SECTION 6B1

COOLING SYSTEM

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

COOLING SYSTEM

DESCRIPTION

The cooling system is a sealed-pressure type. This system maintains a slight pressure when the engine is running at a normal operating temperature. The pressurized system increases the water pump efficiency, reduces the possibility of cavitation at high engine coolant temperatures or with altitude, and prevents afterboil.

The cooling system is made up of the following components:

1. The radiator which is fit with a shroud to assist the fan in directing airflow through the radiator.
2. A radiator filler cap which maintains a specific pressure within the cooling system.
3. A water pump which circulates the coolant through the engine and cooling system.
4. A fan system to move air across the radiator fins to dissipate engine coolant heat.

ENGINE COOLANT RECOMMENDATIONS

CAUTION: Under some conditions, the ethylene glycol in engine coolant is combustible. To help avoid being burned when adding coolant, do not spill it on the exhaust system or engine parts that may be hot.

Engine coolant solutions must meet the following basic requirements:

1. Provide for adequate heat transfer.
2. Provide a corrosion-resistant environment within the cooling system.
3. Prevent formation of scale or sludge deposits in the cooling system.
4. Be compatible with cooling system hose and seal materials.
5. Provide adequate freeze protection during cold weather operation.

A water and ethylene glycol-base antifreeze engine coolant is recommended for year-round use to meet these requirements.

Water

Any water, whether of drinking quality or not, will produce a corrosive environment in the cooling system. Also, scale deposits may form on the internal surfaces of the cooling system due to the mineral content of the water. Therefore, water selected for coolant mixture, or as a coolant, must meet or be properly treated with conditioners to meet the following requirements:

Water Contaminates	Specification (Maximum Parts Per Million)
Total Solids	350
Total Hardness	150
pH	6.9–9.0
Calcium and Magnesium (Combined)	100
Chlorides	50
Sulfates	100
Bicarbonates	150

Antifreeze

The factory-fill engine coolant solution contains a year-round ethylene glycol-base antifreeze. The engine coolant solution is formulated to withstand two full years of normal operation, provided the recommended engine coolant was used when adding engine coolant or when d raining and filling.

The original factory-fill engine coolant provides freeze protection to –36°C (–33°F) or in Canada to –40°C (–40°F), an inhibitor system which provides corrosion protection, pH control and water softening. No additional inhibitors are required on initial fill with a engine coolant solution meeting the above specifications.

Antifreeze concentration mixtures below 30 percent by volume do not provide sufficient corrosion protection, and mixtures greater than 67 percent affect freeze protection and heat transfer capability (figure 1).

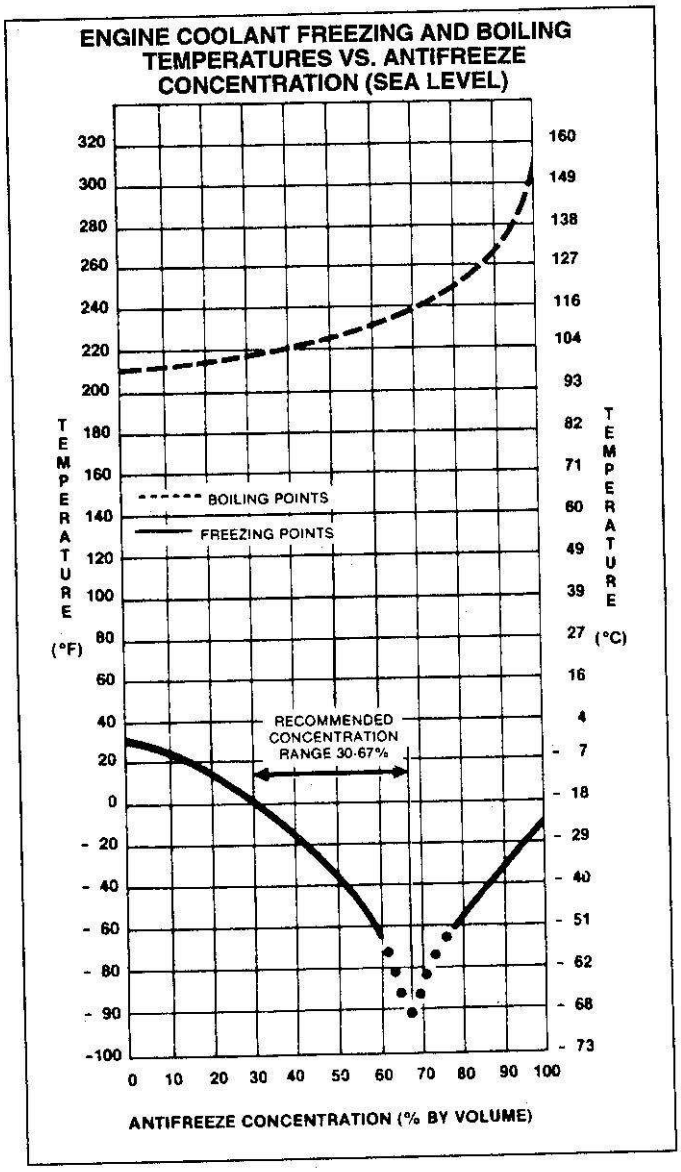


Figure 1. Antifreeze Concentration Graph

CORROSION PREVENTION

Every two years, the cooling system should be serviced as described under "Draining and Filling" later in this section.

1 Remove the radiator cap when the engine is cool.
2. Run the engine, with the cap removed, until the engine is at operating temperature.
3. Drain the engine coolant, when hot, through the radiator drain valve and the engine block drains.

4. Close the valve and drains and add enough plain water to fill the system.
5. Run the engine until normal operating temperature is reached.
6. Drain and refill the system, as described in steps 1 through 5, a sufficient number of times until the drained liquid is clear.
7. Allow the system to drain completely and then close the radiator drain valve. Be sure to tighten the engine block drains.
8. Add the necessary amount of inhibitor and ethyleneglycol-base engine coolant to provide the required freezing and corrosion protection to at least –18°C (0°F).
9. Run the engine until normal operating temperature is reached.
10. Check the level of engine coolant and add engine coolant if necessary.
11. Install the radiator cap.

Important

- Alcohol or methanol-base coolant or plain water are not recommended.

Use of water containing lime alkali, and other impurities is a major cause of rust and scale formation in the cooling system. Air or exhaust gas leaking into the system can also be the cause of rust and corrosion. A rust preventive inhibitor, or water filter should be used continuously.

Drain and flush the cooling system every 24 months and add new antifreeze solution.

Inhibitors

Inhibitors are not cleaners and will not remove scale and rust already formed. Cooling System Inhibitor or equivalent, will retard rust scale formation and is compatible with aluminum components.

The inhibitors in antifreeze should be replenished at about 500 hours or 20,000 miles/32,000 km intervals or by test with a non-chromate inhibitor system.

Commercially available inhibitor systems may be used to renew the inhibiting properties of antifreeze solutions. A non-chromate type inhibitor is required with ethylene glycol antifreeze engine coolant systems.

It is important not to use too much inhibitor or use two different types at the same time. Use the inhibitor only as instructed on the label.

Original equipment water filters contain an inhibitor change which replenishes the engine coolant inhibitor at regular filter service intervals.

Sealer

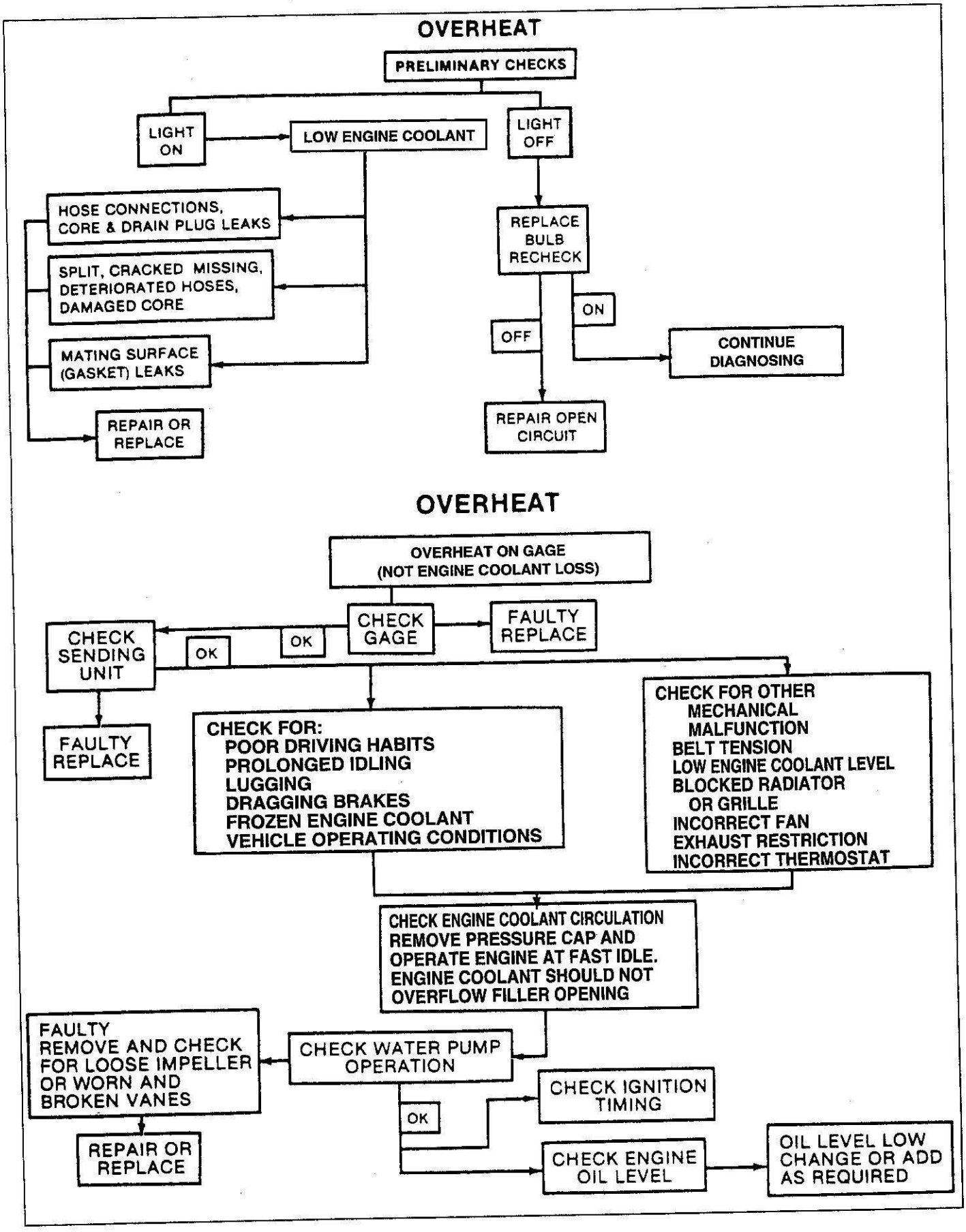
If a sealer is used, follow the manufacturer's instructions. After using the sealer, replace the water filter as the sealer will restrict the engine coolant flow through the filter element.

DIAGNOSIS OF COOLING SYSTEM

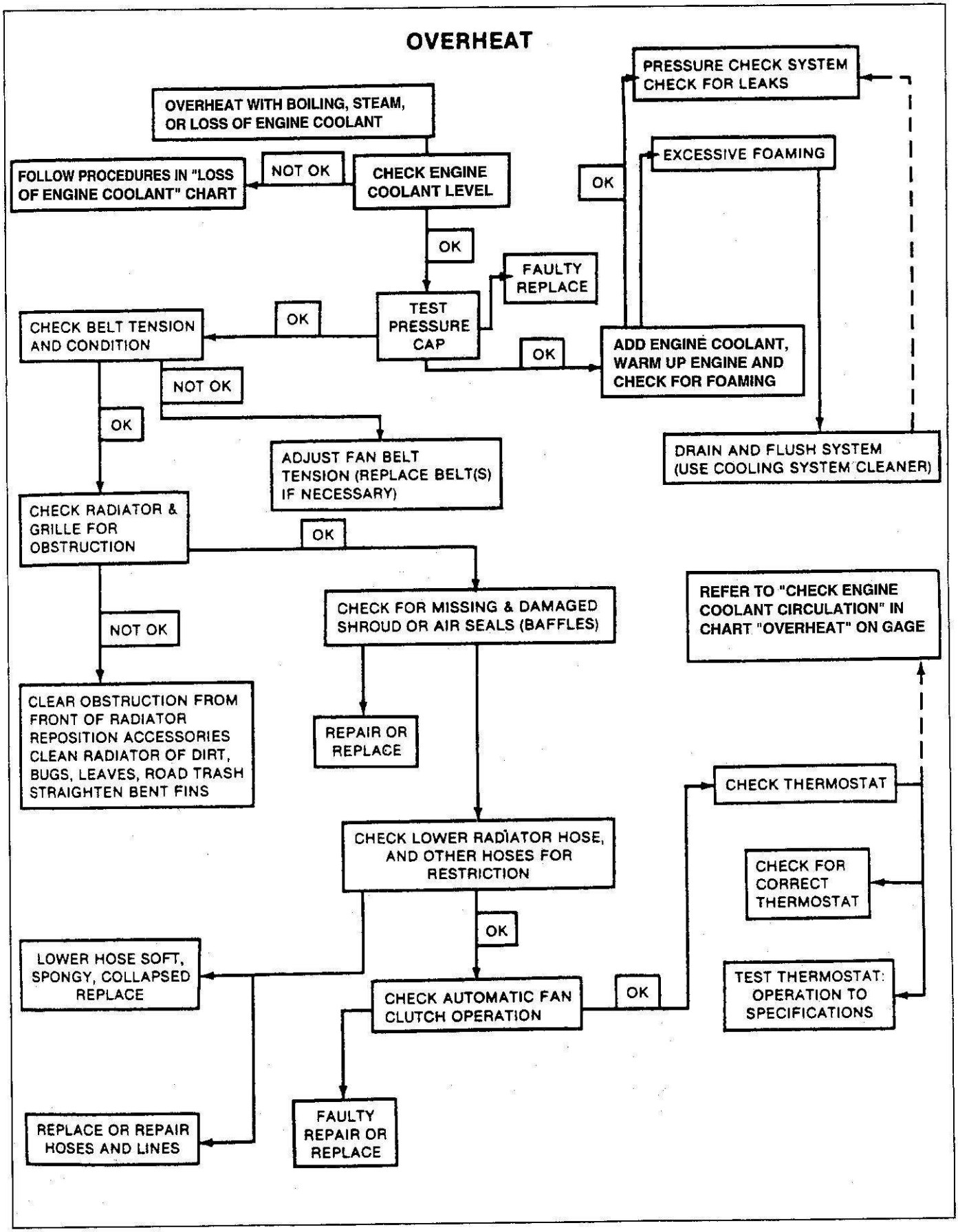
Trouble diagnosis is a process of elimination to find the cause of complaint. Diagnosis charts are a guide to use with the following procedure suggested:

1. Preliminary checks.
2. Visual checks.
3. Mechanical checks.
4. Repair.

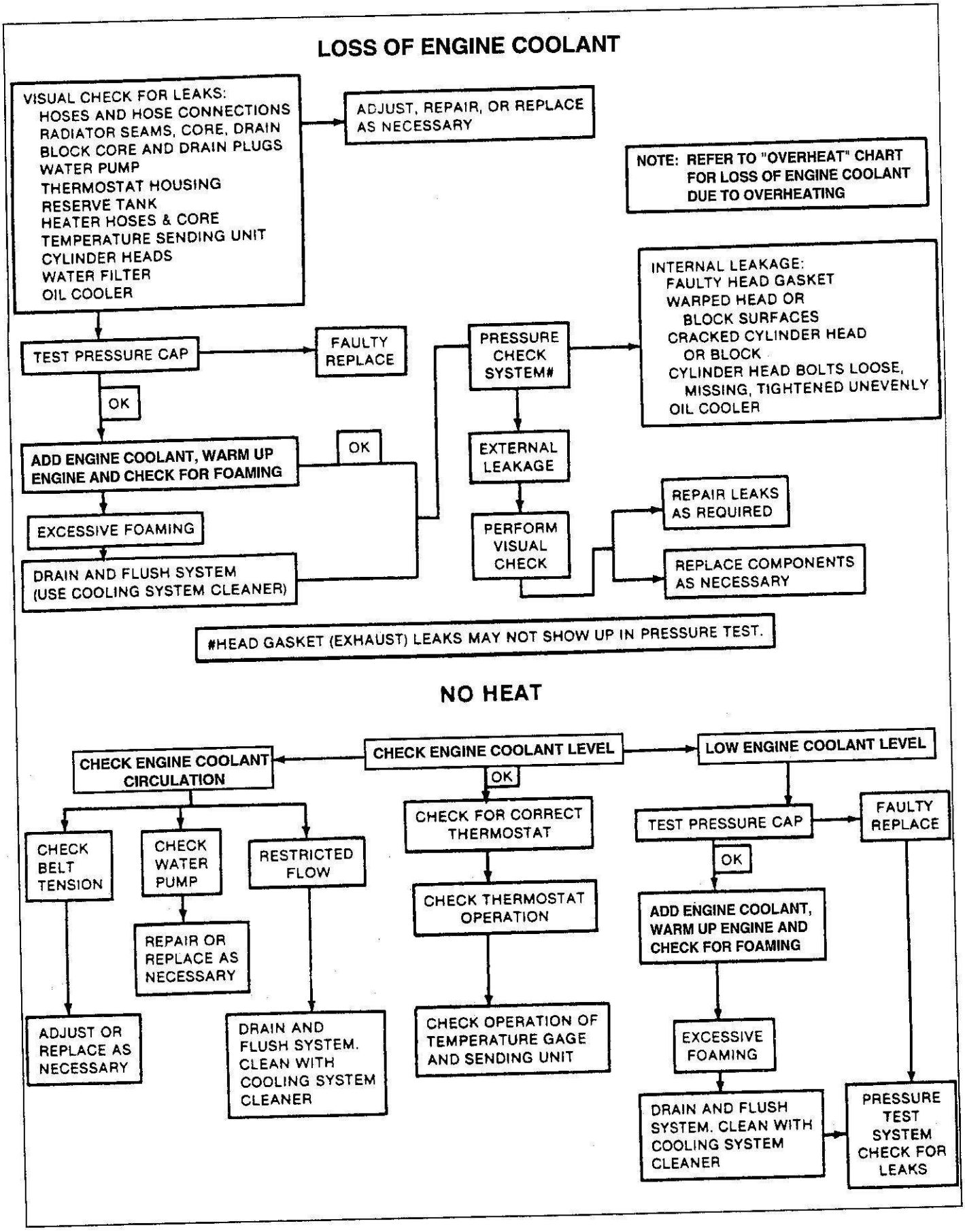
DIAGNOSIS OF COOLING SYSTEM (CONT.)



