COOLING SYSTEMS 1C

INDEX

GENERAL

The cooling system regulates engine operating temperature by allowing the engine to reach normal operating temperature as quickly as possible, maintaining normal operating temperature and preventing overheating (figs. 1C-1, 1C-2 and 1C-3). The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid.

The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

COOLING SYSTEM OPERATION

On four-cylinder engines (with the engine operating), the belt-driven water pump forces coolant into the front of the cylinder block where water jackets route it around all the cylinders. The coolant then passes upwards through holes in the cylinder head gasket and into the head. Coolant flows out the rear of the intake manifold to the heater core. The coolant returns to the water pump from the heater core.

Below 195°F (90°C) coolant does not flow through the thermostat but flows to the front of the intake manifold and returns to the cylinder head. Above 195°F (90°C) part of the coolant flows through the thermostat to the radiator and returns to the pump inlet.

Heat from the coolant is used to warm the intake manifold to prevent fuel condensation.

NOTE: *The EGR CTO valve and spark CTO valve are located in the intake manifold coolant passages.*

On six-cylinder engines, coolant is forced directly into the cylinder block water jackets surrounding the cylinders. It travels up through passages in the head gasket and cylinder head, around the combustion chambers and valves, through intake manifold and forward to the front of the cylinder head. Below 195°F (90°C), the thermostat is closed and coolant flows through the bypass port in the cylinder head, down through the block and back to the water pump where it is recirculated. A bypass port in the thermostat housing allows coolant flow to the heater core.

On eight-cylinder engines, coolant is forced from center of the engine timing case cover through side outlets into both banks of the cylinder block. It flows through the water jackets around all cylinders and up through holes in the block and head gaskets into the cylinder heads to cool the combustion chambers and valves. Coolant then flows through the heads to passages at the front of the heads and through the intake manifold to the thermostat. In the right head, coolant is forced into an intake manifold passage at the rear corner and out to the heater core, through the heater core, and back to the water pump. Below 195°F (91°C), the thermostat is closed and coolant flows out the bypass port through the hose to the water pump, where it is recirculated.

On all engines, the recirculation cycle continues until the coolant temperature reaches the thermostat calibration temperature and the thermostat begins to open. Some coolant then flows to the radiator inlet tank, through the cooling tubes and into the outlet tank. The radiator fan and vehicle motion cause air to flow past

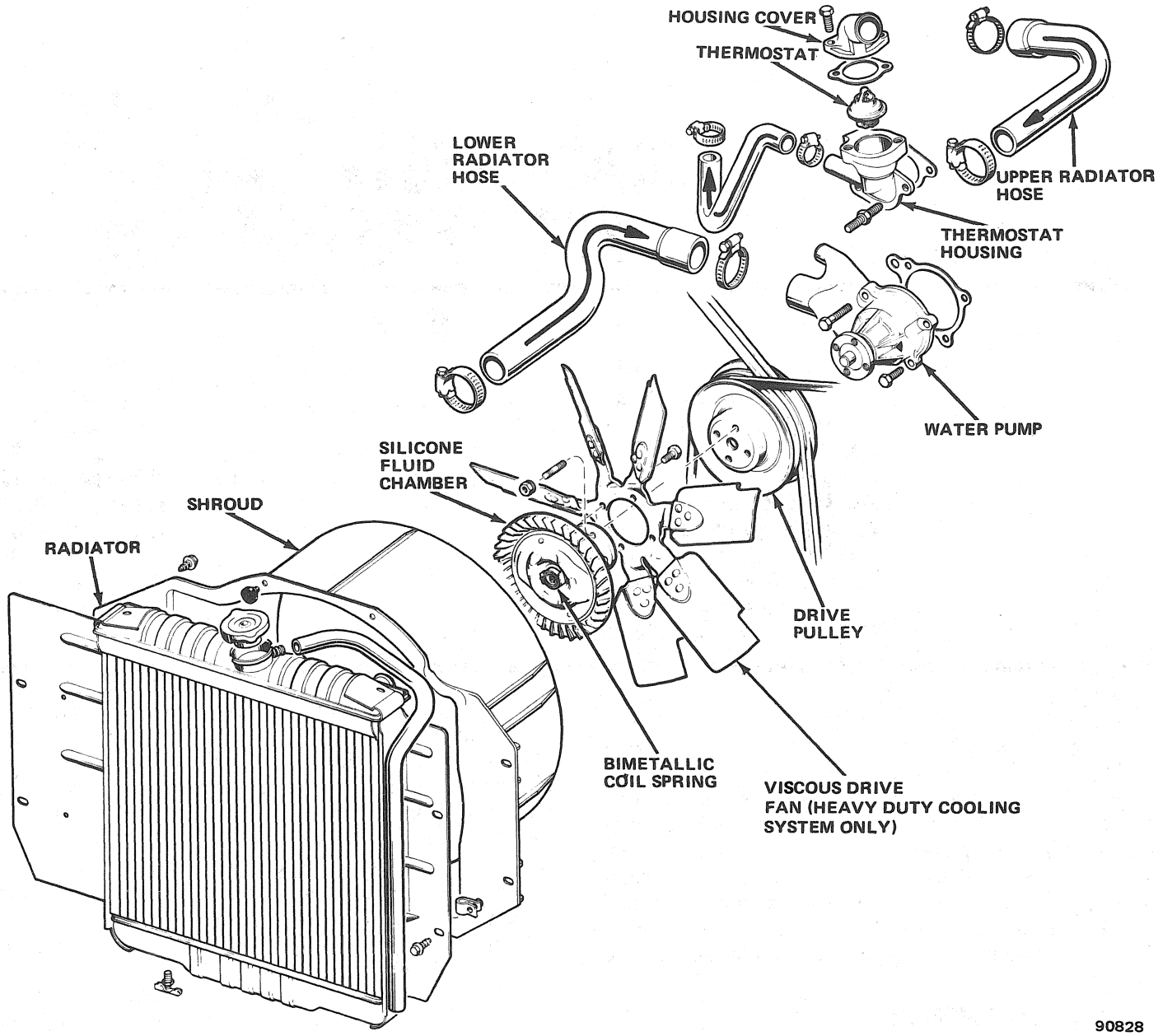

Fig. 1C-1 Four-Cylinder Engine Cooling System Components

the cooling fins to remove heat from the coolant. As the coolant flows through the outlet tank, it passes the automatic transmission fluid cooler, if equipped, and cools the automatic transmission fluid. Coolant is then drawn through the lower radiator hose into the water pump inlet to restart the cycle.

As the thermostat continues to open, it allows more coolant flow to the radiator. When it reaches its maximum open position, maximum coolant flows through the radiator.

Heat causes the coolant to expand and increase the system pressure, which raises the boiling point of the coolant. The pressure cap maintains pressure up to 15 psi (103 kPa). Above 15 psi (103 kPa), the relief valve in the cap allows pressurized coolant to escape through the filler neck overflow tube to the coolant recovery system bottle or to the road.

NOTE: *Immediately after shutdown, the engine enters a condition known as heat soak. This is when the coolant is no longer circulating but engine temperature is still high. If coolant temperature rises above the boiling point, expansion and pressure may force some coolant out of the radiator overflow tube. Normal engine operation will not usually cause this to happen.*

As engine temperature drops, the coolant loses heat and contracts, forming a partial vacuum in the system.

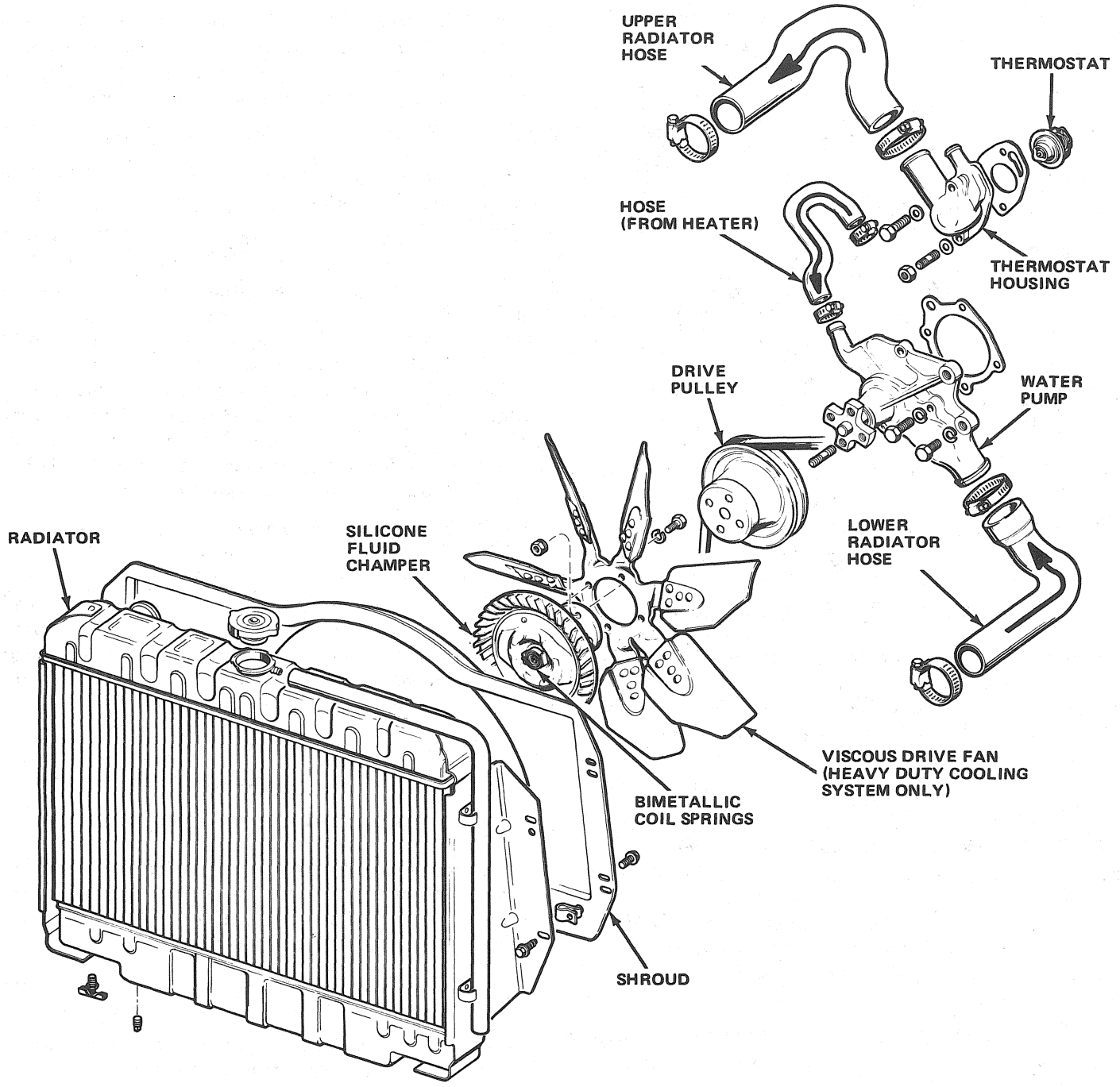

Fig. 1C-2 Six-Cylinder Engine Cooling System Components

The radiator cap vacuum valve allows atmospheric pressure to enter the system to equalize the pressure.

During operation, the coolant temperature is detected by the temperature sending unit. The sending unit electrical resistance varies as temperature changes, causing the temperature gauge to indicate accordingly.

The sender responds to temperature changes and with heavy load operation or on hot days, the coolant will be hotter and the gauge will indicate a higher engine temperature. Unless the gauge pointer moves past the high end of the band or coolant loss occurs, this is normal.

COOLANT

The coolant is a mixture of low mineral content water and ethylene glycol-based antifreeze. The addition of antifreeze to water alters several physical characteristics of water that are important to cooling system performance. The freezing point is lowered, the boiling point is raised and tendencies for corrosion and foaming are reduced. The lowered freezing point protects the engine and cooling system components from damage caused by the expansion of water as it freezes. The

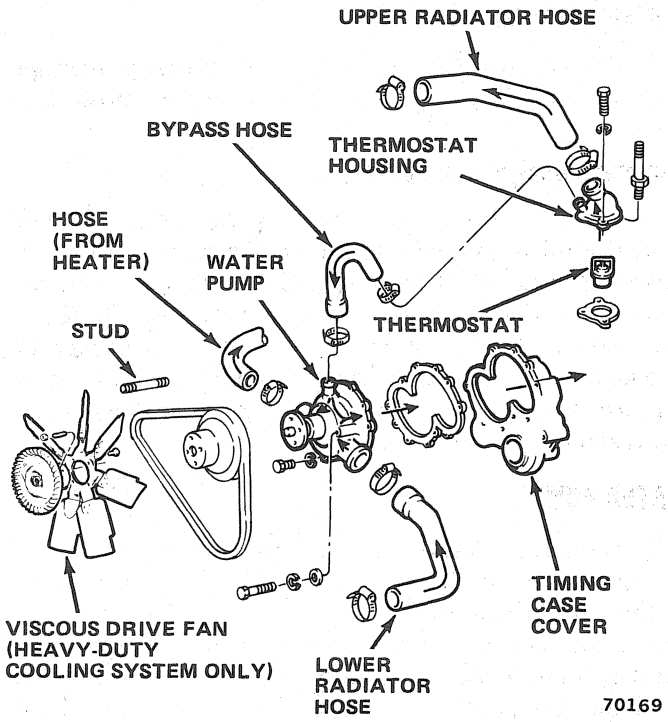

Fig. 1C-3 Eight-Cylinder Engine Cooling System Components

raised boiling point contributes to more efficient heat transfer. Reduced corrosion and reduced foaming permit unobstructed coolant flow for more efficient cooling. During heat-soak conditions after engine shutdown, the higher boiling point helps prevent coolant loss because of boilover. The higher boiling point also helps minimize damage caused by cavitation.

NOTE: *Cavitation is the formation of a partial vacuum by moving a solid body (pump impeller) swiftly through a liquid (coolant). The vacuum reduces the boiling point of the liquid and allows the formation of vapor bubbles, which burst when contacting a hard surface. If enough bubbles burst in a localized area, metal can be eroded, causing leakage.*

Vehicles manufactured at Toledo have an antifreeze concentration that protects against freezing down to -20°F (-28.9° C).

Coolant Level

Maintain the coolant level with a mixture of ethylene glycol based antifreeze and low mineral content water.

CAUTION: *The antifreeze mixture should always be maintained to satisfy local climatic requirements, or 50 percent, whichever is greater. Maximum protection against freezing is provided with a 68 percent antifreeze mixture, which prevents freezing down to -90°F (-68°C). A higher percentage will freeze at a warmer temperature. For example, pure antifreeze freezes at -8°F (-22°C). In addition, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water. The antifreeze mixture MUST ALWAYS be at least 50 percent, year-round and in all climates. If the percentage is lower, engine parts may be eroded by cavitation.*

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

Coolant Level—Without Coolant Recovery

For four-cylinder engines, the coolant level when cold should be maintained 1 to 1-1/4 inches (25 to 32 mm) below the rear edge of the radiator filler neck sealing surface. When the engine is at normal operating temperature, the coolant level should be 1/4 to 1/2 inch (6 to 13 mm) below the sealing surface.

For six- and eight-cylinder engines the coolant level when cold should be 1-1/2 to 2 inches (38 to 51 mm) below the rear of the radiator filler neck sealing surface, and at normal operating temperature it should be 1/2 to 1 inch (13 to 25 mm) below this surface.

WARNING: *With the engine hot and removing the radiator cap, coolant can spray out and scald hands, body and face. If necessary to check level, allow engine to idle for a few moments. Use a heavy rag or towel wrapped over cap and turn cap slowly to the first notch to relieve pressure, then push down to disengage locking tabs and remove cap. If engine is overheated, operate engine above curb idle speed for a few moments with hood up, then shut engine Off and let it cool 15 minutes before removing cap. Pressure can also be reduced during cooldown by spraying the radiator with cool water.*

Coolant Level—With Coolant Recovery

The coolant level in the recovery bottle should be checked only with the engine at normal operating temperature. It should be between the FULL and ADD marks on the coolant recovery bottle.

NOTE: *Do not add coolant unless level is below ADD mark with engine at normal operating temperature.*

When adding coolant during normal maintenance, add only to the recovery bottle, not to the radiator.

NOTE: *Remove the radiator cap only for testing or when refilling the system after service. Removing the cap unnecessarily can cause loss of coolant and allow air to enter the system, which produces corrosion.*

Draining Coolant

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the engine or cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

Drain the coolant from the radiator by loosening the draincock on the bottom tank.

On four-cylinder engines, drain the cylinder block by removing the drain plug at the left-rear of the cylinder block.

On six-cylinder engines, drain the coolant from the cylinder block by removing the two drain plugs located on the left side of the block (plugs may have been replaced by one or two CTO valves).

On eight-cylinder engines, drain the coolant from the cylinder block by removing the centrally located plugs on each side of the block.

Replacing Coolant

Before filling, tighten radiator draincock and all drain plugs. Add the proper mixture of coolant to satisfy local climatic requirements for freeze and cooling protection.

CAUTION: *The antifreeze mixture must always be at least 50 percent, year-round and in all climates. If percentage is lower, engine parts may be eroded by cavitation.*

Fill the radiator to the correct coolant level. On vehicles with a coolant recovery system, fill the radiator to the top and install the radiator cap. Add sufficient coolant to the recovery bottle.

After refilling the system or when air pockets are suspected, purge the cooling system of excess air.

