cooler cavity, the coolant circulates around each cylinder. It then crosses to the transfer (lift) pump side of the engine where it flows up into the cylinder head through openings in top of the cylinder block (Fig. 3). Coolant flows past the valve bridges (Fig. 4), to exhaust manifold side of engine and to thermostat. As coolant flows toward the thermostat, it provides cooling for the injector nozzle.

Also refer to Thermostat Operation—5.9L Diesel Engine. This can be found in the Thermostat section of this group.

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.

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.

GENERAL INFORMATION (Continued)

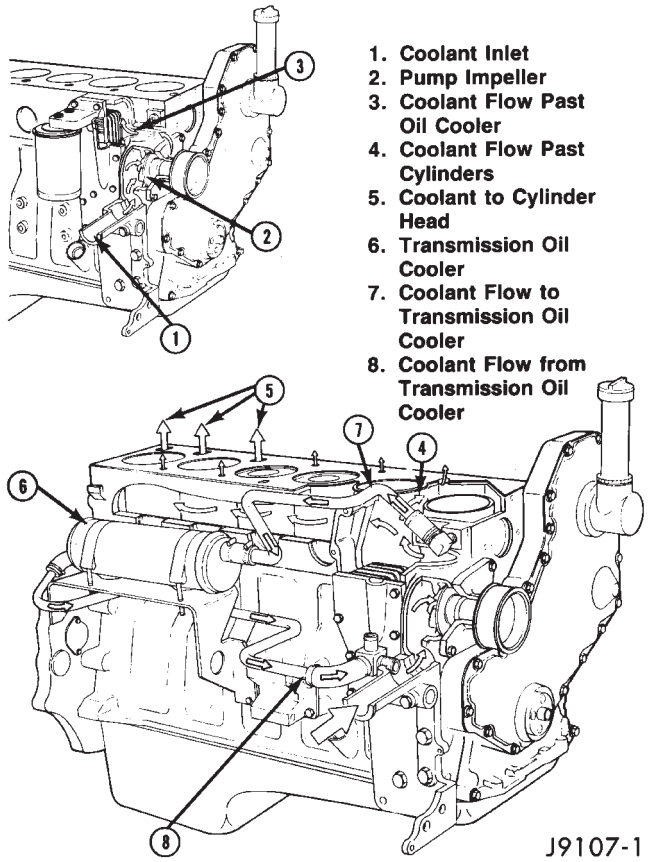


Fig. 3 Cylinder Block Coolant Routing—Diesel Engine

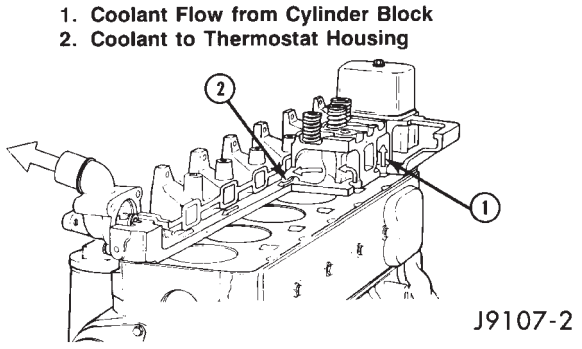


Fig. 4 Cylinder Head Coolant Routing—Diesel Engine

RADIATORS

The radiator used on all engines (both gas powered and diesel) are of a cross-flow design with horizontal tubes through the radiator core and vertical side tanks.

Aluminum cores with plastic side tanks are used on all 3.9L V-6 and 5.2/5.9L V-8 engines. Copper-brass cores are used with the 8.0L V-10 and diesel engines.

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

THERMOSTAT

The thermostat on all gas powered engines is located beneath the thermostat housing at the front of the intake manifold (Fig. 5) (Fig. 6).

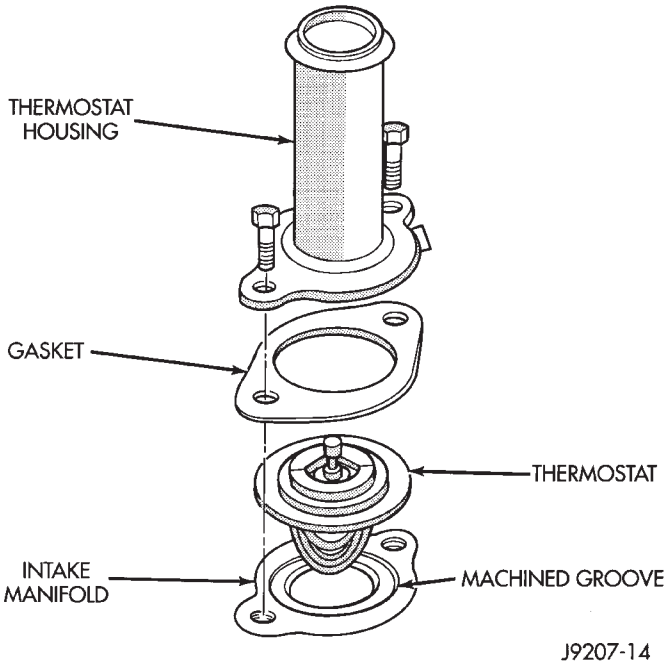


Fig. 5 Thermostat—3.9L V-6 or 5.2/5.9L V-8 Gas Powered Engines

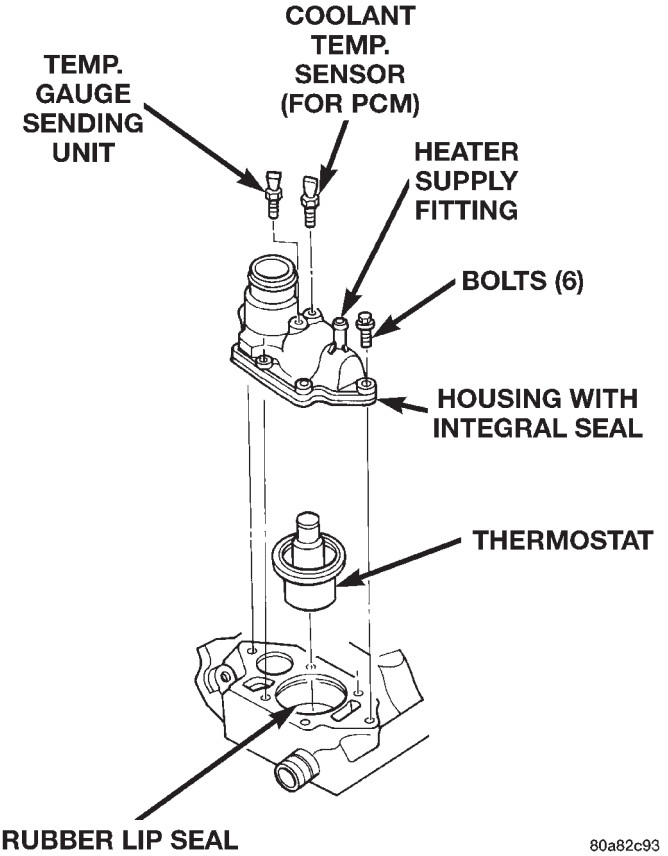


Fig. 6 Thermostat—8.0L V-10 Engine

GENERAL INFORMATION (Continued)

The thermostat of the 5.9L diesel engine is located in the thermostat housing (Fig. 7). The housing is located behind the generator mounting bracket, at

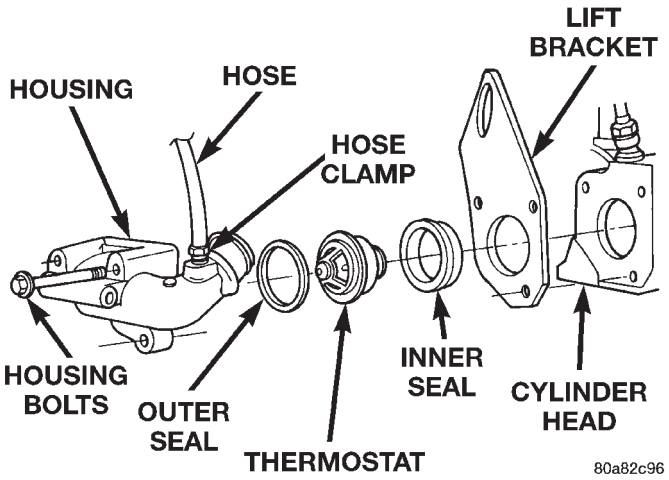


Fig. 7 Thermostat—5.9L Diesel—Typical

front of cylinder head.

Gas powered engines: The thermostat is a wax pellet driven, reverse poppet choke type (3.9L/5.2L/5.9L), or moveable sleeve type (8.0L V-10). The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open. Coolant leakage into the pellet container will cause the thermostat to fail in the open position. Thermostats very rarely stick. Do not attempt to free a thermostat with a prying device.

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.

ENGINE ACCESSORY DRIVE BELTS

All vehicles are available with either a 3.9L V-6, a 5.2L V-8, two different 5.9L V-8 engines, an 8.0L V-10 or a 5.9L in-line 6 cylinder diesel engine.

The accessory drive components are operated by a single, crankshaft driven, serpentine 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.

BELT TENSION—ALL ENGINES

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 any engine. All engines are 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 Automatic Belt Tensioner proceeding in this group. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on any engine.

DESCRIPTION AND OPERATION

THERMOSTAT—V-6, V-8, AND V-10

The thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. The thermostat is closed below 88°C (192°F). When the coolant reaches this temperature, the thermostat begins to open, allowing coolant flow to the radiator. This provides quick engine warmup and overall temperature control. The thermostat is designed to provide a minimum engine operating temperature of 88 to 93°C (192 to 199°F). It 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 the radiator, fan and ambient temperature.

THERMOSTAT—DIESEL

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. 8).

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.

The air bleeds (jiggle pins) that were used on the thermostats of diesel engines in previous years are no longer used. They have been replaced by a vertically mounted one-way check valve (jiggle pin) and a rubber bypass hose. The check valve is used as a servicing feature and will vent air when the system is

DESCRIPTION AND OPERATION (Continued)

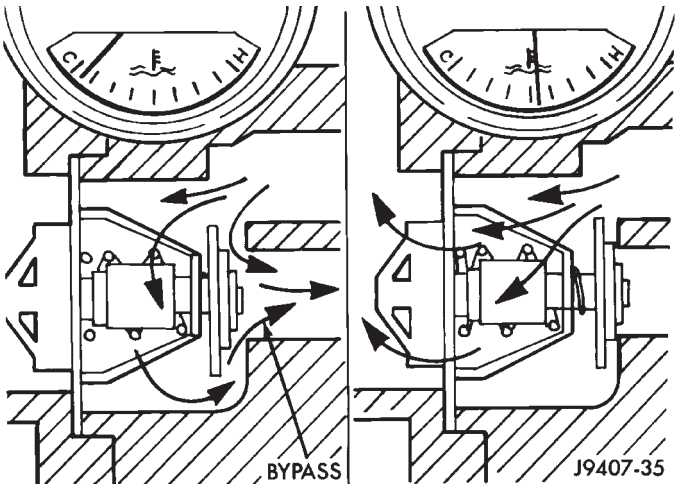


Fig. 8 Thermostat Operation—5.9L Diesel—Typical

being filled. It is also used to block the flow of coolant during engine operation (all coolant will pass through the thermostat).

Water pressure (or flow) will hold the pin closed.

When the engine is off, the check valve will be in the open position. When the engine is operating, the check valve will be in the closed position.

The check valve is located inside of a brass fitting. This fitting is threaded into the front of the cylinder head (Fig. 9). It is connected to the thermostat housing with a rubber hose and screw-type clamps (Fig. 9).

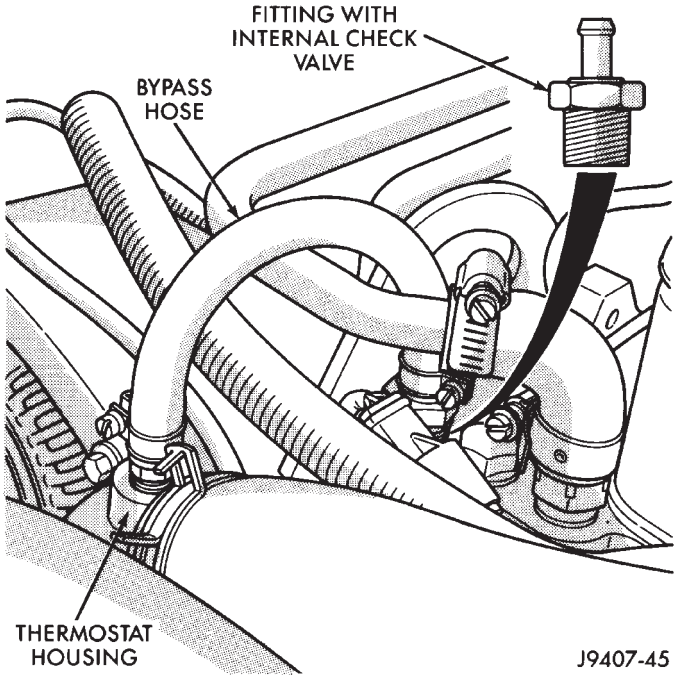


Fig. 9 One-Way Check Valve (Jiggle Pin) Location

AUTOMATIC TRANSMISSION OIL COOLERS—GAS ENGINES

WATER-TO-OIL COOLER

All gas powered models equipped with an automatic transmission are equipped with a transmission oil cooler mounted internally within the radiator side tank. This internal cooler is supplied as standard equipment on all gas powered models equipped with an automatic transmission.

The internal radiator oil cooler **is not used** with the diesel engine.

Transmission oil is cooled when it passes through this separate cooler. In case of a leak in the internal radiator mounted transmission oil cooler, engine coolant may become mixed with transmission fluid or transmission fluid may enter engine cooling system. Both cooling system and transmission should be drained and inspected if the internal radiator mounted transmission cooler is leaking.

Also refer to the section on Transmission Air-to-Oil Coolers. This heavy duty air-to-oil cooler is an option on most engine packages. It is supplied as standard equipment on both the 8.0L V-10 and 5.9L diesel engines.

AUXILIARY TRANSMISSION OIL COOLER

3.9/5.2/5.9L V-8 Gas Powered Engines: An optional air-to-oil transmission oil cooler is available with most engine packages. On the 3.9/5.2/5.9L V-8 engines, this optional cooler is located between the radiator and air conditioning condenser (Fig. 10).

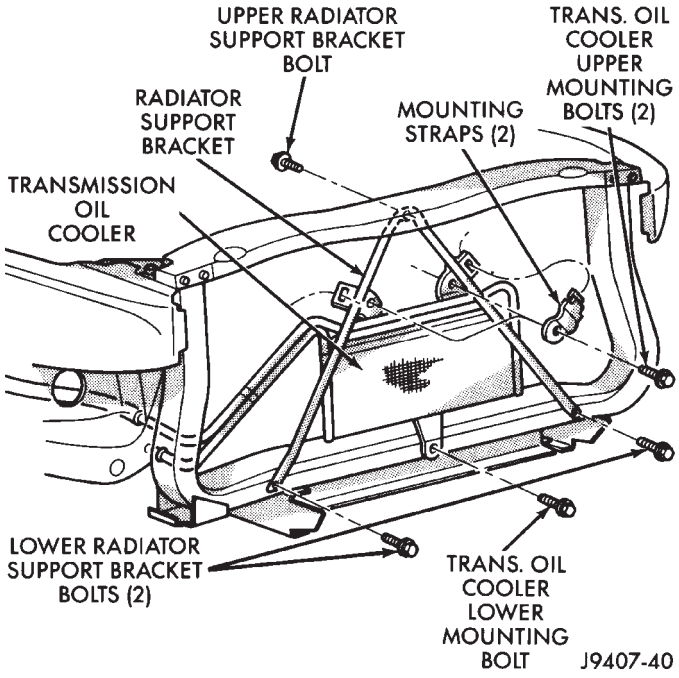


Fig. 10 Auxiliary Transmission Oil Cooler—3.9/5.2/5.9L Engines

DESCRIPTION AND OPERATION (Continued)

8.0L V-10 Engine: The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 11). This secondary cooler is supplied as standard equipment on models equipped with the 8.0L V-10 engine and an automatic transmission.

The oil coolers on all gas powered engines operate in conjunction with the internal radiator mounted main oil cooler. The transmission oil is routed through the main cooler first, then the optional cooler, before returning to the transmission.

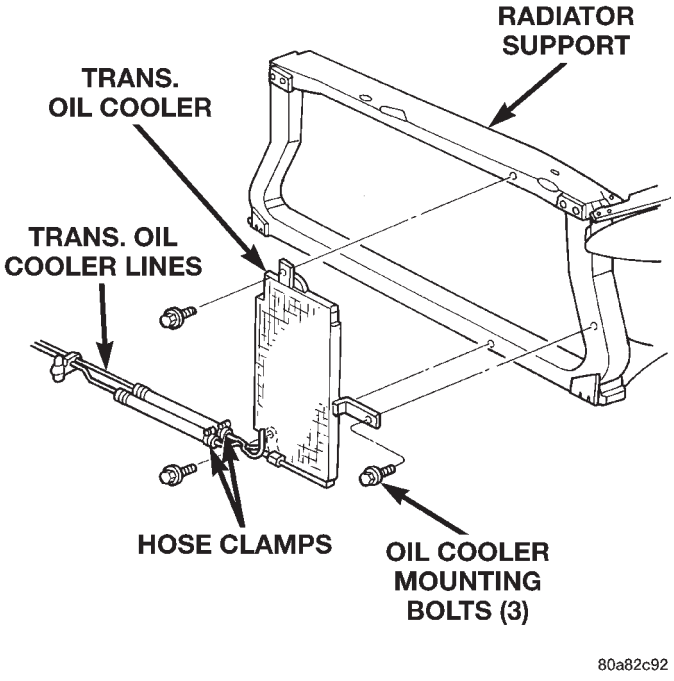


Fig. 11 Auxiliary Transmission Oil Cooler—8.0L Engine

AUTOMATIC TRANSMISSION OIL COOLERS—DIESEL ENGINE

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. 12).

The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 13).

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

AUTOMATIC BELT TENSIONER

Drive belts on all engines are equipped with a spring loaded automatic belt tensioner (Fig. 14) (Fig. 15) (Fig. 16). This belt tensioner will be used with all belt configurations, such as with or without power steering or air conditioning.

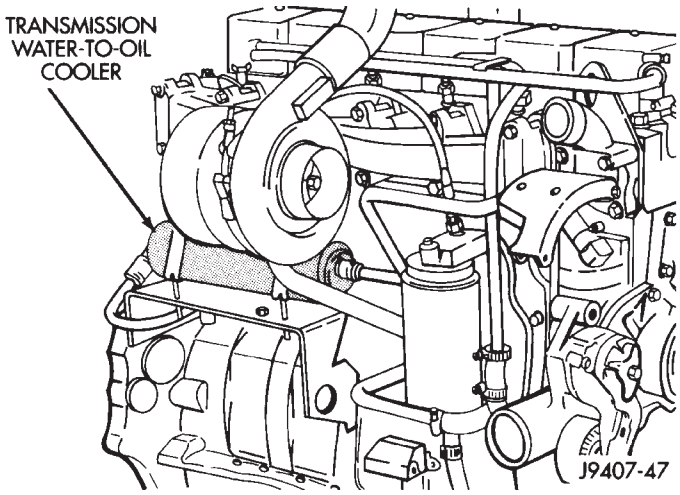


Fig. 12 Transmission Water-To-Oil Cooler—Diesel Engine—Typical

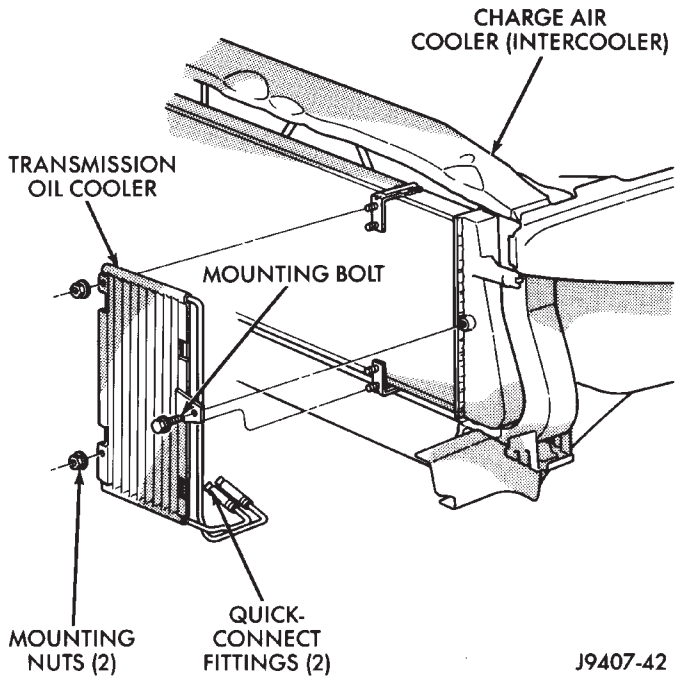


Fig. 13 Auxiliary Transmission Oil Cooler—Diesel Engine

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

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, the tensioner is equipped with an indexing arrow (Fig. 17) 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. 17). Belt is consid-

DESCRIPTION AND OPERATION (Continued)