DIAGNOSIS OF COOLING SYSTEM (CONT.)



DIAGNOSIS OF COOLING SYSTEM (CONT.)



OPERATIONS AND MAINTENANCE

COOLING SYSTEM CHECKS

The procedure for checking the cooling system is outlined as follows. As with all service recommendations, these suggestions should be adjusted to each engine's requirements and vehicle usage.

Drain and Fill The System

Always drain the system coolant when the engine is warm. Running the engine prior to draining will help keep fine particles from settling in the block. Refer to "Draining and Filling the Cooling System" later in this section.

Engine Coolant Check

While draining the engine, check the color and "feel" of the engine coolant. If it shows an unusual amount of oil sediment or feels slippery, engine oil may be leaking into the cooling system. A coating of lube oil on the inside of the engine coolant passages cuts down the system's efficiency. An overheated engine often results. Also, a leak in the cooling system may cause engine coolant to flow into the lube oil passages. The contaminated lubricant can seriously damage the engine.

If engine oil is found in the engine coolant, check the oil cooler core for cracks. Should a pressure check of the core show no leakage, replace the head-to-block gaskets, engine coolant, and oil seals. If this does not solve the problem, the cause may be damaged cylinder head or block.

System Pressure Check

A pressure check of the radiator and engine coolant system will show if the system is able to hold pressure.

A pressure check will also show the cooling efficiency. Refer to "Cooling System Pressure Checks" later in this section.

Thermostat Check

If the engine operating temperature changes from the normal range, remove the thermostat and check it. A thermostat which stays closed or only partially open restricts the flow of engine coolant. This can cause an engine to overheat. Serious damage to engine components may result. A thermostat which is stuck in the wide-open position does not allow the engine to reach its normal operating temperature. The incomplete combustion which results from the cold engine operation aids in the buildup of excess carbon deposits on the pistons, rings, and valves. Replace any thermostat found to be damaged or not working properly. Refer to "Engine Thermostat" later in this section.

Hoses and Brackets Check

Check the condition of hoses and clamps. Hoses should be pliable but show no signs of "ballooning." Look for cracks, cuts, and kinks—areas of possible leaks. If the lower radiator hose shows signs of collapsing when the engine is accelerated, this is a sign of weakness and the hose should be replaced. Replace any hoses which feel unusually hard or spongy.

Inspect the hose brackets, supports, ties, and clamps to be sure they are secure, unbroken, and retaining the hoses properly. Retighten the brackets and clamps as needed. Replace any components which are found to be split or badly corroded, broken, or deteriorated.

Drive Belts Check

For efficient warm weather operation, check the condition of the fan and water pump drive belts. Look for worn or frayed areas and for cracking and splitting on the underside of the belts. Worn belts can break at any time and should be replaced.

Check the tension on serviceable belts and adjust as needed. Avoid over or undertightening fan and pulley belts. Remember, overtightening can lead to early belt and bearing damage. Undertightening results in slippage which can lead to belt and pulley "glazing," inefficient fan and water pump operation, and engine overheating. When replacing the belts, don't guess at the tension required. Use Belt Tension Gage J-23600-B and adjust to the correct tension. Refer to "Belt Tension Adjustment" in FAN (SEC. 6B3) in this manual.

COOLING SYSTEM PRESSURE CHECK

Several types of cooling system pressure checking devices are available locally and manufacturer's instructions should be followed for proper use. One type of tester is J-24460-01.

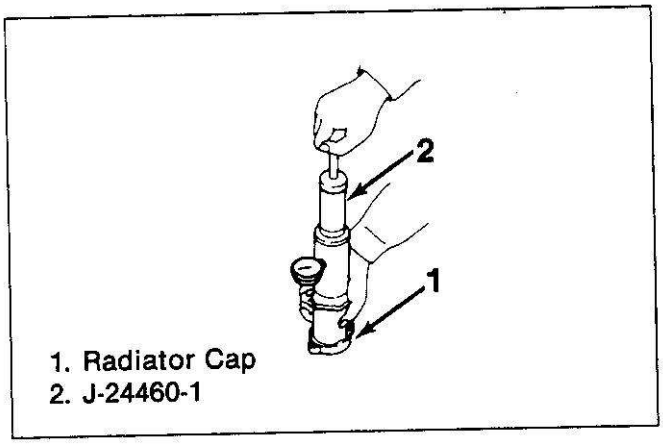
Testing Radiator Cap

(Figure 2)

CAUTION: To avoid the danger of being burned, the radiator cap should not be removed while the engine is at normal operating temperature. The cooling system will blow out scalding fluid and steam under pressure if the cap is removed while

the engine is hot. If it is necessary to remove the cap while the engine is hot, first relieve the pressure in the system by turning the radiator cap counterclockwise to the first stop, using caution not to scald hands (do not press down while rotating). Wait until the pressure has been relieved as indicated by a hissing sound. Push down on the cap and turn counterclockwise to remove the cap.

1. With the radiator filler cap removed, wet the cap gasket with water and wash off any sediment from the sealing surface. Install the cap on the tester.
2. Pump up pressure by operating the pump plunger handle. When the pressure stamped on the cap is reached, watch the tester dial and note the rate of decrease in pressure.
3. The indicator hand on the gage dial should remain within the corresponding pressure segment of the scale for about 10 seconds. If the pressure cap does not meet this requirement, it should be replaced with a new cap.



1. Radiator Cap
2. J-24460-1

Figure 2. Testing Radiator Cap

Testing the Cooling System

1. Tighten all the radiator and heater hose clamps. Also, check other connections for leaks at the air compressor engine coolant lines and reserve tank.
2. Fill the cooling system to level of the filler cap seat.
3. Attach the tester to the filler neck, following the instructions supplied with the tester.
4. Build pressure up to 138 kPa(20 psi) (maximum).
5. The cooling system should hold the 138 kPa (20 psi) pressure for about two minutes. If a measurable amount of pressure drops in less than two minutes, a leak in the system is indicated.

Remove the radiator cap and look for plugging and scale on the inside of the radiator tank. A badly plugged radiator may have to be replaced. Test the radiator and system as directed previously in this section.

Pressure Cap Check

Though only a small item on the engine, this cap is essential to the efficient operation of the cooling system. The pressure cap is a type of valve which regulates the pressure of the engine engine coolant and permits a somewhat higher engine operating temperature. The cap seals the radiator until the pressure in the cooling system exceeds the valve setting. It then opens to allow excess pressur e to escape, which might rupture a radiator, heat exchanger, or oil cooler core. In addition, the cap opens to eliminate any vacuum that might form when the system cools. This prevents the collapse of hoses and other engine parts that are not internally supported.

To ensure the safe, efficient operation of the cooling system, check the radiator cap for proper opening and closing pressures. Replace any cap found to be defective. Test the radiator cap as directed previously in this section.

RADIATOR MAINTENANCE

Check the Radiator

Radiators need special attention to prevent leakage and airflow restriction. Check the outside of the radiator for bent fins, or signs of leakage. Leaking radiator cores should be repaired immediately and not just sealed temporarily with a sealer-type antifreeze or engine coolant additive. Remove any stones between fins. Clean loose debris and road film from the radiator core with a quality grease solvent and compressed air.

To be sure of a thorough cleaning, remove the fan guard, and fan shroud before beginning.

Radiator Internal Deposits

A radiator that has a dirty, obstructed core or is leaking will cause the engine to overheat. A scale deposit inside the radiator is a result of using hard, high mineral content water in the cooling system.

The effect of heat on the mineral in the water causes the formation of scale, or hard coating, on metal surfaces within the radiator, thereby reducing the transfer of heat. Some hard water, instead of forming scale, will produce a silt-like deposit which restricts the flow of water.

Cleaning compounds are commercially available and should be purchased from a reliable source. Most compounds attack metals and should not remain in the engine for more than a few minutes. A

neutralizer should be used in the cooling system immediately after de-scaling solvent is used.

For extremely hard, stubborn coatings, such as lime scale, it may be necessary to use a stronger solution, or remove the radiator and have it cleaned at a radiator repair shop. The corrosive action of a stronger solution will affect the thin metal tubes of the radiator, thereby reducing its operating life. A complete flushing and rinsing is required and must be done with skill and accuracy.

After the solvent and neutralizer have been used and the cooling system is flushed, completely drain the entire system again and fill it with engine coolant. Refer to "Engine Coolant Recommendations" earlier in this section. After filling the cooling system, inspect the radiator, hoses, and other system components for leaks.

DRAINING AND FILLING THE COOLING SYSTEM

Draining

CAUTION: To avoid the danger of being burned, the radiator cap should not be removed while the engine is at normal operating temperature. The cooling system will blow out scalding fluid and steam under pressure if the cap is removed while the engine and radiator are still hot. If it is necessary to remove the cap while the engine is hot, first relieve the pressure in the system by turning the radiator cap counterclockwise to the first stop, using caution not to scald hands (do not press down while rotating). Wait until the pressure has been relieved as indicated by a hissing sound. Push down on the cap and turn counterclockwise to remove the cap.

1. Remove the radiator filler cap.
2. Open the drain cock at the bottom of the radiator core.
3. Open the cylinder block and accessory drain cocks and plugs.

Filling

NOTICE: Do not pour cold water in the radiator while the engine is hot. Wait until the boiling ceases, then add water slowly while the engine is idling. Adding cold water causes rapid cooling and possible distortion of engine casting. Install the radiator cap firmly.

1. Fill the radiator with engine coolant solution until it is visible in the neck (or tank) of the radiator.
2. Start the engine and run a few minutes to expel air. Add more liquid if required.
3. On an engine coolant recovery system, fill to the "hot level" of the reserve tank if the engine is thoroughly warmed up.

Important

- Do not overfill the radiator as expansion will cause some engine coolant to be lost out of the overflow. Do not use more than 67 percent antifreeze engine coolant solution as the engine coolant freeze point will begin to rise and the effectiveness of the engine coolant is lowered (figure 1).

CLEANING THE COOLING SYSTEM

Unless the water in the cooling system is treated with a corrosion inhibitor, rust and scale may clog water passages in the radiator and water jackets. This condition is caused in some localities by the formation of insoluble salts from water used.

Cleaning solutions, commercially available, will successfully clean cooling systems of rust, scale, sludge, and grease when used as directed by the manufacturers. However, if the radiator is clogged with insoluble scale formations, reliable radiator service stations in the various localities are best equipped to remove such formations.

Cooling System Cleaner or other commercial cleaning solutions are especially effective in removing rust, scale, and corrosion from the radiator and engine water passages. Use cleaner only as directed on the label.

Clean

1. Drain the system, then close the drain cocks and install the drain plugs.
2. Fill the system with a cleaning solution. Always follow the manufacturer's directions.
3. With the radiator covered and the radiator cap on tight, run the engine 15 to 20 minutes at fast idle speed, then drain the system completely.
4. If a cleaning solution used requires a neutralizer, use as directed by the manufacturer.

FLUSHING THE COOLING SYSTEM

Flushing

Every two years the cooling system should be drained and flushed with plain water, then completely refilled with fresh engine coolant solution. Refer to "Engine Coolant Recommendations" earlier in this section.

1. Remove the radiator cap.
2. Run the engine for about 15 minutes to thoroughly circulate the engine coolant.

3. Drain the system, open the radiator, engine, and accessory drains.
4. Close all drains. Refill the system with clean, soft water. Start the engine and allow the engine coolant to circulate for at least 15 minutes. If the engine is hot, fill it slowly to prevent rapid cooling and possible distortion of engine castings.
5. Repeat Steps 1 through 4 until the drain liquid is no longer badly discolored.
6. Refill the system with a engine coolant solution to provide required freezing and corrosion protection.

Pressure Flushing

NOTICE: Do not use more than 138 kPa (20 psi) air pressure, as excessive pressure will damage the radiator.

Before pressure flushing the system, tighten the cylinder head bolts to prevent possible water leaks into the cylinders and crankcase and remove the thermostat. When pressure flushing, apply air gradually, as the radiator will stand only a limited amount of pressure.

Reverse Flushing

Reverse flushing should be done with hot water under air pressure, forced through the system in the opposite direction of a normal engine coolant flow. This action loosens scale and corrosion deposits and forces them out. Use a flushing gun and follow the directions stated by the manufacturer.

The addition of additives and other available materials which have not been approved by ISUZU are not recommended. Use of these materials may result in unwarranted operating expense.

Air Suction Test

Air may be drawn into the system due to a low liquid level in the radiator, leaky water pump, or a loose hose connection. This action will also cause corrosion.

1. Replace the radiator cap having an integral pressure relief valve with a plain filler cap less the relief valve.
2. If a separate pressure relief valve is used, remove the valve and install the pressure valve opening cover. Be sure the gasket is in good condition.
3. Be sure the radiator cap seal is in good condition and will make an air-tight seal. Check the level of engine coolant in the radiator, allowing ample room for expansion to avoid any overflow loss during the test.
4. Attach a length of rubber tube to the end of the overflow tube that is connected to the engine coolant reservoir tank. This connection must be air-tight.
   Run the engine with the transmission in "neutral" at a safe speed until the engine coolant temperature gage stops rising and remains stationary.
5. Without changing the engine speed, put the end of the rubber tube in a bottle of water, avoiding kinks and sharp bends that might block the flow of air. Watch for bubbles in the bottle of water. Continuous appearance of bubbles indicates that air is being sucked into the cooling system.
6. Correct the condition by tightening the hose clamps and fitting connections. Also, examine all hoses carefully and if cracked, swollen, or deteriorated in any way, replace with a new hose.

Exhaust Gas Leakage Test

Exhaust gas may be blown into the cooling system past the cylinder head gasket or through cracks in the cylinder head and block. This action will also cause corrosion and possible damage to the engine combustion chamber components.

1. Start the test with the engine cold. Remove the drive belt to prevent water pump operation.
2. Partially drain the cooling system until the engine coolant level is at the top of the thermostat well.
3. With the transmission in "neutral," start the engine and accelerate it several times.
4. Watch for air bubbles in the water or smoke at the surface of the engine coolant while accelerating the engine. Also, watch when the engine speed drops back to idle. The appearance of bubbles or a sudden rise of engine coolant indicates exhaust gas leakage into the cooling system. Perform the exhaust gas leakage test quickly before boiling starts, as steam bubbles will give misleading results.
5. If exhaust gas leakage is evident, replace the cylinder head gasket or gaskets, then test again.
   If leaks are still evident, the cylinder head or block may be cracked. Correct the cause of leakage, then install the thermostat. Install and adjust the drive belt. Then fill the cooling system to the proper level.

COLD-WEATHER OPERATION

Although a year-round antifreeze engine coolant is common, water, properly treated with an inhibitor, can be used as a cooling medium in climates where temperatures do not reach below 0°C (32°F).
Refer to "Engine Coolant Recommendations" earlier in this section.

