

## INSTRUCTIONS - ASTRA III MARINE SEXTANT

A sextant is an optical instrument for measuring angles. Its mirror arrangement allows two objects to be viewed simultaneously, and gives the angle between them. It does not need to be held steady to do this. A marine sextant is mostly used at sea for measuring the vertical angle (altitude) from the horizon to a heavenly body for the purpose of determining position. It can also be used to measure the vertical angle to an earthly object of known height for the purpose of computing distance off, and horizontal angles to three known landmarks for plotting position.

The Astra IIIB is a full sized micrometer drum sextant of light-weight aluminum alloy construction. The Astra III Professional Model has a bronze arc fused to the aluminum frame. They have seven sun filters, large bright mirrors, and a telescope with superior light gathering ability. The scales are electrically illuminated.

### TECHNICAL DATA

Arc	-5° to 130°, radius 153 mm
Telescope	3.5 x 40
Illumination	3v, 2 AA batteries
Net Weight	2 lbs., 10 oz. (Astra IIIB) 3 lbs., 2 oz. (Astra III Professional)

## DELIVERY

Varnished wooden case containing:

Sextant

Telescope

Adjusting wrench

Screwdriver

Brush

## CARE AND MAINTENANCE

With reasonable care a sextant will last for generations.

Hold the sextant by the frame when removing and replacing it in the case. Never grasp it by the index arm. To allow the lid to close, the filters have to be either in or out but not in a half-way state.

Warning: If the telescope is attached to the sextant, make sure the knurled nut that holds it to the frame is tight and that the telescope is thus rigidly attached.

The mirrors and shades are the delicate parts. Do not handle them unless they have to be adjusted or cleaned. Clean gently with a chamois, or a damp, soft, cotton cloth. Do not use artificial material as it scratches.

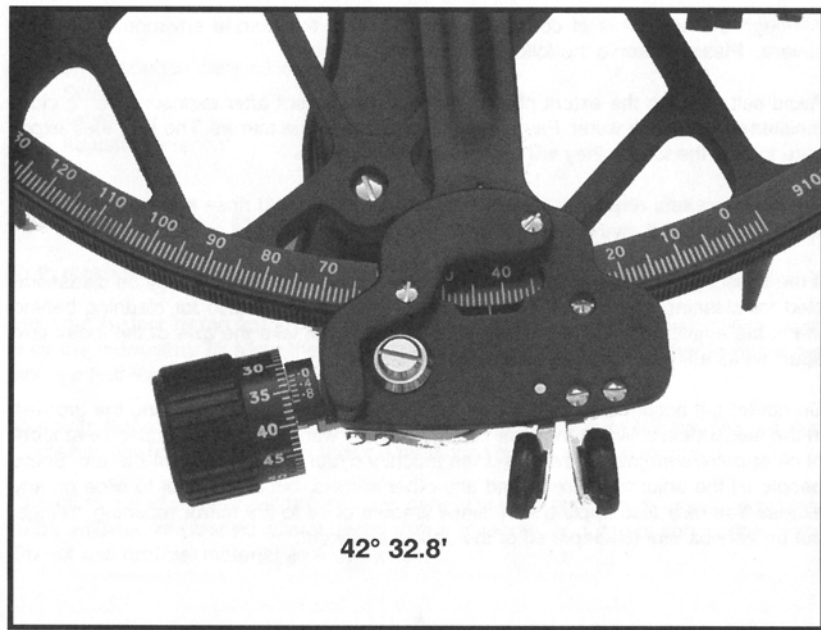
Although the sextant is of corrosion resistant alloy, the marine environment is very severe. Please observe the following basic precautions:

Avoid salt spray to the extent possible. Clean the sextant after exposure with a cloth moistened with fresh water. Pay particular attention to the mirrors. The less their exposure to salt, the longer they will last between silverings.

In extreme cases, remove the telescope and batteries, and rinse the sextant in fresh water. Do not put it away in its box while wet. Either wipe it dry or hang it to dry.

