COOLING SYSTEM

GROUP 11

PART 11-1 GENERAL COOLING SYSTEM SERVICE

1 DIAGNOSIS AND TESTING

DIAGNOSIS

Engine overheating and slow engine warm-up are the two engine troubles most commonly attributed to the cooling system.

Loss of coolant, thermostat stuck in closed position, or the accumulation of rust and scale in the system are the main causes of overheating. Coolant loss may be caused by external leakage at the radiator, radiator supply tank, water pump, hose connections, heater and core plugs. Coolant loss may also be caused by internal leakage due to a defective cylinder head gasket, improper tightening of the cylinder head bolts, or a warped cylinder head or cylinder block gasket surface.

Internal leakage can be detected by operating the engine at fast idle and looking for the formation of bubbles in the radiator supply tank. Oil in the radiator supply tank may indicate leakage in the engine block or a leak in the automatic transmission oil cooler. Water formation on the oil level dipstick could be an indication of internal leakage.

Rust and scale that form in the engine coolant passages are carried into the radiator passages by the circulation of the coolant. This clogs the radiator passages and causes overheating. Rust can be detected by the appearance of the coolant. If the coolant has a rusty or muddy appearance, rust is present.

A defective thermostat that remains open will cause slow engine warm-up.

DIAGNOSIS GUIDE

ENGINE OVERHEATS	Insufficient coolant. Belt tension incorrect. Radiator fins obstructed. Thermostat stuck closed.	Cooling system passages blocked by rust, scale, or other foreign matter. Water pump inoperative. Faulty fan drive clutch.
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE	Thermostat stuck open, or of incorrect heat range. Temperature sending unit defective (causing gauge to indicate low engine temperature).	Temperature gauge defective (not indicating true engine temperature).
LOSS OF COOLANT	Leaking radiator or radiator supply tank. Loose or damaged hose connections. Water pump leaking. Cylinder head gasket defective. Improper tightening of cylinder head bolts.	Cylinder block core plugs leaking. Cracked cylinder head or block, or warped cylinder head or block gasket surface. Radiator pressure cap defective or wrong type.

TESTING

COOLING SYSTEM PRESSURE TEST

It is recommended that a cooling system pressure test gauge be used to properly test the system for:

1. Blown or leaking cooling system sealing gaskets.
2. Internal or external coolant leakage.
3. Pressure cap malfunction.

Many types of pressure gauges are available for use. Therefore, it is recommended that the gauge manufacturer's instructions be followed when performing the test. **Never exceed the rated pressure indicated on the pressure cap when performing the pressure test.**

THERMOSTAT TEST

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open more than ¼ inch.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to a lighted background. Light leakage around the thermostat valve (thermostat at room temperature) is unacceptable and the thermostat should be replaced. It is possible, on some thermostats, that a slight leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

FAN DRIVE CLUTCH TEST

1. Run the engine at approximately 1000 rpm until normal operating temperature is reached. This process can be speeded up by blocking off the front of the radiator with cardboard.

2. Stop the engine and, using a cloth to protect the hand, immediately check the effort required to turn the fan. If considerable effort is required, it can be assumed that the coupling is operating satisfactorily. If very little effort is required to turn the fan, it is an indication that the coupling is not operating properly, and it should be replaced.

2 MAINTENANCE

COOLANT

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes keeping the radiator fins clean and a periodic inspection of the cooling system for leakage.

Use care when removing the radiator cap to avoid injury from escaping steam or hot water.

In production, the cooling system is filled with a new long-life coolant which prevents corrosion and keeps the cooling system clean for best operation summer and winter. This coolant protects to −35° F. It will not be necessary to provide special anti-freeze protection except in areas where temperatures fall below this level.

In areas where lower temperature protection is necessary, refer to the coolant mixture chart on the Ford Rotunda coolant can for the recommended mixture proportions. **Do not mix permanent-type anti-freeze with the methanol type.**

In areas where protection to −35° F. is not required, but some protection is necessary, refer to the coolant mixture chart on the Ford Rotunda coolant can for the recommended mixture proportions. Whenever the cooling system is completely refilled, add Rotunda Radiator Rust Inhibiter.

