

# ALTITUDE, AZIMUTH, *and* LINE OF POSITION

COMPRISING TABLES FOR WORKING SIGHT OF HEAVENLY  
BODY FOR LINE OF POSITION BY THE COSINE-HAVERSINE  
FORMULA, MARCQ SAINT HILAIRE METHOD

AND ALSO

AQUINO'S ALTITUDE AND AZIMUTH TABLES FOR  
LINE OF POSITION, MARCQ SAINT HILAIRE METHOD

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1918



W

EXAMPLE: At sea, January 15, 1916, about 8.30 a. m., in Lat. by D. R. 30° 10' N., Long. by D. R. 45° 15' W., the sextant altitude of the sun's lower limb, bearing southward and eastward, was 17° 40' 50". Index correction +1' 00". Height of eye, 29 feet. Watch time, 8<sup>h</sup> 30<sup>m</sup> 10<sup>s</sup>; C. - W. 3<sup>h</sup> 02<sup>m</sup> 40<sup>s</sup>. Chronometer slow of G. M. T., 7<sup>m</sup> 10<sup>s</sup>. Required: The altitude difference and the azimuth for laying down the line of position from the D. R. position.

Formula:  $\text{hav } z = \text{hav } (L \sim d) + \cos L \cos d \text{ hav } t$   
 $= \text{hav } (L \sim d) + \text{hav } \Theta$

Times.		Declination.		H. D.	Eq. of T.	H. D.
W. T.	8 <sup>h</sup> 30 <sup>m</sup> 10 <sup>s</sup>	G. M. noon,	S. 21° 18'.9	N. 0'.4	(-) to M. T.	
C. - W.	3 02 40	Jan. 15.			9 <sup>m</sup> 11 <sup>s</sup> .4 + 0 <sup>s</sup> . 9	
C. T.	11 32 50	Corr. S.	0.1	G. M. T.	- 3 <sup>h</sup>	Corr. - .3 - 3 <sup>h</sup>
C. C.	+ 7 10					
		S. 21	19'.0	Corr. S.	0.1	9 - 11.1 Corr. 0.3

G. M. T. }		SOLUTION.		Altitude.	
14th Jan.	23 40 00	t =	3 <sup>h</sup> 30 <sup>m</sup> 11. <sup>s</sup> 1	log hav =	9.29213
or 15th Jan.	- 0 20 00	L = N.	30° 10'.0	log cos =	9.93680
		d = S.	21 19'.0	log cos =	9.96922
G. M. T.	23 40 00				
Long. W.	3 01 00				
				$\Theta \log \text{hav} =$	9.19815a
L. M. T.	20 39 00	L ~ d =	51° 29'.0	$\Theta \text{ nat hav} =$	.15782
Eq. of T.	- 9 11.1			nat hav =	.18863
		z =	72 06 55	nat hav =	.34645
L. A. T.	20 29 48.9	Calculated h =	17 53 05		
t =	3 30 11.1	Observed h ⊕ =	17 49 59		
		Alt. diff. =	3' 06'' = 3'.1		

a Since logarithmic haversines and natural haversines are set down side by side in Table IV, the natural haversine may be found from the logarithmic haversine without taking out the value of the corresponding angle.

EXAMPLE: At sea, August 18, 1916, in the early morning, in Lat. by D. R. 34° 10' S., Long. by D. R. 172° 26' 30" E., the sextant altitude of the star Sirius, bearing eastward, was 25° 48' 50". Index correction +3' 10". Height of eye 40 feet. Watch time of observation, 4<sup>h</sup> 30<sup>m</sup> 15<sup>s</sup>. C. - W., 0<sup>h</sup> 29<sup>m</sup> 45<sup>s</sup>. Chronometer fast of G. M. T., 13<sup>m</sup> 40<sup>s</sup>. Required: The altitude difference and the azimuth for laying down the line of position from the D. R. position.

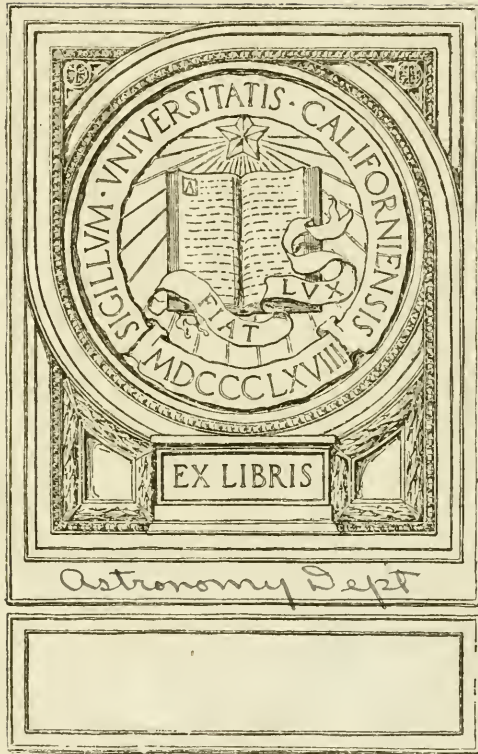
[From Nautical Almanac.]

Times.		R. A. Star.		Dec. star.	R. A. mean sun.
W. T.	4 <sup>h</sup> 30 <sup>m</sup> 15 <sup>s</sup>	Aug. 1 <sup>d</sup>	0 <sup>h</sup> = 6 <sup>m</sup> 41 <sup>m</sup> 27 <sup>s</sup> .8	S. 16° 35'.9	Aug. 17 <sup>d</sup> 0 <sup>h</sup> = 9 <sup>h</sup> 42 <sup>m</sup> 07 <sup>s</sup> .5
C. - W.	0 29 45	Sept. 1	0 = 6 41 23.6	16 35.8	Reduction } 0 47.0
C. T.	5 00 00	Aug. 17 <sup>d</sup>	5 <sup>h</sup> = 6 41 28.2	16 35.8	for G.M.T. }
C. C.	- 13 40				

Times.		SOLUTION.		R. A. M. S.	
G. M. T. }	4 46 20	t =	4 <sup>h</sup> 42 <sup>m</sup> 27 <sup>s</sup> .7	log hav =	9.52381
17th Aug.		L = S.	34° 10'.0	log cos =	9.91772
R. A. M. S.	9 42 54.5	d = S.	16 35.8	log cos =	9.98152
G. S. T.	14 29 14.5			$\Theta \log \text{hav} =$	9.42305a
Long. E.	11 29 46			$\Theta \text{ nat hav} =$	0.26487
		L ~ d =	17° 34'.2	nat hav =	0.02333
L. S. T.	1 59 00.5	z =	64° 56' 15"	nat hav =	0.23820
R. A. star	6 41 28.2	Calculated h =	25 03 45		
t =	4 42 27.7	Observed h * =	25 43 48		
		Alt. diff.	40' 03'' = 40'.05		

173 107 E  
173 117 E



UNIVERSITY OF CALIFORNIA

















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TABLE I

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CORRECTIONS TO BE APPLIED TO  
THE OBSERVED ALTITUDE OF THE  
SUN'S LOWER LIMB, OR OF A  
STAR OR PLANET

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245  
1918

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude.

OBS. ALT.	HEIGHT OF THE EYE.											
	8 Feet.		9 Feet.		10 Feet.		11 Feet.		12 Feet.		13 Feet.	
	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)
6 30	5 29	10 40	5 19	10 50	5 09	11 00	5 00	11 09	4 51	11 18	4 43	11 26
40	5 39	10 30	5 29	10 40	5 19	10 50	5 10	10 59	5 01	11 08	4 53	11 16
50	5 49	10 20	5 39	10 30	5 29	10 40	5 20	10 49	5 11	10 58	5 03	11 06
7 00	5 59	10 10	5 49	10 20	5 39	10 30	5 30	10 39	5 21	10 48	5 13	10 56
10	6 08	10 01	5 58	10 11	5 48	10 21	5 39	10 30	5 30	10 39	5 22	10 47
20	6 17	9 52	6 07	10 02	5 57	10 12	5 48	10 21	5 39	10 30	5 31	10 38
7 30	6 26	9 43	6 16	9 53	6 06	10 03	5 57	10 12	5 48	10 21	5 40	10 29
40	6 34	9 35	6 24	9 45	6 14	9 55	6 05	10 04	5 56	10 13	5 48	10 21
50	6 42	9 27	6 32	9 37	6 22	9 47	6 13	9 56	6 04	10 05	5 56	10 13
8 00	6 50	9 19	6 40	9 29	6 30	9 39	6 21	9 48	6 12	9 57	6 04	10 05
10	6 57	9 12	6 47	9 22	6 37	9 32	6 28	9 41	6 19	9 50	6 11	9 58
20	7 04	9 05	6 54	9 15	6 44	9 25	6 35	9 34	6 26	9 43	6 18	9 51
8 30	7 11	8 58	7 01	9 08	6 51	9 18	6 42	9 27	6 33	9 36	6 25	9 44
40	7 18	8 51	7 08	9 01	6 58	9 11	6 49	9 20	6 40	9 29	6 32	9 37
50	7 24	8 45	7 14	8 55	7 04	9 05	6 55	9 14	6 46	9 23	6 38	9 31
9 00	7 30	8 39	7 20	8 49	7 10	8 59	7 01	9 08	6 52	9 17	6 44	9 25
20	7 42	8 27	7 32	8 37	7 22	8 47	7 13	8 56	7 04	9 05	6 56	9 13
40	7 53	8 16	7 43	8 26	7 33	8 36	7 24	8 45	7 15	8 54	7 07	9 02
10 00	8 04	8 05	7 54	8 15	7 44	8 25	7 35	8 34	7 26	8 43	7 18	8 51
20	8 14	7 55	8 04	8 05	7 54	8 15	7 45	8 24	7 36	8 33	7 28	8 41
40	8 23	7 46	8 13	7 56	8 03	8 06	7 54	8 15	7 45	8 24	7 37	8 32
11 00	8 32	7 37	8 22	7 47	8 12	7 57	8 03	8 06	7 54	8 15	7 46	8 23
30	8 44	7 25	8 34	7 35	8 24	7 45	8 15	7 54	8 06	8 03	7 58	8 11
12 00	8 55	7 14	8 45	7 24	8 35	7 34	8 26	7 43	8 17	7 52	8 09	8 00
30	9 06	7 03	8 56	7 13	8 46	7 23	8 37	7 32	8 28	7 41	8 20	7 49
13 00	9 16	6 53	9 06	7 03	8 56	7 13	8 47	7 22	8 38	7 31	8 30	7 39
30	9 25	6 44	9 15	6 54	9 05	7 04	8 56	7 13	8 47	7 22	8 39	7 30
14 00	9 33	6 36	9 23	6 46	9 13	6 56	9 04	7 05	8 55	7 14	8 47	7 22
15 00	9 49	6 20	9 39	6 30	9 29	6 40	9 20	6 49	9 11	6 58	9 03	7 06
16 00	10 02	6 07	9 52	6 17	9 42	6 27	9 33	6 36	9 24	6 45	9 16	6 53
17 00	10 15	5 54	10 05	6 04	9 55	6 14	9 46	6 23	9 37	6 32	9 29	6 40
18 00	10 25	5 44	10 15	5 54	10 05	6 04	9 56	6 13	9 47	6 22	9 39	6 30
19 00	10 35	5 34	10 25	5 44	10 15	5 54	10 06	6 03	9 57	6 12	9 49	5 20
20 00	10 43	5 25	10 33	5 35	10 23	5 45	10 14	5 54	10 05	6 03	9 57	6 11
22 00	10 59	5 09	10 49	5 19	10 39	5 29	10 30	5 38	10 21	5 47	10 13	5 55
24 00	11 12	4 56	11 02	5 06	10 52	5 16	10 43	5 25	10 34	5 34	10 26	5 42
26 00	11 23	4 45	11 13	4 55	11 03	5 05	10 54	5 14	10 45	5 23	10 37	5 31
28 00	11 33	4 35	11 23	4 45	11 13	4 55	11 04	5 04	10 55	5 13	10 47	5 21
30 00	11 41	4 27	11 31	4 37	11 21	4 47	11 12	4 56	11 03	5 05	10 55	5 13
32 00	11 49	4 19	11 39	4 29	11 29	4 39	11 20	4 48	11 11	4 57	11 03	5 05
34 00	11 56	4 12	11 46	4 22	11 36	4 32	11 27	4 41	11 18	4 50	11 10	4 58
36 00	12 02	4 06	11 52	4 16	11 42	4 26	11 33	4 35	11 24	4 44	11 16	4 52
38 00	12 07	4 01	11 57	4 11	11 47	4 21	11 38	4 30	11 29	4 39	11 21	4 47
40 00	12 12	3 55	12 02	4 05	11 52	4 15	11 43	4 24	11 34	4 33	11 26	4 41
45 00	12 23	3 44	12 13	3 54	12 03	4 04	11 54	4 13	11 45	4 22	11 37	4 30
50 00	12 31	3 35	12 21	3 45	12 11	3 55	12 02	4 04	11 53	4 13	11 45	4 21
55 00	12 38	3 27	12 28	3 37	12 18	3 47	12 09	3 56	12 00	4 05	11 52	4 13
60 00	12 44	3 20	12 34	3 30	12 24	3 40	12 15	3 49	12 06	3 58	11 58	4 06
65 00	12 51	3 13	12 41	3 23	12 31	3 33	12 22	3 42	12 13	3 51	12 05	3 59
70 00	12 56	3 07	12 46	3 17	12 36	3 27	12 27	3 36	12 18	3 45	12 10	3 53
75 00	13 00	3 02	12 50	3 12	12 40	3 22	12 31	3 31	12 22	3 40	12 14	3 48
80 00	13 06	2 56	12 56	3 06	12 46	3 16	12 37	3 25	12 28	3 34	12 20	3 42
85 00	13 10	2 51	13 00	3 01	12 50	3 11	12 41	3 20	12 32	3 29	12 24	3 37
90 00	13 14	2 46	13 04	2 56	12 54	3 06	12 45	3 15	12 36	3 24	12 28	3 32

ADDITIONAL CORR. FOR SUN'S ALT.	Day of month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.		
	1st to 15th...	+18	+15	+8	"	"	0	-8	-13	-14	-11	-5	+3	+11	+16
	16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken at 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

*At my eye*



Corrections to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	14 Feet.		15 Feet.		16 Feet.		17 Feet.		18 Feet.		19 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	4 35	11 34	4 27	11 42	4 20	11 49	4 13	11 56	4 06	12 03	3 59	12 10
40	4 45	11 24	4 37	11 32	4 30	11 39	4 23	11 46	4 16	11 53	4 09	12 00
50	4 55	11 14	4 47	11 22	4 40	11 29	4 33	11 36	4 26	11 43	4 19	11 50
7 00	5 05	11 04	4 57	11 12	4 50	11 19	4 43	11 26	4 36	11 33	4 29	11 40
10	5 14	10 55	5 06	11 03	4 59	11 10	4 52	11 17	4 45	11 24	4 38	11 31
20	5 23	10 46	5 15	10 54	5 08	11 01	5 01	11 08	4 54	11 15	4 47	11 22
7 30	5 32	10 37	5 24	10 45	5 17	10 52	5 10	10 59	5 03	11 06	4 56	11 13
40	5 40	10 29	5 32	10 37	5 25	10 44	5 18	10 51	5 11	10 58	5 04	11 05
50	5 48	10 21	5 40	10 29	5 33	10 36	5 26	10 43	5 19	10 50	5 12	10 57
8 00	5 56	10 13	5 48	10 21	5 41	10 28	5 34	10 35	5 27	10 42	5 20	10 49
10	6 03	10 06	5 55	10 14	5 48	10 21	5 41	10 28	5 34	10 35	5 27	10 42
20	6 10	9 59	6 02	10 07	5 55	10 14	5 48	10 21	5 41	10 28	5 34	10 35
8 30	6 17	9 52	6 09	10 00	6 02	10 07	5 55	10 14	5 48	10 21	5 41	10 28
40	6 24	9 45	6 16	9 53	6 09	10 00	6 02	10 07	5 55	10 14	5 48	10 21
50	6 30	9 39	6 22	9 47	6 15	9 54	6 08	10 01	6 01	10 08	5 54	10 15
9 00	6 36	9 33	6 28	9 41	6 21	9 48	6 14	9 55	6 07	10 02	6 00	10 09
20	6 48	9 21	6 40	9 29	6 33	9 36	6 26	9 43	6 19	9 50	6 12	9 57
40	6 59	9 10	6 51	9 18	6 44	9 25	6 37	9 32	6 30	9 39	6 23	9 46
10 00	7 10	8 59	7 02	9 07	6 55	9 14	6 48	9 21	6 41	9 28	6 34	9 35
20	7 20	8 49	7 12	8 57	7 05	9 04	6 58	9 11	6 51	9 18	6 44	9 25
40	7 29	8 40	7 21	8 48	7 14	8 55	7 07	9 02	7 00	9 09	6 53	9 16
11 00	7 38	8 31	7 30	8 39	7 23	8 46	7 16	8 53	7 09	9 00	7 02	9 07
30	7 50	8 19	7 42	8 27	7 35	8 34	7 28	8 41	7 21	8 48	7 14	8 55
12 00	8 01	8 08	7 53	8 16	7 46	8 23	7 39	8 30	7 32	8 37	7 25	8 44
30	8 12	7 57	8 04	8 05	7 57	8 12	7 50	8 19	7 43	8 26	7 36	8 33
13 00	8 22	7 47	8 14	7 55	8 07	8 02	8 00	8 09	7 53	8 16	7 46	8 23
30	8 31	7 38	8 23	7 46	8 16	7 53	8 09	8 00	8 02	8 07	7 55	8 14
14 00	8 39	7 30	8 31	7 38	8 24	7 45	8 17	7 52	8 10	7 59	8 03	8 06
15 00	8 55	7 14	8 47	7 22	8 40	7 29	8 33	7 36	8 26	7 43	8 19	7 50
16 00	9 08	7 01	9 00	7 09	8 53	7 16	8 46	7 23	8 39	7 30	8 32	7 37
17 00	9 21	6 48	9 13	6 56	9 06	7 03	8 59	7 10	8 52	7 17	8 45	7 24
18 00	9 31	6 38	9 23	6 46	9 16	6 53	9 09	7 00	9 02	7 07	8 55	7 14
19 00	9 41	6 28	9 33	6 36	9 26	6 43	9 19	6 50	9 12	6 57	9 05	7 04
20 00	9 49	6 19	9 41	6 27	9 34	6 34	9 27	6 41	9 20	6 48	9 13	6 55
22 00	10 05	6 03	9 57	6 11	9 50	6 18	9 43	6 25	9 36	6 32	9 29	6 39
24 00	10 18	5 50	10 10	5 58	10 03	6 05	9 56	6 12	9 49	6 19	9 42	6 26
26 00	10 29	5 39	10 21	5 47	10 14	5 54	10 07	6 01	10 00	6 08	9 53	6 15
28 00	10 39	5 29	10 31	5 37	10 24	5 44	10 17	5 51	10 10	5 58	10 03	6 05
30 00	10 47	5 21	10 39	5 29	10 32	5 36	10 25	5 43	10 18	5 50	10 11	5 57
32 00	10 55	5 13	10 47	5 21	10 40	5 28	10 33	5 35	10 26	5 42	10 19	5 49
34 00	11 02	5 06	10 54	5 14	10 47	5 21	10 40	5 28	10 33	5 35	10 26	5 42
36 00	11 08	5 00	11 00	5 08	10 53	5 15	10 46	5 22	10 39	5 29	10 32	5 36
38 00	11 13	4 55	11 05	5 03	10 58	5 10	10 51	5 17	10 44	5 24	10 37	5 31
40 00	11 18	4 49	11 10	4 57	11 03	5 04	10 56	5 11	10 49	5 18	10 42	5 25
45 00	11 29	4 38	11 21	4 46	11 14	4 53	11 07	5 00	11 00	5 07	10 53	5 14
50 00	11 37	4 29	11 29	4 37	11 22	4 44	11 15	4 51	11 08	4 58	11 01	5 05
55 00	11 44	4 21	11 36	4 29	11 29	4 36	11 22	4 43	11 15	4 50	11 08	4 57
60 00	11 50	4 14	11 42	4 22	11 35	4 29	11 28	4 36	11 21	4 43	11 14	4 50
65 00	11 57	4 07	11 49	4 15	11 42	4 22	11 35	4 29	11 28	4 36	11 21	4 43
70 00	12 02	4 01	11 54	4 09	11 47	4 16	11 40	4 23	11 33	4 30	11 26	4 37
75 00	12 06	3 56	11 58	4 04	11 51	4 11	11 44	4 18	11 37	4 25	11 30	4 32
80 00	12 12	3 50	12 04	3 58	11 57	4 05	11 50	4 12	11 43	4 19	11 36	4 26
85 00	12 16	3 45	12 08	3 53	12 01	4 00	11 54	4 07	11 47	4 14	11 40	4 21
90 00	12 20	3 40	12 12	3 48	12 05	3 55	11 58	4 02	11 51	4 09	11 44	4 16

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
		"	"	"	"	"	"	"	"	"	"	"	"	"
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16	
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

TABLE I.

Corrections to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	20 Feet.		21 Feet.		22 Feet.		23 Feet.		24 Feet.		25 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	3 52	12 17	3 46	12 23	3 39	12 30	3 33	12 36	3 27	12 42	3 21	12 48
40	4 .2	12 07	3 56	12 13	3 49	12 20	3 43	12 26	3 37	12 32	3 31	12 38
50	4 12	11 57	4 06	12 03	3 59	12 10	3 53	12 16	3 47	12 22	3 41	12 28
7 00	4 22	11 47	4 16	11 53	4 09	12 00	4 03	12 06	3 57	12 12	3 51	12 18
10	4 31	11 38	4 25	11 44	4 18	11 51	4 12	11 57	4 06	12 03	4 00	12 09
20	4 40	11 29	4 34	11 35	4 27	11 42	4 21	11 48	4 15	11 54	4 09	12 00
7 30	4 49	11 20	4 43	11 26	4 36	11 33	4 30	11 39	4 24	11 45	4 18	11 51
40	4 57	11 12	4 51	11 18	4 44	11 25	4 38	11 31	4 32	11 37	4 26	11 43
50	5 05	11 04	4 59	11 10	4 52	11 17	4 46	11 23	4 40	11 29	4 34	11 35
8 00	5 13	10 56	5 07	11 02	5 00	11 09	4 54	11 15	4 48	11 21	4 42	11 27
10	5 20	10 49	5 14	10 55	5 07	11 02	5 01	11 08	4 55	11 14	4 49	11 20
20	5 27	10 42	5 21	10 48	5 14	10 55	5 08	11 01	5 02	11 07	4 56	11 13
8 30	5 34	10 35	5 28	10 41	5 21	10 48	5 15	10 54	5 09	11 00	5 03	11 06
40	5 41	10 28	5 35	10 34	5 28	10 41	5 22	10 47	5 16	10 53	5 10	10 59
50	5 47	10 22	5 41	10 28	5 34	10 35	5 28	10 41	5 22	10 47	5 16	10 53
9 00	5 53	10 16	5 47	10 22	5 40	10 29	5 34	10 35	5 28	10 41	5 22	10 47
20	6 05	10 04	5 59	10 10	5 52	10 17	5 46	10 23	5 40	10 29	5 34	10 35
40	6 16	9 53	6 10	9 59	6 03	10 06	5 57	10 12	5 51	10 18	5 45	10 24
10 00	6 27	9 42	6 21	9 48	6 14	9 55	6 08	10 01	6 02	10 07	5 56	10 13
20	6 37	9 32	6 31	9 38	6 24	9 45	6 18	9 51	6 12	9 57	6 06	10 03
40	6 46	9 23	6 40	9 29	6 33	9 36	6 27	9 42	6 21	9 48	6 15	9 54
11 00	6 55	9 14	6 49	9 20	6 42	9 27	6 36	9 33	6 30	9 39	6 24	9 45
30	7 07	9 02	7 01	9 08	6 54	9 15	6 48	9 21	6 42	9 27	6 36	9 33
12 00	7 18	8 51	7 12	8 57	7 05	9 04	6 59	9 10	6 53	9 16	6 47	9 22
30	7 29	8 40	7 23	8 46	7 16	8 53	7 10	8 59	7 04	9 05	6 58	9 11
13 00	7 39	8 30	7 33	8 36	7 26	8 43	7 20	8 49	7 14	8 55	7 08	9 01
30	7 48	8 21	7 42	8 27	7 35	8 34	7 29	8 40	7 23	8 46	7 17	8 52
14 00	7 56	8 13	7 50	8 19	7 43	8 26	7 37	8 32	7 31	8 38	7 25	8 44
15 00	8 12	7 57	8 06	8 03	7 59	8 10	7 53	8 16	7 47	8 22	7 41	8 28
16 00	8 25	7 44	8 19	7 50	8 12	7 57	8 06	8 03	8 00	8 09	7 54	8 15
17 00	8 38	7 31	8 32	7 37	8 25	7 44	8 19	7 50	8 13	7 56	8 07	8 02
18 00	8 48	7 21	8 42	7 27	8 35	7 34	8 29	7 40	8 23	7 46	8 17	7 52
19 00	8 58	7 11	8 52	7 17	8 45	7 24	8 39	7 30	8 33	7 36	8 27	7 42
20 00	9 06	7 02	9 00	7 08	8 53	7 15	8 47	7 21	8 41	7 27	8 35	7 33
22 00	9 22	6 46	9 16	6 52	9 09	6 59	9 03	7 05	8 57	7 11	8 51	7 17
24 00	9 35	6 33	9 29	6 39	9 22	6 46	9 16	6 52	9 10	6 58	9 04	7 04
26 00	9 46	6 22	9 40	6 28	9 33	6 35	9 27	6 41	9 21	6 47	9 15	6 53
28 00	9 56	6 12	9 50	6 18	9 43	6 25	9 37	6 31	9 31	6 37	9 25	6 43
30 00	10 04	6 04	9 58	6 10	9 51	6 17	9 45	6 23	9 39	6 29	9 33	6 35
32 00	10 12	5 56	10 06	6 02	9 59	6 09	9 53	6 15	9 47	6 21	9 41	6 27
34 00	10 19	5 49	10 13	5 55	10 06	6 02	10 00	6 08	9 54	6 14	9 48	6 20
36 00	10 25	5 43	10 19	5 49	10 12	5 56	10 06	6 02	10 00	6 08	9 54	6 14
38 00	10 30	5 38	10 24	5 44	10 17	5 51	10 11	5 57	10 05	6 03	9 59	6 09
40 00	10 35	5 32	10 29	5 38	10 22	5 45	10 16	5 51	10 10	5 57	10 04	6 03
45 00	10 46	5 21	10 40	5 27	10 33	5 34	10 27	5 40	10 21	5 46	10 15	5 52
50 00	10 54	5 12	10 48	5 18	10 41	5 25	10 35	5 31	10 29	5 37	10 23	5 43
55 00	11 01	5 04	10 55	5 10	10 48	5 17	10 42	5 23	10 36	5 29	10 30	5 35
60 00	11 07	4 57	11 01	5 03	10 54	5 10	10 48	5 16	10 42	5 22	10 36	5 28
65 00	11 14	4 50	11 08	4 56	11 01	5 03	10 55	5 09	10 49	5 15	10 43	5 21
70 00	11 19	4 44	11 13	4 50	11 06	4 57	11 00	5 03	10 54	5 09	10 48	5 15
75 00	11 23	4 39	11 17	4 45	11 10	4 52	11 04	4 58	10 58	5 04	10 52	5 10
80 00	11 29	4 33	11 23	4 39	11 16	4 46	11 10	4 52	11 04	4 58	10 58	5 04
85 00	11 33	4 28	11 27	4 34	11 20	4 41	11 14	4 47	11 08	4 53	11 02	4 59
90 00	11 37	4 23	11 31	4 29	11 24	4 36	11 18	4 42	11 12	4 48	11 06	4 54

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
		"	"	"	"	"	"	"	"	"	"	"	"	"
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16	
16th to 31st....	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

Obs. ALT.	HEIGHT OF THE EYE.									
	26 Feet.		27 Feet.		28 Feet.		29 Feet.		30 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	3 15	12 54	3 09	13 00	3 04	13 05	2 58	13 11	2 53	13 16
40	3 25	12 44	3 19	12 50	3 14	12 55	3 08	13 01	3 03	13 06
50	3 35	12 34	3 29	12 40	3 24	12 45	3 18	12 51	3 13	12 56
7 00	3 45	12 24	3 39	12 30	3 34	12 35	3 28	12 41	3 23	12 46
10	3 54	12 15	3 48	12 21	3 43	12 26	3 37	12 32	3 32	12 37
20	4 03	12 06	3 57	12 12	3 52	12 17	3 46	12 23	3 41	12 28
7 30	4 12	11 57	4 06	12 03	4 01	12 08	3 55	12 14	3 50	12 19
40	4 20	11 49	4 14	11 55	4 09	12 00	4 03	12 06	3 58	12 11
50	4 28	11 41	4 22	11 47	4 17	11 52	4 11	11 58	4 06	12 03
8 00	4 36	11 33	4 30	11 39	4 25	11 44	4 19	11 50	4 14	11 55
10	4 43	11 26	4 37	11 32	4 32	11 37	4 26	11 43	4 21	11 48
20	4 50	11 19	4 44	11 25	4 39	11 30	4 33	11 36	4 28	11 41
8 30	4 57	11 12	4 51	11 18	4 46	11 23	4 40	11 29	4 35	11 34
40	5 04	11 05	4 58	11 11	4 53	11 16	4 47	11 22	4 42	11 27
50	5 10	10 59	5 04	11 05	4 59	11 10	4 53	11 16	4 48	11 21
9 00	5 16	10 53	5 10	10 59	5 05	11 04	4 59	11 10	4 54	11 15
20	5 28	10 41	5 22	10 47	5 17	10 52	5 11	10 58	5 06	11 03
40	5 39	10 30	5 33	10 36	5 28	10 41	5 22	10 47	5 17	10 52
10 00	5 50	10 19	5 44	10 25	5 39	10 30	5 33	10 36	5 28	10 41
20	6 00	10 09	5 54	10 15	5 49	10 20	5 43	10 26	5 38	10 31
40	6 09	10 00	6 03	10 06	5 58	10 11	5 52	10 17	5 47	10 22
11 00	6 18	9 51	6 12	9 57	6 07	10 02	6 01	10 08	5 56	10 13
30	6 30	9 39	6 24	9 45	6 19	9 50	6 13	9 56	6 08	10 01
12 00	6 41	9 28	6 35	9 34	6 30	9 39	6 24	9 45	6 19	9 50
30	6 52	9 17	6 46	9 23	6 41	9 28	6 35	9 34	6 30	9 39
13 00	7 02	9 07	6 56	9 13	6 51	9 18	6 45	9 24	6 40	9 29
30	7 11	8 58	7 05	9 04	7 00	9 09	6 54	9 15	6 49	9 20
14 00	7 19	8 50	7 13	8 56	7 08	9 01	7 02	9 07	6 57	9 12
15 00	7 35	8 34	7 29	8 40	7 24	8 45	7 18	8 51	7 13	8 56
16 00	7 48	8 21	7 42	8 27	7 37	8 32	7 31	8 38	7 26	8 43
17 00	8 01	8 08	7 55	8 14	7 50	8 19	7 44	8 25	7 39	8 30
18 00	8 11	7 58	8 05	8 04	8 00	8 09	7 54	8 15	7 49	8 20
19 00	8 21	7 48	8 15	7 54	8 10	7 59	8 04	8 05	7 59	8 10
20 00	8 29	7 39	8 23	7 45	8 18	7 50	8 12	7 56	8 07	8 01
22 00	8 45	7 23	8 39	7 29	8 34	7 34	8 28	7 40	8 23	7 45
24 00	8 58	7 10	8 52	7 16	8 47	7 21	8 41	7 27	8 36	7 32
26 00	9 09	6 59	9 03	7 05	8 58	7 10	8 52	7 16	8 47	7 21
28 00	9 19	6 49	9 13	6 55	9 08	7 09	9 02	7 06	8 57	7 11
30 00	9 27	6 41	9 21	6 47	9 16	6 52	9 10	6 58	9 05	7 03
32 00	9 35	6 33	9 29	6 39	9 24	6 44	9 18	6 50	9 13	6 55
34 00	9 42	6 26	9 36	6 32	9 31	6 37	9 25	6 43	9 20	6 48
36 00	9 48	6 20	9 42	6 26	9 37	6 31	9 31	6 37	9 26	6 42
38 00	9 53	6 15	9 47	6 21	9 42	6 26	9 36	6 32	9 31	6 37
40 00	9 58	6 09	9 52	6 15	9 47	6 20	9 41	6 26	9 36	6 31
45 00	10 09	5 58	10 03	6 04	9 58	6 09	9 52	6 15	9 47	6 20
50 00	10 17	5 49	10 11	5 55	10 06	6 00	10 00	6 06	9 55	6 11
55 00	10 24	5 41	10 18	5 47	10 13	5 52	10 07	5 58	10 02	6 03
60 00	10 30	5 34	10 24	5 40	10 19	5 45	10 13	5 51	10 08	5 56
65 00	10 37	5 27	10 31	5 33	10 26	5 38	10 20	5 44	10 15	5 49
70 00	10 42	5 21	10 36	5 27	10 31	5 32	10 25	5 38	10 20	5 43
75 00	10 46	5 16	10 40	5 22	10 35	5 27	10 29	5 33	10 24	5 38
80 00	10 52	5 10	10 46	5 16	10 41	5 21	10 35	5 27	10 30	5 32
85 00	10 56	5 05	10 50	5 11	10 45	5 16	10 39	5 22	10 34	5 27
90 00	11 00	5 00	10 54	5 06	10 49	5 11	10 43	5 17	10 38	5 22

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
		"	"	"	"	"	"	"	"	"	"	"	"	"
	1st to 15th....	+18	+15	+8	0	- 3	-13	-14	-11	-5	+3	+11	+16	
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	- 9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

TABLE I.

Corrections to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

Obs. Alt.	HEIGHT OF THE EYE.									
	31 Feet.		32 Feet.		33 Feet.		34 Feet.		35 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	2 48	13 21	2 42	13 27	2 37	13 32	2 32	13 37	2 27	13 42
40	2 58	13 11	2 52	13 17	2 47	13 22	2 42	13 27	2 37	13 32
50	3 08	13 01	3 02	13 07	2 57	13 12	2 52	13 17	2 47	13 22
7 00	3 18	12 51	3 12	12 57	3 07	13 02	3 02	13 07	2 57	13 12
10	3 27	12 42	3 21	12 48	3 16	12 53	3 11	12 58	3 06	13 03
20	3 36	12 33	3 30	12 39	3 25	12 44	3 20	12 49	3 15	12 54
7 30	3 45	12 24	3 39	12 30	3 34	12 35	3 29	12 40	3 24	12 45
40	3 53	12 16	3 47	12 22	3 42	12 27	3 37	12 32	3 32	12 37
50	4 01	12 08	3 55	12 14	3 50	12 19	3 45	12 24	3 40	12 29
8 00	4 09	12 00	4 03	12 06	3 58	12 11	3 53	12 16	3 48	12 21
10	4 16	11 53	4 10	11 59	4 05	12 04	4 00	12 09	3 55	12 14
20	4 23	11 46	4 17	11 52	4 12	11 57	4 07	12 02	4 02	12 07
8 30	4 30	11 39	4 24	11 45	4 19	11 50	4 14	11 55	4 09	12 00
40	4 37	11 32	4 31	11 38	4 26	11 43	4 21	11 48	4 16	11 53
50	4 43	11 26	4 37	11 32	4 32	11 37	4 27	11 42	4 22	11 47
9 00	4 49	11 20	4 43	11 26	4 38	11 31	4 33	11 36	4 28	11 41
20	5 01	11 08	4 55	11 14	4 50	11 19	4 45	11 24	4 40	11 29
40	5 12	10 57	5 06	11 03	5 01	11 08	4 56	11 13	4 51	11 18
10 00	5 23	10 46	5 17	10 52	5 12	10 57	5 07	11 02	5 02	11 07
20	5 33	10 36	5 27	10 42	5 22	10 47	5 17	10 52	5 12	10 57
40	5 42	10 27	5 36	10 33	5 31	10 38	5 26	10 43	5 21	10 48
11 00	5 51	10 18	5 45	10 24	5 40	10 29	5 35	10 34	5 30	10 39
30	6 03	10 06	5 57	10 12	5 52	10 17	5 47	10 22	5 42	10 27
12 00	6 14	9 55	6 08	10 01	6 03	10 06	5 58	10 11	5 53	10 16
30	6 25	9 44	6 19	9 50	6 14	9 55	6 09	10 00	6 04	10 05
13 00	6 35	9 34	6 29	9 40	6 24	9 45	6 19	9 50	6 14	9 55
30	6 44	9 25	6 38	9 31	6 33	9 36	6 28	9 41	6 23	9 46
14 00	6 52	9 17	6 46	9 23	6 41	9 28	6 36	9 33	6 31	9 38
15 00	7 08	9 01	7 02	9 07	6 57	9 12	6 52	9 17	6 47	9 22
16 00	7 21	8 48	7 15	8 54	7 10	8 59	7 05	9 04	7 00	9 09
17 00	7 34	8 35	7 28	8 41	7 23	8 46	7 18	8 51	7 13	8 56
18 00	7 44	8 25	7 38	8 31	7 33	8 36	7 28	8 41	7 23	8 46
19 00	7 54	8 15	7 48	8 21	7 43	8 26	7 38	8 31	7 33	8 36
20 00	8 02	8 06	7 56	8 12	7 51	8 17	7 46	8 22	7 41	8 27
22 00	8 18	7 50	8 12	7 56	8 07	8 01	8 02	8 06	7 57	8 11
24 00	8 31	7 37	8 25	7 43	8 20	7 48	8 15	7 53	8 10	7 58
26 00	8 42	7 26	8 36	7 32	8 31	7 37	8 26	7 42	8 21	7 47
28 00	8 52	7 16	8 46	7 22	8 41	7 27	8 36	7 32	8 31	7 37
30 00	9 00	7 08	8 54	7 14	8 49	7 19	8 44	7 24	8 39	7 29
32 00	9 08	7 00	9 02	7 06	8 57	7 11	8 52	7 16	8 47	7 21
34 00	9 15	6 53	9 09	6 59	9 04	7 04	8 59	7 09	8 54	7 14
36 00	9 21	6 47	9 15	6 53	9 10	6 58	9 05	7 03	9 00	7 08
38 00	9 26	6 42	9 20	6 48	9 15	6 53	9 10	6 58	9 05	7 03
40 00	9 31	6 36	9 25	6 42	9 20	6 47	9 15	6 52	9 10	6 57
45 00	9 42	6 25	9 36	6 31	9 31	6 36	9 26	6 41	9 21	6 46
50 00	9 50	6 16	9 44	6 22	9 39	6 27	9 34	6 32	9 29	6 37
55 00	9 57	6 08	9 51	6 14	9 46	6 19	9 41	6 24	9 36	6 29
60 00	10 03	6 01	9 57	6 07	9 52	6 12	9 47	6 17	9 42	6 22
65 00	10 10	5 54	10 04	6 00	9 59	6 05	9 54	6 10	9 49	6 15
70 00	10 15	5 48	10 09	5 54	10 04	5 59	9 59	6 04	9 54	6 09
75 00	10 19	5 43	10 13	5 49	10 08	5 54	10 03	5 59	9 58	6 04
80 00	10 25	5 37	10 19	5 43	10 14	5 48	10 09	5 53	10 04	5 58
85 00	10 29	5 32	10 23	5 38	10 18	5 43	10 13	5 48	10 08	5 53
90 00	10 33	5 27	10 27	5 33	10 22	5 38	10 17	5 43	10 12	5 48

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
		"	"	"	"	"	"	"	"	"	"	"	"	"
	1st to 15th....	+18	+15	+8	0	- 8	-13	-14	-11	-5	+3	+11	+16	
16th to 31st....	+17	+12	+4	-4	-11	-14	-13	- 9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



TABLE I.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.									
	36 Feet.		37 Feet.		38 Feet.		39 Feet.		40 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	2 22	13 47	2 17	13 52	2 13	13 56	2 08	14 01	2 03	14 06
40	2 32	13 37	2 27	13 42	2 23	13 46	2 18	13 51	2 13	13 56
50	2 42	13 27	2 37	13 32	2 33	13 36	2 28	13 41	2 23	13 46
7 00	2 52	13 17	2 47	13 22	2 43	13 26	2 38	13 31	2 33	13 36
10	3 01	13 08	2 56	13 13	2 52	13 17	2 47	13 22	2 42	13 27
20	3 10	12 59	3 05	13 04	3 01	13 08	2 56	13 13	2 51	13 18
7 30	3 19	12 50	3 14	12 55	3 10	12 59	3 05	13 04	3 00	13 09
40	3 27	12 42	3 22	12 47	3 18	12 51	3 13	12 56	3 08	13 01
50	3 35	12 34	3 30	12 39	3 26	12 43	3 21	12 48	3 16	12 53
8 00	3 43	12 26	3 38	12 31	3 34	12 35	3 29	12 40	3 24	12 45
10	3 50	12 19	3 45	12 24	3 41	12 28	3 36	12 33	3 31	12 38
20	3 57	12 12	3 52	12 17	3 48	12 21	3 43	12 26	3 38	12 31
8 30	4 04	12 05	3 59	12 10	3 55	12 14	3 50	12 19	3 45	12 24
40	4 11	11 58	4 06	12 03	4 02	12 07	3 57	12 12	3 52	12 17
50	4 17	11 52	4 12	11 57	4 08	12 01	4 03	12 06	3 58	12 11
9 00	4 23	11 46	4 18	11 51	4 14	11 55	4 09	12 00	4 04	12 05
20	4 35	11 34	4 30	11 39	4 26	11 43	4 21	11 48	4 16	11 53
40	4 46	11 23	4 41	11 28	4 37	11 32	4 32	11 37	4 27	11 42
10 00	4 57	11 12	4 52	11 17	4 48	11 21	4 43	11 26	4 38	11 31
20	5 07	11 02	5 02	11 07	4 58	11 11	4 53	11 16	4 48	11 21
40	5 16	10 53	5 11	10 58	5 07	11 02	5 02	11 07	4 57	11 12
11 00	5 25	10 44	5 20	10 49	5 16	10 53	5 11	10 58	5 06	11 03
30	5 37	10 32	5 32	10 37	5 28	10 41	5 23	10 46	5 18	10 51
12 00	5 48	10 21	5 43	10 26	5 39	10 30	5 34	10 35	5 29	10 40
30	5 59	10 10	5 54	10 15	5 50	10 19	5 45	10 24	5 40	10 29
13 00	6 09	10 00	6 04	10 05	6 00	10 09	5 55	10 14	5 50	10 19
30	6 18	9 51	6 13	9 56	6 09	10 00	6 04	10 05	5 59	10 10
14 00	6 26	9 43	6 21	9 48	6 17	9 52	6 12	9 57	6 07	10 02
15 00	6 42	9 27	6 37	9 32	6 33	9 36	6 28	9 41	6 23	9 46
16 00	6 55	9 14	6 50	9 19	6 46	9 23	6 41	9 28	6 36	9 33
17 00	7 08	9 01	7 03	9 06	6 59	9 10	6 54	9 15	6 49	9 20
18 00	7 18	8 51	7 13	8 56	7 09	9 00	7 04	9 05	6 59	9 10
19 00	7 28	8 41	7 23	8 46	7 19	8 50	7 14	8 55	7 09	9 00
20 00	7 36	8 32	7 31	8 37	7 27	8 41	7 22	8 46	7 17	8 51
22 00	7 52	8 16	7 47	8 21	7 43	8 25	7 38	8 30	7 33	8 35
24 00	8 05	8 03	8 00	8 08	7 56	8 12	7 51	8 17	7 46	8 22
26 00	8 16	7 52	8 11	7 57	8 07	8 01	8 02	8 06	7 57	8 11
28 00	8 26	7 42	8 21	7 47	8 17	7 51	8 12	7 56	8 07	8 01
30 00	8 34	7 34	8 29	7 39	8 25	7 43	8 20	7 48	8 15	7 53
32 00	8 42	7 26	8 37	7 31	8 33	7 35	8 28	7 40	8 23	7 45
34 00	8 49	7 19	8 44	7 24	8 40	7 28	8 35	7 33	8 30	7 38
36 00	8 55	7 13	8 50	7 18	8 46	7 22	8 41	7 27	8 36	7 32
38 00	9 00	7 08	8 55	7 13	8 51	7 17	8 46	7 22	8 41	7 27
40 00	9 05	7 02	9 00	7 07	8 56	7 11	8 51	7 16	8 46	7 21
45 00	9 16	6 51	9 11	6 56	9 07	7 00	9 02	7 05	8 57	7 10
50 00	9 24	6 42	9 19	6 47	9 15	6 51	9 10	6 56	9 05	7 01
55 00	9 31	6 34	9 26	6 39	9 22	6 43	9 17	6 48	9 12	6 53
60 00	9 37	6 27	9 32	6 32	9 28	6 36	9 23	6 41	9 18	6 46
65 00	9 44	6 20	9 39	6 25	9 35	6 29	9 30	6 34	9 25	6 39
70 00	9 49	6 14	9 44	6 19	9 40	6 23	9 35	6 28	9 30	6 33
75 00	9 53	6 09	9 48	6 14	9 44	6 18	9 39	6 23	9 34	6 28
80 00	9 59	6 03	9 54	6 08	9 50	6 12	9 45	6 17	9 40	6 22
85 00	10 03	5 58	9 58	6 03	9 54	6 07	9 49	6 12	9 44	6 17
90 00	10 07	5 53	10 02	5 58	9 58	6 02	9 53	6 07	9 48	6 12

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th...	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16
	16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	41 Feet.		42 Feet.		43 Feet.		44 Feet.		45 Feet.		46 Feet.	
	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)
6 30	1 58	14 11	1 54	14 15	1 49	14 20	1 44	14 25	1 39	14 30	1 35	14 34
40	2 08	14 01	2 04	14 05	1 59	14 10	1 54	14 15	1 49	14 20	1 45	14 24
50	2 18	13 51	2 14	13 55	2 09	14 00	2 04	14 05	1 59	14 10	1 55	14 14
7 00	2 28	13 41	2 24	13 45	2 19	13 50	2 14	13 55	2 09	14 00	2 05	14 04
10	2 37	13 32	2 33	13 36	2 28	13 41	2 23	13 46	2 18	13 51	2 14	13 55
20	2 46	13 23	2 42	13 27	2 37	13 32	2 32	13 37	2 27	13 42	2 23	13 46
7 30	2 55	13 14	2 51	13 18	2 46	13 23	2 41	13 28	2 36	13 33	2 32	13 37
40	3 03	13 06	2 59	13 10	2 54	13 15	2 49	13 20	2 44	13 25	2 40	13 29
50	3 11	12 58	3 07	13 02	3 02	13 07	2 57	13 12	2 52	13 17	2 48	13 21
8 00	3 19	12 50	3 15	12 54	3 10	12 59	3 05	13 04	3 00	13 09	2 56	13 13
10	3 26	12 43	3 22	12 47	3 17	12 52	3 12	12 57	3 07	13 02	3 03	13 06
20	3 33	12 36	3 29	12 40	3 24	12 45	3 19	12 50	3 14	12 55	3 10	12 59
8 30	3 40	12 29	3 36	12 33	3 31	12 38	3 26	12 43	3 21	12 48	3 17	12 52
40	3 47	12 22	3 43	12 26	3 38	12 31	3 33	12 36	3 28	12 41	3 24	12 45
50	3 53	12 16	3 49	12 20	3 44	12 25	3 39	12 30	3 34	12 35	3 30	12 39
9 00	3 59	12 10	3 55	12 14	3 50	12 19	3 45	12 24	3 40	12 29	3 36	12 33
20	4 11	11 58	4 07	12 02	4 02	12 07	3 57	14 12	3 52	12 17	3 48	12 21
40	4 22	11 47	4 18	11 51	4 13	11 56	4 08	12 01	4 03	12 06	3 59	12 10
10 00	4 33	11 36	4 29	11 40	4 24	11 45	4 19	11 50	4 14	11 55	4 10	11 59
20	4 43	11 26	4 39	11 30	4 34	11 35	4 29	11 40	4 24	11 45	4 20	11 49
40	4 52	11 17	4 48	11 21	4 43	11 26	4 38	11 31	4 33	11 36	4 29	11 40
11 00	5 01	11 08	4 57	11 12	4 52	11 17	4 47	11 22	4 42	11 27	4 38	11 31
30	5 13	10 56	5 09	11 00	5 04	11 05	4 59	11 10	4 54	11 15	4 50	11 19
12 00	5 24	10 45	5 20	10 49	5 15	10 54	5 10	10 59	5 05	11 04	5 01	11 08
30	5 35	10 34	5 31	10 38	5 26	10 43	5 21	10 48	5 16	10 53	5 12	10 57
13 00	5 45	10 24	5 41	10 28	5 36	10 33	5 31	10 38	5 26	10 43	5 22	10 47
30	5 54	10 15	5 50	10 19	5 45	10 24	5 40	10 29	5 35	10 34	5 31	10 38
14 00	6 02	10 07	5 58	10 11	5 53	10 16	5 48	10 21	5 43	10 26	5 39	10 30
15 00	6 18	9 51	6 14	9 55	6 09	10 00	6 04	10 05	5 59	10 10	5 55	10 14
16 00	6 31	9 38	6 27	9 42	6 22	9 47	6 17	9 52	6 12	9 57	6 08	10 01
17 00	6 44	9 25	6 40	9 29	6 35	9 34	6 30	9 39	6 25	9 44	6 21	9 48
18 00	6 54	9 15	6 50	9 19	6 45	9 24	6 40	9 29	6 35	9 34	6 31	9 38
19 00	7 04	9 05	7 00	9 09	6 55	9 14	6 50	9 19	6 45	9 24	6 41	9 28
20 00	7 12	8 56	7 08	9 00	7 03	9 05	6 58	9 10	6 53	9 15	6 49	9 19
22 00	7 28	8 40	7 24	8 44	7 19	8 49	7 14	8 54	7 09	8 59	7 05	9 03
24 00	7 41	8 27	7 37	8 31	7 32	8 36	7 27	8 41	7 22	8 46	7 18	8 50
26 00	7 52	8 16	7 48	8 20	7 43	8 25	7 38	8 30	7 33	8 35	7 29	8 39
28 00	8 02	8 06	7 58	8 10	7 53	8 15	7 48	8 20	7 43	8 25	7 39	8 29
30 00	8 10	7 58	8 06	8 02	8 01	8 07	7 56	8 12	7 51	8 17	7 47	8 21
32 00	8 18	7 50	8 14	7 54	8 09	7 59	8 04	8 04	7 59	8 09	7 55	8 13
34 00	8 25	7 43	8 21	7 47	8 16	7 52	8 11	7 57	8 06	8 02	8 02	8 06
36 00	8 31	7 37	8 27	7 41	8 22	7 46	8 17	7 51	8 12	7 56	8 08	8 00
38 00	8 36	7 32	8 32	7 36	8 27	7 41	8 22	7 46	8 17	7 51	8 13	7 55
40 00	8 41	7 26	8 37	7 30	8 32	7 35	8 27	7 40	8 22	7 45	8 18	7 49
45 00	8 52	7 15	8 48	7 19	8 43	7 24	8 38	7 29	8 33	7 34	8 29	7 38
50 00	9 00	7 06	8 56	7 10	8 51	7 15	8 46	7 20	8 41	7 25	8 37	7 29
55 00	9 07	6 58	9 03	7 02	8 58	7 07	8 53	7 12	8 48	7 17	8 44	7 21
60 00	9 13	6 51	9 09	6 55	9 04	7 00	8 59	7 05	8 54	7 10	8 50	7 14
65 00	9 20	6 44	9 16	6 48	9 11	6 53	9 06	6 58	9 01	7 03	8 57	7 07
70 00	9 25	6 38	9 21	6 42	9 16	6 47	9 11	6 52	9 06	6 57	9 02	7 01
75 00	9 29	6 33	9 25	6 37	9 20	6 42	9 15	6 47	9 10	6 52	9 06	6 56
80 00	9 35	6 27	9 31	6 31	9 26	6 36	9 21	6 41	9 16	6 46	9 12	6 50
85 00	9 39	6 22	9 35	6 26	9 30	6 31	9 25	6 36	9 20	6 41	9 16	6 45
90 00	9 43	6 17	9 39	6 21	9 34	6 26	9 29	6 31	9 24	6 36	9 20	6 40

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	0	+15	+8	0	- 8	-13	-14	-11	-5	+3	+11
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	- 9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	47 Feet.		48 Feet.		49 Feet.		50 Feet.		51 Feet.		52 Feet.	
	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)	☉ Sun's Corr. (+)	* Star's Corr. (-)
6 30	1 31	14 38	1 27	14 42	1 23	14 46	1 19	14 50	1 15	14 54	1 11	14 58
40	1 41	14 28	1 37	14 32	1 33	14 36	1 29	14 40	1 25	14 44	1 21	14 48
50	1 51	14 18	1 47	14 22	1 43	14 26	1 39	14 30	1 35	14 34	1 31	14 38
7 00	2 01	14 08	1 57	14 12	1 53	14 16	1 49	14 20	1 45	14 24	1 41	14 28
10	2 10	13 59	2 06	14 03	2 02	14 07	1 58	14 11	1 54	14 15	1 50	14 19
20	2 19	13 50	2 15	13 54	2 11	13 58	2 07	14 02	2 03	14 06	1 59	14 10
7 30	2 28	13 41	2 24	13 45	2 20	13 49	2 16	13 53	2 12	13 57	2 08	14 01
40	2 36	13 33	2 32	13 37	2 28	13 41	2 24	13 45	2 20	13 49	2 16	13 53
50	2 44	13 25	2 40	13 29	2 36	13 33	2 32	13 37	2 28	13 41	2 24	13 45
8 00	2 52	13 17	2 48	13 21	2 44	13 25	2 40	13 29	2 36	13 33	2 32	13 37
10	2 59	13 10	2 55	13 14	2 51	13 18	2 47	13 22	2 43	13 26	2 39	13 30
20	3 06	13 03	3 02	13 07	2 58	13 11	2 54	13 15	2 50	13 19	2 46	13 23
8 30	3 13	12 56	3 09	13 00	3 05	13 04	3 01	13 08	2 57	13 12	2 53	13 16
40	3 20	12 49	3 16	12 53	3 12	12 57	3 08	13 01	3 04	13 05	3 00	13 09
50	3 26	12 43	3 22	12 47	3 18	12 51	3 14	12 55	3 10	12 59	3 06	13 03
9 00	3 32	12 37	3 28	12 41	3 24	12 45	3 20	12 49	3 16	12 53	3 12	12 57
20	3 44	12 25	3 40	12 29	3 36	12 33	3 32	12 37	3 28	12 41	3 24	12 45
40	3 55	12 14	3 51	12 18	3 47	12 22	3 43	12 26	3 39	12 30	3 35	12 34
10 00	4 06	12 03	4 02	12 07	3 58	12 11	3 54	12 15	3 50	12 19	3 46	12 23
20	4 16	11 53	4 12	11 57	4 08	12 01	4 04	12 05	4 00	12 09	3 56	12 13
40	4 25	11 44	4 21	11 48	4 17	11 52	4 13	11 56	4 09	12 00	4 05	12 04
11 00	4 34	11 35	4 30	11 39	4 26	11 43	4 22	11 47	4 18	11 51	4 14	11 55
30	4 46	11 23	4 42	11 27	4 38	11 31	4 34	11 35	4 30	11 39	4 26	11 43
12 00	4 57	11 12	4 53	11 16	4 49	11 20	4 45	11 24	4 41	11 28	4 37	11 32
30	5 08	11 01	5 04	11 05	5 00	11 09	4 56	11 13	4 52	11 17	4 48	11 21
13 00	5 18	10 51	5 14	10 55	5 10	10 59	5 06	11 03	5 02	11 07	4 58	11 11
30	5 27	10 42	5 23	10 46	5 19	10 50	5 15	10 54	5 11	10 58	5 07	11 02
14 00	5 35	10 34	5 31	10 38	5 27	10 42	5 23	10 46	5 19	10 50	5 15	10 54
15 00	5 51	10 18	5 47	10 22	5 43	10 26	5 39	10 30	5 35	10 34	5 31	10 38
16 00	6 04	10 05	6 00	10 09	5 56	10 13	5 52	10 17	5 48	10 21	5 44	10 25
17 00	6 17	9 52	6 13	9 56	6 09	10 00	6 05	10 04	6 01	10 08	5 57	10 12
18 00	6 27	9 42	6 23	9 46	6 19	9 50	6 15	9 54	6 11	9 58	6 07	10 02
19 00	6 37	9 32	6 33	9 36	6 29	9 40	6 25	9 44	6 21	9 48	6 17	9 52
20 00	6 45	9 23	6 41	9 27	6 37	9 31	6 33	9 35	6 29	9 39	6 25	9 43
22 00	7 01	9 07	6 57	9 11	6 53	9 15	6 49	9 19	6 45	9 23	6 41	9 27
24 00	7 14	8 54	7 10	8 58	7 06	9 02	7 02	9 06	6 58	9 10	6 54	9 14
26 00	7 25	8 43	7 21	8 47	7 17	8 51	7 13	8 55	7 09	8 59	7 05	9 03
28 00	7 35	8 33	7 31	8 37	7 27	8 41	7 23	8 45	7 19	8 49	7 15	8 53
30 00	7 43	8 25	7 39	8 29	7 35	8 33	7 31	8 37	7 27	8 41	7 23	8 45
32 00	7 51	8 17	7 47	8 21	7 43	8 25	7 39	8 29	7 35	8 33	7 31	8 37
34 00	7 58	8 10	7 54	8 14	7 50	8 18	7 46	8 22	7 42	8 26	7 38	8 30
36 00	8 04	8 04	8 00	8 08	7 56	8 12	7 52	8 16	7 48	8 20	7 44	8 24
38 00	8 09	7 59	8 05	8 03	8 01	8 07	7 57	8 11	7 53	8 15	7 49	8 19
40 00	8 14	7 53	8 10	7 57	8 06	8 01	8 02	8 05	7 58	8 09	7 54	8 13
45 00	8 25	7 42	8 21	7 46	8 17	7 50	8 13	7 54	8 09	7 58	8 05	8 02
50 00	8 33	7 33	8 29	7 37	8 25	7 41	8 21	7 45	8 17	7 49	8 13	7 53
55 00	8 40	7 25	8 36	7 29	8 32	7 33	8 28	7 37	8 24	7 41	8 20	7 45
60 00	8 46	7 18	8 42	7 22	8 38	7 26	8 34	7 30	8 30	7 34	8 26	7 38
65 00	8 53	7 11	8 49	7 15	8 45	7 19	8 41	7 23	8 37	7 27	8 33	7 31
70 00	8 58	7 05	8 54	7 09	8 50	7 13	8 46	7 17	8 42	7 21	8 38	7 25
75 00	9 02	7 00	8 58	7 04	8 54	7 08	8 50	7 12	8 46	7 16	8 42	7 20
80 00	9 08	6 54	9 04	6 58	9 00	7 02	8 56	7 06	8 52	7 10	8 48	7 14
85 00	9 12	6 49	9 08	6 53	9 04	6 57	9 00	7 01	8 56	7 05	8 52	7 09
90 00	9 16	6 44	9 12	6 48	9 08	6 52	9 04	6 56	9 00	7 00	8 56	7 04

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
		"	"	"	"	"	"	"	"	"	"	"	"	"
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16	
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18		

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16". A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	53 Feet.		54 Feet.		55 Feet.		56 Feet.		57 Feet.		58 Feet.	
	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)	Sun's Corr. (+)	* Star's Corr. (-)
6 30	1 07	15 02	1 03	15 06	0 59	15 10	0 55	15 14	0 51	15 18	0 48	15 21
40	1 17	14 52	1 13	14 56	1 09	15 00	1 05	15 04	1 01	15 08	0 58	15 11
50	1 27	14 42	1 23	14 46	1 19	14 50	1 15	14 54	1 11	14 58	1 08	15 01
7 00	1 37	14 32	1 33	14 36	1 29	14 40	1 25	14 44	1 21	14 48	1 18	14 51
10	1 46	14 23	1 42	14 27	1 38	14 31	1 34	14 35	1 30	14 39	1 27	14 42
20	1 55	14 14	1 51	14 18	1 47	14 22	1 43	14 26	1 39	14 30	1 36	14 33
7 30	2 04	14 05	2 00	14 09	1 56	14 13	1 52	14 17	1 48	14 21	1 45	14 24
40	2 12	13 57	2 08	14 01	2 04	14 05	2 00	14 09	1 56	14 13	1 53	14 16
50	2 20	13 49	2 16	13 53	2 12	13 57	2 08	14 01	2 04	14 05	2 01	14 08
8 00	2 28	13 41	2 24	13 45	2 20	13 49	2 16	13 53	2 12	13 57	2 09	14 00
10	2 35	13 34	2 31	13 38	2 27	13 42	2 23	13 46	2 19	13 50	2 16	13 53
20	2 42	13 27	2 38	13 31	2 34	13 35	2 30	13 39	2 26	13 43	2 23	13 46
8 30	2 49	13 20	2 45	13 24	2 41	13 28	2 37	13 32	2 33	13 36	2 30	13 39
40	2 56	13 13	2 52	13 17	2 48	13 21	2 44	13 25	2 40	13 29	2 37	13 32
50	3 02	13 07	2 58	13 11	2 54	13 15	2 50	13 19	2 46	13 23	2 43	13 26
9 00	3 08	13 01	3 04	13 05	3 00	13 09	2 56	13 13	2 52	13 17	2 49	13 20
20	3 20	12 49	3 16	12 53	3 12	12 57	3 08	13 01	3 04	13 05	3 01	13 08
40	3 31	12 38	3 27	12 42	3 23	12 46	3 19	12 50	3 15	12 54	3 12	12 57
10 00	3 42	12 27	3 38	12 31	3 34	12 35	3 30	12 39	3 26	12 43	3 23	12 46
20	3 52	12 17	3 48	12 21	3 44	12 25	3 40	12 29	3 36	12 33	3 33	12 36
40	4 01	12 08	3 57	12 12	3 53	12 16	3 49	12 20	3 45	12 24	3 42	12 27
11 00	4 10	11 59	4 06	12 03	4 02	12 07	3 58	12 11	3 54	12 15	3 51	12 18
30	4 22	11 47	4 18	11 51	4 14	11 55	4 10	11 59	4 06	12 03	4 03	12 06
12 00	4 33	11 36	4 29	11 40	4 25	11 44	4 21	11 48	4 17	11 52	4 14	11 55
30	4 44	11 25	4 40	11 29	4 36	11 33	4 32	11 37	4 28	11 41	4 25	11 44
13 00	4 54	11 15	4 50	11 19	4 46	11 23	4 42	11 27	4 38	11 31	4 35	11 34
30	5 03	11 06	4 59	11 10	4 55	11 14	4 51	11 18	4 47	11 22	4 44	11 25
14 00	5 11	10 58	5 07	11 02	5 03	11 06	4 59	11 10	4 55	11 14	4 52	11 17
15 00	5 27	10 42	5 23	10 46	5 19	10 50	5 15	10 54	5 11	10 58	5 08	11 01
16 00	5 40	10 29	5 36	10 33	5 32	10 37	5 28	10 41	5 24	10 45	5 21	10 48
17 00	5 53	10 16	5 49	10 20	5 45	10 24	5 41	10 28	5 37	10 32	5 34	10 35
18 00	6 03	10 06	5 59	10 10	5 55	10 14	5 51	10 18	5 47	10 22	5 44	10 25
19 00	6 13	9 56	6 09	10 00	6 05	10 04	6 01	10 08	5 57	10 12	5 54	10 15
20 00	6 21	9 47	6 17	9 51	6 13	9 55	6 09	9 59	6 05	10 03	6 02	10 06
22 00	6 37	9 31	6 33	9 35	6 29	9 39	6 25	9 43	6 21	9 47	6 18	9 50
24 00	6 50	9 18	6 46	9 22	6 42	9 26	6 38	9 30	6 34	9 34	6 31	9 37
26 00	7 01	9 07	6 57	9 11	6 53	9 15	6 49	9 19	6 45	9 23	6 42	9 26
28 00	7 11	8 57	7 07	9 01	7 03	9 05	6 59	9 09	6 55	9 13	6 52	9 16
30 00	7 19	8 49	7 15	8 53	7 11	8 57	7 07	9 01	7 03	9 05	7 00	9 08
32 00	7 27	8 41	7 23	8 45	7 19	8 49	7 15	8 53	7 11	8 57	7 08	9 00
34 00	7 34	8 34	7 30	8 38	7 26	8 42	7 22	8 46	7 18	8 50	7 15	8 53
36 00	7 40	8 28	7 36	8 32	7 32	8 36	7 28	8 40	7 24	8 44	7 21	8 47
38 00	7 45	8 23	7 41	8 27	7 37	8 31	7 33	8 35	7 29	8 39	7 26	8 42
40 00	7 50	8 17	7 46	8 21	7 42	8 25	7 38	8 29	7 34	8 33	7 31	8 36
45 00	8 01	8 06	7 57	8 10	7 53	8 14	7 49	8 18	7 45	8 22	7 42	8 25
50 00	8 09	7 57	8 05	8 01	8 01	8 05	7 57	8 09	7 53	8 13	7 50	8 16
55 00	8 16	7 49	8 12	7 53	8 08	7 57	8 04	8 01	8 00	8 05	7 57	8 08
60 00	8 22	7 42	8 18	7 46	8 14	7 50	8 10	7 54	8 06	7 58	8 03	8 01
65 00	8 29	7 35	8 25	7 39	8 21	7 43	8 17	7 47	8 13	7 51	8 10	7 54
70 00	8 34	7 29	8 30	7 33	8 26	7 37	8 22	7 41	8 18	7 45	8 15	7 48
75 00	8 38	7 24	8 34	7 28	8 30	7 32	8 26	7 36	8 22	7 40	8 19	7 43
80 00	8 44	7 18	8 40	7 22	8 36	7 26	8 32	7 30	8 28	7 34	8 25	7 37
85 00	8 48	7 13	8 44	7 17	8 40	7 21	8 36	7 25	8 32	7 29	8 29	7 32
90 00	8 52	7 08	8 48	7 12	8 44	7 16	8 40	7 20	8 36	7 24	8 33	7 27

ADDITIONAL CORR.  
FOR SUN'S ALT.

Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1st to 15th....	"	"	"	"	"	- 8	-13	-14	-11	- 5	+ 3	+11
16th to 31st...	+18	+15	+ 8	0	-11	-14	-13	- 9	- 1	+ 7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

HEIGHT OF THE EYE.												
Obs. ALT.	59 Feet.		60 Feet.		61 Feet.		62 Feet.		63 Feet.		64 Feet.	
	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)
6 30	0 44	15 25	0 40	15 29	0 36	15 33	0 32	15 37	0 29	15 40	0 25	15 44
40	0 54	15 15	0 50	15 19	0 46	15 23	0 42	15 27	0 39	15 30	0 35	15 34
50	1 04	15 05	1 00	15 09	0 56	15 13	0 52	15 17	0 49	15 20	0 45	15 24
7 00	1 14	14 55	1 10	14 59	1 06	15 03	1 02	15 07	0 59	15 10	0 55	15 14
10	1 23	14 46	1 19	14 50	1 15	14 54	1 11	14 58	1 08	15 01	1 04	15 05
20	1 32	14 37	1 28	14 41	1 24	14 45	1 20	14 49	1 17	14 52	1 13	14 56
7 30	1 41	14 28	1 37	14 32	1 33	14 36	1 29	14 40	1 26	14 43	1 22	14 47
40	1 49	14 20	1 45	14 24	1 41	14 28	1 37	14 32	1 34	14 35	1 30	14 39
50	1 57	14 12	1 53	14 16	1 49	14 20	1 45	14 24	1 42	14 27	1 38	14 31
8 00	2 05	14 04	2 01	14 08	1 57	14 12	1 53	14 16	1 50	14 19	1 46	14 23
10	2 12	13 57	2 08	14 01	2 04	14 05	2 00	14 09	1 57	14 12	1 53	14 16
20	2 19	13 50	2 15	13 54	2 11	13 58	2 07	14 02	2 04	14 05	2 00	14 09
8 30	2 26	13 43	2 22	13 47	2 18	13 51	2 14	13 55	2 11	13 58	2 07	14 02
40	2 33	13 36	2 29	13 40	2 25	13 44	2 21	13 48	2 18	13 51	2 14	13 55
50	2 39	13 30	2 35	13 34	2 31	13 38	2 27	13 42	2 24	13 45	2 20	13 49
9 00	2 45	13 24	2 41	13 28	2 37	13 32	2 33	13 36	2 30	13 39	2 26	13 43
20	2 57	13 12	2 53	13 16	2 49	13 20	2 45	13 24	2 42	13 27	2 38	13 31
40	3 08	13 01	3 04	13 05	3 00	13 09	2 56	13 13	2 53	13 16	2 49	13 20
10 00	3 19	12 50	3 15	12 54	3 11	12 58	3 07	13 02	3 04	13 05	3 00	13 09
20	3 29	12 40	3 25	12 44	3 21	12 48	3 17	12 52	3 14	12 55	3 10	12 59
40	3 38	12 31	3 34	12 35	3 30	12 39	3 26	12 43	3 23	12 46	3 19	12 50
11 00	3 47	12 22	3 43	12 26	3 39	12 30	3 35	12 34	3 32	12 37	3 28	12 41
30	3 59	12 10	3 55	12 14	3 51	12 18	3 47	12 22	3 44	12 25	3 40	12 29
12 00	4 10	11 59	4 06	12 03	4 02	12 07	3 58	12 11	3 55	12 14	3 51	12 18
30	4 21	11 48	4 17	11 52	4 13	11 56	4 09	12 00	4 06	12 03	4 02	12 07
13 00	4 31	11 38	4 27	11 42	4 23	11 46	4 19	11 50	4 16	11 53	4 12	11 57
30	4 40	11 29	4 36	11 33	4 32	11 37	4 28	11 41	4 25	11 44	4 21	11 48
14 00	4 48	11 21	4 44	11 25	4 40	11 29	4 36	11 33	4 33	11 36	4 29	11 40
15 00	5 04	11 05	5 00	11 09	4 56	11 13	4 52	11 17	4 49	11 20	4 45	11 24
16 00	5 17	10 52	5 13	10 56	5 09	11 00	5 05	11 04	5 02	11 07	4 58	11 11
17 00	5 30	10 39	5 26	10 43	5 22	10 47	5 18	10 51	5 15	10 54	5 11	10 58
18 00	5 40	10 29	5 36	10 33	5 32	10 37	5 28	10 41	5 25	10 44	5 21	10 48
19 00	5 50	10 19	5 46	10 23	5 42	10 27	5 38	10 31	5 35	10 34	5 31	10 38
20 00	5 58	10 10	5 54	10 14	5 50	10 18	5 46	10 22	5 43	10 25	5 39	10 29
22 00	6 14	9 54	6 10	9 58	6 06	10 02	6 02	10 06	5 59	10 09	5 55	10 13
24 00	6 27	9 41	6 23	9 45	6 19	9 49	6 15	9 53	6 12	9 56	6 08	10 00
26 00	6 38	9 30	6 34	9 34	6 30	9 38	6 26	9 42	6 23	9 45	6 19	9 49
28 00	6 48	9 20	6 44	9 24	6 40	9 28	6 36	9 32	6 33	9 35	6 29	9 39
30 00	6 56	9 12	6 52	9 16	6 48	9 20	6 44	9 24	6 41	9 27	6 37	9 31
32 00	7 04	9 04	7 00	9 08	6 56	9 12	6 52	9 16	6 49	9 19	6 45	9 23
34 00	7 11	8 57	7 07	9 01	7 03	9 05	6 59	9 09	6 56	9 12	6 52	9 16
36 00	7 17	8 51	7 13	8 55	7 09	8 59	7 05	9 03	7 02	9 06	6 58	9 10
38 00	7 22	8 46	7 18	8 50	7 14	8 54	7 10	8 58	7 07	9 01	7 03	9 05
40 00	7 27	8 40	7 23	8 44	7 19	8 48	7 15	8 52	7 12	8 55	7 08	8 59
45 00	7 38	8 29	7 34	8 33	7 30	8 37	7 26	8 41	7 23	8 44	7 19	8 48
50 00	7 46	8 20	7 42	8 24	7 38	8 28	7 34	8 32	7 31	8 35	7 27	8 39
55 00	7 53	8 12	7 49	8 16	7 45	8 20	7 41	8 24	7 38	8 27	7 34	8 31
60 00	7 59	8 05	7 55	8 09	7 51	8 13	7 47	8 17	7 44	8 20	7 40	8 24
65 00	8 06	7 58	8 02	8 02	7 58	8 06	7 54	8 10	7 51	8 13	7 47	8 17
70 00	8 11	7 52	8 07	7 56	8 03	8 00	7 59	8 04	7 56	8 07	7 52	8 11
75 00	8 15	7 47	8 11	7 51	8 07	7 55	8 03	7 59	8 00	8 02	7 56	8 06
80 00	8 21	7 41	8 17	7 45	8 13	7 49	8 09	7 53	8 06	7 56	8 02	8 00
85 00	8 25	7 36	8 21	7 40	8 17	7 44	8 13	7 48	8 10	7 51	8 06	7 55
90 00	8 29	7 31	8 25	7 35	8 21	7 39	8 17	7 43	8 14	7 46	8 10	7 50

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	" "	+18	+15	+8	0	- 8	-13	-14	-11	-5	+3	+11
16th to 31st....	" "	+17	+12	+4	-4	-11	-14	-13	- 9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16". A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	65 Feet.		66 Feet.		67 Feet.		68 Feet.		69 Feet.		70 Feet.	
	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr. (+)	Star's Corr. (-)
6 30	0 21	15 48	0 18	15 51	0 14	15 55	0 10	15 59	0 07	16 02	0 03	16 06
40	0 31	15 38	0 28	15 41	0 24	15 45	0 20	15 49	0 17	15 52	0 13	15 56
50	0 41	15 28	0 38	15 31	0 34	15 35	0 30	15 39	0 27	15 42	0 23	15 46
7 00	0 51	15 18	0 48	15 21	0 44	15 25	0 40	15 29	0 37	15 32	0 33	15 36
10	1 00	15 09	0 57	15 12	0 53	15 16	0 49	15 20	0 46	15 23	0 42	15 27
20	1 09	15 00	1 06	15 03	1 02	15 07	0 58	15 11	0 55	15 14	0 51	15 18
7 30	1 18	14 51	1 15	14 54	1 11	14 58	1 07	15 02	1 04	15 05	1 00	15 09
40	1 26	14 43	1 23	14 46	1 19	14 50	1 15	14 54	1 12	14 57	1 08	15 01
50	1 34	14 35	1 31	14 38	1 27	14 42	1 23	14 46	1 20	14 49	1 16	14 53
8 00	1 42	14 27	1 39	14 30	1 35	14 34	1 31	14 38	1 28	14 41	1 24	14 45
10	1 49	14 20	1 46	14 23	1 42	14 27	1 38	14 31	1 35	14 34	1 31	14 38
20	1 56	14 13	1 53	14 16	1 49	14 20	1 45	14 24	1 42	14 27	1 38	14 31
8 30	2 03	14 06	2 00	14 09	1 56	14 13	1 52	14 17	1 49	14 20	1 45	14 24
40	2 10	13 59	2 07	14 02	2 03	14 06	1 59	14 10	1 56	14 13	1 52	14 17
50	2 16	13 53	2 13	13 56	2 09	14 00	2 05	14 04	2 02	14 07	1 58	14 11
9 00	2 22	13 47	2 19	13 50	2 15	13 54	2 11	13 58	2 08	14 01	2 04	14 05
20	2 34	13 35	2 31	13 38	2 27	13 42	2 23	13 46	2 20	13 49	2 16	13 53
40	2 45	13 24	2 42	13 27	2 38	13 31	2 34	13 35	2 31	13 38	2 27	13 42
10 00	2 56	13 13	2 53	13 16	2 49	13 20	2 45	13 24	2 42	13 27	2 38	13 31
20	3 06	13 03	3 03	13 06	2 59	13 10	2 55	13 14	2 52	13 17	2 48	13 21
40	3 15	12 54	3 12	12 57	3 08	13 01	3 04	13 05	3 01	13 08	2 57	13 12
11 00	3 24	12 45	3 21	12 48	3 17	12 52	3 13	12 56	3 10	12 59	3 06	13 03
30	3 36	12 33	3 33	12 36	3 29	12 40	3 25	12 44	3 22	12 47	3 18	12 51
12 00	3 47	12 22	3 44	12 25	3 40	12 29	3 36	12 33	3 33	12 36	3 29	12 40
30	3 58	12 11	3 55	12 14	3 51	12 18	3 47	12 22	3 44	12 25	3 40	12 29
13 00	4 08	12 01	4 05	12 04	4 01	12 08	3 57	12 12	3 54	12 15	3 50	12 19
30	4 17	11 52	4 14	11 55	4 10	11 59	4 06	12 03	4 03	12 06	3 59	12 10
14 00	4 25	11 44	4 22	11 47	4 18	11 51	4 14	11 55	4 11	11 58	4 07	12 02
15 00	4 41	11 28	4 38	11 31	4 34	11 35	4 30	11 39	4 27	11 42	4 23	11 46
16 00	4 54	11 15	4 51	11 18	4 47	11 22	4 43	11 26	4 40	11 29	4 36	11 33
17 00	5 07	11 02	5 04	11 05	5 00	11 09	4 56	11 13	4 53	11 16	4 49	11 20
18 00	5 17	10 52	5 14	10 55	5 10	10 59	5 06	11 03	5 03	11 06	4 59	11 10
19 00	5 27	10 42	5 24	10 45	5 20	10 49	5 16	10 53	5 13	10 56	5 09	11 00
20 00	5 35	10 33	5 32	10 36	5 28	10 40	5 24	10 44	5 21	10 47	5 17	10 51
22 00	5 51	10 17	5 48	10 20	5 44	10 24	5 40	10 28	5 37	10 31	5 33	10 35
24 00	6 04	10 04	6 01	10 07	5 57	10 11	5 53	10 15	5 50	10 18	5 46	10 22
26 00	6 15	9 53	6 12	9 56	6 08	10 00	6 04	10 04	6 01	10 07	5 57	10 11
28 00	6 25	9 43	6 22	9 46	6 18	9 50	6 14	9 54	6 11	9 57	6 07	10 01
30 00	6 33	9 35	6 30	9 38	6 26	9 42	6 22	9 46	6 19	9 49	6 15	9 53
32 00	6 41	9 27	6 38	9 30	6 34	9 34	6 30	9 38	6 27	9 41	6 23	9 45
34 00	6 48	9 20	6 45	9 23	6 41	9 27	6 37	9 31	6 34	9 34	6 30	9 38
36 00	6 54	9 14	6 51	9 17	6 47	9 21	6 43	9 25	6 40	9 28	6 36	9 32
38 00	6 59	9 09	6 56	9 12	6 52	9 16	6 48	9 20	6 45	9 23	6 41	9 27
40 00	7 04	9 03	7 01	9 06	6 57	9 10	6 53	9 14	6 50	9 17	6 46	9 21
45 00	7 15	8 52	7 12	8 55	7 08	8 59	7 04	8 53	7 01	8 47	6 57	9 01
50 00	7 23	8 43	7 20	8 46	7 16	8 50	7 12	8 54	7 09	8 57	7 05	8 53
55 00	7 30	8 35	7 27	8 38	7 23	8 42	7 19	8 46	7 16	8 49	7 12	8 43
60 00	7 36	8 28	7 33	8 31	7 29	8 35	7 25	8 39	7 22	8 42	7 18	8 46
65 00	7 43	8 21	7 40	8 24	7 36	8 28	7 32	8 32	7 29	8 35	7 25	8 39
70 00	7 48	8 15	7 45	8 18	7 41	8 22	7 37	8 26	7 34	8 29	7 30	8 33
75 00	7 52	8 10	7 49	8 13	7 45	8 17	7 41	8 21	7 38	8 24	7 34	8 28
80 00	7 58	8 04	7 55	8 07	7 51	8 11	7 47	8 15	7 44	8 18	7 40	8 22
85 00	8 02	7 59	7 59	8 02	7 55	8 06	7 51	8 10	7 48	8 13	7 44	8 17
90 00	8 06	7 54	8 03	7 57	7 59	8 01	7 55	8 05	7 52	8 08	7 48	8 12

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	71 Feet.		72 Feet.		73 Feet.		74 Feet.		75 Feet.		76 Feet.	
	Sun's Corr. (+)	Star's Corr. (-)	Sun's Corr.	Star's Corr. (-)	Sun's Corr.	Star's Corr. (-)	Sun's Corr.	Star's Corr. (-)	Sun's Corr.	Star's Corr. (-)	Sun's Corr.	Star's Corr. (-)
6 30	0 00	16 09	-0 04	16 13	-0 08	16 17	-0 11	16 20	-0 14	16 23	-0 17	16 26
40	0 10	15 59	+0 06	16 03	+0 02	16 07	-0 01	16 10	-0 04	16 13	-0 07	16 16
50	0 20	15 49	0 16	15 53	0 12	15 57	+0 09	16 00	+0 06	16 03	+0 03	16 06
7 00	0 30	15 39	0 26	15 43	0 22	15 47	1 19	15 50	0 16	15 53	0 13	15 56
10	0 39	15 30	0 35	15 34	0 31	15 38	1 28	15 41	0 25	15 44	0 22	15 47
20	0 48	15 21	0 44	15 25	0 40	15 29	1 37	15 32	0 34	15 35	0 31	15 38
7 30	0 57	15 12	0 53	15 16	0 49	15 20	1 46	15 23	0 43	15 26	0 40	15 29
40	1 05	15 04	1 01	15 08	0 57	15 12	1 54	15 15	0 51	15 18	0 48	15 21
50	1 13	14 56	1 09	15 00	1 05	15 04	1 02	15 07	0 59	15 10	0 56	15 13
8 00	1 21	14 48	1 17	14 52	1 13	14 56	1 10	14 59	1 07	15 02	1 04	15 05
10	1 28	14 41	1 24	14 45	1 20	14 49	1 17	14 52	1 14	14 55	1 11	14 58
20	1 35	14 34	1 31	14 38	1 27	14 42	1 24	14 45	1 21	14 48	1 18	14 51
8 30	1 42	14 27	1 38	14 31	1 34	14 35	1 31	14 38	1 28	14 41	1 25	14 44
40	1 49	14 20	1 45	14 24	1 41	14 28	1 38	14 31	1 35	14 34	1 32	14 37
50	1 55	14 14	1 51	14 18	1 47	14 22	1 44	14 25	1 41	14 28	1 38	14 31
9 00	2 01	14 08	1 57	14 12	1 53	14 16	1 50	14 19	1 47	14 22	1 44	14 25
20	2 13	13 56	2 09	14 00	2 05	14 04	2 02	14 07	1 59	14 10	1 56	14 13
40	2 24	13 45	2 20	13 49	2 16	13 53	2 13	13 56	2 10	13 59	2 07	14 02
10 00	2 35	13 34	2 31	13 38	2 27	13 42	2 24	13 45	2 21	13 48	2 18	13 51
20	2 45	13 24	2 41	13 28	2 37	13 32	2 34	13 35	2 31	13 38	2 28	13 41
40	2 54	13 15	2 50	13 19	2 46	13 23	2 43	13 26	2 40	13 29	2 37	13 32
11 00	3 03	13 06	2 59	13 10	2 55	13 14	2 52	13 17	2 49	13 20	2 46	13 23
30	3 15	12 54	3 11	12 58	3 07	13 02	3 04	13 05	3 01	13 08	2 58	13 11
12 00	3 26	12 43	3 22	12 47	3 18	12 51	3 15	12 54	3 12	12 57	3 09	13 00
30	3 37	12 32	3 33	12 36	3 29	12 40	3 26	12 43	3 23	12 46	3 20	12 49
13 00	3 47	12 22	3 43	12 26	3 39	12 30	3 36	12 33	3 33	12 36	3 30	12 39
30	3 56	12 13	3 52	12 17	3 48	12 21	3 45	12 24	3 42	12 27	3 39	12 30
14 00	4 04	12 05	4 00	12 09	3 56	12 13	3 53	12 16	3 50	12 19	3 47	12 22
15 00	4 20	11 49	4 16	11 53	4 12	11 57	4 09	12 00	4 06	12 03	4 03	12 06
16 00	4 33	11 36	4 29	11 40	4 25	11 44	4 22	11 47	4 19	11 50	4 16	11 53
17 00	4 46	11 23	4 42	11 27	4 38	11 31	4 35	11 34	4 32	11 37	4 29	11 40
18 00	4 56	11 13	4 52	11 17	4 48	11 21	4 45	11 24	4 42	11 27	4 39	11 30
19 00	5 06	11 03	5 02	11 07	4 58	11 11	4 55	11 14	4 52	11 17	4 49	11 20
20 00	5 14	10 54	5 10	10 58	5 06	11 02	5 03	11 05	5 00	11 08	4 57	11 11
22 00	5 30	10 38	5 26	10 42	5 22	10 46	5 19	10 49	5 16	10 52	5 13	10 55
24 00	5 43	10 25	5 39	10 29	5 35	10 33	5 32	10 36	5 29	10 39	5 26	10 42
26 00	5 54	10 14	5 50	10 18	5 46	10 22	5 43	10 25	5 40	10 28	5 37	10 31
28 00	6 04	10 04	6 00	10 08	5 56	10 12	5 53	10 15	5 50	10 18	5 47	10 21
30 00	6 12	9 56	6 08	10 00	6 04	10 04	6 01	10 07	5 58	10 10	5 55	10 13
32 00	6 20	9 48	6 16	9 52	6 12	9 56	6 09	9 59	6 06	10 02	6 03	10 05
34 00	6 27	9 41	6 23	9 45	6 19	9 49	6 16	9 52	6 13	9 55	6 10	9 58
36 00	6 33	9 35	6 29	9 39	6 25	9 43	6 22	9 46	6 19	9 49	6 16	9 52
38 00	6 38	9 30	6 34	9 34	6 30	9 38	6 27	9 41	6 24	9 44	6 21	9 47
40 00	6 43	9 24	6 39	9 28	6 35	9 32	6 32	9 35	6 29	9 38	6 26	9 41
45 00	6 54	9 13	6 50	9 17	6 46	9 21	6 43	9 24	6 40	9 27	6 37	9 30
50 00	7 02	9 04	6 58	9 08	6 54	9 12	6 51	9 15	6 48	9 18	6 45	9 21
55 00	7 09	8 56	* 7 05	9 00	7 01	9 04	6 58	9 07	6 55	9 10	6 52	9 13
60 00	7 15	8 49	7 11	8 53	7 07	8 57	7 04	9 00	7 01	9 03	6 58	9 06
65 00	7 22	8 42	7 18	8 46	7 14	8 50	7 11	8 53	7 08	8 56	7 05	8 59
70 00	7 27	8 36	7 23	8 40	7 19	8 44	7 16	8 47	7 13	8 50	7 10	8 53
75 00	7 31	8 31	7 27	8 35	7 23	8 39	7 20	8 42	7 17	8 45	7 14	8 48
80 00	7 37	8 25	7 33	8 29	7 29	8 33	7 26	8 36	7 23	8 39	7 20	8 42
85 00	7 41	8 20	7 37	8 24	7 33	8 28	7 30	8 31	7 27	8 34	7 24	8 37
90 00	7 45	8 15	+7 41	8 19	+7 37	8 23	+7 34	8 26	+7 31	8 29	+7 28	8 32

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16
	16th to 31st....	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

HEIGHT OF THE EYE.

