
Step-by-Step
Sextant Users Guide
By
Andrew Evans
Foolish Muse

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Sailing "Foolish Muse"

Introduction

Last Christmas, Santa gave me a beautiful new Davis Mark 3 Sextant. Over the next three months I borrowed five books and two videos from the public library, but was more confused than ever:

- The chapters don't follow a logical order and there was no summation.
- They don't include any of the key data sheets or tell me where to find them. Their examples look different from what I could find.
- They assume that I am on the deck of an aircraft carrier, rather than bucking the waves on my 30' sailboat with the tiller under my knee.
- They add correction factors and decimal points to $1/10^{th}$ of a mile. I just want to find Hawaii!
- They expect levels of accuracy in measurement of speed and direction that are completely unrealistic on a normal sailboat.

It took hours of painful concentration to get a good handle on Celestial Navigation. I've written this guide so that you can skip the research and go right to practice. If Santa brings you a Davis Mark 3, you should be able to find yourself before Christmas dinner!

Notes
At the end of this guide you will find two copies of a Navigation Sheet. The learning sheet is marked with guide numbers in Green. I suggest that you print off several copies. I'll use the second sheet for my working example. These are actual sightings from my own day on the water. *My working example will be marked in Italics in this guide.*

I've made an assumption that you are using your sextant while standing just a few feet above sea level, on a boat or on the shore. If you are standing more than 15 feet above sea level, you will have to make adjustments to the "correction factor" as described in Step 7.

It is possible to use your sextant to navigate with the Sun, Moon, Planets or Stars. I am going to concentrate on the Sun, and I'll leave it up to you to learn about the Moon, Planets and Stars.

The data sheets at the back of this guide are small sections of much larger sheets. I have given all you will need to navigate by the Sun only.

Step 1

Take a sextant shot of the sun and immediately note the exact time.

The manual that came with your sextant tells how to set it up and take a reading. The important parts are these:

- Set the sextant to 0°. Then use the adjustment screws to ensure that the actual horizon is level with the horizon in the mirror.
- Flip down the sun filters, then adjust the arm until the bottom of the sun in the mirror just touches the actual horizon, as shown in Figure 1 (next page). To find this point, swing the bottom of the sextant back and forth like a pendulum. Remember that the sun is always moving so you will be making tiny adjustments to catch up.

This process will take some practice. It is extra challenging when the boat is rocking or the horizon has a layer of mist.

The theory

By taking a sextant shot of the sun, you are finding the angle between the sun and the horizon. Thinking back to high school trigonometry courses, recall that if you know an angle, then you can calculate the distance. In Figure 2 (next page), imagine a very long pole sticking straight out of the ground to the sun. If you know Angle X, then with a little math you can figure out distance to the base of the pole - Y.

What you have determined is your distance from the base of the sun, but this could be anywhere on a very big circle on the earth, as shown in Figure 3 (next page). In later lessons we will narrow down your position to an exact point.

Understanding the time

The sun moves across the sky at 15 miles a minute or one mile every 4 seconds. So you must accurately note the time that you have taken your sextant shot, at least within a few seconds. The method is simple: just lock your sextant on the sun and immediately look at your watch. Only after you have written down the time in Space 2 should you look back at the sextant to read the angle. Write your sextant angle in Space 4. Of course you must make sure that your watch is correct in the first place. You can compare it to the time on your GPS or the Official US Time Clock on the Internet at http://nist.time.gov. (You don't have to go through the process of resetting your watch every time you leave the dock. You might just remember something like "I reset my watch on the first day of the month, and it gains 2 seconds per day." So, for example, on the 6th day of the month you would just add 12 seconds to your watch time.)

In the working example, local time is 13:02:15 and the sextant reading is 53° 14'.

We always work using a 24-hour clock, and time is always listed using Coordinated Universal Time or Greenwich Mean Time. Make sure you know the difference between your local time and GMT. Remember that if you switch to Daylight Savings Time in the spring, your local time will be one hour earlier in GMT. You should write down the current hours of GMT in Space 5 and the minutes and seconds of GMT in Space 8.

In the working example, I've got a GMT of 20:02:15.

If you have a GPS, you should write down your GPS position in Space 3.

Figure 1

Figure 2

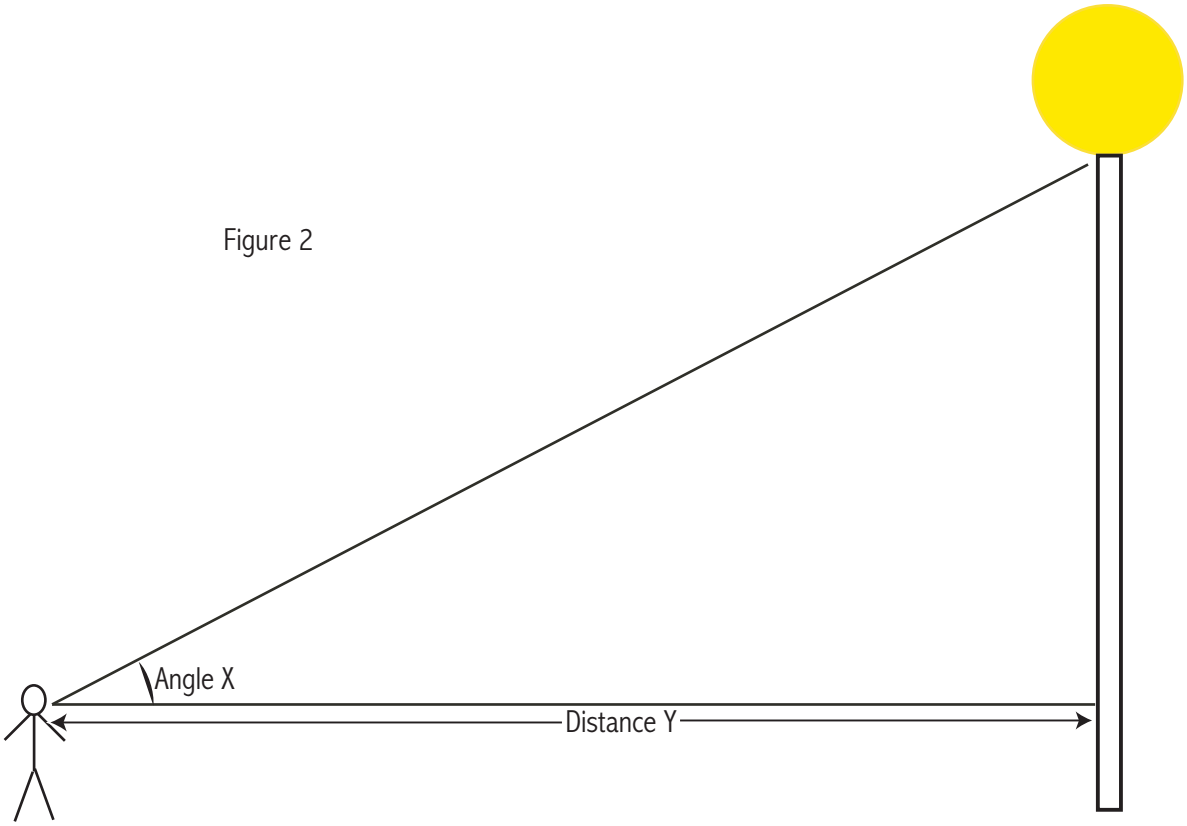
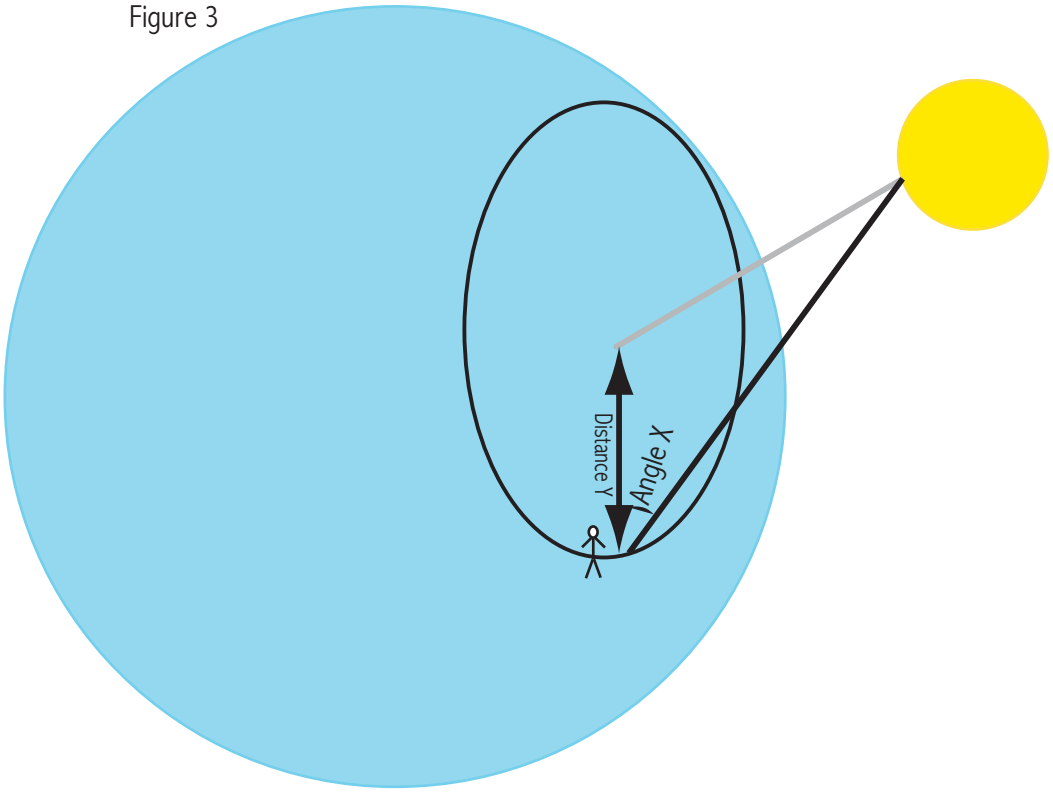


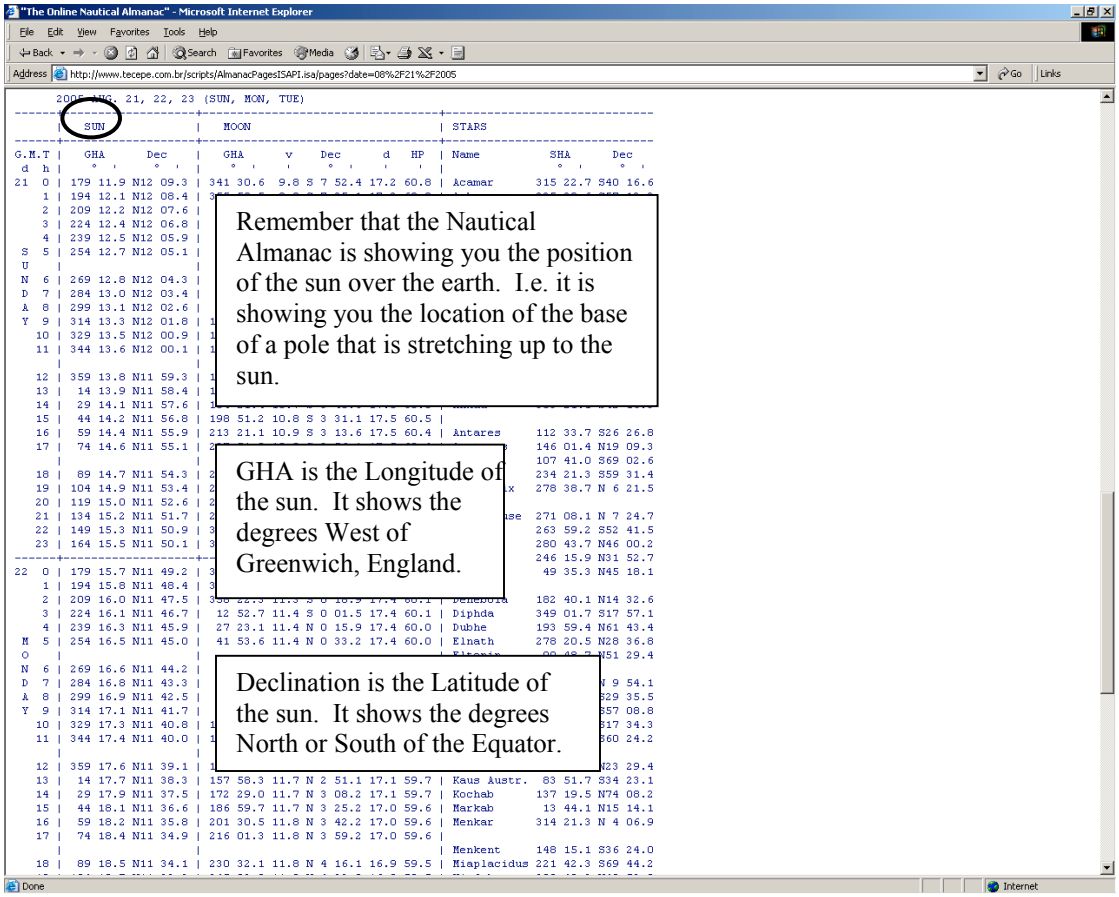
Figure 3



Step 2

Use the Nautical Almanac to determine the position of the sun at your hour.

If we imagine a long pole stretching up from the earth to the sun, we need to determine where is the base of this pole. The base of the pole is its "Geographical Position" or GP. (Keep in mind that because the sun is moving so quickly, its GP is moving just as quickly.) This is such an important concept that every year the government publishes a book about it. This book will tell you exactly where the sun is, at every second of the day, every day of the year. The book is called the "Nautical Almanac". You can purchase an entire Nautical Almanac from the US or British Government, or on-line at www.paracay.com. But these days you don't have to buy the entire book, you can download the important parts on the Internet. I'd suggest you try 'The Online Nautical Almanac" available at: http://www.tecepe.com.br/scripts/AlmanacPagesISAPI.isa Just click on the "go get it" button and you will have the exact position of the sun for the next three days. The first two pages refer to the planets. The following pages refer to the sun, moon and stars. I have included a small section here:



On the screen image, I have circled the word "Sun" at the top of the page. Just below that are the initials "**GHA**". This stands for "Greenwich Hour Angle". This is the number of degrees West from Greenwich, England. This is exactly the same as the degrees of longitude.

Back on the screen image, just to the right of GHA you will see "**Dec**". This is short for "Declination", and is exactly the same as the degrees of latitude and will always be shown with N or S for North or South.

There is one tricky part about GHA. On a map, we travel westwards from 0° to 180°W, then go back down from 180° to 0°E. We all know that 0° is at Greenwich, England, and 180° is in the Pacific Ocean. When using a sextant, we don't stop at 180°, we just keep going all the way to 360°, so there is no W or E.

Remember: Declination can be either N or S, but GHA is always West, so we don't even mention it.

Here are two examples:

Find the position of the sun on Sunday at 17 hours: The sun has a GHA of 74° 14.6', and a Dec of 11° 55.1' N. So a pole stretching up to the sun would have its base in the water just north of Santa Marta, Columbia.

Now, find the position of the sun on Monday at 7 hours. The position is GHA 284° 16.8', Dec 11° 43.3' N. The sun is directly over Southern India. (Equal to 75° 43.2'E, 11° 43.3N. The math on this is simple: 360°- 284° 16.8'= 75° 43.2'E)

Looking back at the screen image again, you see that the numbers for GHA change very quickly, while the numbers for Dec only change by a little. This is because the sun is swinging around the earth very quickly from east to west. But the sun moves very slowly from north to south from June to December and from south to north from December to June.

You write the GHA figure into Space 6 and the Dec figure into Space 7.

For our working example, the values for Sunday at 2000 are GHA 119° 15.0', and Dec N11° 52.6'.

Step 3

Use the Table of Increments and Corrections to determine the position of the sun at your exact minute and second.

The screen image above gives you the position of the sun at every hour. What about the minutes and seconds between the hours? To get these, you have to go to the Table of Increments and Corrections, often called the "Yellow Pages" from a Nautical Almanac. I have included a version of this at the back of this guide. This table does not change from year to year. So keep your copy in good condition and it will last the rest of your life.

Turn to the back of this guide to see the Table of Increments and Corrections. You start by finding the current minute (of time) at the top of the column. There is one column for each minute from 0 – 59. Once you have found the correct minute, you follow down the left side for the correct second. Find where they intersect in the middle of the table and write this number in Space 9.

For our working example, the value for 2 minutes, 15 seconds is 0° 33.8'.

Now you simply add the value for the hour to the value from the minutes and seconds.

In the working example, the total for the two becomes

20hr	*119° 15.0'*	*Space 6*
02min, 15sec	*0° 33.8'*	*Space 9*
Total GHA:	*119° 48.8'*	*Space 10*

This example brings up an important aspect of addition. Remember that when dealing with navigation, there are 60 minutes in a degree and 360 degrees on the globe. So, for example,

0° 35.4' + 0° 43.7'= 1° 19.1'

250°+170°=60°

120°-170°=310°

You see that we work in Degrees, Minutes and Tenths. We do not work with Degrees, Minutes and Seconds. And of course do not get confused between the Degrees, Minutes and Tenths on a chart and the hours, minutes and seconds on your watch.

Through this step we have worked only with the Greenwich Hour Angle, GHA. We have not worked with the Declination. This is because the Declination changes very little over an hour, so we are not concerned with the minutes and seconds.

Step 4

Determine your AP and calculate your LHA.

AP is your "Assumed Position". Let me make this very clear: your AP is NOT where you think you are located at the moment. Your AP is NOT the same as your dead reckoning position. Rather, your AP is an imaginary location (somewhat close to you) that you simply grab out of the air to make the math easier for the next step. (They should never have used the term "Assumed Position". It is misleading because the AP that you choose might be 50 miles away from where you think you are!)

Your AP will have both an "AP-Longitude" and an "AP-Latitude". First, we will work with the AP-Longitude. Keep in mind that this is always West of Greenwich, so it can be from 0° to 360°.

You saw above that we had a total GHA of 119° 48.8'. The Nautical Almanac is not able to work with this level of detail. Your AP-Longitude will get rid of the Minutes and Tenths from your GHA. Later on we will bring back the detail when we are plotting our position.

From my working example, I sail out of Victoria, on the West Coast of Canada. I do most of my sailing north of 48°N, and west of 123°W. In Step 3, we determined that the GHA was 119° 48.8'. From this I would set my AP-Longitude as 123° 48.8'. You see that the minutes from my AP-Longitude are exactly the same as the minutes from the GHA, i.e. 48.8'. You must always do this.

In our working example, the math becomes:

	GHA	*119° 48.8'*
-	*AP-Longitude*	*123° 48.8'*
=	*LHA*	*356°*

(note: In cases where the GHA is less than the AP, the math is made easier if you add 360 to the GHA before attempting the subtraction.)

By subtracting your AP-Longitude from the GHA, you are left with a figure called the LHA. Because we have eliminated the minutes in the calculation, the LHA is a nice, round number: 356°.

LHA stands for "Local Hour Angle". Where the GHA measures the angle of the sun West from Greenwich, England, the LHA measures the angle of the sun **West** of your Assumed Position. LHA is always measured to the West, even if the sun is East of you. For example, if the sun is 10° west of your AP, then the LHA will be 10°. But in our working example, you can see that our LHA is 356°, meaning that the sun is 4° East of my AP.

If the LHA in Space 12 is greater than 180, circle >180 Zn=Z on the sheet. If the LHA is less than 180, circle <180 Zn=360-Z. *In our working example the LHA of 356 is greater than 180, so circle >180 Zn=Z. (Note that in working example #2, the LHA is less than 180.)*

As a second part of this step, we find an AP-Latitude. For this we simply choose the nearest nice round latitude. *In our working example I have chosen 48°.* Write this into Space 13.

Step 5

Use the LHA in the Sight Reduction Tables – Pub 229.

You will often hear of the "Sight Reduction Tables for Marine Navigation" referred to by their number "229". You can download them on the Internet at

http://164.214.12.145/pubs/pubs_j_srtm_list.html

Choose your cruising grounds from the list of latitudes on the first page, and only visit that section. In each section you need only look at the Tables, parts 1-8. Look at the latitudes at the top of each table, and you may find that you only need to download 4 of the sections, instead of all 8. I suggest that you print them off and put them in a binder.

The pages applicable to the working example are included at the back of this guide.

On the top and bottom of each page you will see "Latitude Same Name as Declination" or "Latitude Contrary Name as Declination". This is a strange way of asking if the sun is in the same hemisphere as you. If you are in the Northern Hemisphere, from March 22 to September 21, the sun is also in the Northern Hemisphere so you use the "Same Name" tables. From September 22 to March 21 you would use the "Contrary Name" tables. You see that the Contrary Name section is just a small portion of a page.

On the top corner and bottom corner of each page you will find a pair of numbers such as 110°, 250°. You should find the page that matches with the LHA that you determined in Step 4. *In our working example, we are looking for the page for 356°. It is shown with the heading 4°, 356°. I have included this page at the back of this guide.*

Now you move down the left column until you find just the whole degree portion of your Dec, from Step 2. *In our working example you are looking for 11°.*

Now you move across the top row until you find the column for your AP latitude. *In our working example this is 48°.*

In the middle of the table you will find where these two intersect. At this point you will find three separate numbers: Hc, D, and Z. You should write them into Spaces 14, 15 and 16. The middle value "d" will have + or – with it. You must circle this in space 15.

In our working example these are Hc: 52° 50.9' d: +59.8 Z: 173.5°

Step 6

Make adjustments to Hc and Z

Hc in Space 14 stands for "Computed Height." It really means; what would the sextant read if you took your sighting at the Assumed Position, rather than at your actual position.

We need to make an adjustment to the figure in Space 14 to account for the minutes of Declination from Space 7. The information is included in the table named: "Correction to Tabulated Attitude for Minutes of Declination". I'll refer to this as the "Correction Table", which I have included at the back of the guide.

We work with the Correction Table by using the Minutes from Space 7 and with the value of d from Space 15. In these cases we need to round the numbers to eliminate decimal points. You can see that the Correction Table is symmetrical, so it does not matter whether you use the top or the side for your values. You will arrive at the same answer.

Turn to the Correction Table and go across the top for the minutes of Dec *(in our working example it is 52.6' rounded to 53')*, and down the side for the d *(in our working example it is 59.8 rounded to 60)* and where they intercept is the value of minutes that you put in Space 17 and circle + or - in Space 17. *(in our working example the value is +53')* In Space 17, you circle the same + or – that your circled in Space 15.

Then, depending on the + or -, add or subtract Space 17 to/from Space 14 and put the answer in Space 18. *(in our working example the total is 53°44')* This is the final value for Hc. You should also write it into Space 22.

Zn is the "Azimuth'. It is the compass bearing (in True degrees, not Magnetic) from your Assumed Position to the sun. Earlier you wrote the figure for Z into Space 16, and in Step 4 you circled either >180 Zn=Z or <180 Zn=360-Z. If you circled the former *(which we did in the working example)* then simply write the value of Z from Space 16 into Space 19. If you circled the latter, then write 360 above the value in Space 16 and subtract. Put the answer into Space 19. *(See working example #2 for an example of this).*

Step 7

Make adjustments to your sextant reading and determine Ho.

We know that the sextant reading from Step 1 has flaws and needs adjustments. Each of these adjustments is very small. However in total they can change your location by perhaps 20 miles. The books spend 50 pages describing each of the adjustments in detail.

This is the step where I have taken significant liberty with the textbook approach. I have just condensed all the adjustments down to a single number. Rather than leading you through the painful process of making each incremental calculation, I am going to give you one number to put into Space 20. That number is 0° 8'. I have found that the value 0° 8' works pretty well with my sextant on my boat. Later, we will work out a number to use for your sextant on your boat. P*ut 0°8' into Space 20.*

Next add the value in Space 4 to the value in Space 20, and write the total into Space 21. This is your Ho, or "Height Observed". It is your adjusted sextant reading.

In our working example, the math is:

Sextant:	*53°14'*
Main:	*0° 8'*
Ho:	*53°24'*

Step 8

Determine the distance Towards or Away

Now, compare your Ho in Space 21 with your Hc in Space 22. If the Hc is larger, circle Aw below Space 23. If the Ho is larger, circle Tw below Space 23.

In our working example, Hc of 53°44' is greater than Ho of 53°22', so circle Aw.

Now, subtract whichever is smaller from whichever is larger, between your Ho and Hc. Write the answer in Space 23. Assuming that everything has worked well up to now and that you chose an appropriate AP, this figure will be less than 60'.

In our working example, the math is:

Ho:	*53°22'*
Hc:	*53°44'*
Intp: Tw/Aw	*22'*

- Tw stands for "Towards". It means that your actual position is Towards the sun from your Assumed Position by the amount in Space 23.
- Aw stands for "Away". It means that your actual position is Away from the sun from your Assumed Position by the amount in Space 23.
- Intp stands for "Intercept".

Step 9

Start Plotting!

I have attached a plotting sheet. First make one copy. At the top and bottom of the sheet you will see a group of numbers from 0 to 65. Find your cruising waters latitude from this group (or interpolate where yours would be), and draw a vertical line from the point on the top of the page to the same point on the bottom of the page, on both the right and left sides of the circle.

For the working example, I am sailing in waters around 48°N. So I have drawn heavy vertical lines 48° from the left and right edges of the compass rose.

Because lines of longitude converge as you go north, this is an actual representation of miles in your sailing waters. The circle represents 1° north and south, and your lines represent 1° east and west. The even degree is the middle horizontal line, and 30' is the middle vertical line. You might also want to add more vertical lines, breaking it down into 5' intervals, as I have done on the working example.

Make several photocopies of your customized Plotting Sheet. We will use lots of them. (I make copies with the Navigation Sheet on the front and the Plotting Sheet on the back.)

Keep in mind that 1 nautical mile is equal to 1' of longitude. So any time you want to measure miles on the plotting sheet, just refer to the numbers on the left or right side.

Now, plot your Assumed Position, from Spaces 11 and 13. This will be a spot somewhere on the middle horizontal line. Mark this AP1.

In our working example, the AP1 is 48°N, 123° 48.8. You see that we are not able to get this level of detail on the plotting sheet. Just do the best that you can.

Next, find your Zn (from Space 19) on the compass rose, and using parallel rulers transfer this direction onto your AP1 spot. Draw a long line through AP1. If the sun was south of you put a circle at the south end of the line and mark it Zn1. If the sun was north of you put a circle on the north end of the line and mark it Zn1. This circle represents the sun.

You can see the line and circle on the working example, shown as Zn1.

