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Introduction: Getting Organized

Before we start the clock, let's take a little time out to get organized. The materials you will need to learn celestial navigation using the concepts in this book include:

Pencils. Several, number 2, sharpened, with erasers.

Workforms. Make your own or order preprinted forms from a nautical supply store. (See list of suppliers below.)

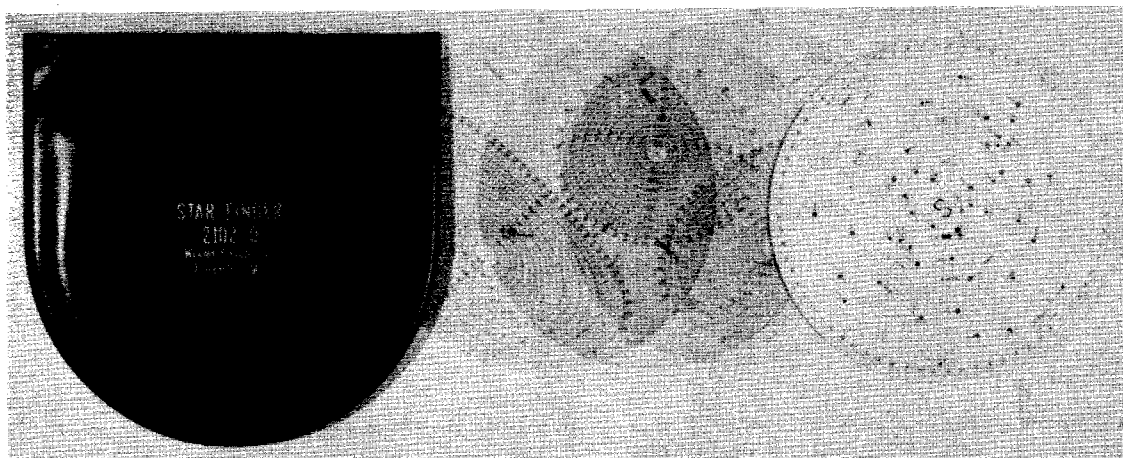
TR 1210 training chart. The standard U.S. training chart 1/80,000 scale covering Martha's Vineyard to Block Island. This chart, which is used to re-

view piloting and dead reckoning, is available at navigation supply stores or from local Power Squadrons.

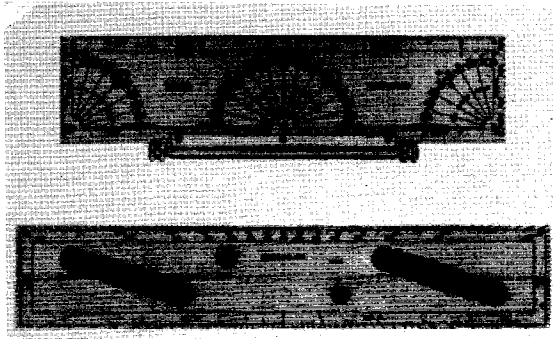
Universal Plotting Sheet VP-OS X001. Available in pads of 50 at navigation supply stores.

Starfinder, 2102-D. A base plate with plastic discs that help identify stars. The book also shows you how the H. O. 229 table can be used to identify stars and planets. This item is optional.

Parallel plotter or parallel rules. A basic plotting tool used to transfer direction on a chart.



The starfinder is a base plate and a series of plastic discs which are used to determine the approximate sextant angle and direction of the 57 navigation stars. Courtesy Weems & Plath, Inc.

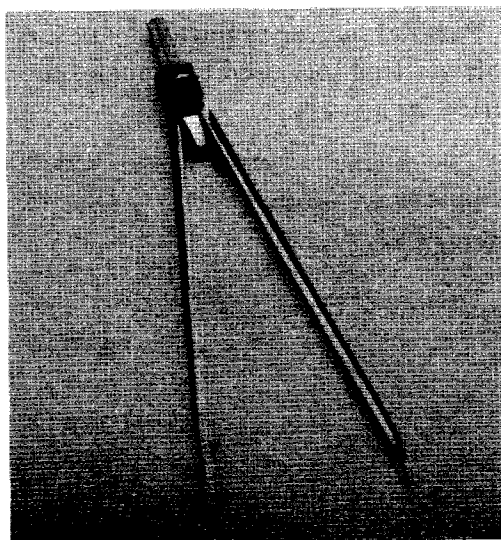


The parallel plotter, *top*, or parallel rules, *bottom*, help the navigator transfer direction lines on the chart. The parallel plotter is particularly useful for constructing celestial lines of position. Courtesy Weems & Plath, Inc.