If the telescope is immersed or contamination is observed inside, it may be disassembled for cleaning and drying. The mirrors may be removed also for cleaning behind them, but adjustment will be needed afterward. Do not take the axle of the index arm apart as its adjustment requires special facilities.

Do not let grit accumulate as it will cause wear. The brush is for cleaning the grooves in the sextant's arc. When they are clean, you may want to apply a minuscule amount of oil or petroleum jelly to them and the machined slot in the bottom of the arc. Some people oil the adjusting screws and any other screws, but are careful to wipe off any excess. You may also apply a very small amount of oil to the mirror retaining springs, but be very careful to keep it off of the optical surfaces.



If desired, two AA batteries may be inserted in the handle to provide lighting of the arc and drum. Pay attention to the polarity indicated. If the batteries are reversed, the LED light will not illuminate.

#### HOW TO USE THE SEXTANT

Observing is a practical skill not so readily acquired from the printed page. The following outline may be of use where no teacher is available.

Familiarize yourself with the various parts of the sextant. Hold the instrument in the right hand and — without forcing anything or putting your fingers on the glass surfaces — learn how the clamp on the index arm works, and the filters move, and the telescope focuses. With the telescope both on and off see how images of two objects can be superimposed by moving the index arm. It is a very simple instrument, and everything is out in the open so you can readily see what is happening.

Reading the Astra IIIB or any modern sextant is straightforward. Take the whole number of degrees from the main arc, and the minutes from the micrometer drum. Be careful when the number of minutes is high — such as 50° or more — that you do not read the main arc a degree too high. Look carefully and see how this might occur. It does not matter whether the fraction of a minute is estimated, or the little vernier is used.

To learn observing, it is easier to start with the sun rather than a star. Warning: do not look at the sun either with the naked eye or through the telescope without filter protection. This can cause eye injury. Do not worry about an occasional flash of light while handling the sextant. This has happened to most navigators.

Swing one of the darker filters down between the index and horizon mirrors. Face the direction of the sun. Hold the sextant in your right hand with the frame vertical. Look at the horizon through the telescope. Focus the horizon sharply. Squeeze the clamp and move the arm forward, and you will see the sun pass through the field of view.

Providing the filter is not too dark, if you do not see the sun it is because you are not holding the sextant vertical, or you are not facing quite in the right direction. The correct direction is where the reflected glare of the sun on the water is the strongest. When you see the sun near the horizon, release the clamp and turn the micrometer to get the bottom edge (lower limb) of the sun to just touch the horizon.

The angle up to the body must be vertical. If it is slightly oblique, the angle measured will be too large. With the image of the sun close to the horizon, find the vertical by tilting the sextant left and right so that the sun appears to pass from higher, through a low point, and higher again. When the image is at that lowest point the sextant is vertical, and that is the place to adjust the image to touch the horizon. From a small boat, sights must be taken to a distant horizon when the vessel is at the top of a wave.

From a big ship they must be taken at the top (in the middle) of a roll where the height of eye is known.

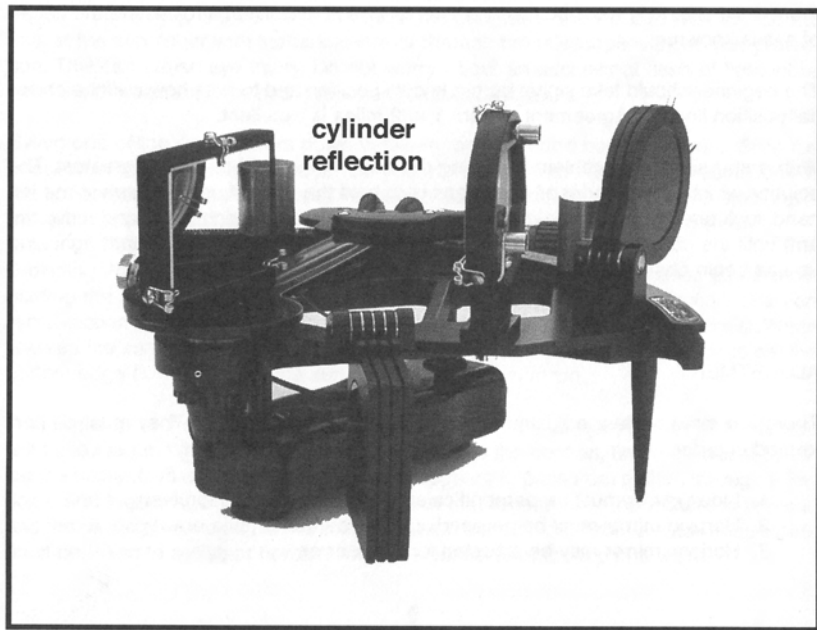
The beginner should take sights from a known position and to note how well the celestial position line fits. Agreement of from 1 to 2 miles is excellent.