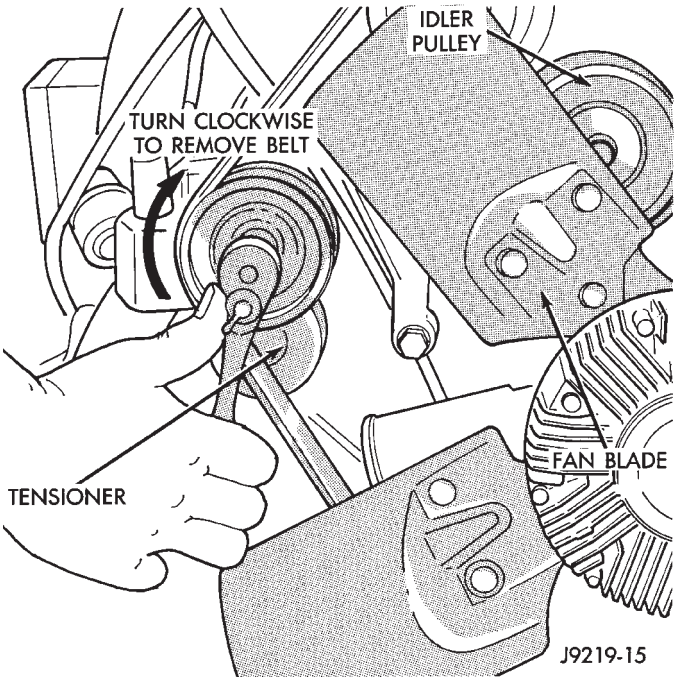


Fig. 14 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

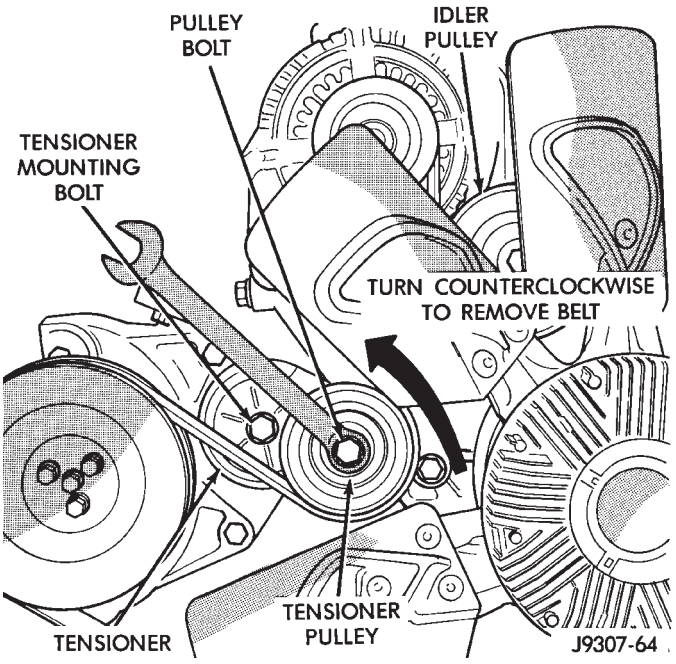


Fig. 15 Belt Tensioner—5.9L HDC-Gas and 8.0L V-10 Engines

ered 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

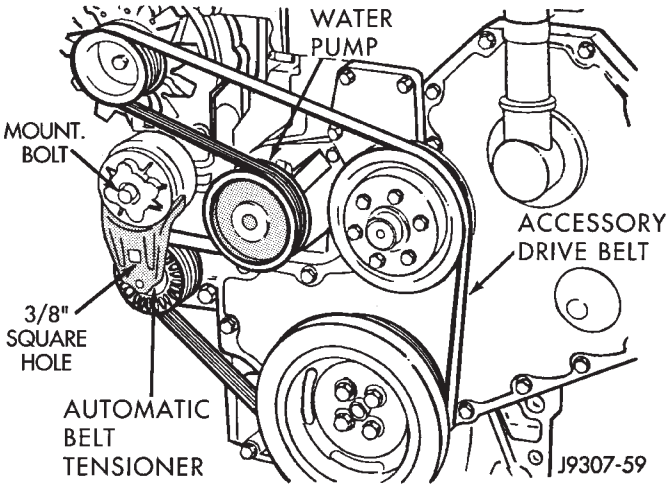


Fig. 16 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

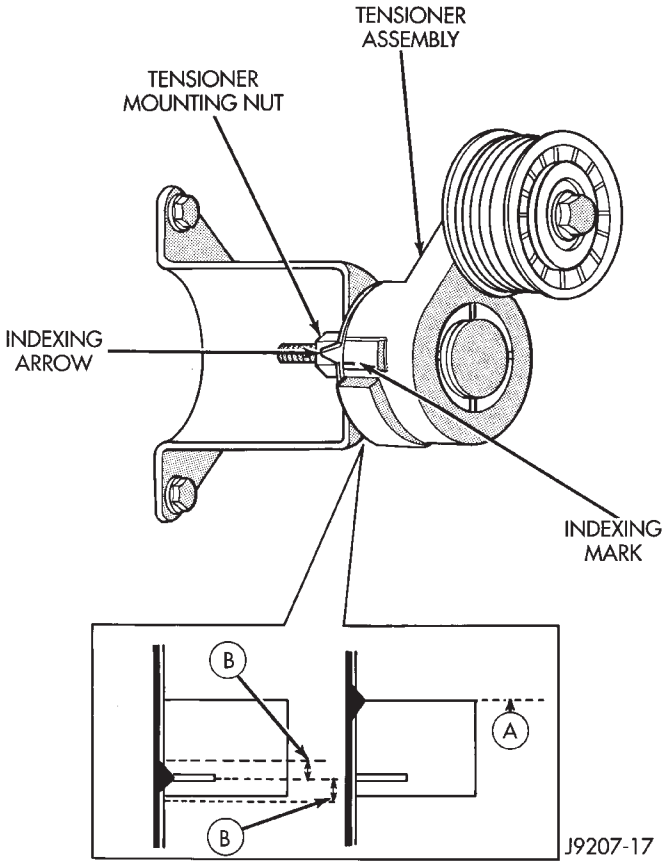


Fig. 17 Indexing Marks—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

- Misalignment of an engine accessory
- Belt incorrectly routed.

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, a used belt should be replaced if tensioner indexing arrow has moved to point-A (Fig. 17). Tensioner travel stops at point-A.

DESCRIPTION AND OPERATION (Continued)

BLOCK HEATERS

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 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 3.9L/5.2L/5.9L gas powered engine has the block heater located on the right side of engine next to the oil filter (Fig. 18).

The 8.0L V-10 engine has the block heater located on the right side of engine next to the engine oil dipstick tube (Fig. 19).

The 5.9L diesel engine has the block heater located on the right side of the engine below the exhaust manifold next to the oil cooler (Fig. 20).

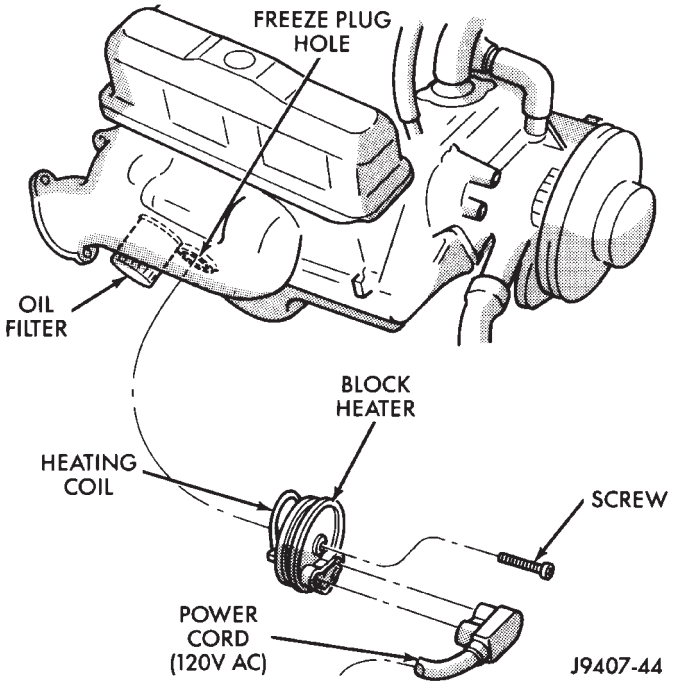


Fig. 18 Engine Block Heater—3.9L/5.2L/5.9L Gas Powered Engine

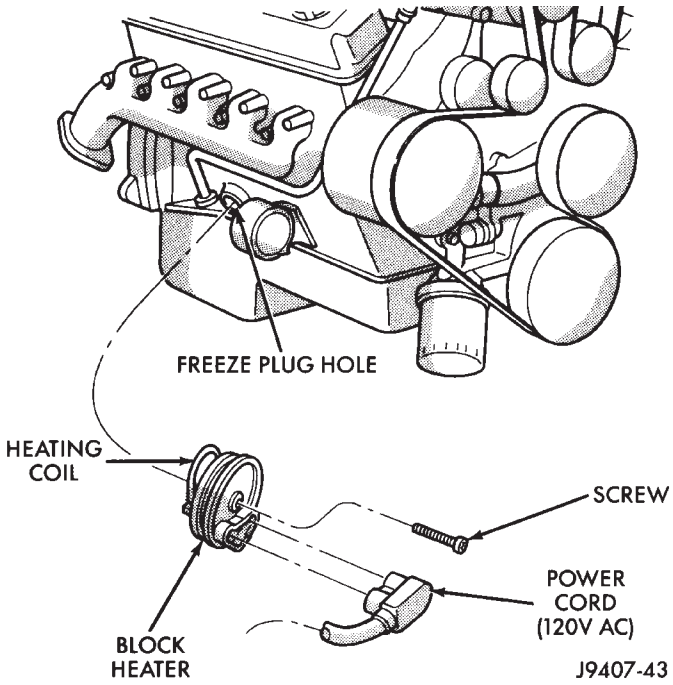


Fig. 19 Engine Block Heater—8.0L V-10 Engine

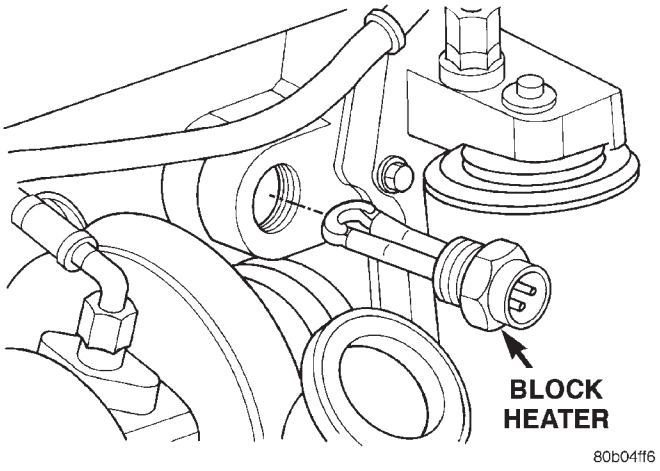


Fig. 20 Engine Block Heater—5.9L Diesel Engine

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

DESCRIPTION AND OPERATION (Continued)

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

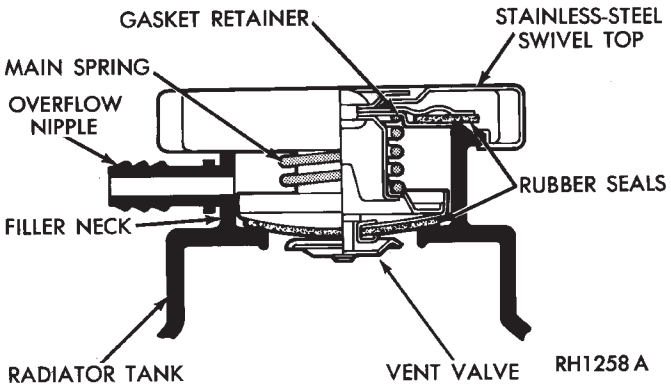


Fig. 21 Radiator Pressure Cap and Filler Neck—Typical

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. 21).

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.

DESCRIPTION AND OPERATION (Continued)

WATER PUMPS—V-6, V-8, AND V-10 ENGINES

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 antifreeze in the coolant mixture. Additional lubrication is not necessary.

WATER PUMP—5.9L DIESEL

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. 22). An automatic belt tensioner (Fig. 22) is used to prevent the belt from slipping.

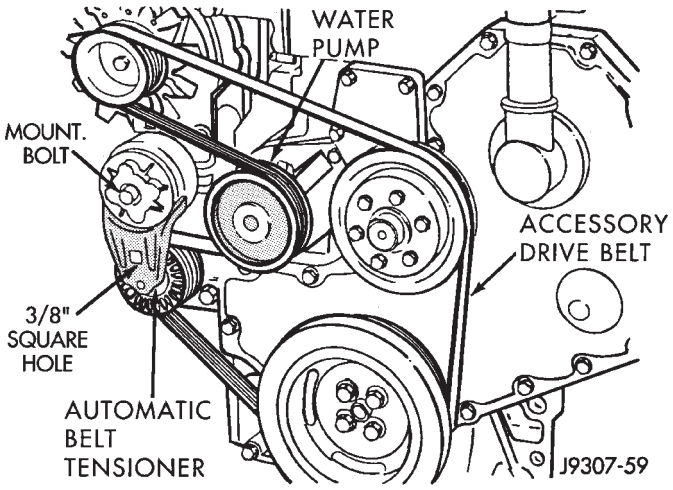


Fig. 22 Water Pump—5.9L Diesel—Typical (non-A/C shown)

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.

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. 23). 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. 24). 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.

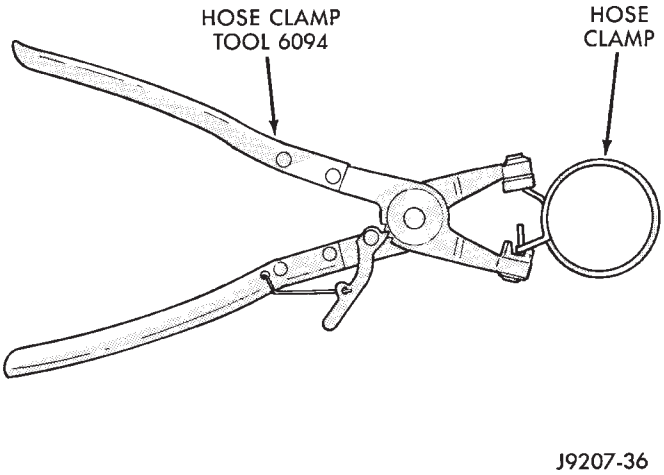


Fig. 23 Hose Clamp Tool—Typical

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 to the radiator to cover minor leaks and evaporation or boiling losses.

DESCRIPTION AND OPERATION (Continued)

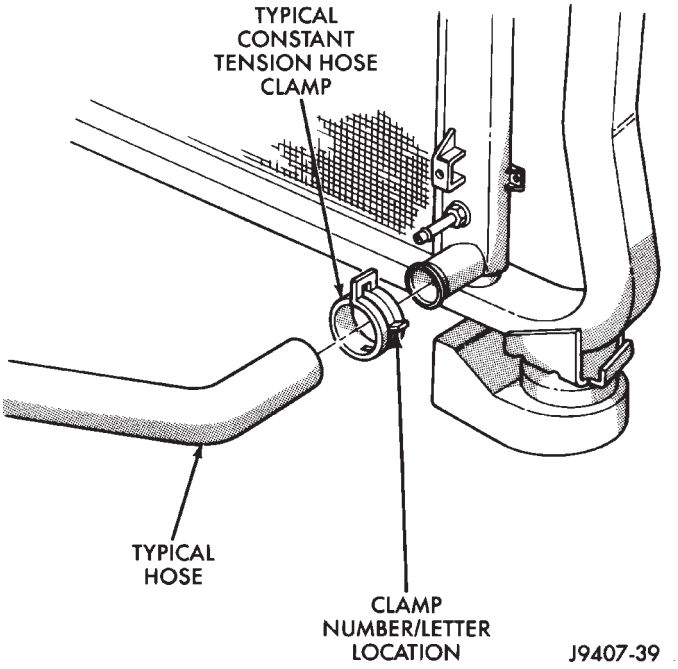


Fig. 24 Clamp Number/Letter Location

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 3.9L/5.2L/5.9L gas engines and the 5.9L diesel engine, the coolant reserve/overflow tank is mounted to the side of the fan shroud (Fig. 25). On the 8.0L V-10 engine the tank is mounted to right inner fender (Fig. 26).

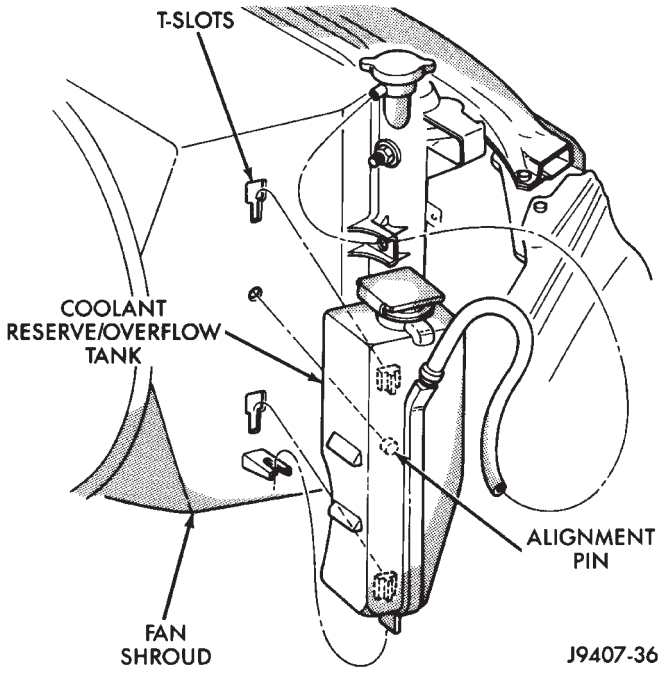


Fig. 25 Coolant Reserve/Overflow Tank—All Except 8.0L V-10 Engine

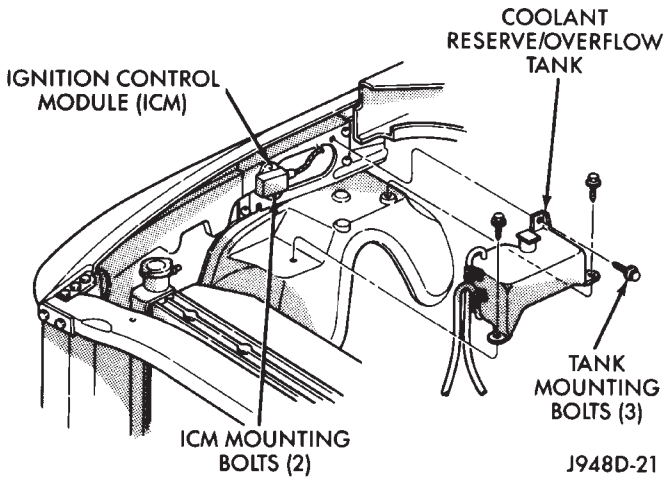


Fig. 26 Coolant Reserve/Overflow Tank—8.0L V-10 Engine

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. 27) (Fig. 28)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.

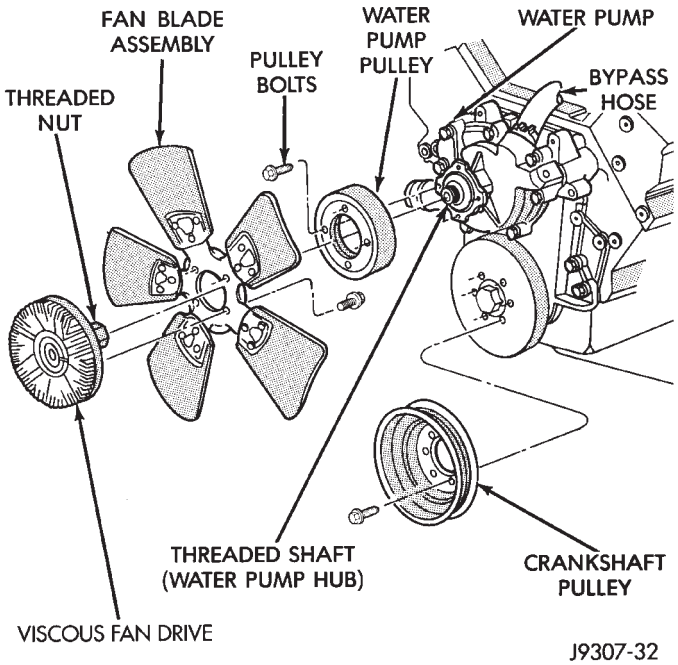


Fig. 27 Viscous Fan Drive—Gas Engines

DESCRIPTION AND OPERATION (Continued)

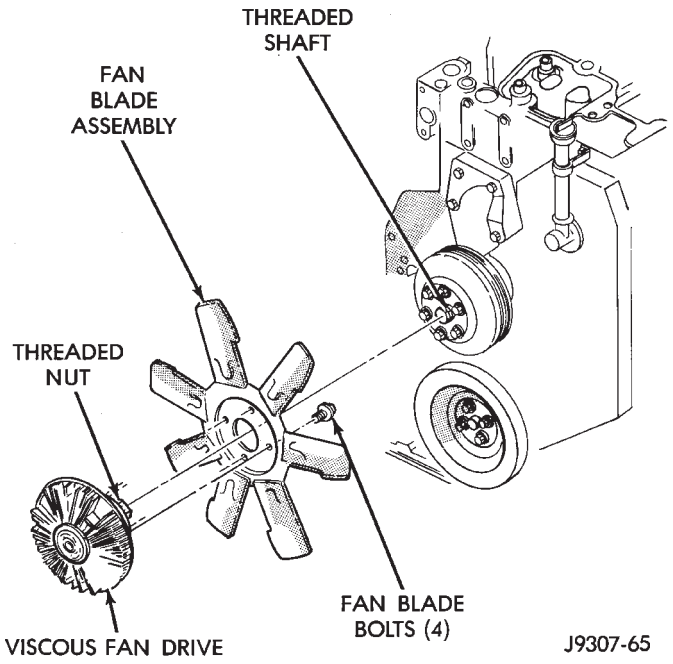


Fig. 28 Viscous Fan Drive—Diesel Engine

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. 29). 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.

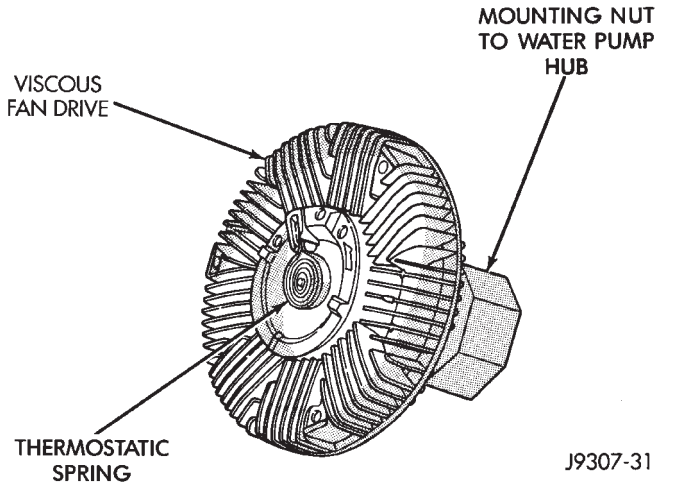


Fig. 29 Viscous Fan Drive—Typical

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: 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.

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

ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The Powertrain Control Module (PCM) has been programmed to monitor the certain following 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 indicate 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 proper procedures)

ACCESSING DIAGNOSTIC TROUBLE CODES

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

DRB SCAN TOOL

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

DIAGNOSIS AND TESTING (Continued)

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.

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?	1. Refer to Group 25, Emission Systems for On-Board Diagnostics and DTC information. Replace thermostat if necessary.
	2. Is the temperature sending unit connected?	2. Check the temperature sensor connector. Refer to Group 8E. Repair connector if 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 CAUTIONS associated with 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.