A standard ethylene glycol hydrometer can be used to check the protection level of long-life coolant.

Refer to Group 19 for the cooling system drain interval.

DRAINING AND FILLING THE COOLING SYSTEM

To prevent loss of anti-freeze when draining the radiator, attach a hose on the radiator drain cock, and drain the anti-freeze into a clean container.

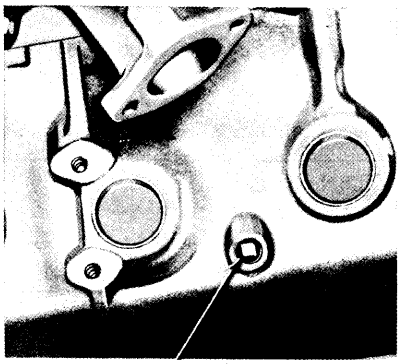

FIG. 1—Typical Cylinder Block Drain Plug

To drain the radiator, open the drain cock located at the bottom corner of the radiator. Drain the cylinder block by removing the drain plugs located on both sides of the block (Fig. 1).

To fill the cooling system, close the radiator drain cock and replace the drain plugs. Disconnect the heater outlet hose at the water pump, to bleed or release trapped air from the system. Fill the system until the coolant begins to flow from the heater outlet hose, then connect the heater outlet hose. Fill the supply tank to a point 1″ below the bottom of the filler neck. Operate the engine until normal operating temperature has been reached. **After the initial fill, the coolant level will drop approximately 1 quart after the engine has been operated about 20 minutes at 2000 rpm. This is due to the displacement of entrapped air.** Add more coolant to fill the radiator supply tank.

FAN DRIVE BELTS

If the fan drive belts are noisy, check the tension of the belts to make certain they are within specifications. Also, check for misaligned pulleys. If the drive belts are worn or frayed, replace them following the procedures in Part 11-1, Section 3.

3 COMMON ADJUSTMENTS AND REPAIRS

ADJUSTMENTS

FAN BELT TENSION

The fan belts should be properly adjusted at all times. Loose belts cause improper alternator, fan and water pump operation. A belt that is too tight places a severe strain on the water pump and the alternator bearings.

1. Install the belt tension tool on the drive belt and check the tension, following the instructions furnished by the tool manufacturer (Fig. 2).

2. If adjustment is necessary, loosen the alternator mounting bolts and the alternator adjusting arm bolt. Move the alternator toward or away from the engine until the correct tension is obtained (see specifications). Remove the gauge. Tighten the alternator adjusting arm bolt and the mounting bolts. Install the tension gauge and check the belt tension (Fig. 2).

Tool—T63L-8620-A

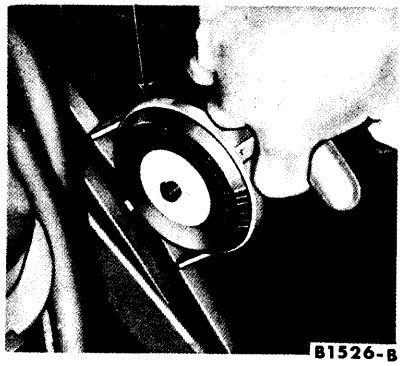

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FIG. 2—Checking Drive Belt Tension

REPAIRS

FAN REPLACEMENT

On a car with an air conditioner, a fan drive clutch is used. Cars without air conditioning utilize a pulley-to-fan spacer.

1. Remove the fan guard. Remove the capscrews and lock washers retaining the fan and spacer (or drive clutch) to the water pump hub. Remove the fan and spacer (or drive clutch).

2. If equipped with a fan drive clutch, remove the retaining capscrews and lock washers and separate the fan from the drive clutch. Position the replacement fan on the drive clutch and install the lock washers and capscrews.

3. Position the fan and spacer (or drive clutch) on the water pump hub and install the lock washers and capscrews. Torque the capscrews to specification. Then, check the fan drive clutch flange-to-water pump hub for proper mating. Install the fan guard.