With a star sight, the problem of finding the body in the field of view is greatest. The solution which works under all conditions is to hold the sextant upside down in the left hand, look directly at the star, unclamp the index arm with the right hand and move the arm until the horizon comes into view. Then clamp the arm, turn the sextant right side up and begin observations of the star which is now on the horizon.

#### ADJUSTMENT

There are three sextant adjustments to be made by the navigator. They must be performed in order:

1. Index mirror must be perpendicular to the frame (reflection test)
2. Horizon mirror must be perpendicular to the frame (side error)
3. Horizon mirror may be adjusted for index error.



**1. Reflection test.** The best way to do this test is with calibrating cylinders or any two small objects of the same height (about 1 inch). Lay the sextant on a table top, and set the arm to about  $30^\circ$ . Remove the telescope. Place one cylinder at the  $0^\circ$  mark on the arc, and the other cylinder at about the  $100^\circ$  mark. Position your eye horizontally level with the tops of the cylinders. Look slightly past the lower end of the index mirror to see part of the  $0^\circ$  cylinder directly. To the left of this, you should see the other cylinder reflected in the index mirror itself. Slightly reposition either cylinder on the arc so that the images converge to resemble one cylinder. If the tops do not coincide, then adjust the index mirror by turning the screw a little with the adjusting wrench.

**2. Side error.** Set main arc near zero and look up to a star. Make sure the telescope is focused, and that the shades are out of the way. You will see two images of the star. Turn the micrometer drum while watching the two images. They should pass through each other. If they do not, then turn the adjusting screw on the horizon mirror until the error is gone. This is the screw farthest from the sextant frame. You don't actually have to use a star; any clearly defined mark will do.

**3. Index error.** Set the main arc near zero and look up to a faint star. Turn the micrometer drum until the two images coincide. Examine the reading. If there is no error it should be exactly zero. Do it a couple of times to see if there is a variation in your readings. An error may be left and applied as an index correction, or it may be removed. To remove it set the arc exactly to zero and look back to the star. The images will be slightly separated. Apply the adjusting wrench to the screw on the horizon mirror (the one

nearer the frame) and turn it until the two star images coincide. If there was a lot of index error, adjusting it out may introduce some side error. If so take the side error out before rechecking the index error and possibly refining the index adjustment. The index error is a direct error in the reading of the sextant angle, and so must be checked often. When checking it, it is necessary to use, if not a star, then at least a distant object (more than 1/4 mile away). Otherwise parallax between the horizon and index mirrors will give an erroneous reading.

The sun may also be used and may be the most accurate. Make sure the sun is 20° or higher (to obviate any differential refraction influence). Select some suitable shades and look up to it. Now instead of superimposing the two images, turn the micrometer until the two images just touch. Take a reading. Look again to the sun and, by turning the micrometer, exchange the images — that is put the bottom one on top, and the top one on the bottom. Take another reading. There is no index error if the two readings are equally spaced on either side of zero, eg. 0°-32.4' and 359°-27.6'. If this is not the case then infer what they should read, set this on the arc and use the adjusting wrench on the horizon mirror to touch the images together.

There are other checks and adjustments that an instrument technician could investigate. Further information may be found in standard texts. As long as the sextant is not abused, they are not of concern to the navigator.

# **ASTRA III**

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