

Sight #					
DR Latitude	N40°				
DR. Longitude	W075°				
Date	9 / 26 /2016	/ /	/ /	/ /	/ /
UT	13:15:15	: :	: :	: :	: :
Hs	50° 07.6'	° '	° '	° '	° '
Index Error	+ 0° 01'				
Hs – Index Error	50° 06.6'				
Hs – Index Error/2= Ha	25° 03.3'	° '	° '	° '	° '
+/-- ACT	+0° 14'	'	'	'	'
Ho	25° 17'	° '	° '	° '	° '
GHA	17° 13.0'	° '	° '	° '	° '
GHA inc.	3° 48.8'	° '	° '	° '	° '
GHA	21° 02'	° '	° '	° '	° '
LHA	306°	°	°	°	°
Dec	-1° 32.1'	° '	° '	° '	° '
Hc	26° 02'	° '	° '	° '	° '
d/d corr	-43 -23'	'	'	'	'
Z	116°	°	°	°	°
Hc	25° 39'	° '	° '	° '	° '
Ap λ	75° 02'	° '	° '	° '	° '
Zn	116°	°	°	°	°
Intercept	22' Away				

Sun sight reduction

Sight, DR. Latitude, DR. Longitude

Form label	What is it?	Where to get it?	Figure
Sight #	Sight number	It's the sequential number of the sight you're taking. It's an orderly way of keeping track of the sights you make.	1
DR. Latitude	Dead Reckoning Latitude	DR. Latitude means <i>Ded Reckoning Latitude</i> and uses the integral degree of Latitude. It's the Latitude <i>you think you're closest to</i> based on your DR Log. Example- N 40° Note- DR Latitude is also, and often, referred to as Ap Latitude- <i>Assumed position Latitude</i> and is typically derived from your DR Log.	N 40°
DR. Longitude	Dead Reckoning Longitude	DR. Longitude means <i>Ded Reckoning Longitude</i> and is the integral degree of Longitude <i>you think you're closest to</i> based on your DR Log. Example- W 075° Note- DR Longitude is also, and often, referred to as Ap Longitude- <i>Assumed position Longitude</i> and is typically derived from your DR Log.	W 075°

"ded" Reckoning stands for "deduced reckoning" but is usually written *dead reckoning*

Date & Time

Form label	What is it?	Where to get it?	Figure
Date	The Date based on Greenwich Time.	<i>See Time below</i>	September 26, 2016
Time	<p>GMT Greenwich Mean Time also known as UT</p> <p>It's based on a 24 hour number.</p>	<p>The time based on Greenwich/Universal Time. Get the time in GMT/UT here- http://time.is/UTC</p> <p>Call NIST- 303-499-7111</p> <p>Shortwave radio- WWV & WWVH 2.5, 5, 10, 15, 20 mHz</p> <p>To figure GMT add or subtract the time difference between your time zone and Greenwich England.</p> <p>For the Eastern US during DST (Daylight Saving Time) add 4 hours to local time. During DST the new day begins at 8 PM local time.</p> <p>For the Eastern US during EST (Eastern Standard Time) add 5 hours to local time. During EST the new day begins at 7 PM local time.</p>	13:15:15