FAN BELT REPLACEMENT

1. Loosen the power steering pump bracket at the water pump and remove the drive belt.

On a car with an air conditioner, remove the compressor drive belt.

2. Loosen the alternator mounting bolts and the alternator adjusting arm bolt. Move the alternator toward the engine. Remove the belts from the alternator and crankshaft pulleys, and lift them over the fan.

3. Place the belts over the fan. Insert the belts in the water pump pulley, crankshaft pulley, and alternator pulley grooves. Adjust the belt tension to specifications.

4. On a car with an air conditioner, install and adjust the compressor drive belt to specifications.

5. Install the power steering pump drive belt and tighten the pump bracket to the water pump. Adjust the drive belt tension to specifications.

RADIATOR HOSE REPLACEMENT

Radiator hoses should be replaced whenever they become cracked, rotted or have a tendency to collapse.

1. Drain the radiator, then loosen the clamps at each end of the hose to be removed. Slide the hose off the radiator connection and the radiator supply tank connection (upper hose) or the water pump connection (lower hose).

2. Position the clamps at least ⅛ inch from each end of the hose. Slide the hose on the connections. **Make sure the clamps are beyond the bead and placed in the center of the clamping surface of the connections.** Tighten the clamps. Fill the radiator with coolant. Operate the engine for several minutes, then check the hoses and connections for leaks. Check for proper coolant level after the engine has reached normal operating temperature.

4 CLEANING AND INSPECTION

CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use either FoMoCo Regular Cooling System Cleanser or in severe cases use Heavy Duty Cleanser. Removal of such material restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head bolts are properly tightened to prevent possible water leakage into the cylinders.

Always remove the thermostat prior to pressure flushing.

A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

CONTROL PISTON

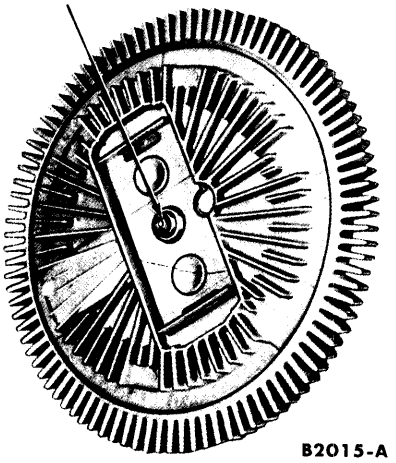

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FIG. 3—Control Piston Installed

WATER PUMP

1. Clean the gasket mounting surfaces of the water pump and cylinder block.

2. Clean and inspect the seal seating surface of the water pump.

3. Clean the pump housing and inspect it for cracks, sand holes, improper machining, and damaged surfaces. If the water pump housing is damaged beyond repair, replace the complete water pump.

FAN DRIVE CLUTCH

Check the control piston for free movement in the coupling. If the control piston sticks, remove the

piston and clean it with emery cloth.

For fan drive clutch test procedures, refer to Part 11-1, Section 1.

Check the bi-metallic strip, and if it is damaged, replace the complete fan drive clutch assembly. Bi-metallic strips are not interchangeable. Be sure to install the bi-metallic strip with the identification stamp "B-1" facing the fan drive clutch.

After the fan drive clutch is assembled, clean the drive with a clean cloth and solvent. **The fan drive clutch should not be dipped in any liquid.**

PART 11-2 WATER PUMP

1 DESCRIPTION AND OPERATION

A centrifugal-type water pump is mounted on the front of the cylinder block. The water pump inlet port is connected to the bottom of the radiator left header tank to draw coolant from the radiator when the thermostat is open. A by-pass port on the water pump is connected to the intake manifold coolant passage to permit coolant circulation within the engine when the thermostat is closed, bypassing the radiator.

A vane-type, cast-iron impeller supplies coolant through centrifugal action to the water pump outlet ports. Two outlet ports, one for each cylinder bank, provide uniform coolant circulation in the engine cooling passages.

