UNIT 5

SEAMANSHIP

READING COMPREHENSION

SHIP HANDLING

There are a number of effects to be considered when handling a ship at sea or in narrow waters.

These include the axial thrust and the transverse thrust of the propeller, the effect of the rudder on the water and the effects of the wind and tide.

The effects of the propeller and rudder can be controlled.

The effects of the wind and tide cannot, but their forces can be used.

The axial thrust of the propeller is the force working in a fore and aft direction. This force causes the ship to move ahead through the water or to go astern. Because of her shape, a ship will move ahead through the water more easily than going astern. See figure 1.

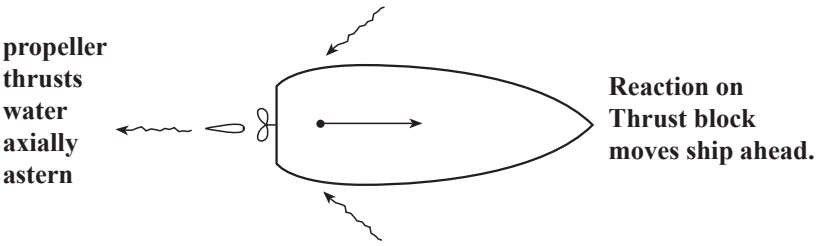


Figure 1. Axial thrust.

The transverse thrust is the sideways force of the propeller as it rotates. The transverse effect of the propeller blades at the top near the surface of the water is not strong enough to counteract the opposite effect of the lower blades. For right - handed propellers this cants the ship's stern to starboard

and her bow to port, when the ship is going ahead. The effect is small and can be corrected by the rudder. When the engines are put astern, the effect is the opposite and the stern cants to port.

The rudder depends for its effect on the deflection of a stream of water. The stream is produced by the ship's movement through the water and by the axial flow of water from the propeller.

The effect of the wind hitting a ship sideways on depends on the area presented to the wind before of aft of her pivoting point.

Current and tide also affect a ship. The current will carry the ship with it, or slow it down when the ship is travelling against the current. The tide will lift the ship and lower it. It will also carry it in its direction and cause the ship to turn when anchored or moored.

GRAMMAR

ARTICLES

Study the lists below of **when** and **when not** to use the definite article (THE) with geographical names and terms:

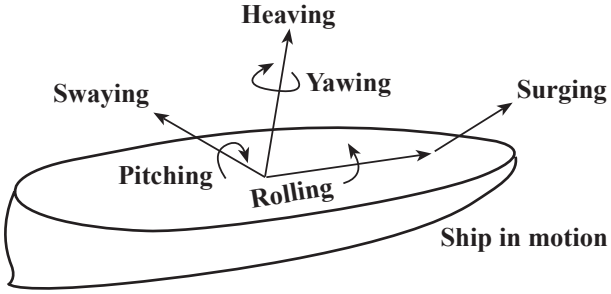
1. Generally THE is not used with names of Continents - Countries - Islands- Cities Towns - Mountains - Lakes - Bays (except when: The Bay of .....)
2. Generally THE is used with the names of: Countries - Areas - Deserts - Group of Islands - Ranges of mountains - Oceans / Seas - Channels / Straits - Gulfs - Estuaries - Currents - Rivers / Canals.

APPLIED TERMINOLOGY

Terms relating to a ship's movement

1. The motions of a ship.

Study the diagram below showing the six motions of a ship:



EXERCISE. Using the diagram to help you, complete these definitions:

(a) A ship is said to be ..... when the bow and stern rise and fall with the oncoming waves.

(b) A ship is said to be ..... when the port and starboard sides rise and fall with waves coming from abeam.

(c) A ship is said to be ..... when the whole ship rises bodily and then sinks into the trough of a wave.

(d) A ship is said to be ..... when she is pushed forward by the waves and seems to move backwards as she falls back into the troughs.

(e) A ship is said to be ..... when the whole ship moves bodily to port and then to starboard.

(f) A ship is paid to be ..... when her bow is pushed first to port and then to starboard.

2. The movement of a ship through the water. Study this definition:

A ship is said to be afloat when she is borne by the water.

NEW WORDS TO STUDY

ABEAM	:	ON A LINE AT RIGHT ANGLES TO THE LENGTH OF A SHIP. (The lighthouse was abeam of the ship)
AHEAD	:	FURTHER FORWARD IN SPACE OR TIME.
ANCHOR	:	HEAVY METAL DEVICE ATTACHED TO A CHAIN AND USED TO MOOR A SHIP TO THE SEA - BOTTOM.
ASTERN	:	IN, AT OR TOWARDS THE STERN OF A SHIP.
BLADE	:	THE BROAD FLATTENED PART OF AN OAR OR PADDLE THAT EXERTS FORCE AGAINST THE WATER TO PROPEL A BOAT.
CHANNELS	:	A STRAIT OR NARROW SEA BETWEEN TWO CLOSE LAND MASSES.
MOOR	:	ATTACH TO A FIXED OBJECT OR THE LAND WITH A ROPE OR AN ANCHOR.
NARROW WATER	:	NARROW PLACE IN A RIVER OR PASS.
PITCHING	:	MOVING UP AND DOWN ON THE WATER OR IN THE AIR.
PIVOT POINT	:	CENTRAL POINT.
PROPELLER	:	TWO OR MORE SPIRAL BLADES FIXED TO A REVOLVING SHAFT FOR PROPELLING AGENT.
RUDDER	:	BROAD FLAT PIECE OF WOOD OR METAL HINGED VERTICALLY AT THE STERN OF A BOAT OR SHIP USED FOR STEERING.
STRAIT	:	NARROW PASSAGE OF WATER CONNECTING TWO SEAS OR TWO LARGE AREAS OF WATER.
SURGING	:	MOVING FORWARD IN OR LIKE WAVES.
SWAG	:	BOUNDLE OF BELONGINGS CARRIED BY A TRAMP.

