The World-Wide Navigational Warning System (WWNWS)

In the interests of continued safe navigation practice, the International Hydrographic Service (IHO) and the International Marine Organization (IMO) have jointly established a global Navigational Hazard Warning System. The service is provided in the English language by radio and may also be promulgated by Notices to Mariners where appropriate.

There are three types of warnings: —

(i) Navarea warnings.
(ii) Coastal warnings.
(iii) Local warnings.

NAVAREA WARNINGS — These cover the whole world, which for the purpose of distribution is divided into sixteen (16) geographic areas. The long-range warnings are issued by an Area Co-Ordinator on frequencies as listed in the Admiralty List of Radio Signals.

COASTAL WARNINGS — These are issued from the country of origin and effect a specific coastal region, in the area of the hazard.

LOCAL WARNINGS — These may supplement coastal warnings and provide detailed information which often relates directly to inshore waters. As such, they may not effect ocean going vessels to the same extent as vessels working inshore. The warnings often originate from coastguards, and may be transmitted in the national language only.

Content of Warnings

The navigational warnings will advise mariners of such changes as:

Newly discovered wrecks, changes to navigational aids, on-going search and rescue operations, cable laying activity or other underwater work, anti-pollution operations, or where natural hazards are present.

Communication and Transmission of Warnings

One of the main methods, and certainly the greatest expanding method of transmissions is by the use of the NAVTEX service. This is currently being developed in other areas of the world and it must be anticipated that this system will dominate in the future.

The United States also issues long range warnings in the form of "HYDROLANT's" or "HYDROPAC's" and information concerning current warnings can be located in the U.S. Weekly Notices to Mariners.

(Additional reading, Ref. Not. 13 Annual Summary)

Changes to Merchant Shipping Notices

Recent changes with regard to Merchant Shipping Notices have been made by the Marine Safety Agency:

As from 1997, **Merchant Shipping Notices will be known as MSN's** and will convey mandatory information which must be complied with under UK, legislation.

In addition:–

Marine Guidance Notes (MGNs) will also be issued with regard to specific topics.
e.g. SOLAS, MARPOL, etc.,

also:–

Marine Information Notes (MINs) will be issued concerning administration detail, aimed at training establishments, equipment manufacturers etc.,
These will be published with a self-cancellation date.

Each of the above will carry a suffix:–

(M) effective for Merchant Ships
(F) effective for Fishing Vessels
(M+F) effective for both Merchant Ships and Fishing Vessels

Chapter Fourteen

ELECTRONIC NAVIGATION SYSTEMS

Introduction

The experienced navigator will tell you the days of the sextant are numbered, the day of software is here. And so it is, but not for everybody ... immediately. This age is already seeing giant steps forward with Digital plotting systems, Electronic Chart Display and Information System (ECDIS), GPS, Integrated Bridge Systems with visual reality and continuous alarm monitoring. The day has indeed arrived, where the navigator is required to know his way about the Computer Keyboard.

There is a need, for marine students to move with the times and master a proficiency with the VDU, the terminal, the integrated bridge system and be aware of the data base contents and how to acquire necessary data ... quickly and efficiently.

The Master of the ship should not feel left out in this IT explosion. The young men of our future will seek guidance from senior officers. It is imperative, in the authors opinion, that both junior and senior learn from each other. Some day soon that junior will be a ships master amongst new bridge systems and he may welcome and need the energies of that bright young man out from the world of College Simulators.

Apelco 7000 LCD Chartplotter.

The world of Decca, Loran, DF and visual fixing will not disappear just yet, but may struggle to maintain market share in the shadow of DGPS with accuracy of 10 metres.

Integrated Bridge System — Open space and clear view, lending to a 'One Man Bridge Operation'.

Nucleus Integrated Navigation System (NINAS)
Central Docking Mode Display Unit, communications, helm and telegraph. Primary and Secondary automatic plotting radars either side. Ninas Workstation, GPS receiver and Electronic Chart Display Unit.

The Integrated Navigation System

The reality of a one man bridge operation has become an acceptable format. What was once an ideal dream has been turned into a reliable aid to safer navigation. Any errors which occur have a tendancy to be human rather than mechanical and that from lack of experience with the equipment being employed.

The provision of a centralised navigation monitoring operation can and does ease the workload of the experienced user.

Considerable data from numerous sources can be amassed to provide a total picture for the watch officer when the vessel is either at sea in open water conditions, entering port in a docking or unberthing mode, or coastal on passage from one port to another.

Monitoring points would include sensors to deliver the following type of information: –

Ships Speed (Velocity sensor) Typical log readout to provide speed over the ground and speed through the water. This has long been an input feature of modern radars. Display in knots.

Ships heading sensor, usual feedback from a Master Gyro Compass. Guarded by off course alarm system providing both visual and audible watch keeper alarms.

Rudder Angle sensor – analogue display on a Navigation VDU display. Additional to rudder angle indicator at the position of the helmsman.

Auto Pilot incorporated for vessel control and/or information source for display of current status of vessel.

Rate of Turn sensor – particularly relevant for the larger vessel with large turning circle. Annalogue display to Navigation VDU.

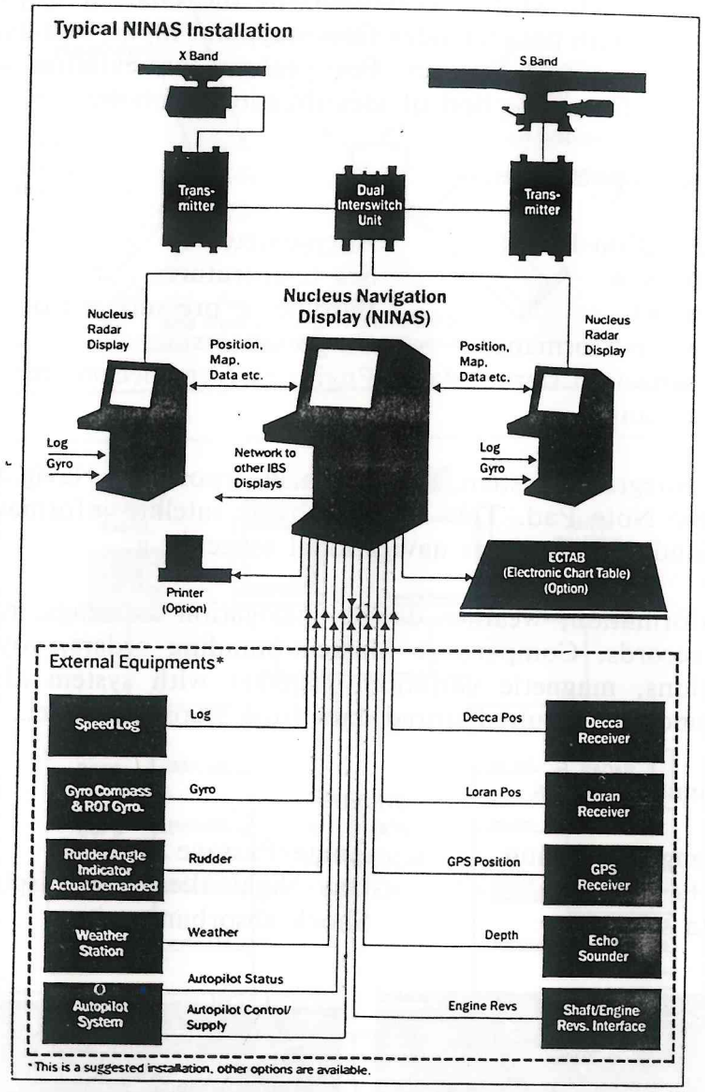
Depth sensor – echo sounder feedback. Digital display on a VDU set in Navigation mode.

Position continuous monitoring from either a GPS or DGPS. Position update on demand, with latitude and longitude on VDU display.

Position check displays from Decca, Omega and/or Loran where appropriate. Some systems have limited range and coverage. Alarm monitoring where secondary system positions to not coincide with primary satellite position fixing system.

Automatic track sensor to allow track analysis and auto correction or manual override. Interfaced with electronic chart system.

SENSOR INPUTS AND INTERFACES



Comprehensive Alarm System – Provision for Alarms includes:

- Deadman
- Off Track
- Sensor Failure
- Depth
- ROT (Rate of Turn
- MOB (Man overboard
- Radar
- Route Monitor
- Operator Defined
- Vigilance (optional)
- Transfer to ship's general Alarm (optional)
- Remote Alarm Indicators (optional)

ARPA interfaced with both Navigation VDU and Electronic Chart Display. Anti collision data on +20 targets can be acquired and introduced visually onto the charted display. Passage data with parallel index lines waypoint input, and guard zones are recognised features. Four colour, presentation with ample scope for a selection of identification symbols.

Additional Inputs from:—

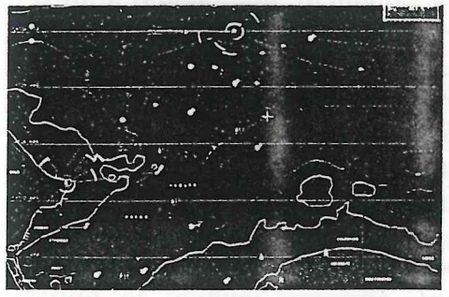
Radio Direction Finder.
Roll sensors.
Pitch sensors.
Bow thrust performance.
Rate of approach stern radars.
CPP pitch angle.
Anemometer.
Sea temperature.
Barometric pressure sensor.
Cargo sensors.
Engine performance parameters.

A fully integrated system would also incorporate a Navigators Electronic Note Pad. This would provide satellite information on demand for numerous navigational aspects e.g.

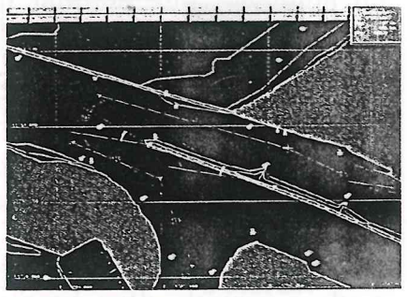
Port information, weather details, navigation warnings, navigation records, Company & Masters standing orders, voyage calculations, magnetic variation, together with system alarm details and any required stored data from ships personnel.

Additional Facilities

Multi language option.
Zoom +/− viewing.
CD data storage.
Route/Passage library.
Day/Night alternative displays.
Shock absorbant unit.

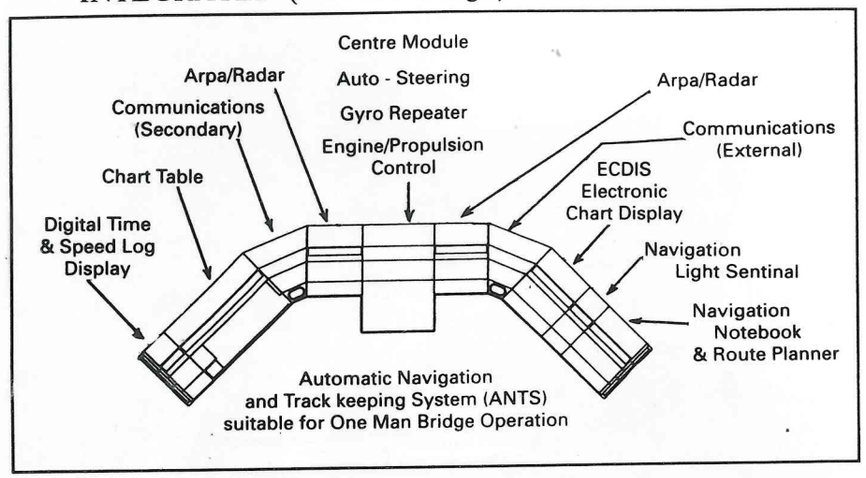


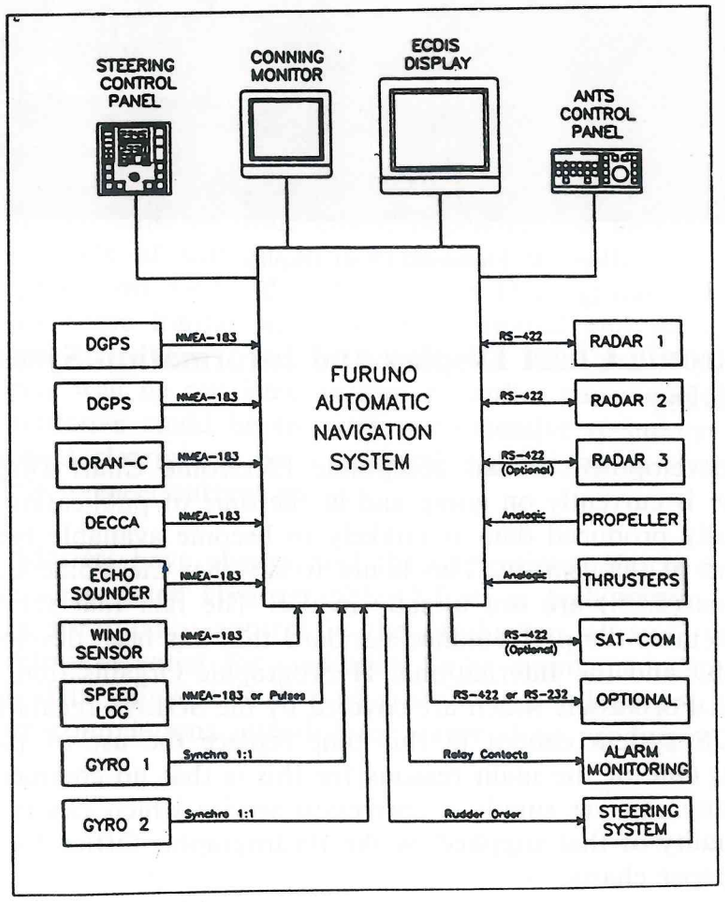
Navigation aids, night display



Route planning, night display

INTEGRATED (Modular design) BRIDGE SYSTEM'S





Electronic Chart Display.

Electronic Chart Display and Information Systems (ECDIS)

The development of an acceptable Electronic Chart Display System is currently on going and at the time of publication the officially produced data is unlikely to become available before the end of the century. This is not to say that Electronic Chart Systems (ECS) are not already in use. The fact that they do not all meet the performance standard that has been developed by IMO and the International Hydrographic Organisation is a reality. For vessels which are covered by the SOLAS regulations an ECS system cannot at this time replace the use of paper charts. One of the main reasons for this is that no commercial company can yet supply a correction service which can match the quality of that supplied by the Hydrographic Office for use with paper charts.

Clearly a major requirement for any future system must possess an equally efficient correction service to provide continuous reliability. The ECDIS is being developed to provide increased safety over and above that of the paper chart. Interfaced with D-GPS it is anticipated that visual reality of the ships position will be a requirement for the eventual performance standard yet to be set by IMO.

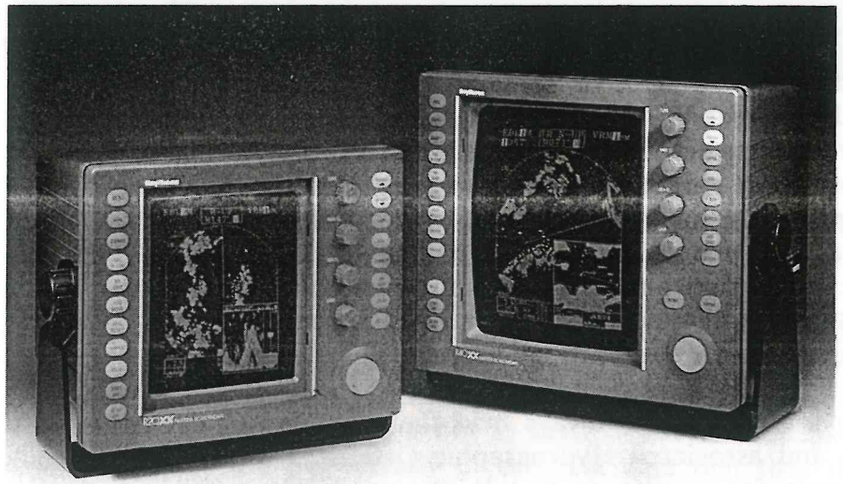
It will allow the Navigator to monitor the ships performance showing intended and actual tracks of the vessel, monitored by eight alarms and seven indicators to warn the navigator of equipment failure or potentially hazardous navigational situations.

The navigating officer may not be to concerned at this moment with the methods being employed to develop ECDIS it should suffice to know that the graphic image is being produced from a method known as raster-scan. This can then display the final image on the computer screen.

In the past paper charts have always had limitations, fixed scales and limited data in some cases, depending on survey dates and methods of survey. It is expected that with input and development on digital data from other Hydrographic Offices most of these limitations can be eliminated and allow the navigator to be free of chart boundaries. The quality of the data may well be restricted to that of earlier paper charts but the alternative could be to carry out extensive re-surveys and this would clearly not be a practical proposition in the time available to meet current needs.

Ships Masters have always held the navigational charts of the UK and associated Hydrographic Offices in high esteem. The concern for quality control in the production of any system is therefore essential for credibility to be maintained. To this end all data supplied is derived from authorised paper charts or from compilations intended for paper chart production.

Raytheon Marine Company
Nav 398 GPS/Loran.



R20XX displaying radar with fishfinder; R40XX displaying radar with electronic chart.

Development of ECDIS is moving towards a graphic display of a continuous rolling chart which will display the ships position in real time. The system will be expected to provide the professional mariner with a "Traffic Overview" which

should effectively reduce the watch officers workload and so reduce stress. Radar information being transferred to the sea-chart display would provide a real time picture of the traffic situation.

A passage planning feature via a variable number of 'way points' would permit a route to be planned in detail taking into account all navigational aids, beacons, lights, traffic separation schemes etc. This would be possible because the system would not only be a visual chart display, but also a data/information system. This would relate to such items as wrecks, lighthouses, light sectors, national boundaries, recognised routeing systems or anything thought relevant to the overall passage plan. It should relieve the need to resort to books and tables as all the information could be called up and displayed. The user being allowed to add, remove or store relevant information which could be recalled to the display on request. This feature would allow updates to be inserted whenever required.

The monitoring principle of passage planning would be achieved by an Automatic Navigation and Track System (ANTS). This would provide close and continuous monitoring of not only the vessels actual position but also of water depth. An 'anti-grounding' alarm system being incorporated through an echo sounder interface.

Additional sensors would activate respective alarms for the vessel being off course by standard interface to Gyro, Magnetic or Fluxgate compass. Similarly an off track situation would be sensed by position reference sensors i.e. GPS, DGPS, Loran C, or Decca.

Variable Features

The provisional IMO Performance Standards for ECDIS have so far influenced the development of the system and the mariner can expect to experience most if not all of the following features with Integrated Bridge Capability: –

1) Built in world chart. Chart card library which allows the Navigator to access any of the charted areas.

2) Liquid Crystal Display (LCD) screen. Auto scroll, zoom and pan functions. Main menu and flexible windows type display. Easily viewable under any conditions of daylight or darkness.

3) Own ship movement. Course over ground (COG), speed over ground (SOG). Leg and total distance display/record, with range bearing and time to next waypoint.

Electronic Chart Display Monitor can be free standing or incorporated into an integrated bridge system.

4) Chart features include full screen chart view with selectable navaids, geographic names, traffic lanes restricted areas etc., Data window inset for own ships Lat/Long, SOG/ COG, Range & Bearings etc.,

5) Route & Track detail. Automatic plotting of intended course and automatic tracking of past course. Reverse route function and position error correction.
(Various manufacturers include a variable number of waypoints, 500–1000 would not be unusual. Also track length upto 2500 nautical miles and memory capability for 20 independant routes would reflect an expected standard)

6) Alarm systems for arrival, cross track error, anchor drift and Man Overboard would be additional to Anti-Grounding alarm, off-course or position error. Any loss of fixed data, power failure or equipment malfunction would also be alarm protected.

7) Language of operation menus, English, French, Italian, German or Spanish.

8) Additional features may include, event markers with different symbols/different colour codes. Local and GMT timings, selectable depth scales metres/feet/fathoms with digital readouts. Variable tracking intervals by either time or distance, heading vector, magnetic variation display and extensive memory.

Summary

The electronic chart is already active with the integrated bridge and can be interfaced with virtually all other bridge operations. The obvious need for operators to familiarise themselves with the equipment is essential to avoid human error, which initially could be the biggest hazard with its use. Simulated training can expect to be beneficial in this field but expertise will only be achieved by active use of specific equipment.

Corrections to charts will probably be achieved by a weekly CD or disk issue in a similar way to the weekly notices to mariners. World updates and corrections being incorporated onto charts by an easy computer application.

DEPARTMENT OF TRANSPORT

MERCHANT SHIPPING NOTICE No. M.1471

Use of Automatic Pilot

Notice to Shipowners, Shipbuilders, Masters, Officers and Seamen of Merchant Ships, and Owners, Builders, Skippers and Crews of Fishing Vessels

This Notice supersedes Notice No. M.1040

1. There have been many casualties in which a contributory cause has been the improper use of, or over-reliance upon, the automatic pilot. Collisions have occurred where one and sometimes both vessels have been on automatic steering with no proper lookout being kept; strandings and other casualties have occurred where automatic steering systems have been in use in restricted waters and a person has not been immediately available to take the wheel; casualties have also happened because watchkeepers were not familiar with the procedure or precautions necessary when changing over from the automatic pilot to manual steering.

2. Attention is drawn to the possible inability of an automatic pilot to closely maintain set headings when a ship is making low speed and/or in heavy seas. The performance of some automatic steering systems is very dependant upon correct control settings suited to the prevailing conditions of ship speed, displacement, and sea state particularly. Use of the automatic pilot must be restricted to conditions within the designed parameters of the automatic control system.

3. If shipowners do not use all the control options which may be incorporated by the various manufacturers into a control console, positive measures should be taken to prevent redundant control settings being used inadvertently, and the labelling arrangements should be amended accordingly.

4. Certain requirements on the use of the automatic pilot are included in Regulation 4 of The Merchant Shipping (Automatic Pilot and Testing of Steering Gear) Regulations 1981 (SI 1981 No. 571) which is reproduced as an Appendix to this Notice. Masters, skippers and watchkeeping officers should be aware of these requirements as well as the general need to ensure that arrangements are adequate for maintaining a safe navigational watch, as described in Merchant Shipping Notice M.1102.

5. Masters, skippers and all watchkeeping personnel must be familiar with the procedure for changing over from steering with the automatic pilot to hand steering (eg through a telemotor) and must ensure that sufficient time is allowed for the operation. Clear instructions must be provided at the control console, and special attention should be given to the procedure when joining a ship because it will vary depending on the particular equipment installed. The operations manual should be kept on the bridge and be readily available to masters, skippers and navigation watchkeeping personnel.

6. Some steering gear control systems enable alignment to be maintained between the helm and the steering gear at all times, irrespective of whether the automatic pilot is or has been used. Where the design does not include this provision, suitable measures should be taken immediately before and after the changeover to ensure that the helm and steering gear are aligned.

7. Attention is drawn to the need to test the manual steering. Paragraph 10(c) on page 3 of M.1102 recommends that the automatic pilot should be "tested manually a least once a watch", while Regulation 4(4) in the appendix to this notice requires that, whilst the vessel is on passage and continuously using the automatic pilot, the manual steering gear be tested at least once a day. To comply with the former recommendation, the manual steering over-ride alter course control incorporated in the automatic-pilot console should be operated once every watch. To comply with the latter requirement, the wheel (or equivalent) steering should be engaged at least once every day and the ship steered by hand. It is strongly recommended that a roster system should be employed so that all persons recognised and qualified for the purpose of steering take a turn at this task. They should steer for a sufficient period for them to maintain their proficiency, including manoeuvring the vessel thus gaining experience in the vessel's response to helm orders.

Department of Transport
Marine Directorate
London WC1V 6LP
December 1991

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APPENDIX

EXTRACT FROM THE MERCHANT SHIPPING (AUTOMATIC PILOT AND TESTING OF STEERING GEAR) REGULATIONS 1981 (SI 1981 NO. 571)

Use of the Automatic Pilot—Regulation 4

1. The master shall ensure that an automatic pilot, where fitted, shall not be used in areas of high traffic density, in conditions of restricted visibility nor in any other hazardous navigational situation unless it is possible to establish manual control of the ship's steering within 30 seconds.

2. Before entering any area of high traffic density, and whenever visibility is likely to become restricted or some other hazardous navigational situation is likely to arise, the master shall arrange, where practicable, for the officer of the watch to have available without delay the services of a qualified helmsman who shall be ready at all times to take over the manual steering.

3. The changeover from automatic to manual steering and vice versa shall be made by, or under the supervision of, the officer of the watch, or, if there is no such officer, the master.

4. The master shall ensure that the manual steering gear is tested (a) after continuous use of the automatic pilot for 24 hours and (b) before entering any areas where navigation demands special caution.

Radar

Marine radars have advanced considerably since the early development years following world war two, when merchant vessels first started to acquire radar as an aid to navigation. The word RADAR itself is an abbreviation from Radio Direction And Range.

The equipment itself has proved invaluable as an anti-collision aid for vessels navigating in conditions of poor visibility. Additionally, it has also been employed as another position fixing method for short range, coastal operations.

The idea of reflecting electro-magnetic waves from a target could well be traced back to the years of Thomas Edison (1885). What became clear in the practical application was that radar energy could identify the position of the target but could not determine the course and speed of that target. In the case of marine radar the course and speed of the target had to be determined by a systematic plotting operation by the observer.