Dividers. A tool used to measure distances and locate positions on a chart.

Volume III of H. O. 229. Selected excerpts from Volume III have been reprinted as Appendix 3 so you can work the example problems with the information in this book. To work practice problems, however, you will need Volume III.

Nautical Almanac for 1983. Excerpts of the 1983 almanac have been reprinted as Appendix 2. You can work all of the example and practice problems using the almanac data supplied with this book.



Dividers measure distance on a nautical chart. They are also useful in determining the latitude and longitude of a point on a chart, given its coordinates. Courtesy Weems & Plath, Inc.

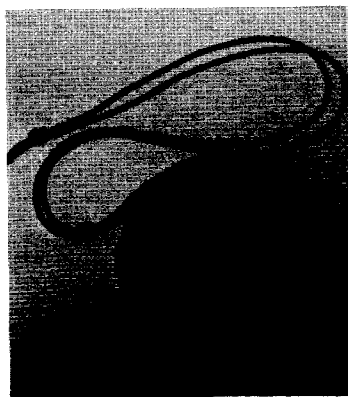


An accurate timepiece, like this Tamaya MQ-Z quartz crystal chronometer, is essential for celestial navigation. This chronometer is accurate to within ± 4.5 seconds per month. Courtesy Tamaya, Ltd., Tokyo.

Once you finish the book and begin to practice celestial navigation you will need some additional equipment including:

Nautical Almanac for the current year.

Charts of the area in which you are sailing.



A handbearing compass is useful not only in piloting but also for celestial navigation. In celestial navigation, the handbearing compass is used to obtain the approximate direction of stars. Courtesy Weems & Plath, Inc.

An accurate timepiece.
 Radio receiver or RDF which can pick up time signals.
 Handbearing compass.
 Knotmeter and distance log.

Choosing a Sextant

The most expensive—and important—piece of gear needed for celestial navigation is the sextant. The sextant is used to measure the angle between the celestial body and the edge of the sea.

In selecting a sextant, the first decision you must make is whether to buy a plastic or metal one.

The advantages of plastic sextants are low cost and light weight. On the negative side, plastic sextants are less accurate and less durable than metal sextants. But how accurate must a sextant be? How much must you spend to get an

instrument that will get you close enough to find a lighthouse or an island?

Top quality metal sextants have instrument certificates guaranteeing that they are within + or - 10" (10 seconds) of arc, meaning for all practical purposes they are error free.

While plastic sextants do not come with instrument certificates, some I have tested gave results within + or - 2.0' (2 miles) of the best metal sextants. The Davis Mark 25 plastic sextant is rated as the best plastic sextant on the market. It is also the only plastic sextant that I would recommend as an alternative to a metal sextant. Since the average yachtsman will have observer errors due to sextant misalignment, wave action, and motion on the order of 5 to 8 miles, a plastic sextant that is accurate to within 1 to 2 miles is acceptable.

There are three things to remember about plastic sextants.



A reliable distance log, like this Walker KDO Knotmaster Log for boats up to 40 feet, helps the offshore navigator maintain an accurate dead-reckoning position. Courtesy Weems & Plath, Inc.

1. The working parts involve plastic rubbing against plastic. Over time, this causes wear and adversely affects the accuracy of the instrument.

2. Plastic—much more than metal—is affected by changes in temperature. A plastic sextant left on deck in direct sunlight may give you a different reading than the same instrument which wasn't heated by the sun.

