

Chapter Twelve

Cooling System

This chapter covers service procedures for the thermostat, engine and stern drive lower unit water pumps, seawater pumps and connecting hoses in both standard and closed cooling systems.

Cooling system flushing procedures are provided in Chapter Four. Drain and refill procedures are given in Chapter Five.

Tightening torques (**Table 1**) are at the end of the chapter.

Standard Cooling System

All MerCruiser engines are equipped with a standard cooling system. The water in which the boat is being operated is used as a coolant to absorb engine heat. Water from outside the boat is picked up by an impeller-type pump. All I-Drive models (except V8 engines with closed cooling) use a pump **inside** the stern drive. A belt-driven seawater pump located at the front of the engine is used on all Models II and III instead of the stern drive pump.

The pump sends the water to the engine's water pump (also called a circulating pump) for circulation through the engine block, head(s) and manifold(s). On some models, the water may be

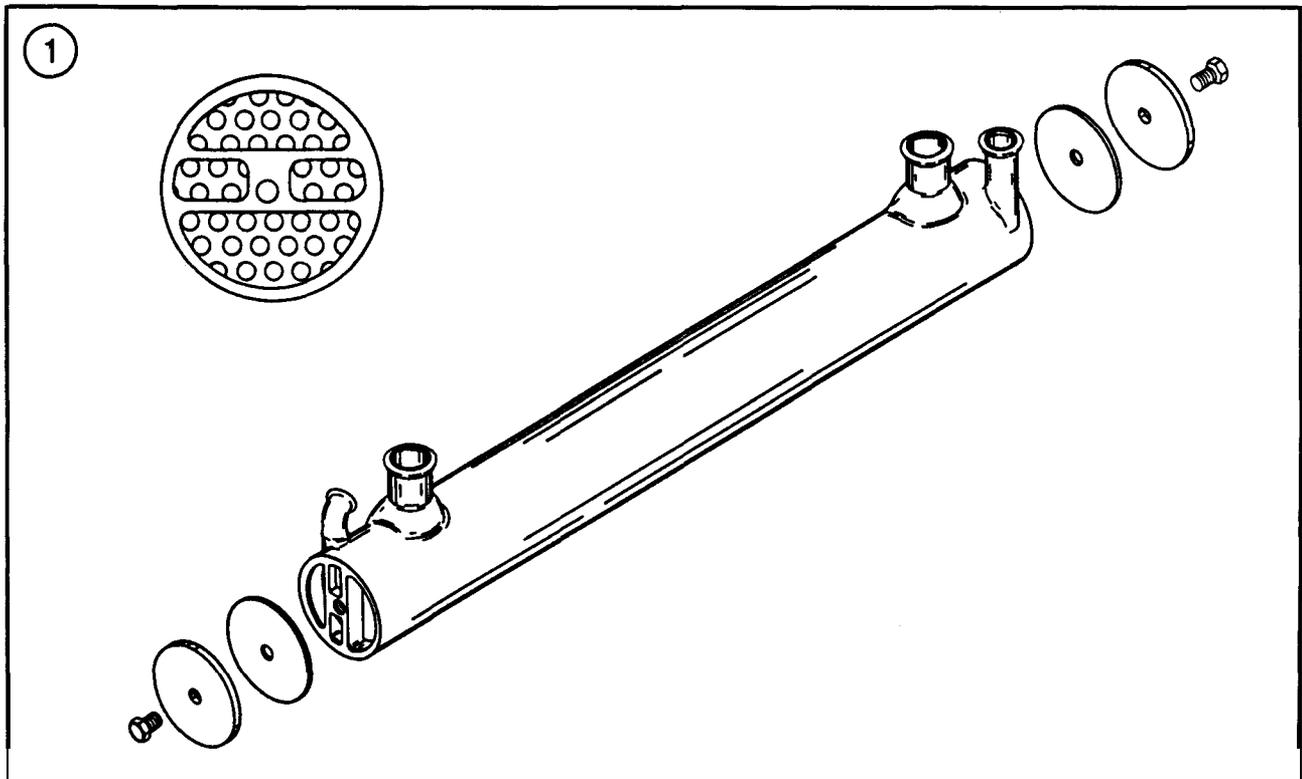
circulated through one or more oil coolers before reaching the engine's water pump. The water absorbs the heat created by engine operation and then enters the exhaust elbow, where it mixes with exhaust gases before being expelled from the boat.

A thermostat controls water circulation to provide quick engine warmup and maintain a constant operating temperature.

Closed Cooling System

MerCruiser engines may also be equipped with a closed cooling system. This cooling system is divided in two separate sub-systems: one uses seawater and the other uses coolant (called "fresh water").

The seawater system operation is similar to the standard cooling system previously described. Water from outside the boat is drawn into the system by a pump in the stern drive on **inline** engine models. V8 engines use a belt-driven seawater pump located at the front of the engine. Instead of passing directly into the engine, however, the water circulates through the power steering, transmission and/or oil cooler(s), if so equipped.



After removing heat from the cooler(s), the water travels through a series of parallel copper tubes in the heat exchanger where it absorbs engine coolant heat before returning to the exhaust elbow(s) for discharge from the boat. **Figure 1** shows a typical heat exchanger design with a cross-section of its interior.

The fresh water system circulates a coolant solution of pure soft water and ethylene glycol antifreeze inside the engine to absorb engine heat. This coolant is then routed to the heat exchanger, where the heat absorbed from engine operation is transferred through the parallel copper tubes to the water in the seawater system.

Engine cooling is thus accomplished without seawater entering the engine. This eliminates the corrosion, build-up of deposits and accumulation of debris which occurs in a standard cooling system, resulting in longer engine life.

Like an automotive cooling system, the fresh water section is pressurized at 14 psi. This raises the boiling point of the coolant to permit higher operating temperatures for increased engine efficiency.

A thermostat controls coolant circulation to provide quick engine warmup and maintain a constant operating temperature.

THERMOSTAT

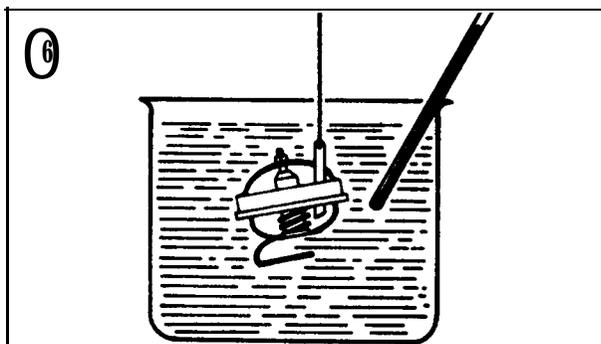
The thermostat blocks coolant flow to the exhaust manifold (standard cooling) or heat exchanger (closed cooling) when the engine is cold. As the engine warms up, the thermostat gradually opens, allowing coolant to circulate through the system.

CAUTION

Do not operate the engine without a thermostat. This can lead to overheating and serious engine damage.

Thermostats are rated according to their opening temperature. **MerCruiser** 470, 485 and 488 models use thermostats which start to open at approximately 160° F and are fully open at 185° F. Thermostats used with all other models start to open at approximately 143° F and are fully open at 168° F. Check the thermostat when removed to determine its opening point; the heat range should be stamped on the thermostat flange.

MerCruiser 470/485/488/170MR/190MR models use 2 different thermostats. While similar in design, the correct thermostat must be used to prevent possible engine damage and assure proper



4. If coolant flows through the housing-to-manifold or housing-to-exhaust elbow hoses before the mark starts to melt, the thermostat is stuck open and should be replaced.

Installation

1. If a new thermostat is being installed, test it as described in this chapter.
2. Clean the thermostat cover or reservoir and housing or manifold mating surfaces of all gasket residue. If a spacer plate is used, clean gasket surfaces on both sides of the plate.
- 3A. Standard cooling systems:
 - a. Install thermostat in housing with thermostatic element facing the engine. The thermostat flange must fit into the housing recess.
 - b. Coat both sides of a new gasket with Perfect Seal (part No. C-92-34227) and install gasket to thermostat cover.
 - c. Install cover and tighten bolts to specifications (Table 1).
- 3B. **In-line** engines, closed cooling systems:
 - a. Install thermostat in housing with thermostatic element facing the engine or

manifold. The thermostat flange must fit into the housing recess.

- b. Coat both sides of a new gasket(s) with Perfect Seal (part No. C-92-34227) and install gasket(s) to reservoir.
 - c. Install reservoir and tighten bolts to specifications (Table 1).
- 3C. Ford V8 blocks with closed cooling system:
- a. Install thermostat in thermostat cover with thermostatic element facing the engine. The thermostat flange must fit into the cover recess.
 - b. Coat both sides of a new gasket with Perfect Seal (part No. C-92-34227) and install gasket to cover.
 - c. If a spacer is used, install spacer to cover/gasket. Coat another gasket and position on spacer.
 - d. Make sure gasket and plate holes align with those in the cover. Install cover assembly to intake manifold and tighten bolts to specifications (Table 1).

NOTE

On 454 cid GM engines, the thermostat housing and cover assembly is reversed from that given in Step 3D.

- 3D. GM V8 blocks with closed cooling system:
- a. Coat both sides of a new thermostat housing gasket with Perfect Seal (part No. C-92-34227).
 - b. Position gasket on intake manifold, then install thermostat housing.
 - c. Install thermostat in housing with thermostatic element facing the engine.
 - d. Position a new cork gasket, then install the retaining sleeve with its rolled-over edge facing downward.
 - e. Coat both sides of a new cover gasket with Perfect Seal. Position gasket on housing and install cover.
 - f. Tighten cover bolts to specifications (Table 1).
4. Reverse Steps 1-3 of *Removal* to complete installation.

HOSE REPLACEMENT

Replace any hoses that are cracked, brittle, mildewed or very soft and spongy. If a hose is in doubtful condition but not definitely bad, replace it to be on the safe side. Hoses in some installations

are definitely difficult to change; attention to hose condition can prevent a failure while you are off-shore.

NOTE

Be sure to use a molded replacement hose. Pleated rubber hoses do not have the same strength as reinforced molded hoses.

Partially drain the seawater section of closed cooling systems when replacing upper hoses. Completely drain it when replacing lower hoses.

CAUTION

Do not pry or apply excessive force to fittings when removing a hose. If necessary, cut the old hose off near the fitting. Slit the portion remaining on the fitting from end to end and peel it off the fitting.

To replace a hose, loosen its clamp nut at each end. Twist the hose to break it free of the fitting and take it off. Clean the fitting of corrosion by wrapping a piece of medium grit sandpaper around it and rotating until the fitting surface is relatively smooth.

CAUTION

Do not use oil or grease as a lubricant to assist in hose replacement. It may cause the rubber to deteriorate.

New hoses can be easily installed by smearing dishwashing liquid on the fitting and the inside the diameter of the hose.

CAUTION

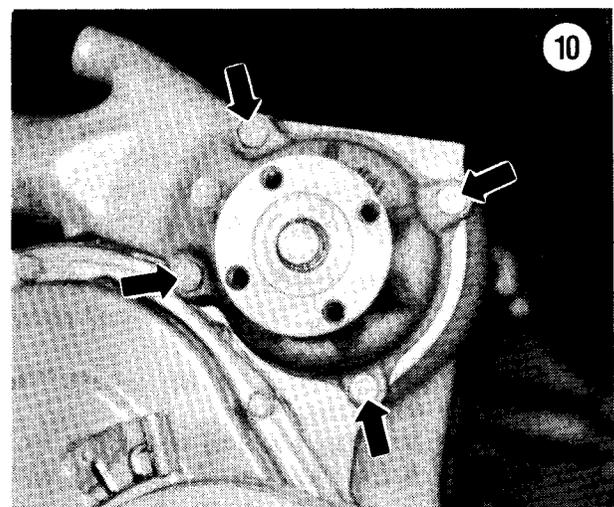
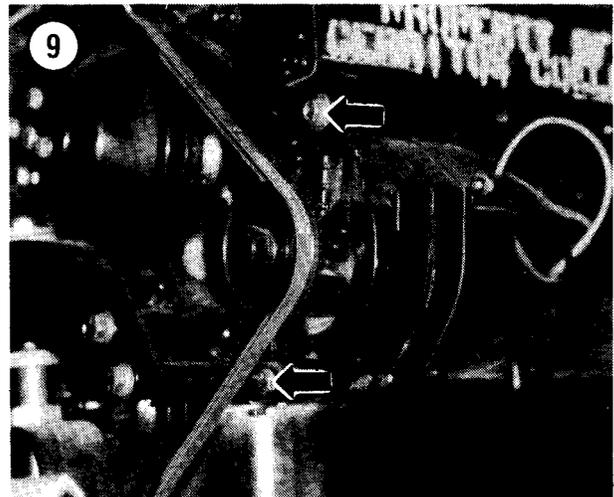
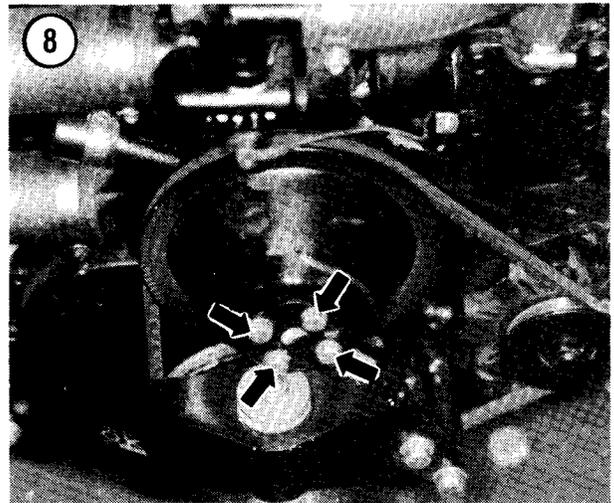
Tighten the hose clamp just enough to compress the end of the hose around the fitting. Overtightening the clamp can cause damage to the hose.

