WATER COOLING SYSTEM

An English language learning unit

based on authentic materials from:

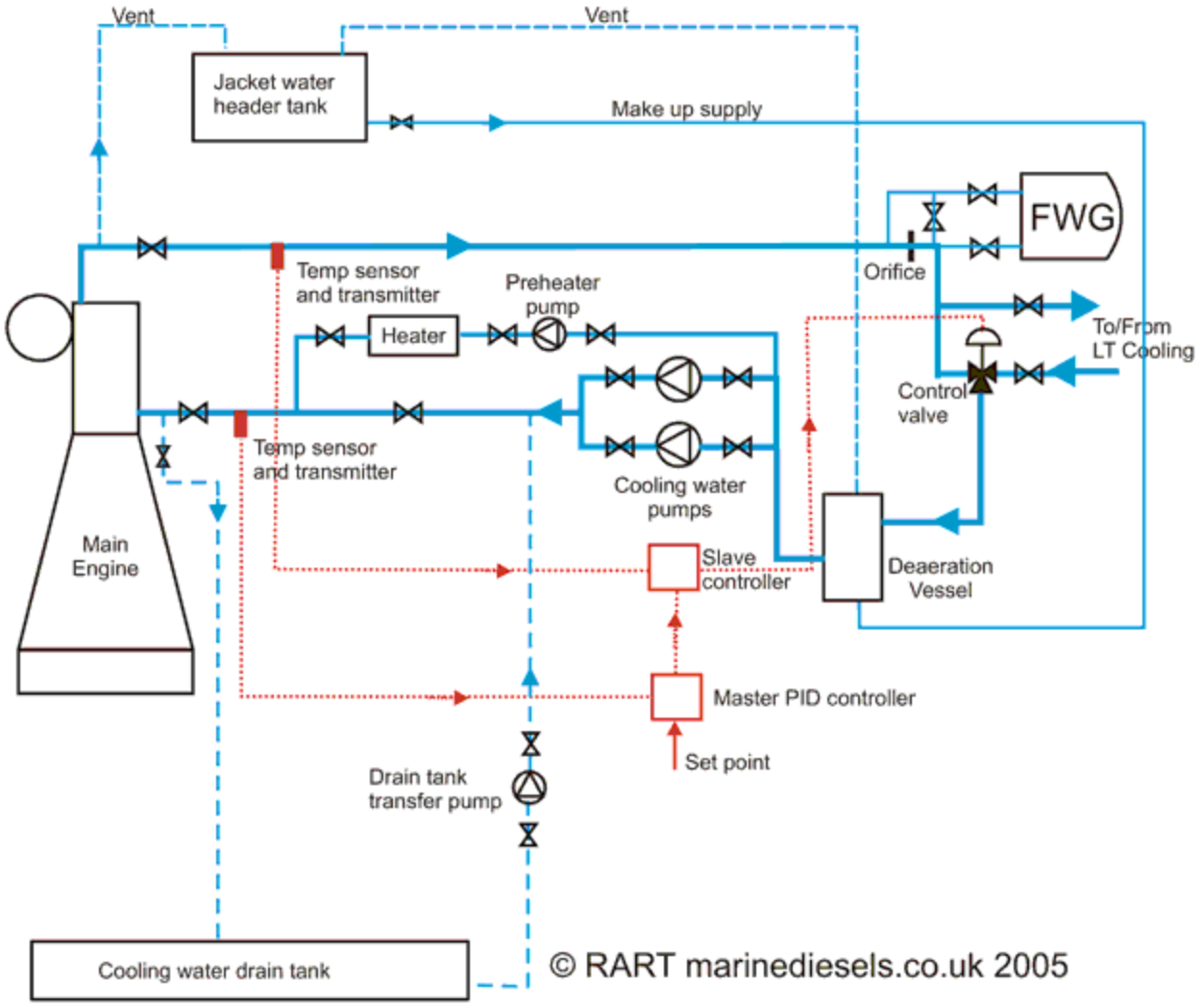
- **www.marinediesels.co.uk**

  (THE LEARNING RESOURCE FOR MARINE ENGINEERS)

- http://www.marinediesels.info/Basics/cooling_the_engine.htm

- http://www.machineryspaces.com/cooling.html

- etc.


Vent
Vent
Jacket water header tank
Make up supply
FWG
Orifice
Temp sensor and transmitter
Preheater pump
Heater
To/From LT Cooling
Control valve
Temp sensor and transmitter
Cooling water pumps
Main Engine
Slave controller
Deaeration Vessel
Master PID controller
Set point
Drain tank transfer pump
Cooling water drain tank
© RART marinediesels.co.uk 2005

How The Engine Is Cooled

http://www.marinediesels.info/Basics/cooling_the_engine.htm

- Although there is an abundance of free sea water available, marine diesel engines do not use it directly to keep the hottest parts of the engine cool. This is because of the corrosion which would be caused in the cooling water spaces, and the salts which would be deposited on the cooling surfaces interfering with the heat flow.
- Instead, the water circulated around the engine is fresh water (or better still, distilled water) which is then itself cooled using sea water. This fresh water is treated with chemicals to keep it slightly alkaline (to prevent corrosion) and to prevent scale formation. Of course, if distilled water, which some ships can make from sea water using evaporators, is used then there is a reduced risk of scale formation.