Using dividers, spread them to the distance of your Intercept, from Space 23. Just use the numbers on the right or left sides of the plotting sheet.

If (as in our working example) you circled Aw in Space 23, transfer the dividers to your line, and starting from your AP mark the end spot on the side away from the sun. If you circled Tw in Space 23, transfer the dividers to your line, and starting from your AP mark the end spot on the side towards the sun.

Hold up a square to your Zn line and at the spot you just marked, draw a long line at 90° to your Zn line. Mark this new line "LOP1". It is your "Line of Position". You are located somewhere on this line. If you think back to Step 1, the LOP is just a very small section of the big circle on the earth.

From our working example, I am showing a Distance Away of 22 nautical miles. The line is marked as LOP1.

You have done all you can do for now. Can you confirm that you are somewhere on LOP1? If you have a GPS or a Chart, you can easily do so.

Step 10

Find your exact location when stationary

So far we only know that you are somewhere on the LOP. How do you find your exact location? The answer is simple. Just come back to the same location a few hours later and go through the entire process again. Use the bottom half of the Navigation Sheet and plot the results on the same Plotting Sheet. This time, mark all of your positions 2 instead of 1.

You are located where LOP1 and LOP2 intersect. Try it and see.

I have marked it all out on the working example. You can see that LOP1 and LOP2 intersect at 48° 25'N, 123° 17'W. This is only 1 mile off of my GPS position of 48° 24'N, 123° 17'W. I'd say that 1 mile is a pretty successful Sextant Shot.

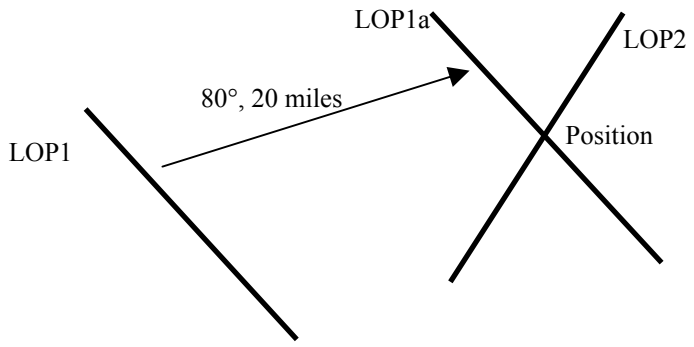
Step 11

Find your exact location when moving

The process to find your location when moving is almost the same. Imagine that between sextant shots you have been travelling in the direction 80° for 4 hours at 5 knots, for a total of 20 nautical miles. Take your second sextant reading and perform all the same plotting until you come up with LOP2.

Now, shift your original LOP1 in the direction of 80° by 20 miles°. Call this new line LOP1a (where "a" stands for advanced). Remember, move the entire LOP1 by 20 miles in the direction of travel. I.E. don't just shift it to the right. You must shift it in the direction 80°.

Your position is where LOP1a and LOP2 intersect. X marks the spot!



Troubleshooting
If you are off your LOP, several errors could have occurred:

- The most obvious is that you read the numbers wrong in the Nautical Almanac or Sight Reduction Tables. There are lots of tiny numbers on those pages. This is my most common point of error, especially on a bouncy boat.
- The second reason is that you performed the math incorrectly. Did you add or subtract the Degrees and Minutes correctly?
- The third reason is that you took a bad reading with the sextant.
- The fourth reason is that you have the incorrect time. Make sure that you have an accurate watch, that you read your watch immediately after taking your sextant reading and that you have converted to GMT correctly. (I made this error just last week!)
- The final reason is that we used an incorrect Main adjustment in Space 20. We will work on this now.

Step 12

Setting your own Main adjustment

You should not follow this instruction until you have done 20 or 30 sextant shots using the process shown above.

The "Main" adjustment, Space 20, is made up of several factors. The largest is because we make our readings from the bottom of the sun, while the calculations are based on the center of the sun. Second is an adjustment for height above sea level, known as "dip". You should stay within a few feet of your normal position above sea level. Find a comfortable place on your boat and use that spot every time you take a sextant shot. (Note that if you are using your sextant on a lake rather than the ocean, your height above sea level will be significant, so you will have a larger Main adjustment.) Third, in the early morning or late evening there is extra refraction, so the sun will appear out of place. Fourth is error that is inadvertently built into the sextant itself. Finally we have "index error". We have already attempted to eliminate this by adjusting the mirrors in Step 1.

As I said before, rather than calculate all of these, I have just given you one number to work with: 0° 8'. If you have done numerous sextant shots using my figure, and if you find that you are constantly off position by a regular amount, then you should find your own Main adjustment. To do so:

1. Take a GPS to determine your exact position.
2. Go through the process on the Left Side of the calculation sheet and determine Hc.
3. Plot your Zn line on the chart.
4. Plot your GPS position on the chart.
5. Draw a line at 90° to your Zn line that intersects the GPS position. This will give your Intp, either Towards or Away.
6. Add or Subtract your Intp from Hc. You now have Ho.
7. Subtract your Sextant Reading from Ho, to get your Main adjustment.
8. Go through this process several times until you are comfortable with a stable Main adjustment.

Step 13
Visit your library to borrow Jack London's hilarious biography "Cruise of the Snark". He didn't learn celestial navigation until well off the coast on his way to Hawaii. If he could hit such a small spot in the ocean a century ago with no experience, it really can't be that hard, can it?

Navigation Sheet

Date:1_____ Local Time:2_____ D.R. 3_____

	GMT	GHA	Dec.	Sextant: 4_____
Hr	5_____	6_____	7_____	Main: 20_____
m/s	8_____	9_____		Ho: 21_____
	Total GHA	10_____	If GHA < AP Long add 360 to GHA	Hc: 22_____
AP Long		11_____		Intp: 23_____
	LHA	12_____	>180 Zn=Z <180 Zn=360-Z	If Hc>HO then Aw. If Hc<Ho then Tw
AP Lat		13_____		

Hc	d	Z
14_____	15+ -____	16_____

17_+ -_____ Zn19_____

18_____

****

Date:1_____ Local Time:2_____ D.R. 3_____

	GMT	GHA	Dec.	Sextant: 4_____
Hr	5_____	6_____	7_____	Main: 20_____
m/s	8_____	9_____		Ho: 21_____
	Total GHA	10_____	If GHA < AP Long add 360 to GHA	Hc: 22_____
AP Long		11_____		Intp: 23_____
	LHA	12_____	>180 Zn=Z <180 Zn=360-Z	If Hc>HO then Aw. If Hc<Ho then Tw
AP Lat		13_____		

Hc	d	Z
14_____	15+ -____	16_____

17_+ -__ _____ Zn19_____

18_____

Date: **August 21, 2005** Time: **13:02:15** D.R. **48° 24'N, 123° 17'W** **1**

	GMT	GHA	Dec.	
Hr	**20**	**119° 15.0'**	**11° 52.6**	Sextant: **53° 14'**
m/s	**02:15**	**0° 33.8'**		Main: **8'**
	Total GHA	**119° 48.8'**		Ho: **53° 22'**
		360		Hc: **53° 44'**
		479° 48.8'		
AP Long		**123° 48.8'**		Intp: **22'**
	LHA	**356**		

If GHA < AP Long add 360 to GHA

>180 Zn=Z
<180 Zn=360-Z

If Hc>HO then Aw. If Hc<Ho then Tw

AP Lat **48**

Hc	d	Z
52° 50.9'	+ **59.8**	**173.5**

+ **53.0** Zn **173**

53° 44'

****

Date: **August 21, 2005** Time: **15:48:01** D.R. **48° 24'N, 123° 17'W** **2**

	GMT	GHA	Dec.	
Hr	**22**	**149° 15.3'**	**11° 50.9**	Sextant: **41° 34'**
m/s	**48:07**	**12° 01.8'**		Main: **8'**
	Total GHA	**161° 17.1'**		Ho: **41° 42'**
AP Long		**123° 17.1'**		Hc: **41° 57'**
				Intp: **15'**
	LHA	**38**		

~~If GHA < AP Long add 360 to GHA~~

>180 Zn=Z
<180 Zn=360-Z

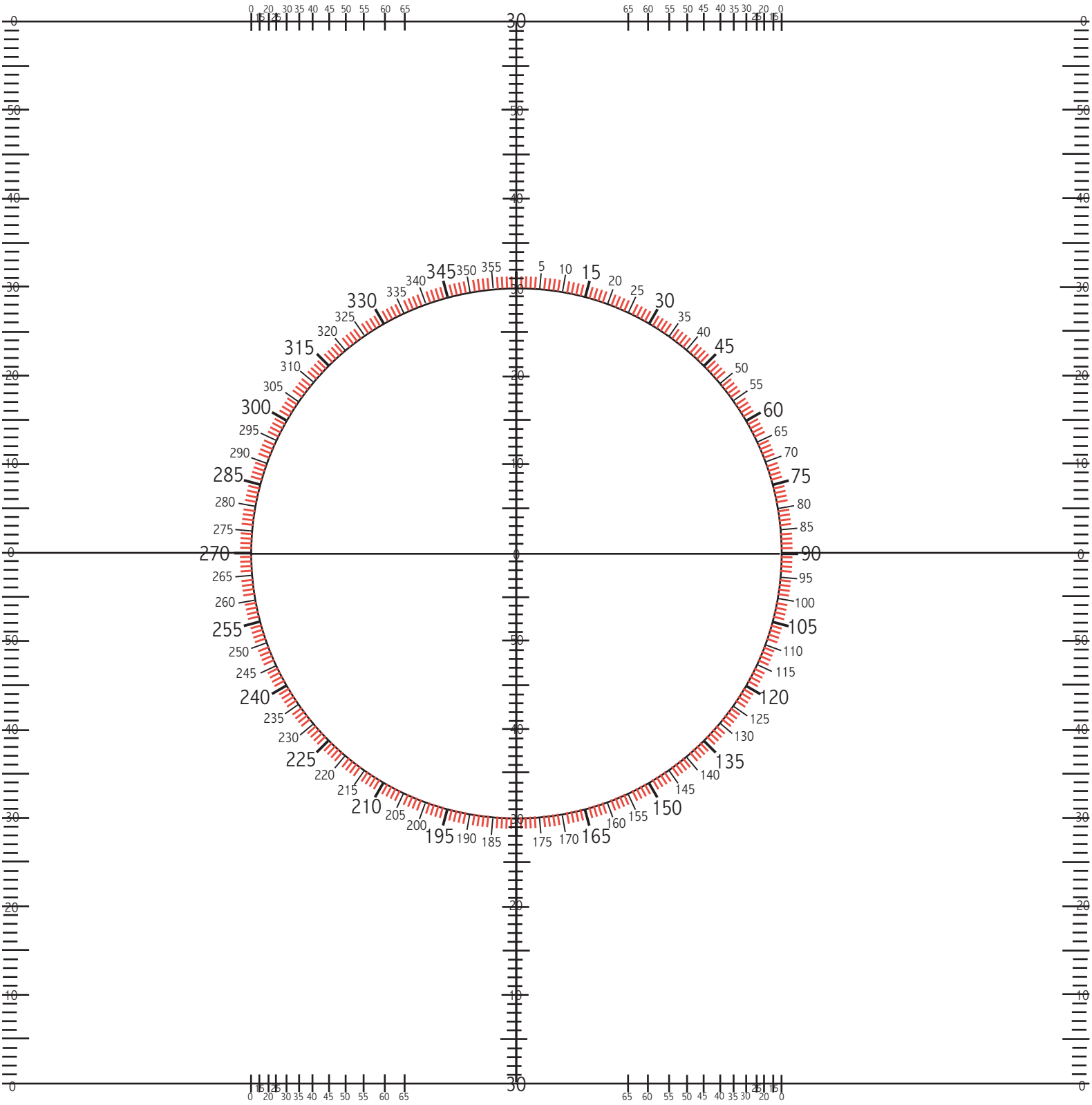
If Hc>HO then Aw. If Hc<Ho then Tw

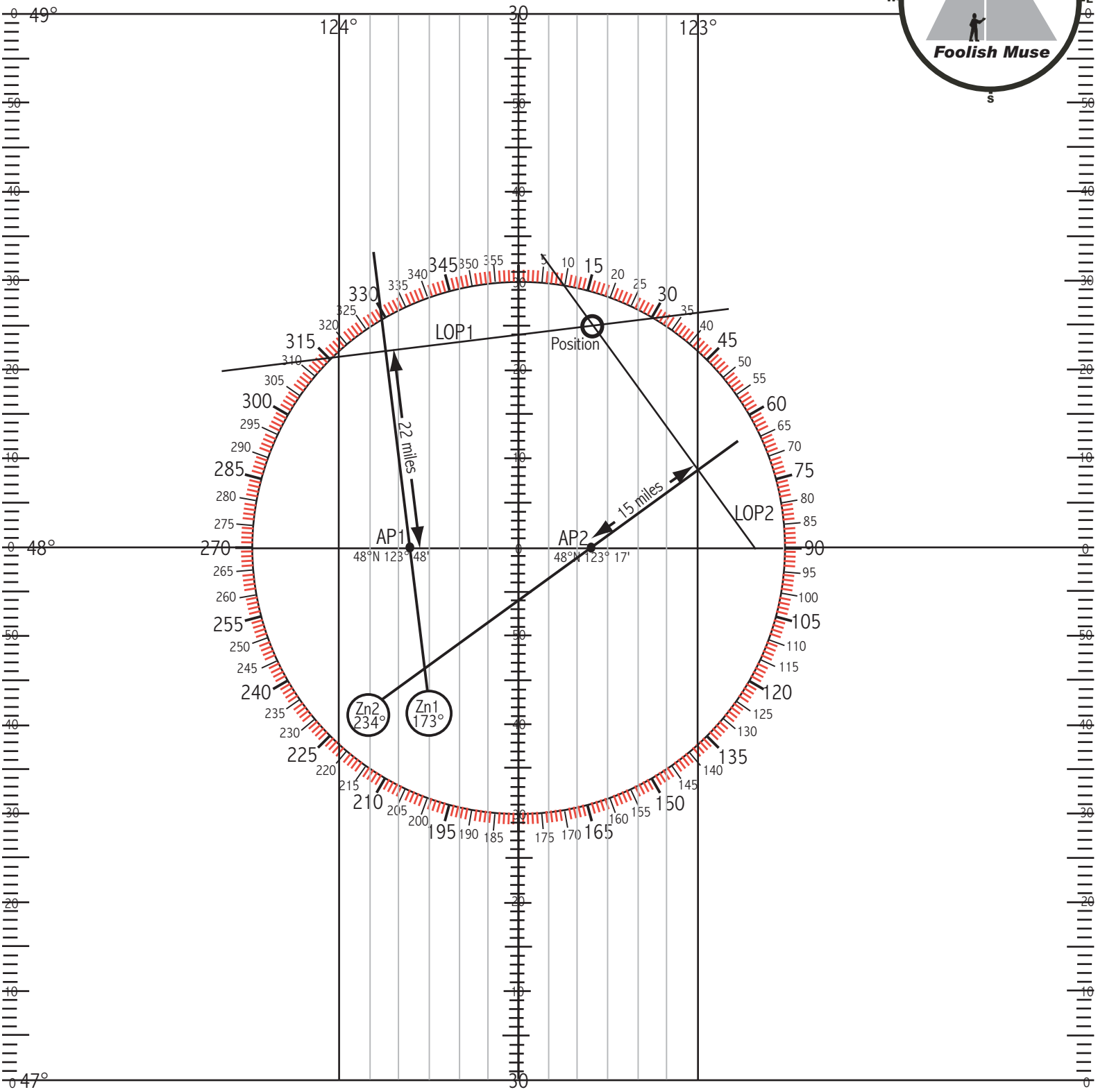
AP Lat **48**

Hc	d	Z
		360
41° 15.2'	+ **50.1**	**126**

+ **42** Zn **234**

41° 57'


0 20 30 35 40 45 50 55 60 65
65 60 55 50 45 40 35 30 20 0
0 50 40 30 20 10 0
30
345 350 355 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340


Foolish Muse
N
S
49°
48°
47°
124°
123°
30
LOP1
LOP2
Position
22 miles
15 miles
AP1
48°N 123° 48'
AP2
48°N 123° 17'
Zn2
234°
Zn1
173°

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

Dec.	45° Hc	d	Z	46° Hc	d	Z	47° Hc	d	Z	48° Hc	d	Z
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°
0	44 51.6	+59.9	174.4	43 51.9	+59.9	174.4	42 52.2	+59.9	174.5	41 52.5	+59.8	174.6
1	45 51.5	+59.8	174.3	44 51.8	+59.8	174.4	43 52.1	+59.8	174.4	42 52.3	+59.9	174.5
2	46 51.3	+59.9	174.1	45 51.6	+59.9	174.3	44 51.9	+59.9	174.4	43 52.2	+59.9	174.5
3	47 51.2	+59.8	174.0	46 51.5	+59.8	174.2	45 51.8	+59.9	174.3	44 52.1	+59.9	174.4
4	48 51.0	+59.8	173.9	47 51.3	+59.9	174.0	46 51.7	+59.8	174.2	45 52.0	+59.8	174.3
5	49 50.8	+59.9	173.8	48 51.2	+59.8	173.9	47 51.5	+59.9	174.1	46 51.8	+59.9	174.2
6	50 50.7	+59.8	173.7	49 51.0	+59.8	173.8	48 51.4	+59.8	173.9	47 51.7	+59.8	174.1
7	51 50.5	+59.8	173.6	50 50.8	+59.9	173.7	49 51.2	+59.8	173.8	48 51.5	+59.9	174.0
8	52 50.3	+59.8	173.4	51 50.7	+59.8	173.6	50 51.0	+59.9	173.7	49 51.4	+59.8	173.8
9	53 50.1	+59.8	173.3	52 50.5	+59.8	173.5	51 50.9	+59.8	173.6	50 51.2	+59.9	173.7
10	54 49.9	+59.7	173.2	53 50.3	+59.8	173.3	52 50.7	+59.8	173.5	51 51.1	+59.8	173.6
11	55 49.6	+59.8	173.0	54 50.1	+59.7	173.2	53 50.5	+59.8	173.3	52 50.9	+59.8	173.5
12	56 49.4	+59.7	172.8	55 49.8	+59.8	173.0	54 50.3	+59.8	173.2	53 50.7	+59.8	173.4
13	57 49.1	+59.8	172.7	56 49.6	+59.8	172.9	55 50.1	+59.7	173.0	54 50.5	+59.8	173.2
14	58 48.9	+59.7	172.5	57 49.4	+59.7	172.7	56 49.8	+59.8	172.9	55 50.3	+59.8	173.1
15	59 48.6	+59.7	172.3	58 49.1	+59.7	172.5	57 49.6	+59.8	172.7	56 50.1	+59.8	172.9
16	60 48.3	+59.7	172.1	59 48.8	+59.8	172.3	58 49.4	+59.7	172.6	57 49.9	+59.7	172.8
17	61 48.0	+59.6	171.9	60 48.6	+59.7	172.1	59 49.1	+59.7	172.4	58 49.6	+59.8	172.6
18	62 47.6	+59.7	171.7	61 48.3	+59.6	171.9	60 48.8	+59.7	172.2	59 49.4	+59.7	172.4
19	63 47.3	+59.6	171.4	62 47.9	+59.7	171.7	61 48.5	+59.7	172.0	60 49.1	+59.7	172.2
20	64 46.9	+59.6	171.2	63 47.6	+59.6	171.5	62 48.2	+59.7	171.8	61 48.8	+59.7	172.0
21	65 46.5	+59.5	170.9	64 47.2	+59.6	171.2	63 47.9	+59.6	171.5	62 48.5	+59.7	171.8
22	66 46.0	+59.5	170.6	65 46.8	+59.6	170.9	64 47.5	+59.6	171.3	63 48.2	+59.6	171.6
23	67 45.5	+59.5	170.2	66 46.4	+59.5	170.6	65 47.1	+59.6	171.0	64 47.8	+59.7	171.3
24	68 45.0	+59.4	169.9	67 45.9	+59.5	170.3	66 46.7	+59.6	170.7	65 47.5	+59.6	171.1
25	69 44.4	+59.4	169.5	68 45.4	+59.4	170.0	67 46.3	+59.5	170.4	66 47.1	+59.5	170.8
26	70 43.8	+59.3	169.0	69 44.8	+59.4	169.6	68 45.8	+59.4	170.0	67 46.6	+59.5	170.5
27	71 43.1	+59.2	168.6	70 44.2	+59.3	169.1	69 45.2	+59.4	169.7	68 46.1	+59.5	170.1
28	72 42.3	+59.1	168.0	71 43.5	+59.2	168.7	70 44.6	+59.4	169.2	69 45.6	+59.4	169.7
29	73 41.4	+59.0	167.5	72 42.7	+59.2	168.2	71 44.0	+59.2	168.8	70 45.0	+59.4	169.3
30	74 40.4	+58.9	166.8	73 41.9	+59.0	167.6	72 43.2	+59.2	168.3	71 44.4	+59.3	168.9
31	75 39.3	+58.7	166.0	74 40.9	+58.9	166.9	73 42.4	+59.1	167.7	72 43.7	+59.2	168.4
32	76 38.0	+58.5	165.2	75 39.8	+58.8	166.2	74 41.5	+58.9	167.1	73 42.9	+59.1	167.8
33	77 36.5	+58.2	164.2	76 38.6	+58.6	165.3	75 40.4	+58.8	166.3	74 42.0	+59.0	167.2
34	78 34.7	+58.0	163.0	77 37.2	+58.3	164.4	76 39.2	+58.6	165.5	75 41.0	+58.9	166.5
35	79 32.7	+57.5	161.6	78 35.5	+58.0	163.2	77 37.8	+58.4	164.5	76 39.9	+58.6	165.7
36	80 30.2	+56.9	160.0	79 33.5	+57.6	161.9	78 36.2	+58.1	163.4	77 38.5	+58.4	164.7
37	81 27.1	+56.2	158.0	80 31.1	+57.0	160.2	79 34.3	+57.7	162.1	78 36.9	+58.2	163.6
38	82 23.3	+55.1	155.5	81 28.1	+56.3	158.3	80 32.0	+57.1	160.5	79 35.1	+57.7	162.3
39	83 18.4	+53.4	•152.3	82 24.4	+55.2	155.8	81 29.1	+56.4	158.5	80 32.8	+57.3	160.7
40	84 11.8	+50.9	•148.1	83 19.6	+53.7	•152.6	82 25.5	+55.4	156.1	81 30.1	+56.5	158.8
41	85 02.7	+46.9	•142.4	84 13.3	+51.1	•148.5	83 20.9	+53.8	153.0	82 26.6	+55.5	156.4
42	85 49.6	+40.2	•134.6	85 04.4	+47.3	•142.9	84 14.7	+51.5	•148.9	83 22.1	+54.1	153.3
43	86 29.8	+28.8	•123.4	85 51.7	+40.5	•135.0	85 06.2	+47.5	•143.3	84 16.2	+51.7	•149.3
44	86 58.6	+11.7	•107.9	86 32.2	+29.2	•123.8	85 53.7	+40.9	•135.5	85 07.9	+47.8	•143.8
45	87 10.3	−8.9	• 88.6	87 01.4	+11.9	•108.2	86 34.6	+29.7	•124.3	85 55.7	+41.4	•136.0
46	87 01.4	−26.8	• 69.0	87 13.3	−9.0	• 88.6	87 04.3	+12.0	•108.5	86 37.1	+30.0	•124.8
47	86 34.6	−38.9	• 52.8	87 04.3	−27.2	• 68.6	87 16.3	−9.2	• 88.5	87 07.1	+12.3	•108.8
48	85 55.7	−46.1	• 41.1	86 37.1	−39.3	• 52.3	87 07.1	−27.5	• 68.2	87 19.4	−9.3	• 88.5
49	85 09.6	−50.5	• 32.8	85 57.8	−46.5	• 40.6	86 39.6	−39.7	• 51.8	87 10.1	−28.0	• 67.8
50	84 19.1	−53.1	• 26.9	85 11.3	−50.7	• 32.3	85 59.9	−46.8	• 40.0	86 42.1	−40.1	• 51.2
51	83 26.0	−54.9	22.6	84 20.6	−53.4	• 26.4	85 13.1	−51.0	• 31.8	86 02.0	−47.2	• 39.4
52	82 31.1	−56.1	19.3	83 27.2	−55.0	22.1	84 22.1	−53.6	• 25.9	85 14.8	−51.3	• 31.2
53	81 35.0	−56.8	16.7	82 32.2	−56.2	18.9	83 28.5	−55.2	21.7	84 23.5	−53.7	• 25.4
54	80 38.2	−57.5	14.6	81 36.0	−56.9	16.3	82 33.3	−56.3	18.4	83 29.8	−55.4	21.2
55	79 40.7	−57.8	12.9	80 39.1	−57.6	14.3	81 37.0	−57.0	15.9	82 34.4	−56.4	18.0
56	78 42.9	−58.3	11.5	79 41.5	−57.9	12.6	80 40.0	−57.7	13.9	81 38.0	−57.2	15.5
57	77 44.6	−58.4	10.3	78 43.6	−58.3	11.2	79 42.3	−58.0	12.3	80 40.8	−57.7	13.6
58	76 46.2	−58.7	9.3	77 45.3	−58.5	10.0	78 44.3	−58.3	10.9	79 43.1	−58.1	12.0
59	75 47.5	−58.9	8.4	76 46.8	−58.7	9.0	77 46.0	−58.6	9.8	78 45.0	−58.4	10.6
60	74 48.6	−59.0	7.6	75 48.1	−58.9	8.2	76 47.4	−58.8	8.8	77 46.6	−58.6	9.5
61	73 49.6	−59.1	7.0	74 49.2	−59.1	7.4	75 48.6	−58.9	7.9	76 48.0	−58.8	8.5
62	72 50.5	−59.2	6.4	73 50.1	−59.1	6.8	74 49.7	−59.1	7.2	75 49.2	−59.0	7.7
63	71 51.3	−59.2	5.8	72 51.0	−59.2	6.2	73 50.6	−59.1	6.5	74 50.2	−59.1	7.0
64	70 52.1	−59.4	5.4	71 51.8	−59.3	5.6	72 51.5	−59.3	6.0	73 51.1	−59.2	6.3
65	69 52.7	−59.4	4.9	70 52.5	−59.4	5.2	71 52.2	−59.3	5.4	72 51.9	−59.3	5.7
66	68 53.3	−59.5	4.5	69 53.1	−59.4	4.7	70 52.9	−59.4	5.0	71 52.6	−59.3	5.2
67	67 53.8	−59.5	4.2	68 53.7	−59.5	4.3	69 53.5	−59.5	4.5	70 53.3	−59.4	4.8
68	66 54.3	−59.5	3.8	67 54.2	−59.5	4.0	68 54.0	−59.5	4.2	69 53.9	−59.5	4.4
69	65 54.8	−59.6	3.5	66 54.7	−59.6	3.7	67 54.5	−59.5	3.8	68 54.4	−59.5	4.0
70	64 55.2	−59.6	3.2	65 55.1	−59.6	3.4	66 55.0	−59.6	3.5	67 54.9	−59.6	3.6
71	63 55.6	−59.6	3.0	64 55.5	−59.6	3.1	65 55.4	−59.6	3.2	66 55.3	−59.6	3.3
72	62 56.0	−59.7	2.7	63 55.9	−59.6	2.8	64 55.8	−59.6	2.9	65 55.7	−59.6	3.0
73	61 56.3	−59.7	2.5	62 56.3	−59.7	2.6	63 56.2	−59.7	2.7	64 56.1	−59.6	2.8
74	60 56.6	−59.7	2.3	61 56.6	−59.7	2.3	62 56.5	−59.6	2.4	63 56.5	−59.7	2.5
75	59 56.9	−59.7	2.1	60 56.9	−59.7	2.1	61 56.9	−59.7	2.2	62 56.8	−59.7	2.3
76	58 57.2	−59.7	1.9	59 57.2	−59.7	1.9	60 57.2	−59.8	2.0	61 57.1	−59.7	2.1
77	57 57.5	−59.8	1.7	58 57.5	−59.8	1.7	59 57.4	−59.7	1.8	60 57.4	−59.7	1.9
78	56 57.7	−59.7	1.5	57 57.7	−59.7	1.6	58 57.7	−59.8	1.6	59 57.7	−59.8	1.7
79	55 58.0	−59.8	1.4	56 58.0	−59.8	1.4	57 57.9	−59.7	1.4	58 57.9	−59.7	1.5
80	54 58.2	−59.8	1.2	55 58.2	−59.8	1.2	56 58.2	−59.8	1.3	57 58.2	−59.8	1.3
81	53 58.4	−59.8	1.1	54 58.4	−59.8	1.1	55 58.4	−59.8	1.1	56 58.4	−59.8	1.1
82	52 58.6	−59.8	0.9	53 58.6	−59.8	0.9	54 58.6	−59.8	1.0	55 58.6	−59.8	1.0
83	51 58.8	−59.8	0.8	52 58.8	−59.8	0.8	53 58.8	−59.8	0.8	54 58.8	−59.8	0.8
84	50 59.0	−59.8	0.7	51 59.0	−59.8	0.7	52 59.0	−59.8	0.7	53 59.0	−59.8	0.7
85	49 59.2	−59.8	0.5	50 59.2	−59.8	0.6	51 59.2	−59.8	0.6	52 59.2	−59.8	0.6
86	48 59.4	−59.9	0.4	49 59.4	−59.9	0.4	50 59.4	−59.9	0.4	51 59.4	−59.9	0.5
87	47 59.5	−59.8	0.3	48 59.5	−59.8	0.3	49 59.5	−59.8	0.3	50 59.5	−59.8	0.3
88	46 59.7	−59.8	0.2	47 59.7	−59.8	0.2	48 59.7	−59.8	0.2	49 59.7	−59.8	0.2
89	45 59.9	−59.9	0.1	46 59.9	−59.9	0.1	47 59.9	−59.9	0.1	48 59.9	−59.9	0.1
90	45 00.0	−59.9	0.0	46 00.0	−59.9	0.0	47 00.0	−59.9	0.0	48 00.0	−59.9	0.0
	45°			46°			47°			48°		