Hs, IE, Dip, AH/2, ACT, Ho

Form label	What is it?	Where to get it?	Figure
Hs	Height of sextant	<p>Height of sextant- the initial, uncorrected, sextant angle reading of the object you observed. The sextant measurement is from the sea horizon or an Artificial Horizon (AH) to the celestial body (star, Sun, planet, moon) in the sky.</p> <p>The "LL" stands for Lower Limb. See the Artificial Horizon picture with the Sun's Limbs included herein.</p>	50° 07.6' LL
Index Error	The amount of misalignment between the Index mirror and the Horizon mirror.	<p>Set the sextant to 0° 00.0° and look at a bright star. If you see only one star, or if they are side by side, there is no Index Error.</p> <p>If you see two of the same star one over top of the other there is Index Error (IE). To find the Index Error in this case turn the micrometer drum until both images of the star appear superimposed or side by side. Read the the amount of IE.</p> <p>If the IE is greater than 0° then the IE is <i>on the arc</i> and must be subtracted from the Hs.</p> <p>If the IE is less than 0° then the IE is <i>off the arc</i> and must be added to the Hs.</p> <p>In our example the IE is <i>on the arc</i> so it must be subtracted from the Hs.</p>	+ 0° 01'
Hs- Index Error	Height of sextant minus the Index Error.	Subtract the Index Error from the Height of sextant.	$\begin{array}{r} \text{(Hs) } 50^\circ 07.6' \\ - 0^\circ 01' \\ \hline 50^\circ 06.6' \end{array}$
Dip	Dip is the amount of angle to subtract from the Hs when making an observation using the ocean's horizon. The amount to subtract is determined by the Height of your Eye above the water.	<p>Dip correction can be found on ALTITUDE CORRECTION TABLES 10° -90° —SUN, STARS, PLANETS on the right hand column of that table.</p> <p>In this example we're "on the hard" (on land) and using an Artificial Horizon (AH). There's no Dip correction required when using an Artificial Horizon (AH).</p> <p>ALTITUDE CORRECTION TABLES are attached at the end herein.</p>	When using an AH there is no need to correct for Dip.
Hs – Index Error/2= Ha	Hs <i>minus</i> Index Error divided by 2 = Ha Ha means <i>Height apparent</i> .	Get the final figure from Hs <i>minus</i> Index Error (above) and divide it by 2. The result is the Ha <i>or Height apparent</i> .	$\begin{array}{r} 50^\circ 06.6' \\ \text{divided by 2} \\ \hline \text{Ha} = 25^\circ 03.3' \end{array}$
ACT	Altitude Correction Table	<p>Use the ALTITUDE CORRECTION TABLES 10° -90° — SUN,STARS,PLANETS. For brevity these tables are referred to as ACT. Find the <i>Ha</i> correction for the Sun in the SUN APR.-SEPT. App. Alt. column. Look in the Lower Limb column and find where the Ha of 25° 02.8' would approximately be located- between 24° 53' and 26° 00'.</p> <p>ALTITUDE CORRECTION TABLES are attached at the end herein.</p> <p>For the Sun- Lower Limb observations are always added to the Ha figure.</p>	0° 14'
Ho	Height observed	Add the Sun's Lower Limb ACT (0° 14') to the Ha to arrive at the <i>Ho</i> (Height observed). After all of the above corrections Ho= 25° 17.3' (round it down to 25° 17').	$\begin{array}{r} \text{(Ha) } 25^\circ 03.3' \\ \text{(Act) } + 0^\circ 14' \\ \hline \text{Ho} = 25^\circ 17' \end{array}$

Getting the Sun's GHA and declination

Form label	What is it?	Where to get it?	Figure
GHA	Greenwich Hour Angle based on the integral hour of the sextant observation.	<p>The necessary portion of The Nautical Almanac is provided at the end of this file.</p> <p>Find the Sun's GHA in the Sun's GHA column of The Nautical Almanac daily pages for the date and time of the observation. The GHA figure is based only on the integral hour of the observation.</p> <p>Get The Nautical Almanac <i>daily pages</i> at TheNauticalAlmanac.com</p>	17° 13.0'
Dec	Declination of the Sun. The Sun's position in degrees North or South of the equator	<p>The necessary portion of The Nautical Almanac is provided at the end of this file.</p> <p>Getting the Sun's declination now in this step will save time as you only need to open The Nautical Almanac once to get both GHA and Dec. Declination is recorded in the Sun sight reduction form Dec space.</p> <p>Find the Sun's declination in the Sun's Dec column of The Nautical Almanac daily pages for the date and time of the observation. The dec figure is based only on the integral hour of the observation.</p> <p>The Sun's declination has a <i>Name</i>- it's either <i>Same Name</i> or <i>Contrary Name</i>.</p> <p>Northern Hemisphere seasons In the Northern Hemisphere its declination is <i>Same Name</i> from the beginning of Spring until the end of Summer. Its declination is <i>Contrary Name</i> from the beginning of Autumn until the end of Winter.</p> <p>Southern Hemisphere seasons In the Southern Hemisphere from the beginning of Spring until the end of Summer its declination is <i>Same Name</i>. Its declination is <i>Contrary Name</i> from the beginning of Autumn until the end of Winter.</p> <p>Get The Nautical Almanac <i>daily pages</i> at TheNauticalAlmanac.com</p>	-1° 32.1
GHA inc.	Greenwich Hour Angle <i>increment</i> for the minutes and seconds of time of the sextant observation.	<p>The Nautical Almanac- <i>Increments & Corrections for Sun, Planets, Aries, Moon (the "yellow pages")</i> for the minutes and seconds of time of the observation. You can get the Increments & Corrections Table here-</p> <p>https://thenauticalalmanac.com/Increments & Corrections Table.pdf</p> <p>You can also get the GHA for the Sun on 1 page here: https://thenauticalalmanac.com/Increments & Corrections Sun only.pdf</p> <p>The Sun's Increments & Corrections is provided at the end of this file.</p>	3° 48.8'
GHA	Greenwich Hour Angle total	<p>Add the Sun's GHA integral hour figure to the Sun's GHA Increment figure. Round the figure up or down.</p>	17° 13.0' + 3° 48.8' 21° 02'