Purging Air from Cooling System

Trapped air will hamper or stop coolant flow, or cause burping of engine coolant out of the radiator overflow tube.

Move the heater control to the HEAT position and the heater temperature control to the full WARM or HIGH position.

On vehicles without a coolant recovery system, purge air by operating the engine (with a properly filled cooling system) with the radiator cap off until coolant has completely circulated throughout the engine, or until normal operating temperature is attained. Add coolant if necessary, and install radiator cap.

On vehicles with a coolant recovery system, fill the system with coolant and operate the engine with all coolant caps in place. After coolant has reached normal operating temperature, shut engine off and allow to cool. Add coolant to recovery bottle as necessary.

NOTE: *This procedure may have to be repeated several times to maintain the correct coolant level at normal operating temperature.*

NOTE: *With some models, it may be necessary to remove a heater hose to provide an escape for trapped air when filling the system.*

Coolant Freezing Point Test

Check coolant freezing point, or freeze protection, with an antifreeze hydrometer to determine protection level.

Removing Coolant from Crankcase

If coolant leaks into the lubricating system, **it will clog the oil passages and cause the pistons to seize. Severe damage to the engine will result.** If coolant has leaked into the lubricating system, locate the source of the coolant leaks, such as a faulty head gasket or cracked block, and make the necessary repairs. After repairing the leaks, use Jeep Crankcase Cleaner, or equivalent, to flush engine.

WATER PUMP

A centrifugal water pump circulates the coolant through the water jackets, passages, radiator core, hoses of the system and heater core. The pump is driven from the engine crankshaft by a V-type belt or belts (some eight-cylinder engines). A single serpentine drive belt is used for six-cylinder engines manufactured for sale in California. The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has a small hole to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant. No additional lubrication is necessary.

Water Pump Pulley Replacement

(1) Disconnect fan shroud from radiator, if equipped.

(2) Remove fan or Tempatrol drive attaching screws.

(3) Remove fan and spacer or Tempatrol fan and drive. Remove shroud. Refer to Fan Replacement.

(4) Loosen all belts routed around water pump pulley.

(5) Remove pulley.

(6) Install pulley.

(7) Position fan, spacer and shroud.

(8) Install and tighten belts. Refer to Drive Belt Adjustments.

(9) Install fan attaching screws and tighten.

(10) Install shroud attaching screws and tighten.

Water Pump Replacement

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

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and being drained only to service the cooling system, drain into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

Removal—Four-Cylinder Engine

(1) Drain coolant. Observe WARNING and NOTE stated above.

(2) Remove drive belt and fan. Refer to Fan Replacement.

(3) Disconnect lower radiator and heater hoses from pump.

(4) Remove pump attaching bolts and water pump.

Installation—Four-Cylinder Engine

(1) Scrape and clean gasket surface area on block.

(2) Position replacement gasket.

(3) Install water pump on block. Tighten bolts with 25 foot-pounds (30 N•m) torque.

(4) Connect lower radiator and heater hoses.

(5) Install coolant. Use correct mixture.

(6) Install fan and drive belt. Tighten drive belt. Refer to Drive Belt Adjustments.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

NOTE: *The fan assembly and pulley must be installed with the drive belt in position on the pulley. Tighten attaching nuts with 18 foot-pounds (34 N•m) torque.*

(7) Operate engine and check for leaks.

Removal—Six-Cylinder Engine

The following procedure applies to all vehicles with or without power steering, air injection and air conditioning.

(1) Drain cooling system. Observe WARNING and NOTE stated above.

(2) Disconnect radiator and heater hoses from pump.

(3) Remove drive belts.

(4) Remove fan shroud attaching screws from radiator, if equipped.

(5) Remove fan assembly and remove fan shroud. Refer to Fan Replacement.

NOTE: *On some models, fan removal may be easier if the fan shroud is rotated 1/2 turn.*

(6) Remove water pump and gasket.

Installation—Six-Cylinder Engine

CAUTION: *Six-cylinder engines (California) with a serpentine (single) drive belt have a reverse rotating water pump and viscous (Tempatrol) fan drive assembly. The components are identified by the words "REVERSE" stamped on the cover of the viscous drive and inner side of the fan, and "REV" cast into the water pump body. Do not install components that are intended for non-serpentine drive belts.*

Before installing pump, clean gasket mating surfaces and (if original pump) remove deposits and other foreign material from impeller cavity. Inspect block surface for erosion or other faults.

(1) Install replacement gasket and water pump. Tighten bolts with 13 foot-pounds (18 N•m) torque. Rotate shaft by hand to ensure it turns freely.

(2) Position shroud against front of engine, if removed, and install fan and hub assembly. Tighten screws with 18 foot-pounds (24 N•m) torque.

(3) Install fan shroud on radiator.

(4) Install drive belts and tighen to specified tension with Tension Gauge J-23600. Refer to Drive Belt Adjustments.

(5) Connect hoses to water pump.

(6) Fill system with coolant. Use correct mixture.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(7) Operate engine with heater control valve open and radiator cap off until thermostat opens to purge air from cooling system.

(8) Check coolant level and add as required.

Removal—Eight-Cylinder Engine

(1) Disconnect battery negative cable.

WARNING: *DO NOT remove block drain plugs with system under pressure because serious scalding from coolant can occur.*

(2) Drain radiator and disconnect upper radiator hose at radiator.

(3) Loosen all drive belts.

(4) If vehicle is equipped with radiator shroud, separate shroud from radiator.

(5) Install one radiator/shroud screw to retain radiator.

(6) Remove fan and hub from water pump. Remove fan and shroud, if equipped, from engine compartment.

(7) If vehicle is equipped with air conditioning, install double nut on air conditioning compressor bracket-to-water pump stud and remove stud (fig. 1C-4).

NOTE: *Removal of this stud eliminates the necessity of removing compressor mounting bracket.*

(8) Remove alternator and mount bracket assembly and place aside. Do not disconnect wires.

(9) If equipped with power steering, remove two nuts that attach power steering pump to rear half of pump mounting bracket.

(10) Remove two screws that attach front half of bracket to rear half.

(11) Remove remaining upper screw from inner air pump support brace, loosen lower bolt and drop brace away from power steering front bracket (fig. 1C-4).

(12) Remove front half of power steering bracket from water pump mounting stud.

(13) Disconnect heater hose, bypass hose and lower radiator hose at water pump.

(14) Remove water pump and gasket from timing case cover.

(15) Clean all gasket material from gasket mating surface of timing case cover.

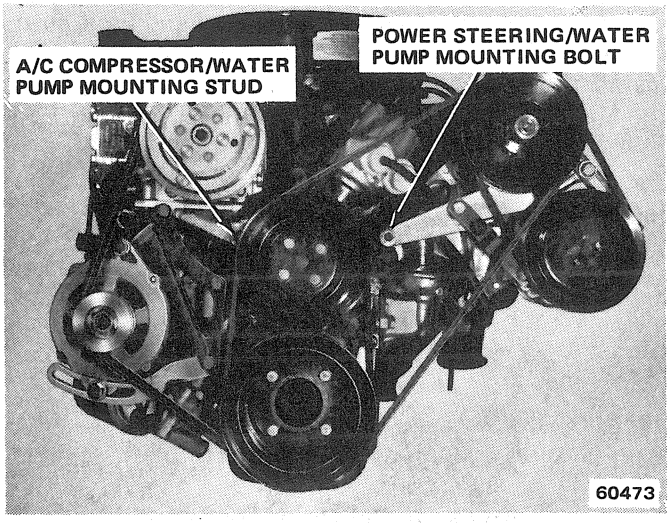

Fig. 1C-4 Water Pump Removal—Eight-Cylinder Engine

Installation—Eight-Cylinder Engine

NOTE: *Check timing case cover for erosion damage caused by cavitation.*

(1) Install water pump and replacement gasket on timing case cover.

(2) Tighten retaining screws to specified torque.

(3) If removed, install front section of power steering mount bracket, power steering pulley and drive belt.

(4) Tighten drive belt to specified tension, then tighten pulley retaining nut to 55 to 60 foot-pounds (75 to 81 N•m) torque.

(5) Install air pump drive belt, if removed, and tighten to specified tension.

(6) Install alternator and mount bracket assembly.

(7) Connect heater hose, bypass hose and lower radiator hose to water pump.

CAUTION: *Check and ensure the wire coil is installed in the lower radiator hose. Failure to install this coil will result in the hose collapsing during high engine rpm.*

(8) Position shroud against front of engine and install engine fan and hub assembly. Tighten retaining screws to specified torque.

(9) Position shroud on radiator and install with attaching screws.

(10) Install alternator drive belt and tighten to specified tension.

(11) Connect upper radiator hose to radiator.

(12) Connect battery negative cable.

(13) Fill cooling system with a mixture of 50 percent Jeep All-Season Coolant, or equivalent, and 50 percent water. Operate engine with heater control valve open until thermostat opens. Shut off engine, recheck coolant level and add as necessary.

(14) Reset clock, if equipped.

Water Pump Tests

Loose Impeller

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain cooling system.

(2) Loosen fan belt.

(3) Disconnect lower radiator hose from water pump.

(4) Bend stiff clothes hanger or welding rod (fig. 1C-5).

(5) Position rod in water pump inlet and attempt to hold impeller while turning fan blades. If impeller is loose and can be held with rod while fan blades are turning, pump is defective. If impeller turns, pump is OK.

NOTE: *If equipped with a Tempatrol fan, turn water pump shaft with socket and breaker bar attached to a mounting flange nut.*

(6) Connect hose and install coolant, or proceed with further repairs.

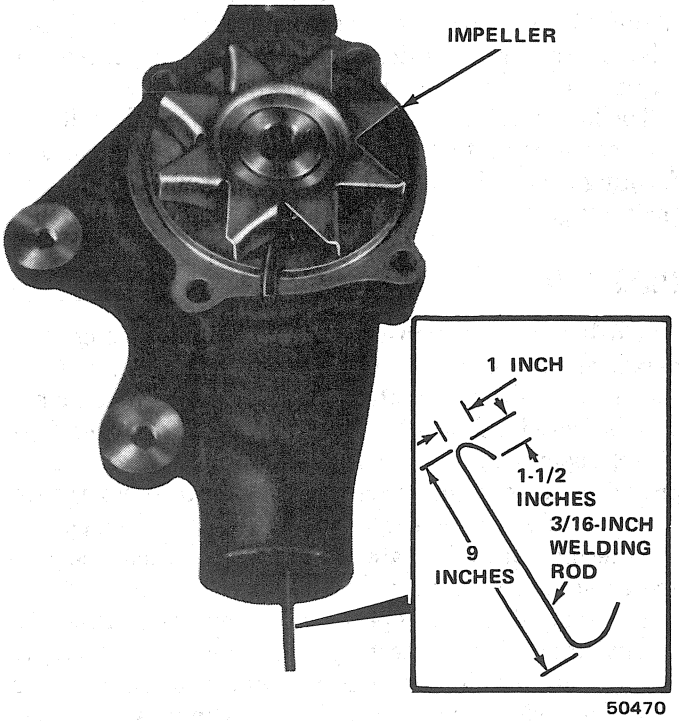

Fig. 1C-5 Testing Water Pump for Loose Impeller—Typical

Inspecting for Inlet Restrictions

With six- and eight-cylinder engines, poor heater performance may be caused by a casting restriction in the water pump heater hose inlet.

NOTE: *This procedure does not apply to the four-cylinder engine.*

(1) Drain sufficient coolant from radiator to permit removal of heater hose from water pump.
(2) Remove heater hose.
(3) Check inlet for casting flash or other restrictions.

NOTE: *Remove pump from engine before removing restriction to prevent contamination of coolant with debris. Refer to Water Pump Removal.*

HOSES

Rubber hoses route coolant to and from the radiator core and heater core. A coolant control valve is installed in the heater core inlet hose to control coolant flow to the heater core.

The lower radiator hose on all engines is spring-reinforced to prevent collapse caused by water pump suction.

Hose Inspection

Inspect hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when under pressure.

In areas where specific routing clamps are not provided, ensure hoses are positioned to clear exhaust manifold and pipe, fan blades and drive belts. Otherwise, improperly positioned hoses will be damaged, resulting in coolant loss and overheating.

The lower radiator hose on all engines is fitted with an internal spring to prevent hose collapse. When performing a hose inspection, check for proper position of the spring.

THERMOSTAT

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines, the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warmup and overall temperature control. An arrow or the words TO RAD is stamped on the thermostat to indicate the proper installed position. The same thermostat is used for winter and summer. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, poor warmup performance and crankcase condensation that can result in sludge formation.

Thermostat Replacement

On four-cylinder engines, install the thermostat with the pellet inside the thermostat housing. Insert replacement gasket between thermostat and housing cover.

On six- and eight-cylinder engines, install the thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position. Observe the recess in the cylinder head and position the thermostat in the groove (fig. 1C-6 and 1C-7). Next, install the gasket and thermostat housing. Tightening the housing unevenly or with the thermostat out of its recess will result in a cracked housing.

Thermostat Testing

(1) Remove thermostat. Refer to Thermostat Replacement.

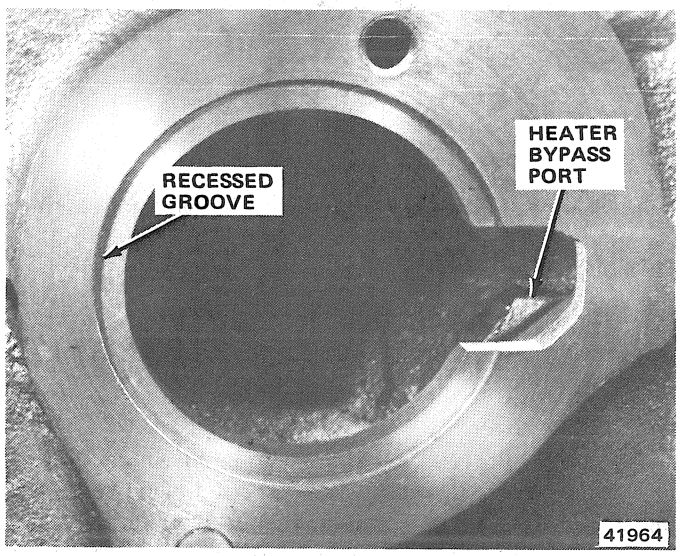

Fig. 1C-6 Thermostat Recess—Six-Cylinder Engine

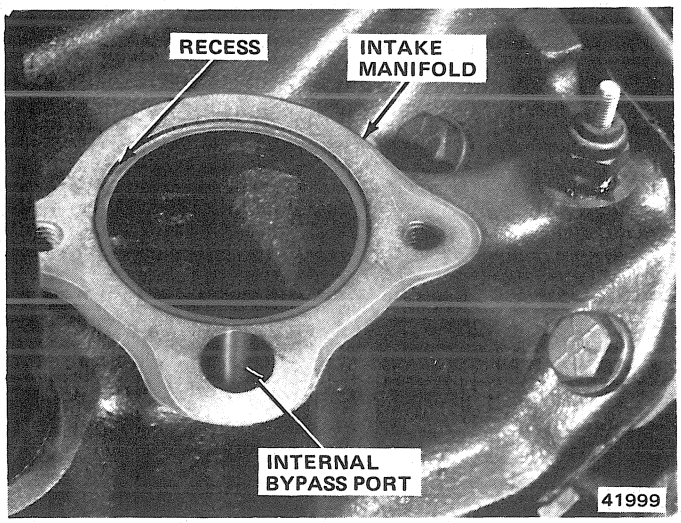

Fig. 1C-7 Thermostat Recess—Eight-Cylinder Engine

(2) Insert 0.003-inch (0.076-mm) feeler gauge, with wire or string attached, between valve and seat (fig. 1C-8).

WARNING: *Antifreeze is poisonous. Keep out of reach of children.*

(3) Submerge thermostat in container of pure antifreeze and suspend it so that it does not touch sides or bottom of container.

(4) Suspend thermometer in solution so that is does not touch container.

WARNING: *Do not breathe fumes.*

(5) Heat solution.

(6) Apply slight tension on feeler gauge while solution is heated. When valve opens 0.003-inch (0.076-mm), feeler gauge will slip free from valve. Note temperature. Refer to Thermostat Calibrations chart below. If faulty, replace thermostat.

(7) Install thermostat.

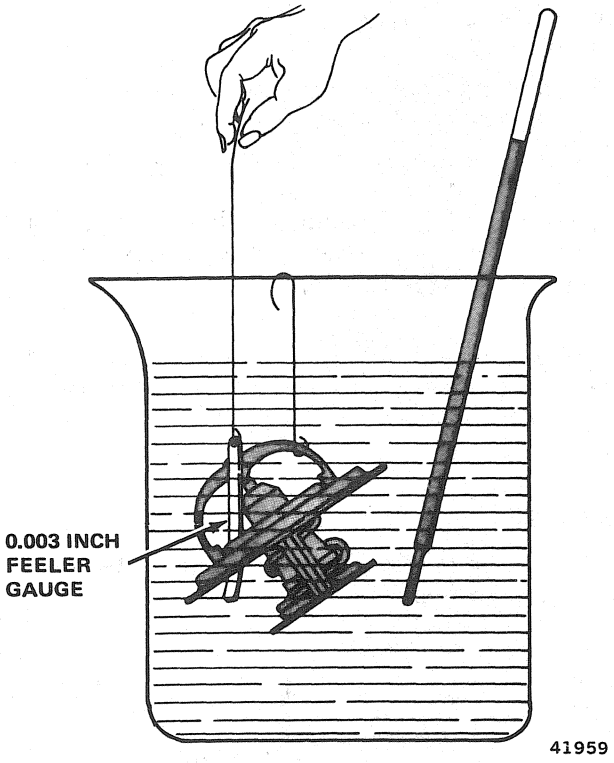

Fig. 1C-8 Testing Thermostat

Thermostat Calibrations

	4-, 6- and 8-Cyl
Must Be Open 0.003-Inch (0.076 mm)	90°C 195°F
Must Be Fully Open	103°C 218°F

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RADIATOR

The radiator, a tube and spacer type, is composed of two tanks soldered to the cooling tubes. The filler neck has an overflow tube that routes excess coolant to the road or to the coolant recovery bottle, if equipped.