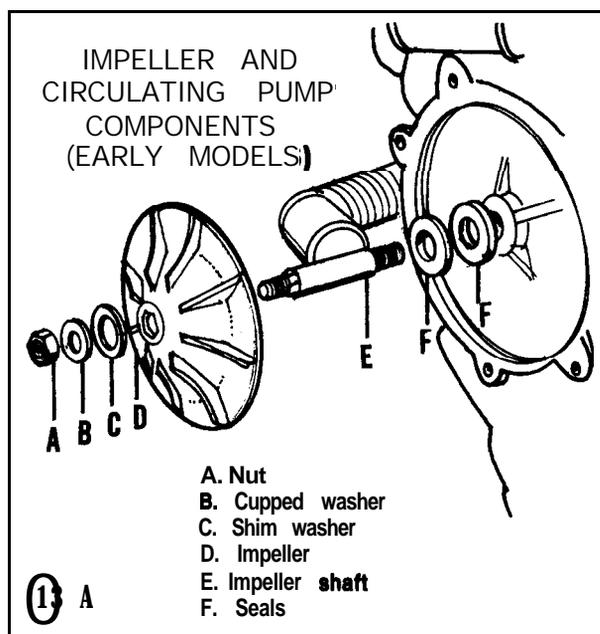
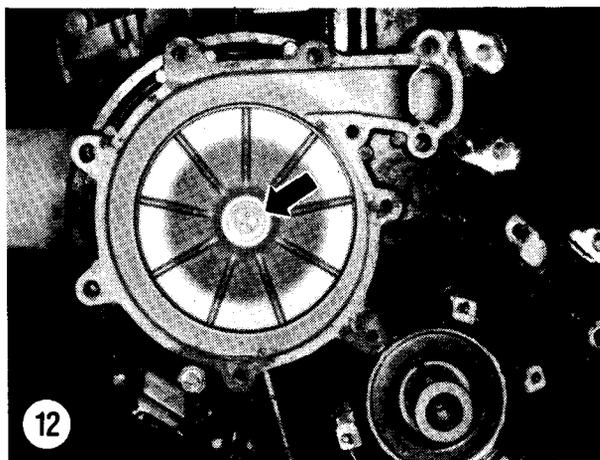
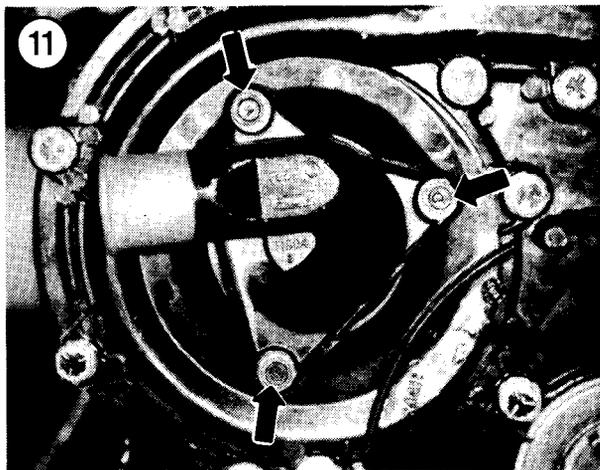
Tighten the hose clamps snugly. Recheck for tightness after operating the engine for a few hours.

ENGINE CIRCULATING PUMP

The circulating pump may warn of impending failure by making noise. If the seal is defective, coolant or water may leak from behind the pump pulley. The pump can be replaced on all models with the engine in the boat.

The pump used on Models 470,485 and 488 is a 2-piece unit, with a replaceable cover attached to the front cover. The pump shaft and impeller are





available as separate replacement items if the pump fails. On all other models, the pump is serviced as an assembly.

Removal/Installation
 (Except MerCruiser 470, 485,488, 170MR and 190MR)

1. Disconnect the negative battery cable.
2. Drain the cylinder block. See Chapter Four.
3. Loosen but do not remove the pump pulley fasteners (Figure 8).
4. Loosen the alternator adjusting bracket and pivot bolts (Figure 9). Swivel alternator toward engine and remove the drive belt.
5. Remove the pump pulley fasteners. Remove the pulley.
6. Disconnect the hose(s) from the circulating pump.
7. Remove pump-to-cylinder block bolts (Figure 10). Remove pump and gasket. Discard the gasket.
8. Clean all gasket residue from pump and engine block mounting surfaces.
9. Installation is the reverse of removal. Tighten all fasteners to specifications (Table 1). Adjust drive belts. See Chapter Thirteen. Fill fresh water section of closed cooling systems with coolant. See Chapter Five. Start engine and check for leaks.

Removal/Installation
 (MerCruiser 470, 485, 488, 170MR and 190MR)

1. Drain fresh water section of closed cooling system. See Chapter Five.

NOTE

If a pyramid-type front engine mount is used, support the engine with an overhead hoist. Remove the front engine mount/bracket assembly to provide access for Step 2.

2. Remove the alternator rotor and stator. See Chapter Ten.
3. Disconnect inlet hose from pump inlet cover.
4. Remove impeller cover fasteners (Figure 11). Remove cover and gasket. Discard the gasket.
5. Remove the impeller fastener (Figure 12).
 - a. On early models, the impeller is attached with a nut (Figure 13A). Turn the nut clockwise (left-hand threads) to remove. Remove the nut, washer, shim and impeller.

- b. On late models, the impeller is attached with a bolt. Turn the bolt counterclockwise (right-hand threads) to remove. Remove the bolt, washer, lockwasher and impeller.

CAUTION

On early models, the impeller shaft (E, Figure 13A) is removable from the camshaft (left-hand threads). On late models (Figure 13B), the impeller is part of the camshaft and cannot be removed. Do not attempt to remove the impeller shaft on late models.

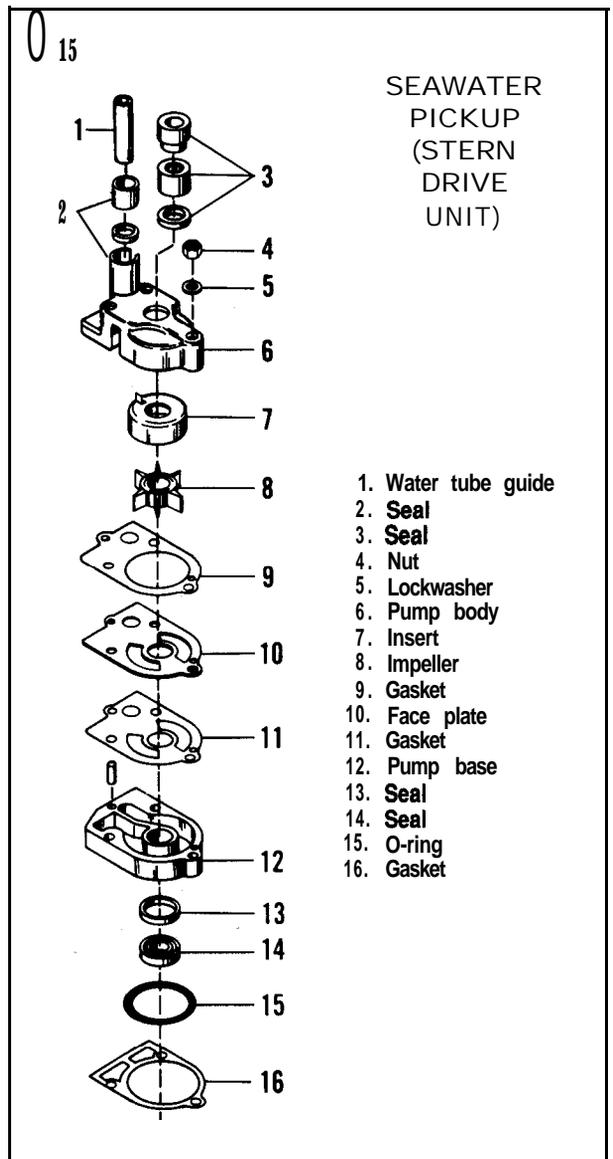
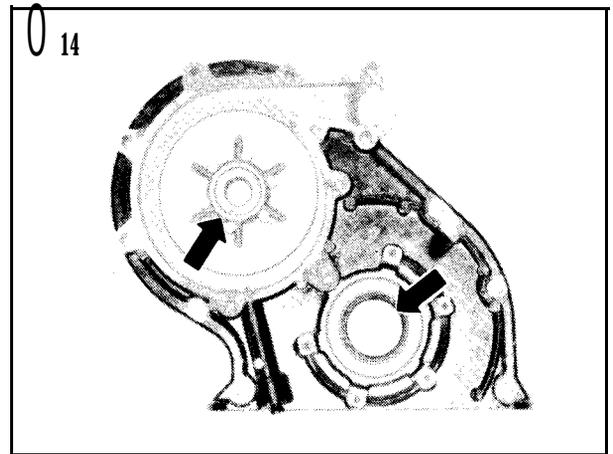
- 6. Early models (impeller attached with a nut)—Unscrew the impeller shaft from the camshaft by turning it clockwise (left-hand threads). Remove the shaft from the front cover.

7A. Early models—If seal replacement is required, remove the old seals (Figure 14) using a slide hammer puller. Coat the outer diameter of the new seals with Loctite 27 1. Install the new seals with their lips facing away from the engine block, as described in Chapter Ten.

7B. Late models—If seal replacement is required, remove the engine front cover and replace the seals as described in Chapter Ten.

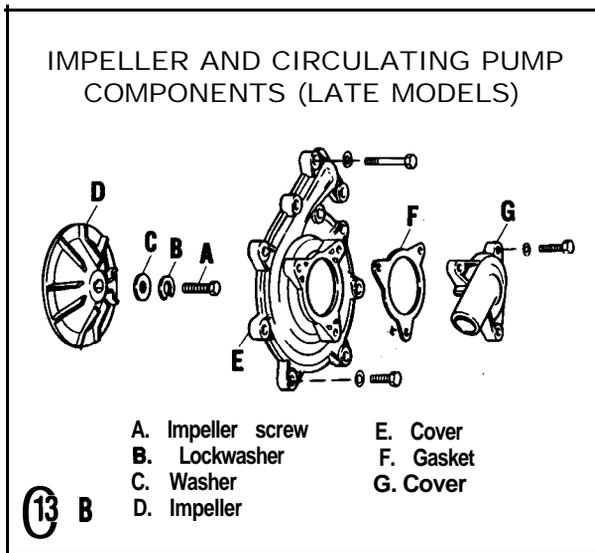
8. Early models—Apply Loctite 680 to the threads on the camshaft end of the impeller shaft: Insert the shaft through the seals and into the camshaft. Turn the shaft counterclockwise until securely tightened.

9A. Early models—Install the impeller, shim washer, cup washer and nut on the impeller shaft. The shim washer fits on the large diameter of the shaft; the hollow side of the cup washer faces the impeller. Tighten the impeller nut to 40 ft.-lb.



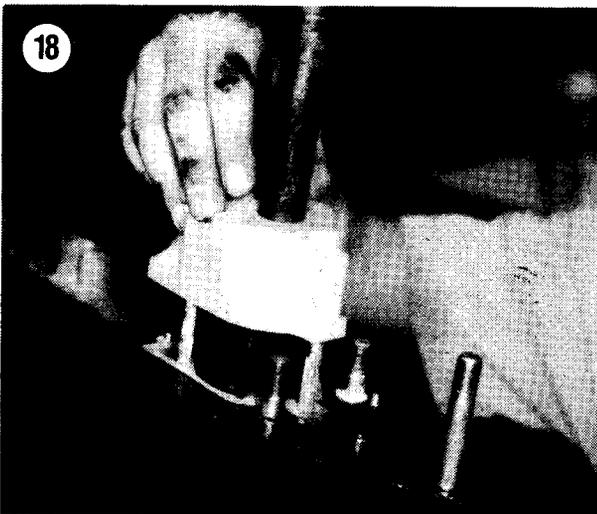
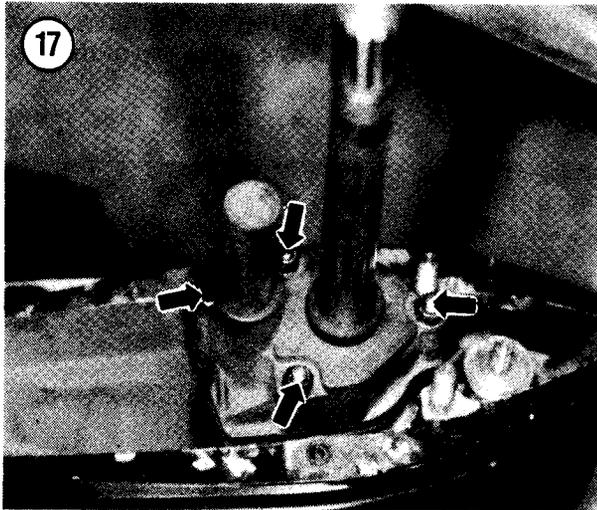
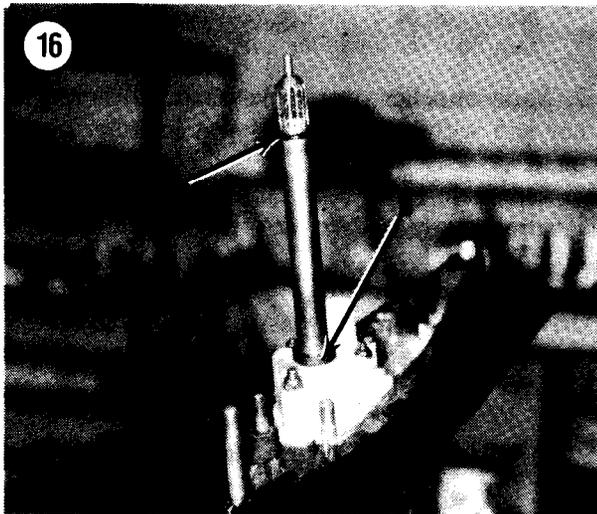
SEAWATER PICKUP (STERN DRIVE UNIT)

- 1. Water tube guide
- 2. Seal
- 3. Seal
- 4. Nut
- 5. Lockwasher
- 6. Pump body
- 7. Insert
- 8. Impeller
- 9. Gasket
- 10. Face plate
- 11. Gasket
- 12. Pump base
- 13. Seal
- 14. Seal
- 15. O-ring
- 16. Gasket



IMPELLER AND CIRCULATING PUMP COMPONENTS (LATE MODELS)

- A. Impeller screw
- B. Lockwasher
- C. Washer
- D. Impeller
- E. Cover
- F. Gasket
- G. Cover



9B. Late models-Install the impeller on the shaft. Place the washer and lockwasher on the bolt. Apply Loctite 271 to the threads of the bolt, then install the bolt and tighten (right-hand threads) to 15 ft.-lb.

10. Coat both sides of a new gasket and wipe the cover bolt threads with Perfect Seal (part No. C-92-34227). Position gasket to front cover and install impeller cover. Tighten cover bolts to specifications.

11. Reverse Steps 1-3 to complete installation. Fill freshwater section of cooling system with coolant. See Chapter Five. Start engine and check for leaks.

**SEAWATER PICKUP PUMP
(STERN DRIVE UNIT)**

This pump is used on all MerCruiser I-Drive models. The stern drive water pump is located in the gear housing (lower unit). **Figure 15** is an exploded view of the pump components.

CAUTION

Whenever the engine is operated, water must circulate through the stern drive or the water pump will be damaged.

Removal

1. Remove the stern drive lower unit. See Chapter Fifteen.
2. Secure the lower unit upright in a vise with protective jaws.
3. Remove the O-ring (A, **Figure 16**) and centrifugal slinger (B, **Figure 16**) from the drive shaft upper end.
4. Remove screw, nuts and washers holding water pump body in place. See **Figure 17**.
5. Insert 2 screwdriver blades in the pry slots provided and pry pump body from base. Slide body off shaft (**Figure 18**).

