

Pub. No. 249 Vol. 1 star sight reduction form

Sight #	1	2			
Star	Alpheratz	Kochab			
DR Latitude	N 40°	N 40°			
DR Longitude	W 075°	W 075°			
Date	9/22/2016	9/21/2016			
UT	01:20:15	01:25:37			
Hs	84° 43'	80° 25'			
Index Error	+ 0° 01' (On)	+ 0° 01' (On)			
Hs - Index Error	84° 42'				
Dip	Using AH				
(AH / 2) = Ha	42° 21'				
ACT	-0° 1.1'				
Ho	42° 19.9'				
GHA Υ	16° 19.6'				
GHA Υ increment for minutes & seconds	5° 04.6'				
GHA Υ	21° 24.2'				
AP λ	W 075° 24.2'				
LHA Υ	306°				
Hc	43° 12'				
Zn	085°				
Intercept	0° 52' <i>Away</i>				

Star sight reduction

Pub. No. 249 Vol. 1

Sight, Star, 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
Star	The name of the star you're shooting	USNO Navigational Star Chart Alpheratz is located in the constellation Andromeda	Alpheratz
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°	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°	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.	See <i>Time</i> below	September 22, 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>	01:20:15

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

Form label	What is it?	Where to get it?	Figure
Hs	Height of sextant	Height of sextant- the initial, uncorrected, sextant angle reading of the star 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.	84° 43'
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.	$\begin{array}{r} \text{(Hs) } 84^{\circ} 43' \\ - 0^{\circ} 01' \\ \hline 84^{\circ} 42' \end{array}$
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.
(AH / 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> .	$\begin{array}{r} 84^{\circ} 42' \\ \text{divided by 2} \\ \hline \text{Ha} = 42^{\circ} 21' \end{array}$
ACT	Altitude Correction Table	<p>ALTITUDE CORRECTION TABLES are attached at the end herein.</p> <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 star in the STARS AND PLANETS column. Find where the Ha of 42° 21' would approximately be located- between 40° 08' and 42° 44'.</p> <p>For stars the correction is always subtracted from the Ha figure.</p>	-0° 1.1'
Ho	Height observed	Subtract the star ACT (0° 1.1') from the Ha to arrive at the <i>Ho</i> (Height observed). After all of the above corrections Ho= 42° 19.9' (round it up to 42° 20').	$\begin{array}{r} \text{(Ha) } 42^{\circ} 21' \\ \text{(Act)- } 0^{\circ} 1.1' \\ \hline \text{Ho} = 42^{\circ} 20' \end{array}$

Getting GHA Aries

Form label	What is it?	Where to get it?	Figure
GHA ☿	Greenwich Hour Angle Aries based on the integral hour and date of the sextant observation.	<p>The necessary portion of The Nautical Almanac is provided at the end of this file.</p> <p>You'll find the GHA ☿ in 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>	16° 19.6'
GHA ☿ increment for minutes & seconds	Greenwich Hour Angle Aries increment 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- https://www.thenauticalalmanac.com/Increments_and_Corrections/Increments_and_Corrections_Table.pdf</p> <p>You can also use the GHA ☿ Increment from TABLE 4 – GHA ☿ FOR THE YEARS 2011 – 2019 (the second page of TABLE 4)</p> <p>The second page of TABLE 4 is provided at the end of this file.</p>	5° 04.6'
GHA ☿	Greenwich Hour Angle Aries total	<p>Add the GHA ☿ integral hour figure to the GHA ☿ Increment figure. Round the final figure up or down.</p>	$\begin{array}{r} 16^{\circ} 19.6' \\ + 5^{\circ} 04.6' \\ \hline 21^{\circ} 24.2' \end{array}$

Calculating LHA Aries

Form label	What is it?	Where to get it?	Figure
Ap λ	Assumed position Longitude	<p><u>Ap λ in Western Longitudes</u></p> <p>Combine the DR. Longitude figure with only the minutes (of arc) of the total GHA Ψ figure. The Ap λ figure will be used when plotting the LOP on the UPS.</p> <p><u>Ap λ in Eastern Longitudes</u></p> <p>In Eastern longitudes the Ap λ is determined as follows;</p> <p>DR longitude + (0°60' minus GHA minutes of arc)</p> <p>Example- E 075° + (0°60' - 0° 24.2')= E 075° 35.8' Ap λ</p>	<p>DR Longitude W 075°</p> <p>Ap λ W075° 24.2'</p>
LHA Ψ	Local Hour Angle Aries total	<p>To get the LHA Ψ subtract or add the Ap λ from/to the GHA Ψ total according to the following rules-</p> <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 Ψ to next highest degree and add the DR. longitude integral degree to it. If the resulting figure is over 360 then subtract 360 from it.</p>	<p>GHA Ψ 21° 24.2'</p> <p>+ 360°</p> <p>381° 24.2'</p> <hr/> <p>- Ap λ W 075° 24.2'</p> <p>LHA Ψ = 306°</p>

$$\text{LHA } \Psi = 306^\circ$$

The LHA figure and DR. Latitude figure are both needed to find Hc and Zn in Pub. No. 249 Vol. 1

Finding 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. 1 is provided at the end of this file. You can get the entire Pub. No. 249 here-</p> <p>https://thenauticalalmanac.com/Pub_No_249/Vol_1_Epoch_2020/Pub_249_Vol_1_Epoch_2020.pdf</p> <p>Hc is found in Pub. No. 249 Vol 1.</p> <p>To find Hc you need the DR. Latitude (N 40°) and the LHA φ (306°).</p> <p>Locate the LHA φ row of 306° on the sheet and move across until you see where the star, Alpheratz, intersects that row. Find Hc in the Hc column under Alpheratz</p>	Hc= 43° 12'
Zn	Azimuth number or Azimuth angle	<p>The necessary portion of Pub. No. 249 Vol. 1 is provided at the end of this file.</p> <p>Zn is the horizontal angle in degrees that points to the star from the Ap. λ.</p> <p>Approximately, and close enough for us, Zn is the horizontal angle that points to the star from where we took the sextant observation.</p> <p>Zn is based on True North and not magnetic North.</p> <p>Locate the LHA row of 306° on the sheet and move across until you see where the star, Alpheratz, intersects that row. Find Zn in the Zn column under Alpheratz</p>	Zn= 085°
Intercept	Intercept is the distance and direction the LOP (Line Of Position) is drawn from the Ap. λ	<p>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.</p> <p>The direction of the intercept line must be determined and is drawn either <i>Away</i> or <i>Towards</i> the star on the azimuth line from the Ap λ of W 075° 24.2'.</p> <p>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 star beginning at the Ap λ.</p> <p>The UPS LOP plot is at the end of this file.</p>	Hc= 43° 12' Ho= 42° 20' Intercept= 0° 52'

How to plot an LOP

The following procedure and label is not on the sight reduction form

LOP	Line of Position	<p>Get it here-</p> <p>https://thenauticalalmanac.com/Procedures/Procedure-_Plotting_an_LOP.pdf</p>
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Altitude Correction Tables for 10° to 90° — Sun, Stars, Planets