49° Hc	d	Z	50° Hc	d	Z	51° Hc	d	Z	52° Hc	d	Z	Dec.
° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	°
40 52.7	+59.9	174.7	39 53.0	+59.9	174.8	38 53.2	+59.9	174.9	37 53.5	+59.9	174.9	0
41 52.6	+59.9	174.6	40 52.9	+59.9	174.7	39 53.1	+59.9	174.8	38 53.4	+59.9	174.9	1
42 52.5	+59.9	174.5	41 52.8	+59.9	174.6	40 53.0	+59.9	174.7	39 53.3	+59.9	174.8	2
43 52.4	+59.9	174.5	42 52.7	+59.8	174.5	41 52.9	+59.9	174.6	40 53.2	+59.9	174.7	3
44 52.3	+59.8	174.4	43 52.5	+59.9	174.5	42 52.8	+59.9	174.6	41 53.1	+59.9	174.6	4
45 52.1	+59.9	174.3	44 52.4	+59.9	174.4	43 52.7	+59.9	174.5	42 53.0	+59.9	174.6	5
46 52.0	+59.9	174.2	45 52.3	+59.9	174.3	44 52.6	+59.9	174.4	43 52.9	+59.9	174.5	6
47 51.9	+59.8	174.1	46 52.2	+59.8	174.2	45 52.5	+59.9	174.3	44 52.8	+59.9	174.4	7
48 51.7	+59.9	174.0	47 52.0	+59.9	174.1	46 52.4	+59.8	174.2	45 52.7	+59.8	174.3	8
49 51.6	+59.8	173.9	48 51.9	+59.9	174.0	47 52.2	+59.9	174.1	46 52.5	+59.9	174.2	9
50 51.4	+59.9	173.8	49 51.8	+59.8	173.9	48 52.1	+59.9	174.0	47 52.4	+59.9	174.1	10
51 51.3	+59.8	173.6	50 51.6	+59.9	173.8	49 52.0	+59.8	173.9	48 52.3	+59.9	174.0	11
52 51.1	+59.8	173.5	51 51.5	+59.8	173.7	50 51.8	+59.9	173.8	49 52.2	+59.8	173.9	12
53 50.9	+59.8	173.4	52 51.3	+59.8	173.5	51 51.7	+59.8	173.7	50 52.0	+59.9	173.8	13
54 50.7	+59.8	173.2	53 51.1	+59.9	173.4	52 51.5	+59.9	173.6	51 51.9	+59.8	173.7	14
55 50.5	+59.8	173.1	54 51.0	+59.8	173.3	53 51.4	+59.8	173.4	52 51.7	+59.9	173.6	15
56 50.3	+59.8	173.0	55 50.8	+59.8	173.1	54 51.2	+59.8	173.3	53 51.6	+59.8	173.5	16
57 50.1	+59.8	172.8	56 50.6	+59.8	173.0	55 51.0	+59.8	173.2	54 51.4	+59.8	173.3	17
58 49.9	+59.7	172.6	57 50.4	+59.7	172.8	56 50.8	+59.8	173.0	55 51.2	+59.9	173.2	18
59 49.6	+59.8	172.5	58 50.1	+59.8	172.7	57 50.6	+59.8	172.9	56 51.1	+59.8	173.1	19
60 49.4	+59.7	172.3	59 49.9	+59.8	172.5	58 50.4	+59.8	172.7	57 50.9	+59.8	172.9	20
61 49.1	+59.7	172.1	60 49.7	+59.7	172.3	59 50.2	+59.7	172.6	58 50.7	+59.8	172.8	21
62 48.8	+59.7	171.9	61 49.4	+59.7	172.1	60 49.9	+59.8	172.4	59 50.5	+59.7	172.6	22
63 48.5	+59.7	171.6	62 49.1	+59.7	171.9	61 49.7	+59.7	172.2	60 50.2	+59.8	172.4	23
64 48.2	+59.6	171.4	63 48.8	+59.7	171.7	62 49.4	+59.7	172.0	61 50.0	+59.7	172.2	24
65 47.8	+59.6	171.1	64 48.5	+59.7	171.5	63 49.1	+59.7	171.8	62 49.7	+59.8	172.0	25
66 47.4	+59.6	170.8	65 48.2	+59.6	171.2	64 48.8	+59.7	171.5	63 49.5	+59.7	171.8	26
67 47.0	+59.5	170.5	66 47.8	+59.6	170.9	65 48.5	+59.6	171.3	64 49.2	+59.6	171.6	27
68 46.5	+59.5	170.2	67 47.4	+59.5	170.6	66 48.1	+59.6	171.0	65 48.8	+59.7	171.4	28
69 46.0	+59.5	169.8	68 46.9	+59.5	170.3	67 47.7	+59.6	170.7	66 48.5	+59.6	171.1	29
70 45.5	+59.4	169.4	69 46.4	+59.5	169.9	68 47.3	+59.6	170.4	67 48.1	+59.6	170.8	30
71 44.9	+59.3	169.0	70 45.9	+59.4	169.5	69 46.9	+59.5	170.0	68 47.7	+59.6	170.5	31
72 44.2	+59.2	168.5	71 45.3	+59.4	169.1	70 46.4	+59.4	169.7	69 47.3	+59.5	170.1	32
73 43.4	+59.2	168.0	72 44.7	+59.2	168.6	71 45.8	+59.4	169.2	70 46.8	+59.5	169.8	33
74 42.6	+59.0	167.3	73 43.9	+59.2	168.1	72 45.2	+59.3	168.8	71 46.3	+59.4	169.3	34
75 41.6	+58.9	166.6	74 43.1	+59.1	167.5	73 44.5	+59.2	168.2	72 45.7	+59.3	168.9	35
76 40.5	+58.7	165.8	75 42.2	+58.9	166.8	74 43.7	+59.1	167.6	73 45.0	+59.2	168.4	36
77 39.2	+58.5	164.9	76 41.1	+58.8	166.0	75 42.8	+58.9	167.0	74 44.2	+59.2	167.8	37
78 37.7	+58.2	163.8	77 39.9	+58.5	165.1	76 41.7	+58.9	166.2	75 43.4	+59.0	167.1	38
79 35.9	+57.8	162.5	78 38.4	+58.3	164.0	77 40.6	+58.6	165.3	76 42.4	+58.8	166.4	39
80 33.7	+57.4	161.0	79 36.7	+57.9	162.8	78 39.2	+58.3	164.2	77 41.2	+58.7	165.5	40
81 31.1	+56.6	159.1	80 34.6	+57.5	161.2	79 37.5	+58.0	163.0	78 39.9	+58.4	164.5	41
82 27.7	+55.7	156.7	81 32.1	+56.7	159.4	80 35.5	+57.6	161.5	79 38.3	+58.1	163.2	42
83 23.4	+54.2	153.7	82 28.8	+55.9	157.1	81 33.1	+56.9	159.7	80 36.4	+57.6	161.8	43
84 17.6	+52.0	•149.7	83 24.7	+54.4	154.1	82 30.0	+56.0	157.4	81 34.0	+57.1	160.0	44
85 09.6	+48.2	•144.2	84 19.1	+52.2	•150.1	83 26.0	+54.6	154.5	82 31.1	+56.1	157.7	45
85 57.8	+41.8	•136.5	85 11.3	+48.6	•144.7	84 20.6	+52.5	•150.6	83 27.2	+54.9	154.8	46
86 39.6	+30.5	•125.3	85 59.9	+42.2	•137.0	85 13.1	+48.9	•145.2	84 22.1	+52.7	•151.0	47
87 10.1	+12.5	•109.2	86 42.1	+30.9	•125.8	86 02.0	+42.6	•137.6	85 14.8	+49.3	•145.7	48
87 22.6	−9.6	• 88.5	87 13.0	+12.7	•109.5	86 44.6	+31.4	•126.3	86 04.1	+43.0	•138.1	49
87 13.0	−28.4	• 67.4	87 25.7	−9.7	• 88.5	87 16.0	+13.0	•109.9	86 47.1	+31.9	•126.9	50
86 44.6	−40.5	• 50.6	87 16.0	−28.9	• 67.0	87 29.0	−10.0	• 88.4	87 19.0	+13.3	•110.3	51
86 04.1	−47.6	• 38.8	86 47.1	−41.0	• 50.0	87 19.0	−29.3	• 66.6	87 32.3	−10.2	• 88.4	52
85 16.5	−51.5	• 30.6	86 06.1	−47.8	• 38.1	86 49.7	−41.5	• 49.4	87 22.1	−29.8	• 66.1	53
84 25.0	−54.0	• 24.9	85 18.3	−51.9	• 30.1	86 08.2	−48.2	• 37.5	86 52.3	−42.0	• 48.7	54
83 31.0	−55.5	20.8	84 26.4	−54.1	24.4	85 20.0	−52.1	• 29.5	86 10.3	−48.6	• 36.8	55
82 35.5	−56.5	17.6	83 32.3	−55.7	20.3	84 27.9	−54.4	23.9	85 21.7	−52.4	• 28.8	56
81 39.0	−57.3	15.2	82 36.6	−56.7	17.2	83 33.5	−55.8	19.8	84 29.3	−54.6	23.3	57
80 41.7	−57.8	13.2	81 39.9	−57.3	14.8	82 37.7	−56.8	16.7	83 34.7	−56.0	19.3	58
79 43.9	−58.1	11.6	80 42.6	−57.9	12.9	81 40.9	−57.5	14.4	82 38.7	−56.9	16.3	59
78 45.8	−58.5	10.3	79 44.7	−58.2	11.3	80 43.4	−57.9	12.5	81 41.8	−57.6	14.0	60
77 47.3	−58.7	9.2	78 46.5	−58.6	10.0	79 45.5	−58.3	11.0	80 44.2	−58.0	12.1	61
76 48.6	−58.8	8.3	77 47.9	−58.7	8.9	78 47.2	−58.6	9.7	79 46.2	−58.4	10.6	62
75 49.8	−59.1	7.4	76 49.2	−58.9	8.0	77 48.6	−58.8	8.6	78 47.8	−58.6	9.4	63
74 50.7	−59.1	6.7	75 50.3	−59.0	7.2	76 49.8	−59.0	7.7	77 49.2	−58.8	8.3	64
73 51.6	−59.2	6.1	74 51.3	−59.2	6.5	75 50.8	−59.0	6.9	76 50.4	−59.0	7.4	65
72 52.4	−59.3	5.5	73 52.1	−59.3	5.9	74 51.8	−59.2	6.2	75 51.4	−59.2	6.7	66
71 53.1	−59.4	5.0	72 52.8	−59.3	5.3	73 52.6	−59.3	5.6	74 52.2	−59.2	6.0	67
70 53.7	−59.4	4.6	71 53.5	−59.4	4.8	72 53.3	−59.4	5.1	73 53.0	−59.3	5.4	68
69 54.3	−59.5	4.2	70 54.1	−59.5	4.4	71 53.9	−59.4	4.6	72 53.7	−59.4	4.9	69
68 54.8	−59.6	3.8	69 54.6	−59.5	4.0	70 54.5	−59.5	4.2	71 54.3	−59.4	4.4	70
67 55.2	−59.5	3.5	68 55.1	−59.5	3.6	69 55.0	−59.5	3.8	70 54.9	−59.5	4.0	71
66 55.7	−59.6	3.2	67 55.6	−59.6	3.3	68 55.5	−59.6	3.4	69 55.4	−59.6	3.6	72
65 56.1	−59.7	2.9	66 56.0	−59.6	3.0	67 55.9	−59.6	3.1	68 55.8	−59.6	3.3	73
64 56.4	−59.6	2.6	65 56.4	−59.7	2.7	66 56.3	−59.6	2.8	67 56.2	−59.6	2.9	74
63 56.8	−59.7	2.4	64 56.7	−59.7	2.4	65 56.7	−59.7	2.5	66 56.6	−59.7	2.6	75
62 57.1	−59.7	2.1	63 57.0	−59.7	2.2	64 57.0	−59.7	2.3	65 56.9	−59.6	2.4	76
61 57.4	−59.8	1.9	62 57.3	−59.7	2.0	63 57.3	−59.7	2.0	64 57.3	−59.7	2.1	77
60 57.6	−59.7	1.7	61 57.6	−59.7	1.8	62 57.6	−59.7	1.8	63 57.6	−59.8	1.9	78
59 57.9	−59.8	1.5	60 57.9	−59.8	1.6	61 57.9	−59.8	1.6	62 57.8	−59.7	1.7	79
58 58.1	−59.7	1.3	59 58.1	−59.7	1.4	60 58.1	−59.7	1.4	61 58.1	−59.8	1.5	80
57 58.4	−59.8	1.2	58 58.4	−59.8	1.2	59 58.4	−59.8	1.2	60 58.3	−59.7	1.3	81
56 58.6	−59.8	1.0	57 58.6	−59.8	1.0	58 58.6	−59.8	1.1	59 58.6	−59.8	1.1	82
55 58.8	−59.8	0.9	56 58.8	−59.8	0.9	57 58.8	−59.8	0.9	58 58.8	−59.8	0.9	83
54 59.0	−59.8	0.7	55 59.0	−59.8	0.7	56 59.0	−59.8	0.8	57 59.0	−59.8	0.8	84
53 59.2	−59.8	0.6	54 59.2	−59.8	0.6	55 59.2	−59.8	0.6	56 59.2	−59.8	0.6	85
52 59.4	−59.9	0.5	53 59.4	−59.9	0.5	54 59.4	−59.9	0.5	55 59.4	−59.9	0.5	86
51 59.5	−59.8	0.3	52 59.5	−59.8	0.3	53 59.5	−59.8	0.3	54 59.5	−59.8	0.4	87
50 59.7	−59.8	0.2	51 59.7	−59.8	0.2	52 59.7	−59.8	0.2	53 59.7	−59.8	0.2	88
49 59.9	−59.9	0.1	50 59.9	−59.9	0.1	51 59.9	−59.9	0.1	52 59.9	−59.9	0.1	89
49 00.0	−59.9	0.0	50 00.0	−59.9	0.0	51 00.0	−59.9	0.0	52 00.0	−59.9	0.0	90
49°			50°			51°			52°			