TIDE	:	REGULAR RISE AND FALL IN THE LEVEL OF THE SEA, CAUSED BY THE ATTRACTION OF THE MOON AND SUN.
TRANSVERS	:	LYING OR ACTING IN A CROSSWISE DIRECTION.
YAWING	:	TURNING UNSTEADILY OFF A STRAIGHT OR CORRECT COURSE.

UNIT 6

CARGO WORK

READING COMPREHENSION

DIFFERENT TYPES OF CARGO

Merchant ships are designed to carry cargo. This cargo may be divided into two basic types: bulk cargo and general cargo. Bulk cargo consists of a single commodity. This commodity is usually carried loose. General cargo consists of a variety of goods.

These goods are packed separately. Bulk cargo is carried in specially designed vessels, therefore stowage presents few problems. With general cargo stowage presents many problems, because each item has its own type of packaging and characteristics.

Bulk cargo can be divided into liquid or dry bulk cargo. Liquid bulk cargo is carried in tankers. Most tankers are designed to carry crude oil or its refined products, such as fuel oils. The oil is carried in tanks. Dry bulk cargo includes grain, irone - ore, coal and sugar. It is loaded automatically by buckets on a conveyor belt.

e.g. Broken Stowage

Space which is lost to cargo because of the shape of the cargo, packaging, dunnage, shape of compartment pillars, etc.

For example, one of the effects of palletisation is to increase broken stowage.

Stowage factor

The stowage factor of any commodity is the number of cubic feet. (cubic metres) which a ton of that commodity will occupy in stowage.

General Cargo vessels

Container vessels

Bulk carrier and OBO's

Special vessels

Tankers

system or through large tubes

General cargo can be divided into containerized, non - containerized and refrigerated cargo.

Goods may be in bags, bales, cases or steel drums. Individual pieces of machinery may not be packaged at all. Some cargoes such as tobacco and rubber have a strong odour and will taint delicate cargoes such as tea and rice.

GRAMMAR

(A) PREPOSITIONS OF PLACE

A preposition can have several meanings. Study how the following prepositions are used to describe position:

1. AT / AWAY FROM - Used with reference to a point

● AT	● AWAY FROM
The helmsman stood at the wheel.	The engineer stood away from the flames.
The ship refuelled at Dakar.	The ship anchored away from other ships.

2. ON / OFF - Used with reference to a line or surface.

ON	OFF
The ship stayed on course.	The ship was off course.
The chart lay on the table.	The keel was Just off the seabed.

CARE OF CARGO ON VOYAGE

Damage to cargo during the voyage may arise from:

(1) The cargo breaking loose and in extreme cases going through the side of the ship.

(2) Infestation by rats weevils. This hazard can be reduced by inspection before and during loading.

(3) Heating. Many cargoes such as coal cotten are liable to spontaneously heat up on passage.

(4) Water damage. This can either be from salt water or fresh water it is probably due to leaks through the hatch covers and it could be from the cargo itself, rain while loading or leaking pipes.

3. IN/OUT OF - used with reference to an area or volume.

IN	OUT OF
The ship moored in the harbour.	The instruments lay out of their box.
Spirits are kept in lock - ups	He stood out of the way of the derrick.

EXERCISE. Complete these sentences with a preposition from above:

(a) Meat is carried ..... refrigerated holds.

(b) The photograph hung ..... the cabin wall.

(c) The ship sank a mile ..... shore.

(d) The cargo was stowed ..... the boilers.

(e) The tanker took on supplies ..... Cape Town.

(f) The sailor sat ..... the heat of the sun.

(g) Ammunition is kept ..... magazines.

(h) The ship's company formed up ..... the quarter deck.

Now study how these prepositions are used to describe relative position:

4. ABOVE / BELOW means on a higher or lower level.

ABOVE	The clouds are above the horizon.
BELOW	Cargo is usually stowed below deck.

5. OVER / UNDER - implies a direct vertical relationship.

OVER	The helicopter hovered over the platform.
UNDER	The student put the flame under the flask.

6. ON TOP OF / UNDERNEATH suggests contact or concealment.

ON TOP OF	His suitcase lay on top of his bunk.
UNDERNEATH	The spanner was found underneath the tarpaulin.

7. BEHIND / IN FRONT OF

	The navigator sat behind the pilot.
	He stood in front of the mirror.

APPLIED TERMINOLOGY

Measurement

A ship's UNDERDECK, GROSS and NET tonnage are measurements of volume not of weight. They are measured in cubic capacity and then converted to tons using the formula 100 cubic feet = 1 ton.

UNDERDECK TONNAGE

This is the total volume of a ship below the tonnage deck. If the ship has double - bottom tanks, these are not included.

GROSS REGISTER TONNAGE

This is the sum of the underdeck tonnage and the permanently closed - in spaces above the tonnage deck. Certain spaces are excluded. Passenger ships are usually measured in gross tons.

NET REGISTER TONNAGE

This is the cargo - carrying capacity of a ship. It can be calculated by deducting the machinery, navigating, boiler and bunker space and the crew and storage spaces from the gross tonnage. Port and canal charges are calculated on the net tonnage.

