

CHAPTER NINE

LIQUID COOLING SYSTEM

The pressurized liquid cooling system consists of a radiator, water pump, thermostat, coolant reserve tank and a electric cooling fan.

CAUTION

*Drain and flush the cooling system at least every 2 years. Refer to **Coolant Change** in Chapter Three. Refill with a mixture of ethylene glycol antifreeze (formulated for aluminum engines) and purified water. Do not reuse the old coolant as it deteriorates with use. **Do not** operate the cooling system with only purified water (even in climates where antifreeze protection is not required). This is important because the engine is all aluminum; it will not rust but it will oxidize internally and have to be replaced. Refer to **Coolant Change** in Chapter Three.*

This chapter describes the repair and replacement of the cooling system components. **Table 1** lists all of the cooling system specifications. **Table 1** is located at the end of this chapter. For routine maintenance and pressure testing of the system, refer to Chapter Three.

The cooling system must be cool prior to removing any component of the system.

WARNING

*Do **not** remove the radiator fill cap (**Figure 1**) when the engine is **HOT**. The coolant is very hot and is under pressure. Severe scalding could result if the escaping coolant comes in contact with your skin.*

HOSES AND HOSE CLAMPS

The small diameter coolant hoses are very stiff and are sometimes difficult to install onto the metal

fittings of the various cooling system parts. Prior to installing the hoses, apply a small amount of Armor All or rubber lube to the inside surface of these hoses and they will slide on much easier.

Different type of hose clamps are used on the various hoses. Either the clamping screw type that is released with a screwdriver or the clamping band type where the ends must be pinched open with a pair of gas pliers. These clamps are used at specific locations due to space limitations around a specific part. Be sure to reinstall the correct type of clamp at the correct location.

COOLING SYSTEM CHECK

Two checks should be made before disassembly if a cooling system fault is suspected.

1. Run the engine until it reaches operating temperature. While the engine is running a pressure surge should be felt when the water pump outlet hose (**Figure 2**), is squeezed.
2. If a substantial coolant loss is noted, one of the head gaskets may be blown. In extreme cases sufficient coolant will leak into a cylinder(s) when the bike is left standing for several hours so the engine cannot be turned over with the starter. White smoke (steam) might also be observed at the muffler(s) when the engine is running. Coolant may also find its way into the oil supply. Check the dipstick; if it looks like green chocolate malt (milky or foamy) there is coolant in the oil system. If so, correct the cooling system immediately.

CAUTION

After the cooling system problems are corrected, drain and thoroughly flush the engine oil system to eliminate all coolant residue. Refill with fresh engine oil; refer to Chapter Three. Recheck the condition of the oil and drain and refill if necessary.

PRESSURE CHECK

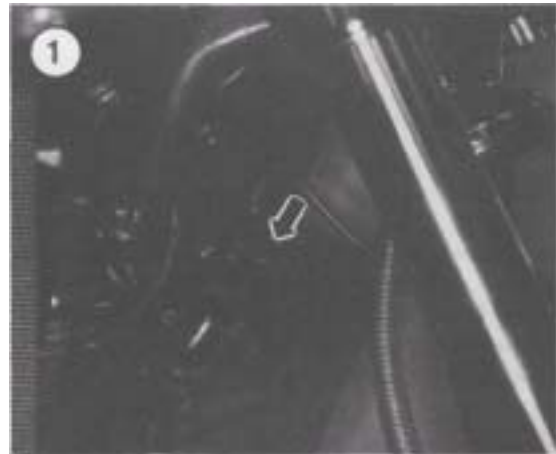
If the cooling system requires repeated refilling, there is probably a leak somewhere in the system. Perform *Cooling System Inspection* in Chapter Three.

RADIATOR

Removal/Installation

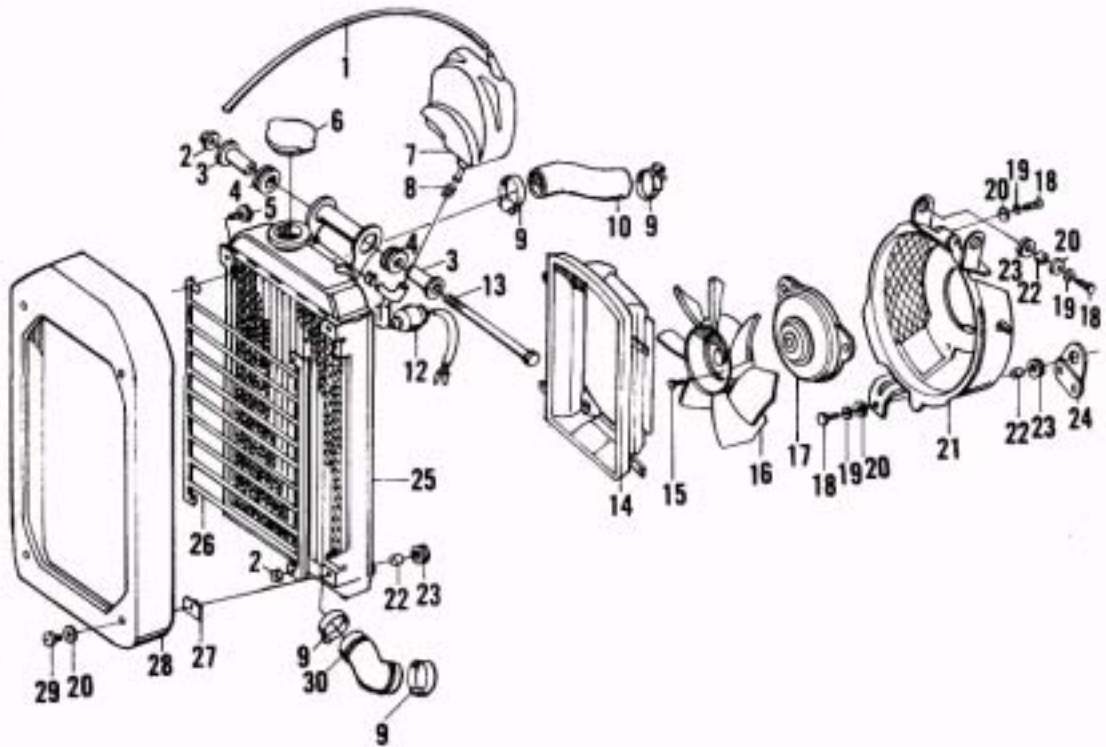
Refer to Figure 3 for this procedure.