This plotting procedure is still widely practised today either manually or in the case of the more updated technological equipment, with Automatic Radar Plotting Aids (ARPA). The navigator should note that all the ARPA will do is carry out a

Raytheon Marine Company R11XX Multiscreen TM Radar.

series of calculations automatically, and clearly a lot quicker than the human observer could do. It will not make anti-collision manoeuvres.

All plotting activities, in conjunction with radar equipment will have inherent errors, and it should be realised that even the sophisticated ARPA's as other instruments, have a delay factor before displaying the obtainable data. (All be it a small delay).

Radar Plotting Errors

a) Errors in range of targets.
b) Errors in bearings of targets.
c) Incorrect estimation of own vessels data.
d) Errors in timeing of the plotting interval.
e) Incorrect interpretation of target data.

a) Range Errors

Errors in obtaining a defined range of a target will depend on several factors, not least the quality of the equipment being used and the skill of the observer. The observer should employ the fixed range rings when possible and interpolate between rings with the "Variable Range Marker" (VRM). The near edge of the echo should be employed as that point to establish the range.

The brilliance control should be applied to the range rings to establish a fine hard line to provide the cleanest range possible. If the equipment is new, then an anticipated error of upto 2.5% of the range scale in use can be expected. Should the equipment have been in service some years the percentage error could be as much as 5% of the range scale.

If the target is slow moving the accuracy of the plot is more likely to be less accurate than one with a target moving quickly.

Regular checking of the VRM against the fixed range rings is to be recommended especially if the VRM is being continually employed to define the range of the target.

b) Errors in Bearings

The type of display employed could well reflect considerably on the accuracy of any bearing obtained. For example: –

If a display is stabilised then a greater accuracy in the obtained bearing is achieved compared to a relative motion display, which may show upto +/– 2°. If a head-up, unstabilised display is being used then the ships head must be noted at the instant the bearing is taken. This lends to the involvement of human error if on manual steering at the time or an inaccuracy risk if the vessel is experiencing unsettled bow movement.

As the bearing, in most displays, is normally obtained from the screen centre (Not applicable to off-centre displays) then the initial setting up and ensuring that the heading marker and the centreing is correct is essential for accuracy in bearings.

c) Use of own vessels data — incorrectly

Accurate plotting exercises can only be realised if a correct input of the observers own vessels course and speed can be assured. Errors in own vessels course and speed will result in large errors in the course and speed of the target estimates.

The observer should maintain a continual check on own ships performance and the plotting interval should be increased to reduce the margin of error that could be effected in nearest approach of target.

d) Irregular timeing of Plotting Interval

Where manual plotting is engaged the plotting interval becomes subject to human error. Lack of concentration by the observer or unexpected interruptions could render the plot unreliable.

Increasing the number of plots and reducing the time interval between the plots tends to lend to improved accuracy and reliability of the targets performance. Any plot needs to be completed in a systematic manner to allow correct analysis.

e) Incorrect interpretation of the targets data

A plot can be unreliable for numerous reasons, but if the correct principles have been applied then the observer could expect to obtain acceptable information on the target. Levels of accuracy being adequate for practical anti-collision manoeuvres.

The observer should realise that radar is still an aid to navigation. Plotting activity must be carried out in a systematic manner with increased plotting intervals. The target will require close monitoring which could incur human failings. To minimise this and provide greater reliability 'Clear Weather' plotting should be encouraged by masters just as much as 'Foul Weather' plotting. Daytime and visual comparison with plotted information should be encouraged as a means of on board training.

Radar Plot Analysis

Once the systematic plot is established the observer is faced with the task of obtaining the maximum information from the construction. Namely:

1) Course and Speed of the target,
2) Distance and Time target will pass ahead/astern of own ship.
3) CPA and TCPA.
4) Aspect of target.
5) Relative bearing of target.

The decision to act or not to act on this information must then be taken. Such a decision should take account of all the options available;
i.e. Stop Engines, Reduce Speed, Increase Speed, Alter Course to Port/Starboard, or operate astern propulsion.

Whatever manoeuvre is chosen it must be legal and take into account the Regulations for the Prevention of Collision at Sea. (COLREGS)

Any action taken must be safe and substantial to:

a) produce an adequate CPA

b) provide clear indication to an external observer, the degree of change.

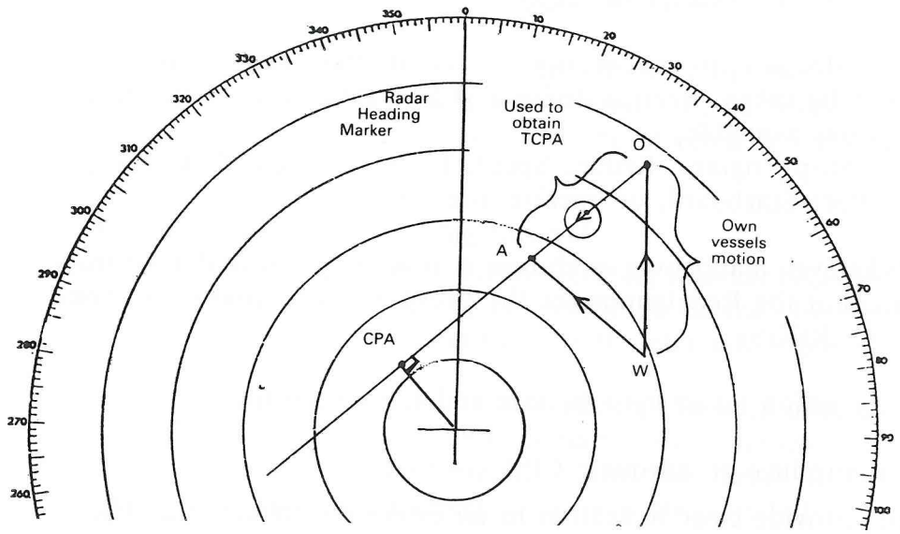
Consideration should be directed to 'Why' the action was taken, and what will the new consequences of that action be.
It should also be seen not to bring the vessel into a new close quarters situation with either the same or another target.

NB. Mariners may raise an eyebrow at the option to increase speed, mentioned above. This should not be taken out of context and the author would clarify that an increase in speed can be just as effective in collision avoidance as a decrease in speed. However, it is not being advocated that observing vessels should be quick to increase speed. This option, which is all that it is, must be accompanied by long range scanning, to ascertain what the vessel is moving towards.

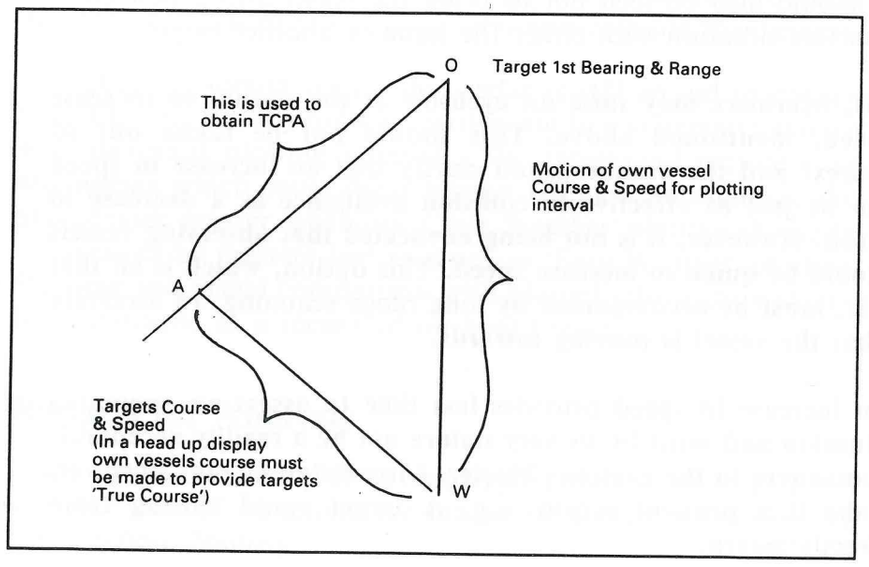
An increase in speed provides less time to assess an oncoming situation and must by its very nature not be a readily acceptable manoeuvre to the cautious Master. Circumstances may however, make it a prudent action. e.g. A target vessel closing from directly astern.

THE BASIC RADAR PLOT
Head Up Presentation

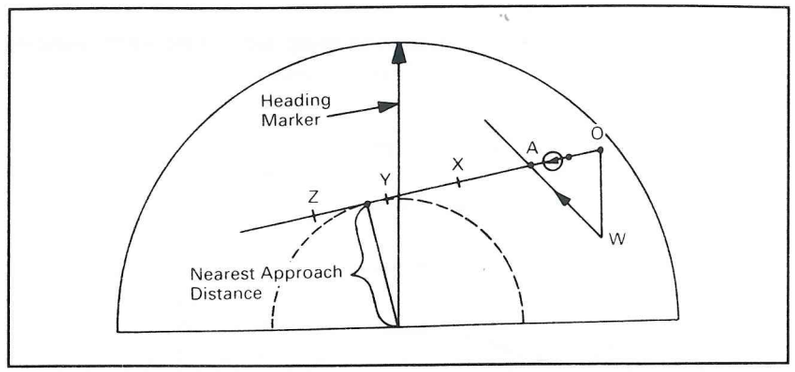
PLOTTING SHEET



OA Represents the apparent motion of the target.
WA Represents the true course and speed of the target.
WO Represents own ships motion, course and speed.



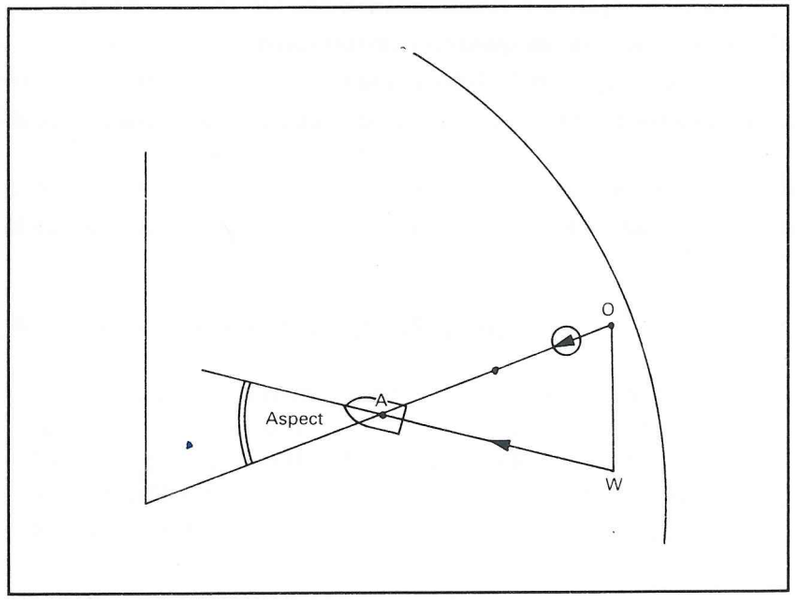
RADAR PLOTTING – NEAREST APPROACH



Assume target is observed at 0800 hrs 'O'
" 0810 " 'A'
" 0820 " 'X'
" 0830 " 'Y'

Time of Nearest Approach (just after point 'Y')
= *0833 hrs approx.*

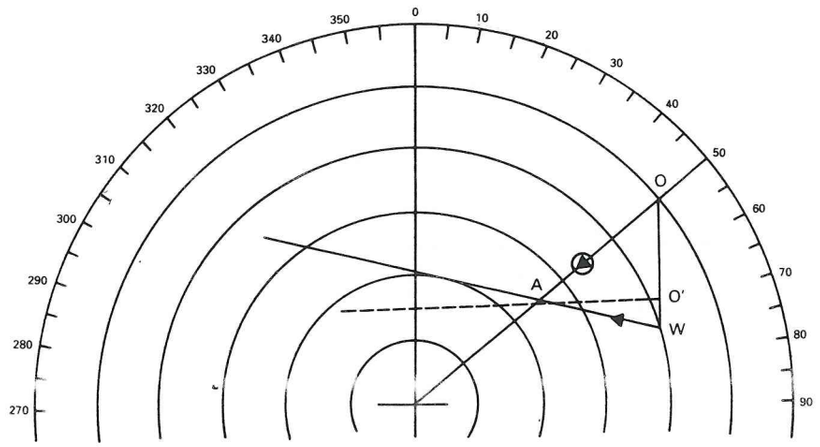
RADAR PLOTTING – ASPECT



Definition
The Aspect is defined as the relative bearing of own vessel as taken from the target.
or
That angle contained between the ships head of the target and the bearing of the target.

RADAR PLOTTING – AVOIDING ACTION BY OWN VESSEL

Reduction of Speed – Course maintained following initial plot which indicates a collision situation.



Example target on apparent collision situation

Assuming own vessel reduces speed to ¼ of full speed.

The WO' represents (¼ of WO) = New speed.

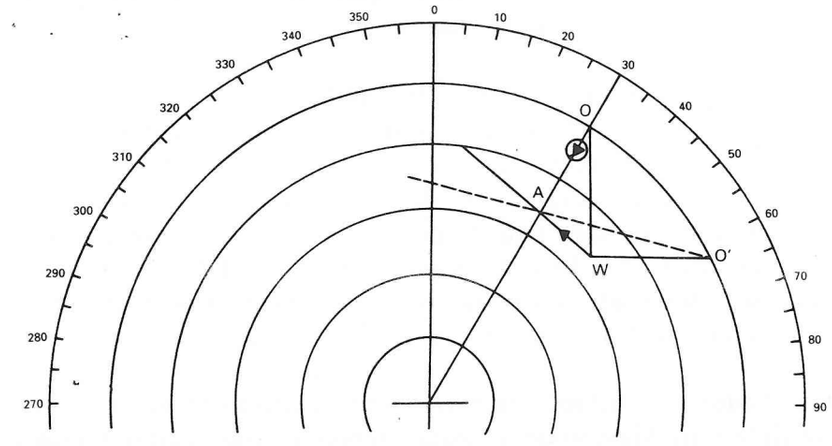
NB. The direction of the vessel WO remains unaltered as the ships course has not changed. (Only the rate of motion has changed)

The AO' represents the new apparent motion of the target.

Apparent line of approach now shows NO collision following this reduction in own vessels speed.

RADAR PLOTTING – AVOIDING ACTION BY OWN VESSEL

Alteration of Course by 90° to Starboard – Speed maintained following initial plot which indicates a collision situation.



Example target on apparent collision situation

Assuming own vessel alters course 90° to starboard.

OWO' represents the angle of alteration 90°

O'A represents new apparent motion of target after alteration (assuming the alteration is instantaneous)

Apparent line of approach now shows NO collision following this alteration of course.

RADAR – Presentation Methods

1.	Ships Head Up unstabilised.	(Relative Motion)
2.	North Up, stabilised.	(Relative Motion)
3.	North Up, stabilised off centre.	(Relative Motion)
4.	Sea Stabilised	(True Motion)
5.	Ground Stabilised	(Ground Stabilised)

---

1) Relative Motion — Ships Head Up — Unstabilised.

Main Advantages – Relative bearings provide a quick indication of the targets bearing in relation to own ships head. Also a direct comparison with a visual contact.

Main dis-advantages – The observer must ascertain the ships heading from the helmsman when actually taking the bearing. Echo paints will blur on the screen when altering course or if own ship is steering badly.
Relative movement of an echo is difficult to determine due to the movement of own ships head.

2) Relative Motion — North Up stabilised

Main Advantages – This presentation allows direct comparison with the chart. Movement of own ships head does not cause blur or smear of targets on screen. Course changes do not cause picture rotation, which could produce a confusing image. The accuracy of the bearing is good and the CPA can be easily obtained. Observation of the relative movement of the echo can be continued as long as the after glow remains.

Dis-advantage – subject to gyro compass performing correctly. Any defect in Master Gyro would directly effect radar picture.

3) Relative Motion — North Up stabilised, off-centre

Main Advantages – With the increased range visible on screen an earlier warning of approaching targets can be obtained. It is better for parallel index usage, and no centring error is involved.

Dis-advantages – Less warning from beam or astern targets with the increase in the ahead range. Must have an Electronic Bearing Indicator (EBI) because the mechanical bearing cursor cannot be employed with off-centre display.

NB. Off-Centre Displays

The majority of marine radar units offer an off-centre presentation in addition to the own ship, fixed centre presentation. This additional facility allows the point of origin to be shifted to the lower part of the screen and provides the distinct advantage of looking ahead over a greater range. The alternative would require the observer to select a longer range operation which would only offer reduced target definition.

If the off-centre operation is required it would mean that the timebase would have to produce a longer scan than that required

by the range in use. For example if the 6 mile range is employed then the timebase is effected to nominally sweep the trace from the centre to the screen edge in 75 microseconds, and then return back. However, if operating in off-centre mode the displayed range from own vessel could be nearly twice the selected range of 6 miles and the timebase would need to be extended to take this into account.

The off-centre is a feature of 'True Motion' presentation.

4) True Motion Sea Stabilised

Main advantages – This presentation indicates the course of all ships through the water, and set and drift can be clearly identified by observing the movement of a stationary echo.

Any alteration of the targets course or speed is displayed immediately while if own ship alters course echoes remain unaffected. Centring error is eliminated and an increased range ahead is achieved to provide earlier warning of approaching echoes.

Dis-advantages – Resetting of the centre spot is required, which could occur at an awkward time and break continuity. Own ships data could cause false movement to be screened. e.g. Compass error, or incorrect speed input.

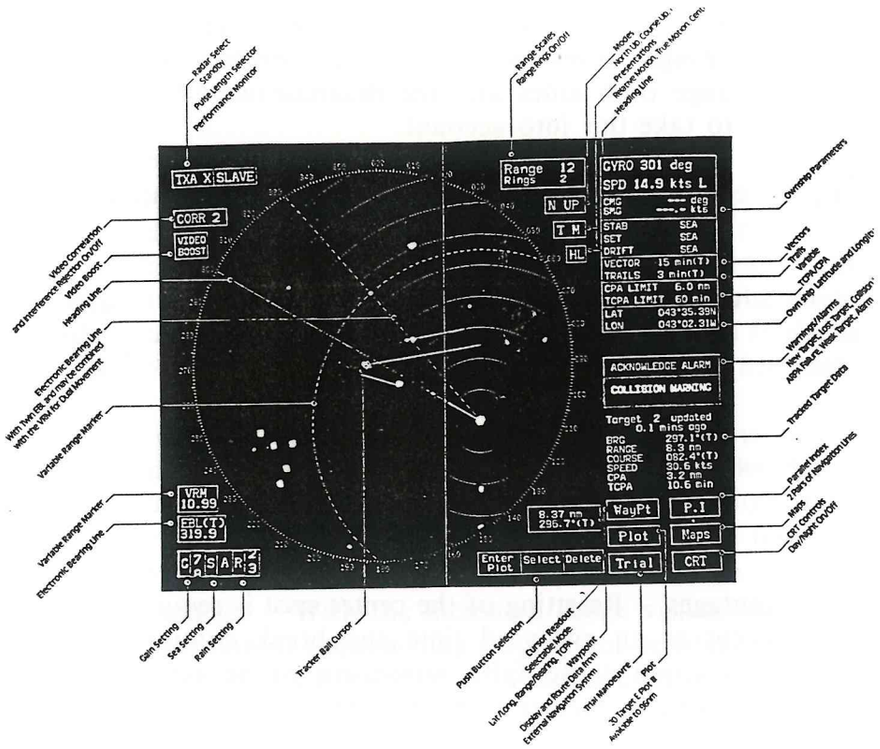
The speed used must be speed through the water and tide controls set at zero.
By necessity the equipment must have an EBI and additional controls for reset.

5) True Motion Ground Stabilised

Main advantages – Has many of the advantages of the Sea Stabilised but indicates course and speed over the ground not through the water. This is useful in pilotage waters. Also separation of stationary and moving echoes can be an asset.

Dis-advantages – As above this presentation has all similar dis-advantages as a Sea Stabilised presentation with the exception that course and speed of own ship through water is not indicated and tide controls require frequent adjustment to allow for change in tides.

RADAR — Modern Marine Display



Global Positioning System (GPS)

Hyperbolic navigation systems like Decca and Loran have been active for private use since their development for the military by the end of World War II. Both these systems had limitations in operational range and accuracy. Typically Decca can provide continually updated positioning but is limited to about 240 miles with an accuracy of approximately 30 metres. While Loran C, has a lesser degree of accuracy but an effective range of upto 1000 miles. Clearly a world wide system which was not restricted by range limitations coupled with accuracy which could also provide a continuous updated position was desirable, hence the Global Positioning System (GPS).

The GPS system has been developed by the United States military and is now widely available for all commercial and

private use. The U.S. Defence Department have retained a reservation to scramble the GPS signal for example in times of hostile activity and this is known as 'Selective Availability' (SA).

The theoretical accuracy under SA conditions, for civilian use, is limited to plus or minus 100 metres. However experiences during the Gulf War when SA was switched off provided accuracy estimated at +/− 05 metres. The long term outcome for SA, has to date not been disclosed.

The GPS-NAVSTAR system operates with 24 satellites in three orbital planes, 10900 nautical miles above the earth, in a 12 hour period. This results in between six and eleven satellites being accessible to the receiver, anywhere in the world. Positional accuracy being less than 100 metres for 95% of the time.
(Note comparison D-GPS accuracy page 412)

The Position Fix

The navigator would establish his/her position by receiving very high frequency signals from the selected satellites. Operational frequencies of 1227 MHz, and 1575 MHz, are emitted from the orbital satellites and although weak when they reach the earths surface, they are virtually free from other electrical/radio interference.

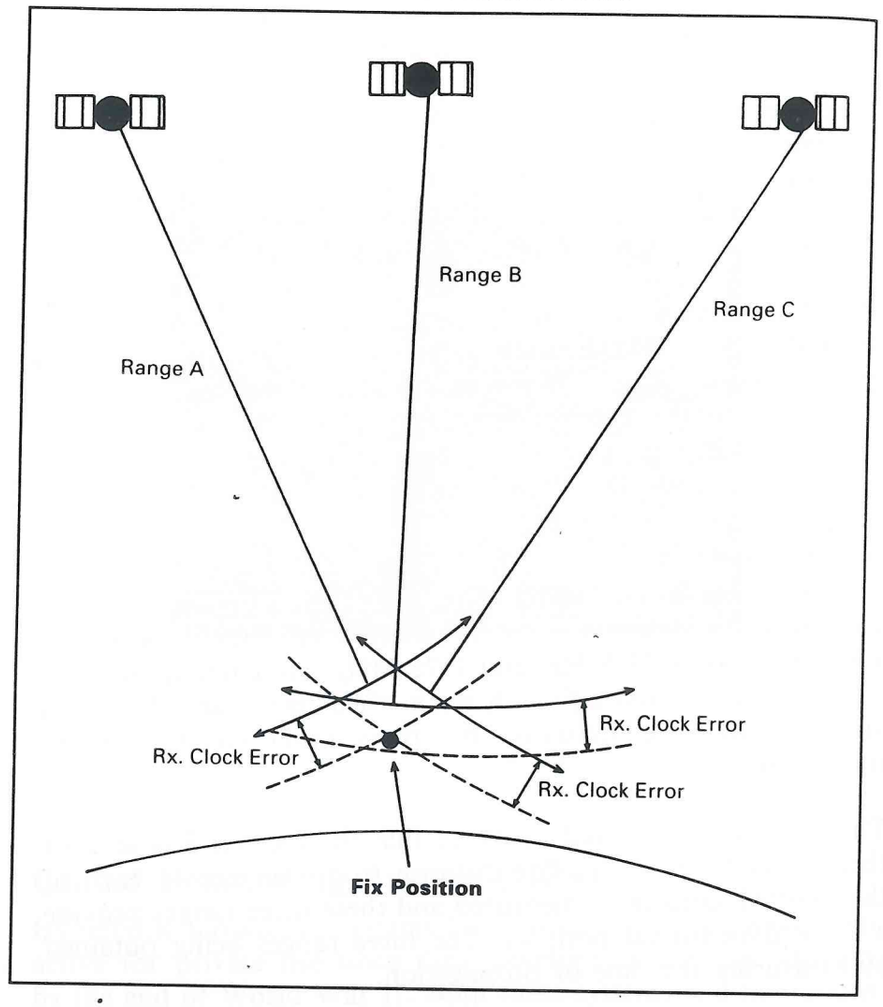
The position is achieved provided that the receiver has at least three satellites in view. The distance from the user to each of the selected satellites is measured and these three ranges provide a three dimensional position. The three ranges being obtained by measuring the time of propagation.

All receivers display the position in Latitude and Longitude and can be plotted directly onto the navigational chart.

Navigators will however, have experienced some charts bearing a notation that the Satellite position may need an applied correction prior to setting on the chart. Generally the correction is small but not always so.