LATITUDE CONTRARY NAME TO DECLINATION L.H.A. 4°, 356°

Dec.	45° Hc	d	Z	46° Hc	d	Z	47° Hc	d	Z	48° Hc	d	Z	49° Hc	d	Z	50° Hc	d	Z	51° Hc	d	Z	52° Hc	d	Z	Dec.
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	°
0	44 51.6	−59.8	174.4	43 51.9	−59.8	174.4	42 52.2	−59.9	174.5	41 52.5	−59.9	174.6	40 52.7	−59.9	174.7	39 53.0	−59.9	174.8	38 53.2	−59.9	174.9	37 53.5	−60.0	174.9	0
1	43 51.8	−59.9	174.4	42 52.1	−59.9	174.5	41 52.3	−59.9	174.6	40 52.6	−59.9	174.7	39 52.8	−59.9	174.8	38 53.1	−59.9	174.9	37 53.3	−59.9	174.9	36 53.5	−59.9	175.0	1
2	42 51.9	−59.8	174.5	41 52.2	−59.9	174.6	40 52.4	−59.8	174.7	39 52.7	−59.9	174.8	38 52.9	−59.9	174.9	37 53.2	−59.9	174.9	36 53.4	−59.9	175.0	35 53.6	−59.9	175.1	2
3	41 52.1	−59.9	174.6	40 52.3	−59.9	174.7	39 52.6	−59.9	174.8	38 52.8	−59.9	174.9	37 53.0	−59.9	174.9	36 53.3	−59.9	175.0	35 53.5	−59.9	175.1	34 53.7	−59.9	175.1	3
4	40 52.2	−59.9	174.7	39 52.4	−59.9	174.8	38 52.7	−59.9	174.9	37 52.9	−59.9	174.9	36 53.1	−59.9	175.0	35 53.4	−59.9	175.1	34 53.6	−59.9	175.1	33 53.8	−59.9	175.2	4
5	39 52.3	−59.9	174.8	38 52.5	−59.8	174.9	37 52.8	−59.9	174.9	36 53.0	−59.9	175.0	35 53.2	−59.9	175.1	34 53.5	−60.0	175.1	33 53.7	−59.9	175.2	32 53.9	−59.9	175.3	5
6	38 52.4	−59.9	174.9	37 52.7	−59.9	175.0	36 52.9	−59.9	175.0	35 53.1	−59.9	175.1	34 53.3	−59.9	175.1	33 53.5	−59.9	175.2	32 53.8	−60.0	175.3	31 54.0	−60.0	175.3	6
7	37 52.5	−59.8	175.0	36 52.8	−59.9	175.0	35 53.0	−59.9	175.1	34 53.2	−59.9	175.2	33 53.4	−59.9	175.2	32 53.6	−59.9	175.3	31 53.8	−59.9	175.3	30 54.0	−59.9	175.4	7
8	36 52.7	−59.9	175.0	35 52.9	−59.9	175.1	34 53.1	−59.9	175.2	33 53.3	−59.9	175.2	32 53.5	−59.9	175.3	31 53.7	−59.9	175.3	30 53.9	−59.9	175.4	29 54.1	−59.9	175.4	8
9	35 52.8	−59.9	175.1	34 53.0	−59.9	175.2	33 53.2	−59.9	175.2	32 53.4	−59.9	175.3	31 53.6	−59.9	175.3	30 53.8	−59.9	175.4	29 54.0	−59.9	175.4	28 54.2	−59.9	175.5	9
10	34 52.9	−59.9	175.2	33 53.1	−59.9	175.3	32 53.3	−59.9	175.3	31 53.5	−59.9	175.4	30 53.7	−59.9	175.4	29 53.9	−59.9	175.5	28 54.1	−60.0	175.5	27 54.3	−60.0	175.5	10
11	33 53.0	−59.9	175.3	32 53.2	−59.9	175.3	31 53.4	−59.9	175.4	30 53.6	−59.9	175.4	29 53.8	−59.9	175.5	28 54.0	−60.0	175.5	27 54.1	−59.9	175.6	26 54.3	−59.9	175.6	11
12	32 53.1	−59.9	175.3	31 53.3	−59.9	175.4	30 53.5	−59.9	175.4	29 53.7	−59.9	175.5	28 53.9	−60.0	175.5	27 54.0	−59.9	175.6	26 54.2	−59.9	175.6	25 54.4	−59.9	175.6	12
13	31 53.2	−59.9	175.4	30 53.4	−59.9	175.5	29 53.6	−59.9	175.5	28 53.8	−60.0	175.5	27 53.9	−59.9	175.6	26 54.1	−59.9	175.6	25 54.3	−59.9	175.7	24 54.5	−60.0	175.7	13
14	30 53.3	−59.9	175.5	29 53.5	−59.9	175.5	28 53.7	−59.9	175.6	27 53.8	−59.9	175.6	26 54.0	−59.9	175.6	25 54.2	−59.9	175.7	24 54.4	−60.0	175.7	23 54.5	−59.9	175.8	14
15	29 53.4	−59.9	175.5	28 53.6	−59.9	175.6	27 53.8	−60.0	175.6	26 53.9	−59.9	175.7	25 54.1	−59.9	175.7	24 54.3	−60.0	175.7	23 54.4	−59.9	175.8	22 54.6	−59.9	175.8	15
16	28 53.5	−59.9	175.6	27 53.7	−59.9	175.6	26 53.8	−59.9	175.7	25 54.0	−59.9	175.7	24 54.2	−59.9	175.8	23 54.3	−59.9	175.8	22 54.5	−59.9	175.8	21 54.7	−60.0	175.9	16
17	27 53.6	−59.9	175.7	26 53.8	−60.0	175.7	25 53.9	−59.9	175.7	24 54.1	−59.9	175.8	23 54.3	−60.0	175.8	22 54.4	−59.9	175.8	21 54.6	−60.0	175.9	20 54.7	−59.9	175.9	17
18	26 53.7	−59.9	175.7	25 53.8	−59.9	175.8	24 54.0	−59.9	175.8	23 54.2	−60.0	175.8	22 54.3	−59.9	175.9	21 54.5	−59.9	175.9	20 54.6	−59.9	175.9	19 54.8	−60.0	176.0	18
19	25 53.8	−59.9	175.8	24 53.9	−59.9	175.8	23 54.1	−59.9	175.9	22 54.2	−59.9	175.9	21 54.4	−59.9	175.9	20 54.6	−60.0	176.0	19 54.7	−59.9	176.0	18 54.8	−59.9	176.0	19
20	24 53.9	−59.9	175.9	23 54.0	−59.9	175.9	22 54.2	−59.9	175.9	21 54.3	−59.9	175.9	20 54.5	−60.0	176.0	19 54.6	−59.9	176.0	18 54.8	−60.0	176.0	17 54.9	−59.9	176.0	20
21	23 54.0	−60.0	175.9	22 54.1	−59.9	175.9	21 54.3	−60.0	176.0	20 54.4	−59.9	176.0	19 54.5	−59.9	176.0	18 54.7	−59.9	176.1	17 54.8	−60.0	176.1	16 55.0	−60.0	176.1	21
22	22 54.0	−59.9	176.0	21 54.2	−59.9	176.0	20 54.3	−59.9	176.0	19 54.5	−60.0	176.1	18 54.6	−59.9	176.1	17 54.8	−60.0	176.1	16 54.9	−59.9	176.1	15 55.0	−59.9	176.1	22
23	21 54.1	−59.9	176.0	20 54.3	−60.0	176.1	19 54.4	−59.9	176.1	18 54.5	−59.9	176.1	17 54.7	−59.9	176.1	16 54.8	−59.9	176.2	15 55.0	−60.0	176.2	14 55.1	−60.0	176.2	23
24	20 54.2	−59.9	176.1	19 54.3	−59.9	176.1	18 54.5	−59.9	176.1	17 54.6	−59.9	176.2	16 54.8	−60.0	176.2	15 54.9	−59.9	176.2	14 55.0	−59.9	176.2	13 55.1	−59.9	176.2	24
25	19 54.3	−59.9	176.1	18 54.4	−59.9	176.2	17 54.6	−60.0	176.2	16 54.7	−59.9	176.2	15 54.8	−59.9	176.2	14 55.0	−60.0	176.2	13 55.1	−60.0	176.3	12 55.2	−59.9	176.3	25
26	18 54.4	−59.9	176.2	17 54.5	−59.9	176.2	16 54.6	−59.9	176.2	15 54.8	−60.0	176.3	14 54.9	−59.9	176.3	13 55.0	−59.9	176.3	12 55.1	−59.9	176.3	11 55.3	−60.0	176.3	26
27	17 54.5	−60.0	176.3	16 54.6	−59.9	176.3	15 54.7	−59.9	176.3	14 54.8	−59.9	176.3	13 55.0	−60.0	176.3	12 55.1	−60.0	176.3	11 55.2	−59.9	176.4	10 55.3	−59.9	176.4	27
28	16 54.5	−59.9	176.3	15 54.7	−60.0	176.3	14 54.8	−59.9	176.3	13 54.9	−59.9	176.4	12 55.0	−59.9	176.4	11 55.1	−59.9	176.4	10 55.3	−60.0	176.4	9 55.4	−60.0	176.4	28
29	15 54.6	−59.9	176.4	14 54.7	−59.9	176.4	13 54.9	−60.0	176.4	12 55.0	−60.0	176.4	11 55.1	−59.9	176.4	10 55.2	−59.9	176.4	9 55.3	−59.9	176.4	8 55.4	−59.9	176.5	29
30	14 54.7	−59.9	176.4	13 54.8	−59.9	176.4	12 54.9	−59.9	176.4	11 55.0	−59.9	176.5	10 55.2	−60.0	176.5	9 55.3	−60.0	176.5	8 55.4	−60.0	176.5	7 55.5	−60.0	176.5	30
31	13 54.8	−60.0	176.5	12 54.9	−59.9	176.5	11 55.0	−59.9	176.5	10 55.1	−59.9	176.5	9 55.2	−59.9	176.5	8 55.3	−59.9	176.5	7 55.4	−59.9	176.5	6 55.5	−59.9	176.5	31
32	12 54.8	−59.9	176.5	11 55.0	−60.0	176.5	10 55.1	−60.0	176.5	9 55.2	−60.0	176.6	8 55.3	−60.0	176.6	7 55.4	−59.9	176.6	6 55.5	−59.9	176.6	5 55.6	−59.9	176.6	32
33	11 54.9	−59.9	176.6	10 55.0	−59.9	176.6	9 55.1	−59.9	176.6	8 55.2	−59.9	176.6	7 55.3	−59.9	176.6	6 55.5	−60.0	176.6	5 55.6	−60.0	176.6	4 55.7	−60.0	176.6	33
34	10 55.0	−59.9	176.6	9 55.1	−59.9	176.6	8 55.2	−59.9	176.6	7 55.3	−59.9	176.7	6 55.4	−59.9	176.7	5 55.5	−59.9	176.7	4 55.6	−59.9	176.7	3 55.7	−59.9	176.7	34
35	9 55.1	−59.9	176.7	8 55.2	−60.0	176.7	7 55.3	−60.0	176.7	6 55.4	−60.0	176.7	5 55.5	−60.0	176.7	4 55.6	−60.0	176.7	3 55.7	−60.0	176.7	2 55.8	−60.0	176.7	35
36	8 55.2	−60.0	176.7	7 55.2	−59.9	176.7	6 55.3	−59.9	176.7	5 55.4	−59.9	176.7	4 55.5	−59.9	176.8	3 55.6	−59.9	176.8	2 55.7	−59.9	176.8	1 55.8	−59.9	176.8	36
37	7 55.2	−59.9	176.8	6 55.3	−59.9	176.8	5 55.4	−59.9	176.8	4 55.5	−59.9	176.8	3 55.6	−59.9	176.8	2 55.7	−59.9	176.8	1 55.8	−60.0	176.8	0 55.9	−60.0	176.8	37
38	6 55.3	−59.9	176.8	5 55.4	−59.9	176.8	4 55.5	−59.9	176.8	3 55.6	−60.0	176.8	2 55.7	−60.0	176.8	1 55.8	−60.0	176.8	0 55.8	−59.9	176.8	0 04.1	+59.9	3.2	38
39	5 55.4	−60.0	176.9	4 55.5	−60.0	176.9	3 55.6	−60.0	176.9	2 55.6	−59.9	176.9	1 55.7	−59.9	176.9	0 55.8	−59.9	176.9	0 04.1	+59.9	3.1	1 04.0	+60.0	3.1	39
40	4 55.4	−59.9	176.9	3 55.5	−59.9	176.9	2 55.6	−59.9	176.9	1 55.7	−59.9	176.9	0 55.8	−59.9	176.9	0 04.1	+60.0	3.1	1 04.0	+60.0	3.1	2 04.0	+59.9	3.1	40
41	3 55.5	−59.9	177.0	2 55.6	−59.9	177.0	1 55.7	−59.9	177.0	0 55.8	−60.0	177.0	0 04.1	+60.0	3.0	1 04.1	+59.9	3.0	2 04.0	+59.9	3.0	3 03.9	+59.9	3.0	41
42	2 55.6	−59.9	177.0	1 55.7	−60.0	177.0	0 55.8	−60.0	177.0	0 04.2	+59.9	3.0	1 04.1	+59.9	3.0	2 04.0	+59.9	3.0	3 03.9	+60.0	3.0	4 03.8	+60.0	3.0	42
43	1 55.7	−60.0	177.1	0 55.7	−59.9	177.1	0 04.2	+59.9	2.9	1 04.1	+59.9	2.9	2 04.0	+60.0	2.9	3 03.9	+60.0	2.9	4 03.9	+59.9	2.9	5 03.8	+59.9	2.9	43
44	0 55.7	−59.9	177.1	0 04.2	+59.9	2.9	1 04.1	+59.9	2.9	2 04.0	+60.0	2.9	3 04.0	+59.9	2.9	4 03.9	+59.9	2.9	5 03.8	+59.9	2.9	6 03.7	+60.0	2.9	44
45	0 04.2	+59.9	2.8	1 04.1	+59.9	2.8	2 04.0	+60.0	2.8	3 04.0	+59.9	2.8	4 03.9	+59.9	2.8	5 03.8	+60.0	2.8	6 03.7	+60.0	2.8	7 03.7	+59.9	2.8	45
46	1 04.1	+59.9	2.8	2 04.0	+60.0	2.8	3 04.0	+59.9	2.8	4 03.9	+59.9	2.8	5 03.8	+60.0	2.8	6 03.8	+59.9	2.8	7 03.7	+59.9	2.8	8 03.6	+60.0	2.8	46
47	2 04.0	+60.0	2.7	3 04.0	+59.9	2.7	4 03.9	+59.9	2.7	5 03.8	+60.0	2.7	6 03.8	+59.9	2.7	7 03.7	+59.9	2.7	8 03.6	+60.0	2.8	9 03.6	+59.9	2.8	47
48	3 04.0	+59.9	2.7	4 03.9	+59.9	2.7	5 03.8	+60.0	2.7	6 03.8	+59.9	2.7	7 03.7	+59.9	2.7	8 03.6	+60.0	2.7	9 03.6	+59.9	2.7	10 03.5	+59.9	2.7	48
49	4 03.9	+59.9	2.6	5 03.8	+60.0	2.6	6 03.8	+59.9	2.6	7 03.7	+59.9	2.6	8 03.6	+60.0	2.6	9 03.6	+59.9	2.7	10 03.5	+60.0	2.7	11 03.4	+60.0	2.7	49
50	5 03.8	+59.9	2.6	6 03.8	+59.9	2.6	7 03.7	+59.9	2.6	8 03.6	+60.0	2.6	9 03.6	+59.9	2.6	10 03.5	+60.0	2.6	11 03.5	+59.9	2.6	12 03.4	+59.9	2.6	50
51	6 03.7	+60.0	2.5	7 03.7	+59.9	2.5	8 03.6	+60.0	2.5	9 03.6	+59.9	2.5	10 03.5	+59.9	2.6	11 03.5	+59.9	2.6	12 03.4	+59.9	2.6	13 03.3	+60.0	2.6	51
52	7 03.7	+59.9	2.5	8 03.6	+59.9	2.5	9 03.6	+59.9	2.5	10 03.5	+59.9	2.5	11 03.4	+60.0	2.5	12 03.4	+59.9	2.5	13 03.3	+60.0	2.5	14 03.3	+59.9	2.5	52
53	8 03.6	+59.9	2.4	9 03.5	+60.0	2.4	10 03.5	+59.9	2.4	11 03.4	+60.0	2.5	12 03.4	+59.9	2.5	13 03.3	+60.0	2.5	14 03.3	+59.9	2.5	15 03.2	+60.0	2.5	53
54	9 03.5	+59.9	2.4	10 03.5	+59.9	2.4	11 03.4	+59.9	2.4	12 03.4	+59.9	2.4	13 03.3	+59.9	2.4	14 03.3	+59.9	2.4	15 03.2	+59.9	2.4	16 03.2	+59.9	2.4	54
55	10 03.4	+60.0	2.3	11 03.4	+59.9	2.3	12 03.3	+60.0	2.3	13 03.3	+59.9	2.4	14 03.2	+60.0	2.4	15 03.2	+59.9	2.4	16 03.1	+60.0	2.4	17 03.1	+59.9	2.4	55
56	11 03.4	+59.9	2.3	12 03.3	+60.0	2.3	13 03.3	+59.9	2.3	14 03.2	+60.0	2.3	15 03.2	+59.9	2.3	16 03.1	+60.0	2.3	17 03.1	+59.9	2.3	18 03.0	+60.0	2.4	56
57	12 03.3	+59.9	2.2	13 03.3	+59.9	2.2	14 03.2	+59.9	2.2	15 03.2	+59.9	2.3	16 03.1	+59.9	2.3	17 03.1	+59.9	2.3	18 03.0	+60.0	2.3	19 03.0	+59.9	2.3	57
58	13 03.2	+59.9	2.2	14 03.2	+59.9	2.2	15 03.1	+60.0	2.2	16 03.1	+59.9	2.2	17 03.0	+60.0	2.2	18 03.0	+59.9	2.2	19 03.0	+59.9	2.2	20 02.9	+59.9	2.3	58
59	14 03.1	+60.0	2.1	15 03.1	+59.9	2.1	16 03.1	+59.9	2.1	17 03.0	+59.9	2.2	18 03.0	+59.9	2.2	19 02.9	+60.0	2.2	20 02.9	+59.9	2.2	21 02.8	+60.0	2.2	59
60	15 03.1	+59.9	2.1	16 03.0	+59.9	2.1	17 03.0	+59.9	2.1	18 02.9	+60.0	2.1	19 02.9	+59.9	2.1	20 02.9	+59.9	2.1	21 02.8	+60.0	2.1	22 02.8	+59.9	2.2	60
61	16 03.0	+59.9	2.0	17 02.9	+60.0	2.0	18 02.9	+59.9	2.0	19 02.9	+59.9	2.1	20 02.8	+60.0	2.1	21 02.8	+59.9	2.1	22 02.8	+59.9	2.1	23 02.7	+59.9	2.1	61
62	17 02.9	+59.9	2.0	18 02.9	+59.9	2.0	19 02.8	+60.0	2.0	20 02.8	+59.9	2.0	21 02.8	+59.9	2.0	22 02.7	+60.0	2.0	23 02.7	+59.9	2.0	24 02.6	+60.0	2.1	62
63	18 02.8	+59.9	1.9	19 02.8	+59.9	1.9	20 02.8	+59.9	1.9	21 02.7	+59.9	1.9	22 02.7	+59.9	2.0	23 02.7	+59.9	2.0	24 02.6	+59.9	2.0	25 02.6	+59.9	2.0	63
64	19 02.7	+60.0	1.9	20 02.7	+59.9	1.9	21 02.7	+59.9	1.9	22 02.6	+60.0	1.9	23 02.6	+59.9	1.9	24 02.6	+59.9	1.9	25 02.5	+60.0	1.9	26 02.5	+59.9	2.0	64
65	20 02.7	+59.9	1.8	21 02.6	+60.0	1.8	22 02.6	+59.9	1.8	23 02.6	+59.9	1.8	24 02.5	+60.0	1.8	25 02.5	+59.9	1.9	26 02.5	+59.9	1.9	27 02.4	+60.0	1.9	65
66	21 02.6	+59.9	1.7	22 02.6	+59.9	1.8	23 02.5	+59.9	1.8	24 02.5	+59.9	1.8	25 02.5	+59.9	1.8	26 02.4	+60.0	1.8	27 02.4	+59.9	1.8	28 02.4	+59.9	1.8	66
67	22 02.5	+59.9	1.7	23 02.5	+59.9	1.7	24 02.4	+60.0	1.7	25 02.4	+59.9	1.7	26 02.4	+59.9	1.7	27 02.4	+59.9	1.8	28 02.3	+60.0	1.8	29 02.3	+59.9	1.8	67
68	23 02.4	+59.9	1.6	24 02.4	+59.9	1.6	25 02.4	+59.9	1.7	26 02.3	+60.0	1.7	27 02.3	+59.9	1.7	28 02.3	+59.9	1.7	29 02.3	+59.9	1.7	30 02.2	+60.0	1.7	68
69	24 02.3	+59.9	1.6	25 02.3	+59.9	1.6	26 02.3	+59.9	1.6	27 02.3	+59.9	1.6	28 02.2	+59.9	1.6	29 02.2	+59.9	1.6	30 02.2	+59.9	1.7	31 02.2	+59.9	1.7	69
70	25 02.2	+59.9	1.5	26 02.2	+59.9	1.5	27 02.2	+59.9	1.5	28 02.2	+59.9	1.5	29 02.1	+60.0	1.6	30 02.1	+59.9	1.6	31 02.1	+59.9	1.6	32 02.1	+59.9	1.6	70
71	26 02.1	+60.0	1.4	27 02.1	+59.9	1.5	28 02.1	+59.9	1.5	29 02.1	+59.9	1.5	30 02.1	+59.9	1.5	31 02.0	+60.0	1.5	32 02.0	+59.9	1.5	33 02.0	+59.9	1.6	71
72	27 02.1	+59.9	1.4	28 02.0	+59.9	1.4	29 02.0	+59.9	1.4	30 02.0	+59.9	1.4	31 02.0	+59.9	1.4	32 02.0	+59.9	1.5	33 01.9	+60.0	1.5	34 01.9	+59.9	1.5	72
73	28 02.0	+59.9	1.3	29 01.9	+60.0	1.3	30 01.9	+59.9	1.3	31 01.9	+59.9	1.4	32 01.9	+59.9	1.4	33 01.9	+59.9	1.4	34 01.9	+59.9	1.4	35 01.8	+60.0	1.4	73
74	29 01.9	+59.9	1.3	30 01.9	+59.9	1.3	31 01.8	+59.9	1.3	32 01.8	+59.9	1.3	33 01.8	+59.9	1.3	34 01.8	+59.9	1.3	35 01.8	+59.9	1.3	36 01.8	+59.9	1.4	74
75	30 01.8	+59.9	1.2	31 01.8	+59.9	1.2	32 01.7	+59.9	1.2	33 01.7	+59.9	1.2	34 01.7	+59.9	1.2	35 01.7	+59.9	1.3	36 01.7	+59.9	1.3	37 01.7	+59.9	1.3	75
76	31 01.7	+59.9	1.1	32 01.7	+59.9	1.1	33 01.6	+59.9	1.2	34 01.6	+59.9	1.2	35 01.6	+59.9	1.2	36 01.6	+59.9	1.2	37 01.6	+59.9	1.2	38 01.6	+59.9	1.2	76
77	32 01.6	+59.9	1.1	33 01.6	+59.9	1.1	34 01.5	+59.9	1.1	35 01.5	+59.9	1.1	36 01.5	+59.9	1.1	37 01.5	+59.9	1.1	38 01.5	+59.9	1.1	39 01.5	+59.9	1.2	77
78	33 01.5	+59.9	1.0	34 01.5	+59.9	1.0	35 01.4	+59.9	1.0	36 01.4	+59.9	1.0	37 01.4	+59.9	1.0	38 01.4	+59.9	1.1	39 01.4	+59.9	1.1	40 01.4	+59.9	1.1	78
79	34 01.4	+59.9	0.9	35 01.4	+59.8	0.9	36 01.3	+59.9	0.9	37 01.3	+59.9	1.0	38 01.3	+59.9	1.0	39 01.3	+59.9	1.0	40 01.3	+59.9	1.0	41 01.3	+59.9	1.0	79
80	35 01.3	+59.8	0.8	36 01.2	+59.9	0.9	37 01.2	+59.9	0.9	38 01.2	+59.9	0.9	39 01.2	+59.9	0.9	40 01.2	+59.9	0.9	41 01.2	+59.9	0.9	42 01.2	+59.9	0.9	80
81	36 01.1	+59.9	0.8	37 01.1	+59.9	0.8	38 01.1	+59.9	0.8	39 01.1	+59.9	0.8	40 01.1	+59.9	0.8	41 01.1	+59.9	0.8	42 01.1	+59.9	0.8	43 01.1	+59.9	0.9	81
82	37 01.0	+59.9	0.7	38 01.0	+59.9	0.7	39 01.0	+59.9	0.7	40 01.0	+59.9	0.7	41 01.0	+59.9	0.7	42 01.0	+59.9	0.7	43 01.0	+59.9	0.8	44 01.0	+59.9	0.8	82
83	38 00.9	+59.9	0.6	39 00.9	+59.9	0.6	40 00.9	+59.9	0.6	41 00.9	+59.9	0.6	42 00.9	+59.9	0.7	43 00.9	+59.9	0.7	44 00.9	+59.9	0.7	45 00.9	+59.9	0.7	83
84	39 00.8	+59.9	0.5	40 00.8	+59.9	0.5	41 00.8	+59.9	0.6	42 00.8	+59.9	0.6	43 00.8	+59.9	0.6	44 00.8	+59.9	0.6	45 00.8	+59.9	0.6	46 00.8	+59.9	0.6	84
85	40 00.7	+59.8	0.5	41 00.7	+59.8	0.5	42 00.7	+59.8	0.5	43 00.7	+59.8	0.5	44 00.7	+59.8	0.5	45 00.7	+59.8	0.5	46 00.7	+59.8	0.5	47 00.7	+59.8	0.5	85
86	41 00.5	+59.9	0.4	42 00.5	+59.9	0.4	43 00.5	+59.9	0.4	44 00.5	+59.9	0.4	45 00.5	+59.9	0.4	46 00.5	+59.9	0.4	47 00.5	+59.9	0.4	48 00.5	+59.9	0.4	86
87	42 00.4	+59.9	0.3	43 00.4	+59.9	0.3	44 00.4	+59.9	0.3	45 00.4	+59.9	0.3	46 00.4	+59.9	0.3	47 00.4	+59.9	0.3	48 00.4	+59.9	0.3	49 00.4	+59.9	0.3	87
88	43 00.3	+59.8	0.2	44 00.3	+59.8	0.2	45 00.3	+59.8	0.2	46 00.3	+59.8	0.2	47 00.3	+59.8	0.2	48 00.3	+59.8	0.2	49 00.3	+59.8	0.2	50 00.3	+59.8	0.2	88
89	44 00.1	+59.9	0.1	45 00.1	+59.9	0.1	46 00.1	+59.9	0.1	47 00.1	+59.9	0.1	48 00.1	+59.9	0.1	49 00.1	+59.9	0.1	50 00.1	+59.9	0.1	51 00.1	+59.9	0.1	89
90	45 00.0	+59.9	0.0	46 00.0	+59.9	0.0	47 00.0	+59.9	0.0	48 00.0	+59.9	0.0	49 00.0	+59.9	0.0	50 00.0	+59.9	0.0	51 00.0	+59.9	0.0	52 00.0	+59.9	0.0	90
	45°			46°			47°			48°			49°			50°			51°			52°			

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

LATITUDE SAME NAME AS DECLINATION L.H.A. 176°, 184°

N. Lat. {L.H.A. greater than 180° .....Zn=Z; L.H.A. less than 180°.............Zn=360°–Z}

Dec.	45° Hc	45° d	45° Z	46° Hc	46° d	46° Z	47° Hc	47° d	47° Z	48° Hc	48° d	48° Z
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°
0	33 51.8	+51.0	132.1	33 11.3	+51.5	132.6	32 30.5	+51.9	133.1	31 49.3	+52.4	133.6
1	34 42.8	+50.8	131.5	34 02.8	+51.3	132.0	33 22.4	+51.8	132.5	32 41.7	+52.3	133.0
2	35 33.6	+50.5	130.9	34 54.1	+51.1	131.4	34 14.2	+51.6	131.9	33 34.0	+52.0	132.4
3	36 24.1	+50.4	130.2	35 45.2	+50.9	130.7	35 05.8	+51.4	131.3	34 26.0	+51.9	131.8
4	37 14.5	+50.1	129.5	36 36.1	+50.6	130.1	35 57.2	+51.2	130.7	35 17.9	+51.7	131.2
5	38 04.6	+49.9	128.8	37 26.7	+50.5	129.4	36 48.4	+51.0	130.0	36 09.6	+51.5	130.6
6	38 54.5	+49.6	128.1	38 17.2	+50.2	128.7	37 39.4	+50.7	129.3	37 01.1	+51.3	129.9
7	39 44.1	+49.3	127.4	39 07.4	+49.9	128.0	38 30.1	+50.5	128.7	37 52.4	+51.1	129.3
8	40 33.4	+49.0	126.6	39 57.3	+49.6	127.3	39 20.6	+50.3	128.0	38 43.5	+50.8	128.6
9	41 22.4	+48.7	125.9	40 46.9	+49.4	126.6	40 10.9	+50.0	127.3	39 34.3	+50.6	127.9
10	42 11.1	+48.4	125.1	41 36.3	+49.1	125.8	41 00.9	+49.7	126.5	40 24.9	+50.3	127.2
11	42 59.5	+48.0	124.3	42 25.4	+48.7	125.0	41 50.6	+49.4	125.8	41 15.2	+50.1	126.5
12	43 47.5	+47.7	123.5	43 14.1	+48.4	124.3	42 40.0	+49.1	125.0	42 05.3	+49.7	125.8
13	44 35.2	+47.3	122.6	44 02.5	+48.1	123.4	43 29.1	+48.8	124.2	42 55.0	+49.5	125.0
14	45 22.5	+46.9	121.7	44 50.6	+47.6	122.6	44 17.9	+48.4	123.4	43 44.5	+49.1	124.2
15	46 09.4	+46.4	120.9	45 38.2	+47.3	121.7	45 06.3	+48.0	122.6	44 33.6	+48.8	123.4
16	46 55.8	+46.0	119.9	46 25.5	+46.8	120.8	45 54.3	+47.7	121.7	45 22.4	+48.4	122.6
17	47 41.8	+45.5	119.0	47 12.3	+46.4	119.9	46 42.0	+47.2	120.9	46 10.8	+48.0	121.8
18	48 27.3	+45.1	118.0	47 58.7	+45.9	119.0	47 29.2	+46.8	119.9	46 58.8	+47.6	120.9
19	49 12.4	+44.4	117.0	48 44.6	+45.4	118.0	48 16.0	+46.3	119.0	47 46.4	+47.2	120.0
20	49 56.8	+43.9	116.0	49 30.0	+44.9	117.0	49 02.3	+45.8	118.1	48 33.6	+46.7	119.1
21	50 40.7	+43.3	114.9	50 14.9	+44.3	116.0	49 48.1	+45.3	117.1	49 20.3	+46.3	118.1
22	51 24.0	+42.7	113.8	50 59.2	+43.8	114.9	50 33.4	+44.8	116.0	50 06.6	+45.7	117.1
23	52 06.7	+41.9	112.7	51 43.0	+43.1	113.8	51 18.2	+44.1	115.0	50 52.3	+45.2	116.1
24	52 48.6	+41.3	111.5	52 26.1	+42.4	112.7	52 02.3	+43.6	113.9	51 37.5	+44.6	115.0
25	53 29.9	+40.5	110.3	53 08.5	+41.7	111.5	52 45.9	+42.8	112.8	52 22.1	+43.9	114.0
26	54 10.4	+39.7	109.0	53 50.2	+40.9	110.3	53 28.7	+42.2	111.6	53 06.0	+43.4	112.8
27	54 50.1	+38.8	107.7	54 31.1	+40.2	109.1	54 10.9	+41.4	110.4	53 49.4	+42.6	111.7
28	55 28.9	+38.0	106.4	55 11.3	+39.3	107.8	54 52.3	+40.6	109.1	54 32.0	+41.8	110.5
29	56 06.9	+37.0	105.0	55 50.6	+38.4	106.5	55 32.9	+39.8	107.9	55 13.8	+41.1	109.2
30	56 43.9	+36.0	103.6	56 29.0	+37.5	105.1	56 12.7	+38.9	106.5	55 54.9	+40.3	107.9
31	57 19.9	+34.9	102.1	57 06.5	+36.5	103.6	56 51.6	+37.9	105.1	56 35.2	+39.3	106.6
32	57 54.8	+33.8	100.6	57 43.0	+35.4	102.2	57 29.5	+37.0	103.7	57 14.5	+38.5	105.2
33	58 28.6	+32.7	99.0	58 18.4	+34.2	100.6	58 06.5	+35.8	102.2	57 53.0	+37.4	103.8
34	59 01.3	+31.3	97.4	58 52.6	+33.1	99.1	58 42.3	+34.8	100.7	58 30.4	+36.3	102.3
35	59 32.6	+30.1	95.8	59 25.7	+31.9	97.4	59 17.1	+33.6	99.1	59 06.7	+35.3	100.8
36	60 02.7	+28.7	94.0	59 57.6	+30.5	95.8	59 50.7	+32.2	97.5	59 42.0	+34.0	99.2
37	60 31.4	+27.2	92.3	60 28.1	+29.1	94.0	60 22.9	+31.0	95.8	60 16.0	+32.8	97.5
38	60 58.6	+25.7	90.4	60 57.2	+27.7	92.2	60 53.9	+29.6	94.0	60 48.8	+31.4	95.8
39	61 24.3	+24.2	88.6	61 24.9	+26.1	90.4	61 23.5	+28.1	92.2	61 20.2	+30.0	94.1
40	61 48.5	+22.4	86.6	61 51.0	+24.5	88.5	61 51.6	+26.5	90.4	61 50.2	+28.5	92.2
41	62 10.9	+20.8	84.7	62 15.5	+22.8	86.6	62 18.1	+24.9	88.5	62 18.7	+27.0	90.4
42	62 31.7	+18.9	82.6	62 38.3	+21.1	84.6	62 43.0	+23.2	86.5	62 45.7	+25.3	88.4
43	62 50.6	+17.1	80.6	62 59.4	+19.3	82.5	63 06.2	+21.5	84.5	63 11.0	+23.6	86.4
44	63 07.7	+15.2	78.5	63 18.7	+17.4	80.4	63 27.7	+19.5	82.4	63 34.6	+21.7	84.4
45	63 22.9	+13.2•	76.3	63 36.1	+15.4•	78.3	63 47.2	+17.7	80.3	63 56.3	+19.9	82.3
46	63 36.1	+11.1•	74.1	63 51.5	+13.4•	76.1	64 04.9	+15.7•	78.1	64 16.2	+18.0•	80.1
47	63 47.2	+9.1•	71.9	64 04.9	+11.3•	73.9	64 20.6	+13.6•	75.9	64 34.2	+15.9•	77.9
48	63 56.3	+7.1•	69.7	64 16.2	+9.3•	71.6	64 34.2	+11.5•	73.6	64 50.1	+13.8•	75.6
49	64 03.4	+4.8•	67.4	64 25.5	+7.1•	69.3	64 45.7	+9.3•	71.3	65 03.9	+11.7•	73.3
50	64 08.2	+2.8•	65.1	64 32.6	+4.9•	67.0	64 55.0	+7.2•	69.0	65 15.6	+9.4•	71.0
51	64 11.0	+0.5•	62.8	64 37.5	+2.7•	64.7	65 02.2	+4.9•	66.6	65 25.0	+7.3•	68.6
52	64 11.5	−1.6•	60.5	64 40.2	+0.5•	62.4	65 07.1	+2.7•	64.3	65 32.3	+4.9•	66.3
53	64 09.9	−3.7•	58.2	64 40.7	−1.7•	60.0	65 09.8	+0.5•	61.9	65 37.2	+2.6•	63.8
54	64 06.2	−5.9•	56.0	64 39.0	−3.9•	57.7	65 10.3	−1.9•	59.5	65 39.8	+0.4•	61.4
55	64 00.3	−8.0•	53.7	64 35.1	−6.1•	55.4	65 08.4	−4.0•	57.1	65 40.2	−2.0•	59.0
56	63 52.3	−10.1•	51.4	64 29.0	−8.3•	53.1	65 04.4	−6.4•	54.8	65 38.2	−4.3•	56.6
57	63 42.2	−12.2•	49.2	64 20.7	−10.3•	50.8	64 58.0	−8.5•	52.4	65 33.9	−6.6•	54.2
58	63 30.0	−14.1	47.0	64 10.4	−12.5•	48.5	64 49.5	−10.7•	50.1	65 27.3	−8.8•	51.8
59	63 15.9	−16.1	44.8	63 57.9	−14.5•	46.3	64 38.8	−12.8•	47.8	65 18.5	−11.0•	49.4
60	62 59.8	−18.0	42.7	63 43.4	−16.5	44.1	64 26.0	−14.9•	45.5	65 07.5	−13.2•	47.0
61	62 41.8	−19.8	40.6	63 26.9	−18.4	41.9	64 11.1	−16.9•	43.3	64 54.3	−15.4•	44.7
62	62 22.0	−21.6	38.5	63 08.5	−20.2	39.8	63 54.2	−18.9	41.1	64 38.9	−17.3•	42.5
63	62 00.4	−23.3	36.5	62 48.3	−22.1	37.7	63 35.3	−20.7	38.9	64 21.6	−19.4	40.2
64	61 37.1	−24.8	34.6	62 26.2	−23.7	35.7	63 14.6	−22.5	36.8	64 02.2	−21.2	38.1
65	61 12.3	−26.5	32.7	62 02.5	−25.4	33.7	62 52.1	−24.3	34.8	63 41.0	−23.1	35.9
66	60 45.8	−27.9	30.8	61 37.1	−27.0	31.8	62 27.8	−25.9	32.8	63 17.9	−24.8	33.9
67	60 17.9	−29.4	29.0	61 10.1	−28.5	29.9	62 01.9	−27.5	30.9	62 53.1	−26.5	31.9
68	59 48.5	−30.7	27.3	60 41.6	−29.8	28.1	61 34.4	−29.1	29.0	62 26.6	−28.1	29.9
69	59 17.8	−32.0	25.6	60 11.8	−31.3	26.4	61 05.3	−30.4	27.2	61 58.5	−29.6	28.0
70	58 45.8	−33.2	24.0	59 40.5	−32.5	24.6	60 34.9	−31.8	25.4	61 28.9	−31.0	26.2
71	58 12.6	−34.3	22.4	59 08.0	−33.7	23.0	60 03.1	−33.1	23.7	60 57.9	−32.4	24.4
72	57 38.3	−35.5	20.8	58 34.3	−34.9	21.4	59 30.0	−34.3	22.0	60 25.5	−33.7	22.7
73	57 02.8	−36.4	19.3	57 59.4	−36.0	19.9	58 55.7	−35.4	20.4	59 51.8	−34.9	21.0
74	56 26.4	−37.5	17.9	57 23.4	−37.0	18.4	58 20.3	−36.6	18.9	59 16.9	−36.0	19.4
75	55 48.9	−38.4	16.5	56 46.4	−38.0	16.9	57 43.7	−37.6	17.4	58 40.9	−37.1	17.9
76	55 10.5	−39.2	15.1	56 08.4	−38.9	15.5	57 06.1	−38.5	15.9	58 03.8	−38.2	16.4
77	54 31.3	−40.1	13.8	55 29.5	−39.8	14.1	56 27.6	−39.4	14.5	57 25.6	−39.0	14.9
78	53 51.2	−40.9	12.5	54 49.7	−40.6	12.8	55 48.2	−40.3	13.2	56 46.6	−40.1	13.5
79	53 10.3	−41.6	11.3	54 09.1	−41.4	11.6	55 07.9	−41.2	11.9	56 06.5	−40.8	12.2
80	52 28.7	−42.3	10.1	53 27.7	−42.1	10.3	54 26.7	−41.8	10.6	55 25.7	−41.7	10.9
81	51 46.4	−43.0	9.0	52 45.6	−42.7	9.2	53 44.9	−42.6	9.4	54 44.0	−42.4	9.6
82	51 03.4	−43.6	7.8	52 02.9	−43.5	8.0	53 02.3	−43.3	8.2	54 01.6	−43.1	8.4
83	50 19.8	−44.1	6.7	51 19.4	−44.0	6.9	52 19.0	−43.9	7.1	53 18.5	−43.8	7.2
84	49 35.7	−44.7	5.7	50 35.4	−44.7	5.8	51 35.1	−44.6	5.9	52 34.7	−44.4	6.1
85	48 51.0	−45.3	4.7	49 50.7	−45.1	4.8	50 50.5	−45.1	4.9	51 50.3	−45.0	5.0
86	48 05.7	−45.7	3.7	49 05.6	−45.7	3.8	50 05.4	−45.6	3.8	51 05.3	−45.6	3.9
87	47 20.0	−46.3	2.7	48 19.9	−46.2	2.8	49 19.8	−46.1	2.8	50 19.7	−46.1	2.9
88	46 33.7	−46.6	1.8	47 33.7	−46.6	1.8	48 33.7	−46.6	1.9	49 33.6	−46.5	1.9
89	45 47.1	−47.1	0.9	46 47.1	−47.1	0.9	47 47.1	−47.1	0.9	48 47.1	−47.1	0.9
90	45 00.0	−47.5	0.0	46 00.0	−47.5	0.0	47 00.0	−47.5	0.0	48 00.0	−47.5	0.0
	45°			46°			47°			48°		