1. Drain the cooling system as described under *Coolant Change* in Chapter Three.
2. Remove the seat as described in Chapter Thirteen.
3. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
4. Remove the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.
5. Remove the screws securing both the right- and left-hand frame head side covers. Remove both side covers.
6. Remove the screws securing the radiator cover (**Figure 4**) and remove the cover.
7. Loosen the radiator upper mounting bolt (**Figure 5**) and nut.



3

RADIATOR AND FAN ASSEMBLY



- | | |
|------------------------|--------------------|
| 1. Overflow hose | 16. Fan blade |
| 2. Nut | 17. Fan motor |
| 3. Spacer | 18. Bolt |
| 4. Rubber grommet | 19. Lockwasher |
| 5. Bolt | 20. Washer |
| 6. Radiator cap | 21. Fan shroud |
| 7. Coolant reserve cap | 22. Collar |
| 8. Hose clamp | 23. Rubber grommet |
| 9. Hose clamp | 24. Bracket |

- 10. Radiator upper hose
- 11. Hose
- 12. Cooling fan switch
- 13. Bolt
- 14. Fan duct
- 15. Bolt

- 25. Radiator
- 26. Grille
- 27. Special nut
- 28. Radiator cap cover
- 29. Screw
- 30. Radiator lower hose

8. Loosen the clamping screw on the upper hose clamp (A, **Figure 6**). Move the clamp back onto the hose and off the neck of the front cylinder head fitting. Leave the hose attached to the radiator.
9. Loosen the clamping screw on the upper hose clamp (A, **Figure 7**). Move the clamp back onto the hose and off of the neck of the fitting on the frame rail. Leave the hose attached to the radiator.
10. Disconnect the fan motor thermo switch individual electrical connector (B, **Figure 6**).
11. Remove the bolt (B, **Figure 7**) securing the radiator at the bottom.
12. Remove the radiator upper mounting bolt (**Figure 5**) and nut loosened in Step 7.
13. Carefully pull the radiator and reserve tank (C, **Figure 6**) slightly forward and down. Remove the radiator and reserve tank assembly from the frame.
14. Install by reversing these removal steps, noting the following:
 - a. Replace both radiator hoses if either is starting to deteriorate or is damaged.
 - b. Make sure the fan motor thermo switch electrical connections are free of corrosion and are tight.
 - c. Make sure the collar (A, **Figure 8**) is in place on each side of the radiator upper mount.
 - d. Refill the cooling system with the recommended type and quantity of coolant as described in Chapter Three.