(NB. Currently the Hydrographic Office is conducting a survey on the subject of GPS Position Shift and charted differences)

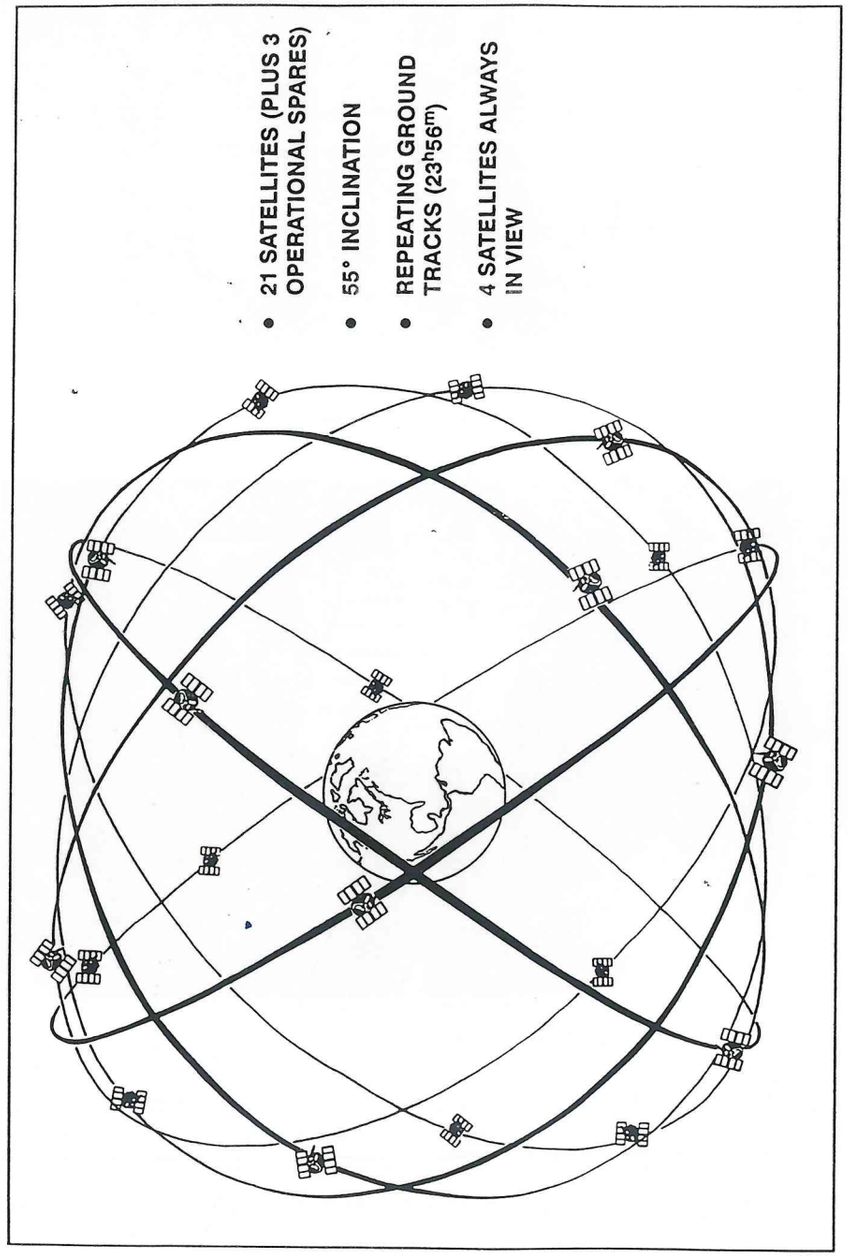
THE GPS POSITION FIX



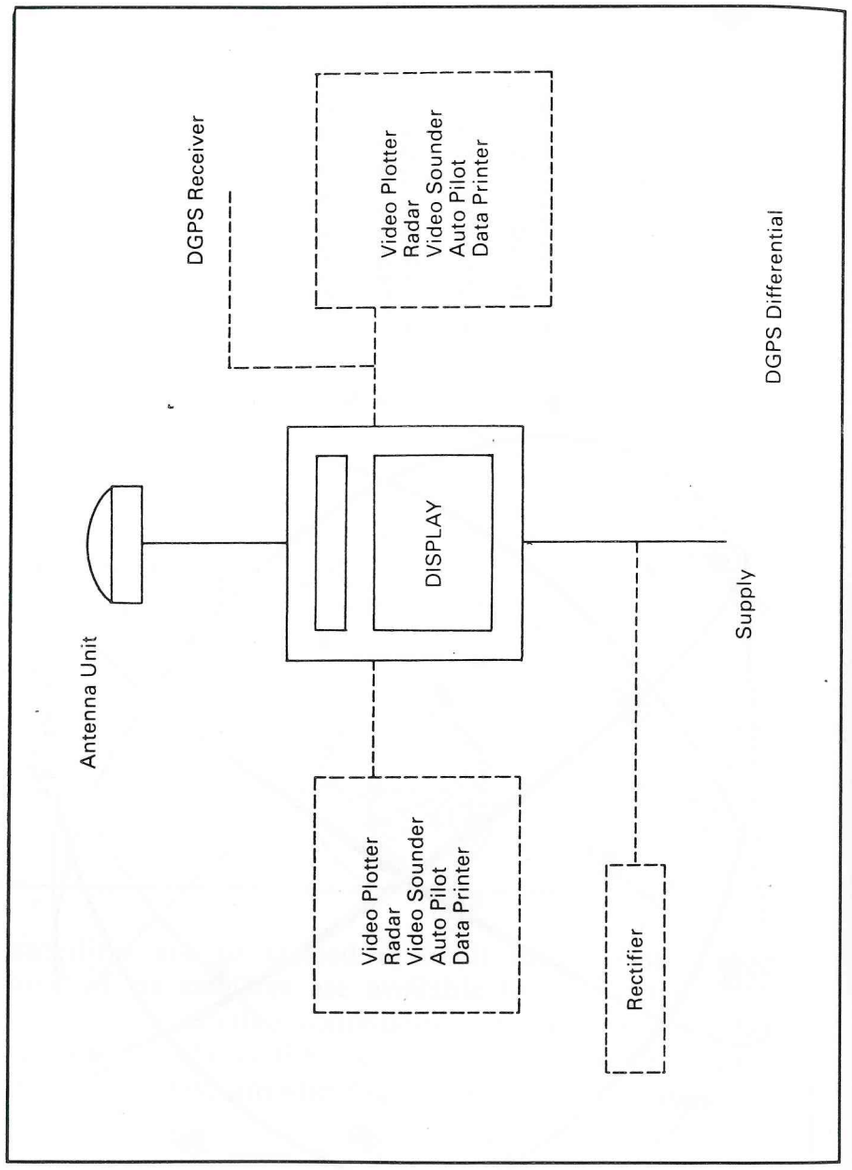
The satellites are so spaced in orbit that at any time a minimum of six satellites are available to users anywhere in the world. Each satellite continuously transmits position and time data which allows the user to obtain an accurate fix at any time of the day, anywhere in the world and in all weather conditions.

The receiver clock error (Rx.) being applied to the respective satellite ranges to provide a definitive fix of the vessels position.

THE DEPLOYED CONSTELLATION



GPS NAVIGATION SYSTEM



Raytheon Marine Company
Nav 298 GPS/Loran.

Apelco 6700 Loran/GPS/Plotter

The geometry of the position fix can be seen from the two position circles. When two satellites are employed all positions on the circles are the same range from the respective satellites. As these satellites are continually moving the crossing angles of the position circles are always changing. If a third satellite

is involved with a subsequent third position circle, then the positional error is reduced.

The resulting accuracy of the position becomes dependent on what is known as Horizontal Dilution of Precision (HDOP). Which is assumed to be a single value. This value is subsequently multiplied by the range measurement from the satellite in determining position error.

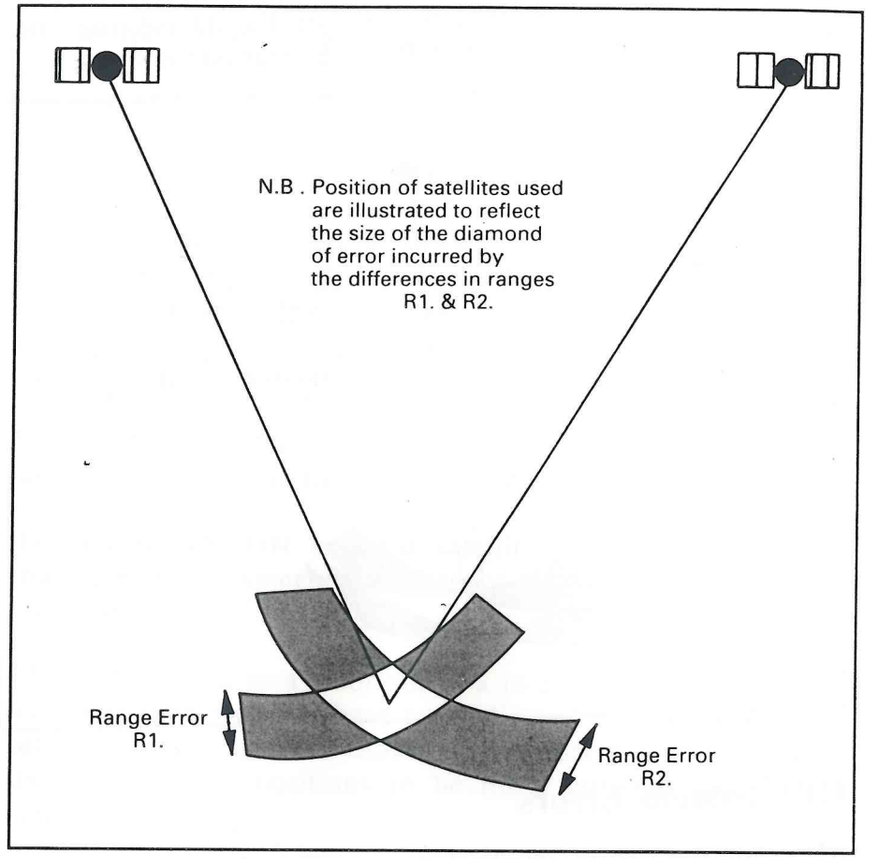
If the range measurement is considered it will be realised that this depends on measuring the time of propagation from the satellite to the navigator. This must assume that the receiving clock is synchronised with the satellite clock. The reality is that errors in range will be incurred by delays when transmission passes through the troposphere and the ionosphere and the result is known as a pseudo-range. (False Range)

The mariners GPS receiver will provide accuracy of approximately 100 metres by engaging the pseudo-range for three satellites and the corrected receiver clock errors.

The accuracy of the GPS fix equates to a multiple of the error in the range measurement and the HDOP. Many GPS receivers have pre-set limits which exclude satellites having large HDOP values. Clearly the smaller the value of the HDOP the better the accuracy of the fix.

NB. Some manufacturers allow the navigator to input designated limits of HDOP and will display status of each satellite.

THE GPS POSITION FIX
THE HORIZONTAL DILUTION OF PRECISION



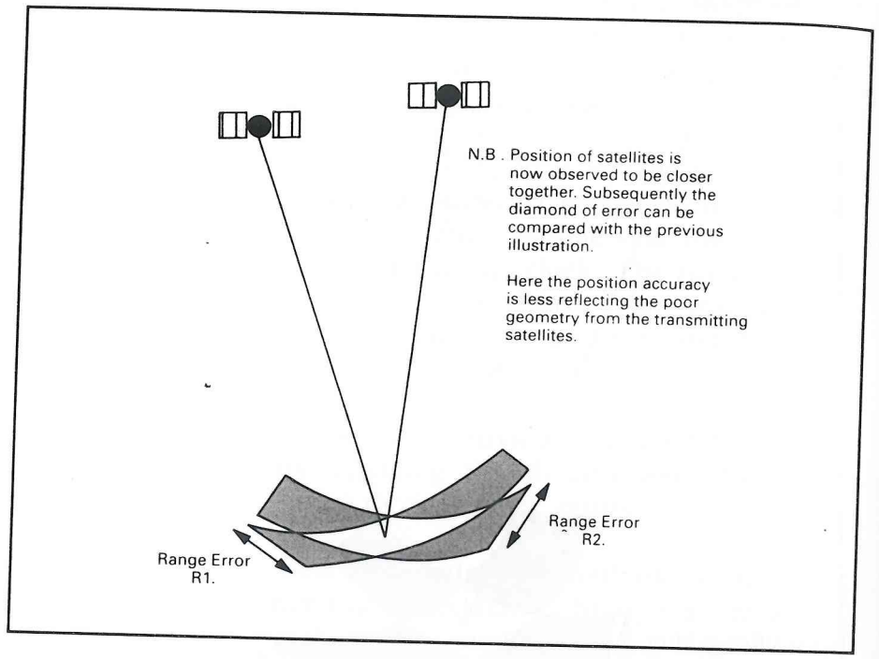
The accuracy of any positional fix will be dependent on the type of errors incurred. Range measurements are based on not only the satellite clock which is monitored by the control segment of the system, but also on the assumption that the position of the transmitting satellite is itself in the correct position.

Fluctuations in the satellite clock and the satellite position can produce an overall error of upto 20 metres approx., inclusive of refractive errors.

Improved accuracy is obtainable when the satellites are near to right angles to one another.

Measurement Accuracy

Practically, the positional accuracy will depend on the positions of the satellites being used because of the intersecting angles of the position lines (Ranges) from the transmitters.



GPS System Errors

Although the errors involved are small and quoted accuracy of 100 metres is the anticipated norm, in practice accuracy of under 65 metres is not unusual. The main errors are known as:

Satellite Clock Error

Each satellite is equipped with a highly accurate atomic clock with a known or predictable variation from GPS time. These satellites are monitored from a ground support and although may deviate approximately to a mili-second over a seven day period they can be corrected. However, the time error could induce range errors which are difficult to decipher from the satellites small orbital altitude changes that could occur. The resulting error should not normally exceed +/− 2 metres.

Multi-path Error

This error is one which is caused by reception of data from the Space Vehicle (SV) from more than one source. An example of this may be observed from a reflecting surface close to the antenna. This is a variable error because the siting of each receiver and aerial unit is local to a specific vessel. Incurred error values would not be expected to be above 5 metres.

Chart Datum Error

The GPS system is based on a chart datum which is a derivative of the World Geodetic System 1984 (WGS 84). British Admiralty Charts, European Charts and other areas of the world generally employ a local datum. Consequently navigators must apply a correction to GPS fixes before transferring to the chart.

New Charts and New Editions published since 1981 carry a notation usually near the title, when applicable to the fact:

the amount of shift between satellite derived positions and chart positions. Namely a difference to be added to Latitude Longitude.

Clearly this could be a laborious task to a navigator on the coast and most GPS receivers have a selection of datums available to suit the charted area. A choice of the respective datum allows the correction to positions to be made automatically by the receiver.

NB. Electronic chart systems may be set to one datum when the operator could well be switching to another chart with another datum. Care is needed to maintain plotting accuracy.

Refraction Errors

These are variable and are incurred as the signals from the satellites pass through the ionosphere and the troposphere. The user would not expect accuracy to be impaired by more than 20 metres from refractive errors.

Mariners have always been trained with safety as the priority and with sophisticated instruments it would be all too easy to become complacent. Manufacturers of GPS systems warn that

adverse weather conditions could effect overall performance specifically:— heavy rain, snow and thunder storms.

It is also worth noting that a well known, world wide shipping company retains an active policy of insisting all Deck Officers take weekly sights. There was an occasion when a junior Third Mate placed the ships position 200 miles away from the GPS position. After receiving the ridicule from his more senior colleagues it was found that the GPS was suffering a malfunction. Much to the relief of the junior third mate.

It should be remembered that all instruments suffer from a delay factor which may be great or less so, depending on the data being acquired. The mariners eyes do not have the same problem and visual fixing together with an effective lookout can often be healthily reassuring.

Differential GPS

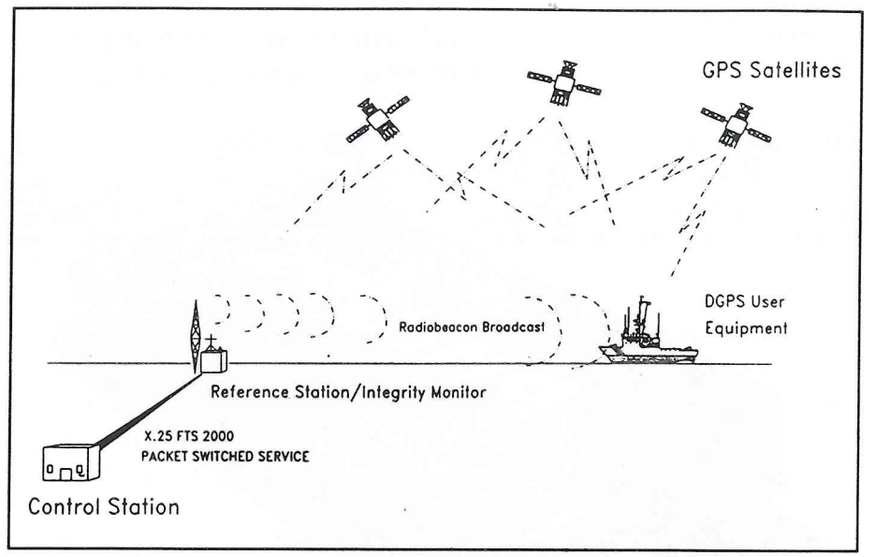
At the time of publication the DGPS system is the most accurate of navigation systems available to commercial users. By overcoming the effects of "Selective Availability" (S/A) and the other errors incurred in GPS systems positional accuracy of approximately five (5) metres can be achieved.

Principle of Operation

DGPS cannot operate without the current GPS signal. A stationary GPS receiver is positioned precisely in a known position to measure the difference between the true position and that position ascertained by the stationary receiver. The difference between the two positions (the error) is then transmitted by radio to the mobile DGPS receivers.

The DGPS user will use this differential error information on the GPS system to correct for positional accuracy.

DGPS ELEMENTS



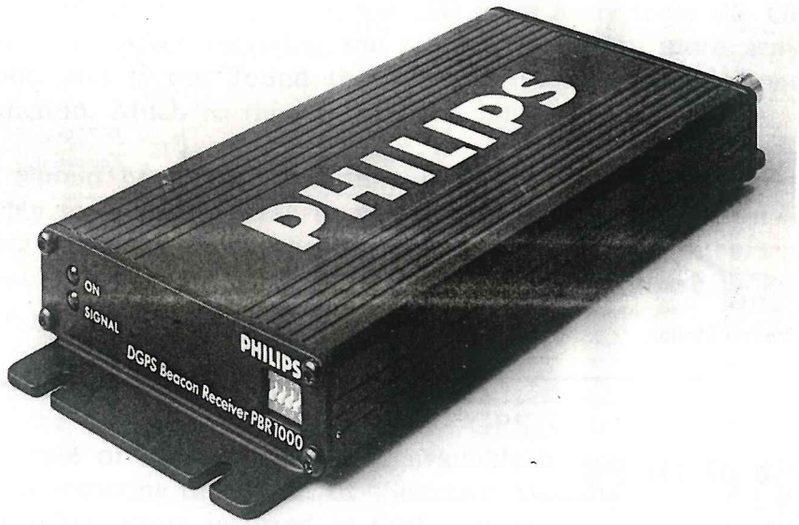
Use of DGPS

Although the coverage areas of DGPS are at the present time limited, many additional radio transmitting beacons are planned for the future. Expansion areas include Europe and the Mediterranean, Alaska, the Great Lakes, Caribbean, New Zealand, Australia & Hawaii. Extensive coverage already exists around Scandinavia, the Baltic Sea, Iceland and the United Kingdom, as well as Canada & USA, although the UK operates a pay/charge system.

Additional receiver equipment is required by the user in order to collect the navigational signals from all the satellites in view, plus the differential corrections from the DGPS station in the area. Existing GPS equipment can be upgraded to include reception of DGPS signals, and most manufacturers have an add an unit to allow for this. The latest GPS receivers are inclusive of DGPS capability.

The DGPS system is essentially two receivers tuned to process information not only from the GPS satellites but also from a

fixed land based station. As the position of the land base is known, any error in fixing position can be quantified and transmitted to user operators. Clearly any standard GPS errors can be eliminated to provide enhanced accuracy of plus/minus 5m.



DGPS Beacon Receiver PBR 1000.

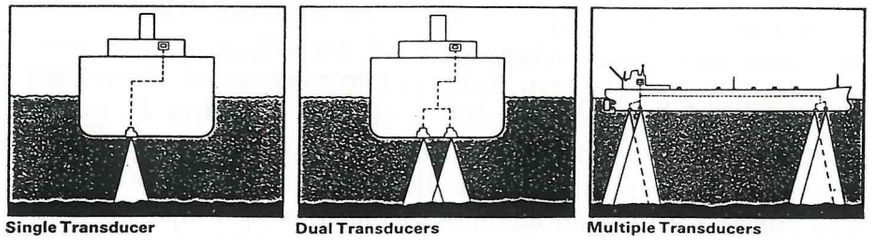
Use of the Echo Sounder

The echo sounder is probably the most re-assuring of all navigation instruments. It provides the Master with virtually continuous indication of the vessels underkeel clearance. Echo sounders are generally designed to operate and record depths assuming a velocity of sound in water of 1500 metres per second.

NB. The velocity of sound in water in actual fact can vary from approximately 1445 to 1535 metres per second and may be influenced at the same place by temperature and salinity at any one time.

However, this should not effect the accuracy of the instrument by more than 5% away from the true values.

TRANSDUCER POSITIONING



Echo sounding equipment must comply with the IMO performance standards and the specifications issued by the Marine Safety Agency. Transducers should be situated clear of hull projections and openings in order to provide satisfactory performance.

Some larger, high tonnage vessels may be fitted with multiple transducers and the position of these should be known. This is especially important when navigating in areas of limited depth when heel or trim could directly influence the measured depth under the keel.

Echo sounder graphic display is normally sited on the bridge but the modern concept is to interface depth recorders into an integrated navigation display unit providing digital read out as well as a graphical print out.

Echo Sounding — Principle of Operation

The echo sounding principle operates on the basis of measuring pulses of sound energy transmitted from the bottom of the vessel, and reflected back upwards from the sea bed. The depth under the vessel is a proportional measurement of the time interval from the moment of transmission to reception.

Assume the velocity of sound in water is = 1500 metre/second.

Let the time interval between transmission and reception = t seconds.

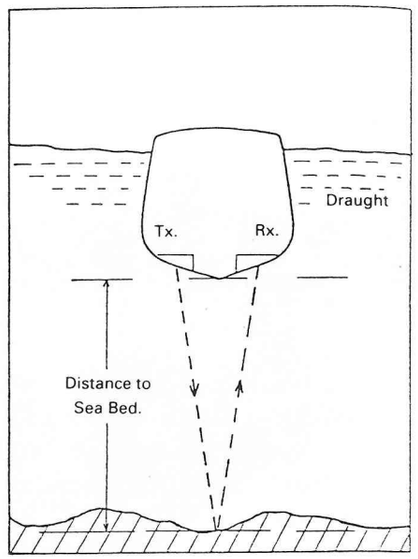
Let the distance to the sea bed and back be represented by 2s metres. but: —

$$\text{distance} = \text{Speed} \times \text{Time}$$

$$2s = 1500 \times t$$

$$s = \frac{1500\ t}{2}$$

where s represents the depth of water under the transmitter.



Operational Accuracy

It is essential that the navigator ensures that the pen arm is referenced at the zero mark of the scale intended for use. If this is not correctly set, then an additional error known as 'Transmission Line Error' could be incurred.

The actual calculation of depth is based on the propagation of sound through water as being 1500 metres per sec. However, this value will vary around the world due to salinity, temperature values and pressure changes. The mariner is reminded that the 1500 m/sec is an international standard and provides an acceptable degree of accuracy for most commercial shipping requirements. Where it may become necessary to apply a correction then Admiralty Tables (NP 139) can supply fine corrections.

Should a vessel be fitted with separate Tx/Rx Transducers mariners should note that a pythagorean error could effect the observed depth. This would be more accentuated in shallow waters where the slant distance is measured, not the vertical distance under the keel.
When operating in greater depths the pythagorean error is minimal and can usually be ignored.

Echo Sounder — Operational Details

The installation of an echo sounder, must comply with the performance standards set by IMO and the performance specifications of the Marine Safety Agency. Equipment would be such as to be capable of operation over at least two separate ranges in order to provide a measurement from 2 metres to 400 metres. Operational frequencies vary but normally function well between 30–50 kHz. Audible noise from the ship itself is generally below 30 kHz and so minimal interference occurs with the sounders efficiency.

Effects of Squat

Most vessels record the actual depth of water under the transducer. If a vessel is known to experience squat (possibly in excess of 2.0 metres) the recorded depth will still reflect the depth under the transducer, irrespective of the value of squat.

Clearly, deep draughted vessels or those concerned with underkeel clearance may require actual depths fore and aft and as such should consider the fitting of additional transducers to indicate the depth being encountered from stem to stern.

Chart Comparison — Indicated Depth

Mariners are reminded that most sounders provide the depth under the transducer, not the actual charted depth. Before making a comparison with the chart account should be taken of the ships draft and any height of tide at the the time of sounding.

The siting of the transducer could also be relevant. A fixed correction may be applicable if the transducer was not situated at the lowest level of the keel. Similarly, an excessive trim in way of the transducer could also influence accuracy relating to overall underkeel clearance (UKC).

Echo Sounding — False Echoes

All echo sounding equipment is liable to incur false readings for one reason or another. Mariners can expect changing conditions to effect the values of obtained depths or even obtain double or multiple echoes.

False Bottom Echoes

A false reading may occur from a correctly adjusted sounder if a returning echo is received after the stylus has completed one or more revolutions and the next pulse is transmitted.

Sounding machines have a variety of scales, and if say one revolution of the stylus corresponds to say 300 metres, an actual depth of say 40 metres could be recorded as '40', or '340' or even '640' metres.

Double Echoes

A double echo is caused by the transmitted pulse being reflected from the sea bottom and then being reflected a second time from the water surface, before being returned the second time from the sea bed into the receiver.

