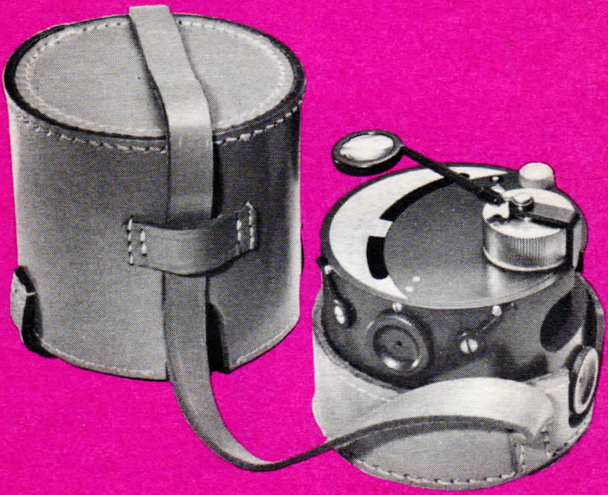
SMALL CRAFT PRECISION SEXTANT



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INTRODUCTION

This is an extremely well made instrument enabling the navigator to fix his position by a noon sight to the nearest 0°–1' of Latitude, or find his distance off an object of known height even more accurately than with a full sized sextant owing to the very small instrument parallax. Its small size and light weight makes it very easy to use in a small vessel and also less vulnerable than a full sized instrument.

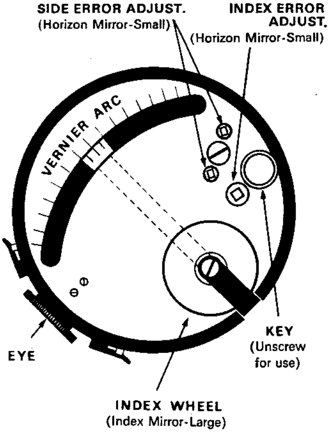
The instrument leaves the Works carefully adjusted. The only two adjustments the user is likely to have to make are for side error and index error.

(a) To adjust for side error proceed as follows:– Just above the 137½° end of the arc will be seen two recessed keyed screws. With the instrument held vertically, look at some well defined distant object, preferably a star, and move the index arrow across the zero of the arc. The reflected image should pass over the direct image of the star. If it does not, loosen one of the keyed screws and tighten the other until the two images are in the same plane. (This adjustment is very sensitive and the screws should only be turned about one-eighth of a complete rotation at a time. Do not over-tighten.) (See Fig.1.)

(b) To adjust for index error (1) look at a very distant horizon or a star and see that index arrow is exactly at zero when the direct and reflected images coincide or (2) a more accurate method is to look at the sun with the arrow at zero. Move the index wheel one way until the bottom of the reflected sun exactly touches the top of the sun seen direct. The reading should be 32' OFF the arc. (Do not forget to read the vernier backwards when reading OFF the arc.) Now move the index wheel the other way until the top of the reflected sun exactly touches the bottom of the sun seen direct. If these two readings are equal either side then there is no index error. (See Fig.2.) To adjust, turn the keyed screw located just above the side error screws as required (See Fig.1. again) If you find you cannot get the adjustment exact it is better that the reading should be larger OFF the arc, for then you must add the error to all your readings.

The perpendicularity adjustment on the base of the index mirror should be adjusted by an instrument maker. To check for perpendicularity, set the index bar about midway on the arc. Hold the instrument face down over a bright light, then look obliquely through the open section of the instrument into the index mirror; you will then be able to see a short piece of the arc reflected. If this reflected arc appears to be in line with the direct view of the arc, there is no perpendicularity error.

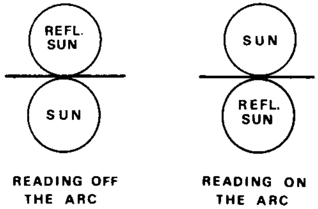
FIG. 1



TO USE THE INSTRUMENT

Place the strap over your head to avoid the risk of losing the sextant overboard and remove the leather cap. Now hold the sextant by the other half of the leather case in your right hand so that the instrument is on its side with the large knurled index wheel to the left and uppermost. Look through the eyepiece at the horizon and by turning the index wheel the sun, or light house lantern, will be brought down until it appears to be on the horizon. (With the exception of the sun or moon the centre of the object should be on the horizon.) With the sun or moon the upper or lower limb (edge of disc) should just touch the horizon and the semi-diameter (16') added or subtracted from the sight. (See Fig.3.)

