

Sec. 6. COOLING SYSTEM (CS)

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6. Cooling System

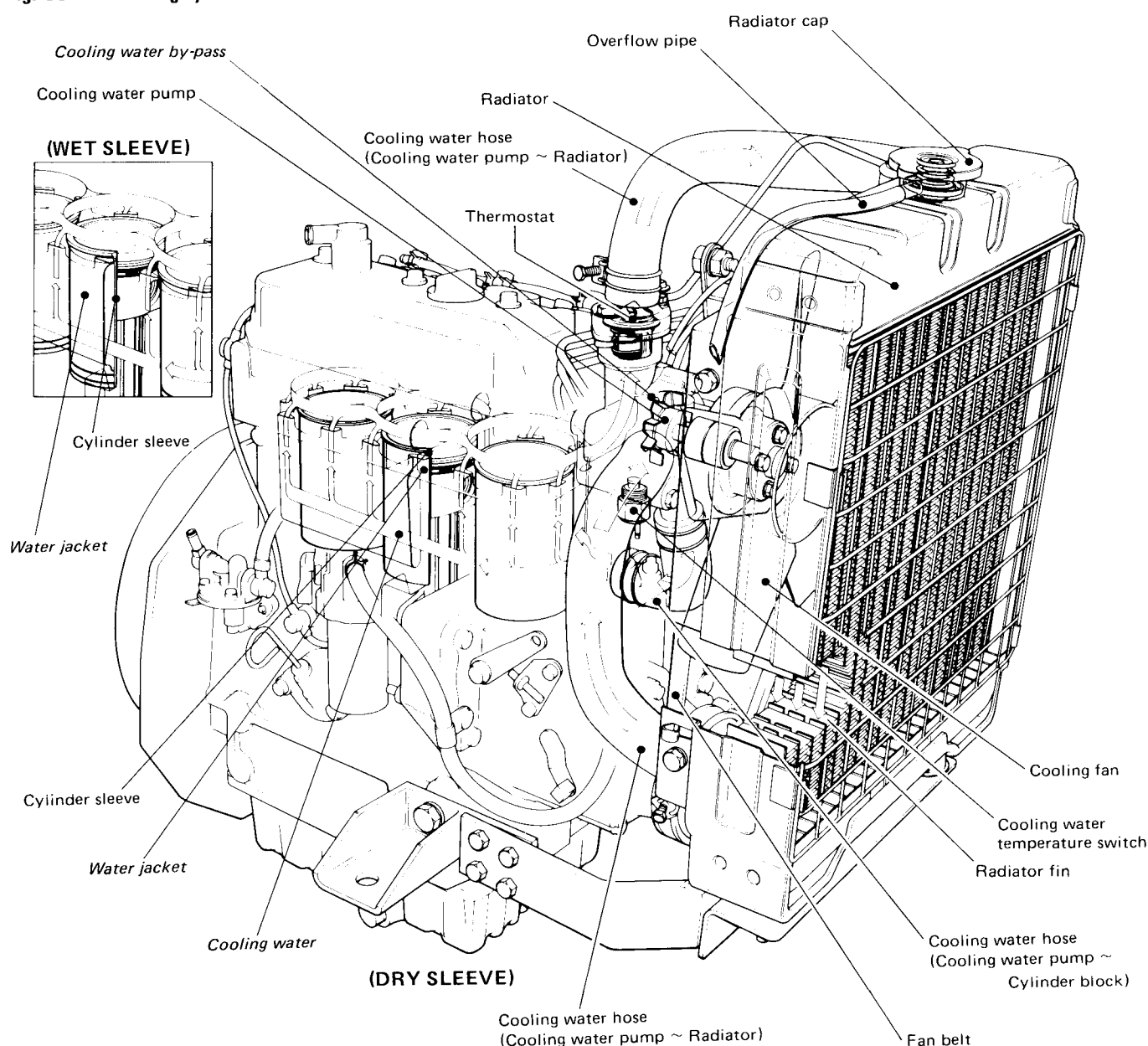
1. Service Information

[1-1] Description

The engine has a “radiator and engine fan type” cooling system (Fig. CS-1). A water temperature gauge is installed in the vicinity of the cooling water outlet port on the cylinder head. If the water

temperature rises above a specified level, the alarm lamp indicates the abnormal rise early enough to prevent the engine from overheating.