NOTE

In extreme cases, it may be necessary to split the impeller hub with a hammer and chisel to remove it in Step 6.

6. Remove impeller drive key and impeller. If necessary, drive impeller upward on shaft with a punch and hammer.
7. Remove face plate and gaskets (one on each side). Discard the gaskets.

CAUTION

Work carefully with pry tool in Step 8 to avoid damage to the gear housing mating surface.

8. Pry pump base loose. Remove base from shaft (Figure 19).
9. Remove and discard . base-to-gear housing gasket.

Inspection

1. Clean all metal parts in solvent and blow dry with compressed air, if available.
2. Replace all oil seals in pump base and body units (A, Figure 20) with tool part No. 9 1-44110 or equivalent). Apply Loctite Type A to OD of each new seal before installation. Lip of small seal faces impeller side of base; large seal lip faces gear housing side of base. Pump body seal lip faces upward.
3. Replace the drive shaft if the area where it contacts the oil seal lips is grooved.
4. Check pump impeller blades for wear. Check impeller and hub for proper bonding. An impeller blade with excessively curved blades (3, Figure 20) has taken a "set" and should be replaced.
5. Inspect pump face plate for grooving or other defects. Replace if any defects are found.
6. Replace O-ring on bottom of pump base.

Installation

1. Install a new gasket on the water pump base.
2. Wipe pump base O-ring and oil seal lips with a light coat of Universal Joint Lubricant (part No. C-92-74057A1).
3. Tape drive shaft O-ring groove to prevent seal damage. Slide pump base over drive shaft and into housing.
4. Install a new lower gasket on pump base. Install face plate with its lip facing downward. Install another new gasket on top of face plate.
5. Remove the tape applied in Step 3.
6. Install impeller drive key in shaft slot with Universal Joint Lubricant to keep it in place.

CAUTION

Mercury recommends that the water pump impeller be replaced if removal was required. If the original impeller must be reused, install it in the same rotational direction to avoid premature failure. The curl of the blades should be

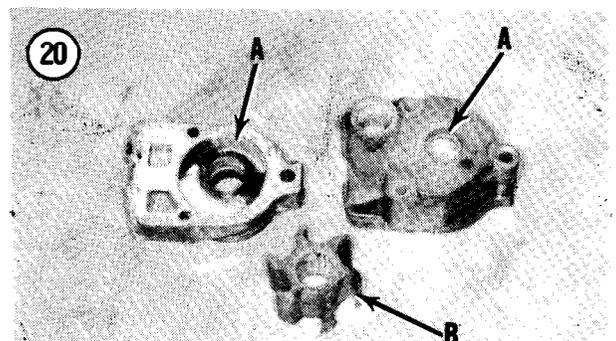
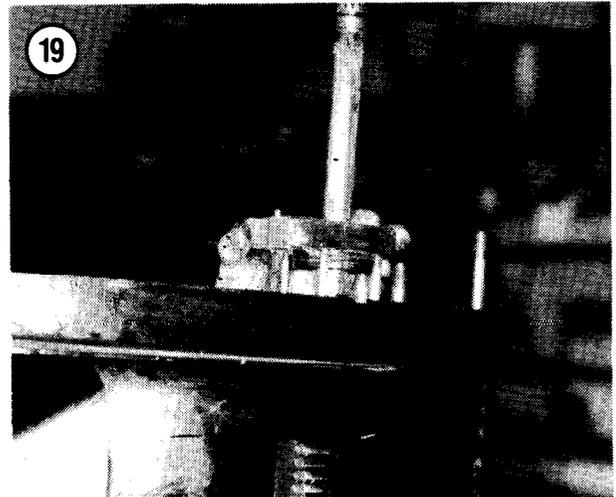
positioned in a counterclockwise direction, as seen from the top of the unit. See Figure 21.

7. Slide impeller over drive shaft, align impeller key slot with shaft key and seat impeller on face plate.
8. Lubricate water pump insert with soapy water. Position pump body over drive shaft and seat on pump studs.
9. Push downward on pump body while rotating drive shaft clockwise to assist impeller in entering the cover.

CAUTION

Proper torque is required in Step 10 or the water pump may fail prematurely.

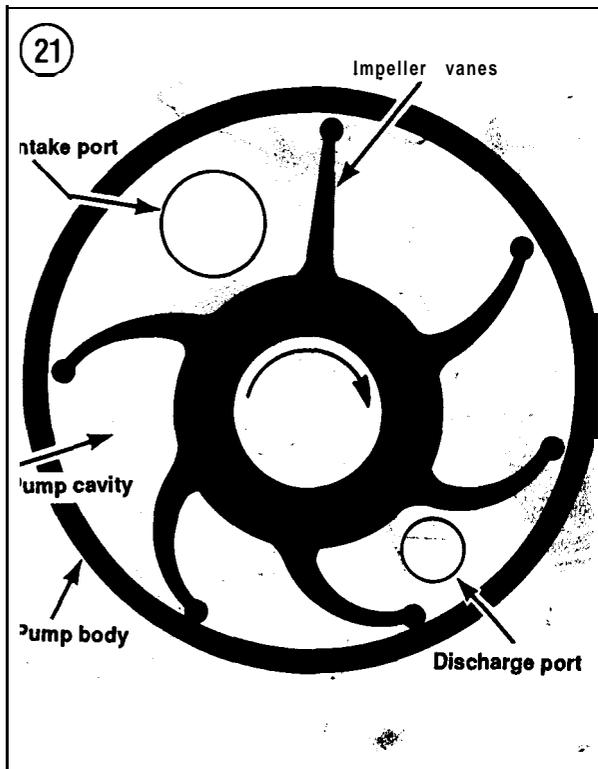
10. Install pump body fasteners. Tighten aft bolt and nuts, then the forward nut to specifications.
11. Install centrifugal slinger and -drive shaft O-ring. Install a new O-ring at the top of the drive shaft.



12. Install the stern drive lower unit. See Chapter Fifteen.

SEAWATER ENGINE PUMP

A seawater pump may be found on V8 engines regardless of cooling system used. In most cases, it is located in the vicinity of the alternator.



Removal/Installation

1. Loosen hose clamps and remove inlet/outlet hoses from the aft side of the pump.
2. Loosen but do not remove the bolts holding the pump pulley to the pulley hub.
3. Loosen the pump brace bolts and mounting bracket bolt(s). Swivel pump toward engine and remove drive belt.
4. Remove pump pulley fasteners. Remove pulley.

NOTE

If clearance exists, the pump can now be removed by loosening the mounting bracket clamp bolt and sliding the pump from the bracket. If clearance is insufficient for removal in this manner, proceed with Step 5.

5A. Ford blocks—Remove bolt, washer(s) and nut holding adjusting brace to mounting bracket. Remove bracket from alternator bracket. Remove the pump and mounting bracket assembly.

5B. GM blocks—Remove bolt, washer(s) and nut holding adjusting brace to mounting bracket. Remove bracket from engine block. Remove the pump and mounting bracket assembly.

6. Installation is the reverse of removal. Hand-tighten all fasteners until pump is properly positioned to align its pulley with the crankshaft pulley, and its hose fittings with the hoses. Tighten clamp bolt to 20 ft.-lb. and all other fasteners to specifications (Table 1). Adjust the drive belt. See Chapter Thirteen.

CLOSED COOLING SYSTEM MAINTENANCE

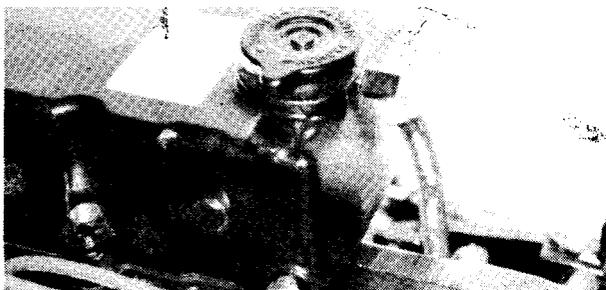
**Pressure Testing
Fresh Water Section**

When the fresh water section of a closed cooling system requires frequent topping up, it probably has a leak. Small leaks in a cooling system are not easy to locate; the hot coolant evaporates as fast as it leaks out, preventing the formation of tell-tale rusty or grayish-white stains.

A pressure test of the fresh water section will usually help pinpoint the source of the leak. The procedure is very similar to that used in pressure testing automotive cooling systems and uses the same type of pressure tester.

1. Remove the pressure fill cap from the heat exchanger or reservoir (Figure 22).

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2. Wash the cap with clean water to remove any debris or deposits from its sealing surfaces.
3. Check the gasket (if so equipped) and rubber seal on the cap for cuts, cracks, tears or deterioration. See **Figure 23**. Replace cap if seal is damaged. Make sure the locking tabs on the cap are not damaged or bent.
4. Dip the cap in water and attach to a cooling system pressure tester, using the adapters supplied with the tester. See **Figure 24**.
5. Rump the pressure to 14 psi. If the cap fails to hold pressure for 30 seconds without dropping under 11 psi, replace it.
6. Inspect the filler neck seat and sealing surface (**Figure 25**) for nicks, dents, distortion or contamination. Wipe the sealing surface with a clean cloth to remove any rust or dirt. Make sure the locking cams are not bent or damaged.
7. Check coolant level; it should be within one inch of the filler neck. Top up if necessary.
8. Connect the cooling system pressure tester to the filler neck and pressurize the fresh water section to 17 psi. If pressure does not hold constant for at least 2 minutes, check all hoses, gaskets, drain plugs, drain valves, core plugs and other potential leak points for leakage. Listen for a hissing or bubbling sound while the system is under pressure.
9. If no leaks are found, refer to the appropriate cooling system flow diagram (**Figures 26-46**) and disconnect the sea water outlet hose from the heat exchanger. Repressurize system to 17 psi and note outlet connection on heat exchanger. If water flows from the connection, air bubbles are seen in the water or a bubbling/hissing sound is heard, there is probably a leak between the fresh and sea water sections within the heat exchanger.
10. If no signs of leakage can be found in Step 8 or Step 9, yet the coolant level continues to require frequent topping up, there is an internal leak. This could be caused by a blown head gasket, loose cylinder head, intake manifold, exhaust elbow or distribution block bolts, or a cracked or porous head, block or manifold. On Model 470 and Ford V8 blocks, it may also be caused by a defective front cover or pump seals.

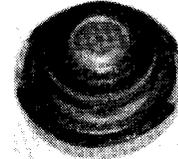
Alkalinity Test

The coolant used in the fresh water section of a closed cooling system should be replaced every 2 years. After a year's service, test the coolant for

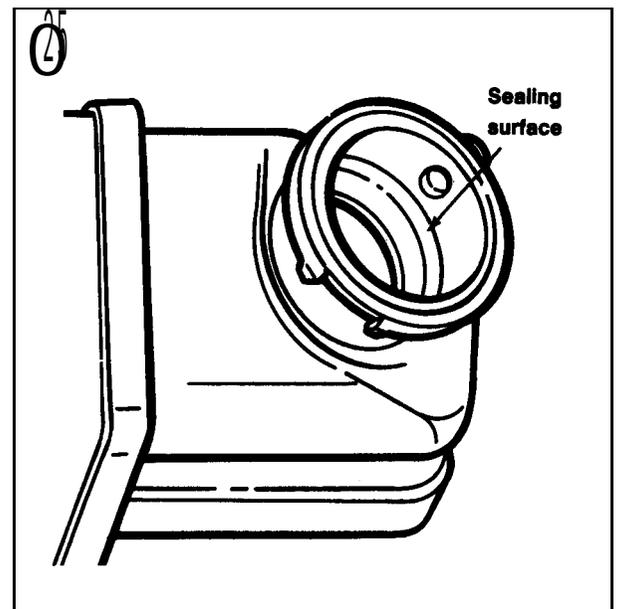
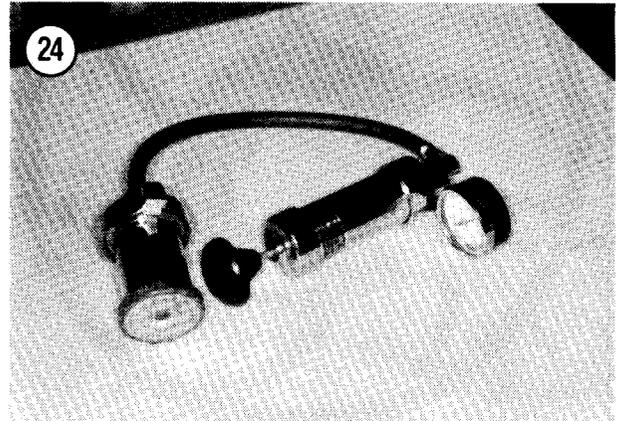
alkalinity with pink litmus paper obtained from a local drug store.

1. With the engine cold, remove the pressure fill cap from the heat exchanger or reservoir.
2. Insert one end of the litmus paper into the coolant, wait a few seconds and withdraw it:

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- a. If the pink litmus paper has turned blue, the coolant alkalinity is satisfactory.
- b. If the litmus paper does not change color, the coolant has lost its alkalinity and should be replaced. Drain and refill the fresh water section of the cooling system. See Chapter Five.

Cleaning Fresh Water Section

The fresh water section should be flushed and cleaned at every coolant change or 2 years. Any high-quality automotive cooling system cleaning solution can be used to remove scale, rust, mineral deposits or other contamination. Use the cleaning solution according to the manufacturer's directions.

