How to measure Index Correction using the Sun

This is an old method, developed by those explorers who did most sights on land using an artificial horizon (Lewis and Clark, for example). It can be quite accurate and offers a quick check by measuring the sun's semidiameter at the time of the sight and comparing that with the value listed in the Nautical Almanac or computed by the StarPilot. It is not entirely clear, however, if this solar IC method is superior for routine sights at sea using a true sea horizon. In these cases, it could be that the conventional methods we discuss elsewhere might be preferred. For lunar distance sights, on the other hand, this solar method is likely best.

Notes

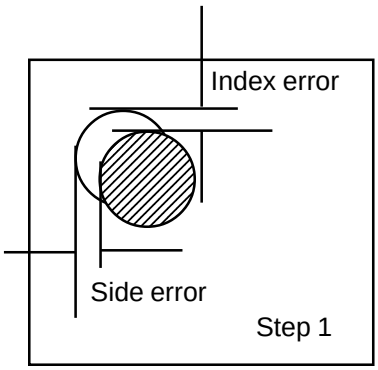
(1) we will be looking straight toward the sun and through a telescope to boot. So we must be very careful that all sun shades are in place and we do not somehow distort our view and look around the edge of the shades. Do not under any circumstances look directly at the sun without it being completely covered by the shades.

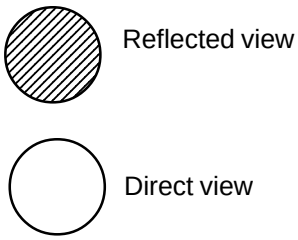
(2) Use the highest power scope you have for this. Monocular 6x35 or 7x30 etc work well.

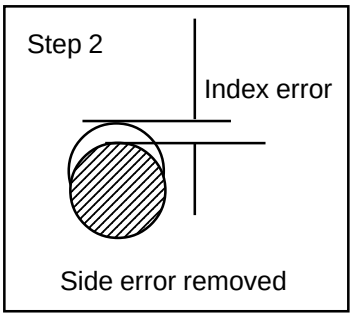
(3) Adjust the shades if you have that option so the reflected and direct view of the sun appear as different colors.

Procedure

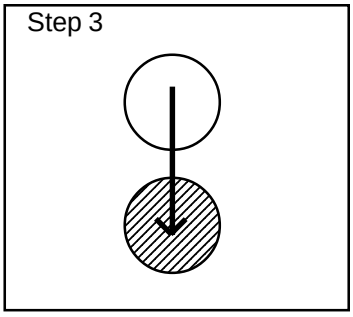
(1) Set the sextant to 0° 0.0' and look toward the sun on a clear day. You will see something like the following, where we use the convention that shaded sun is the reflected view on the right side of the horizon mirror and the unshaded one is the direct view through the clear glass of the left side of the horizon glass.





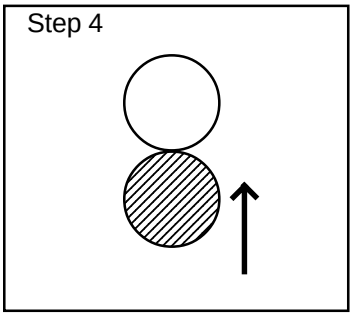


(2) Adjust the side error to remove it by first adjusting the Index mirror to be perpendicular to the frame of the arc and then adjusting the horizon mirror so it is parallel to the frame as well. Then you will see the picture to the right above which is almost all index error with no side error.

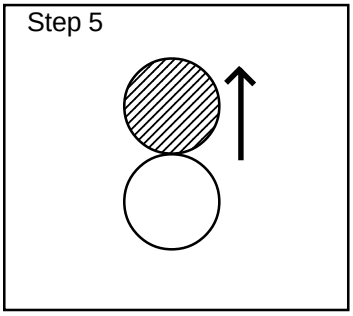


First we will measure the "Toward" value of the IC

(3) Turn the micrometer Away from you until all of the reflected image is well below the direct image.



(4) Now turn micrometer Toward you slowly and uniformly so the reflected image rises till the top edge of it just touches the bottom edge of the direct image. And read the dial. It should read something like 32' on the scale -- depending on your IC. Record this ON value. Accurate to the tenth. In this running example we will call this 34.0' ON.



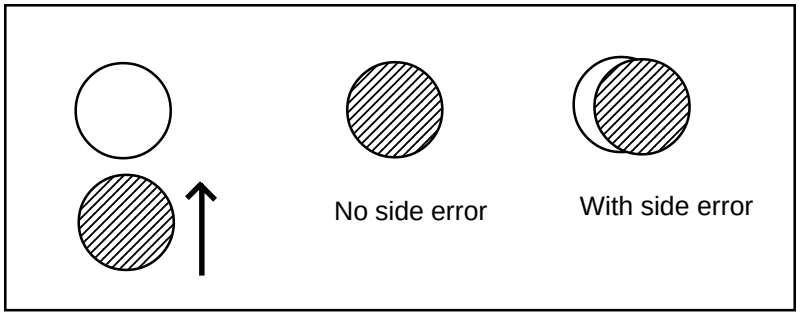
(5) Now continue to turn, slowly and uniformly, in the Toward direction until the bottom edge of the reflected image aligns with the top edge of the direct image. If you overshoot, we need to start all over again!. The idea is to be turning only in one direction when we stop. This time the dial will read about 28' but this will be an OFF the scale measurement, so we have to subtract whatever it reads from 60. In this example, let's assume micrometer read 29.2', which would be 60.0'-29.2' = 30.8' OFF the scale. Record this OFF value.