The water pump has a sealed bearing integral with the water pump shaft. The bearing requires no lubrication. The hole in the water pump housing is a bleed hole to allow water that may leak past the seal to be thrown out by the slinger. **This is not a lubrication hole.**

The cooling fan hub is pressed a specified distance onto the water pump shaft.

2 REMOVAL AND INSTALLATION

REMOVAL

1. Drain the cooling system.
2. Disconnect the power steering pump bracket from the water pump and remove the drive belt. Wire the power steering pump assembly to the left side of the car in a position that will prevent the oil from draining out.

On a car with an air conditioner remove the compressor drive belt.

3. Remove the alternator adjusting arm bolt at the alternator and loosen the adjusting arm bolt at the water pump. Loosen the two alternator mounting bolts at the bracket. Move the alternator inward and remove the fan belt. Remove the fan, spacer and pulley.

On an engine equipped with a fan drive clutch, remove the capscrews retaining the fan drive clutch to the water pump hub. Remove the fan drive clutch and fan as an assembly. Remove the water pump pulley.

4. Disconnect the radiator lower hose and heater hose at the water pump.
5. Remove the alternator bracket retaining bolt at the water pump. Loosen the alternator bracket retaining bolt at the cylinder block, and move the bracket away from the water pump.
6. Loosen and move the water pump bypass hose front clamp to the rear. Remove the bolts retaining the water pump to the block, and remove the water pump assembly and gaskets.
7. Remove the alternator adjusting arm retaining bolt and remove the arm from the pump.

INSTALLATION

Before the water pump is installed, check it for damage. If it is damaged and requires repair, replace it with a new pump or install a rebuilt pump obtained from a Ford-Authorized Reconditioner.

1. Install the alternator adjusting arm, fan, spacer, and pulley on the water pump.

On an engine equipped with a fan drive clutch, position the pulley, fan drive clutch and fan on the water pump hub. Install the retaining capscrews and torque to specifications. After the capscrews have been torqued, check the fan drive clutch flange-to-water pump hub for proper mating.

2. Remove all the gasket material from the mounting surfaces of the water pump and the cylinder block. Position new gaskets, coated on both sides with water-resistant sealer, on the cylinder block, then install the pump. Tighten the retaining bolts evenly and alternately to avoid fracturing the bosses.
3. Position the water pump bypass hose front clamp. Install the alternator mounting bracket to the pump; then tighten the alternator mounting bracket bolt at the cylinder block.
4. Connect the radiator lower hose and heater hose.
5. Position the fan belts over the pulleys and install the alternator adjusting arm bolt at the alternator. Adjust the belt tension to specifications, and tighten the alternator adjusting arm bolts and the mounting bolts at the bracket.
6. On a car with an air conditioner, install and adjust the compressor drive belt to specifications.

Install the power steering pump drive belt and attach the pump bracket to the water pump. Adjust the drive belt tension to specifications.

7. Fill and bleed the cooling system. Operate the engine until normal operating temperature has been reached, then check for leaks.

PART 11-3 RADIATOR, SUPPLY TANK AND THERMOSTAT

1 DESCRIPTION AND OPERATION

RADIATOR

The radiator is of the tube and corrugated-fin-core type with the tubes arranged horizontally for cross-flow of the coolant. Two header tanks, one on each side of the radiator (Fig. 4), provide uniform distribution of the coolant to the cross-flow tubes. The header tank, or chamber, on the left side of the radiator contains a heat exchanger for cooling the transmission fluid. The radiator outlet port (lower left side) is connected to the water pump inlet port.

SUPPLY TANK

A separate radiator supply tank (Fig. 4) is connected to the radiator inlet port to control coolant surging and provide a pressure chamber for the pressurized cooling system. The inlet port of the supply tank is connected to the intake manifold coolant passage at the thermostat, thereby permitting coolant circulation through the supply tank and radiator when the thermostat is open.

THERMOSTAT

A poppet-type thermostat is mounted in a recess in the coolant outlet passage of the intake manifold. When the thermostat is closed, coolant flows to the water pump through a bypass passage at the front of the intake manifold.

The thermostat used in production is for use with water or permanent-type anti-freeze. A lower temperature thermostat is also available for use with non-permanent-type anti-freeze or water. For operating temperatures, refer to the specifications.