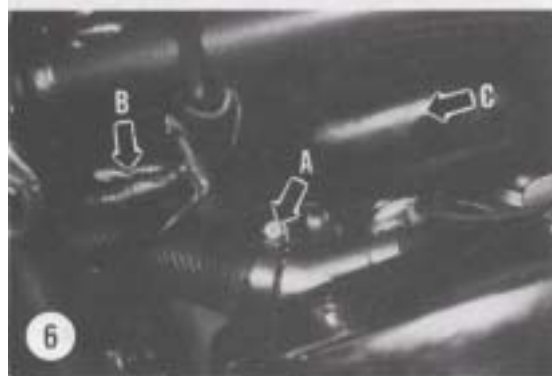
Inspection

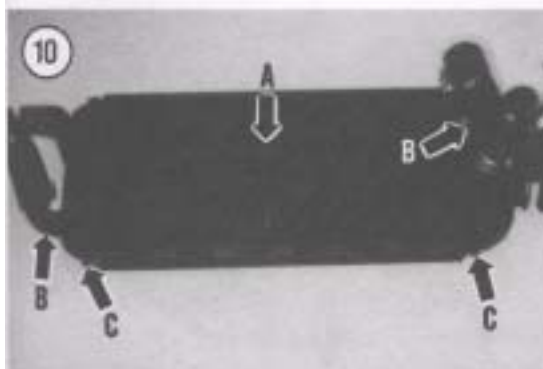
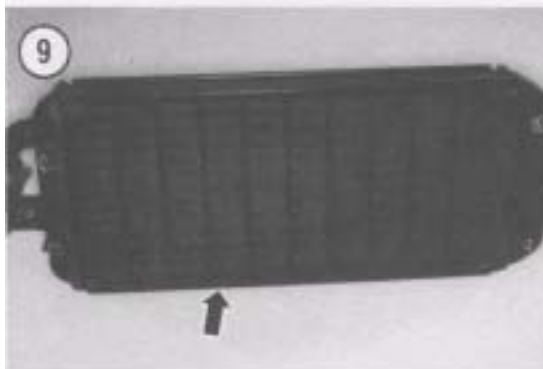
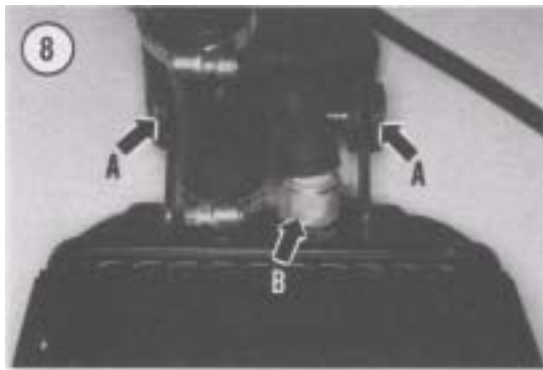
1. If not already removed, remove the screws securing the grille (**Figure 9**) and remove the grille from the front of the radiator.
2. If compressed air is available, use short spurts of air directed to the *backside of* the radiator and blow out dirt and bugs.
3. Flush off the exterior of the radiator (A, **Figure 10**) with a garden hose on low pressure. Spray both the front and the back to remove all road dirt and bugs. Carefully use a whisk broom or stiff paint brush to remove any stubborn dirt.

CAUTION

Do not press too hard or the cooling fins and tubes may be damaged causing a leak. Do not use a wire brush.

4. Carefully straighten out any bent cooling fins with a broad tipped screwdriver or putty knife.





5. Check for cracks or leakage (usually a moss-green colored residue) at the filler neck, the inlet and outlet hose fittings (B, **Figure 10**) and the upper and lower tank seams (C, **Figure 10**).

6. Inspect the upper and lower (**Figure 11**) mounting brackets. Check for cracks or fractures and repair if necessary.

7. If the condition of the radiator is doubtful, have it checked as described under *Pressure Check* in Chapter Three. The radiator can be pressure checked while removed or installed on the bike.

8. To prevent oxidation to the radiator, touch up any area where the black paint is worn off. Use a good quality spray paint and apply several *light* coats of paint. Do not apply heavy coats as this will cut down on the cooling efficiency of the radiator.

9. If necessary, unscrew the thermostatic switch (B, **Figure 8**) from the radiator. Apply a silicone based sealant to the threads of the switch and install the switch in the radiator and tighten securely.

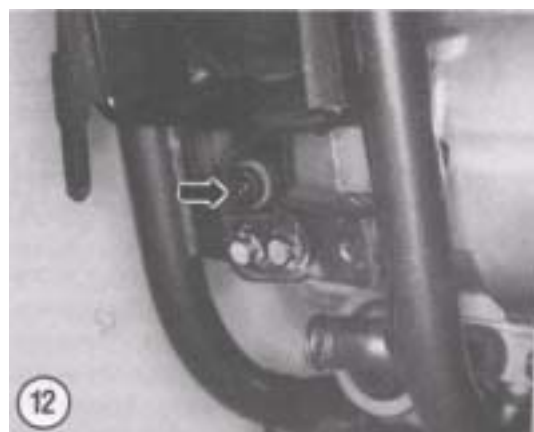
COOLING FAN, SHROUD AND

FAN DUCT

Removal/Installation

Refer to **Figure 3** for this procedure.

1. Remove the radiator as described in this chapter.
2. Disconnect the thermostatic switch individual electrical connectors (B, **Figure 6**).
3. Remove the lower bolt, lockwasher and washer (**Figure 12**) securing the fan, fan shroud and fan duct assembly.