OBS. ALT.	77 Feet.		78 Feet.		79 Feet.		80 Feet.		81 Feet.		82 Feet.	
	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)
	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
6 30	-0 21	16 30	-0 24	16 33	-0 28	16 37	-0 31	16 40	-0 34	16 43	-0 37	16 46
40	-0 11	16 20	-0 14	16 23	-0 18	16 27	-0 21	16 30	-0 24	16 33	-0 27	16 36
50	-0 01	16 10	-0 04	16 13	-0 08	16 17	-0 11	16 20	-0 14	16 23	-0 17	16 26
7 00	+0 09	16 00	+0 06	16 03	+0 02	16 07	-0 01	16 10	-0 04	16 13	-0 07	16 16
10	0 18	15 51	0 15	15 54	0 11	15 58	+0 08	16 01	+0 05	16 04	+0 02	16 07
20	0 27	15 42	0 24	15 45	0 20	15 49	0 17	15 52	0 14	15 55	0 11	15 58
7 30	0 36	15 33	0 33	15 36	0 29	15 40	0 26	15 43	0 23	15 46	0 20	15 49
40	0 44	15 25	0 41	15 28	0 37	15 32	0 34	15 35	0 31	15 38	0 28	15 41
50	0 52	15 17	0 49	15 20	0 45	15 24	0 42	15 27	0 39	15 30	0 36	15 33
8 00	1 00	15 09	0 57	15 12	0 53	15 16	0 50	15 19	0 47	15 22	0 44	15 25
10	1 07	15 02	1 04	15 05	1 00	15 09	0 57	15 12	0 54	15 15	0 51	15 18
20	1 14	14 55	1 11	14 58	1 07	15 02	1 04	15 05	1 01	15 08	0 58	15 11
8 30	1 21	14 48	1 18	14 51	1 14	14 55	1 11	14 58	1 08	15 01	1 05	15 04
40	1 28	14 41	1 25	14 44	1 21	14 48	1 18	14 51	1 15	14 54	1 12	14 57
50	1 34	14 35	1 31	14 38	1 27	14 42	1 24	14 45	1 21	14 48	1 18	14 51
9 00	1 40	14 29	1 37	14 32	1 33	14 36	1 30	14 39	1 27	14 42	1 24	14 45
20	1 52	14 17	1 49	14 20	1 45	14 24	1 42	14 27	1 39	14 30	1 36	14 33
40	2 03	14 06	2 00	14 09	1 56	14 13	1 53	14 16	1 50	14 19	1 47	14 22
10 00	2 14	13 55	2 11	13 58	2 07	14 02	2 04	14 05	2 01	14 08	1 58	14 11
20	2 24	13 45	2 21	13 48	2 17	13 52	2 14	13 55	2 11	13 58	2 08	14 01
40	2 33	13 36	2 30	13 39	2 26	13 43	2 23	13 46	2 20	13 49	2 17	13 52
11 00	2 42	13 27	2 39	13 30	2 35	13 34	2 32	13 37	2 29	13 40	2 26	13 43
30	2 54	13 15	2 51	13 18	2 47	13 22	2 44	13 25	2 41	13 28	2 38	13 31
12 00	3 05	13 04	3 02	13 07	2 58	13 11	2 55	13 14	2 52	13 17	2 49	13 20
30	3 16	12 53	3 13	12 56	3 09	13 00	3 06	13 03	3 03	13 06	3 00	13 09
13 00	3 26	12 43	3 23	12 46	3 19	12 50	3 16	12 53	3 13	12 56	3 10	12 59
30	3 35	12 34	3 32	12 37	3 28	12 41	3 25	12 44	3 22	12 47	3 19	12 50
14 00	3 43	12 26	3 40	12 29	3 36	12 33	3 33	12 36	3 30	12 39	3 27	12 42
15 00	3 59	12 10	3 56	12 13	3 52	12 17	3 49	12 20	3 46	12 23	3 43	12 26
16 00	4 12	11 57	4 09	12 00	4 05	12 04	4 02	12 07	3 59	12 10	3 56	12 13
17 00	4 25	11 44	4 22	11 47	4 18	11 51	4 15	11 54	4 12	11 57	4 09	12 00
18 00	4 35	11 34	4 32	11 37	4 28	11 41	4 25	11 44	4 22	11 47	4 19	11 50
19 00	4 45	11 24	4 42	11 27	4 38	11 31	4 35	11 34	4 32	11 37	4 29	11 40
20 00	4 53	11 15	4 50	11 18	4 46	11 22	4 43	11 25	4 40	11 28	4 37	11 31
22 00	5 09	10 59	5 06	11 02	5 02	11 06	4 59	11 09	4 56	11 12	4 53	11 15
24 00	5 22	10 46	5 19	10 49	5 15	10 53	5 12	10 56	5 09	10 59	5 06	11 02
26 00	5 33	10 35	5 30	10 38	5 26	10 42	5 23	10 45	5 20	10 48	5 17	10 51
28 00	5 43	10 25	5 40	10 28	5 36	10 32	5 33	10 35	5 30	10 38	5 27	10 41
30 00	5 51	10 17	5 48	10 20	5 44	10 24	5 41	10 27	5 38	10 30	5 35	10 33
32 00	5 59	10 09	5 56	10 12	5 52	10 16	5 49	10 19	5 46	10 22	5 43	10 25
34 00	6 06	10 02	6 03	10 05	5 59	10 09	5 56	10 12	5 53	10 15	5 50	10 18
36 00	6 12	9 56	6 09	9 59	6 05	10 03	6 02	10 06	5 59	10 09	5 56	10 12
38 00	6 17	9 51	6 14	9 54	6 10	9 58	6 07	10 01	6 04	10 04	6 01	10 07
40 00	6 22	9 45	6 19	9 48	6 15	9 52	6 12	9 55	6 09	9 58	6 06	10 01
45 00	6 33	9 34	6 30	9 37	6 26	9 41	6 23	9 44	6 20	9 47	6 17	9 50
50 00	6 41	9 25	6 38	9 28	6 34	9 32	6 31	9 35	6 28	9 38	6 25	9 41
55 00	6 48	9 17	6 45	9 20	6 41	9 24	6 38	9 27	6 35	9 30	6 32	9 33
60 00	6 54	9 10	6 51	9 13	6 47	9 17	6 44	9 20	6 41	9 23	6 38	9 26
65 00	7 01	9 03	6 58	9 06	6 54	9 10	6 51	9 13	6 48	9 16	6 45	9 19
70 00	7 06	8 57	7 03	9 00	6 59	9 04	6 56	9 07	6 53	9 10	6 50	9 13
75 00	7 10	8 52	7 07	8 55	7 03	8 59	7 00	9 02	6 57	9 05	6 54	9 08
80 00	7 16	8 46	7 13	8 49	7 09	8 53	7 06	8 56	7 03	8 59	7 00	9 02
85 00	7 20	8 41	7 17	8 44	7 13	8 48	7 10	8 51	7 07	8 54	7 04	8 57
90 00	+7 24	8 36	+7 21	8 39	+7 17	8 43	+7 14	8 46	+7 11	8 49	+7 08	8 52

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	- 8	-13	-14	-11	-5	+3	+11
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	- 9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



TABLE I.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

Obs. ALT.		HEIGHT OF THE EYE.											
		83 Feet.		84 Feet.		85 Feet.		86 Feet.		87 Feet.		88 Feet.	
		☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)
6	30	-0 41	16 50	-0 44	16 53	-0 47	16 56	-0 50	16 59	-0 53	17 02	-0 57	17 06
	40	-0 31	16 40	-0 34	16 43	-0 37	16 46	-0 40	16 49	-0 43	16 52	-0 47	16 56
	50	-0 21	16 30	-0 24	16 33	-0 27	16 36	-0 30	16 39	-0 33	16 42	-0 37	16 46
7	00	-0 11	16 20	-0 14	16 23	-0 17	16 26	-0 20	16 29	-0 23	16 32	-0 27	16 36
	10	-0 02	16 11	-0 05	16 14	-0 08	16 17	-0 11	16 20	-0 14	16 23	-0 18	16 27
	20	+0 07	16 02	+0 04	16 05	+0 01	16 08	-0 02	16 11	-0 05	16 14	-0 09	16 18
7	30	0 16	15 53	0 13	15 56	0 10	15 59	+0 07	16 02	+0 04	16 05	0 00	16 09
	40	0 24	15 45	0 21	15 48	0 18	15 51	0 15	15 54	0 12	15 57	+0 08	16 01
	50	0 32	15 37	0 29	15 40	0 26	15 43	0 23	15 46	0 20	15 49	0 16	15 53
8	00	0 40	15 29	0 37	15 32	0 34	15 35	0 31	15 38	0 28	15 41	0 24	15 45
	10	0 47	15 22	0 44	15 25	0 41	15 28	0 38	15 31	0 35	15 34	0 31	15 38
	20	0 54	15 15	0 51	15 18	0 48	15 21	0 45	15 24	0 42	15 27	0 38	15 31
8	30	1 01	15 08	0 58	15 11	0 55	15 14	0 52	15 17	0 49	15 20	0 45	15 24
	40	1 08	15 01	1 05	15 04	1 02	15 07	0 59	15 10	0 56	15 13	0 52	15 17
	50	1 14	14 55	1 11	14 58	1 08	15 01	1 05	15 04	1 02	15 07	0 58	15 11
9	00	1 20	14 49	1 17	14 52	1 14	14 55	1 11	14 58	1 08	15 01	1 04	15 05
	20	1 32	14 37	1 29	14 40	1 26	14 43	1 23	14 46	1 20	14 49	1 16	14 53
	40	1 43	14 26	1 40	14 29	1 37	14 32	1 34	14 35	1 31	14 38	1 27	14 42
10	00	1 54	14 15	1 51	14 18	1 48	14 21	1 45	14 24	1 42	14 27	1 38	14 31
	20	2 04	14 05	2 01	14 08	1 58	14 11	1 55	14 14	1 52	14 17	1 48	14 21
	40	2 13	13 56	2 10	13 59	2 07	14 02	2 04	14 05	2 01	14 08	1 57	14 12
11	00	2 22	13 47	2 19	13 50	2 16	13 53	2 13	13 56	2 10	13 59	2 06	14 03
	30	2 34	13 35	2 31	13 38	2 28	13 41	2 25	13 44	2 22	13 47	2 18	13 51
	40	2 45	13 24	2 42	13 27	2 39	13 30	2 36	13 33	2 33	13 36	2 29	13 40
12	00	2 56	13 13	2 53	13 16	2 50	13 19	2 47	13 22	2 44	13 25	2 40	13 29
	30	3 06	13 03	3 03	13 06	3 00	13 09	2 57	13 12	2 54	13 15	2 50	13 19
	40	3 15	12 54	3 12	12 57	3 09	13 00	3 06	13 03	3 03	13 06	2 59	13 10
14	00	3 23	12 46	3 20	12 49	3 17	12 52	3 14	12 55	3 11	12 58	3 07	13 02
	15	3 39	12 30	3 36	12 33	3 33	12 36	3 30	12 39	3 27	12 42	3 23	12 46
	16	3 52	12 17	3 49	12 20	3 46	12 23	3 43	12 26	3 40	12 29	3 36	12 33
	17	4 05	12 04	4 02	12 07	3 59	12 10	3 56	12 13	3 53	12 16	3 49	12 20
	18	4 15	11 54	4 12	11 57	4 09	12 00	4 06	12 03	4 03	12 06	3 59	12 10
	19	4 25	11 44	4 22	11 47	4 19	11 50	4 16	11 53	4 13	11 56	4 09	12 00
	20	4 33	11 35	4 30	11 38	4 27	11 41	4 24	11 44	4 21	11 47	4 17	11 51
	22	4 49	11 19	4 46	11 22	4 43	11 25	4 40	11 28	4 37	11 31	4 33	11 35
	24	5 02	11 06	4 59	11 09	4 56	11 12	4 53	11 15	4 50	11 18	4 46	11 22
	26	5 13	10 55	5 10	10 58	5 07	11 01	5 04	11 04	5 01	11 07	4 57	11 11
	28	5 23	10 45	5 20	10 48	5 17	10 51	5 14	10 54	5 11	10 57	5 07	11 01
	30	5 31	10 37	5 28	10 40	5 25	10 43	5 22	10 46	5 19	10 49	5 15	10 53
	32	5 39	10 29	5 36	10 32	5 33	10 35	5 30	10 38	5 27	10 41	5 23	10 45
	34	5 46	10 22	5 43	10 25	5 40	10 28	5 37	10 31	5 34	10 34	5 30	10 38
	36	5 52	10 16	5 49	10 19	5 46	10 22	5 43	10 25	5 40	10 28	5 36	10 32
	38	5 57	10 11	5 54	10 14	5 51	10 17	5 48	10 20	5 45	10 23	5 41	10 27
	40	6 02	10 05	5 59	10 08	5 56	10 11	5 53	10 14	5 50	10 17	5 46	10 21
	45	6 13	9 54	6 10	9 57	6 07	10 00	6 04	10 03	6 01	10 06	5 57	10 10
	50	6 21	9 45	6 18	9 48	6 15	9 51	6 12	9 54	6 09	9 57	6 05	10 01
	55	6 28	9 37	6 25	9 40	6 22	9 43	6 19	9 46	6 16	9 49	6 12	9 53
	60	6 34	9 30	6 31	9 33	6 28	9 36	6 25	9 39	6 22	9 42	6 18	9 46
	65	6 41	9 23	6 38	9 26	6 35	9 29	6 32	9 32	6 29	9 35	6 25	9 39
	70	6 46	9 17	6 43	9 20	6 40	9 23	6 37	9 26	6 34	9 29	6 30	9 33
	75	6 50	9 12	6 47	9 15	6 44	9 18	6 41	9 21	6 38	9 24	6 34	9 28
	80	6 56	9 06	6 53	9 09	6 50	9 12	6 47	9 15	6 44	9 18	6 40	9 22
	85	7 00	9 01	6 57	9 04	6 54	9 07	6 51	9 10	6 48	9 13	6 44	9 17
	90	+7 04	8 56	+7 01	8 59	+6 58	9 02	+6 55	9 05	+6 52	9 08	+6 48	9 12

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.

Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	89 Feet.		90 Feet.		91 Feet.		92 Feet.		93 Feet.		94 Feet.	
	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)
6 30	-1 00	17 09	-1 03	17 12	-1 06	17 15	-1 09	17 18	-1 12	17 21	-1 15	17 24
40	-0 50	16 59	-0 53	17 02	-0 56	17 05	-0 59	17 08	-1 02	17 11	-1 05	17 14
50	-0 40	16 49	-0 43	16 52	-0 46	16 55	-0 49	16 58	-0 52	17 01	-0 55	17 04
7 00	-0 30	16 39	-0 33	16 42	-0 36	16 45	-0 39	16 48	-0 42	16 51	-0 45	16 54
20	-0 21	16 30	-0 24	16 33	-0 27	16 36	-0 30	16 39	-0 33	16 42	-0 36	16 45
10	-0 12	16 21	-0 15	16 24	-0 18	16 27	-0 21	16 30	-0 24	16 33	-0 27	16 36
7 30	-0 03	16 12	-0 06	16 15	-0 09	16 18	-0 12	16 21	-0 15	16 24	-0 18	16 27
40	+0 05	16 04	+0 02	16 07	-0 01	16 10	-0 04	16 13	-0 07	16 16	-0 10	16 19
50	0 13	15 56	0 10	15 59	+0 07	16 02	+0 04	16 05	+0 01	16 08	-0 02	16 11
8 00	0 21	15 48	0 18	15 51	0 15	15 54	0 12	15 57	0 09	16 00	+0 06	16 03
10	0 28	15 41	0 25	15 44	0 22	15 47	0 19	15 50	0 16	15 53	0 13	15 56
20	0 35	15 34	0 32	15 37	0 29	15 40	0 26	15 43	0 23	15 46	0 20	15 49
8 30	0 42	15 27	0 39	15 30	0 36	15 33	0 33	15 36	0 30	15 39	0 27	15 42
40	0 49	15 20	0 46	15 23	0 43	15 26	0 40	15 29	0 37	15 32	0 34	15 35
50	0 55	15 14	0 52	15 17	0 49	15 20	0 46	15 23	0 43	15 26	0 40	15 29
9 00	1 01	15 08	0 58	15 11	0 55	15 14	0 52	15 17	0 49	15 20	0 46	15 23
20	1 13	14 56	1 10	14 59	1 07	15 02	1 04	15 05	1 01	15 08	0 58	15 11
40	1 24	14 45	1 21	14 48	1 18	14 51	1 15	14 54	1 12	14 57	1 09	15 00
10 00	1 35	14 34	1 32	14 37	1 29	14 40	1 26	14 43	1 23	14 46	1 20	14 49
20	1 45	14 24	1 42	14 27	1 39	14 30	1 36	14 33	1 33	14 36	1 30	14 39
40	1 54	14 15	1 51	14 18	1 48	14 21	1 45	14 24	1 42	14 27	1 39	14 30
11 00	2 03	14 06	2 00	14 09	1 57	14 12	1 54	14 15	1 51	14 18	1 48	14 21
30	2 15	13 54	2 12	13 57	2 09	14 00	2 06	14 03	2 03	14 06	2 00	14 09
12 00	2 26	13 43	2 23	13 46	2 20	13 49	2 17	13 52	2 14	13 55	2 11	13 58
30	2 37	13 32	2 34	13 35	2 31	13 38	2 28	13 41	2 25	13 44	2 22	13 47
13 00	2 47	13 22	2 44	13 25	2 41	13 28	2 38	13 31	2 35	13 34	2 32	13 37
30	2 56	13 13	2 53	13 16	2 50	13 19	2 47	13 22	2 44	13 25	2 41	13 28
14 00	3 04	13 05	3 01	13 08	2 58	13 11	2 55	13 14	2 52	13 17	2 49	13 20
15 00	3 20	12 49	3 17	12 52	3 14	12 55	3 11	12 58	3 08	13 01	3 05	13 04
16 00	3 33	12 36	3 30	12 39	3 27	12 42	3 24	12 45	3 21	12 48	3 18	12 51
17 00	3 46	12 23	3 43	12 26	3 40	12 29	3 37	12 32	3 34	12 35	3 31	12 38
18 00	3 56	12 13	3 53	12 16	3 50	12 19	3 47	12 22	3 44	12 25	3 41	12 28
19 00	4 06	12 03	4 03	12 06	4 00	12 09	3 57	12 12	3 54	12 15	3 51	12 18
20 00	4 14	11 54	4 11	11 57	4 08	12 00	4 05	12 03	4 02	12 06	3 59	12 09
22 00	4 30	11 38	4 27	11 41	4 24	11 44	4 21	11 47	4 18	11 50	4 15	11 53
24 00	4 43	11 25	4 40	11 28	4 37	11 31	4 34	11 34	4 31	11 37	4 28	11 40
26 00	4 54	11 14	4 51	11 17	4 48	11 20	4 45	11 23	4 42	11 26	4 39	11 29
28 00	5 04	11 04	5 01	11 07	4 58	11 10	4 55	11 13	4 52	11 16	4 49	11 19
30 00	5 12	10 56	5 09	10 59	5 06	11 02	5 03	11 05	5 00	11 08	4 57	11 11
32 00	5 20	10 48	5 17	10 51	5 14	10 54	5 11	10 57	5 08	11 00	5 05	11 03
34 00	5 27	10 41	5 24	10 44	5 21	10 47	5 18	10 50	5 15	10 53	5 12	10 56
36 00	5 33	10 35	5 30	10 38	5 27	10 41	5 24	10 44	5 21	10 47	5 18	10 50
38 00	5 38	10 30	5 35	10 33	5 32	10 36	5 29	10 39	5 26	10 42	5 23	10 45
40 00	5 43	10 24	5 40	10 27	5 37	10 30	5 34	10 33	5 31	10 36	5 28	10 39
45 00	5 54	10 13	5 51	10 16	5 48	10 19	5 45	10 22	5 42	10 25	5 39	10 28
50 00	6 02	10 04	5 59	10 07	5 56	10 10	5 53	10 13	5 50	10 16	5 47	10 19
55 00	6 09	9 56	6 06	9 59	6 03	10 02	6 00	10 05	5 57	10 08	5 54	10 11
60 00	6 15	9 49	6 12	9 52	6 09	9 55	6 06	9 58	6 03	10 01	6 00	10 04
65 00	6 22	9 42	6 19	9 45	6 16	9 48	6 13	9 51	6 10	9 54	6 07	9 57
70 00	6 27	9 36	6 24	9 39	6 21	9 42	6 18	9 45	6 15	9 48	6 12	9 51
75 00	6 31	9 31	6 28	9 34	6 25	9 37	6 22	9 40	6 19	9 43	6 16	9 46
80 00	6 37	9 25	6 34	9 28	6 31	9 31	6 28	9 34	6 25	9 37	6 22	9 40
85 00	6 41	9 20	6 38	9 23	6 35	9 26	6 32	9 29	6 29	9 32	6 26	9 35
90 00	+6 45	9 15	+6 42	9 18	+6 39	9 21	+6 36	9 24	+6 33	9 27	+6 30	9 30

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11	+16
	16th to 31st..	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



Corrections\* to be Applied to the Observed Altitude of a Star or of the Sun's Lower Limb, to Find the True Altitude—Continued.

OBS. ALT.	HEIGHT OF THE EYE.											
	95 Feet.		96 Feet.		97 Feet.		98 Feet.		99 Feet.		100 Feet.	
	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)	☉ Sun's Corr.	* Star's Corr. (-)
6 30	-1 18	17 27	-1 21	17 30	-1 24	17 33	-1 27	17 36	-1 30	17 39	-1 33	17 42
40	-1 08	17 17	-1 11	17 20	-1 14	17 23	-1 17	17 26	-1 20	17 29	-1 23	17 32
50	-0 58	17 07	-1 01	17 10	-1 04	17 13	-1 07	17 16	-1 10	17 19	-1 13	17 22
7 00	-0 48	16 57	-0 51	17 00	-0 54	17 03	-0 57	17 06	-1 00	17 09	-1 03	17 12
10	-0 39	16 48	-0 42	16 51	-0 45	16 54	-0 48	16 57	-0 51	17 00	-0 54	17 03
20	-0 30	16 39	-0 33	16 42	-0 36	16 45	-0 39	16 48	-0 42	16 51	-0 45	16 54
7 30	-0 21	16 30	-0 24	16 33	-0 27	16 36	-0 30	16 39	-0 33	16 42	-0 36	16 45
40	-0 13	16 22	-0 16	16 25	-0 19	16 28	-0 22	16 31	-0 25	16 34	-0 28	16 37
50	-0 05	16 14	-0 08	16 17	-0 11	16 20	-0 14	16 23	-0 17	16 26	-0 20	16 29
8 00	+0 03	16 06	0 00	16 09	-0 03	16 12	-0 06	16 15	-0 09	16 18	-0 12	16 21
10	0 10	15 59	+0 07	16 02	+0 04	16 05	+0 01	16 08	-0 02	16 11	-0 05	16 14
20	0 17	15 52	0 14	15 55	0 11	15 58	0 08	16 01	+0 05	16 04	+0 02	16 07
8 30	0 24	15 45	0 21	15 48	0 18	15 51	0 15	15 54	0 12	15 57	0 09	16 00
40	0 31	15 38	0 28	15 41	0 25	15 44	0 22	15 47	0 19	15 50	0 16	15 53
50	0 37	15 32	0 34	15 35	0 31	15 38	0 28	15 41	0 25	15 44	0 22	15 47
9 00	0 43	15 26	0 40	15 29	0 37	15 32	0 34	15 35	0 31	15 38	0 28	15 41
20	0 55	15 14	0 52	15 17	0 49	15 20	0 46	15 23	0 43	15 26	0 40	15 29
40	1 06	15 03	1 03	15 06	1 00	15 09	0 57	15 12	0 54	15 15	0 51	15 18
10 00	1 17	14 52	1 14	14 55	1 11	14 58	1 08	15 01	1 05	15 04	1 02	15 07
20	1 27	14 42	1 24	14 45	1 21	14 48	1 18	14 51	1 15	14 54	1 12	14 57
40	1 36	14 33	1 33	14 36	1 30	14 39	1 27	14 42	1 24	14 45	1 21	14 48
11 00	1 45	14 24	1 42	14 27	1 39	14 30	1 36	14 33	1 33	14 36	1 30	14 39
30	1 57	14 12	1 54	14 15	1 51	14 18	1 48	14 21	1 45	14 24	1 42	14 27
12 00	2 08	14 01	2 05	14 04	2 02	14 07	1 59	14 10	1 56	14 13	1 53	14 16
30	2 19	13 50	2 16	13 53	2 13	13 56	2 10	13 59	2 07	14 02	2 04	14 05
13 00	2 29	13 40	2 26	13 43	2 23	13 46	2 20	13 49	2 17	13 52	2 14	13 55
30	2 38	13 31	2 35	13 34	2 32	13 37	2 29	13 40	2 26	13 43	2 23	13 46
14 00	2 46	13 23	2 43	13 26	2 40	13 29	2 37	13 32	2 34	13 35	2 31	13 38
15 00	3 02	13 07	2 59	13 10	2 56	13 13	2 53	13 16	2 50	13 19	2 47	13 22
16 00	3 15	12 54	3 12	12 57	3 09	13 00	3 06	13 03	3 03	13 06	3 00	13 09
17 00	3 28	12 41	3 25	12 44	3 22	12 47	3 19	12 50	3 16	12 53	3 13	12 56
18 00	3 38	12 31	3 35	12 34	3 32	12 37	3 29	12 40	3 26	12 43	3 23	12 46
19 00	3 48	12 21	3 45	12 24	3 42	12 27	3 39	12 30	3 36	12 33	3 33	12 36
20 00	3 59	12 12	3 53	12 15	3 50	12 18	3 47	12 21	3 44	12 24	3 41	12 27
22 00	4 12	11 56	4 09	11 59	4 06	12 02	4 03	12 05	4 00	12 08	3 57	12 11
24 00	4 25	11 43	4 22	11 46	4 19	11 49	4 16	11 52	4 13	11 55	4 10	11 58
26 00	4 36	11 32	4 33	11 35	4 30	11 38	4 27	11 41	4 24	11 44	4 21	11 47
28 00	4 46	11 22	4 43	11 25	4 40	11 28	4 37	11 31	4 34	11 34	4 31	11 37
30 00	4 54	11 14	4 51	11 17	4 48	11 20	4 45	11 23	4 42	11 26	4 39	11 29
32 00	5 02	11 06	4 59	11 09	4 56	11 12	4 53	11 15	4 50	11 18	4 47	11 21
34 00	5 09	10 59	5 06	11 02	5 03	11 05	5 00	11 08	4 57	11 11	4 54	11 14
36 00	5 15	10 53	5 12	10 56	5 09	10 59	5 06	11 02	5 03	11 05	5 00	11 08
38 00	5 20	10 48	5 17	10 51	5 14	10 54	5 11	10 57	5 08	11 00	5 05	11 03
40 00	5 25	10 42	5 22	10 45	5 19	10 48	5 16	10 51	5 13	10 54	5 10	10 57
45 00	5 36	10 31	5 33	10 34	5 30	10 37	5 27	10 40	5 24	10 43	5 21	10 46
50 00	5 44	10 22	5 41	10 25	5 38	10 28	5 35	10 31	5 32	10 34	5 29	10 37
55 00	5 51	10 14	5 48	10 17	5 45	10 20	5 42	10 23	5 39	10 26	5 36	10 29
60 00	5 57	10 07	5 54	10 10	5 51	10 13	5 48	10 16	5 45	10 19	5 42	10 22
65 00	6 04	10 00	6 01	10 03	5 58	10 06	5 55	10 09	5 52	10 12	5 49	10 15
70 00	6 09	9 54	6 06	9 57	6 03	10 00	6 00	10 03	5 57	10 06	5 54	10 09
75 00	6 13	9 49	6 10	9 52	6 07	9 55	6 04	9 58	6 01	10 01	5 58	10 04
80 00	6 19	9 43	6 16	9 46	6 13	9 49	6 10	9 52	6 07	9 55	6 04	9 58
85 00	6 23	9 38	6 20	9 41	6 17	9 44	6 14	9 47	6 11	9 50	6 08	9 53
90 00	6 27	9 33	+6 24	9 36	+6 21	9 39	+6 18	9 42	+6 15	9 45	+6 12	9 48

ADDITIONAL CORR. FOR SUN'S ALT.	Day of Month.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	1st to 15th....	+18	+15	+8	0	-8	-13	-14	-11	-5	+3	+11
16th to 31st...	+17	+12	+4	-4	-11	-14	-13	-9	-1	+7	+14	+18

\* The corrections for the observed altitude of a Star or Planet involves the dip and the refraction; and for the observed altitude of the Sun's lower limb, the dip, refraction, parallax, and mean semidiameter, which is taken as 16'. A supplementary correction taking account of the variation of the Sun's semidiameter in the different months of the year is given at the foot of the main table.



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TABLE II

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CORRECTIONS TO BE APPLIED TO  
THE OBSERVED ALTITUDE OF THE  
MOON'S UPPER LIMB, AND ALSO OF  
THE LOWER LIMB

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The height of the eye is assumed to be 35 feet, and the correction for other elevations is given at the bottom of the table, and is to be added or subtracted according as the height of the eye is less or greater than 35 feet

Corrections for the Observed Altitudes of the Moon's Lower Limb.

OBS. ALT. LOWER LIMB.	HORIZONTAL PARALLAX.							
	54'	55'	56'	57'	58'	59'	60'	61'
° ' "	° ' "	° ' "	° ' "	° ' "	° ' "	° ' "	° ' "	° ' "
5 30	53 46	55 03	56 19	57 36	58 53	60 09	61 27	62 44
6 00	54 22	55 38	56 54	58 11	59 28	60 44	62 01	63 18
6 30	54 51	56 08	57 24	58 40	59 57	61 13	62 29	63 46
7 00	55 17	56 33	57 50	59 06	60 22	61 38	62 54	64 11
7 30	55 39	56 55	58 12	59 28	60 44	62 00	63 16	64 33
8 00	55 58	57 15	58 31	59 47	61 03	62 19	63 36	64 52
8 30	56 15	57 31	58 47	60 03	61 19	62 35	63 52	65 08
9 00	56 29	57 45	59 01	60 16	61 33	62 49	64 05	65 20
9 30	56 42	57 58	59 13	60 29	61 45	63 01	64 17	65 32
10 00	56 54	58 10	59 25	60 40	61 56	63 11	64 27	65 43
11	57 10	58 26	59 41	60 56	62 12	63 27	64 43	65 58
12	57 22	58 37	59 52	61 07	62 23	63 39	64 54	66 09
13	57 29	58 45	59 59	61 14	62 30	63 45	65 00	66 15
14	57 35	58 50	60 04	61 18	62 33	63 48	65 03	66 17
15	57 35	58 50	60 04	61 18	62 33	63 48	65 03	66 17
16	57 33	58 47	60 01	61 15	62 30	63 45	64 59	66 13
17	57 30	58 44	59 57	61 11	62 25	63 39	64 53	66 07
18	57 22	58 36	59 49	61 03	62 17	63 31	64 45	65 59
19	57 15	58 28	59 41	60 54	62 08	63 21	64 35	65 49
20	57 05	58 18	59 31	60 44	61 57	63 10	64 23	65 36
21	56 53	58 06	59 18	60 31	61 44	62 56	64 09	65 22
22	56 40	57 52	59 03	60 15	61 28	62 40	63 53	65 05
23	56 26	57 38	58 49	60 00	61 12	62 24	63 36	64 48
24	56 09	57 20	58 31	59 42	60 54	62 06	63 18	64 29
25	55 51	57 02	58 13	59 24	60 36	61 47	62 58	64 08
26	55 32	56 43	57 53	59 03	60 14	61 25	62 36	63 46
27	55 12	56 22	57 32	58 41	59 51	61 01	62 12	63 22
28	54 51	56 00	57 09	58 18	59 29	60 38	61 48	62 57
29	54 28	55 37	56 46	57 55	59 05	60 14	61 23	62 33
30	54 04	55 13	56 21	57 29	58 38	59 47	60 56	62 05
31	53 39	54 47	55 55	57 03	58 12	59 20	60 28	61 36
32	53 14	54 22	55 29	56 36	57 44	58 52	60 00	61 07
33	52 47	53 54	55 01	56 08	57 15	58 22	59 29	60 36
34	52 20	53 26	54 31	55 37	56 44	57 50	58 57	60 03
35	51 51	52 56	54 01	55 06	56 12	57 18	58 24	59 30
36	51 21	52 26	53 30	54 35	55 41	56 46	57 51	58 55
37	50 51	51 54	52 57	54 02	55 07	56 12	57 17	58 22
38	50 19	51 23	52 26	53 29	54 33	55 37	56 41	57 45
39	49 47	50 50	51 52	52 55	53 58	55 02	56 05	57 08
40	49 13	50 15	51 16	52 18	53 21	54 24	55 27	56 30
41	48 38	49 40	50 41	51 43	52 45	53 47	54 49	55 50
42	48 03	49 04	50 04	51 05	52 07	53 09	54 11	55 12
43	47 28	48 28	49 28	50 29	51 30	52 29	53 30	54 30
44	46 51	47 51	48 49	49 49	50 49	51 48	52 48	53 47
45	46 13	47 12	48 10	49 09	50 09	51 08	52 07	53 06
46	45 35	46 33	47 30	48 28	49 27	50 26	51 24	52 22
47	44 55	45 53	46 50	47 48	48 46	49 43	50 41	51 38
48	44 15	45 13	46 09	47 06	48 03	48 59	49 56	50 52
49	43 36	44 32	45 27	46 23	47 19	48 15	49 11	50 06
50	42 54	43 50	44 44	45 39	46 34	47 30	48 25	49 20
51	42 12	43 07	44 01	44 55	45 50	46 44	47 38	48 32
52	41 30	42 23	43 16	44 09	45 04	45 57	46 51	47 44
53	40 46	41 39	42 31	43 24	44 17	45 09	46 02	46 54
54	40 02	40 54	41 45	42 37	43 30	44 21	45 13	46 04
55	39 17	40 09	40 59	41 50	42 42	43 32	44 23	45 14
56	38 33	39 23	40 13	41 02	41 53	42 44	43 34	44 24
57	37 47	38 37	39 26	40 14	41 04	41 53	42 43	43 32
58	37 01	37 50	38 38	39 25	40 14	41 03	41 52	42 39
59	36 15	37 03	37 49	38 36	39 24	40 11	40 59	41 46
60	35 28	36 15	37 00	37 46	38 34	39 20	40 06	40 52
61	34 39	35 25	36 10	36 56	37 42	38 27	39 13	39 58
62	33 50	34 35	35 19	36 04	36 49	37 34	38 19	39 03
63	33 02	33 46	34 29	35 13	35 57	36 41	37 25	38 08



Corrections for the Observed Altitudes of the Moon's Lower Limb.

OBS. ALT. LOWER LIMB.	HORIZONTAL PARALLEL.							
	54'	55'	56'	57'	58'	59'	60'	61'
° ' / "	' "	' "	' "	' "	' "	' "	' "	' "
64	32 13	32 56	33 38	34 21	35 05	35 47	36 30	37 13
65	31 23	32 06	32 47	33 28	34 11	34 52	35 34	36 16
66	30 33	31 14	31 54	32 35	33 17	33 57	34 38	35 19
67	29 42	30 22	31 01	31 41	32 22	33 01	33 41	34 21
68	28 51	29 31	30 09	30 47	31 27	32 06	32 45	33 24
69	27 59	28 38	29 15	29 53	30 32	31 10	31 48	32 26
70	27 07	27 46	28 22	28 59	29 36	30 14	30 51	31 27
71	26 15	26 52	27 27	28 04	28 40	29 16	29 53	30 28
72	25 23	25 58	26 32	27 08	27 43	28 19	28 54	29 28
73	24 30	25 05	25 38	26 12	26 46	27 21	27 55	28 29
74	23 37	24 11	24 43	25 16	25 49	26 22	26 56	27 28
75	22 44	23 16	23 47	24 19	24 53	25 25	25 57	26 28
76	21 51	22 22	22 52	23 23	23 55	24 26	24 57	25 27
77	20 57	21 27	21 56	22 26	22 57	23 27	23 57	24 26
78	20 02	20 32	21 00	21 29	21 59	22 27	22 56	23 25
79	19 08	19 36	20 04	20 31	21 00	21 27	21 56	22 23
80	18 13	18 41	19 07	19 33	20 01	20 27	20 55	21 22
81	17 19	17 45	18 10	18 35	19 02	19 27	19 55	20 21
82	16 24	16 49	17 13	17 37	18 03	18 28	18 54	19 18
83	15 29	15 53	16 16	16 40	17 04	17 27	17 52	18 16
84	14 33	14 57	15 19	15 42	16 05	16 27	16 50	17 13
85	13 38	14 00	14 21	14 43	15 05	15 27	15 49	16 10
86	12 43	13 04	13 24	13 45	14 06	14 27	14 48	15 08
87	11 47	12 08	12 26	12 46	13 06	13 26	13 46	14 05
88	10 52	11 11	11 28	11 47	12 06	12 24	12 44	13 02
89	9 56	10 15	10 31	10 49	11 07	11 24	11 42	11 59
90	9 00	9 18	9 34	9 50	10 07	10 23	10 41	10 57

HEIGHT OF EYE CORRECTION.	
Height in feet.	Correction.
10	+2 42
12	+2 24
14	+2 08
16	+1 53
18	+1 39
20	+1 25
22	+1 12
24	+1 00
26	+0 48
28	+0 37
30	+0 26
35	0 00
40	-0 24
45	-0 48
50	-1 08
55	-1 28
60	-1 47
65	-2 06
70	-2 24
75	-2 41
80	-2 58
85	-3 14
90	-3 30
95	-3 45
100	-4 00

Corrections for the Observed Altitude of the Moon's Upper Limb.

OBS. ALT. UPPER LIMB.	HORIZONTAL PARALLAX.							
	54'	55'	56'	57'	58'	59'	60'	61'
5 30	23 38	24 21	25 05	25 48	26 31	27 13	27 56	28 38
6 00	24 18	25 01	25 44	26 27	27 10	27 54	28 37	29 19
6 30	24 52	25 35	26 18	27 02	27 44	28 28	29 11	29 54
7 00	25 21	26 04	26 48	27 31	28 13	28 57	29 40	30 24
7 30	25 47	26 30	27 13	27 56	28 39	29 22	30 05	30 48
8 00	26 09	26 52	27 35	28 18	29 01	29 44	30 27	31 09
8 30	26 28	27 11	27 54	28 37	29 20	30 03	30 46	31 28
9 00	26 45	27 27	28 10	28 53	29 36	30 19	31 02	31 44
9 30	27 00	27 42	28 24	29 06	29 49	30 32	31 15	31 57
10 00	27 10	27 53	28 36	29 19	30 01	30 44	31 27	32 09
11	27 31	28 13	28 55	29 38	30 21	31 03	31 46	32 28
12	27 45	28 27	29 10	29 52	30 34	31 16	31 58	32 40
13	27 54	28 36	29 18	30 00	30 42	31 24	32 07	32 49
14	27 59	28 40	29 22	30 05	30 47	31 29	32 11	32 52
15	28 01	28 42	29 24	30 06	30 48	31 30	32 11	32 52
16	28 01	28 42	29 23	30 04	30 45	31 27	32 09	32 50
17	27 58	28 39	29 20	30 01	30 42	31 23	32 04	32 45
18	27 51	28 32	29 13	29 54	30 34	31 15	31 55	32 35
19	27 44	28 24	29 05	29 45	30 26	31 06	31 46	32 26
20	27 34	28 13	28 54	29 34	30 14	30 54	31 34	32 15
21	27 23	28 03	28 43	29 23	30 02	30 41	31 21	32 01
22	27 10	27 49	28 29	29 08	29 47	30 27	31 06	31 45
23	26 55	27 33	28 12	28 52	29 30	30 09	30 49	31 27
24	26 39	27 17	27 56	28 35	29 13	29 52	30 31	31 10
25	26 22	27 00	27 38	28 17	28 55	29 33	30 11	30 48
26	26 03	26 40	27 18	27 56	28 34	29 12	29 49	30 26
27	25 43	26 20	26 58	27 36	28 12	28 49	29 26	30 03
28	25 21	25 58	26 35	27 12	27 48	28 25	29 03	29 39
29	24 59	25 35	26 12	26 48	27 24	28 01	28 37	29 12
30	24 36	25 11	25 47	26 24	26 59	27 35	28 10	28 46
31	24 12	24 47	25 22	25 57	26 32	27 07	27 43	28 18
32	23 45	24 20	24 55	25 30	26 04	26 39	27 14	27 48
33	23 19	23 53	24 27	25 01	25 35	26 09	26 43	27 17
34	22 51	23 24	23 58	24 32	25 05	25 39	26 12	26 45
35	22 22	22 55	23 28	24 01	24 34	25 07	25 40	26 12
36	21 53	22 25	22 58	23 30	24 02	24 34	25 07	25 39
37	21 23	21 54	22 26	22 58	23 29	24 00	24 31	25 03
38	20 51	21 22	21 53	22 24	22 54	23 25	23 55	24 28
39	20 19	20 49	21 20	21 50	22 20	22 50	23 20	23 50
40	19 46	20 15	20 45	21 15	21 45	22 14	22 43	23 12
41	19 11	19 40	20 09	20 38	21 06	21 35	22 04	22 33
42	18 37	19 05	19 33	20 01	20 29	20 57	21 25	21 54
43	18 00	18 27	18 55	19 23	19 50	20 18	20 45	21 13
44	17 24	17 50	18 17	18 45	19 11	19 37	20 04	20 32
45	16 46	17 12	17 38	18 04	18 30	18 56	19 22	19 48
46	16 07	16 33	16 58	17 24	17 49	18 14	18 40	19 05
47	15 28	15 53	16 18	16 43	17 07	17 32	17 57	18 21
48	14 48	15 12	15 36	16 00	16 24	16 48	17 12	17 36
49	14 07	14 31	14 55	15 17	15 40	16 04	16 27	16 50
50	13 26	13 49	14 11	14 34	14 56	15 19	15 41	16 03
51	12 44	13 06	13 27	13 49	14 10	14 32	14 54	15 15
52	12 02	12 23	12 44	13 05	13 25	13 46	14 07	14 27
53	11 19	11 39	11 59	12 19	12 38	12 59	13 19	13 38
54	10 36	10 54	11 13	11 32	11 51	12 11	12 30	12 49
55	9 51	10 09	10 27	10 45	11 03	11 23	11 41	11 59
56	9 06	9 23	9 40	9 58	10 15	10 32	10 49	11 06
57	8 21	8 37	8 53	9 10	9 26	9 43	9 59	10 15
58	7 35	7 50	8 05	8 21	8 36	8 52	9 07	9 22
59	6 48	7 02	7 17	7 32	7 46	8 01	8 16	8 30
60	6 00	6 13	6 27	6 41	6 55	7 09	7 23	7 36
61	5 12	5 24	5 37	5 50	6 04	6 17	6 29	6 42
62	4 23	4 35	4 48	5 00	5 12	5 23	5 35	5 46
63	3 35	3 46	3 57	4 08	4 19	4 30	4 40	4 51

Corrections for the Observed Altitude of the Moon's Upper Limb.

OBS. ALT. UPPER LIMB.	HORIZONTAL PARALLAX.							
	54'	55'	56'	57'	58'	59'	60'	61'
° "	' "	' "	' "	' "	' "	' "	' "	' "
64	2 46	2 56	3 06	3 16	3 26	3 36	3 46	3 56
65	1 56	2 04	2 13	2 23	2 32	2 42	2 51	3 00
66	1 06	1 14	1 22	1 31	1 39	1 47	1 55	2 03
67	0 16	0 22	0 29	0 37	0 44	0 51	0 58	1 06
68	0 36	0 30	0 24	0 17	0 11	0 04	0 02	0 08
69	1 27	1 22	1 17	1 11	1 06	1 02	0 57	0 51
70	2 19	2 15	2 11	2 06	2 02	1 58	1 54	1 50
71	3 11	3 08	3 05	3 01	2 58	2 55	2 52	2 48
72	4 03	4 01	3 59	3 56	3 54	3 52	3 50	3 48
73	4 55	4 56	4 54	4 52	4 51	4 50	4 49	4 47
74	5 49	5 50	5 49	5 48	5 48	5 48	5 48	5 47
75	6 43	6 44	6 44	6 45	6 46	6 47	6 48	6 48
76	7 37	7 39	7 40	7 42	7 44	7 45	7 47	7 49
77	8 31	8 34	8 37	8 39	8 42	8 44	8 47	8 50
78	9 25	9 29	9 33	9 36	9 40	9 44	9 48	9 51
79	10 19	10 24	10 29	10 33	10 38	10 43	10 48	10 52
80	11 13	11 20	11 26	11 31	11 37	11 43	11 49	11 54
81	12 08	12 15	12 22	12 28	12 35	12 42	12 50	12 57
82	13 03	13 11	13 19	13 27	13 34	13 43	13 51	13 59
83	13 58	14 07	14 16	14 25	14 34	14 43	14 52	15 01
84	14 53	15 04	15 14	15 23	15 33	15 44	15 54	16 03
85	15 48	16 00	16 11	16 21	16 33	16 44	16 55	17 06
86	16 44	16 57	17 09	17 20	17 32	17 45	17 57	18 08
87	17 39	17 53	18 06	18 18	18 32	18 45	18 59	19 11
88	18 35	18 50	19 04	19 18	19 32	19 46	20 00	20 14
89	19 31	19 47	20 02	20 16	20 31	20 47	21 03	21 17
90	20 26	20 43	21 00	21 15	21 31	21 48	22 04	22 20

HEIGHT OF EYE CORRECTION.	
Height in feet.	Correction.
10	+2 42
12	+2 24
14	+2 08
16	+1 53
18	+1 39
20	+1 25
22	+1 12
24	+1 00
26	+0 48
28	+0 37
30	+0 26
35	0 00
40	-0 24
45	-0 48
50	-1 08
55	-1 28
60	-1 47
65	-2 06
70	-2 24
75	-2 41
80	-2 58
85	-3 14
90	-3 30
95	-3 45
100	-4 00





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TABLE III  
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LOGARITHMIC SINES  
AND  
LOGARITHMIC COSINES

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	0° 0'	Add for Tan.	0° 10'	Add for Tan.	0° 20'	Add for Tan.	0° 30'	Add for Tan.	0° 40'	Add for Tan.	0° 50'	Add for Tan.	1° 0'	Add for Tan.	1° 10'	Add for Tan.	1° 20'	Add for Tan.
+ 0'	∞		7.46373	0	7.76475	1	7.94084	2	8.06578	3	8.16268	5	8.24186	7	8.30879	9	8.36678	12
10''	5.68557	0	.47090	0	.76836	1	7.94325	2	.06758	3	.16413	5	.24306	7	.30983	9	.36768	12
20	5.98660	0	.47797	0	.77193	1	7.94564	2	.06938	3	.16557	5	.24426	7	.31086	9	.36858	12
30	6.16270	0	.48491	0	.77548	1	7.94802	2	.07117	3	.16700	5	.24546	7	.31188	9	.36948	12
40	6.28763	0	.49175	0	.77899	1	7.95039	2	.07295	3	.16843	5	.24665	7	.31291	9	.37038	12
50	6.38454	0	.49849	0	.78248	1	7.95274	2	.07473	3	.16986	5	.24785	7	.31393	9	.37128	12
+ 1'	6.46373	0	.50512	0	.78594	1	7.95508	2	.07650	3	.17128	5	.24903	7	.31495	9	.37217	12
10''	6.53067	0	.51165	0	.78938	1	7.95741	2	.07826	3	.17270	5	.25022	7	.31597	9	.37306	12
20	6.58866	0	.51808	0	.79278	1	7.95973	2	.08002	3	.17411	5	.25140	7	.31699	9	.37395	12
30	6.63982	0	.52442	0	.79616	1	7.96203	2	.08176	3	.17552	5	.25258	7	.31800	9	.37484	12
40	6.68557	0	.53067	0	.79952	1	7.96432	2	.08350	3	.17692	5	.25375	7	.31901	9	.37573	12
50	6.72697	0	.53683	0	.80284	1	7.96660	2	.08524	3	.17832	5	.25493	7	.32002	9	.37662	12
+ 2'	6.76476	0	.54291	0	.80615	1	7.96887	2	.08696	3	.17971	5	.25609	7	.32103	10	.37750	12
10''	6.79952	0	.54890	0	.80942	1	7.97113	2	.08868	3	.18110	5	.25726	7	.32203	10	.37838	12
20	6.83170	0	.55481	0	.81268	1	7.97337	2	.09040	3	.18249	5	.25842	7	.32303	10	.37926	12
30	6.86167	0	.56064	0	.81591	1	7.97560	2	.09210	3	.18387	5	.25958	7	.32403	10	.38014	13
40	6.88969	0	.56639	0	.81911	1	7.97782	2	.09380	3	.18524	5	.26074	7	.32503	10	.38101	13
50	6.91602	0	.57206	0	.82229	1	7.98003	2	.09550	3	.18662	5	.26189	7	.32602	10	.38189	13
+ 3'	6.94085	0	.57767	0	.82545	1	7.98223	2	.09718	3	.18798	5	.26304	7	.32702	10	.38276	13
10''	6.96433	0	.58320	0	.82859	1	7.98442	2	.09886	3	.18935	5	.26419	7	.32801	10	.38363	13
20	6.98660	0	.58866	0	.83170	1	7.98660	2	.10054	3	.19071	5	.26533	7	.32899	10	.38450	13
30	7.00779	0	.59406	0	.83479	1	7.98876	2	.10220	3	.19206	5	.26648	7	.32998	10	.38537	13
40	7.02800	0	.59939	0	.83786	1	7.99092	2	.10386	4	.19341	5	.26761	7	.33096	10	.38624	13
50	7.04730	0	.60465	0	.84091	1	7.99306	2	.10552	4	.19476	5	.26875	8	.33195	10	.38710	13
+ 4'	7.06579	0	.60985	0	.84393	1	7.99520	2	.10717	4	.19610	5	.26988	8	.33292	10	.38796	13
10''	7.08351	0	.61499	0	.84694	1	7.99732	2	.10881	4	.19744	5	.27101	8	.33390	10	.38882	13
20	7.10055	0	.62007	0	.84992	1	7.99943	2	.11044	4	.19877	5	.27214	8	.33488	10	.38968	13
30	7.11694	0	.62509	0	.85289	1	8.00154	2	.11207	4	.20010	5	.27326	8	.33585	10	.39054	13
40	7.13273	0	.63006	0	.85583	1	8.00363	2	.11370	4	.20143	5	.27438	8	.33682	10	.39139	13
50	7.14797	0	.63496	0	.85876	1	8.00571	2	.11531	4	.20275	6	.27550	8	.33779	10	.39225	13
+ 5'	7.16270	0	.63982	0	.86166	1	8.00779	2	.11693	4	.20407	6	.27661	8	.33875	10	.39310	13
10''	7.17694	0	.64461	0	.86455	1	8.00985	2	.11853	4	.20538	6	.27773	8	.33972	10	.39395	13
20	7.19072	0	.64936	0	.86741	1	8.01190	2	.12013	4	.20669	6	.27883	8	.34068	10	.39480	13
30	7.20409	0	.65406	0	.87026	1	8.01395	2	.12174	4	.20800	6	.27994	8	.34164	10	.39565	13
40	7.21705	0	.65870	0	.87309	1	8.01598	2	.12331	4	.20930	6	.28104	8	.34260	11	.39649	13
50	7.22964	0	.66330	0	.87590	1	8.01801	2	.12489	4	.21060	6	.28215	8	.34355	11	.39734	14
+ 6'	7.24188	0	.66784	0	.87870	1	8.02002	2	.12647	4	.21189	6	.28324	8	.34450	11	.39818	14
10''	7.25378	0	.67235	0	.88147	1	8.02203	2	.12804	4	.21319	6	.28434	8	.34546	11	.39902	14
20	7.26536	0	.67689	0	.88423	1	8.02403	2	.12961	4	.21447	6	.28543	8	.34640	11	.39986	14
30	7.27664	0	.68121	1	.88697	1	8.02601	2	.13117	4	.21576	6	.28652	8	.34735	11	.40070	14
40	7.28763	0	.68557	1	.88969	1	8.02799	2	.13272	4	.21703	6	.28761	8	.34830	11	.40156	14
50	7.29836	0	.68989	1	.89240	1	8.02996	2	.13427	4	.21831	6	.28869	8	.34924	11	.40237	14
+ 7'	7.30882	0	.69417	1	.89509	1	8.03192	3	.13581	4	.21958	6	.28977	8	.35018	11	.40320	14
10''	7.31904	0	.69841	1	.89776	1	8.03387	3	.13735	4	.22085	6	.29085	8	.35112	11	.40403	14
20	7.32903	0	.70261	1	.90041	1	8.03581	3	.13888	4	.22211	6	.29193	8	.35206	11	.40486	14
30	7.33879	0	.70676	1	.90305	1	8.03775	3	.14041	4	.22337	6	.29300	8	.35299	11	.40569	14
40	7.34833	0	.71088	1	.90568	1	8.03967	3	.14193	4	.22463	6	.29407	8	.35392	11	.40651	14
50	7.35767	0	.71496	1	.90829	1	8.04159	3	.14344	4	.22588	6	.29514	8	.35485	11	.40734	14
+ 8'	7.36682	0	.71900	1	.91088	1	8.04350	3	.14495	4	.22713	6	.29621	8	.35578	11	.40816	14
10''	7.37577	0	.72300	1	.91346	1	8.04540	3	.14646	4	.22838	6	.29727	9	.35671	11	.40898	14
20	7.38454	0	.72697	1	.91602	1	8.04729	3	.14796	4	.22962	6	.29833	9	.35764	11	.40980	14
30	7.39314	0	.73090	1	.91857	1	8.04918	3	.14945	4	.23086	6	.29939	9	.35856	11	.41062	14
40	7.40158	0	.73479	1	.92110	2	8.05105	3	.15094	4	.23210	6	.30044	9	.35948	11	.41144	14
50	7.40985	0	.73865	1	.92362	2	8.05292	3	.15243	4	.23333	6	.30150	9	.36040	11	.41225	15
+ 9'	7.41797	0	.74248	1	.92612	2	8.05478	3	.15391	4	.23456	6	.30255	9	.36131	11	.41307	15
10''	7.42594	0	.74627	1	.92861	2	8.05663	3	.15538	4	.23578	6	.30359	9	.36223	12	.41388	15
20	7.43376	0	.75003	1	.93108	2	8.05848	3	.15685	4	.23700	6	.30464	9	.36314	12	.41469	15
30	7.44145	0	.75376	1	.93354	2	8.06031	3	.15832	5	.23822	7	.30568	9	.36405	12	.41550	15
40	7.44900	0	.75745	1	.93599	2	8.06214	3	.15978	5	.23944	7	.30672	9	.36496	12	.41631	15
50	7.45643	0	.76112	1	.93842	2	8.06396	3	.16123	5	.24065	7	.30776	9	.36587	12	.41711	15
+10'	7.46373	0	.76475	1	.94084	2	8.06578	3	.16268	5	.24186	7	.30879	9	.36678	12	.41792	15



Log. Sines.

	1° 30'	Add for Tan.	1° 40'	Add for Tan.	1° 50'	Add for Tan.	2° 0'	Add for Tan.	2° 10'	Add for Tan.	2° 20'	Add for Tan.	2° 30'	Add for Tan.	2° 40'	Add for Tan.	2° 50'	Add for Tan.
+0'	8.41792	15	8.46366	18	8.50504	22	8.54282	26	8.57757	31	8.60973	36	8.63965	41	8.66769	47	8.69400	53
10''	.41872	15	.46439	18	.50570	22	.54342	27	.57812	31	.61025	36	.64016	41	.66814	47	.69442	53
20	.41952	15	.46511	19	.50636	22	.54402	27	.57868	31	.61077	36	.64064	42	.66859	47	.69485	54
30	.42032	15	.46583	19	.50701	22	.54462	27	.57923	31	.61128	36	.64112	42	.66904	47	.69527	54
40	.42112	15	.46655	19	.50767	23	.54522	27	.57979	31	.61180	36	.64160	42	.66949	47	.69570	54
50	.42192	15	.46727	19	.50832	23	.54582	27	.58034	31	.61231	36	.64208	42	.66994	48	.69612	54
+1'	.42272	15	.46799	19	.50897	23	.54642	27	.58089	32	.61282	37	.64256	42	.67039	48	.69654	54
10''	.42351	15	.46870	19	.50963	23	.54702	27	.58144	32	.61334	37	.64304	42	.67084	48	.69697	54
20	.42430	15	.46942	19	.51028	23	.54762	27	.58200	32	.61385	37	.64352	42	.67129	48	.69739	54
30	.42510	15	.47013	19	.51092	23	.54821	27	.58255	32	.61436	37	.64400	42	.67174	48	.69781	54
40	.42589	15	.47084	19	.51157	23	.54881	27	.58310	32	.61487	37	.64448	42	.67219	48	.69823	54
50	.42667	15	.47155	19	.51222	23	.54940	27	.58364	32	.61538	37	.64495	42	.67263	48	.69865	54
+2'	.42746	16	.47226	19	.51287	23	.54999	27	.58419	32	.61589	37	.64543	42	.67308	48	.69907	54
10''	.42825	16	.47297	19	.51351	23	.55059	27	.58474	32	.61640	37	.64590	43	.67353	48	.69949	54
20	.42903	16	.47368	19	.51416	23	.55118	28	.58529	32	.61691	37	.64638	43	.67397	48	.69991	55
30	.42982	16	.47439	19	.51480	23	.55177	28	.58583	32	.61742	37	.64685	43	.67442	49	.70033	55
40	.43060	16	.47509	19	.51544	23	.55236	28	.58638	32	.61792	37	.64733	43	.67486	49	.70075	55
50	.43138	16	.47580	19	.51609	23	.55295	28	.58693	32	.61843	37	.64780	43	.67531	49	.70117	55
+3'	.43216	16	.47650	19	.51673	23	.55354	28	.58747	33	.61894	38	.64827	43	.67575	49	.70159	55
10''	.43293	16	.47720	20	.51737	24	.55413	28	.58801	33	.61944	38	.64875	43	.67619	49	.70201	55
20	.43371	16	.47790	20	.51801	24	.55471	28	.58856	33	.61995	38	.64922	43	.67664	49	.70242	55
30	.43448	16	.47860	20	.51864	24	.55530	28	.58910	33	.62045	38	.64969	43	.67708	49	.70284	55
40	.43526	16	.47930	20	.51928	24	.55589	28	.58964	33	.62096	38	.65016	43	.67752	49	.70326	55
50	.43603	16	.48000	20	.51992	24	.55647	28	.59018	33	.62146	38	.65063	43	.67796	49	.70367	56
+4'	.43680	16	.48069	20	.52055	24	.55705	28	.59072	33	.62196	38	.65110	44	.67841	49	.70409	56
10''	.43757	16	.48139	20	.52119	24	.55764	28	.59126	33	.62246	38	.65157	44	.67885	49	.70451	56
20	.43834	16	.48208	20	.52182	24	.55822	28	.59180	33	.62297	38	.65204	44	.67929	50	.70492	56
30	.43910	16	.48278	20	.52245	24	.55880	28	.59234	33	.62347	38	.65251	44	.67973	50	.70534	56
40	.43987	16	.48347	20	.52308	24	.55938	29	.59288	33	.62397	38	.65298	44	.68017	50	.70575	56
50	.44063	17	.48416	20	.52371	24	.55996	29	.59341	33	.62447	39	.65344	44	.68060	50	.70616	56
+5'	.44139	17	.48485	20	.52434	24	.56054	29	.59395	33	.62497	39	.65391	44	.68104	50	.70658	56
10''	.44216	17	.48554	20	.52497	24	.56112	29	.59448	34	.62546	39	.65438	44	.68148	50	.70699	56
20	.44292	17	.48622	20	.52560	24	.56170	29	.59502	34	.62596	39	.65484	44	.68192	50	.70740	57
30	.44367	17	.48691	20	.52623	25	.56227	29	.59555	34	.62646	39	.65531	44	.68236	50	.70781	57
40	.44443	17	.48760	21	.52685	25	.56285	29	.59609	34	.62696	39	.65577	45	.68279	50	.70823	57
50	.44519	17	.48828	21	.52748	25	.56342	29	.59662	34	.62745	39	.65624	45	.68323	50	.70864	57
+6'	.44594	17	.48896	21	.52810	25	.56400	29	.59715	34	.62795	39	.65670	45	.68367	51	.70905	57
10''	.44669	17	.48965	21	.52872	25	.56457	29	.59768	34	.62844	39	.65717	45	.68410	51	.70946	57
20	.44745	17	.49033	21	.52935	25	.56515	29	.59821	34	.62894	39	.65763	45	.68454	51	.70987	57
30	.44820	17	.49101	21	.52997	25	.56572	29	.59874	34	.62943	39	.65809	45	.68497	51	.71028	57
40	.44895	17	.49169	21	.53059	25	.56629	29	.59927	34	.62993	40	.65855	45	.68540	51	.71069	57
50	.44969	17	.49236	21	.53121	25	.56686	30	.59980	34	.63042	40	.65901	45	.68584	51	.71110	57
+7'	.45044	17	.49304	21	.53183	25	.56743	30	.60033	34	.63091	40	.65947	45	.68627	51	.71151	58
10''	.45119	17	.49372	21	.53245	25	.56800	30	.60086	35	.63140	40	.65994	45	.68670	51	.71192	58
20	.45193	17	.49440	21	.53306	25	.56857	30	.60139	35	.63189	40	.66040	46	.68714	51	.71232	58
30	.45267	17	.49506	21	.53368	25	.56914	30	.60191	35	.63238	40	.66085	46	.68757	51	.71273	58
40	.45341	18	.49574	21	.53429	25	.56970	30	.60244	35	.63288	40	.66131	46	.68800	52	.71314	58
50	.45415	18	.49641	21	.53491	26	.57027	30	.60296	35	.63336	40	.66177	46	.68843	52	.71355	58
+8'	.45489	18	.49708	21	.53552	26	.57084	30	.60349	35	.63385	40	.66223	46	.68886	52	.71395	58
10''	.45563	18	.49775	22	.53614	26	.57140	30	.60401	35	.63434	40	.66269	46	.68929	52	.71436	58
20	.45637	18	.49842	22	.53675	26	.57196	30	.60454	35	.63483	40	.66314	46	.68972	52	.71476	58
30	.45710	18	.49908	22	.53736	26	.57253	30	.60506	35	.63532	41	.66360	46	.69015	52	.71517	59
40	.45784	18	.49975	22	.53797	26	.57309	30	.60558	35	.63580	41	.66406	46	.69058	52	.71557	59
50	.45857	18	.50042	22	.53858	26	.57365	31	.60610	35	.63629	41	.66451	46	.69101	52	.71598	59
+9'	.45930	18	.50108	22	.53919	26	.57421	31	.60662	36	.63678	41	.66497	46	.69144	52	.71638	59
10''	.46003	18	.50174	22	.53979	26	.57477	31	.60714	36	.63726	41	.66542	47	.69187	53	.71679	59
20	.46076	18	.50241	22	.54040	26	.57533	31	.60766	36	.63775	41	.66588	47	.69229	53	.71719	59
30	.46149	18	.50307	22	.54101	26	.57589	31	.60818	36	.63823	41	.66633	47	.69272	53	.71759	59
40	.46222	18	.50373	22	.54162	26	.57645	31	.60870	36	.63871	41	.66678	47	.69315	53	.71800	59
50	.46294	18	.50439	22	.54222	26	.57701	31	.60922	36	.63920	41	.66724	47	.69357	53	.71840	59
+10'	.46366	18	.50504	22	.54282	26	.57757	31	.60973	36	.63968	41	.66769	47	.69400	53	.71880	60

## TABLE III.

Log. Sines.