In lower temperatures, antifreeze solutions must be used. Before installing the antifreeze solution, the cooling system should be inspected and serviced for cold-weather operation, as described earlier in "Cleaning the System."

Cylinder head bolts should be checked for tightness and the gasket replaced if necessary, to avoid the possibility of antifreeze solution leaking into the engine, and exhaust gases entering the cooling system. If ethylene glycol antifreeze is to be used in vehicles having a water filter, the water filter must be serviced at regular intervals. After the antifreeze solution has been installed, the entire system should be inspected for leaks.

Important

- It is the owner's responsibility to use the right amount of antifreeze protection for the area in which the vehicle will be operated.

Thawing the Cooling System

If cooling solution in the system becomes frozen solid, place the vehicle in a warm place until the ice is completely thawed out.

NOTICE: Under no circumstances should this engine be run when the cooling system is frozen solid or damage to the engine components will occur.

ON-VEHICLE SERVICE: COOLING SYSTEM COMPONENTS

ENGINE THERMOSTAT

The thermostat consists of a restriction valve controlled by a thermostatic element. The restriction valve starts to open at a predetermined temperature and continues to open as the engine engine coolant temperature increases. To assure proper cooling and engine warm up, it is important that the correct thermostat be used.

Thermostat Replacement

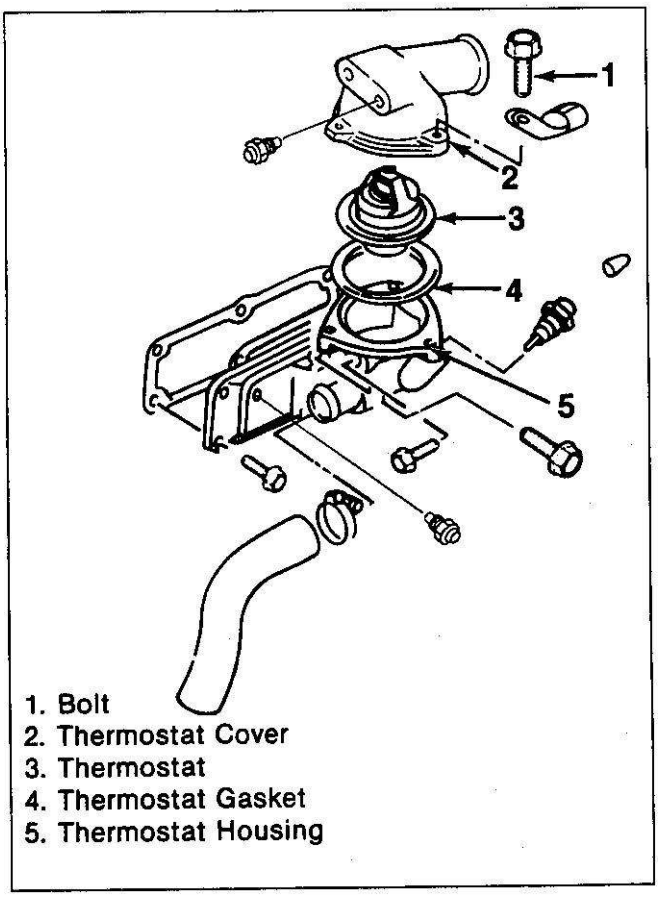
Remove or Disconnect (Figure 3)

1. Partially drain the radiator.
2. Negative battery cable.
3. Wiring harness clips.
4. Upper radiator hose at the thermostat housing (5).
5. Thermostat bolts (1) from the thermostat cover (2).
6. Thermostat (3).
7. Gasket (4).

Inspect

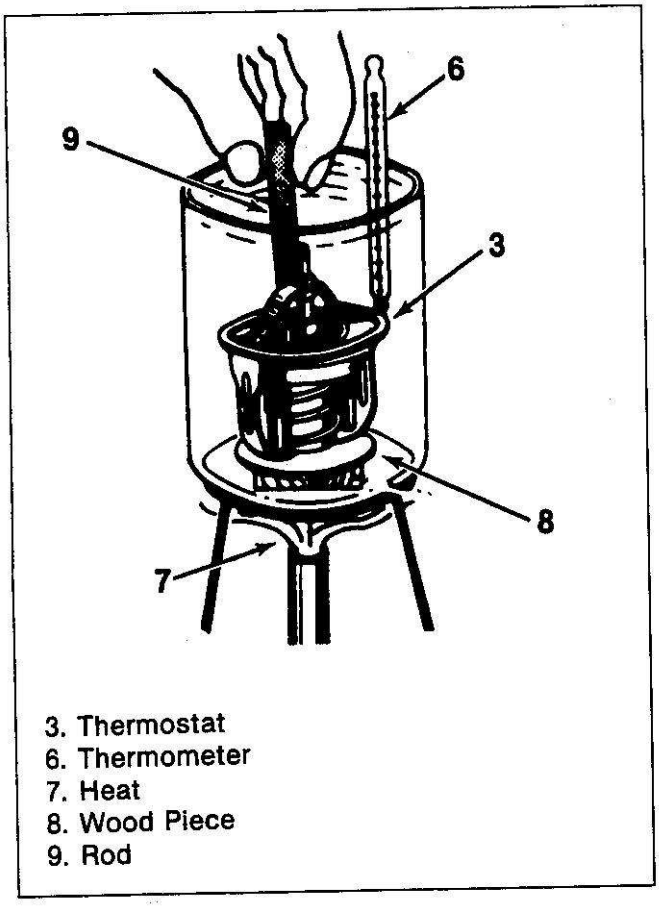
The thermostat to be sure it's in good condition. The following test should be done:
Suspend the thermostat (3) and thermometer (6) in water with the thermometer located close to the thermostat. Be sure the thermostat is placed on the wood piece (8) inside the flask. Agitate the water with a small rod. Apply heat (7) to the water and record both the temperature at which the thermostat begins to open and the temperature at which the thermostat is fully opened (figure 4).

Compare temperature readings taken in the test. The valve opening temperature should be about 82°C (180°F). The full open temperature should be about 94°C (202°F).



1. Bolt
2. Thermostat Cover
3. Thermostat
4. Thermostat Gasket
5. Thermostat Housing

Figure 3. Thermostat Components



3. Thermostat
6. Thermometer
7. Heat
8. Wood Piece
9. Rod

Figure 4. Testing the Thermostat

Important

- Do not attempt to repair the thermostat. If the thermostat does not function properly, replace with a new unit which has been checked as described previously.

Install or Connect (Figure 3)

1. A new thermostat gasket (4).
2. Thermostat (3).
3. Thermostat cover (2).

NOTICE: See "NOTICE" on page 6B1-1 of this section.

4. Bolts (1).

Tighten

- Bolts to 20 N·m (14 lb·ft).

5. Upper radiator hose.
6. Wiring harness clips.
7. Negative battery cable.
8. Fill the cooling system and run the engine. Check for engine coolant leaks at thermostat housing and at cover gasket.

ENGINE OIL COOLER

Oil is circulated through the radiator oil cooler, through the oil filter, and into the engine main oil passage.

If engine difficulties are encountered, or the engine has stopped, foreign material may have entered the oil cooler. The oil cooler, connecting lines, and filter adapter assembly must be flushed before the engine is put back into operation. The oil cooler should be flushed in the following manner.

1. Disconnect oil cooler lines at the oil filter adapter.
2. Back-flush oil cooler and lines using clean solvent and compressed air.

Important

- Do not exceed 690 kPa (100 psi) air pressure.

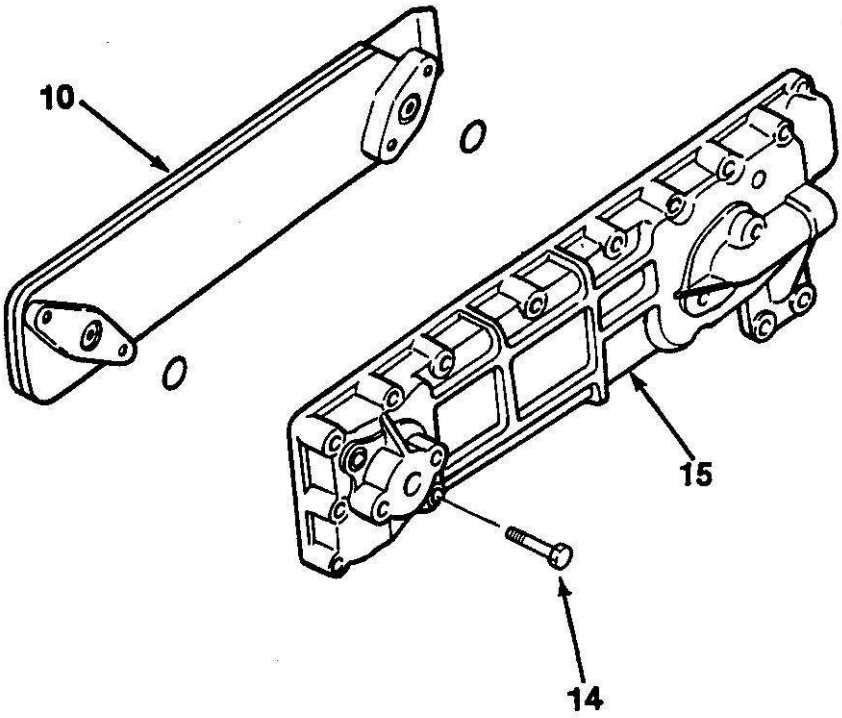
3. Remove all remaining cleaning solvent from the system with compressed air.
4. Flush the system again, this time with engine oil.
5. Remove the filter adapter from the engine and clean the adapter in solvent. Dry with compressed air and flush thoroughly with engine oil.
6. Remove the gasket from the engine block and inspect the seal (0-ring) on the adapter for damage or distortion. Install a new gasket in the engine block cavity and a new seal on the adapter if needed.
7. Install adapter screws and a new oil filter.
8. Test the flow of oil through the cooler before connecting the oil lines. If the flow is not restricted, connect the oil lines to the adapter. If the flow is restricted, replace the radiator.
9. Start the engine and check for leaks.

Oil Cooler Replacement

(Figures 5 and 6)

- Tilt the cab.

1. Disconnect the negative battery cable.
2. Remove the injection pump assembly. Refer to DIESEL FUEL INJECTION (SEC. 6C3) in this manual.
3. Remove the oil cooler mounting bolts (14).
4. Remove the oil cooler element (10) and oil cooler housing (15).
5. Remove the bolt (11).
6. Remove the spring (12).
7. Remove the bypass valve (13).



10. Element
14. Oil Cooler Mounting Bolts
15. Oil Cooler Housing

Figure 5. Oil Cooler Assembly

8. Clean the all parts.

NOTICE: For steps 2, see "NOTICE" on page 6B1-1 of this section.

9. Install the oil cooler element (10) to oil cooler housing (15) using new gaskets.
10. Install the oil cooler mounting bolts (14). Tighten in numerical sequence as shown in figure 6.

Tighten

- Oil cooler mounting bolts to 26 N·m (20 lb·ft).

11. Install the injection pump assembly. Refer to DIESEL FUEL INJECTION (SEC. 6C3) in this manual.
12. Connect the negative battery cable.
    - Time the engine as described in DIESEL FUEL INJECTION (SEC. 6C3) of this manual.

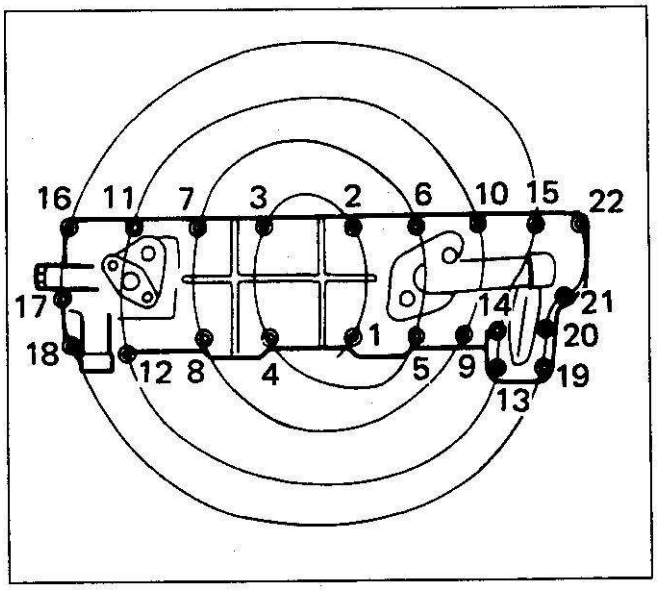


Figure 6. Oil Cooler Mounting Bolts Tightening Sequence

WATER PUMP REPLACEMENT

Remove or Disconnect (Figure 7)

- Tilt the cab.

1. Negative battery cable.
2. Generator adjusting bolt.
3. Fan belts (21).
4. Heater hoses.
5. Nuts (18) and bolts (23).
6. Cooling fan (17) and fan clutch (16).
7. Spacer fixing bolts (20).
8. Spacer (22) and fan pulley.
9. Water pump fixing bolts.
10. Water pump.

Install or Connect (Figure 7)

NOTICE: For steps 2, 4 and 6 see "NOTICE" on page 6B1-1 of this section.

1. Water pump.
2. Pump bolts.

Tighten

- Water pump bolts to 26 N·m (20 lb·ft).

3. Fan pulley and spacer (22).

Tighten

- Bolts (20) to 19 N·m (14 lb·ft).

4. Fan clutch (16) and cooling fan (17).

Tighten

- Bolts (23) and nuts (18) to 19 N·m (14 lb·ft).

5. Heater hoses.
6. Fan belts (21).
7. Alternator adjusting bolt.
   - Refer to "Drive Belts" in FAN (SEC. 6B3) in this manual for adjustment procedure.
8. Negative battery cable.
9. Replace any lost engine coolant.