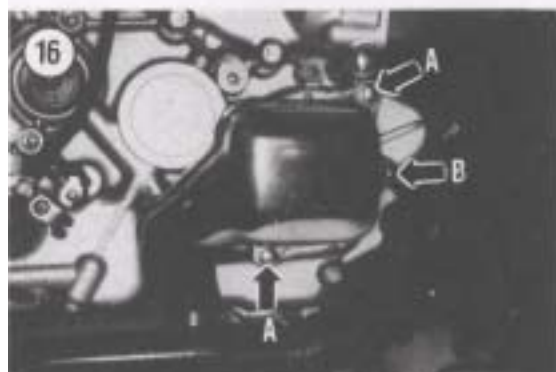
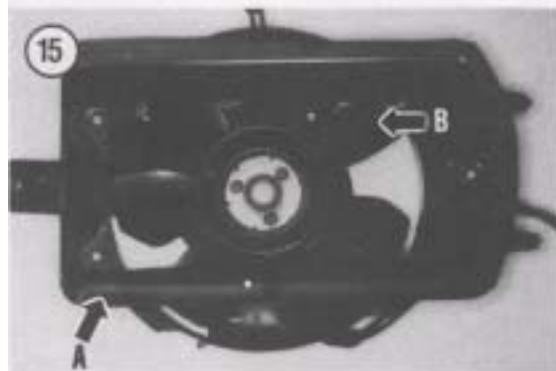
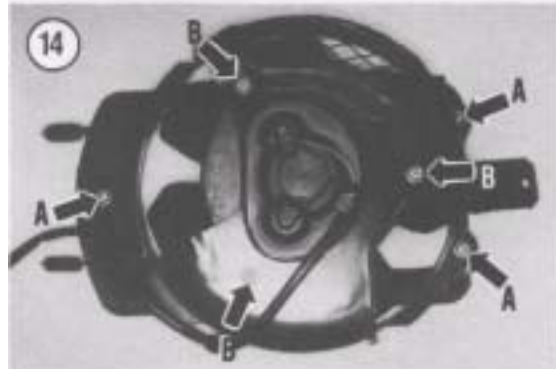
4. Remove the upper bolt, lockwasher and washer (A, **Figure 13**) securing the fan, fan shroud and fan duct assembly to each side.
5. Remove the assembly from the frame (B, **Figure 13**).
6. To remove the fan duct, remove the screws (A, **Figure 14**) securing the fan duct to the fan and fan shroud assembly. Remove the fan duct (A, **Figure 15**).
7. To remove the fan motor and fan, remove the screws (B, **Figure 14**) securing the assembly to the fan shroud and remove the assembly.
8. To remove the fan blade from the motor, remove the screws securing the fan blade (B, **Figure 15**). Remove the fan blade from the motor.
9. Install by reversing these removal steps, noting the following:
 - a. Apply blue Loctite (No. 242) to the threads on the fan motor mounting screws. Install the screws and tighten securely.
 - b. Refill the cooling system with the recommended type and quantity of coolant as described in Chapter Three.

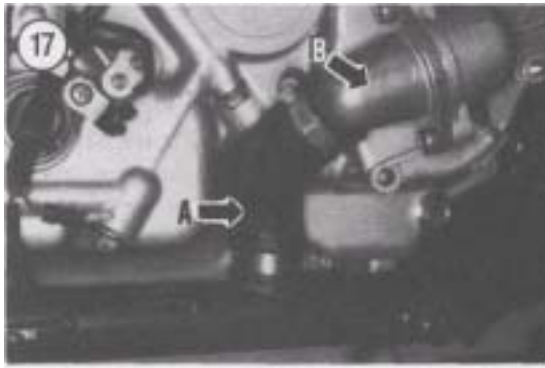
THERMOSTAT AND HOUSING

Thermostat Removal/Installation

The thermostat is located on the side of the water pump on the left-hand side of the engine just forward of the swing arm left-hand pivot point.

1. Drain the cooling system as described under *Coolant Change* in Chapter Three.
2. Remove the bolts (A, **Figure 16**) and acorn nut (B, **Figure 16**) securing the water pump trim cover and remove the cover.
3. Loosen the clamping screw on the water pump inlet hose clamps. Move the clamps back onto the hose and off of the neck of the fitting on the frame rail and water pump connector. Remove the hose (A, **Figure 17**) from both fittings.
4. Remove the screws securing the water pump connector (B, **Figure 17**) and remove the connector from the water pump cover. The thermostat may stay with the connector or with the water pump cover; remove the thermostat (**Figure 18**) from either part.





5. Clean the mating surfaces of both the water pump cover and the water pump connector of all dirt and any old coolant residue.

6. If reusing the same thermostat, inspect it as follows:

- a. Inspect the perimeter rubber seal (**Figure 19**) for damage or deterioration. Replace the thermostat if this area is damaged to prevent a coolant leak.
- b. Make sure the return spring (**Figure 20**) is operating correctly and has not sagged. Replace the thermostat if necessary.

7. Install the thermostat into the connector (**Figure 18**). Push it in until it seats completely. Make sure the rubber sealing surface of the thermostat is not damaged during installation.

8. Install the water pump connector (B, **Figure 17**) onto the water pump cover and install the screws. Tighten the screws securely in a crisscross pattern.

9. Replace the water pump inlet hose hoses if it is starting to deteriorate or is damaged.

10. Install the water pump inlet hose onto both fittings and tighten the clamping screw on the water pump inlet hose clamps.

11. Install the water pump trim cover, bolts (A, **Figure 16**) and acorn nut (B, **Figure 16**) and tighten securely.

12. Refill the cooling system with the recommended type and quantity of coolant as described in Chapter Three.

Thermostat Testing

Test the thermostat to ensure proper operation. The thermostat should be replaced if it remains open at normal room temperature or stays closed after the specified temperature has been reached during the test procedure.

1. Place the thermostat on a small piece of wood in a pan of water (**Figure 21**).

2. Place a thermometer in the pan of water (use a cooking or candy thermometer that is rated higher than the test temperature).

3. Gradually heat the water and continue to gently stir the water until it reaches 73.5-76.5° C (164.3-169.7° F). At this temperature the thermostat valve should start to open.

4. Continue to heat the water until the temperature reaches 90° C (194° F) and beyond. At this tempera-

ture, the thermostat valve should have opened to the maximum of 6.0 mm (0.24 in.).