SUN October – March			SUN April – September			Stars & Planets		Additional Altitude Correction for Mars & Venus	Refraction		DIP <i>always subtracted from Hs</i>				
App. Alt.	Lower Limb	Upper Limb	App. Alt.	Lower Limb	Upper Limb	App. Alt.	Corr		App. Alt.	Corr	Ht. of Eye	Corr	Ht. of Eye	Ht. of Eye	Corr
9 33	+10.8	- 21.5	9 39	+10.6	- 21.2	9 55	-5.3	5.5	-9.1	2.4		8.0	1.0	-1.8	
9 45	+10.9	-21.4	9 50	+10.7	-21.1	10 07	-5.2	6.0	-8.5	2.6	-2.8	8.6	1.5	-2.2	
9 56	+11.0	-21.3	10 02	+10.8	-21.0	10 20	-5.1	6.5	-7.9	2.8	-2.9	9.2	2.0	-2.5	
10 08	+11.1	-21.2	10 14	+10.9	-20.9	10 32	-5.0	7.0	-7.5	3.0	-3.0	9.8	2.5	-2.8	
10 20	+11.2	-21.1	10 27	+11.0	-20.8	10 46	-4.9	7.5	-7.0	3.2	-3.1	10.5	3.0	-3.0	
10 33	+11.3	-21.0	10 40	+11.1	-20.7	10 59	-4.8	8.0	-6.6	3.4	-3.2	11.2			
10 46	+11.4	-20.9	10 53	+11.2	-20.6	11 14	-4.7	8.5	-6.3	3.6	-3.3	11.9		See table	
11 00	+11.5	-20.8	11 07	+11.3	-20.5	11 29	-4.6	9.0	-5.9	3.8	-3.4	12.6			
11 15	+11.6	-20.7	11 22	+11.4	-20.4	11 44	-4.6	9.5	-5.7	4.0	-3.5	13.3			
11 30	+11.7	-20.6	11 37	+11.5	-20.3	12 00	-4.5	10.0	-5.4	4.3	-3.6	14.1	20	-7.9	
11 45	+11.8	-20.5	11 53	+11.6	-20.2	12 17	-4.4	10.5	-5.1	4.5	-3.7	14.9	22	-8.3	
12 01	+11.9	-20.4	12 10	+11.7	-20.1	12 35	-4.3	11.0	-4.9	4.7	-3.8	15.7	24	-8.6	
12 18	+12.0	-20.3	12 27	+11.8	-20.0	12 53	-4.2	11.5	-4.7	5.0	-3.9	16.5	26	-9.0	
12 36	+12.1	-20.2	14 45	+11.9	-19.9	13 12	-4.1	12.0	-4.5	5.2	-4.0	17.4	28	-9.3	
12 54	+12.2	-20.1	13 04	+12.0	-19.8	13 32	-4.0	12.5	-4.4	5.5	-4.1	18.3			
13 14	+12.3	-20.0	13 24	+12.1	-19.7	13 53	-3.9	13.0	-4.2	5.8	-4.2	19.1	30	-9.6	
13 34	+12.4	-19.9	13 44	+12.2	-19.6	14 16	-3.8	13.5	-4.0	6.1	-4.3	20.1	32	-10.0	
13 55	+12.5	-19.8	14 06	+12.3	-19.5	14 39	-3.7	14.0	-3.9	6.3	-4.4	21.0	34	-10.3	
14 17	+12.6	-19.7	14 29	+12.4	-19.4	15 03	-3.6	14.5	-3.8	6.6	-4.5	22.0	36	-10.6	
14 41	+12.7	-19.6	14 53	+12.5	-19.3	15 29	-3.5	15.0	-3.6	6.9	-4.6	22.9	38	-10.8	
15 05	+12.8	-19.5	15 18	+12.6	-19.2	15 56	-3.4	15.5	-3.5	7.2	-4.7	23.9			
15 31	+12.9	-19.4	15 45	+12.7	-19.1	16 25	-3.3	16.0	-3.4	7.5	-4.8	24.9	40	-11.1	
15 59	+13.0	-19.3	16 13	+12.8	-19.0	16 55	-3.2	16.5	-3.3	7.9	-4.9	26.0	42	-11.4	
16 27	+13.1	-19.2	16 43	+12.9	-18.9	17 27	-3.1	17.0	-3.2	8.2	-5.0	27.1	44	-11.7	
16 58	+13.2	-19.1	17 14	+13.0	-18.8	18 01	-3.0	17.5	-3.1	8.5	-5.1	28.1	46	-11.9	
17 30	+13.3	-19.0	17 47	+13.1	-18.7	18 37	-2.9	18.0	-3.0	8.8	-5.2	29.2	48	-12.2	
18 05	+13.4	-18.9	18 23	+13.2	-18.6	19 16	-2.8	18.5	-2.9	9.2	-5.3	30.4		feet	
18 41	+13.5	-18.8	19 00	+13.3	-18.5	19 56	-2.7	19.0	-2.9	9.5	-5.4	31.5	2	-1.4	
19 20	+13.6	-18.7	19 41	+13.4	-18.4	20 40	-2.6	19.5	-2.8	9.9	-5.5	32.7	4	-1.9	
20 02	+13.7	-18.6	20 24	+13.5	-18.3	21 27	-2.5	20.0	-2.7	10.3	-5.6	33.9	6	-2.4	
20 46	+13.8	-18.5	21 10	+13.6	-18.2	22 17	-2.4	21.0	-2.6	10.6	-5.7	35.1	8	-2.7	
21 34	+13.9	-18.4	21 59	+13.7	-18.1	23 11	-2.3	22.0	-2.4	11.0	-5.8	36.3	10	-3.1	
22 25	+14.0	-18.3	22 52	+13.8	-18.0	24 09	-2.2	23.0	-2.3	11.4	-5.9	37.6		See table	
23 20	+14.1	-18.2	23 49	+13.9	-17.9	25 12	-2.1	24.0	-2.2	11.8	-6.0	38.9			
24 20	+14.2	-18.1	24 51	+14.0	-17.8	26 20	-2.0	25.0	-2.1	12.2	-6.1	40.1		feet	
25 24	+14.3	-18.0	25 58	+14.1	-17.7	27 34	-1.9	26.0	-2.0	12.6	-6.2	41.5	70	-8.1	
26 34	+14.4	-17.9	27 11	+14.2	-17.6	28 54	-1.8	27.0	-1.9	13.0	-6.3	42.8	75	-8.4	
27 50	+14.5	-17.8	28 31	+14.3	-17.5	30 22	-1.7	28.0	-1.9	13.4	-6.4	44.2	80	-8.7	
29 13	+14.6	-17.7	29 58	+14.4	-17.4	31 58	-1.6	29.0	-1.8	13.8	-6.5	45.5	85	-8.9	
30 44	+14.7	-17.6	31 33	+14.5	-17.3	33 43	-1.5	30.0	-1.7	14.2	-6.6	46.9	90	-9.2	
32 24	+14.8	-17.5	33 18	+14.6	-17.2	35 38	-1.4	31.0	-1.7	14.7	-6.7	48.4	95	9.5	
34 15	+14.9	-17.4	35 15	+14.7	-17.1	37 45	-1.3	32.0	-1.6	15.1	-6.8	49.8	100	-9.7	
36 17	+15.0	-17.3	37 24	+14.8	-17.0	40 06	-1.2	33.0	-1.5	15.5	-6.9	51.3	105	-9.9	
38 34	+15.1	-17.2	39 48	+14.9	-16.9	42 42	-1.1	34.0	-1.5	16.0	-7.0	52.8	110	-10.2	
41 06	+15.2	-17.1	42 28	+15.0	-16.8	45 34	-1.0	35.0	-1.4	16.5	-7.1	54.3	115	-10.4	
43 56	+15.3	-17.0	45 29	+15.1	-16.7	48 45	-0.9	36.0	-1.4	16.9	-7.2	55.8	120	-10.6	
47 07	+15.4	-16.9	48 52	+15.2	-16.6	52 16	-0.8	37.0	-1.3	17.4	-7.3	57.4	125	-10.8	
50 43	+15.5	-16.8	51 41	+15.3	-16.5	56 09	-0.7	38.0	-1.3	17.9	-7.4	58.9			
54 46	+15.6	-16.7	56 59	+15.4	-16.4	60 26	-0.6	39.0	-1.2	18.4	-7.5	60.5	130	-11.1	
59 21	+15.7	-16.6	61 50	+15.5	-16.3	65 06	-0.5	40.0	-1.2	18.8	-7.6	62.1	135	-11.3	
64 28	+15.8	-16.5	67 15	+15.6	-16.2	70 09	-0.4	45.0	-1.0	19.3	-7.7	63.8	140	-11.5	
70 10	+15.9	-16.4	73 14	+15.7	-16.1	75 32	-0.3	50.0	-0.8	19.8	-7.8	65.4	145	-11.7	
76 24	+16.0	-16.3	79 42	+15.8	-16.0	81 12	-0.2	55.0	-0.7	20.4	-7.9	67.1	150	-11.9	
83 05	+16.1	-16.2	86 21	+15.9	-15.9	87 03	0.0	60.0	-0.6	20.9	-8.0	68.8	155	-12.1	
90 00			90 00			90 00		65.0	-0.5	21.4	-8.1	70.5			
								70.0	-0.4						
								75.0	-0.3						
								80.0	-0.2						
								85.0	-0.1						