(6) Now take the difference between the ON value and the OFF value and divide that by 2 to find your IC. Just subtract the smaller from the larger. The label of your result will be the same as the label of the larger value. In this example: 34.0 - 30.8 = 3.2' and 3.2'/2 = 1.6' and since 34 was ON, the answer is ON, ie our IC is 1.6' ON the scale.

(7) Now check your result by comparing to the actual semidiameter of the sun at the time of the sight. Our example was measured on 02/28/01 using an Astra 3b deluxe model sextant with traditional mirror. From the Nautical Almanac, we get that SD = 16.2'. The SD of the sun equals the ON value plus the OFF value divided by 4. In this example, 34.0+30.8 = 64.8 and 64.8/4 = 16.2 which is right.

More notes

A quick and dirty method to measure the IC this way, or maybe to double check the result to see that it all makes sense, is just to align the reflected and direct images on top of each other and read the dial. That reading will be your IC, it is just that the above procedure is a more accurate way to get the value. In this case we would see what is shown here, depending on whether or not we had side error. In our example, the dial would read 1.6' ON the scale when either of the two right-side alignments were set.



Now you can repeat the full process turning always in the Away direction. Careful data will often show a slight difference for the Toward and Away values, even for a metal sextant (see sample data to follow). For plastic sextants, on the other hand, the toward and away values will almost always be rather large, some few minutes or so.

Date 2/28/01 SD 16.2’

Toward or Away

ON	OFF	Diff	Check SD
34.0	60.0	34.0	34.0
1.	− 29.2	− 30.8	+ 30.8
	= 30.8	= 3.2 ÷ 2	= 64.8 ÷ 4
		= 1.6 on	= 16.2

ON	OFF	Diff	Check SD
33.8	60.0	33.8	33.8
2.	− 29.8	− 30.2	+ 30.2
	= 30.2	= 3.6 ÷ 2	= 64.0 ÷ 4
		= 1.8 on	= 16.0

ON	OFF	Diff	Check SD
33.8	60.0	33.8	33.8
3.	− 29.2	− 30.4	+ 30.4
	= 30.8	= 3.4 ÷ 2	= 64.2 ÷ 4
		= 1.7	= 16.05

ON	OFF	Diff	Check SD
34.0	60.0	34.0	34.0
4.	− 29.6	− 30.4	+ 30.4
	= 30.4	= 3.6 ÷ 2	= 64.4 ÷ 4
		= 1.8	= 16.1

ON	OFF	Diff	Check SD
	60.0		
5.	−	−	+
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
6.	−	−	+
		= ÷ 2	= ÷ 4
		=	=

average = (1.6+1.8+1.7+1.8) / 4 = 1.7’ On when turning in the Toward direction.

Date 2/28/01 SD 16.2’

Toward or Away

ON	OFF	Diff	Check SD
33.6	60.0	33.6	33.6
1.	− 28.8	− 31.2	+ 31.2
	= 31.2	= 2.4 ÷ 2	= 64.8 ÷ 4
		= 1.2 on	= 16.2

ON	OFF	Diff	Check SD
33.4	60.0	33.4	33.4
2.	− 29.0	− 31.0	+ 31.0
	= 31.0	= 2.4 ÷ 2	= 64.4 ÷ 4
		= 1.2	= 16.1

ON	OFF	Diff	Check SD
33.4	60.0	33.4	33.4
3.	− 29.0	− 31.0	+ 31.0
	= 31.0	= 2.4 ÷ 2	= 64.4 ÷ 4
		= 1.2	= 16.1

ON	OFF	Diff	Check SD
33.6	60.0	33.6	33.6
4.	− 29.2	− 30.8	+ 30.8
	= 30.8	= 2.8 ÷ 2	= 64.4 ÷ 4
		= 1.4	= 16.1

ON	OFF	Diff	Check SD
33.6	60.0	33.6	33.6
5.	− 29.2	− 30.8	+ 30.8
	= 30.8	= 2.8 ÷ 2	= 64.4 ÷ 4
		= 1.4	= 16.1

ON	OFF	Diff	Check SD
	60.0		
6.	−	−	+
		= ÷ 2	= ÷ 4
		=	=

average = (1.2+1.2+1.2+1.4+1.4)/5 = 1.3’ On when turning in the Away direction.

This data is from navigator Lanny Petitjean using Astra w. traditional mirror. He has since used the results to achieve numerous sights from land with accuracies all below 0.4 miles and lunar distance sights below 30 seconds. Thanks Lanny.

Date_____SD_____

Toward or Away

ON	OFF	Diff	Check SD
	60.0		
1.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
2.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
3.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
4.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
5.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
6.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=

Date_____SD_____

Toward or Away

ON	OFF	Diff	Check SD
	60.0		
1.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
2.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
3.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
4.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
5.	– _____	– _____	+ _____
	=	= ÷ 2	= ÷ 4
		=	=

ON	OFF	Diff	Check SD
	60.0		
6.	– _____	– _____	+ _____
		= ÷ 2	= ÷ 4
		=	=