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Yachtmaster Coastal

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YACHTMASTER COASTAL COURSE NOTES

Tuition Notes published by International Yacht Training Worldwide

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Contents

1

Chart-work Instruments, Charts & Publications

The practical navigator does not require expensive equipment to work effectively. The basic needs are as follows:

2B pencils
Erasers
Dividers
Parallel rules or plotter/protractor.

In addition other useful items include:

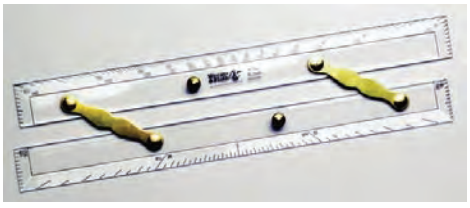
Note book.
Pencil sharpener.

Pencils 2B pencils should be used for chartwork to avoid scoring the surface of a chart and to allow easy removal. Mechanical pencils work well not requiring sharpeners.

Dividers Used to measure distances (in nautical miles from the latitude scale.). A cheap school type is adequate, but the single-handed brass type makes life easier.

Single handed dividers

Parallel Rules Used to measure courses, bearings, lines of position etc. by reference to a compass rose printed on a chart. Worked by walking or rolling (depending on type) the rule across the chart to/from compass rose. These are not very accurate in a rolling sea or in bad weather.



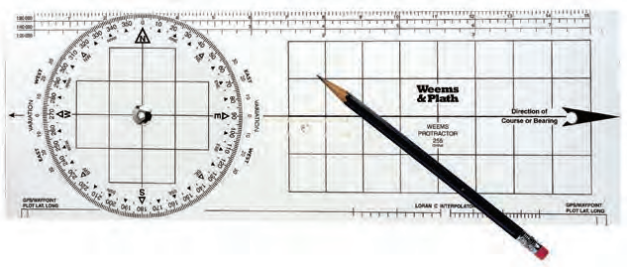
Parallel rules

Or preferred

Breton Type Plotter this comprises a circular protractor mounted on a rectangular base, all made of plastic. The protractor is marked with degrees and a grid for lining up easily and the rectangular part acts as the ruler.

This type of plotter eliminates the need for the compass rose on the chart, can be used on rough surfaces, and in small or large vessels. This is the most accurate of plotters having a correction factor of 1º.

With a chart, Parallel rules or plotter/protractor and dividers, most basic navigational problems can be solved. It is possible to determine the position (latitude and longitude) of a given point on the chart, plot a position on the chart whose latitude and longitude are known, plot a course from one point to another, plot bearings and lines of position and measure and mark off distances.



Breton Plotter

Charts are maps of the undersea bottom, objects in on and under the water and includes the adjoining land. They are intended primarily for the use of mariners to assist in route planning, pilotage and navigation, and used to find information concerning the depth of water, hazards to navigation, aids to navigation, channels, anchorage areas, harbors, tides, water levels, magnetic variation and currents.

Nautical Chart

Charts are published by various agencies of most maritime countries.
In the USA charts are published by 2 agencies.

The National Oceanic and Atmospheric Administration (NOAA) and the Defense Mapping Agency (DMA)
Various publishers produce "Chart Kits", books which cover a large area, i.e. the Bahamas.
There are a number of charts now produced on CD ROM for use on a computer and when linked to a GPS acts a chart plotter.
In the UK the British Admiralty (BA) charts are published by the hydrographic office of the Ministry of Defense.
Small craft charts, designed to be used aboard small boats, published by various publishers and often on water-resistant paper. E.g. Imray-Iolaire yachting charts covering the Caribbean.

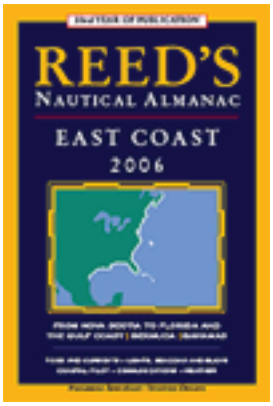
Chart Catalogs of Nautical Charts and Publications are published by the various chart producing agencies. They list the charts available and the respective chart numbers.

Chart No 1 is a publication in book form listing all the symbols, abbreviations and terms used on nautical charts.

Chart BA 5050 and NP5011 are UK Admiralty publications listing all the symbols, abbreviations and terms used on nautical charts.

Notices to Mariners are intended to promulgate and correct/up-date marine publications. They are published on a regular basis throughout the year by the various chart producing agencies.

Notices to Mariners Annual Edition are marine publications intended to promulgate issues pertaining to navigation, marine safety, and search and rescue. They are published annually by the various chart producing agencies and used to add to more information on hazards to navigation, aids to navigation, and charts and publications.



Sailing Directions/Pilots/Cruising Guides expand information contained on charts and provide other information in the interest of safe navigation. Designed to be read in conjunction with charts amplifying information in particular specific details regarding depths of water, hazards to navigation, aids to navigation, channels, anchorage areas, harbors, tides and currents as well as information on weather, fuel availability, customs and immigration requirements etc.

Collision Regulations outlines the agreed international convention for the prevention of collision at sea, "The Rules of the Road".

Admiralty Nautical Almanac provides all necessary astronomical data required by the navigator to achieve positional sights using the stars, planets, sun and moon. It can be used to determine compass errors and for any other astronomical calculations. It contains information for one year only.

Almanacs are publications such as Reeds Nautical Almanac, which include data such as tides and currents, ephemeris, harbor and lights information and lots more. (See Reeds Almanac 1998).

CHESAPEAKE BAY ENTRAN

CURRENT TABLE 2004 36°58.80'N 75°59.88'W

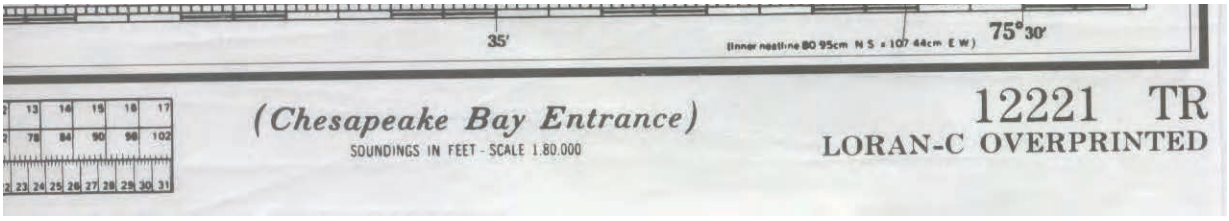
Eastern Time (75°W) Corrected for Daylight Saving Time

MAY **JU**

	Slack time	Max time	Fld knots	Ebb knots		Slack time	Max time	Fld knots	Ebb knots		Slack time	Max time	Fld knots	Ebb knots
		0016		1.1			0153		1.2			0136		1.4
1	0330	0601	0.7		**16**	0502	0709	0.6		**1**	0448	0657	0.8	
Sa	0855	1237		1.3	Su	0959	1345		1.2	Tu	0937	1330		1.6
	1558	1838	0.9			1648	1936	1.0			1636	1926	1.5	
	2154					2314					2308			
		0108		1.2			0241		1.3			0230		1.6
2	0420	0642	0.8		**17**	0547	0750	0.6		**2**	0538	0748	0.8	
Su	0937	1319		1.5	M	1032	1421		1.2	W	1030	1423		1.7
	1631	1915	1.2			1721	2011	1.0		○	1723	2016	1.6	
	2243					2351					2358			
		0159		1.4			0322		1.3			0321		1.7
3	0509	0726	0.9		**18**	0631	0833	0.5		**3**	0629	0843	0.9	
M	1019	1403		1.6	Tu	1104	1454		1.2	Th	1124	1516		1.7
	1707	1956	1.4			1754	2049	1.1		○	1813	2108	1.6	
	2329													
		0250		1.6		0028	0358		1.2		0049	0411		1.7
4	0557	0815	0.9		**19**	0714	0915	0.5		**4**	0723	0938	0.9	
Tu	1103	1449		1.7	W	1137	1525		1.2	F	1220	1607		1.7
○	1748	2042	1.5		●	1830	2126	1.0			1907	2201	1.6	
		0338		1.7		0104	0432		1.2		0142	0502		1.7
5	0016 0648	0906	0.9		**20**	0757	0956	0.5		**5**	0819	1031	0.9	

Tide and Current Tables

Tidal Current Tables and Tide Tables, contain information on the times and heights of tides and the direction of currents.



Information Contained on charts

Title/Number

The area that the chart covers and its reference number.

Scale

The scale to which the chart is drawn is important as it indicates how much detail is included. Scale is expressed as a ratio, i.e.: 1:10,000; one unit on the chart equates to 10,000 units on the earth's surface.

Large scale charts are used when more detail is required; for example Harbor charts which show a small area in great detail, usually 1:3000 to 1:20,000.

Smaller scale charts are used when detail is less important, such as Ocean charts, which may be at 1:500,000 or greater, and show a large area with less detail. These may be used for passage planning purposes or for plotting an ocean crossing.

In between these two extremes are multiple other scale charts for Port approaches and coastal passage making.

As the scale of the chart increases, a smaller area is shown with more detail. It is best to use the largest scale of chart available.

Projection
The type of projection will be shown. Some distortion occurs when producing a section of the earth's surface, (a sphere) on a flat chart. The type of projection used to create the chart determines the amount of distortion. The two main chart projections likely to be used are the Mercator projection and the gnomonic projection. On these charts, distances are measured using the latitude scale of the chart, with one minute of latitude being equal to one nautical mile.

Heights and depths
In the USA the usual standard of measurement will be imperial rather than metric. Depths or soundings will be given in feet or fathoms (1 fathom = 6 feet) and heights of objects will be shown in feet. On a "fathoms" chart, depths below 2 fathoms may be shown as 11/2 or as fathoms and feet, i.e. 32 = 3 fathoms 2 feet. Always check carefully the unit of measurement especially when changing to another chart.
European and some other charts are likely to be metric, as are US charts drawn from foreign sources. These will be marked on the title block and on the upper/lower margins, "SOUNDINGS IN METERS".

Horizontal datum
This is the datum from which the chart is drawn and it is necessary to know what it is particularly when using satellite derived position fixing.
The majority of UK charts are now produced using the World Geodetic System 1984 (WGS 84), however older charts may still use the Ordinance Survey of Great Britain or similar system.
The majority of US charts are North American Datum 1983 (NAD 83) which is virtually the same as World Geodetic System 1984 (WGS 84).
The importance of the datum is for using GPS when the correct setting must be selected.

Place		Height referred to datum of soundings (MLLW)			
Name	(LAT/LONG)	Mean Higher High Water	Mean High Water	Mean Low Water	Extreme Low Water
		feet	feet	feet	feet
Great Machipango Inlet	(37°24'N/75°34'W)	4.4	4.1	0.2	-2.5
Fisherman's Island	(37°06'N/75°59'W)	3.5	3.2	0.2	-2.5
Old Point Comfort	(37°00'N/75°19'W)	2.8	2.6	0.1	-3.5

Depths, elevations and clearances
A fixed level or datum is established for both heights and depths. For US charts, in order to be on the "safe side" the depth of water is measured from the lowest likely water level, Mean Lower Low Water (MLLW) while the heights of bridge clearances and other heights are measured from Mean High Water. Therefore the actual depth of water at any time will be the charted depth PLUS the height of the tide, and the height or clearance of bridges and the height of other charted objects will be usually that shown on the chart OR GREATER.

For the UK, in order to be on the "safe side" the depth of water is measured from the lowest likely water level, Lowest Astronomical Tide (LAT) while the heights of bridge clearances and other heights are measured from Mean High Water Springs (MHWS). Therefore the actual depth of water at any time will be the charted depth PLUS the height of the tide, and the height or clearance of bridges and the height of other charted objects will be usually that shown on the chart OR GREATER.

Special notes cautions and warnings
Lists certain features, dangers and other information in the area covered by the chart and which the navigator must make him/herself aware for safe navigation.

Date of issue and latest corrections
The date that the chart was first published is printed on the top center margin, and the date of the current issue is printed on the bottom left margin. All corrections are then annotated alongside the current issue date.

North/Compass Rose
True North is always at the top of the chart and South is always at the bottom. This can vary with strip charts and chart books. The compass rose is printed in several locations on the chart and the outer ring shows true degrees from 000º to 359º whilst the inner ring shows magnetic degrees from 000º to 359º. The difference is the variation at the time when the chart was printed. In the center of the rose the variation is noted along with the annual change.

2

Latitude & Longitude

Charts are laid out in the form of a grid, much like land maps, and these co-ordinates enable the navigator to identify a position anywhere on the earth's surface.

The co-ordinates are derived from the surface of the earth being overlaid with theoretical vertical and horizontal lines that form circles on the surface of the globe. The earth's spherical form and the overlaid grid are then projected onto the flat surface of the chart. There are many types of chart projection but the navigator will find those most commonly used will be Mercator and Gnomonic. On a Mercator chart a straight line is known as a rhumb line (it cuts all the meridians of longitude at the same angle), because the chart is a representation of a curved surface the rhumb line is a distorted and is not the shortest distance between two points. This distortion however is small and can be ignored when plotting courses of less than 600 miles. On a Gnomonic chart a straight line is known as a great circle and will be the shortest route between two points on the globe. (This will only be of real interest to the ocean navigator).

All chart work and navigation requires the navigator to be familiar with angles and their units of measurement. Simply an angle is the measurement of the distance between two lines whose ends meet.

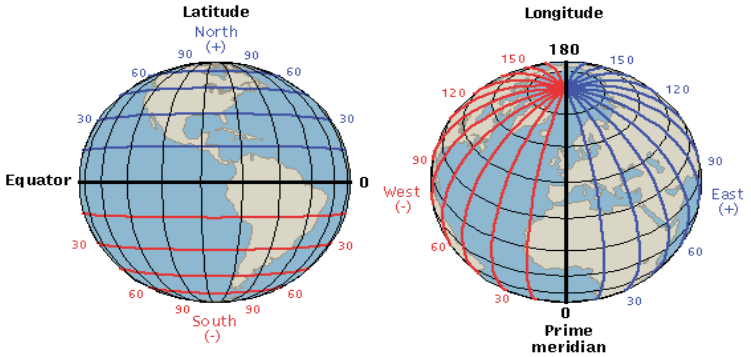
A complete circle is divided into 360 degrees; each degree is further divided into 60 minutes, which can then be further divided into decimals of a minute.

The sign for a degree is º e.g. 360º
The sign for a minute is ‘ e.g. 36’
Thus 45 degrees 28 point 5 minutes is written, in the US, 45º 28. 5’

Latitude and Longitude

Latitude

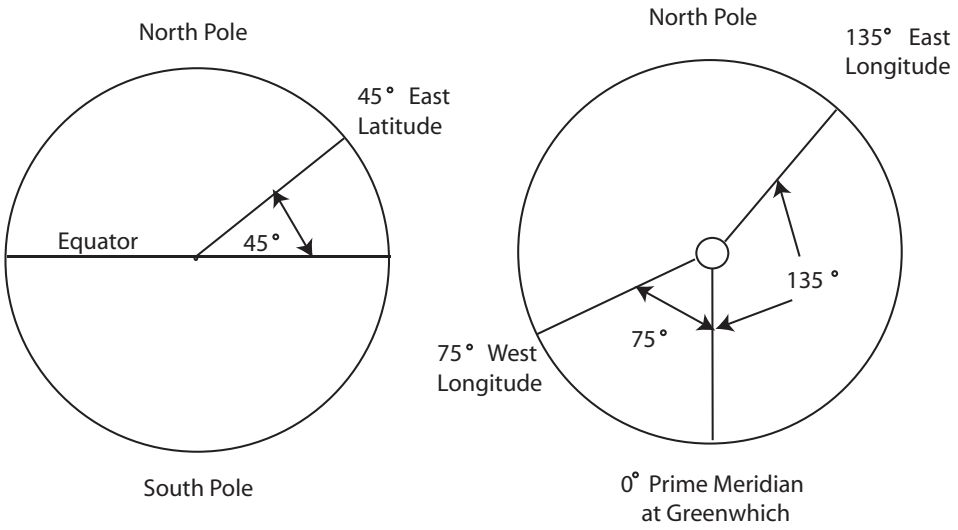
The lines which run horizontally on the earth's surface are called parallels of latitude. The Equator circles the center of the earth and divides it into the northern and southern hemispheres. Parallel to the equator, both north and south are the imaginary lines which are known as Parallels of Latitude, and are graduated from zero degrees at the equator to ninety degrees at the North and South Poles.



Longitude

The lines, which run North/South from the poles, are called meridians of longitude. Longitude is measured East or West (0º - 180º) from the Internationally agreed 0º or "Prime Meridian" which runs through the Old Royal Observatory building in Greenwich, London, England. This line is also known as the Greenwich Meridian, and is the reference line from which the other meridians of longitude are measured. This also why Greenwich Mean Time GMT or UTC as it is now referred to is used as the standard time by navigators worldwide.

Both latitude and longitude are derived by measuring the angular distance between two points on the surface and a point at the center of the earth.



Position by Latitude and Longitude
By convention most charts are drawn with north at the top. On these charts the Latitude scale is on either side and the Longitude scale is on the top and bottom. Care should be exercised when using chart books or small craft charts when this convention may well not be followed.

To plot a latitude and longitude or find the position of a place, for example Latitude 44º 44' .4 N Longitude 111º 11' .1W

First align the plotter on the latitude scale on the side of the chart so that the edge runs through the object and the grid on the plotter aligns with any part of the grid on the chart. Read off the latitude.

Then with the dividers measure from the object to the nearest line of longitude on the chart and then without changing the dividers transfer the reading to the top or bottom longitude scale. Read off the longitude.

The latitude scale is also used for measuring distance, this will be covered in Chapter 3, but the fact to remember is that **one minute of arc of latitude equals one nautical mile.**

The majority of charts that we use are a Mercator projection. In order to portray a flat representation of the curved surface of the Earth this format distorts the meridians of longitude and makes them parallel whereas in reality, because the Earth is a globe, these parallels of Longitude will converge until they meet at the poles.

At the equator there is no distortion so 1º of Latitude will equal 1º of Longitude however as you travel away from the Equator towards the Polar Regions the difference between them grows as the table below shows:

At the Equator or 0º	5º of Latitude	=	5.0º of longitude or 100%
Between 25ºN & 30ºN	5º of Latitude	=	5.7º of Longitude or 87.7%
Between 35ºN & 40ºN	5º of Latitude	=	6.3º of Longitude or 79.3%
Between 45ºN & 50ºN	5º of Latitude	=	7.4º of Longitude or 67.5%

Note that these scales are the same whether you are measuring º N. or S.

Be sure to use the Latitude scale adjacent to the area that you are working in when measuring your distance.

3

Direction, Time, Speed & Distance

Direction

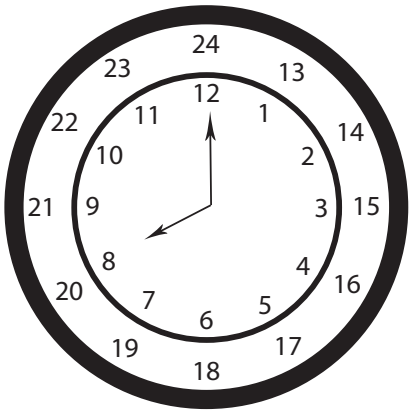
The navigator needs to know the direction to shape a course to steer in order to get a vessel from one place to another and, also for obtaining a bearing from the vessel to a specific object. Direction is measured as an angle starting at 000° (True North) and continuing clockwise (through East, South, West and back to North) to 360° or 000°. The position of a vessel can be described in relation to a feature on the chart by establishing the distance and bearing from that feature. For example if you were approaching Port Everglades, Ft Lauderdale from due east you could describe your position as being 090º from Port Everglades entrance.

Time

For the navigator time is always expressed by referring to the 24 hour clock and not "am/pm". Ambiguity is avoided in this way. The day starts at 0000 hours (midnight) and progresses through the day to 2400 hours (midnight again).
The time 1.00 am is expressed as "Oh one hundred", 5.20 am as "Oh five twenty", 1.00 pm as "Thirteen hundred" and 5.20 pm as "Seventeen twenty".
The use of the word 'hours' after the numbers is incorrect, e g say "fifteen twenty" **not** "fifteen twenty hours".

The time zone should be clearly defined as in 1520 UT or UTC (Universal Time or Coordinated Universal Time) 2020 EST (Eastern Standard Time)
In the summer time beware of the change to Daylight Saving Time, if this has been applied this should be stated 2120 EDT (Eastern Daylight Time).

Twenty Four Hour Clock



Conversion of conventional time to marine time

1. Delete colons and AM/PM designators
2. Add first digit zero to hours between 1:00 a.m. and 9:00 a.m. to arrive at marine time.
3. Delete colons
4. Add 12 hours to all hours between 1:00 p.m. and 11:00 p.m.
5. Midnight is 2400 or 0000

Examples:

10:00 a.m.	=	1000 or ten hundred
9:00 a.m.	=	0900 or O nine hundred
12:00 noon	=	1200 or twelve hundred
1:00 p.m.	=	1300 or thirteen hundred
1:15 p.m.	=	1315 or thirteen fifteen
7:00 p.m.	=	1900 or nineteen hundred
10:05 p.m.	=	2205 or twenty two O five

Speed

In navigation speed is expressed in knots, where 1 knot is one nautical mile per hour. **Remember one knot equals one nautical mile per hour, therefore you would say that the speed of an object is "one knot" it is never expressed as "one knot per hour".**

There is a simple formula for working out Speed, Time or Distance.
It is written as: D = S x T

Where S = Speed in knots
D = Distance in nautical miles
T = Time in minutes

If any two of the variables are known, the third can be calculated.

Example If a vessel is travelling at 5 knots and the distance to go is 20 miles, how long will this take?
Boat Speed 5 knots
Distance to go 20 miles
ℑ∋⊃⊕⊃⊆≫⊕⊃ 20 ÷ 5 = 4hours

Or, How far will a vessel travel in 2½ Hrs at 8 knots?

Time	2½ Hrs
Boat Speed	8 Knots
∴2.5 X 8 = 20 Miles	

Distance

On charts in the USA there are two basic distance units used. On Inland Waterways the unit is the statute mile, 5280 feet or 1760 yards. On navigational charts the unit of measurement is the Nautical Mile. This is the length of 1' of arc of latitude at 48º latitude, which is internationally set as 6080 feet; or roughly 2000 yards (latitude varies slightly from the equator to the poles). The Nautical mile is divided into 1/10th's, one division is 200yards and is called "a cable". It is because of this relationship of latitude and distance that the latitude scale on the side of the chart is used to measure distance on the chart. **Never use the longitude scale at the top and bottom of charts.**

Great care must be taken when moving from one chart to another, be sure to check if the scale of the new chart is the same as the one that you are finished with. It is a common mistake to mark off the wrong distance because of a change in scale between two charts.

4

Variation, Deviation & The Magnetic Compass

The Magnetic Compass

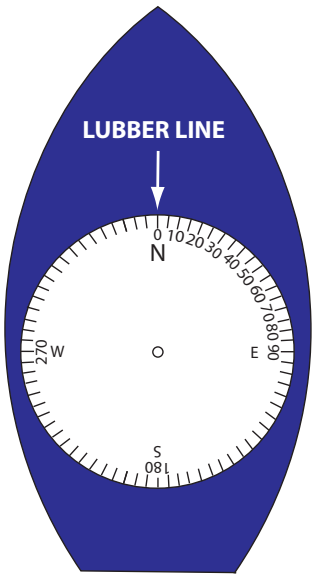
The magnetic compass comprises a magnetic needle mounted on a pivot and a card that is divided into 360º increments, called degrees, 0º and 360º being the same, also labeled north.

Most modern compasses have the needle attached to the card and it operates by the needle pointing to magnetic north whilst the compass card indicates the vessels magnetic direction of travel. The vessel's compass is mounted on or parallel to the fore and aft centerline of the vessel.

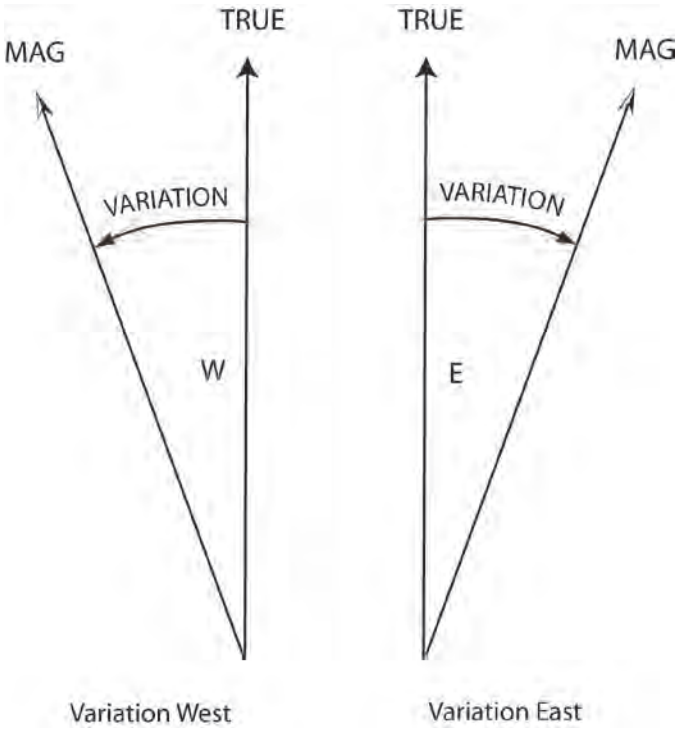
A compass is used to steer a course, that is the direction in which the vessel wishes to travel, or to take bearings, which is the direction of an object for charting purposes.

Lubber Line

A lubber line is located on the fixed part of the compass and is positioned on the fore and aft line of the vessel, to enable accurate reading of a course or bearing. Most compasses have lubber lines etched on the forward and after part of the compass (to indicate reciprocal direction).



True North
True North is the taken to be the North Pole, the point at the top of the globe where all the meridians of longitude meet.



Magnetic North
Unfortunately Magnetic North is not at the same place as True North. The north magnetic pole is situated in the vicinity of Bathurst Island in northern Canada, about 1600 km (about 1000 miles) from the North Pole; it also permanently in motion. This means that from almost everywhere on the earth's surface True North will vary from Magnetic North. The direction of Magnetic North is shown on the compass rose on the chart, as is the annual change.

Variation
The direction of True North and Magnetic North are both graphically shown on the chart as two compass cards overlaid on each other, known as a compass rose. Variation is the angular difference between the direction of True North, and the direction of Magnetic North. If the compass points east of True North, variation is named east and vice versa. The variation can be found printed in the center of the compass rose and it notes also the annual change.

Deviation
The earth's magnetic field will cause the compass to point to Magnetic North, however any magnetic effects on a particular vessel will cause the compass to be deflected east or west from Magnetic North. This is named deviation and is also calculated east or west. Deviation is caused by ferrous objects and some electrical equipment which create a magnetic field close to the compass. As the vessel alters course so will the deviation alter.
A professional Compass Adjuster can usually eliminate most of the deviation by the judicious use of magnets placed around the compass. If it is not all eliminated a deviation card is made up by a compass adjuster for each compass.

Compass error
The sum of both deviation and variation is collectively known as compass error, and it should be clearly noted in any record on a vessel whether the degrees are True (T), Magnetic (M) or Compass (C). Navigation has three languages:

True (T)
The true compass rose and parallels of Latitude & Meridians of longitude on the chart all refer to true north as a datum.
Magnetic (M)
Takes into account or is affected by Variation only, for example Hand-bearing compass gives readouts in magnetic when used at a location on the vessel which is unaffected by deviation.
Compass (C)
Uses magnetic north as its datum and takes into account or is affected by both variation and deviation.

Everything is converted to "true" for plotting on the chart.
Everything is converted to "compass" for instructions and work on deck.

Applying Variation
In order to apply the correct variation it is necessary to work out the current figure. This is done by finding the nearest compass rose on the chart, reading the variation and year and applying the annual increase or decrease.
It must be remembered, all work on charts is True, whilst all information used to steer or plot courses is magnetic.

Therefore to correct:
True to magnetic add west and subtract east variation (Add on).
Magnetic to true subtract west and add east variation (Subtract).
A good mnemonic is:

"Variation West, Compass Best
Variation East, Compass Least"

T +W/-E = M
M +E/-W = T

Example

MAGNETIC	VARIATION	TRUE
177º	7º W	170º

Applying Deviation
Deviation taken from the deviation card, for the course/bearing in question is applied in exactly the same way as variation:

"Deviation West, Compass Best
Deviation East, Compass Least"

T +W/-E = C
C +E/-W = T

Applying compass error
When applying both variation and deviation it must be done in the correct order:
From **TRUE – MAGNETIC – COMPASS**
From **COMPASS – MAGNETIC – TRUE**

A good mnemonic is:
True **V**irtue **M**akes **D**ull **C**ompany,

Or

TRUE	VARIATION	MAGNETIC	DEVIATION	COMPASS
079º	11º W	=090º	4º E	=086º

Another mnemonic for how to apply compass error is:

CADET
Compass **AD**d **E**ast = **T**rue

5

Position Fixing

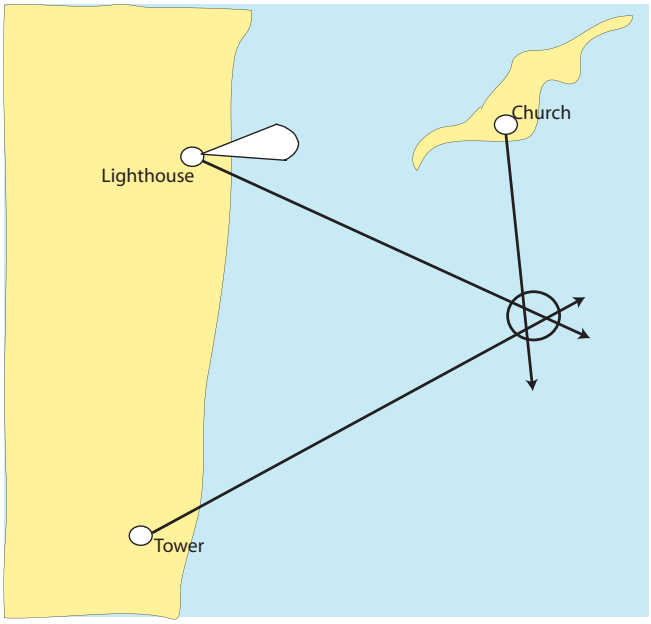
A prudent navigator takes every opportunity that presents itself to find his position and plot it on a chart. Even with the advent of modern electronic navigation aids, a regular check by traditional methods should be made. Obviously weather conditions will dictate how regular these should be; fog, low visibility and bad weather are some examples when the time between fixes should be reduced.

Position Line (LOP)
A position line is a line (drawn on the chart) somewhere on which the vessel's position lies. On its own, a single LOP cannot give the vessel's exact position, other information is required, but a single LOP, when plotted on a chart, can confirm that you are/are not close to a point of danger.

Fixes
A fix is a reasonably accurate determination of a vessel's position. It requires two or more LOPs, derived from simultaneous compass bearings, crossing each other to establish the position of the vessel fairly accurately. However, a fix that uses only two position lines is not as accurate as one that uses three. It is preferable always to take compass bearings of three different objects when possible.

Two Point Fix
The point of intersection of two simultaneous bearings of two charted objects (LOPs) gives a reasonable fix of the position of the vessel.

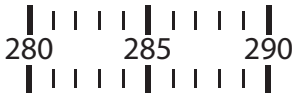
Three Point Fix
Better than a two-point fix for reliability, the third LOP gives greater accuracy or highlights an error in one or both of the other LOPs. If the three LOPs coincide closely it indicates a reasonably accurate fix.

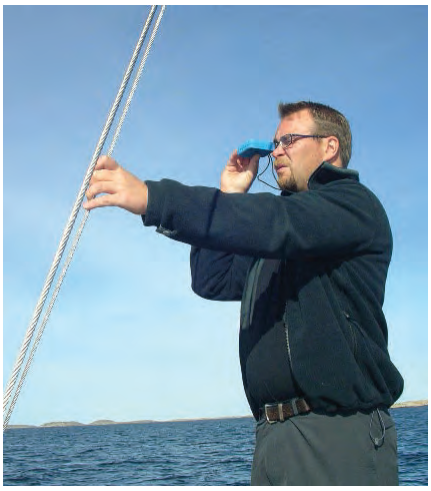


Cocked Hat
When a three-bearing fix is plotted the result will often be a triangle. In the event that the cocked hat, as it is known, is small, it is customary to take the position at the center point of the triangle. When the cocked hat is large, good navigation practice dictates that the Navigator should assume his position to be that which is closest to the point of danger. If it is a very large cocked hat the bearings should be re taken if possible.
Except in the most favorable conditions, a cocked hat is most likely to be the result due to one or more LOPs not being accurate.

Compass Bearings

The main source of position lines is by a compass bearing of a known object ashore or fixed navigational mark. These are usually obtained with the use of a hand-bearing compass, used away from any magnetic influence on the vessel. Write down the bearings as they are taken, and the time and the distance shown on the ship's log. The bearings must then be converted to true before they can be plotted on a chart using the true compass rose and parallel ruler or a plotter.





Bearings can be taken of any thing or object that is conspicuous and marked on the chart, such as lighthouses, buoys, beacons, TV antennae, chimneys, water towers, conspicuous buildings and also islands, hills and headlands that are easily identified.

Planning a Fix

Identify all objects on the charts and then identify those same objects on the land. Make sure that the object you are looking at is the object you plan to use on the chart.

Write down the bearings as they are taken.

Take the bearings as quickly as possible, the bearings on the beam should be taken last because their angle will change more rapidly.

The angle between bearings should be at least 40º and less than 120º; the best angle of cut is about 90º for a two-point fix and about 60º for a three-point fix.

Running Fix

A running fix, employed when only one object for a fix is visible, is obtained from two separate bearings taken of the same object, combined with the direction and distance traveled by the vessel. It is only as accurate as the information that goes into plotting it - in particular, the vessel's course and speed. If there is a large amount of current and leeway present, then the running fix's accuracy is greatly reduced, although allowance for both can be made.

The procedure for a running fix is as follows:

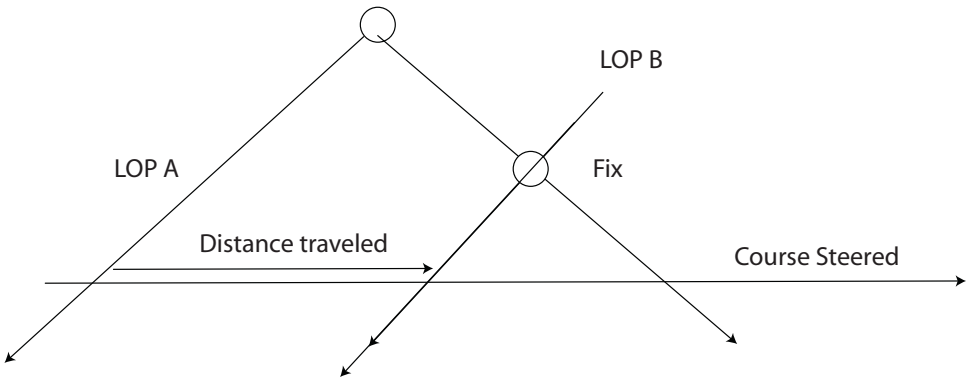
Take and plot a LOP from the single object, note the time, the log reading and the course being steered.

LOP A

Wait until the bearing of the object has changed at least by 30º or more, then take and plot a second LOP, note the time, the log reading.

LOP B

On the chart, from anywhere on the first LOP, transfer the first LOP in the same direction and distance traveled between the times of the two bearings. The point at which the transferred LOP cuts the second LOP is the fix.

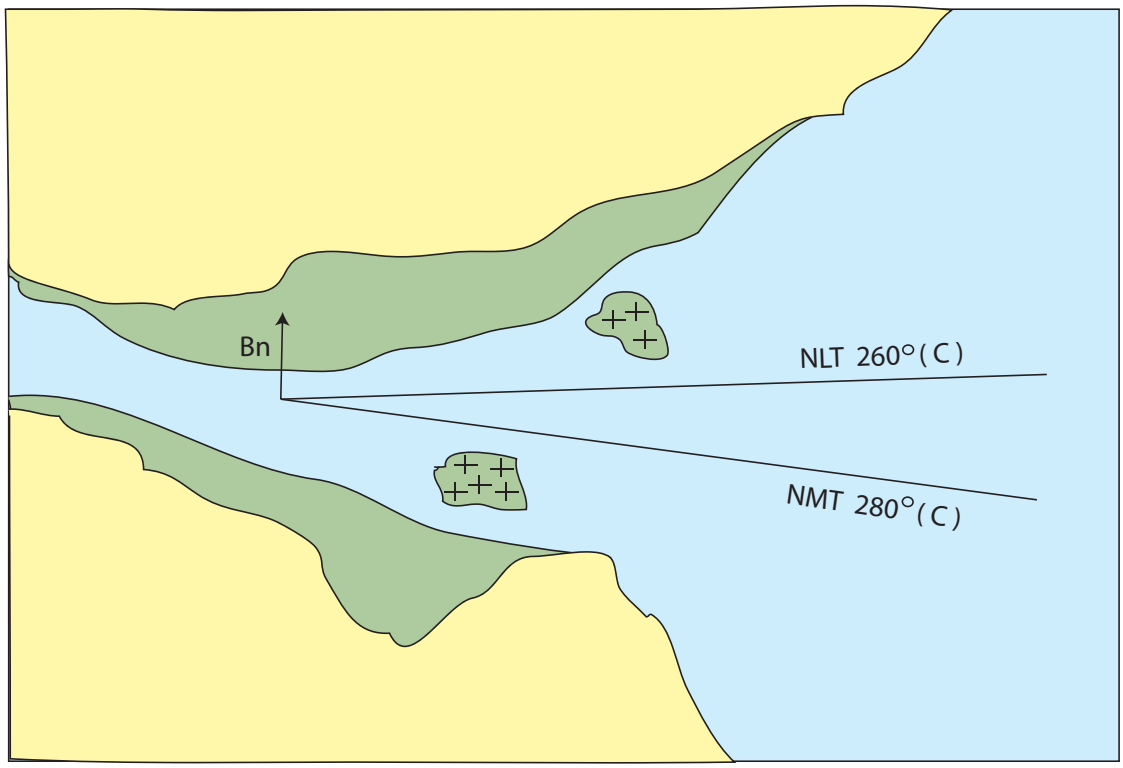


Other sources of position lines
A range or transit where two identifiable objects on the chart line up, the vessel must be positioned on this line, and this may be crossed with one or more other LOPs to give a fix.
Sectored lights will give a LOP when on the line where the change over of the color occurs.