Fig. CS-1 Cooling system



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[1-2] Specifications

		2T72HLE	2T75HLE	3T72HLE	3T75HLE	2T90LE	3T80LE	3T90LE
Cooling system capacity liter (US gal., Imp. gal)	Engine	1.2 (0.32, 0.26)	1.5 (0.40, 0.33)	2.0 (0.53, 0.44)	2.3 (0.61, 0.51)	2.9 (0.77, 0.64)	3.8 (1.01, 0.84)	4.4 (1.16, 0.97)
	Radiator	3.0 (0.79, 0.66)	3.0 (0.79, 0.66)	3.1 (0.82, 0.68)	3.1 (0.82, 0.68)	4.0 (1.06, 0.88)	4.0 (1.06, 0.88)	4.0 (1.06, 0.88)
Cooling water pump type		Centrifugal						
Radiator capacity		10,000 Kcal/Hr		14,400 Kcal/Hr		18,800 Kcal/Hr		20,500 Kcal/Hr
Thermostat		Wax pellet type (open: 71°C, (344K/160°F), Full open: 85°C (358K/185°F)						
Radiator fan Pusher Puller		5-blade, ϕ310 mm (12.2 in.) 6-blade, ϕ300 mm (11.81 in.)				6-blade, ϕ360 mm (14.17 in.) 6-blade, ϕ360 mm (14.17 in.)		
Radiator cap working pressure		0.9 kgf/cm ² (0.9 Bar/12.8 psi)						
Fan belt tension		10 ~ 15 mm (0.4 ~ 0.6 in.)						
Water temperature sender switch		107 ~ 113°C (380 ~ 386K/225 ~ 235°F): ON, 99 ~ 105°C (372 ~ 378K/210 ~ 221°F): OFF						

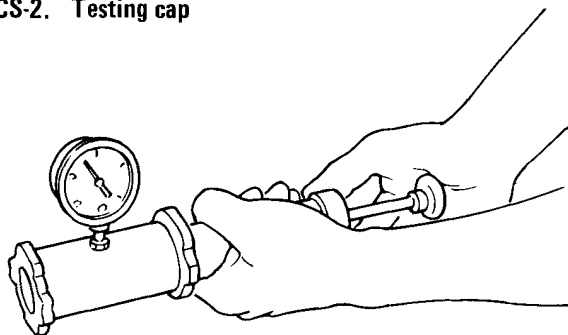
2. Radiator

[2-1] Inspection

a) Cap check

1. Attach the cap to the tester.
2. Operate the water pump of the tester to build up water pressure. The cap is working if the gauge needle stays within the normal pressure range for 6 seconds. If the water pressure does not rise, or if it drops immediately after it has risen, either the cap packing is worn, cracked or broken, or the cap spring has deteriorated. Replace the cap.

Fig. CS-2. Testing cap



3. Remove the cap, turn it 180°, and retest it. This is to eliminate any possibility of an inaccurate measurement. Remove and test the cap twice.

Cap working pressure	0.9 kgf/cm ² (0.9 Bar/12.8 psi)
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b) Check for leaks in the radiator and cooling

water system

It is advisable to perform this check with the engine warmed up.

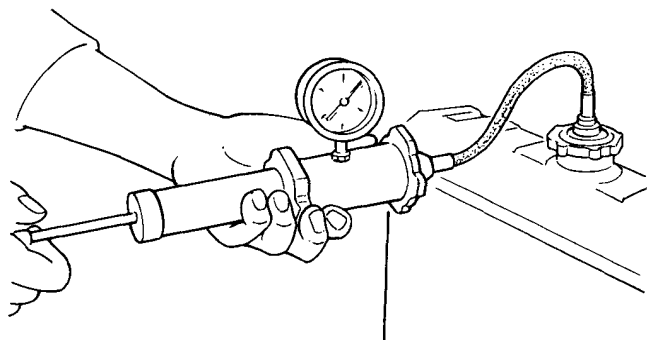
1. Fill the radiator with cooling water up to the normal water level.
2. Connect the adaptor furnished with a tester unit. Connect the tip of the adaptor to the water filter port.
3. Operate the pump and apply the amount of pressure indicated on the radiator cap. Excessive pressure may break the radiator and/or hose.