The second echo is never as strong as the first 'True' echo and it could be faded if the sensitivity control was to be reduced.

Multiple Echoes

Usually occur in depths greater than 100 metres. The transmitted pulse being reflected several times from the sea bed to either the sea surface or the ships hull. This may cause several echoes to be recorded and an adjustment of the sensitivity control could provide a more positive trace on the true depth.

Additional False Echoes: may be caused by the following,

a) Layers of water of differing densities cause different speeds of propagation of sound.
b) Submarine fresh water springs.
c) Shoals of fish.
d) Kelp or seaweed.
e) Electrical faults or manufactured noise levels to high.
f) Turbulence in the water from cross currents or eddies.
g) The deep scattering layer set at about 300 to 450 metres below the surface. This layer tends to move closer to the surface at night and consists of plankton and fish.
h) Excessive aeration.

Measurement of Speed/Distance

Marine Speed Logs

A necessity for continuous ship monitoring has always required the navigator to be aware of his vessels speed, both through the water and effectively over the ground. Accurate navigation has also employed relevant distance over the ground or through a set period of time.

It is then little wonder that speed logs have entered the world of microprocessors and moved with the times. The seemingly romantic days of the 'dutchmans log', or the 'rotator log' have been surpassed with a vengence.

There are many manufactured examples available to the mariner, the majority of which carry all or most of the following: –

Clearly arranged transflective Liquid Crystal Display (LCD)

User friendly with simple calibration and coded set up procedures.

Storage facility for operational data, in the event of power failure.

Electromagnetic measuring principle providing a high level of sensitivity.

No moving parts in a sensing element, which can be easily replaced without dry docking.

Main and repeater display units with alternative; console, bulkhead or bracket mountings.

Resettable daily and voyage mileage counters.

Enhanced accuracy by programmable storage of water temperature and salinity values.

Digital and analogue speed output/display.

Integrated stop watch facility.

Built in test facility.

Highly accurate speed indication of vessels movement through the water, even at low speeds.

Microprocessor technology providing exceptional reliability.

Compatible for ARPA requirements and meeting IMO and MSA resolutions.

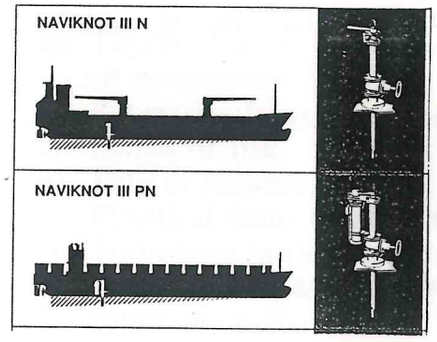
Speed Logs

Many examples of speed logs are multifunctional by way of providing not only speed but distance parameters. Depth alarms may also be an incorporated feature. Most manufacturers have risen to the neèds of the end user and designed specific logs for particular types of vessels, namely: –

All types of vessels employed in deep water (Speed range from −5 to +25 knots) – Blade sensor.

High Speed vessels e.g. Hydrofoils. (Speed range from −5 to +80 knots) – Flush sensor.

Shallow water operators (Speed range from −5 to 35 knots) – Flush sensor.



Commercial vessels fitted with 'Blade Sensors'.
Usually engaged in deep water type IIIN, manually deployed, type IIIPN pneumatically deployed.

Display units are positioned on the bridge with any control unit.

Sensor position to suit most convenience.

Radio Direction Finders (DF)

Introduction

All British merchant vessels of 1600 grt are required to be equipped with a Radio Direction Finder. The installation has two main uses:

a) for obtaining Radio Bearings of marine and selected aero beacons and,
b) for taking Radio Bearings of vessels in distress.

The distinct advantage of the system is that it is unaffected by restricted visibility conditions and may be employed when the observing station is out of sight of the transmitting station or casualty.

Principle of Operation

The early direction finders operated on the basis of radio waves being transmitted from a shore station. The lines of force committed from the transmitting aerial were then received by a rotable loop aerial established on the vessel.

It is widely accepted that when magnetic lines of force pass through a coil, a voltage will be induced. This principle is directly used by the insertion of windings into the loop aerial, effectively turning the aerial into a large coil.

As the transmitted lines of force increase and decrease an alternating voltage is established in the coil. The actual voltage in the loop will then be greatest when the loop aerial is turned towards the transmitter. Clearly the directional aerial could be related to the vessels compass in order to provide the required bearing of the transmitter.

Reference to: Admiralty List of Radio Signals.

Marine radio beacons and sample aero beacons can be identified by the navigator on inspection of Volume 2 of the Admiralty List of Radio Signals, respective to the area of operation.

Information available in the list regarding radio beacons would include such items as: Call sign, range, operational frequency, transmission schedules and position of station.

Operational Errors: Experienced with Direction Finders

Coast Effect

Radio Beacons are nearly always located in coastal regions and subsequently electromagnetic waves are influenced as they pass over land masses and then over the sea surface. (or vice versa) This apparent refraction causes: –

a) a small error when the bearing is being taken from the ship and
b) a much larger error when the bearing is being taken from a shore side station.

Night Effect

During the period of daylight the ionosphere is ionized by sunlight. However at night the ionized layers are reduced and sky wave may interfere with ground wave transmission over relatively short ranges.

Although the ground wave will generally not be effected, the sky wave, after reflection, could well cause an incorrect bearing to be obtained by the receiving aerial. The sky wave cutting the loop aerial causing polarization to change and an E.M.F. will be noted.

The observer should be alert for the symptoms of night effect which can render bearings unreliable:

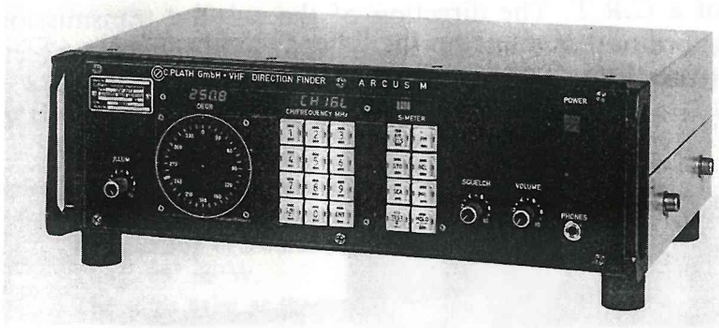
(a) a slurred zero by a constantly changing sky wave.
(Geographic area may contain mountain ranges or steep coastlines between transmission and reception stations)

(b) cross bearings of different beacons are producing a 'cocked hat'.

(c) signal 'fading' may be experienced.

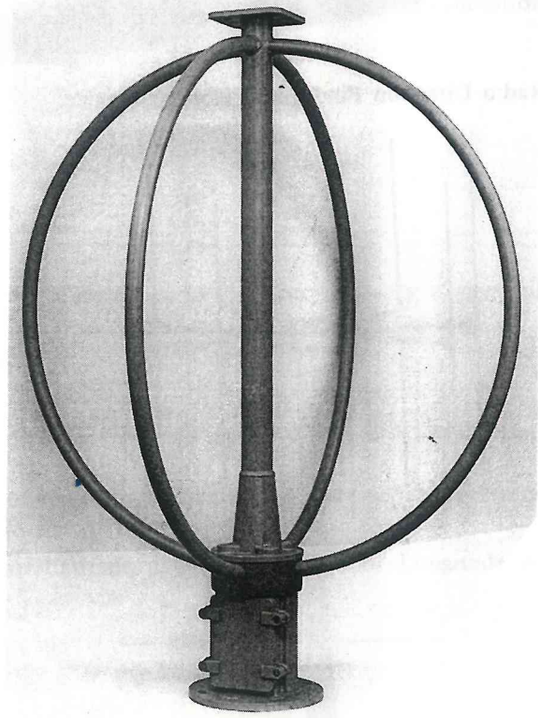
Night effect may last some time and where it becomes necessary to take radio bearings navigators are advised to take numerous bearings over a short period, with the view to averaging. In any event where night effect is established any result must be treated as being less than reliable.

DIRECTION FINDER EQUIPMENT



VHF Marine Radio Direction Finder Unit.
Manufactured by C. Plath GmbH

DIRECTION FINDER – AERIAL EQUIPMENT

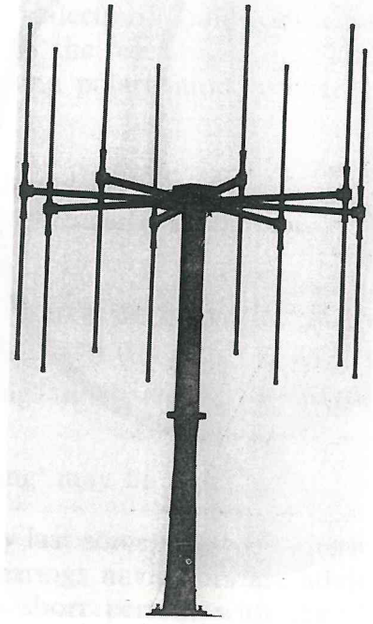


Crossed Loop Bellini-Tosi type aerial, with integrated sense antenna. Operation 100 kHz and 4 MHz.

Visual Cathode Ray Tube (CRT) Display of D.F.

The loops of a Bellini Tosi aerial are connected to the deflector plates of a C.R.T. The direction of the original transmission is then reproduced as a line on the tubes face towards the direction of the trasmitting station.

Radio Direction Finder and Homing Device.



Typical VHF — DF antenna operation 20 — 180 MHz.

Correction of Radio (Great Circle) Bearing to Mercatorial Bearing

NB. The navigator will require to lay the obtained DF bearings onto a Mercator Chart and will subsequently be required to apply the half convergency correction.

Example: A vessel in an Estimated Position of Lat. 50° 30′N Long. 30° 00′W observes a Radio Bearing of 130° from transmitting beacon in position Lat. 55° 20′N Long. 05° 50′W. The ships head at the time of taking the bearing is 310°. Find the correct Mercatorial Bearing to lay off on the chart.

Bearing Observed	130°	Relative.
Quadrantal Correction	$3\frac{1}{4}°$	(obtained from calibration curve)
Corrected Radio Brg.	$126\frac{3}{4}°$	Relative
Ships Head	310°	True
	$436\frac{3}{4}°$	
	360°	
G.C Bearing	$76\frac{3}{4}°$	
Half convergency Corr'n	$+9\frac{3}{4}°$	(Correction is always allowed towards the equator)
Mercatorial Bearing	$086\frac{1}{2}°$	True.

Bearings on the chart must always be laid off FROM the radio station.

NB. Half Convergency Correction is obtained by reference to Nautical Tables, e.g. Norries or Burtons.

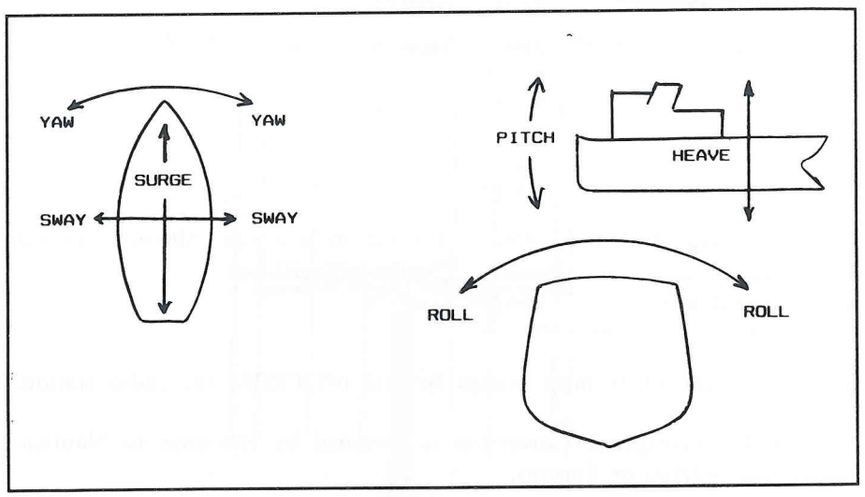
Table of Mean Latitude against Difference of Longitude of the ship and radio station.

Dynamic Positioning (DP)

Dynamic Positioning is an entire system necessary to enable a vessel to automatically hold station and heading, without resorting to the use of anchors or moorings. The types of vessels so equipped are usually specialised craft like: –

Diving Support Vessels (DSV), Supply Vessels for the Offshore Industry, Cable Laying or Survey Ships and heavy Lift Vessels. Other examples can be found amongst Drilling Ships, Fire-fighting Vessels, Dredgers, Offshore Loading Tankers, Flotel Accommodation Units, and Semi Submersibles.

In order for DP to be effective the vessel will be equipped with thrust units capable of producing transverse thrust and/or azimuth thrusters which can provide thrust in any direction. In simplified form, these thrust units are brought into operation to control the six freedoms of movement of the vessel.



Control is achieved 'automatically' but the DP system will incorporate a manual "Joystick" controller. Combined use of both Automatic and manual functions can be employed to suit the needs of the vessel.

Example: Auto control of the vessels surge movement combined with manual control of Yaw and Sway.

Station Holding with a DP system can be achieved by several methods of Position Reference Techniques. However, probably the most widely used are: –

(i) Taut Wire Position Reference System.
(ii) Hydroacoustic Position Reference System.
(iii) Artemis Microwave Position Reference System.

(i) Taut Wire (PRS)

In this system a weight of approximately 0.5 tonne is lowered to the sea bed on an extended ships boom. The wire is turned to a constant tension winch set to about 0.25 tonne tension.

The length of the wire paid out, together with the angle to the vertical in both the longitudinal and the transverse planes is monitored by sensors at the lead sheave and winch. The position of the vessel being defined from the data being relayed back from the sensors into the D.P. System.

(ii) Hydroacoustic (PRS)

This system employs a transducer on the bottom of the ship and transponders which are positioned on the sea bed. The vessel transmits acoustic signals towards the transponders. The received signal is re-transmitted back to the ship (Similar to echo sounding), the range and direction from the transponder can then be determined.

The ships position, being defined in relation to the transponder, is relayed into the D.P. system.

(iii) Artemis Microwave (PRS)

With this system a radio link is established between two transceivers. One being mounted in a fixed position usually on an installation, while the other is mounted as a mobile on the vessel.

A microwave link joins the two via antennae and the signal passing between the two can be interpreted to provide range and bearing which can then be passed to the D.P. system.

Principles of Dynamic Positioning

On Board Units

D.P. Console situated on the Bridge.

Computer Bank – May be duplicated in certain vessel types

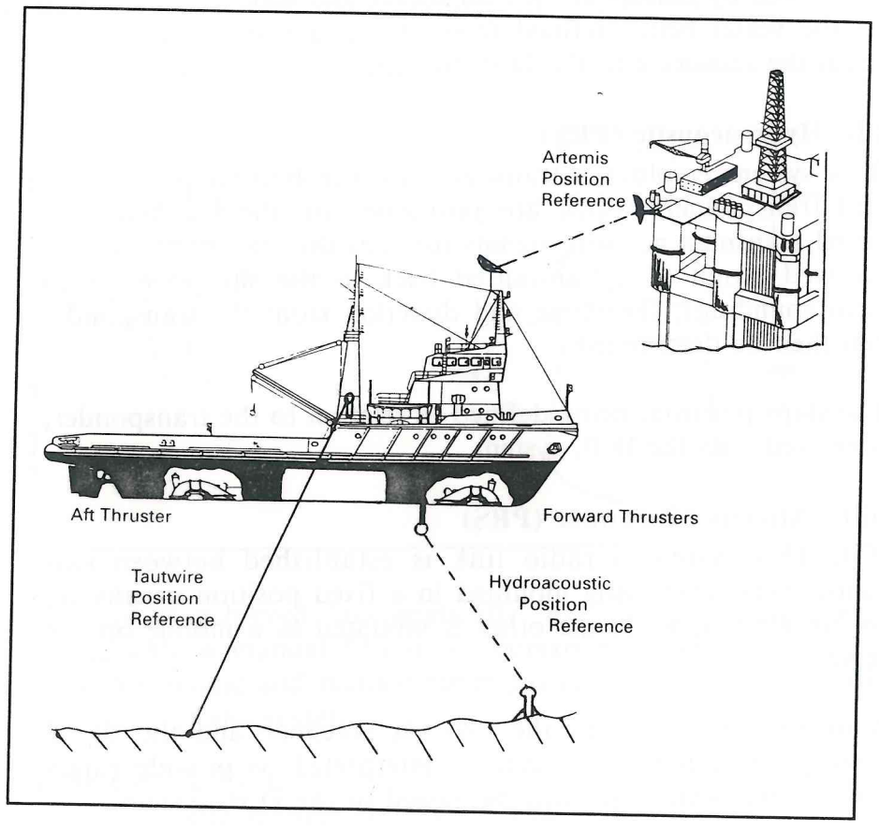
Off station sensors and alarm systems

Gyroscopic compass.

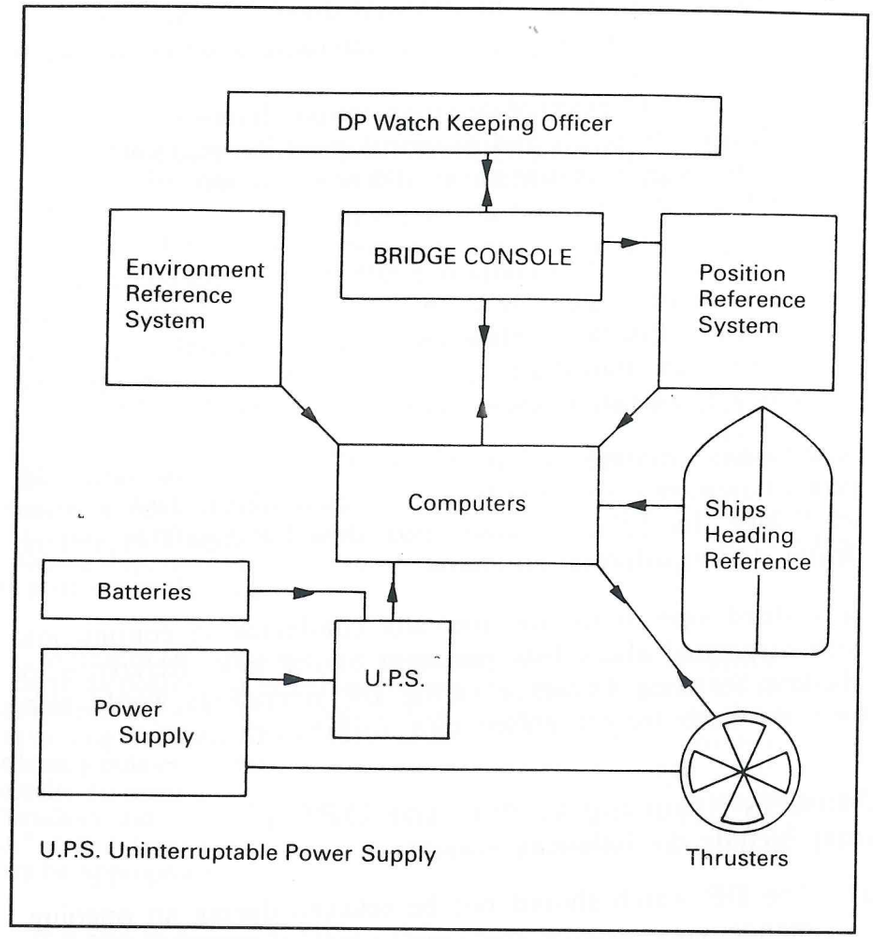
Power Supply – Usually Diesel-Electric or direct drive diesel. Plus the D.P. systems own Uninterruptible Power Supply.

Vertical Reference Sensors. (Monitoring of Roll and Pitch)

A D.P. Operator would also provide a manual overide in the event of a 'drift off' or a 'drift on' situation occuring.



DYNAMIC POSITIONING – OPERATIONAL ELEMENTS



Dynamic Positioning – Watchkeeping Duties

The watch officers duties aboard a DP vessel will vary considerably depending on the function and operation of the vessel. For example the needs of the diving support vessel (DSV) would differ to the needs of a platform supply vessel.

A general requirement for DP watchkeeping is for two officers to be on the bridge. One being a designated DPO, while the other would tend to all other watch keeping duties. When accepting the watch the DPO would ascertain the relevant status of:

1) The vessels position.
2) Work in progress – by external divers, diving bell, ROV.
3) Operational data on position reference systems in use, or on stand-by.
4) Internal and external communication channels.
5) Weather forecasts and meteorological information.
6) Power supply management and alarm system.
7) DP performance and alarm parameters.

It is usual practice to maintain a DP status 'chalkboard' which provides details regarding active generators, thruster status, and indicates Position Reference elements engaged. It provides at a glance an immediate appraisal of the DP operation and remains a powerful, visual overview for the DPO.

Additional documentation, by way of log books and DP performance records would also be maintained. DSV's often work with "footprint" diagrams providing DP capability and/or diving station information charts.

Specialised operations are normally conducted in conjunction with associated check lists pertinent to the task. Reference to Masters Standing Orders covering DP operations would also form the basis for recognised safe working practice.

Masters Standing Orders for DPO's
(may include the following examples)

a) The DP watch should not be relieved during an ongoing manoeuvre.
b) Minimum 3 Position References (PR) must be employed when engaged in diving operations.
c) Minimum 2 PR's employed when navigating under 100 metres to a surface construction.
d) Respective check lists to be completed before commencing operations. e.g. Diving.
e) Vessel to be established and steady for 30 minutes prior to commencing activity.
f) Capability graph and all alarm systems checked and set.
g) Escape/contingency plan to be established prior to station holding.
h) Call Master at any time if concerned or in doubt.

DEPARTMENT OF TRANSPORT MERCHANT SHIPPING NOTICE No. **M.1221**

DYNAMICALLY POSITIONED VESSELS AND THE DANGERS TO DIVERS OPERATING FROM SUCH VESSELS

Notice to Shipowners, Masters and Officers of Merchant Ships and Fishing Vessels

This Notice supersedes Notice No. M.895

1. The attention of mariners is drawn to the special limitations imposed on Dynamically Positioned Vessels by the nature of their work and the need for them to operate in sea conditions as favourable as possible. Further, these vessels when operating in the diving support mode are required to hold position most accurately often very close to the legs of platforms. In the event of movement of the vessel, which may be due, for example, to the wash of a passing ship, risk of serious injury to the divers and/or damage to the vessel or platform could occur.

2. In view of these considerations, mariners are requested to give as wide a berth as possible to vessels displaying the signals required by Rule 27 paragraphs (b) and (d) as applicable of the International Regulations for Preventing Collisions at Sea 1972, as amended. If they are unable to pass at least ½ mile-clear, they should reduce speed when navigating near such vessels. To assist in identification Dynamically Positioned Diving Support Vessels should, when engaged in diving operations, also use the single letter "A" of the International Code of Signals using any method of signalling which may be appropriate.

3. It is also recommended that a Dynamically Positioned Vessel should, before commencing diving operations, ascertain that no other vessel is operating in its immediate vicinity. The vessel should also broadcast on the appropriate frequencies a navigation warning to all ships indicating the nature of its operation and such broadcast should be repeated at intervals whilst the operation is in progress. Additionally the vessel should ensure that the broadcasts are acknowledged by the appropriate coastal radio station who will rebroadcast them in their routine schedules.

4. Attention is also drawn to the provisions of Rule 36 of the Regulations referred to in paragraph 2 above which enables a vessel to make signals to attract the attention of another vessel to alert her to a danger which may exist.

DEPARTMENT OF TRANSPORT MERCHANT SHIPPING NOTICE No. **M.1292**

TRAINING AND QUALIFICATIONS OF MASTERS AND OFFICERS OF VESSELS CONTROLLED BY DYNAMIC POSITIONING (DP) SYSTEMS

Notice to Owners, Operators, Masters and Officers of DP Vessels

1. The Department of Energy has published a Report on Dynamic Positioning System Incidents which have occurred during the period 1980 to 1986. In over half of the 76 incidents which were investigated operator error is given as the main or secondary cause.

2. Incidents due to operator error arise, for the most part, from deficiencies in training. The Nautical Institute has devised a voluntary training programme for DP operators to remedy this deficiency. This programme comprises:

1. A four day induction course using a DP simulator;
2. A period of 30 days at sea following a familiarisation programme designed to provide practical experience in using DP systems, their sensors and power units;
3. An intensive four day simulator course involving visiting lecturers and some very demanding exercises;
4. Six months supervised shipboard service.

On satisfactory completion of this training programme a DP Operator's Certificate is issued by the Nautical Institute. Officers with more than 12 months DP watchkeeping experience can, for two years after the date of issue of this Notice, undertake a special two-day advanced simulator course in emergency procedures to qualify for a certificate.

3. The Department recommends the Nautical Institute training programme to masters and officers of DP vessels as the appropriate way of obtaining a recognisable qualification to equip them for safe operations. Further information can be obtained from:

The Registrar
The Nautical Institute
202 Lambeth Road
LONDON SE1 7LQ.

Communications — NAVTEX

With the GMDSS requirements pending the majority of Merchant Vessels will be required to have a NAVTEX receiver and printer. The international service is expected to be developed world wide for promulgation of navigation, meteorological, and safety messages.

The dedicated equipment operates on 518 kHz and has an integral role within the GMDSS and the World Wide Navigation Warning System (WWNWS). Areas of operation are established by the position of transmitters but the expected range of reception is expected to be within 200 nautical miles.