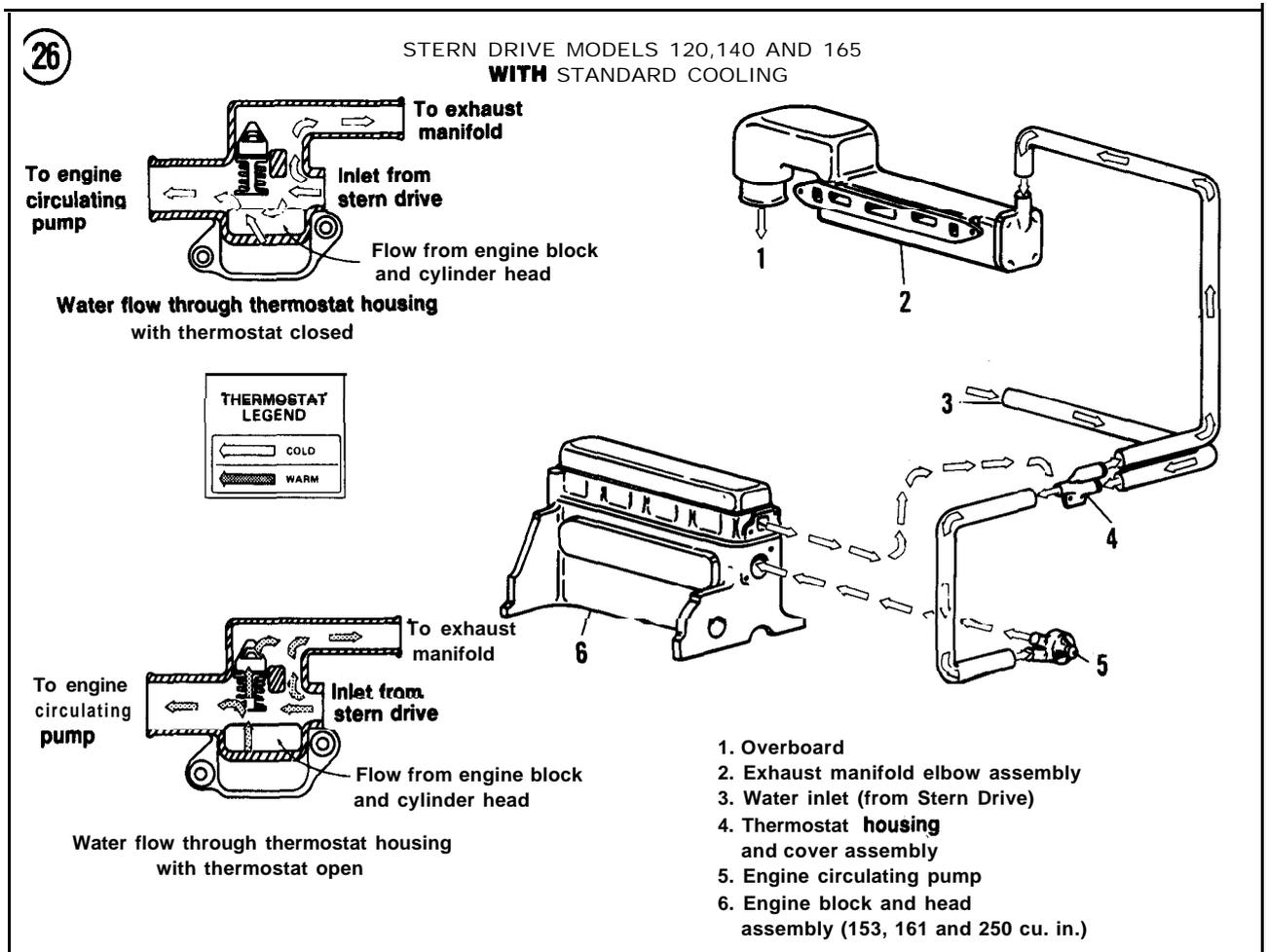
If extremely dirty or corroded, remaining deposits may be flushed out with a pressure flushing device. Refer to the appropriate cooling

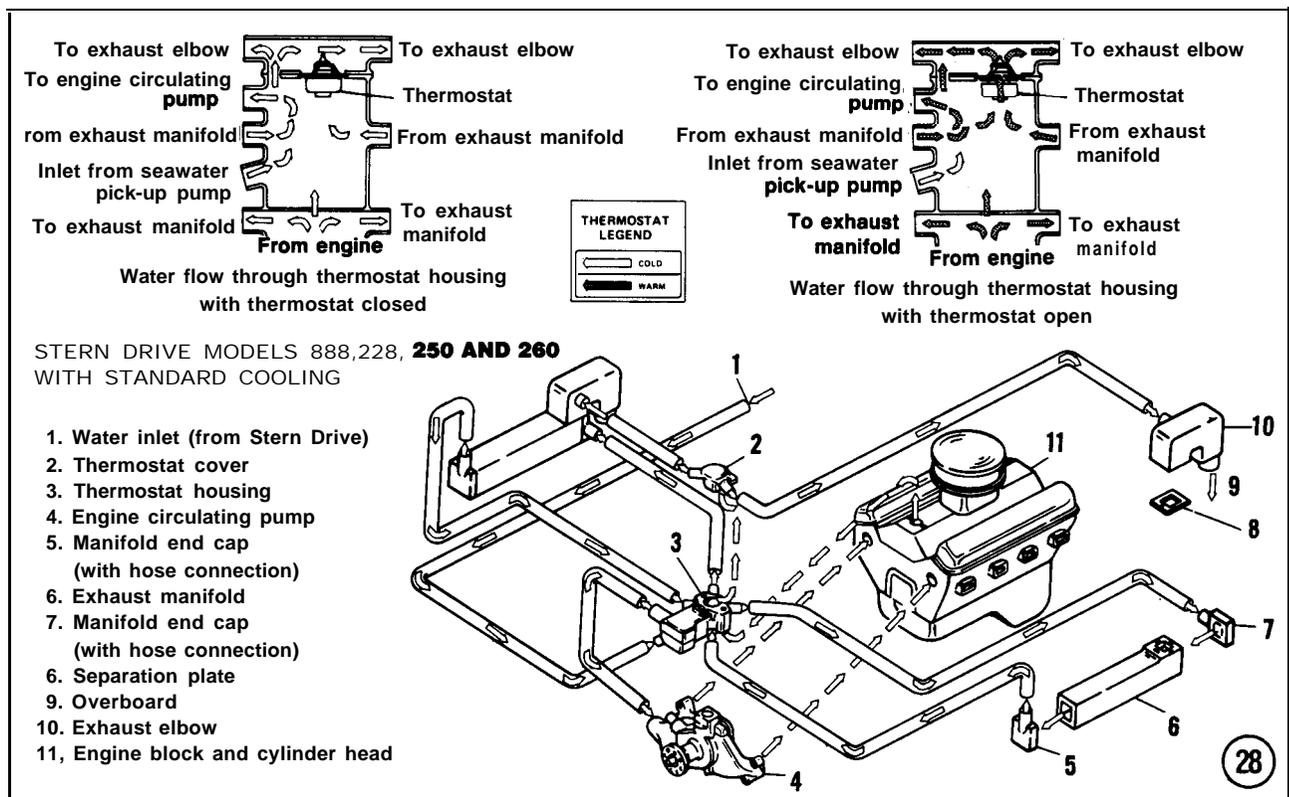
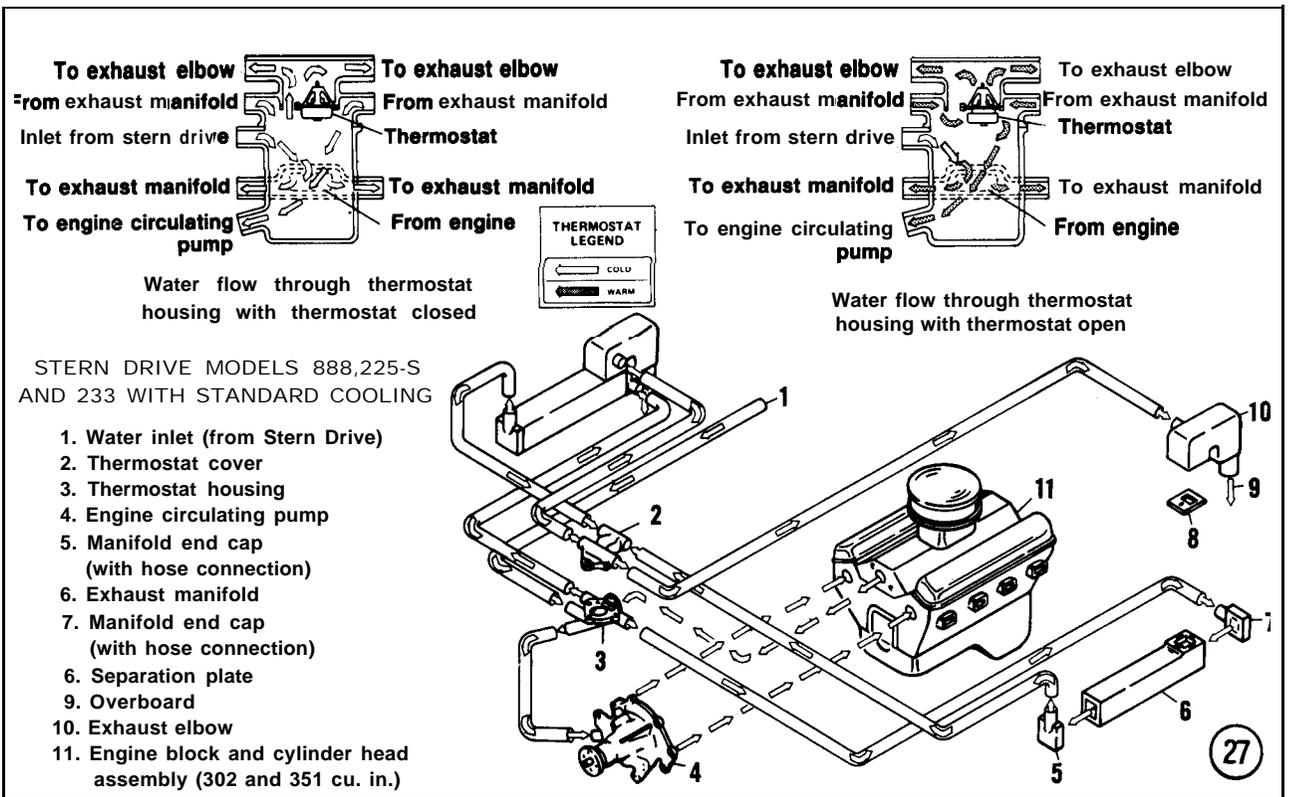
system flow diagram (Figures 26-46) and follow the manufacturer's instructions regarding the connection of the pressure flushing device and procedure to be followed.

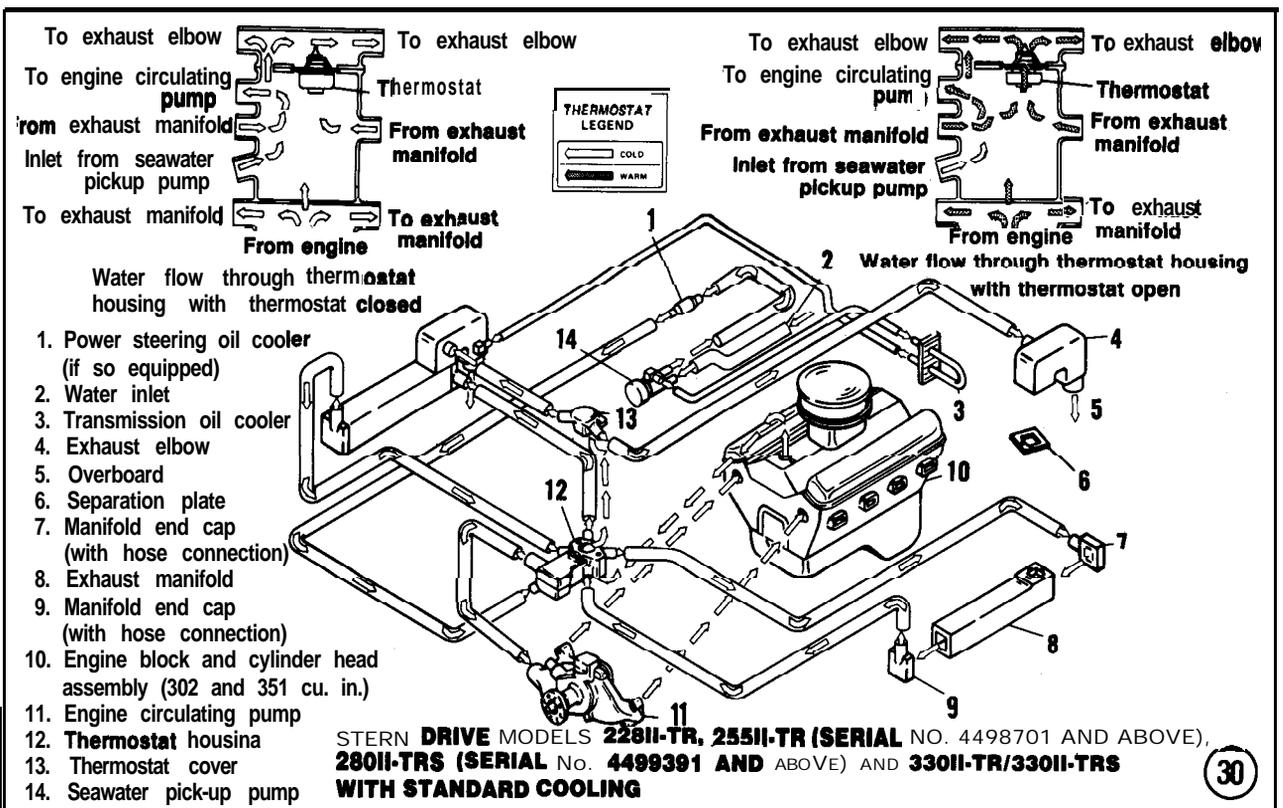
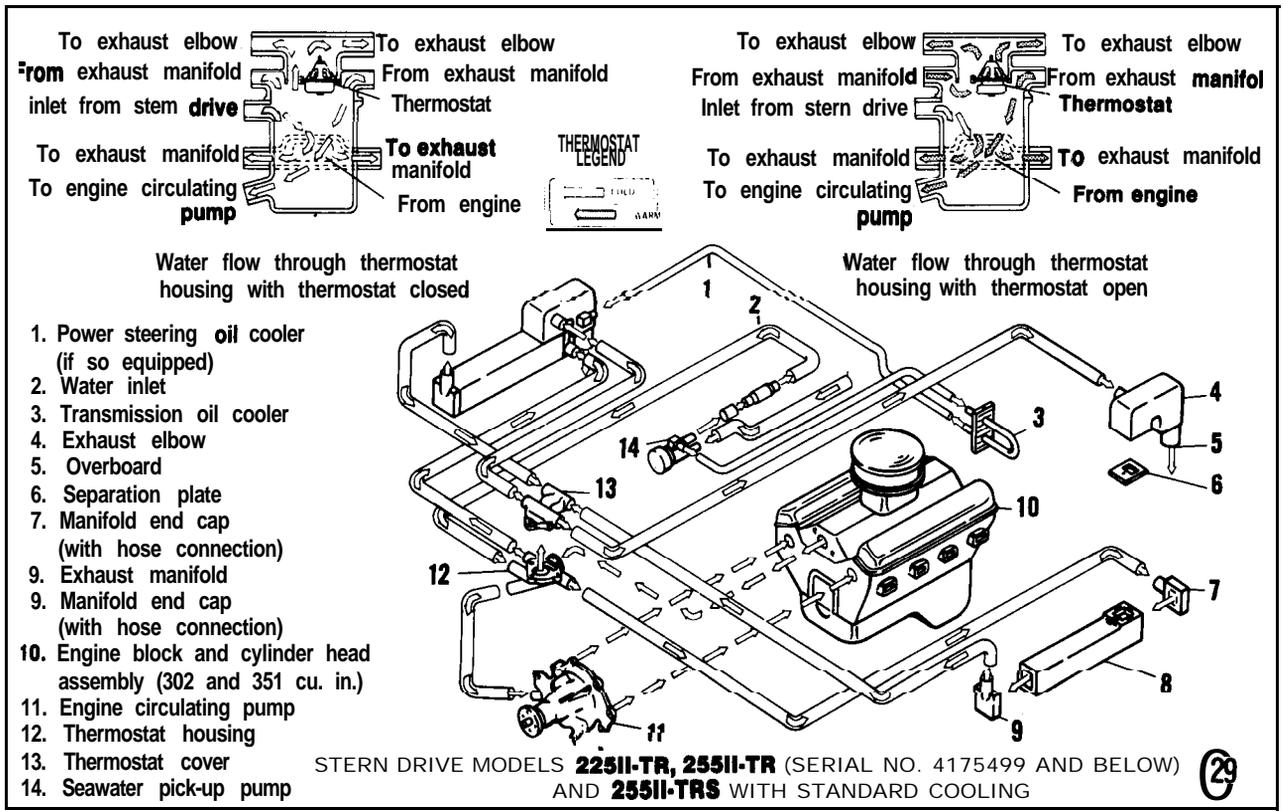
Cleaning Seawater Section of Heat Exchanger

Contaminants and minerals collect inside the copper tubes in the seawater section of the heat exchanger during engine operation. Such foreign material reduces the ability of the heat exchanger to operate efficiently and, if not removed periodically, will eventually lead to engine overheating. It is a good idea to remove and clean the heat exchanger when the coolant is changed.