Clearing lines
When piloting a vessel through a narrow passage or when avoiding a shoal or other hazard it is good practice to use a lead mark or, if non available, a clearing bearing is drawn on the chart and used to steer on to ensure safe passage. These lines are bearings that pass a certain distance off a known danger. Ideally they should be as close to parallel to the course steered as possible. These bearing lines will be marked, either:

NMT - Not more than ***NLT - Not less than***

Should either of these be more or less than the bearing specified on the clearing bearing, the vessel will be standing into danger.



Leading Lines/Marks
Ideally the leading mark should be a range/transit; however if one is not available select a compass bearing on an object either directly ahead of (easier to steer on) or astern of (known as a back bearing) the planned course on the chart. If the bearing changes, the vessel is being set off track and will need to alter course to regain track.

When rounding points of land or shoals, allow plenty of room - cutting corners is dangerous.

6

Dead Reckoning & Estimated Position

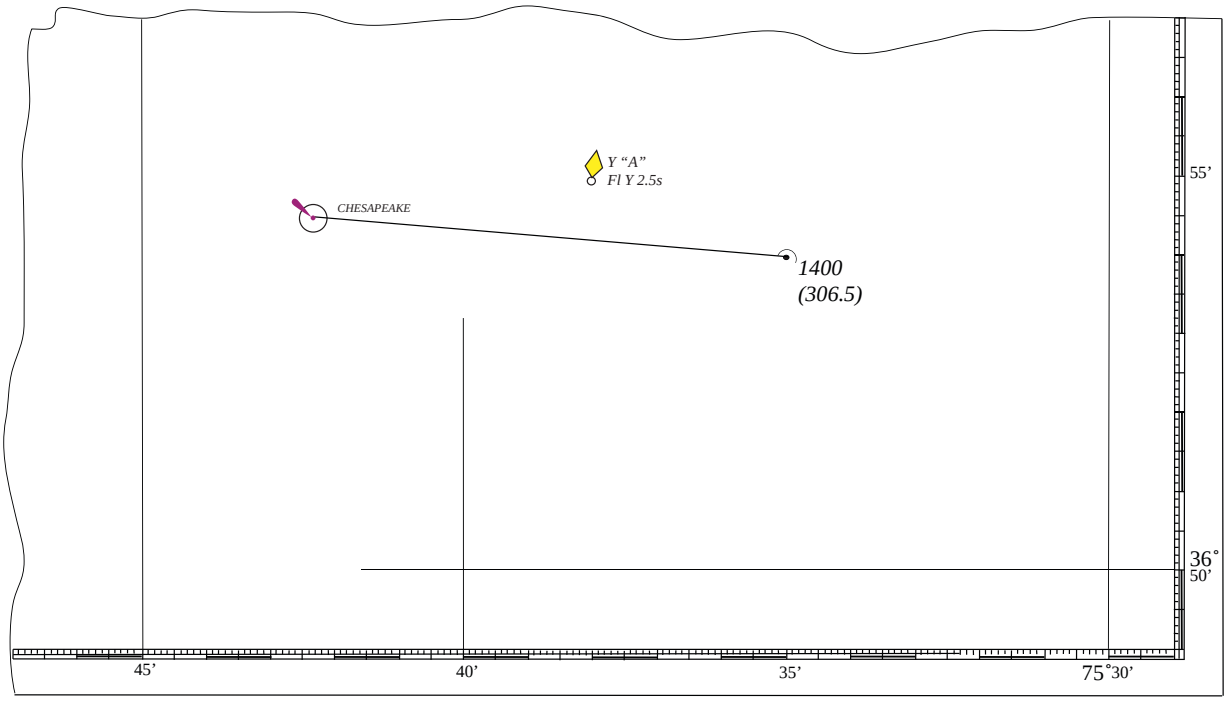
It is important always to know the vessel's position on the chart and in the absence of reliable fixes there are two methods of obtaining an estimate of position.

Dead Reckoning Position (DR)
It is not always possible to fix the boat's position at regular intervals, because suitable objects from which to take bearings may not be available. In this case the navigator will keep a log of courses steered and distances traveled to enable an approximate position to be maintained however the result will not be as accurate as a fix.

The position arrived at by this method, when only course steered and distance traveled are taken into account, is called a Dead Reckoning Position (DR) from Deduced reckoning. It is shown on the chart by a dot on the course line with a half circle around it, alongside which is written the time and the log reading in brackets.

To "work up" a DR position, the plot must be started from a known position. The course steered, converted to true, is plotted and the distance traveled is marked on the line.

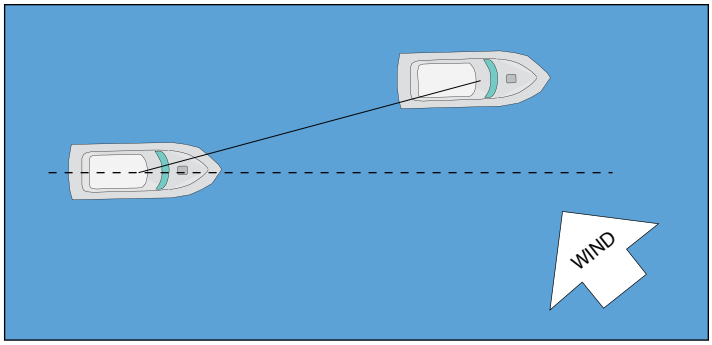
The accuracy of any DR position is only good if there is no current, tide or wind setting the vessel off course, the distance log is accurate and the course steered is accurate.



The DR is plotted and the time and log reading written on the chart

Estimated Position (EP)

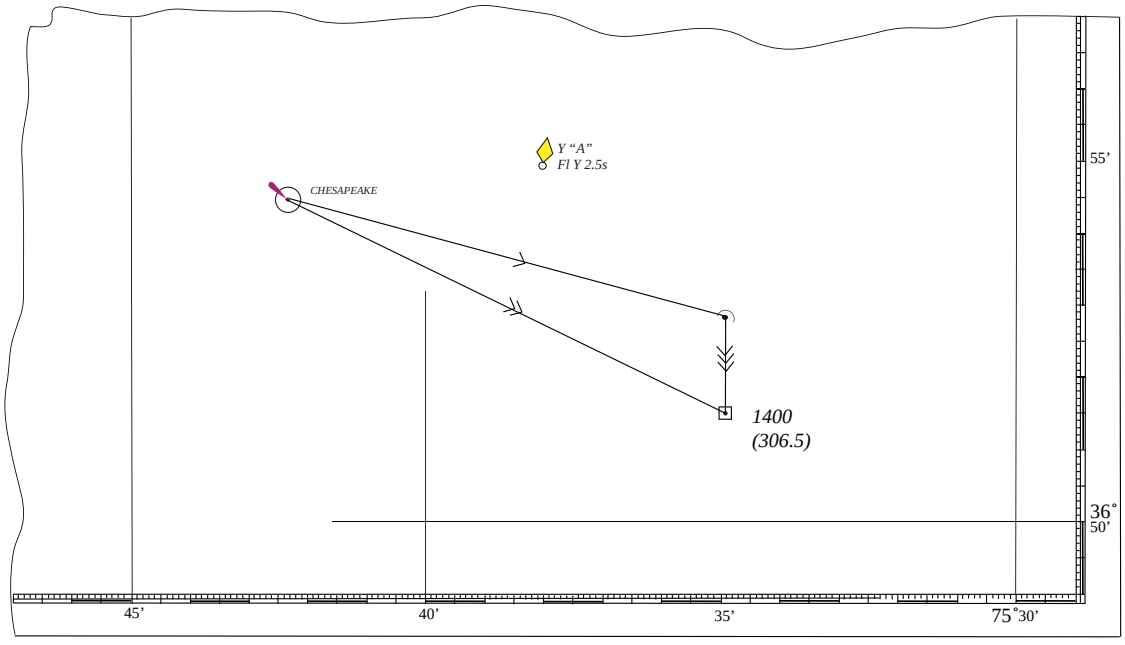
In order to improve on the results obtained by a DR plot, further information can be applied as known or estimated. By estimating the sideways drift, caused by the wind (leeway), and the effects of the tidal stream or current and applying these to the DR position, the more accurate position arrived at is called an Estimated Position (EP). This is shown on the chart by a dot with a square around it. An estimated position is more accurate that a dead reckoning position but not as good as a fix.



To work up an EP, the plot must be started from a known position. The course steered, converted to true and with leeway applied away from the direction the wind is blowing (the boat will have been blown sideways downwind), the water track is then drawn. The distance traveled is marked on the line and from the end of the water track a line representing the direction and speed of the current is drawn (set and drift).

If the tidal stream is from ahead or astern, only the boat's speed over the ground will be affected. If the tidal stream is acting across the course of the boat she will be set sideways at a rate dependent on the set (direction) and rate (speed) of the stream.

It is important to update regularly the DR/EP, because it shows at a glance, the vessel's approximate position (for emergency purposes). It also allows the navigator to make important decisions as to the proper action to be taken in event of fog, bad weather, equipment failure etc. and, most importantly, it shows the intended course does not place the vessel close to or on a navigational hazard.



7

Chartwork, Plotting & Ships Log

There is an established process and format for chartwork and for keeping a record of events and navigational information. All information is recorded in the vessels logbook.

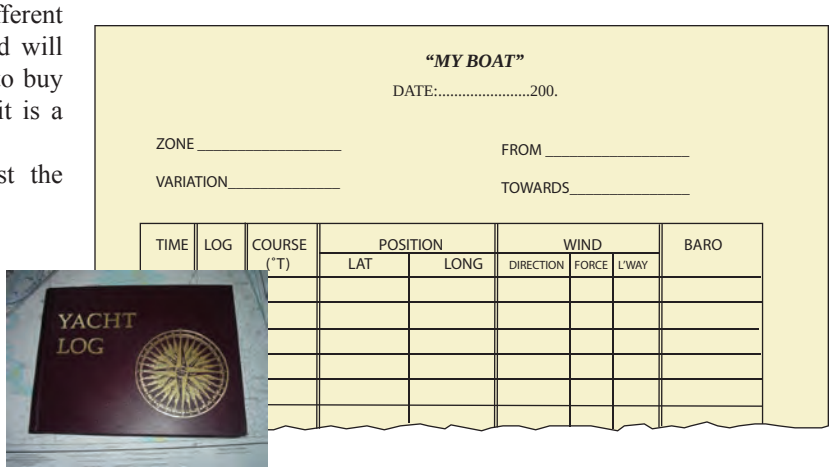
Log Book

The ships logbook makes up the navigational record of the vessel and is the point of reference for working up DR, EP and fixes. It also will contain information concerning weather, sea state, engine hours, barometric pressure and also sometimes a narrative of the voyage.

Different navigators have different requirements for what is included and will often design their own. It is possible to buy proprietary brands in boating stores; it is a matter of preference.

A typical logbook will have at least the following minimum:

- Time
- Log reading
- Course steered
- Barometer reading
- Wind speed and direction
- Comments
- Position



Plotting

Over time an accepted practice has become established for plotting this information on a chart, and the methods and symbols used on the chart by the navigator are the same throughout the US.

It is much easier to work on a level surface, preferably on a specially designed chart table with instrument repeaters on display and books etc to hand.

As the voyage progresses the navigator should follow a set process:

Always enter into the log book and plot times on the chart, i.e. time of departure, time of course changes, and times of passing significant points along the way, times of any significant events etc.

If the boat has a (distance) log, record this in the logbook and note these on the chart along the DR course line.

Plot the DR position at regular intervals so, at a glance, the vessels approximate position can be seen.

Identify each buoy and light that passed while on passage, these will help to confirm the vessel's position and often be the basis of an accurate fix.

Compare the DR/EP to every fix, the difference will indicate if there is any current or tide and thus the set and drift can be established.

Never use ink or ballpoint pen for chart work, use a soft pencil that allows all notes and lines drawn on the chart to be easily erased.

All entries made on a chart during a previous passage should be removed before the chart is used for another trip. At the same time (and well before departure date) it is advisable to check whether the chart needs correcting.

Charts should not be allowed to get wet or damp. However if a chart has to be used in the cockpit, it is a good idea to put it into a large plastic wallet.

Terminology

Course to Steer (CTS)
The direction to be maintained to a destination point. A course line is drawn on the chart indicating the intended direction of travel; this is the Course To Steer abbreviated to CTS.

Leeway
The sideways motion of the vessel through the water caused by the action of the wind blowing it. This can sometimes be significant particularly in a sailboat going to windward.

Heading
The heading is the direction in which the vessel is pointing as indicated by the ship's compass. Ideally this should be the same as the course. The heading may be different from the course due to leeway, and due to counteracting tide or current.

Speed (S)
The speed of the boat through the water. This may be different from speed over the ground, see Speed Made Good below.

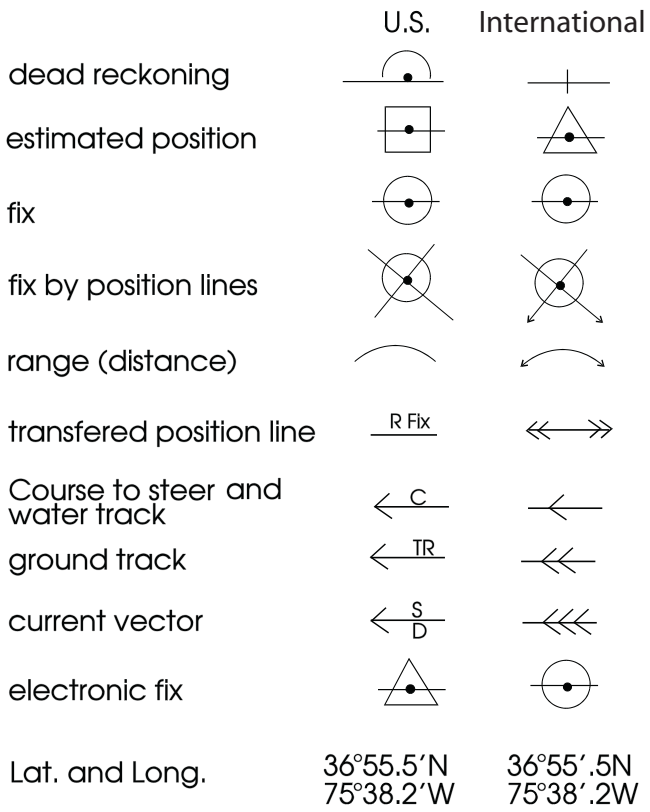
Set (SET)
The direction in which the current or tide is affecting the vessel.

Drift (Dft)
The speed of the current or tide.

Course Made Good (CMG) AKA Course Over Ground (COG)
The actual direction in which the boat is moving over the bottom or the ground track. This may differ from the Course through the Water because of the effect of current and leeway.

Speed Made Good (SMG) AKA Speed Over Ground (SOG)
The actual speed of the boat over the bottom. This may differ from the speed of the boat through the water because of the effect of current and leeway.

Chart Work Symbols



Danger Circles

Emphasize dangers near the track by circling them boldly in pencil. The limits of water for safe-depth can be drawn in to show the limits of the navigable channel.

8

Tides

The navigator requires a detailed knowledge and understanding of tides in order that they may be used to help in making a safe and secure passage. Tides have two significant effects for the navigator, and these change constantly, depth of water and the speed of horizontal flow.

In most places there are two tidal cycles every day, comprising two high tides and two low tides, and this phenomenon is known as a semi diurnal tide. A few places have only a single tidal cycle each day, this is known as a diurnal tide. Still fewer places have a combination known as mixed tides.

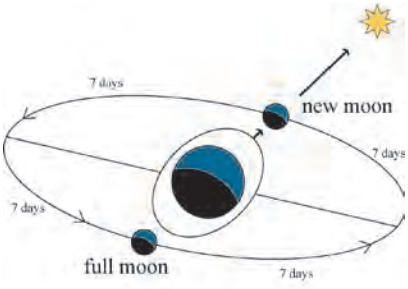
Tides

Tides are the vertical rise and fall in the sea level brought about by the movement of the earth, moon and sun and the effect of the gravitational attraction between these bodies. In effect the combined gravitational pull of the sun and moon causes a "tidal wave" to revolve around the earth. Tides originate in the open waters of the earth's seas and oceans, but are only noticeable and significant close to shore.

Tidal currents are the horizontal flow of water that result from the "tidal wave" meeting landmasses and shallow areas and are easily observed along beaches, bays and sounds and up rivers.

Cause of tides

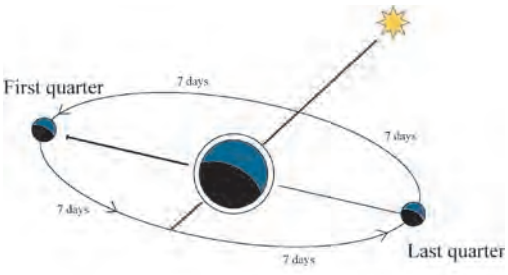
Tides result from the differences between centrifugal forces and gravitational forces of mainly the moon and earth. (However to a lesser extent the sun also exerts gravitational pull). Although the mass of the moon is only a tiny fraction of that of the sun, it is much closer to the earth and its pull is about twice as powerful. As a result, tides are mainly lunar.



Spring Tides

This gravitational pull from the moon "pulls" the surface of the sea towards it causing a "bulge". As the moon rotates around the earth the gravitational pull causes the water to bulge, the resulting wave is then carried around the earth. On the opposite side of the earth the moon's gravitational pull is diminished, which allows the water to move away from the earth causing a second bulge.

Tidal rhythm therefore is generally in tune with the rotation of the moon around the earth. Since this "lunar day" is 24 hours and 50 minutes, the two high and two low waters each day occur about 50 minutes later than the corresponding tides of the previous day.



Neap Tides

In the course of any one lunar month, the sun, moon and earth are lined up twice, technically, in conjunction. The new moon is when the order is sun moon earth and full when the order is sun earth moon. In both cases, the sun's gravitational pull lines up with that of the moon, which results in higher tidal ranges called **spring tides**.

Similarly, twice during the course of a lunar month, the relative positions of the moon and sun are at 90º to each other. In this instance the sun counteracts to some extent the pull of the moon, which results in lower tidal ranges called **neap tides.**

Spring tides produce higher high water and lower low water, whilst neap tides produce lower high water higher low water. Because of the greater volume of water moving between high and low water the rate of flow of the current is much greater during a spring tide. Calculating this rate of flow will be dealt with in the chapter dealing with currents, chapter 9.

Tidal Definitions

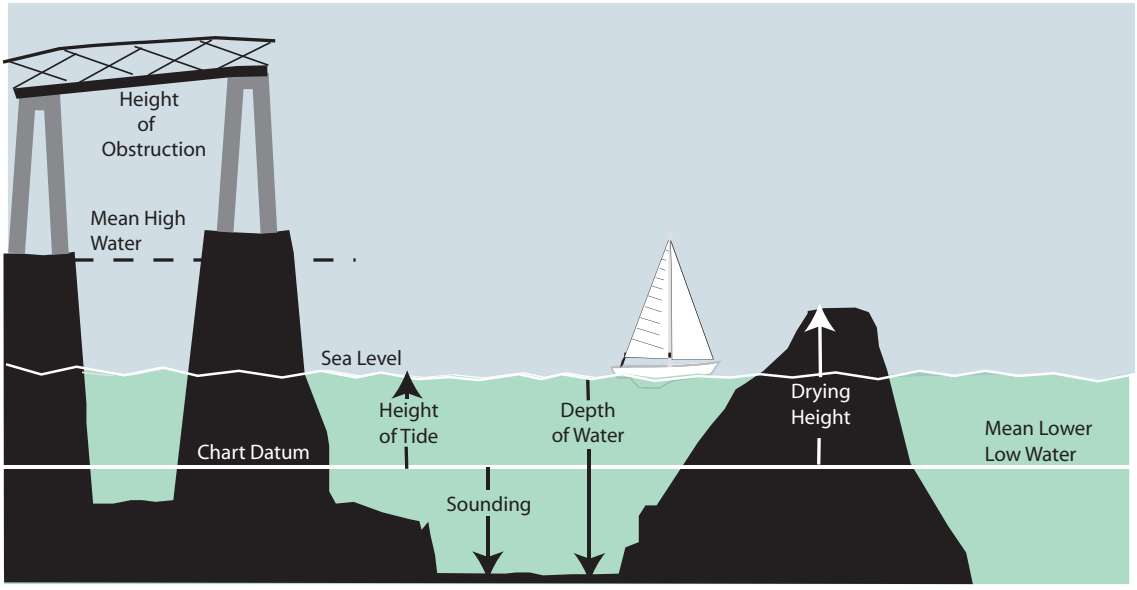
Chart Datum
Chart Datum is the reference point from which all depths and drying heights are measured on a nautical chart. American charts commonly use Mean Lower Low Water (MLLW). British Admiralty metric charts use Lowest Astronomical Tide (LAT).

Charted Depth
The distance below chart datum of an object or feature often referred to as soundings.

Drying height
This is the height of an object or feature above chart datum; these features may be uncovered at low water.

Duration
This is the interval of time between successive high and low waters.

Height of Tide
This is the height of water above Chart datum and is found by using the tide tables to find high or low water and then applying the corrections derived from the appropriate tables.



Tidal Height Definitions

High Water
The time at which a tide reaches its maximum height. The tide tables predict the times that high and low water are expected to occur as well as the heights expected. (These predictions assume normal weather conditions)

Low Water
The time at which a tide reaches its minimum height.

Lowest Astronomical Tide (LAT)
LAT is the lowest tide level that can be predicted to occur under normal meteorological conditions and so using this datum there will rarely be less water than is shown on the chart.

Mean High Water (MHW)
This is the average height of high waters for a particular place: this average is worked out over a 19 year period. This is the point from which the height of structure such as bridges and lighthouses are measured.

Mean Lower Low Water (MLLW)
The average of the lower low waters of each tidal day over a 19 year period. Used as Chart Datum on US charts. Using this datum there will often be less water than is shown on the chart.

Neap Tide
Neap tides occur about a week after spring tides and feature smaller ranges therefore slower flows.

Range
The difference between the height of successive high and low waters, this is found by subtracting the height of low water from the height of high water.

Standard Ports
These are usually larger ports that have their own tide tables published that contain complete tidal information with the time and height of every tide.

Reference Stations
These are usually larger ports that have their own tide tables published which contain complete tidal information with the time and height of every tide.

Spring Tide
Two spring tides occur every lunar month, just after the full and new moons. The spring tide features the higher high water and the lower low water and therefore much faster tidal flows

Secondary Ports
These are places that do not have their own tide tables so the information has to be calculated by using the Tide Differences Table.

Subordinate Stations
These are places that do not have their own tide tables so the information has to be calculated by using the Tide Differences Table.

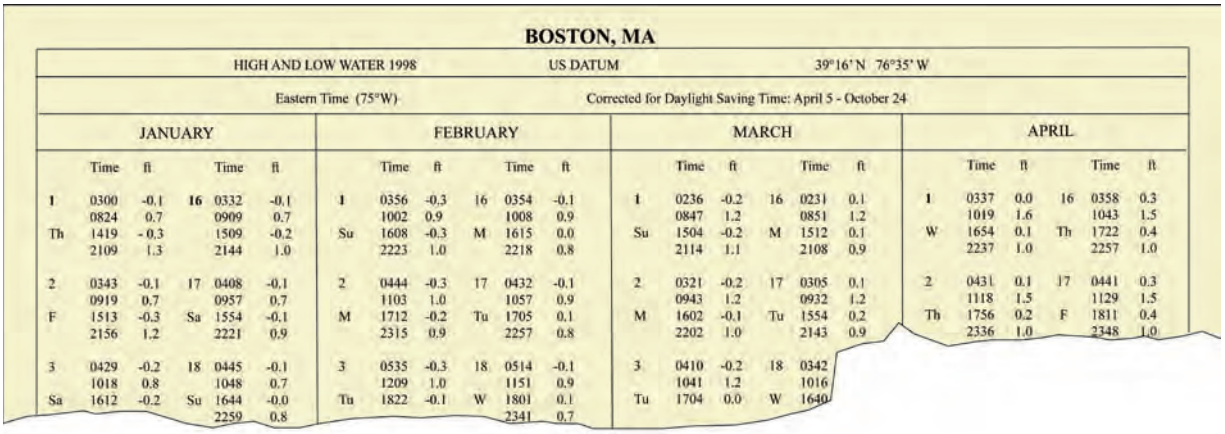
Rule of twelfths
In most places where the tide has a regular cycle there is a simple way to estimate the height of the tide. **It is important to note that this is a very rough approximation and will only work where the rise and fall are uniform over a six hour period.** The rule of twelfths works on the basis that the rate of rise or fall is slow at the beginning and end of the cycle but reach a maximum at mid tide.

To reflect this we take the range and divide it into twelfths, then say that in the first hour the tide will as follows:

1st hour	1/12 of the range	1/12 cumulative rise or fall
2nd hour	2/12 of the range	3/12 cumulative rise or fall
3rd hour	3/12 of the range	6/12 cumulative rise or fall
4th hour	3/12 of the range	9/12 cumulative rise or fall
5th hour	2/12 of the range	11/12 cumulative rise or fall
6th hour	1/12 of the range	12/12 cumulative rise or fall

Tide Tables

The predicted times and heights of the tides are calculated and published every year in tide tables in publications such as REEDS Nautical Almanac. These will give the times of high and low waters for selected reference ports or stations around the coast. These tables will show every high and low water time along with the heights for every day of the year. If the height shown has no symbol before it then it is a positive figure if it has a minus (-) symbol in front of it then it is a negative number. These heights are a measure of the depth of water to be added, or subtracted in the case of a minus figure, from the depth of water shown on the chart. In the example below we can see these elements laid out. Under the title is the vital information such as the year, geographical location of the station, confirmation that this information is referred to US Datum, the time zone and the fact that the times are corrected for daylight saving. Some tide tables will give all times in a standard zone time and leave the user to make these corrections when and where necessary.



BOSTON, MA

HIGH AND LOW WATER 1998 — US DATUM — 39°16' N 76°35' W

Eastern Time (75°W) — Corrected for Daylight Saving Time: April 5 - October 24

JANUARY					FEBRUARY					MARCH					APRIL				
	Time	ft	Time	ft		Time	ft	Time	ft		Time	ft	Time	ft		Time	ft	Time	ft
1	0300	-0.1	0332	-0.1	1	0356	-0.3	0354	-0.1	1	0236	-0.2	0231	0.1	1	0337	0.0	0358	0.3
	0824	0.7	0909	0.7		1002	0.9	1008	0.9		0847	1.2	0851	1.2		1019	1.6	1043	1.5
Th	1419	-0.3	1509	-0.2	Su	1608	-0.3	1615	0.0	Su	1504	-0.2	1512	0.1	W	1654	0.1	1722	0.4
	2109	1.3	2144	1.0		2223	1.0	2218	0.8		2114	1.1	2108	0.9		2237	1.0	2257	1.0
2	0343	-0.1	0408	-0.1	2	0444	-0.3	0432	-0.1	2	0321	-0.2	0305	0.1	2	0431	0.1	0441	0.3
	0919	0.7	0957	0.7		1103	1.0	1057	0.9		0943	1.2	0932	1.2		1118	1.5	1129	1.5
F	1513	-0.3	1554	-0.1	M	1712	-0.2	1705	0.1	M	1602	-0.1	1554	0.2	Th	1756	0.2	1811	0.4
	2156	1.2	2221	0.9		2315	0.9	2257	0.8		2202	1.0	2143	0.9		2336	1.0	2348	1.0
3	0429	-0.2	0445	-0.1	3	0535	-0.3	0514	-0.1	3	0410	-0.2	0342						
	1018	0.8	1048	0.7		1209	1.0	1151	0.9		1041	1.2	1016						
Sa	1612	-0.2	1644	-0.0	Tu	1822	-0.1	1801	0.1	Tu	1704	0.0	1640						
			2259	0.8				2341	0.7										

Using the above tide table:

1. Look up the port that you are interested in.
2. Find the column with the appropriate month. (Many errors are caused by looking up the wrong month)
3. Look down column and find correct day

For example: Find the information relating to the tide at Baltimore on *Monday 2nd March 1998*

LW	0321EST	-0.2ft
HW	0943EST	1.2ft
LW	1602EST	-0.1ft
HW	2202EST	1.0ft

What does this information mean?
At 9.43AM Eastern Standard Time there is predicted to be 1.2ft more water than is shown on the chart. At 4:02 PM EST there is predicted to be 0.1ft **LESS** water than is shown on the chart.

If the area that you are operating in is not close to a reference station then you will need to find your local port in the *table of differences and subordinate stations*. This is a list of secondary ports and places among which you will want to find the place closest to where you are operating. Each location is given with figures that will enable you to modify the tidal information from the reference port to show the time and height of tide in your area.

These tables are usually laid out geographically, as they are located around the coast.

An extract of this table is shown below:

Table of differences and subordinate stations

PLACE	POSITION north latitude	POSITION west longitude	DIFFERENCES Time high h m	DIFFERENCES Time low h m	DIFFERENCES Height high ft	DIFFERENCES Height low ft	RANGE spring ft
			On Baltimore, p. T84				
Hooper Island Light	38° 15'	76° 15'	-5:03 5:13	-	*1.36 *1.38		1.8
Hooper Island	38° 18'	76° 12'	-4:56 4:41	-	*1.36 *1.38		1.7
			On St John, p. T 18				
Burntcoat Head	45° 18'	63° 48'	+1:07 +1:11		(*1.77 - 0.6)		52.6

The table contains:

1. The name of the location concerned
2. Its position in Lat & Long
3. The name of the reference port
4. The Modifications to be applied to the information from the reference station
   - **Time difference** + or – indicating whether this number of hours and minutes should be added to or subtracted from the time of high or low water at the reference station.
   - **Height difference** This figure can be applied in various ways, if the figure is preceded by a + or – then it will be added or subtracted. If it is preceded by a * then the figure should be multiplied
   - In the example above, for Burntcoat Head with its reference station at St. John, the tidal height modifiers are enclosed by parentheses. When this is the case the tidal height information from the reference station is multiplied by the first figure *1.77 then, depending on the sign, the second figure is either added or subtracted from the result, in this case 0.6ft is subtracted.

Q1. What are the times and heights of High and Low waters at the Hooper Island Light during the day of Thursday April 2nd?

The reference Station is Baltimore, MD.

Times

Baltimore, April 2nd	HW 11:18EST	LW 17:56EST
Differences	-5:03	-5:13
Hooper Island Light	HW 06:15	LW 12:43

Heights

Baltimore, April 2nd	HW 1.5ft	LW 0.2FT
Differences	x1.36	x1.38
Hooper Island Light	2.04ft	0.276ft

∴On April 2nd at Hooper Island Light: HW 0617 EST 2.0ft, LW 1243 EST 0.3ft

Q2. What are the times and heights of high water at Burntcoat Head (Bay of Fundy) in the early morning of March 30th?

The reference Station is Saint John, NB. (Burntcoat head info on previous page)

Times

Saint John, March 30th	HW	00:55AST	LW 07:13AST
Differences		+1:07	+1:11
Burntcoat Head	HW	02:02AST	LW 08:24AST

Heights

Saint John, March 30th	HW	28.1ft	LW 0.2ft
Differences		*1.77	*1.77
		49.7ft	0.4ft
		- 0.6ft	- 0.6ft
Burntcoat Head HW		49.1ft	LW - 0.2ft

∴On March 30th at Burntcoat Head: HW 02:02 AST 49.1ft, LW 08:24 AST -0.2ft

SAINT JOHN, NB

HIGH AND LOW WATER 1998 — Canadian DATUM — 45°16' N 66°04' W

Atlantic Time (60°W) — Corrected for Daylight Saving Time: April 5 - October 24

JANUARY					FEBRUARY					MARCH					APRIL				
	Time	ft	Time	ft		Time	ft	Time	ft		Time	ft	Time	ft		Time	ft	Time	ft
14	0036	25.3	0001	25.7	14	0127	25.0			14	0022	25.4	0006	27.9	14	0159	25.6	0226	28.0
	0645	3.0	0613	2.3		0737	3.4				0634	3.0	0623	0.3		0815	3.3	0847	0.7
W	1252	26.4	1220	27.3	Sa	1343	25.4			Sa	1240	25.6	1231	28.0	Tu	1421	24.8	1457	26.7
	1909	2.1	1841	1.0		1957	3.2				1852	3.1	1847	0.4		2030	4.4	2111	2.4
15	0117	25.1	0048	26.1	15	0203	24.8			15	0056	25.3	0055	28.1	15	0234	25.4	0319	27.3
	0726	3.4	0701	2.0		0813	3.8				0708	3.2	0713	0.2		0851	3.6	0940	1.6
Th	1333	25.9	1308	27.3	Su	1420	24.9			Su	1314	25.3	1322	27.7	W	1457	24.4	1552	25.9
	1950	2.6	1929	0.9		2033	3.7				1925	3.5	1938	0.9		2106	4.8	2205	3.4

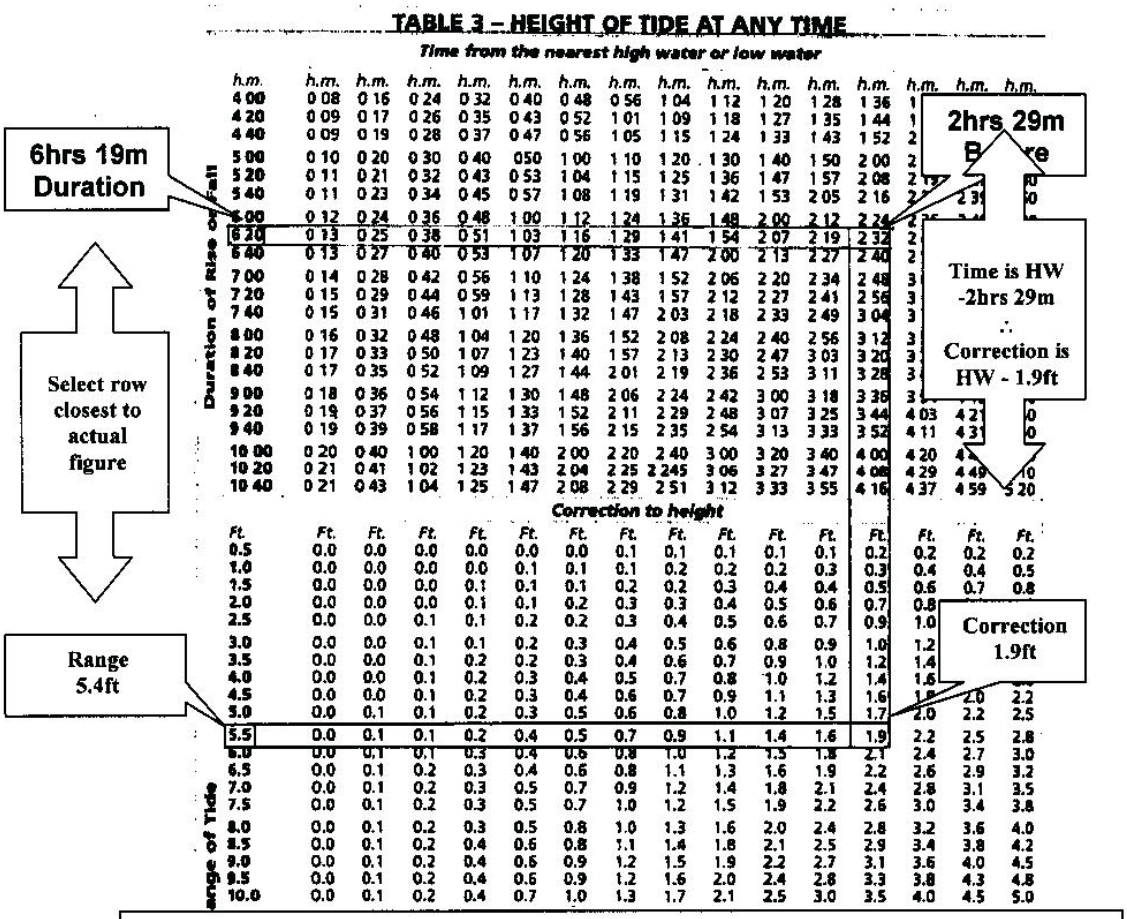
Note that in the above table that we used for Question 2 the depths are referred to Canadian Datum and the times are given in Atlantic Standard Time, this is one hour ahead of Eastern Standard Time.

So far, we have only looked at the times of high and low water but often we want to know how much water we have at other times. To find this we need to use Table 3 – Height of tide at any time
This table does two things, by useing the duration of rise or fall and the range of tide it enables you to produce a correction to the high or low water height and thus find the height of tide at any given time. Using the same figures you can also work out at what time you will have particular depth of water. This enables you to see if you have enough water to enter a particular harbor and if not how long you will have to wait for the tide to rise sufficiently for you to be able to enter.

To determine the duration of rise or fall simply work out the time interval between the high and low water times that are either side of the time in question. The range of tide will be obtained by subtracting that same low water height from the high water height. In the upper body of the table select the row that is headed by the time closest to the duration that you have worked out then go to the lower body of the table and do the same for the range.