	3° 0'	Add for Tan.	3° 10'	Add for Tan.	3° 20'	Add for Tan.	3° 30'	Add for Tan.	3° 40'	Add for Tan.	3° 50'	Add for Tan.
+ 0'	8. 71880	60	8. 74226	66	8. 76451	74	8. 78568	81	8. 80585	89	8. 82513	97
10''	8. 71920	60	8. 74264	66	8. 76487	74	8. 78602	81	8. 80618	89	8. 82544	97
20	8. 71960	60	8. 74302	67	8. 76523	74	8. 78636	81	8. 80651	89	8. 82576	98
30	8. 72000	60	8. 74340	67	8. 76559	74	8. 78671	81	8. 80684	89	8. 82607	98
40	8. 72040	60	8. 74378	67	8. 76595	74	8. 78705	82	8. 80716	90	8. 82639	98
50	8. 72080	60	8. 74416	67	8. 76631	74	8. 78739	82	8. 80749	90	8. 82670	98
+ 1'	8. 72120	60	8. 74454	67	8. 76667	74	8. 78774	82	8. 80782	90	8. 82701	98
10''	8. 72160	60	8. 74491	67	8. 76703	74	8. 78808	82	8. 80815	90	8. 82732	98
20	8. 72200	60	8. 74529	67	8. 76739	75	8. 78842	82	8. 80847	90	8. 82764	98
30	8. 72240	60	8. 74567	67	8. 76775	75	8. 78876	82	8. 80880	90	8. 82795	99
40	8. 72280	61	8. 74605	68	8. 76811	75	8. 78910	82	8. 80913	90	8. 82826	99
50	8. 72320	61	8. 74642	68	8. 76847	75	8. 78945	82	8. 80945	90	8. 82857	99
+ 2'	8. 72359	61	8. 74680	68	8. 76883	75	8. 78979	83	8. 80978	91	8. 82888	99
10''	8. 72399	61	8. 74718	68	8. 76919	75	8. 79013	83	8. 81010	91	8. 82920	99
20	8. 72439	61	8. 74755	68	8. 76954	75	8. 79047	83	8. 81043	91	8. 82951	99
30	8. 72478	61	8. 74793	68	8. 76990	75	8. 79081	83	8. 81075	91	8. 82982	99
40	8. 72518	61	8. 74831	68	8. 77026	76	8. 79115	83	8. 81108	91	8. 83013	100
50	8. 72558	61	8. 74868	68	8. 77061	76	8. 79149	83	8. 81140	91	8. 83044	100
+ 3'	8. 72597	62	8. 74906	68	8. 77097	76	8. 79183	83	8. 81173	91	8. 83075	100
10''	8. 72637	62	8. 74943	69	8. 77133	76	8. 79217	84	8. 81205	92	8. 83106	100
20	8. 72676	62	8. 74980	69	8. 77168	76	8. 79251	84	8. 81237	92	8. 83137	100
30	8. 72716	62	8. 75018	69	8. 77204	76	8. 79284	84	8. 81270	92	8. 83168	100
40	8. 72755	62	8. 75055	69	8. 77239	76	8. 79318	84	8. 81302	92	8. 83199	100
50	8. 72794	62	8. 75092	69	8. 77275	76	8. 79352	84	8. 81334	92	8. 83230	101
+ 4'	8. 72834	62	8. 75130	69	8. 77310	77	8. 79386	84	8. 81367	92	8. 83261	101
10''	8. 72873	62	8. 75167	69	8. 77346	77	8. 79420	84	8. 81399	92	8. 83292	101
20	8. 72912	62	8. 75204	69	8. 77381	77	8. 79453	85	8. 81431	93	8. 83322	101
30	8. 72951	63	8. 75241	70	8. 77416	77	8. 79487	85	8. 81463	93	8. 83353	101
40	8. 72991	63	8. 75279	70	8. 77452	77	8. 79521	85	8. 81496	93	8. 83384	101
50	8. 73030	63	8. 75316	70	8. 77487	77	8. 79555	85	8. 81528	93	8. 83415	101
+ 5'	8. 73069	63	8. 75353	70	8. 77522	77	8. 79588	85	8. 81560	93	8. 83446	102
10''	8. 73108	63	8. 75390	70	8. 77558	77	8. 79622	85	8. 81592	93	8. 83476	102
20	8. 73147	63	8. 75427	70	8. 77593	78	8. 79655	85	8. 81624	93	8. 83507	102
30	8. 73186	63	8. 75464	70	8. 77628	78	8. 79689	85	8. 81656	93	8. 83538	102
40	8. 73225	63	8. 75501	70	8. 77663	78	8. 79722	86	8. 81688	94	8. 83568	102
50	8. 73264	63	8. 75538	71	8. 77698	78	8. 79756	86	8. 81720	94	8. 83599	102
+ 6'	8. 73303	64	8. 75575	71	8. 77733	78	8. 79789	86	8. 81752	94	8. 83630	102
10''	8. 73342	64	8. 75612	71	8. 77768	78	8. 79823	86	8. 81784	94	8. 83660	103
20	8. 73380	64	8. 75648	71	8. 77803	78	8. 79856	86	8. 81816	94	8. 83691	103
30	8. 73419	64	8. 75685	71	8. 77838	78	8. 79890	86	8. 81848	94	8. 83721	103
40	8. 73458	64	8. 75722	71	8. 77873	79	8. 79923	86	8. 81880	94	8. 83752	103
50	8. 73497	64	8. 75759	71	8. 77908	79	8. 79956	86	8. 81912	95	8. 83783	103
+ 7'	8. 73535	64	8. 75795	71	8. 77943	79	8. 79990	87	8. 81944	95	8. 83813	103
10''	8. 73574	64	8. 75832	71	8. 77978	79	8. 80023	87	8. 81975	95	8. 83844	103
20	8. 73613	65	8. 75869	72	8. 78013	79	8. 80056	87	8. 82007	95	8. 83874	104
30	8. 73651	65	8. 75905	72	8. 78048	79	8. 80090	87	8. 82039	95	8. 83904	104
40	8. 73690	65	8. 75942	72	8. 78083	79	8. 80123	87	8. 82071	95	8. 83935	104
50	8. 73728	65	8. 75979	72	8. 78118	79	8. 80156	87	8. 82103	95	8. 83965	104
+ 8'	8. 73767	65	8. 76015	72	8. 78152	80	8. 80189	87	8. 82134	96	8. 83996	104
10''	8. 73805	65	8. 76052	72	8. 78187	80	8. 80222	88	8. 82166	96	8. 84026	104
20	8. 73844	65	8. 76088	72	8. 78222	80	8. 80255	88	8. 82198	96	8. 84056	104
30	8. 73882	65	8. 76125	72	8. 78257	80	8. 80289	88	8. 82229	96	8. 84087	105
40	8. 73920	65	8. 76161	73	8. 78291	80	8. 80322	88	8. 82261	96	8. 84117	105
50	8. 73959	66	8. 76197	73	8. 78326	80	8. 80355	88	8. 82292	96	8. 84147	105
+ 9'	8. 73997	66	8. 76234	73	8. 78360	80	8. 80388	88	8. 82324	96	8. 84177	105
10''	8. 74035	66	8. 76270	73	8. 78395	80	8. 80421	88	8. 82356	97	8. 84208	105
20	8. 74073	66	8. 76306	73	8. 78430	81	8. 80454	88	8. 82387	97	8. 84238	105
30	8. 74112	66	8. 76343	73	8. 78464	81	8. 80487	89	8. 82419	97	8. 84268	105
40	8. 74150	66	8. 76379	73	8. 78499	81	8. 80519	89	8. 82450	97	8. 84298	106
50	8. 74188	66	8. 76415	73	8. 78533	81	8. 80552	89	8. 82482	97	8. 84328	106
+ 10'	8. 74226	66	8. 76451	74	8. 78568	81	8. 80585	89	8. 82513	97	8. 84358	106



TABLE III.

Log. Sines.

	4° 0'	Add for Tan.	4° 10'	Add for Tan.	4° 20'	Add for Tan.	4° 30'	Add for Tan.	4° 40'	Add for Tan.	4° 50'	Add for Tan.
+ 0'	8.84358	106	8.86128	115	8.87829	124	8.89464	134	8.91040	144	8.92561	155
10''	8.84389	106	8.86157	115	8.87856	124	8.89491	134	8.91066	144	8.92586	155
20	8.84419	106	8.86186	115	8.87884	125	8.89518	134	8.91092	145	8.92611	155
30	8.84449	106	8.86215	115	8.87912	125	8.89545	135	8.91118	145	8.92636	155
40	8.84479	107	8.86244	116	8.87940	125	8.89571	135	8.91143	145	8.92660	155
50	8.84509	107	8.86273	116	8.87967	125	8.89598	135	8.91169	145	8.92685	156
+ 1'	8.84539	107	8.86301	116	8.87995	125	8.89625	135	8.91195	145	8.92710	156
10''	8.84569	107	8.86330	116	8.88023	125	8.89651	135	8.91221	145	8.92735	156
20	8.84599	107	8.86359	116	8.88050	126	8.89678	135	8.91246	146	8.92760	156
30	8.84629	107	8.86388	116	8.88078	126	8.89704	136	8.91272	146	8.92784	156
40	8.84659	107	8.86416	116	8.88106	126	8.89731	136	8.91298	146	8.92809	156
50	8.84688	108	8.86445	117	8.88133	126	8.89758	136	8.91323	146	8.92834	157
+ 2'	8.84718	108	8.86474	117	8.88161	126	8.89784	136	8.91349	146	8.92859	157
10''	8.84748	108	8.86502	117	8.88188	126	8.89811	136	8.91374	146	8.92883	157
20	8.84778	108	8.86531	117	8.88216	127	8.89837	136	8.91400	147	8.92908	157
30	8.84808	108	8.86560	117	8.88243	127	8.89864	137	8.91426	147	8.92933	157
40	8.84838	108	8.86588	117	8.88271	127	8.89890	137	8.91451	147	8.92957	158
50	8.84867	108	8.86617	118	8.88298	127	8.89917	137	8.91477	147	8.92982	158
+ 3'	8.84897	109	8.86645	118	8.88326	127	8.89943	137	8.91502	147	8.93007	158
10''	8.84927	109	8.86674	118	8.88353	127	8.89970	137	8.91528	147	8.93031	158
20	8.84957	109	8.86703	118	8.88381	128	8.89996	137	8.91553	148	8.93056	158
30	8.84986	109	8.86731	118	8.88408	128	8.90023	138	8.91579	148	8.93081	159
40	8.85016	109	8.86760	118	8.88435	128	8.90049	138	8.91604	148	8.93105	159
50	8.85045	109	8.86788	118	8.88463	128	8.90075	138	8.91630	148	8.93130	159
+ 4'	8.85075	109	8.86816	119	8.88490	128	8.90102	138	8.91655	148	8.93154	159
10''	8.85105	110	8.86845	119	8.88518	128	8.90128	138	8.91680	149	8.93179	159
20	8.85134	110	8.86873	119	8.88545	129	8.90154	138	8.91706	149	8.93203	159
30	8.85164	110	8.86902	119	8.88572	129	8.90181	139	8.91731	149	8.93228	160
40	8.85193	110	8.86930	119	8.88600	129	8.90207	139	8.91757	149	8.93253	160
50	8.85223	110	8.86958	119	8.88627	129	8.90233	139	8.91782	149	8.93277	160
+ 5'	8.85252	110	8.86987	120	8.88654	129	8.90260	139	8.91807	149	8.93301	160
10''	8.85282	111	8.87015	120	8.88681	129	8.90286	139	8.91833	150	8.93326	160
20	8.85311	111	8.87043	120	8.88709	129	8.90312	139	8.91858	150	8.93350	160
30	8.85341	111	8.87072	120	8.88736	130	8.90338	140	8.91883	150	8.93375	161
40	8.85370	111	8.87100	120	8.88763	130	8.90364	140	8.91909	150	8.93399	161
50	8.85400	111	8.87128	120	8.88790	130	8.90391	140	8.91934	150	8.93424	161
+ 6'	8.85429	111	8.87156	121	8.88817	130	8.90417	140	8.91959	150	8.93448	161
10''	8.85458	111	8.87185	121	8.88845	130	8.90443	140	8.91984	151	8.93472	161
20	8.85488	112	8.87213	121	8.88872	130	8.90469	140	8.92010	151	8.93497	162
30	8.85517	112	8.87241	121	8.88899	131	8.90495	141	8.92035	151	8.93521	162
40	8.85546	112	8.87269	121	8.88926	131	8.90521	141	8.92060	151	8.93546	162
50	8.85576	112	8.87297	121	8.88953	131	8.90548	141	8.92085	151	8.93570	162
+ 7'	8.85605	112	8.87325	121	8.88980	131	8.90574	141	8.92110	152	8.93594	162
10''	8.85634	112	8.87354	122	8.89007	131	8.90600	141	8.92135	152	8.93619	162
20	8.85663	113	8.87382	122	8.89034	131	8.90626	141	8.92161	152	8.93643	163
30	8.85693	113	8.87410	122	8.89061	132	8.90652	142	8.92186	152	8.93667	163
40	8.85722	113	8.87438	122	8.89088	132	8.90678	142	8.92211	152	8.93691	163
50	8.85751	113	8.87466	122	8.89115	132	8.90704	142	8.92236	152	8.93716	163
+ 8'	8.85780	113	8.87494	122	8.89142	132	8.90730	142	8.92261	153	8.93740	163
10''	8.85809	113	8.87522	123	8.89169	132	8.90756	142	8.92286	153	8.93764	164
20	8.85838	113	8.87550	123	8.89196	132	8.90782	142	8.92311	153	8.93788	164
30	8.85867	114	8.87578	123	8.89223	133	8.90808	143	8.92336	153	8.93812	164
40	8.85896	114	8.87606	123	8.89250	133	8.90834	143	8.92361	153	8.93837	164
50	8.85926	114	8.87634	123	8.89277	133	8.90859	143	8.92386	153	8.93861	164
+ 9'	8.85955	114	8.87661	123	8.89304	133	8.90885	143	8.92411	154	8.93885	164
10''	8.85984	114	8.87689	124	8.89330	133	8.90911	143	8.92436	154	8.93909	165
20	8.86013	114	8.87717	124	8.89357	133	8.90937	144	8.92461	154	8.93933	165
30	8.86042	114	8.87745	124	8.89384	134	8.90963	144	8.92486	154	8.93957	165
40	8.86070	115	8.87773	124	8.89411	134	8.90989	144	8.92511	154	8.93981	165
50	8.86099	115	8.87801	124	8.89438	134	8.91015	144	8.92536	155	8.94006	165
+10'	8.86128	115	8.87829	124	8.89464	134	8.91040	144	8.92561	155	8.94030	165



Time.	Arc.	0h 20m 5°		0h 24m 6°		0h 28m 7°		0h 32m 8°		0h 36m 9°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	8.94030	142	9.01923	118	9.08589	102	9.14356	89	9.19433	79	60	+4
4	1	8.94174	14	9.02043	12	9.08692	10	9.14445	9	9.19513	8	59	56
8	2	8.94317	28	9.02163	24	9.08795	20	9.14535	18	9.19592	16	58	52
12	3	8.94461	43	9.02283	35	9.08897	31	9.14624	27	9.19672	24	57	48
16	4	8.94603	57	9.02402	47	9.08999	41	9.14714	36	9.19751	32	56	44
20	5	8.94746	71	9.02520	59	9.09101	51	9.14803	45	9.19830	40	55	40
24	6	8.94887	85	9.02639	71	9.09202	61	9.14891	53	9.19909	47	54	36
28	7	8.95029	99	9.02757	83	9.09304	71	9.14980	62	9.19988	55	53	32
32	8	8.95170	114	9.02874	94	9.09405	82	9.15069	71	9.20067	63	52	28
36	9	8.95310	128	9.02992	106	9.09506	92	9.15157	80	9.20145	71	51	24
40	10	8.95450	138	9.03109	116	9.09606	99	9.15245	87	9.20223	78	50	20
44	11	8.95589	14	9.03226	12	9.09707	10	9.15333	9	9.20302	8	49	16
48	12	8.95728	28	9.03342	23	9.09807	20	9.15421	17	9.20380	16	48	12
52	13	8.95867	41	9.03458	35	9.09907	30	9.15508	26	9.20458	23	47	8
+1	56	8.96005	55	9.03574	46	9.10006	40	9.15596	35	9.20535	31	46	4
	15	8.96143	69	9.03690	58	9.10106	50	9.15683	44	9.20613	39	45	+3
	4	8.96280	83	9.03805	70	9.10205	59	9.15770	52	9.20691	47	44	56
	8	8.96417	97	9.03920	81	9.10304	69	9.15857	61	9.20768	55	43	52
	12	8.96553	110	9.04034	93	9.10402	79	9.15944	70	9.20845	62	42	48
	16	8.96689	124	9.04149	104	9.10501	89	9.16030	78	9.20922	70	41	44
	20	8.96825	133	9.04262	113	9.10599	97	9.16116	85	9.20999	76	40	40
	24	8.96960	13	9.04376	11	9.10697	10	9.16203	9	9.21076	8	39	36
	28	8.97095	27	9.04490	23	9.10795	19	9.16289	17	9.21153	15	38	32
	32	8.97229	40	9.04603	34	9.10893	29	9.16374	26	9.21229	23	37	28
	36	8.97363	53	9.04715	45	9.10990	39	9.16460	34	9.21306	30	36	24
	40	8.97496	67	9.04828	57	9.11087	49	9.16545	43	9.21382	38	35	20
	44	8.97629	80	9.04940	68	9.11184	58	9.16631	51	9.21458	46	34	16
	48	8.97762	93	9.05052	79	9.11281	68	9.16716	60	9.21534	53	33	12
	52	8.97894	106	9.05164	90	9.11377	78	9.16801	68	9.21610	61	32	8
	56	8.98026	120	9.05275	102	9.11474	87	9.16886	77	9.21685	68	31	4
+2	30	8.98157	129	9.05386	110	9.11570	95	9.16970	84	9.21761	75	30	+2
	4	8.98288	13	9.05497	11	9.11666	10	9.17055	8	9.21836	8	29	56
	8	8.98419	26	9.05607	22	9.11761	19	9.17139	17	9.21912	15	28	52
	12	8.98549	39	9.05717	33	9.11857	29	9.17223	25	9.21987	23	27	48
	16	8.98679	52	9.05827	44	9.11952	38	9.17307	34	9.22062	30	26	44
	20	8.98808	65	9.05937	55	9.12047	48	9.17391	42	9.22137	38	25	40
	24	8.98937	77	9.06046	66	9.12142	57	9.17474	50	9.22211	45	24	36
	28	8.99066	90	9.06155	77	9.12236	67	9.17558	59	9.22286	53	23	32
	32	8.99194	103	9.06264	88	9.12331	76	9.17641	67	9.22361	60	22	28
	36	8.99322	116	9.06372	99	9.12425	86	9.17724	76	9.22435	68	21	24
	40	8.99450	125	9.06481	107	9.12519	93	9.17807	82	9.22509	74	20	20
	44	8.99577	13	9.06589	11	9.12612	9	9.17890	8	9.22583	7	19	16
	48	8.99704	25	9.06696	21	9.12706	19	9.17973	16	9.22657	15	18	12
	52	8.99830	38	9.06804	32	9.12799	28	9.18055	25	9.22731	22	17	8
	56	8.99956	50	9.06911	43	9.12892	37	9.18137	33	9.22805	30	16	4
+3	44	9.00082	63	9.07018	54	9.12985	47	9.18220	41	9.22878	37	15	+1
	4	9.00207	75	9.07124	64	9.13078	56	9.18302	49	9.22952	44	14	56
	8	9.00332	88	9.07231	75	9.13171	65	9.18383	57	9.23025	52	13	52
	12	9.00456	100	9.07337	86	9.13263	74	9.18465	66	9.23098	59	12	48
	16	9.00581	113	9.07442	96	9.13355	84	9.18547	74	9.23171	67	11	44
	20	9.00704	122	9.07548	104	9.13447	91	9.18628	81	9.23244	72	10	40
	24	9.00828	12	9.07653	10	9.13539	9	9.18709	8	9.23317	7	9	36
	28	9.00951	24	9.07758	21	9.13630	18	9.18790	16	9.23390	14	8	32
	32	9.01074	37	9.07863	31	9.13722	27	9.18871	24	9.23462	22	7	28
	36	9.01196	49	9.07968	42	9.13813	36	9.18952	32	9.23535	29	6	24
	40	9.01318	61	9.08072	52	9.13904	46	9.19033	41	9.23607	36	5	20
	44	9.01440	73	9.08176	62	9.13994	55	9.19113	49	9.23679	43	4	16
	48	9.01561	85	9.08280	73	9.14085	64	9.19193	57	9.23752	50	3	12
	52	9.01682	98	9.08383	83	9.14175	73	9.19273	65	9.23823	58	2	8
	56	9.01803	110	9.08486	94	9.14266	82	9.19353	73	9.23895	65	1	4
+4	60	9.01923		9.08589		9.14356		9.19433		9.23967		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		84°	5h 36m	83°	5h 32m	82°	5h 28m	81°	5h 24m	80°	5h 20m		

Log. Sines.

Time.	Arc.	0h 40m 10°		0h 44m 11°		0h 48m 12°		0h 52m 13°		0h 56m 14°		Arc.	Time.	
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.			
0	0	9.23967	71	9.28060	65	9.31788	59	9.35209	54	9.38368	51	60	+4	
4	1	9.24039	7	9.28125	7	9.31847	6	9.35263	5	9.38418	5	59	56	
8	2	9.24110	14	9.28190	13	9.31907	12	9.35318	11	9.38469	10	58	52	
12	3	9.24181	21	9.28254	20	9.31966	18	9.35373	16	9.38519	15	57	48	
16	4	9.24253	28	9.28319	26	9.32025	24	9.35427	22	9.38570	20	56	44	
20	5	9.24324	36	9.28384	33	9.32084	30	9.35481	27	9.38620	26	55	40	
24	6	9.24395	43	9.28448	39	9.32143	35	9.35536	32	9.38670	31	54	36	
28	7	9.24466	50	9.28512	46	9.32202	41	9.35590	38	9.38721	36	53	32	
32	8	9.24536	57	9.28577	52	9.32261	47	9.35644	43	9.38771	41	52	28	
36	9	9.24607	64	9.28641	59	9.32319	53	9.35698	49	9.38821	46	51	24	
40	10	9.24677	70	9.28705	63	9.32378	58	9.35752	54	9.38871	50	50	20	
44	11	9.24748	7	9.28769	6	9.32437	6	9.35806	5	9.38921	5	49	16	
48	12	9.24818	14	9.28833	13	9.32495	12	9.35860	11	9.38971	10	48	12	
52	13	9.24888	21	9.28896	19	9.32553	17	9.35914	16	9.39021	15	47	8	
+1	56	14	9.24958	28	9.28960	25	9.32612	23	9.35968	22	9.39071	20	46	4
	4	15	9.25028	35	9.29024	32	9.32670	29	9.36022	27	9.39121	25	45	+3
8	16	9.25098	42	9.29087	38	9.32728	35	9.36075	32	9.39170	30	44	56	
12	17	9.25168	49	9.29150	44	9.32786	41	9.36129	38	9.39220	35	43	52	
16	18	9.25237	56	9.29214	50	9.32844	46	9.36182	43	9.39270	40	42	48	
20	19	9.25307	63	9.29277	57	9.32902	52	9.36236	49	9.39319	45	41	44	
24	20	9.25376	69	9.29340	62	9.32960	58	9.36289	53	9.39369	49	40	40	
28	21	9.25445	7	9.29403	6	9.33018	6	9.36342	5	9.39418	5	39	36	
32	22	9.25514	14	9.29466	12	9.33075	12	9.36395	11	9.39467	10	38	32	
36	23	9.25583	21	9.29529	19	9.33133	17	9.36449	16	9.39517	15	37	28	
40	24	9.25652	28	9.29591	25	9.33190	23	9.36502	21	9.39566	20	36	24	
44	25	9.25721	35	9.29654	31	9.33248	29	9.36555	27	9.39615	25	35	20	
48	26	9.25790	41	9.29716	37	9.33305	35	9.36608	32	9.39664	29	34	16	
52	27	9.25858	48	9.29779	43	9.33362	41	9.36660	37	9.39713	34	33	12	
56	28	9.25927	55	9.29841	50	9.33420	46	9.36713	42	9.39762	39	32	8	
56	29	9.25995	62	9.29903	56	9.33477	52	9.36766	48	9.39811	44	31	4	
+2	30	9.26063	68	9.29966	62	9.33534	57	9.36819	52	9.39860	49	30	+2	
4	31	9.26131	7	9.30028	6	9.33591	6	9.36871	5	9.39909	5	29	56	
8	32	9.26199	14	9.30090	12	9.33647	11	9.36924	10	9.39958	10	28	52	
12	33	9.26267	20	9.30151	19	9.33704	17	9.36976	16	9.40006	15	27	48	
16	34	9.26335	27	9.30213	25	9.33761	23	9.37028	21	9.40055	20	26	44	
20	35	9.26403	34	9.30275	31	9.33818	29	9.37081	26	9.40103	25	25	40	
24	36	9.26470	41	9.30336	37	9.33874	34	9.37133	31	9.40152	29	24	36	
28	37	9.26538	48	9.30398	43	9.33931	40	9.37185	36	9.40200	34	23	32	
32	38	9.26605	54	9.30459	50	9.33987	46	9.37237	42	9.40249	39	22	28	
36	39	9.26672	61	9.30521	56	9.34043	51	9.37289	47	9.40297	44	21	24	
40	40	9.26739	67	9.30582	61	9.34100	56	9.37341	52	9.40346	48	20	20	
44	41	9.26806	7	9.30643	6	9.34156	6	9.37393	5	9.40394	5	19	16	
48	42	9.26873	13	9.30704	12	9.34212	11	9.37445	10	9.40442	10	18	12	
52	43	9.26940	20	9.30765	18	9.34268	17	9.37497	16	9.40490	14	17	8	
56	44	9.27007	27	9.30826	24	9.34324	22	9.37549	21	9.40538	19	16	4	
+3	45	9.27073	34	9.30887	31	9.34380	28	9.37600	26	9.40586	24	15	+1	
4	46	9.27140	40	9.30947	37	9.34436	34	9.37652	31	9.40634	29	14	56	
8	47	9.27206	47	9.31008	43	9.34491	39	9.37703	36	9.40682	34	13	52	
12	48	9.27273	54	9.31068	49	9.34547	45	9.37755	42	9.40730	38	12	48	
16	49	9.27339	60	9.31129	55	9.34602	50	9.37806	47	9.40778	43	11	44	
20	50	9.27405	66	9.31189	60	9.34658	55	9.37858	51	9.40825	47	10	40	
24	51	9.27471	7	9.31250	6	9.34713	6	9.37909	5	9.40873	5	9	36	
28	52	9.27537	13	9.31310	12	9.34769	11	9.37960	10	9.40921	9	8	32	
32	53	9.27602	20	9.31370	18	9.34824	17	9.38011	15	9.40968	14	7	28	
36	54	9.27668	26	9.31430	24	9.34879	22	9.38062	20	9.41016	19	6	24	
40	55	9.27734	33	9.31490	30	9.34934	28	9.38113	26	9.41063	24	5	20	
44	56	9.27799	40	9.31549	36	9.34989	33	9.38164	31	9.41111	28	4	16	
48	57	9.27864	46	9.31609	42	9.35044	39	9.38215	36	9.41158	33	3	12	
52	58	9.27930	53	9.31669	48	9.35099	44	9.38266	41	9.41205	38	2	8	
56	59	9.27995	59	9.31728	54	9.35154	50	9.38317	46	9.41252	42	1	4	
+4	60	9.28060		9.31788		9.35209		9.38368		9.41300		0	0	
		Cos.		Cos.		Cos.		Cos.		Cos.				
		79° 5h 16m		78° 5h 12m		77° 5h 8m		76° 5h 4m		75° 5h 0m				

Log. Cosines.



TABLE III.

Log. Sines.

Time.	Arc.	1h 0m 15°		1h 4m 16°		1h 8m 17°		1h 12m 18°		1h 16m 19°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	s. m.
0	0	9.41300	47	9.44034	44	9.46594	41	9.48998	39	9.51264	36	60	+4
4	1	9.41347	5	9.44078	4	9.46635	4	9.49037	4	9.51301	4	59	56
8	2	9.41394	9	9.44122	9	9.46676	8	9.49076	8	9.51338	7	58	52
12	3	9.41441	14	9.44166	13	9.46717	12	9.49115	12	9.51374	11	57	48
16	4	9.41488	19	9.44210	18	9.46758	16	9.49153	16	9.51411	14	56	44
20	5	9.41535	24	9.44253	22	9.46800	21	9.49192	20	9.51447	18	55	40
24	6	9.41582	28	9.44297	26	9.46841	25	9.49231	23	9.51484	22	54	36
28	7	9.41628	33	9.44341	31	9.46882	29	9.49269	27	9.51520	25	53	32
32	8	9.41675	38	9.44385	35	9.46923	33	9.49308	31	9.51557	29	52	28
36	9	9.41722	42	9.44428	40	9.46964	37	9.49347	35	9.51593	32	51	24
40	10	9.41768	46	9.44472	43	9.47005	41	9.49385	39	9.51629	36	50	20
44	11	9.41815	5	9.44516	4	9.47045	4	9.49424	4	9.51666	4	49	16
48	12	9.41861	9	9.44559	9	9.47086	8	9.49462	8	9.51702	7	48	12
52	13	9.41908	14	9.44602	13	9.47127	12	9.49500	12	9.51738	11	47	8
56	14	9.41954	18	9.44646	17	9.47168	16	9.49539	16	9.51774	14	46	4
+1	15	9.42001	23	9.44689	22	9.47209	21	9.49577	20	9.51811	18	45	+3
4	16	9.42047	28	9.44733	26	9.47249	25	9.49615	23	9.51847	22	44	56
8	17	9.42093	32	9.44776	30	9.47290	29	9.49654	27	9.51883	25	43	52
12	18	9.42140	37	9.44819	34	9.47330	33	9.49692	31	9.51919	29	42	48
16	19	9.42186	41	9.44862	39	9.47371	37	9.49730	35	9.51955	32	41	44
20	20	9.42232	46	9.44905	43	9.47411	40	9.49768	38	9.51991	36	40	40
24	21	9.42278	5	9.44948	4	9.47452	4	9.49806	4	9.52027	4	39	36
28	22	9.42324	9	9.44992	9	9.47492	8	9.49844	8	9.52063	7	38	32
32	23	9.42370	14	9.45035	13	9.47533	12	9.49882	11	9.52099	11	37	28
36	24	9.42416	18	9.45077	17	9.47573	16	9.49920	15	9.52135	14	36	24
40	25	9.42461	23	9.45120	22	9.47613	20	9.49958	19	9.52171	18	35	20
44	26	9.42507	28	9.45163	26	9.47654	24	9.49996	23	9.52207	22	34	16
48	27	9.42553	32	9.45206	30	9.47694	28	9.50034	27	9.52242	25	33	12
52	28	9.42599	37	9.45249	34	9.47734	32	9.50072	30	9.52278	29	32	8
56	29	9.42644	41	9.45292	39	9.47774	36	9.50110	34	9.52314	32	31	4
+2	30	9.42690	45	9.45334	42	9.47814	40	9.50148	38	9.52350	35	30	+2
4	31	9.42735	5	9.45377	4	9.47854	4	9.50185	4	9.52385	4	29	56
8	32	9.42781	9	9.45419	8	9.47894	8	9.50223	8	9.52421	7	28	52
12	33	9.42826	14	9.45462	13	9.47934	12	9.50261	11	9.52456	11	27	48
16	34	9.42872	18	9.45504	17	9.47974	16	9.50298	15	9.52492	14	26	44
20	35	9.42917	23	9.45547	21	9.48014	20	9.50336	19	9.52527	18	25	40
24	36	9.42962	27	9.45589	25	9.48054	24	9.50374	23	9.52563	21	24	36
28	37	9.43008	32	9.45632	29	9.48094	28	9.50411	27	9.52598	25	23	32
32	38	9.43053	36	9.45674	34	9.48133	32	9.50449	30	9.52634	28	22	28
36	39	9.43098	41	9.45716	38	9.48173	36	9.50486	34	9.52669	32	21	24
40	40	9.43143	45	9.45758	42	9.48213	40	9.50523	37	9.52705	35	20	20
44	41	9.43188	5	9.45801	4	9.48252	4	9.50561	4	9.52740	4	19	16
48	42	9.43233	9	9.45843	8	9.48292	8	9.50598	7	9.52775	7	18	12
52	43	9.43278	14	9.45885	13	9.48332	12	9.50635	11	9.52811	11	17	8
56	44	9.43323	18	9.45927	17	9.48371	16	9.50673	15	9.52846	14	16	4
+3	45	9.43367	23	9.45969	21	9.48411	20	9.50710	19	9.52881	18	15	+1
4	46	9.43412	27	9.46011	25	9.48450	24	9.50747	22	9.52916	21	14	56
8	47	9.43457	32	9.46053	29	9.48490	28	9.50784	26	9.52951	25	13	52
12	48	9.43502	36	9.46095	34	9.48529	32	9.50821	30	9.52986	28	12	48
16	49	9.43546	41	9.46136	38	9.48568	36	9.50858	33	9.53021	32	11	44
20	50	9.43591	44	9.46178	41	9.48607	39	9.50896	37	9.53056	35	10	40
24	51	9.43635	4	9.46220	4	9.48647	4	9.50933	4	9.53092	4	9	36
28	52	9.43680	9	9.46262	8	9.48686	8	9.50970	7	9.53126	7	8	32
32	53	9.43724	13	9.46303	12	9.48725	12	9.51007	11	9.53161	11	7	28
36	54	9.43769	18	9.46345	16	9.48764	16	9.51043	15	9.53196	14	6	24
40	55	9.43813	22	9.46386	21	9.48803	20	9.51080	19	9.53231	18	5	20
44	56	9.43857	26	9.46428	25	9.48842	23	9.51117	22	9.53266	21	4	16
48	57	9.43901	31	9.46469	29	9.48881	27	9.51154	26	9.53301	25	3	12
52	58	9.43946	35	9.46511	33	9.48920	31	9.51191	30	9.53336	28	2	8
56	59	9.43990	40	9.46552	37	9.48959	35	9.51227	33	9.53370	32	1	4
+4	60	9.44034		9.46594		9.48998		9.51264		9.53405		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		74°	4h 56m	73°	4h 52m	72°	4h 48m	71°	4h 44m	70°	4h 40m		

Log. Cosines.



TABLE III.

Log. Sines.

Time.	Arc.	1h 20m 20°		1h 24m 21°		1h 28m 22°		1h 32m 23°		1h 36m 24°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	s. m.
0	0	9.53405	35	9.55433	33	9.57358	31	9.59188	30	9.60931	28	60	+4
4	1	9.53440	4	9.55466	3	9.57389	3	9.59218	3	9.60960	3	59	56
8	2	9.53475	7	9.55499	7	9.57420	6	9.59247	6	9.60988	6	58	52
12	3	9.53509	11	9.55532	10	9.57451	9	9.59277	9	9.61016	8	57	48
16	4	9.53544	14	9.55564	13	9.57482	12	9.59307	12	9.61045	11	56	44
20	5	9.53578	18	9.55597	17	9.57514	16	9.59336	15	9.61073	14	55	40
24	6	9.53613	21	9.55630	20	9.57545	19	9.59366	18	9.61101	17	54	36
28	7	9.53647	25	9.55663	23	9.57576	22	9.59396	21	9.61129	20	53	32
32	8	9.53682	28	9.55695	26	9.57607	25	9.59425	24	9.61158	22	52	28
36	9	9.53716	32	9.55728	30	9.57638	28	9.59455	27	9.61186	25	51	24
40	10	9.53751	34	9.55761	32	9.57669	31	9.59484	29	9.61214	28	50	20
44	11	9.53785	3	9.55793	3	9.57700	3	9.59514	3	9.61242	3	49	16
48	12	9.53819	7	9.55826	6	9.57731	6	9.59543	6	9.61270	6	48	12
52	13	9.53854	10	9.55858	10	9.57762	9	9.59573	9	9.61298	8	47	8
56	14	9.53888	14	9.55891	13	9.57793	12	9.59602	12	9.61326	11	46	4
+1	15	9.53922	17	9.55923	16	9.57824	16	9.59632	15	9.61354	14	45	+3
4	16	9.53957	20	9.55956	19	9.57855	19	9.59661	17	9.61382	17	44	56
8	17	9.53991	24	9.55988	22	9.57885	22	9.59690	20	9.61411	20	43	52
12	18	9.54025	27	9.56021	26	9.57916	25	9.59720	23	9.61438	22	42	48
16	19	9.54059	31	9.56053	29	9.57947	28	9.59749	26	9.61466	25	41	44
20	20	9.54093	34	9.56085	32	9.57978	30	9.59778	29	9.61494	28	40	40
24	21	9.54127	3	9.56118	3	9.58008	3	9.59808	3	9.61522	3	39	36
28	22	9.54161	7	9.56150	6	9.58039	6	9.59837	6	9.61550	6	38	32
32	23	9.54195	10	9.56182	10	9.58070	9	9.59866	9	9.61578	8	37	28
36	24	9.54229	14	9.56215	13	9.58101	12	9.59895	12	9.61606	11	36	24
40	25	9.54263	17	9.56247	16	9.58131	15	9.59924	15	9.61634	14	35	20
44	26	9.54297	20	9.56279	19	9.58162	18	9.59954	17	9.61662	17	34	16
48	27	9.54331	24	9.56311	22	9.58192	21	9.59983	20	9.61689	20	33	12
52	28	9.54365	27	9.56343	26	9.58223	24	9.60012	23	9.61717	22	32	8
56	29	9.54399	31	9.56375	29	9.58253	27	9.60041	26	9.61745	25	31	4
+2	30	9.54433	34	9.56408	32	9.58284	30	9.60070	29	9.61773	28	30	+2
4	31	9.54466	3	9.56440	3	9.58314	3	9.60099	3	9.61800	3	29	56
8	32	9.54500	7	9.56472	6	9.58345	6	9.60128	6	9.61828	6	28	52
12	33	9.54534	10	9.56504	10	9.58375	9	9.60157	9	9.61856	8	27	48
16	34	9.54567	14	9.56536	13	9.58406	12	9.60186	12	9.61883	11	26	44
20	35	9.54601	17	9.56568	16	9.58436	15	9.60215	15	9.61911	14	25	40
24	36	9.54635	20	9.56599	19	9.58467	18	9.60244	17	9.61939	17	24	36
28	37	9.54668	24	9.56631	22	9.58497	21	9.60273	20	9.61966	20	23	32
32	38	9.54702	27	9.56663	26	9.58527	24	9.60302	23	9.61994	22	22	28
36	39	9.54735	31	9.56695	29	9.58557	27	9.60331	26	9.62021	25	21	24
40	40	9.54769	33	9.56727	32	9.58588	30	9.60359	29	9.62049	27	20	20
44	41	9.54802	3	9.56759	3	9.58618	3	9.60388	3	9.62076	3	19	16
48	42	9.54836	7	9.56790	6	9.58648	6	9.60417	6	9.62104	5	18	12
52	43	9.54869	10	9.56822	10	9.58678	9	9.60446	9	9.62131	8	17	8
56	44	9.54903	13	9.56854	13	9.58709	12	9.60474	12	9.62159	11	16	4
+3	45	9.54936	17	9.56886	16	9.58739	15	9.60503	15	9.62186	14	15	+1
4	46	9.54969	20	9.56917	19	9.58769	18	9.60532	17	9.62214	16	14	56
8	47	9.55003	23	9.56949	22	9.58799	21	9.60561	20	9.62241	19	13	52
12	48	9.55036	26	9.56980	26	9.58829	24	9.60589	23	9.62268	22	12	48
16	49	9.55069	30	9.57012	29	9.58859	27	9.60618	26	9.62296	24	11	44
20	50	9.55102	33	9.57044	31	9.58889	30	9.60646	29	9.62323	27	10	40
24	51	9.55136	3	9.57075	3	9.58919	3	9.60675	3	9.62350	3	9	36
28	52	9.55169	7	9.57107	6	9.58949	6	9.60704	6	9.62377	5	8	32
32	53	9.55202	10	9.57138	9	9.58979	9	9.60732	9	9.62405	8	7	28
36	54	9.55235	13	9.57169	12	9.59009	12	9.60761	12	9.62432	11	6	24
40	55	9.55268	17	9.57201	16	9.59039	15	9.60789	15	9.62459	14	5	20
44	56	9.55301	20	9.57232	19	9.59069	18	9.60818	17	9.62486	16	4	16
48	57	9.55334	23	9.57264	22	9.59098	21	9.60846	20	9.62513	19	3	12
52	58	9.55367	26	9.57295	25	9.59128	24	9.60875	23	9.62541	22	2	8
56	59	9.55400	30	9.57326	28	9.59158	27	9.60903	26	9.62568	24	1	4
+4	60	9.55433		9.57358		9.59188		9.60931		9.62595		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		69°	4h 36m	68°	4h 32m	67°	4h 28m	66°	4h 24m	65°	4h 20m		

Log. Cosines.

TABLE III.

Log Sines.

Time.	Arc.	1h 40m 25°		1h 44m 26°		1h 48m 27°		1h 52m 28°		1h 56m 29°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	m. s.
0	0	9.62595	27	9.64184	26	9.65705	25	9.67161	24	9.68557	23	60	+4
4	1	9.62622	3	9.64210	3	9.65729	3	9.67185	2	9.68580	2	59	56
8	2	9.62649	5	9.64236	5	9.65754	5	9.67208	5	9.68603	5	58	52
12	3	9.62676	8	9.64262	8	9.65779	8	9.67232	7	9.68625	7	57	48
16	4	9.62703	11	9.64288	10	9.65804	10	9.67256	10	9.68648	9	56	44
20	5	9.62730	14	9.64313	13	9.65828	13	9.67280	12	9.68671	12	55	40
24	6	9.62757	16	9.64339	16	9.65853	15	9.67303	14	9.68694	14	54	36
28	7	9.62784	19	9.64365	18	9.65878	18	9.67327	17	9.68716	16	53	32
32	8	9.62811	22	9.64391	21	9.65902	21	9.67350	19	9.68739	18	52	28
36	9	9.62838	24	9.64417	23	9.65927	23	9.67374	22	9.68762	21	51	24
40	10	9.62865	27	9.64442	26	9.65952	25	9.67398	23	9.68784	23	50	20
44	11	9.62892	3	9.64468	3	9.65976	3	9.67421	2	9.68807	2	49	16
48	12	9.62918	5	9.64494	5	9.66001	5	9.67445	5	9.68829	5	48	12
52	13	9.62945	8	9.64519	8	9.66025	8	9.67468	7	9.68852	7	47	8
56	14	9.62972	11	9.64545	10	9.66050	10	9.67492	9	9.68875	9	46	4
+1	15	9.62999	14	9.64571	13	9.66075	13	9.67515	12	9.68897	12	45	+3
4	16	9.63026	16	9.64596	16	9.66099	15	9.67539	14	9.68920	14	44	56
8	17	9.63052	19	9.64622	18	9.66124	18	9.67562	16	9.68942	16	43	52
12	18	9.63079	22	9.64647	21	9.66148	20	9.67586	18	9.68965	18	42	48
16	19	9.63106	24	9.64673	23	9.66173	23	9.67609	21	9.68987	21	41	44
20	20	9.63133	27	9.64698	25	9.66197	24	9.67633	23	9.69010	22	40	40
24	21	9.63159	3	9.64724	3	9.66221	2	9.67656	2	9.69032	2	39	36
28	22	9.63186	5	9.64749	5	9.66246	5	9.67680	5	9.69055	4	38	32
32	23	9.63213	8	9.64775	8	9.66270	7	9.67703	7	9.69077	7	37	28
36	24	9.63239	11	9.64800	10	9.66295	10	9.67726	9	9.69100	9	36	24
40	25	9.63266	14	9.64826	13	9.66319	12	9.67750	12	9.69122	11	35	20
44	26	9.63292	16	9.64851	15	9.66343	14	9.67773	14	9.69144	13	34	16
48	27	9.63319	19	9.64877	18	9.66368	17	9.67796	16	9.69167	15	33	12
52	28	9.63345	22	9.64902	20	9.66392	19	9.67820	18	9.69189	18	32	8
56	29	9.63372	24	9.64927	23	9.66416	22	9.67843	21	9.69212	20	31	4
+2	30	9.63398	26	9.64953	25	9.66441	24	9.67866	23	9.69234	22	30	+2
4	31	9.63425	3	9.64978	3	9.66465	2	9.67890	2	9.69256	2	29	56
8	32	9.63451	5	9.65003	5	9.66489	5	9.67913	5	9.69279	4	28	52
12	33	9.63478	8	9.65029	8	9.66513	7	9.67936	7	9.69301	7	27	48
16	34	9.63504	10	9.65054	10	9.66537	10	9.67959	9	9.69323	9	26	44
20	35	9.63531	13	9.65079	13	9.66562	12	9.67982	12	9.69345	11	25	40
24	36	9.63557	16	9.65104	15	9.66586	14	9.68006	14	9.69368	13	24	36
28	37	9.63583	18	9.65130	18	9.66610	17	9.68029	16	9.69390	15	23	32
32	38	9.63610	21	9.65155	20	9.66634	19	9.68052	18	9.69412	18	22	28
36	39	9.63636	23	9.65180	23	9.66658	22	9.68075	21	9.69434	20	21	24
40	40	9.63662	26	9.65205	25	9.66682	24	9.68098	23	9.69456	22	20	20
44	41	9.63689	3	9.65230	3	9.66706	2	9.68121	2	9.69479	2	19	16
48	42	9.63715	5	9.65255	5	9.66731	5	9.68144	5	9.69501	4	28	12
52	43	9.63741	8	9.65281	8	9.66755	7	9.68167	7	9.69523	7	17	8
56	44	9.63767	10	9.65306	10	9.66779	10	9.68190	9	9.69545	9	16	4
+3	45	9.63794	13	9.65331	13	9.66803	12	9.68213	12	9.69567	11	15	+1
4	46	9.63820	16	9.65356	15	9.66827	14	9.68237	14	9.69589	13	14	56
8	47	9.63846	18	9.65381	18	9.66851	17	9.68260	16	9.69611	15	13	52
12	48	9.63872	21	9.65406	20	9.66875	19	9.68283	18	9.69633	18	12	48
16	49	9.63898	23	9.65431	23	9.66899	22	9.68305	21	9.69655	20	11	44
20	50	9.63924	26	9.65456	25	9.66922	24	9.68328	23	9.69677	22	10	40
24	51	9.63950	3	9.65481	3	9.66946	2	9.68351	2	9.69699	2	9	36
28	52	9.63976	5	9.65506	5	9.66970	5	9.68374	5	9.69721	4	8	32
32	53	9.64002	8	9.65531	8	9.66994	7	9.68397	7	9.69743	7	7	28
36	54	9.64028	10	9.65556	10	9.67018	10	9.68420	9	9.69765	9	6	24
40	55	9.64054	13	9.65580	13	9.67042	12	9.68443	12	9.69787	11	5	20
44	56	9.64080	16	9.65605	15	9.67066	14	9.68466	14	9.69809	13	4	16
48	57	9.64106	18	9.65630	18	9.67090	17	9.68489	16	9.69831	15	3	12
52	58	9.64132	21	9.65655	20	9.67113	19	9.68512	18	9.69853	18	2	8
56	59	9.64158	23	9.65680	23	9.67137	22	9.68534	21	9.69875	20	1	4
+4	60	9.64184		9.65705		9.67161		9.68557		9.69897		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		64°	4h 16m	63°	4h 12m	62°	4h 8m	61°	4h 4m	60°	4h 0m		

Log. Cosines.



Log Sines.

Time.	Arc.	2h 0m 30°		2h 4m 31°		2h 8m 32°		2h 12m 33°		2h 16m 34°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	9.69897	22	9.71184	21	9.72421	20	9.73611	19	9.74756	19	60	+4
4	1	9.69919	2	9.71205	2	9.72441	2	9.73630	2	9.74775	2	59	56
8	2	9.69941	4	9.71226	4	9.72461	4	9.73650	4	9.74794	4	58	52
12	3	9.69963	7	9.71247	6	9.72482	6	9.73669	6	9.74812	6	57	48
16	4	9.69984	9	9.71268	8	9.72502	8	9.73689	8	9.74831	8	56	44
20	5	9.70006	11	9.71289	11	9.72522	10	9.73708	10	9.74850	10	55	40
24	6	9.70028	13	9.71310	13	9.72542	12	9.73727	11	9.74868	11	54	36
28	7	9.70050	15	9.71331	15	9.72562	14	9.73747	13	9.74887	13	53	32
32	8	9.70072	18	9.71352	17	9.72582	16	9.73766	16	9.74906	15	52	28
36	9	9.70093	20	9.71373	19	9.72602	18	9.73785	17	9.74924	17	51	24
40	10	9.70115	22	9.71393	21	9.72622	20	9.73805	19	9.74943	19	50	20
44	11	9.70137	2	9.71414	2	9.72643	2	9.73824	2	9.74961	2	49	16
48	12	9.70159	4	9.71435	4	9.72663	4	9.73843	4	9.74980	4	48	12
52	13	9.70180	7	9.71456	6	9.72683	6	9.73863	6	9.74999	6	47	8
56	14	9.70202	9	9.71477	8	9.72703	8	9.73882	8	9.75017	8	46	4
+1	15	9.70224	11	9.71498	11	9.72723	10	9.73901	10	9.75036	10	45	+3
4	16	9.70245	13	9.71519	13	9.72743	12	9.73921	11	9.75054	11	44	56
8	17	9.70267	15	9.71539	15	9.72763	14	9.73940	13	9.75073	13	43	52
12	18	9.70288	18	9.71560	17	9.72783	16	9.73959	15	9.75091	15	42	48
16	19	9.70310	20	9.71581	19	9.72803	18	9.73978	17	9.75110	17	41	44
20	20	9.70332	21	9.71602	21	9.72823	20	9.73997	19	9.75128	18	40	40
24	21	9.70353	2	9.71622	2	9.72843	2	9.74017	2	9.75147	2	39	36
28	22	9.70375	4	9.71643	4	9.72863	4	9.74036	4	9.75165	4	38	32
32	23	9.70396	6	9.71664	6	9.72883	6	9.74055	6	9.75184	5	37	28
36	24	9.70418	8	9.71685	8	9.72902	8	9.74074	8	9.75202	7	36	24
40	25	9.70439	11	9.71705	11	9.72922	10	9.74093	10	9.75221	9	35	20
44	26	9.70461	13	9.71726	13	9.72942	12	9.74113	11	9.75239	11	34	16
48	27	9.70482	15	9.71747	15	9.72962	14	9.74132	13	9.75258	13	33	12
52	28	9.70504	17	9.71767	17	9.72982	16	9.74151	15	9.75276	14	32	8
56	29	9.70525	19	9.71788	19	9.73002	18	9.74170	17	9.75294	16	31	4
+2	30	9.70547	21	9.71809	21	9.73022	20	9.74189	19	9.75313	18	30	+2
4	31	9.70568	2	9.71829	2	9.73041	2	9.74208	2	9.75331	2	29	56
8	32	9.70590	4	9.71850	4	9.73061	4	9.74227	4	9.75350	4	28	52
12	33	9.70611	6	9.71870	6	9.73081	6	9.74246	6	9.75368	5	27	48
16	34	9.70633	8	9.71891	8	9.73101	8	9.74265	8	9.75386	7	26	44
20	35	9.70654	11	9.71911	11	9.73121	10	9.74284	10	9.75405	9	25	40
24	36	9.70675	13	9.71932	13	9.73140	12	9.74303	11	9.75423	11	24	36
28	37	9.70697	15	9.71952	15	9.73160	14	9.74322	13	9.75441	13	23	32
32	38	9.70718	17	9.71973	17	9.73180	16	9.74341	15	9.75459	14	22	28
36	39	9.70739	19	9.71994	19	9.73200	18	9.74360	17	9.75478	16	21	24
40	40	9.70761	21	9.72014	20	9.73219	20	9.74379	19	9.75496	18	20	20
44	41	9.70782	2	9.72034	2	9.73239	2	9.74398	2	9.75514	2	19	16
48	42	9.70803	4	9.72055	4	9.73259	4	9.74417	4	9.75533	4	18	12
52	43	9.70824	6	9.72075	6	9.73278	6	9.74436	6	9.75551	5	17	8
56	44	9.70846	8	9.72096	8	9.73298	8	9.74455	8	9.75569	7	16	4
+3	45	9.70867	11	9.72116	10	9.73318	10	9.74474	10	9.75587	9	15	+1
4	46	9.70888	13	9.72137	12	9.73337	12	9.74493	11	9.75605	11	14	56
8	47	9.70909	15	9.72157	14	9.73357	14	9.74512	13	9.75624	13	13	52
12	48	9.70931	17	9.72177	16	9.73377	16	9.74531	15	9.75642	14	12	48
16	49	9.70952	19	9.72198	18	9.73396	18	9.74549	17	9.75660	16	11	44
20	50	9.70973	21	9.72218	20	9.73416	20	9.74568	19	9.75678	18	10	40
24	51	9.70994	2	9.72238	2	9.73435	2	9.74587	2	9.75696	2	9	36
28	52	9.71015	4	9.72259	4	9.73455	4	9.74606	4	9.75714	4	8	32
32	53	9.71036	6	9.72279	6	9.73474	6	9.74625	6	9.75733	5	7	28
36	54	9.71058	8	9.72299	8	9.73494	8	9.74644	8	9.75751	7	6	24
40	55	9.71079	11	9.72320	10	9.73513	10	9.74662	10	9.75769	9	5	20
44	56	9.71100	13	9.72340	12	9.73533	12	9.74681	11	9.75787	11	4	16
48	57	9.71121	15	9.72360	14	9.73552	14	9.74700	13	9.75805	13	3	12
52	58	9.71142	17	9.72381	16	9.73572	16	9.74719	15	9.75823	14	2	8
56	59	9.71163	19	9.72401	18	9.73591	18	9.74737	17	9.75841	16	1	4
+4	60	9.71184		9.72421		9.73611		9.74756		9.75859		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		59°	3h 56m	58°	3h 52m	57°	3h 48m	56°	3h 44m	55°	3h 40m		



TABLE III.

Log. Sines.

Time.	Arc.	2h 20m 35°		2h 24m 36°		2h 28m 37°		2h 32m 38°		2h 36m 39°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	9.75859	18	9.76922	17	9.77946	17	9.78934	16	9.79887	16	60	+4
4	1	9.75877	2	9.76939	2	9.77963	2	9.78950	2	9.79903	2	59	56
8	2	9.75895	4	9.76957	3	9.77980	3	9.78967	3	9.79918	3	58	52
12	3	9.75913	5	9.76974	5	9.77997	5	9.78983	5	9.79934	5	57	48
16	4	9.75931	7	9.76991	7	9.78013	7	9.78999	6	9.79950	6	56	44
20	5	9.75949	9	9.77009	9	9.78030	9	9.79015	8	9.79965	8	55	40
24	6	9.75967	11	9.77026	10	9.78047	10	9.79031	10	9.79981	10	54	36
28	7	9.75985	13	9.77043	12	9.78063	12	9.79047	11	9.79996	11	53	32
32	8	9.76003	14	9.77061	14	9.78080	14	9.79063	13	9.80012	13	52	28
36	9	9.76021	16	9.77078	15	9.78097	15	9.79079	14	9.80027	14	51	24
40	10	9.76039	18	9.77095	17	9.78113	17	9.79095	16	9.80043	15	50	20
44	11	9.76057	2	9.77112	2	9.78130	2	9.79111	2	9.80058	2	49	16
48	12	9.76075	4	9.77130	3	9.78147	3	9.79128	3	9.80074	3	48	12
52	13	9.76093	5	9.77147	5	9.78163	5	9.79144	5	9.80089	5	47	8
56	14	9.76111	7	9.77164	7	9.78180	7	9.79160	6	9.80105	6	46	4
+1	15	9.76129	9	9.77181	9	9.78197	9	9.79176	8	9.80120	8	45	+3
4	16	9.76146	11	9.77199	10	9.78213	10	9.79192	10	9.80136	9	44	56
8	17	9.76164	13	9.77216	12	9.78230	12	9.79208	11	9.80151	11	43	52
12	18	9.76182	14	9.77233	14	9.78246	14	9.79224	13	9.80166	12	42	48
16	19	9.76200	16	9.77250	15	9.78263	15	9.79240	14	9.80182	14	41	44
20	20	9.76218	18	9.77268	17	9.78280	16	9.79256	16	9.80197	15	40	40
24	21	9.76236	2	9.77285	2	9.78296	2	9.79272	2	9.80213	2	39	36
28	22	9.76253	4	9.77302	3	9.78313	3	9.79288	3	9.80228	3	38	32
32	23	9.76271	5	9.77319	5	9.78329	5	9.79304	5	9.80244	5	37	28
36	24	9.76289	7	9.77336	7	9.78346	6	9.79319	6	9.80259	6	36	24
40	25	9.76307	9	9.77353	9	9.78362	8	9.79335	8	9.80274	8	35	20
44	26	9.76324	11	9.77370	10	9.78379	10	9.79351	10	9.80290	9	34	16
48	27	9.76342	13	9.77387	12	9.78395	11	9.79367	11	9.80305	11	33	12
52	28	9.76360	14	9.77405	14	9.78412	13	9.79383	13	9.80320	12	32	8
56	29	9.76378	16	9.77422	15	9.78428	14	9.79399	14	9.80336	14	31	4
+2	30	9.76395	18	9.77439	17	9.78445	16	9.79415	16	9.80351	15	30	+2
4	31	9.76413	2	9.77456	2	9.78461	2	9.79431	2	9.80366	2	29	56
8	32	9.76431	4	9.77473	3	9.78478	3	9.79447	3	9.80382	3	28	52
12	33	9.76448	5	9.77490	5	9.78494	5	9.79463	5	9.80397	5	27	48
16	34	9.76466	7	9.77507	7	9.78510	6	9.79478	6	9.80412	6	26	44
20	35	9.76484	9	9.77524	9	9.78527	8	9.79494	8	9.80428	8	25	40
24	36	9.76501	11	9.77541	10	9.78543	10	9.79510	10	9.80443	9	24	36
28	37	9.76519	13	9.77558	12	9.78560	11	9.79526	11	9.80458	11	23	32
32	38	9.76537	14	9.77575	14	9.78576	13	9.79542	13	9.80473	12	22	28
36	39	9.76554	16	9.77592	15	9.78592	14	9.79558	14	9.80489	14	21	24
40	40	9.76572	17	9.77609	17	9.78609	16	9.79573	16	9.80504	15	20	20
44	41	9.76590	2	9.77626	2	9.78625	2	9.79589	2	9.80519	2	19	16
48	42	9.76607	3	9.77643	3	9.78642	3	9.79605	3	9.80534	3	18	12
52	43	9.76625	5	9.77660	5	9.78658	5	9.79621	5	9.80550	5	17	8
56	44	9.76642	7	9.77677	7	9.78674	6	9.79636	6	9.80565	6	16	4
+3	45	9.76660	9	9.77694	9	9.78691	8	9.79652	8	9.80580	8	15	+1
4	46	9.76677	10	9.77711	10	9.78707	10	9.79668	10	9.80595	9	14	56
8	47	9.76695	12	9.77728	12	9.78723	11	9.79684	11	9.80610	11	13	52
12	48	9.76712	14	9.77744	14	9.78739	13	9.79699	13	9.80625	12	12	48
16	49	9.76730	15	9.77761	15	9.78756	14	9.79715	14	9.80641	14	11	44
20	50	9.76747	17	9.77778	17	9.78772	16	9.79731	16	9.80656	15	10	40
24	51	9.76765	2	9.77795	2	9.78788	2	9.79746	2	9.80671	2	9	36
28	52	9.76782	3	9.77812	3	9.78805	3	9.79762	3	9.80686	3	8	32
32	53	9.76800	5	9.77829	5	9.78821	5	9.79778	5	9.80701	5	7	28
36	54	9.76817	7	9.77846	7	9.78837	6	9.79793	6	9.80716	6	6	24
40	55	9.76835	9	9.77862	9	9.78853	8	9.79809	8	9.80731	8	5	20
44	56	9.76852	10	9.77879	10	9.78869	10	9.79825	10	9.80746	9	4	16
48	57	9.76870	12	9.77896	12	9.78886	11	9.79840	11	9.80762	11	3	12
52	58	9.76887	14	9.77913	14	9.78902	13	9.79856	13	9.80777	12	2	8
56	59	9.76904	15	9.77930	15	9.78918	14	9.79872	14	9.80792	14	1	4
+4	60	9.76922		9.77946		9.78934		9.79887		9.80807		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		54° 3h 36m		53° 3h 32m		52° 3h 28m		51° 3h 24m		50° 3h 20m			

Log. Cosines.

TABLE III.

Log. Sines.

Time.	Arc.	2h 40m 40°		2h 44m 41°		2h 48m 42°		2h 52m 43°		2h 56m 44°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	s. m.
0	0	9.80807	15	9.81694	14	9.82551	14	9.83378	14	9.84177	13	60	+4
4	1	9.80822	2	9.81709	1	9.82565	1	9.83392	1	9.84190	1	59	56
8	2	9.80837	3	9.81723	3	9.82579	3	9.83405	3	9.84203	3	58	52
12	3	9.80852	5	9.81738	4	9.82593	4	9.83419	4	9.84216	4	57	48
16	4	9.80867	6	9.81752	6	9.82607	6	9.83432	6	9.84229	5	56	44
20	5	9.80882	8	9.81767	7	9.82621	7	9.83446	7	9.84242	7	55	40
24	6	9.80897	9	9.81781	8	9.82635	8	9.83459	8	9.84255	8	54	36
28	7	9.80912	11	9.81796	10	9.82649	10	9.83473	10	9.84269	9	53	32
32	8	9.80927	12	9.81810	11	9.82663	11	9.83486	11	9.84282	10	52	28
36	9	9.80942	14	9.81825	13	9.82677	13	9.83500	13	9.84295	12	51	24
40	10	9.80957	15	9.81839	14	9.82691	14	9.83513	13	9.84308	13	50	20
44	11	9.80972	2	9.81854	1	9.82705	1	9.83527	1	9.84321	1	49	16
48	12	9.80987	3	9.81868	3	9.82719	3	9.83540	3	9.84334	3	48	12
52	13	9.81002	5	9.81882	4	9.82733	4	9.83554	4	9.84347	4	47	8
56	14	9.81017	6	9.81897	6	9.82747	6	9.83567	5	9.84360	5	46	4
+1	15	9.81032	8	9.81911	7	9.82761	7	9.83581	7	9.84373	7	45	+3
4	16	9.81047	9	9.81926	8	9.82775	8	9.83594	8	9.84385	8	44	56
8	17	9.81061	11	9.81940	10	9.82788	10	9.83608	9	9.84398	9	43	52
12	18	9.81076	12	9.81955	11	9.82802	11	9.83621	10	9.84411	10	42	48
16	19	9.81091	14	9.81969	13	9.82816	13	9.83634	12	9.84424	12	41	44
20	20	9.81106	15	9.81983	14	9.82830	14	9.83648	13	9.84437	13	40	40
24	21	9.81121	2	9.81998	1	9.82844	1	9.83661	1	9.84450	1	39	36
28	22	9.81136	3	9.82012	3	9.82858	3	9.83674	3	9.84463	3	38	32
32	23	9.81151	5	9.82026	4	9.82872	4	9.83688	4	9.84476	4	37	28
36	24	9.81166	6	9.82041	6	9.82885	6	9.83701	5	9.84489	5	36	24
40	25	9.81180	8	9.82055	7	9.82899	7	9.83715	7	9.84502	7	35	20
44	26	9.81195	9	9.82069	8	9.82913	8	9.83728	8	9.84515	8	34	16
48	27	9.81210	11	9.82084	10	9.82927	10	9.83741	9	9.84528	9	33	12
52	28	9.81225	12	9.82098	11	9.82941	11	9.83755	10	9.84540	10	32	8
56	29	9.81240	14	9.82112	13	9.82955	13	9.83768	12	9.84553	12	31	4
+2	30	9.81254	15	9.82126	14	9.82968	14	9.83781	13	9.84566	13	30	+2
4	31	9.81269	2	9.82141	1	9.82982	1	9.83795	1	9.84579	1	29	56
8	32	9.81284	3	9.82155	3	9.82996	3	9.83808	3	9.84592	3	28	52
12	33	9.81299	5	9.82169	4	9.83010	4	9.83821	4	9.84605	4	27	48
16	34	9.81314	6	9.82184	6	9.83023	6	9.83834	5	9.84618	5	26	44
20	35	9.81328	8	9.82198	7	9.83037	7	9.83848	7	9.84630	7	25	40
24	36	9.81343	9	9.82212	8	9.83051	8	9.83861	8	9.84643	8	24	36
28	37	9.81358	11	9.82226	10	9.83065	10	9.83874	9	9.84656	9	23	32
32	38	9.81372	12	9.82240	11	9.83078	11	9.83887	10	9.84669	10	22	28
36	39	9.81387	14	9.82255	13	9.83092	13	9.83901	12	9.84682	12	21	24
40	40	9.81402	15	9.82269	14	9.83106	14	9.83914	13	9.84694	13	20	20
44	41	9.81417	2	9.82283	1	9.83120	1	9.83927	1	9.84707	1	19	16
48	42	9.81431	3	9.82297	3	9.83133	3	9.83940	3	9.84720	3	18	12
52	43	9.81446	5	9.82311	4	9.83147	4	9.83954	4	9.84733	4	17	8
56	44	9.81461	6	9.82326	6	9.83161	6	9.83967	5	9.84745	5	16	4
+3	45	9.81475	8	9.82340	7	9.83174	7	9.83980	7	9.84758	7	15	+1
4	46	9.81490	9	9.82354	8	9.83188	8	9.83993	8	9.84771	8	14	56
8	47	9.81505	11	9.82368	10	9.83202	10	9.84006	9	9.84784	9	13	52
12	48	9.81519	12	9.82382	11	9.83215	11	9.84020	10	9.84796	10	12	48
16	49	9.81534	14	9.82396	13	9.83229	13	9.84033	12	9.84809	12	11	44
20	50	9.81549	15	9.82410	14	9.83242	14	9.84046	13	9.84822	13	10	40
24	51	9.81563	1	9.82424	1	9.83256	1	9.84059	1	9.84835	1	9	36
28	52	9.81578	3	9.82439	3	9.83270	3	9.84072	3	9.84847	3	8	32
32	53	9.81592	4	9.82453	4	9.83283	4	9.84085	4	9.84860	4	7	28
36	54	9.81607	6	9.82467	6	9.83297	6	9.84098	5	9.84873	5	6	24
40	55	9.81622	7	9.82481	7	9.83310	7	9.84112	7	9.84885	7	5	20
44	56	9.81636	8	9.82495	8	9.83324	8	9.84125	8	9.84898	8	4	16
48	57	9.81651	10	9.82509	10	9.83338	10	9.84138	9	9.84911	9	3	12
52	58	9.81665	11	9.82523	11	9.83351	11	9.84151	10	9.84923	10	2	8
56	59	9.81680	13	9.82537	13	9.83365	13	9.84164	12	9.84936	12	1	4
+4	60	9.81694		9.82551		9.83378		9.84177		9.84949		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		49°	3h 16m	48°	3h 12m	47°	3h 8m	46°	3h 4m	45°	3h 0m		

Log. Cosines.



Time.	Arc.	3h 0m 45°		3h 4m 46°		3h 8m 47°		3h 12m 48°		3h 16m 49°		Arc.	Time.
m. s.	'	Sine.	P.P.	Sine.	P.P.	Sine.	P.P.	Sine.	P.P.	Sine.	P.P.	'	s. m.
0	0	9.84949	13	9.85693	12	9.86413	12	9.87107	11	9.87778	11	60	+4
4	1	9.84961	1	9.85706	1	9.86425	1	9.87119	1	9.87789	1	59	56
8	2	9.84974	3	9.85718	2	9.86436	2	9.87130	2	9.87800	2	58	52
12	3	9.84986	4	9.85730	4	9.86448	4	9.87141	3	9.87811	3	57	48
16	4	9.84999	5	9.85742	5	9.86460	5	9.87153	4	9.87822	4	56	44
20	5	9.85012	7	9.85754	6	9.86472	6	9.87164	6	9.87833	6	55	40
24	6	9.85024	8	9.85766	7	9.86483	7	9.87175	7	9.87844	7	54	36
28	7	9.85037	9	9.85779	8	9.86495	8	9.87187	8	9.87855	8	53	32
32	8	9.85049	10	9.85791	10	9.86507	10	9.87198	9	9.87866	9	52	28
36	9	9.85062	12	9.85803	11	9.86518	11	9.87209	10	9.87877	10	51	24
40	10	9.85074	13	9.85815	12	9.86530	12	9.87221	11	9.87887	11	50	20
44	11	9.85087	1	9.85827	1	9.86542	1	9.87232	1	9.87898	1	49	16
48	12	9.85100	3	9.85839	2	9.86554	2	9.87243	2	9.87909	2	48	12
52	13	9.85112	4	9.85851	4	9.86565	4	9.87255	3	9.87920	3	47	8
56	14	9.85125	5	9.85864	5	9.86577	5	9.87266	4	9.87931	4	46	4
+1	15	9.85137	7	9.85876	6	9.86589	6	9.87277	6	9.87942	6	45	+3
4	16	9.85150	8	9.85888	7	9.86600	7	9.87288	7	9.87953	7	44	56
8	17	9.85162	9	9.85900	8	9.86612	8	9.87300	8	9.87964	8	43	52
12	18	9.85175	10	9.85912	10	9.86624	10	9.87311	9	9.87975	9	42	48
16	19	9.85187	12	9.85924	11	9.86635	11	9.87322	10	9.87985	10	41	44
20	20	9.85200	12	9.85936	12	9.86647	12	9.87334	11	9.87996	11	40	40
24	21	9.85212	1	9.85948	1	9.86659	1	9.87345	1	9.88007	1	39	36
28	22	9.85225	2	9.85960	2	9.86670	2	9.87356	2	9.88018	2	38	32
32	23	9.85237	4	9.85972	4	9.86682	4	9.87367	3	9.88029	3	37	28
36	24	9.85250	5	9.85984	5	9.86694	5	9.87378	4	9.88040	4	36	24
40	25	9.85262	6	9.85996	6	9.86705	6	9.87390	6	9.88051	6	35	20
44	26	9.85274	7	9.86008	7	9.86717	7	9.87401	7	9.88061	7	34	16
48	27	9.85287	8	9.86020	8	9.86728	8	9.87412	8	9.88072	8	33	12
52	28	9.85299	10	9.86032	10	9.86740	10	9.87423	9	9.88083	9	32	8
56	29	9.85312	11	9.86044	11	9.86752	11	9.87434	10	9.88094	10	31	4
+2	30	9.85324	12	9.86056	12	9.86763	12	9.87446	11	9.88105	11	30	+2
4	31	9.85337	1	9.86068	1	9.86775	1	9.87457	1	9.88115	1	29	56
8	32	9.85349	2	9.86080	2	9.86786	2	9.87468	2	9.88126	2	28	52
12	33	9.85361	4	9.86092	4	9.86798	4	9.87479	3	9.88137	3	27	48
16	34	9.85374	5	9.86104	5	9.86809	5	9.87490	4	9.88148	4	26	44
20	35	9.85386	6	9.86116	6	9.86821	6	9.87501	6	9.88158	6	25	40
24	36	9.85399	7	9.86128	7	9.86832	7	9.87513	7	9.88169	7	24	36
28	37	9.85411	8	9.86140	8	9.86844	8	9.87524	8	9.88180	8	23	32
32	38	9.85423	10	9.86152	10	9.86855	10	9.87535	9	9.88191	9	22	28
36	39	9.85436	11	9.86164	11	9.86867	11	9.87546	10	9.88201	10	21	24
40	40	9.85448	12	9.86176	12	9.86879	11	9.87557	11	9.88212	11	20	20
44	41	9.85460	1	9.86188	1	9.86890	1	9.87568	1	9.88223	1	19	16
48	42	9.85473	2	9.86200	2	9.86902	2	9.87579	2	9.88234	2	18	12
52	43	9.85485	4	9.86211	4	9.86913	3	9.87590	3	9.88244	3	17	8
56	44	9.85497	5	9.86223	5	9.86924	4	9.87601	4	9.88255	4	16	4
+3	45	9.85510	6	9.86235	6	9.86936	6	9.87613	6	9.88266	6	15	+1
4	46	9.85522	7	9.86247	7	9.86947	7	9.87624	7	9.88276	7	14	56
8	47	9.85534	8	9.86259	8	9.86959	8	9.87635	8	9.88287	8	13	52
12	48	9.85547	10	9.86271	10	9.86970	9	9.87646	9	9.88298	9	12	48
16	49	9.85559	11	9.86283	11	9.86982	10	9.87657	10	9.88308	10	11	44
20	50	9.85571	12	9.86295	12	9.86993	11	9.87668	11	9.88319	11	10	40
24	51	9.85583	1	9.86306	1	9.87005	1	9.87679	1	9.88330	1	9	36
28	52	9.85596	2	9.86318	2	9.87016	2	9.87690	2	9.88340	2	8	32
32	53	9.85608	4	9.86330	4	9.87028	3	9.87701	3	9.88351	3	7	28
36	54	9.85620	5	9.86342	5	9.87039	4	9.87712	4	9.88362	4	6	24
40	55	9.85632	6	9.86354	6	9.87050	6	9.87723	6	9.88372	6	5	20
44	56	9.85645	7	9.86366	7	9.87062	7	9.87734	7	9.88383	7	4	16
48	57	9.85657	8	9.86377	8	9.87073	8	9.87745	8	9.88394	8	3	12
52	58	9.85669	10	9.86389	10	9.87085	9	9.87756	9	9.88404	9	2	8
56	59	9.85681	11	9.86401	11	9.87096	10	9.87767	10	9.88415	10	1	4
+4	60	9.85693		9.86413		9.87107		9.87778		9.88425		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		44° 2h 56m		43° 2h 52m		42° 2h 48m		41° 2h 44m		40° 2h 40m			



TABLE III.

Log. Sines.