Calculating the Sun's LHA

Form label	What is it?	Where to get it?	Figure
GHA	Greenwich Hour Angle total	<p>This was already done in the previous step but has been included here for clarity</p> <p>Add the Sun's GHA integral hour figure to the Sun's GHA Increment figure. Round the figure up or down.</p>	$\begin{array}{r} 17^{\circ} 13.0' \\ + 3^{\circ} 48.8' \\ \hline 21^{\circ} 02' \end{array}$
Ap λ	Assumed position Longitude	Combine the DR. Longitude figure with only the minutes (of arc) of the total GHA figure. The Ap λ figure will be used when plotting the LOP on the UPS.	<p>DR Longitude W 075°</p> <p>Ap λ W075° 02'</p>
LHA	Local Hour Angle total	<p><u>In Western longitudes</u></p> <p>Subtract Ap λ from the GHA total. Ignore the minutes of GHA. In Western Longitudes if GHA is <i>less than</i> the Ap λ first add 360 to the GHA and then subtract the Ap λ from it.</p> <p><u>In Eastern longitudes</u></p> <p>Round up the GHA to next highest degree and add the DR. longitude to it. If the resulting figure is over 360 then subtract 360 from it.</p>	$\begin{array}{r} \text{GHA } 21^{\circ} 02' \\ + 360^{\circ} \\ \hline 381^{\circ} 02' \\ \hline 381^{\circ} 02' \\ - \text{Ap } \lambda \text{ W } 075^{\circ} 02' \\ \hline \text{LHA} = 306^{\circ} \end{array}$

Finding the Sun's Hc and Zn

Form label	What is it?	Where to get it?	Figure
Hc	Height computed	<p>The necessary portion of Pub. No. 249 Vol. 2 is provided at the end of this file.</p> <p>Hc is found in Pub. No. 249 Vol 2. Locate the pages-</p> <p style="text-align: center;">LAT 40° DECLINATION (0°---14°) CONTRARY NAME TO LATITUDE (It's on page 242)</p> <p>To find Hc you need the DR. Latitude (N 40°) and the LHA (306°) and whole degree of declination.</p> <p>Locate the LHA row of 306° on the sheet and move across until you see where the 1° column (Contrary declination) intersects that row. Find Hc in the Hc column.</p> <p>In this Sun sight reduction the Sun's declination is <i>Contrary Name</i> as the Sun's declination is below the equator.</p>	Hc= 26° 02'
d	declination correction figure	<p>The necessary portion of Pub. No. 249 Vol. 2 is provided at the end of this file.</p> <p>"d" is found in Pub. No. 249 Vol 2. Locate the pages-</p> <p style="text-align: center;">LAT 40° DECLINATION (0°---14°) CONTRARY NAME TO LATITUDE (It's on page 242)</p> <p>To find d you need the DR. Latitude (N 40°) and the LHA (306°).</p> <p>Locate the LHA row of 306° on the sheet and move across until you see where the 1° column (Contrary declination) intersects that row. Find d in the d column.</p> <p>Notice there's a <i>minus</i> sign beside the d figure. That means the correction figure that will be found in the next step must be subtracted from Hc.</p>	-43
d corr	declination correction amount	<p>The "d corr" figure is the amount that will be added, or subtracted, from Hc and is based on the change of the Sun's declination during the minutes and seconds of time when the observation was made.</p> <p>Use Table 5- Correction to Tabulated Altitude for Minutes of Declination to find the correction. First, find where the Sun's minutes of declination appear in the far right or far left column of the table. Locate the d figure found in the previous step in the horizontal row at the top of the Table. Where those two figures intersect you'll find the d corr figure.</p> <p>Table 5 is provided at the end of this file.</p> <p>Note- in this Sun sight reduction example the Sun's declination was -1° 32.1' Round that down to -1° 32'. You're using the 32' (<i>thirtytwo minutes of arc</i>) figure in Table 5 and not 32 minutes of time.</p> <p>In this example "d" had a <i>minus</i> sign beside it. So, you must put a <i>minus</i> sign beside the d corr figure.</p>	-43 / -23