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

Altitude Correction Tables for 0° to 10° — Sun, Stars, Planets

App. Alt.	Sun		Sun		Stars & Planets	App. Alt.	Sun		Sun		Stars & Planets
	October - March		April - September				October - March		April - September		
	Lower Limb	Upper Limb	Lower Limb	Upper Limb			Lower Limb	Upper Limb	Lower Limb	Upper Limb	
0 00	-17.5	-49.8	-17.8	-49.6	-33.8	3 30	+ 3.4	-28.9	+ 3.1	-28.7	-12.9
0 03	16.9	49.2	17.2	49.0	33.2	3 35	3.6	28.7	3.3	28.5	12.7
0 06	16.3	48.6	16.6	48.4	32.6	3 40	3.8	28.5	3.6	28.2	12.5
0 09	15.7	48.0	16.0	47.8	32.0	3 45	4.0	28.3	3.8	28.0	12.3
0 12	15.2	47.5	15.4	47.2	31.5	3 50	4.2	28.1	4.0	27.8	12.1
0 15	14.6	46.9	14.8	46.6	30.9	3 55	4.4	27.9	4.1	27.7	11.9
0 18	-14.1	-46.4	-14.3	-46.1	-30.4	4 00	+ 4.6	-27.7	+ 4.3	-27.5	-11.7
0 21	13.5	45.8	13.8	45.6	29.8	4 05	4.8	27.5	4.5	27.3	11.5
0 24	13.0	45.3	13.3	45.1	29.3	4 10	4.9	27.4	4.7	27.1	11.4
0 27	12.5	44.8	12.8	44.6	28.8	4 15	5.1	27.2	4.9	26.9	11.2
0 30	12.0	44.3	12.3	44.1	28.3	4 20	5.3	27.0	5.0	26.8	11.0
0 33	11.6	43.9	11.8	43.6	27.9	4 25	5.4	26.9	5.2	26.6	10.9
0 36	-11.1	-10.0	-11.3	-43.1	-27.4	4 30	+ 5.6	-26.7	+ 5.3	-26.5	-10.7
0 39	10.6	42.9	10.9	42.7	26.9	4 35	5.7	26.6	5.5	26.3	10.6
0 42	10.2	42.5	10.5	42.3	26.5	4 40	5.9	26.4	5.6	26.2	10.4
0 45	9.8	42.1	10.0	41.8	26.1	4 45	6.0	26.3	5.8	26.0	10.3
0 48	9.4	41.7	9.6	41.4	25.7	4 50	6.2	26.1	5.9	25.9	10.1
0 51	9.0	41.3	9.2	41.0	25.3	4 55	6.3	26.0	6.1	25.7	10.0
0 54	-8.6	-40.9	-8.8	-40.6	-24.9	5 00	+ 6.4	-25.9	+ 6.2	-25.6	-9.9
0 57	8.2	40.5	8.4	40.2	24.5	5 05	6.6	25.7	6.3	25.5	9.7
1 00	7.8	40.1	8.0	39.8	24.1	5 10	6.7	25.6	6.5	25.3	9.6
1 03	7.4	39.7	7.7	39.5	23.7	5 15	6.8	25.5	6.6	25.2	9.5
1 06	7.1	39.4	7.3	39.1	23.4	5 20	7.0	25.3	6.7	25.1	9.3
1 09	6.7	39.0	7.0	38.8	23.0	5 25	7.1	25.2	6.8	25.0	9.2
1 12	-6.4	-38.7	-6.6	-38.4	-22.7	5 30	+ 7.2	-25.1	+ 6.9	-24.9	-9.1
1 15	6.0	38.3	6.3	38.1	22.3	5 35	7.3	25.0	7.1	24.7	9.0
1 18	5.7	38.0	6.0	37.8	22.0	5 40	7.4	24.9	7.2	24.6	8.9
1 21	5.4	37.7	5.7	37.5	21.7	5 45	7.5	24.8	7.3	24.5	8.8
1 24	5.1	37.4	5.3	37.1	21.4	5 50	7.6	24.7	7.4	24.4	8.7
1 27	4.8	37.1	5.0	36.8	21.1	5 55	7.7	24.6	7.5	24.3	8.6
1 30	-4.5	-36.8	-4.7	-36.5	-20.8	6 00	+ 7.8	-24.5	+ 7.6	-24.2	-8.5
1 35	4.0	36.3	4.3	36.1	20.3	6 10	8.0	24.3	7.8	24.0	8.3
1 40	3.6	35.9	3.8	35.6	19.9	6 20	8.2	24.1	8.0	23.8	8.1
1 45	3.1	35.4	3.4	35.2	19.4	6 30	8.4	23.9	8.2	23.6	7.9
1 50	2.7	35.0	2.9	34.7	19.0	6 40	8.6	23.7	8.3	23.5	7.7
1 55	2.3	34.6	2.5	34.3	18.6	6 50	8.7	23.6	8.5	23.3	7.6
2 00	-1.9	-34.2	-2.1	-33.9	-18.2	7 00	+ 8.9	-23.4	+ 8.7	-23.1	-7.4
2 05	1.5	33.8	1.7	33.5	17.8	7 10	9.1	23.2	8.8	23.0	7.2
2 10	1.1	33.4	1.4	33.2	17.4	7 20	9.2	23.1	9.0	22.8	7.1
2 15	0.8	33.1	1.0	32.8	17.1	7 30	9.3	23.0	9.1	22.7	6.9
2 20	0.4	32.7	0.7	32.5	16.7	7 40	9.5	22.8	9.2	22.6	6.8
2 25	-0.1	32.4	-0.3	32.1	16.4	7 50	9.6	22.7	9.4	22.4	6.7
2 30	+ 0.2	-32.1	0.0	-31.8	-16.1	8 00	+ 9.7	-22.6	+ 9.5	-22.3	-6.6
2 35	0.5	31.8	+ 0.3	31.5	15.8	8 10	9.9	22.4	9.6	22.2	6.4
2 40	0.8	31.5	0.6	31.2	15.4	8 20	10.0	22.3	9.7	22.1	6.3
2 45	1.1	31.2	0.9	30.9	15.2	8 30	10.1	22.2	9.9	21.9	6.2
2 50	1.4	30.9	1.2	30.6	14.9	8 40	10.2	22.1	10.0	21.8	6.1
2 55	1.7	30.6	1.4	30.4	14.9	8 50	10.3	22.0	10.1	21.7	6.0
3 00	+ 2.0	-30.3	+ 1.7	-30.1	-14.3	9 00	+ 10.4	-21.9	+ 10.2	-21.6	-5.9
3 05	2.2	30.1	2.0	29.8	14.1	9 10	10.5	21.8	10.3	21.5	5.8
3 10	2.5	29.8	2.2	29.6	13.8	9 20	10.6	21.7	10.4	21.4	5.7
3 15	2.7	29.6	2.5	29.3	13.6	9 30	10.7	21.6	10.5	21.3	5.6
3 20	2.9	29.4	2.7	29.1	13.4	9 40	10.8	21.5	10.6	21.2	5.5
3 25	3.2	29.1	2.9	28.9	13.4	9 50	10.9	21.4	10.6	21.2	5.4
3 30	3.4	-28.9	+ 3.1	-28.7	-12.9	10 00	+ 11.0	-21.3	+ 10.7	-21.1	-5.3

For bubble sextant observations- ignore dip and use star corrections for the Sun, planets and stars.

September 21, 22, 23 UT (Wed., Thu., Fri.)