NEW WORDS TO STUDY

BAG	:	A CONTAINER MADE OF PLASTIC OR OTHER FLEXIBLE MATERIAL CLOSED ON ALL SIDES EXCEPTS FOR AN OPENING THAT MAY BE CLOSED.
BALES	:	A LARGE BUNDLE OF GOODS FOR STORAGE OR TRANSPORTATION.
BUCKETS	:	ANY VESSEL FOR CATCHING, HOLDING OR CARRYING LIQUIDS OR SOLIDS.
BUNK	:	A LOG CAR OR LOG TRUCK.
CASE	:	A BOX OR RECEPTACLE TO CONTAIN OR HOLD SOMETHING.
CONVEYOR	:	A MECHANICAL APPARATUS FOR CARRYING PACKAGES OR BULK MATERIAL FROM PLACE TO PLACE.
DRUM	:	A LONG OPEN - ENDED CYLINDER IN WHICH LOGS ARE TUMBLED IN WATER TO LOOSEN AND REMOVE THE BARK.
HELMSMAN	:	PERSON WHO STEERS A SHIP.

UNIT 7

NAVIGATION

READING COMPREHENSION

NAVIGATING TECHNIQUES AND INSTRUMENTS

It is the Deck officer's job to take the ship safely from place to place as quickly and economically as possible. To do this he must have a thorough knowledge of navigation. From the moment a ship leaves a berth to her arrival at the next port her position is constantly checked and plotted on a chart. To do this accurately, the navigator uses a number of instruments and techniques.

When out of sight of land, a ship's position can be found by using the techniques of celestial navigation.

Celestial navigation involves taking observations of the sun, moon and stars with a sextant. This is an instrument which measures the angle between the celestial body and the horizon. The exact time that the sight is made must also be recorded. This is done on the ship's chronometer, which is a very accurate clock. With this information and the tables given in a book called a nautical almanac, the navigator is able to calculate the ship's position. The position is marked on the chart by a dot with a circle round it. A time is also given. By joining up the dots with a pencil line, The ship's track can be seen.

While in sight of land, the navigator uses the techniques of coastal navigation to find his position. Navigation in coastal waters is known as pilotage.

A fairly accurate estimation of a ship's position can be calculated by a technique known as dead reckoning (DR). To do this the navigator needs to know the ship's course, speed and distance run. A DR Position is made

more difficult to calculate by the effects of wind, tide and current.

Masters and deck officers, must have greatly increased the value of this piece of apparatus as an aid to navigation and safety.

THE CHART

This must be the most used and the most essential piece of navigational equipment.

THE LOG

The traditional name given to the device which measures the ship's speed.

RADIO DIRECTION FINDER

With this device the bearing of known radio beacons can be taken and also the bearing of radio distress signals.
It therefore has a safety as well as navigational use.

RADAR

Radar is wortly of special mention.
It serves a twofold function combining that of an easy - to - use position fixing device with that of an all weather lookout.

LORAN

There are two basic models.
Standard loran or loran (A) and loran (C)

OMEGA

It has a very long wave length and is the only electronic aid that can be used by nuclear submarines without surfacing or putting up some sort of aerial.

NAVIGATIONAL SATELLITES

It can be used world wide and fixes can be obtained on an average about every hour.

ECHO SOUNDER

This is a sonic device which measures the depth of water under the ship.

WEATHER FACSIMILE RECORDER

This enables ships at sea to receive weather forecast charts from the main forecast centres of the world.

COMMUNICATIONS

All vessels must be able to maintain some kind of radio contact. V.H.F. radio telephone this is a short range radio telephone used for talking to other ships, tugs, etc.

PREPOSITIONS OF PLACE

Study how the following prepositions are used to describe destination:

1. TO/ FROM - used with reference to a point.

TO . ● ● . FROM

They took the ferry to calais — The QEII sailed from southampton.

2. ON TO / OFF - Used with reference to a line or surface

ONTO . ——— ——— . OFF

The case fell onto the deck — The launch took off the pilot.

3. INTO / OUT OF - Used with reference to an area or volume.

INTO . □ — OUT OF . □

The cargo was lowered into the hold. — The cargo was lifted out of the hold.

Now study how these are used to describe direction:

4. TOWARDS / AWAY FROM - express motion with reference to a directional path.

TOWARDS --------➤ ● — ● --------➤ AWAY FROM

The ship was driven towards the rocks. — The wood drifted away from the shore.

5. UP / DOWN - express motion with reference to vertical axis.

The sailor climbed up the mast.

The flag was hauled down.