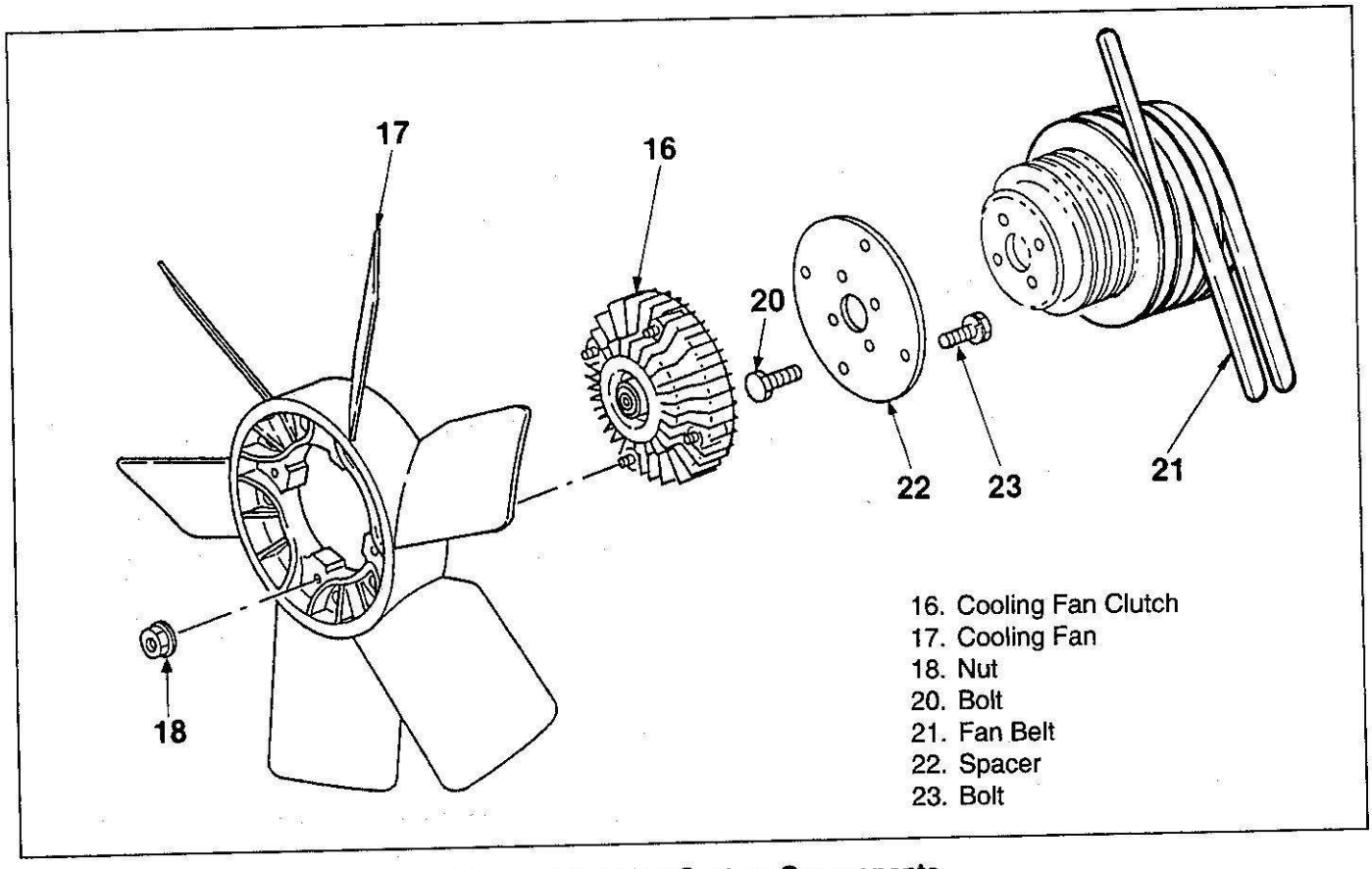


Figure 7. Cooling System Components

WATER PUMP UNIT REPAIR

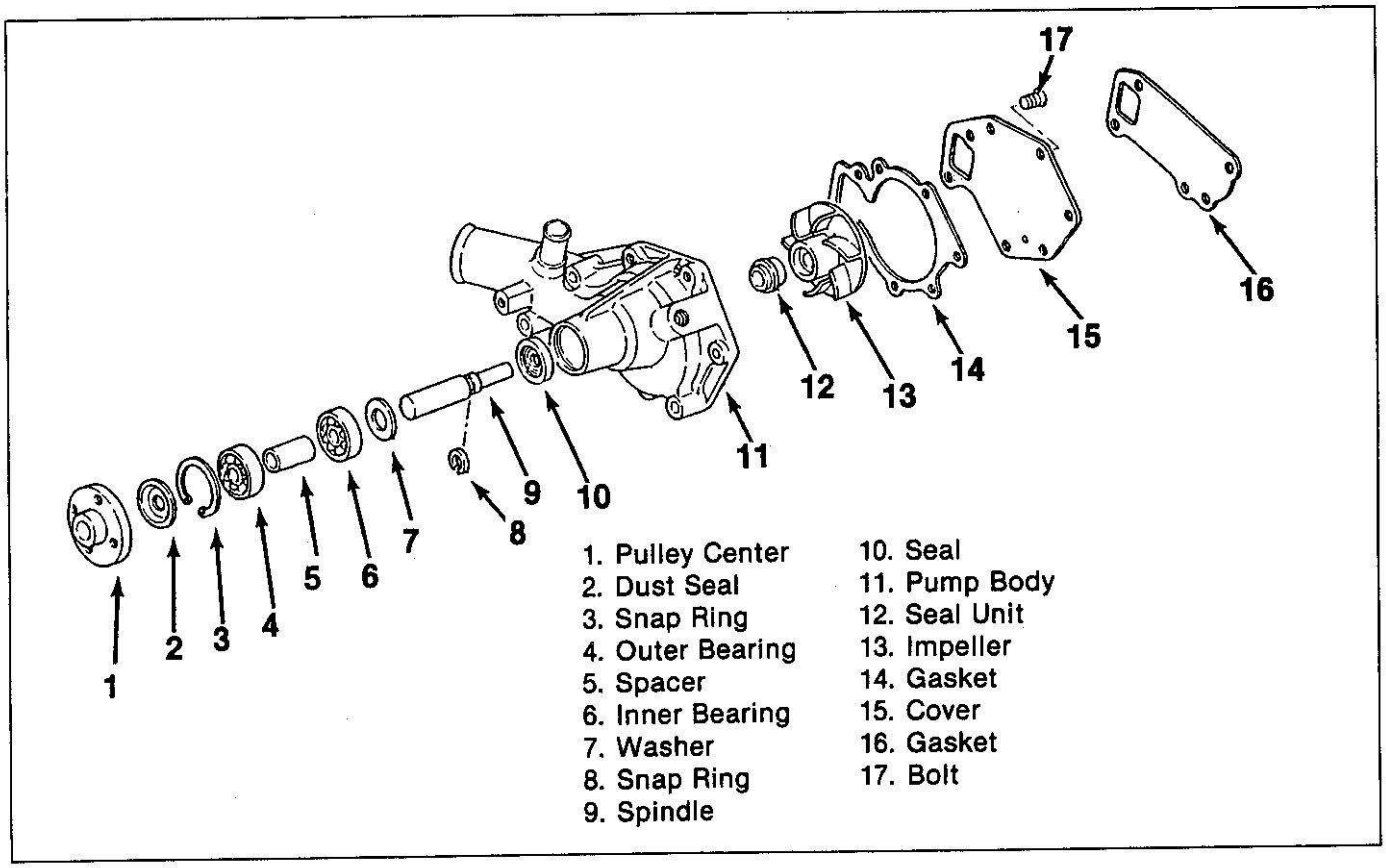


Figure 8. Water pump Components

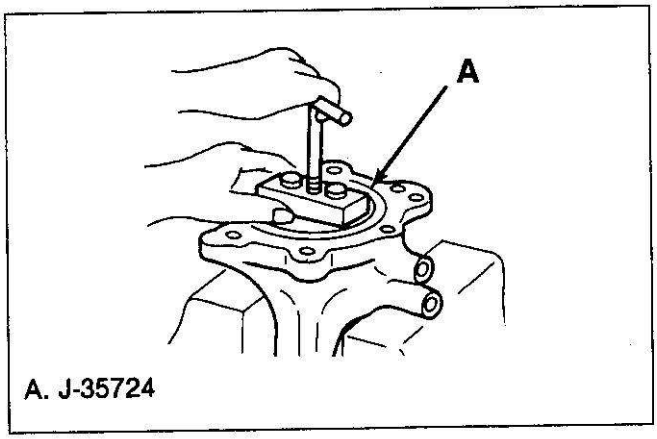


Figure 9. Removing Impeller

Disassemble (Figures 8-11)

1. Cover and gasket (16, 15, 14).
2. Impeller (13) using a J-35724 (figure 9).
3. Pulley center (1) using a bench press and a suitable rod (figure 10).
4. Dust seal (2).
5. Snap ring (3) using snap ring pliers (figure 11).
6. Spindle, bearings and spacer (4, 5, 6, 9) using a bench press and suitable remover (figure 12).
7. Seal unit, washer and seal (7, 10, 12) using a suitable remover (figure 13).

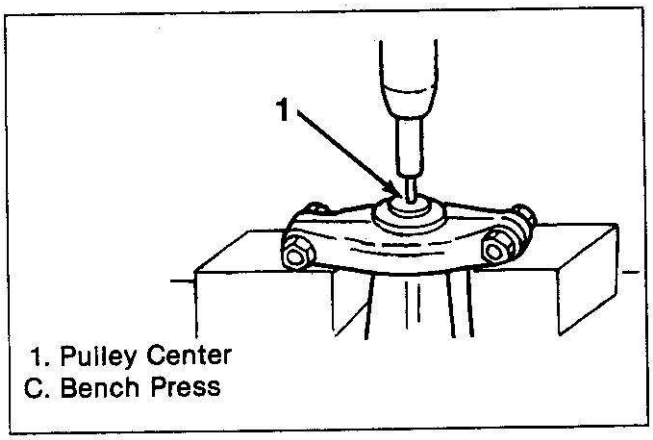


Figure 10. Removing Pulley Center

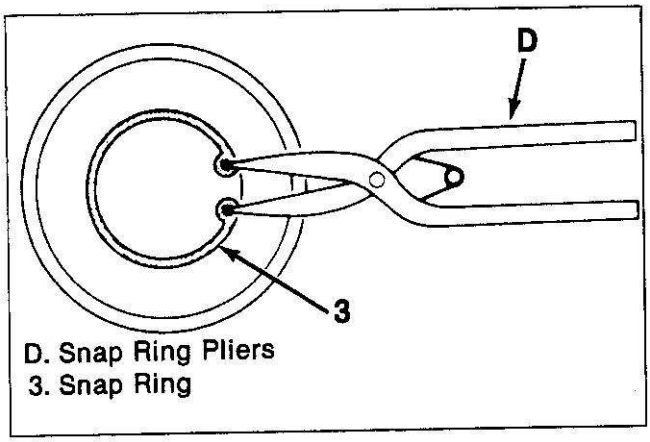


Figure 11. Removing Snap Ring

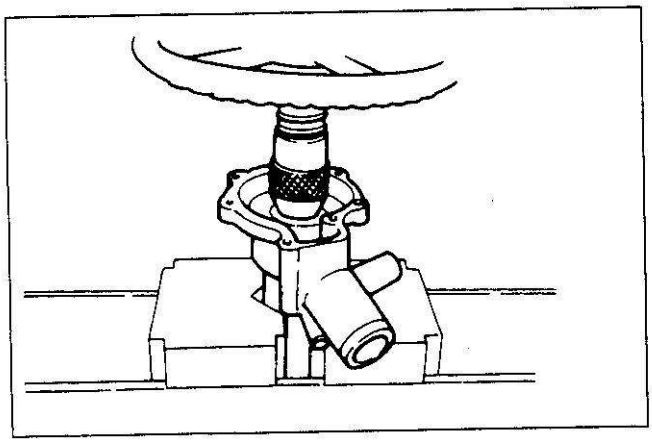


Figure 12. Removing Spindle, Bearing and Spacer

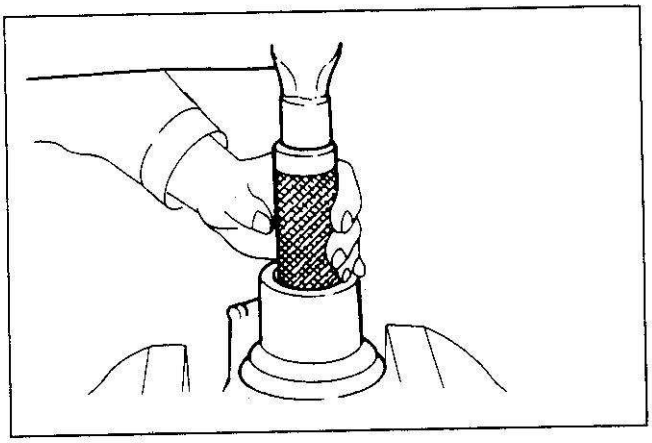


Figure 13. Removing Seal Unit, Washer and Seal

Inspect

- Bearings and remove and replace, if necessary, using the procedure that follows.
- Replace or repair any component that has wear, damage or any other abnormal condition found through inspection.

Bearing Replacement

(Figures 14 and 15)

- Remove the two bearings and spacer from the spindle using a bench press.

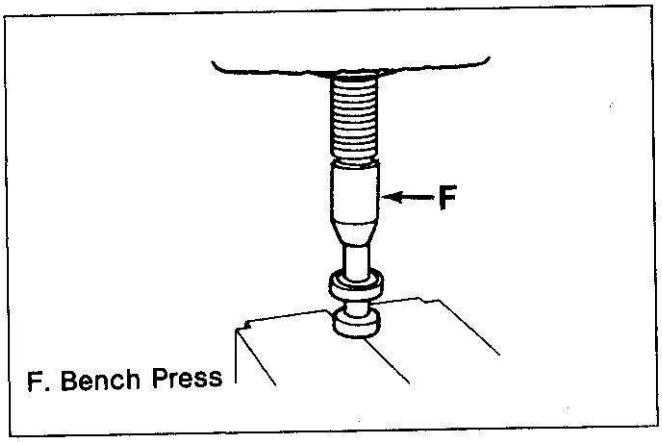


Figure 14. Removing Bearings and Spacer

- Be sure the bearings are installed so their sealed sides are turned outwards.
- Install the two bearings and spacer onto the spindle using bench press J-35725.

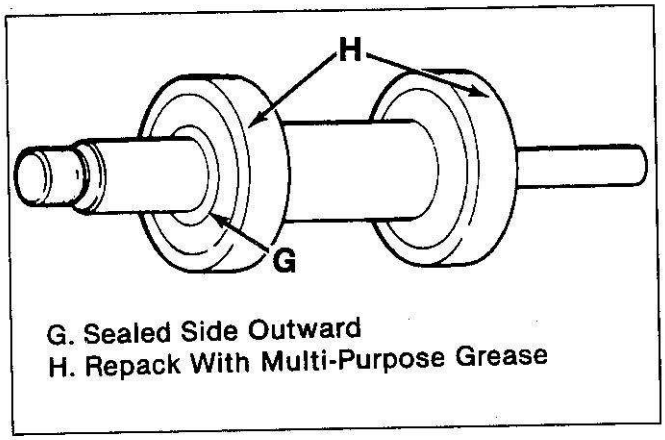


Figure 15. Installing Bearings and Spacer

Measure

- The clearance between:

Item	Clearance
Spindle and Impeller	0.020–0.060 mm (0.0008–0.0024 in)
Spindle and Pulley Center	0.07–0.11 mm (0.0028–0.0043 in)
Pulley and Pulley Center	0.14 mm (0.0055 in) or less

Assemble (Figures 8, 15-18)

- Repack the bearings with a multipurpose type grease before installing into the pump body.

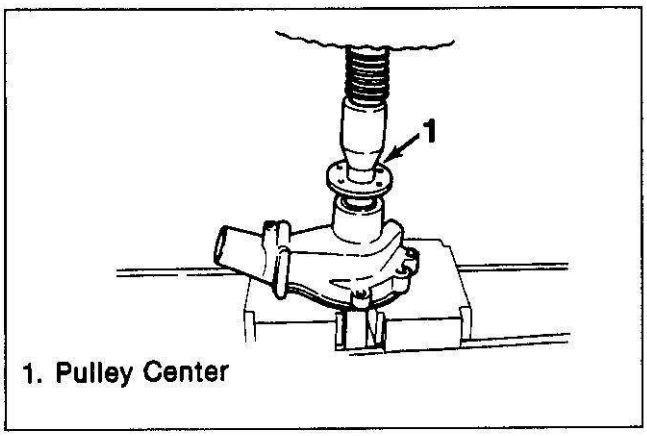


Figure 16. Installing Pulley Center

1. Spindle, bearings and spacer (4, 5, 6), using a bench press and a suitable installer (figure 15).
2. Seal unit, washer, and seal (7, 10, 12).
   - Apply a thin coat of liquid gasket (Belco Bond No.4 or its equivalent) to the surface in contact with the pump body before installing (figure 17).
3. Snap ring (3) using snap ring pliers.
4. Dust seal (2).
5. Pulley center (1) using a bench press (figure 16).
6. Impeller (13) using a bench press.

Measure

- Clearance between the impeller and body using a feeler gage as shown in figure 18. Clearance should be within 0.3–0.8 mm (0.012–0.031 in).

7. Gaskets and cover (14, 15, 16).

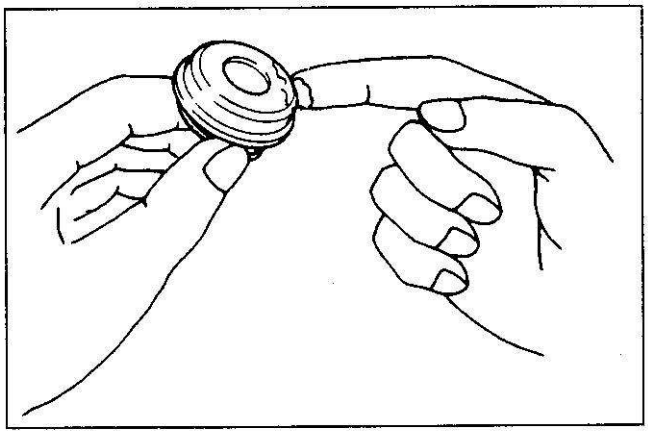


Figure 17. Apply Liquid Gasket

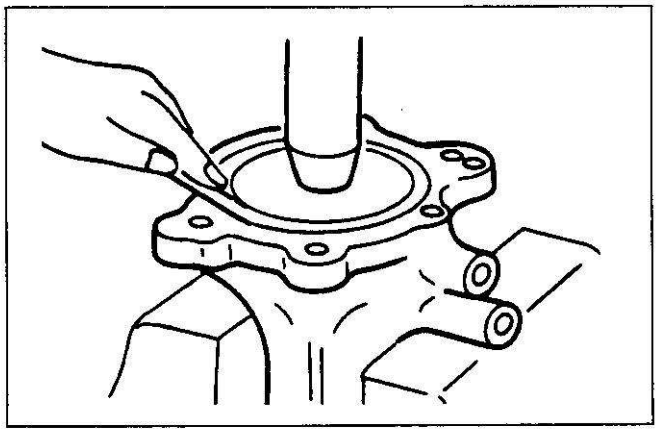


Figure 18. Measuring Clearance Between Impeller and Body

ENGINE WARMING-UP SYSTEM

Under the engine cold condition, this warming-up system operates to accelerate the engine warming-up speed, at engine idling.