Answer the following questions

How The Engine Is Cooled

1. How are the hottest parts of the engine cooled?
   - .....
2. Why do we not use sea water for direct cooling?
   - .....
3. What is used instead?
   - .....
4. Why is fresh water is treated with chemicals?
   - .....
5. How is distilled water produced on bord?
   - .....
6. What is the advantage uf using distilled water?
   - .....

- The cooling water pump which may be engine driven or be a separate electrically driven pump pushes the water around the circuit. After passing through the engine, where it removes the heat from the cylinder liners, cylinder heads, exhaust valves and sometimes the turbochargers, it is cooled by seawater and then returns to the engine. The temperature of the cooling water is closely controlled using a three way control valve. If the water is allowed to get too cold then it will cause thermal shocking which may lead to component failure and will also allow water and acids to condense on the cylinder bores washing away the lubricating film and causing corrosion. If it gets too hot then it will not remove the heat effectively causing excessive wear and there is a greater danger of scale formation. For this reason the cooling water outlet temperature is usually maintained at about 78-82°C. Because it is at a higher temperature than the cooling water used for other purposes (known as the LT cooling), the water for cooling the engine is known as the HT (High Temperature) cooling water.

Fill in the gaps

- The cooling water pump which may be _____ driven or be a separate _____ driven pump pushes the water around the _____ .
- After passing through the engine, where it _____ the heat from the cylinder liners, cylinder heads, _____ and sometimes the turbochargers, it is cooled by _____ and then returns to the engine.
- The temperature of the cooling water is closely controlled using a _____ control valve.
- If the water is allowed to get too cold then it will cause thermal _____ which may lead to component _____ and will also allow water and acids to condense on the _____ washing away the lubricating film and causing _____ .
- If it gets too hot then it will not remove the heat effectively causing excessive wear and there is a greater danger of scale formation.
- For this reason the cooling water outlet temperature is usually maintained at about 78-82°C.
- Because it is at a higher temperature than the _____ used for other purposes (known as the _____), the water for cooling the engine is known as the HT (_____) cooling water.

Supply the missing info:

- The cooling water pump which may be ..... or ..... pushes the water around the circuit.
- After passing through the engine, where it ....., cylinder heads, exhaust valves and sometimes the turbochargers, it is cooled by seawater and then .....
- The temperature of the cooling water is closely controlled using ..... .
- If the water is allowed to get too cold then it will cause thermal shocking which may lead to ..... and will also allow water and ..... washing away the lubricating film and causing corrosion.
- If it ..... then it will not remove the heat effectively causing excessive wear and there is a greater danger of scale formation.
- ..... the cooling water outlet temperature is usually maintained at about 78-82°C.
- Because it is at a higher temperature than the cooling water used for other purposes (known as the LT cooling), the ..... is known as the HT (High Temperature) cooling water.

There are two HT **cooling pumps** fitted. These are centrifugal pumps which maintain the cooling water circulating pressure at about 4 Bar.

The temperature of the cooling water is controlled automatically by **a 3 way valve**. If no cooling is required (when the engine is stopped) then the valve allows water to circulate through the valve back to the pumps.

If cooling is required, then water is diverted to the Low Temperature (**LT)** system and replaced with cool water from the LT system. The LT water is cooled using sea water in plate coolers.

- Cooling can be achieved by using a **dedicated cooler** or by **mixing** in some of the water from the LT cooling circuit. The LT cooling water is then cooled in the sea water coolers. The temperature is controlled using cascade control which monitors both the inlet and outlet temperatures from the engine. This allows a fast response to any change in temperature due to a change in engine load.

The **fresh water generator (or evaporator)** uses the heat from the main engines in the cooling water to produce fresh water from sea water. The pressure in the evaporator is below atmospheric (i.e. a vacuum) so that the water boils at a lower temperature (about 65°C). On a large passenger vessel the evaporators can produce 500 tons/day. This version is for a container ship and can produce 30 tons/day.

- To make up for any leaks in the system there is a header tank, which automatically makes up any deficiency. Vents from the system are also led to this header tank to allow for any expansion in the system and to get rid of any air (if you are familiar with a domestic central heating system then you will see the similarities). The header tank is relatively small, and usually placed high in the engine room. It is deliberately made to be manually replenished, and is fitted with a low level alarm. This is so that any major leak would be noticed immediately. Under normal conditions, the tank is checked once per watch, and if it needs topping up, then the amount logged.