All vehicles have downflow type radiators. A top tank and a bottom tank are soldered to vertical cooling tubes. The radiator cap and filler neck are located on the inlet tank. The bottom, or outlet, tank contains the draincock. It also contains the transmission fluid cooler for vehicles with an automatic transmission.

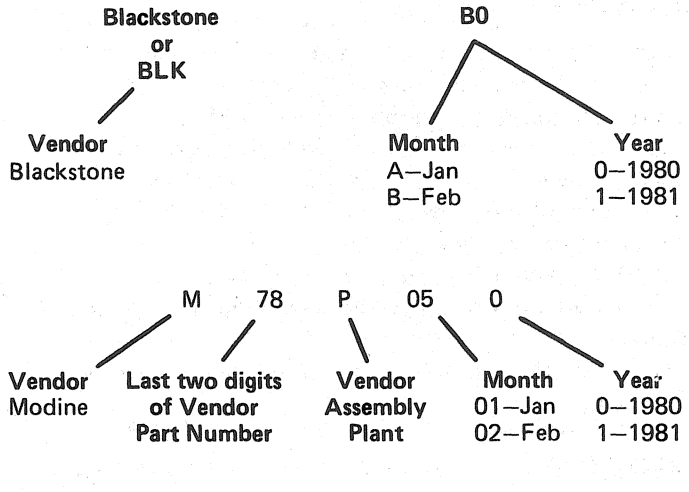
Some radiators have a plastic shroud attached to funnel air more directly through the radiator for improved engine cooling during idle and low rpm speeds.

Some vehicles are equipped with air seals between the radiator and various body structures. This prevents air from flowing forward around the radiator and recirculating through the core.

Radiator Identification

Radiators are identified by a Jeep part number and the vendor build code number embossed on the upper tank. Some Cherokees, Wagoneers and Trucks have the code located at the radiator right side support.

Radiator Identification



Radiator Maintenance

NOTE: *To test radiator for leaks or pressure loss, refer to Troubleshooting—Cooling System Leakage.*

The radiator should be free from any obstruction of airflow. This includes bugs, clogged bug screens, leaves, mud, emblems, flags, fog lamps, improperly mounted license plates, large nonproduction bumper guards or collision damage.

NOTE: *Remove dirt and other debris by blowing compressed air from the engine side of the radiator through the fins.*

Several problems may affect radiator performance:
- bent or damaged tubes,
- corrosive deposits restricting coolant flow,
- tubes blocked because of improper soldering.

Repair damaged tubes that affect proper operation. Leaks can be detected by applying 3 to 5 psi (21 to 34 kPa) air pressure to the radiator while it is submerged in water. Repair tubes with solder. Clean a clogged radiator with solvent or by reverse flushing. Refer to Cooling System Maintenance.

Replacement—All Models

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Position drain pan under radiator and remove draincock. Observe WARNING above.
(2) Remove radiator cap.
(3) Disconnect upper radiator hose.
(4) Disconnect coolant recovery hose, if equipped.
(5) On air-conditioned, four-cylinder engine models, remove charcoal canister and bracket.
(6) Remove fan shroud screws, if equipped.
(7) Remove top radiator attaching screws.
(8) Remove lower hose.
(9) Disconnect and plug transmission fluid cooler lines, if equipped with automatic transmission.
(10) Remove bottom radiator attaching screws.
(11) Remove radiator.
(12) Install radiator.
(13) Install radiator attaching screws.
(14) Install charcoal canister and bracket, if removed.
(15) Position fan shroud and install screws, if removed.
(16) Install draincock.
(17) Remove plugs and connect transmission fluid cooler lines, if disconnected.
(18) Install lower radiator hose using replacement clamp.
(19) Install upper hose using replacement clamp.
(20) Install coolant. Use correct mixture.
(21) Connect coolant recovery hose, if removed.
(22) Install radiator cap.

Radiator Pressure Cap

The radiator cap consists of a pressure valve and a vacuum valve. The cap has several functions (fig. 1C-9):
- prevents coolant loss when the vehicle is in motion;
- prevents impurities from entering the system and this minimizes corrosion;
- allows atmospheric pressure to eliminate the vacuum that occurs in the system during cooldown;
- seals cooling system pressure up to 15 psi (103.4 kPa), which raises the coolant boiling point approximately 2-1/2°F per psi of pressure (0.20°C per kPa).

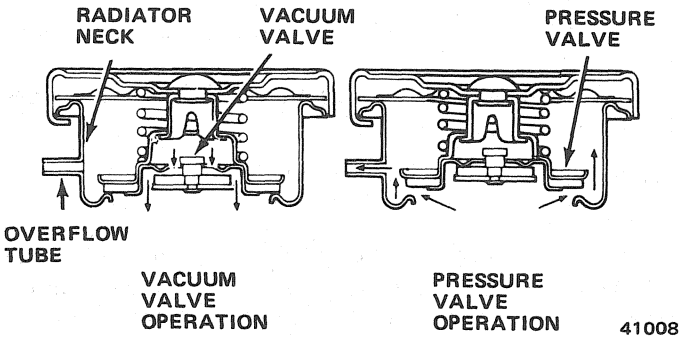


Fig. 1C-9 Radiator Cap Operation

Radiator Pressure Cap Testing

(1) Remove cap from radiator.
(2) Ensure seating surfaces are clean.
(3) Wet rubber gasket with water and install cap on tester (fig. 1C-10)
(4) Operate tester pump and observe gauge pointer at its highest point. Cap release pressure should be 12 to 15 psi (82.7 kPa to 103.4 kPa).

NOTE: *Cap is OK when pressure holds steady or holds within the 12 to 15 psi (82.7 to 103.4 kPa) range for 30 seconds or more. If pointer drops quickly, replace cap.*

FAN ASSEMBLY

Refer to the Cooling System Components chart for specific applications.

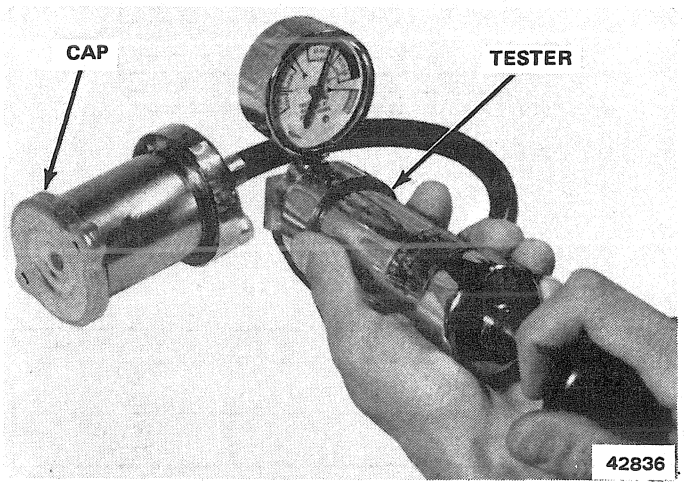


Fig. 1C-10 Radiator Cap Pressure Test

There are several types of metal fans available for all engines. Most engines with standard cooling use a seven-bladed rigid fan. Some engines are fitted with standard-equipment multi-bladed viscous fans for noise reduction. Most air-conditioned vehicles have a viscous (Tempatrol) fan (fig. 1C-11).

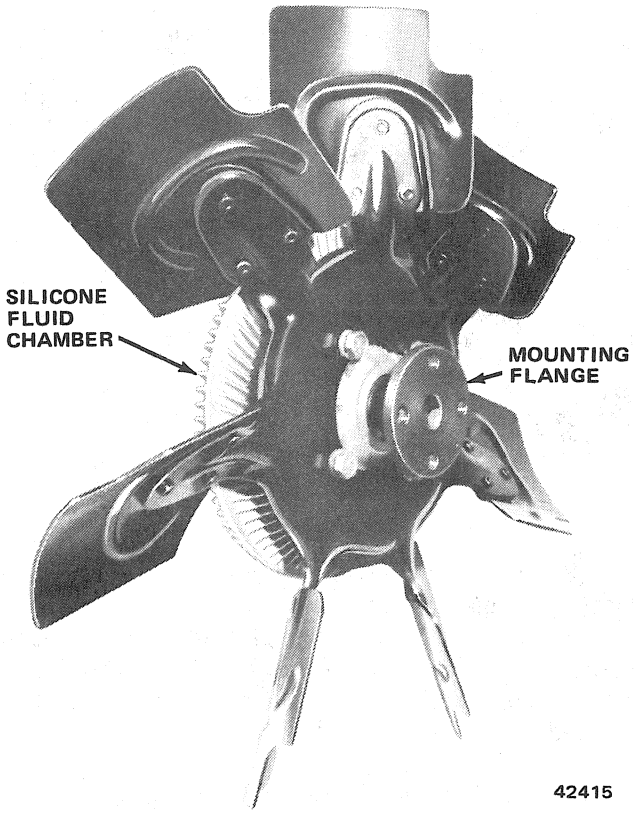


Fig. 1C-11 Tempatrol Fan—Typical

The Tempatrol fan drive is a torque- and temperature-sensitive clutch unit that automatically increases or decreases fan speed to provide proper engine cooling.

The Tempatrol fan drive clutch is essentially a silicone-fluid-filled coupling connecting the fan assembly to the fan/water pump pulley. The coupling allows the fan to be driven in a normal manner at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds. A bimetallic spring coil is located on the front face. This spring coil reacts to the temperature of the radiator discharge air and engages the drive clutch 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 the engine speed. Only when sufficient heat is present in the air flowing through the radiator core to cause a reaction from the bimetallic coil will the Tempatrol drive clutch engage and increase fan speed to provide the necessary additional engine cooling.

Once maximum fan speed is attained, the fan will not rotate faster regardless of increased engine speed. When the necessary engine cooling has been accomplished and the degree of heat in the air flowing through the radiator core has been reduced, the bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

Rigid fan blades are fastened by rivets. The fan is mounted on an aluminum spacer to provide the proper distance between the fan and radiator.

WARNING: *Do not stand in direct line with the fan when the engine is operating, particularly at speeds above idle.*

Cherokees, Wagoneers and Trucks equipped with air conditioning (or heavy-duty cooling) are equipped with a Tempatrol (viscous drive) fan assembly. Six-cylinder engines not equipped with air conditioning or heavy-duty cooling have a rigid metal, four-bladed fan. All CJ vehicles with eight-cylinder engines and air conditioning are equipped with a Tempatrol (viscous drive) fan assembly.

Fan blade assemblies are balanced within 0.25 in. oz. and should not be altered in any way. Replace a damaged or bent fan. Do not attempt repair. Refer to the Cooling System Components chart for fan applications.

CAUTION: *Fans are designed to be compatible with certain applications only. DO NOT attempt to increase cooling capacity by installing a fan not intended for a given engine. Fan or water pump damage and noise may result.*

Replacement—All Models

(1) Disconnect fan shroud from radiator, if equipped.
(2) Remove fan attaching bolts.
(3) Remove fan, spacer and shroud.

NOTE: *If equipped with a Tempatrol fan assembly, remove attaching nuts and remove fan and drive as a unit.*

(4) Position fan, spacer and shroud, if equipped.
(5) Install fan attaching bolts (or nuts) and tighten.
(6) Install shroud attaching screws and tighten, if removed.

Tempatrol Fan Blade and Drive Unit Replacement

CAUTION: *Six-cylinder engines (California) with a serpentine (single) drive belt have a reverse rotating water pump and viscous (Tempatrol) fan drive assembly. The components are identified by the words "REVERSE" stamped on the cover of the viscous drive and inner side of the fan, and "REV" cast into the water pump body. Do not install components that are intended for nonserpentine drive belts.*

If it necessary to replace either the Tempatrol fan blade unit or the drive unit separately, use the following procedure.

The Tempatrol drive unit should be replaced if there is an indication of a fluid leak, noise, or if roughness is detected when turning by hand. If the drive cannot be turned by hand, or if the leading edge of the fan can be moved more than 1/4 inch (6.35 mm) front to rear, replace the drive unit.

(1) Remove fan shroud attaching screws.

(2) Remove nuts attaching fan assembly and pulley to water pump. Remove drive belt.

(3) Move shroud rearward and remove fan assembly.

CAUTION: *To prevent silicone fluid from draining into fan drive bearing and contaminating the lubricant, do not place Tempatrol fan unit on work bench with rear mounting flange pointing downward.*

(4) Remove bolts attaching fan blade unit to drive unit.

(5) Attach replacement unit. Tighten bolts with 13 foot-pounds (18 N•m) torque.

(6) Install fan assembly and pulley on water pump. Tighten nuts with 18 foot-pounds (24 N•m) torque.

NOTE: *If a four-cylinder engine, the fan assembly and pulley must be installed with the drive belt in position on pulleys.*

Tempatrol Fan Test

In an engine overheating situation, the Tempatrol drive unit can be statically tested for proper operation by observing movement of the bimetallic spring coil and shaft. To test, disconnect end of bimetallic spring coil from slot (fig. 1C-12) and rotate it counterclockwise until a stop is felt.

NOTE: *Do not force beyond stop.*

Gap between end of coil and clip on housing should be approximately 1/2 inch (13 mm). Replace unit if shaft does not rotate with coil. After test, connect end of coil in slot.

Dynamic Test

CAUTION: *Ensure there is adequate fan blade clearance before drilling.*

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

(2) Insert dial thermometer (0° to 220°F [-18° to 105°C]) with 8-inch stem, or equivalent, through hole in shroud.

NOTE: *Ensure there is adequate clearance from fan blades.*

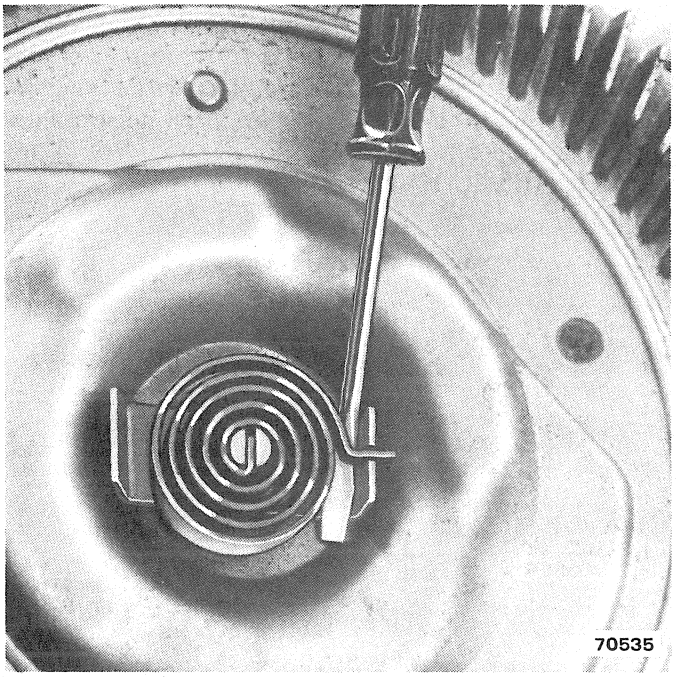


Fig. 1C-12 Disconnecting Tempatrol Spring Coil

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

(4) Block air flow through radiator by securing sheet of plastic in front of radiator (or air conditioning condenser). Tape shut at top and ensure air flow is blocked.

NOTE: *Ensure air conditioner, if equipped, is turned off.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(5) Start engine and operate at 2400 rpm with timing light aimed at fan blades (strobe light).

(6) Within ten minutes air temperature (indicated on dial thermometer) should reach 190°F (88°C). Satisfactory operation of fan drive requires that it engage before or at 200°F (93°C). Engagement is distinguishable by increase in fan roar. Timing light will also indicate increase in speed of fan.

(7) When air temperature reaches 200°F (93°C), remove plastic sheet. Satisfactory operation of Tempatrol fan requires air temperature to drop 20°F (11°C) or more. Definite decrease of audible fan air flow should be noticed. Replace defective fan assemblies.

NOTE: *The cooling system must be in good condition prior to performing the test outlined above to ensure against excessively high coolant temperature.*

FAN SHROUD

In some extreme situations, the engine fan blades may contact the shroud. An examination for proper engine mounting should isolate the problem. If not, examine the shroud position. To compensate for normal engine movement, loosen the shroud attaching screws and reposition shroud to prevent fan-to-shroud contact. Inspect the fan for bent blades and replace fan if necessary.

COOLANT RECOVERY SYSTEM

The coolant recovery system consists of a special pressure radiator cap, an overflow tube and a plastic coolant recovery bottle (fig. 1C-13). Refer to the Cooling System Components chart for specific applications.