Message priority is listed as being:

(i) Vital
(ii) Important
(iii) Routine

Certain messages may be rejected by the ship when they are not applicable. e.g. Omega messages for a vessel not fitted with an Omega receiver. However, some messages cannot be rejected on the grounds of safety, namely: —

Navigational Warnings, Meteorological Warnings and Search and Rescue messages.

Categories of messages are as follows:

A. Coastal Navigation Warnings.
B. Metorological Warnings.
C. Ice Reports.
D. Search and Rescue Alerts.
E. Metorological Forecasts.
F. Pilot Message.
G. Decca Message.
H. Loran-C, Message.
I. Omega Message.
J. Differential Omega Message.
K. Other electronic navigational aid — system message.
L. Navarea warnings -inclusive of rig listings.
M — Y. No category has yet been allocated.
Z. No message on hand.

Navtex receivers can be either desk mounted or bulkhead mounted and must be fitted with a self testing ability. A Navtex hand-book is issued with the equipment for use by the operator.

The user may select to receive messages from a single transmitter appropriate to the vessels area or from several transmitters when the geographic position allows. The power of transmitters being such as to avoid undue interference from each other. However, it is normal practice to programme the receiver to print out messages from the nearest transmitter to the ships position.

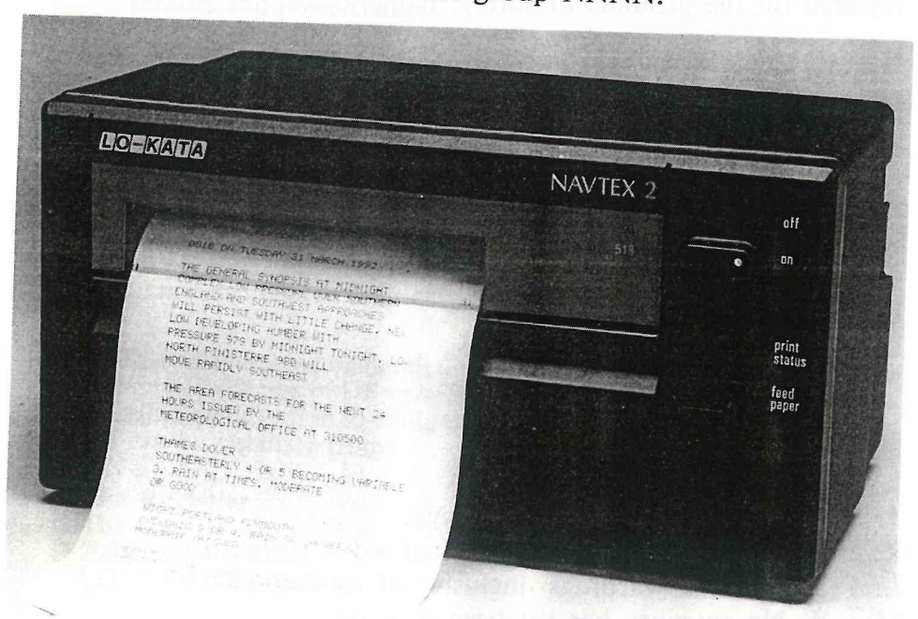
Message Format

Each message will commence with a 'header code' followed by four characters to indicate: –

The origin, the type and the number of the message.
(Message numbers run from 01 to 99, and then repeated)

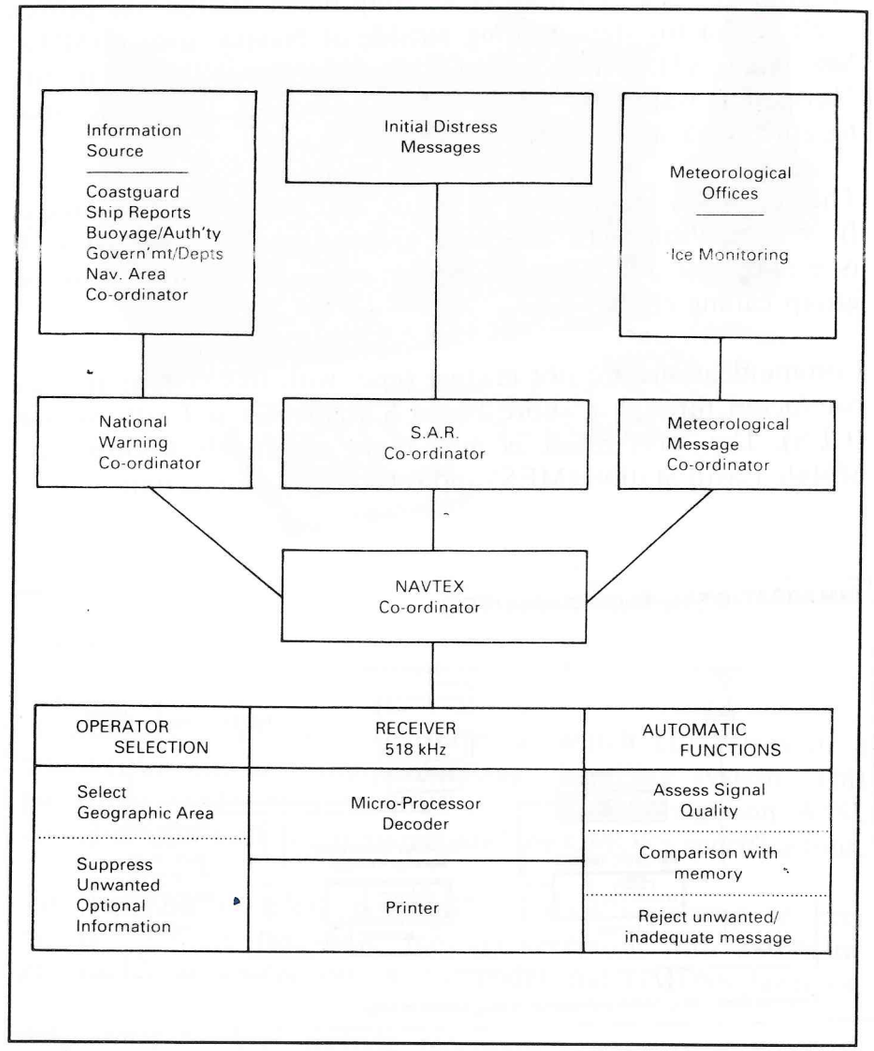
Certain messages are dated and timed after the header code. e.g. Weather transmissions.

All messages conclude with the group NNNN.



NAVTEX Reader.

NAVTEX OPERATION

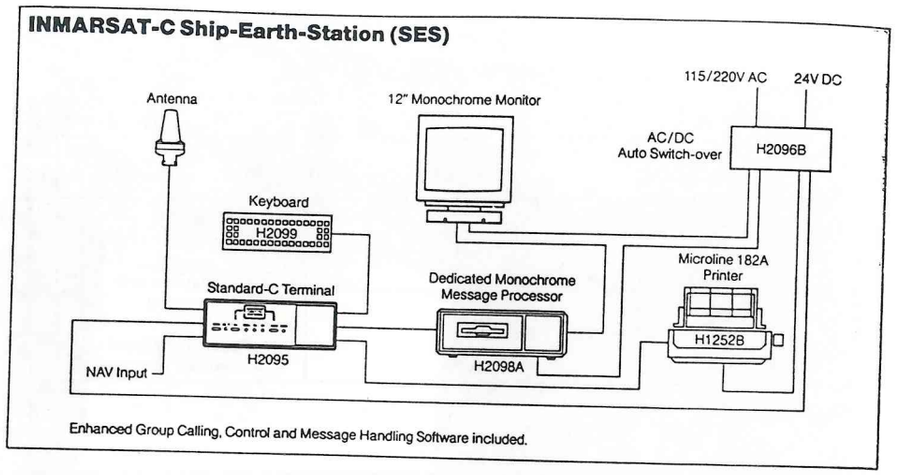


Communications Provision

With the development of GMDSS and its implementation by 1999 the need for automated mobile Transmit and receiving stations aboard merchant vessels has become a necessary requirement. The INMARST C, Ship-Earth Station has proved itself useful for ships trading outside of Navtex areas (GMDSS Sea Area A3). The equipment has the capability to receive Navigation warnings, Weather Data, Distress Communications together with urgency and safety information.

The facility is inclusive of a "Store and Forward" Telex relay. It is compatible with on board instrumentation, e.g. GPS. It is economical and easy to operate and can provide enhanced group calling (EGC).

Communications are not in 'real time' with this system and are conducted through a shore based Satellite Coast Earth Station (CES). The term S.E.S. is now more commonly known as a Mobile Earth Station (MES) and refers to all mobile units.



Communication terminal — transceiver and Computer/Message handling system.

GMDSS — Communications Equipment Example

Communications terminal-transceiver and Computer/Message Handling system.

A compact communication terminal which comprises of a transceiver and a computer/message handling system. This particular model manufactured by 'Philips Navigation A/S', complies with both the Inmarsat and the GMDSS specifications.

The unit offers telex, position and data reporting service, mobile to shore fax, EGC message reception with automatic geographic area selection, Access codes and GMDSS facilities.

Additional features include reception storage of 128 Kbyte together with a dedicated distress button, which is well protected against inadvertent use. GPS and printer interface.

FIXED INSTALLATION – VHF RADIO TELEPHONE

Husun 55

A VHF radio manufactured by 'Kelvin Hughes' which provides full coverage of all international channels allocated for Port Operations, intership and ship to shore communication.
Dual watch capability on channel 16, and provision for upto five private channels.

Husun 70

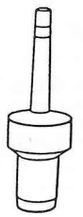
Full coverage of international channels, dual watch channel 16, and fitted with priority override. Handset operation and provision is made for remote loudspeaker.

EMERGENCY – ELECTRONIC AIDS

Survival Equipment

Handheld VHF to GMDSS Specification when equipment replaced
- Waterproof (IP57)
- Lithium Batteries stored in Lifeboat

Two for 300GT to 500GT
Three for 500GT or greater



EPIRB
SARSAT/COSPAS
406 MHz or L Band

Radar Transponder (9 gHz) SART)

One for 300GT to 500GT
Two for 500GT or greater

Solas Convention as amended 1991 requires every passenger vessel and on every cargo vessel over 500 tons gross to be equipped with at least three two-way radios, for use with survival craft.

Fixed installations may be an alternative if fitted into survival craft.

Regulation 7, of the SOLAS convention as amended in 1991. The requirement for vessels engaged in sea areas: A1, A2 & A3, are such that they must have the capability of transmitting a ship-to-shore distress alert by a 406 MHz EPIRB through the polar orbiting satellite (COSPAS-SARSAT)

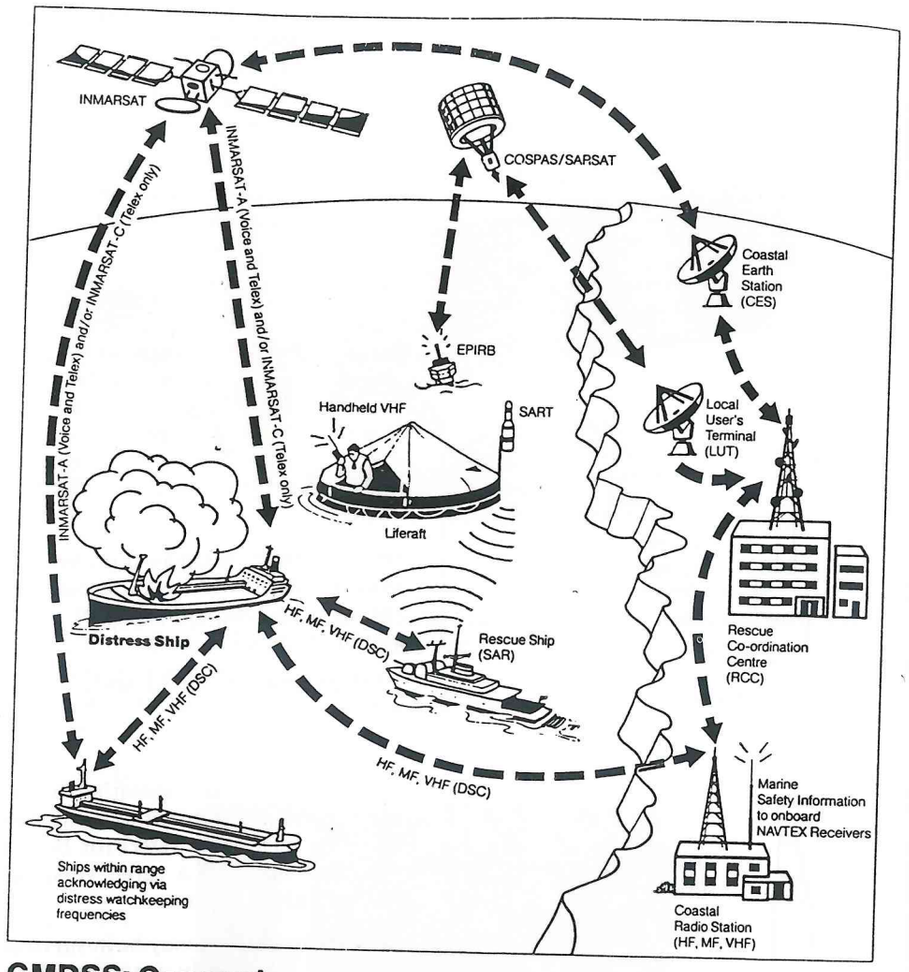
or if the vessel is engaged on voyages only within INMARSAT areas then through the INMARSAT geo-stationary satellite.

EPIRBS may be fitted with remote activation.

Radar transponders operating in the 9GHz band are required to be carried on either side of the vessel for both a passenger ship and a cargo vessel of 500 tons gross or more.

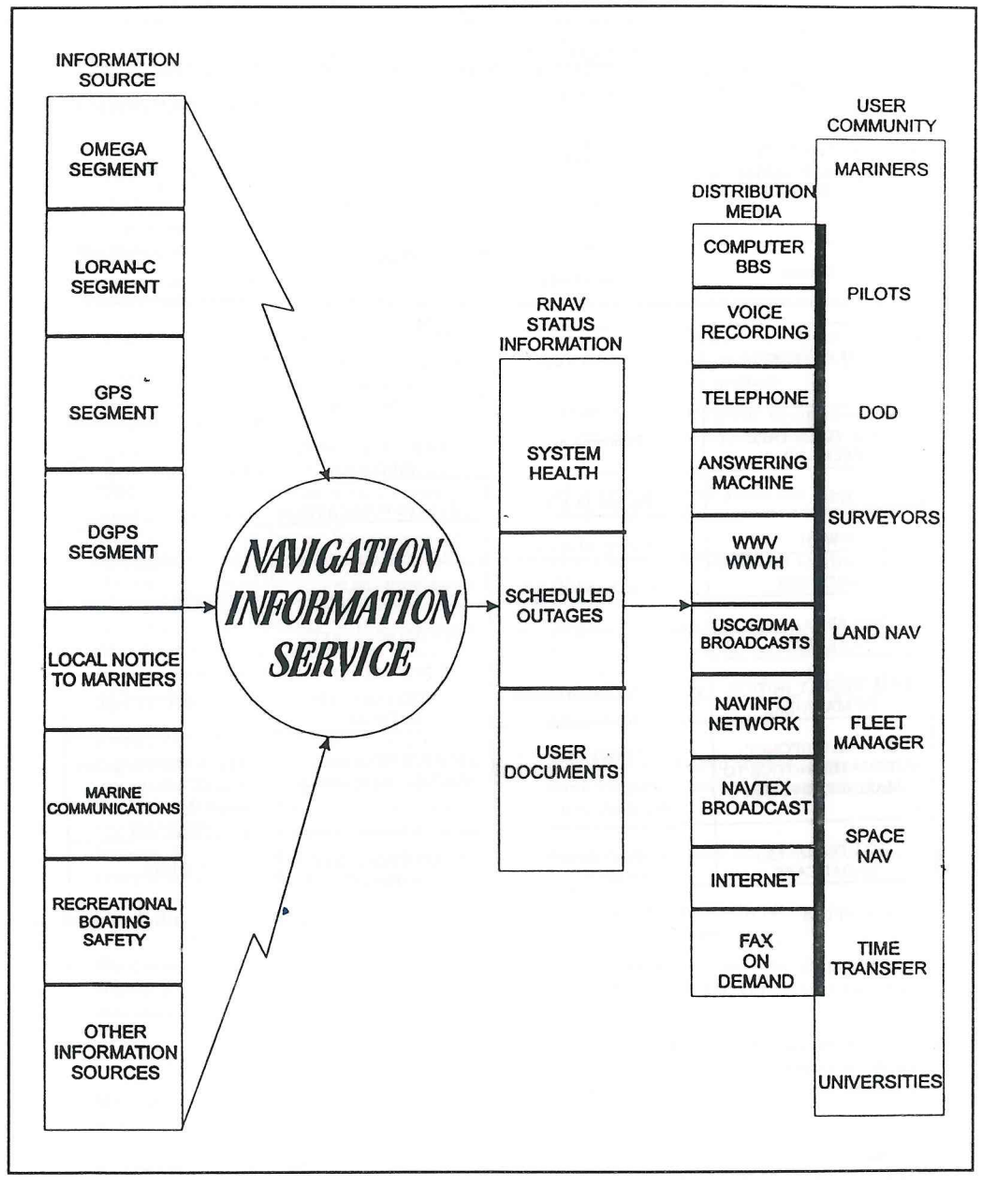
Alternative stowage may be in survival craft, or be readily transferred to survival craft.
(Exception the 6 man liferaft positioned forward or aft)

EMERGENCY COMMUNICATION LINK



GMDSS: Concept (Areas A1, A2, A3)

US COAST GUARD – NAVIGATION INFORMATION SERVICE (NIS) FOR USE BY THE CIVILIAN COMMUNITY WITH GPS/DGPS



THE NIS QUICK REFERENCE OAB DISTRIBUTION

The Navigation Information Service provides the Operational Advisory Broadcasts through the following services:

SERVICE	AVAILABILITY	INFO TYPE	CONTACT NUMBER
NIS WATCHSTANDER	24 hours a day	USER INQUIRES	PHONE (703)313-5900 FAX (703)-313-5920
NIS COMPUTER BULLETIN BOARD SERVICE	24 hours a day	STATUS FORE/HIST/OUTAGES NGS DATA OMEGA/FRPMISC INFO	BBS (703) 313-5910 (300-28800 bps) -or- SprintNet (X.25)31103501132800
Internet	24 hours a day	STATUS FORE/HIST/OUTAGES/ NGS DATA/OMEGA/FRP AND MISC INFO	http://www.navcen.uscg.mil gopher://gopher.navcen.uscg.mil
Fax on Demand	24 hours a day	STATUS FORE/HIST/OUTAGES/ NGS DATA/OMEGA/FRP AND MISC INFO	(703) 313-5931/5932
NIS VOICE TAPE RECORDING	24 hours a day	STATUS FORECASTS HISTORIC	(703) 313-5906 - OMEGA (703)-313-5907 - GPS
WWV	Minutes 14 & 15	STATUS FORECASTS	2.5 5 10 15and 20 MHz
WWVH	Minutes 43 & 44	STATUS FORECASTS	2.5 5 10 and 15 MHz
USCG MIB	When broadcasted	STATUS FORECASTS	VHF Radio marine band
DMA BROADCAST WARNINGS	When broadcasted Outages	STATUS FORECASTS	
DMA WEEKLY NOTICE TO MARINERS	Published & mailed weekly	STATUS FORECAST OUTAGES	(301) 227-3126
DMA NAVINFONET AUTOMATED NOTICE TO MARINERS SYSTEM	24 Hours a day	STATUS FORECASTS HISTORIC ALMANACS	(301) 227-3351 300 BAUD (301)227-5925 1200 BAUD (301) 227-4360 2400 BAUD
NAVTEX DATA BROADCAST	6 TIMES DAILY	STATUS FORECAST OUTAGES	518 KHZ

MSA
MARINE SAFETY AGENCY

MERCHANT SHIPPING NOTICE

No. M.1631

Operating, Maintaining and Testing Magnetic Compasses

Notice to Shipowners, Shiprepairers, Masters, Navigation Officers, Fishing Vessel Owners and Skippers, Compass Makers and Compass Adjusters

This Notice supersedes Notices M.1116 & M.1219

1. This Notice offers guidance on the operation, maintenance and testing of magnetic compasses.

Requirements for Compasses

2. Generally, requirements for compasses on seagoing ships (other than fishing vessels) are given in the **Merchant Shipping (Navigational Equipment) Regulations, 1993**, as amended. Ships to which the Regulations do not apply should meet the requirements as far as practicable. Further advice and information is available in the **Survey of Merchant Shipping Navigational Equipment Installations: Instructions for the Guidance of Surveyors.**

3. Requirements for fishing vessels with a registered length of 12 metres or more are given in the **Fishing Vessels (Safety Provisions) Rules 1975** and the **Instructions for the Guidance of Surveyors of Fishing Vessels.** Smaller fishing vessels should make every effort to meet the same requirements.

Responsibility for Maintenance

4. The Owner and the Master are responsible for ensuring that compasses on their ships are maintained in good working order.

When to Adjust Compasses

5. Magnetic compasses should be adjusted when:

   (a) they are first installed;

   (b) they become unreliable;

   (c) the ship undergoes structural repairs or alterations that could affect its permanent and induced magnetism;

   (d) electrical or magnetic equipment close to the compass is added, removed or altered; or,

   (e) a period of two years has elapsed since the last adjustment.

Effect of Changes in Magnetism During the Life of a Ship

6. Because the magnetism of a new ship can be particularly unstable, the performance of magnetic compasses should be monitored carefully during the early life of a ship, and adjustments made if necessary.

7. Masters are advised that it is essential to check the performance of magnetic compasses, particularly after:

   (a) carrying cargoes which have magnetic properties;

   (b) using electromagnetic lifting appliances to load or discharge;

   (c) a casualty in which the ship has been subject to severe contact or electrical charges; or,

   (d) the ship has been laid up or has been lying idle – even a short period of idleness can lead to serious deviations, especially for small vessels.

8. Further to 7(b), the retentive magnetism can alter a ship's magnetism, making compasses unreliable. However, a large amount of the

magnetism induced by an electromagnet may subsequently decay so immediate readjustment is not advised. Every effort should be made to determine the compass deviation.

Monitoring Compass Performance

9. Compass performance should be monitored by frequently recording deviations in a compass deviation book. This may show the need for repair, testing or adjustment. In addition, compasses should be inspected occasionally by a competent officer or compass adjuster.

Adjustments and Repairs

10. In the UK, all adjustments should be made by a compass adjuster who holds a Department of Transport **Certificate of Competency as Compass Adjuster.** If a qualified compass adjustor is unavailable and the Master considers it necessary then adjustments may be made by a person holding a Certificate of Competency (Deck Officer) Class 1 (Master Mariner).

11. The date of any adjustment and other details should be noted in the compass deviation book. The position of correctors should be recorded in the compass book and on deviation cards. Because the distances from the co-efficients B and C correctors to the standard compass card and to the transmitting element are different, a transmitting magnetic compass will be overcompensated resulting in an error, which can be as much as 2½ degrees and cannot be corrected. Separate deviation cards should be prepared for the standard compass and the transmitting magnetic compass repeater by comparing headings.

12. Repairs should only be made by a compass manufacturer or other competent person using proper test facilities. When the work is finished, the repairer should supply the Owner or Master with a certificate specifying that the work was done in accordance with the requirements of ISO 2269, which sets out international standards for magnetic compasses.

Portable Equipment that may interfere with Compasses

13. Masters and Officers are advised that portable electrical equipment (e.g. radios and tape recorders) or items made of steel can affect the performance of a compass. Care should be taken to ensure that such items are kept away from the compass position.

Spare Bowl

14. If a spare magnetic compass bowl is required, then it should be carefully stowed together with its gimbal units away from the bridge structure so that they are unaffected by any casualty disabling the bridge.

Transmitting Magnetic Compasses (TMC)

15. If a new or existing standard magnetic compass is modified to provide a transmission output then the device must be certified or re-certified with the transmitting element in place. Re-certification of modified existing compasses should be made, with the transmitting element attached to the compass bowl, by the **Defence Test and Evaluation Organisation, Compass Test Centre, Land Magnetic Facility, Portland Bill, Portland, Dorset DT5 2JT. (Formerly the Admiralty Compass Observatory.)**

16. Modifications should be made by an experienced compass technician, who should ensure that the transmitting element is compatible with the binnacle. The performance of the equipment cannot be relied upon until the compass has been re-certified (as described above) and adjustments have been made by a certified compass adjuster.

17. Ancillary equipment included in the modifications (e.g. electronic units, displays and power supplies) should be type-tested to establish safe distances from the compass. In particular, care should be taken to avoid the effect on the compass of spurious radio frequency transmissions. Guidance can be found in the IMO **Resolution A.694(17).**

18. If a transmitting magnetic compass provides heading information, i.e. it is read by the helmsman at the main steering position, then the spare bowl must be fitted with a transmitting element, and individual testing is required. Alternatively, if heading information is provided by the reflected image of a standard compass or by a separate steering compass, and a transmitting compass is fitted voluntarily to provide a repeater facility to navigation equipment, then the spare bowl does not require a separate transmitting element.

Marine Safety Agency
Spring Place
Southampton
SO15 1EG

August 1995

An executive agency of
THE DEPARTMENT OF TRANSPORT

NAVIGATION SELF-EXAMINER

CHARTS AND PUBLICATIONS

Q1. List in general terms the reliability of navigational charts.