Underline the terms pertaining to cooling water:

To make up for any leaks in the system there is a header tank, which automatically makes up any deficiency. Vents from the system are also led to this header tank to allow for any expansion in the system and to get rid of any air. The header tank is relatively small, and usually placed high in the engine room. It is deliberately made to be manually replenished, and is fitted with a low level alarm. This is so that any major leak would be noticed immediately. Under normal conditions, the tank is checked once per watch, and if it needs topping up, then the amount logged.

Supply the missing info:

- To make up for any leaks in the system there is a header tank, which …… .
- Vents from the system are …… . system and to get rid of any air (if you are familiar …… . then you will see the similarities).
- The header tank is relatively small, and usually placed …… . .
- It is deliberately made …… . , and is fitted with a low level alarm.
- This is so that any major leak would …… . .
- …… ., the tank is checked once per watch, and if it needs topping up, then the amount logged.

- The system will also contain a **heater** which is to keep the cooling water hot when the engine is stopped, or to allow the temperature to be raised to a suitable level prior to starting. Some ships use a central cooling system, whereby the same cooling water is circulated through the main engine(s) and the alternator engines. This system has the advantage whereby the engines which are stopped are kept warm ready for immediate starting by the engines which are running.

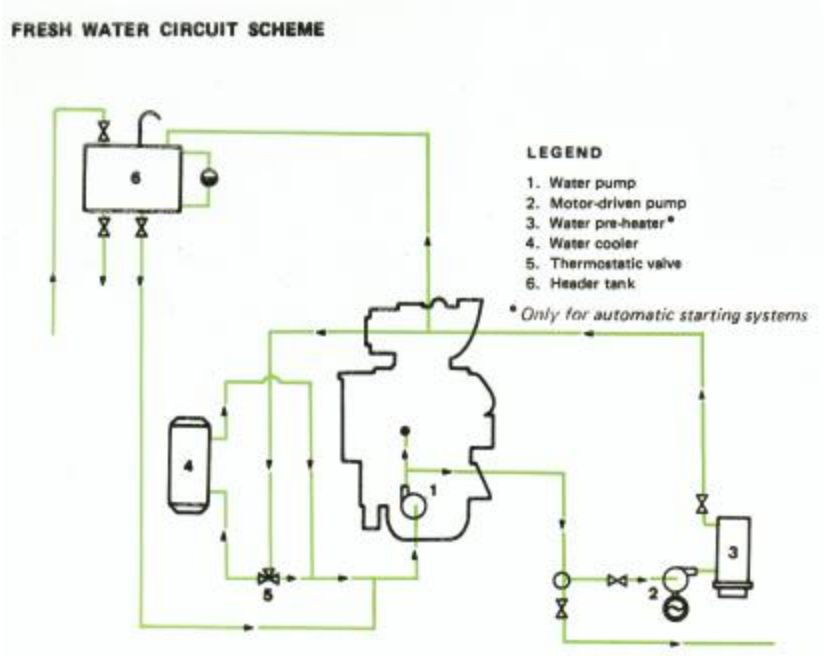
Complete the following sentences:

- The function of the heater is to ……
- It is also used to ……
- Some ships use a central cooling system, whereby the same cooling water is circulated ……
- This system has the advantage because ……

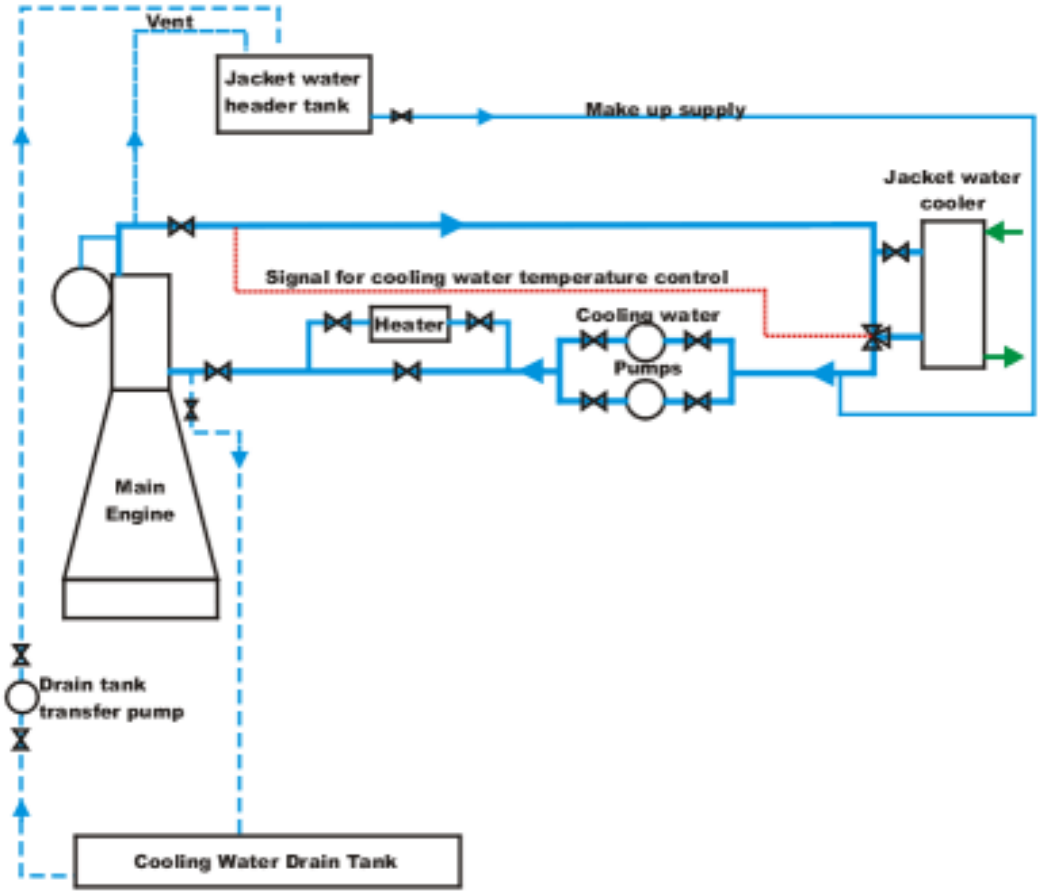
- A **fresh water generator** (FWG) which is used to produce fresh water from sea water is also incorporated.
- A **drain tank** has been included. This is for when the engine is drained down for maintenance purposes. Because of the quantities of water involved and the chemical treatment, it is not economically viable or environmentally responsible to dump the treated water overboard each time. This way the water can be re-used.

