MILLENNIUM 2000
THE RYA AND SA SAILING
YACHT HAND / COMPETENT CREW AND YACHT SKIPPER (CLUB, INLAND, AND LOCAL WATERS SKIPPERS)

Shorebased (Theory) Course

A S.A. Sailing Approved Course

incorporating the syllabus of the

Royal Yachting Association
and the
Australian Yachting Federation

By
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Yachtmaster Ocean Services cc
Cape Town

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By the same author:

'YACHTMASTER OCEAN - THE COMPLETE RYA AND CASA SYLLABUS SHOREBASED COURSE'*

'COASTAL SKIPPER/YACHTMASTER OFFSHORE - THE COMPLETE RYA AND CASA SYLLABUS SHOREBASED COURSE'

'COMPETENT CREW PRACTICAL COURSE'

'YACHT SKIPPER (LOCAL WATERS) PRACTICAL COURSE'

The above courses conform with the RYA and CASA syllabuses.
Also:

'RADIOTELEPHONE OPERATORS RESTRICTED (MARINE) CERTIFICATE COURSE FOR EXAMINATION CANDIDATES'

'ASTRO NAVIGATION IN EMERGENCIES'
- FOR THE NON-ASTRO NAVIGATOR

* Acclaimed by a Yachtmaster examiner who assessed the instructional value of the work, as ...

'The best I have ever seen'.

* A senior corporate executive who attended a course describes the book as ...

'absolutely excellent'

and the course as ...

'The best well run course I have ever attended'.

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GENERAL INTRODUCTION

The Syllabus

The detail of the course syllabus is contained in the Inland Waters Yachtsmans' Logbook. In summary, the courses' syllabuses are as follows:

1. Competent Crew (Yacht Hand) Inland Waters.

ALL candidates MUST know:

a. The main nautical terms.

b. Sail handling.

c. Ropework.

d. Fire precautions and fire fighting.

e. Personal Safety Equipment.

f. Man-Overboard procedures.[1]

g. Distress signals.

h. Manners and customs.

i. Rules of the Road.

j. Dinghies.[1]

k. Meteorology.

l. Helmsmanship.[1]

m. Engines.[2]

Desirable (not essential) knowledge)

n. Swimming.[3]

o. Artificial Resuscitation.[4]

p. First Aid.[4]

2. Yacht Skipper (Inland Waters).

a. Preparation for sailing.

b. Action in adverse weather.[1]

c. Deck work.[1]

d. Meteorology.

e. Rules of the Road.

f. Maintenance and repair work.[2]

g. Emergency situations.[1]

h. Boat handling.[1]

i. Artificial resuscitation.[4]

j. First Aid.[4]

3. Competent Crew/Skipper (Local Waters)

For offshore sailing, in addition to the aspects covered in the above two paragraphs, the candidate must also have a knowledge of:

a. Anchorwork (includes types of anchors/methods of anchoring).

b. Navigational Charts and Publications.

c. Navigational Drawing Instruments.

d. Compasses.

e. Chartwork.

f. Position Fixing.

g. Tides and Tidal Streams.

h. Pilotage.

i. Visual Aids to Navigation.

j. Passage Planning.

k. Navigation in Restricted Visibility.

[1] To be covered in the practical phase of the course.
[2] Refer to "Owners' Manuals" and suppliers/agents.
[3] Beyond the scope of this course.
[4] Take a proper First Aid course - it could be important!

Pre-Course Qualifications

There are no, repeat NO pre-course qualifications required for people wishing to do the Competent Crew (Yacht Hand) course - they should however be physically able to perform any task expected of a crew person.

The Yacht Skipper (Inland Waters) candidate should have accrued 50 hours active crewing experience including 200 miles sailed by the end of the course (the practical course sailing will involve about 20 to 25 hours of active sailing and cover approximately 50 miles). For the required 50 hours, only periods of four or more hours (75% of which must have been spent sailing) can be counted. The Skipper (Local Waters) must, in addition, have 8 hours night watch keeping experience by the end of the course which will involve only one or two hours of night sailing. These requirements are necessary so that the instructor can legitimately sign the 'Qualifying Experience' section of the student's log book at the end of the course.

Aim of the Course

The aim of this course is to help students to develop confidence in themselves as worthy members of a crew, and to prepare Yacht Skipper (Inland Waters) and Yacht Skipper (Local Waters) candidates for the Association's examination.

Examination

There is no examination for Competent Crew. For Skippers, whereas an end-of-course test may be conducted, students eligible for the Association's qualifying examination can arrange to be examined at a convenient early date, time and place after the course. The differing fees for the examination by members and non-members,

and the duration of the examination, preclude this examination being part of the course. More detail regarding the examinations and examination requirements can be found in the Yachtsman's Log Book, obtainable from any of the Associations' offices.

Certificates

Students passing the end-of-course test or who are assessed by the instructor to have attained a satisfactory standard, will receive the Association's 'Course Completion Certificate'. Students who study this book on their own will not, unfortunately, be eligible for this certificate.

PART 1

CHAPTER 1

NAUTICAL TERMS

Introduction

As with learning any new game, sport or subject, there are new words, phrases and ideas with which one must become familiar. This is particularly true with the sport of sailing where the language of the sea and of ships has been developing over hundreds of years.

Three of the most basic words get very little attention, yet the understanding of their meanings is fundamental to any study of sailing. They are:

Yacht Any 'private pleasure craft', no matter how propelled (sail, engine power or other means), is called a yacht. The word is not limited to sailing vessels, as evidenced by the existence of the Royal Yacht Brittanica - it looks just like a passenger liner.

Ship and **Boat.** Few dictionaries adequately define these two words. The student sailor may well be confused when reading that the former is 'a large seagoing vessel ...' and the latter is 'any small vessel ...'. But **Tugboats** are hardly 'small'. A definition by an old sea captain seems more appropriate:

> 'A **Ship** can never be carried on the deck of a boat or another ship,
> but a **Boat** can be carried on the deck of another boat or a ship'.

So a Yacht can also be a boat or a ship, but a ship is never a boat (nor vice versa). Ships' crews are insulted if asked 'What boat are you from?', although some dictionaries and common usage indicate (wrongly) that the words 'boat' and 'ship' are interchangeable.

Since we are concerned with yachts, we will start by introducing the terms applicable to the main varieties of their hulls and equipment parts, and for sailing craft, their **Rigs** - the type and number of masts, and therefore the types and numbers of sails a vessel may use, determine the **Rig** of the vessel.

HULLS' SHAPES/TYPES:

MONOHULL	CATAMARAN	TRIMARAN

Plan View

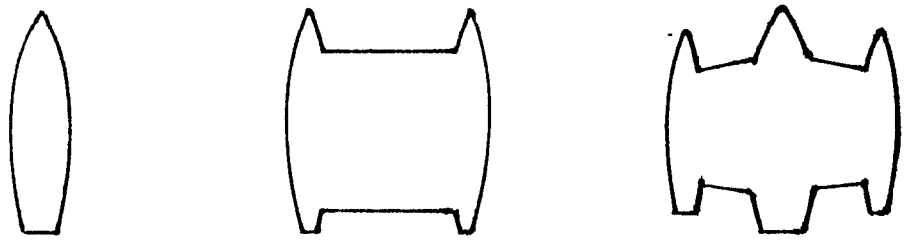
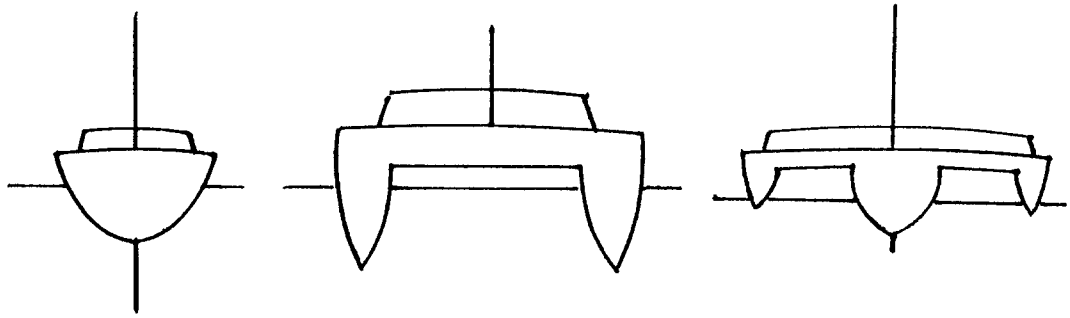


Fig. 1.a.

Front View



Side View

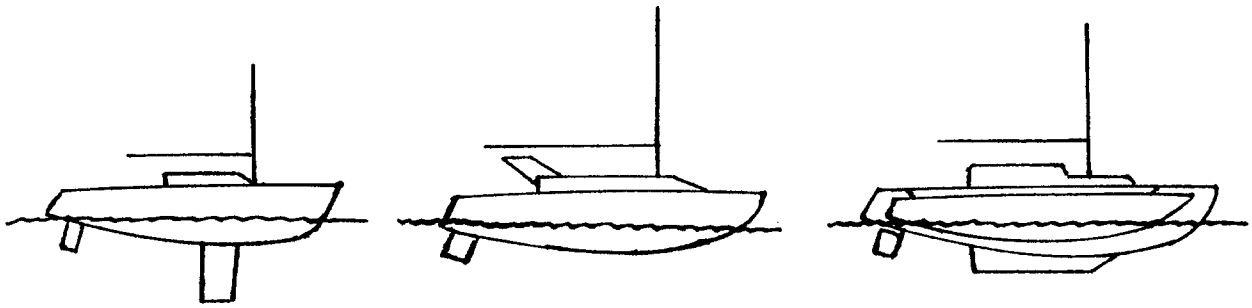
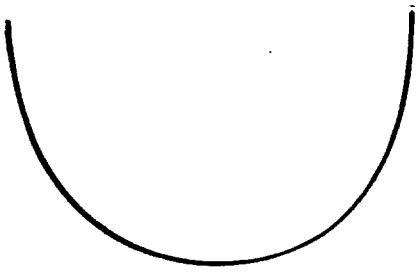


Fig. 1.b.

POWER BOATS

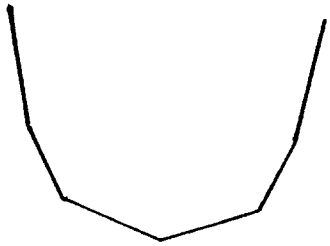
Hulls:

Round Bilge

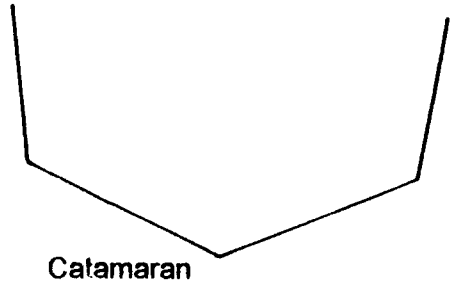


Hard (or Single) Chine
(or Shallow VEE)

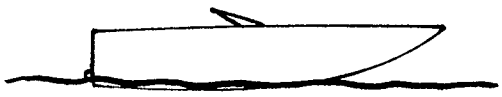
Multi Chine



Deep VEE



Racing/Planing



Catamaran

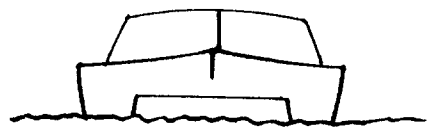
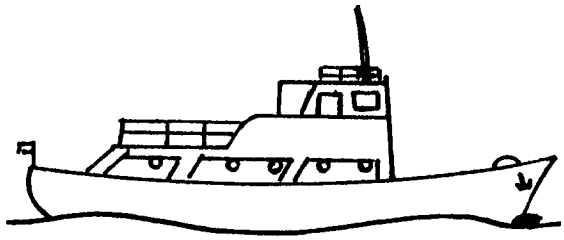
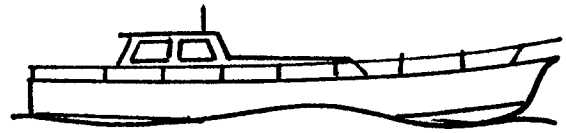


Fig. 2.a.

Displacement



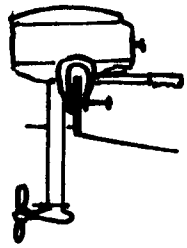
Semi-Displacement



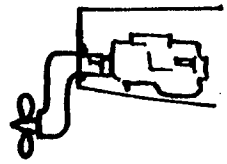
Engine/Propeller Arrangements:

Inboard

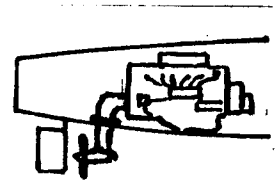
Outboard



Outdrive

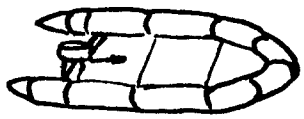


Z Drive or Sterndrive



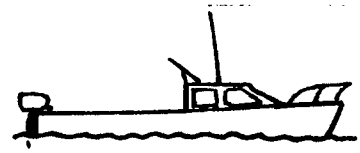
Types of Power Craft:

Inflatable (or Rubber Duck)

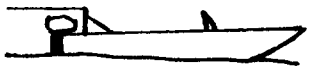


Day Fisherman

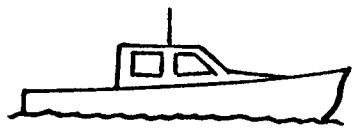
Weekender



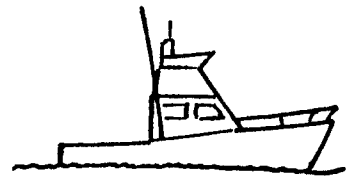
Ski Boat



Sports Fisherman

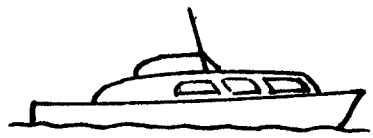


Deep Sea Fisherman



Sports Day Cruiser

Fast Cruiser Cruiser



Long Distance

Fig. 2.b.

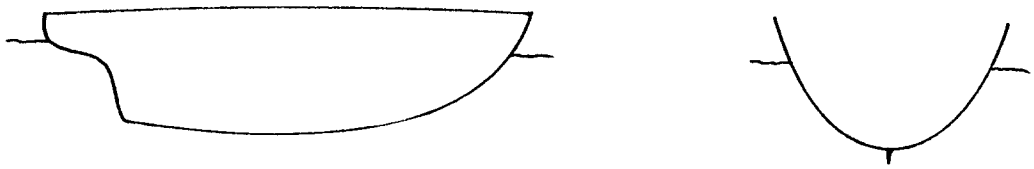
SAILING YACHTS

Keels:

1. **Cruising yachts**

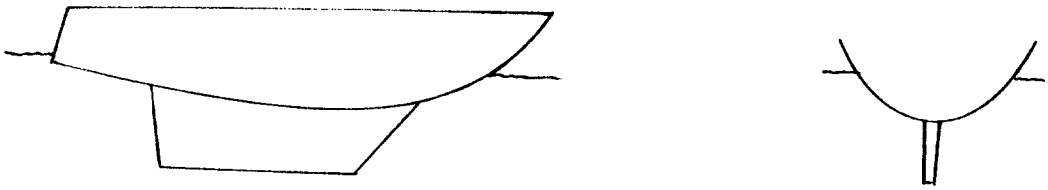
Full Keel: Side View Front View

(or **Long Keel**)



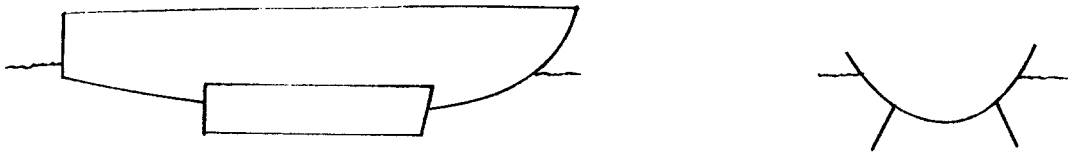
Three quarter Keel:

(or Motor Sailer Keel)



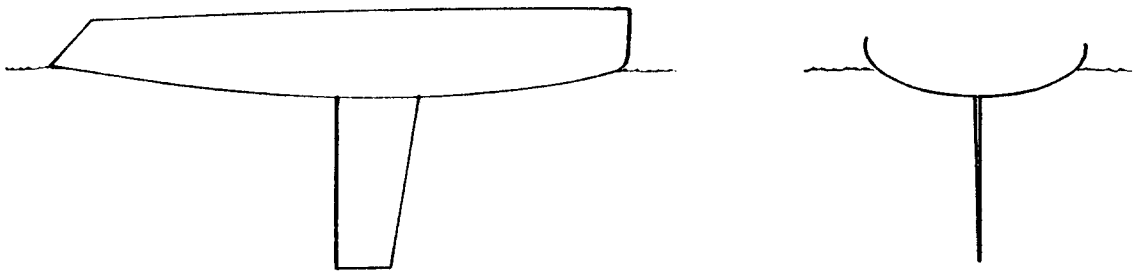
Bilge Keel

(or Twin Keels)



2. **Racing Yachts**

Fin Keel



Wing Keel

Fig. 3.a.

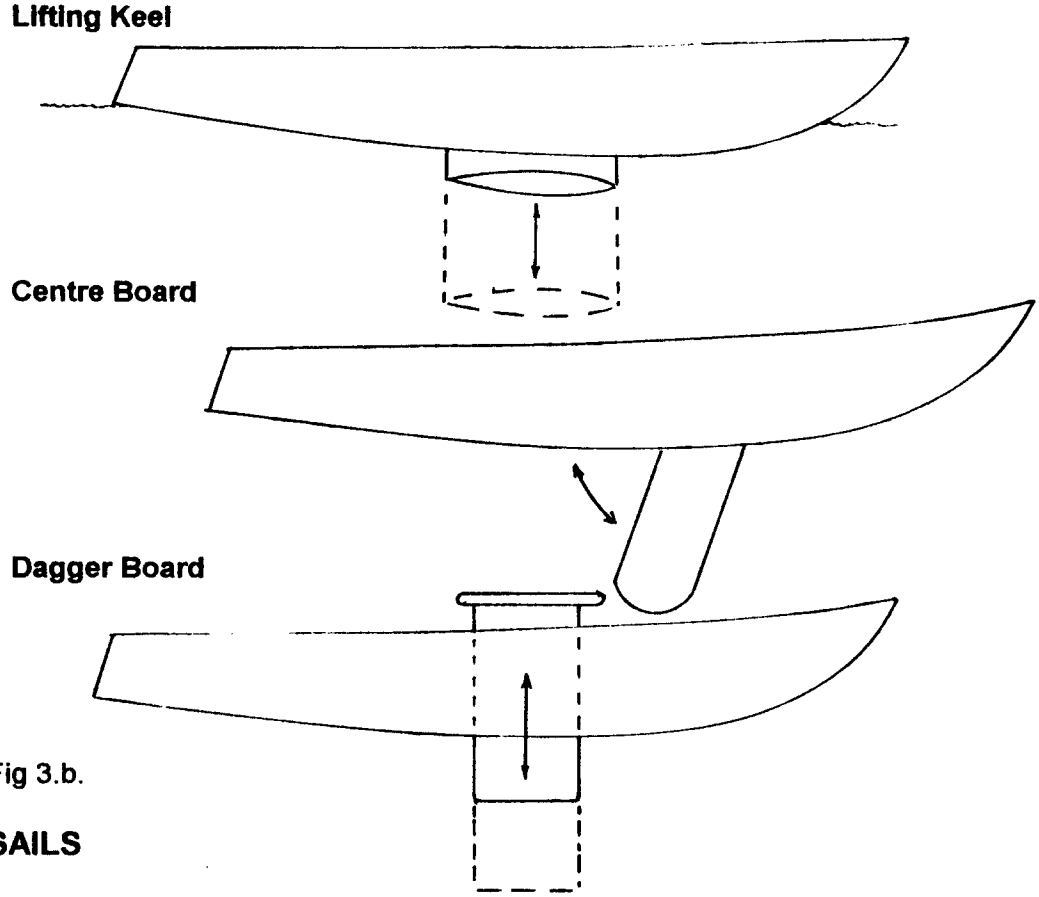


Fig 3.b.

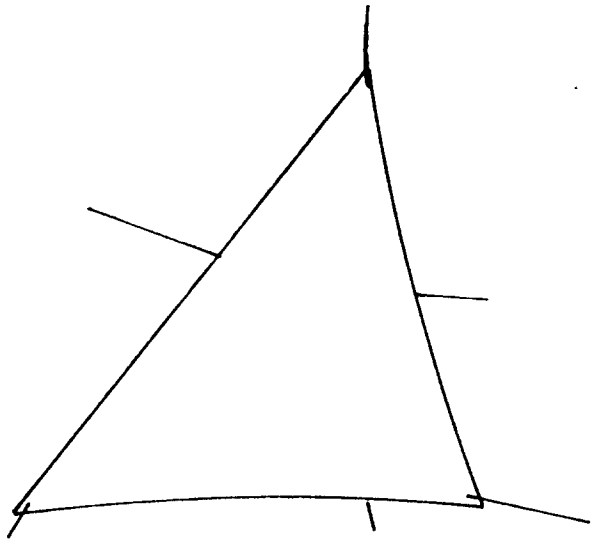
SAILS

Most sails have three sides and therefore three corners:

The HEAD - the top corner of a sail to which the halyard is connected so as to pull it up or lower it down

Boat's front.

The LUFF - the leading edge of a sail



The LEECH - the back edge of a sail

The CLEW - the bottom back corner of a sail.

The FOOT - the bottom edge of a sail.

The TACK - the bottom leading corner of a sail.

Fig. 4.

A 'Mainsail' is usually more sophisticated:

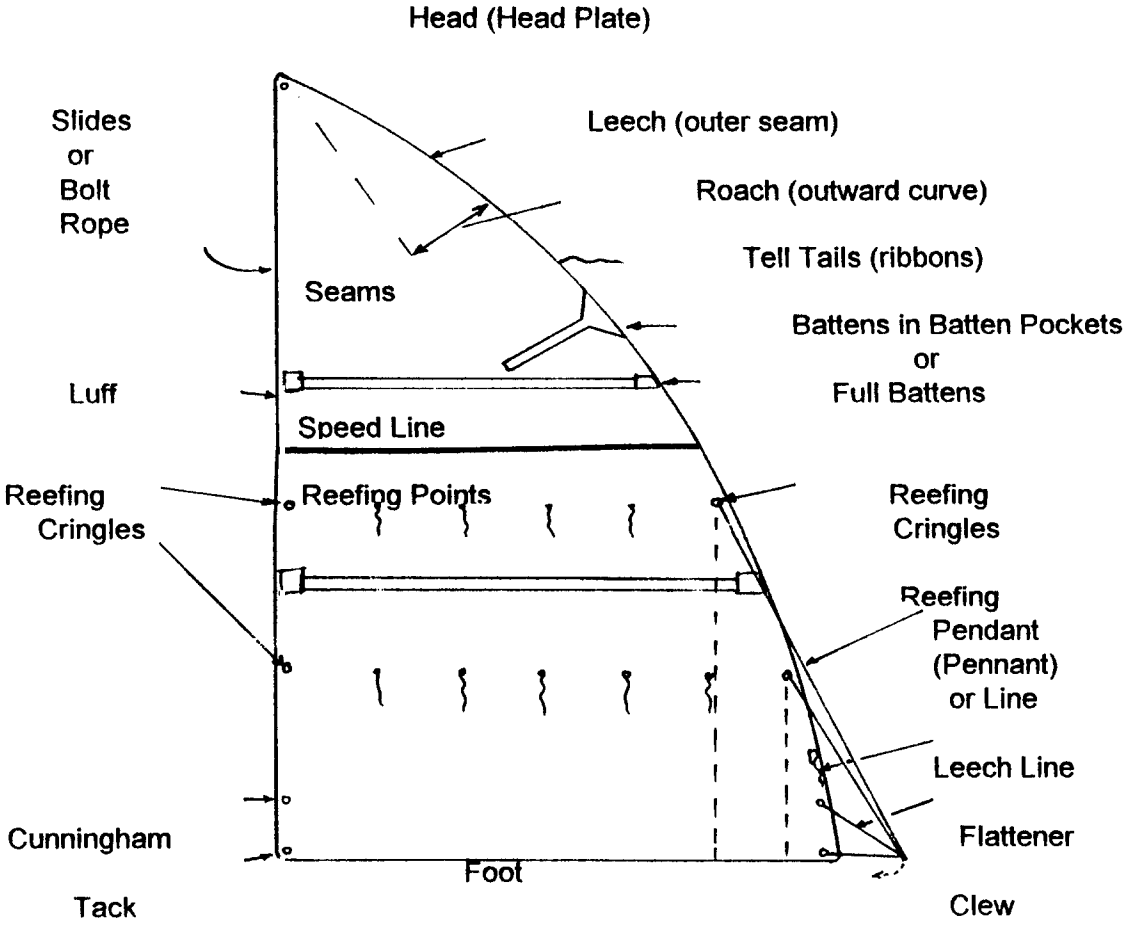


Fig. 5. Foot fitted with slides, Bolt Rope, or it is Loose - footed

A 'Headsail' can take several forms:

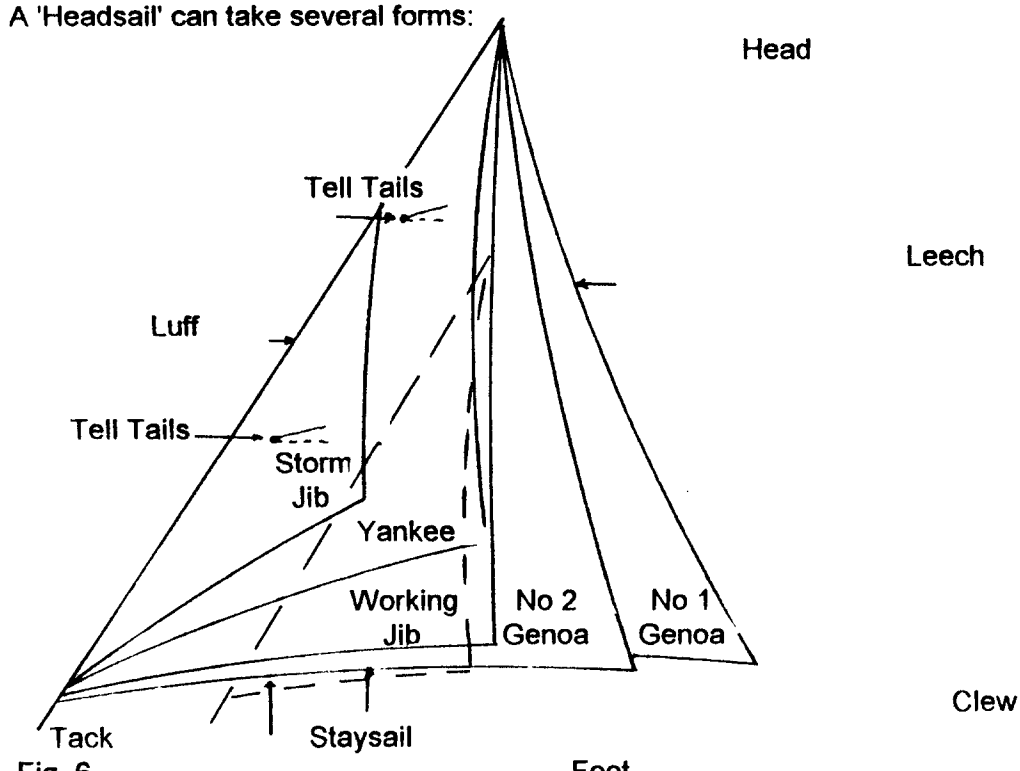


Fig. 6.

Other sails include:
The **TRYSAIL**
(for storm conditions, in lieu of the fully reefed mainsail)

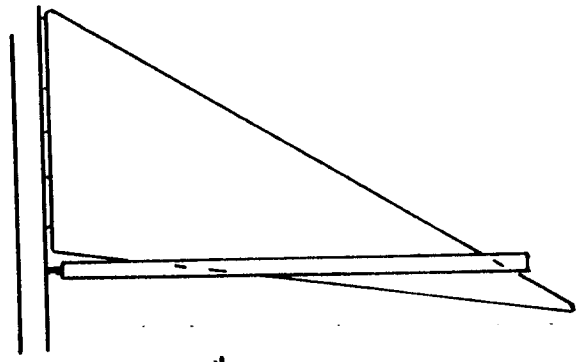


Fig. 7.

The **SPINNAKER**

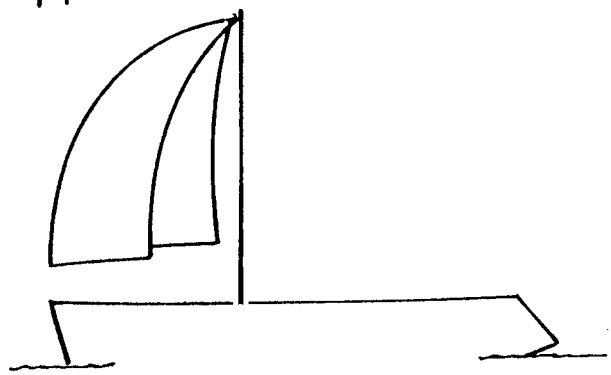


Fig. 8.

The **GENNAKER**
(or Cruising Chute)

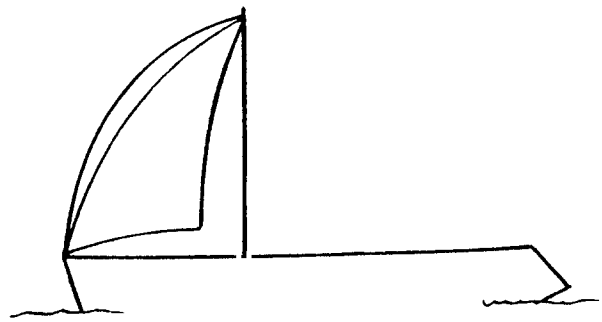


Fig. 9.

The **Blooper**

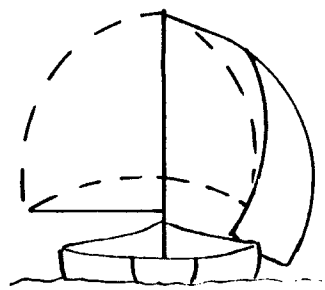


Fig. 10.

The Cruising Twin Headsail or '**Booster**'.

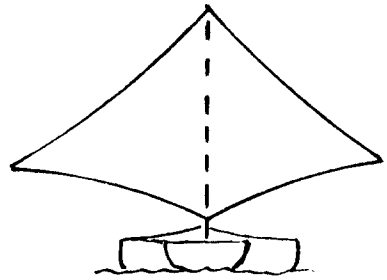


Fig. 11.

The **STAYSAIL**

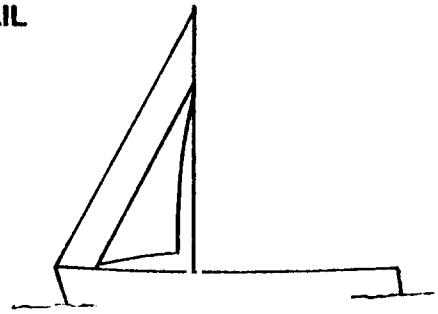


Fig. 12.

The **MIZZEN**

Fig. 13.

The **MIZZEN STAYSAIL**

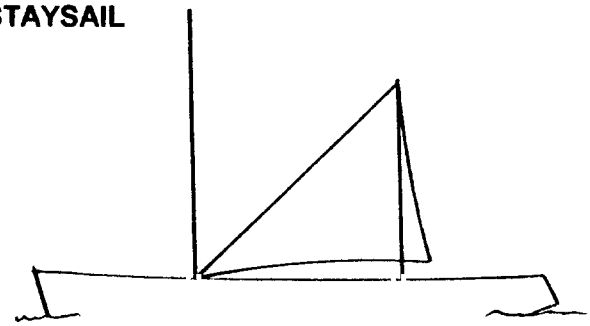


Fig. 14.

Sails on Larger Vessels

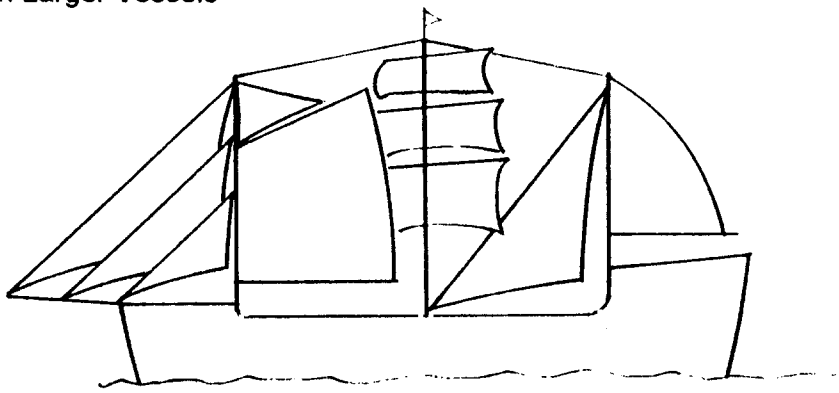


Fig. 15.

Types of Main Sails

Bermudan Gunter Gaff Lugsail Spritsail

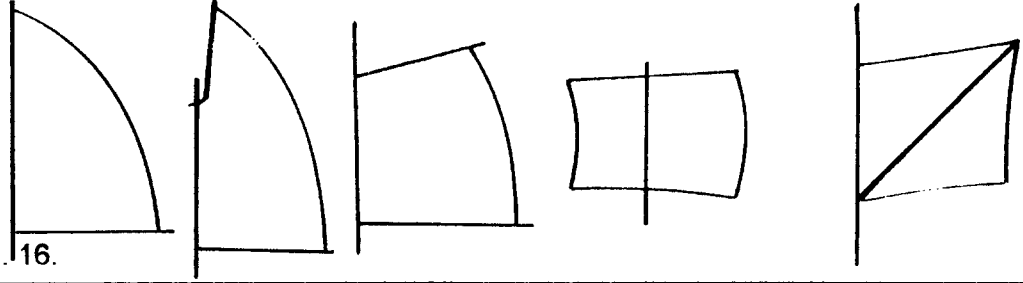


Fig. 16.

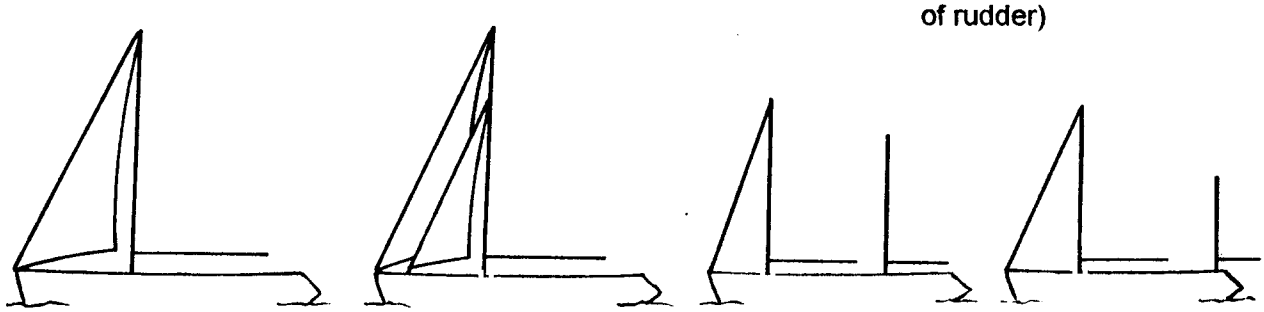
RIGS

Sloop (One mast)

Cutter Sloop (Two foresails)

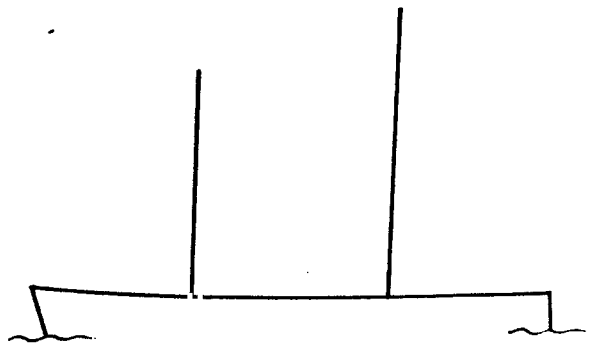
Ketch (Two masts)

Yawl (Aft mast aft of rudder)



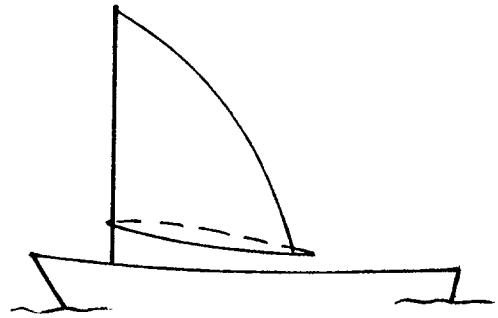
Schooner

Masts (two or more):
Same Height, or fore mast shorter

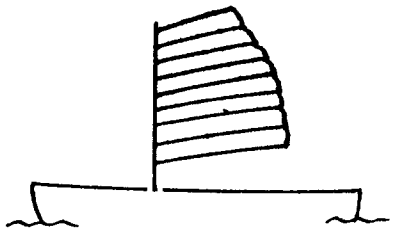


Freedom

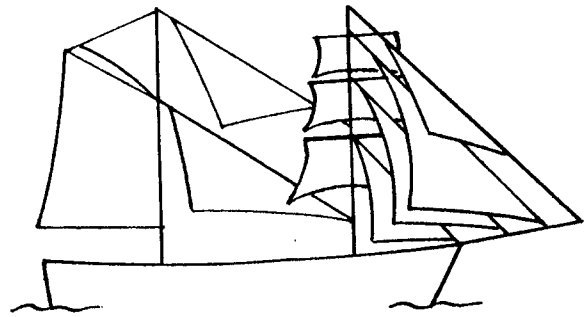
No Stays/Shrouds; Wind Surfer type wishbone in lieu of a boom



Chinese Junk



A 'Brig' (Brigantine Schooner)



A 'Bark' (Barquantine Schooner, having three or more masts.) All the old schooners were called Clipper Ships - they raced to 'clip' days off the record time to deliver their cargos.

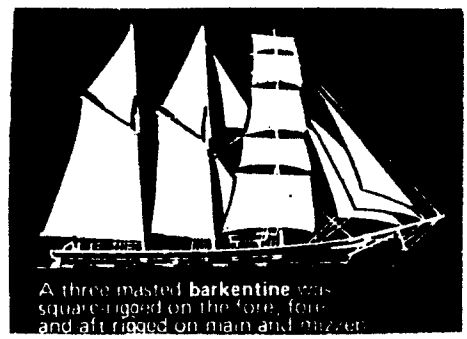


Fig. 17.

POWER BOAT PARTS

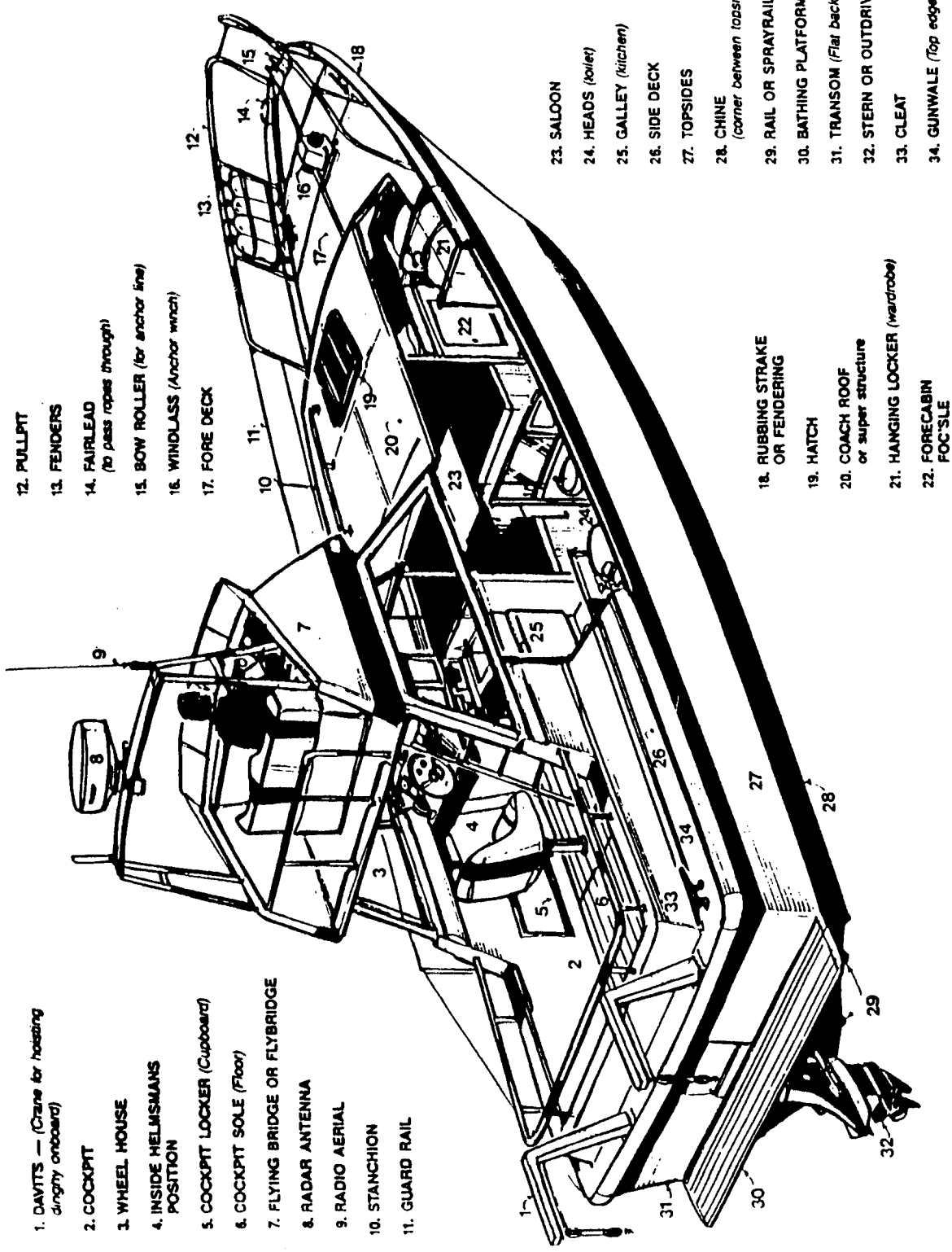


Fig. 18.

SAILING BOAT PARTS (External parts view.)

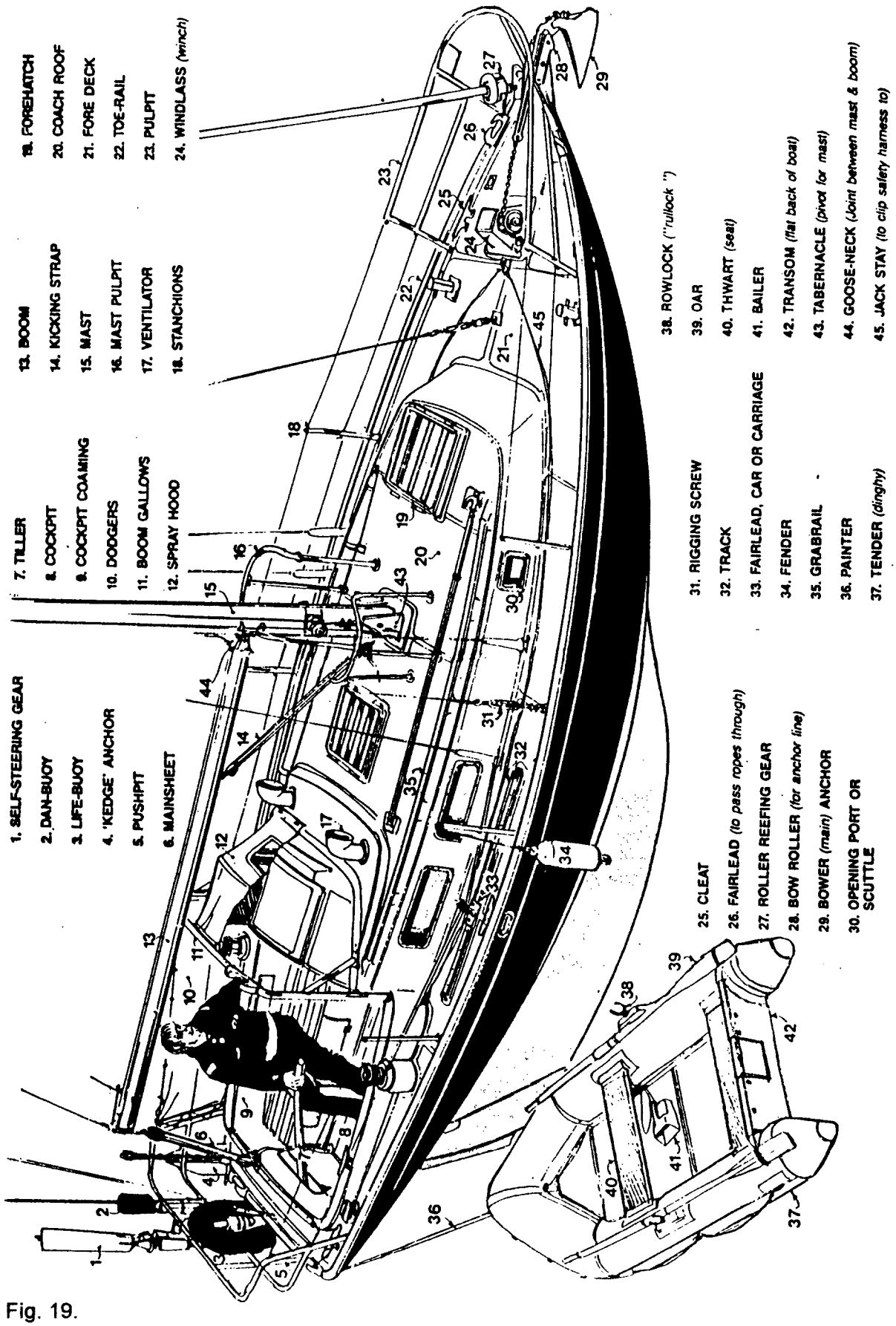


Fig. 19.

SAILING BOAT PARTS (Internal parts view.)

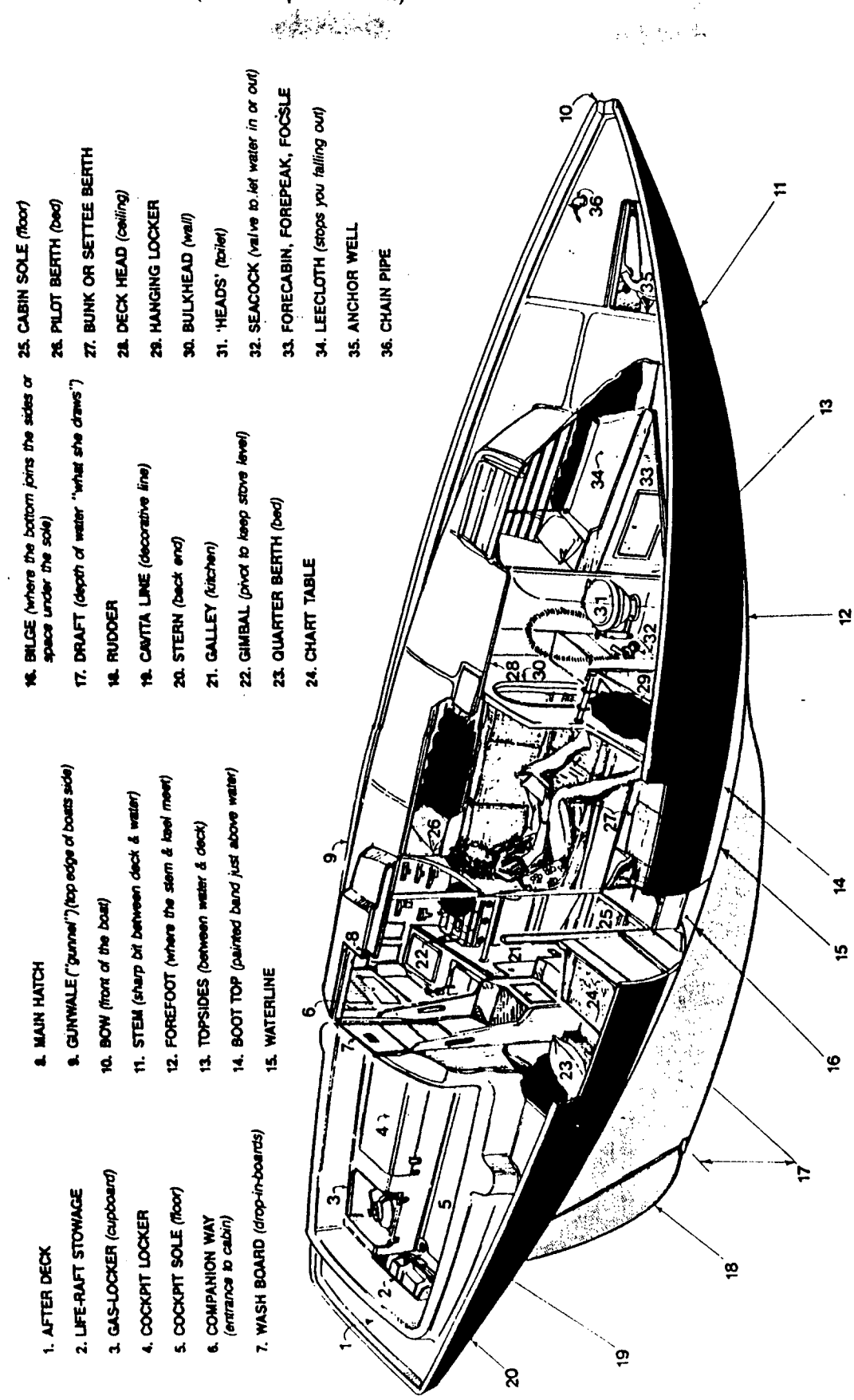


Fig. 20.

NAUTICAL TERMS

(The student must be able to identify the following parts - not necessarily to quote the definition.)

1. Hull and Fittings

Ballast - weight added to a vessel to aid stability and trim of the hull in the water when making way.

Bilge - the bottom section of a vessel below water.

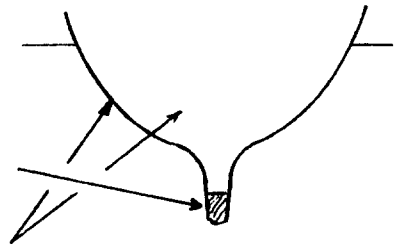
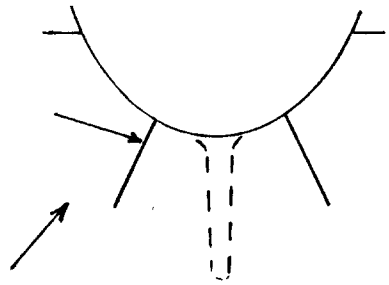


Fig. 21.

Bilge keel - one of two keels, parallel to the centre line, in lieu of one central keel. They are shorter than a single central keel, and allow a bilge keeler vessel to enter shallower areas and to stand unaided on the seabed bottom at low tide.



Bilge keeler- a vessel having two bilge keels. Fig. 22.

Bilge Pump - a pump, whose inlet pipe opens low down in the bilge area, to remove liquids which may leak or be spilt into the bottom of the vessel's hull area - its bilge. They may be operated by battery or mechanically driven, but manually operable 'back-ups' are essential.

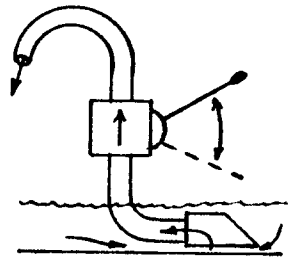


Fig. 23.

Bitts - Two solid and strong vertical posts on a dock or large vessel, for the purpose of securing docking, mooring or towing lines in a figure of eight pattern - hence they are <u>not</u> connected at their top by a horizontal bar.

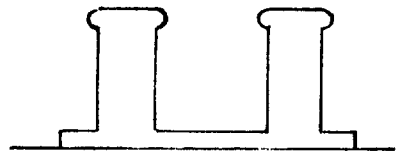


Fig. 24.

Bollard - A single solid, strong, vertical post on a dock or vessel's deck, to attach docking, mooring or towing lines.

Fig. 25.

Bow - The front end of a vessel. ("At the bow" = on deck, forward: "In the bow" = below deck, forward.)

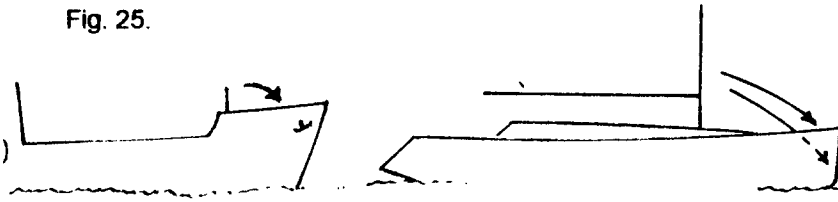


Fig. 26.

Bulkhead - The wall-like partitions which sub-divide and give strength to the hull of a vessel.

Fig. 27.

Bulwark - The raised edge of the hull above deck level.

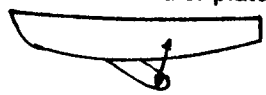
Fig. 28.

Bunk - A bed-like area for sleeping in.

Fig. 29.

Ceiling - Overhead beams supporting the under surface of the coachroof or deck above.

Centreboard - a non-ballast pivotable (not sliding type) retractable board or plate serving as a keel while sailing.(See Fig. 3.b., and 'Dagger board'.)

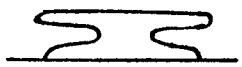


Chainplate - a strong metal strap, attached to a hull, for securing shrouds and stays.

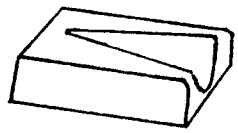
Fig. 30.

Cleat - a fitting for securing a line:

T - cleat



Jammer Cleat



Over lock cleat (Lever to clutch or cam)

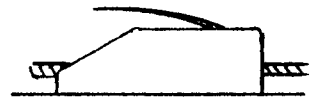


Fig. 31.

Coachroof - The deck or roof over the central hull section.

Cockpit - the above deck seated section where the helmsman steers the vessel and from where the crew adjust sails' sheets.

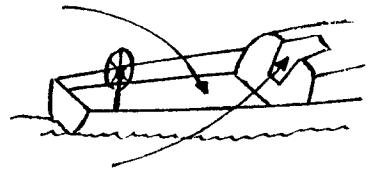


Fig. 32.

Companionway - the entrance way, usually with a ladder or steps, between the cockpit and below deck area.

Fig. 34.

Dagger Board - a retractable keel similar to a centreboard, but which slides up or down in a slot. (See Fig. 3.b.)

Davit - a crane-like arm for raising and lowering heavy items from and to the sea - usually a tender.

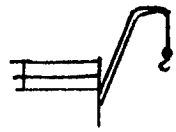


Fig. 35.

Deck - the outside surface, intended for walking on.

Deckhead - the ceiling inside a vessel.

Drain - a system for getting unwanted liquids to gravitate out of the vessel. No 'T' with other pipes.

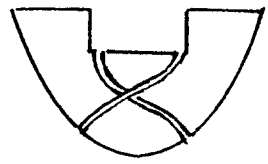


Fig. 36.

Fairlead - a fitting to guide a static line where a bend is necessary - it reduces chafe'. (See 'Organiser'.)

Fig. 37.

Fiddle - a lip to the edge of tables, stoves, etc., to stop items falling off.

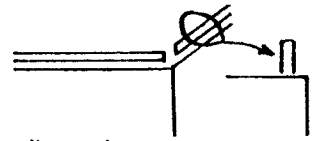


Fig. 38.

Fin keel - deep keel, short in the 'fore and aft' direction, it may have extra ballast at its tip. See page 4.

Guardrail - a solid rail around the outside of the deck to stop people from falling overboard.

Fig. 39.

Gudgeon - a stern - fitted bracket with a near horizontal hole through which a rudder's attaching pin (see 'pintle') passes, allowing the rudder to be firmly attached to the vessel yet still turn from side to side to steer the vessel.

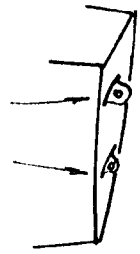


Fig. 40.

Gunwale - the area of the join of the hull to the deck.

Fig. 41.

Hatch/ hatchway - the entrance/exit area to/from the inside of a vessel, via a hatch.

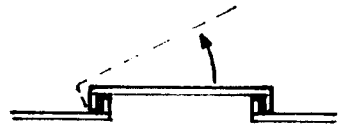


Fig. 42.

Hawsepipe - a pipe at the bows of a vessel, from deck level down and outwards, through which the anchor chain passes from the windlass to the anchor.

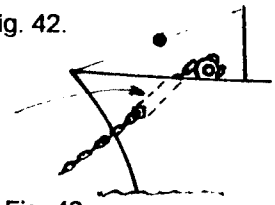


Fig. 43.

Heads - the toilet on a ship.

Hull - the sides and bottom of a vessel.

Keel - the centre bottom section of a hull.

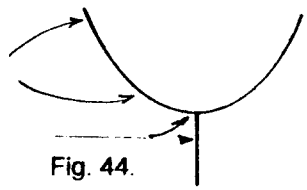


Fig. 44.

Lifeline - a strong line or wire cable running the length of the vessel, fairly loose on the deck, one on each side, to which crew can attach their harness strops.

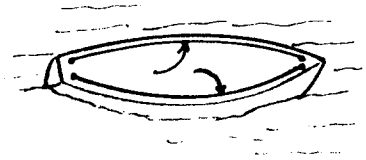


Fig. 45.

Organiser - a flat 'surface-fitted' pulley wheel located where a bend in a moveable line (i.e. running rigging) is required. (See 'Fairlead'.)

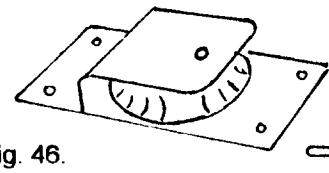


Fig. 46.

Pintle - a rudder 'leading edge' -fitted bracket with a downward pointing pin which acts as a pivot point when inserted into the hole of the Gudgeon fixed at the stern of the vessel's hull.

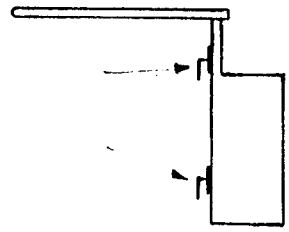


Fig. 47.

Rudder - a flat board-like device fitted aft to a vessel and below the water line, for the purpose of steering the vessel.

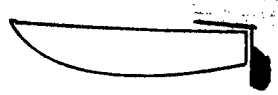


Fig. 48.

Scupper - a hole in the bulwark at deck level to let water on deck return to the sea.

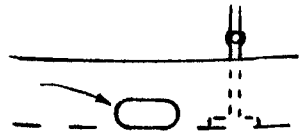


Fig. 49.

Scuttle i. a glazed aperture to admit air and light.
ii. to sink a vessel by letting water in.

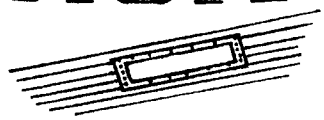


Fig. 50.

Seacock - a hull skin fitting, with an 'open/close' valve, for a pipe to allow fluids in or out of a vessel.

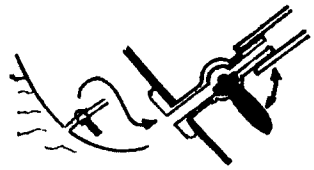


Fig. 51.

Skeg - a fixed vertical blade aft below the keel, usually directly ahead of a rudder as protection for the latter.

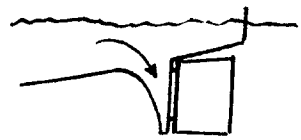


Fig. 52.

Stanchion - a vertical post at the outer edge of the deck which supports the safety lines or guardrail.

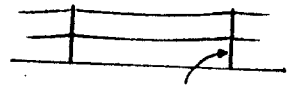


Fig. 53.

Stern - the back end of a vessel. Or the skipper's face when he is given a warm beer.

Tabernacle - a bracket mounted on the deck to hold the bottom of a mast, with horizontal 'pin' bolts - when all but one such bolts are removed, the mast can be pivoted down (or raised up).

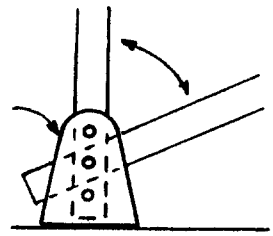


Fig. 54.

Tiller - a lever fixed to the top of a rudder's shaft for the purpose of controlling the rudder angle (i.e. steering the vessel).

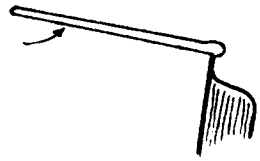


Fig. 55.

Toerail - a 'lip' or small upright ledge around the outer edge of the deck to stop a slipping foot from sliding over the edge.

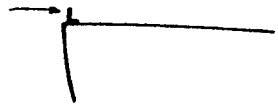


Fig. 56.

Transom - the flat(tish) back surface (not necessarily vertical) of a vessel.

Fig. 57.

Wheel (The) - the vessel's steering wheel. Or a yachtie who thinks he knows everything.

Winch - a device for increasing the pulling power on a line by winding on a handle, which, via gears, slowly turns a 'drum' around which the line is wound.

Fig. 58.

Windlass - A rotatable drum, powered via gears by a hand operated lever or an electric motor, or by mechanical means, for the purpose of raising a heavy anchor rode (wound around the drum) and anchor.

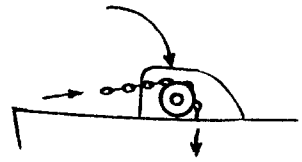


Fig. 59.

2. Masts, Spars, Fittings and Standing Rigging

Boom - a pole extending approximately horizontally aft from the aft edge of a mast, about 5% of the mast height above the deck, for the purpose of supporting the foot of the sail and/or the outhaul to pull the clew aft.

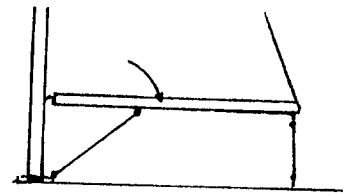


Fig. 60.

Bottlescrew - See 'Rigging screw', next page.

Bowsprit - a fixed pole extending forward from the bow to enable the tack of a headsail and therefore the centre of effort (of the wind in the combined sails) to be carried further forward than normal.

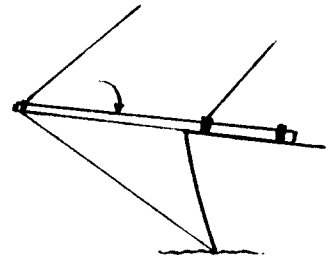


Fig. 61.

Bull Horns - the inverted 'hooks' above the gooseneck for securing the reef cringle/ring. See Fig. 62.

Crosstrees - See 'Spreaders'.

Gooseneck - a flexible coupling joining the the boom to the mast.

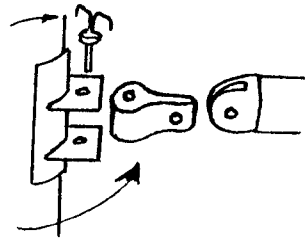


Fig. 62.

Mast - the (almost) vertical pole reaching high above the deck, to hold the sails up (as well as other equipment).

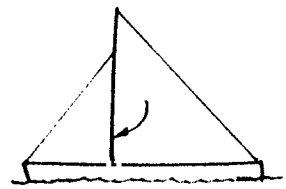


Fig. 63.

Where two or more masts are used:

- foremast - the forward mast when not the tallest mast.
- mainmast - the tallest mast, or front mast if the masts are of the same height.
- mizzen - the aft mast when not the tallest mast.

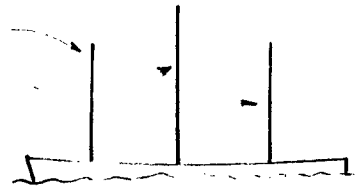


Fig. 64.

Rigging screw* - a bolt threaded pipe section with eye bolts or similar at either end (one of which has its screw thread direction of rotation reversed) for inserting in a shroud or stay so as to adjust the cable tension. *Also called Bottlescrew or Turnbuckle.

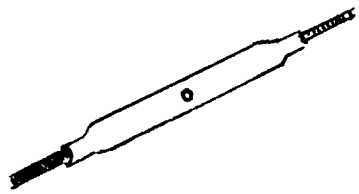


Fig. 65.

Spinnaker pole - a light pole, attached via a flexible coupling on a vertical slide on the front of the main or foremast, which can extend outwards from ahead to almost abeam, the far end being the position of the tack of a spinnaker.

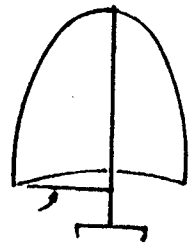


Fig. 66.

Spreaders - short poles extending sideways and almost horizontally off a mast, and located at convenient heights, to hold the cap and/or mid/intermediate shrouds away from the mast thereby increasing their angle of pull/leverage at the top end of the shroud.
NB: Note that to work efficiently, the angles 'a' and 'b' must be equal.

Fig. 67.

Shackle - a 'D' shaped metal "chain link", the straight part being a removable screw in/out pin for opening or closing the link - it is used to join two loops/rings/links/etc.

Fig. 68.

Shrouds - cables from the side of a vessel to the mast to provide it with lateral support - they stop the mast from falling over to one side of the vessel.

- cap - shrouds which reach to the top of the mast.
- mid/inter-mediate - shrouds which reach to the mast higher than the lower shrouds but not to the masthead/cap shrouds.
- lower - the shortest of the shrouds.

Stay - a cable from the bow or stem to the top or near top of a mast to give it fore and aft support.

Tang - the attachment on a mast where the top end of shrouds are fixed to a mast.

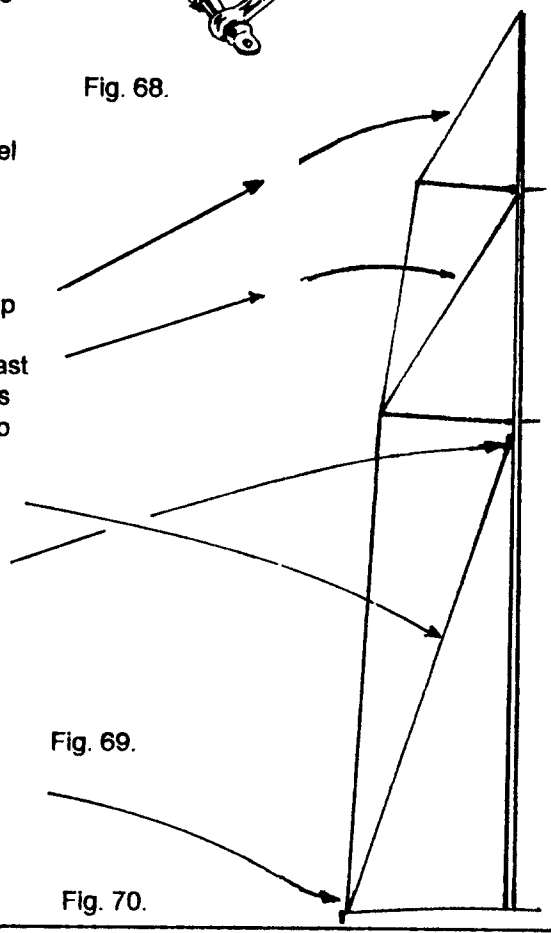


Fig. 69.

Toggle link - a link between a chainplate and the bottom end of a rigging screw, to provide three dimensional flexibility (not to be used just as a 'spacer').

Fig. 70.

Track - a rail along which a slide with a pulley wheel, a 'sheave', can be moved to alter the direction of pull on a line.

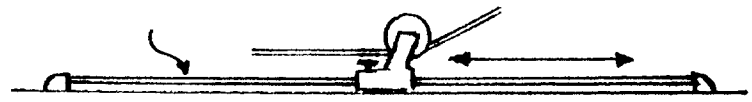


Fig. 71.

Twin track stay - a forestay to which an aluminium alloy tube has been added, the cross section of which shows it has two parallel grooves running the length of the stay so that two independent foresails can be used simultaneously, or one can be raised/lowered while the other is in use.

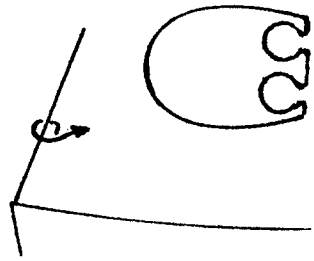


Fig. 72.

Yard - a pole whose ends are the same size and whose girth is greatest at its centre. It is normally used up a mast to support the top horizontal side of a four sided **sail**.

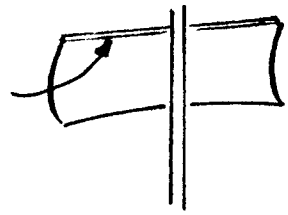


Fig. 73.

3. Running Rigging

Block - a metal, metal/wood, or metal/plastic frame containing one or more pulley wheels (sheaves), and an attachment link or shackle at one side - it may have a 'becket' opposite the link/ shackle. A single sheave block may be used simply as a turning point for a moveable line, whereas a a multi-sheave block is invariably part of a 'block and tackle' system for decreasing the power required to lift/move a heavy object.

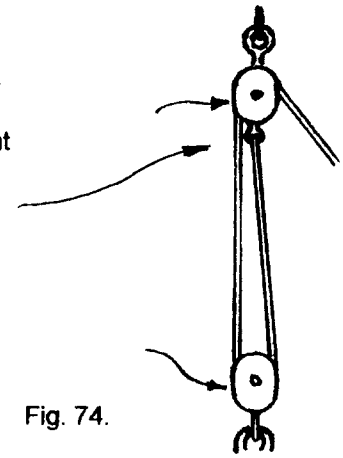


Fig. 74.

Cunningham - a facility for adjusting, usually from the cockpit, the luff tension on a sail attached to a mast, such as the mainsail. This is done to match the position of the deepest part of curve a sail has, to the wind speed at the time - as the wind strength changes, so the tension on the luff should be changed to keep optimum sail trim effieciency.

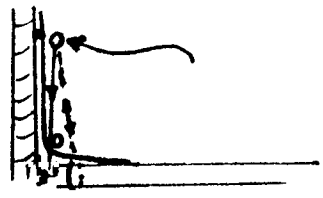


Fig. 75.

Downhaul - a line to exert downward tension on a sail or spar (e.g. a spinnaker pole).

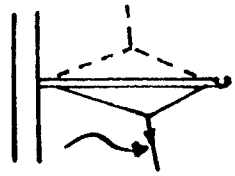


Fig. 76.

Flattener - a facility similar to a Cunningham but applied at the leech a little above the clew: increasing tension reduces the amount of cross-sectional curve in the bottom third of a sail.

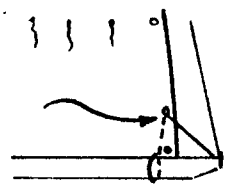


Fig. 77.

Guy - the windward sheet used with a spinnaker.

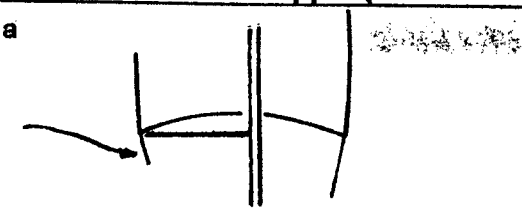


Fig. 78.

Halyard - a low, or no-stretch line of polyester, kevlar or a combination of either of them with wire cable, used to raise or lower a sail or other item.

On a Gaff rig:

- **peak halyard** - raises and lowers the peak (upper, outer) end of the gaff. (The peak must be kept higher than the throat while raising or lowerting a gaff sail.)

- **throat halyard** - raises and lowers the mast end of the gaff (pole)

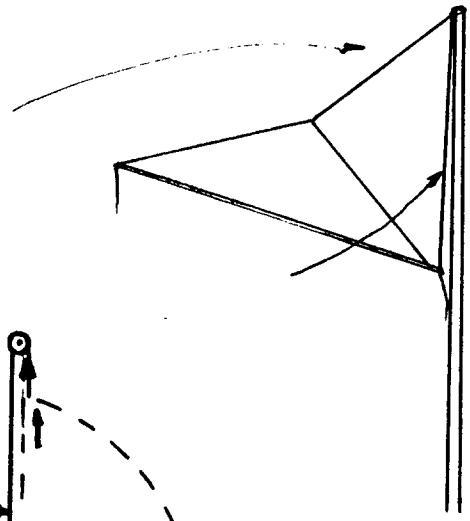


Fig. 79.

Kicking strap /boom vang - a 'block and tackle' or similar type tensioner from the aft base of a mast to the lower edge of a boom, about 15% of its length from the mast, to stop the boom lifting when wind creates pressure in the sail.

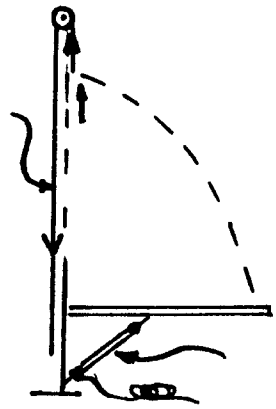


Fig. 80.

Lanyard - a short line attached to a user, to an important piece of equipment to prevent its loss if dropped, e.g. a pocket/sailor's knife, torch, sextant, etc.

Fig. 81.

Outhaul - the line from the clew of a sail, which is fitted to a boom and mast, to adjust the outward tension and therefore amount of cross-sectional curve in setting a sail for optimum performance.

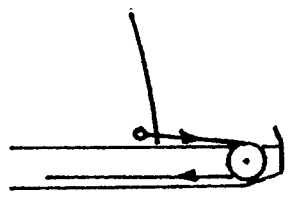


Fig. 82.

Purchase - the mechanical power advantage, usually expressed as a ratio of work done to effort applied, e.g. 2:1, when using a block and tackle - sometimes also called a 'handy-billy'.

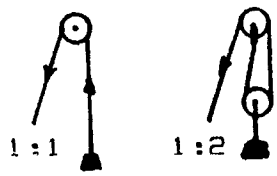


Fig. 83.

Running back stay - one of a pair of backstays, one each to the port and starboard quarters respectively, which can and must be released one at a time to allow the aft end of a boom to swing passed. They are usually only used when sailing down wind when a foresail on a forestay applies great force on a mast other than at the top of a mast i.e. where the forestay attaches to the mast some distance below the masthead (e.g. with fractional rigged sloops or when using the staysail in a cutter rig).

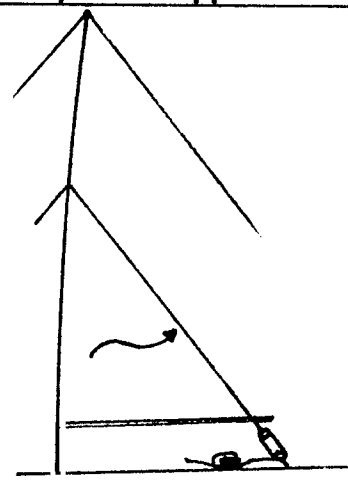


Fig. 84.

Sheet - a line from the clew of sail, or from the aft end or near aft end of a boom if used, to adjust the angle of the sail relative to the wind angle and vessel's heading, when trimming sails.

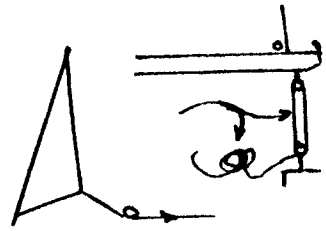


Fig. 85.

Topping lift - a line via the masthead to the aft end of a boom to hold the boom up during reefing and when no sail is set.

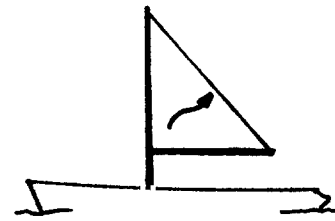


Fig. 86.

4. Sails

Batten - a wood or synthetic material strip located in batten pockets in the leech of a sail to hold the roach from collapsing outward and to leeward, or alternatively strips which extend the full horizontal length of that part of the sail at which each is located, for the same purpose.

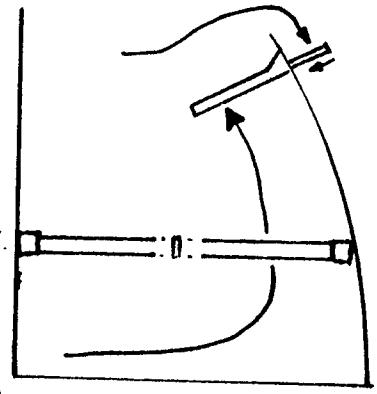


Fig. 87.

Batten pocket - a tube-like pocket stitched to a sail to hold a batten where it is required to be.

Fig. 88.

Boltrope - the rope stitched into the seam at the luff of a sail, and sometimes at the foot, to slide into and along the groove up the aft edge of the mast and along the top edge of the boom, to attach the sail to the mast/boom.

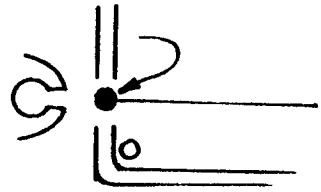
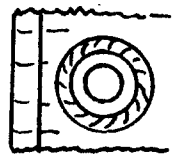


Fig. 89.

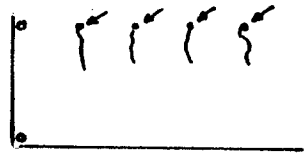
Clew - the corner of a sail formed by the join of the foot and the leech.

Fig. 90.

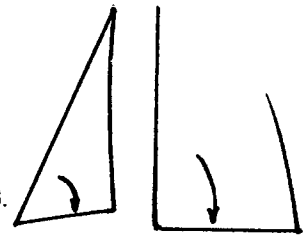
Cringle - the reinforcing around a hole in a sail's tack, clew and head (if no head plate fitted), and at reef points at the luff and leech, as well as at the cunningham and the flattener. Fig. 91.



Eyelet - smaller reinforcings, usually of brass plate, around smaller diameter (than cringles) holes in sails such as at the reef points mid sail. Fig. 92.



Foot - the bottom edge of a sail, between the tack and the clew. In a headsail, if the foot is close to the deck, it is said to be a low cut sail, whereas a high cut sail has its foot going up from the tack towards the clew at a fairly steep angle. Fig. 93.



Headsail /foresail - any flat 'fore and aft' sail used forward of the mast, with its tack at or just above deck level, e.g. jib, genoa, yankey, etc. See figures 6 and 8 to 11.

Head - the top corner of a sail.

Leach/Leech* - the trailing edge of a sail. *Leech is the more common spelling; both are acceptable.

Leech line - a draw string in the seam of the leech for tightening the leech - the leech then curves to windward causing the sail to become more 'baggy' - desirable in light winds and when sailing with the wind. See page 6, Fig. 5.

Luff - the leading edge of a sail.

Luff (up), to - to luff a sail is to turn the vessel to windward or let out the sheet until the sail starts to 'flog' in the wind.

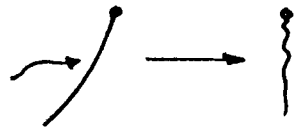
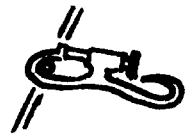


Fig. 94.

Piston Hank - a device fitted at regular intervals along the luff of some foresails to attach the luff to the forestay. Fig. 95.



Mizzen - the aft mast, providing it is not the tallest mast, and or the sail set on and aft of that mast.

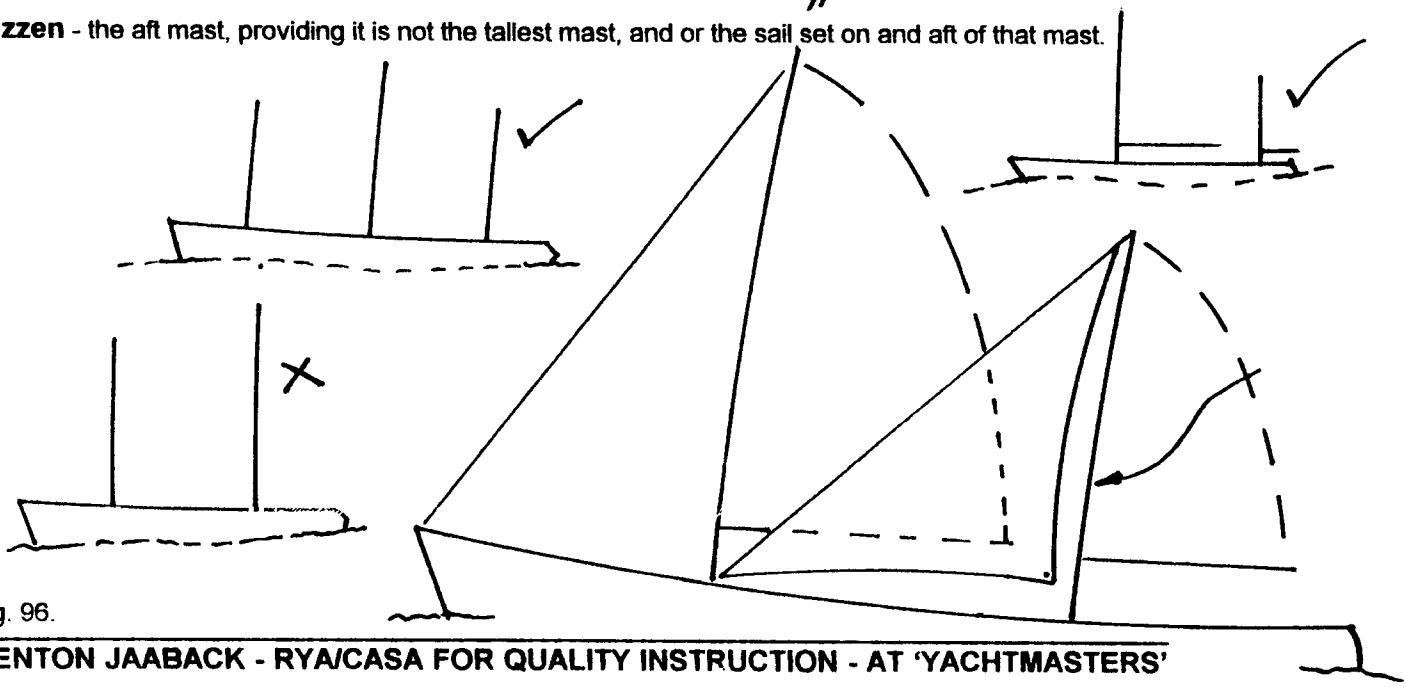


Fig. 96.

Mizzen Staysail - a sail set forward from the mizzen. like a foresail from the foremast. See Fig. 96 on page 22.

Reef points - eyelets, fitted with short lines hanging down both sides of a sail, arranged in horizontal rows between the luff and leech cringles, and evenly spaced, to tie up the rolled surplus sail at the foot after reefing. See page 6, Fig. 5.

Roach - the outward curve of the leech. See page 6, Fig. 5.

Seams - the stitched join of adjacent panels of sails' cloth, normally triple stitched.

Fig. 97.

Slides /slugs - in lieu of a boltrope, the luff (and foot) of a sail may have slugs or slides attached at regular spaced intervals which fit into and slide up and down (or along) the groove in the mast (or boom).

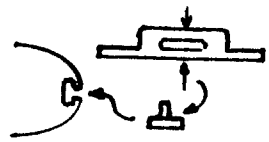


Fig. 98.

Spinnaker - a balloon shaped sail, usually but not exclusively for downwind sailing. The tack is 'flying', i.e. not fixed at the bow; it moves with the end of the spinnaker pole. See page 7, Fig. 8.

Tack - the corner of a sail formed at the junction of its luff and foot i.e. the bottom of the leading edge of a sail. The maker's logo is near this corner which usually has the strongest reinforcing cloth layers/web.

Fig. 99.

Trysail - a thick, strong sail designed for storm conditions, to replace the mainsail which is disconnected from the mast (only - not the foot from the boom where the now disused mainsail is lashed); its luff attaches to the mast in the normal manner, it is loose footed, and the clew is sheeted to the stern of the vessel. See page 7, Figure 7.

5. Anchor parts, lines and mooring gear

Anchor (Various types are listed in Chapter 3, pages 56 and 57.) A typical anchor and its parts is:
The ***Admiralty*** or ***Fisherman*** anchor :

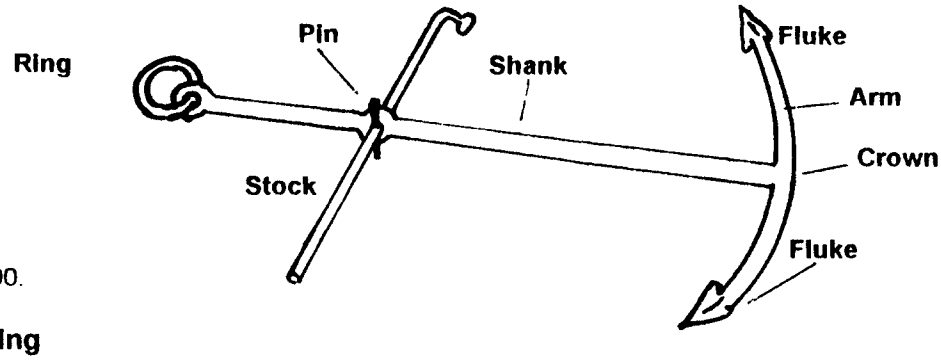


Fig. 100.

Anchoring - arrangement

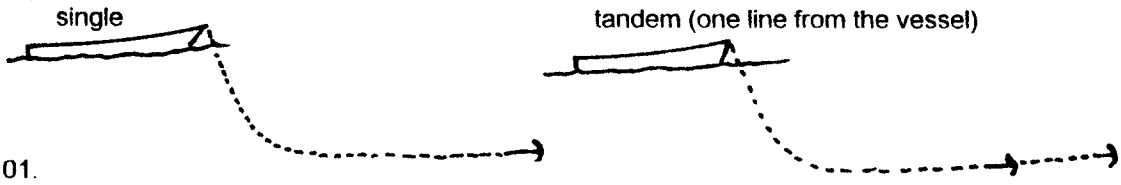


Fig. 101.