Applied pressure	0.9 kgf/cm ² (0.9 Bar/12.8 psi)
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4. With pressure applied, check the following:

- Hose connections
- Radiator cooling water pump packing
- Radiator drain cock

Fig. CS-3. Pressure testing



5. If the gauge indicates a drop in pressure, but no cooling water leakage is detected, water may be leaking from the cooling water system and/or gaskets of the cylinder block and cylinder head. The engine must be disassembled for the check.

3. Cooling Water Fan Belt

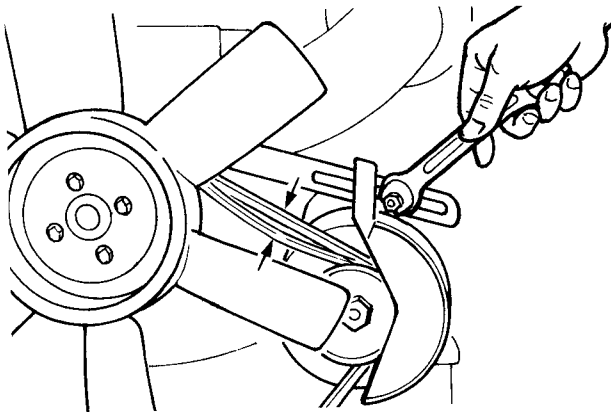
The cooling water fan belt is subject to stretching, the wet and other possible damage after a long period of service.

[3-1] Fan belt Tension

1. If the belt is loose, it will slip, causing the battery to be undercharged, the cooling system to malfunction, and the V-belt groove to wear abnormally. Check the tension periodically and adjust it if required.

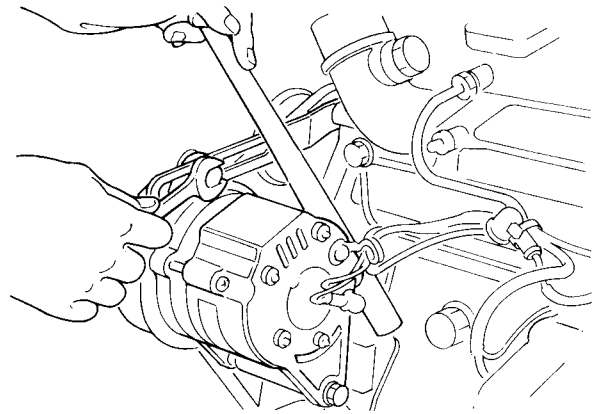
Belt tension	Press hard with the fingers to get a play of 10~15mm (0.4~0.6 in.)
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Fig. CS-4. Measuring belt tension



2. Loosen the charging generator bolts and shift the generator until the belt has the proper tension. When the belt has been replaced, check the tension for any damage after 20 and 50 hours.

Fig. CS-5. Adjusting belt tension



Fan belt specifications:

Model	Belt type x size
2T72HLE	A x 42 in.
2T75HLE	A x 42 in.
3T72HLE	A x 33 in.
3T75HLE	A x 33 in.
2T90LE	A x 37 in.
3T80LE	A x 36 in.
3T90LE	A x 37 in.

4. Thermostat

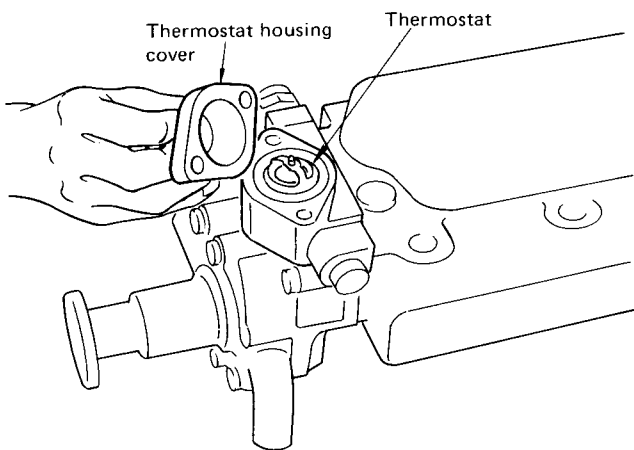
[4-1] Description

To shorten the engine warm-up time, a thermostat has been placed in the cooling water circuit. Cooling water circulates through the bypass circuit until the cooling water temperature reaches 71°C (344K/166°F). At 71°C (344K/160°F), the thermostat operates to open the main cooling water circuit to prevent abnormal temperature rises.