Fill in the gaps

- A fresh water generator (FWG) which is used to produce _____ from sea water is also incorporated.
- A _____ has been included.
- This is for when the engine is _____ down for maintenance purposes.
- Because of the quantities of water involved and the chemical _____, it is not economically viable or environmentally responsible to _____ the treated water overboard each time.
- This way the water can be _____.



This system shows a typical **cooling water circuit** for a single medium speed engine with an engine driven main pump and an electrically driven auxiliary circ pump and heater for keeping the engine warm when stopped.



A simple circulation system for an engine. It is similar to the main diagram, but this time a **dedicated HT cooler** is used.

http://www.machineryspaces.com/cooling.html

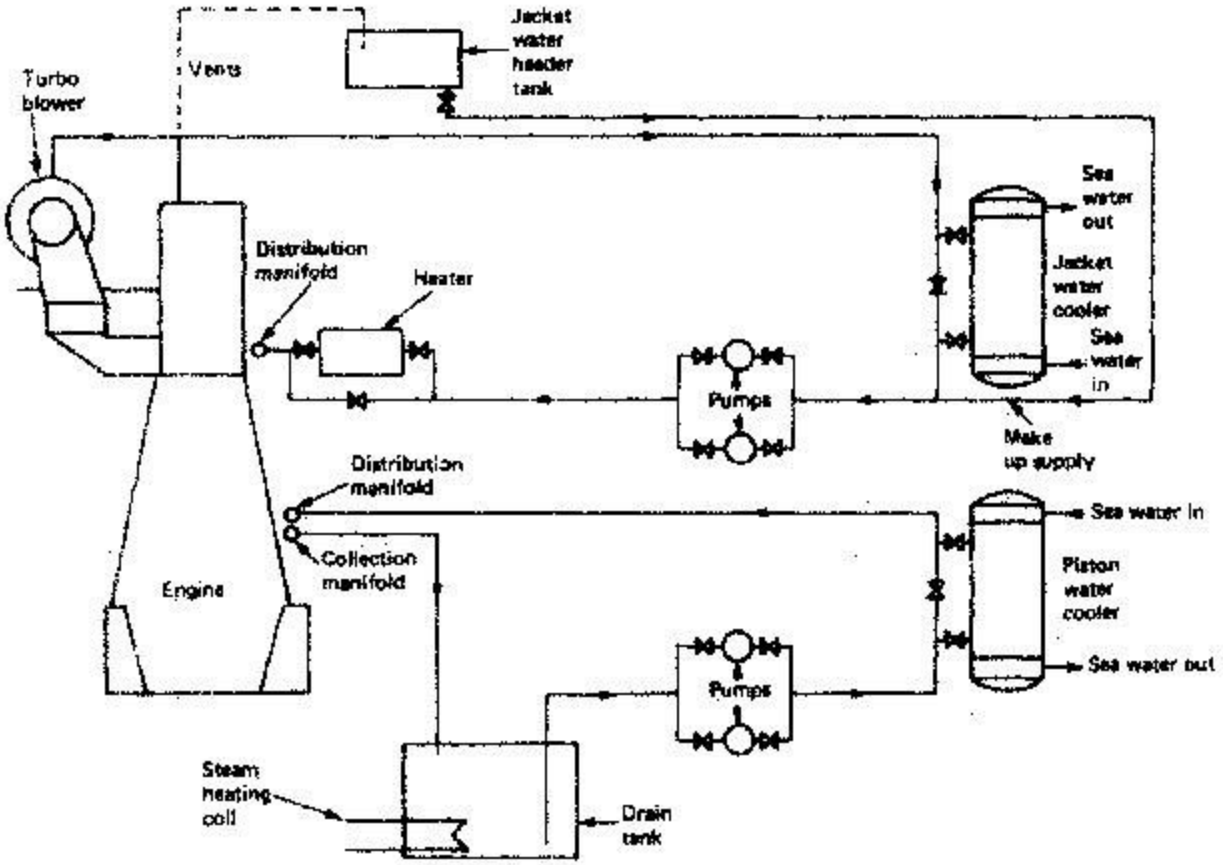
- Cooling of engines is achieved by circulating a cooling liquid around internal passages within the engine. The cooling liquid is thus heated up and is in turn cooled by a sea water circulated cooler. Without adequate cooling certain parts of the engine which are exposed to very high temperatures, as a result of burning fuel, would soon fail.