Thermo Switch

The thermo switch is installed on the thermostat housing (figure 20) to operate this system for the following conditions.

Automatic Engine Warm-up

(Figure 19)

When the engine engine coolant temperature is below 40°C (104°F) when the engine is started, a working current is supplied by the QOSIII controller to the upperstream of the accelerator switch (12). But all other conditions than the accelerator switch (12) remain unchanged. Therefore, the magnetic valve (13) is turned on and activates the exhaust brake valve (17) to promote the engine warm-up.

When the engine engine coolant temperature rises above the 40°C (104°F) level, the QOSIII controller automatically deactivates the engine warm-up function.

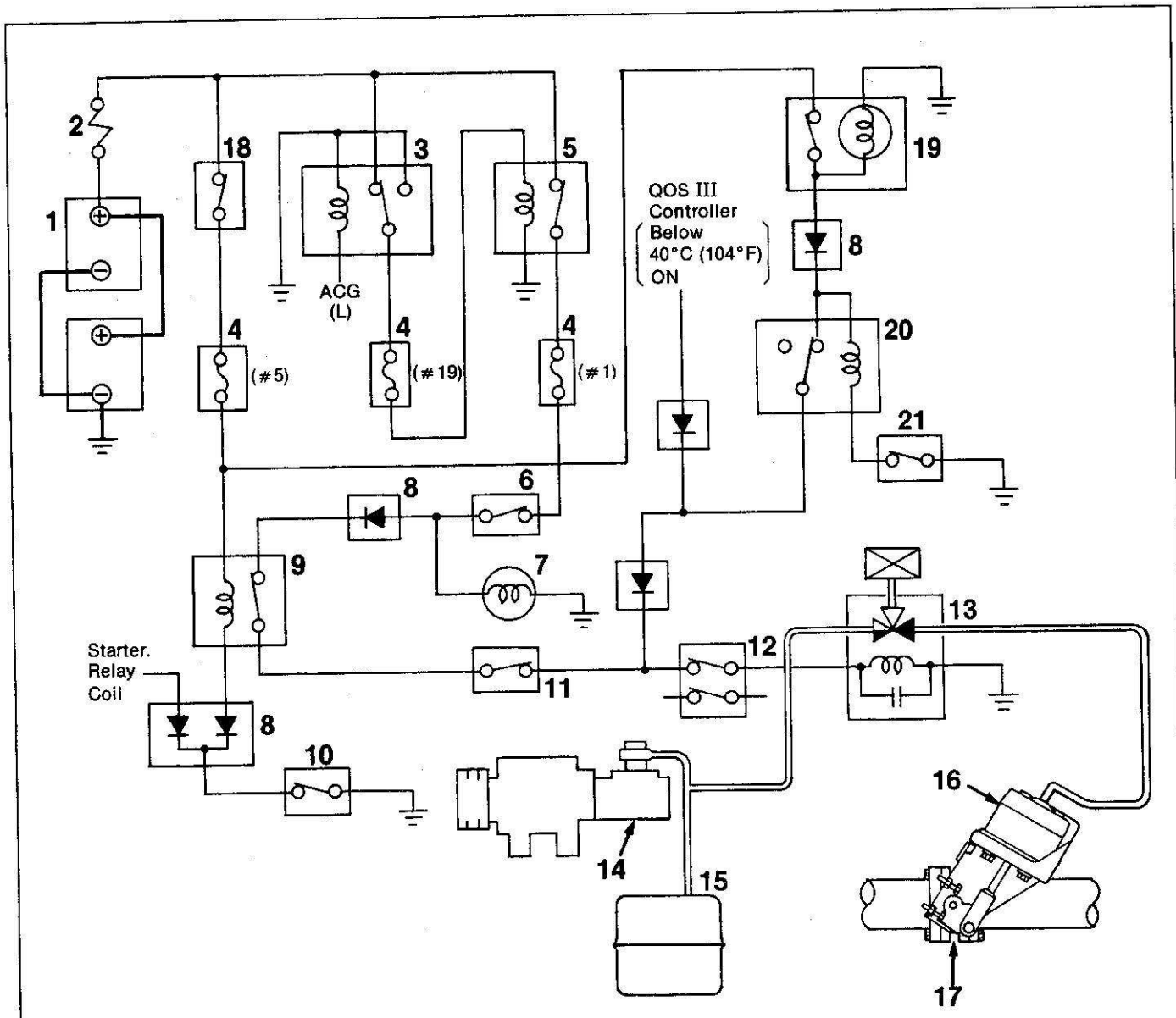
Manual Engine Warm-up

(Figure 19)

When the engine warming-up switch (19) turned on with the engine engine coolant temperature below 70°C (158°F) and the key switch (18) turned on, the indicator light built into the switch lights up and the engine warming cut relay (20) goes on at the same time. This causes electricity to flow to the

magnetic valve (13) and activates the exhaust brake valve (17) to promote the engine warm-up.

When the engine engine coolant temperature rises above the 70°C (158°F) level, the thermo switch (21) and the engine warming cut relay (20) go off simultaneously. The engine warm-up function is ended as a result.



1. Batteries
2. Fusible Link Wire
3. Charge Relay
4. Fuse
5. Exhaust Brake Relay
6. Exhaust Brake Switch
7. Indicator Light
8. Diode
9. Exhaust Brake Control Relay
10. Neutral switch (M/T)
    Inhibitor Switch (A/T)
11. Clutch Switch (M/T only)
12. Accelerator Switch
13. Magnetic Valve
14. Vacuum Pump
15. Vacuum Tank
16. Vacuum Chamber
17. To Exhaust Brake Valve
18. Key Switch
19. Engine Warming-up Switch
20. Engine Warming Cut Relay
21. Engine Coolant Temperature Switch

A/T: Automatic Transmission
M/T: Manual Transmission

Figure 19. Exhaust Brake and Engine Warm-up Controls

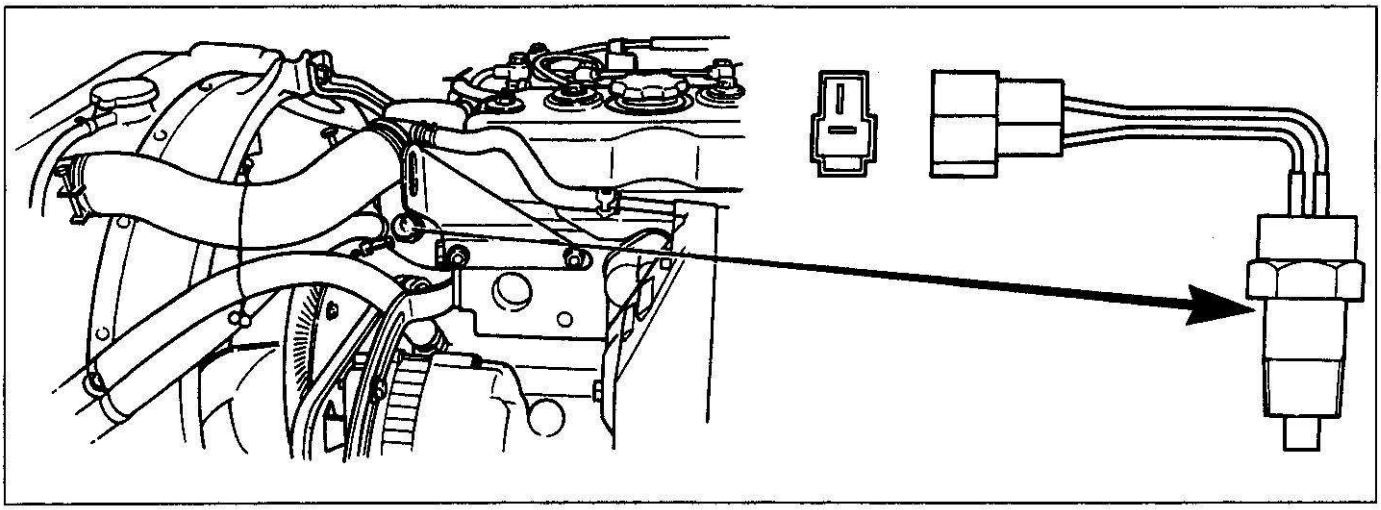


Figure 20. Thermo Switch; Engine Warming

Refer to CAB AND CHASSIS ELECTRICAL (Section 8) for WIRING DIAGRAM, AND TROUBLESHOOTING.

SPECIFICATIONS

THERMOSTAT

Number Used.	Opening Temperature	Full Open Temperature
1	Primary value 80–84°C (176–183°F) Secondary value 83–87°C (181–189°F)	95°C (203°F)

FASTENER TORQUES

Thermostat Cover Bolts	20 N·m (14 lb·ft)
Oil Cooler Mounting Bolts	26 N·m (20 lb·ft)
Water Pump Bolts	26 N·m (20 lb·ft)
Fan Clutch Plate and Pulley to Water Pump Bolts	19 N·m (14 lb·ft)
Fan Clutch Plate to Fan Clutch Bolts	19 N·m (14 lb·ft)

SPECIAL TOOLS

J-24460-01 Cooling	System and Radiator Cap Tester
J-35724	Impeller Remover
J-35725	Spindle, Bearing and Spacer Installer

SECTION 6B2

RADIATOR

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

ON-VEHICLE SERVICE

DESCRIPTION

The radiator on this vehicle is a downflow tube type. It is fitted with a shroud designed to assist the fan in directing airflow through the radiator core and also serves as a fan guard.

The radiator is equipped with a engine coolant recovery system which allows for engine coolant expansion. A reserve tank is placed in a bracket mounted to the frame rail, and has hoses connecting it to the radiator. This catches engine coolant overflow so that frequent refills are not necessary.

Pressure is maintained in the system by a pressure cap. The pressure cap has two valves: one which relieves pressure and the other to compensate for engine coolant contraction when the engine is off. The radiator cap on this system has a 103 kPa (15 psi) rating.

RADIATOR MAINTENANCE

Radiators need special attention to prevent leakage and airflow restriction. Check the outside of the radiator for bent fins or signs of leakage. Leaking radiator cores should be repaired immediately and not just sealed temporarily with a sealer-type antifreeze or engine coolant additive. Remove any stones between the fins.

Remove the radiator cap and look for plugging and scale on the inside of the tank. A badly plugged radiator may have to be replaced. Test the radiator and system as described in COOLING SYSTEM (SEC. 6B1) of this manual.

1. Check the engine coolant level. If low, add recommended engine coolant as required.
2. Check the hose connections and tighten the clamps if leakage is evident. Cracked, stripped, or corroded clamps should be replaced.
3. Check the engine coolant hoses for a spongy or cracked appearance. Deteriorated hoses should be replaced or bursting could occur which would result in engine coolant loss and extensive engine damage due to overheating.
4. Check the radiator core for leaks and for accumulation of dirt which may obstruct the air passages and reduce effective heat transfer.

5. Check the reserve tank for leaks. Plastic bottles may develop cracks from being damaged by flying objects.
6. Inspect the radiator rubber mountings for deterioration and replace as necessary. Check the mounting bolts, supports, and stabilizer rods.
   Components should be securely fastened in place. If mounting bolts are missing, loose, or stripped, replace them. Also check for damage to the core side flanges and supporting components.
7. Check for proper clearance between the fan blades, core, and shroud. Check the fan attaching bolts for tightness and that none are missing. Replace the fan if any blade is bent. The distance between the blades and shroud should be equal around the entire perimeter of the shroud. Adjust as necessary after any adjustment has been made to the fan or the fan mounting bracket and hub.
8. Inspect the filler cap seal for evidence of cracking, separation, or deterioration. Replace as required.
9. To assist in maintaining efficient heat dissipation, an occasional external flushing with water will remove the majority of dirt accumulation and foreign matter from between core fins. Water under moderate pressure should be directed from behind the core to force debris out in the opposite direction of its entry. Water stream should be directed in line with the fins to reduce the possibility of bending fins.

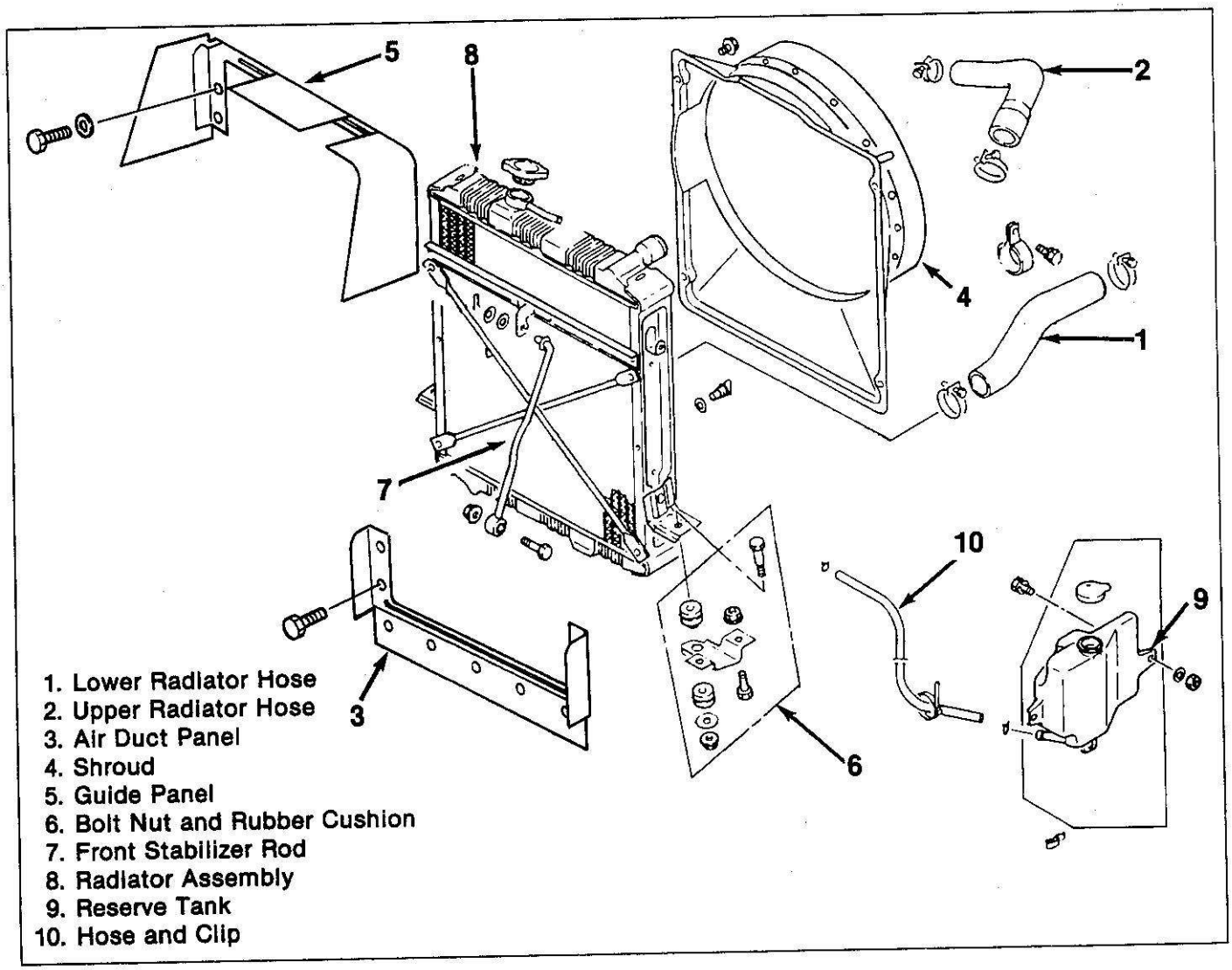


Figure 1. Radiator Components

Radiator Internal Deposits

A radiator that has a dirty obstructed core, or is leaking will cause the engine to overheat. A scale deposit inside the radiator is a result of using hard, high mineral content water in the cooling system. The effect of heat on the minerals in the water causes the formation of scale, or a hard coating on metal surfaces within the radiator, thereby reducing the transfer of heat. Some hard water, instead of forming scale, will produce a silt-like deposit which restricts the flow of water. This must be flushed out at least every 24 months- more often if necessary.

Scale Removal

To remove the hardened scale, a direct chemical action is necessary. A flushing compound at the specified rate of 30 grams per liter (4 oz. per gallon) of radiator capacity, should be added to the engine coolant water in the form of a dissolved solution while the engine is running. Operate the engine for at least 15 minutes then drain and flush the system with clean water.

There are various types of flushing compounds commercially available and should be obtained from a reliable source. Most compounds attack metals and should not remain in the engine for more than a few minutes. A neutralizer should be used in the cooling system immediately after a descaling solvent is used.