Finding the Sun's Hc and Zn *continued*

Form label	What is it?	Where to get it?	Figure
Z	Azimuth number or Azimuth angle	<p>The necessary portion of Pub. No. 249 Vol. 2 is provided at the end of this file.</p> <p>Z is found in Pub. No. 249 Vol 2. Locate the pages-</p> <p style="text-align: center;">LAT 40° DECLINATION (0°---14°) <u>CONTRARY</u> NAME TO LATITUDE (It's on page 242)</p> <p>To find Z you need the DR. Latitude (N 40°) and the LHA (306°).</p> <p>Locate the LHA row of 306° on the sheet and move across until you see where the 1° column (Contrary declination) intersects that row. Find Z in the Z column.</p> <p>Z is the horizontal angle in degrees that points to the Sun from the Ap. λ.</p> <p>Approximately, and close enough for us, Z is the horizontal angle that points to the Sun from where we took the sextant observation.</p> <p>Z is based on True North and not magnetic North.</p>	Zn= 116°
Hc	Height computed <i>the final Hc figure</i>	Using the initial Hc figure found in Pub. No. 249 Vol. 2 add, or subtract, the d corr figure.	Hc= 26° 02' d corr = - 0°23' Hc= 25° 39'

Ap λ, Zn and Intercept

Form label	What is it?	Where to get it?	Figure
Ap λ	Assumed position Longitude	Combine the DR. Longitude figure with only the minutes (of arc) of the Sun's total GHA figure. The Ap λ figure will be used when plotting the LOP on the UPS.	DR Longitude W 075° Sun's GHA= 21° 02' Ap λ W075° 02'
Zn	Azimuth number	See explanation above in Z . Zn is the final azimuth number. Most of the pages of Pub. No. 249 Vol. 2 have the following Zn rules at the top and bottom of each page. <u>Zn Rules</u> <u>To put Z into the right quadrant, apply the following rules-</u> <u>For North Latitudes:</u> LHA greater than 180° then Zn=Z LHA less than 180° then Zn=360° - Z <u>For South Latitudes:</u> LHA greater than 180° then Zn=180° - Z LHA less than 180° then Zn=180° + Z	LHA = 306° Zn= 116°
Intercept	Intercept is the distance and direction the LOP (Line Of Position) is drawn from the Ap. λ	The intercept is a mark on the azimuth line on the UPS. The length of the intercept is calculated by comparing Hc to Ho and subtracting the smaller of the two figures from the larger. Once the intercept is calculated and marked on the azimuth line, a 90° line will be drawn through the intercept. This will be the LOP. The direction of the intercept line must be determined and is drawn either <i>Away</i> or <i>Towards</i> the Sun on the azimuth line from the Ap λ of W 075° 02'. If Hc is greater then the Intercept point is <i>Away</i> from the Ap λ. If Ho is greater then the Intercept point is <i>Towards</i> the Sun beginning at the Ap λ. In this example Hc is greater so the intercept will be drawn <i>Away</i> from Ap λ. The UPS LOP plot is at the end of this file.	Hc= 25° 39' Ho= 25° 17' Intercept= 0° 22'