- **methods**

i. **dropping** - turning the bow to wind, stopping/stalling, lowering anchor as the vessel falls astern. See Fig. 217, page 58.

ii. **running** - proceed downwind, lower the anchor over the desired spot, continue downwind until nearly all the required scope is deployed, then turn to the side the anchor line is, until facing bow to wind - the vessel will stall then fall aft to take up excess slack in the anchor line. See Fig. 216 on page 58.

Boathook - a wood, plastic or light alloy pole of about 2 metres in length (longer is better if no stowage problem), with a blunt, rounded hook of plastic material, hook diameter about 50 mm.

Fig. 102.

Bow line /head rope - a line from the bow of a vessel forward to the dock when tied up alongside a dock or 'walk-on' mooring pontoon.

Breast line - a line from a docked vessel to the dock, at approximately right angles from the dock to the vessel.

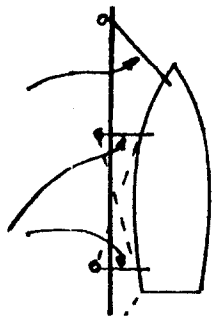


Fig. 103.

Depth - i. At Sea. The chart depth PLUS the height of the tide at a time.

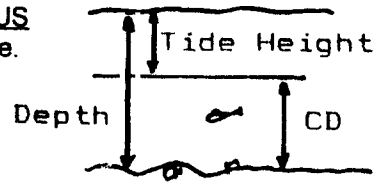


Fig. 104.

ii. Inland. The vertical distance from the water surface to the lake/dam/river bed below.
iii. Of a Ship. The vertical measurement from the deepest part to the open deck level.

Fender - a cushion device to place between the hull of a vessel and the adjacent vessel/dock/jetty/ pontoon to protect against rubbing/ chafe.

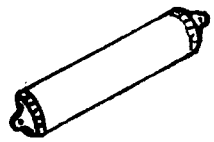


Fig. 105.

Gypsy - a pulley wheel, being part of an anchor windlass, designed to take a chain.

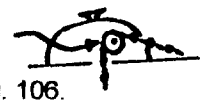


Fig. 106.

Heaving line - a light line with a weighted end for throwing - usually used to get a line between a towing vessel and the vessel to be towed, or between a vessel and the dock when coming alongside, so that a heavier, stronger line can be pulled into position. Also invaluable for throwing to a person in the water in the event of a 'man overboard' situation.

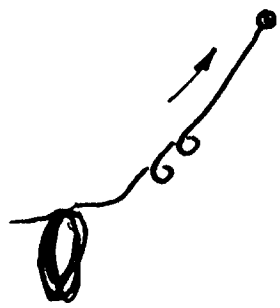


Fig. 107.

Kedge - an anchor used as a secondary or support anchor to aid the primary anchor; usually smaller than the main anchor.

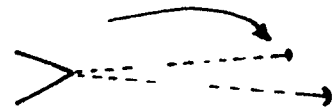


Fig. 108.

Painter - a line from the bow of a tender for towing/pulling it along, or for tying it to a jetty or similar.

Fig. 109.

Mooring - any method of securing a vessel other than anchoring (when the vessel is free to swing about the anchor the full radius of the scope) or docking/berthing alongside a non-floating dock i.e. the radius of swing, and possibly the arc, are reduced relative to anchoring.

single buoy double buoy/trot pontoon

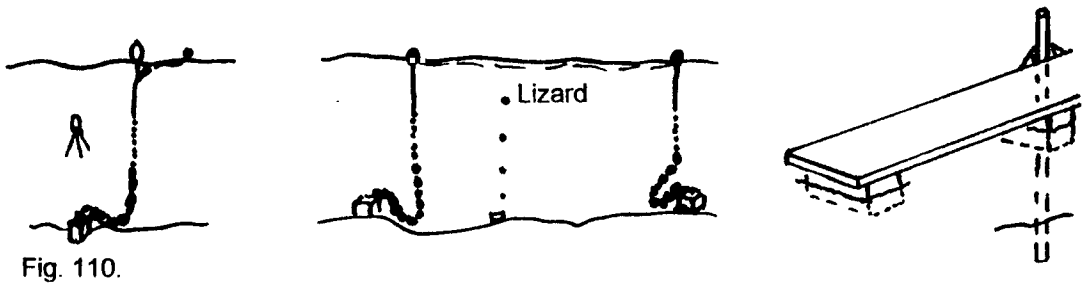


Fig. 110.

Mooring (Contd)

'Vee' with stern line/anchor Navy moor 'All Fours'

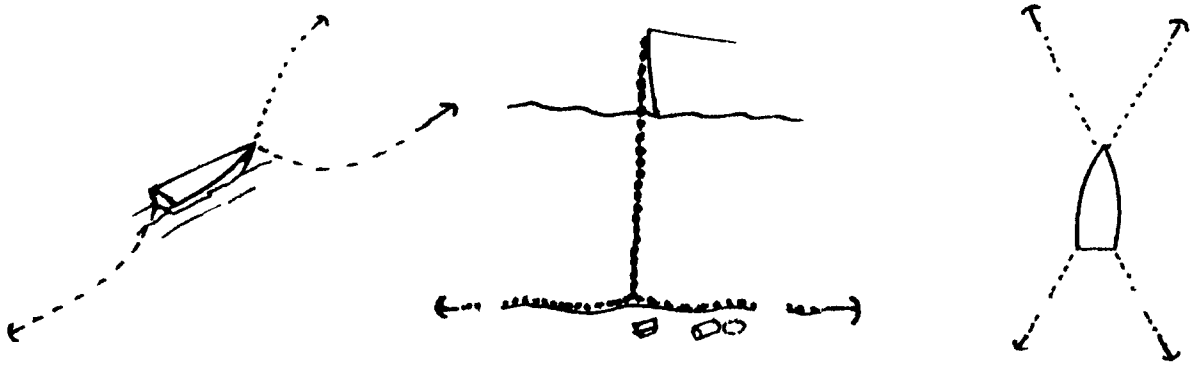


Fig. 111.

Mousing - the securing of tightened shackle pins with light wire so that they can not come undone unintentionally.

Fig. 112.

Navy moor - a method of mooring, using a vessel's own gear, so as to create an upside down 'T' with two anchors and a single (short) line up to the vessel - see Figure 111 above.

Rode - the material (NOT length - see 'Scope' below) used in an anchor line e.g. chain, chain and rope, or rope only (not recommended).

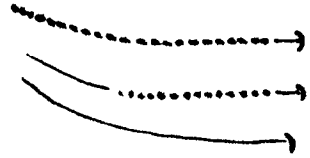


Fig. 114.

Scope - the length of the anchor line/ rode, from the anchor to the waterline under the vessel's bow, when at anchor. In light conditions, chain only, it may be three times the depth; in strong wind conditions seven or more times the depth.

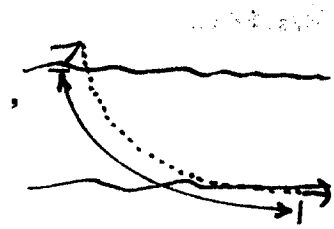


Fig. 115.

Slip line - a mooring line arrangement when about to leave (slip) moorings, with a line being attached at one end to the vessel, then passing around a strong point on the dock (or mooring) and back to the deck where it is held or temporarily cleated - the latter end can be released when required and the line pulled back on board from the other, cleated, end.

Fig. 116.

Springs - mooring or docking lines used when alongside, which run diagonally from the bow of the vessel to the dock opposite the stern of the vessel (bow spring) and from the stern of the vessel to the dock opposite the bow (stern spring), to stop a vessel rocking excessively in the fore and aft direction.

Stern line - a line from the stern of a vessel tied up alongside a dock or similar, to a position on the dock further aft than the vessel's stern.

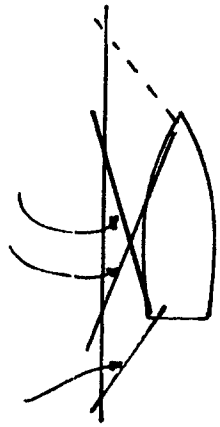


Fig. 117.

Tandem - anchoring using two anchors in line for extra anchoring security - see 'anchoring', page 24, Figure 101.

Tripping Line - a light but strong line from the crown of an anchor in use to a float at the water's surface - it can be used to pull a snagged anchor backwards and up, or just to assist in lifting the total weight of anchor plus rode if there is no serviceable windlass.

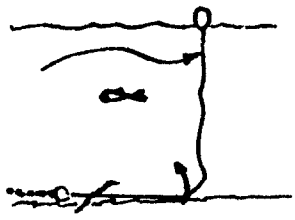


Fig. 118.

6. Navigational Instruments and Aids

Anemometer - a device for measuring <u>apparent</u> wind speed. Usually a three armed 'paddle wheel' with small cups in place of paddles, which spins as the wind blows over it - the faster the wind, the faster the wheel turns, generating electric pulses which are transmitted through wires to the counter/ display unit.

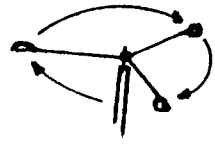


Fig. 119.

Barometer - a device for measuring atmospheric pressure. The outer scale on the dial may be graduated in millibars or inches, or both.

Fig. 120.

Compass - a device which when allowed to rest and pivot in a horizontal plane, settles with one part always pointing towards the apparent magnetic north pole direction; a round plate fitted to it and marked from its centre with the 360° of a circle allows a user to determine the magnetic direction from the compass to a distant object.

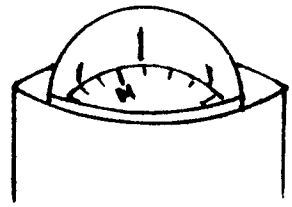


Fig. 121.

Compasses (a pair of) - a drawing instrument for (drawing) scribing a circle or arc of a circle of a required radius.

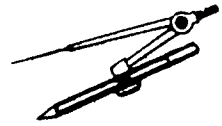


Fig. 122.

Deck log - see Logbook.

Depth (or echo) sounder - a low frequency sound wave pulse transmitter / receiver which transmits its signal downwards and measures the time taken for the echo's return to the vessel. As the speed of sound in water is known, with 'time' measured, the distance the sound wave travelled can be computed - half the 'there and back' distance is the depth.

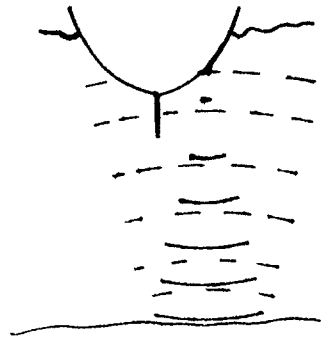


Fig. 123.

Dividers - a device having two pointed arms, joined at a pivot point at one end, which can be opened to a required angle as a means of comparing the distance between its two pointed ends and a distance scale. Nautical dividers allow one-handed use.

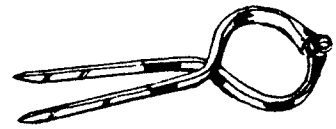


Fig. 124.

Hand lead or 'Lead line' - a line with a weight at one end, for measuring depth. They used to be specially made with a concave base for inserting a grease which would stick to and bring up samples of the bottom type e.g. sand, stone, etc. The rope used to be marked at specific intervals and in a special way - we can use plain rope and mark it any way we want to, and use any suitable weight.

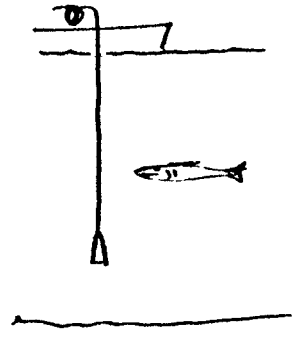


Fig. 125.

Log - a device for measuring the distance travelled through the water. If it has its own built in clock, it can, with 'time', compute 'speed' as well. The most common type is the 'Paddle Wheel' log. As the vessel moves, the wheel is turned, and a magnet in the wheel turns changing the magnetic pole influence on a switch mechanism which can sense these changes. The changing influences are passed, via electric wires, to the 'log' instrument where the counting and computing takes place - we see the result, the distance travelled in the water and the speed through that water.

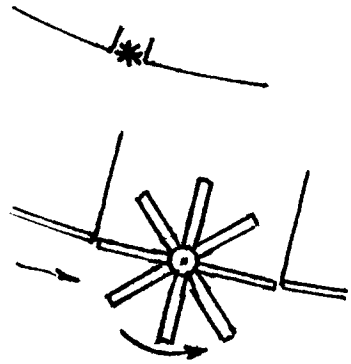


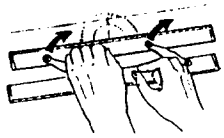
Fig. 126.

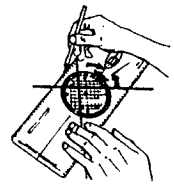
Log book (Or **Deck Log**) - a book in which all matters relevant to the management of the vessel and its travels are to be recorded - it is a legal requirement for every vessel to have such a book and for regular entries to be made.

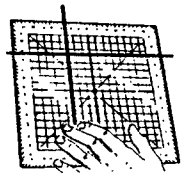
Navigation Lights - the lights required to be displayed by a vessel from sunset to sunrise and in poor visibility.

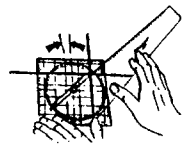
Navigation Instruments - rulers, protractors and plotters for use by the navigator while doing chartwork.

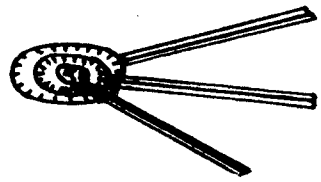
- **Parallel rule**
  Capt Field's
- **Plotter**
  Breton
- **Protractor**
  Douglas
  Hurst
- **Station Pointer**
- **Triangles**











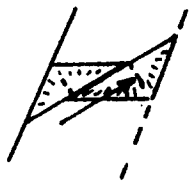


Fig. 127.

Radio Direction Finder (RDF) - a radio receiver with a built-in compass, designed for the purpose of detecting a specific transmission from a known place and enabling the user to then determine the magnetic direction from the user to the transmitter beacon.

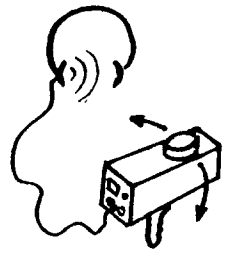


Fig. 128.

Sextant - an instrument for accurately measuring angles between distant objects.

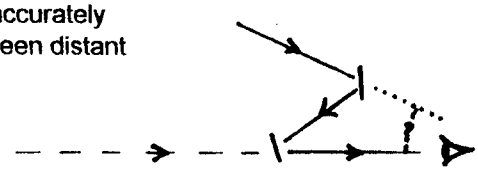


Fig. 129.

Wind speed/ direction Indicator - an anemometer with a wind vane, usually located forward of the masthead, which drive electronic sensors and which are connected to instruments with dials visible to the helmsman to show apparent wind speed and apparent wind direction.

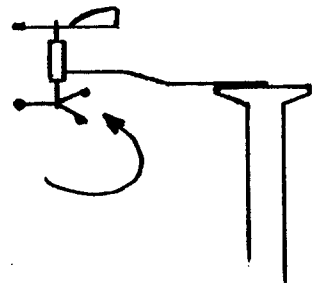


Fig. 130.

7. Sailing and General Nautical Terms

Aback - said of a sail which is sheeted to windward.

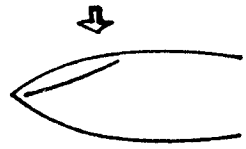


Fig. 131.

Abaft - 'behind', e.g. the seat is abaft the wheel.

Abeam - adjacent to the beam; at right angles to the fore and aft line, from the beam (side, centre).

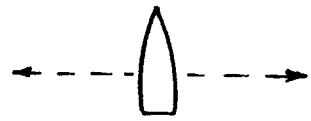


Fig. 132.

Aboard - on board; on the vessel.

Adrift - floating free, not under control.

Afloat - floating e.g. after being launched or after being aground, as a vessel breaks free of the ground, she is afloat again.

Aft - behind; the back of something.

Aground - said of a vessel whose keel is touching the seabed or any part of the ground below the vessel.

Ahead - to the front e.g. land ahead.

Alongside - parallel and adjacent to the side of a vessel e.g. a vessel is alongside a dock, and/or it may have another vessel tied up alongside itself.

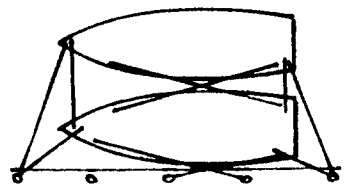


Fig. 133.

Amidships - the centre of a vessel.

Apparent wind - the wind experienced on a moving platform, e.g. a boat, is not the same as the wind experienced if speed/the boat were to be stopped. Imagine being on a stationary motorcycle with the wind being 10 knots from the side. As the motorcycle starts to accelerate forward, the wind gets stronger and the direction from which the wind comes moves towards the front. It is this stronger wind that is felt, that blows in your face or sails as you move, and the direction experienced moves closer to the 'ahead' direction. This wind speed and direction actually experienced is called the apparent wind - it is this wind which acts on the sails.

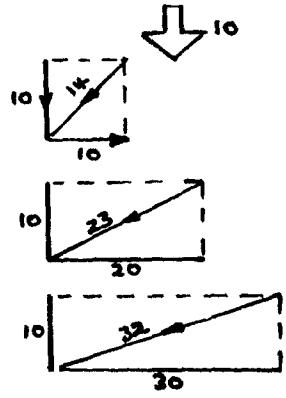


Fig. 134.

Ashore - on the land e.g. the skipper has gone ashore.

Astern - reverse e.g. "go astern". May also be used to mean 'behind'.

Athwart - across, e.g. athwart the tide, athwart the boat.

Athwartships - across a vessel from side to side, e.g. the main strengthening beam runs athwartships.

Awash - with water spilling over the decks.

Aweigh - said of an anchor when it has been broken out of the ground during the raising process.

Back - the anticlockwise change in wind direction.

Beam - the greatest width of a vessel.

Bear away /off /Come off - while under sail, to alter course away from the direction from which the wind comes, but not so much as to gybe.

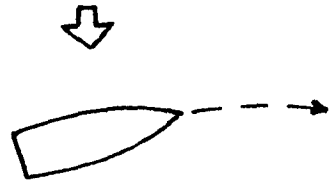


Fig. 135.

Bear up - while under sail, to adjust the course steered so as to reduce the angle between the wind direction and the track, but not so much as to cause the sail(s) to stall in the 'no-go-zone'.

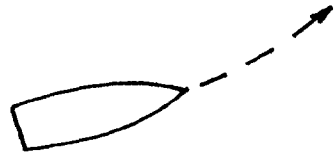


Fig. 136.

Bearing - a direction, usually taken from a compass, from an observer to an object.

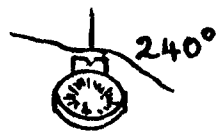


Fig. 137.

Beat - to sail a course very close to windward. Sea 'Close hauled', page 48. Beating may include more than one tack, i.e. a series of upwind 'legs' or tacks.

Belay - to secure a line to a belaying pin. For a quick release, the belaying pin is pulled out of the Fife-rail in which it is mounted. (Securing a line to a cleat is NOT 'belaying'.)

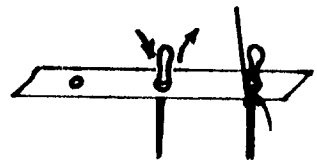


Fig. 138.

Below - inside a vessel, e.g. 'go below'.

Berth - a position for a vessel to dock or lie at moorings: also a bunk - a sleeping place for a person.

Bight - a loop in a line, other than at its ends.

Bow - the front of a vessel.

Bowse - to bowse down is to tighten down with a lashing.

Broach - when steering a course down wind, a following wave overtaking the vessel may lift the vessel's stern and slew it round to a side, turning the vessel 90° so as to be parallel to the waves - and vulnerable to being rolled over by the following swell/wave.

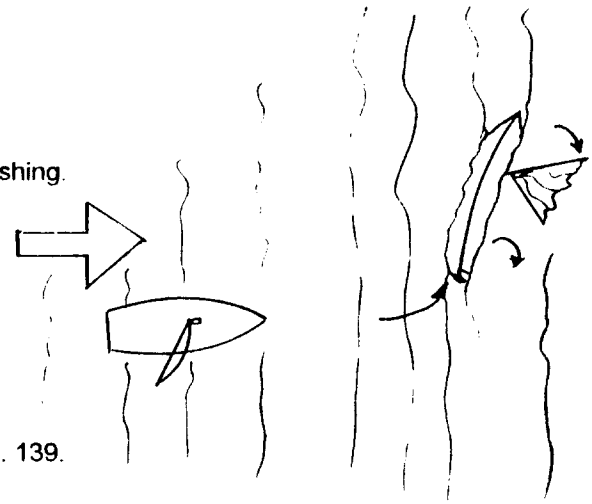


Fig. 139.

Burgee - a small triangular flag (rectangular when racing) showing the owner's, a club's, or an association's colours; it is flown from the masthead or if that is not possible, from the starboard crosstrees. It is taken down at night and when the owner leaves the vessel for more than just an hour or two.

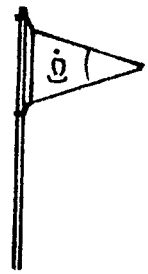


Fig. 140.

By the head - a vessel trimmed so that she is bow heavy/bow down. e.g. "She was sailing by the head."

By the lee - sailing downwind with the mainsail on the same side as the wind.

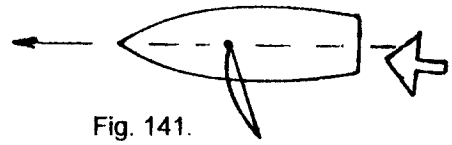


Fig. 141.

By the stern - a vessel trimmed so that she is stern heavy/stern down.

Cable - i. An anchor 'cable' of chain is a length of 30 metres (approximately).
ii. one tenth of a nautical mile.

Carry away - to break or part.

Carry way - to continue to move through the water.

Cast off - disconnect a line (if a mooring slip line, make sure it does not then drag in the water where it could be caught up in the propeller).

Check - i. to stop a line which is running out.
ii. to slowly ease out a line (a sheet or a halyard).

Close haul/pinch - to sail hard on the wind, close to a stall at the edge of the no-go-zone as possible. See page 48.

Con, to - to give instructions to the helmsman.

Course - the direction of movement of a vessel; the angle between north and the track of a vessel, measured clockwise in the 360° notation.

Crutch - a thwartships beam to support the aft end of a boom when the sail is not in use.

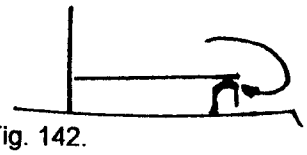


Fig. 142.

Current - the sideways flow of the seas waters due to the circular motion of waters within an ocean - they are almost constant in direction and rate all year round. (See also 'Tidal Stream'.)

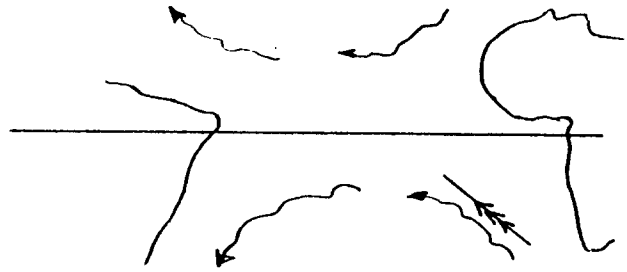


Fig. 143.

Dip (a flag) - to lower or collapse the ensign temporarily as a sign of respect or as a salute.

Draught - draught of a vessel is the depth of the vessel in the water when afloat - it is greater when the vessel is laden and least when all possible removable items are offloaded (or in some cases when the vessel is caused to heel over towards one side).

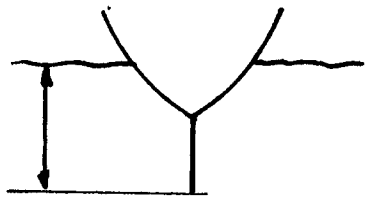


Fig. 144.

Ensign - the maritime flag of national registration of a vessel, usually the national flag of that country, but not so in the United Kingdom where there are three ensigns: the White Ensign for the Royal Squadron, the Blue Ensign for the navy and the Red Ensign for all the other UK registered vessels. It is flown at the stern of a vessel from sunrise to sunset when the vessel is manned.

Ensign staff- a short pole at the stern of a vessel from which the ensign is flown.

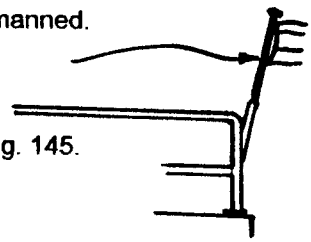


Fig. 145.

Fetch - see 'Close Reach', page 46.

Fore and aft - a line either on or parallel to the vessel's centre line.

F'ard/For'ard - ('For' as in forrest, 'ard' as in hard) the nautical way of saying 'Forward'.

Forward - the front or fore area, or direction.

Freeboard - the vertical height from the waterline to the deck level.

Galley - the kitchen of a vessel.

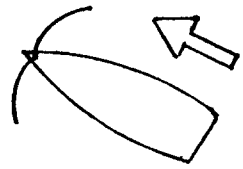
Gimbals - the system of hinged connections allowing a flat surface to remain level when a vessel heels.

Fig. 146.

Go about, to (or to tack) - while sailing, to turn the bow of the boat towards and through the wind so that it can sail with the wind on the opposite side (the opposite tack). See page 50.

Gybe - to turn a vessel under sail away from the wind so that the wind will change from blowing from one side of the vessel onto a sail, to blow onto the other side of the sail (the opposite tack). See page 51.

Goosewing - to sail downwind with two head-sails, one each side of the forestay, and the windward sail usually being 'poled out' - held to windward by having its sheet pass through the end of a spinnaker pole. (This is NOT 'WING-ON-WING'). Fig. 147.



Head rope - See 'Bow Line', page 24.

Heave to - to stop a sailing vessel using the power of the wind, by going about but not changing the sheets of the foresail so that it will become backed (aback), then turning the rudder to windward - the backed foresail and the angle of the rudder have contrary turning influences which cancel and the vessel will lie square to the wind and drift very slowly ahead with a leeway of about 30°.

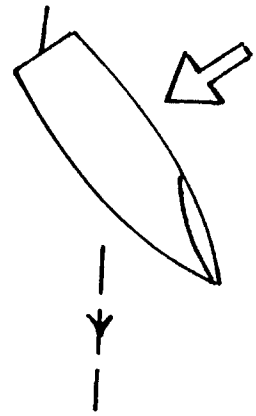


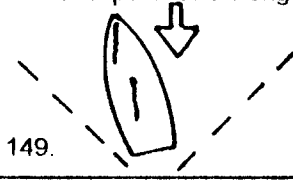
Fig. 148.

Heel - i. the bottom of a mast.
ii. the temporarily lean a boat over towards one side.
iii. the bottom aft end of a long keel.

Helm - the steering control, either a tiller or a steering wheel.
- lee helm - a tendency of the vessel, under its present state of trim, to turn away from the wind when the rudder is in the fore and aft plane. To keep the vessel on a straight course, it is then necessary to have the rudder slightly to windward to counter this tendency, i.e. the rudder's tiller is slightly to leeward ('lee helm').
- weather helm - the opposite of lee helm.

Inboard - within the hull or inside a vessel, e.g. usually said as a description of an engine mounted inboard.

In Irons - a sailing vessel, under sail, which has been steered on a course within the no-go-zone and whose sails have therefore stalled causing the vessel to stall. Fig. 149.



Inshore - close to the shore e.g. 'sail inshore to get the advantage of the eddy currents'.

Jury rig - an improvised, self-made mast to enable the crew to continue to sail after the original mast has unintentionally come down.

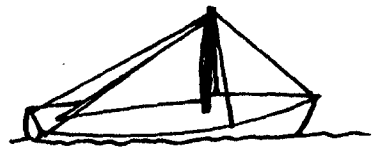


Fig. 150.

Knot - i. a speed of one nautical mile (1 852 metres) per hour. We speak of a vessel's speed as a number of knots, e.g. 6 knots, not 6 knots per hour as knots already means 'per hour'!
ii. a way of securing, tying, or joining a line.
iii. To 'tie the knot' - to let a lady get her way and secure a permanent strangle hold on her man.

Lashing - a method of tying or securing something, usually a sail not in use or a container, to a strong point so that it cannot move regardless of the weather and vessel's motion.

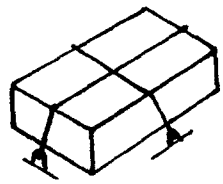


Fig. 151.

Launch - i. a motor boat, usually intended for pleasure.
ii. the act of putting a vessel into the water.

Lee-oh - the call from the helmsman as the vessel starts to pass through the no-go-zone during tacking or going about.

Leeward - pronounced 'Loo-ard', it is the downwind side (as opposed to the windward side) of a vessel\sail.

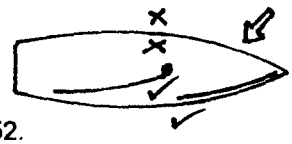


Fig. 152.

Let draw - pull in the sheets so that the sails fill.

Let fly - let go the sheets (quickly) to spill the wind.

List - the semi-permanent lean of a vessel to one side due to an unequal distribution of mass (load) on board.

Luff, to - to turn a sailing vessel towards the wind until the sail(s) begin to flutter. See page 47, figure 180.

Make water - to have water leaking in.

Make way - to move, or being moving, under control.

Man, to - to crew, or to operate manually. 'Man the pumps'.

Masthead - the top of a mast.

On deck - not below deck; on the vessel but in the open air.

Outboard - usually a detachable engine; outside the gunwale.

Overboard - no longer on the vessel; in the water having been on the vessel.

Pay off - to turn a vessel away from the wind.

Pay out - to let out more line under control.

Pinch - to sail so close to the edge of the no-go-zone that speed is sacrificed.

Pooped - to have a wave break over the stern deck of a vessel - hence the name 'poop deck' given to raised aft decks.

Port - i. the left side of a vessel.
ii. a shelter area for vessels where they can dock or moor, get replenishments, load or discharge cargo, or have repairs done. (A harbour).

Quarter - half way between abeam and astern;
a direction from a vessel, or the area
of a vessel in that direction from its centre.

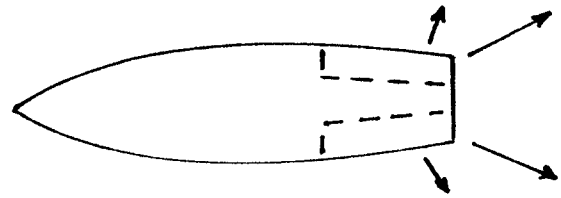


Fig. 153.

Reach - a sailing course between close hauled and a run:
i. Close reach (Fetch)

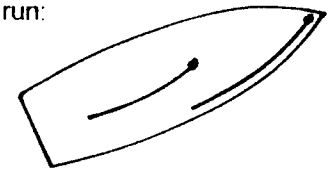


Fig. 154.

ii. Beam Reach

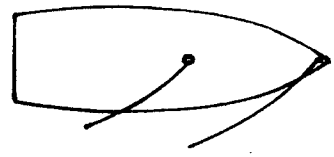


Fig 155.

iii. Broad reach

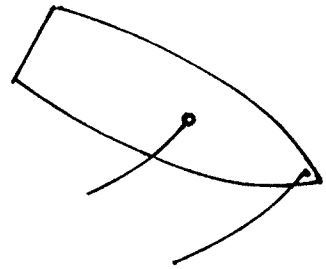


Fig. 156.

Reef - i. to reef - to reduce the size of a sail.
ii. an obstacle to shipping just below the water's surface, usually of rock or coral.

Run - to sail a course in line with the wind.

Sail, to i. Back a sail - see 'aback'.
ii. Make sail - to get under way by hoisting sails.
iii. Shorten sail - reduce sail area by reefing/using smaller sails.
iv. Trim sails - adjust the sail shape for optimum performance.

Ship, to - i. to take on board, as in loading cargo.
ii. to ship water can mean to load water but it can also mean the vessel is leaking and water is getting into the bilge.

Sound, to - to measure the depth of water in which the vessel is located, by using a depth sounder.

Suit of - a range of sail types and sizes carried or for a sails vessel.

Starboard - the right hand side of a vessel.

Steady - an order to the helmsman to stay on the present course (and maintain the same speed).

Steerage - control of a moving vessel's direction by having sufficient way on (speed) and therefore rate of flow of water across the rudder for it to have effect.

Surge - i. to wind a line around a bollard.
ii. a sudden and temporary movement, usually of a mass of water due to the changing sea swell.

Tack - i. the bottom forward corner of a sail.
ii. 'to tack' (see 'Go about', page 33) means to turn a sailing vessel so that the bow passes through the wind so that she can sail with the wind on the opposite side; while undertaking this turn a vessel is said to be 'tacking', BUT...
iii. 'a tack' is:
a. any straight course e.g. 'We were on a tack towards ...'.
b. either 'Port Tack' or 'Starboard Tack', an indication as to which side of the vessel the wind comes from. (Note: not which direction it is blowing towards.)

Thwart - a plank, seat or beam running across a vessel's beam, either as a seat for an oarsman or for structural reasons.

Fig. 157.

Tide - the rise and fall of the sea due to the changing tidal influences of the sun and especially the moon as the earth orbits the sun and is orbited by the moon. The tide changes from one extreme to the other in approximately 6 hours - as it changes, the water flow to or from an area is also changing in rate and direction (set) of flow.

Turn-up - to 'make fast'; to secure, tie up, cleat, belay, etc.

Veer - i. to swing at anchor.
ii. a clockwise change in the direction of the wind, regardless of hemisphere.
iii. to pay out a line.

Wake - the pattern formed on the water after a vessel has passed; the pattern of disturbed water behind a moving vessel.

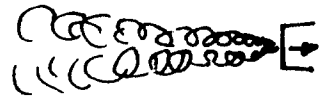


Fig. 158.

Wash - i. to clean, using water - a rare experience for some!
ii. the wave form made by a vessel moving through the water.

Way - i. Leeway - the sideways slip of a vessel relative to the course being steered, due to the wind.

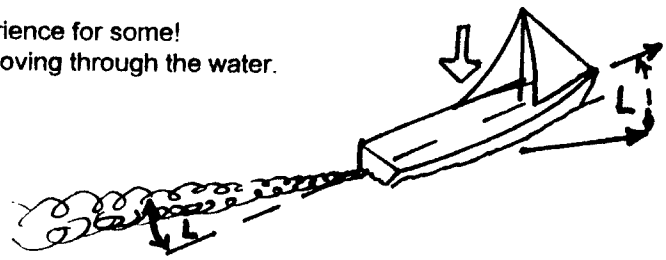


Fig. 159.

ii. Under way - a vessel is under way when it is no longer held by its anchor, is no longer attached to its mooring or when it has let go all lines to the dock - it may not necessarily be moving.

iii. to have 'way on' is to be moving.
(NB: A vessel may be 'under way with no way on' or 'under way and have way on'.

iv. a 'fairway' is a wide, deep area allowing deep draughted vessels freedom of movement.

Weather - i. the meteorological conditions.
ii. to endure i.e. weather the storm.
iii. the 'upwind' side, e.g. 'The harbour entrance is to weather'.

Weigh, to - to pull in the anchor from the sea bottom.

Wing on Wing - to sail downwind with the mainsail on one side and the foresail on the other.

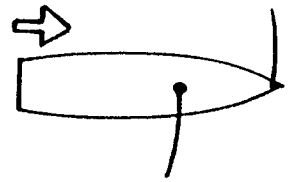


Fig. 160.

Yaw, to - the side to side/zig-zag course usually due to poor helmsmanship, or caused by wave or swell motion when sailing down wind with the waves.

There are many more nautical terms a vessel's master must be familiar with, but the above are the minimum required by the curriculum. ***Yachtmaster Ocean Services'*** imminent new ***Dictionary of Yachtmasters' Nautical Terms*** goes out of the way to bring the many local and imported nautical dictionaries up to date.

NOTES

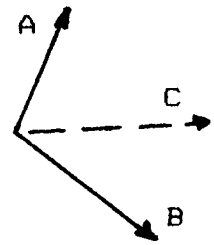
CHAPTER 2

THE THEORY OF SAILS

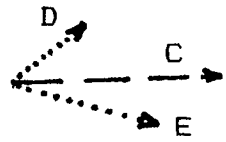
Introduction

It is necessary to revise on some elementary facts of nature:

1. When two forces, A and B, act at different directions on one object, that object is induced to move in a direction and at a speed equal to the effect of both forces - or the 'resultant' force (C), which is the diagonal formed from the parallelogram of A and B i.e. two forces combine to result in one force; the direction and magnitude of the resultant force is different to either of the applied forces. Fig. 161.



2. If two different forces can be represented by one resultant force, then one force can be represented by two component forces (i.e. if, as in 1. above, A and B result in C, then C results from A and B OR C from D and E). Fig. 162.



3. Air moving over the inside of a curved surface slows, causing a pressure increase on the inside surface of the curve; this pushes on the curved surface.

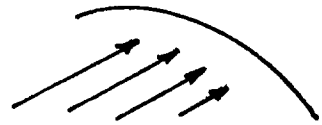
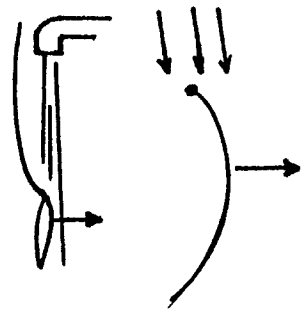


Fig. 163.

Pressure $_{(\text{low altitude})}$ = Constant - (Wind Velocity^2/16)
(So slow wind = more pressure: fast wind = less pressure)
Force = Pressure (of wind) x Surface area (of sails)

4. Air moving at speed over a curved surface causes a decrease in pressure on the outside surface of the curve; this decrease in pressure causes a suction or pulling force on the curved surface. The direction of this suction force is at right angles to the curve. Try it! Hold the ends of one side of a sheet of paper horizontally in front of your mouth so that it is in line with and close to your lips. The sheet must not be held at any other points. Let the sheet hang down. Blow across the TOP SURFACE ONLY; see how the hanging sheet rises! Fig. 164.



This compression and suction is what enables aeroplanes to fly, and sails to pull boats (sailing yachts) along.

The Theory of Sails

Laminar and Turbulent Flow

A sail trimmed in an air flow causes the air (A) passing close to the sail itself to increase in speed because it has further to travel to keep up with the adjacent air.

No air can pass through the sail (B).

Air flow behind the sail (C) stays travelling in a straight line and as a result of no air passing through the sail, a low pressure (L) area builds up sucking this leeward flow in towards the sail.

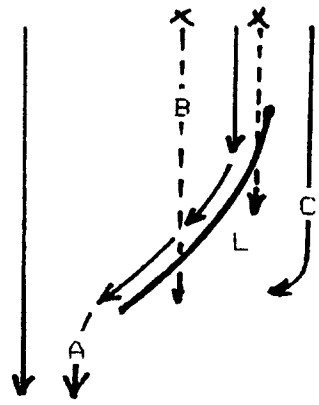


Fig. 165.

This flow (C) therefore curves away from its normal route, curves towards the low pressure area/the sail's leeward side (D), and as it passes the leech of the sail, it is re-united (E) with the wind which has accelerated around the front of the sail.

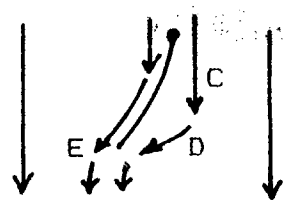


Fig. 166.

IF the sail has been correctly trimmed, the air passing the leech from both sides of the sail (E) will be travelling at the same speed and there will be a smooth air flow in that area - this is called 'Laminar Flow'. To see this in practice, we tie thin strips of surplus sail cloth to the leech at several places between the clew and the head of the sail - when we have laminar flow these strips, 'Tell Tails', flow straight out behind and in line with the sail.

If the angle of the sail to the wind direction is not correctly set, it will be either because we have sheeted in the sail too tight (F) causing the leeward wind to curl round in 'eddies' (G) behind the sail, or the sail will not have been sheeted in enough such that it starts to collapse in to windward and flap/ flog, 'to Luff' (H), just behind the mast. In either case the laminar flow is interrupted and turbulent air results.

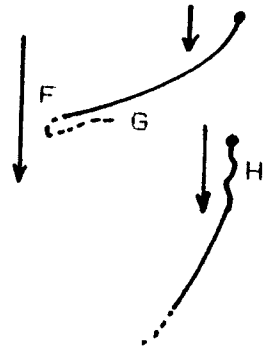


Fig. 167.

Turbulent air may still create a low pressure area at the lee of the sail, sucking/pulling the sail - and therefore the yacht will still be sailing along with an ignorant crew unaware that the sail is technically 'stalled'. The vessel will be moving slower (and may be heeling over more) than it should be - that is why racing crew are always trimming their sails, for every little change in wind direction the sail sheet tension must be changed -just as it must for every change, no matter how small, the helmsman makes to the course being steered. The angle of the sail to the wind direction is most important to efficient sailing (but we don't get too carried away about it if we are sailing just for fun and not racing!).

Incidently, that is the reason a helmsman calls 'Bearing up' or 'Bearing away' (or whatever is agreed on a particular boat) when changing the course steered, even for small changes - it serves to wake the dozing crew up and inform them that the sheet(s) need adjusting/sail(s) need re-trimming for the new course (the new wind-boat angle).

Trimming Sails

1. Halyard Tension.

Some sails, especially some racing yacht's sails, have a 'speed line' - a horizontal coloured stripe across the sail from luff to leech. For sails without it, any horizontal line across a sail, whether a full length batten, a seam in the sail's panels, or even an imagined horizontal line will serve the same purpose. Its function is to tell the crew when the halyard tension is correct and therefore when the cross sectional shape of the sail is set for optimum efficiency.

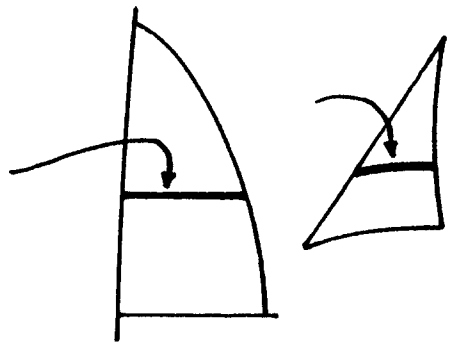


Fig. 168.

The optimum for a sail whose luff is near vertical and whose foot is tensioned on a boom (e.g. a mainsail) is when the deepest part of the cross sectional curve (D) is mid-way along the speed line, namely at the centre of this line's length.

If the halyard is too loose, D will be aft of the centre point (Da); if the halyard is too tight, D will be forward of the centre point (Df).

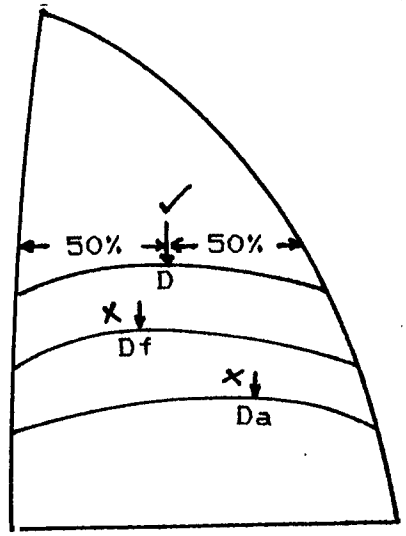


Fig. 169.

Once set correctly, the luff tension may need changing if the wind speed increases - it causes D to move further aft, so we need to tighten the luff (the halyard or Cunningham). If set for moderate, fresh or strong winds which later change to light wind conditions, D may move forward requiring the luff tension to be decreased, either by loosening the halyard, or by letting out on the Cunningham.

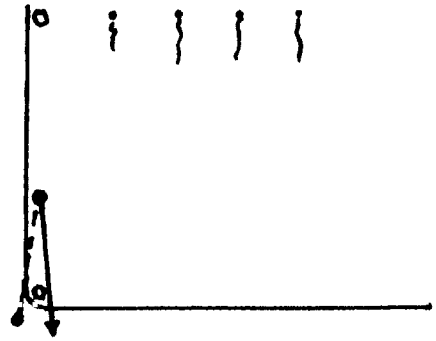


Fig. 170.

For headsails, the deepest part of the curve should be just forward of the centre mark (H) - at about 45% of the total length from the luff. The position of this deepest part of the curve can be moved further aft or forward by loosening or tightening the halyard respectively.

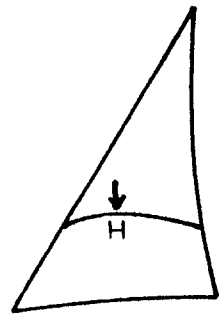


Fig. 171.

2. Clew Tension/Sheeting.

i. **Headsails**. Near the luff of a headsail, at about three different levels, are 'Tell Tails'; thin ribbons of sailcloth attached to both sides of the sail. When we have the correct laminar flow across a headsail, the leeward tell tails will be hard against the lee of the sail and will point horizontally aft. The tell tails on the windward side will point aft but upwards - at about 30° to the line of the lee tell tails. If either side's tell tails do not do as described, then the sheet tension is not correct - move the sheet/the clew towards the side which has the

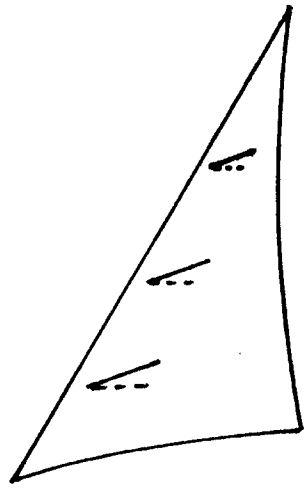


Fig.172.

defaulting tell tail. So if the near tell tail is hanging down or has a vertical rampant erection (points straight up), the sail must move nearer i.e. tighten the sheet. If the far (leeward) tell tail is not pointing aft horizontally, the sail must go further away - i.e. we must slacken the sheet.

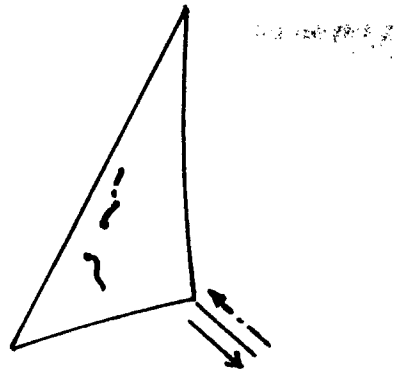


Fig. 173.

It may also happen that the tell tails at one level are doing the right thing on both sides of the sail, but at the other levels either the windward or the leeward tell tail is not pointing the direction expected. This will be because the angle of pull of the sheet is wrong. It can be rectified by moving the 'car' (the pulley wheel/sheave in the slide on the genoa track along the sides of the deck or coachroof) through which the sheet passes on its route from the clew of the sail. The car can be slid further forward or aft - move the car until all (three?) levels of tell tails act together. When the bottom tell tails act correctly, if at a higher level the lee tell tail(s) is/are wrong, the car must be slid further aft: if the windward tell tail(s) is/are wrong, the car must move further forward.

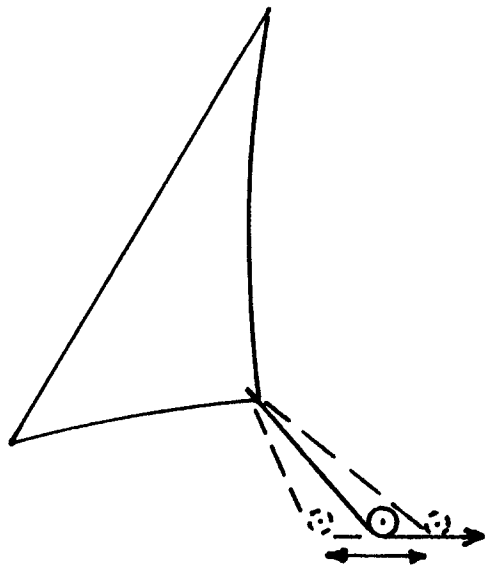


Fig. 174.

ii. **The mainsail.** Once the halyard tension is correct, we can adjust the outhaul - the lighter the wind, the more cross-sectional curve the sail requires and therefore the looser the outhaul must be. Conversely, the faster the wind, the flatter the sail must be, the tighter must the outhaul be. The amount of tension the outhaul requires is difficult to determine - one cannot see a tell tail for advice.

Practice and experience are best - each time you alter a setting, see if the boat's speed improves or not.

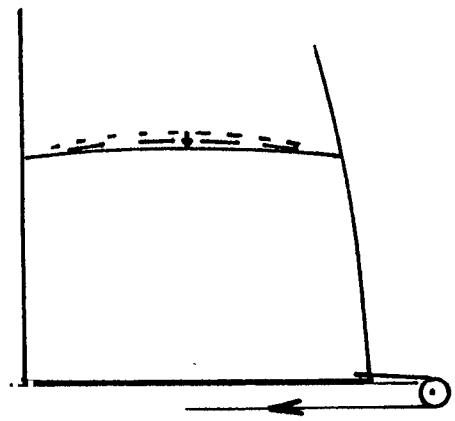


Fig. 175.

The sheet setting is best described by the quote "**IF IN DOUBT, LET OUT**!". This is because there is a common tendency to pull it (and most other adjustable lines - the 'running rigging') in tight or too tight. Look at the tell tails at the leech - are they tucked in behind the lee of the leech (T)(turbulent flow)? If 'yes', the sheet is too tight ...

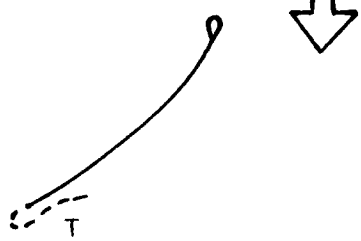
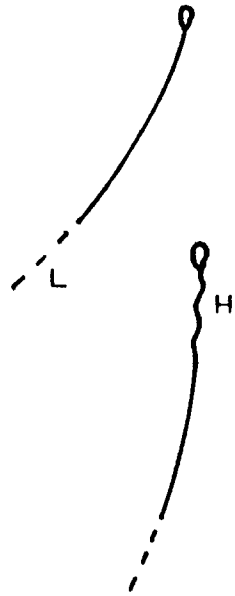


Fig. 176.1.

... let out the sheet until they are streaming aft in line with the sail (L), then we have laminar flow. That may not be enough!



Let out the sheet some more until the sail, behind the luff and at about half way (H) between the luff and the deepest part of the sail's curve, starts to cave in - to flog or luff. Then sheet in half the difference between this setting and the setting when the tell tails started to stream aft as you were letting the sheet out. The sail must not show any sign of wanting to luff in its forward section, but the exact position differs from vessel to vessel and in different sea conditions. Look at the boat speed indicator when you adjust a sheet - does it make things better or worse? (If you have no speed indicator, try to judge by the speed of the water passing the cockpit).

Fig. 176.2.

The flattener (Fl) is tensioned in fresh winds when sailing close to the wind (close hauled or close reach/ fetch) to make the sail have less cross sectional curve than the out-haul tension alone can give. It only alters the curve in the bottom third of the sail - Fig. 177. The top two thirds curve is controlled by mast bend. Tightening a backstay flattens the top section of the sail; slacken -ing a backstay straightens the mast and puts more curve in the top of the sail for lighter conditions (Fig. 178).

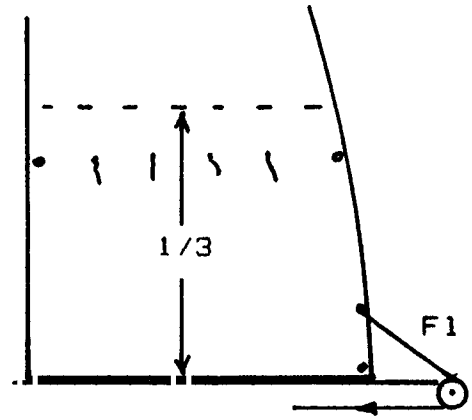


Fig. 177.

The kicking strap (Ks) or boom vang (often just called the vang) stops the boom from rising as the sheet is eased when the wind is more from the side - the beam i.e. when on a beam reach, or when going with the wind (a broad reach or run). See Fig. 179.1. Sailing close to the wind, the sheet is in tight and the vang has no role, other than to keep downward tension near the centre of the boom to stop it bending upwards. In light conditions the apparent wind direction at the bottom of the sail is closer to ahead than at the top of the mast where the apparent wind speed is faster. With differing apparent wind directions between the bottom and the top of the sail, the sail angle requirements at the top and bottom of the sail differ - see Fig. 179.2.

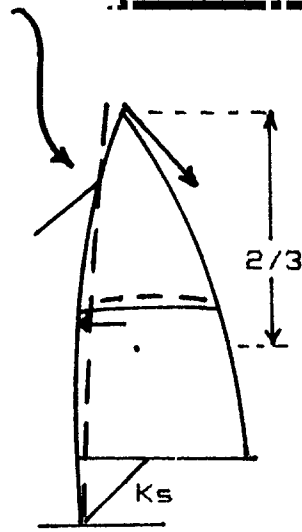


Fig. 178.

Fig. 179.1

- we need to cater for both so the sail must be induced to have 'twist'. We achieve this by letting the vang loose, pulling the bottom end of the mainsheet attachment on its car or 'traveller' to the windward extreme of its track, then easing the sheet until all levels of tell tails at the leech are streaming aft.

In light conditions when nearer a beam reach, it is sometimes better to let the traveller down to the extreme of its leeward movement, then adjust the sheet for best boat speed.

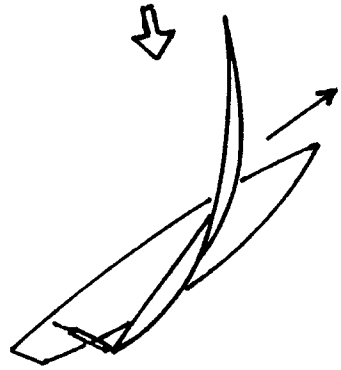
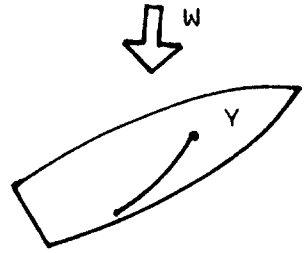


Fig. 179.2.

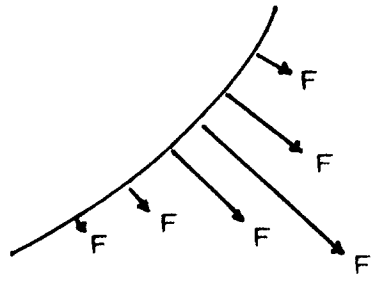
Well trimmed sails will not only help a yacht go faster; there will be less wear and tear on the sails, and it will sail closer to the wind when required to with greater efficiency than a similar vessel with poorly trimmed sails. The forward pulling forces resulting from the 'parallelogram of forces' acting on a sail will be greatest.

The Parallelogram of Forces applied to Sails

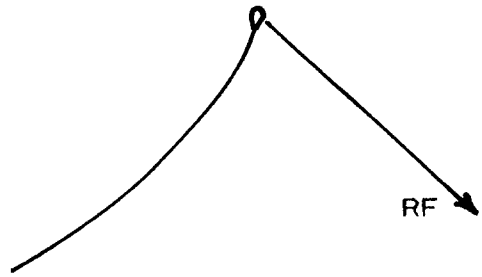
Masts with sails set do not float too well unless we put a boat under them! So let's see a sailing vessel (Y) with a mainsail set and sailing, with laminar air flow across the sail, and wind direction represented by the arrow (W).



As the forces acting on each part of a sail do so at right angles to that part of the sail, these forces could each be represented by lots of 'suction force' arrows - the length of each being in proportion to the force (F) at that spot.



As we saw in the introduction to this section, where we have two (or more) forces acting on one object, we can combine these forces into one resultant force (RF). Since the sail is connected to, and acts on the mast, which is connected to and acts on the yacht, we can take the mast as a convenient central spot to represent the force RF acting on the boat as a whole. Fig. 180.



The sailing vessel cannot, because of its keel or centreboard, move in the direction of this force RF. This force RF must therefore find an outlet in the direction allowed by the keel or centreboard. If we take the forward force (FF) in this direction as one of the two components of the total force RF, the diagonal of a parallelogram, then there must be another (wasted) force, Z.

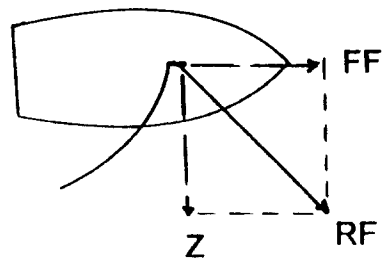


Fig. 181.

So now we have two main forces, FF and Z, acting on the vessel, both due to the wind. FF gives us the forward motion while Z serves to slow the vessel, partly acting against FF, while also adding to heeling forces.

Force FF, and therefore the vessel's heading, can be in any direction, so long as the sail is not allowed to luff, and for most sailing boats the sails will luff (Lf) if the heading becomes less than about 45° from the wind direction - i.e. in a total angle of 90°, called 'The No-Go-Zone'. If a vessel's heading remains anywhere within the 90° with the sails luffing (stalled), the speed will drop off until the rudder stalls (the speed of water flow across the rudder will become too slow for it to have any effect). The vessel is then said to be 'In irons'.

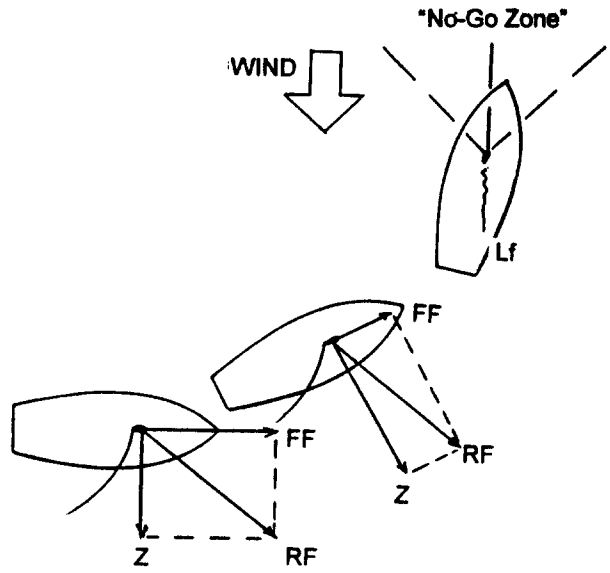


Fig. 182.

Tacks and Points of Sail

Tacks

A "Tack", "Tacks", and "Tacking" have several meanings. A 'tack' can mean any straight line course sailed, and it can mean the side of a vessel the wind is coming from. It is the latter meaning we now refer to.

If the wind blows from the port side of a sailing vessel towards her starboard side, we say the vessel is on a Port Tack.

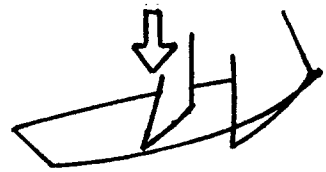


Fig. 183.

Wind blowing from the starboard to the port of a sailing vessel means that the vessel is on a Starboard Tack.

Fig. 184.

Note therefore that the sail is on the opposite side of the vessel to her tack. Therefore the boom is also on the opposite side of the vessel to her tack.

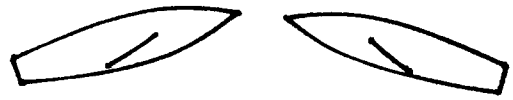


Fig. 185.

Points of Sail

The angle a sailing boat's course makes to the wind direction, regardless of tack, are described as:

a. **Close hauled**: The yacht sails as close to the wind as it can without going into irons. (Also called 'Pinching'.)

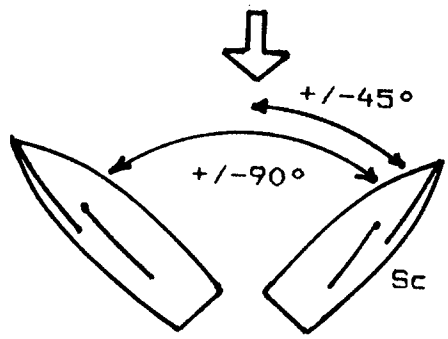


Fig. 186.

b. **Close reach (Fetch)**: an angle between close hauled and the vessel's heading being at 90° to the wind. (A sailing vessel going to a windward destination will sail faster on each close reach tack than if close hauled; it will get to a windward destination faster sailing a series of fetching tacks than if close hauled.)

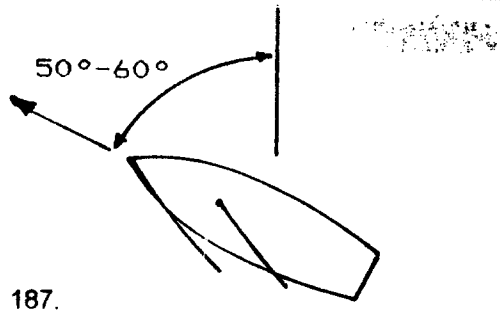


Fig. 187.

c. **Beam reach**: a heading 90° to the wind, or near 90° (say about 75° to about 115°) to the wind, is called a beam reach. For any given wind speed, it is the fastest point of sail for most sailing boats.

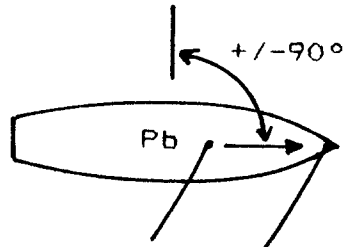


Fig. 188.

d. **Broad reach**: a course between a beam reach (about 115°) and a run (near to 180° from the wind i.e. sailing almost with the wind).

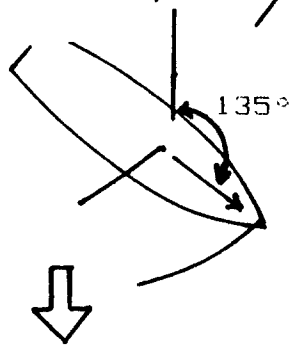
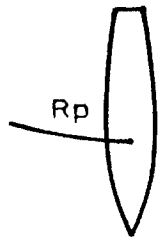


Fig. 189.

e. Run: sailing in line, or almost in line with the wind.



Note that the tack and the point of sail are both used to describe the direction a vessel is sailing relevant to the wind direction. So a vessel can be 'Port tack, beam reach' (Pb), 'Starboard tack, close hauled' (Sc), etc. When on a run it could be on either a port tack (Rp) or starboard tack (Rs), depending on which side the boom and therefore the sail are carried.

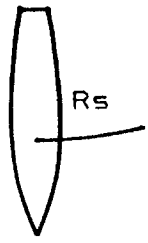


Fig. 190.

Heel

Look back at the Parallelogram of Forces again for a moment. What makes the yacht sail forwards is the straight ahead (FF) component of the single resultant force (RF). The closer a vessel steers towards the wind, the smaller the FF force becomes BUT the bigger the Z (heel) force becomes.

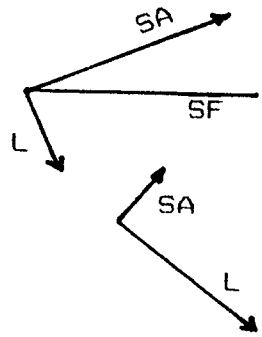


Fig. 191.

Now one of the laws of physics (Isaac Newton's second law) says that for every force there is an equal but opposite reaction force. So if the total force exerted by the wind on the yacht as a whole (sails, mast, rigging, hull, etc.)(W), is, say, 100 units, there will be an equal resistance force (from the water pressure on the keel) of 100 units acting in the direction of the wind i.e. towards the wind.

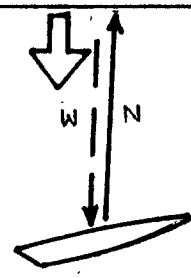


Fig. 192.

Since the wind acts on the mast above the water, and the keel exerts its resistance to leeway below the water, the vessel will heel: the closer to windward the course, the smaller the FF force and the greater the Z force, the more the vessel will heel. As it heels, more of the hull is exposed to the wind increasing leeway forces, the mast gets shorter, the keel gets shallower, more wind is spilt upwards off the sail, more of the FF (resultant low pressure sucking force which pulls the sail - and therefore the boat) acts downwards rather than horizontally, and the harder it is for the helmsman to keep the yacht on the intended course.

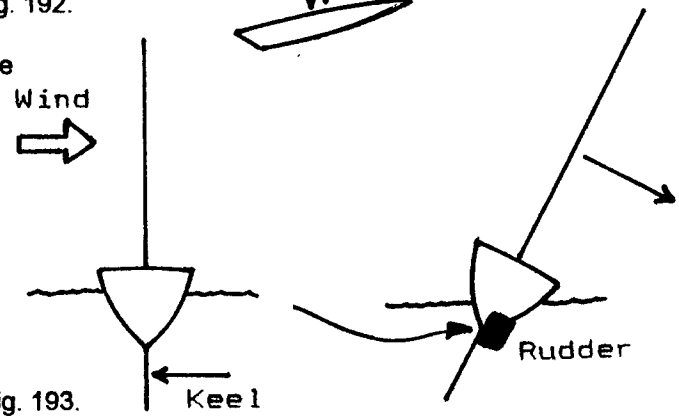


Fig. 193.

Rudder offset becomes necessary to keep the course straight as the hull is no longer symmetrical in the water, more rudder drag resistance is created in the water, and the slower the yacht will move - with heel angle increasing. This happens when we sail close hauled. If we bear away a little, speed will increase noticeably, heel angle will decrease, and the greater efficiency is achieved.

It is nicer too!

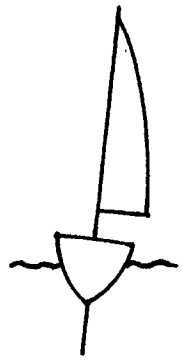


Fig. 194.

Tacking/Going About, and Gybing

1. Tacking/Going About.

'To tack' or 'to go about' is to turn the bow of the boat up towards and through the wind, i.e. through the no-go-zone. When a helmsman decides it is time to tack, he or she will indicate the intention with a call something like "Ready to tack". It is not necessary to use the same words; the only important aspect is that all on board understand the system used on their yacht and act as one team. Once all are ready they will reply with 'Ready' and the helmsman starts the turn calling "Lee Oh", "Helms'-a -Lee", "Tacking" or "Going about" etc, as the turn commences.

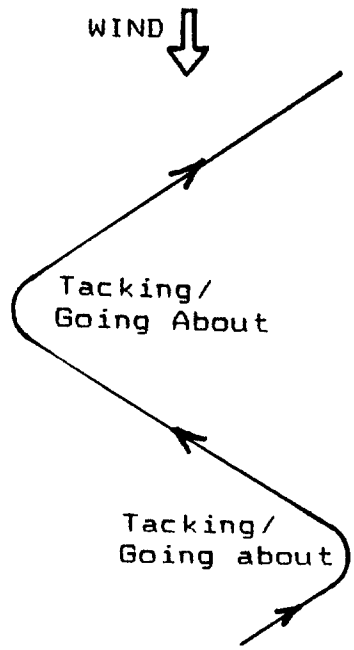


Fig. 195.

The crew member who is manning the leeward (under tension) sheet must prepare for the tack by getting ready to 'let fly' that sheet: if cleated or in a jammer, the sheet must be uncleated and as the turn is commenced, he watches the forward area of the headsail - as it starts to cave-in (luff)(L), he must let fly by spinning the sheet windings off the top of the winch (W) as fast as possible and let go. At the same time as this crew member lets go, the crew member on the opposite sheet has prepared by taking up the slack in the 'lazy' sheet and has wound the sheet twice **clockwise** around the winch on the windward side; at this stage this sheet must now be pulled in,'sheeted in', as fast as possible. The helmsman steers the vessel to its new course and the sails are trimmed.

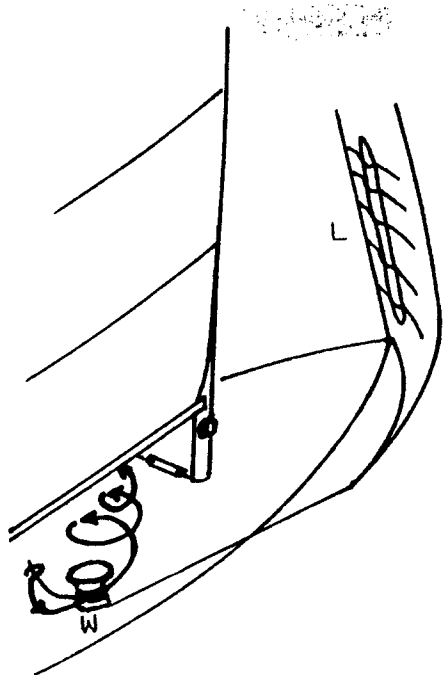


Fig. 196.

Note that no mention has been made of the main sheet and mainsail. If sufficient crew are available, one member can tend the main sheet, tightening it during the turn unless it was already tight, and trimming it on the new tack. If there are not enough crew, it can be left until after the turn and the headsail sheet is adjusted, before being trimmed. If the tack was part of a beat, i.e. a series of upwind tacks, the main sheet is likely to be kept tight and can therefore be ignored.

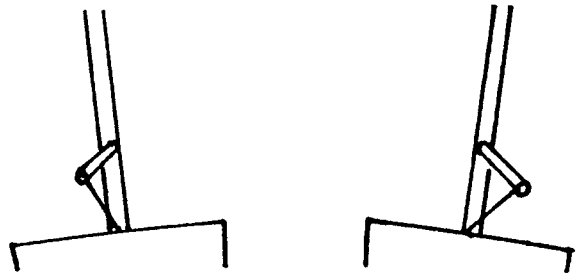


Fig. 197.

2. **Gybing**.

Gybing is changing tack by turning the bow of the vessel away from and through the wind, i.e. the stern of the vessel points at the wind direction at a stage during the turn. The procedure for gybing is similar to tacking, except that an additional preparation step is necessary, involving sheeting in the mainsail boom. If the main sheet was not tightened before a gybe, the boom would be held to one side by the wind - as the wind changes sides during the turn by passing around the back, the leech, of the sail, it will cause the boom to sweep across to the opposite side with <u>great force</u>. The force of a boom swinging across during an uncontrolled gybe must

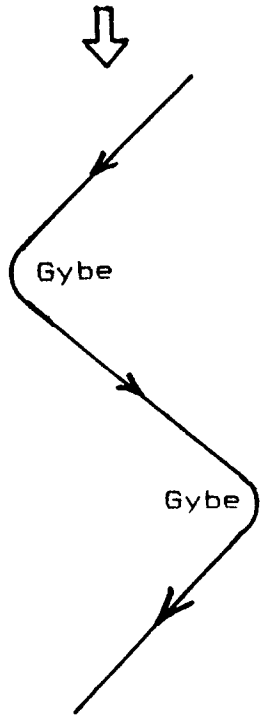


Fig. 198.

never be underestimated - it can smash everything in its way and sweep crew overboard - it can and does kill.

When the helmsman decides that the need for a gybe is imminent, he will call 'Ready to gybe'(A). Crew manning the headsail sheets get ready and call out 'Ready' just as they did for tacking. The crew person responsible for the mainsheet must, on hearing the helmsman's preparatory call, sheet in the mainsail as tight as it can be pulled in (B) then call 'Ready' -if this is not automatically done, the helmsman must call 'Sheet in the main (sail)'. Only when the helmsman is satisfied that the boom is in tight, and that everyone else is ready, may he commence the turn to gybe. As the wind changes sides, the new course is steered (C) and the sheets/sails are trimmed for the new tack (D). The actual words, signals and acknowledgements procedure will vary from boat to boat, and from skipper to skipper, but the above is a suggested method, especially for crew getting used to the drills.

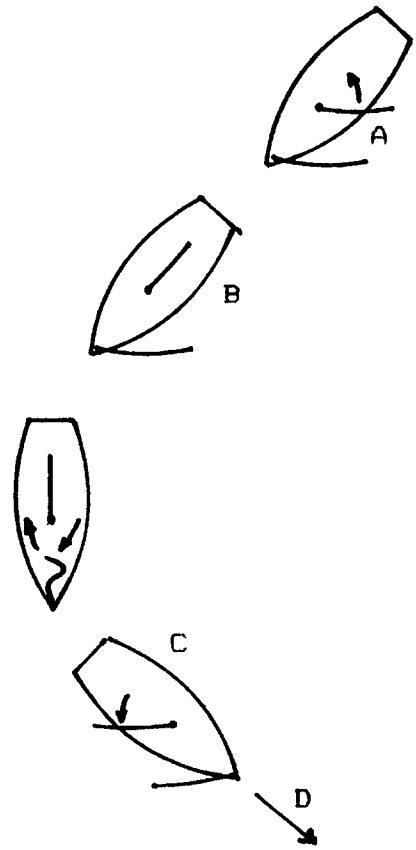


Fig. 199.

Reefing, headsail changing, and spinnaker work are covered in the practical phase of your course - this is because there are so many differences between boats, skippers, etc.

NOTES

NOTES (Continued)

CHAPTER 3

ANCHORING, MOORING AND BERTHING/DOCKING

Introduction

Unless a vessel is under way, it must be secured to a dock, mooring, or the seabed. The lines or anchor gear used must be strong, or expensive damage may result.

For most yachtsmen and -women, their yacht is a substantial investment. Few are adequately insured, if at all. Some yachts are built 'on the cheap', and anchor and mooring gear are often facets which are grossly neglected. Weekend and short distance sailors sailing on yachts equipped with a primary anchor and one kedge anchor will more than likely have no problem. If it is rough, they can stay on shore and wait for a better weekend, while many mooring lines hold the yacht where they left it. If it turns rough while sailing, one may have to dock (berth) in strong winds, or even anchor and wait for the wind strength to abate.

If one does not have the right gear in such circumstances, or of one does not use it correctly, expensive damage to one's own boat could result, and worse, damage to other vessels may follow - and guess who will have to pay! Worse still, injury or death could be one of the consequences - the crew, other vessels' crew, and rescue crew are all put at risk.

A Fundamental Anchoring Rule

Home-made, untested anchors are often a potential disaster - they only collapse at a time when they are most needed. The fundamental rule is therefore: 'Get the biggest, the best, and the strongest anchors and associated gear you can'. When you need to rely on them, you want to be able to do just that!

ANCHORING AND MOORING

Definitions

Anchored. A vessel is at anchor when she is held to the seabed/bottom surface via one line/rode (chain, rope or a combination of the two) from the vessel, to one or more inter-connected anchors, the line's scope (length) being suitable for use with just one anchor. So a vessel at anchor can swing ('veer') with the changing tide or wind, in a wide radius almost equal to the length of the line (the 'scope'), in an arc of 360°.

Moored. A vessel is moored when she is held to the seabed/bottom surface in such a manner that, by comparison with being at anchor, her radius and/or arc of veer is/are in any way reduced.

Anchoring

Types of Anchors. The modern range of anchors for yachts continues to grow. Not all are ideal for any type of seabed/bottom surface; some are best suited to mud, some to rock or coral, and only a few could be regarded as 'general purpose'. In light wind conditions, almost any anchor will do, providing it is heavy enough. As conditions deteriorate, the importance of the right type of anchor(s), the right minimum length of the proper chain (and the rope if used in combination with chain), and their connection one to another and to the vessel, increase in importance. Remember the 'Fundamental rule of anchoring'. So let's look at the anchors.

1. **The Fisherman**.

'For'	'Against'
Grips/holds on any/all seabed types, e.g. weed, mud, sand, rock, pebbles, etc.	Heavy in comparison to other anchors of the same holding power.
Very strong. Best holding power of all anchors.	The 'stock' ('T' piece) is held in position by a pin, called a 'forelock' which can work loose - if it comes out and the stock slips out, the anchor will lie flat on the seabed - it will not 'dig in'.
Folds flat for stowing.	The arm and flukes snag ropes on deck easily. Cumbersome to stow and handle; to raise and lower over the side.

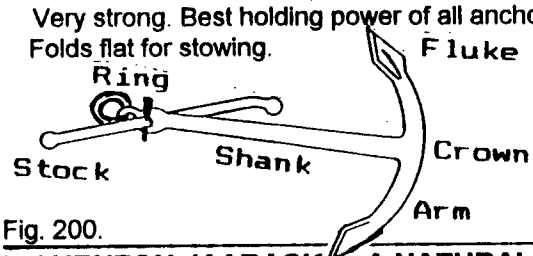


Fig. 200.

2. **The Danforth** (or Meon).

'For'

Holds on most seabed types.
Folds flat for stowage.
Good holding power.
Lighter than equivalent holding powered Fisherman anchor.

'Against'

When the direction of pull changes, it often breaks out and then drags some distance before it will dig in again.
When stowed with its chain and rope, it can snag, causing tangles.
Can be very difficult to break out of mud.
Does not hold well in kelp.

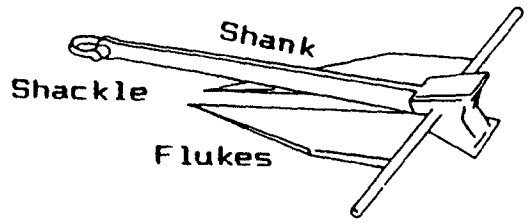
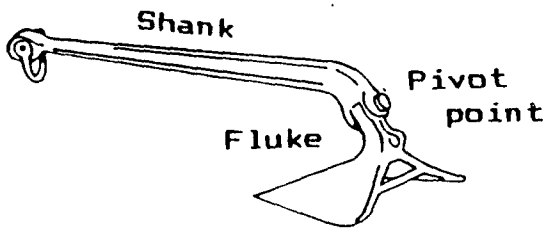


Fig.201.

3. **Plough Anchors**

a. **The CQR.**



'For'

It 'digs-in' well.
It is lighter than an equivalent holding powered Fisherman.
Holds well in sand, mud, clay, ooze, silt, etc.

Fig. 202.

'Against'

Does not fold flat for stowage. Bulky and awkward to handle. Can be difficult to break out of mud etc.

b. **The Bruce.**

'For'

As for CQR, above. Breaks out of the seabed fairly easily. No moving parts.

'Against'

Does not fold to stow.
Bulky and awkward to stow.
Does not dig into seaweed kelp.
Ability to get a firm grip on a rocky bottom is questionable.
The three flukes and the shank form a four-sided claw - it can fill with a large stone, then just drag along the bottom.

Fig. 203.

c. **The Deepset-Plow.**

'General Comment'

This anchor is relatively new, and tests claim it has far superior holding power to other 'Plough' anchors.

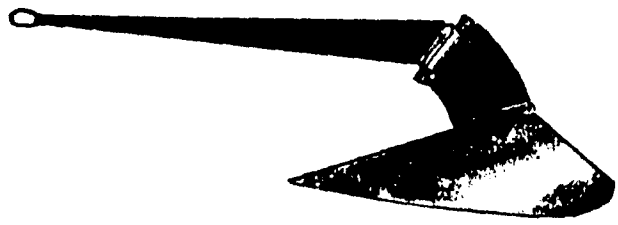


Fig. 204.

4. **The Folding Grapnel.**

'For'

Folds flat to stow. Does not snag ropes on deck/in an anchor locker.
Holds/grips well on rock and seaweed.

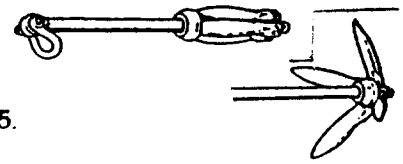


Fig. 205.

'Against'

Too many moving parts - 4 arms, a collar, and the shank (6 pieces).
Its strength is questionable, therefore its holding power is not great.

A grapnel (small) is usually used by light craft such as ski-boats and tenders from larger yachts.

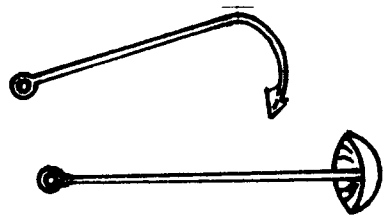
5. **Other Types.** Other anchor types include the:

i. Delta (see page 24),

ii. Fortress (see page 25),

iii. Rond, and the Fig. 206.

iv. Mushroom. Fig. 207.



Size Tables

The bigger the vessel, the bigger and stronger the anchor gear it must have. The following table is intended as a guide. Remember: '... the bigger, the stronger, the longer, etc, the better...' And rather one too many anchors than one too few!

Displace-ment Tons	Fisherman	CQR (+Delta)	Bruce	Danforth	Chain	Rope (*Circumf.)
< 5 tons	18 kg	16 kg	10 kg	14 kg	6 mm	38 mm
5 - 8 tons	20 kg	16 kg	15 kg	14 kg	8 mm	45 mm
8 - 10 tons	22 kg	16 kg	15 kg	14 kg	10 mm	52 mm
10 -15 tons	27 kg	20 kg	20 kg	18 kg	12 mm	58 mm
15 -20 tons	32 kg	20 kg	20 kg	18 kg	12 mm	58 mm
20 -28 tons	36 kg	20 kg	30 kg	18 kg	12 mm	65 mm
28 -35 tons	45 kg	20 kg	30 kg	18 kg	13 mm	65 mm
35 -40 tons	54 kg	27 kg	30 kg	30 kg	13 mm	70 mm
40 -45 tons	60 kg	35 kg	50 kg	30 kg	15 mm	70 mm

* See page 56 for converting circumference to diameter.

The Deepset-Plow equates approximately to the lighter of the CQR and the Bruce for any stipulated boat size.
The Fortress equates to approximately half the weight of a Danforth for much better results!

Chain

The chain must be the 'hi - tensile' steel, 'short link' type; not the general purpose variety. The dimension of the chain in the above table refers to the diameter of the metal 'rod' used to make the chain links. The length ('scope') of chain set out, if the primary anchor's 'rode' (the attachment between vessel and anchor when at anchor) is to be all chain, should not be less than three to four times the maximum depth in which one may anchor. The length of chain carried for this purpose should be as 60 metres or more, but not less than 50 metres. Mark (paint) it at five metre intervals.

Secondary, or kedge anchors' rodes may comprise a combination of chain and rope. Here the chain should not be less than five metres in length to be effective. These minimums are quoted despite some books/authorities' 'Suggested Minimum Scales of Safety Equipment' recommendations being for shorter lengths.

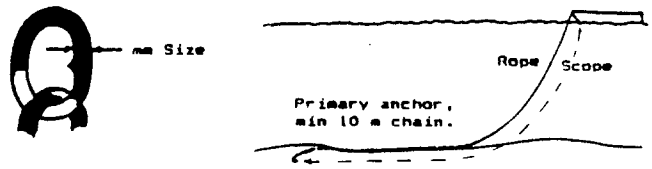


Fig. 208.

The chain is attached to the anchor with a shackle, the strength of which must be equal to or greater than the rated strength of the chain. Once the shackle's pin has been tightened, a soft wire seizing ('mousing wire') is used to hold the pin from working loose. The shackle is then 'moused'.

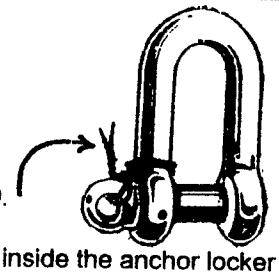


Fig. 209.

The other end of the chain, if chain only is used, should be secured inside the anchor locker with rope tied to the chain's end and to a strong point in the locker. The rope should be long enough to allow the chain's end to be exposed on deck if all the chain is pulled out. In an emergency, if it becomes necessary to abandon the anchor in a hurry, this rope can be cut (tie a float and line to the chain for later recovery).

Scope of Chain. The scope of chain used should be (minimum in calm conditions):

1. **RYA Formula**. Scope = 12 x √ maximum depth
2. **CASA Formula**. Scope = 3 x maximum depth ('Maximum' - means at the highest high tide expected.)

For example, if anchoring where the depth at high tide is not expected to exceed 10 metres:

Minimum Scope by RYA formula:
Scope = 12 x √ 10 m
= 12 x 3,2 m
= 38 m (to the nearest metre)
Minimum Scope by CASA formula:
Scope = 3 x 10 m
= 30 m

And if the maximum depth expected is 20 metres:

RYA Formula:	CASA formula:
Scope = 12 x √ 20 m	Scope = 3 x 20 m
= 12 x 4,5 m	= 60 m
= 54 m	

The differences are not large. In addition, we do not calculate a scope to a decimal of a metre: in fact, having worked out the scope required to the nearest (approximate) metre, we then usually 'round-up' to the nearest multiple of five metres - if one's chain is marked at five metre intervals!

In stronger wind conditions the scope must be increased. In winds of over about 27 knots, the scope calculated above should be doubled, and in winds over 40 knots the scope could be 7 to 10 times the maximum depth. From 'calm' to 'very strong' winds, the chain's scope should be increased in proportion to (or be longer than) the wind speeds/lengths quoted.

The weight of the scope of chain used creates a curved 'catenary' or spring which stops the vessel from 'jerking' during periods of strong wind or choppy waters.

The magnitude of the scope ensures that, because of the weight of the chain, the end of the chain nearest the anchor lies flat on the seabed/bottom surface and therefore the pull on the anchor is in a horizontal plane. The design of anchors is such that when pulled horizontally, the anchor will dig down into the seabed - the stronger the pull, the deeper it will go, increasing its grip.

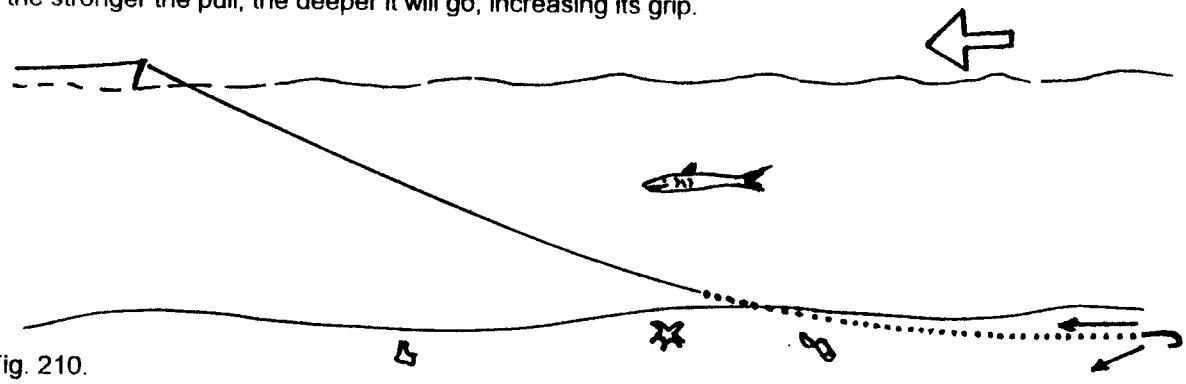


Fig. 210.