Dec.	49° Hc	49° d	49° Z	50° Hc	50° d	50° Z	51° Hc	51° d	51° Z	52° Hc	52° d	52° Z
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°
0	31 07.8	+52.8	134.0	30 26.0	+53.2	134.4	29 43.8	+53.6	134.8	29 01.3	+54.0	135.2
1	32 00.6	+52.7	133.5	31 19.2	+53.1	133.9	30 37.4	+53.5	134.3	29 55.3	+53.9	134.7
2	32 53.3	+52.5	132.9	32 12.3	+53.0	133.4	31 30.9	+53.4	133.8	30 49.2	+53.8	134.2
3	33 45.8	+52.4	132.3	33 05.3	+52.8	132.8	32 24.3	+53.3	133.3	31 43.0	+53.7	133.7
4	34 38.2	+52.2	131.7	33 58.1	+52.6	132.2	33 17.6	+53.0	132.7	32 36.7	+53.5	133.2
5	35 30.4	+52.0	131.1	34 50.7	+52.5	131.6	34 10.6	+53.0	132.2	33 30.2	+53.4	132.6
6	36 22.4	+51.8	130.5	35 43.2	+52.3	131.0	35 03.6	+52.7	131.6	34 23.6	+53.2	132.1
7	37 14.2	+51.6	129.9	36 35.5	+52.1	130.4	35 56.3	+52.6	131.0	35 16.8	+53.0	131.5
8	38 05.8	+51.4	129.2	37 27.6	+51.9	129.8	36 48.9	+52.5	130.4	36 09.8	+52.9	131.0
9	38 57.2	+51.1	128.6	38 19.5	+51.7	129.2	37 41.4	+52.2	129.8	37 02.7	+52.7	130.4
10	39 48.3	+50.9	127.9	39 11.2	+51.5	128.5	38 33.6	+52.0	129.2	37 55.4	+52.6	129.8
11	40 39.2	+50.7	127.2	40 02.7	+51.2	127.9	39 25.6	+51.8	128.5	38 48.0	+52.3	129.2
12	41 29.9	+50.4	126.5	40 53.9	+51.0	127.2	40 17.4	+51.5	127.9	39 40.3	+52.1	128.5
13	42 20.3	+50.1	125.8	41 44.9	+50.7	126.5	41 08.9	+51.4	127.2	40 32.4	+51.9	127.9
14	43 10.4	+49.8	125.0	42 35.6	+50.5	125.8	42 00.3	+51.0	126.5	41 24.3	+51.6	127.2
15	44 00.2	+49.5	124.2	43 26.1	+50.2	125.0	42 51.3	+50.8	125.8	42 15.9	+51.4	126.5
16	44 49.7	+49.1	123.4	44 16.3	+49.8	124.3	43 42.1	+50.5	125.1	43 07.3	+51.2	125.8
17	45 38.8	+48.8	122.6	45 06.1	+49.5	123.5	44 32.6	+50.2	124.3	43 58.5	+50.8	125.1
18	46 27.6	+48.4	121.8	45 55.6	+49.2	122.7	45 22.8	+49.9	123.5	44 49.3	+50.6	124.4
19	47 16.0	+48.0	120.9	46 44.8	+48.8	121.8	46 12.7	+49.6	122.7	45 39.9	+50.3	123.6
20	48 04.0	+47.6	120.0	47 33.6	+48.4	121.0	47 02.3	+49.1	121.9	46 30.2	+49.9	122.8
21	48 51.6	+47.1	119.1	48 22.0	+48.0	120.1	47 51.4	+48.8	121.1	47 20.1	+49.5	122.0
22	49 38.7	+46.7	118.2	49 10.0	+47.5	119.2	48 40.2	+48.4	120.2	48 09.6	+49.2	121.2
23	50 25.4	+46.1	117.2	49 57.5	+47.1	118.2	49 28.6	+48.0	119.3	48 58.8	+48.8	120.3
24	51 11.5	+45.6	116.2	50 44.6	+46.5	117.3	50 16.6	+47.4	118.4	49 47.6	+48.3	119.4
25	51 57.1	+45.1	115.1	51 31.1	+46.0	116.3	51 04.0	+47.0	117.4	50 35.9	+47.9	118.5
26	52 42.2	+44.4	114.0	52 17.1	+45.5	115.2	51 51.0	+46.5	116.4	51 23.8	+47.4	117.5
27	53 26.6	+43.7	112.9	53 02.6	+44.9	114.2	52 37.5	+45.9	115.4	52 11.2	+46.9	116.5
28	54 10.3	+43.1	111.8	53 47.5	+44.2	113.0	53 23.4	+45.3	114.3	52 58.1	+46.4	115.5
29	54 53.4	+42.4	110.6	54 31.7	+43.5	111.9	54 08.7	+44.7	113.2	53 44.5	+45.7	114.4
30	55 35.8	+41.5	109.3	55 15.2	+42.8	110.7	54 53.4	+44.0	112.0	54 30.2	+45.2	113.3
31	56 17.3	+40.7	108.0	55 58.0	+42.1	109.5	55 37.4	+43.2	110.8	55 15.4	+44.4	112.2
32	56 58.0	+39.9	106.7	56 40.1	+41.2	108.2	56 20.6	+42.6	109.6	55 59.8	+43.8	111.0
33	57 37.9	+38.9	105.3	57 21.3	+40.3	106.8	57 03.2	+41.6	108.3	56 43.6	+43.0	109.8
34	58 16.8	+37.9	103.9	58 01.6	+39.4	105.4	57 44.8	+40.9	107.0	57 26.6	+42.2	108.5
35	58 54.7	+36.8	102.4	58 41.0	+38.4	104.0	58 25.7	+39.8	105.6	58 08.8	+41.3	107.1
36	59 31.5	+35.7	100.9	59 19.4	+37.3	102.5	59 05.5	+38.9	104.1	58 50.1	+40.3	105.8
37	60 07.2	+34.5	99.3	59 56.7	+36.2	101.0	59 44.4	+37.8	102.6	59 30.4	+39.4	104.3
38	60 41.7	+33.3	97.6	60 32.9	+35.0	99.4	60 22.2	+36.7	101.1	60 09.8	+38.3	102.8
39	61 15.0	+31.9	95.9	61 07.9	+33.7	97.7	60 58.9	+35.5	99.5	60 48.1	+37.2	101.2
40	61 46.9	+30.4	94.1	61 41.6	+32.4	96.0	61 34.4	+34.2	97.8	61 25.3	+36.0	99.6
41	62 17.3	+29.0	92.3	62 14.0	+30.9	94.2	62 08.6	+32.9	96.1	62 01.3	+34.7	97.9
42	62 46.3	+27.4	90.4	62 44.9	+29.4	92.3	62 41.5	+31.4	94.3	62 36.0	+33.3	96.2
43	63 13.7	+25.7	88.4	63 14.3	+27.8	90.4	63 12.9	+29.8	92.4	63 09.3	+31.9	94.4
44	63 39.4	+24.0	86.4	63 42.1	+26.1	88.4	63 42.7	+28.3	90.4	63 41.2	+30.3	92.5
45	64 03.4	+22.1	84.3	64 08.2	+24.4	86.4	64 11.0	+26.5	88.4	64 11.5	+28.7	90.5
46	64 25.5	+20.2	82.2	64 32.6	+22.4	84.3	64 37.5	+24.7	86.3	64 40.2	+26.9	88.5
47	64 45.7	+18.2•	80.0	64 55.0	+20.6	82.1	65 02.2	+22.8	84.2	65 07.1	+25.2	86.4
48	65 03.9	+16.1•	77.7	65 15.6	+18.5•	79.8	65 25.0	+20.9•	82.0	65 32.3	+23.1•	84.2
49	65 20.0	+14.1•	75.4	65 34.1	+16.3•	77.6	65 45.9	+18.7•	79.7	65 55.4	+21.2•	81.9
50	65 34.1	+11.8•	73.1	65 50.4	+14.2•	75.2	66 04.6	+16.7•	77.4	66 16.6	+19.0•	79.6
51	65 45.9	+9.5•	70.7	66 04.6	+12.0•	72.8	66 21.3	+14.3•	75.0	66 35.6	+16.9•	77.2
52	65 55.4	+7.3•	68.3	66 16.6	+9.6•	70.4	66 35.6	+12.1•	72.6	66 52.5	+14.5•	74.8
53	66 02.7	+4.9•	65.9	66 26.2	+7.3•	68.0	66 47.7	+9.7•	70.1	67 07.0	+12.2•	72.3
54	66 07.6	+2.6•	63.4	66 33.5	+4.9•	65.5	66 57.4	+7.3•	67.6	67 19.2	+9.8•	69.8
55	66 10.2	+0.2•	60.9	66 38.4	+2.5•	63.0	67 04.7	+4.9•	65.1	67 29.0	+7.3•	67.2
56	66 10.4	−2.1•	58.5	66 40.9	+0.1•	60.4	67 09.6	+2.4•	62.5	67 36.3	+4.8•	64.6
57	66 08.3	−4.6•	56.0	66 41.0	−2.4•	57.9	67 12.0	−0.1•	59.9	67 41.1	+2.3•	62.0
58	66 03.7	−6.8•	53.5	66 38.6	−4.7•	55.4	67 11.9	−2.6•	57.3	67 43.4	−0.3•	59.4
59	65 56.9	−9.2•	51.1	66 33.9	−7.2•	52.9	67 09.3	−5.1•	54.8	67 43.1	−2.9•	56.7
60	65 47.7	−11.4•	48.7	66 26.7	−9.5•	50.4	67 04.2	−7.5•	52.2	67 40.2	−5.4•	54.1
61	65 36.3	−13.6•	46.3	66 17.2	−11.9•	47.9	66 56.7	−9.9•	49.7	67 34.8	−7.9•	51.5
62	65 22.7	−15.8•	43.9	66 05.3	−14.0•	45.5	66 46.8	−12.3•	47.1	67 26.9	−10.3•	48.9
63	65 06.9	−17.8•	41.6	65 51.3	−16.3•	43.1	66 34.5	−14.6•	44.7	67 16.6	−12.8•	46.3
64	64 49.1	−19.9•	39.4	65 35.0	−18.4•	40.8	66 19.9	−16.8•	42.2	67 03.8	−15.1•	43.8
65	64 29.2	−21.8	37.2	65 16.6	−20.4•	38.5	66 03.1	−18.9•	39.9	66 48.7	−17.4•	41.4
66	64 07.4	−23.6	35.0	64 56.2	−22.4	36.2	65 44.2	−21.0•	37.5	66 31.3	−19.6•	38.9
67	63 43.8	−25.4	32.9	64 33.8	−24.2	34.1	65 23.2	−23.0	35.3	66 11.7	−21.6•	36.6
68	63 18.4	−27.1	30.9	64 09.6	−26.1	31.9	65 00.2	−24.9	33.1	65 50.1	−23.6•	34.3
69	62 51.3	−28.7	28.9	63 43.5	−27.7	29.9	64 35.3	−26.7	30.9	65 26.5	−25.6	32.1
70	62 22.6	−30.2	27.0	63 15.8	−29.3	27.9	64 08.6	−28.4	28.9	65 00.9	−27.4	29.9
71	61 52.4	−31.7	25.2	62 46.5	−30.8	26.0	63 40.2	−30.0	26.9	64 33.5	−29.0	27.8
72	61 20.7	−33.0	23.4	62 15.7	−32.3	24.1	63 10.2	−31.5	24.9	64 04.5	−30.7	25.8
73	60 47.7	−34.3	21.6	61 43.4	−33.7	22.3	62 38.7	−32.9	23.1	63 33.8	−32.3	23.8
74	60 13.4	−35.5	20.0	61 09.7	−34.9	20.6	62 05.8	−34.4	21.3	63 01.5	−33.6	22.0
75	59 37.9	−36.6	18.4	60 34.8	−36.2	18.9	61 31.4	−35.6	19.5	62 27.9	−35.0	20.2
76	59 01.3	−37.7	16.8	59 58.6	−37.2	17.3	60 55.8	−36.7	17.9	61 52.9	−36.3	18.4
77	58 23.6	−38.8	15.3	59 21.4	−38.4	15.8	60 19.1	−38.0	16.2	61 16.6	−37.5	16.7
78	57 44.8	−39.6	13.9	58 43.0	−39.3	14.3	59 41.1	−38.9	14.7	60 39.1	−38.6	15.1
79	57 05.2	−40.6	12.5	58 03.7	−40.3	12.8	59 02.2	−40.0	13.2	60 00.5	−39.6	13.6
80	56 24.6	−41.4	11.1	57 23.4	−41.1	11.4	58 22.2	−40.9	11.8	59 20.9	−40.6	12.1
81	55 43.2	−42.2	9.8	56 42.3	−42.0	10.1	57 41.3	−41.7	10.4	58 40.3	−41.5	10.7
82	55 01.0	−43.0	8.6	56 00.3	−42.8	8.8	56 59.6	−42.6	9.0	57 58.8	−42.4	9.3
83	54 18.0	−43.6	7.4	55 17.5	−43.5	7.6	56 17.0	−43.4	7.8	57 16.4	−43.2	8.0
84	53 34.4	−44.3	6.2	54 34.0	−44.2	6.4	55 33.6	−44.0	6.5	56 33.2	−43.9	6.7
85	52 50.1	−44.9	5.1	53 49.8	−44.8	5.2	54 49.6	−44.7	5.3	55 49.3	−44.6	5.5
86	52 05.2	−45.5	4.0	53 05.0	−45.4	4.1	54 04.9	−45.4	4.2	55 04.7	−45.3	4.3
87	51 19.7	−46.1	3.0	52 19.6	−46.0	3.0	53 19.5	−46.0	3.1	54 19.4	−45.9	3.2
88	50 33.6	−46.6	1.9	51 33.6	−46.6	2.0	52 33.5	−46.5	2.0	53 33.5	−46.5	2.1
89	49 47.0	−47.0	1.0	50 47.0	−47.0	1.0	51 47.0	−47.0	1.0	52 47.0	−47.0	1.0
90	49 00.0	−47.5	0.0	50 00.0	−47.5	0.0	51 00.0	−47.5	0.0	52 00.0	−47.5	0.0
	49°			50°			51°			52°		