[4-2] Removal

1. Drain the coolant from the radiator.
2. Disconnect the upper radiator hose from the thermostat housing.
3. Remove the thermostat housing cover and thermostat.

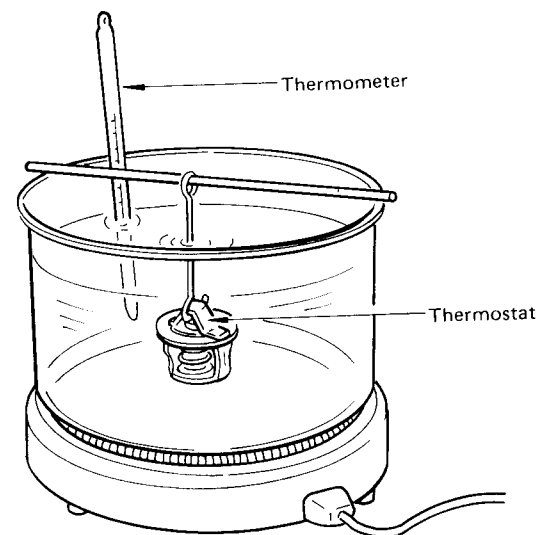
Fig. CS-6. Removing thermostat



[4-3] Inspection

1. Replace the thermostat if it opens at room temperature.
2. Suspend the thermostat in a container of water.

Fig. CS-7. Testing thermostat



3. Heat the water and check temperature with a thermometer. Check temperature at which the thermostat first opens and at full lift.

Note:

Do not let the thermostat touch bottom of the hot container.

4. Measure the lift height of the thermostat when fully open.

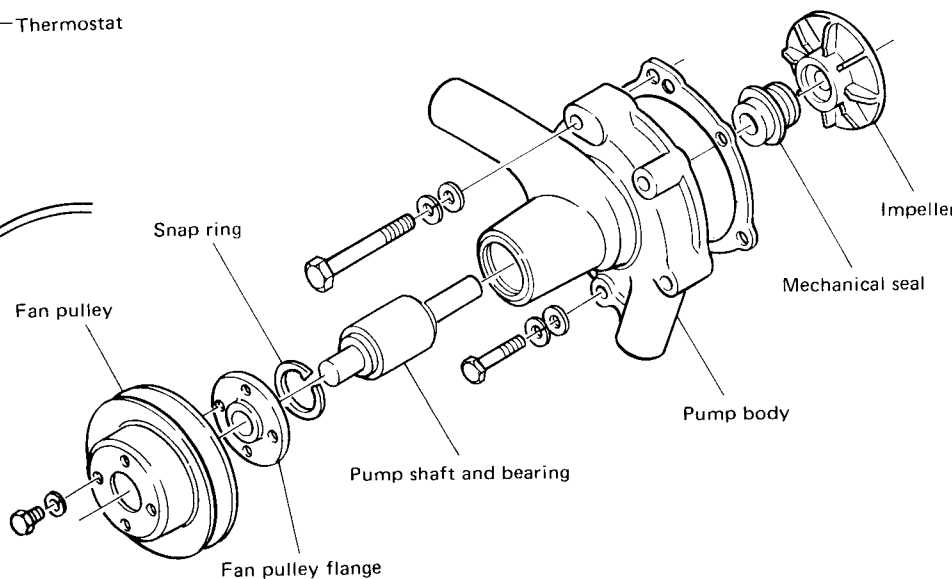
Lift height	8 mm (0.31 in.)
Starts opening	71°C (344K/160°F)
Fully open	85°C (358K/185°F)

[4-4] Installation

1. Install the thermostat in the housing.
2. Apply sealing agent to both sides of a new housing cover gasket. Install the housing cover.
3. Connect the upper radiator hose to the thermostat housing and secure with the hose clamp.