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	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 the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-20).
	2. Is the temperature gauge reading correctly?	2. Check gauge. Refer to Group 8E. Repair as necessary.
	3. Is the temperature warning illuminating unnecessarily?	3. Check warning lamp operation. Refer to Group 8E. Repair as necessary.
	4. Coolant low in coolant reserve/ overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. Refer to Testing Cooling System for Leaks in this Group.
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.	5. Tighten cap
	6. Poor seals at the radiator cap.	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.
	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	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	8. Incorrect coolant concentration	8. Check coolant. Refer to Coolant section in this Group for correct coolant/water mixture ratio.
	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.
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.	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 should return to normal range after vehicle is driven.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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 Cooling System-Testing for leaks in this group.
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.	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. 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 Accessory Drive Belts in this group. Check and correct as necessary.
	9. Air leak on the suction side of the 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 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 Cooling System-Testing For Leaks in this group.
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of coolant not correct. Mixture is too rich or too lean.	2. Check coolant concentration. Refer to the Coolant section of this group and adjust ratio as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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.
NOISY VISCOUS FAN/DRIVE	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.	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	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.	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.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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	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 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 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. 30).

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

DIAGNOSIS AND TESTING (Continued)

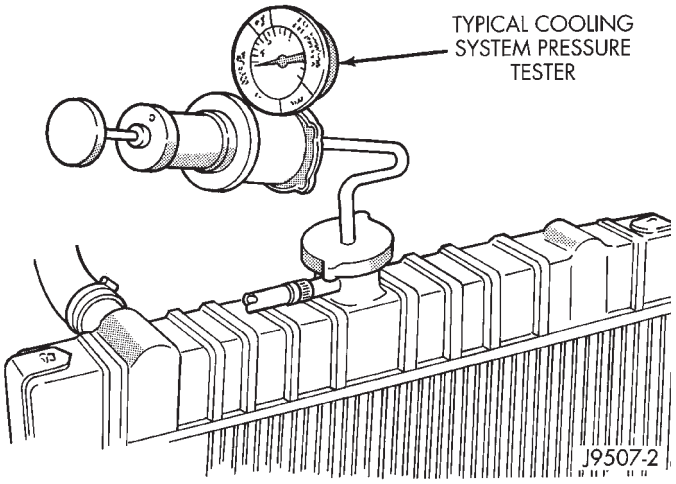


Fig. 30 Pressure Testing Cooling System—Typical

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.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 31).

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.

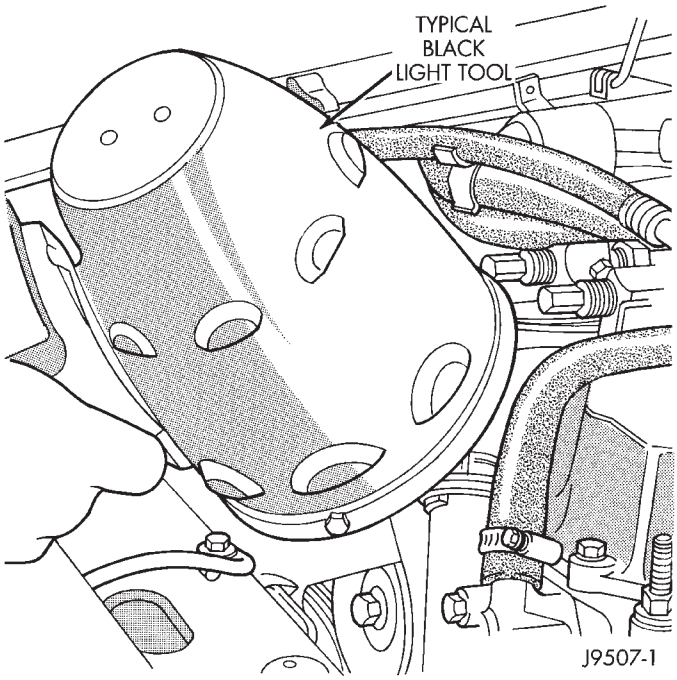


Fig. 31 Leak Detection Using Black Light—Typical

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.

DIAGNOSIS AND TESTING (Continued)

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-COCK 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

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.

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 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 start to occur at/between:

- 3.9L/5.2L/5.9L gas engines — 79° C (175° F)
- 8.0L engine — 88° to 96° C (190° to 205° F)
- 5.9L diesel engine — 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.

DIAGNOSIS AND TESTING (Continued)

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.

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. 32), 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. 32). 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.

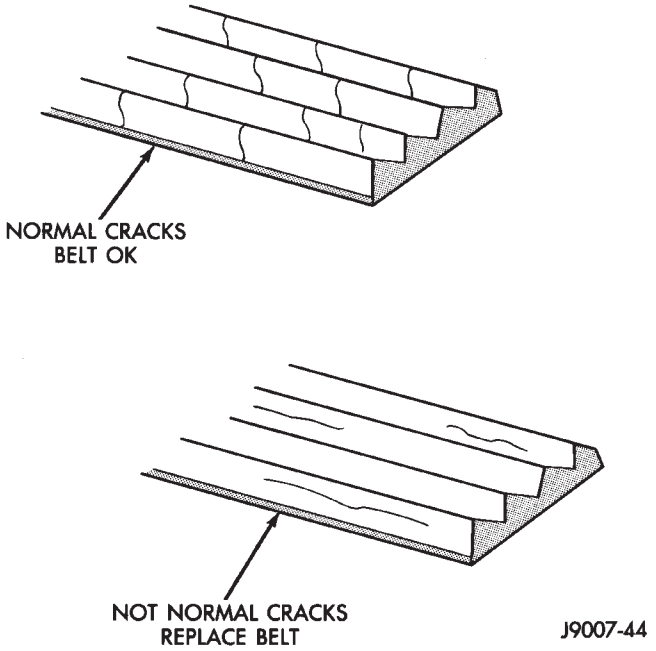


Fig. 32 Belt Wear Patterns

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.

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. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	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	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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
	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

DIAGNOSIS AND TESTING (Continued)

THERMOSTAT—DIESEL

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.**

NOTE: The DRB scan tool cannot be used to monitor engine coolant temperature on the diesel engine.

(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.

(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).

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

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

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.

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

DIAGNOSIS AND TESTING (Continued)

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.

PRESSURE TESTING RADIATOR CAPS

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. 33).

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.

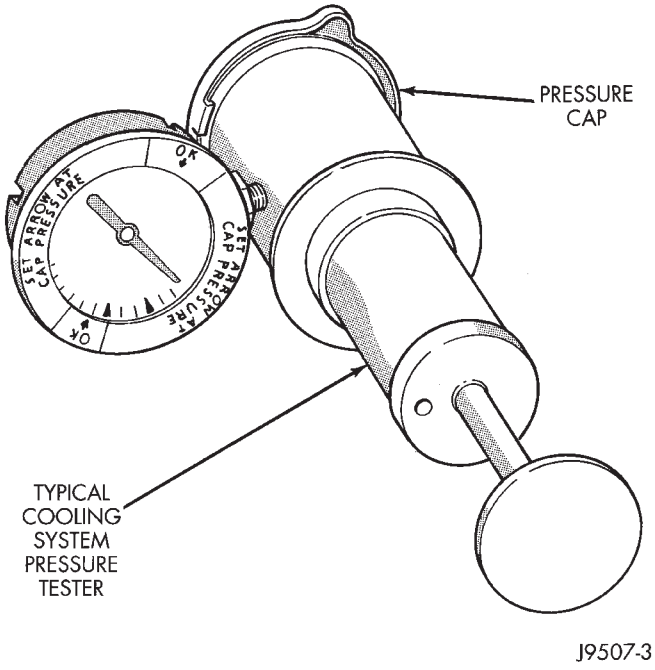


Fig. 33 Pressure Testing Radiator Cap—Typical Tester

LOW COOLANT 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—V-6, V-8, AND V-10 ENGINES

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

COOLANT SERVICE—DIESEL ENGINE

It is recommended that the cooling system be drained and flushed every 36 months or 77,000 kilometers (48,000 miles), whichever occurs first.

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) On vehicles equipped with gas powered engines, remove the cylinder block drain plugs. These are located on the sides of the block just above the oil pan (Fig. 34).

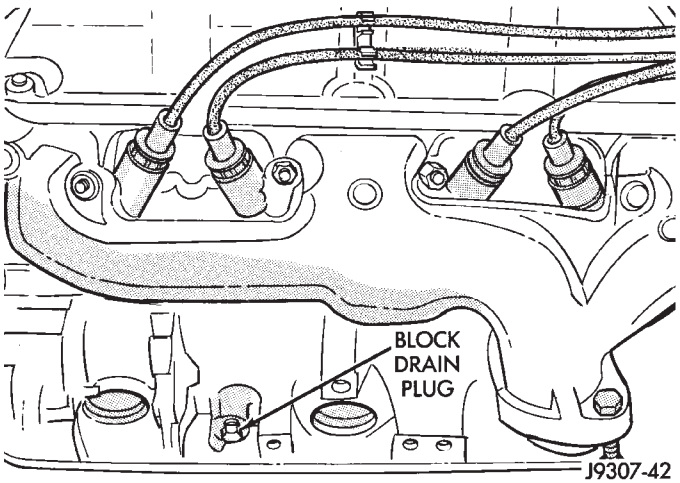


Fig. 34 Drain Plugs—Gas Powered Engines—Typical

(5) Remove radiator pressure cap.

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. 34).

(2) Close radiator drain plug.

SERVICE PROCEDURES (Continued)

(3) Fill the cooling system with a 50/50 mixture of water and antifreeze. **5.9L Diesel Engine Only:** The diesel engine is equipped with a one-way check valve (jiggle pin). The check valve is used as a servicing feature and will vent air when the system is being filled. Water pressure (or flow) will hold the valve closed. **Due to the use of this valve, the engine must not be operating when refilling the cooling system.** Refer to Thermostat Operation—5.9L Diesel Engine in the Thermostat section of this group for more information.

(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.

(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. 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—V-6, V-8, AND V-10

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.

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.

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 tube (Fig. 35).

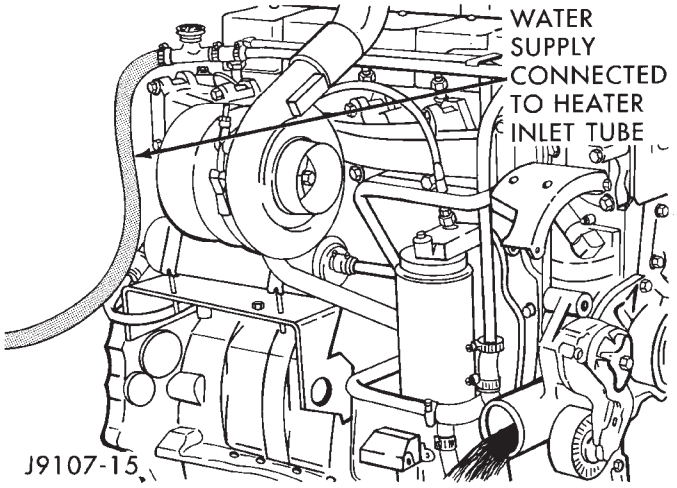


Fig. 35 Typical Reverse-flushing—5.9L Diesel

(4) Attach water supply hose to heater tube.

(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

COOLANT RESERVE/OVERFLOW TANK

TANK REMOVAL—ALL EXCEPT 8.0L V-10 ENGINE

(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. 36) 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.

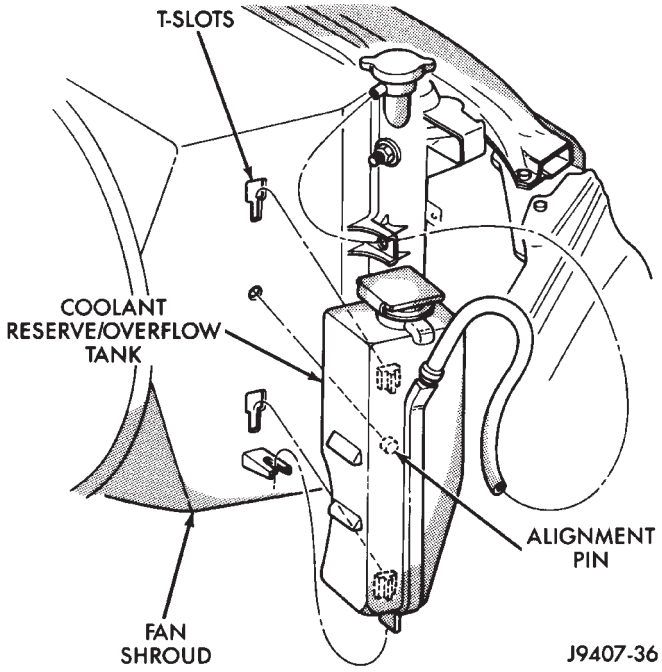


Fig. 36 COOLANT RESERVE/OVERFLOW TANK—ALL EXCEPT 8.0L V-10 ENGINE

TANK REMOVAL—8.0L V-10 ENGINE

(1) Remove overflow hose from radiator.

(2) Remove three tank mounting bolts (Fig. 37) and remove tank.

INSTALLATION

(1) Position tank to inner fender.

(2) Install bolts and tighten to 6 N·m (50 in. lbs.) torque.

(3) Connect overflow hose to radiator.

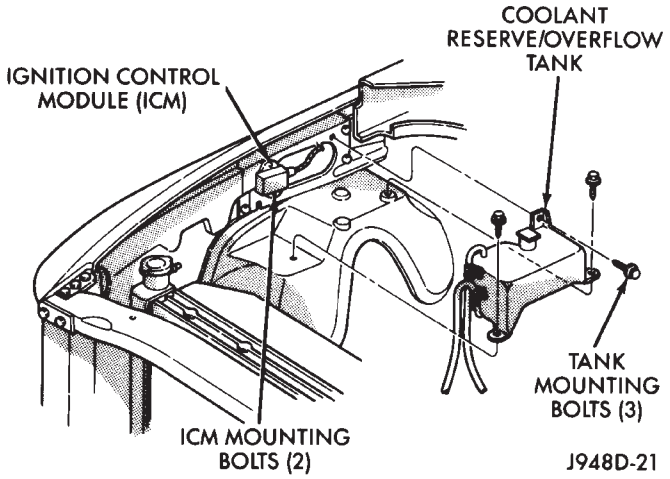


Fig. 37 COOLANT RESERVE/OVERFLOW TANK—V-10 ENGINE

WATER PUMP—V-6 AND V-8 ENGINES

REMOVAL

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

The water pump on all gas powered engines is bolted directly to the engine timing chain case/cover.

On all 3.9L/5.2L/5.9L gas powered engines, 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.

(1) Disconnect negative battery cable from battery.

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

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

(3) Remove windshield washer reservoir tank from radiator fan shroud. Refer to Group 8K, Windshield Wiper and Washer Systems.

(4) Disconnect the coolant reserve/overflow tank-to-radiator hose at the tank.

(5) Remove the four fan shroud mounting bolts at the radiator (Fig. 38). Do not attempt to remove shroud from vehicle at this time.

REMOVAL AND INSTALLATION (Continued)

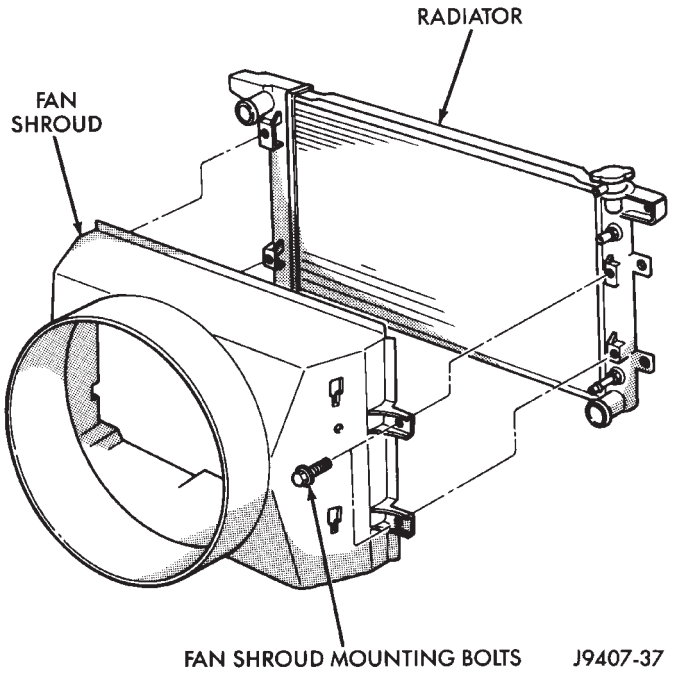


Fig. 38 Typical Fan Shroud Mounting

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.

(6) Remove upper radiator hose at radiator.

(7) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 39). Remove the fan/fan drive assembly from water pump by turning the mounting nut counterclockwise (as viewed from front). Threads on the 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 the water pump pulley bolts (Fig. 39) to prevent the pulley from rotating.

(8) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 39) from the thermal control fan drive.

(9) Remove fan blade/fan drive and fan shroud as an assembly from vehicle.

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

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

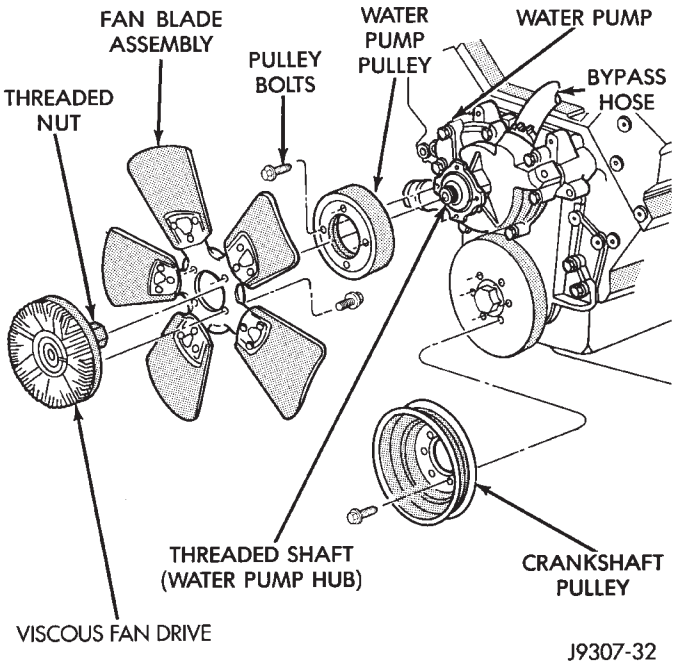


Fig. 39 Fan Blade and Viscous Fan Drive—Typical

(12) Remove accessory drive belt as follows: The drive belt is equipped with a spring loaded automatic tensioner (Fig. 40) (Fig. 41).

(13) 3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines: Relax the tension from the belt by rotating the tensioner clockwise (as viewed from front) (Fig. 40). When all belt tension has been relaxed, remove accessory drive belt.

(14) 5.9L HDC-Gas Engine: Relax the tension from the belt by rotating the tensioner counterclockwise (as viewed from front) (Fig. 41). When all belt tension has been relaxed, remove accessory drive belt.

(15) Remove the four water pump pulley-to-water pump hub bolts (Fig. 39) and remove pulley from vehicle.

(16) Remove the lower radiator hose and heater hose from water pump.

(17) Loosen heater hose coolant return tube mounting bolt (Fig. 42) (Fig. 43)and remove tube from water pump. Discard the old tube O-ring.

(18) Remove the seven water pump mounting bolts (Fig. 44).

(19) Loosen the clamp at the water pump end of bypass hose (Fig. 39). Slip the bypass hose from the water pump while removing pump from vehicle. Do not remove the clamp from the bypass hose.

(20) Discard old gasket.

REMOVAL AND INSTALLATION (Continued)

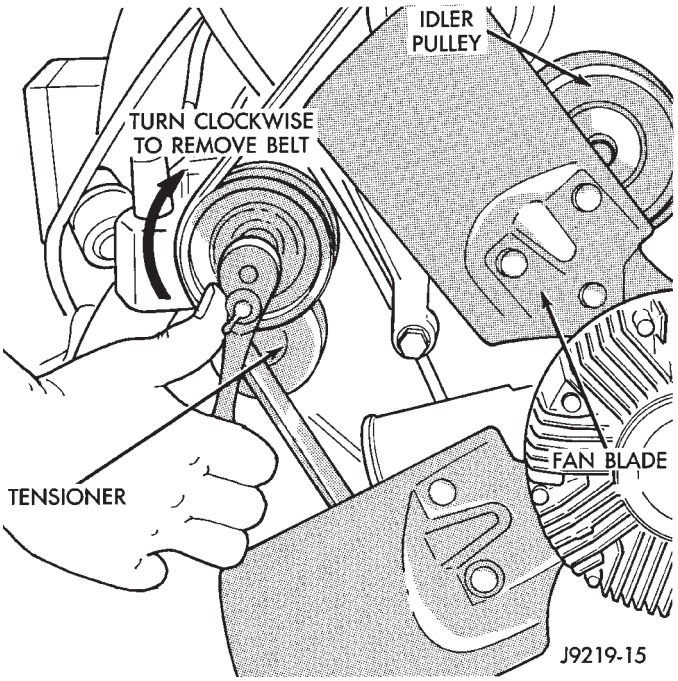


Fig. 40 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

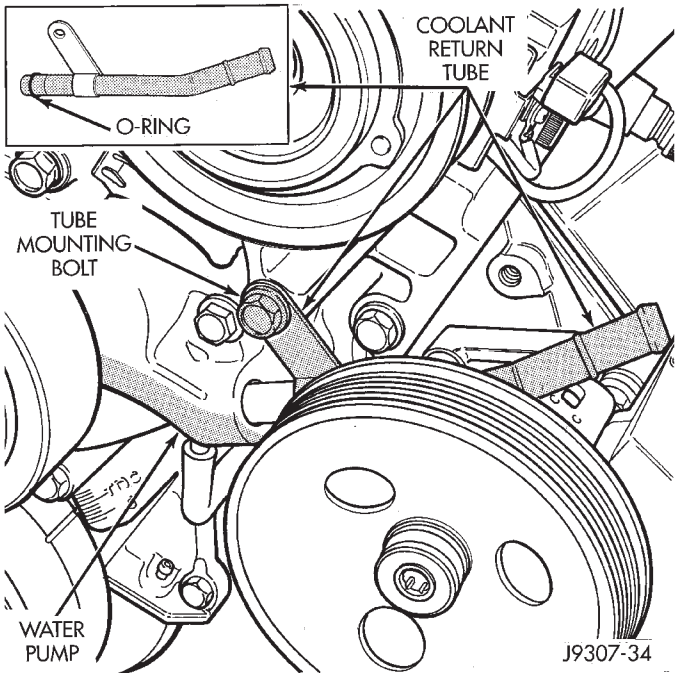


Fig. 42 Coolant Return Tube—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

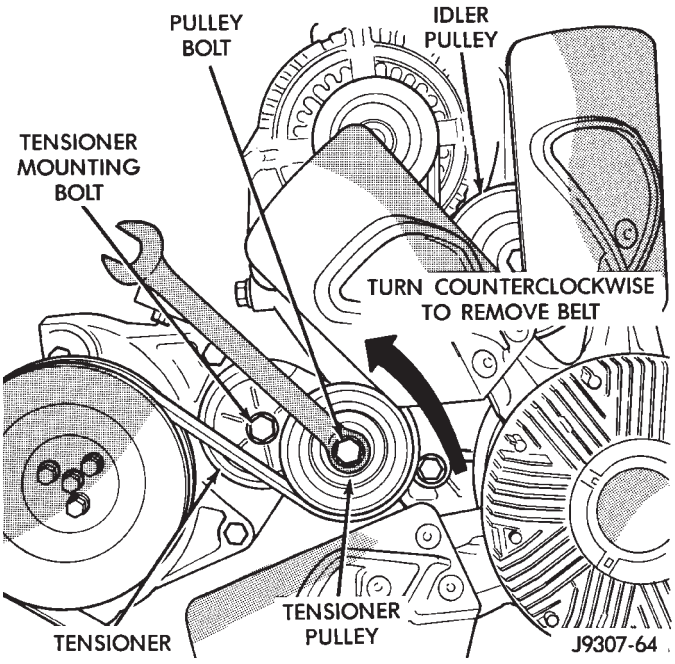


Fig. 41 Belt Tensioner—5.9L HDC-Gas Engine

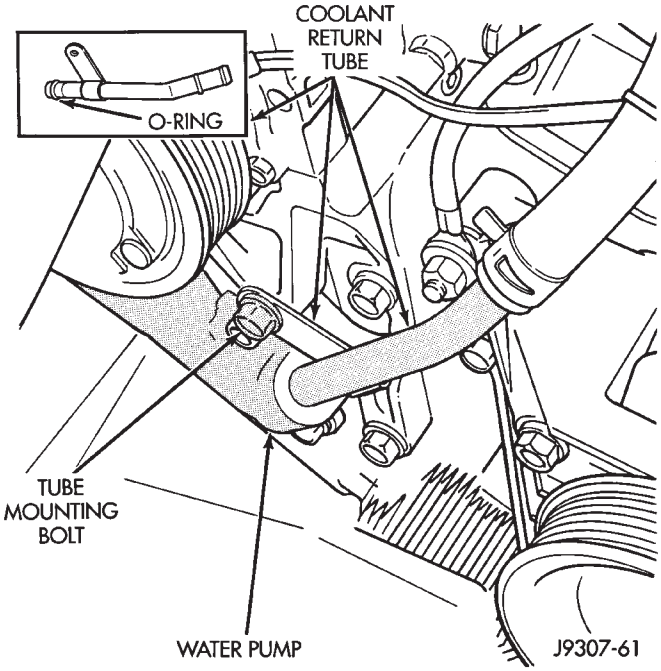


Fig. 43 Coolant Return Tube—5.9L HDC-Gas Engine

CAUTION: Do not pry the 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. 44). 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. 42) (Fig. 43). Coat the new o-ring with antifreeze before installation.