FIG. 2



Now turn the sextant on its side and with the magnifying glass read the number of degrees on the main scale at or immediately to the right of the index arrow. If the arrow does not coincide exactly, then follow along the vernier scale, attached to the index bar, until you find the line which exactly coincides with a line on the main scale. The line selected on the vernier scale indicates the number of minutes to be added to the number of degrees originally read on the main scale. In the case of the example (Fig.4.) the line on the main scale to the right of the arrow reads 10½ degrees. The coinciding line on the vernier scale reads 15 mins. Therefore, the total measured angle is 10° 30′ plus 15′, i.e., 10° 45′.

FIG. 3

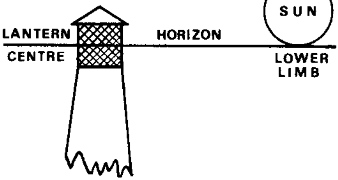
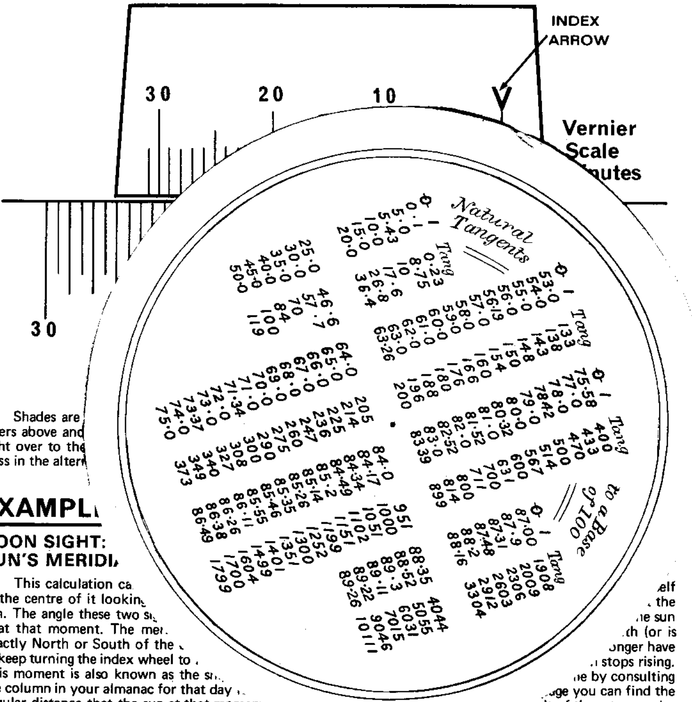


FIG. 4



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glass in the alter

EXAMPL

NOON SIGHT:
SUN'S MERIDI

This calculation ca ... elf
in the centre of it lookin ... the
sun. The angle these two s ... ne sun
is at that moment. The me ... th (or is
exactly North or South of the ... onger have
to keep turning the index wheel to ... stops rising.
This moment is also known as the s ... ne by consulting
the column in your almanac for that day ... ge you can find the
angular distance that the sun at that moment ... esult of these two angles
is your latitude (See Figures 6 & 7).

When taking your sight there are a number of corrections you must make either individually or collectively. (1) You must have your eye some distance above the water level in order to get a horizon at all. A table in your almanac gives you the angle to *subtract* from your sight for various heights of eye. (2) Due to moisture in the atmosphere your line of sight will be refracted considerably at low angles and not at all when looking vertically up at the sun. On the same page will be found a table of the angle to be *again subtracted* from your sight. (3) Because you are actually taking a sight from the surface of the earth (4000 miles from the centre) the Parallax due to this must, in this case, be *added*. A table for this will be found on the same, or adjoining, page in your almanac. (4) It is impossible to estimate the centre of the sun, so you take your angle from the point where the sun's lower limb (bottom of its disc) touches the horizon. (See Figures 5 & 7.) The sun's angular semi-diameter varies between 15.8′ from May to August and 16.3′ in December and January. Unless extreme accuracy is required the semi-diameter may be taken as 16′, which should be *added*.

In actual practice all the above corrections have been put together under the heading of *"SUN'S TOTAL CORRECTION"* and an abridged table extracted from an almanac will be found in the cover of this instrument. The angle shown must always be *added*. (See Fig.6.)