For extremely hard stubborn coatings, such as lime scale, it may be necessary to use a stronger solution. The corrosive action of a stronger solution will affect the thin metals of the radiator, thereby reducing its operating life. A complete flushing and rinsing is mandatory and must be accomplished skillfully.

After the solvent and neutralizer have been used and the cooling system is flushed, completely drain the entire system again and fill it with clean, soft water plus a rust inhibitor or a high boiling point-type antifreeze. After filling the cooing system, check for engine coolant leaks at the radiator and all hose connections.

RADIATOR REPLACEMENT

When oil cooler lines are removed, use an approved container to catch the oil from the cooler and lines. DO NOT reuse this oil. Refill any drained reservoirs to a recommended level with clean, new fluid after radiator installation.

After the radiator has been removed from the vehicle, be sure to check the mounting supports, retainers, and brackets. If any of these components are deteriorated or worn, replace them immediately.

Remove or Disconnect (Figure 1)

- Disconnect the battery cables.
- Drain the engine coolant.

1. Lower and upper radiator hoses (1 and 2), clips or brackets attached to the radiator.
2. Air duct panel (3).
3. Shroud (4).
4. Guide panel (5).
5. Bolts, nuts, and rubber cushions (6).
6. Front stabilizer rod (7) from the radiator.
7. Radiator (8).

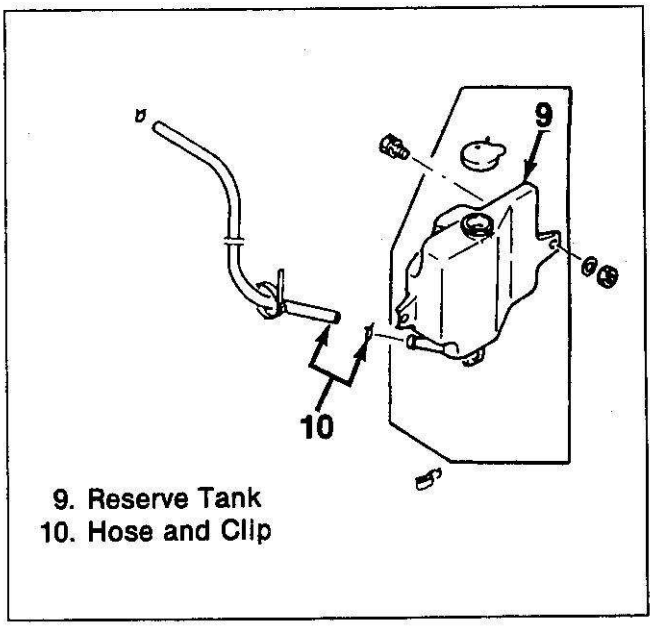
Install or Connect (Figure 1)

1. Radiator (8).
2. Front stabilizer rod (7).
3. Bolts, nuts, and rubber cushions (6).
4. Guide panel (5).
5. Shroud (4).
6. Air duct panel (3).
7. Lower and upper radiator hoses (1 and 2), clips or brackets that were removed.
8. Battery cables.

Fill the system with new engine coolant as described in COOLING SYSTEM (SEC. 6B1) of this manual. Then check the system for leaks.

ENGINE COOLANT RECOVERY SYSTEM

The engine coolant recovery system consists of a reserve tank, cap, brackets, and hose. The engine coolant level must be maintained between the MAX and MIN markings on the tank.



9. Reserve Tank
10. Hose and Clip

Figure 2. Reserve Tank

Remove or Disconnect (Figure 2)

- Tilt the cab.

1. Battery cables.

Important

- Drain the reserve tank.

2. Hose and clip (10).
3. Reserve tank (9).

Install or Connect (Figure 2)

1. Reserve tank (9).
2. Hose and clip (10).
3. Battery cables.

Important

- Fill the reserve tank with new engine coolant. Start the engine and check for leaks.

RADIATOR MOUNTINGS

Radiator mounting maintenance is of extreme importance. A check should be made to be sure that no looseness exists that would allow excessive vibration and shock loads (figure 1). Bolt, nut and rubber cushions (6), front stabilizer rod (7), air duct and guide panels (3 and 5) are subject to deterioration, weakening and breakage. Replace any component found in doubtful condition.

STABILIZER RODS

Stabilizer rods hold the radiator in position. The front stabilizer rod (7) is mounted on the front crossmember and at the stabilizer rod that is mounted on the front of the radiator (8) (figure 1). No adjustments can be made to these rods.

SHROUD REPLACEMENT

A radiator shroud is attached to the rear of the radiator and is designed to assist the fan in directing airflow, through the radiator core. The shroud also serves as a fan guard.

Inspect

The shroud for damage or deterioration. Check for missing and loose fasteners. Replace the shroud if it is damaged.

Remove or Disconnect (Figure 1)

- Tilt the cab.
- Disconnect the negative battery cables.
- Partially drain the radiator.

1. Upper radiator hose (2).
2. Two heater hoses.
3. Generator adjusting bolt.
4. Belts and wiring.
5. Fan assembly from the hub.
6. Shroud mounting bolts.
7. Shroud (4).

Install or Connect (Figure 1)

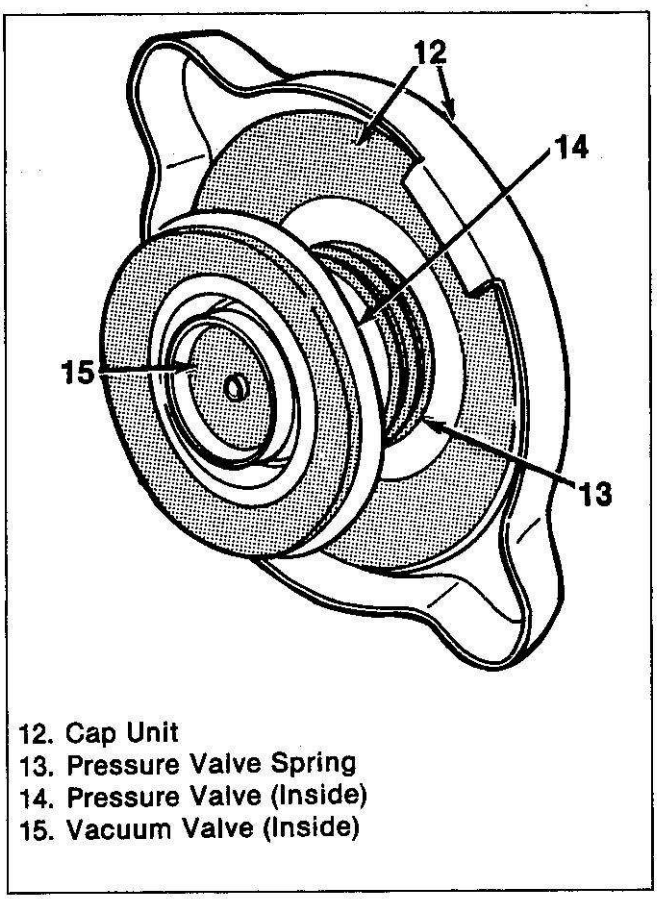
1. Shroud (4).
2. Shroud mounting bolts.
3. Fan assembly.
4. Belts and wiring.
5. Alternator adjusting bolt.
   — Refer to COOLING SYSTEM (SEC. 6B1) of this manual for belt tightening information.
6. Heater hoses.
7. Upper radiator hose (2).

Important

Fill the radiator with new engine coolant. Connect the battery cables. Start the engine and check for leaks.

PRESSURE CAP

The pressure relief valve assembly, integral with the filler cap, incorporates a pressure valve (14) and a vacuum valve (15) (figure 3). When pressure in the system reaches valve setting, the pressure valve opens and vapor is allowed to escape.



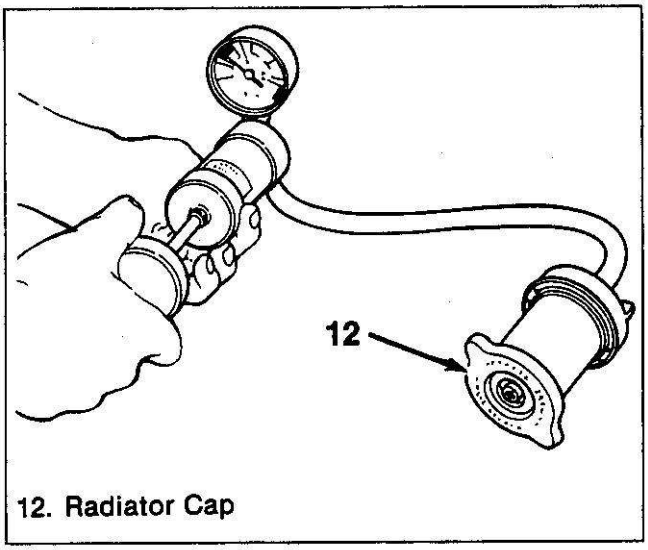
12. Cap Unit
13. Pressure Valve Spring
14. Pressure Valve (Inside)
15. Vacuum Valve (Inside)

Figure 3. Pressure Cap

As liquid in the system cools, it contracts. This allows the pressure valve to close and also creates a partial vacuum in the system. Atmospheric pressure acting through the overflow tube unseats the vacuum valve and allows air to enter th e system. The overflow pipe connects to the filler neck of the radiator where the cap is installed. No liquid or air can therefore escape from the system when both valves are in the closed position.

The radiator filler cap is constructed with a spring-loaded rubber seal which is pressed firmly against the surface of the filler neck seat when the cap is installed. The rubber seal must be in good condition and the top of the radiator filler neck must be clean and smooth in order to form an air-tight seal. The seal of the filler cap and the operation of the pressure relief valve can be checked using a conventional cooling system test kit (figure 4).

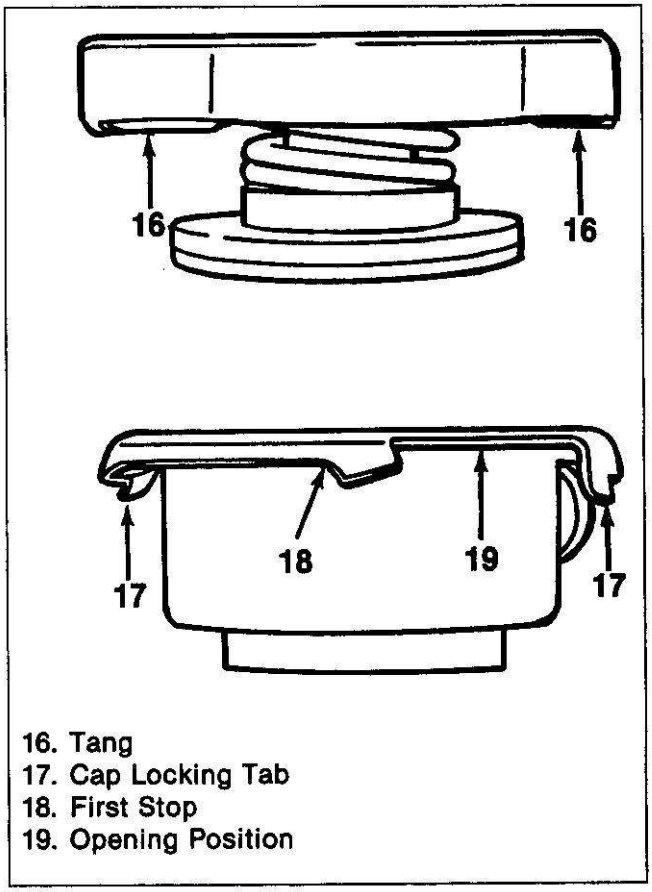
When the engine is at normal operating temperature or above, the internal pressure buildup in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of engine coolant and to avoid the danger of being burned, the engine coolant level should be checked or engine coolant added only when the engine is cool. If the cap must be removed when the engine is hot, place a cloth over the cap.



12. Radiator Cap

Figure 4. Testing the Radiator Cap

When removing the cap, press down on the cap and turn it slowly counterclockwise to the first stop. This will allow the pressure to escape. Then, push down on the cap again and turn it counterclockwise past the first stop to the opening position and lift off the cap.



16. Tang
17. Cap Locking Tab
18. First Stop
19. Opening Position

Figure 5. Radiator Cap and Filler Neck

SPECIFICATIONS

Cooling System Capacity	17 Liters 4.5 gal
Pressure Cap Opening Pressure	103 kPa (15 psi)

SECTION 6B3

FAN

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

DESCRIPTION

FAN

The engine cooling fan is used to increase the air flow through the radiator. The fan shroud prevents recirculation of air around the fan and therefore assures adequate air flow through the radiator.

NOTICE: If a fan blade is damaged in any way, no attempts should be made to repair and reuse the damaged part. A damaged fan assembly should always be replaced with a new fan assembly.

It is essential that fan assemblies remain in proper balance and proper balance cannot be assured once a fan assembly has been damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use creating an extremely dangerous condition.

When it is necessary to replace a damaged fan assembly, use the recommended original equipment replacement parts. Usage of a fan of different diameter, pitch, number of blades, or type of blade material may alter the cooling efficiency, performance, durability, and noise level.

If a fan assembly should ever fail, a close inspection of the hub and drive components should be made. A fan assembly may fail due to imbalance in the hub or drive and may not be the fault of the blade itself.

AUTOMATIC FAN CLUTCH

The automatic fan clutch (figure 1) is a hydraulic device used to vary the speed of the fan in relation to engine temperature. Automatic fan clutches permit the use of a high delivery fan to ensure adequate cooling at reduced engine speeds while eliminating over-cooling, excessive noise, and power loss at high speeds.

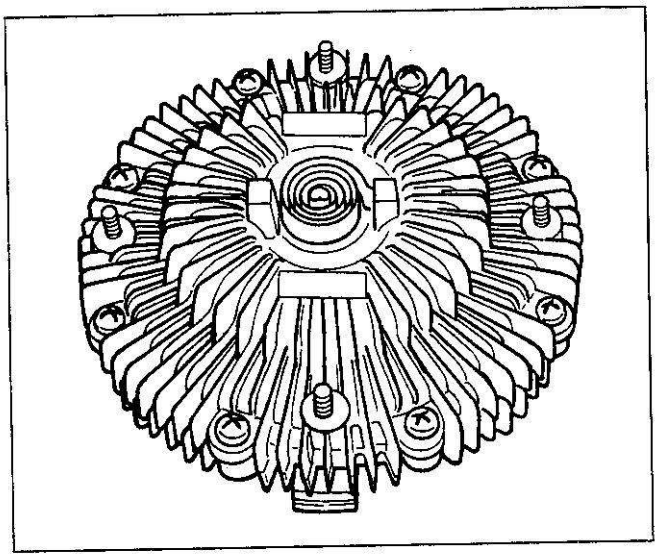
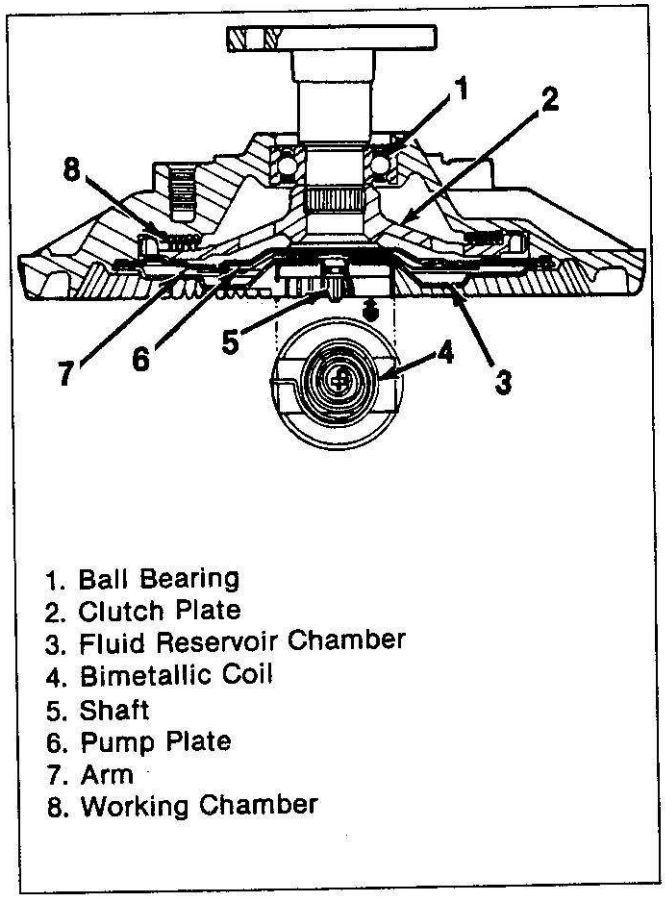


Figure 1. Automatic Fan Clutch

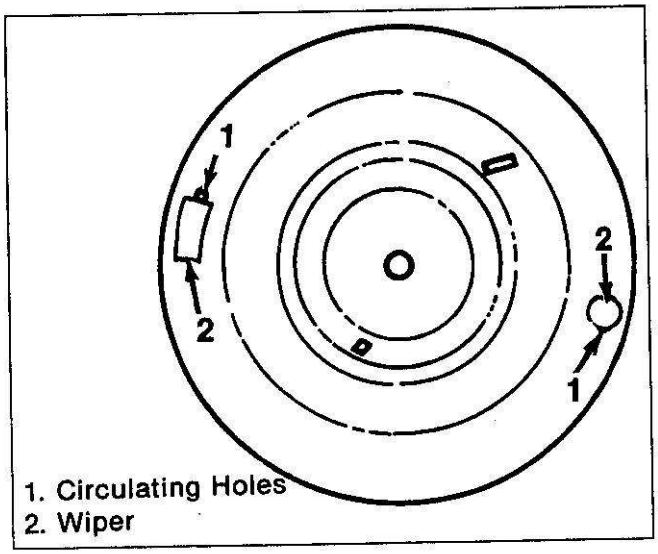
The automatic fan clutch has two modes of operation, the engaged mode (engine cold or high speed driving) occurs when the silicone fluid is contained in the reservoir area of the fan clutch. As the temperature of the engine rises, so does the temperature of the bimetallic coil. This bimetallic coil (figure 2) is connected to the arm shaft in such a way that, as the temperature rises, the shaft moves the arm exposing an opening in the pump plate. This opening allows the silicone fluid to flow from the reservoir into the working chamber of the automatic fan clutch.