Time. m. s.	Arc. '	3h 20m 50°		3h 24m 51°		3h 28m 52°		3h 32m 53°		3h 36m 54°		Arc. '	Time. s. m.
		Sine.	P.P.	Sine.	P.P.	Sine.	P.P.	Sine.	P.P.	Sine.	P.P.		
0	0	9.88425	11	9.89050	10	9.89653	10	9.90235	9	9.90796	9	60	+4
4	1	9.88436	1	9.89060	1	9.89663	1	9.90244	1	9.90805	1	59	56
8	2	9.88447	2	9.89071	2	9.89673	2	9.90254	2	9.90814	2	58	52
12	3	9.88457	3	9.89081	3	9.89683	3	9.90263	3	9.90823	3	57	48
16	4	9.88468	4	9.89091	4	9.89693	4	9.90273	4	9.90832	4	56	44
20	5	9.88478	6	9.89101	5	9.89702	5	9.90282	5	9.90842	5	55	40
24	6	9.88489	7	9.89112	6	9.89712	6	9.90292	5	9.90851	5	54	36
28	7	9.88499	8	9.89122	7	9.89722	7	9.90301	6	9.90860	6	53	32
32	8	9.88510	9	9.89132	8	9.89732	8	9.90311	7	9.90869	7	52	28
36	9	9.88521	10	9.89142	9	9.89742	9	9.90320	8	9.90878	8	51	24
40	10	9.88531	11	9.89152	10	9.89752	10	9.90330	9	9.90887	9	50	20
44	11	9.88542	1	9.89162	1	9.89761	1	9.90339	1	9.90896	1	49	16
48	12	9.88552	2	9.89173	2	9.89771	2	9.90349	2	9.90906	2	48	12
52	13	9.88563	3	9.89183	3	9.89781	3	9.90358	3	9.90915	3	47	8
56	14	9.88573	4	9.89193	4	9.89791	4	9.90368	4	9.90924	4	46	4
+1	15	9.88584	6	9.89203	5	9.89801	5	9.90377	5	9.90933	5	45	+3
4	16	9.88594	7	9.89213	6	9.89810	6	9.90386	5	9.90942	5	44	56
8	17	9.88605	8	9.89223	7	9.89820	7	9.90396	6	9.90951	6	43	52
12	18	9.88615	9	9.89233	8	9.89830	8	9.90405	7	9.90960	7	42	48
16	19	9.88626	10	9.89244	9	9.89840	9	9.90415	8	9.90969	8	41	44
20	20	9.88636	10	9.89254	10	9.89849	10	9.90424	9	9.90978	9	40	40
24	21	9.88647	1	9.89264	1	9.89859	1	9.90434	1	9.90987	1	39	36
28	22	9.88657	2	9.89274	2	9.89869	2	9.90443	2	9.90996	2	38	32
32	23	9.88668	3	9.89284	3	9.89879	3	9.90452	3	9.91005	3	37	28
36	24	9.88678	4	9.89294	4	9.89888	4	9.90462	4	9.91014	4	36	24
40	25	9.88688	5	9.89304	5	9.89898	5	9.90471	5	9.91023	5	35	20
44	26	9.88699	6	9.89314	6	9.89908	6	9.90480	5	9.91033	5	34	16
48	27	9.88709	7	9.89324	7	9.89918	7	9.90490	6	9.91042	6	33	12
52	28	9.88720	8	9.89334	8	9.89927	8	9.90499	7	9.91051	7	32	8
56	29	9.88730	9	9.89344	9	9.89937	9	9.90509	8	9.91060	8	31	4
+2	30	9.88741	10	9.89354	10	9.89947	10	9.90518	9	9.91069	9	30	+2
4	31	9.88751	1	9.89364	1	9.89956	1	9.90527	1	9.91078	1	29	56
8	32	9.88761	2	9.89375	2	9.89966	2	9.90537	2	9.91087	2	28	52
12	33	9.88772	3	9.89385	3	9.89976	3	9.90546	3	9.91096	3	27	48
16	34	9.88782	4	9.89395	4	9.89985	4	9.90555	4	9.91105	4	26	44
20	35	9.88793	5	9.89405	5	9.89995	5	9.90565	5	9.91114	5	25	40
24	36	9.88803	6	9.89415	6	9.90005	6	9.90574	5	9.91123	5	24	36
28	37	9.88813	7	9.89425	7	9.90014	7	9.90583	6	9.91132	6	23	32
32	38	9.88824	8	9.89435	8	9.90024	8	9.90592	7	9.91141	7	22	28
36	39	9.88834	9	9.89445	9	9.90034	9	9.90602	8	9.91149	8	21	24
40	40	9.88844	10	9.89455	10	9.90043	10	9.90611	9	9.91158	9	20	20
44	41	9.88855	1	9.89465	1	9.90053	1	9.90620	1	9.91167	1	19	16
48	42	9.88865	2	9.89475	2	9.90063	2	9.90630	2	9.91176	2	18	12
52	43	9.88875	3	9.89485	3	9.90072	3	9.90639	3	9.91185	3	17	8
56	44	9.88886	4	9.89495	4	9.90082	4	9.90648	4	9.91194	4	16	4
+3	45	9.88896	5	9.89504	5	9.90091	5	9.90657	5	9.91203	5	15	+1
4	46	9.88906	6	9.89514	6	9.90101	6	9.90667	5	9.91212	5	14	56
8	47	9.88917	7	9.89524	7	9.90111	7	9.90676	6	9.91221	6	13	52
12	48	9.88927	8	9.89534	8	9.90120	8	9.90685	7	9.91230	7	12	48
16	49	9.88937	9	9.89544	9	9.90130	9	9.90694	8	9.91239	8	11	44
20	50	9.88948	10	9.89554	10	9.90139	10	9.90704	9	9.91248	9	10	40
24	51	9.88958	1	9.89564	1	9.90149	1	9.90713	1	9.91257	1	9	36
28	52	9.88968	2	9.89574	2	9.90159	2	9.90722	2	9.91266	2	8	32
32	53	9.88978	3	9.89584	3	9.90168	3	9.90731	3	9.91274	3	7	28
36	54	9.88989	4	9.89594	4	9.90178	4	9.90741	4	9.91283	4	6	24
40	55	9.88999	5	9.89604	5	9.90187	5	9.90750	5	9.91292	5	5	20
44	56	9.89009	6	9.89614	6	9.90197	6	9.90759	5	9.91301	5	4	16
48	57	9.89010	7	9.89624	7	9.90206	7	9.90768	6	9.91310	6	3	12
52	58	9.89030	8	9.89633	8	9.90216	8	9.90777	7	9.91319	7	2	8
56	59	9.89040	9	9.89643	9	9.90225	9	9.90787	8	9.91328	8	1	4
+4	60	9.89050		9.89653		9.90235		9.90796		9.91336		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		39° 2h 36m		38° 2h 32m		37° 2h 28m		36° 2h 24m		35° 2h 20m			

Time.	Arc.	3h 40m 55°	3h 44m 56°	3h 48m 57°	3h 52m 58°	3h 56m 59°	Arc.	Time.					
m. s.	'	Sine. P. P.	Sine. P. P.	Sine. P. P.	Sine. P. P.	Sine. P. P.	'	s. m.					
0	0	9.91336	9	9.91857	8	9.92359	8	9.92842	8	9.93307	8	60	+4
4	1	9.91345	1	9.91866	1	9.92367	1	9.92850	1	9.93314	1	59	56
8	2	9.91354	2	9.91874	2	9.92376	2	9.92858	2	9.93322	2	58	52
12	3	9.91363	3	9.91883	2	9.92384	2	9.92866	2	9.93329	2	57	48
16	4	9.91372	4	9.91891	3	9.92392	3	9.92874	3	9.93337	3	56	44
20	5	9.91381	5	9.91900	4	9.92400	4	9.92881	4	9.93344	4	55	40
24	6	9.91389	5	9.91908	5	9.92408	5	9.92889	5	9.93352	5	54	36
28	7	9.91398	6	9.91917	6	9.92416	6	9.92897	6	9.93360	6	53	32
32	8	9.91407	7	9.91925	6	9.92425	6	9.92905	6	9.93367	6	52	28
36	9	9.91416	8	9.91934	7	9.92433	7	9.92913	7	9.93375	7	51	24
40	10	9.91425	9	9.91942	8	9.92441	8	9.92921	8	9.93382	8	50	20
44	11	9.91433	1	9.91951	1	9.92449	1	9.92929	1	9.93390	1	49	16
48	12	9.91442	2	9.91959	2	9.92457	2	9.92936	2	9.93397	2	48	12
52	13	9.91451	3	9.91968	2	9.92465	2	9.92944	2	9.93405	2	47	8
56	14	9.91460	4	9.91976	3	9.92473	3	9.92952	3	9.93412	3	46	4
+1	15	9.91469	5	9.91985	4	9.92482	4	9.92960	4	9.93420	4	45	+3
4	16	9.91477	5	9.91993	5	9.92490	5	9.92968	5	9.93427	5	44	56
8	17	9.91486	6	9.92002	6	9.92498	6	9.92976	6	9.93435	6	43	52
12	18	9.91495	7	9.92010	6	9.92506	6	9.92983	6	9.93442	6	42	48
16	19	9.91504	8	9.92018	7	9.92514	7	9.92991	7	9.93450	7	41	44
20	20	9.91512	9	9.92027	8	9.92522	8	9.92999	8	9.93457	7	40	40
24	21	9.91521	1	9.92035	1	9.92530	1	9.93007	1	9.93465	1	39	36
28	22	9.91530	2	9.92044	2	9.92538	2	9.93014	2	9.93472	1	38	32
32	23	9.91538	3	9.92052	2	9.92546	2	9.93022	2	9.93480	2	37	28
36	24	9.91547	4	9.92060	3	9.92555	3	9.93030	3	9.93487	3	36	24
40	25	9.91556	5	9.92069	4	9.92563	4	9.93038	4	9.93495	4	35	20
44	26	9.91565	5	9.92077	5	9.92571	5	9.93046	5	9.93502	4	34	16
48	27	9.91573	6	9.92086	6	9.92579	6	9.93053	6	9.93510	5	33	12
52	28	9.91582	7	9.92094	6	9.92587	6	9.93061	6	9.93517	6	32	8
56	29	9.91591	8	9.92102	7	9.92595	7	9.93069	7	9.93525	6	31	4
+2	30	9.91599	9	9.92111	8	9.92603	8	9.93077	8	9.93532	7	30	+2
4	31	9.91608	1	9.92119	1	9.92611	1	9.93084	1	9.93539	1	29	56
8	32	9.91617	2	9.92127	2	9.92619	2	9.93092	2	9.93547	1	28	52
12	33	9.91625	3	9.92136	2	9.92627	2	9.93100	2	9.93554	2	27	48
16	34	9.91634	4	9.92144	3	9.92635	3	9.93108	3	9.93562	3	26	44
20	35	9.91643	5	9.92152	4	9.92643	4	9.93115	4	9.93569	4	25	40
24	36	9.91651	5	9.92161	5	9.92651	5	9.93123	5	9.93577	4	24	36
28	37	9.91660	6	9.92169	6	9.92659	6	9.93131	6	9.93584	5	23	32
32	38	9.91669	7	9.92177	6	9.92667	6	9.93138	6	9.93591	6	22	28
36	39	9.91677	8	9.92186	7	9.92675	7	9.93146	7	9.93599	6	21	24
40	40	9.91686	9	9.92194	8	9.92683	8	9.93154	8	9.93606	7	20	20
44	41	9.91695	1	9.92202	1	9.92691	1	9.93161	1	9.93614	1	19	16
48	42	9.91703	2	9.92211	2	9.92699	2	9.93169	2	9.93621	1	18	12
52	43	9.91712	3	9.92219	2	9.92707	2	9.93177	2	9.93628	2	17	8
56	44	9.91720	4	9.92227	3	9.92715	3	9.93184	3	9.93636	3	16	4
+3	45	9.91729	5	9.92235	4	9.92723	4	9.93192	4	9.93643	4	15	+1
4	46	9.91738	5	9.92244	5	9.92731	5	9.93200	5	9.93650	4	14	56
8	47	9.91746	6	9.92252	6	9.92739	6	9.93207	6	9.93658	5	13	52
12	48	9.91755	7	9.92260	6	9.92747	6	9.93215	6	9.93665	6	12	48
16	49	9.91763	8	9.92269	7	9.92755	7	9.93223	7	9.93673	6	11	44
20	50	9.91772	9	9.92277	8	9.92763	8	9.93230	8	9.93680	7	10	40
24	51	9.91781	1	9.92285	1	9.92771	1	9.93238	1	9.93687	1	9	36
28	52	9.91789	2	9.92293	2	9.92779	2	9.93246	2	9.93695	1	8	32
32	53	9.91798	3	9.92302	2	9.92787	2	9.93253	2	9.93702	2	7	28
36	54	9.91806	4	9.92310	3	9.92795	3	9.93261	3	9.93709	3	6	24
40	55	9.91815	5	9.92318	4	9.92803	4	9.93269	4	9.93717	4	5	20
44	56	9.91823	5	9.92326	5	9.92810	5	9.93276	5	9.93724	4	4	16
48	57	9.91832	6	9.92335	6	9.92818	6	9.93284	6	9.93731	5	3	12
52	58	9.91840	7	9.92343	6	9.92826	6	9.93292	6	9.93738	6	2	8
56	59	9.91849	8	9.92351	7	9.92834	7	9.93299	7	9.93746	6	1	4
+4	60	9.91857		9.92359		9.92842		9.93307		9.93753		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		34° 2h 16m		33° 2h 12m		32° 2h 8m		31° 2h 4m		30° 2h 0m			



TABLE III.

Log. Sines.

Time.	Arc.	4h 0m 60°		4h 4m 61°		4h 8m 62°		4h 12m 63°		4h 16m 64°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	s. m.
0	0	9.93753	7	9.94182	7	9.94593	7	9.94988	6	9.95366	6	60	+4
4	1	9.93760	1	9.94189	1	9.94600	1	9.94995	1	9.95372	1	59	56
8	2	9.93768	1	9.94196	1	9.94607	1	9.95001	1	9.95378	1	58	52
12	3	9.93775	2	9.94203	2	9.94614	2	9.95007	2	9.95384	2	57	48
16	4	9.93782	3	9.94210	3	9.94620	3	9.95014	2	9.95391	2	56	44
20	5	9.93789	4	9.94217	4	9.94627	4	9.95020	3	9.95397	3	55	40
24	6	9.93797	4	9.94224	4	9.94634	4	9.95027	4	9.95403	4	54	36
28	7	9.93804	5	9.94231	5	9.94640	5	9.95033	4	9.95409	4	53	32
32	8	9.93811	6	9.94238	6	9.94647	6	9.95039	5	9.95415	5	52	28
36	9	9.93819	6	9.94245	6	9.94654	6	9.95046	5	9.95421	5	51	24
40	10	9.93826	7	9.94252	7	9.94660	7	9.95052	6	9.95427	6	50	20
44	11	9.93833	1	9.94259	1	9.94667	1	9.95059	1	9.95434	1	49	16
48	12	9.93840	1	9.94266	1	9.94674	1	9.95065	1	9.95440	1	48	12
52	13	9.93847	2	9.94273	2	9.94680	2	9.95071	2	9.95446	2	47	8
56	14	9.93855	3	9.94279	3	9.94687	3	9.95078	2	9.95452	2	46	4
+1	15	9.93862	4	9.94286	4	9.94694	4	9.95084	3	9.95458	3	45	+3
	16	9.93869	4	9.94293	4	9.94700	4	9.95090	4	9.95464	4	44	56
8	17	9.93876	5	9.94300	5	9.94707	5	9.95097	4	9.95470	4	43	52
12	18	9.93884	6	9.94307	6	9.94714	6	9.95103	5	9.95476	5	42	48
16	19	9.93891	6	9.94314	6	9.94720	6	9.95110	5	9.95482	5	41	44
20	20	9.93898	7	9.94321	7	9.94727	7	9.95116	6	9.95488	6	40	40
24	21	9.93905	1	9.94328	1	9.94734	1	9.95122	1	9.95494	1	39	36
28	22	9.93912	1	9.94335	1	9.94740	1	9.95129	1	9.95500	1	38	32
32	23	9.93920	2	9.94342	2	9.94747	2	9.95135	2	9.95507	2	37	28
36	24	9.93927	3	9.94349	3	9.94753	3	9.95141	2	9.95513	2	36	24
40	25	9.93934	4	9.94355	4	9.94760	4	9.95148	3	9.95519	3	35	20
44	26	9.93941	4	9.94362	4	9.94767	4	9.95154	4	9.95525	4	34	16
48	27	9.93948	5	9.94369	5	9.94773	5	9.95160	4	9.95531	4	33	12
52	28	9.93955	6	9.94376	6	9.94780	6	9.95167	5	9.95537	5	32	8
56	29	9.93963	6	9.94383	6	9.94786	6	9.95173	5	9.95543	5	31	4
+2	30	9.93970	7	9.94390	7	9.94793	7	9.95179	6	9.95549	6	30	+2
4	31	9.93977	1	9.94397	1	9.94799	1	9.95185	1	9.95555	1	29	56
8	32	9.93984	1	9.94404	1	9.94806	1	9.95192	1	9.95561	1	28	52
12	33	9.93991	2	9.94410	2	9.94813	2	9.95198	2	9.95567	2	27	48
16	34	9.93998	3	9.94417	3	9.94819	3	9.95204	2	9.95573	2	26	44
20	35	9.94005	4	9.94424	4	9.94826	4	9.95211	3	9.95579	3	25	40
24	36	9.94012	4	9.94431	4	9.94832	4	9.95217	4	9.95585	4	24	36
28	37	9.94020	5	9.94438	5	9.94839	5	9.95223	4	9.95591	4	23	32
32	38	9.94027	6	9.94445	6	9.94845	6	9.95229	5	9.95597	5	22	28
36	39	9.94034	6	9.94451	6	9.94852	6	9.95236	5	9.95603	5	21	24
40	40	9.94041	7	9.94458	7	9.94858	7	9.95242	6	9.95609	6	20	20
44	41	9.94048	1	9.94465	1	9.94865	1	9.95248	1	9.95615	1	19	16
48	42	9.94055	1	9.94472	1	9.94871	1	9.95254	1	9.95621	1	18	12
52	43	9.94062	2	9.94479	2	9.94878	2	9.95261	2	9.95627	2	17	8
56	44	9.94069	3	9.94485	3	9.94885	3	9.95267	2	9.95633	2	16	4
+3	45	9.94076	4	9.94492	4	9.94891	4	9.95273	3	9.95639	3	15	+1
	46	9.94083	4	9.94499	4	9.94898	4	9.95279	4	9.95645	4	14	56
8	47	9.94090	5	9.94506	5	9.94904	5	9.95286	4	9.95651	4	13	52
12	48	9.94098	6	9.94513	6	9.94911	6	9.95292	5	9.95657	5	12	48
16	49	9.94105	6	9.94519	6	9.94917	6	9.95298	5	9.95663	5	11	44
20	50	9.94112	7	9.94526	7	9.94923	7	9.95304	6	9.95668	6	10	40
24	51	9.94119	1	9.94533	1	9.94930	1	9.95310	1	9.95674	1	9	36
28	52	9.94126	1	9.94540	1	9.94936	1	9.95317	1	9.95680	1	8	32
32	53	9.94133	2	9.94546	2	9.94943	2	9.95323	2	9.95686	2	7	28
36	54	9.94140	3	9.94553	3	9.94949	3	9.95329	2	9.95692	2	6	24
40	55	9.94147	4	9.94560	4	9.94956	4	9.95335	3	9.95698	3	5	20
44	56	9.94154	4	9.94567	4	9.94962	4	9.95341	4	9.95704	4	4	16
48	57	9.94161	5	9.94573	5	9.94969	5	9.95348	4	9.95710	4	3	12
52	58	9.94168	6	9.94580	6	9.94975	6	9.95354	5	9.95716	5	2	8
56	59	9.94175	6	9.94587	6	9.94982	6	9.95360	5	9.95722	5	1	4
+4	60	9.94182		9.94593		9.94988		9.95366		9.95728		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		29° 1h 56m		28° 1h 52m		27° 1h 48m		26° 1h 44m		25° 1h 40m			

Log. Cosines.



TABLE III.

Log. Sines.

Time.	Arc.	4h 20m 65°		4h 24m 66°		4h 28m 67°		4h 32m 68°		4h 36m 69°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	9.95728	6	9.96073	6	9.96403	5	9.96717	5	9.97015	5	60	+4
4	1	9.95733	1	9.96079	1	9.96408	1	9.96722	1	9.97020	1	59	56
8	2	9.95739	1	9.96084	1	9.96413	1	9.96727	1	9.97025	1	58	52
12	3	9.95745	2	9.96090	2	9.96419	2	9.96732	2	9.97030	2	57	48
16	4	9.95751	2	9.96095	2	9.96424	2	9.96737	2	9.97035	2	56	44
20	5	9.95757	3	9.96101	3	9.96429	3	9.96742	3	9.97039	3	55	40
24	6	9.95763	4	9.96107	4	9.96435	3	9.96747	3	9.97044	3	54	36
28	7	9.95769	4	9.96112	4	9.96440	4	9.96752	4	9.97049	4	53	32
32	8	9.95775	5	9.96118	5	9.96445	4	9.96757	4	9.97054	4	52	28
36	9	9.95780	5	9.96123	5	9.96451	5	9.96762	5	9.97059	5	51	24
40	10	9.95786	6	9.96129	6	9.96456	5	9.96767	5	9.97063	5	50	20
44	11	9.95792	1	9.96135	1	9.96461	1	9.96772	1	9.97068	1	49	16
48	12	9.95798	1	9.96140	1	9.96467	1	9.96778	1	9.97073	1	48	12
52	13	9.95804	2	9.96146	2	9.96472	2	9.96783	2	9.97078	2	47	8
56	14	9.95810	2	9.96151	2	9.96477	2	9.96788	2	9.97083	2	46	4
+1	15	9.95815	3	9.96157	3	9.96483	3	9.96793	3	9.97087	3	45	+3
4	16	9.95821	4	9.96162	4	9.96488	3	9.96798	3	9.97092	3	44	56
8	17	9.95827	4	9.96168	4	9.96493	4	9.96803	4	9.97097	4	43	52
12	18	9.95833	5	9.96174	5	9.96498	4	9.96808	4	9.97102	4	42	48
16	19	9.95839	5	9.96179	5	9.96504	5	9.96813	5	9.97107	5	41	44
20	20	9.95844	6	9.96185	5	9.96509	5	9.96818	5	9.97111	5	40	40
24	21	9.95850	1	9.96190	1	9.96514	1	9.96823	1	9.97116	1	39	36
28	22	9.95856	1	9.96196	1	9.96520	1	9.96828	1	9.97121	1	38	32
32	23	9.95862	2	9.96201	2	9.96525	2	9.96833	2	9.97126	2	37	28
36	24	9.95868	2	9.96207	2	9.96530	2	9.96838	2	9.97130	2	36	24
40	25	9.95873	3	9.96212	3	9.96535	3	9.96843	3	9.97135	3	35	20
44	26	9.95879	4	9.96218	3	9.96541	3	9.96848	3	9.97140	3	34	16
48	27	9.95885	4	9.96223	4	9.96546	4	9.96853	4	9.97145	4	33	12
52	28	9.95891	5	9.96229	4	9.96551	4	9.96858	4	9.97149	4	32	8
56	29	9.95897	5	9.96234	5	9.96556	5	9.96863	5	9.97154	5	31	4
+2	30	9.95902	6	9.96240	5	9.96562	5	9.96868	5	9.97159	5	30	+2
4	31	9.95908	1	9.96245	1	9.96567	1	9.96873	1	9.97163	1	29	56
8	32	9.95914	1	9.96251	1	9.96572	1	9.96878	1	9.97168	1	28	52
12	33	9.95920	2	9.96256	2	9.96577	2	9.96883	2	9.97173	2	27	48
16	34	9.95925	2	9.96262	2	9.96582	2	9.96888	2	9.97178	2	26	44
20	35	9.95931	3	9.96267	3	9.96588	3	9.96893	3	9.97182	3	25	40
24	36	9.95937	4	9.96273	3	9.96593	3	9.96898	3	9.97187	3	24	36
28	37	9.95942	4	9.96278	4	9.96598	4	9.96903	4	9.97192	4	23	32
32	38	9.95948	5	9.96284	4	9.96603	4	9.96907	4	9.97196	4	22	28
36	39	9.95954	5	9.96289	5	9.96608	5	9.96912	5	9.97201	5	21	24
40	40	9.95960	6	9.96294	5	9.96614	5	9.96917	5	9.97206	5	20	20
44	41	9.95965	1	9.96300	1	9.96619	1	9.96922	1	9.97210	1	19	16
48	42	9.95971	1	9.96305	1	9.96624	1	9.96927	1	9.97215	1	18	12
52	43	9.95977	2	9.96311	2	9.96629	2	9.96932	2	9.97220	2	17	8
56	44	9.95982	2	9.96316	2	9.96634	2	9.96937	2	9.97224	2	16	4
+3	45	9.95988	3	9.96322	3	9.96640	3	9.96942	3	9.97229	3	15	+1
4	46	9.95994	4	9.96327	3	9.96645	3	9.96947	3	9.97234	3	14	56
8	47	9.96000	4	9.96333	4	9.96650	4	9.96952	4	9.97238	4	13	52
12	48	9.96005	5	9.96338	4	9.96655	4	9.96957	4	9.97243	4	12	48
16	49	9.96011	5	9.96343	5	9.96660	5	9.96962	5	9.97248	5	11	44
20	50	9.96017	6	9.96349	5	9.96665	5	9.96966	5	9.97252	5	10	40
24	51	9.96022	1	9.96354	1	9.96670	1	9.96971	1	9.97257	1	9	36
28	52	9.96028	1	9.96360	1	9.96676	1	9.96976	1	9.97262	1	8	32
32	53	9.96034	2	9.96365	2	9.96681	2	9.96981	2	9.97266	2	7	28
36	54	9.96039	2	9.96370	2	9.96686	2	9.96986	2	9.97271	2	6	24
40	55	9.96045	3	9.96376	3	9.96691	3	9.96991	3	9.97276	3	5	20
44	56	9.96050	4	9.96381	3	9.96696	3	9.96996	3	9.97280	3	4	16
48	57	9.96056	4	9.96387	4	9.96701	4	9.97001	4	9.97285	4	3	12
52	58	9.96062	5	9.96392	4	9.96706	4	9.97005	4	9.97289	4	2	8
56	59	9.96067	5	9.96397	5	9.96711	5	9.97010	5	9.97294	5	1	4
+4	60	9.96073		9.96403		9.96717		9.97015		9.97299		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		24° 1h 36m		23° 1h 32m		22° 1h 28m		21° 1h 24m		20° 1h 20m			

Log. Cosines.

Log. Sines.

Time.	Arc.	4h 40m 70°		4h 44m 71°		4h 48m 72°		4h 52m 73°		4h 56m 74°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	9.97299	5	9.97567	4	9.97821	4	9.98060	4	9.98284	4	60	+4
4	1	9.97303	1	9.97571	0	9.97825	0	9.98063	0	9.98288	0	59	56
8	2	9.97308	1	9.97576	1	9.97829	1	9.98067	1	9.98291	1	58	52
12	3	9.97312	2	9.97580	1	9.97833	1	9.98071	1	9.98295	1	57	48
16	4	9.97317	2	9.97584	2	9.97837	2	9.98075	2	9.98299	2	56	44
20	5	9.97322	3	9.97589	2	9.97841	2	9.98079	2	9.98302	2	55	40
24	6	9.97326	3	9.97593	2	9.97845	2	9.98083	2	9.98306	2	54	36
28	7	9.97331	4	9.97597	3	9.97849	3	9.98087	3	9.98309	3	53	32
32	8	9.97335	4	9.97602	3	9.97853	3	9.98090	3	9.98313	3	52	28
36	9	9.97340	5	9.97606	4	9.97857	4	9.98094	4	9.98317	4	51	24
40	10	9.97344	5	9.97610	4	9.97861	4	9.98098	4	9.98320	4	50	20
44	11	9.97349	1	9.97615	0	9.97866	0	9.98102	0	9.98324	0	49	16
48	12	9.97353	1	9.97619	1	9.97870	1	9.98106	1	9.98327	1	48	12
52	13	9.97358	2	9.97623	1	9.97874	1	9.98110	1	9.98331	1	47	8
56	14	9.97363	2	9.97628	2	9.97878	2	9.98113	2	9.98334	2	46	4
+1	15	9.97367	3	9.97632	2	9.97882	2	9.98117	2	9.98338	2	45	+3
4	16	9.97372	3	9.97636	2	9.97886	2	9.98121	2	9.98342	2	44	56
8	17	9.97376	4	9.97640	3	9.97890	3	9.98125	3	9.98345	3	43	52
12	18	9.97381	4	9.97645	3	9.97894	3	9.98129	3	9.98349	3	42	48
16	19	9.97385	5	9.97649	4	9.97898	4	9.98132	4	9.98352	4	41	44
20	20	9.97390	4	9.97653	4	9.97902	4	9.98136	4	9.98356	4	40	40
24	21	9.97394	0	9.97657	0	9.97906	0	9.98140	0	9.98359	0	39	36
28	22	9.97399	1	9.97662	1	9.97910	1	9.98144	1	9.98363	1	38	32
32	23	9.97403	1	9.97666	1	9.97914	1	9.98147	1	9.98366	1	37	28
36	24	9.97408	2	9.97670	2	9.97918	2	9.98151	2	9.98370	2	36	24
40	25	9.97412	2	9.97674	2	9.97922	2	9.98155	2	9.98373	2	35	20
44	26	9.97417	2	9.97679	2	9.97926	2	9.98159	2	9.98377	2	34	16
48	27	9.97421	3	9.97683	3	9.97930	3	9.98162	3	9.98381	3	33	12
52	28	9.97426	3	9.97687	3	9.97934	3	9.98166	3	9.98384	3	32	8
56	29	9.97430	4	9.97691	4	9.97938	4	9.98170	4	9.98388	4	31	4
+2	30	9.97435	4	9.97696	4	9.97942	4	9.98174	4	9.98391	3	30	+2
4	31	9.97439	0	9.97700	0	9.97946	0	9.98177	0	9.98395	0	29	56
8	32	9.97444	1	9.97704	1	9.97950	1	9.98181	1	9.98398	1	28	52
12	33	9.97448	1	9.97708	1	9.97954	1	9.98185	1	9.98402	1	27	48
16	34	9.97453	2	9.97713	2	9.97958	2	9.98189	2	9.98405	1	26	44
20	35	9.97457	2	9.97717	2	9.97962	2	9.98192	2	9.98409	2	25	40
24	36	9.97461	2	9.97721	2	9.97966	2	9.98196	2	9.98412	2	24	36
28	37	9.97466	3	9.97725	3	9.97970	3	9.98200	3	9.98415	2	23	32
32	38	9.97470	3	9.97729	3	9.97974	3	9.98204	3	9.98419	2	22	28
36	39	9.97475	4	9.97734	4	9.97978	4	9.98207	4	9.98422	3	21	24
40	40	9.97479	4	9.97738	4	9.97982	4	9.98211	4	9.98426	3	20	20
44	41	9.97484	0	9.97742	0	9.97986	0	9.98215	0	9.98429	0	19	16
48	42	9.97488	1	9.97746	1	9.97989	1	9.98218	1	9.98433	1	18	12
52	43	9.97492	1	9.97750	1	9.97993	1	9.98222	1	9.98436	1	17	8
56	44	9.97497	2	9.97754	2	9.97997	2	9.98226	2	9.98440	1	16	4
+3	45	9.97501	2	9.97759	2	9.98001	2	9.98229	2	9.98443	2	15	+1
4	46	9.97506	2	9.97763	2	9.98005	2	9.98233	2	9.98447	2	14	56
8	47	9.97510	3	9.97767	3	9.98009	3	9.98237	3	9.98450	2	13	52
12	48	9.97515	3	9.97771	3	9.98013	3	9.98240	3	9.98453	2	12	48
16	49	9.97519	4	9.97775	4	9.98017	4	9.98244	4	9.98457	3	11	44
20	50	9.97523	4	9.97779	4	9.98021	4	9.98248	4	9.98460	3	10	40
24	51	9.97528	0	9.97784	0	9.98025	0	9.98251	0	9.98464	0	9	36
28	52	9.97532	1	9.97788	1	9.98029	1	9.98255	1	9.98467	1	8	32
32	53	9.97536	1	9.97792	1	9.98032	1	9.98259	1	9.98471	1	7	28
36	54	9.97541	2	9.97796	2	9.98036	2	9.98262	2	9.98474	1	6	24
40	55	9.97545	2	9.97800	2	9.98040	2	9.98266	2	9.98477	2	5	20
44	56	9.97550	2	9.97804	2	9.98044	2	9.98270	2	9.98481	2	4	16
48	57	9.97554	3	9.97808	3	9.98048	3	9.98273	3	9.98484	2	3	12
52	58	9.97558	3	9.97812	3	9.98052	3	9.98277	3	9.98488	2	2	8
56	59	9.97563	4	9.97817	4	9.98056	4	9.98281	4	9.98491	3	1	4
+4	60	9.97567		9.97821		9.98060		9.98284		9.98494		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		19° 1h 16m		18° 1h 12m		17° 1h 8m		16° 1h 4m		15° 1h 0m			

Log. Cosines.



TABLE III.

Log. Sines.

Time.	Arc.	5h 0m 75°		5h 4m 76°		5h 8m 77°		5h 12m 78°		5h 16m 79°		Arc.	Time.
m. s.	'	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	'	s. m.
0	0	9.98494	3	9.98690	3	9.98872	3	9.99040	3	9.99195	2	60	+4
4	1	9.98498	0	9.98694	0	9.98875	0	9.99043	0	9.99197	0	59	56
8	2	9.98501	1	9.98697	1	9.98878	1	9.99046	1	9.99200	0	58	52
12	3	9.98505	1	9.98700	1	9.98881	1	9.99048	1	9.99202	1	57	48
16	4	9.98508	1	9.98703	1	9.98884	1	9.99051	1	9.99204	1	56	44
20	5	9.98511	2	9.98706	2	9.98887	2	9.99054	2	9.99207	1	55	40
24	6	9.98515	2	9.98709	2	9.98890	2	9.99056	2	9.99209	1	54	36
28	7	9.98518	2	9.98712	2	9.98893	2	9.99059	2	9.99212	1	53	32
32	8	9.98521	2	9.98715	2	9.98896	2	9.99062	2	9.99214	2	52	28
36	9	9.98525	3	9.98719	3	9.98898	3	9.99064	3	9.99217	2	51	24
40	10	9.98528	3	9.98722	3	9.98901	3	9.99067	3	9.99219	2	50	20
44	11	9.98531	0	9.98725	0	9.98904	0	9.99070	0	9.99221	0	49	16
48	12	9.98535	1	9.98728	1	9.98907	1	9.99072	1	9.99224	0	48	12
52	13	9.98538	1	9.98731	1	9.98910	1	9.99075	1	9.99226	1	47	8
56	14	9.98541	1	9.98734	1	9.98913	1	9.99078	1	9.99229	1	46	4
+1	15	9.98545	2	9.98737	2	9.98916	2	9.99080	2	9.99231	1	45	+3
4	16	9.98548	2	9.98740	2	9.98919	2	9.99083	2	9.99233	1	44	56
8	17	9.98551	2	9.98743	2	9.98921	2	9.99086	2	9.99236	1	43	52
12	18	9.98555	2	9.98746	2	9.98924	2	9.99088	2	9.99238	2	42	48
16	19	9.98558	3	9.98750	3	9.98927	3	9.99091	3	9.99241	2	41	44
20	20	9.98561	3	9.98753	3	9.98930	3	9.99093	3	9.99243	2	40	40
24	21	9.98565	0	9.98756	0	9.98933	0	9.99096	0	9.99245	0	39	36
28	22	9.98568	1	9.98759	1	9.98936	1	9.99099	1	9.99248	0	38	32
32	23	9.98571	1	9.98762	1	9.98938	1	9.99101	1	9.99250	1	37	28
36	24	9.98574	1	9.98765	1	9.98941	1	9.99104	1	9.99252	1	36	24
40	25	9.98578	2	9.98768	2	9.98944	2	9.99106	2	9.99255	1	35	20
44	26	9.98581	2	9.98771	2	9.98947	2	9.99109	2	9.99257	1	34	16
48	27	9.98584	2	9.98774	2	9.98950	2	9.99112	2	9.99260	1	33	12
52	28	9.98588	2	9.98777	2	9.98953	2	9.99114	2	9.99262	2	32	8
56	29	9.98591	3	9.98780	3	9.98955	3	9.99117	3	9.99264	2	31	4
+2	30	9.98594	3	9.98783	3	9.98958	3	9.99119	3	9.99267	2	30	+2
4	31	9.98597	0	9.98786	0	9.98961	0	9.99122	0	9.99269	0	29	56
8	32	9.98601	1	9.98789	1	9.98964	1	9.99124	1	9.99271	0	28	52
12	33	9.98604	1	9.98792	1	9.98967	1	9.99127	1	9.99274	1	27	48
16	34	9.98607	1	9.98795	1	9.98969	1	9.99130	1	9.99276	1	26	44
20	35	9.98610	2	9.98798	2	9.98972	2	9.99132	2	9.99278	1	25	40
24	36	9.98614	2	9.98801	2	9.98975	2	9.99135	2	9.99281	1	24	36
28	37	9.98617	2	9.98804	2	9.98978	2	9.99137	2	9.99283	1	23	32
32	38	9.98620	2	9.98807	2	9.98980	2	9.99140	2	9.99285	2	22	28
36	39	9.98623	3	9.98810	3	9.98983	3	9.99142	3	9.99288	2	21	24
40	40	9.98627	3	9.98813	3	9.98986	3	9.99145	3	9.99290	2	20	20
44	41	9.98630	0	9.98816	0	9.98989	0	9.99147	0	9.99292	0	19	16
48	42	9.98633	1	9.98819	1	9.98991	1	9.99150	1	9.99294	0	18	12
52	43	9.98636	1	9.98822	1	9.98994	1	9.99152	1	9.99297	1	17	8
56	44	9.98640	1	9.98825	1	9.98997	1	9.99155	1	9.99299	1	16	4
+3	45	9.98643	2	9.98828	2	9.99000	2	9.99157	2	9.99301	1	15	+1
4	46	9.98646	2	9.98831	2	9.99002	2	9.99160	2	9.99304	1	14	56
8	47	9.98649	2	9.98834	2	9.99005	2	9.99162	2	9.99306	1	13	52
12	48	9.98652	2	9.98837	2	9.99008	2	9.99165	2	9.99308	2	12	48
16	49	9.98656	3	9.98840	3	9.99011	3	9.99167	3	9.99310	2	11	44
20	50	9.98659	3	9.98843	3	9.99013	3	9.99170	2	9.99313	2	10	40
24	51	9.98662	0	9.98846	0	9.99016	0	9.99172	0	9.99315	0	9	36
28	52	9.98665	1	9.98849	1	9.99019	1	9.99175	0	9.99317	0	8	32
32	53	9.98668	1	9.98852	1	9.99022	1	9.99177	1	9.99319	1	7	28
36	54	9.98671	1	9.98855	1	9.99024	1	9.99180	1	9.99322	1	6	24
40	55	9.98675	2	9.98858	2	9.99027	2	9.99182	1	9.99324	1	5	20
44	56	9.98678	2	9.98861	2	9.99030	2	9.99185	1	9.99326	1	4	16
48	57	9.98681	2	9.98864	2	9.99032	2	9.99187	1	9.99328	1	3	12
52	58	9.98684	2	9.98867	2	9.99035	2	9.99190	2	9.99331	2	2	8
56	59	9.98687	3	9.98869	3	9.99038	3	9.99192	2	9.99333	2	1	4
+4	60	9.98690		9.98872		9.99040		9.99195		9.99335		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		14° 0h 56m		13° 0h 52m		12° 0h 48m		11° 0h 44m		10° 0h 40m			

Log. Cosines.



Log. Sines.

Time.	Arc.	5h 20m 80°		5h 24m 81°		5h 28m 82°		5h 32m 83°		5h 36m 84°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.	Sine.	P. P.		
0	0	9.99335	2	9.99462	2	9.99575	2	9.99675	2	9.99761	1	60	+4
4	1	9.99337	0	9.99464	0	9.99577	0	9.99677	0	9.99763	0	59	56
8	2	9.99340	0	9.99466	0	9.99579	0	9.99678	0	9.99764	0	58	52
12	3	9.99342	1	9.99468	1	9.99581	1	9.99680	1	9.99765	0	57	48
16	4	9.99344	1	9.99470	1	9.99582	1	9.99681	1	9.99767	0	56	44
20	5	9.99346	1	9.99472	1	9.99584	1	9.99683	1	9.99768	1	55	40
24	6	9.99348	1	9.99474	1	9.99586	1	9.99684	1	9.99769	1	54	36
28	7	9.99351	1	9.99476	1	9.99588	1	9.99686	1	9.99771	1	53	32
32	8	9.99353	2	9.99478	2	9.99589	2	9.99687	2	9.99772	1	52	28
36	9	9.99355	2	9.99480	2	9.99591	2	9.99689	2	9.99773	1	51	24
40	10	9.99357	2	9.99482	2	9.99593	2	9.99690	1	9.99775	1	50	20
44	11	9.99359	0	9.99484	0	9.99595	0	9.99692	0	9.99776	0	49	16
48	12	9.99362	0	9.99486	0	9.99596	0	9.99693	0	9.99777	0	48	12
52	13	9.99364	1	9.99488	1	9.99598	1	9.99695	0	9.99778	0	47	8
56	14	9.99366	1	9.99490	1	9.99600	1	9.99696	0	9.99780	0	46	4
+1	15	9.99368	1	9.99492	1	9.99601	1	9.99698	1	9.99781	1	45	+3
4	16	9.99370	1	9.99494	1	9.99603	1	9.99699	1	9.99782	1	44	56
8	17	9.99372	1	9.99495	1	9.99605	1	9.99701	1	9.99783	1	43	52
12	18	9.99375	2	9.99497	2	9.99607	2	9.99702	1	9.99785	1	42	48
16	19	9.99377	2	9.99499	2	9.99608	2	9.99704	1	9.99786	1	41	44
20	20	9.99379	2	9.99501	2	9.99610	2	9.99705	1	9.99787	1	40	40
24	21	9.99381	0	9.99503	0	9.99612	0	9.99707	0	9.99788	0	39	36
28	22	9.99383	0	9.99505	0	9.99613	0	9.99708	0	9.99790	0	38	32
32	23	9.99385	1	9.99507	1	9.99615	1	9.99710	0	9.99791	0	37	28
36	24	9.99388	1	9.99509	1	9.99617	1	9.99711	0	9.99792	0	36	24
40	25	9.99390	1	9.99511	1	9.99618	1	9.99713	1	9.99793	1	35	20
44	26	9.99392	1	9.99513	1	9.99620	1	9.99714	1	9.99795	1	34	16
48	27	9.99394	1*	9.99515	1	9.99622	1	9.99716	1	9.99796	1	33	12
52	28	9.99396	2	9.99517	2	9.99624	2	9.99717	1	9.99797	1	32	8
56	29	9.99398	2	9.99518	2	9.99625	2	9.99718	1	9.99798	1	31	4
+2	30	9.99400	2	9.99520	2	9.99627	2	9.99720	1	9.99800	1	30	+2
4	31	9.99402	0	9.99522	0	9.99629	0	9.99721	0	9.99801	0	29	56
8	32	9.99404	0	9.99524	0	9.99630	0	9.99723	0	9.99802	0	28	52
12	33	9.99407	1	9.99526	1	9.99632	1	9.99724	0	9.99803	0	27	48
16	34	9.99409	1	9.99528	1	9.99633	1	9.99726	0	9.99804	0	26	44
20	35	9.99411	1	9.99530	1	9.99635	1	9.99727	1	9.99806	1	25	40
24	36	9.99413	1	9.99532	1	9.99637	1	9.99728	1	9.99807	1	24	36
28	37	9.99415	1	9.99533	1	9.99638	1	9.99730	1	9.99808	1	23	32
32	38	9.99417	2	9.99535	2	9.99640	2	9.99731	1	9.99809	1	22	28
36	39	9.99419	2	9.99537	2	9.99642	2	9.99733	1	9.99810	1	21	24
40	40	9.99421	2	9.99539	2	9.99643	2	9.99734	1	9.99812	1	20	20
44	41	9.99423	0	9.99541	0	9.99645	0	9.99736	0	9.99813	0	19	16
48	42	9.99425	0	9.99543	0	9.99647	0	9.99737	0	9.99814	0	18	12
52	43	9.99427	1	9.99545	1	9.99648	1	9.99738	0	9.99815	0	17	8
56	44	9.99429	1	9.99546	1	9.99650	1	9.99740	0	9.99816	0	16	4
+3	45	9.99432	1	9.99548	1	9.99651	1	9.99741	1	9.99817	1	15	+1
4	46	9.99434	1	9.99550	1	9.99653	1	9.99742	1	9.99819	1	14	56
8	47	9.99436	1	9.99552	1	9.99655	1	9.99744	1	9.99820	1	13	52
12	48	9.99438	2	9.99554	2	9.99656	2	9.99745	1	9.99821	1	12	48
16	49	9.99440	2	9.99556	2	9.99658	2	9.99747	1	9.99822	1	11	44
20	50	9.99442	2	9.99557	2	9.99659	2	9.99748	1	9.99823	1	10	40
24	51	9.99444	0	9.99559	0	9.99661	0	9.99749	0	9.99824	0	9	36
28	52	9.99446	0	9.99561	0	9.99663	0	9.99751	0	9.99825	0	8	32
32	53	9.99448	1	9.99563	1	9.99664	1	9.99752	0	9.99827	0	7	28
36	54	9.99450	1	9.99565	1	9.99666	1	9.99753	0	9.99828	0	6	24
40	55	9.99452	1	9.99566	1	9.99667	1	9.99755	1	9.99829	1	5	20
44	56	9.99454	1	9.99568	1	9.99669	1	9.99756	1	9.99830	1	4	16
48	57	9.99456	1	9.99570	1	9.99670	1	9.99757	1	9.99831	1	3	12
52	58	9.99458	2	9.99572	2	9.99672	2	9.99759	1	9.99832	1	2	8
56	59	9.99460	2	9.99574	2	9.99674	2	9.99760	1	9.99833	1	1	4
+4	60	9.99462		9.99575		9.99675		9.99761		9.99834		0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		9° 0h 36m		8° 0h 32m		7° 0h 28m		6° 0h 24m		5° 0h 20m			

Log. Cosines.

Time.	Arc.	5h 40m 85°		5h 44m 86°		5h 48m 87°		5h 52m 88°		5h 56m 89°		Arc.	Time.
		Sine.	P. P.	Sine.	P. P.	Sine.		Sine.		Sine.			
0	0	9.99834	1	9.99894	1	9.99940		9.99974		9.99993		60	+4
4	1	9.99836	0	9.99895	0	9.99941		9.99974		9.99994		59	56
8	2	9.99837	0	9.99896	0	9.99942		9.99974		9.99994		58	52
12	3	9.99838	0	9.99897	0	9.99942		9.99975		9.99994		57	48
16	4	9.99839	0	9.99898	0	9.99943		9.99975		9.99994		56	44
20	5	9.99840	1	9.99898	1	9.99944		9.99976		9.99994		55	40
24	6	9.99841	1	9.99899	1	9.99944		9.99976		9.99995		54	36
28	7	9.99842	1	9.99900	1	9.99945		9.99977		9.99995		53	32
32	8	9.99843	1	9.99901	1	9.99946		9.99977		9.99995		52	28
36	9	9.99844	1	9.99902	1	9.99946		9.99977		9.99995		51	24
40	10	9.99845	1	9.99903	1	9.99947		9.99978		9.99995		50	20
44	11	9.99846	0	9.99904	0	9.99948		9.99978		9.99996		49	16
48	12	9.99847	0	9.99904	0	9.99948		9.99979		9.99996		48	12
52	13	9.99848	0	9.99905	0	9.99949		9.99979		9.99996		47	8
56	14	9.99850	0	9.99906	0	9.99949		9.99979		9.99996		46	4
+1	15	9.99851	1	9.99907	1	9.99950		9.99980		9.99996		45	+3
4	16	9.99852	1	9.99908	1	9.99951		9.99980		9.99996		44	56
8	17	9.99853	1	9.99909	1	9.99951		9.99981		9.99997		43	52
12	18	9.99854	1	9.99909	1	9.99952		9.99981		9.99997		42	48
16	19	9.99855	1	9.99910	1	9.99952		9.99981		9.99997		41	44
20	20	9.99856	1	9.99911	1	9.99953		9.99982		9.99997		40	40
24	21	9.99857	0	9.99912	0	9.99954		9.99982		9.99997		39	36
28	22	9.99858	0	9.99913	0	9.99954		9.99982		9.99997		38	32
32	23	9.99859	0	9.99913	0	9.99955		9.99983		9.99997		37	28
36	24	9.99860	0	9.99914	0	9.99955		9.99983		9.99998		36	24
40	25	9.99861	1	9.99915	1	9.99956		9.99983		9.99998		35	20
44	26	9.99862	1	9.99916	1	9.99956		9.99984		9.99998		34	16
48	27	9.99863	1	9.99917	1	9.99957		9.99984		9.99998		33	12
52	28	9.99864	1	9.99917	1	9.99958		9.99984		9.99998		32	8
56	29	9.99865	1	9.99918	1	9.99958		9.99985		9.99998		31	4
+2	30	9.99866	1	9.99919	1	9.99959		9.99985		9.99998		30	+2
4	31	9.99867	0	9.99920	0	9.99959		9.99985		9.99998		29	56
8	32	9.99868	0	9.99920	0	9.99960		9.99986		9.99999		28	52
12	33	9.99869	0	9.99921	0	9.99960		9.99986		9.99999		27	48
16	34	9.99870	0	9.99922	0	9.99961		9.99986		9.99999		26	44
20	35	9.99871	1	9.99923	1	9.99961		9.99987		9.99999		25	40
24	36	9.99872	1	9.99923	1	9.99962		9.99987		9.99999		24	36
28	37	9.99873	1	9.99924	1	9.99962		9.99987		9.99999		23	32
32	38	9.99874	1	9.99925	1	9.99963		9.99988		9.99999		22	28
36	39	9.99875	1	9.99926	1	9.99963		9.99988		9.99999		21	24
40	40	9.99876	1	9.99926	1	9.99964		9.99988		9.99999		20	20
44	41	9.99877	0	9.99927	0	9.99964		9.99989		9.99999		19	16
48	42	9.99878	0	9.99928	0	9.99965		9.99989		9.99999		18	12
52	43	9.99879	0	9.99929	0	9.99966		9.99989		9.99999		17	8
56	44	9.99879	0	9.99929	0	9.99966		9.99989	0.00000			16	4
+3	45	9.99880	1	9.99930	1	9.99967		9.99990	0.00000			15	+1
4	46	9.99881	1	9.99931	1	9.99967		9.99990	0.00000			14	56
8	47	9.99882	1	9.99932	1	9.99967		9.99990	0.00000			13	52
12	48	9.99883	1	9.99932	1	9.99968		9.99990	0.00000			12	48
16	49	9.99884	1	9.99933	1	9.99968		9.99991	0.00000			11	44
20	50	9.99885	1	9.99934	1	9.99969		9.99991	0.00000			10	40
24	51	9.99886	0	9.99934	0	9.99969		9.99991	0.00000			9	36
28	52	9.99887	0	9.99935	0	9.99970		9.99992	0.00000			8	32
32	53	9.99888	0	9.99936	0	9.99970		9.99992	0.00000			7	28
36	54	9.99889	0	9.99936	0	9.99971		9.99992	0.00000			6	24
40	55	9.99890	1	9.99937	1	9.99971		9.99992	0.00000			5	20
44	56	9.99891	1	9.99938	1	9.99972		9.99992	0.00000			4	16
48	57	9.99891	1	9.99938	1	9.99972		9.99993	0.00000			3	12
52	58	9.99892	1	9.99939	1	9.99973		9.99993	0.00000			2	8
56	59	9.99893	1	9.99940	1	9.99973		9.99993	0.00000			1	4
+4	60	9.99894		9.99940		9.99974		9.99993	0.00000			0	0
		Cos.		Cos.		Cos.		Cos.		Cos.			
		4°	0h 16m	3°	0h 12m	2°	0h 8m	1°	0h 4m	0°	0h 0m		

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TABLE IV

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NATURAL HAVERSINES  
AND  
LOGARITHMIC HAVERSINES

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TABLE IV.

Haversines.

S /	0h 0m 0° 0'		0h 2m 0° 30'		0h 4m 1° 0'		0h 6m 1° 30'		0h 8m 2° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	—00	0.00000	5.27963	0.00002	5.88168	0.00008	6.23385	0.00017	6.48371	0.00030	60
2	1.72333	.00000	.29399	.00002	.88889	.00008	.23866	.00017	.48732	.00031	58
4+1	2.32539	.00000	.30811	.00002	.89604	.00008	.24345	.00018	.49092	.00031	56
6	2.67757	.00000	.32201	.00002	.90313	.00008	.24821	.00018	.49450	.00031	54
8+2	2.92745	0.00000	5.33569	0.00002	5.91016	0.00008	6.25294	0.00018	6.49807	0.00031	52
10	3.12127	.00000	.34916	.00002	.91714	.00008	.25765	.00018	.50162	.00032	50
12+3	3.27963	.00000	.36242	.00002	.92406	.00008	.26233	.00018	.50516	.00032	48
14	3.41353	.00000	.37548	.00002	.93093	.00009	.26699	.00018	.50868	.00032	46
16+4	3.52951	0.00000	5.38835	0.00002	5.93774	0.00009	6.27162	0.00019	6.51219	0.00033	44
18	3.63182	.00000	.40103	.00003	.94450	.00009	.27623	.00019	.51568	.00033	42
20+5	3.72333	.00000	.41352	.00003	.95121	.00009	.28081	.00019	.51916	.00033	40
22	3.80612	.00000	.42585	.00003	.95786	.00009	.28537	.00019	.52263	.00033	38
24+6	3.88169	0.00000	5.43799	0.00003	5.96447	0.00009	6.28991	0.00019	6.52608	0.00034	36
26	3.95122	.00000	.44997	.00003	.97102	.00009	.29442	.00020	.52952	.00034	34
28+7	4.01559	.00000	.46179	.00003	.97753	.00010	.29891	.00020	.53295	.00034	32
30	4.07551	.00000	.47345	.00003	.98399	.00010	.30337	.00020	.53636	.00034	30
32+8	4.13157	0.00000	5.48496	0.00003	5.99040	0.00010	6.30781	0.00020	6.53976	0.00035	28
34	.18423	.00000	.49631	.00003	5.99676	.00010	.31223	.00021	.54315	.00035	26
36+9	.23388	.00000	.50752	.00003	6.00308	.00010	.31663	.00021	.54652	.00035	24
38	.28084	.00000	.51858	.00003	.00935	.00010	.32101	.00021	.54988	.00035	22
40+10	4.32539	0.00000	5.52951	0.00003	6.01557	0.00010	6.32536	0.00021	6.55323	0.00036	20
42	.36777	.00000	.54030	.00003	.02176	.00011	.32969	.00021	.55656	.00036	18
44+11	.40818	.00000	.55095	.00004	.02789	.00011	.33400	.00022	.55988	.00036	16
46	.44679	.00000	.56148	.00004	.03399	.00011	.33829	.00022	.56319	.00037	14
48+12	4.48375	0.00000	5.57189	0.00004	6.04004	0.00011	6.34256	0.00022	6.56649	0.00037	12
50	.51921	.00000	.58216	.00004	.04605	.00011	.34681	.00022	.56977	.00037	10
52+13	.55328	.00000	.59232	.00004	.05202	.00011	.35103	.00022	.57304	.00037	8
54	.58606	.00000	.60236	.00004	.05795	.00011	.35524	.00023	.57630	.00038	6
56+14	4.61765	0.00000	5.61229	0.00004	6.06384	0.00012	6.35943	0.00023	6.57955	0.00038	4
58	4.64813	0.00000	5.62211	0.00004	6.06969	0.00012	6.36359	0.00023	6.58278	0.00038	2
	23h 59m		23h 57m		23h 55m		23h 53m		23h 51m		

S /	0h 1m 0° 0'		0h 3m 0° 30'		0h 5m 1° 0'		0h 7m 1° 30'		0h 9m 2° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0+15	4.67757	0.00000	5.63181	0.00004	6.07550	0.00012	6.36774	0.00023	6.58600	0.00039	60
2	.70605	.00000	.64141	.00004	.08127	.00012	.37186	.00024	.58921	.00039	58
4+16	.73363	.00001	.65090	.00004	.08700	.00012	.37597	.00024	.59241	.00039	56
6	.76036	.00001	.66029	.00005	.09270	.00012	.38006	.00024	.59560	.00039	54
8+17	4.78629	0.00001	5.66958	0.00005	6.09836	0.00013	6.38412	0.00024	6.59878	0.00040	52
10	.81147	.00001	.67877	.00005	.10398	.00013	.38817	.00024	.60194	.00040	50
12+18	.83594	.00001	.68787	.00005	.10956	.00013	.39220	.00025	.60509	.00040	48
14	.85973	.00001	.69687	.00005	.11511	.00013	.39622	.00025	.60823	.00041	46
16+19	4.88290	0.00001	5.70578	0.00005	6.12063	0.00013	6.40021	0.00025	6.61136	0.00041	44
18	.90546	.00001	.71460	.00005	.12611	.00013	.40418	.00025	.61448	.00041	42
20+20	.92745	.00001	.72332	.00005	.13155	.00014	.40814	.00026	.61759	.00041	40
22	.94890	.00001	.73197	.00005	.13696	.00014	.41203	.00026	.62068	.00042	38
24+21	4.96983	0.00001	5.74052	0.00006	6.14234	0.00014	6.41600	0.00026	6.62377	0.00042	36
26	4.99027	.00001	.74900	.00006	.14769	.00014	.41990	.00026	.62684	.00042	34
28+22	5.01024	.00001	.75739	.00006	.15300	.00014	.42379	.00027	.62991	.00043	32
30	.02976	.00001	.76570	.00006	.15828	.00014	.42766	.00027	.63296	.00043	30
32+23	5.04885	0.00001	5.77394	0.00006	6.16353	0.00015	6.43151	0.00027	6.63600	0.00043	28
34	.06753	.00001	.78209	.00006	.16874	.00015	.43534	.00027	.63903	.00044	26
36+24	.08581	.00001	.79017	.00006	.17393	.00015	.43916	.00027	.64205	.00044	24
38	.10372	.00001	.79818	.00006	.17908	.00015	.44296	.00028	.64504	.00044	22
40+25	5.12127	0.00001	5.80611	0.00006	6.18421	0.00015	6.44675	0.00028	6.64806	0.00044	20
42	.13837	.00001	.81397	.00007	.18930	.00015	.45052	.00028	.65105	.00045	18
44+26	.15534	.00001	.82176	.00007	.19437	.00016	.45427	.00028	.65403	.00045	16
46	.17188	.00001	.82948	.00007	.19940	.00016	.45800	.00029	.65700	.00045	14
48+27	5.18812	0.00002	5.83713	0.00007	6.20441	0.00016	6.46172	0.00029	6.65996	0.00046	12
50	.20406	.00002	.84472	.00007	.20938	.00016	.46543	.00029	.66291	.00046	10
52+28	.21971	.00002	.85224	.00007	.21433	.00016	.46911	.00029	.66585	.00046	8
54	.23508	.00002	.85969	.00007	.21925	.00017	.47279	.00030	.66878	.00047	6
56+29	5.25019	0.00002	5.86709	0.00007	6.22415	0.00017	6.47644	0.00030	6.67170	0.00047	4
58	.26503	.00002	.87442	.00008	.22901	.00017	.48008	.00030	.67461	.00047	2
60+30	5.27963	0.00002	5.88168	0.00008	6.23385	0.00017	6.48371	0.00030	6.67751	0.00048	0
	23h 58m		23h 56m		23h 54m		23h 52m		23h 50m		



TABLE IV.

## Haversines.

s	0h 10m 2° 30'		0h 11m 3° 0'		0h 14m 3° 30'		0h 16m 4° 0'		0h 18m 4° 30'		s	
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.		
0	6.67751	0.00048	6.83584	0.00069	6.96970	0.00093	7.08564	0.00122	7.18790	0.00154	60	
2	.68040	.00048	.83825	.00069	.97176	.00094	.08745	.00122	.18950	.00155	58	
4+1	.68328	.00048	.84065	.00069	.97382	.00094	.08925	.00123	.19111	.00155	56	
6	.68615	.00049	.84304	.00070	.97588	.00095	.09105	.00123	.19271	.00156	54	
8+2	6.68901	0.00049	6.84543	0.00070	6.97793	0.00095	7.09284	0.00124	7.19430	0.00156	52	
10	.69186	.00049	.84782	.00070	.97997	.00095	.09464	.00124	.19590	.00157	50	
12+3	.69470	.00050	.85019	.00071	.98201	.00096	.09642	.00125	.19749	.00158	48	
14	.69754	.00050	.85256	.00071	.98405	.00096	.09821	.00125	.19908	.00158	46	
16+4	6.70036	0.00050	6.85492	0.00072	6.98608	0.00097	7.09999	0.00126	7.20066	0.00159	44	
18	.70318	.00050	.85728	.00072	.98811	.00097	.10177	.00126	.20225	.00159	42	
20+5	.70598	.00051	.85963	.00072	.99013	.00098	.10354	.00127	.20383	.00160	40	
22	.70878	.00051	.86197	.00073	.99214	.00098	.10531	.00127	.20540	.00160	38	
24+6	6.71157	0.00051	6.86431	0.00073	6.99416	0.00099	7.10708	0.00128	7.20698	0.00161	36	
26	.71435	.00052	.86664	.00074	6.99616	.00099	.10884	.00128	.20855	.00162	34	
28+7	.71712	.00052	.86897	.00074	6.99817	.00100	.11060	.00129	.21012	.00162	32	
30	.71988	.00052	.87129	.00074	7.00017	.00100	.11236	.00130	.21168	.00163	30	
32+8	6.72263	0.00053	6.87360	0.00075	7.00216	0.00101	7.11411	0.00130	7.21325	0.00163	28	
34	.72537	.00053	.87591	.00075	.00415	.00101	.11586	.00131	.21481	.00164	26	
36+9	.72811	.00053	.87821	.00076	.00613	.00101	.11760	.00131	.21636	.00165	24	
38	.73084	.00054	.88050	.00076	.00811	.00102	.11934	.00132	.21792	.00165	22	
40+10	6.73355	0.00054	6.88279	0.00076	7.01009	0.00102	7.12108	0.00132	7.21947	0.00166	20	
42	.73626	.00054	.88507	.00077	.01206	.00103	.12282	.00133	.22102	.00166	18	
44+11	.73896	.00055	.88735	.00077	.01403	.00103	.12455	.00133	.22256	.00167	16	
46	.74166	.00055	.88962	.00078	.01599	.00104	.12627	.00134	.22411	.00168	14	
48+12	6.74434	0.00056	6.89188	0.00078	7.01795	0.00104	7.12800	0.00134	7.22565	0.00168	12	
50	.74702	.00056	.89414	.00078	.01990	.00105	.12972	.00135	.22718	.00169	10	
52+13	.74969	.00056	.89639	.00079	.02185	.00105	.13144	.00135	.22872	.00169	8	
54	.75235	.00057	.89864	.00079	.02379	.00106	.13315	.00136	.23025	.00170	6	
56+14	6.75500	0.00057	6.90088	0.00080	7.02573	0.00106	7.13486	0.00136	7.23178	0.00171	4	
58	6.75764	0.00057	6.90312	0.00080	7.02767	0.00107	7.13657	0.00137	7.23331	0.00171	2	
		23h 49m		23h 47m		23h 45m		23h 43m		23h 41m		
s	0h 11m 2° 30'		0h 13m 3° 0'		0h 15m 3° 30'		0h 17m 4° 0'		0h 19m 4° 30'		s	
0+15	6.76028	0.00058	6.90535	0.00080	7.02960	0.00107	7.13827	0.00137	7.23483	0.00172	60	
2	.76290	.00058	.90757	.00081	.03153	.00108	.13997	.00138	.23635	.00172	58	
4+16	.76552	.00058	.90979	.00081	.03345	.00108	.14167	.00139	.23787	.00173	56	
6	.76814	.00059	.91200	.00082	.03537	.00108	.14337	.00139	.23939	.00174	54	
8+17	6.77074	0.00059	6.91421	0.00082	7.03729	0.00109	7.14506	0.00140	7.24090	0.00174	52	
10	.77334	.00059	.91641	.00082	.03920	.00109	.14674	.00140	.24241	.00175	50	
12+18	.77592	.00060	.91860	.00083	.04110	.00110	.14843	.00141	.24392	.00175	48	
14	.77851	.00060	.92079	.00083	.04300	.00110	.15011	.00141	.24543	.00176	46	
16+19	6.78108	0.00060	6.92298	0.00084	7.04490	0.00111	7.15179	0.00142	7.24693	0.00177	44	
18	.78364	.00061	.92516	.00084	.04680	.00111	.15346	.00142	.24843	.00177	42	
20+20	.78620	.00061	.92733	.00085	.04869	.00112	.15513	.00143	.24993	.00178	40	
22	.78875	.00061	.92950	.00085	.05057	.00112	.15680	.00143	.25143	.00178	38	
24+21	6.79129	0.00062	6.93166	0.00085	7.05245	0.00113	7.15846	0.00144	7.25292	0.00179	36	
26	.79383	.00062	.93382	.00086	.05433	.00113	.16013	.00145	.25441	.00180	34	
28+22	.79630	.00063	.93597	.00086	.05620	.00114	.16178	.00145	.25590	.00180	32	
30	.79888	.00063	.93812	.00087	.05807	.00114	.16344	.00146	.25738	.00181	30	
32+23	6.80139	0.00063	6.94026	0.00087	7.05994	0.00115	7.16509	0.00146	7.25886	0.00181	28	
34	.80390	.00064	.94239	.00088	.06180	.00115	.16674	.00147	.26034	.00182	26	
36+24	.80640	.00064	.94453	.00088	.06366	.00116	.16839	.00147	.26182	.00183	24	
38	.80889	.00064	.94665	.00088	.06551	.00116	.17003	.00148	.26330	.00183	22	
40+25	6.81137	0.00065	6.94877	0.00089	7.06736	0.00117	7.17167	0.00148	7.26479	0.00184	20	
42	.81385	.00065	.95089	.00089	.06920	.00117	.17331	.00149	.26627	.00185	18	
44+26	.81632	.00066	.95300	.00090	.07105	.00118	.17494	.00150	.26771	.00185	16	
46	.81879	.00066	.95510	.00090	.07288	.00118	.17657	.00150	.26917	.00186	14	
48+27	6.82124	0.00066	6.95720	0.00091	7.07472	0.00119	7.17820	0.00151	7.27064	0.00186	12	
50	.82369	.00067	.95930	.00091	.07655	.00119	.17982	.00151	.27210	.00187	10	
52+28	.82614	.00067	.96139	.00091	.07837	.00120	.18144	.00152	.27355	.00188	8	
54	.82857	.00067	.96347	.00092	.08019	.00120	.18306	.00152	.27501	.00188	6	
56+29	6.83100	0.00068	6.96555	0.00092	7.08201	0.00121	7.18468	0.00153	7.27646	0.00189	4	
58	.83342	.00068	.66763	.00093	.08383	.00121	.18629	.00154	.27791	.00190	2	
60+30	6.83584	0.00069	6.96970	0.00093	7.08564	0.00122	7.18790	0.00154	7.27936	0.00190	0	
		23h 48m		23h 46m		23h 44m		23h 42m		23h 40m		



TABLE IV.  
Haversines.

s	0h 20m 5° 0'		0h 22m 5° 30'		0h 24m 6° 0'		0h 26m 6° 30'		0h 28m 7° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	7.27936	0.00190	7.36209	0.00230	7.43760	0.00274	7.50706	0.00321	7.57135	0.00373	60
2	.28080	.00191	.36340	.00231	.43880	.00275	.50817	.00322	.57238	.00374	58
4+1	.28225	.00192	.36471	.00232	.44001	.00275	.50928	.00323	.57341	.00374	56
6	.28369	.00192	.36602	.00232	.44121	.00276	.51039	.00324	.57444	.00375	54
8+2	7.28513	0.00193	7.36733	0.00233	7.44241	0.00277	7.51149	0.00325	7.57547	0.00376	52
10	.28656	.00193	.36864	.00234	.44361	.00278	.51260	.00326	.57650	.00377	50
12+3	.28800	.00194	.36994	.00234	.44480	.00278	.51370	.00326	.57752	.00378	48
14	.28943	.00195	.37124	.00235	.44600	.00279	.51481	.00327	.57855	.00379	46
16+4	7.29086	0.00195	7.37254	0.00236	7.44719	0.00280	7.51591	0.00328	7.57957	0.00380	44
18	.29228	.00196	.37384	.00237	.44838	.00281	.51701	.00329	.58060	.00381	42
20+5	.29371	.00197	.37514	.00237	.44957	.00282	.51811	.00330	.58162	.00382	40
22	.29513	.00197	.37643	.00238	.45076	.00282	.51921	.00331	.58264	.00383	38
24+6	7.29655	0.00198	7.37773	0.00239	7.45194	0.00283	7.52030	0.00331	7.58366	0.00383	36
26	.29797	.00199	.37902	.00239	.45313	.00284	.52140	.00332	.58467	.00384	34
28+7	.29938	.00199	.38030	.00240	.45431	.00285	.52249	.00333	.58569	.00385	32
30	.30079	.00200	.38159	.00241	.45549	.00285	.52358	.00334	.58670	.00386	30
32+8	7.30220	0.00201	7.38288	0.00241	7.45667	0.00286	7.52467	0.00335	7.58772	0.00387	28
34	.30361	.00201	.38416	.00242	.45785	.00287	.52576	.00336	.58873	.00388	26
36+9	.30502	.00202	.38544	.00243	.45903	.00288	.52685	.00336	.58974	.00389	24
38	.30642	.00203	.38672	.00244	.46020	.00289	.52794	.00337	.59075	.00390	22
40+10	7.30782	0.00203	7.38800	0.00244	7.46138	0.00289	7.52902	0.00338	7.59176	0.00391	20
42	.30922	.00204	.38927	.00245	.46255	.00290	.53011	.00339	.59277	.00392	18
44+11	.31062	.00204	.39054	.00246	.46372	.00291	.53119	.00340	.59378	.00392	16
46	.31201	.00205	.39182	.00247	.46489	.00292	.53227	.00341	.59478	.00393	14
48+12	7.31340	0.00206	7.39300	0.00247	7.46605	0.00292	7.53335	0.00341	7.59579	0.00394	12
50	.31479	.00206	.39435	.00248	.46722	.00293	.53443	.00342	.59679	.00395	10
52+13	.31618	.00207	.39562	.00249	.46838	.00294	.53550	.00343	.59779	.00396	8
54	.31757	.00208	.39688	.00249	.46955	.00295	.53658	.00344	.59879	.00397	6
56+14	7.31895	0.00208	7.39815	0.00250	7.47071	0.00296	7.53766	0.00345	7.59979	0.00398	4
58	7.32033	0.00209	7.39941	0.00251	7.47187	0.00296	7.53873	0.00346	7.60079	0.00399	2
	23h 39m		23h 37m		23h 35m		23h 33m		23h 31m		
s	0h 21m 5° 0'		0h 23m 5° 30'		0h 25m 6° 0'		0h 27m 6° 30'		0h 29m 7° 0'		s
0+15	7.32171	0.00210	7.40067	0.00252	7.47302	0.00297	7.53980	0.00347	7.60179	0.00400	60
2	.32309	.00210	.40192	.00252	.47418	.00298	.54087	.00347	.60279	.00401	58
4+16	.32446	.00211	.40318	.00253	.47533	.00299	.54194	.00348	.60378	.00402	56
6	.32583	.00212	.40443	.00254	.47649	.00300	.54301	.00349	.60478	.00403	54
8+17	7.32720	0.00212	7.40568	0.00255	7.47764	0.00300	7.54407	0.00350	7.60577	0.00403	52
10	.32857	.00213	.40693	.00255	.47879	.00301	.54514	.00351	.60676	.00404	50
12+18	.32994	.00214	.40818	.00256	.47994	.00302	.54620	.00352	.60775	.00405	48
14	.33130	.00214	.40943	.00257	.48109	.00303	.54727	.00353	.60874	.00406	46
16+19	7.33266	0.00215	7.41067	0.00257	7.48223	0.00304	7.54833	0.00353	7.60973	0.00407	44
18	.33402	.00216	.41191	.00258	.48337	.00304	.54939	.00354	.61072	.00408	42
20+20	.33538	.00216	.41315	.00259	.48452	.00305	.55045	.00355	.61170	.00409	40
22	.33673	.00217	.41439	.00260	.48566	.00306	.55150	.00356	.61269	.00410	38
24+21	7.33809	0.00218	7.41563	0.00260	7.48680	0.00307	7.55256	0.00357	7.61367	0.00411	36
26	.33944	.00218	.41686	.00261	.48794	.00308	.55361	.00358	.61466	.00412	34
28+22	.34079	.00219	.41810	.00262	.48907	.00308	.55467	.00359	.61564	.00413	32
30	.34213	.00220	.41933	.00263	.49021	.00309	.55572	.00360	.61662	.00414	30
32+23	7.34348	0.00221	7.42056	0.00263	7.49134	0.00310	7.55677	0.00360	7.61760	0.00415	28
34	.34482	.00221	.42179	.00264	.49247	.00311	.55782	.00361	.61858	.00416	26
36+24	.34616	.00222	.42301	.00265	.49360	.00312	.55887	.00362	.61955	.00416	24
38	.34750	.00223	.42424	.00266	.49473	.00312	.55992	.00363	.62053	.00417	22
40+25	7.34884	0.00223	7.42546	0.00266	7.49586	0.00313	7.56096	0.00364	7.62151	0.00418	20
42	.35017	.00224	.42668	.00267	.49699	.00314	.56201	.00365	.62248	.00419	18
44+26	.35150	.00225	.42790	.00268	.49811	.00315	.56305	.00366	.62345	.00420	16
46	.35283	.00225	.42912	.00269	.49923	.00316	.56409	.00367	.62442	.00421	14
48+27	7.35416	0.00226	7.43034	0.00269	7.50036	0.00316	7.56513	0.00367	7.62540	0.00422	12
50	.35549	.00227	.43155	.00270	.50148	.00317	.56617	.00368	.62636	.00423	10
52+28	.35681	.00227	.43277	.00271	.50259	.00318	.56721	.00369	.62733	.00424	8
54	.35813	.00228	.43398	.00272	.50371	.00319	.56825	.00370	.62830	.00425	6
56+29	7.35945	0.00229	7.43519	0.00272	7.50483	0.00320	7.56928	0.00371	7.62927	0.00426	4
58	.36077	.00229	.43639	.00273	.50594	.00321	.57032	.00372	.63023	.00427	2
60+30	7.36209	0.00230	7.43760	0.00274	7.50706	0.00321	7.57135	0.00373	7.63120	0.00428	0
	23h 38m		23h 36m		23h 34m		23h 32m		23h 30m		



TABLE IV.