NOTE

Valve operation is sometimes sluggish; it usually takes 3-5 minutes for the valve to operate properly.

5. If the valve fails to open in Step 3 or to the dimension listed in Step 4, the thermostat should be replaced (it cannot be serviced). Be sure to replace it with one of the correct temperature rating.

WATER PUMP

Removal

Refer to **Figure 22** for this procedure.

1. Drain the cooling system as described under *Coolant Change* in Chapter Three.
2. Remove the bolts (A, **Figure 16**) and acorn nut (B, **Figure 16**) securing the water pump trim cover and remove the trim cover.
3. Loosen the clamping screw on the water pump inlet hose clamps. Move the clamps back onto the hose and off of the neck of the fitting on the frame rail and water pump connector. Remove the hose (A, **Figure 17**) from both fittings.

NOTE

The remaining steps are shown with the engine removed from the frame for clarity. It is not necessary to remove the engine for water pump removal and installation.

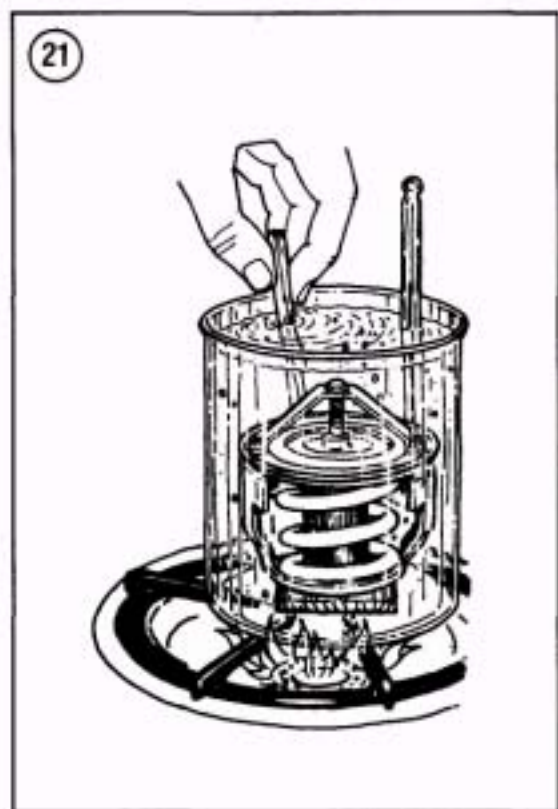
4. Remove the remaining bolt (A, **Figure 23**) securing the water pump cover. Slide the cover off the threaded stud in the crankcase and remove the water pump cover (B, **Figure 23**) from the crankcase.
5. Rotate the impeller (**Figure 24**) until the holes in the impeller align with the Phillips screws securing the water pump assembly to the crankcase.
6. Remove the Phillips screws (**Figure 25**) securing the water pump assembly to the crankcase.
7. Withdraw the water pump and gasket from the crankcase.
8. If necessary, remove the bolts (A, **Figure 26**) securing the connector (B, **Figure 26**) to the water pump cover and remove the connector and thermostat.

Inspection

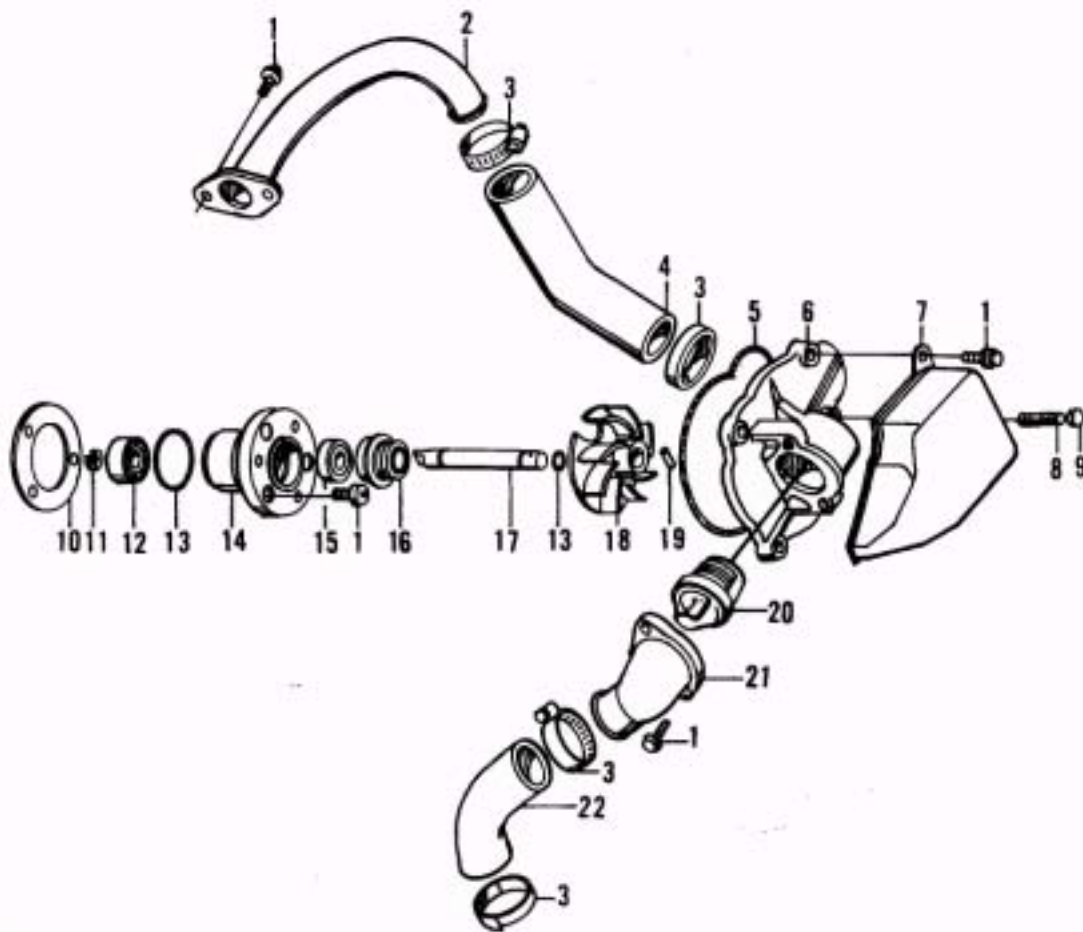
1. Inspect the water pump assembly for wear or damage. Rotate the impeller (A, **Figure 27**) and shaft to make sure the bearing (**Figure 28**) is not worn or damaged. If the bearing is damaged, replace the bearing.
2. Check the impeller blades for cracks or damage; replace the impeller if necessary.
3. Remove the O-ring seal (B, **Figure 27**) from the housing. This seal must be replaced each time the water pump is removed to prevent an oil leak. Install a new O-ring seal.
4. Remove the O-ring seal from the pump cover. This seal must be replaced each time the water pump is removed to prevent an coolant leak. Install a new O-ring seal.

