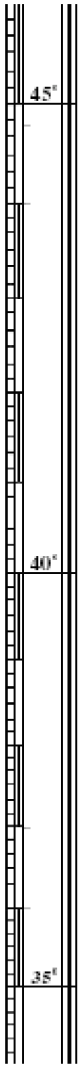
Charts

The basic for plotting positions and reading charts.



Nautical Charts

Admiralty charts supplied by International Hydrographic Bureau, contain the most relevant information for Divers. Any late amendments are coloured Magenta and are published in Admiralty Notice to Mariners.

They come in two main scales:

- Small scale = large area, little detail
- Large scale = small area, lots of detail

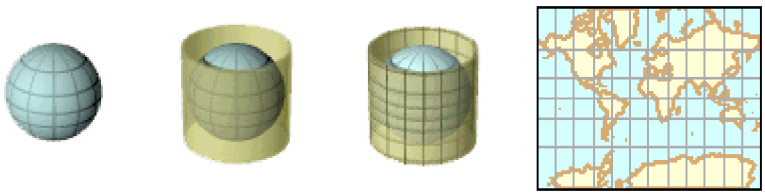
The nautical chart is an image of a part of the earth in two dimensions. This reproduction is a two dimensional image of a part of the earth, which is of course 3 dimensional. This results in various distortions, but as long as two requirements are met we can use this image for navigational purposes. Firstly, the angles between three object in the chart should be the same as the angles between the real objects which they represent. Secondly, a straight course should appear as a straight line in the chart.

To fulfil these demands our chart ought to have both parallels & meridians which are straight and parallel. As such the meridians & parallels will be perpendicular to each other.

Mercator Projection

A well known method to create such a chart is called the Mercator Projection after Gerard Kremer (Mercator), a Flamish scholar who studied in 's Hertogenbosch and Leuven. In 1569 he invented the projection which made him famous. His chart was designed for sailors and constructed by wrapping a cylinder around the planet so that it touches the equator. On this cylinder the surface of the earth is projected and finally the cylinder is cut open to yield our chart. But where the meridians converge on the globe they run parallel in the projection (see chart below), indicating the distortion. Look, for example, at a high parallel. The length of such a parallel on the globe is much smaller than the equator. Yet, on the chart they have exactly the same length creating a

distortion which gets bigger nearer to the poles. The figure below shows us the construction of the mercator projection. From this it is clear that only the vertical scales should be used for measuring distances.



The vertical scale depicted on the right demonstrates the distortion. While the two little gray markers have the same size, the upper one measures only 0.71 degrees. So, distances (in miles or in minutes) should not only be read on the vertical scale, but also at approximately the same height.

The horizontal scale is only valid for one latitude in the chart and can therefore only be used for the coordinates (a point, but not a line). If you divide the surface of the earth in eight pieces, and lift one out and project it, you end up with the figure below. The result is that both A-A' and B-B' are now as long as the bottom of the chart and are 'too long'.

Organization of the Chart

Charts should contain the following information:

- **Authority:** The publisher responsible for the information in the chart. "British Admiralty Charts" or "Imray Charts". Check their corrections.
- **Title:** The Title gives a description of the area covered by the chart. For example: " The Mediterranean Sea".
- **Number:** Different chart types of the same area can be distinguished by the chart's number.
- **Projection:** Most likely the Mercator projection as described above. Charts covering small areas can be constructed by stereographic projection.
- **Scale:** For example: 1:193000. But since the chart is distorted this holds only for one specific latitude in the chart. The scale gives an indication of how detailed the chart is.