Aries		Venus		Mars		Jupiter		Saturn		Stars		
Wed	GHA	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	SHA	Dec	
0	0°18.0	155°19.9	S10°05.0	94°50.0	S25°54.0	177°35.7	N00°01.1	110°41.9	S20°37.5	Alpheratz	357°40.8	29°11.0
1	15°20.5	170°19.5	06.2	109°50.7	54.0	192°37.7	00.9	125°44.2	37.6	Ankaa	353°13.2	-42°12.8
2	30°23.0	185°19.1	07.4	124°51.4	54.0	207°39.7	00.6	140°46.5	37.6	Schedar	349°37.3	56°37.7
3	45°25.4	200°18.7	· · 08.6	139°52.1	· · 54.1	222°41.6	· · 00.4	155°48.8	· · 37.6	Diphda	348°53.4	-17°53.6
4	60°27.9	215°18.3	09.8	154°52.8	54.1	237°43.6	N00°00.2	170°51.1	37.6	Achernar	335°24.7	-57°09.0
5	75°30.3	230°18.0	11.0	169°53.5	54.1	252°45.6	S00°00.0	185°53.4	37.7	Hamal	327°58.0	23°32.4
6	90°32.8	245°17.6	S10°12.2	184°54.2	S25°54.1	267°47.6	S00°00.2	200°55.7	S20°37.7	Polaris	316°25.7	89°19.8
7	105°35.3	260°17.2	13.4	199°54.9	54.1	282°49.5	00.4	215°58.0	37.7	Acamar	315°16.4	-40°14.2
8	120°37.7	275°16.8	14.6	214°55.6	54.1	297°51.5	00.6	231°00.3	37.8	Menkar	314°12.5	4°09.3
9	135°40.2	290°16.4	· · 15.8	229°56.3	· · 54.2	312°53.5	· · 00.9	246°02.6	· · 37.8	Mirfak	308°36.8	49°54.9
10	150°42.7	305°16.0	17.0	244°57.0	54.2	327°55.4	01.1	261°04.9	37.8	Aldebaran	290°46.7	16°32.4
11	165°45.1	320°15.6	18.2	259°57.7	54.2	342°57.4	01.3	276°07.3	37.8	Rigel	281°09.9	-8°11.0
12	180°47.6	335°15.3	S10°19.4	274°58.4	S25°54.2	357°59.4	S00°01.5	291°09.6	S20°37.9	Capella	280°31.1	46°00.5
13	195°50.1	350°14.9	20.6	289°59.1	54.2	13°01.3	01.7	306°11.9	37.9	Bellatrix	278°29.6	6°21.8
14	210°52.5	5°14.5	21.8	304°59.8	54.2	28°03.3	01.9	321°14.2	37.9	Elnath	278°09.8	28°37.0
15	225°55.0	20°14.1	· · 23.1	320°00.5	· · 54.3	43°05.3	· · 02.1	336°16.5	· · 38.0	Alnilam	275°44.1	-1°11.5
16	240°57.5	35°13.7	24.3	335°01.2	54.3	58°07.2	02.4	351°18.8	38.0	Betelgeuse	270°58.9	7°24.5
17	255°59.9	50°13.3	25.5	350°01.9	54.3	73°09.2	02.6	6°21.1	38.0	Canopus	263°55.2	-52°42.1
18	271°02.4	65°12.9	S10°26.7	5°02.6	S25°54.3	88°11.2	S00°02.8	21°23.4	S20°38.0	Sirius	258°31.8	-16°44.3
19	286°04.8	80°12.5	27.9	20°03.3	54.3	103°13.1	03.0	36°25.7	38.1	Adhara	255°10.9	-28°59.6
20	301°07.3	95°12.1	29.1	35°04.0	54.3	118°15.1	03.2	51°28.0	38.1	Procyon	244°57.6	5°10.9
21	316°09.8	110°11.8	· · 30.3	50°04.7	· · 54.3	133°17.1	· · 03.4	66°30.3	· · 38.1	Pollux	243°25.2	27°59.0
22	331°12.2	125°11.4	31.5	65°05.4	54.4	148°19.1	03.6	81°32.6	38.2	Avior	234°17.4	-59°33.6
23	346°14.7	140°11.0	32.7	80°06.1	54.4	163°21.0	03.9	96°34.9	38.2	Suhail	222°51.1	-43°29.9
Mer.pass.:23:55		v-0.4 d-1.2 m-3.8		v0.7 d-0.0 m-0.1		v2.0 d-0.2 m-1.5		v2.3 d-0.0 m0.5		Miaplacidus	221°39.7	-69°47.0
										Alphard	217°54.2	-8°43.8
										Regulus	207°41.5	11°53.2
										Dubhe	193°49.8	61°39.6
										Denebola	182°31.8	14°28.9
										Genah	175°50.3	-17°37.9
										Acruz	173°07.4	-63°11.4
										Gacrux	171°58.9	-57°12.3
										Alioth	166°19.4	55°52.4
										Spica	158°29.2	-11°14.7
										Alkaid	152°57.7	49°14.1
										Hadar	148°45.2	-60°27.1
										Menkent	148°05.3	-36°27.0
										Arcturus	145°54.0	19°06.0
										Rigel Kent.	139°49.1	-60°54.2
										Kochab	137°21.1	74°05.6
										Zuben'ubi	137°03.2	-16°06.4
										Alphecca	126°09.4	26°39.9
										Antares	112°23.7	-26°27.9
										Atria	107°23.6	-69°03.4
										Sabik	102°10.1	-15°44.5
										Shaula	96°19.0	-37°06.8
										Rasalhague	96°04.5	12°33.3
										Eltanin	90°45.1	51°29.7
										Kaus Aust.	83°40.9	-34°22.4
										Vega	80°37.4	38°48.4
										Nunki	75°55.5	-26°16.4
										Altair	62°05.9	8°55.1
										Peacock	53°15.5	-56°40.8
										Deneb	49°29.6	45°20.8
										Enif	33°44.7	9°57.3
										Al Na'ir	27°40.6	-46°52.7
										Fomalhaut	15°21.3	-29°31.9
										Scheat	13°50.9	28°10.6
										Markab	13°35.8	15°17.9
										Sep 21 Wed	SHA	Mer.pass
										Venus	155°01.9	13:39
										Mars	94°32.0	17:40
										Jupiter	177°17.7	12:08
										Saturn	110°23.8	16:35
										Sep 22 Thu	SHA	Mer.pass
										Venus	153°53.4	13:40
										Mars	93°49.6	17:39
										Jupiter	177°05.8	12:05
										Saturn	110°20.1	16:31
										Sep 23 Fri	SHA	Mer.pass
										Venus	152°44.8	13:40
										Mars	93°07.0	17:38
										Jupiter	176°53.9	12:02
										Saturn	110°16.2	16:27
										Horizontal parallax		
										Venus:		0.1
										Mars:		0.1
Mer.pass.:23:47		v-0.4 d-1.2 m-3.8		v0.7 d-0.0 m-0.0		v2.0 d-0.2 m-1.5		v2.3 d-0.0 m0.5				

TABLE 4- GHA Υ (ARIES) FOR THE YEARS 2022-2030

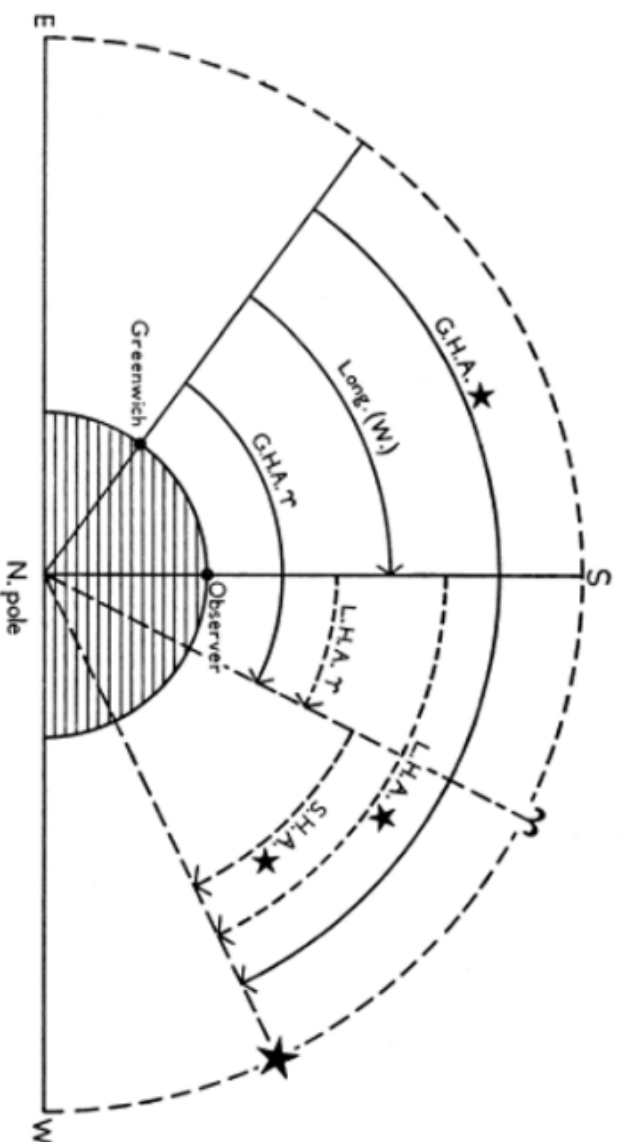
c. INCREMENT OF GHA Υ FOR MINUTES AND SECONDS