Haversines.

s	0h 30m 7° 30'		0h 32m 8° 0'		0h 34m 8° 30'		0h 36m 9° 0'		0h 38m 9° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	7.63120	0.00428	7.68717	0.00487	7.73974	0.00549	7.78929	0.00616	7.83615	0.00686	60
2	.63216	.00429	.68807	.00488	.74059	.00550	.79009	.00617	.83691	.00687	58
4+1	.63312	.00430	.68897	.00489	.74143	.00551	.79089	.00618	.83767	.00688	56
6	.63408	.00431	.68987	.00490	.74228	.00552	.79169	.00619	.83842	.00689	54
8+2	7.63504	0.00432	7.69077	0.00491	7.74313	0.00554	7.79249	0.00620	7.83918	0.00691	52
10	.63600	.00433	.69167	.00492	.74398	.00555	.79329	.00621	.83994	.00692	50
12+3	.63696	.00433	.69257	.00493	.74482	.00556	.79409	.00622	.84070	.00693	48
14	.63792	.00434	.69347	.00494	.74567	.00557	.79489	.00623	.84145	.00694	46
16+4	7.63887	0.00435	7.69437	0.00495	7.74651	0.00558	7.79568	0.00625	7.84221	0.00695	44
18	.63983	.00436	.69526	.00496	.74735	.00559	.79648	.00626	.84296	.00697	42
20+5	.64078	.00437	.69616	.00497	.74819	.00560	.79728	.00627	.84372	.00698	40
22	.64173	.00438	.69705	.00498	.74904	.00561	.79807	.00628	.84447	.00699	38
24+6	7.64269	0.00439	7.69794	0.00499	7.74988	0.00562	7.79886	0.00629	7.84522	0.00700	36
26	.64364	.00440	.69883	.00500	.75072	.00563	.79966	.00630	.84597	.00701	34
28+7	.64458	.00441	.69972	.00501	.75155	.00564	.80045	.00632	.84672	.00703	32
30	.64553	.00442	.70061	.00502	.75239	.00565	.80124	.00633	.84747	.00704	30
32+8	7.64648	0.00443	7.70150	0.00503	7.75323	0.00567	7.80203	0.00634	7.84822	0.00705	28
34	.64743	.00444	.70239	.00504	.75407	.00568	.80282	.00635	.84897	.00706	26
36+9	.64837	.00445	.70328	.00505	.75490	.00569	.80361	.00636	.84972	.00707	24
38	.64932	.00446	.70416	.00506	.75574	.00570	.80440	.00637	.85047	.00709	22
40+10	7.65026	0.00447	7.70505	0.00507	7.75657	0.00571	7.80519	0.00639	7.85122	0.00710	20
42	.65120	.00448	.70593	.00508	.75740	.00572	.80598	.00640	.85196	.00711	18
44+11	.65214	.00449	.70682	.00509	.75824	.00573	.80677	.00641	.85271	.00712	16
46	.65308	.00450	.70770	.00510	.75907	.00574	.80755	.00642	.85346	.00714	14
48+12	7.65402	0.00451	7.70858	0.00511	7.75990	0.00575	7.80834	0.00643	7.85420	0.00715	12
50	.65496	.00452	.70946	.00512	.76073	.00576	.80912	.00644	.85494	.00716	10
52+13	.65590	.00453	.71034	.00513	.76156	.00578	.80991	.00646	.85569	.00717	8
54	.65683	.00454	.71122	.00514	.76239	.00579	.81069	.00647	.85643	.00719	6
56+14	7.65777	0.00455	7.71210	0.00515	7.76321	0.00580	7.81147	0.00648	7.85717	0.00720	4
58	.65870	.00456	.71298	.00516	.76404	.00581	.81225	.00649	.85791	.00721	2
23h 29m			23h 27m		23h 25m		23h 23m		23h 21m		
s	0h 31m 7° 30'		0h 33m 8° 0'		0h 35m 8° 30'		0h 37m 9° 0'		0h 39m 9° 30'		s
0+15	7.65964	0.00457	7.71385	0.00517	7.76487	0.00582	7.81303	0.00650	7.85866	0.00722	60
2	.66057	.00458	.71473	.00518	.76569	.00583	.81382	.00651	.85940	.00723	58
4+16	.66150	.00459	.71560	.00520	.76652	.00584	.81459	.00653	.86014	.00725	56
6	.66243	.00460	.71648	.00521	.76734	.00585	.81537	.00654	.86087	.00726	54
8+17	7.66336	0.00461	7.71735	0.00522	7.76816	0.00586	7.81615	0.00655	7.86161	0.00727	52
10	.66429	.00462	.71822	.00523	.76898	.00587	.81693	.00656	.86235	.00728	50
12+18	.66521	.00463	.71909	.00524	.76981	.00589	.81771	.00657	.86309	.00730	48
14	.66614	.00464	.71996	.00525	.77063	.00590	.81848	.00658	.86382	.00731	46
16+19	7.66706	0.00465	7.72083	0.00526	7.77145	0.00591	7.81926	0.00660	7.86456	0.00732	44
18	.66799	.00466	.72170	.00527	.77227	.00592	.82003	.00661	.86530	.00733	42
20+20	.66891	.00467	.72257	.00528	.77308	.00593	.82081	.00662	.86603	.00735	40
22	.66983	.00468	.72343	.00529	.77390	.00594	.82158	.00663	.86676	.00736	38
24+21	7.67075	0.00469	7.72430	0.00530	7.77472	0.00595	7.82235	0.00664	7.86750	0.00737	36
26	.67167	.00470	.72516	.00531	.77553	.00596	.82313	.00665	.86823	.00738	34
28+22	.67259	.00471	.72603	.00532	.77635	.00598	.82390	.00667	.86896	.00740	32
30	.67351	.00472	.72689	.00533	.77716	.00599	.82467	.00668	.86969	.00741	30
32+23	7.67443	0.00473	7.72775	0.00534	7.77798	0.00600	7.82544	0.00669	7.87042	0.00742	28
34	.67535	.00474	.72861	.00535	.77879	.00601	.82621	.00670	.87115	.00743	26
36+24	.67626	.00475	.72948	.00536	.77960	.00602	.82698	.00671	.87188	.00745	24
38	.67718	.00476	.73034	.00537	.78041	.00603	.82774	.00673	.87261	.00746	22
40+25	7.67809	0.00477	7.73119	0.00538	7.78122	0.00604	7.82851	0.00674	7.87334	0.00747	20
42	.67900	.00478	.73205	.00540	.78203	.00605	.82928	.00675	.87407	.00748	18
44+26	.67991	.00479	.73291	.00541	.78284	.00607	.83004	.00676	.87480	.00750	16
46	.68082	.00480	.73377	.00542	.78365	.00608	.83081	.00677	.87552	.00751	14
48+27	7.68173	0.00481	7.73462	0.00543	7.78446	0.00609	7.83157	0.00679	7.87625	0.00752	12
50	.68264	.00482	.73548	.00544	.78526	.00610	.83234	.00680	.87697	.00753	10
52+28	.68355	.00483	.73633	.00545	.78607	.00611	.83310	.00681	.87770	.00755	8
54	.68445	.00484	.73718	.00546	.78688	.00612	.83386	.00682	.87842	.00756	6
56+29	7.68536	0.00485	7.73803	0.00547	7.78768	0.00613	7.83463	0.00683	7.87915	0.00757	4
58	.68627	.00486	.73889	.00548	.78848	.00614	.83539	.00685	.87987	.00758	2
60+30	7.68717	0.00487	7.73974	0.00549	7.78929	0.00616	7.83615	0.00686	7.88059	0.00760	0
23h 28m			23h 26m		23h 24m		23h 22m		23h 20m		



Haversines.

s	0h 40m 10° 0'		0h 42m 10° 30'		0h 44m 11° 0'		0h 46m 11° 30'		0h 48m 12° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	7.88059	<b>0.00760</b>	7.92286	<b>0.00837</b>	7.96315	<b>0.00919</b>	8.00163	<b>0.01004</b>	8.03847	<b>0.01093</b>	60
2	.88131	<b>.00761</b>	.92354	<b>.00839</b>	.96380	<b>.00920</b>	.00226	<b>.01005</b>	.03907	<b>.01094</b>	58
4+1	.88203	<b>.00762</b>	.92423	<b>.00840</b>	.96446	<b>.00921</b>	.00289	<b>.01007</b>	.03967	<b>.01096</b>	56
6	.88276	<b>.00763</b>	.92492	<b>.00841</b>	.96511	<b>.00923</b>	.00351	<b>.01008</b>	.04027	<b>.01097</b>	54
8+2	7.88348	<b>0.00765</b>	7.92560	<b>0.00843</b>	7.96577	<b>0.00924</b>	8.00414	<b>0.01010</b>	8.04087	<b>0.01099</b>	52
10	.88419	<b>.00766</b>	.92629	<b>.00844</b>	.96642	<b>.00926</b>	.00476	<b>.01011</b>	.04147	<b>.01100</b>	50
12+3	.88491	<b>.00767</b>	.92697	<b>.00845</b>	.96707	<b>.00927</b>	.00539	<b>.01012</b>	.04207	<b>.01102</b>	48
14	.88563	<b>.00768</b>	.92766	<b>.00847</b>	.96773	<b>.00928</b>	.00601	<b>.01014</b>	.04267	<b>.01103</b>	46
16+4	7.88635	<b>0.00770</b>	7.92834	<b>0.00848</b>	7.96838	<b>0.00930</b>	8.00664	<b>0.01015</b>	8.04326	<b>0.01105</b>	44
18	.88707	<b>.00771</b>	.92902	<b>.00849</b>	.96903	<b>.00931</b>	.00726	<b>.01017</b>	.04386	<b>.01106</b>	42
20+5	.88778	<b>.00772</b>	.92970	<b>.00851</b>	.96968	<b>.00933</b>	.00785	<b>.01018</b>	.04446	<b>.01108</b>	40
22	.88850	<b>.00774</b>	.93039	<b>.00852</b>	.97033	<b>.00934</b>	.00851	<b>.01020</b>	.04506	<b>.01109</b>	38
24+6	7.88921	<b>0.00775</b>	7.93107	<b>0.00853</b>	7.97098	<b>0.00935</b>	8.00913	<b>0.01021</b>	8.04565	<b>0.01111</b>	36
26	.88993	<b>.00776</b>	.93175	<b>.00855</b>	.97163	<b>.00937</b>	.00975	<b>.01023</b>	.04625	<b>.01112</b>	34
28+7	.89064	<b>.00777</b>	.93243	<b>.00856</b>	.97228	<b>.00938</b>	.01037	<b>.01024</b>	.04684	<b>.01114</b>	32
30	.89135	<b>.00779</b>	.93311	<b>.00857</b>	.97293	<b>.00940</b>	.01099	<b>.01026</b>	.04744	<b>.01115</b>	30
32+8	7.89207	<b>0.00780</b>	7.93379	<b>0.00859</b>	7.97358	<b>0.00941</b>	8.01161	<b>0.01027</b>	8.04803	<b>0.01117</b>	28
34	.89278	<b>.00781</b>	.93447	<b>.00860</b>	.97423	<b>.00942</b>	.01223	<b>.01029</b>	.04863	<b>.01118</b>	26
36+9	.89349	<b>.00783</b>	.93514	<b>.00861</b>	.97478	<b>.00944</b>	.01285	<b>.01030</b>	.04922	<b>.01120</b>	24
38	.89420	<b>.00784</b>	.93582	<b>.00863</b>	.97552	<b>.00945</b>	.01347	<b>.01032</b>	.04981	<b>.01122</b>	22
40+10	7.89491	<b>0.00785</b>	7.93650	<b>0.00864</b>	7.97617	<b>0.00947</b>	8.01409	<b>0.01033</b>	8.05041	<b>0.01123</b>	20
42	.89562	<b>.00786</b>	.93717	<b>.00865</b>	.97681	<b>.00948</b>	.01471	<b>.01034</b>	.05100	<b>.01125</b>	18
44+11	.89633	<b>.00788</b>	.93785	<b>.00867</b>	.97746	<b>.00949</b>	.01532	<b>.01036</b>	.05159	<b>.01126</b>	16
46	.89704	<b>.00789</b>	.93852	<b>.00868</b>	.97810	<b>.00951</b>	.01594	<b>.01037</b>	.05218	<b>.01128</b>	14
48+12	7.89775	<b>0.00790</b>	7.93920	<b>0.00869</b>	7.97875	<b>0.00952</b>	8.01656	<b>0.01039</b>	8.05277	<b>0.01129</b>	12
50	.89846	<b>.00792</b>	.93987	<b>.00871</b>	.97939	<b>.00954</b>	.01717	<b>.01040</b>	.05336	<b>.01131</b>	10
52+13	.89916	<b>.00793</b>	.94055	<b>.00872</b>	.98003	<b>.00955</b>	.01779	<b>.01042</b>	.05395	<b>.01132</b>	8
54	.89987	<b>.00794</b>	.94122	<b>.00873</b>	.98068	<b>.00956</b>	.01840	<b>.01043</b>	.05454	<b>.01134</b>	6
56+14	7.90057	<b>0.00795</b>	7.94189	<b>0.00875</b>	7.98132	<b>0.00958</b>	8.01902	<b>0.01045</b>	8.05513	<b>0.01135</b>	4
58	7.90128	<b>0.00797</b>	7.94257	<b>0.00876</b>	7.98196	<b>0.00959</b>	8.01963	<b>0.01046</b>	8.05572	<b>0.01137</b>	2
	23h 19m		23h 17m		23h 15m		23h 13m		23h 11m		
s	0h 41m 10° 0'		0h 43m 10° 30'		0h 45m 11° 0'		0h 47m 11° 30'		0h 49m 12° 0'		s
0+15	7.90198	<b>0.00798</b>	7.94324	<b>0.00877</b>	7.98260	<b>0.00961</b>	8.02025	<b>0.01048</b>	8.05631	<b>0.01138</b>	60
2	.90269	<b>.00799</b>	.94391	<b>.00879</b>	.98325	<b>.00962</b>	.02086	<b>.01049</b>	.05690	<b>.01140</b>	58
4+16	.90339	<b>.00801</b>	.94458	<b>.00880</b>	.98389	<b>.00964</b>	.02148	<b>.01051</b>	.05749	<b>.01142</b>	56
6	.90409	<b>.00802</b>	.94525	<b>.00882</b>	.98453	<b>.00965</b>	.02209	<b>.01052</b>	.05808	<b>.01143</b>	54
8+17	7.90480	<b>0.00803</b>	7.94592	<b>0.00883</b>	7.98517	<b>0.00966</b>	8.02270	<b>0.01054</b>	8.05866	<b>0.01145</b>	52
10	.90550	<b>.00804</b>	.94659	<b>.00884</b>	.98581	<b>.00968</b>	.02331	<b>.01055</b>	.05925	<b>.01146</b>	50
12+18	.90620	<b>.00806</b>	.94726	<b>.00886</b>	.98644	<b>.00969</b>	.02392	<b>.01057</b>	.05984	<b>.01148</b>	48
14	.90690	<b>.00807</b>	.94792	<b>.00887</b>	.98708	<b>.00971</b>	.02453	<b>.01058</b>	.06042	<b>.01149</b>	46
16+19	7.90760	<b>0.00808</b>	7.94859	<b>0.00888</b>	7.98772	<b>0.00972</b>	8.02515	<b>0.01060</b>	8.06101	<b>0.01151</b>	44
18	.90830	<b>.00810</b>	.94926	<b>.00890</b>	.98836	<b>.00974</b>	.02576	<b>.01061</b>	.06159	<b>.01152</b>	42
20+20	.90900	<b>.00811</b>	.94992	<b>.00891</b>	.98899	<b>.00975</b>	.02637	<b>.01063</b>	.06218	<b>.01154</b>	40
22	.90970	<b>.00812</b>	.95059	<b>.00892</b>	.98963	<b>.00976</b>	.02697	<b>.01064</b>	.06276	<b>.01155</b>	38
24+21	7.91039	<b>0.00814</b>	7.95126	<b>0.00894</b>	7.99027	<b>0.00978</b>	8.02758	<b>0.01066</b>	8.06335	<b>0.01157</b>	36
26	.91109	<b>.00815</b>	.95192	<b>.00895</b>	.99090	<b>.00979</b>	.02819	<b>.01067</b>	.06393	<b>.01159</b>	34
28+22	.91179	<b>.00816</b>	.95259	<b>.00897</b>	.99154	<b>.00981</b>	.02880	<b>.01069</b>	.06451	<b>.01160</b>	32
30	.91248	<b>.00817</b>	.95325	<b>.00898</b>	.99217	<b>.00982</b>	.02941	<b>.01070</b>	.06510	<b>.01162</b>	30
32+23	7.91318	<b>0.00819</b>	7.95391	<b>0.00899</b>	7.99281	<b>0.00984</b>	8.03001	<b>0.01072</b>	8.06568	<b>0.01163</b>	28
34	.91387	<b>.00820</b>	.95458	<b>.00901</b>	.99344	<b>.00985</b>	.03062	<b>.01073</b>	.06626	<b>.01165</b>	26
36+24	.91457	<b>.00821</b>	.95524	<b>.00902</b>	.99407	<b>.00986</b>	.03123	<b>.01075</b>	.06684	<b>.01166</b>	24
38	.91526	<b>.00823</b>	.95590	<b>.00903</b>	.99470	<b>.00988</b>	.03183	<b>.01076</b>	.06742	<b>.01168</b>	22
40+25	7.91596	<b>0.00824</b>	7.95656	<b>0.00905</b>	7.99534	<b>0.00989</b>	8.03244	<b>0.01078</b>	8.06800	<b>0.01170</b>	20
42	.91665	<b>.00825</b>	.95722	<b>.00906</b>	.99597	<b>.00991</b>	.03304	<b>.01079</b>	.06859	<b>.01171</b>	18
44+26	.91734	<b>.00827</b>	.95788	<b>.00908</b>	.99660	<b>.00992</b>	.03365	<b>.01081</b>	.06917	<b>.01173</b>	16
46	.91803	<b>.00828</b>	.95854	<b>.00909</b>	.99723	<b>.00994</b>	.03425	<b>.01082</b>	.06975	<b>.01174</b>	14
48+27	7.91872	<b>0.00829</b>	7.95920	<b>0.00910</b>	7.99786	<b>0.00995</b>	8.03486	<b>0.01084</b>	8.07032	<b>0.01176</b>	12
50	.91941	<b>.00831</b>	.95986	<b>.00912</b>	.99849	<b>.00997</b>	.03546	<b>.01085</b>	.07090	<b>.01177</b>	10
52+28	.92010	<b>.00832</b>	.96052	<b>.00913</b>	.99912	<b>.00998</b>	.03606	<b>.01087</b>	.07148	<b>.01179</b>	8
54	.92079	<b>.00833</b>	.96118	<b>.00914</b>	7.99975	<b>.00999</b>	.03666	<b>.01088</b>	.07206	<b>.01180</b>	6
56+29	7.92148	<b>0.00835</b>	7.96183	<b>0.00916</b>	8.00038	<b>0.01001</b>	8.03727	<b>0.01090</b>	8.07264	<b>0.01182</b>	4
58	.92217	<b>.00836</b>	.96249	<b>.00917</b>	.00100	<b>.01002</b>	.03787	<b>.01091</b>	.07322	<b>.01184</b>	2
60+30	7.92286	<b>0.00837</b>	7.96315	<b>0.00919</b>	8.00163	<b>0.01004</b>	8.03847	<b>0.01093</b>	8.07379	<b>0.01185</b>	0
	23h 18m		23h 16m		23h 14m		23h 12m		23h 10m		

TABLE IV.

Haversines.

s	0h 50m 12° 30'		0h 52m 13° 0'		0h 54m 13° 30'		0h 56m 14° 0'		0h 58m 14° 30'		s	
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.		
0 0	8.07379	<b>0.01185</b>	8.10772	<b>0.01282</b>	8.14035	<b>0.01382</b>	8.17179	<b>0.01485</b>	8.20211	<b>0.01593</b>	60	
2	.07437	<b>.01187</b>	.10827	<b>.01283</b>	.14089	<b>.01383</b>	.17230	<b>.01487</b>	.20261	<b>.01594</b>	58	
4+ 1	.07494	<b>.01188</b>	.10883	<b>.01285</b>	.14142	<b>.01385</b>	.17282	<b>.01489</b>	.20310	<b>.01596</b>	56	
6	.07552	<b>.01190</b>	.10938	<b>.01286</b>	.14195	<b>.01387</b>	.17333	<b>.01491</b>	.20360	<b>.01598</b>	54	
8+ 2	8.07610	<b>0.01192</b>	8.10993	<b>0.01288</b>	8.14248	<b>0.01388</b>	8.17384	<b>0.01492</b>	8.20410	<b>0.01600</b>	52	
10	.07667	<b>.01193</b>	.11049	<b>.01290</b>	.14302	<b>.01390</b>	.17436	<b>.01494</b>	.20459	<b>.01602</b>	50	
12+ 3	.07725	<b>.01195</b>	.11104	<b>.01291</b>	.14355	<b>.01392</b>	.17487	<b>.01496</b>	.20509	<b>.01604</b>	48	
14	.07782	<b>.01196</b>	.11159	<b>.01293</b>	.14408	<b>.01393</b>	.17538	<b>.01498</b>	.20558	<b>.01605</b>	46	
16+ 4	8.07839	<b>0.01198</b>	8.11214	<b>0.01295</b>	8.14461	<b>0.01395</b>	8.17590	<b>0.01499</b>	8.20608	<b>0.01607</b>	44	
18	.07897	<b>.01199</b>	.11269	<b>.01296</b>	.14514	<b>.01397</b>	.17641	<b>.01501</b>	.20657	<b>.01609</b>	42	
20+ 5	.07954	<b>.01201</b>	.11324	<b>.01298</b>	.14567	<b>.01399</b>	.17692	<b>.01503</b>	.20706	<b>.01611</b>	40	
22	.08011	<b>.01203</b>	.11379	<b>.01300</b>	.14620	<b>.01400</b>	.17743	<b>.01505</b>	.20756	<b>.01613</b>	38	
24+ 6	8.08069	<b>0.01204</b>	8.11435	<b>0.01301</b>	8.14673	<b>0.01402</b>	8.17794	<b>0.01506</b>	8.20805	<b>0.01615</b>	36	
26	.08126	<b>.01206</b>	.11490	<b>.01303</b>	.14726	<b>.01404</b>	.17845	<b>.01508</b>	.20854	<b>.01616</b>	34	
28+ 7	.08183	<b>.01207</b>	.11544	<b>.01305</b>	.14779	<b>.01405</b>	.17896	<b>.01510</b>	.20904	<b>.01618</b>	32	
30	.08240	<b>.01209</b>	.11599	<b>.01306</b>	.14832	<b>.01407</b>	.17947	<b>.01512</b>	.20953	<b>.01620</b>	30	
32+ 8	8.08297	<b>0.01211</b>	8.11654	<b>0.01308</b>	8.14885	<b>0.01409</b>	8.17998	<b>0.01513</b>	8.21002	<b>0.01622</b>	28	
34	.08354	<b>.01212</b>	.11709	<b>.01309</b>	.14938	<b>.01411</b>	.18049	<b>.01515</b>	.21051	<b>.01624</b>	26	
36+ 9	.08411	<b>.01214</b>	.11764	<b>.01311</b>	.14991	<b>.01412</b>	.18100	<b>.01517</b>	.21100	<b>.01626</b>	24	
38	.08468	<b>.01215</b>	.11819	<b>.01313</b>	.15043	<b>.01414</b>	.18151	<b>.01519</b>	.21149	<b>.01627</b>	22	
40+10	8.08525	<b>0.01217</b>	8.11873	<b>0.01314</b>	8.15096	<b>0.01416</b>	8.18202	<b>0.01521</b>	8.21199	<b>0.01629</b>	20	
42	.08582	<b>.01218</b>	.11928	<b>.01316</b>	.15149	<b>.01417</b>	.18253	<b>.01522</b>	.21248	<b>.01631</b>	18	
44+11	.08639	<b>.01220</b>	.11983	<b>.01317</b>	.15201	<b>.01419</b>	.18303	<b>.01524</b>	.21297	<b>.01633</b>	16	
46	.08696	<b>.01222</b>	.12038	<b>.01319</b>	.15254	<b>.01421</b>	.18354	<b>.01526</b>	.21346	<b>.01635</b>	14	
48+12	8.08752	<b>0.01223</b>	8.12092	<b>0.01321</b>	8.15307	<b>0.01423</b>	8.18405	<b>0.01528</b>	8.21395	<b>0.01637</b>	12	
50	.08809	<b>.01225</b>	.12147	<b>.01323</b>	.15359	<b>.01424</b>	.18455	<b>.01530</b>	.21444	<b>.01638</b>	10	
52+13	.08866	<b>.01226</b>	.12201	<b>.01324</b>	.15412	<b>.01426</b>	.18506	<b>.01531</b>	.21493	<b>.01640</b>	8	
54	.08922	<b>.01228</b>	.12256	<b>.01326</b>	.15464	<b>.01428</b>	.18557	<b>.01533</b>	.21541	<b>.01642</b>	6	
56+14	8.08979	<b>0.01230</b>	8.12310	<b>0.01328</b>	8.15517	<b>0.01429</b>	8.18607	<b>0.01535</b>	8.21590	<b>0.01644</b>	4	
58	8.09036	<b>0.01231</b>	8.12365	<b>0.01329</b>	8.15569	<b>0.01431</b>	8.18658	<b>0.01537</b>	8.21639	<b>0.01646</b>	2	
		23h 9m		23h 7m		23h 5m		23h 3m		23h 1m		
s	0h 51m 12° 30'		0h 53m 13° 0'		0h 55m 13° 30'		0h 57m 14° 0'		0h 59m 14° 30'		s	
0+15	8.09092	<b>0.01233</b>	8.12419	<b>0.01331</b>	8.15622	<b>0.01433</b>	8.18709	<b>0.01538</b>	8.21688	<b>0.01648</b>	60	
2	.09149	<b>.01234</b>	.12473	<b>.01333</b>	.15674	<b>.01435</b>	.18759	<b>.01540</b>	.21737	<b>.01650</b>	58	
4+16	.09205	<b>.01236</b>	.12528	<b>.01334</b>	.15726	<b>.01436</b>	.18810	<b>.01542</b>	.21785	<b>.01651</b>	56	
6	.09262	<b>.01238</b>	.12582	<b>.01336</b>	.15779	<b>.01438</b>	.18860	<b>.01544</b>	.21834	<b>.01653</b>	54	
8+17	8.09318	<b>0.01239</b>	8.12636	<b>0.01338</b>	8.15831	<b>0.01440</b>	8.18910	<b>0.01546</b>	8.21883	<b>0.01655</b>	52	
10	.09374	<b>.01241</b>	.12691	<b>.01339</b>	.15883	<b>.01442</b>	.18961	<b>.01547</b>	.21932	<b>.01657</b>	50	
12+18	.09431	<b>.01243</b>	.12745	<b>.01341</b>	.15935	<b>.01443</b>	.19011	<b>.01549</b>	.21980	<b>.01659</b>	48	
14	.09487	<b>.01244</b>	.12799	<b>.01343</b>	.15987	<b>.01445</b>	.19062	<b>.01551</b>	.22029	<b>.01661</b>	46	
16+19	8.09543	<b>0.01246</b>	8.12853	<b>0.01344</b>	8.16040	<b>0.01447</b>	8.19112	<b>0.01553</b>	8.22077	<b>0.01663</b>	44	
18	.09600	<b>.01247</b>	.12907	<b>.01346</b>	.16092	<b>.01448</b>	.19162	<b>.01555</b>	.22126	<b>.01664</b>	42	
20+20	.09656	<b>.01249</b>	.12961	<b>.01348</b>	.16144	<b>.01450</b>	.19212	<b>.01556</b>	.22175	<b>.01666</b>	40	
22	.09712	<b>.01251</b>	.13015	<b>.01349</b>	.16196	<b>.01452</b>	.19263	<b>.01558</b>	.22223	<b>.01668</b>	38	
24+21	8.09768	<b>0.01252</b>	8.13069	<b>0.01351</b>	8.16248	<b>0.01454</b>	8.19313	<b>0.01560</b>	8.22272	<b>0.01670</b>	36	
26	.09824	<b>.01254</b>	.13123	<b>.01353</b>	.16300	<b>.01455</b>	.19363	<b>.01562</b>	.22320	<b>.01672</b>	34	
28+22	.09880	<b>.01255</b>	.13177	<b>.01354</b>	.16352	<b>.01457</b>	.19413	<b>.01564</b>	.22368	<b>.01674</b>	32	
30	.09936	<b>.01257</b>	.13231	<b>.01356</b>	.16404	<b>.01459</b>	.19463	<b>.01565</b>	.22417	<b>.01676</b>	30	
32+23	8.09992	<b>0.01259</b>	8.13285	<b>0.01358</b>	8.16456	<b>0.01461</b>	8.19513	<b>0.01567</b>	8.22465	<b>0.01678</b>	28	
34	.10048	<b>.01260</b>	.13339	<b>.01360</b>	.16508	<b>.01462</b>	.19563	<b>.01569</b>	.22514	<b>.01679</b>	26	
36+24	.10104	<b>.01262</b>	.13392	<b>.01361</b>	.16559	<b>.01464</b>	.19613	<b>.01571</b>	.22562	<b>.01681</b>	24	
38	.10160	<b>.01264</b>	.13446	<b>.01363</b>	.16611	<b>.01466</b>	.19663	<b>.01573</b>	.22610	<b>.01683</b>	22	
40+25	8.10216	<b>0.01265</b>	8.13500	<b>0.01365</b>	8.16663	<b>0.01468</b>	8.19713	<b>0.01574</b>	8.22658	<b>0.01685</b>	20	
42	.10271	<b>.01267</b>	.13554	<b>.01366</b>	.16715	<b>.01469</b>	.19763	<b>.01576</b>	.22707	<b>.01687</b>	18	
44+26	.10327	<b>.01268</b>	.13607	<b>.01368</b>	.16766	<b>.01471</b>	.19813	<b>.01578</b>	.22755	<b>.01689</b>	16	
46	.10383	<b>.01270</b>	.13661	<b>.01370</b>	.16818	<b>.01473</b>	.19863	<b>.01580</b>	.22803	<b>.01691</b>	14	
48+27	8.10439	<b>0.01272</b>	8.13714	<b>0.01371</b>	8.16870	<b>0.01475</b>	8.19913	<b>0.01582</b>	8.22851	<b>0.01692</b>	12	
50	.10494	<b>.01273</b>	.13768	<b>.01373</b>	.16921	<b>.01476</b>	.19963	<b>.01584</b>	.22899	<b>.01694</b>	10	
52+28	.10550	<b>.01275</b>	.13822	<b>.01375</b>	.16973	<b>.01478</b>	.20012	<b>.01585</b>	.22947	<b>.01696</b>	8	
54	.10605	<b>.01277</b>	.13875	<b>.01376</b>	.17024	<b>.01480</b>	.20062	<b>.01587</b>	.22996	<b>.01698</b>	6	
56+29	8.10661	<b>0.01278</b>	8.13928	<b>0.01378</b>	8.17076	<b>0.01482</b>	8.20112	<b>0.01589</b>	8.23044	<b>0.01700</b>	4	
58	.10716	<b>.01280</b>	.13982	<b>.01380</b>	.17127	<b>.01483</b>	.20162	<b>.01591</b>	.23092	<b>.01702</b>	2	
60+30	8.10772	<b>0.01282</b>	8.14035	<b>0.01382</b>	8.17179	<b>0.01485</b>	8.20211	<b>0.01593</b>	8.23140	<b>0.01704</b>	0	
		23h 8m		23h 6m		23h 4m		23h 2m		23h 0m		



Haversines.

s	1h 0m 15° 0'		1h 1m 15° 15'		1h 2m 15° 30'		1h 3m 15° 45'		1h 4m 16° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.23140	.01704	8.24567	.01761	8.25971	.01818	8.27352	.01877	8.28711	.01937	60
1	.23164	.01705	.24591	.01762	.25994	.01819	.27375	.01878	.28734	.01938	59
2	.23188	.01706	.24614	.01763	.26017	.01820	.27398	.01879	.28756	.01939	58
3	.23212	.01707	.24638	.01764	.26040	.01821	.27420	.01880	.28779	.01940	57
+ 1'	8.23235	.01707	8.24661	.01764	8.26064	.01822	8.27443	.01881	8.28801	.01941	56
5	.23259	.01708	.24685	.01765	.26087	.01823	.27466	.01882	.28823	.01942	55
6	.23283	.01709	.24708	.01766	.26110	.01824	.27489	.01883	.28846	.01943	54
7	.23307	.01710	.24732	.01767	.26133	.01825	.27512	.01884	.28868	.01944	53
+ 2'	8.23331	.01711	8.24755	.01768	8.26156	.01826	8.27534	.01885	8.28891	.01945	52
9	.23355	.01712	.24779	.01769	.26179	.01827	.27557	.01886	.28913	.01946	51
10	.23379	.01713	.24803	.01770	.26203	.01828	.27580	.01887	.28936	.01947	50
11	.23403	.01714	.24826	.01771	.26226	.01829	.27603	.01888	.28958	.01948	49
+ 3'	8.23427	.01715	8.24850	.01772	8.26249	.01830	8.27626	.01889	8.28980	.01949	48
13	.23451	.01716	.24873	.01773	.26272	.01831	.27648	.01890	.29003	.01950	47
14	.23475	.01717	.24897	.01774	.26295	.01832	.27671	.01891	.29025	.01951	46
15	.23499	.01718	.24920	.01775	.26318	.01833	.27694	.01892	.29048	.01952	45
+ 4'	8.23523	.01719	8.24944	.01776	8.26341	.01834	8.27717	.01893	8.29070	.01953	44
17	.23546	.01720	.24967	.01777	.26364	.01835	.27739	.01894	.29092	.01954	43
18	.23570	.01721	.24991	.01778	.26388	.01836	.27762	.01895	.29115	.01955	42
19	.23594	.01722	.25014	.01779	.26411	.01837	.27785	.01896	.29137	.01956	41
+ 5'	8.23618	.01723	8.25037	.01780	8.26434	.01838	8.27807	.01897	8.29159	.01957	40
21	.23642	.01724	.25061	.01781	.26457	.01839	.27830	.01898	.29182	.01958	39
22	.23666	.01724	.25084	.01782	.26480	.01840	.27853	.01899	.29204	.01959	38
23	.23690	.01725	.25108	.01783	.26503	.01841	.27876	.01900	.29226	.01960	37
+ 6'	8.23713	.01726	8.25131	.01784	8.26526	.01842	8.27898	.01901	8.29249	.01961	36
25	.23737	.01727	.25155	.01785	.26549	.01843	.27921	.01902	.29271	.01962	35
26	.23761	.01728	.25178	.01786	.26572	.01844	.27944	.01903	.29293	.01963	34
27	.23785	.01729	.25202	.01787	.26595	.01845	.27966	.01904	.29316	.01964	33
+ 7'	8.23809	.01730	8.25225	.01788	8.26618	.01846	8.27989	.01905	8.29338	.01965	32
29	.23832	.01731	.25248	.01789	.26641	.01847	.28012	.01906	.29360	.01966	31
30	.23856	.01732	.25272	.01789	.26664	.01848	.28034	.01907	.29383	.01967	30
31	.23880	.01733	.25295	.01790	.26687	.01849	.28057	.01908	.29405	.01968	29
+ 8'	8.23904	.01734	8.25319	.01791	8.26710	.01850	8.28080	.01909	8.29427	.01969	28
33	.23928	.01735	.25342	.01792	.26733	.01851	.28102	.01910	.29449	.01970	27
34	.23951	.01736	.25365	.01793	.26756	.01852	.28125	.01911	.29472	.01971	26
35	.23975	.01737	.25389	.01794	.26779	.01853	.28147	.01912	.29494	.01972	25
+ 9'	8.23999	.01738	8.25412	.01795	8.26802	.01854	8.28170	.01913	8.29516	.01973	24
37	.24022	.01739	.25435	.01796	.26825	.01855	.28193	.01914	.29539	.01974	23
38	.24046	.01740	.25459	.01797	.26848	.01856	.28215	.01915	.29561	.01975	22
39	.24070	.01741	.25482	.01798	.26871	.01857	.28238	.01916	.29583	.01976	21
+ 10'	8.24094	.01742	8.25505	.01799	8.26894	.01858	8.28260	.01917	8.29605	.01977	20
41	.24118	.01743	.25529	.01800	.26917	.01859	.28283	.01918	.29628	.01978	19
42	.24141	.01743	.25552	.01801	.26940	.01860	.28306	.01919	.29650	.01979	18
43	.24165	.01744	.25575	.01802	.26963	.01861	.28328	.01920	.29672	.01980	17
+ 11'	8.24189	.01745	8.25599	.01803	8.26986	.01861	8.28351	.01921	8.29694	.01981	16
45	.24212	.01746	.25622	.01804	.27009	.01862	.28373	.01922	.29716	.01982	15
46	.24236	.01747	.25645	.01805	.27032	.01863	.28396	.01923	.29739	.01983	14
47	.24260	.01748	.25669	.01806	.27055	.01864	.28418	.01924	.29761	.01984	13
+ 12'	8.24283	.01749	8.25692	.01807	8.27078	.01865	8.28441	.01925	8.29783	.01985	12
49	.24307	.01750	.25715	.01808	.27100	.01866	.28464	.01926	.29805	.01986	11
50	.24331	.01751	.25738	.01809	.27123	.01867	.28486	.01927	.29827	.01987	10
51	.24354	.01752	.25762	.01810	.27146	.01868	.28509	.01928	.29850	.01988	9
+ 13'	8.24378	.01753	8.25785	.01811	8.27169	.01869	8.28531	.01929	8.29872	.01989	8
53	.24402	.01754	.25808	.01812	.27192	.01870	.28554	.01930	.29894	.01990	7
54	.24425	.01755	.25831	.01813	.27215	.01871	.28576	.01931	.29916	.01991	6
55	.24449	.01756	.25855	.01814	.27238	.01872	.28599	.01932	.29938	.01992	5
+ 14'	8.24473	.01757	8.25878	.01815	8.27261	.01873	8.28621	.01933	8.29960	.01993	4
57	.24496	.01758	.25901	.01816	.27283	.01874	.28644	.01934	.29982	.01994	3
58	.24520	.01759	.25924	.01817	.27306	.01875	.28666	.01935	.30005	.01995	2
59	.24543	.01760	.25948	.01818	.27329	.01876	.28689	.01936	.30027	.01997	1
+ 15'	8.24567	.01761	8.25971	.01818	8.27352	.01877	8.28711	.01937	8.30049	.01998	0

22h 59m

22h 58m

22h 57m

22h 56m

22h 55m

TABLE IV.

Haversines.

s	1h 5m 16° 15'		1h 6m 16° 30'		1h 7m 16° 45'		1h 8m 17° 0'		1h 9m 17° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.30049	.01998	8.31366	.02059	8.32663	.02121	8.33940	.02185	8.35199	.02249	60
1	.30071	.01999	.31388	.02060	.32684	.02122	.33962	.02186	.35220	.02250	59
2	.30093	.02000	.31410	.02061	.32706	.02123	.33983	.02187	.35241	.02251	58
3	.30115	.02001	.31431	.02062	.32727	.02125	.34004	.02188	.35261	.02252	57
+ 1'	8.30137	.02002	8.31453	.02063	8.32749	.02126	8.34025	.02189	8.35282	.02253	56
5	.30159	.02003	.31475	.02064	.32770	.02127	.34046	.02190	.35303	.02254	55
6	.30182	.02004	.31497	.02065	.32792	.02128	.34067	.02191	.35324	.02255	54
7	.30204	.02005	.31518	.02066	.32813	.02129	.34088	.02192	.35345	.02257	53
+ 2'	8.30226	.02006	8.31540	.02067	8.32834	.02130	8.34109	.02193	8.35365	.02258	52
9	.30248	.02007	.31562	.02068	.32856	.02131	.34130	.02194	.35386	.02259	51
10	.30270	.02008	.31584	.02069	.32877	.02132	.34152	.02195	.35407	.02260	50
11	.30292	.02009	.31605	.02070	.32899	.02133	.34173	.02196	.35428	.02261	49
+ 3'	8.30314	.02010	8.31627	.02071	8.32920	.02134	8.34194	.02198	8.35449	.02262	48
13	.30336	.02011	.31649	.02072	.32941	.02135	.34215	.02199	.35469	.02263	47
14	.30358	.02012	.31670	.02073	.32963	.02136	.34236	.02200	.35490	.02264	46
15	.30380	.02013	.31692	.02075	.32984	.02137	.34257	.02201	.35511	.02265	45
+ 4'	8.30402	.02014	8.31714	.02076	8.33006	.02138	8.34278	.02202	8.35532	.02266	44
17	.30424	.02015	.31735	.02077	.33027	.02139	.34299	.02203	.35552	.02267	43
18	.30446	.02016	.31757	.02078	.33048	.02140	.34320	.02204	.35573	.02268	42
19	.30468	.02017	.31779	.02079	.33070	.02141	.34341	.02205	.35594	.02270	41
+ 5'	8.30490	.02018	8.31800	.02080	8.33091	.02142	8.34362	.02206	8.35614	.02271	40
21	.30512	.02019	.31822	.02081	.33112	.02143	.34383	.02207	.35635	.02272	39
22	.30534	.02020	.31844	.02082	.33134	.02145	.34404	.02208	.35656	.02273	38
23	.30556	.02021	.31865	.02083	.33155	.02146	.34425	.02209	.35677	.02274	37
+ 6'	8.30578	.02022	8.31887	.02084	8.33176	.02147	8.34446	.02210	8.35697	.02275	36
25	.30600	.02023	.31909	.02085	.33198	.02148	.34467	.02211	.35718	.02276	35
26	.30622	.02024	.31930	.02086	.33219	.02149	.34488	.02212	.35739	.02277	34
27	.30644	.02025	.31952	.02087	.33240	.02150	.34509	.02214	.35759	.02278	33
+ 7'	8.30666	.02026	8.31974	.02088	8.33262	.02151	8.34530	.02215	8.35780	.02279	32
29	.30688	.02027	.31995	.02089	.33283	.02152	.34551	.02216	.35801	.02280	31
30	.30710	.02028	.32017	.02090	.33304	.02153	.34572	.02217	.35821	.02281	30
31	.30732	.02029	.32039	.02091	.33325	.02154	.34593	.02218	.35842	.02283	29
+ 8'	8.30754	.02030	8.32060	.02092	8.33347	.02155	8.34614	.02219	8.35863	.02284	28
33	.30776	.02031	.32082	.02093	.33368	.02156	.34635	.02220	.35883	.02285	27
34	.30798	.02032	.32103	.02094	.33389	.02157	.34656	.02221	.35904	.02286	26
35	.30820	.02033	.32125	.02095	.33411	.02158	.34677	.02222	.35925	.02287	25
+ 9'	8.30842	.02034	8.32147	.02096	8.33432	.02159	8.34698	.02223	8.35945	.02288	24
27	.30863	.02035	.32168	.02097	.33453	.02160	.34719	.02224	.35966	.02289	23
38	.30885	.02036	.32190	.02098	.33474	.02161	.34740	.02225	.35987	.02290	22
39	.30907	.02037	.32211	.02099	.33496	.02162	.34761	.02226	.36007	.02291	21
+ 10'	8.30929	.02038	8.32233	.02101	8.33517	.02164	8.34782	.02227	8.36028	.02292	20
41	.30951	.02039	.32254	.02102	.33538	.02165	.34803	.02229	.36048	.02293	19
42	.30973	.02040	.32276	.02103	.33559	.02166	.34823	.02230	.36069	.02295	18
43	.30995	.02042	.32297	.02104	.33580	.02167	.34844	.02231	.36090	.02296	17
+ 11'	8.31017	.02043	8.32319	.02105	8.33602	.02168	8.34865	.02232	8.36110	.02297	16
45	.31039	.02044	.32341	.02106	.33623	.02169	.34886	.02233	.36131	.02298	15
46	.31060	.02045	.32362	.02107	.33644	.02170	.34907	.02234	.36151	.02299	14
47	.31082	.02046	.32384	.02108	.33665	.02171	.34928	.02235	.36172	.02300	13
+ 12'	8.31104	.02047	8.32405	.02109	8.33686	.02172	8.34949	.02236	8.36193	.02301	12
49	.31126	.02048	.32427	.02110	.33708	.02173	.34970	.02237	.36213	.02302	11
50	.31148	.02049	.32448	.02111	.33729	.02174	.34991	.02238	.36234	.02303	10
51	.31170	.02050	.32470	.02112	.33750	.02175	.35011	.02239	.36254	.02304	9
+ 13'	8.31192	.02051	8.32491	.02113	8.33771	.02176	8.35032	.02240	8.36275	.02305	8
53	.31213	.02052	.32513	.02114	.33792	.02177	.35053	.02241	.36295	.02307	7
54	.31235	.02053	.32534	.02115	.33814	.02178	.35074	.02243	.36316	.02308	6
55	.31257	.02054	.32556	.02116	.33835	.02179	.35095	.02244	.36337	.02309	5
+ 14'	8.31279	.02055	8.32577	.02117	8.33856	.02181	8.35116	.02245	8.36357	.02310	4
57	.31301	.02056	.32599	.02118	.33877	.02182	.35137	.02246	.36378	.02311	3
58	.31322	.02057	.32620	.02119	.33898	.02183	.35157	.02247	.36398	.02312	2
59	.31344	.02058	.32642	.02120	.33919	.02184	.35178	.02248	.36419	.02313	1
+ 15'	8.31366	.02059	8.32663	.02121	8.33940	.02185	8.35199	.02249	8.36439	.02314	0
	22h 54m		22h 53m		22h 52m		22h 51m		22h 50m		



TABLE IV.

Haversines.

s	1h 10m 17 30'		1h 11m 17° 45'		1h 12m 18° 0'		1h 13m 18° 15'		1h 14m 18° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.36439	.02314	8.37662	.02330	8.38867	.02447	8.40055	.02515	8.41226	.02584	60
1	.36460	.02315	.37682	.02331	.38886	.02448	.40074	.02516	.41246	.02585	59
2	.36480	.02316	.37702	.02332	.38906	.02449	.40094	.02517	.41265	.02586	58
3	.36501	.02317	.37722	.02334	.38926	.02451	.40114	.02518	.41284	.02587	57
+ 1'	8.36521	.02319	8.37742	.02335	8.38946	.02452	8.40133	.02520	8.41304	.02588	56
5	.36542	.02320	.37763	.02336	.38966	.02453	.40153	.02521	.41323	.02590	55
6	.36562	.02321	.37783	.02337	.38986	.02454	.40172	.02522	.41343	.02591	54
7	.36583	.02322	.37803	.02338	.39006	.02455	.40192	.02523	.41362	.02592	53
+ 2'	8.36603	.02323	8.37823	.02339	8.39026	.02456	8.40212	.02524	8.41381	.02593	52
9	.36624	.02324	.37843	.02390	.39046	.02457	.40231	.02525	.41401	.02594	51
10	.36644	.02325	.37864	.02391	.39066	.02458	.40251	.02526	.41420	.02595	50
11	.36665	.02326	.37884	.02392	.39086	.02460	.40271	.02528	.41439	.02597	49
+ 3'	8.36685	.02327	8.37904	.02394	8.39105	.02461	8.40290	.02529	8.41459	.02598	48
13	.36706	.02328	.37924	.02395	.39125	.02462	.40310	.02530	.41478	.02599	47
14	.36726	.02329	.37944	.02396	.39145	.02463	.40329	.02531	.41497	.02600	46
15	.36746	.02331	.37964	.02397	.39165	.02464	.40349	.02532	.41517	.02601	45
+ 4'	8.36767	.02332	8.37985	.02398	8.39185	.02465	8.40369	.02533	8.41536	.02602	44
17	.36787	.02333	.38005	.02399	.39205	.02466	.40388	.02534	.41555	.02603	43
18	.36808	.02334	.38025	.02400	.39225	.02467	.40408	.02536	.41575	.02605	42
19	.36828	.02335	.38045	.02401	.39245	.02469	.40427	.02537	.41594	.02606	41
+ 5'	8.36849	.02336	8.38065	.02402	8.39264	.02470	8.40447	.02538	8.41613	.02607	40
21	.36869	.02337	.38085	.02404	.39284	.02471	.40467	.02539	.41632	.02608	39
22	.36889	.02338	.38105	.02405	.39304	.02472	.40486	.02540	.41652	.02609	38
23	.36910	.02339	.38126	.02406	.39324	.02473	.40506	.02541	.41671	.02610	37
+ 6'	8.36930	.02340	8.38146	.02407	8.39344	.02474	8.40525	.02542	8.41690	.02612	36
25	.36951	.02342	.38166	.02408	.39364	.02475	.40545	.02544	.41710	.02613	35
26	.36971	.02343	.38186	.02409	.39384	.02476	.40564	.02545	.41729	.02614	34
27	.36991	.02344	.38206	.02410	.39403	.02478	.40584	.02546	.41748	.02615	33
+ 7'	8.37012	.02345	8.38226	.02411	8.39423	.02479	8.40603	.02547	8.41767	.02616	32
29	.37032	.02346	.38246	.02412	.39443	.02480	.40623	.02548	.41787	.02617	31
30	.37053	.02347	.38266	.02414	.39463	.02481	.40642	.02549	.41806	.02619	30
31	.37073	.02348	.38286	.02415	.39482	.02482	.40662	.02550	.41825	.02620	29
+ 8'	8.37093	.02349	8.38306	.02416	8.39502	.02483	8.40681	.02552	8.41845	.02621	28
33	.37114	.02350	.38326	.02417	.39522	.02484	.40701	.02553	.41864	.02622	27
34	.37134	.02351	.38346	.02418	.39542	.02486	.40721	.02554	.41883	.02623	26
35	.37154	.02353	.38367	.02419	.39562	.02487	.40740	.02555	.41902	.02624	25
+ 9'	8.37175	.02354	8.38387	.02420	8.39581	.02488	8.40760	.02556	8.41921	.02626	24
37	.37195	.02355	.38407	.02421	.39601	.02489	.40779	.02557	.41941	.02627	23
38	.37215	.02356	.38427	.02423	.39621	.02490	.40799	.02559	.41960	.02628	22
39	.37236	.02357	.38447	.02424	.39641	.02491	.40818	.02560	.41979	.02629	21
+ 10'	8.37256	.02358	8.38467	.02425	8.39660	.02492	8.40837	.02561	8.41998	.02630	20
41	.37276	.02359	.38487	.02426	.39680	.02493	.40857	.02562	.42018	.02631	19
42	.37297	.02360	.38507	.02427	.39700	.02495	.40876	.02563	.42037	.02633	18
43	.37317	.02361	.38527	.02428	.39720	.02496	.40896	.02564	.42056	.02634	17
+ 11'	8.37337	.02363	8.38547	.02429	8.39739	.02497	8.40915	.02565	8.42075	.02635	16
45	.37358	.02364	.38567	.02430	.39759	.02498	.40935	.02567	.42095	.02636	15
46	.37378	.02365	.38587	.02431	.39779	.02499	.40954	.02568	.42114	.02637	14
47	.37398	.02366	.38607	.02433	.39799	.02500	.40974	.02569	.42133	.02638	13
+ 12'	8.37419	.02367	8.38627	.02434	8.39818	.02501	8.40993	.02570	8.42152	.02639	12
49	.37439	.02368	.38647	.02435	.39838	.02503	.41013	.02571	.42171	.02641	11
50	.37459	.02369	.38667	.02436	.39858	.02504	.41032	.02572	.42190	.02642	10
51	.37479	.02370	.38687	.02437	.39877	.02505	.41052	.02573	.42210	.02643	9
+ 13'	8.37500	.02371	8.38707	.02438	8.39897	.02506	8.41071	.02575	8.42229	.02644	8
53	.37520	.02372	.38727	.02439	.39917	.02507	.41090	.02576	.42248	.02645	7
54	.37540	.02374	.38747	.02440	.39937	.02508	.41110	.02577	.42267	.02646	6
55	.37560	.02375	.38767	.02442	.39956	.02509	.41129	.02578	.42286	.02648	5
+ 14'	8.37581	.02376	8.38787	.02443	8.39976	.02510	8.41149	.02579	8.42305	.02649	4
57	.37601	.02377	.38807	.02444	.39996	.02512	.41168	.02580	.42324	.02650	3
58	.37621	.02378	.38827	.02445	.40015	.02513	.41187	.02582	.42344	.02651	2
59	.37641	.02379	.38847	.02446	.40035	.02514	.41207	.02583	.42363	.02652	1
+ 15'	8.37662	.02380	8.38867	.02447	8.40055	.02515	8.41226	.02584	8.42382	.02653	0
	22h 49m		22h 48m		22h 47m		22h 46m		22h 45m		

TABLE IV.

Haversines.

s	1h 15m 18° 45'		1h 16m 19° 0'		1h 17m 19° 15'		1h 18m 19° 30'		1h 19m 19° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.42382	.02653	8.43522	.02724	8.44647	.02796	8.45757	.02868	8.46852	.02941	60
1	.42401	.02655	.43541	.02725	.44665	.02797	.45775	.02869	.46871	.02942	59
2	.42420	.02656	.43560	.02726	.44684	.02798	.45794	.02870	.46889	.02943	58
3	.42439	.02657	.43578	.02728	.44703	.02799	.45812	.02871	.46907	.02945	57
+ 1'	8.42458	.02658	8.43597	.02729	8.44721	.02800	8.45830	.02873	8.46925	.02946	56
5	.42477	.02659	.43616	.02730	.44740	.02802	.45849	.02874	.46943	.02947	55
6	.42497	.02661	.43635	.02731	.44758	.02803	.45867	.02875	.46961	.02949	54
7	.42516	.02662	.43654	.02732	.44777	.02804	.45885	.02876	.46979	.02950	53
+ 2'	8.42535	.02663	8.43673	.02734	8.44796	.02805	8.45904	.02878	8.46998	.02951	52
9	.42554	.02664	.43692	.02735	.44814	.02806	.45922	.02879	.47016	.02952	51
10	.42573	.02665	.43710	.02736	.44833	.02808	.45940	.02880	.47034	.02954	50
11	.42592	.02666	.43729	.02737	.44851	.02809	.45959	.02881	.47052	.02955	49
+ 3'	8.42611	.02668	8.43748	.02738	8.44870	.02810	8.45977	.02883	8.47070	.02956	48
13	.42630	.02669	.43767	.02739	.44889	.02811	.45995	.02884	.47088	.02957	47
14	.42649	.02670	.43786	.02741	.44907	.02812	.46014	.02885	.47106	.02958	46
15	.42668	.02671	.43805	.02742	.44926	.02814	.46032	.02886	.47124	.02960	45
+ 4'	8.42687	.02672	8.43823	.02743	8.44944	.02815	8.46050	.02887	8.47142	.02961	44
17	.42706	.02673	.43842	.02744	.44963	.02816	.46069	.02889	.47160	.02962	43
18	.42725	.02675	.43861	.02745	.44981	.02817	.46087	.02890	.47178	.02963	42
19	.42745	.02676	.43880	.02747	.45000	.02818	.46105	.02891	.47197	.02965	41
+ 5'	8.42764	.02677	8.43899	.02748	8.45018	.02820	8.46124	.02892	8.47215	.02966	40
21	.42783	.02678	.43917	.02749	.45037	.02821	.46142	.02893	.47233	.02967	39
22	.42802	.02679	.43936	.02750	.45055	.02822	.46160	.02895	.47251	.02968	38
23	.42821	.02680	.43955	.02751	.45074	.02823	.46179	.02896	.47269	.02970	37
+ 6'	8.42840	.02682	8.43974	.02753	8.45093	.02824	8.46197	.02897	8.47287	.02971	36
25	.42859	.02683	.43992	.02754	.45111	.02826	.46215	.02898	.47305	.02972	35
26	.42878	.02684	.44011	.02755	.45130	.02827	.46233	.02900	.47323	.02973	34
27	.42897	.02685	.44030	.02756	.45148	.02828	.46252	.02901	.47341	.02974	33
+ 7'	8.42916	.02686	8.44049	.02757	8.45167	.02829	8.46270	.02902	8.47359	.02976	32
29	.42935	.02688	.44067	.02759	.45185	.02830	.46288	.02903	.47377	.02977	31
30	.42954	.02689	.44086	.02760	.45204	.02832	.46306	.02904	.47395	.02978	30
31	.42973	.02690	.44105	.02761	.45222	.02833	.46325	.02906	.47413	.02979	29
+ 8'	8.42992	.02691	8.44124	.02762	8.45241	.02834	8.46343	.02907	8.47431	.02981	28
33	.43011	.02692	.44142	.02763	.45259	.02835	.46361	.02908	.47449	.02982	27
34	.43030	.02693	.44161	.02764	.45278	.02836	.46379	.02909	.47467	.02983	26
35	.43049	.02695	.44180	.02766	.45296	.02838	.46398	.02911	.47485	.02984	25
+ 9'	8.43068	.02696	8.44199	.02767	8.45315	.02839	8.46416	.02912	8.47503	.02986	24
37	.43087	.02697	.44217	.02768	.45333	.02840	.46434	.02913	.47521	.02987	23
38	.43106	.02698	.44236	.02769	.45352	.02841	.46452	.02914	.47539	.02988	22
39	.43125	.02699	.44255	.02771	.45370	.02842	.46471	.02915	.47557	.02989	21
+ 10'	8.43144	.02700	8.44273	.02772	8.45388	.02844	8.46489	.02917	8.47575	.02991	20
41	.43163	.02702	.44292	.02773	.45407	.02845	.46507	.02918	.47593	.02992	19
42	.43181	.02703	.44311	.02774	.45425	.02846	.46525	.02919	.47611	.02993	18
43	.43200	.02704	.44330	.02775	.45444	.02847	.46544	.02920	.47629	.02994	17
+ 11'	8.43219	.02705	8.44348	.02776	8.45462	.02849	8.46562	.02922	8.47647	.02996	16
45	.43238	.02706	.44367	.02778	.45481	.02850	.46580	.02923	.47665	.02997	15
46	.43257	.02708	.44386	.02779	.45499	.02851	.46598	.02924	.47683	.02998	14
47	.43276	.02709	.44404	.02780	.45518	.02852	.46616	.02925	.47701	.02999	13
+ 12'	8.43295	.02710	8.44423	.02781	8.45536	.02853	8.46634	.02926	8.47719	.03000	12
49	.43314	.02711	.44442	.02782	.45554	.02855	.46653	.02928	.47737	.03002	11
50	.43333	.02712	.44460	.02784	.45573	.02856	.46671	.02929	.47755	.03003	10
51	.43352	.02713	.44479	.02785	.45591	.02857	.46689	.02930	.47773	.03004	9
+ 13'	8.43371	.02715	8.44498	.02786	8.45610	.02858	8.46707	.02931	8.47791	.03005	8
53	.43390	.02716	.44516	.02787	.45628	.02859	.46725	.02933	.47809	.03007	7
54	.43409	.02717	.44535	.02788	.45646	.02861	.46744	.02934	.47827	.03008	6
55	.43427	.02718	.44554	.02790	.45665	.02862	.46762	.02935	.47844	.03009	5
+ 14'	8.43446	.02719	8.44572	.02791	8.45683	.02863	8.46780	.02936	8.47862	.03010	4
57	.43465	.02721	.44591	.02792	.45702	.02864	.46798	.02938	.47880	.03012	3
58	.43484	.02722	.44610	.02793	.45720	.02866	.46816	.02939	.47898	.03013	2
59	.43503	.02723	.44628	.02794	.45738	.02867	.46834	.02940	.47916	.03014	1
+ 15'	8.43522	.02724	8.44647	.02796	8.45757	.02868	8.46852	.02941	8.47934	.03015	0
	22h 44m		22h 43m		22h 42m		22h 41m		22h 40m		



TABLE IV.

Haversines.

s	1h 20m 20° 0'		1h 21m 29° 15'		1h 22m 20° 30'		1h 23m 20° 45'		1h 24m 21° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.47934	.03015	8.49002	.03090	8.50056	.03166	8.51098	.03243	8.52127	.03321	60
1	.47952	.03017	.49020	.03092	.50074	.03168	.51115	.03245	.52144	.03323	59
2	.47970	.03018	.49037	.03093	.50091	.03169	.51132	.03246	.52161	.03324	58
3	.47988	.03019	.49055	.03094	.50109	.03170	.51150	.03247	.52178	.03325	57
+ 1'	8.48006	.03020	8.49073	.03095	8.50126	.03171	8.51167	.03248	8.52195	.03326	56
5	.48024	.03022	.49090	.03097	.50144	.03173	.51184	.03250	.52212	.03328	55
6	.48041	.03023	.49108	.03098	.50161	.03174	.51201	.03251	.52229	.03329	54
7	.48059	.03024	.49126	.03099	.50179	.03175	.51219	.03252	.52246	.03330	53
+ 2'	8.48077	.03025	8.49143	.03101	8.50196	.03177	8.51236	.03254	8.52263	.03331	52
9	.48095	.03027	.49161	.03102	.50214	.03178	.51253	.03255	.52280	.03333	51
10	.48113	.03028	.49179	.03103	.50231	.03179	.51270	.03256	.52297	.03334	50
11	.48131	.03029	.49196	.03104	.50248	.03180	.51287	.03257	.52314	.03335	49
+ 3'	8.48149	.03030	8.49214	.03106	8.50266	.03182	8.51305	.03259	8.52331	.03337	48
13	.48167	.03032	.49232	.03107	.50283	.03183	.51322	.03260	.52348	.03338	47
14	.48184	.03033	.49249	.03108	.50301	.03184	.51339	.03261	.52365	.03339	46
15	.48202	.03034	.49267	.03109	.50318	.03186	.51356	.03263	.52382	.03341	45
+ 4'	8.48220	.03035	8.49284	.03111	8.50335	.03187	8.51374	.03264	8.52399	.03342	44
17	.48238	.03037	.49302	.03112	.50353	.03188	.51391	.03265	.52416	.03343	43
18	.48256	.03038	.49320	.03113	.50370	.03189	.51408	.03266	.52433	.03344	42
19	.48274	.03039	.49337	.03114	.50388	.03191	.51425	.03268	.52450	.03346	41
+ 5'	8.48292	.03040	8.49355	.03116	8.50405	.03192	8.51442	.03269	8.52467	.03347	40
21	.48309	.03042	.49373	.03117	.50422	.03193	.51459	.03270	.52484	.03348	39
22	.48327	.03043	.49390	.03118	.50440	.03194	.51477	.03272	.52501	.03350	38
23	.48345	.03044	.49408	.03119	.50457	.03196	.51494	.03273	.52518	.03351	37
+ 6'	8.48363	.03045	8.49425	.03121	8.50475	.03197	8.51511	.03274	8.52535	.03352	36
25	.48381	.03047	.49443	.03122	.50492	.03198	.51528	.03275	.52552	.03354	35
26	.48399	.03048	.49461	.03123	.50509	.03200	.51545	.03277	.52569	.03355	34
27	.48416	.03049	.49478	.03125	.50527	.03201	.51562	.03278	.52585	.03356	33
+ 7'	8.48434	.03050	8.49496	.03126	8.50544	.03202	8.51580	.03279	8.52602	.03358	32
29	.48452	.03052	.49513	.03127	.50561	.03204	.51597	.03281	.52619	.03359	31
30	.48470	.03053	.49531	.03128	.50579	.03205	.51614	.03282	.52636	.03360	30
31	.48488	.03054	.49548	.03130	.50596	.03206	.51631	.03283	.52653	.03361	29
+ 8'	8.48505	.03055	8.49566	.03131	8.50614	.03207	8.51648	.03285	8.52670	.03363	28
33	.48523	.03057	.49584	.03132	.50631	.03209	.51665	.03286	.52687	.03364	27
34	.48541	.03058	.49601	.03133	.50648	.03210	.51682	.03287	.52704	.03365	26
35	.48559	.03059	.49619	.03135	.50666	.03211	.51700	.03288	.52721	.03367	25
+ 9'	8.48576	.03060	8.49636	.03136	8.50683	.03212	8.51717	.03290	8.52738	.03368	24
37	.48594	.03062	.49654	.03137	.50700	.03214	.51734	.03291	.52755	.03369	23
38	.48612	.03063	.49671	.03138	.50718	.03215	.51751	.03292	.52772	.03371	22
39	.48630	.03064	.49689	.03140	.50735	.03216	.51768	.03294	.52789	.03372	21
+ 10'	8.48648	.03065	8.49706	.03141	8.50752	.03218	8.51785	.03295	8.52806	.03373	20
41	.48665	.03067	.49724	.03142	.50770	.03219	.51802	.03296	.52822	.03375	19
42	.48683	.03068	.49742	.03144	.50787	.03220	.51819	.03298	.52839	.03376	18
43	.48701	.03069	.49759	.03145	.50804	.03221	.51836	.03299	.52856	.03377	17
+ 11'	8.48719	.03070	8.49777	.03146	8.50821	.03223	8.51854	.03300	8.52873	.03379	16
45	.48736	.03072	.49794	.03147	.50839	.03224	.51871	.03301	.52890	.03380	15
46	.48754	.03073	.49812	.03149	.50856	.03225	.51888	.03303	.52907	.03381	14
47	.48772	.03074	.49829	.03150	.50873	.03227	.51905	.03304	.52924	.03382	13
+ 12'	8.48789	.03075	8.49847	.03151	8.50891	.03228	8.51922	.03305	8.52941	.03384	12
49	.48807	.03077	.49864	.03152	.50908	.03229	.51939	.03307	.52958	.03385	11
50	.48825	.03078	.49882	.03154	.50925	.03230	.51956	.03308	.52974	.03386	10
51	.48843	.03079	.49899	.03155	.50943	.03232	.51973	.03309	.52991	.03388	9
+ 13'	8.48860	.03080	8.49917	.03156	8.50960	.03233	8.51990	.03311	8.53008	.03389	8
53	.48878	.03082	.49934	.03157	.50977	.03234	.52007	.03312	.53025	.03390	7
54	.48896	.03083	.49952	.03159	.50994	.03236	.52024	.03313	.53042	.03392	6
55	.48914	.03084	.49969	.03160	.51012	.03237	.52041	.03314	.53059	.03393	5
+ 14'	8.48931	.03085	8.49987	.03161	8.51029	.03238	8.52058	.03316	8.53076	.03394	4
57	.48949	.03087	.50004	.03163	.51046	.03239	.52076	.03317	.53092	.03396	3
58	.48967	.03088	.50022	.03164	.51063	.03241	.52093	.03318	.53109	.03397	2
59	.48984	.03089	.50039	.03165	.51081	.03242	.52110	.03320	.53126	.03398	1
+ 15'	8.49002	.03090	8.50056	.03166	8.51098	.03243	8.52127	.03321	8.53143	.03400	0
	22h 39m		22h 38m		22h 37m		22h 36m		22h 35m		

TABLE IV.

Haversines.

s	1h 25m 21° 15'		1h 26m 21° 30'		1h 27m 21° 45'		1h 28m 22° 0'		1h 29m 22° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.53143	<b>.03400</b>	8.54147	<b>.03479</b>	8.55139	<b>.03560</b>	8.56120	<b>.03641</b>	8.57089	<b>.03723</b>	60
1	.53160	<b>.03401</b>	.54164	<b>.03480</b>	.55156	<b>.03561</b>	.56136	<b>.03642</b>	.57105	<b>.03724</b>	59
2	.53177	<b>.03402</b>	.54180	<b>.03482</b>	.55172	<b>.03562</b>	.56152	<b>.03644</b>	.57121	<b>.03726</b>	58
3	.53193	<b>.03404</b>	.54197	<b>.03483</b>	.55189	<b>.03564</b>	.56169	<b>.03645</b>	.57137	<b>.03727</b>	57
+ 1'	8.53210	<b>.03405</b>	8.54214	<b>.03484</b>	8.55205	<b>.03565</b>	8.56185	<b>.03646</b>	8.57153	<b>.03728</b>	56
5	.53227	<b>.03406</b>	.54230	<b>.03486</b>	.55221	<b>.03566</b>	.56201	<b>.03648</b>	.57169	<b>.03730</b>	55
6	.53244	<b>.03408</b>	.54247	<b>.03487</b>	.55238	<b>.03568</b>	.56217	<b>.03649</b>	.57185	<b>.03731</b>	54
7	.53261	<b>.03409</b>	.54263	<b>.03488</b>	.55254	<b>.03569</b>	.56233	<b>.03650</b>	.57201	<b>.03733</b>	53
+ 2'	8.53277	<b>.03410</b>	8.54280	<b>.03490</b>	8.55271	<b>.03570</b>	8.56250	<b>.03652</b>	8.57217	<b>.03734</b>	52
9	.53294	<b>.03411</b>	.54297	<b>.03491</b>	.55287	<b>.03572</b>	.56266	<b>.03653</b>	.57233	<b>.03735</b>	51
10	.53311	<b>.03413</b>	.54313	<b>.03492</b>	.55303	<b>.03573</b>	.56282	<b>.03654</b>	.57250	<b>.03737</b>	50
11	.53328	<b>.03414</b>	.54330	<b>.03494</b>	.55320	<b>.03574</b>	.56298	<b>.03656</b>	.57266	<b>.03738</b>	49
+ 3'	8.53345	<b>.03415</b>	8.54346	<b>.03495</b>	8.55336	<b>.03576</b>	8.56315	<b>.03657</b>	8.57282	<b>.03740</b>	48
13	.53361	<b>.03417</b>	.54363	<b>.03496</b>	.55353	<b>.03577</b>	.56331	<b>.03659</b>	.57298	<b>.03741</b>	47
14	.53378	<b>.03418</b>	.54380	<b>.03498</b>	.55369	<b>.03578</b>	.56347	<b>.03660</b>	.57314	<b>.03742</b>	46
15	.53395	<b>.03419</b>	.54396	<b>.03499</b>	.55385	<b>.03580</b>	.56363	<b>.03661</b>	.57330	<b>.03744</b>	45
+ 4'	8.53412	<b>.03421</b>	8.54413	<b>.03500</b>	8.55402	<b>.03581</b>	8.56379	<b>.03663</b>	8.57346	<b>.03745</b>	44
17	.53429	<b>.03422</b>	.54429	<b>.03502</b>	.55418	<b>.03582</b>	.56396	<b>.03664</b>	.57362	<b>.03746</b>	43
18	.53445	<b>.03423</b>	.54446	<b>.03503</b>	.55435	<b>.03584</b>	.56412	<b>.03665</b>	.57378	<b>.03748</b>	42
19	.53462	<b>.03425</b>	.54462	<b>.03504</b>	.55451	<b>.03585</b>	.56428	<b>.03667</b>	.57394	<b>.03749</b>	41
+ 5'	8.53479	<b>.03426</b>	8.54479	<b>.03506</b>	8.55467	<b>.03587</b>	8.56444	<b>.03668</b>	8.57410	<b>.03751</b>	40
21	.53496	<b>.03427</b>	.54496	<b>.03507</b>	.55484	<b>.03588</b>	.56460	<b>.03669</b>	.57426	<b>.03752</b>	39
22	.53512	<b>.03429</b>	.54512	<b>.03509</b>	.55500	<b>.03589</b>	.56477	<b>.03671</b>	.57442	<b>.03753</b>	38
23	.53529	<b>.03430</b>	.54529	<b>.03510</b>	.55516	<b>.03591</b>	.56493	<b>.03672</b>	.57458	<b>.03755</b>	37
+ 6'	8.53546	<b>.03431</b>	8.54545	<b>.03511</b>	8.55533	<b>.03592</b>	8.56509	<b>.03674</b>	8.57474	<b>.03756</b>	36
25	.53563	<b>.03433</b>	.54562	<b>.03513</b>	.55549	<b>.03593</b>	.56525	<b>.03675</b>	.57490	<b>.03757</b>	35
26	.53580	<b>.03434</b>	.54578	<b>.03514</b>	.55566	<b>.03595</b>	.56541	<b>.03676</b>	.57506	<b>.03759</b>	34
27	.53596	<b>.03435</b>	.54595	<b>.03515</b>	.55582	<b>.03596</b>	.56557	<b>.03678</b>	.57522	<b>.03760</b>	33
+ 7'	8.53613	<b>.03437</b>	8.54612	<b>.03517</b>	8.55598	<b>.03597</b>	8.56574	<b>.03679</b>	8.57538	<b>.03762</b>	32
29	.53630	<b>.03438</b>	.54628	<b>.03518</b>	.55615	<b>.03599</b>	.56590	<b>.03680</b>	.57554	<b>.03763</b>	31
30	.53646	<b>.03439</b>	.54645	<b>.03519</b>	.55631	<b>.03600</b>	.56606	<b>.03682</b>	.57570	<b>.03764</b>	30
31	.53663	<b>.03441</b>	.54661	<b>.03521</b>	.55647	<b>.03601</b>	.56622	<b>.03683</b>	.57585	<b>.03766</b>	29
+ 8'	8.53680	<b>.03442</b>	8.54678	<b>.03522</b>	8.55664	<b>.03603</b>	8.56638	<b>.03685</b>	8.57601	<b>.03767</b>	28
33	.53697	<b>.03443</b>	.54694	<b>.03523</b>	.55680	<b>.03604</b>	.56654	<b>.03686</b>	.57617	<b>.03769</b>	27
34	.53713	<b>.03445</b>	.54711	<b>.03525</b>	.55696	<b>.03605</b>	.56670	<b>.03687</b>	.57633	<b>.03770</b>	26
35	.53730	<b>.03446</b>	.54727	<b>.03526</b>	.55713	<b>.03607</b>	.56687	<b>.03689</b>	.57649	<b>.03771</b>	25
+ 9'	8.53747	<b>.03447</b>	8.54744	<b>.03527</b>	8.55729	<b>.03608</b>	8.56703	<b>.03690</b>	8.57665	<b>.03773</b>	24
37	.53764	<b>.03449</b>	.54760	<b>.03529</b>	.55745	<b>.03610</b>	.56719	<b>.03691</b>	.57681	<b>.03774</b>	23
38	.53780	<b>.03450</b>	.54777	<b>.03530</b>	.55762	<b>.03611</b>	.56735	<b>.03693</b>	.57697	<b>.03775</b>	22
39	.53797	<b>.03451</b>	.54793	<b>.03531</b>	.55778	<b>.03612</b>	.56751	<b>.03694</b>	.57713	<b>.03777</b>	21
+ 10'	8.53814	<b>.03453</b>	8.54810	<b>.03533</b>	8.55794	<b>.03614</b>	8.56767	<b>.03695</b>	8.57729	<b>.03778</b>	20
41	.53830	<b>.03454</b>	.54826	<b>.03534</b>	.55811	<b>.03615</b>	.56783	<b>.03697</b>	.57745	<b>.03780</b>	19
42	.53847	<b>.03455</b>	.54843	<b>.03535</b>	.55827	<b>.03616</b>	.56799	<b>.03698</b>	.57761	<b>.03781</b>	18
43	.53864	<b>.03457</b>	.54859	<b>.03537</b>	.55843	<b>.03618</b>	.56816	<b>.03700</b>	.57777	<b>.03782</b>	17
+ 11'	8.53880	<b>.03458</b>	8.54876	<b>.03538</b>	8.55859	<b>.03619</b>	8.56832	<b>.03701</b>	8.57793	<b>.03784</b>	16
45	.53897	<b>.03459</b>	.54892	<b>.03539</b>	.55876	<b>.03620</b>	.56848	<b>.03702</b>	.57809	<b>.03785</b>	15
46	.53914	<b>.03460</b>	.54909	<b>.03541</b>	.55892	<b>.03622</b>	.56864	<b>.03704</b>	.57825	<b>.03787</b>	14
47	.53930	<b>.03462</b>	.54925	<b>.03542</b>	.55908	<b>.03623</b>	.56880	<b>.03705</b>	.57841	<b>.03788</b>	13
+ 12'	8.53947	<b>.03463</b>	8.54942	<b>.03543</b>	8.55925	<b>.03624</b>	8.56896	<b>.03706</b>	8.57856	<b>.03789</b>	12
49	.53964	<b>.03464</b>	.54958	<b>.03545</b>	.55941	<b>.03626</b>	.56912	<b>.03708</b>	.57872	<b>.03791</b>	11
50	.53980	<b>.03466</b>	.54975	<b>.03546</b>	.55957	<b>.03627</b>	.56928	<b>.03709</b>	.57888	<b>.03792</b>	10
51	.53997	<b>.03467</b>	.54991	<b>.03547</b>	.55973	<b>.03629</b>	.56944	<b>.03711</b>	.57904	<b>.03794</b>	9
+ 13'	8.54014	<b>.03468</b>	8.55008	<b>.03549</b>	8.55990	<b>.03630</b>	8.56960	<b>.03712</b>	8.57920	<b>.03795</b>	8
53	.54030	<b>.03470</b>	.55024	<b>.03550</b>	.56006	<b>.03631</b>	.56977	<b>.03713</b>	.57936	<b>.03796</b>	7
54	.54047	<b>.03471</b>	.55041	<b>.03551</b>	.56022	<b>.03633</b>	.56993	<b>.03715</b>	.57952	<b>.03798</b>	6
55	.54064	<b>.03472</b>	.55057	<b>.03553</b>	.56039	<b>.03634</b>	.57009	<b>.03716</b>	.57968	<b>.03799</b>	5
+ 14'	8.54080	<b>.03474</b>	8.55073	<b>.03554</b>	8.56055	<b>.03635</b>	8.57025	<b>.03717</b>	8.57984	<b>.03800</b>	4
57	.54097	<b>.03475</b>	.55090	<b>.03555</b>	.56071	<b>.03637</b>	.57041	<b>.03719</b>	.58000	<b>.03802</b>	3
58	.54114	<b>.03476</b>	.55106	<b>.03557</b>	.56087	<b>.03638</b>	.57057	<b>.03720</b>	.58015	<b>.03803</b>	2
59	.54130	<b>.03478</b>	.55123	<b>.03558</b>	.56104	<b>.03639</b>	.57073	<b>.03722</b>	.58031	<b>.03805</b>	1
+ 15'	8.54147	<b>.03479</b>	8.55139	<b>.03560</b>	8.56120	<b>.03641</b>	8.57089	<b>.03723</b>	8.58047	<b>.03806</b>	0
	22h 34m		22h 33m		22h 32m		22h 31m		22h 30m		



TABLE IV.  
Haversines.

s	1h 30m 22° 30'		1h 31m 22° 45'		1h 32m 23° 0'		1h 33m 23° 15'		1h 34m 23° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.58047	.03806	8.58994	.03890	8.59931	.03975	8.60857	.04060	8.61773	.04147	60
1	.58063	.03807	.59010	.03891	.59947	.03976	.60873	.04062	.61789	.04148	59
2	.58079	.03809	.59026	.03893	.59962	.03978	.60888	.04063	.61804	.04150	58
3	.58095	.03810	.59042	.03894	.59978	.03979	.60903	.04065	.61819	.04151	57
+ 1'	8.58111	.03812	8.59057	.03896	8.59993	.03980	8.60919	.04066	8.61834	.04153	56
5	.58127	.03813	.59073	.03897	.60009	.03982	.60934	.04068	.61849	.04154	55
6	.58142	.03814	.59089	.03898	.60024	.03983	.60949	.04069	.61864	.04156	54
7	.58158	.03816	.59104	.03900	.60040	.03985	.60965	.04070	.61880	.04157	53
+ 2'	8.58174	.03817	8.59120	.03901	8.60055	.03986	8.60980	.04072	8.61895	.04159	52
9	.58190	.03819	.59136	.03903	.60071	.03988	.60995	.04073	.61910	.04160	51
10	.58206	.03820	.59151	.03904	.60086	.03989	.61011	.04075	.61925	.04162	50
11	.58222	.03821	.59167	.03905	.60102	.03990	.61026	.04076	.61940	.04163	49
+ 3'	8.58238	.03823	8.59183	.03907	8.60117	.03992	8.61041	.04078	8.61955	.04164	48
13	.58253	.03824	.59198	.03908	.60133	.03993	.61057	.04079	.61971	.04166	47
14	.58269	.03826	.59214	.03910	.60148	.03995	.61072	.04081	.61986	.04167	46
15	.58285	.03827	.59230	.03911	.60164	.03996	.61087	.04082	.62001	.04169	45
+ 4'	8.58301	.03828	8.59245	.03912	8.60179	.03998	8.61103	.04083	8.62016	.04170	44
17	.58317	.03830	.59261	.03914	.60195	.03999	.61118	.04085	.62031	.04172	43
18	.58333	.03831	.59277	.03915	.60210	.04000	.61133	.04086	.62046	.04173	42
19	.58348	.03833	.59292	.03917	.60226	.04002	.61149	.04088	.62061	.04175	41
+ 5'	8.58364	.03834	8.59308	.03918	8.60241	.04003	8.61164	.04089	8.62077	.04176	40
21	.58380	.03835	.59323	.03920	.60256	.04005	.61179	.04091	.62092	.04177	39
22	.58396	.03837	.59339	.03921	.60272	.04006	.61194	.04092	.62107	.04179	38
23	.58412	.03838	.59355	.03922	.60287	.04007	.61210	.04094	.62122	.04180	37
+ 6'	8.58427	.03839	8.59370	.03924	8.60303	.04009	8.61225	.04095	8.62137	.04182	36
25	.58443	.03841	.59386	.03925	.60318	.04010	.61240	.04096	.62152	.04183	35
26	.58459	.03842	.59402	.03927	.60334	.04012	.61256	.04098	.62167	.04185	34
27	.58475	.03844	.59417	.03928	.60349	.04013	.61271	.04099	.62182	.04186	33
+ 7'	8.58491	.03845	8.59433	.03929	8.60365	.04015	8.61286	.04101	8.62197	.04188	32
29	.58506	.03846	.59448	.03931	.60380	.04016	.61301	.04102	.62213	.04189	31
30	.58522	.03848	.59464	.03932	.60396	.04017	.61317	.04104	.62228	.04191	30
31	.58538	.03849	.59480	.03934	.60411	.04019	.61332	.04105	.62243	.04192	29
+ 8'	8.58554	.03851	8.59495	.03935	8.60426	.04020	8.61347	.04106	8.62258	.04194	28
33	.58570	.03852	.59511	.03936	.60442	.04022	.61362	.04108	.62273	.04195	27
34	.58585	.03853	.59527	.03938	.60457	.04023	.61378	.04109	.62288	.04196	26
35	.58601	.03855	.59542	.03939	.60473	.04025	.61393	.04111	.62303	.04198	25
+ 9'	8.58617	.03856	8.59558	.03941	8.60488	.04026	8.61408	.04112	8.62318	.04199	24
37	.58633	.03858	.59573	.03942	.60504	.04027	.61423	.04114	.62333	.04201	23
38	.58648	.03859	.59589	.03944	.60519	.04029	.61439	.04115	.62348	.04202	22
39	.58664	.03860	.59604	.03945	.60534	.04030	.61454	.04117	.62363	.04204	21
+ 10'	8.58680	.03862	8.59620	.03946	8.60550	.04032	8.61469	.04118	8.62379	.04205	20
41	.58696	.03863	.59636	.03948	.60565	.04033	.61484	.04119	.62394	.04207	19
42	.58711	.03865	.59651	.03949	.60581	.04035	.61500	.04121	.62409	.04208	18
43	.58727	.03866	.59667	.03951	.60596	.04036	.61515	.04122	.62424	.04210	17
+ 11'	8.58743	.03867	8.59682	.03952	8.60611	.04038	8.61530	.04124	8.62439	.04211	16
45	.58759	.03869	.59698	.03953	.60627	.04039	.61545	.04125	.62454	.04212	15
46	.58774	.03870	.59714	.03955	.60642	.04040	.61561	.04127	.62469	.04214	14
47	.58790	.03872	.59729	.03956	.60658	.04042	.61576	.04128	.62484	.04215	13
+ 12'	8.58806	.03873	8.59745	.03958	8.60673	.04043	8.61591	.04130	8.62499	.04217	12
49	.58822	.03875	.59760	.03959	.60688	.04045	.61606	.04131	.62514	.04218	11
50	.58837	.03876	.59776	.03961	.60704	.04046	.61621	.04133	.62529	.04220	10
51	.58853	.03877	.59791	.03962	.60719	.04048	.61637	.04134	.62544	.04221	9
+ 13'	8.58869	.03879	8.59807	.03963	8.60734	.04049	8.61652	.04135	8.62559	.04223	8
53	.58885	.03880	.59822	.03965	.60750	.04050	.61667	.04137	.62574	.04224	7
54	.58900	.03882	.59838	.03966	.60765	.04052	.61682	.04138	.62589	.04226	6
55	.58916	.03883	.59853	.03968	.60781	.04053	.61697	.04140	.62604	.04227	5
+ 14'	8.58932	.03884	8.59869	.03969	8.60796	.04055	8.61713	.04141	8.62619	.04229	4
57	.58947	.03886	.59885	.03971	.60811	.04056	.61728	.04143	.62634	.04230	3
58	.58963	.03887	.59900	.03972	.60827	.04058	.61743	.04144	.62649	.04232	2
59	.58979	.03889	.59916	.03973	.60842	.04059	.61758	.04146	.62664	.04233	1
+ 15'	8.58994	.03890	8.59931	.03975	8.60857	.04060	8.61773	.04147	8.62680	.04234	0
	22h 29m		22h 28m		22h 27m		22h 26m		22h 25m		

Haversines.

