Unit ***24***

AN INTRODUCTION TO NAVIGATION

Basic terms

• aids to navigation • lead line • wind rose • course
• Little Bear • Polaris • Pole Star • coastal navigation
• ocean navigation • magnetic compass
• celestial/astronomical navigation • sea chart
• land marks • sea marks • dead reckoning
• cartography • gyroscopic compass
• radar • radio-telegraphy • piloting
• electronic navigation • observation • sextant

History. All the earliest navigation was purely coastal. The first boats large enough to carry some cargo are generally dated around 3,500 B.C. and this period marks the beginning of navigation. The only aids to navigation were the lead line and the wind rose showing the direction of the eight principal winds. Vessels normally only sailed by day and anchored at night.

During the first millennium B.C. the Phoenicians could plot a course by the recognition of certain stars (the constellation of the Little Bear and Polaris or the Pole Star). This marked the beginning of ocean navigation, though until the 18th century it was largely a story of hit and miss.

The most significant inventions in navigation were the magnetic compass (13th century), and the first sea charts ("portolano" or "rutter"). The predecessors of the modem sextant were the back-staff, astrolabe and quadrant. The period between 1400 and 1800 marked the growth of land and sea marks.

Cartography flourished in the 17th century (Mercator) which enabled a system of navigation known as dead reckoning.

In 1907 the Sperry gyroscopic compass underwent its first sea tria1s. The second greatest invention in the early 20th century was the development of radio telegraphy and the radar in World War II. The radio-wave, then, became the basis of the various radio and electronic systems of modem navigation such as the Decca Navigator, Loran, Consol, Omega, Satnav, GPS, inertia1 navigation, integrated navigationa1 systems, etc.

Types of Navigation

Navigation is commonly divided into four elements: a. piloting
b. dead reckoning c. celestia1 navigation d. electronic navigation *COASTAL NA VIGATION* or *PILOTING* includes conducting vessels a1ong coasts and in and out of bays and harbours anywhere. Piloting requires the greatest experience and the nicest judgment of any form of navigation. The term piloting implies an important element of navigation which bas a much broader meaning than the work of a harbour pilot limited to familiar waters.

DEAD RECKONING was origina1ly ca1led "deduced" reckoning, thence abbreviated d-e-d, or in the vernacular "dead" reckoning. It is an element both of piloting and of navigation at sea. In modem navigation, it is the process of finding the approximate position of the ship by plotting courses and distances from the last well-determined position, which was found from lighthouses or other marks a1ong the coast, or from observations of heavenly bodies. This task seems simple, but for various reasons such positions may be inaccurate.

CELESTIAL or astro-navigation is applied in conducting a ship by observation of celestia1 or heavenly bodies, as distinguished from observations of coasta1 objects.

ELECTRONIC NAVIGATION consists of the use of various recently developed radio navigational devices for fixing the position of the ship, both in piloting near land or among other ships, as well as at sea. The importance of electronic navigation is increasing rapidly with improvements in qua1ity and availability of electronic equipment (Collision avoidance systems, radar, etc.).

IMO STANDARD MARINE COMMUNICATION PHRASES

III/6.2.2.3 - *Course*

Your track is parallel with reference line.
Your track is diverging from reference line.
Your track is converging to reference line.

You are steering dangerous course.
Vessel ahead of you on same course ... degrees.
Advise you make course of ... degrees.
Advise you keep your present course.
Advise you alter course to ... degrees in position ... .

What is your present course?
- My present course ... degrees.

You are running info danger. Shallow water ahead of you.
You are running info danger. Submerged wreck ahead of you.
You are running info danger. Risk of collision.
Risk of collision with vessel distance ... kilometres/nautical miles, bearing. degrees.
You are running info danger. Fog bank ahead of you.
You are running info danger. Bridge defective.