	00 ^s	04 ^s	08 ^s	12 ^s	16 ^s	20 ^s	24 ^s	28 ^s		32 ^s	36 ^s	40 ^s	44 ^s	48 ^s	52 ^s	56 ^s	60 ^s	
m	°	°	°	°	°	°	°	°	m	°	°	°	°	°	°	°	°	m
00	0 00	0 01	0 02	0 03	0 04	0 05	0 06	0 07	00	0 08	0 09	0 10	0 11	0 12	0 13	0 14	0 15	00
01	0 15	0 16	0 17	0 18	0 19	0 20	0 21	0 22	01	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 30	01
02	0 30	0 31	0 32	0 33	0 34	0 35	0 36	0 37	02	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45	02
03	0 45	0 46	0 47	0 48	0 49	0 50	0 51	0 52	03	0 53	0 54	0 55	0 56	0 57	0 58	0 59	1 00	03
04	1 00	1 01	1 02	1 03	1 04	1 05	1 06	1 07	04	1 08	1 09	1 10	1 11	1 12	1 13	1 14	1 15	04
05	1 15	1 16	1 17	1 18	1 19	1 20	1 21	1 22	05	1 23	1 24	1 25	1 26	1 27	1 28	1 29	1 30	05
06	1 30	1 31	1 32	1 33	1 34	1 35	1 36	1 37	06	1 38	1 39	1 40	1 41	1 42	1 43	1 44	1 45	06
07	1 45	1 46	1 47	1 48	1 49	1 50	1 51	1 52	07	1 53	1 54	1 55	1 56	1 57	1 58	1 59	2 00	07
08	2 00	2 01	2 02	2 03	2 04	2 05	2 06	2 07	08	2 08	2 09	2 10	2 11	2 12	2 13	2 14	2 15	08
09	2 15	2 16	2 17	2 18	2 19	2 20	2 21	2 22	09	2 23	2 24	2 25	2 26	2 27	2 28	2 29	2 30	09
10	2 30	2 31	2 32	2 33	2 34	2 35	2 36	2 37	10	2 38	2 39	2 40	2 41	2 42	2 43	2 44	2 45	10
11	2 45	2 46	2 47	2 48	2 49	2 50	2 51	2 52	11	2 53	2 54	2 55	2 56	2 57	2 58	2 59	3 00	11
12	3 00	3 01	3 02	3 04	3 05	3 06	3 07	3 08	12	3 09	3 10	3 11	3 12	3 13	3 14	3 15	3 16	12
13	3 16	3 17	3 18	3 19	3 20	3 21	3 22	3 23	13	3 24	3 25	3 26	3 27	3 28	3 29	3 30	3 31	13
14	3 31	3 32	3 33	3 34	3 35	3 36	3 37	3 38	14	3 39	3 40	3 41	3 42	3 43	3 44	3 45	3 46	14
15	3 46	3 47	3 48	3 49	3 50	3 51	3 52	3 53	15	3 54	3 55	3 56	3 57	3 58	3 59	4 00	4 01	15
16	4 01	4 02	4 03	4 04	4 05	4 06	4 07	4 08	16	4 09	4 10	4 11	4 12	4 13	4 14	4 15	4 16	16
17	4 16	4 17	4 18	4 19	4 20	4 21	4 22	4 23	17	4 24	4 25	4 26	4 27	4 28	4 29	4 30	4 31	17
18	4 31	4 32	4 33	4 34	4 35	4 36	4 37	4 38	18	4 39	4 40	4 41	4 42	4 43	4 44	4 45	4 46	18
19	4 46	4 47	4 48	4 49	4 50	4 51	4 52	4 53	19	4 54	4 55	4 56	4 57	4 58	4 59	5 00	5 01	19
20	5 01	5 02	5 03	5 04	5 05	5 06	5 07	5 08	20	5 09	5 10	5 11	5 12	5 13	5 14	5 15	5 16	20
21	5 16	5 17	5 18	5 19	5 20	5 21	5 22	5 23	21	5 24	5 25	5 26	5 27	5 28	5 29	5 30	5 31	21
22	5 31	5 32	5 33	5 34	5 35	5 36	5 37	5 38	22	5 39	5 40	5 41	5 42	5 43	5 44	5 45	5 46	22
23	5 46	5 47	5 48	5 49	5 50	5 51	5 52	5 53	23	5 54	5 55	5 56	5 57	5 58	5 59	6 00	6 01	23
24	6 01	6 02	6 03	6 04	6 05	6 06	6 07	6 08	24	6 09	6 10	6 11	6 12	6 13	6 14	6 15	6 16	24
25	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	25	6 24	6 25	6 26	6 27	6 28	6 29	6 30	6 31	25
26	6 31	6 32	6 33	6 34	6 35	6 36	6 37	6 38	26	6 39	6 40	6 41	6 42	6 43	6 44	6 45	6 46	26
27	6 46	6 47	6 48	6 49	6 50	6 51	6 52	6 53	27	6 54	6 55	6 56	6 57	6 58	6 59	7 00	7 01	27
28	7 01	7 02	7 03	7 04	7 05	7 06	7 07	7 08	28	7 09	7 10	7 11	7 12	7 13	7 14	7 15	7 16	28
29	7 16	7 17	7 18	7 19	7 20	7 21	7 22	7 23	29	7 24	7 25	7 26	7 27	7 28	7 29	7 30	7 31	29
30	7 31	7 32	7 33	7 34	7 35	7 36	7 37	7 38	30	7 39	7 40	7 41	7 42	7 43	7 44	7 45	7 46	30
31	7 46	7 47	7 48	7 49	7 50	7 51	7 52	7 53	31	7 54	7 55	7 56	7 57	7 58	7 59	8 00	8 01	31
32	8 01	8 02	8 03	8 04	8 05	8 06	8 07	8 08	32	8 09	8 10	8 11	8 12	8 13	8 14	8 15	8 16	32
33	8 16	8 17	8 18	8 19	8 20	8 21	8 22	8 23	33	8 24	8 25	8 26	8 27	8 28	8 29	8 30	8 31	33
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35	8 46	8 47	8 48	8 49	8 50	8 51	8 52	8 53	35	8 54	8 55	8 56	8 57	8 58	8 59	9 00	9 01	35
36	9 01	9 02	9 03	9 04	9 05	9 06	9 07	9 08	36	9 10	9 11	9 12	9 13	9 14	9 15	9 16	9 17	36
37	9 17	9 18	9 19	9 20	9 21	9 22	9 23	9 24	37	9 25	9 26	9 27	9 28	9 29	9 30	9 31	9 32	37
38	9 32	9 33	9 34	9 35	9 36	9 37	9 38	9 39	38	9 40	9 41	9 42	9 43	9 44	9 45	9 46	9 47	38
39	9 47	9 48	9 49	9 50	9 51	9 52	9 53	9 54	39	9 55	9 56	9 57	9 58	9 59	10 00	10 01	10 02	39
40	10 02	10 03	10 04	10 05	10 06	10 07	10 08	10 09	40	10 10	10 11	10 12	10 13	10 14	10 15	10 16	10 17	40
41	10 17	10 18	10 19	10 20	10 21	10 22	10 23	10 24	41	10 25	10 26	10 27	10 28	10 29	10 30	10 31	10 32	41
42	10 32	10 33	10 34	10 35	10 36	10 37	10 38	10 39	42	10 40	10 41	10 42	10 43	10 44	10 45	10 46	10 47	42
43	10 47	10 48	10 49	10 50	10 51	10 52	10 53	10 54	43	10 55	10 56	10 57	10 58	10 59	11 00	11 01	11 02	43
44	11 02	11 03	11 04	11 05	11 06	11 07	11 08	11 09	44	11 10	11 11	11 12	11 13	11 14	11 15	11 16	11 17	44
45	11 17	11 18	11 19	11 20	11 21	11 22	11 23	11 24	45	11 25	11 26	11 27	11 28	11 29	11 30	11 31	11 32	45
46	11 32	11 33	11 34	11 35	11 36	11 37	11 38	11 39	46	11 40	11 41	11 42	11 43	11 44	11 45	11 46	11 47	46
47	11 47	11 48	11 49	11 50	11 51	11 52	11 53	11 54	47	11 55	11 56	11 57	11 58	11 59	12 00	12 01	12 02	47
48	12 02	12 03	12 04	12 05	12 06	12 07	12 08	12 09	48	12 10	12 11	12 12	12 13	12 14	12 15	12 16	12 17	48
49	12 17	12 18	12 19	12 20	12 21	12 22	12 23	12 24	49	12 25	12 26	12 27	12 28	12 29	12 30	12 31	12 32	49
50	12 32	12 33	12 34	12 35	12 36	12 37	12 38	12 39	50	12 40	12 41	12 42	12 43	12 44	12 45	12 46	12 47	50
51	12 47	12 48	12 49	12 50	12 51	12 52	12 53	12 54	51	12 55	12 56	12 57	12 58	12 59	13 00	13 01	13 02	51
52	13 02	13 03	13 04	13 05	13 06	13 07	13 08	13 09	52	13 10	13 11	13 12	13 13	13 14	13 15	13 16	13 17	52
53	13 17	13 18	13 19	13 20	13 21	13 22	13 23	13 24	53	13 25	13 26	13 27	13 28	13 29	13 30	13 31	13 32	53
54	13 32	13 33	13 34	13 35	13 36	13 37	13 38	13 39	54	13 40	13 41	13 42	13 43	13 44	13 45	13 46	13 47	54
55	13 47	13 48	13 49	13 50	13 51	13 52	13 53	13 54	55	13 55	13 56	13 57	13 58	13 59	14 00	14 01	14 02	55
56	14 02	14 03	14 04	14 05	14 06	14 07	14 08	14 09	56	14 10	14 11	14 12	14 13	14 14	14 15	14 16	14 17	56
57	14 17	14 18	14 19	14 20	14 21	14 22	14 23	14 24	57	14 25	14 26	14 27	14 28	14 29	14 30	14 31	14 32	57
58	14 32	14 33	14 34	14 35	14 36	14 37	14 38	14 39	58	14 40	14 41	14 42	14 43	14 44	14 45	14 46	14 47	58
59	14 47	14 48	14 49	14 50	14 51	14 52	14 53	14 54	59	14 55	14 56	14 57	14 58	14 59	15 00	15 01	15 02	59