REMOVAL AND INSTALLATION (Continued)

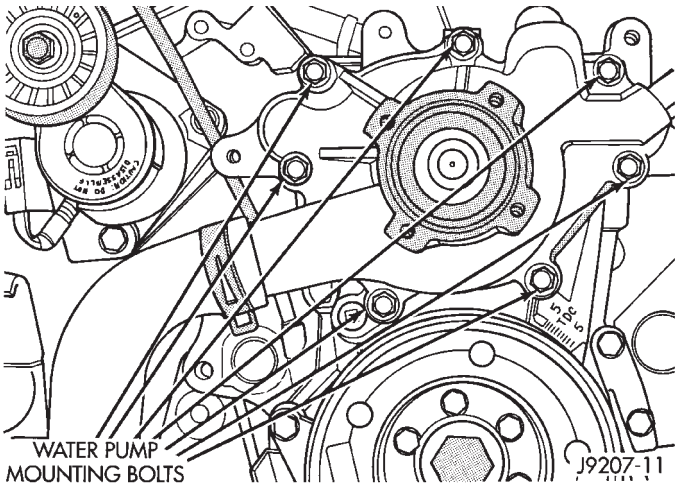


Fig. 44 Water Pump Bolts—3.9L V-6 or 5.2/5.9L V-8 Gas Engines—Typical

(6) Install coolant return tube and its mounting bolt to engine (Fig. 42) (Fig. 43). 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. 39) to prevent pulley from rotating.

(10) Relax tension from automatic belt tensioner (Fig. 40) (Fig. 41). Install 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. 45) (Fig. 46) (Fig. 47) 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 Refilling Cooling System in this group.

(15) Connect negative battery cable.

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

WATER PUMP—8.0L V-10 ENGINE

REMOVAL

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

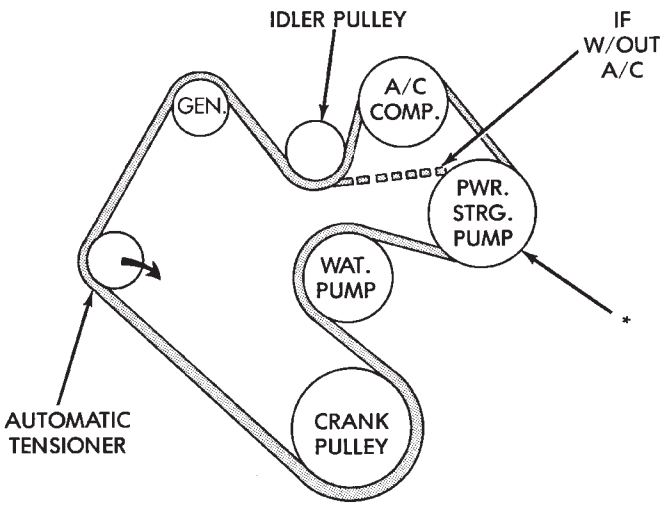


Fig. 45 Belt Routing—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

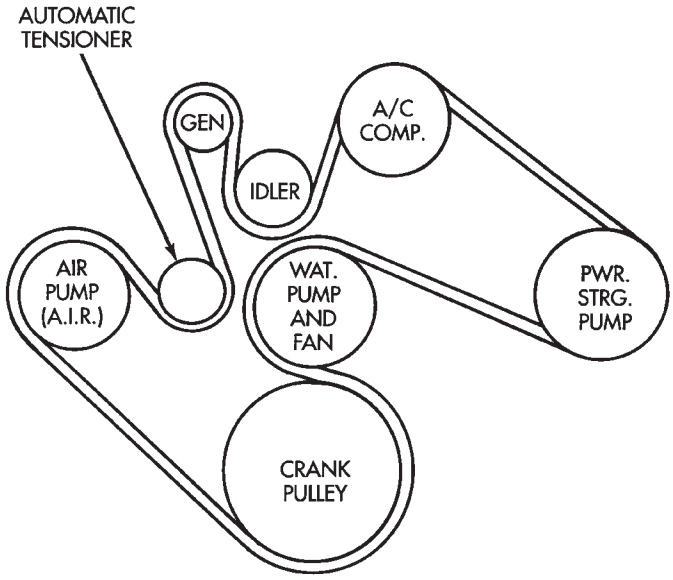


Fig. 46 Belt Routing—5.9L HDC-Gas Engine—With A/C

The water pump on all gas powered engines is bolted directly to the engine timing chain case/cover.

On the 8.0L V-10 engine, a rubber o-ring (instead of 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

REMOVAL AND INSTALLATION (Continued)

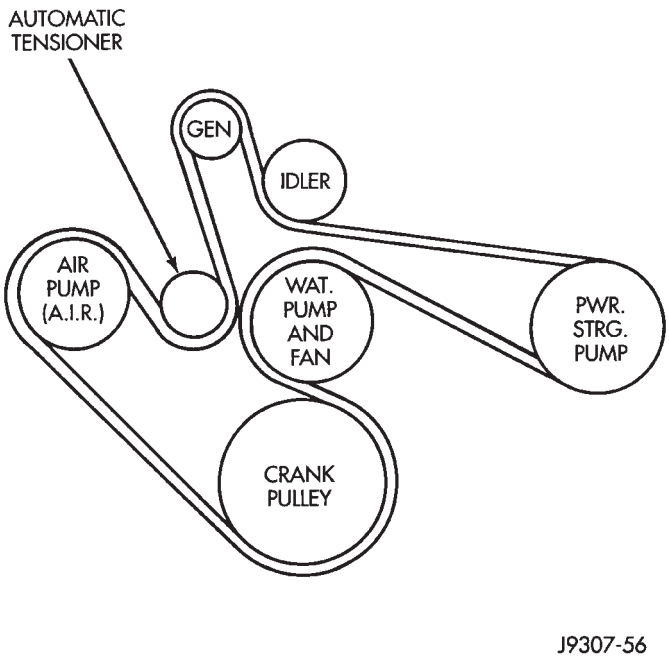


Fig. 47 Belt Routing—5.9L HDC-Gas Engine—Without A/C

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.

(1) Disconnect negative battery cable from battery.

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

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

(3) Remove windshield washer reservoir tank from radiator fan shroud. Refer to Group 8K, Windshield Wiper and Washer Systems.

(4) Remove the four fan shroud mounting bolts at the radiator (Fig. 48). Do not attempt to remove shroud from vehicle at this time.

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.

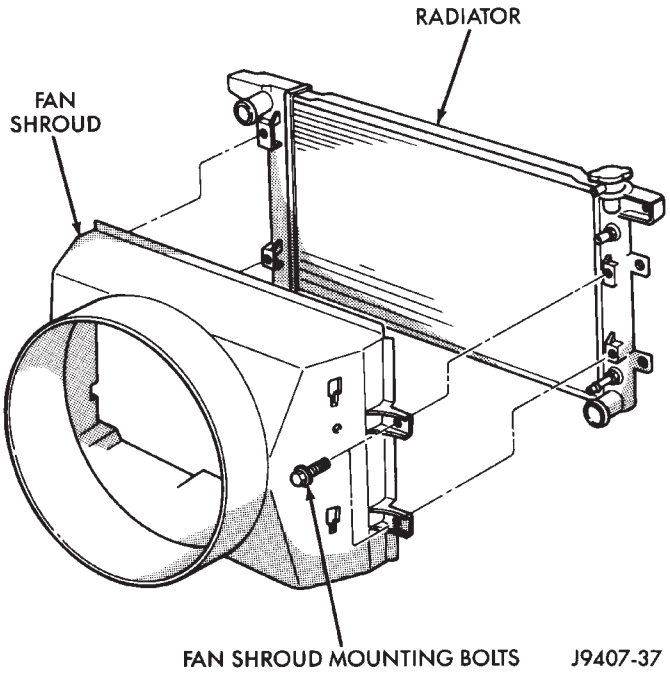


Fig. 48 Typical Fan Shroud Mounting

(5) Remove upper radiator hose at radiator.

(6) The thermal viscous fan drive is attached (threaded) to the water pump hub shaft (Fig. 49). Remove the fan/fan drive assembly from water pump by turning the mounting nut counterclockwise (as viewed from front). Threads on the 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 the water pump pulley bolts (Fig. 49) to prevent the pulley from rotating.

(7) If water pump is being replaced, do not unbolt fan blade assembly (Fig. 49) from the thermal control fan drive.

(8) Remove fan blade/fan drive and fan shroud as an assembly from vehicle.

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

Do not remove the water pump pulley bolts at this time.

(9) Remove accessory drive belt by placing a wrench or socket on the accessory drive belt tensioner pulley bolt (Fig. 50). Rotate the tensioner pulley counter-clockwise until belt tension is relieved and slip the belt off of the alternator pulley.

NOTE: The belt tensioner pulley bolt will not loosen because it has left-handed threads.

REMOVAL AND INSTALLATION (Continued)

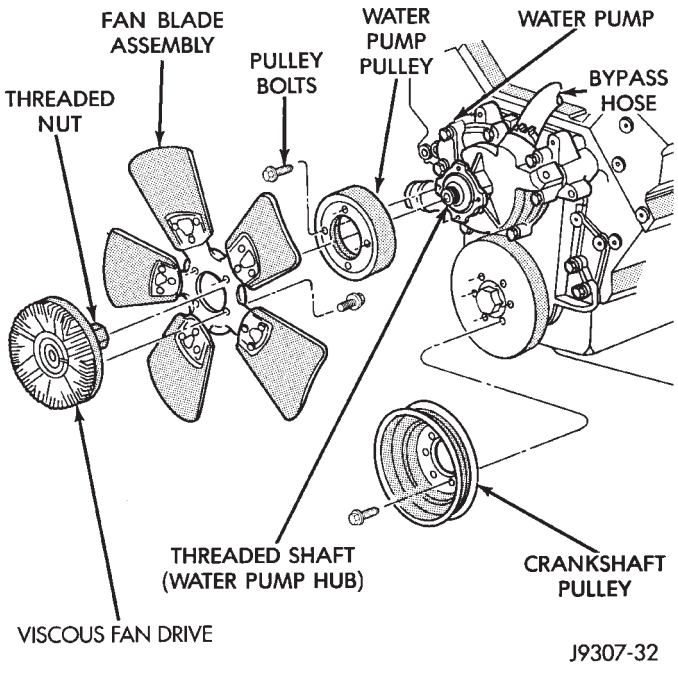


Fig. 49 Fan Blade and Viscous Fan Drive—Typical

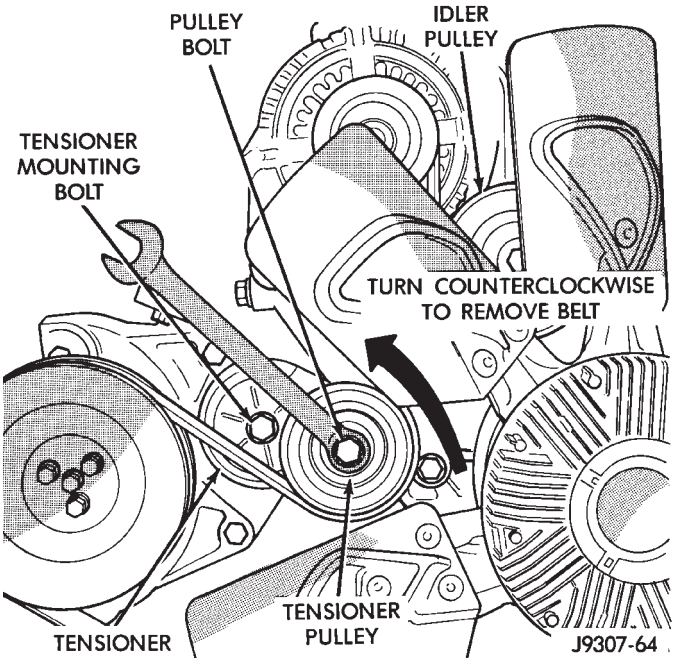


Fig. 50 Belt Tensioner—8.0L V-10 Engine

(10) Remove the four water pump pulley-to-water pump hub bolts (Fig. 49) and remove pulley from vehicle.

(11) Remove the lower radiator hose at water pump.

(12) Remove heater hose at water pump fitting.

(13) Remove the seven water pump mounting bolts (Fig. 51).

(14) Loosen the clamp at the water pump end of bypass hose. Slip the bypass hose from the water pump while removing pump from vehicle. Do not remove the clamp from the bypass hose.

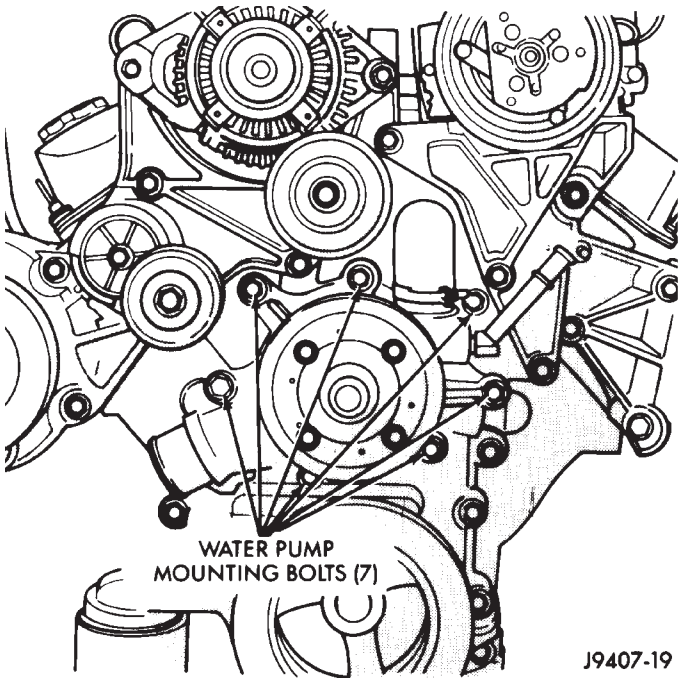


Fig. 51 Water Pump Bolts—8.0L V-10—Typical

(15) Discard the water pump-to-timing chain/case cover o-ring seal (Fig. 52).

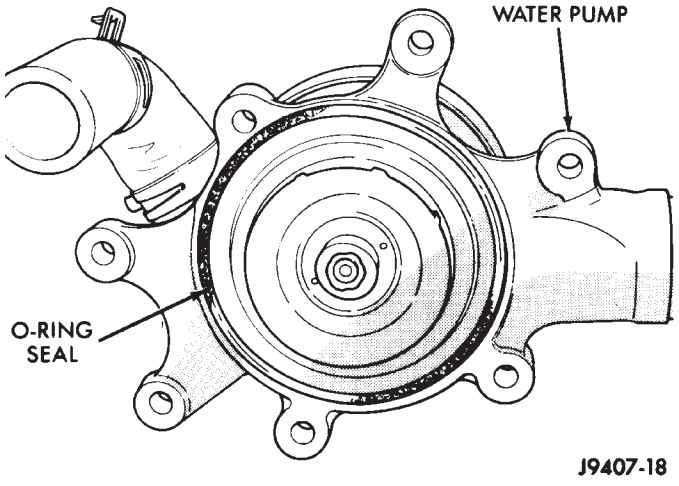


Fig. 52 Water Pump O-Ring Seal—8.0L V-10

(16) Remove the heater hose fitting from water pump if pump replacement is necessary. Note position (direction) of fitting before removal. Fitting must be re-installed to same position.

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) If water pump is being replaced, install the heater hose fitting to the pump. Tighten fitting to 16 N·m (144 in. lbs.) torque. After fitting has been torqued, position fitting as shown in (Fig. 53). When positioning fitting, do not back off (rotate counterclockwise). Use a sealant on the fitting such as Mopar® Thread Sealant With Teflon. Refer to the directions on the package.

CAUTION: This heater hose fitting must be installed to pump before pump is installed to engine.

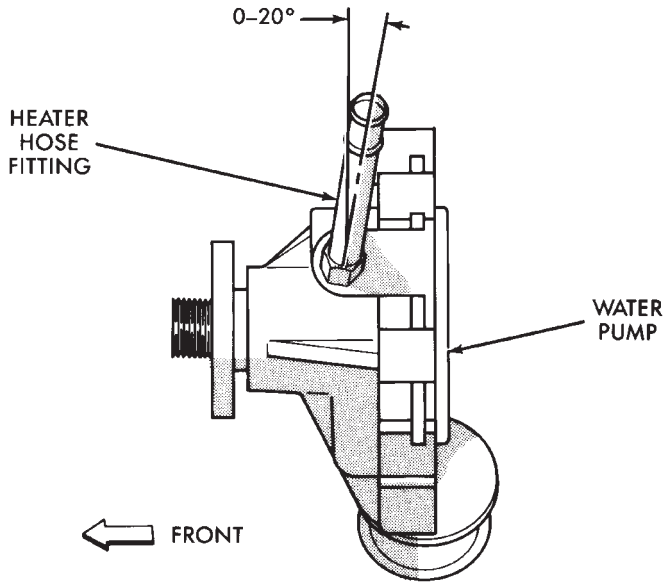


Fig. 53 Heater Hose Fitting Position—8.0L V-10

(2) Clean the o-ring mating surfaces at rear of water pump and front of timing chain/case cover.

(3) Apply a small amount of petroleum jelly to o-ring (Fig. 52). This will help retain o-ring to water pump.

(4) Install water pump to engine as follows: Guide water pump fitting into bypass hose as pump is being installed. Install water pump bolts (Fig. 51). Tighten water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.

(5) Position bypass hose clamp to bypass hose.

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

(7) Connect radiator lower hose to water pump.

(8) Connect heater hose and hose clamp to heater hose fitting.

(9) Install water pump pulley. Tighten bolts to 22 N·m (16 ft. lbs.) torque. Place a bar or screwdriver between water pump pulley bolts (Fig. 49) to prevent pulley from rotating.

(10) Relax tension from automatic belt tensioner (Fig. 50). Install 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. 54) (Fig. 55)for correct belt routing. The correct belt with correct length must be used.

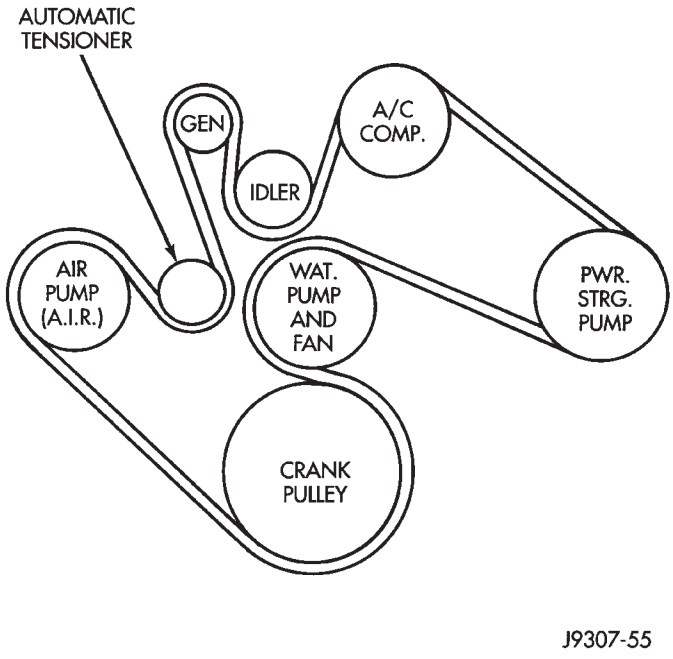


Fig. 54 Belt Routing—8.0L V-10 Engine—With A/C

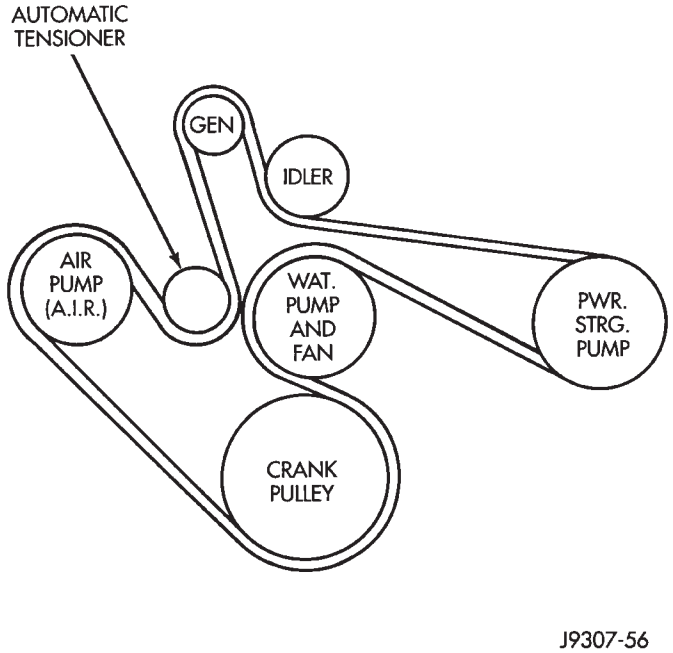


Fig. 55 Belt Routing—8.0L V-10 Engine—Without A/C

REMOVAL AND INSTALLATION (Continued)

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

(12) Install fan shroud to radiator. Tighten bolts to 6 N·m (50 in. lbs.) torque.