Do not attempt to repair the thermostat. It should be replaced if it is not operating properly.

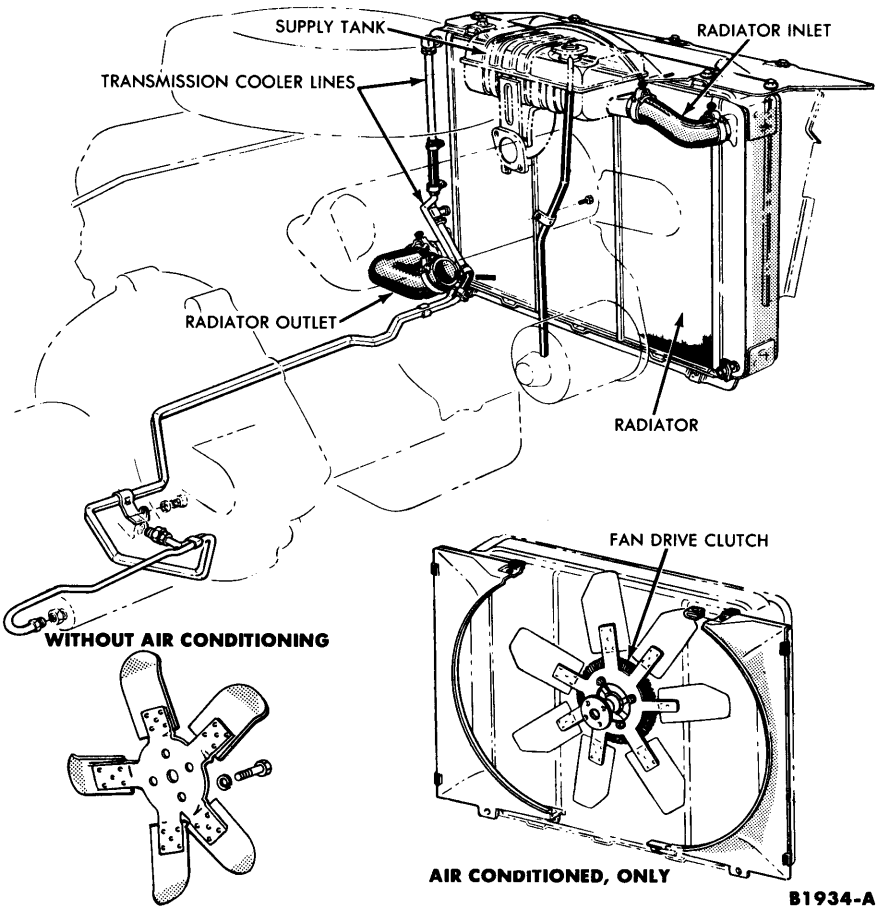

FIG. 4—Radiator and Supply Tank

2 REMOVAL AND INSTALLATION

RADIATOR

REMOVAL

1. Drain the cooling system.
2. Remove the radiator upper support.
3. If equipped with an air conditioner, remove the fan shroud retaining screws and position the shroud out of the way.
4. Disconnect the radiator upper and lower hoses at the radiator.
5. Disconnect the transmission oil cooler inlet and outlet lines at the radiator.
6. Remove the radiator upper and lower support bolts; then remove the radiator. The radiator supply tank need not be removed unless required.

INSTALLATION

1. If a new radiator is to be installed, remove the drain cock from

the old radiator and install it on the new radiator.

2. Position the radiator in the chassis and install and tighten the support bolts.

3. Connect the transmission oil cooler inlet and outlet lines.

4. Connect the radiator upper and lower hoses.

5. If equipped with an air conditioner, install the fan shroud.

6. Install the radiator upper support.

7. Close the drain cock. Fill and bleed the cooling system. Operate the engine and check for coolant leaks. Check the transmission oil cooler lines for leakage. Check the transmission fluid level.

RADIATOR SUPPLY TANK

REMOVAL

1. Drain the cooling system so that the coolant level is below the radiator supply tank. Disconnect the radiator upper hose at the radiator supply tank (Fig. 4).