Example. The value of GHA Υ for March 17, 2027 at GMT 05:11:41 is (a) 158° 35' + (b) 090° 59' + (c) 002° 55' = 171° 29'.

Reminder- GHA Υ can never exceed 360°. If total is greater than 360° then subtract 360° from it.

GHA LHA SHA diagram



The above diagram, showing the plane of the equator as seen from the north pole, illustrates the relationship between the Greenwich and local hour angles, and longitude and sidereal hour angle.

G.H.A. of Aries (γ), Sun, Moon and planets are tabulated directly ; for these :

$$L.H.A. = G.H.A. - W. \text{ longitude } (+ E. \text{ longitude})$$

For the stars :

$$G.H.A. \star = G.H.A. \gamma + S.H.A. \star$$

$$L.H.A. \star = G.H.A. \gamma + S.H.A. \star - W. \text{ longitude } (+ E. \text{ longitude})$$

$$L.H.A. \star = L.H.A. \gamma + S.H.A. \star$$

LHA Υ	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
0	+CAPELLA	ALDEBARAN	+Diphda	FOMALHAUT	ALTAIR	+VEGA	Kochab							
1	34°03' 055	26°21' 090	31°11' 168	19°00' 194	26°58' 258	30°00' 297	27°38' 348							
2	34 41 056	27 07 091	31 20 169	18 49 195	26 13 259	29 19 298	27 28 348							
3	35 19 056	27 53 091	31 29 170	18 37 196	25 28 260	28 38 298	27 19 348							
4	35 57 057	28 38 092	31 36 171	18 24 197	24 42 261	27 58 299	27 10 349							
5	36 35 057	29 24 093	31 43 172	18 10 198	23 57 261	27 18 299	27 01 349							
6	37 14 057	30 10 093	31 49 173	17 56 199	23 12 262	26 38 300	26 52 349							
7	37 53 058	30 56 094	31 54 174	17 41 199	22 26 263	25 58 300	26 44 349							
8	38 32 058	31 42 095	31 58 175	17 25 200	21 40 263	25 18 301	26 35 350							
9	39 11 058	32 28 095	32 01 177	17 09 201	20 55 264	24 39 301	26 27 350							
10	39 50 058	33 14 096	32 04 178	16 52 202	20 09 265	23 59 301	26 19 350							
11	40 29 059	33 59 097	32 05 179	16 34 203	19 23 265	23 20 302	26 12 351							
12	41 08 059	34 45 097	32 06 180	16 16 204	18 37 266	22 41 302	26 04 351							
13	41 48 059	35 30 098	32 05 181	15 57 205	17 51 267	22 03 303	25 57 351							
14	42 27 060	36 16 099	32 04 182	15 38 205	17 06 267	21 24 303	25 50 351							
15	43 07 060	37 01 100	32 02 183	15 18 206	16 20 268	20 46 304	25 43 352							
15	+CAPELLA	BETELGEUSE	RIGEL	+Diphda	Enif	+DENEBO	Kochab							
16	43 47 060	17 00 095	14 04 114	31 59 184	37 28 249	43 33 299	25 37 352							
17	44 27 060	17 45 095	14 46 114	31 55 186	36 45 250	42 52 299	25 30 352							
18	45 07 061	18 31 096	15 28 115	31 50 187	36 02 251	42 12 300	25 24 352							
19	45 47 061	19 17 097	16 09 116	31 44 188	35 18 251	41 32 300	25 18 353							
20	46 27 061	20 03 098	16 50 117	31 38 189	34 35 252	40 53 300	25 12 353							
21	47 08 062	20 48 098	17 31 117	31 31 190	33 51 253	40 13 300	25 07 353							
22	47 48 062	21 34 099	18 12 118	31 22 191	33 07 254	39 33 301	25 02 354							
23	48 29 062	22 19 099	18 52 119	31 12 192	32 23 255	38 54 301	24 57 354							
24	49 09 062	23 04 100	19 32 120	31 02 193	31 38 255	38 15 301	24 52 354							
25	49 50 062	23 49 101	20 12 120	30 51 194	30 54 256	37 35 302	24 47 354							
26	50 31 063	24 35 101	20 52 121	30 40 195	30 09 257	36 56 302	24 43 355							
27	51 12 063	25 20 102	21 31 122	30 27 197	29 24 258	36 18 302	24 39 355							
28	51 53 063	26 04 103	22 10 123	30 13 198	28 39 258	35 39 303	24 35 355							
29	52 34 063	26 49 104	22 48 124	29 59 199	27 54 259	35 00 303	24 32 356							
30	53 15 064	27 34 104	23 26 124	29 44 200	27 09 260	34 22 303	24 28 356							
30	+CAPELLA	BETELGEUSE	RIGEL	+Diphda	Alpheratz	+DENEBO	Kochab							
31	53 56 064	28 18 105	24 04 125	29 28 201	64 54 253	33 44 304	24 25 356							
32	54 37 064	29 02 106	24 41 126	29 02 202	64 09 254	33 05 304	24 22 357							
33	55 19 064	29 47 107	25 18 127	28 54 203	63 25 255	32 27 305	24 19 357							
34	56 01 064	30 31 107	25 54 128	28 36 204	62 41 256	31 50 305	24 17 357							
35	56 43 064	31 14 108	26 31 129	28 17 205	61 56 257	31 12 305	24 15 357							
36	57 23 064	31 58 109	27 06 130	27 57 206	61 11 258	30 35 306	24 13 358							
37	58 04 065	32 41 110	27 41 131	27 37 207	60 26 259	29 57 306	24 11 358							
38	58 46 065	33 24 111	28 16 131	27 16 208	59 41 260	29 20 306	24 10 358							
39	59 27 065	34 07 111	28 50 132	26 54 209	58 55 261	28 43 307	24 08 359							
40	60 09 065	34 50 112	29 24 133	26 31 210	58 10 262	28 07 307	24 07 359							
41	60 51 065	35 32 113	29 57 134	26 08 211	57 24 262	27 30 308	24 07 359							
42	61 32 065	36 14 114	30 30 135	25 44 212	56 39 263	26 54 308	24 06 000							
43	62 14 065	36 56 115	31 02 136	25 20 213	55 53 264	26 18 308	24 06 000							
44	62 55 065	37 38 116	31 33 137	24 54 214	55 07 265	25 42 309	24 06 000							
45	63 37 065	38 19 117	32 04 138	24 29 215	54 22 266	25 06 309	24 06 000							
45	+Dubhe	POLLUX	SIRIUS	+RIGEL	Diphda	+Alpheratz	DENEBO							
46	22 11 026	31 02 078	12 43 125	32 35 139	24 02 216	53 36 266	24 31 310							
47	22 32 026	31 47 078	13 21 126	33 04 140	23 35 216	52 50 267	23 55 310							
48	22 52 027	32 32 079	13 58 127	33 33 141	23 08 217	52 04 268	23 20 310							
49	23 13 027	33 18 080	14 35 127	34 02 142	22 39 218	51 18 268	22 45 311							
50	23 34 027	34 03 080	15 11 128	34 30 143	22 11 219	50 32 269	22 11 311							
51	23 55 028	34 48 081	15 47 129	34 57 144	21 41 220	49 46 270	21 36 312							
52	24 17 028	35 33 081	16 23 130	35 23 145	21 12 221	49 00 270	21 02 312							
53	24 39 028	36 19 082	16 58 130	35 49 147	20 41 222	48 14 271	20 28 313							
54	25 01 029	37 04 082	17 32 131	36 14 148	20 10 223	47 28 272	19 55 313							
55	25 23 029	37 50 083	18 07 132	36 38 149	19 39 223	46 42 272	19 21 314							
56	25 46 029	38 36 083	18 41 133	37 01 150	19 07 224	45 56 273	18 48 314							
57	26 08 030	39 21 084	19 14 134	37 24 151	18 35 225	45 10 273	18 15 315							
58	26 31 030	40 07 085	19 47 135	37 46 152	18 02 226	44 25 274	17 42 315							
59	26 54 030	40 53 085	20 20 136	38 07 153	17 29 227	43 39 275	17 10 315							
60	27 17 031	41 39 086	20 52 136	38 27 155	16 55 228	42 53 275	16 38 316							
60	+Dubhe	POLLUX	PROCYON	+SIRIUS	RIGEL	+Hamal	Schedar							
61	27 41 031	42 25 086	29 42 110	21 23 137	38 46 156	61 16 244	54 04 314							
62	28 05 031	43 10 087	30 25 111	21 54 138	39 04 157	60 34 245	53 31 314							
63	28 29 032	43 56 088	31 08 112	22 25 139	39 22 158	59 52 246	52 58 314							
64	28 53 032	44 42 088	31 50 112	22 55 140	39 39 159	59 10 247	52 25 314							
65	29 17 032	45 28 089	32 33 113	23 24 141	39 54 161	58 28 248	51 52 314							
66	29 42 032	46 14 089	33 15 114	23 53 142	40 09 162	57 45 249	51 19 314							
67	30 07 033	47 00 090	33 57 115	24 21 142	40 23 163	57 02 250	50 46 314							
68	30 32 033	47 46 091	34 38 116	24 49 143	40 35 165	56 18 251	50 13 314							
69	30 57 033	48 32 091	35 19 117	25 16 144	40 47 166	55 35 252	49 40 314							
70	31 22 033	49 18 092	36 00 118	25 43 145	40 58 167	54 51 253	49 07 314							
71	31 47 034	50 04 093	36 41 119	26 09 146	41 08 168	54 07 254	48 34 314							
72	32 13 034	50 50 093	37 21 119	26 34 147	41 16 170	53 22 255	48 01 314							
73	32 39 034	51 36 094	38 01 120	26 59 148	41 24 171	52 38 256	47 28 314							
74	33 05 034	52 21 095	38 40 121	27 23 149	41 31 172	51 53 257	46 55 314							
75	33 31 035	53 07 096	39 19 122	27 46 150	41 36 174	51 08 258	46 22 314	</						