6. ACROSS / ALONG - express motion with reference to a horizontal axis or Plane.

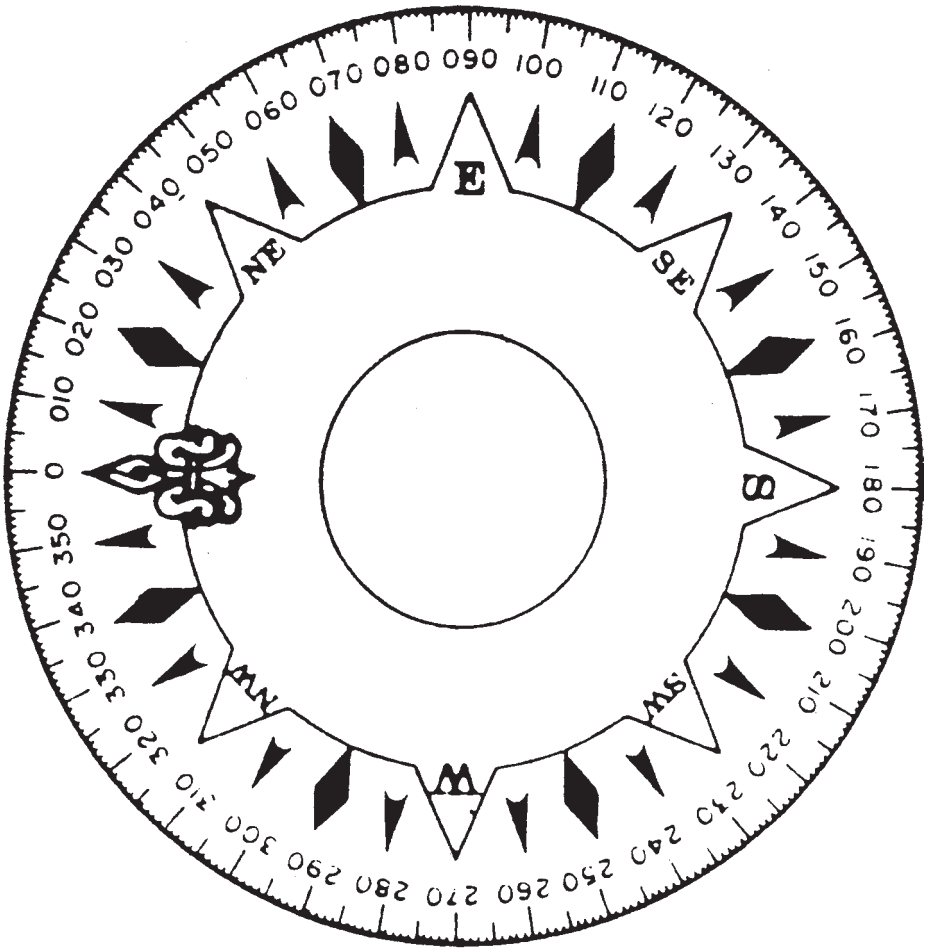
The dinghy tacked across the bay

They sailed along the coast.

APPLIED TERMINOLOGY

(A) Terms relating to compass cards

Study the compass card below. It is divided up clockwise into 360 degrees. It also shows eight of the points of the compass (N, NE, E, etc.)



EXERCISE 1. Write out in full the eight points of the compass shown above (The first two have been done for you):

(a) N = North
(b) NE = North - East
(c) E = ...
(d) SE = ...
(e) S = ...
(f) SW = ...
(g) W= .....
(h) NW = ...

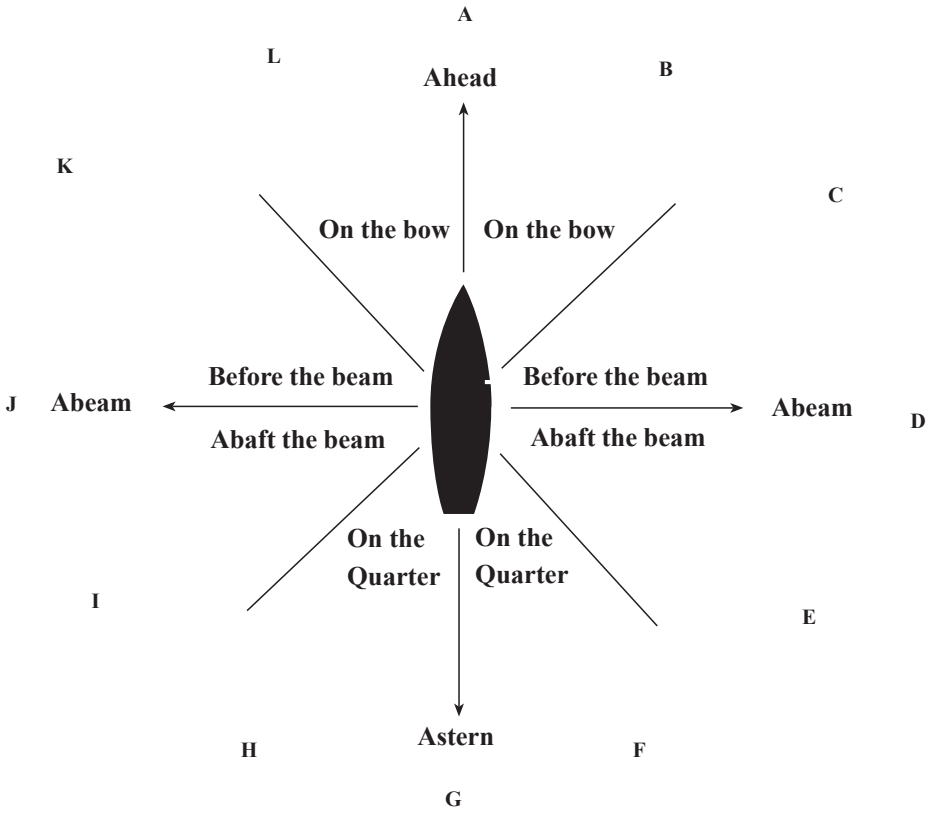
EXERCISE 2. What would the following points be in degrees?

(a) S (b) NE (c) NW (d) E

(e) SW (f) N (g) W (h) SE

B) Terms describing position in relation to a ship.

Study the diagram below



Terms describing position in relation to a ship

In order to describe the position of ships in relation to the tanker, they can be used as follows:

1. Ship A is (dead) ahead. / Ship A is ahead of the tanker.
2. Ship B is on the starboard bow.
3. Ship C is before the starboard beam.
4. Ship D is a beam. / Ship D is on the starboard beam.

EXERCISE 3. Now continue describing the position of the other ships:

(a) Ship E is .....

(b) Ship F is .....

(c) Ship G is .....

(d) Ship H is .....