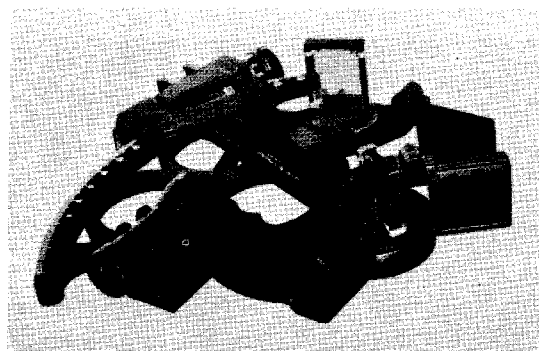
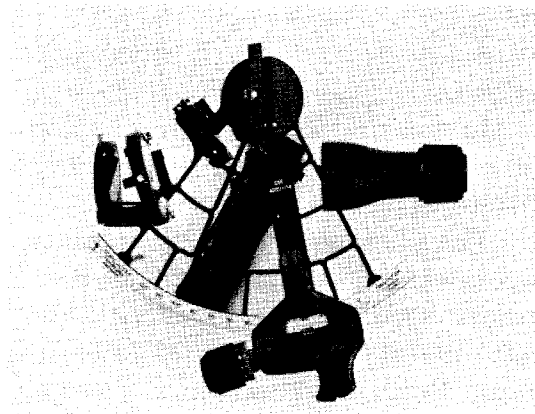
3. Plastic sextants go out of adjustment more easily than metal sextants. Therefore, the mirrors on a plastic sextant should be adjusted each time the instrument is used. This is no problem, really, but you must remember to check the mirror alignment frequently.

When you buy a sextant you are buying two systems. The mechanical system consists of a frame, index arm, release clamp, micrometer drum, and worm gears. The optical system consists of the shade glasses, mirrors, and scope. The mechanical system should operate smoothly. When you release the clamp, the gears should click solidly in place. There should be little or no movement in the index arm when the release clamp and gears are engaged.

Good sextants have optical quality shades, mirrors, and scopes. This eliminates light distortion and improves accuracy. You should look for a sextant with large index and horizon mirrors. These admit more light and help you obtain sights in difficult conditions.

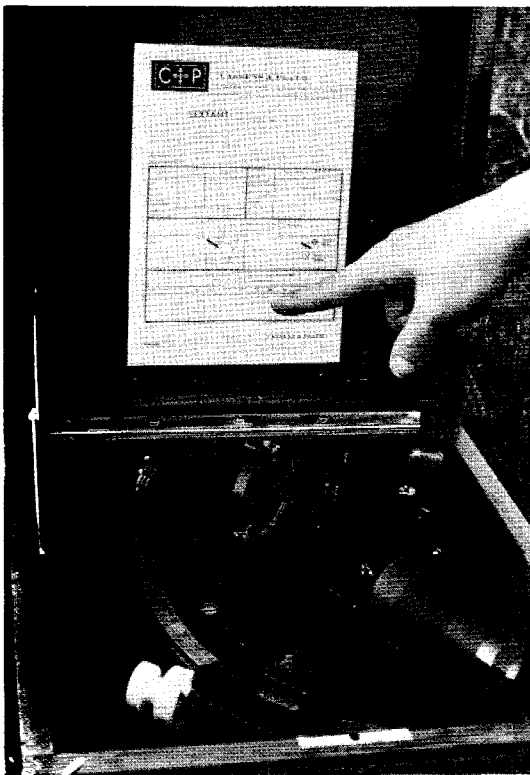
A wide range of shade glasses is useful. The standard sextant comes with four shades on the index mirror and three shades on the horizon mirror. A sextant with variable density shades is a better choice than one fitted with a single polarizing filter. If you try to use a polarizing filter on a pitching, rolling boat, the movement of the vessel changes the angle of the filter which affects the amount of light that comes to your eye.

A sextant should feel comfortable in your hand. It should be well balanced, with the handle angled slightly to fit your grip. Since sextants come in a variety of weights, you can choose one to suit your liking. A sextant that is too light may not be steady enough. One that is too heavy can cause fatigue. Metal sextants now come in lightweight aluminum alloys as well as the heavier traditional brass.



These photos illustrate the wide range of choices you have when considering a sextant. The Weems & Plath metal sextant, *top*, has a 4 × 40 scope and whole horizon mirrors. The Davis Mark 25 plastic sextant, *bottom*, has a 3-power scope and whole horizon mirror. Courtesy Weems & Plath, Inc. and Davis Instruments.

Once you have made your decision about plastic versus metal, you have to decide on the following features: type of mirrors; type of scope; lighted or unlighted arc and drum; and whether or not you want a prism level.



Metal sextants, like this Cassens & Plath, have instrument certificates mounted inside the lid of the sextant case.

Whole horizon versus half-silvered mirrors: The new whole horizon mirror superimposes both the horizon and the celestial body on the entire mirror. This gives you the whole viewing surface of the mirror to work with.