The advantages of using chain are:

i. Chafe. It is virtually immune to chafe.
ii. Strength. It is very strong.
iii. Length. The scope is shorter than it needs to be where chain and rope are used together.

The two disadvantages of the use of chain only in the rode make-up are:

a. Weight. Chain is heavy creating stowage 'balance' problems, and it is heavy to recover when weighing anchor.
b. Cost. Chain is expensive; more so than the rope (nylon line) used by most yachts. Two lengths at least are required as the secondary anchor requires at least 5 metres in my opinion (CASA say 2 metres but 10 metres would be better). If more anchors are held, they also will need lengths of chain.

Rope and Chain Combination

Rope used from the anchor to the vessel would not be heavy enough on its own to ensure a horizontal pull on an anchor (unless the scope were very long). Worse still, rope would not survive the chafe from the ground materials such as stone, rock, coral, etc. It should, therefore, be used only as a temporary measure in calm conditions, or as a kedge rode in an emergency.

Any combination of rope and chain in a rode should have as much chain as possible, and not less than 10 metres in the case of a primary/bower anchor. This anchor's rope component should not be less than 50 metres for inland waters, and for offshore 100 metres (I prefer even longer). When anchoring using a chain/rope combination, ignore the length of the chain component and calculate the rope length required as follows:

Scope (of Rope with Chain)

1. **RYA Formula**: Scope (rope) = 20 x $\sqrt{}$ maximum depth.

2. **CASA Formula**: Scope (rope) = 4 x maximum depth.
So in our earlier example of anchoring in an area where the maximum depth expected is 10 metres:

RYA:		CASA:	
Rope	= 20 x $\sqrt{}$ 10 m	Rope	= 4 x 10 m
	= 20 x 3,2 m		= 40 m
	= 64 m		

The RYA's recommended rope length in this situation is more than 50% greater than CASA's.

These are, however, recommendations for calm to mild conditions and, therefore, their differences become almost academic. Both Associations strongly advise that, as the wind is expected to increase or at the latest as it starts to increase, let out more scope. Here we emphasise the '...strongest...' part of the Fundamental Rule, and a long rode increases holding power (strength)! The length of rope used (with chain) in the rode should be at least 50 to 100 % longer than the length of chain used in a 'chain only' situation.

Purists do not refer to 'rope' on a yacht or any sea-going vessel (unless it is the 'bell rope' to sound the bell or the bolt rope at the luff and/or foot of a mainsail!): each piece of rope is named according to its function e.g. halyard, sheet, etc. Spare rope is called a 'warp', as is a general purpose piece of rope. Once we use the 'spare warp', it becomes a 'line', e.g. a line used to lash some item on the vessel, a mooring line, a heaving line, and an anchor line, etc. An anchor line is not a hawser - a hawser is used on large vessels/ships and is about 10 centimetres or more in diameter.

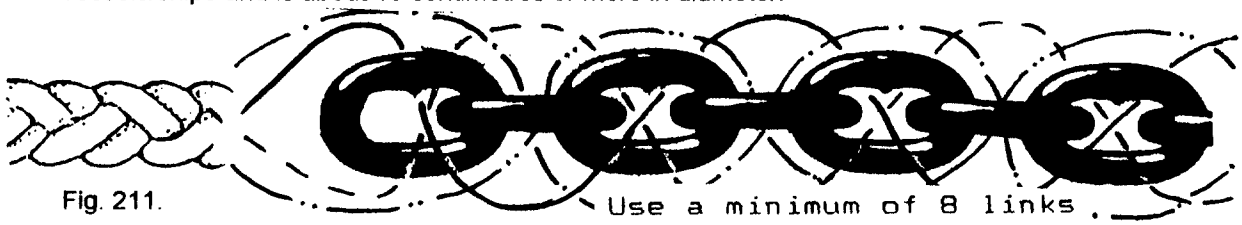


Fig. 211.

An anchor line can be connected to an anchor chain either by using a rope-to-chain splice (Figure 211), or the chain can be shackled to a thimble-lined eye splice in the end of the anchor line (Figure 212). Or the 'fisherman's bend' knot can be used.

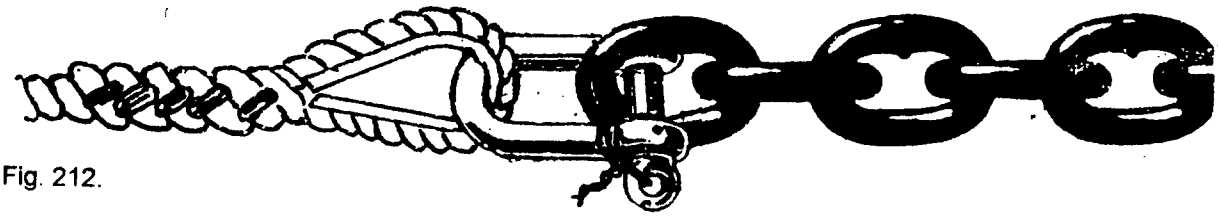


Fig. 212.

Rope (Anchor Line)

Look back at the table on page 53. Rope sizes are frequently specified in terms of their circumferences, whereas one often finds it easier to comprehend when the diameter is known. Here is a quick conversion:

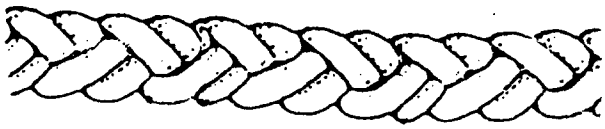
Circumference		Diameter
38 mm	=	12 mm (<0,5 inch)
45 mm	=	14 mm (>0,5 inch)
52 mm	=	16 mm
58 mm	=	18 mm
65 mm	=	20 mm
70 mm	=	22 mm
75 mm	=	24 mm
80 mm	=	25,4 mm (1 inch)

An anchor line must provide 'spring' (stretch) in lieu of the catenary of a chain having its own weight. Polyesters (except non pre-stretched polyester), especially Kevlar which is expensive, have very little and no stretch respectively, and are therefore suited to the roles of halyard (both polyester and Kevlar) and sheets (polyester).

Nylon and non pre-stretched polyester have considerable elasticity and are, therefore, most suited to the role of anchor, mooring and towing line. The rope referred to in the table on page 53, is nylon. It is available as conventional three-strand rope (Figure 213) in all the range of sizes, or as 'multi-plait' ('twin' four-strand) rope (Figure 214) in the mid- to larger sizes only. Both forms can be spliced to chain and both can be worked to form an eye splice.

Fig. 213.

Fig. 214.



Nylon rope will melt if enough heat is applied, before it will burn. This allows a rope worker to make a simple, neat, and fairly quick cut using a hot metal edge - either a heated knife blade or an electrically heated blade made for the purpose. If nylon is left exposed to the sun for long periods, or is stowed in a locker subjected to the engine's heat, it will harden. Non pre-stretched polyester (3 strand and multi plait) has the same properties without hardening.

The cut ends of nylon rope should still be secured by whipping, preferably a 'sail maker's whipping', because the melted end 'seal' can break and the threads can start to splay out, and a common whipping is prone to come loose after a period.

Chafe effects all ropes, so remember to protect your mooring and anchor lines. Use hose pipe or any other binding to protect the rope where it passes over objects which could cause chafe.

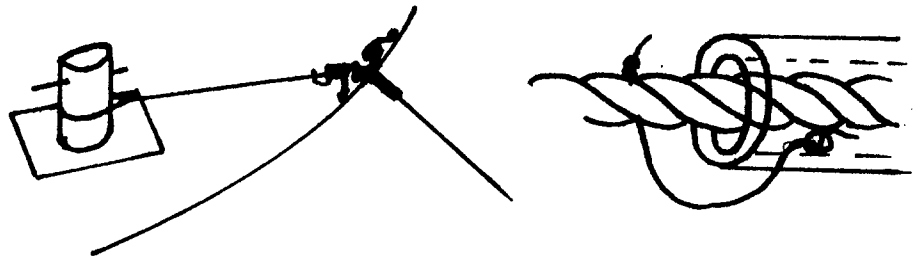


Fig. 215.

How Many Anchors?

A yacht is required to have at least two anchors and associated gear (chain or chain and anchor line). One anchor is the main or primary (or bower) anchor, and the second is called the kedge anchor. A kedge anchor is usually smaller and lighter than the primary anchor, and it is used mainly to assist the primary when two anchors are laid off the bow, or it is used to 'moor' (i.e. to restrict the veer (or swing) of the vessel) - usually by laying the kedge far aft. If possible, this second anchor should also be as big and strong, and of as good a quality, as the primary anchor - it does not have to be smaller. The chain (and warp if used) should equally be as strong and long as the primary rode, but more often than not one has to compromise and use a limited chain length for this anchor. Cruising yachts usually have three or four anchors.

Selecting an Anchorage

More often than not one anchors in an area where one has anchored before and where one is reasonably familiar with the area. The anchoring process becomes a subconscious routine. However, if one is to anchor in an unfamiliar area, there are several considerations the skipper must weigh up.

A. Is the anchorage to the lee of some protection?

B. Which spot will be the best in terms of wind and swell direction?

C. Will the vessel at anchor be in the way of other vessels which may pass the area?

D. Is/are the right type of anchor(s) available for the seabed/bottom surface type (e.g. mud, coral, etc.)?

E. Is there sufficient room and depth should the wind or tidal stream cause the vessel to swing through 360°?

F. If there is not enough room, would the use of a kedge anchor to limit swing be beneficial? Or could it result in the vessel lying 'beam-on' to the swell when/if it changes?

G. Is there any possibility of obstructions on the seabed such as coral reefs, rock, or wrecks which could either foul the anchor chain or anchor line, or be struck by the keel as the vessel veers at anchor?

H. Will the presence of other vessels in the vicinity now and/or later affect the vessel's access to the spot, or departure from that spot under normal conditions or in an emergency?

I. If the storm were to become more severe, what anchor or combination of anchors would be best?

J. If more than one anchor is to be used, is there sufficient space and suitable seabed/bottom surface holding ground for all the anchors?

K. Will the minimum depth, at the time of the lowest tide to be expected, be adequate, even if the vessel veers?

L. Will the vessel be far enough away from the surf at low tide?

M. Will there be any threat to your vessel's safety from other vessels coming or going, or if another vessel were to drag her anchor? How can this threat be minimised?

N. Is there any restriction to anchoring in the area?

O. If it becomes desirable or necessary, will one be able to get ashore using the dinghy/tender? If not, does it really matter?

P. If the approach to the anchorage is at night, how is accurate navigation/pilotage to the spot to be done? Can the approach, as is always the rule, be delayed until sunrise when one can see to navigate/exercise pilotage?

ONLY IN AN EXTREME EMERGENCY SHOULD ONE APPROACH AN UNFAMILIAR AREA IN DARKNESS.

There may be other considerations peculiar to a specific place which will become apparent as one approaches. As long as the above questions have been satisfactorily answered, there should be no undue problem in using the selected anchorage.

Methods of Anchoring

There are two methods of anchoring; the 'running' method and the 'dropping' method. Both can be performed under power or sail.

1. **The Running Method.**

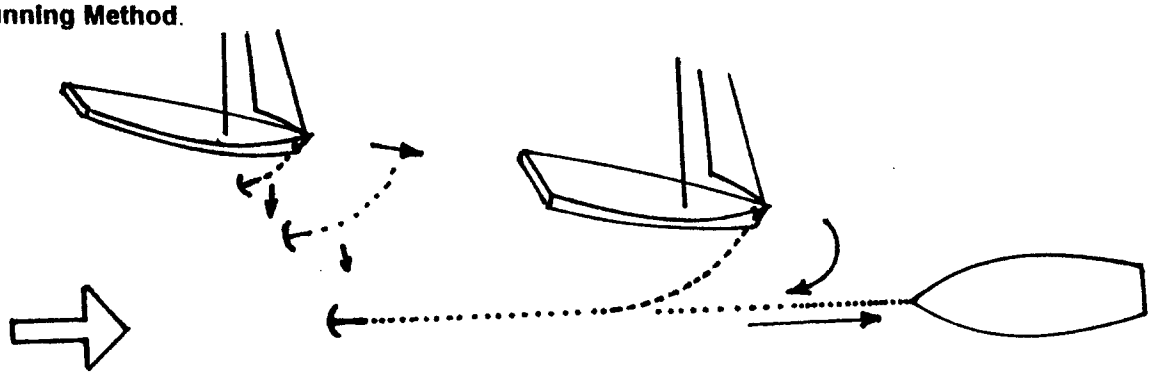


Fig. 216.

Once the vessel has settled facing the anchor, or nearly so, note the depth reading on the depth sounder, and select transits abeam on land (or take a compass bearing to an object abeam) if possible. Any subsequent change in the transits' aspects, or the compass bearing, will be an indication that the anchor is not holding and that the vessel has moved - it will probably continue to move/drag anchor. One can either let out more scope, if there is enough room, and check for new transits or compass bearings, or re anchor where there is better holding ground.

Make sure the anchor chain or line is properly secured to a deck fitting (bollard or cleat) that is strong enough for the purpose, and that the chain/line cannot come loose. Do not just leave the chain over the gypsy wheel of the windlass.

Once the vessel is securely at anchor, a duty 'anchor watch' list is prepared and the crew must take turns to monitor the vessel's position in case it starts to drag the anchor again, or in case any other threat to the safety of the vessel arises (e.g. another vessel arrives and anchors too close). By day, the 'at anchor' ball shape is raised to a position where it can best be seen from all around, and at night, the 'all-round (white) anchor light' is set.

2. **The 'Dropping' Method.**

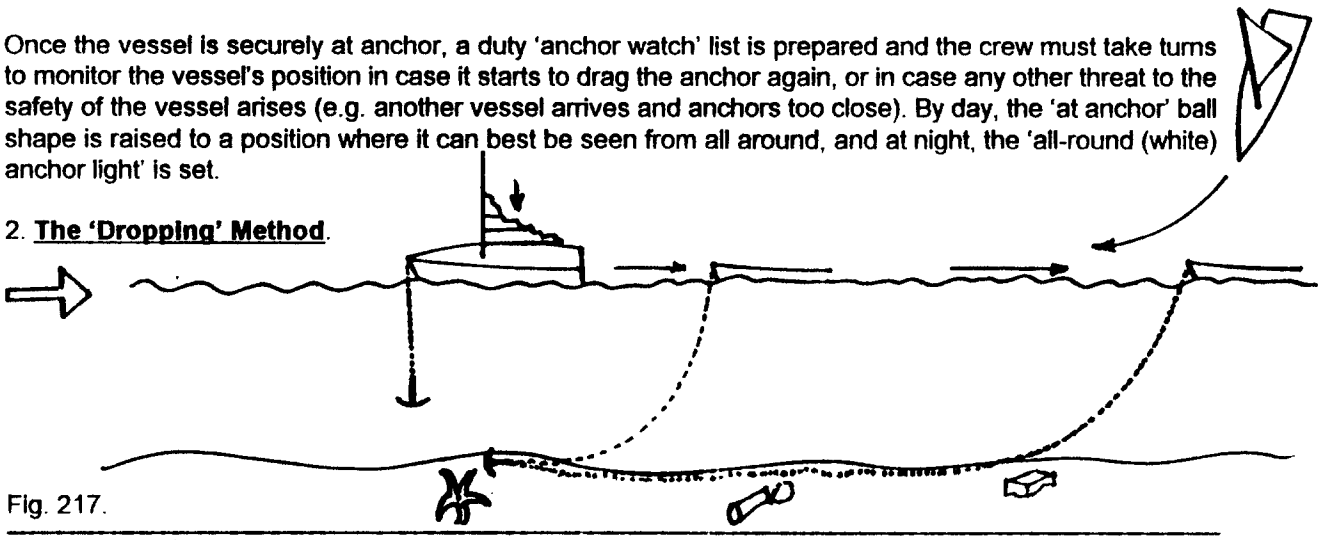


Fig. 217.

As the vessel falls astern. the bow will fall off to one side fairly quickly, and as soon as about 50% or more of the scope is out, a temporary 'snubbing' or 'checking' (stopping the line) by a few turns around the bollard or cleat, will turn the vessel bow to wind again, and then more scope can be released. If this is not done, it is possible that the rode may get under the vessel and foul with the keel, the propeller or the rudder.

Once all the scope has been let out, the rest of the procedure is the same as for the 'running' method, above.

Tripping Lines

A tripping line is any thin warp, strong enough to lift the weight of an anchor and its chain, and long enough to reach from the seabed/bottom surface to the water's surface at high tide, plus a few extra metres. The end opposite the anchor has a float attached. The extra few metres allow for bringing the 'float end' on deck even though the bow of the vessel is not directly above the anchor. When an anchor gets stuck on something below, it can invariably be pulled out backwards quite easily.

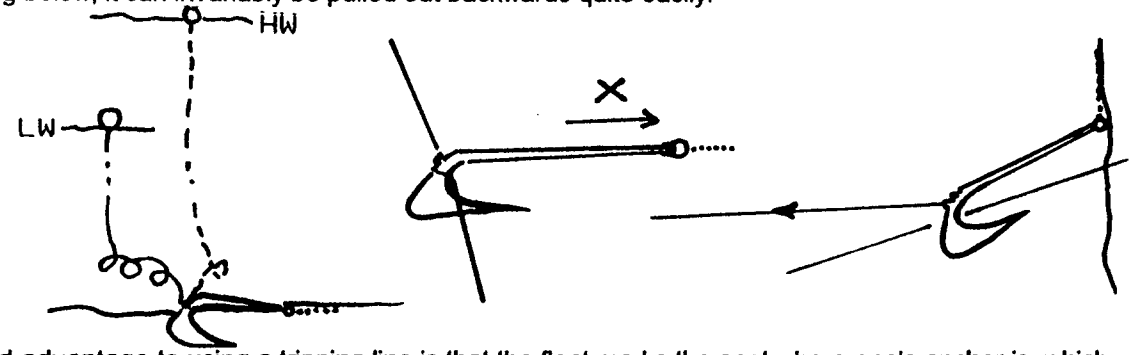


Fig. 218.

An added advantage to using a tripping line is that the float marks the spot where one's anchor is, which helps during the recovery stage, and as the vessel veers with changing conditions of wind and tidal stream, one can see the extent of the veering. Any other vessel approaching to anchor nearby will see both the anchored vessel and the float, and will (hopefully) not anchor too close to either.

Tandem Anchoring

Where space allows, and when very strong wind conditions are forecast, it is desirable to use the longest scope possible. The tendency will also be to lay out two or more anchors in different directions - why not? What about the fundamental principle ('...the bigger, the best, the most...')? Obviously the more anchors out, the better! That will be fine and correct, but only while the wind direction remains the same. A two anchors system where a wind shift will not matter is the Tandem arrangement.

In order to have the single, long rode, and the benefit of the holding power of more than one anchor, use the 'tandem anchoring' technique. This involves the use of two anchors in line, with, if practical, one's best and heaviest anchor (tripping line attached) furthest from the vessel. This anchor's chain connects to the crown (or equivalent part) of the second anchor which is connected via the rode (as much chain as possible) to the vessel's bow in the normal way. The chain from the furthest anchor must not be shackled to the tripping line attaching point on the nearest anchor - it is not strong enough. Tie and shackle the chain around the crown or shank of this intermediate anchor.

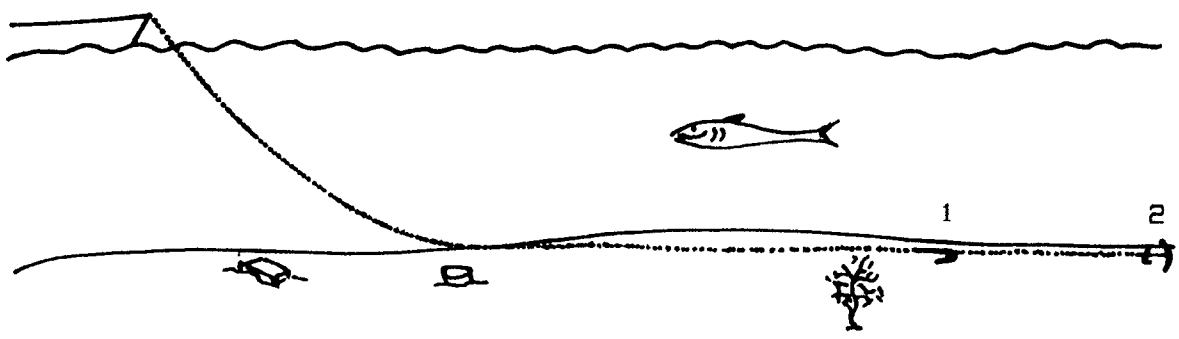


Fig. 219.

The procedure for preparing and lowering this arrangement of tandem-connected anchors is most important. If this is not done correctly, one anchor may be lowered down one side of the forestay or pulpit leg while the second anchor is being lowered down the other. Practice it in calm conditions, not forgetting to attach a tripping line to the furthest anchor.

This method of anchoring for a strong wind, provided a very long scope is used, is regarded as one of the safest.

Recovering Anchor Gear

Assuming space is available, and one has the benefit of a working engine, when the time comes to leave the anchorage, the procedure is quite simple. One motors slowly forward to the anchor's position (made easier if the helmsman can see where it is by observing the tripping line's float, or by having a crew member point in the direction of the anchor as indicated by the anchor line). As the vessel gets closer, the rode is pulled in either by crew or a windlass. The anchor is finally raised to its stowage position and the rode is stowed and anchor secured. The helmsman is free to manoeuvre the vessel away.

Without an engine, and with limited space possibly due to vessels anchored nearby and abeam, the situation calls for a little more ingenuity. A second anchor will be necessary, and it can be taken out (much further upwind) on a tender and laid as far upwind as the scope will allow. The slack on this line can then be taken in and the yacht pulled forward using both anchors' lines . The original anchor line will get to its end with the raising of the first anchor. With sails ready to be raised at short notice, or raised but 'luffing' (very loose so they 'flutter' in the wind), the yacht is pulled further ahead.

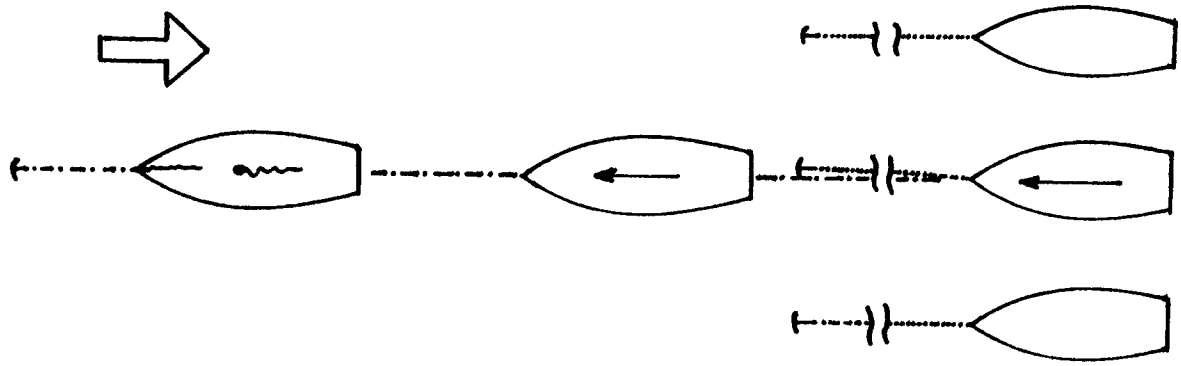


Fig. 220.

It should by now be a considerable distance upwind of the other vessels. If one continues pulling on the anchor line, it will eventually get too short to hold and the vessel will start to drag the anchor. Initially, this will be slow and the crew should work as fast as possible to get the anchor up on board and secure. As the yacht starts to drag the anchor, its bow will fall off the wind to one side. As soon as the anchor is above the water, or at a stage the skipper deems it safe to do so, the sails' sheets can be tightened and she will begin to gain speed and steerage way.

To sail off an anchorage where other vessels are anchored nearby abeam, and there is no room to get out ahead, means that one has to go out astern. Either the anchor line will have to be attached to a float and eventually left behind for later recovery, or another vessel or strong point (a mooring buoy ?) directly upwind will have to be used as an attachment point for a slip line. Whichever is to be the case, with sails ready to go up or to be sheeted in, the yacht is allowed to ease slowly astern. When she has gone sufficiently far astern to be clear of the other anchored vessels, the slip line can be slipped or the anchor line, with float attached, put over the side (for later recovery). Sheets can now be tightened and the yacht will begin to sail.

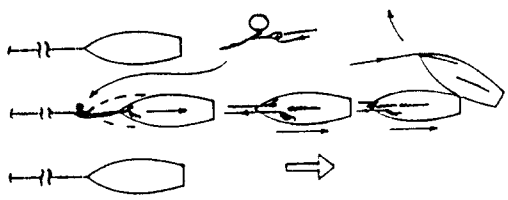


Fig. 221.

When at anchor with only one anchor and/or one anchor rode, a crew member must be on 'anchor-watch duty' - in case something goes wrong, as happens when least expected.

MOORING

Look back at the definitions of 'anchored' and of 'moored' on page 50. The essential difference between the two is that mooring involves a shorter radius of swing, and/or the restriction of the arc of swing of a vessel. There is also only one rode when at anchor, and an anchor's scope is long.

When 'moored', either the scope is much shorter to reduce the radius of swing, or a second (or more) lines are set in different directions from the vessel. Where the scope is much shorter, conventional anchors cannot be used; they would not grip into the seabed/bottom surface.

Mooring with the Vessel's Own Anchors

1. **Using Two Anchors.**

a. **In-Line Mooring**. Where one finds an anchorage fairly full with other yachts, or a mooring has been arranged so as to maximise the usage of available space, one will find that it is a requirement to moor between two or next to one vessel in a row of parallel moored vessels. Anchor in the normal way, then let out much more scope than is required, until the stern is over the spot where you want the second anchor to be - then lower this anchor and pull in on the anchor line at the bow, positioning the vessel mid-way between the two anchors.

The scope of both anchors should conform with the length requirements for a single anchor.

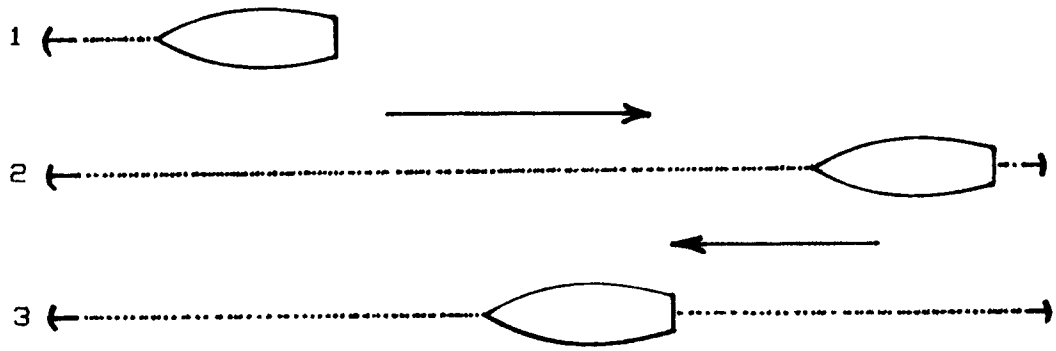


Fig. 222.

b. **'V' Arrangement**. Where space is not too restricted, two anchors can be set from the bow so as to form an angle of about 45° between their rodes. This method is normally used only where there is negligible tidal stream or current, but fairly constant wind. Each anchor's rode is set with the scope the same as if only one anchor were used. The first anchor is set in the normal way, then the vessel is motored slowly forward and to one side, so as to lower the second anchor where required. When at rest, the vessel will swing or yaw, albeit over a smaller area than if she were lying to one anchor. At any one moment, except as the tension passes from the one to the other, unless the wind is very strong, only one rode will be taut - that is why each rode's scope must be set as if it were the only anchor.

WHEN THE TWO ANCHORS DO NOT HOLD THE YACHT SIMULTANEOUSLY, e.g. as it veers in light winds, THERE IS NO INCREASED HOLDING POWER ADVANTAGE.

This arrangement is sometimes used just for the sake of having two anchors down (one as a back-up) so that anchor-watch duties can be avoided!

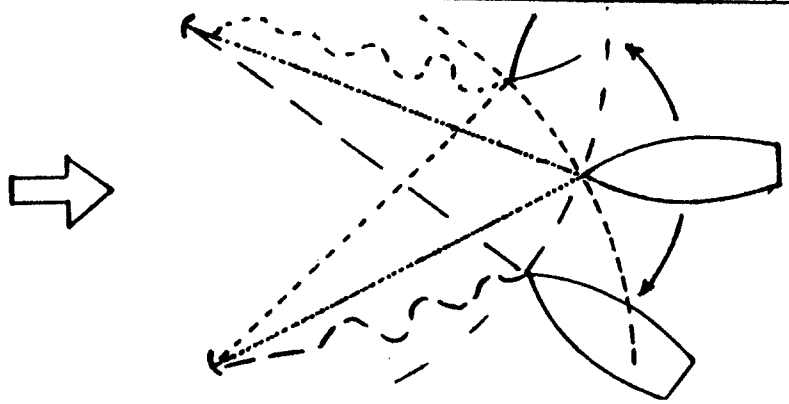


Fig. 223.

c. **The Navy Moor**. A development from the 'V' arrangement, the Navy moor is regarded as very strong, and if the horizontal chain sections are long, it is easier to set up than at first appears to be the case. There will be slack in the chain along the seabed/bottom surface, but the leeward anchor's chain stops the windward rode from pulling almost straight up as it reaches to the vessel above. The angle of pull on both anchors remains horizontal/near horizontal.

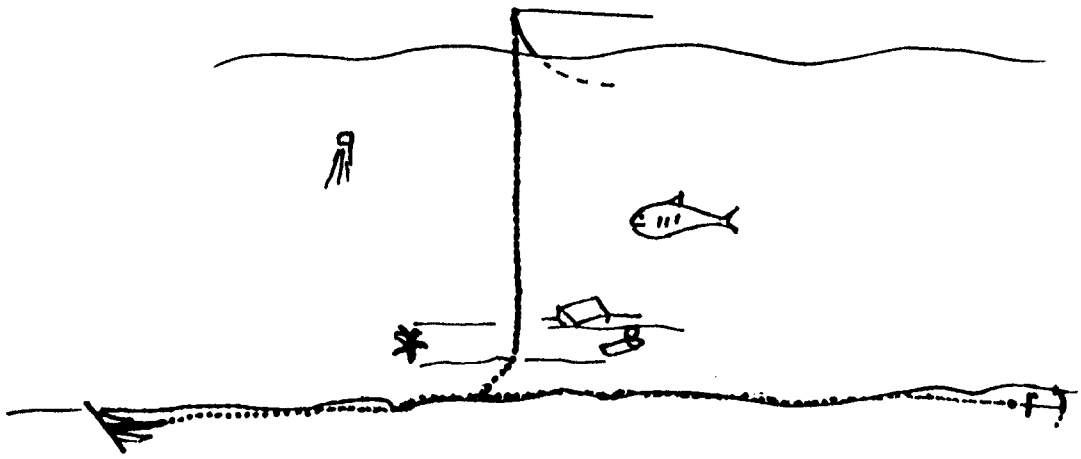
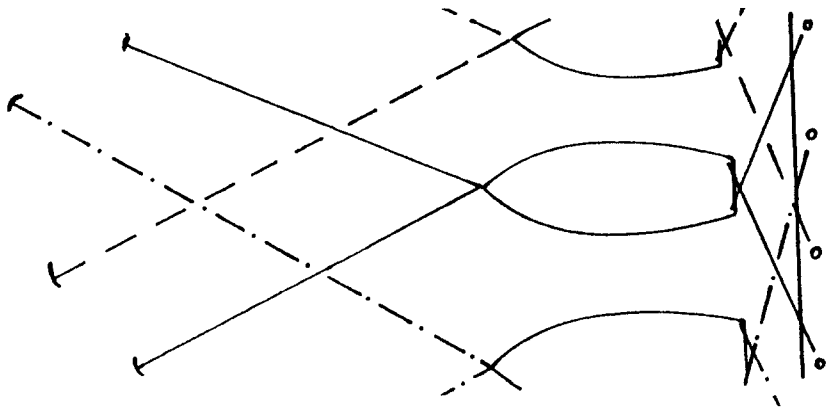


Fig. 224.

2. **Three or More Anchors**. Where more than two anchors are carried, one can arrange them as three anchors off the bow (a 'W' instead of a 'V'), a 'V' and a stern anchor, or any other way which may be easiest and strongest under the circumstances.

3. **'Stern-to' Mooring**. Where dock space is limited, it may be the norm to moor 'stern-to' with one or two anchors (the 'V' arrangement) off the bow unless a buoy is provided. Stern lines to the dock should cross, i.e. from the port quarter to the dock on the vessel's starboard side, and from the starboard quarter to the dock on the vessel's port side. The inevitable problem is the tangle of bow lines when any one yacht wishes to leave!



Mooring Using Fixed Mooring Equipment

Single Buoy Moorings. A single buoy mooring consists of a very heavy weight set in the seabed/on the bottom surface, and a chain or strong line up to a rope which is attached to a float at the water's surface. There are variations to this, such as a marker pole, and a second, lighter, float (with or without a 'lifting out pole' or hooking ring) and a strong line terminated with an eye-splice for lifting up to deck level and attaching one's own (clean) securing line.

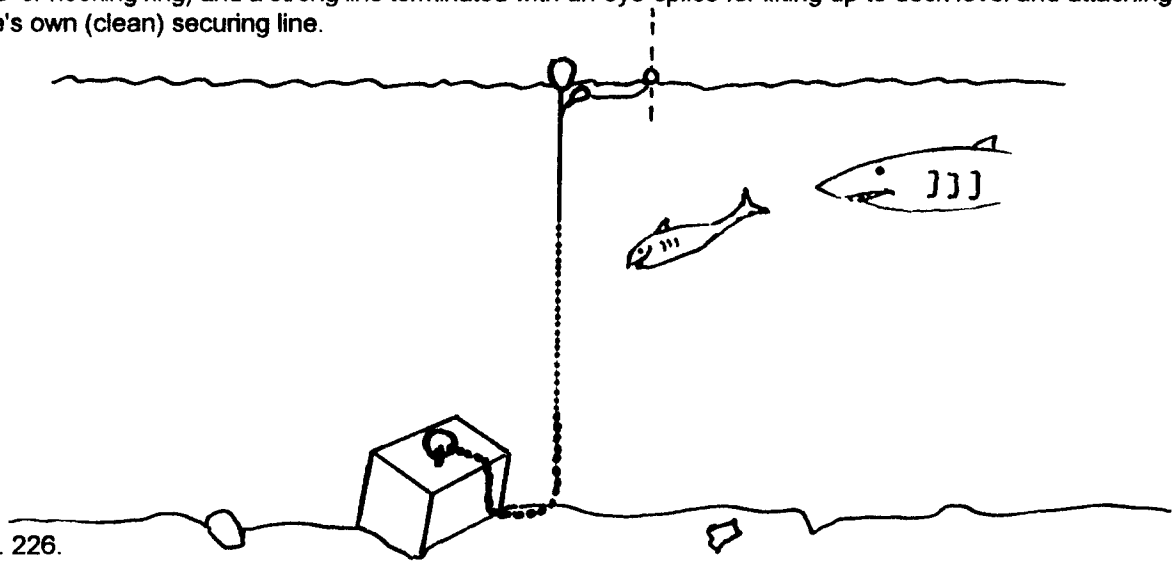


Fig. 226.

A vessel moored to a single mooring buoy will be free to swing about 360°, although the radius will be short.

Double Mooring Buoys. Double mooring buoys consist of two single mooring buoys, usually in line with the dominant wind. They are spaced approximately 1,5 times the length of the average vessel to be moored, and they are joined by a floating line called a 'lizard'.

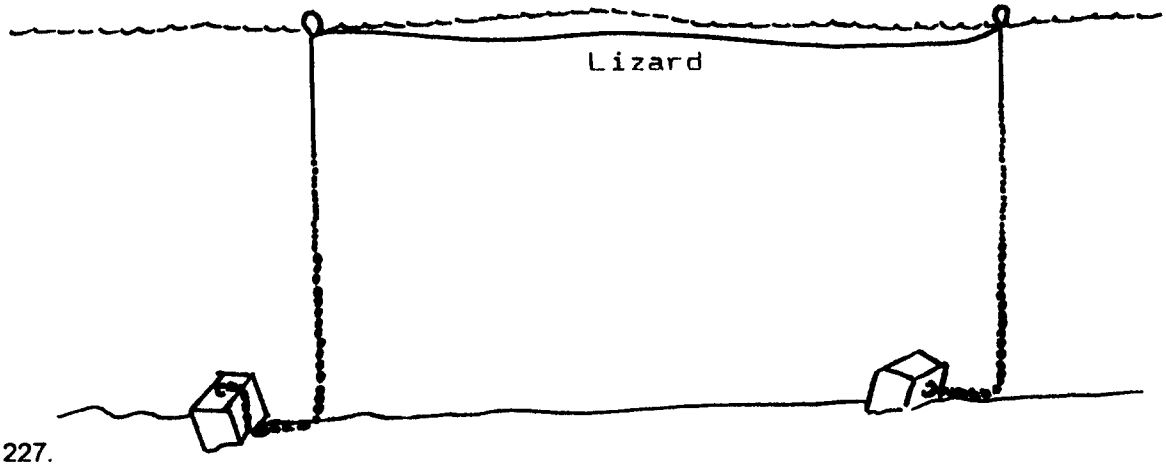


Fig. 227.

When approaching a double mooring buoy to tie up, do so at a shallow angle to the lizard so as to allow a crew member in the bow the opportunity to hook and lift the lizard with a boat hook. As soon as the lizard is reached by hand, one crew member can hand-walk along the lizard forward, and one aft. The lizard is then pulled in until the stronger mooring lines are reached, and they are secured to strong cleats or bollards; one in the bow and one at the stem. The lizard is then put over the side out of the way, or it can be left hooked along the vessel's safety line.

Leaving a double buoy mooring has its own brand of complication, namely the lizard. Lizards and propellers are like oil and water! When motoring out of a double buoy mooring, special care must be taken to ensure that the lizard is kept hand-tight above the water by the crew, so that it cannot get under the hull and near the propeller.

Whether one's vessel is under sail or engine power, the procedure for approaching or leaving a mooring is virtually the same as that for anchoring.

Pile Moorings. As these are only found in some places in England, their detail is excluded here, but see Annex. 1 to this Chapter.

BERTHING/DOCKING

Definition. 'Berthing' is the act of securing a vessel to a rigid quayside or berthing wall, made for the purpose of 'parking' a vessel alongside.

'Docking' is another word for berthing - they mean the same thing.

To tie up adjacent to a non-rigid structure, such as another vessel which, although berthed, is floating and therefore rises and falls with the tide, or to tie up to a floating pontoon, is called 'mooring', although the procedure is almost identical to berthing/docking. As most yachts use floating pontoons, i.e. they moor, we will refer to the lines which hold the vessel to the dock or mooring pontoon as mooring lines. They could equally be called berthing or docking lines.

Preparation for Berthing. If the skipper is already familiar with the berth (the actual position in which to 'park' the vessel) and he or she knows which side of the vessel the berth or dock will be, he or she can simply instruct the crew to 'prepare for berthing, "port side-to"' (or 'starboard side-to' as the case may be). If not familiar with the berth allocated, it is wise to first pass close by and look at the berth. Look to see what strong points are used (e.g. bollards or rings, etc.), and decide which direction to approach and which side the berth, and therefore fenders, etc. will be. If one has the option, it is usually best to approach so that the vessel will come to a stop facing into the dominant wind or tidal stream.

Before approaching to tie up, fenders and mooring lines must be prepared. If the exercise is to be done under power, the sails must be taken down but remain ready to go up again at short notice if the engine suddenly fails. Do not rely on the engine alone; it sometimes happens that engines cut out, or the gear lever jams in the 'ahead' position just when it is necessary to change the thrust to 'astern'.

This is probably a good stage to define:

Murphy's Law of the Sea

'Murphy's Law of the Sea states that whatever cannot go wrong, will go wrong,
when least expected to go wrong, and will cause other things to go wrong,
causing the most damage, the most inconvenience, and the most embarrassment,
all at the greatest expense.'

So mooring lines are prepared, with bowlines (loops) at their ends if the dock is fitted with bollards, as follows:

1. **Bow Line**. This line is usually priority one, being from the bow to the dockside ahead of the vessel when it is stopped. If there is a strong wind or tidal stream from ahead when berthing, as the vessel stops, this line will stop the vessel from falling back astern.

2. **Stern Spring**. As soon as or concurrent with the bow line being installed, the stern spring is secured in place to share the astern load of the vessel once the engine power is off and she has stopped.

3. **Stern Line**. As the vessel starts to pull astern due to the wind or tidal stream, the bow line and stern spring come under tension. The vessel's stern tends to move away from the dock if the spring is looser than the bow line. A stern line will stop the vessel's stern from swinging outwards.

4. **Bow Spring**. If or when the wind direction reverses, or when the tidal stream changes, the push on the vessel will be in the opposite direction, from astern. A bow spring will then serve in the same way as the stern spring does when the push is from ahead.

See Fig. 228.

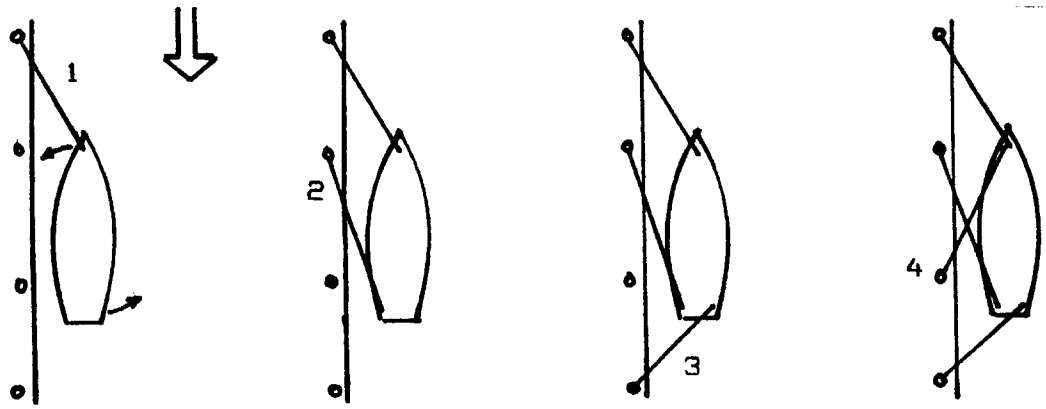


Fig. 228.

If one is sailing up to the dock, in order to maintain steerage way, one should aim still to have a little way on when reaching the spot the vessel is to be stopped. If several metres 'overshoot' does not matter, proceed as if the position the vessel stops is where it was initially intended to stop. If it is essential to stop at the exact spot, the bow spring is used as the brake. The priorities for getting the docking lines (also called 'mooring lines') ashore and made fast, changes. The bow spring now becomes the first priority, and it is arranged to be the right length from bow to aft bollard/strong point with enough extra for a 'round turn and two half hitches' or other suitable knot. The other lines are prepared as before.

As the vessel, with some way on, gets to the dockside, the bow spring (1) is very quickly secured to the chosen bollard/strong point. It will come up tight and the vessel's momentum will then cause the stern to swing out away from the dock. To stop this happening, a stern line (2) is the next priority. It should be positioned at the same time as the bow spring with quick temporary knots/coils around cleats, taking up slack until the outward swing starts.

As the vessel comes to a stop due to the braking force of the bow spring, the bow line (3) and then the stern spring (4) must be put in position.

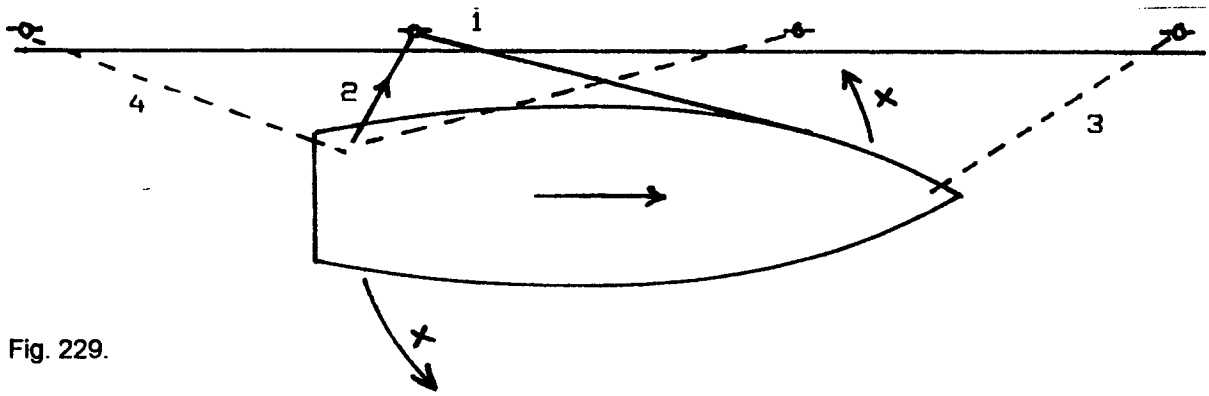


Fig. 229.

Etiquette

If it is necessary to tie-up alongside a vessel which is itself berthed, it is the required etiquette to first call the skipper or crew of the vessel and request permission to tie-up alongside, even if instructed to berth there by the local harbour/marina master. The permission, in such cases, cannot be refused, but it is still correct to request permission. Make sure the fenders are in the right position, then berth using two additional lines, the 'breast lines'. See Fig. 103. A 'breast line' is a mooring line which runs approximately at right angles to the vessel's fore and aft line. Ensure that the masts and rigging lines of the two vessels will not touch or snag - move your vessel slightly more ahead or astern as necessary.

All berthing lines, whether to the dock, pontoon or another vessel, should be made fast in such a manner that any surplus line is on one's own deck, not left at the other end on the dock. A bowline or other loop in the end of a berthing line, if being placed over a bollard which already has a looped line around it, should be brought up through the existing loop; this way, either line can subsequently be removed without disturbing the other. See Figs. 230 and 231.

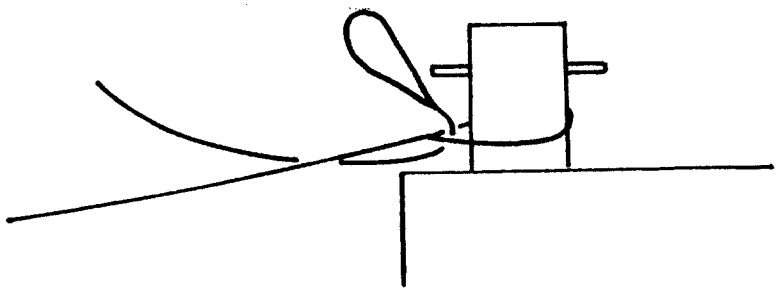


Fig. 230.

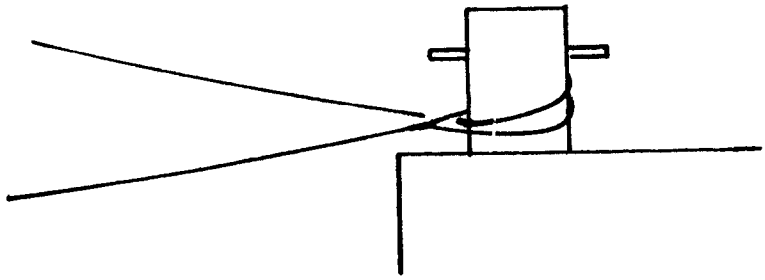


Fig. 231.

Having tied up alongside another vessel:

i. neatly coil the surplus lengths of the berthing lines on one's deck.

ii. any crossing of the neighbouring boat to get on to the dock should be done quietly, with soft soled (not black rubber) or bare feet.

iii. any movement across another vessel should be forward of its mast - that way there will be no temptation to invade the privacy of that vessel's crew by looking in their companionway from the stern.

iv. any hoses for topping up water tanks or cleaning the deck, or any containers taken ashore or brought to the yacht, must not be allowed to mark the neighbouring vessel.

v. avoid crossing the vessel late at night, and if it is necessary, do so as quietly as possible.

vi. do not play loud music - few people have the same tastes in music at the same time.

vii. loud voices, and especially the use of foul language is very unpleasant for everyone - do not allow it on your yacht.

Tidal Considerations. When tied up to another vessel or to a floating dock or pontoon, the yacht's berthing lines can be made fast and no subsequent adjustment to their lengths will be necessary. If, on the other hand, one ties up to a fixed wall such that the berthing lines' length requirement changes as the tide height changes, one must either:

a. set all the lines so that the length of each is at least three times the tidal range (the vertical difference measurement between the highest and the lowest tides); or

b. leave a crew member in attendance all the time to adjust the length of the lines as the height of the tide changes; or

c. arrange heavy weights in the middle of the lines to keep them under a degree of tension, regardless of the state of the tide.

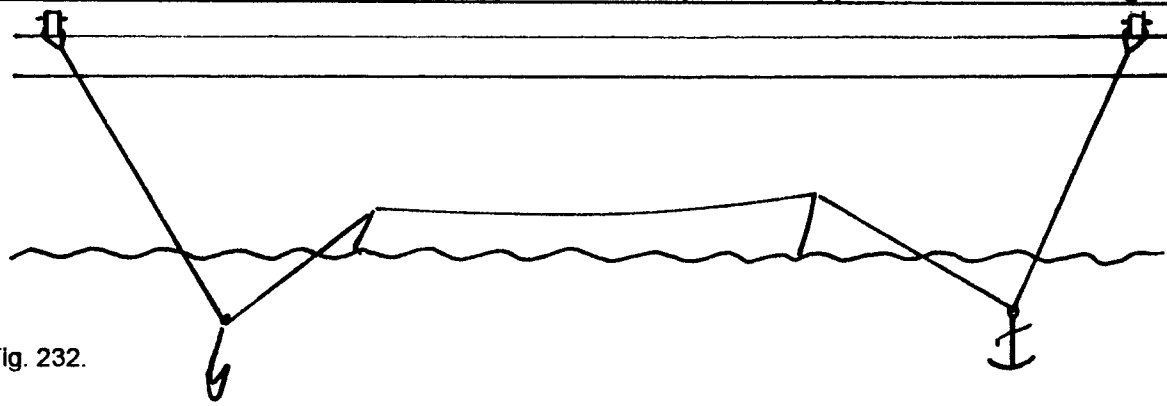


Fig. 232.

If the depth at low tide is to be so low that the keel rests on the seabed, a line can be rigged (the mainsail's halyard?) from the masthead to a strong point on the dock opposite the beam to prevent the vessel falling over on her side away from the dock.

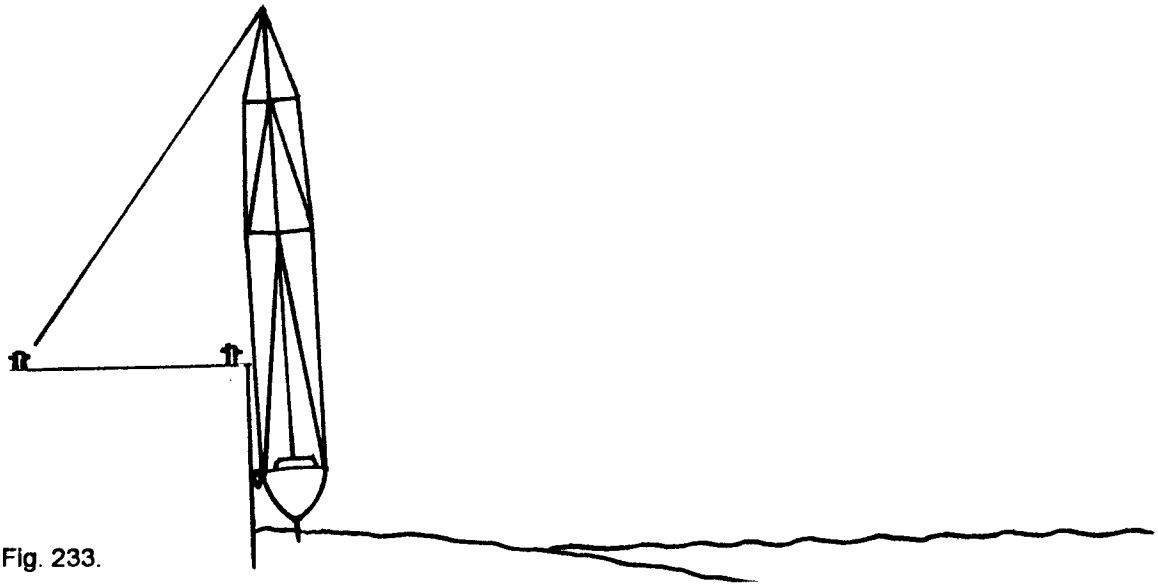


Fig. 233.

Manoeuvring: Turning 'On The Spot'. When a yacht is turned by changing the angle of her rudder in the water, she turns as if the centre of the yacht was a fulcrum or pivot point, i.e. she turns on her centre. The push from the propeller causes water under pressure to flow passed the rudder, and an angled rudder transfers a sideways push to the stern of the vessel. The vessel then turns about its centre.

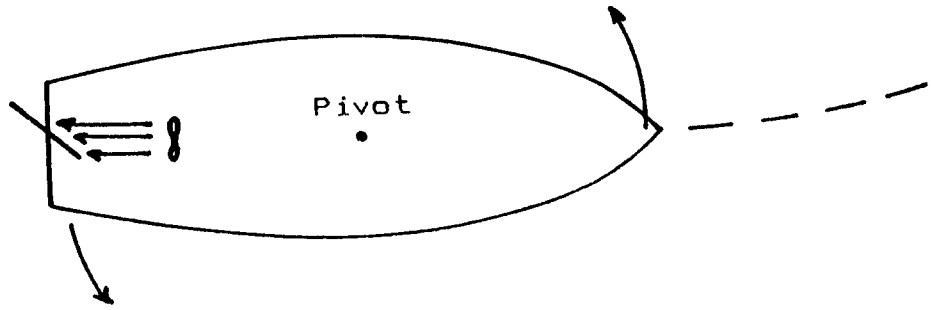


Fig. 234.

When applying astern propulsion from a stationary position, initially there is no flow of water over the rudder's surfaces -the propeller pushes water away from the rudder. The propeller, meanwhile, is turning in a plane at right angles to the fore and aft centre-line of the vessel. As it does so, it creates 'lateral' forces to the sides which are not equal. There will be a greater sideways force exerted by the propeller to one side only - depending on whether the propeller turns clockwise or anti-clockwise in the 'astern' gear.

The sideways pushing forces of the propeller, whether in 'ahead' or 'astern' gear, are used to advantage when manoeuvring a 'single screw' vessel. For example, if in the 'astern' gear the stern of the vessel, due to propeller 'lateral thrust', tends to move to starboard, the vessel favours turning to port. So, if the rudder is turned to be hard to port, a very short period of 'ahead' power will cause the stern to move to starboard (the vessel turns on its centre remember) and bow to port.

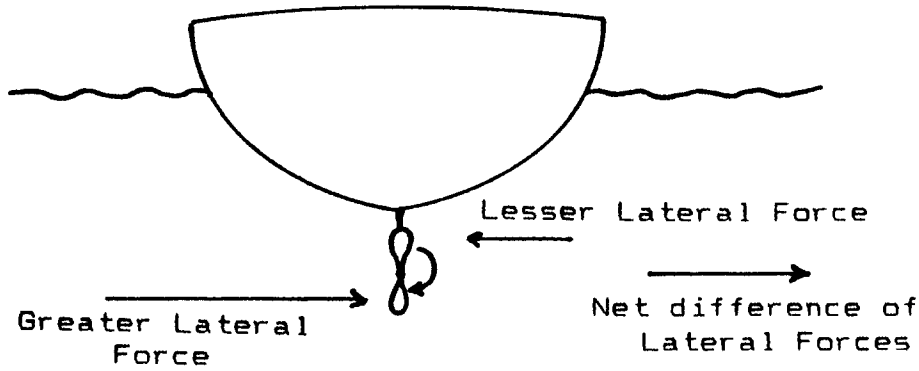


Fig. 235.

As the stern starts to move to starboard, and before there is much forwards movement, the gear is changed to 'astern'. The stern is induced to move further to starboard, and before the vessel starts to make sternway, the gear is changed to 'ahead'. The rudder (and boat's stern) is again pushed to starboard, and before the vessel starts any significant forwards movement, ... - the process is repeating. No matter whether the gear is set ahead or astern, providing it is only for a few moments in each direction, the vessel, especially one with a fin (short, deep) keel, will turn around her centre, 360° if needs be, without going ahead or astern. She will turn about on the spot.

Knowing this, we can leave the dock with more confidence, ready to stop and change direction in a very confined space if necessary.

Leaving a Berth

1. **Pre-Departure Checks**. Before leaving the dock it is wise to:

   a. Have an idea of what the weather forecast is.

   b. Ensure all the required safety equipment is on board, and that it is in useable condition.

   c. Ensure the crew know where the safety equipment is stowed and how to use it.

   d. Ensure the crew know what is required of them, including the basic operation of the vessel.

   e. Check that everything needed for the outing/voyage is on board and in useable order, e.g. fuel, water, food, engine serviceable, etc.

2. **Preparation.** Once the pre-departure checks have been completed and you are ready to leave the dock, start the engine to give it time to warm up. Take the sail covers off and have the halyards connected to the heads of the sails which should be ready to go up at a moment's notice if the engine cuts out once you are under way. Mooring lines are changed to slip lines (get the slip lines in and holding the vessel before you take the mooring lines off).

Do a 'gear' check - does the gear lever cause the forward and astern gears to engage when required? Providing no other vessels are under way and in the way, and that your vessel will not obstruct any other vessel under way, you are ready to leave the dock.

3. **Leaving the Dock**. It may now just be a case of instructing the crew to 'Cast off' or 'Let go' f'ard (forward) and 'Let go aft', and engaging gear and motoring away. But remember 'Murphy's Law'. There could be a vessel tied up directly ahead, and one close astern. This means that before the vessel begins

to move f'ard or astern, either the bow or the stern must be moved out, away from the dock so that the vessel is at an angle suitable to motor clear.

To get the bow to swing out, use a slip stern spring and with all other lines gone, apply astern power - the vessel will not go astern because of the spring; instead it turns, bringing the stern towards the dock. Make sure this area has adequate fenders. The same thing will happen in the opposite direction using the bow spring and applying 'ahead' power with the rudder either straight or turned to assist the stern to come away from the dock.

Getting the Stern to Swing Out

Getting the Bow to Swing Out

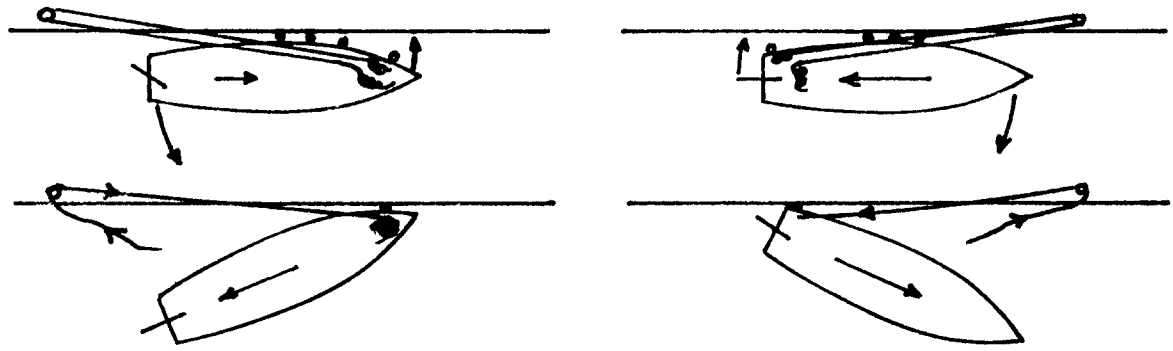


Fig. 236.

Under Sail. If the dock is to the lee of the vessel, there is little likelihood of being able to sail. One would either have to be towed away from the dock, or take a kedge anchor upwind in a tender and then winch the vessel away from the dock. This is not really practical with a large yacht and if the wind is anything more than 'light'.

That leaves three other possible main directions the wind could be, namely from ahead, from the land, or from the stern. To sail off a dock with the wind from astern is not as easy as it may sound - wait until you have a lot of sailing experience before trying it. The other two are easier:

a. **Wind from Ahead**

i. Rig slip lines then remove the mooring lines.

ii. Place extra fenders near the stern on the dock side.

iii. Raise the sails allowing them to luff with loose sheets.

iv. Check the fairway is clear of other vessels, then 'let go' all slip lines except the stern spring.

v. Sheet in the headsail on the dock's side - it will cause the bow to move away from the dock and the headsail will be 'aback'.

vi. As the bow is turning away from the dock, keep the rudder towards the dock - it helps, especially if there is a tidal stream from ahead, keep the stern from touching or applying pressure on the dock.

vii. As the vessel gets to an angle a little over 45° to the wind, and the bow is clear of any vessel moored close ahead, bring the headsail across and sheet in both sails (the headsail and the main sail) hard. She will start to sail and the stern spring can be slipped as soon as it begins to go slack.

(If the vessel is a ketch, the mizzen can be backed at the same time as the headsail to help keep the stern away from the dock. Keep it backed until the vessel starts to sail.)

See Fig. 237.

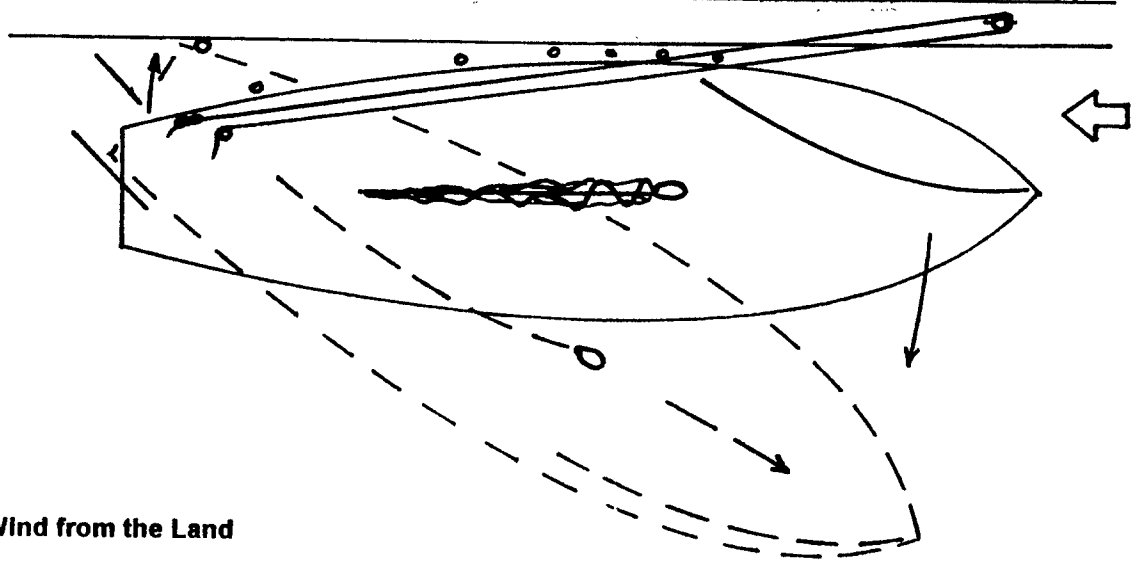


Fig. 237.

b. **Wind from the Land**

i. Prepare slip lines, remove the mooring lines, and have the halyards ready to raise the sails.

ii. When all is clear, reduce slip lines to one at the bow and one at the stern.

iii. Check the fairway is clear, then raise the headsail, 'let go' f'ard, and sheet in the headsail on the leeward side. The bow will move to the lee - away from the dock. The stern slip line should not be too tight at this stage so it will not cause the stern to push on the dock.

iv. When the vessel's angle to the dock is enough to clear any vessel berthed ahead, 'let go aft' and raise the main sail with the boom far out to the lee. The vessel's angle to wind will be as for a broad reach - it will not be possible to get the mainsail up properly. What little one can get up, however, will help to get the vessel clear of the dock and other vessels.

v. As soon as space allows, head up to the wind long enough to get the mainsail up and the halyard set to the required tension and cleated. Then bear away, and sail away!

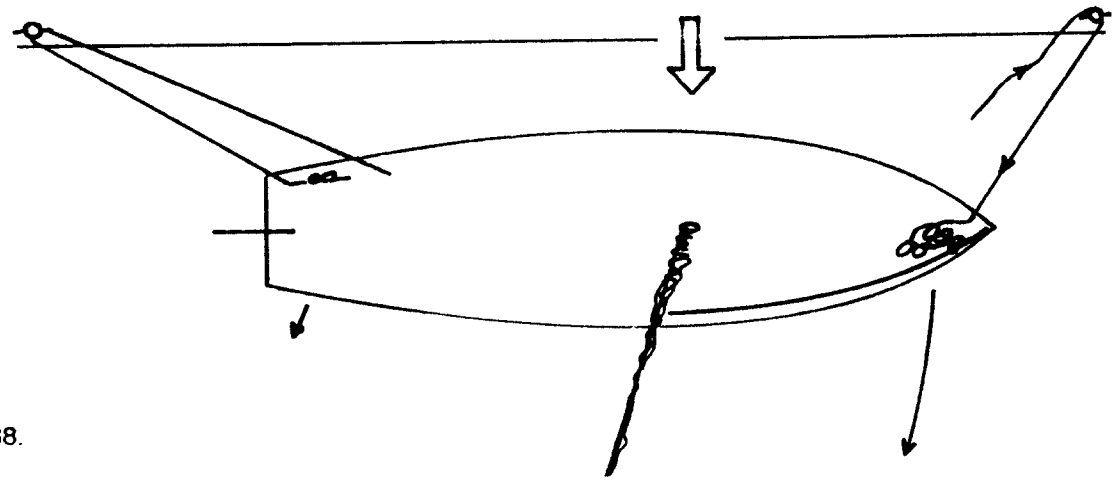


Fig. 238.

Remember:

1. Check the strength and direction of the tidal stream, if applicable, to see how it will effect your actions.

2. Check that no other vessels' movements or imminent movements will be affected by your timing.

3. In light conditions, practice sailing onto your mooring with the engine idling on 'stand-by' just in case. Sooner or later you will have an engine failure and you will have to sail onto the mooring - let it be <u>after</u> you have had some practice at it - it will then be less of a shock when it happens.

PILE MOORINGS

Pile moorings consist of two vertical posts driven hard into the solid surface below the water, usually in rivers. They are positioned so that a line between them is in line with the flow of water in the river, whether it be tidal or not. A vertical bar 'handle' is often fitted to each pole so that the handle is on the side facing the other of the two poles.

It is around this handle one passes one's mooring line. If it is absent, there may be a type of 'float-ring' around the pole. In either case, one must allow one's mooring lines to permit the vessel to move in the vertical plane with the change in the tide.

The technique is to approach the pile mooring against the flow of the water in the river, whether it be a flooding or an ebbing tide. With the stern line cleated at one end at the stern, the other end is at midships, on the side the first pole is to pass. Pass close to this pole so that a crew member can pass the stern line's end (at midships) through the vertical 'handle' (or around the float ring provided or around the pole itself).

Continue against the flow of the water towards the second pole, paying out the first (stern) line as a slip line. Aim to just pass (close to) the second pole with the bow before the vessel is stopped in the water. Have fenders ready on the second pole's side, and as the bow stops next to this pole, pass a 'slip' bow line around the vertical 'handle' (or float ring or the pole itself). The vessel will start to drift astern with the flow of water in the river. Adjust the lengths of the two (bow and stern) slip lines so that the vessel rests approximately mid-way between the poles.

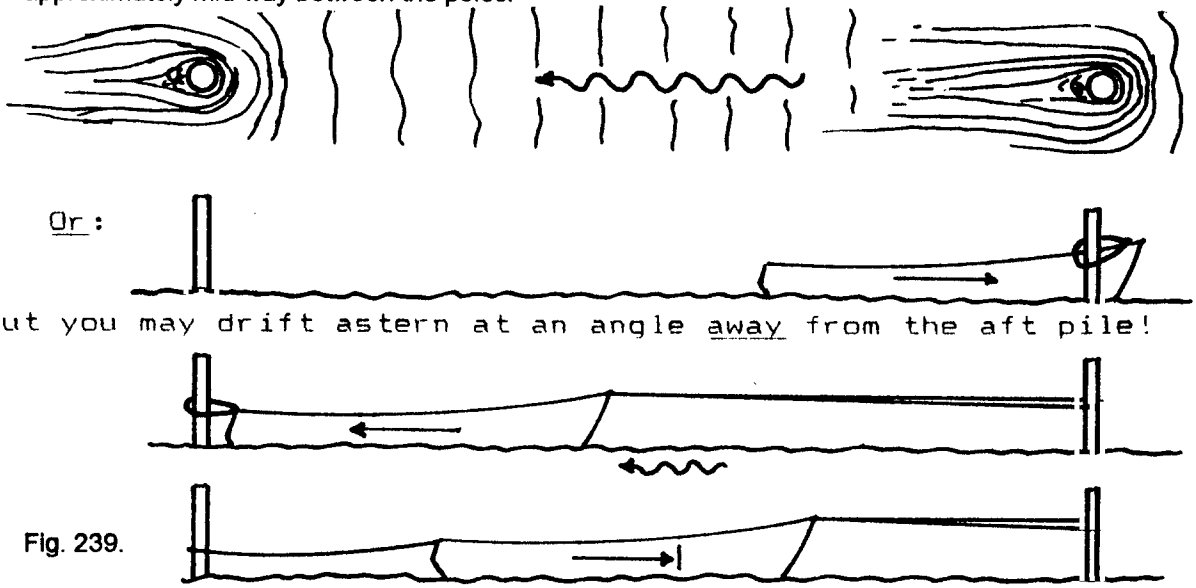


Fig. 239.

To leave a pile mooring, adjust the tensions and attachment positions of the slip lines so that the boat rests at an angle to the flow of the stream/mooring. Now either under power or sail, get underway by slipping lines and steering the required course. (If possible, if the stern faces the tide, first turn her to face the bow into the oncoming slow stream.)

NOTES

CHAPTER 4

RULES OF THE ROAD

(Rules for the Prevention of Collisions at Sea)

Introduction

Drivers of vehicles on our roads are supposed to adhere to rules which are designed to co-ordinate traffic and minimise accidents. These drivers therefore have to know the rules and pass drivers' tests. Yet there are still accidents. On the water an accident between two vessels is potentially more serious than an accident on land where the vehicles involved would be stopped and the occupants can await assistance; the vessels could sink, taking the (injured?) occupants down with them.

Despite the rules, there are still drivers without licences and people who take vessels onto the water without the proper skipper's 'ticket', knowledge or skills, and who disregard the basics, so that the rest of us have to be doubly careful.

Rules for vessels under way and at anchor are, therefore, most important. Other factors such as fog, tides and tidal streams, and many others, make rules vital for safe passages by all vessels.

Arrangement of the Rules

The rules are arranged in four parts with four annexes. No one is expected to remember rules' numbers or which Part they appear in. The Parts and their rules are as follows:

Part A. General.

Part B. Steering and Sailing Rules. This part is divided into three sections:

Section I. Conduct of vessels in any condition of visibility.

Section II. Conduct of vessels in sight of one another.

Section III. Conduct of vessels in restricted visibility.

Part C. Lights and Shapes.

Part D. Sound and Light Signals.

Annexures

1. Positioning and technical details of lights and shapes.
2. Additional signals for fishing vessels fishing in close proximity.
3. Technical details of sound signal appliances.
4. Distress signals.

Our syllabus does not require us to study the details of Annexures 1 and 3, but you may find it informative to read through them if you have a copy of the rules.

PART A. GENERAL

Rule 1 Application (To whom the rules apply)

'(a) ... apply to <u>all vessels</u> upon the High Seas <u>and all waters connected therewith</u> navigable by sea going vessels.'

[So <u>all</u> the rules apply to all our yachts and pleasure craft, other than those on inland waters where 'some' rules apply i.e. those rules which are obviously only applicable on the sea/in harbours do not apply.]

'(b) Nothing ...shall interfere with ...special rules...' [So a Local Authority such as the Port Captain of a port, or the Senior Parks Board Officer in respect of a Parks Board controlled lagoon or equivalent, may make local rules which will have precedence over these rules.]

Rule 2 Responsibility

'(a) Nothing ... shall exonerate any vessel, owner, master or crew ... from the consequences of any neglect to comply...'
[So ignorance is no excuse for not conforming to the rules.]

'(b) ... vessels ... may make a departure from these rules [only] ... to avoid immediate danger.'
[So if the Master or Skipper, for example, knowing he may not turn his (powered) vessel to port to avoid another (powered) vessel on his vessel's port side, turns to port, he will not have contravened the rules providing he can show that in a crisis situation, it was the only way he could avoid danger.]

Rule 3 General Definitions

'(a) ... "vessel" ... every description of water craft, ... including non-displacement craft and seaplanes ... capable of being used ... on water.'
[So hovercraft, surfers and wind surfers, Jet skis, hobbies cats, etc., are all governed by these rules.]

'(b) ... "power-driven vessel" ... means ... propelled by machinery.'
[So rules for power-driven vessels do not necessarily apply to sail-powered vessels.]
'(c) ... "sailing vessel" ... any vessel under sail ... provided ... machinery, if fitted, is not being used.'
[So with sail up, if the engine is also driving the propeller, the vessel is not a 'vessel under sail', but a 'power-driven vessel'. However, if the engine is on and the gear in neutral as when just charging batteries, the vessel is still 'under sail'.]
'(d) ... "vessel engaged in fishing" means any vessel ... (using) ... fishing apparatus which restrict(s) manoeuvrability ..."
[This does not include 'pleasure craft' i.e. privately owned and operated non-commercial ski boats, etc.]
'(e) ... "seaplane" ... means any aircraft designed to manoeuvre on the water.'
'(f) ... "vessel not under command" ... some exceptional circumstance is unable to manoeuvre ... unable to keep out of the way ...'
[DO NOT confuse this term/definition with the next one in (g) below, and as you will see later, remember that a vessel not under command has the right of way over all other vessels.]
'(g) ... "vessel restricted in her ability to manoeuvre" ... a vessel ... which from the nature of her work ... is ... unable to keep out of the way ... (such as vessels...);
i. ... laying, servicing, or picking up a navigation mark (a buoy), sub-marine cable or pipeline,
ii. ... dredging, surveying, or underwater operations,
iii. ... replenishment, or transfer ... while under way,
iv. ... launching or recovery of aircraft ... (an aircraft carrier),
v. ... minesweeping...,
vi. ... towing operation ... severely restricts the towing vessel and her tow ... to deviate from their course.
[So if a vessel in the normal compliance of the rules would be required to 'give way', and if it cannot give way because it is 'restricted in its ability to manoeuvre', it will become the 'right of way' or 'stand-on' vessel if it informs other vessels (by shapes or light signals) of its condition.]
'(h) ... "constrained by her draught" ... a power driven vessel ... [whose] draught in relation to the available depth ... severely restricts her ability to deviate ... (from her course).'
[Remember the terminology 'constrained by her draught'. An example would be a large tanker in a harbour approach channel where only the depth in the channel is adequate for the vessel - it could not turn out of the channel to give way.]
'(i) ... "under way" ... means ... not at anchor, nor made fast to the shore (or seabed), nor aground.'
[A vessel can be 'under way' but not moving (stopped) i.e. have 'no way on'. To indicate a vessel is or was moving, we say it is or was 'making way' or it does or did have 'way on'.]
'(j) ... length and breadth ... mean length overall and (her) greatest breadth.'
['Length Overall' (LOA) is naturally taken to mean the maximum length. This can cause confusion when dealing with sailing vessels which have bowsprits fitted, as some authorities exclude the length of the bowsprit from the LOA measurement.]

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

[In thick fog vessels could be less than 100 metres apart and not be 'in sight of one another'; a harbour construction or land between two vessels could prevent one vessel from being seen from the other.]

'(l) ... "restricted visibility" means ... visibility [which is] restricted by fog, mist, falling snow, heavy rainstorms, sand-storms or ... similar causes.'

[The restriction of an arc of visibility due to a vessel's construction/design at lookout deck level) does not fall within the definition of 'restricted visibility'.]

(Believe it or not, the Masters of most tugs DO NOT have an unrestricted view and it is very difficult at times for them to see small craft, including yachts. The rules require that we keep clear of tugs and work-boats - they will not be responsible if they collide with a yacht!)

PART B: STEERING AND SAILING RULES

Section 1. 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 lookout by sight and hearing as well as all available means appropriate in the prevailing circumstances and conditions ... to make full appraisal of the situation and the risk of collision.'

[This is one of the most neglected rules - how often have you seen a helmsman look behind? As a delivery skipper in the North Atlantic, I nearly killed my crew and myself by not complying with this rule. On watch at about 3,00 a.m. and comfortably looking (now and again) ahead I ignored the astern arc; we had seen nothing for 16 days, why worry now? I suddenly had the feeling 'Look <u>now</u>' and I turned to see the high bow of a ship passing within about 100 metres of our stern as it crossed our track at an acute angle. The ship's crew appeared to be unaware of our presence, despite our tricolour light being on.]

['Proper' and 'all available means' in the case of vessels fitted with radar, is taken to mean that in addition to a 'look-out', a radar if used, <u>must be used correctly</u>, i.e. the user must be able to plot crossing courses, determine the other vessel's course and speed, and know the limitations of radar in order to plan correct action to avoid a collision. See Rules 6 (b) and 7 (b) and (c).]

Rule 6 Safe Speed

'(Vessels must) ... proceed at a safe speed ... [to] take proper and effective action to avoid a collision, and be stopped ... (in time when necessary).

In determining a safe speed ... (consider the) following factors ...:

(a) By all vessels:

i. ... visibility,
ii. ... traffic density ...,
iii. ... manoeuvrability ...,
iv. ... at night, .. background light ... shore lights ...,
v. ... state of the wind, sea and current ... proximity of hazards,
vi. ... draught in relation to available depth ...

(b) Additionally, by vessels with operational radar:

i. ... efficiency of the ... equipment,
ii. any restraints imposed by the radar range scale in use,
iii. the effect ... sea state and weather, and other sources of interference,
iv. ... small (radar targets) ... may not be detected ...
v. the number, location and movement of vessels detected by radar,
vi. the more exact assessment of visibility ... to determine the range of vessels or other objects ...'

[So always travel at a slow enough speed to be able to take avoiding action should something suddenly appear ahead from around a bend or out of the fog, etc. Be aware of other vessels and hazards, and if you have an operational radar on board, it must be used correctly. DO NOT rely on the radar to show everything!]

Rule 7 Risk of Collision

'(a) ... use all available means ... to determine if risk of collision exists. If there is any doubt, ... (it) shall be deemed to exist. [See (d) i below.]

(b) Proper use ... of radar ... including long range scanning ... 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) ...considerations...:
i. such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change.
ii. ... may exist even when ... an appreciable bearing change ... when approaching a very large vessel, a long tow, or ... approaching a vessel at close range.'
[In other words, just 'be aware' of the possibility of a collision occurring at any time. Check the bearing from your vessel to other vessels - if the bearing, or the angle from your vessel's course to a line from you to the other vessel, is not changing, a collision is probable.]

Rule 8 Action to Avoid Collision

'(a) Any action ... to avoid collision ... shall be positive, made in ample time ... observance of good seamanship.

(b) Any alteration of course and/or speed ... shall ... be large enough to be readily apparent to another vessel ... a succession of small changes ... should be avoided.

(c) If (there is) ... sufficient sea room, alteration of course alone may be ... effective ... provided that it is made in good time, is substantial, and does not result in another close quarter situation.

(d) Action taken ... (must) result in passing at a safe distance. The effectiveness (of action taken) ... shall be checked until the other vessel is finally past and clear.

(e) If necessary, ... slacken her (your) speed or take all way off (stop) ...'
[Of importance is the need for <u>early</u> and <u>substantial</u> avoiding action to be taken by the crew on the 'give way' vessel, so that the other vessel's crew are left in no doubt that adequate and effective action is being taken in plenty of time - there must not be a last minute rush to make extra course and/or speed changes.]

Rule 9 Narrow Channels

'(a) ... keep as near to the outer limit ... on her starboard side...

(b) A vessel less than 20 metres (65 feet) in length or a sailing vessel shall not impede ... a vessel which can safely navigate only within a narrow channel ...

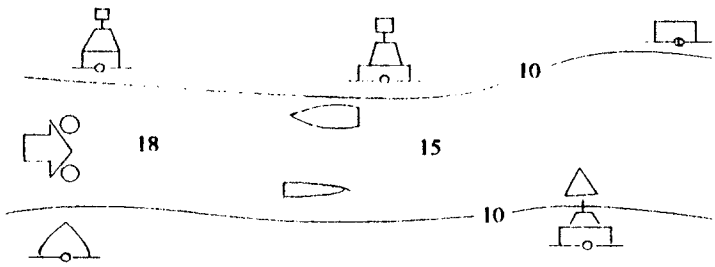


Fig. 240.

(c) A vessel ... fishing shall not impede ... any other vessel ... within a narrow channel.

(d) A vessel shall not cross a narrow channel ... if such crossing impedes ... [a vessel which can only navigate safely in the channel].

(e) i. ... when overtaking ... [and the] vessel to be overtaken has to take action to permit safe passing, ...[the overtaking vessel] shall indicate her intention by sounding the appropriate signal ... in Rule 34(c)I.'
[i.e.: 'I wish to overtake on your starboard side' - 2 long blasts and 1 short blast,
'I wish to overtake on your port side' - 2 long blasts and 2 short blasts.]
' ... The vessel to be overtaken shall, if in agreement, sound the appropriate signal ... see Rule 34(c)ii, ... and take steps to permit a safe passing. If in doubt [i.e. does not agree to being overtaken] ... sound the signal ... in Rule 34(d).' [i.e.: 'I agree to being overtaken' - 1 long, 1 short, 1 long and 1 short blasts, or 'I am in doubt as to the safety of being overtaken' - at least 5 short, rapid blasts.]

ii. This Rule does not relieve the overtaking vessel of her obligation under Rule 13 [to keep clear of the vessel being overtaken].

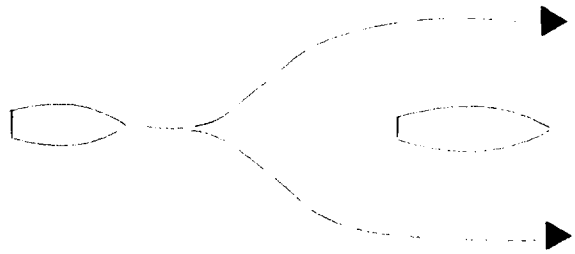


Fig. 241.

(f) ... nearing a bend ... (in a narrow channel) where other vessels may be obscured ... navigate with particular alertness and caution ... sound the appropriate sound signal...Rule 34(e).
[i.e. 'I am in a narrow channel and approaching a bend or obscured area - 1 long blast. Vessels under way in a confined area normally accessible through an obscured channel, on hearing one long blast, shall reply with one long blast.]

(g) ... avoid anchoring in a narrow channel.

[Notice that the sound signals 'asking' for permission to pass are made only if the vessel to be overtaken has to take some action, e.g. move over to the side of the channel. In such a case, if the vessel to be overtaken indicates doubt about the safety of being overtaken, or does not want to move to a side and indicates so by at least five (i.e. five OR MORE) short blasts, the vessel intending to overtake may not do so. In practice, with excellent radio communications available, the above procedure would be used only if no satisfactory radio contact could be made to make verbal arrangements to overtake.

However, at any stage, if one feels one wishes to make sure that one's approach has been noticed, one can cause one's vessel to sound one long blast - it also means 'a power-driven vessel under way'.]

(Rule 10 is not applicable.)

Section 2. Conduct of vessels in sight of one another

Rule 11 Application

' ... [This section] applies to vessels in sight of one another.' [I doubt that this rule was really necessary!]

Rule 12 Sailing Vessels

'(a) When two sailing vessels are approaching ... one ... will keep out of the way as follows:
i. when each has the wind on a different side, the vessel which has the wind on the port side [the 'port tack vessel'] shall keep ... [clear],
(b) ii. ... both have the wind on the same side ... [the] windward [vessel] shall keep out of the way.

iii. (When) ... a vessel with the wind from the port side, sees a vessel to windward and cannot determine ... [which side the wind is over the windward vessel] ... she shall keep ...[clear].

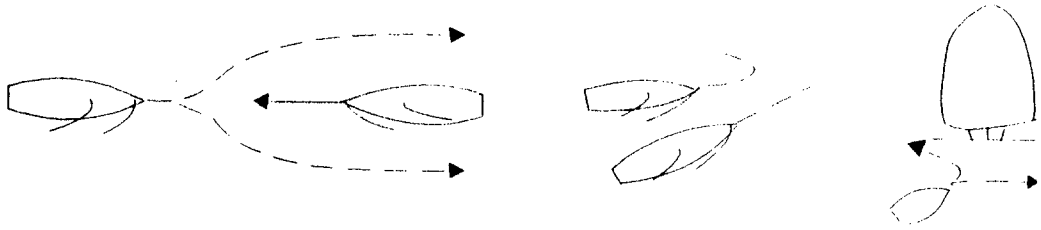


Fig. 242.

(b) (The) ... windward side ... (is) the side opposite to that on which the mainsail is carried... '
[The windward side is also the side we name the vessel's 'tack' - 'starboard tack' means the wind comes from the vessel's starboard side.

(If not part of a race, a sailing vessel downwind of a sailing vessel flying a spinnaker, will normally keep clear of the spinnakered vessel - but do not rely on it; not every skipper has manners. If one cannot determine which side the other vessel has the wind, assume it has the wind on its starboard side and keep clear (unless your vessel has the wind from the same side, and is the leeward vessel).