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

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

(15) Connect negative battery cable.

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

WATER PUMP—5.9L DIESEL

REMOVAL

(1) Disconnect the negative battery cables from both batteries.

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

(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 the Engine Accessory Drive Belt section of this group.

(5) Remove water pump mounting bolts (Fig. 56).

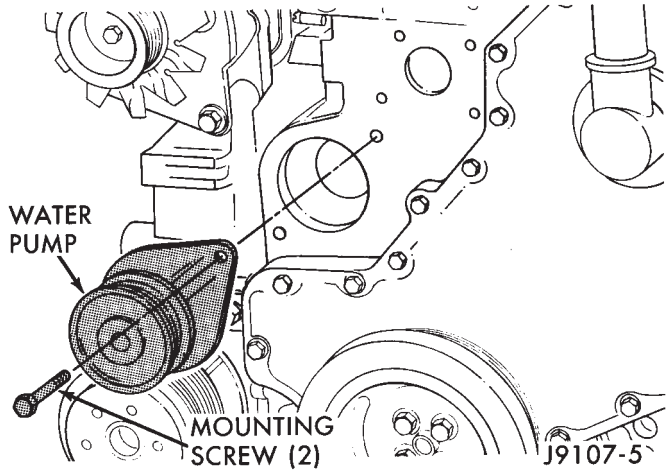


Fig. 56 Pump Removal/Installation—5.9L Diesel

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

INSTALLATION

(1) Install new O-ring seal in groove on water pump (Fig. 57).

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

(3) Install accessory drive belt. Refer to the Engine Accessory Drive Belt section of 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.

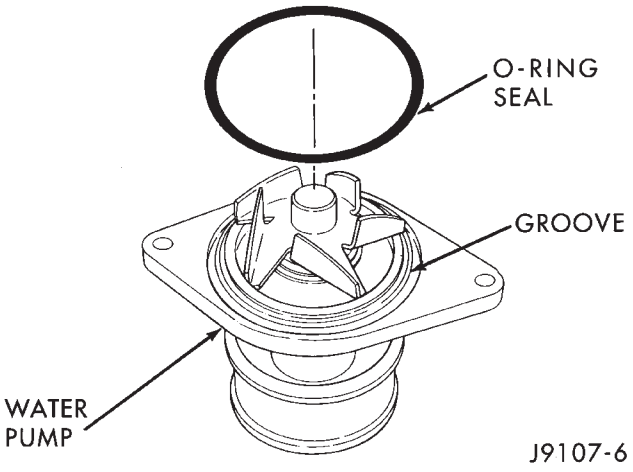


Fig. 57 Pump O-ring Seal—5.9L Diesel

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

WATER PUMP BYPASS HOSE

REMOVAL—3.9L V-6 OR 5.2/5.9L V-8 ENGINES WITHOUT AIR CONDITIONING

A water pump bypass hose (Fig. 58) is used between the intake manifold and water pump on all gas powered engines. To test for leaks, refer to Testing Cooling System for Leaks in this group.

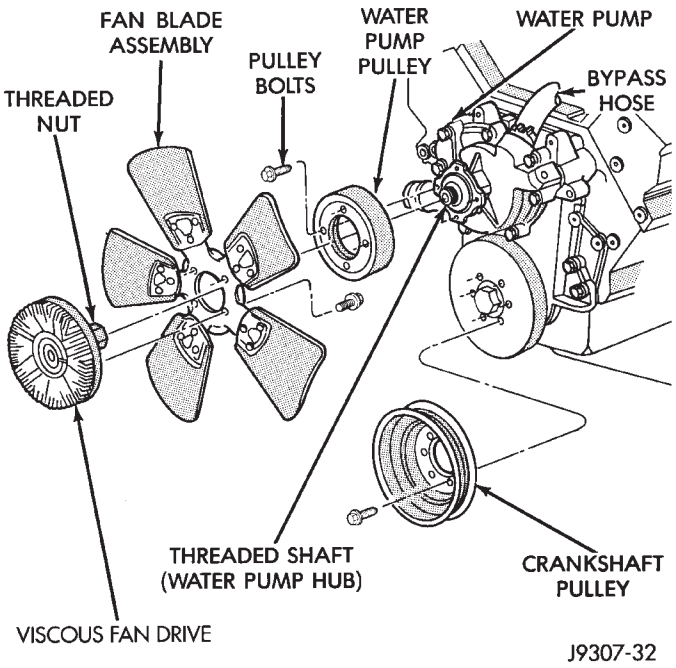


Fig. 58 Water Pump Bypass Hose—Typical

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

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

REMOVAL AND INSTALLATION (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). 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) Loosen both bypass hose clamps and position to the center of hose.
(4) Remove hose from vehicle.

INSTALLATION

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

REMOVAL—3.9L V-6 OR 5.2/5.9L V-8 ENGINE—WITH AIR CONDITIONING

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 59) must be partially removed. Removing the generator or A/C compressor from their mounting bracket is not necessary. Also, discharging the A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

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

(1) Disconnect negative battery cable from battery.
(2) Partially drain cooling system. Refer to Draining Cooling System in this group.
(3) Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.
(4) Remove upper radiator hose clamp at radiator. A special clamp tool must be used to remove the constant tension clamps. Remove hose at radiator.
(5) Disconnect throttle cable from clip at radiator fan shroud.
(6) Unplug wiring harness from A/C compressor.
(7) Remove the air cleaner assembly.

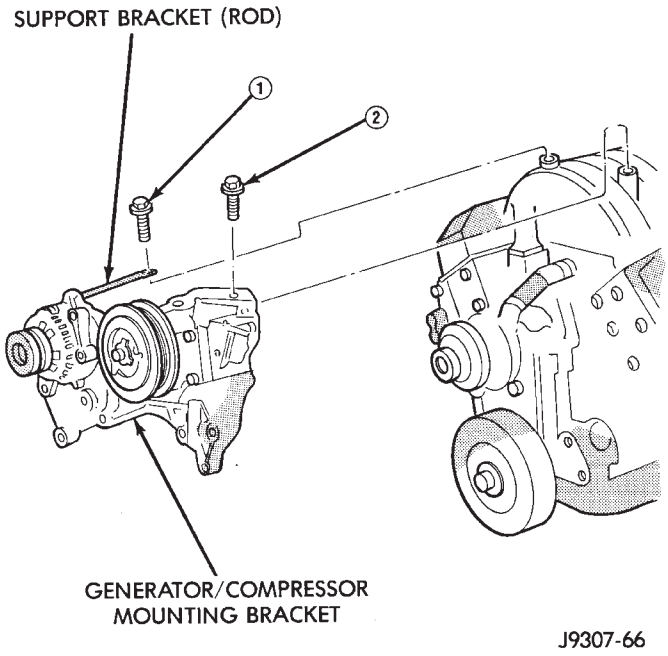


Fig. 59 Generator—A/C Compressor Mounting Bracket—Typical

(8) Remove accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.
(9) (8) **3.9L V-6 or 5.2/5.9L V-8 LDC-Gas:** The drive belt idler pulley must be removed to gain access to one of the A/C compressor/generator bracket mounting bolts. Remove the idler pulley bolt and remove idler pulley (Fig. 60).

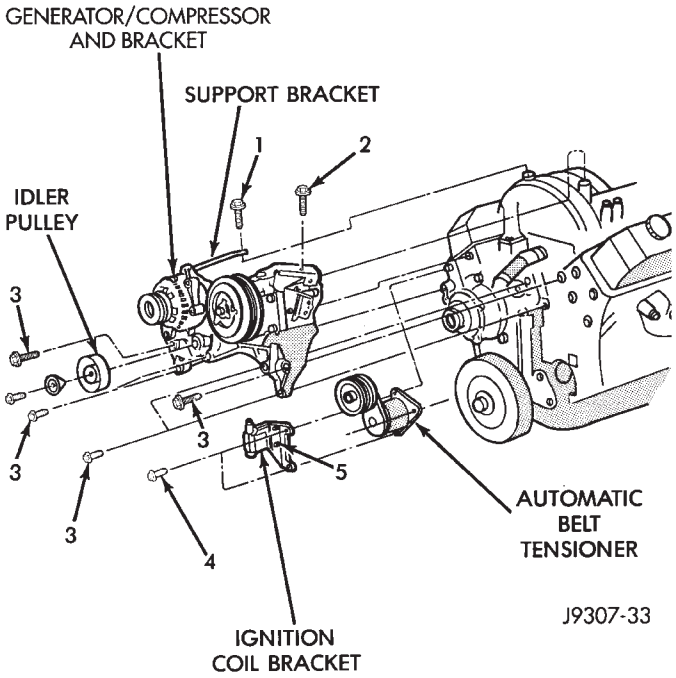


Fig. 60 Idler Pulley—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

REMOVAL AND INSTALLATION (Continued)

(10) **5.9L HDC-Gas:** The automatic belt tensioner/pulley assembly must be removed to gain access to one of the A/C compressor/generator bracket mounting bolts. Remove the tensioner mounting bolt (Fig. 61) and remove tensioner.

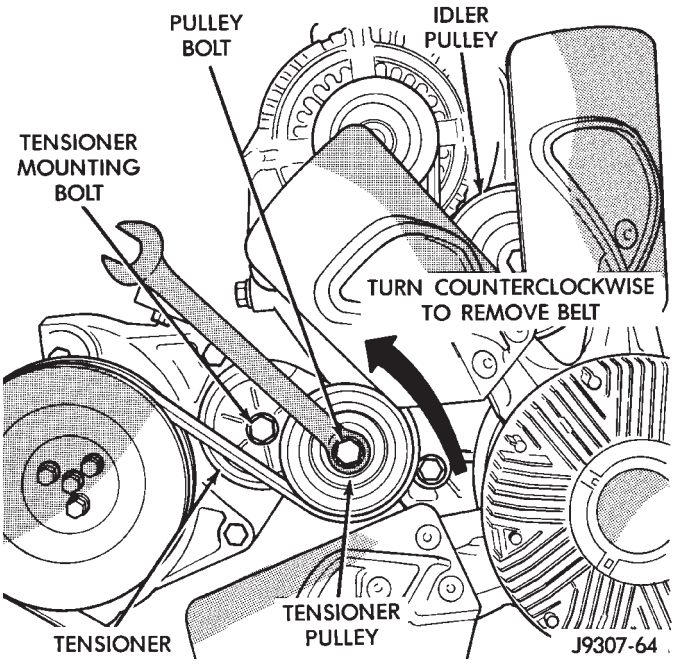


Fig. 61 Belt Tensioner—5.9L HDC-Gas Engine

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

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

(13) Remove heater hose coolant return tube mounting bolt (Fig. 62) (Fig. 63)and remove tube from engine. Discard the old tube O-ring.

(14) Remove bracket-to-intake manifold bolts (number 1 and 2 (Fig. 59).

(15) Remove remaining bracket-to-engine bolts (Fig. 64) (Fig. 65).

(16) 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.

(17) Loosen and position both hose clamps to the center of bypass hose. A special clamp tool must be used to remove the constant tension clamps. Remove hose from vehicle.

INSTALLATION

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

(2) Install bypass hose to engine.

(3) Secure both hose clamps.

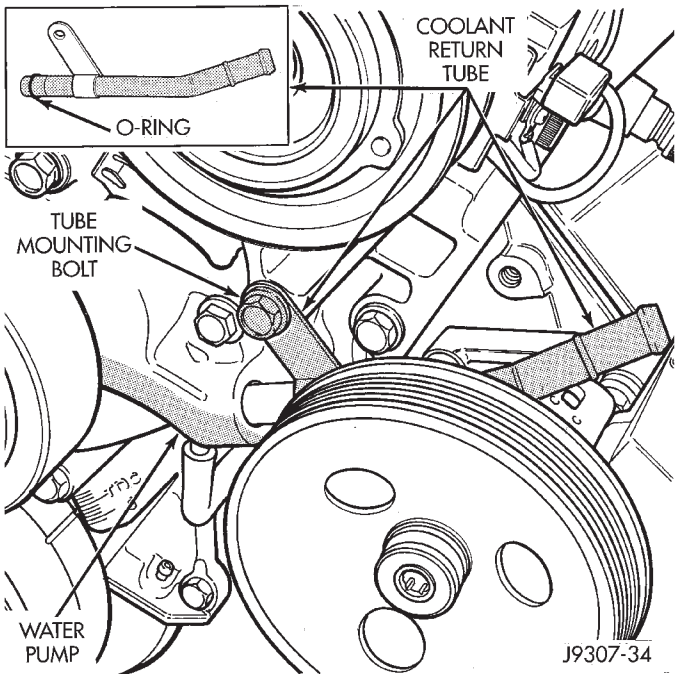


Fig. 62 Coolant Return Tube—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

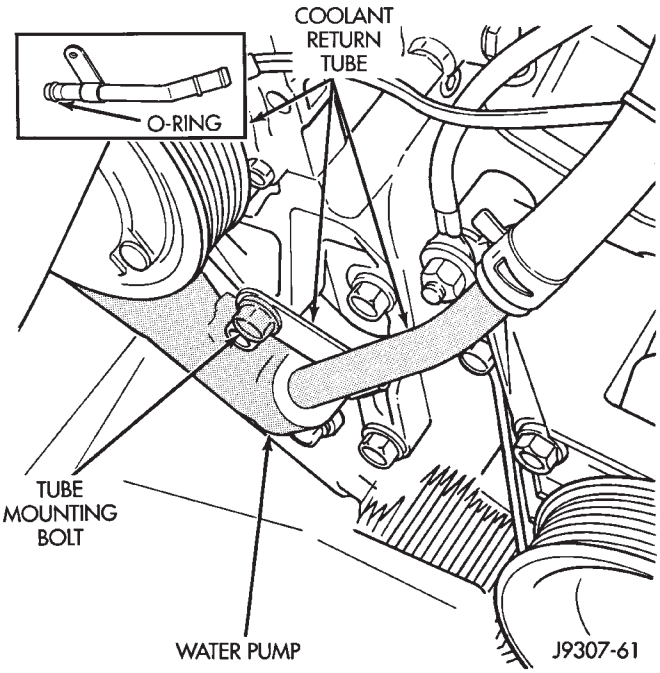


Fig. 63 Coolant Return Tube—5.9L HDC-Gas Engine

(4) Install generator-A/C mounting bracket assembly to engine. Tighten bolt number 1 (Fig. 59) to 41 N·m (30 ft. lbs.) torque. Tighten bolt number 2 (Fig. 59) to 28 N·m (20 ft. lbs.) torque. Tighten bracket mounting bolts (Fig. 64) (Fig. 65)to 40 N·m (30 ft. lbs.) torque.

(5) Install a new O-ring to the heater hose coolant return tube (Fig. 62) (Fig. 63). Coat the new O-ring with antifreeze before installation.

REMOVAL AND INSTALLATION (Continued)

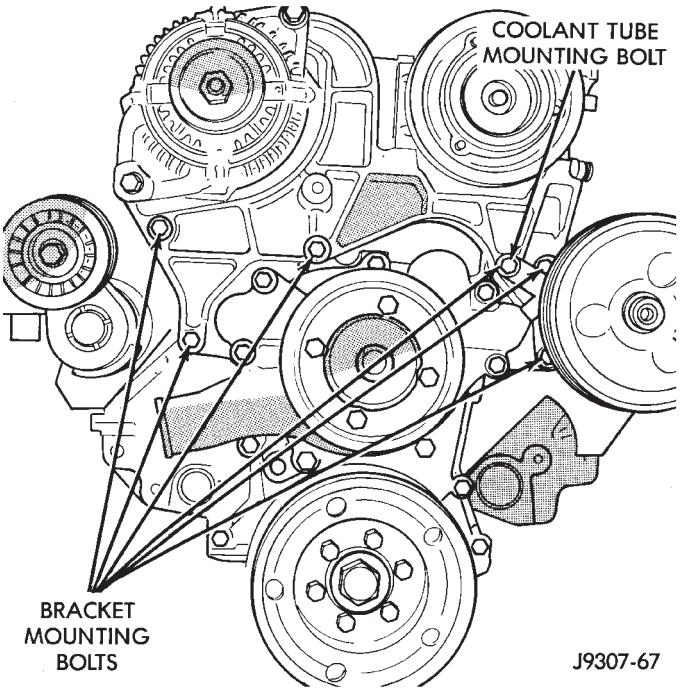


Fig. 64 Bracket Bolts—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

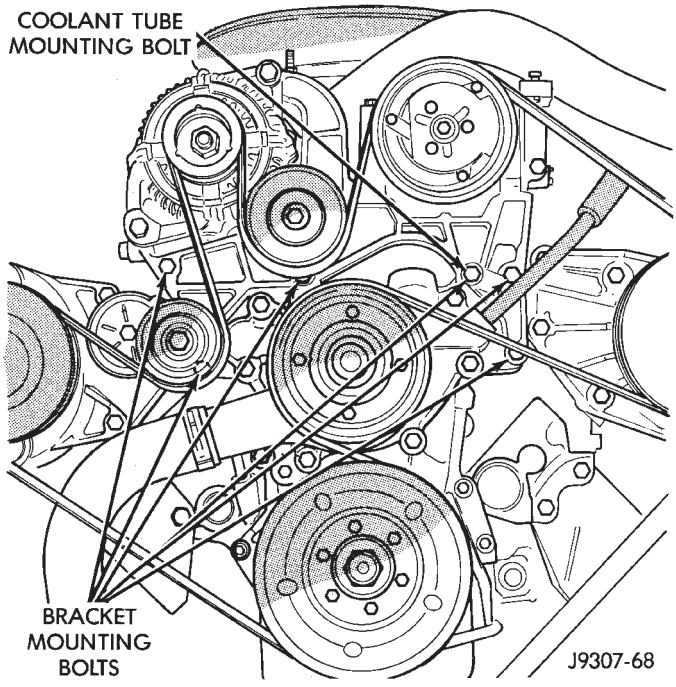


Fig. 65 Bracket Bolts—5.9L HDC-Gas Engine

(6) Install coolant return tube and its mounting bolt to engine (Fig. 62) (Fig. 63).

(7) Connect throttle body control cables.

(8) Install oil dipstick mounting bolt.

(9) **3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines:** Install idler pulley. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

(10) **5.9L HDC-Gas:** Install automatic belt tensioner assembly to mounting bracket. A dowel pin is located on back of tensioner (Fig. 66). Align this to dowel hole (Fig. 67) in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

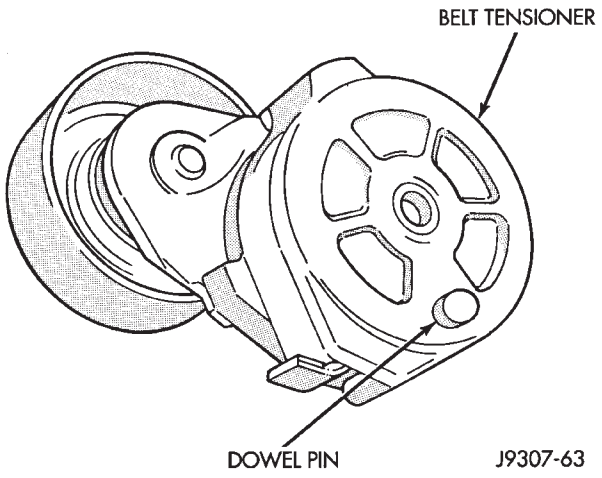


Fig. 66 Tensioner Dowel Pin—5.9L HDC-Gas Engine

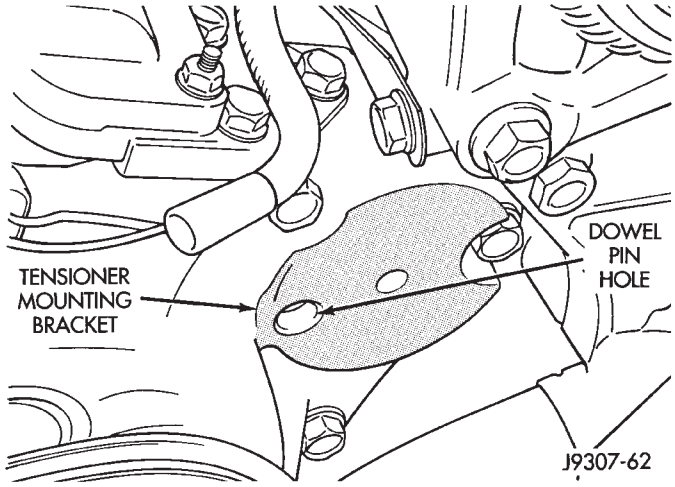


Fig. 67 Tensioner Mounting Bracket Dowel Hole—5.9L HDC-Gas Engine

(11) Install drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Belt Schematics in the Engine Accessory Drive Belt section of this group for correct belt routing. The correct belt with the correct length must be used.

(12) Install air cleaner assembly.

(13) Install upper radiator hose to radiator.

REMOVAL AND INSTALLATION (Continued)

(14) Connect throttle cable to clip at radiator fan shroud.

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

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

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

THERMOSTAT—3.9L V-6 OR 5.2/5.9L V-8

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.

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

Factory installed thermostat housings on 3.9L V-6 or 5.2/5.9L V-8 engines are installed on a gasket with an anti-stick coating. This will aid in gasket removal and cleanup.

(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. If not equipped with air conditioning, proceed to step number 4.

(3) If equipped with air conditioning:

(a) Remove the support bracket (rod) located near the rear of generator (Fig. 68).

(b) The drive belt must be removed. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

(c) The generator must be partially removed. Remove the two generator mounting bolts. Do not remove any wiring at generator. If equipped with 4WD, unplug the 4WD indicator lamp wiring harness (located near rear of generator).

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

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.