LAT 40°N										LAT 40°N											
LHA	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	LHA	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
Υ											Υ										
180	*VEGA	Alphecca	ARCTURUS	*SPICA	REGULUS	*POLLUX	CAPELLA				270	*Alpheratz	ALTAIR	Nunki	*ANTARES	ARCTURUS	*Alkaid	Kochab			
181	17°48' 054	43°50' 090	54°05' 115	35°01' 154	52°46' 229	37°10' 278	21°25' 313				271	16°39' 066	50°13' 134	22°27' 166	20°20' 201	38°02' 263	45°35' 304	49°30' 342			
182	18 25 057	44 36 090	54 46 117	35 21 155	52 11 230	36 24 278	20 51 313				272	17 21 066	50 46 135	22 37 167	20 03 202	37 16 264	44 56 304	49 16 342			
183	19 03 055	45 22 091	55 27 118	35 40 156	51 35 231	35 39 279	20 18 314				273	18 03 067	51 18 136	22 47 168	19 45 203	36 30 265	44 18 304	49 01 342			
184	20 18 056	46 08 092	56 08 119	35 58 157	50 59 233	34 53 279	19 45 314				274	19 28 068	52 20 139	23 04 170	19 08 205	34 59 266	43 03 305	48 32 341			
185	20°56' 056	47°39' 093	57°27' 121	36°31' 160	49°45' 235	33°23' 280	18°39' 315				275	20°11' 068	52°50' 141	23°12' 171	18°48' 206	34°13' 267	42°25' 305	48°17' 341			
186	21 35 057	48 25 094	58 06 123	36 47 161	49 07 236	32 38 281	18 07 316				276	20 53 069	53 18 142	23 18 172	18 28 207	33 27 268	41 47 305	48 02 341			
187	22 13 057	49 11 094	58 45 124	37 01 162	48 29 237	31 53 282	17 35 316				277	21 36 069	53 46 143	23 24 173	18 07 208	32 41 268	41 10 305	47 47 341			
188	22 52 058	49 57 095	59 22 125	37 15 163	47 50 238	31 08 282	17 03 316				278	22 19 070	54 13 145	23 29 174	17 45 208	31 55 269	40 32 306	47 32 341			
189	23 31 058	50 43 096	60 00 127	37 28 164	47 10 239	30 23 283	16 32 317				279	23 03 070	54 39 146	23 34 175	17 23 209	31 09 270	39 55 306	47 16 340			
190	24°10' 059	51°28' 097	60°36' 128	37°40' 166	46°31' 240	29°38' 283	16°00' 317				280	23°46' 071	55°04' 148	23°37' 176	17°00' 210	30°23' 270	39°18' 306	47°01' 340			
191	24 49 059	52 14 097	61 12 130	37 51 167	45 50 241	28 53 284	15 29 318				281	24 30 072	55 28 150	23 40 177	16 37 211	29 37 271	38 41 307	46 45 340			
192	25 29 060	53 00 098	61 47 131	38 01 168	45 10 242	28 09 284	14 59 318				282	25 13 072	55 50 151	23 42 178	16 13 212	28 51 271	38 04 307	46 29 340			
193	26 09 060	53 45 099	62 21 133	38 09 169	44 29 243	27 24 285	14 28 319				283	25 57 073	56 12 153	23 43 179	15 49 213	28 05 272	37 27 307	46 14 340			
194	26 49 060	54 30 100	62 54 135	38 17 171	43 48 244	26 40 285	13 58 319				284	26 41 073	56 32 155	23 44 180	15 24 213	27 19 273	36 51 307	45 58 340			
195	DENEBO	*VEGA	ARCTURUS	*SPICA	REGULUS	*POLLUX	Dubhe				285	*Alpheratz	Enif	ALTAIR	*Rasalhague	ARCTURUS	*Alkaid	*Kochab			
196	13°02' 041	27°29' 061	63°56' 136	38°24' 172	43°06' 245	25°55' 286	62°09' 331				286	27°25' 074	42°43' 118	56°52' 156	56°52' 220	26°33' 273	36°14' 308	45°42' 340			
197	13 02 041	28 09 061	63 57 138	38 30 173	42 24 246	25 11 286	61 47 330				287	28 09 074	43 24 119	57 09 158	56 22 222	25 48 274	35 38 308	45 26 340			
198	14 02 042	28 49 062	64 28 140	38 35 174	41 42 247	24 27 287	61 24 329				288	28 53 075	44 04 120	57 26 160	55 51 223	25 02 275	35 02 308	45 10 339			
199	14 33 042	29 30 062	64 57 142	38 40 176	40 59 248	23 43 287	61 00 329				289	29 38 075	44 44 121	57 41 162	55 19 224	24 16 275	34 26 309	44 54 339			
200	15°35' 043	30°11' 063	65°24' 144	38°43' 177	40°17' 249	23°00' 288	60°36' 328				290	30 22 076	45 23 122	57 55 165	54 46 226	23 30 276	33 50 309	44 37 339			
201	15 35 043	30 52 063	65 53 146	38 45 178	39 34 250	22 16 289	60 12 328				291	31 07 076	46 02 123	58 08 165	54 13 227	22 44 276	33 14 309	44 22 339			
202	16 07 044	31 33 064	66 16 148	38 46 179	38 50 251	21 32 289	59 47 327				292	31 52 077	46 40 124	58 19 167	53 39 229	21 59 277	32 39 310	44 05 339			
203	16 39 044	32 14 064	66 40 150	38 46 181	38 07 252	20 49 290	59 22 327				293	32 36 077	47 18 125	58 28 169	53 40 230	21 13 278	32 03 310	43 49 339			