lll/6.2.3.5 - *Avoiding dangerous situations, providing safe movements*

It is dangerous to anchor / remain in your present position.
It is dangerous to alter course to port / starboard side.
Large vessel leaving fairway- keep clear of fairway approach.
Nets with buoys / without buoys in this area - navigate with caution.
MV... aground in position ... .
MV... on .fire in position.
Stand by for giving assistance.
Vessels must keep clear of this area/area ... .
Vessels must avoid this area/area ... .
Vessels must navigate with caution.
Advise you keep clear of ... - search and rescue in operation.
Your present course too close to outbound / inbound vessel.
Your present course too close to vessel that you are overtaking.
Your present course too close to starboard / port limit of fairway.
You are proceeding at dangerous speed.
You must proceed by... fairway/ ... route. You must keep to ... side of fairway line. You must stay clear of fairway. Do not overtake.
Do not cross fairway.
You must wait for MV ... to cross ahead of you.
You must wait for MV... to clear ... before entering / leaving.
Advise you alter course to port / starboard side.
Advise you stop engines.
Advise you pass north/south/east/west of ... mark.
MV... wishes to overtake on your port* I *starboard side.
MV... approaching obscured area ... - approaching vessels acknowledge.

A. Comprehension & vocabulary

A.1 *Say whether the following statements are true or false. If false, correct them:*

	TRUE	FALSE
1. Pilotage refers to the navigation of ships which do not require celestial observations.		
2. A magnetic compass is not affected by the ship's magnetic field.		
3. In astro-navigation ship s are conducted by observing heavenly bodies.		
4. Terrestrial navigation relies on land and sea marks.		
5. A gyroscopic compass is affected by the ship's magnetism.		
6. Piloting refers to coastal navigation.		
7. A sextant was invented in the eighteenth century.		
8. Wind rose and lead line were the earliest aids to navigation.		
9. A radio-wave is the basis for any type of electronic navIgatIon.		
10. Dead reckoning is the most accurate way of fixing the ship's position.		

A.2 *Fill in the gaps with the suitable word or term below:*

• piloting • celestial bodies • gyroscopic compass
• spherical hyperbolas • North Pole • seamanship • dead reckoning
• short range • conducting • inertial navigation

1. Variation and deviation are not factors which can affect the _____ .
2. The gyroscopic compass points to the true _____ .
3. The Decca, Loran, Consol and Omega navigational systems give the positions to ships by the intersection of position lines having the form of _____.
4. The Decca Navigator is an accurate _____ system which ranges out to 250 miles from the transmitting station.
5. Satellite navigation is also known as _____ .
6. The art of working, managing and handling a vessel in a seaway in a sea manlike manner is called _____ .
7. In _____ the ship is conducted without the use of celestial observations, while the ship is in sight of land.
8. Navigation is the art _____ of a ship from one place to another.
9. The calculation for determining the ship's position by using the courses steered and distances run is called _____ .
10. The Sun, Moon, planets and the stars are _____ .

A.3 *Supply the appropriate term:*

- ***meteorological offices*** • ***radio-room*** • ***direction finder***
- ***route*** • ***echo sounder*** • ***speed log*** • ***readings***
- ***gyro-compass*** • ***autopilot*** • ***course*** • ***stars***
- ***magnetic compass***

Ships still carry a sextant, chronometer and a 1. _____, but navigation today relies more on electronics than on the 2. _____ . Once clear of port and congested coastal waters, the captain of a modem liner sets his 3._____ and leaves the 4. _____ to hold it. The slightest variation is registered by the 5. _____ and passed on to the automatic pilot, which alters the setting of the rudder through a hydraulic mechanism. As a check against failure of the gyro-compass, a warning device will sound if the 6._____ of the gyro- and magnetic compasses differ by more than a few degrees.

Meanwhile an electronic 7. _____ keeps a continuous record of speed and direction; ultrasonic depth-sounding (8._____) equipment measures and records the depth of the sea bed; automatic radio 9._____ receives and interprets signals from shore transmitters and plots the ship's course; radar screens pick out any other ship in the vicinity; and officers in the 10. _____ maintain constant contact with the shore, and with other ships. 11. _____ transmit regular weather, wave and ice charts, which are printed out by special receivers on the ship. It is usual to follow a 12. _____ based on the most favourable wind and wave conditions, rather than on the shortest distance.