- **Horizontal Geodetic Datum:** The definition of the relationship between the ellipsoid adopted as the model of the Earth's shape, and the Earth itself. Though there are hundreds of datum's in use, most are only locally valid.
- **The WGS-84 datum** is global in scope and positions obtained by satellite navigation systems are usually referred to this datum. Therefore a correction needs to be applied to a WGS-84 GPS position to agree with charts using other horizontal datum's. For example to correct WGS-84 to the European datum, add 0.06'N, 0.04'E to the WGS-84 position indicated by the GPS. Fortunately, most GPS receivers may be set to display positions in several other datum's besides WGS-84.
- **Chart Sounding Datum:** The tidal datum to which soundings and drying heights on a chart are referred. Often shortened to 'chart datum' when it is clear that reference is not being made to a horizontal datum. Chart Sounding Datum's are also used as reference for heights (lighthouses, mountains, bridges). Multiple datum's can be used in one chart: LAT for soundings and ML for heights.
- **Soundings & Height Units:** Soundings and Heights can be stated in -for example- meters, feet or fathoms. Nowadays even most British charts use the metric system.
- **Horizontal Scale:** Natural scale at for example 40° 15',0 latitude where the horizontal scale can be used for measuring distances and were the chart scale is true.
- **GPS compatibility:** Most charts neither have the precision nor the resolution to fully use the (differential) GPS positioning potential. Moreover, still plenty of charts result from surveys done in the 19th century. Also, GPS data often requires a correction for a local horizontal chart datum before it can be used in the chart.
- **Corrections & Edition:** The chart is for example an 1996 edition but is - when properly corrected - still valid in 2000. Corrections are published several times and should be mentioned in the bottom left corner of the chart.

Information in the Chart

- **Depths reduced to Chart Datum:** A sounding like (35) indicates 3,5 meters of water above Lowest Astronomical Tide (if the unit is 'meters' and the chart datum is 'LAT'). An underlined sounding like (04) indicates a height of 40 cm at LAT which has fallen dry.
- The blue contour lines on a chart indicate a depth of 2m or 5m. 10m and 20m can either be all blue or blue on the landward side.
- The green patches on the coastline of a chart indicate where land covers and uncover in the tidal range.
- **Isobaths:** Lines connecting positions with the same depth: depth contours.
- **Heights reduced to Chart Datum:** Heights of for instance, lighthouses, mountains and cliffs are more often reduced to another datum such as Mean High Water (MHW) or Mean High Water Spring.
- **Tidal information:** Details of both the horizontal and the vertical movement of the water is often in included in the chart.
- **Buoys & Marks:** Lightships, lateral and cardinal marks.
- **Seabed qualities:** Pebbles, seaweed, rocks, wrecks, pipelines.
- **Lighthouses:** Their height, colour, range, and other properties.
- **Magnetic Variation:** The angle between the true North and the magnetic North varies in place and time. The variation is indicated in the compass card.
- **Churches, Radio masts, mountain tops, etc.** These can all be used for navigation and are marked in the chart.

Chart and Coordinates

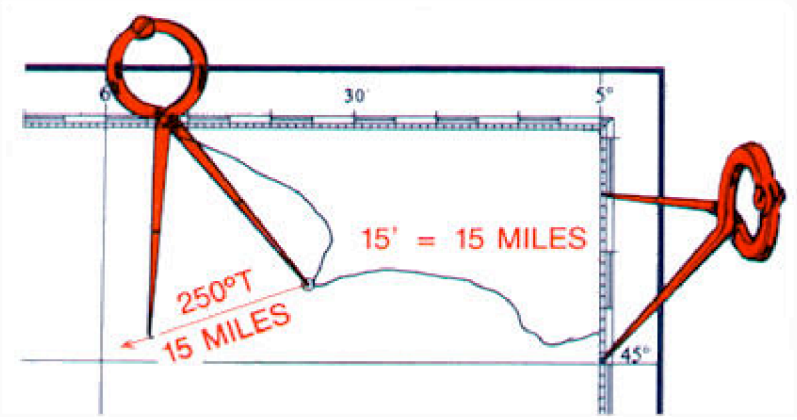
We use a pair of nautical dividers to obtain precise coordinates from the chart. This gadget enables you to take the distance between that particular position and the closest grid line. You then place the dividers on the scale with one end on this grid line, leaving the other end precisely at your coordinate. Do this twice to get both Latitude and Longitude. Below are some examples. To find a position on the chart is

of course done by reversing this method. Some chart symbols come with a little circle indicating their precise location (see visible wreck).