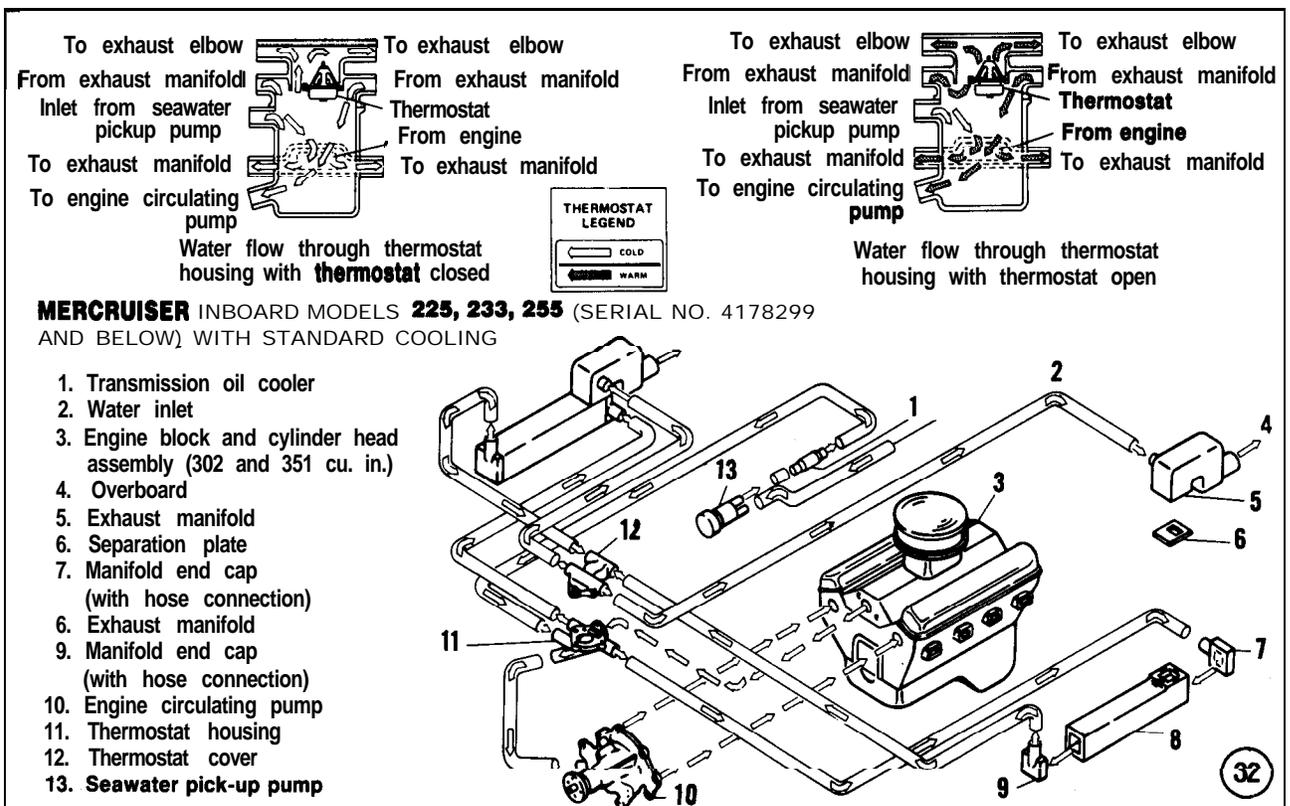
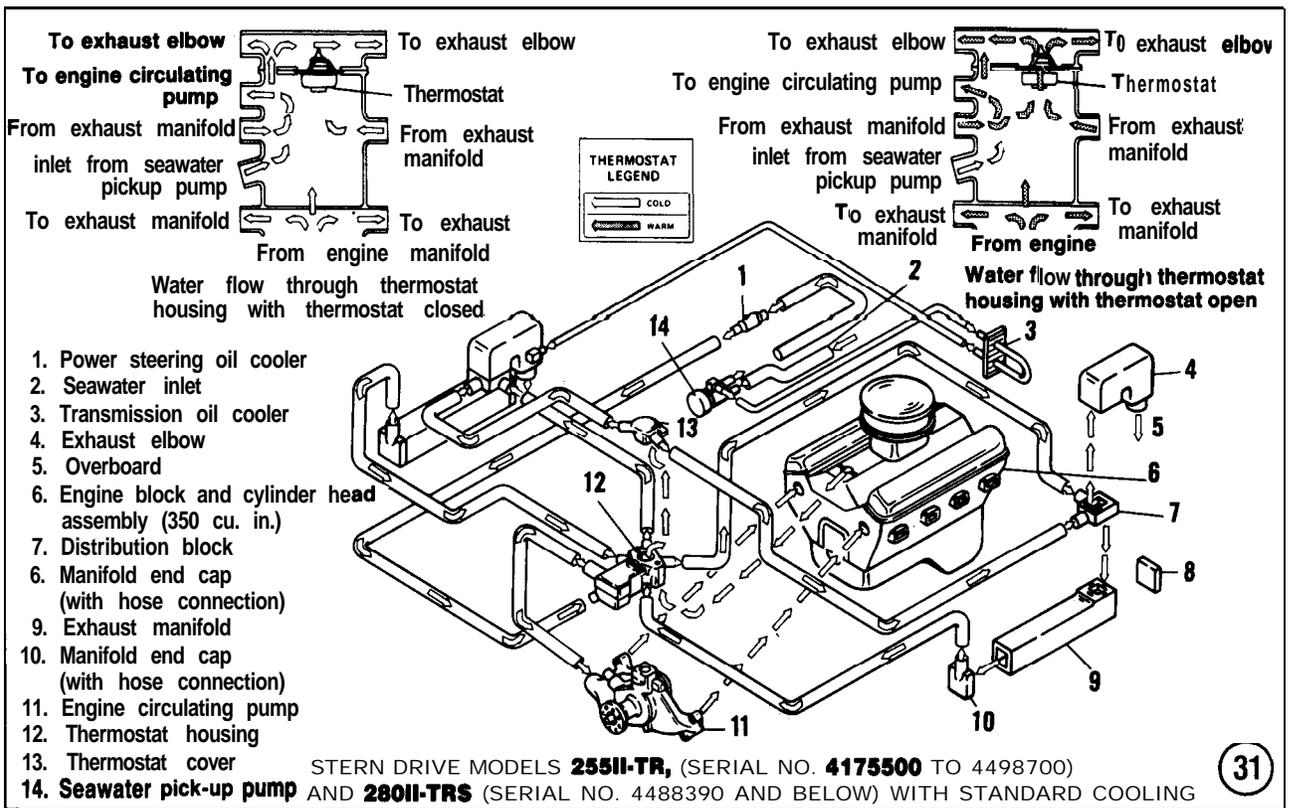
1A. On all except V8 engine with front mounted system and MerCruiser 470, 485, 488, 170MR and 190MR models, drain both sections of the closed cooling system. See Chapter Five. Loosen the hose





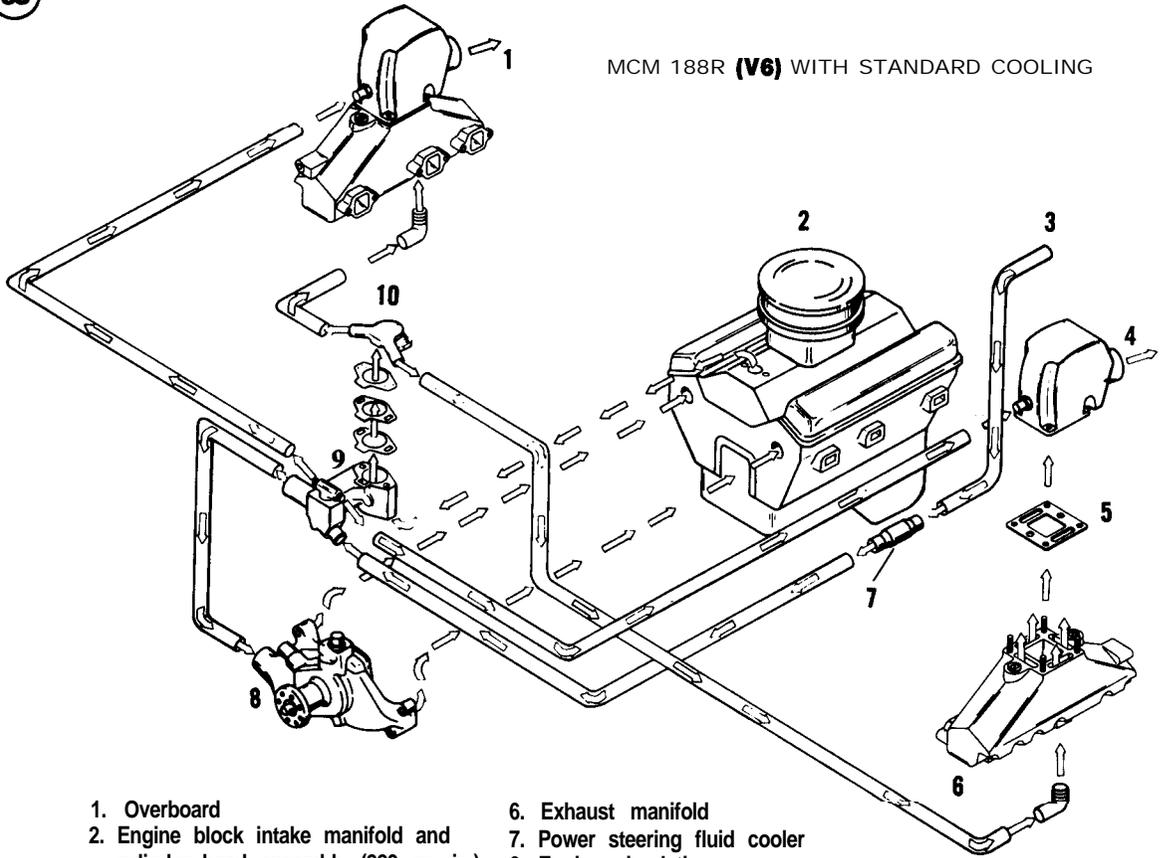


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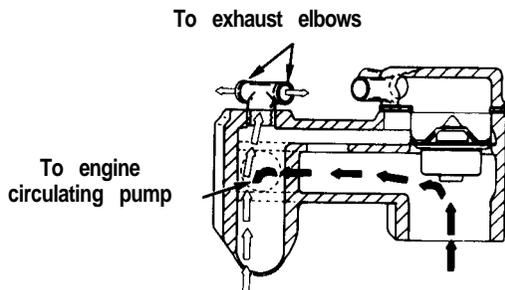


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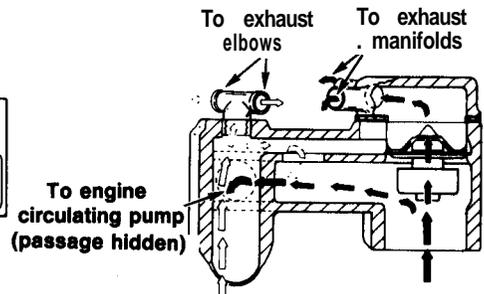
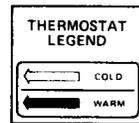
MCM 188R (V6) WITH STANDARD COOLING



- 1. Overboard
- 2. Engine block intake manifold and cylinder head assembly (229 cu. in.)
- 3. Water inlet (from Stern Drive)
- 4. Exhaust elbow
- 5. Restrictor plate
- 6. Exhaust manifold
- 7. Power steering fluid cooler
- 6. Engine circulating pump
- 9. Thermostat housing
- 10. Thermostat cover