s	1h 35m 23° 45'		1h 36m 24° 0'		1h 37m 24° 15'		1h 38m 24° 30'		1h 39m 24° 45'		s			
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.				
0	8.62680	.04234	8.63576	.04323	8.64463	.04412	8.65340	.04502	8.66208	.04593	60			
1	.62695	.04236	.63591	.04324	.64477	.04413	.65355	.04503	.66223	.04594	59			
2	.62710	.04237	.63606	.04326	.64492	.04415	.65369	.04505	.66237	.04596	58			
3	.62725	.04239	.63620	.04327	.64507	.04416	.65384	.04506	.66251	.04597	57			
+ 1'	8.62740	.04240	8.63635	.04329	8.64521	.04418	8.65398	.04508	8.66266	.04599	56			
5	.62755	.04242	.63650	.04330	.64536	.04419	.65413	.04509	.66280	.04600	55			
6	.62770	.04243	.63665	.04332	.64551	.04421	.65427	.04511	.66295	.04602	54			
7	.62785	.04245	.63680	.04333	.64565	.04422	.65442	.04512	.66309	.04604	53			
+ 2'	8.62800	.04246	8.63695	.04335	8.64580	.04424	8.65456	.04514	8.66323	.04605	52			
9	.62815	.04248	.63709	.04336	.64595	.04425	.65471	.04516	.66338	.04607	51			
10	.62830	.04249	.63724	.04338	.64609	.04427	.65485	.04517	.66352	.04608	50			
11	.62845	.04251	.63739	.04339	.64624	.04428	.65500	.04519	.66366	.04610	49			
+ 3'	8.62860	.04252	8.63754	.04340	8.64639	.04430	8.65514	.04520	8.66381	.04611	48			
13	.62875	.04253	.63769	.04342	.64653	.04431	.65529	.04522	.66395	.04613	47			
14	.62890	.04255	.63784	.04343	.64668	.04433	.65543	.04523	.66409	.04614	46			
15	.62904	.04256	.63798	.04345	.64683	.04434	.65558	.04525	.66424	.04616	45			
+ 4'	8.62919	.04258	8.63813	.04346	8.64697	.04436	8.65572	.04526	8.66438	.04617	44			
17	.62934	.04259	.63828	.04348	.64712	.04437	.65587	.04528	.66453	.04619	43			
18	.62949	.04261	.63843	.04349	.64727	.04439	.65601	.04529	.66467	.04620	42			
19	.62964	.04262	.63858	.04351	.64741	.04440	.65616	.04531	.66481	.04622	41			
+ 5'	8.62979	.04264	8.63872	.04352	8.64756	.04442	8.65630	.04532	8.66496	.04623	40			
21	.62994	.04265	.63887	.04354	.64771	.04443	.65645	.04534	.66510	.04625	39			
22	.63009	.04267	.63902	.04355	.64785	.04445	.65659	.04535	.66524	.04626	38			
23	.63024	.04268	.63917	.04357	.64800	.04446	.65674	.04537	.66539	.04628	37			
+ 6'	8.63039	.04270	8.63932	.04358	8.64815	.04448	8.65688	.04538	8.66553	.04629	36			
25	.63054	.04271	.63946	.04360	.64829	.04449	.65703	.04540	.66567	.04631	35			
26	.63069	.04273	.63961	.04361	.64844	.04451	.65717	.04541	.66582	.04633	34			
27	.63084	.04274	.63976	.04363	.64859	.04452	.65732	.04543	.66596	.04634	33			
+ 7'	8.63099	.04276	8.63991	.04364	8.64873	.04454	8.65746	.04544	8.66610	.04636	32			
29	.63114	.04277	.64006	.04366	.64888	.04455	.65761	.04546	.66625	.04637	31			
30	.63129	.04278	.64020	.04367	.64902	.04457	.65775	.04547	.66639	.04639	30			
31	.63144	.04280	.64035	.04369	.64917	.04458	.65790	.04549	.66653	.04640	29			
+ 8'	8.63159	.04281	8.64050	.04370	8.64932	.04460	8.65804	.04550	8.66668	.04642	28			
33	.63174	.04283	.64065	.04372	.64946	.04461	.65819	.04552	.66682	.04643	27			
34	.63189	.04284	.64079	.04373	.64961	.04463	.65833	.04553	.66696	.04645	26			
35	.63204	.04286	.64094	.04375	.64976	.04464	.65848	.04555	.66710	.04646	25			
+ 9'	8.63218	.04287	8.64109	.04376	8.64990	.04466	8.65862	.04556	8.66725	.04648	24			
37	.63233	.04289	.64124	.04378	.65005	.04467	.65876	.04558	.66739	.04649	23			
38	.63248	.04290	.64139	.04379	.65019	.04469	.65891	.04559	.66753	.04651	22			
39	.63263	.04292	.64153	.04381	.65034	.04470	.65905	.04561	.66768	.04652	21			
+ 10'	8.63278	.04293	8.64168	.04382	8.65049	.04472	8.65920	.04562	8.66782	.04654	20			
41	.63293	.04295	.64183	.04384	.65063	.04473	.65934	.04564	.66796	.04655	19			
42	.63308	.04296	.64198	.04385	.65078	.04475	.65949	.04565	.66811	.04657	18			
43	.63323	.04298	.64212	.04387	.65092	.04476	.65963	.04567	.66825	.04659	17			
+ 11'	8.63338	.04299	8.64227	.04388	8.65107	.04478	8.65978	.04569	8.66839	.04660	16			
45	.63353	.04301	.64242	.04390	.65122	.04479	.65992	.04570	.66853	.04662	15			
46	.63368	.04302	.64257	.04391	.65136	.04481	.66006	.04572	.66868	.04663	14			
47	.63382	.04304	.64271	.04393	.65151	.04482	.66021	.04573	.66882	.04665	13			
+ 12'	8.63397	.04305	8.64286	.04394	8.65165	.04484	8.66035	.04575	8.66896	.04666	12			
49	.63412	.04306	.64301	.04395	.65180	.04485	.66050	.04576	.66911	.04668	11			
50	.63427	.04308	.64315	.04397	.65194	.04487	.66064	.04578	.66925	.04669	10			
51	.63442	.04309	.64330	.04398	.65209	.04488	.66079	.04579	.66939	.04671	9			
+ 13'	8.63457	.04311	8.64345	.04400	8.65224	.04490	8.66093	.04581	8.66953	.04672	8			
53	.63472	.04312	.64360	.04401	.65238	.04491	.66107	.04582	.66968	.04674	7			
54	.63487	.04314	.64374	.04403	.65253	.04493	.66122	.04584	.66982	.04675	6			
55	.63502	.04315	.64389	.04404	.65267	.04494	.66136	.04585	.66996	.04677	5			
+ 14'	8.63516	.04317	8.64404	.04405	8.65282	.04496	8.66151	.04587	8.67010	.04678	4			
57	.63531	.04318	.64418	.04407	.65296	.04497	.66165	.04588	.67025	.04680	3			
58	.63546	.04320	.64433	.04409	.65311	.04499	.66179	.04590	.67039	.04682	2			
59	.63561	.04321	.64448	.04410	.65325	.04500	.66194	.04591	.67053	.04683	1			
+ 15'	8.63576	.04323	8.64463	.04412	8.65340	.04502	8.66208	.04593	8.67067	.04685	0			
		22h 24m			22h 23m			22h 22m			22h 21m			22h 20m



Haversines.

s	1h 40m 25° 0'		1h 41m 25° 15'		1h 42m 25° 30'		1h 43m 25° 45'		1h 44m 26° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.67067	.04685	8.67918	.04777	8.68760	.04871	8.69593	.04965	8.70418	.05060	60
1	.67082	.04686	.67932	.04779	.68773	.04872	.69607	.04967	.70431	.05062	59
2	.67096	.04688	.67946	.04780	.68787	.04874	.69620	.04968	.70445	.05063	58
3	.67110	.04689	.67960	.04782	.68801	.04875	.69634	.04970	.70459	.05065	57
+ 1'	8.67124	.04691	8.67974	.04783	8.68815	.04877	8.69648	.04971	8.70472	.05067	56
5	.67139	.04692	.67988	.04785	.68829	.04879	.69662	.04973	.70486	.05068	55
6	.67153	.04694	.68002	.04787	.68843	.04880	.69676	.04975	.70500	.05070	54
7	.67167	.04695	.68016	.04788	.68857	.04882	.69690	.04976	.70513	.05071	53
+ 2'	8.67181	.04697	8.68030	.04790	8.68871	.04883	8.69703	.04978	8.70527	.05073	52
9	.67196	.04698	.68045	.04791	.68885	.04885	.69717	.04979	.70541	.05075	51
10	.67210	.04700	.68059	.04793	.68899	.04886	.69731	.04981	.70554	.05076	50
11	.67224	.04702	.68073	.04794	.68913	.04888	.69745	.04982	.70568	.05078	49
+ 3'	8.67238	.04703	8.68087	.04796	8.68927	.04890	8.69758	.04984	8.70582	.05079	48
13	.67252	.04705	.68101	.04797	.68941	.04891	.69772	.04986	.70595	.05081	47
14	.67267	.04706	.68115	.04799	.68955	.04893	.69786	.04987	.70609	.05083	46
15	.67281	.04708	.68129	.04801	.68969	.04894	.69800	.04989	.70623	.05084	45
+ 4'	8.67295	.04709	8.68143	.04802	8.68983	.04896	8.69814	.04990	8.70636	.05086	44
17	.67309	.04711	.68157	.04804	.68996	.04897	.69827	.04992	.70650	.05087	43
18	.67323	.04712	.68171	.04805	.69010	.04899	.69841	.04994	.70664	.05089	42
19	.67338	.04714	.68185	.04807	.69024	.04901	.69855	.04995	.70677	.05091	41
+ 5'	8.67352	.04715	8.68199	.04808	8.69038	.04902	8.69869	.04997	8.70691	.05092	40
21	.67366	.04717	.68213	.04810	.69052	.04904	.69882	.04998	.70704	.05094	39
22	.67380	.04718	.68227	.04811	.69066	.04905	.69896	.05000	.70718	.05095	38
23	.67394	.04720	.68241	.04813	.69080	.04907	.69910	.05001	.70732	.05097	37
+ 6'	8.67409	.04722	8.68256	.04815	8.69094	.04908	8.69924	.05003	8.70745	.05099	36
25	.67423	.04723	.68270	.04816	.69108	.04910	.69937	.05005	.70759	.05100	35
26	.67437	.04725	.68284	.04818	.69122	.04912	.69951	.05006	.70773	.05102	34
27	.67451	.04726	.68298	.04819	.69136	.04913	.69965	.05008	.70786	.05104	33
+ 7'	8.67465	.04728	8.68312	.04821	8.69149	.04915	8.69979	.05009	8.70800	.05105	32
29	.67480	.04729	.68326	.04822	.69163	.04916	.69992	.05011	.70813	.05107	31
30	.67494	.04731	.68340	.04824	.69177	.04918	.70006	.05013	.70827	.05108	30
31	.67508	.04732	.68354	.04825	.69191	.04919	.70020	.05014	.70841	.05110	29
+ 8'	8.67522	.04734	8.68368	.04827	8.69205	.04921	8.70034	.05016	8.70854	.05111	28
33	.67536	.04735	.68382	.04829	.69219	.04923	.70047	.05017	.70868	.05113	27
34	.67550	.04737	.68396	.04830	.69233	.04924	.70061	.05019	.70881	.05115	26
35	.67565	.04739	.68410	.04832	.69247	.04926	.70075	.05021	.70895	.05116	25
+ 9'	8.67579	.04740	8.68424	.04833	8.69260	.04927	8.70089	.05022	8.70909	.05118	24
37	.67593	.04742	.68438	.04835	.69274	.04929	.70102	.05024	.70922	.05119	23
38	.67607	.04743	.68452	.04836	.69288	.04930	.70116	.05025	.70936	.05121	22
39	.67621	.04745	.68466	.04838	.69302	.04932	.70130	.05027	.70949	.05123	21
+ 10'	8.67635	.04746	8.68480	.04839	8.69316	.04934	8.70144	.05028	8.70963	.05124	20
41	.67649	.04748	.68494	.04841	.69330	.04935	.70157	.05030	.70977	.05126	19
42	.67664	.04749	.68508	.04843	.69344	.04937	.70171	.05032	.70990	.05127	18
43	.67678	.04751	.68522	.04844	.69358	.04938	.70185	.05033	.71004	.05129	17
+ 11'	8.67692	.04752	8.68536	.04846	8.69371	.04940	8.70198	.05035	8.71017	.05131	16
45	.67706	.04754	.68550	.04847	.69385	.04941	.70212	.05036	.71031	.05132	15
46	.67720	.04756	.68564	.04849	.69399	.04943	.70226	.05038	.71045	.05134	14
47	.67734	.04757	.68578	.04850	.69413	.04945	.70240	.05040	.71058	.05135	13
+ 12'	8.67748	.04759	8.68592	.04852	8.69427	.04946	8.70253	.05041	8.71072	.05137	12
49	.67763	.04760	.68606	.04854	.69441	.04948	.70267	.05043	.71085	.05139	11
50	.67777	.04762	.68620	.04855	.69454	.04949	.70281	.05044	.71099	.05140	10
51	.67791	.04762	.68634	.04857	.69468	.04951	.70294	.05046	.71112	.05142	9
+ 13'	8.67805	.04765	8.68648	.04858	8.69482	.04952	8.70308	.05048	8.71126	.05144	8
53	.67819	.04766	.68662	.04860	.69496	.04954	.70322	.05049	.71140	.05145	7
54	.67833	.04768	.68676	.04861	.69510	.04956	.70336	.05051	.71153	.05147	6
55	.67847	.04769	.68690	.04863	.69524	.04957	.70349	.05052	.71167	.05148	5
+ 14'	8.67861	.04771	8.68704	.04864	8.69537	.04959	8.70363	.05054	8.71180	.05150	4
57	.67875	.04773	.68718	.04866	.69551	.04960	.70377	.05055	.71194	.05152	3
58	.67890	.04774	.68732	.04868	.69565	.04962	.70390	.05057	.71207	.05153	2
59	.67904	.04776	.68746	.04869	.69579	.04964	.70404	.05059	.71221	.05155	1
+ 15'	8.67918	.04777	8.68760	.04871	8.69593	.04965	8.70418	.05060	8.71234	.05156	0
		22h 19m		22h 18m		22h 17m		22h 16m		22h 15m	

TABLE IV.

Haversines.

s	1h 45m 26° 15'		1h 46m 26° 30'		1h 47m 26° 45'		1h 48m 27° 0'		1h 49m 27° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.71234	.05156	8.72043	.05253	8.72844	.05351	8.73637	.05450	8.74423	.05549	60
1	.71248	.05158	.72057	.05255	.72857	.05353	.73650	.05451	.74436	.05551	59
2	.71261	.05160	.72070	.05257	.72871	.05354	.73663	.05453	.74449	.05552	58
3	.71275	.05161	.72083	.05258	.72884	.05356	.73677	.05455	.74462	.05554	57
+ 1'	8.71289	.05163	8.72097	.05260	8.72897	.05358	8.73690	.05456	8.74475	.05556	56
5	.71302	.05164	.72110	.05261	.72910	.05359	.73703	.05458	.74488	.05557	55
6	.71316	.05166	.72124	.05263	.72924	.05361	.73716	.05460	.74501	.05559	54
7	.71329	.05168	.72137	.05265	.72937	.05363	.73729	.05461	.74514	.05561	53
+ 2'	8.71343	.05169	8.72150	.05266	8.72950	.05364	8.73742	.05463	8.74527	.05562	52
9	.71356	.05171	.72164	.05268	.72963	.05366	.73755	.05464	.74540	.05564	51
10	.71370	.05172	.72177	.05270	.72977	.05367	.73769	.05466	.74553	.05566	50
11	.71383	.05174	.72191	.05271	.72990	.05369	.73782	.05468	.74566	.05567	49
+ 3'	8.71397	.05176	8.72204	.05273	8.73003	.05371	8.73795	.05470	8.74579	.05569	48
13	.71410	.05177	.72217	.05274	.73016	.05372	.73808	.05471	.74592	.05571	47
14	.71424	.05179	.72231	.05276	.73030	.05374	.73821	.05473	.74605	.05572	46
15	.71437	.05181	.72244	.05278	.73043	.05376	.73834	.05474	.74618	.05574	45
+ 4'	8.71451	.05182	8.72257	.05279	8.73056	.05377	8.73847	.05476	8.74631	.05576	44
17	.71464	.05184	.72271	.05281	.73069	.05379	.73860	.05478	.74644	.05577	43
18	.71478	.05185	.72284	.05283	.73083	.05381	.73874	.05479	.74657	.05579	42
19	.71491	.05187	.72298	.05284	.73096	.05382	.73887	.05481	.74670	.05581	41
+ 5'	8.71505	.05189	8.72311	.05286	8.73109	.05384	8.73900	.05483	8.74683	.05582	40
21	.71518	.05190	.72324	.05287	.73122	.05385	.73913	.05484	.74696	.05584	39
22	.71532	.05192	.72338	.05289	.73136	.05387	.73926	.05486	.74709	.05586	38
23	.71545	.05193	.72351	.05291	.73149	.05389	.73939	.05488	.74722	.05587	37
+ 6'	8.71559	.05195	8.72364	.05292	8.73162	.05390	8.73952	.05489	8.74735	.05589	36
25	.71572	.05197	.72378	.05294	.73175	.05392	.73965	.05491	.74748	.05591	35
26	.71586	.05198	.72391	.05296	.73189	.05394	.73978	.05493	.74761	.05593	34
27	.71599	.05200	.72404	.05297	.73202	.05395	.73992	.05494	.74774	.05594	33
+ 7'	8.71613	.05201	8.72418	.05299	8.73215	.05397	8.74005	.05496	8.74787	.05596	32
29	.71626	.05203	.72431	.05300	.73228	.05399	.74018	.05498	.74800	.05597	31
30	.71640	.05205	.72445	.05302	.73241	.05400	.74031	.05499	.74813	.05599	30
31	.71653	.05206	.72458	.05304	.73255	.05402	.74044	.05501	.74826	.05601	29
+ 8'	8.71667	.05208	8.72471	.05305	8.73268	.05404	8.74057	.05503	8.74839	.05603	28
33	.71680	.05210	.72485	.05307	.73281	.05405	.74070	.05504	.74852	.05604	27
34	.71694	.05211	.72498	.05309	.73294	.05407	.74083	.05506	.74864	.05606	26
35	.71707	.05213	.72511	.05310	.73308	.05408	.74096	.05508	.74877	.05607	25
+ 9'	8.71721	.05214	8.72525	.05312	8.73321	.05410	8.74109	.05509	8.74890	.05609	24
37	.71734	.05216	.72538	.05314	.73334	.05412	.74122	.05511	.74903	.05611	23
38	.71748	.05218	.72551	.05315	.73347	.05413	.74135	.05513	.74916	.05613	22
39	.71761	.05219	.72565	.05317	.73360	.05415	.74149	.05514	.74929	.05614	21
+ 10'	8.71774	.05221	8.72578	.05318	8.73374	.05417	8.74162	.05516	8.74942	.05616	20
41	.71788	.05222	.72591	.05320	.73387	.05418	.74175	.05518	.74955	.05618	19
42	.71801	.05224	.72605	.05322	.73400	.05420	.74188	.05519	.74968	.05619	18
43	.71815	.05226	.72618	.05323	.73413	.05422	.74201	.05521	.74981	.05621	17
+ 11'	8.71828	.05227	8.72631	.05325	8.73426	.05423	8.74214	.05523	8.74994	.05623	16
45	.71842	.05229	.72644	.05326	.73440	.05425	.74227	.05524	.75007	.05624	15
46	.71855	.05231	.72658	.05328	.73453	.05427	.74240	.05526	.75020	.05626	14
47	.71869	.05232	.72671	.05330	.73466	.05428	.74253	.05528	.75033	.05628	13
+ 12'	8.71882	.05234	8.72684	.05331	8.73479	.05430	8.74266	.05529	8.75046	.05629	12
49	.71895	.05235	.72698	.05333	.73492	.05431	.74279	.05531	.75059	.05631	11
50	.71909	.05237	.72711	.05335	.73505	.05433	.74292	.05533	.75072	.05633	10
51	.71922	.05239	.72724	.05336	.73519	.05435	.74305	.05534	.75084	.05634	9
+ 13'	8.71936	.05240	8.72738	.05338	8.73532	.05436	8.74318	.05536	8.75097	.05636	8
53	.71949	.05242	.72751	.05340	.73545	.05438	.74331	.05537	.75110	.05638	7
54	.71963	.05244	.72764	.05341	.73558	.05440	.74344	.05539	.75123	.05639	6
55	.71976	.05245	.72778	.05343	.73571	.05441	.74357	.05541	.75136	.05641	5
+ 14'	8.71989	.05247	8.72791	.05345	8.73584	.05443	8.74371	.05542	8.75149	.05643	4
57	.72003	.05248	.72804	.05346	.73598	.05445	.74384	.05544	.75162	.05644	3
58	.72016	.05250	.72817	.05348	.73611	.05446	.74397	.05546	.75175	.05646	2
59	.72030	.05252	.72831	.05349	.73624	.05448	.74410	.05547	.75188	.05648	1
+ 15'	8.72043	.05253	8.72844	.05351	8.73637	.05450	8.74423	.05549	8.75201	.05649	0
	22h 14m		22h 13m		22h 12m		22h 11m		22h 10m		



TABLE IV.

Haversines.

s	1h 50m 27o 30'		1h 51m 27° 45'		1h 52m 28° 0'		1h 53m 28° 15'		1h 54m 28° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.75201	.05649	8.75972	.05751	8.76735	.05853	8.77492	.05955	8.78241	.06059	60
1	.75214	.05651	.75984	.05752	.76748	.05854	.77504	.05957	.78254	.06061	59
2	.75227	.05653	.75997	.05754	.76760	.05856	.77517	.05959	.78266	.06063	58
3	.75239	.05655	.76010	.05756	.76773	.05858	.77529	.05961	.78278	.06064	57
+ 1'	8.75252	.05656	8.76023	.05757	8.76786	.05859	8.77542	.05962	8.78291	.06066	56
5	.75265	.05658	.76035	.05759	.76798	.05861	.77554	.05964	.78303	.06068	55
6	.75278	.05660	.76048	.05761	.76811	.05863	.77567	.05966	.78316	.06070	54
7	.75291	.05661	.76061	.05762	.76824	.05865	.77579	.05968	.78328	.06071	53
+ 2'	8.75304	.05663	8.76074	.05764	8.76836	.05866	8.77592	.05969	8.78341	.06073	52
9	.75317	.05665	.76086	.05766	.76849	.05868	.77604	.05971	.78353	.06075	51
10	.75330	.05666	.76099	.05768	.76862	.05870	.77617	.05973	.78365	.06077	50
11	.75343	.05668	.76112	.05769	.76874	.05871	.77630	.05974	.78378	.06078	49
+ 3'	8.75355	.05670	8.76125	.05771	8.76887	.05873	8.77642	.05976	8.78390	.06080	48
13	.75368	.05671	.76138	.05773	.76900	.05875	.77655	.05978	.78403	.06082	47
14	.75381	.05673	.76150	.05774	.76912	.05877	.77667	.05980	.78415	.06083	46
15	.75394	.05675	.76163	.05776	.76925	.05878	.77680	.05981	.78428	.06085	45
+ 4'	8.75407	.05676	8.76176	.05778	8.76938	.05880	8.77692	.05983	8.78440	.06087	44
17	.75420	.05678	.76189	.05779	.76950	.05882	.77705	.05985	.78452	.06089	43
18	.75433	.05680	.76201	.05781	.76963	.05883	.77717	.05986	.78465	.06090	42
19	.75446	.05681	.76214	.05783	.76975	.05885	.77730	.05988	.78477	.06092	41
+ 5'	8.75458	.05683	8.76227	.05785	8.76988	.05887	8.77742	.05990	8.78490	.06094	40
21	.75471	.05685	.76240	.05786	.77001	.05888	.77755	.05992	.78502	.06096	39
22	.75484	.05686	.76252	.05788	.77013	.05890	.77767	.05993	.78514	.06097	38
23	.75497	.05688	.76265	.05790	.77026	.05892	.77780	.05995	.78527	.06099	37
+ 6'	8.75510	.05690	8.76278	.05791	8.77039	.05894	8.77792	.05997	8.78539	.06101	36
25	.75523	.05691	.76291	.05793	.77051	.05895	.77805	.05999	.78551	.06103	35
26	.75536	.05693	.76303	.05795	.77064	.05897	.77817	.06000	.78564	.06104	34
27	.75548	.05695	.76316	.05796	.77076	.05899	.77830	.06002	.78576	.06106	33
+ 7'	8.75561	.05697	8.76329	.05798	8.77089	.05901	8.77842	.06004	8.78589	.06108	32
29	.75574	.05698	.76341	.05800	.77102	.05902	.77855	.06005	.78601	.06110	31
30	.75587	.05700	.76354	.05802	.77114	.05904	.77867	.06007	.78613	.06111	30
31	.75600	.05702	.76367	.05803	.77127	.05906	.77880	.06009	.78626	.06113	29
+ 8'	8.75613	.05703	8.76380	.05805	8.77139	.05907	8.77892	.06011	8.78638	.06115	28
33	.75626	.05705	.76392	.05807	.77152	.05909	.77905	.06012	.78651	.06117	27
34	.75638	.05707	.76405	.05808	.77165	.05911	.77917	.06014	.78663	.06118	26
35	.75651	.05708	.76418	.05810	.77177	.05913	.77930	.06016	.78675	.06120	25
+ 9'	8.75664	.05710	8.76431	.05812	8.77190	.05914	8.77942	.06018	8.78688	.06122	24
37	.75677	.05712	.76443	.05813	.77202	.05916	.77955	.06019	.78700	.06124	23
38	.75690	.05713	.76456	.05815	.77215	.05918	.77967	.06021	.78712	.06125	22
39	.75703	.05715	.76469	.05817	.77228	.05919	.77980	.06023	.78725	.06127	21
+ 10'	8.75715	.05717	8.76481	.05819	8.77240	.05921	8.77992	.06024	8.78737	.06129	20
41	.75728	.05718	.76494	.05820	.77253	.05923	.78005	.06026	.78749	.06130	19
42	.75741	.05720	.76507	.05822	.77265	.05925	.78017	.06028	.78762	.06132	18
43	.75754	.05722	.76519	.05824	.77278	.05926	.78029	.06030	.78774	.06134	17
+ 11'	8.75767	.05724	8.76532	.05825	8.77291	.05928	8.78042	.06031	8.78787	.06136	16
45	.75779	.05725	.76545	.05827	.77303	.05930	.78054	.06033	.78799	.06137	15
46	.75792	.05727	.76558	.05829	.77316	.05931	.78067	.06035	.78811	.06139	14
47	.75805	.05729	.76570	.05830	.77328	.05933	.78079	.06037	.78824	.06141	13
+ 12'	8.75818	.05730	8.76583	.05832	8.77341	.05935	8.78092	.06038	8.78836	.06143	12
49	.75831	.05732	.76596	.05834	.77353	.05936	.78104	.06040	.78848	.06144	11
50	.75844	.05734	.76608	.05836	.77366	.05938	.78117	.06042	.78861	.06146	10
51	.75856	.05735	.76621	.05837	.77379	.05940	.78129	.06044	.78873	.06148	9
+ 13'	8.75869	.05737	8.76634	.05839	8.77391	.05942	8.78142	.06045	8.78885	.06150	8
53	.75882	.05739	.76646	.05841	.77404	.05943	.78154	.06047	.78898	.06151	7
54	.75895	.05740	.76659	.05842	.77416	.05945	.78167	.06049	.78910	.06153	6
55	.75908	.05742	.76672	.05844	.77429	.05947	.78179	.06050	.78922	.06155	5
+ 14'	8.75920	.05744	8.76684	.05846	8.77441	.05949	8.78191	.06052	8.78935	.06157	4
57	.75933	.05745	.76697	.05847	.77454	.05950	.78204	.06054	.78947	.06158	3
58	.75946	.05747	.76710	.05849	.77466	.05952	.78216	.06056	.78959	.06160	2
59	.75959	.05749	.76722	.05851	.77479	.05954	.78229	.06057	.78972	.06162	1
+ 15'	8.75972	.05751	8.76735	.05853	8.77492	.05955	8.78241	.06059	8.78984	.06164	0
	22h 9m		22h 8m		22h 7m		22h 6m		22h 5m		

TABLE IV.

Haversines.

s	1h 55m 28° 45'		1h 56m 29° 0'		1h 57m 29° 15'		1h 58m 29° 30'		1h 59m 29° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.78984	.06164	8.79720	.06269	8.80449	.06375	8.81172	.06482	8.81889	.06590	60
1	.78996	.06165	.79732	.06271	.80462	.06377	.81184	.06484	.81901	.06592	59
2	.79009	.06167	.79744	.06273	.80474	.06379	.81196	.06486	.81913	.06594	58
3	.79021	.06169	.79757	.06274	.80486	.06381	.81208	.06488	.81925	.06595	57
+ 1'	8.79033	.06171	8.79769	.06276	8.80498	.06382	8.81220	.06489	8.81937	.06597	56
5	.79046	.06172	.79781	.06278	.80510	.06384	.81232	.06491	.81948	.06599	55
6	.79058	.06174	.79793	.06280	.80522	.06386	.81244	.06493	.81960	.06601	54
7	.79070	.06176	.79805	.06281	.80534	.06388	.81256	.06495	.81972	.06603	53
+ 2'	8.79082	.06178	8.79818	.06283	8.80546	.06389	8.81268	.06497	8.81984	.06605	52
9	.79095	.06179	.79830	.06285	.80558	.06391	.81280	.06499	.81996	.06606	51
10	.79107	.06181	.79842	.06287	.80570	.06393	.81292	.06500	.82008	.06608	50
11	.79119	.06183	.79854	.06288	.80582	.06395	.81304	.06502	.82020	.06610	49
+ 3'	8.79132	.06185	8.79866	.06290	8.80595	.06397	8.81316	.06504	8.82032	.06612	48
13	.79144	.06186	.79879	.06292	.80607	.06398	.81328	.06505	.82043	.06614	47
14	.79156	.06188	.79891	.06294	.80619	.06400	.81340	.06507	.82055	.06615	46
15	.79169	.06190	.79903	.06295	.80631	.06402	.81352	.06509	.82067	.06617	45
+ 4'	8.79181	.06192	8.79915	.06297	8.80643	.06404	8.81364	.06511	8.82079	.06619	44
17	.79193	.06193	.79927	.06299	.80655	.06405	.81376	.06513	.82091	.06621	43
18	.79205	.06195	.79940	.06301	.80667	.06407	.81388	.06514	.82103	.06623	42
19	.79218	.06197	.79952	.06303	.80679	.06409	.81400	.06516	.82115	.06624	41
+ 5'	8.79230	.06199	8.79964	.06304	8.80691	.06411	8.81412	.06518	8.82126	.06626	40
21	.79242	.06200	.79976	.06306	.80703	.06413	.81424	.06520	.82138	.06628	39
22	.79255	.06202	.79988	.06308	.80715	.06414	.81436	.06522	.82150	.06630	38
23	.79267	.06204	.80000	.06310	.80727	.06416	.81448	.06523	.82162	.06632	37
+ 6'	8.79279	.06206	8.80013	.06311	8.80739	.06418	8.81460	.06525	8.82174	.06633	36
25	.79291	.06207	.80025	.06313	.80751	.06420	.81472	.06527	.82186	.06635	35
26	.79304	.06209	.80037	.06315	.80764	.06421	.81484	.06529	.82198	.06637	34
27	.79316	.06211	.80049	.06317	.80776	.06423	.81496	.06531	.82209	.06639	33
+ 7'	8.79328	.06213	8.80061	.06318	8.80788	.06425	8.81508	.06532	8.82221	.06641	32
29	.79341	.06214	.80073	.06320	.80800	.06427	.81520	.06534	.82233	.06642	31
30	.79353	.06216	.80086	.06322	.80812	.06429	.81531	.06536	.82245	.06644	30
31	.79365	.06218	.80098	.06324	.80824	.06430	.81543	.06538	.82257	.06646	29
+ 8'	8.79377	.06220	8.80110	.06326	8.80836	.06432	8.81555	.06540	8.82269	.06648	28
33	.79390	.06221	.80122	.06327	.80848	.06434	.81567	.06541	.82280	.06650	27
34	.79402	.06223	.80134	.06329	.80860	.06436	.81579	.06543	.82292	.06652	26
35	.79414	.06225	.80146	.06331	.80872	.06438	.81591	.06545	.82304	.06653	25
+ 9'	8.79426	.06227	8.80158	.06333	8.80884	.06439	8.81603	.06547	8.82316	.06655	24
37	.79439	.06229	.80171	.06334	.80896	.06441	.81615	.06549	.82328	.06657	23
38	.79451	.06230	.80183	.06336	.80908	.06443	.81627	.06550	.82340	.06659	22
39	.79463	.06232	.80195	.06338	.80920	.06445	.81639	.06552	.82351	.06661	21
+ 10'	8.79475	.06234	8.80207	.06340	8.80932	.06446	8.81651	.06554	8.82363	.06662	20
41	.79488	.06236	.80219	.06341	.80944	.06448	.81663	.06556	.82375	.06664	19
42	.79500	.06237	.80231	.06343	.80956	.06450	.81675	.06558	.82387	.06666	18
43	.79512	.06239	.80243	.06345	.80968	.06452	.81687	.06559	.82399	.06668	17
+ 11'	8.79524	.06241	8.80256	.06347	8.80980	.06451	8.81699	.06561	8.82410	.06670	16
45	.79537	.06243	.80268	.06349	.80992	.06455	.81710	.06563	.82422	.06671	15
46	.79549	.06244	.80280	.06350	.81004	.06457	.81722	.06565	.82434	.06673	14
47	.79561	.06246	.80292	.06352	.81016	.06459	.81734	.06567	.82446	.06675	13
+ 12'	8.79573	.06248	8.80304	.06354	8.81028	.06461	8.81746	.06568	8.82458	.06677	12
49	.79586	.06250	.80316	.06356	.81040	.06463	.81758	.06570	.82470	.06679	11
50	.79598	.06251	.80328	.06357	.81052	.06464	.81770	.06572	.82481	.06681	10
51	.79610	.06253	.80340	.06359	.81064	.06466	.81782	.06574	.82493	.06682	9
+ 13'	8.79622	.06255	8.80353	.06361	8.81076	.06468	8.81794	.06576	8.82505	.06684	8
53	.79634	.06257	.80365	.06363	.81088	.06470	.81806	.06577	.82517	.06686	7
54	.79647	.06258	.80377	.06365	.81100	.06471	.81818	.06579	.82529	.06688	6
55	.79659	.06260	.80389	.06366	.81112	.06473	.81830	.06581	.82540	.06690	5
+ 14'	8.79671	.06262	8.80401	.06368	8.81124	.06475	8.81841	.06583	8.82552	.06691	4
57	.79683	.06264	.80413	.06370	.81136	.06477	.81853	.06585	.82564	.06693	3
58	.79696	.06265	.80425	.06372	.81148	.06479	.81865	.06586	.82576	.06695	2
59	.79708	.06267	.80437	.06373	.81160	.06480	.81877	.06588	.82588	.06697	1
+ 15'	8.79720	.06269	8.80449	.06375	8.81172	.06482	8.81889	.06590	8.82599	.06699	0
	22h 4m		22h 3m		22h 2m		22h 1m		22h 0m		



Haversines.

s	2h 0m 30° 0'		2h 1m 30° 15'		2h 2m 30° 30'		2h 3m 30° 45'		2h 4m 31° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.82599	.06699	8.83303	.06808	8.84002	.06919	8.84694	.07030	8.85380	.07142	60
1	.82611	.06701	.83315	.06810	.84013	.06920	.84705	.07032	.85391	.07144	59
2	.82623	.06702	.83327	.06812	.84025	.06922	.84717	.07033	.85403	.07145	58
3	.82635	.06704	.83338	.06814	.84036	.06924	.84728	.07035	.85414	.07147	57
+ 1'	8.82646	.06706	8.83350	.06816	8.84048	.06926	8.84740	.07037	8.85425	.07149	56
5	.82658	.06708	.83362	.06817	.84059	.06928	.84751	.07039	.85437	.07151	55
6	.82670	.06710	.83374	.06819	.84071	.06930	.84762	.07041	.85448	.07153	54
7	.82682	.06711	.83385	.06821	.84083	.06931	.84774	.07043	.85459	.07155	53
+ 2'	8.82694	.06713	8.83397	.06823	8.84094	.06933	8.84785	.07045	8.85471	.07157	52
9	.82705	.06715	.83409	.06825	.84106	.06935	.84797	.07046	.85482	.07158	51
10	.82717	.06717	.83420	.06826	.84117	.06937	.84808	.07048	.85494	.07160	50
11	.82729	.06719	.83432	.06828	.84129	.06939	.84820	.07050	.85505	.07162	49
+ 3'	8.82741	.06721	8.83444	.06830	8.84140	.06941	8.84831	.07052	8.85516	.07164	48
13	.82752	.06722	.83455	.06832	.84152	.06943	.84843	.07054	.85528	.07166	47
14	.82764	.06724	.83467	.06834	.84164	.06944	.84854	.07056	.85539	.07168	46
15	.82776	.06726	.83479	.06836	.84175	.06946	.84866	.07058	.85550	.07170	45
+ 4'	8.82788	.06728	8.83490	.06838	8.84187	.06948	8.84877	.07059	8.85562	.07172	44
17	.82799	.06730	.83502	.06839	.84198	.06950	.84889	.07061	.85573	.07173	43
18	.82811	.06731	.83513	.06841	.84210	.06952	.84900	.07063	.85585	.07175	42
19	.82823	.06733	.83525	.06843	.84221	.06954	.84912	.07065	.85596	.07177	41
+ 5'	8.82835	.06735	8.83537	.06845	8.84233	.06956	8.84923	.07067	8.85607	.07179	40
21	.82846	.06737	.83548	.06847	.84244	.06957	.84934	.07069	.85619	.07181	39
22	.82858	.06739	.83560	.06849	.84256	.06959	.84946	.07071	.85630	.07183	38
23	.82870	.06741	.83572	.06850	.84268	.06961	.84957	.07073	.85641	.07185	37
+ 6'	8.82882	.06742	8.83583	.06852	8.84279	.06963	8.84969	.07074	8.85653	.07187	36
25	.82893	.06744	.83595	.06854	.84291	.06965	.84980	.07076	.85664	.07189	35
26	.82905	.06746	.83607	.06856	.84302	.06967	.84992	.07078	.85675	.07190	34
27	.82917	.06748	.83618	.06858	.84314	.06968	.85003	.07080	.85687	.07192	33
+ 7'	8.82929	.06750	8.83630	.06860	8.84325	.06970	8.85015	.07082	8.85698	.07194	32
29	.82940	.06752	.83642	.06861	.84337	.06972	.85026	.07084	.85709	.07196	31
30	.82952	.06753	.83653	.06863	.84348	.06974	.85037	.07086	.85721	.07198	30
31	.82964	.06755	.83665	.06865	.84360	.06976	.85049	.07087	.85732	.07200	29
+ 8'	8.82976	.06757	8.83676	.06867	8.84371	.06978	8.85060	.07089	8.85743	.07202	28
33	.82987	.06759	.83688	.06869	.84383	.06980	.85072	.07091	.85755	.07204	27
34	.82999	.06761	.83700	.06871	.84394	.06981	.85083	.07093	.85766	.07205	26
35	.83011	.06763	.83711	.06872	.84406	.06983	.85095	.07095	.85777	.07207	25
+ 9'	8.83023	.06764	8.83723	.06874	8.84417	.06985	8.85106	.07097	8.85789	.07209	24
37	.83034	.06766	.83735	.06876	.84429	.06987	.85117	.07099	.85800	.07211	23
38	.83046	.06768	.83746	.06878	.84441	.06989	.85129	.07100	.85811	.07213	22
39	.83058	.06770	.83758	.06880	.84452	.06991	.85140	.07102	.85823	.07215	21
+ 10'	8.83069	.06772	8.83769	.06882	8.84464	.06993	8.85152	.07104	8.85834	.07217	20
41	.83081	.06773	.83781	.06884	.84475	.06994	.85163	.07106	.85845	.07219	19
42	.83093	.06775	.83793	.06885	.84487	.06996	.85175	.07108	.85857	.07220	18
43	.83105	.06777	.83804	.06887	.84498	.06998	.85186	.07110	.85868	.07222	17
+ 11'	8.83116	.06779	8.83816	.06889	8.84510	.07000	8.85197	.07112	8.85879	.07224	16
45	.83128	.06781	.83828	.06891	.84521	.07002	.85209	.07114	.85891	.07226	15
46	.83140	.06783	.83839	.06893	.84533	.07004	.85220	.07115	.85902	.07228	14
47	.83151	.06784	.83851	.06895	.84544	.07006	.85232	.07117	.85913	.07230	13
+ 12'	8.83163	.06786	8.83862	.06896	8.84556	.07007	8.85243	.07119	8.85925	.07232	12
49	.83175	.06788	.83874	.06898	.84567	.07009	.85254	.07121	.85936	.07234	11
50	.83187	.06790	.83886	.06900	.84579	.07011	.85266	.07123	.85947	.07236	10
51	.83198	.06792	.83897	.06902	.84590	.07013	.85277	.07125	.85959	.07237	9
+ 13'	8.83210	.06794	8.83909	.06904	8.84602	.07015	8.85289	.07127	8.85970	.07239	8
53	.83222	.06795	.83920	.06906	.84613	.07017	.85300	.07129	.85981	.07241	7
54	.83233	.06797	.83932	.06907	.84625	.07019	.85311	.07130	.85992	.07243	6
55	.83245	.06799	.83944	.06909	.84636	.07020	.85323	.07132	.86004	.07245	5
+ 14'	8.83257	.06801	8.83955	.06911	8.84648	.07022	8.85334	.07134	8.86015	.07247	4
57	.83268	.06803	.83967	.06913	.84659	.07024	.85346	.07136	.86026	.07249	3
58	.83280	.06805	.83978	.06915	.84671	.07026	.85357	.07138	.86038	.07251	2
59	.83292	.06806	.83990	.06917	.84682	.07028	.85368	.07140	.86049	.07253	1
+ 15'	8.83303	.06808	8.84002	.06919	8.84694	.07030	8.85380	.07142	8.86060	.07254	0
	21h 59m		21h 58m		21h 57m		21h 56m		21h 55m		

Haversines.

s	2h 5m 31° 15'		2h 6m 31° 30'		2h 7m 31° 45'		2h 8m 32° 0'		2h 9m 32° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.86060	<b>.07254</b>	8.86735	<b>.07368</b>	8.87404	<b>.07482</b>	8.88068	<b>.07598</b>	8.88726	<b>.07714</b>	60
1	.86072	<b>.07256</b>	.86746	<b>.07370</b>	.87415	<b>.07484</b>	.88079	<b>.07600</b>	.88737	<b>.07716</b>	59
2	.86085	<b>.07258</b>	.86757	<b>.07372</b>	.87426	<b>.07486</b>	.88090	<b>.07601</b>	.88748	<b>.07717</b>	58
3	.86094	<b>.07260</b>	.86769	<b>.07374</b>	.87437	<b>.07488</b>	.88101	<b>.07603</b>	.88759	<b>.07719</b>	57
+ 1'	8.86105	<b>.07262</b>	8.86780	<b>.07376</b>	8.87448	<b>.07490</b>	8.88112	<b>.07605</b>	8.88769	<b>.07721</b>	56
5	.86117	<b>.07264</b>	.86791	<b>.07377</b>	.87460	<b>.07492</b>	.88123	<b>.07607</b>	.88780	<b>.07723</b>	55
6	.86128	<b>.07266</b>	.86802	<b>.07379</b>	.87471	<b>.07494</b>	.88134	<b>.07609</b>	.88791	<b>.07725</b>	54
7	.86139	<b>.07268</b>	.86813	<b>.07381</b>	.87482	<b>.07496</b>	.88145	<b>.07611</b>	.88802	<b>.07727</b>	53
+ 2'	8.86151	<b>.07270</b>	8.86825	<b>.07383</b>	8.87493	<b>.07498</b>	8.88156	<b>.07613</b>	8.88813	<b>.07729</b>	52
9	.86162	<b>.07271</b>	.86836	<b>.07385</b>	.87504	<b>.07500</b>	.88167	<b>.07615</b>	.88824	<b>.07731</b>	51
10	.86173	<b>.07273</b>	.86847	<b>.07387</b>	.87515	<b>.07502</b>	.88178	<b>.07617</b>	.88835	<b>.07733</b>	50
11	.86184	<b>.07275</b>	.86858	<b>.07389</b>	.87526	<b>.07503</b>	.88189	<b>.07619</b>	.88846	<b>.07735</b>	49
+ 3'	8.86196	<b>.07277</b>	8.86869	<b>.07391</b>	8.87537	<b>.07505</b>	8.88200	<b>.07621</b>	8.88857	<b>.07737</b>	48
13	.86207	<b>.07279</b>	.86880	<b>.07393</b>	.87548	<b>.07507</b>	.88211	<b>.07623</b>	.88868	<b>.07739</b>	47
14	.86218	<b>.07281</b>	.86892	<b>.07395</b>	.87559	<b>.07509</b>	.88222	<b>.07625</b>	.88879	<b>.07741</b>	46
15	.86229	<b>.07283</b>	.86903	<b>.07397</b>	.87570	<b>.07511</b>	.88233	<b>.07627</b>	.88890	<b>.07743</b>	45
+ 4'	8.86241	<b>.07285</b>	8.86914	<b>.07398</b>	8.87582	<b>.07513</b>	8.88244	<b>.07628</b>	8.88900	<b>.07745</b>	44
17	.86252	<b>.07287</b>	.86925	<b>.07400</b>	.87593	<b>.07515</b>	.88255	<b>.07630</b>	.88911	<b>.07747</b>	43
18	.86263	<b>.07288</b>	.86936	<b>.07402</b>	.87604	<b>.07517</b>	.88266	<b>.07632</b>	.88922	<b>.07749</b>	42
19	.86275	<b>.07290</b>	.86947	<b>.07404</b>	.87615	<b>.07519</b>	.88277	<b>.07634</b>	.88933	<b>.07751</b>	41
+ 5'	8.86286	<b>.07292</b>	8.86959	<b>.07406</b>	8.87626	<b>.07521</b>	8.88288	<b>.07636</b>	8.88944	<b>.07752</b>	40
21	.86297	<b>.07294</b>	.86970	<b>.07408</b>	.87637	<b>.07523</b>	.88299	<b>.07638</b>	.88955	<b>.07754</b>	39
22	.86308	<b>.07296</b>	.86981	<b>.07410</b>	.87648	<b>.07525</b>	.88310	<b>.07640</b>	.88966	<b>.07756</b>	38
23	.86320	<b>.07298</b>	.86992	<b>.07412</b>	.87659	<b>.07527</b>	.88321	<b>.07642</b>	.88977	<b>.07758</b>	37
+ 6'	8.86331	<b>.07300</b>	8.87003	<b>.07414</b>	8.87670	<b>.07528</b>	8.88332	<b>.07644</b>	8.88988	<b>.07760</b>	36
25	.86342	<b>.07302</b>	.87014	<b>.07416</b>	.87681	<b>.07530</b>	.88343	<b>.07646</b>	.88998	<b>.07762</b>	35
26	.86353	<b>.07304</b>	.87026	<b>.07417</b>	.87692	<b>.07532</b>	.88354	<b>.07648</b>	.89009	<b>.07764</b>	34
27	.86365	<b>.07305</b>	.87037	<b>.07419</b>	.87703	<b>.07534</b>	.88364	<b>.07650</b>	.89020	<b>.07766</b>	33
+ 7'	8.86376	<b>.07307</b>	8.87048	<b>.07421</b>	8.87714	<b>.07536</b>	8.88375	<b>.07652</b>	8.89031	<b>.07768</b>	32
29	.86387	<b>.07309</b>	.87059	<b>.07423</b>	.87725	<b>.07538</b>	.88386	<b>.07654</b>	.89042	<b>.07770</b>	31
30	.86398	<b>.07311</b>	.87070	<b>.07425</b>	.87737	<b>.07540</b>	.88397	<b>.07656</b>	.89053	<b>.07772</b>	30
31	.86410	<b>.07323</b>	.87081	<b>.07427</b>	.87748	<b>.07542</b>	.88408	<b>.07657</b>	.89064	<b>.07774</b>	29
+ 8'	8.86421	<b>.07315</b>	8.87093	<b>.07429</b>	8.87759	<b>.07544</b>	8.88419	<b>.07659</b>	8.89075	<b>.07776</b>	28
33	.86432	<b>.07317</b>	.87104	<b>.07431</b>	.87770	<b>.07546</b>	.88430	<b>.07661</b>	.89086	<b>.07778</b>	27
34	.86443	<b>.07319</b>	.87115	<b>.07433</b>	.87781	<b>.07548</b>	.88441	<b>.07663</b>	.89096	<b>.07780</b>	26
35	.86455	<b>.07321</b>	.87126	<b>.07435</b>	.87792	<b>.07549</b>	.88452	<b>.07665</b>	.89107	<b>.07782</b>	25
+ 9'	8.86466	<b>.07322</b>	8.87137	<b>.07437</b>	8.87803	<b>.07551</b>	8.88463	<b>.07667</b>	8.89118	<b>.07784</b>	24
37	.86477	<b>.07324</b>	.87148	<b>.07438</b>	.87814	<b>.07553</b>	.88474	<b>.07669</b>	.89129	<b>.07786</b>	23
38	.86488	<b>.07326</b>	.87159	<b>.07440</b>	.87825	<b>.07555</b>	.88485	<b>.07671</b>	.89140	<b>.07788</b>	22
39	.86499	<b>.07328</b>	.87171	<b>.07442</b>	.87836	<b>.07557</b>	.88496	<b>.07673</b>	.89151	<b>.07789</b>	21
+ 10'	8.86511	<b>.07330</b>	8.87182	<b>.07444</b>	8.87847	<b>.07559</b>	8.88507	<b>.07675</b>	8.89162	<b>.07791</b>	20
41	.86522	<b>.07332</b>	.87193	<b>.07446</b>	.87858	<b>.07561</b>	.88518	<b>.07677</b>	.89172	<b>.07793</b>	19
42	.86533	<b>.07334</b>	.87204	<b>.07448</b>	.87869	<b>.07563</b>	.88529	<b>.07679</b>	.89183	<b>.07795</b>	18
43	.86544	<b>.07336</b>	.87215	<b>.07450</b>	.87880	<b>.07565</b>	.88540	<b>.07681</b>	.89194	<b>.07797</b>	17
+ 11'	8.86556	<b>.07338</b>	8.87226	<b>.07452</b>	8.87891	<b>.07567</b>	8.88551	<b>.07683</b>	8.89205	<b>.07799</b>	16
45	.86567	<b>.07340</b>	.87237	<b>.07454</b>	.87902	<b>.07569</b>	.88562	<b>.07685</b>	.89216	<b>.07801</b>	15
46	.86578	<b>.07341</b>	.87248	<b>.07456</b>	.87913	<b>.07571</b>	.88573	<b>.07686</b>	.89227	<b>.07803</b>	14
47	.86589	<b>.07343</b>	.87260	<b>.07458</b>	.87924	<b>.07573</b>	.88584	<b>.07688</b>	.89238	<b>.07805</b>	13
+ 12'	8.86600	<b>.07345</b>	8.87271	<b>.07459</b>	8.87935	<b>.07574</b>	8.88595	<b>.07690</b>	8.89248	<b>.07807</b>	12
49	.86611	<b>.07347</b>	.87282	<b>.07461</b>	.87946	<b>.07576</b>	.88606	<b>.07692</b>	.89259	<b>.07809</b>	11
50	.86623	<b>.07349</b>	.87293	<b>.07463</b>	.87957	<b>.07578</b>	.88616	<b>.07694</b>	.89270	<b>.07811</b>	10
51	.86634	<b>.07351</b>	.87304	<b>.07465</b>	.87968	<b>.07580</b>	.88627	<b>.07696</b>	.89281	<b>.07813</b>	9
+ 13'	8.86645	<b>.07353</b>	8.87315	<b>.07467</b>	8.87980	<b>.07582</b>	8.88638	<b>.07698</b>	8.89292	<b>.07815</b>	8
53	.86657	<b>.07355</b>	.87326	<b>.07469</b>	.87991	<b>.07584</b>	.88649	<b>.07700</b>	.89303	<b>.07817</b>	7
54	.86668	<b>.07357</b>	.87337	<b>.07471</b>	.88002	<b>.07586</b>	.88660	<b>.07702</b>	.89314	<b>.07819</b>	6
55	.86679	<b>.07359</b>	.87349	<b>.07473</b>	.88013	<b>.07588</b>	.88671	<b>.07704</b>	.89324	<b>.07821</b>	5
+ 14'	8.86690	<b>.07360</b>	8.87360	<b>.07475</b>	8.88024	<b>.07590</b>	8.88682	<b>.07706</b>	8.89335	<b>.07823</b>	4
57	.86701	<b>.07362</b>	.87371	<b>.07477</b>	.88035	<b>.07592</b>	.88693	<b>.07708</b>	.89346	<b>.07825</b>	3
58	.86713	<b>.07364</b>	.87382	<b>.07479</b>	.88046	<b>.07594</b>	.88704	<b>.07710</b>	.89357	<b>.07827</b>	2
59	.86724	<b>.07366</b>	.87393	<b>.07480</b>	.88057	<b>.07596</b>	.88715	<b>.07712</b>	.89368	<b>.07829</b>	1
+ 15'	8.86735	<b>.07368</b>	8.87404	<b>.07482</b>	8.88068	<b>.07598</b>	8.88726	<b>.07714</b>	8.89379	<b>.07830</b>	0
	21h 54m		21h 53m		21h 52m		21h 51m		21h 50m		



TABLE IV.  
Haversines.

s	2h 10m 32° 30'		2h 11m 32° 45'		2h 12m 33° 0'		2h 13m 33' 15'		2h 14m 33° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.89379	<b>.07830</b>	8.90026	<b>.07948</b>	8.90668	<b>.08066</b>	8.91306	<b>.08186</b>	8.91938	<b>.08306</b>	60
1	.89389	<b>.07832</b>	.90037	<b>.07950</b>	.90679	<b>.08068</b>	.91316	<b>.08188</b>	.91948	<b>.08308</b>	59
2	.89400	<b>.07834</b>	.90048	<b>.07952</b>	.90690	<b>.08070</b>	.91327	<b>.08190</b>	.91959	<b>.08310</b>	58
3	.89411	<b>.07836</b>	.90058	<b>.07954</b>	.90700	<b>.08072</b>	.91337	<b>.08192</b>	.91969	<b>.08312</b>	57
+ 1'	8.89422	<b>.07838</b>	8.90069	<b>.07956</b>	8.90711	<b>.08074</b>	8.91348	<b>.08194</b>	8.91980	<b>.08314</b>	56
5	.89433	<b>.07840</b>	.90080	<b>.07958</b>	.90722	<b>.08076</b>	.91358	<b>.08196</b>	.91990	<b>.08316</b>	55
6	.89444	<b>.07842</b>	.90091	<b>.07960</b>	.90732	<b>.08078</b>	.91369	<b>.08198</b>	.92001	<b>.08318</b>	54
7	.89454	<b>.07844</b>	.90101	<b>.07962</b>	.90743	<b>.08080</b>	.91380	<b>.08200</b>	.92011	<b>.08320</b>	53
+ 2'	8.89465	<b>.07846</b>	8.90112	<b>.07964</b>	8.90754	<b>.08082</b>	8.91390	<b>.08202</b>	8.92022	<b>.08322</b>	52
9	.89476	<b>.07848</b>	.90123	<b>.07966</b>	.90764	<b>.08084</b>	.91401	<b>.08204</b>	.92032	<b>.08324</b>	51
10	.89487	<b>.07850</b>	.90134	<b>.07968</b>	.90775	<b>.08086</b>	.91411	<b>.08206</b>	.92043	<b>.08326</b>	50
11	.89498	<b>.07852</b>	.90144	<b>.07970</b>	.90786	<b>.08088</b>	.91422	<b>.08208</b>	.92053	<b>.08328</b>	49
+ 3'	8.89509	<b>.07854</b>	8.90155	<b>.07972</b>	8.90796	<b>.08090</b>	8.91432	<b>.08210</b>	8.92064	<b>.08330</b>	48
13	.89519	<b>.07856</b>	.90166	<b>.07974</b>	.90807	<b>.08092</b>	.91443	<b>.08212</b>	.92074	<b>.08332</b>	47
14	.89530	<b>.07858</b>	.90176	<b>.07976</b>	.90818	<b>.08094</b>	.91454	<b>.08214</b>	.92084	<b>.08334</b>	46
15	.89541	<b>.07860</b>	.90187	<b>.07978</b>	.90828	<b>.08096</b>	.91464	<b>.08216</b>	.92095	<b>.08336</b>	45
+ 4'	8.89552	<b>.07862</b>	8.90198	<b>.07980</b>	8.90839	<b>.08098</b>	8.91475	<b>.08218</b>	8.92105	<b>.08338</b>	44
17	.89563	<b>.07864</b>	.90209	<b>.07982</b>	.90849	<b>.08100</b>	.91485	<b>.08220</b>	.92116	<b>.08340</b>	43
18	.89573	<b>.07866</b>	.90219	<b>.07983</b>	.90860	<b>.08102</b>	.91496	<b>.08222</b>	.92126	<b>.08342</b>	42
19	.89584	<b>.07868</b>	.90230	<b>.07985</b>	.90871	<b>.08104</b>	.91506	<b>.08224</b>	.92137	<b>.08344</b>	41
+ 5'	8.89595	<b>.07870</b>	8.90241	<b>.07987</b>	8.90881	<b>.08106</b>	8.91517	<b>.08226</b>	8.92147	<b>.08346</b>	40
21	.89606	<b>.07872</b>	.90252	<b>.07989</b>	.90892	<b>.08108</b>	.91527	<b>.08228</b>	.92158	<b>.08348</b>	39
22	.89617	<b>.07873</b>	.90262	<b>.07991</b>	.90903	<b>.08110</b>	.91538	<b>.08230</b>	.92168	<b>.08350</b>	38
23	.89627	<b>.07875</b>	.90273	<b>.07993</b>	.90913	<b>.08112</b>	.91549	<b>.08232</b>	.92179	<b>.08352</b>	37
+ 6'	8.89638	<b>.07877</b>	8.90284	<b>.07995</b>	8.90924	<b>.08114</b>	8.91559	<b>.08234</b>	8.92189	<b>.08354</b>	36
25	.89649	<b>.07879</b>	.90294	<b>.07997</b>	.90935	<b>.08116</b>	.91570	<b>.08236</b>	.92200	<b>.08356</b>	35
26	.89660	<b>.07881</b>	.90305	<b>.07999</b>	.90945	<b>.08118</b>	.91580	<b>.08238</b>	.92210	<b>.08358</b>	34
27	.89671	<b>.07883</b>	.90316	<b>.08001</b>	.90956	<b>.08120</b>	.91591	<b>.08240</b>	.92221	<b>.08360</b>	33
+ 7'	8.89681	<b>.07885</b>	8.90326	<b>.08003</b>	8.90966	<b>.08122</b>	8.91601	<b>.08242</b>	8.92231	<b>.08362</b>	32
29	.89692	<b>.07887</b>	.90337	<b>.08005</b>	.90977	<b>.08124</b>	.91612	<b>.08244</b>	.92241	<b>.08364</b>	31
30	.89703	<b>.07889</b>	.90348	<b>.08007</b>	.90988	<b>.08126</b>	.91622	<b>.08246</b>	.92252	<b>.08366</b>	30
31	.89714	<b>.07891</b>	.90359	<b>.08009</b>	.90998	<b>.08128</b>	.91633	<b>.08248</b>	.92262	<b>.08368</b>	29
+ 8'	8.89725	<b>.07893</b>	8.90369	<b>.08011</b>	8.91009	<b>.08130</b>	8.91643	<b>.08250</b>	8.92273	<b>.08370</b>	28
33	.89735	<b>.07895</b>	.90380	<b>.08013</b>	.91019	<b>.08132</b>	.91654	<b>.08252</b>	.92283	<b>.08372</b>	27
34	.89746	<b>.07897</b>	.90391	<b>.08015</b>	.91030	<b>.08134</b>	.91664	<b>.08254</b>	.92294	<b>.08374</b>	26
35	.89757	<b>.07899</b>	.90401	<b>.08017</b>	.91041	<b>.08136</b>	.91675	<b>.08256</b>	.92304	<b>.08376</b>	25
+ 9'	8.89768	<b>.07901</b>	8.90412	<b>.08019</b>	8.91051	<b>.08138</b>	8.91685	<b>.08258</b>	8.92315	<b>.08378</b>	24
37	.89779	<b>.07903</b>	.90423	<b>.08021</b>	.91062	<b>.08140</b>	.91696	<b>.08260</b>	.92325	<b>.08380</b>	23
38	.89789	<b>.07905</b>	.90433	<b>.08023</b>	.91073	<b>.08142</b>	.91707	<b>.08262</b>	.92335	<b>.08382</b>	22
39	.89800	<b>.07907</b>	.90444	<b>.08025</b>	.91083	<b>.08144</b>	.91717	<b>.08264</b>	.92346	<b>.08384</b>	21
+ 10'	8.89811	<b>.07909</b>	8.90455	<b>.08027</b>	8.91094	<b>.08146</b>	8.91728	<b>.08266</b>	8.92356	<b>.08386</b>	20
41	.89822	<b>.07911</b>	.90466	<b>.08029</b>	.91104	<b>.08148</b>	.91738	<b>.08268</b>	.92367	<b>.08388</b>	19
42	.89832	<b>.07913</b>	.90476	<b>.08031</b>	.91115	<b>.08150</b>	.91749	<b>.08270</b>	.92377	<b>.08390</b>	18
43	.89843	<b>.07915</b>	.90487	<b>.08033</b>	.91126	<b>.08152</b>	.91759	<b>.08272</b>	.92388	<b>.08392</b>	17
+ 11'	8.89854	<b>.07917</b>	8.90498	<b>.08035</b>	8.91136	<b>.08154</b>	8.91770	<b>.08274</b>	8.92398	<b>.08394</b>	16
45	.89865	<b>.07919</b>	.90508	<b>.08037</b>	.91147	<b>.08156</b>	.91780	<b>.08276</b>	.92409	<b>.08396</b>	15
46	.89875	<b>.07921</b>	.90519	<b>.08039</b>	.91157	<b>.08158</b>	.91791	<b>.08278</b>	.92419	<b>.08398</b>	14
47	.89886	<b>.07923</b>	.90530	<b>.08041</b>	.91168	<b>.08160</b>	.91801	<b>.08280</b>	.92429	<b>.08400</b>	13
+ 12'	8.89897	<b>.07924</b>	8.90540	<b>.08043</b>	8.91179	<b>.08162</b>	8.91812	<b>.08282</b>	8.92440	<b>.08402</b>	12
49	.89908	<b>.07926</b>	.90551	<b>.08045</b>	.91189	<b>.08164</b>	.91822	<b>.08284</b>	.92450	<b>.08404</b>	11
50	.89919	<b>.07928</b>	.90562	<b>.08047</b>	.91200	<b>.08166</b>	.91833	<b>.08286</b>	.92461	<b>.08406</b>	10
51	.89929	<b>.07930</b>	.90572	<b>.08049</b>	.91210	<b>.08168</b>	.91843	<b>.08288</b>	.92471	<b>.08408</b>	9
+ 13'	8.89940	<b>.07932</b>	8.90583	<b>.08051</b>	8.91221	<b>.08170</b>	8.91854	<b>.08290</b>	8.92482	<b>.08410</b>	8
53	.89951	<b>.07934</b>	.90594	<b>.08053</b>	.91232	<b>.08172</b>	.91864	<b>.08292</b>	.92492	<b>.08412</b>	7
54	.89962	<b>.07936</b>	.90604	<b>.08055</b>	.91242	<b>.08174</b>	.91875	<b>.08294</b>	.92502	<b>.08414</b>	6
55	.89972	<b>.07938</b>	.90615	<b>.08057</b>	.91253	<b>.08176</b>	.91885	<b>.08296</b>	.92513	<b>.08416</b>	5
+ 14'	8.89983	<b>.07940</b>	8.90626	<b>.08059</b>	8.91263	<b>.08178</b>	8.91896	<b>.08298</b>	8.92523	<b>.08418</b>	4
57	.89994	<b>.07942</b>	.90636	<b>.08061</b>	.91274	<b>.08180</b>	.91906	<b>.08300</b>	.92534	<b>.08420</b>	3
58	.90005	<b>.07944</b>	.90647	<b>.08063</b>	.91284	<b>.08182</b>	.91917	<b>.08302</b>	.92544	<b>.08422</b>	2
59	.90015	<b>.07946</b>	.90658	<b>.08065</b>	.91295	<b>.08184</b>	.91927	<b>.08304</b>	.92554	<b>.08424</b>	1
+ 15'	8.90026	<b>.07948</b>	8.90668	<b>.08066</b>	8.91306	<b>.08186</b>	8.91938	<b>.08306</b>	8.92565	<b>.08427</b>	0
	21h 49m		21h 48m		21h 47m		21h 46m		21h 45m		

TABLE IV.

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Haversines.

s	2h 15m 33° 45'		2h 16m 34° 0'		2h 17m 34° 15'		2h 18m 34° 30'		2h 19m 34° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.92565	<b>.08427</b>	8.93187	<b>.08548</b>	8.93805	<b>.08671</b>	8.94417	<b>.08794</b>	8.95025	<b>.08918</b>	60
1	.92575	<b>.08429</b>	.93197	<b>.08550</b>	.93815	<b>.08673</b>	.94427	<b>.08796</b>	.95035	<b>.08920</b>	59
2	.92586	<b>.08431</b>	.93208	<b>.08552</b>	.93825	<b>.08675</b>	.94438	<b>.08798</b>	.95045	<b>.08922</b>	58
3	.92596	<b>.08433</b>	.93218	<b>.08554</b>	.93835	<b>.08677</b>	.94448	<b>.08800</b>	.95055	<b>.08924</b>	57
+ 1'	8.92607	<b>.08435</b>	8.93228	<b>.08556</b>	8.93846	<b>.08679</b>	8.94458	<b>.08802</b>	8.95065	<b>.08926</b>	56
5	.92617	<b>.08437</b>	.93239	<b>.08558</b>	.93856	<b>.08681</b>	.94468	<b>.08804</b>	.95076	<b>.08928</b>	55
6	.92627	<b>.08439</b>	.93249	<b>.08560</b>	.93866	<b>.08683</b>	.94478	<b>.08806</b>	.95086	<b>.08930</b>	54
7	.92638	<b>.08441</b>	.93259	<b>.08562</b>	.93876	<b>.08685</b>	.94488	<b>.08808</b>	.95096	<b>.08932</b>	53
+ 2'	8.92648	<b>.08443</b>	8.93270	<b>.08564</b>	8.93886	<b>.08687</b>	8.94498	<b>.08810</b>	8.95106	<b>.08934</b>	52
9	.92659	<b>.08445</b>	.93280	<b>.08566</b>	.93897	<b>.08689</b>	.94509	<b>.08812</b>	.95116	<b>.08936</b>	51
10	.92669	<b>.08447</b>	.93290	<b>.08568</b>	.93907	<b>.08691</b>	.94519	<b>.08814</b>	.95126	<b>.08938</b>	50
11	.92679	<b>.08449</b>	.93301	<b>.08571</b>	.93917	<b>.08693</b>	.94529	<b>.08816</b>	.95136	<b>.08940</b>	49
+ 3'	8.92690	<b>.08451</b>	8.93311	<b>.08573</b>	8.93927	<b>.08695</b>	8.94539	<b>.08818</b>	8.95146	<b>.08943</b>	48
13	.92700	<b>.08453</b>	.93321	<b>.08575</b>	.93938	<b>.08697</b>	.94549	<b>.08820</b>	.95156	<b>.08945</b>	47
14	.92710	<b>.08455</b>	.93332	<b>.08577</b>	.93948	<b>.08699</b>	.94559	<b>.08823</b>	.95166	<b>.08947</b>	46
15	.92721	<b>.08457</b>	.93342	<b>.08579</b>	.93958	<b>.08701</b>	.94570	<b>.08825</b>	.95176	<b>.08949</b>	45
+ 4'	8.92731	<b>.08459</b>	8.93352	<b>.08581</b>	8.93968	<b>.08703</b>	8.94580	<b>.08827</b>	8.95186	<b>.08951</b>	44
17	.92742	<b>.08461</b>	.93363	<b>.08583</b>	.93979	<b>.08705</b>	.94590	<b>.08829</b>	.95197	<b>.08953</b>	43
18	.92752	<b>.08463</b>	.93373	<b>.08585</b>	.93989	<b>.08707</b>	.94600	<b>.08831</b>	.95207	<b>.08955</b>	42
19	.92762	<b>.08465</b>	.93383	<b>.08587</b>	.93999	<b>.08709</b>	.94610	<b>.08833</b>	.95217	<b>.08957</b>	41
+ 5'	8.92773	<b>.08467</b>	8.93393	<b>.08589</b>	8.94009	<b>.08711</b>	8.94620	<b>.08835</b>	8.95227	<b>.08959</b>	40
21	.92783	<b>.08469</b>	.93404	<b>.08591</b>	.94019	<b>.08714</b>	.94630	<b>.08837</b>	.95237	<b>.08961</b>	39
22	.92794	<b>.08471</b>	.93414	<b>.08593</b>	.94030	<b>.08716</b>	.94641	<b>.08839</b>	.95247	<b>.08963</b>	38
23	.92804	<b>.08473</b>	.93424	<b>.08595</b>	.94040	<b>.08718</b>	.94651	<b>.08841</b>	.95257	<b>.08965</b>	37
+ 6'	8.92814	<b>.08475</b>	8.93435	<b>.08597</b>	8.94050	<b>.08720</b>	8.94661	<b>.08843</b>	8.95267	<b>.08967</b>	36
25	.92825	<b>.08477</b>	.93445	<b>.08599</b>	.94060	<b>.08722</b>	.94671	<b>.08845</b>	.95277	<b>.08970</b>	35
26	.92835	<b>.08479</b>	.93455	<b>.08601</b>	.94071	<b>.08724</b>	.94681	<b>.08847</b>	.95287	<b>.08972</b>	34
27	.92845	<b>.08481</b>	.93466	<b>.08603</b>	.94081	<b>.08726</b>	.94691	<b>.08849</b>	.95297	<b>.08974</b>	33
+ 7'	8.92856	<b>.08483</b>	8.93476	<b>.08605</b>	8.94091	<b>.08728</b>	8.94701	<b>.08851</b>	8.95307	<b>.08976</b>	32
29	.92866	<b>.08485</b>	.93486	<b>.08607</b>	.94101	<b>.08730</b>	.94712	<b>.08853</b>	.95317	<b>.08978</b>	31
30	.92877	<b>.08487</b>	.93496	<b>.08609</b>	.94111	<b>.08732</b>	.94722	<b>.08856</b>	.95327	<b>.08980</b>	30
31	.92887	<b>.08489</b>	.93507	<b>.08611</b>	.94122	<b>.08734</b>	.94732	<b>.08858</b>	.95337	<b>.08982</b>	29
+ 8'	8.92897	<b>.08491</b>	8.93517	<b>.08613</b>	8.94132	<b>.08736</b>	8.94742	<b>.08860</b>	8.95347	<b>.08984</b>	28
33	.92908	<b>.08493</b>	.93527	<b>.08615</b>	.94142	<b>.08738</b>	.94752	<b>.08862</b>	.95357	<b>.08986</b>	27
34	.92918	<b>.08495</b>	.93538	<b>.08617</b>	.94152	<b>.08740</b>	.94762	<b>.08864</b>	.95368	<b>.08988</b>	26
35	.92928	<b>.08497</b>	.93548	<b>.08619</b>	.94162	<b>.08742</b>	.94772	<b>.08866</b>	.95378	<b>.08990</b>	25
+ 9'	8.92939	<b>.08499</b>	8.93558	<b>.08621</b>	8.94173	<b>.08744</b>	8.94782	<b>.08868</b>	8.95388	<b>.08992</b>	24
37	.92949	<b>.08501</b>	.93568	<b>.08624</b>	.94183	<b>.08746</b>	.94793	<b>.08870</b>	.95398	<b>.08994</b>	23
38	.92960	<b>.08503</b>	.93579	<b>.08626</b>	.94193	<b>.08748</b>	.94803	<b>.08872</b>	.95408	<b>.08997</b>	22
39	.92970	<b>.08505</b>	.93589	<b>.08628</b>	.94203	<b>.08750</b>	.94813	<b>.08874</b>	.95418	<b>.08999</b>	21
+ 10'	8.92980	<b>.08508</b>	8.93599	<b>.08630</b>	8.94213	<b>.08753</b>	8.94823	<b>.08876</b>	8.95428	<b>.09001</b>	20
41	.92991	<b>.08510</b>	.93610	<b>.08632</b>	.94224	<b>.08755</b>	.94833	<b>.08878</b>	.95438	<b>.09003</b>	19
42	.93001	<b>.08512</b>	.93620	<b>.08634</b>	.94234	<b>.08757</b>	.94843	<b>.08880</b>	.95448	<b>.09005</b>	18
43	.93011	<b>.08514</b>	.93630	<b>.08636</b>	.94244	<b>.08759</b>	.94853	<b>.08882</b>	.95458	<b>.09007</b>	17
+ 11'	8.93022	<b>.08516</b>	8.93640	<b>.08638</b>	8.94254	<b>.08761</b>	8.94863	<b>.08885</b>	8.95468	<b>.09009</b>	16
45	.93032	<b>.08518</b>	.93651	<b>.08640</b>	.94264	<b>.08763</b>	.94874	<b>.08887</b>	.95478	<b>.09011</b>	15
46	.93042	<b>.08520</b>	.93661	<b>.08642</b>	.94275	<b>.08765</b>	.94884	<b>.08889</b>	.95488	<b>.09013</b>	14
47	.93053	<b>.08522</b>	.93671	<b>.08644</b>	.94285	<b>.08767</b>	.94894	<b>.08891</b>	.95498	<b>.09015</b>	13
+ 12'	8.93063	<b>.08524</b>	8.93681	<b>.08646</b>	8.94295	<b>.08769</b>	8.94904	<b>.08893</b>	8.95508	<b>.09017</b>	12
49	.93073	<b>.08526</b>	.93692	<b>.08648</b>	.94305	<b>.08771</b>	.94914	<b>.08895</b>	.95518	<b>.09019</b>	11
50	.93084	<b>.08528</b>	.93702	<b>.08650</b>	.94315	<b>.08773</b>	.94924	<b>.08897</b>	.95528	<b>.09022</b>	10
51	.93094	<b>.08530</b>	.93712	<b>.08652</b>	.94326	<b>.08775</b>	.94934	<b>.08899</b>	.95538	<b>.09024</b>	9
+ 13'	8.93104	<b>.08532</b>	8.93722	<b>.08654</b>	8.94336	<b>.08777</b>	8.94944	<b>.08901</b>	8.95548	<b>.09026</b>	8
53	.93115	<b>.08534</b>	.93733	<b>.08656</b>	.94346	<b>.08779</b>	.94954	<b>.08903</b>	.95558	<b>.09028</b>	7
54	.93125	<b>.08536</b>	.93743	<b>.08658</b>	.94356	<b>.08781</b>	.94965	<b>.08905</b>	.95568	<b>.09030</b>	6
55	.93135	<b>.08538</b>	.93753	<b>.08660</b>	.94366	<b>.08783</b>	.94975	<b>.08907</b>	.95578	<b>.09032</b>	5
+ 14'	8.93146	<b>.08540</b>	8.93764	<b>.08662</b>	8.94376	<b>.08785</b>	8.94985	<b>.08909</b>	8.95588	<b>.09034</b>	4
57	.93156	<b>.08542</b>	.93774	<b>.08664</b>	.94387	<b>.08788</b>	.94995	<b>.08911</b>	.95598	<b>.09036</b>	3
58	.93166	<b>.08544</b>	.93784	<b>.08666</b>	.94397	<b>.08790</b>	.95005	<b>.08914</b>	.95608	<b>.09038</b>	2
59	.93177	<b>.08546</b>	.93794	<b>.08668</b>	.94407	<b>.08792</b>	.95015	<b>.08916</b>	.95618	<b>.09040</b>	1
+ 15'	8.93187	<b>.08548</b>	8.93805	<b>.08671</b>	8.94417	<b>.08794</b>	8.95025	<b>.08918</b>	8.95628	<b>.09042</b>	0
	21h 44m		21h 43m		21h 42m		21h 41m		21h 40m		



s	2h 20m 35° 0'		2h 21m 35° 15'		2h 22m 35° 30'		2h 23m 35° 45'		2h 24m 36° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.95628	<b>.09042</b>	8.96227	<b>.09168</b>	8.96821	<b>.09294</b>	8.97411	<b>.09421</b>	8.97997	<b>.09549</b>	60
1	.95638	<b>.09044</b>	.96237	<b>.09170</b>	.96831	<b>.09296</b>	.97421	<b>.09423</b>	.98006	<b>.09551</b>	59
2	.95648	<b>.09047</b>	.96247	<b>.09172</b>	.96841	<b>.09298</b>	.97431	<b>.09426</b>	.98016	<b>.09553</b>	58
3	.95658	<b>.09049</b>	.96257	<b>.09174</b>	.96851	<b>.09301</b>	.97441	<b>.09428</b>	.98026	<b>.09556</b>	57
+ 1'	8.95668	<b>.09051</b>	8.96267	<b>.09176</b>	8.96861	<b>.09303</b>	8.97450	<b>.09430</b>	8.98035	<b>.09558</b>	56
5	.95678	<b>.09053</b>	.96277	<b>.09178</b>	.96871	<b>.09305</b>	.97460	<b>.09432</b>	.98045	<b>.09560</b>	55
6	.95688	<b>.09055</b>	.96287	<b>.09181</b>	.96881	<b>.09307</b>	.97470	<b>.09434</b>	.98055	<b>.09562</b>	54
7	.95698	<b>.09057</b>	.96297	<b>.09183</b>	.96890	<b>.09309</b>	.97480	<b>.09436</b>	.98065	<b>.09564</b>	53
+ 2'	8.95709	<b>.09059</b>	8.96307	<b>.09185</b>	8.96900	<b>.09311</b>	8.97489	<b>.09438</b>	8.98074	<b>.09566</b>	52
9	.95719	<b>.09061</b>	.96317	<b>.09187</b>	.96910	<b>.09313</b>	.97499	<b>.09440</b>	.98084	<b>.09568</b>	51
10	.95729	<b>.09063</b>	.96326	<b>.09189</b>	.96920	<b>.09315</b>	.97509	<b>.09443</b>	.98094	<b>.09571</b>	50
11	.95739	<b>.09065</b>	.96336	<b>.09191</b>	.96930	<b>.09317</b>	.97519	<b>.09445</b>	.98103	<b>.09573</b>	49
+ 3'	8.95749	<b>.09067</b>	8.96346	<b>.09193</b>	8.96940	<b>.09320</b>	8.97529	<b>.09447</b>	8.98113	<b>.09575</b>	48
13	.95759	<b>.09070</b>	.96356	<b>.09195</b>	.96950	<b>.09322</b>	.97538	<b>.09449</b>	.98123	<b>.09577</b>	47
14	.95769	<b>.09072</b>	.96366	<b>.09197</b>	.96959	<b>.09324</b>	.97548	<b>.09451</b>	.98132	<b>.09579</b>	46
15	.95779	<b>.09074</b>	.96376	<b>.09199</b>	.96969	<b>.09326</b>	.97558	<b>.09453</b>	.98142	<b>.09581</b>	45
+ 4'	8.95789	<b>.09076</b>	8.96386	<b>.09202</b>	8.96979	<b>.09328</b>	8.97568	<b>.09455</b>	8.98152	<b>.09583</b>	44
17	.95799	<b>.09078</b>	.96396	<b>.09204</b>	.96989	<b>.09330</b>	.97577	<b>.09457</b>	.98162	<b>.09586</b>	43
18	.95809	<b>.09080</b>	.96406	<b>.09206</b>	.96999	<b>.09332</b>	.97587	<b>.09460</b>	.98171	<b>.09588</b>	42
19	.95819	<b>.09082</b>	.96416	<b>.09208</b>	.97009	<b>.09334</b>	.97597	<b>.09462</b>	.98181	<b>.09590</b>	41
+ 5'	8.95828	<b>.09084</b>	8.96426	<b>.09210</b>	8.97018	<b>.09337</b>	8.97607	<b>.09464</b>	8.98191	<b>.09592</b>	40
21	.95838	<b>.09086</b>	.96436	<b>.09212</b>	.97028	<b>.09339</b>	.97617	<b>.09466</b>	.98200	<b>.09594</b>	39
22	.95848	<b>.09088</b>	.96446	<b>.09214</b>	.97038	<b>.09341</b>	.97626	<b>.09468</b>	.98210	<b>.09596</b>	38
23	.95858	<b>.09090</b>	.96456	<b>.09216</b>	.97048	<b>.09343</b>	.97636	<b>.09470</b>	.98220	<b>.09598</b>	37
+ 6'	8.95868	<b>.09093</b>	8.96465	<b>.09218</b>	8.97058	<b>.09345</b>	8.97646	<b>.09472</b>	8.98229	<b>.09601</b>	36
25	.95878	<b>.09095</b>	.96475	<b>.09220</b>	.97068	<b>.09347</b>	.97656	<b>.09474</b>	.98239	<b>.09603</b>	35
26	.95888	<b>.09097</b>	.96485	<b>.09223</b>	.97077	<b>.09349</b>	.97665	<b>.09477</b>	.98249	<b>.09605</b>	34
27	.95898	<b>.09099</b>	.96495	<b>.09225</b>	.97087	<b>.09351</b>	.97675	<b>.09479</b>	.98259	<b>.09607</b>	33
+ 7'	8.95908	<b>.09101</b>	8.96505	<b>.09227</b>	8.97097	<b>.09353</b>	8.97685	<b>.09481</b>	8.98268	<b>.09609</b>	32
29	.95918	<b>.09103</b>	.96515	<b>.09229</b>	.97107	<b>.09356</b>	.97695	<b>.09483</b>	.98278	<b>.09611</b>	31
30	.95928	<b>.09105</b>	.96525	<b>.09231</b>	.97117	<b>.09358</b>	.97704	<b>.09485</b>	.98288	<b>.09613</b>	30
31	.95938	<b>.09107</b>	.96535	<b>.09233</b>	.97127	<b>.09360</b>	.97714	<b>.09487</b>	.98297	<b>.09616</b>	29
+ 8'	8.95948	<b>.09109</b>	8.96545	<b>.09235</b>	8.97136	<b>.09362</b>	8.97724	<b>.09489</b>	8.98307	<b>.09618</b>	28
33	.95958	<b>.09111</b>	.96555	<b>.09237</b>	.97146	<b>.09364</b>	.97734	<b>.09492</b>	.98317	<b>.09620</b>	27
34	.95968	<b>.09113</b>	.96564	<b>.09239</b>	.97156	<b>.09366</b>	.97743	<b>.09494</b>	.98326	<b>.09622</b>	26
35	.95978	<b>.09116</b>	.96574	<b>.09242</b>	.97166	<b>.09368</b>	.97753	<b>.09496</b>	.98336	<b>.09624</b>	25
+ 9'	8.95988	<b>.09118</b>	8.96584	<b>.09244</b>	8.97176	<b>.09370</b>	8.97763	<b>.09498</b>	8.98346	<b>.09626</b>	24
37	.95998	<b>.09120</b>	.96594	<b>.09246</b>	.97186	<b>.09372</b>	.97773	<b>.09500</b>	.98355	<b>.09628</b>	23
38	.96008	<b>.09122</b>	.96604	<b>.09248</b>	.97195	<b>.09375</b>	.97782	<b>.09502</b>	.98365	<b>.09631</b>	22
39	.96018	<b>.09124</b>	.96614	<b>.09250</b>	.97205	<b>.09377</b>	.97792	<b>.09504</b>	.98375	<b>.09633</b>	21
+ 10'	8.96028	<b>.09126</b>	8.96624	<b>.09252</b>	8.97215	<b>.09379</b>	8.97802	<b>.09506</b>	8.98384	<b>.09635</b>	20
41	.96038	<b>.09128</b>	.96634	<b>.09254</b>	.97225	<b>.09381</b>	.97812	<b>.09509</b>	.98394	<b>.09637</b>	19
42	.96048	<b>.09130</b>	.96644	<b>.09256</b>	.97235	<b>.09383</b>	.97821	<b>.09511</b>	.98404	<b>.09639</b>	18
43	.96058	<b>.09132</b>	.96653	<b>.09258</b>	.97244	<b>.09385</b>	.97831	<b>.09513</b>	.98413	<b>.09641</b>	17
+ 11'	8.96068	<b>.09134</b>	8.96663	<b>.09260</b>	8.97254	<b>.09387</b>	8.97841	<b>.09515</b>	8.98423	<b>.09643</b>	16
45	.96078	<b>.09136</b>	.96673	<b>.09263</b>	.97264	<b>.09389</b>	.97851	<b>.09517</b>	.98433	<b>.09646</b>	15
46	.96088	<b>.09139</b>	.96683	<b>.09265</b>	.97274	<b>.09392</b>	.97860	<b>.09519</b>	.98442	<b>.09648</b>	14
47	.96098	<b>.09141</b>	.96693	<b>.09267</b>	.97284	<b>.09394</b>	.97870	<b>.09521</b>	.98452	<b>.09650</b>	13
+ 12'	8.96108	<b>.09143</b>	8.96703	<b>.09269</b>	8.97294	<b>.09396</b>	8.97880	<b>.09524</b>	8.98462	<b>.09652</b>	12
49	.96118	<b>.09145</b>	.96713	<b>.09271</b>	.97303	<b>.09398</b>	.97890	<b>.09526</b>	.98471	<b>.09654</b>	11
50	.96128	<b>.09147</b>	.96723	<b>.09273</b>	.97313	<b>.09400</b>	.97899	<b>.09528</b>	.98481	<b>.09656</b>	10
51	.96138	<b>.09149</b>	.96733	<b>.09275</b>	.97323	<b>.09402</b>	.97909	<b>.09530</b>	.98491	<b>.09658</b>	9
+ 13'	8.96148	<b>.09151</b>	8.96742	<b>.09277</b>	8.97333	<b>.09404</b>	8.97919	<b>.09532</b>	8.98500	<b>.09661</b>	8
53	.96158	<b>.09153</b>	.96752	<b>.09280</b>	.97343	<b>.09406</b>	.97928	<b>.09534</b>	.98510	<b>.09663</b>	7
54	.96167	<b>.09155</b>	.96762	<b>.09282</b>	.97352	<b>.09409</b>	.97938	<b>.09536</b>	.98520	<b>.09665</b>	6
55	.96177	<b>.09157</b>	.96772	<b>.09284</b>	.97362	<b>.09411</b>	.97948	<b>.09538</b>	.98529	<b>.09667</b>	5
+ 14'	8.96187	<b>.09160</b>	8.96782	<b>.09286</b>	8.97372	<b>.09413</b>	8.97958	<b>.09541</b>	8.98539	<b>.09669</b>	4
57	.96197	<b>.09162</b>	.96792	<b>.09288</b>	.97382	<b>.09415</b>	.97967	<b>.09543</b>	.98549	<b>.09671</b>	3
58	.96207	<b>.09164</b>	.96802	<b>.09290</b>	.97392	<b>.09417</b>	.97977	<b>.09545</b>	.98558	<b>.09673</b>	2
59	.96217	<b>.09166</b>	.96812	<b>.09292</b>	.97401	<b>.09419</b>	.97987	<b>.09547</b>	.98568	<b>.09676</b>	1
+ 15'	8.96227	<b>.09168</b>	8.96821	<b>.09294</b>	8.97411	<b>.09421</b>	8.97997	<b>.09549</b>	8.98578	<b>.09678</b>	0
	21h 39m		21h 38m		21h 37m		21h 36m		21h 35m		