- Visual Wreck 40° 04',8 N , 24° 52',0 E
- Tower 39° 55',0 N , 24° 58',0 E
- Dangerous! Wreck 39° 52',8 N , 24° 42',2 E
- Good Anchorage 39° 58',5 N , 24° 55',7 E
- Buoy with red Light 39° 52',5 N , 24° 37',2 E

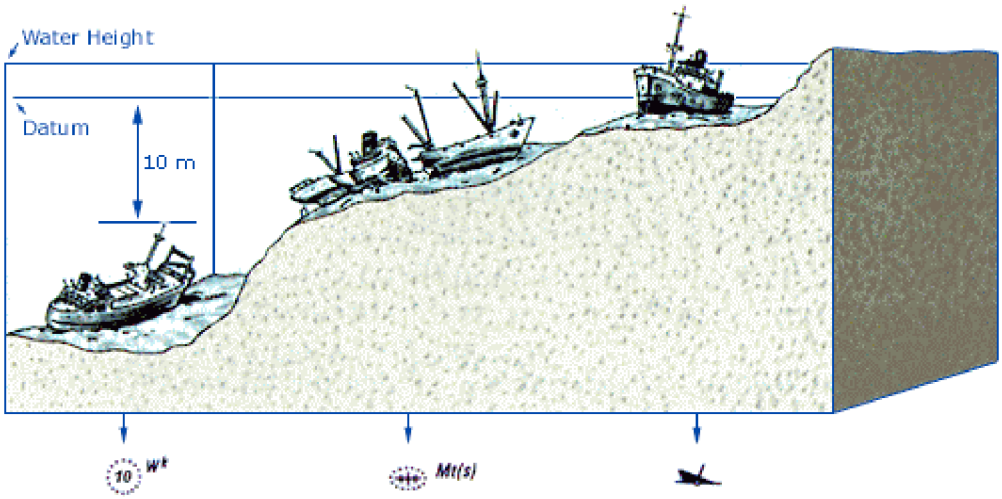
Measuring Distances

To measure the distances between, for instance, these two points, we will again need our dividers. Remember, we can only use the vertical scale. We first measure the distance using the divider and then measure the distance on the nearest vertical scale i.e., latitude.



Important Symbols

Symbol	Meaning	Symbol	Meaning
	Super(light)buoy, Lanby.		Light Buoy
	Lateral green starboard hand buoy		Lateral red port hand buoy
	Safe water mark (red/white)		Cardinal buoy, West mark
	Stone; drying height above chart datum		Foul seabed, avoid anchoring here
	Danger, least depth by sounding		Danger, depth swept by wire drag
	Wreck visible at chart datum		Wreck showing Mast(s) above chart datum
	Dangerous! Wreck, depth unknown		Wreck, not dangerous (10 m below chart datum)
	Danger line, in general		Position for which tidal stream data are tabulated
Obstn	Obstruction	PA	Position Approximate
FL 42m 29M	Flashing light, 42 meters above datum, range 29'	LFl 10s	Long flashing light, period 10 seconds



Types of sea bottom

In a combined list of bottom types, the main constituent is given first.

Sea Bed Types		Qualifying terms	
S	Sand	f	Fine
M	Mud	m	Medium
Cy	Clay	c	Coarse
Si	Silt	bk	Broken
St	Stones	sy	Sticky
G	Gravel	so	Soft
P	Pebbles	st	Stiff
Cb	Cobbles	v	Volcanic
R	Rock	ca	Calcerous
Co	Coral	h	Hard
Sh	Shells		
Wd	Weed		
S/M	Sand over mud (2 layers)		

The Chart 5011 contains the symbols and abbreviations used on all Admiralty Charts.