UNIT 26

ELECTRONIC AIDS TO NAVIGATION

Basic terms

aid to navigation >Loran-C >Omega >Transit satellite >GPS >hyperbolic systems > satellite navigation system >fix accuracy small-screen >satnav receiver >Navstar GPS >globe >sequential readings >GPS receiver > satnav system >Automatic Radar Plotting Aid* (ARPA) *>approved radar >rasterscan display > radar > radar presentation

Nowadays, a mariner can obtain his position from Decca Navigator, Loran-C, Omega, Transit satellite or GPS-systems. Although none of these is yet mandatory (except Loran-C off the American coasts), the use of two or more is common, since none of the hyperbolic systems (Decca, Loran-C, Omega and the French Syledis) is alone truly effective for global use.

Satellite Navigation Systems

Of the two best known satellite navigation systems, at present Transit is intermittent in action and the new Navstar GPS not yet complete. Decca and Syledis provide coverage over relatively restricted geographical areas. Although Loran's coverage is being extended through Europe and elsewhere, as more transmitters are established, it is still far from universal. Omega is intended to provide a fully global system but the very low frequencies which give its transmissions their extremely long range suffer from a complexity of propagation problems. These can degrade fix accuracies to an unacceptable degree in coastal or congested waters, although they may be tolerated in mid-ocean.

Transit provides fixes only at intervals which differ according to the observer's

latitude. In equatorial regions the intervals may be as long as several hours. Its coverage is global, therefore, but not continuous. Accurate fixes can be obtained and many hybrid satnav receivers can also use Omega transmissions to maintain dead reckoning between Transit satellite appearances. It has become common practice for ocean-going ships to augment Transit with one or more of the hyperbolic systems and to fit two or even three separate position-fixing receivers. An alternative to carrying two or more such receivers is found in Racal's MNS 2000, which can derive position from the signals of the Decca system, Loran-C, Omega and the Transit satellites, automatically selecting the system or combination of systems that provide the optimum fix accuracies for the region in which the ship is sailing.

Seafarers now use the US Navstar Global Positioning System (GPS). This has been developed for military purposes but is also available to commercial shipping. It deploys up to 24 satellites, instead of the half dozen of the Transit system it will eventually replace. These satellites circle the globe in three different planes at an altitude of some 17,600 km. With such a constellation, simultaneous sequential readings from at least three and frequently four satellites are obtainable in rapid succession anywhere in the world at any time. A GPS receiver could take a positive fix at least once every minute, with no need to maintain dead reckoning.

Automatic Radar Plotting Aid (ARPA)

It was the need to plot the movements of other vessels that brought about the development of the automatic radar plotting aid (ARPA). On 1 September, 1988, ARPA became mandatory for all ships of 15,000 G.T. or more and also on those of 10,000 G.T. and upwards built after 1 September, 1984. An approved radar, not necessarily an ARPA, must also be fitted on ships of between 500 and 1,600 G.T. built since that date and on all ships between 1,600 and 9,999 G.T., whatever their date of construction.

In developing ARPA, most of the manufacturers have produced individual solutions to the problem of man/machine communication. In one aspect of presentation, however, there is some agreement. Most manufacturers now market the daylight viewable, steady picture, rastercan display in their ARPAs. Though rasterscan first came into use some 10 years ago, the technique could only be employed in small-screen radars, most of them in colour. Then, in 1984, Krupp Atlas Elektronik of Bremen introduced its 7,600/8,600 series of 16 in radars and ARPAs, the first rasterscan sets acceptable under IMO performance and specification standards. Racal has gone a step further with the introduction of its 2,690 BT, which has a colour presentation derived from its earlier Bright Track small craft radar.

Other modern navigating aids on board are various types of radars, RDF, speed, logs, depth finders, chronometers, compasses and electronic charts.