The radiator cap used with the recovery system has a gasket to prevent air leakage at the filler neck. The cap has small finger grips (to discourage unnecessary removal) and has a mark on top that aligns with the overflow tube to indicate the proper installed position. The rubber overflow tube fits into the top of the plastic bottle and extends to the bottom. The overflow tube must always be submerged in coolant. The bottle also has a molded-in tube to allow excess coolant to escape. This same tube allows atmospheric pressure to enter the bottle during recovery operation. The bottle is fitted with a plain plastic cap.

Coolant Recovery Operation

As engine temperature increases, the coolant expands. The radiator cap pressure vent valve (normally open) slowly allows transfer of expanding coolant to the coolant recovery bottle. Any air trapped in the system will also be expelled during this period.

If ambient temperature is high, the system continues heating until vapor bubbles form. These vapor bubbles pass rapidly through the radiator cap vent valve, causing it to close. Further expansion of the coolant pressurizes the system up to 15 psi (103.4 kPa). Above 15 psi (103.4 kPa) the relief valve in the cap allows pressurized coolant to escape to the coolant recovery system.

As engine temperature drops, the coolant loses heat and contracts, forming a partial vacuum in the system. The radiator cap vacuum valve then opens and allows atmospheric pressure to force coolant from the recovery bottle into the system to equalize the pressure. Air is not admitted as long as the overflow tube remains submerged in the recovery bottle.

Coolant Recovery Bottle Replacement—All Models

(1) Remove tube from radiator filler neck.
(2) Remove bottle from radiator support panel.
(3) Pour coolant into clean container for reuse.
(4) Remove tube from bottle.
(5) Install tube in replacement bottle.

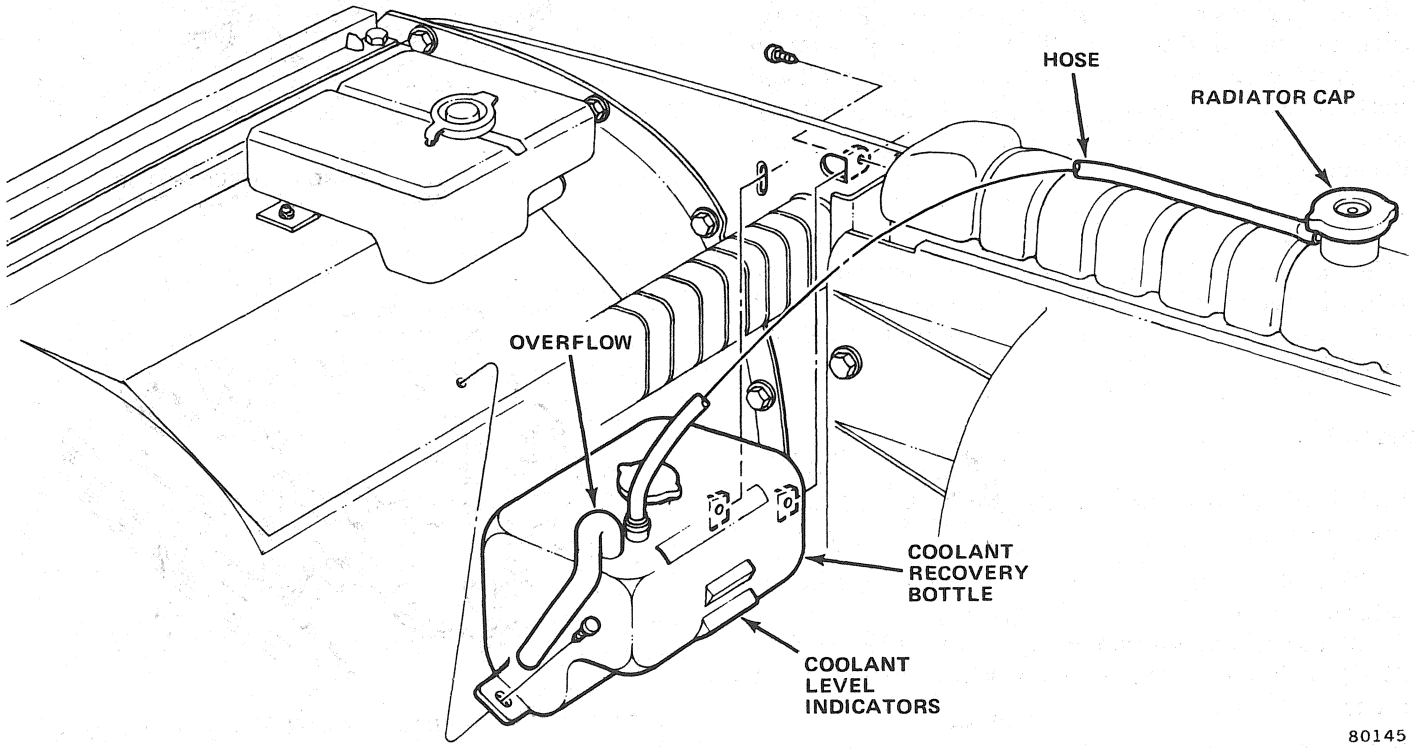


Fig. 1C-13 Coolant Recovery System—Typical

(6) Install bottle on radiator support panel.
(7) Connect tube to radiator filler neck.
(8) Install coolant in bottle. Ensure tube is submerged in coolant.

COOLANT TEMPERATURE GAUGE

All vehicles are equipped with a coolant temperature gauge. Refer to Chapter 1L—Power Plant Instrumentation for operation, diagnosis and repair of the temperature gauge system.

ENGINE BLOCK HEATER

A factory-installed engine block heater is optional. It consists of a 600W, 120V heater element fitted into a core plug hole in the block, a power cord and nylon straps are placed in the glove box for later installation.

Engine Block Heater Installation

NOTE: *DO NOT WASTE reuseable coolant. If solution is clean and is being drained only to service the engine or cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain coolant from engine. See NOTE and WARNING above.
(2) Remove core plug and install block heater (fig.1C-14). Tighten T-bolt type with 20 inch-pounds (2.3 N•m) torque. Tighten compression nut type with 10 foot-pounds (14 N•m) torque.

CAUTION: *Use care when tightening block heater attaching parts. Improper tightening may damage seal or allow heater to loosen, resulting in coolant loss and engine damage.*

(3) From front of vehicle, route heater (female) end of power cord through hole in front panel, along wire harness and connect to block heater.
(4) Use nylon straps furnished to tie cord to wire harness and to inside of grille. Allow cord to extend outside of grille.
(5) Install coolant in engine.

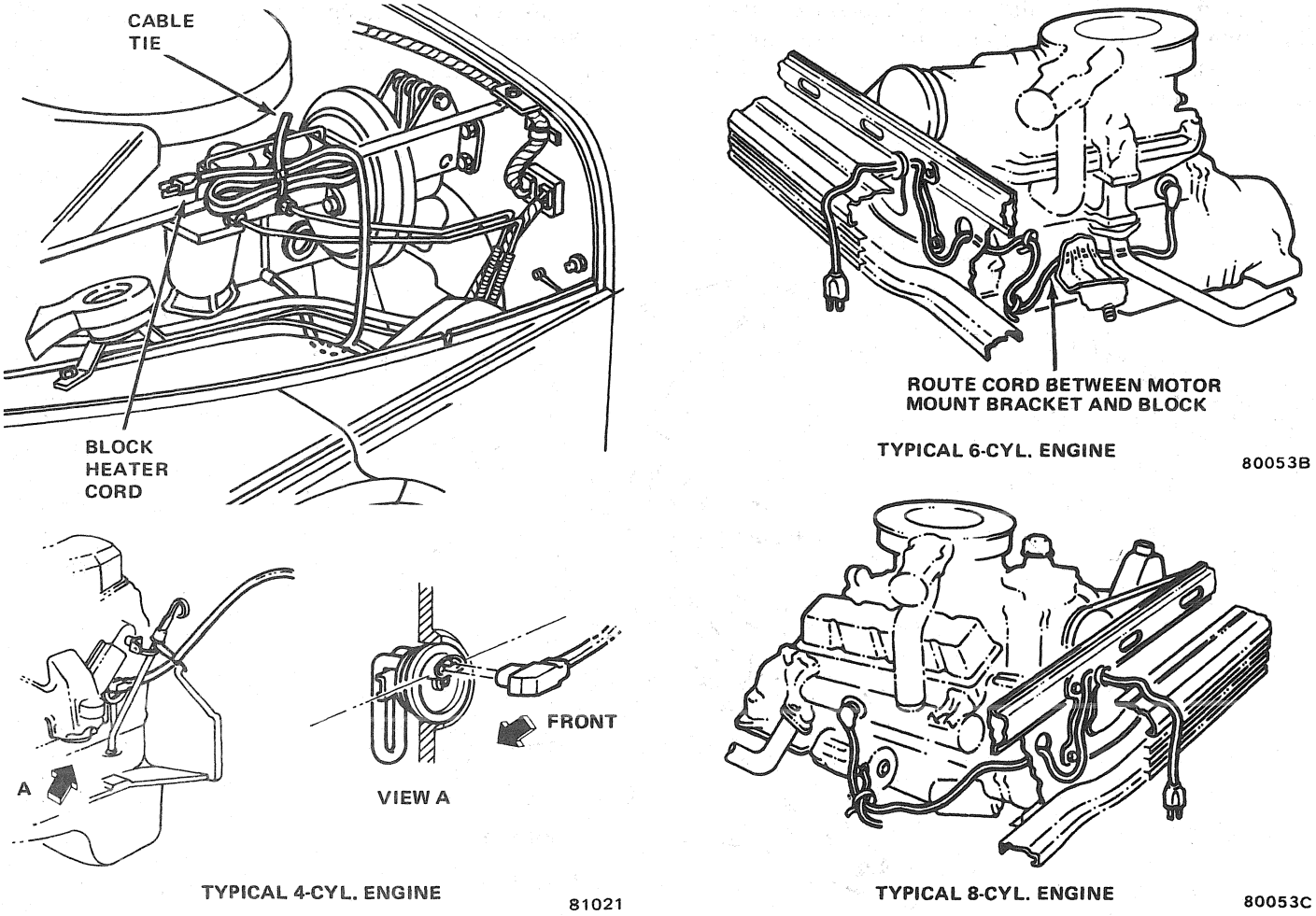


Fig. 1C-14 Engine Block Heater Installation

COOLING SYSTEM MAINTENANCE

Engine Flushing

CAUTION: *The cooling system normally operates at 12 to 15 psi (83 to 103 kPa) pressure. Exceeding this pressure may damage the radiator, heater core, or hoses.*

(1) Remove thermostat housing and thermostat. Install thermostat housing.
(2) Attach flushing gun to upper radiator hose at radiator end.
(3) Attach leadaway hose to water pump inlet.
(4) Connect water supply and air supply hoses to flushing gun.
(5) Allow engine to fill with water.
(6) When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through leadaway hose.
(7) Remove thermostat housing and install thermostat. Install thermostat housing, using a replacement gasket.
(8) Connect radiator hoses.
(9) Refill cooling system with correct antifreeze-water mixture.

Solvent Cleaning

In some instances, the use of a radiator cleaner (Jeep Radiator Kleen, or equivalent) before flushing will soften scale and deposits and aide the flushing operation.

CAUTION: *Ensure instructions on the container are followed.*

Radiator Reverse Flushing

(1) Disconnect radiator hoses.
(2) Attach piece of radiator hose to radiator bottom outlet and insert flushing gun.
(3) Connect water supply hose and air supply line to flushing gun. Note excess pressure caution above.
(4) Allow radiator to fill with water.
(5) When radiator is filled, apply air in short blasts, allowing radiator to refill between blasts.

Continue this reverse flushing until clean water flows through top radiator opening. If flushing fails to clear radiator passages, have the radiator cleaned more extensively by a radiator repair shop.

Transmission Fluid Cooler Repairs

Because of the high pressure applied to the fluid cooler, do not attempt conventional soldering to repair leaks. **All repairs must be silver soldered or brazed.**

Core Plugs

Prior to hot tanking for block boiling, remove casting flash causing hot spots or coolant flow blockage. Remove core plugs with hammer, chisel and prying tool. Apply a sealer to edges of replacement plugs and position plugs with lip to outside of block. Install with hammer and suitable tool. Refer to Core Plug Sizes chart.

Core Plug Sizes

Location	Diameter	
	inches	mm
Four-Cylinder Head (rear inside water jacket)	0.637	16
Four-Cylinder Head (rear)	1.9	48.5
Four-Cylinder Block (3 on side)	1.6	41.5
Four Cylinder Block (1 on rear)	1.9	48.3
Six-Cylinder Head (3 left side)	0.875	22
Six-Cylinder Head (rear)	2.0	51
Six-Cylinder Block (3 left, 1 rear)	2.0	51
Eight-Cylinder Heads (outer sides, 2 each)	1.0	24.4
Eight-Cylinder Blocks (3 each side)	1.5	38.1
Eight-Cylinder Heads (1 each end)	1.5	38.1

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COOLING SYSTEM DIAGNOSIS

If the cooling system requires frequent addition of coolant to maintain the correct level, inspect all units and connections in the cooling system for evidence of leakage. Perform the inspection with the cooling system cold. Small leaks, which may appear as dampness or dripping, can easily escape detection if they are rapidly evaporated by engine heat. Telltale stains of a grayish white or rusty color, or dye stains from antifreeze, may appear at connecting joints in the cooling system. These stains are almost always a sure indication of small leaks, though there may appear to be no defects.

Air may be drawn into the cooling system through incomplete sealing at the water pump seal or through incomplete sealing in the coolant recovery system. Combustion pressure may be forced into the cooling system through a leak at the cylinder head gasket, though the passage is too small to allow coolant to enter the combustion chamber.

TROUBLESHOOTING

Cooling System Leakage

NOTE: *Engine should be warm. Recheck system cold if cause of coolant loss is not located during warm engine troubleshooting.*

WARNING: *Hot, pressurized coolant can cause injury by scalding.*

Service Diagnosis

Condition	Possible Cause	Correction
HIGH TEMPERATURE INDICATION-OVERHEATING	(1) Coolant level low.	(1) Replenish coolant level.
	(2) Fan belt loose.	(2) Adjust fan belt.
	(3) Radiator hose(s) collapsed.	(3) Replace hose(s).
	(4) Radiator blocked to airflow.	(4) Remove restriction (bugs, fog lamps, etc.)
	(5) Faulty radiator cap.	(5) Replace cap.
	(6) Vehicle overloaded.	(6) Reduce load or shift to lower gear.
	(7) Ignition timing incorrect.	(7) Adjust ignition timing.
	(8) Idle speed low.	(8) Adjust idle speed.
	(9) Air trapped in cooling system.	(9) Purge air.
	(10) Vehicle in heavy traffic.	(10) Operate at fast idle intermittently in neutral gear to cool engine.
	(11) Incorrect cooling system component(s) installed.	(11) Install proper component(s).
	(12) Faulty thermostat.	(12) Replace thermostat.
	(13) Water pump shaft broken or impeller loose.	(13) Replace water pump.
	(14) Radiator tubes clogged.	(14) Flush radiator.
	(15) Cooling system clogged.	(15) Flush system.
	(16) Casting flash in cooling passages.	(16) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.
	(17) Brakes dragging.	(17) Repair brakes.
	(18) Excessive engine friction.	(18) Repair engine.
	(19) Antifreeze concentration over 68%.	(19) Lower antifreeze content.
	(20) Missing air seals between hood and radiator.	(20) Replace air seals.