(e) Ship I is .....

(f) Ship J is .....

(g) Ship K is .....

(h) Ship L is .....

NEW WORDS TO STUDY

BODY	:	ONE OF THE SEVEN PLANETS OF THE OLD ASTRONOMY CALLED ALSO CELESTIAL BODY, HEAVENLY BODY.
CELESTIAL NAVIGATION	:	NAVIGATION IN WHICH THE OBSERVED POSITIONS OF CELESTIAL BODIES AT EXACT INSTANTS OF TIME ARE EMPLOYED BY A NAVIGATOR TO DETERMINE HIS POSITION.
COMPASS CARD	:	THE CIRCULAR CARD ATTACHED TO THE NEEDLES OF A MARINER'S COMPASS ON WHICH ARE MARKED THE 32 POINTS OF THE COMPASS AND THE 360 OF THE CIRCLE.
COURSE	:	THE PATH OVER WHICH SOMETHING MOVES.
DEAD RECKONING (D.R)	:	THE DETERMINATION POSITION OF A SHIP DEDUCED FROM THE RECORD OF THE COURSES SAILED.
DINGHY	:	A ROWBOAT USED AS A TENDER AND LIFE - BOAT IN A YACHT.
FERRY	:	BOAT THAT CARRIES PEOPLE AND GOODS ACROSS A STRETCH OF WATER.
NAUTICAL ALMANAC	:	GIVES INFORMATION ABOUT THE SUN, MOON, ...
SEXTANT	:	INSTRUMENT USED FOR MEASURING THE ATTITUDE OF THE SUN, STARS.
SIGHT	:	ABILITY TO SEE.

UNIT 8

MAIN ENGINES

READING COMPREHENSION

DIFFERENT TYPES OF MARINE ENGINE

There are four main types of marine engine: the diesel engine, the steam turbine, the gas turbine and the marine nuclear plant. Each type of the engine has its own particular application.

The diesel engine is a form of internal combustion engine similar to that used in a bus. Its power is expressed as brake horse power (bhp). This is the power put out by the engine. Effective horsepower is the power developed by the piston in the cylinder, but some of this is lost by friction within the engine. The power output of a modern marine diesel engine is about 40000 brake horsepower. This is now expressed in kilowatts.

By comparison the engine of a small family car has an output of about 80 bhp.

In steam turbines high pressure steam is directed into a series of blades or vanes attached to a shaft, causing it to rotate. This rotary motion is transferred to the propeller shaft by gears. Steam is produced by boiling water in a boiler, which is fired by oil.

Gas turbines differ from steam turbines in that gas tather than steam is used to turn shaft. These have also become more suitable for use in ships. Many naval vessels are powered by gas turbines and several container ships are fitted with them. A gas turbine engine is very light and easily removed for maintenance.

Nuclear power in ships has mainly been confined to naval vessels, Particu-

larly submarines. But this form of power will be used more in merchant ships as oil fuels become more expensive.

Engine building

CASUAL VERBS

There are several verbs which can be used to express cause.

1. To HAVE and TO GET

Study these examples:

He had the engines overhauled.

He got the engines overhauled.

In these sentences the subject 'he' caused the action, but did not perform it himself. In the following sentences the person performing the actions is introduced. Note how the infinitive is used.

He had the Engine Department **overhaul** the engines.

He had the engines overhauled by the Engine Department.

He got the Engine Department **to overhaul** the engines.

He got the engines overhauled by the Engine Department.

EXERCISE. Write out these notes using the verbs in brackets and the appropriate pattern above.

e.g. (had, to examine) The Master - the equipment - the electrician.

The Master had the equipment examined by the electrician.

(a) (got, to plot) The Second Mate - the cadet - the course.

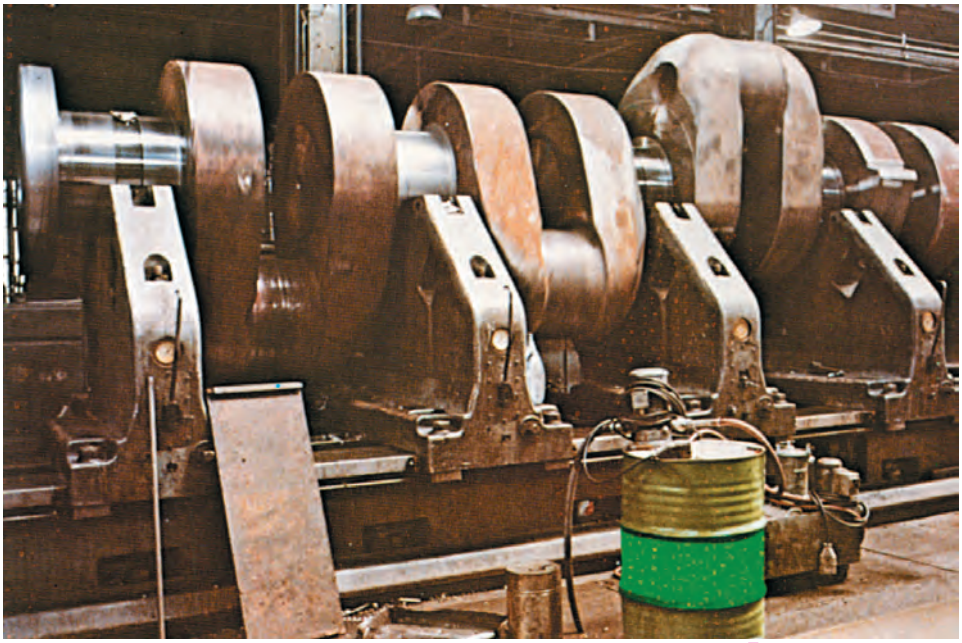
(b) (had, to check) The First Mate - the cargo.