Table 3 – Height of Tide at anytime

Time from nearest high water or low water



h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.
4 00	0 08	0 16	0 24	0 32	0 40	0 48	0 56	1 04	1 12	1 20	1 28	1 36	1		
4 20	0 09	0 17	0 26	0 35	0 43	0 52	1 01	1 09	1 18	1 27	1 35	1 44	1		
4 40	0 09	0 19	0 28	0 37	0 47	0 56	1 05	1 15	1 24	1 33	1 43	1 52	2		
5 00	0 10	0 20	0 30	0 40	050	1 00	1 10	1 20	1 30	1 40	1 50	2 00	2		
5 20	0 11	0 21	0 32	0 43	0 53	1 04	1 15	1 25	1 36	1 47	1 57	2 08	2		
5 40	0 11	0 23	0 34	0 45	0 57	1 08	1 19	1 31	1 42	1 53	2 05	2 16	2	2 31	
6 00	0 12	0 24	0 36	0 48	1 00	1 12	1 24	1 36	1 48	2 00	2 12	2 24	2		
6 20	0 13	0 25	0 38	0 51	1 03	1 16	1 29	1 41	1 54	2 07	2 19	2 32	2		
6 40	0 13	0 27	0 40	0 53	1 07	1 20	1 33	1 47	2 00	2 13	2 27	2 40	2		
7 00	0 14	0 28	0 42	0 56	1 10	1 24	1 38	1 52	2 06	2 20	2 34	2 48	3		
7 20	0 15	0 29	0 44	0 59	1 13	1 28	1 43	1 57	2 12	2 27	2 41	2 56	3		
7 40	0 15	0 31	0 46	1 01	1 17	1 32	1 47	2 03	2 18	2 33	2 49	3 04	3		
8 00	0 16	0 32	0 48	1 04	1 20	1 36	1 52	2 08	2 24	2 40	2 56	3 12	3		
8 20	0 17	0 33	0 50	1 07	1 23	1 40	1 57	2 13	2 30	2 47	3 03	3 20	3		
8 40	0 17	0 35	0 52	1 09	1 27	1 44	2 01	2 19	2 36	2 53	3 11	3 28	3		
9 00	0 18	0 36	0 54	1 12	1 30	1 48	2 06	2 24	2 42	3 00	3 18	3 36	3		
9 20	0 19	0 37	0 56	1 15	1 33	1 52	2 11	2 29	2 48	3 07	3 25	3 44	4 03	4 21	0
9 40	0 19	0 39	0 58	1 17	1 37	1 56	2 15	2 35	2 54	3 13	3 33	3 52	4 11	4 31	0
10 00	0 20	0 40	1 00	1 20	1 40	2 00	2 20	2 40	3 00	3 20	3 40	4 00	4 20	4	
10 20	0 21	0 41	1 02	1 23	1 43	2 04	2 25	2 245	3 06	3 27	3 47	4 08	4 29	4 49	10
10 40	0 21	0 43	1 04	1 25	1 47	2 08	2 29	2 51	3 12	3 33	3 55	4 16	4 37	4 59	5 20

Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
1.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5
1.5	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8
2.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8		
2.5	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0		
3.0	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.2		
3.5	0.0	0.0	0.1	0.2	0.2	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.4		
4.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.6		
4.5	0.0	0.0	0.1	0.2	0.3	0.4	0.6	0.7	0.9	1.1	1.3	1.6	1.8	2.0	2.2
5.0	0.0	0.1	0.1	0.2	0.3	0.5	0.6	0.8	1.0	1.2	1.5	1.7	2.0	2.2	2.5
5.5	0.0	0.1	0.1	0.2	0.4	0.5	0.7	0.9	1.1	1.4	1.6	1.9	2.2	2.5	2.8
6.0	0.0	0.1	0.1	0.3	0.4	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.4	2.7	3.0
6.5	0.0	0.1	0.2	0.3	0.4	0.6	0.8	1.1	1.3	1.6	1.9	2.2	2.6	2.9	3.2
7.0	0.0	0.1	0.2	0.3	0.5	0.7	0.9	1.2	1.4	1.8	2.1	2.4	2.8	3.1	3.5
7.5	0.0	0.1	0.2	0.3	0.5	0.7	1.0	1.2	1.5	1.9	2.2	2.6	3.0	3.4	3.8
8.0	0.0	0.1	0.2	0.3	0.5	0.8	1.0	1.3	1.6	2.0	2.4	2.8	3.2	3.6	4.0
8.5	0.0	0.1	0.2	0.4	0.6	0.8	1.1	1.4	1.8	2.1	2.5	2.9	3.4	3.8	4.2
9.0	0.0	0.1	0.2	0.4	0.6	0.9	1.2	1.5	1.9	2.2	2.7	3.1	3.6	4.0	4.5
9.5	0.0	0.1	0.2	0.4	0.6	0.9	1.2	1.6	2.0	2.4	2.8	3.3	3.8	4.3	4.8
10.0	0.0	0.1	0.2	0.4	0.7	1.0	1.3	1.7	2.1	2.5	3.0	3.5	4.0	4.5	5.0

The correction factor, in this case 1.9ft, should be subtracted from high water or added to low water to find the predicted height of tide at any given time.

The next piece of information required is the number of hours and minutes between the time in question and the nearest high or low water, either will do but it must be the closest in terms of time. Read along the top row until you reach the figure closest to this time then follow that column down until you reach the row highlighted by the range and the figure that you find at that point is the correction factor to apply to the high or low water height. How you apply this correction is a matter of common sense. If you used the time before or after high water in the table then the water level will be rising to or falling from high water, in either case there will be less water so subtract the correction from the high water height. If you used low water then you will have to add the figure to the low water height.

SANDY HOOK, NJ.

HW & LW US Datum 40º 28'N 74º 00'W

Eastern time (75ºW) corrected for daylight saving

	h. m.	ft.
July	0014	0.6
	0607	4.2
6	1215	0.5
	1834	5.3

Before we use table 3 we will need to find the tidal information for the port that we are interested in. For this example, we will take JFK International Airport, which is a subordinate station and uses Sandy Hook NJU as its reference station.

Q3. What is the height of tide at 16:30EDT on July 16th in the vicinity of JFK International Airport?

		Time		Height		Range
		High	Low	High	Low	
JFK	40°37'N 73°47'W	+0:25	+0:25	*1.14	*1.15	6.4ft

Reference station **Sandy Hook, NJ**

Sandy Hook, July 6th	LW 12:15	Ht 0.5ft	HW 18:34	Ht 5.3ft
Differences	+0:25	*1.15	+0:25	*1.14
JFK Int. Airport	12:40	0.6	18:59	6.0

HW is at 18hrs 59m HW Ht. 6.0ft

LW is at 12hrs 40m LW Ht. 0.6ft

Duration is 6hrs 19m **Range** is 5.4ft

The duration of the tide is **6h 19m** so if we look down the first column of table 3 in the section marked Duration of rise or fall until we come to **6h 20m** which is the closest figure to the duration that we have. This indicates the row to highlight.

Now we take the range, which is **5.4ft** and run down the first column in the correction to height section of the table. Here we find the closest figure is **5.5ft** so we highlight this row.

The time required is **16:30** this is **3h 50m** after the **12:40 LW** but it is only **2h 29m** before the **18:59 HW** so as we have to use the closest we will be using **2h 29m**.

Starting at the **6h 20m** figure for duration we run across this row to searching for the closest number to **2h 29m** and we find **2h 32m**. From this point we follow this column down until we cross the row indicated by the range, here we find the correction factor, which in this case is **1.9ft.**

As the tide is rising towards high water there will be less water so we will subtract the **1.9ft** from the predicted high water height of **6.0ft** to find the predicted height at this time.

HW	6.0ft
Correction	- 1.9ft
Height of water at JFK at 16:30	**4.1ft**

∴ At 4:30PM 0n July 16th the height of tide at JFK International Airport will be 4.1ft.

U.K. Tides

Tide Tables

The predicted times and heights of the tides are calculated and published every year in Admiralty Tide Tables, or are included in publications such as REEDS Nautical Almanac.
These will give the times of high and low waters for selected Standard Ports around the coast and will show every high and low water time with the associated heights for every day of the year.

There will also be a table of Secondary Ports that are geographically located between the Standard Ports as well as the corrections to apply to the associated Standard Port Information to convert it into the Secondary Port data.

If the height shown has no symbol before it then it is a positive figure if it has a minus (-) symbol in front of it then it is a negative number. These heights are a measure of the depth of water to be added, or subtracted in the case of a minus figure, from the depth of water shown on the chart. In the example below we can see these elements laid out.

Under the title is the vital information such as the year, geographical location of the station, confirmation that this information is referred to UK Datum, the time zone and the fact that the times are corrected for summer time. Some tide tables will give all times in a standard zone time and leave the user to make these corrections when and where necessary.

Using the tide table:

1. Look up the Standard Port that you are interested in.
2. Find the column with the appropriate month. (Many errors are caused by looking up the wrong month)
3. Look down column and find correct day
4. Find the times and heights of the tide for the period required

Note that in some tide tables daylight Saving/Summer time is quoted and in others it will be local.

ENGLAND – FALMOUTH

LAT 50°09'N LONG 5°03'W

TIME ZONE **UT(GMT)** TIMES AND HEIGHTS OF HIGH AND LOW WATERS YEAR **2000**

MAY

	Time	m		Time	m
1	0259	4.8	**16**	0347	5.0
	0929	1.3		1032	0.9
M	1529	4.8	TU	1614	5.0
	2154	1.2		2251	0.9
2	0345	5.0	**17**	0428	5.1
	1019	0.9		1114	0.8
TU	1611	5.0	W	1650	5.1
	2242	0.9		2332	0.8
3	0428	5.2	**18**	0505	5.1
	1106	0.7		1152	0.7
W	1652	5.2	TH	1724	5.2
	2328	0.7	O		
4	0511	5.3	**19**	0009	0.8
	1150	0.5		0539	5.1
TH	1733	5.3	F	1228	0.8
●				1756	5.2
5	0012	0.5	**20**	0043	0.9
	0555	5.4		0613	5.0
F	1234	0.5	SA	1259	1.0
	1817	5.4		1826	5.1
6	0055	0.5	**21**	0114	1.0
	0642	5.4		0645	4.9
SA	1316	0.5	SU	1327	1.2
	1901	5.4		1857	5.0
7	0136	0.5	**22**	0142	1.2
	0728	5.3		0717	4.8
SU	1356	0.7	M	1353	1.4
	1944	5.3		1931	4.9
8	0218	0.7	**23**	0210	1.4
	0814	5.1		0753	4.6
M	1438	1.0	TU	1419	1.5
	2029	5.2		2005	4.8
9	0302	1.0	**24**	0239	1.5
	0905	4.8		0831	4.4
TU	1525	1.3	W	1448	1.7
	2119	4.9		2045	4.6
10	0354	1.4	**25**	0316	1.7
	1004	4.5		0917	4.2
W	1620	1.6	TH	1530	1.9
	2220	4.7		2133	4.4
11	0500	1.6	**26**	0413	1.9
	1121	4.3		1015	4.1
TH	1733	1.8	F	1640	2.1
	2344	4.5		2233	4.3
12	0625	1.7	**27**	0532	2.0
	1241	4.3		1126	4.1
F	1901	1.8	SA	1803	2.1
				2346	4.3
13	0102	4.5	**28**	0644	1.8
	0748	1.5		1245	4.2
SA	1348	4.5	SU	1914	1.9
	2017	1.6			
14	0207	4.7	**29**	0103	4.4
	0853	1.4		0749	1.5
SU	1445	4.7	M	1353	4.4
	2117	1.4		2018	1.6
15	0301	4.9	**30**	0211	4.7
	0946	1.1		0848	1.3
M	1533	4.9	TU	1447	4.7
	2207	1.1		2117	1.3
			31	0307	4.9
				0944	1.0
			W	1537	5.0
				2211	1.0

JUNE

	Time	m		Time	m
1	0358	5.1	**16**	0438	4.9
	1036	0.8		1124	1.1
TH	1623	5.2	F	1656	5.0
	2302	0.7	O	2343	1.1
2	0445	5.2	**17**	0513	4.9
	1126	0.6		1201	1.1
F	1709	5.4	SA	1729	5.1
●	2351	0.6			
3	0533	5.3	**18**	0019	1.1
	1215	0.5		0549	4.9
SA	1755	5.5	SU	1234	1.1
				1804	5.1
4	0040	0.5	**19**	0052	1.1
	0625	5.3		0626	4.8
SU	1302	0.5	M	1305	1.2
	1844	5.5		1841	5.0
5	0127	0.5	**20**	0123	1.2
	0716	5.3		0704	4.8
M	1348	0.7	TU	1334	1.3
	1933	5.4		1916	5.0
6	0214	0.6	**21**	0154	1.3
	0808	5.1		0740	4.6
TU	1435	0.9	W	1404	1.5
	2022	5.3		1951	4.9
7	0302	0.8	**22**	0225	1.5
	0901	4.9		0818	4.5
W	1522	1.1	TH	1435	1.5
	2114	5.1		2027	4.7
8	0352	1.1	**23**	0300	1.5
	1000	4.7		0858	4.4
TH	1614	1.4	F	1512	1.6
	2211	4.8		2109	4.6
9	0449	1.4	**24**	0343	1.6
	1105	4.5		0945	4.3
F	1713	1.6	SA	1600	1.8
	2321	4.6		2159	4.5
10	0555	1.5	**25**	0440	1.7
	1212	4.4		1042	4.2
SA	1822	1.7	SU	1706	1.9
				2259	4.4
11	0030	4.5	**26**	0552	1.7
	0706	1.5		1149	4.3
SU	1314	4.4	M	1823	1.8
	1934	1.7			
12	0133	4.5	**27**	0008	4.5
	0813	1.5		0704	1.6
M	1409	4.5	TU	1257	4.4
	2038	1.5		1936	1.7
13	0227	4.6	**28**	0121	4.6
	0911	1.4		0811	1.5
TU	1458	4.7	W	1404	4.6
	2133	1.4		2042	1.5
14	0316	4.7	**29**	0231	4.8
	1000	1.3		0913	1.2
W	1542	4.8	TH	1505	4.9
	2221	1.3		2144	1.2
15	0359	4.8	**30**	0332	5.0
	1044	1.1		1011	1.0
TH	1620	4.9	F	1559	5.1
	2304	1.1		2241	0.9

JULY

	Time	m		Time	m
1	0425	5.1	**16**	0451	4.8
	1106	0.7		1138	1.2
SA	1648	5.3	SU	1709	5.0
●	2335	0.6	O	2359	1.2
2	0517	5.2	**17**	0529	4.8
	1159	0.6		1214	1.2
SU	1738	5.5	M	1747	5.1
3	0027	0.5	**18**	0034	1.1
	0612	5.3		0609	4.8
M	1250	0.5	TU	1247	1.2
	1831	5.5		1826	5.1
4	0118	0.4	**19**	0107	1.1
	0707	5.3		0650	4.8
TU	1339	0.6	W	1318	1.2
	1923	5.5		1904	5.0
5	0206	0.5	**20**	0138	1.2
	0800	5.2		0729	4.8
W	1426	0.7	TH	1349	1.3
	2013	5.4		1938	5.0
6	0253	0.6	**21**	0209	1.2
	0851	5.0		0804	4.7
TH	1511	0.9	F	1419	1.3
	2101	5.2		2010	4.9
7	0338	0.9	**22**	0241	1.3
	0942	4.8		0838	4.6
F	1555	1.2	SA	1452	1.4
	2151	5.0		2046	4.8
8	0424	1.2	**23**	0316	1.4
	1034	4.6		0917	4.5
SA	1642	1.5	SU	1531	1.5
	2243	4.7		2128	4.7
9	0514	1.5	**24**	0400	1.5
	1132	4.4		1005	4.4
SU	1735	1.6	M	1621	1.6
	2347	4.5		2222	4.6
10	0612	1.6	**25**	0458	1.6
	1230	4.3		1105	4.3
M	1838	1.8	TU	1729	1.8
				2328	4.5
11	0050	4.3	**26**	0616	1.7
	0720	1.8		1215	4.4
TU	1328	4.3	W	1855	1.8
	1949	1.8			
12	0150	4.3	**27**	0045	4.5
	0827	1.7		0737	1.6
W	1422	4.4	TH	1331	4.5
	2055	1.7		2014	1.6
13	0245	4.4	**28**	0206	4.6
	0925	1.6		0849	1.5
TH	1511	4.6	F	1441	4.8
	2150	1.5		2124	1.3
14	0332	4.6	**29**	0315	4.8
	1015	1.5		0954	1.2
F	1553	4.8	SA	1541	5.1
	2237	1.4		2226	1.0
15	0413	4.7	**30**	0412	5.0
	1058	1.3		1053	0.9
SA	1631	4.9	SU	1634	5.3
	2320	1.3		2323	0.7
			31	0506	5.2
				1147	0.6
			M	1724	5.5
			●		

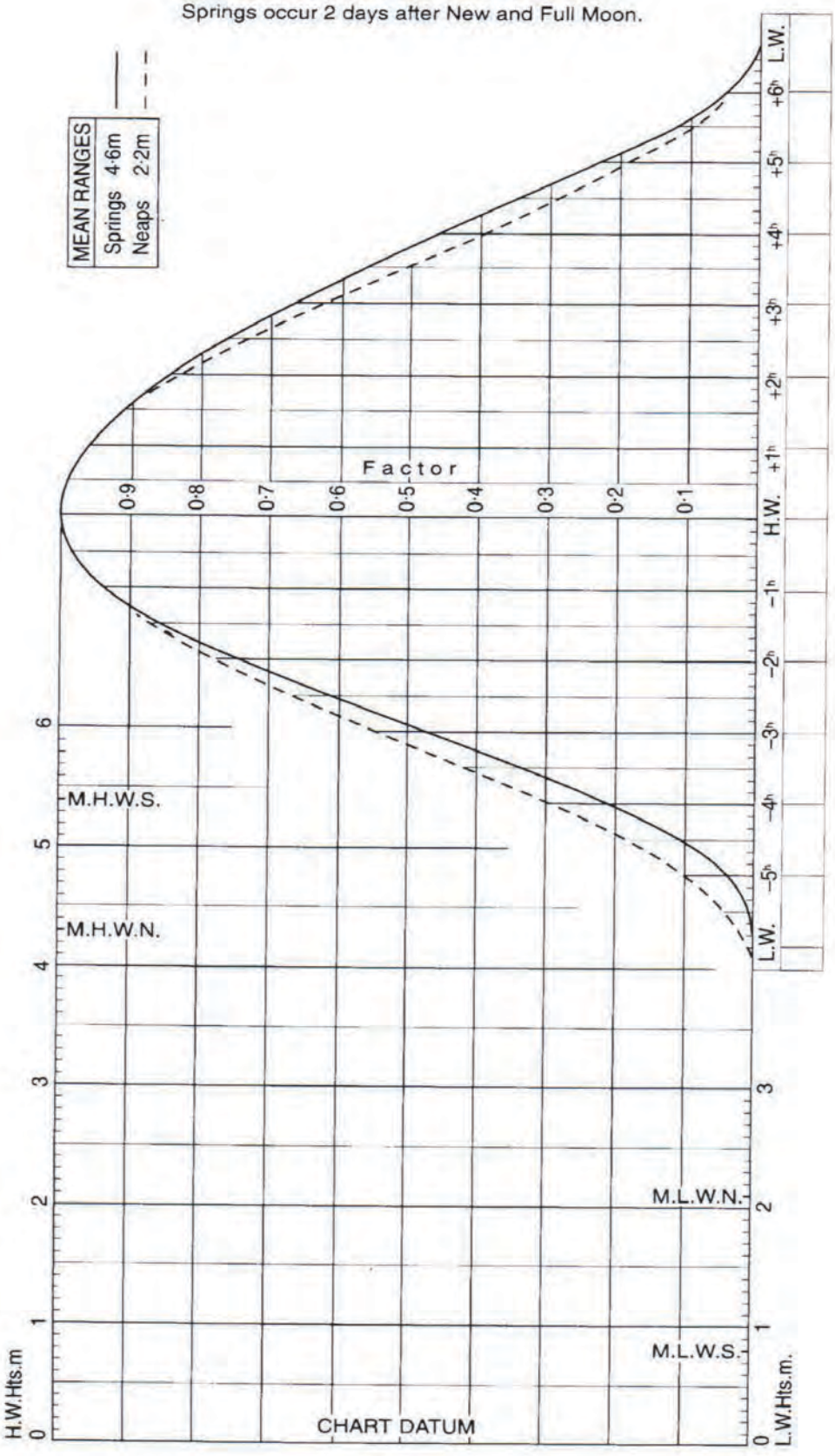
AUGUST

	Time	m		Time	m
1	0016	0.4	**16**	0014	1.0
	0559	5.3		0551	4.9
TU	1238	0.5	W	1228	1.1
	1817	5.6		1807	5.2
2	0105	0.3	**17**	0048	1.0
	0653	5.3		0632	5.0
W	1325	0.4	TH	1300	1.0
	1909	5.6		1846	5.2
3	0151	0.3	**18**	0119	1.0
	0743	5.3		0710	4.9
TH	1409	0.5	F	1330	1.0
	1956	5.5		1922	5.1
4	0233	0.5	**19**	0149	1.0
	0829	5.2		0744	4.9
F	1449	0.7	SA	1400	1.1
	2038	5.3		1953	5.0
5	0313	0.7	**20**	0219	1.1
	0911	5.0		0815	4.8
SA	1528	1.0	SU	1432	1.2
	2117	5.1		2024	4.9
6	0351	1.1	**21**	0252	1.2
	0948	4.7		0850	4.7
SU	1606	1.4	M	1507	1.4
	2153	4.7		2102	4.8
7	0430	1.5	**22**	0330	1.4
	1028	4.4		0934	4.6
M	1649	1.7	TU	1550	1.5
	2232	4.4		2153	4.6
8	0517	1.8	**23**	0420	1.6
	1120	4.2		1032	4.4
TU	1742	2.0	W	1650	1.8
	2336	4.2		2259	4.4
9	0617	2.0	**24**	0533	1.8
	1234	4.1		1147	4.4
W	1851	2.1	TH	1822	1.9
10	0107	4.1	**25**	0024	4.3
	0732	2.1		0711	1.9
TH	1345	4.2	F	1310	4.5
	2012	2.0		1958	1.8
11	0215	4.2	**26**	0155	4.5
	0850	1.9		0836	1.6
F	1442	4.4	SA	1427	4.7
	2122	1.8		2115	1.5
12	0309	4.4	**27**	0307	4.7
	0948	1.7		0945	1.3
SA	1529	4.7	SU	1530	5.1
	2214	1.5		2217	1.0
13	0353	4.6	**28**	0404	5.0
	1034	1.5		1043	0.9
SU	1610	4.9	M	1622	5.4
	2258	1.3		2312	0.6
14	0433	4.8	**29**	0454	5.3
	1116	1.3		1134	0.6
M	1649	5.1	TU	1711	5.6
	2338	1.2	●		
15	0511	4.9	**30**	0001	0.4
	1153	1.2		0544	5.4
TU	1727	5.2	W	1222	0.4
O				1759	5.7
			31	0048	0.2
				0632	5.4
			TH	1306	0.3
				1847	5.7

FALMOUTH

MEAN SPRING AND NEAP CURVES

Springs occur 2 days after New and Full Moon.



For example:
Find the information relating to the tide at Falmouth on **Monday 2nd May 2000**

	Time UT (or GMT).	Height in metres
HW	0345	5.0
LW	1019	0.9
HW	1611	5.0
LW	2242	0.9

What does this information mean?
At 03.45 there is predicted to be 5.0 m more water than is shown on the chart.
At 10.19 there is predicted to be 0.9 m more water than is shown on the chart.

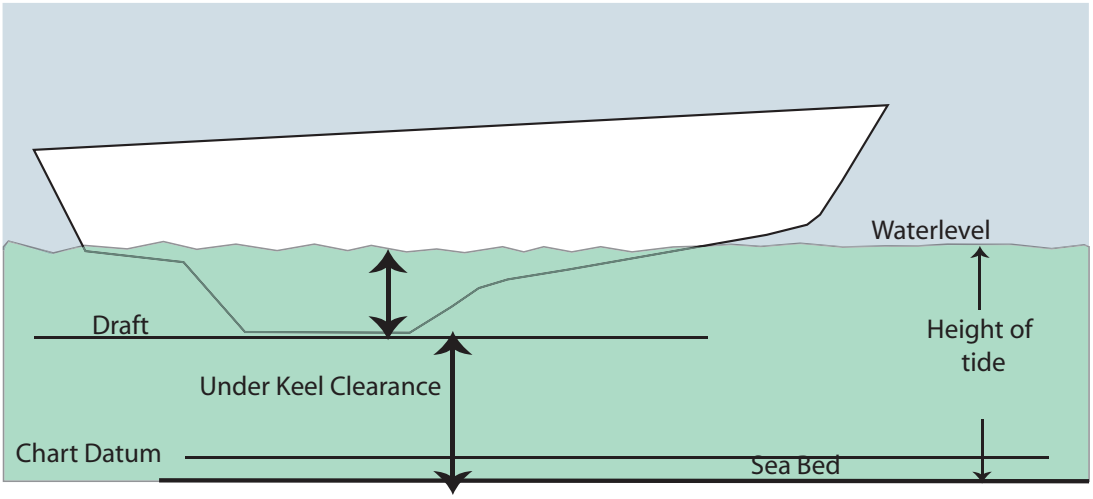
Each Standard Port will also have a tidal graph to assist the calculation of the height of tide at times in between high and low water and also the times that a certain height of tide will occur.

Mean Spring and Neap Curves
Enter the Heights of High and Low Water onto the top and the bottom of the table and join these two points.
When time of a certain height of tide is required, the required height can then be entered onto the graph and a horizontal line marked from this point to the appropriate curve.
When the height at a certain time is required, then the required time can be entered before or after High Water on the base of the graph and a vertical line drawn from this point to the appropriate curve. At the point of intersection to the curve, draw a horizontal line to cut the graph joining the heights and read of the required height.

Curve interpolation
Mean Spring and Neap Curves for Standard Ports show the factor of the range attained at given time intervals relative to that of HW: thus by definition HW=1and LW=0.

The spring curve is shown in solid line and the neap curve is pecked. Interpolation can be made by eye using the plotted positions of the predicted heights with reference to the levels of MHWS etc. No attempt should be made to extrapolate beyond the spring or neap curves: for ranges greater than springs the spring curve should be used, while for ranges less than neaps then the neap curve should be used.
Where there is an appreciable change in duration between spring and neap tides the results obtained may have a slight error. This error will normally be greatest near LW but in the few cases where the times are plotted relative to LW it will be greatest near HW.

Tidal Calculations



Example 1: Using the Falmouth tidal data and curves on the preceding pages.

Calculate the following:
a) The times and heights of high and low water on 31st July.
b) The height of tide at 1000 GMT on the 31st July.
c) At what time will there be a height of tide of 4.0 metres on the afternoon flood tide of the 31st July?

From tidal information page, times and heights of HW and LW are:

a)
HW	0506	5.2 m
LW	1147	0.6 m
HW	1724	5.5 m

b) Range for day = 5.2 - 0.6 = 4.6 m

From tidal curve, Spring range = 4.6 m. Neap range = 2.2 m.

As our range for day = 4.6 m Therefore use the spring curve.

Note: Depending on range for day, interpolation between spring and neap curves may be required.

Required the height of tide at 1000
Time of HW (nearest) 0506
Required time is 4 Hours 54 minutes after HW
Using the spring curve, Height of tide at 1000 is 1.75 metres.

c) Required the time height of tide will be 4.0 m on the afternoon flood tide.
Using curves, Height of tide of 4.0 m will be: 2 Hours 15 minutes before HW.
Time of HW 17.24
Time height is 4.0 metres is 15. 09

If the area that you are operating in is not close to a Standard Port then you will need to find your local Secondary Port information in the Secondary Port - table of differences. This is a list of secondary ports and their associated Standard Port. It may not always be the nearest Standard Port, but the one that closely follows the tidal pattern of the Secondary Port. Each location is given with figures that will enable you to modify the tidal information from the Standard Port to show the time and height of tide in that Secondary Port.

These tables are usually laid out geographically, as they are located around the coast.

Secondary Ports

The Secondary Port table contains:
1. The name of the Secondary Port concerned
2. It's position in Lat & Long
3. The name of the associated Standard Port
4. The Modifications to be applied to the Standard Port information

Time difference + or – indicating whether this number of hours and minutes should be added to or subtracted from the time of high or low water at the Standard Port.
Height difference This figure can be applied in various ways, if the figure is preceded by a + or – then it will be added or subtracted.

The times of high and low water are obtained by applying the time differences tabulated in the daily prediction for the

most suitable (not necessarily the closest) Standard Port. The Standard Port to be used is that which appears in bold type at the head of the subsection. Other Standard Ports may occur within a subsection in their correct geographical sequence but full data for these are not shown. The times obtained by applying these corrections are in the zone time shown next above the Secondary Port irrespective of the zone time used for the Standard Port predictions. Special care is needed when considering adjacent ports in different countries that may not be keeping the same time.

The time differences given are approximately the maximum and minimum differences that will be found to occur under normal weather conditions. Although these differences are normally shown to the nearest minute it must not be assumed that the resulting predictions will be to this accuracy.
Predictions, which fall between the times given for the Standard Port at the head of each column, can be obtained by simple interpolation between the columns. Time differences must not be extrapolated but only interpolated between the given values for times at Standard Ports that give values throughout a 24-hour period.

Tabulated Time Differences

Thus for secondary port Worthing, refer to Standard Port SHOREHAM:

			H.W.	**L.W.**	
		0500	**1000**	**0000**	**0600**
81 SHOREHAM		and	and	and	and
		1700	**2200**	**1200**	**1800**
75 Worthing	50°48'N 0°22W	+0010	0000	-0005	0010

The HW time difference for a tide that occurs at SHOREHAM at 1200, must be interpolated between the values tabulated for 1000 (0000) and 1700 (+0010).
200/700 x 10 = + 3 minutes
Low Water that occurs at SHOREHAM at 2300, must have their time differences interpolated between those values tabulated for 1800 (0010) and 0000 (-0005).
500/600 x 5 = - 4 minutes
Note: If a number of tides are required stretching over a period a graphical solution is a convenient method of obtaining this interpolation.

The heights of high and low water are obtained by applying the height differences tabulated in the daily predictions for the same Standard Port as is used for the times. These differences are tabulated for mean spring and mean neap levels at the Standard Port. Unless there is a statement to the contrary, it may be assumed that the variation is linear and differences for heights other than springs and neaps may be obtained by interpolation or extrapolation.

NOTE: The predictions for the Standard Ports include the seasonal variations for the Standard Port that may be different from those for the Secondary Port.

Step 1 is therefore to SUBTRACT ALGEBRAICALLY the seasonal variation for the Standard Port from the predicted height obtained.

Step 2 is to apply the height difference corresponding to this corrected height at the Standard Port, interpolating or extrapolating as necessary.

Step 3 is to ADD ALGEBRAICALLY the seasonal variation for the Secondary Port.

Take care to ensure that the signs of the seasonal variations are correctly applied. Where no seasonal variations are given they are less than 0.1 m and can be ignored. Allowance has been made in the preparation of the tables for any difference in the level of chart datum between the Standard and Secondary Port and the resulting heights are referred to chart datum at the Secondary Port concerned.
The accuracy of a prediction for a Secondary Port will depend on the amount of work involved. The less work undertaken, the less accurate the prediction is likely to be.

9

Currents

Currents are the horizontal movements of water from any cause, such as tidal phenomena, prolonged wind activity or river flow. A boat moving at a speed through still water where there is no current will be traveling at the same speed and direction over the bottom. When this same boat moves into a body of water that is affected by a current it's speed and direction of travel over the bottom will change. Before we look at how to work out the allowances that have to be made for current we need to understand the terms involved.

Definition of terms

Flood Stream
This usually refers to the flow of water associated with an incoming tide

Ebb Stream
The "falling" or outgoing tide is called the EBB, so a tide may be said to be ebbing or flooding dependant upon whether it is going out or coming in.

Slack Water
Slack is the period between the flood and ebb tides when the movement of the water tails off sometimes to a complete stop before the tide turns and flows a new direction.

Spring and Neap rates
The speed of the currents associated with Spring tides are greater than those of Neaps because of the greater volume of water flowing between high and low water at Springs.

Current Tables
These are published tables containing the data collected by the U.S. National Ocean Service (NOS) and the Canadian Hydrographic Service (CHS). REEDS Nautical Almanac publishes tide tables and information for the East Coast of North America

In the UK there are published tables and tidal atlases containing the direction and speed of the tidal streams round the UK.
In Europe by their respective hydrographic offices or maritime services

Direction
The information about direction is always given in degrees true so can be plotted directly on the chart without correction.

Rate
The rate is the speed, given in knots, at which the current is moving. Normally two rates given the one for springs and the one for neaps.

Tidal Current charts
In places where the direction and rate of flow varies in a given area or is too complex to be conveyed purely in figures a chart is often published, this can also be called a Tidal Stream Atlas. This is actually a series of chartlets, each of which represents one hour in the life of the tidal cycle. The direction of the current is shown with arrows, each of which will have a figure showing the associated rate. These have the advantage of showing the navigator a picture of the tide and how it is flowing.

Using the Current Tables

The Navigator needs to be able to make allowances for the current so he needs information about these currents. As with the tidal heights this information is found in a nautical almanac like REEDS under the heading of *Current tables.*

The Current Tables give the following information:

- The time of slack water
- The time and rate of the maximum flow of the flood tide.
- The time and rate of the maximum flow of the ebb tide.
- The direction of flow of both the flood and ebb tides in °T.

In the example opposite taken from the current table for **The Race, Long Island Sound,** we can see the following:

- The current on the flood runs in the direction of 302°T and current on the ebb runs in the direction of 112°T.

THE RACE, LONG ISLAND SOUND

Flood 302T° Ebb 112°T

Corrected for Daylight Saving Time

APRIL

	Slack time	Max time	Fld knots	Ebb knots		Slack time
1 W	0221	0528		3.8	16 Th	0244
	0848	1135	3.1			0916
	1456	1754		3.3		1518
	2103	2357	3.1			2122
2 Th	0318	0625		3.4	17 F	0327
	0947	1233	2.8			1003
	1557	1853		2.9		

Taking April 1st as an example we see that:

- Slack water will occur at 0221, 0848, 1456 and 2103.
- The ebb reaches a maximum speed of 3.8 knots at 0528 and 3.3 knots at 1754.
- The flood reaches a maximym speed of 3.1 knots at6 1135 and 3.1 knots at 2357.

Subordinate Stations

As with the tidal height tables there are difference tables that supply corrections to apply to the current data from the reference station. These enable the navigator to calculate the rate of the current at various geographical locations between the reference stations.

In this table the corrections for time will be marked + or – and will be added or subtracted. The corrected speed is found by taking the current speed for the reference station and multiplying it by the speed ratio given in the table.

PLACE	POSITION		TIME DIFFERENCES				SPEED RATIOS		CURRENT DIRECTION & MAX SPEED			
	North Latitude	West Longitude	Slack Before flood	Max flood	Slack Before ebb	Max ebb	flood	ebb	Flood Dir °T	Ebb Dir	Flood knots	Ebb
			h m	h m	h m	h m						
			on THE RACE, P. C 40									
Sound Beach, NY .2.2mi Nth of...	41° 00.33’	72° 58.45’	+0: 18	+0:	-0: 06	-0:36	0.3	0.3	270	075	0.9	0.9
Charles Island, CT.0.8 mi SSE of.....	41° 10.77’	73° 02.63’	-0: 30	-0: 15	-0:21	-1: 06	0.2		0.1	250	070	0.4

10

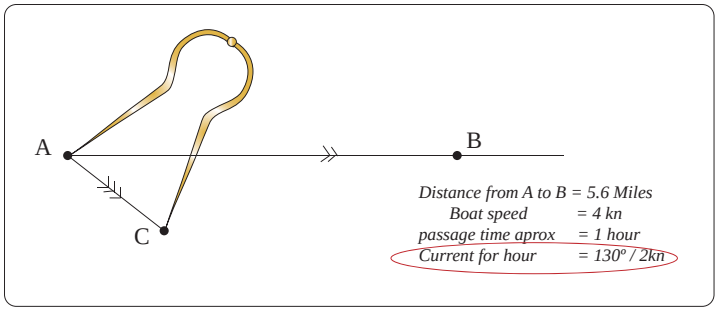
Course To Steer To Counteract A Current

In Section 9 we learned how to obtain information about the direction and speed of currents. Armed with this information it is possible to predict how far off your desired course the current would push you and so work out a course to counteract this. This is called the course to steer.

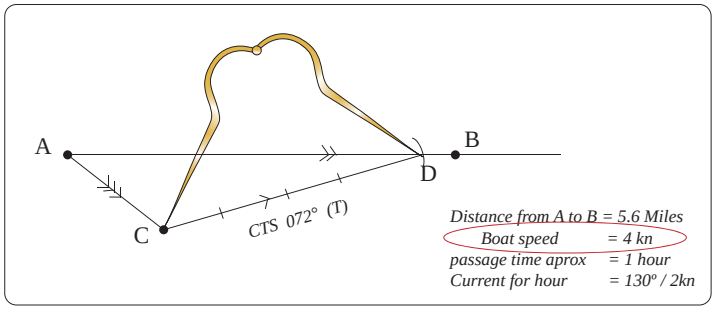
To work out a **course to steer**; we construct a triangle from the information that we have extracted from the current tables or atlas.

Plotting a CTS

1. Decide on a suitable time scale; periods of one hour are usually easiest to work with.
2. Estimate what you expect the speed of the boat will be under the existing conditions.
3. Measure the distance from the departure point to the destination.
4. Divide the distance by the speed to find how many full hours the passage will take.
5. Find and write down the tidal direction and rate for each full hour of the passage.
6. Draw a line on the chart from the departure point (A), through the destination (B).
7. From the departure point plot the set and drift of the current for the first hour (AC).
8. Set the dividers to the distance the boat will travel through the water in 1 hour (4 Miles).
9. The true Course To Steer is then CD. With one point of the dividers on C mark where the other point cuts the ground, AB. Call this point D. Note that the current vector is marked with 3 arrows, the ground track is marked with two arrows and the CTS is marked with a single arrow.



Plotting the current, set and drift for the first hour.



Plotting the distance the boat will travel through the water during the first hour

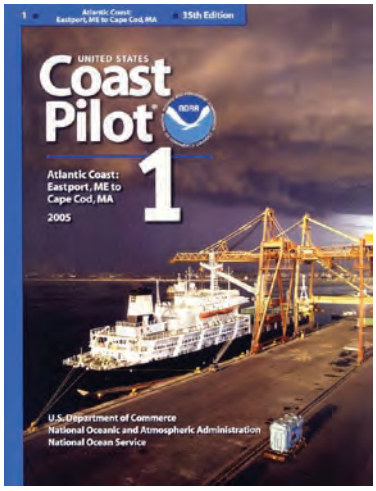
After one hour the boat will be at the position shown at D, not B where the passage is intended to end. This is quite correct; if the distance from D to B is appreciable a second course to steer will have to be plotted from D for the next hour. A common mistake is to just join C to B which will not give the correct course to steer. In the example above the distance from D to B is small and a second course to steer would not normally be required.