NOTE: *Immediately after shutdown, the engine enters a condition known as heat soak. This is caused by the cooling system being inoperative while engine temperature is still high. If coolant temperature rises above boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does not occur frequently, it is considered normal.*

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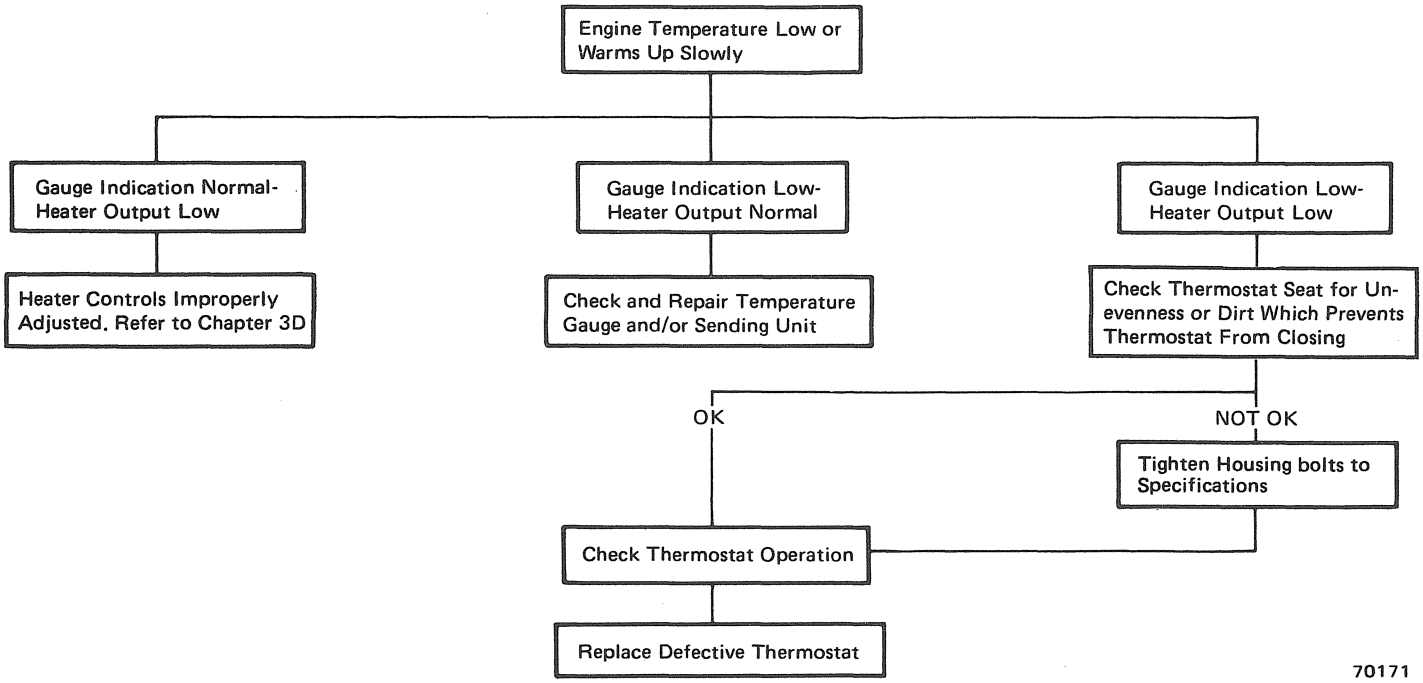
Service Diagnosis (Continued)

Condition	Possible Cause	Correction
	(21) Faulty gauge.	(21) Repair or replace gauge.
	(22) Loss of coolant flow caused by leakage or foaming.	(22) Repair leak, replace coolant.
	(23) Tempatrol fan inoperative.	(23) Perform Tempatrol fan test. Repair as necessary.
COOLANT LOSS—BOILOVER	Refer to Overheating Causes in addition to the following:	
	(1) Overfilled cooling system.	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run.	(2) Allow engine to run at fast idle prior to shutdown.
	(3) Air in system resulting in occasional "burping" of coolant.	(3) Purge system.
	(4) Insufficient antifreeze allowing coolant boiling point to be too low	(4) Add antifreeze to raise boiling point.
	(5) Antifreeze deteriorated because of age of contamination.	(5) Replace coolant.
	(6) Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator.	(6) Pressure test system to locate leak then repair as necessary.
	(7) Faulty head gasket.	(7) Replace head gasket.
	(8) Cracked head, manifold, or block.	(8) Replace as necessary.
COOLANT ENTRY INTO CRANKCASE OR CYLINDER	(1) Faulty head gasket.	(1) Replace head gasket.
	(2) Crack in head, manifold or block.	(2) Replace as necessary.
COOLANT RECOVERY SYSTEM INOPERATIVE	(1) Coolant level low.	(1) Replenish coolant to FULL mark.
	(2) Leak in system.	(2) Pressure test to isolate leak and repair as necessary.
	(3) Pressure cap not tight or gasket missing or leaking.	(3) Repair as necessary.

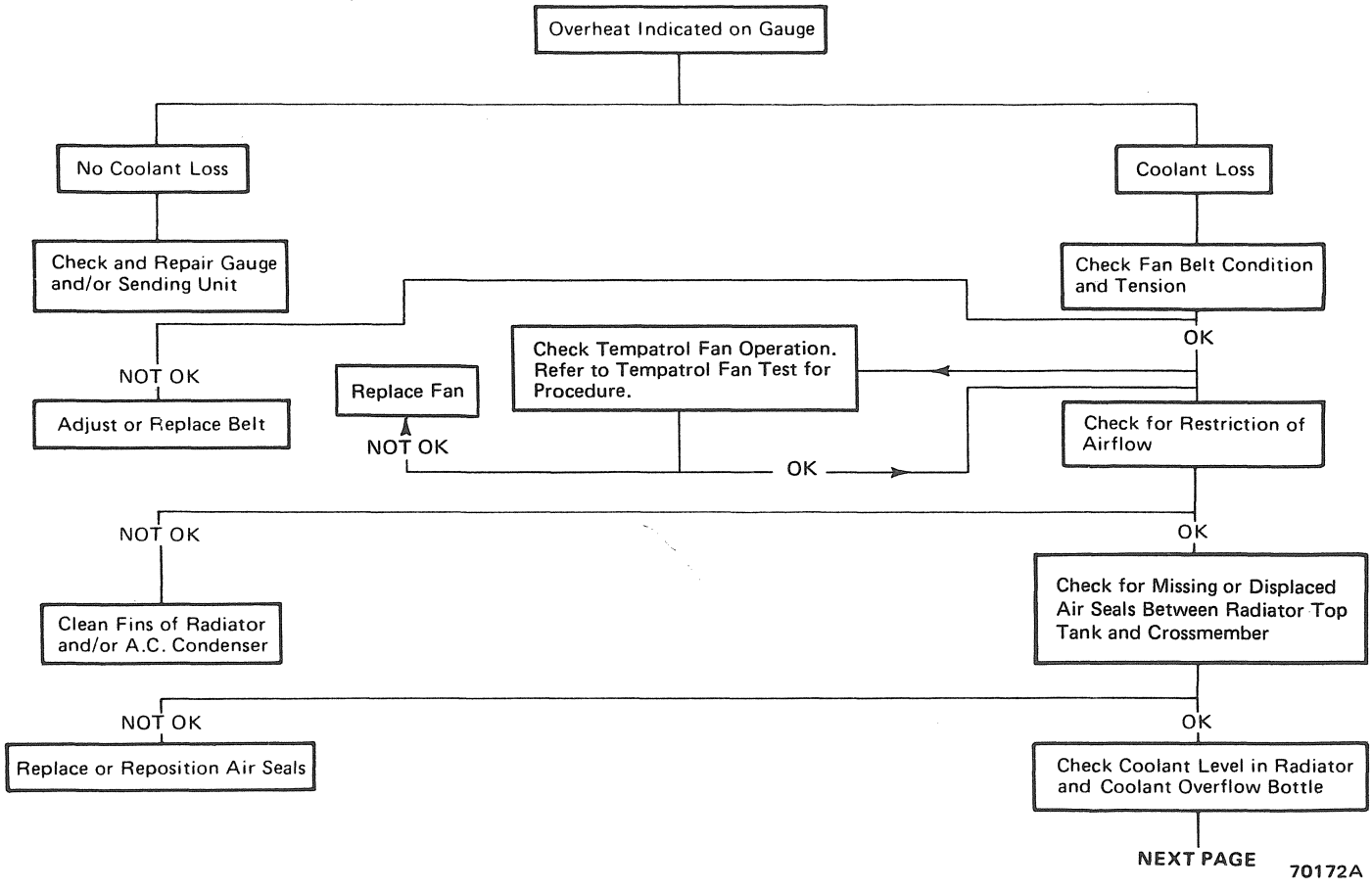
Service Diagnosis (Continued)

Condition	Possible Cause	Correction
	(4) Pressure cap defective.	(4) Replace cap.
	(5) Overflow tube clogged or leaking.	(5) Repair as necessary.
	(6) Overflow tube kinked .	(6) Repair as necessary.
	(7) Recovery bottle vent plugged.	(7) Remove restriction.
NOISE	(1) Fan contacting shroud.	(1) Reposition shroud and check engine mounts.
	(2) Loose water pump impeller.	(2) Replace pump.
	(3) Dry fan belt.	(3) Apply silicone or replace belt.
	(4) Loose fan belt.	(4) Adjust fan belt.
	(5) Rough surface on drive pulley.	(5) Replace pulley.
	(6) Water pump bearing worn.	(6) Remove belt to isolate. Replace pump.
	(7) Belt alignment.	(7) Check for improper pulley locations. Shim power steering pump.
LOW TEMPERATURE INDICATION— UNDERCOOLING	(1) Thermostat stuck open.	(1) Replace thermostat.
	(2) Faulty gauge.	(2) Repair or replace gauge.
	(3) Tempatrol fan drive constantly engaged.	(3) Perform fan test. Repair as necessary.
NO COOLANT FLOW THROUGH HEATER CORE	(1) Plugged return pipe in water pump.	(1) Remove obstruction.
	(2) Heater hose collapsed or plugged.	(2) Remove obstruction or replace hose.
	(3) Plugged heater core.	(3) Remove obstruction or replace core.
	(4) Plugged outlet in thermostat housing.	(4) Remove flash or obstruction.
	(5) Heater bypass hole in cylinder head plugged.	(5) Remove obstruction.
	(6) Heater tubes assembled on core incorrectly.	(6) Mount tubes correctly.

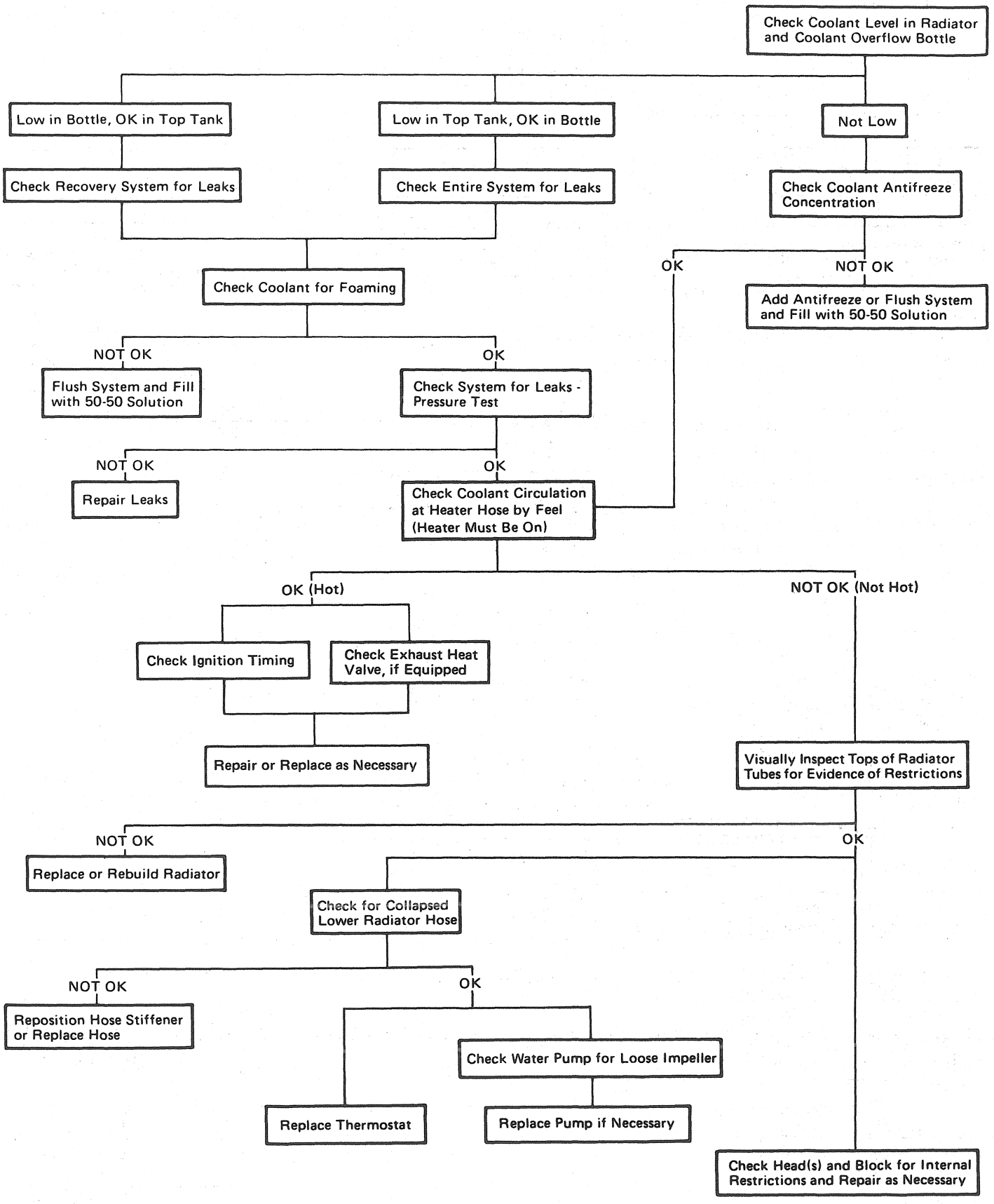
Low Engine Temperature Diagnosis Guide



Engine Overheating Diagnosis Guide



Engine Overheating Diagnosis Guide (Continued)



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(1) Carefully remove radiator pressure cap from filler neck and check coolant level.

NOTE: *Push down on the cap to disengage from the stop tabs.*

(2) Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder bumps.

(3) Inspect overflow tube for internal obstructions. Insert a wire through tube to ensure it is clear.

(4) Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully.

(5) Attach pressure tester to filler neck (fig. 1C-15). **Do not force.**

(6) Operate tester pump to apply 15 psi (103.4 kPa) pressure to system. If hoses swell excessively while testing, replace as necessary.

(7) Observe gauge pointer:

(a) **Holds Steady:** If pointer remains steady for two minutes, there are no serious leaks in the system.

NOTE: *There may be an internal leak that does not appear with normal system pressure. If it is certain that coolant is being lost and no leaks can be detected, check for interior leakage or perform Combustion Leakage Test.*

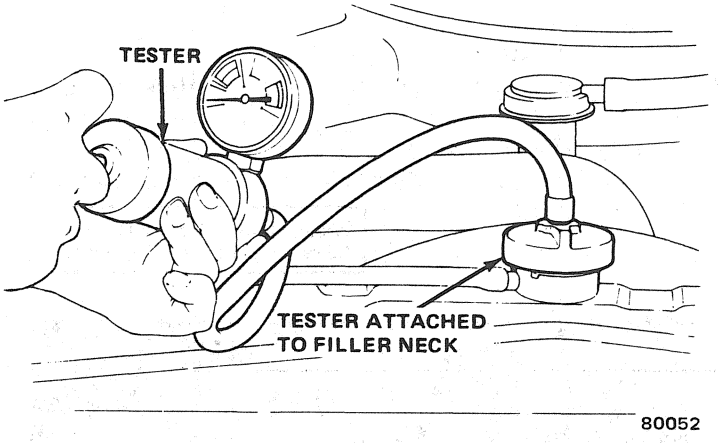

Fig. 1C-15 Cooling System Pressure Test

(b) **Drops Slowly:** Indicates presence of small leaks or seepage. Examine all connections for seepage or slight leakage with a flashlight. Check radiator, hose, gaskets and heater. Seal small leaks with AMC Sealer Lubricant, or equivalent. Repair leaks and recheck system.

(c) **Drops Quickly:** Indicates that serious leakage is present. Examine system for serious external leakage. If no leaks are visible, check for internal leakage.

NOTE: *Large radiator leaks should be repaired by a reputable radiator repair shop.*

Inspecting for Internal Leakage

(1) Remove oil pan drain plug and drain small amount of engine oil (coolant, being heavier, should drain first), or operate engine to churn oil, then examine dipstick for water globules.

(2) Inspect transmission dipstick for water globules.

(3) Inspect transmission fluid cooler for leakage. Refer to Transmission Fluid Cooler Leakage Test.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) Operate engine without pressure cap on radiator until thermostat opens.

(5) Attach Pressure Tester to filler neck. If pressure builds up quickly, leak exists as result of faulty head gasket or crack. Repair as necessary.

WARNING: *Do not allow pressure to exceed 15 psi (103.4 kPa). Turn engine Off. 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.*

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

CAUTION: *Do not disconnect spark plug wires while engine is operating.*

(7) Isolate compression leak by shorting each spark plug. Gauge pointer should stop or decrease vibration when spark plug of leaking cylinder is shorted because of the absence of combustion pressure.

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

Testing for Combustion Leakage (Without Pressure Tester)

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain sufficient coolant to allow thermostat removal.

(2) Disconnect water pump drive belt.

(3) **Four- and Eight-Cylinder Engine:** Remove thermostat housing cover and remove thermostat.

Six-Cylinder Engine: Disconnect upper radiator hose from thermostat housing, remove thermostat and install thermostat housing on cylinder head.

(4) Add coolant to engine to bring level within 1/4 inch (6.3 mm) 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 boilover.*

(5) Start engine and accelerate rapidly to approximately 3000 rpm three times while observing coolant. If any internal engine combustion leaks to cooling system exist, bubbles will appear in coolant. If bubbles do not appear, there are no internal leaks.

Transmission Fluid Cooler Leakage Test

Transmission Fluid cooler leaks can be detected by the presence of transmission fluid in the coolant. If fluid appears in the coolant, check the fluid level of the automatic transmission. If the fluid level is low, check the fluid cooler as follows:

(1) Remove transmission-to-cooler lines at radiator.

(2) Plug one fitting in cooler.

(3) Remove radiator cap and ensure radiator is filled with coolant.

(4) Apply shop air pressure (50 to 100 psi [344 to 690 kPa]) to other fitting on cooler.

CAUTION: *Because of high fluid pressure, conventional soldering must not be used for fluid cooler repair. All repairs must be silver-soldered or brazed.*

Bubbles in coolant at filler neck indicate a leak in fluid cooler. If a transmission fluid cooler leak is discovered, remove radiator for cooler repair. Unsolder outlet tank for access to fluid cooler.

DRIVE BELT ADJUSTMENTS

General

After the need for adjustment has been determined, drive belts are adjusted by pivoting the driven component in its mount to achieve the desired tension. In some applications, a belt may drive several components or, for California six-cylinder engines, a single serpentine drive belt drives all components. It is necessary to loosen and pivot only one component.

(1) Locate drive belt that is to be tested for correct tension.

(2) Test tension with Gauge J-23600 (fig. 1C-16).

(3) If necessary, adjust drive belt.

(4) Test tension after adjustment.