Ans. No chart is completely reliable because of: —

(a) Incomplete surveys or alterations in topography.
(b) Date and methods of survey not being as dependable because the measuring instruments previously employed were not as accurate e.g. lead and line compared with electronics.
(c) Alterations occur subsequent to the time of survey. Sea bottom may also be unstable and not present a correct representation as per old surveys.
(d) Paper of charts may have some distortion when being printed, due to various causes.
(e) Magnetic variation will change with the passing of time.
(f) The use of small scale charts requires extreme caution and mariners are continually advised to use the largest scale chart available.

Q2. For what aspects of navigation would you expect to use a gnomonic chart?

Ans. The gnomonic chart is used for: —

(a) Great circle sailing.
(b) Polar navigation in high latitudes.
(c) For the large scale plans of harbour approaches.

Q3. When referring to charts, what is a 'new edition'?

Ans. When a chart is completely or partly revised it will be dated and marked as 'new edition', set to the right of the date of publication.

All previous copies of the chart are cancelled.

Q4. What is a 'new chart'?

Ans. A chart which is published for the first time.

The date of publication being inserted outside the bottom margin in the middle of the chart.

Q5. When correcting charts by applying a 'block' correction what would you paste, the block or the chart and why?

Ans. The area of the chart where the block is to be affixed is pasted. The block should be pencilled around when in position and the pencil area of the chart pasted.

If the block was pasted the moisture in the paste would cause excessive distortion to the block and cause inaccuracy when fixing. Also the chart paper would be expected to be of stronger texture than that used for the blocks, as cut from notices to mariners.

Q6. Who issues and publishes the 'weekly notices' to mariners?

Ans. The Hydrographic Department of the Navy.

Q7. What is a 'new danger' and how is it marked for identification by the mariner?

Ans. A new danger is the term used to describe newly discovered hazards which have not yet been indicated in nautical publications. They include natural occurring obstructions such as sandbanks and rocks or man made dangers such as wrecks.

New dangers are marked in accordance with the IALA buoyage system and will have at least one of the marks duplicated.

The duplicate mark will be identical to its partner in all respects and may carry a 'RACON' providing a signal of Morse 'D'. The signal length being of 1 nautical mile on the radar display.

The duplicate mark may be removed when the appropriate authority is satisfied that information concerning the new danger has been sufficiently promulgated.

Q8. When transferring positions from one chart to another, how would the Master instruct a junior officer to ensure that the operation was carried out correctly?

Ans. Transfer the position by use of 'bearing and distance', from a fixed point which is common to both charts. The new position should be checked against the old position by means of latitude and longitude.

NB The scale of charts may differ.

Always obtain an additional fix of the ships position as soon after the transfer, as time permits.

If magnetic compass bearings are being used ensure that the magnetic variation on one chart is not different to that of the next chart.

Always transfer to the largest scale chart available.

Q9. What information on the chart may be used to assess the possibility of lesser depth occurring between the charted depths.

Ans. Carry out a detailed chart inspection to include all and any notations inset into:

(a) The borders of the chart.
(b) Under the title blocks of the chart.
(c) The source data block — for dates of surveys.
(d) Special navigation notes on land or sea areas.

Tidal stream information, as charted, is referred to the high water at a particular port. Greater distances from the port of reference could reflect greater unreliability on the information being used.

Some charts will carry special reference to tidal levels and charted data.

I would also take into account Annual Notices to Mariners Nos. 1, 15 and 15A which refer to tidal surges and the warning service.

Mariners should also remember that topography changes with time. The last date of survey would provide the navigator with a relative standard of reliability of the charted information.

Q10. What would you use a 'co-tidal/co-range' chart for?

Ans. The chart is used to find the times and heights of high water in offshore areas and at places which lie between secondary ports.

ICE

Q11. Describe the sources of information which are available to the Master, regarding the latest 'ice situation' in the North Atlantic?

Ans. Ice reports — available from the ice patrol and distributed by the U.S. Naval Oceanographic Office.

Navtex — ice reports via various transmitters, e.g. Norwegian Sea and Icelandic areas by Norway.

Ship routing advisory service available from the Meteorological Office Bracknell, ENGLAND.

Ice Charts — as supplied by Admiralty Hydrographic Department of the Canadian Hydrographic Service.

Radio — advisory warning reports from Halifax, Nova Scotia. Ref: to Admiralty List of Radio Signals.

Reports from other shipping which is outward bound from respective ice effected regions.

General reference should be made to relevant publications such as: —
Mariners Handbook, Ocean Passages of the World, Admiralty Sailing Directions and Weekly Notices to Mariners.

Q12. What instructions should the Master give to the officer of the watch, when participating with other vessels in an ice convoy?

Ans. He should be informed of the ship's position within the convoy and the position in relation to that of the ice breaker or command vessel.

A specified distance must be maintained between own vessel and the vessel ahead. The greatest benefit being at about 150 metres from the ice breaker, however, this distance must be such as to allow the vessel to stop without collision if so ordered.

The OOW may receive orders to operate astern propulsion at any time while in convoy and if so ordered should do so immediately. Full use of engines and all navigation equipment should be readily available at all times, together with full communication systems, includ-

ing international code flags. Ships details of speed, length, draught and tonnage should be passed to command vessel at the onset.

Q13. State the navigational problems that you would expect to encounter when navigating in cold climates, inside ice regions, with respect to the use of:

Beacons and sectored lights for position fixing purpose?

Ans. Where ice conditions are prevalent, windows of lights may be covered by frost or ice which will greatly reduce sighting and visible range of the light. The lantern glass may also be subject to moisture build up with temperature changes which could further diffuse the lights rays. Snow build up, especially in extreme conditions could cause complete obscurity of the light for navigation purpose.

Any of the above could well create uncertainty where sector lights are employed. The width of sectors being directly effected by increased levels of frost or ice build up in and around the lamp. The width of sectors in coloured lights could well appear more or less white. The greatest effect is on weak or green lights. White lights tend to extend their sector width in such conditions.

Q14. Where would you expect to obtain ice information for navigation in the Baltic Sea?

Ans. General reference should be made to all official publications which provide ice information and additionally to:

Baltic Pilot Vol 1	Publication No 18
Baltic Pilot Vol 2	Publication No 19
Baltic Pilot Vol 3	Publication No 20
Mariners Handbook	Publication No 100
ALRS	Publication No 283

Relevant charts of the area and the use of the weekly notices to mariners should be consulted for 'T' and 'P' notices.

Weather reports and facsimile charts from Meteorological Office, Bracknell.

Both the Finnish and Swedish Ice Services operate ice-breakers and local information can be obtained from these.

Q15. What physical indications would the mariner observe when entering an area where ice conditions might prevail?

Ans. The sea temperature would be set about 1° C. Sea birds and wildlife maybe sighted far from land. Ice fragments may be sighted on the surface. Ships position being associated with a known ice region or close to a cold iceberg bearing current.

TROPICAL REVOLVING STORM

Q16. A vessel is alongside in harbour, when a tropical revolving storm is forecast. The projected path of the storm would put the vessel in the dangerous semi-circle as the storm passes over.

What options are open to the Master of the vessel?

Ans. The Master should consider letting go his moorings in plenty of time and moving into open water to ride out the storm at sea. The decision should be taken early and should leave the vessel 'hove to' clear of harbour roads. The possibility of obtaining the lee of an island clear of the dangerous semi-circle, is more likely if the decision to clear the harbour is made earlier rather than later.

If the vessel intends to remain in port, then additional moorings should be stretched. The ships side should

be well fended and the gangway hoisted clear of the quayside.

The progress of the storm should be monitored and its position plotted on the chart. Weather forecasts should be kept updated. In all cases the ship should be secured against heavy weather and all cargo work halted.

Q17. What geographical conditions are most favourable for the formation of a tropical revolving storm?

Ans. A tropical revolving storm would normally form and develop in an area where there is a large continent with a large expanse of sea area to the eastward, in which there are many small islands and coastlines which run north/south, e.g. Gulf of Mexico, East Coast of Africa.

Formation would take place between 5°–10° latitudes, north or south of the Equator when the sea temperature is high in a region of +27° C. It would not form or develop in the South Atlantic Ocean.

Q18. Why do tropical revolving storms not form and develop in the South Atlantic Ocean?

Ans. The waters of the South Atlantic are comparatively cool at surface level. A possible reason for this is that the equatorial trough, (the doldrums) does not penetrate into the South Atlantic, which could account for cool surface water. Tropical revolving storms form over regions of the highest sea surface temperatures. Large supplies of water vapour being accumulated by air passing over the warmer sea surface. The South Atlantic cooler surface waters do not lend themselves to conditions which allow TRS formation.

Weak cyclonic circulations are also unknown in this region and TRS would require cyclonic circulation, (tropical depression) as an essential condition for its development.

ROUTING

Q19. Which areas would you consider that climatological routing to be appropriate and satisfactory?

Ans. North Atlantic, predominantly westbound.
South Atlantic and North Pacific (winter months).

Q20. Describe the types of vessels that would use the various types of prescribed routes?

Ans. Ice free route — vessels without or only partly ice strengthened (Ice Classification A1)

All weather route — passenger vessels, or roll on roll off ferries.

Deep Water Route — vessels constrained by their draught, e.g. deep laden tankers.

Climatic route — all ships, especially container vessels.

Q21. What benefits are gained by the owner/charterer when the shoreside 'METROUTE' service is employed for the ship?

Ans. The owners or charterers will obtain post-voyage information for management and accounting purposes, and additionally:

(a) Round the clock accurate monitoring of the vessels progress.
(b) Comparisons between actual and alternative routes. (These demonstrate the benefits of the service).
(c) Comparisons of the actual speeds achieved against charter speeds, after making appropriate allowance for weather and currents.
(d) Documented information regarding the weather related performance of the vessel throughout the whole voyage.

(e) Metrouted vessels may attract more favourable insurance premiums.

Q22. State what factors the Master would consider when selecting an optimum ocean passage?

Ans. Pre-statement: Any route selected should not stand the vessel into danger and the prime consideration should be the safe navigation throughout the voyage.

(a) Shortest distance may not always be the most acceptable because of ice or prevailing bad weather. Least time over a short distance does not always follow and the Master would need to consider the overall weather pattern for all areas of the proposed route. Seasonal changes may effect final choice.

(b) Depending on the nature of the cargo, consideration towards limiting damage, especially to sensitive cargoes, must be a major factor.

(c) Charter party clauses may stipulate that the voyage is conducted at a 'constant speed'. An order to achieve this 'Metrouting' may well influence the Masters final choice of route.

(d) Whichever route is selected the Master would take into account the capabilities of his own vessel. Any special features, such as ice strengthening, or whether being a low powered vessel, could effect the safe passage of the ship.

(e) Reference to Ocean Passages (NP 136) and consideration to recommendations from this publication would also be considered prudent by any Master selecting an ocean passage route.

(f) Loadlines may also influence the selected route.

Q23. When acting as Master, what instructions and precautions would you take if your vessel was approaching the Grand Banks off Newfoundland during the month of March?

Ans. The region of the Grand Banks at this time of year is notorious for icebergs, growlers, pack ice and fog. Gales

are known to be frequent and severe. It is also an area well used by deep sea traffic (European to North American Trades) and extensively by fishing boats. More recently offshore exploration has commenced for oil, gas and minerals.

As Master of the vessel I would advise all watch officers to the known hazards prior to entering the region. I would stress the need for extreme vigilance when conducting their watch. To ensure this I would draw up standing orders for the actions of the OOW when:—

(a) Encountering poor visibility.
(b) If ice is expected or sighted near the ships course.
(c) Or if heavy weather is being experienced.

I would also communicate with the coast radio station and obtain the regular reports from the international ice patrol. I would expect the OOW to plot all known ice positions on the navigational chart.

Weather reports would be monitored at regular intervals and instructions would remain with the OOW to call the Master in the event of any changes being experienced in the prevailing weather.

In the event of poor visibility being encountered in this region I would 'double watches' and maintain a continual radar watch by a second watch-keeper.

Once entering the region, the Master would proceed at a safe speed relevant to the prevailing conditions. In any case, main engines would be on a stand-by status as soon as the vessels position is observed to be approaching the known ice limits.

Additionally I would expect all watch officers to advise look-out personnel of the dangers of the region and that they would be expected to report all ice sightings, together with all traffic movements. Manual steering would be employed when entering and passing through this region.

OPTIMUM ROUTE FACTORS

Q24. Consider a vessel which is expected to sail from San Francisco to Yokohama in January, the Master is considering 3 alternative routes: —

'A' Direct great circle.

'B' A rhumb line which remains within the summer load line at latitude 35° 00' N.

'C' A route north of the Aleutian Islands.

What factors would the Master take into consideration when deciding the most appropriate passage?

Ans:

FACTOR	ROUTE 'A'	ROUTE 'B'	ROUTE 'C'
Distance	4440 miles	4772 miles	4505 miles
Currents	Variable	Adverse 1 kn.	Part Favourable 1 kn.
Winds	Gales (contrary)	Occ. Gales (cont)	Gales (favourable)
Icebergs	Not Likely	No	Possible
Loadline	Winter	Summer	Winter
Steaming Time	Medium	Greatest	Least
Possible Damage	Greatest	Least	Medium

The overall safety of the vessel throughout would influence the final decision, together with the nature of the cargo and the economics of each route.

NB The prudent Master would also consult such publications as Ocean Passages of the World, The North Pacific Pilot (vol 23) and the Sailing Directions and Planning Guide for the North Pacific Ocean (publication 152 of the Defence Mapping Agency of the USA).

With regard to the 'C' route the Bering Sea is north of the usual storm path. Vessels westbound would therefore benefit from favourable winds and following seas, the vessel being situated in the favourable semi-circle.

Neither would vessels expect to encounter opposing currents and the route would therefore be acceptable to low powered ships.

MERSAR

Q25. Whilst proceeding towards a marine distress situation, where casualties are known to be in the water, discuss what preparations you would make aboard your vessel.

Ans. Depending on the general circumstances and the available equipment on board my vessel the following actions would be considered:

(a) Plot the rendezvous position, datum point, (last known position) of casualty, together with any search pattern limits.
(b) Establish communications with Rescue Co-ordination Centre (RCC) and pass own position, ETA and other relevant details to co-ordinator.
(c) Obtain current weather report.
(d) Maintain my own vessel on operational status, radar watch, manual steering and lookouts posted, on closing the area of distress.
(e) Prepare hospital to treat for hypothermia and shock.
(f) Turn out rescue boat ready for immediate launch, stand-by emergency boats crew and rig guest warp.
(g) Assess potential navigational hazards for own ship.
(h) Update target information and revise ETA to the rescue co-ordination centre.
(i) Keep engine room informed regarding manoeuvring speed.
(j) Plot prevailing currents and estimate drift on target.
(k) Continually monitor the vessels progress and note all activities in the log book.
(l) Note charted positions for purpose of deviation.
(m) Brief operational personnel prior to engagement, e.g. Boats, coxswain, medical staff, officer of watch.

Q26. If a vessel is to engage in a winching operation from the deck of the vessel where should the Master effect the relative wind direction?

Ans. Depending on the availability of deck space, if the operation is to take place: —

(a) Aft Deck — Wind 30° Port Bow.
(b) Midships — Wind 30° Port Bow or Beam wind.
(c) Forward — Wind 30° Starboard Quarter.

Q27. A vessel is requisitioned to engage in MERSAR search, what would be the duties of the navigation officer?

Ans. The navigator would need to plot the search area limits together with the datum point. The adopted search pattern together with all course alteration points would be charted. A track space and the position of the CSP (commence search pattern) would be designated, and an appropriate speed established.

Q28. What type of messages are transmitted by vessels which are participants of the AMVER organisation?

Ans. (a) A sailing plan before departure.
(b) A departure report, as soon as possible after departure.
(c) A position report at the first 24 hours then 48 hours after.
(d) An arrival report on reaching destination.
(e) Deviation report when the vessel diverts from the sailing plan.

PILOTAGE

Q29. Summarise the navigational precautions and preparations for a vessel engaging with a smaller craft?

Ans. Establish and brief the 'bridge team' ie. lookouts, helmsman, OOW, pilot, radar operator, radio officer and engine room.

Assess the approach plan with regard to navigational dangers, currents and tidal effects and underkeel clearance. Advance early warning and instructions to engine room with regard to manoeuvring.

Exhibit correct signals and monitor all communications. Carry out specific instrument and propulsion checks prior to engagement. Obtain local weather information. Manoeuvre to create a lee for small boats coming alongside. Establish visual contact and retain it throughout the operation. Record and maintain log books and make full use of relevant navigational publications.

NB. Avoid interaction with smaller craft.

Q30. If your vessel was approaching a 'pilot station', and did not require the services of the marine pilot, what actions would the Master take on the bridge?

Ans. Reduce speed on approach towards the pilot roads. Brief lookout personnel to watch for small boats or pilot cutters. Enter the speed reduction in the log book relative to the ships position. Contact the pilot station (or boat) and inform them of your name, course, speed and intentions.

Q31. When undertaking a long river passage what information would the Master give to the pilot when he boards?

Ans. (a) Draught of the vessel.
(b) Present position, course and detail of compass errors.
(c) Engine status and speeds at respective revolutions.
(d) Type of propeller and position of thruster units — if any.
(e) Type of machinery and number of propellers.
(f) Ships details regarding length and breadth. Whether the vessel is fitted with bulbous bow or not. State of readiness of anchors.
(g) List of VHF guarded channels.
(h) Radar status — head up, stabilised, true motion etc.

(i) Radar range.
(j) Port from which the ship has last departed.
(k) Port from which the ship is bound to and the nature of cargo.
(l) Any defects or deficiencies regarding navigational equipment.

Additionally the Master would introduce himself by name and much of the above information would be indicated to the pilot by means of a display board.

MISCELLANEOUS

Q32. Describe a good location for the magnetic compass?

Ans. It should be positioned on the fore and aft centre line of the vessel (exceptions: aircraft carriers etc.) with adequate height to provide an all round view.

It should be housed in a binnacle at or near the steering position and far enough away from the navigational instruments so as not to be effected by electrical effects. (Ref 'M1116, M1219 & Merchant Shipping Regulations — Navigational Equipment, Regulation 10') Radars/ Magnetic Compasses

Q33. When would you expect to carry out a 'compass-swing'?

Ans. (a) With a new ship, after completion of ship trails. A new vessel would also carry out a swing prior to a maiden voyage, during that voyage and at the end of the voyage.
(b) When large structural alterations have occurred to the superstructure or to the hull.
(c) Following collision or stranding and major repairs become necessary. If bridge electrical apparatus is installed which could influence the magnetic effect in close proximity to the compass position.
(d) Following a long lay-up period and the vessel being brought back into active service.

(e) In the event of a large fire on board or if the vessel is struck by lightening.
(Ref: should also be made to 'M' 1219).

Q34. When checking the compass by means of the AMPLITUDE method state the correct position of the sun when carrying out the observation.

State also why this method of observation is considered unreliable when navigating in high latitudes?

Ans. When observing the amplitude the centre of the body should be on the celestial horizon of the observer.

NB. The visible horizon does not coincide with the celestial horizon because of the combined effects of refraction, parallax and dip.

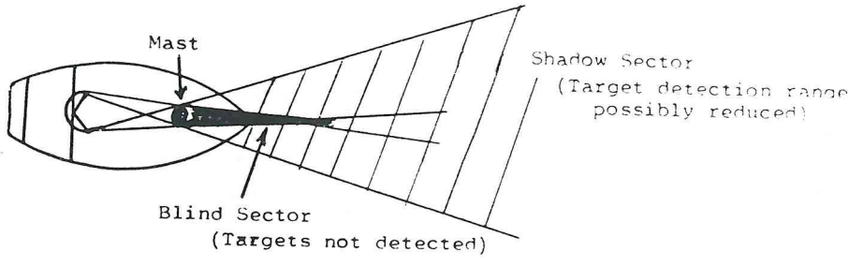
In high latitudes the rate that the body is changing its azimuth is comparatively large. Consequently a small change in altitude results in a large change in azimuth.

These conditions would make the accuracy of the observation unreliable, unless the observer could be precise regarding the time that the body's centre was on the observers celestial horizon.

Q35. When using radar as a navigation aid, discuss the difference between 'blind' and 'shadow' sectors?

Ans. Blind and shadow sectors can be caused by obstructions on land or by other vessels or more commonly noticeable by obstructions aboard your own vessel.
i.e. Masts, samson posts, and cross trees.

Both types of sectors can be experienced in either the horizontal or vertical. With regard to target detection the radar beam is completely cut off in a blind sector, whereas the shadow sector allows reduced target definition at a shorter range than normal.



Q36. State what factors would effect the amount of 'squat' a vessel could expect to experience and list also what signs might be observed by the OOW, if a vessel was being affected by shallow water effects.

Ans. Factors affecting 'SQUAT'

a)	Speed of vessel	The value of squat is directly related to speed^2
b)	Draught/depth of water (Ratio)	High ratio equates to a greater rate of squat.
c)	High engine revolutions	High revs, will increase stern trim.
d)	Position of the longitudinal centre of buoyancy (LCB)	Determines the trimming effect.
e)	Type of bow fitted.	Affects wavemaking and pressure distribution.
f)	Length/breadth ratio.	Short-tubby ships squat more.
g)	Block coefficient. (C^b)	A vessel with a large C^b will experience greater squat.
h)	Breadth/channel width	High ratio will cause greater squat.
i)	Trim	Greater squat is experienced with a bow trim than a stern trim.

Signs that a vessel is experiencing 'squat'

Speed and R.P.M. will decrease and vibration may occur. The steering is usually effected and the vessel becomes sluggish to manoeuvre.
Waves from the ships movement increase in amplitude and the wake left by the vessel may change colour and become mud-stained.

Suggested immediate action — reduce speed.

Q37. State the factors that the Master would take into consideration when determining the manning and composition of watches on a vessel about to make a passage through the English Channel via the Dover Strait?

Ans. The Master should take account of the number of watch keeping personnel on board the vessel and the roles that respective ranks can perform.
i.e. Watch officers, helmsman, lookouts, communications, pilot, etc.,

He should consider the abilities and the endurance of personnel and remember that fatigue could effect efficiency.
The weather, especially the state of visibility, would influence directly decisions to engage double watches especially when a continuous radar watch may be required. Continual monitoring of weather forecasts must be considered essential and to this end the use of key personnel should be prudent to match critical stages of the passage plan.
e.g. Dover Strait Area.

The degree of experience that watch officers and crew have of the ships systems and of the area could influence which personnel are assigned to specific areas of the passage.

Early planning and anticipated focal points of high traffic density should be compatible with the use of the most

experienced watch personnel. High traffic density would also dictate when the Master MUST be in attendance on the bridge.

The need for rest and meal reliefs should be considered and the Master should ensure that these times, as well as watch handovers, are conducted in a correct manner.

With any busy waterway the navigation and safety of the vessel is paramount and Masters should take into account that position fixing and communications may lead to distraction of that most essential element of keeping a proper and effective lookout. The watch officer alone, especially one with limited experience, may find reassurance with the addition of another pair of 'eyes on the bridge'.
If traffic or weather dictates the need to double watches the Master should not hesitate to instigate this option.

Q38. What line of action would the Master probably take when called to the bridge by a junior watch officer who reports a mine clearance vessel ahead on the vessels track?

Ans. The Master would probably order the vessel stopped, or the speed reduced, to allow time to establish communications with the warship. Communications established by VHF radio following station identification or by flashlight morse (Aldis Lamp), if radio silence prevails.

Confirmation would be obtained regarding:

a) Is the warship engaged in exercise, or
b) Is the warship engaged on actual mine clearance.

The Master would also request information regarding any clear navigable water areas, as well as any areas defined which are known to be obstructed by mines.

An alteration of course towards clear waters would be made following recommendations by the warship. Any alteration being such as to give the mine clearance vessel

a wide berth and should not bring the vessel within 1000 metres of the warship.

Obstructed areas would be plotted on the chart, especially important for vessels which are intending a return passage through the same area.

NB: It would be normal practice for navigational warnings to be issued when mine clearance operations are either expected or known to be ongoing. Subsequent checks should therefore be made with local coast radio stations.

Following the many recent conflicts around the world mariners are advised that hostile areas where mines may have been laid may still be active possibly due to indiscriminate mine laying during the times of conflict. Extreme caution should be exercised where the geography and the history of the location reflect this possibility.

Q39. On your approach to a port, you sight a vessel which has run aground.
What action would the Master be expected to make with regard to the safe navigation of his vessel?

Ans. A probable line of action would be for the vessel to be immediately stopped and all way taken off. This would allow time to make a full chart assessment and allow the positions of both the aground vessel as well as your own vessel to be plotted on the chart.

The echo sounder may well be operational, but if not then a prudent Master would require this instrument switched on and ongoing soundings recorded.

Although the vessel aground is not in distress, useful communications could be established in order to obtain the existing draught of the vessel aground, and the time that she grounded.
(Time of grounding would allow the state of tide to be determined)

Alternative routing may have to be investigated in order for your own vessel to navigate clear of the obstructing vessel and any shallow waters. Alternative tracks would be observed from a comprehensive chart assessment, made earlier.

Masters should at all times be aware of their own draught and be concerned regarding underkeel clearance. State of tide should be investigated and any approaches to ports and harbours should be made with adequate underkeel clearance.

The use of a contingency, such as going to an anchorage and obtaining the services of a pilot, would of course be additional considerations that may be thought appropriate under the circumstances.