IMO STANDARD MARINE COMMUNICATION PHRASES

III/3.2.3 - *Electronic navaids*

GPS Satellite ... (number) ***unusable from ...*** (date and time) ***to ...*** (date and time)***. Cancel one hour after time of restoration.***
LORAN station ... (name number master/slave) ***off air from ...*** (date and time) ***to ... Cancel one hour after time restoration.***
DECCA ...(identify chain and colour) ***off air from ...*** (date and time) ***to ...*** (date and time)***.***
Cancel one hour after time of restoration.
RACON ... (name of station) ***in position ... off air from ...*** (date and time) ***to ... . Cancel one hour after time of restoration.***

A. Comprehension & vocabulary

A.1 *State whether the following statements are true or false:*

1. Decca covers a relatively large area.
2. Omega is intended as a fully global system.
3. Omega suffers from propagation problems because of low frequencies.
4. The coverage of Transit is restricted.
5. Transit can be combined with other satnav or hyperbolic systems.

6. Navstar GPS is used for military purposes only.
7. Racal MNS 2000 is a complex navigation unit.
8. 8.Inmarsat will provide a position-fixing capability by means of their own satellites.
9. Arpas are mandatory for all ships of 10,000 G.T. or more.
10. All ships of 1,600 G.T. or more must carry an approved radar.

A.2 *Which navaids are described below?*

1. _____: a satnav system up to 18-24 satellites circling the globe at an altitude of 17,600 km.
2. _____: a navaid mandatory off the American coasts also extended to Europe and Japan.
3. _____: a system with global coverage but intermittent in action.
4. _____ : another global system of navigational aids using very low frequencies and providing extremely long range.
5. _____: a navigational system around the British Isles with limited range.
6. _____: a navaid used in avoiding collisions.
7. _____: a would-be international, civilian-controlled satnav system.
8. _____: the two short range navaids.

A.3 *Supply the missing terms in brackets:*

Decca navigator

Decca is a 1._____ navigation system which makes use of phase comparison of low frequency, unmodulated, continuous 2._____ to offer highly accurate 3._____ obtained in less than a minute with reference to two relevant position coordinate values indicated by two of the three coordinate meters of the receivers and then referring them to an appropriate navigational 4._____ reporting the Decca 5._____.
(chart,,fixes, hyperbolic, lattice, transmissions)

A Decca 6._____ usually consists of four transmitting stations operating in three pairs: master/red 7._____ station, master/green 8._____ station, and master/purple slave station. Each slave station is located about 60 to 120 miles from the 9._____ station.
(master, slave, chain, slave)

A ship carries a Decca 10._____ and three 11_____ (red, green and 12._____) together with a Decca lattice 13._____ on which the system of 14._____ is shown. *(decometers, receiver, chart, hyperbolae, purple)*

The Decometer can determine accurately the 15._____ difference, expressed as any 16._____ from 0 to 360°, between the waves from the master and one of the 17._____ stations.
(slave, phase, interval)

This figure enables the user to fix his 18._____ as somewhere on a curved 19._____ on the 20.._____ chart.
(line, Decca, position)

A similar comparison between the 21._____ and a different slave 22._____ fixes another 23._____ line or narrow 24._____ on the chart.

(band, master, curved, station)

Where these intersect, in a 25._____ if the lines are definite, or else in diamond of 26._____ is the ship's 27._____.

(error, point, position)

The degree of 28._____ of a Decca 29._____ varies within the 30._____ area, but it also depends on the time of the 31._____; the system is however unaffected by 32._____ or bad 33._____, and operates continuously 24 hours.

(coverage, fog, day, visibility, accuracy, fix)

Most ships also have 34._____ and use it to detect the 35._____ and other shipping at close 36._____.

(coastline, range, radar)

A.4 *Supply the missing tterms:*

** display indicator * transducer * dead reckoning * speed*
**relative speed *electro-magnetic log *aids *log *magnetic field *true speed*

Speed log

Knowledge of a ship's 1._____ is an essential part of navigation. Apart from assessing distance run for 2._____ purposes, this knowledge is essential for the operation of the arpa and those other 3._____ with which speed logs can be interfaced. For this purpose, speed through the water –4._____- may not be considered adequate. 5._____ over the ground is a more accurate measure of the ship's movement. Relative speed can be measured by the towed 6._____ , but this is far from precise and more or less obsolete. The 7._____ provides a better estimate of relative velocity. In this method a retractable 8._____ in the ship's bottom plating contains a coil and two electrodes. An alternating current passing through the coil creates a 9._____between the electrodes. Influenced by passage through the water, the electromotive force generated in the electrodes varies with the ship's speed and causes them to transmit a signal to the electronic circuits of a 10._____ which presents both speed and distance run in digital form.