TABLE IV

Haversines.

s	2h 25m 36° 15'		2h 26m 36° 30'		2h 27m 36° 45'		2h 28m 37° 0'		2h 29m 37° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	8.98578	<b>.09678</b>	8.99154	<b>.09807</b>	8.99727	<b>.09937</b>	9.00295	<b>.10068</b>	9.00860	<b>.10200</b>	60
1	.98587	<b>.09680</b>	.99164	<b>.09809</b>	.99736	<b>.09939</b>	.00305	<b>.10070</b>	.00869	<b>.10202</b>	59
2	.98597	<b>.09682</b>	.99173	<b>.09811</b>	.99746	<b>.09942</b>	.00314	<b>.10073</b>	.00878	<b>.10204</b>	58
3	.98606	<b>.09684</b>	.99183	<b>.09814</b>	.99755	<b>.09944</b>	.00324	<b>.10075</b>	.00888	<b>.10206</b>	57
+ 1'	8.98616	<b>.09686</b>	8.99193	<b>.09816</b>	8.99765	<b>.09946</b>	9.00333	<b>.10077</b>	9.00897	<b>.10209</b>	56
5	.98626	<b>.09689</b>	.99202	<b>.09818</b>	.99774	<b>.09948</b>	.00342	<b>.10079</b>	.00906	<b>.10211</b>	55
6	.98635	<b>.09691</b>	.99212	<b>.09820</b>	.99784	<b>.09950</b>	.00352	<b>.10081</b>	.00916	<b>.10213</b>	54
7	.98645	<b>.09693</b>	.99221	<b>.09822</b>	.99793	<b>.09953</b>	.00361	<b>.10084</b>	.00925	<b>.10215</b>	53
+ 2'	8.98655	<b>.09695</b>	8.99231	<b>.09824</b>	8.99803	<b>.09955</b>	9.00371	<b>.10086</b>	9.00935	<b>.10218</b>	52
9	.98664	<b>.09697</b>	.99240	<b>.09827</b>	.99812	<b>.09957</b>	.00380	<b>.10088</b>	.00944	<b>.10220</b>	51
10	.98674	<b>.09699</b>	.99250	<b>.09829</b>	.99822	<b>.09959</b>	.00390	<b>.10090</b>	.00953	<b>.10222</b>	50
11	.98684	<b>.09701</b>	.99260	<b>.09831</b>	.99831	<b>.09961</b>	.00399	<b>.10092</b>	.00963	<b>.10224</b>	49
+ 3'	8.98693	<b>.09704</b>	8.99269	<b>.09833</b>	8.99841	<b>.09963</b>	9.00408	<b>.10095</b>	9.00972	<b>.10226</b>	48
13	.98703	<b>.09706</b>	.99279	<b>.09835</b>	.99850	<b>.09966</b>	.00418	<b>.10097</b>	.00981	<b>.10228</b>	47
14	.98712	<b>.09708</b>	.99288	<b>.09837</b>	.99860	<b>.09968</b>	.00427	<b>.10099</b>	.00991	<b>.10231</b>	46
15	.98722	<b>.09710</b>	.99298	<b>.09840</b>	.99869	<b>.09970</b>	.00437	<b>.10101</b>	.01000	<b>.10233</b>	45
+ 4'	8.98732	<b>.09712</b>	8.99307	<b>.09842</b>	8.99879	<b>.09972</b>	9.00446	<b>.10103</b>	9.01009	<b>.10235</b>	44
17	.98741	<b>.09714</b>	.99317	<b>.09844</b>	.99888	<b>.09974</b>	.00456	<b>.10105</b>	.01019	<b>.10237</b>	43
18	.98751	<b>.09717</b>	.99327	<b>.09846</b>	.99898	<b>.09977</b>	.00465	<b>.10108</b>	.01028	<b>.10240</b>	42
19	.98761	<b>.09719</b>	.99336	<b>.09848</b>	.99907	<b>.09979</b>	.00474	<b>.10110</b>	.01037	<b>.10242</b>	41
+ 5'	8.98770	<b>.09721</b>	8.99346	<b>.09850</b>	8.99917	<b>.09981</b>	9.00484	<b>.10112</b>	9.01047	<b>.10244</b>	40
21	.98780	<b>.09723</b>	.99355	<b>.09853</b>	.99926	<b>.09983</b>	.00493	<b>.10114</b>	.01056	<b>.10246</b>	39
22	.98790	<b>.09725</b>	.99365	<b>.09855</b>	.99936	<b>.09985</b>	.00503	<b>.10116</b>	.01065	<b>.10248</b>	38
23	.98799	<b>.09727</b>	.99374	<b>.09857</b>	.99945	<b>.09987</b>	.00512	<b>.10119</b>	.01075	<b>.10251</b>	37
+ 6'	8.98809	<b>.09729</b>	8.99384	<b>.09859</b>	8.99955	<b>.09990</b>	9.00522	<b>.10121</b>	9.01084	<b>.10253</b>	36
25	.98818	<b>.09732</b>	.99393	<b>.09861</b>	.99964	<b>.09992</b>	.00531	<b>.10123</b>	.01094	<b>.10255</b>	35
26	.98828	<b>.09734</b>	.99403	<b>.09863</b>	.99974	<b>.09994</b>	.00540	<b>.10125</b>	.01103	<b>.10257</b>	34
27	.98838	<b>.09736</b>	.99412	<b>.09866</b>	.99983	<b>.09996</b>	.00550	<b>.10127</b>	.01112	<b>.10259</b>	33
+ 7'	8.98847	<b>.09738</b>	8.99422	<b>.09868</b>	8.99993	<b>.09998</b>	9.00559	<b>.10130</b>	9.01122	<b>.10262</b>	32
29	.98857	<b>.09740</b>	.99432	<b>.09870</b>	9.00002	<b>.10000</b>	.00569	<b>.10132</b>	.01131	<b>.10264</b>	31
30	.98866	<b>.09742</b>	.99441	<b>.09872</b>	.00012	<b>.10003</b>	.00578	<b>.10134</b>	.01140	<b>.10266</b>	30
31	.98876	<b>.09745</b>	.99451	<b>.09874</b>	.00021	<b>.10005</b>	.00587	<b>.10136</b>	.01150	<b>.10268</b>	29
+ 8'	8.98886	<b>.09747</b>	8.99460	<b>.09876</b>	9.00031	<b>.10007</b>	9.00597	<b>.10138</b>	9.01159	<b>.10270</b>	28
33	.98895	<b>.09749</b>	.99470	<b>.09879</b>	.00040	<b>.10009</b>	.00606	<b>.10141</b>	.01168	<b>.10273</b>	27
34	.98905	<b>.09751</b>	.99479	<b>.09881</b>	.00049	<b>.10011</b>	.00616	<b>.10143</b>	.01178	<b>.10275</b>	26
35	.98915	<b>.09753</b>	.99489	<b>.09883</b>	.00059	<b>.10014</b>	.00625	<b>.10145</b>	.01187	<b>.10277</b>	25
+ 9'	8.98924	<b>.09755</b>	8.99498	<b>.09885</b>	9.00068	<b>.10016</b>	9.00634	<b>.10147</b>	9.01196	<b>.10279</b>	24
37	.98934	<b>.09757</b>	.99508	<b>.09887</b>	.00078	<b>.10018</b>	.00644	<b>.10149</b>	.01206	<b>.10281</b>	23
38	.98943	<b>.09760</b>	.99517	<b>.09890</b>	.00087	<b>.10020</b>	.00653	<b>.10152</b>	.01215	<b>.10284</b>	22
39	.98953	<b>.09762</b>	.99527	<b>.09892</b>	.00097	<b>.10022</b>	.00663	<b>.10154</b>	.01224	<b>.10286</b>	21
+ 10'	8.98963	<b>.09764</b>	8.99536	<b>.09894</b>	9.00106	<b>.10025</b>	9.00672	<b>.10156</b>	9.01234	<b>.10288</b>	20
41	.98972	<b>.09766</b>	.99546	<b>.09896</b>	.00116	<b>.10027</b>	.00681	<b>.10158</b>	.01243	<b>.10290</b>	19
42	.98982	<b>.09768</b>	.99556	<b>.09898</b>	.00125	<b>.10029</b>	.00691	<b>.10160</b>	.01252	<b>.10293</b>	18
43	.98991	<b>.09770</b>	.99565	<b>.09900</b>	.00135	<b>.10031</b>	.00700	<b>.10163</b>	.01262	<b>.10295</b>	17
+ 11'	8.99001	<b>.09773</b>	8.99575	<b>.09903</b>	9.00144	<b>.10033</b>	9.00710	<b>.10165</b>	9.01271	<b>.10297</b>	16
45	.99011	<b>.09775</b>	.99584	<b>.09905</b>	.00154	<b>.10035</b>	.00719	<b>.10167</b>	.01280	<b>.10299</b>	15
46	.99020	<b>.09777</b>	.99594	<b>.09907</b>	.00163	<b>.10038</b>	.00728	<b>.10169</b>	.01289	<b>.10301</b>	14
47	.99030	<b>.09779</b>	.99603	<b>.09909</b>	.00172	<b>.10040</b>	.00738	<b>.10171</b>	.01299	<b>.10304</b>	13
+ 12'	8.99039	<b>.09781</b>	8.99613	<b>.09911</b>	9.00182	<b>.10042</b>	9.00747	<b>.10174</b>	9.01308	<b>.10306</b>	12
49	.99049	<b>.09783</b>	.99622	<b>.09913</b>	.00191	<b>.10044</b>	.00756	<b>.10176</b>	.01317	<b>.10308</b>	11
50	.99058	<b>.09786</b>	.99632	<b>.09916</b>	.00201	<b>.10046</b>	.00766	<b>.10178</b>	.01327	<b>.10310</b>	10
51	.99068	<b>.09788</b>	.99641	<b>.09918</b>	.00210	<b>.10049</b>	.00775	<b>.10180</b>	.01336	<b>.10312</b>	9
+ 13'	8.99078	<b>.09790</b>	8.99651	<b>.09920</b>	9.00220	<b>.10051</b>	9.00785	<b>.10182</b>	9.01345	<b>.10315</b>	8
53	.99087	<b>.09792</b>	.99660	<b>.09922</b>	.00229	<b>.10053</b>	.00794	<b>.10184</b>	.01355	<b>.10317</b>	7
54	.99097	<b>.09794</b>	.99670	<b>.09924</b>	.00239	<b>.10055</b>	.00803	<b>.10187</b>	.01364	<b>.10319</b>	6
55	.99106	<b>.09796</b>	.99679	<b>.09926</b>	.00248	<b>.10057</b>	.00813	<b>.10189</b>	.01373	<b>.10321</b>	5
+ 14'	8.99116	<b>.09799</b>	8.99689	<b>.09929</b>	9.00258	<b>.10059</b>	9.00822	<b>.10191</b>	9.01383	<b>.10323</b>	4
57	.99126	<b>.09801</b>	.99698	<b>.09931</b>	.00267	<b>.10062</b>	.00831	<b>.10193</b>	.01392	<b>.10326</b>	3
58	.99135	<b>.09803</b>	.99708	<b>.09933</b>	.00276	<b>.10064</b>	.00841	<b>.10196</b>	.01401	<b>.10328</b>	2
59	.99145	<b>.09805</b>	.99717	<b>.09935</b>	.00286	<b>.10066</b>	.00850	<b>.10198</b>	.01411	<b>.10330</b>	1
+ 15'	8.99154	<b>.09807</b>	8.99727	<b>.09937</b>	9.00295	<b>.10068</b>	9.00860	<b>.10200</b>	9.01420	<b>.10332</b>	0
	21h 34m		21h 33m		21h 32m		21h 31m		21h 30m		



Haversines.

s	2h 30m 37° 30'		2h 31m 37° 45'		2h 32m 38° 0'		2h 33m 38° 15'		2h 34m 38° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.01420	<b>.10332</b>	9.01976	<b>.10466</b>	9.02528	<b>.10599</b>	9.03077	<b>.10734</b>	9.03621	<b>.10870</b>	60
1	.01429	<b>.10335</b>	.01985	<b>.10463</b>	.02538	<b>.10602</b>	.03086	<b>.10736</b>	.03630	<b>.10872</b>	59
2	.01438	<b>.10337</b>	.01995	<b>.10470</b>	.02547	<b>.10604</b>	.03095	<b>.10739</b>	.03639	<b>.10874</b>	58
3	.01448	<b>.10339</b>	.02004	<b>.10472</b>	.02556	<b>.10606</b>	.03104	<b>.10741</b>	.03648	<b>.10876</b>	57
+ 1'	9.01457	<b>.10341</b>	9.02013	<b>.10474</b>	9.02565	<b>.10608</b>	9.03113	<b>.10743</b>	9.03657	<b>.10879</b>	56
5	.01466	<b>.10343</b>	.02022	<b>.10477</b>	.02574	<b>.10611</b>	.03122	<b>.10745</b>	.03667	<b>.10881</b>	55
6	.01476	<b>.10346</b>	.02031	<b>.10479</b>	.02583	<b>.10613</b>	.03131	<b>.10748</b>	.03676	<b>.10883</b>	54
7	.01485	<b>.10348</b>	.02041	<b>.10481</b>	.02593	<b>.10615</b>	.03141	<b>.10750</b>	.03685	<b>.10885</b>	53
+ 2'	9.01494	<b>.10350</b>	9.02050	<b>.10483</b>	9.02602	<b>.10617</b>	9.03150	<b>.10752</b>	9.03694	<b>.10888</b>	52
9	.01504	<b>.10352</b>	.02059	<b>.10486</b>	.02611	<b>.10620</b>	.03159	<b>.10754</b>	.03703	<b>.10890</b>	51
10	.01513	<b>.10354</b>	.02068	<b>.10488</b>	.02620	<b>.10622</b>	.03168	<b>.10757</b>	.03712	<b>.10892</b>	50
11	.01522	<b>.10357</b>	.02078	<b>.10490</b>	.02629	<b>.10624</b>	.03177	<b>.10759</b>	.03721	<b>.10895</b>	49
+ 3'	9.01531	<b>.10359</b>	9.02087	<b>.10492</b>	9.02638	<b>.10626</b>	9.03186	<b>.10761</b>	9.03730	<b>.10897</b>	48
13	.01541	<b>.10361</b>	.02096	<b>.10494</b>	.02648	<b>.10629</b>	.03195	<b>.10763</b>	.03739	<b>.10899</b>	47
14	.01550	<b>.10363</b>	.02105	<b>.10497</b>	.02657	<b>.10631</b>	.03204	<b>.10766</b>	.03748	<b>.10901</b>	46
15	.01559	<b>.10366</b>	.02115	<b>.10499</b>	.02666	<b>.10633</b>	.03213	<b>.10768</b>	.03757	<b>.10904</b>	45
+ 4'	9.01569	<b>.10368</b>	9.02124	<b>.10501</b>	9.02675	<b>.10635</b>	9.03222	<b>.10770</b>	9.03766	<b>.10906</b>	44
17	.01578	<b>.10370</b>	.02133	<b>.10503</b>	.02684	<b>.10638</b>	.03231	<b>.10772</b>	.03775	<b>.10908</b>	43
18	.01587	<b>.10372</b>	.02142	<b>.10506</b>	.02693	<b>.10640</b>	.03241	<b>.10775</b>	.03784	<b>.10910</b>	42
19	.01596	<b>.10374</b>	.02151	<b>.10508</b>	.02702	<b>.10642</b>	.03250	<b>.10777</b>	.03793	<b>.10913</b>	41
+ 5'	9.01606	<b>.10377</b>	9.02161	<b>.10510</b>	9.02712	<b>.10644</b>	9.03259	<b>.10779</b>	9.03802	<b>.10915</b>	40
21	.01615	<b>.10379</b>	.02170	<b>.10512</b>	.02721	<b>.10647</b>	.03268	<b>.10781</b>	.03811	<b>.10917</b>	39
22	.01624	<b>.10381</b>	.02179	<b>.10515</b>	.02730	<b>.10649</b>	.03277	<b>.10784</b>	.03820	<b>.10919</b>	38
23	.01634	<b>.10383</b>	.02188	<b>.10517</b>	.02739	<b>.10651</b>	.03286	<b>.10786</b>	.03829	<b>.10922</b>	37
+ 6'	9.01643	<b>.10386</b>	9.02197	<b>.10519</b>	9.02748	<b>.10653</b>	9.03295	<b>.10788</b>	9.03838	<b>.10924</b>	36
25	.01652	<b>.10388</b>	.02207	<b>.10521</b>	.02757	<b>.10655</b>	.03304	<b>.10790</b>	.03847	<b>.10926</b>	35
26	.01661	<b>.10390</b>	.02216	<b>.10523</b>	.02767	<b>.10658</b>	.03313	<b>.10793</b>	.03856	<b>.10929</b>	34
27	.01671	<b>.10392</b>	.02225	<b>.10526</b>	.02776	<b>.10660</b>	.03322	<b>.10795</b>	.03865	<b>.10931</b>	33
+ 7'	9.01680	<b>.10394</b>	9.02234	<b>.10528</b>	9.02785	<b>.10662</b>	9.03331	<b>.10797</b>	9.03874	<b>.10933</b>	32
29	.01689	<b>.10397</b>	.02244	<b>.10530</b>	.02794	<b>.10664</b>	.03340	<b>.10799</b>	.03883	<b>.10935</b>	31
30	.01698	<b>.10399</b>	.02253	<b>.10532</b>	.02803	<b>.10667</b>	.03350	<b>.10802</b>	.03892	<b>.10938</b>	30
31	.01708	<b>.10401</b>	.02262	<b>.10535</b>	.02812	<b>.10669</b>	.03359	<b>.10804</b>	.03901	<b>.10940</b>	29
+ 8'	9.01717	<b>.10403</b>	9.02271	<b>.10537</b>	9.02821	<b>.10671</b>	9.03368	<b>.10806</b>	9.03910	<b>.10942</b>	28
33	.01726	<b>.10405</b>	.02280	<b>.10539</b>	.02830	<b>.10673</b>	.03377	<b>.10809</b>	.03919	<b>.10944</b>	27
34	.01736	<b>.10408</b>	.02290	<b>.10541</b>	.02840	<b>.10676</b>	.03386	<b>.10811</b>	.03928	<b>.10947</b>	26
35	.01745	<b>.10410</b>	.02299	<b>.10544</b>	.02849	<b>.10678</b>	.03395	<b>.10813</b>	.03937	<b>.10949</b>	25
+ 9'	9.01754	<b>.10412</b>	9.02308	<b>.10546</b>	9.02858	<b>.10680</b>	9.03404	<b>.10815</b>	9.03946	<b>.10951</b>	24
37	.01763	<b>.10414</b>	.02317	<b>.10548</b>	.02867	<b>.10682</b>	.03413	<b>.10818</b>	.03955	<b>.10953</b>	23
38	.01773	<b>.10417</b>	.02326	<b>.10550</b>	.02876	<b>.10685</b>	.03422	<b>.10820</b>	.03964	<b>.10956</b>	22
39	.01782	<b>.10419</b>	.02336	<b>.10552</b>	.02885	<b>.10687</b>	.03431	<b>.10822</b>	.03973	<b>.10958</b>	21
+ 10'	9.01791	<b>.10421</b>	9.02345	<b>.10555</b>	9.02894	<b>.10689</b>	9.03440	<b>.10824</b>	9.03982	<b>.10960</b>	20
41	.01800	<b>.10423</b>	.02354	<b>.10557</b>	.02904	<b>.10691</b>	.03449	<b>.10827</b>	.03991	<b>.10963</b>	19
42	.01810	<b>.10425</b>	.02363	<b>.10559</b>	.02913	<b>.10694</b>	.03458	<b>.10829</b>	.04000	<b>.10965</b>	18
43	.01819	<b>.10428</b>	.02372	<b>.10561</b>	.02922	<b>.10696</b>	.03467	<b>.10831</b>	.04009	<b>.10967</b>	17
+ 11'	9.01828	<b>.10430</b>	9.02381	<b>.10564</b>	9.02931	<b>.10698</b>	9.03476	<b>.10833</b>	9.04018	<b>.10969</b>	16
45	.01837	<b>.10432</b>	.02391	<b>.10566</b>	.02940	<b>.10700</b>	.03486	<b>.10836</b>	.04027	<b>.10972</b>	15
46	.01847	<b>.10434</b>	.02400	<b>.10568</b>	.02949	<b>.10703</b>	.03495	<b>.10838</b>	.04036	<b>.10974</b>	14
47	.01856	<b>.10436</b>	.02409	<b>.10570</b>	.02958	<b>.10705</b>	.03504	<b>.10840</b>	.04045	<b>.10976</b>	13
+ 12'	9.01865	<b>.10439</b>	9.02418	<b>.10573</b>	9.02967	<b>.10707</b>	9.03513	<b>.10842</b>	9.04054	<b>.10978</b>	12
49	.01874	<b>.10441</b>	.02427	<b>.10575</b>	.02977	<b>.10709</b>	.03522	<b>.10845</b>	.04063	<b>.10981</b>	11
50	.01884	<b>.10443</b>	.02437	<b>.10577</b>	.02986	<b>.10712</b>	.03531	<b>.10847</b>	.04072	<b>.10983</b>	10
51	.01893	<b>.10445</b>	.02446	<b>.10579</b>	.02995	<b>.10714</b>	.03540	<b>.10849</b>	.04081	<b>.10985</b>	9
+ 13'	9.01902	<b>.10448</b>	9.02455	<b>.10582</b>	9.03004	<b>.10716</b>	9.03549	<b>.10851</b>	9.04090	<b>.10988</b>	8
53	.01911	<b>.10450</b>	.02464	<b>.10584</b>	.03013	<b>.10718</b>	.03558	<b>.10854</b>	.04099	<b>.10990</b>	7
54	.01921	<b>.10452</b>	.02473	<b>.10586</b>	.03022	<b>.10721</b>	.03567	<b>.10856</b>	.04108	<b>.10992</b>	6
55	.01930	<b>.10454</b>	.02483	<b>.10588</b>	.03031	<b>.10723</b>	.03576	<b>.10858</b>	.04117	<b>.10994</b>	5
+ 14'	9.01939	<b>.10457</b>	9.02492	<b>.10591</b>	9.03040	<b>.10725</b>	9.03585	<b>.10861</b>	9.04126	<b>.10997</b>	4
57	.01948	<b>.10459</b>	.02501	<b>.10593</b>	.03050	<b>.10727</b>	.03594	<b>.10863</b>	.04135	<b>.10999</b>	3
58	.01958	<b>.10461</b>	.02510	<b>.10595</b>	.03059	<b>.10730</b>	.03603	<b>.10865</b>	.04144	<b>.11001</b>	2
59	.01967	<b>.10463</b>	.02519	<b>.10597</b>	.03068	<b>.10732</b>	.03612	<b>.10867</b>	.04153	<b>.11004</b>	1
+ 15'	9.01976	<b>.10466</b>	9.02528	<b>.10599</b>	9.03077	<b>.10734</b>	9.03621	<b>.10870</b>	9.04162	<b>.11006</b>	0
	21h 29m		21h 28m		21h 27m		21h 26m		21h 25m		

TABLE IV.

Haversines.

s	2h 35m 33° 45'		2h 36m 39° 0'		2h 37m 39° 15'		2h 38m 39° 30'		2h 39m 39° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.04162	<b>.11006</b>	9.04699	<b>.11143</b>	9.05232	<b>.11280</b>	9.05762	<b>.11419</b>	9.06288	<b>.11558</b>	60
1	.04171	<b>.11008</b>	.04708	<b>.11145</b>	.05241	<b>.11283</b>	.05771	<b>.11421</b>	.06297	<b>.11560</b>	59
2	.04180	<b>.11010</b>	.04717	<b>.11147</b>	.05250	<b>.11285</b>	.05780	<b>.11423</b>	.06305	<b>.11563</b>	58
3	.04189	<b>.11013</b>	.04726	<b>.11150</b>	.05259	<b>.11287</b>	.05788	<b>.11426</b>	.06314	<b>.11565</b>	57
+ 1'	9.04198	<b>.11015</b>	9.04735	<b>.11152</b>	9.05268	<b>.11290</b>	9.05797	<b>.11428</b>	9.06323	<b>.11567</b>	56
5	.04207	<b>.11017</b>	.04744	<b>.11154</b>	.05277	<b>.11292</b>	.05806	<b>.11430</b>	.06332	<b>.11569</b>	55
6	.04216	<b>.11019</b>	.04753	<b>.11156</b>	.05285	<b>.11294</b>	.05815	<b>.11433</b>	.06340	<b>.11572</b>	54
7	.04225	<b>.11022</b>	.04761	<b>.11159</b>	.05294	<b>.11296</b>	.05823	<b>.11435</b>	.06349	<b>.11574</b>	53
+ 2'	9.04234	<b>.11024</b>	9.04770	<b>.11161</b>	9.05303	<b>.11299</b>	9.05832	<b>.11437</b>	9.06358	<b>.11577</b>	52
9	.04243	<b>.11026</b>	.04779	<b>.11163</b>	.05312	<b>.11301</b>	.05841	<b>.11440</b>	.06367	<b>.11579</b>	51
10	.04252	<b>.11029</b>	.04788	<b>.11166</b>	.05321	<b>.11303</b>	.05850	<b>.11442</b>	.06375	<b>.11581</b>	50
11	.04261	<b>.11031</b>	.04797	<b>.11168</b>	.05330	<b>.11306</b>	.05859	<b>.11444</b>	.06384	<b>.11584</b>	49
+ 3'	9.04270	<b>.11033</b>	9.04806	<b>.11170</b>	9.05339	<b>.11308</b>	9.05867	<b>.11447</b>	9.06393	<b>.11586</b>	48
13	.04279	<b>.11035</b>	.04815	<b>.11172</b>	.05347	<b>.11310</b>	.05876	<b>.11449</b>	.06401	<b>.11588</b>	47
14	.04288	<b>.11038</b>	.04824	<b>.11175</b>	.05356	<b>.11313</b>	.05885	<b>.11451</b>	.06410	<b>.11590</b>	46
15	.04297	<b>.11040</b>	.04833	<b>.11177</b>	.05365	<b>.11315</b>	.05894	<b>.11453</b>	.06419	<b>.11593</b>	45
+ 4'	9.04306	<b>.11042</b>	9.04842	<b>.11179</b>	9.05374	<b>.11317</b>	9.05903	<b>.11456</b>	9.06428	<b>.11595</b>	44
17	.04315	<b>.11044</b>	.04851	<b>.11182</b>	.05383	<b>.11320</b>	.05911	<b>.11458</b>	.06436	<b>.11597</b>	43
18	.04324	<b>.11047</b>	.04859	<b>.11184</b>	.05392	<b>.11322</b>	.05920	<b>.11460</b>	.06445	<b>.11600</b>	42
19	.04333	<b>.11049</b>	.04868	<b>.11186</b>	.05400	<b>.11324</b>	.05929	<b>.11463</b>	.06454	<b>.11602</b>	41
+ 5'	9.04341	<b>.11051</b>	9.04877	<b>.11189</b>	9.05409	<b>.11326</b>	9.05938	<b>.11465</b>	9.06462	<b>.11604</b>	40
21	.04350	<b>.11054</b>	.04886	<b>.11191</b>	.05418	<b>.11329</b>	.05946	<b>.11467</b>	.06471	<b>.11607</b>	39
22	.04359	<b>.11056</b>	.04895	<b>.11193</b>	.05427	<b>.11331</b>	.05955	<b>.11470</b>	.06480	<b>.11609</b>	38
23	.04368	<b>.11058</b>	.04904	<b>.11195</b>	.05436	<b>.11333</b>	.05964	<b>.11472</b>	.06489	<b>.11611</b>	37
+ 6'	9.04377	<b>.11060</b>	9.04913	<b>.11198</b>	9.05445	<b>.11336</b>	9.05973	<b>.11474</b>	9.06497	<b>.11614</b>	36
25	.04386	<b>.11063</b>	.04922	<b>.11200</b>	.05453	<b>.11338</b>	.05982	<b>.11477</b>	.06506	<b>.11616</b>	35
26	.04395	<b>.11065</b>	.04931	<b>.11202</b>	.05462	<b>.11340</b>	.05990	<b>.11479</b>	.06515	<b>.11618</b>	34
27	.04404	<b>.11067</b>	.04939	<b>.11205</b>	.05471	<b>.11343</b>	.05999	<b>.11481</b>	.06523	<b>.11621</b>	33
+ 7'	9.04413	<b>.11070</b>	9.04948	<b>.11207</b>	9.05480	<b>.11345</b>	9.06008	<b>.11484</b>	9.06532	<b>.11623</b>	32
29	.04422	<b>.11072</b>	.04957	<b>.11209</b>	.05489	<b>.11347</b>	.06017	<b>.11486</b>	.06541	<b>.11625</b>	31
30	.04431	<b>.11074</b>	.04966	<b>.11211</b>	.05498	<b>.11349</b>	.06025	<b>.11488</b>	.06550	<b>.11628</b>	30
31	.04440	<b>.11076</b>	.04975	<b>.11214</b>	.05506	<b>.11352</b>	.06034	<b>.11491</b>	.06558	<b>.11630</b>	29
+ 8'	9.04449	<b>.11079</b>	9.04984	<b>.11216</b>	9.05515	<b>.11354</b>	9.06043	<b>.11493</b>	9.06567	<b>.11632</b>	28
33	.04458	<b>.11081</b>	.04993	<b>.11218</b>	.05524	<b>.11356</b>	.06052	<b>.11495</b>	.06576	<b>.11635</b>	27
34	.04467	<b>.11083</b>	.05002	<b>.11221</b>	.05533	<b>.11359</b>	.06060	<b>.11498</b>	.06584	<b>.11637</b>	26
35	.04476	<b>.11086</b>	.05011	<b>.11223</b>	.05542	<b>.11361</b>	.06069	<b>.11500</b>	.06593	<b>.11639</b>	25
+ 9'	9.04485	<b>.11088</b>	9.05019	<b>.11225</b>	9.05551	<b>.11363</b>	9.06078	<b>.11502</b>	9.06602	<b>.11642</b>	24
37	.04494	<b>.11090</b>	.05028	<b>.11228</b>	.05559	<b>.11366</b>	.06087	<b>.11504</b>	.06611	<b>.11644</b>	23
38	.04503	<b>.11092</b>	.05037	<b>.11230</b>	.05568	<b>.11368</b>	.06095	<b>.11507</b>	.06619	<b>.11646</b>	22
39	.04512	<b>.11095</b>	.05046	<b>.11232</b>	.05577	<b>.11370</b>	.06104	<b>.11509</b>	.06628	<b>.11649</b>	21
+ 10'	9.04520	<b>.11097</b>	9.05055	<b>.11234</b>	9.05586	<b>.11373</b>	9.06113	<b>.11511</b>	9.06637	<b>.11651</b>	20
41	.04529	<b>.11099</b>	.05064	<b>.11237</b>	.05595	<b>.11375</b>	.06122	<b>.11514</b>	.06645	<b>.11653</b>	19
42	.04538	<b>.11102</b>	.05073	<b>.11239</b>	.05603	<b>.11377</b>	.06131	<b>.11516</b>	.06654	<b>.11656</b>	18
43	.04547	<b>.11104</b>	.05082	<b>.11241</b>	.05612	<b>.11379</b>	.06139	<b>.11518</b>	.06663	<b>.11658</b>	17
+ 11'	9.04556	<b>.11106</b>	9.05090	<b>.11244</b>	9.05621	<b>.11382</b>	9.06148	<b>.11521</b>	9.06671	<b>.11660</b>	16
45	.04565	<b>.11108</b>	.05099	<b>.11246</b>	.05630	<b>.11384</b>	.06157	<b>.11523</b>	.06680	<b>.11663</b>	15
46	.04574	<b>.11111</b>	.05108	<b>.11248</b>	.05639	<b>.11386</b>	.06166	<b>.11525</b>	.06689	<b>.11665</b>	14
47	.04583	<b>.11113</b>	.05117	<b>.11251</b>	.05648	<b>.11389</b>	.06174	<b>.11528</b>	.06697	<b>.11667</b>	13
+ 12'	9.04592	<b>.11115</b>	9.05126	<b>.11253</b>	9.05656	<b>.11391</b>	9.06183	<b>.11530</b>	9.06706	<b>.11670</b>	12
49	.04601	<b>.11117</b>	.05135	<b>.11255</b>	.05665	<b>.11393</b>	.06192	<b>.11532</b>	.06715	<b>.11672</b>	11
50	.04610	<b>.11120</b>	.05144	<b>.11257</b>	.05674	<b>.11396</b>	.06201	<b>.11535</b>	.06724	<b>.11674</b>	10
51	.04619	<b>.11122</b>	.05153	<b>.11260</b>	.05683	<b>.11398</b>	.06209	<b>.11537</b>	.06732	<b>.11677</b>	9
+ 13'	9.04628	<b>.11124</b>	9.05161	<b>.11262</b>	9.05692	<b>.11400</b>	9.06218	<b>.11539</b>	9.06741	<b>.11679</b>	8
53	.04637	<b>.11127</b>	.05170	<b>.11264</b>	.05700	<b>.11403</b>	.06227	<b>.11542</b>	.06750	<b>.11681</b>	7
54	.04646	<b>.11129</b>	.05179	<b>.11267</b>	.05709	<b>.11405</b>	.06235	<b>.11544</b>	.06758	<b>.11684</b>	6
55	.04654	<b>.11131</b>	.05188	<b>.11269</b>	.05718	<b>.11407</b>	.06244	<b>.11546</b>	.06767	<b>.11686</b>	5
+ 14'	9.04663	<b>.11134</b>	9.05197	<b>.11271</b>	9.05727	<b>.11410</b>	9.06253	<b>.11549</b>	9.06776	<b>.11688</b>	4
57	.04672	<b>.11136</b>	.05206	<b>.11274</b>	.05736	<b>.11412</b>	.06262	<b>.11551</b>	.06784	<b>.11691</b>	3
58	.04681	<b>.11138</b>	.05215	<b>.11276</b>	.05744	<b>.11414</b>	.06270	<b>.11553</b>	.06793	<b>.11692</b>	2
59	.04690	<b>.11140</b>	.05223	<b>.11278</b>	.05753	<b>.11416</b>	.06279	<b>.11556</b>	.06802	<b>.11695</b>	1
+ 15'	9.04699	<b>.11143</b>	9.05232	<b>.11280</b>	9.05762	<b>.11419</b>	9.06288	<b>.11558</b>	9.06810	<b>.11698</b>	0
	21h 24m		21h 23m		21h 22m		21h 21m		21h 20m		



TABLE IV.  
Haversines.

s	2h 40m 40° 0'		2h 41m 40° 15'		2h 42m 40° 30'		2h 43m 40° 45'		2h 44m 41° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.06810	.11698	9.07329	.11838	9.07845	.11980	9.08357	.12122	9.08865	.12265	60
1	.06819	.11700	.07338	.11841	.07853	.11982	.08365	.12124	.08874	.12267	59
2	.06828	.11702	.07346	.11843	.07862	.11984	.08374	.12127	.08882	.12269	58
3	.06836	.11705	.07355	.11845	.07870	.11987	.08382	.12129	.08890	.12272	57
+ 1'	9.06845	.11707	9.07364	.11848	9.07879	.11989	9.08391	.12131	9.08899	.12274	56
5	.06854	.11709	.07372	.11850	.07887	.11992	.08399	.12134	.08907	.12276	55
6	.06862	.11712	.07381	.11852	.07896	.11994	.08408	.12136	.08916	.12279	54
7	.06871	.11714	.07390	.11855	.07905	.11996	.08416	.12138	.08924	.12281	53
+ 2'	9.06880	.11716	9.07398	.11857	9.07913	.11999	9.08425	.12141	9.08933	.12284	52
9	.06888	.11719	.07407	.11860	.07922	.12001	.08433	.12143	.08941	.12286	51
10	.06897	.11721	.07415	.11862	.07930	.12003	.08442	.12146	.08949	.12288	50
11	.06906	.11724	.07424	.11864	.07939	.12006	.08450	.12148	.08958	.12291	49
+ 3'	9.06914	.11726	9.07433	.11867	9.07947	.12008	9.08459	.12150	9.08966	.12293	48
13	.06923	.11728	.07441	.11869	.07956	.12010	.08467	.12153	.08975	.12296	47
14	.06932	.11731	.07450	.11871	.07964	.12013	.08475	.12155	.08983	.12298	46
15	.06940	.11733	.07458	.11874	.07973	.12015	.08484	.12157	.08992	.12300	45
+ 4'	9.06949	.11735	9.07467	.11876	9.07981	.12018	9.08492	.12160	9.09000	.12303	44
17	.06958	.11738	.07476	.11878	.07990	.12020	.08501	.12162	.09009	.12305	43
18	.06966	.11740	.07484	.11881	.07999	.12022	.08509	.12165	.09017	.12307	42
19	.06975	.11742	.07493	.11883	.08007	.12025	.08518	.12167	.09025	.12310	41
+ 5'	9.06984	.11745	9.07501	.11885	9.08016	.12027	9.08526	.12169	9.09034	.12312	40
21	.06992	.11747	.07510	.11888	.08024	.12029	.08535	.12172	.09042	.12315	39
22	.07001	.11749	.07519	.11890	.08033	.12032	.08543	.12174	.09051	.12317	38
23	.07010	.11752	.07527	.11892	.08041	.12034	.08552	.12176	.09059	.12319	37
+ 6'	9.07018	.11754	9.07536	.11895	9.08050	.12036	9.08560	.12179	9.09068	.12322	36
25	.07027	.11756	.07544	.11897	.08058	.12039	.08569	.12181	.09076	.12324	35
26	.07036	.11759	.07553	.11900	.08067	.12041	.08577	.12184	.09084	.12327	34
27	.07044	.11761	.07562	.11902	.08075	.12044	.08586	.12186	.09093	.12329	33
+ 7'	9.07053	.11763	9.07570	.11904	9.08084	.12046	9.08594	.12188	9.09101	.12331	32
29	.07062	.11766	.07579	.11907	.08092	.12048	.08603	.12191	.09110	.12334	31
30	.07070	.11768	.07587	.11909	.08101	.12051	.08611	.12193	.09118	.12336	30
31	.07079	.11770	.07596	.11911	.08110	.12053	.08620	.12195	.09126	.12339	29
+ 8'	9.07088	.11773	9.07605	.11914	9.08118	.12055	9.08628	.12198	9.09135	.12341	28
33	.07096	.11775	.07613	.11916	.08127	.12058	.08637	.12200	.09143	.12343	27
34	.07105	.11777	.07622	.11918	.08135	.12060	.08645	.12203	.09152	.12346	26
35	.07113	.11780	.07630	.11921	.08144	.12062	.08654	.12205	.09160	.12348	25
+ 9'	9.07122	.11782	9.07639	.11923	9.08152	.12065	9.08662	.12207	9.09169	.12351	24
37	.07131	.11784	.07647	.11925	.08161	.12067	.08671	.12210	.09177	.12353	23
38	.07139	.11787	.07656	.11928	.08169	.12070	.08679	.12212	.09185	.12355	22
39	.07148	.11789	.07665	.11930	.08178	.12072	.08687	.12214	.09194	.12358	21
+ 10'	9.07157	.11791	9.07673	.11933	9.08186	.12074	9.08696	.12217	9.09202	.12360	20
41	.07165	.11794	.07682	.11935	.08195	.12077	.08704	.12219	.09211	.12363	19
42	.07174	.11796	.07690	.11937	.08203	.12079	.08713	.12222	.09219	.12365	18
43	.07183	.11798	.07699	.11940	.08212	.12081	.08721	.12224	.09227	.12367	17
+ 11'	9.07191	.11801	9.07708	.11942	9.08220	.12084	9.08730	.12226	9.09236	.12370	16
45	.07200	.11803	.07716	.11944	.08229	.12086	.08738	.12229	.09244	.12372	15
46	.07208	.11806	.07725	.11947	.08237	.12089	.08747	.12231	.09253	.12374	14
47	.07217	.11808	.07733	.11949	.08246	.12091	.08755	.12233	.09261	.12377	13
+ 12'	9.07226	.11810	9.07742	.11951	9.08254	.12093	9.08764	.12236	9.09269	.12379	12
49	.07234	.11813	.07750	.11954	.08263	.12096	.08772	.12238	.09278	.12382	11
50	.07243	.11815	.07759	.11956	.08271	.12098	.08781	.12241	.09286	.12384	10
51	.07252	.11817	.07768	.11958	.08280	.12100	.08789	.12243	.09295	.12386	9
+ 13'	9.07260	.11820	9.07776	.11961	9.08288	.12103	9.08797	.12245	9.09303	.12389	8
53	.07269	.11822	.07785	.11963	.08297	.12105	.08806	.12248	.09311	.12391	7
54	.07277	.11824	.07793	.11966	.08306	.12108	.08814	.12250	.09320	.12394	6
55	.07286	.11827	.07802	.11968	.08314	.12110	.08823	.12253	.09328	.12396	5
+ 14'	9.07295	.11829	9.07810	.11970	9.08323	.12112	9.08831	.12255	9.09337	.12398	4
57	.07303	.11831	.07819	.11973	.08331	.12115	.08840	.12257	.09345	.12401	3
58	.07312	.11834	.07827	.11975	.08340	.12117	.08848	.12260	.09353	.12403	2
59	.07321	.11836	.07836	.11977	.08348	.12119	.08857	.12262	.09362	.12406	1
+ 15'	9.07329	.11838	9.07845	.11980	9.08357	.12122	9.08865	.12265	9.09370	.12408	0
	21h 19m		21h 18m		21h 17m		21h 16m		21h 15m		

TABLE IV.

Haversines.

s	2h 45m 41° 15'		2h 46m 41° 30'		2h 47m 41° 45'		2h 48m 42° 0'		2h 49m 42° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.09370	.12408	9.09872	.12552	9.10371	.12697	9.10866	.12843	9.11358	.12989	60
1	.09379	.12410	.09880	.12555	.10379	.12700	.10874	.12845	.11366	.12992	59
2	.09387	.12413	.09889	.12557	.10387	.12702	.10882	.12848	.11374	.12994	58
3	.09395	.12415	.09897	.12559	.10395	.12704	.10891	.12850	.11382	.12996	57
+ 1'	9.09404	.12418	9.09905	.12562	9.10404	.12707	9.10899	.12852	9.11391	.12999	56
5	.09412	.12420	.09914	.12564	.10412	.12709	.10907	.12855	.11399	.13001	55
6	.09421	.12422	.09922	.12567	.10420	.12712	.10915	.12857	.11407	.13004	54
7	.09429	.12425	.09930	.12569	.10429	.12714	.10923	.12860	.11415	.13006	53
+ 2'	9.09437	.12427	9.09939	.12572	9.10437	.12717	9.10932	.12862	9.11423	.13009	52
9	.09446	.12430	.09947	.12574	.10445	.12719	.10940	.12865	.11431	.13011	51
10	.09454	.12432	.09955	.12576	.10453	.12721	.10948	.12867	.11440	.13014	50
11	.09462	.12434	.09964	.12579	.10462	.12724	.10956	.12870	.11448	.13016	49
+ 3'	9.09471	.12437	9.09972	.12581	9.10470	.12726	9.10965	.12872	9.11456	.13018	48
13	.09479	.12439	.09980	.12584	.10478	.12729	.10973	.12874	.11464	.13021	47
14	.09488	.12442	.09989	.12586	.10486	.12731	.10981	.12877	.11472	.13023	46
15	.09496	.12444	.09997	.12588	.10495	.12733	.10989	.12879	.11480	.13026	45
+ 4'	9.09504	.12446	9.10005	.12591	9.10503	.12736	9.10997	.12882	9.11489	.13028	44
17	.09513	.12449	.10014	.12593	.10511	.12738	.11006	.12884	.11497	.13031	43
18	.09521	.12451	.10022	.12596	.10519	.12741	.11014	.12887	.11505	.13033	42
19	.09529	.12454	.10030	.12598	.10528	.12743	.11022	.12889	.11513	.13036	41
+ 5'	9.09538	.12456	9.10039	.12600	9.10536	.12746	9.11030	.12891	9.11521	.13038	40
21	.09546	.12458	.10047	.12603	.10544	.12748	.11038	.12894	.11529	.13041	39
22	.09555	.12461	.10055	.12605	.10553	.12750	.11047	.12896	.11538	.13043	38
23	.09563	.12463	.10064	.12608	.10561	.12753	.11055	.12899	.11546	.13045	37
+ 6'	9.09571	.12466	9.10072	.12610	9.10569	.12755	9.11063	.12901	9.11554	.13048	36
25	.09580	.12468	.10080	.12613	.10577	.12758	.11071	.12904	.11562	.13050	35
26	.09588	.12470	.10088	.12615	.10586	.12760	.11079	.12906	.11570	.13053	34
27	.09596	.12473	.10097	.12617	.10594	.12763	.11088	.12909	.11578	.13055	33
+ 7'	9.09605	.12475	9.10105	.12620	9.10602	.12765	9.11096	.12911	9.11586	.13058	32
29	.09613	.12478	.10113	.12622	.10610	.12767	.11104	.12913	.11595	.13060	31
30	.09622	.12480	.10122	.12625	.10619	.12770	.11112	.12916	.11603	.13063	30
31	.09630	.12482	.10130	.12627	.10627	.12772	.11120	.12918	.11611	.13065	29
+ 8'	9.09638	.12485	9.10138	.12629	9.10635	.12775	9.11129	.12921	9.11619	.13067	28
33	.09647	.12487	.10147	.12632	.10643	.12777	.11137	.12923	.11627	.13070	27
34	.09655	.12490	.10155	.12634	.10652	.12780	.11145	.12926	.11635	.13072	26
35	.09663	.12492	.10163	.12637	.10660	.12782	.11153	.12928	.11643	.13075	25
+ 9'	9.09672	.12494	9.10172	.12639	9.10668	.12784	9.11161	.12930	9.11652	.13077	24
37	.09680	.12497	.10180	.12641	.10676	.12787	.11170	.12933	.11660	.13080	23
38	.09688	.12499	.10188	.12644	.10685	.12789	.11178	.12935	.11668	.13082	22
39	.09697	.12502	.10196	.12646	.10693	.12792	.11186	.12938	.11676	.13085	21
+ 10'	9.09705	.12504	9.10205	.12649	9.10701	.12794	9.11194	.12940	9.11684	.13087	20
41	.09713	.12506	.10213	.12651	.10709	.12797	.11202	.12943	.11692	.13090	19
42	.09722	.12509	.10221	.12654	.10718	.12799	.11211	.12945	.11700	.13092	18
43	.09730	.12511	.10230	.12656	.10726	.12801	.11219	.12948	.11709	.13095	17
+ 11'	9.09739	.12514	9.10238	.12658	9.10734	.12804	9.11227	.12950	9.11717	.13097	16
45	.09747	.12516	.10246	.12661	.10742	.12806	.11235	.12952	.11725	.13099	15
46	.09755	.12519	.10255	.12663	.10751	.12809	.11243	.12955	.11733	.13102	14
47	.09764	.12521	.10263	.12666	.10759	.12811	.11252	.12957	.11741	.13104	13
+ 12'	9.09772	.12523	9.10271	.12668	9.10767	.12814	9.11260	.12960	9.11749	.13107	12
49	.09780	.12526	.10279	.12671	.10775	.12816	.11268	.12962	.11757	.13109	11
50	.09789	.12528	.10288	.12673	.10784	.12818	.11276	.12965	.11766	.13112	10
51	.09797	.12531	.10296	.12675	.10792	.12821	.11284	.12967	.11774	.13114	9
+ 13'	9.09805	.12533	9.10304	.12678	9.10800	.12823	9.11292	.12970	9.11782	.13116	8
53	.09814	.12536	.10313	.12680	.10808	.12826	.11301	.12972	.11790	.13119	7
54	.09822	.12538	.10321	.12683	.10816	.12828	.11309	.12974	.11798	.13121	6
55	.09830	.12540	.10329	.12685	.10825	.12831	.11317	.12977	.11806	.13124	5
+ 14'	9.09839	.12543	9.10337	.12687	9.10833	.12833	9.11325	.12979	9.11814	.13126	4
57	.09847	.12545	.10346	.12690	.10841	.12836	.11333	.12982	.11822	.13129	3
58	.09856	.12547	.10354	.12692	.10849	.12838	.11342	.12984	.11831	.13131	2
59	.09864	.12550	.10362	.12695	.10858	.12840	.11350	.12987	.11839	.13134	1
+ 15'	9.09872	.12552	9.10371	.12697	9.10866	.12843	9.11358	.12989	9.11847	.13136	0
	21h 14m		21h 13m		21h 12m		21h 11m		21h 10m		



TABLE IV.  
Haversines.

s	2h 50m 42° 30'		2h 51m 42° 45'		2h 52m 43° 0'		2h 53m 43° 15'		2h 54m 43° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.11847	.13136	9.12332	.13284	9.12815	.13432	9.13295	.13581	9.13771	.13731	60
1	.11855	.13139	.12341	.13286	.12823	.13435	.13303	.13584	.13779	.13734	59
2	.11863	.13141	.12349	.13289	.12831	.13437	.13311	.13586	.13787	.13736	58
3	.11871	.13143	.12357	.13291	.12839	.13440	.13319	.13589	.13795	.13739	57
+ 1'	9.11879	.13146	9.12365	.13294	9.12847	.13442	9.13326	.13591	9.13803	.13741	56
5	.11887	.13148	.12373	.13296	.12855	.13445	.13334	.13594	.13811	.13744	55
6	.11895	.13151	.12381	.13299	.12863	.13447	.13342	.13596	.13819	.13746	54
7	.11904	.13153	.12389	.13301	.12871	.13450	.13350	.13599	.13827	.13749	53
+ 2'	9.11912	.13156	9.12397	.13304	9.12879	.13452	9.13358	.13601	9.13834	.13751	52
9	.11920	.13158	.12405	.13306	.12887	.13455	.13366	.13604	.13842	.13754	51
10	.11928	.13161	.12413	.13309	.12895	.13457	.13374	.13607	.13850	.13756	50
11	.11936	.13163	.12421	.13311	.12903	.13460	.13382	.13609	.13858	.13759	49
+ 3'	9.11944	.13166	9.12429	.13314	9.12911	.13462	9.13390	.13611	9.13866	.13761	48
13	.11952	.13168	.12437	.13316	.12919	.13465	.13398	.13614	.13874	.13764	47
14	.11960	.13171	.12445	.13318	.12927	.13467	.13406	.13616	.13882	.13766	46
15	.11968	.13173	.12453	.13321	.12935	.13470	.13414	.13619	.13890	.13769	45
+ 4'	9.11977	.13175	9.12461	.13323	9.12943	.13472	9.13422	.13621	9.13898	.13771	44
17	.11985	.13178	.12470	.13326	.12951	.13474	.13430	.13624	.13906	.13774	43
18	.11993	.13180	.12478	.13328	.12959	.13477	.13438	.13626	.13913	.13776	42
19	.12001	.13183	.12486	.13331	.12967	.13479	.13446	.13629	.13921	.13779	41
+ 5'	9.12009	.13185	9.12494	.13333	9.12975	.13482	9.13454	.13631	9.13929	.13781	40
21	.12017	.13188	.12502	.13336	.12983	.13484	.13462	.13634	.13937	.13784	39
22	.12025	.13190	.12510	.13338	.12991	.13487	.13470	.13636	.13945	.13786	38
23	.12033	.13193	.12518	.13341	.12999	.13489	.13478	.13639	.13953	.13789	37
+ 6'	9.12041	.13195	9.12526	.13343	9.13007	.13492	9.13486	.13641	9.13961	.13791	36
25	.12050	.13198	.12534	.13346	.13015	.13494	.13494	.13644	.13969	.13794	35
26	.12058	.13200	.12542	.13348	.13023	.13497	.13501	.13646	.13977	.13796	34
27	.12066	.13203	.12550	.13351	.13031	.13499	.13509	.13649	.13985	.13799	33
+ 7'	9.12074	.13205	9.12558	.13353	9.13039	.13502	9.13517	.13651	9.13992	.13801	32
29	.12082	.13207	.12566	.13356	.13047	.13504	.13525	.13654	.14000	.13804	31
30	.12090	.13210	.12574	.13358	.13055	.13507	.13533	.13656	.14008	.13806	30
31	.12098	.13212	.12582	.13360	.13063	.13509	.13541	.13659	.14016	.13809	29
+ 8'	9.12106	.13215	9.12590	.13363	9.13071	.13512	9.13549	.13661	9.14024	.13811	28
33	.12114	.13217	.12598	.13365	.13079	.13514	.13557	.13664	.14032	.13814	27
34	.12122	.13220	.12606	.13368	.13087	.13517	.13565	.13666	.14040	.13816	26
35	.12130	.13222	.12614	.13370	.13095	.13519	.13573	.13669	.14048	.13819	25
+ 9'	9.12139	.13225	9.12622	.13373	9.13103	.13522	9.13581	.13671	9.14056	.13822	24
37	.12147	.13227	.12630	.13375	.13111	.13524	.13589	.13674	.14063	.13824	23
38	.12155	.13230	.12638	.13378	.13119	.13527	.13597	.13676	.14071	.13827	22
39	.12163	.13232	.12647	.13380	.13127	.13529	.13605	.13679	.14079	.13829	21
+ 10'	9.12171	.13235	9.12655	.13383	9.13135	.13532	9.13613	.13681	9.14087	.13832	20
41	.12179	.13237	.12663	.13385	.13143	.13534	.13621	.13684	.14095	.13834	19
42	.12187	.13239	.12671	.13388	.13151	.13537	.13628	.13686	.14103	.13837	18
43	.12195	.13242	.12679	.13390	.13159	.13539	.13636	.13689	.14111	.13839	17
+ 11'	9.12203	.13244	9.12687	.13393	9.13167	.13542	9.13644	.13691	9.14119	.13842	16
45	.12211	.13247	.12695	.13395	.13175	.13544	.13652	.13694	.14127	.13844	15
46	.12219	.13249	.12703	.13398	.13183	.13547	.13660	.13696	.14134	.13847	14
47	.12228	.13252	.12711	.13400	.13191	.13549	.13668	.13699	.14142	.13849	13
+ 12'	9.12236	.13254	9.12719	.13403	9.13199	.13552	9.13676	.13701	9.14150	.13852	12
49	.12244	.13257	.12727	.13405	.13207	.13554	.13684	.13704	.14158	.13854	11
50	.12252	.13259	.12735	.13408	.13215	.13557	.13692	.13706	.14166	.13857	10
51	.12260	.13262	.12743	.13410	.13223	.13559	.13700	.13709	.14174	.13859	9
+ 13'	9.12268	.13264	9.12751	.13412	9.13231	.13562	9.13708	.13711	9.14182	.13862	8
53	.12276	.13267	.12759	.13415	.13239	.13564	.13716	.13714	.14190	.13864	7
54	.12284	.13269	.12767	.13417	.13247	.13567	.13724	.13716	.14197	.13866	6
55	.12292	.13272	.12775	.13420	.13255	.13569	.13732	.13719	.14205	.13869	5
+ 14'	9.12300	.13274	9.12783	.13422	9.13263	.13571	9.13739	.13721	9.14213	.13872	4
57	.12308	.13276	.12791	.13425	.13271	.13574	.13747	.13724	.14221	.13874	3
58	.12316	.13279	.12799	.13427	.13279	.13576	.13755	.13726	.14229	.13877	2
59	.12324	.13281	.12807	.13430	.13287	.13579	.13763	.13729	.14237	.13879	1
+ 15'	9.12332	.13284	9.12815	.13432	9.13295	.13581	9.13771	.13731	9.14245	.13882	0
	21h 9m		21h 8m		21h 7m		21h 6m		21h 5m		

TABLE IV.

Haversines.

s	2h 55m 43° 45'		2h 56m 44° 0'		2h 57m 44° 15'		2h 58m 44° 30'		2h 59m 44° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.14245	.13882	9.14715	.14033	9.15183	.14185	9.15647	.14337	9.16109	.14491	60
1	.14252	.13884	.14723	.14035	.15190	.14187	.15655	.14340	.16117	.14493	59
2	.14260	.13887	.14731	.14038	.15198	.14190	.15663	.14343	.16124	.14496	58
3	.14268	.13889	.14739	.14041	.15206	.14192	.15670	.14345	.16132	.14498	57
+ 1'	9.14276	.13892	9.14746	.14043	9.15214	.14195	9.15678	.14348	9.16140	.14501	56
5	.14284	.13894	.14754	.14046	.15221	.14198	.15686	.14350	.16147	.14504	55
6	.14292	.13897	.14762	.14048	.15229	.14200	.15694	.14353	.16155	.14506	54
7	.14300	.13899	.14770	.14051	.15237	.14203	.15701	.14355	.16163	.14509	53
+ 2'	9.14307	.13902	9.14778	.14053	9.15245	.14205	9.15709	.14358	9.16170	.14511	52
9	.14315	.13904	.14785	.14056	.15253	.14208	.15717	.14360	.16178	.14514	51
10	.14323	.13907	.14793	.14058	.15260	.14210	.15724	.14363	.16186	.14516	50
11	.14331	.13909	.14801	.14061	.15268	.14213	.15732	.14366	.16193	.14519	49
+ 3'	9.14339	.13912	9.14809	.14063	9.15276	.14215	9.15740	.14368	9.16201	.14521	48
13	.14347	.13914	.14817	.14066	.15284	.14218	.15748	.14371	.16209	.14524	47
14	.14355	.13917	.14824	.14068	.15291	.14220	.15755	.14373	.16216	.14527	46
15	.14362	.13920	.14832	.14071	.15299	.14223	.15763	.14376	.16224	.14529	45
+ 4'	9.14370	.13922	9.14840	.14073	9.15307	.14226	9.15771	.14378	9.16232	.14532	44
17	.14378	.13925	.14848	.14076	.15315	.14228	.15778	.14381	.16239	.14534	43
18	.14386	.13927	.14856	.14079	.15322	.14231	.15786	.14383	.16247	.14537	42
19	.14394	.13930	.14863	.14081	.15330	.14233	.15794	.14386	.16255	.14539	41
+ 5'	9.14402	.13932	9.14871	.14084	9.15338	.14236	9.15802	.14388	9.16262	.14542	40
21	.14410	.13935	.14879	.14086	.15346	.14238	.15809	.14391	.16270	.14545	39
22	.14417	.13937	.14887	.14089	.15353	.14241	.15817	.14394	.16278	.14547	38
23	.14425	.13940	.14895	.14091	.15361	.14243	.15825	.14396	.16285	.14550	37
+ 6'	9.14433	.13942	9.14902	.14094	9.15369	.14246	9.15832	.14399	9.16293	.14552	36
25	.14441	.13945	.14910	.14096	.15377	.14248	.15840	.14401	.16301	.14555	35
26	.14449	.13947	.14918	.14099	.15384	.14251	.15848	.14404	.16308	.14557	34
27	.14457	.13950	.14926	.14101	.15392	.14253	.15855	.14406	.16316	.14560	33
+ 7'	9.14465	.13952	9.14934	.14104	9.15400	.14256	9.15863	.14409	9.16324	.14562	32
29	.14472	.13955	.14941	.14106	.15408	.14259	.15871	.14411	.16331	.14565	31
30	.14480	.13957	.14949	.14109	.15415	.14261	.15879	.14414	.16339	.14568	30
31	.14488	.13960	.14957	.14111	.15423	.14264	.15886	.14417	.16346	.14570	29
+ 8'	9.14496	.13962	9.14965	.14114	9.15431	.14266	9.15894	.14419	9.16354	.14573	28
33	.14504	.13965	.14973	.14116	.15439	.14269	.15902	.14422	.16362	.14575	27
34	.14512	.13967	.14980	.14119	.15446	.14271	.15909	.14424	.16369	.14578	26
35	.14519	.13970	.14988	.14122	.15454	.14274	.15917	.14427	.16377	.14580	25
+ 9'	9.14527	.13972	9.14996	.14124	9.15462	.14276	9.15925	.14429	9.16385	.14583	24
37	.14535	.13975	.15004	.14127	.15470	.14279	.15932	.14432	.16392	.14586	23
38	.14543	.13977	.15012	.14129	.15477	.14281	.15940	.14434	.16400	.14588	22
39	.14551	.13980	.15019	.14132	.15485	.14284	.15948	.14437	.16408	.14591	21
+ 10'	9.14559	.13983	9.15027	.14134	9.15493	.14287	9.15955	.14440	9.16415	.14593	20
41	.14566	.13985	.15035	.14137	.15500	.14289	.15963	.14442	.16423	.14596	19
42	.14574	.13988	.15043	.14139	.15508	.14292	.15971	.14445	.16431	.14598	18
43	.14582	.13990	.15050	.14142	.15516	.14294	.15978	.14447	.16438	.14601	17
+ 11'	9.14590	.13993	9.15058	.14144	9.15524	.14297	9.15986	.14450	9.16446	.14604	16
45	.14598	.13995	.15066	.14147	.15531	.14299	.15994	.14452	.16453	.14606	15
46	.14606	.13998	.15074	.14149	.15539	.14302	.16002	.14455	.16461	.14609	14
47	.14613	.14000	.15082	.14152	.15547	.14304	.16009	.14457	.16469	.14611	13
+ 12'	9.14621	.14003	9.15089	.14154	9.15555	.14307	9.16017	.14460	9.16476	.14614	12
49	.14629	.14005	.15097	.14157	.15562	.14309	.16025	.14463	.16484	.14616	11
50	.14637	.14008	.15105	.14160	.15570	.14312	.16032	.14465	.16492	.14619	10
51	.14645	.14010	.15113	.14162	.15578	.14315	.16040	.14468	.16499	.14622	9
+ 13'	9.14653	.14013	9.15120	.14165	9.15585	.14317	9.16048	.14470	9.16507	.14624	8
53	.14660	.14015	.15128	.14167	.15593	.14320	.16055	.14473	.16515	.14627	7
54	.14668	.14018	.15136	.14170	.15601	.14322	.16063	.14475	.16522	.14629	6
55	.14676	.14020	.15144	.14172	.15609	.14325	.16071	.14478	.16530	.14632	5
+ 14'	9.14684	.14023	9.15152	.14175	9.15616	.14327	9.16078	.14480	9.16537	.14634	4
57	.14692	.14025	.15159	.14177	.15624	.14330	.16086	.14483	.16545	.14637	3
58	.14699	.14028	.15167	.14180	.15632	.14332	.16094	.14486	.16553	.14639	2
59	.14707	.14030	.15175	.14182	.15640	.14335	.16101	.14488	.16560	.14642	1
+ 15'	9.14715	.14033	9.15183	.14185	9.15647	.14337	9.16109	.14491	9.16568	.14645	0
	21h 4m		21h 3m		21h 2m		21h 1m		21h 0m		



TABLE IV.

Haversines.

s	3h 0m 45° 0'		3h 1m 45° 15'		3h 2m 45° 30'		3h 3m 45° 45'		3h 4m 46° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.16568	.14645	9.17024	.14799	9.17477	.14955	9.17928	.15110	9.18376	.15267	60
1	.16576	.14647	.17032	.14802	.17485	.14957	.17935	.15113	.18383	.15270	59
2	.16583	.14650	.17039	.14804	.17492	.14960	.17943	.15116	.18390	.15272	58
3	.16591	.14652	.17047	.14807	.17500	.14962	.17950	.15118	.18398	.15275	57
+ 1'	9.16598	.14655	9.17054	.14810	9.17507	.14965	9.17958	.15121	9.18405	.15278	56
5	.16606	.14658	.17062	.14812	.17515	.14968	.17965	.15123	.18413	.15280	55
6	.16614	.14660	.17069	.14815	.17522	.14970	.17973	.15125	.18420	.15283	54
7	.16621	.14663	.17077	.14817	.17530	.14973	.17980	.15129	.18428	.15285	53
+ 2'	9.16629	.14665	9.17085	.14820	9.17538	.14975	9.17988	.15131	9.18435	.15288	52
9	.16637	.14668	.17092	.14822	.17545	.14978	.17995	.15134	.18443	.15291	51
10	.16644	.14670	.17100	.14825	.17553	.14981	.18003	.15137	.18450	.15293	50
11	.16652	.14673	.17107	.14828	.17560	.14983	.18010	.15139	.18457	.15296	49
+ 3'	9.16659	.14676	9.17115	.14830	9.17568	.14986	9.18018	.15142	9.18465	.15298	48
13	.16667	.14678	.17122	.14833	.17575	.14988	.18025	.15144	.18472	.15301	47
14	.16675	.14681	.17130	.14835	.17583	.14991	.18033	.15147	.18480	.15304	46
15	.16682	.14683	.17138	.14838	.17590	.14993	.18040	.15150	.18487	.15306	45
+ 4'	9.16690	.14686	9.17145	.14841	9.17598	.14996	9.18048	.15152	9.18495	.15309	44
17	.16697	.14688	.17153	.14843	.17605	.14999	.18055	.15155	.18502	.15312	43
18	.16705	.14691	.17160	.14846	.17613	.15001	.18062	.15157	.18509	.15314	42
19	.16713	.14693	.17168	.14848	.17620	.15004	.18070	.15160	.18517	.15316	41
+ 5'	9.16720	.14696	9.17175	.14851	9.17628	.15006	9.18077	.15163	9.18524	.15319	40
21	.16728	.14699	.17183	.14853	.17635	.15009	.18085	.15165	.18532	.15322	39
22	.16735	.14701	.17191	.14856	.17643	.15012	.18092	.15168	.18539	.15325	38
23	.16743	.14704	.17198	.14859	.17650	.15014	.18100	.15170	.18547	.15327	37
+ 6'	9.16751	.14706	9.17206	.14861	9.17658	.15017	9.18107	.15173	9.18554	.15330	36
25	.16758	.14709	.17213	.14864	.17665	.15019	.18115	.15176	.18561	.15333	35
26	.16766	.14712	.17221	.14866	.17673	.15022	.18122	.15178	.18569	.15335	34
27	.16774	.14714	.17228	.14869	.17680	.15025	.18130	.15181	.18576	.15337	33
+ 7'	9.16781	.14717	9.17236	.14872	9.17688	.15027	9.18137	.15183	9.18584	.15340	32
29	.16789	.14719	.17243	.14874	.17695	.15030	.18145	.15186	.18591	.15343	31
30	.16796	.14722	.17251	.14877	.17703	.15032	.18152	.15189	.18598	.15346	30
31	.16804	.14724	.17259	.14879	.17710	.15035	.18160	.15191	.18606	.15348	29
+ 8'	9.16812	.14727	9.17266	.14882	9.17718	.15038	9.18167	.15194	9.18613	.15351	28
33	.16819	.14730	.17274	.14885	.17725	.15040	.18174	.15197	.18621	.15353	27
34	.16827	.14732	.17281	.14887	.17733	.15043	.18182	.15199	.18628	.15356	26
35	.16834	.14735	.17289	.14890	.17740	.15045	.18189	.15202	.18636	.15359	25
+ 9'	9.16842	.14737	9.17296	.14892	9.17748	.15048	9.18197	.15204	9.18643	.15361	24
37	.16850	.14740	.17304	.14895	.17755	.15051	.18204	.15207	.18650	.15364	23
38	.16857	.14743	.17311	.14898	.17763	.15053	.18212	.15210	.18658	.15367	22
39	.16865	.14745	.17319	.14900	.17770	.15056	.18219	.15212	.18665	.15369	21
+ 10'	9.16872	.14748	9.17327	.14903	9.17778	.15058	9.18227	.15215	9.18673	.15372	20
41	.16880	.14750	.17334	.14905	.17785	.15061	.18234	.15217	.18680	.15374	19
42	.16887	.14753	.17342	.14908	.17793	.15064	.18242	.15220	.18687	.15377	18
43	.16895	.14755	.17349	.14910	.17800	.15066	.18249	.15222	.18695	.15379	17
+ 11'	9.16903	.14758	9.17357	.14913	9.17808	.15069	9.18256	.15225	9.18702	.15382	16
45	.16910	.14760	.17364	.14916	.17815	.15071	.18264	.15228	.18710	.15385	15
46	.16918	.14763	.17372	.14918	.17823	.15074	.18271	.15230	.18717	.15388	14
47	.16925	.14766	.17379	.14921	.17830	.15077	.18279	.15233	.18724	.15390	13
+ 12'	9.16933	.14768	9.17387	.14923	9.17838	.15079	9.18286	.15236	9.18732	.15393	12
49	.16941	.14771	.17394	.14926	.17845	.15082	.18294	.15238	.18739	.15395	11
50	.16948	.14773	.17402	.14929	.17853	.15084	.18301	.15241	.18747	.15398	10
51	.16956	.14776	.17409	.14931	.17860	.15087	.18309	.15244	.18754	.15401	9
+ 13'	9.16963	.14779	9.17417	.14934	9.17868	.15090	9.18316	.15246	9.18762	.15403	8
53	.16971	.14781	.17425	.14936	.17875	.15092	.18324	.15249	.18769	.15406	7
54	.16979	.14784	.17432	.14939	.17883	.15095	.18331	.15251	.18776	.15409	6
55	.16986	.14786	.17440	.14942	.17890	.15097	.18338	.15254	.18784	.15411	5
+ 14'	9.16994	.14789	9.17447	.14944	9.17898	.15100	9.18346	.15257	9.18791	.15414	4
57	.17001	.14791	.17455	.14947	.17905	.15103	.18353	.15259	.18798	.15416	3
58	.17009	.14794	.17462	.14949	.17913	.15105	.18361	.15262	.18806	.15419	2
59	.17016	.14797	.17470	.14952	.17920	.15108	.18368	.15264	.18813	.15422	1
+ 15'	9.17024	.14799	9.17477	.14955	9.17928	.15110	9.18376	.15267	9.18821	.15424	0
		20h 59m		20h 58m		20h 57m		20h 56m		20h 55m	

TABLE IV.