NB: Vessels aground may draw attention to their plight and exhibit relevant signals, such as:

'L' You should stop your vessel instantly.

or

'U' You are running into danger.

Q40. Your vessel is scheduled to carry out a routine helicopter land on/take off operation. What line of action would the Master expect to take in order to establish a safe navigational situation for the conduct of the operation.

Ans. The Master should meet with all heads of departments and other interested parties regarding the detailed conduct of the operation.

NB: Additional personnel could well include the watch officer, and the deck landing officer.

A chart assessment of the intended area of engagement should be made to ensure that the safe navigation of the vessel is maintained throughout:

a) Adequate sea room is available in alternative directions.
(Actual course being determined by the wind direction/pilots requirements)

b) That the area of engagement is clear of navigational obstructions and shallows, and that the area is not going to obstruct other traffic operations. e.g. Cross traffic seperation schemes.

c) Underkeel clearance is adequate to allow time to complete the operation.

d) That state of machinery is on 'stand by' and that manoeuvring speed is maintained.
Relevant times of stand-by to be advised.

e) Communications officer to be in contact with:
i) The aircraft as soon as possible.
ii) The deck landing officer.
iii) Internal stations, e.g engine room.

f) Deck preparations to be completed on route to include: Wind direction indicator, and navigation signals for 'restricted in ability to manoeuvre' to be made ready.
Deck area cleared and obstructions by way of rigging removed.
Contingency — rescue boat turned out.

g) Weather report monitored.

h) Time of manual steering to be engaged, predetermined. Also when lookouts would be placed and deck fire party placed on stand by.

MARINE SAFETY – ANNEX TO VOLUME

The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996 (No. M 1642/COLREG 1)

MSA
MARINE SAFETY AGENCY

MERCHANT SHIPPING NOTICE

No. M.1642/COLREG 1

The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996

Notice to Owners, Masters, Skippers, Officers and Crews of Merchant Ships, Fishing Vessels, Pleasure Vessels, Yachts and Other Seagoing Craft

This Notice and the Rules referred to in it are an integral part of the Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996, which come into force on 1 May 1996. These Regulations implement the Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended. They enhance safe navigation, by prescribing the conduct of vessels underway, specify the display of internationally-understood lights and sound signals and set out collision avoidance actions in close quarter situations.

In these Regulations -

(1) The traffic separation schemes referred to in Rule 10(a) are the schemes listed in Notice to Mariners No 17 and marked "*" in the margin;

(2) The diagram mentioned in paragraph 7 of Annex I is the diagram specified in the Chromaticity Chart (1975) published by the International Illumination Commission (CIE); and

(3) The International Code of Signals referred to in paragraph 3 of Annex IV is published by the International Maritime Organisation.

Marine Safety Agency
Spring Place
105 Commercial Road
SOUTHAMPTON
SO15 1EG
March 1996

Safe Ships Clean Seas

An executive agency of
THE DEPARTMENT OF TRANSPORT

Table of Contents of the International Regulations

INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1972

(as amended by Resolutions A464(XII), A626(15), A678(16) and A736(18))

PART A - GENERAL

Rule 1

Application

(a) These Rules shall apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels.

(b) Nothing in these Rules shall interfere with the operation of special rules made by an appropriate authority for roadsteads, harbours, rivers, lakes or inland waterways connected with the high seas and navigable by seagoing vessels. Such special rules shall conform as closely as possible to these Rules.

(c) Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any State with respect to additional station or signal lights, shapes or whistle signals for ships of war and vessels proceeding under convoy, or with respect to additional station or signal lights or shapes for fishing vessels engaged in fishing as a fleet. These additional station or signal lights, shapes or whistle signals shall, so far as possible, be such that they cannot be mistaken for any light, shape or signal authorised elsewhere under these Rules.

(d) Traffic separation schemes may be adopted by the Organization for the purpose of these Rules.

(e) Whenever the Government concerned shall have determined that a vessel of any special construction or purpose cannot comply with the provisions of any of these Rules with respect to the number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signalling appliances, such vessel shall comply with such other provisions in regard to the number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signalling appliances, as her Government shall have determined to be the closest possible compliance with these Rules in respect of that vessel.

Rule 2

Responsibility

(a) Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(b) In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

Rule 3

General definitions

For the purpose of these Rules, except where the context otherwise requires:

(a) The word "vessel" includes every description of water craft, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.

(b) The term "power-driven vessel" means any vessel propelled by machinery.

(c) The term "sailing vessel" means any vessel under sail provided that propelling machinery, if fitted, is not being used.

(d) The term "vessel engaged in fishing" means any vessel fishing with nets, lines, trawls or other fishing apparatus which restrict manoeuvrability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manoeuvrability.

(e) The word "seaplane" includes any aircraft designed to manoeuvre on the water.

(f) The term "vessel not under command" means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.

(g) The term "vessel restricted in her ability to manoeuvre" means a vessel which from the nature of her work is restricted in her ability to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel. The term "vessels restricted in their ability to manoeuvre" shall include but not be limited to:

(i) a vessel engaged in laying, servicing or picking up a navigation mark, submarine cable or pipeline ;

(ii) a vessel engaged in dredging, surveying or underwater operations;

(iii) a vessel engaged in replenishment or transferring persons, provisions or cargo while underway;

(iv) a vessel engaged in the launching or recovery of aircraft;

(v) a vessel engaged in mine clearance operations;

(vi) a vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.

(h) The term "vessel constrained by her draught" means a power-driven vessel which, because of her draught in relation to the available depth and width of navigable water, is severely restricted in her ability to deviate from the course she is following.

(i) The word "underway" means that a vessel is not at anchor, or made fast to the shore, or aground.

(j) The words "length" and "breadth" of a vessel mean her length overall and greatest breadth.

(k) Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other.

(l) The term "restricted visibility" means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.

PART B - STEERING AND SAILING RULES

Section I - Conduct of vessels in any condition of visibility

Rule 4

Application

Rules in this Section apply in any condition of visibility.

Rule 5

Look-out

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

Rule 6

Safe speed

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

(a) By all vessels:

(i) the state of visibility;

(ii) the traffic density including concentrations of fishing vessels or any other vessels;

(iii) the manoeuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;

(iv) at night the presence of background light such as from shore lights or from back scatter of her own lights;

(v) the state of wind, sea and current, and the proximity of navigational hazards;

(vi) the draught in relation to the available depth of water.

(b) Additionally, by vessels with operational radar:

(i) the characteristics, efficiency and limitations of the radar equipment;

(ii) any constraints imposed by the radar range scale in use;

(iii) the effect on radar detection of the sea state, weather and other sources of interference;

(iv) the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;

(v) the number, location and movement of vessels detected by radar;

(vi) the more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

Rule 7

Risk of collision

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.

(b) Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

(c) Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

(d) In determining if risk of collision exists the following considerations shall be among those taken into account:

(i) such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change;

(ii) such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

Rule 8

Action to avoid collision

(a) Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.

(c) If there is sufficient sea-room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.

(d) Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.

(e) If necessary to avoid collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion.

(f) (i) A vessel which, by any of these Rules, is required not to impede the passage or safe passage of another vessel shall, when required by the circumstances of the case, take early action to allow sufficient sea-room for the safe passage of the other vessel.

(ii) A vessel required not to impede the passage or safe passage of another vessel is not relieved of this obligation if approaching the other vessel so as to involve risk of collision and shall, when taking action, have full regard to the action which may be required by the Rules of this Part.

(iii) A vessel the passage of which is not to be impeded remains fully obliged to comply with the Rules of this Part when the two vessels are approaching one another so as to involve risk of collision.

Rule 9

Narrow channels

(a) A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.

(b) A vessel of less than 20 metres in length or a sailing vessel shall not impede the passage of a vessel which can safely navigate only within a narrow channel or fairway.

(c) A vessel engaged in fishing shall not impede the passage of any other vessel navigating within a narrow channel or fairway.

(d) A vessel shall not cross a narrow channel or fairway if such crossing impedes the passage of a vessel which can safely navigate only within such channel or fairway. The latter vessel may use the sound signal prescribed in Rule 34(d) if in doubt as to the intention of the crossing vessel.

(e) (i) In a narrow channel or fairway when overtaking can take place only if the vessel to be overtaken has to take action to permit safe passing, the vessel intending to overtake shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c)(i).The vessel to be overtaken shall, if in agreement, sound the appropriate signal prescribed in Rule 34(c)(ii) and take steps to permit safe passing. If in doubt she may sound the signals prescribed in Rule 34(d).

(ii) This Rule does not relieve the overtaking vessel of her obligation under Rule 13.

(f) A vessel nearing a bend or an area of a narrow channel or fairway where other vessels may be obscured by an intervening obstruction shall navigate with particular alertness and caution and shall sound the appropriate signal prescribed in Rule 34(e).

(g) Any vessel shall, if the circumstances of the case admit, avoid anchoring in a narrow channel.

Rule 10

Traffic separation schemes

(a) This Rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other Rule.

(b) A vessel using a traffic separation scheme shall:

(i) proceed in the appropriate traffic lane in the general direction of traffic flow for that lane;

(ii) so far as practicable keep clear of a traffic separation line or separation zone;

(iii) normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.

(c) A vessel shall, so far as practicable, avoid crossing traffic lanes but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.

(d) (i) A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 metres in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.

(ii) Notwithstanding sub-paragraph (d)(i), a vessel may use an inshore traffic zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.

(e) A vessel other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:

(i) in cases of emergency to avoid immediate danger;

(ii) to engage in fishing within a separation zone.

(f) A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.

(g) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near its terminations.

(h) A vessel not using a traffic separation scheme shall avoid it by as wide a margin as is practicable.

(i) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

(j) A vessel of less than 20 metres in length or a sailing vessel shall not impede the safe passage of a power-driven vessel following a traffic lane.

(k) A vessel restricted in her ability to manoeuvre when engaged in an operation for the maintenance of safety of navigation in a traffic separation scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.

(l) A vessel restricted in her ability to manoeuvre when engaged in an operation for the laying, servicing or picking up of a submarine cable, within a traffic separation scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Section II - Conduct of vessels in sight of one another

Rule 11

Application

Rules in this Section apply to vessels in sight of one another.

Rule 12

Sailing Vessels

(a) When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

(i) when each has the wind on a different side, the vessel which has the wind on the port side shall keep out of the way of the other;

(ii) when both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward;

(iii) if a vessel with the wind on the port side sees a vessel to windward and cannot determine with certainty whether the other vessel has the wind on the port or on the starboard side, she shall keep out of the way of the other.

(b) For the purposes of this Rule the windward side shall be deemed to be the side opposite to that on which the mainsail is carried or, in the case of a square-rigged vessel, the side opposite to that on which the largest fore-and-aft sail is carried.

Rule 13

Overtaking

(a) Notwithstanding anything contained in the Rules of Part B, Sections I and II, any vessel overtaking any other shall keep out of the way of the vessel being overtaken.

(b) A vessel shall be deemed to be overtaking when coming up with another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights.

(c) When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.

(d) Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel within the meaning of these Rules or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

Rule 14

Head-on situation

(a) When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision each shall alter her course to starboard so that each shall pass on the port side of the other.

(b) Such a situation shall be deemed to exist when a vessel sees the other ahead or nearly ahead and by night she would see the mast head lights of the other in a line or nearly in a line and/or both sidelights and by day she observes the corresponding aspect of the other vessel.

(c) When a vessel is in any doubt as to whether such a situation exists she shall assume that it does exist and act accordingly.

Rule 15

Crossing situation

When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Rule 16

Action by give-way vessel

Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

Rule 17

Action by stand-on vessel

(a) (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.

(ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.

(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

(c) A power-driven vessel which takes action in a crossing situation in accordance with sub-paragraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.

(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

Rule 18

Responsibilities between vessels

Except where Rules 9, 10 and 13 otherwise require:

(a) A power-driven vessel underway shall keep out of the way of:

(i) a vessel not under command;

(ii) a vessel restricted in her ability to manoeuvre;

(iii) a vessel engaged in fishing;

(iv) a sailing vessel.

(b) A sailing vessel underway shall keep out of the way of:

(i) a vessel not under command;

(ii) a vessel restricted in her ability to manoeuvre;

(iii) a vessel engaged in fishing.

(c) A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of:

(i) a vessel not under command;

(ii) a vessel restricted in her ability to manoeuvre.

(d) (i) Any vessel other than a vessel not under command or a vessel restricted in her ability to manoeuvre shall, if the circumstances of the case admit, avoid impeding the safe passage of a vessel constrained by her draught, exhibiting the signals in Rule 28.

(ii) A vessel constrained by her draught shall navigate with particular caution having full regard to her special condition.

(e) A seaplane on the water shall, in general, keep well clear of all vessels and avoid impeding their navigation. In circumstances, however, where risk of collision exists, she shall comply with the Rules of this Part.

Section III - Conduct of vessels in restricted visibility

Rule 19

Conduct of vessels in restricted visibility

(a) This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.

(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of Section I of this Part.

(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:

(i) an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;

(ii) an alteration of course towards a vessel abeam or abaft the beam.

(e) Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

PART C - LIGHTS AND SHAPES

Rule 20

Application

(a) Rules in this Part shall be complied with in all weathers.

(b) The Rules concerning lights shall be complied with from sunset to sunrise and during such times no other lights shall be exhibited, except such lights as cannot be mistaken for the lights specified in these Rules or do not impair their visibility or distinctive character, or interfere with the keeping of a proper look-out.

(c) The lights prescribed by these Rules shall, if carried, also be exhibited from sunrise to sunset in restricted visibility and may be exhibited in all other circumstances when it is deemed necessary.

(d) The Rules concerning shapes shall be complied with by day.

(e) The lights and shapes specified in these Rules shall comply with the provisions of Annex I to these Regulations.

Rule 21

Definitions

(a) "Masthead light" means a white light placed over the fore and aft centreline of the vessel showing an unbroken light over an arc of the horizon of 225 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the vessel.

(b) "Sidelights" means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of the horizon of 112.5 degrees and so fixed as to show the light from the right ahead to 22.5 degrees abaft the beam on its respective side. In a vessel of less than 20 metres in length the sidelights may be combined in one lantern carried on the fore and aft centreline of the vessel.

(c) "Sternlight" means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135 degrees and so fixed as to show the light 67.5 degrees from right aft on each side of the vessel.

(d) "Towing light" means a yellow light having the same characteristics as the "sternlight" defined in paragraph (c) of this Rule.

(e) "All-round light" means a light showing an unbroken light over an arc of the horizon of 360 degrees.

(f) "Flashing light" means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.

Rule 22

Visibility of lights

The lights prescribed in these Rules shall have an intensity as specified in Section 8 of Annex I to these Regulations so as to be visible at the following minimum ranges:

(a) In vessels of 50 metres or more in length:

- a masthead light, 6 miles;
- a sidelight, 3 miles;
- a sternlight, 3 miles;
- a towing light, 3 miles;
- a white, red, green or yellow all-round light, 3 miles.

(b) In vessels of 12 metres or more in length but less than 50 metres in length:

- a masthead light, 5 miles; except that where the length of the vessel is less than 20 metres, 3 miles;
- a sidelight, 2 miles;
- a sternlight, 2 miles;
- a towing light, 2 miles;
- a white, red, green or yellow all-round light, 2 miles.

(c) In vessels of less than 12 metres in length:

- a masthead light, 2 miles;
- a sidelight, 1 mile;
- a sternlight, 2 miles;
- a towing light, 2 miles
- a white, red, green or yellow all-round light, 2 miles.

(d) In inconspicuous, partly submerged vessels or objects being towed:

- a white all-round light, 3 miles.

Rule 23

Power-driven vessels underway

(a) A power-driven vessel underway shall exhibit:

(i) a masthead light forward;

(ii) a second masthead light abaft of and higher than the forward one; except that a vessel of less than 50 metres in length shall not be obliged to exhibit such light but may do so;

(iii) sidelights;

(iv) a sternlight.

(b) An air-cushion vessel when operating in the non-displacement mode shall, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit an all-round flashing yellow light.

(c) (i) A power-driven vessel of less than 12 metres in length may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and sidelights;

(ii) a power-driven vessel of less than 7 metres in length whose maximum speed does not exceed 7 knots may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and shall, if practicable, also exhibit sidelights;

(iii) the masthead light or all-round white light on a power-driven vessel of less than 12 metres in length may be displaced from the fore and aft centreline of the vessel if centreline fitting is not practicable, provided that the sidelights are combined in one lantern which shall be carried on the fore and aft centreline of the vessel or located as nearly as practicable in the same fore and aft line as the masthead light or the all-round white light.

Rule 24

Towing and pushing

(a) A power-driven vessel when towing shall exhibit:

(i) instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line. When the length of the tow, measuring from the stern of the towing vessel to the after end of the tow exceeds 200 metres, three such lights in a vertical line;

(ii) sidelights;

(iii) a sternlight;

(iv) a towing light in a vertical line above the sternlight;

(v) when the length of the tow exceeds 200 metres, a diamond shape where it can best be seen.

(b) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and exhibit the lights prescribed in Rule 23.

(c) A power-driven vessel when pushing ahead or towing alongside, except in the case of a composite unit, shall exhibit:

(i) instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line;

(ii) sidelights;

(iii) a sternlight.

(d) A power-driven vessel to which paragraph (a) or (c) of this Rule applies shall also comply with Rule 23(a)(ii).

(e) A vessel or object being towed, other than those mentioned in paragraph (g) of this Rule, shall exhibit:

(i) sidelights;

(ii) a sternlight;

(iii) when the length of the tow exceeds 200 metres, a diamond shape where it can best be seen.

(f) Provided that any number of vessels being towed alongside or pushed in a group shall be lighted as one vessel,

(i) a vessel being pushed ahead, not being part of a composite unit, shall exhibit at the forward end sidelights;

(ii) a vessel being towed alongside shall exhibit a sternlight and at the forward end, sidelights.

(g) An inconspicuous, partly submerged vessel or object, or combination of such vessels or objects being towed, shall exhibit:

(i) if it is less than 25 metres in breadth, one all-round white light at or near the forward end and one at or near the after end except that dracones need not exhibit a light at or near the forward end;

(ii) if it is 25 metres or more in breadth, two additional all-round white lights at or near the extremities of its breadth;

(iii) if it exceeds 100 metres in length, additional all-round white lights between the lights prescribed in sub-paragraphs (i) and (ii) so that the distance between the lights shall not exceed 100 metres;

(iv) a diamond shape at or near the aftermost extremity of the last vessel or object being towed and if the length of the tow exceeds 200 metres an additional diamond shape where it can best be seen and located as far forward as is practicable.

(h) Where from any sufficient cause it is impracticable for a vessel or object being towed to exhibit the lights or shapes prescribed in paragraph (e) or (g) of this Rule, all possible measures shall be taken to light the vessel or object towed or at least to indicate the presence of such vessel or object.

(i) Where from any sufficient cause it is impracticable for a vessel not normally engaged in towing operations to display the lights prescribed in paragraph (a) or (c) of this Rule, such vessel shall not be required to exhibit those lights when engaged in towing another vessel in distress or otherwise in need of assistance. All possible measures shall be taken to indicate the nature of the relationship between the towing vessel and the vessel being towed as authorized by Rule 36, in particular by illuminating the towline.

Rule 25

Sailing vessels underway and vessels under oars

(a) A sailing vessel underway shall exhibit:

(i) sidelights;

(ii) a sternlight.

(b) In a sailing vessel of less than 20 metres in length the lights prescribed in paragraph (a) of this Rule may be combined in one lantern carried at or near the top of the mast where it can best be seen.

(c) A sailing vessel underway may, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit at or near the top of the mast, where they can best be seen, two all-round lights in a vertical line, the upper being red and the lower green, but these lights shall not be exhibited in conjunction with the combined lantern permitted by paragraph (b) of this Rule.

(d) (i) A sailing vessel of less than 7 metres in length shall, if practicable, exhibit the lights prescribed in paragraph (a) or (b) of this Rule, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.

(ii) A vessel under oars may exhibit the lights prescribed in this Rule for sailing vessels, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.

(e) A vessel proceeding under sail when also being propelled by machinery shall exhibit forward where it can best be seen a conical shape, apex downwards.

Rule 26

Fishing Vessels

(a) A vessel engaged in fishing, whether underway or at anchor, shall exhibit only the lights and shapes prescribed in this Rule.

(b) A vessel when engaged in trawling, by which is meant the dragging through the water of a dredge net or other apparatus used as a fishing appliance, shall exhibit:

(i) two all-round lights in a vertical line, the upper being green and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other;

(ii) a masthead light abaft of and higher than the all-round green light; a vessel of less than 50 metres in length shall not be obliged to exhibit such a light but may do so;

(iii) when making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a sternlight.

(c) A vessel engaged in fishing, other than trawling, shall exhibit:

(i) two all-round lights in a vertical line, the upper being red and the lower white, or a shape consisting of two cones with apexes together in a vertical line one above the other;

(ii) when there is outlying gear extending more than 150 metres horizontally from the vessel, an all-round white light or a cone apex upwards in the direction of the gear;

(iii) when making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a sternlight.

(d) The additional signals described in Annex II to these Regulations apply to a vessel engaged in fishing in close proximity to other vessels engaged in fishing.

(e) A vessel when not engaged in fishing shall not exhibit the lights or shapes prescribed in this Rule, but only those prescribed for a vessel of her length.

Rule 27

Vessels not under command or restricted in their ability to manoeuvre

(a) A vessel not under command shall exhibit:

(i) two all-round red lights in a vertical line where they can best be seen;

(ii) two balls or similar shapes in a vertical line where they can best be seen;

(iii) when making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a sternlight.

(b) A vessel restricted in her ability to manoeuvre, except a vessel engaged in mine-clearance operations, shall exhibit:

(i) three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white;

(ii) three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes shall be balls and the middle one a diamond;

(iii) when making way through the water, a masthead light or lights, sidelights and a sternlight, in addition to the lights prescribed in sub-paragraph (i);

(iv) when at anchor, in addition to the lights or shapes prescribed in sub-paragraphs (i) and (ii), the light, lights or shape prescribed in Rule 30.

(c) A power-driven vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course shall, in addition to the lights or shapes prescribed in Rule 24(a), exhibit the lights or shapes prescribed in sub-paragraphs (b)(i) and (ii) of this Rule.

(d) A vessel engaged in dredging or underwater operations, when restricted in her ability to manoeuvre, shall exhibit the lights and shapes prescribed in sub-paragraphs (b)(i), (ii) and (iii) of this Rule and shall in addition, when an obstruction exists, exhibit:

(i) two all-round red lights or two balls in a vertical line to indicate theside on which the obstruction exists;

(ii) two all-round green lights or two diamonds in a vertical line to indicate the side on which another vessel may pass;

(iii) when at anchor, the lights or shapes prescribed in this paragraph instead of the lights or shape prescribed in Rule 30.

(e) Whenever the size of a vessel engaged in diving operations makes it impracticable to exhibit all lights and shapes prescribed in paragraph (d) of this Rule, the following shall be exhibited:

(i) three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white;

(ii) a rigid replica of the International Code flag "A" not less than 1 metre in height. Measures shall be taken to ensure its all-round visibility.

(f) A vessel engaged in mine-clearance operations shall in addition to the lights prescribed for a power-driven vessel in Rule 23 or to the lights or shape prescribed for a vessel at anchor in Rule 30 as appropriate, exhibit three all-round green lights or three balls. One of these lights or shapes shall be exhibited near the foremast head and one at each end of the fore yard. These lights or shapes indicate that it is dangerous for another vessel to approach within 1000 metres of the mine clearance vessel.

(g) Vessels of less than 12 metres in length, except those engaged in diving operations, shall not be required to exhibit the lights and shapes prescribed in this Rule.

(h) The signals prescribed in this Rule are not signals of vessels in distress and requiring assistance. Such signals are contained in Annex IV to these Regulations.

Rule 28

Vessels constrained by their draught

A vessel constrained by her draught may, in addition to the lights prescribed for power-driven vessels in Rule 23, exhibit where they can best be seen three all-round red lights in a vertical line, or a cylinder.

Rule 29

Pilot vessels

(a) A vessel engaged on pilotage duty shall exhibit:

(i) at or near the masthead, two all-round lights in a vertical line, the upper being white and the lower red;

(ii) when underway, in addition, sidelights and a sternlight;

(iii) when at anchor, in addition to the lights prescribed in sub-paragraph (i), the light, lights or shape prescribed in Rule 30 for vessels at anchor.

(b) A pilot vessel when not engaged on pilotage duty shall exhibit the lights or shapes prescribed for a similar vessel of her length.

Rule 30

Anchored vessels and vessels aground

(a) A vessel at anchor shall exhibit where it can best be seen:

(i) in the fore part, an all-round white light or one ball;

(ii) at or near the stern and at a lower level than the light prescribed in sub-paragraph (i), an all-round white light.

(b) A vessel of less than 50 metres in length may exhibit an all-round white light where it can best be seen instead of the lights prescribed in paragraph (a) of this Rule.

(c) A vessel at anchor may, and a vessel of 100 metres and more in length shall, also use the available working or equivalent lights to illuminate her decks.

(d) A vessel aground shall exhibit the lights prescribed in paragraph (a) or (b) of this Rule and in addition, where they can best be seen:

(i) two all-round red lights in a vertical line;

(ii) three balls in a vertical line.

(e) A vessel of less than 7 metres in length, when at anchor, not in or near a narrow channel, fairway or anchorage, or where other vessels normally navigate, shall not be required to exhibit the lights or shape prescribed in paragraphs (a) and (b) of this Rule.