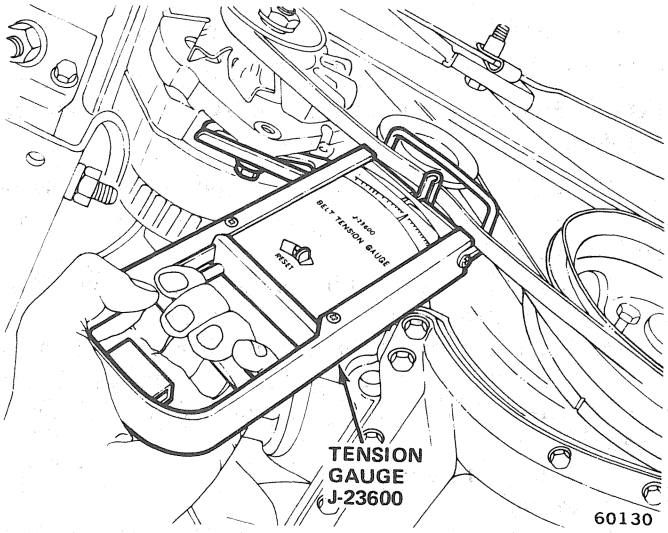

Fig. 1C-16 Testing Drive Belt Tension—Typical

Four-Cylinder Engine

Alternator and Fan (without Air Conditioner)

(1) Position Tension Gauge J-23600 on upper section of belt midway between alternator pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-17).

(a) Loosen alternator pivot and adjusting bolts.

(b) Tighten belt with pry bar. Pry on alternator front housing only.

(c) Tighten adjusting and pivot bolts with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

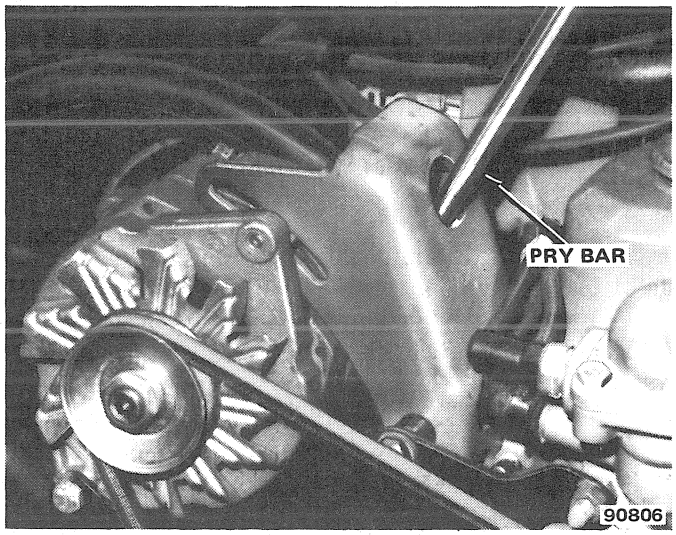

Fig. 1C-17 Four-Cylinder Engine Alternator Drive Belt Adjustment

Power Steering Pump

(1) Position Tension Gauge J-23600 on upper section of belt midway between pump pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-18).

(a) Loosen pump-to-mounting bracket locknuts.

(b) Loosen pivot bolts.

(c) Insert drive lug of 1/2-inch drive ratchet into adjustment hole and pivot pump to tighten belt.

(d) Tighen nuts and pivot bolt with 28 foot-pounds (38 N•m) torque.

(e) Re-test tension.

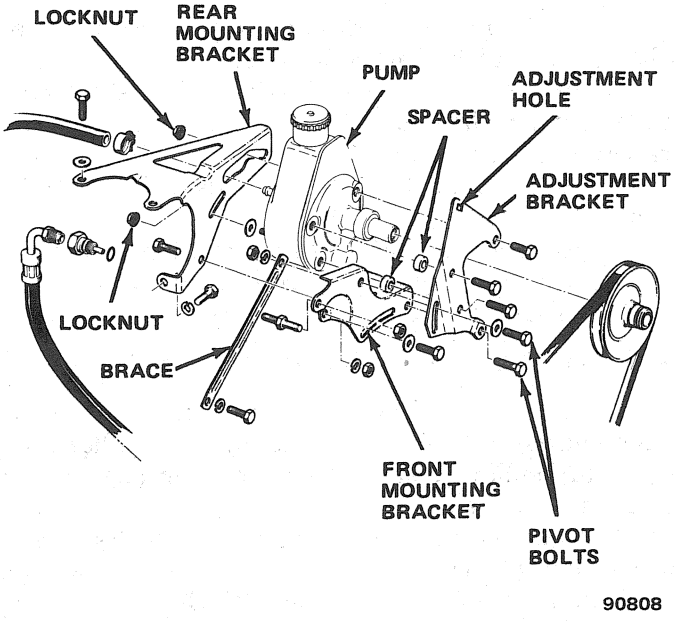

Fig. 1C-18 Four-Cylinder Engine Power Steering Pump Drive Belt Adjustment

Six- and Eight-Cylinder Engine

Alternator and Fan (Six-Cylinder Engine without Air Conditioner and All Eight-Cylinder Engines)

(1) Position Tension Gauge J-23600 on upper section of belt midway between alternator pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-19 and 1C-20).

(a) Loosen alternator pivot and adjusting bolts.

(b) Tighten belt with pry bar. Pry on alternator front housing only.

(c) Tighten adjusting bolt with 18 foot-pounds (24 N•m) torque. Tighten pivot bolt with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

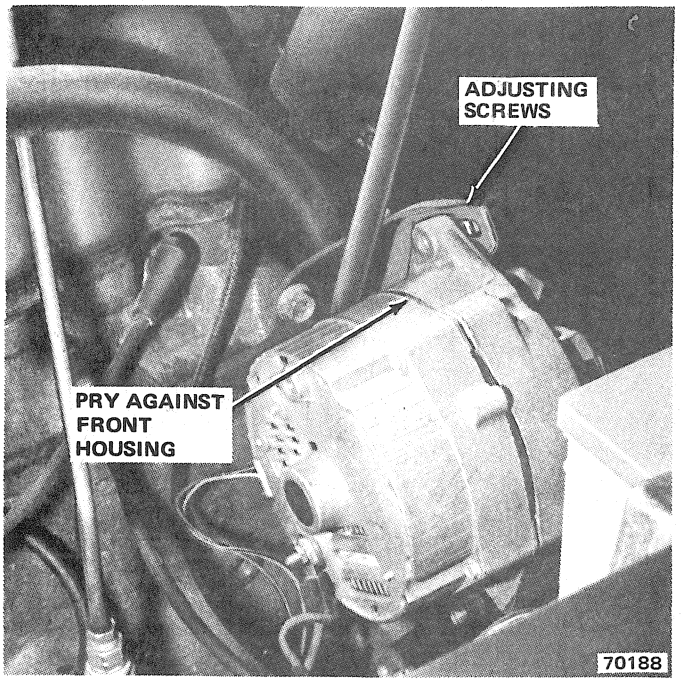

Fig. 1C-19 Six-Cylinder Engine (w/o A/C) Alternator Drive Belt Adjustment

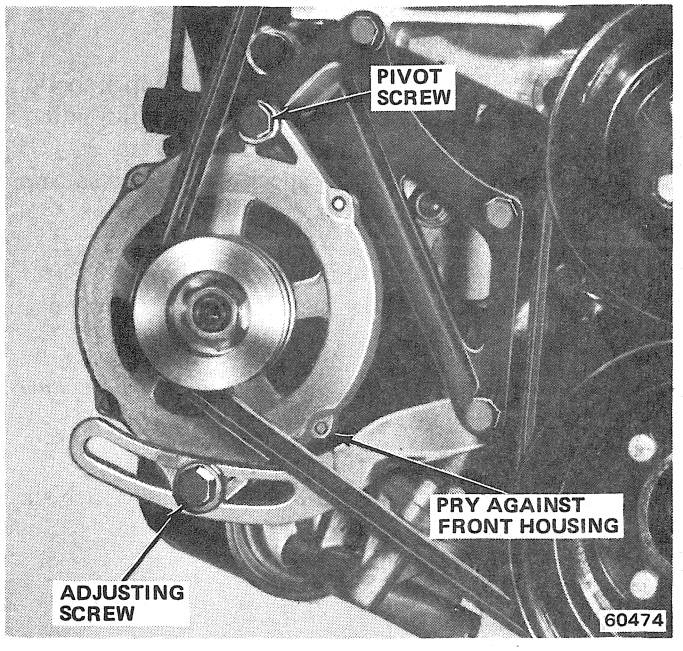

Fig. 1C-20 Eight-Cylinder Engine Alternator Drive Belt Adjustment

Alternator and Fan (Six-Cylinder Engine with Air Conditioner)

(1) Position Tension Gauge J-23600 on section of belt adjacent to inner fender panel. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-21).

(a) From underside of engine compartment, loosen lower mounting bracket pivot nut and adjusting bolt.

(b) Insert pry bar into hole in bottom of bracket and pry to tighten belt.

(c) Tighten adjusting bolt with 18 foot-pounds (24 N•m) torque. Tighten pivot nut with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

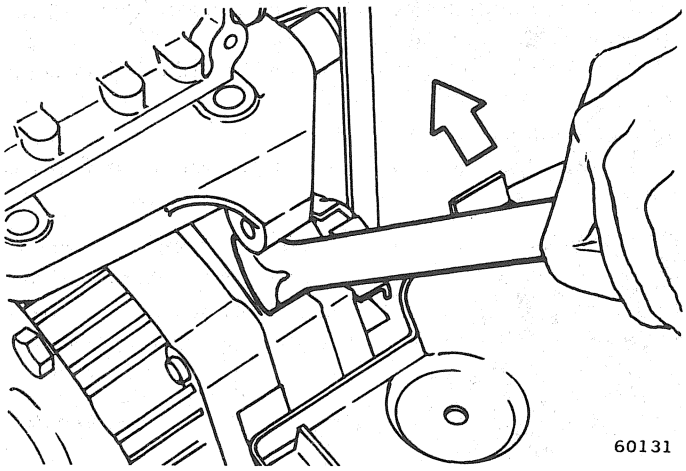

Fig. 1C-21 Six-Cylinder Engine (w/A/C) Alternator Drive Belt Adjustment

Air Pump (without Power Steering)

(1) Position Tension Gauge J-23600 on upper section of belt midway between air pump pulley and fan pulley. Test tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 60 pounds-force (267 N).

(3) Adjustment.

(a) Loosen lower retaining/pivot bolt.

(b) Loosen upper adjusting bolt to allow pump to be moved.

CAUTION: *Do not pry against sides of pump because internal pump damage may result.*

(c) Raise pump to tighten belt.

(d) Tighten bolts with 20 foot-pounds (27 N•m) torque.

(e) Re-test tension.

Air Pump (with Power Steering)

(1) Remove flexible tube attached to air cleaner snorkel.

(2) Position Tension Gauge J-23600 on outer section of belt (adjacent to inner fender panel) midway between power steering pump pulley and air pump pulley. Test belt tension according to instructions on gauge.

(3) Adjust belt tension to specification if less than 60 pounds-force (267 N).

(4) Adjustment.

(a) Loosen upper adjusting bolt.

(b) Loosen lower pivot nut to allow pump to be moved.

CAUTION: *Do not pry against sides of pump because internal pump damage may result.*

(c) Raise pump to tighten belt.

(d) Tighten adjusting bolt with 20 foot-pounds (27 N•m) torque. Tighten pivot nut with 15 foot-pounds (20 N•m) torque.

(e) Re-test tension.

Air Conditioner Compressor

(1) Position Tension Gauge J-23600 on upper section of belt midway between compressor pulley and either idler pulley or alternator pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment.

(a) If equipped with idler pulley, loosen clamp bolt and idler pulley bracket pivot bolt.

(b) Insert drive lug of 1/2-inch drive ratchet into adjustment hole in idler pulley bracket and pivot bracket to tighten belt.

(c) Tighten bolts with 18 foot-pounds (24 N•m) torque.

(d) If not equipped with idler pulley, follow alternator drive belt adjustment procedure.

(e) Re-test tension.

Power Steering Pump—Six- and Eight-Cylinder Engines

(1) Position Tension Gauge J-23600 on lower section of belt midway between power steering pump pulley and crankshaft pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (figs. 1C-22 and 1C-23).

(a) Loosen air pump drive belt (refer to Air Pump Drive Belt Adjustment).

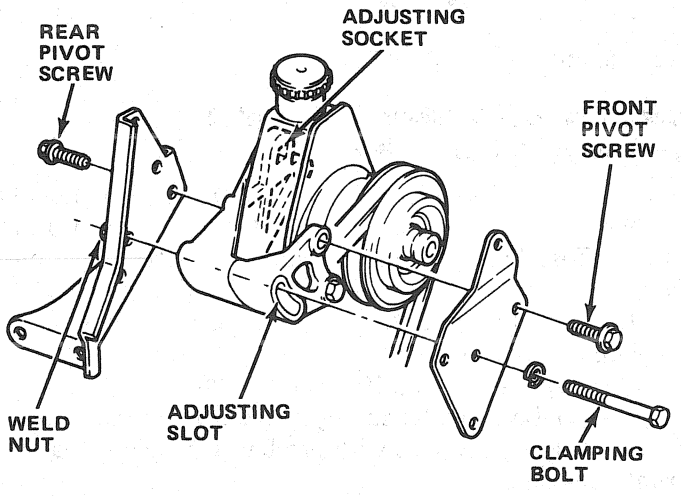

Fig. 1C-22 Six-Cylinder Engine Power Steering Pump Drive Belt Adjustment

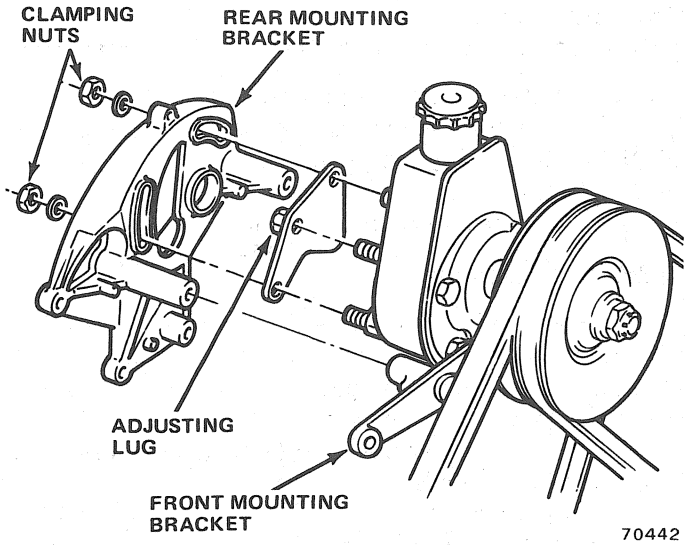

Fig. 1C-23 Eight-Cylinder Engine Power Steering Pump Drive Belt Adjustment

(b) Loosen adjusting bolts that attach power steering pump bracket to adaptor plates.

NOTE: *The bolt that attaches pump bracket to rear adaptor plate is located behind rear adaptor plate flange.*

(c) Insert drive lug of 1/2-inch drive ratchet into adjustment hole in bracket and pivot bracket to tighten belt.

(d) Tighten bolts with 30 foot-pounds (41 N•m) torque.

(e) Re-test tension.

(f) Adjust air pump drive belt (refer to Air Pump Drive Belt Adjustment).

Serpentine Drive Belt (California Only)

(1) Position Tension Gauge J-23600-B on largest accessible span of belt. Test belt tension according to manufacturer's instructions.

(2) Adjust belt tension to specification if less than 140 pounds-force (623 N).

(3) Adjustment.

(a) Loosen alternator adjustment and pivot bolts.

CAUTION: *Maintain a clearance of at least 1.2 inches (30.5 mm) between power steering pump body and air pump body. A 1.2-inch (30.5 mm) block gauge may prove useful to rapidly establish clearance between pumps. Do not use power steering pump to increase belt tension.*

(b) Tighten belt with pry bar. Pry on alternator front housing only.

(c) Tighten adjustment and pivot bolts with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

NOTE: *Because of the higher tension required for serpentine drive belts, a helper may be necessary for belt adjustment.*

SERPENTINE DRIVE BELT DIAGNOSIS

Refer to diagnosis chart when servicing serpentine drive belts.

Serpentine Drive Belt Diagnosis

Condition	Possible Cause	Correction
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	(1) Grooved or backside idler pulley diameters are less than minimum recommended.	(1) Replace pulley(s) not conforming to specification.
	(2) Tension sheeting contacting stationary object.	(2) Correct rubbing condition.
	(3) Excessive heat causing woven fabric to age.	(3) Replace belt.
	(4) Tension sheeting splice has fractured.	(4) Replace belt.
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	(1) Belt slippage.	(1) Adjust belt.
	(2) Bearing noise.	(2) Locate and repair.
	(3) Belt misalignment.	(3) Align belt/pulley(s).
	(4) Belt-to-pulley mismatch.	(4) Install correct belt.