ALTITUDE CORRECTION TABLES 10°-90°—SUN, STARS, PLANETS

OCT.—MAR. SUN			APR.—SEPT.			STARS AND PLANETS				DIP							
App. Alt.	Lower Limb	Upper Limb	App. Alt.	Lower Limb	Upper Limb	App. Alt.	Corr ⁿ	App. Alt.	Additional Corr ⁿ	Ht. of Eye	Corr ⁿ	Ht. of Eye	Ht. of Eye	Corr ⁿ			
						2003				m		ft.					
						VENUS				2.4		-2.8		8.0		1.0 - 1.8	
						Jan. 1–Feb. 20				2.6		-2.9		8.6		1.5 - 2.2	
						° /				2.8		-3.0		9.2		2.0 - 2.5	
						0 +0.2				3.0		-3.1		9.8		2.5 - 2.8	
						41 +0.1				3.2		-3.2		10.5		3.0 - 3.0	
						76 +0.1				3.4		-3.3		11.2		See table ←	
						Feb. 21–Dec. 31				3.6		-3.4		11.9			
						° /				3.8		-3.5		12.6		m /	
						0 +0.1				4.0		-3.6		13.3			
						60 +0.1				4.3		-3.7		14.1		20 - 7.9	
						MARS				4.5		-3.8		14.9		22 - 8.3	
						Jan. 1–May 2				4.7		-3.9		15.7		24 - 8.6	
						Dec. 17–Dec. 31				5.0		-4.0		16.5		26 - 9.0	
						° /				5.2		-4.1		17.4		28 - 9.3	
						0 +0.1				5.5		-4.2		18.3		30 - 9.6	
						60 +0.1				5.8		-4.3		19.1			
						May 3–June 26				6.1		-4.3		20.1		32 - 10.0	
						Oct. 26–Dec. 16				6.3		-4.4		21.0		34 - 10.3	
						° /				6.6		-4.5		22.0		36 - 10.6	
						0 +0.2				6.9		-4.6		22.9		38 - 10.8	
						41 +0.1				7.2		-4.7		23.9		40 - 11.1	
						76 +0.1				7.5		-4.8		24.9			
						June 27–Aug. 1				7.9		-4.9		26.0		42 - 11.4	
						Sept. 23–Oct. 25				8.2		-5.0		27.1		44 - 11.7	
						° /				8.5		-5.1		28.1		46 - 11.9	
						0 +0.3				8.8		-5.2		29.2		48 - 12.2	
						34 +0.2				9.2		-5.3		30.4		ft. /	
						60 +0.1				9.5		-5.4		31.5			
						80 +0.1				9.9		-5.5		32.7		4 - 1.9	
						Aug. 2–Sept. 22				10.3		-5.6		33.9		6 - 2.4	
						° /				10.6		-5.7		35.1		8 - 2.7	
						0 +0.4				11.0		-5.8		36.3		10 - 3.1	
						29 +0.3				11.4		-5.9		37.6		See table ←	
						51 +0.2				11.8		-6.0		38.9			
						68 +0.1				12.2		-6.1		40.1		ft. /	
						83				12.6		-6.2		41.5			
						25 14 -2.0				13.0		-6.3		42.8		75 - 8.4	
						26 22 -1.9				13.4		-6.4		44.2		80 - 8.7	
						27 36 -1.8				13.8		-6.5		45.5		85 - 8.9	
						28 56 -1.7				14.2		-6.6		46.9		90 - 9.2	
						30 24 -1.6				14.7		-6.7		48.4		95 - 9.5	
						32 00 -1.5				15.1		-6.8		49.8			
						33 45 -1.4				15.5		-6.9		51.3		100 - 9.7	
						35 40 -1.3				16.0		-7.0		52.8		105 - 9.9	
						37 48 -1.2				16.5		-7.1		54.3		110 - 10.2	
						40 08 -1.1				16.9		-7.2		55.8		115 - 10.4	
						42 44 -1.0				17.4		-7.3		57.4		120 - 10.6	
						45 36 -0.9				17.9		-7.4		58.9		125 - 10.8	
						48 47 -0.8				18.4		-7.5		60.5			
						52 18 -0.7				18.8		-7.6		62.1		130 - 11.1	
						56 11 -0.6				19.3		-7.7		63.8		135 - 11.3	
						60 28 -0.5				19.8		-7.8		65.4		140 - 11.5	
						65 08 -0.4				20.4		-7.9		67.1		145 - 11.7	
						70 11 -0.3				20.9		-8.0		68.8		150 - 11.9	
						75 34 -0.2				21.4		-8.1		70.5		155 - 12.1	
						81 13 -0.1											
						87 03 0.0											
						90 00 0.0											

App. Alt. = Apparent altitude = Sextant altitude corrected for index error and dip.