  Cooling enables the engine metals to retain their mechanical properties. The usual coolant used is fresh water: sea water is not used directly as a coolant because of its corrosive action. Lubricating oil is sometimes used for piston cooling since leaks into the crankcase would not cause problems. As a result of its lower specific heat however about twice the quantity of oil compared to water would be required

Re-cap

- Cooling of engines is achieved by ……
- The cooling liquid is thus heated up and is in turn …… .
- Without adequate cooling certain parts of the engine which …… , as a result of burning fuel, would soon fail.
- Cooling enables the engine metals to retain ……
- …… is fresh water: sea water is not used directly as a coolant because of its corrosive action.
- Lubricating oil is sometimes used for piston cooling since …… .
- …… however about twice the quantity of oil compared to water would be required.

Using the diagram below describe the water cooling sytem, first in writing, then make an oral presentation of the same



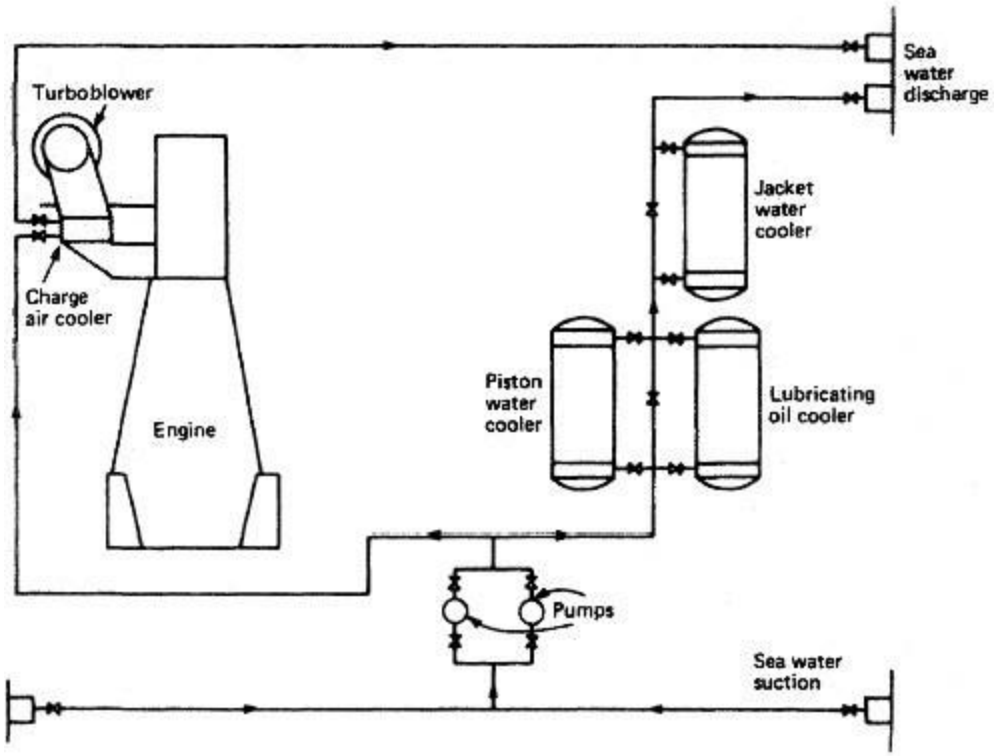
- A water cooling system for a slow-speed diesel engine is shown in Figure above. It is divided into **two separate systems**: one for cooling the cylinder jackets, cylinder heads and turbo-blowers; the other for piston cooling.

  The cylinder jacket cooling water after leaving the engine passes to a sea-water-circulated cooler and then into the jacket-water circulating pumps. It is then pumped around the cylinder jackets, cylinder heads and turbo-blowers. A header tank allows for expansion and water make-up in the system. Vents are led from the engine to the header tank for the release of air from the cooling water. A heater in the circuit facilitates warming of the engine prior to starting by circulating hot water.