11

Pilotage and Passage Planning

Pilotage

Pilotage is the name we give to the techniques that a navigator uses to find his way around a local area or through a more confined area than the open sea. It will rely more upon visual references rather than the plotting and charting that is needed when navigating offshore. The helmsman will still need a course to steer but the progress and position of the vessel is likely to be monitored by reference to buoys, channel markers, land features etc.



Pilot books and Sailing Directions

There are published books of pilotage information which provide localized information about dangers and how to best avoid them, which channels to use and which to avoid in different tidal of weather conditions.

Nautical Almanacs

These will usually contain information about harbors, lights tidal and other navigational information. There are locally produced editions for small areas as well as national publications like REEDS who publish one book with information for the whole Western Seaboard of the US and another for the Caribbean Sea.

Pilotage Plans

Planning a departure is easier as you have a well-defined starting point whereas if you are approaching a harbor from seaward you will need to choose a clearly defined and easily confirmed starting mark.

Draw the track of your planned route and try to plan the track to pass some easily recognized marks to keep up with your progress.

Check along your track to see if the depth of water is going to be a critical factor and if so draw up the tidal information for the time of your passage.

Check the published information to see what, if any the harbor regulations are and what VHF Channels are used to control and monitor traffic movements, bridge openings and marina traffic.

Once you have drawn up a pilotage plan and begin to execute it resist the temptation to shortcut, stick to the plan and make sure that you positively identify each mark, **do not rush, stop if you need to, make sure of your position.** Check what you see ahead of you against the bearing you have taken from the chart to confirm the identity of the next mark. Don't neglect the echo sounder as a way of checking, it will often warn you of the location of the channel edge and if you set an alarm will alert you to the danger of running aground before the boat shudders to an unexpected halt.

Leave the steering to someone else but make sure that your instructions to him or her are clear and accompany all directional instructions with a compass course as a check. This will eliminate good many potential mistakes.

Try to keep track of your last point of reference, as this will be a place to return to if you become uncertain of your position. Never be afraid to slow down or stop or even to turn around and back track to your last known position then ask the crew to hold the boat in that position while you resolve the problem.

Your pilotage plan will be part of you overall PASSAGE PLAN.

Passage Planning

A Passage Plan begins with an outline of the whole trip that you intend to make along with all the relevant information that you will require during the passage. You will need to consult many different publications to gather this information.

1. The first step will usually be to look at a chart that will give you an overall view of the whole passage.

From this, you will be able to see the distance involved and so determine the length of the contemplated voyage.

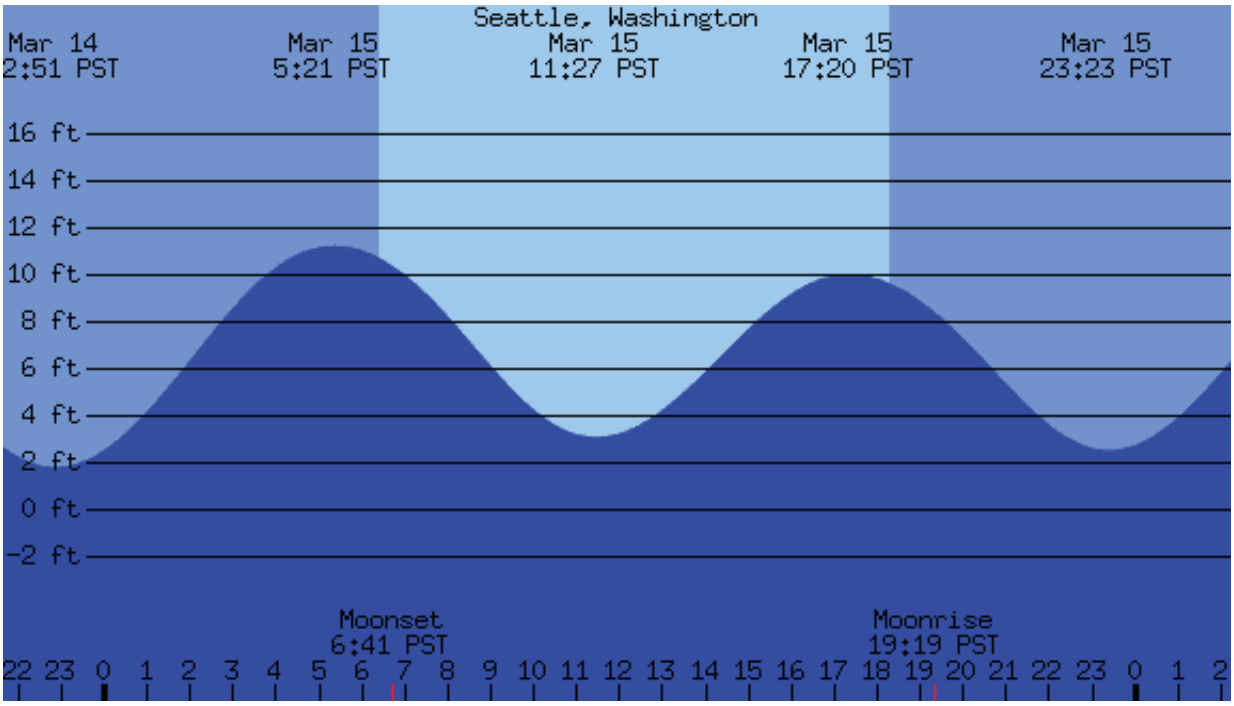
2. On the passage chart, draw the track that that you would like to follow and check to see if this brings you close to any dangers.
3. Check in the **Sailing Directions** to see if there are any published dangers, typically there can be dangerous races off some headlands in tidal areas. These will need to be either avoided or navigated only at certain phases of the tide, ledges which are deep enough not to be a direct danger can still set up dangerous surface disturbances at certain states of tide or with combinations of wind and tide. All of these potential hazards will need to be considered as part of the passage plan; it is a good idea to circle these hazards to highlight them on the chart, particularly if they are small and so otherwise easily overlooked.
4. Having now modified you original track to avoid these dangers, you will be able to check the distance and with an idea of your boats, speed will be able to get an idea of the length of the passage in terms of time. If you decide not to make overnight passages then you will look for **safe havens** for your overnight stops, either a harbor or anchorage.
5. You will also want to find **safe havens** for use in the case of emergencies or bad weather. You will need to carefully research these harbors or shelters to see whether they are available at all states of tide and what weather conditions will make the approach or entrance dangerous.
6. It will be easier to work out your pilotage plan well in advance in the comfort of your home rather than at the last minute as you approach the harbor maybe in rough weather. You could pick out a safe point to start this plan and note the Lat./Long. as a waypoint for your GPS or Loran.
7. If you are going to need to refuel then make sure that the fuel that you need is supplied on the dock and not at a gas station a mile from the dock! It can ruin your whole day to have to lug 100gallons of fuel a mile in jugs.
8. Look for any **tidal gates,** these maybe in the form of a geographical constriction such as a channel or headland where the tide may run very swiftly so as to make progress against it very slow or a lock which can only be accessed at certain states of the tide. If either of these are encountered then the timing for the passage may need to be worked back from that point. For example if, halfway through the passage, there is a headland around which the current races and causes dangerous conditions you will want to consult the **Tide Tables** to find the time of slack and work back from that time so as to arrive there at that time.
9. Having worked these factors out you will now need to decide on the charts that you will use for navigation and pilotage during the voyage. The NOAA chart catalog will be useful in determining which charts will be best to use.
10. If you decide to run the passage overnight or for a long duration then you will need to consider putting a watch scheme in place. This will ensure that the crew gets to rest and that someone is always available to keep watch and run the boat. There are many different schemes to choose from and each have their own merits, the most important thing is to pick a scheme which suits the crew and passage.
11. If you are going **foreign** then you will need to make sure that all the crew have their passports and that they hold any visas or other paperwork that may be required. You will need to carry all the ships papers and licenses as well as your own licenses. Check on customs and entry regulations for the country that you plan to visit, for example Mexico has a very strong policy banning the import weapons and declaring them can mean having them impounded, not declaring them can mean long prison terms

When, after all this careful preparation you get to execute the passage, make sure that you keep track of your progress and monitor all the important factors.

- **Time**: Are you making the speed that you planned for? Going too fast could be as bad as going too slow. You don't want to arrive before the tide has risen sufficiently for you to get into the harbor.
- **Fuel**: Monitor consumption if it is higher than expected do you still have sufficient reserve or will you have to start planning a refueling stop? Don't hesitate to refuel if you have any doubts about you range.
- **Crew**: How are they coping with the conditions, is the watch system working? Are people eating well, sleeping, being affected by seasickness?
- **Position**: Are you where you should be? Don't just steer the course; plot your position on a regular basis.
- **Systems**: Oil, fluid and water levels need to be checked as well as bilge's inspected on a regular basis.
- **Weather**: One of the things that can creep up and bite you if you ignore it is the weather. Keep monitoring

every forecast as the weather can change suddenly sometimes with disastrous consequences but, with a few hours warning of the impending change, precautions can be taken.

One way to make sure that these and other factors are monitored is to set out the routine in the logbook and make sure that every watch fills in the log at a regular interval.



Example of tidal information

12

Meteorology

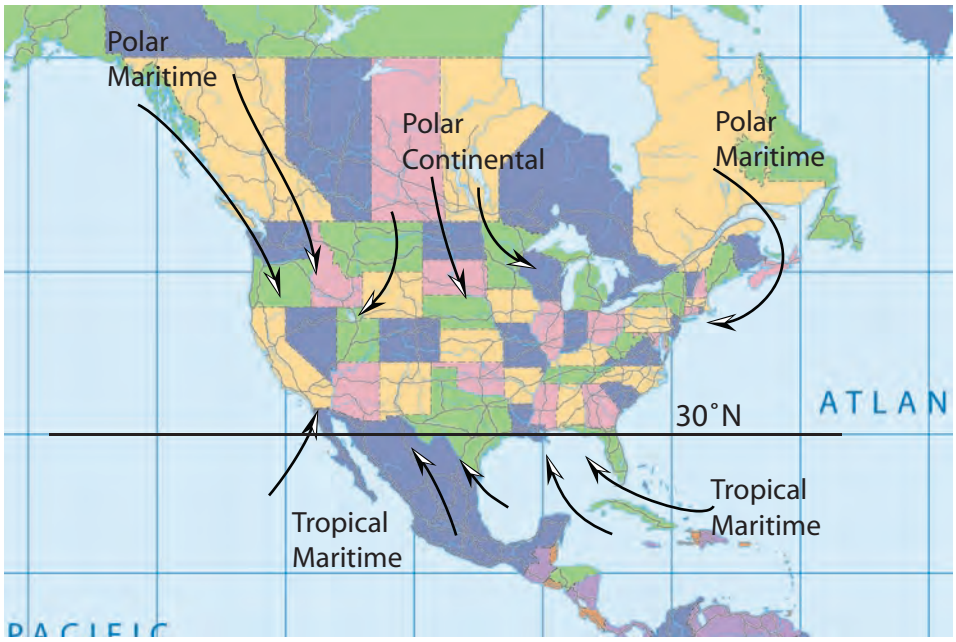
This is a vast and very complex subject; it is worth bearing in mind that some of the most powerful computers in the world are the ones designed to assist in the forecasting of weather, such is the complexity and difficulty involved. What we are aiming to achieve here is to provide an introduction and provide some building bricks with which you will be able to build a greater understanding.

Air masses

Our weather is formed mainly in the layer of the atmosphere that is called the troposphere, the first 11 miles; it is driven by the energy of the sun and the rotation of the Earth.

The sun heats up the surface at different rates causing the warmer air to rise above its cooler counterparts. As this air rises it is pushed outward by more air rising beneath it. Generally these air masses will rise in the equatorial regions and drift towards the poles. The rotation of the Earth creates what is called the Coriolis effect this is what causes the circular movement in weather systems. As the Earth rotates on its axis, through the poles, the surface will be moving at different rates. To illustrate this let us think of a person standing on the equator, the circumference of his rotation will be about 24,000 miles. To complete one rotation in 24 hours he will have to travel at about 1,000 mph. If we take another person (an Eskimo) standing about 4 miles from the North Pole, the circumference of his rotation will be 24 miles so his velocity will only be about 1 mph. The warm air spilling out towards the poles from the Equatorial region will retain this velocity which, in the Northern Hemisphere, will cause it to be deflected to the right. So as this air descends and so creates an area of high pressure it will acquire its clockwise spin. In the Southern Hemisphere the deflection is to the left and so the rotation is counter clockwise.

Below is a diagram showing the principle air masses that affect the weather in the US.



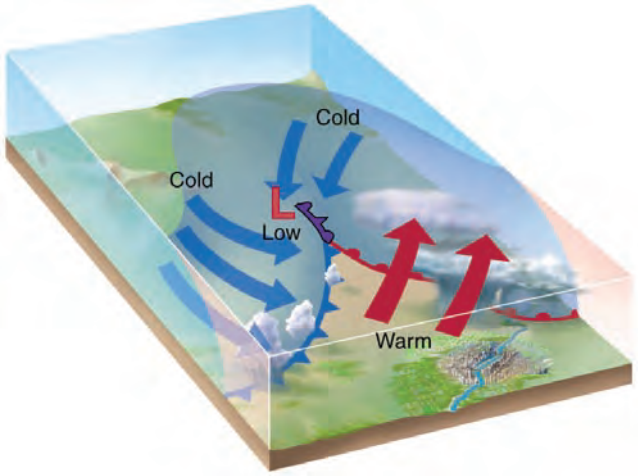
As the names suggest, the polar air mass will be cold and the tropical warm, the maritime will be moist and the continental will be dry. It is the meeting and mixing of these in conjunction with the rising thermals created by the suns energy that create the complex patterns that we term weather.

Fronts

A front is the term used to describe the dividing line between two air masses. An approaching front will often signal its arrival with a variety of discernable signals, the most visible of these are usually cloud formations, other clues will be changing wind direction or strength, visibility and temperature changes. You will see a good example of a front in the illustration used in the section below dealing with synoptic charts.

Warm Front

A warm front is the leading edge of a warm air mass and when it meets a cold air mass it will tend to rise over the colder more dense air. As the warm air rises the moisture it contains condenses out into clouds, rain and drizzle. At high altitudes the leading edge of this front may extend as much as 600 miles ahead of the front at ground level. As the warm front approaches the cloud layer becomes thicker and just ahead there will often be fog along with poor visibility and rain.

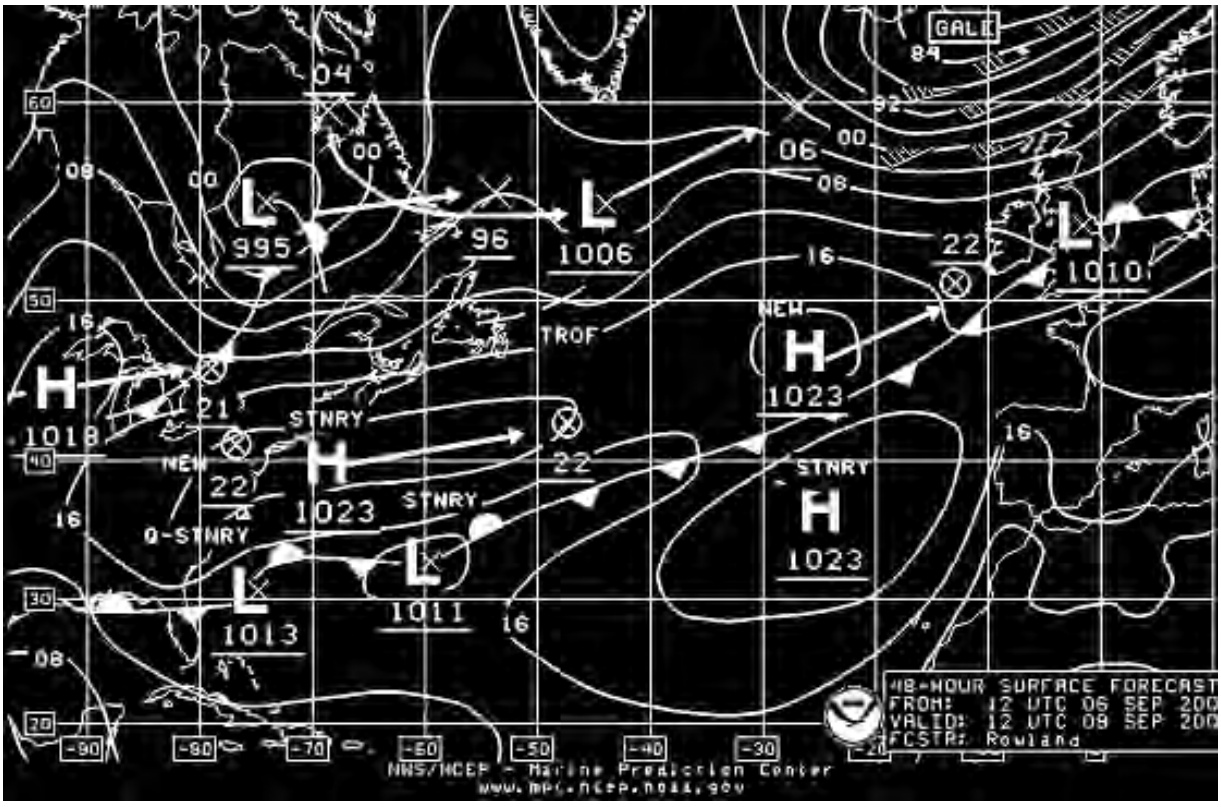


Cold Front

A cold front is the leading edge of a cold air mass and as the cold air is denser it will slide under warmer air like a wedge. This will cause the warm air to rise, in some cases vertically, resulting in rapid cooling of the warm air. This results in heavy rain and squally conditions as the swiftly rising air sheds its moisture and heat energy.

Synoptic Charts

A synoptic chart is a graphical representation of the features that combine to create our weather.



In the above example, which is a chart covering the North Atlantic at 1200 UTC on the 6th of September 2000, we can see many of these features displayed.

We can see the Azores High sitting at 35ºN 25ºW this large semi permanent feature dominates the weather in the Atlantic and is responsible for driving the ocean currents as well as having a major effect on weather patterns in Northern Europe. Stretching for over 4,000 miles from the Gulf of Mexico to Denmark we can see a front or the dividing line between the Polar and Tropical air masses. To the north of Scotland are the tightly packed isobars spiraling counter clockwise around a depression or low pressure system with a central pressure of 980mb, the wind arrows show wind speeds of 45 knots, a severe gale force 9 is raging here. Meanwhile the widely spaced isobars over Florida suggest very little wind but the front creeping down from Georgia is bringing a lot of rain with it as it pushes the leading edge of cold air into the tropical air mass coming up from the Caribbean.

Clouds

These are the visible manifestation of rising columns of warm moist air or of parcels of saturated air, that is air that has reached its dew point. The warmer a parcel of air is the more moisture it can carry, so as warm air rises it carries moisture that it has collected from the surface through evaporation. This rising air begins to cool, this occurs because the higher you climb the lower the air pressure becomes. This drop in pressure causes the parcel of air to expand, this expansion in turn causes the air to cool, this is called adiabatic cooling. Eventually the air cools to a point at which it can no longer retain all the moisture that it carries and at this point the excess moisture condenses out in the form of water vapor or clouds.

Cirrus

Cumulus

Fog

Fog is basically a cloud that occurs at ground level; it is usually caused by either cold air blowing over a body of warm water or by a warm moist airmass being pushed over a cold surface area.

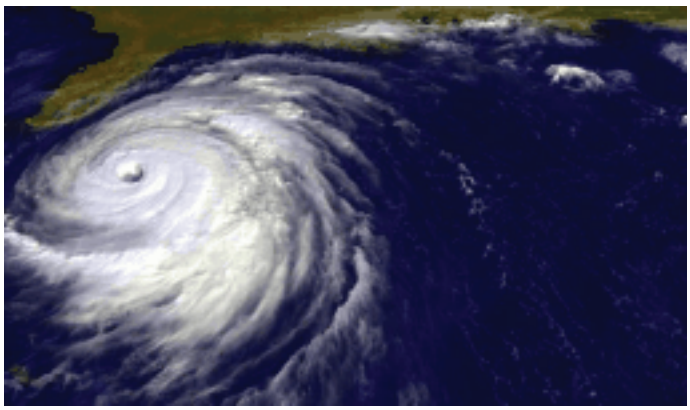
Sources of weather information

There is now a wealth of weather information available to seafarers. In the United States most VHF radios are capable of receiving the WX stations which broadcast continuous local weather information. On television the Weather Channel also gives continuously updated specialized broadcasts including marine forecasts. Many marinas and Harbor Masters offices will post current weather faxes on their notice boards. If the boat is equipped with a single side band receiver then weather faxes can be down loaded from short wave sources.

In the UK there are regular shipping forecasts on the radio and most VHF radios are capable of receiving the WX stations that broadcast continuous local weather information. Navtext will also provide regular weather forecasts.

Tropical revolving storms (TRS)

Intense depressions forming in the tropical regions are known by various names such as hurricanes (Atlantic), typhoons (Pacific), cyclones (Indian Ocean). The terms *tropical revolving storm* or *tropical cyclone* are used to describe these intense low pressure systems. These storms can give rise to violent conditions in which yachts and their crews will often be unable to survive. Tropical cyclones do not occur with anything like the frequency of the depressions experienced in temperate climates such as Ireland.



Hurricanes can seriously damage your health

Anyone venturing into areas in which Tropical Revolving Storms occur should avail of every

opportunity to learn about them, possible areas of refuge ('hurricane holes') and what, if any, forecasting facilities may be available.

Many marinas in the U.S will not allow boats to enter if a hurricane is forecast, indeed some marinas may try to force boats already in the marina to leave. Insurance policies may not cover use in hurricane prone areas during the hurricane season. Some marinas will dig keel holes ashore into which the boat is craned and left until the hurricane season is over.
So-called 'hurricane holes' may well offer some degree of safety but not when they become filled with charter boats hastily anchored on hopelessly inadequate ground tackle.

Consider the following extracts:

1. "In December, 1944, vessels of the United States Pacific Fleet, operating to the east of the Philippines, were caught near the center of a typhoon of extreme violence. Three destroyers capsized and went down with practically all hands. Serious damage was sustained by a light cruiser, three small carriers, three escort carriers and three destroyers. ..About 750 officers and men were lost or killed." (Admiralty Manual of Navigation, Vol. 1).
2. "A mature hurricane is by far the most powerful event on earth; the combined nuclear arsenals of the United States and the former Soviet Union don't contain enough energy to keep a hurricane going for one day. A typical hurricane encompasses a million cubic miles of atmosphere and could provide all the electrical power needed by the United States for three or four years. During the Labor Day Hurricane of 1935, winds surpassed 200 miles an hour and people caught outside were sandblasted to death. Rescue workers found nothing but their shoes and belt buckles. So much rain can fall during a hurricane - up to 5 inches an hour - that the soil liquefies. ..... In 1970, a hurricane drowned half a million people in what is now Bangladesh. In 1938, a hurricane put downtown Providence, Rhode Island, under ten feet of ocean. The waves generated by that storm were so huge that they literally shook the earth; seismographs in Alaska picked up their impact five thousand miles away." (The Perfect Storm).

Source of energy
Air is composed of nitrogen, oxygen and water in the form of vapor. The warmer the air is the more moisture it can contain. In the tropics air is heated by coming into contact with the sea which has in turn been warmed by the sun. As the air becomes warmed it is able to absorb more moisture which is supplied by evaporation from the surface of the sea. Energy, supplied by the sun, is required to evaporate the water. The warm air mass containing the water vapor rises and is cooled. The water vapor condenses back into water and the latent heat, or energy, contained by the vapor is released.

Tropical cyclones obtain their terrific energy by evaporating water from the sea surface and releasing this energy when the moisture vapor condenses into the form of torrential rain. By the time the rising air mass reaches the upper limit of the cyclone, which can be 8 miles or more above the sea surface, the air has become dry and cold. This dry cold air moves rapidly outward from the center of the hurricane and, being cold and therefore heavy, descends back to sea level Warmed by contact with the sea surface the dry air absorbs moisture once again and is drawn towards the low pressure area in the center of the cyclone and the cycle begins to repeat itself. Cyclones, once started, are therefore self generating as long as warm, moist, surface air is available. There are no fronts, either warm or cold, in a tropical cyclone and the isobars are more or less circular.

Conditions required for formation of TRS
Three conditions must be fulfilled for a tropical cyclone to develop; the first condition is that of sea surface temperature. The rate of evaporation necessary to allow a TRS to form requires a sea surface temperature greater than about 27° Centigrade (81° Fahrenheit). Sea temperatures as high as this only occur in the North Atlantic, for example, during the summer and autumn of that hemisphere and usually on the western side, i.e. in the Caribbean and Gulf of Mexico.

The second requirement for a tropical cyclone to develop is the existence of Corioli's force which will set up an counterclockwise spinning motion in the northern hemisphere or clockwise in the southern hemisphere. Corioli's force does not exist until about 7° north, or south, of the equator.

The third requirement is for weak upper level winds.

Tropical waves
An elongated area of low pressure (a trough) of low pressure is known as a Tropical wave, as it originates in the tropics. Many originate as a cluster of thunderstorms which move off the west coast of Africa. They move from east to west, carried along by the circulation around the Azores, or Bermuda High. If conditions are right, they may develop further into a Tropical Disturbance.

Tropical Disturbance
In tropical or sub-tropical areas when light winds have been circulating for 24 hours around an area of low pressure the air circulation is designated a tropical disturbance. A tropical disturbance is non frontal and may be approximately from 100 to 300 miles in diameter.

Tropical Depression
A tropical cyclone in which the sustained surface wind speed does not exceed 33 knots is called a tropical depression. At this stage the depression will be given a name such as TD2 (i.e. Tropical Depression no. 2).

Tropical Storm
When the sustained wind speeds at surface level reach from 33 knots to a maximum of 64 knots the cyclone is designated a tropical storm. The high speed circulation of the wind in the center of the depression throws air outwards by centrifugal force and cold, dry (and therefore cloudless) air from high altitudes is drawn in to replace the outgoing air. Thus the cloudless, calm, center 'eye' of the storm is formed. At this stage the storm will be given a name, female and male names being used alternately, i.e. Hurricane Charlie, Hurricane Camille, etc., in areas such as the Caribbean covered by the US weather service.

Hurricane
When the maximum sustained surface wind speed of the cyclone exceeds 64 knots the cyclone is designated a hurricane. A hurricane is also given a category number from 1 to 5, based on the maximum wind speed sustained over a period of 1 minute of time. An international color tracking code is also used.

The categories are:

Category 1	wind speeds from	65 to 83 knots	(red)
Category 2		84 to 95 knots	(light red)
Category 3		96 to 113 knots	(magenta)
Category 4		114 to 134 knots	(light magenta)
Category 5		135 + knots.	(white)

Areas TRS prone

Western side of the North Atlantic	(50)
Eastern side of the North Pacific	(30)
Western side of South Pacific	(30)
Western North Pacific	(250)
Southern Indian Ocean	(60)
Bay of Bengal	(20)
Arabian Sea	(10)
North West Australia.	(10)

The figures in brackets indicate the average number of severe tropical storms recorded over 10 years. These figures are from the BA Admiralty Manual of Navigation and were obtained prior to 1960. Remember that some storms may not have been recorded or the observers may not have survived to report them.

No tropical cyclones had been recorded in the South Atlantic, until 2004, when one moved onto the coast of Brazil.

North Atlantic TRS
The following numbers of tropical cyclones and hurricanes were recorded in the north Atlantic (: http://weather.unisys.com/hurricane/atlantic)

Year	Tropical Storms	Hurricanes
1995	19	11
2001	6	9
2002	8	4
2003	9	7
2004	5	9
2005	12	15

Seasons
June 1 until November 30 is the official hurricane season in the North Atlantic, although hurricanes have occurred in every month of the year. The peak of the North Atlantic hurricane season is September 14th. Generally hurricanes develop during the late summer and early autumn months of their hemisphere when the sea temperature has reached its hottest for the year. This means that they are rare from mid November until mid June in the Northern hemisphere and from mid May until November in the Southern hemisphere. The western North Pacific may have tropical cyclones during any month and they are more likely in the Arabian sea at the change of monsoon around October-November and May-June.

Path or Track
The direction along which a Tropical Cyclone is travelling.

Origins and tracks
In the northern hemisphere tropical cyclones originate in the doldrums between about 7° and 15° north of the equator. The initial track is often between 275° and 350°. When the storm reaches about latitude 25°N the track turns (recurves) away from the equator and by the time the storm has reached 30°N it will often be travelling in NE direction.

Southern hemisphere tropical storms originate between 7° and 15° south of the equator and initially move in either a

WSW or SSW direction recurving when they reach about 15° to 20° south. Having recurved the storm track usually continues in a SE direction.

Sometimes storms, both in the northern and southern hemisphere, do not recurve but continue along their original track until they reach the mainland where they usually die as they will be starved of their supply of warm surface water.

Storm tracks do not always conform to any rules, many factors such as the upper level wind direction and adjacent areas of high and low pressure effect the storms ultimate path.

The Vertex
The furthest point reached by the storm's track before the storm recurves is called the vertex.

Eye of the storm
The center of the storm, which will have light or no winds and clear skies, is called the eye. The eye will be from 10 to 30 miles in diameter and within this area winds may be expected to be light. Although the wind will be light in the eye of the storm at sea waves will be mountainous and very confused. For the crew of a yacht caught here survival may only be through resurrection!

Speed of advance
At the beginning a TRS will move along its track at a speed of 10 or perhaps 15 knots, the speed of advance increasing to between 20 and 25 knots after it has recurved. Speeds of advance up to 40 knots or more have been recorded.

Eyewall
The circle of clouds surrounding the eye of a tropical cyclone. The strongest winds will be in the eyewall.

13

Electronic Navigation Aids

Today most yachts carry a variety of electronics whereas not so many years ago it was common to find yachts going to sea without any electronics at all. The **magnetic compass** was in use to give the sailor his direction before electricity was harnessed. The lead line required only muscle power to swing it ahead of the vessel to tell him the depth of water and a piece of wood tied to a knotted string would give him his speed. The **mechanical trail log** replaced the knotted string to record speed and distance; this in turn has been replaced by the paddle wheel and Doppler type logs. Then the **electronic depth finder** was developed which meant that sailors would no longer have to stand around "swinging the lead".

Magnetic Compass

RDF or **radio direction finding** was one of the first electronic navigation aids to be widely used. This operated on a chain of radio beacons each of which would transmit a Morse coded signal of a specific frequency which the navigator would find published in the list of radio signals or almanac. The receiver is fitted with a directionally sensitive aerial so when the unit is aligned in the direction of the transmitter the signal is lost; this is called the Null point. By checking the compass fitted to the unit as you reach the Null Point a bearing to the source of the signal can be obtained. The geographical position is given along with its characteristics in the various publications.

Logs

- Trail log: This is now superseded by newer technology. It's advantages are that it has no need for power and is simple to install by simply attaching it to the stern rail then streaming the plaited line with the rotor at it's end. Disadvantages are that larger fish will often take the rotor as it spins, it can be inaccurate when running before a following sea and it needs to be brought in before stopping or maneuvering.
- Impeller or Paddle wheel log: This is a through hull unit that has a small paddle wheel protruding into the water flow passed the hull. One of the vanes on this wheel contains a small magnet, the main unit detects the magnetic pulse on each rotation that it counts and converts to boat speed. This log works well even at very low speeds. The impeller is vulnerable and can be damaged; it will also become fouled by weed or marine growth and needs to be withdrawn for regular cleaning.
- Doppler log: The Doppler Effect is what causes Police sirens and train whistles to have a higher pitch as they travel towards you than when they are moving away. This is due to a variation in the sound waves (or light waves, called Red Shift) emitted by a moving object. This is a very accurate way or measuring speed and is used by astronomers to measure the speed at which stars are moving millions of light years away. A doppler log has a transducer that is mounted facing ahead but angled down so as to send out a signal at about a 45º angle which is returned by either the seabed or deeper layers of water. The distortion caused by the forward motion of the boat is translated into boat speed. There are no moving parts or protrusions but this type of log is more expensive than other types and can become inaccurate in rough weather.
- Electromagnetic log: The electromagnetic log uses two electrodes in a through hull transducer. When a water flow is established between these electrodes, a voltage is induced which is measured and used to calculate speed and distance by the unit. This unit is accurate and has no moving parts but has to be mounted through the hull; it is expensive and must be mounted well away from the magnetic compass.

Echo sounders

The echo sounder or depth finder is a simple and usually very reliable instrument; it consists of a sender unit or transducer and a display unit.

The transducer sends a pulse of sound through the water and then measures the time that it takes for that pulse to be returned as an echo from the seabed. A simple calculation performed by the unit will then give the depth of water. These transducers can be fitted as through hull or internally mounted.

Most displays are now digital and will display the measured depth in units of your choosing, either feet, fathoms or meters. The unit will display the depth of water below the transducer but most sets will allow you to select an offset to account for the position of the transducer. This will allow you to have the unit display the actual depth of water, by adding the distance between the waterline and the transducer or display the depth below the keel by subtracting the distance between the transducer and the bottom of the keel.

Global Positioning System (GPS)

GPS is probably the most used instrument on a small boat today, the ease of use and low cost of unit now means that nearly every boat has at least one unit on board.

The GPS system is a constellation of navigational satellites set up and controlled by the US Department of Defense each of these satellites broadcasts a coded signal which is translated by the receiver on the boat. The latest GPS units can track up to 8 satellites however with information from only three of these the unit can derive a fix. Each satellite signal will allow the GPS receiver to produce a spherical position line and as with terrestrial fixes three position lines will give a fix.

The GPS unit will provide positional information in the form of Latitude and longitude and these will typically give a position to three decimal places of a minute. Although this is very **precise**, 0.001'being 2 yards, the **accuracy** of the information does not match this precision. There are a number of reasons for this that the navigator should be aware of.

- Many electrical and physical factors can interfere with and degrade the accuracy of the signal. The fix derived from this information will therefore be less accurate. Atmospheric interference, electrical problems with the equipment on board the vessel, errors of interpretation or translation of the data within the receiver or satellite. Even telemetry data being fed to the satellite can be in error and if the position of the satellite is wrong then there will be an error in its range, which is the source of the position line.
- The US Department of Defense used to degrade the signal for civilian use by the use of SA or Selective Availability, which was a slight degradation of the accuracy in the time signal, which had the effect of reducing accuracy to 100 meters. SA was switched off on the 1st May 2000 giving ever user full accuracy BUT it would be possible to switch it back on again at any time. In case of an international emergency, the US Government could turn the whole system off entirely.
- If there is not a good separation in the angle of the satellites used to fix the position then you will get what is termed a high HDOP (Horizontal Dilution Of Position). When two position line cross each other at a shallow angle as they do in this case there is a much greater area of uncertainty about where the true position lays.
- If the GPS unit is not set to the same **Datum** as the chart then there can be a considerable discrepancy in the charted position of objects shown. The most often and widely used datum is World Geodetic System 1984 (WGS84). The datum and any corrections that need to be made will be found in the notes section under the title of the chart under the heading of Satellite derived positions.

Loran C

Loran C is a ground based navigation system, which, along with its European cousin Decca operates by using radio signals broadcast from a chain of radio stations. The navigational information delivered by these receivers to the user is the same as would be given by a GPS unit, that is a position given in Latitude and Longitude and the boats course and speed over ground. The Chain of Decca stations will most likely disappear before the Loran C chains are discontinued but both are rumored to be under threat of closure.

Having said that in the last few years a new Loran C chain has been put in place to cover Northern Europe, an area

previously covered only by Decca. The advantages and disadvantages of these two systems are very similar the main difference between them being their respective operational ranges. Decca is accurate up to 400 miles by day and 250 miles at night whereas Loran C gives a high degree of accuracy up to 1,000 miles offshore.

- Decca and Loran C are systems dedicated primarily to civilian navigation and so are not subject to military control in times of international crisis.
- The errors induced by ground effects are repeatable and can therefore be canceled out with corrections for a local area.

The disadvantages are:

- Neither system gives the worldwide coverage afforded by the GPS system.
- The ground based hyperbolic systems are adversely affected by atmospheric and “Twilight Effects”, that is that they can become unreliable around dusk and dawn
- The increasing popularity of GPS means that the price of a GPS unit is very much less than either Loran C or Decca receivers.

14

International Regulations for Preventing Collisions at Sea

In 1910 the first internationally agreed set of rules, or code, setting out the behavior required of vessels under certain conditions in order that they should keep clear of each other came into being. First set out in the Brussels Regulations of 1910 these rules have been updated and added to over the years. The Rules were updated by a conference of the International Maritime Organization in 1972 and are usually referred to as the 72 COLREGS or just the COLREGS. Amendments were made to the Rules in 1983 and again in 1989 bringing them to the general form in which they presently exist. In the U.S. Congress adopted the 72 COLREGS as the International Navigational Rules Act of 1977 and the Rules were imported into English law by Section 418 of the Merchant Shipping Act 1894.

It is not necessary to know all of the Rules off by heart but a thorough knowledge of the COLREGS is essential, it is totally unacceptable to say “I don’t know what it is, or what to do, but I’ll look it up in the Almanac”. This attitude causes accidents and endangers others as well as yourself. The full text of the COLREGS are readily available from many sources and are including in the excellent Reed’s Nautical Companion.

Possibly the most difficult section to learn is that which deals with the lights required by vessels operating under different circumstances at night. Computer programs are available to help but perhaps one of the best ways to learn the COLREG lights is with a set of playing card sized cards which have various combinations of lights in color on a black background on one side and the description of the vessel(s) the lights represent printed on the back. These cards are readily available from most marine stores and only cost a few dollars.