LATITUDE CONTRARY NAME TO DECLINATION L.H.A. 38°, 322°

Dec.	45° Hc	d	Z	46° Hc	d	Z	47° Hc	d	Z	48° Hc	d	Z	49° Hc	d	Z	50° Hc	d	Z	51° Hc	d	Z	52° Hc	d	Z	Dec.
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	°
0	33 51.8	−51.2	132.1	33 11.3	−51.6	132.6	32 30.5	−52.1	133.1	31 49.3	−52.5	133.6	31 07.8	−53.0	134.0	30 26.0	−53.4	134.4	29 43.8	−53.8	134.8	29 01.3	−54.1	135.2	0
1	33 00.6	−51.4	132.8	32 19.7	−51.9	133.2	31 38.4	−52.3	133.7	30 56.8	−52.7	134.1	30 14.8	−53.1	134.6	29 32.6	−53.5	135.0	28 50.0	−53.8	135.4	28 07.2	−54.2	135.7	1
2	32 09.2	−51.5	133.4	31 27.8	−52.0	133.8	30 46.1	−52.4	134.3	30 04.1	−52.9	134.7	29 21.7	−53.2	135.1	28 39.1	−53.6	135.5	27 56.2	−54.0	135.9	27 13.0	−54.3	136.2	2
3	31 17.7	−51.7	134.0	30 35.8	−52.1	134.4	29 53.7	−52.6	134.8	29 11.2	−52.9	135.2	28 28.5	−53.4	135.6	27 45.5	−53.7	136.0	27 02.2	−54.1	136.4	26 18.7	−54.5	136.7	3
4	30 26.0	−51.9	134.6	29 43.7	−52.3	135.0	29 01.1	−52.7	135.4	28 18.3	−53.1	135.8	27 35.1	−53.4	136.1	26 51.8	−53.9	136.5	26 08.1	−54.2	136.8	25 24.2	−54.5	137.2	4
5	29 34.1	−52.0	135.2	28 51.4	−52.4	135.6	28 08.4	−52.8	135.9	27 25.2	−53.2	136.3	26 41.7	−53.6	136.6	25 57.9	−53.9	137.0	25 13.9	−54.2	137.3	24 29.7	−54.6	137.6	5
6	28 42.1	−52.2	135.7	27 59.0	−52.6	136.1	27 15.6	−52.9	136.5	26 32.0	−53.3	136.8	25 48.1	−53.7	137.1	25 04.0	−54.0	137.5	24 19.7	−54.4	137.8	23 35.1	−54.6	138.1	6
7	27 49.9	−52.3	136.3	27 06.4	−52.7	136.6	26 22.7	−53.1	137.0	25 38.7	−53.5	137.3	24 54.4	−53.7	137.6	24 10.0	−54.1	138.0	23 25.3	−54.4	138.2	22 40.5	−54.8	138.5	7
8	26 57.6	−52.4	136.8	26 13.7	−52.8	137.2	25 29.6	−53.2	137.5	24 45.2	−53.5	137.8	24 00.7	−53.9	138.1	23 15.9	−54.2	138.4	22 30.9	−54.5	138.7	21 45.7	−54.8	139.0	8
9	26 05.2	−52.5	137.4	25 20.9	−52.9	137.7	24 36.4	−53.2	138.0	23 51.7	−53.6	138.3	23 06.8	−53.9	138.6	22 21.7	−54.3	138.9	21 36.4	−54.6	139.2	20 50.9	−54.8	139.4	9
10	25 12.7	−52.7	137.9	24 28.0	−53.0	138.2	23 43.2	−53.4	138.5	22 58.1	−53.7	138.8	22 12.9	−54.1	139.1	21 27.4	−54.3	139.3	20 41.8	−54.6	139.6	19 56.1	−55.0	139.8	10
11	24 20.0	−52.7	138.4	23 35.0	−53.1	138.7	22 49.8	−53.5	139.0	22 04.4	−53.8	139.3	21 18.8	−54.1	139.6	20 33.1	−54.4	139.8	19 47.2	−54.7	140.0	19 01.1	−55.0	140.3	11
12	23 27.3	−52.9	139.0	22 41.9	−53.2	139.2	21 56.3	−53.5	139.5	21 10.6	−53.8	139.8	20 24.7	−54.1	140.0	19 38.7	−54.5	140.3	18 52.5	−54.8	140.5	18 06.1	−55.0	140.7	12
13	22 34.4	−53.0	139.5	21 48.7	−53.3	139.7	21 02.8	−53.6	140.0	20 16.8	−54.0	140.2	19 30.6	−54.3	140.5	18 44.2	−54.5	140.7	17 57.7	−54.8	140.9	17 11.1	−55.1	141.1	13
14	21 41.4	−53.0	140.0	20 55.4	−53.4	140.2	20 09.2	−53.7	140.5	19 22.8	−54.0	140.7	18 36.3	−54.3	140.9	17 49.7	−54.6	141.1	17 02.9	−54.9	141.3	16 16.0	−55.2	141.5	14
15	20 48.4	−53.2	140.5	20 02.0	−53.5	140.7	19 15.5	−53.8	141.0	18 28.8	−54.1	141.2	17 42.0	−54.4	141.4	16 55.1	−54.7	141.6	16 08.0	−54.9	141.8	15 20.8	−55.2	141.9	15
16	19 55.2	−53.2	141.0	19 08.5	−53.5	141.2	18 21.7	−53.8	141.4	17 34.7	−54.1	141.6	16 47.6	−54.4	141.8	16 00.4	−54.7	142.0	15 13.1	−55.0	142.2	14 25.6	−55.2	142.3	16
17	19 02.0	−53.3	141.5	18 15.0	−53.6	141.7	17 27.9	−53.9	141.9	16 40.6	−54.2	142.1	15 53.2	−54.5	142.3	15 05.7	−54.7	142.4	14 18.1	−55.0	142.6	13 30.4	−55.3	142.7	17
18	18 08.7	−53.3	142.0	17 21.4	−53.7	142.2	16 34.0	−54.0	142.3	15 46.4	−54.3	142.5	14 58.7	−54.5	142.7	14 11.0	−54.8	142.8	13 23.1	−55.1	143.0	12 35.1	−55.3	143.1	18
19	17 15.4	−53.5	142.4	16 27.7	−53.7	142.6	15 40.0	−54.0	142.8	14 52.1	−54.3	143.0	14 04.2	−54.6	143.1	13 16.2	−54.9	143.3	12 28.0	−55.1	143.4	11 39.8	−55.3	143.5	19
20	16 21.9	−53.5	142.9	15 34.0	−53.8	143.1	14 46.0	−54.1	143.3	13 57.8	−54.3	143.4	13 09.6	−54.6	143.5	12 21.3	−54.9	143.7	11 32.9	−55.1	143.8	10 44.5	−55.4	143.9	20
21	15 28.4	−53.5	143.4	14 40.2	−53.8	143.5	13 51.9	−54.1	143.7	13 03.5	−54.4	143.8	12 15.0	−54.6	144.0	11 26.4	−54.9	144.1	10 37.8	−55.1	144.2	9 49.1	−55.4	144.3	21
22	14 34.9	−53.7	143.9	13 46.4	−53.9	144.0	12 57.8	−54.2	144.1	12 09.1	−54.4	144.3	11 20.4	−54.7	144.4	10 31.5	−54.9	144.5	9 42.7	−55.2	144.6	8 53.7	−55.4	144.7	22
23	13 41.2	−53.6	144.3	12 52.5	−54.0	144.5	12 03.6	−54.2	144.6	11 14.7	−54.5	144.7	10 25.7	−54.8	144.8	9 36.6	−55.0	144.9	8 47.5	−55.2	145.0	7 58.3	−55.5	145.1	23
24	12 47.6	−53.7	144.8	11 58.5	−54.0	144.9	11 09.4	−54.3	145.0	10 20.2	−54.5	145.1	9 30.9	−54.7	145.2	8 41.6	−55.0	145.3	7 52.3	−55.3	145.4	7 02.8	−55.4	145.5	24
25	11 53.9	−53.8	145.2	11 04.5	−54.0	145.3	10 15.1	−54.2	145.5	9 25.7	−54.5	145.6	8 36.2	−54.8	145.6	7 46.6	−55.0	145.7	6 57.0	−55.2	145.8	6 07.4	−55.5	145.9	25
26	11 00.1	−53.8	145.7	10 10.5	−54.0	145.8	9 20.9	−54.3	145.9	8 31.2	−54.6	146.0	7 41.4	−54.8	146.1	6 51.6	−55.0	146.1	6 01.8	−55.3	146.2	5 11.9	−55.5	146.2	26
27	10 06.3	−53.8	146.1	9 16.5	−54.1	146.2	8 26.6	−54.4	146.3	7 36.6	−54.6	146.4	6 46.6	−54.8	146.5	5 56.6	−55.1	146.5	5 06.5	−55.3	146.6	4 16.4	−55.5	146.6	27
28	9 12.5	−53.9	146.6	8 22.4	−54.1	146.7	7 32.2	−54.3	146.7	6 42.0	−54.6	146.8	5 51.8	−54.9	146.9	5 01.5	−55.0	146.9	4 11.2	−55.3	147.0	3 20.9	−55.5	147.0	28
29	8 18.6	−53.9	147.0	7 28.3	−54.2	147.1	6 37.9	−54.4	147.2	5 47.4	−54.6	147.2	4 56.9	−54.8	147.3	4 06.5	−55.1	147.3	3 15.9	−55.3	147.4	2 25.4	−55.5	147.4	29
30	7 24.7	−53.9	147.5	6 34.1	−54.2	147.5	5 43.5	−54.4	147.6	4 52.8	−54.6	147.6	4 02.1	−54.9	147.7	3 11.4	−55.1	147.7	2 20.6	−55.3	147.7	1 29.9	−55.5	147.8	30
31	6 30.8	−53.9	147.9	5 39.9	−54.1	148.0	4 49.1	−54.5	148.0	3 58.2	−54.7	148.1	3 07.2	−54.8	148.1	2 16.3	−55.1	148.1	1 25.3	−55.3	148.1	0 34.4	−55.6	148.1	31
32	5 36.9	−54.0	148.4	4 45.8	−54.2	148.4	3 54.6	−54.4	148.4	3 03.5	−54.7	148.5	2 12.4	−54.9	148.5	1 21.2	−55.1	148.5	0 30.0	−55.3	148.5	0 21.2	+55.5	31.5	32
33	4 42.9	−54.0	148.8	3 51.6	−54.3	148.8	3 00.2	−54.4	148.9	2 08.8	−54.6	148.9	1 17.5	−54.9	148.9	0 26.1	−55.1	148.9	0 25.3	+55.3	31.1	1 16.7	+55.5	31.1	33
34	3 48.9	−54.0	149.2	2 57.3	−54.2	149.3	2 05.8	−54.5	149.3	1 14.2	−54.7	149.3	0 22.6	−54.9	149.3	0 29.0	+55.1	30.7	1 20.6	+55.3	30.7	2 12.2	+55.5	30.7	34
35	2 54.9	−54.0	149.7	2 03.1	−54.2	149.7	1 11.3	−54.4	149.7	0 19.5	−54.7	149.7	0 32.3	+54.9	30.3	1 24.1	+55.1	30.3	2 15.9	+55.3	30.3	3 07.7	+55.5	30.3	35
36	2 00.9	−54.0	150.1	1 08.9	−54.2	150.1	0 16.9	−54.5	150.1	0 35.2	+54.6	29.9	1 27.2	+54.9	29.9	2 19.2	+55.1	29.9	3 11.2	+55.3	29.9	4 03.2	+55.5	30.0	36
37	1 06.9	−54.0	150.5	0 14.7	−54.3	150.5	0 37.6	+54.4	29.5	1 29.8	+54.7	29.5	2 22.1	+54.8	29.5	3 14.3	+55.1	29.5	4 06.5	+55.3	29.5	4 58.7	+55.5	29.6	37
38	0 12.9	−54.0	151.0	0 39.6	+54.2	29.0	1 32.0	+54.5	29.0	2 24.5	+54.7	29.1	3 16.9	+54.9	29.1	4 09.4	+55.0	29.1	5 01.8	+55.3	29.1	5 54.2	+55.4	29.2	38
39	0 41.1	+54.0	28.6	1 33.8	+54.2	28.6	2 26.5	+54.4	28.6	3 19.2	+54.6	28.6	4 11.8	+54.9	28.7	5 04.4	+55.1	28.7	5 57.1	+55.2	28.8	6 49.6	+55.5	28.8	39
40	1 35.1	+54.1	28.2	2 28.0	+54.3	28.2	3 20.9	+54.5	28.2	4 13.8	+54.6	28.2	5 06.7	+54.8	28.3	5 59.5	+55.0	28.3	6 52.3	+55.2	28.4	7 45.1	+55.4	28.4	40
41	2 29.2	+54.0	27.7	3 22.3	+54.2	27.7	4 15.4	+54.4	27.8	5 08.4	+54.7	27.8	6 01.5	+54.8	27.9	6 54.5	+55.1	27.9	7 47.5	+55.3	28.0	8 40.5	+55.4	28.0	41
42	3 23.2	+53.9	27.3	4 16.5	+54.2	27.3	5 09.8	+54.4	27.3	6 03.1	+54.6	27.4	6 56.3	+54.8	27.4	7 49.6	+54.9	27.5	8 42.8	+55.1	27.6	9 35.9	+55.4	27.6	42
43	4 17.1	+54.0	26.8	5 10.7	+54.1	26.9	6 04.2	+54.4	26.9	6 57.7	+54.5	27.0	7 51.1	+54.8	27.0	8 44.5	+55.0	27.1	9 37.9	+55.2	27.2	10 31.3	+55.3	27.3	43
44	5 11.1	+54.0	26.4	6 04.8	+54.2	26.4	6 58.6	+54.3	26.5	7 52.2	+54.6	26.6	8 45.9	+54.7	26.6	9 39.5	+55.0	26.7	10 33.1	+55.1	26.8	11 26.6	+55.4	26.9	44
45	6 05.1	+53.9	26.0	6 59.0	+54.1	26.0	7 52.9	+54.3	26.1	8 46.8	+54.5	26.1	9 40.6	+54.8	26.2	10 34.5	+54.9	26.3	11 28.2	+55.1	26.4	12 22.0	+55.2	26.5	45
46	6 59.0	+53.9	25.5	7 53.1	+54.1	25.6	8 47.2	+54.3	25.6	9 41.3	+54.5	25.7	10 35.4	+54.6	25.8	11 29.4	+54.8	25.9	12 23.3	+55.1	26.0	13 17.2	+55.3	26.1	46
47	7 52.9	+53.9	25.1	8 47.2	+54.1	25.1	9 41.5	+54.3	25.2	10 35.8	+54.5	25.3	11 30.0	+54.7	25.4	12 24.2	+54.9	25.5	13 18.4	+55.0	25.6	14 12.5	+55.2	25.7	47
48	8 46.8	+53.8	24.6	9 41.3	+54.1	24.7	10 35.8	+54.2	24.8	11 30.3	+54.4	24.9	12 24.7	+54.6	24.9	13 19.1	+54.8	25.0	14 13.4	+55.0	25.1	15 07.7	+55.1	25.3	48
49	9 40.6	+53.9	24.2	10 35.4	+54.0	24.3	11 30.0	+54.2	24.3	12 24.7	+54.4	24.4	13 19.3	+54.6	24.5	14 13.9	+54.7	24.6	15 08.4	+54.9	24.7	16 02.8	+55.2	24.9	49
50	10 34.5	+53.7	23.7	11 29.4	+53.9	23.8	12 24.2	+54.2	23.9	13 19.1	+54.3	24.0	14 13.9	+54.5	24.1	15 08.6	+54.7	24.2	16 03.3	+54.9	24.3	16 58.0	+55.0	24.4	50
51	11 28.2	+53.8	23.3	12 23.3	+53.9	23.4	13 18.4	+54.1	23.5	14 13.4	+54.3	23.6	15 08.4	+54.4	23.7	16 03.3	+54.7	23.8	16 58.2	+54.8	23.9	17 53.0	+55.0	24.0	51
52	12 22.0	+53.7	22.8	13 17.2	+53.9	22.9	14 12.5	+54.0	23.0	15 07.7	+54.2	23.1	16 02.8	+54.5	23.2	16 58.0	+54.6	23.3	17 53.0	+54.8	23.5	18 48.0	+55.0	23.6	52
53	13 15.7	+53.6	22.4	14 11.1	+53.8	22.5	15 06.5	+54.0	22.6	16 01.9	+54.2	22.7	16 57.3	+54.3	22.8	17 52.6	+54.5	22.9	18 47.8	+54.7	23.0	19 43.0	+54.9	23.2	53
54	14 09.3	+53.6	21.9	15 04.9	+53.8	22.0	16 00.5	+54.0	22.1	16 56.1	+54.1	22.2	17 51.6	+54.3	22.3	18 47.1	+54.5	22.5	19 42.5	+54.7	22.6	20 37.9	+54.8	22.7	54
55	15 02.9	+53.5	21.4	15 58.7	+53.7	21.6	16 54.5	+53.9	21.7	17 50.2	+54.1	21.8	18 45.9	+54.3	21.9	19 41.6	+54.4	22.0	20 37.2	+54.5	22.2	21 32.7	+54.8	22.3	55
56	15 56.4	+53.5	21.0	16 52.4	+53.6	21.1	17 48.4	+53.8	21.2	18 44.3	+54.0	21.3	19 40.2	+54.1	21.4	20 36.0	+54.3	21.6	21 31.7	+54.6	21.7	22 27.5	+54.6	21.9	56
57	16 49.9	+53.4	20.5	17 46.0	+53.6	20.6	18 42.2	+53.7	20.7	19 38.3	+53.9	20.9	20 34.3	+54.1	21.0	21 30.3	+54.3	21.1	22 26.3	+54.4	21.3	23 22.1	+54.6	21.4	57
58	17 43.3	+53.3	20.0	18 39.6	+53.5	20.1	19 35.9	+53.7	20.3	20 32.2	+53.8	20.4	21 28.4	+54.0	20.5	22 24.6	+54.2	20.7	23 20.7	+54.3	20.8	24 16.7	+54.6	21.0	58
59	18 36.6	+53.3	19.5	19 33.1	+53.5	19.7	20 29.6	+53.6	19.8	21 26.0	+53.8	19.9	22 22.4	+54.0	20.1	23 18.8	+54.1	20.2	24 15.0	+54.3	20.4	25 11.3	+54.4	20.5	59
60	19 29.9	+53.1	19.1	20 26.6	+53.3	19.2	21 23.2	+53.5	19.3	22 19.8	+53.7	19.4	23 16.4	+53.8	19.6	24 12.9	+54.0	19.7	25 09.3	+54.2	19.9	26 05.7	+54.4	20.0	60
61	20 23.0	+53.1	18.6	21 19.9	+53.3	18.7	22 16.7	+53.4	18.8	23 13.5	+53.6	19.0	24 10.2	+53.8	19.1	25 06.9	+53.9	19.2	26 03.5	+54.1	19.4	27 00.1	+54.2	19.6	61
62	21 16.1	+53.0	18.1	22 13.2	+53.1	18.2	23 10.1	+53.4	18.3	24 07.1	+53.5	18.5	25 04.0	+53.6	18.6	26 00.8	+53.8	18.8	26 57.6	+54.0	18.9	27 54.3	+54.2	19.1	62
63	22 09.1	+52.9	17.6	23 06.3	+53.1	17.7	24 03.5	+53.2	17.8	25 00.6	+53.4	18.0	25 57.6	+53.6	18.1	26 54.6	+53.7	18.3	27 51.6	+53.8	18.4	28 48.5	+54.0	18.6	63
64	23 02.0	+52.9	17.1	23 59.4	+53.0	17.2	24 56.7	+53.1	17.3	25 54.0	+53.2	17.5	26 51.2	+53.4	17.6	27 48.3	+53.6	17.8	28 45.4	+53.8	17.9	29 42.5	+53.9	18.1	64
65	23 54.9	+52.7	16.5	24 52.4	+52.8	16.7	25 49.8	+53.0	16.8	26 47.2	+53.2	16.9	27 44.6	+53.3	17.1	28 41.9	+53.5	17.3	29 39.2	+53.7	17.4	30 36.4	+53.8	17.6	65
66	24 47.6	+52.6	16.0	25 45.2	+52.8	16.1	26 42.8	+52.9	16.3	27 40.4	+53.1	16.4	28 37.9	+53.2	16.6	29 35.4	+53.4	16.7	30 32.9	+53.5	16.9	31 30.2	+53.7	17.1	66
67	25 40.2	+52.4	15.5	26 38.0	+52.6	15.6	27 35.7	+52.8	15.7	28 33.5	+52.9	15.9	29 31.1	+53.1	16.0	30 28.8	+53.2	16.2	31 26.4	+53.4	16.4	32 23.9	+53.6	16.6	67
68	26 32.6	+52.4	14.9	27 30.6	+52.5	15.1	28 28.5	+52.7	15.2	29 26.4	+52.8	15.4	30 24.2	+53.0	15.5	31 22.0	+53.1	15.7	32 19.8	+53.2	15.8	33 17.5	+53.4	16.0	68
69	27 25.0	+52.2	14.4	28 23.1	+52.4	14.5	29 21.2	+52.5	14.7	30 19.2	+52.6	14.8	31 17.2	+52.8	15.0	32 15.1	+53.0	15.1	33 13.0	+53.1	15.3	34 10.9	+53.2	15.5	69
70	28 17.2	+52.1	13.8	29 15.5	+52.2	14.0	30 13.7	+52.3	14.1	31 11.8	+52.5	14.3	32 10.0	+52.6	14.4	33 08.1	+52.8	14.6	34 06.1	+53.0	14.7	35 04.1	+53.1	14.9	70
71	29 09.3	+51.9	13.3	30 07.7	+52.1	13.4	31 06.0	+52.2	13.5	32 04.3	+52.4	13.7	33 02.6	+52.5	13.8	34 00.9	+52.6	14.0	34 59.1	+52.7	14.2	35 57.2	+52.9	14.3	71
72	30 01.2	+51.8	12.7	30 59.8	+51.9	12.8	31 58.2	+52.1	13.0	32 56.7	+52.2	13.1	33 55.1	+52.3	13.3	34 53.5	+52.5	13.4	35 51.8	+52.7	13.6	36 50.1	+52.8	13.8	72
73	30 53.0	+51.7	12.1	31 51.7	+51.7	12.2	32 50.3	+51.9	12.4	33 48.9	+52.0	12.5	34 47.4	+52.2	12.7	35 46.0	+52.3	12.8	36 44.5	+52.4	13.0	37 42.9	+52.6	13.2	73
74	31 44.7	+51.4	11.5	32 43.4	+51.6	11.6	33 42.2	+51.7	11.8	34 40.9	+51.8	11.9	35 39.6	+52.0	12.1	36 38.3	+52.1	12.2	37 36.9	+52.2	12.4	38 35.5	+52.3	12.5	74
75	32 36.1	+51.3	10.9	33 35.0	+51.4	11.0	34 33.9	+51.5	11.2	35 32.7	+51.7	11.3	36 31.6	+51.7	11.4	37 30.4	+51.9	11.6	38 29.1	+52.0	11.7	39 27.8	+52.2	11.9	75
76	33 27.4	+51.1	10.3	34 26.4	+51.2	10.4	35 25.4	+51.3	10.5	36 24.4	+51.4	10.7	37 23.3	+51.6	10.8	38 22.3	+51.6	11.0	39 21.1	+51.9	11.1	40 20.0	+52.0	11.3	76
77	34 18.5	+50.9	9.7	35 17.6	+51.0	9.8	36 16.7	+51.1	9.9	37 15.8	+51.3	10.0	38 14.9	+51.3	10.2	39 13.9	+51.5	10.3	40 13.0	+51.6	10.4	41 12.0	+51.7	10.6	77
78	35 09.4	+50.6	9.0	36 08.6	+50.8	9.1	37 07.8	+50.9	9.2	38 07.1	+51.0	9.4	39 06.2	+51.2	9.5	40 05.4	+51.2	9.6	41 04.6	+51.3	9.8	42 03.7	+51.4	9.9	78
79	36 00.0	+50.5	8.3	36 59.4	+50.6	8.5	37 58.7	+50.7	8.6	38 58.1	+50.7	8.7	39 57.4	+50.8	8.8	40 56.6	+51.0	8.9	41 55.9	+51.1	9.1	42 55.1	+51.2	9.2	79
80	36 50.5	+50.2	7.7	37 50.0	+50.3	7.8	38 49.4	+50.4	7.9	39 48.8	+50.5	8.0	40 48.2	+50.6	8.1	41 47.6	+50.7	8.2	42 47.0	+50.8	8.4	43 46.3	+51.0	8.5	80
81	37 40.7	+50.0	7.0	38 40.3	+50.0	7.1	39 39.8	+50.2	7.2	40 39.3	+50.3	7.3	41 38.8	+50.4	7.4	42 38.3	+50.5	7.5	43 37.8	+50.5	7.6	44 37.3	+50.6	7.8	81
82	38 30.7	+49.7	6.3	39 30.3	+49.9	6.4	40 30.0	+49.9	6.5	41 29.6	+50.0	6.6	42 29.2	+50.0	6.7	43 28.8	+50.1	6.8	44 28.3	+50.3	6.9	45 27.9	+50.3	7.0	82
83	39 20.4	+49.5	5.6	40 20.2	+49.5	5.6	41 19.9	+49.6	5.7	42 19.6	+49.6	5.8	43 19.2	+49.8	5.9	44 18.9	+49.8	6.0	45 18.6	+49.9	6.1	46 18.2	+50.0	6.2	83
84	40 09.9	+49.2	4.8	41 09.7	+49.2	4.9	42 09.5	+49.2	5.0	43 09.2	+49.4	5.1	44 09.0	+49.4	5.1	45 08.7	+49.5	5.2	46 08.5	+49.6	5.3	47 08.2	+49.7	5.4	84
85	40 59.1	+48.8	4.1	41 58.9	+48.9	4.1	42 58.7	+49.0	4.2	43 58.6	+49.0	4.3	44 58.4	+49.1	4.4	45 58.2	+49.2	4.4	46 58.1	+49.2	4.5	47 57.9	+49.2	4.6	85
86	41 47.9	+48.6	3.3	42 47.8	+48.6	3.4	43 47.7	+48.6	3.4	44 47.6	+48.7	3.5	45 47.5	+48.7	3.5	46 47.4	+48.8	3.6	47 47.3	+48.8	3.7	48 47.1	+48.9	3.7	86
87	42 36.5	+48.2	2.5	43 36.4	+48.2	2.6	44 36.3	+48.3	2.6	45 36.3	+48.3	2.6	46 36.2	+48.4	2.7	47 36.2	+48.3	2.7	48 36.1	+48.4	2.8	49 36.0	+48.5	2.8	87
88	43 24.7	+47.8	1.7	44 24.6	+47.9	1.7	45 24.6	+47.9	1.8	46 24.6	+47.9	1.8	47 24.6	+47.9	1.8	48 24.5	+48.0	1.9	49 24.5	+48.0	1.9	50 24.5	+48.0	1.9	88
89	44 12.5	+47.5	0.9	45 12.5	+47.5	0.9	46 12.5	+47.5	0.9	47 12.5	+47.5	0.9	48 12.5	+47.5	0.9	49 12.5	+47.5	0.9	50 12.5	+47.5	1.0	51 12.5	+47.5	1.0	89
90	45 00.0	+47.1	0.0	46 00.0	+47.1	0.0	47 00.0	+47.1	0.0	48 00.0	+47.1	0.0	49 00.0	+47.0	0.0	50 00.0	+47.0	0.0	51 00.0	+47.0	0.0	52 00.0	+47.0	0.0	90
	45°			46°			47°			48°			49°			50°			51°			52°			