  The piston cooling system employs similar components, except that a drain tank is used instead of a header tank and the vents are then led to high points in the machinery space. A separate piston cooling system is used to limit any contamination from piston cooling glands to the piston cooling system only.

Sea water cooling system

- The various cooling liquids which circulate the engine are themselves cooled by sea water. The usual arrangement uses individual coolers for lubricating oil, jacket water, and the piston cooling system, each cooler being circulated by sea water. Some modern ships use what is known as a 'central cooling system' with only one large sea-water-circulated cooler. This cools a supply of fresh water, which then circulates to the other Individual coolers. With less equipment in contact with sea water the corrosion problems are much reduced in this system.


Sea
water
discharge
Turboblower
Jacket
water
cooler
Charge
air cooler
Engine
Piston
water
cooler
Lubricating
oil cooler
Pumps
Sea water
suction

- A sea water cooling system is shown in Figure . From the sea suction one of a pair of sea-water circulating pumps provides sea water which circulates the lubricating oil cooler, the jacket water cooler and the piston water cooler before discharging overboard. Another branch of the sea water main provides sea water to directly cool the charge air (for a direct-drive two-stroke diesel).

Read the three slides above and complete the following sentences

- Water cooling systems on bord ship are divided into …….
- A header tank allows for ……
- Vents are led from the engine to the header tank for …….
- The piston cooling system employs ……
- A separate piston cooling system is used to …….
- Some modern ships use what is known as a 'central cooling system' with only one ……
- In the sea water cooling system the water passes from …… to ……

Central cooling system

- In a central cooling system the sea water circuit is made up of high and low suctions, usually on either side of the machinery space, suction strainers and several sea water pumps. The sea water is circulated through the central coolers and then discharged overboard.

  A low-temperature and high-temperature circuit exist in the fresh water system. The fresh water in the high-temperature circuit circulates the main engine and may, if required, be used as a heating medium for an evaporator. The low-temperature circuit circulates the main engine air coolers, the lubricating oil coolers and all other heat exchangers. A regulating valve controls the mixing of water between the high-temperature and low-temperature circuits. A temperature sensor provides a signal

Underline the key-words or phrases below to make your note of the text

- The water cooling system for a slow speed diesel engine consists of **two separate circuits**: one for cooling the cylinder jackets, cylinder heads and turboblowers; the other for piston cooling. A separate piston cooling system is used to prevent any possibility of contamination from piston cooling glands.
- The jacket cooling system is a closed circuit. Water passing from the engine returns through a cooler to the circulating pump and then to the engine. A headre or expansion tank is placed at a sufficient height to allow the venting and water make-up in the system. This has connection from the engine discharge and to the pump suction line. A heater is included with by pass to warm the engine prior to starting by circulating hot water.

Underline the key-words or phrases below to make your note of the text

- Water enters at the lower end of the jackets, passing up to the cylinder covers and then to the exhaust valve cages, if these are fitted. Some water is taken from the discharge and passed through the turbo-charger turbine cooling spaces, before returning to the main discharge.
- The piston cooling system pump draws from the supply (or drain) tank passing water to the piston cooler and then to the engine piston distribution manifold. The return from these flows by gravity to the supply tank. Arrangements may also be included for the return of any leakage from the glands. This must first pass through an oil separator and inspection tank. A steam coil is fitted in the piston cooling water supply tank for preparing the engine for sea.

Underline the key-words or phrases below to make your note of the text

- All fresh water coolers are circulated with the salt (or raw) water and have by-pass valve fitted. Thermostatic valves are provided to regulate the flow of either the fresh water or sea water and so control the temperature of water passing through the engine. Fresh water pressure should always be greater than that of the salt water to prevent any possibility of salt water entering the engine system. To reduce the corrosive action and inhibit the formation of scale deposit in the system it is usual to provide some form of water treatment.
- Both jacket and piston cooling systems must have alarms fitted to give warning of loss in pressure, high or low tank level or, in some cases, excess of temperature.
- On most engines the fresh water and sea water pumps are both of the centrifugal type. They may be engine driven or they may be separately driven by electricmotors.

Writing and speaking skills

- **Using your notes summarize the text of the three slides above (a writing task)**

- **Speaking sk8ills (pair work): Discuss the cooling water system of a martine diesel engine with your partner**

QUESTIONS AND DISCUSSION

1. Which parts of the diesel engine require cooling ?
2. Why is cooling necessary ?
3. How is cooling for a slow speed diesel engine carried out ?
4. When is a cooling system said to be of a closed type ?
5. Why is the water cooling system fitted with a header tank ?
6. What is the purpose of the heater ?
7. Is the water for piston cooling also drawn from the header tank ?
8. Is the sea water the primary cooling medium in the system ?
9. What are the thermostatic valves provided for ?
10. Why must cooling water be adequately treated ?
11. What alarms should the cooling system be supplied with ?
12. What are the fresh and sea water pumps driven by ?