2. Remove the supply tank retaining screws. Remove the supply tank. Remove the thermostat and gasket from the supply tank.

INSTALLATION

1. Remove all the gasket material from the mounting surfaces of the supply tank and the intake manifold. Coat a new supply tank gasket with sealer, then position the gasket on the intake manifold opening. **The supply tank gasket must be positioned on the manifold before the thermostat is installed.**

2. Install the thermostat in the manifold opening with the copper pellet or element toward the engine. **If the thermostat is improperly installed it will cause the engine to overheat.**

3. Position the supply tank against the manifold; then install and torque the retaining screws to specifications.

If a new tank is installed, remove the overflow hose from the old tank and install it on the new tank.

4. Connect the radiator upper hose. Fill and bleed the cooling system. Check for leaks and proper coolant level after the engine has reached normal operating temperature.

THERMOSTAT REPLACEMENT

To remove or install the thermostat, refer to "Radiator Supply Tank Removal or Installation."

Check the thermostat before installing it, following the procedure under "Thermostat Test."

PART 11-4 FAN DRIVE CLUTCH

1 DESCRIPTION AND OPERATION

The fan drive clutch (Fig. 5) is a fluid coupling containing silicone oil. Fan speed is regulated by the torque-carrying capacity of the silicone oil. The more silicone oil in the coupling the greater the fan speed, and the less silicone oil the slower the fan speed.

A bi-metallic strip and control piston on the front of the fluid coupling regulates the amount of silicone oil entering the coupling. The bi-metallic strip bows outward with an increase in surrounding temperature and allows a piston to move outward. The piston opens a valve regulating the flow of silicone oil into the coupling from a reserve chamber. The silicone oil is returned to the reserve chamber through a bleed hole when the valve is closed. Therefore, when the air passing through the radiator becomes hotter, the fan speed increases, and as the temperature decreases, the fan slows down.

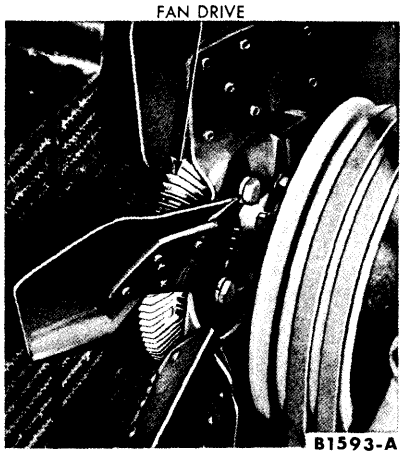

FIG. 5—Fan Drive Clutch

The input side of the coupling is attached to the water pump hub and the fan is attached to the output side. Fins are cast integrally on the exterior of the fluid coupling to dissipate the heat generated by the shearing action of the silicone oil.

2 REMOVAL AND INSTALLATION

REMOVAL

1. Remove the radiator upper support.
2. Remove the capscrews retaining the fan drive clutch to the water pump hub (Fig. 5). Remove the fan drive clutch and fan as an assembly.
3. Remove the retaining capscrews and separate the fan from the fan drive clutch.

INSTALLATION

1. Position the fan on the fan drive clutch and install the retaining capscrews.
2. Position the fan drive clutch and fan assembly to the water pump hub (Fig. 5). Install and tighten the retaining capscrews.
3. Install the radiator upper support.

3 MAJOR REPAIR OPERATION

DISASSEMBLY

1. Remove the bi-metallic strip (Fig. 6) by pushing one end of the strip toward the fan clutch body so that it clears the retaining bracket. Then push the strip to the side so that the opposite end of the strip will spring out of the bracket.
2. Remove the control piston.

CLEANING AND INSPECTION

For cleaning and inspection procedures, refer to Part 11-1.

ASSEMBLY

The fan drive clutch assembly is shown in Fig. 7.

1. Install the control piston (Fig. 3) so that the projection on the end of the piston will contact the bi-metallic strip.
2. Install the bi-metallic strip with the identification stamp "B-1" facing the fan drive clutch.