N. Lat. { LHA greater than 180°Zn=Z
L.H.A less than 180°Zn=360°-Z

DECLINATION (0° - 14°) SAME NAME AS LATITUDE

LAT 40°

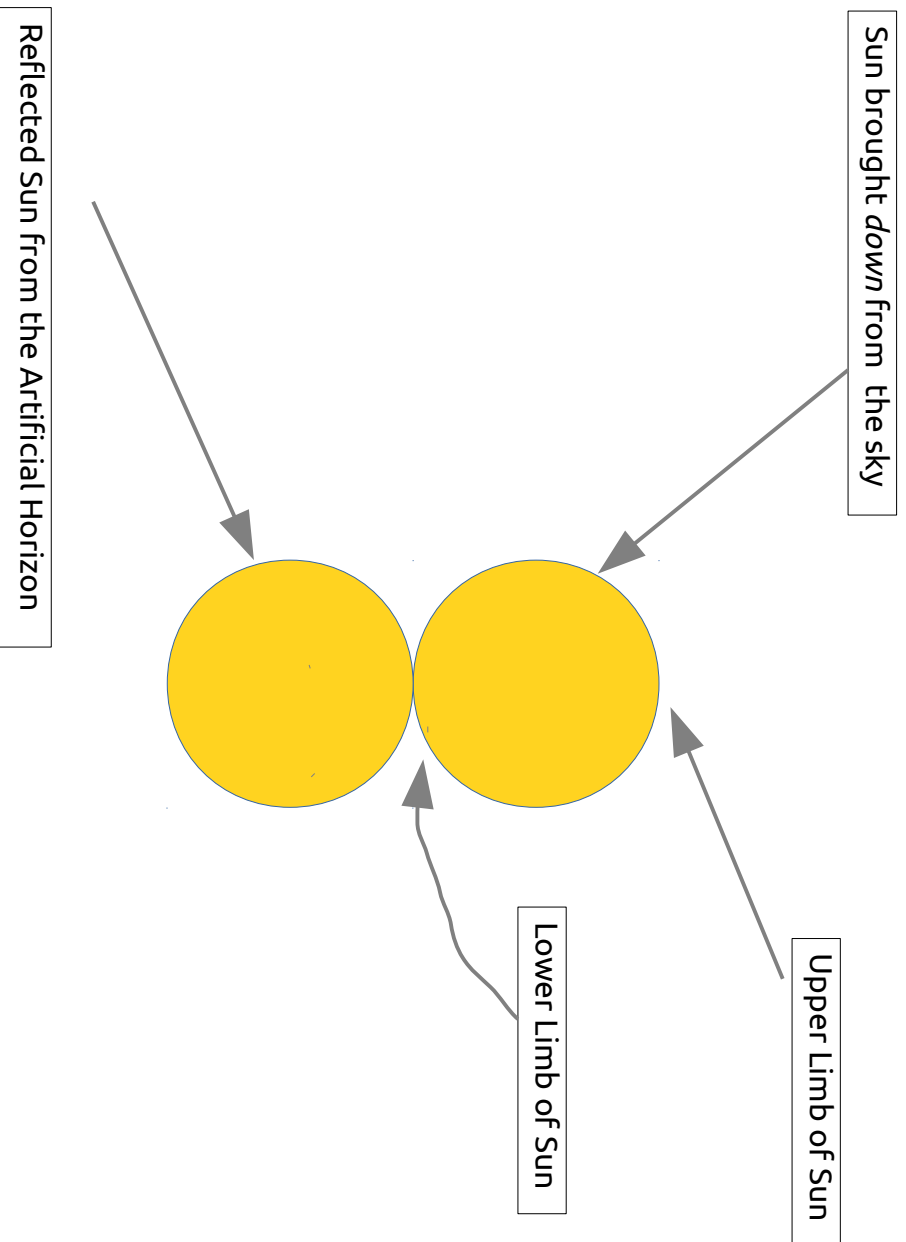
Table with columns for LHA (0 to 69) and rows for Declination (0° to 14°). Each cell contains three values: Hc, d, Z. The table is a grid for celestial navigation calculations.