EXAMPLE :- (See Figures 5 & 6).

Assuming height of eye 14ft., 1400 GMT. at longitude 30° W and 8th August 1969.

FIG. 5

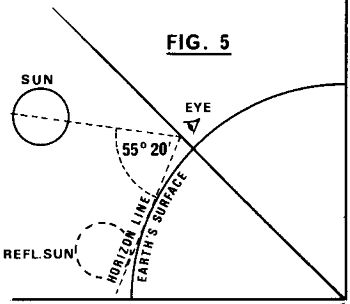
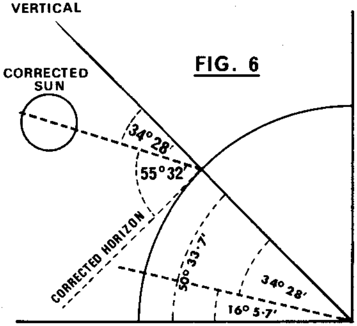


FIG. 6



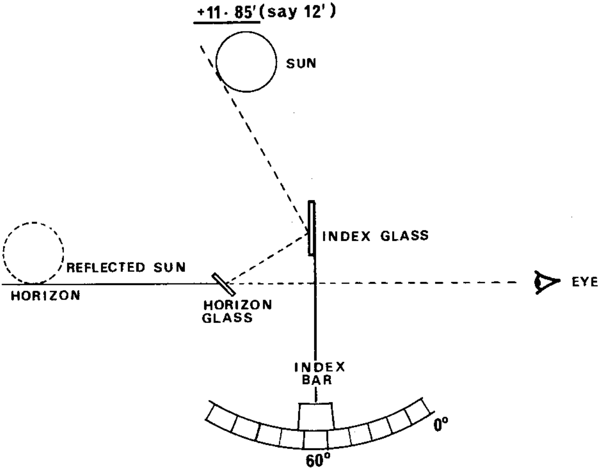
Dip (height of eye)	=	− 3·4′
Refraction	=	− ·7′
Parallax	=	+ 0·15′
Semi Diameter	=	+ 15·8′

∴ Total Correction = + 11·85′ (say 12′)

Sun's observed Meridian Altitude	55° 20′
Total Correction (add)	12′
∴ True Meridian Altitude	55° 32′
Vertical	90°
True Meridian Altitude (subtract)	55° 32′
∴ Zenith Distance	34° 28′
Sun's Declination (add)	16° 5·7′ N
∴Latitude	50° 33·7′ N

Now the angle you wish to find is that between the vertical and the sun but you have no means of fixing a vertical point (90° from the horizon) in the sky. So you take a sight (measure the angle) between the sun and the horizon and subtract this from 90°. The difference is the angle between the vertical and the sun. (See Fig.6.) Now consult your tables in the current almanac for the "Declination" of the sun. This is the angle that the sun is North (or South) of the equator and is tabulated at 2-hourly intervals throughout the year in degrees, minutes and decimals of the minute according to GMT. You must have some idea of your longtitude when taking your sight. If your position were 15° West longtitude this would make your ship's mean time 1 hour slow of GMT, so that if we assumed your position to be 30° West then you must look for the declination for 1400 GMT for that day.

FIG. 7



EX MERIDIAN TABLES

It sometimes occurs that the sun is obscured by cloud at noon but appears again shortly afterwards. If you have mastered the former calculations you can go on to using the ex meridian tables to be found in Reed's Nautical Almanac on pages 232–235 in the 1969 edition. A reasonable fix may be obtained up to half an hour after the meridian passage by using these tables. Pages 172 and 173 of this almanac give a detailed account of how to use these tables.

AZIMUTH SIGHT

Once you have mastered the noon sight you can go on to trying a sight in azimuth. Reed's Nautical Almanac gives you various methods of doing this and with a position line found at about 3 hours or more before noon (or after) you can get an exact fix.