Disassembly/Assembly

The water pump can be disassembled for replacement of the bearing, oil seal, mechanical seal and impeller. If only one or two of these parts is faulty;



WATER PUMP



- | | |
|--------------------------|---------------------|
| 1. Bolt | 12. Bearing |
| 2. Coolant pipe | 13. O-ring |
| 3. Hose clamp | 14. Housing |
| 4. Hose | 15. Oil seal |
| 5. O-ring gasket | 16. Mechanical seal |
| 6. Water pump cover | 17. Shaft |
| 7. Water pump trim cover | 18. Impeller |
| 8. Threaded stud | 19. Pin |
| 9. Cap nut | 20. Thermostat |
| | 21. Connector |

10. Gasket
11. E-ring

22. Hose

replace them. If the condition of the water pump is doubtful and most of these parts require replacement it is suggested the water pump assembly be replaced with a new one. Refer to **Figure 22** for this procedure.

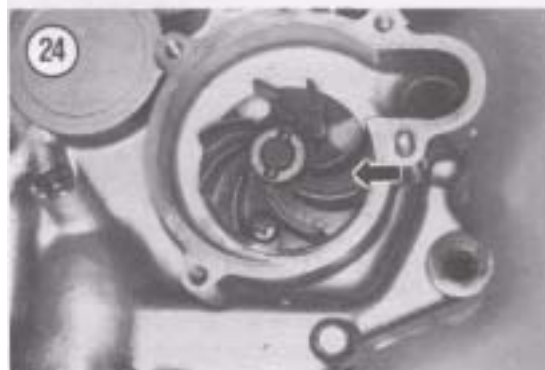
CAUTION

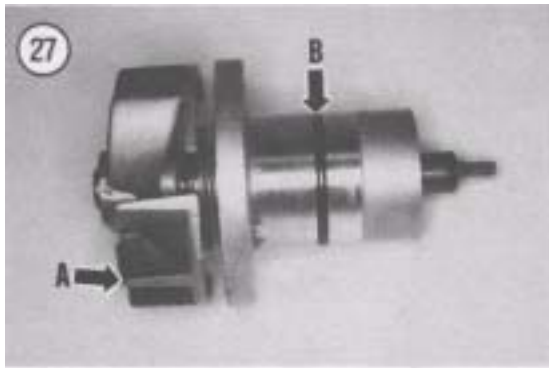
Do not try to remove the bearing from the housing without the Suzuki special tools. If substitute tools are used, the housing may be damaged and must be replaced.

NOTE

Figure 29 is shown with the water pump removed from the crankcase, turned over, then set back into the crankcase to hold the assembly upside down in order to remove the E-clip.

1. Remove the E-clip (**Figure 29**) securing the shaft into the water pump housing.
2. Carefully withdraw the impeller and shaft out of the housing and mechanical seal (**Figure 30**).
3. If necessary, remove the impeller and pin from the shaft.
4. If the mechanical seal is removed, also remove the oil seal in the housing behind it.
5. To remove the bearing, perform the following:
 - a. Install the Suzuki special tool, bearing remover (part No. 09921-20200), into the backside of the housing.
 - b. Attach the Suzuki special tool, sliding shaft (part No. 09930-30102), onto the bearing remover.
 - c. Using the weight on the slide shaft, withdraw the bearing from the housing.
6. To remove the oil seal, use the same tool set-up and same procedure used for bearing removal.
7. To replace the mechanical seal, perform the following:
 - a. Turn the housing over with the backside facing up and set it on 2 wood blocks.
 - b. From the backside of the housing, carefully tap the mechanical seal out of the housing.
8. Apply clean engine oil to the outer surfaces of the new parts to be installed and to the inner surface of the housing. This will make installation easier.
9. Tap the oil seal, then the bearing into the housing using a socket of the appropriate size to fit the bearing outer race. Tap the bearing in until it seats.