B. Grammar

B.1 *Complete the sentence with the suitable prepositions:*

**for *with * for *among *in*

Magnetic compass

1._____ magnetic compasses, one fitted 2._____ a fluxgate coil, can drive remote repeaters, 3._____ example 4._____ the emergency steering position, and can also provide stabilisation inputs 5._____ arpa, radar, automatic direction finder, satnav receiver, auto-pilot or any other aid requiring a heading reference.

B.2 *Supply the right tense of the verb:*

Gyrocompass

The compass, one form or another, (be) 1._____ the seafarer's basic navigational tool

since the 13th century. Its modern version (be) 2._____ still mandatory equipment, under IMO requirements, for all ships from 150 G.T. upwards which *(build)* 3._____ since 1 September, 1984. In the tonnage bracket up to 1,599 G.T., ships *(bind)* 4._____ to carry at least a standard steering magnetic compass and, if of 1,600 G.T. or more, *(have to)* 5._____ carry the gyrocompass.

Gyrocompasses *(base)* 6._____ on the phenomenon of the gyroscope, which, when it *(spin)* 7._____ at high speed, *(maintain)* 8._____ a fixed direction in space and can therefore *(align)* 9._____ with true North. They *(design)* 10._____ by Anschutz in Germany, Brown in UK and Sperry in the US early this century. They *(adopt)* 11._____ by their respective navies in the 1914-1918 war but relatively few merchant ships *(fit)* 12._____ them until after the Seeond World War. Since then many makes and models *(become)* 13._____ available. In some, the sensing of direction *(perform)* 14._____ completely electronically. As with the transmitting magnetic compass a number of remote repeaters *can (drive)* 15._____. The gyrocompass *(be)* 16._____ remarkably efficient at providing heading inputs to the other navaids which *(mention)* 17._____ already.

B.3 *Supply the adjective and adverb in brackets in the right place in the sentence:*

Speed log (continued)

In speed logs the principle is similar to that used in the echo sounder *(acoustic, basically).* Pulses of sound are transmitted in succession from a hull mounted transducer *(rapid).* Their reflections from the seabed are received by a second element, in the same mounting but a distance apart from the first along the fore and aft line of the ship *(actually, short).* Due to the physical separation of the two transducer elements, a time delay occurs in the reception of the returned echoes and this is translated and displayed in term of speed on an indicator *(respective, electronically).*

The distance run is shown and a by-product of this method can be depth measurement *(also, simultaneous).* The principle is applied in the Doppler speed log *(acoustic, differently),* which measures the Doppler shift between the reception of pulses transmitted in the shape of narrow lobes *(successive, very).* Like time-delay measuring logs, Doppler logs can track the seabed in shallow waters *(only, relatively).* Beyond their range they, too, resort to using the stationary water mass as a "bottom" reference *(maximum).* Both time delay and Doppler types of logs can be fitted with multiple transducers to measure transverse as well as velocities, which is useful in narrow channels or in the berthing of large ships *(longitudinal, very).*

C. Writing skills

C.1 *Give an account of the reading text using the answers to the questions below as guidelines:*

l. Which aids can a navigator use today to obtain his position?

2. Which of them is mandatory and where?

3. Why should two or more navaids be used?

4.What are the best known world satnav systems?

5. Give, the features, advantages and drawbacks of:
a. Transit

b. Decca
c. Loran-C
d. Omega
e. GPS

6. How can the use of transit satnav system be improved?
7. What are the features of the Racal MNS 2000?
8. Describe the Navstar GPS.
9. How is Inmarsat expected to contribute to an efficient positioning of ships?
10. Why was ARPA brought about?
11. What are some mandatory requirements for carrying arpas on ships today?
12. What are the features of the most recent arpas?