The silicone is kept circulating through the fan clutch by wipers located on the pump plate. A hole is located in front of each wiper (figure 3). The speed differential between the clutch plate and the pump plate develops high pressure areas in front of the wipers, thus the fluid is forced back into the reservoir. But as the temperature rises, the arm uncovers more of the silicone fluid to enter the working chamber.



1. Ball Bearing
2. Clutch Plate
3. Fluid Reservoir Chamber
4. Bimetallic Coil
5. Shaft
6. Pump Plate
7. Arm
8. Working Chamber

Figure 2. Fan Clutch Coil and Components



1. Circulating Holes
2. Wiper

Figure 3. Fan Clutch Pump Plate

The automatic fan clutch becomes fully engaged when the silicone fluid, circulating between the working chamber and the reservoir, reaches a sufficient level in the working chamber to completely fill the grooves in the clutch body and the clutch plate.

The resistance of the silicone fluid to the shearing action caused by the speed differential between the grooves transmits torque to the clutch body. The reverse situation occurs when the temperature drops. The arm slowly closes off the return hole, thus blocking the fluid flow from the reservoir into the working chamber.

The continuous action of the wipers removes the silicone fluid from the grooves in the working chamber and reduces the shearing action and the speed of the fan decreases.

The temperature at which the automatic fan clutch engages and disengages is controlled by the setting of the bimetallic coil. This setting is factory-set for the requirements of each model.

DIAGNOSIS OF AUTOMATIC FAN CLUTCH

Tools Required
J-6742-03 Dial Type Thermometer.

Noise

Fan noise is sometimes evident under the following normal conditions:

1. When the clutch is engaged for the maximum cooling
2. During the first few minutes after a startup until the clutch can redistribute the silicone fluid back to its normal disengaged operating condition after overnight settling.

However, fan noise or an excessive roar will generally occur continuously under high engine speed conditions (2,500 RPM and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

Looseness

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 6.4 mm (1/4 in) maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

Silicone Fluid Leak

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. However, if the degree of leakage appears excessive, proceed to "Engine Overheating."

Engine Overheating

1. Start with a cool engine to ensure complete fan clutch disengagement. Refer to item two under "Noise" previously in this section.
2. If the fan and clutch assembly free-wheels with no drag (revolves over five times when spun by hand), the clutch should be replaced. If the clutch performs properly with a slight drag, go to step three.

   Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.
3. Use a dial type thermometer J-6742-03, or a similar type.

   Thermometer J-6742-03 reads to 82°C (180°F), therefore, allow approximately 4.8 mm (3/16 in) pointer movement for each 5.5°C (10°F) over 82°C(180°F).

   NOTICE: Check for adequate clearance between fan blades and thermometer sensor before starting engine or possible damage could occur.

4. Position the thermometer so that the thermometer sensor is centered in the space between the fan blades and the radiator. This can be achieved by inserting the sensor through one of the existing holes in the fan shroud or fan guard, or by placing it between the radiator and the shroud.

   On some models, it may be necessary to drill a 4.8 mm (3/16 in) hole in the fan shroud to insert the thermometer J-6742-03.
5. Cover the radiator grille sufficiently to induce a high engine temperature. Start the engine, and turn on the air conditioning, if equipped. Maintain a position in front of the vehicle to observe the thermometer reading. With a rod, broom handle, or other suitable instrument, push on the accelerator linkage to maintain approximately 3,000 RPM. Use a tachometer if available.

6. Observe the thermometer when the clutch engages. It will take approximately five to ten minutes for the temperature to become high enough to allow engagement of the fan clutch. This will be indicated by an increase or roar in the fan air noise and by a drop in the thermometer reading of approximately 2–5°C (36–41°F). If the clutch did not engage between 74 and 88°C (165 and 190°F), the unit should be replaced.

NOTICE: Do not continue test past a thermometer reading of 88°C (190°F) to prevent engine overheating.

If no sharp increase in fan noise or temperature drop was observed, and the fan noise level was constantly high from start of test to 88°C (190°F), the unit should be replaced.

7. As soon as the clutch engages, remove the radiator grille cover to assist in engine cooling. The engine should be run at approximately 1,500 RPM.
8. After several minutes the fan clutch should disengage, as indicated by a reduction in fan speed and roar.

ON-VEHICLE SERVICE: COOLING COMPONENTS

FAN REPLACEMENT

CAUTION: Keep hands and clothing clear of moving fan blades. (Fan may run when the engine is off.) Blades are exposed and can cause personal injury.

Remove or Disconnect (Figure 4)

- Tilt the cab.
  1. Battery negative cable.
  2. Nuts (3) and bolts (5).
  3. Cooling fan (2).

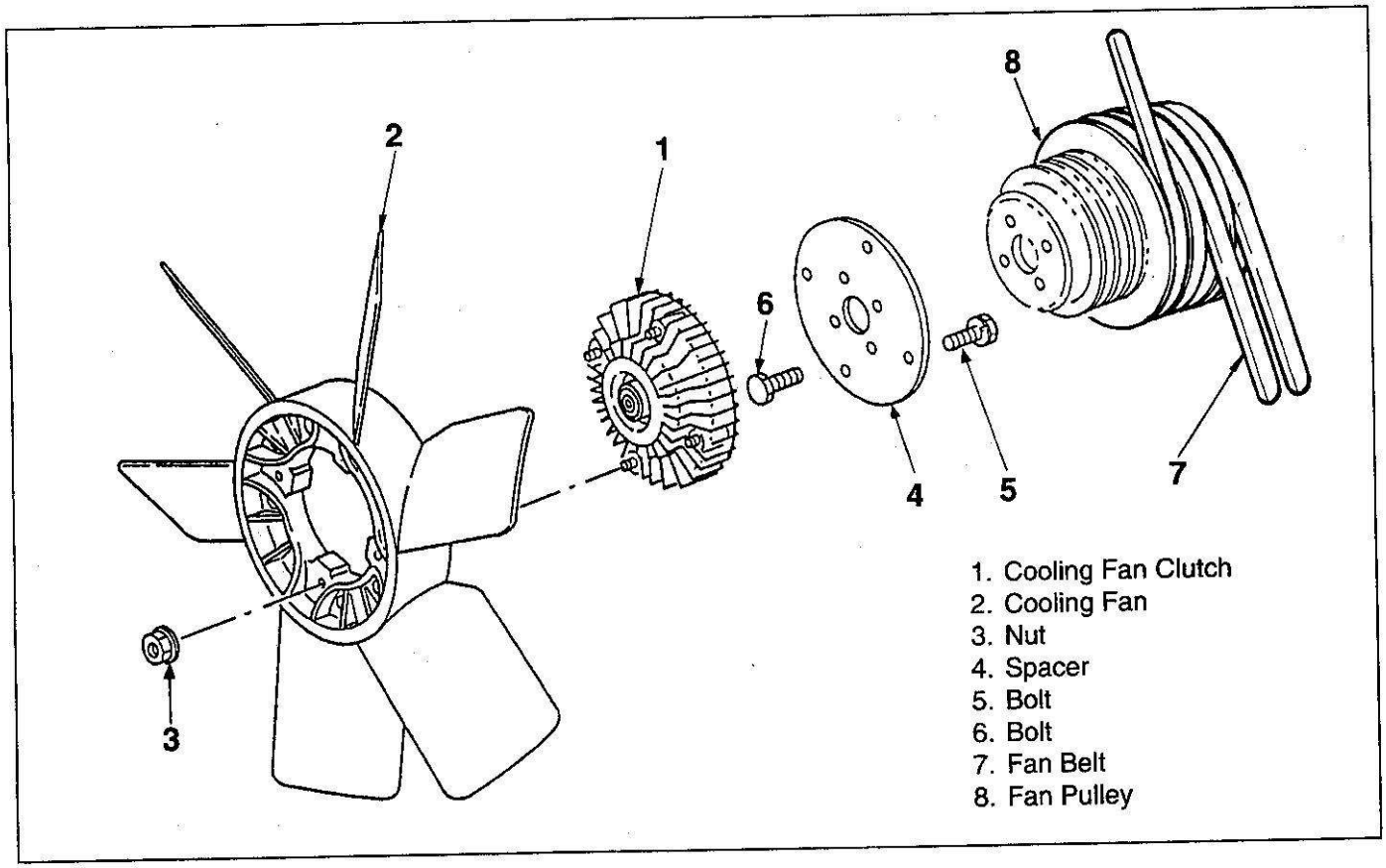


Figure 4. Cooling System Components

Install or Connect (Figure 4)

1. Cooling fan (2).

NOTICE: See "NOTICE" on page 6B3-1 of this section.

2. Bolts (5) and nuts (3).

Tighten

- Bolts (5) and nuts (3) to 19 N·m (14 lb·ft).

3. Battery negative cable.

FAN CLUTCH REPLACEMENT

Remove or Disconnect (Figure 4)

- Tilt the cab.

1. Battery negative cable.
2. Generator adjusting bolt.
3. Fan belts (7).
4. Heater hoses.
5. Plate to clutch bolts (5).
6. Fan (2) and clutch (1) assembly.
7. Fan to clutch bolts (3).
8. Fan (2) from the fan clutch (1).

Install or Connect (Figure 4)

NOTICE: See "NOTICE" on page 6B3-1 of this section for steps 2 and 3.

1. Fan (2) to the fan clutch (1).
2. Fan to clutch bolts (3).

Tighten

- Bolts (3) to 8 N·m (69 lb·in).

3. Fan and fan clutch assembly.
4. Plate to clutch bolts (5).

Tighten

- Bolts (5) to 19 N·m (14 lb·ft).

5. Heater hoses.
6. Fan belts (7).
7. Generator adjusting bolt.
   - Refer to "Belt Tension Adjustment" later in this section.
8. Battery negative cable.
9. Replace any lost engine coolant.

FAN PULLEY REPLACEMENT

Remove or Disconnect (Figures 4 and 5)

- Tilt the cab.

1. Battery negative cable.
2. Generator adjusting bolt.
3. Fan belt (7).
4. Heater hoses.
5. Plate to clutch bolts (5).
6. Fan and clutch assembly.
7. Plate to water pump bolts (6).
8. Plate (4) and fan pulley (8).

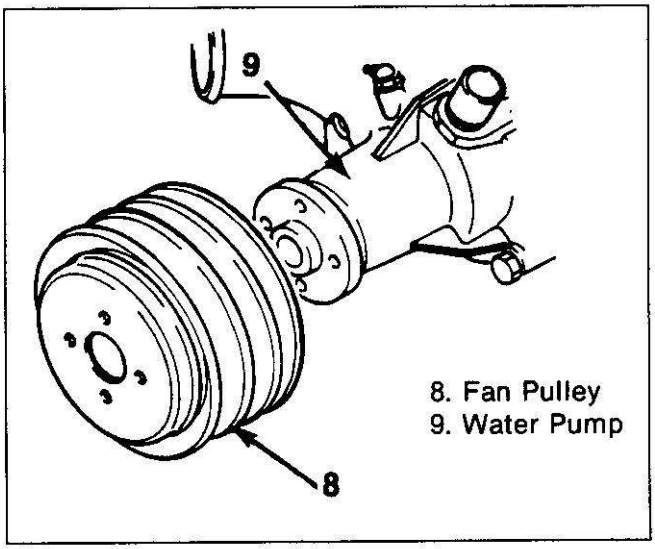


Figure 5. Fan Pulley Replacement

Install or Connect (Figures 4 and 5)

NOTICE: For steps 2 and 4 see "NOTICE" on page 6B3-1 of this section.

1. Fan pulley (8) and fan clutch plate (4).
2. Plate to water pump bolts (6).

Tighten

- Bolts (6) to 19 N·m (14 lb·ft).

3. Fan and clutch assembly.
4. Plate to clutch bolts (5).

Tighten

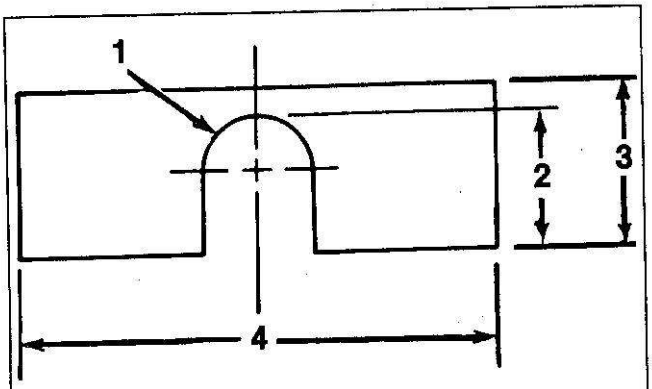
- Bolts (5) to 19 N·m (14 lb·ft).

5. Heater hoses.
6. Drive belts (6).
7. Generator adjusting bolt.
   - Refer to "Belt Tension Adjustment" later in this section.
8. Battery negative cable.
9. Replace any lost engine coolant.

FAN ADJUSTMENT

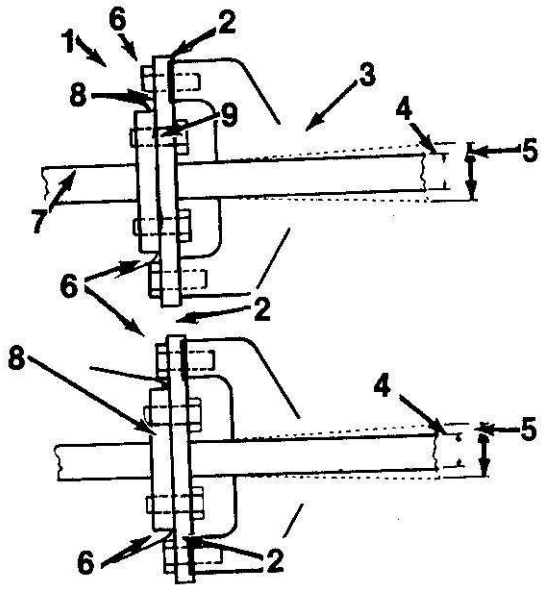
Radial Runout Check Procedure

1. Secure the fan blade to prevent rotation.
2. Mount a dial indicator (0.01 mm/0.0004 in graduations) to the engine and place the indicator pointer on the fan blade spider. Preferably on the longest band or space on the spider.
3. Rotate the water pump pulley in one direction and note the total amount of indicator needle movement. This represents the total radial runout. Mark the point on the pulley at which the highest reading is obtained.
   Do not rotate the pulley by pulling on the fan assembly blades.



1. 8 mm (5/16 in) Diameter
2. 11 mm (7116 in)
3. 12.5 mm (112 in)
4. 19 mm (3/4 in)

Figure 6. Shim Dimensions



1. Pulley
2. Shim
3. Fan Clutch Hub
4. Zero (0)*
5. 0.51 mm (0.020 in)*
6. Attaching Bolt
7. Water Pump Hub
8. Runout Mark
9. Adapter

*Total Runout ÷ 2 = Shim Thickness To Obtain Zero (0) Runout.

Example:

0.51 mm (0.020 in) ÷ 2 = 0.25 mm (0.010 in)
0.25 mm (0.010 in) Shim = 0 Runout

Figure 7. Shim Placement

NOTICE: See "NOTICE" on page 6B3-1 of this section.