I. Complete the sentences by choosing the correct ending:

1. **In a closed cooling system the water leaving the engine jacket is**
   - not returned to the engine at all .
   - recirculated without exposure to air.
   - Exposed to air before being recirculated.
2. **In the cooler salt water pressure should always be**
   - lower than fresh water pressure equal to fresh water pressure.
   - greater than fresh water pressure.
3. **The secondary cooling medium used to extract heat from the primary coolant by passing through the heat exchanger is**
   - air.
   - fresh water.
   - raw water.

Complete the sentences by choosing the correct ending (ctd.):

- extract pu**4. centrifugal or axial flow type pump that supplies cooling water to machinery is known as the:**
- mp.
- circulating pump.
- feed pump.

5. The hard deposit that forms on inside of boilers, water-pipes or on exposed ferrous metals is named:

- rust.
- scale.
- soot.

II. Match the statements in column A with the right terms listed at random in column B.

A	B	
a) Acessory that adjust the engine cooling water to a constant operating temperature. b) Sleeve of soft material used to secure a tight packing on a piston c) A unit that transfers heat from one fluid to another, as fro water or oil to water or air d) A container connected to an engine cooling system, generally at the highest point, partly filled with water for venting and make up e) A device used to remove water and other impurities from lubricating and fuel oils f) A turbine driven air compressor powered by the exhaust gas	1. Drain tank 2. Header 3. Heater 4. Heat exchanger 5. Gland 6. Thermometer 7. Thermostat 8. Turbo-blower 9. Distribution manifold 10. Oil separator	

III. Study the Fig.14.2. showing a main engine cooling system

Make a list of the main components:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

- Describe the function of each of the components.
- Explain the method of cooling shown in the diagram.

Verb study: *to provide*

Glagol "provide" jedan je od najčešćih glagola u tehničkim tekstovima:

- *Thermostatic valves are provided to regulate the flow of either the fresh water or the sea water.*
- U sustavu hlađenja postavljeni su (ugrađeni, instalirani, nalaze se) termostatski ventili radi reguliranja protoka slatke ili morske vode.
- *To reduce the corrosive action and inhibit the formation of scale deposits in the system it is usual to provide some form of water treatmen*t.
- Da bi se smanjilo djelovanje korozije i spriječilo stvaranje kamenca u sistemu, obično postoji (se vrši) neka vrsta obrade vode.
- *In order to compensate for air which may become dissolved in the water and released when heated, an open tank is provided at the height above the highest point of the system.*
- Kako bi se nadomjestio zrak koji može biti otopljen na visini iznad najviše točke sistema (hlađenja) nalazi se (ugrađen je, montiran je, instaliran je) otvoreni tank.

Glagol "provide" može se zamijeniti sa there is …, **to fit, to mount, to build in, to install, to supply**, npr:

(1a) There are thermostatic valves to regulate the flow of either the sea or the fresh water.

(1b) Thermostatic valves are fitted (supplied, mounted, placed, installed, built in) to regulate the flow of either the fresh or the sea water.

(2a) … in the systems, there is some form of water treatment.

(2b) … it is usual to install (fit) some form of water treatment.

(3a) … and released when heated, there is an open tank at the height above …

(3b) … and released when heated, an open tank is fitted (mounted, installed, built in, placed) at the height above …

Te zamjene (there is, fit, mount, install, build in, supply) odgovaraju našim glagolima "**nalazi(e) se", "postoji(e)", "ugraditi", "montirati", "instalirati", "postaviti".**

Glagol "provide" najčešće je u pasivnom obliku i označava postojanje ili položaj nečeg. Osim toga glagol "provide" često znači i "dati", "pružiti", "osigurati", (give, offer, ensure):

Automatic sprinkler system provides the highest level of safety on board.

Automatski sprinkler-sistem pruža (daje) najveću sigurnost na brodu.

Noun study - ***provision***

Slično je i sa imenicom "provision":

The provision of a water treatment system was urgent.

Bilo je hitno ugraditi (montirati, postaviti) sistem obrade vode.

Provision must be made for a new water treatment system.

(kolokacija "make provision for").

Mora se postaviti (osigurati) novi sistem obrade vode.