204	17 11 045	32 55 064	67 02 152	38 45 182	37 23 252	20 06 290	58 57 327				294	33 21 078	47 55 126	58 37 171	52 29 231	20 28 278	31 28 310	43 32 339			
205	17 43 045	33 37 065	67 23 155	38 43 183	36 39 253	19 23 291	58 32 326				295	34 06 078	48 32 128	58 43 173	51 52 232	19 42 279	30 53 311	43 16 339			
206	18°16' 046	34°19' 065	67°42' 157	38°39' 184	35°55' 254	18°40' 291	58°06' 326				296	34 51 079	49 08 129	58 48 175	51 16 234	18 57 279	30 18 311	42 59 339			
207	18 49 046	35 01 066	67 59 159	38 35 186	35 11 255	17 57 292	57 40 325				297	35 37 080	49 43 130	58 52 176	50 38 235	18 12 280	29 44 311	42 43 339			
208	19 22 046	35 43 066	68 14 162	38 30 187	34 26 256	17 15 292	57 14 325				298	36 22 080	50 18 131	58 54 178	50 01 236	17 26 281	29 09 312	42 27 339			
209	19 55 047	36 25 067	68 28 164	38 24 188	33 42 256	16 32 293	56 47 325				299	37 07 081	50 53 132	58 55 180	49 22 237	16 41 281	28 51 312	42 10 339			
210	20 29 047	37 07 067	68 39 167	38 17 189	32 57 257	15 50 294	56 20 324				300	37 52 081	51 26 134	58 54 182	48 43 238	15 56 282	28 01 312	41 54 339			
211	DENEBO	*VEGA	Rasalhague	ANTARES	*SPICA	REGULUS	*Dubhe				301	*Mirfak	Alpheratz	*Enif	ALTAIR	Rasalhague	*Alphecca	Kochab			
212	21°03' 048	37°49' 067	35°28' 105	14°54' 146	38°09' 191	32°12' 258	55°54' 324				302	18 11 039	38 38 082	51 59 135	58 51 184	48 04 239	34 24 278	41 37 339			
213	21 03 048	38 32 068	36 12 104	15 19 146	38 00 192	31 27 259	55 27 324				303	18 40 040	39 23 082	52 31 136	58 47 186	47 24 240	33 39 278	41 21 339			
214	22 11 049	39 14 068	36 56 106	15 44 147	37 51 193	30 42 259	54 59 324				304	19 10 040	40 09 083	53 03 138	58 42 188	46 44 241	32 54 279	41 04 339			
215	22 46 049	39 57 069	37 41 107	16 09 148	37 40 194	29 57 260	54 32 323				305	19 40 040	40 55 083	53 33 139	58 35 190	46 04 242	32 08 279	40 48 339			
216	23 21 050	40 40 069	38 24 108	16 33 149	37 28 196	29 12 261	54 05 323				306	20 10 041	41 40 084	54 03 141	58 26 192	45 23 243	31 23 280	40 32 339			
217	23 56 050	41 23 070	39 08 109	16 57 150	37 15 197	28 26 262	53 37 323				307	20 40 041	42 26 085	54 31 142	58 16 193	44 41 244	30 38 281	40 15 339			
218	24 31 051	42 06 070	39 52 108	17 19 151	37 01 198	27 41 261	53 09 323				308	21 10 042	43 12 085	54 59 144	58 05 195	44 00 245	29 52 281	39 59 339			
219	25 07 051	42 49 070	40 35 110	17 42 151	36 47 199	26 55 262	52 41 323				309	21 41 042	43 58 086	55 26 145	57 52 197	43 18 246	29 07 282	39 43 339			
220	25 43 051	43 33 071	41 18 111	18 03 152	36 31 200	26 09 264	52 13 322				310	22 12 043	44 43 086	55 52 147	57 38 199	42 35 247	28 22 282	39 26 339			
221	26 18 052	44 16 071	42 01 112	18 24 153	36 15 201	25 24 264	51 45 322				311	22 43 043	45 29 087	56 16 148	57 22 201	41 53 248	27 38 283	39 10 339			
222	26 55 052	45 00 071	42 43 113	18 45 154	35 58 203	24 38 265	51 17 322				312	23 15 043	46 15 088	56 40 150	57 05 202	41 10 249	26 53 283	38 54 339			
223	27 31 052	45 43 072	43 25 114	19 05 155	35 40 204	23 52 266	50 49 322				313	23 46 044	47 01 088	57 02 152	56 47 204	40 27 250	26 08 284	38 38 339			
224	28 07 053	46 27 072	44 07 115	19 24 156	35 21 205	23 06 266	50 21 322				314	24 18 044	47 47 089	57 24 153	56 28 205	39 44 251	25 24 284	38 22 340			
225	28 44 053	47 11 073	44 49 116	19 42 157	35 01 206	22 20 267	49 52 322				315	24 50 045	48 33 089	57 44 155	56 07 208	39 00 252	24 39 285	38 06 340			
226	29 21 054	47 55 073	45 30 117	20 00 158	34 40 207	21 35 268	49 24 322				316	25 23 045	49 19 090	58 02 157	55 45 209	38 16 253	23 55 286	37 50 340			
227	DENEBO	*ALTAIR	Rasalhague	ANTARES	*SPICA	Denebola	*Dubhe				317	*Mirfak	Hamal	Diphda	*FOMALHAUT	ALTAIR	*VEGA	Kochab			
228	29°58' 054	18°48' 094	46°11' 118	34°19' 158	41°25' 252	48°56' 322					318	25 55 045	24 29 079	12 04 126	15 13 154	55 22 211	62 37 279	37 34 340			
229	30 35 054	19 30 095	46 51 119	20 34 159	40 41 253	48 27 322					319	26 28 046	25 15 080	12 41 127	15 33 154	54 58 212	61 52 280	37 18 340			
230	31																				