4. If the total indicator reading is less than 0.15 mm (0.006 in) the assembly is within specification. Torque attaching bolts to specification. Install fan belt and adjust tension.
   If total runout exceeds 0.15 mm (0.006 in), proceed to step 5.
5. Divide the total indicator reading in half and obtain this thickness from stock 12.5×19 mm (1/2 × 3/4in) and rework as shown in figure 6. Place this shim between the adapter and the fan clutch at the bolt closest to the point marked on the pulley in step 3. If the runout mark on the pulley is between two bolts so that it is difficult to determine which bolt is closest, use two shims placing one under each bolt adjacent to the mark (figure 7).

Bolt Torque Sequence

NOTICE: See "NOTICE" on page 6B3-1 of this section.

1. When one shim is used, first torque the bolt over which the shim has been placed; second, the bolt opposite; and finally, the other two. Torque to specification.
2. When two shim packs are used, each bolt must be torqued partially, then to full torque alternating between opposite bolts, then the other two bolts in the same manner. Torque to specification.

Important

- Excessive runout may result if the above sequence and recommended torque is not used.

3. Recheck total indicator runout to verify that runout is within 0.15 mm (0.006 in). Install the fan belt and adjust the tension.

ON-VEHICLE SERVICE: DRIVE BELTS

DIAGNOSIS OF BELTS

Normal belt and pulley wear will be even. It is the unusual signs of wear that indicate some correction is needed. Damage to the belts may have been caused by a damaged pulley, misaligned drive, bent shafts, or other mechanical component. Refer to "Inspection and Replacement" later in this section for replacing damaged belts.

Short Belt Life

The following can affect belt life:

1. Misalignment of pulleys.
2. Incorrect belt size.
3. Improper belt length.
4. Incorrect tension.
5. Damaged pulley sheaves or bent pulley shafts.
6. Defective belt.
7. Belt damage during installation.
8. Severe operating environment.

The correction of any of the listed conditions will contribute to longer belt life.

Base Cracking

Excessive cross-checking extending into the rubber on the base of a belt and showing little or no side wear indicates that the belt has run a short time and that it is damaged.

If small cracks are in the cover material only, severe belt damage is not indicated.

If the sidewalls show wear after six months of use, the belt should not be classified as defective. However, if the base of the belt also shows crosschecking, the belt has been exposed to weather to the extent that the inner fabric is beginning to rot.

Fabric Rupture

A fabric rupture can be caused by the following three conditions:

1. Operating a belt over a badly worn pulley.
2. Too much tension, which forces the belt down into the groove.
3. Foreign objects falling into the pulley groove while the drive is operating.

Inspect

1. Pulleys for wear or damage.
2. Pulley alignment.
3. Belt sheaves.

Cover Tear

A tear in the cover of a belt results from the belt coming into contact with some other part of the application. It is not the fault of the belt or its construction.

Cover tears are usually caused by belts running too loose, allowing them to "throw out" and rub other parts of the application. Proper belt tension will prevent this from happening. Check for correct length.

A slight raveling of the belt covering at the splice location does not indicate premature belt damage. Simply cut off loose raveling.

Slip Burn

Slip burns are usually caused by lack of belt tension, wrong size belt, or slipping underload. When a belt grabs, it snaps. Check for a worn pulley. Install a new belt and use the correct tension.

Gouged Edge

A gouged edge in a belt can be caused by a damaged pulley or interference with some other part of the application.

Check the condition of the pulley. Be sure the belt does not rub on any part of the application while operating.

Worn Sides

Badly worn belt sides are a result of long operation without enough tension and/or slip burn. The sides will be worn and slightly burned around the entire circumference.

Check for proper belt tension, and check the pulleys for incorrect alignment.

Excessive Stretch

A belt that stretches excessively is one that stretches beyond the adjustment provided, to take up normal belt stretch. Replace the belt, and check the tension.

Lumpy Belts

Lumpy belts usually occur and are more noticeable on variable speed drives and other high-speed belt installations. The result is excessive vibration. If the belts are not relieved of tension while the engine or vehicle is stored, they will often cause temporary vibration upon start-up. Give them time to straighten out. Use correct storage procedures.

Internal Cord Damage

Damage to one or more of the internal tension cords will result in the belt rolling out of the pulley groove. Cords can be broken by prying a new belt over the pulley.

Improper Length

It is possible that an improper length belt could be installed on an engine. Always check to be certain that the proper length belt is installed.

Unusual Sounds

Squeal

Squeals are most commonly heard during acceleration. Squeals are caused by the belt slipping on the pulley. To correct squeal, check belt tension and pulley alignment. Also check for grease or other contaminants and clean the pulley and replace the belt as necessary.

Squeak

Squeaks usually occur at engine idle speed and sound like a bird chirping. They are most common with a sheet steel pulley and they most frequently appear on cold, damp mornings. Squeaks are often mistaken for belt squeal, which is usually belt slippage. Belt squeak is harmless, however belt tension and pulley alignment should be checked. DO NOT overtighten belts because of squeak.

Whine

Whine is a high pitch and shrill sound, which may be caused by a ball bearing turning in its housing. Check the fan hub and other driven accessories.

Replace the affected component and adjust the belts to the correct tension.

Engine Vibration

Fan Blade Assembly Damaged

If there are bent or split blades, loose blade or mounting bracket and shaft assembly; replace the blade assembly, tighten the mounting bracket assembly; then check the belts and pulleys for damage and adjust the belt tension.

Lumpy Belts

Lumpy belts are usually found after an engine or vehicle has been in storage for an extended period of time. Use proper storing procedures for belts. See "Storing Drive Belts" later in this section.

Uneven Belt Wear-Wear on One Side Only

Misalignment of pulleys will allow continual wear of belts on one side. Loose engine mounts may also contribute to this wear pattern.

Inspect

1. Pulley sheaves for a rough surface and scratches.
2. Pulley for one wall bent inward.
   - Align the pulleys if necessary.
   - Replace if damaged.

Belt Glazed Excessively

A glazed belt will have a "baked" appearance caused from excessive slippage. It may be caused from one of the following:

1. Insufficient pressure on belt sides—Use correct pulley.
2. Excessive oil on the belt surfaces—Check the bearings and seals and other areas for source of oil.
3. Belt tension incorrect—Tension the belt to "Specification."
4. Installation of optional equipment may prevent long enough belt contact in the pulley sheaves.
5. Pulley binding or pulley shaft bent or binding.

Belt Disintegration

Belt disintegration may be caused by excessive engine speed for belt size and type, pulleys out of alignment, or bent sheaves. Excessive slippage will cause heat buildup in the belt and, if not corrected, it may lead to early belt damage. Check for the correct belt usage and note if the sheaves are bent and if any signs of belt and misalignment or tensioning indicates corrections.

If a belt has been in use in an area of extreme

climatic and temperature changes, has many miles of operation, or several seasons of use, it may begin to fall apart as a normal process of wear.

Belt Flip-Over

Belt flip usually occurs at high speeds. If this happens at a low speed, check for the correct length belt, proper tension, and correct pulleys. High speed flip-over will usually be due to pulley misalignment.

INSPECTION AND REPLACEMENT

When replacing dual or triple drive belts, the entire set must be replaced at the same time. Belts are available in matched sets only. Never install one belt from a different set of matched belts; install a complete matched belt set.

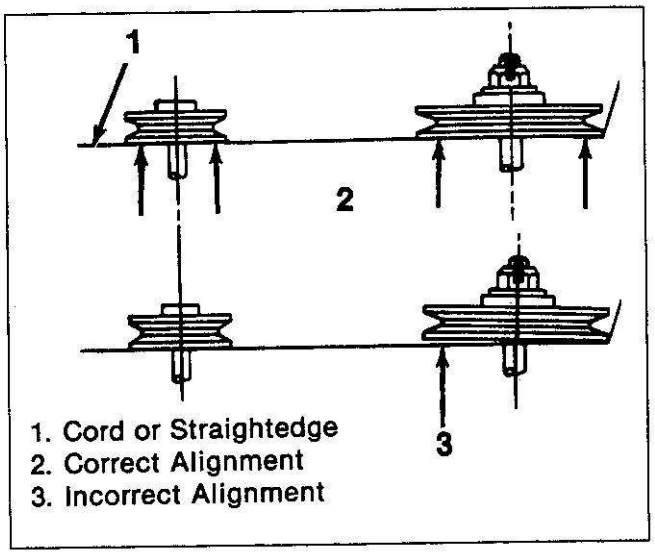


Figure 8. Pulley Alignment

Inspect

1. Pulleys for chips, nicks, tool marks, cracks, bent sidewalls, rust, corrosion, or other damage.
2. Belts for cracks, fabric rupture, tears, fraying, or other damage.
3. Pulley alignment (figure 8).
   - Place a straightedge, or position a cord line across both pulleys so that they touch at all points.
   - Turn each pulley a half revolution and recheck with a straightedge or cord. Full contact at all points should still be made. If contact is not made at all points, the pulley may be warped or a shaft bent. Replace any damaged parts.

Refer to "Diagnosis of Belts" earlier in this section.

Replacement

Important

- On some installations, several accessories may be driven from a multiple groove crankshaft pulley, and the replacement of any one inside drive belt will make it necessary to rmove all the outside belts first.
- On some installations when special equipment has been installed or other accessories relocated, it may be necessary to remove these items to replace the drive belts.
- Use J-23600-B, Belt Tension Gage to adjust the drive belts required for other system components.

Remove or Disconnect

1. Pulley tension to the position of most slack in the belt.
2. Belts.

Inspect

1. Pulleys. See "Inspect" earlier in this section.
2. Pulley alignment. See "Inspect" earlier in this section.
3. Belts for wear or damage.

Install or Connect

- Belts into the pulley grooves by hand.

Important

- Do not force a belt into a pulley groove by prying with a screwdriver, crowbar, or other wedge type of tool. Prying a belt into position can damage both the belt and drive components.

Adjust

- Belt tension. See "Belt Tension Adjustment" following.

BELT TENSION ADJUSTMENT

To carry their full load, drive belts must grip the entire area of contact with the pulley. When operated in a loose condition, belts can slip, tear, burn, or grab and snap. More belts fail from undertightening than from overtightening.

When operated in too tight a condition, belts can damage the engine by causing side loading on the crankshaft, crankshaft bearings, and accessories or accessory bearings. Excessive tension will also stretch and weaken the belts.

After a belt has been in operation about 15 minutes, it is considered used. When drive belts are worn, they should be replaced as overtightening will not prevent slippage and can cause damage to the bearings. Check the belts at every other oil change or at 6,000 mile (9,000 km) intervals. Also at that time, check all accessory mounting or adjusting bracket bolts. Tighten as necessary to correct torque.

DO NOT use belt dressings for longer belt life. Most dressings contain chemicals which tend to soften the belts. This softening process will temporarily increase the friction between the belt and pulley grooves.

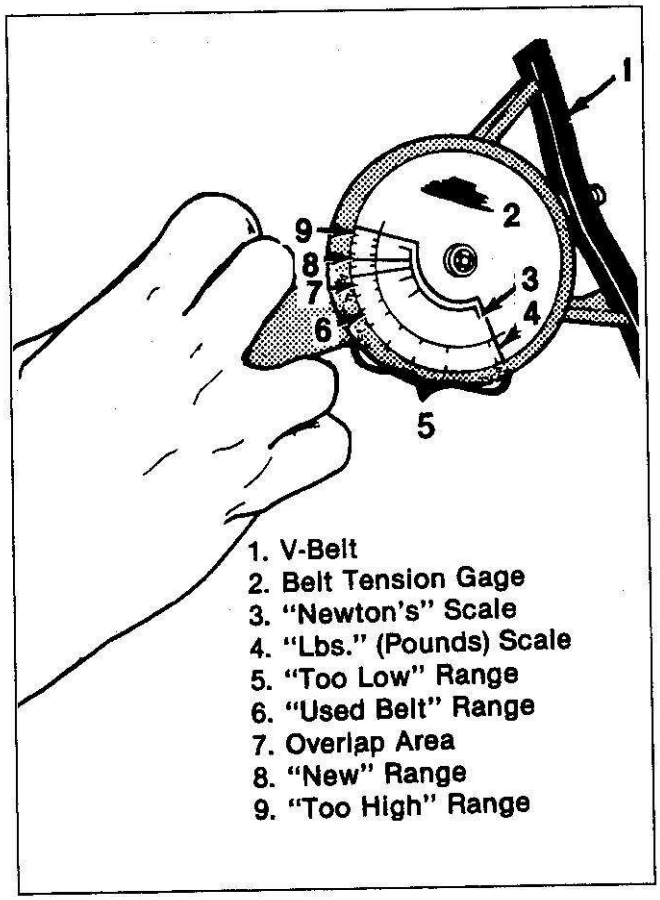
Adjust

Tool Required:
J-23600-B, Belt Tension Gage.

- V-belt tension to the following chart.

V-Belt Tension Chart

	Two Pulleys	Three or More Pulleys
New	400–440N	530–620N
	90–100lb	120–140lb
Used	350–400N	440–530N
	80–90lb	100–120lb



1. V-Belt
2. Belt Tension Gage
3. "Newton's" Scale
4. "Lbs." (Pounds) Scale
5. "Too Low" Range
6. "Used Belt" Range
7. Overlap Area
8. "New" Range
9. "Too High" Range

Figure 9. Using V-Belt Tension Gage

CLEANING AND STORAGE

Cleaning Drive Belts

Clean the belts by wiping them with a clean cloth. Use a non-flammable cleaner or solvent to remove excess grease and oil. Water and detergent soap can also be used.

CAUTION: Do not attempt to clean the belts while the engine is running. Belts may "grab" cleaning equipment and damage belts or personal injury may result. Do not use flammable cleaning solvents. Possible accidental ignition of flammables can cause personal injury.

Remove all grease and oil from belts as soon as possible to prevent damage to belts.

Storing Drive Belts

The proper storage of belts is important to belt life.

1. Store belts in a clean, cool, dry location. Do not store belts on a damp floor or near heat radiators or they can shrink and deteriorate.
2. Keep belts away from sunlight and heat.
3. Do not pile belts in bins for long periods of time. This can distort the belts.
4. Do not hang heavy belts on small pegs or nails. Heavy belts can become weakened and distorted.
5. Do not break up matched sets.

If a vehicle or engine is to be stored for a long period of time, do the following:

Vehicle or Engine Storage

- Remove the all belts, if practical.
- Clean the belts as described earlier.

Important

- Store belts in a clean, cool, dry location out of direct sunlight.
- Lubricate pulley grooves where belts have been removed with an anti-rust compound or grease.
- Be sure to remove rust preventative before installing the belts.

Important

If the belts are not removed from the engine, relieve the belt tension by loosening the proper accessory or adjusting brackets. This will prevent the belts from "setting" or developing unequal stresses, which could lead to early failure.

NOTICE: When replacing the fan and generator belts on the NPR/W4 with the automatic transmission, a notch is incorporated into the lower fan shroud just below the engine-to-shroud mounting bracket on the driver's side to facilitate belt removal. The cooling fan does not need to be removed.

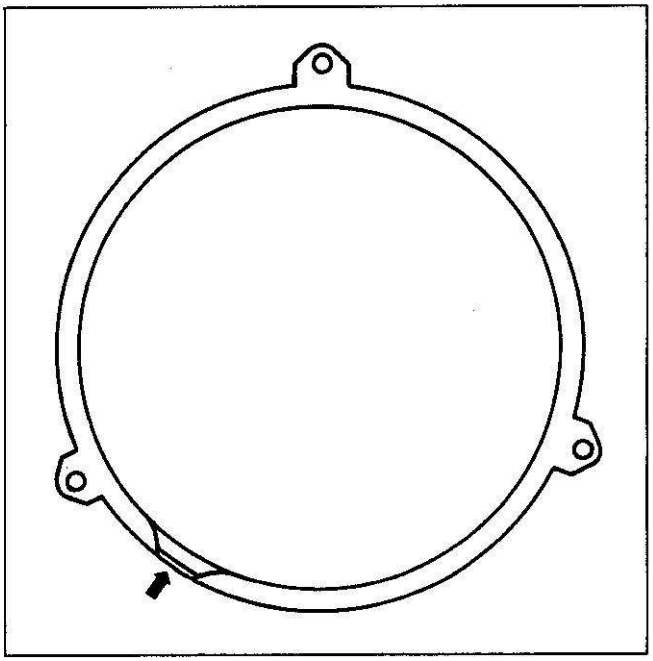


Figure 10. Fan shroud notch for belt removal

SPECIFICATIONS

FASTENER TORQUES

Fan to Fan Clutch Bolts	8 N·m(69 lb·in)
Fan Clutch Plate to Fan Clutch Bolts	19 N·m (14 lb·ft)
Fan Clutch Plate and Pulley to Water Pump Bolts	19 N·m (14 lb·ft)

SPECIAL TOOLS

J-6742-0	Dial-Type Thermometer
J-23600-B	Belt Tension Gage