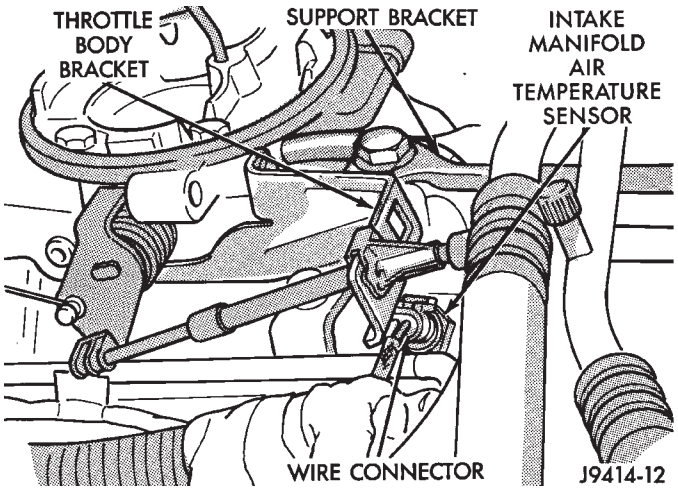


Fig. 68 Support Bracket—Generator Mounting Bracket-to-Intake Manifold—Typical

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 upper radiator hose clamp. Remove upper radiator hose at thermostat housing.

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

(6) Remove thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 69). Discard old gasket.

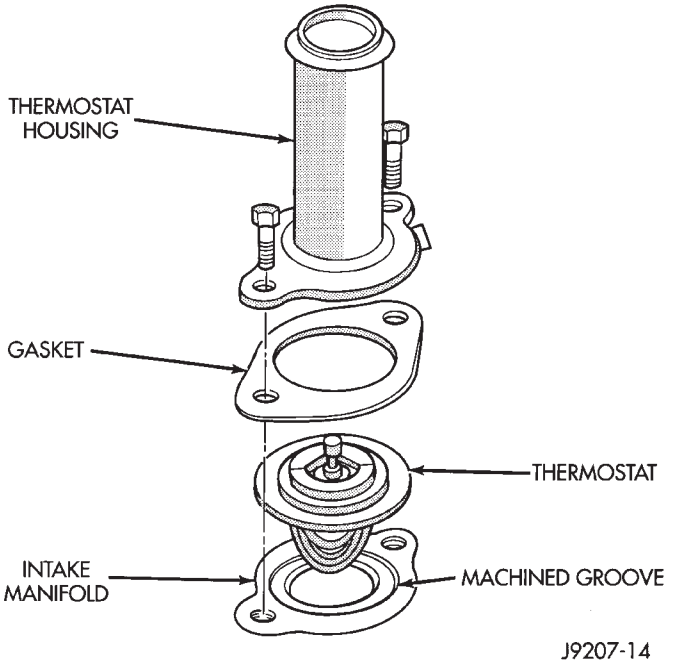


Fig. 69 Thermostat—3.9L V-6 or 5.2/5.9L V-8 Gas Engines

REMOVAL AND INSTALLATION (Continued)

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. 69).

(3) Install gasket on intake manifold and over thermostat (Fig. 69).

(4) Position the thermostat housing to the intake manifold. Note the word FRONT stamped on the housing (Fig. 70). For adequate clearance, this **must** be placed towards the front of vehicle. The housing should be slightly angled forward after installation to intake manifold.

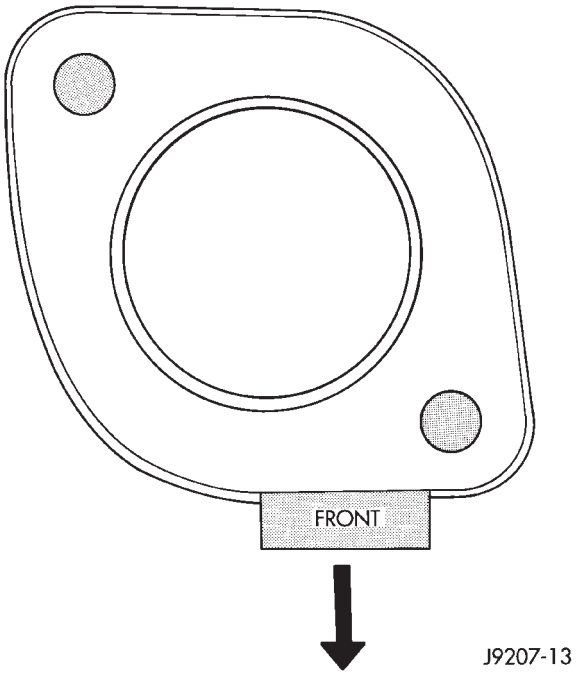


Fig. 70 Thermostat Position—3.9L V-6 or 5.2/5.9L V-8 Gas Engines

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

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

(6) Install upper radiator hose to thermostat housing.

(7) Air conditioned vehicles:

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

(b) Install support bracket (generator mounting bracket-to-intake manifold) (Fig. 68). Tighten bolts to 54 N·m (40 ft. lbs.) torque.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to Belt Schematics in the Engine Accessory Drive Belt section of this group for correct engine belt routing. The correct belt with the correct length must be used.

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

(9) Connect negative battery cable to battery.

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

THERMOSTAT—8.0L V-10

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.

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

A rubber lip-type seal with a metal shoulder is pressed into the intake manifold beneath the thermostat (Fig. 71).

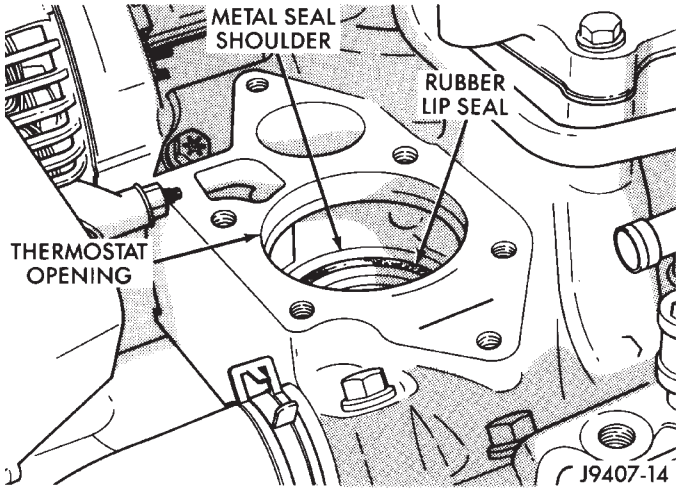


Fig. 71 Thermostat Seal—8.0L V-10 Engine

(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) Remove the two support rod mounting bolts and remove support rod (intake manifold-to-generator mount) (Fig. 72).

REMOVAL AND INSTALLATION (Continued)

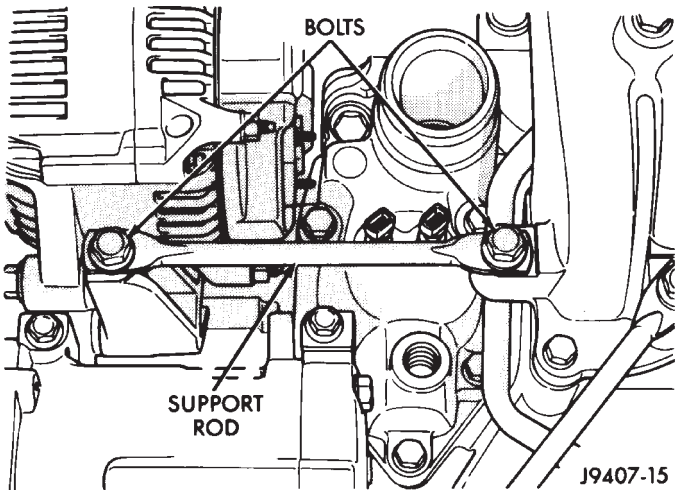


Fig. 72 Support Rod—8.0L V-10 Engine

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 upper radiator hose clamp. Remove upper radiator hose at thermostat housing.
(5) Disconnect the wiring connectors at both of the sensors located on thermostat housing.
(6) Remove six thermostat housing mounting bolts, thermostat housing and thermostat.

INSTALLATION

(1) Clean mating areas of intake manifold and thermostat housing.
(2) Check the condition (for tears or cracks) of the rubber thermostat seal located in the intake manifold (Fig. 71) (Fig. 73). The thermostat should fit snugly into the rubber seal.
(3) If seal replacement is necessary, coat the outer (metal) portion of the seal with Mopar® Gasket Maker. Install the seal into the manifold using Special Seal Tool number C-3995-A with handle tool number C-4171.
(4) Install thermostat into recessed machined groove on intake manifold (Fig. 73).
(5) Install thermostat housing (Fig. 73).
(6) Install housing-to-intake manifold bolts. Tighten bolts to 25 N·m (220 in. lbs.) torque.

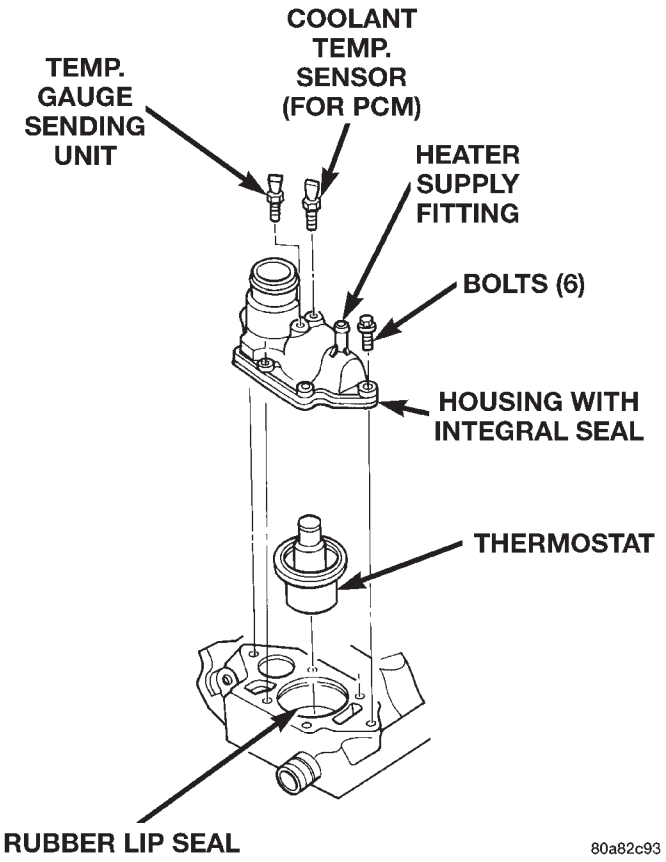


Fig. 73 Thermostat—8.0L V-10 Engine

CAUTION: Housing bolts should be tightened evenly to prevent damage to housing and to prevent leaks.

(7) Connect the wiring to both sensors.
(8) Install the upper radiator hose and hose clamp to thermostat housing.
(9) Install support rod.
(10) Fill cooling system. Refer to Refilling Cooling System in this group.
(11) Connect negative battery cable to battery.
(12) Start and warm engine. Check for leaks.

THERMOSTAT—DIESEL ENGINE

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 both negative battery cables from both batteries.

REMOVAL AND INSTALLATION (Continued)

(2) Remove accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section 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. A special clamp tool must be used to remove the constant tension clamps.

(5) Remove the hose clamp and check valve hose at thermostat housing (Fig. 74).

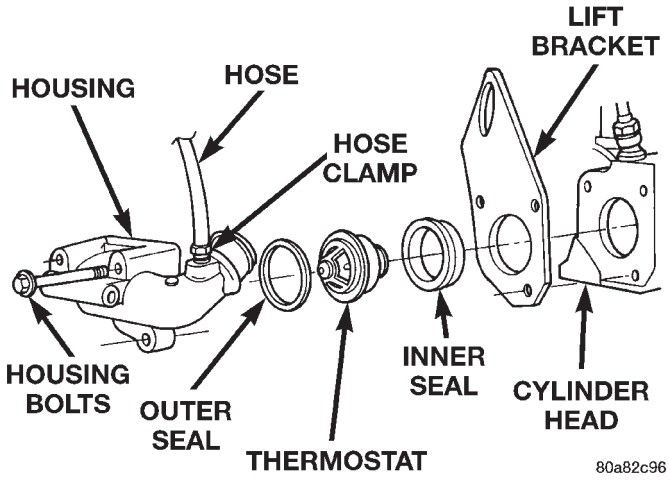


Fig. 74 Thermostat Removal—5.9L Diesel

(6) Remove the two upper generator bracket mounting bolts (Fig. 75).

(7) Remove the upper generator mounting bracket (Fig. 75).

(8) Loosen but do not remove the generator lower pivot bolt.

(9) Position the generator to gain access to thermostat housing and housing bolts.

(10) Remove thermostat housing mounting bolts.

(11) Remove the thermostat housing, thermostat, inner and outer seals and lift bracket (Fig. 74).

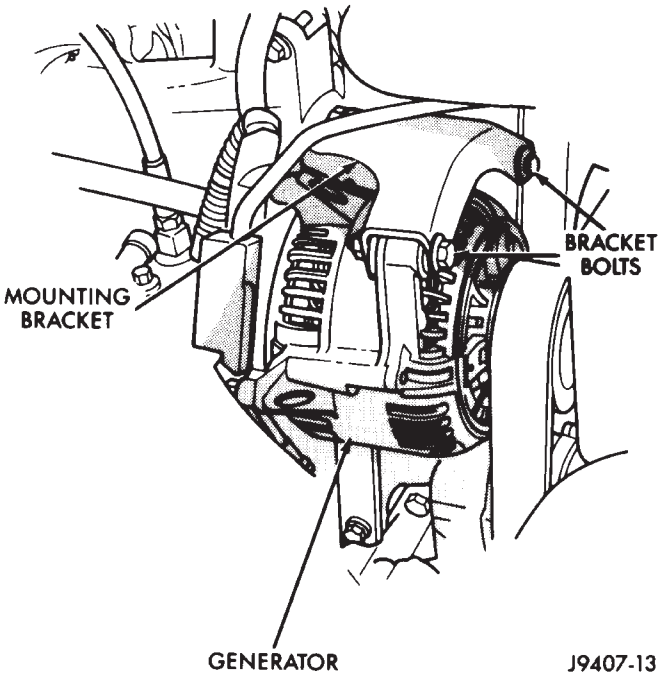


Fig. 75 Generator Mounting Bracket Bolts—Diesel

(12) Clean the mating surfaces of the thermostat housing and the cylinder head.

INSTALLATION

(1) Install the outer seal (Fig. 74) (Fig. 76)into the machined shoulder on the thermostat housing.

(2) Install the thermostat into the machined shoulder next to the outer seal. Note direction of thermostat in (Fig. 74) (Fig. 76).

(3) Position the inner thermostat seal with the shoulder towards the thermostat housing (Fig. 76).

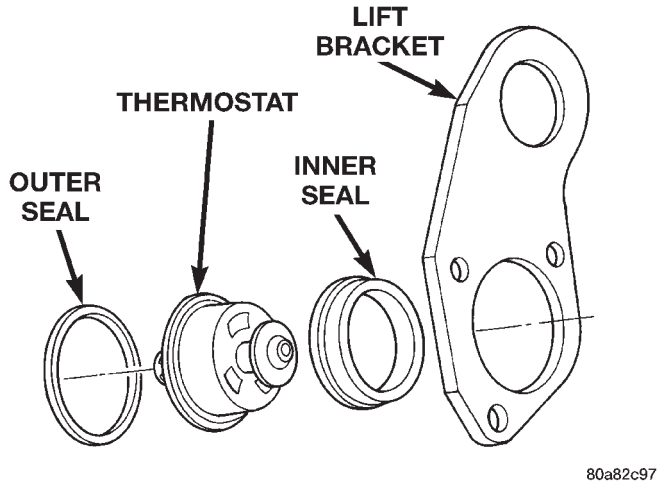


Fig. 76 Thermostat Seals—5.9L Diesel—Typical

(4) Install thermostat, lift bracket, seals and housing to the engine as an assembly. Install and tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

(5) Position generator to thermostat housing. Install and tighten mounting bolt to 24 N·m torque. Tighten pivot bolt to 43 N·m (32 ft. lbs.) torque.

(6) Install the check valve hose and hose clamp at thermostat housing (Fig. 74).

(7) Install accessory drive belt. Refer to Belt Removal/Installation in the Engine Accessory Drive Belt section of this group.

(8) Connect negative battery cables to both batteries.

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

REPLACING WATER-TO-OIL COOLER IN RADIATOR SIDE TANK

The internal transmission oil cooler located within the radiator is not serviceable. If it requires service, the radiator must be replaced.

Once the repaired or replacement radiator has been installed, fill the cooling system and inspect for leaks. Refer to the Refilling Cooling System and Testing Cooling System For Leaks sections in this group. If the transmission operates properly after repairing the leak, drain the transmission and remove the transmission oil pan. Inspect for sludge and/or rust. Inspect for a dirty or plugged inlet filter. If none of these conditions are found, the transmission and torque convertor may not require reconditioning. Refer to Group 21 for automatic transmission servicing.

AUXILIARY TRANSMISSION OIL COOLER—3.9L/ 5.2L/5.9L ENGINES

REMOVAL

(1) Disconnect battery negative cable.

(2) Recover refrigerant and remove the a/c condenser (if equipped). Refer to Group 24, Heating and Air Conditioning for the correct procedure.

(3) Place a drain pan under the oil cooler lines.

(4) Disconnect the auxiliary transmission oil cooler line quick-connect fitting at the cooler outlet using the quick connect release tool 6935. Loosen clamp from inlet connection and slide hose off of nipple. Plug cooler lines to prevent oil leakage.

(5) Remove the oil cooler lower mounting bolt (oil cooler-to- vehicle body) (Fig. 77).

(6) Remove three bolts (radiator support bracket-to-body). Remove this A-shaped support bracket and the transmission oil cooler as an assembly from the vehicle. Take care not to damage the radiator core or A/C condenser fins with the cooling lines when removing.

(7) Remove oil cooler from A-shaped support bracket by removing two upper mounting strap bolts and mounting straps at support bracket (Fig. 77).

(8) Remove oil cooler from the A-shaped radiator support bracket.

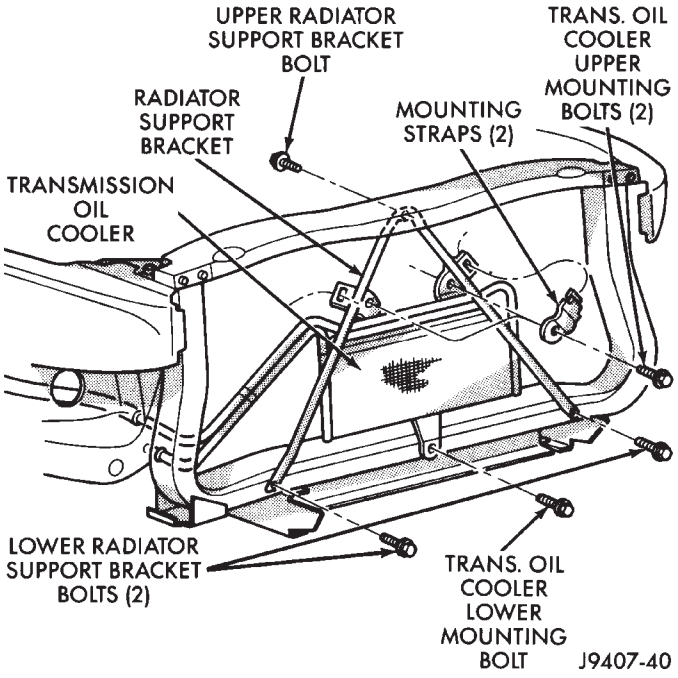


Fig. 77 Auxiliary Transmission Oil Cooler—3.9/5.2/ 5.9L Engines

INSTALLATION

(1) Install the oil cooler assembly to the A-shaped radiator support bracket using the two upper mounting bolts and mounting straps. Install the bolts but do not tighten at this time.

(2) Install the radiator support bracket and oil cooler (as an assembly) to the vehicle.

(3) Install the two lower radiator A-shaped support bracket bolts. Do not tighten bolts at this time.

(4) Slide and position the oil cooler on the A-shaped bracket until its lower mounting hole lines up with the bolt hole on the vehicle body. Tighten the oil cooler mounting strap bolts to 6 N·m (50 in. lbs.) torque.

(5) Install the upper radiator A-shaped support bracket bolt. Tighten all three radiator support bracket mounting bolts to 11 N·m (95 in. lbs.) torque.

(6) Inspect quick connect fitting for debris and install the quick-connect fitting on the auxiliary cooler outler tube until an audible “click” is heard. Pull apart to verify connection.

(7) Connect battery negative cable.

(8) Start the engine and check all fittings for leaks.

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

REMOVAL AND INSTALLATION (Continued)

AUXILIARY TRANSMISSION OIL COOLER—8.0L ENGINE

REMOVAL

(1) Place a drain pan under the oil cooler lines.

(2) Disconnect the two transmission lines from the oil cooler by loosening the two worm gear clamps and pulling the rubber hoses off of the oil cooler tubes (Fig. 78). Plug all oil cooler lines to prevent oil leakage.

(3) Remove three oil cooler-to-radiator support mounting bolts (Fig. 78).

(4) Remove the oil cooler and line assembly from the vehicle.

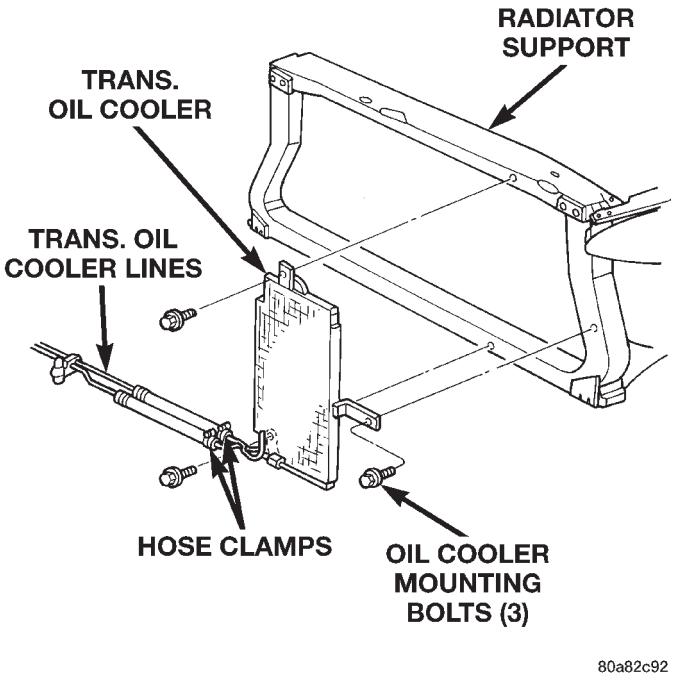


Fig. 78 Auxiliary Transmission Oil Cooler—8.0L Engine

INSTALLATION

(1) Install the oil cooler and cooler line assembly to the vehicle.

(2) Install three mounting bolts and tighten to 6 N·m (50 in. lbs.) torque.

(3) Connect the transmission cooling lines to the oil cooler by pushing the rubber hoses onto the oil cooler tubes. Tighten the worm gear clomps to 2 N·m (18 in. lbs.)

(4) Start the engine and check all fittings for leaks.