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

LATITUDE SAME NAME AS DECLINATION L.H.A. 142°, 218°

Table of Increments and Corrections

	0		1		2		3		4		5		6		7		8		9		
sec	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	sec
0	0	0.0	0	15.0	0	30.0	0	45.0	1	0.0	1	15.0	1	30.0	1	45.0	2	0.0	2	15.0	0
1	0	0.3	0	15.3	0	30.3	0	45.3	1	0.3	1	15.3	1	30.3	1	45.3	2	0.3	2	15.3	1
2	0	0.5	0	15.5	0	30.5	0	45.5	1	0.5	1	15.5	1	30.5	1	45.5	2	0.5	2	15.5	2
3	0	0.8	0	15.8	0	30.8	0	45.8	1	0.8	1	15.8	1	30.8	1	45.8	2	0.8	2	15.8	3
4	0	1.0	0	16.0	0	31.0	0	46.0	1	1.0	1	16.0	1	31.0	1	46.0	2	1.0	2	16.0	4
5	0	1.3	0	16.3	0	31.3	0	46.3	1	1.3	1	16.3	1	31.3	1	46.3	2	1.3	2	16.3	5
6	0	1.5	0	16.5	0	31.5	0	46.5	1	1.5	1	16.5	1	31.5	1	46.5	2	1.5	2	16.5	6
7	0	1.8	0	16.8	0	31.8	0	46.8	1	1.8	1	16.8	1	31.8	1	46.8	2	1.8	2	16.8	7
8	0	2.0	0	17.0	0	32.0	0	47.0	1	2.0	1	17.0	1	32.0	1	47.0	2	2.0	2	17.0	8
9	0	2.3	0	17.3	0	32.3	0	47.3	1	2.3	1	17.3	1	32.3	1	47.3	2	2.3	2	17.3	9
10	0	2.5	0	17.5	0	32.5	0	47.5	1	2.5	1	17.5	1	32.5	1	47.5	2	2.5	2	17.5	10
11	0	2.8	0	17.8	0	32.8	0	47.8	1	2.8	1	17.8	1	32.8	1	47.8	2	2.8	2	17.8	11
12	0	3.0	0	18.0	0	33.0	0	48.0	1	3.0	1	18.0	1	33.0	1	48.0	2	3.0	2	18.0	12
13	0	3.3	0	18.3	0	33.3	0	48.3	1	3.3	1	18.3	1	33.3	1	48.3	2	3.3	2	18.3	13
14	0	3.5	0	18.5	0	33.5	0	48.5	1	3.5	1	18.5	1	33.5	1	48.5	2	3.5	2	18.5	14
15	0	3.8	0	18.8	0	33.8	0	48.8	1	3.8	1	18.8	1	33.8	1	48.8	2	3.8	2	18.8	15
16	0	4.0	0	19.0	0	34.0	0	49.0	1	4.0	1	19.0	1	34.0	1	49.0	2	4.0	2	19.0	16
17	0	4.3	0	19.3	0	34.3	0	49.3	1	4.3	1	19.3	1	34.3	1	49.3	2	4.3	2	19.3	17
18	0	4.5	0	19.5	0	34.5	0	49.5	1	4.5	1	19.5	1	34.5	1	49.5	2	4.5	2	19.5	18
19	0	4.8	0	19.8	0	34.8	0	49.8	1	4.8	1	19.8	1	34.8	1	49.8	2	4.8	2	19.8	19
20	0	5.0	0	20.0	0	35.0	0	50.0	1	5.0	1	20.0	1	35.0	1	50.0	2	5.0	2	20.0	20
21	0	5.3	0	20.3	0	35.3	0	50.3	1	5.3	1	20.3	1	35.3	1	50.3	2	5.3	2	20.3	21
22	0	5.5	0	20.5	0	35.5	0	50.5	1	5.5	1	20.5	1	35.5	1	50.5	2	5.5	2	20.5	22
23	0	5.8	0	20.8	0	35.8	0	50.8	1	5.8	1	20.8	1	35.8	1	50.8	2	5.8	2	20.8	23
24	0	6.0	0	21.0	0	36.0	0	51.0	1	6.0	1	21.0	1	36.0	1	51.0	2	6.0	2	21.0	24
25	0	6.3	0	21.3	0	36.3	0	51.3	1	6.3	1	21.3	1	36.3	1	51.3	2	6.3	2	21.3	25
26	0	6.5	0	21.5	0	36.5	0	51.5	1	6.5	1	21.5	1	36.5	1	51.5	2	6.5	2	21.5	26
27	0	6.8	0	21.8	0	36.8	0	51.8	1	6.8	1	21.8	1	36.8	1	51.8	2	6.8	2	21.8	27
28	0	7.0	0	22.0	0	37.0	0	52.0	1	7.0	1	22.0	1	37.0	1	52.0	2	7.0	2	22.0	28
29	0	7.3	0	22.3	0	37.3	0	52.3	1	7.3	1	22.3	1	37.3	1	52.3	2	7.3	2	22.3	29
30	0	7.5	0	22.5	0	37.5	0	52.5	1	7.5	1	22.5	1	37.5	1	52.5	2	7.5	2	22.5	30
31	0	7.8	0	22.8	0	37.8	0	52.8	1	7.8	1	22.8	1	37.8	1	52.8	2	7.8	2	22.8	31
32	0	8.0	0	23.0	0	38.0	0	53.0	1	8.0	1	23.0	1	38.0	1	53.0	2	8.0	2	23.0	32
33	0	8.3	0	23.3	0	38.3	0	53.3	1	8.3	1	23.3	1	38.3	1	53.3	2	8.3	2	23.3	33
34	0	8.5	0	23.5	0	38.5	0	53.5	1	8.5	1	23.5	1	38.5	1	53.5	2	8.5	2	23.5	34
35	0	8.8	0	23.8	0	38.8	0	53.8	1	8.8	1	23.8	1	38.8	1	53.8	2	8.8	2	23.8	35
36	0	9.0	0	24.0	0	39.0	0	54.0	1	9.0	1	24.0	1	39.0	1	54.0	2	9.0	2	24.0	36
37	0	9.3	0	24.3	0	39.3	0	54.3	1	9.3	1	24.3	1	39.3	1	54.3	2	9.3	2	24.3	37
38	0	9.5	0	24.5	0	39.5	0	54.5	1	9.5	1	24.5	1	39.5	1	54.5	2	9.5	2	24.5	38
39	0	9.8	0	24.8	0	39.8	0	54.8	1	9.8	1	24.8	1	39.8	1	54.8	2	9.8	2	24.8	39
40	0	10.0	0	25.0	0	40.0	0	55.0	1	10.0	1	25.0	1	40.0	1	55.0	2	10.0	2	25.0	40
41	0	10.3	0	25.3	0	40.3	0	55.3	1	10.3	1	25.3	1	40.3	1	55.3	2	10.3	2	25.3	41
42	0	10.5	0	25.5	0	40.5	0	55.5	1	10.5	1	25.5	1	40.5	1	55.5	2	10.5	2	25.5	42
43	0	10.8	0	25.8	0	40.8	0	55.8	1	10.8	1	25.8	1	40.8	1	55.8	2	10.8	2	25.8	43
44	0	11.0	0	26.0	0	41.0	0	56.0	1	11.0	1	26.0	1	41.0	1	56.0	2	11.0	2	26.0	44
45	0	11.3	0	26.3	0	41.3	0	56.3	1	11.3	1	26.3	1	41.3	1	56.3	2	11.3	2	26.3	45
46	0	11.5	0	26.5	0	41.5	0	56.5	1	11.5	1	26.5	1	41.5	1	56.5	2	11.5	2	26.5	46
47	0	11.8	0	26.8	0	41.8	0	56.8	1	11.8	1	26.8	1	41.8	1	56.8	2	11.8	2	26.8	47
48	0	12.0	0	27.0	0	42.0	0	57.0	1	12.0	1	27.0	1	42.0	1	57.0	2	12.0	2	27.0	48
49	0	12.3	0	27.3	0	42.3	0	57.3	1	12.3	1	27.3	1	42.3	1	57.3	2	12.3	2	27.3	49
50	0	12.5	0	27.5	0	42.5	0	57.5	1	12.5	1	27.5	1	42.5	1	57.5	2	12.5	2	27.5	50
51	0	12.8	0	27.8	0	42.8	0	57.8	1	12.8	1	27.8	1	42.8	1	57.8	2	12.8	2	27.8	51
52	0	13.0	0	28.0	0	43.0	0	58.0	1	13.0	1	28.0	1	43.0	1	58.0	2	13.0	2	28.0	52
53	0	13.3	0	28.3	0	43.3	0	58.3	1	13.3	1	28.3	1	43.3	1	58.3	2	13.3	2	28.3	53
54	0	13.5	0	28.5	0	43.5	0	58.5	1	13.5	1	28.5	1	43.5	1	58.5	2	13.5	2	28.5	54
55	0	13.8	0	28.8	0	43.8	0	58.8	1	13.8	1	28.8	1	43.8	1	58.8	2	13.8	2	28.8	55
56	0	14.0	0	29.0	0	44.0	0	59.0	1	14.0	1	29.0	1	44.0	1	59.0	2	14.0	2	29.0	56
57	0	14.3	0	29.3	0	44.3	0	59.3	1	14.3	1	29.3	1	44.3	1	59.3	2	14.3	2	29.3	57
58	0	14.5	0	29.5	0	44.5	0	59.5	1	14.5	1	29.5	1	44.5	1	59.5	2	14.5	2	29.5	58
59	0	14.8	0	29.8	0	44.8	0	59.8	1	14.8	1	29.8	1	44.8	1	59.8	2	14.8	2	29.8	59
60	0	15.0	0	30.0	0	45.0	1	0.0	1	15	1	30.0	1	45.0	2	0.0	2	15	2	30.0	60

sec	10 °	10 ′	11 °	11 ′	12 °	12 ′	13 °	13 ′	14 °	14 ′	15 °	15 ′	16 °	16 ′	17 °	17 ′	18 °	18 ′	19 °	19 ′	sec
0	2	30.0	2	45.0	3	0.0	3	15.0	3	30.0	3	45.0	4	0.0	4	15.0	4	30.0	4	45.0	0
1	2	30.3	2	45.3	3	0.3	3	15.3	3	30.3	3	45.3	4	0.3	4	15.3	4	30.3	4	45.3	1
2	2	30.5	2	45.5	3	0.5	3	15.5	3	30.5	3	45.5	4	0.5	4	15.5	4	30.5	4	45.5	2
3	2	30.8	2	45.8	3	0.8	3	15.8	3	30.8	3	45.8	4	0.8	4	15.8	4	30.8	4	45.8	3
4	2	31.0	2	46.0	3	1.0	3	16.0	3	31.0	3	46.0	4	1.0	4	16.0	4	31.0	4	46.0	4
5	2	31.3	2	46.3	3	1.3	3	16.3	3	31.3	3	46.3	4	1.3	4	16.3	4	31.3	4	46.3	5
6	2	31.5	2	46.5	3	1.5	3	16.5	3	31.5	3	46.5	4	1.5	4	16.5	4	31.5	4	46.5	6
7	2	31.8	2	46.8	3	1.8	3	16.8	3	31.8	3	46.8	4	1.8	4	16.8	4	31.8	4	46.8	7
8	2	32.0	2	47.0	3	2.0	3	17.0	3	32.0	3	47.0	4	2.0	4	17.0	4	32.0	4	47.0	8
9	2	32.3	2	47.3	3	2.3	3	17.3	3	32.3	3	47.3	4	2.3	4	17.3	4	32.3	4	47.3	9
10	2	32.5	2	47.5	3	2.5	3	17.5	3	32.5	3	47.5	4	2.5	4	17.5	4	32.5	4	47.5	10
11	2	32.8	2	47.8	3	2.8	3	17.8	3	32.8	3	47.8	4	2.8	4	17.8	4	32.8	4	47.8	11
12	2	33.0	2	48.0	3	3.0	3	18.0	3	33.0	3	48.0	4	3.0	4	18.0	4	33.0	4	48.0	12
13	2	33.3	2	48.3	3	3.3	3	18.3	3	33.3	3	48.3	4	3.3	4	18.3	4	33.3	4	48.3	13
14	2	33.5	2	48.5	3	3.5	3	18.5	3	33.5	3	48.5	4	3.5	4	18.5	4	33.5	4	48.5	14
15	2	33.8	2	48.8	3	3.8	3	18.8	3	33.8	3	48.8	4	3.8	4	18.8	4	33.8	4	48.8	15
16	2	34.0	2	49.0	3	4.0	3	19.0	3	34.0	3	49.0	4	4.0	4	19.0	4	34.0	4	49.0	16
17	2	34.3	2	49.3	3	4.3	3	19.3	3	34.3	3	49.3	4	4.3	4	19.3	4	34.3	4	49.3	17
18	2	34.5	2	49.5	3	4.5	3	19.5	3	34.5	3	49.5	4	4.5	4	19.5	4	34.5	4	49.5	18
19	2	34.8	2	49.8	3	4.8	3	19.8	3	34.8	3	49.8	4	4.8	4	19.8	4	34.8	4	49.8	19
20	2	35.0	2	50.0	3	5.0	3	20.0	3	35.0	3	50.0	4	5.0	4	20.0	4	35.0	4	50.0	20
21	2	35.3	2	50.3	3	5.3	3	20.3	3	35.3	3	50.3	4	5.3	4	20.3	4	35.3	4	50.3	21
22	2	35.5	2	50.5	3	5.5	3	20.5	3	35.5	3	50.5	4	5.5	4	20.5	4	35.5	4	50.5	22
23	2	35.8	2	50.8	3	5.8	3	20.8	3	35.8	3	50.8	4	5.8	4	20.8	4	35.8	4	50.8	23
24	2	36.0	2	51.0	3	6.0	3	21.0	3	36.0	3	51.0	4	6.0	4	21.0	4	36.0	4	51.0	24
25	2	36.3	2	51.3	3	6.3	3	21.3	3	36.3	3	51.3	4	6.3	4	21.3	4	36.3	4	51.3	25
26	2	36.5	2	51.5	3	6.5	3	21.5	3	36.5	3	51.5	4	6.5	4	21.5	4	36.5	4	51.5	26
27	2	36.8	2	51.8	3	6.8	3	21.8	3	36.8	3	51.8	4	6.8	4	21.8	4	36.8	4	51.8	27
28	2	37.0	2	52.0	3	7.0	3	22.0	3	37.0	3	52.0	4	7.0	4	22.0	4	37.0	4	52.0	28
29	2	37.3	2	52.3	3	7.3	3	22.3	3	37.3	3	52.3	4	7.3	4	22.3	4	37.3	4	52.3	29
30	2	37.5	2	52.5	3	7.5	3	22.5	3	37.5	3	52.5	4	7.5	4	22.5	4	37.5	4	52.5	30
31	2	37.8	2	52.8	3	7.8	3	22.8	3	37.8	3	52.8	4	7.8	4	22.8	4	37.8	4	52.8	31
32	2	38.0	2	53.0	3	8.0	3	23.0	3	38.0	3	53.0	4	8.0	4	23.0	4	38.0	4	53.0	32
33	2	38.3	2	53.3	3	8.3	3	23.3	3	38.3	3	53.3	4	8.3	4	23.3	4	38.3	4	53.3	33
34	2	38.5	2	53.5	3	8.5	3	23.5	3	38.5	3	53.5	4	8.5	4	23.5	4	38.5	4	53.5	34
35	2	38.8	2	53.8	3	8.8	3	23.8	3	38.8	3	53.8	4	8.8	4	23.8	4	38.8	4	53.8	35
36	2	39.0	2	54.0	3	9.0	3	24.0	3	39.0	3	54.0	4	9.0	4	24.0	4	39.0	4	54.0	36
37	2	39.3	2	54.3	3	9.3	3	24.3	3	39.3	3	54.3	4	9.3	4	24.3	4	39.3	4	54.3	37
38	2	39.5	2	54.5	3	9.5	3	24.5	3	39.5	3	54.5	4	9.5	4	24.5	4	39.5	4	54.5	38
39	2	39.8	2	54.8	3	9.8	3	24.8	3	39.8	3	54.8	4	9.8	4	24.8	4	39.8	4	54.8	39
40	2	40.0	2	55.0	3	10.0	3	25.0	3	40.0	3	55.0	4	10.0	4	25.0	4	40.0	4	55.0	40
41	2	40.3	2	55.3	3	10.3	3	25.3	3	40.3	3	55.3	4	10.3	4	25.3	4	40.3	4	55.3	41
42	2	40.5	2	55.5	3	10.5	3	25.5	3	40.5	3	55.5	4	10.5	4	25.5	4	40.5	4	55.5	42
43	2	40.8	2	55.8	3	10.8	3	25.8	3	40.8	3	55.8	4	10.8	4	25.8	4	40.8	4	55.8	43
44	2	41.0	2	56.0	3	11.0	3	26.0	3	41.0	3	56.0	4	11.0	4	26.0	4	41.0	4	56.0	44
45	2	41.3	2	56.3	3	11.3	3	26.3	3	41.3	3	56.3	4	11.3	4	26.3	4	41.3	4	56.3	45
46	2	41.5	2	56.5	3	11.5	3	26.5	3	41.5	3	56.5	4	11.5	4	26.5	4	41.5	4	56.5	46
47	2	41.8	2	56.8	3	11.8	3	26.8	3	41.8	3	56.8	4	11.8	4	26.8	4	41.8	4	56.8	47
48	2	42.0	2	57.0	3	12.0	3	27.0	3	42.0	3	57.0	4	12.0	4	27.0	4	42.0	4	57.0	48
49	2	42.3	2	57.3	3	12.3	3	27.3	3	42.3	3	57.3	4	12.3	4	27.3	4	42.3	4	57.3	49
50	2	42.5	2	57.5	3	12.5	3	27.5	3	42.5	3	57.5	4	12.5	4	27.5	4	42.5	4	57.5	50
51	2	42.8	2	57.8	3	12.8	3	27.8	3	42.8	3	57.8	4	12.8	4	27.8	4	42.8	4	57.8	51
52	2	43.0	2	58.0	3	13.0	3	28.0	3	43.0	3	58.0	4	13.0	4	28.0	4	43.0	4	58.0	52
53	2	43.3	2	58.3	3	13.3	3	28.3	3	43.3	3	58.3	4	13.3	4	28.3	4	43.3	4	58.3	53
54	2	43.5	2	58.5	3	13.5	3	28.5	3	43.5	3	58.5	4	13.5	4	28.5	4	43.5	4	58.5	54
55	2	43.8	2	58.8	3	13.8	3	28.8	3	43.8	3	58.8	4	13.8	4	28.8	4	43.8	4	58.8	55
56	2	44.0	2	59.0	3	14.0	3	29.0	3	44.0	3	59.0	4	14.0	4	29.0	4	44.0	4	59.0	56
57	2	44.3	2	59.3	3	14.3	3	29.3	3	44.3	3	59.3	4	14.3	4	29.3	4	44.3	4	59.3	57
58	2	44.5	2	59.5	3	14.5	3	29.5	3	44.5	3	59.5	4	14.5	4	29.5	4	44.5	4	59.5	58
59	2	44.8	2	59.8	3	14.8	3	29.8	3	44.8	3	59.8	4	14.8	4	29.8	4	44.8	4	59.8	59
60	2	45.0	3	0.0	3	15	3	30.0	3	45.0	4	0.0	4	15	4	30.0	4	45.0	5	0.0	60

	20		21		22		23		24		25		26		27		28		29		
sec	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	sec
0	5	0.0	5	15.0	5	30.0	5	45.0	6	0.0	6	15.0	6	30.0	6	45.0	7	0.0	7	15.0	0
1	5	0.3	5	15.3	5	30.3	5	45.3	6	0.3	6	15.3	6	30.3	6	45.3	7	0.3	7	15.3	1
2	5	0.5	5	15.5	5	30.5	5	45.5	6	0.5	6	15.5	6	30.5	6	45.5	7	0.5	7	15.5	2
3	5	0.8	5	15.8	5	30.8	5	45.8	6	0.8	6	15.8	6	30.8	6	45.8	7	0.8	7	15.8	3
4	5	1.0	5	16.0	5	31.0	5	46.0	6	1.0	6	16.0	6	31.0	6	46.0	7	1.0	7	16.0	4
5	5	1.3	5	16.3	5	31.3	5	46.3	6	1.3	6	16.3	6	31.3	6	46.3	7	1.3	7	16.3	5
6	5	1.5	5	16.5	5	31.5	5	46.5	6	1.5	6	16.5	6	31.5	6	46.5	7	1.5	7	16.5	6
7	5	1.8	5	16.8	5	31.8	5	46.8	6	1.8	6	16.8	6	31.8	6	46.8	7	1.8	7	16.8	7
8	5	2.0	5	17.0	5	32.0	5	47.0	6	2.0	6	17.0	6	32.0	6	47.0	7	2.0	7	17.0	8
9	5	2.3	5	17.3	5	32.3	5	47.3	6	2.3	6	17.3	6	32.3	6	47.3	7	2.3	7	17.3	9
10	5	2.5	5	17.5	5	32.5	5	47.5	6	2.5	6	17.5	6	32.5	6	47.5	7	2.5	7	17.5	10
11	5	2.8	5	17.8	5	32.8	5	47.8	6	2.8	6	17.8	6	32.8	6	47.8	7	2.8	7	17.8	11
12	5	3.0	5	18.0	5	33.0	5	48.0	6	3.0	6	18.0	6	33.0	6	48.0	7	3.0	7	18.0	12
13	5	3.3	5	18.3	5	33.3	5	48.3	6	3.3	6	18.3	6	33.3	6	48.3	7	3.3	7	18.3	13
14	5	3.5	5	18.5	5	33.5	5	48.5	6	3.5	6	18.5	6	33.5	6	48.5	7	3.5	7	18.5	14
15	5	3.8	5	18.8	5	33.8	5	48.8	6	3.8	6	18.8	6	33.8	6	48.8	7	3.8	7	18.8	15
16	5	4.0	5	19.0	5	34.0	5	49.0	6	4.0	6	19.0	6	34.0	6	49.0	7	4.0	7	19.0	16
17	5	4.3	5	19.3	5	34.3	5	49.3	6	4.3	6	19.3	6	34.3	6	49.3	7	4.3	7	19.3	17
18	5	4.5	5	19.5	5	34.5	5	49.5	6	4.5	6	19.5	6	34.5	6	49.5	7	4.5	7	19.5	18
19	5	4.8	5	19.8	5	34.8	5	49.8	6	4.8	6	19.8	6	34.8	6	49.8	7	4.8	7	19.8	19
20	5	5.0	5	20.0	5	35.0	5	50.0	6	5.0	6	20.0	6	35.0	6	50.0	7	5.0	7	20.0	20
21	5	5.3	5	20.3	5	35.3	5	50.3	6	5.3	6	20.3	6	35.3	6	50.3	7	5.3	7	20.3	21
22	5	5.5	5	20.5	5	35.5	5	50.5	6	5.5	6	20.5	6	35.5	6	50.5	7	5.5	7	20.5	22
23	5	5.8	5	20.8	5	35.8	5	50.8	6	5.8	6	20.8	6	35.8	6	50.8	7	5.8	7	20.8	23
24	5	6.0	5	21.0	5	36.0	5	51.0	6	6.0	6	21.0	6	36.0	6	51.0	7	6.0	7	21.0	24
25	5	6.3	5	21.3	5	36.3	5	51.3	6	6.3	6	21.3	6	36.3	6	51.3	7	6.3	7	21.3	25
26	5	6.5	5	21.5	5	36.5	5	51.5	6	6.5	6	21.5	6	36.5	6	51.5	7	6.5	7	21.5	26
27	5	6.8	5	21.8	5	36.8	5	51.8	6	6.8	6	21.8	6	36.8	6	51.8	7	6.8	7	21.8	27
28	5	7.0	5	22.0	5	37.0	5	52.0	6	7.0	6	22.0	6	37.0	6	52.0	7	7.0	7	22.0	28
29	5	7.3	5	22.3	5	37.3	5	52.3	6	7.3	6	22.3	6	37.3	6	52.3	7	7.3	7	22.3	29
30	5	7.5	5	22.5	5	37.5	5	52.5	6	7.5	6	22.5	6	37.5	6	52.5	7	7.5	7	22.5	30
31	5	7.8	5	22.8	5	37.8	5	52.8	6	7.8	6	22.8	6	37.8	6	52.8	7	7.8	7	22.8	31
32	5	8.0	5	23.0	5	38.0	5	53.0	6	8.0	6	23.0	6	38.0	6	53.0	7	8.0	7	23.0	32
33	5	8.3	5	23.3	5	38.3	5	53.3	6	8.3	6	23.3	6	38.3	6	53.3	7	8.3	7	23.3	33
34	5	8.5	5	23.5	5	38.5	5	53.5	6	8.5	6	23.5	6	38.5	6	53.5	7	8.5	7	23.5	34
35	5	8.8	5	23.8	5	38.8	5	53.8	6	8.8	6	23.8	6	38.8	6	53.8	7	8.8	7	23.8	35
36	5	9.0	5	24.0	5	39.0	5	54.0	6	9.0	6	24.0	6	39.0	6	54.0	7	9.0	7	24.0	36
37	5	9.3	5	24.3	5	39.3	5	54.3	6	9.3	6	24.3	6	39.3	6	54.3	7	9.3	7	24.3	37
38	5	9.5	5	24.5	5	39.5	5	54.5	6	9.5	6	24.5	6	39.5	6	54.5	7	9.5	7	24.5	38
39	5	9.8	5	24.8	5	39.8	5	54.8	6	9.8	6	24.8	6	39.8	6	54.8	7	9.8	7	24.8	39
40	5	10.0	5	25.0	5	40.0	5	55.0	6	10.0	6	25.0	6	40.0	6	55.0	7	10.0	7	25.0	40
41	5	10.3	5	25.3	5	40.3	5	55.3	6	10.3	6	25.3	6	40.3	6	55.3	7	10.3	7	25.3	41
42	5	10.5	5	25.5	5	40.5	5	55.5	6	10.5	6	25.5	6	40.5	6	55.5	7	10.5	7	25.5	42
43	5	10.8	5	25.8	5	40.8	5	55.8	6	10.8	6	25.8	6	40.8	6	55.8	7	10.8	7	25.8	43
44	5	11.0	5	26.0	5	41.0	5	56.0	6	11.0	6	26.0	6	41.0	6	56.0	7	11.0	7	26.0	44
45	5	11.3	5	26.3	5	41.3	5	56.3	6	11.3	6	26.3	6	41.3	6	56.3	7	11.3	7	26.3	45
46	5	11.5	5	26.5	5	41.5	5	56.5	6	11.5	6	26.5	6	41.5	6	56.5	7	11.5	7	26.5	46
47	5	11.8	5	26.8	5	41.8	5	56.8	6	11.8	6	26.8	6	41.8	6	56.8	7	11.8	7	26.8	47
48	5	12.0	5	27.0	5	42.0	5	57.0	6	12.0	6	27.0	6	42.0	6	57.0	7	12.0	7	27.0	48
49	5	12.3	5	27.3	5	42.3	5	57.3	6	12.3	6	27.3	6	42.3	6	57.3	7	12.3	7	27.3	49
50	5	12.5	5	27.5	5	42.5	5	57.5	6	12.5	6	27.5	6	42.5	6	57.5	7	12.5	7	27.5	50
51	5	12.8	5	27.8	5	42.8	5	57.8	6	12.8	6	27.8	6	42.8	6	57.8	7	12.8	7	27.8	51
52	5	13.0	5	28.0	5	43.0	5	58.0	6	13.0	6	28.0	6	43.0	6	58.0	7	13.0	7	28.0	52
53	5	13.3	5	28.3	5	43.3	5	58.3	6	13.3	6	28.3	6	43.3	6	58.3	7	13.3	7	28.3	53
54	5	13.5	5	28.5	5	43.5	5	58.5	6	13.5	6	28.5	6	43.5	6	58.5	7	13.5	7	28.5	54
55	5	13.8	5	28.8	5	43.8	5	58.8	6	13.8	6	28.8	6	43.8	6	58.8	7	13.8	7	28.8	55
56	5	14.0	5	29.0	5	44.0	5	59.0	6	14.0	6	29.0	6	44.0	6	59.0	7	14.0	7	29.0	56
57	5	14.3	5	29.3	5	44.3	5	59.3	6	14.3	6	29.3	6	44.3	6	59.3	7	14.3	7	29.3	57
58	5	14.5	5	29.5	5	44.5	5	59.5	6	14.5	6	29.5	6	44.5	6	59.5	7	14.5	7	29.5	58
59	5	14.8	5	29.8	5	44.8	5	59.8	6	14.8	6	29.8	6	44.8	6	59.8	7	14.8	7	29.8	59
60	5	15	5	30.0	5	45.0	6	0.0	6	15	6	30.0	6	45.0	7	0.0	7	15	7	30.0	60