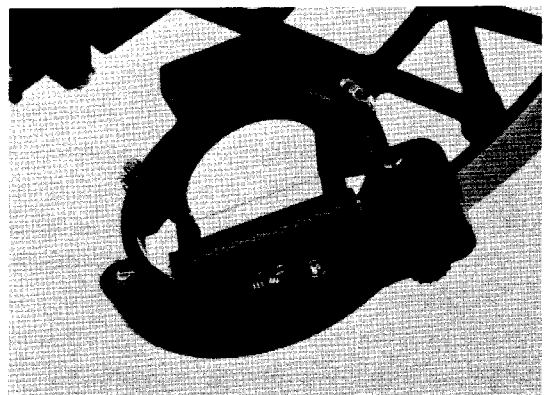
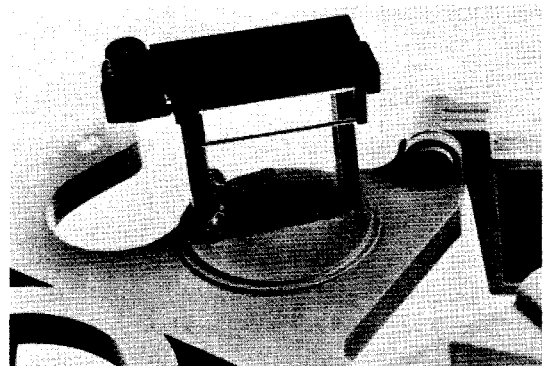
Traditional sextants show the celestial body through a half-silvered mirror while viewing the horizon through the clear half. As a result, you end up working with about half the viewing surface of the horizon mirror.

Whole horizon sextants use specially coated optics to obtain their effect. The coating reduces by a small amount the light coming through the horizon mirror. Traditional sextants with an uncoated horizon glass transmit a bit more light but give you less viewing area. I've used both, and give a slight nod to the whole horizon sextants. The larger viewing surface makes it easier to find stars and

planets and helps you bring the body tangent to the horizon.

Whole horizon mirrors are available as original equipment on new plastic or metal sextants or as conversion kits for metal sextants. The whole horizon feature goes by several different trade names, depending on the sextant manufacturer: Weems & Plath call it Fulvew; Tamaya calls it Univision; C. Plath calls it Transflex; and Davis Instruments calls it the Beam Converger.

Type of Scope: For all-around use, a 4×40 scope is excellent. This scope has a large objective lens and admits a great deal of light. The four power magnification helps locate stars and keep them in view. This scope can also be used for sun and moon sights. Some navigators like a 6×30 or 7×35 monocular for sun sights because the increased magnification helps determine the point where the



Prism levels. The one above is for use with a plastic sextant; the one below for use with a metal one.

sun's edge is tangent to the horizon. The increased magnification, however, makes finding and holding sights more difficult on a pitching deck.

Lighted arc and drum: Some sextants are fitted with a tiny light that illuminates the arc and the micrometer drum. This is a very useful option, since many of your sights will be taken at twilight when it is really difficult to read the sextant. A button on the handle activates the light.

Prism level: This is an optional, clip-on device that can be fitted to plastic sextants and most metal sextants. Invented by retired Admiral Thomas D. Davies, this device can significantly reduce observer error by making it easier to line up the body, the sextant, and the horizon correctly. The prism level optically moves a section of the horizon up or down as the sextant is tilted. When the sextant is correctly lined up, the horizon shows as an unbroken line.

Nautical Equipment Suppliers

Weems & Plath
214 Eastern Avenue
Annapolis, Maryland 21403

Navigation tools, instruments, charts, and books.

Baker, Lyman & Company
3220 S I 10 Service Road West
Metairie, Louisiana 70001

Nautical instruments, sextants, calculators, plotting tools, navigation books, compasses, charts, plotting sheets.

Davis Instruments
3465 Diablo Avenue
Hayward, California 94545

Plastic sextants, handbearing compasses, plotting tools, and workforms.

Kelvin Hughes Limited
New North Road
Hainault, Ilford, Essex IG6 2UR
England

Charts, nautical publications, sextants, binoculars, navigational instruments, British Admiralty charts and publications.

Waterway Guide
6151 Powers Ferry Road, N.W.
Atlanta, Georgia 30339

Cruising guides to the East and Gulf Coasts plus the Bahamas in three volumes. Distributor of NOAA charts.