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

WATER-TO-OIL COOLER—5.9L DIESEL ENGINE

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. 79).

(7) Lift oil cooler off of mounting bracket.

(8) If replacing cooler, make sure to transfer converter drain back valve to new cooler.

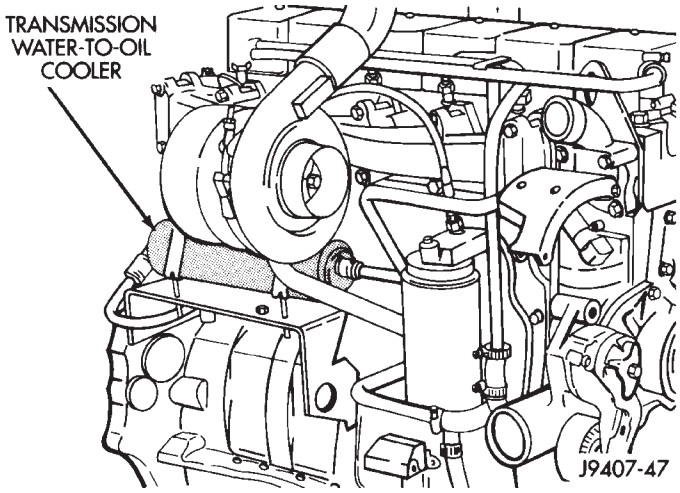


Fig. 79 Transmission Water-To- Oil Cooler—Diesel

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.

REMOVAL AND INSTALLATION (Continued)

AUXILIARY TRANSMISSION OIL COOLER—5.9L DIESEL ENGINE

REMOVAL

(1) Remove front bumper. Refer to Group 23, Body.
(2) Place a drain pan under the oil cooler.
(3) Raise the vehicle.
(4) Disconnect the oil cooler quick-connect fittings from the transmission lines. These are located near the power steering gearbox. Refer to Group 21, Transmissions for procedures.
(5) Remove the charge air cooler-to-oil cooler bolt (Fig. 80).

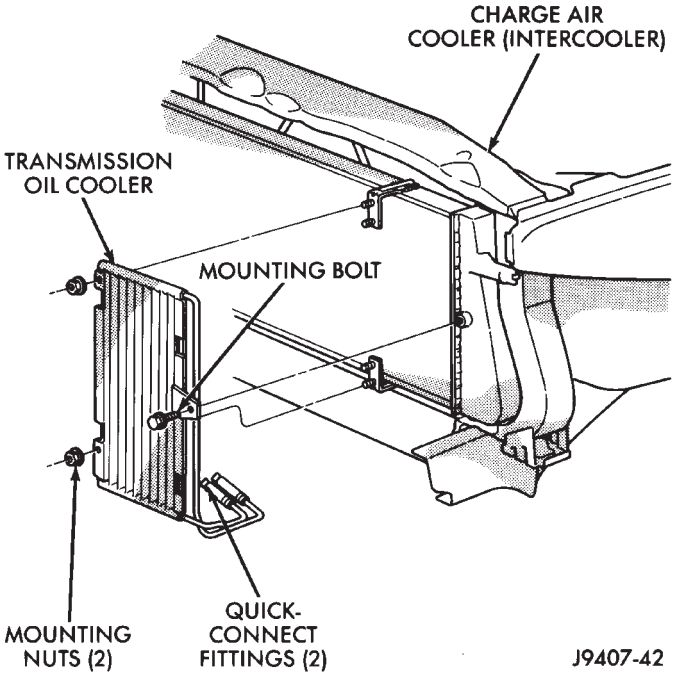


Fig. 80 Auxiliary Transmission Oil Cooler—Diesel Engine

(6) Remove two mounting nuts.
(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. Tighten to 11 N·m (95 in. lbs.) torque.
(3) Connect the quick-connect fittings to the transmission cooler lines. Refer to Group 21, Transmissions for procedures.
(4) Install front bumper. Refer to Group 23, Body.
(5) Start the engine and check all fittings for leaks.
(6) Check the fluid level in the automatic transmission. Refer to Group 21, Transmissions for procedures.

RADIATOR

REMOVAL—ALL ENGINES

(1) **All Engines Except Diesel:** Disconnect battery negative cables.
(2) **Diesel engine:** Disconnect both battery negative cables. Remove the nuts retaining the positive cable to the top of radiator. Position positive battery cable to rear of vehicle.

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.

(3) 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.

(4) Remove hose clamps and hoses from radiator.
(5) All engines: Remove coolant reserve/overflow tank hose from radiator filler neck nipple.
(6) All engines **except 8.0L V-10:** Remove the coolant reserve/overflow tank from the fan shroud (pull straight up). The tank slips into T-slots on the fan shroud.
(7) Disconnect electrical connectors at windshield washer reservoir tank and remove tank. Refer to Group 8K, Windshield Wiper and Washer Systems for procedures.
(8) If equipped with an automatic transmission (all engines except diesel), disconnect oil cooler lines (hoses) at radiator tank, using quick connect fitting release tool 6935 on 3.9/5.2/5.9L models, and tool 6931 on 8.0L models.
(9) **Diesel Engine Only:** Remove the two metal clips retaining the upper part of fan shroud to the top of radiator.

REMOVAL AND INSTALLATION (Continued)

(10) Remove the four fan shroud mounting bolts (Fig. 81). Position shroud rearward over the fan blades towards engine.

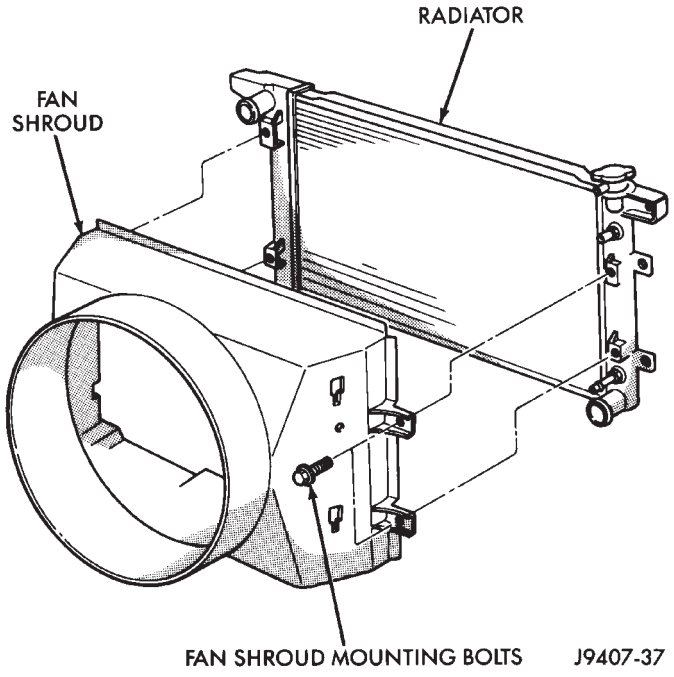


Fig. 81 Typical Fan Shroud Mounting

(11) All Engines **Except 8.0L V-10 and Diesel:** Except 8.0L V-10 and Diesel: Remove the plastic clips retaining the rubber shields to the sides of radiator. Position rubber shields to the side.

(12) Remove the two radiator upper mounting bolts (Fig. 82).

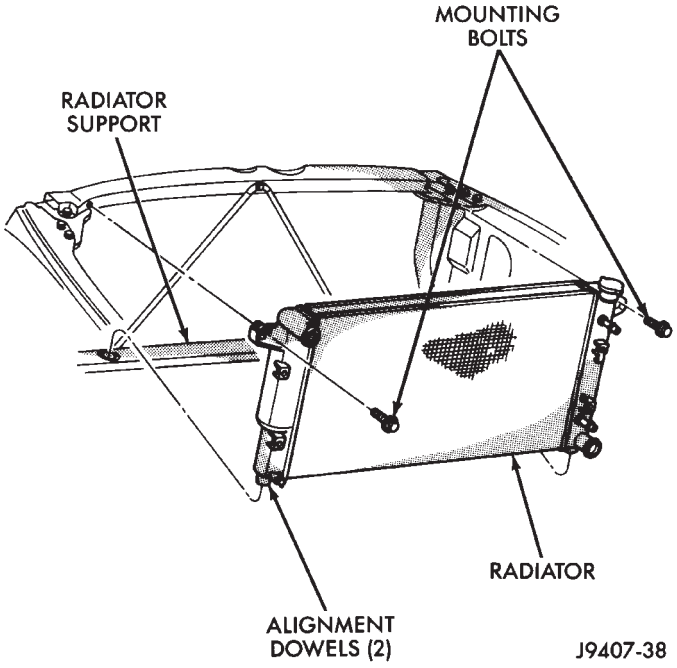


Fig. 82 Typical Radiator Mounting

(13) 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. 82). 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.

(3) Lower the radiator into position while guiding the two alignment dowels into lower radiator support. Different alignment holes are provided in the lower radiator support for each engine application.

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

(5) 3.9L V-6 or 5.2L/5.9L V-8 Engines: Position the rubber shields to the sides of radiator. Install the plastic clips retaining the rubber shields to the sides of radiator.

(6) Connect both radiator hoses. Refer to previous **CAUTION** and install hose clamps.

(7) Connect transmission cooler lines to radiator tank. Inspect quick connect fittings for debris and install until an audible “click” is heard. Pull apart to verify connection.

(8) Install windshield washer reservoir tank. Refer to Group 8K.

(9) Position fan shroud to flanges on sides of radiator. Install fan shroud mounting bolts (Fig. 81). Tighten bolts to 6 N·m (50 in. lbs.) torque.

(10) **Diesel Engines:** Install metal clips to top of fan shroud.

(11) All engines: Install coolant reserve/overflow tank hose to radiator filler neck nipple.

(12) All Engines **Except 8.0L V-10:** Install coolant reserve/overflow tank to fan shroud (fits into T-slots on shroud).

(13) Install battery negative cables..

(14) **Diesel Engine:** Install positive battery cable to top of radiator. Tighten radiator-to-battery cable mounting nuts.

(15) Position heater controls to **full heat** position.

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

(17) Operate engine until it reaches normal temperature. Check cooling system and automatic transmission (if equipped) fluid levels.

REMOVAL AND INSTALLATION (Continued)

BLOCK HEATER—GASOLINE ENGINES

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 battery negative cable.
(2) Drain coolant from radiator and cylinder block.
(3) Remove power cord from heater by unplugging (Fig. 83) (Fig. 84).
(4) Loosen (but do not completely remove) the screw at center of block heater (Fig. 83) (Fig. 84).
(5) Remove block heater by carefully prying from side-to-side. Note direction of heating element coil (up or down). Element coil must be installed correctly to prevent damage.

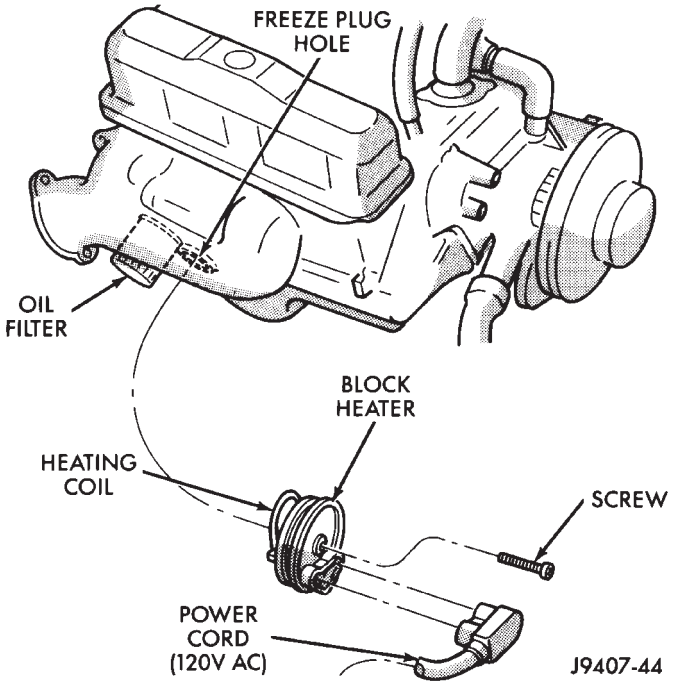


Fig. 83 Block Heater—3.9L/5.2L/5.9L Gasoline Engine

INSTALLATION

(1) Clean and inspect the block heater hole.
(2) Install new O-ring seal(s) to heater in gasoline engines.
(3) Insert block heater into cylinder block.
(4) With heater fully seated, tighten center screw to 2 N·m (17 in. lbs.).
(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.

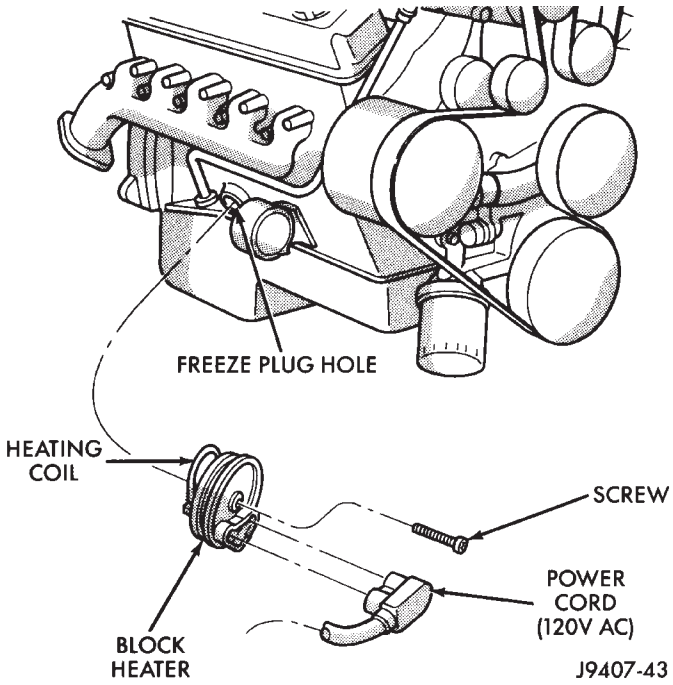


Fig. 84 Block Heater—8.0L V-10 Engine

BLOCK HEATER—DIESEL ENGINE

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 negative battery cable(s) from battery(s).
(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. 85).

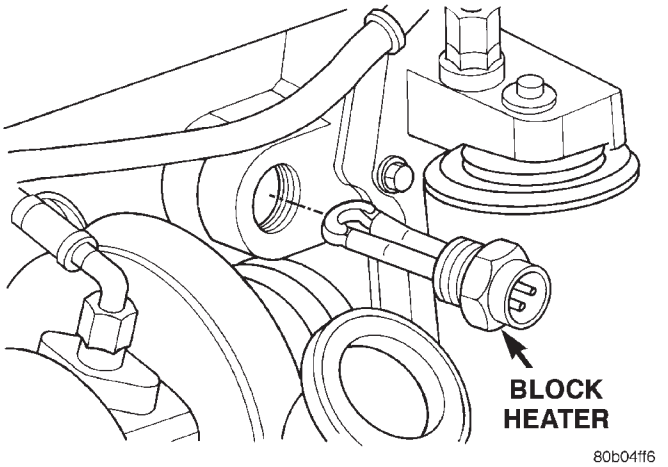


Fig. 85 Block Heater—Diesel Engine

REMOVAL AND INSTALLATION (Continued)

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.

ACCESSORY DRIVE BELTS

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.

3.9L V-6 OR 5.2/5.9L V-8 LDC-GAS ENGINES

REMOVAL

Drive belts on these engines are equipped with a spring loaded automatic belt tensioner (Fig. 86). 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, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 86).

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

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing 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. 87) for correct engine belt routing. The correct belt with correct length must be used.

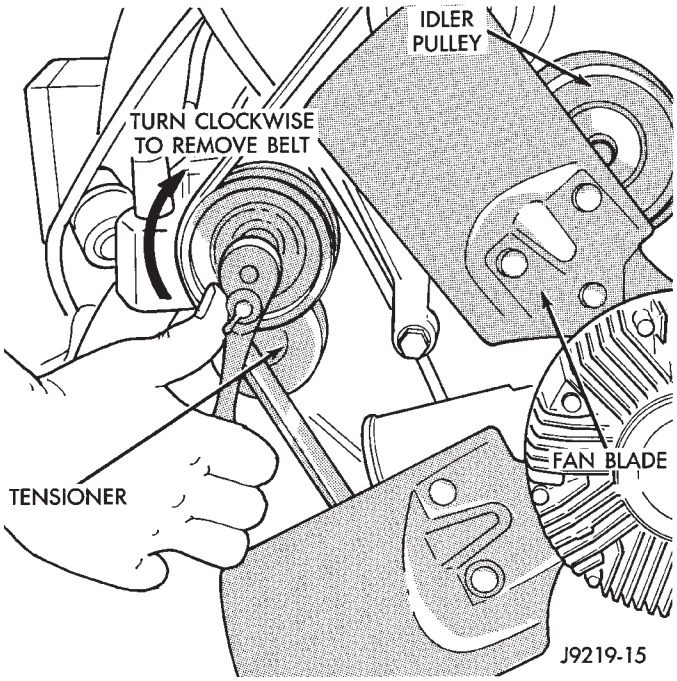


Fig. 86 Belt Tensioner—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

(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. 86).

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

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

5.9L HDC-GAS AND 8.0L V-10 ENGINES

REMOVAL

Drive belts are equipped with a spring loaded automatic belt tensioner (Fig. 88). 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, proceeding in this group.

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 88). The threads on the pulley mounting bolt are left- hand.

(2) Relax the tension from the belt by rotating the tensioner counterclockwise (as viewed from front) (Fig. 88). When all belt tension has been relaxed, remove belt from tensioner pulley first and other pulleys last.

REMOVAL AND INSTALLATION (Continued)

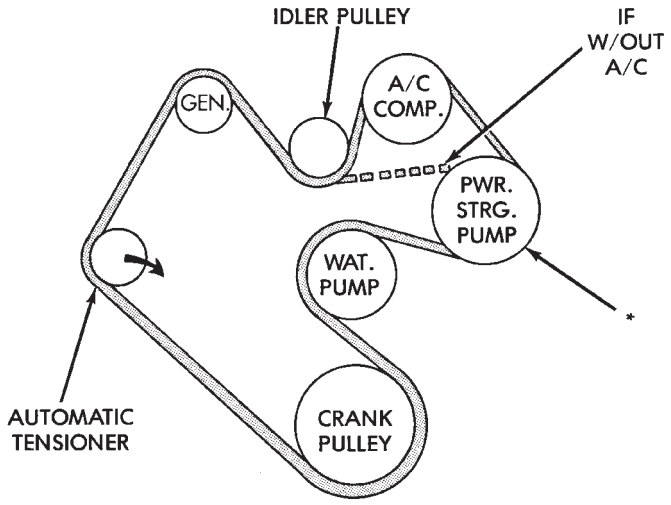


Fig. 87 Belt Routing—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

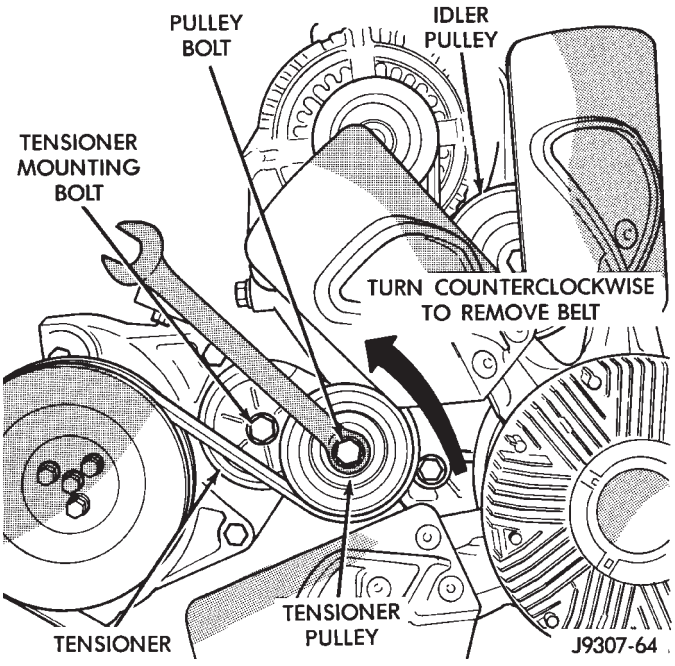


Fig. 88 Belt Tensioner—5.9L HDC-Gas and 8.0L V-10 Engines—Typical

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. 89) (Fig. 90)for correct engine belt routing. The correct belt with correct length must be used.

CAUTION: If the pulley is to be removed from the tensioner, its mounting bolt has left-hand threads.

(1) Position drive belt over all pulleys **except** tensioner pulley.

(2) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 88).

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

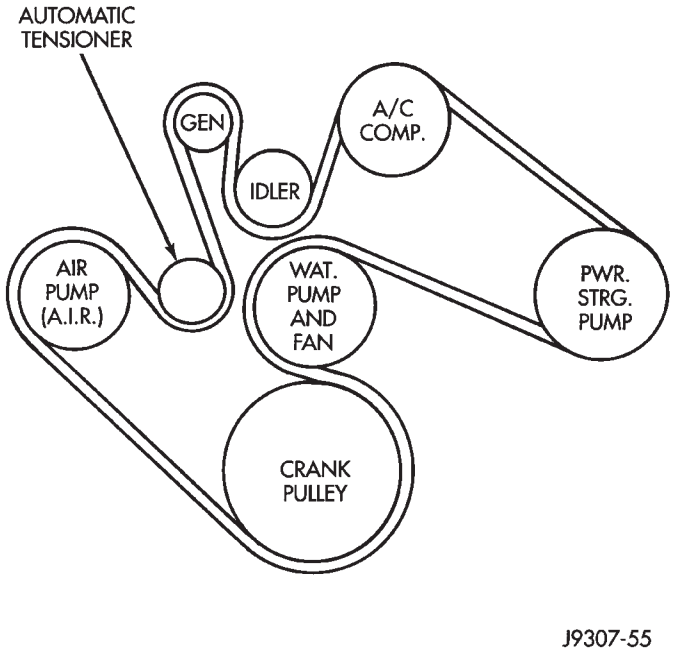


Fig. 89 Belt Routing—5.9L HDC-Gas Engine and 8.0 L V-10—With A/C

5.9L DIESEL ENGINE

REMOVAL

Drive belts on diesel engines are equipped with a spring loaded automatic belt tensioner (Fig. 91). **(Fig. 91) 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.

(1) A 3/8 inch square hole is provided in the automatic belt tensioner (Fig. 91). 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.

(3) Remove belt from water pump pulley first.

(4) Remove belt from vehicle.