Fluke conditions do occur whereby it is possible to have two vessels under spinnaker, both sailing down wind, and being on a 'head-on' collision course. In such circumstances, both skippers should initiate avoiding action, although the vessels are likely to run out of wind before they meet.

If in doubt, get or keep well out of the way.

Delivery skippers say there are only two rules to remember:
1. Wooden boats keep clear of 'plastic' boats.
2. Wooden and plastic boats keep clear of steel boats.
This uses the principle 'Might is right.'!]

Rule 13 Overtaking

'(a) ... any vessel overtaking ... shall keep out of the way of the vessel being overtaken.

(b) A vessel shall be deemed to be overtaking when coming up ... (to) another vessel from a direction more than 22,5° abaft the beam ... at night she would ... see only the stern light of that vessel but neither of her sidelights.

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

(d) Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel ... and [possibly] relieve her of her duty to keep clear ... until ... past and clear.'

[When driving a car, we give as wide a berth as possible to any vehicle we overtake, and we should make a point of not cutting in on the overtaken vehicle. The same principles apply at sea.

Please note that these rules, as demonstrated by Rule 13 (d), are not the same as when racing. Racing rules are complex allowing a vessel on the lee, if it has overtaken (or not) a windward boat to the extent that it is 'abeam' (i.e. not 'finally past and clear') to head up to windward to sail hard on the wind, thereby forcing the windward (overtaken) vessel to head up, possibly missing a mark or having to tack as a result.]

Rule 14 Head-on Situation

'(a) When two power driven vessels are meeting on ... [nearly] reciprocal courses ... each shall alter her course to starboard so that each shall pass on the port side of the other.

Fig. 243.

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

(c) [If in] ... any doubt ... such a situation exists ... assume that it does and act accordingly.'
[In the case of sailing vessels, they would have the wind on opposite sides, and therefore Rule 12(a)I would apply - the starboard tack vessel has the right of way.]

Rule 15 Crossing Situation

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

[In simple words, 'Give way to the right' (starboard). But remember, this applies to power driven vessels.]

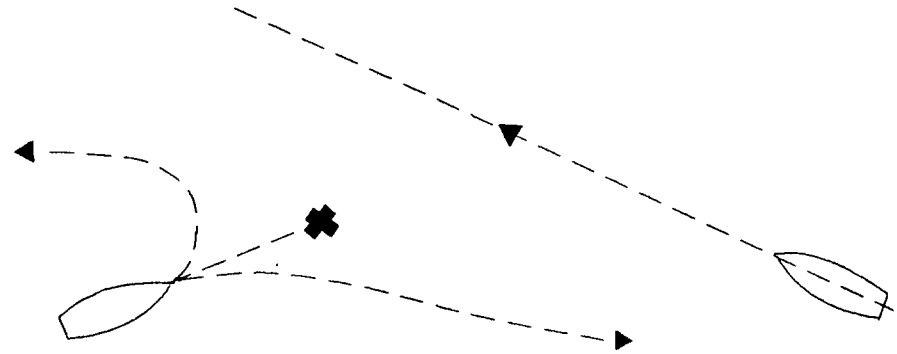


Fig. 244.

Rule 16 Action by Give-way Vessel

'Every vessel which is ... to keep out of the way ... shall ... take early and substantial action to keep well clear.'

[The 'early' and 'substantial' cannot be over stressed - give the crew of the other vessel plenty of time to see that your vessel is taking adequate avoiding action. This way, last minute confusion, panic, and a possible collision will be avoided.]

Rule 17 Action by Stand-on Vessel

'(a) i. ... [the stand-on vessel] ... shall keep her course and speed.

ii. ... [it] may however take action to avoid a collision ... [if/when it becomes apparent that] the vessel required to keep out of the way is not taking appropriate action ...

(b) When ... [the stand-on vessel] ... finds ... that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action ... best ... to avoid collision.

(c) ... [when a stand-on vessel takes action to avoid a collision as per (b) above, she may]... 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.'

[Note that it is primarily the duty of the give-way vessel to keep clear, and the stand-on vessel has to keep her course and speed. However, there comes a point where, if the action by the give-way vessel is not by itself adequate to avoid a collision, the stand-on vessel must now also give-way i.e. at this stage both vessels are give-way vessels. So if a collision occurs, both Masters will carry a degree of the blame.]
And:
DO NOT, EVER, TURN TO PORT TO AVOID A VESSEL ON YOUR VESSEL'S PORT SIDE.
(THIS APPLIES TO POWER-DRIVEN VESSELS, REMEMBER.)

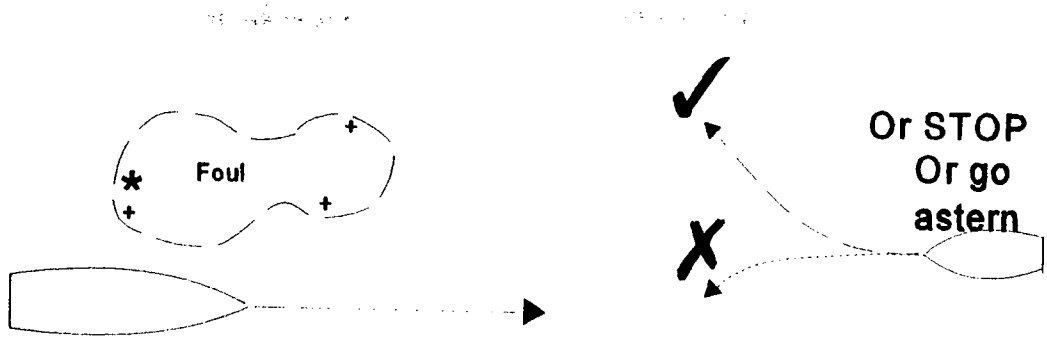


Fig. 245.

Rule 18 Responsibilities between Vessels

'Except where Rules 9, 10, and 13 otherwise require:

(a) a power driven vessel under way shall keep out of the way of:
  i. a vessel not under command,
  ii. a vessel restricted in its ability to manoeuvre,
    (... and a vessel constrained by her draught)
  iii. a vessel engaged in fishing,
  iv. a sailing vessel.
    (and a Seaplane on the water).

(b) A sailing vessel under way shall keep out of the way of:
  [i. to iii. above.]

(c) A vessel engaged in fishing when under way [even if it has no way on!] shall, so far as possible, keep out of the way of:
  [i and ii. above.]

(d) i. Any vessel ... other than [i and ii above] ... shall ... avoid impeding ... a vessel constrained by its draught, exhibiting the signals in Rule 28.
(Rule 28 ... she may display, at night, 3 red all round lights vertically arranged in addition to her other lights, or by day a cylinder.)
[This means a vessel constrained by her draught will only get preferential treatment by other vessels if/when she displays the appropriate signals.]

  ii. A vessel constrained ... shall navigate with particular caution ... regard to her special condition.

(e) A seaplane on the water ... shall ... keep well clear of all vessels ... where risk of collision exists, she shall comply with the rules of this part.'

[So the order of precedence becomes:
1. ...not under command;
2. ...restricted in her ability to manoeuvre;
3. ...constrained by her draught;
4. ...engaged in fishing;
5. ...sailing;
6. ...seaplane.

(Note: i. at the bottom of the right of way list is a powered vessel.
ii. that vessels under oars, surf boards, etc., have no rights of way.

What then about a ship flying the 'H' flag (pilot on board)? In the case of vessels in the categories 1 to 3 above, if they were in a harbour controlled area, they would be attended by tugs, and a pilot would be on board. Pilots have communication one to another and to tugs, and they will co-ordinate their vessel's movements between themselves. So the pilot on a vessel not being any of 1 to 3 above, would be in contact with the pilot or Master on the inhibited vessel and they would both decide what action each should take to best suit them both.]

Section 3. Conduct of vessels in restricted visibility

Rule 19 Conduct of Vessels in Restricted Visibility

'(a) ... applies to vessels not in sight of one another ... in or near an area of restricted visibility.

(b) ... proceed at a safe speed ... power driven vessel shall have her engines ready for immediate manoeuvre.

(c) ... have due regard to ... prevailing circumstances and conditions of restricted visibility when complying with the rules of Section 1 of this Part.
[Rules of Section 1: Look-out, Safe speed [especially Rule 6.a.], Risk of Collision, Action to Avoid Collision, Narrow Channels, and Traffic Separation Schemes.]

(d) A vessel which detects by radar alone ... another vessel ... shall determine if a close quarters situation is developing and/or the risk of collision exists. ... take avoiding action in ample time ...and avoid:
i. an alteration of course to port for a vessel forward of the beam, other than 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 there is no risk of collision]... every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close quarters situation ... shall reduce her speed to a minimum at which she can be kept on course. ... if necessary take all way off ... navigate with extreme caution ...'

[Where the range of visibility is restricted to 100 metres, you should remember that a vessel's speed/time to cover that distance is as follows:
3 knots will take 65 seconds
6 knots will take 32 seconds
10 knots will take 19 seconds
15 knots will take 13 seconds
20 knots will take 10 seconds
25 knots will take 8 seconds.
So a ship which does not slow down in fog and relies on its radar (which may not detect a yacht's presence ahead - not that it could do anything about it at that speed anyway) is only seconds away from running a yacht down once first sighted. So the onus is on the yacht's skipper and crew to be alert and ready to take immediate avoiding action.]

PART C. LIGHTS AND SHAPES

Rule 20 Application

'(a) ... [to be complied with] ... in all weathers.

(b) The rules concerning lights ... [apply] from sunset to sunrise, and during such times, no other lights ... except ... as cannot be mistaken for the lights specified ... or which do not ... interfere with the keeping of a proper look-out.

(c) [These lights shall] also be exhibited from sunrise to sunset in restricted visibility ... and may be ...(used) when deemed necessary.

(d) The Rules concerning shapes ... [apply] by day.

(e) The lights and shapes specified ... shall comply with ... Annex. 1. (Positioning and technical details.)'

[Although Annex.1 is not included in the course syllabus, this does not absolve a skipper from the responsibility of, when lights are required to be used, using the correct lights (colours, in their correct positions and of the right minimum and maximum - where applicable - intensity over the required arcs).]

Rule 21 Definitions

'(a) "Masthead light" means a white light ... over the fore and aft centre line ... showing an unbroken light over an arc of the horizon of 225º ... to show the light from right ahead to 22,5º abaft the beam on either side ... [i.e. from dead ahead to 112,5º on each side.]

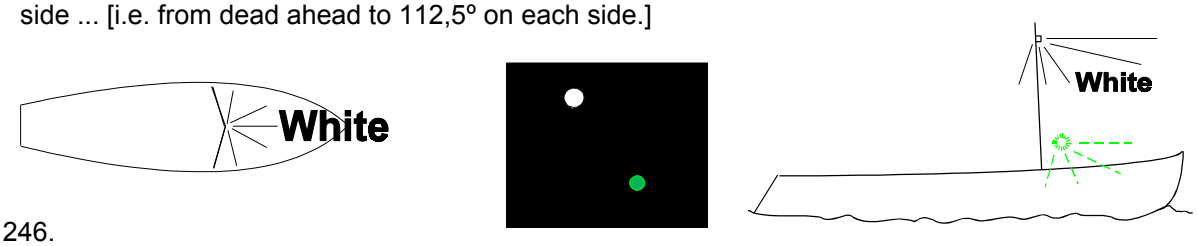


Fig. 246.

(b) "Sidelights" ... green ... starboard and red ... port, each showing an unbroken light over an arc of the horizon of 112,5º... from right ahead to 22,5º abaft the beam on their respective sides. In a vessel less than 20 metres (65 feet) in length, the sidelights may be combined in one lantern (one unit) carried on the ... centre line. [i.e. if over 20 m, they must be on the sides.] [For the use of a tricolour light, see Rule 25(b).]

Fig. 247.

(c) "Stern light" ... white ... as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135º ... to show ... 67,5º from right aft, on each side of the vessel.

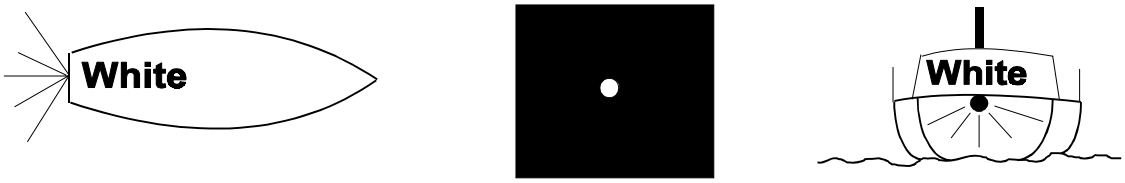


Fig. 248.

(d) "Towing light" ... yellow ... the same characteristics as a stern light ... (above the stern light).

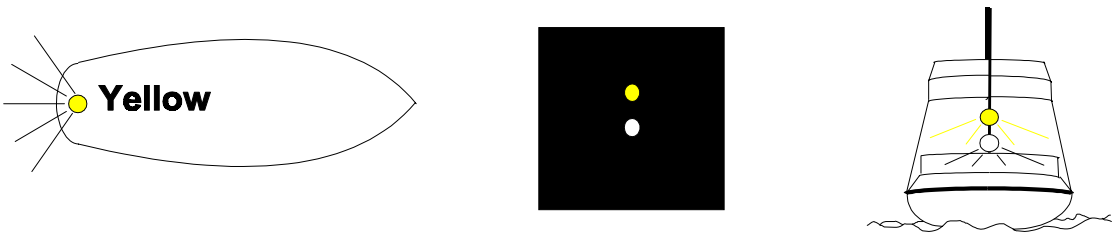


Fig. 249.

(e) "All round light" ... arc over the horizon of 360º...

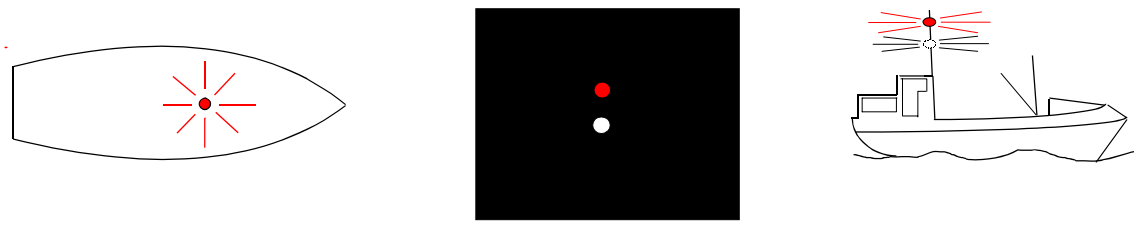


Fig. 250.

(f) "Flashing light" ... regular intervals ...120 flashes or more per minute.

Rule 22 Visibility of Lights

'The lights prescribed ... to be visible at the following minimum ranges:

(a) In vessels of 50 metres (165 feet) or more in length:
- a masthead light, 6 miles.
- ... [all others e.g. sidelight, stern, towing, etc.], 3 miles.

(b) In vessels 12 metres (40 feet) or more in length but less than 50 metres (165 feet):
- a masthead light, 5 miles
  except where the length is less than 20 metres (65 feet), 3 miles.
- ...[all others], 2 miles.

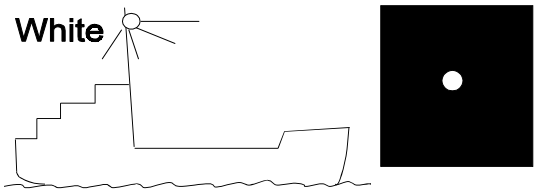
(c) In vessels of less than 12 metres (40 feet) in length:
- sidelights, 1 mile.
- ...[all others], 2 miles.'

[When one buys lights for a yacht, the packaging usually states what the expected or minimum range for a given supply voltage and wattage light bulb, will be. Yachts with under-rated lights should not get their seaworthy clearance.]

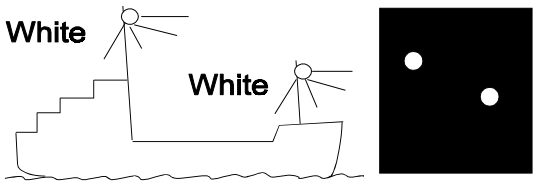
Rule 23 Power-Driven Vessels Under Way

'(a) A power-driven vessel under way shall exhibit:
i. a masthead light forward,
ii. [if 50 metres or longer] ... a second masthead light abaft of and higher than the forward one ... if shorter "may" exhibit such light ...,
iii. sidelights,
iv. a stern light.

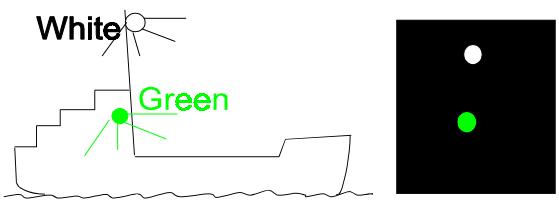
i. Less than 50 m.



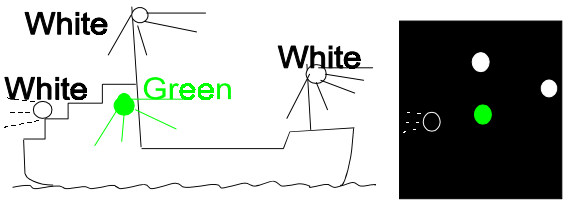
ii. More than 50 m, or optional if under 50 m.



iii. All vessels less those under 7 m/7 knots.



iv. All vessels less those under 7 m/7 knots.



Dotted lines mean not visible from this side.

Fig. 251.

(b) An air-cushion vessel ... in the non-displacement mode [shall also exhibit] ... an all-round flashing yellow light.

(c) ...less than 7 metres (23 feet) and maximum speed does not exceed 7 knots, ... an all-round white light. ...if practicable, also exhibit sidelights.'

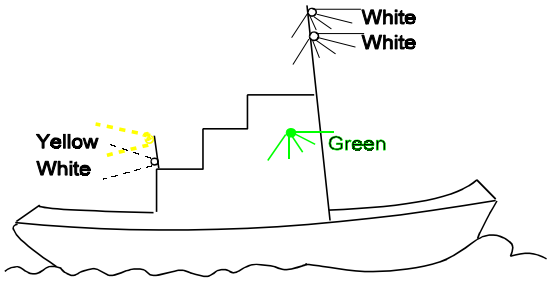
[Annex. 1 also makes it clear that the masthead light must be higher than the sidelights. Therefore, the practice by some yachts of having a masthead light on in conjunction with the tricolour light at the mast top to indicate the vessel is under power, is wrong and contrary to the rules.]

Rule 24 Towing and Pushing

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

i. ... two masthead lights forward in a vertical line. When the length of the tow, measured from the stern of the towing vessel to the after end of the tow, exceeds 200 metres (650 feet), three such masthead lights in a vertical line,
ii. sidelights,
iii. a stern light,
iv. a towing light in a vertical line above the stern light,
v. [by day] ... where the tow exceeds 200 metres in length (650 feet), a diamond shape where it can best be seen.

Day Shape
(Tow over 200 m)



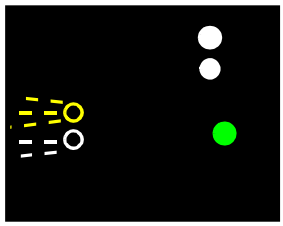
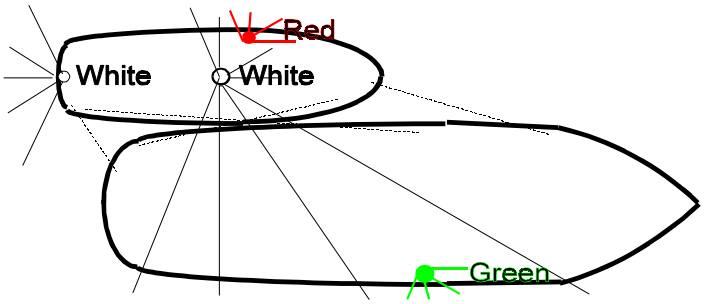


Fig. 252.

(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 (above).
[They are therefore regarded as one vessel.]

If visible from above:



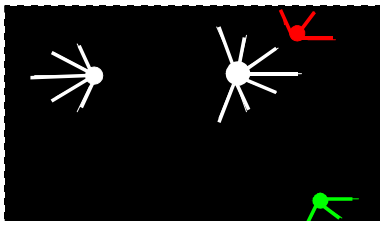
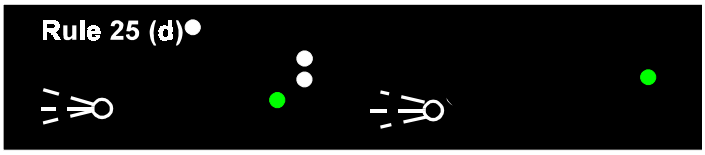


Fig. 253.

(c) A power-driven vessel when pushing ahead or towing alongside, except in the case of a composite unit, shall exhibit:
i. ... two masthead lights forward in a vertical line,
ii. sidelights,
iii. a stern light.
[Note: no towing light.]



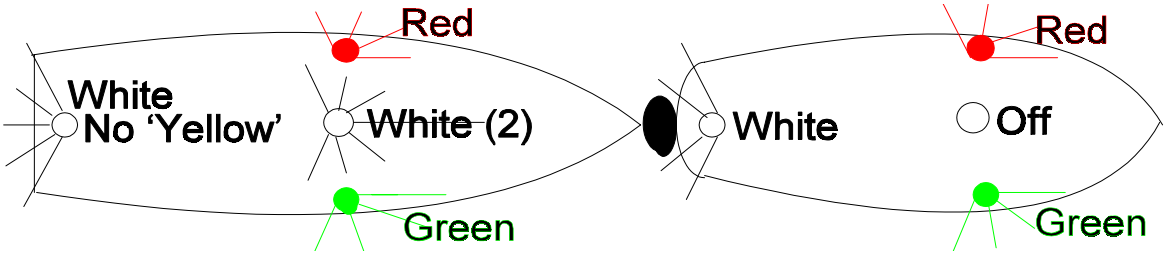


Fig. 254.

(d) ... [if the towing vessel is over 50 metres (165 feet), an aft, higher masthead light] ... [to] comply with Rule 23(a)ii.

(e) A vessel or object being towed shall exhibit:
- i. sidelights,
- ii. a stern light,
- iii. ... [by day, when the tow length exceeds 200 metres] ... a diamond shape where it can best be seen.'

[So by day, if the tow exceeds 200 metres, both the towing and the towed vessels display a diamond shape. If the tow is less than 200 metres, by day neither vessel need display any shape or signal - they are regarded as being close enough as to be readily apparent to an observer that a tow is in progress.]

'(f) ... 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 stern light and at the forward end, sidelights.

(g) Where ... it is impracticable ... to exhibit the lights prescribed, ... all possible measures shall be taken to light the vessel or object towed, or at least to indicate the presence of the unlighted ... object.'

[**BE WARNED**: Not every vessel complies correctly with these rules. On a calm, dark, overcast night while under power heading west near the deep-sea oil rigs off the Brazilian coast, the lights of a vessel over 50 metres in length glided across our path ahead (it was coming from the south and should have given way - if it was possible). There were no other lights, and no lights on any object astern of the ship. So as it crossed, we accelerated, only to notice at the last possible moment a cable running out from the stern, apparently under tension. Then we saw it. A row of barges, four abreast, and six rows in all, one behind the other just like tanks on parade. We were just able to go about and get clear before the first row passed - with not a light on any of them, and no light from the towing ship to indicate the presence of objects being towed. We would not have survived that impact.]

Rule 25 Sailing Vessels Under Way and Vessels Under Oars

'(a) A sailing vessel under way shall exhibit:
- i. sidelights,
- ii. a stern light.

[Note: As no engine power is being used to propel the vessel, there is no masthead light - often called the "steaming" light. See Figure 250.]

(b) In a sailing vessel less than 20 metres (65 feet) in length, the lights ... may be combined in one lantern ... at ... the top of the mast where it can best be seen.
[Note: This rule is an amended rule in that the size limit used to be "sailing vessels less than 12 metres (40 feet) ... "could use this combined 'lantern' - called a "tricolour" - now larger sailing vessels can legally use it. The habit of having the tricolour light 'on' in addition to some or all of the other lights, is wrong. See Figure 256. The lights in (b) above, and in (c) (see next page) must be where they `can best be seen', so in harbours or similar, or in the proximity of other vessels, use deck level lights. When close to tugs, ferries, etc, a tricolour is too high and it appears to their captains that there is no light, or vessel, ahead.]

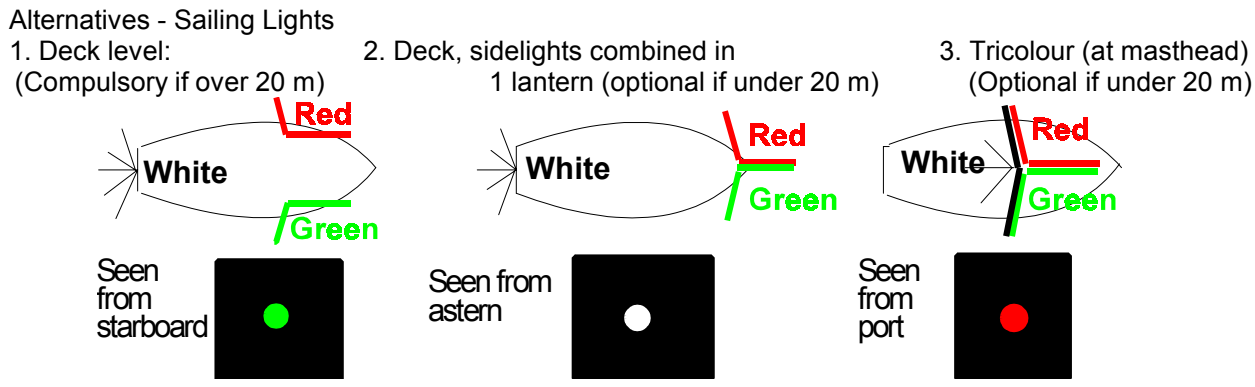
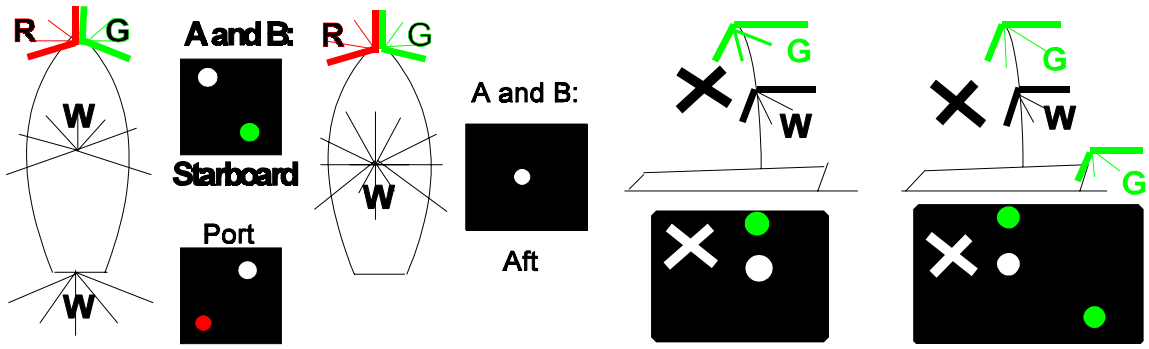


Fig. 255. (NB: See optional additional lights, red over green, Rule 25 (c).)

Alternatives - Powered Vessels' Lights (A, over 12 m, optional if under 12 m; B, under 12 m. Not C nor D).

A. B. C. D.



NB: 1. If the vessel is over 20 m LOA, sidelights must be separated to their sides.
Fig. 256. 2. The WHITE Masthead ('Steaming') light MUST BE HIGHER than any coloured light.

(c) ... [while under sail] ... may [also] exhibit at or near the top of the mast, two all-round lights in a vertical line, the upper light being red and the lower light green ... BUT NOT in conjunction with the combined lantern [the tricolour] at the mast top ...

(d) i. A sailing vessel less than 7 metres (23 feet) in length shall if practicable exhibit the lights in (a) and (b) above, but if she does not, ... she shall have ready at hand an electric torch or lighted lantern ... exhibited in sufficient time to prevent a collision,
ii. A vessel under oars may exhibit the lights prescribed ... or an electric torch ... (as in i. above).

[By day:]

(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.'

[Shapes used by day, whether a conical shape apex downwards, a ball shape, a diamond shape, etc. are all black in colour.]

Rule 26 Fishing vessels

'(a) A vessel engaged in fishing, whether under way or at anchor, shall exhibit the lights and shapes prescribed by this rule.

(b) A vessel when engaged in trawling ... the dragging through the water of a dredge net or other apparatus ... shall exhibit:

i. two all-round lights in a vertical line, the upper being green and the lower white (by night), or (by day) a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel less than 20 metres (65 feet) may instead of this shape exhibit a basket,

ii. a masthead light abaft and higher than the all-round green light; a vessel less than 20 metres (65 feet) in length shall not be obliged to exhibit such light ... ,

iii. when making way ... sidelights and a stern light.

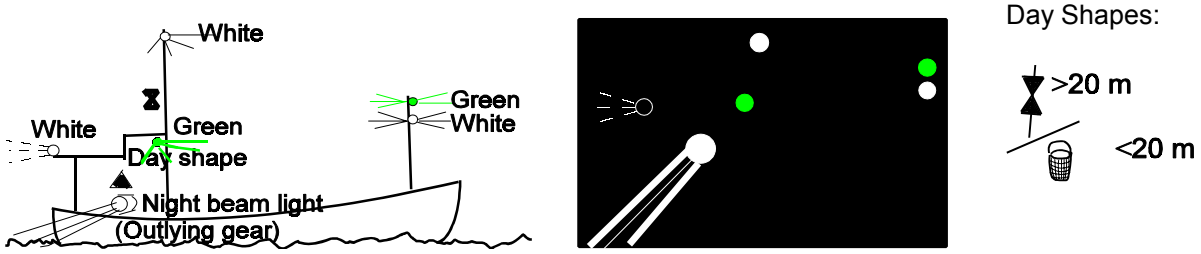


Fig. 257. (FISH HAVE WHITE BELLIES - WHITE IS THE BOTTOM COLOUR, GREEN GRASS IS ON THE SURFACE, GREEN OVER WHITE = SURFACE FISH, = "TRAWLING".)

(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 [by day] ... [the same shapes as used by a trawler].

ii. when there is outlying gear extending more than 150 metres (500 feet) ... an all-round white light

(by night) or a (by day) cone apex upwards in the direction of the gear,

iii. when making way ... in addition ... sidelights and a stern light.

Over 50 m: From Port From Starboard From Astern

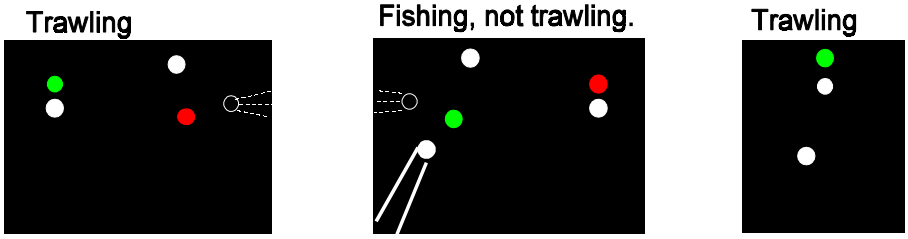


Fig. 258.

('RED OVER WHITE'; NATURE'S CAMOUFLAGE, RED IS THE FIRST COLOUR TO BECOME INVISIBLE AT DEPTH, DEEP FISH ARE RED [WHITE BELLIES]: RED OVER WHITE = FISHING, "NOT TRAWLING".)

(d) A vessel engaged in fishing in close proximity to other vessels engaged in fishing may exhibit the additional signals described in Annex. 2. (See Annex 2, page 98.)

(e) ... not engaged in fishing ... shall not exhibit the lights and shapes prescribed in this rule ...'

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 (by night) 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 (by day)'

iii. when making way ... in addition ... sidelights and a stern light (by night).

[Although using her engines, no masthead light(s) are exhibited.]

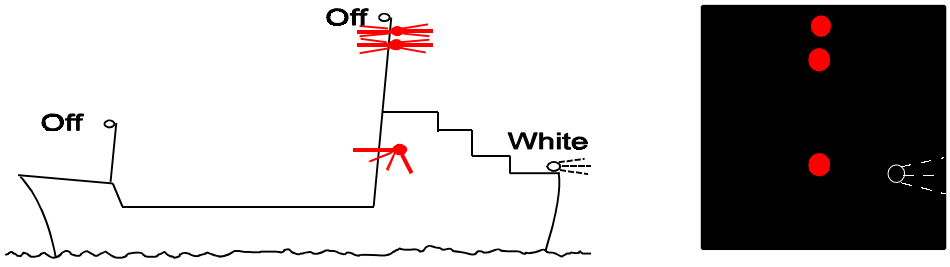


Fig. 259.

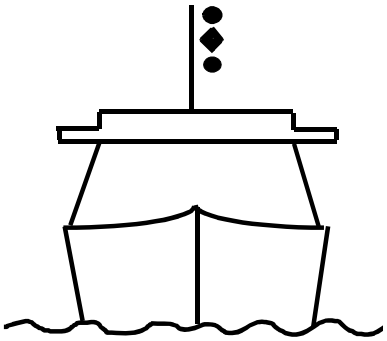
(b) A vessel restricted in her ability to manoeuvre, except ... engaged in minesweeping operations, shall exhibit:

i. (by night) three all-round lights in a vertical line, the highest and lowest being red, and the middle light being white,

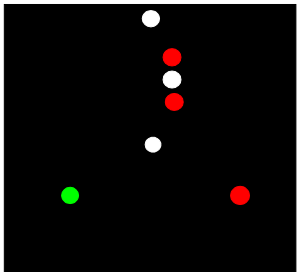
ii. (by day) three shapes in a vertical line where they can best be seen, the top and bottom being balls and the middle one a diamond,

iii. when making way ... [by night] ... [in addition] masthead light(s), sidelights and a stern light ... ,

iv. when at anchor, the lights as in (b) I. above [by night] or the shapes as in (b) ii. above (by day) as well as the lights and shapes prescribed in rule 30.



Vessels over 50 m, two Masthead lights, 1 f'ard, 1 aft:

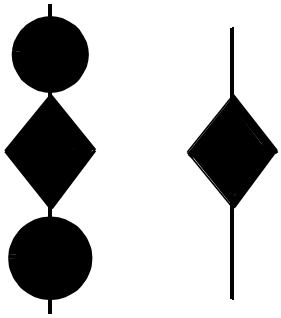


(THE THORN, WHITE, BETWEEN THE ROSES, REDS; YOUR MOVEMENT WOULD BE RESTRICTED IF YOU HAD THORNS NEXT TO YOU!).

Fig. 260.

(c) A vessel engaged in towing ... rendering her unable to deviatefrom her course, shall, in addition to the lights and shapes in i and ii above, exhibit the lights and shapes in Rule 24 (a).
[So a tug displaying a diamond shape, if also restricted in her ability to manoeuvre, must display the 'ball-diamond-ball' shapes.]

(THE THORN BETWEEN THE ROSES; IF YOU HAD THORNS AT YOUR SIDE, YOU WOULD BE RESTRICTED IN YOUR DIAMOND" MOVEMENTS TOO.)

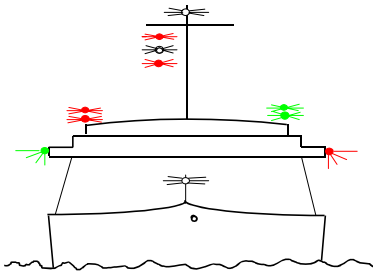


(IF SOMEONE WAS TRYING TO TAKE YOUR DIAMONDS FROM YOU, YOU WOULD "PULL" THEM AWAY FROM THAT PERSON; "PULL THE [BACK TO YOU] - BUT NOT IF THEIR VALUE WAS LESS THAN $ 200 [not used if the tow is less than 200 m.).)

Fig. 261.

(d) A vessel engaged in dredging or underwater operations, when restricted in her ability to manoeuvre, shall exhibit ... as in (b) above ... and shall in addition, when an obstruction exists, exhibit:
i. two all-round red lights or two balls in a vertical line to indicate the side 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 making way through the water, in addition ... masthead light(s), sidelights, and a stern light,
iv. ... when at anchor ... the lights as in I. and ii. above instead of the lights or shapes prescribed in rule 30.

Under way



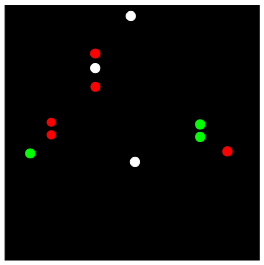
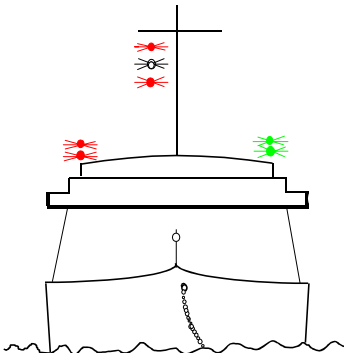
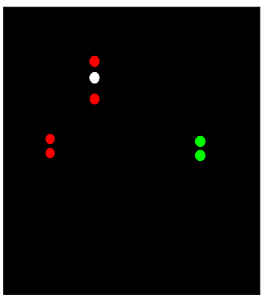


Fig. 262.

At anchor





(GREEN MEANS GO, RED MEANS STOP; PASS THE 'GREENS' SIDE, STOP THE 'REDS'.)
Fig. 263.

(e) Whenever the size of a vessel engaged in diving operations makes it impracticable to exhibit the shapes prescribed (above), a rigid replica of the International Code "A" flag not less than 1 metre (39,5 inches) in height shall be exhibited. Measures shall be taken to ensure all-round visibility.

(f) A vessel engaged in minesweeping operations shall ... exhibit three all-round green lights or three balls. One of these lights or ball shapes will be at or near the fore mast head and one each at each end of the fore yard. ... it is dangerous for another vessel to approach within 500 metres (1 640 feet) of her beam and 1 000 metres (3 280 feet) of her stern.

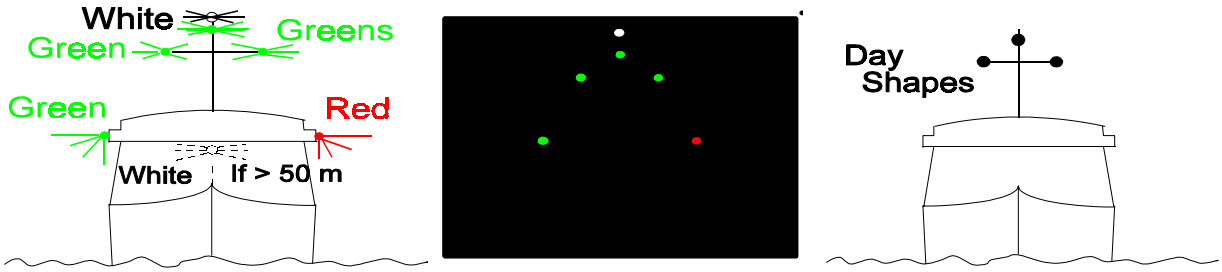


Fig. 264. (MINE FIELDS ARE LAID IN CLUSTERS OF THREE [AP] MINES, IN THE GREEN GRASS)

(g) Vessels less than 7 metres (23 feet) in length will not be required to exhibit the lights prescribed in this rule.

(h) The signals prescribed in this rule are not signals of distress and requiring assistance. (See Annex. 4.)'

Rule 28 Vessels Constrained by their Draught

'A vessel constrained by her draught may, in addition ... [to her other lights at night] ... exhibit where they can best be seen three red all-round lights in a vertical line, or [by day] a cylinder.'

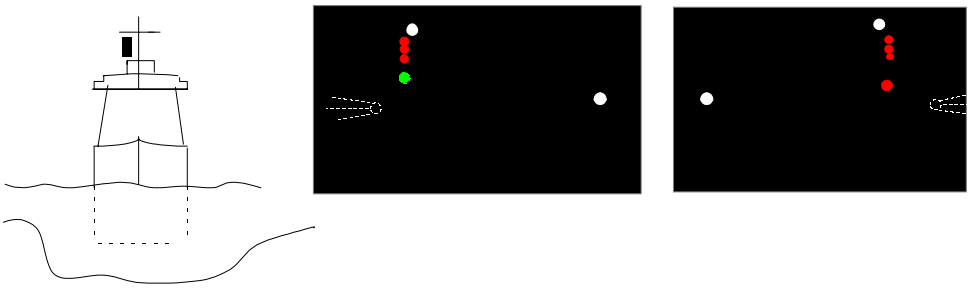
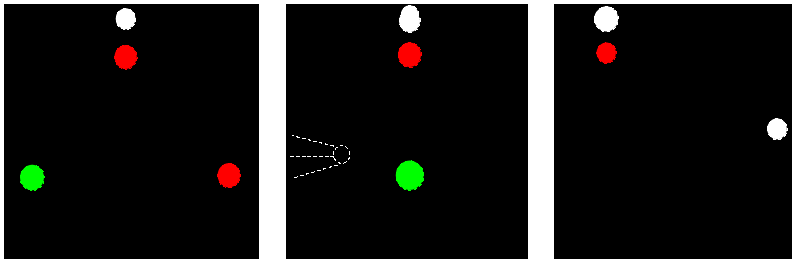


Fig. 265.

Rule 29 Pilot Vessels

'(a) A vessel engaged in pilotage duty shall exhibit:
i. at or near the masthead, two all-round lights in a vertical line, the upper white and the lower red,
ii. when under way, in addition, sidelights and a stern light,
iii. when at anchor, in addition ... the anchor light(s) or shape.



Left: As seen from ahead.
Centre: As seen from starboard
Right: At anchor, or, as seen from astern.
(PILOT'S NAVAL UNIFORM HAS A WHITE TOPPED HAT; THEY HAVE RED CHEEKS FROM YEARS OF DRINKING WHISKY;
WHITE OVER RED = PILOT.)
Fig. 266.

(b) ... when not engaged in pilotage duty ... (only) exhibit the lights or shapes prescribed for a similar vessel of her length.'

[So, except when tied up alongside a dock, a vessel's 'on pilot duty' lights must be 'on', even at anchor. From astern, one should see 'white over red over white' where the lower white is the vessel's stern light, and the vertical spacing between the two lower lights may or may not be the same as the space between the upper two lights. Note also that the white over red all-round lights are in place of, not in addition to, the masthead light used by power-driven vessels.]

Rule 30 Anchored Vessels and Vessels Aground

'(a) A vessel at anchor shall exhibit where it can best be seen:
[vessels over 50 metres - 165 feet]

i. in the fore part, an all-round white light (at night) or one ball (by day),
ii. at or near the stern and at a lower level than the light ... in I. above ... , one all-round white light.

(b) A vessel less than 50 metres (165 feet) in length may exhibit an all-round white light where it can best be seen instead of the lights ... (in (a) above).
[A yacht's anchor light therefore need not be at the 'fore part' of the vessel, nor must it be at the mast head where, as is often the case, it is so high that to other yachts manoeuvring close by, its presence appears not to be marked by illumination at all.]

(c) A vessel at anchor may, and a vessel of 100 metres (328 feet) or more in length shall, also use the available working or equivalent lights to illuminate her decks.

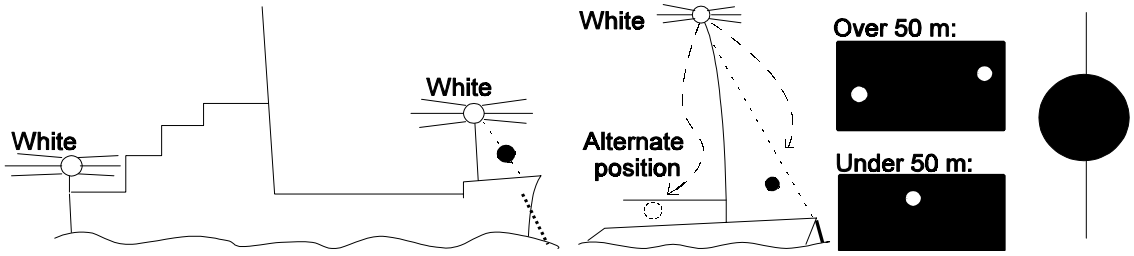


Fig. 267.

(d) A vessel aground shall exhibit the lights in (a) or (b) above ... 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 (23 feet) in length ... [if out of the way of other vessels' navigable areas] ... shall not be required to exhibit ... [the above lights].'

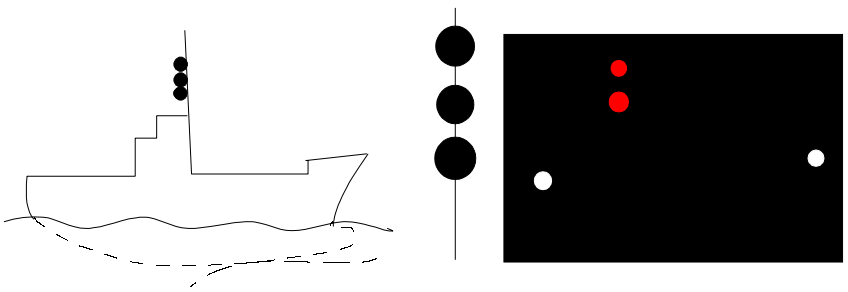


Fig. 268.

PART D: SOUND AND LIGHT SIGNALS

Rule 32 Definitions

(See the 'pictorial' sound rules on page 91.)

'(a) ... "whistle" ... (specifications - Annex. 3, not included. A horn or hooter device).

(b) ... "short blast" ... one to two second's duration.

(c) ... "prolonged blast" ... from four to six seconds duration.'

Rule 33 Equipment for Sound Signals

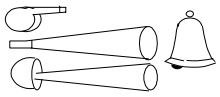
'(a) A vessel of 12 metres (40 feet) or more in length shall be provided with a whistle and a bell ... vessels of 100 metres (328 feet) or more in length ... in addition ... a gong ... the tone of which cannot be confused with that of the bell. ... [They must comply with the technical specifications in Annex. 3] ... They can be replaced by other equipment having the same sound characteristics [e.g. electronic hooters, etc.] ... provided that manual sounding of the required signals shall always be possible.

[So on a yacht we must have a 'blow horn' in addition to any other device we may have. The nice shiny bell is there for a reason - it will be of little use in a place of honour inside the saloon or wheelhouse!]

(b) A vessel of less than 12 metres (40 feet) in length shall not be obliged to carry the sound signalling appliances ... in (a) above ... , but if she does not, she shall be provided with some other means of making an efficient sound signal.'

MARINE SOUND SIGNALS

BASED ON THE INTERNATIONAL REGULATIONS FOR THE PREVENTION OF COLLISIONS AT SEA.

Equipment:	Vessels less than 12 m:-	Vessels from 12 m up to 100 m:-	Vessels over 100 m:
	Any efficient sound device.	Whistle or horn, and a bell. 	In addition, a gong at the stern. 

If these devices are mechanical or electrical units, a manually operable unit must also be available.

TURNING

To Starboard

To Port

Short blast 1-2 secs

ASTERN PROPULSION

My engines are applying astern propulsion

PILOT VESSEL

I am on Pilot duty (so keep clear of me - I may have to turn to port despite your presence in my port sidelight arc)

YOUR INTENTION IS NOT CLEAR

You should be giving way - GET OUT OF MY WAY!

MANOEUVRING

I intend overtaking you on your starboard side (so please move to port or make room for me)

I intend overtaking on your port side (so please move to starboard or make room for me)

I agree to being overtaken (and will leave you room to pass)

I or another vessl may be approaching a blind corner, or in poor visibility, it is a general warning of my/their movement

Long blast 5-6 secs

RESTRICTED VISIBILTY (e.g. In FOG)

Powered vessel making way (i.e. moving)

Stopped, not making way

Inhibited vessel (not under command, sail, under water ops)

Towed/last of a line of towed vessels - after the tug's signal

At Anchor — Every one minute:

a. Vessels less than 100 m — 5 seconds rapid bell ringing

b. Vessels over 100 m: F'ard: 5 seconds rapid ringing then; Aft: 5 seconds rapid gong strikes

Aground

a. Vessels less than 100 m — Bell: 3 strikes + 5 seconds rapid + 3 strikes

b. Vessels over 100 m — Bell at bow: 3 strikes + 5 seconds rapid, + 3 strikes, Gong at the stern: followed by 5 seconds rapid.

General warning of your presence to an approaching vessel

DISTRESS

A continuous blast, or morse "S.O.S.":

Fig. 269.

Rule 34 Manoeuvring and Warning Signals

'(a) When vessels are in sight of one another, a power driven vessel under way, when manoeuvring ... shall indicate ... [using] the following signals on her whistle:
- one short blast ... "I am altering my course to starboard",
- two short blasts ..."I am altering my course to port",
- three short blasts ..."I am operating astern propulsion".

[Note the word 'shall', not 'may'; and especially that the three short blasts DOES NOT MEAN "I (and therefore hopefully my vessel) am going astern" - the use of astern propulsion may be just to assist in making a rapid stop!]

(b) Any vessel may supplement the ... [above] ... signals (with a light) ... whilst the manoeuvre is being carried out:
i. one flash ... "I am altering course to starboard",
two flashes..."I am altering course to port",
three flashes..."I am operating astern propulsion",
ii. the duration of a flash ... one second, the interval between flashes ... one second, and the interval between successive signals shall not be less than ten seconds,
iii. the light used ... shall ... be an all-round white light, visible ... [from] 5 miles, and [comply with Annex. 1].

(c) When in sight of one another in a narrow channel or fairway:
i. a vessel intending to overtake ... shall ... indicate her intention by the following signals on her whistle:
2 prolonged plus 1 short blasts - "I intend to overtake you on your starboard side",
2 prolonged plus 2 short blasts - "I intend to overtake you on your port side".
ii. the vessel about to be overtaken ... shall indicate her agreement by ... :
1 prolonged, 1 short, 1 prolonged, and 1 short blast.

(d) When vessels ... are approaching each other and ... either vessel fails to understand the intentions or the actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, ... [she blasts] ... 5 or more ["at least 5"] short blasts ... [which] may be supplemented by 5 or more short and rapid flashes.

(e) A vessel nearing a bend or an area ... [which] may be obscured ... shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel (any vessel under way which hears the signal) ... around the obstruction or bend.
[See also Rule 35 (a) - a power-driven vessel under way in restricted visibility.]

(f) If [two or more] whistles are fitted on a vessel at a distance apart of more than 100 metres (328 feet), 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 ... [following] signals ...shall be used:

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

(b) A power driven vessel under way but stopped [i.e. having no 'way on'] ... two prolonged blasts [not more than every two minutes].

(c) A vessel not under command, restricted in her ability to manoeuvre, constrained by her draught, a sailing vessel, a fishing vessel, and a vessel engaged in towing or pushing ... shall instead ... sound ... [at least] every two minutes three blasts, namely one prolonged and two short blasts.
[The sound signal '1 long, 2 short' is the Morse code for the letter 'D', and the flag 'D' means 'manoeuvring with difficulty so keep clear'.]

(d) A vessel towed ... or the last of a line of towed vessels, if manned, shall at intervals of not more than 2 minutes and immediately after the signal made by the towing vessel, sound four blasts, namely one prolonged and three short.

(e) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a [one] power-driven vessel and shall give the signals ... [as a single vessel].

(f) A vessel at anchor shall at intervals of not more than one minute ring the bell rapidly for about five seconds. In a vessel of 100 metres (328 feet) or more in length the bell shall be sounded in the fore part of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about five 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 the possibility of a collision to an approaching vessel.
[So a yacht at anchor in fog, of over 12 metres (40 feet), must* ring a bell for five seconds at least every minute. *In practice, this is most unlikely to happen as it may have to go on for many hours - no one would be able to get any rest and it would be very difficult to ring a bell every minute - the probability of a vessel coming close to a collision situation would have to be very real before this would happen.]

(g) A vessel aground shall give the bell signal and if required the gong signal ... [as if at anchor] ... 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 ... [e.g. as in (f) above].

(h) A vessel of less than 12 metres (40 feet) in length shall not be obliged to make the above mentioned signals but, if she does not, [she] shall make some other efficient sound signal at intervals of not more than 2 minutes.

(i) A pilot vessel when engaged on pilotage duty may in addition ... sound an identity signal consisting of four short blasts.'
[A pilot vessel's identity signal is not sounded so that the pilot can brag! In addition to letting a vessel, which might be awaiting a pilot, know that the pilot (vessel) has arrived, it also serves to warn other ships and small craft which may be on its port side, that as a pilot vessel it may have to alter course to port away from the ship it has been alongside. Normally remember, a power driven vessel may not turn to port for a vessel on its own port side.]

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 authorized 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.'

Rule 37 Distress Signals

'When a vessel is in distress, and requires assistance she shall use or exhibit the signals prescribed in Annex. 4.'

ANNEXURE 2

Additional Signals for Fishing Vessels In Close Proximity

1. **General**

The lights mentioned herein shall ... be placed where they can best be seen. They shall be at least 0,9 metres (3 feet) apart but at a lower level than the lights prescribed in Rule 26(b)I. and (c)I. (Trawling, 'green over white'; fishing other than trawling, 'red over white'). The lights shall be visible all round the horizon at a distance of at least one mile but at a lesser distance than the lights prescribed by these rules for fishing vessels (i.e. the green/red over white).

2. **Signals for Trawlers**

(a) Vessels when engaged in trawling ... may 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 engaged in pair trawling may 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 their nets have come fast upon an obstruction, the lights ... as in 2(a) above.

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 [both to have the same intensity/candle power] and occultation duration [both to have the same flash/dim timing intervals]. These lights may be exhibited only when the vessel is hampered by its fishing gear.

ANNEXURE 4

Distress Signals

1. The following signals, used or exhibited either together or separately, indicate distress and need of assistance:

(a) a signal sent by radiotelephony consisting of the spoken word 'MAYDAY', (on VHF channel 16, or SSB on frequency 2 182 kHz or 4 125 kHz). [If 2 182 kHz is in use, 2 191 kHz is opened as an alternative.]

(b) the radio telephone alarm signal (this is a two tone signal which, if necessary, turns radio receivers within range and which are on 'stand-by', to 'on' and activates a hooter signal from the radio receiver's loud speaker to attract attention).

(c) the radio telegraph alarm signal (this is similar to the system in (b) above, but on the telegraph frequencies).

(d) the radio telegraph 'SOS' signal.

(e) signals transmitted by 'E.P.I.R.B.s' - emergency position-indicating radio beacons. These signals can be on the aircraft emergency frequencies (VHF and UHF) or on satellite monitored frequencies which instantly relay the 'SOS' message and the ship's position, determined by satellite, to a control centre which is continuously manned.

(f) rockets or shells throwing red stars fired one at a time at short intervals.

(g) a rocket parachute flare or a hand flare showing a red light.

(h) a smoke signal giving off orange-coloured smoke.

(i) a light or sound signal in Morse code consisting of the letters "SOS" (- - - --- --- --- - - -).

(j) a continuous sound with any fog signalling apparatus.

(k) the International Code Signal of distress indicated by "N.C." - the flags "N" over "C".

(l) a square flag having above or below it a ball or anything resembling a ball (flags made for the purpose, consisting of an orange background and a black square and black ball shape, are available from some retail outlets).

(m) a gun or other explosive signal fired at intervals of about one minute.

(n) slowly raising and lowering both arms in unison, and

(o) flames/black smoke (from the bow - not the funnel).

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 Shipping Search and Rescue Manual and the following signals:

(a) A ... (orange flag as in 1.(l) -see page 94).

(b) a dye (orange) marker.

EXTRACT FROM
THE MERCHANT SHIPPING (SIGNALS OF DISTRESS) RULES 1977

1. No signal of distress shall be used by any ship unless the master of the ship so orders.

2. The master of the ship shall not order any signal of distress to be used by his ship unless he is satisfied:

(a) that his ship is in serious and imminent danger, or that another ship or aircraft is in serious and imminent danger and cannot itself send that signal; and

(b) that the ship in danger (whether his own ship or another ship) or the aircraft in danger, as the case may be, requires immediate assistance in addition to any assistance then available to her.

3. The master of a ship which has sent any signal of distress by means of radio, shall cause that signal to be revoked as soon as he is satisfied that the ship or aircraft to which the signal relates is no longer in need of assistance as aforesaid.

EXTRACT FROM S.O.L.A.S. 1974 CHAPTER V REGULATION 9

The use of the international distress signal, except for the purpose of indicating distress, is prohibited.

NOTES

CHAPTER 5

SAFETY AT SEA (or 'SAFETY ON THE WATER')

Introduction

The sea/dam's waters and the weather do not know who is rich and who is poor, who is well qualified, who cheated their 'ticket', who is experienced or who is a beginner - it will treat everyone the same.

There are people who have sailed around the world and never had a problem related to safety or even a serious gale. There are also single-handed 'BOC Challenge' around the world racers who have been lost overboard when not wearing a harness. Safety procedures and equipment are designed to augment common sense - use them!

The Need for 'Rules of the Road'

The 'Rules of the Road' have been adopted by the maritime nations of the world to reduce the risk of accidents. A few examples of some of the rules which are regularly ignored by many yachtsmen, and the possible consequences to one's safety, are set out below.

1. ' ... safe speed ... ' A safe speed is a speed at which the vessel is moving slow enough to be able to take adequate timeous action, either by altering course, slowing, stopping or going astern, to avoid a possible collision.

2. '... maintain a 360° all round look-out, by sight AND HEARING at all times while under way so as to make early appraisal of the risk of collision ...'. The duty watch on any vessel must maintain effective look-out, including the use of radar if fitted, so as to be able to take avoiding action should a danger arise FROM ANY DIRECTION.
   (Tugs, contrary to the layman's belief, do not have a clear 360° all round visibility. While manoeuvring in a harbour a small pleasure craft (that includes a sailing yacht despite a tall mast) is not always visible to the officer in control on the tug's bridge. No tug will detour to get out of a sailing yacht's way - so be warned.)

3. '... take early and substantial course change action as the 'give way' vessel ...'. It must be easily apparent to the helmsman of the 'stand on' vessel, when there is still plenty of time to spare, that the 'give way' vessel is in fact giving way adequately. A small course change by the 'give way' vessel may in itself be adequate to just avoid a collision, but if the 'stand on' vessel does not see avoiding action being taken, the latter vessel is then obliged to also give way.

A ship at cruising speed on the ocean takes many miles to start a turn or to stop. If a yacht is on or near its course, the yacht crew need to be alert to the need to take early and positive avoiding action - the ship cannot! (It may be on autopilot with the one and only person on watch on the bridge doing anything except keeping a good lookout).

It should be clear that these rules are for our safety - but on nearly every voyage or local sailing you can observe the duty helmsman or woman: 'How many times, if at all, does he or she turn to look ALL ROUND to ensure there is no danger developing?'. How often do yachts which get taken out for a sail or race return after dark with the wrong lights being displayed? Ask the crew of most racing yachts how often and under what circumstances they wear their harnesses - most will tell you 'never' - "Harnesses are for beginners - we don't need them because we are experienced racing crew"! A skipper allowing this attitude who then loses a crew member overboard should be sent to jail for life. But by then the damage is done.

Personal Safety Equipment

Each person on board should have a number of items of safety equipment for his or her personal use. The climate, season, weather conditions and trip being sailed are some of the factors that will determine which items are needed, but if there is any likelihood of their being required, they should be available. They include;

1. **A Harness**. One per person on deck is a legal requirement. Ideally the strop should have a spring-loaded release clip at both ends, and the harness should have a crutch strap. They should be worn whenever the

skipper instructs that they be worn, from last light until sunrise by all persons on deck, when the wind is strong enough to warrant reefing the mainsail, and if any individual crew member(s) wish to at any other times. If one is wearing a harness, IT IS OF NO USE UNLESS IT IS ATTACHED TO THE YACHT! The skipper is responsible for the safety of his vessel and the crew - make your crew wear them when necessary, and check regularly that they are attaching themselves.

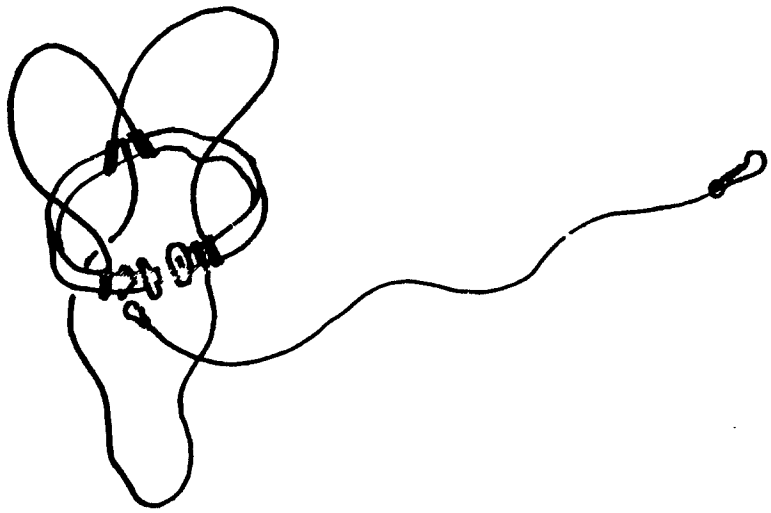


Fig. 270.

2. **A Life-jacket**. One per person is the legal requirement, and they must be of the approved type, not just "floatation" aids. The main buoyancy is applied to the chest so that the user will float 'face up'. There is also buoyancy behind the head so that even if unconscious, the user's mouth and nose area is kept above the water line. A whistle must be attached for the user to generate noise, and optional extras can be a sachet of orange dye powder, a mini-flare set and a light or strobe light.

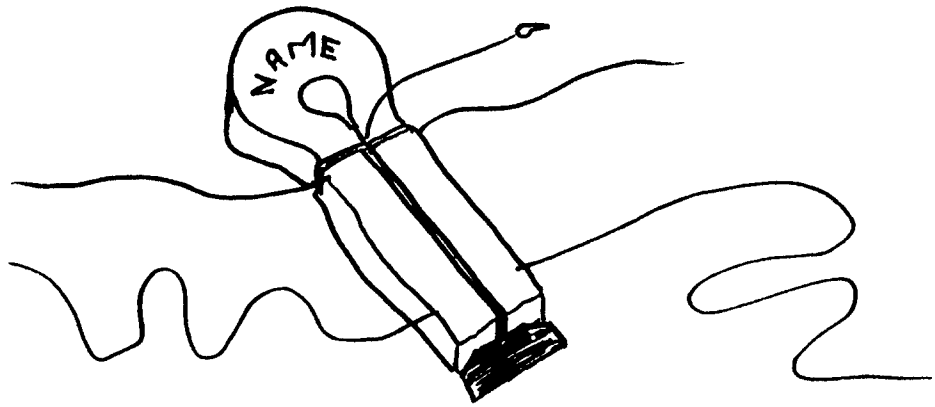


Fig. 271.

3. **'Oilies'**. Wet weather protective clothing which keeps the wearer dry, is desirable. Colours such as yellow, and orange can be seen easier than dark red, green, blue or white which are almost impossible to see in rough waters with breaking waves. Some sophisticated suits have built in harnesses, liners for warmth, inflatable compartments, and self igniting lights, etc., as standard fittings. These extras are hardly ever used and are, in my opinion, an expensive waste for most owners.

4. **Deck Boots, Head Warmer, Gloves and Thermal Underwear**. Deck boots serve to keep the feet dry and if worn with thermal socks, keep the feet warm. Thermal underwear keeps the wearer warm and functional. If one gets too cold, one cannot think logically and the brain stops controlling the nervous system - the result is death. Most body heat is lost from one's head, so a woolen balaclava or head warmer is essential in cold weather.

5. **Torch**. A small but efficient pocket torch (waterproof?) per crew member can be invaluable. They save the 'ship's torches'!

6. **Man overboard Light**. A self-igniting light of the strobe or continuous light types can be small and inconspicuous when worn by a crew person out of the water. When entering the water, the light is automatically switched on, helping to pin-point the wearer for the search vessel in the hours of darkness.

7. **Mini Flare Set**. A set of six mini or pencil flares are sealed in a small watertight plastic container which can be tied to a crew member's clothing and kept in a pocket. Or a set can be tied to the Danbuoy's lifering.

8. **Beacon Radio Transmitter**. As yet still a very new development is the wearing of a mini radio transmitter which is automatically switched on when the wearer is in the water. It will transmit a low or medium frequency tone which is detectable by the standard Radio Direction Finder (RDF).

9. **Yachtsman's Pocket Knife**. A good pocket knife has a very sharp blade as well as a shackle spanner, a screw driver end and a Marline Spike. It is attached to the user by a lanyard so that it cannot be dropped overboard, especially useful if working up a mast. In an emergency there is sometimes a need for a knife and no time to spare to go and get one.

10. **Sunglasses and Sunburn Protection**. Apart from the effects on one's health, a sunburnt crew member is not fully functional.

General Safety Equipment

The Government Gazette, Number 10042 dated 20 December 1985, contains Government Notice Number 2799 of the same date issued by the Department of Transport. Annexure A sets out the 'RULES' for 'Design and Construction and Power and Other Installations and Appliances', and Annexure B sets out the 'Safety Appliances and Equipment Rules'. These rules refer to the various 'Category' of vessels defined as follows: "Category" when used to describe a ship or vessel,

> "Category" when used to describe a ship or vessel, means the category according to which a ship or vessel is identified in terms of these regulations, as follows:
>
> Category A--Ships or vessels being used, handled or operated at sea.
>
> Category AI--Power-driven mono-hulled or multi-hulled vessels fitted with an inboard engine or with more than one outboard engine:
> (1) Fully decked vessels and wet deck vessels, other than inflatables, being self draining with built in buoyancy;
> (2) partially decked vessels, other than inflatable vessels;
> (3) vessels, other than inflatables, not contemplated in categories A1(1) and A1(2); and
> (4) inflatable vessels.
>
> Category AII--Sailing vessels:
> (1) Self-righting vessels;
> (2) muti-hulled vessels 6 metres and more in length; and
> (3) non self righting monohulled vessels and multi-hulled vessels less than 6 metres in length.
>
> Category AIII--Vessels not contemplated under AI or AII:
> (1) Vessels, including inflatable vessels, fitted with one only outboard engine; and
> (2) other vessels.
>
> Category B--Vessels used, handled or operated on inland waters.

The annexures referred to are reproduced as Appendices A and B to this Chapter and are self explanatory. In

addition the following comments amplify or add to (as appropriate) the contents of the above Rules.

RULE 1

Life-rafts. The requirement to have a life-raft depends on the category of vessel (see above definitions), the vessel's construction (see regulation 12(2) below), and whether the vessel is to be sailed in 'Local Waters' or further - and Local Waters are defined (at the end of Annexure B) as ' ... daylight sailing ... not more than 30 miles from the low water mark...'.

Regulation 12(2) states:

'A vessel shall be constructed or fitted with buoyancy in such a way that it will remain afloat on an even keel or as near an even keel as practicable for a period of not less than 48 hours when completely flooded, swamped or capsized:

Provided that, if a vessel is not so constructed or fitted, it shall be equipped in accordance with Rule 1 of Annexure B' (i.e. have a liferaft).

In summary:

a. Self-righting mono-hulled yachts, and
b. Multi-hulled sailing yachts 6 metres or more in length,

which are to be sailed in daylight only and within 30 miles of the low water mark, are NOT required to have a life-raft.

ALL other yachts either sailing in the hours of darkness or more than 30 miles from the coast MUST have an approved life-raft. Life-raft capacity must not be exceeded by the number of persons on board, and every life-raft MUST be inspected and serviced by an approved agency at least every twelve months. A certificate to the effect that it has been serviced is to be kept on board the vessel.

All life-rafts must have red flares, torches with spare batteries and spare bulbs, a puncture repair kit and pump, a knife, a First Aid kit, paddles, etc.

RULE 2

1. **Life jackets.** Must be of the approved type, marked with the name and port of registry of the vessel, and there is to be one per person on board.

2. **Lifebuoy/Danbuoy**. In addition to the whistle and self-igniting light, adding a drogue will slow the unit's drift so that the wind will not float it away from the person in the water . A mini-flare set, a low-powered beacon transmitter, a mini strobe at the top of the pole, and a sachet of orange dye marker could also be part of the complete unit.

3. **Lifebuoy**. A second lifebuoy ring is to provide for a crew member to be put over the side to help someone already in the water. It should preferably be attached to the vessel with a long floating (polypropylene) rope.

4. **Flares**. Most flares have an approved shelf-life of three years after which they must be replaced. White hand-held flares are not prescribed in the rules above, but CASA and the RYA recommend a minimum of four for every vessel which may be at sea at night. (They, white flares, are used when the vessel's own lights will not operate and are to warn approaching vessels of the danger of collision ahead.) The dates of manufacture and expiry are stamped or marked on each flare.

5. **Torch**. Torches have a horrible habit of not working when one needs them most. Two or more torches are required; they should always (like other safety equipment) be kept in the same place when not in use, and there should be ample spare batteries and spare bulbs. These 'ship's' torches are separate to the individual torches carried by each crew member, and should be waterproof.

6. **Signalling Mirror**. A signalling mirror is a shiny metal plate with a small hole through it so it can be used to 'aim' the reflected sun's rays at a passing vessel to attract attention. See Fig. 272.

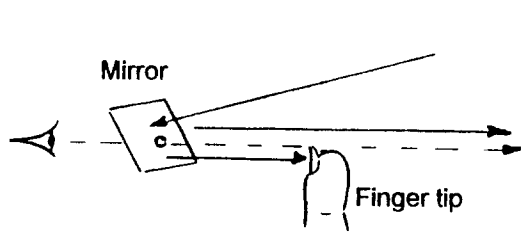


Fig. 272.

7. **Sound Signalling Device.** An electric (battery powered) or mechanical horn or hooter must be backed up by a manually operable (blow type) horn.

8. **Flags**. The larger the better - in an emergency, if one has no other way of communicating, one wants these flags to be seen AND IDENTIFIABLE.

9. **Radar Reflector.** The larger the better - it will give a stronger return signal, especially if mounted in the "rain catching position". It need not be permanently mounted; if not, it must be easily raised when required.

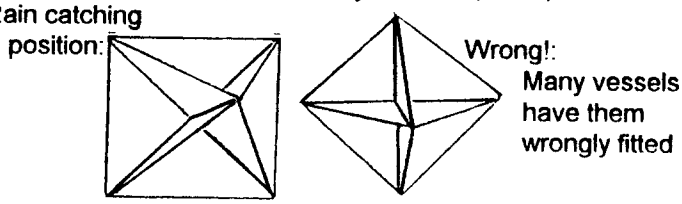


Fig. 273.

10. **Radios**. There must (CASA/RYA requirement) also be a spare antenna and cable carried for the VHF radio. This is in case the original, on a mast, is lost. A portable VHF radio as a back up or for use from the tender to the parent vessel, or from a life-raft, is very nice to have.

11. **Patent Log**. Paddle wheels and impellers that are spun by the passing water are often jammed by dirt in the water. Sometimes they are broken, and the 'trailing log' (Walker type) is sometimes taken by a shark or other large sea creature. Have spares on board and be able to fix or replace them at sea.

12. **Hand-Bearing Compass**. As with other fragile yet important equipment that is moved about and even brought on deck, tie it to the user with a lanyard that will not break or snap.

13. **Navigation Charts**. Ensure charts used are updated by the most recent Notices to Mariners.

14. **Hydrographic Publications**.
   a. The book or chart 'Chart Symbols and Abbreviations', British Admiralty publication number 5011, or South African number SAN 3001.
   b. A 'Ship's Log' (a logbook/deck log).
   c. A copy of 'Rules for the Prevention of Collisions at Sea'.
   d. 'List of Lights, Fog Signals and Radio Services', SAN HO-1
      "SAN HO" means 'South African Navy Hydrgraphic Office' and the number is the document number.
   e. Tide Tables.
   f. Books on rope work and sail repair.
   g. The vessel's 'Engine Repair Manual'.
   h. Reminder' books on 'how to' for navigation, meteorology general sailing subjects, or even cooking at sea.
   j. First Aid for Yachtsmen.

15. **Sails**. Storm sails may include a Trysail.

16. **Bolt Cutter**. If a mast ends up in the water, it is unlikely, especially as it fills with water, that it will be recoverable and the longer it is free to bump the hull, the sooner hull damage will occur. Bolt cutters must be of a suitable size to easily cut through the strongest of the stays and shrouds. They are unfortunately usually constructed from materials which rust quickly, so they need to be well greased and regularly checked.

17. **Fire Extinguishers**. Take bigger sizes and more of them if you can - a fire which has been burning for more than just a few seconds takes a lot of extinguishing. Any fire needs heat, oxygen, and fuel in order to exist - if

we remove any one of those three elements, a fire will go out. So, in putting out a fire, the person fighting the fire must try to cool it (remove the heat), smother it (deny it oxygen), and/or starve it (deny it fuel). These steps are achieved by adding water (cooling), spraying with chemicals (smothering), and turning off gas/fuel lines and pulling other flammables out of its reach (starve it). Once out, as oxygen is still present in the air, and flammable parts of the boat cannot be removed (e.g. wood bulkheads, beams, etc.), any subsequent warming up/heating of the area will cause the fire to re-ignite. So once out, keep the area cool.

Gas bottles will explode if they get hot, and liquids, like petrol and thinners, can vaporise so quickly when excessive heat is applied, that they explode like a bomb. While in liquid form, if spilt, water added will just cause them to spread - and in turn they will spread a fire. So never use water to fight a fire of burning flammable liquids. Use a chemical fire extinguisher. BCF leaves no mess, CO_2 is a gas extinguisher, and DCP is a Dry Chemical Powder - it is messy to clean up.

Xxxxxx

To reduce the risk of fire,

i. Do not allow smoking below decks.
ii. Do not have any naked lights or lit cigarettes nearby when refuelling, and switch the engine's electrics off.
iii. Check electrical wires and terminals for chafe, heat, and tightness.
iv. Check fuel lines, gas pipes, tanks and containers for leaks.
v. Stow flammable liquids in externally vented lockers.

Keep fire fighting equipment in good condition and readily accessible - stowed in two or more SEPARATED places.

18. **Buckets**. Two metal buckets facilitates one easy method of steering a yacht when the rudder is useless. Additional plastic buckets are useful for the galley as well as being available as spare bailers. A canvas bucket, apart from looking nautical, is just as serviceable as other buckets and can be folded small for stowing.

19. **Bilge Pumps**. Electric bilge pumps, with or without self activating switches, are not a substitute for manual pumps. At least two manual pumps of adequate size should be fitted, and one of these must be operable from within the vessel when it is closed as in rough weather.

20. **Heaving Line**. The longer the better - so long as it can be thrown its full length. 15 to 20 metres is normal.

21. **Boat Hook**. Two are better than one, and again it is a case of the longer the better. Often one finds standard length boat hooks on large yachts where the pole is too short to reach down and out to get to a mooring buoy even when it is quite close. A wooden pole is usually better than a metal telescopic type, but both should have some kind of line attaching it to the vessel - NOT the user unless one also has a sharp knife ready 'in case'.

22. **Sea Anchor or Drogue**. These two items must not be confused. An anchor STOPS a vessel, a drogue SLOWS a vessel. A drogue is used, normally from the stern, to slow a vessel and to reduce the risk of broaching. A proper sea anchor should ONLY be used from the bow. The stopped vessel's bow is then kept to windward, facing the oncoming waves - they should not be allowed to smash into the stern.

23. **Anchor Equipment**. The more anchors one has, the bigger and the better the quality, the safer that vessel will be when anchored in a severe 'blow'. The longer the chain, the better. All chain, as opposed to a combination of chain and rope, is best. Make sure that when anchored, sufficient length of chain and rope allows for a scope TEN times the depth when in strong wind conditions. And do not omit a tripping line.

24. **First Aid.** A good, comprehensive First Aid kit is essential. Know what it contains and how to use it.

Other Items

Not covered by the Government Notice are various other items which are required (by CASA and the RYA) and which it is common sense to have. They include:

a. Binoculars - for positive identification of land marks etc.

b. Boarding Ladder - the metal fold-down type at the stern can be dangerous in a swell.

c. Bosun's Chair - to get to the masthead (use two halyards).

d. Emergency Tiller - if not normally steered by a tiller, an emergency tiller is to be available should the other means of steering become unserviceable. This is also a legal requirement which appears in the Regulations, Annexure A, Rule 1, item 2.

e. Fire Blanket and fire hose (a bilge pump whose inlet pipe can reach overboard into the water, and whose outlet pipe has a garden hose type end fitting).

f. Flare Pistol - a supplement to normal flares carried.

g. Gas Detector - to warn of gas accumulating in the bilge. Make sure the sensor unit in the bilge is kept dry (impossible?) and the whole equipment is in working order. Better still, save money and smell for gas regularly.

h. Hand Holds - especially valuable below decks crossing the saloon or in the galley, they reduce the risk of falling and injuries.

I. Lifelines - a CASA and RYA (and very logical) requirement.

j. Plugs set - cone shaped plugs made from wood or firm rubber which can be used to seal a hole created by a broken seacock or any other unwanted aperture in a hull.

k. Pulpit, Pushpit, Stanchions and Safety Line - these serve to keep the crew from falling overboard (as well as having other functions) and should therefore be very strong, securely fixed AND TALL ENOUGH to keep people on board, not act as a line to trip crew.

l. Shapes - in addition to the two black ball shapes mentioned in Annexure B, a sailing vessel while proceeding by day with with sails up and using her engines, is to display an inverted black cone shape of the same proportional size as the ball shapes.

m. Ship's Knife - kept sharp and in its own set place.

n. Spares - for the engine(s) and any other repair.

o. Tools - for every type of repair or adjustment that may be necessary and useable when under way. A test meter for electric circuits, and a hydrometer to test the state of the the batteries should be included.

Safe and Unsafe Practices

The lists of safe and unsafe practices which follows are a tip of the iceberg, and one can add to them all the time. They are nevertheless some general guidelines.

Safe Practices

1. Wear harnesses whenever:
   a. It is dark.
   b. The wind is strong enough to warrant reefing.
   c. There is fog.
   d. Whenever one would feel safer wearing a harness, whether the skipper has ordered them to be worn or not.

2. While sailing and the yacht is heeling to the leeward side movement fore or aft along the vessel should be on the windward side only - if one falls, one is likely to fall onto the coach house roof, whereas if one falls from the leeward side, the chances are one will fall into the water.

3. While moving fore or aft on the deck of a heeling yacht, keep the body weight low and keep one hand firmly gripped to a strong hand hold at all times, walking the hands along.

4. Keep lockers closed or locked so that they cannot come open and spill their contents - this usually happens

at the most inconvenient time.

5. Keep a regular 'all round' watch for approaching danger from any possible direction.

6. Keep a regular watch on the weather and the barometer.

7. Turn gas off at the cylinder when it is not required to be on.

8. Save battery power by turning lights and other battery powered items off when they are not in use.

9. Return items used to their normal stowage place when they are no longer needed.

10. Smell for gas in the bilge regularly.

11. Reef when you first start to think it may become necessary - reef earlier rather than later

12. Keep everything on board, personal and ship's, tidy at all times - an untidy ship becomes a dangerous ship!

Unsafe Practices

1. Males should not urinate over the stern of a vessel under sail. Statistics show that a very high percentage of yachtsmen lost overboard or who fall overboard, do so while urinating from the stern. If the heads cannot be used then males should rather move for'ard on the windward side to the mast, cross to the leeward shrouds where they can have one or both arms around the shrouds and be firmly supported.

2. Procrastination with repair tasks normally leads to other 'things' going wrong, and soon a whole series of problems can result.

3. Glass bottles, drinking glasses and anything glass left loose when under way can and probably will fall and leave splinters of broken glass to add to other problems. If glasses are preferred for drinking, restrict their use to calm, flat sea conditions when there is no rolling, when inshore, at moorings, or when docked.

4. The use of matches to ignite the gas stove can be dangerous as some match sticks do break when struck and the burning end falls free. If it falls in the wrong place while still flaring having been struck, a fire or explosion can result.

5. A kettle of water left on a stove to boil, if placed so that the spout faces to one of the moving vessel's sides, could, especially if nearly full, result in boiling water being spat from the spout. This could give rise to severe burns. Place the spout pointing ahead or astern.

6. When pouring boiling water or any very hot liquid in the galley, it is natural to hold on to the yacht with one hand while pouring the liquid into a mug or equivalent on the galley table using the other hand. In any but flat seas this will invariably end in spillage and there is a risk of the person doing the pouring getting severely burnt. Rather wedge one's self firmly so that two hands can be used without falling, then hold the mug in one hand and pour using the other - there is far more control.

7. Standing on the leeward side of a heeling vessel speeding along under sail, even on a flat sea, can be exhilarating as the water rushes by so close at one's feet - a sense of security is imagined and the thought of holding on tight and getting to the windward side disappears. Man-overboard is a natural result.

8. Seacocks are often left open permanently. Rethink the wisdom of leaving them open when they are not required to be open. If unused for long periods, they can seize open and will not close later when an emergency occurs.

9. There are often yachts seen with numerous people on deck going for a short outing - obviously with more people than there are life jackets on board! It is illegal and madness.

10. Often a navigator, expecting to see something on land to help the navigation, will accept an object to be what he or she wants it to be rather than either positively identifying it or alternatively disregarding it. A typical example is wrong identification of a lighthouse - when looking for a light 'Fl(3) 15s' and seeing one whose

characteristics are similar yet different but assuming the latter to be the former and then using it to fix the vessel's position. This happens often.

11. Even when not totally familiar with an area of the coast, the recent newcomer does not refer to the chart for the area the vessel is in. Reefs, blinders, foul ground and numerous hazards can end a pleasant day's outing in disaster. Do not assume that because no hazard can be seen, it is safe to proceed.

12. Cleating two or more lines on one cleat is unwise. In an emergency where one line is required to be released quickly, Murphy's Law of the Sea is that the line to be released will be at the bottom and by releasing the top line, something else unpleasant will happen.

These lists can be added to as time goes on, but it is hoped that in doing so, it is not as a result of lessons learned 'the hard way'.

Safety With Dinghies

Dinghies (tenders) are very often misused by overloading and by the lack of having the right equipment on board. During your practical training, get someone to show you the proper way to row using oars - which SHOULD be carried at all times in case the outboard engine fails. The rowlocks/crutches for the oars should be tied on so they cannot fall overboard. Also to be carried on board are:

i. A bailer and a sponge.
ii. By day, if the weather necessitates it, a lifejacket per person (I suggest you always have them on board).
iii. At night lifejackets must be worn by each person, and there must be a torch.

Do not allow a dinghy to be overloaded - at night and in rough weather, take less load than in calm conditions/by day. Distribute the load for the best trim.

An outboard engine must be attached to the dinghy with a strong line/lanyard, and the user must be competent to use it and to carry out basic fault finding/simple maintenance.

APPENDIX A

GOVERNMENT NOTICE 10042 OF DECEMBER 1985; ANNEXURE A

ANNEXURE A

DESIGN AND CONSTRUCTION AND POWER AND OTHER INSTALLATIONS AND APPLIANCES

Rule 1

The construction requirements stipulated in column (2) of the table hereunder are applicable to the various categories of vessels set out in column (1):

Column 1	Column 2
Category of vessel	Construction requirements
AI (1), AI (2), AII (1) and AII (2) of 5 metres or more in length	1. (a) Shall be fitted with an inboard engine or more than one outboard engine capable of driving the vessel at a speed of at least 5 knots in smooth water; provided that in the case of a sailing vessel only one outboard engine is required.
	(b) Shall be fitted with an electrical system consisting of two identical banks of batteries, one of which shall be sufficient to supply all the electrical power needs of the vessel provided that in the case of a vessel which is fitted with a hand-starter, only one bank of batteries may be installed.
AII (1) and AII (2)	2. Emergency means of steering shall be provided if any vessel is steered otherwise than by a tiller.
AI (1), AII (1) and AII (2), of 9 metres or more in length, except vessels which proceed to sea from the beach and through the surf	3. (a) Shall be fitted with efficient guard rails or the equivalent thereof, round the perimenter of the deck, to a height of at least 600 millimetres above the deck in the case of vessels 9 metres and more in length, and to a height of at least 450 millimetres above the deck in the case of vessels less than 9 metres in length: Provided that if lifelines are used, the space between them shall not exceed 300 millimetres. (b) Shall be fitted with an efficient towing bollard with fairlead at or near the bows and at or near the stern, respectively.
AI (1) and AI (2)	4. (a) Shall be fitted with an efficient towing bollard or eye plate at or near the bow and stern, respectively. (b) Shall have alternate steering when remote control is fitted.
AI (1), AI (2) and AI (3)	5. Shall be provided with a means for the fitting of a grab-line around the gunwale or a capsize rope; provided that this requirement is not applicable to vessels carrying one or more inflatable liferaft.
AI (1), AI (2) and AI (3) of more than 5 metres but not more than 9 metres in length except vessels which are self-draining	6. Shall be fitted with hand operated diaphragm type pump together with suitable hoses.
AI (1), AI (2) and AI (3) of more than 9 metres in length	7. Shall be fitted with a power-driven bilge pump having a rating of at least 3 000 litres per hour, together with suitable pipe lines.
AII (1) and AII (2) of more than 9 metres in length	8. Shall be fitted with at least two bilge pumps, one being internally operated.

Rule 2

Limitations with regard to the capacity of outboard engines

The weight and capacity of outboard engines of a vessel shall be commensurate with the size of the vessel and its intended use.

/Rule 3....

Rule 3

Servicing and maintenance of machinery

The propulsion machinery of a vessel shall be periodically serviced and maintained to ensure effective functioning thereof at all times. The period between servicings shall not exceed the period recommended by the manufacturers of the machinery. The servicings, maintenance and repairs shall be performed by competent persons.

Rule 4

Installation of inboard petrol engines

Any inboard petrol engine installation shall comply with the following requirements:

(a) The engine is to be installed in a compartment which is completely watertight and vapourtight;

(b) a manuel bilge pump is to be installed in the engine compartment;

(c) fuel shut-off valves are to be fitted to the outlets of fuel tanks;

(d) batteries are to be installed in a watertight compartment which is completely isolated from the engine compartment;

(e) fuel tanks are to be installed completely away from the engine compartment;

(f) a marinised carburettor with flash arrester is to be installed;

(g) a sparkless alternator with starter is to be installed;

(h) an extractor fan which is flameproof and set to operate for at least 30 seconds before the engine starts, is to be installed in the engine compartment;

(i) a remote-controlled fire extinguishing system is to be installed for the engine compartment; and

(j) an auxiliary outboard engine is to be installed in the case of AI vessels having a single inboard petrol engine.