S. Lat. { LHA greater than 180°Zn=180°-Z
L.H.A less than 180°Zn=180°+Z

DECLINATION (0° - 14°) SAME NAME AS LATITUDE

LAT 40°

Make the Sun look like this when using an Artificial Horizon



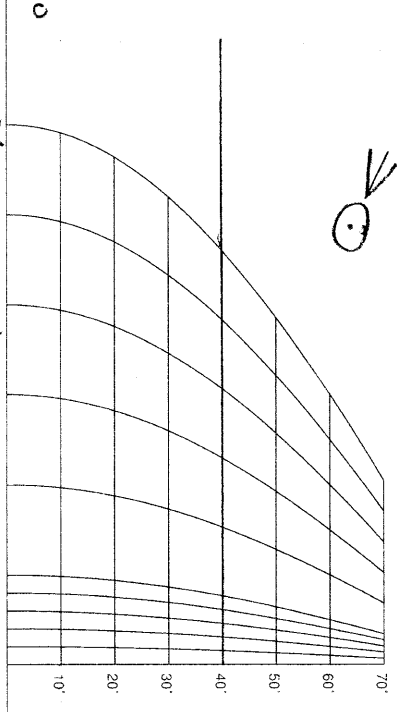
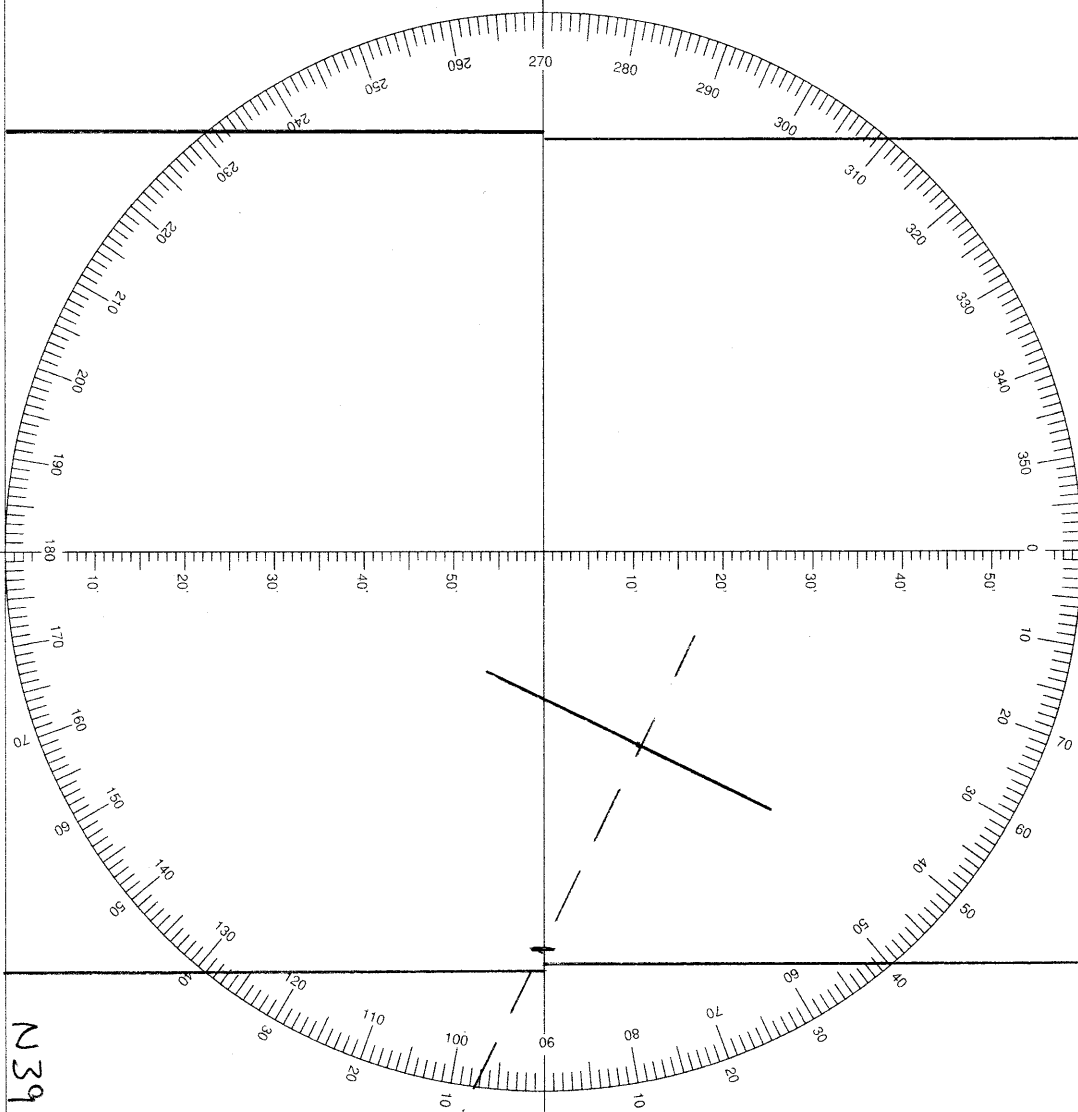
W0770

W0760

W0750

N410

N400



N390

50' 40' 30' 20' 10'

Plot time & date: 07/26/2014 UT 13:15:15

Page: _____