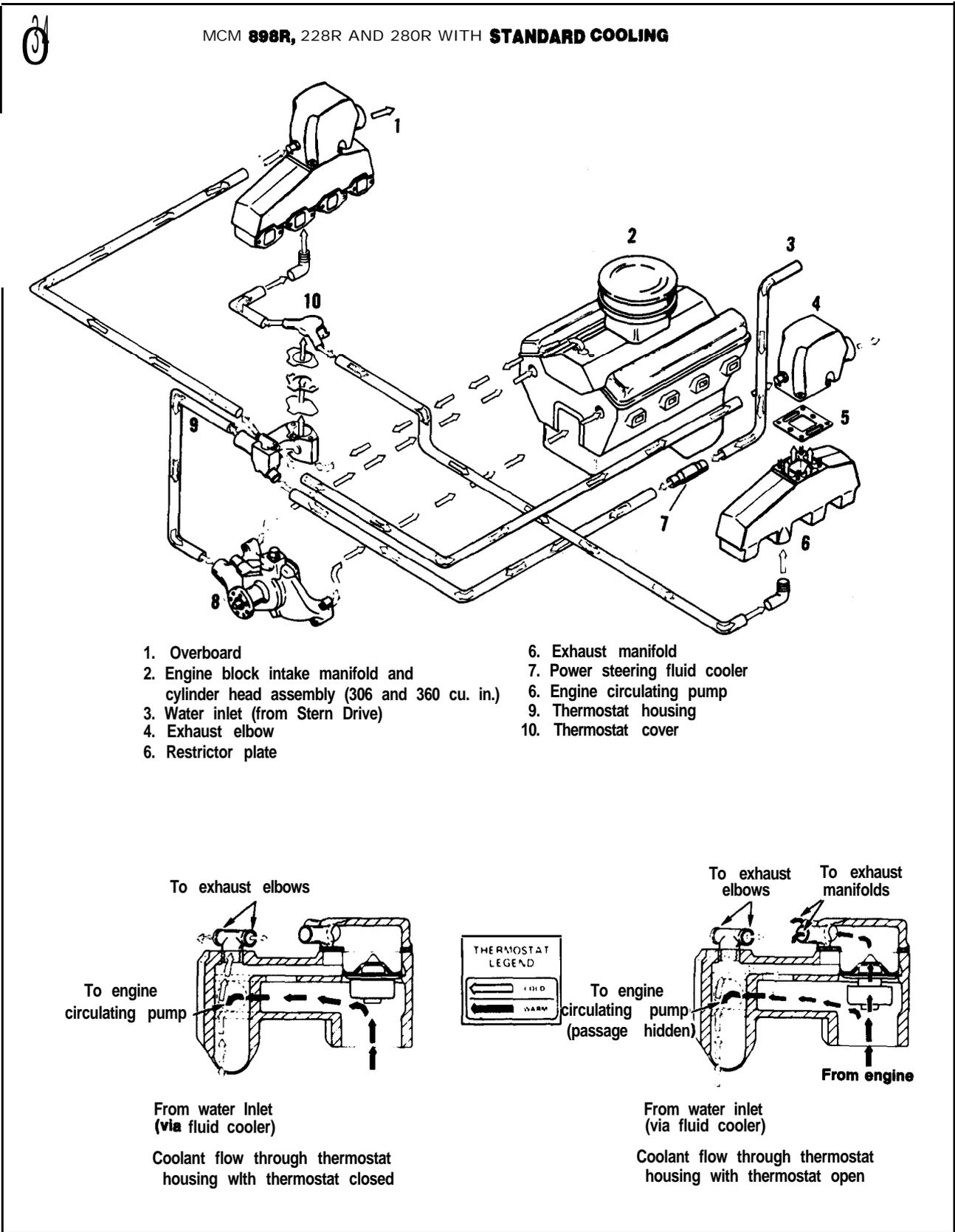


From water inlet (via fluid cooler)
To engine circulating pump
To exhaust elbows
Seawater flow through thermostat housing with thermostat closed



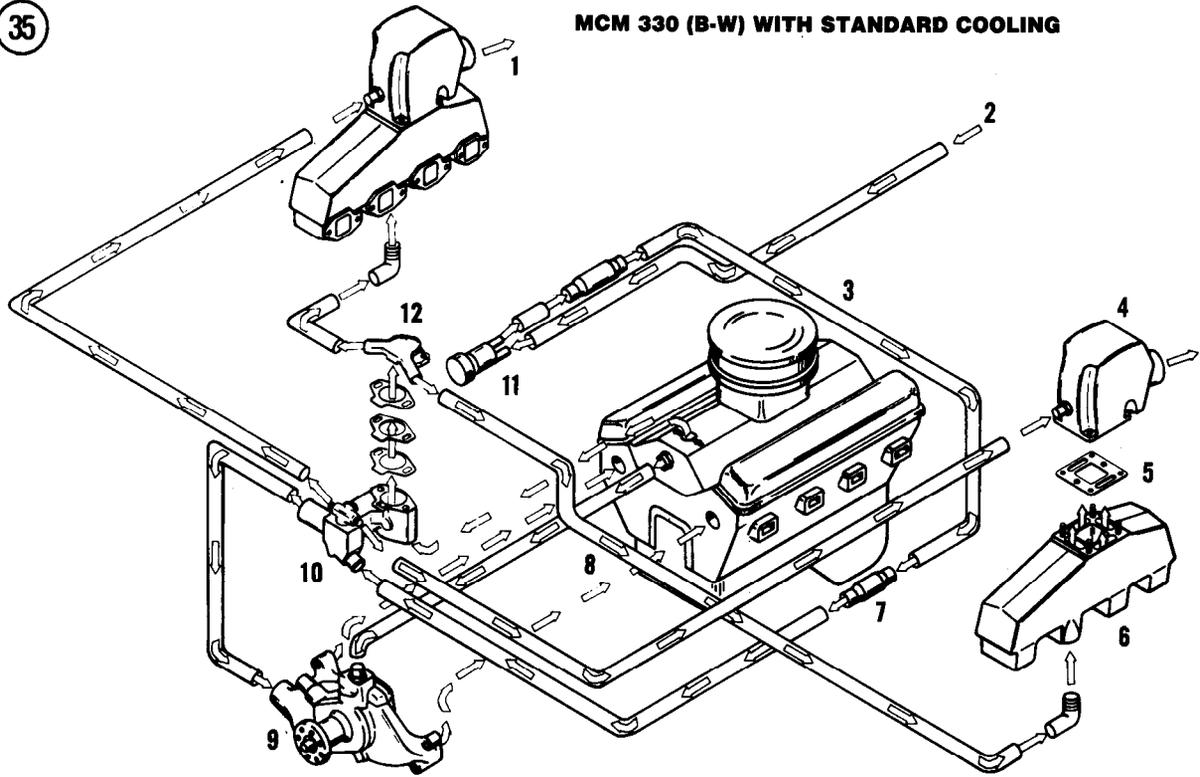
From water inlet (via fluid cooler)
To engine circulating pump (passage hidden)
To exhaust elbows
To exhaust manifolds
Seawater flow through thermostat housing with thermostat open

12



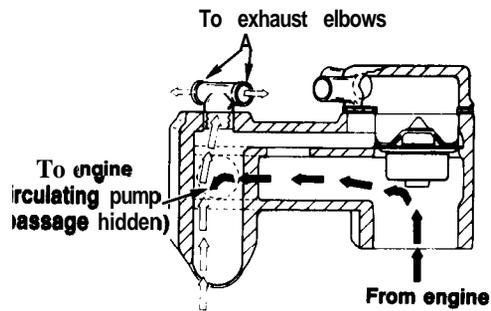
35

MCM 330 (B-W) WITH STANDARD COOLING



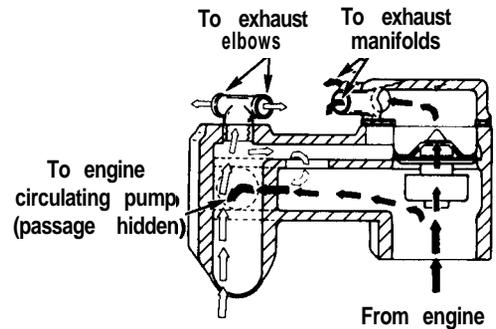
- 1. Overboard
- 2. Seawater inlet
- 3. Engine block, intake manifold and cylinder head assembly (454 cu. in.)
- 4. Exhaust elbow
- 5. Restrictor plate
- 8. Exhaust manifold
- 7. Engine oil and power steering fluid cooler
- 8. Bypass hose
- 9. Engine circulating pump
- 10. Thermostat housing
- 11. Seawater pickup pump
- 12. Thermostat cover

12



From seawater pickup pump (via fluid cooler)

Coolant flow through thermostat housing with thermortat closed

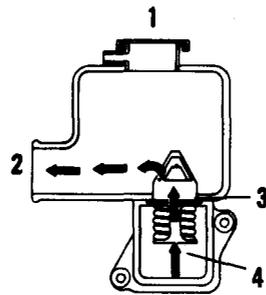


From seawater pickup pump (via fluid cooler)

Coolant flow through thermostat housing with thermortat closed



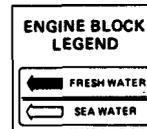
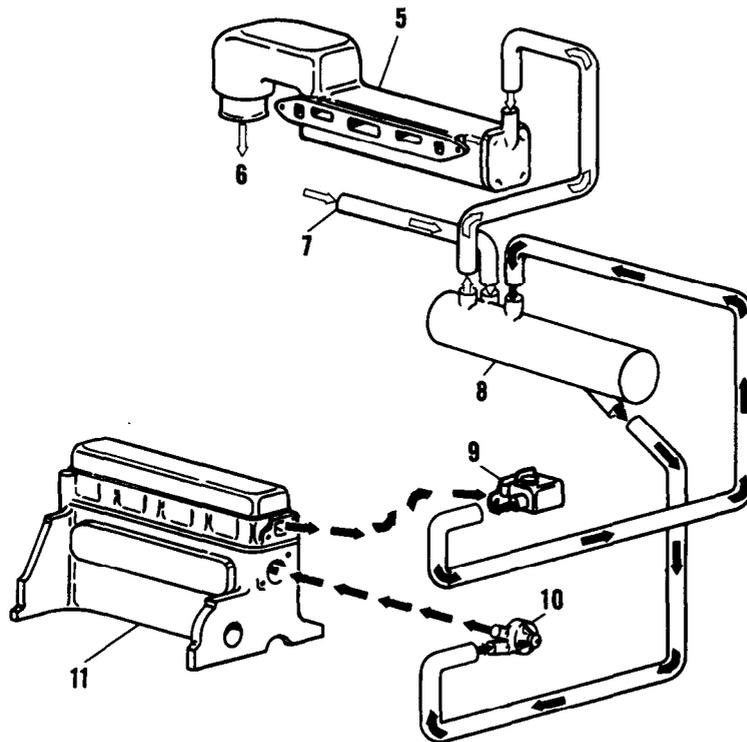
STERN DRIVE MODELS 120,140 AND 165 WITH CLOSED COOLING



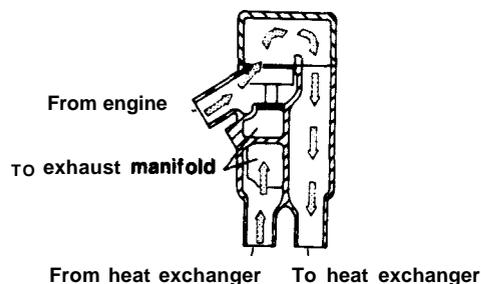
NOTE: Minimum flow occurs when the thermostat is closed.

Coolant flow through thermostat housing and reservoir

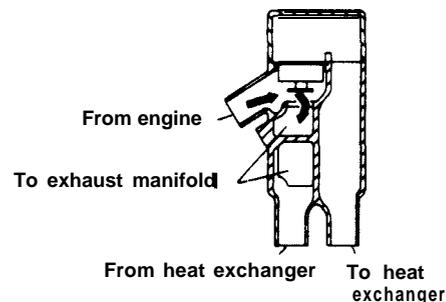
- 1. Filler cap
- 2. To heat exchanger
- 3. Thermostat
- 4. Flow from engine block and cylinder head
- 5. Exhaust manifold and elbow assembly
- 6. Overboard
- 7. Water inlet from Stern Drive
- 8. Heat exchanger
- 9. Thermostat housing and reservoir
- 10. Engine circulating pump
- 11. Engine block and head assembly (153, 161 and 250 cu. in.)



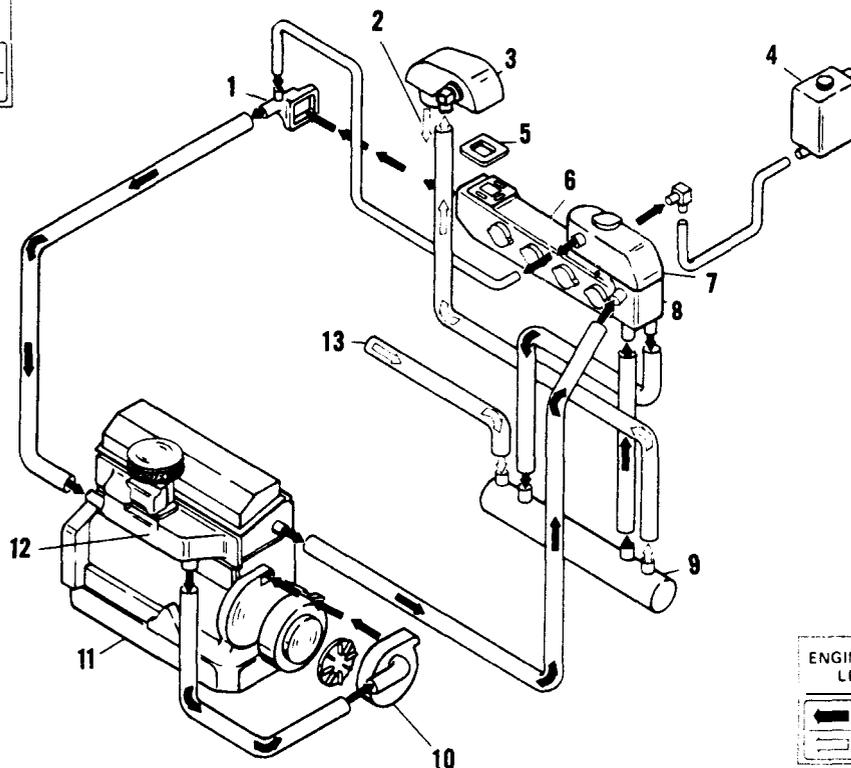
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Coolant flow through distribution block with thermostat open