Rule 5

Buoyancy of inflatable vessels

An inflatable vessel, other than a tender, shall not have less than three separate buoyancy chambers and have the capacity to stay afloat, even when two thirds of the chambers are deflated.

Rule 6

Charging of batteries

Suitable battery charging appliances are to be installed on board if handstarting is not possible, provided that this rule shall apply to vessels of categories AI (1) and AI (2) only.

Rule 7

Tool kits

Each vessel is to carry a tool kit appropriate for the machinery and other equipment aboard.

APPENDIX B

GOVERNMENT NOTICE 10042 OF DECEMBER 1985; ANNEXURE B

ANNEXURE B

SAFETY APPLIANCES AND EQUIPMENT RULES

Rule 1

Vessel of category AI (1), AI (2), AI (3), AII (1) or AII (2) which is not constructed or fitted in accordance with regulation 12 (2), shall have on board an inflatable lifecraft capable of carrying all the occupants of the vessel. Provided that vessels of category AII (1) and category AII (2) which are used in local waters, are exempted from this requirement.

Rule 2

The following items of safety appliances and equipment are prescribed as a minimum, for each vessel of the various categories of vessels, to be available aboard in good working condition:

Item No.	Description of safety appliances and equipment units	Category											
		AI (1)		AI (2)		AI (3)		AI (4)	AII (1) and AII (2)		AII (3)	AIII (1)	AIII (2)
		Less than 9 metres in length	9 metres or more in length	Less than 5 metres in length	5 metres or more in length	Less than 5 metres in length	5 metres or more in length		Operating in local waters	Operating in coastal or ocean waters	Operating during day-light hours	Operating during day-light hours	Operating during day-light hours
(1)	Suitable lifejacket for each person on board	×	×	×	×	×	×	×	×	×		×	
(2)	Suitable buoyancy aid for each person on board										×		×
(3) (a)	Lifebuoy with self-igniting light and whistle attached to a Dan Buoy		×							×			
(3) (b)	Lifebuoy with whistle								×				
(4)	One safety harness for each crew member............................									×			
(5)	Two safety harnesses per vessel								×				

Item No.	Description of safety appliances and equipment units	Category											
		AI (1)		AI (2)		AI (3)		AI (4)	AII (1) and AII (2)		AII (3)	AIII (1)	AIII (2)
		Less than 9 metres in length	9 metres or more in length	Less than 5 metres in length	5 metres or more in length	Less than 5 metres in length	5 metres or more in length		Operating in local waters	Operating in coastal or ocean waters	Operating during daylight hours	Operating during daylight hours	Operating during daylight hours
(6)	One projectile hand flare set......										×	×	×
(7)	Six hand-held red distress flares	×	×	×	×	×	×	×	×	×			
(8)	Six red rocket parachute flares ...		×							×			
(9)	Two red rocket parachute flares	×			×		×	×	×				
(10)	One hand-held orange smoke marker............................			×		×			× or	× or	×	×	×
(11)	Two 4-minute buoyant orange smoke markers	×	×		×		×	×	×	×			
(12)	One waterproof signalling torch with a full set of spare batteries and a spare bulb	×	×	×	×		×	×	×	×			
(13)	One signalling mirror.............	×	×	×	×	×	×	×	×	×	×	×	×
(14)	One sound signalling device or alternative means of producing an audible sound......................	×	×	×	×	×	×	×	×	×		×	
(15)	Distress signalling flags:												
	(a) "N" + "C"	× or	×						×	×			
	(b) "V"	×	×	×	×	×	×	×		×			
	(c) "W".......................		×							×			
(16)	Two black balls or shapes of at least 400 milimetres in diameter		×						×	×			
(17)	Radar reflector.....................	×	×				×		×	×			
(18)	SSB radiotelephone with a minimum range determined by calculation of 100 nautical miles, capable of transmission and reception on 2 182 kHz and on at least two working frequencies (one being intership) in the appropriate bands between 1 606,5 and 2 850kHz and complying with the provisions of Appendix 17 of the Radio Regulations (Geneva 1982)...............................									× or			

Item No.	Description of safety appliances and equipment units	Category											
		AI (1)		AI (2)		AI (3)		AI (4)	AII (1) and AII (2)		AII (3)	AIII (1)	AIII (2)
		Less than 9 metres in length	9 metres or more in length	Less than 5 metres in length	5 metres or more in length	Less than 5 metres in length	5 metres or more in length		Operating in local waters	Operating in coastal or ocean waters	Operating during day-light hours	Operating during day-light hours	Operating during day-light hours
(19)	VHF radiotelephone with a rated output of not more than 25 watts, suitable for the area in which it is used and capable of operation on at least channels 6, 12 and 16 and one ship-to-shore channel in the VHF maritime band and complying with the provisions of Appendix 19 of the Radio Regulations (Geneva 1982)......................		×						× or	×			
(20)	Radio transreceiver with a rated output of not more than 5 watts, suitable for the area in which it is used and capable of operation on at least channels 19 and 6 (A and B) in the 29 mHz land mobile band and complying with the provisions of the Postmaster-General for equipment operating in this band................................	×		×	×	×	×	×	×				
(21)	Radio direction-finding apparatus		×							×			
(22)	Echo sounder or lead line		×							×			
(23)	Patent log or distance measuring instrument..........................		×							×			
(24)	Suitable magnetic compass with table of residual deviations	×	×						×	×			
(25)	Hand-bearing compass if the main compass is of such a type that it cannot be used for taking bearings	×	×	×	×	×	×	×	×	×		×	
(26)	Navigation charts appropriate to the voyage or operations	×	×		×				×	×			
(27)	Hydrographic publications appropriate to the voyage or operations: (a) Tide tables									×			
	(b) List of lights	×	×						×	×			
	(c) Sailing directions.........									×			
(28)	Full set of sails including the appropriate storm sails								×	×			

Item No.	Description of safety appliances and equipment units	Category												
		AI (1)		AI (2)		AI (3)		AI (4)	AII (1) and AII (2)		AII (3)	AIII (1)	AIII (2)	
		Less than 9 metres in length	9 metres or more in length	Less than 5 metres in length	5 metres or more in length	Less than 5 metres in length	5 metres or more in length		Operating in local waters	Operating in coastal or ocean waters	Operating during daylight hours	Operating during daylight hours	Operating during daylight hours	
(29)	A suitable means for cutting standing rigging								×	×				
(30)	One fire extinguisher of at least 1.5 kilogram dry powder, or the one kilogram "BCF" equivalent thereof, which has been duly serviced not longer than one year ago			×		×	×		× (See note 2)			×		
(31)	Two fire extinguishers as described for item (30)	×	×		×			×		×				
(32) (a)	Metal bucket, capacity 9 litres, with lanyard	×	×	×	×	×	×		×	×				
(b)	Other bailing device							×						
(33)	Bailer, capacity 2 litres unless vessel is selfdraining										×	×		
(34)	Manually operated bilge pump of the diaphragm type (See note 3)	×	×	×	×				×	×				
(35)	Two paddles or oars			×		×		×			×	×		
(36)	Grab-line becketted to outside of gunwale for at least 70% of the length of the side of the vessel or capsize ropes provided that a vessel which carries an inflatable liferaft, is exempted from this item			×	×	×	×	×				×		
(37)	Buoyant heaving line of at least 5 metres in length and 10 millimetres in diameter, attached to a buoyant rescue quoit								×	×				
(38)	Boat hook, at least 1 800 millimetres in length		×		×		×		×	×				
(39)	Suitable sea anchor or drogue, complete with hawser and tripping line	×	×	×	×	×	×	×						
(40)	Suitable steel anchor and chain with at least 50 metres of synthetic rope of adequate strength			×		×			×		×	×	× (If practicable)	

Item No.	Description of safety appliances and equipment units	Category											
		AI (1)		AI (2)		AI (3)		AI (4)	AII (1) and AII (2)		AII (3)	AIII (1)	AIII (2)
		Less than 9 metres in length	9 metres or more in length	Less than 5 metres in length	5 metres or more in length	Less than 5 metres in length	5 metres or more in length		Operating in local waters	Operating in coastal or ocean waters	Operating during day-light hours	Operating during day-light hours	Operating during day-light hours
(41)	Suitable steel anchor and chain with at least 100 metres of synthetic rope of adequate strength	×	×		×		×	×		×			
(42)	Spare anchor with chain and rope of appropriate size and strength	×	×							×			
(43)	Capsize kit, including rope and bottle, containing at least flares, identification sheet, torch, survival blanket for each person aboard, a knife and emergency rations	×		×	×	×	×	×					
(44)	Emergency rations, plus 1 litre of drinking water for each person aboard		×										
(45)	Suitable air bellows for inflatable vessel							×					
(46)	First aid outfit	×	×	×	×	×	×	×	×	×	×	×	

Notes:

1. In the above table the following expressions have the meanings as indicated:
   (a) "Local Waters"—that area of the sea where a vessel may be navigated during hours of daylight but at no time being more than 30 nautical miles from the low-water mark.
   (b) "Coastal Waters"—that area of the sea along the South African, Ciskeian, Transkeian and South West African coast line extending not further than 50 nautical miles from the low-water mark.
   (c) "Ocean Waters"—that area of the sea beyond the coastal waters.
2. Provided that a vessel of 9 metres or more in length shall carry two fire extinguishers.
3. Provided that this item shall not apply in the case of totally self-draining vessels.

Rule 3

Security and accessibility of equipment

(a) All safety appliances and equipment shall be so stowed, secured, packed or installed, whichever is the case, as to be at all times readily accessible by all persons on board. Storage spaces shall not be locked at any time whilst the vessel is being used. All equipment shall be stored, secured, packed or installed in such a way as to ensure its safe carriage in any state of weather.

(b) Pyrotechnics on board of a vessel of category AI shall be stored in a waterproof container which is clearly marked to indicate the number and type of each pyrotechnic.

(c) Any portable radio equipment on board of a vessel of category AI shall be stored in such a way that it is protected from the elements.

(d) Any first-aid kit shall be packed in a waterproof container clearly marked with a red cross on a white background and with the words "First Aid/Noodhulp". A list of the contents thereof and instructions for the use shall be affixed to the inside of the lid of the container.

Rule 4

Marking of equipment

All items of the safety appliances and equipment shall be indelibly and permanently marked with the name of the vessel or its identification number.

Where applicable the trailer used to carry the vessel shall be similarly marked and shall also reflect the owner's name and telephone number.

Rule 5

The skipper of any vessel shall inspect the safety appliances and equipment regularly and ensure that it is in good working condition at all times.

NOTES

CHAPTER 6

ROPEWORK

Introduction

If we did not have ropes, we would not be able to sail. There are different types of ropes for all the various applications, and names given to each according to its function, so only the 'bell rope' and a sail's boltrope have the name 'rope' - others are sheets, halyards, topping lifts, etc. So the general term for rope becomes 'warp', and when a warp is taken for allocation to a specific task, albeit temporary, it becomes known as a line, e.g. a heaving line, a towing line, etc. (The US Navy refer to rope meaning wire rope, and line as fibre rope.)

No rope, warp, or line can be of any use unless it can be joined to something. So we have a variety of knots and splices to learn. But first let's look at the types and parts of ropes.

ROPES

A rope which is not attached to anything, has two loose ends, called **'bitter ends'**, or if there is one loose end it is called the **'bitter end'**. The rope between the ends is the **'standing part'**, and if a loop is made in the line it is called a **'bight'**.

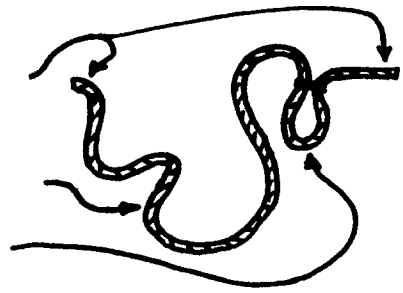


Fig. 274.

We are concerned with **braided** (plaited) rope and **3-strand** (twisted, 'laid up') rope, the latter normally being nylon.

Braid **3 Strand**

Fig. 275.

Nylon. Nylon is very strong and has considerable elasticity - it will stretch under load and regain its length when the load is removed. It is therefore suitable for mooring lines, anchor lines, and towing lines as the stretch/shrink properties act as a spring to remove the jerks that would otherwise be present when the line pulls tight. It chafes, and the sun's ultra-violet rays cause it to harden. Modern American and British nylon ropes are less prone to this problem (See polyester three strand and multi-plait). It is normally either 3-strand or 'multi-plait'.

Multi-plait

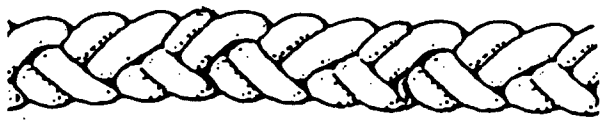


Fig. 276.

Polyester. The braided form of this rope has very little stretch, and it is therefore used for halyards and sheets, and general running rigging. The three strand and multi-plait forms of this rope are invariably "non pre-stretched" and they then behave as nylon with the advantage that they do not harden with age and exposure to the sun and heat. This form of polyester has about 80% of nylon's strength.

Kevlar. This is a no-stretch equivalent of the polyester rope, being regarded as having the same strength as wire rope.

Polypropylene. This is commonly found used as the tow rope for water skiers when towed by speed boats, and it has a plastic appearance. It floats and is therefore useful as a heaving line and line to be used in 'man-overboard' recovery situations. It is made as a form of loose braid, and one can almost see through the line between the adjacent strands.

Whippings

To prevent the bitter ends of a rope from splaying open, becoming an untidy mess, and having to be cut back from time to time, a wax impregnated whipping twine is used to 'bind' ('whip') the ends (string can be used as a temporary measure). There are two main methods of whipping a line that we are concerned with; they are the **Common Whipping** and the **Sailmaker's Whipping**. The latter is also known as the **Needle and Palm Whipping**.

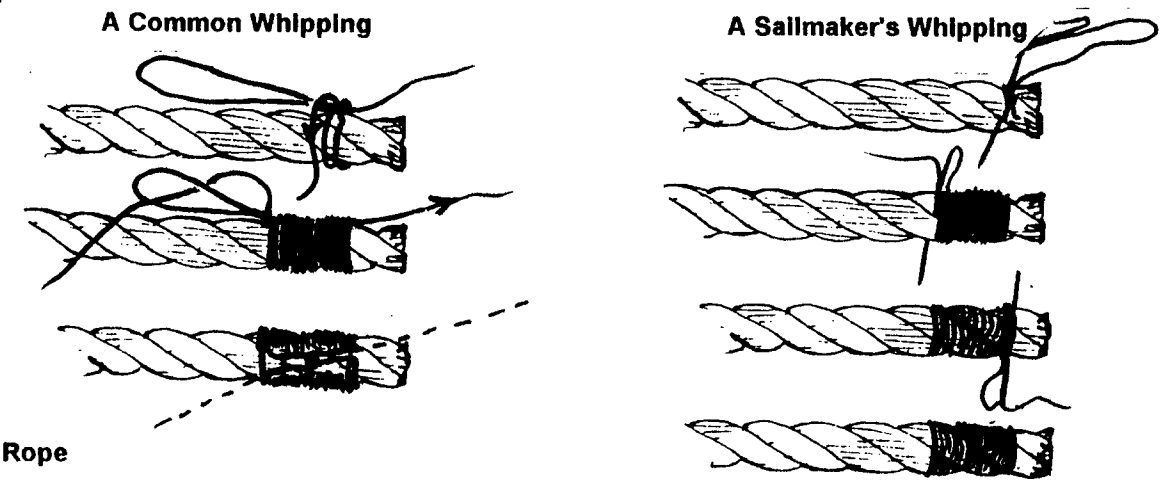


Fig. 277.

Handling Rope

Coiling Rope. Braided rope has no particular bias to its make up, and can, therefore, be coiled and handled with ease. However, if we coil braided rope without thought to twisting, it will become a tangled mess. If twisted to coil as a flat coil as is done with 3-strand ropes, the twists will stay in the line which will develop kinks and these will snag. It is therefore better to coil braided rope as a series of figure eights.

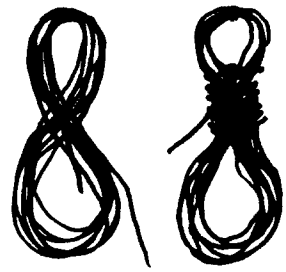


Fig. 278.

3-Stranded rope on the other hand is made up from strands whose fibres are laid up twisted, anticlockwise or in a left hand direction; the strands are then wound together (laid up) in a clockwise or right hand direction to make the rope we see. It therefore needs a little more care when being handled, especially when being coiled. Coiling is done by twisting successive loops to be added to the coil so that each is in a plane parallel to the rest of the coil.

Fig. 279.

If the coil has been formed for the purpose of stowing the rope which is no longer required, a length of about two loops from the end is used for lashing the coil:

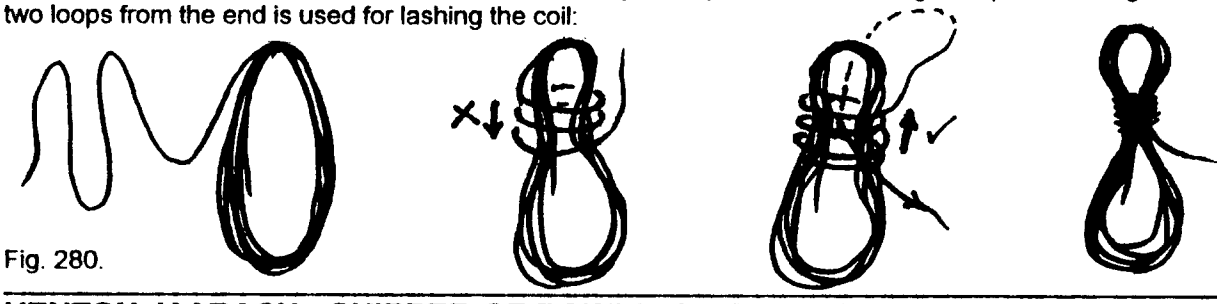


Fig. 280.

Stowing a Coil. A coil of rope which may be used while under way is left ready as a simple coil. If it is the surplus part of a halyard which is cleated, the coil is attached to the cleat by hanging a twisted loop, formed by the short length from the cleat to the coil, over the top prong of the cleat.

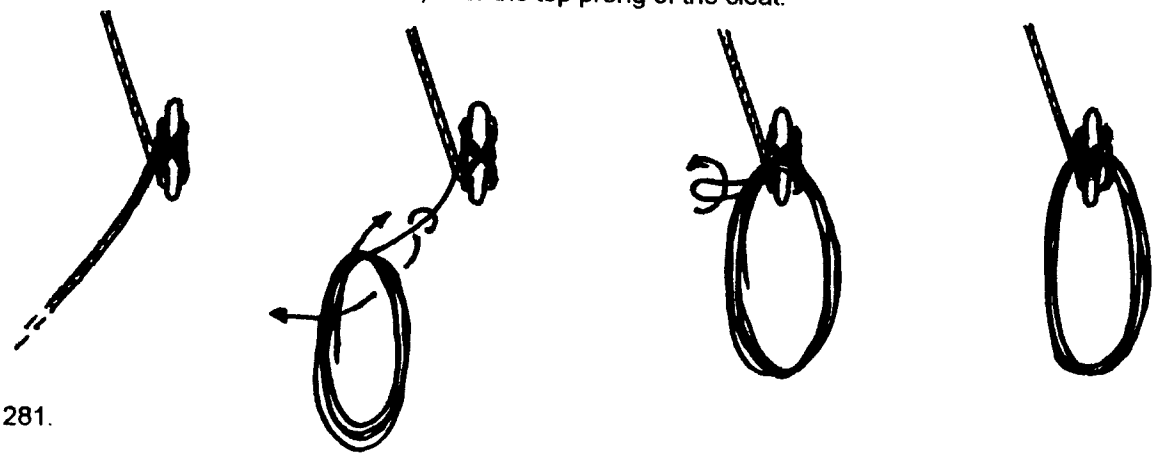


Fig. 281.

Heaving a Line. When it is necessary to 'heave a line', the rope is coiled in loops (not figure eight) in the same manner but it is arranged in two sections of the coil, one in each hand. The throwing hand holds the weighted end with about two thirds of the coiled rope, and the other hand the balance. The end to be thrown is weighted, normally with a knot called a monkey's fist, or a floating rubber quoit, and the other end is secured so that the whole line does not disappear when the line is 'heaved'. When heaving the line, stand with the feet apart and with an imaginary line extending through the ankles, off to the side opposite your throwing hand as it 'aims' at your 'target' - your shoulders should also be in line with the target off at your side. Then a fast swivel action in an arc, like a discus thrower, gets the coil with the monkey's fist going - the fist carrying the end the furthest. As it does so, the coiled line in the other hand is allowed to 'pay out' by pointing the open hand in the direction the line was thrown. See Figure 107 on page 25.

Cleating a Line. A line which is to be kept under tension from one end, is usually cleated before the surplus is hung on the cleat. The cleating starts by taking the tensioned line around the far side of the cleat first, winding once around the cleat a full 360°, then doing a 'figure of 8', then one more 360° around, tucking this last loop in behind the other windings, between these windings and the mast.

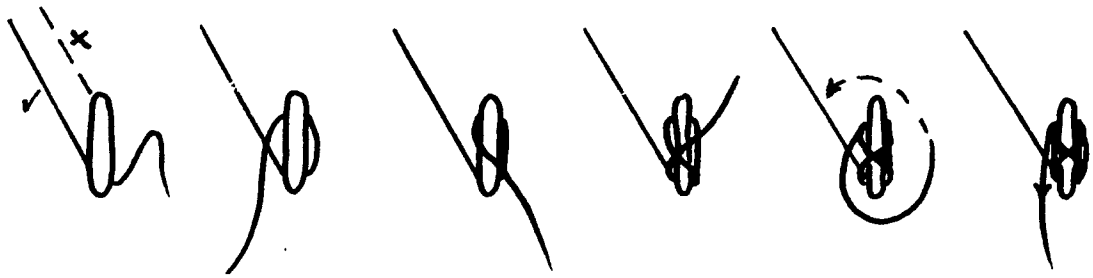


Fig. 282.

KNOTS

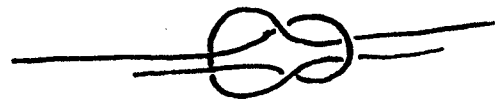
(I recommend you get the *'Colour Book of Knots'* if you want to do more ropework - it shows individual strands in different colours making each knot, splice and fancy ropework very easy to follow. There is also Ashley's Book of Knots showing some 3 800 things that can be done with rope.)

The Figure of 8.

This is a stop knot for use near (not at the end of a sheet, etc. If the line slips and runs out, the knot will stop it running out through a block or hole; the crew will be able to hold the tail and pull the line back into position.

Fig. 283.

A Reef Knot

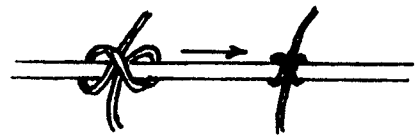


It is used to join the two ends of a piece of rope or two pieces of the same kind and size of rope. If it pulls very tight, it can become impossible to untie, making it necessary to cut. (It is not used in this form on a yacht.) Fig. 284.

A Slipped Reef Knot

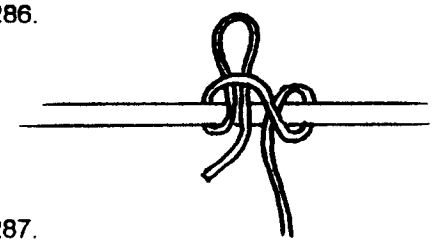
The reef knot, with a bow in one strand, similar to tying a shoe lace. When it is to be undone, this bow's strand can be pulled out. Folded mainsails are tied to a boom with this knot. Fig. 285.

A Clove Hitch



A temporary tie where the pull on the line is to be at about 90° to the pole, beam, etc, to which it is tied. It can come loose on its own. Fig. 286.

A Slipped Clove Hitch



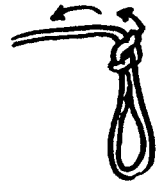
A loop or bow is made with one strand in a clove hitch so that it can be collapsed easily/quickly. Fig. 287.

A Round Turn and Two Half Hitches

Unlike the clove hitch, this knot is as permanent as any can be - it will not come undone unless it is deliberately untied. Note that the two half hitches both turn in the same direction to form a clove hitch. It is used for the dock end of mooring lines, to hold fenders in place, and where ever the tie is for more than a very temporary knot. Fig. 288.

A Bowline

The bowline forms a loop in the end of a line. It can be tied any one of several methods as long as the end result is correct. Check it: holding the standing part leading towards the far end pointing upwards and called 'the neck', we then see a 'collar' around the neck, and below the collar, a 'belt', and below the belt, two 'legs'. The short leg, the bitter end, should be inside the circle/loop of the bowline. If one wishes to, one can add to the security of the knot by tying the short leg into a half hitch around the long leg. Fig. 289.

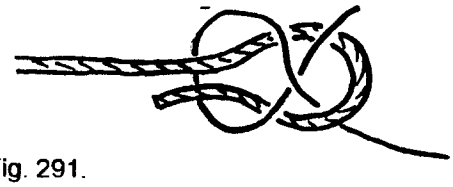


The loop/bowline is secure and will not come undone no matter how hard it has been pulled. It will, never-the-less, be easy to undo by bending the 'neck' forward and sliding the collar forward - the knot will then collapse. Fig. 290.

Other Knots. In addition to the knots required by the syllabus are the following knots which are very useful (although one can make do with just the Bowline and the Round Turn and Two Half Hitches).

The Sheet Bend. For joining two lines of differing diameters and/or textures.

The Single Sheet Bend



The Double Sheet Bend

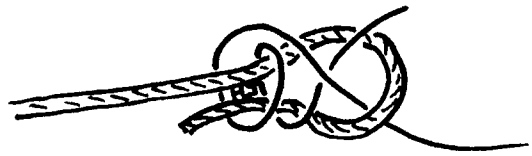


Fig. 291.

The Fisherman's Bend

For tying a line to an anchor shackle or to a shackle at the end of an anchor chain. It looks like the Round Turn and Two Half Hitches but differs in that the first half hitch passes under the 'round turn'.

Fig. 292.

The Rolling Hitch

This knot allows one to pull another rope or wire which is under tension, 'in-line' with the pulling rope, and with no slip. I also use it to hold the Ensign on the backstay! The knot consists of a clove hitch with an extra turn on the side the pull is to be applied.

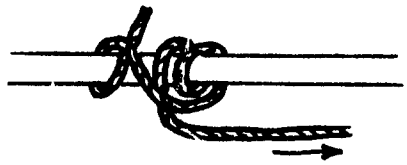


Fig. 293.

Splicing

(Splicing of braid/plait is a job for a specialist using special tools - we will stick to 3-strand rope splicing as per the syllabus.)

The Eye Splice. An eye splice forms a loop in the end of a line, which can be reinforced by the inclusion of a thimble - a metal lining. The start sequence is very important - make sure every strand's tuck is always in the direction from bottom right towards top left i.e. almost at 90° to the strands of the standing part under which they tuck.

Tuck 1 - centre strand tucks at the top of the circumference of the standing part.

Tuck 2 - left strand passes left of the first tuck by the centre strand crosses over the strand on the standing part where the first / centre strand tuck took place, then tucks under the next strand of the standing part. (The right strand is not only to the right, it is folded under the standing part.)

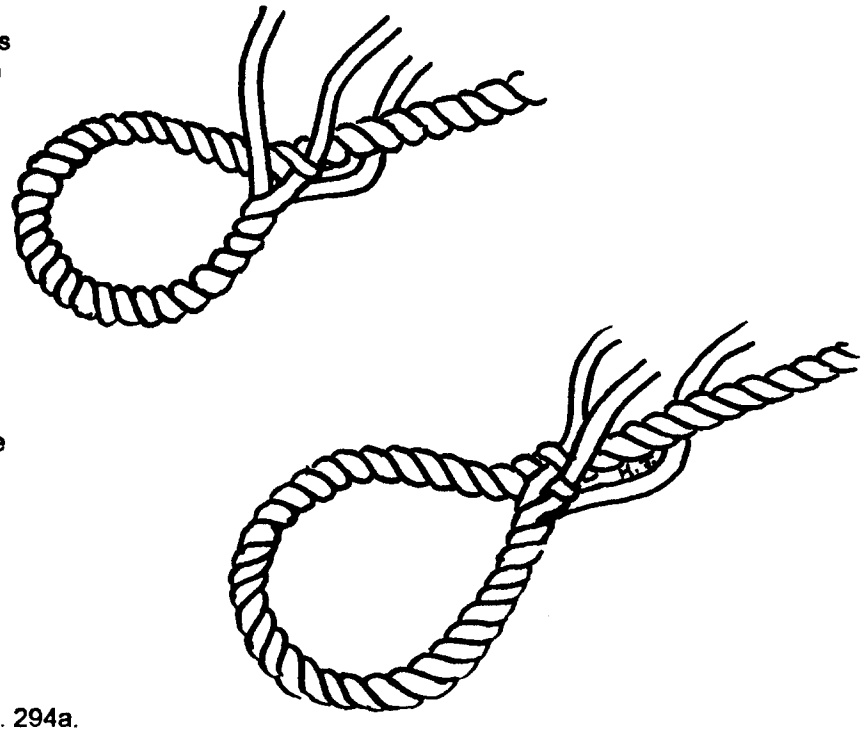


Fig. 294a.

Tuck 3 - turn the whole rope/splice over, 180°. The strand that was on the right and under is now on the left - it is the only strand not yet tucked, and there is only one strand in the standing part which does not yet have a tuck under it. Find it, then tuck this third strand under it, remembering to tuck from bottom right towards top left.

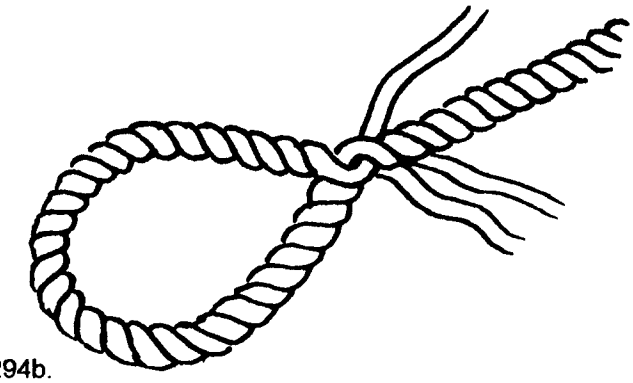


Fig. 294b.

All other tucks are now in the same direction, one strand at a time, and the strands being tucked must not cross each other. They go over one (strand of the standing part), under one, over one, under one, etc, until each strand has tucked at least three times in the case of natural fibre rope (e.g. sisal) and five times in the case of synthetic ropes.

A Back Splice. This forms a splice at the end of a rope in lieu of a figure 8 knot which is temporary. The fatter spliced end stops the line from coming out of a block. It is formed by splicing as we did for the eye splice, but it is started with a crown knot.

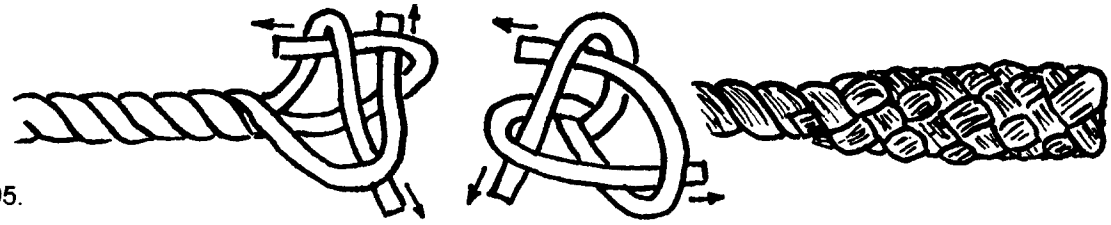


Fig. 295.

A Short Splice. This splice is used to join two ends of a rope where an increase in diameter does not matter. The tucks of each strand are made just as if one were making an eye splice.

Fig. 296.

A rope-to-wire splice is definitely for the expert professional only.

NOTES

CHAPTER 7

METEOROLOGY

Introduction

Before we go sailing, and while we are under way, we need to have an idea of what the wind speed and direction is likely to be: to be forewarned is to be forearmed. Shall we go to the boat or not? If already on the boat, is any weather change likely? What effect will it have on us? Do we need to take any precautions now? We can get forecasts from the newspapers, radio, TV, and the Met Office where the forecasts originate - but the 'on the spot' advice must come from you - you are at the scene and see the present picture, whereas the forecasters are far away in an office looking at dials, gauges, and reports from outsiders. Their forecast is based on information which, by the time you get it, is obsolete! So we must have an idea how the weather pattern works.

The Weather 'Picture'

The area of the equator is understandably hotter than those areas at the two poles. As the land is heated, the air over the heated land also warms up, and we all know warm air rises. A little further away from the equator, the land is not warmed as much as it is at the equator and the air is therefore cooler. Warming air expands and becomes less dense, and therefore lighter than cooler, more dense air. The lighter (less dense, warmed) air (A) rises at the equator and the cooler, more dense, heavier air (B) a little further away from the equator moves in towards the equator to even the differences in densities.

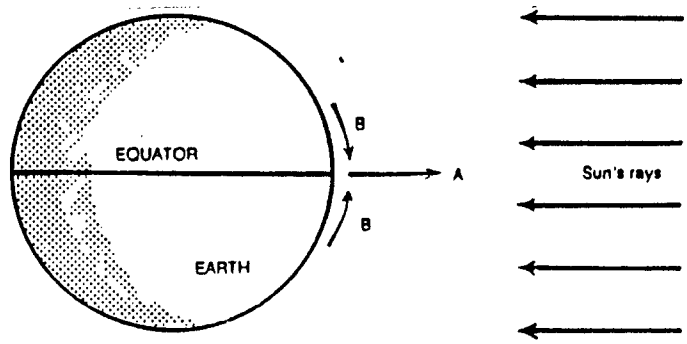


Fig. 297.

If we look at the movement of the cooler air, from the direction of the sun, we would expect to see:

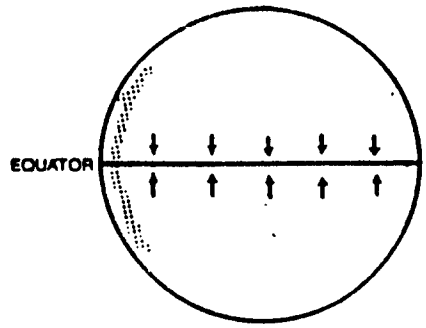


Fig. 298.

'Highs' - Winds Around

Due to the rotation of the earth and the high (atmospheric) pressure areas that exist in all oceans, this wind causes the outward blowing winds from the 'Highs' to spiral - clockwise in the Northern Hemisphere and anticlockwise in the Southern Hemisphere.

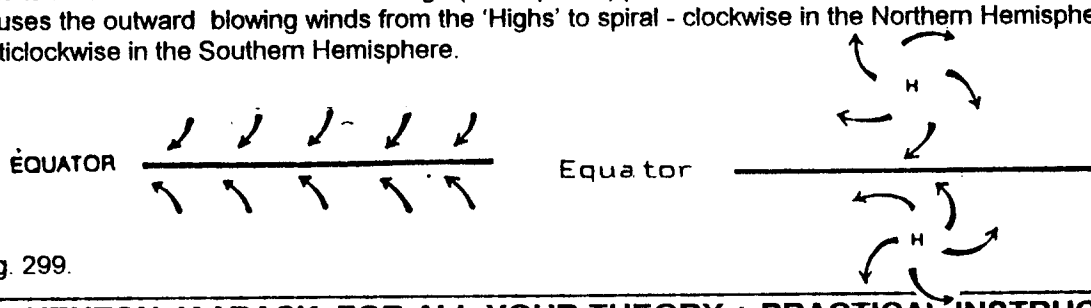


Fig. 299.

The ocean 'highs' are always present, but vary in exact pressure, size, shape and position within that hemisphere's ocean. In the southern hemisphere especially, particularly in the South Atlantic, the 'high' frequently enlarges in an east-west direction, then splits in two, with the eastern portion moving off towards the East under the influence of the westerly trades. As it does so, it has an effect on the SA coast from the Cape to Northern Natal.

If we were sailing in a yacht between say, Port Elizabeth and Mossel Bay, and we observed our ship's barometer reading rising, it can only be because a 'high' is 'ridging' around the country, moving west to east (or approximately west to east), and as it passes, we would expect a wind direction change as follows:

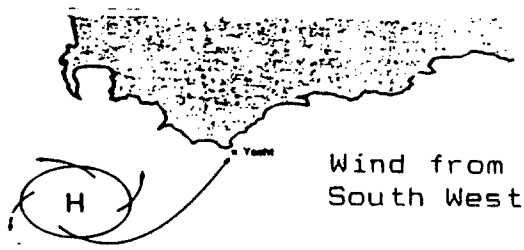


Fig. 300.

A cell of high pressure starts ridging around the coast, wind at the yacht is 'south-westerly'. (We always describe wind direction as the direction from which it comes.)

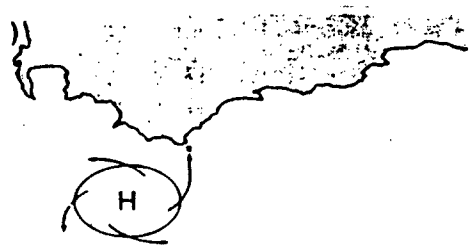


Fig. 301.

As the high gets further east, the wind direction becomes southerly - it has changed in an anti-clockwise direction from south-westerly to southerly. We say it has 'backed'. When wind directions change in a clockwise direction we say the wind has 'veered'.

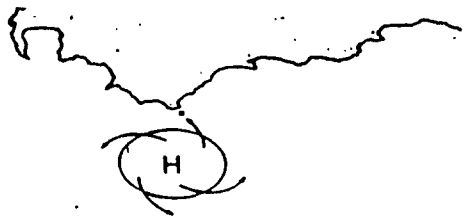


Fig. 302.

The 'high' has moved further east, wind 'backed' to south-easterly.

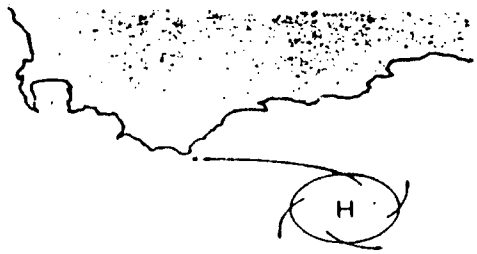


Fig. 303.

The 'high' is now even further east, wind 'backed' more to easterly. As the high has passed a position directly off-shore opposite our yacht, the atmospheric pressures seen on our barometer which were previously rising as the 'high' approached, will now drop as the 'high' gets further away to the east. As a general rule, in the southern hemisphere, a rising barometer means westerly or south-westerly winds, backing as the barometer 'tops' and becoming easterly or north-easterly as the barometer reading decreases. So a rising or falling barometer is now telling us wind direction information.

'Lows'

Areas of low atmospheric pressure occur as a result of the uneven heating of the earth's surface when some areas are shaded by cloud and others not (as well as other causes).

If we have an area of low pressure with it's lowest pressure at the centre of the 'lows' we would assume higher pressure air would blow in to the centre of the low from all adjacent areas, again like the spokes of the wheel leading to the centre.

But when we have a 'low', somewhere adjacent there will be the rotational winds around a 'high'. So the outward spiralling winds from a high are bent towards the low and spiral in towards the centre of the low in an attempt to balance their pressure differences; winds blowing into a 'low' are termed 'cyclonic':

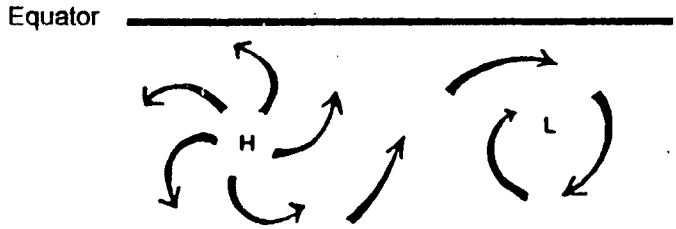


Fig. 304.

So we see that in the northern hemisphere winds around a 'low' blow anticlockwise and spiral inwards, and in the southern hemisphere blow clockwise and spiral inwards.

Unlike ocean 'highs', all other 'highs' and all the 'lows' move roughly from west to east.

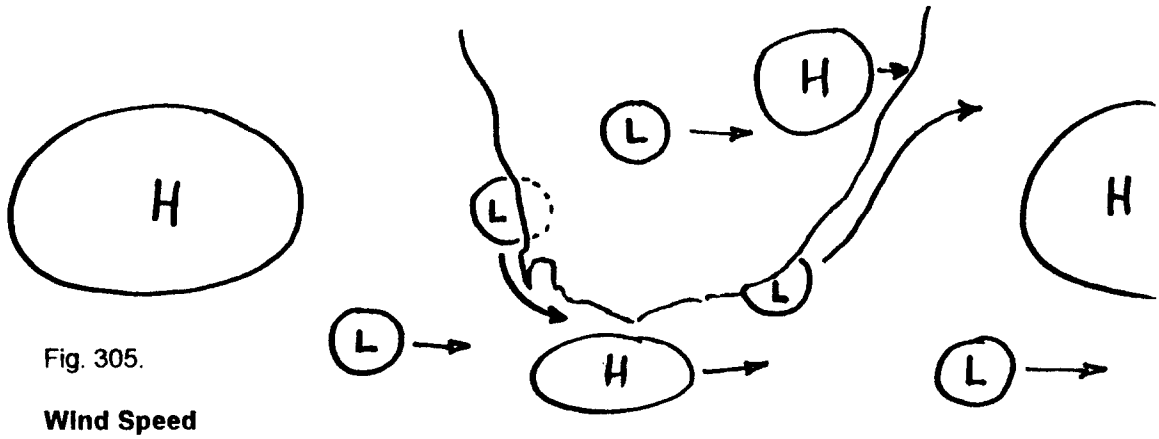


Fig. 305.

Wind Speed

A bit more about wind speed. Wind speed depends largely on the pressure differences over distance - the pressure gradient. If we have a large pressure differential over a short distance, we can expect strong winds. Conversely a small pressure differential over a long distance will herald light winds. From experience, remembering the west to east movement of pressure systems, we normally say a barometric pressure change of less than 1 mb per hour is not going to result in strong winds. A change of 1 mb per hour for 3 or more continuous hours, is likely to bring fresh winds (over 20 knots) and a change of 2 mb per hour (over 3 hours) or more is likely to bring a gale or worse. Dam/lake sailors beware: a flat calm can become a gale in seconds, especially in the afternoons. Ask the locals about the weather pattern, and watch the water for ripples/dark patches approaching.

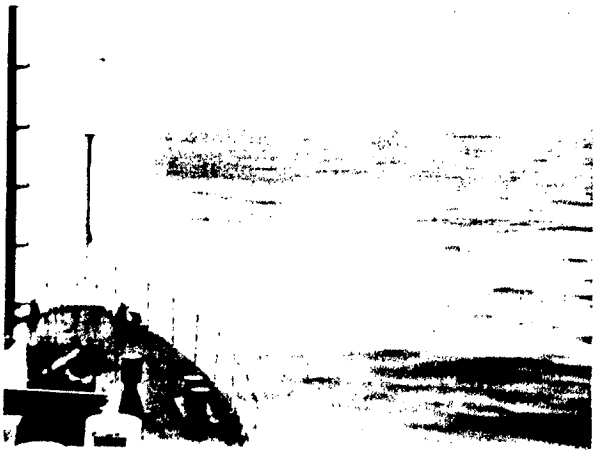
However, there is a phenomenon called the 'diurnal effect' where atmospheric pressure may increase (2

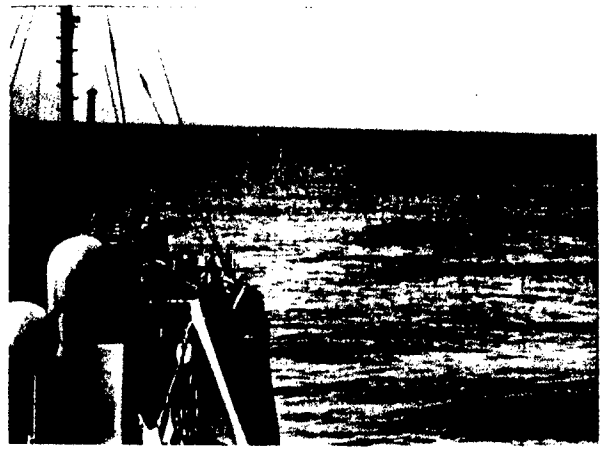
to 3 mb near the equator, and less as latitudes get higher down to about 1 mb at approximately 30°) twice daily, namely at approximately 04h00 and 16h00, and it decreases back to normal within a few hours. These diurnal pressure changes are not indications of wind strength changes. More detail on the diurnal effect can be found in *Admiralty Pilots*. Wind speeds are easiest understood in terms of knots, but the Beaufort Scale is still in fairly wide use and therefore it is important to know the scale's significance.

Beaufort Scale

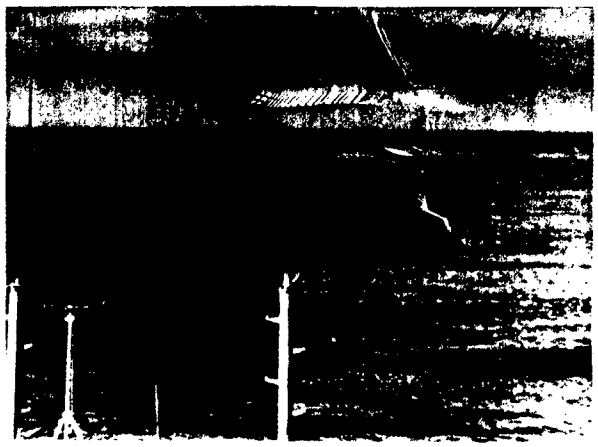
Before the advent of modern-day devices for measuring wind speed in knots, the mariner used a system of describing wind speed which was related to the effect of the wind on the sea surface. The Beaufort Scale, as it is known, is still in use and it has an advantage over describing the wind speed in knots in that it is not so precise, and overcomes argument as to whether wind speed is, for example, 8 or 9 or even 10 knots. Who knows which instrument measuring the 8, 9 or 10 knots was more correct anyway? Wave heights stated are for the open sea - near upwind land/in dams, the 'fetch' is short, waves are smaller.

	Beaufort Number (Wind Force):	**Wind Speed** (in Knots):	**Description of Sea** (sea state):
A.	0 (Calm)	Less than 1 knot	Flat smooth sea.



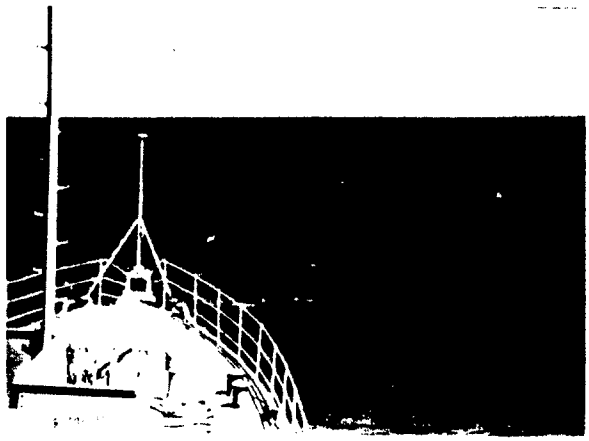


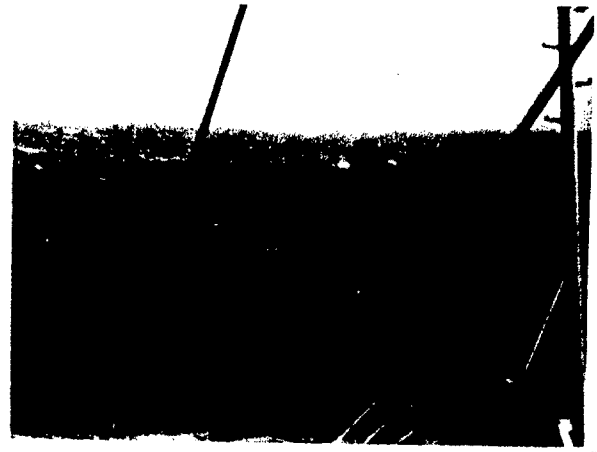
B	1 (Light airs)	1 - 3 knots	Small ripples appear
C	2 (Light Breeze)	4 - 6 knots	Small wavelets, no white crests; height 0,2 m



D	3 (Gentle Breeze)	7 - 10 knots	Large wavelets, few crests break, height up to 0,6 m

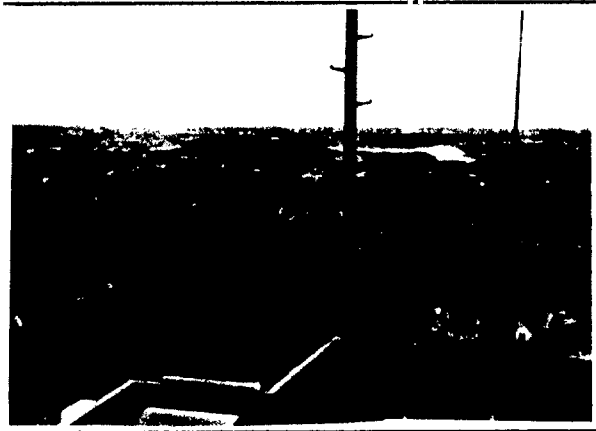
E 4 (Moderate Breeze)	11 - 16 knots	Small waves, several white wavelets, height 1 to 1,5 m



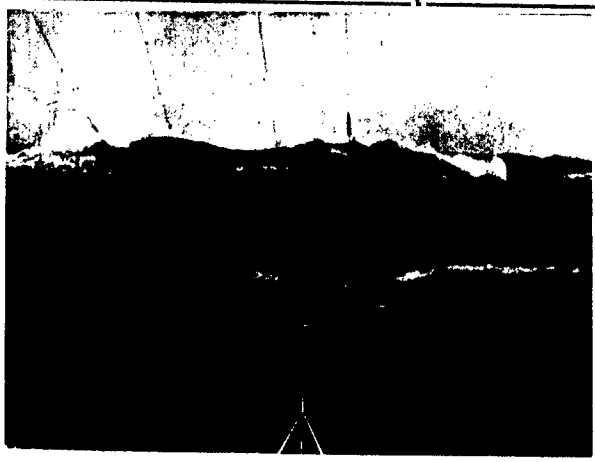


F 5 (Fresh breeze)	17 - 21 knots	Moderate waves of a long pronounced form, many white cap waves, heights 2 to 2,5 metres.
G 6 (Strong breeze)	22 - 27 knots	Large waves, lots of white caps, little spray 3,0 to 4,0 metres.

H 7 (Near gale)	28 - 33 knots	Sea heaps up, white foam blown in spray streaks, 4,0 to 5,5 metres
J 8 (Gale)	34 - 40 knots	Moderate high waves of greater length. Well marked streaks of spray and foam 5,5 to 7,5 metres.



K	9 (Strong gale)	41 - 47	High waves. Dense streaks of spray. Crests of waves begin to topple, tumble and roll over. 7,0 to 10,0 metres.
L	10 (Storm)	48 - 55	Very high waves, long overhanging crests, sea has white appearance, poor visibility, waves 9,0 to 12,5 metres.



M	11 (Violent storm)	56 - 63	Exceptionally high waves. Sea completely covered in foam, wave crests blown into froth, 11 to 16 m.
N	12 (Hurricane)	64 + knots	Air is filled with foam and spray, driving spray, bad visibility. Waves over 14 metres.

Fig. 306.

Coastal Effects

Weather bulletins (note bulletins, not forecasts, the former tells us what the weather was at a time earlier) for an area with a long coastline normally include what the actual barometric pressures were at places along the coast. For example:

i.	Richards Bay	1 023 mb	ii.	Durban	1 020 mb
iii.	Port Shepstone	1 017 mb	iv.	Port St Johns	1 015 mb
v.	East London	1 013 mb	vi.	Port Elizabeth	1 010 mb
vii.	Cape St Francis	1 008 mb	viii.	Cape Agulhas	1 010 mb
ix.	Cape Point	1 013 mb			

We know that winds blow from a high pressure area to a low pressure area. Along the coast we frequently experience what appears to be an invisible wall, extending many kilometres upwards from the shore line, making the coastal maritime winds and isobars independent of those over land. The effect of this is that, if we were to receive the above barometric pressure reports, we would know that the winds from Richard's Bay to Cape St Francis will be north-easterly in the north and easterly in the south - following the coast and blowing from the highest pressure towards the lowest. The centre of the coastal low will be off the coast at Cape St Francis, west of which the winds will be westerly to south-westerly. At Cape Point we see the pressure is 1 013 mb - the boundary pressure between a 'high' and a 'low'. It is probable that further west of Cape Point the pressure will be even higher. Due to the 'invisible wall' at the shore line the winds around the South Atlantic 'high' get 'squeezed' between the cell area and the 'wall' and we get strong southerly winds in the vicinity of the Cape Peninsula.

While we are sailing between Richards Bay and Cape St Francis, the 'low' is moving eastward around the coast - as it does so, the pressure where we are will be seen to be dropping - 'barometer dropping, winds north-easterly (or easterly)'. Between Cape Point and Cape St Francis the 'low' is getting further away - the pressure here is rising and the wind is westerly to south-westerly 'barometer rising, winds westerly (or south westerly)'.

As a very general guide, the changes we see on our barometer at a particular time, will affect wind changes about six hours later - after seeing the barometer 'bottom' at 1 008 mb and then start to rise as the 'low' passes, we can reckon on the wind changing to westerly six hours later - but it can happen within minutes -so be warned.

Wind strengths can also be anticipated by the following approximate guide:

1 mb pressure change per 100 M of coastline, winds +/- 8 knots
2 mb pressure change per 100 M of coastline, winds +/- 14 knots
3 mb pressure change per 100 M of coastline, winds +/- 20 knots
4 mb pressure change per 100 M of coastline, winds +/- 30 knots

(We could also say, for example, 1 mb per 50 M would be the same as 2 mb per 100 M, so we need to check places' distances apart as well as their pressures when interpreting the weather bulletin.)

Wind versus Current

Charts and sailing directions warn of the dangers of sea conditions where strong winds blow contrary to strong currents. This is particularly relevant on the coastline in South Africa where, to the east, the Agulhas Current flows strongly towards the south-west - during south-westerly gales the seas become very steep and abnormal waves occur:

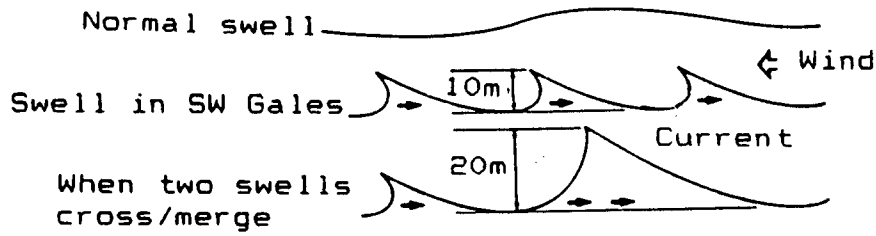


Fig. 307.

A vertical wall of water of 10 m to 20 m in height can break the back of big ships - to a yacht the probable consequences are horrific.

The Benguela Current flowing up the Cape west coast can also be opposed by the north-westerly gales and similar wave patterns can occur.

Fortunately, these dangers occur only to seaward of the 200 metre depth contour where the continental shelf has its edge - so when you work out wind directions and speeds using Buys Ballots Law and the rate of change of atmospheric pressure from your barometer, and you see winds are likely to be strong and contrary to the current, sail well inshore of the 200 metre depth contour!

Wind versus current situations anywhere in the world give rise to steep seas, so if in a strong current area, watch for signs of contrary winds and have an 'escape plan' if possible. Strong currents are normally not very wide, so one can get out of the current if advance warning signs are heeded.

Land and Sea Breezes

Land and sea breezes are normally associated with a high pressure system where fairly stable wind conditions due to the 'high' persist.

Sea Breeze

As the sun rises during the day, it heats the land quite significantly but the sea temperatures are hardly affected. As the day progresses, the land warms up and by midday the air above the land is heated by the warm land, expands, and starts to rise. The cooler air over the cooler adjacent sea is more dense and moves in to displace and replace the warmer air as it rises. This breeze, being from the sea towards the land is called a sea breeze (we always label wind direction according to the direction from which the winds come - opposite to the method for currents).

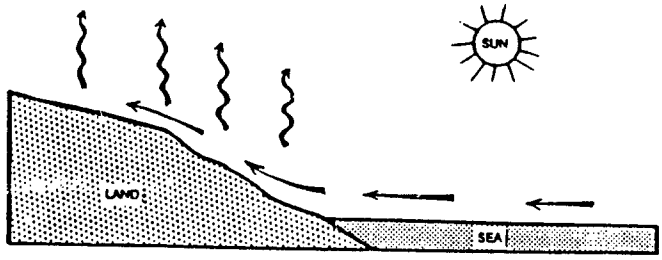


Fig. 308.

The effect of the sea breeze, as with a land breeze, can be experienced for several miles either side of the coast, and it can reach up to about 15 knots. Sea breezes are normally experienced only in the afternoons.

Land Breeze

Land breezes on the other hand, happen during the latter part of the night. Once the sun has set, the land cools rapidly as compared with the almost negligible cooling of the sea. As the night wears on, the cooler land surface having cooled the air in contact with it, results in colder, more dense (heavier) air over the land than over the sea. The cold, heavy air therefore flows out to sea to displace the relatively warm, less dense, lighter air which rises. The breeze which results is a land breeze - it flows from the land towards the sea (remember wind directions are described in relation to the direction from which the winds come).

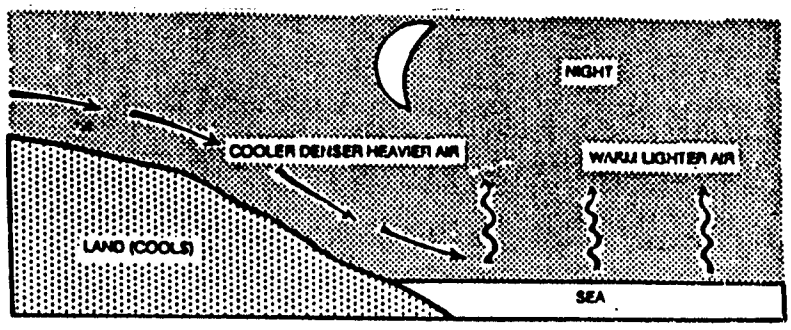


Fig. 309.

Inland waters such as dams and lakes experience frequent and rapid wind direction changes, and often have strong winds after midday. These winds are due to the same temperature effects which cause the land and sea breezes; they are often strong due to the close proximity of cool water to hot land around the dam/lake.

Air Masses

The almost permanent high pressure systems in the oceans normally cover a vast area and the pressure

gradient moving away from the centre of the 'high' is very gradual, resulting in slow moving air. During this slow movement of the air, it has time to take on the same characteristics of temperature, and humidity as that existing at the centre of the high. A large area of similar temperature and humidity (homogeneous in a horizontal direction) surrounding the centre of a 'high' develops and this is known as an 'air mass'. If the air mass is from a high in sub-tropical latitudes, it will normally be warm and humid, whereas an air mass from a polar region will be cold with a high moisture content. In addition, moisture content will vary according to whether the mass is over the sea or land.

Polar air masses are warmed from below when they move over warmer seas, and clouds formed are mainly cumulous and cumulonimbus. Showers and squalls are common.

Tropical ocean air masses, being warm and moist, form fog, drizzle and even rain when cooled as they move over cooler seas.

Fronts

When two air masses of different characteristics meet, they do not mix readily and a 'boundary wall' forms, called a 'front'. The leading edge of the colder air cools the trailing edge of the warm air and rain occurs at the junction - large volumes of water vapour condense and rain drops form and drop to the sea - the space left by the vapour condensing results in a drop of pressure at the front. The wind from the faster moving cold air mass blows in to the area of low pressure, so there is normally a stronger wind at the cold front.

On weather charts, known as synoptic charts, the leading edge of a cold air mass is drawn as:

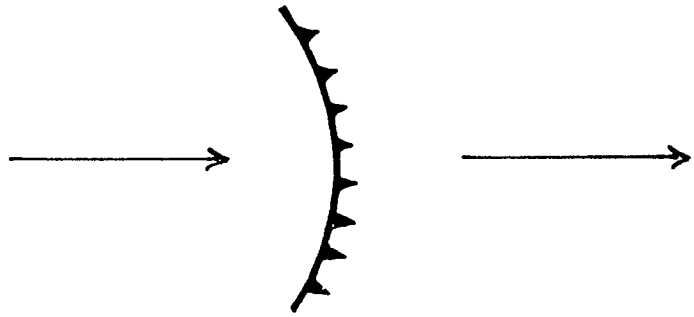


Fig. 310.

and a warm air mass boundary (where light rain may occur due to the leading edge of the warm air being cooled by the stable air ahead of the front) as:

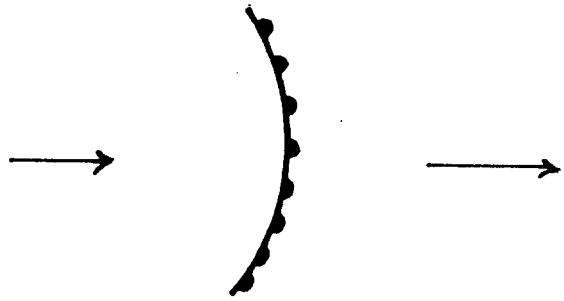


Fig. 311.

Where the cold and warm fronts meet, the colder, denser, faster moving air from the cold air mass moves in under the slow moving warm air which is lifted up above sea level; this is called an occlusion:

Northern Hemisphere

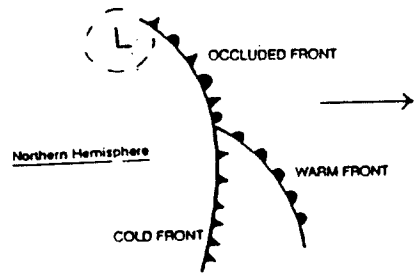


Fig. 312.

Southern Hemisphere

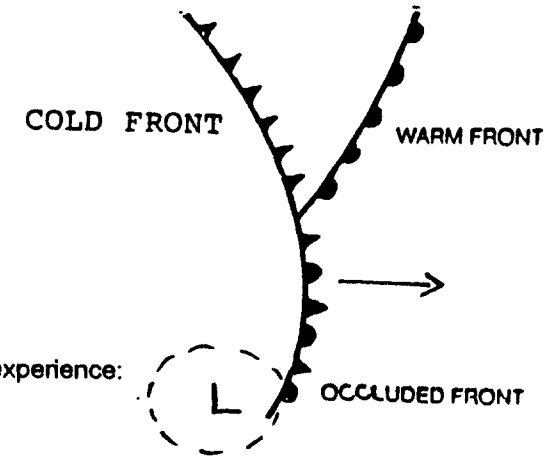


Fig. 313.

If a front is approaching, one will experience:

A. **Clouds**.

High clouds (8 000 to 10 000 metres) will usually precede middle level clouds (2 000 to 8 000 metres) which follow some hours, or a day or two later, then within 12 to 24 hours clouds get lower and darker until low rain clouds cover the area. At the coast, the passing of a front usually involves about 6 to 12 hours of rain before it slowly starts to clear up. Inland, the passage of a front is normally more rapid, with the rain only lasting one or two hours.

B. **Wind**

In the southern hemisphere, wind veers and strengthens at the approach of the warm front, backs and then remains constant on the passage of the warm front and while the warm sector passes, and finally backs as the cold front passes and continues to back in the cold air sector - in the cold air mass.

In the northern hemisphere wind direction changes are the opposite.

C. **Temperature**

The temperature rises slightly on the approach and passage of the warm front and warm sector, then drops as the cold front arrives, passes, and remains cold in the cold air sector.

D. **Atmospheric Pressure**

Pressure decreases (slightly) right up to the passage of the cold front when a rise occurs.

An Occlusion

A cold front moves faster than a warm front and therefore the former catches up to the latter, lifting the warm air upwards. Once this has happened, the warm air mass being 'out of the way', the front disappears. As occlusion takes place there is normally a noticeable change of wind direction and the wind is squally. We will see more of what 'fronts' look like in 'synoptic charts'. See Fig. 312 and 313.

Synoptic Charts

Weather forecasting agencies get their information from satellite photographs of various types, as well as many widely spaced weather reporting stations. Armed with the knowledge about 'highs', 'lows' (and how they and their winds move), and fronts and clouds, they are able to draw existing weather conditions on a chart, and predict how they will change in intervals of time, be they 6, 12, 24, 48, 72 or more hours into the future. These predictions can be illustrated by using the same 'drawing on charts' techniques, as well as being given out to the media for dissemination to the public.

A weather chart is called a synoptic chart. One must understand the symbols used on a synoptic chart if these charts are to be meaningful. The most significant are the lines, almost circles, drawn around the centre of 'highs' and 'lows'. These lines show points of equal pressure, and are known as 'isobars'. And we already know how the winds move around 'highs' and 'lows', and that strong winds exist where there is a steep pressure gradient (isobars will be close) and where we have light winds the pressure gradient

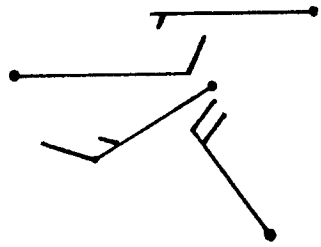
is shallow (isobars will be further apart). Wind symbols on a synoptic chart look like arrows and show the direction (the direction the arrow appears to be going) and speed (the number and length of the 'feathers' at the back of the arrow). For example:

Westerly, 5 knots

Easterly, 10 knots

South westerly, 15 knots

North westerly, 20 knots



See the top synoptic chart over the page. There is calm weather over the western side of the Atlantic, as is the case right across the southern portion of the ocean (isobars are spaced far apart). The North Atlantic 'high' (frequently known as the Azores High or the Bermuda High) has a barometric pressure at its centre of 1 030 mb. There is a deep low south-west of Lands End. The 'high' we can expect will remain in its general area, but the 'low' will move eastwards (or north-east or south-east - we need to check regularly by looking at consecutive synoptic charts to see more accurately which way the low is actually moving. Other than ocean 'highs', all weather systems move in a general west-to-east direction due to the earth's rotation).

The second synoptic chart is a typical southern ocean situation.

North Atlantic Ocean Synoptic Chart

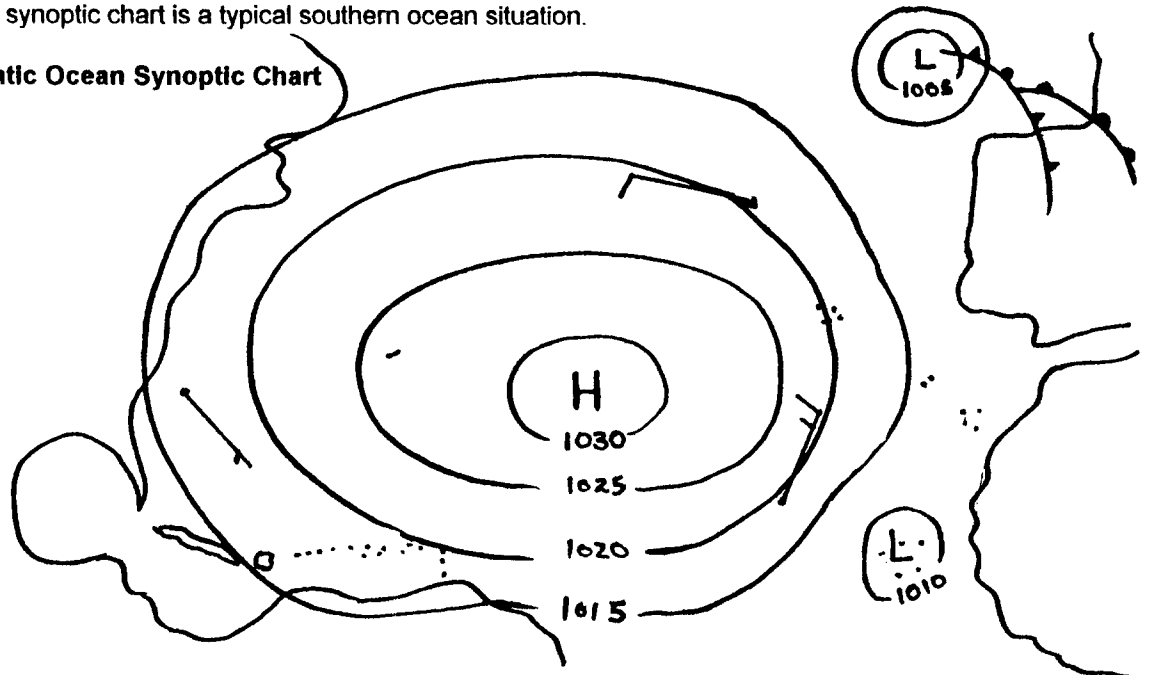


Fig. 314.

South Atlantic Ocean Synoptic Chart

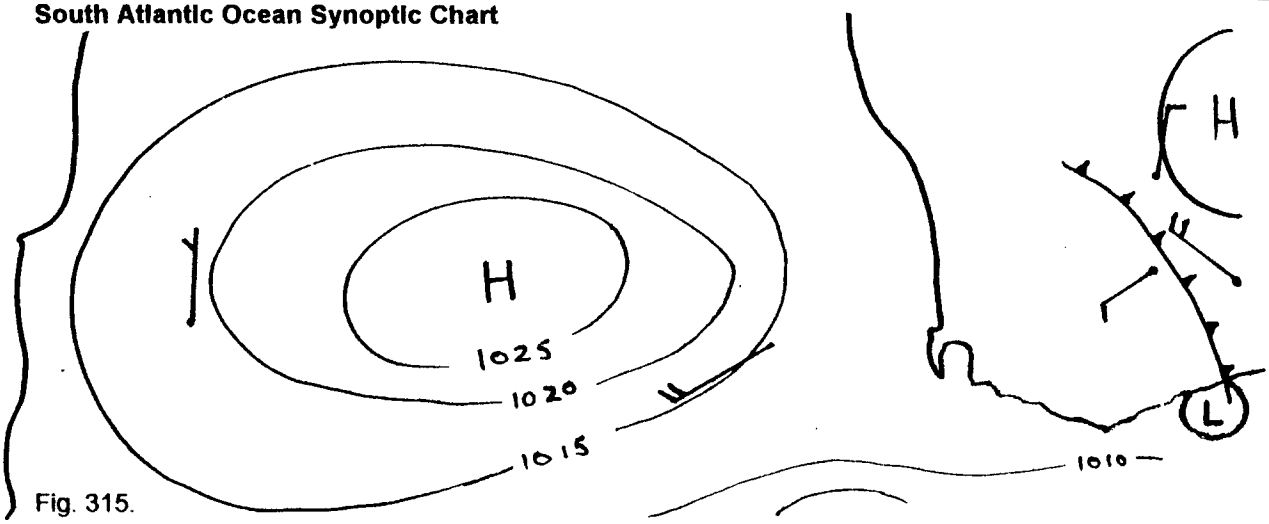


Fig. 315.

The front sweeping over the South African east coastal area in a west to east direction has one difference from other fronts we have looked at. There is no warm air mass as such, but the air ahead of the cold front is normally warm and humid (moist) anyway! We therefore experience the passage of the front in much the same way as the one we have just looked at in the northern hemisphere, but there is no central warm air mass area. These fronts normally pass with a 'bang', are very violent, but do not last long! High clouds (cirrus) and medium-level clouds (altostratus) may be absent.

Fog

The maximum amount of water vapour in the air depends on the air temperature. Warm air can hold more water vapour than colder air. The air is said to be saturated when it holds all the water vapour it can at a given temperature, which is then termed its 'dew point'. If any cooling takes place to lower the temperature below its dew point, condensation will occur resulting in fog. So, in essence, for fog to occur, warm moist air must pass over cooler surfaces which can cool the air to a temperature below dew point - for tropical maritime air it needs to cool to below approximately 12° C.

A. Radiation Fog

At night as land cools, heat from the land is given off to the air above and this in turn rises, the process of giving off this heat being termed 'radiation' - the land 'radiates heat'. The more heat that is given off, the less there is left to give off, and the land cools. Eventually the cooling reaches a stage where the dew point (temperature) is reached and further cooling results in the formation of fog. This is radiation fog. It is more common in cooler climates, and occurs mainly on cloudless nights when the warm air heated by the cooling land is able to continue rising and is not kept down by layers of cloud. The presence of wind, however, can push the fog upwards by turbulence and stratus cloud forms, or the fog may be pushed out to sea.

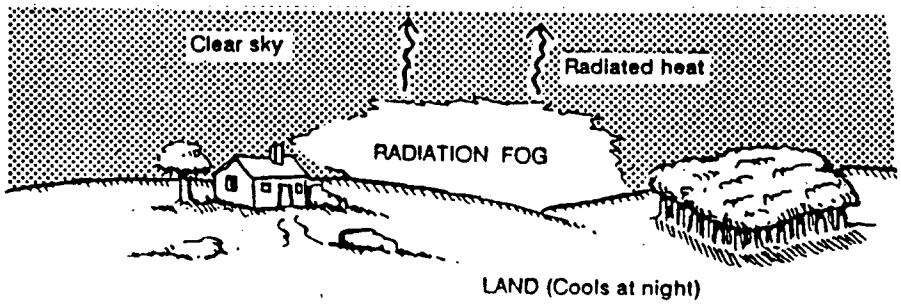


Fig. 316.

B. Advection Fog

Advection fog occurs when a warm, moist air mass moves over a cold surface, mainly the sea. The colder sea causes cooling of the air mass and the dew point is passed. This can occur by day or night, and can happen in winds up to about force 6.

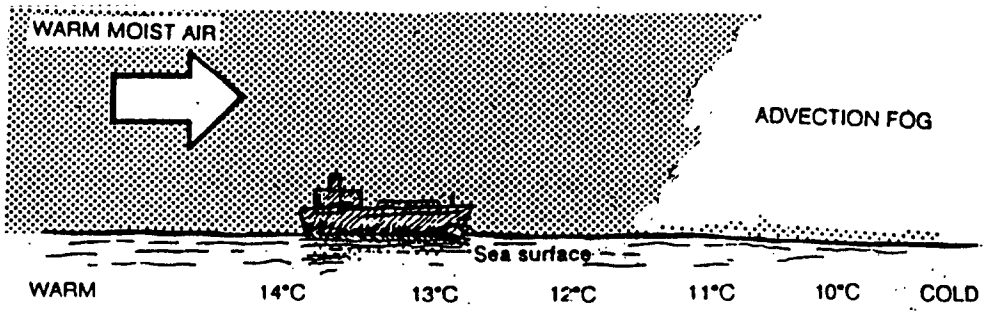


Fig. 317.

Weather Forecasting

Before one leaves the mooring, and at all times when under way, the prudent yachtsman will monitor weather conditions so as to be warned in advance of what to expect. Of primary interest are wind direction and speed; sun, rain, hot or cold are of less significance other than with regard to the dangers of fog.

We all know the (unfortunate) saying that if you want to know what the weather will do today, listen to what the weather forecaster has to say, then prepare for the opposite! This is unfortunate because most people do not appreciate that the forecaster is dealing with a non-exact science.

Sources of Forecast Information

To be as sure as we can about how the weather will treat us, we therefore gather as much relevant detail as possible. There are a number of sources of weather forecast information available to us, and they include:

1. **Forecasts for Shipping**

1.a. Depending where one is, there is nearly always a marine forecast transmitted on marine radio channel (VHF and SSB) working frequencies, usually after an initial advisory call on the calling and answering channels (VHF channel 16, SSB on 2182 kHz and 4125 kHz). These forecasts are normally broadcast at least twice per day. There is a separate transmission, a weather bulletin, which tells one what the weather actually was at various places at a given time, and includes (some countries) a statement of what the barometric pressure readings were. This information is invaluable when deciding how the coastal winds will blow. (See Coastal Effects, page 126).

1.b. National radio broadcast services nearly always have one or two (or more) weather forecast broadcasts during a 24-hour period, and some of these will include a 'Forecast for Shipping'.

2. Synoptic Charts of (sea) surface level conditions are produced by many countries a few times a day and are transmitted as data on SSB radio frequencies which can be received by on-board radio receiver facsimile units. If in a harbour, not having a facsimile receiver, one can invariably get a copy from a yacht or ship nearby which has. Simplified forms of synoptic charts also appear in some newspapers and are seen on T.V.

   However, find out at what time it is/was relevant.

3. **Weather Bureau**. Ports at places where airports exist are invariably served by a branch of the national meteorological service. A telephone call to the 'Met' office has obvious advantages, even if made as a 'link call' from a vessel under way. For routine 'met' enquiries, however, one should telephone the 'Weather Line' '082' tape recorded service for your area - it is updated every 12 hours.

4. Newspapers.

5. Television.

6. Own Observation. Clouds and a regular watch on the barometric pressures (preferably every two to three hours) for changes in the pressure, can be good indicators to the mariner.

Practice makes perfect - see the T.V. and newspapers' synoptic charts, and listen to the radio forecast in your area. At the same time, observe wind speeds and directions and the barometric pressure to decide what you think the weather will do.

Speak to people in your area who are 'in the know' - and get to know the early warning signs of bad weather/strong winds approaching.

NOTES

PART 2 - OFFSHORE SAILING

CHAPTER 8

TIDES AND TIDAL STREAMS

A. TIDES

Introduction

The tide (sea level) rises, and it falls. It goes from one extreme to the other in about six hours on average. As it changes, the water has to come or go from or to somewhere; there is a constantly changing sideways flow of the water. Unless we sail in deep waters only, we need to know the state of the tide at times we wish to sail over shallow areas. If we ignore it, the result could be that we go aground - if the ground is rocks or a reef, the result could be fatal.

Understanding Tides

Our earth orbits 360° once around the sun in a year (i.e. it moves through an arc of the annual orbit of almost 1° in 24 hours). It also revolves on its own axis once every 24 hours. The moon, which is much nearer the earth than the sun, orbits around the earth once every approximately 29 days - its speed around the earth is NOT constant. In one 24 hour period the moon moves through an arc of about 12°15' - it takes on average 7,25 days to move through an arc of 90°.

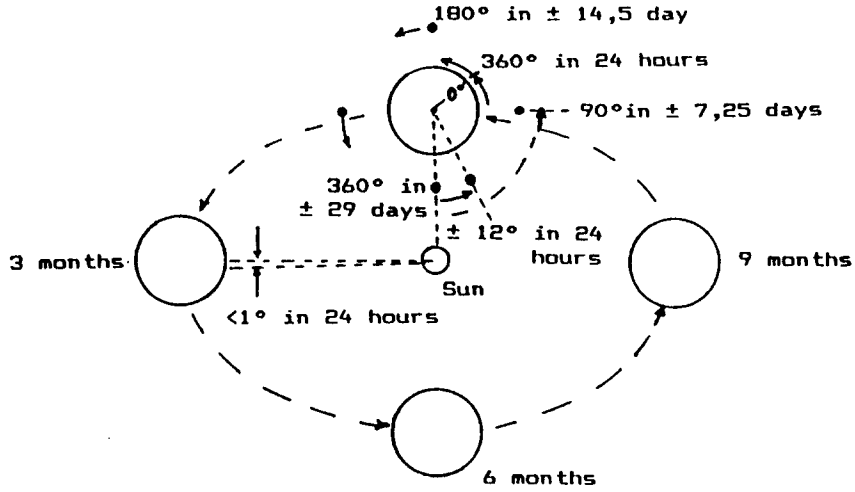


Fig. 318.

Gravity and Centrifuge. Both the sun and the moon exert gravitational 'pull' forces on the earth. The sun's pull is balanced at the centre of the earth by the centrifugal forces in the earth (as it spins around the sun) which try to force the earth to swing away from the sun. This is the same thing as a weight on a string which is swung around at speed - if the string was to be cut, the weight would shoot off away from the centre or pivot point. While the weight is spinning around the pivot point, if the outward force (the centrifugal force) exceeded the strength of the string (the gravitational pull force), the weight would move rapidly away from the centre pivot point - for ever! Similarly, if the inward pulling force (gravity) exceeded the centrifugal force, the weight would get pulled into the centre -the pivot point. If the centre was the sun, and the weight the earth, the earth would get pulled into the sun and burn up - and ruin an otherwise nice day!

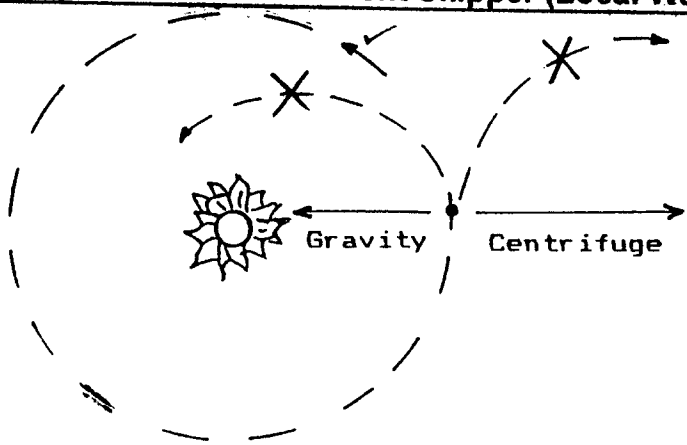


Fig. 319.

The constantly opposing forces of gravity and of centrifuge cause the earth's path around the sun to 'wobble' or vary during the earth's annual orbit. This wobbling earth's orbit path, its Elliptic, constantly changes the sun-earth distance during a year. The gravitational forces become stronger the closer the two (the sun and the earth) are, and weaker the further they are apart. At one time during the year, at the Autumnal Equinox on approximately the 23 September each year, the distance between the sun and earth is at its minimum - and therefore the gravitational force exerted by the sun on the earth is stronger than at any other time of the year.

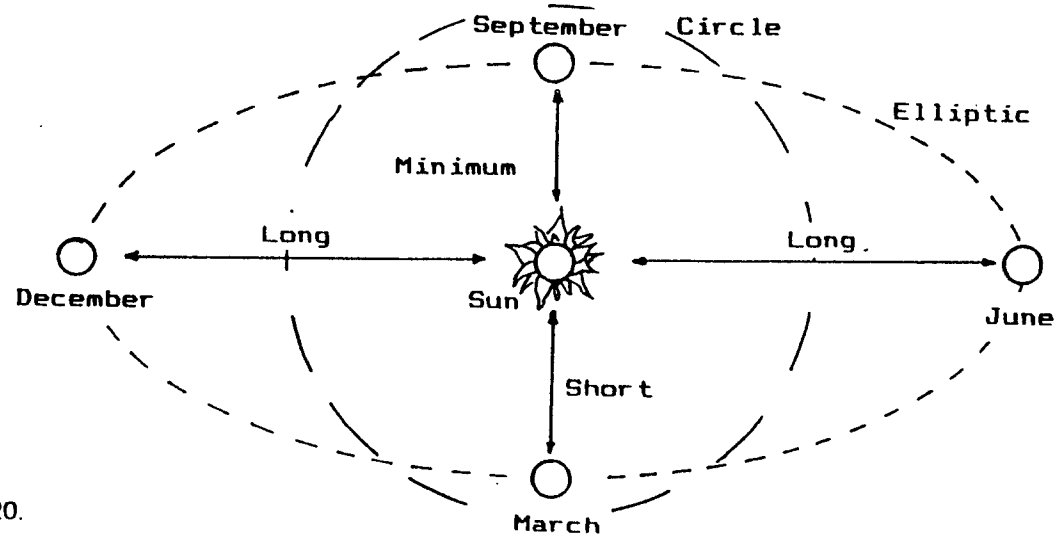


Fig. 320.

'**Equinox**' is the term used to mean that the centre of the sun is on the same plane as the earth's equator. When the sun crosses from the Southern Hemisphere's skies to the Northern Hemisphere's skies, we have 'Vernal Equinox'; the opposite direction crossing is 'Autumnal Equinox'. The sun to earth angle with the plane of the equator is 0° - the Declination (Dec) of the sun is 0°. When the declination is at its maximum (23°26'), we say that it is (at) '**Solstice**' - either Northern Solstice (June) or Southern Solstice (December).

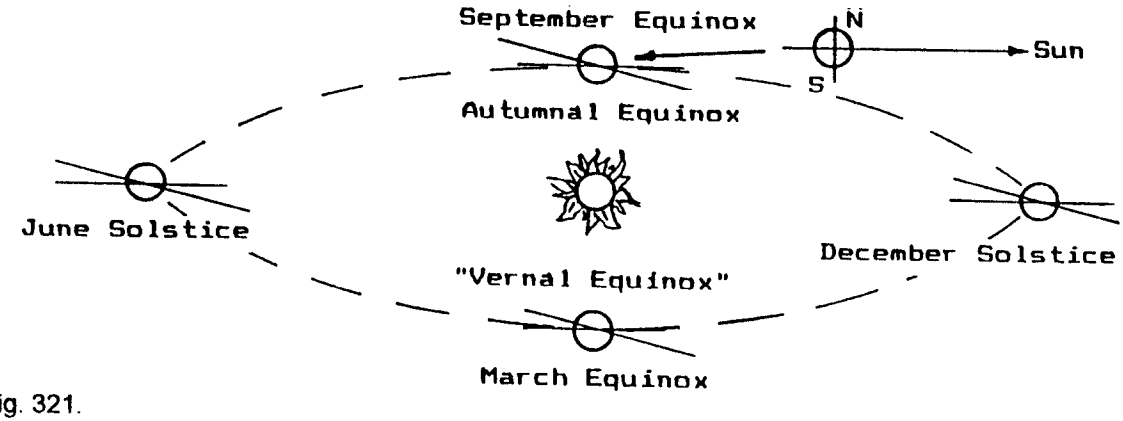


Fig. 321.

