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Boating Tip #6: Plotting Tools

In order to navigate safely, you need certain tools. Plotting tools which should be aboard every boat include: paper charts, a magnetic compass and a separate hand bearing compass, parallel rulers or a course plotter, a triangle, dividers, pencil and eraser, depth sounder, knot meter, and a clock. A magnifying lens, binoculars, and calculator are also recommended. Reference books such as GPS waypoints, the Coast Pilot, current and tide tables, light lists, cruising guide, Chart #1, Navigation Rules, and Local Notice to Mariners will also provide valuable information in helping you to navigate.

Traditionalists may have celestial navigation instruments, including a sextant aboard. On a modern recreational vessel you may also have electronic instruments to help you navigate, such as: global positioning system (GPS), radio direction finder (RDF), radio detecting and ranging (RADAR), sonic ranging (SONAR), long range navigation (LORAN), chartplotters or a computer with navigation software and raster or vector charts installed.

Charts

Charts are maps designed for navigating on the water. U.S. charts are published by the National Ocean Service (NOS), a division of the National Oceanic & Atmospheric Administration (NOAA), an agency of the U.S. Government. Charts show soundings, fathom curves that connect points of equal depth, shoreline, landmarks, buoys, light visibility range, positioning of aids to navigation, heights, traffic separation schemes, and hazards. The correction date of the last weekly Notice to Mariners applied to the chart is shown on the lower left border of the chart. Paper charts, waterproof paper charts, spiral bound chart books, and computerized charts are also available.

Mercator projection charts are most commonly used for coastal navigation. Flemish geographer, astronomer, theologian and cartographer Gerhard Kramer (AKA: Gerhardus Mercator) published his first, very accurate for its time, worldwide ocean navigation chart in 1569. Mercator charts are cylindrical projections tangent to the earth at the equator then flattened out. They allow latitude and longitude from a spherical earth to appear as horizontal and vertical lines on a flat chart. Relative size of features on the chart are distorted, but correct angular relationships between points on the chart is maintained. Most importantly, they permit sailing from point to point on a straight

course.

Charts come in three types: general or small scale charts, coast or medium scale charts, and harbor or large scale charts. Large scale charts cover a small geographic area, while small scale charts cover a large area in great detail. Scale is written as a ratio. For example, a chart scale of 1: 50,000 scale means 1" on the chart is equal to 50,000 real inches.

In order to interpret the information and symbols on a chart, refer to Chart #1. Today Chart #1 entitled "Nautical Chart Symbols, Abbreviations and Terms, USA" is published in booklet form. It includes 5 sections (general, topography, hydrography, aids and services, and an alphabetic index), and 24 subsections:

General	
A	Chart Number, Title, Margin Notes
B	Positions, Distances, Directions, Compass
Topography	
C	Natural Features
D	Cultural Features
E	Landmarks
F	Ports
G	Topographical Terms
Hydrography	
H	Tides, Currents
I	Depths
J	Nature of the Seabed
K	Rocks, Wrecks, Obstructions
L	Offshore Installations
M	Tracks, Routes
N	Areas, Limits
O	Hydrographic Terms
Aids and Services	
P	Lights
Q	Buoys, Beacons
R	Fog Signals
S	Radar, Radio, Electronic Position-Fixing
Systems	
T	Services
U	Small Craft Facilities
Alphabetical Indexes	
V	Index of Abbreviations
W	International Abbreviations
X	List of Descriptors

Finding Compass Course

A magnetic compass uses the earth's magnetic force to determine direction the boat is heading. It is a simple and reliable device. A magnetic compass will usually continue to operate even if there is a power failure, fire, collision, or grounding. Use the compass card for reading course direction while looking at the lubbers line. The lubbers line is a reference mark on the inside of the compass bowl that is aligned with the ship's keel. The binnacle is the non magnetic housing which supports the compass.

A hand bearing compass allows you to simultaneously look at an object and the compass scale. Readings taken from a hand bearing compass allow you to determine the bearing or direction of another object in relation to your position on the boat. A hand bearing compass can help you plot your position, can be used to determine if you are on a collision course with another boat, and can tell you if you are dragging at anchor.

Finding Direction

Course plotters are clear, rectangular straight edges, overlayed with protractor scales and parallel lines. To use a plotter, place the plotter on the chart and align the straight (top) edge along the course. Roll or slide the plotter across the chart by applying pressure with one hand, so the center point on the compass printed on the plotter is on any meridian. Read the course at the point on the edge of the compass that lies on the meridian to determine direction. Similarly, parallel rules can be walked across the chart from the DR to a compass rose printed on the chart.

A triangle can be used instead of a compass rose to determine direction. Keeping aligned with your parallel plotter, move the triangle to a meridian. When 0 touches a meridian, read the edge of the compass to determine direction. Remember "East is least. West is best." When heading in an easterly direction read the numbers less than 180°. When heading in a westerly direction, read the numbers greater than 180° on the triangle. Chart lines are always drawn in relation to true north, but you steer a compass course. Remember to convert.

Measuring Distance

Dividers are used for measuring distance. For accurate measurements, make sure the leg points are sharp. Open and close dividers with one hand. Extend the legs and place one leg of the dividers on location A and the other leg of the dividers on location B. Take the extended dividers, without changing their spacing, to the nearest latitude scale on the side of the chart and count the distance. Remember 1 minute of latitude equals 1 nautical mile. Or, extend the dividers to a known distance using the bar scales, then walk the dividers along the course. Dividers can also be used to measure the location of a point using the closest line of latitude and longitude.

Measuring Speed

In the olden days, speed was measured with a chip log. A chip log was a piece of wood attached to a line with evenly spaced knots. The knots were counted as they paid out behind the stern of the ship over a certain amount of time. Today, boat speed, a measure of boat movement through the water, is measured with a knotmeter. A knotmeter is an impeller type underwater log. It uses a propeller which spins as the boat moves through the water. This produces an electrical impulse which is converted to a digital reading used to measure speed through the water. The paddlewheel is easily clogged with marine growth and needs frequent cleaning. To clean, remove the through hull paddlewheel, and temporarily replace it with the blank plug. After cleaning with a wire brush, remember to replace the paddlewheel facing the bow and in line with the keel from bow to stern.

Speed over ground is affected by current and wind, so boat speed through the water, and speed over ground are not necessarily the same. A GPS tells you speed over ground.

Measuring Depth

In the olden days, depth was measured using a hand lead line which was lowered to the bottom. Today, a fathometer (also known as a depthfinder or depth sounder) transmits a sound signal vertically and measures the time between the transmission of the signal and the return of the echo after bouncing off the bottom. Average speed of sound waves is 800 fathoms per second. Depth is half the distance the sound waves traveled. Depthfinders show present depth below the vessel on a digital display. Depthfinders that provide a graphic display of the boat's path through the water are also available. Many depthfinders have shallow water alarms that you can set at a specific depth to warn you that you are entering shallow water, prior to running aground. Since the signal is sent from the bottom of the keel, depths recorded by the fathometer should be depth below the keel, not from below the waterline.