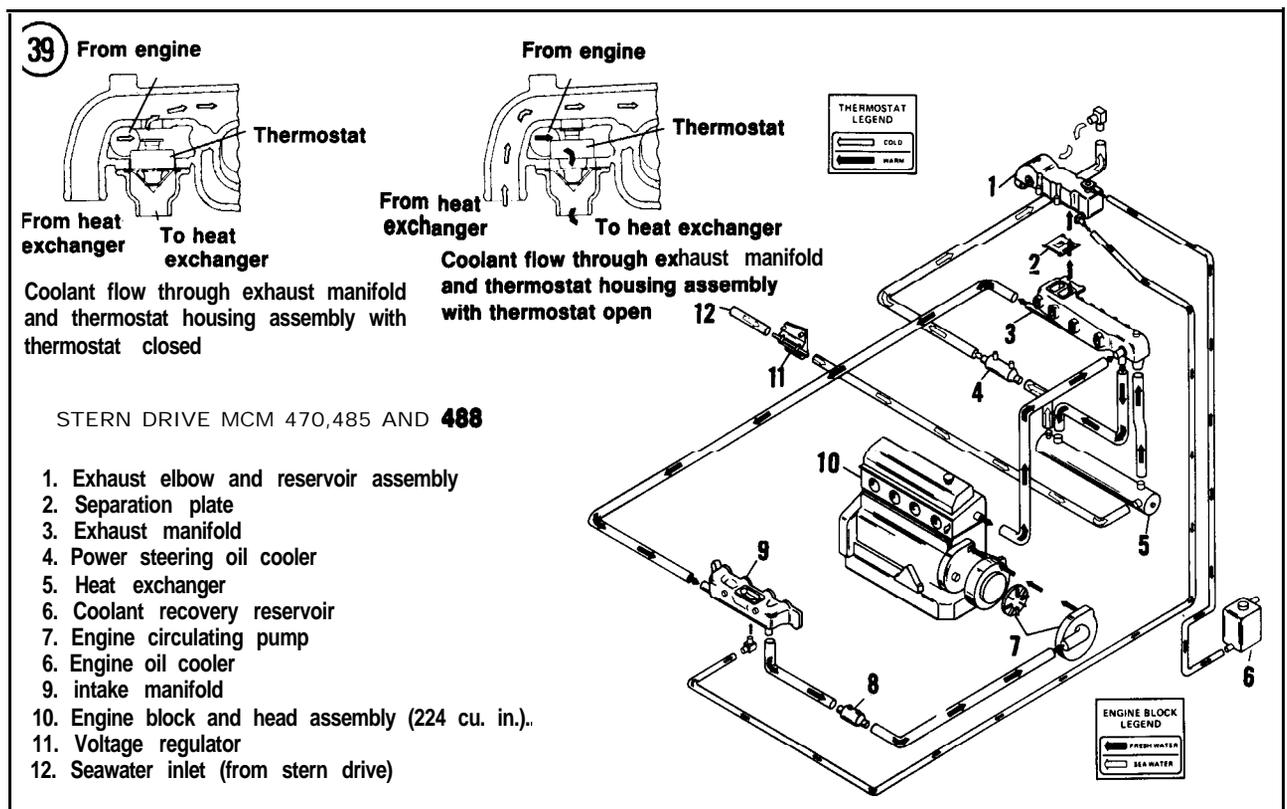
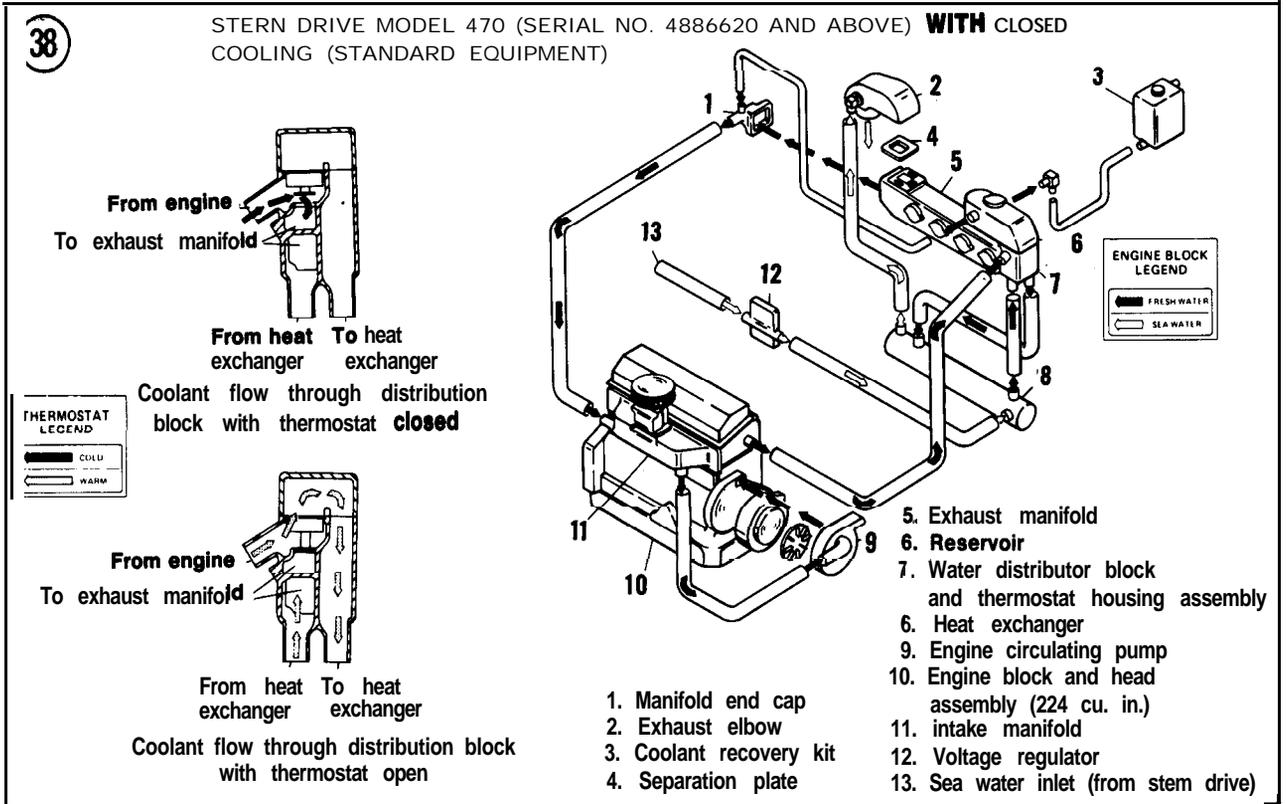
Coolant flow through distribution block with thermostat

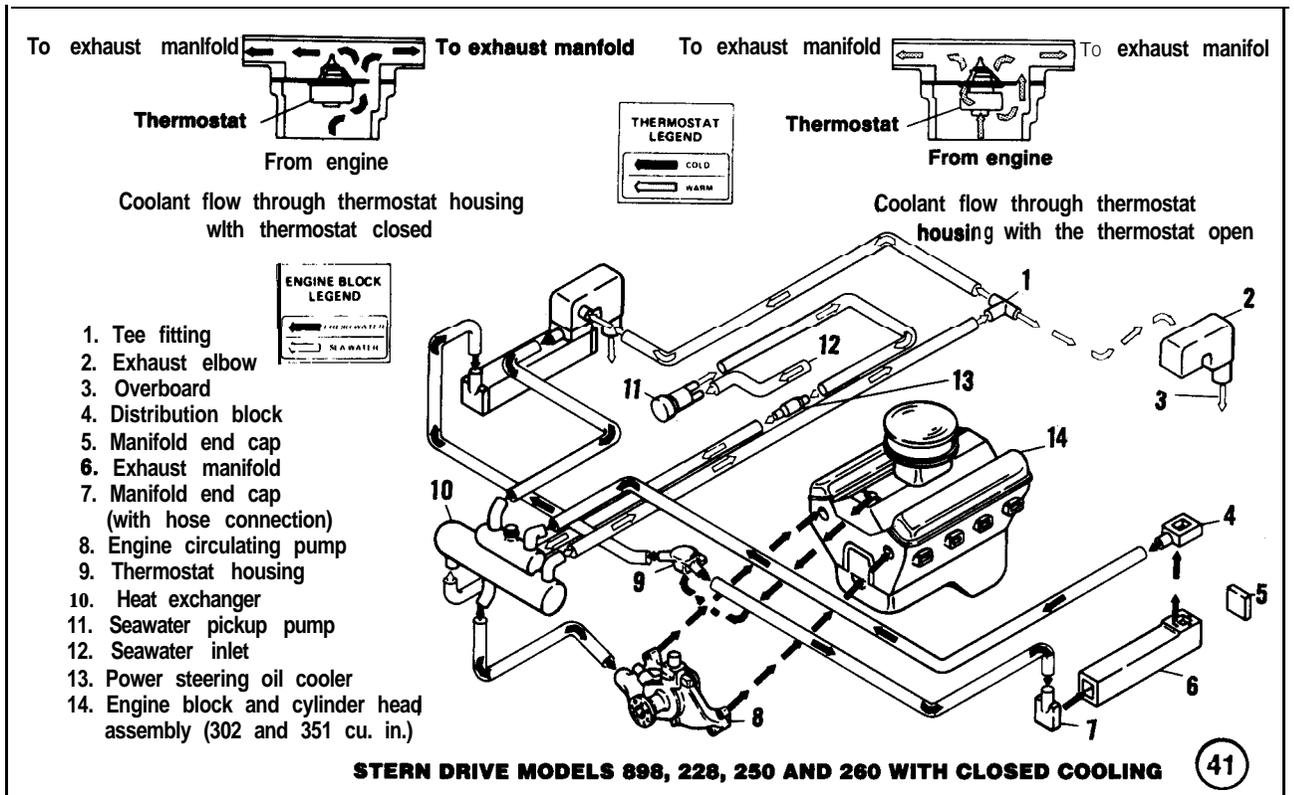
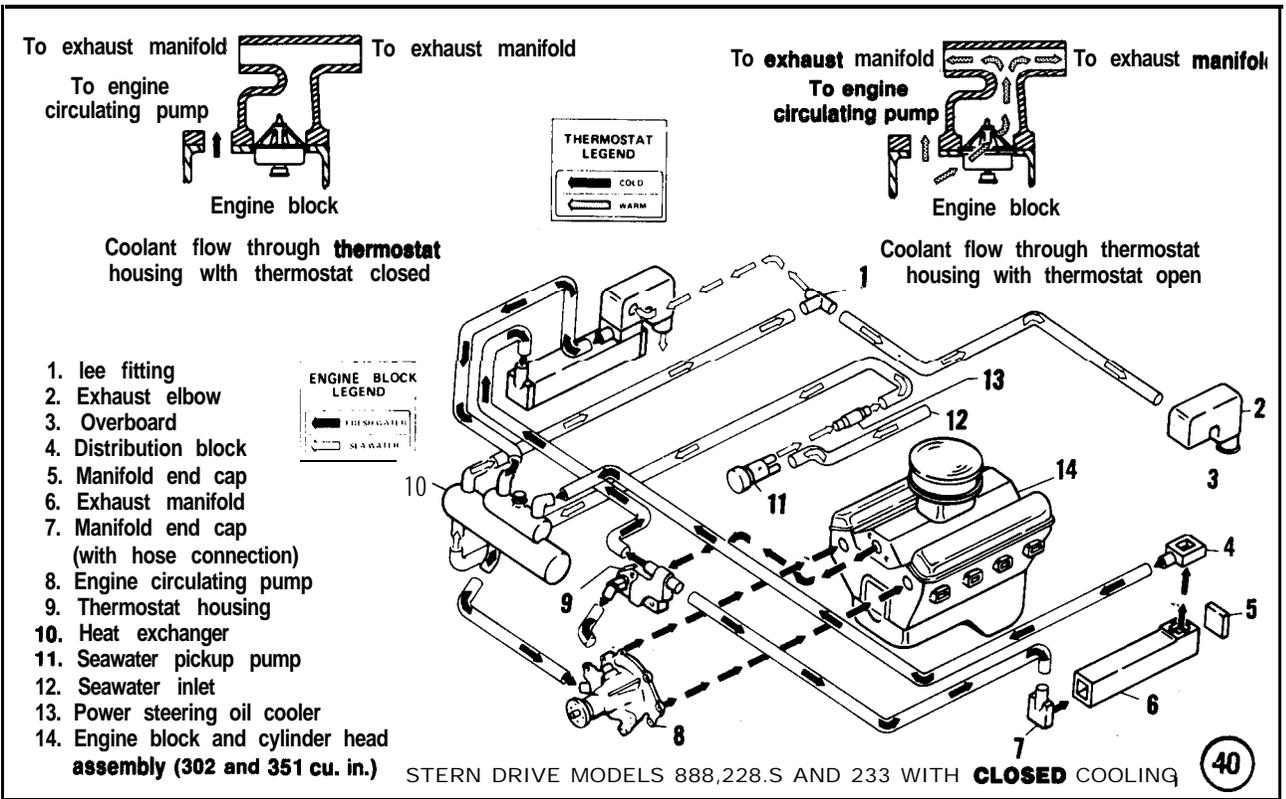


STERN DRIVE MODEL 470 (SERIAL NO. 4886619 AND BELOW) WITH CLOSED COOLING (STANDARD EQUIPMENT)

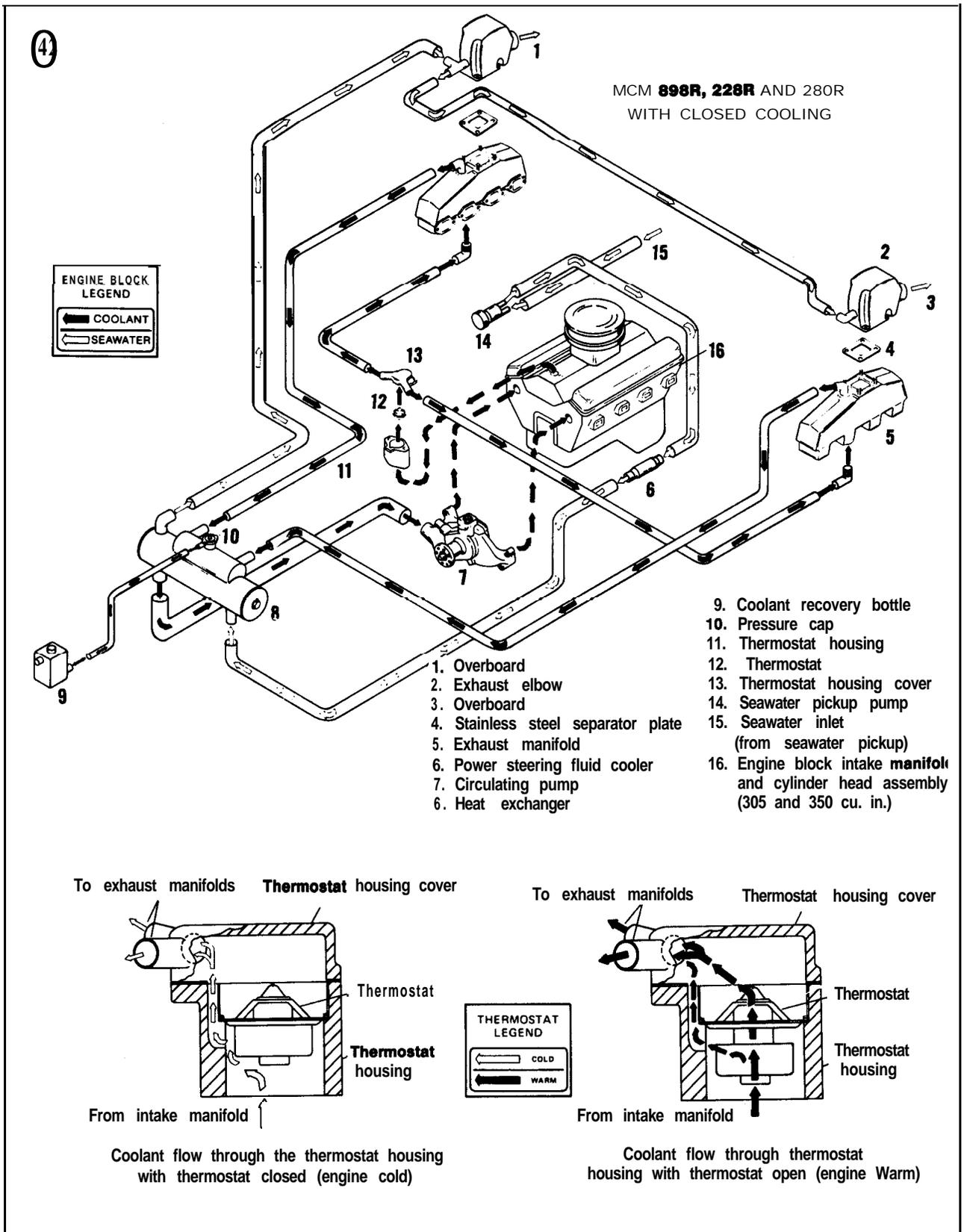
- | | |
|-------------------------|--|
| 1. Manifold end cap | 8. Water distributor block and thermostat housing assembly |
| 2. Overboard | 9. Heat exchanger |
| 3. Exhaust elbow | 10. Engine circulating pump |
| 4. Coolant recovery kit | 11. Engine block and head assembly (224 cu. in.) |
| 5. Separation plate | 12. Intake manifold |
| 6. Exhaust manifold | 13. Seawater inlet (from Stern Drive) |
| 7. Reservoir | |