The gravitational force exerted by the moon is, for our purposes, constant. The earth-moon distance does not vary significantly, and as the moon is much closer to the earth than the sun, the gravitational force exerted on the earth by the moon is far greater than that exerted by the sun.

Movement of the Oceans' Waters. Approximately 70% of the earth's surface is water. The forces of gravity from the sun and the moon, and the earth's own centrifugal force, all acting on the earth, cause the waters of the earth's oceans to move. The waters swell or bulge (Flood Tide) in the directions of the pulling forces. To swell or bulge in any one or more directions means the water level in those directions must increase. For there to be an increase in the oceans' water levels at one or more places, the extra water required must come from somewhere. It comes from areas of the oceans where there are less, or no pulling or swelling forces. In these areas therefore, the water that moves away (Ebb Tide) causes the sea level to go down.

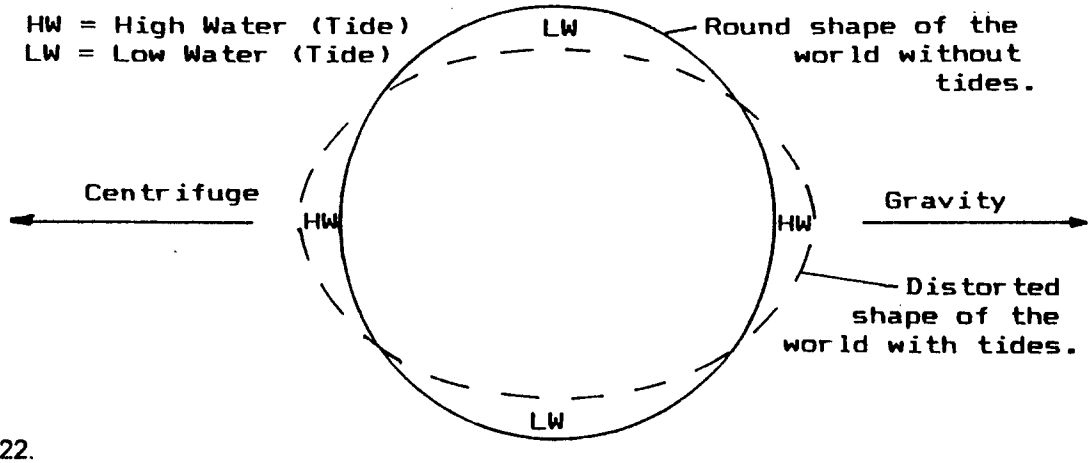


Fig. 322.

Springs. Spring tides occur when the sun, moon and earth are in line (A and B in Figure 316). In 'A', the combined pull of the sun and the moon are in the same direction. Coupled with the centrifugal force acting in exactly the opposite direction, a larger than normal swelling or bulging of the seas nearest the directions of those forces is caused. Therefore a correspondingly lower low level of seas off to the sides of the earth results. If the moon is still in line but at the opposite side of the earth (B) so as to pull in line with the centrifugal forces, the same thing happens, but the tide levels (high and low) will not be quite the same (as high and as low).

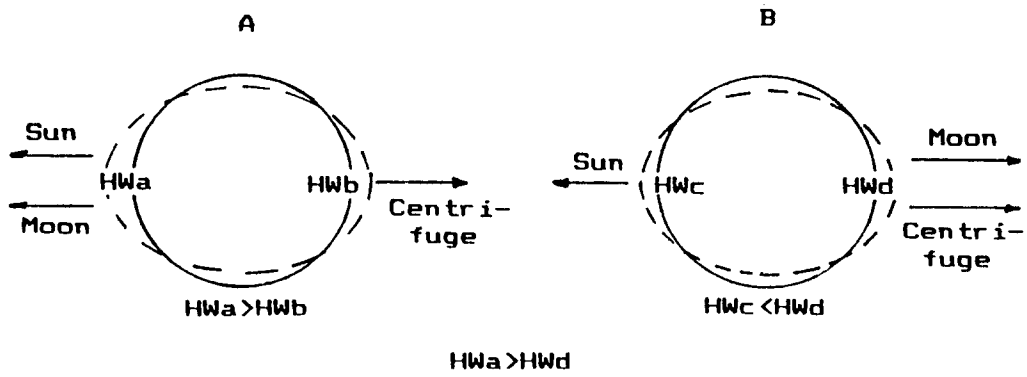


Fig. 323.

At both these conditions (A and B above) we have what is called Springs - when the height of the sea level is higher (and lower 90° away) than at other times. As the earth rotates once per 24 hours, it will turn through 90° in 6 hours - high tide changes to low tide (and vice versa) every +/- 6 hours (+/- because the moon moves slightly, and not at a constant speed). Since the moon takes approximately 14,5 days to orbit half way around the earth, Springs occur every +/- 14,5 days. At the Springs when the sun and moon are on the same side of the earth (A), the 'high' level of the sea is slightly higher than when the moon is in line but on the opposite side of the earth (B).

Any 'high' of the sea level is called 'High Tide' or 'High Water' (HW). Similarly, when the sea level is at a 'low' we say it is 'Low Tide' or 'Low Water' (LW).

Neaps. When the moon-earth line is at a right angle to the earth-sun line, the gravitational pulls of the moon and of the sun are opposed to each other. One of the two is trying to induce a high tide where the pull of the other would induce a low tide - the two opposing influences are reducing the effect one would have on its own. So instead of a 'high' High Water, we get a 'low' High Water in line with the moon - the dominant force - and therefore we get a mild low tide, a 'high' (higher then normal) Low Water. The resulting smaller than usual changes in the tide levels are called Neap Tides. We get High Water Neaps and Low Water Neaps.

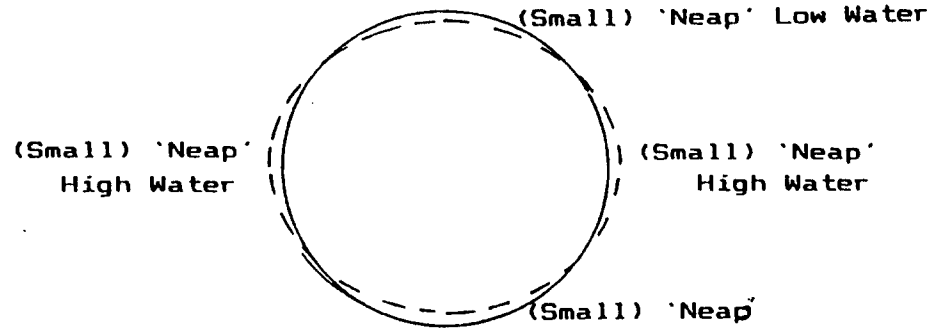


Fig. 324.

When High Water occurs at any two opposite sides of the earth at a time, a corresponding Low water occurs at the sides, 90° away.

Tide Terms

The difference in sea levels between its level at High Water and at Low Water is called the Range of the Tide - or the Tidal Range. At Springs we get the Spring Range, and at Neaps we get the Neap Range. The average sea level over a period of a year (during which all the variations in tide levels are experienced), is called the Mean Sea Level (MSL). The Height of Tide is the amount the sea level will rise above a reference level, or Chart Datum. Nearly all charts printed within the last few years use the 'Lowest Astronomical Tide' as this depth 'Datum'.

The average or 'mean' sea levels at the various stages of the tides during a year's cycle become important when taking reference levels from which tide calculations are made. We therefore get the 'Mean High Water Springs' (MHWS), the 'Mean Low Water Springs' (MLWS), The 'Mean High Water Neaps' (MHWN), the 'Mean Low Water Neaps' (MLWN) and the 'Mean Sea Level' (MSL), etc.

Since the earth is constantly turning on its axis, the places experiencing High Water (HW) are constantly changing in line with the moon's pull. Therefore at any one place on earth we need to describe the Height of Tide AT A TIME.

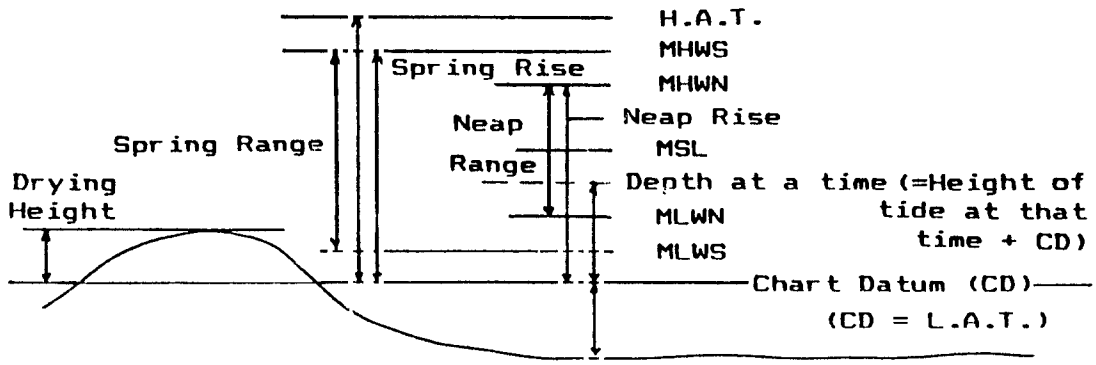


Fig. 325.

The Lowest Astronomical Tide or 'L.A.T.', occurs when the 'sun to earth distance' is shortest during the year, when the gravitational pull of the sun therefore, is at its strongest - at Autumnal Equinox - see page 136, AND when the moon coincides to be between the sun and the earth. At this stage, the lowest Low Tide, the lowest spring low tide, occurs and therefore we get the shallowest depth the water can fall to (excluding storm effects which may happen at that time). (The corresponding high tide is called the Highest Astronomical Tide - H.A.T.)

Chart Datum. The minimum depth of the sea at a place when the L.A.T. occurs is the depth used and shown on charts at that place - it is called 'Chart Datum (CD)'.

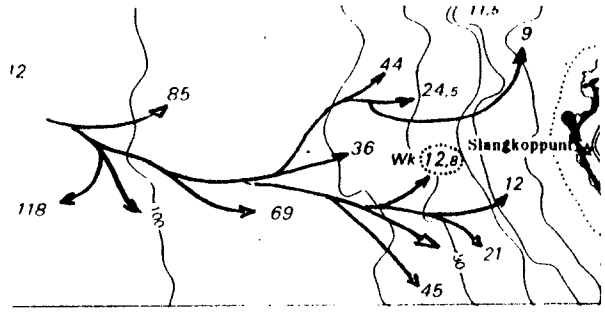


Fig. 326.

Depth. The depth at any place at a time is the CD plus the height of tide at that place at that time.

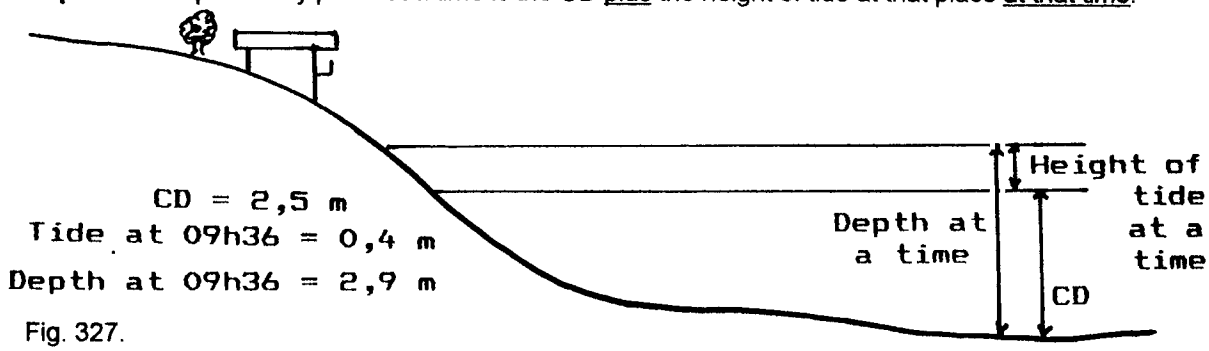


Fig. 327.

The Pattern of Tides

If one looks at a Tide Table for a place showing the alternating heights of tide at low and at high tides, and the times of each, one would see something like this:

Day/Date	Time(Hrs/mins)	Height(metres)
Fri	03 35	1,98
9	09 36	0,40
	15 50	1,93
	21 42	0,31
Sat	04 05	2,04
10	10 03	0,37
	16 19	1,96
	22 07	0,29

Fig. 328.

The 'Time Zone' is shown at the top of every page of Marine Tide Tables - it may be 'GMT/UTC' (Greenwich Mean Time/ Universal Time Co-ordinated), or, as in South African Tables, 'Time Zone 2' - meaning '2 hours ahead of GMT/UTC'. The British Admiralty Tide Tables are in three volumes covering tables for the whole world -time and time zones are obviously very important.

If we look at the time intervals between successive high-low-high tides we see:

	Time Difference	Gain/ Loss in mins.
1.	06 01	
		+13
2.	06 14	
		-16
3.	05 58	
		+25
4.	06 23	

(Continued on next page.)

		-25
5.	05 58	
		+19
6.	06 17	
		-29
7.	05 48	

Fig. 329. Here is proof that the moon's speed is not constant.

Application of Tide Tables

In many parts of the world, the rate of change of the tide is uniform and can be plotted as a sine wave graph. This is particularly common at places in the Southern Hemisphere.

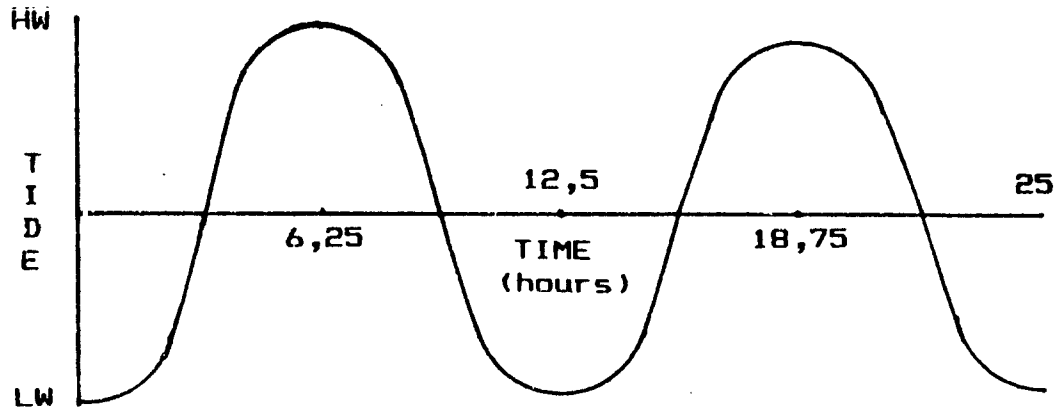


Fig. 330.

"Duration" and Rule of Twelfths. The curve of the graph represents the tidal curve of a tide which has a duration of about six hours, i.e. it changes from one extreme to the other in about six hours.

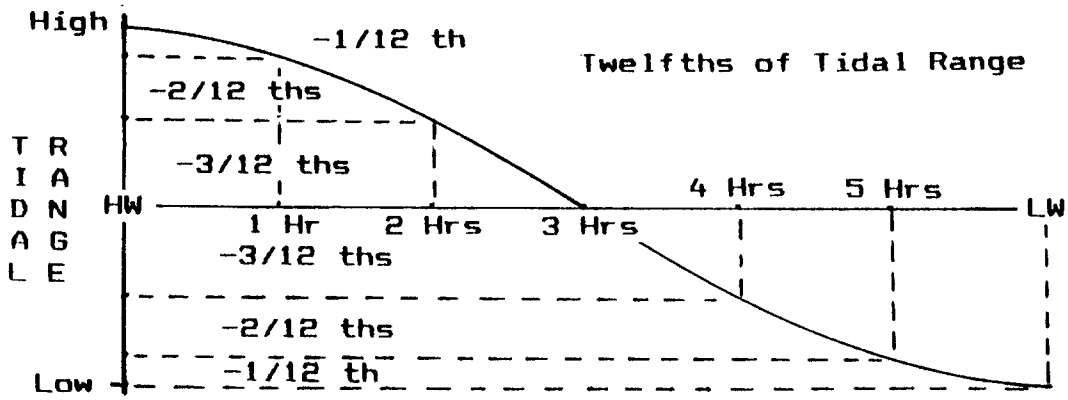


Fig. 331.

It is seen from the graph that in the first hour, the tide changes 1/12 th of the tidal range, in the second hour it changes 2/12 ths, in the third 3/12 ths, in the fourth 3/12 ths, in the fifth 2/12 ths and in the sixth hour 1/12 th. This gives rise to the 'Rule of Twelfths' enabling the height of tide, at a time between high and low or low and high tides, to be determined fairly accurately.

As an example, let's say we have a yacht whose draught is 1,7 m and we wish to enter a lagoon blocked by a sand bank shown as having a charted depth of 1,0 m. For safety sake we require a safe clearance margin of at least 0,5 m. Let's assume that the tide table for that place, and the date being the 9 th, are as per Figure 328 on page 139. The problem is to find out the earliest time after 8.00 a.m. that we can cross the sand bank with the required safety clearance margin.

Step 1 is SKETCH THE REQUIREMENT. (Most student errors with tide problems like this, is that they do not sketch the requirement and end up correctly calculating an answer that was not the question asked!)

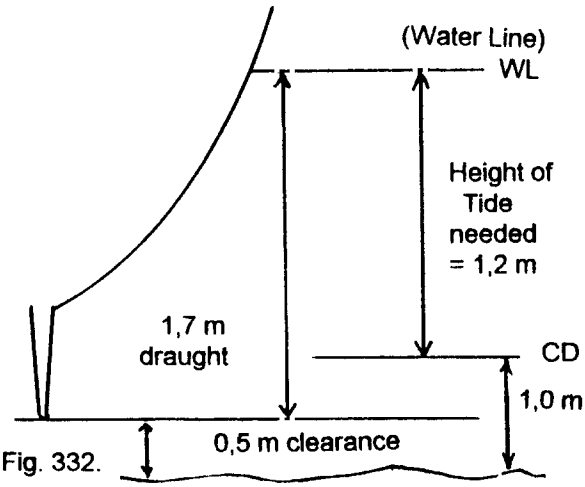


Fig. 332.

1,7 + 0,5 - 1,0 = 1,2

From the sketch we see we need a height of tide of not less than 1,2 m. Low Tide (LW) is at 09h36 when it will be 0,40 m. HW is at 15h50 when it will be 1,93 m. The time difference is actually 6h14, but we ignore the 14 minutes - it will make very little difference. The tidal range is 1,93 - 0,40 m, i.e. 1,53 m. One twelfth of 1,53 m is (to the nearest two decimal places) 0,13 m. So, in the first hour, the tide will rise from 0,40 m by 0,13 m to 0,53 m (at 10h36). In the second, from 0,53 m by 0,26 m to 0,79 m (at 11h36). In the third hour, from 0,79 m by 0,39 m to 1,18 m (at 12h36). From the sketch we see we need 1,2 m of tide and we now see that it will rise to 1,18 m by 12h36 (minutes). A little bit of interpolation (guesswork really!) lets us say that the safe time we set out to determine is: (approximately) **12h45**.

Here is another example. A bridge spans a ***deep*** channel river between the river mouth and a marina. The bottom of the bridge over the centre of the river where the bridge is highest, is shown on the chart to be at a height of 20 metres. According to the chart's 'Statement' - see Chapter 9, page 194 - the height datum in use on that chart is 'MHWS' which, from the table of 'Tidal Levels referred to Datum of Soundings', is 3,2 m above CD (Chart Datum).

The top of the lightning protection rod at the top of a yacht's mast (the highest point of the yacht) is 21,4 m above the water line. On a day when the tide table is as shown below, what is the latest time in the afternoon that the yacht can pass under the bridge with a safety clearance of 0,3 m ? The tide table shows:

"02h19 0,7 m
08h28 2,5 m
14h31 0,8 m
20h40 2,6 m"

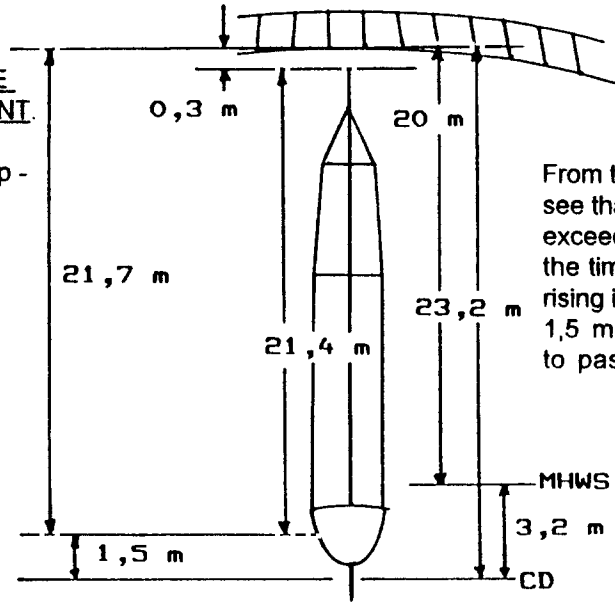
LW = 0,8 m
Tidal Range = 1,8 m
HW = 2,6 m

1/12 th of 1,8 m = 0,15 m

"... deep ..." so ignore depth

Step 1 SKETCH THE REQUIREMENT.

NEVER omit this step - one day you may go aground if ignored.



From the sketch at the left we can see that the height of tide must not exceed 1,5 m - so we need to find the time the flooding tide (it is rising in the afternoon) reaches 1,5 m - that will be the latest time to pass under the bridge - the time we must now determine.

Fig. 333.

Hour	Rise by	Rise from	Rise to	At (time)
1	0,15 m	0,8 m	0,95 m	15h31
2	0,30 m	0,95 m	1,25 m	16h31
3	0,45 m	1,25 m	1,70 m	17h31

We require to know the time the tide will reach 1,5 m, or very nearly half way between the tide levels at 16h31 and 17h31. This occurs during the third hour of the change between tide extremes, and if we look at the sine wave graph pattern during the third (and fourth) hour(s), we see the graph line is nearly a straight line - the rate of change is uniform, and it is safe to interpolate the time the tide will reach 1,5 m to be 17h00.

Therefore, as the tide is rising, the latest time the yacht can pass under the bridge with the required clearance is 17h00.

The Rule of Twelfths is easy to apply and does not take much time to get the required answer. It can however, only be used where the Tidal Curve is that of a regular Sine Wave. In many parts of the coastal areas around Europe, especially around the United Kingdom, the tidal curves are not sinusoidal - the tidal curves are distorted.

COMPLEX TIDES (Applicable around North West Europe; ignore this section in South African waters.)

In some cases, the distortions of the Tidal Curves are due mainly to the irregular shape of the seabed and the separated flows of the flooding tides around islands. The main body of moving water splits into two streams rounding opposite sides of islands, and as each stream rounds behind the islands, they pass each other going in opposite directions. The flood tide brings High Water and the two separated streams carry the High Water around the two sides of each island. The 'HW' having passed, the ebbing tide leaves sea levels dropping, only to be raised again an hour or so later as the HW from the stream rounding the islands in the opposite direction arrives and causes the levels to rise again.

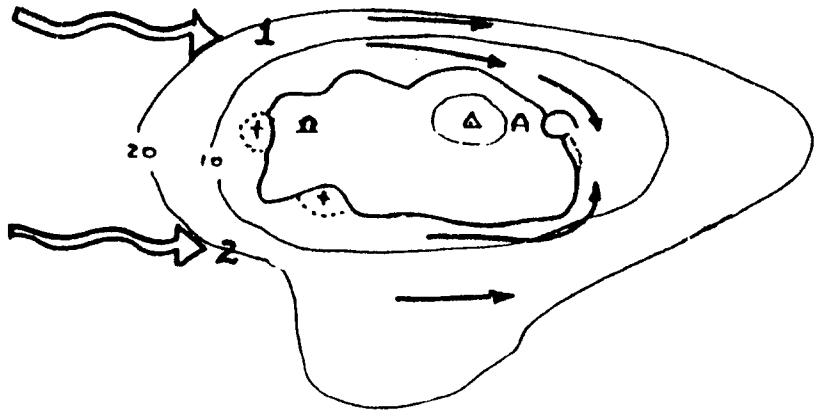


Fig. 334.

In the above simplified illustration, stream 1 brings HW to Port A probably an hour or so before stream 2 does - Port A experiences two high tides about an hour apart! The Tidal Curve for Port A may appear as:

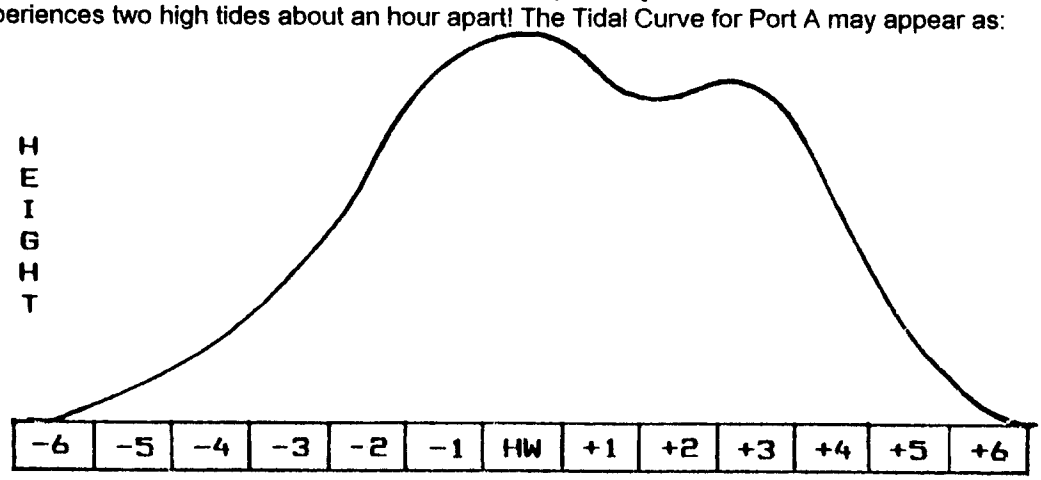


Fig. 335.

In the areas where these distorted tidal curves occur, the Tide Tables, in addition to supplying the times and heights of the high and low tides for every day of the year for each major place (as in Figure 328, page 139), also supplies a graph of the tidal curve as it is shaped for each place. The tidal curve as it is supplied for the Port of Southampton appears in Fig. 336. below.

Note the sharp turn of the curve at Low Water (LW) compared to the indistinct position of the curve's peak at HW. Notice also that the flood tide lasts longer (approximately 6 hours 30 minutes) than the ebb tide (which lasts approximately 5 hours 50 minutes) The solid curve line is used at Springs, and the dotted line, where it differs, shows the curve to be used at Neaps. We interpolate as required between Springs and Neaps.

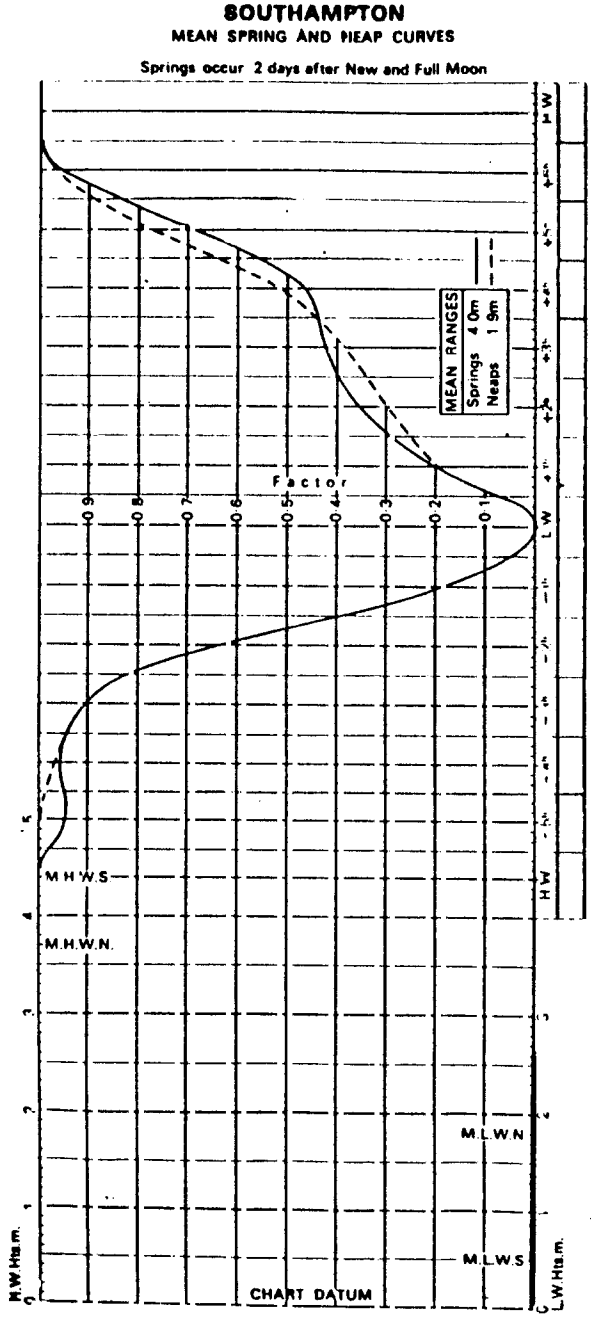


Fig. 336.

Standard Ports

As there are hundreds of places for which tidal information of this sort is required, it is not practical to supply tidal curve graphs and the daily times and heights for each tide for every place. In addition, the tidal curves for places in the same general vicinities would be the same, and there would be unnecessary duplication. For these main reasons, only the detail of times and heights of tides and the tidal curves for places of major significance, called 'Standard Ports', are supplied.

To Find The Time For A (required level of) Height

Let's do an example 'Tides' problem for a Standard Port. Assume our yacht, a bilge keeler, is moored at a double chain mooring in an area of Swansea Harbour which, as shown on an imaginary chart, has a drying height of 4,0 metres. We wish to go sailing, but only want to depart when there is a safety clearance under the keel of 0,20 m, and we decide we need to return before the ebbing tide gets below the same safety clearance level. The draught of the yacht is 1,3 m and the tide heights and times for the day are:

(Time zone UT/GMT SWANSEA Year 19XY)

00h27	7,6	
06h42	2,8	(Assume we judge these levels
13h07	7,7	to be mid-way between Springs
19h23	2,9	and Neaps)

At what time can we leave the mooring, and by what time must we be back at the mooring?

Step 1 SKETCH THE REQUIREMENT

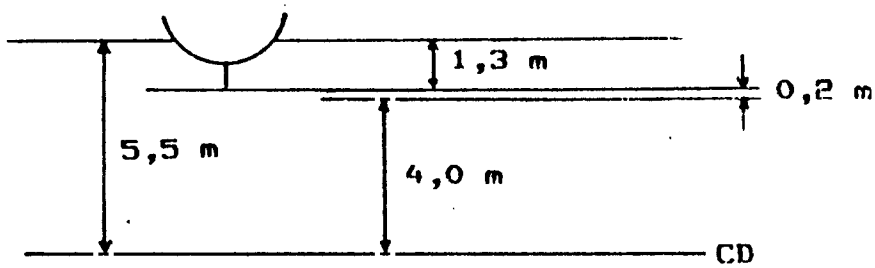


Fig. 337.

The sketch shows that the height of tide must rise to 5,5 m before we can leave, and we must be back by the time it falls to that level again on the ebb.

We turn to the Swansea Tidal Curve (see next page), and see that the right hand side, bottom line, has a series of blocks and one near the centre has the letters 'HW' above it. In this block we write the time of the midday high tide (13h07). In the blocks to the left of the HW block we write the times, 1 hour earlier in each block as we get further from the HW block:

LW	-5h	-4h	-3h	-2h	-1h	HW
07h07	08h07	09h07	10h07	11h07	12h07	13h07

And to the right, the hours after HW:

HW	+1h	+2h	+3h	+4h	+5h	LW
13h07	14h07	15h07	16h07	17h07	18h07	19h07

The fact that the times arrived at for the LW times are not exactly as per the tide tables for the day, is not important. There are only a few minutes difference in each case.

Now in the top left corner of the squared section of the page containing the tidal curve for Swansea, we see 'H.W.Hts.m.' (meaning High Water Heights in metres). Next to the day's table where we got '13h07' we see the high tide level is to be 7,7 m, and we now make a pencil mark along this top horizontal line at the 7,7 m position.

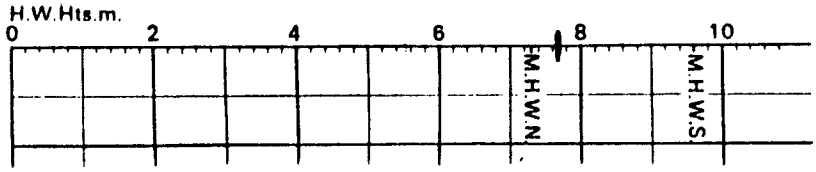


Fig. 338.

We do the same at the bottom left for the low tide which is to be 2,8 m (before HW and 2,9 m after HW).

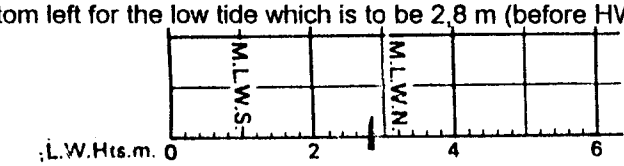


Fig. 339.

We then rule a straight line joining the 7,7 m and 2,8 m marks on the top and bottom scales respectively. On the top scale we find the required height of tide level mark of 5,5 m, and rule a vertical line down from that mark so as to cross the first diagonal line joining the high and low water level marks. At this intersection of the two ruled lines, rule a third line, horizontally to the right so as to cross the near side of the curve representing the rising tide. Where this third line crosses the curve, we can rule a fourth line vertically down to cross the time scale along the bottom edge of the graph.

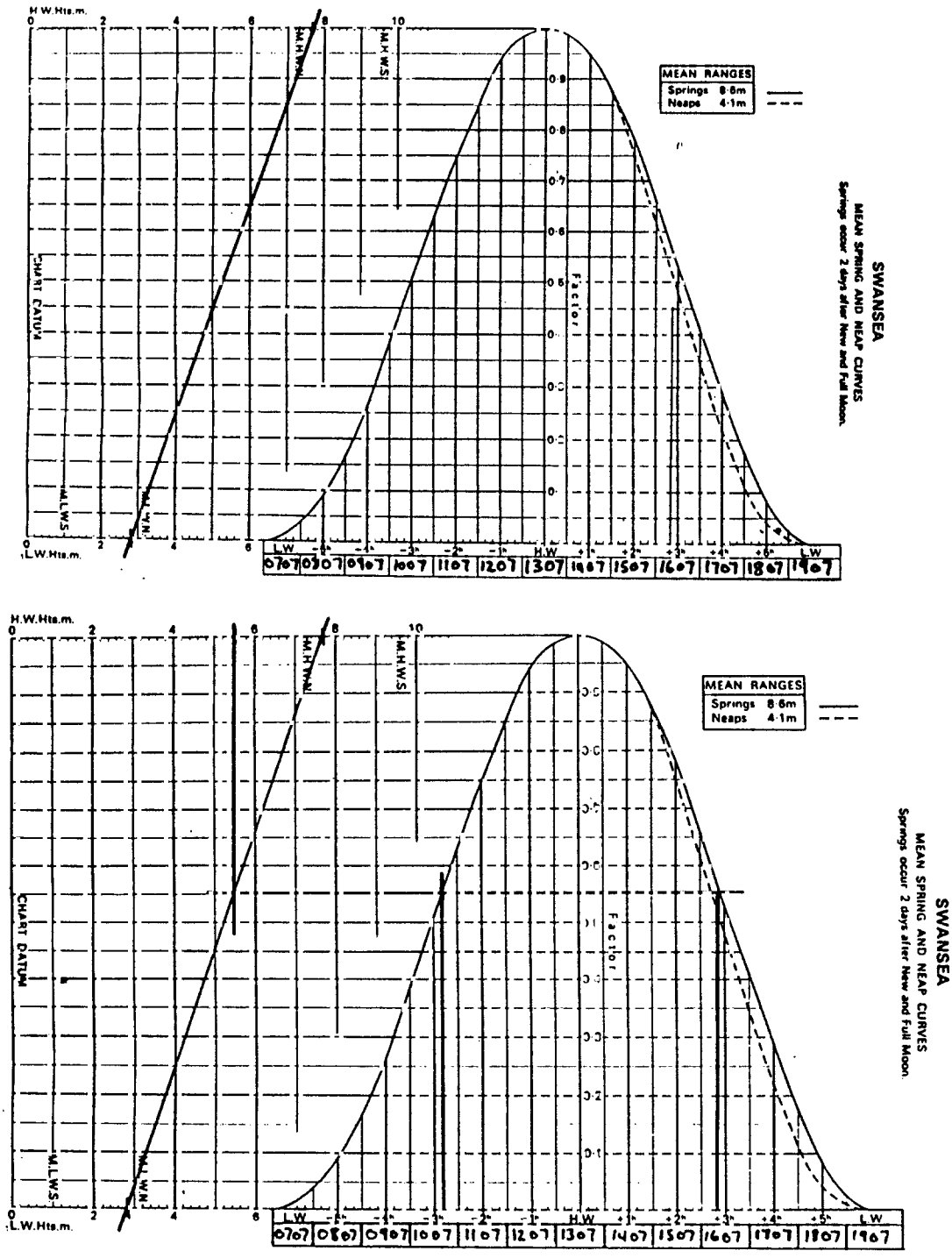


Fig. 340.

We see that the last vertical line down cuts the time scale at, by interpolation, 10h17. So it will be safe to leave the mooring at 10h17 GMT. (10h15 for practical purposes.)

For the time at which we must be back on the falling (ebb) tide, we can erase the lines ruled so far and begin again. We make the mark on the top left scale at the 7,7 m position as before, and since we are now concerned with the low tide after the HW, we see the LW is 2,9 m so we make the mark at the 2,9 m position on the bottom scale. We then rule a line, as before, joining the two (7,7 m and 2,9 m) marks and rule a vertical line down from the 5,5 m mark. From the intersection we rule a horizontal line across to the right to intersect the right hand side of the curve - both the solid and dotted lines. Since it is mid-way between Springs and Neaps, we make a mark on this line mid-way between the solid and dotted curved lines. From this mark we rule a line vertically down to intersect the time scale at the bottom. We see it intersects at, by interpolation, 15h57. So we must be back at the mooring by 15h57.

From 10h17 to 15h57 is 5 hours 40 minutes - we must not be away from the mooring for longer.

Note that these times are GMT/UTC. From late March to late October every year, the 'daylight saving' time adjustment comes into being. During the summer period between these dates, British Summer Time (BST) applies when the standard time is advanced 1 hour. So the standard time will be GMT/UTC plus 1 hour. If our example above had been during the summer daylight saving period, the GMT/UTC times of 10h17 and 15h57 would both have to have one hour added so that the answers obtained are as per the skipper's 'local time' clock. The final answers would then have been 11h17 and 16h57 British Summer Time.

We have just done an example of finding the time the tide will be at a height. Our height was 5,5 m and the answers were times.

To Find The Height At A (Required) Time

The question could have been: "What will the height of tide at the Standard Port, Swansea, be at 14h00 GMT?"

We go about solving the problem in a very similar way. First we look up the time of HW in the Tide Tables and enter it in the appropriate block along the bottom row of the Tidal Curve graph sheet. Since the time of HW is before 14h00, the time at which we need to find the height of tide will be later than the HW time. So we add one hour and enter the answer in the block to the right of the HW block. In our example, 13h07 is written in the HW block and 14h07 is written in the block to its right. 14h00 is 7 minutes to the left of the 14h07 mark, and the first small graduation to the left is 10 minutes earlier. By interpolation we make a mark where the 14h00 time should

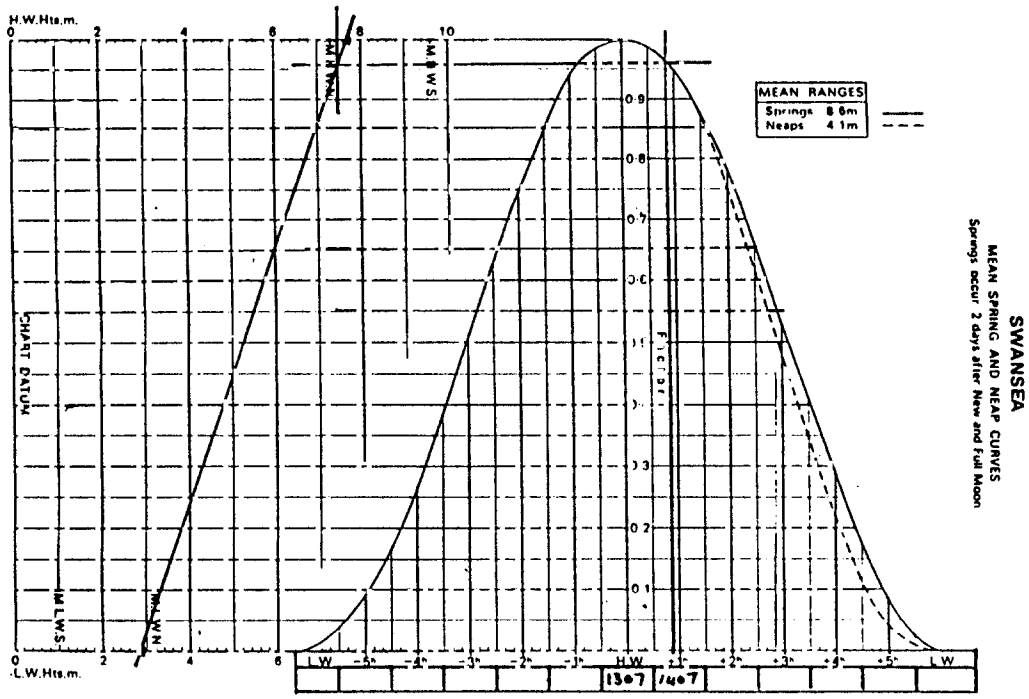


Fig. 341.

be on the bottom scale, and then we rule a vertical line from that mark to the (assume it is Springs) solid curve line. At this point we go horizontally to the left to intersect the angled line joining the 7,7 m and 2,9 m marks at the left of the form. At this last intersection we rule a line vertically upwards and see it crosses the top scale between the 7,4 m and 7,5 m mark. We could say, therefore, that the height of tide at 14h00 will be 7,4 m (or 7,5 m); we could use the second decimal place although this is unusual - if we did, the answer would be 7,45m.

Secondary Ports

Whereas Standard Ports have Tidal Curve graphs, and details for every time and height of every high and low tide for every day of the year, there are many places or 'ports' for which this type of information is desirable but not practical - there are just too many of them. So they are grouped with nearby Standard Ports.

Ports or places near a Standard Port which have the same or very similar shaped tidal curve patterns are grouped with that Standard Port and are called Secondary Ports. So the Secondary Ports share their Standard Ports' Tidal Curve graph, but have no daily data of times or heights of tides for each day of the year. Instead a Table of Differences schedule is supplied in the Tide Tables book. The differences are applied to the times and the heights applicable to the standard port to get the times and heights required for the secondary port, then the calculation is done as for the standard port.

B. TIDAL STREAMS

Lateral or Sideways Flow

A change of tide height of about twelve metres takes place at the Port of Bristol at springs. This change happens in approximately 6 hours. Thousands upon thousands of cubic metres of water have to go or come to the area as the tide changes. This water can only come from the sides - there must be a sideways flow, called a Tidal Stream, which will change direction as the tide changes. There may be a period as it changes when there is no sideways movement, therefore it must build up from zero speed or 'slow' to maximum and then go back to zero ("slack") or 'slow' by the end of a tide change. So the Rate (speed) of a tidal stream is always changing.

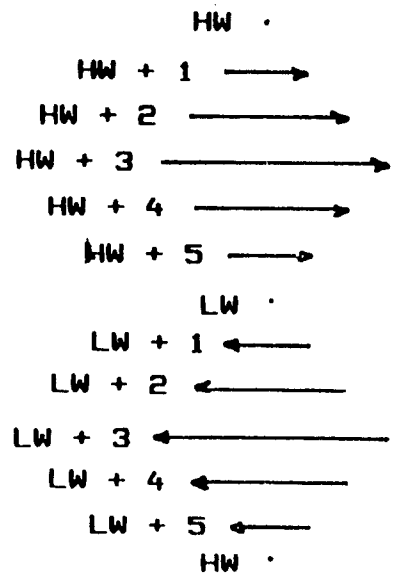


Fig. 342.

The direction is also changing all the time, as every 6 hours there is a change from flood tide to ebb and then ebb back to flood in the next 6 hours. There are also changes within the 6 hours as the tide, at

different levels, detours around underwater obstacles of differing heights (or depths). This is not only applicable to Bristol - it happens all around the British Isles and on both sides of the channel, albeit at a lesser rate.

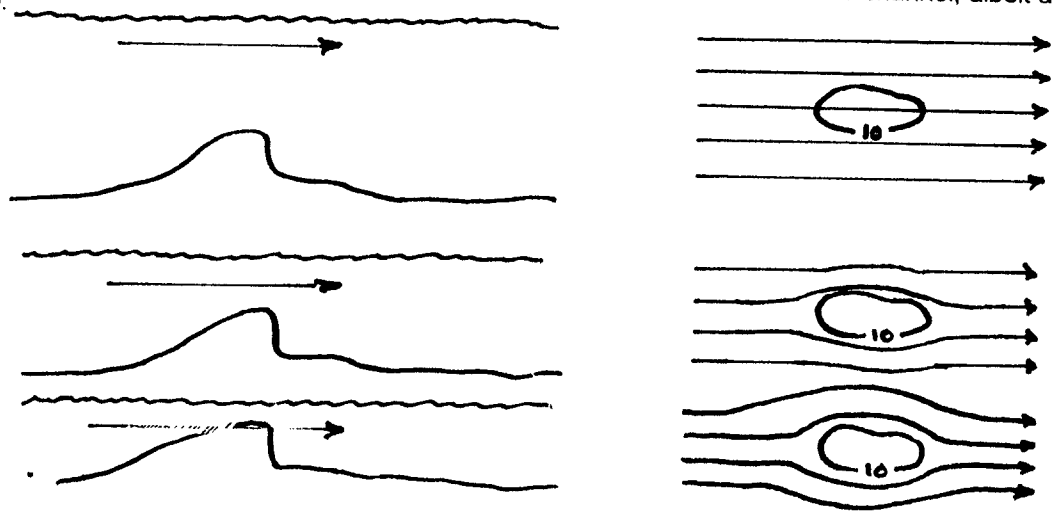


Fig. 343.

Terms Used

1. **Tidal Stream**. The sideways or horizontal flow of the sea, or waters connected to the sea, due to the changing gravitational forces of the sun and the moon acting on the earth.

2. **Set**. The 'set' of a tidal stream is the horizontal direction of flow of sea waters moving due to tide changes.

a. On a Tidal Atlas, the 'set' is shown by the direction(s) of a series of short arrows, darker arrows representing the main (stronger) stream:

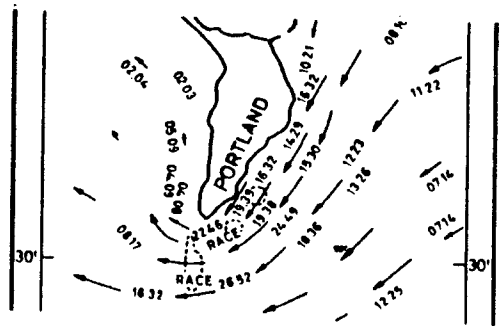


Fig. 344.

b. When used in a navigational 'vector triangle', the set is shown by three arrow heads in the centre of the line.

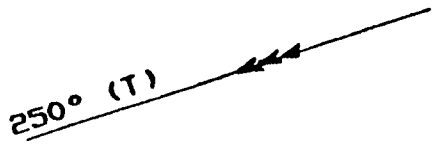
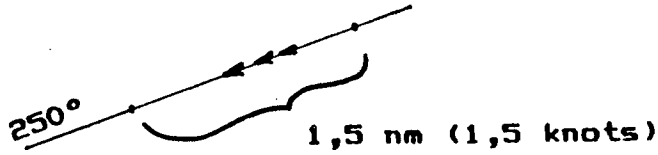


Fig. 345.

3. **Rate**. The rate of a Tidal Stream is its speed. It is always quoted in knots (nautical miles per hour), and in navigational vector triangles, the length of the "set" line (to scale) in miles and decimals of a mile is the rate of the stream. (This is the case when a '1 hour' time base is used for the vector, as is normal. If the time base is, say, halved to half an hour, the length of the set line must also be halved to keep the correct proportions for the rate.)

Fig. 346.



4. **Drift**. The 'drift' of a tidal stream is the distance a free floating object in the stream will move (due to the forces of the tidal stream only - e.g. excluding wind) in a period of time. If the rate is 2 knots, in 2 hours the drift will be 4 miles. In 45 minutes it would be 1,5 miles.

Sources of Tidal Stream Data

Charts.

Tidal Stream information for an area where these streams exist, is shown on the appropriate chart by a system of 'Tidal Diamonds' and 'Tidal Diamond Tables'. Adjacent areas where the stream's set and rate are the same or very similar, have a 'diamond' symbol containing a letter of the alphabet, printed at or near the centre of the applicable area. Elsewhere on the chart, so as not to cover any other areas' details, a table is printed with the applicable data. A typical example of how the diamonds appear on a chart is shown below, copied from British Admiralty training chart 5050:

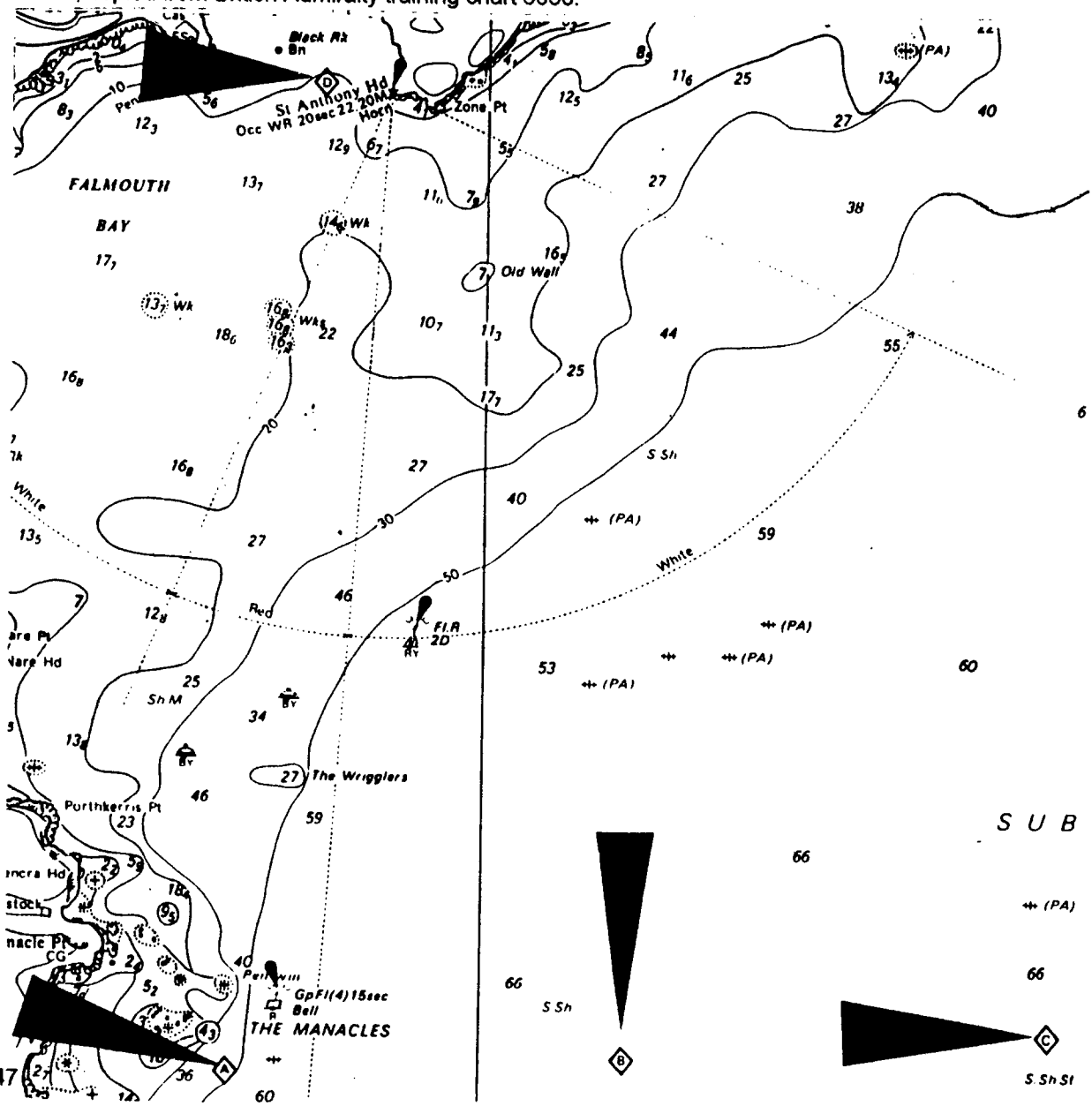


Fig. 347

The Tidal Table that appears on that chart is as follows:

Tidal Streams referred to HW at DEVONPORT

Hours		A 50°02·4N 5 02·3W			B 50°02·5N 4 58·7W			C 50°02·7N 4 54·8W			D 50°08·6N 5 01·5W			E 50°08·0N 4 52·3W			F 50°17·0N 4 26·6W			G 50°18·3N 4 10·8W			H 50°18·3N 4 07·7W			J 50°12·5N 4 05·2W		
		Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np	Dir	Rate (kn) Sp	Np
Before HW	6	201	1·0	0·5	216	1·0	0·5	217	0·7	0·4	338	0·2	0·1	222	0·4	0·2	253	0·6	0·4	236	0·7	0·4	297	0·8	0·4	266	0·8	0·4
	5	309	0·1	0·0	220	0·5	0·2	232	0·5	0·2	006	0·6	0·3	249	0·2	0·1	270	0·7	0·3	264	0·6	0·3	306	0·7	0·3	284	0·8	0·4
	4	006	1·0	0·5	293	0·1	0·1	277	0·3	0·1	022	0·9	0·4		*Slack*		282	0·5	0·2	316	0·6	0·3	307	0·6	0·3	294	0·8	0·4
	3	011	1·4	0·7	017	0·5	0·2	349	0·4	0·2	023	0·6	0·3	077	0·2	0·1	362	0·3	0·1	031	0·5	0·2	304	0·3	0·2	316	0·5	0·2
	2	015	1·5	0·8	029	0·9	0·5	014	0·7	0·3	022	0·4	0·2	037	0·4	0·2	040	0·5	0·3	047	0·7	0·4	092	0·3	0·1	059	0·4	0·2
	1	022	1·5	0·7	043	1·2	0·6	051	0·9	0·4	036	0·2	0·1	042	0·5	0·3	060	0·8	0·4	063	1·0	0·5	109	0·7	0·3	087	0·8	0·4
HW		028	1·2	0·6	043	1·2	0·6	060	1·1	0·5		*Slack*		040	0·7	0·3	072	0·9	0·5	081	1·0	0·5	110	0·0	0·4	099	1·0	0·5
After HW	1	030	0·5	0·2	040	0·7	0·4	069	0·8	0·4	217	0·3	0·1	036	0·5	0·2	084	0·9	0·4	111	0·8	0·4	111	0·8	0·4	110	0·9	0·4
	2	202	0·4	0·2		*Slack*		107	0·3	0·1	213	0·5	0·2		*Slack*		103	0·6	0·3	129	0·3	0·2	121	0·6	0·3	129	0·6	0·4
	3	196	1·2	0·6	214	0·5	0·3	212	0·4	0·2	207	0·7	0·3	210	0·2	0·1	136	0·4	0·2	235	0·3	0·1	156	0·3	0·2	170	0·2	0·1
	4	195	1·7	0·9	210	0·9	0·5	224	0·7	0·4	190	0·8	0·4	219	0·6	0·3	207	0·3	0·2	242	0·8	0·4	265	0·4	0·2	267	0·2	0·1
	5	197	1·6	0·8	213	1·3	0·6	220	0·8	0·4	180	0·5	0·2	211	0·7	0·4	241	0·6	0·3	226	0·8	0·4	284	0·7	0·4	271	0·6	0·3
	6	202	1·2	0·6	216	1·2	0·6	217	0·8	0·4	276	0·1	0·0	216	0·5	0·3	249	0·8	0·4	232	0·9	0·5	291	0·8	0·4	284	0·8	0·4

Fig. 348.

Note that it is headed by a statement saying that all the data at hourly intervals is with regard to the time of High Tide at the Standard Port of Devonport. So if on a day the HW Devonport is 12h00 GMT, 2 hours before 'HW Devonport' would mean 10h00 GMT on that day.

For each diamond's data, there are three columns:

1. Set. The direction of flow of the tidal stream during that hour. It is the same set regardless of whether it is Springs, Neaps, or in between the two extremes. The set at Diamond "B" which is at 50°02,5'N, 4°58,7'W, 4 hours before HW at Devonport, is "293°".

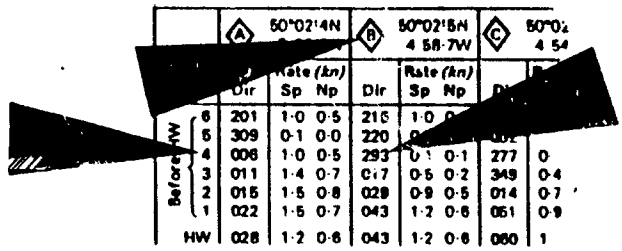


Fig. 349.

2. 'Sp' Rate (The Rate at Springs). This is the annual average rate of the tidal stream during Springs.

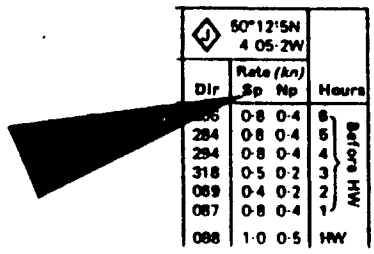


Fig. 350.

3. 'Np' Rate (The Rate at Neaps). This is the annual average rate of the tidal stream during Neaps.

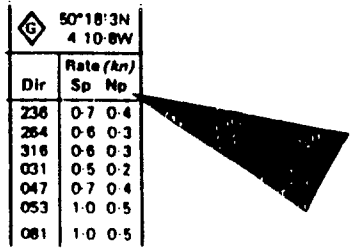


Fig. 351.

NB: Between Springs and Neaps, the rate of the tidal stream during any hour can be determined by interpolation.

'The Hour'. Let's assume HW is at 12h00 GMT. What time does '3 Hours Before HW' mean? 09h00? Yes, obviously, BUT for what hour does the set and rate quoted in the next two columns apply? 09h00 to 10h00, or 08h00 to 09h00? The answer is neither. The data for HW applies for a whole hour, just as each of the other hours' data. The only way the table's times can be translated so as to be consistent is as follows:

	Actual Time	Hours: From	To	Explanation
B 6	06h00	05h30	06h30	We find the exact time
E 5	07h00	06h30	07h30	of HW at the Standard
F 4	08h00	07h30	08h30	Port. The data applic-
O 3	09h00	08h30	09h30	able for the 'HW hour'
R 2	10h00	09h30	10h30	is used for 30 minutes
E 1	11h00	10h30	11h30	before to 30 minutes
HW	12H00	11h30	12h30	after the time of HW.
A 1	13h00	12h30	13h30	'1 Hour BEFORE' means,
F 2	14h00	13h30	14h30	therefore, 1 hr 30 min
T 3	15h00	14h30	15h30	to 30 minutes before
E 4	16h00	15h30	16h30	HW. All other 'hours'
R 5	17h00	16h30	17h30	are determined in the
6	18h00	17h30	18h30	same manner.

The Rate. The Springs and Neaps rates are quoted to the right of the 'set' ('Dir' - Direction) in the Tidal Diamond Table. The set applies without change regardless of whether it is Springs, or Neaps, or in between the two. The rate, if not Springs or Neaps, must be determined by estimation and / or interpolation. In doing so, we always 'round-off' to one decimal place of a knot. Here are some examples:

Sp	Np	No. of Days Since Sp/Np	Last one Sp or Np?	Estimated Rate
3,6	1,0	5	Sp	a (See
3,8	1,1	3	Sp	b next
3,5	1,0	4	Np	c page)
2,9	0,9	6	Sp	d
2,0	0,7	2	Np	e

1. **Step 1**. Check the Tide Tables to find the number of days between last Springs or Neaps (which ever was the most recent), and the next of either Springs or Neaps. It is usually 7 days, but sometimes 8 and even 9 days. We will assume 7 days for all our examples.

2. **Step 2**. Count how many days have passed since the last Springs or Neaps, whichever was the most recent. This number, with the '7' from the time interval between Springs and Neaps (Step 1), gives us the fraction of the change, from the 'Sp Rate' to the 'Np Rate' or vice versa, depending on which way the change is. In the first example above, it is 5/7.

3. **Step 3**. Find the difference between the 'Sp' rate and the 'Np' rate - in the first example above it is '2,6 knots'.

4. **Step 4**. Find the fraction (5/7 ths) of the difference in rates:

$$\text{Fraction} = \frac{5 \times 2{,}6}{7}$$

= 1,9 knots (to the nearest single decimal.)

5. **Step 5**. Change the last applicable rate, Springs or Neaps, by the amount of the fraction, towards the next to occur, Springs or Neaps:

Sp 3,6 - 1,9 = 1,7 knots.

The Tidal Stream Rate to be used on the day (five days after springs), when the hour before or after HW (at the Standard Port) shows the Sp and Np rates to be 3,6 and 1,0 knots respectively, is 1,7 knots.

So in the table of examples above, 'a' is 1,7 (knots). And:

b = 2,6 knots c = 2,4 knots d = 1,2 knots e = 1,1 knots

The Tidal Stream Atlas

There are two types of Tidal Stream Atlas; the Admiralty approved one appears as a series of sketch charts - one for each hour, and each showing the set and rate during that hour relative to HW at a specified Standard Port. The arrows showing the set are interrupted at intervals to show two 2-digit numbers, e.g. '09.15'. The first number, '09', relates to Neaps and means the Neap rate is 0,9 knots - the decimal indicator has been omitted. The second, '15', is the Spring rate and means 1,5 knots. One is required to interpolate between Springs and Neaps. This form of Tidal Atlas, as seen in books like Reed's and MacMillan's yachtsmens' almanacs, can only be used to find the set and rate of a tidal stream at a time. An example appears below:

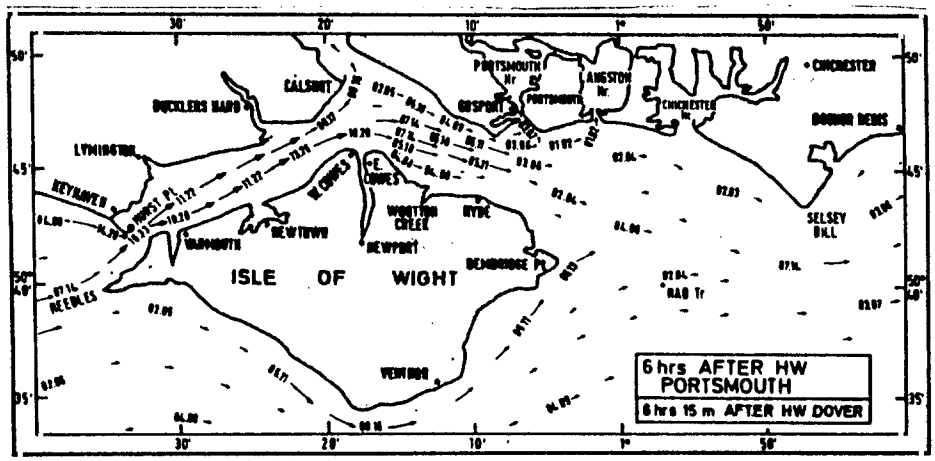


Fig. 352.

To get the set (direction) at any place, a protractor is placed over the chart with its centre on the direction arrow line of interest. Its is orientated so the 360° points to the top of the page, parallel to the left and right side margins. The direction required can then be read from the outer edge of the protractor.

Application of Tidal Stream Data

We have seen that the set and rate of a tidal stream is continually changing, and that, for practical convenience, both the set and rate 'averages' for each successive period of an hour are tabulated for the navigators' use.

Look briefly at Chapter 9, 'Navigation', and 'Estimated Positions', or 'Eps'. An 'EP' we defined as a position at sea which has been determined by the factors used in determining a 'DR' position (Direction, Time and Speed - the latter two giving distance), PLUS the factors 'current (or tidal stream) and/or leeway'. So if we know the set and rate of the tidal stream, we can calculate the EP at any time.

Equally if not more important, we can determine a course to steer to overcome the effects of the Tidal Stream which would otherwise push the yacht way off course.

Let's see how it works. Firstly, let's see the chartwork symbols used:

Course steered :

Ground Track or
Course Made Good (CMG) :
or C.O.G. (Course over the ground)

Current, or Tidal
Stream Set :

Fig. 353.

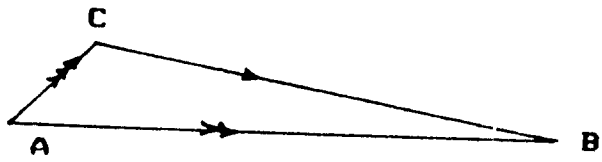
Assume we wish to sail from 'A' to 'B'. If there is no current and no Tidal Stream, we would convert the chart direction (degrees 'True') to a magnetic equivalent (add 'Var' if West), and then apply the deviation from the yacht's Deviation Card (add west, subtract east) to get the compass course to steer, and the

yacht will then sail along that line. If however there is a current or Tidal Stream present, the yacht will get "pushed" off course by an amount and in a way determined by the set and rate of the stream.

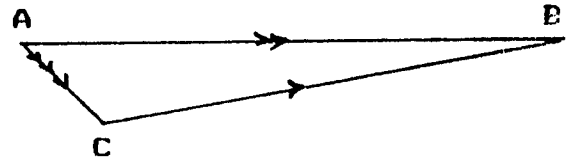
This is how it may be plotted on a chart:

Required course 090° T, yacht speed 6 knots, Rate 1,5 knots:

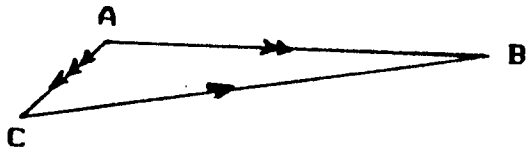
1
Set 045°



2
Set 135°



3
Set 225°



4
Set 315°

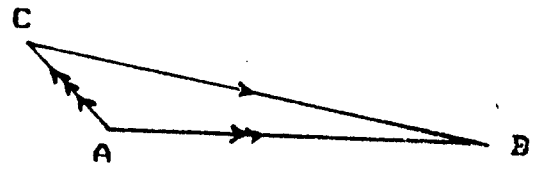
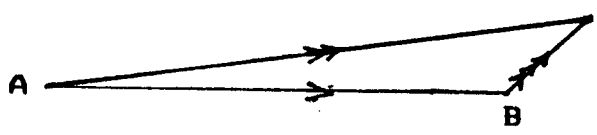


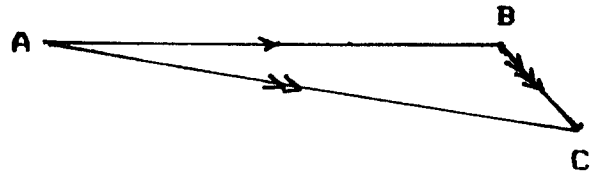
Fig. 354.

The scale used in the above figures is 10 mm : 1 nm. In every case, the course steered is CB, the set AC, and the CMG, AB. If the yacht is making a speed of 6 knots over the water, in the one hour time frame used for the vector triangle, the yacht actually moves the length of line CB (or CB1, CB2, etc) in 1 hour - the scale measurement of that line converted to 'nm' will give the actual speed achieved in knots - the distance moved in the hour, or 'Speed Made Good' ('SMG' or 'SOG', 'Speed over the ground'). If the set and rate of the Tidal Stream is ignored the course (and speed) made good will vary and where one will end up depends on the Tidal Stream:

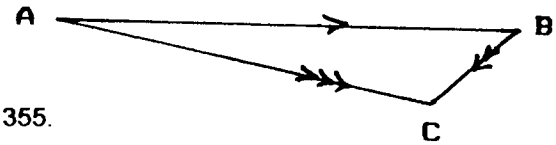
1



2



3



4

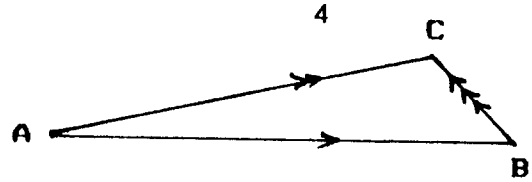


Fig. 355.

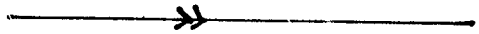
To consolidate:

We have two choices; make allowance for the tidal stream from the start of the journey (to counteract it), or ignore it and end up in a place other than that intended.

In the first case (counteract it from the start):

1. The line you wish the boat to travel along becomes the Course Over the Ground (COG)/Ground Track.

Fig. 356.



2. Rule the 'Set' line from the start of the Ground Track. Measure from the start point along the Set line a distance to scale equal to the 'Rate' of the Tidal Stream.

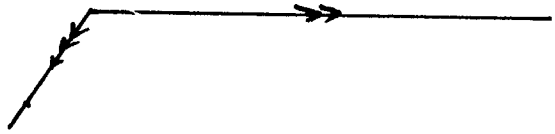


Fig. 357.

3. From the 'downstream end' of the Set/Rate line (at the mark made as in 2. above) measure the boat's speed to scale so that the other end of the speed line intersects the Ground track/COG/CMG.

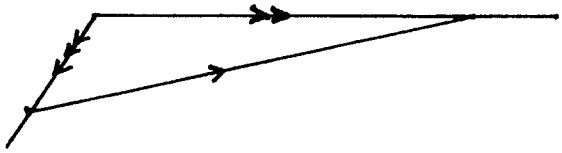


Fig. 358.

4. The direction of the last line ruled, the boat's speed line, is the 'Course to Steer'. A measure of the length of the Ground Track (or CMG/COG) will give the SMG (Speed Made Good) or SOG (Speed Over the Ground).

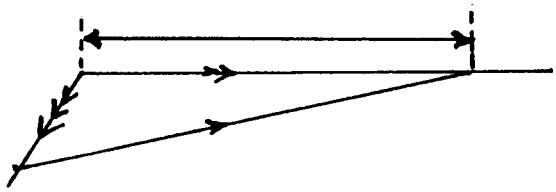


Fig. 359.

In the second case (i.e. where will we end up?):

1. Rule a line, representing the course being steered, from the start to the end of that course.

Fig. 360.

2. Measure to scale, back from the end point a distance equating to the boat's speed - distance per hour.

Fig. 361.

3. From the end point, rule a line representing the 'Set' and measure off to scale the 'Rate' - the distance per hour of the Tidal Stream (or current).

Fig. 362.

4. Rule a line from the point measured in 2. above, to the 'downstream' end of the set/rate line (to the measured length mark as in 3. above). This line becomes the Ground Track or COG/CMG, and a measure of its length will give the SMG/SOG.

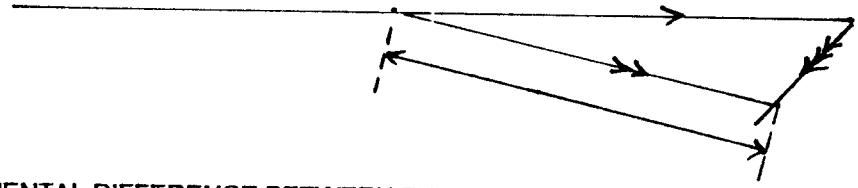


Fig. 363.

NOTE THE FUNDAMENTAL DIFFERENCE BETWEEN THE TWO ACTIONS: in the first case, the course to steer is from the 'downstream' end of the set/rate line back to the line joining the start and end points of the course. In the second case the course steered is on the line joining the start and end points. Both are the length, to scale, of the boat's speed ON the water.

So lets' do an example.

We wish to sail from Murray Harbour (Chart SAN 3002, Robben Island) to an imaginary marina at Bloubergstrand (east of Murray Harbour). We rule a line joining the two places, and see it is a direction of 095°T. We measure the distance and see it is 4 nm. Our boat speed will be 5 knots (estimated). We expect to leave at 0900 SAST (South African Standard Time) and see that tidal diamond "A" refers to the area we are to sail through. We look up the Tide Tables for Cape Town for the day and see:

Mon	0513	0,6
23	1125	1,9
	1731	0,5
	2348	1,8

We see that it is four days after Neaps (3 days before Springs). As HW is at 11h25 and we wish to sail at 09h00, we will be sailing in the "2 Hours BEFORE HW Cape Town":

HW	1055	to	1155	(HW is at 1125 - in the middle of this hour period).
1 Hour Before	0955	to	1055	(We ignore 5 minutes from 0855 to 0900 - it is too small).
2 Hours Before	0855	to	0955.	

The Tidal Diamond Table for "2 hours before HW Cape Town" indicates the set to be 167°(T) and the rates (in knots) to be Sp = 1,0 and Np = 0,5. The difference between the two rates of 0,5 and 1,0 is 0,5. 4/7 ths of 0,5 is 0,3 (to the nearest single decimal). The tide is changing from Neaps to Springs so the rate today will be 0,8 knots.

We go to the chart and plot the set (167°), mark off the 0,8 nm mark, and measure 5 nm from that mark to the line from the harbour to the marina. The last line gives the course to steer and the length of the Ground Track between the marks gives SMG -the course to steer is 087°True (110°Magnetic) and SMG 5,3 knots.
(True, Magnetic and Compass courses are explained in the next Chapter, where exercises for you to do are also to be found.)

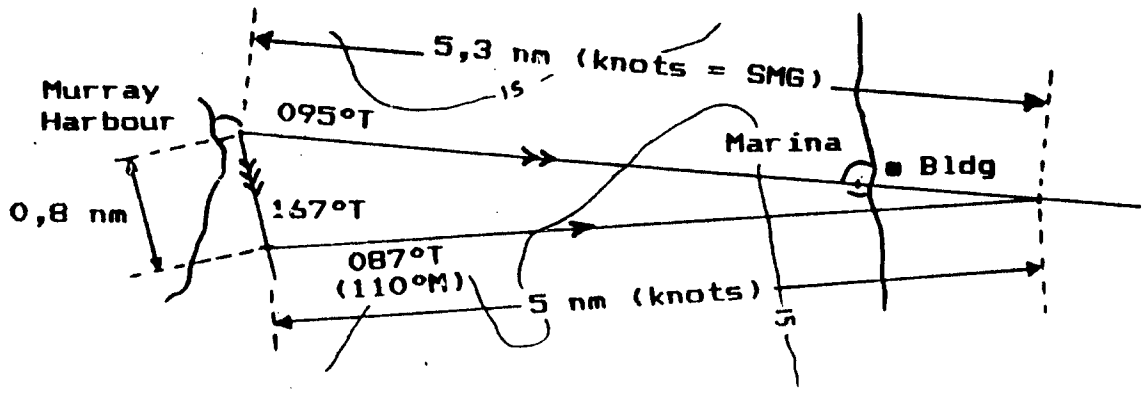


Fig. 364.

NOTES

CHAPTER 9

INTRODUCTION TO NAVIGATION

What is 'Navigation?'

'Navigation' can be defined as the art of guiding a person, persons or vehicle(s) (motor vehicle, aircraft or ship) across the land, air or sea, SAFELY from one place to another.

We are concerned with navigating at sea near land. The presence of the land enables the navigator to use many different methods of determining a vessel's position, and thereafter, plan the course to steer to get to a place. The navigator has tools to assist in performing this task.

Basic Tools for Navigation

The Earth's 'Rings'

Our round earth spins on its axis which passes through the poles, and for convenience, we split the upper half from the lower half by an imaginary circle around the earth which we call the equator. The top half we call the northern hemisphere and the pole in that hemisphere we call the North Pole. The bottom half is the southern hemisphere, and at the bottom we have the South Pole.

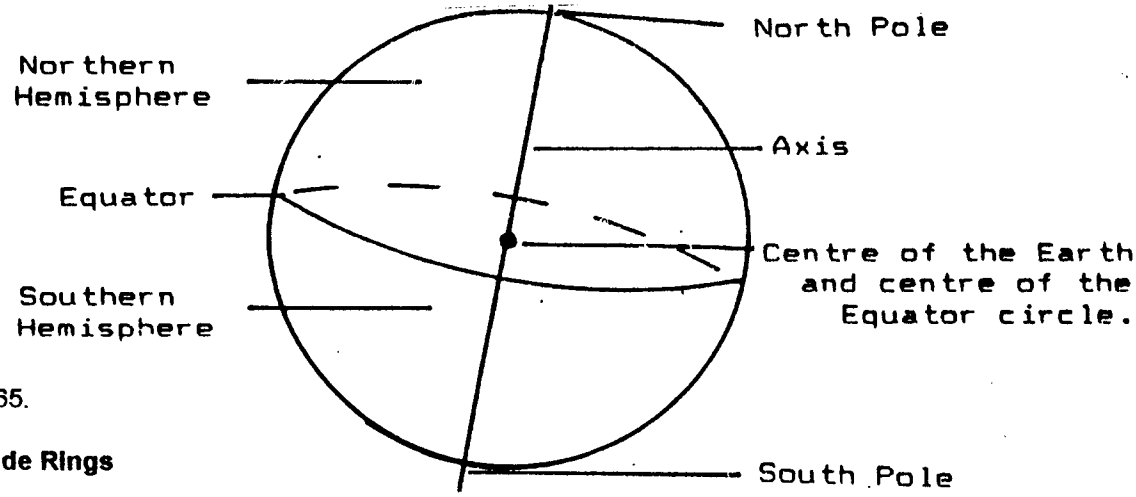


Fig. 365.

Latitude Rings

The planes of rings around the earth which are parallel to the plane of the equator, facilitate an angular measurement at the earth's centre, of how far the rings are, north or south, relative to the equator. We call the angular measurement from the equator, the latitude. Note also that the further these rings are away from the equator, the shorter their circumferences become. See Figure 366 on the next page.

Meridians

There are also imaginary circles which have their centres at the centre of the earth and whose circumferences pass through both poles. Therefore, any part of the circumference of any one of these rings is always in a 'north - south' line. If we use one half of one of these rings, from a pole to the other, as an angular reference 'zero line', we can measure at a pole the angle formed between that reference line and any other half-ring joining the poles. These half-rings we call meridians, and the reference meridian has been universally accepted as that meridian which passes through a specific spot in Greenwich, England. It is, therefore, called the Greenwich Meridian (often just called 'Greenwich') and all other meridians (one can imagine as many as one likes at differing angles apart) can be stated to be an angle east or west of the Greenwich Meridian, up to 180°. The angle between the Greenwich Meridian and any other meridian is a measurement of the latter's longitude.

Position

The position of a place (or ship) can be expressed as being at the intersection of a ring of latitude and a

meridian of longitude. The position is ALWAYS stated 'Latitude first, Longitude last'. For example (see charts 5050 and SAN 3002), Manacle Point is '50°03' North, 5°04' West', and Cape Town '33°55' South, 18°25' East'.

(Often the 'North' and 'South' are written as 'N' and 'S', and the 'East' and 'West' as 'E' and 'W'.)

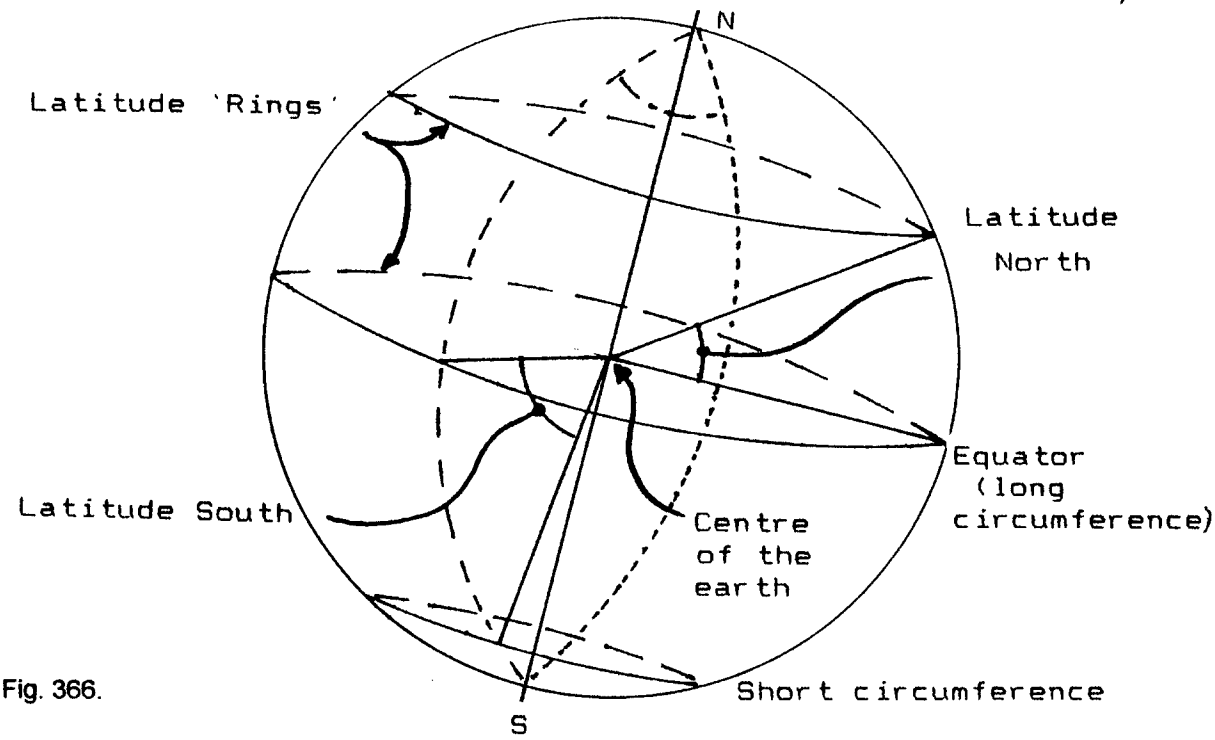


Fig. 366.

Position can also be expressed (note the sequence) as 'Direction (from a known /marked point on the chart), Place (that point) and Distance (in nautical miles)', e.g. '135°T (*), Gibraltar Lighthouse, 15 nm'. (*For 'T' - see the bottom of page 161.)

CHARTS

The primary tool for any navigator is a chart. The way a chart is constructed is called its 'projection' - we use Mercator Projection charts whose longitude (left to right, East to West scale is constant but whose latitude (up and down, vertical scale) increase the further we go from the equator:

MERCATOR PROJECTION

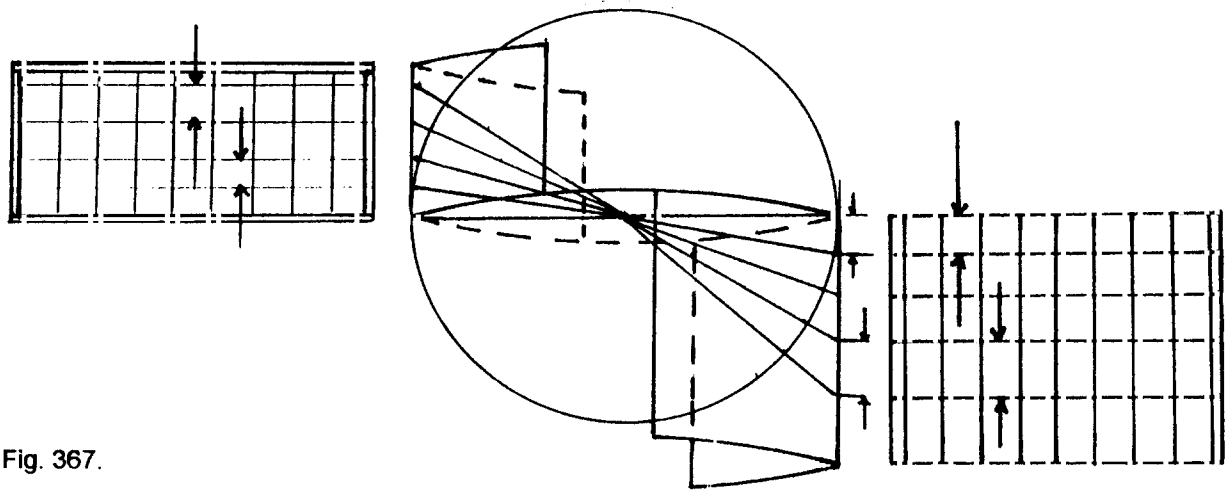


Fig. 367.

A small scale mercator projection chart and a large scale chart's vertical scale are illustrated in Figure 368.

The bigger the scale of a chart, the smaller the area of the earth it shows, and the shorter the distance of land or sea from one end of the chart to the other, BUT therefore the more space available on the chart for more detail to be included. Conversely, the smaller the scale, the greater the area of the earth shown

on the chart, the longer the distance of land or sea from one end of the chart to the other, and the less detail that can be shown.

A chart's scale may be shown to be, for example, '1:100 000' (one in one hundred thousand) meaning one unit of length on the chart (let's say one centimetre) represents one hundred thousand units (centimetres) of the land. A '1:50 000' scale chart is regarded as a very big scale chart as it shows a small area in great (big) detail, but a '1: 250 000' is a small scale chart as it shows a large area and can therefore only show small detail. REMEMBER: Big scale, big detail (small area); Small scale, small detail (big area).