10. Install a new oil seal and mechanical seal. Tap them in until they are completely seated.

11. If removed, install a new O-ring onto the shaft, then install the impeller and pin.

12. Apply clean engine oil to the shaft and install the shaft and impeller into the mechanical seal (**Figure 30**) and through the bearing at the other end.

13. Install the E-clip (**Figure 29**) securing the shaft into the water pump housing. Make sure the E-clip is properly seated in the shaft groove.

14. Rotate the impeller and shaft and make sure it rotates freely with no binding.

Installation

Refer to **Figure 22** for this procedure.

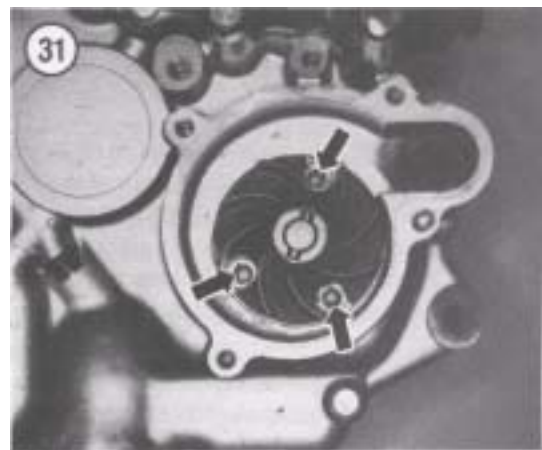
1. Install the thermostat into the connector (**Figure 18**). Push it in until it seats completely. Make sure the rubber sealing surface of the thermostat is not damaged during installation.

2. Install the water pump connector (B, **Figure 26**) onto the water pump cover and install the screws (A, **Figure 26**). Tighten the screws securely and evenly.

3. Install the water pump and new gasket into the crankcase.

4. Rotate the water pump housing until the mounting holes are aligned with the crankcase holes (**Figure 31**).

5. Install the Phillips screws (**Figure 25**) securing the water pump assembly to the crankcase and tighten securely.



6. Apply some cold grease into the groove in the backside of the water pump cover and install a new O-ring seal (**Figure 32**).

CAUTION

Do not install the cover nor any fasteners until the assembly is completely seated against the crankcase. Do not try to force the assembly into place with the mounting bolts and nut as both the oil pump and the water pump may be damaged.

7. Slide the cover over the threaded stud in the crankcase and push the water pump cover onto the crankcase until it seats completely. Make sure the O-ring seal is still in place.

8. Install the front upper bolt (A, **Figure 23**) securing the water pump cover. Tighten the bolt finger-tight at this time. It should be tightened later, after the cover and its bolts are installed.

9. Replace the water pump inlet hose if it is starting to deteriorate or is damaged.

10. Install the water pump inlet hose onto the connector and onto the fitting on the frame. Move the clamps into position and tighten securely.

11. Install the trim cover onto the water pump and install the bolts (A, **Figure 16**) and acorn nut (B, **Figure 16**). Tighten the bolts and nut securely in a crisscross pattern. Be sure to tighten the bolt installed in Step 8.

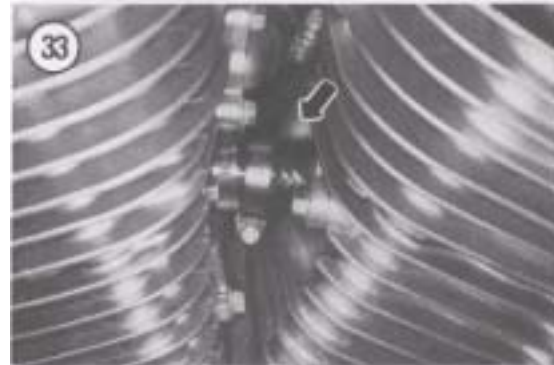
12. Refill the cooling system as described under *Coolant Change* in Chapter Three.

13. Start the bike and check for leaks.

HOSES

Hoses deteriorate with age and should be replaced periodically or whenever they show signs of cracking or leakage. To be safe, replace the hoses every 2 years. The spray of hot coolant from a cracked hose can injure the rider and passenger. Loss of coolant can also cause the engine to overheat causing damage.