REMOVAL AND INSTALLATION (Continued)

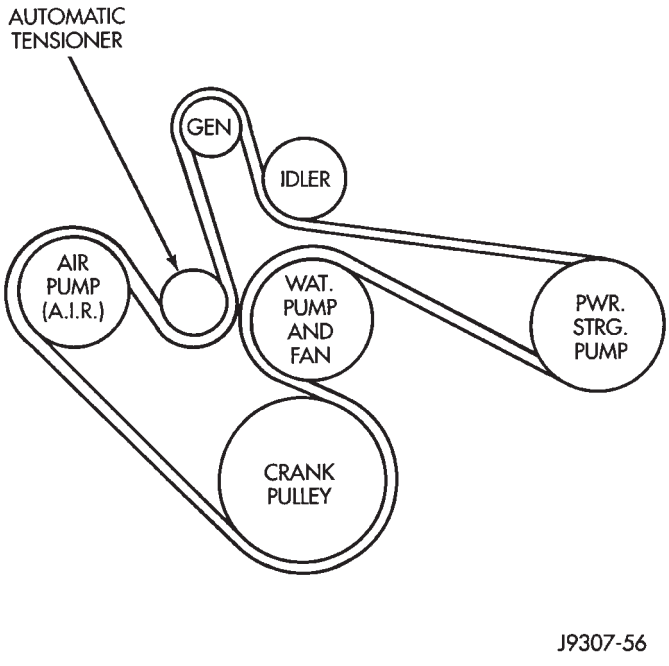


Fig. 90 Belt Routing—5.9L HDC-Gas Engine and 8.0 L V-10—Without A/C

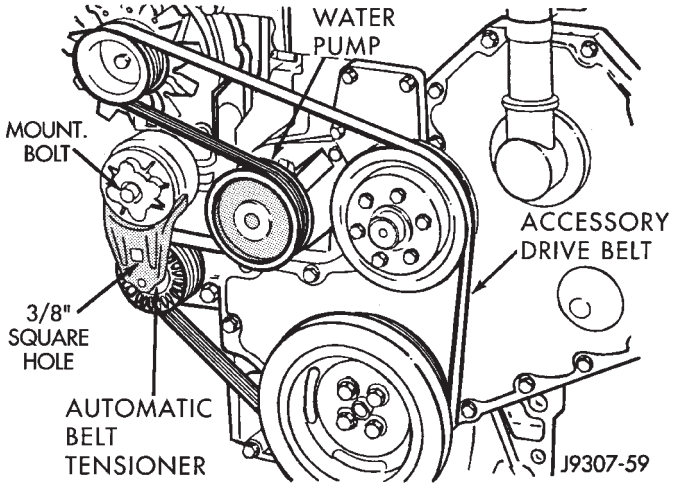


Fig. 91 Belt Tensioner—5.9L Diesel—Typical (non-A/C shown)

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. 92) (Fig. 93)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.

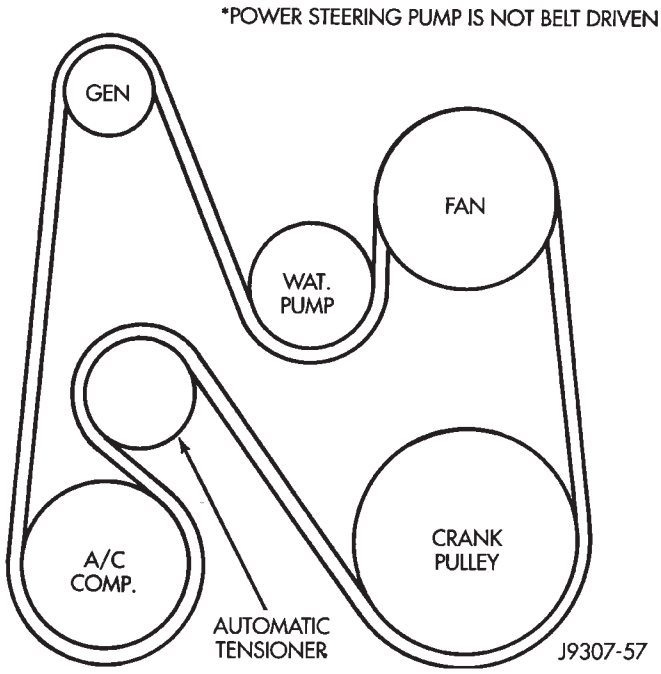


Fig. 92 Belt Routing—5.9L Diesel Engine—With A/C

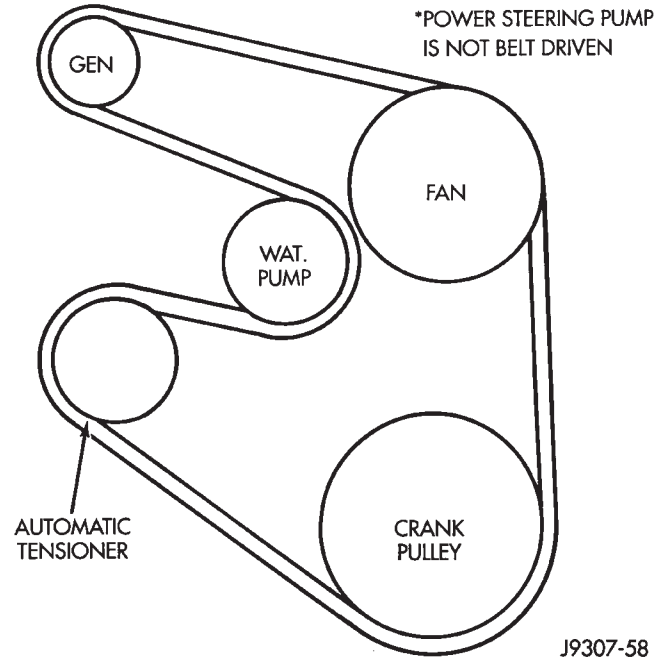


Fig. 93 Belt Routing—5.9L Diesel Engine—Without A/C

REMOVAL AND INSTALLATION (Continued)

AUTOMATIC BELT TENSIONER

NOTE: On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, the tensioner is equipped with an indexing arrow (Fig. 94) 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. 94). 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.**

On 3.9L V-6 or 5.2/5.9L V-8 LDC-gas engines, a used belt should be replaced if tensioner indexing arrow has moved to point-A (Fig. 94). Tensioner travel stops at point-A.

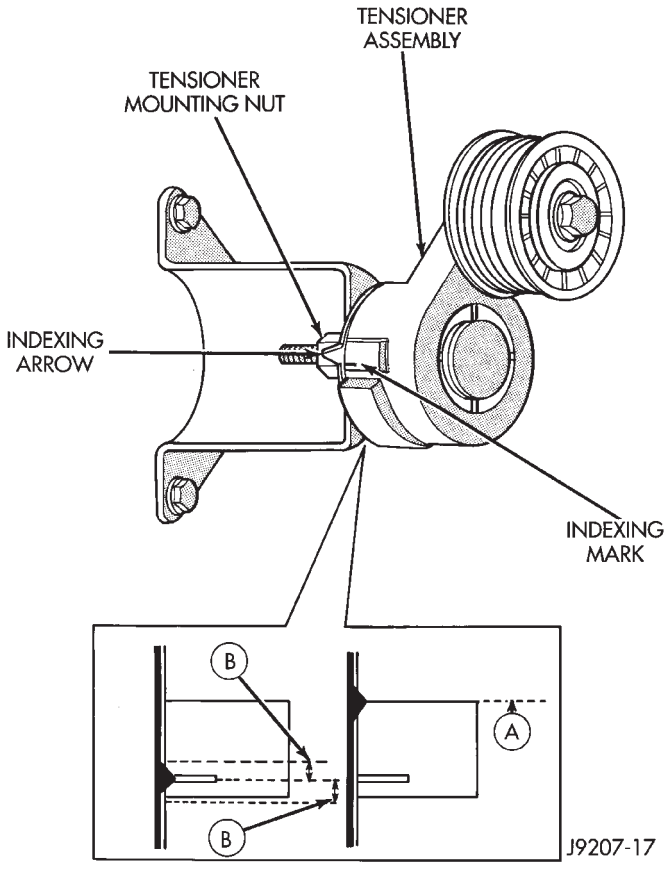


Fig. 94 Indexing Marks—3.9L V-6 or 5.2/5.9L V-8 LDC-Gas Engines

3.9L V-6 OR 5.2/5.9L V-8 LDC-GAS ENGINES

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

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

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

(4) Remove tensioner assembly from mounting bracket (one nut) (Fig. 94).

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

(5) 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.) torque.

(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.) torque.

(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) Install drive belt. Refer to Belt Removal/Installation in this group.

(6) Check belt indexing marks (Fig. 94).

5.9L HDC-GAS AND 8.0L V-10 ENGINES

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

(2) Remove tensioner mounting bolt (Fig. 95) and remove tensioner.

CAUTION: If the pulley is to be removed from the tensioner, its mounting bolt has left-hand threads.

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

REMOVAL AND INSTALLATION (Continued)

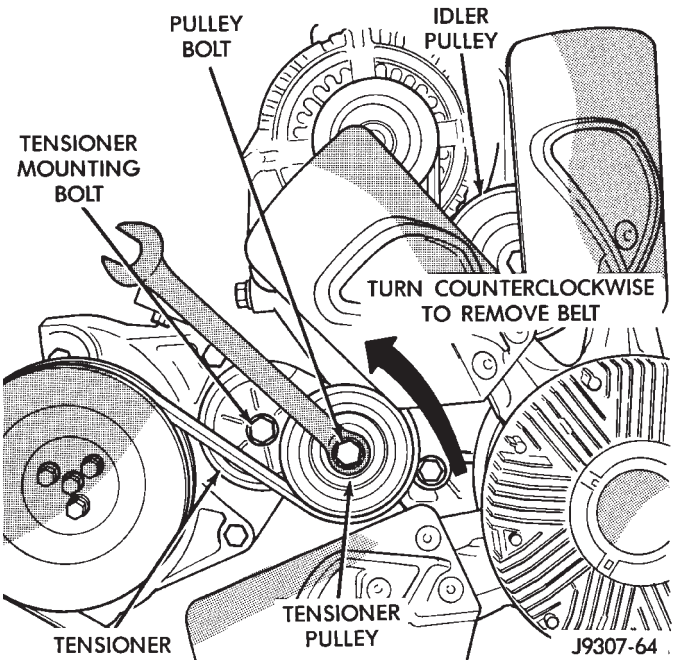


Fig. 95 Belt Tensioner—5.9L HDC-Gas and 8.0L v-10

INSTALLATION

(1) Install pulley and pulley bolt to tensioner (observe the previous CAUTION). Tighten bolt to 88 N·m (65 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. A dowel pin is located on back of tensioner (Fig. 96). Align this to dowel hole (Fig. 97) in tensioner mounting bracket. Tighten bolt to 41 N·m (30 ft. lbs.) torque.

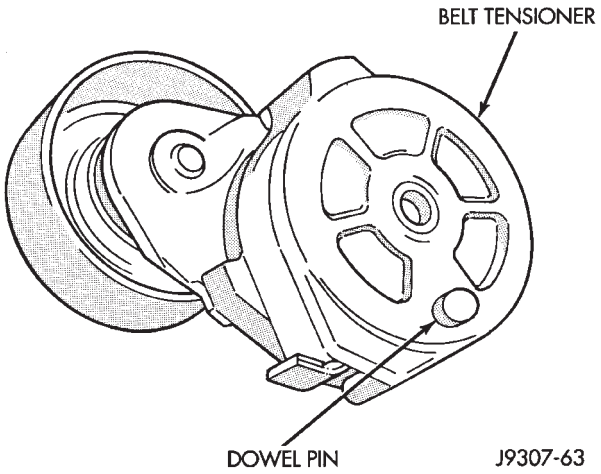


Fig. 96 Tensioner Dowel Pin—5.9L HDC-Gas and 8.0L V-10 Engines

(3) Install drive belt. Refer to Belt Removal/Installation in this group.

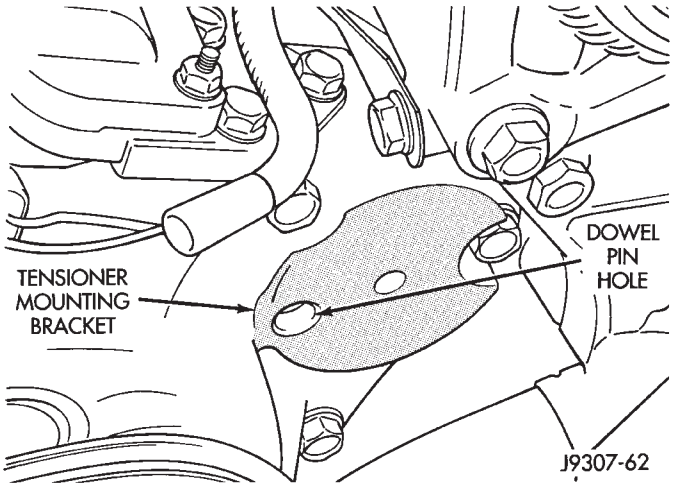


Fig. 97 Tensioner Dowel Hole—5.9L HDC-Gas and 8.0L V-10 Engines

5.9L DIESEL ENGINE

REMOVAL

(1) Remove accessory drive belt. Refer to Belt Removal/Installation in this group.

(2) Remove tensioner mounting bolt (Fig. 95) and remove tensioner.

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

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.

COOLING SYSTEM FAN—GAS ENGINES

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 negative battery cable from battery.

(2) Remove throttle cable at top of fan shroud.

REMOVAL AND INSTALLATION (Continued)

(3) All Except 8.0L V-10 Engine: Unsnap coolant reserve/overflow tank from fan shroud and lay aside. The tank is held to shroud with T- shaped slots. Do not disconnect hose or drain coolant from tank.

(4) The thermal viscous fan drive/fan blade assembly is attached (threaded) to water pump hub shaft (Fig. 98). 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. 98) to prevent pulley from rotating.

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

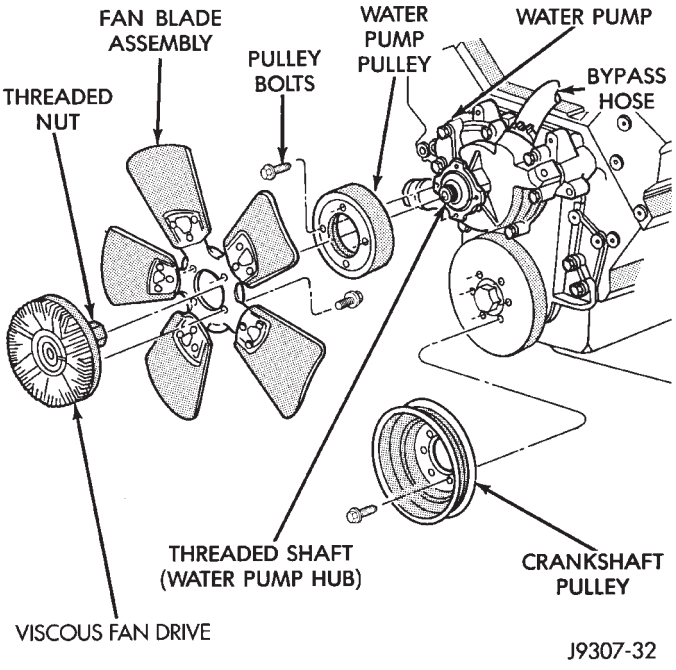


Fig. 98 Fan Blade/Viscous Fan Drive—Gas Engines—Typical

(6) Do not unbolt fan blade assembly (Fig. 98) from viscous fan drive at this time.

(7) Remove four fan shroud-to-radiator mounting bolts.

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

(9) 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. 68). This pulley is under spring tension.

(10) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 98).

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 bolts (Fig. 98) 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. 98).

(5) Except 8.0L V-10 Engine: Install coolant reserve/overflow tank to fan shroud. Snaps into position.

(6) Install throttle cable to fan shroud.

(7) Connect negative battery cable.

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 SYSTEM FAN DRIVE—DIESEL ENGINE

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 both negative battery cables at both batteries.

(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. 99). Remove the fan blade/fan drive assembly from fan pulley by turning the mounting nut clockwise (as

REMOVAL AND INSTALLATION (Continued)

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.

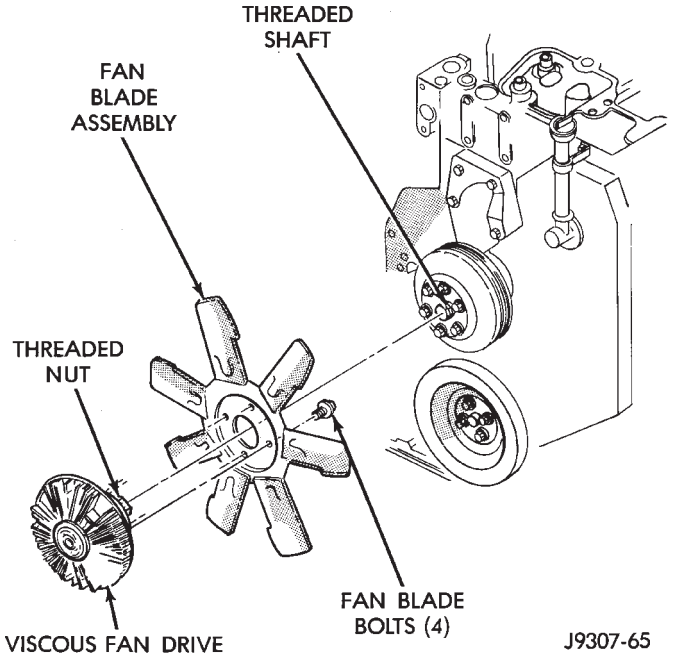


Fig. 99 Fan Blades/Viscous Fan Drive—5.9L Diesel

(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. Tighten mounting nut to 57 N·m (42 ft. lbs.) torque.

(4) Install fan shroud bolts.

(5) Install battery cables to batteries.

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.

CLEANING AND INSPECTION

RADIATOR CAP

INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 100) at bottom of cap should open. If rubber gasket has swollen and prevents vent valve from opening, replace cap.

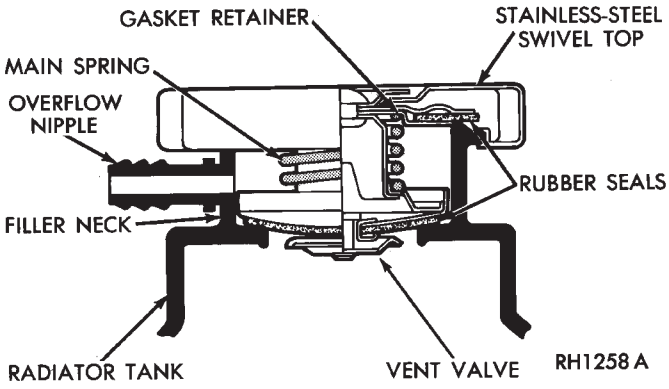


Fig. 100 Radiator Pressure Cap

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.

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.

WATER PUMP INSPECTION

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

- The body is cracked or damaged

CLEANING AND INSPECTION (Continued)

- 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 rubs either the pump body or timing chain case/cover

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 proceeding Viscous Fan Drive section for additional information.

COOLANT CAPACITY CHART

ENGINE	CAPACITY*
3.9L/5.2L/5.9L GAS	19 L (20 Qts.)
8.0L	25L (26Qts.)
5.9L DIESEL	23L (24 Qts.)
Nominal refill capacities are shown. A variation may be observed due to manufacturing tolerances and refill procedures.	
Capacities shown include vehicles with air conditioning and/or heavy duty cooling systems.	

SPECIFICATIONS

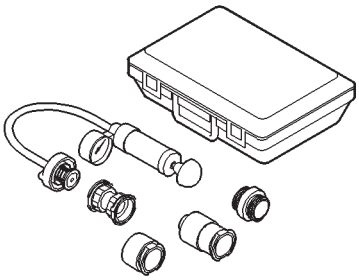
COOLANT CAPACITIES

TORQUE

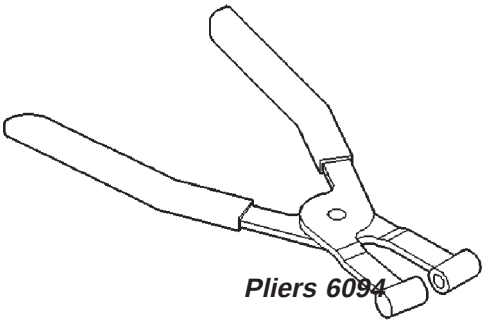
DESCRIPTION	TORQUE
Belt Tensioner Pulley-(3.9/5.2/5.9L LDC Gas Engine)	
Bolt	61 N·m (45 ft. lbs.)
Belt Tensioner Pulley-(5.9L HDC Gas and 8.0L Engine)	
Bolt	88 N·m (65 ft. lbs.)
Belt Tensioner to Mounting Bracket-(3.9/5.2/5.9L LDC Gas Engine)	
Bolt	67 N·m (50 ft. lbs.)
Belt Tensioner to Mounting Bracket-(5.9L HDC Gas and 8.0L Engine)	
Bolt	41 N·m (30 ft. lbs.)
Block Heater—Gasoline Engines	
Screw	2 N·m (17 in. lbs.)
Block Heater—Diesel Engines	
Hex	43 N·m (32 ft. lbs.)
Fan Shroud to Radiator Mounting	
Bolts	6 N·m (50 in. lbs.)
Heater Hose Fitting at Water Pump-(8.0L)	
Fitting	16 N·m (44 ft. lbs.)
Idler Pulley Mounting-(All Gas Engines)	
Bolt	61 N·m (45 ft. lbs.)
Radiator Mounting	
Bolts	11 N·m (95 in. lbs.)
Thermal Viscous Fan to Hub-(Diesel)	
Nut	57 N·m (42 ft. lbs.)
Thermostat Housing-(3.9/5.2/5.9L)	
Bolts	23 N·m (200 in. lbs.)
Thermostat Housing-(8.0L)	
Bolts	25 N·m (220 in. lbs.)
Thermostat Housing-(Diesel)	
Bolts	24 N·m (18 ft. lbs.)
Water Pump Mounting-(All Gas Engines)	
Bolts	40 N·m (30 ft. lbs.)
Water Pump Pulley-(All Gas Engines)	
Bolts	22 N·m (16 ft. lbs.)
Water Pump Mounting-(Diesel)	
Bolts	24 N·m (18 ft. lbs.)

SPECIAL TOOLS

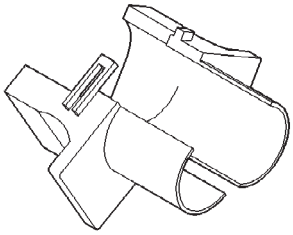
COOLING



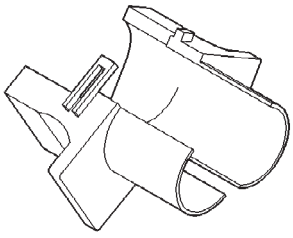
Pressure Tester 7700–A



Pliers 6094



1/2” Disconnect Tool (8.0L/Diesel Engines)—6931



3/8” Disconnect Tool (3.9/5.2/5.9L Engines)—6935