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Condition	Possible Cause	Correction
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION) (Continued)	(5) Driven component induced vibration.	(5) Locate defective driven component and repair.
	(6) System resonant frequency induced vibration.	(6) Vary belt tension within specifications. Replace belt.
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	(1) Foreign objects imbedded in pulley grooves.	(1) Remove foreign objects from pulley grooves.
	(2) Installation damage.	(2) Replace belt.
	(3) Drive loads in excess of design specifications.	(3) Adjust belt tension.
	(4) Insufficient internal belt adhesion.	(4) Replace belt.
RIB OR BELT WEAR (BELT RIBS CONTACT BOTTOM OF PULLEY GROOVES)	(1) Pulley(s) misaligned.	(1) Align pulley(s).
	(2) Mismatch of belt and pulley groove widths.	(2) Replace belt.
	(3) Abrasive environment.	(3) Replace belt.
	(4) Rusted pulley(s).	(4) Clean rust from pulley(s).
	(5) Sharp or jagged pulley groove tips.	(5) Replace pulley.
	(6) Rubber deteriorated.	(6) Replace belt.
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	(1) Belt has mistracked from pulley groove.	(1) Replace belt.
	(2) Pulley groove tip has worn away rubber to tensile member.	(2) Replace belt.
BELT SLIPS	(1) Belt slipping because of insufficient tension.	(1) Adjust tension.
	(2) Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction.	(2) Replace belt and clean pulleys.
	(3) Driven component bearing failure.	(3) Replace faulty component bearing.
	(4) Belt glazed and hardened from heat and excessive slippage.	(4) Replace belt.

Condition	Possible Cause	Correction
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY, OR TURNS OVER AND/OR RUNS OFF PULLEYS)	(1) Insufficient belt tension.	(1) Adjust belt tension.
	(2) Pulley(s) not within design tolerance.	(2) Replace pulley(s).
	(3) Foreign object(s) in grooves.	(3) Remove foreign objects from grooves.
	(4) Excessive belt speed.	(4) Avoid excessive engine acceleration.
	(5) Pulley misalignment.	(5) Align pulley(s).
	(6) Belt-to-pulley profile mismatched.	(6) Install correct belt.
	(7) Belt cordline is distorted.	(7) Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	(1) Excessive tension.	(1) Replace belt and adjust tension to specification.
	(2) Tensile members damaged during belt installation.	(2) Replace belt.
	(3) Belt turnover.	(3) Replace belt.
	(4) Severe misalignment.	(4) Align pulley(s).
	(5) Bracket, pulley, or bearing failure.	(5) Replace defective component and belt.
CORD EDGE FAILURE (TENSILE MEMBER EXPOSED AT EDGES OF BELT OR SEPARTED FROM BELT BODY)	(1) Excessive tension.	(1) Adjust belt tension.
	(2) Drive pulley misalignment.	(2) Align pulley.
	(3) Belt contacting stationary object.	(3) Correct as necessary.
	(4) Pulley irregularities.	(4) Replace pulley.
	(5) Improper pulley construction.	(5) Replace pulley.
	(6) Insufficient adhesion between tensile member and rubber matrix.	(6) Replace belt and adjust tension to specifications.
SPORADIC RIB CRACKING (MULTIPLE CRACKS IN BELT RIBS AT RANDOM INTER-VALS)	(1) Ribbed pulley(s) diameter less than minimum specification.	(1) Replace pulley(s).
	(2) Backside bend flat pulley(s) diameter below minimum.	(2) Replace pulley(s).
	(3) Excessive heat condition causing rubber to harden.	(3) Correct heat condition as necessary.
	(4) Excessive belt thickness.	(4) Replace belt.
	(5) Belt overcured.	(5) Replace belt.
	(6) Excessive tension.	(6) Adjust belt tension.

SPECIFICATIONS

Cooling System Specifications

	Four-Cylinder Engine		Six-Cylinder Engine		Eight-Cylinder Engine	
	USA	Metric	USA	Metric	USA	Metric
Radiator Cap Relief Pressure	15 psi	103 kPa	15 psi	103 kPa	15 psi	103 kPa
Thermostat						
Rating	195°F	91°C	195°F	91°C	195°F	91°C
Must be open 0.003 inch (0.076mm) at	192°-198°F	89°-92°C	192-198°F	89-92°C	192-198°F	89-92°C
Fully open	218°F	103°C	218°F	103°C	218°F	103°C
Water Pump						
Type	Centrifugal		Centrifugal		Centrifugal	
Drive	V-Belt		V-Belt*		V-Belt	
Radiator						
Type	Tube & Spacer		Tube & Fin		Tube & Fin	
Cooling System Capacities						
(includes 1 quart for heater)	7.8 qts.	7.1 liters	10.5 qts.	9.9 liters	13.0 qts. (11.6 imp. qts.) 304 CID engine	12.3 liters
					14.0 qts. (10.8 imp. qts.) 360 CID engine	13.2 liters
Fan						
Number of Blades	Refer to Cooling System Components Chart					
Diameter	Refer to Cooling System Components Chart					
Drive Belt						
Angle of V	36°		38°		38°	
Width—top of groove	0.38 in.	9.65mm	0.391-0.453 in.	9.931-11.506 mm	0.391-0.453 in.	9.931-11.506 mm
Type (plain or cogged)	plain		plain		plain	
Serpentine						
Number of Ribs	6					
Rib Angle	40°					
Rib Width	0.14 in. 3.56mm					

* California: Serpentine Drive Belt

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Cooling System Components

Model	Cooling Package			Engine				Transmission		Radiator		Fan				Shroud
	STD	HD	AC	151	258	304	360	Man.	Auto.	Fins Per Inch	Rows of Tubes	Diam. (Inches)	No. of Blades	Spacer (Inches)	Tempa-trol	
	●				●			●		8	2	16.25③	4	0.88		
	●				●				●①	9	2	16.25③	4	0.88		
		●②			●			●		15	2	15.62	7	1.22		●
CJ-5		●②			●				●①	15	2	15.62	7	1.22		●
85			●②		●			●		15	2	15.62	7	1.22		●
			●②		●				●①	15	2	15.62	7	1.22		●
CJ-7	●					●		●		10.5	2	19.00	4	1.50		
87	●					●			●①	12	2	19.00	4	1.50		
		●	●			●		●		16	2	19.50	7		●	●
		●	●			●			●①	16	2	19.50	7		●	●
	●			●					●①	13	2	15.00	4	1.70		●
		●		●					●①	16	2	16.00	7		●	●
	●			●				●		11	2	15.00	4	1.70		●
		●		●				●		13	2	16.00	7		●	●
	●				●			●		9	2	16.25③	4	0.88		
	●				●				●	10	2	16.25③	4	0.88		
Wagoneer		●			●			●		15	2	19.50③	7		●	●
15		●			●				●	15	2	19.50③	7		●	●
			●		●			●		15	2	19.50③	7		●	●
Cherokee			●		●				●	15	2	19.50③	7		●	●
16, 17, 18	●						●	●		11.5	2	19.50	7		●	
	●						●		●	12.5	2	19.50	7		●	
Truck		●					●	●		16	2	19.50	7		●	●
25, 26, 27		●					●		●	16	2	19.50	7		●	●
			●				●	●		16	2	19.50	7		●	●
			●				●		●	16	2	19.50	7		●	●

NOTE: All radiator caps are rated at 15 psi (103 kPa)
① Not applicable to CJ-5 vehicles
② Not available in California
③ California: Reverse Rotation

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Engine Drive Belt Tension

	Initial Pounds-Force New Belt	Reset Pounds-Force Used Belt	Initial Newtons New Belt	Reset Newtons Used Belt
Air Conditioner				
All	125-155	90-115	556-689	400-512
Air Pump				
All except six-cylinder w/PS	125-155	90-115	556-689	400-512
Six-Cylinder w/PS (3/8-inch belt)	65-75	60-70	289-334	267-311
Fan And Alternator	125-155	90-115	556-689	400-512
Power Steering Pump	125-155	90-115	556-689	400-512
Serpentine Drive Belt (Six-cylinder engine California)	180-200	140-160	800-890	623-712

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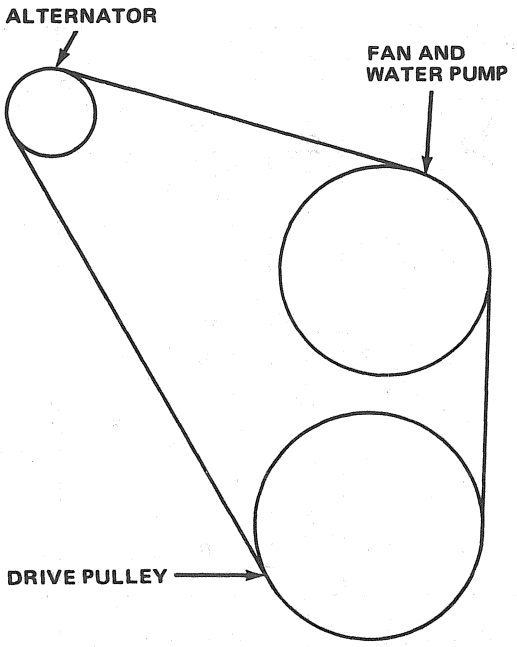
Engine Drive Belt Arrangements



FOUR-CYLINDER ENGINE
BASIC BELT ARRANGEMENT

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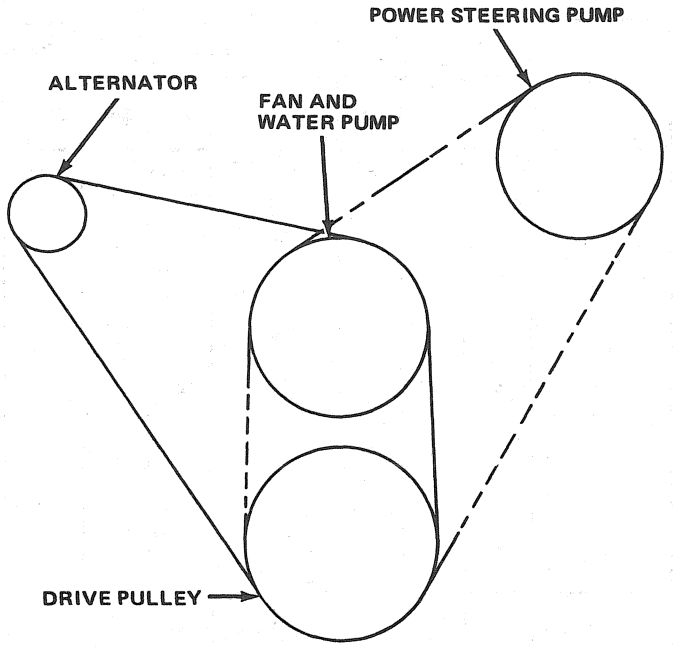
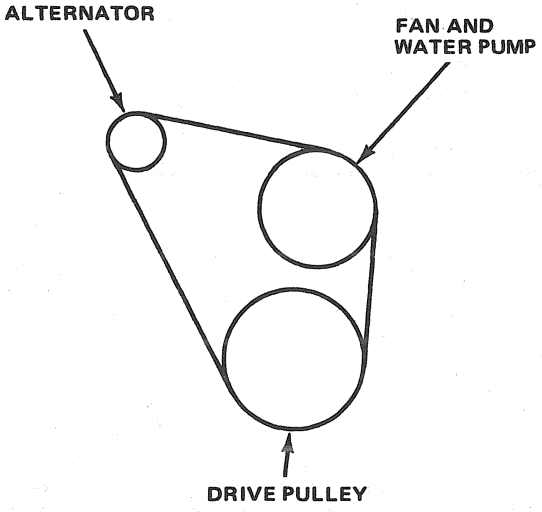


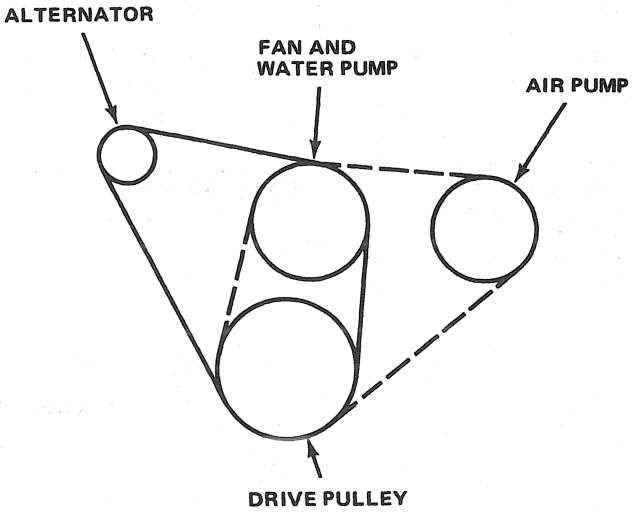
FOUR-CYLINDER ENGINE WITH
ALTERNATOR AND POWER STEERING

70708B



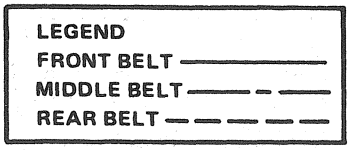
SIX-CYLINDER ENGINE
BASIC BELT ARRANGEMENT

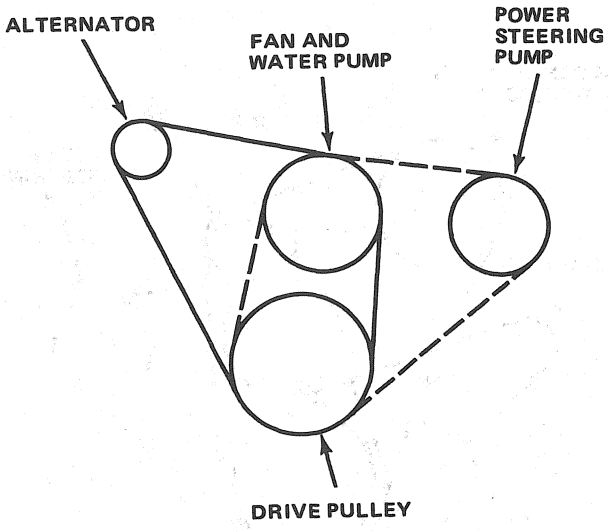
80415A



SIX-CYLINDER ENGINE WITH
ALTERNATOR AND AIR PUMP

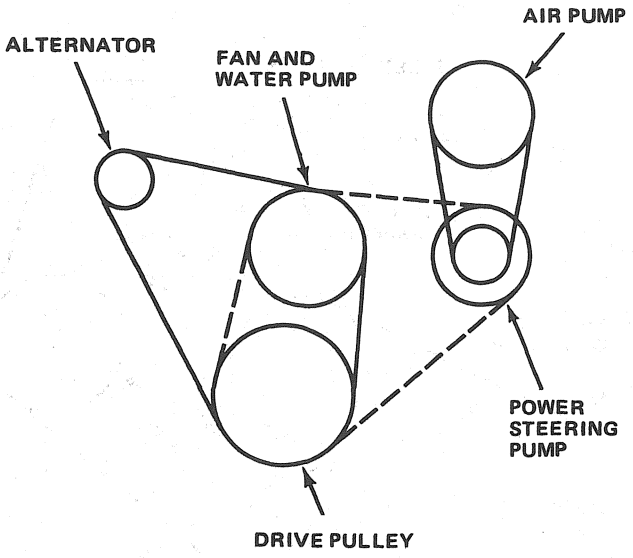
80415B





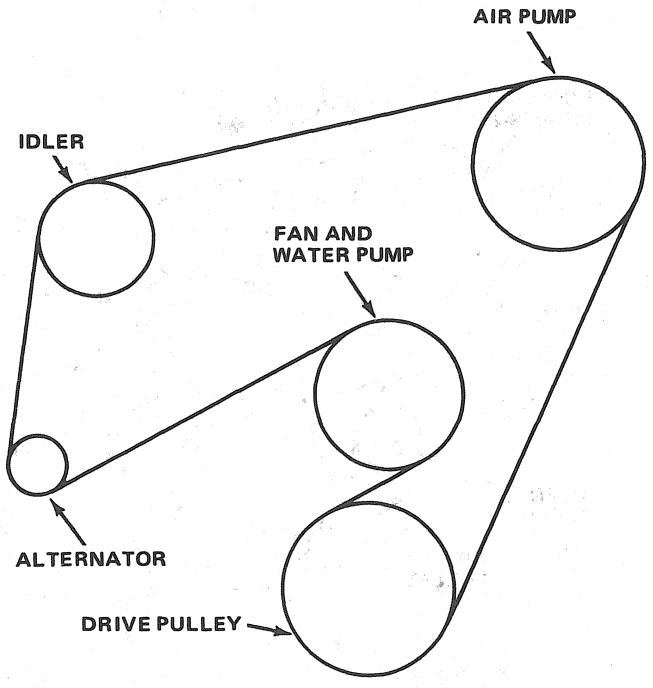
SIX-CYLINDER ENGINE WITH ALTERNATOR AND POWER STEERING

80415C



SIX-CYLINDER ENGINE WITH ALTERNATOR POWER STEERING AND AIR PUMP

80415D



SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR AND AIR PUMP

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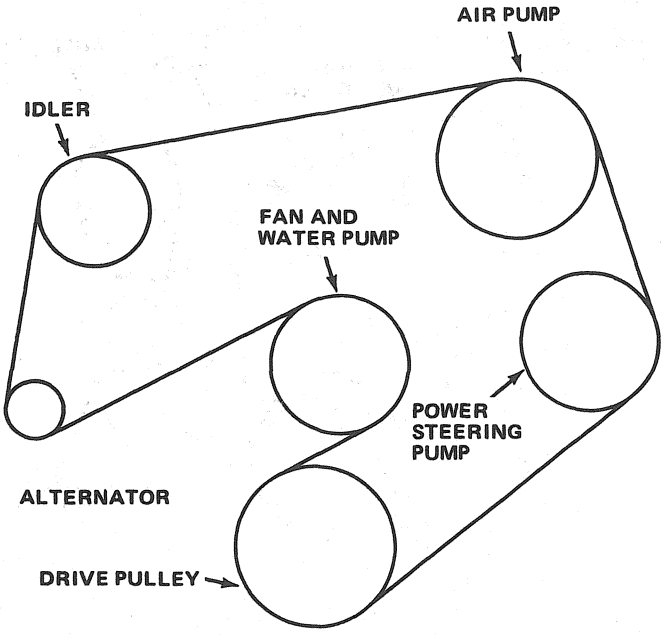

SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR, POWER STEERING AND AIR PUMP

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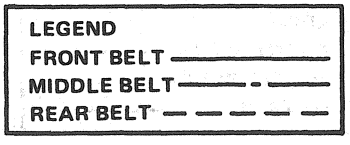
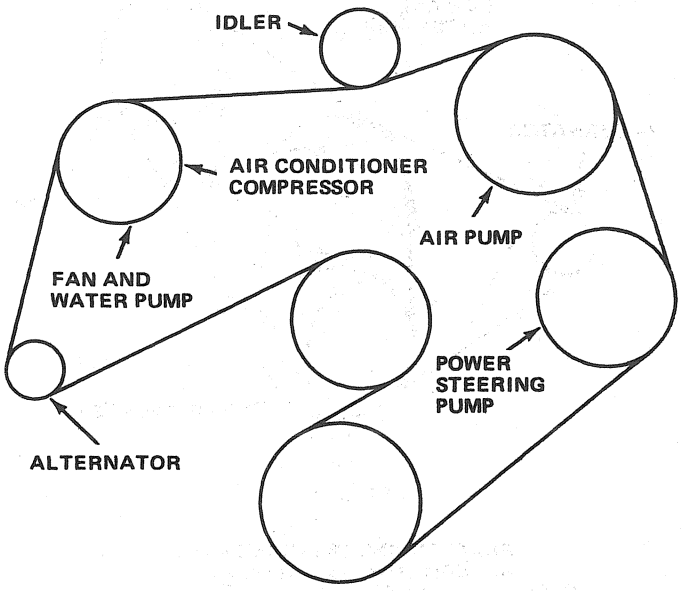
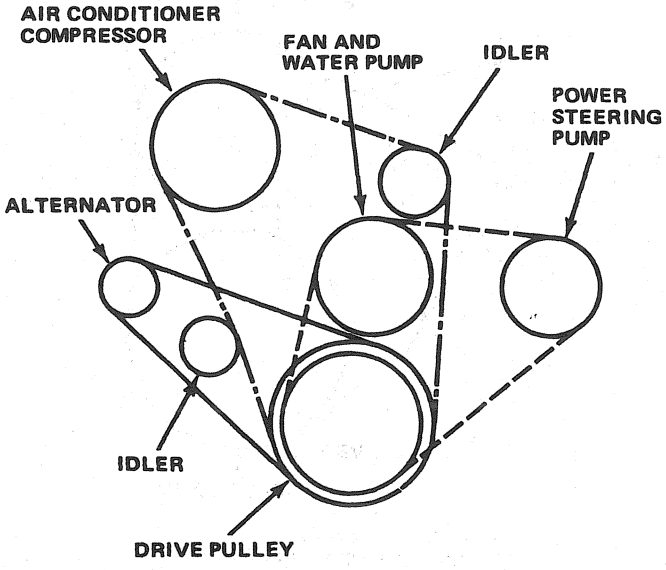




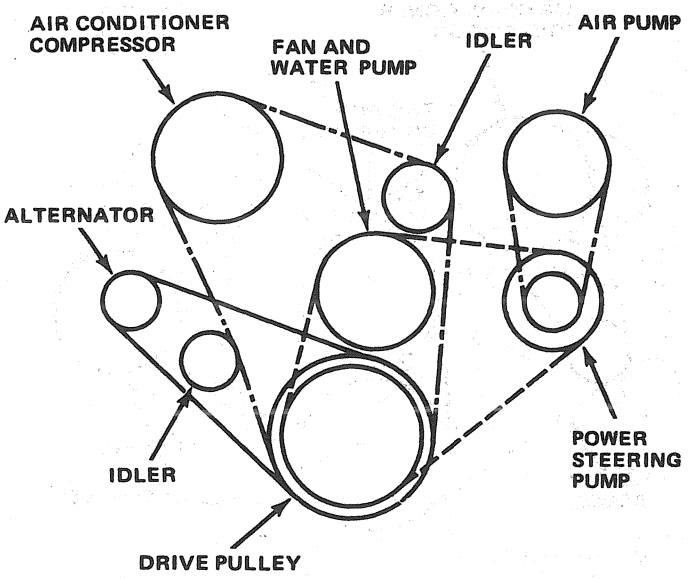
SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR, AIR CONDITIONING, POWER STEERING AND AIR PUMP

80415M



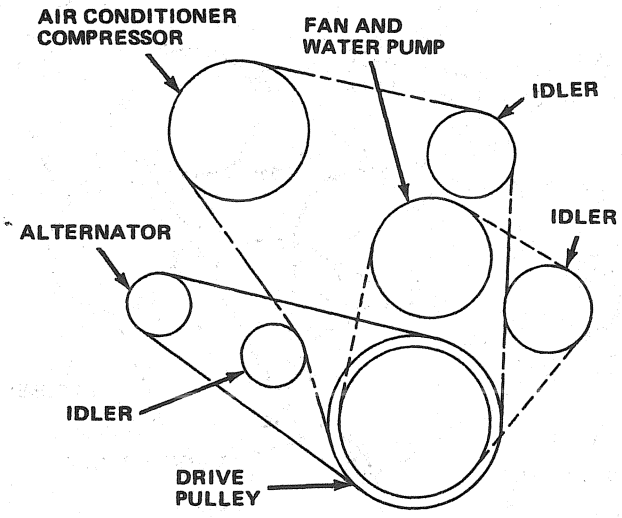
SIX-CYLINDER ENGINE WITH ALTERNATOR, AIR CONDITIONING AND POWER STEERING

90977A



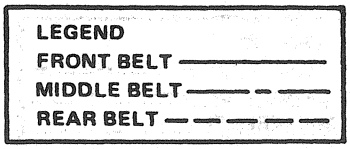
SIX-CYLINDER ENGINE WITH ALTERNATOR, POWER STEERING, AIR PUMP AND AIR CONDITIONING

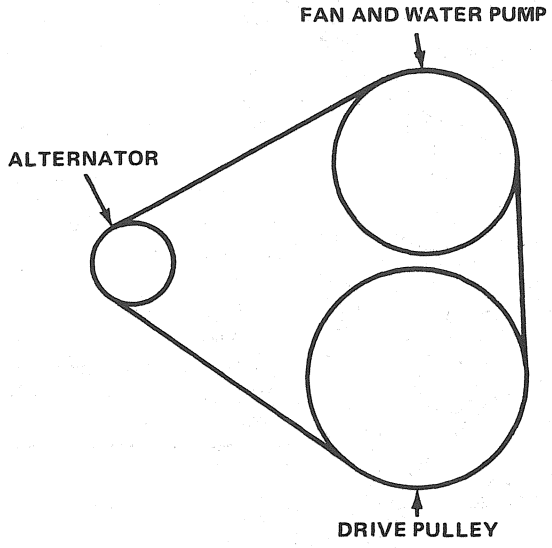
90977B



SIX-CYLINDER ENGINE WITH ALTERNATOR AND AIR CONDITIONER

90977C

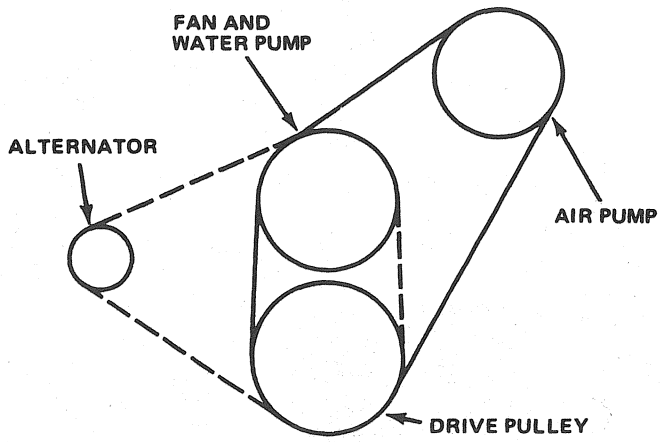




EIGHT-CYLINDER ENGINE
BASIC BELT ARRARNGEMENT

NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELTS

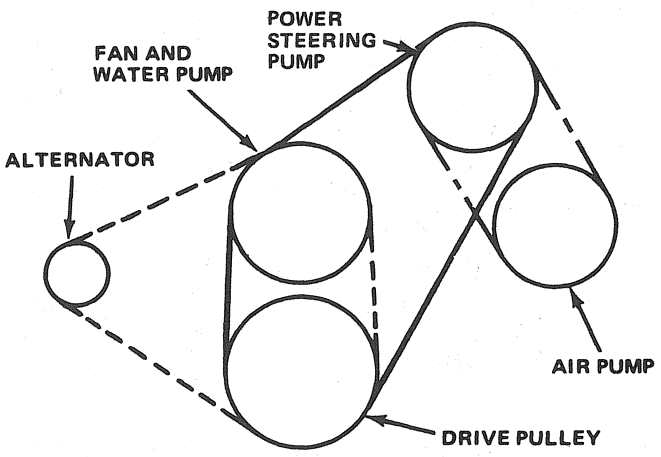
90977D



EIGHT-CYLINDER ENGINE WITH
ALTERNATOR AND AIR PUMP

NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELT

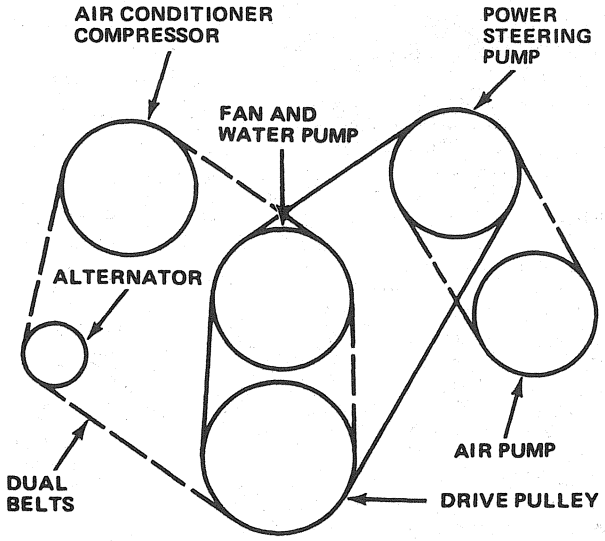
90977E



EIGHT-CYLINDER ENGINE WITH ALTERNATOR,
AIR PUMP AND POWER STEERING

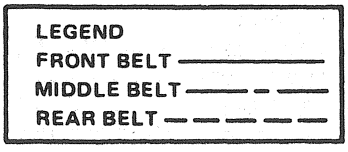
NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELTS

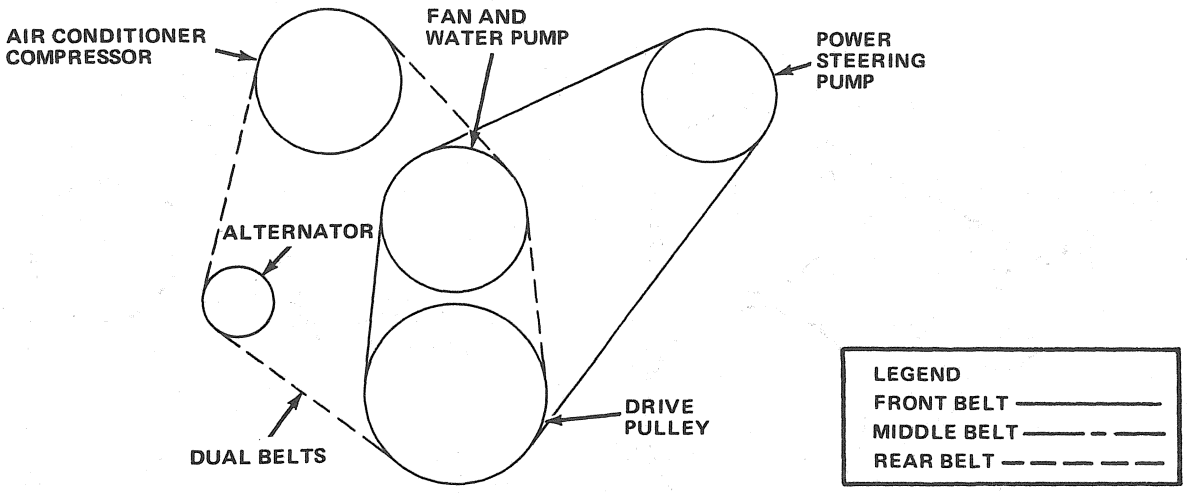
90977F



EIGHT-CYLINDER ENGINE WITH ALTERNATOR,
AIR PUMP, AIR CONDITIONING, AND POWER STEERING

90977G





EIGHT-CYLINDER ENGINE WITH ALTERNATOR, AIR CONDITIONING AND POWER STEERING

90977H

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.

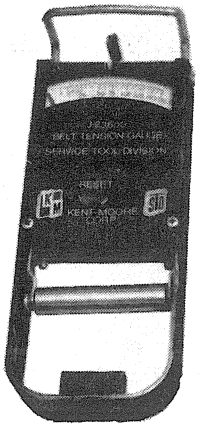
	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Accessory Drive Pulley Screws (Six-Cylinder)	18	12-25	24	16-34
Air Conditioning Idler Pulley Bracket to Timing Case Cover Nut	7	4-9	10	5-12
Air Pump-to-Bracket Screws	20	15-22	27	20-30
Air Pump Bracket-to-Engine Screws	25	18-28	34	24-38
Air Pump Adjusting Strap to Pump	20	15-22	27	20-30
Alternator Adjusting Bolt (Six- and Eight-Cylinder)	18	15-20	24	20-27
Alternator Adjusting Bolt (Four-Cylinder)	20	15-25	27	20-34
Alternator Mounting Bracket-to-Engine Bolt	28	23-30	38	31-41
Alternator Pivot Bolt or Nut	28	20-35	38	27-48
Alternator Pivot Mounting Bolt to Head	33	30-35	45	41-48
A/T Fluid Cooler Line Flared Fitting Nuts	25	15-30	34	20-41
A/T Fluid Cooler Line Radiator Fitting	15	10-30	20	14-41
Crankshaft Pulley to Damper Screw	23	18-28	31	24-38
Engine Block Heater Nut — Compression Type	10	8-13	14	11-18
Engine Block Heater Nut — T-Bolt Type	20 in-lbs	17-25 in-lbs	2	2-3
Fan Blades and Pulley to Hub Screw	18	12-25	24	16-34
Idler Pulley Bearing Shaft to Bracket Nut	33	28-38	45	38-52
Idler Pulley Bracket to Front Cover Nut	7	4-9	10	5-12
Power Steering Pump-to-Bracket (Four-Cylinder)	28	24-32	38	32-44
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-48
Power Steering Pump Pressure Line Nut	30	30-45	41	41-61
Power Steering Pump Pulley Nut	58	40-69	79	54-94
Thermostat Housing (Six- and Eight-Cylinder)	13	10-18	18	14-24
Thermostat Housing (Four-Cylinder)	20	17-23	27	24-30
Timing Case Cover to Block (Eight-Cylinder) (through Water Pump)	25	18-33	34	24-45
Water Pump-to-Block Screws (Six-Cylinder)	13	9-18	18	12-24
Water Pump to Block (Four- and Eight-Cylinder)	25	18-33	34	24-45
Water Pump-to-Timing Case Cover Screen (Eight Cylinder)	48 in-lbs	40-55 in-lbs	5	5-6

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

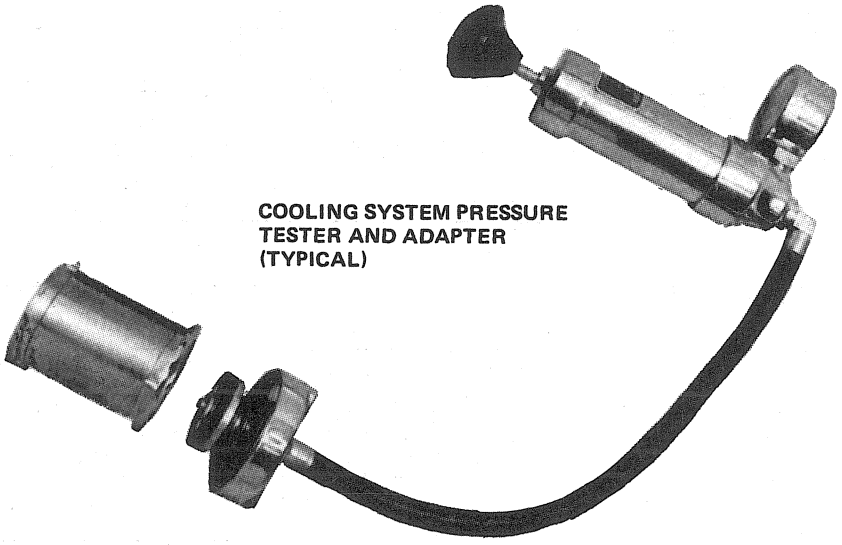
Refer to Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

60250

Tools



J-23600
BELT TENSION GAUGE



COOLING SYSTEM PRESSURE
TESTER AND ADAPTER
(TYPICAL)

AJ42005