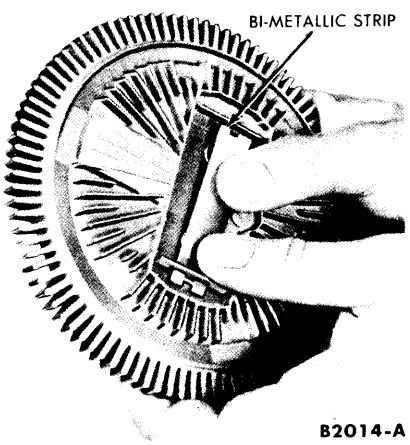

FIG. 6—Fan Drive Clutch Assembly

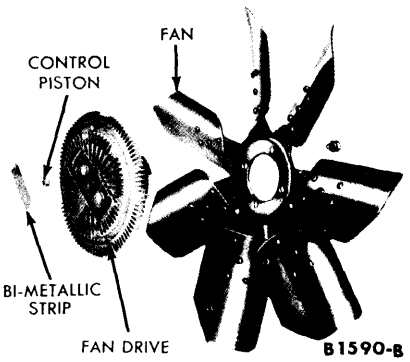

FIG. 7—Fan and Drive Clutch

PART 11-5 SPECIFICATIONS

COOLING FAN

	OUTSIDE DIAMETER	NO. OF BLADES
Standard	18.50 inches	5
Air-Conditioner-Equipped	18.00 inches	7

WATER PUMP

WATER PUMP DRIVE ARRANGEMENT	
Dual belts drive water pump, fan and alternator	
WATER PUMP PULLEY TO ENGINE RATIO	
Standard Cooling and Air-Conditioner-Equipped	0.94:1
WATER PUMP ASSEMBLY DIMENSIONS	
Front Face of Pulley Hub to Pump Housing Face	7.569 inches
Impeller to Housing Cover Mounting Surface Clearance	0.070-0.080 inches

DRIVE BELT TENSION

BETWEEN ALTERNATOR AND WATER PUMP PULLEY (SINGLE BELT)	
New	110-140
*Used	80-110
Minimum Operating Tension	70
BETWEEN ALTERNATOR AND WATER PUMP PULLEY (DUAL BELTS)†	
New—Front	110-140
Rear	105-155
*Used—Front	80-110
Rear	75-120
Minimum Operating Tension	70
BETWEEN WATER PUMP AND AIR COMPRESSOR PULLEY	
New	120-150
*Used	90-120
Minimum Operating Tension	80
BETWEEN CRANKSHAFT AND POWER STEERING PULLEY	
New	120-150
*Used	90-120
Minimum Operating Tension	80

*Belt operated for a minimum of 10 minutes is considered a used belt.

†Dual Belts Used When Equipped With Air Conditioner.

COOLING SYSTEM CAPACITY

	APPROXIMATE CAPACITY* (QUARTS)	
Cooling System	U. S. Measure	Imperial Measure
Standard	19½	16¼

*Add 1 quart extra for heater.

THERMOSTATS

LOW TEMPERATURE	
Opens °F.	157°-164°
Fully Open	184°-188°
HIGH TEMPERATURE	
Opens °F.	192°-199°
Fully Open	219°-221°

TORQUE VALUES

NOTE: All specifications are given in ft-lbs unless otherwise noted.

Water Pump to Cylinder Block	20-25
Water Outlet Housing	12-15
Fan and Spacer to Pulley Hub	12-18
Fan to Fan Clutch (with a/c)	10-15
Fan Drive Clutch to Water Pump Hub	12-18
Fan Shroud Assembly	10-15
Radiator to Front End	10-15
Upper Support to Radiator	4-7
Radiator to Engine Hose Clamps	1.0-2.5
Transmission Oil Cooler Tubes to Radiator	18-25
Hose Clamps	15-20 in-lbs.

SPECIAL SERVICE TOOLS

FORD TOOL NO.	FORMER TOOL NO.	DESCRIPTION
T63L-8620-A	8620-A	Belt Tension Gauge