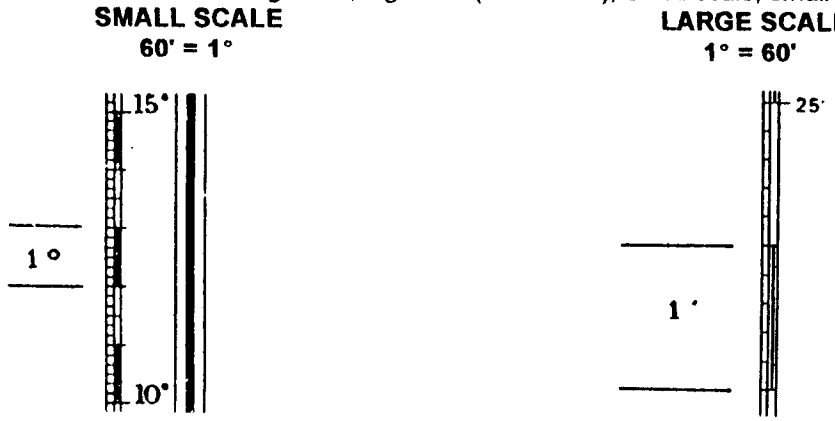


Fig. 368.

We measure distances on a Mercator chart using the side vertical scale only - horizontally opposite the area of interest. This is to ensure we get the right proportion of scale depending on the distance from the equator:

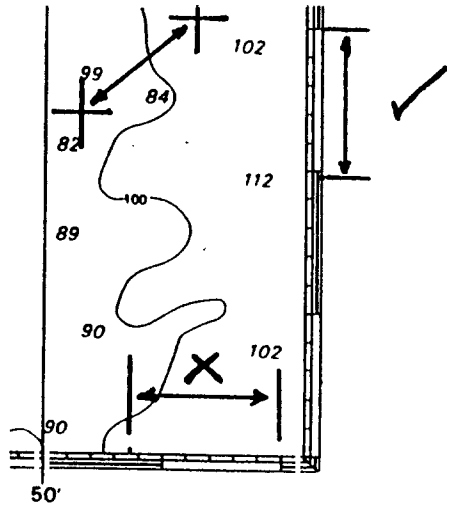


Fig. 369.

Distance is measured in nautical miles (abbreviated M or nm); we NEVER use kilometres/kms. Distances involving a fraction of a mile are shown as a decimal of a mile to the nearest single decimal only, e.g. 6 M, 7,3 M, or 6 n.m., 7,3 n.m., not 7,33 M.

A Nautical Mile is the length on the surface of the earth of an arc of a Great Circle (for this definition, the equator) subtended by an angle at the centre of the earth of one minute (1'). It is 1 852 metres long which is over 200 metres longer than a statute (land) mile.

A Cable is one-tenth of a nautical mile (185,2 metres or +/- 200 yards).

A Great Circle is ANY circle around the earth whose centre is also the centre of the earth.

The shortest distance between any two places on earth is a measurement of the shortest arc of a great circle passing through both of those places.

A Rhumb Line course is a straight line course on a Mercator Projection chart. Unlike other projection charts, it has the advantage that the compass heading being steered does not change - the angle the course makes with successive meridians is constant. We use Rhumb line courses/Mercator Projection charts.

Let's get back to charts.

Charts are framed by a black ruled border. Outside the border, at the top left and bottom right hand corners, is the **Chart Number**. Outside the bottom edge starting at the left corner is the record of corrections to the chart. Corrections to charts are made as a result of amending instructions being published in '**Notices to Mariners**' - notices are serially numbered from '1' upwards from the start of each year, so the chart is marked with the year and notice number to indicate that the correction has been done to the chart. For example, '1990 . 14 . 39' would mean that '**Notices to Mariners**' numbers 14 and 39 of 1990 had correcting instructions for this chart AND that they have been applied to this chart. The third and last piece of information outside this black margin is the detail of printing showing when it was printed, who printed it, the date of the latest edition, etc.

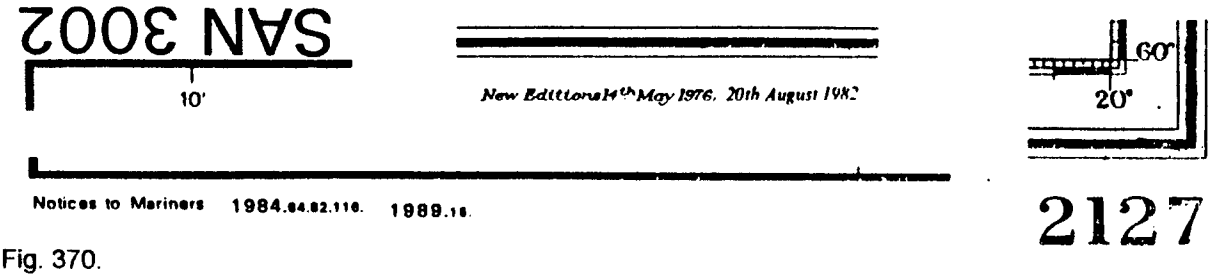


Fig. 370.

The black framing margin contains the longitude scale and longitude angle (with reference to the Greenwich Meridian to give the actual longitude) along the top and bottom horizontal margins, and the side vertical scale shows the latitude scale and latitude angle (with reference to the equator to give actual latitude). Notice how distance is measured on the vertical latitude scale - each 1' is 1 nm and the length of line for 1' is subdivided into five equal parts representing 0,2 nm each. For odd number decimals we estimate or 'interpolate'. Remember, we only work to one decimal place of a mile.

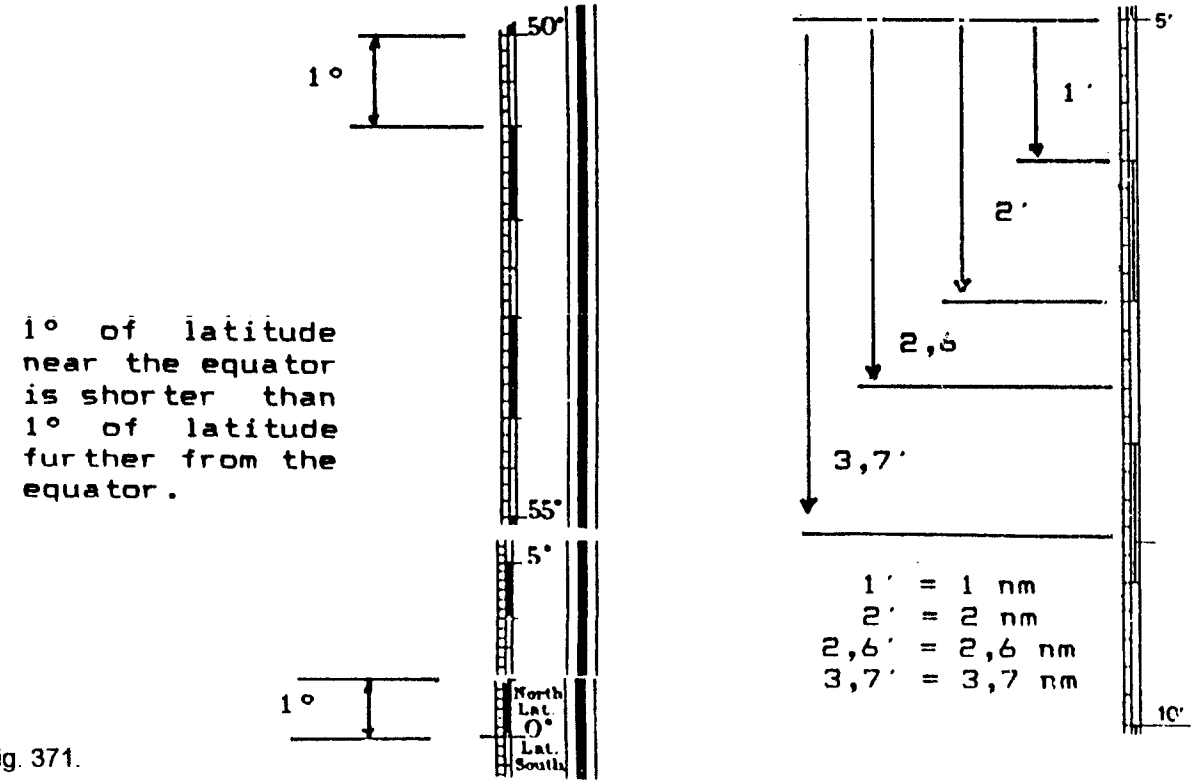


Fig. 371.

Chart Statement

Inside the framing margin, usually near the top of the chart providing it does not obscure any relevant land, coast or sea area, we find the Chart Statement which comprises most of:

1. The publishing authority's crest.
2. The title of the chart e.g. 'Atlantic Ocean'.
3. The type of 'projection' used in the make-up of the chart e.g. 'Mercator Projection'.
4. The scale of the chart.
5. The reference or datum from which all heights above sea level are measured, and the units of measurement used e.g. feet, metres.
6. The reference datum from which all depths are measured, and the units of measurement of depth e.g. feet, fathoms or metres.
7. 'Notices', 'Warnings' and/or 'Cautions' applicable to navigating in the area depicted by the chart.
8. A table headed 'Tidal Levels Referred to Datum of Soundings'.

(It may also have a separate table for 'Tidal Stream' information - see Chapter 8 or Admiralty Chart 5050 or Chart SAN 3002.)

Look at a chart and study the statement - not every chart's statement is the same although they are similar. Look at the statements on the British Admiralty chart 5050 and SAN 3002. The 'SAN' in the number indicates 'published by the South African Navy'.

Chart Symbols and Abbreviations

Charts representing large areas do not have enough space to fit in all the detail and names, explanations, descriptions, etc. Therefore a universal system of symbols was accepted by the world's maritime nations, and these, together with the abbreviations used on English language charts, enable the charts to remain relatively uncluttered yet contain a wealth of information. The complete list is available in the book (or in chart form - same number) British Admiralty 5011, or South African SAN 3001).

Conversion Scale

A conversion scale for converting units from one type to another is usually included on large-scale charts. An example, using part of the table from chart SAN 3002, appears below:

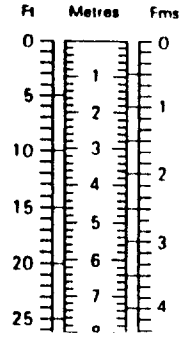


Fig. 372.

The Compass Rose

A **Compass Rose** appears in either two or three places on a chart. Look at the compass rose from the south-west of Cape Point on chart SAN 3002 (shown on the next page).

Notice that the outer ring showing the 360° graduations of a circle is orientated to point the 360° (or 000°) mark towards the north pole, or to '**True North**'. It is then called '360°T'. The inner ring also shows 360° but it is orientated to point its 360° mark in a different direction. The direction it is pointing is towards the magnetic North Pole or '**Magnetic North**' as it appears from that place. As the influence of the earth's magnetic field varies according to the place on earth, the difference in directions to the true and magnetic north poles will differ depending on where it is measured.

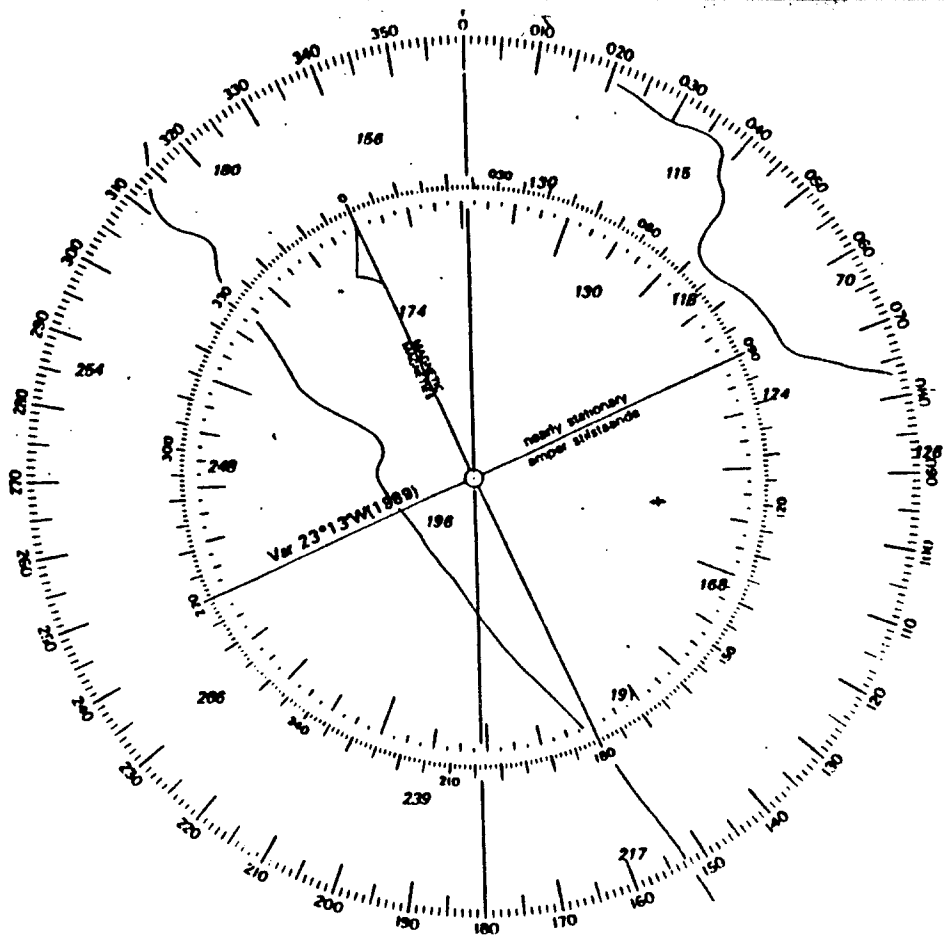


Fig. 373.

Variation

The compass roses on a chart are there to inform the navigator of the magnitude of the magnetic effect on the compass, or 'magnetic variation', in the vicinity of those compass roses. The navigator uses the information from the compass rose nearest to the relevant area. At the centre of the compass rose is a statement of what the angle difference is, between the directions 'True North' and 'Magnetic North', as measured at that place. This direction towards the Magnetic North may be east or west of the direction to True North. (In the Atlantic and Indian Oceans it is west: in the Pacific Ocean it is east.)

In Fig. 373 it is '23°13'W (1989)'. The year is stated because the magnetic north pole is not stationary - it is moving, albeit very, very slowly. This results in a calculated forecast of annual rate of change to the magnetic variation and this information appears near the centre of the compass rose. In Fig. 373 it is shown as 'nearly stationary' (i.e. too small to worry about!) but the compass rose in False Bay shows 'increasing 1' annually' So in 1992 the variation is:

23°13'W
+3' (3 years since 1989 at 1' per year)
23°16'W

We always do this updating sum to correct to the present year, then, although it seems as if we have wasted our time, we 'round-off' to the nearest integer (whole number) of degrees.

So in False Bay, variation will be 23°W until the year 2006. In 2007 the sum works out at 23°31'(W) which is closer to 24°W when rounded off.

It may seem a pointless exercise, but it must be remembered that not all charts that the navigator uses were published in recent years. An old chart, for a place where the annual rate of change of variation is large, may result in an updating calculation correcting the printed variation by several degrees. If this is ignored, it could mean the difference between a safe passage and landing on rocks.

To convert a direction's description from a 'True' direction to a 'Magnetic' direction, look at Fig. 373. Take a soft lead (B2) pencil and a ruler and rule three or four lines from the centre of the rose, in different directions, so that the lines cross both the rings. Each line ruled represents a direction, and, because

variation is 'west', the number of degrees read from the scale on the outer (True) ring is seen to be smaller than the number on the scale on the inner (Magnetic) ring. The actual direction is the same, in line with the pencil line(s) ruled, but the True and Magnetic numbers of degrees differ BY AN AMOUNT OF THE VARIATION (i.e. 23°). Since variation is west, the magnetic number IS ALWAYS the bigger of the two numbers.

So when variation is 'West', the magnetic number is bigger, or 'Best'. We remember this by saying:

'Error west, compass best'

where the 'variation' is called 'error'.

Any calculation converting a 'True' direction to a 'Magnetic' direction requires the (westerly) variation to be added.

To convert a 'Magnetic' direction to a 'True' direction the (westerly) variation must be subtracted.

Getting this wrong has resulted in many a vessel's grounding.

Until one is 100% familiar with this conversion procedure, OR WHEN ONE IS TIRED, write it down when doing the calculation - and if possible get someone else to check - don't be proud, it could cost you the vessel and one or more lives. It is surprising how easy it is to make simple arithmetic errors when one is tired, or cold, or both!

MOST NAVIGATION ERRORS RESULT FROM SIMPLE ARITHMETIC ERRORS.

Course to Steer (or 'To Lay off a Course')

When a magnetic course to steer is needed, begin by placing a parallel rule or plotter on the appropriate chart, and ruling a pencil line (soft lead, do not press hard) from the start point to the destination. If this would result in the course crossing an area where the vessel should not go (e.g. restricted area or shallows), an intermediate turning point - called a waypoint - is used to 'go around' the obstacle. There will be two straight line courses, not one. Or there could be more, with two or more waypoints.

The parallel rule is orientated along the line(s) ruled (one at a time), then 'walked' to the compass rose so that one edge is aligned with the centre of the rose. Rule a pencil line from the centre of the rose in the direction the course will require the vessel to go, crossing the inner and outer rings of the rose. The outer ring gives the True direction and the inner ring the Magnetic direction.

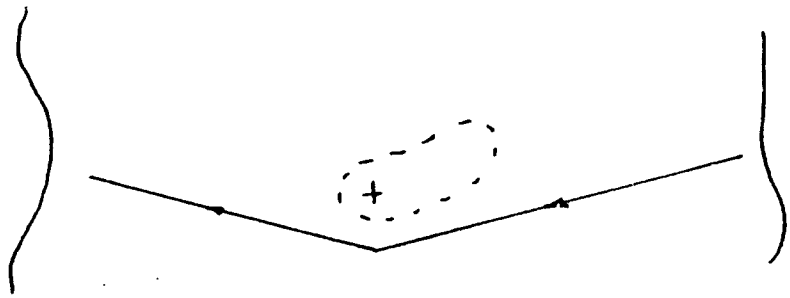


Fig. 374.

If the chart is old and the annual change in variation large, the inner ring will be somewhat out of orientation. In addition, on small-scale charts showing a whole ocean, the compass rose does not show an inner ring, but instead shows the equivalent of contour lines joining all points of the same variation, leaving it up to the navigator to interpolate the variation at the place of interest. In these two cases, the navigator must read the 'True' degrees, and convert to 'Magnetic' by adding the westerly variation or subtracting the easterly variation.

If 'True' (T) = 330°, and 'Variation' (V) = 23° W, 'Magnetic (M) = 353°. To avoid confusion as to which numbers of degrees are True and which are Magnetic, we write 'T' or 'M' after the number.

So we could have written 330°T + 23°W = 353°M.

(The 'M' here is not to be confused with the 'M' which means 'miles': since the 'M' here follows the degree symbol, it must refer to 'Magnetic' e.g. 235°M.)

If we know the Magnetic direction and need the True direction:

353°M - 23°W = 330°T

(Since the True is always smaller than Magnetic when 'Var = W'.)

Line of Position

While sailing along that course, the navigator may wish to take a magnetic bearing from the vessel to a lighthouse using the vessel's Hand-Bearing Compass. Its readings are 'Magnetic'; as it is not used in one fixed position, Deviation - see below - is not consistent and is ignored. BUT we normally try to use this compass in one place, as high up as is practical, so deviation is minimized and the same; it is as far from other onboard magnetic metals as possible. The steering compass is used for bearings where possible, as accurate deviation is known.

The magnetic reading that is obtained is converted to a True direction by subtracting the westerly (or adding the easterly) variation. By reversing the process with the ruler, orientating it along the True direction calculated and compass rose centre-point line, then 'walking' it to the lighthouse on the chart so that one edge of the ruler lies on the middle 'dot' of the lighthouse symbol, a pencil line can be ruled from the lighthouse to seaward, representing a line along which the vessel was located at the time the bearing was noted. This line is called a Line of Position, or (LOP). Two bearings taken in quick succession, a second from another land feature, will intersect at the observer's (the navigator's and therefore the ship's) position at the time the bearings were taken.

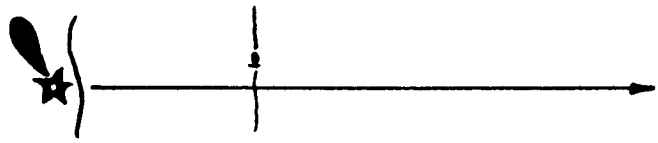


Fig. 375.

The same reverse procedure can be used if a magnetic course is being steered and it is desired to plot this course on a chart. Since charts are orientated to True North, we need to know the True equivalent of the Magnetic value obtained from the compass. (We could, however, use the inner Magnetic ring in the compass rose on the chart.)

Deviation

The course steered according to the ship's steering compass, which is mounted directly in front of the helmsman, is not always the Magnetic direction. Every vessel has some amount of 'magnet-affecting metal' in its make up, such as the engine, tanks, mechanical and electronic equipment on board, tools, etc. These metallic objects affect the compass, and they affect the compass by differing amounts depending on whether the vessel is facing north, south, east or west - or any other direction. The effect is called deviation. See Figure 376.

Swinging the Compass

To establish what the deviation of a compass is on any particular ship's heading, the first step is to obtain the services of a qualified 'compass adjuster' who will 'Swing the Compass'. This process of swinging the compass involves sailing the vessel away from the immediate surrounds of other metals into 'open' water, then slowly turning the vessel through 360° and checking the compass readings against known calculated values of what the compass should read. Transits and conspicuous objects on land are used for this check. Any difference is the deviation, and the compass adjuster will attempt to adjust the compass's 'compensating magnets' to get the deviation to a minimum on all headings. Once the adjusting process

has minimised the deviation, any remaining deviation is reported to the vessel's skipper in the form of a Deviation Card. (If there is no qualified adjuster available for the task, DO NOT attempt to adjust the compass. Determine the deviations as described above, short of doing the adjustment.)

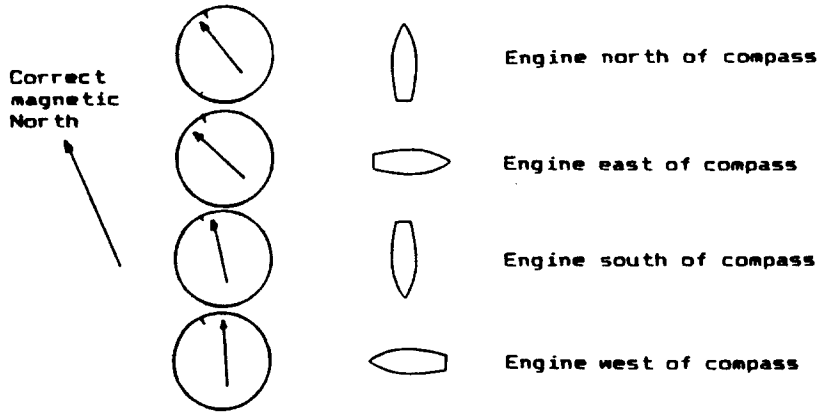


Fig. 376.

The Deviation Card supplied to the skipper must remain on the vessel. It can take the form of a table of deviations (corrections - see below) or a graph, see Figure 371.

TABULAR DEVIATION CARD

Ship's Name: .....

Date: ..... Name/type of compass: .....

Compass	Deviation	Magnetic	Compass	Deviation	Magnetic
361°	1°W	360°	178°	2°E	180°
24,5°	2°W	022,5°	199,5°	3°E	202,5°
048°	3°W	045°	222°	3°E	225°
070,5°	3°W	067,5°	245.5°	2°E	247,5°
092°	2°W	090°	268°	2°E	270°
113,5°	1°W	112,5°	291,5°	1°E	292,5°
135°	0°	135°	314°	1°E	315°
156,5°	1°E	157,5°	337,5°	0°	337,5°
178°	2°E	180°	361°	1°W	360°

Fig. 377.

TABULAR DEVIATION CARD

Ship's Name: .....

Date: ..... Name/type of compass: .....

5°	4°	3°	2°	1°	0°	1°	2°	3°	4°	5°
					Magnetic					
					045°					
					090°					
					135°					
					180°					
					225°					
					270°					
					315°					

Fig. 378.

Graph deviation presentations are rare these days, most vessels having the tabular layout card. A compass should be readjusted (re-swung) every three years or whenever there have been major changes to equipment holdings or positions.

When taking deviation into account, if deviation is 'West' on a particular ship's heading, we apply the westerly deviation to the equation just as we did the westerly variation.

First we change the True direction to a Magnetic direction by adding the westerly variation. Then we change the Magnetic direction to a 'compass direction' by adding westerly, or subtracting easterly, deviation. Remember:

'Error west, compass best (bigger)'.

If the error, variation and / or deviation, is /are WEST, the compass number is BEST (bigger). Compass is 'bigger' than Magnetic which is bigger than True.

Error east, compass least (smaller)

If a vessel is sailing south, 180° T (True) where magnetic variation is 23° W (West), the magnetic course will be:

T	V		M
180°	+ 23° W	=	203°

"+" because V (variation) is west and M must be bigger, and the compass course, using the Deviation Card in Figure 377, will be:

M	D		C
203°	- 3° E	=	200°

"-" because D (deviation) is east and C must be smaller (least).

We can put it all in one line:

T	V		M	D		C
180°T	+ 23°W	=	203°M,	- 3°E	=	200°C

Notice how each number of degrees has a letter behind it so that there can be no confusion as to what each is. This is most important when any one number is written on its own. For example, to write in the log book that the ship's course was '275°' is ambiguous - is it 275° True, Magnetic, or Compass? A bearing to a lighthouse stated as '145°' could be True or Magnetic. A letter behind the number removes all confusion.

If we know the compass course being steered by the helmsman, we can find the True equivalent in order to plot it on a chart by working the arithmetic backwards (and reversing the plus and minus signs).

T	V	M	D	C

becomes

C	D	M	V	T

and

C	D		M	V		T
200°C	+ 3°E	=	203°M,	- 23°W	=	180°T

It is often necessary to interpolate when using the Deviation Card - we use the nearest Magnetic heading shown on the card to that being steered or to be steered, to read off the deviation. It may also be necessary to interpolate the number of degrees of deviation in the rare case of a difference of 2° or more between successive deviations shown.

Deviation and the Deviation Card apply to the ship's steering compass. The compass is mounted in a fixed position relative to the ship's 'interfering' metals, and the Deviation Card's values remain valid for any heading of the ship. The hand-bearing compass, on the other hand, is seldom used in or from the same place every time it is brought on deck, and therefore a Deviation Card would be necessary for each

position or place it is used. This is not practical, so we use no deviation at all with this compass. To minimise the disturbing influences of other metals on the vessel, we use this compass as high as we can and as far as we can get it from the ship's compass and other metals. The minimum distance it should be from the steering compass is approximately two metres. When moving away from the ship's steering compass, do not move close to other interference sources e.g. the metal in items included in the life-raft and strong magnets in loudspeakers of music hi-fi's mounted just under the deck.

Speed

Everyone knows that motor cars travel at speeds described as 'miles per hour' or 'kilometres per hour'. In marine terminology we use the term 'Knots'. A knot is the unit of speed of a vessel at sea, and is one nautical mile per hour. To say 'knots per hour' is wrong because it translates to 'nautical miles per hour "per hour"'! Since the nautical mile is longer than the statute (land) mile, knots do not apply on land.

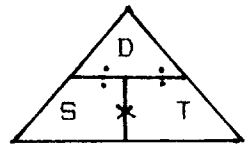
As 'speed' is determined by miles (distance) per hour (time), if we know any two of these values we can calculate the third.

Remember the triangle:

Speed = $\frac{\text{Distance}}{\text{Time}}$, and

Time = $\frac{\text{Distance}}{\text{Speed}}$, and

Distance = Speed X Time.



$S = \frac{D}{T}$

$T = \frac{D}{S}$

$D = T \times S$

So, if a vessel has to cover a distance of 30 nm and it sails at 6 knots, it will take 5 hours to do the trip. Also, if a vessel covers a distance of 15 nm in 2 hours, its speed is 7,5 knots. Similarly, a vessel travelling at 5 knots for 4 hours will cover a distance of 20 nm.

Directions

Directions (courses, set, bearings, etc.) of less than 100° must have a zero first so that there are always three digits, and if the direction is less than 010° it must have two zeros first for the same reason. Only angles such as variation and deviation may have less than three digits. So we could have 300°, 030° or 003°, all being directions. Directions should also always be qualified as T, M, or C.

Chartwork Symbols

As more than one person usually gets involved with the navigation, a common system of chart markings, is necessary. Marking a chart with courses lines, chartwork symbols, etc, is called 'Plotting'. Let's look at the symbols for chartwork.

Course Steered

Fig. 379.

This is represented by a line on the chart showing the direction the vessel is pointed as it proceeds on its way. The single arrowhead is near the centre of the line. The course, although ruled in the direction of its True number of degrees, may have the number of degrees as True, Magnetic or Compass, T, M or C, stated/written along the line.

Ground Track (or Course Made Good - CMG, or Course Over the Ground - COG)

Fig. 380.

Although a vessel may be pointed in a direction while sailing, wind or a current or tidal stream may cause the vessel to 'slip sideways'. This sideways slip, if due to wind, is called 'leeway'. A current or tidal stream causes a vessel to drift sideways off the course steered. The resulting route taken by the vessel above/over the ground (the sea bed below) is called the 'ground track' - sometimes also called the 'Course

Made Good', abbreviated to 'CMG'. Notice the CMG has two arrowheads near the centre of the line. The direction, T,M,or C, may also be written next to this line, as for course steered, above.

Set

Fig. 381.

The direction of the current or tidal stream, called the 'Set', has three arrowheads near the centre of the line. The direction of the set is always ONLY expressed in relation to True headings. The direction, True, may also be written next to the set line on the chart.

Line of Position (LOP)

Fig. 382.

Here the single line, like the line from the lighthouse in the earlier explanation of an LOP on page 164, has one arrowhead at its seaward end. The direction, as True or Magnetic, SHOULD be written along this line or near its seaward end as well as the Time it applied and the ship's Log reading (distance travelled counter) at that time.

Advanced or Transferred LOP

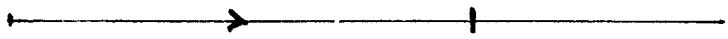
Fig. 383.

Where it is required to plot a line parallel to a LOP, the parallel line is called an 'Advanced' or 'Transferred' LOP - it has no separate abbreviation. It is denoted by the two arrowheads at the end of the line, optionally two arrow heads at both ends of the line.

Position of a (Vessel)

1. DEAD RECKONED or 'DR' POSITION

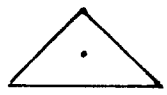
Fig. 384.



A short line crossing the course line at right angles, or a cross at the spot, indicates a 'DR' or Dead (from 'Deduced') Reckoned position. It is obtained from taking into account only the factors direction, time, and speed (time and speed give distance). It ignores factors of current/tidal stream set, and leeway. The Log, Time and Date (the date if at sea for more than the one day) MUST be written next to the DR mark, and the letters 'DR' may be written next to the symbol.

2. ESTIMATED POSITION or 'EP'

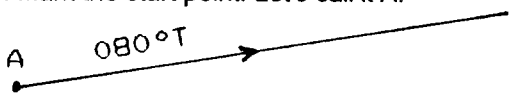
Fig. 385.



An estimated position takes the DR factors of direction, time and speed (distance) into account AND the influences of current/tidal stream 'set' AND/OR leeway. The position is indicated by being enclosed in a triangle, and the Log, Time and Date (date if at sea for more than the one day) MUST be written next to the triangle.

An estimated position due to set only, is obtained by first 'plotting' (ruling in its correct place) the course line - let's say a course of 080°T. Mark the start point. Let's call it A:

Fig. 386.



From the start (place), if we wish to 'steer-off' to counteract the effects of the set, from the start point on the chart, we plot (rule) a line in the set's direction and make a mark along this line at the place where a drifting object would get to after one hour - call it B. (This drift in 1 hour is the 'rate' of the current or tidal stream.) Remember:

'SET' is the direction of surface water flow due to the current or tidal stream, e.g. 180°(T).
'DRIFT' is the distance a free floating object will move in any specified period of time due to the tidal stream or current, e.g. 1.5 nm (in two and a half hours).
'RATE' is the speed in knots of surface water flow due to the current or tidal stream, e.g. 2 knots.

Assume a set of 225°T (here we do not have to write 'T' as it is current or tidal stream being referred to - they are always only 'True') at a rate of 2 knots.

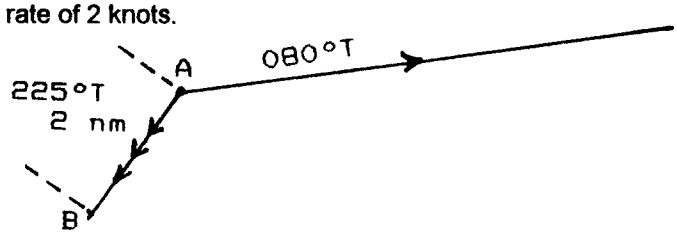


Fig. 387.

From B, plot a line using the same units of length used for the current drift in 1 hour, to be the length/distance the boat will travel over the water in the same period of time ie 1 hour - if its speed is 6 knots then this line must be six units of length long where it meets the course to be travelled line (080°T) - at C.

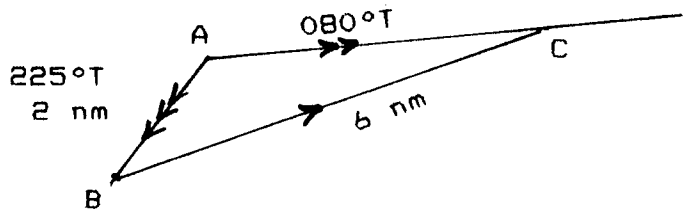


Fig. 388.

The direction of line BC is the course to steer to overcome the set, AB, and the boat will then move along the line AC - which is the Ground Track or Course Made Good (CMG) or Course Over the Ground (COG). Since the time frame is one hour and the boat moves from A to C in that hour, a measure of the length of line AC will be the speed of the vessel over the ground - Speed over the Ground (SOG) or Speed Made Good (SMG).

After the 1 hour the boat will be at C. C is the 'EP' after 1 hour, and we mark it by drawing a triangle around the spot, and we write the Date, Time and Log next to the symbol.

If no allowance for set was made at the beginning of the trip, the vessel would end up at a different place. To see where a vessel being steered on a course will end up if no allowance is made for the set, we apply the set line at any point at or near the end of the course steered line (let's call it X). From that point the set is plotted to scale. Assume a course steered of 080°T and the same current or tidal stream as above, i.e. 225° (T) at 2 knots. Call the end of the set line Y:

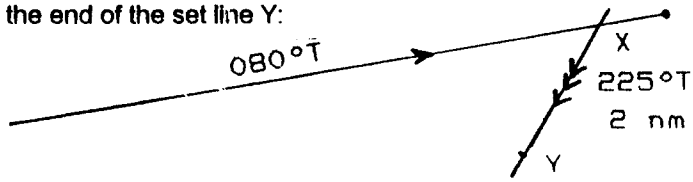


Fig. 389.

Measure back from X along the course steered line, six units (the boat speed) of length and make a mark - call it Z.

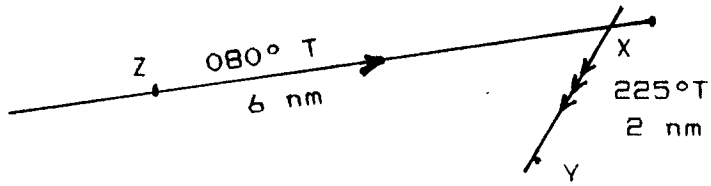


Fig. 390.

ZY is the Ground Track or COG/CMG, and its length will reveal changed speed (SOG or SMG). (The time frame being used is 1 hour.)

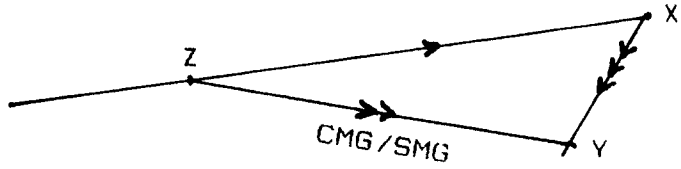


Fig. 391.

If Z was the actual start point, then after 1 hour the EP would be at Y.

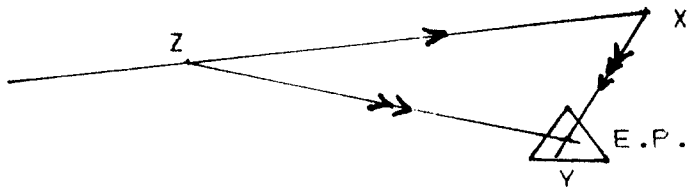


Fig. 392.

If the actual start point was somewhere else along line ZX (between Z and X or not), plot a line parallel to ZY starting from the actual start point (e.g. a harbour exit). This line will be the Ground Track or CMG, and since we know the new speed (line ZY 'per hour'), we can ascertain an EP at any time after starting. The EP after 30 minutes is:

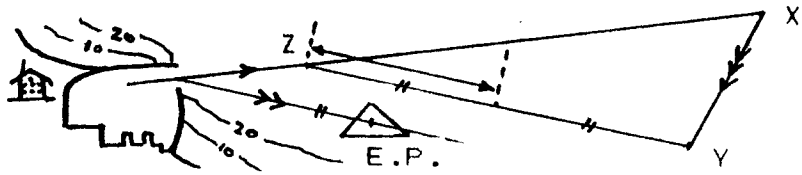


Fig. 393.

Leeway

There is one other aspect to EP's and that is 'Leeway'. Remember that an EP is a position obtained from including the factors 'current/tidal stream AND/ OR leeway'.

Assume the course is approximately towards the east and the wind is northerly (blowing FROM the north). While sailing along we look in the water behind the yacht to see the wake - its trail left in the water. If the wake is not fairly consistently in line with the 'fore and aft' line of the yacht, allowing for the slight swing of the yacht about the course steered due to swell/waves, then there is either leeway present, or the helmsman needs to improve! If there is leeway, use the hand-bearing compass and take bearings on the fore and aft line and the direction of the wake. The difference in these bearings is the leeway angle.

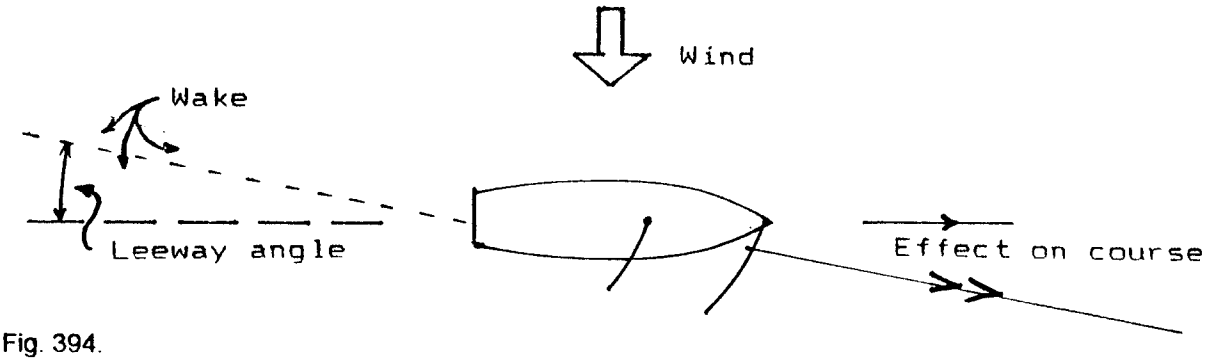


Fig. 394.

To overcome the leeway, adjust the course steered TOWARDS THE WIND by the leeway angle measured. This will mean turning towards the north by an amount equal to the Leeway angle. By turning slightly towards north while sailing east, the course steered direction as seen on a compass rose, will be changing anticlockwise - it will get smaller by the leeway angle:

Plotted or calculated course to steer '<u>minus</u>' leeway if the wind is from the vessel's Port side.

If the wind had been from the south, it would be <u>plus</u> the leeway - we would be turning clockwise towards the wind.

If there is current or tidal stream present, and we experience leeway, we first would plot the course to steer, then start sailing, then check for leeway, and if it is present we then adjust towards the wind by the leeway angle. We can not know in advance what the leeway will be, if any - so the leeway part of the exercise is always last.
<u>IF</u> leeway is ever plotted on a chart, it is likely to be for or in an examination ONLY - it is not otherwise

plotted. Here is how to show it if plotted (A-making allowance for it, B-ignoring it):

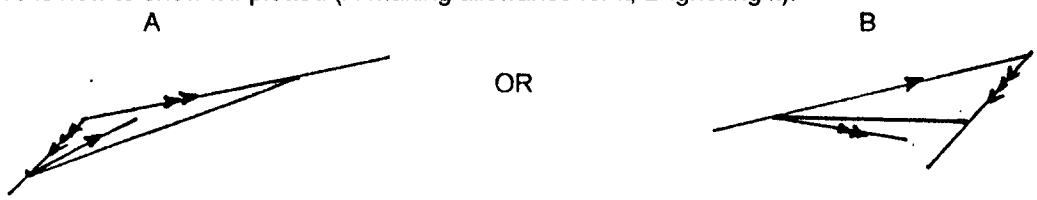


Fig. 395.

Back to Chartwork Symbols.

3. A 'FIX' POSITION

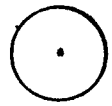


Fig. 396.

The position of a vessel established as a result of taking measurements from fixed objects on land (or the seabed, or even celestial bodies - the sun, stars, moon and planets), is termed a 'Fix' or a 'Fix(ed) Position)'. The symbol is a circle around the position, and again it must have the Time, Log reading and Date (if applicable) written next to it. There are several methods of taking a 'fix', and these will be dealt with in the next chapter.

Transits

A transit is an imaginary line between two fixed objects on land and extending seaward. A vessel can sail along that line by keeping the two objects in line - 'in transit'. The symbols used, if a transit is to be plotted on a chart or sketch, are a circle around the object furthest from the water and a circle with a line through it, in line with the two objects, around the other object:

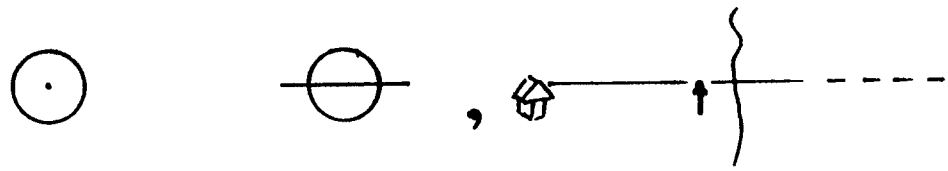


Fig. 397.

Clearing Lines (or Clearing Bearings/Horizontal Danger Angles)

A clearing line on a chart or sketch represents a magnetic bearing, for use with the hand-bearing compass, from the vessel to an object on land; it is safe for the vessel to be on one side of that line but unsafe on the other. While on the safe side of a clearing line, a bearing to the object may be larger or smaller (depending which is the safe side) than the clearing line direction, BUT NOT BOTH. There can be two clearing lines forming a 'V' with the object at the junction of the two sides of the 'V', or the two bearing lines could be taken from separate objects. Either way, two clearing lines can form the sides of a 'safe corridor'. It will be safe if the bearing to the object is either 'Not More' than ('NM') or 'Not Less' than ('NL') a pre-calculated value.

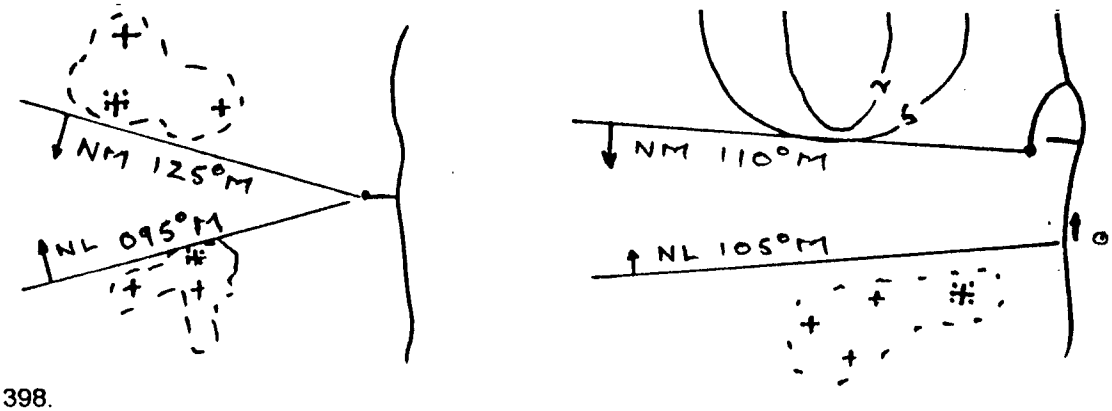


Fig. 398.

OTHER TOOLS

Navigation Drawing Instruments

1. **Drawing Compass**. A mathematics set drawing compass for arcs of circles and circles. Its use will be described in the next chapter.

2. **Navigator's Dividers**. The 'one-handed' operation type with the bulge near the pivot point is best, leaving the navigator's other hand free to hold the chart and other items from slipping on the moving chart table. The longer the arms, the better.

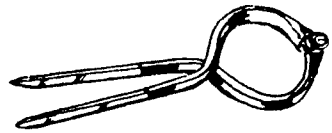
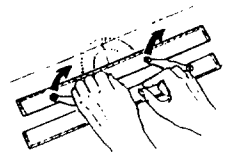


Fig. 399.

3. **Plotters** - only one is necessary. The Breton Plotter is recommended, but one can choose between the Breton Plotter, Hurst Plotter, Douglas Protractor, Parallel rule (plain or Capt Field's type), etc. The Parallel Rule looks like this (A):

The two long parallel sides swing apart and together, always staying parallel, and they can therefore 'walk'; when set in a direction, the rule can be walked to the compass rose, one edge to touch the centre, then read the direction in degrees relative to True North - counting clockwise from 000°.

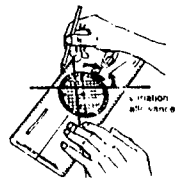
A



A Breton Plotter looks like this (B), and a Douglas Protractor like this (C):

If you get one, get the supplier to show you how it works. It is simple and has the advantage that it does not have to be moved and will not therefore slip as a parallel rule does.

B



C

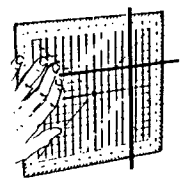


Fig. 400.

Stationery

The Navigator will also need:

a. A note pad or jotter for rough work.

b. A pencil with a soft lead (e.g. 2B). If the pencil is not of the 'clutch pencil' type, a good sharpener will be necessary to keep it sharp. Do not press hard on the chart so that all markings can be erased without trace indentations in the paper.

c. A soft rubber eraser.

Other Aids

Also necessary for the navigator to complete the navigation task are:

i. A sextant (not for this course).

ii. Tide Tables/Depth Sounder.

iii. A means of telling the time.

iv. A hand-bearing compass.

v. Binoculars.

vi. The vessel's log for distance and speed measurements.

vii. A log book being either the vessel's log book, or a separate navigator's log book in which all the major navigation activities, etc., are recorded.

Techniques of Visual Position Fixing

If one travels a particular route frequently, and knows the area well, whether walking, driving or sailing from one place to another, one does so without conscious thought as to where one is at any moment, when to turn or how much to turn. One's eyes are seeing and the subconscious brain is assimilating and giving the correct controlling instructions. If, suddenly, the eyes could not see, one would stop immediately and the conscious brain would get involved - 'Where am I?' Progress thereafter would be a problem.

Sight, and the knowledge of where one is at sea, are most important to the skipper and navigator. What one sees while navigating at sea, allows one to make instant decisions as to the course to be steered. Some visual aids to navigation are natural and some man-made; some are very good, accurate and reliable, while others can be misleading, lack consistency, and be dangerous to safe navigation. Passing close by a marker buoy is a quick, positive way of knowing the vessel's position (unless the buoy has broken loose from its securing chain!). Two buoys, especially at low tide and more so if it is a normally shallow area, may appear to be suitable to use as a 'transit', but counter-currents could deceive.

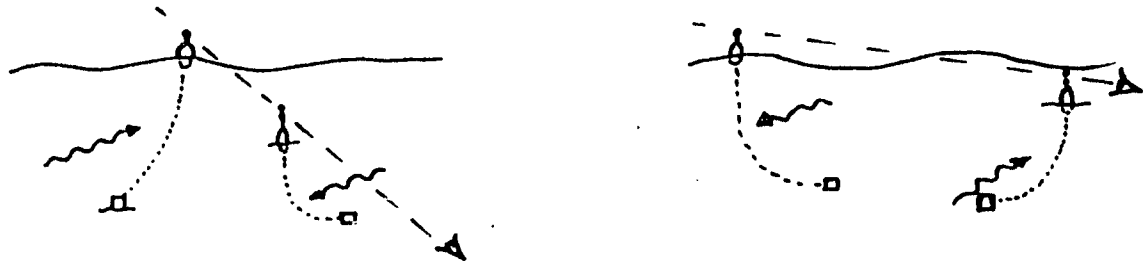


Fig. 401.

So buoys should be treated with suspicion. Large old buildings and trees which have been in place for centuries, are unfortunately seldom shown any respect by the modern day developer who can demolish them in minutes - the navigators' landmark of today is gone tomorrow. Similarly towers, the 'permanent caravan camp', masts and flag poles - in fact anything man has put there, despite being conspicuous and a good, convenient landmark, can be moved - or removed. A flagstaff or 'conspicuous building' shown on a chart are far less likely to disappear suddenly, but then one must consider 'Will it be visible from my position?' The flagstaff will not be seen from three miles away, or at the angle where it is obstructed by an adjacent building, or a headland.

The Use of Measurements

The further we go using DRs or EPs, the less accurately the vessel's position is known. We can rectify this by 'taking a fix' - determining the vessel's position, using basic navigation tools, by taking measurements to or of fixed objects on land that can be seen AND POSITIVELY IDENTIFIED, and are shown on the chart. (Mid-ocean we get LOPs from measurements of the sun, etc.)

There are several ways or methods of taking a fix, some more accurate than others and some easy and quick to do, others needing a bit more effort and time. What is important though, is that THE SKIPPER

AND NAVIGATOR ***MUST KNOW THE VESSEL'S POSITION AT ALL TIMES*** - on the sea and on the chart. If ever there is doubt, and the vessel may be near an obstacle, 'STOP' -do not proceed, and if necessary, turn about and go back. BE SURE THE COURSE AHEAD HAS ADEQUATE DEPTH, including safety clearance before continuing. If entering an unfamiliar area, harbour or marina for the first time, do so only in the hours of daylight.

Make sure the hand-bearing compass is reading accurately - to test it, try doing a 'Swinging the Compass' exercise and making a deviation card for it - you may just get a shock. Take bearings from the nearest possible objects because, the further away the compass is from an object, the bigger the inaccuracy of the reading obtained, as the compass is not a precise measuring tool. Movement on a swaying deck also makes accuracy hard to achieve -if necessary, read the upper and lower values of the direction as the compass disc swings from side to side, then 'average'.

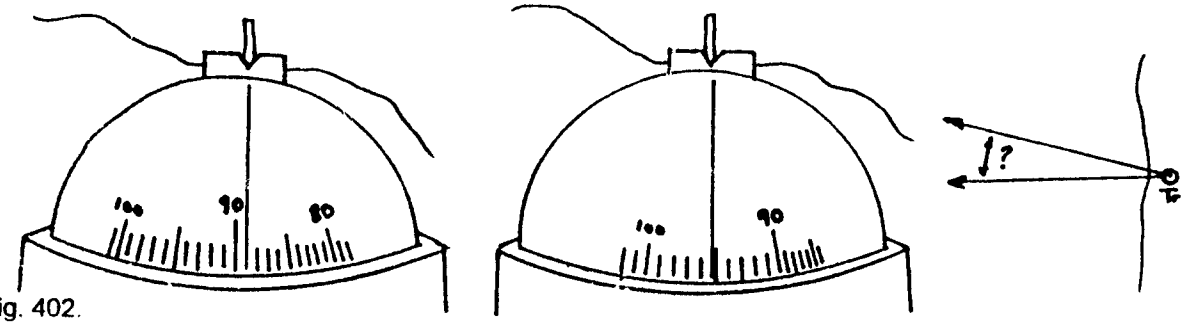


Fig. 402.

Where two bearings are taken to get an intersection, try to select land objects which will result in the intersecting bearings being at or near a right angle - the area of possible error is smaller.

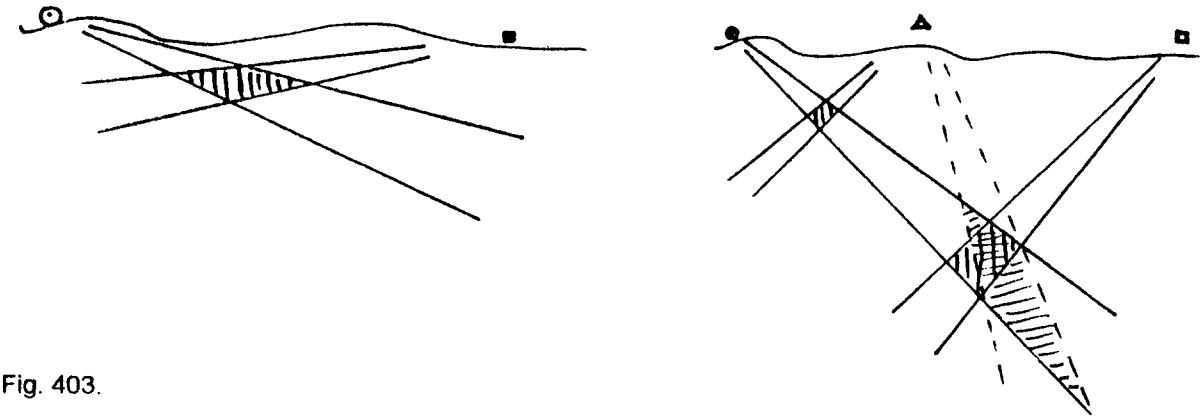


Fig. 403.

Where three bearings are taken, the angles formed between them should, as near as possible, result in an equilateral triangle.

DESIRABLE UNDESIRABLE

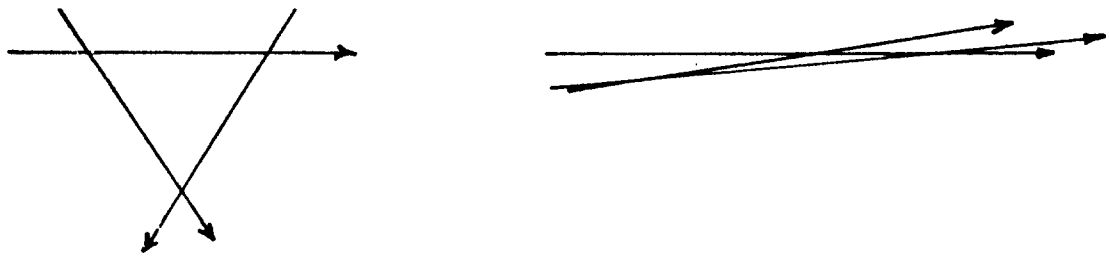


Fig. 404.

METHODS OF TAKING A FIX

Actions Common to All Methods. USE THE LARGEST SCALE CHART. When taking readings for a fix, ALWAYS make a note of the time, the log (distance) reading, and, if within range, the depth from the depth sounder. Course and speed noted will assist in DR or EP navigation subsequent to the 'fix'. When using depth, the reading obtained must be reduced by an amount which is the height of tide at that time - obtained from the Tide Tables. The remainder is the depth using the same reference level as the chart's 'Datum'.

WARNING: The object(s) on land used to take bearings MUST be POSITIVELY identified, both by sight AND on the chart. Do not assume, hope or accept an object to be what you think it may be - BE SURE or do not use it.

1. **One LOP and Depth**. Take a bearing with the hand-held compass on the nearest prominent feature on land. As it is a magnetic value, change it to a 'True' value so that it can be plotted on the chart. (Remember charts are printed with their 'north' orientated to 'True North' so all the lines drawn by a navigator on a chart MUST also be 'True'.)

From the object as seen on the chart, rule a pencil line to seaward passed where you imagine the vessel to be. As this line represents an LOP, use the correct chartwork symbol and draw an arrowhead at the seaward end of the LOP. Note the time, log and depth at the time of taking the bearing. The height of tide is subtracted from the depth sounding and the remaining figure compared with depth contours and depth 'numbers' as shown on the chart. By interpolation if necessary, PROVIDING the sea bed slope or shape is not a straight line at a shallow angle (where a small depth error could mean a large error in position of the vessel), we can ascertain where along the LOP the correct depth applies -the Fix Position. Draw the chartwork symbol of a circle around the point, and write next to it the date, time and log (reading).

Assume a bearing taken with the hand-held compass on Eddystone Lighthouse (chart 5050) was seen to be 060°M when the depth sounder read 55 metres. If the (magnetic) variation is 8°West, the True bearing would be 052°T. This can be ruled on the chart as an LOP GOING IN THE DIRECTION 052°T FROM THE VESSEL TO THE LIGHTHOUSE - do not make the common mistake of regarding it as 052°T from the lighthouse to the vessel.

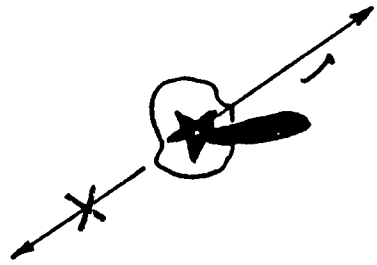


Fig. 405.

Subtract the height of tide (let's say 4 metres) from the sounding and you are left with 51 metres - look at the chart and by interpolation assess where the 51 metre depth is on the LOP, it may be on a depth contour making it easy. Make a dot, circle it, and write the date, time and log applicable.

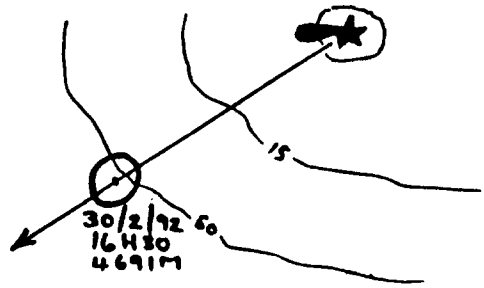


Fig. 406.

2. **Two LOPs**. The magnetic bearings for two LOPs taken in quick succession such that they cross at as near 90° as possible, will 'fix' the vessel's position at the intersection point with the least possible error. The magnetic bearings are converted to True bearings and the two resulting LOPs are plotted on the chart. The fix symbol, a circle, is drawn around the intersection point and the Date (if at sea for more than one day), Time and Log are written next to the symbol.

If while sailing out of Cape Town (chart SAN 3002), bearings recorded were Robben Island Lighthouse (Minto Hill) 312°M, and the 'conspic' (conspicuous) building at Bloubergstrand 063°M, the plotted fix would as shown.

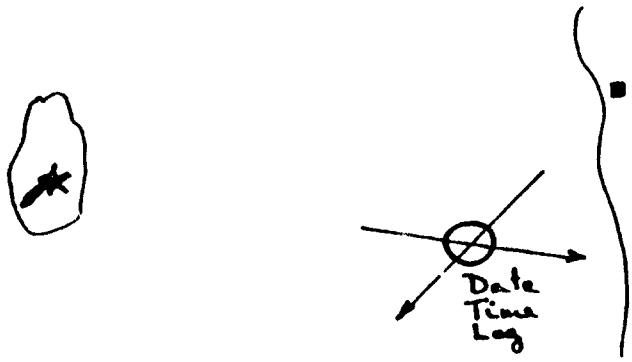


Fig. 407.

NB: When taking two (or more) bearings with the hand-held compass, bearings to objects abeam should be taken first as they will be changing more rapidly than bearings to objects near the fore and aft line of the vessel which change slowly.

3. **Two LOPS and Depth**. Remember that common to all fixes, the navigator notes, among other details, the depth at the time of taking the two bearings for a two LOP fix. He or she is able to adjust the depth sounding by subtracting the height of tide at that time to get the depth as shown on the chart. The two LOP fix is plotted as explained in method 2 above. The third factor, depth, as determined by the sounding and corrected for the state of the tide, is now compared with the depth as seen on the chart at the LOPs intersection point - whether it is obvious, being on a depth contour, or by interpolation/ assessment.

If the corrected sounding and chart indication of depth at the intersection point are the same or nearly so, the 'fix' is 'good'. The corrected depth may be 'out' by a small percentage of the chart depth (or one or two metres if the vessel is in shallow waters) - this is because the depth sounders are never 100% accurate, and the 'transducer' (the depth sensor built in to the hull) which is mounted below the vessel's water line is not giving a sounding from the water surface as expected (unless adjusted for this).

If the corrected sounding (depth) and the depth as indicated on the chart at the LOPs intersection point differ by more than a small percentage, or one or two metres when in shallow waters, SOMETHING IS WRONG. If and whenever there is doubt about any one factor of a 'fix' not matching the pattern of the other factors, DO NOT IGNORE IT. Check and re-check until the mistake is identified and corrected.

Let's assume that two bearings and the depth were noted in order to establish a 'fix'. Using chart SAN 3002, the bearings were Green Point Lighthouse 286°M and Minto Hill (Robben Island) 022°M when the depth sounder showed 32,5 metres.

The height of tide from the Tide Tables was seen to be 1,5 m at the time, so the corrected depth for chart comparison purposes is 31 m.

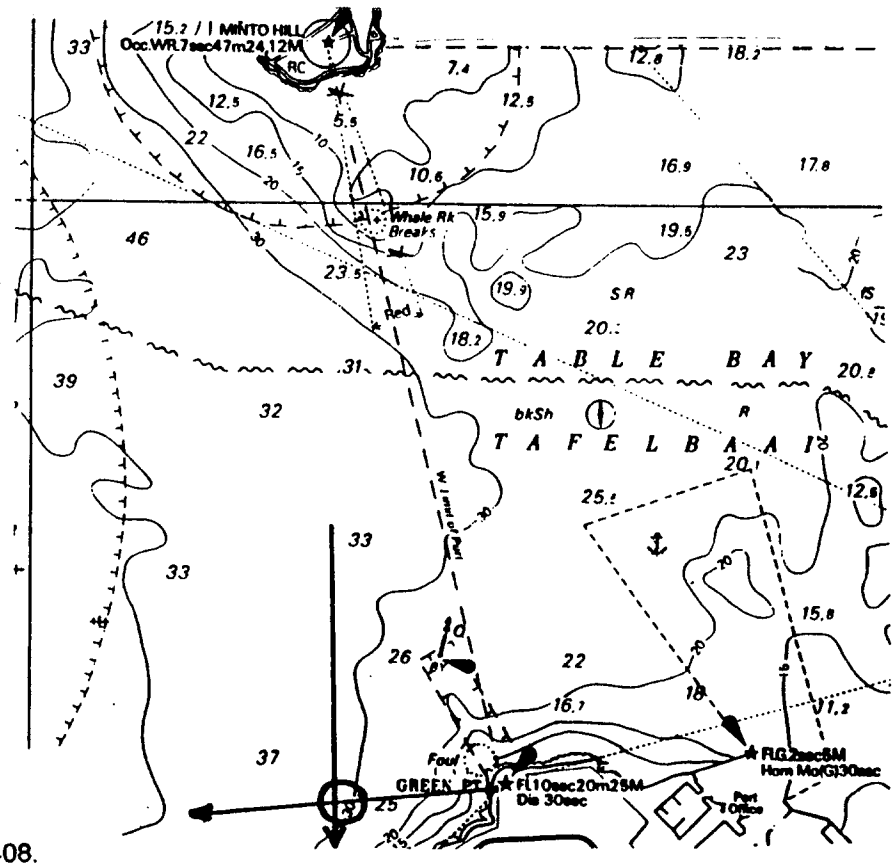


Fig. 408.

The depth at the plotted intersection of the two LOPs is almost exactly on the 30 m contour line - our corrected depth was 31 m, so the 'fix' was good! If it was not, it would be necessary to take all the readings again.

4. **Three LOPs - The 'Simple Fix'**. Probably the most common and popular fix method - some authorities say that the previous methods mentioned are not really recognised 'fix' methods whereas the simple fix is - it allows the navigator to get an idea of how accurate he or she is being.

Three objects, positively identified on land and on the chart, are selected so that the resulting LOPs will cross to form a triangle which is close to an equilateral triangle. If the navigator is very accurate, the hand-held compass is good, or it has been a 'fluke', the three LOPs will cross at the same point. The 'fix' will be at that point.

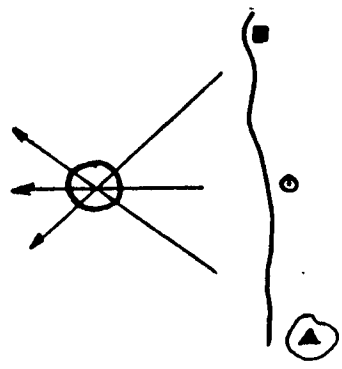


Fig. 409.

If the three LOPs do not all cross at the same spot, they form the three sides of a triangle. This triangle is called the 'Triangle of uncertainty', or as it is better known, a 'Cocked Hat'.

The centre of the triangle is the logical place to select for the fix. A navigator can assess his or her accuracy by the size of the triangle - THE SMALLER THE TRIANGLE, THE MORE ACCURATE THE MEASUREMENTS HAVE BEEN. (Use the largest scale chart possible.)

In coastal navigation, because we are always near land, we are always near danger. To increase our safety margin we do not use the centre of the triangle as the 'fix' - we take the corner of the triangle closest to land or to danger as the 'fix' position. We circle and label it with 'Date, Time and Log'.

A 'simple fix' exercise at sea, using 7°W variation as per the chart (1992), obtained the following bearings (chart 5050):

a. House, ('conspic') north of Helford River, 274°M,

b. St Anthony Head, 329°M,

c. Porthmullion Head, 005°M.

When plotted, the 'fix' appeared as shown in Figure 410.

5. **The Simple Fix and Depth**. The same 'simple fix' procedure as above can go one better - at the time of taking the bearings for the LOPs, the reading of the depth sounder (as well as Log and Time) is automatically noted. As with the 'Two LOPs and Depth', the depth comparison is done with the fix obtained from the three LOPs 'simple fix'. So long as the two depth indications are approximately the same, the 'fix' is good. If not, even with a small triangle formed by the three LOPs, check! And re-check. Only when all measurements agree is it safe to accept the resulting 'fix'.

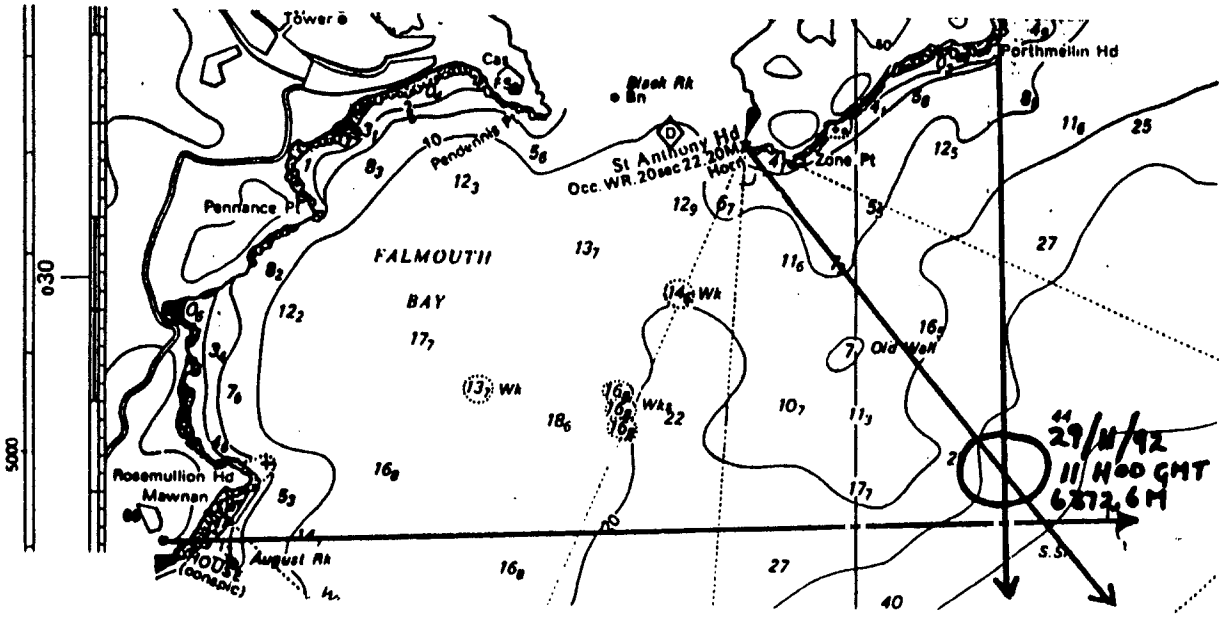


Fig. 410.

6. **The 'Running Fix'**. A great deal of coastal sailing is on courses approximately parallel to the general coastline. Often only one object on land can be seen and positively identified (and too often, none - when DRs or EPs are used in lieu of 'fixes'). A 'One LOP and Depth' fix can be done, but if the sea bed is flat and horizontal for miles around, or if the sea bed is too deep for the depth sounder to register a depth, then another method is called for. One such option is the 'Running Fix'.

Plot the course being steered anywhere near where it is guessed to be. As the vessel comes in sight of the identifiable object on land, take a bearing on it using the hand-held compass and plot the resulting LOP so that it crosses the plotted course line. Note the Time and Log (and depth if a further check, later, is required). Let's say the course is 015°C (using the deviation card on page 165, deviation is near enough nil, so it = 015°M, -23°W variation becomes 352°T), and the first LOP bearing on Robben Island Lighthouse is 055°M (= 032°T). Let the time be 10h00, the Log 3456,7 M and depth recorded be 63 m when the tide was 0,5 m.

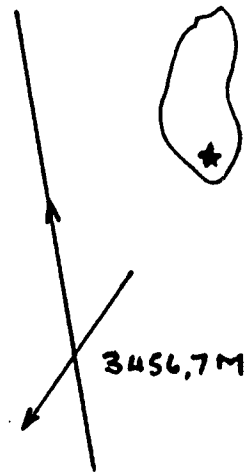


Fig. 411.

When the vessel has moved a distance such that a new LOP from the object and the original LOP will form a reasonable angle (say from about 30° or more - up to about 150°), take the bearing for, and plot a second LOP. Note the Time and Log (and if you wish to do the extra check, the Depth).

What is the difference between the two log readings?

The difference is the distance the vessel has moved along its course direction in the time between the two LOPs being recorded.

If we therefore measure, from the intersection of the course line plotted and the plot of the first LOP, in the direction the vessel moved, the distance it travelled between the taking of the two LOPs, we can mark on the course line where we think the vessel may be. Let's say the second LOP was 124°M (=101°T) and Log 3460,2 M at 10h45 when depth was recorded as 60 m (tide 0,6 m).

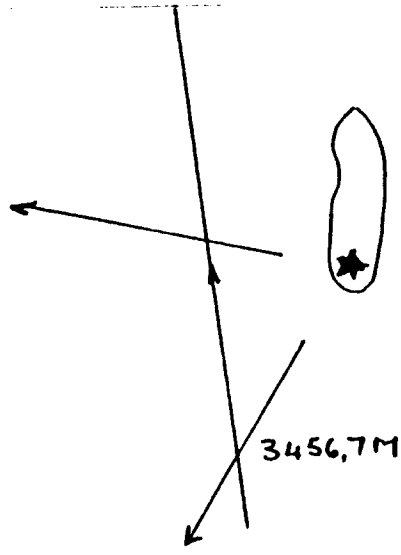


Fig. 412.

Since, at the time of the first LOP the vessel's position was somewhere along that line, and at the time of the second LOP the position is somewhere along this second LOP line, if we move the first LOP the distance the vessel moved, the actual position must be where the moved LOP intersects the second LOP. The moving of an LOP in this way is called 'Advancing' or 'Transferring' a LOP.

In our example, the difference in log readings is 4,5 M.

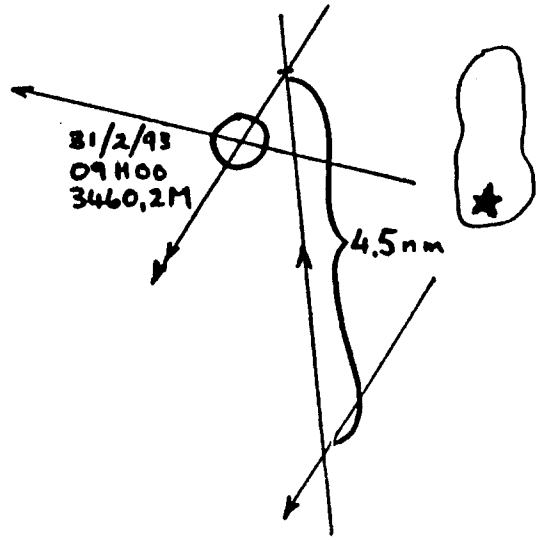


Fig. 413.

This intersection is the 'fix'. We label the 'fix' with the Date, Time and Log. (The 'Time' being that of the second LOP).

We can also, if we wish, check the depth at the 'fix' to see that it conforms with that expected from the depth reading taken at the time of the second LOP. If it does not, check the depth as at the first LOP. The vessel's position having been fixed, the course line can now be ruled in the correct place from the 'fix'. Extend the newly ruled course line backwards to intersect with the first LOP and check the depth as at that time - do the chart-indicated and the recorded depths agree?

If one of the depths recorded does not agree with the chart depths at the respective places they were recorded, it is possible that there is an isolated hole or tall reef/rock which is not shown on the chart which is responsible for the confusing depths. If both depths checked do not match the chart depths, be very wary of accepting the 'fix' - rather take another fix, even if it just confirms the first as correct.

In our example, the recorded depths minus the 0,5 m and 0,6 m gave us depths which, as far as we can tell, match the chart depths at those places. We can relax in the knowledge that our fix is good!

NB: The depth check aspect described above is NOT part of the standard Running Fix - it is included here as an extra check you can do if you wish. The same depth check MAY also be carried out when doing ANY 'fix'.

7. **The 'Four Point' Fix**. The old method of describing a direction using the ship's compass was to use various combinations, shown on the compass face, of the names of the cardinal points, North, South, East and West. Young sailors had to learn to 'box the compass' - to describe these directions, from north, clockwise all the way round, in jumps of one 'point' (11°15') at a time:

360°00' = North
011°15' = North by East
022°30' = North, North East
033°45' = North East by North
045°00' = North East
056°15' = North East by East
etc. (See Figure 414.)

So 'four points' is a way of saying 45°, e.g. 'Alter course "four points" to starboard'.

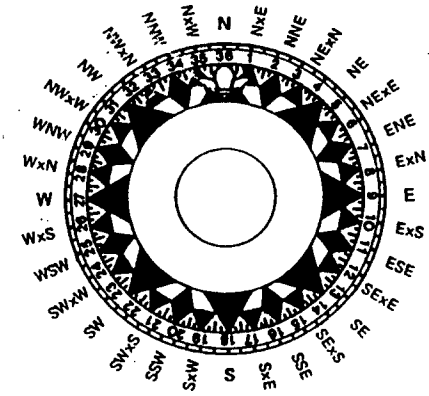


Fig. 414.

A navigator on a vessel, seeing an object on land which is also marked on the chart, can monitor the bearing to it and note the log reading when the angle between the vessel's course line and bearing to the object is 45° (or 'four points'):

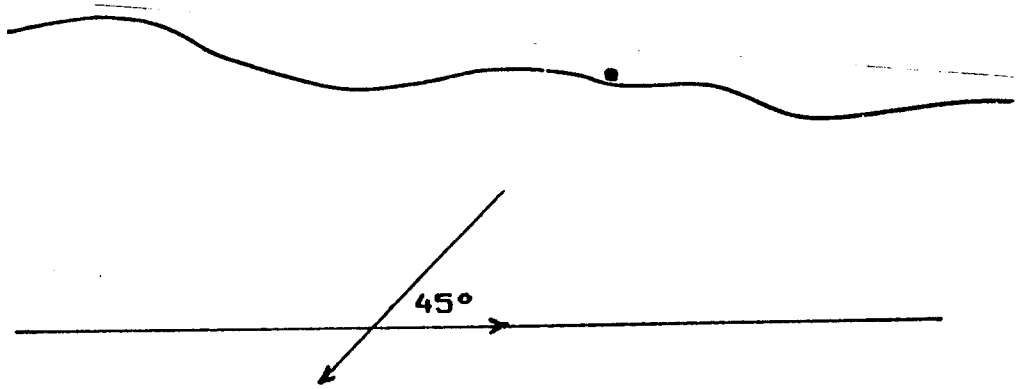


Fig. 415.

The angle between the course line and the bearing to the object will be seen to increase as the vessel continues along its course. When this angle becomes eight points, or 90°, the log is again noted and the distance travelled from the first to the second bearing is obtained. The angle between the course line and bearing to the object has changed by 45° ('four points').

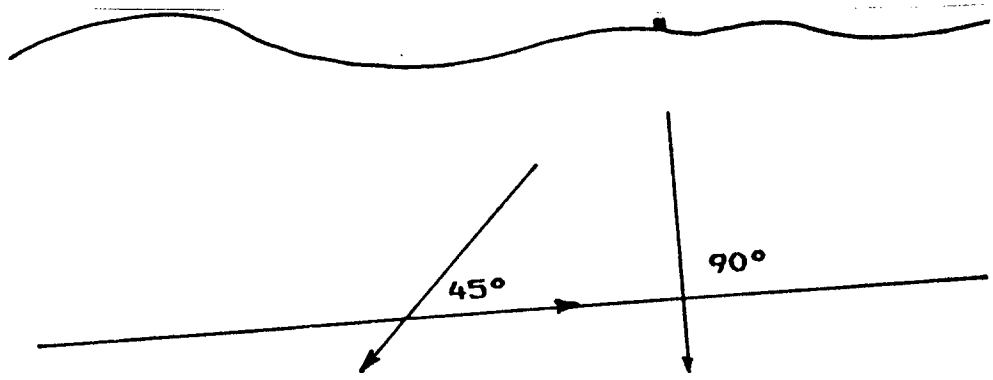


Fig. 416.

A triangle's three angles total 180°. If one angle is 45° while another is 90°, the third angle must be 45°. If two of the angles of a triangle are the same (e.g. 45°), it must be an isosceles triangle, and the length of the two sides not common to both angles must be the same length - if we know the length of one side from the comparison of the log readings, we know the length of the other. The second bearing from the course line to the object is that side of the triangle - the distance of the vessel from the object is therefore now known, and the bearing is plotted on the chart. The distance measured along that line from the object gives the 'fix' position of the vessel, by the 'four point fix' method. We draw a circle around the spot to show it is a 'fix', and we label it with the 'Date, Time and Log'.

In practice, the navigator, having established the first bearing (and log reading at that time) to the object when it is 45° off the bow, plots this 'LOP' across the assumed course line. The second bearing direction is then calculated when it will form an angle at the bow of 90°. Knowing what the second bearing must be for the angle to double, the navigator watches the land object via the hand-bearing compass until the second bearing applies, then a note is made of the log and time. The rest is as above.

4. **Fix by Doubling The Angle at the Bow**. This method is exactly the same as the 'four point fix', except that the first angle (at the bow) between the course line and the bearing to the object on land can be ANY angle - not just 45°. At the time of the second bearing, the angle between the course line and a line to the object on land must be double the first angle (at the bow) with the first bearing. Therefore there is still an isosceles triangle so the logic of the 'four point fix' applies equally with doubling the angle at the bow.

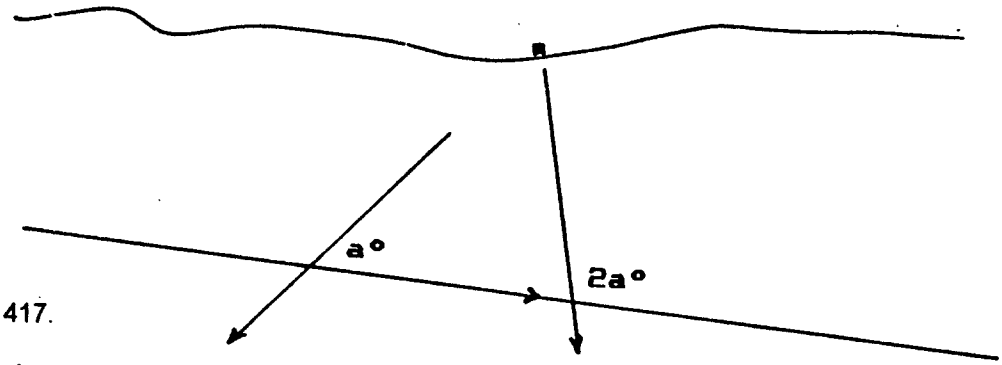


Fig. 417.

LOP by Radio

When a vessel starts to close with the coast which is still not visible, or when fog, poor visibility or lack of detail due to distance prevents a navigator from seeing enough to identify an object on land from which a bearing for a LOP can be taken, a RADIO DIRECTION FINDER can be used to get a LOP.

Places where radio beacons are located along a coast are marked on a chart by a purple- or magenta-coloured circle. The detail applicable to that radio beacon is to be found in the *'Admiralty List of Radio Signals'* ('ALRS') Volume 2 for beacons world-wide, and for the South African and Namibian coasts, in the South African *'List of Lights, Fog Signals, and Radio Services'*, SAN HO-1.

The detail for a beacon is shown like this:

'1830 Danger Point LtHo (D6320) 34°37,45'S 19°18,05'E
Frequency 308,5 A2A Range 100 miles

Characteristic: Period		30 seconds
ZDP (	)	6 seconds
Silent		2 seconds
Long dash		20 seconds
Silent		2 seconds
	Period	30 seconds

Beacon Service: Continuous.'

The '1830' is the beacon number and 'D6320' the number of the lighthouse at which it is located, the lighthouse being at Danger Point. The latitude and longitude enable one to find it easily on a chart. The 'A2A' refers to the type of radio signal and the range is 'for the average receiver'. Many of the cheaper yacht-type Radio Direction Finders (RDFs) will only receive the beacon's signal a lot closer to the transmitter.

The 30-second cycle breakdown needs no further explanation, and the transmitted signal cycle is repeated 24 hours a day.

The frequency units are 'kilohertz'(abbreviated kHz). The vessel's RDF is turned on and tuned to the

frequency and the call sign, in the above example 'ZDP', is listened for. When a morse code signal is heard, from the morse code for ZDP shown in the beacons' detail book, try and identify the code. It is not difficult because the code is transmitted very slowly.

Adjust the volume and frequency to get the best signal. This means the radio, held so that it is vertical and therefore the antenna inside is horizontal, has to be turned in the horizontal plane. When the signal is strong or as good as you can get it, wait for the start of the 20 seconds long 'beee ... eeep', then slowly turn the RDF in the horizontal plane until the weakest signal is heard. It may be necessary to turn down the volume control to hear a decrease in signal strength, or a weak beacon signal may result in an arc of no signal.

The direction to the weakest signal or to the average of the bearings on each side of the 'no signal' arc, is the direction from which the RDF receives the long dash tone - if the radio wave has not been bent on its way to the vessel, it is also the direction from the vessel to the beacon. This direction can be read from an in built compass.

It could alternatively be 180° in the opposite direction as the RDF only reacts when its antenna is in line with the transmitter, off either end. At Local Skipper level, if we get it wrong, we will get a LOP putting us on land - it will be obvious we are using the wrong side.

The direction bearing obtained is converted to a True bearing and it is plotted on the chart. It is an LOP and it was obtained by radio - the RDF.

At sunset and at dawn, and to a certain extent during the night, the path of the radio waves is often bent so that when it arrives at the receiver, it is not coming in the direction of the beacon. The amount and times of the bending varies from day to day and there is no way to know 'when' or 'how much'. The navigator's experience will help him or her decide. The amount of metal in the boat will also affect the accuracy - so get the RDF as high as possible when in use.

Navigation in Restricted Visibility (or 'Procedure When Fog Approaches')

When ever under way in fog, very heavy rain, sleet, or in conditions where normal visibility is seriously impaired, there are a set of basic precautions which are taken to aid safety.

They help to avoid our being run down by larger vessels, or running into any other danger. They are:

1. Hoist a radar reflector (if not permanently up).
2. Slow down to a safe speed - see 'Safe Speed', page .
3. All crew to wear lifejackets and harnesses, BUT do not use the harness to clip on - they are to be used if one is in the water if run down by a ship, then clip on to the liferaft when you get to it.
4. A lookout (and listening watch) is posted forward.
5. If within range of the sounder, start taking depth readings (soundings).
6. Have an anchor ready to use, but also be ready to weigh anchor very quickly or abandon it until later if it is used - have a float tied to it to mark its position/support the recovery line for later.
7. Keep silence on deck so everyone can listen for approaching danger.
8. Sound the appropriate sound signal at the required intervals.
9. Be ready to take DF bearings if possible.
10. If in doubt about the ship's position, do not steer a course towards danger - steer away from it/the coast, or at least parallel to it, not towards it.
11. Have the ship's navigation lights 'on'.
12. Have the engine 'on', or at least have the engine warmed up for immediate use.
13. If the vessel is fitted for radar, have it on to check for danger.
14. Ensure the liferaft is ready for immediate deployment.
15. Consider whether an announcement over the radio (VHF) of your vessel's description, position, course and speed will be helpful.

Buoyage

Introduction. The International Association of Lighthouse Authorities, (**IALA**), has agreed on two 'Regions' for the world's buoyage system. The sea waters of the Americas, Canada, the Philippines, South Korea and Japan constitute 'Region B', and all other sea waters of the world are in 'Region A'.

The only differences between the two Regions' systems occur with Lateral Marks and Preferred Channel Marks where the red and green colours (not the shapes) are interchanged - where one has green, the other has red.

A Buoy

A buoy can take many shapes or forms. Common to all buoys is a method of attaching it to the seabed (an anchor or heavy weight) with a strong flexible connection - chain or cable - to the floating part, the buoy itself. Some buoys have 'top marks' fitted where others do not, some have a light which makes them easy to notice and to identify at night, some have either a bell or siren/hooter/fog horn, and the colours of each have a special significance.

The top marks are either large ball shapes, cone (triangle) shapes, a shape showing a square top, or a shape which tends towards or forms a pointed top, or a diagonally mounted cross. At night, the colour of the light and the characteristic way in which each goes on and off tells the observer the same information as the buoys' shapes, colours and top marks do by day.