B. Grammar

B.1 *Supply the right forms of the verbs in brackets:*

The marine radar

Radar, Radio Detection and Range involves *(transmit)* 1. _____ pulses of radio-energy with a directional aerial, and *(receive)* 2. _____ the echoes of these pulses, which are reflected back by any objects in their path. As radio-waves travel at a constant speed, not only the direction but also the distance of objects can *(calculate)* 3. _____ . Thus, when visibility is poor, the captain can "see" and *(keep)* 4. _____ track of other ships in the area, while near land the radar screen *(show)* 5. _____ the shape of the coastline from which he can identify his position. Advanced radar systems can plot and show the course of other ships, as well as *(display)* 6._____ the effect of *(change)* 7. _____ one's own course,

which can be helpful in *(avoid)* 8. _____ a collision (ARPA = Automatic radio-plotting aid).
Sonar *(involve)* 9. _____ the same principle as radar, but uses pulses of high-frequency sound. The latest development provides the captain with a further means of *(check)* 10. _____ his position, *(use)* 11. _____ computers and electronic "maps" of the sea bed. Continuous readings from the ship's sonar *(pass)* 12. _____ to the computer, which can then pinpoint the ship's position on the electronic map.

B.2 *Put the expressions in brackets info the right place in the sentence:*

Electronic navaids
Maritime navigation is undergoing a revolution brought about by the introduction of microprocessor-based highly specialized electronic navigation aids to replace the more traditional apparatus *(today, mainly).* A ship's master can rely on a keen eye and a sixth sense for the safe operation of his vessel *(no longer).* The days when an approximate estimate of the vessel's speed, heading or position were adequate are gone *(long).* Although dead reckoning is practised, the key word for maritime safety and efficiency must be precision *(still).*
Fixing a ship's position bas been a source of pride for a shipmaster *(precisely, always).* Position fixing is achieved by the use of one of the hyperbolic systems such as Decca, Loran-C and Omega *(easily, now).* Each of these systems possess limiting factors which cause fix accuracy to be less than perfect *(however).* In order to fix the ship's position, data is received from orbiting *(precisely).* The fix accuracy is within 100 metres, and the accuracy surpasses this figure and may be better than 10 metres *(in many cases, normally).*

C. Translation

C.1 *Translate the following sentences info English:*

1. Oggi la navigazione si sta sviluppando assieme e sotto l'influenza dell'elettronica e della ricerca spaziale.
2. Nella navigazione costiera vengono presi rilevamenti di punti di riferimento come fari, campanili, cime di montagne, etc.
3. La navigazione stimata è spesso imprecisa per un numero di fattori come il vento, la marea, la corrente.
4. La bussola giroscopica registra persino le minime variazioni di rotta?
5. Che cosa registra il solcometro elettro-magnetico? Registra la velocità.
6. Come funziona l'eco scandaglio?

Further reading

From the very earliest times the lead line, log and lookout have been the golden rule for all the navigators, and even today, when on the bridge of a modem ship there is a mass of complex electronics, the same principles are equally important.

Not so long ago, given a chart, compass, chronometer and a sextant, the navigator could sail all over the world using the same celestial bodies which had guided seamen for thousands of years. The gyrocompass and the depth-.finder have been of greatest help to the modem seaman. A reliable log measuring the speed over the ground has made dead reckoning more accurate.

The greatest event was the introduction of radar on merchant vessels. It serves both as a navigation aid and as a means for the prevention of collisions. Before the appearance of a reliable radar the ship had been at the mercy of weather and bad visibility, and subject to collision and grounding. A prudent seaman was forced either to slow down or stop the ship until the visibility improved.

A reliable radar, which is well used by a trained bridge team, has enabled the ship to maintain the sailing schedule, and to navigate with a reasonable degree of accuracy along the shore even when it is not visible. Amo1tg other navigation aids the Decca Navigator is one of the most significant and reliable aids; it is an electronic navigation system providing the navigator with the co-ordinates to indicate the position of the ship on a special chart. Unfortunately, this system only covers the areas of Northern Europe and the Japanese Sea.

In the open sea the navigator depended on weather and visibility to obtain his position. It was only at morning and evening twilight (at dawn and dusk) that best fixes could be obtained. This disadvantage has been overcome by long-range hyperbolic systems such as LORAN-C, Omega, etc. The greatest advance has been achieved by the development of the satellite navigation system. In this way the ship can determine its position at any time.

With the high accuracy of these systems, and the availability of on-board computers it has become possible to integrate all the navigational functions on board. Thus the ship's position is fed into the computer together with the information from the log, echo sounder, gyro-compass, autopilot and rada1: Further, weather data can also be added, and an updated optimum course to be steered can be obtained, in order to make the best time to port or to save most fuel. The integration includes maritime communications, safety and machinery control to be integrated into a single computer, electronic charts are also integrated.