	30		31		32		33		34		35		36		37		38		39		
sec	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	sec
0	7	30.0	7	45.0	8	0.0	8	15.0	8	30.0	8	45.0	9	0.0	9	15.0	9	30.0	9	45.0	0
1	7	30.3	7	45.3	8	0.3	8	15.3	8	30.3	8	45.3	9	0.3	9	15.3	9	30.3	9	45.3	1
2	7	30.5	7	45.5	8	0.5	8	15.5	8	30.5	8	45.5	9	0.5	9	15.5	9	30.5	9	45.5	2
3	7	30.8	7	45.8	8	0.8	8	15.8	8	30.8	8	45.8	9	0.8	9	15.8	9	30.8	9	45.8	3
4	7	31.0	7	46.0	8	1.0	8	16.0	8	31.0	8	46.0	9	1.0	9	16.0	9	31.0	9	46.0	4
5	7	31.3	7	46.3	8	1.3	8	16.3	8	31.3	8	46.3	9	1.3	9	16.3	9	31.3	9	46.3	5
6	7	31.5	7	46.5	8	1.5	8	16.5	8	31.5	8	46.5	9	1.5	9	16.5	9	31.5	9	46.5	6
7	7	31.8	7	46.8	8	1.8	8	16.8	8	31.8	8	46.8	9	1.8	9	16.8	9	31.8	9	46.8	7
8	7	32.0	7	47.0	8	2.0	8	17.0	8	32.0	8	47.0	9	2.0	9	17.0	9	32.0	9	47.0	8
9	7	32.3	7	47.3	8	2.3	8	17.3	8	32.3	8	47.3	9	2.3	9	17.3	9	32.3	9	47.3	9
10	7	32.5	7	47.5	8	2.5	8	17.5	8	32.5	8	47.5	9	2.5	9	17.5	9	32.5	9	47.5	10
11	7	32.8	7	47.8	8	2.8	8	17.8	8	32.8	8	47.8	9	2.8	9	17.8	9	32.8	9	47.8	11
12	7	33.0	7	48.0	8	3.0	8	18.0	8	33.0	8	48.0	9	3.0	9	18.0	9	33.0	9	48.0	12
13	7	33.3	7	48.3	8	3.3	8	18.3	8	33.3	8	48.3	9	3.3	9	18.3	9	33.3	9	48.3	13
14	7	33.5	7	48.5	8	3.5	8	18.5	8	33.5	8	48.5	9	3.5	9	18.5	9	33.5	9	48.5	14
15	7	33.8	7	48.8	8	3.8	8	18.8	8	33.8	8	48.8	9	3.8	9	18.8	9	33.8	9	48.8	15
16	7	34.0	7	49.0	8	4.0	8	19.0	8	34.0	8	49.0	9	4.0	9	19.0	9	34.0	9	49.0	16
17	7	34.3	7	49.3	8	4.3	8	19.3	8	34.3	8	49.3	9	4.3	9	19.3	9	34.3	9	49.3	17
18	7	34.5	7	49.5	8	4.5	8	19.5	8	34.5	8	49.5	9	4.5	9	19.5	9	34.5	9	49.5	18
19	7	34.8	7	49.8	8	4.8	8	19.8	8	34.8	8	49.8	9	4.8	9	19.8	9	34.8	9	49.8	19
20	7	35.0	7	50.0	8	5.0	8	20.0	8	35.0	8	50.0	9	5.0	9	20.0	9	35.0	9	50.0	20
21	7	35.3	7	50.3	8	5.3	8	20.3	8	35.3	8	50.3	9	5.3	9	20.3	9	35.3	9	50.3	21
22	7	35.5	7	50.5	8	5.5	8	20.5	8	35.5	8	50.5	9	5.5	9	20.5	9	35.5	9	50.5	22
23	7	35.8	7	50.8	8	5.8	8	20.8	8	35.8	8	50.8	9	5.8	9	20.8	9	35.8	9	50.8	23
24	7	36.0	7	51.0	8	6.0	8	21.0	8	36.0	8	51.0	9	6.0	9	21.0	9	36.0	9	51.0	24
25	7	36.3	7	51.3	8	6.3	8	21.3	8	36.3	8	51.3	9	6.3	9	21.3	9	36.3	9	51.3	25
26	7	36.5	7	51.5	8	6.5	8	21.5	8	36.5	8	51.5	9	6.5	9	21.5	9	36.5	9	51.5	26
27	7	36.8	7	51.8	8	6.8	8	21.8	8	36.8	8	51.8	9	6.8	9	21.8	9	36.8	9	51.8	27
28	7	37.0	7	52.0	8	7.0	8	22.0	8	37.0	8	52.0	9	7.0	9	22.0	9	37.0	9	52.0	28
29	7	37.3	7	52.3	8	7.3	8	22.3	8	37.3	8	52.3	9	7.3	9	22.3	9	37.3	9	52.3	29
30	7	37.5	7	52.5	8	7.5	8	22.5	8	37.5	8	52.5	9	7.5	9	22.5	9	37.5	9	52.5	30
31	7	37.8	7	52.8	8	7.8	8	22.8	8	37.8	8	52.8	9	7.8	9	22.8	9	37.8	9	52.8	31
32	7	38.0	7	53.0	8	8.0	8	23.0	8	38.0	8	53.0	9	8.0	9	23.0	9	38.0	9	53.0	32
33	7	38.3	7	53.3	8	8.3	8	23.3	8	38.3	8	53.3	9	8.3	9	23.3	9	38.3	9	53.3	33
34	7	38.5	7	53.5	8	8.5	8	23.5	8	38.5	8	53.5	9	8.5	9	23.5	9	38.5	9	53.5	34
35	7	38.8	7	53.8	8	8.8	8	23.8	8	38.8	8	53.8	9	8.8	9	23.8	9	38.8	9	53.8	35
36	7	39.0	7	54.0	8	9.0	8	24.0	8	39.0	8	54.0	9	9.0	9	24.0	9	39.0	9	54.0	36
37	7	39.3	7	54.3	8	9.3	8	24.3	8	39.3	8	54.3	9	9.3	9	24.3	9	39.3	9	54.3	37
38	7	39.5	7	54.5	8	9.5	8	24.5	8	39.5	8	54.5	9	9.5	9	24.5	9	39.5	9	54.5	38
39	7	39.8	7	54.8	8	9.8	8	24.8	8	39.8	8	54.8	9	9.8	9	24.8	9	39.8	9	54.8	39
40	7	40.0	7	55.0	8	10.0	8	25.0	8	40.0	8	55.0	9	10.0	9	25.0	9	40.0	9	55.0	40
41	7	40.3	7	55.3	8	10.3	8	25.3	8	40.3	8	55.3	9	10.3	9	25.3	9	40.3	9	55.3	41
42	7	40.5	7	55.5	8	10.5	8	25.5	8	40.5	8	55.5	9	10.5	9	25.5	9	40.5	9	55.5	42
43	7	40.8	7	55.8	8	10.8	8	25.8	8	40.8	8	55.8	9	10.8	9	25.8	9	40.8	9	55.8	43
44	7	41.0	7	56.0	8	11.0	8	26.0	8	41.0	8	56.0	9	11.0	9	26.0	9	41.0	9	56.0	44
45	7	41.3	7	56.3	8	11.3	8	26.3	8	41.3	8	56.3	9	11.3	9	26.3	9	41.3	9	56.3	45
46	7	41.5	7	56.5	8	11.5	8	26.5	8	41.5	8	56.5	9	11.5	9	26.5	9	41.5	9	56.5	46
47	7	41.8	7	56.8	8	11.8	8	26.8	8	41.8	8	56.8	9	11.8	9	26.8	9	41.8	9	56.8	47
48	7	42.0	7	57.0	8	12.0	8	27.0	8	42.0	8	57.0	9	12.0	9	27.0	9	42.0	9	57.0	48
49	7	42.3	7	57.3	8	12.3	8	27.3	8	42.3	8	57.3	9	12.3	9	27.3	9	42.3	9	57.3	49
50	7	42.5	7	57.5	8	12.5	8	27.5	8	42.5	8	57.5	9	12.5	9	27.5	9	42.5	9	57.5	50
51	7	42.8	7	57.8	8	12.8	8	27.8	8	42.8	8	57.8	9	12.8	9	27.8	9	42.8	9	57.8	51
52	7	43.0	7	58.0	8	13.0	8	28.0	8	43.0	8	58.0	9	13.0	9	28.0	9	43.0	9	58.0	52
53	7	43.3	7	58.3	8	13.3	8	28.3	8	43.3	8	58.3	9	13.3	9	28.3	9	43.3	9	58.3	53
54	7	43.5	7	58.5	8	13.5	8	28.5	8	43.5	8	58.5	9	13.5	9	28.5	9	43.5	9	58.5	54
55	7	43.8	7	58.8	8	13.8	8	28.8	8	43.8	8	58.8	9	13.8	9	28.8	9	43.8	9	58.8	55
56	7	44.0	7	59.0	8	14.0	8	29.0	8	44.0	8	59.0	9	14.0	9	29.0	9	44.0	9	59.0	56
57	7	44.3	7	59.3	8	14.3	8	29.3	8	44.3	8	59.3	9	14.3	9	29.3	9	44.3	9	59.3	57
58	7	44.5	7	59.5	8	14.5	8	29.5	8	44.5	8	59.5	9	14.5	9	29.5	9	44.5	9	59.5	58
59	7	44.8	7	59.8	8	14.8	8	29.8	8	44.8	8	59.8	9	14.8	9	29.8	9	44.8	9	59.8	59
60	7	45.0	8	0.0	8	15	8	30.0	8	45.0	9	0.0	9	15	9	30.0	9	45.0	10	0.0	60

	40		41		42		43		44		45		46		47		48		49		
sec	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	o	'	sec
0	10	0.0	10	15.0	10	30.0	10	45.0	11	0.0	11	15.0	11	30.0	11	45.0	12	0.0	12	15.0	0
1	10	0.3	10	15.3	10	30.3	10	45.3	11	0.3	11	15.3	11	30.3	11	45.3	12	0.3	12	15.3	1
2	10	0.5	10	15.5	10	30.5	10	45.5	11	0.5	11	15.5	11	30.5	11	45.5	12	0.5	12	15.5	2
3	10	0.8	10	15.8	10	30.8	10	45.8	11	0.8	11	15.8	11	30.8	11	45.8	12	0.8	12	15.8	3
4	10	1.0	10	16.0	10	31.0	10	46.0	11	1.0	11	16.0	11	31.0	11	46.0	12	1.0	12	16.0	4
5	10	1.3	10	16.3	10	31.3	10	46.3	11	1.3	11	16.3	11	31.3	11	46.3	12	1.3	12	16.3	5
6	10	1.5	10	16.5	10	31.5	10	46.5	11	1.5	11	16.5	11	31.5	11	46.5	12	1.5	12	16.5	6
7	10	1.8	10	16.8	10	31.8	10	46.8	11	1.8	11	16.8	11	31.8	11	46.8	12	1.8	12	16.8	7
8	10	2.0	10	17.0	10	32.0	10	47.0	11	2.0	11	17.0	11	32.0	11	47.0	12	2.0	12	17.0	8
9	10	2.3	10	17.3	10	32.3	10	47.3	11	2.3	11	17.3	11	32.3	11	47.3	12	2.3	12	17.3	9
10	10	2.5	10	17.5	10	32.5	10	47.5	11	2.5	11	17.5	11	32.5	11	47.5	12	2.5	12	17.5	10
11	10	2.8	10	17.8	10	32.8	10	47.8	11	2.8	11	17.8	11	32.8	11	47.8	12	2.8	12	17.8	11
12	10	3.0	10	18.0	10	33.0	10	48.0	11	3.0	11	18.0	11	33.0	11	48.0	12	3.0	12	18.0	12
13	10	3.3	10	18.3	10	33.3	10	48.3	11	3.3	11	18.3	11	33.3	11	48.3	12	3.3	12	18.3	13
14	10	3.5	10	18.5	10	33.5	10	48.5	11	3.5	11	18.5	11	33.5	11	48.5	12	3.5	12	18.5	14
15	10	3.8	10	18.8	10	33.8	10	48.8	11	3.8	11	18.8	11	33.8	11	48.8	12	3.8	12	18.8	15
16	10	4.0	10	19.0	10	34.0	10	49.0	11	4.0	11	19.0	11	34.0	11	49.0	12	4.0	12	19.0	16
17	10	4.3	10	19.3	10	34.3	10	49.3	11	4.3	11	19.3	11	34.3	11	49.3	12	4.3	12	19.3	17
18	10	4.5	10	19.5	10	34.5	10	49.5	11	4.5	11	19.5	11	34.5	11	49.5	12	4.5	12	19.5	18
19	10	4.8	10	19.8	10	34.8	10	49.8	11	4.8	11	19.8	11	34.8	11	49.8	12	4.8	12	19.8	19
20	10	5.0	10	20.0	10	35.0	10	50.0	11	5.0	11	20.0	11	35.0	11	50.0	12	5.0	12	20.0	20
21	10	5.3	10	20.3	10	35.3	10	50.3	11	5.3	11	20.3	11	35.3	11	50.3	12	5.3	12	20.3	21
22	10	5.5	10	20.5	10	35.5	10	50.5	11	5.5	11	20.5	11	35.5	11	50.5	12	5.5	12	20.5	22
23	10	5.8	10	20.8	10	35.8	10	50.8	11	5.8	11	20.8	11	35.8	11	50.8	12	5.8	12	20.8	23
24	10	6.0	10	21.0	10	36.0	10	51.0	11	6.0	11	21.0	11	36.0	11	51.0	12	6.0	12	21.0	24
25	10	6.3	10	21.3	10	36.3	10	51.3	11	6.3	11	21.3	11	36.3	11	51.3	12	6.3	12	21.3	25
26	10	6.5	10	21.5	10	36.5	10	51.5	11	6.5	11	21.5	11	36.5	11	51.5	12	6.5	12	21.5	26
27	10	6.8	10	21.8	10	36.8	10	51.8	11	6.8	11	21.8	11	36.8	11	51.8	12	6.8	12	21.8	27
28	10	7.0	10	22.0	10	37.0	10	52.0	11	7.0	11	22.0	11	37.0	11	52.0	12	7.0	12	22.0	28
29	10	7.3	10	22.3	10	37.3	10	52.3	11	7.3	11	22.3	11	37.3	11	52.3	12	7.3	12	22.3	29
30	10	7.5	10	22.5	10	37.5	10	52.5	11	7.5	11	22.5	11	37.5	11	52.5	12	7.5	12	22.5	30
31	10	7.8	10	22.8	10	37.8	10	52.8	11	7.8	11	22.8	11	37.8	11	52.8	12	7.8	12	22.8	31
32	10	8.0	10	23.0	10	38.0	10	53.0	11	8.0	11	23.0	11	38.0	11	53.0	12	8.0	12	23.0	32
33	10	8.3	10	23.3	10	38.3	10	53.3	11	8.3	11	23.3	11	38.3	11	53.3	12	8.3	12	23.3	33
34	10	8.5	10	23.5	10	38.5	10	53.5	11	8.5	11	23.5	11	38.5	11	53.5	12	8.5	12	23.5	34
35	10	8.8	10	23.8	10	38.8	10	53.8	11	8.8	11	23.8	11	38.8	11	53.8	12	8.8	12	23.8	35
36	10	9.0	10	24.0	10	39.0	10	54.0	11	9.0	11	24.0	11	39.0	11	54.0	12	9.0	12	24.0	36
37	10	9.3	10	24.3	10	39.3	10	54.3	11	9.3	11	24.3	11	39.3	11	54.3	12	9.3	12	24.3	37
38	10	9.5	10	24.5	10	39.5	10	54.5	11	9.5	11	24.5	11	39.5	11	54.5	12	9.5	12	24.5	38
39	10	9.8	10	24.8	10	39.8	10	54.8	11	9.8	11	24.8	11	39.8	11	54.8	12	9.8	12	24.8	39
40	10	10.0	10	25.0	10	40.0	10	55.0	11	10.0	11	25.0	11	40.0	11	55.0	12	10.0	12	25.0	40
41	10	10.3	10	25.3	10	40.3	10	55.3	11	10.3	11	25.3	11	40.3	11	55.3	12	10.3	12	25.3	41
42	10	10.5	10	25.5	10	40.5	10	55.5	11	10.5	11	25.5	11	40.5	11	55.5	12	10.5	12	25.5	42
43	10	10.8	10	25.8	10	40.8	10	55.8	11	10.8	11	25.8	11	40.8	11	55.8	12	10.8	12	25.8	43
44	10	11.0	10	26.0	10	41.0	10	56.0	11	11.0	11	26.0	11	41.0	11	56.0	12	11.0	12	26.0	44
45	10	11.3	10	26.3	10	41.3	10	56.3	11	11.3	11	26.3	11	41.3	11	56.3	12	11.3	12	26.3	45
46	10	11.5	10	26.5	10	41.5	10	56.5	11	11.5	11	26.5	11	41.5	11	56.5	12	11.5	12	26.5	46
47	10	11.8	10	26.8	10	41.8	10	56.8	11	11.8	11	26.8	11	41.8	11	56.8	12	11.8	12	26.8	47
48	10	12.0	10	27.0	10	42.0	10	57.0	11	12.0	11	27.0	11	42.0	11	57.0	12	12.0	12	27.0	48
49	10	12.3	10	27.3	10	42.3	10	57.3	11	12.3	11	27.3	11	42.3	11	57.3	12	12.3	12	27.3	49
50	10	12.5	10	27.5	10	42.5	10	57.5	11	12.5	11	27.5	11	42.5	11	57.5	12	12.5	12	27.5	50
51	10	12.8	10	27.8	10	42.8	10	57.8	11	12.8	11	27.8	11	42.8	11	57.8	12	12.8	12	27.8	51
52	10	13.0	10	28.0	10	43.0	10	58.0	11	13.0	11	28.0	11	43.0	11	58.0	12	13.0	12	28.0	52
53	10	13.3	10	28.3	10	43.3	10	58.3	11	13.3	11	28.3	11	43.3	11	58.3	12	13.3	12	28.3	53
54	10	13.5	10	28.5	10	43.5	10	58.5	11	13.5	11	28.5	11	43.5	11	58.5	12	13.5	12	28.5	54
55	10	13.8	10	28.8	10	43.8	10	58.8	11	13.8	11	28.8	11	43.8	11	58.8	12	13.8	12	28.8	55
56	10	14.0	10	29.0	10	44.0	10	59.0	11	14.0	11	29.0	11	44.0	11	59.0	12	14.0	12	29.0	56
57	10	14.3	10	29.3	10	44.3	10	59.3	11	14.3	11	29.3	11	44.3	11	59.3	12	14.3	12	29.3	57
58	10	14.5	10	29.5	10	44.5	10	59.5	11	14.5	11	29.5	11	44.5	11	59.5	12	14.5	12	29.5	58
59	10	14.8	10	29.8	10	44.8	10	59.8	11	14.8	11	29.8	11	44.8	11	59.8	12	14.8	12	29.8	59
60	10	15	10	30.0	10	45.0	11	0.0	11	15	11	30.0	11	45.0	12	0.0	12	15	12	30.0	60

sec	50		51		52		53		54		55		56		57		58		59		sec
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	
0	12	30.0	12	45.0	13	0.0	13	15.0	13	30.0	13	45.0	14	0.0	14	15.0	14	30.0	14	45.0	0
1	12	30.3	12	45.3	13	0.3	13	15.3	13	30.3	13	45.3	14	0.3	14	15.3	14	30.3	14	45.3	1
2	12	30.5	12	45.5	13	0.5	13	15.5	13	30.5	13	45.5	14	0.5	14	15.5	14	30.5	14	45.5	2
3	12	30.8	12	45.8	13	0.8	13	15.8	13	30.8	13	45.8	14	0.8	14	15.8	14	30.8	14	45.8	3
4	12	31.0	12	46.0	13	1.0	13	16.0	13	31.0	13	46.0	14	1.0	14	16.0	14	31.0	14	46.0	4
5	12	31.3	12	46.3	13	1.3	13	16.3	13	31.3	13	46.3	14	1.3	14	16.3	14	31.3	14	46.3	5
6	12	31.5	12	46.5	13	1.5	13	16.5	13	31.5	13	46.5	14	1.5	14	16.5	14	31.5	14	46.5	6
7	12	31.8	12	46.8	13	1.8	13	16.8	13	31.8	13	46.8	14	1.8	14	16.8	14	31.8	14	46.8	7
8	12	32.0	12	47.0	13	2.0	13	17.0	13	32.0	13	47.0	14	2.0	14	17.0	14	32.0	14	47.0	8
9	12	32.3	12	47.3	13	2.3	13	17.3	13	32.3	13	47.3	14	2.3	14	17.3	14	32.3	14	47.3	9
10	12	32.5	12	47.5	13	2.5	13	17.5	13	32.5	13	47.5	14	2.5	14	17.5	14	32.5	14	47.5	10
11	12	32.8	12	47.8	13	2.8	13	17.8	13	32.8	13	47.8	14	2.8	14	17.8	14	32.8	14	47.8	11
12	12	33.0	12	48.0	13	3.0	13	18.0	13	33.0	13	48.0	14	3.0	14	18.0	14	33.0	14	48.0	12
13	12	33.3	12	48.3	13	3.3	13	18.3	13	33.3	13	48.3	14	3.3	14	18.3	14	33.3	14	48.3	13
14	12	33.5	12	48.5	13	3.5	13	18.5	13	33.5	13	48.5	14	3.5	14	18.5	14	33.5	14	48.5	14
15	12	33.8	12	48.8	13	3.8	13	18.8	13	33.8	13	48.8	14	3.8	14	18.8	14	33.8	14	48.8	15
16	12	34.0	12	49.0	13	4.0	13	19.0	13	34.0	13	49.0	14	4.0	14	19.0	14	34.0	14	49.0	16
17	12	34.3	12	49.3	13	4.3	13	19.3	13	34.3	13	49.3	14	4.3	14	19.3	14	34.3	14	49.3	17
18	12	34.5	12	49.5	13	4.5	13	19.5	13	34.5	13	49.5	14	4.5	14	19.5	14	34.5	14	49.5	18
19	12	34.8	12	49.8	13	4.8	13	19.8	13	34.8	13	49.8	14	4.8	14	19.8	14	34.8	14	49.8	19
20	12	35.0	12	50.0	13	5.0	13	20.0	13	35.0	13	50.0	14	5.0	14	20.0	14	35.0	14	50.0	20
21	12	35.3	12	50.3	13	5.3	13	20.3	13	35.3	13	50.3	14	5.3	14	20.3	14	35.3	14	50.3	21
22	12	35.5	12	50.5	13	5.5	13	20.5	13	35.5	13	50.5	14	5.5	14	20.5	14	35.5	14	50.5	22
23	12	35.8	12	50.8	13	5.8	13	20.8	13	35.8	13	50.8	14	5.8	14	20.8	14	35.8	14	50.8	23
24	12	36.0	12	51.0	13	6.0	13	21.0	13	36.0	13	51.0	14	6.0	14	21.0	14	36.0	14	51.0	24
25	12	36.3	12	51.3	13	6.3	13	21.3	13	36.3	13	51.3	14	6.3	14	21.3	14	36.3	14	51.3	25
26	12	36.5	12	51.5	13	6.5	13	21.5	13	36.5	13	51.5	14	6.5	14	21.5	14	36.5	14	51.5	26
27	12	36.8	12	51.8	13	6.8	13	21.8	13	36.8	13	51.8	14	6.8	14	21.8	14	36.8	14	51.8	27
28	12	37.0	12	52.0	13	7.0	13	22.0	13	37.0	13	52.0	14	7.0	14	22.0	14	37.0	14	52.0	28
29	12	37.3	12	52.3	13	7.3	13	22.3	13	37.3	13	52.3	14	7.3	14	22.3	14	37.3	14	52.3	29
30	12	37.5	12	52.5	13	7.5	13	22.5	13	37.5	13	52.5	14	7.5	14	22.5	14	37.5	14	52.5	30
31	12	37.8	12	52.8	13	7.8	13	22.8	13	37.8	13	52.8	14	7.8	14	22.8	14	37.8	14	52.8	31
32	12	38.0	12	53.0	13	8.0	13	23.0	13	38.0	13	53.0	14	8.0	14	23.0	14	38.0	14	53.0	32
33	12	38.3	12	53.3	13	8.3	13	23.3	13	38.3	13	53.3	14	8.3	14	23.3	14	38.3	14	53.3	33
34	12	38.5	12	53.5	13	8.5	13	23.5	13	38.5	13	53.5	14	8.5	14	23.5	14	38.5	14	53.5	34
35	12	38.8	12	53.8	13	8.8	13	23.8	13	38.8	13	53.8	14	8.8	14	23.8	14	38.8	14	53.8	35
36	12	39.0	12	54.0	13	9.0	13	24.0	13	39.0	13	54.0	14	9.0	14	24.0	14	39.0	14	54.0	36
37	12	39.3	12	54.3	13	9.3	13	24.3	13	39.3	13	54.3	14	9.3	14	24.3	14	39.3	14	54.3	37
38	12	39.5	12	54.5	13	9.5	13	24.5	13	39.5	13	54.5	14	9.5	14	24.5	14	39.5	14	54.5	38
39	12	39.8	12	54.8	13	9.8	13	24.8	13	39.8	13	54.8	14	9.8	14	24.8	14	39.8	14	54.8	39
40	12	40.0	12	55.0	13	10.0	13	25.0	13	40.0	13	55.0	14	10.0	14	25.0	14	40.0	14	55.0	40
41	12	40.3	12	55.3	13	10.3	13	25.3	13	40.3	13	55.3	14	10.3	14	25.3	14	40.3	14	55.3	41
42	12	40.5	12	55.5	13	10.5	13	25.5	13	40.5	13	55.5	14	10.5	14	25.5	14	40.5	14	55.5	42
43	12	40.8	12	55.8	13	10.8	13	25.8	13	40.8	13	55.8	14	10.8	14	25.8	14	40.8	14	55.8	43
44	12	41.0	12	56.0	13	11.0	13	26.0	13	41.0	13	56.0	14	11.0	14	26.0	14	41.0	14	56.0	44
45	12	41.3	12	56.3	13	11.3	13	26.3	13	41.3	13	56.3	14	11.3	14	26.3	14	41.3	14	56.3	45
46	12	41.5	12	56.5	13	11.5	13	26.5	13	41.5	13	56.5	14	11.5	14	26.5	14	41.5	14	56.5	46
47	12	41.8	12	56.8	13	11.8	13	26.8	13	41.8	13	56.8	14	11.8	14	26.8	14	41.8	14	56.8	47
48	12	42.0	12	57.0	13	12.0	13	27.0	13	42.0	13	57.0	14	12.0	14	27.0	14	42.0	14	57.0	48
49	12	42.3	12	57.3	13	12.3	13	27.3	13	42.3	13	57.3	14	12.3	14	27.3	14	42.3	14	57.3	49
50	12	42.5	12	57.5	13	12.5	13	27.5	13	42.5	13	57.5	14	12.5	14	27.5	14	42.5	14	57.5	50
51	12	42.8	12	57.8	13	12.8	13	27.8	13	42.8	13	57.8	14	12.8	14	27.8	14	42.8	14	57.8	51
52	12	43.0	12	58.0	13	13.0	13	28.0	13	43.0	13	58.0	14	13.0	14	28.0	14	43.0	14	58.0	52
53	12	43.3	12	58.3	13	13.3	13	28.3	13	43.3	13	58.3	14	13.3	14	28.3	14	43.3	14	58.3	53
54	12	43.5	12	58.5	13	13.5	13	28.5	13	43.5	13	58.5	14	13.5	14	28.5	14	43.5	14	58.5	54
55	12	43.8	12	58.8	13	13.8	13	28.8	13	43.8	13	58.8	14	13.8	14	28.8	14	43.8	14	58.8	55
56	12	44.0	12	59.0	13	14.0	13	29.0	13	44.0	13	59.0	14	14.0	14	29.0	14	44.0	14	59.0	56
57	12	44.3	12	59.3	13	14.3	13	29.3	13	44.3	13	59.3	14	14.3	14	29.3	14	44.3	14	59.3	57
58	12	44.5	12	59.5	13	14.5	13	29.5	13	44.5	13	59.5	14	14.5	14	29.5	14	44.5	14	59.5	58
59	12	44.8	12	59.8	13	14.8	13	29.8	13	44.8	13	59.8	14	14.8	14	29.8	14	44.8	14	59.8	59
60	12	45.0	13	0.0	13	15	13	30.0	13	45.0	14	0.0	14	15	14	30.0	14	45.0	15	0.0	60

Correction to Tabulated Attitude for Minutes of Declination

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