Buoys and Marks

To help ensure safety and to clearly mark out obstacles and hazards that exist both in and under the water there exists and internationally agreed sets of marks and lights. These are developed with the assistance of the "International Association of Lighthouse Authorities" (IALA.) There are two major systems.

Region A (IALA A) covers all of Europe and most of the rest of the world except for the areas covered in **Region B (IALA B)** which is North America, South America, Japan, The Philippines and Korea. Fortunately most of the differences between the two systems are few. The most important is that which deals with the "direction of buoyage" which defines on which side of a channel the Lateral or Channel Buoys or Marks are placed.

For both IALA A and IALA B, the shapes, when returning from sea, are conical buoys or (triangles if fixed) to starboard, can shaped buoys (or square if fixed) marks to port. These Lateral or Channel Marks define the limits of the navigable water across a channel, though designed in principle to define the limits for large commercial ships they are also vital for the safety of smaller vessels. It is almost never wise to attempt to pass between a channel mark and the shore behind.

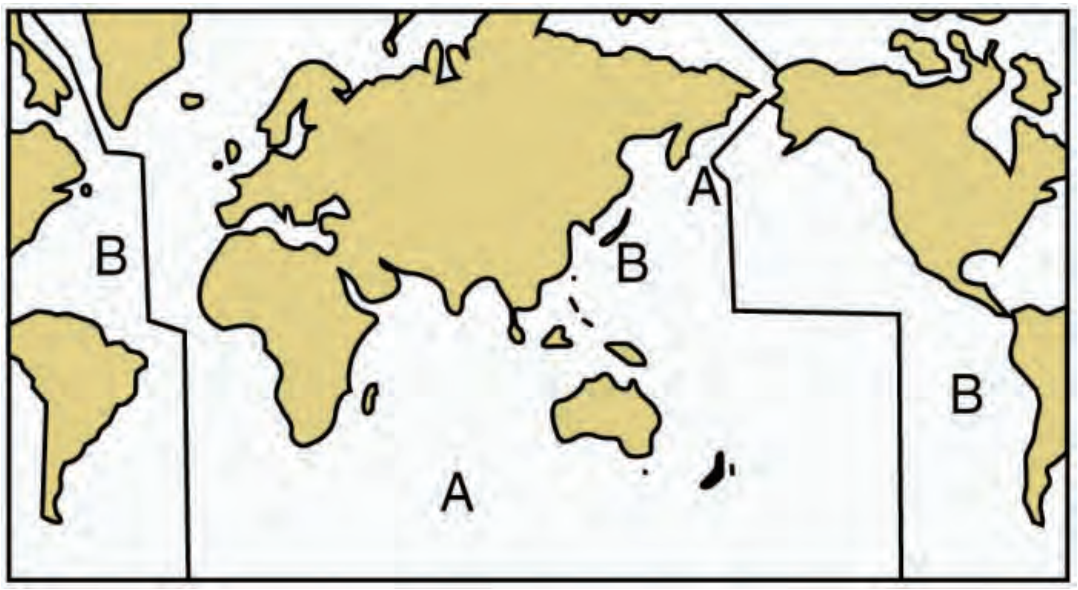
Marks can either be a buoy floating in the water or a pole set into the rocks or sea bed which will be painted in the correct color and carry the required shape at the top.

IALA A leave red to port, green to starboard when returning from sea.
IALA B leave red to starboard, green to port when returning from sea.

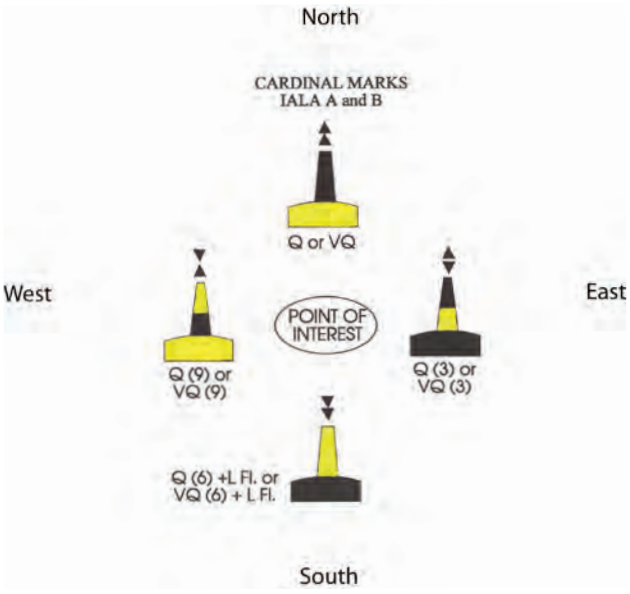
In this section it is intended to present a synopsis of the Rules and present them pictorially where possible.

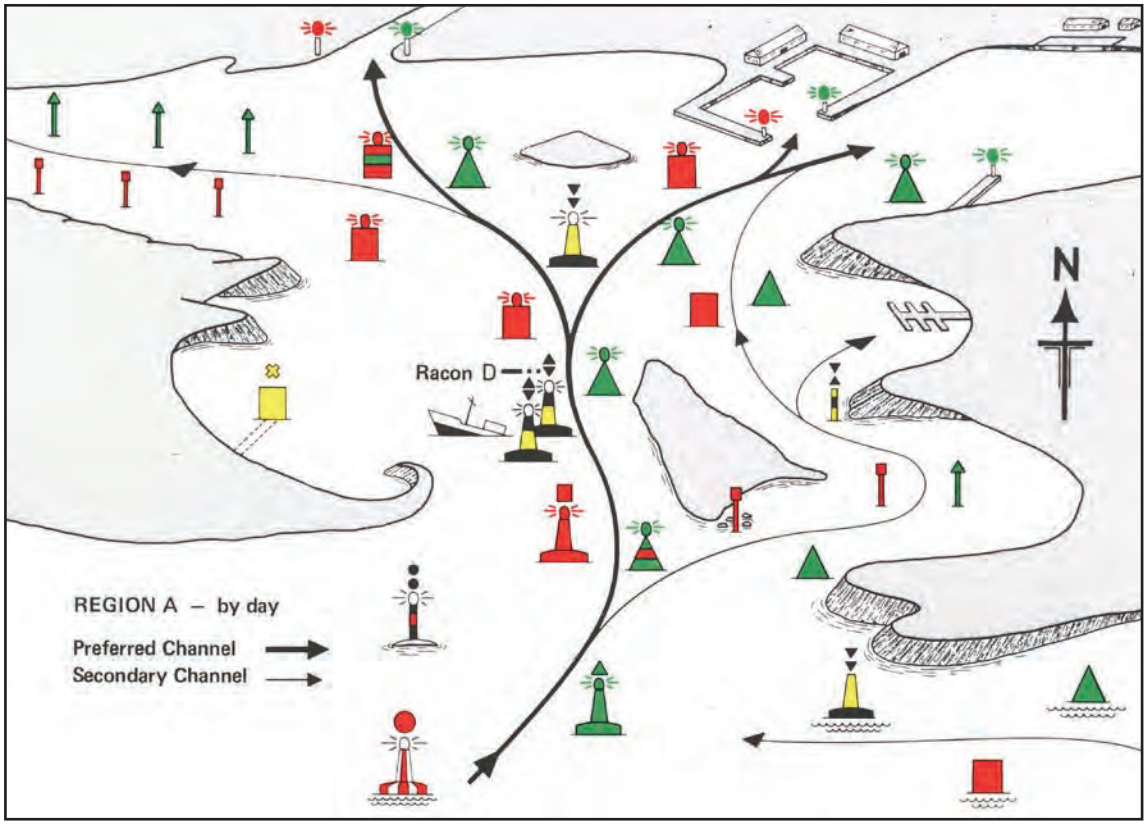
IALA Maritime Buoyage System

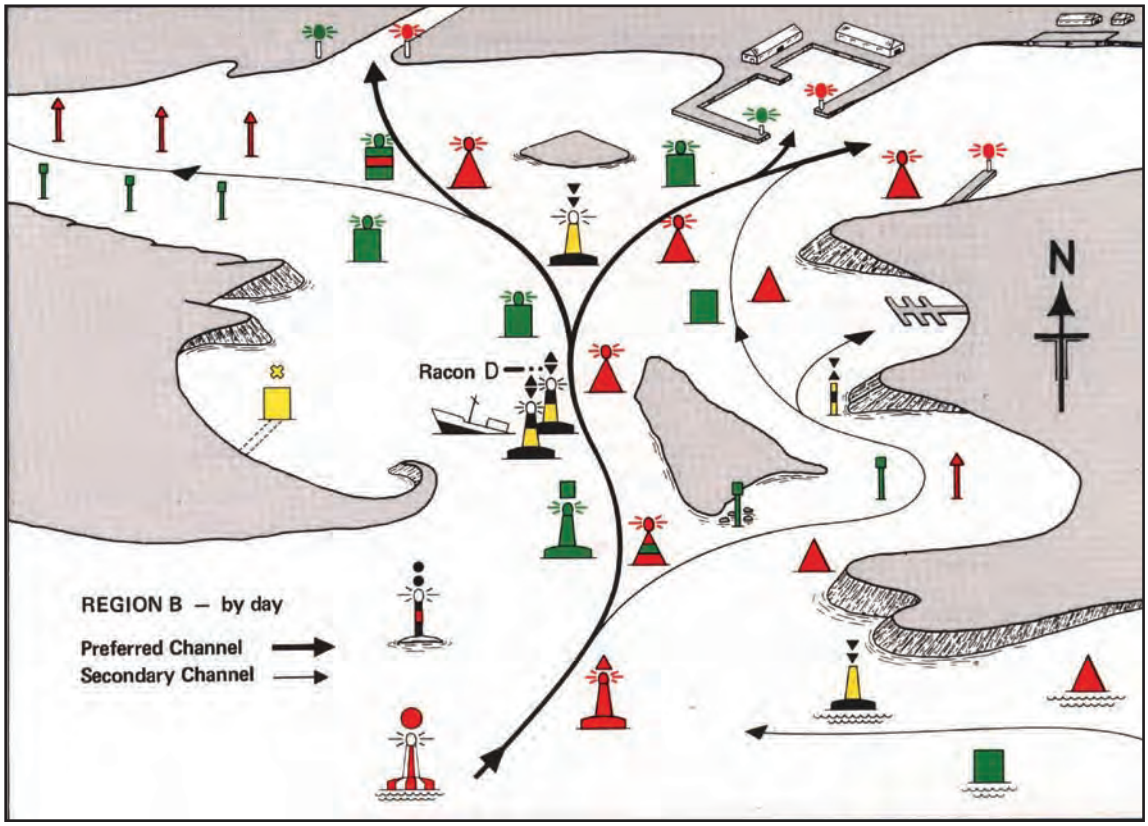
Buoyage Regions A and B, November 1980



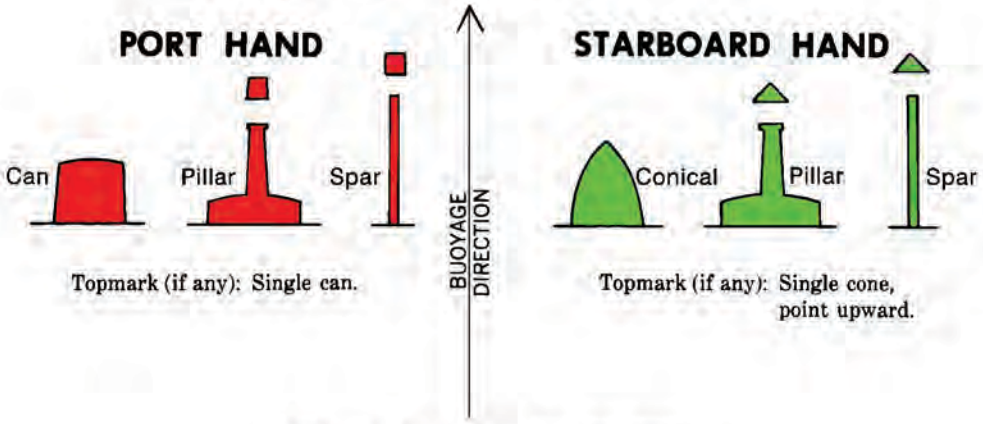
Common to both areas:




Racon D
N
REGION A – by day
Preferred Channel
Secondary Channel


Racon D
N
REGION B – by day
Preferred Channel
Secondary Channel

IALA MARITIME BUOYAGE SYSTEM
LATERAL MARKS REGION A

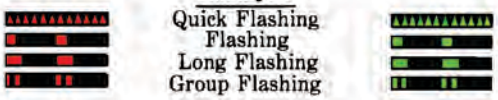


Topmark (if any): Single can.

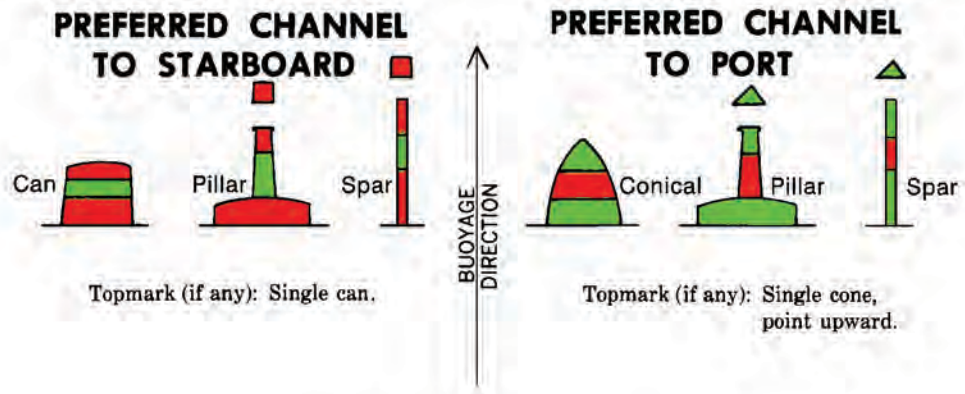
Topmark (if any): Single cone, point upward.

Lights, when fitted, may have any phase characteristic other than that used for preferred channels.

Examples



Quick Flashing
Flashing
Long Flashing
Group Flashing



Topmark (if any): Single can.

Topmark (if any): Single cone, point upward.

Lights, when fitted, are composite group flashing Fl (2 + 1).

The 72 COLREGS

The COLREGS consist of 38 rules which are set out in 5 parts, as follows:

Part A: General
Part B: Steering and Sailing Rules
Part C: Lights and Shapes
Part D: Sound and Light Signals
Part E: Exemptions

Part A, General

Part A defines that the Rules apply to all vessels (regardless of size) on the high seas and to all waters connected to the high seas that are navigable by seagoing vessels.

The Rules, however, allow appropriate authorities to operate special rules in harbors, rivers, lakes and inland waterways but state that any such special rules should conform as closely as possible to the COLREGS.

In the U.S., for example, special rules called the Inland Navigation Rules apply on the inland waters of the United States. Many of the Inland Rules are in fact identical to the International Rules. The point at which the rules change from International to Inland is marked on U.S. charts by the words 'COLREGS DEMARCATION LINE."

Part A also contains definitions which should be understood:

Power driven vessel:	any vessel propelled by machinery
Sailing vessel	vessel under sail provided an engine is not also being used.
Fishing vessel	vessel using nets, lines, trawls, etc., which restrict maneuverability.
Not under command	vessel which is unable to maneuver as required by the Rules due to some exceptional circumstance. (e.g.: damaged steering).
Restricted in ability to maneuver	vessel which is unable to maneuver as required by the Rules due to the nature of her work. (e.g. dredging, surveying, pipe or cable laying, towing, etc.).
Constrained by draft	power driven vessel which cannot deviate from her course due to her deep draft relative to the surrounding depth of water.
Underway	vessel which is not at anchor, or made fast to the shore, or aground.
Restricted visibility	visibility restricted by fog, mist, heavy rain, snow, etc.

Part B, Steering and Sailing Rules

This section defines what action must be taken by vessels to avoid collisions under specific circumstances.

One of the most important of all the Rules is Rule 5 which is given here verbatim:

Lookout "Rule 5"

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

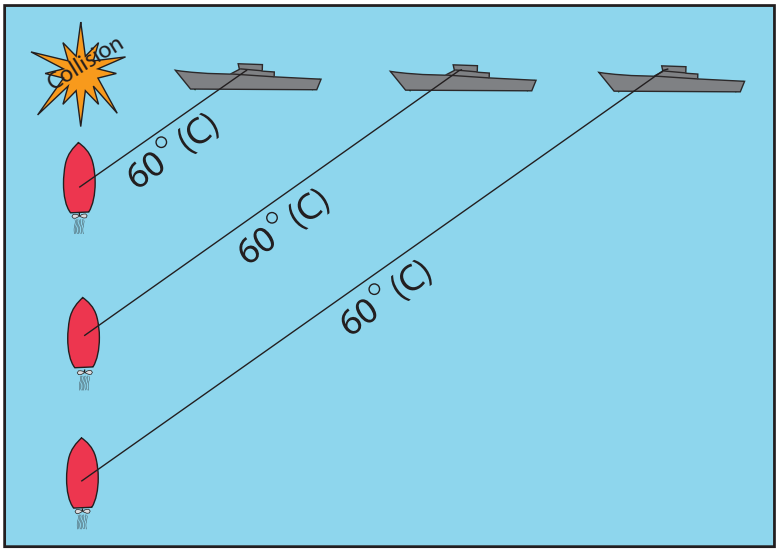
Safe speed "Rule 6"

Vessels shall at all times proceed at a safe speed taking into consideration visibility, traffic density, maneuverability of the vessel, background lights at night, state of the wind, sea, current, and proximity of navigational hazards.

Rrisk of Collision "Rule 7"
Vessels shall use all available means to determine if risk of collision exists. Risk of collision shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change; risk of collision may sometimes exist with a large vessel, a tow or a vessel at close range even if the bearing does change appreciably.

If there is any doubt risk of collision shall be deemed to exist.

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



Risk of collision exists if the compass bearing to the other vessel remains constant.

Action to Avoid Collision "Rule 8"
Any action taken to avoid collision shall be positive, made in ample time and with due regard to good seamanship. A change of direction and/or speed shall be large enough to be obvious to the other vessel - avoid small successive changes in speed and/or direction.

Narrow Channels "Rule 9"
Vessels should keep as close as practical to the starboard side of a channel or fairway. A vessel less than 20 meters, a sailing vessel or a fishing vessel shall not impede the passage of a vessel that can only safely navigate within a narrow channel or fairway.

'Give Way', 'Stand On'
If risk of collision exists between two vessels correct application of the Rules will require one vessel to give way and confer right of way to the other vessel. The vessel required to give way is called the Give Way vessel and the vessel with right of way is called the Stand On vessel; both vessels have specific responsibilities under the Rules.

Action by Give Way vessel "Rule 16"
The Give Way vessel shall take early and substantial action to keep clear.

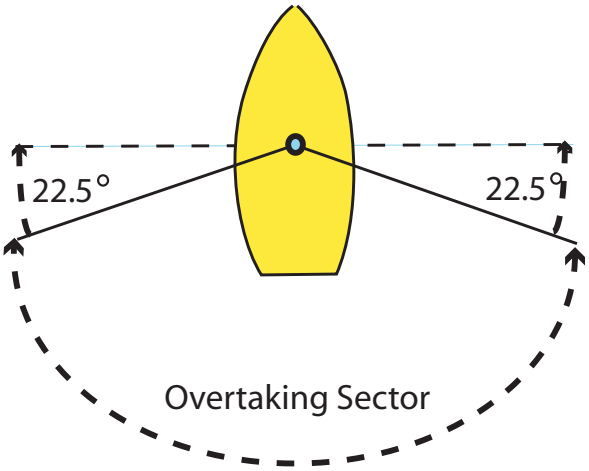
Action by the Stand On vessel "Rule 17"
The stand on vessel must maintain her course and speed.

The stand on vessel may, however, take action to avoid collision by her maneuver alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is no taking appropriate action in compliance with these Rules.

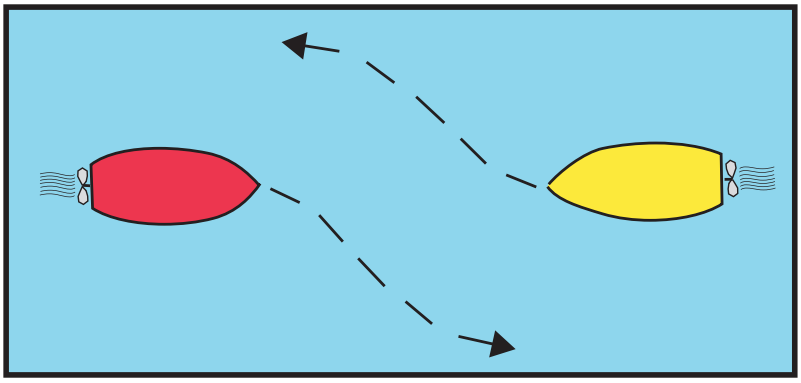
When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

Overtaking "Rule 13"
Any vessel overtaking any other vessel shall keep out of the way of the vessel being overtaken. A vessel is deemed to be overtaking if she is coming up with another vessel from a direction more than 22.5° abaft her beam. In other words at night time only the stern light of the vessel being overtaken would be visible.

If a vessel is in any doubt as to whether she is overtaking she must assume that she is overtaking and act accordingly.



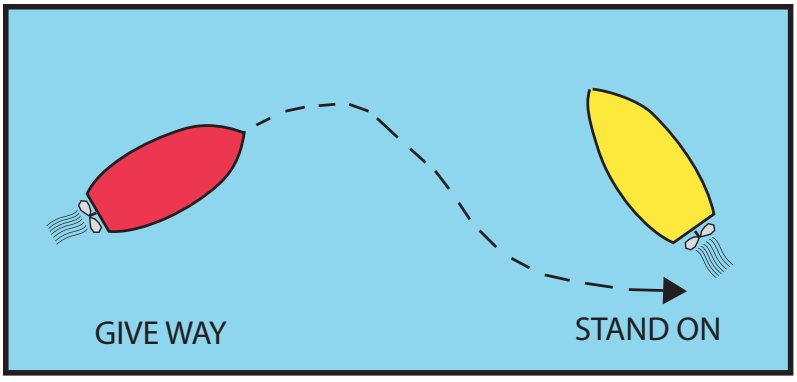
Power driven vessels meeting head on "Rule 14"
When two power driven vessels are meeting head on both alter course to starboard.



Power vessels meeting head on - both turn to starboard

Power driven vessels crossing "Rule 15"
When two power driven vessels are crossing, or converging, and risk of collision exists the vessel which has the other on her own starboard side must give way.

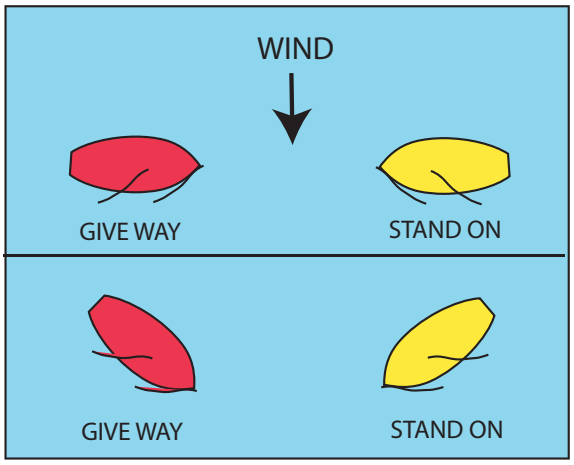
The give way vessel must not 'give way' by crossing ahead of the other vessel.



Power vessels crossing or converging:
give way to vessel on your starboard side
stand on for vessel on your port side.

Sailing vessels "Rule 12"

When risk of collision exists between two sailing vessels the wind direction relative to
the vessels determines which is the give way vessel and which is the stand on vessel. There are three Rules for sailing vessels:



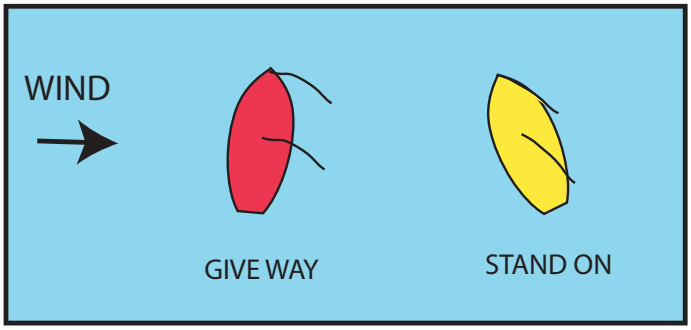
Port tack gives way, Starboard tack stands on.

(i) When each (sailing vessel) has the wind on a different side, the vessel with the wind on the port side shall keep out of the way of the other.

In other words a boat on port tack gives way to a boat on starboard tack. A sailing vessel with the wind coming over the port side is said to be on port tack, when the wind is coming over the starboard side the vessel is said to be on starboard tack.

The main sail indicates visually which tack the vessel is on as it will be carried on the opposite side to the side over which the wind is blowing.

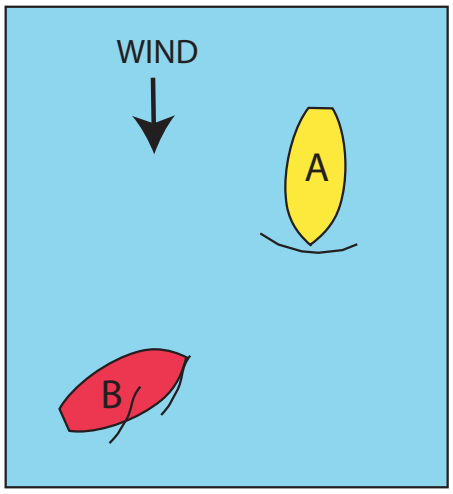
(ii) When both have the wind on the same side the vessel which is to windward shall keep out of the way of the vessel which is to leeward.



Same tack: windward boat gives way

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

In figure 14.7 the yacht B, on port tack, cannot see which side the mainsail of the other boat, A, is being carried on as it is obscured by the large headsail.
B, on port should therefore give way.



If in doubt port tack, B, gives way

Conduct of vessels in restricted visibility "Rule 19"

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

- Every vessel shall proceed at a safe speed;
- a power driven vessel must have her engines ready for immediate maneuver.

A vessel which detects by radar alone the presence of another vessel shall determine if risk of collision exists. If risk of collision exists she shall take avoiding action in ample time, but where possible she shall not:

- alter course to port for a vessel forward of the beam (unless overtaking);
- alter course toward a vessel abeam or abaft the beam.

Every vessel which hears the fog signal of another vessel forward of her beam (unless it has been determined that risk of collision does not exist) shall:

- reduce speed to minimum;
- if necessary take all way off;
- navigate with extreme caution until danger of collision is over.

Responsibilities Between Vessels "Rule 18"

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

1. a vessel not under command;
2. a vessel restricted in her ability to maneuver;
3. a vessel engaged in fishing;
4. a sailing vessel.

A sailing vessel underway shall keep out of the way of:

1. a vessel not under command;
2. a vessel restricted in her ability to maneuver;
3. a vessel engaged in fishing.

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

1. a vessel not under command;
2. a vessel restricted in her ability to maneuver.

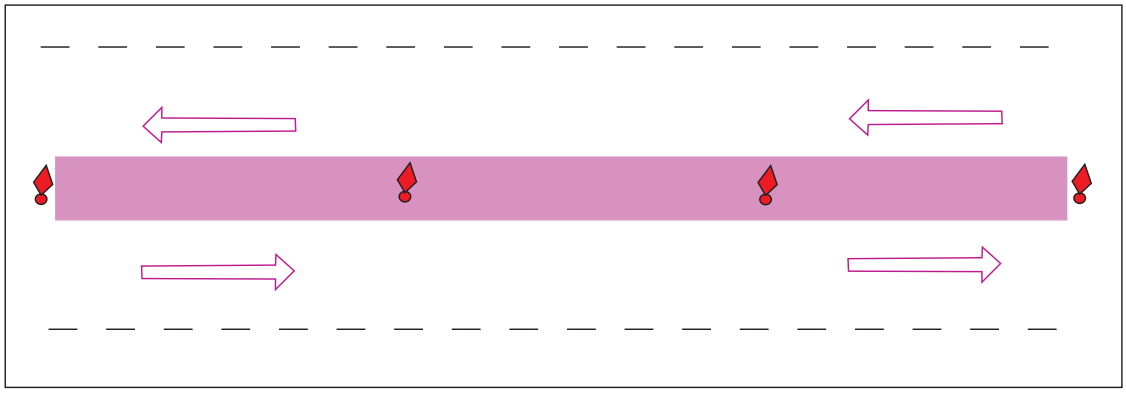
Any vessel other than a vessel not under command or a vessel restricted in her ability to maneuver shall, if the circumstances of the case admit, avoid impeding the safe passage of a vessel constrained by her draft, exhibiting the signals in Rule 28.

(The signals in Rule 28 are three all round red lights in a vertical line at night or a cylinder by day)

Traffic Separation Schemes (TSS) "Rule 10"

Traffic separation schemes have been set up at various places which experience heavy concentrations of shipping. The object of these schemes is to separate shipping into two distinct lanes. All vessels going in one direction proceed in one lane and all vessels going in the opposite direction proceed in the other lane; a no-go zone separates the two lanes. The system is similar to a motorway with a central barrier dividing traffic moving in opposite directions.

Traffic separation schemes are printed in magenta colors on charts. For example there is a TSS about 4.5 miles ENE from Cape Henry light on practice chart 12221.



Traffic Separation Scheme. The arrows show the direction of travel.
The separation zone is not always marked with buoys as is shown in this example

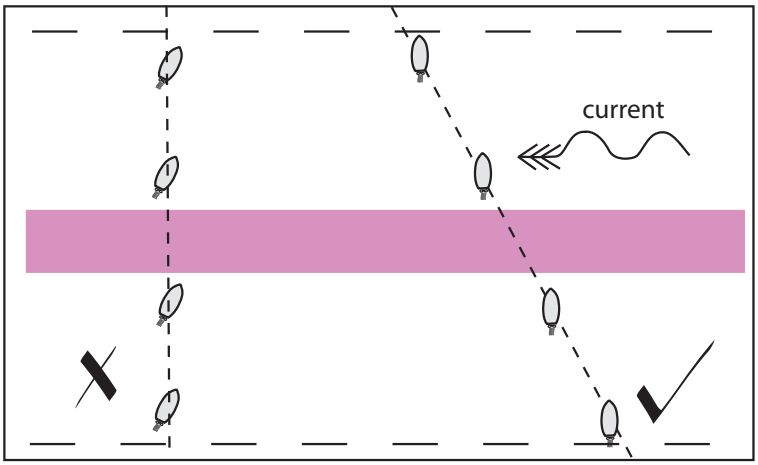
TSS Rules

A vessel using a traffic separation scheme shall:

- proceed in the general direction of the traffic flow for that lane;
- as far as is practicable keep clear of a separation zone;
- normally join or leave a traffic lane at the ends of the lane, but if joining or leaving from either side of the lane shall do so at as small an angle to the lane as practicable;
- as far as practicable avoid crossing traffic lanes.
- If a vessel must cross traffic lanes she should cross on a heading of 90° to the general direction of traffic flow.
- Vessels of less than 20 meters, sailing vessels and fishing vessels do not have to use traffic separation schemes but may use inshore traffic zones (if one exists).
- Vessels should not normally enter or cross a separation zone except to avoid immediate danger or to engage in fishing.
- Vessels should not anchor in a traffic separation scheme.
- Vessels less than 20 meters in length and sailing vessels shall not impede the safe passage of a power driven vessel following a traffic lane.
- Fishing vessels shall not impede the passage of any vessel following a traffic lane.

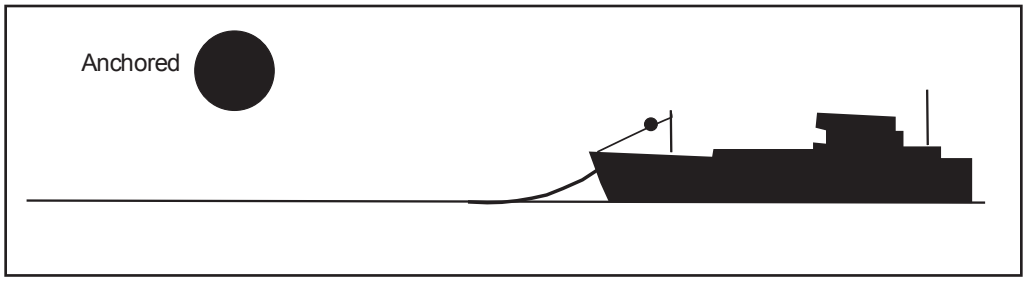
Crossing on a heading of 90°

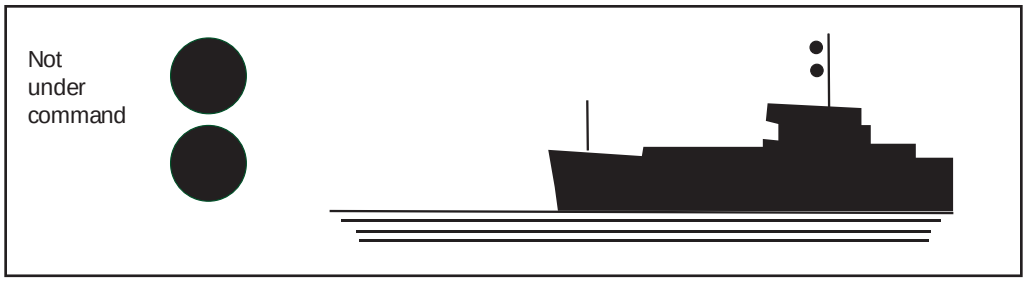
It is important to appreciate that a vessel should cross a separation scheme on a heading of 90° to the direction of travel rather than counteracting the effect of current and leeway to give a ground track of 90°. Crossing on a heading of 90° gives a shorter crossing time and makes it easier for shipping to appreciate that the vessel is crossing the scheme and not joining it.

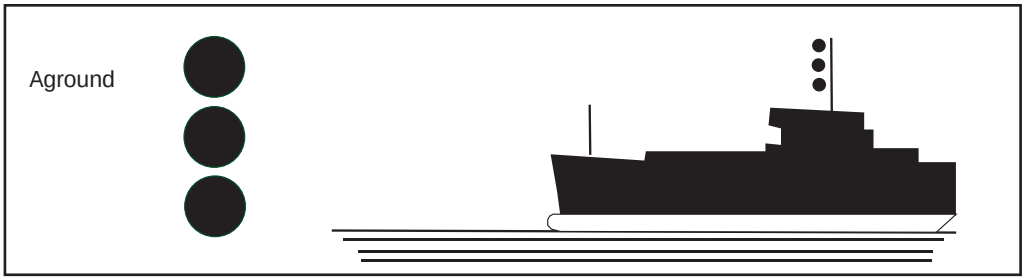


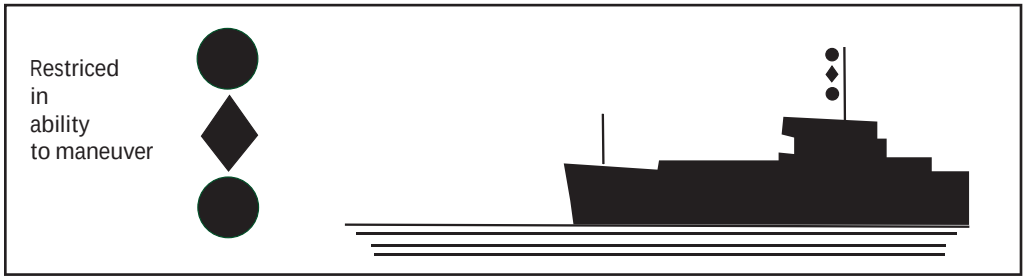
Cross a TSS on a heading of 90°

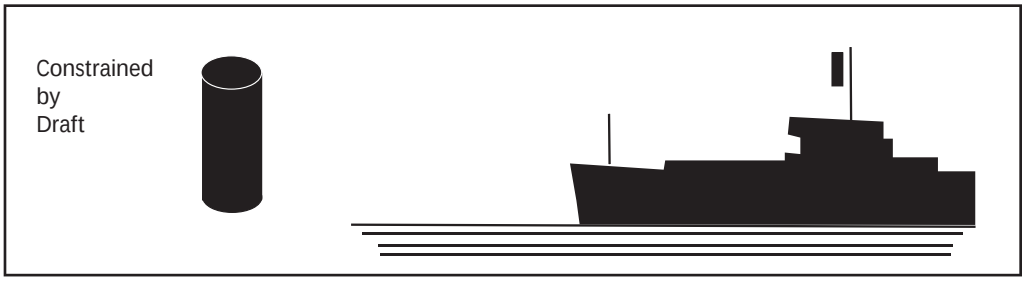
DAY SHAPES

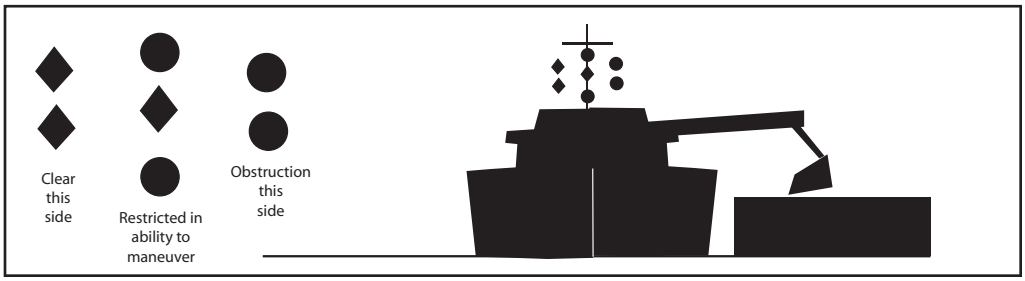

Anchored


Not
under
command


Aground


Restriced
in
ability
to maneuver

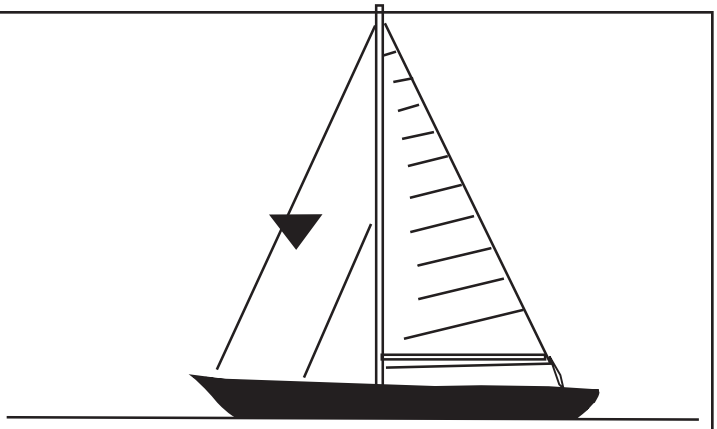

Constrained
by
Draft


Clear
this
side
Restricted in
ability to
maneuver
Obstruction
this
side

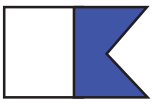
Fishing

+, when outlying gear extends more
than 150 m horizontally,
cone, apex up, in direction of gear.