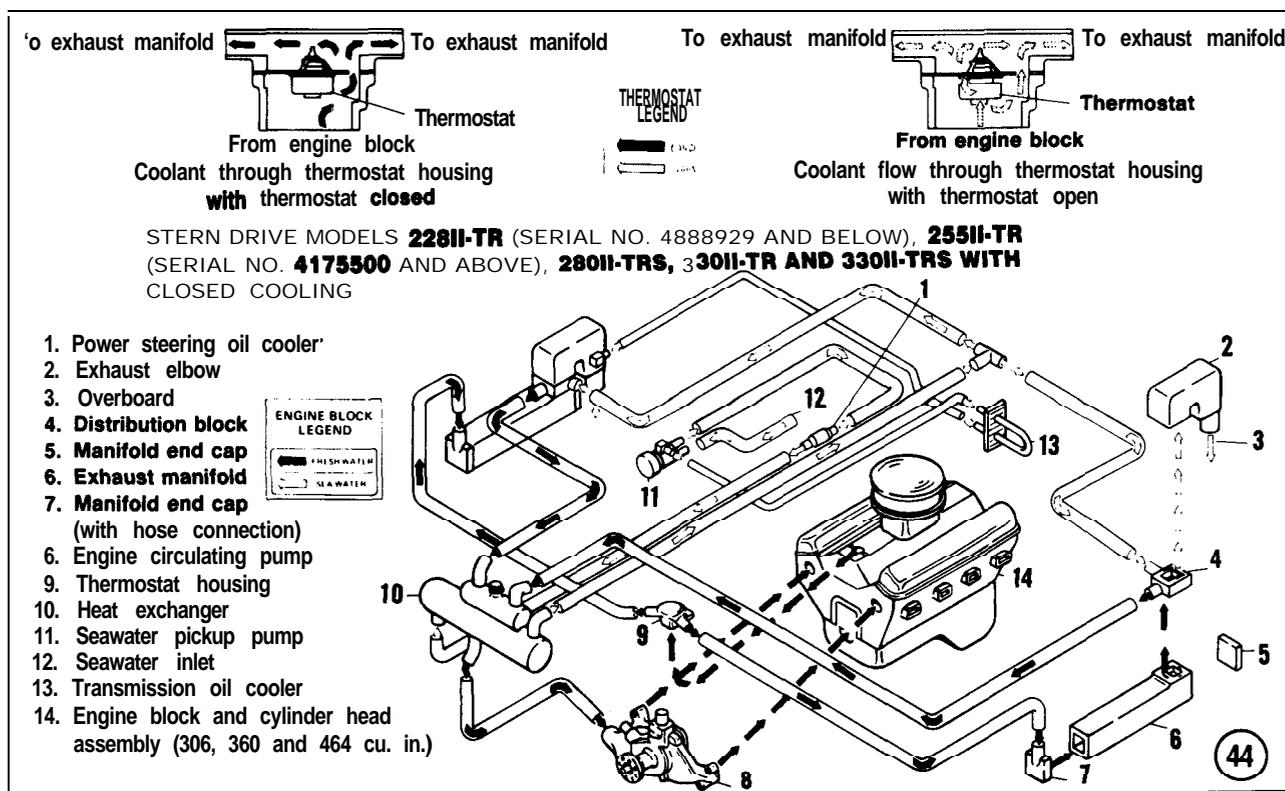
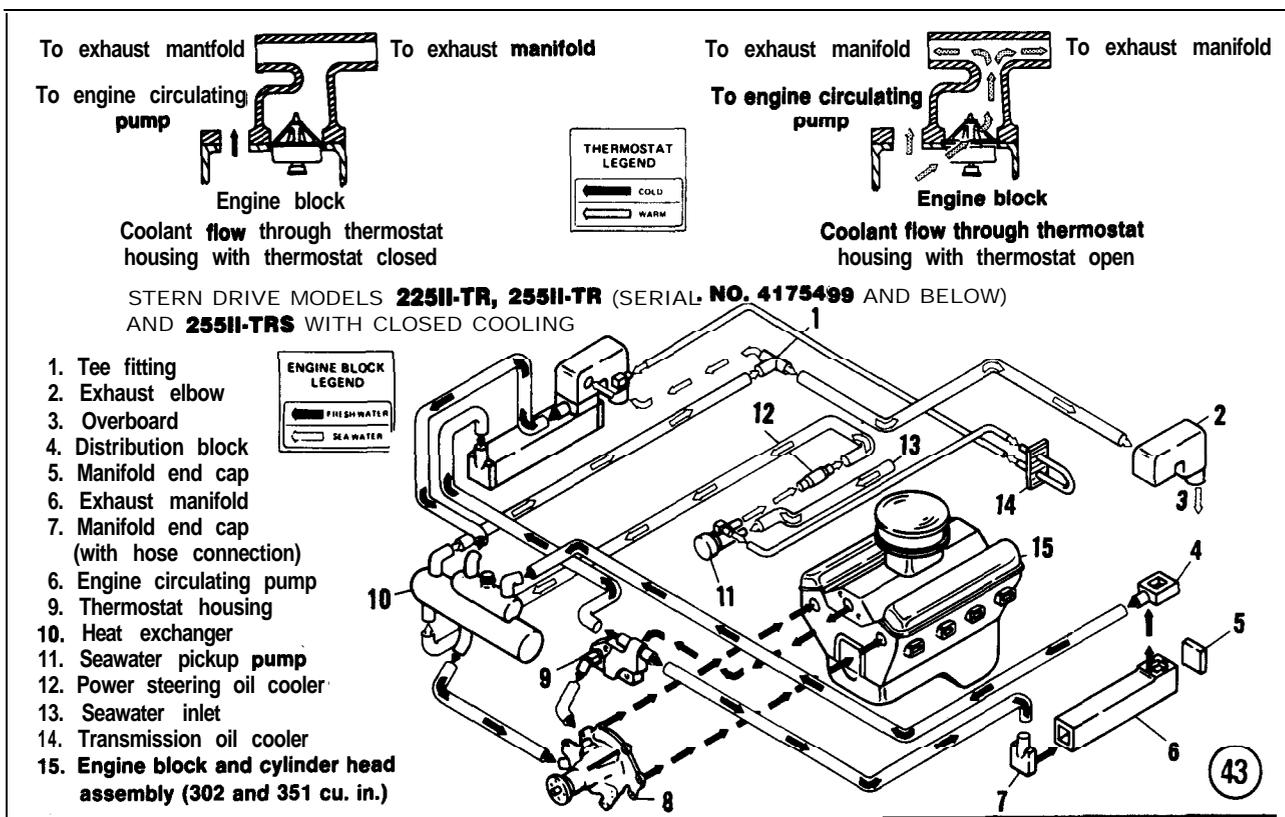
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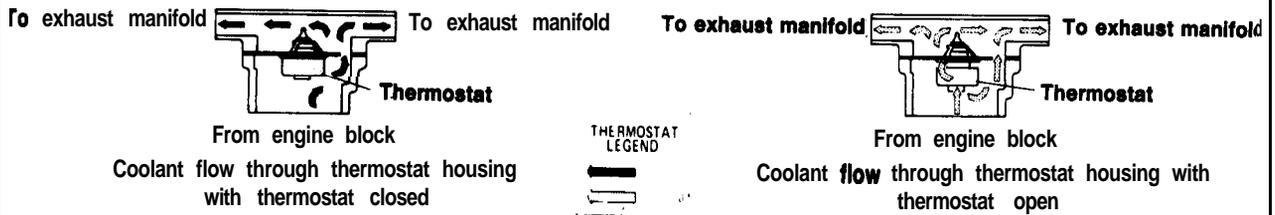


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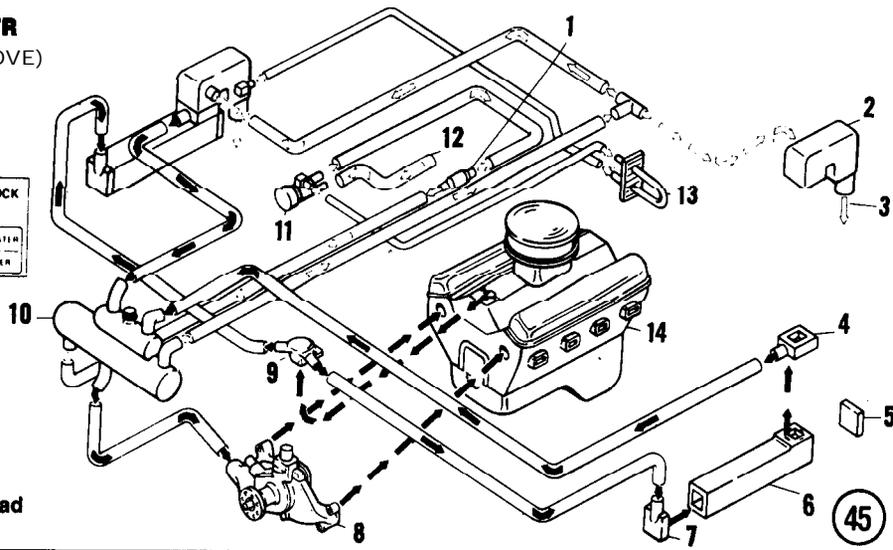


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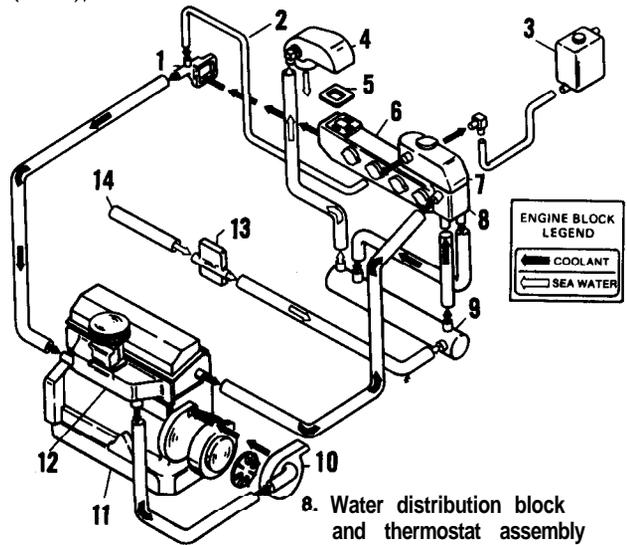
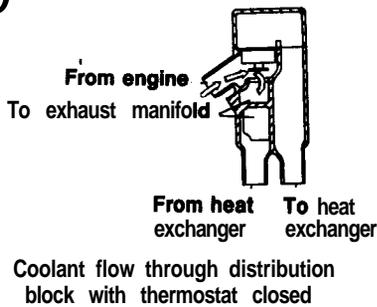
STERN DRIVE MODEL 228II-TR
(SERIAL NO. 4886930 AND ABOVE)
WITH CLOSED COOLING

1. Power steering oil cooler
2. Exhaust elbow
3. Overboard
4. Distribution block
5. Manifold end cap
6. Exhaust manifold
7. Manifold end cap (with hose connection)
8. Engine circulating pump
9. Thermostat housing
10. Heat exchanger
11. Seawater pickup pump
12. Seawater inlet
13. Transmission oil cooler
14. Engine block and cylinder head assembly (305 cu. in.)



4

MCM 470 WATER FLOW CIRCUITS WITH 3 IN. (8 CM), DIAMETER HEAT EXCHANGER



1. Manifold end cap
2. Air bleed hose
3. Coolant recovery reservoir
4. Exhaust elbow
5. Separation plate (non-vented)
6. Exhaust manifold
7. Reservoir
8. Water distribution block and thermostat assembly
9. Heat exchanger
10. Engine circulating pump
11. Engine block and head assembly (224 cu. in.)
12. intake manifold
13. Voltage regulator (not on air-cooled regulator models)
14. Seawater inlet (from Stern Drive)

clamps and remove all hoses at the heat exchanger. Remove the attaching bolts. Remove the heat exchanger.

1 B. On V8 engines with front mounted system and MerCruiser 470, 485 and 488 models, remove drain plug from bottom of heat exchanger. Allow water to drain, then coat plug threads with Perfect Seal (part No. C-92-34227) and reinstall.

2. Unbolt and remove the heat exchanger end plate(s). Remove and discard the seal washer(s) and gasket(s).

3. Clean all gasket residue from the end plate(s) and heat exchanger sealing surfaces.

4. Insert an appropriate-size wire brush into each passage in the heat exchanger. Work brush back and forth with a vigorous motion.

5. Remove brush, hold heat exchanger with the end plate end facing downward and blow loosened particles from the heat exchanger with compressed air.

6. Repeat Step 4 and Step 5 as necessary to remove as much of the accumulated deposits as possible.

7. Remove zinc electrode, if so equipped, and check for erosion. If more than 25 percent gone, install a new electrode. Coat electrode threads with Perfect Seal.

8. Coat both sides of new end plate gasket(s) with Perfect Seal and reinstall end plate(s) with a new seal washer. Tighten end plate bolt(s) to 16 ft.-lb.

9. Install heat exchanger, if removed. Connect hoses and tighten hose clamps.

10. Fill fresh water section with coolant. See Chapter Five. Start the engine and check for leaks.

**STANDARD COOLING SYSTEM
MAINTENANCE**

The only maintenance required for the standard cooling system is a periodic cleaning of the exhaust manifold. See the appropriate chapter for your engine.

Table 1 TIGHTENING TORQUE

Fastener	ft.-lb.	in.-lb.
Alternator rotor to crank	50	
Engine water pump		
5/16-18	14	
3/8-16	30	
Heat exchanger end plate bolts	16	
Impeller		
Cover	15	
Nut	40	
Seawater pump bracket clamp bolt	20	
Stern drive water pump		
Housing screw		15-20
Housing stud nut (1/4-28)		25-30
Housing stud nut (5/16-24)		35-40
Thermostat housing		
5/16-18	15	
3/8-16	30	
Met-Cruiser 470, 485, 488, 170MR, 190MR	10	