TO FIX THE SHIP'S POSITION WHEN IN SIGHT OF LAND

The simplest way to obtain a fix is by compass bearings of prominent objects. Two bearings are sufficient but when possible a third should be taken as a check. The lines drawn from all three objects should intersect at the same point and this point will be your position. If they do not all cross at the same point then this is called a "Cocked Hat" and you should assume your position to be at the intersection of the two lines nearest to the danger. Then try again. Example:– By your magnetic compass you find a light house bearing of 322°, a church bearing of 007° and a prominent rock bearing of 037°. The magnetic variation is 7° West, so this must be subtracted, giving you true bearings of 315°, 000° and 030° respectively. Referring to your chart, lay your parallel rule onto the compass rose nearest to your assumed position, joining the centre with the 315° mark, then walk or roll it along until its edge passes through the symbol marking the position of the light house and draw a line from it to a point a little further seawards than your assumed position. Repeat this operation for the church and the rock. The point where these lines intersect is your position. (See also example for Horizontal Sextant Angle.)

To take bearings, your compass must be fitted with an azimuth ring or you must use a separate hand bearing compass. In each case a prism is mounted in such a way that you can read off the bearing from the compass card at the same time as you sight your object in the vee sight.

HORIZONTAL SEXTANT ANGLES

In many yachts the compass is fixed in such a position that bearings cannot be taken with it, and because of this an additional hand bearing compass is often carried. However, if you own a sextant you can overcome this in any of three ways, as follows:–

(1) You can take bearings of objects relative to the ship's head, i.e., compass course, by holding the sextant horizontally and measuring the angle between the ship's head and the object. Add the angle so obtained to your true course if the object is to starboard and subtract the angle if it is to port. You can, of course, simplify this operation by heading the ship at one object.
(2) If you require a very accurate position, such as that of your permanent mooring, you obtain this from three objects shown on the chart provided the centre one of the three is nearer to you than a line drawn between the outer two. In your almanac, on pages 318 and 319, you will find tables for finding your position from horizontal angles. On the preceding two pages will be found instructions for using these tables.
(3) If you merely want to plot your position on the chart you can do this by making a temporary "Station Pointer" with a piece of tracing paper. From a point on a common line draw lines each side at the angles between the central object and the other two chosen objects as observed with your sextant. Lay this over the chart and move it about until all lines pass through their respective objects. With your dividers, prick through the intersection point onto the chart; this is your position.

VERTICAL SEXTANT ANGLES (Distance off)

Unless you have two or more objects in view you cannot obtain a fix by horizontal angles. If, however, you have one object of known height such as the Wolfe Rock light house you can take a compass bearing of this and after converting to a true bearing you can draw on your chart a position line. Now with your sextant held vertically bring the centre of the light house lantern down to the horizon and read off the angle. Turn to the tables on pages 312–315 of your almanac and along the top you will find various heights. In the case of the Wolfe Rock light house look down the column headed 110 feet. Follow this column down until you find the angle you have just read. Now follow this line across to the side and read off the distance in miles and cables, e.g., 0°–57′ = 1 mile 1 cable. Your position is then expressed – "Wolfe Rock L.H. bearing (say 352°) – 1 mile 1 cable.

The state of the tide and the height of your eye can generally be ignored but if you wish for great accuracy you must add on the difference between high tide and the height at the moment as the heights of objects are given above high tide level. Again the tables are based on a height of eye of 15 feet. If your eye is less than 15 feet above sea level you must add the difference and vice versa if it is higher.

SMALL CRAFT PRECISION SEXTANT

SPECIFICATION:–

Material	Lightweight Metal
Weight	approx. 8½ ozs. (¼ kilogram)
Height	2 ins. (5 cm)
Diameter	3 ins. (7·6 cm)
Radius of arc	1.78in. (4.5cm)
Main Scale	0° – 137½°
Vernier Scale (inset) . .	0′ – 30′
Reading to	1′
Drive	Combined Fast and Slow (planetary)
Mirrors	Corrosion-resistant metallic reflective coating
Shades (2)	Tinted (differing intensities)
Eye Pieces (2)	Clear and Tinted
Adjustments	Horizon Mirror (Horizontal and Vertical) Index Mirror (Vertical)
Finish	Green/Bronze enamel and Silver (corrosion-resistant). Boxed and supplied with instructions and examples for use.
Ever-ready carrying case. . .	Saddle leather

This instrument is also used for surveying when either the carrying of a heavy theodolite is not warranted, or the working area is limited; the foregoing instructions are similarly applicable and separate tangent tables are supplied.

The screw at the base of the case is threaded for attachment to a tripod. An adaptor can be provided for use with our tumble-overhead survey tripod, which permits the taking of vertical angles and facilitates the taking of accurate vertical and horizontal angles. A circular level can be provided for setting up.