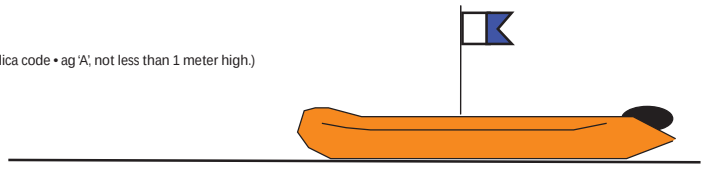
Motor Sailing

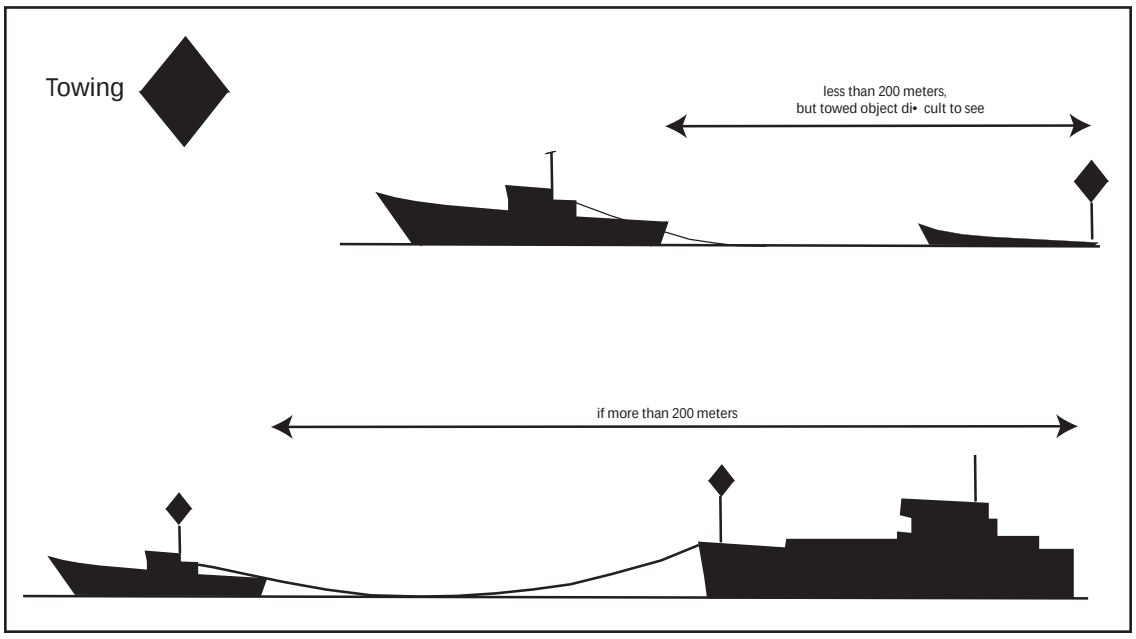


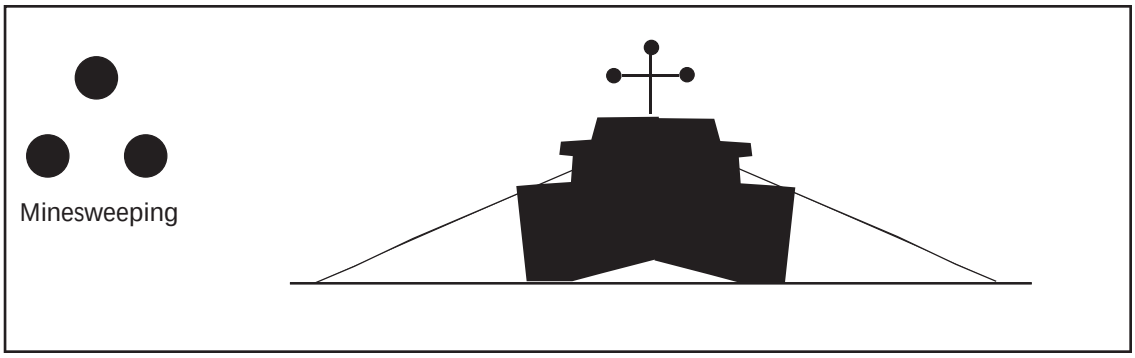
Diving Operations



(Rigid replica code • ag 'A', not less than 1 meter high.)




Towing
less than 200 meters,
but towed object di• cult to see
if more than 200 meters


Minesweeping

= 1 second horn blast

= 4 to 6 second horn blast

Morse 'U'

Means "You are running into danger":
This signal is often used by oil rigs, etc.

Sound Signals In Poor Visibility

Sound Signal		Every
	Power underway, making way	2 min
	Power underway, not making way	2 min
	Vessel sailing; vessel fishing; restricted in ability to maneuvre; constrained by draft; not under command; vessel towing or pushing	2 min
	Last manned vessel of tow	2 min
	Warning from vessel at anchor	when required
	Pilot vessel on duty	
5 secs	Vessel at anchor: Rapid bell for 5 secs. (+ gong aft for 5 s if vessel > 100 m)	1 min
1 2 3 — 5 secs — 1 2 3	Vessel aground As for at anchor + 3 strokes on bell before & after rapid bell rings	

Maneuvering and Warning Signals For Vessels In Sight Of Each Other

	I am altering course to starboard
	I am altering course to port
	I am operating astern propulsion
(Or More)	I do not understand your intentions! I doubt you are taking sufficient or appropriate action to avoid collision
	I intend to overtake on your starboard side
	I intend to overtake on your port side
	Agreement by overtaken vessel
	Approaching blind bend in channel
	Reply from vessel on other side of bend

LIGHTS

Lights using combinations of white, red, green and yellow colors are used at night to convey information regarding a vessel's

- direction of movement;
- method of propulsion;
- size.

Additional lights are used to indicate if the vessel is:

- towing;
- fishing;
- Not Under Command;
- Restricted in Ability to Maneuver;
- Constrained by Draft;
- aground;
- at anchor.

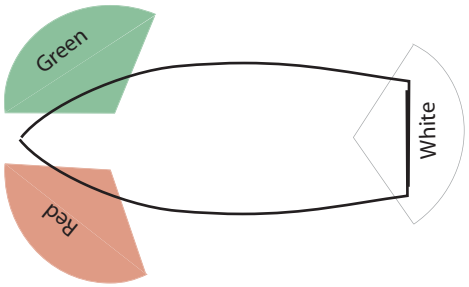
When attempting to decipher the meanings of a vessel's lights try breaking the lights down into sections by identifying the basic lights and then concentrate on the lights that remain. Usually the most important decision is whether risk of collision exists; if risk of collision does exist it is obviously necessary to work out details of the other vessel before deciding on the correct course of action.

Perhaps the best sequence is to decide the vessel's

1. aspect (ahead, astern, port, starboard);
2. propulsion (i.e. under power, under sail, being towed);
3. length;
4. other information (i.e. towing, fishing, Restricted in Ability to Maneuver, Not Under Command, etc.)

Side lights and stern light

A vessel underway (not at anchor, or made fast to shore, or aground) shows three basic lights, two sidelights and a stern light:
a green light on the starboard side,
a red light on the port side, and
a white light at the stern.
The sidelights each cover an arc of 112.5°, the stern light covers the remaining 135°.



Sidelights and stern light of vessel underway

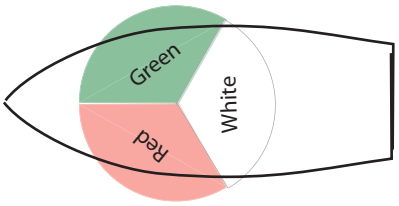
From directly ahead the green and red sidelights would both be visible at the same time, altering course would mean that only one of the sidelights would be visible, either red or green depending upon the course change. From a position astern of the vessel only the white light would be visible.

These three basic lights are for a vessel underway but note that this vessel is not under power, it may therefore perhaps be under sail, oars or being towed.

Extra lights are added when the vessel is under power.

Sailing vessels less than 20 meters may use a combined side and stern light
A sailing vessel less than 20 meters (65 ft) in length may combine side and stern lights in one lantern carried at or near the top of the mast. A combined lantern uses only one bulb instead of three and thus uses 1/3 of the electrical current that would be used by 3 lights: an important consideration for smaller yachts.

Note that this combined lantern must not be used when the yacht is using her engine.



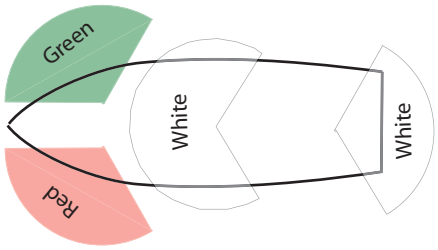
Sailing vessels less than 20 meters may use a combined side and stern light

Seen From: Ahead Port Starboard Astern

Power driven vessels
A power driven vessel underway less than 50 m (164 ft) in length shows a white masthead light above the sidelights. A masthead light covers the same arc as the sidelights combined.

Power driven vessel underway, less than 50 meters in length

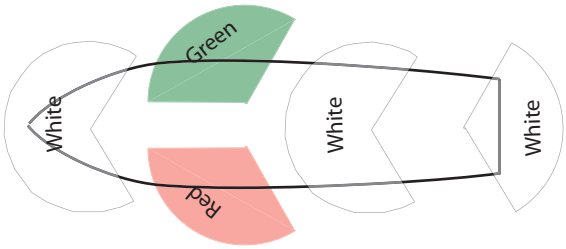
From directly ahead the green and red sidelights would be visible with the white masthead light above, altering course would mean that only one of the sidelights, either red or green depending upon the course change, would be visible with the white masthead light above it. From a position astern of the vessel only the white light would be visible.



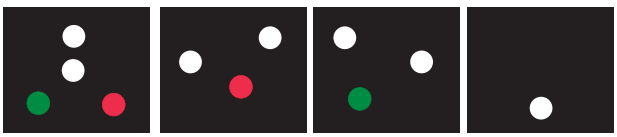
Power driven vessel underway, less than 50 meters in length

Seen From: Ahead Port Starboard Astern

A power driven vessel underway greater than 50 m in length shows a white masthead light forward and a second masthead light behind and higher than the forward masthead light.



Power driven vessel underway, greater than 50 meters in length



Seen From: Ahead Port Starboard Astern

Towing

A vessels which is towing another vessel or object must show in addition to the normal sidelights and stern light:

- A yellow stern light directly above the white stern light and covering the same arc;
- two masthead lights in a vertical line if the length of tow is less than 200 meters;
- three masthead lights in a vertical line if the length of tow is greater than 200 m.

Seen from directly ahead two white masthead lights in a vertical line may indicate a power driven vessel greater than 50 m in length or it may be a power driven vessel less than 50 m with a tow of less than 200 m. However if it is directly ahead a change of course is obviously required; when the course is altered the two white masthead lights will either appear to separate (= power > 50 m) or they will remain in the one vertical line (= power vessel < 50 m, towing, length of tow < 200 m), in which case look very carefully for the sidelight(s) of the towed vessel. A similar situation arises when three masthead lights are visible in a vertical line, the solution becomes apparent in the same way.

Similar lights are required for a vessel pushing unless the pushing vessel is rigidly connected to the vessel being pushed in which case they are lit as one single vessel only.

Towed vessel

A vessel being towed shows red and green side lights and white stern light, i.e. the lights of a vessel underway, not under power; a vessel being towed alongside shows the same. When two or more vessels are being towed the first in the tow shows sidelights and the last shows a sternlight. A vessel being pushed ahead, but not rigidly connected to the pushing vessel, shows her sidelights only.

Towed objects

Objects and partly submerged vessels being towed must be lit with an all-round (360°) white light at the front and another at the back. Two further all-round whites must also be placed at the maximum breadth if the object is greater than 25 m in breadth.

A towed object greater than 100 m in length must also have an all-round white light at least every 100 m along its length.

Assistance and Distress, etc.

Where for sufficient cause it is impossible or impractical for the towing vessel and/or the towed vessel to display the required lights all possible measures should be taken to indicate that a tow is taking place and to light the towed vessel.

Vessel < 50 m towing, length of tow < 200m

Seen From: *Ahead* *Port* *Starboard* *Astern*

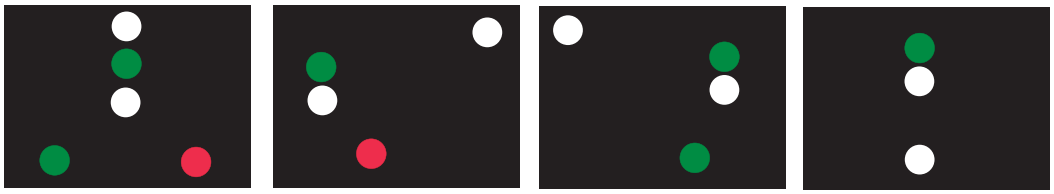
Vessel > 50 m towing, length of tow > 200m

Seen From: *Ahead* *Port* *Starboard* *Astern*

Trawlers

Vessels underway when trawling show two all round-lights, green over white, in a vertical line. When the trawler is making way (moving under power through the water) she must also show her two side lights and stern light; if the trawler is greater than 50 m in length a white masthead light must be shown above and behind the all-round green light.

Trawler > 50m, underway, making way



Seen From: *Ahead* *Port* *Starboard* *Astern*

Fishing vessels

Vessels when fishing other than trawling show two all round-lights in a vertical line, red over white. When the fishing vessel is making way she must also show her two side lights and stern light. Note that a fishing vessel does not show white masthead steaming lights, therefore her length cannot be determined, but, if there is outlying fishing gear extending more than 150 meters horizontally, an all-round white light (or cone apex up in daylight) is shown in the direction of the gear.

Fishing other than trawling < 50m, underway, making way

Seen From: *Ahead* *Port* *Starboard* *Astern*

Pilot vessel

A pilot vessel on duty shows, at or near the masthead two all-round lights, white over red, in a vertical line plus sidelights and stern light when under way.

Pilot vessel on duty, underway

Seen From: *Ahead* *Port* *Starboard* *Astern*

Vessels Not Under Command

A vessel Not Under Command shows two all round lights, red over red, plus sidelights, and stern light when under way. As no steaming lights are used length is not known.

Not Under Command, underway, (length not known)

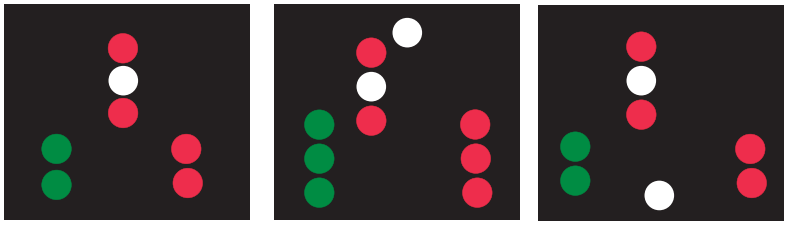
Seen From: *Ahead* *Port* *Starboard* *Astern*

Restricted in Ability to Maneuver

A vessel Restricted in Ability to Maneuver shows three all-round lights, red over white over red, plus sidelights, stern light and appropriate masthead lights when under way.

Power vessel > 50m underway, Restricted in Ability to Maneuver

A vessel engaged in underwater operations may show the safe side to pass with two all-round green lights in a vertical line and the obstructed side shown by two all-round red lights in a vertical line.



Unknown
not underway
pass 2x green side

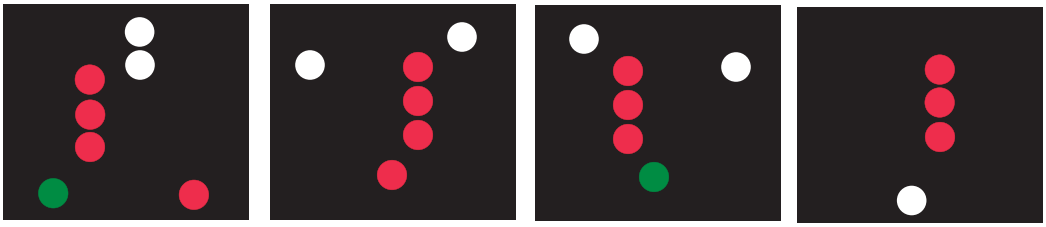
Ahead, < 50 m
underway
pass 3x green side

Astern
underway
pass 2x green side

Vessel Constrained by Draft

A vessel Constrained by Draft shows three all-round red lights in a vertical line plus sidelights, stern light and appropriate masthead lights when under way

Power vessel > 50m underway, Constrained by Draft

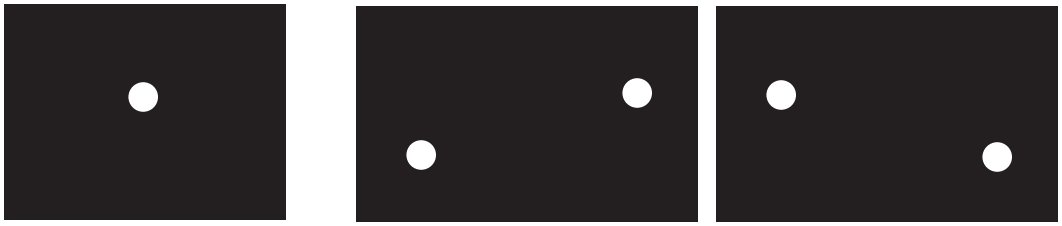


Seen From: *Ahead* *Port* *Starboard* *Astern*

Vessels at Anchor

A vessel at anchor, less than 50 m in length, must show an all round white light where it may best be seen.
A vessel at anchor, greater than 50 m in length, must show in the fore part an all-round white light and a second all-round white light at or near the stern which is lower than the forward light.
If a vessel at anchor is greater than 100 m in length she shall use available lights to illuminate her deck.

Vessels at anchor



< than 50 m *> than 50 m, starboard side* *> than 50 m lport side*

Vessel aground

A vessel aground shall use the anchor lights appropriate to her size plus two all-round red lights in a vertical line.

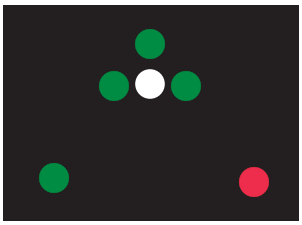
vessel aground

< than 50 m *> than 50 m, STARBOARD* *> than 50 m PORT*

Minesweepers

A minesweeper, sweeping mines at night shows three all-round green lights at the masthead in a triangular pattern plus sidelights and masthead light(s) when underway. This light combination means that it is dangerous to approach to within 1000 meters.

Minesweeper, less than 50 m, underway, ahead



'Small boat' exemptions

A motor driven vessel of less than 7 m in length and with a maximum speed of not more than 7 knots may have an all-round white light only when underway.
A sailing boat of less than 7 m in length and a rowing boat when underway may use a white light from a torch or lantern which should be used in sufficient time to prevent collision.
A vessel of less than 7 m in length does not have to exhibit the anchor or aground lights if it is not in a narrow channel, fairway or anchorage, or where other vessels normally navigate.

Special lights

Some additional lights are specified in the Rules:

Trawlers may exhibit:

when shooting nets two white lights in a vertical line;
when hauling nets a white light over a red light in a vertical line;
when nets are fast on an obstruction two red lights in a vertical line.

Each vessel engaged in pair trawling may also exhibit:

a searchlight directed forward onto the other vessel of the pair.

Purse seiners may, when hampered by their fishing gear, exhibit:

two yellow lights in a vertical line flashing (1 sec) alternately.

An air-cushion vessel in non displacement mode shall exhibit:

a yellow flashing light as well as sidelights and masthead light(s).

A sailing vessel underway may, as well as sidelights and stern light, exhibit

a red over a green all-round light at the top of the mast but these lights must not be used with a combined (tricolor) masthhead light.

Signals to attract attention:

a vessel may direct the beam of a spotlight in the direction of danger.

Technical details of lights and shapes

Annex 1 of the Rules details the correct spacing, positioning, light intensity, size etc., of the lights and shapes. Many leisure boats are sadly deficient in their compliance with the Rules. Lights which cannot be seen or are angled incorrectly lead to confusion and danger. Many pulpit mounted sidelights on sailing boats are obviously pointing in the wrong direction due to damaged steel work and many need a thump to get them to work.
Fines are imposed in some countries for not having a motorsailing cone aboard a yacht.

Note that the Rules actually state that a power driven vessel underway less than 50 m in length must show one white masthead light and *may* show *two* masthead lights if she wishes. Most leisure craft, small boats, yachts, etc., don't carry the optional light. Seeing two masthead lights it would therefore be more correct to consider the vessel "....power driven, *probably* over 50 m.....". Vessels over 50 m must, of course, have the second masthead light.

Distress signals

Annex 1V of the Rules details the international Distress signals which are:

1. a gun or other explosive device fired at intervals of about 1 minute;

2. a continuous sounding with any fog signaling apparatus;
3. rockets or shells, throwing red stars fired one at a time at short intervals;
4. a signal sent by any method of the Morse Code group (SOS);
5. a signal sent by radiotelephony consisting of the spoken word “MAYDAY”;
6. the International Code Signal of distress indicated by NC;
7. a signal consisting of a square flag having above or below it a ball;
8. flames on the vessel (as from burning tar barrel or oil barrel, etc.);
9. a rocket parachute or a hand flare showing a red light;
10. a smoke signal giving off orange colored smoke;
11. slowly and repeatedly raising and lowering arms outstretched to each side;
12. the radiotelegraph alarm signal;
13. the radiotelephone alarm signal;
14. signals transmitted by emergency position-indicating radio beacons (EPIRB);
15. approved signals transmitted by radiocommunication systems.

Whales

A new requirement agreed in the middle of 1998 by an international marine convention requires that vessels over 300 DWT must give way to whales in designated waters off the east coast of the U.S. The designated waters are off the coasts of New England and Florida. Ships entering theses designated areas must give their position to the Coast Guard who will give the positions, direction and speed of pods of whales which can be seen by satellites. (Deadweight tonnage is the maximum weight of cargo, people, stores, fuel and water that a ship can carry when floating at her summer load draft.)

Inland Navigation Rules

As was pointed out at the start of this section special rules, called the Inland Navigation Rules apply on the inland waterways of the U.S. COLREGS demarcation lines are printed on charts and given in United States Coast Pilots of the respective area. Generally the International and Inland Rules are similar, the main differences under the Inland Rules are indicated briefly below.

- Submarines may exhibit an all-round amber light flashing three times at three second intervals followed by dark for three seconds.
- A power driven vessel in narrow channels or fairways on the Great Lakes, Western Rivers (i.e. Mississippi and its tributaries) proceeding downbound with a following current shall have the right of way over an up bound vessel. The vessel proceeding up-bound against the current shall hold as necessary to permit safe passing.
- Under some conditions the use of VHF communications may replace sound signals.
- A power driven vessel crossing a river must keep out of the way of a power driven vessel going up or down stream.
- A vessel pushing ahead or towing alongside exhibits *two* towing lights.
- A vessel being pushed ahead or towed alongside shall exhibit, at the forward end, sidelights and a special light flashing yellow at a rate of 50 to 70 flashes per minute and covering an arc forward of between 180° and 225°.
- When vessels are towed alongside on both sides of the towing vessel a stern light shall be exhibited on the stern of the outside vessel on each side of the towing vessel, and a single set of sidelights as far forward and as far outboard as is practicable, and a single special flashing light.

Canada has Modifications and additions to the COLREGS which apply to all vessels in Canadian waters or fishing zones. Reed’s Nautical Companion gives details and should be read before entering Canadian waters.

Power driven vessels meeting or crossing within ½ a mile of each other when maneuvering as authorized or required by the Inland Navigation Rules shall indicate the maneuver by the following signals on her whistle:

- 1 short blast = “I intend to leave you on my port side”
- 2 short blasts = “I intend to leave you on my starboard side”
  (note the difference between the International and Inland Rules in 1 and 2 above.)
- 3 short blasts = “I am operating astern propulsion”

These signals may be supplemented with simultaneous and synchronized flashes from an all-round white or yellow light. (A short blast is of about 1 second duration)

A vessel hearing the one or two blast signal shall, if in agreement, sound the same whistle signal and take the necessary steps to effect a safe passing. If, however, from any cause the vessel doubts the safety of the proposed maneuver, she shall sound the danger signal of at least five short blasts on the whistle.

A vessel that reaches agreement with another vessel in a meeting, crossing, or overtaking situation by using the radiotelephone as prescribed by the Bridge-to-Bridge Radiotelephone Act is not obliged to make the sound signals but may do so if she wishes. If agreement is not reached, then whistle signals shall be exchanged in a timely manner and shall prevail. Briefly, the Bridge-to-Bridge radiotelephone regulations apply to vessels greater than 20 meters in length and vessels greater than 100 tons carrying one or more passengers. The U.S. Coast Pilot for the area details the channels which must be guarded; the bridge-to-bridge navigational frequency in U.S. navigable waters is International Channel 13 (156.650 Mhz).

The Inland Navigation Rules include a high intensity white light flashing at regular intervals from 50 to 70 times per minute as a Distress signal.

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Use of VHF Radio

The VHF radio is used for communications between vessels at sea and between vessels and shore stations. VHF's effective range is short (often referred to "Line of Sight" range), but is extensively used by commercial ships, pleasure yachts and shore based radio stations. It is suffers minimum interference from electrical equipment and normally receives a good clear signal. It requires low power to operate and therefore is ideally suitable for hand held sets with rechargeable batteries.
A VHF radio is a very important safety item aboard a vessel and is affordable; VHF radios can be purchased for less than £100. They are easy to install with simple inexpensive aerials and easy to operate

VHF

Very High Frequency (VHF) is the frequency band within which this short-range radio transmitter and receiver is work. The VHF radio is a transmitter and receiver combined in one instrument, called a "transceiver". When a message is sent from one transceiver it can be received by another transceiver provided that it is within range and set to the same channel or frequency. Both transceivers MUST be tuned to the same frequency to enable a conversation to take place

CHANNELS/FREQUENCIES

VHF marine transceivers operate between 156 MHz and 174 MHz and within this range there are 57 international agreed frequencies or "Channels" available. Although there are 57 international channels they are numbered from 01 and finish at 88, there are no channel numbers between 29 and 59.
It is unnecessary to know the specific frequency related to a channel. A channel is given a simple one or two figure number. Channel 16 is the calling frequency to establish communication and is on 156.8 MHz, it is also the international distress, safety channel. All VHF transceivers must be fitted with Ch 16 and Ch 06.
To select a specific frequency or channel turn a control knob or press the number keypad that corresponds to the channel you require.

A lists of channels used by all shore stations is given in Admiralty Lists of Radio Signals, Vol. 1 (ALRS Vol. 1) and in the Macmillan Nautical Almanac.

THE VHF TRANSCEIVER

CONTROLS

On/ off
The set is switched on and off by turning the on/ off control a knob or button. This control may control the volume of received signal as well switch on the set.

Volume
The volume control increases or decreases the volume or amplification of the incoming signal and does not change the output power from the transmitter.

Squelch
The 'squelch' control adjusts the sensitivity of the receiver. It is adjusted until a continuous background noise is heard. The control is then turned back slightly until the background noise disappears, at this setting the receiver is at its maximum sensitivity and allows the receiver to pick up all signals within range.

Channel (sometimes CH)
The rotary knob or digital keypad marked 'CH' (CHannel) is adjusted to select the required channel. Some sets automatically select channel 16, the Distress and Safety channel, when first switched on. On most modern VHS sets the number displayed in large numbers visible from a distance away from the display indicates the selected channel.

Dual Watch (DW)
Channel 16 is the Call Up, Distress and Safety channel and therefore it should be listened to at all times. A dual watch facility allows listening to channel 16 and another channel at the same time.
To select dual watch and another channel, select a channel i.e. 12, and press the DW button. The receiver will then switch between channel 12 and channel 16, repeating this cycle continuously until the dual watch is switched off. If a signal is detected on Channel 16 it will lock on 16 if on dual watch mode.

Channel 16
Most sets provide quick access to Channel 16, the Distress and Safety channel for calling up and an emergency. Pressing the button marked '16' automatically selects channel 16 at high power transmission.
Every station should keep a continuous watch on Ch 16 therefore any station called should hear on Channel 16. When contact is established both change to an appropriate working channel to continue the communication. The minimum time possible should be spent on Ch 16, in order to leave Ch 16 clear for its designated purpose. The maximum time allowed on channel 16 is 60 seconds, except for Distress Urgency or Safety traffic. Another working and call-up channel may be designated, to avoid using Channel 16 and this will be allocated in the ALRS.

1/25
The maximum VHF output power allowed is 25 Watts. Sometimes a lower output is sufficient for close communications. Most VHF sets transmit at 25 Watts, but some sets have a switch to reduce output to 1 Watt for close range communications.

Transmit (Tx)
Tx is abbreviation for transmit. Whilst transmitting normally a little red light is shown to confirm that the set is transmitting.
Note: Rx is the abbreviation for Receive.

Microphone
The transmitter consists of a microphone into which you to speak. Somewhere on the microphone there is a switch to depress when speaking. This switches OFF the receiver and switches ON the transmitter allowing the message to be transmitted.

DIM
Pressing the DIM switch for nighttime use can reduce the brightness of the display

Aerial socket
At the back of the set is the aerial lead is connected. Never transmit without an aerial connected because this will damage the set.

Maximum Range
The maximum range of a VHF signal is 'line of sight'. The radio waves travel in straight lines, but the surface of the earth is curved, therefore the maximum range between two VHF transceivers is dependant on the heights of both transmitting and receiving aerial.

Ship to Coast Radio Station
Ship to Shore channels are used for a vessel to communicate with a shore based radio station, such as a Coast Radio Station. They would control communications and broadcast messages such as safety information, navigation warnings, gale warnings and weather forecasts.

Ship to Port Station
Channels are allocated for VHF traffic between a ship and harbor or port authority and used for VTS, requesting a pilot or when seeking permission to enter a port etc.

Ship to Ship
Ship to ship channels are for one vessel to communicate with another vessel. Every VHF radio must have the primary ship-to-ship channel 06.

Channel 70.
Channel 70 is reserved for Digital Selective Calling and must not on any account be used for speech transmissions.

NORMAL OPERATING PROCEDURE

The correct VHF procedure should be used to reduce the time of communications to a minimum.

- Switch the VHF on.
- Select the required channel
- Adjust squelch control.
- Ensure channel is not in use.
- Press the microphone transmission switch.
- Speak clearly into the microphone.
- Keep the message as brief as possible.
- Complete the message with the word "OVER".
- Release the transmission switch
- Wait for a reply.

PHONETIC ALPHABET

When transmitting a single letter by VHF the following phonetic alphabet has been adopted internationally and must be used.

Letter	Word to use	Letter	Word to use
A	**Alfa**	**N**	**November**
B	**Bravo**	**O**	**Oscar**
C	**Charlie**	**P**	**Papa**
D	**Delta**	**Q**	**Quebec**
E	**Echo**	**R**	**Romeo**
F	**Foxtrot**	**S**	**Sierra**
G	**Golf**	**T**	**Tango**
H	**Hotel**	**U**	**Uniform**
I	**India**	**V**	**Victor**
J	**Juliet**	**W**	**Whiskey**
K	**Kilo**	**X**	**X-ray**
L	**Lima**	**Y**	**Yankee**
M	**Mike**	**Z**	**Zulu**

Figure	Spoken as
0	Zero
1	Wun
2	Too
3	Three
4	Fo-wer
5	Fifer
6	Six
7	Seven
8	Ait
9	**Niner**

DISTRESS (MAYDAY)

THE DISTRESS SIGNAL IS THE SPOKEN WORD "MAYDAY"

A Distress signal is the most important transmission that can be made and as such takes precedence over all other radio transmissions. Nothing must interfere with a Distress message.

The distress signal indicates that a ship, aircraft, or vehicle is threatened by grave and imminent danger and requires immediate assistance."

The Mayday message should be as follows:

MAYDAY, MAYDAY, MAYDAY
THIS IS"YACHT W", "YACHT W", "YACHT W",
MAYDAY,
"YACHT W"
,POSITION,
NATURE OF DISTRESS AND ASSISTANCE REQUIRED,
ANY OTHER USEFUL INFORMATION,
OVER.

To acknowledge receipt of a Distress message:

"MAYDAY
NAME of vessel in distress repeated 3 times,
THIS IS
"YACHT X", "YACHT X", "YACHT X"
RECEIVED
MAYDAY"

Radio silence is imposed by:

CONTROLLING STATION	**"SEELONCE MAYDAY"**
ANY OTHER STATION	**"SEELONCE DISTRESS"**
When Channel 16 can return to restricted use:	**"PRU-DONCE"**
When the distress has been down graded and normal working can resume:	**"SEELONCE FEENEE"**

URGENCY (PAN PAN)

THE URGENCY SIGNAL IS "PAN-PAN"

An Urgency message takes precedence over all other radio communications except Distress. Therefore it is the second most important message that can be transmitted.

An Urgency message concerns safety of the vessel (i.e., broken down, require a tow) or safety of person (non life threatening injury)
The Pan Pan message should be as follows:

PAN-PAN, PAN-PAN, PAN-PAN,
HELLO ALL STATIONS, HELLO ALL STATIONS, HELLO ALL STATIONS,
THIS IS
" YACHT Y ", " YACHT Y ", "YACHT Y",
POSITION
NATURE OF URGENCY AND ASSISTANCE REQUIRED,
ANY FURTHER RELEVANT INFORMATION,
OVER.

SAFETY (SECURITE)

THE SAFETY SIGNAL IS "SECURITE" (pronounced "say-cure-e-tay")

The safety call is normally only used by a Coast Radio Station and it warns that a message of importance to shipping is about to follow. The message may be regarding a navigational hazard or danger to shipping i.e. a gale or hurricane warning. A vessel itself may issue a Securite if it feels it may constitute a hazard to navigation.The Safety signal will be transmitted on Ch 16 but the message will normally follow on a working channel.

EPIRBs (Emergency Position Indicating Radio Beacon)

An EPIRB, when activated, sends an emergency signal on frequencies monitored by satellites. The popular ones transmit on 406 MHz (which is monitored continuously by satellites) and on 121.5 MHz to aid location. Some have GPS combined to give position in latitude and longitude. Less effective EPIRBs transmit on 121.5 MHz, the frequency monitored by commercial airlines.

PROCEDURE WORDS

Procedure words are single words that are used to define a specific and unambiguous meaning. They are used for the sake of brevity.

OVER.	Invitation to reply
OUT.	End of communications
OVER AND OUT	**Should not be used, it is incorrect**
SAY AGAIN.	Repeat the message
I SAY AGAIN.	I repeat (e.g. important words)
I SPELL.	I will spell the word using the phonetic alphabet
STATION CALLING.	Used when a station is uncertain of the identity of a station calling
ACKNOWLEDGE.	Have you received and understood the message?
RECEIVED.	Acknowledge receipt of the message
CORRECTION.	I have made an error. The correct version is:.....
RADIO CHECK.	Please inform me the strength and clarity of my transmission
WAIT.... MINUTES.	If a station is unable to accept traffic immediately it will indicate how long before it can accept traffic.
NOTHING HEARD.	When no reply is heard from a station being called.

16

Safety At Sea

Safety Equipment and Regulations

US Coast Guard Safety Equipment Requirements

There is a number of safety requirements specified by the U.S. Coast Guard for sailors operating vessels on lakes, rivers and in open ocean. These requirements are subject to change and every captain must keep him/herself up to date. Current requirements, (as of July 14th 2000) can be found in Appendix 2.

Other Recommended Safety Equipment

Additional means of propulsion such as oars, paddle or auxiliary power.
A manual bailing device such as a bucket or bilge pump.
A basic first aid kit with instructions.
Anchors and chain/anchor line.
A tool kit, appropriate to the vessel and its area of operations.
Spare parts appropriate to the vessel and its area of operations. Through-hull plugs.
A portable VHF radio.
Navigation charts and compass.
First Aid box appropriate to the vessel and its area of operations
Ditch/ grab bag
Liferaft see chapter on Sea Survival
EPIRB
Personal safety equipment.

Handheld VHF Radio

Handheld Compass

SOLAS Liferaft

MOB

In the event of losing a person overboard the your chances of recovering the casualty will be greatly enhanced if you have at least discussed and preferably practiced a drill for MAN OVERBOARD RECOVERY.

1. Alert the rest of the crew.
2. Throw floatation if appropriate.
3. Designate someone to watch the casualty.
4. Slow down/turn so as to keep the casualty in sight.
5. Maneuver the boat to a position down wind of the casualty.
6. Bring the boat alongside and recover crew.
7. Treat and monitor, removing to hospital if in any doubt of condition.

Photos by John Rousmaniere and Phil Cowley

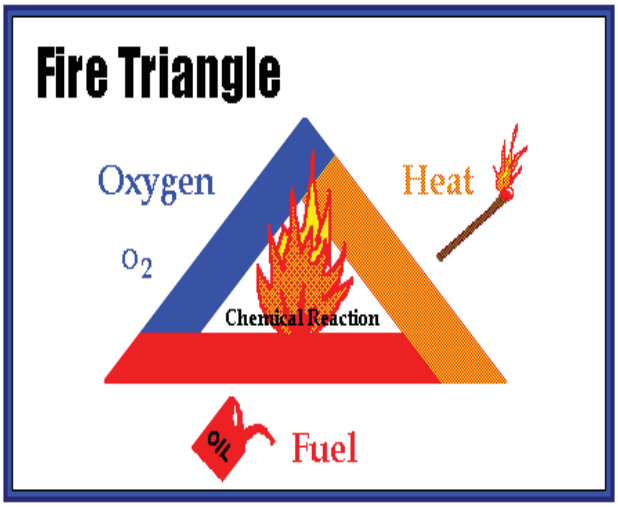
Fire Prevention and Firefighting

Fire is the visible effect of combustion. Combustion is induced by the chemical combination of oxygen with one or more elements or with one or more constituents of a substance.