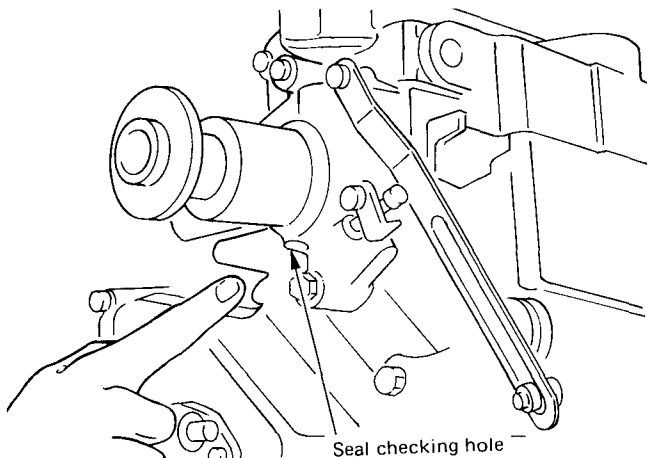
5. Cooling Water Pump

Fig. CS-8. Cooling water pump exploded view (Typical)

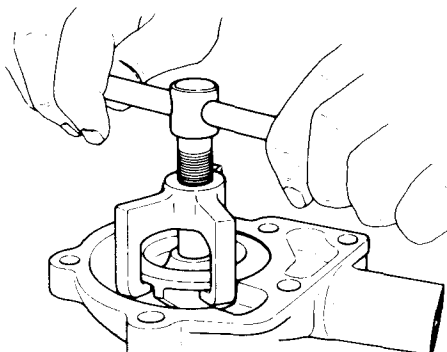


[5-1] Cooling water pump inspection

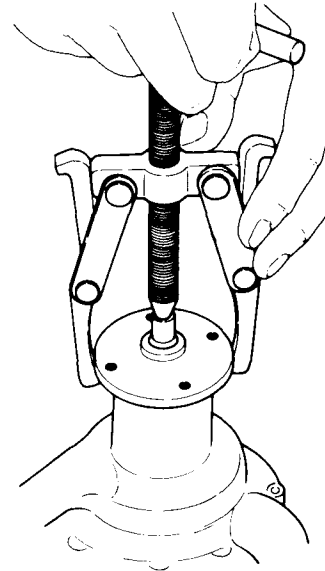
1. Make sure that the pump shaft rotates smoothly.
2. Make sure that there is no "play" on the pump shaft. If there is excessive play, disassemble the pump and replace the pump shaft with bearing.
3. Make sure that cooling water does not leak from the hole in the lower section of the pump unit during operation. If there is leakage, the mechanical seal in the hole may be broken. Disassemble the pump and replace the mechanical seal.

Fig. CS-9. Checking mechanical seal leakage**[5-2] Water pump disassembly**

1. Remove the water pump (see page ED-6).
2. Remove the impeller using a gear puller.

Fig. CS-10. Removing impeller

3. Remove the mechanical seal.
4. Remove the fan pulley flange using a gear puller.

Fig. CS-11. Removing pulley flange

5. Remove the snap ring.
6. Press the pump shaft and bearing assembly out from the impeller end to the fan pulley end.
7. Reassemble in the reverse order to disassembly.
8. Install the water pump (see page ED-29).

6. Cooling Water Check**a) Radiator cap removal**

It is not advisable to remove the radiator cap until the engine has cooled down. However, if it is necessary, cover the cap with a thick cloth and gently turn the cap with both hands. Keep your face as far away as possible to prevent getting burnt by the steam.

b) Adding cooling water

Add cooling water if required. The normal water level is just above the baffle board of the radiator.

c) Cooling water

Use clean soft water to fill the radiator.

7. Remedies for Overheating

The engine is overheated when the water temperature control switch activates and the alarm lamp lights up.

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When the engine overheats, do not suddenly stop the engine. This will only accelerate overheating since cooling water circulation will stop. Also, if cooling water is added to the radiator with the engine stopped, the engine will cool too quickly, which may cause cracks in the cylinder head, cylinder block, etc.

If the engine overheats, operate the engine at an extremely low speed until the water temperature drops. Then slowly replenish the cooling water.

Causes of Overheating:

1. Cooling water level may be low.
 2. The cooling water pump drive belt may be broken or loose.
 3. The engine may be overloaded.
 4. The cooling efficiency may be lowered due to contaminants in the cooling water.
 5. The cooling water pump may be damaged.
- Check all of these possible causes before restarting the engine.