(f) A vessel of less than 12 metres in length, when aground, shall not be required to exhibit the lights or shapes prescribed in sub-paragraphs (d)(i) and (ii) of this Rule.

Rule 31

Seaplanes

Where it is impracticable for a seaplane to exhibit lights and shapes of the characteristics or in the positions prescribed in the Rules of this Part she shall exhibit lights and shapes as closely similar in characteristics and position as is possible.

PART D - SOUND AND LIGHT SIGNALS

Rule 32

Definitions

(a) The word "whistle" means any sound signalling appliance capable of producing the prescribed blasts and which complies with the specifications in Annex III to these Regulations.

(b) The term "short blast" means a blast of about one second's duration.

(c) The term "prolonged blast" means a blast of from four to six seconds' duration.

Rule 33

Equipment for sound signals

(a) A vessel of 12 metres or more in length shall be provided with a whistle and a bell and a vessel of 100 metres or more in length shall, in addition, be provided with a gong, the tone and sound of which cannot be confused with that of the bell. The whistle, bell and gong shall comply with the specifications in Annex III to these Regulations. The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the prescribed signals shall always be possible.

(b) A vessel of less than 12 metres in length shall not be obliged to carry the sound signalling appliances prescribed in paragraph (a) of this Rule but if she does not, she shall be provided with some other means of making an efficient sound signal.

Rule 34

Manoeuvring and warning signals

(a) When vessels are in sight of one another, a power-driven vessel underway, when manoeuvring as authorized or required by these Rules, shall indicate that manoeuvre by the following signals on her whistle:

- one short blast to mean "I am altering my course to starboard";
- two short blasts to mean "I am altering my course to port";
- three short blasts to mean "I am operating astern propulsion".

(b) Any vessel may supplement the whistle signals prescribed in paragraph (a) of this Rule by light signals, repeated as appropriate, whilst the manoeuvre is being carried out:

(i) these light signals shall have the following significance

- one flash to mean "I am altering my course to starboard";
- two flashes to mean "I am altering my course to port";
- three flashes to mean "I am operating astern propulsion";

(ii) the duration of each flash shall be about one second, the interval between flashes shall be about one second, and the interval between successive signals shall be not less than ten seconds;

(iii) the light used for this signal shall, if fitted, be an all-round white light, visible at a minimum range of 5 miles, and shall comply with the provisions of Annex I to these Regulations.

(c) When in sight of one another in a narrow channel or fairway:

(i) a vessel intending to overtake another shall in compliance with Rule 9(e)(i) indicate her intention by the following signals on her whistle:

- two prolonged blasts followed by one short blast to mean "I intend to overtake you on your starboard side";

- two prolonged blasts followed by two short blasts to mean "I intend to overtake you on your port side".

(ii) the vessel about to be overtaken when acting in accordance with Rule 9(e)(i) shall indicate her agreement by the following signal on her whistle:

- one prolonged, one short, one prolonged and one short blast, in that order.

(d) When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle. Such signal may be supplemented by a light signal of at least five short and rapid flashes.

(e) A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel that may be within hearing around the bend or behind the intervening obstruction.

(f) If whistles are fitted on a vessel at a distance apart of more than 100 metres, one whistle only shall be used for giving manoeuvring and warning signals.

Rule 35

Sound signals in restricted visibility

In or near an area of restricted visibility, whether by day or night, the signals prescribed in this Rule shall be used as follows:

(a) A power-driven vessel making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast.

(b) A power-driven vessel underway but stopped and making no way through the water shall sound at intervals of not more than 2 minutes two prolonged blasts in succession with an interval of about 2 seconds between them.

(c) A vessel not under command, a vessel restricted in her ability to manoeuvre, a vessel constrained by her draught, a sailing vessel, a vessel engaged in fishing and a vessel engaged in towing or pushing another vessel shall, instead of the signals prescribed in paragraphs (a) or (b) of this Rule, sound at intervals of not more than 2 minutes three blasts in succession, namely one prolonged followed by two short blasts.

(d) A vessel engaged in fishing, when at anchor, and a vessel restricted in her ability to manoeuvre when carrying out her work at anchor, shall instead of the signals prescribed in paragraph (g) of this Rule sound the signal prescribed in paragraph (c) of this Rule.

(e) A vessel towed or if more than one vessel is towed the last vessel of the tow, if manned, shall at intervals of not more than 2 minutes sound four blasts in succession, namely one prolonged followed by three short blasts. When practicable, this signal shall be made immediately after the signal made by the towing vessel.

(f) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and shall give the signals prescribed in paragraphs (a) or (b) of this Rule.

(g) A vessel at anchor shall at intervals of not more than one minute ring the bell rapidly for about 5 seconds. In a vessel of 100 metres or more in length the bell shall be sounded in the forepart of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about 5 seconds in the after part of the vessel. A vessel at anchor may in addition sound three blasts in succession, namely one short, one prolonged and one short blast, to give warning of her position and of the possibility of collision to an approaching vessel.

(h) A vessel aground shall give the bell signal and if required the gong signal prescribed in paragraph (g) of this Rule and shall, in addition, give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell. A vessel aground may in addition sound an appropriate whistle signal.

(i) A vessel of less than 12 metres in length shall not be obliged to give the above-mentioned signals but, if she does not, shall make some other efficient sound signal at intervals of not more than 2 minutes.

(j) A pilot vessel when engaged on pilotage duty may in addition to the signals prescribed in paragraphs (a),(b) or (g) of this Rule sound an identity signal consisting of four short blasts.

Rule 36

Signals to attract attention

If necessary to attract the attention of another vessel any vessel may make light or sound signals that cannot be mistaken for any signal authorised elsewhere in these Rules, or may direct the beam of her searchlight in the direction of the danger, in such a way as not to embarrass any vessel. Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation. For the purpose of this Rule the use of high intensity intermittent or revolving lights, such as strobe lights, shall be avoided.

Rule 37

Distress signals

When a vessel is in distress and requires assistance she shall use or exhibit the signals described in Annex IV to these Regulations.

PART E - EXEMPTIONS

Rule 38

Exemptions

Any vessel (or class of vessels) provided that she complies with the requirements of the International Regulations for Preventing Collisions at Sea, 1960 **(a)**, the keel of which is laid or which is at a corresponding stage of construction before the entry into force of these Regulations may be exempted from compliance therewith as follows:

(a) The installation of lights with ranges prescribed in Rule 22, until 4 years after the date of entry into force of these Regulations.

(b) The installation of lights with colour specifications as prescribed in Section 7 of Annex I to these Regulations, until 4 years after the date of entry into force of these Regulations.

(c) The repositioning of lights as a result of conversion from Imperial to metric units and rounding off measurement figures, permanent exemption.

(d) (i) The repositioning of masthead lights on vessels of less than 150 metres in length, resulting from the prescriptions of Section 3(a) of Annex I to these Regulations, permanent exemption.

(ii) The repositioning of masthead lights on vessels of 150 metres or more in length, resulting from the prescriptions of Section 3(a) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(e) The repositioning of masthead lights resulting from the prescriptions of Section 2(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(f) The repositioning of sidelights resulting from the prescriptions of Sections 2(g) and 3(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(g) The requirements for sound signal appliances prescribed in Annex III to these Regulations, until 9 years after the date of entry into force of these Regulations.

(h) The repositioning of all-round lights resulting from the prescription of Section 9(b) of Annex I to these Regulations, permanent exemption.

(a) See Cmnd.2956 and Schedule 1 to the Collision Regulations (Ships and Seaplanes on the Water) and Signals of Distress (Ships) Order 1965 (S.I. 1965/1525)

ANNEX I

Positioning and technical details of lights and shapes

1 ***Definition***

The term "height above the hull" means height above the uppermost continuous deck. This height shall be measured from the position vertically beneath the location of the light.

2 ***Vertical positioning and spacing of lights***

(a) On a power-driven vessel of 20 metres or more in length the masthead lights shall be placed as follows:

(i) the forward masthead light, or if only one masthead light is carried, then that light, at a height above the hull of not less than 6 metres, and, if the breadth of the vessel exceeds 6 metres, then at a height above the hull not less than such breadth, so however that the light need not be placed at a greater height above the hull than 12 metres;

(ii) when two masthead lights are carried the after one shall be at least 4.5 metres vertically higher than the forward one.

(b) The vertical separation of masthead lights of power-driven vessels shall be such that in all normal conditions of trim the after light will be seen over and separate from the forward light at a distance of 1,000 metres from the stem when viewed from sea-level.

(c) The masthead light of a power-driven vessel of 12 metres but less than 20 metres in length shall be placed at a height above the gunwale of not less than 2.5 metres.

(d) A power-driven vessel of less than 12 metres in length may carry the uppermost light at a height of less than 2.5 metres above the gunwale. When however a masthead light is carried in addition to sidelights and a sternlight or the all-round light prescribed in Rule 23(c)(i) is carried in addition to sidelights, then such masthead light or all-round light shall be carried at least 1 metre higher than the sidelights.

(e) One of the two or three masthead lights prescribed for a power-driven vessel when engaged in towing or pushing another vessel shall be placed in the same position as either the forward masthead light or the after masthead light; provided that, if carried on the aftermast, the lowest after masthead light shall be at least 4.5 metres vertically higher than the forward masthead light.

(f) (i) The masthead light or lights prescribed in Rule 23(a) shall be so placed as to be above and clear of all other lights and obstructions except as described in sub-paragraph (ii).

(ii) When it is impracticable to carry the all-round lights prescribed by Rule 27(b)(i) or Rule 28 below the masthead lights, they may be carried above the after masthead light(s) or vertically in between the forward masthead light(s) and the after masthead light(s) provided that in the latter case the requirement of Section 3(c) of this Annex shall be complied with.

(g) The sidelights of a power-driven vessel shall be placed at a height above the hull not greater than three-quarters of that of the forward masthead light. They shall not be so low as to be interfered with by deck lights.

(h) The sidelights, if in a combined lantern and carried on a power-driven vessel of less than 20 metres in length, shall be placed not less than 1 metre below the masthead light.

(i) When the Rules prescribe two or three lights to be carried in a vertical line, they shall be spaced as follows:

(i) on a vessel of 20 metres in length or more such lights shall be spaced not less than 2 metres apart, and the lowest of these lights shall, except where a towing light is required, be placed at a height of not less than 4 metres above the hull;

(ii) on a vessel of less than 20 metres in length such lights shall be spaced not less than 1 metre apart and the lowest of these lights shall, except where a towing light is required, be placed at a height of not less than 2 metres above the gunwale;

(iii) when three lights are carried they shall be equally spaced.

(j) The lower of the two all-round lights prescribed for a vessel when engaged in fishing shall be at a height above the sidelights not less than twice the distance between the two vertical lights.

(k) The forward anchor light prescribed in Rule 30(a)(i), when two are carried, shall not be less than 4.5 metres above the after one. On a vessel of 50 metres or more in length this forward anchor light shall be placed at a height of not less than 6 metres above the hull.

3 *Horizontal positioning and spacing of lights*

(a) When two masthead lights are prescribed for a power-driven vessel, the horizontal distance between them shall not be less than one-half of the length of the vessel but need not be more than 100 metres. The forward light shall be placed not more than one-quarter of the length of the vessel from the stem.

(b) On a power-driven vessel of 20 metres or more in length the sidelights shall not be placed in front of the forward masthead lights. They shall be placed at or near the side of the vessel.

(c) When the lights prescribed in Rule 27(b)(i) or Rule 28 are placed vertically between the forward masthead light(s) and the after masthead light(s) these all-round lights shall be placed at a horizontal distance of not less than 2 metres from the fore and aft centreline of the vessels in the athwartship direction.

(d) When only one masthead light is prescribed for a power-driven vessel, this light shall be exhibited forward of amidships; except that a vessel of less than 20 metres in length need not exhibit this light forward of amidships but shall exhibit it as far forward as is practicable.

4 *Details of location of direction-indicating lights for fishing vessels, dredgers and vessels engaged inunderwater operations*

(a) The light indicating the direction of the outlying gear from a vessel engaged in fishing as prescribed in Rule 26(c)(ii) shall be placed at a horizontal distance of not less than 2 metres and not more than 6 metres away from the two all-round red and white lights. This light shall be placed not higher than the all-round white light prescribed in Rule 26(c)(i) and not lower than the sidelights.

(b) The lights and shapes on a vessel engaged in dredging or underwater operations to indicate the obstructed side and/or the side on which it is safe to pass, as prescribed in Rule 27(d)(i) and (ii), shall be placed at the maximum practical horizontal distance, but in no case less than 2 metres, from the lights or shapes prescribed in Rule 27(b)(i) and (ii). In no case shall the upper of these lights or shapes be at a greater height than the lower of the three lights or shapes prescribed in Rule 27(b)(i) and (ii).

5. *Screens for sidelights*

The sidelights of vessels of 20 metres or more in length shall be fitted with inboard screens painted matt black, and meeting the requirements of Section 9 of this Annex. On vessels of less than 20 metres in length the sidelights, if necessary to meet the requirements of Section 9 of this Annex, shall be fitted with inboard matt black screens. With a combined lantern, using a single vertical filament and a very narrow division between the green and red sections, external screens need not be fitted.

6 *Shapes*

(a) Shapes shall be black and of the following sizes:

(i) a ball shall have a diameter of not less than 0.6 metre;

(ii) a cone shall have a base diameter of not less than 0.6 metre and a height equal to its diameter;

(iii) a cylinder shall have a diameter of at least 0.6 metre and a height of twice its diameter

(iv) a diamond shape shall consist of two cones as defined in (ii) above having a common base.

(b) The vertical distance between shapes shall be at least 1.5 metres.

(c) In a vessel of less than 20 metres in length shapes of lesser dimensions but commensurate with the size of the vessel may be used and the distance apart may be correspondingly reduced.

7. *Colour specification of lights*

The chromaticity of all navigation lights shall conform to the following standards, which lie within the boundaries of the area of the diagram specified for each colour by the International Commission on Illumination (CIE).

The boundaries of the area for each colour are given by indicating the corner co-ordinates, which are as follows:

(i) White

x	0.525	0.525	0.452	0.310	0.310	0.443
y	0.382	0.440	0.440	0.348	0.283	0.382

(ii) Green

x	0.028	0.009	0.300	0.203
y	0.385	0.723	0.511	0.356

(iii) Red

x	0.680	0.660	0.735	0.721
y	0.320	0.320	0.265	0.259

(iv) Yellow

x	0.612	0.618	0.575	0.575
y	0.382	0.382	0.425	0.406

8. *Intensity of lights*

(a) The minimum luminous intensity of lights shall be calculated by using

$$I = 3.43 \times 10^6 \times T \times D^2 \times K^{-D}$$

where I is luminous intensity in candelas under service conditions,

T is threshold factor 2×10^{-7} lux,

D is range of visibility (luminous range) of the light in nautical miles,

K is atmospheric transmissivity.

For prescribed lights the value of K shall be 0.8, corresponding to a meteorological visibility of approximately 13 nautical miles.

(b) A selection of figures derived from the formula is given in the following table:

Range of visibility (luminous range) of light in nautical miles D	Luminous intensity of light in candelas for K = 0.8 I
1	0.9
2	4.3
3	12
4	27
5	52
6	94

Note : The maximum luminous intensity of navigation lights should be limited to avoid undue glare. This shall not be achieved by a variable control of the luminous intensity.

9. *Horizontal sectors*

(a) (i) In the forward direction, sidelights as fitted on the vessel shall show the minimum required intensities. The intensities shall decrease to reach practical cut-off between 1 degree and 3 degrees outside the prescribed sectors.

(ii) For sternlights and masthead lights at 22.5 degrees abaft the beam for sidelights, the minimum required intensities shall be maintained over the arc of the horizon up to 5 degrees within the limits of the sectors prescribed in Rule 21. From 5 degrees within the prescribed sectors the intensity may decrease by 50 per cent up to the prescribed limits: it shall decrease steadily to reach practical cut-off at not more than 5 degrees outside the prescribed sectors.

(b) (i) All-round lights shall be so located as not to be obscured by masts, topmasts or structures within angular sectors of more than 6 degrees, except anchor lights prescribed in Rule 30, which need not be placed at an impracticable height above the hull.

(ii) If it is impracticable to comply with paragraph (b)(i) of this section by exhibiting only one all-round light, two all-round lights shall be used suitably positioned or screened so that they appear, as far as practicable, as one light at a distance of one mile.

10. *Vertical sectors*

(a) The vertical sectors of electric lights as fitted, with the exception of lights on sailing vessels underway shall ensure that:

(i) at least the required minimum intensity is maintained at all angles from 5 degrees above to 5 degrees below the horizontal;

(ii) at least 60 per cent of the required minimum intensity is maintained from 7.5 degrees above to 7.5 degrees below the horizontal.

(b) In the case of sailing vessels underway the vertical sectors of electric lights as fitted shall ensure that:

(i) at least the required minimum intensity is maintained at all angles from 5 degrees above to 5 degrees below the horizontal;

(ii) at least 50 per cent of the required minimum intensity is maintained from 25 degrees above to 25 degrees below the horizontal.

(c) In the case of lights other than electric these specifications shall be met as closely as possible.

11. *Intensity of non-electric lights*

Non-electric lights shall so far as practicable comply with the minimum intensities, as specified in the table given in Section 8 of this Annex.

12. *Manoeuvring light*

Notwithstanding the provisions of paragraph 2(f) of this Annex the manoeuvring light described in Rule 34(b) shall be placed in the same fore and aft vertical plane as the masthead light or lights and, where practicable, at a minimum height of 2 metres vertically above the forward masthead light, provided that it shall be carried not less than 2 metres vertically above or below the after masthead light. On a vessel where only one masthead light is carried the manoeuvring light, if fitted, shall be carried where it can best be seen, not less than 2 metres vertically apart from the masthead light.

13. *High Speed Craft*

The masthead light of high speed craft with a length to breadth ratio of less than 3.0 may be placed at a height related to the breadth of the craft lower than that prescribed in paragraph 2(a)(i) of this Annex, provided that the base angle of the isosceles triangles formed by the sidelights and masthead light, when seen in end elevation, is not less than 27 degrees.

14. *Approval*

The construction of lights and shapes and the installation of lights on board the vessel shall be to the satisfaction of the appropriate authority of the State whose flag the vessel is entitled to fly.

ANNEX II

Additional signals for fishing vessels fishing in close proximity

1. *General*

The lights mentioned herein shall, if exhibited in pursuance of Rule 26(d), be placed where they can best be seen. They shall be at least 0.9 metre apart but at a lower level than lights prescribed in Rule 26(b)(i) and (c)(i). The lights shall be visible all round the horizon at a distance of at least 1 mile but at a lesser distance than the lights prescribed by these Rules for fishing vessels.

2. *Signals for trawlers*

(a) Vessels of 20 metres or more in length when engaged in trawling, whether using demersal or pelagic gear, shall exhibit:

(i) when shooting their nets, two white lights in a vertical line;

(ii) when hauling their nets, one white light over one red light in a vertical line;

(iii) when the net has come fast upon an obstruction, two red lights in a vertical line.

(b) Each vessel of 20 metres or more in length engaged in pair trawling shall exhibit:

(i) by night, a searchlight directed forward and in the direction of the other vessel of the pair;

(ii) when shooting or hauling their nets or when the nets have come fast upon an obstruction, the lights prescribed in 2(a) above.

(c) A vessel of less than 20 metres in length engaged in trawling, whether using demersal or pelagic gear or engaged in pair trawling, may exhibit the lights prescribed in paragraphs (a) or (b) of this Section, as appropriate.

3. *Signals for purse seiners*

Vessels engaged in fishing with purse seine gear may exhibit two yellow lights in a vertical line. These lights shall flash alternately every second and with equal light and occultation duration. These lights may be exhibited only when the vessel is hampered by its fishing gear.

ANNEX III

Technical details of sound signal appliances

1. *Whistles*

(a) ***Frequencies and range of audibility***

The fundamental frequency of the signal shall lie within the range 70 - 700 Hz.

The range of audibility of the signal from a whistle shall be determined by those frequencies, which may include the fundamental and/or one or more higher frequencies, which lie within the range 180 - 700 Hz (±1 per cent) and which provide the sound pressure levels specified in paragraph 1(c) below.

(b) ***Limits of fundamental frequencies***

To ensure a wide variety of whistle characteristics, the fundamental frequency of a whistle shall be between the following limits:

(i) 70 - 200 Hz, for a vessel 200 metres or more in length;

(ii) 130 - 350 Hz, for a vessel 75 metres but less than 200 metres in length;

(iii) 250 - 700 Hz, for a vessel less than 75 metres in length.

(c) ***Sound signal intensity and range of audibility***

A whistle fitted in a vessel shall provide, in the direction of maximum intensity of the whistle and at a distance of 1 metre from it, a sound pressure level in at least one 1/3rd-octave band within the range of frequencies 180 - 700 Hz (±1 per cent) of not less than the appropriate figure given in the table below.

Length of vessel in metres	1/3rd-octave band level at 1 metre in dB referred to 2×10^{-5} N/m^2	Audibility range in nautical miles
200 or more	143	2
75 but less than 200	138	1.5
20 but less than 75	130	1
Less than 20	120	0.5

The range of audibility in the table above is for information and is approximately the range at which a whistle may be heard on its forward axis with 90 per cent probability in conditions of still air on board a vessel having average background noise level at the listening posts (taken to be 68 dB in the octave band centred on 250 Hz and 63 dB in the octave band centred on 500 Hz).

In practice the range at which a whistle may be heard is extremely variable and depends critically on weather conditions; the values given can be regarded as typical but under conditions of strong wind or high ambient noise level at the listening post the range may be much reduced.

(d) *Directional Properties*

The sound pressure level of a directional whistle shall be not more than 4 dB below the prescribed sound pressure level on the axis at any direction in the horizontal plane within ±45 degrees of the axis. The sound pressure level at any other direction in the horizontal plane shall be not more than 10 dB below the prescribed sound pressure level on the axis, so that the range in any direction will be at least half the range on the forward axis. The sound pressure level shall be measured in that 1/3rd-octave band which determines the audibility range.

(e) *Positioning of whistles*

When a directional whistle is to be used as the only whistle on a vessel, it shall be installed with its maximum intensity directed straight ahead.

A whistle shall be placed as high as practicable on a vessel, in order to reduce interception of the emitted sound by obstructions and also to minimize hearing damage risk to personnel. The sound pressure level of the vessel's own signal at listening posts shall not exceed 110 dB (A) and so far as practicable should not exceed 100 dB (A).

(f) *Fitting of more than one whistle*

If whistles are fitted at a distance apart of more than 100 metres, it shall be so arranged that they are not sounded simultaneously.

(g) *Combined whistle systems*

If due to the presence of obstructions the sound field of a single whistle or one of the whistles referred to in paragraph l(f) above is likely to have a zone of greatly reduced signal level, it is recommended that a combined whistle system be fitted so as to overcome this reduction. For the purposes of the Rules a combined whistle system is to be regarded as a single whistle. The whistles of a combined system shall be located at a distance apart of not more than 100 metres and arranged to be sounded simultaneously. The frequency of any one whistle shall differ from those of the others by at least 10 Hz.

2. *Bell or gong*

(a) *Intensity of signal*

A bell or gong, or other device having similar sound characteristics shall produce a sound pressure level of not less than 110 dB at a distance of 1 metre from it.

(b) *Construction*

Bells and gongs shall be made of corrosion-resistant material and designed to give a clear tone. The diameter of the mouth of the bell shall be not less than 300 mm for vessels of 20 metres or more in length, and shall be not less than 200 mm for vessels of 12 metres or more, but of less than 20 metres in length. Where practicable, a power-driven bell striker is recommended to ensure constant force but manual operation shall be possible. The mass of the striker shall be not less than 3 per cent of the mass of the bell.

3. *Approval*

The construction of sound signal appliances, their performance and their installation on board the vessel shall be to the satisfaction of the appropriate authority of the State whose flag the vessel is entitled to fly.

ANNEX IV

Distress signals

1. The following signals, used or exhibited either together or separately, indicate distress and need of assistance:

(a) a gun or other explosive signal fired at intervals of about a minute;

(b) a continuous sounding with any fog-signalling apparatus;

(c) rockets or shells, throwing red stars fired one at a time at short intervals;

(d) a signal made by radiotelegraphy or by any other signalling method consisting of the group ... - - - ... (SOS) in the Morse Code;

(e) a signal sent by radiotelephony consisting of the spoken word " Mayday";

(f) the International Code Signal of distress indicated by N.C.;

(g) a signal consisting of a square flag having above or below it a ball or anything resembling a ball;

(h) flames on the vessel (as from a burning tar barrel, oil barrel, etc.);

(i) a rocket parachute flare or a hand flare showing a red light;

(j) a smoke signal giving off orange-coloured smoke;

(k) slowly and repeatedly raising and lowering arms outstretched to each side;

(l) the radiotelegraph alarm signal;

(m) the radiotelephone alarm signal;

(n) signals transmitted by emergency position-indicating radio beacons;

(o) approved signals transmitted by radiocommunication systems, including survival craft radar transponders.

2. The use or exhibition of any of the foregoing signals except for the purpose of indicating distress and need of assistance and the use of other signals which may be confused with any of the above signals is prohibited.

3. Attention is drawn to the relevant sections of the International Code of Signals, the Merchant Ship Search and Rescue Manual and the following signals:

(a) a piece of orange-coloured canvas with either a black square and circle or other appropriate symbol (for identification from the air);

(b) a dye marker.

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