For a fire to exist, there must be three things:

FUEL	Something to burn.
HEAT	Something to raise the temperature of the fuel.
OXYGEN	Something for the fire to breathe.

A fire can only exist if the triangle is intact. Break the triangle by removing one side and the fire will be extinguished. This is the basic concept of firefighting.



a) Removing heat is called cooling.
b) Removing oxygen is called smothering.
c) Removing fuel is called starving.

Fire extinguishers can be used to remove one side of the fire triangle or the triangle of combustion and thus extinguishing the fire. They are generally sufficiently small and light in weight to be carried readily by hand and are then known as hand extinguishers. Larger extinguishers, usually foam or dry powder, mounted on trolley units may be found in machinery spaces.

Basically extinguishers are divided into 2 groups:

1. Those that cool.
2. Those that smother.

They are further sub-divided into the following groups as per selection chart types.

Fire Extinguisher Ratings

Class A Extinguishers will put out fires in ordinary combustibles, such as wood and paper. The numerical rating for this class of fire extinguisher refers to the amount of water the fire extinguisher holds and the amount of fire it will extinguish.

Class B Extinguishers should be used on fires involving flammable liquids, such as grease, gasoline, oil, etc. The numerical rating for this class of fire extinguisher states the approximate number of square feet of a flammable liquid fire that a non-expert person can expect to extinguish.

Class C Extinguishers are suitable for use on electrically energized fires. This class of fire extinguishers does not have a numerical rating. The presence of the letter "C" indicates that the extinguishing agent is non-conductive.

Class D Extinguishers are designed for use on flammable metals and are often specific for the type of metal in question. There is no picture designator for Class D extinguishers. These extinguishers generally have no rating nor are they given a multi-purpose rating for use on other types of fires.

It's easy to remember how to use a fire extinguisher if you can remember the acronym PASS, which stands for Pull, Aim, Squeeze, and Sweep.

Pull the Pin

Aim at the base of the fire.

If you aim at the flames (which is frequently the temptation), the extinguishing agent will fly right through and do no good. You want to hit the fuel.

Squeeze the top handle or lever.

This depresses a button that releases the pressurized Extinguishing agent in the extinguisher.

Sweep from side to side

until the fire is completely out. Start using the extinguisher from a safe distance away, then move forward.
Once the fire is out, keep an eye on the area in case it re-ignites.

Fog and Low Visibility

In the event of being caught in an area of low visibility such as fog etc., immediate action should be to obtain a fix of position. If this is not possible the best known position should be worked out from the last available information. The logbook should be regularly updated with positions and courses.
Extra lookouts should be posted and engine/s ready for immediate maneuver. The VHF radio should be monitored and if in a shipping lane a "Securite" call made to advise all shipping of the vessel's current position.
In dense fog when the coastline cannot be seen and normal bearings are not possible, two immediate dangers occur:

1. Being run down by a larger boat which will probably be unaware of a small boat's presence (radar on big ships does not always pick up the echo from a small boat).
2. To prevent going aground all available instruments that will help to fix the boat's position should be used. For example, the echo sounder should be started if a line of soundings is possible or there is a danger of going aground. It is important to keep a steady course and speed, as constant changes make accurate navigation difficult or impossible; the speed should be slow enough to stop or alter course at the first signs of danger. Great care must be taken if another vessel is heard close at hand, and the following precautions should be taken to ensure the safety of the crew and the boat.
3. Inflated lifejackets must be worn; these can save lives in case of collision.
4. A good lookout should be posted in the bows to report to the helmsman everything, however trivial, observed or heard, and a good listening watch should he maintained by every crew member for the fog signals of other boats or navigational marks. If in doubt, course should be altered away from the suspected danger.
5. The appropriate fog signal should be sounded.
6. Silence must he maintained by all the crew.
7. The radar reflector should be hoisted as high as possible.
8. All safety equipment must be checked over and made ready for immediate use. If a liferaft is not carried the dinghy should be fully inflated and towed astern.
9. Flares, especially white ones, should be easily to hand.
10. If the engine is not already in use it should be turned over so that it is ready if needed.
11. If the engine is being used it may be turned off periodically to listen, but if this is done a careful check of how far the boat drifts in the time the engine is off must be kept.

LOW VISIBILITY TACTICS

The tactics will be dictated by several factors including, the final destination, where the boat is at the time the visibility deteriorated, the expected time low visibility may last, the accuracy of the latest fix, the instruments available, and the ability and experience of the navigator. There are several courses of action:

1. If close to a marked channel hold position outside the channel and close to a buoy.
2. Go inshore at right angles to the coast, using the echo sounder, and try to pick up a contour line so that a course parallel to the shore can be maintained. The advantage of this action is that it keeps the boat in shallower water not used by larger boats, and so the chances of collision are minimized. Accurate and careful navigation is needed to avoid grounding and inshore hazards. It may, however, be possible to see the coast close inshore and use the headlands for fixes.
3. If an acceptable anchorage can be found, the vessel can anchor and wait for visibility to improve. Unless it has a comparatively easy entry, it is much safer to wait for the fog to lift.
4. Standing offshore in deeper water may be better on an outward passage or if there are a lot of inshore hazards but, if there are deeper water channels and shipping staying inshore may be safer.
5. On no account stay in the shipping lanes. If the vessel finds herself in a shipping lane, the shortest route out should be found.
6. Do not attempt to cross a shipping lane or traffic separation scheme.

In all low visibility situations a constant and careful lookout is extremely more important.

Heavy Weather
If shipping forecasts have been studied and weather reports obtained regularly, there will usually be some warning

of approaching bad Weather. If still in port and there is any doubt as to the ability of the crew, the seaworthiness of the boat or the severity of the threatening weather, the boat should not leave. Had this decision been made on some occasions, the coastguard would not have had to go out searching for survivors.

If at sea and there is no suitable port near at hand which can be safely entered in the worst expected conditions, preparations must be made to ensure the safety of the crew and the boat.

SAILS

Sails should be reefed or changed down in good time. Being over canvassed when a severe storm hits the boat is the cause of much of the trouble encountered by the unwise sailor. It is too late and too dangerous to reef after the event, but should this have to be done, the minimum number of crew should be on the foredeck, and their safety harness clips should be securely fastened to a strong point.

A trysail, which is a small strong, loose-footed sail, can be used instead of the mainsail. This saves wear on the mainsail and enables the main boom to be lashed down, hut it may take some time to fit unless there is a special track on the mast, also the boat cannot sail as close to the wind as with a deeply reefed mainsail. Some long distance sailors keep such a sail permanently fitted on its own track ready to hoist quickly when needed.

STOWAGE

All gear must be stowed securely both above and below deck. Heavy objects hitting the hull of the boat can do much damage. See that all safety equipment is accessible and ready for immediate use. Turn the engine over to check that it will start if needed.

If there is danger of a rogue cross-wave, this effect starts at about 10 fathoms or 20m. Often the boat will be safer offshore, especially if there is a danger of being blown onto a leeshore.

Lying a-hull

Some boats will lie quite well with no sails hoisted at all with the tiller to leeward (lying a-hull), however as the broadside of the boat will be presented to the weather she will roll badly. Many modern sailing boats lie with the bows away from the wind, and much damage can then be caused by breaking waves. If there is time, prepare food and hot soup in a vacuum flask, as this will be appreciated later when there is not much chance of anyone going below if conditions are severe. One of the contributory factors to seasickness is becoming cold through lack of food; hypothermia is then a risk.

Everyone must wear an efficient safety harness, which must be clipped on to a strong point if there is any danger of falling overboard. It is wise to clip on when leaving the cabin before climbing up on to the deck, as at this point most people are balanced on one foot and are unstable. Guardrails are not strongpoints.

Washboards and hatch covers must be in position and fixed so that they cannot accidentally come undone, and if there are storm boards, these should be put in place.

HEAVY WEATHER TACTICS

Drogues and Sea Anchors
These are different names for the same thing, which is a waterborne parachute. When the seas get too large to deal with the drogue is streamed from the bow to keep the vessel pointing into the swell. This is intended to keep the boat being knocked beam on to the sea and then knocked down.

Trailing Warps
Sometimes it is better to run before the wind with only a small amount of sail area if there is plenty of sea room, trailing long heavy warps behind to keep the boat steady. Shallow water causes otherwise fairly regular seas to become confused due to upsurge from the bottom, with breaking seas.

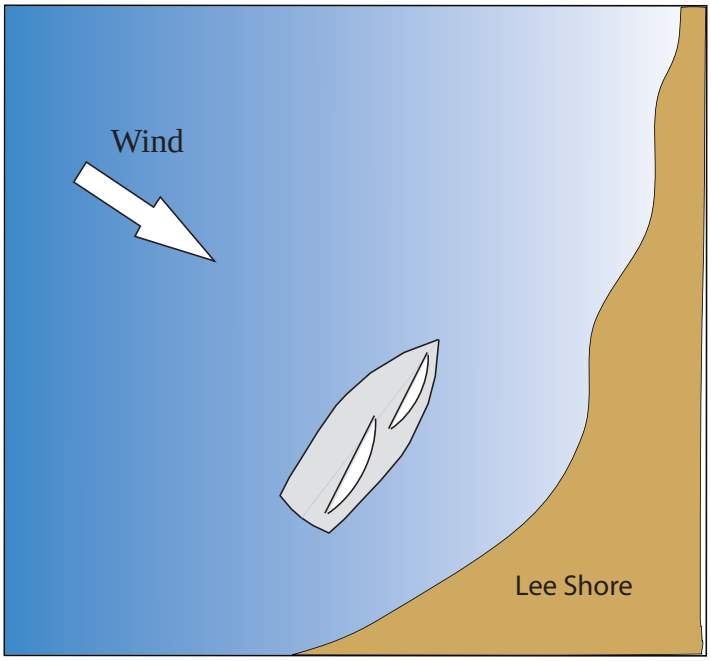
Heaving-to
If the boat can heave-to comfortably, and there is plenty of sea room, this can give breathing space to cope with an emergency, to reef, or to go below for a quick meal. The easiest way to heave-to is to tack, leaving the foresail cleated; when the foresail backs, the helm is brought to leeward and secured. The mainsail is adjusted according to the size of the foresail. This is thus an easy maneuver which results in a boat nearly stationary, with the foresail backed counteracting the forward drive of the mainsail. The boat's motion is steady and gives the opportunity in rough weather of a break for a rest. When hove-to the boat will make considerable leeway, but she can be tacked if there is a navigational hazard to leeward.

In the hove – to position, the helm is lashed to leeward and the foresail sheeted to windward. The drive of the mainsail is thus counteracted, and the boat should lie comfortably riding the seas making slow forward leeway.

Power Vessels
If the boat is a motorboat, it has to conserve fuel and attempt to gain a suitable port or shelter before this is exhausted. It may be necessary to motor gently into the weather to keep the bows into breaking waves.

LEESHORE

In rough weather there is always the danger of a leeshore, one on to which the wind is blowing and the seas breaking. Particularly dangerous is a gradually shelving beach between two headlands. In strong winds a boat should keep well clear.
Frequently what appears to be a safe harbor requires an approach close to a leeshore. The prudence of such an approach must be carefully considered as it may well be safer to choose an alternative harbor, to remain at sea or to wait for high tide when the seas may be flatter. In the event of engine failure it can be difficult to get away from a leeshore, as it is quite likely that even the heaviest anchor, with all available chain let out, may drag in the heavy swell.



17

Sea Survival

The critical element of survival at sea depends on the awareness of the crew, the survival equipment onboard the vessel and how to use that equipment with maximum effect. In an emergency the survival of each person depends on his own and his crewmates foreknowledge and preparedness. It relies upon each mans ability to remain calm and act quickly and effectively because panic ensures catastrophe.
Survival equipment carried aboard yachts varies greatly according to the size of the boat, its mode and area of operation, the size of its crew and its frequency of operation. These notes are designed to help the captain and crew develops an awareness of generally accepted procedures.

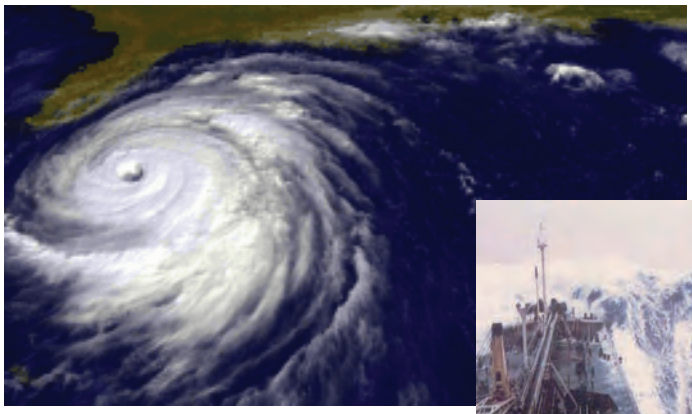
Fire

- Engine Room, Fuel – Diesel – Petroleum. Insufficient ventilation or extractor fans. Faulty fuel lines, broken hoses, volatile fuels.
- Galley, Explosions – forgetting to switch off propane. Propane locker must have overboard drainage and ventilation.
- Cigarettes, Crew or guests fall asleep while smoking. Electrical, May occur anywhere on the vessel. Damp atmosphere causing short circuits.
- Exhaust Manifold, extremely high temperatures. Wires, cloths, bulkheads or anything that will come into contact
- Other, Hydrogen gas from charging batteries. Methane gas from holding tank.

Open hatches or Collision

- Most collisions occur in fog or limited visibility.
- A ship traveling at 30 knots is on top of you in 7.5 minutes.
- Large or small-scale damage to boat, water tight bulkheads, if not closed at time of collision can cause boat to sink

Whales & Containers



- Whales are responsible for a high percentage of all small boat sinkings per year worldwide.
- Approximately 1000, 40ft containers fall off ships every year worldwide; each one is potential hazard to shipping.

Heavy Weather

- Tropical revolving storms (TRS)
- Risk of lee shore, reef or shoals
- Knockdowns, capsizing, running aground.

- Sea sickness, MOB, panic attack
- Shifting objects

Flooding
- Through hull fittings
- portholes
- Heavy weather

Seven Steps to Survival

Recognition	You must confront the fact that a life threatening emergency exists. Do not wait until it is too late.
Inventory	What have you got that will help you cope with the emergency. You should already have a ditch bag assembled.
Shelter	Your boat is your best shelter as long as it remains afloat. It also increases your ability to be spotted. It is a crucial mistake to leave the boat too soon. If you must abandon ship, exposure suits and liferafts become your best means of shelter at sea.
Signals	Your hope of survival depends upon alerting someone who can help you. When you no longer have radio contact, you must use whatever means you have available – EPIRB, SART, flares, strobes, flashlights, mirrors, dyes, etc.
Water	Fresh water is critical for survival. There will be fresh water in the liferaft, but take as much extra water as possible. Ration the water immediately and never drink salt water, alcohol or urine. Maintain a watch for rain and devise a method of catchment. Some liferafts provide this.
Food	High energy (but low salt) food should be in your ditch bag in addition to the contents of the liferaft. Sea sickness tablets should be taken soon after entering the raft. Even the hardiest of sailors will soon turn green in a pitching liferaft and vomiting increases dehydration. It is recommended procedure not to eat for the first 24 hours which allows your stomach to shrink.
Will to Survive	Create a will to survive and maintain it. Collect any knives or sharp objects and dispose of in case of irrational behavior and to prevent accidental puncturing of the liferaft. Create a sense of well being, try to keep up moral, appoint people to handle water rations, food rations, and first aid. Keep flares handy and make sure everyone knows how to use them.

Life Saving Equipment

There are many types of equipment and lifesaving devices that can assist in an emergency situation. They include:

· Life Jackets

Buoyancy Aids

· Life Rings and Horse Shoe Buoys

· M.O.B. Sling, Generally used aboard sailboats

· Life Rafts, There are many types, sizes and models available.

- EPIRB's
- Flares
- Waterproof flashlight
- Mirrors
- Dyes
- Guns
- Handheld VHF
- Cellular Phone
- Whistle
- Air Horn

EPIRB

Flares

Whistle

Handheld VHF

Airharn

Possible Contents of a Ditch Bag

Hand Held VHF
Waterproof Flashlight
SOLAS flares
Cellular Phone
Bucket or bailer
High energy food packs
Sponge
Reflective mirror
Vitamin supplements
Hand held GPS
Water
Sea Sickness Tablets
Sun Screen
Fish hooks & line
Dive knife
Mask & Snorkel
Duct tape
Waterproof pad & pencil
Electrical tape
First Aid Kit
Pliers
Whistle
Air horn
Ziplock Bags
Dyes
Strobe Light
Hand Held Compass
Binoculars
Sunglasses
EPIRB

The Liferaft

- In a yacht liferaft, you can install your own requirements depending upon your area and mode of operation. In the Tropics, you should have lots of water and no real need for a survival suit.
- Stow it where it is accessible to everyone.
- Install senhouse slip or hydrostatic release.
- Liferaft should be serviced every year or as required by manufacturers recommendations
- The gas in the liferaft is a mixture of CO2 and Nitrogen to prevent freezing.

Procedure for Abandoning Ship

- Put on warm waterproof clothing
- Put on lifejacket
- Grab ditchbag and anything else that may be of help
- Board liferaft – stay dry if possible
- Cut painter
- Stream drogue – this will create drag and prevent drift and stops the wind getting under the raft and flipping it.
- Dry out raft with bucket and sponge. It is essential to keep as dry as possible
- Appoint a watchkeeping assignment
- Distribute sea sickness tablets.
- Keep raft fully inflated – in the heat of the day the gas in the raft expands and escapes

Launching the Liferaft

- Check painter is secure
- Remove quick release
- Carry to side of boat in an obstruction free area
- Check over the side that it is clear
- Double check painter
- Drop raft over the side
- Pull painter to inflate rafdt
- Liferaft will fully inflate in approximately 25 seconds

Survival in a liferaft / Surviving the ordeal

- Never leave your yacht unless absolutely necessary.
- Be aware of drowning, exposure, heat, cold, lack of fluid and lack of food with your crew.
- Know how to use all the equipment in your liferaft and your ditch bag
- Stay warm – 1/3 of body heat is lost through your head, 2/3 of body heat is lost through your legs.
- Water – you can last up to 3 days without water. Milk, water, fruit, sodas, are all liquid sources
- Only get into a liferaft when you have to step up into it.
- Food - tinned proteins are not the best unless you have lots of liquid. Protein removes fluid from your body. Carbohydrates help preserve fluids.
- Panic can be a major problem with abandoning ship. One fourth of people react positively. One half waits to be told what to do. One forth is incline to panic. Try to calm the panic stricken person or persons.
- When you are preparing to abandon ship, grab as much extra stuff as you can in canned food, can opener, blankets, & ship log. Foul weather gear, pillows, water, drinking fluids, sleeping bags, and anything that you think might be of use in the liferaft.

Medical Problems in Liferaft Occupation

Lack of Fluids
In the Tropics, this can be a major problem. Fluid is lost by perspiration, seasickness bleeding urinating and tears.
In hot weather you should shelter from the sun, ventilate raft. Secure sea anchor on the entrance side to open it up to wind direction.
Do not drink seawater or urine.
Keep canopy cool by putting water (sea) on it.

Hypothermia
Remove all wet clothes, wring out excess water and put back on if no dry clothes are available. Layers of air are important.
Keep liferaft as dry as possible, huddle together for extra body heat.

Sores
Salt water sores are extremely painful. Keep liferaft as dry and salt free as possible

Shock
Shock is probably the largest problem that you will have to encounter with your crew. The loss of a yacht, and all your personal possessions.

18

Anchors & Anchoring
Mooring Alongside

Types of Anchors

There are a number of different types of anchor; each has its own advantages and disadvantages. The principle types are:
(a) Fisherman/Admiralty anchor
(b) CQR/Plough anchor
(c) Danforth anchor
(d) Bruce anchor
(e) Grapnel anchor (folding type). Some manufacturers produce their own "improved " versions based on these basic types.

Fisherman/Admiralty
The traditional type of anchor is sometimes known as an Admiralty Pattern anchor.

Advantages

1. Can be stowed flat.
2. Good holding power in sand and mud.
3. Few moving parts to get fouled up.

Disadvantages

1. A heavier anchor needed than some other types to give equal holding power.
2. When stowed on deck, the flukes can do damage in heavy seas unless well secured.
3. Because there is a vertical fluke when it is on the seabed, there is a possibility of the anchor chain or warp fouling this, or the boat settling on it.

Fisherman

CQR/Plough Type

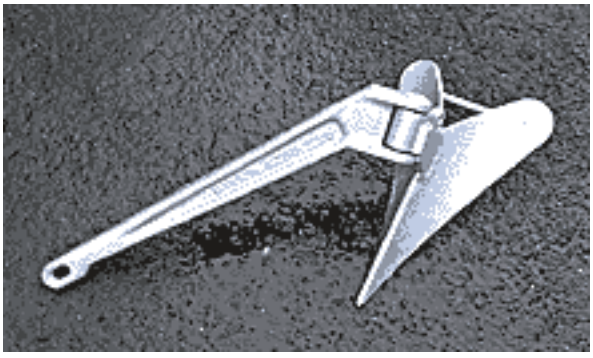
The CQR is a proprietary type of anchor as shown in (b). It is also called a plough. Copying manufacturers' versions are sometimes of inferior quality.

Advantages

1. Holds well in soft sand and mud.
2. Lighter anchor required than a Fisherman to give equal holding power.
3. Usually digs in well.

Disadvantages

1. There may be stowage difficulties, and special chocks are needed to secure it unless fitted over the bow roller.
2. Movable parts can become fouled and damage the fingers.
3. Can capsize.
4. Can be difficult to break out of mud unless



CQR/Plough

a tripping line is used.

5. Does not hold too well in kelp or hard sand.

Delta

Delta

A fixed version of the Plough. Easy to stow in bow roller

Delta

Danforth

Danforth

The Danforth is a flat twin fluke anchor with the stock built into the head.

Advantages

1. Good holding power in sand and mud.
2. Less weight needed to equal holding power compared with a Fisherman but about equal to a CQR.
3. Can be stowed flat.

Disadvantages

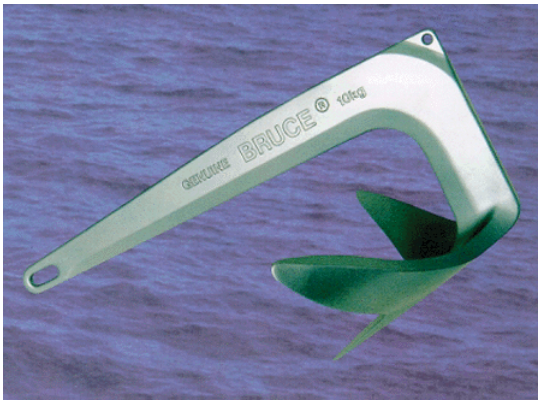
1. Movable parts can become fouled and can damage fingers.
2. Not too good in rock.
3. Can be difficult to break out of mud unless a tripping line is used.

Danforth

Bruce

Advantages

1. A much lighter anchor needed to equal the holding power of the other types.
2. No movable parts.
3. Digs well into the seabed however it lies, and quickly buries itself.
4. Good holding power in sand and mud.
5. Easy to break out.

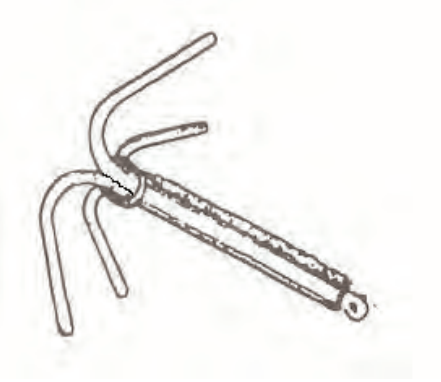


Bruce

Bruce

Disadvantages

1. Difficult to stow without a special chock which, due to lack of space on the foredeck, cannot always be fitted. It can, however, be stowed over the bow roller if well secured.



Grapnel

Grapnel

A good holding anchor on coral and rock and useful to use as a kedge.

Kedge

A more portable smaller anchor of any appropriate type used for anchoring temporarily, for emergencies such as help to re-float after going aground, as a stern anchor or for assisting the main anchor.

Anchoring

Anchors hold best in soft bottoms such as sand and mud, but will hold in hard sand, shingle or pebbles. Smooth rock and weed are not good holding. The Fisherman is probably the best for holding in rock. It is best to carry two main anchors of different types, and a kedge.

Whichever type of anchor is used, to hold the vessel without dragging, a horizontal pull along the seabed must be created. This requires the correct amount of scope; at least 5 times the maximum depth of water for chain and at least 7 times the maximum depth for warp. **Scope** is defined as the ratio of length of anchor line in use to the vertical distance from the bow of the vessel to the bottom of the water. Larger boats generally carry all chain while smaller boats are more likely to carry a short length of chain attached to a nylon warp. The anchor line is called **"rode".** The rode may be line (nylon warp or fiber rope), chain, wire rope or a combination of line or wire rope and chain.

The advantages and disadvantages of both are listed below:

Anchor Chain

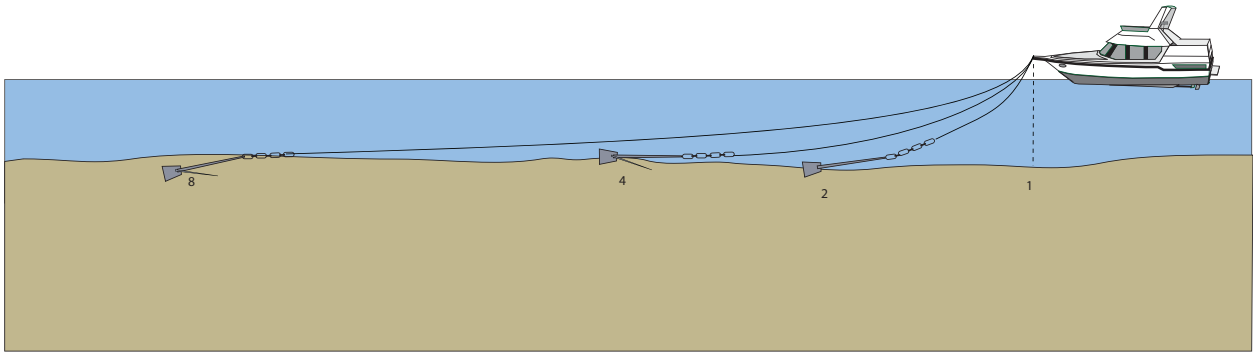
1. The heavier weight gives better horizontal pull.
2. The weight of chain increases the catenary, which reduces the chances of snatching when anchored in rough seas.

3. All chain rode is very heavy.
4. Chain is harder to handle and needs a chain gypsy on the anchor windlass.

Anchor Chain and Anchor Warp
1. Even the short length of chain helps the horizontal pull on the anchor.
2. The elasticity of the nylon warp helps to reduce snatching when anchored in rough seas.
3. Chain and warp is lighter.
4. Warp is easier to handle.

Scope

Scope is defined as the ratio of length of anchor line in use to the vertical distance from the bow of the vessel to the bottom of the water. The scope of chain or nylon warp will vary with conditions, the type of anchor and size and type of boat but, if the anchor is dragging, more should be let out. Whether chain or nylon warp is used, both ends must be made fast securely. The inboard end should be lashed with a light line so that it can be quickly released, by cutting if necessary. At the anchor, shackles should be fastened with stainless steel wire (moused) to stop the pin turning. Nylon warps should be attached either with a fisherman's bend or with a hard eye spliced in the line (around a metal thimble), fastened with a moused shackle.



Fouled Anchor

If the seabed is covered with spoil and debris the anchor can become fouled. A trip line can save the ground tackle and before deployment it should be fastened to the anchor so that the crown can pull it up. There is a hole or ring on most anchors for the attachment of such a line. The other end of the line may be attached to a small buoy (which has the advantage of marking the position of your anchor) or led back to the boat and secured on board (a longer line is required if the latter method is used, but it avoids the danger of the buoy becoming a hazard to other boats).

Anchoring

It is important to make clear that it is not the anchor alone that holds the yacht in place but the combined effect of both anchor and chain. The anchor fixes the chain to the seabed and the weight of the chain and the friction of it on the seabed hold the yacht in place. One of the most important considerations is the depth of water and one must remember that it will change according to the tide. The procedure requires a minimum of two people, one to work the anchor gear and the second to steer the vessel.

Setting the Anchor.

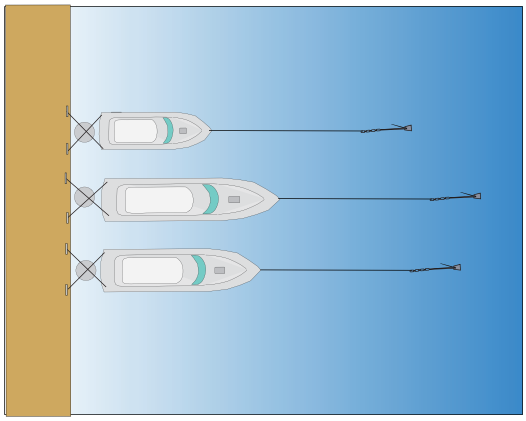
- ✓ Do not anchor in prohibited areas, for example where there are submarine cables, these will be marked on the chart.
- ✓ Having established the depth of water at high tide in the location you wish to anchor you will prepare to lay out your anchor and chain. Under average conditions you will need to lay out five times the maximum

depth if you are using all chain or eight times if you are using a mixture of rope and chain. In light conditions this can be less and if you are expecting it to be rough then lay down more.

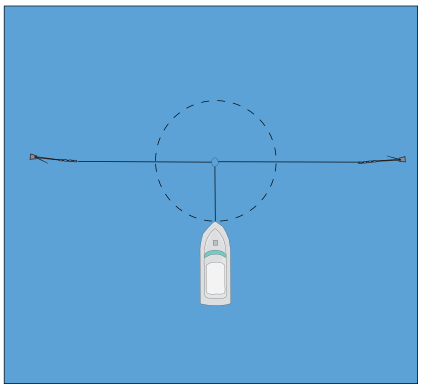
- ✓ First examine the way yachts on the other moorings are lying this will help you evaluate the best place to anchor. Yachts will either be lying head to wind called wind rode or if the current is stronger heading into the current called current rode.
- ✓ If the anchorage is crowded it is best to plan to anchor among vessels that are similar to your own, power boats and sailing boats have different characteristics in the way they lie at anchor and it best to swing with a similar group of vessels.
- ✓ Remember the yacht will swing on its anchor so you need room between you and other vessels to allow your yacht to possibly swing through 360 degrees.
  Go forward from the point where you wish your vessel to finally lie by slightly less the length of the chain you intend to use.
- ✓ Let the effect of the wind or current on your vessel bring you to a virtual stop. Make a visual note of this spot.
- ✓ Let the anchor go, your chain should be marked to show the length of chain let out and when the anchor hits the bottom the chain will slacken momentarily.
- ✓ Once the anchor is on the bottom go astern slowly and at the same time pay out the anchor until you reach the length you decided to use.
- ✓ At this point when you stop paying out the anchor chain will become taught and run forward from the vessel at a shallow angle, close to horizontal.
- ✓ You should feel the vessel slow as the chain becomes taught, take the engine out of gear and the boat should pull back forwards until the chain is hanging close to vertical from the bow.
- ✓ Once the yacht has settled, after a short while take compass bearings off objects that you can clearly define, or take a reading from the GPS if fitted.
- ✓ Repeat the last process after a period of time, the figures should match reasonably closely. Even if the yacht turns with the wind or current to head in a different direction these bearings should remain constant.
- ✓ If there are large changes in the bearing the anchor is dragging and will have to be reset.

Mooring

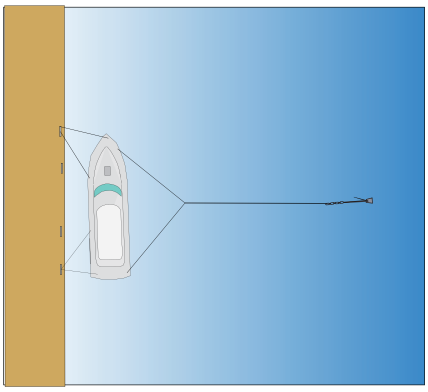
Mediterranean moor – Stern to dock with bow anchor to hold vessel off.



Bahamian Moor – use of two anchors meeting at a swivel, reduces swinging room.



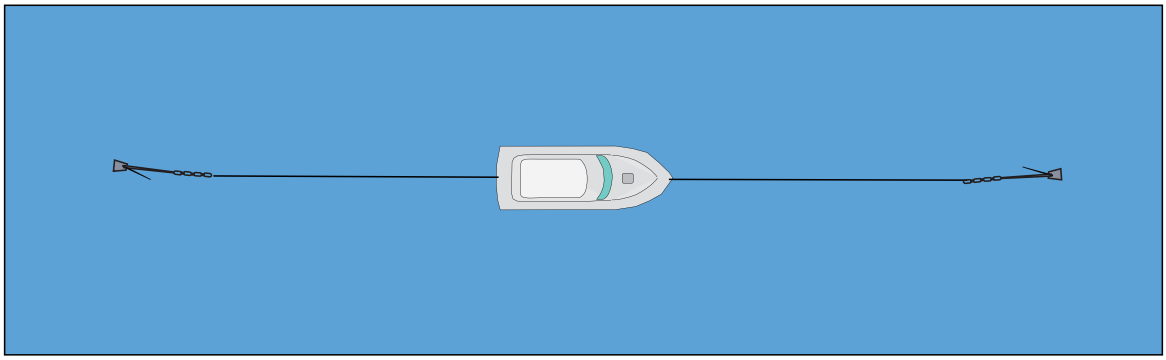
Baltic Moor – alongside with an anchor laid out abeam midships to hold vessel off the dock.



Laying A Second Anchor

Sometimes it is necessary to lay a second anchor to reduce the swing or yaw of the boat due to tidal stream or strong wind, especially in a confined anchorage (the boat is then technically said to be moored). – See Bahamian Moor above.

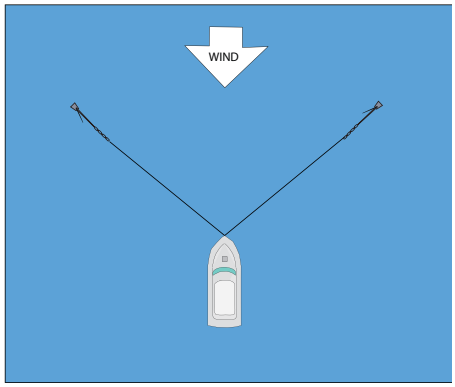
Unfortunately not all boats, because of their different hull configurations, lie at the same angle in identical conditions. Some will lie more to wind and some more to tidal stream.
One method of laying two anchors is to lead both from the bows, the heaviest one in the direction of the strongest tidal stream and the other in the opposite direction. This method is only suitable for a strong tidal stream with little or no wind. If there is a crosswind, both anchors will drag. In calm conditions both anchors can be led out over the bow, the heaviest one laid towards the strongest tidal stream; but in a cross wind, both anchors may drag.



Main anchor set in the direction of the strongest tide/current or wind

Anchoring fore and aft is not normally suitable for a small boat as it induces too much strain in a cross-tide or a strong cross wind.

Another way is to position the two anchors well forward from the bows, with not too wide an angle between them. This method is used when expecting strong winds.



Choosing An Anchorage
Before reaching the proposed anchorage, estimate the direction the boat will lie and the length of chain or warp required. This should not be flaked down on deck because accidents can easily occur and the deck damaged. It should be marked at convenient intervals for depth identification.

When the boat has reached the anchorage and has stopped making way through the water, the anchor is lowered and, as the boat falls back, the chain or warp is paid out. An anchor ball or, if at night, an anchor light, should be displayed high in the forward part of the boat.

The inboard end of the chain or warp should be secured around a samson post or cleat. After the vessel has settled back on the anchor, bearings of objects abeam should be taken, or suitable transits noted, this allows the anchor watch to confirm that the anchor is not dragging. The maximum swinging circle should then be established to make sure that the vessel does not swing into shallow water or other vessels etc. after tidal stream changes or the wind shifts.

The following points should be taken into account when choosing an anchor berth.

1. The nature of the bottom and is it good holding ground suitable for the anchor that you carry.
2. The maximum and minimum depth of water, to determine the scope of rode to pay out and to ensure that you do not ground at low water.
3. Adequate shelter from all expected winds and other conditions for the duration of your stay.
4. Adequate swinging room at all states of tide.
5. Clear of channels and high traffic areas.
6. Take bearings and transits to confirm the vessel is stationary and not dragging.
7. Close to shore and to a safe landing point.

Docking

When docking in a new and unfamiliar area always check to see what the rise and fall of the tide will be and what state of the tide you are at now. Allow for the rise and fall of the tide and use sufficiently long warps unless docking to a floating pontoon. As a general rule, you should allow at least three times the expected rise or fall of the tide. The lines to be used for docking will mainly depend upon the size and type of the boat and should take into account local conditions.

Suggested dimensions of mooring lines are as follows:

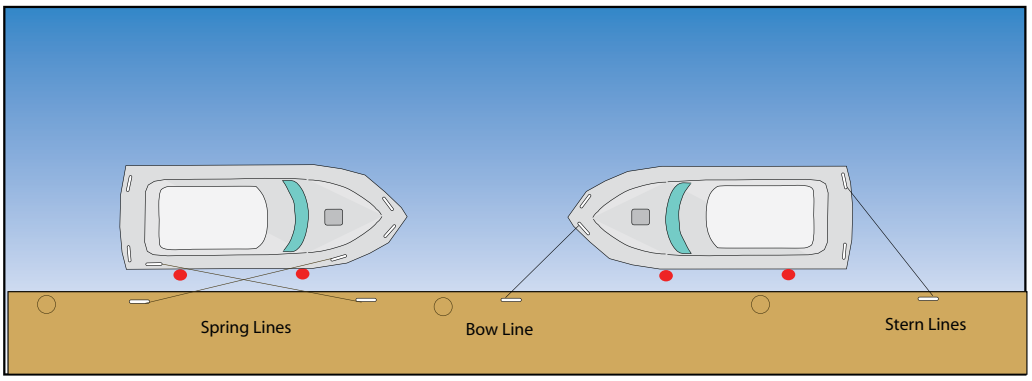
Diameter: **1/8 inch (3mm) for every 9 feet of (2.7m) overall boat length.**

Length: Bow and stern lines, two thirds of overall boat length, spring lines, one and a quarter times overall boat length.