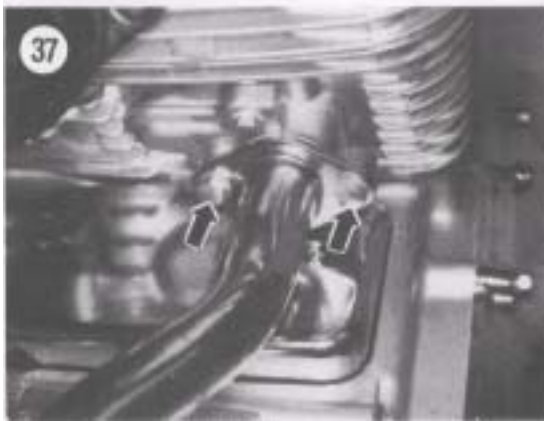
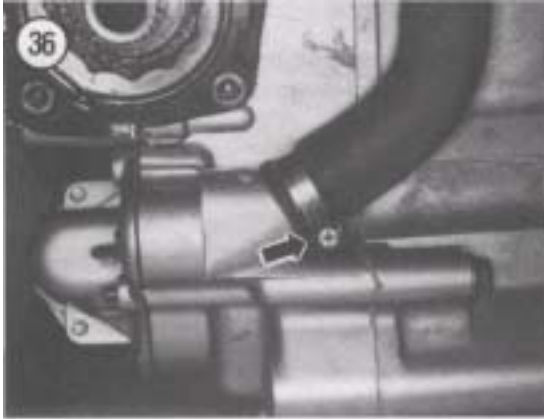
Whenever any component of the cooling system is removed, inspect the hose(s) and determine if replacement is necessary.



Replacement

NOTE

To replace both short sections of hose that run between the cylinder heads and the cylinders (**Figure 33**), one of the cylinders must be removed. Refer to



Cylinder Head and Cylinder Removal in Chapter Four.

1. Drain the cooling system as described under *Coolant Change* in Chapter Three.

NOTE

The radiator upper and lower hoses are very short and also very stiff. The working area around the frame upper hose is very limited, therefore it is suggested that the radiator first be removed from the frame. Replace the hoses while the radiator is removed from the frame.

2. Remove the radiator as described in this chapter.
3. After the radiator is removed, perform the following:
 - a. Loosen the clamping screw of the upper hose clamp. Move the clamp back onto the hose and off the neck of the radiator, then remove the upper hose (A, **Figure 34**) from the radiator.
 - b. Loosen the clamping screw of the lower hose clamp. Move the clamp back onto the hose and off the neck of the radiator, then remove the lower hose (B, **Figure 34**) from the radiator.
4. To remove the water pump outlet hose, perform the following:
 - a. Remove the battery case (A, **Figure 35**) as described under *Battery Case Removal/Installation* in Chapter Eight.

NOTE

Figure 36 and Figure 37 are shown with the engine removed for clarity.

- b. Loosen the clamping screw (**Figure 36**) on the water pump outlet hose fitting at the back of the crankcase. Move the clamp back onto the hose and off the neck of the fitting, then remove the hose (B, **Figure 35**) from the crankcase fitting.
 - c. Remove the bolts (**Figure 37**) securing the metal coolant pipe to the rear cylinder.
 - d. Move the metal coolant pipe (C, **Figure 35**) away from the cylinder.
 - e. Remove the metal coolant pipe and rubber hose assembly from the engine and frame.
5. To remove the water pump inlet hose, perform the following:
 - a. Remove the bolts (A, **Figure 38**) and acorn nut (B, **Figure 38**) securing the water pump trim cover, then remove the trim cover.

- b. Loosen the clamping screw on the water pump inlet hose clamps. Move the clamps back onto the hose and off the neck of the fitting on the frame rail and water pump connector.
- c. Remove the hose (**Figure 39**) from both fittings.
6. Install the new hoses along with the correct type of hose clamp. Tighten the clamps securely, but not so tight that the clamps cut into the new hose.
7. When installing the water pump outlet hose onto the rear cylinder, install a new O-ring seal (**Figure 40**) into the receptacle in the cylinder and apply a light coat of clean engine oil to the O-ring.
8. Install all of components that were removed.
9. Refill the cooling system with the recommended type and quantity of coolant. Refer to *Coolant Change* in Chapter Three.
10. Start the engine and check for leaks.

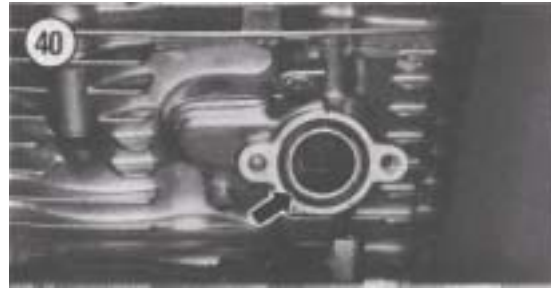
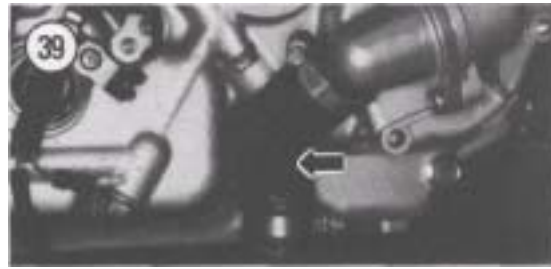


Table 1 COOLING SYSTEM SPECIFICATIONS

Coolant capacity Radiator	1.7 liters (1.8 U.S. qt. [1.5 Imp. qt.]
cap relief pressure	75-105 kPa (10.7-14.9 psi)
Thermostat begins to open	73.5-76.5° C (164.3-1169.7° F)
Valve lift	Minimum of 6 mm (0.24 in.) @ 90° C (194° F)