Cardinal Marks

'Cardinal Points' are the directions North, South, East and West. A 'Cardinal Mark' is a buoy placed in one of these directions relative to an obstacle to shipping. So a 'North Cardinal Marker' will be to the north of an obstruction and to pass the obstruction with safety, one must sail to the north of the north cardinal buoy. The other three cardinals are to be passed outside the buoy to the side of the respective buoys' name e.g. pass to the East of an East Cardinal - keep to the east of it, pass to the South of a South Cardinal, etc.

They are black and yellow in colour, the north and south cardinals having one band each of black and yellow, and the east and west cardinals have two bands of one colour and one band of the other. The exact shape and size of the buoy(s) may vary. See Fig. 418.

Cardinal marker buoys also have distinctive shapes, called "Topmarks", fitted above the buoys. In bad light or poor visibility, or from a distance when the black and yellow colours cannot be seen, these topmarks enable one to determine which buoy is being observed

If a black hulled vessel sails behind a buoy, the black topmarks cannot easily be seen - the colours the help.

The Cardinal Marks without topmarks:

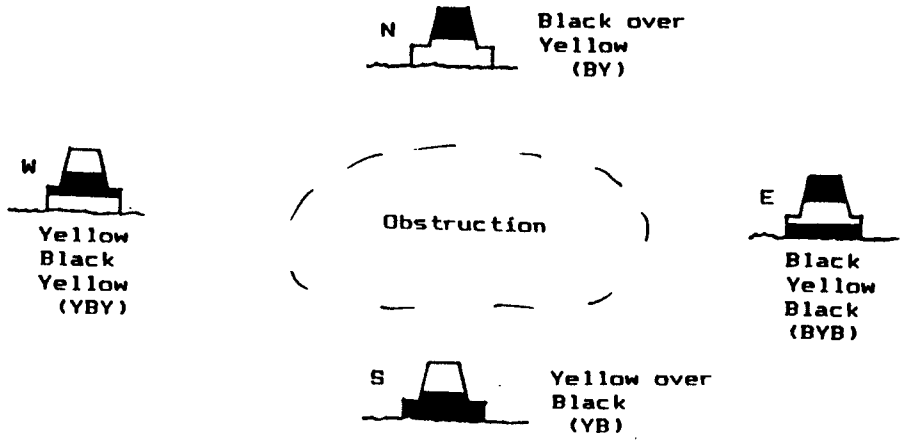


Fig. 418.

Top marks consist of two black triangle shapes mounted one above the other. The apex of each triangle points either up or down, towards the area of the buoy which is painted black:

The Cardinal Marks with topmarks:

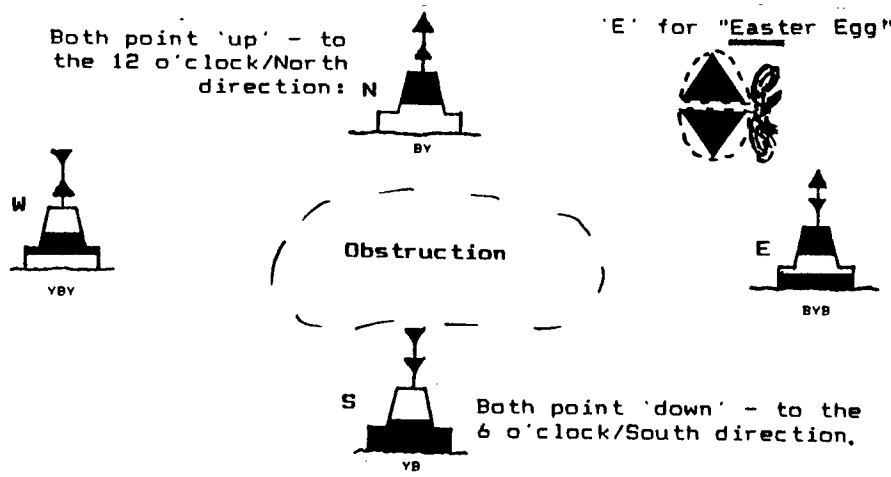


Fig. 419

Each is also fitted with a light (white) with its own sequence of flashing characteristics (if 'Q' or 'VQ' is printed next to the chart's buoy symbol, it means 'flashing at the rate of 50 to 60' or '100 to 120' flashes per minute respectively). The number of flashes each buoy makes is easier to remember if one thinks of a clock face:

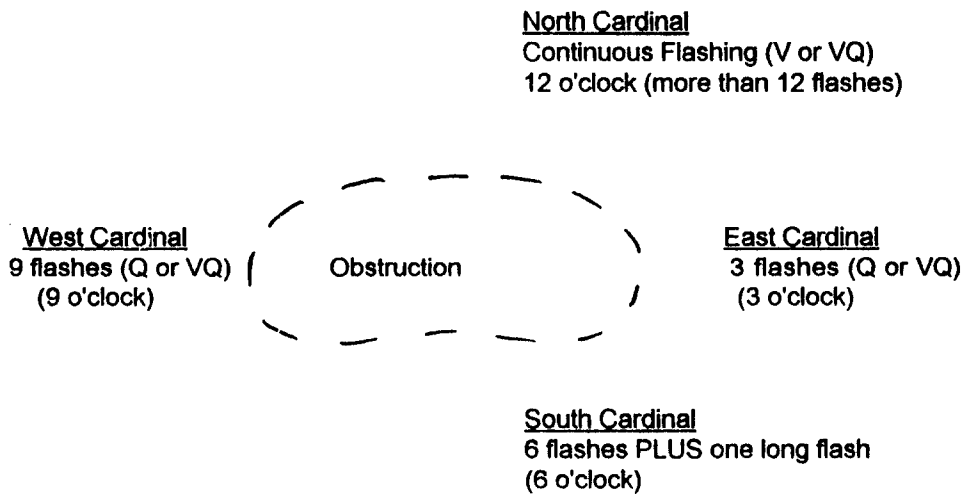


Fig. 420.

Lateral Marks

Buoys (or poles/posts) marking the sides (or a side) of a channel or confined passageway are called Lateral Marks, Markers or Buoys. The shapes, colours and positions of the different shaped buoys vary as to which IALA Region is referred to. Common to both regions' systems is the method of description regarding position - they are always described as seen when one is moving in the 'Flood(ing) Tide' direction - e.g. as seen when going IN to a harbour from seaward.

IALA Region A.

Port Marks. Port (left hand side when entering) markers are red in colour and are often described as '(tin) can shaped' i.e. when viewed from an approaching vessel, they appear as square shapes although they are round in cross section, like a drum floating upright in the water. Alternatively they can be any buoy shape, or even a pole sticking out of the water: they will, however, be red and have a square (or almost square) top mark fitted. It may be a solid square shape or a frame just showing the outline of the square. If fitted, the night light will be red and its 'on/off' sequence will be as described on the chart next to the buoy symbol.

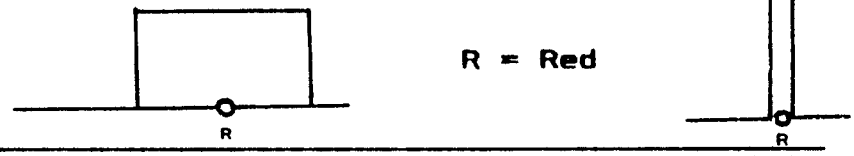


Fig. 421.

Starboard Marks. Starboard (right hand side when entering) markers are green in colour and have sides which tend to curve towards a point at the top (conical shaped), or a cone or triangle, apex up, top mark is fitted. A green light at night, if fitted, will go 'on' and 'off' in a sequence as described on the chart next to the buoy symbol.

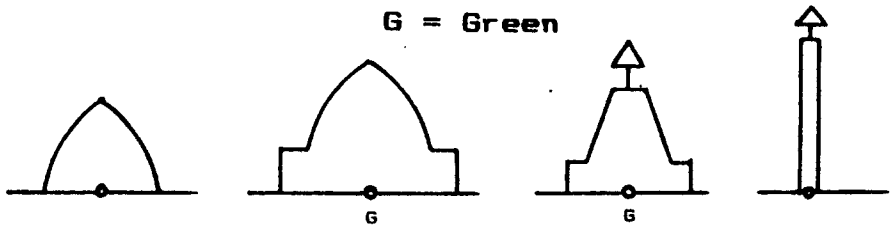


Fig. 422.

Preferred Channel Markers. Where a channel divides giving the mariner the option of proceeding along either channel, left (port) or right (starboard), a 'preferred channel' indicator, positioned where the channel divides, advises which direction is the better of the two. The reason may be greater depth, less traffic, less tidal stream effect, the main route to a main destination, or just to route traffic which does not have to go the one way, to take the alternative route. The shape and overall colour is that for the buoy one would expect to see on the appropriate side once one has entered the preferred channel, and a horizontal stripe of the opposite colour around the buoy advises that it is a Preferred Channel Marker. At night, the light, if fitted, will be Gp Fl 2+1 (white) i.e. two flashes in fairly quick succession followed by a single flash later. No other buoys use this flashing sequence.

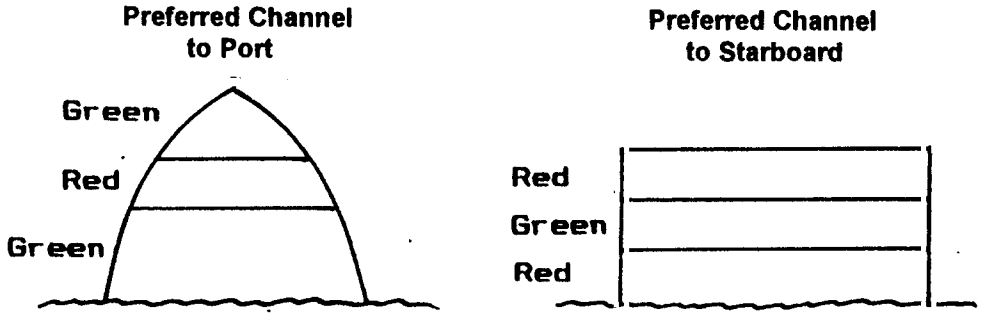


Fig. 423.

IALA Region B. (The same as Region A except the colours change.)
Port Marks. The Port Markers are green with square or canned shaped top marks, if fitted.

Starboard Marks. They are red with pointed tops (i.e. as before but the colour has changed).

Preferred Channel Marks.

1. **Preferred Channel to Port**. A Starboard Mark with a green horizontal band around it.

2. **Preferred Channel to Starboard**. A Port Mark with a red horizontal band around it.

Port Marker **Starboard Marker**

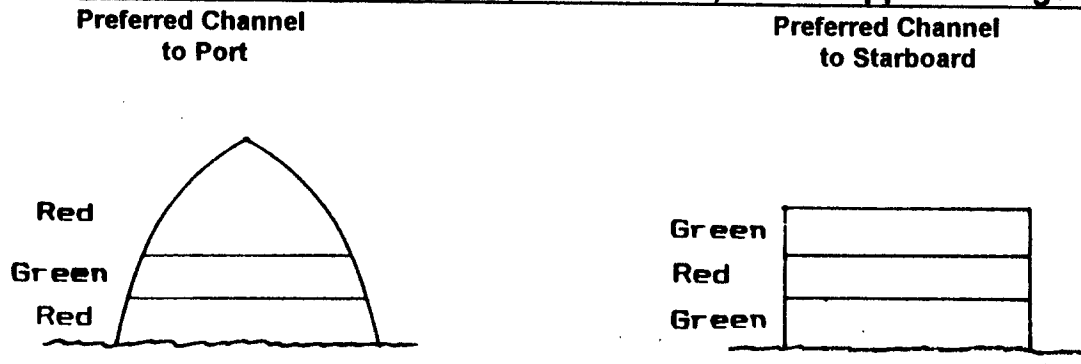


Fig. 424.

Isolated Danger. An Isolated Danger Mark is placed where generally navigable waters are interrupted by a small area of shallows. The nature of the bottom, the reason for the shallow, and the Charted Depth are usually stated on the chart. While under way, one sees a buoy or a pole, being black in colour with one or more wide red bands, and a top mark consisting of two black balls vertically arranged. A night or poor visibility light, if fitted, will have characteristics as shown on the chart next to the symbol.

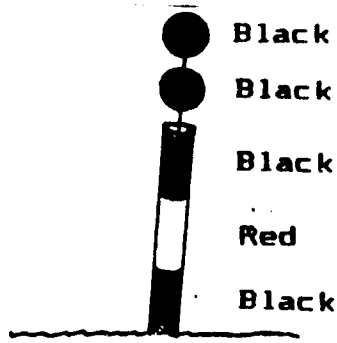


Fig. 425.

Safe Water Mark. (Also called a 'Mid-Channel' or 'Fairway' mark, or a Landfall Buoy.) A buoy, coloured red and white in vertical bands, and fitted with one red ball-shaped top mark, indicates a (relatively) deep water area where it is safe for vessels to proceed. If such a mark appears on its own in a wide open area of similar depth as seen on the chart, it usually means the area is suitable to use as an anchorage area. The chart(s) however are more likely to show the anchor symbol if it is intended to draw attention to the area for anchoring. Where two or more of these buoys are in line, they usually denote the centre line of a narrow channel where it is not practical to place lateral marks. Night lights, if fitted, are white and the exact 'on/off' sequence for each buoy is printed on the chart next to the symbol for that buoy.

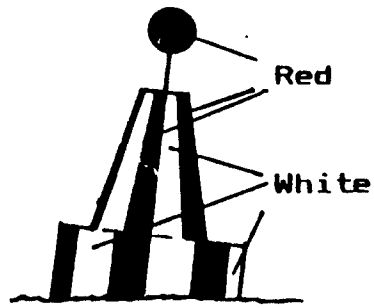


Fig. 426.

Special Mark. A 'Special Mark' buoy is all yellow and it has a top mark consisting of a yellow diagonally mounted cross (in some cases the cross may be missing but this will by default - all Special Marks should have a yellow diagonal cross as a top mark). A yellow night light, if fitted, will have an 'on/off' sequence ("light's characteristic") as described on the chart next to the buoy symbol.

Fig. 427.

In areas where it is too shallow for commercial shipping and even smaller powered craft such as ferries and harbour work boats, the edges of these very shallow areas are sometimes marked (by the local yacht club?) with thin poles or poles with top marks which could be almost any shape. The colours used could be almost any colour or combination of colours, and the poles, acting as beacons for (shallow draught) pleasure craft, may or may not be shown on the chart. If shown on the chart, they are very likely to be reliable (as a condition of being included on a chart, navigation marks shown must in the normal course of events, be reliable). If not shown on the chart, a marker pole may be there one day and gone, or worse - moved, the next.

Marker poles or beacons may be used as channel markers or as Transits or Clearing Line marks, and therefore must be reliable if they are to be used at all.

The example illustration on page 189 shows how the buoys and navigation marks could be employed.

Lights

'Lights', or Navigation Lights (as opposed to Ships' Lights - which are explained in Chapter 4), are the lights on lighthouses, buoys, pier heads, etc, used by navigators of vessels under way to assist in the proper navigation of the vessel.

Identifying a (Navigation) Light. Small scale charts which show a large area and therefore not too much detail, may show some of the (navigation) Lights, but not all. Small scale charts which show comparatively small areas but in great detail usually show all the navigation lights in the area. A (navigation) light on a chart is quickly found and identified as a navigation light by the purple (magenta) coloured 'tear-drop' shape which has its pointed end nearest the actual position of the light. At this pointed end of the 'tear-drop' is a black star shape with a small plain coloured ball shape in the centre. A dot in the middle of the 'ball shape' indicates the exact position of the light as shown by the chart.

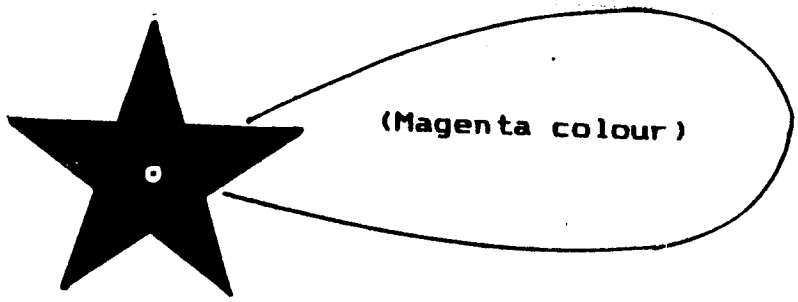


Fig. 428.

ILLUSTRATION OF BUOYS IN USE

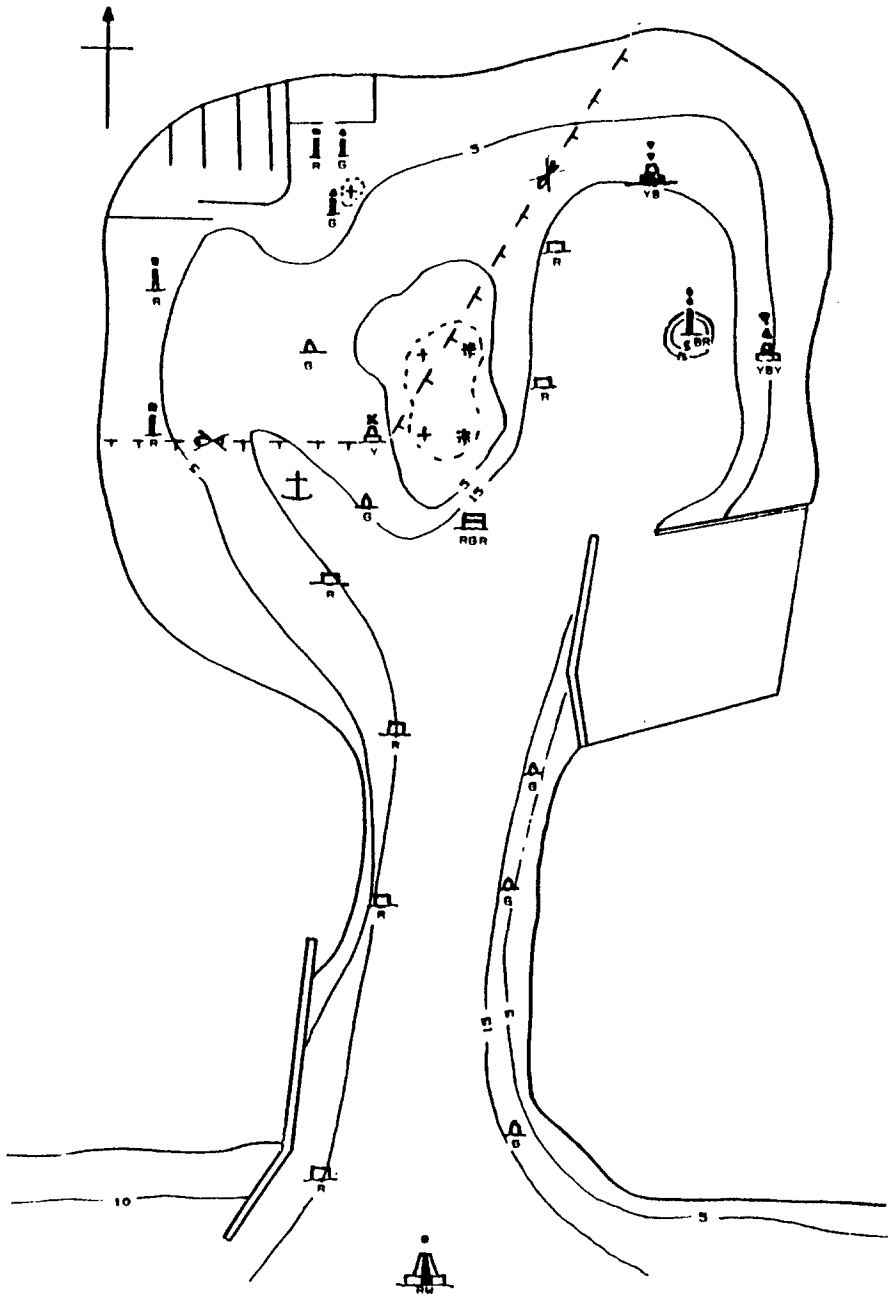


Fig. 429.

Characteristics of a Light. Next to a light as seen on a chart, one will see the Lights' Characteristics. This is an abbreviated statement of the detailed description of the light. It consists of four parts:

1. **The 'On/Off' Sequence**. The time a light is 'on', compared to the time the light is 'off', and the number of times the light comes 'on' in a given cycle of its regular pattern:

1.1. **'Flashing'** ('Fl')- the light is 'on' for shorter periods than it is 'off'. A 'Fl' light may also be 'Fixed' ('F') - the light Is permanentl (fixed) 'on' but dimmed, having 'flashes' of brightness. It would then be seen on a chart as "F Fl".

1.2. **'Isophase'** ('Iso') - the 'on' and 'off' times are equal.

1.3. **'Occulting'** ('Oc') - the 'on' period is longer than the 'off' period.

NB: 'Colour'. The colour of a light is 'White' if the letter 'W', or if none of the following letters appears after one of the above abbreviations: 'R' - red, 'G' - green, 'Y' - yellow.

Examples:

'Fl 3' - a white light is 'off' most of the time, and there are, at regular intervals, three flashes of (bright) light.

'Iso R' - a red light is alternating 'on' and 'off' for equal periods of light and darkness.

'F Fl 3+1' - a white light is on dimmed, and flashes bright, goes back to dim, bright, dim, bright, then dim for a while longer than the previous dim periods, then a bright and back to /dim for an even longer period (In other words, there are three bright flashes in fairly quick succession followed a while later by one flash on its own - when no bright flash is 'on', the white light is 'on' but dimmed.)

'Oc Y 2' - a yellow light which is ordinarily 'on', will have groups of two short periods of darkness.

'Iso RW' - a navigation light construction which has two colours, a red and a white - each covering a specific arc (see the chart), and the 'on' period is equal to the 'off' period. (It could also be that there are two lights, a white - the higher, and the red - lower; the red is likely to cover a specific limited arc as shown on the chart. This will become clear when we see the 'Range' of a light, later.)

'Fl 3' - a white light flashing 'on' three times followed by a longer period of darkness, and a second light, 'FR' red in colour, and usually lower than the white light, which remains 'on'.

'Hurst Point' at the west end of the Solent has two lights at different heights up a tower and they are described as:

'High Lt Iso R W .....' and 'Low Lt Iso...' (W).

2. **Duration**. The 'Duration' of a light is the time, in seconds, from the start of a sequence of a flash or flashes, plus the period(s) of darkness, to the start of the repeat of that sequence. So:

'Fl 2 (10s)' would mean there are two flashes with one short period of darkness between them, and they are followed by one longer dark period - the total time of flashes and darkness being 10 seconds e.g. 'On' 1 second, 'Off' 2 seconds, 'On' 1 second, 'Off' 6 seconds;

Total Time (Duration) = 1 + 2 + 1 +6 = 10 seconds

'Fl 2+1 (20s)' would mean the time allocation for 'on' and 'off' could be (the 'on' periods could be slightly shorter or longer with corresponding adjustments to the 'off' periods):

'On' 1 second, 'Off' 2 seconds, 'On' 1 second, 'Off' 5 seconds, 'On' 1 second, 'Off' 10 seconds;

Duration = 1 + 2 + 1 + 5 + 1 + 10 = 20 seconds

At the end of the 'Duration', the cycle or sequence repeats itself, and it continues to repeat (for most navigation lights) from sunset to sunrise. In addition to automatic timers to switch the system 'on' and 'off' at dusk and dawn, some buoys are left to operate their lights 24 hours a day. Others have a light intensity sensing capability and they can switch themselves on and off as required depending on the amount of natural light about at the time - so if cloud (or fog, mist or haze) causes poor light through poor visibility, the navigation light begins to function on its own.

3. **Height**. The height of a light follows the 'Duration' information, and it is expressed as the nearest whole number of metres measured vertically upwards from the 'Height Datum'. The Height Datum used by different chart producers varies - it is defined in the 'Chart Statement': In the UK the new Admiralty charts (see Chart 5050) use 'MHWS' (Mean High Water Springs), and the South African charts (see Chart SAN 3002) use 'MSL' (Mean Sea Level). So on a chart, after the 'Duration' information for a navigation light, one may see '25 m'- meaning the light is 25 metres above the Height Datum.

The 'Height of a Light' is important information to the navigator who may well be determining his or her vessel's position at sea by 'Dipping' (or Bobbing) the light, or determining 'distance off' by vertical sextant angle .

Other than places like South Africa where tide heights are not high, the height of the tide at the time can make a significant difference. For example a light which is shown as 25 m high relative to MHWS could well be over 38 m above sea level at a time when it is Low Tide at Springs (e.g. along some parts of the south west coast of England).

A sextant can be set at an angle (minimum or maximum) to measure whether a vessel is too close or too far to or from the obstruction if its actual height at the time is known.

Where two lights are located in the same vertical plane, the top light is usually the white light and the lower light is usually a coloured light. The latter is also usually 'Fixed' ('on') and is only visible over a limited arc e.g. the arc covering an obstacle such as a reef.

'Fl 4 (30s) 45 m i.e. when feint/not obvious, look
F R 35 m' 10 m down for the red light.

4. **Range**. The range of a light as stated on a chart is the 'Nominal Range', where:

4.1. The 'Visual Range' is the distance in nautical miles that a light can be seen under the prevailing conditions at a time, such as rain, mist, haze, elevation, height of eye and curvature of the earth.

4.2. The 'Luminous Range' is the range of a light at a time due to its candle power (the light intensity) and the prevailing meteorological conditions - no account is taken of the height of eye, elevation or curvature of the earth.

4.3. The 'Nominal Range' is the Luminous Range when the meteorological visibility is 10 nautical miles.

The fourth and last part of a light's characteristics as stated on a chart, the 'Nominal Range' of that light, is shown as a number followed by 'M' for nautical miles e.g. '25 M' - meaning the Nominal Range of the light is 25 nautical miles. Remember that, depending on its elevation at the time (its height corrected for the state of the tide) and the height of eye on a yacht, one may be a lot closer before being able to see it due to the shorter Visual Range.

Where two lights are co-located, having different colours and/or ranges, and if it is beneficial to the mariner to know the ranges of both lights, both ranges will be given:

'F Fl 4 (30s) 30m 20 M
F R 25m 10 M'
(The white light's nominal range is 20 nm while the red light's nominal range is 10 nm.)

And:

'Iso W R (6s) 23 m 14 - 11 M'
(The white light's nominal range is 14 nm while the red light's nominal range is 11 nm.)

Lights' Details; Buoys and Lighthouses. Large scale charts which show a small area in large detail, will show all the navigation lights and their full 'characteristics'. The exact position of a buoy as shown on a chart is the centre of the small circle in the baseline of the symbol. The exact position of a lighthouse as seen on a chart is the centre of the star part of the lighthouse symbol.

Smaller scale charts may not show ALL the lights, and for those that are shown, the characteristics are often cut short to give only the colour(s) and 'F/Fl/Iso/Oc' information. Where this is the case and the full detail of a light is required, the remainder of the light's characteristics can be found in one or other book kept on board for the purpose. The '*Admiralty List of Lights*' (several volumes) cover all the lights on a world - wide basis. The lights along the South African and Namibian coasts, and for the approaches to and within their harbours and ports, are contained in the South African Navy publication 'SAN HO-1'. An example, which has the same style format as the British Admiralty's books, is taken from SAN HO-1:

Number	Name	Lat (S)	Long (E)	Charac-teristic	Elev m	Range	Descrip -tion
D6370	Cape Agulhas	34°49,8'	20°00,6'	Fl 5s	53	25	W* round tower - red bands (*W = white)

At the extreme right there is a '**Remarks**' column which, in the above example, shows 'fl 0,3 RC'. It means the light is on during its flash for 0,3 second, and that at the same place as the light, there is a Radio Beacon ('RC'). The detail for the radio beacon can be found in the appropriate reference book for radio beacons. (Also in SAN HO-1.)

Other Terms. In the 'Characteristics of a Light', one may also see the following terms whose meanings are explained:

'L Fl' - for 'Long Flashing' where a flash lasts longer than 2 seconds.

'Al' - for 'Alternating' e.g. 'Al WR' means that successive exposures of light alternate between White and Red.

'Gp Fl' - for 'group flashing', this is seldom now used. It was originally used to mean there was more than one flash i.e. a group of two or more flashes. Now it means there are two distinct separate groups of flashes e.g. 'Fl 2+1' - the first group consists of two flashes and the second of one flash (as described earlier). However the '2+1' tells the navigator the same thing, so the word 'Group' is unnecessary and is invariably omitted.

Common Faults. The most common fault on the part of navigators when it comes to navigation lights, is to read the characteristics of a light on a chart, then to look for that light where he or she expects it to be. On seeing a light with similar characteristics, the latter is accepted as the light sought - it is 'made' to 'fit'. The consequent bearing to the wrong light, and the wrong LOP plot on the chart leads to the wrong course being taken. The ultimate result could be terminal!

The absence of a light sought does not necessarily mean that the light is still too far away or obstructed - it may be faulty! So beware.

Pilotage

'Pilotage' can be defined as pre-planned close quarter navigation of a vessel.

When a route is to be followed with which the master or navigator is not totally familiar, and the route involves one or several turns after short straights, with reefs or other obstructions close by, and the possibility exists of complicating tidal streams or currents to push a vessel off course, one should exercise 'Pilotage'. There will not be time to take a fix, then determine the next course to steer, then turn on to that course. Course(s) to steer, the speed, time per 'leg', turning points, allowance for tidal streams, the depth along the route, visual progress checks using buoys, transits and clearing lines and bearings to prominent features must all be pre-planned.

The three main rules of Pilotage are:

1. Study all available sources of information about the port or place you intend to enter, thoroughly well in advance; make a sketch plan and a list of all the checks and actions in the order they are to happen/be used.

2. Never enter a harbour or similar at night unless you already know the area - rather wait for daylight to be on your side.

3. While entering an area with which you are not familiar, even if exercising Pilotage, do not proceed along the planned route if at any stage there may be any doubt about any checks being correct, where the vessel is, and what or when the next action should be. Rather stop, and if necessary go back, re-calculate or re-plan as necessary, then try again.

To assist the navigator, there are the charts (use the largest scale possible - they have the most detail), books e.g. '(The Ocean) *Pilot*', '*Sailing Directions*', and '*Tide Tables*', the normal navigation 'tools' (binoculars, parallel rule and/or plotter, dividers, etc., and the buoys, beacons and other aids used around a harbour for the purpose. 'Transits' and 'Clearing Lines' are extremely helpful (see page 171).

Transits. Two objects which are in fixed positions are said to be 'in transit' when an imaginary line joining the two and extending out to seaward, passes through the observer's position.

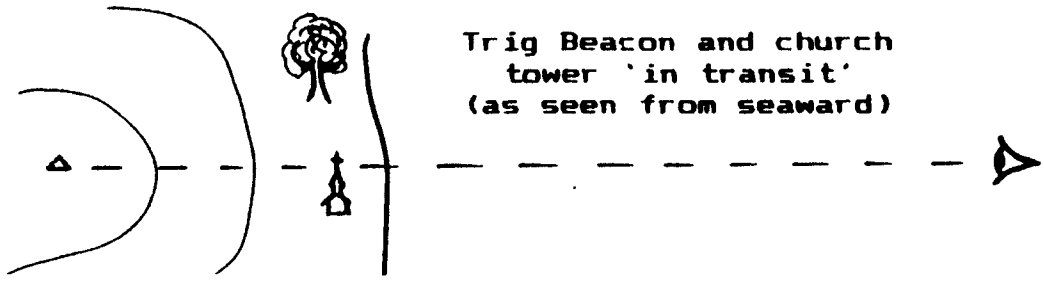


Fig. 430.

A 'transit' can serve as a guide to a helmsperson steering a vessel along the transit line, either towards or away from the two objects - if the vessel is seen to move off to one side of the transit line, the helmsperson notices immediately and can correct by steering back to the line.

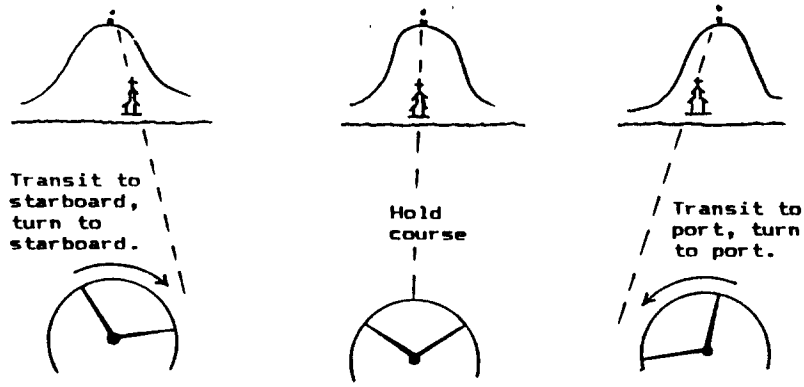


Fig. 431.

Buoys on flexible chain couplings, vehicles on the foreshore or anything which can and may move, should not be used as one of the two objects selected for the transit. Use objects which are permanent structures or features, and which will be clearly identifiable on the chart and on land.

The edge of a cliff face is a very exact mark if seen from its side, but if seen square on, no exact 'mark' is possible. A flagstaff may be ideally placed as seen on the chart, but will the distance from it allow it to be easily visible for use in a transit? Buildings, towers, hill tops (if distinct), bridges etc are ideal objects to choose.

Where possible, pre-plan transits for each leg of the route being piloted. If they cannot be pre-planned, look for easy to use transits when the vessel turns on to its new course.

Most harbours have 'Leading Lights' which form a transit for the main purpose of assisting in the proper pilotage of a vessel into that harbour. The 'Leading Lights Line ' guides the helmsperson to steer the vessel along the most suitable approach route. The exact 'True' direction of the transit formed by Leading Lights is invariably printed on the chart next to the line, and this can be used to carry out a quick and accurate compass check.

Clearing Lines. A 'Clearing Line' is a magnetic bearing (line) to a fixed object, which may not be allowed to get bigger or smaller, as the case may be, than a pre-determined value. A vessel must stay

on or to the safe side of a clearing line.

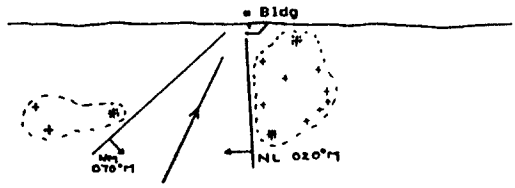


Fig. 432.

If a vessel goes to port of a desired line, the magnetic bearing to an object in the approximate direction of the destination will get larger (Figure 433.). If the vessel goes to starboard of that line, the magnetic bearing will get smaller (Figure 434.).

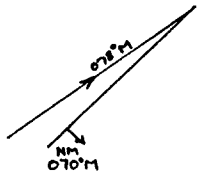


Fig. 433.

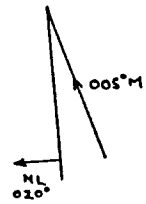


Fig. 434.

If it is necessary to ensure that a vessel does not go too far to port and/or to starboard of a desired line, the navigator can use 'Clearing Lines'. In Figure 433 above, the clearing line critical direction would be 070°M - the bearing from the vessel to the tower can be 070°M or a lesser bearing but NOT MORE than 070°M - we say the Clearing Line is 'Not More than 070°M' and it is shown on the chart, with a short line with an arrow to the 'safe' side and the abbreviated instruction 'NM 070°M'.

Pre-Planning. Imagine arriving outside the harbour of a place you have not previously visited, and of which you have no local knowledge. You wish to enter the harbour and to proceed to a yacht marina which you know by name only. In addition to asking for advice or route instructions via the radio, if there is a language problem or the route may be more than just a bit complicated, it is strongly advised that time be taken to prepare your own Pilotage plan.

Start by reading the applicable harbour's detail in the Ocean Pilot and/or Sailing Directions, referring to the largest scale chart available as you do so. Read about the hazards, the safe channels, the navigation marks recommended, the effect of tide heights and tidal streams, restricted areas, good anchorage areas in case of problems, docking requirements for new arrivals, etc.

Then select the course you intend to follow, and make a sketch of the route with all the relevant information EXCLUDING the irrelevant and possibly misleading detail found on a chart. Show the course, leg by leg, the turn points, the depth along the route so you can check as you go, the distance of each leg and therefore the time each will take travelling at the speed you intend to follow, any transits and clearing lines to be used, and the bearings from key points along the route to prominent features, lighthouses, etc.

A check list of what has to be checked as you travel along also helps to keep confusion at bay. Only refer to the chart if you really must.

NOTES

CHAPTER 10

COMMUNICATIONS AT SEA

Introduction

In addition to the Sound Signals, Shapes, and Ships' Lights we dealt with in the Chapter on the Rules for the Prevention of Collisions at Sea, there are flags and best of all, radios, to enable us to convey a message from our vessel to someone further away. Wherever we have a choice, we always use radio because it is so efficient when compared to other means.

RADIO

How a Radio Works

Cycle. When one speaks, the sound that comes from one's mouth is a series of alternating high and low pressure pulses - there is compression of the air and immediately thereafter, a very short space of time later, decompression or more correctly the rarefaction, then compression, decompression, etc. The speed of the changes from the one to the other is determined by how many of each there are in a period of time. The start of a compression, building up to its maximum, then decreasing back to normal or 'neutral' pressure, followed by a decrease to minimum and back to neutral again, is one complete 'cycle':

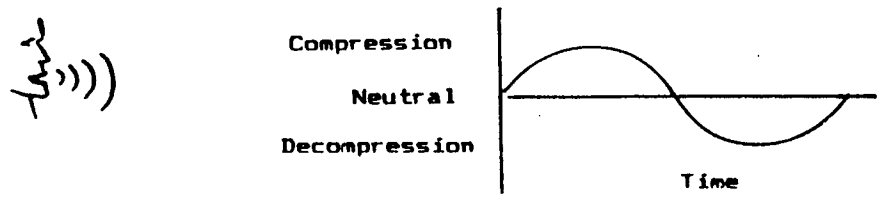


Fig. 435.

Wavelength. The distance from any part of a cycle to where that same part first repeats itself is called 'wavelength'.

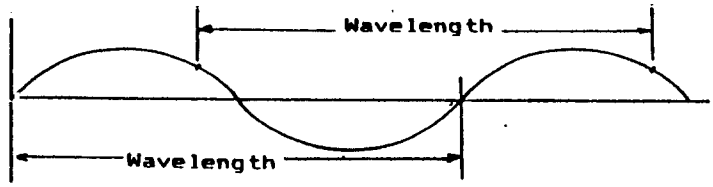


Fig. 436.

Frequency. If there are five complete 'cycles' in a second of time, the frequency is 5 cycles per second, or 5 c/s, and the wavelength of one cycle will be one-fifth of the length of the 'one cycle per second' pulse.

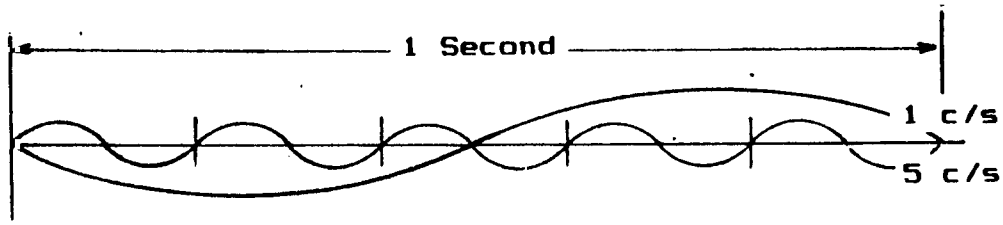


Fig. 437.

Audio Frequencies. In reality, to be heard, a sound's frequency must be at least 20 c/s for the very, very low, base sounds, and up to about 20 000 c/s for the very high notes. Not everyone can hear these extremes.

Hertz. To honour scientists in our history, some of their names have been used in place of the normal English language word or words for some aspect of science. The German physicist, Hertz, has his name used for the phrase 'cycles per second' . Since most of the frequencies we deal with are in multiples of

thousands, we refer to 'kilohertz' (kHz). Radios' transmission frequencies are even higher, in the millions of hertz, or 'megahertz' (MHz) ranges.

Sound to Electric Pulses. The sound wave from one's mouth travels outwards and spreads. If a microphone is placed in the path of the sound waves, the microphone will convert the compression / rarefaction (decompression) changes in the air into electric current changes in the input electric circuit of the radio. These input electric pulses will be of the same frequency and pattern as the sound pulses from the voice.

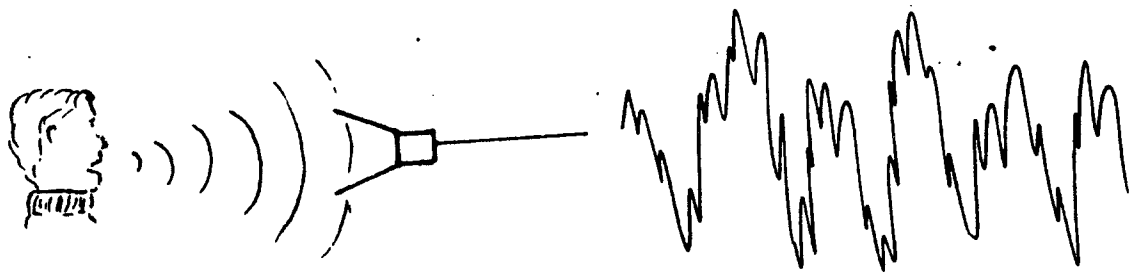


Fig. 438.

Modulation. The radio will be set by you to a 'channel' which generates what is called a 'carrier' wave. A 'carrier' is a clean sine wave pattern of even smooth cycles of the frequency you select. The frequency of each channel's carrier wave is different. The input signal from the microphone is routed into a 'modulator' where it meets up with the carrier wave. The output from the modulator is a number of waves, including one which is the sum of the frequencies of the carrier + the input waves. This one is kept and the others are 'filtered' off. The combined wave is then amplified (i.e. is increased in strength, or power), and sent to the antenna where it causes an identical pattern of electro-magnetic waves in the surrounding atmosphere, spreading outwards.

Receivers. Some distance away another radio has its receiver on, and this receiver has been set to a channel whose demodulation frequency, when mixed with the received signal (after a few other actions), results in a number of products, one of which is the difference between the incoming modulated frequency and our receiver's set frequency, and it is the audio frequency from the transmitting operator's voice. This frequency wave pattern is amplified (made stronger) while all the other resulting frequency products are filtered off. The amplified signal is fed to the loudspeaker, which may take the form of headphones, and the receiving operator hears the message.

Interference. A signal being sent on one channel of a radio system will not ordinarily interfere with the signal of other radio-users operating on another channel. If the antenna length is not the correct fraction of a wavelength of the frequency being used, or very nearly so, the power output will be decreased, and interference on other channels can result. Interference can also be caused by radios that have not been tuned to the operating frequency correctly, which have other minor faults, are not 'ground connected', or any of several other reasons.

VHF

'VHF' is the abbreviation for 'Very High Frequency', and Very High Frequencies are any in the range from 30 to 300 MHz. The maritime radios use channels whose frequencies are in the 156,0 to 162,0 MHz band of frequencies.

Range. The higher the frequency of a radio signal travelling through the atmosphere, the greater the tendency for it to travel in straight lines. The VHF signals are like light rays; they do not curve or bend. If two users' radios are on the same channel, and they wish to communicate with each other, the radios' antennas need to be in line of sight of each other. If one is beyond and below the horizon relative to the other, it will not matter what quality or brand name of radio is being used, there will be no contact. Even an increase in the power of the transmitted signal will make no difference.

Therefore we should place our VHF antenna as high as possible. Land VHF radio stations try to get their antennas on top of tall masts on the top of the highest hill in the area. This way, the range for 'line of sight' communications is considerably increased. When only one side of a conversation is heard, it is sometimes because only one of the radios' antennas is within 'line of sight' of one's own antenna - the other is beyond and below the horizon.

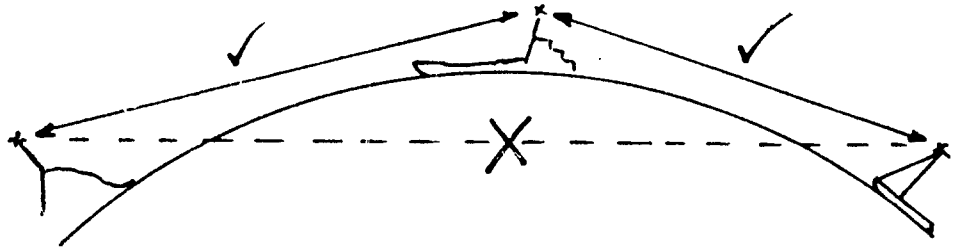


Fig. 439.

Duplex. There could be another reason why one hears only one side of a two-way conversation - the channel being used may be a 'duplex' channel. Duplex means the use of one frequency to transmit and another to receive. So if radio A transmits to radio B on a frequency (say frequency No 1), then radio B must have its receiver tuned to receive that frequency. At the same time, radio B could have its transmitter tuned to another frequency (say frequency No 2) while radio A's receiver is set to receive signals using frequency 2. So A transmits on No 1 and receives on No 2, while B transmits on No 2 and receives on No 1. As a third party listening, you will hear only A or B, depending on which frequency your radio's receiver is set for.

The main reason we have 'duplex' channels from the user's point of view is that it enables us to transmit and receive simultaneously as on a cell-phone. If we had the right equipment on a yacht, we could have a normal telephone conversation without having to take turns in transmitting, and without using the word 'over' when it becomes the other person's turn to transmit, just as with a cell-phone.

Simplex. Where two radios use the same frequencies to transmit, and therefore receive, it is called 'simplex' working. The use of turns to transmit while the other party receives is then the only way one can communicate.

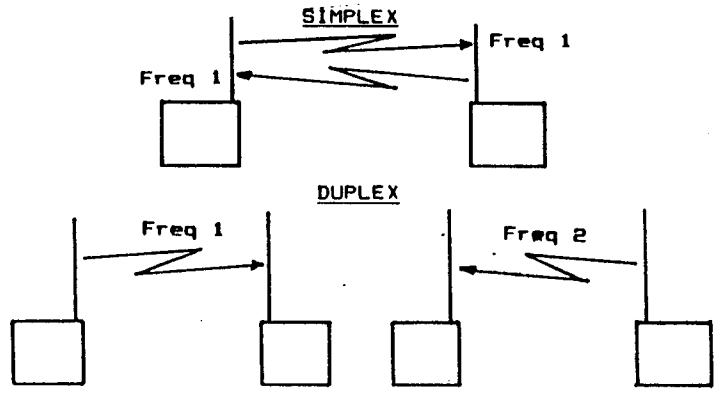


Fig. 440.

Channels. The channel allocations for VHF radios are as follows:

a. **Channel 16.** This is called the '**Calling, Answering and DISTRESS**' channel. A vessel under way is required to maintain a listening watch on channel 16 - any one station wanting to communicate with another can call on channel 16 knowing the other will have its receiver on that channel. **Only in the case of DISTRESS is the whole conversation to be conducted on this channel**. In all other cases, having made initial contact, both parties must agree to a 'working channel' and then switch to that channel. Channel 16 must be used as little as possible, keeping it free for other users and for emergencies.

b. **Working Channels**

i. **Ship-to-Port Control**. Channels 12 and 14 are allocated for this purpose. When calling the Port Control on channel 16, if the conversation is likely to involve more than just a few seconds of 'on-the-air' time, ask for the use of channel 12 - if it is channel 14 the controller wants the two of you to use, he will say so.

ii. **Ship-to-Ship**. Once you have made contact with another vessel, change to channel 6, 8, or Channel 10 for your conversation - check which one is clear before you make the initial call on channel 16.

iii. **Ship-to-Shore** (to the Coast Station). Telephone calls and telegrams to and from ships at sea, are communicated on channels 23 to 28 - the coast station operator will tell you which one to use. These channels is also used several times daily by the Coast Station to read the weather information and 'Navigation Warnings'.

SSB

SSB, or Single Side Band radios that we use are in the MF and HF frequency bands (MF = 0,3 MHz to 3,0 MHz, and HF = 3,0 MHz to 30,0 MHz). The lower the frequency, the greater its ability to follow a curve path. The SSB equivalent of VHF Channel 16 is the frequency '2,182 MHz' (2182 kHz). There is a second 'Calling, Answering, and DISTRESS' frequency for SSB working, namely 4125 kHz (4,125 MHz). A basic understanding of the path taken by the radio waves will make the reason for this clear.

Wave Paths. We have said that the lower the frequency, the easier it is for a wave to follow a curved path. So the limit of its range to communicate will depend on, amongst other things, the power output used, and how far it will go before it is too weak to use - before it is dissipated. See Fig. 434. At the same time as a radio wave leaves the transmitter's antenna and follows the curve of the earth (a 'surface wave'), other radio waves are going off in all other directions (omni-directional transmissions). Some are going straight (or nearly so) up into the atmosphere; others go up into the atmosphere at angles between the vertical and horizontal.

Fig. 441.

The Ionosphere. About 10 000 metres above the earth, is a layer of electrically charged 'ions', called the 'ionosphere'. Radio waves, if the frequency is high or if the angle of entry is too near 90°, will pass through the ionosphere and escape into space. For a given frequency, as the angle of incidence into the ionosphere decreases, a stage is reached where that radio wave will no longer escape - it will be 'bent', or 'refracted' back to earth. There is, therefore, a minimum range for this type of radio wave - called a 'sky wave'. See Figure 442.

Skip. As often happens, the maximum range of the surface wave is not as far away as the minimum range of the sky wave from the same frequency transmission. There is a 'dead' area between the two limits, called the 'skip zone' or 'skip distance', or just 'skip'. See Figure 443.

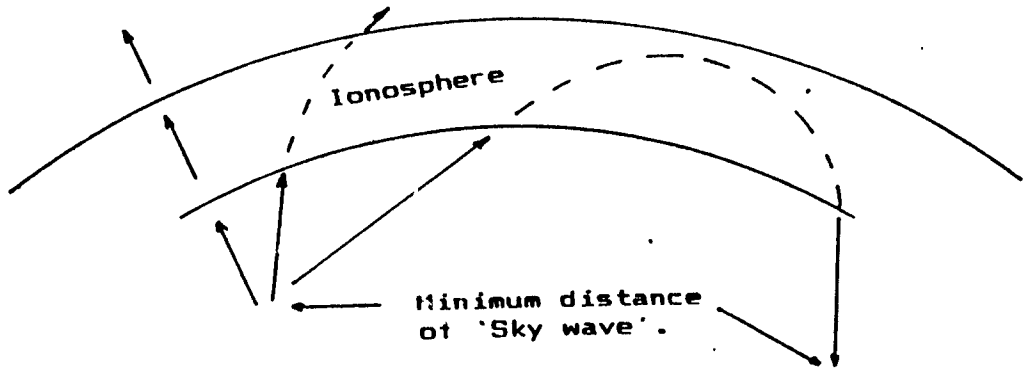


Fig. 442.

So when calling on 2182 kHz, if after a few calls there is no reply, it could be due to the skip. Change to the alternate call frequency (4125 kHz), and try again. The two frequencies' skip zones will not overlap - you should be able to get through using one of them.

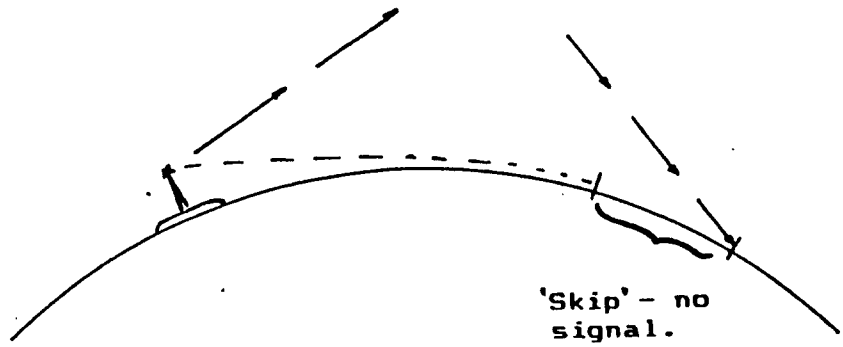


Fig. 443.

Day. By day, with the energy of the sun having its influence, the ionosphere has more power to bend (refract) radio waves back to earth, so a higher frequency can be returned. At the higher frequencies there is less radio 'noise', so we try to use the highest frequencies possible during daylight hours.

Night. At night, the refractive power of the ionosphere is reduced, and lower frequencies have to be used to communicate over the same distance that applied by day with the higher frequencies. However, because at the lower frequencies we find 'noise', our communications at night are not as clear as by day (usually).

Distance. The distance between the two radio stations is also important. For a given frequency, the further the two stations are apart, the smaller the incidence angle of the radio wave entering the ionosphere - the less 'bending' or refracting has to be done. Therefore, higher frequencies can be used.

Other Factors. Apart from the differences between day and night, and the distance between the two stations involved, there are also seasonal effects and a phenomenon called the '11 Year Cycle' (the optimum usable frequency for a distance and time rises and falls over an eleven year period). All of these effect the choice of frequency for any particular communication. More often than not, when one hears an SSB owner say 'SSB is useless', it is a case of his ignorance and the incorrect selection of the frequency used (i.e. he does not know about the effects of day and night, seasonal effects, distance and the effect of the 11 Year Cycle).

Frequency Prediction Charts. To help one choose the most suitable frequency, one can get a copy of the current 'Frequency Predictions' (for HF and the layers of the ionosphere) chart. If you do not know where to get a copy, find the nearest radio 'Ham' (Amateur Radio Operator) - he will know how to find out.

Speech Clarity. When speaking on an SSB radio, the procedure is the same as for using a VHF radio. However, because the quality of the reception of incoming signals is not always as good as VHF, one should speak with more conscious thought to clarity of pronunciation, and slower speech. Raising the pitch of one's voice helps; female voices often get through when male voices are unintelligible.

Listen First. The distances one's transmitted signals travel are vast. So are those from other users. There is, therefore, a greater potential for interference. Always listen to make sure the frequency is not in use before transmitting.

Channels. Unlike VHF, although the individual channels have channel numbers allocated, there are too many channels on SSB to remember them all. So one either uses a reference book to look up a frequency for a specified channel in order to tune a radio to the required frequency (if no automatic channel change switch is provided), or if one does not refer to channel numbers, one may refer only to the actual frequency(ies). Other than the calling frequencies, most SSB channels are duplex requiring the transmitter and the receiver to be set up on different frequencies. (A 'Restricted' Marine Radio Operator's certificate allows one to operate ONLY automatic frequency select radios using a channel select knob/switch. Free tuning of the various controls of a complex, manual tuning transmitter and receiver stages is not permitted.)

Essentials. Much of the success of SSB communications depends on:

1. **The antenna**. The antenna plays a VITAL role - if it is not right, all other efforts will be wasted. Get it put right by a professional radio person.

2. **The 'ground'**. A million dollar radio with a million pound antenna is only worth a few rands if there is no GOOD, EFFECTIVE radio 'ground'. Never underestimate this item's importance. For a yacht, especially one with a wood or fibreglass hull, a gold-plated metal sheet about 0,5 metre square, flush with the hull and well below the waterline, should be connected to the radio 'ground' with a thick, wide copper braid. Two such plates a short distance apart are better. Alternatively one can buy and fit a Dyna-tape which is made for this purpose.

Satellite Communications

Radios operating in the UHF band (Ultra High Frequencies - frequencies from 300 MHz to 3 000 MHz) are now being used on vessels at sea for the purpose of linking into global telephone networks via satellites in the INMARSAT system. They are very expensive and antenna systems for INMARSAT A are like large balloons of ± 0,75 to 1,0 metre diameter; INMARSAT C are small. They are not often seen on yachts.

Radio Users' Procedures

A radio being operated on any of the marine frequencies must be operated by, or under the supervision of, a person who has a valid 'Radiotelephone Operators (Marine) Certificate', or a 'Radiotelephone Operators Restricted (Marine) Certificate'. The former permits the operator to use telegraph systems, whereas the latter is for 'voice operation' only. (We no longer need to know the morse code - only how to flash and recognise the flash of 'S-O-S' and the name of our vessel.)

Operators' Checks. Before using a marine radio, it is the operator's duty to ensure that it is in proper working order, that the batteries are adequately charged, and that when transmitting, the radio will not be a source of interference to other users. Even if all is technically 'OK', the radio can still cause interference if the operator fails to **LISTEN BEFORE TRANSMITTING**. Check that the frequency/channel is clear before you start talking.

The operator starts by turning the radio to the 'Calling, Answering, and DISTRESS' channel. Listen to make sure the channel is clear. Make sure the radio is properly tuned, as per the manufacturer's instructions. In the case of VHF, this only involves setting the 'squelch' control.

What to Say. When the channel is clear, begin your call by saying the name of the radio station you are calling, up to three times, followed by the words 'THIS IS', then your own vessel's name up to three times. (In practice, especially when the quality of communications are good, most operators only say the call sign(s) once, maybe twice, and they omit the 'THIS IS'. The examiner though, wants you to say it three times.) Invite a reply by saying 'Do you receive me?, OVER'. Expressions like 'Do you read?' are common, but 'Come-in please' sounds more like a taxi co-ordinator's network.

'OVER' and **'OUT'**. The word 'Over' means 'I am stopping transmission; I am now wanting your reply'. The word 'Out' is used at the end of the conversation, when both parties have finished talking - it tells other radio users that the channel is now available for their use. So 'Over and Out' is a contradiction in itself. It belongs in the 'Good guys versus Bad Guys' films.

WAIT Before Repeating a Call. Having made the initial call, if there is no reply, wait three minutes before repeating the call. Do not, after only a few seconds, start repeating the call - it makes other users angry. If you are calling a Coast Station, you will probably be made to wait even longer. The Coast Station staff, although you do not hear it on your channel, are most probably busy with other channels to ships far away - they cannot just stop at the first moment a yacht operator calls.

Use a Working Channel. Once you get a reply to your call, tell the called operator which working channel you want him or her to change to, then you both turn to that channel. Once on the working channel, after the initial call, usually saying the respective call signs once only, you are free to have your conversation. In high density shipping areas, do not keep the channel in use too long - there may be others waiting to use it.

The DISTRESS Call

All Crew. All qualified crew members must be able to transmit a DISTRESS call. A DISTRESS call may, however, only be transmitted on the orders of the Master of the vessel. (In law, the Master of a yacht is called a Skipper.)

Justification. The reason for the transmission of such a call must fall within the following definition: the vessel, or one or more persons on board, or another vessel or an aircraft, must be in grave and imminent danger, and in need of immediate assistance. A call for assistance for a person who has fallen overboard is not, however, regarded as a justifiable 'Mayday' call. Here, if help to search is required, the 'Pan-Pan' call is used.

The Call. Begin by turning the radio to the DISTRESS channel, then listen to ensure the channel is clear. Even in an emergency - if you transmit while someone else is transmitting, you will only cause unintelligible interference and delay. When it is clear, if using a SSB radio, transmit the automatic 'Alarm Signal' (if fitted) for 30 to 60 seconds, then say three times:

'MAYDAY, MAYDAY, MAYDAY'.

Then say:

'This is'

followed by your vessel's name three times:

'Yacht Crest, Yacht Crest, Yacht Crest.'

Now repeat, once only:

'MAYDAY, Yacht Crest.' leaving out 'This is'.

Next, the vessel's position must be clearly stated. This can be done in one of two ways:

1. By stating a direction, from an easily identifiable place, and the distance from that place to the yacht:

'Position, 140°Magnetic, Needles Lighthouse, 6 Miles', or

2. By giving the geographic co-ordinates of latitude and longitude:

'Position, 50° 35' North, 1° 28' West.'

Having announced the absolute minimum essential information to enable something to be done about the yacht's predicament, the operator should now state the reason for the DISTRESS call:

'Sinking, abandoning ship into liferaft.'

Finally, and still being brief, state what assistance is required (obviously in this case it will be 'rescue'):

'Require rescue, 6 persons on board.'

Then invite a reply by saying... 'OVER.'

When a station replies, and in all subsequent conversations during the emergency up until it is officially ended,

a. all conversations are to be preceded by the word 'MAYDAY', and

b. all stations involved stay on channel 16/SSB DISTRESS frequencies and limit transmissions to the DISTRESS only.

RADIO SILENCE IS TO BE KEPT ON CHANNEL 16/SSB DISTRESS FREQUENCIES BY ALL STATIONS NOT INVOLVED IN THE EMERGENCY.

Who is the Control? A vessel calling for assistance is the control station unless or until it can no longer properly perform the control function, or until the control responsibility is assumed or delegated by the nearest Port Captain or Rescue Co-ordination Centre, or rescuing ship.

Other Key Words/Phrases.

1. **SEELONCE.** It can happen that a vessel approaching the area, previously out of VHF radio range, is not aware of the fact that a 'Mayday' situation is in progress. As may be normal, that vessel starts to call the port control on channel 16, and in doing so, breaks the 'radio silence' requirement. The controlling station, either the vessel being assisted, another vessel in the vicinity or a nearby shore station, will announce

   'SEELONCE MAYDAY. THIS IS (e.g. ...) CAPE TOWN RADIO.'

   This tells the newcomer that radio silence on the channel is in force because of a mayday situation.

2. **PRUDONCE.** If the situation becomes protracted, the controlling station may deem it prudent to allow other vessels, not involved in the mayday situation, to use channel 16 or a SSB equivalent. This would be for the purpose of arranging a working channel with another station, where the time spent using channel 16 or a SSB equivalent would only be a few seconds. The controlling station would say:

   'MAYDAY, ALL STATIONS (X 3), THIS IS ... . PRUDONCE. OUT.'

3. **MAYDAY RELAY.** Where the distance between a coast station and the vessel in distress is such that they are out of VHF radio range, an intermediately located vessel may be required to act as a radio relay station. If this is the case, the relaying station must prefix all its transmissions with the words:

   'MAYDAY RELAY, MAYDAY RELAY, MAYDAY RELAY.'

   Messages relayed must be verbatim.

4. **MAYDAY FINIS**. When the emergency is over, the controlling station will announce:

'MAYDAY FINIS' (Pronounced Fin-nay.)
and the time. Normal use of channel 16/SSB equivalent is reinstated.

OTHER DISTRESS SIGNALS. For other methods of indicating Distress, see page 94.)

URGENCY Signal

'Pan-Pan'. Where a situation arises such that there is no '**grave and imminent danger**', but a vessel does need urgent assistance, *in lieu* of the Mayday procedure, the vessel needing assistance will, on channel 16 (or one of the MF/HF calling, answering, and DISTRESS channels if using SSB), use the 'Urgency' signal, for example:

'PAN-PAN, PAN-PAN, PAN-PAN. ALL STATIONS (X 3), THIS IS ...etc.'

The vessel's position, problem, and help required, etc, follows the same format as the Mayday signal. Once contact is made with a station replying to the 'Pan-Pan' call, the stations involved move off channel 16/SSB equivalent to a working channel.

Announcing Important Navigation (New) Information:

'Securité'. The use of the prefix 'SECURITÉ, SECURITÉ, SECURITÉ' to a radio transmission on a calling, answering, and DISTRESS channel, is made to announce that some important new navigational information is about to transmitted. It is announced on that channel, with the statement 'Listen on channel ... VHF, and .... (MF/HF frequencies)'. If one then changes to that working channel, one will hear the same prefix followed by the actual message. For example, a navigation buoy may have broken its chain and be out of position, and it could be a danger to shipping. Any ship or a shore station could originate such a message.

Telephone ('Link') Calls

It may be that someone on board needs to make a telephone call. To do so, the operator must initiate the call on the calling, answering, and Distress channel or frequency. Once a check has been made that the channel is clear, he or she will begin by saying the name of the called coast radio station up to three times.

Ports usually have two separate radio stations monitoring the calling channels - one is the "... place name ... Port Control", and the other is "... (place name) ... Radio". The latter, which has the suffix 'Radio' to the place's name, is the Coast Station, whose role includes managing incoming and out going messages, telephone calls and telegrams. They also usually have the responsibility to read out the weather forecasts, etc.

Once the Coast Station has replied to the initial call, the yacht's radio operator asks to make a 'link' (telephone) call. They will then tell the yacht's operator which working channel to switch to. Once contact is made on a working channel, the coast station operator will ask (UK only) for the accounting code of the station making the call, or (other places) for the full name of the vessel, its radio call sign, and the registered address as per the vessel's radio licence - all its "QRC" details. Once that has been recorded, the coast station operator will dial the number requested, and on getting through, will connect the telephone circuit to the radio system. When the call is over, the telephone user hangs up and the coast operator's attention is called by a buzzer or light. He will disconnect and tell the vessel's operator how long the call was, for subsequent accounting purposes.

Log Book Entries. All calls made from a vessel should be recorded in a log book.

Phonetic Alphabet. The phonetic alphabet is used to aid spelling when communications quality is not good, or when sending telegrams. The phonetic alphabet and some of the remaining detail expected to be known by a Marine Radiotelephone Operator is contained in an extract from a Telkom hand-out to prospective examination candidates. It is included as Annex. 1 to this Chapter. **Yachtmaster's** book '***A Course for the Radiotelephone Operators Restricted (Marine) Certificate Examination***' covers the full syllabus in detail.

Morse Code

As said earlier, we do not have to know the morse code, but it is advisable to know how to send (flash) and recognise 'SOS' and our vessel's name by flashlight/torch, - you will have to know how to do it for higher level tests, plus the letters D, F, J, K, L, O, T, U, AND W. So here is the code:

A ·—	B —···	C —·—·	D —··	E ·	F ··—·
G ——·	H ····	I ··	J ·———	K —·—	L ·—··
M ——	N —·	O ———	P ·——·	Q ——·—	R ·—·
S ···	T —	U ··—	V ···—	W ·——	X —··—
Y —·——	Z ——··				

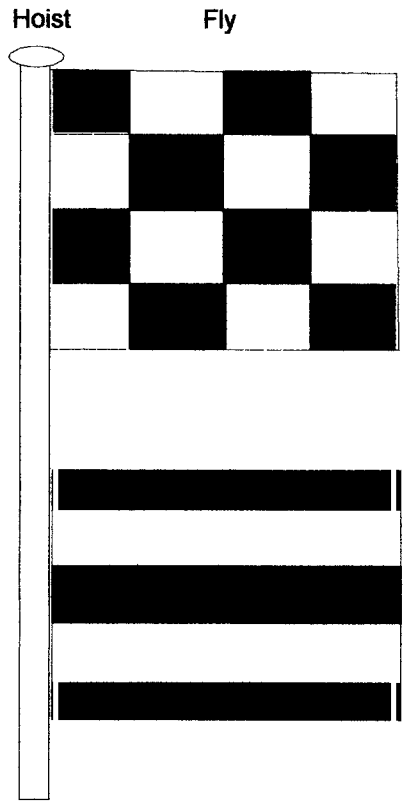
1 ·————	2 ··———	3 ···——	4 ····—	5 ·····
6 —····	7 ——···	8 ———··	9 ————·	0 —————

Some charts show fog warnings consisting of loud blasts on a horn in morse code. One must positively identify a signal before accepting it. So, if the code has not been learnt, a copy must be handy for reference.

Radio Navigation Beacons emit the morse code for the purpose of allowing a navigator to get a Line of Position, even when still beyond the horizon or in fog. The code must be referred to in order to get a positive identification - so a copy needs to be on board, and one should have a book with the beacon's detail on board - see Chapter 9, page 182.

FLAGS (Not mentioned in the syllabus.)

Alphabet Flags. The syllabus makes no mention of flags, but yet as a skipper, your vessel must carry at least three or four flags - so you may as well know what they mean. They are the flags C,N,V and probably W -colour them in; it may help you to learn them. The sides of a flag are the 'Hoist' (at the mast) and the 'Fly' - furthest from the mast.



N 'No', or 'Negative.'

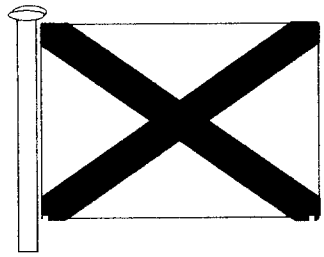
over

C 'Yes', or 'Affirmative.'

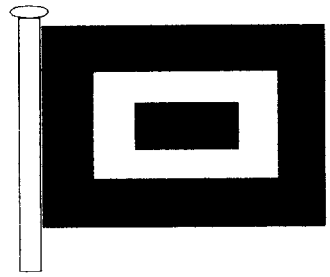
= **DISTRESS**

(THE TWO FLAGS TOGETHER, N OVER C, MEAN "MY VESSEL IS IN DISTRESS - I NEED IMMEDIATE ASSISTANCE"'.)

V 'I require assistance.'



W 'I require medical assistance.'



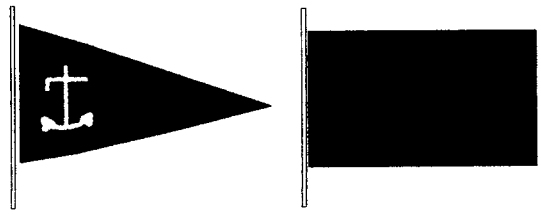
Flag Etiquette

Ensigns. An 'ensign' is the maritime flag indicating the country of registration of the vessel. Ensigns are flown from the stern of a vessel, from sunrise until sunset, providing someone is on board the vessel, or is due on board soon. If the vessel is closed up and left at its moorings or berth, the ensign is removed and stowed.

Saluting. A custom of the sea is for a vessel under way, passing or being passed by a naval vessel (any country's navy), to lower its ensign (or collapse it by holding it) until the navy vessel has returned the compliment or is clear passsed. The navy vessel's return salute may be to lower and raise its ensign, or an officer may salute or just wave from the bridge.

Dressing Ship. To celebrate special occasions, a ship's flags can be connected to each other and hung from the masthead(s) as shown below. Do get the sequence right! See the illustration on the next page.

Club and Association Burgees. A cruising yacht's burgee is triangular in shape: a yacht engaged in racing (i.e. from the ten minute gun until crossing the finish line) uses a rectangular burgee.



A burgee is normally flown at the mast head, or, if lights, antenna and wind instrument sensors at the mast head are in the way, it is flown from the spreaders.
A yacht-owner or the skipper may belong to an association in addition to a club, or to two or more clubs and/or associations. In such a case, all the burgees may be flown, but there is an accepted sequence of seniority. It is:

Uppermost Burgee:	The burgee of one's home waters club, when in home waters. If visiting another place where one is also a club member, then the burgee of that club.
Second down:	The burgee of the Association of which your home waters club is a member.
Third down:	Any other Associations you may belong to, in order of seniority - 'Royal' associations taking precedence.
Fourth down:	Burgees of any other clubs of which one is a member, in order of seniority, 'Royals' taking precedence over 'non-Royals'.

Burgees may be flown day and night if the owner (or skipper, if the burgees belong to him) is on board or is only away for a few hours at a time.

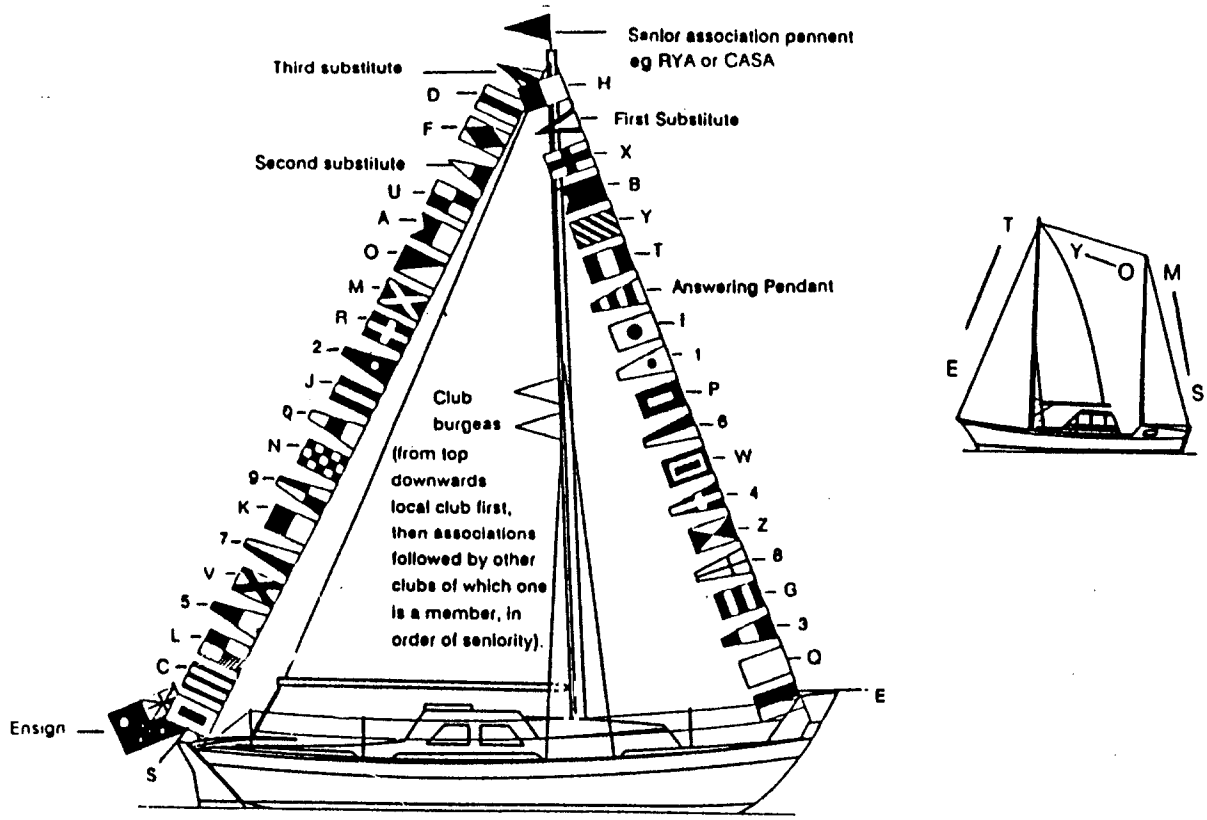


Fig. 444.

Other Etiquette

1. When entering or leaving a harbour or marina, ensure the vessel looks right, e.g.:
   i. Fenders are put out or away, as required.
   ii. No lines are hanging over the side.
   iii. Sails are properly trimmed or properly and neatly down and secured/folded, or bagged and put away.
   iv. Gear on deck is neat and tidy, with all spare lines properly coiled.
   v. Only burgees, pennants and flags to which the owner/skipper/vessel is/are entitled or should display, are displayed.

2. Never throw refuse/garbage overboard - only vessels going more than 50 miles offshore may do so, and then only in a special way i.e. as small loose pieces, but no plastic nor bottles or broken glass, etc..

3. 'Think Seamanship' - if under power, give way to sailing craft and give them a wide berth - do not cause your vessel's wake to affect the sailing vessel. And if sailing, do not needlessly get in the way of the passing powered craft.

4. Whether under sail or power, keep away from racing vessels - keep to their leeward and/or astern of them.
(If you are racing against me, stay behind me!).

5. As a visitor, do not just help yourself to any vacant mooring; get permission and direction as to where to go and which mooring to use. Do not damage it nor mark it in any way - look after it as if it were your own.

6. Loud music or other loud radio or tape playing is not appreciated; have consideration for others likes and dislikes.

7. Do not paint, spray paint, or work on your vessel at the mooring if other vessels may be affected.

8. Do not allow any pollutants to enter the water.

9. Do not hog the water hose nor the water supply pressure by leaving the water running - if you have a long wash down job ahead of you, let others use the hose first if their need is just to fill tanks, etc.

10. Do not leave surplus lengths of mooring lines on the dock or walk on; coil it on deck.

11. Do not leave items on the walk-on or dock which could get in other people's way or offend.

12. Do not leave unsightly items in view of others, e.g. laundry.

ANNEXURE 1
EXTRACT FROM A POST OFFICE'S RADIOTELEPHONE OPERATORS RESTRICTED (MARINE) CERTIFICATE REQUIREMENTS

ABRIDGED SYLLABUS FOR RESTRICTED R/T EXAMINATION

MAYDAY PROCEDURE

TWO TONE ALARM (IF TIME PERMITS)
MAYDAY MAYDAY MAYDAY
THIS IS
NAME OF YOUR VESSEL (THREE TIMES)
MAYDAY
NAME OF YOUR VESSEL OR CALL SIGN
POSITION
NATURE OF DISTRESS
ANY OTHER INFORMATION WHICH MIGHT FACILITATE RESCUE
OVER

ACKNOWLEDGEMENT OF A MAYDAY MESSAGE

MAYDAY
NAME OF VESSEL IN DISTRESS (THREE TIMES)
THIS IS
YOUR VESSEL'S NAME (THREE TIMES)
RECEIVED OR ROMEO ROMEO ROMEO
MAYDAY

TO IMPOSE SILENCE IF YOU ARE IN CONTROL OF A DISTRESS

SEELONCE MAYDAY FOLLOWED BY YOUR VESSEL'S NAME

TO IMPOSE SILENCE IF YOU ARE NOT IN CONTROL OF A DISTRESS
(TO BE USED WITH CIRCUMSPECT)

SEELONCE DISTRESS FOLLOWED BY YOUR VESSEL'S NAME
WHEN COMPLETE SILENCE IS NO LONGER NECESSARY ON A FREQUENCY WHICH IS BEING USED FOR DISTRESS TRAFFIC THE FOLLOWING MESSAGE MAY BE SENT
MAYDAY
HELLO ALL STATIONS OR CHARLIE QUEBEC (THREE TIMES)
THIS IS
YOUR VESSEL'S NAME
TIME OF HANDING IN OF MESSAGE
NAME OF STATION IN DISTRESS
PRU-DONCE

WHEN THE DISTRESS TRAFFIC HAS COMPLETELY CEASED ON A FREQUENCY WHICH HAS BEEN USED FOR DISTRESS TRAFFIC THE FOLLOWING MESSAGE MUST BE SENT

MAYDAY
HELLO ALL STATIONS OR CHARLIE QUEBEC (THREE TIMES)
THIS IS
YOUR VESSEL'S NAME
TIME OF HANDING IN OF MESSAGE
THE NAME OF THE VESSEL WHICH WAS IN DISTRESS
SEELONCE FEENEE

A STATION MAY TRANSMIT A DISTRESS MESSAGE WHEN IT IS ITSELF NOT IN DISTRESS ONLY WHEN

1. THE STATION IN DISTRESS CANNOT ITSELF TRANSMIT A DISTRESS MESSAGE

2. WHEN THE PERSON RESPONSIBLE FOR THE SHIP NOT IN DISTRESS CONSIDERS FURTHER HELP IS NECESSARY

3. WHEN, ALTHOUGH NOT IN A POSITION TO RENDER ASSISTANCE, IT HAS HEARD A DISTRESS MESSAGE WHICH HAS NOT BEEN ACKNOWLEDGED.

THE RELAYED DISTRESS MESSAGE TAKES THE FOLLOWING FORM :

MAYDAY RELAY MAYDAY RELAY MAYDAY RELAY
THIS IS
YOUR VESSEL'S NAME (THREE TIMES)
THE MAYDAY MESSAGE IS RECEIVED FROM THE VESSEL IN DISTRESS

ANY STATION WHICH HAS KNOWLEDGE OF DISTRESS TRAFFIC AND WHICH CANNOT ITSELF ASSIST THE STATION IN DISTRESS SHALL NEVERTHELESS FOLLOW SUCH TRAFFIC UNTIL IT IS EVIDENT THAT ASSISTANCE IS BEING PROVIDED.

VESSELS WHICH RECEIVE A DISTRESS MESSAGE IN THEIR IMMEDIATE VICINITY MUST ACKNOWLEDGE IMMEDIATELY (CARE BEING TAKEN NOT TO INTERFERE WITH A COAST STATION'S ACKNOWLEDGEMENT)

THE FOLLOWING INFORMATION MUST BE GIVEN

YOUR VESSEL'S NAME
POSITION
SPEED PROCEEDING TOWARDS AND EXPECTED ETA AT DISTRESS POSITION
ANY ADDITIONAL INFORMATION

THE URGENCY SIGNAL INDICATES THAT THE STATION SENDING IT HAS A VERY URGENT MESSAGE TO TRANSMIT CONCERNING THE SAFETY OF A VESSEL OR PERSON. THE MESSAGE MAY BE SENT TO ALL STATIONS OR A PARTICULAR STATION. IF SENT TO ALL STATIONS IT MUST BE CANCELLED WHEN ACTION IS NO LONGER NECESSARY.

URGENCY PROCEDURE

PAN PAN - PAN PAN - PAN PAN
HELLO ALL STATIONS - HELLO ALL STATIONS - HELLO ALL STATIONS
THIS IS
NAME OF YOUR VESSEL (THREE TIMES)
THE URGENT MESSAGE
OVER

SAFETY PROCEDURE

THE SAFETY SIGNAL INDICATES THAT THE STATION IS ABOUT TO TRANSMIT A MESSAGE CONTAINING AN IMPORTANT NAVIGATIONAL OR IMPORTANT METEOROLOGICAL WARNING.

SAFETY PROCEDURE

SECURITE - SECURITE - SECURITE
HELLO ALL STATIONS - HELLO ALL STATIONS - HELLO ALL STATIONS
THIS IS
YOUR VESSEL'S NAME (THREE TIMES)
THE SAFETY MESSAGE

ALL STATIONS HEARING THE SAFETY SIGNAL MUST LISTEN TO THE SAFETY MESSAGE UNTIL THEY ARE SATISFIED THAT IT IS OF NO CONCERN TO THEM. THEY SHALL NOT MAKE ANY TRANSMISSION LIKELY TO INTERFERE WITH THE MESSAGE.

CALLING PROCEDURE

THE NAME OF THE STATION CALLED (NOT MORE THAN THREE TIMES)
THIS IS
YOUR VESSEL'S NAME (NOT MORE THAN THREE TIMES)
I HAVE ONE RADIOTELEGRAM FOR YOU MY WORKING FREQUENCY IS
2009 kHz
OVER

THE COAST STATION WILL REPLY :

YOUR VESSEL'S NAME (UP TO THREE TIMES)
THIS IS
COAST STATIONS NAME
2009 kHz LISTEN 2761 kHz
OVER

WHEN CONTACT IS ESTABLISHED ON THE WORKING FREQUENCIES AND THE COAST STATION HAS GIVEN HIS INVITATION TO TRANSMIT THE RADIOTELEGRAM, THE SHIP STATION PROCEEDS AS FOLLOWS.

COAST STATION'S NAME
THIS IS
YOUR VESSEL'S NAME
RADIO TELEGRAM BEGINS
NAME OF SHIP OF ORIGIN
SERIAL NUMBER
NUMBER OF WORDS
DATE
TIME OF HANDING IN
SERVICE INSTRUCTIONS (IF ANY)
SUPPLEMENTARY INSTRUCTIONS (IF ANY)
ADDRESS
TEXT
SIGNATURE (IF ANY)
RADIO TELEGRAM ENDS
OVER

ACKNOWLEDGEMENT OF A RADIO TELEGRAM WILL BE INDICATED BY THE RECEIVING STATION SAYING

YOUR NUMBER.....RECEIVED - OUT

SHIP STATIONS MUST KEEP A CONTINUOUS WATCH ON 2182 KHZ AND CH16 AS FAR AS PRACTICABLE.

ENTRIES TO BE MADE IN THE LOG BOOK

1. NAME OF THE OPERATOR AND THE TIMES AT WHICH HE GOES ON AND OFF WATCH, THE TIME AT WHICH RADIO WATCH IS FOR ANY REASON DISCONTINUED, TOGETHER WITH THE REASON, AND THE TIME AT WHICH RADIO WATCH WAS RESUMED.

2. DETAILS OF ALL DISTRESS MESSAGES HEARD OR SENT AND OF ANY DISTRESS TRAFFIC WHICH TAKES PLACE. IT IS IMPORTANT THAT THE GENERAL SENSE OF THE MESSAGES SHOULD BE ENTERED.

3. A STATEMENT EACH HALF HOUR DURING THE HOURS OF WATCH THAT THE SILENCE PERIOD HAS BEEN OBSERVED.

4. A SUMMARY OF ALL URGENCY AND SAFETY COMMUNICATIONS RECEIVED.

5. A RECORD OF COMMUNICATIONS EXCHANGED BETWEEN THE SHIP STATION AND COAST STATIONS OR OTHER SHIP STATIONS. ENTRIES IN RESPECT OF RADIOTELEGRAMS OR RADIOTELEPHONE CALLS SHOULD BE RESTRICTED TO THE SERIAL NUMBER OF THE MESSAGE OR CALL AND THE TIME SENT OR RECEIVED. DIFFICULTIES IN DISPOSING OF TRAFFIC SHOULD BE RECORDED.

6. IMPORTANT SERVICE INCIDENTS SUCH AS BREAKDOWNS AND THE REPAIRS EFFECTED.

7. DETAILS OF THE CHARGING OF THE BATTERIES, TIME ON CHARGE, TIME OFF CHARGE AN ENTRY AS TO THE STATE OF THE BATTERIES SHOULD BE ENTERED AT LEAST ONCE PER DAY.

8. THE APPROXIMATE POSITION OF THE SHIP AT LEAST ONCE PER DAY IF THE SHIP'S RULES PERMIT.

9. DETAILS OF THE WEEKLY TESTS OF THE PORTABLE RADIO EQUIPMENT.

THE MASTER MUST INSPECT AND SIGN EACH DAY'S ENTRIES IN THE LOG. IF THE MASTER IS NOT THE RADIOTELEPHONE OPERATOR THE LATTER MUST INSPECT AND SIGN THE LOG DAILY AND SUBMIT THE LOG TO THE MASTER FOR HIS SIGNATURE, DRAWING HIS ATTENTION TO ANY ENTRIES OF IMPORTANCE OR INTEREST.

PHONETIC ALPHABET

A	ALPHA	B	BRAVO	C	CHARLIE
D	DELTA	E	ECHO	F	FOXTROT
G	GOLF	H	HOTEL	I	INDIA
J	JULIET	K	KILO	L	LIMA
M	MIKE	N	NOVEMBER	O	OSCAR
P	PAPA	Q	QUEBEC	R	ROMEO
S	SIERA	T	TANGO	U	UNIFORM
V	VICTOR	W	WHISKEY	X	XRAY
Y	YANKEE	Z	ZULU		

NOTES