The docking lines required to secure a vessel properly are:

1. Bow line. A line lead forward from the bows of the boat.
2. Stern line. A line lead aft from the stern of the boat.
3. Breast ropes. Lines lead abreast of the boat from the bows and the stern. These keep the boat into the dock and they should be kept slightly slack.
4. Springs. One line lead from the bows of the vessel aft to the dock and one from the stern of the vessel lead forward to the dock. These stop the boat moving fore and aft and should be taut.

Adequate fenders both in size and quantity must be used to protect the hull and topsides. When alongside and where there are pilings proud of the dock a fender board will give the best protection.



When arriving at a new destination call ahead to the dockmaster to find where your dock is and which side you will need to come alongside. In coming alongside prepare in advance the necessary lines and fenders and clearly brief the crew on the duties and order in which things need to be done.
Do not jump ashore until the vessel is close enough to do it safely, and make sure arms, legs and other parts of the body do not get between the vessel and the dock or pilings.
On leaving make sure there are no lines in the water to foul the propellers and once clear of the dock untie and stow all lines, fenders and fender boards.

Etiquette Alongside

1. If lying alongside another boat for more than a short stop, lines from the bow and stern should be made fast directly ashore. It is preferable not to rely on the other vessels' lines and also it facilitates the inner boats' departure if she wishes to leave before the outer boat. In the case of a raft of several boats this also relieves the strain on the cleats of the innermost boat and will stabilize the raft.
2. Adequate fenders must be placed between boats or between the boat and the pontoon.
3. Spreaders should be staggered to avoid clashing in a swell.
4. When crossing another boat's deck, it should be done forward of the mast/deck house and not across the cockpit. Obviously cross as quietly as possible, taking care not to bring on dirt from shoes. If possible obtain permission first if there is someone aboard.
5. If on a sail boat rig frapping lines to prevent halyards slapping the mast.
6. Keep noise to a minimum.

19

Preparation For Sea - Check Lists

Before departure file a **Float Plan/Trip Plan.**

1. Complete the plan with all the details to assist initiating a call for search and rescue in case of emergency
2. File the plan with a trusty person ashore with instructions and contact numbers of emergency services in case of emergency
3. Update the plan to avoid the person making a call for search and rescue initiating unnecessary emergency action
4. Update the plan to avoid the person making a call for search and rescue initiating unnecessary emergency action
5. Leave plan with responsible person/s ashore with instructions and contact numbers of emergency services

Name Of Vessel **Type of Vessel Sail/power**

Make of Vessel **Length of Vessel**

Hull Identification Number **Registration Number**

Type and Color of Hull **Color of Topsides**

Distinguishing Features

Engine/s Size and Make

Sails, Number and Color

Radios **SSB** **VHF** **Call Sign**

Channels Monitored

Safety equipment carried

Flares Number and type

Lifejackets **Life Rafts number/type/size**

Trip Plan Include interim ports

Number of people on board

Proposed Route

Appendix 1

INTERNATIONALLY RECOGNIZED DISTRESS SIGNALS – Rule37

Extract from The International Regulations for preventing collisions at Sea

Rule 37 Distress signals
When a vessel is in distress and requires assistance she shall use or exhibit the signals prescribed in Annex IV of these regulations.
Annex IV
1. The following signals, used or exhibited either together or separately, indicate distress and need of assistance:
(a) a gun or other explosive device fired at intervals of about 1 minute;

(b) a continuous sounding with any fog signaling apparatus;

(c) rockets or shells, throwing red stars fired one at a time at short intervals;

(d) a signal sent by any method of the Morse Code group (SOS)… ---…;

(e) a signal sent by radiotelephony consisting of the spoken word “MAYDAY”;

(f) the International Code Signal of distress indicated by NC;

(g) a signal consisting of a square flag having above or below it a ball;

(h) flames on the vessel (as from burning tar barrel or oil barrel, etc.);

(i) a rocket parachute or a hand flare showing a red light;

(j) a smoke signal giving off orange colored smoke;

(k) slowly and repeatedly raising and lowering arms outstretched to each side;

(l) the radiotelegraph alarm signal;

(m) the radiotelephone alarm signal;

(n) signals transmitted by emergency position-indicating radio beacons (EPIRB);

(o) approved signals transmitted by radio communication systems.

2. *The use or exhibition of any of the foregoing signals except for the purpose of indicating distress and need of assistance and the use of other signals which may be confused with any of the above signals is prohibited.*

3. *Attention is drawn to the relevant sections of the International Code of Signals, the Merchant Ship Search and Rescue Manual and the following signals;*

(a) A piece of orange colored canvas with either a black square and circle or other appropriate symbol (for identification from the air).
(b) A dye marker.

Appendix 2

Safety equipment

USCG Safety Checklist

1. In addition to federal requirements, vessels must also comply with the requirements of the state where the boat is registered and is being operated.

2. The vessel is required to be registered in the state where it is to be mainly used and carry a Certificate with Registration Number. Where and how this number must be displayed varies according to each state's requirements. Any change in ownership, address change or boat status must be registered with the state within 15 days.

3. The US Coast Guard or any law enforcement officials may board the vessel when you are underway and fine the owner and/or captain They may also take control of the vessel for negligent operation or violation of state and/or federal regulations.

4. Although auxiliary vessels of 12 meters (39.4 feet) or larger in length must carry both the International Collision Regulations, and those for Inland Waterways aboard, it is recommended for all vessels, because all captains are responsible for knowing and following the Navigation Rules.

5. All vessels with inboard gasoline engines must have a flame arrester fitted to the carburetor.

6. USCG approved fire extinguishers must be carried aboard all auxiliary powered vessels.
   Boats less than 26 feet must have one Type B-1.
   Boats 26-40 feet must have two Type B-1s or one Type B-2.

7. USCG approved Personal Flotation Device (PFDs) of Type I; II, III or V is required for each person aboard the vessel and one Type IV (throwable) for vessels larger than 16 feet in length.

8. USCG approved Visual Distress Signals must be carried aboard vessels except: boats less than 16 feet in length, boats in organized events such as regattas, open sailboats less than 26 feet in length without auxiliary power, and manually propelled boats.

9. Although vessels of 12 meters (39.4 feet) or larger in length, but less than 20 meters (65.5 feet) must have a power whistle or horn, and a bell, it is required for all vessels to comply with sound signal navigation rules in certain circumstances.

10. Ventilation is required for most vessels with gasoline powered engines.

11. Vessels operating or anchored between sunset and sunrise are required to display navigation lights.

12. Vessels restricted in their ability to maneuver because of diving operations must display a rigid replica of the red/white diver flag or the code flag "A".

13. The Refuse Act of 1899 prohibits depositing of any refuse into US waters to 3 miles offshore and no oil or hazardous waste within 200 miles of US coastline.

    An oil discharge notice must be prominently displayed in the engine room and a garbage discharge notice displayed in the galley area.

14. Vessels equipped with Marine Heads must meet USCG requirements which basically requires a holding tank and which if it has an overboard pump out must be closed while within 12 miles of the coast.
15. Boating accidents must be reported to the nearest state authority.

Appendix 3

Ropework, Knots, Bends & Splices

Knots, Bends, Splices, Hitches and Seizings are all ways of fastening one or more lines together or for attaching a line to an object such as a spar or ring. Bends and hitches are ways of fastening lines to one another or to an object. A splice is made by untwisting two rope ends, (or part of itself if a loop is required) and intertwining them together. A seizing is made by joining two spars, lines, or two parts of the same line by means of a smaller diameter seizing cord.

Selection of the right knot, bend, or hitch for the job is essential to prevent it undoing and also to take account of the type and size of rope. Consideration must be given to the construction and material of the rope. Simply, synthetic lines tend to have a smooth surfaces, some more so than others, and the holding power of knots and splices will be affected accordingly. It is also important to consider the 'lay' of the line; many knots and splices require some degree of twist, and laid line may resist this, buckling or kinking if forced. The line will cooperate much better if tension is taken out by a half twist in the knot making process or when coiling.

The ends of a line will unravel if not secure. Melting the exposed filaments of synthetic line will help but not for long if the line is in regular use. A more secure method is by use of a tight whipping using the correct thickness of whipping twine.

Ropework
Ropework considers the construction of ropes and its correct usage. During the manufacturing process the word rope is used no matter what size or construction. When in use, rope is variously described as line, rope, cordage, small stuff, painters etc. depending upon its function. Rope making is essentially a series of twisting operations. After fibres are made the rope is constructed by three twisting processes.

Normally rope is made as "right-laid" rope. Firstly the roping is twisted from left to right to spin the yarn. Next the yarns are twisted from right to left to form the strand, and finally the strands are twisted from left to right to lay the rope. Alternatively the process can be reversed, resulting in a "left-laid" rope. This method of construction using opposing twists gives a rope stability.

Inspection of wires and ropes
Wires, flexible steel wire ropes, supplied to ships are normally composed of strands of steel wire formed into strands laid, right handed, around rope core. The rope core forms a reservoir for the oil or wire rope dressing. The type of wire rope is identified by the number wires in each strand and the number of the strands. A 6 x 8 wire rope will have six wires in each of eight strands. Wire rope is generally galvanized to prevent corrosion and used in standing and running rigging. If a visual inspection of the wire rope reveals broken wires or excessive wear, the rope must not be used. If, in a length of ten diameters, the total number of broken wires exceeds five percent of the total number of wires, the wire must be taken out of use. No wire rope may be used if there is any knot in it or if strands are seriously deformed or kinked. Wire ropes should be cleaned to remove foreign materials such as sand which may stick to them and the correct wire rope dressing applied to keep them properly lubricated. Hand splicing of wire ropes is no longer acceptable and "Talurit" splices are used. These will have a serial number and safe working load (SWL) stamped onto them. All wires supplied to ships should have a wire rope certificate. Lifting wires used in lifesaving appliances must be end for ended every thirty months and replaced every five years.

Care of Rope
Natural fiber rope has been replaced to a large extent by man made fiber ropes, but is still used, especially in lifeboats for lifelines and grablines and for manropes on pilot ladders. If man made fiber ropes are used, these must be approved for LSA use.

Most natural fiber is sisal, but hemp and manila are also used. Only manila resists the effects of seawater, sisal and hemp should be tarred to prevent their rotting when exposed to seawater. The table gives the approximate breaking strains for commonly used rope. The size of a rope is the circumference. It is normally three stranded, right hand hawser laid and supplied in 120 fathom coils. The breaking strain is in tons and the size is given in inches. The breaking strain for sisal is approximately half of that for nylon. These strengths are approximate and apply to new rope. If the rope has been stored badly, it will be weakened and it will deteriorate in use. Misuse and incorrect handling will hasten this process. Contact with chemicals causes serious damage to natural fiber ropes and salt water had an adverse effect on them. Man made fiber ropes are badly affected by ultra-violet radiation and require protection from direct tropical sunlight. Man made fiber ropes, especially nylon are very elastic and a length of nylon is often incorporated into towing springs, where extra elasticity is required.

Ropes should be inspected and condemned if there are obvious defects such as broken strands and kinks or signs of rot.

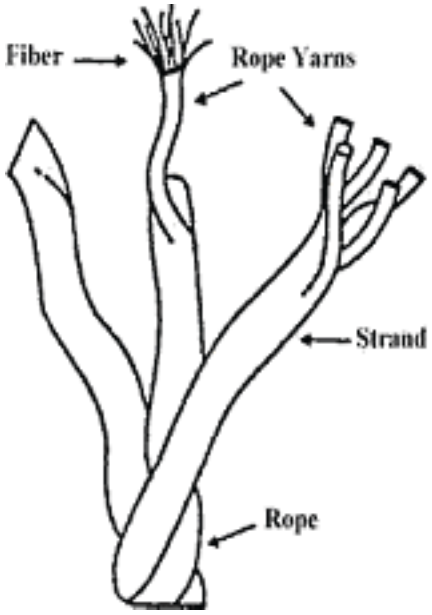
Of greater significance than breaking strain to the mariner is the Safe Working Load (SWL). This should be clearly marked on every, shackle, sheave, hook and wire splice. It is taken as being one sixth of the breaking strain.

Modern Rope Construction

Lines can be either stranded or braided. A stranded line consists of fibers twisted in one direction to form a rope yarn which, when twisted again in the opposite direction, creates the strand. Three strands are then twisted again in the same direction as the fibers to create the final rope. This alternating torsion causes the line to tighten on itself and thus prevents it from unravelling. A braided line comprises a core of braided or stranded threads covered with a sheath. The center or core of the line gives it strength, and the sheath provides protection and ease of handling.

The effects of chemicals, water, salt, sand and sun on rope fibers all cause wear and tear, potentially reducing their strength. All ropes and lines should be protected from wear and tear and checked frequently. Ropes that are not used regularly should be uncoiled from time to time to prevent them from losing their flexibility. When storing ropes and cords, they should be hung in a dry place after coiling.

Braided



Stranded

Knots, splices, hitches etc

Knots in the end of a single line

These knots are used in fastening a line upon itself or around some other object. Some of these are:

1. Overhand knot: Used in making other knots; never used alone.
2. Bowline: A temporary eye in the end of a line. It will not slip or jam.
3. Bowline on a bight: Used to sling a man over the side. It will not slip and constrict him.
4. Figure eight: Used to prevent the end of a line from unreeving through a block or eyebolt.
5. Blackwall hitch: Used to secure a line to a hook quickly.

Knots for bending two lines together

These knots are those that are used for joining two lines.

1. Square or reef: For tying reef points and bending lines together.
2. Granny knot: Usually a mistake for a square knot. It will slip under strain.
3. Sheet or becket bend (single): Used for bending line to becket and for bending lines of different sizes together.
4. Sheet or becket bend (double): Same uses as the sheet or becket bend (single).
5. Two bowlines: A safe and convenient way of bending two hawsers together.

Knots for securing a line to a ring or spar

These knots are called hitches or bends

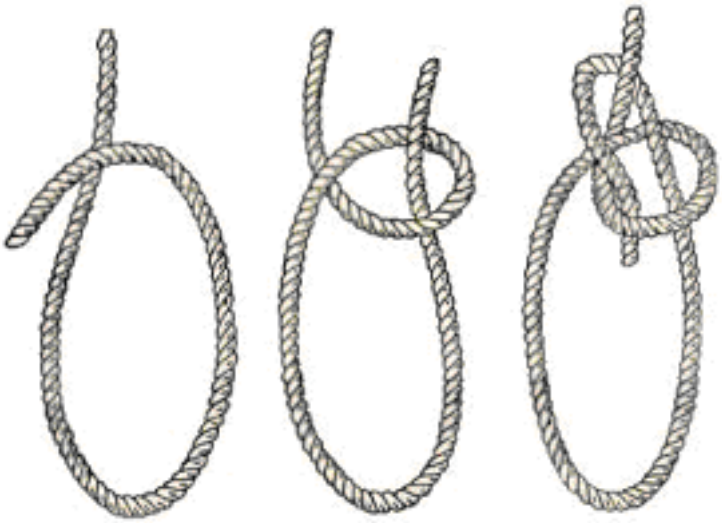
1. Fisherman's bend: Used to secure a rope to a buoy or a hawser to the ring of an anchor.
2. Rolling hitch: Used to bend a line to a spar or to the standing part of another line.
3. Round turn and two half hitches: Used to secure the end of a line made around any object.
4. Half hitch or two half hitches: Used to secure a line temporarily around any object.
5. Clove or ratline hitch: Convenient for making a line fast to a spar, the standing part of another line, or a bollard.
6. Stopper on a line: Used to check a running line.
7. Catspaw: Used to secure a line to a hook.

Overhand Knot

Figure of Eight Knot

Granny Knot

Reef or Square Knot

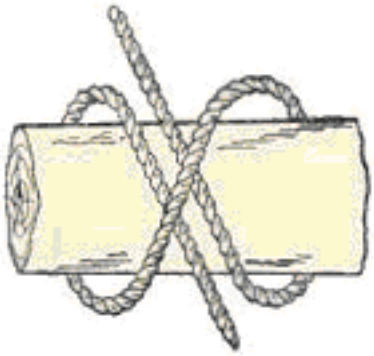


Bowline

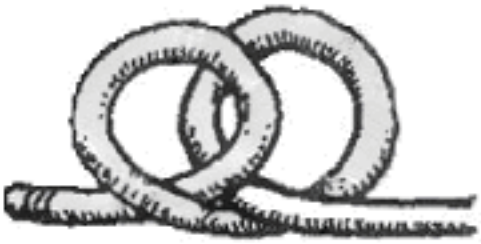
Half Hitch

Running Bowline

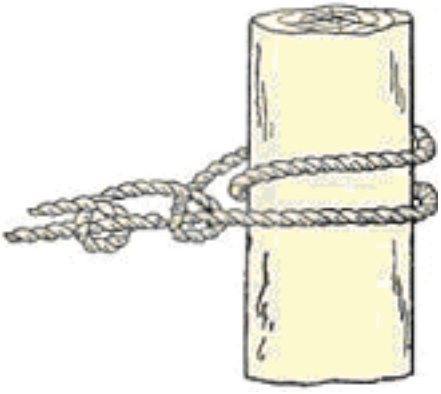
Sheep Shank



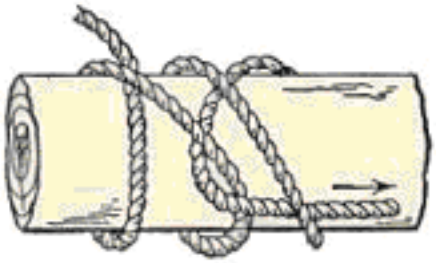
Clove Hitch



Clove Hitch



Round Turn and 2 Half Hitches



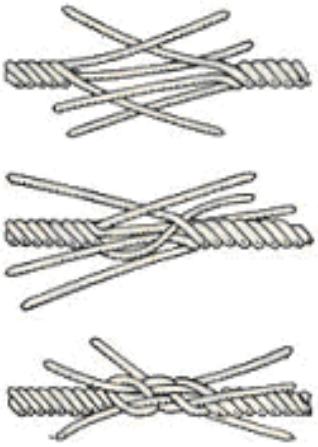
Rolling Hitch

Blackwall Hitch

Catspaw

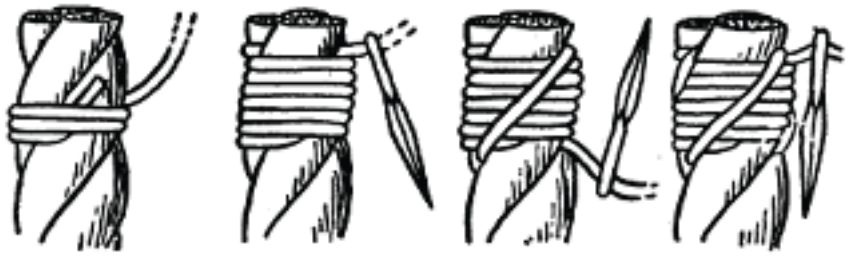
Sheet Bend

Double Sheet Bend



Short Splice

Eye Splice



Common Whipping

International Regulations For Avoiding Collisions At Sea

The Rules of the Road
Part A - General

Rule 1
Application

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

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

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

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

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

Rule 2
Responsibility

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

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

Rule 3
General Definitions

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

(a) The word “vessel” includes every description of watercraft, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.
(b) The term “power driven vessel” means any vessel propelled by machinery.

(c) The term “sailing vessel” means any vessel under sail provided that propelling machinery, if fitted, is not being used.
(d) The term “vessel engaged in fishing” means any vessel fishing with nets, lines, trawls, or other fishing apparatus which restrict maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manageability.
(e) The term “seaplane” includes any aircraft designed to maneuver on the water.
(f) The term “vessel not under command” means a vessel which through some exceptional circumstance is unable to maneuver as required by these Rules and is therefore unable to keep out of the way of another vessel.
(g) The term “vessel restricted in her ability to maneuver” means a vessel which from the nature of her work is restricted in her ability to maneuver as required by these Rules and is therefore unable to keep out of the way of another vessel.
The term “vessel restricted in her ability to maneuver” shall include but not be limited to:
(i) A vessel engaged in laying, servicing, or picking up a navigational mark, submarine cable or pipeline;
(ii) A vessel engaged in dredging, surveying or underwater operations;
(iii) A vessel engaged in replenishment or transferring persons, provisions or cargo while underway;
(iv) A vessel engaged in the launching or recovery of aircraft;
(v) A vessel engaged in mineclearance operations;
(vi) A vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.
(h) The term “vessel constrained by her draft” means a power-driven vessel which because of her draft in relation to the available depth and width of navigable water is severely restricted in her ability to deviate from the course she is following.
(i) The word “underway” means a vessel is not at anchor, or made fast to the shore, or aground.
(j) The words “length” and “breadth” of a vessel mean her length overall and greatest breadth.
(k) Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other.
(l) The term “restricted visibility” means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms and any other similar causes.
(m) The term “Wing-In Ground (WIG) craft” means a multimodal craft which, in its main operational mode, flies in close proximity to the surface by utilizing surface-effect action.

Part B - Steering and Sailing Rules

Section I - Conduct of Vessels in any Condition of Visibility

Rule 4
Application

Rules in this section apply to any condition of visibility.

Rule 5
Look-out

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

Rule 6
Safe Speed

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.
In determining a safe speed the following factors shall be among those taken into account:
(a)By all vessels:
(i)The state of visibility;

(ii) The traffic density including concentrations of fishing vessels or any other vessels;
(iii) The maneuverability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;
(iv) At night the presence of background light such as from shore lights or from back scatter from her own lights;
(v) The state of wind, sea and current, and the proximity of navigational hazards;
(vi) The draft in relation to the available depth of water.
(b) Additionally, by vessels with operational radar:
(i) The characteristics, efficiency and limitations of the radar equipment;
(ii) Any constrains imposed by the radar range scale in use;
(iii) The effect on radar detection of the sea state, weather and other sources of interference;
(iv) The possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;
(v) The number location and movement of vessels detected by radar;
(vi) The more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

Rule 7
Risk of Collision

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.
(b) Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.
(c) Assumptions shall not be made on the basis of scanty information, especially scanty radar information.
(d) In determining if risk of collision exists the following considerations shall be among those taken into account:
(i) Such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change;
(ii) Such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

Rule 8
Action to Avoid Collision

(a)Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.
(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit be large enough to be readily apparent to another vessel observing visually or by radar;
a succession of small alterations of course and/or speed shall be avoided.
(c) If there is sufficient sea room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.
(d) Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.
(e) If necessary to avoid collision or allow more time to asses the situation, a vessel may slacken her speed or take all way off by stopping or reversing her means of propulsion.
(f)(i) A vessel which, by any of these rules, is required not to impede the passage or safe passage of another vessel shall when required by the circumstances of the case, take early action to allow sufficient sea room for the safe passage of the other vessel.
(ii) A vessel required not to impede the passage or safe passage of another vessel is not relieved of this obligation if approaching the other vessel so as to involve risk of collision and shall, when taking action, have full regard to the action which may be required by the rules of this part.
(iii) A vessel the passage of which is not to be impeded remains fully obliged to comply with the rules of this part when the two vessels are approaching one another so as to involve risk of collision.

Rule 9
Narrow Channels

(a) A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.
(b) A vessel of less than 20 meters in length or a sailing vessel shall not impede the passage of a vessel which can safely navigate only within a narrow channel or fairway.
(c) A vessel engaged in fishing shall not impede the passage of any other vessel navigating within a narrow passage or fairway.
(d) A vessel shall not cross a narrow passage or fairway if such crossing impedes the passage of a vessel which can safely navigate only within such channel or fairway. The latter vessel may use the sound signal prescribed in Rule 34(d) if in doubt as to the intention of the crossing vessel.
(e)

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

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

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

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

Rule 10
Traffic Separation Schemes

(a) This rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other rule.
(b) A vessel using a traffic separation scheme shall:
(i) Proceed in the appropriate traffic lane in the general direction of traffic flow for that lane.
(ii) So far as is practicable keep clear of a traffic separation line or separation zone.
(iii) Normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.
(c) A vessel shall so far as practicable avoid crossing traffic lanes, but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.
(d)

(i)A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 meters in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.
(ii)Notwithstanding subparagraph (d)(i), a vessel may use an inshore traffic Zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.
(e) A vessel, other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:
(i) in cases of emergency to avoid immediate danger;
(ii) to engage in fishing within a separation zone.
(f) A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.

(g) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near its terminations.
(h) A vessel not using a traffic separating scheme shall avoid it by as wide a margin as is practicable.
(i) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.
(j) A vessel of less than 20 meters in length or a sailing vessel shall not impede the safe passage of a power driven vessel following a traffic lane.
(k) A vessel restricted in her ability to maneuver when engaged in an operation for the maintenance of safety of navigation in a traffic separating scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.
(l) A vessel restricted in her ability to maneuver when engaged in an operation for the laying, servicing or picking up a submarine cable, within a traffic separating scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Section II - Conduct of Vessels in Sight of One Another

Rule 11
Application

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

Rule 12
Sailing Vessels

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

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

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

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

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

Rule 13
Overtaking

(a) Notwithstanding anything contained in the Rules of Part B, Sections I and II, any vessel overtaking any other shall keep out of the way of the vessel being overtaken.
(b) A vessel shall be deemed to be overtaking when coming up with a another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights.
(c) When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.
(d) Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel within the meaning of these Rules or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

Rule 14
Head-on Situation

(a) When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of

collision each shall alter her course to starboard so that each shall pass on the port side of the other.
(b) Such a situation shall be deemed to exist when a vessel sees the other ahead or nearly ahead and by night she could see the masthead lights in line or nearly in line and/or both sidelights and by day she observes the corresponding aspect of the other vessel.
(c) When a vessel is in any doubt as to whether such a situation exists she shall assume that it does exist and act accordingly.

Rule 15
Crossing Situation

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

Rule 16
Action by Give-way Vessel

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

Rule 17
Action by Stand-on Vessel

(a)

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

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

(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.
(c) A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.
(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

Rule 18
Responsibilities Between Vessels

Except where rule 9, 10, and 13 otherwise require:
(a)A power driven vessel underway shall keep out of the way of:
(i)a vessel not under command;
(ii)a vessel restricted in her ability to maneuver;
(iii)a vessel engaged in fishing;
(iv)a sailing vessel;
(b) A sailing vessel under way shall keep out of the way of:
(i)a vessel not under command;
(ii)a vessel restricted in her ability to maneuver;
(iii)a vessel engaged in fishing;
(c)A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of:
(i)a vessel not under command;
(ii)a vessel restricted in her ability to maneuver.

(d)

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

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

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

Section III - Conduct of Vessels in Restricted Visibility

Rule 19
Conduct of Vessels in Restricted Visibility

(a) This rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.
(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and condition of restricted visibility. A power-driven vessel shall have her engines ready for immediate maneuver.
(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of Section I of this Part.
(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration in course, so far as possible the following shall be avoided:

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

(ii) An alteration of course toward a vessel abeam or abaft the beam.

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

Part C - Lights and Shapes

Rule 20
Application

(a)Rules in this part shall be complied with in all weathers.
(b) The Rules concerning lights shall be complied with from sunset to sunrise, and during such times no other lights shall be exhibited, except such lights which cannot be mistaken for the lights specified in these Rules or do not impair their visibility or distinctive character, or interfere with the keeping of a proper look-out.
(c) The lights prescribed by these rules shall, if carried, also be exhibited from sunrise to sunset in restricted visibility and may be exhibited in all other circumstances when it is deemed necessary.
(d) The Rules concerning shapes shall be complied with by day.
(e) The lights and shapes specified in these Rules shall comply with the provisions of Annex I to these Regulations.

Rule 21
Definitions

(a)”Masthead light” means a white light placed over the fore and aft centerline of the vessel showing an unbroken light over an arc of horizon of 225 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the vessel.
(b) “Sidelights” means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of horizon of 112.5 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the

beam on the respective side. In a vessel of less than 20 meters in length the sidelights may be combined in one lantern carried on the fore and aft centerline of the vessel.
(c) "Sternlight", means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of horizon of 135 degrees and so fixed as to show the light 67.5 degrees from right aft on each side of the vessel.
(d) "Towing light" means a yellow light having the same characteristics as the "sternlight" defined in paragraph (c) of this Rule.
(e) "All round light" means a light showing an unbroken light over an arc of horizon of 360 degrees.
(f) "Flashing light" means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.

Rule 22
Visibility of Lights

The lights prescribed in these Rules shall have an intensity as specified in Section 8 of Annex I to these Regulations so as to be visible at the following minimum ranges:
(a) In vessels of 50 meters or more in length:
a masthead light, 6 miles;
a sidelight, 3 miles;
a towing light, 3 miles;
a white red, green or yellow all-around light, 3 miles.
(b)In vessels of 12 meters or more in length but less than 50 meters in length;
a masthead light, 5 miles; except that where the length of the vessel is less than 20 meters, 3 miles;
a sidelight, 2 miles;
a sternlight, 2 miles, A towing light, 2 miles;
a white, red, green or yellow all-round light, 2 miles.
(c) In vessels of less than 12 meters in length:
a masthead light, 2 miles;
a sidelight, 1 miles;
a towing light, 2 miles;
a white red, green or yellow all-around light, 2 miles.
(d) In inconspicuous, partly submerged vessels or objects being towed;
a white all-round light; 3 miles.

Rule 23
Power-driven Vessels Underway

(a)A power-driven vessel underway shall exhibit:
(i) a masthead light forward;
(ii) a second masthead light abaft of and higher than the forward one;
except that a vessel of less than 50 meters in length shall not be obliged to exhibit such a light but may do so;
(iii) sidelights: and
(iv) a sternlight.
(b) An air-cushion vessel when operating in nondisplacement mode shall, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit an all-round flashing yellow light.
(c)
(i) A power-driven vessel of less than 12 meters in length may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and sidelights.
(ii) a power-driven vessel of less than 7 meters in length whose maximum speed does not exceed 7 knots may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and shall, if practicable, also exhibit sidelights.
(iii) the masthead light or all-round white light on a power-driven vessel of less than 12 meters in length may be displaced from the fore and aft centerline of the vessel if centerline fitting is not practicable,

provided the sidelights are combined in one lantern which shall be carried on the fore and aft centerline of the vessel or located as nearly as practicable in the same fore and aft line as the masthead light or all-round white light.

Rule 24
Towing and Pushing

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

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

(ii) sidelights;

(iii) a sternlight;

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

and

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

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

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

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

(ii) sidelights;

(iii) a sternlight.

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

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

(i) sidelights;

(ii) a sternlight;

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

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

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

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

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

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

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

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

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

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

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

Rule 25
Sailing Vessels Underway and Vessels Under Oars

(a) a sailing vessel underway shall exhibit:

(i) sidelights;

(ii) a sternlight.

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

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

(d)

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

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

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

Rule 26
Fishing Vessels

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

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

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

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

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

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

(i) two all-round lights in a vertical line, the upper being red and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel of less than 20 meters in length may instead of this shape exhibit a basket;

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

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

(d) A vessel engaged in fishing in close proximity to other vessels engaged in fishing may exhibit the additional signals described in Annex II to these Regulations.

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

Rule 27
Vessels Not Under Command or Restricted in Their Ability to Maneuver

(a) A vessel not under command shall exhibit:

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

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

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

(b) A vessel restricted in her ability to maneuver, except a vessel engaged in mineclearance operations, shall exhibit:

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

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

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

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

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

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

(i) two all-round red lights or two balls in a vertical line to indicate 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 at anchor, the lights or shapes prescribed in this paragraph instead of the lights or shapes prescribed in Rule 30.

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

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

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

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

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

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

Rule 28
Vessels Constrained by their Draft

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

Rule 29
Pilot Vessels

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

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

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

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

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

Rule 30
Anchored Vessels and Vessels Aground

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

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

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

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

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

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

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

(ii) three balls in a vertical line.

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

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

Rule 31
Seaplanes

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

Part D - Sound and Light Signals

Rule 32
Definitions

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

(b) The term “short blast” means a blast of about one second’s duration.

(c) The term “prolonged blast” means a blast from four to six seconds’ duration.

Rule 33
Equipment for Sound Signals

(a) A vessel of 12 meters or more in length shall be provided with a whistle and a bell and a vessel of 100 meters or

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

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

Rule 34
Maneuvering and Warning Signals

(a) When vessels are in sight of one another, a power-driven vessel under way, when maneuvering as authorized or required by these Rules, shall indicate that maneuver by the following signals on her whistle:
one short blast to mean "I am altering my course to starboard";
two short blasts to mean "I am altering my course to port";
three short blasts to mean "I am operating astern propulsion".
(b) Any vessel may supplement the whistle signals prescribed in paragraph (a) of this Rule by light signals, repeated as appropriate, whilst the maneuver is being carried out:

(i) these signals shall have the following significance:
one flash to mean "I am altering my course to starboard";
two flashes to mean "I am altering my course to port";
three flashes to mean "I am operating astern propulsion".
(ii) the duration of each flash shall be about one second, the interval between flashes shall be about one second, and the interval between successive signals shall not be less than ten seconds.
(iii) the light used for this signal shall, if fitted, be an all-round white light, visible at a minimum range of 5 miles, and shall comply with the provisions of Annex I to these Regulations.

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

(i) a vessel intending to overtake another shall in compliance with Rule 9 (e)(i) indicate her intention by the following signals on her whistle.
two prolonged blasts followed by one short blast to mean "I intend to overtake you on your starboard side";
two prolonged blasts followed by two short blasts to mean "I intend to overtake you on your port side".
(ii) the vessel about to be overtaken when acting in accordance with 9(e)(i) shall indicate her agreement by the following signal on her whistle:
one prolonged, one short, one prolonged and one short blast, in that order.

(d) When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle. Such signal may be supplemented by at least five short and rapid flashes.
(e) A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel that may be within hearing around the bend or behind the intervening obstruction.
(f) If whistles are fitted on a vessel at a distance apart of more than 100 meters, one whistle only shall be used for giving maneuvering and warning signals.

Rule 35
Sound Signals in Restricted Visibility

In or near an area of restricted visibility, whether by day or night the signals prescribed in this Rule shall be used as follows:
(a) A power-driven vessel making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast.
(b) A power-driven vessel underway but stopped and making no way through the water shall sound at intervals of no

more than 2 minutes two prolonged blasts in succession with an interval of about 2 seconds between them.
(c) A vessel not under command, a vessel restricted in her ability to maneuver, a vessel constrained by her draft, a sailing vessel, a vessel engaged in fishing and a vessel engaged in towing or pushing another vessel shall, instead of the signals prescribed in paragraph (a) or (b) of this Rule, sound at intervals of not more than 2 minutes three blasts in succession, namely one prolonged followed by two short blasts.
(d) A vessel engaged in fishing, when at anchor, and a vessel restricted in her ability to maneuver when carrying out her work at anchor, shall instead of the signals prescribed in paragraph (g) of this Rule sound the signal prescribed in paragraph (c) of this Rule.
(e) A vessel towed or if more than one vessel is being towed the last vessel of the tow, if manned, shall at intervals of not more than 2 minutes sound four blasts in succession, namely one prolonged followed by three short blasts. When practicable, this signal shall be made immediately after the signal made by the towing vessel.
(f) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and shall give the signals prescribed in paragraphs (a) or (b) of this Rule.
(g) A vessel at anchor shall at intervals of not more than 1 minute ring the bell rapidly for five seconds. In a vessel 100 meters or more in length the bell shall be sounded in the forepart of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about 5 seconds in the after part of the vessel. A vessel at anchor may in addition sound three blasts in succession, namely one short, one long and one short blast, to give warning of her position and of the possibility of collision to an approaching vessel.
(h) A vessel aground shall give the bell signal and if required the gong signal prescribed in paragraph (g) of this Rule and shall, in addition, give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell. A vessel aground may in addition sound an appropriate whistle signal.
(i) A vessel of less than 12 meters in length shall not be obliged to give the above mentioned signals but, if she does not, shall make some other efficient sound signal at intervals of not more than 2 minutes.
(j) A pilotage vessel when engaged on pilotage duty may in addition to the signals prescribed in paragraph (a), (b) or (g) of this Rule sound an identity signal consisting of four short blasts.

Rule 36
Signals to Attract Attention

If necessary to attract the attention of another vessel, any vessel may make light or sound signals that cannot be mistaken for any signal 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 Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation. For the purpose of this Rule the use of high intensity intermittent or revolving lights, such as strobe lights, shall be avoided.

Rule 37
Distress Signals

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

Part E - Exemptions

Rule 38
Exemptions

Any vessel (or class of vessel) provided that she complies with the requirements of the International Regulations for the Preventing of Collisions at Sea, 1960, the keel of which is laid or is at a corresponding stage of construction before the entry into force of these Regulations may be exempted from compliance therewith as follows:
(a) The installation of lights with ranges prescribed in Rule 22, until 4 years after the date of entry into force of these regulations.
(b) The installation of lights with color specifications as prescribed in Section 7 of Annex I to these Regulations, until

4 years after the entry into force of these Regulations.
(c) The repositioning of lights as a result of conversion from Imperial to metric units and rounding off measurement figures, permanent exemption.
(d)

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

(e) The repositioning of masthead lights resulting from the prescriptions of Section 2(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.
(f) The repositioning of sidelights resulting from the prescriptions of Section 2(g) and 3(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.
(g) The requirements for sound signal appliances prescribed in Annex II to these Regulations, until 9 years after the date of entry into force of these Regulations.
(h) The repositioning of all-round lights resulting from the prescription of Section 9(b) of Annex I to these Regulations, permanent exemption.

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International Yacht Training

WORLDWIDE

Suite 482, 9-3151 Lakeshore Road
Kelowna, British Columbia, V1W3S9 Canada
Tel: +778-477-5668 Fax: +778-477-5526
support@iytworld.com - www.iytworld.com