(c) (had, to lower) The Bosun - the boats - the apprentices.

(d) (got, to adjust) The Master - the compasses.

(e) (got, to clean) The Carpenter - the bilges - the ratings.

Engine building



Crank shaft on the turning lathe

Machine finishing of a crank pin

Assembly of a main Diesel motor

2. Enverbs

Verbs ending or beginning with - EN mean to make something happen- The - EN is usually attached to the adjective, but sometimes the noun is used.

e.g. To make tight = to tighten

To make longer = to lengthen.

3. CASUAL VERBS.

(a) General causual verbs: TO MAKE, TO CAUSE

(b) Specific causual verbs: TO INCREASE, TO RAISE, TO REDUCE, TO LOWER, etc.

(c) Verbs enabling something to happen; TO PERMIT, TO ALLOW, TO LET.

APPLIED TERMINOLOGY

Measurement

1. BASIC UNITS

Study the table below showing the six basic units of the SI system and their symbols, and the two supplementary symbols. Some have already been used in previous units.

Quantity	Unit	Symbol
Length	Metre	m
Mass	Kilogramme	kg
Time	Second	s
Electric current	Ampere	A
Luminous intensity	Candela	cd
Temperature	Kelvin	k
Plane angle	Radian	r
Solid angle	Steradian	Sr

2. DERIVED UNIT I

These are units expressed in terms of base and supplementary units only.

e.g. Unit of area = square metre = m^2

EXERCISE. Complete the following table:

Quantity	Unit	Symbol
Area	Square metre	.....
Volume	Cubic metre	.....
Velocity	Metre per second	.....
Angular velocity	Radian per second	.....
Acceleration	Metre per second second	.....
Density	Kilogramme per cubic metre	.....
Momentum	Kilogramme metre per second	.....

3. DERIVED UNITS II

Some units have special names. These are shown in the table below.

Frequency	Hertz	Hz
Force	Newton	N
Work, energy, heat	Joule	J
Power	Watt	W
Heat - Flow - Rate		

4. DERIVED UNITS III

Some units are expressed interms of other derived units only or other derived units and base - units.

e.g. Unit of stress = newton per square metre = N / m^2

EXERCISE. Complete the table below.

Quantity	Unit	Symbol
Torque	Newton metre	.....
Stress	.....	N/m^2
Pressure	Newton per square metre	.....
Intensity of heat flow rate	.....	W/m^2
Thermal conductivity	Watt per metre degree celsius	.....
Coefficient of heat transfer	.....	W/m^2. C
Heat capacity	Joule per degree celsius	.....
Specific heat capacity	.....	J/kg. C

NEW WORDS TO STUDY

BOILER	: A VESSEL USED FOR BOILING.
BRAKE HORSE POWER (bhp)	: THE POWER OF AN ENGINE OR OTHER MOTOR AS CALCULATED FROM THE FORCE EXERTED ON A FRICTION BRAKE.
COMBUSTION	: A PROCESS OR INSTANCE OF BURNING.
ELECTRICIAN	: PERSON WHOSE JOB IS TO INSTALL, OPERATE, REPAIR ELECTRICAL EQUIPMENT.
OVERHAUL	: EXAMINE CAREFULLY AND THOROUGHLY AND MAKE ANY NECESSARY REPAIRS.
PLANT	: MACHINERY, EQUIPMENT.
SHAFT	: BAR OR ROD JOINING PARTS OF A MACHINE OR TRANSMITTING POWER IN A MACHINE.
STEAM	: INVISIBLE GAS INTO WHICH WATER IS CHANGED BY BOILING.
TURBINE	: MACHINE OR MOTOR DRIVEN BY A WHEEL WHICH IS TURNED BY A CURRENT OF WATER, STEAM, AIR OR GAS.
VANES	: BLADE OF A PROPELLER.
VELOCITY	: SPEED.

UNIT 9

AUXILIARY MACHINERY

READING COMPREHENSION

FUNCTION OF AUXILIARY MACHINERY

Read through this passage and note down (1) the different functions that auxiliary machinery is designed to carry out and (2) examples of the equipment designed to carry out those functions.

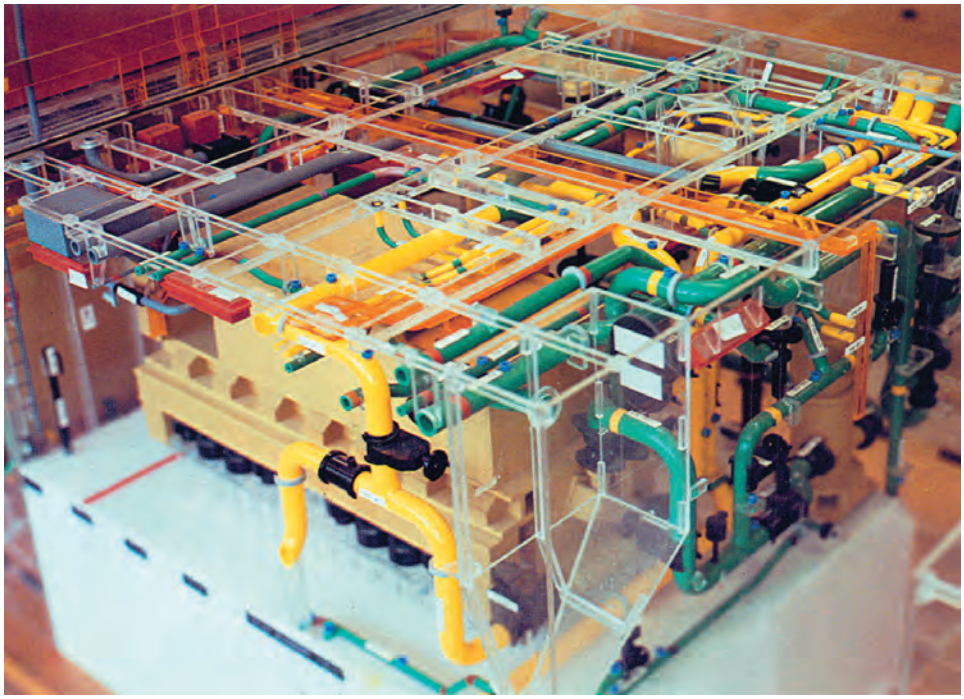
Besides running and maintaining the main propulsion machinery of the ship, the Engineer officer has a great deal of auxiliary machinery to look after.