8. Cooling Water Capacity

Model	Capacity l (U.S.Gal.)
2T72HLE	4.2 (1.11)
2T75HLE	4.5 (1.19)
2T90LE	6.9 (1.83)
3T72HLE	5.1 (1.35)
3T75HLE	5.4 (1.43)
3T80LE	7.8 (2.07)
3T90LE	8.4 (2.22)

9. Anti-Freeze

If the engine is to be operated in freezing temperatures, it is necessary to add an anti-freeze to the cooling water.

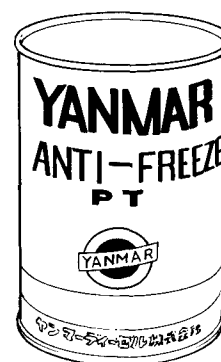
a) Types of anti-freeze

1. Anti-freeze is available in two types — a permanent (PT) and a semi-permanent type (SPT). The permanent type is recommended because it provides high stability cooling efficiency.
2. Long-life Coolant (LLC)
The LLC is a special, year-round coolant for use in automobiles, etc. It is also effective as a rust inhibitor.

b) Anti-freeze filling procedure

1. Before adding anti-freeze, drain the cooling water from the radiator and engine and clean the cooling water system by flushing fresh water through it. Also check that no cooling water leaks from the system.
2. Determine the proper amount of anti-freeze by referring to the reference table. Remove the radiator cap and pour the solution into the filler port.
3. Fill the radiator with cooling water, and idle the engine for 30 minutes so that the cooling water and solution mix thoroughly.
4. When freezing weather passes, drain the cooling water-antifreeze solution. Then clean the radiator and engine with fresh water. Refill with fresh water and rust inhibitor.

Fig. CS-12. Anti-freeze solution



	Cooling water ca- pacity (l)	-5°C 268K/23°F	-10°C 263K/14°F	-15°C 258K/5°F	-20°C 253K/-4°F	-25°C 248K/ -13°F	-30°C 243K/ -22°F	-35°C 238K/ -31°F	-40°C 233K/ -40°F
% ratio of anti - freeze	—	12%	22%	29%	35%	40%	44%	48%	52%
2T72HLE	4.2	0.5	0.9	1.2	1.5	1.7	1.5	2.0	2.2
2T75HLE	4.5	0.5	1.0	1.3	1.6	1.8	2.0	2.2	2.3
2T90LE	6.9	0.8	1.5	2.0	2.4	2.8	3.0	3.3	3.6
3T72HLE	5.1	0.6	1.1	1.5	1.8	2.0	2.2	2.5	2.7
3T75HLE	5.4	0.7	1.2	1.7	1.9	2.2	2.4	2.6	2.8
3T80LE	7.8	0.9	1.7	2.2	2.7	3.1	3.4	3.7	4.1
3T90LE	8.4	1.0	1.9	2.5	2.9	3.4	3.7	4.0	4.4

10. Rust Inhibitor

In water-cooled diesel engines, rust prevention in the cooling system is an important preventive measure. The following preventive measures must be taken:

- * Clean the radiator periodically to prevent solid matter from entering the cooling system.
- * Use a rust inhibitor in the cooling water.

a) Effect of rust inhibitor

A rust inhibitor mixed with the cooling water helps prevent the formation of rust in the cooling water system. There are a variety of rust inhibitors. The rust inhibiting action differs according to the type, and its effect on metals differs according to the type of metal. Therefore, a combination of rust inhibiting materials, most suitable for both the metal of the cooling system and the purpose for their use, must be chosen for diesel engines.

A rust inhibitor forms a protective film similar to an anti-corrosive plating on metal surfaces. In other words, the rust inhibiting ingredient dissolves in the cooling water, and forms a protective film over metal surfaces to keep out oxygen.

b) Rust inhibitor handling procedure

1. Clean and flush the cooling system with clean fresh water. First add the rust inhibitor, and fresh water to the proper level.
2. If the level of the cooling water becomes low, add rust inhibitor and fresh water in a ratio of 1:10;
3. To prevent the cooling water from freezing in cold areas, add an anti-freeze solution.
4. The "life" of the rust inhibitor is 6 months. Replace it every 6 months.

Fig. CS-13. Rust inhibitor