I. Rearrange these sentences using the verb "provide".Also make the necessary changes.

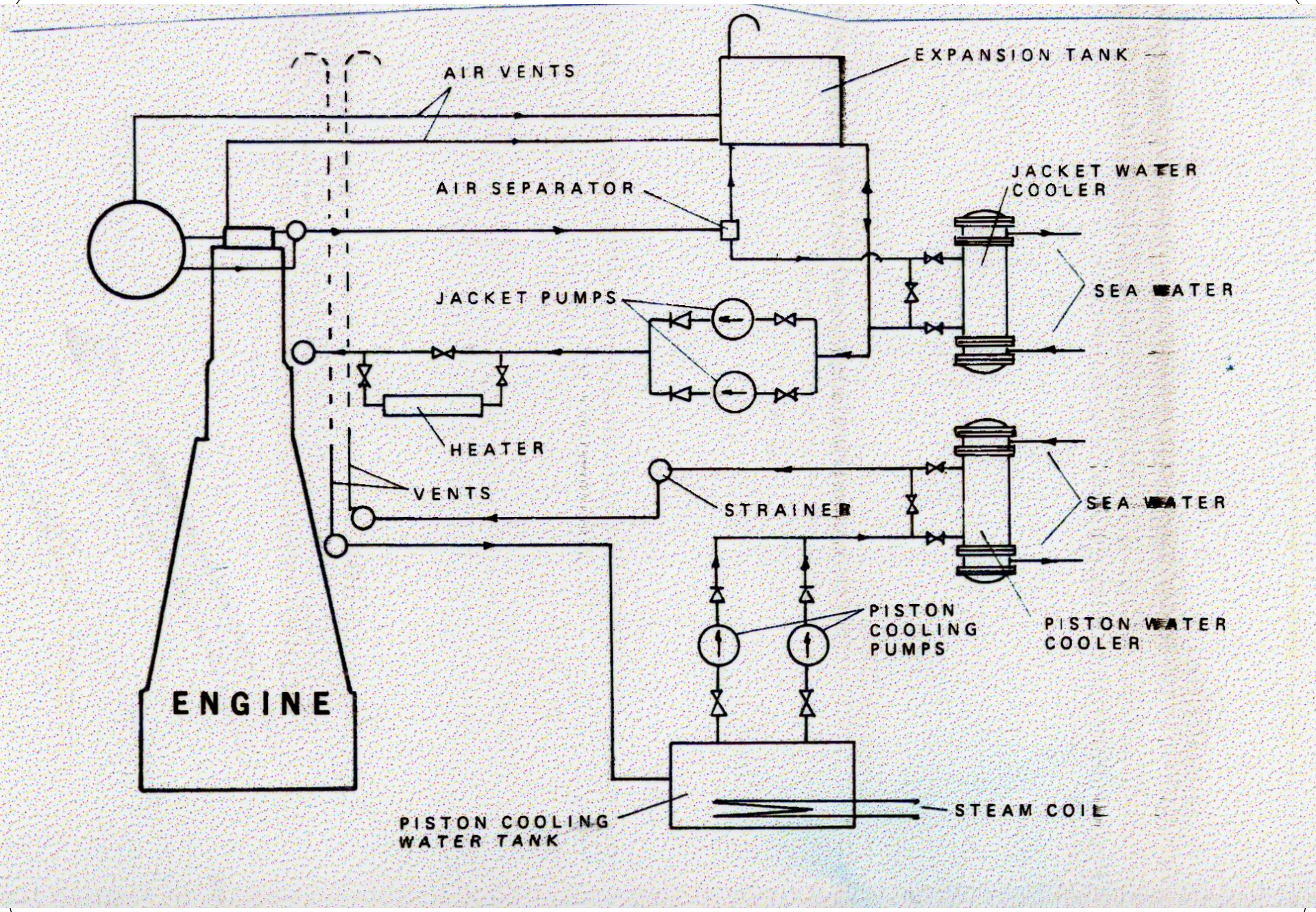
Eg.

- ***There are doors on the cylinder casing, through which the water spaces may be cleaned and inspected when overhauling the engine.***
- ***Doors are provided on the cylinder casing, through which the water spaces may be cleaned and inspected when overhauling the engine.***

1. These manufacturers supply the piston rings which can be run in quickly.
2. Modern medium-speed engines are turbocharged.
3. There is a control bore in the cylinder cover to enable possible gas leakage to be detected between the two parts of the cover.
4. The new maintenance system ensures higher reliability and lower costs.
5. On most engines sea water and fresh water pumps are fitted.
6. This design is termed the "coctailshaker", the motion of the oil offering extremely good heat transfer.
7. In the cylinder head there is an indicator for measuring the cylinder pressure.
8. The cylinder cover-insert is fitted with the necessary bore holes to accommodate the valves.

II. Translate into English (use the verb "*provide*"):

1. Na ulasku u cirkulacionu pumpu nalazi se filter goriva.
2. Ovaj brod pruža najbolje uvjete života posadi.
3. Na jednom kraju klackalice nalazi se vijak za podešavanje zračnosti ventila.
4. Ugradnjom manometra pritisak se može stalno kontrolirati.
5. Većina srednjehodnih dizel motora izvedena je s direktnim prekretanjem.
6. Na glavi cilindra montiran je i ventil uputnog zraka.
7. Da bi se ležaj zaštitio od korozije oni imaju tanki sloj indija ili olova.


EXPANSION TANK
AIR VENTS
AIR SEPARATOR
JACKET WATER COOLER
SEA WATER
JACKET PUMPS
HEATER
VENTS
STRAINER
SEA WATER
PISTON COOLING PUMPS
PISTON WATER COOLER
ENGINE
PISTON COOLING WATER TANK
STEAM COIL