Auxiliary machinery covers everything mechanical on board ship except the main engines and boilers. It includes almost all the pipes and fittings and the equipment needed to carry out a number of functions. This functions may be summarized as follows.

To supply the needs of the main engines and boilers. Air compressors are used to supply compressed air for starting engines. Coolers are used for cooling either oil or water. Water for the boiler is also heated before being admitted into the boiler by feed water heaters. This increases the efficiency of the boiler.

To keep the ship dry and trimmed. This is done through the bilge and ballast pumping systems. The former removes water which has gathered in machinery, cargo and other spaces. The latter pumps water into and out of the ballast tanks.

To supply domestic needs such as fresh water from distillation plant, sanitation from sewage plant and heating and ventilation from heaters and air - conditioners.



Part of auxiliary engine room model

Covered graving Dock "D" during construction

To supply the ship with electrical power and lighting. This is done by steam or diesel - powered generators.
To provide for safety. Firefighting and fire detection equipment, lifeboat engines and launching gear also included.

Change of state verbs

Change from one state to another can be expressed verbally by:

1. Specific change of state verbs.
   e.g. to melt, to freeze, to condense, to rot, to rust.
2. Verbs fromed by adding -IFY, - IZE (-ISE) to nouns and adjectives
   e.g. solid =to solidify vapour = to vaporize
   liquid = to liquefy crystal = to crystallize
3. General change of state verbs.
   TO BECOME + ADJECTIVE / NOUN
   e.g. When air is compressed, it becomes hot.
   When copper and tin are mixed, they become bronze.
   TO GET + PAST PARTICIPLE / ADJECTIVE
   e.g. with poor lubrication, pistons got worn.
   TO TURN + COLOUR
   e.g. Blue litmus paper turns red, if immersed in acid.
   TO CHANGE INTO + NOUN
   e.g. Water changes into ice when the temperature drops below ◦ C.
   TO CONVERT / BE CONVERTED INTO + NOUN
   e.g. At an oil refinery crude oil is converted into different oil products.

EXERCISE. Complete the following sentences by using one of the verbs above in the appropriate form:

(a) An internal combustion engine ..... chemical energy into mechanical energy.
(b) With poor lubrication engines parts ..... worn.
(c) When gas is cooled below a certain temperature, it ..... .
(d) Water ..... steam when it reaches boiling point.
(e) Natural fibre ropes ....., if allowed to remain wet.
(f) When red litmus paper is placed in an alkali, it ..... blue.
(g) Liquids .... less dense, when they are heated.
(i) The sky often ..... red at sunset.

APPLIED TERMINOLOGY

Measurement

1. Derived units - Electrical

Study the table below showing electrical units in the SI system:

Quantity	unit	symbol
Electric charge Quantity of electricity	Coulomb	C
Electric pontial Electromotive force	Volt	V
Resistance	Ohm	?
Capacitance	Farad	F
Self inductance	Henry	H

SI electrical units are interrelated with base units through electrical formulae.

EXERCISE 1. Write out the following formulae to show the relationship between the symbols. The first is done for you.

(a) V . A? Volts equal amperes multiplied by ohms.

(b) C . AS .....

(c) V . $\frac{W}{A}$ .....

(d) ? . $\frac{V}{A}$ .....

(e) F . $\frac{A_S}{V}$ .....

(f) H . $\frac{V_S}{A}$ .....

2. MULTIPLES AND SUBMULTIPLES.

Decimal multiples and submultiples of SI units are formed by combining the unit with the prefixes listed below.

Factor by which basic unit is multiplied	Prefix	Symbol
10^9(1000000000)	giga	G
10^6(1000000)	mega	M
10^3(1000)	kilo	K
10^{-1}(0.1)	deci	d
10^{-2}(0.01)	centi	c
10^{-3}(0.001)	milli	m
10^{-6}(0.000001)	micro	/

EXERCISE 2. Complete the following table. The first line has been done for you.

1000.000J . one megaJoule . 1MJ . 10^6 J
1000N . . 1KN . 10^3N
0.001V . . . 10^{-3}V
0.00000? . . .
. one kiloJoule . .
0.001A . . .

NEW WORDS TO STUDY

AUXILIARY	:	GIVING HELP OR SUPPORT, AN AUXILIARY GENERATOR IN CASE OF POWER CUTS.
BALLAST	:	A RELATIVELY HEAVY SUBTANCE USED TO MAINTAIN A SHIP AT ITS PROPER DRAFT OR TRIM OR TO IMPROVE ITS STABILITY.
FITTINGS	:	SMALL STANDARD PARTS OF COMPONENT.
LUBRICATE	:	PUT OIL OR GREASE ON OR IN MACHINERY SO THAT IT MOVES EASILY.
PROPULSION	:	BEING DRIVEN FORWARD.
SEWAGE	:	WASTE MATTER FROM HUMAN BODIES.
TRIM	:	IN A GOOD ORDER, NEAT AND TIDY.

UNIT 10

MAINTENANCE

READING COMPREHENSION

MAINTENANCE ON BOARD

Much of the work of the Deck Department on board a ship concerns the maintenance of the ship and her fittings. This is the responsibility of the chief officer. He and the men in his charge must protect the ship from the damaging effects of salt water, changes in temperature and the action of waves.

The principal material used in building a ship is mild steel, and steel of different types is used for making most fittings and equipment. Unfortunately, steel undergoes a chemical change known as rusting when in contact with air, water or salt solutions. This causes the metal to deteriorate rapidly, unless some form of protection is given.

To try and prevent this corrosion, the metal is coated with cement wash, bitumen and paint. Cement wash is a mixture of cement powder and fresh water. It is used in fresh water tanks and double bottom tanks. However, the principal protective coating is paint. There are many types of paint available nowadays in a wide variety of colours and it is now longer necessary for the Boatswain to mix his own. Paints are stowed in the paint locker, which is usually situated under the forecastle head.

The most common kinds of paint found on board ship are as follows: metal primers, which are applied to a bare surface to give protection against rust and to act as a key to the next coat; undercoats, which are used over the primer before the top coat. A ship's bottom is given a coating of anti - foul-

ing paint.

Before an area can be repainted, proper preparation is essential. They are must be cleaned and washed with a cleaning solution to remove all salt, dirt and oil.

GRAMMAR

Noun Compounds

Compounds are common in technical writing. They provide a way of creating new words to describe new objects and processes. They also permit a very condensed form of writing.

Here are three forms of noun compound.

1. NOUN + noun Compounds are formed as follows:

A ship for cargo	becomes	a cargo ship
A for B	.	B A

Many different kinds of relationship are possible in such noun + noun compounds. Some more are listed below:

A of B	e.g. The cover of a cylinder
	. The cylinder cover
A with / has B	e.g. Water with salt in it
	. Salt water
A contains B	e.g. The house contains the wheel
	. The wheelhouse
A made of / from B	e.g. Wire made of copper
	. Copper wire
A in /on /at B	e.g. The plate at the back
	. The back plate
A operated by B	e.g. A pump operated by hand
	. A hand pump
A shaped like B	e.g. A nut shaped like a butterfly
	. A butterfly nut
A uses B	e.g. A turbine driven by steam
	. A steam turbine

A invented by B e. g. Calipers invented by vernier
. Vernier calipers

EXERCISE 1. Try and Identify the relationships in the following compounds:

(a) a needle valve
(b) carbon steel
(c) a petrol tank
(d) a wire rope
(e) corner bolts
(f) a foot pump
(g) floor plates
(h) a diesel engine
(i) a container ship

2. Present Participle + noun compounds are formed as follows:
Valves which regulate . regulating valves
Water which cools . cooling water.

3. Past participle + noun Compounds are formed as follows:
Bolts which have been fitted . fitted bolts.
Iron which has been cast . cast iron.

EXERCISE 2. From compounds out of the following clauses:

(a) air which has been compressed
(b) oil which is used for lubricating
(c) ropes which are used for mooring
(d) a joint which has been riveted
(e) a surface which has been machined
(f) a valve which is sticking
(g) oil which has been heated.
(h) air which is used for scavenging
(i) a Joint which has been welded
(j) rags which are used for cleaning.

APPLIED TERMINOLOGY

Measurement

Number Compounds

1. The length, height, weight etc., of an object can be described in the following way:

   e.g. The mast is twenty feet high . it is a twenty - foot mast The load weight ten tons . it is a ten -ton load

   The size of the gun is six inches . it is a six - inch gun.

2. Number compounds can also beformed by using these prefixes:

Prefix	Meaning	Examples
uni - / mono -	one, single	unicolour, monotone
bi -	two	biplane
tri -	three	tripod
quadr -	four	quadrilateral
semi- / hemi -	half	semi - skilled, hemisphere
multi- / poly-	many	multi - deck, polygon
twin -	two the same	twin- masted

EXERCISE. Explain these compounds:

(a) a six - inch ruler

(b) a twin - screw vessel

(c) a two - inch nail

(d) a bipod

(e) three - stranded hemp line

(f) multi - grade oil

(g) 15 ton derrick

(h) a uni - flow scavenging air system

(i) 120 - fathom coils of rope

NEW WORDS TO STUDY

BITUMEN	:	ANY OF VARIOUS MIXTURES OF HYDROCARBONS (AS ASPHALT, CRUDE PETROLEUM, OR TAR)
BOATSWAIN	:	A PETTY OFFICER ON A MERCHANT SHIP HAVING IMMEDIATE SUPERVISION OF THE DECK FORCE.
PRIMER	:	SUBSTANCE USED TO PRIME A SURFACE FOR PAINTING.
ROPE	:	THICK CORD OR WIRE MADE BY TWISTING FINER CORDS OR WIRES TOGETHER.
RUST	:	REDDISH - BROWN COATING FORMED ON IRON OR STEEL BY THE ACTION OF WATER AND AIR.
UNDERCOATS	:	LAYERS OF PAINT UNDER A FINISHING COAT.
WHEELHOUSE	:	SMALL ENCLOSED CABIN ON A SHIP WHERE THE PILOT STANDS AT THE WHEEL TO STEER.