Haversines.

s	3h 5m 46° 15'		3h 5m 46° 30'		3h 5m 46° 45'		3h 5m 47° 0'		3h 5m 47° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.18821	.15424	9.19263	.15582	9.19703	.15741	9.20140	.15900	9.20574	.16060	60
1	.18828	.15427	.19270	.15585	.19710	.15743	.20147	.15903	.20582	.16063	59
2	.18835	.15430	.19278	.15588	.19717	.15746	.20154	.15905	.20589	.16065	58
3	.18843	.15432	.19285	.15590	.19725	.15748	.20162	.15908	.20596	.16068	57
+ 1'	9.18850	.15435	9.19292	.15593	9.19732	.15751	9.20169	.15911	9.20603	.16071	56
5	.18858	.15437	.19300	.15595	.19739	.15754	.20176	.15913	.20611	.16073	55
6	.18865	.15440	.19307	.15598	.19747	.15757	.20184	.15916	.20618	.16076	54
7	.18872	.15443	.19315	.15601	.19754	.15759	.20191	.15919	.20625	.16079	53
+ 2'	9.18880	.15445	9.19322	.15603	9.19761	.15762	9.20198	.15921	9.20632	.16081	52
9	.18887	.15448	.19329	.15606	.19769	.15765	.20205	.15924	.20639	.16084	51
10	.18895	.15451	.19337	.15609	.19776	.15767	.20213	.15927	.20647	.16087	50
11	.18902	.15453	.19344	.15611	.19783	.15770	.20220	.15929	.20654	.16089	49
+ 3'	9.18909	.15456	9.19351	.15614	9.19790	.15773	9.20227	.15932	9.20661	.16092	48
13	.18917	.15458	.19359	.15617	.19798	.15775	.20234	.15935	.20668	.16095	47
14	.18924	.15461	.19366	.15619	.19805	.15778	.20242	.15937	.20675	.16097	46
15	.18932	.15464	.19373	.15622	.19812	.15781	.20249	.15940	.20683	.16100	45
+ 4'	9.18939	.15466	9.19381	.15625	9.19820	.15783	9.20256	.15943	9.20690	.16103	44
17	.18946	.15469	.19388	.15627	.19827	.15786	.20263	.15945	.20697	.16105	43
18	.18954	.15472	.19395	.15630	.19834	.15789	.20271	.15948	.20704	.16108	42
19	.18961	.15474	.19403	.15632	.19842	.15791	.20278	.15951	.20712	.16111	41
+ 5'	9.18968	.15477	9.19410	.15635	9.19849	.15794	9.20285	.15953	9.20719	.16113	40
21	.18976	.15479	.19417	.15638	.19856	.15796	.20292	.15956	.20726	.16116	39
22	.18983	.15482	.19425	.15640	.19863	.15799	.20300	.15959	.20733	.16119	38
23	.18991	.15485	.19432	.15643	.19871	.15802	.20307	.15961	.20740	.16121	37
+ 6'	9.18998	.15487	9.19439	.15646	9.19878	.15804	9.20314	.15964	9.20748	.16124	36
25	.19005	.15490	.19447	.15648	.19885	.15807	.20321	.15967	.20755	.16127	35
26	.19013	.15493	.19454	.15651	.19893	.15810	.20329	.15969	.20762	.16129	34
27	.19020	.15495	.19461	.15654	.19900	.15812	.20336	.15972	.20769	.16132	33
+ 7'	9.19027	.15498	9.19469	.15656	9.19907	.15815	9.20343	.15975	9.20776	.16135	32
29	.19035	.15501	.19476	.15659	.19914	.15818	.20350	.15977	.20784	.16137	31
30	.19042	.15503	.19483	.15662	.19922	.15820	.20358	.15980	.20791	.16140	30
31	.19050	.15506	.19491	.15664	.19929	.15823	.20365	.15983	.20798	.16143	29
+ 8'	9.19057	.15509	9.19498	.15667	9.19936	.15826	9.20372	.15985	9.20805	.16146	28
33	.19064	.15511	.19505	.15670	.19944	.15828	.20379	.15988	.20812	.16148	27
34	.19072	.15514	.19513	.15672	.19951	.15831	.20386	.15991	.20820	.16151	26
35	.19079	.15516	.19520	.15675	.19958	.15834	.20394	.15993	.20827	.16154	25
+ 9'	9.19086	.15519	9.19527	.15677	9.19965	.15836	9.20401	.15996	9.20834	.16156	24
37	.19094	.15522	.19535	.15680	.19973	.15839	.20408	.15999	.20841	.16159	23
38	.19101	.15524	.19542	.15683	.19980	.15842	.20415	.16001	.20848	.16162	22
39	.19109	.15527	.19549	.15685	.19987	.15844	.20423	.16004	.20856	.16164	21
+ 10'	9.19116	.15530	9.19557	.15688	9.19995	.15847	9.20430	.16007	9.20863	.16167	20
41	.19123	.15532	.19564	.15691	.20002	.15850	.20437	.16009	.20870	.16170	19
42	.19131	.15535	.19571	.15693	.20009	.15852	.20444	.16012	.20877	.16172	18
43	.19138	.15537	.19579	.15696	.20016	.15855	.20452	.16015	.20884	.16175	17
+ 11'	9.19145	.15540	9.19586	.15699	9.20024	.15858	9.20459	.16017	9.20891	.16178	16
45	.19153	.15543	.19593	.15701	.20031	.15860	.20466	.16020	.20899	.16180	15
46	.19160	.15545	.19600	.15704	.20038	.15863	.20473	.16023	.20906	.16183	14
47	.19167	.15548	.19608	.15706	.20045	.15866	.20481	.16025	.20913	.16186	13
+ 12'	9.19175	.15551	9.19615	.15709	9.20053	.15868	9.20488	.16028	9.20920	.16188	12
49	.19182	.15553	.19622	.15712	.20060	.15871	.20495	.16031	.20927	.16191	11
50	.19190	.15556	.19630	.15714	.20067	.15874	.20502	.16033	.20935	.16194	10
51	.19197	.15559	.19637	.15717	.20075	.15876	.20509	.16036	.20942	.16196	9
+ 13'	9.19204	.15561	9.19644	.15720	9.20082	.15879	9.20517	.16039	9.20949	.16199	8
53	.19212	.15564	.19652	.15722	.20089	.15881	.20524	.16041	.20956	.16202	7
54	.19219	.15566	.19659	.15725	.20096	.15884	.20531	.16044	.20963	.16204	6
55	.19226	.15569	.19666	.15728	.20104	.15887	.20538	.16047	.20971	.16207	5
+ 14'	9.19234	.15572	9.19674	.15730	9.20111	.15889	9.20546	.16049	9.20978	.16210	4
57	.19241	.15574	.19681	.15733	.20118	.15892	.20553	.16052	.20985	.16212	3
58	.19248	.15577	.19688	.15736	.20125	.15895	.20560	.16055	.20992	.16215	2
59	.19256	.15580	.19696	.15738	.20133	.15898	.20567	.16057	.20999	.16218	1
+ 15'	9.19263	.15582	9.19703	.15741	9.20140	.15900	9.20574	.16060	9.21006	.16220	0
	20h 54m		20h 53m		20h 52m		20h 51m		20h 50m		



s	3h 10m 47° 30'		3h 11m 47° 45'		3h 12m 48° 0'		3h 13m 48° 15'		3h 14m 48° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.21006	<b>.16220</b>	9.21436	<b>.16382</b>	9.21863	<b>.16543</b>	9.22287	<b>.16706</b>	9.22709	<b>.16869</b>	60
1	.21014	<b>.16233</b>	.21443	<b>.16384</b>	.21870	<b>.16546</b>	.22294	<b>.16709</b>	.22716	<b>.16872</b>	59
2	.21021	<b>.16236</b>	.21450	<b>.16387</b>	.21877	<b>.16549</b>	.22301	<b>.16711</b>	.22723	<b>.16874</b>	58
3	.21028	<b>.16239</b>	.21457	<b>.16390</b>	.21884	<b>.16552</b>	.22308	<b>.16714</b>	.22730	<b>.16877</b>	57
+ 1'	9.21035	<b>.16231</b>	9.21464	<b>.16392</b>	9.21891	<b>.16554</b>	9.22315	<b>.16717</b>	9.22737	<b>.16880</b>	56
5	.21042	<b>.16234</b>	.21471	<b>.16395</b>	.21898	<b>.16557</b>	.22322	<b>.16720</b>	.22744	<b>.16883</b>	55
6	.21049	<b>.16237</b>	.21479	<b>.16398</b>	.21905	<b>.16560</b>	.22329	<b>.16722</b>	.22751	<b>.16885</b>	54
7	.21057	<b>.16239</b>	.21486	<b>.16401</b>	.21912	<b>.16562</b>	.22336	<b>.16725</b>	.22758	<b>.16888</b>	53
+ 2'	9.21064	<b>.16242</b>	9.21493	<b>.16403</b>	9.21919	<b>.16565</b>	9.22343	<b>.16728</b>	9.22765	<b>.16891</b>	52
9	.21071	<b>.16245</b>	.21500	<b>.16406</b>	.21926	<b>.16568</b>	.22350	<b>.16730</b>	.22772	<b>.16893</b>	51
10	.21078	<b>.16247</b>	.21507	<b>.16409</b>	.21934	<b>.16571</b>	.22358	<b>.16733</b>	.22779	<b>.16896</b>	50
11	.21085	<b>.16250</b>	.21514	<b>.16411</b>	.21941	<b>.16573</b>	.22365	<b>.16736</b>	.22786	<b>.16899</b>	49
+ 3'	9.21092	<b>.16253</b>	9.21521	<b>.16414</b>	9.21948	<b>.16576</b>	9.22372	<b>.16738</b>	9.22793	<b>.16902</b>	48
13	.21100	<b>.16255</b>	.21529	<b>.16417</b>	.21955	<b>.16579</b>	.22379	<b>.16741</b>	.22800	<b>.16904</b>	47
14	.21107	<b>.16258</b>	.21536	<b>.16419</b>	.21962	<b>.16581</b>	.22386	<b>.16744</b>	.22807	<b>.16907</b>	46
15	.21114	<b>.16261</b>	.21543	<b>.16422</b>	.21969	<b>.16584</b>	.22393	<b>.16747</b>	.22814	<b>.16910</b>	45
+ 4'	9.21121	<b>.16263</b>	9.21550	<b>.16425</b>	9.21976	<b>.16587</b>	9.22400	<b>.16749</b>	9.22821	<b>.16913</b>	44
17	.21128	<b>.16266</b>	.21557	<b>.16427</b>	.21983	<b>.16589</b>	.22407	<b>.16752</b>	.22828	<b>.16915</b>	43
18	.21135	<b>.16269</b>	.21564	<b>.16430</b>	.21990	<b>.16592</b>	.22414	<b>.16755</b>	.22835	<b>.16918</b>	42
19	.21143	<b>.16271</b>	.21571	<b>.16433</b>	.21997	<b>.16595</b>	.22421	<b>.16757</b>	.22842	<b>.16921</b>	41
+ 5'	9.21150	<b>.16274</b>	9.21578	<b>.16436</b>	9.22004	<b>.16598</b>	9.22428	<b>.16760</b>	9.22849	<b>.16924</b>	40
21	.21157	<b>.16277</b>	.21585	<b>.16438</b>	.22011	<b>.16600</b>	.22435	<b>.16763</b>	.22856	<b>.16926</b>	39
22	.21164	<b>.16280</b>	.21593	<b>.16441</b>	.22019	<b>.16603</b>	.22442	<b>.16766</b>	.22863	<b>.16929</b>	38
23	.21171	<b>.16282</b>	.21600	<b>.16444</b>	.22026	<b>.16606</b>	.22449	<b>.16768</b>	.22870	<b>.16932</b>	37
+ 6'	9.21178	<b>.16285</b>	9.21607	<b>.16446</b>	9.22033	<b>.16608</b>	9.22456	<b>.16771</b>	9.22877	<b>.16934</b>	36
25	.21186	<b>.16288</b>	.21614	<b>.16449</b>	.22040	<b>.16611</b>	.22463	<b>.16774</b>	.22884	<b>.16937</b>	35
26	.21193	<b>.16290</b>	.21621	<b>.16452</b>	.22047	<b>.16614</b>	.22470	<b>.16777</b>	.22891	<b>.16940</b>	34
27	.21200	<b>.16293</b>	.21628	<b>.16454</b>	.22054	<b>.16616</b>	.22477	<b>.16779</b>	.22898	<b>.16943</b>	33
+ 7'	9.21207	<b>.16296</b>	9.21635	<b>.16457</b>	9.22061	<b>.16619</b>	9.22484	<b>.16782</b>	9.22905	<b>.16945</b>	32
29	.21214	<b>.16298</b>	.21642	<b>.16460</b>	.22068	<b>.16622</b>	.22491	<b>.16785</b>	.22912	<b>.16948</b>	31
30	.21221	<b>.16301</b>	.21650	<b>.16462</b>	.22075	<b>.16625</b>	.22498	<b>.16787</b>	.22919	<b>.16951</b>	30
31	.21229	<b>.16304</b>	.21657	<b>.16465</b>	.22082	<b>.16627</b>	.22505	<b>.16790</b>	.22926	<b>.16953</b>	29
+ 8'	9.21236	<b>.16306</b>	9.21664	<b>.16468</b>	9.22089	<b>.16630</b>	9.22512	<b>.16793</b>	9.22933	<b>.16956</b>	28
33	.21243	<b>.16309</b>	.21671	<b>.16471</b>	.22096	<b>.16633</b>	.22519	<b>.16795</b>	.22940	<b>.16959</b>	27
34	.21250	<b>.16312</b>	.21678	<b>.16473</b>	.22103	<b>.16635</b>	.22526	<b>.16798</b>	.22947	<b>.16962</b>	26
35	.21257	<b>.16314</b>	.21685	<b>.16476</b>	.22111	<b>.16638</b>	.22533	<b>.16801</b>	.22954	<b>.16964</b>	25
+ 9'	9.21264	<b>.16317</b>	9.21692	<b>.16479</b>	9.22118	<b>.16641</b>	9.22540	<b>.16804</b>	9.22961	<b>.16967</b>	24
37	.21272	<b>.16320</b>	.21699	<b>.16481</b>	.22125	<b>.16644</b>	.22547	<b>.16806</b>	.22968	<b>.16970</b>	23
38	.21279	<b>.16323</b>	.21706	<b>.16484</b>	.22132	<b>.16646</b>	.22555	<b>.16809</b>	.22975	<b>.16973</b>	22
39	.21286	<b>.16325</b>	.21714	<b>.16487</b>	.22139	<b>.16649</b>	.22562	<b>.16812</b>	.22982	<b>.16975</b>	21
+ 10'	9.21293	<b>.16328</b>	9.21721	<b>.16489</b>	9.22146	<b>.16652</b>	9.22569	<b>.16815</b>	9.22989	<b>.16978</b>	20
41	.21300	<b>.16331</b>	.21728	<b>.16492</b>	.22153	<b>.16654</b>	.22576	<b>.16817</b>	.22996	<b>.16981</b>	19
42	.21307	<b>.16333</b>	.21735	<b>.16495</b>	.22160	<b>.16657</b>	.22583	<b>.16820</b>	.23003	<b>.16984</b>	18
43	.21314	<b>.16336</b>	.21742	<b>.16498</b>	.22167	<b>.16660</b>	.22590	<b>.16823</b>	.23010	<b>.16986</b>	17
+ 11'	9.21322	<b>.16339</b>	9.21749	<b>.16500</b>	9.22174	<b>.16663</b>	9.22597	<b>.16825</b>	9.23017	<b>.16989</b>	16
45	.21329	<b>.16341</b>	.21756	<b>.16503</b>	.22181	<b>.16665</b>	.22604	<b>.16828</b>	.23024	<b>.16992</b>	15
46	.21336	<b>.16344</b>	.21763	<b>.16506</b>	.22188	<b>.16668</b>	.22611	<b>.16831</b>	.23031	<b>.16994</b>	14
47	.21343	<b>.16347</b>	.21770	<b>.16508</b>	.22195	<b>.16671</b>	.22618	<b>.16834</b>	.23038	<b>.16997</b>	13
+ 12'	9.21350	<b>.16349</b>	9.21778	<b>.16511</b>	9.22202	<b>.16673</b>	9.22625	<b>.16836</b>	9.23045	<b>.17000</b>	12
49	.21357	<b>.16352</b>	.21785	<b>.16514</b>	.22209	<b>.16676</b>	.22632	<b>.16839</b>	.23052	<b>.17003</b>	11
50	.21364	<b>.16355</b>	.21792	<b>.16516</b>	.22216	<b>.16679</b>	.22639	<b>.16842</b>	.23059	<b>.17005</b>	10
51	.21372	<b>.16357</b>	.21799	<b>.16519</b>	.22224	<b>.16681</b>	.22646	<b>.16844</b>	.23066	<b>.17008</b>	9
+ 13'	9.21379	<b>.16360</b>	9.21806	<b>.16522</b>	9.22231	<b>.16684</b>	9.22653	<b>.16847</b>	9.23073	<b>.17011</b>	8
53	.21386	<b>.16363</b>	.21813	<b>.16524</b>	.22238	<b>.16687</b>	.22660	<b>.16850</b>	.23080	<b>.17014</b>	7
54	.21393	<b>.16366</b>	.21820	<b>.16527</b>	.22245	<b>.16690</b>	.22667	<b>.16853</b>	.23087	<b>.17016</b>	6
55	.21400	<b>.16368</b>	.21827	<b>.16530</b>	.22252	<b>.16692</b>	.22674	<b>.16855</b>	.23094	<b>.17019</b>	5
+ 14'	9.21407	<b>.16371</b>	9.21834	<b>.16533</b>	9.22259	<b>.16695</b>	9.22681	<b>.16858</b>	9.23100	<b>.17022</b>	4
57	.21414	<b>.16374</b>	.21841	<b>.16535</b>	.22266	<b>.16698</b>	.22688	<b>.16861</b>	.23107	<b>.17024</b>	3
58	.21422	<b>.16376</b>	.21848	<b>.16538</b>	.22273	<b>.16701</b>	.22695	<b>.16864</b>	.23114	<b>.17027</b>	2
59	.21429	<b>.16379</b>	.21856	<b>.16541</b>	.22280	<b>.16703</b>	.22702	<b>.16866</b>	.23121	<b>.17030</b>	1
+ 15'	9.21436	<b>.16382</b>	9.21863	<b>.16543</b>	9.22287	<b>.16706</b>	9.22709	<b>.16869</b>	9.23128	<b>.17033</b>	0
	20h 49m		20h 48m		20h 47m		20h 46m		20h 45m		

TABLE IV.

Haversines.

s	3h 15m 48° 45'		3h 16m 49° 0'		3h 17m 49° 15'		3h 18m 49° 30'		3h 19m 49° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.23128	<b>.17033</b>	9.23545	<b>.17197</b>	9.23960	<b>.17362</b>	9.24372	<b>.17528</b>	9.24782	<b>.17694</b>	60
1	.23135	<b>.17035</b>	.23552	<b>.17200</b>	.23967	<b>.17365</b>	.24379	<b>.17530</b>	.24789	<b>.17697</b>	59
2	.23142	<b>.17038</b>	.23559	<b>.17203</b>	.23974	<b>.17368</b>	.24386	<b>.17533</b>	.24796	<b>.17699</b>	58
3	.23149	<b>.17041</b>	.23566	<b>.17205</b>	.23981	<b>.17370</b>	.24393	<b>.17536</b>	.24803	<b>.17702</b>	57
+ 1'	9.23156	<b>.17044</b>	9.23573	<b>.17208</b>	9.23988	<b>.17373</b>	9.24400	<b>.17539</b>	9.24809	<b>.17705</b>	56
4	.23163	<b>.17046</b>	.23580	<b>.17211</b>	.23994	<b>.17376</b>	.24406	<b>.17541</b>	.24816	<b>.17708</b>	55
5	.23170	<b>.17049</b>	.23587	<b>.17214</b>	.24001	<b>.17379</b>	.24413	<b>.17544</b>	.24823	<b>.17710</b>	54
6	.23177	<b>.17052</b>	.23594	<b>.17216</b>	.24008	<b>.17381</b>	.24420	<b>.17547</b>	.24830	<b>.17713</b>	53
+ 2'	9.23184	<b>.17055</b>	9.23601	<b>.17219</b>	9.24015	<b>.17384</b>	9.24427	<b>.17550</b>	9.24837	<b>.17716</b>	52
9	.23191	<b>.17057</b>	.23608	<b>.17222</b>	.24022	<b>.17387</b>	.24434	<b>.17552</b>	.24843	<b>.17719</b>	51
10	.23198	<b>.17060</b>	.23615	<b>.17225</b>	.24029	<b>.17390</b>	.24441	<b>.17555</b>	.24850	<b>.17722</b>	50
11	.23205	<b>.17063</b>	.23622	<b>.17227</b>	.24036	<b>.17392</b>	.24448	<b>.17558</b>	.24857	<b>.17724</b>	49
+ 3'	9.23212	<b>.17066</b>	9.23629	<b>.17230</b>	9.24043	<b>.17395</b>	9.24454	<b>.17561</b>	9.24864	<b>.17727</b>	48
13	.23219	<b>.17068</b>	.23635	<b>.17233</b>	.24050	<b>.17398</b>	.24461	<b>.17563</b>	.24871	<b>.17730</b>	47
14	.23226	<b>.17071</b>	.23642	<b>.17235</b>	.24056	<b>.17401</b>	.24468	<b>.17566</b>	.24877	<b>.17733</b>	46
15	.23233	<b>.17074</b>	.23649	<b>.17238</b>	.24063	<b>.17403</b>	.24475	<b>.17569</b>	.24884	<b>.17735</b>	45
+ 4'	9.23240	<b>.17076</b>	9.23656	<b>.17241</b>	9.24070	<b>.17406</b>	9.24482	<b>.17572</b>	9.24891	<b>.17738</b>	44
17	.23247	<b>.17079</b>	.23663	<b>.17244</b>	.24077	<b>.17409</b>	.24489	<b>.17575</b>	.24898	<b>.17741</b>	43
18	.23254	<b>.17082</b>	.23670	<b>.17246</b>	.24084	<b>.17412</b>	.24495	<b>.17577</b>	.24905	<b>.17744</b>	42
19	.23261	<b>.17085</b>	.23677	<b>.17249</b>	.24091	<b>.17414</b>	.24502	<b>.17580</b>	.24911	<b>.17746</b>	41
+ 5'	9.23268	<b>.17087</b>	9.23684	<b>.17252</b>	9.24098	<b>.17417</b>	9.24509	<b>.17583</b>	9.24918	<b>.17749</b>	40
21	.23275	<b>.17090</b>	.23691	<b>.17255</b>	.24105	<b>.17420</b>	.24516	<b>.17586</b>	.24925	<b>.17752</b>	39
22	.23282	<b>.17093</b>	.23698	<b>.17257</b>	.24111	<b>.17423</b>	.24523	<b>.17588</b>	.24932	<b>.17755</b>	38
23	.23289	<b>.17096</b>	.23705	<b>.17260</b>	.24118	<b>.17425</b>	.24530	<b>.17591</b>	.24939	<b>.17758</b>	37
+ 6'	9.23295	<b>.17098</b>	9.23712	<b>.17263</b>	9.24125	<b>.17428</b>	9.24536	<b>.17594</b>	9.24945	<b>.17760</b>	36
25	.23302	<b>.17101</b>	.23718	<b>.17266</b>	.24132	<b>.17431</b>	.24543	<b>.17597</b>	.24952	<b>.17763</b>	35
26	.23309	<b>.17104</b>	.23725	<b>.17268</b>	.24139	<b>.17434</b>	.24550	<b>.17600</b>	.24959	<b>.17766</b>	34
27	.23316	<b>.17107</b>	.23732	<b>.17271</b>	.24146	<b>.17436</b>	.24557	<b>.17602</b>	.24966	<b>.17769</b>	33
+ 7'	9.23323	<b>.17109</b>	9.23739	<b>.17274</b>	9.24153	<b>.17439</b>	9.24564	<b>.17605</b>	9.24973	<b>.17772</b>	32
29	.23330	<b>.17112</b>	.23746	<b>.17277</b>	.24160	<b>.17442</b>	.24571	<b>.17608</b>	.24979	<b>.17774</b>	31
30	.23337	<b>.17115</b>	.23753	<b>.17279</b>	.24166	<b>.17445</b>	.24577	<b>.17611</b>	.24986	<b>.17777</b>	30
31	.23344	<b>.17117</b>	.23760	<b>.17282</b>	.24173	<b>.17447</b>	.24584	<b>.17613</b>	.24993	<b>.17780</b>	29
+ 8'	9.23351	<b>.17120</b>	9.23767	<b>.17285</b>	9.24180	<b>.17450</b>	9.24591	<b>.17616</b>	9.25000	<b>.17783</b>	28
33	.23358	<b>.17123</b>	.23774	<b>.17288</b>	.24187	<b>.17453</b>	.24598	<b>.17619</b>	.25007	<b>.17785</b>	27
34	.23365	<b>.17126</b>	.23781	<b>.17290</b>	.24194	<b>.17456</b>	.24605	<b>.17622</b>	.25013	<b>.17788</b>	26
35	.23372	<b>.17128</b>	.23788	<b>.17293</b>	.24201	<b>.17458</b>	.24612	<b>.17624</b>	.25020	<b>.17791</b>	25
+ 9'	9.23379	<b>.17131</b>	9.23794	<b>.17296</b>	9.24208	<b>.17461</b>	9.24618	<b>.17627</b>	9.25027	<b>.17794</b>	24
37	.23386	<b>.17134</b>	.23801	<b>.17299</b>	.24215	<b>.17464</b>	.24625	<b>.17630</b>	.25034	<b>.17797</b>	23
38	.23393	<b>.17137</b>	.23808	<b>.17301</b>	.24221	<b>.17467</b>	.24632	<b>.17633</b>	.25040	<b>.17799</b>	22
39	.23400	<b>.17139</b>	.23815	<b>.17304</b>	.24228	<b>.17470</b>	.24639	<b>.17636</b>	.25047	<b>.17802</b>	21
+ 10'	9.23407	<b>.17142</b>	9.23822	<b>.17307</b>	9.24235	<b>.17472</b>	9.24646	<b>.17638</b>	9.25054	<b>.17805</b>	20
41	.23414	<b>.17145</b>	.23829	<b>.17310</b>	.24242	<b>.17475</b>	.24653	<b>.17641</b>	.25061	<b>.17808</b>	19
42	.23421	<b>.17148</b>	.23836	<b>.17313</b>	.24249	<b>.17478</b>	.24659	<b>.17644</b>	.25068	<b>.17811</b>	18
43	.23427	<b>.17150</b>	.23843	<b>.17315</b>	.24256	<b>.17481</b>	.24666	<b>.17647</b>	.25074	<b>.17813</b>	17
+ 11'	9.23434	<b>.17153</b>	9.23850	<b>.17318</b>	9.24263	<b>.17483</b>	9.24673	<b>.17649</b>	9.25081	<b>.17816</b>	16
45	.23441	<b>.17156</b>	.23857	<b>.17321</b>	.24269	<b>.17486</b>	.24680	<b>.17652</b>	.25088	<b>.17819</b>	15
46	.23448	<b>.17159</b>	.23863	<b>.17323</b>	.24276	<b>.17489</b>	.24687	<b>.17655</b>	.25095	<b>.17822</b>	14
47	.23455	<b>.17161</b>	.23870	<b>.17326</b>	.24283	<b>.17492</b>	.24694	<b>.17658</b>	.25102	<b>.17824</b>	13
+ 12'	9.23462	<b>.17164</b>	9.23877	<b>.17329</b>	9.24290	<b>.17494</b>	9.24700	<b>.17661</b>	9.25108	<b>.17827</b>	12
49	.23469	<b>.17167</b>	.23884	<b>.17332</b>	.24297	<b>.17497</b>	.24707	<b>.17663</b>	.25115	<b>.17830</b>	11
50	.23476	<b>.17170</b>	.23891	<b>.17335</b>	.24304	<b>.17500</b>	.24714	<b>.17666</b>	.25122	<b>.17833</b>	10
51	.23483	<b>.17172</b>	.23898	<b>.17337</b>	.24311	<b>.17503</b>	.24721	<b>.17669</b>	.25129	<b>.17836</b>	9
+ 13'	9.23490	<b>.17175</b>	9.23905	<b>.17340</b>	9.24317	<b>.17505</b>	9.24728	<b>.17672</b>	9.25135	<b>.17838</b>	8
53	.23497	<b>.17178</b>	.23912	<b>.17343</b>	.24324	<b>.17508</b>	.24734	<b>.17674</b>	.25142	<b>.17841</b>	7
54	.23504	<b>.17181</b>	.23919	<b>.17346</b>	.24331	<b>.17511</b>	.24741	<b>.17677</b>	.25149	<b>.17844</b>	6
55	.23511	<b>.17183</b>	.23926	<b>.17348</b>	.24338	<b>.17514</b>	.24748	<b>.17680</b>	.25156	<b>.17847</b>	5
+ 14'	9.23518	<b>.17186</b>	9.23932	<b>.17351</b>	9.24345	<b>.17517</b>	9.24755	<b>.17683</b>	9.25163	<b>.17849</b>	4
57	.23525	<b>.17189</b>	.23939	<b>.17354</b>	.24352	<b>.17519</b>	.24762	<b>.17686</b>	.25169	<b>.17852</b>	3
58	.23532	<b>.17192</b>	.23946	<b>.17357</b>	.24359	<b>.17522</b>	.24768	<b>.17688</b>	.25176	<b>.17855</b>	2
59	.23538	<b>.17194</b>	.23953	<b>.17359</b>	.24365	<b>.17525</b>	.24775	<b>.17691</b>	.25183	<b>.17858</b>	1
+ 15'	9.23545	<b>.17197</b>	9.23960	<b>.17362</b>	9.24372	<b>.17528</b>	9.24782	<b>.17694</b>	9.25190	<b>.17861</b>	0
	20h 44m		20h 43m		20h 42m		20h 41m		20h 40m		



s	3h 20m 50° 0'		3h 21m 50° 15'		3h 22m 50° 30'		3h 23m 50° 45'		3h 24m 51° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.25190	<b>.17861</b>	9.25595	<b>.18028</b>	9.25998	<b>.18196</b>	9.26398	<b>.18365</b>	9.26797	<b>.18534</b>	60
1	.25196	<b>.17863</b>	.25602	<b>.18031</b>	.26005	<b>.18199</b>	.26405	<b>.18368</b>	.26804	<b>.18537</b>	59
2	.25203	<b>.17866</b>	.25608	<b>.18034</b>	.26011	<b>.18202</b>	.26412	<b>.18370</b>	.26810	<b>.18540</b>	58
3	.25210	<b>.17869</b>	.25615	<b>.18036</b>	.26018	<b>.18205</b>	.26418	<b>.18373</b>	.26817	<b>.18542</b>	57
+ 1'	9.25217	<b>.17872</b>	9.25622	<b>.18039</b>	9.26025	<b>.18207</b>	9.26425	<b>.18376</b>	9.26823	<b>.18545</b>	56
5	.25224	<b>.17875</b>	.25629	<b>.18042</b>	.26031	<b>.18210</b>	.26432	<b>.18379</b>	.26830	<b>.18548</b>	55
6	.25230	<b>.17877</b>	.25635	<b>.18045</b>	.26038	<b>.18213</b>	.26438	<b>.18382</b>	.26837	<b>.18551</b>	54
7	.25237	<b>.17880</b>	.25642	<b>.18048</b>	.26045	<b>.18216</b>	.26445	<b>.18384</b>	.26843	<b>.18554</b>	53
+ 2'	9.25244	<b>.17883</b>	9.25649	<b>.18050</b>	9.26051	<b>.18219</b>	9.26452	<b>.18387</b>	9.26850	<b>.18557</b>	52
9	.25251	<b>.17886</b>	.25655	<b>.18053</b>	.26058	<b>.18221</b>	.26458	<b>.18390</b>	.26856	<b>.18559</b>	51
10	.25257	<b>.17888</b>	.25662	<b>.18056</b>	.26065	<b>.18224</b>	.26465	<b>.18393</b>	.26863	<b>.18562</b>	50
11	.25264	<b>.17891</b>	.25669	<b>.18059</b>	.26071	<b>.18227</b>	.26472	<b>.18396</b>	.26870	<b>.18565</b>	49
+ 3'	9.25271	<b>.17894</b>	9.25676	<b>.18062</b>	9.26078	<b>.18230</b>	9.26478	<b>.18399</b>	9.26876	<b>.18568</b>	48
13	.25278	<b>.17897</b>	.25682	<b>.18064</b>	.26085	<b>.18233</b>	.26485	<b>.18401</b>	.26883	<b>.18571</b>	47
14	.25284	<b>.17900</b>	.25689	<b>.18067</b>	.26091	<b>.18235</b>	.26492	<b>.18404</b>	.26890	<b>.18574</b>	46
15	.25291	<b>.17902</b>	.25696	<b>.18070</b>	.26098	<b>.18238</b>	.26498	<b>.18407</b>	.26896	<b>.18576</b>	45
+ 4'	9.25298	<b>.17905</b>	9.25703	<b>.18073</b>	9.26105	<b>.18241</b>	9.26505	<b>.18410</b>	9.26903	<b>.18579</b>	44
17	.25305	<b>.17908</b>	.25709	<b>.18076</b>	.26112	<b>.18244</b>	.26512	<b>.18413</b>	.26909	<b>.18582</b>	43
18	.25311	<b>.17911</b>	.25716	<b>.18078</b>	.26118	<b>.18247</b>	.26518	<b>.18415</b>	.26916	<b>.18585</b>	42
19	.25318	<b>.17914</b>	.25723	<b>.18081</b>	.26125	<b>.18249</b>	.26525	<b>.18418</b>	.26923	<b>.18588</b>	41
+ 5'	9.25325	<b>.17916</b>	9.25729	<b>.18084</b>	9.26132	<b>.18252</b>	9.26532	<b>.18421</b>	9.26929	<b>.18591</b>	40
21	.25332	<b>.17919</b>	.25736	<b>.18087</b>	.26138	<b>.18255</b>	.26538	<b>.18424</b>	.26936	<b>.18593</b>	39
22	.25339	<b>.17922</b>	.25743	<b>.18090</b>	.26145	<b>.18258</b>	.26545	<b>.18427</b>	.26942	<b>.18596</b>	38
23	.25345	<b>.17925</b>	.25750	<b>.18092</b>	.26152	<b>.18261</b>	.26551	<b>.18430</b>	.26949	<b>.18599</b>	37
+ 6'	9.25352	<b>.17928</b>	9.25756	<b>.18095</b>	9.26158	<b>.18263</b>	9.26558	<b>.18432</b>	9.26956	<b>.18602</b>	36
25	.25359	<b>.17930</b>	.25763	<b>.18098</b>	.26165	<b>.18266</b>	.26565	<b>.18435</b>	.26962	<b>.18605</b>	35
26	.25366	<b>.17933</b>	.25770	<b>.18101</b>	.26172	<b>.18269</b>	.26571	<b>.18438</b>	.26969	<b>.18608</b>	34
27	.25372	<b>.17936</b>	.25776	<b>.18104</b>	.26178	<b>.18272</b>	.26578	<b>.18441</b>	.26975	<b>.18610</b>	33
+ 7'	9.25379	<b>.17939</b>	9.25783	<b>.18106</b>	9.26185	<b>.18275</b>	9.26585	<b>.18444</b>	9.26982	<b>.18613</b>	32
29	.25386	<b>.17941</b>	.25790	<b>.18109</b>	.26192	<b>.18277</b>	.26591	<b>.18446</b>	.26989	<b>.18616</b>	31
30	.25393	<b>.17944</b>	.25797	<b>.18112</b>	.26198	<b>.18280</b>	.26598	<b>.18449</b>	.26995	<b>.18619</b>	30
31	.25399	<b>.17947</b>	.25803	<b>.18115</b>	.26205	<b>.18283</b>	.26605	<b>.18452</b>	.27002	<b>.18622</b>	29
+ 8'	9.25406	<b>.17950</b>	9.25810	<b>.18118</b>	9.26212	<b>.18286</b>	9.26611	<b>.18455</b>	9.27008	<b>.18624</b>	28
33	.25413	<b>.17953</b>	.25817	<b>.18120</b>	.26218	<b>.18289</b>	.26618	<b>.18458</b>	.27015	<b>.18627</b>	27
34	.25420	<b>.17955</b>	.25823	<b>.18123</b>	.26225	<b>.18292</b>	.26625	<b>.18461</b>	.27022	<b>.18630</b>	26
35	.25426	<b>.17958</b>	.25830	<b>.18126</b>	.26232	<b>.18294</b>	.26631	<b>.18463</b>	.27028	<b>.18633</b>	25
+ 9'	9.25433	<b>.17961</b>	9.25837	<b>.18129</b>	9.26238	<b>.18297</b>	9.26638	<b>.18466</b>	9.27035	<b>.18636</b>	24
37	.25440	<b>.17964</b>	.25844	<b>.18132</b>	.26245	<b>.18300</b>	.26644	<b>.18469</b>	.27041	<b>.18639</b>	23
38	.25447	<b>.17967</b>	.25850	<b>.18134</b>	.26252	<b>.18303</b>	.26651	<b>.18472</b>	.27048	<b>.18641</b>	22
39	.25453	<b>.17969</b>	.25857	<b>.18137</b>	.26259	<b>.18306</b>	.26658	<b>.18475</b>	.27055	<b>.18644</b>	21
+ 10'	9.25460	<b>.17972</b>	9.25864	<b>.18140</b>	9.26265	<b>.18308</b>	9.26664	<b>.18478</b>	9.27061	<b>.18647</b>	20
41	.25467	<b>.17975</b>	.25870	<b>.18143</b>	.26272	<b>.18311</b>	.26671	<b>.18480</b>	.27068	<b>.18650</b>	19
42	.25474	<b>.17978</b>	.25877	<b>.18146</b>	.26279	<b>.18314</b>	.26678	<b>.18483</b>	.27074	<b>.18653</b>	18
43	.25480	<b>.17981</b>	.25884	<b>.18148</b>	.26285	<b>.18317</b>	.26684	<b>.18486</b>	.27081	<b>.18656</b>	17
+ 11'	9.25487	<b>.17983</b>	9.25891	<b>.18151</b>	9.26292	<b>.18320</b>	9.26691	<b>.18489</b>	9.27088	<b>.18658</b>	16
45	.25494	<b>.17986</b>	.25897	<b>.18154</b>	.26299	<b>.18323</b>	.26697	<b>.18492</b>	.27094	<b>.18661</b>	15
46	.25500	<b>.17989</b>	.25904	<b>.18157</b>	.26305	<b>.18325</b>	.26704	<b>.18494</b>	.27101	<b>.18664</b>	14
47	.25507	<b>.17992</b>	.25911	<b>.18160</b>	.26312	<b>.18328</b>	.26711	<b>.18497</b>	.27107	<b>.18667</b>	13
+ 12'	9.25514	<b>.17995</b>	9.25917	<b>.18162</b>	9.26319	<b>.18331</b>	9.26717	<b>.18500</b>	9.27114	<b>.18670</b>	12
49	.25521	<b>.17997</b>	.25924	<b>.18165</b>	.26325	<b>.18334</b>	.26724	<b>.18503</b>	.27121	<b>.18673</b>	11
50	.25528	<b>.18000</b>	.25931	<b>.18168</b>	.26332	<b>.18337</b>	.26731	<b>.18506</b>	.27127	<b>.18675</b>	10
51	.25534	<b>.18003</b>	.25938	<b>.18171</b>	.26339	<b>.18339</b>	.26737	<b>.18509</b>	.27134	<b>.18678</b>	9
+ 13'	9.25541	<b>.18006</b>	9.25944	<b>.18174</b>	9.26345	<b>.18342</b>	9.26744	<b>.18511</b>	9.27140	<b>.18681</b>	8
53	.25548	<b>.18008</b>	.25951	<b>.18176</b>	.26352	<b>.18345</b>	.26751	<b>.18514</b>	.27147	<b>.18684</b>	7
54	.25554	<b>.18011</b>	.25958	<b>.18179</b>	.26359	<b>.18348</b>	.26757	<b>.18517</b>	.27154	<b>.18687</b>	6
55	.25561	<b>.18014</b>	.25964	<b>.18182</b>	.26365	<b>.18351</b>	.26764	<b>.18520</b>	.27160	<b>.18690</b>	5
+ 14'	9.25568	<b>.18017</b>	9.25971	<b>.18185</b>	9.26372	<b>.18353</b>	9.26770	<b>.18523</b>	9.27167	<b>.18692</b>	4
57	.25575	<b>.18020</b>	.25978	<b>.18188</b>	.26378	<b>.18356</b>	.26777	<b>.18526</b>	.27173	<b>.18695</b>	3
58	.25581	<b>.18022</b>	.25984	<b>.18190</b>	.26385	<b>.18359</b>	.26784	<b>.18528</b>	.27180	<b>.18698</b>	2
59	.25588	<b>.18025</b>	.25991	<b>.18193</b>	.26392	<b>.18362</b>	.26790	<b>.18531</b>	.27186	<b>.18701</b>	1
+ 15'	9.25595	<b>.18028</b>	9.25998	<b>.18196</b>	9.26398	<b>.18365</b>	9.26797	<b>.18534</b>	9.27193	<b>.18704</b>	0
	20h 39m		20h 38m		20h 37m		20h 36m		20h 35m		

TABLE IV.

## Haversines.

s	3h 25m 51° 15'		3h 26m 51° 30'		3h 27m 51° 45'		3h 28m 52° 0'		3h 29m 52° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.27193	.18704	9.27587	.18874	9.27979	.19045	9.28368	.19217	9.28756	.19389	60
1	.27200	.18707	.27594	.18877	.27985	.19048	.28375	.19220	.28762	.19392	59
2	.27206	.18710	.27600	.18880	.27992	.19051	.28381	.19223	.28769	.19395	58
3	.27213	.18712	.27607	.18883	.27998	.19054	.28388	.19226	.28775	.19398	57
+ 1'	9.27219	.18715	9.27613	.18886	9.28005	.19057	9.28394	.19228	9.28782	.19401	56
5	.27226	.18718	.27620	.18888	.28011	.19060	.28401	.19231	.28788	.19404	55
6	.27233	.18721	.27626	.18891	.28018	.19062	.28407	.19234	.28794	.19406	54
7	.27239	.18724	.27633	.18894	.28024	.19065	.28414	.19237	.28801	.19409	53
+ 2'	9.27246	.18727	9.27639	.18897	9.28031	.19068	9.28420	.19240	9.28807	.19412	52
9	.27252	.18729	.27646	.18900	.28037	.19071	.28427	.19243	.28814	.19415	51
10	.27259	.18732	.27652	.18903	.28044	.19074	.28433	.19246	.28820	.19418	50
11	.27265	.18735	.27659	.18906	.28050	.19077	.28440	.19248	.28827	.19421	49
+ 3'	9.27272	.18738	9.27666	.18908	9.28057	.19080	9.28446	.19251	9.28833	.19424	48
13	.27279	.18741	.27672	.18912	.28063	.19082	.28453	.19254	.28840	.19427	47
14	.27285	.18744	.27679	.18914	.28070	.19085	.28459	.19257	.28846	.19429	46
15	.27292	.18746	.27685	.18917	.28076	.19088	.28465	.19260	.28852	.19432	45
+ 4'	9.27298	.18749	9.27692	.18920	9.28083	.19091	9.28472	.19263	9.28859	.19435	44
17	.27305	.18752	.27698	.18923	.28089	.19094	.28478	.19266	.28865	.19438	43
18	.27311	.18755	.27705	.18926	.28096	.19097	.28485	.19269	.28872	.19441	42
19	.27318	.18758	.27711	.18928	.28102	.19100	.28491	.19271	.28878	.19444	41
+ 5'	9.27325	.18761	9.27718	.18931	9.28109	.19102	9.28498	.19274	9.28885	.19447	40
21	.27331	.18763	.27724	.18934	.28115	.19105	.28504	.19277	.28891	.19450	39
22	.27338	.18766	.27731	.18937	.28122	.19108	.28511	.19280	.28897	.19452	38
23	.27344	.18769	.27737	.18940	.28128	.19111	.28517	.19283	.28904	.19455	37
+ 6'	9.27351	.18772	9.27744	.18943	9.28135	.19114	9.28524	.19286	9.28910	.19458	36
25	.27357	.18775	.27751	.18945	.28141	.19117	.28530	.19289	.28917	.19461	35
26	.27364	.18778	.27757	.18948	.28148	.19120	.28537	.19291	.28923	.19464	34
27	.27371	.18780	.27764	.18951	.28154	.19122	.28543	.19294	.28930	.19467	33
+ 7'	9.27377	.18783	9.27770	.18954	9.28161	.19125	9.28549	.19297	9.28936	.19470	32
29	.27384	.18786	.27777	.18957	.28167	.19128	.28556	.19300	.28942	.19473	31
30	.27390	.18789	.27783	.18960	.28174	.19131	.28562	.19303	.28949	.19475	30
31	.27397	.18792	.27790	.18963	.28180	.19134	.28569	.19306	.28955	.19478	29
+ 8'	9.27403	.18795	9.27796	.18965	9.28187	.19137	9.28575	.19309	9.28962	.19481	28
33	.27410	.18797	.27803	.18968	.28193	.19140	.28582	.19311	.28968	.19484	27
34	.27417	.18800	.27809	.18971	.28200	.19142	.28588	.19314	.28974	.19487	26
35	.27423	.18803	.27816	.18974	.28206	.19145	.28595	.19317	.28981	.19490	25
+ 9'	9.27430	.18806	9.27822	.18977	9.28213	.19148	9.28601	.19320	9.28987	.19493	24
37	.27436	.18809	.27829	.18980	.28219	.19151	.28608	.19323	.28994	.19496	23
38	.27443	.18812	.27835	.18983	.28226	.19154	.28614	.19326	.29000	.19499	22
39	.27449	.18815	.27842	.18985	.28232	.19157	.28620	.19329	.29007	.19501	21
+ 10'	9.27456	.18817	9.27848	.18988	9.28239	.19160	9.28627	.19332	9.29013	.19504	20
41	.27463	.18820	.27855	.18991	.28245	.19163	.28633	.19335	.29019	.19507	19
42	.27469	.18823	.27861	.18994	.28252	.19165	.28640	.19337	.29026	.19510	18
43	.27476	.18826	.27868	.18997	.28258	.19168	.28646	.19340	.29032	.19513	17
+ 11'	9.27482	.18829	9.27875	.19000	9.28265	.19171	9.28653	.19343	9.29039	.19516	16
45	.27489	.18832	.27881	.19002	.28271	.19174	.28659	.19346	.29045	.19519	15
46	.27495	.18834	.27888	.19005	.28278	.19177	.28666	.19349	.29051	.19522	14
47	.27502	.18837	.27894	.19008	.28284	.19180	.28672	.19352	.29058	.19524	13
+ 12'	9.27508	.18840	9.27901	.19011	9.28291	.19183	9.28679	.19355	9.29064	.19527	12
49	.27515	.18843	.27907	.19014	.28297	.19185	.28685	.19358	.29071	.19530	11
50	.27522	.18846	.27914	.19017	.28304	.19188	.28691	.19360	.29078	.19533	10
51	.27528	.18849	.27920	.19020	.28310	.19191	.28698	.19363	.29084	.19536	9
+ 13'	9.27535	.18852	9.27927	.19022	9.28317	.19194	9.28704	.19366	9.29090	.19539	8
53	.27541	.18854	.27933	.19025	.28323	.19197	.28711	.19369	.29096	.19542	7
54	.27548	.18857	.27940	.19028	.28330	.19200	.28717	.19372	.29103	.19545	6
55	.27554	.18860	.27946	.19031	.28336	.19203	.28724	.19375	.29109	.19548	5
+ 14'	9.27561	.18863	9.27953	.19034	9.28342	.19205	9.28730	.19378	9.29116	.19551	4
57	.27567	.18866	.27959	.19037	.28349	.19208	.28737	.19381	.29122	.19553	3
58	.27574	.18869	.27966	.19040	.28355	.19211	.28743	.19383	.29128	.19556	2
59	.27580	.18871	.27972	.19042	.28362	.19214	.28749	.19386	.29135	.19559	1
+ 15'	9.27587	.18874	9.27979	.19045	9.28368	.19217	9.28756	.19389	9.29141	.19562	0
	20h 34m		20h 33m		20h 32m		20h 31m		20h 30m		



Haversines.

s	3h 30m 52° 30'		3h 31m 52° 45'		3h 32m 53° 0'		3h 33m 53° 15'		3h 34m 53° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.29141	.19562	9.29524	.19735	9.29906	.19909	9.30285	.20084	9.30662	.20259	60
1	.29148	.19565	.29531	.19738	.29912	.19912	.30291	.20087	.30668	.20262	59
2	.29154	.19568	.29537	.19741	.29918	.19915	.30297	.20090	.30674	.20265	58
3	.29160	.19571	.29543	.19744	.29925	.19918	.30303	.20093	.30680	.20268	57
+ 1'	9.29167	.19573	9.29550	.19747	9.29931	.19921	9.30310	.20095	9.30687	.20271	56
5	.29173	.19576	.29556	.19750	.29937	.19924	.30316	.20098	.30693	.20273	55
6	.29180	.19579	.29563	.19753	.29943	.19927	.30322	.20101	.30699	.20276	54
7	.29186	.19582	.29569	.19756	.29950	.19930	.30329	.20104	.30705	.20279	53
+ 2'	9.29192	.19585	9.29575	.19758	9.29956	.19932	9.30335	.20107	9.30712	.20282	52
9	.29199	.19588	.29582	.19761	.29962	.19935	.30341	.20110	.30718	.20285	51
10	.29205	.19591	.29588	.19764	.29969	.19938	.30348	.20113	.30724	.20288	50
11	.29212	.19594	.29594	.19767	.29975	.19941	.30354	.20116	.30730	.20291	49
+ 3'	9.29218	.19597	9.29601	.19770	9.29981	.19944	9.30360	.20119	9.30737	.20294	48
13	.29224	.19599	.29607	.19773	.29988	.19947	.30366	.20122	.30743	.20297	47
14	.29231	.19602	.29614	.19776	.29994	.19950	.30373	.20125	.30749	.20300	46
15	.29237	.19605	.29620	.19779	.30000	.19953	.30379	.20127	.30755	.20303	45
+ 4'	9.29244	.19608	9.29626	.19782	9.30007	.19956	9.30385	.20130	9.30762	.20306	44
17	.29250	.19611	.29633	.19785	.30013	.19959	.30392	.20133	.30768	.20309	43
18	.29256	.19614	.29639	.19787	.30019	.19962	.30398	.20136	.30774	.20312	42
19	.29263	.19617	.29645	.19790	.30026	.19964	.30404	.20139	.30780	.20314	41
+ 5'	9.29269	.19620	9.29652	.19793	9.30032	.19967	9.30410	.20142	9.30787	.20317	40
21	.29276	.19623	.29658	.19796	.30038	.19970	.30417	.20145	.30793	.20320	39
22	.29282	.19625	.29664	.19799	.30045	.19973	.30423	.20148	.30799	.20323	38
23	.29288	.19628	.29671	.19802	.30051	.19976	.30429	.20151	.30805	.20326	37
+ 6'	9.29295	.19631	9.29677	.19805	9.30057	.19979	9.30436	.20154	9.30812	.20329	36
25	.29301	.19634	.29683	.19808	.30064	.19982	.30442	.20157	.30818	.20332	35
26	.29307	.19637	.29690	.19811	.30070	.19985	.30448	.20160	.30824	.20335	34
27	.29314	.19640	.29696	.19814	.30076	.19988	.30454	.20162	.30830	.20338	33
+ 7'	9.29320	.19643	9.29703	.19816	9.30083	.19991	9.30461	.20165	9.30837	.20341	32
29	.29327	.19646	.29709	.19819	.30089	.19994	.30467	.20168	.30843	.20344	31
30	.29333	.19649	.29715	.19822	.30095	.19996	.30473	.20171	.30849	.20347	30
31	.29339	.19651	.29722	.19825	.30102	.19999	.30480	.20174	.30855	.20350	29
+ 8'	9.29346	.19654	9.29728	.19828	9.30108	.20002	9.30486	.20177	9.30862	.20352	28
33	.29352	.19657	.29734	.19831	.30114	.20005	.30492	.20180	.30868	.20355	27
34	.29359	.19660	.29741	.19834	.30121	.20008	.30498	.20183	.30874	.20358	26
35	.29365	.19663	.29747	.19837	.30127	.20011	.30505	.20186	.30880	.20361	25
+ 9'	9.29371	.19666	9.29753	.19840	9.30133	.20014	9.30511	.20189	9.30887	.20364	24
37	.29378	.19669	.29760	.19843	.30139	.20017	.30517	.20192	.30893	.20367	23
38	.29384	.19672	.29766	.19845	.30146	.20020	.30524	.20195	.30899	.20370	22
39	.29391	.19675	.29772	.19848	.30152	.20023	.30530	.20198	.30905	.20373	21
+ 10'	9.29397	.19677	9.29779	.19851	9.30158	.20026	9.30536	.20200	9.30912	.20376	20
41	.29403	.19680	.29785	.19854	.30165	.20028	.30542	.20203	.30918	.20379	19
42	.29410	.19683	.29791	.19857	.30171	.20031	.30549	.20206	.30924	.20382	18
43	.29416	.19686	.29798	.19860	.30177	.20034	.30555	.20209	.30930	.20385	17
+ 11'	9.29422	.19689	9.29804	.19863	9.30184	.20037	9.30561	.20212	9.30937	.20388	16
45	.29429	.19692	.29810	.19866	.30190	.20040	.30567	.20215	.30943	.20391	15
46	.29435	.19695	.29817	.19869	.30196	.20043	.30574	.20218	.30949	.20394	14
47	.29442	.19698	.29823	.19872	.30203	.20046	.30580	.20221	.30955	.20396	13
+ 12'	9.29448	.19701	9.29829	.19874	9.30209	.20049	9.30586	.20224	9.30962	.20399	12
49	.29454	.19703	.29836	.19877	.30215	.20052	.30593	.20227	.30968	.20402	11
50	.29461	.19706	.29842	.19880	.30222	.20055	.30599	.20230	.30974	.20405	10
51	.29467	.19709	.29848	.19883	.30228	.20058	.30605	.20233	.30980	.20408	9
+ 13'	9.29473	.19712	9.29855	.19886	9.30234	.20060	9.30611	.20235	9.30987	.20411	8
53	.29480	.19715	.29861	.19889	.30240	.20063	.30618	.20238	.30993	.20414	7
54	.29486	.19718	.29867	.19892	.30247	.20066	.30624	.20241	.30999	.20417	6
55	.29493	.19721	.29874	.19895	.30253	.20069	.30630	.20244	.31005	.20420	5
+ 14'	9.29499	.19724	9.29880	.19898	9.30259	.20072	9.30636	.20247	9.31012	.20423	4
57	.29505	.19727	.29886	.19901	.30266	.20075	.30643	.20250	.31018	.20426	3
58	.29512	.19730	.29893	.19903	.30272	.20078	.30649	.20253	.31024	.20429	2
59	.29518	.19732	.29899	.19906	.30278	.20081	.30655	.20256	.31030	.20432	1
+ 15'	9.29524	.19735	9.29906	.19909	9.30285	.20084	9.30662	.20259	9.31036	.20435	0
	20h 29m		20h 28m		20h 27m		20h 26m		20h 25m		

TABLE IV.

Haversines.

s	3h 35m 53° 45'		3h 36m 54° 0'		3h 37m 54° 15'		3h 38m 54° 30'		3h 39m 54° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.31036	.20435	9.31409	.20611	9.31780	.20788	9.32149	.20965	9.32516	.21143	60
1	.31043	.20437	.31416	.20614	.31786	.20790	.32155	.20968	.32522	.21146	59
2	.31049	.20440	.31422	.20617	.31793	.20793	.32161	.20971	.32528	.21149	58
3	.31055	.20443	.31428	.20620	.31799	.20796	.32168	.20974	.32534	.21152	57
+ 1'	9.31061	.20446	9.31434	.20623	9.31805	.20799	9.32174	.20977	9.32541	.21155	56
5	.31068	.20449	.31440	.20626	.31811	.20802	.32180	.20980	.32547	.21158	55
6	.31074	.20452	.31447	.20629	.31817	.20805	.32186	.20983	.32553	.21161	54
7	.31080	.20455	.31453	.20631	.31823	.20808	.32192	.20986	.32559	.21164	53
+ 2'	9.31086	.20458	9.31459	.20634	9.31830	.20811	9.32198	.20989	9.32565	.21167	52
9	.31093	.20461	.31465	.20637	.31836	.20814	.32204	.20991	.32571	.21169	51
10	.31099	.20464	.31471	.20640	.31842	.20817	.32210	.20994	.32577	.21172	50
11	.31105	.20467	.31478	.20643	.31848	.20820	.32217	.20997	.32583	.21175	49
+ 3'	9.31111	.20470	9.31484	.20646	9.31854	.20823	9.32223	.21000	9.32589	.21178	48
13	.31117	.20473	.31490	.20649	.31860	.20826	.32229	.21003	.32595	.21181	47
14	.31124	.20476	.31496	.20652	.31867	.20829	.32235	.21006	.32601	.21184	46
15	.31130	.20479	.31502	.20655	.31873	.20832	.32241	.21009	.32608	.21187	45
+ 4'	9.31136	.20481	9.31508	.20658	9.31879	.20835	9.32247	.21012	9.32614	.21190	44
17	.31142	.20484	.31515	.20661	.31885	.20838	.32253	.21015	.32620	.21193	43
18	.31149	.20487	.31521	.20664	.31891	.20841	.32259	.21018	.32626	.21196	42
19	.31155	.20490	.31527	.20667	.31897	.20844	.32266	.21021	.32632	.21199	41
+ 5'	9.31161	.20493	9.31533	.20670	9.31903	.20847	9.32272	.21024	9.32638	.21202	40
21	.31167	.20496	.31539	.20673	.31910	.20850	.32278	.21027	.32644	.21205	39
22	.31173	.20499	.31546	.20675	.31916	.20852	.32284	.21030	.32650	.21208	38
23	.31180	.20502	.31552	.20678	.31922	.20855	.32290	.21033	.32656	.21211	37
+ 6'	9.31186	.20505	9.31558	.20681	9.31928	.20858	9.32296	.21036	9.32662	.21214	36
25	.31192	.20508	.31564	.20684	.31934	.20861	.32302	.21039	.32668	.21217	35
26	.31198	.20511	.31570	.20687	.31940	.20864	.32308	.21042	.32675	.21220	34
27	.31205	.20514	.31577	.20690	.31947	.20867	.32315	.21045	.32681	.21223	33
+ 7'	9.31211	.20517	9.31583	.20693	9.31953	.20870	9.32321	.21048	9.32687	.21226	32
29	.31217	.20520	.31589	.20696	.31959	.20873	.32327	.21051	.32693	.21229	31
30	.31223	.20523	.31595	.20699	.31965	.20876	.32333	.21054	.32699	.21232	30
31	.31229	.20525	.31601	.20702	.31971	.20879	.32339	.21057	.32705	.21235	29
+ 8'	9.31236	.20528	9.31607	.20705	9.31977	.20882	9.32345	.21060	9.32711	.21238	28
33	.31242	.20531	.31614	.20708	.31983	.20885	.32351	.21063	.32717	.21241	27
34	.31248	.20534	.31620	.20711	.31990	.20888	.32357	.21066	.32723	.21244	26
35	.31254	.20537	.31626	.20714	.31996	.20891	.32363	.21069	.32729	.21247	25
+ 9'	9.31260	.20540	9.31632	.20717	9.32002	.20894	9.32370	.21072	9.32735	.21250	24
37	.31267	.20543	.31638	.20720	.32008	.20897	.32376	.21074	.32741	.21253	23
38	.31273	.20546	.31644	.20723	.32014	.20900	.32382	.21077	.32748	.21256	22
39	.31279	.20549	.31651	.20726	.32020	.20903	.32388	.21080	.32754	.21259	21
+ 10'	9.31285	.20552	9.31657	.20729	9.32026	.20906	9.32394	.21083	9.32760	.21262	20
41	.31291	.20555	.31663	.20731	.32033	.20909	.32400	.21086	.32766	.21265	19
42	.31298	.20558	.31669	.20734	.32039	.20912	.32406	.21089	.32772	.21268	18
43	.31304	.20561	.31675	.20737	.32045	.20915	.32412	.21092	.32778	.21271	17
+ 11'	9.31310	.20564	9.31682	.20740	9.32051	.20918	9.32418	.21095	9.32784	.21274	16
45	.31316	.20567	.31688	.20743	.32057	.20920	.32425	.21098	.32790	.21277	15
46	.31323	.20570	.31694	.20746	.32063	.20923	.32431	.21101	.32796	.21280	14
47	.31329	.20573	.31700	.20749	.32069	.20926	.32437	.21104	.32802	.21282	13
+ 12'	9.31335	.20575	9.31706	.20752	9.32076	.20929	9.32443	.21107	9.32808	.21285	12
49	.31341	.20578	.31712	.20755	.32082	.20932	.32449	.21110	.32814	.21288	11
50	.31347	.20581	.31719	.20758	.32088	.20935	.32455	.21113	.32820	.21291	10
51	.31354	.20584	.31725	.20761	.32094	.20938	.32461	.21116	.32827	.21294	9
+ 13'	9.31360	.20587	9.31731	.20764	9.32100	.20941	9.32467	.21119	9.32833	.21297	8
53	.31366	.20590	.31737	.20767	.32106	.20944	.32473	.21122	.32839	.21300	7
54	.31372	.20593	.31743	.20770	.32112	.20947	.32480	.21125	.32845	.21303	6
55	.31378	.20596	.31749	.20773	.32119	.20950	.32486	.21128	.32851	.21306	5
+ 14'	9.31385	.20599	9.31756	.20776	9.32125	.20953	9.32492	.21131	9.32857	.21309	4
57	.31391	.20602	.31762	.20779	.32131	.20956	.32498	.21134	.32863	.21312	3
58	.31397	.20605	.31768	.20782	.32137	.20959	.32504	.21137	.32869	.21315	2
59	.31403	.20608	.31774	.20785	.32143	.20962	.32510	.21140	.32875	.21318	1
+ 15'	9.31409	.20611	9.31780	.20788	9.32149	.20965	9.32516	.21143	9.32881	.21321	0
	20h 24m		20h 23m		20h 22m		20h 21m		20h 20m		



Haversines.

s	3h 40m 55° 0'		3h 41m 55° 15'		3h 42m 55° 30'		3h 43m 55° 45'		3h 44m 56° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.32881	.21321	9.33244	.21500	9.33605	.21680	9.33965	.21860	9.34322	.22040	60
1	.32887	.21324	.33250	.21503	.33611	.21683	.33971	.21863	.34328	.22043	59
2	.32893	.21327	.33256	.21506	.33617	.21686	.33976	.21866	.34334	.22046	58
3	.32899	.21330	.33262	.21509	.33623	.21689	.33982	.21869	.34340	.22049	57
+ 1'	9.32905	.21333	9.33268	.21512	9.33629	.21692	9.33988	.21872	9.34346	.22052	56
5	.32911	.21336	.33274	.21515	.33635	.21695	.33994	.21875	.34352	.22055	55
6	.32918	.21339	.33280	.21518	.33641	.21698	.34000	.21878	.34358	.22058	54
7	.32924	.21342	.33286	.21521	.33647	.21701	.34006	.21881	.34363	.22061	53
+ 2'	9.32930	.21345	9.33292	.21524	9.33653	.21704	9.34012	.21884	9.34369	.22064	52
9	.32936	.21348	.33298	.21527	.33659	.21707	.34018	.21887	.34375	.22067	51
10	.32942	.21351	.33305	.21530	.33665	.21710	.34024	.21890	.34381	.22071	50
11	.32948	.21354	.33311	.21533	.33671	.21713	.34030	.21893	.34387	.22074	49
+ 3'	9.32954	.21357	9.33317	.21536	9.33677	.21716	9.34036	.21896	9.34393	.22077	48
13	.32960	.21360	.33323	.21539	.33683	.21719	.34042	.21899	.34399	.22080	47
14	.32966	.21363	.33329	.21542	.33689	.21722	.34048	.21902	.34405	.22083	46
15	.32972	.21366	.33335	.21545	.33695	.21725	.34054	.21905	.34411	.22086	45
+ 4'	9.32978	.21369	9.33341	.21548	9.33701	.21728	9.34060	.21908	9.34417	.22089	44
17	.32984	.21372	.33347	.21551	.33707	.21731	.34066	.21911	.34423	.22092	43
18	.32990	.21375	.33353	.21554	.33713	.21734	.34072	.21914	.34429	.22095	42
19	.32996	.21378	.33359	.21557	.33719	.21737	.34078	.21917	.34435	.22098	41
+ 5'	9.33002	.21381	9.33365	.21560	9.33725	.21740	9.34084	.21920	9.34441	.22101	40
21	.33008	.21384	.33371	.21563	.33731	.21743	.34090	.21923	.34446	.22104	39
22	.33014	.21387	.33377	.21566	.33737	.21746	.34096	.21926	.34452	.22107	38
23	.33021	.21390	.33383	.21569	.33743	.21749	.34102	.21929	.34458	.22110	37
+ 6'	9.33027	.21393	9.33389	.21572	9.33749	.21752	9.34108	.21932	9.34464	.22113	36
25	.33033	.21396	.33395	.21575	.33755	.21755	.34114	.21935	.34470	.22116	35
26	.33039	.21399	.33401	.21578	.33761	.21758	.34120	.21938	.34476	.22119	34
27	.33045	.21402	.33407	.21581	.33767	.21761	.34126	.21941	.34482	.22122	33
+ 7'	9.33051	.21405	9.33413	.21584	9.33773	.21764	9.34132	.21944	9.34488	.22125	32
29	.33057	.21408	.33419	.21587	.33779	.21767	.34138	.21947	.34494	.22128	31
30	.33063	.21411	.33425	.21590	.33785	.21770	.34143	.21950	.34500	.22131	30
31	.33069	.21414	.33431	.21593	.33791	.21773	.34149	.21953	.34506	.22134	29
+ 8'	9.33075	.21417	9.33437	.21596	9.33797	.21776	9.34155	.21956	9.34512	.22137	28
33	.33081	.21420	.33443	.21599	.33803	.21779	.34161	.21959	.34518	.22140	27
34	.33087	.21423	.33449	.21602	.33809	.21782	.34167	.21962	.34524	.22143	26
35	.33093	.21426	.33455	.21605	.33815	.21785	.34173	.21965	.34529	.22146	25
+ 9'	9.33099	.21429	9.33461	.21608	9.33821	.21788	9.34179	.21968	9.34535	.22149	24
37	.33105	.21431	.33467	.21611	.33827	.21791	.34185	.21971	.34541	.22152	23
38	.33111	.21434	.33473	.21614	.33833	.21794	.34191	.21974	.34547	.22155	22
39	.33117	.21437	.33479	.21617	.33839	.21797	.34197	.21977	.34553	.22158	21
+ 10'	9.33123	.21440	9.33485	.21620	9.33845	.21800	9.34203	.21980	9.34559	.22161	20
41	.33129	.21443	.33491	.21623	.33851	.21803	.34209	.21983	.34565	.22164	19
42	.33135	.21446	.33497	.21626	.33857	.21806	.34215	.21986	.34571	.22167	18
43	.33142	.21449	.33503	.21629	.33863	.21809	.34221	.21989	.34577	.22170	17
+ 11'	9.33148	.21452	9.33509	.21632	9.33869	.21812	9.34227	.21992	9.34583	.22173	16
45	.33154	.21455	.33515	.21635	.33875	.21815	.34233	.21995	.34589	.22176	15
46	.33160	.21458	.33521	.21638	.33881	.21818	.34239	.21998	.34595	.22179	14
47	.33166	.21461	.33527	.21641	.33887	.21821	.34245	.22001	.34600	.22182	13
+ 12'	9.33172	.21464	9.33533	.21644	9.33893	.21824	9.34251	.22004	9.34606	.22185	12
49	.33178	.21467	.33539	.21647	.33899	.21827	.34256	.22007	.34612	.22188	11
50	.33184	.21470	.33545	.21650	.33905	.21830	.34262	.22010	.34618	.22191	10
51	.33190	.21473	.33551	.21653	.33911	.21833	.34268	.22013	.34624	.22194	9
+ 13'	9.33196	.21476	9.33557	.21656	9.33917	.21836	9.34274	.22016	9.34630	.22197	8
53	.33202	.21479	.33563	.21659	.33923	.21839	.34280	.22019	.34636	.22200	7
54	.33208	.21482	.33569	.21662	.33929	.21842	.34286	.22022	.34642	.22203	6
55	.33214	.21485	.33575	.21665	.33935	.21845	.34292	.22025	.34648	.22206	5
+ 14'	9.33220	.21488	9.33581	.21668	9.33941	.21848	9.34298	.22028	9.34654	.22209	4
57	.33226	.21491	.33587	.21671	.33947	.21851	.34304	.22031	.34660	.22212	3
58	.33232	.21494	.33593	.21674	.33953	.21854	.34310	.22034	.34666	.22215	2
59	.33238	.21497	.33599	.21677	.33959	.21857	.34316	.22037	.34671	.22218	1
+ 15'	9.33244	.21500	9.33605	.21680	9.33965	.21860	9.34322	.22040	9.34677	.22221	0
	20h 19m		20h 18m		20h 17m		20h 16m		20h 15m		

TABLE IV.

## Haversines.

s	3h 45m 56° 15'		3h 46m 56° 30'		3h 47m 56° 45'		3h 48m 57° 0'		3h 49m 57° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.34677	.22221	9.35031	.22403	9.35383	.22585	9.35733	.22768	9.36081	.22951	60
1	34683	.22225	35037	.22406	35389	.22588	35738	.22771	36086	.22954	59
2	34689	.22228	35043	.22409	35394	.22591	35744	.22774	36092	.22957	58
3	34695	.22231	35049	.22412	35400	.22594	35750	.22777	36098	.22960	57
+ 1'	9.34701	.22234	9.35054	.22415	9.35406	.22598	9.35756	.22780	9.36104	.22964	56
5	34707	.22237	35060	.22418	35412	.22601	35762	.22783	36110	.22967	55
6	34713	.22240	35066	.22421	35418	.22604	35767	.22786	36115	.22970	54
7	34719	.22243	35072	.22424	35424	.22607	35773	.22789	36121	.22973	53
+ 2'	9.34725	.22246	9.35078	.22427	9.35429	.22610	9.35779	.22792	9.36127	.22976	52
9	34730	.22249	35084	.22430	35435	.22613	35785	.22795	36133	.22979	51
10	34736	.22252	35090	.22433	35441	.22616	35791	.22799	36139	.22982	50
11	34742	.22255	35096	.22437	35447	.22619	35797	.22802	36144	.22985	49
+ 3'	9.34748	.22258	9.35101	.22440	9.35453	.22622	9.35802	.22805	9.36150	.22988	48
13	34754	.22261	35107	.22443	35459	.22625	35808	.22808	36156	.22991	47
14	34760	.22264	35113	.22446	35464	.22628	35814	.22811	36162	.22994	46
15	34766	.22267	35119	.22449	35470	.22631	35820	.22814	36167	.22997	45
+ 4'	9.34772	.22270	9.35125	.22452	9.35476	.22634	9.35826	.22817	9.36173	.23000	44
17	34778	.22273	35131	.22455	35482	.22637	35831	.22820	36179	.23003	43
18	34784	.22276	35137	.22458	35488	.22640	35837	.22823	36185	.23006	42
19	34789	.22279	35143	.22461	35494	.22643	35843	.22826	36191	.23009	41
+ 5'	9.34795	.22282	9.35148	.22464	9.35500	.22646	9.35849	.22829	9.36196	.23012	40
21	34801	.22285	35154	.22467	35505	.22649	35855	.22832	36202	.23016	39
22	34807	.22288	35160	.22470	35511	.22652	35860	.22835	36208	.23019	38
23	34813	.22291	35166	.22473	35517	.22655	35866	.22838	36214	.23022	37
+ 6'	9.34819	.22294	9.35172	.22476	9.35523	.22658	9.35872	.22831	9.36219	.23025	36
25	34825	.22297	35178	.22479	35529	.22661	35878	.22834	36225	.23028	35
26	34831	.22300	35184	.22482	35535	.22664	35884	.22837	36231	.23031	34
27	34837	.22303	35189	.22485	35540	.22667	35889	.22840	36237	.23034	33
+ 7'	9.34843	.22306	9.35195	.22488	9.35546	.22671	9.35895	.22835	9.36243	.23037	32
29	34848	.22309	35201	.22491	35552	.22674	35901	.22837	36248	.23040	31
30	34854	.22312	35207	.22494	35558	.22677	35907	.22840	36254	.23043	30
31	34860	.22315	35213	.22497	35564	.22680	35913	.22843	36260	.23046	29
+ 8'	9.34866	.22318	9.35219	.22500	9.35570	.22683	9.35918	.22846	9.36266	.23049	28
33	34872	.22321	35225	.22503	35575	.22686	35924	.22849	36271	.23052	27
34	34878	.22324	35230	.22506	35581	.22689	35930	.22852	36277	.23055	26
35	34884	.22327	35236	.22509	35587	.22692	35936	.22855	36283	.23058	25
+ 9'	9.34890	.22330	9.35242	.22512	9.35593	.22695	9.35942	.22849	9.36289	.23061	24
37	34896	.22333	35248	.22515	35599	.22698	35947	.22851	36294	.23065	23
38	34901	.22336	35254	.22518	35604	.22701	35953	.22854	36300	.23068	22
39	34907	.22340	35260	.22522	35610	.22704	35959	.22857	36306	.23071	21
+ 10'	9.34913	.22343	9.35266	.22525	9.35616	.22707	9.35965	.22850	9.36312	.23074	20
41	34919	.22346	35271	.22528	35622	.22710	35971	.22853	36318	.23077	19
42	34925	.22349	35277	.22531	35628	.22713	35976	.22856	36323	.23080	18
43	34931	.22352	35283	.22534	35634	.22716	35982	.22859	36329	.23083	17
+ 11'	9.34937	.22355	9.35289	.22537	9.35639	.22719	9.35988	.22852	9.36335	.23086	16
45	34943	.22358	35295	.22540	35645	.22722	35994	.22855	36341	.23089	15
46	34949	.22361	35301	.22543	35651	.22725	36000	.22858	36346	.23092	14
47	34954	.22364	35307	.22546	35657	.22728	36005	.22861	36352	.23095	13
+ 12'	9.34960	.22367	9.35312	.22549	9.35663	.22731	9.36011	.22854	9.36358	.23098	12
49	34966	.22370	35318	.22552	35669	.22735	36017	.22857	36364	.23101	11
50	34972	.22373	35324	.22555	35674	.22738	36023	.22860	36369	.23104	10
51	34978	.22376	35330	.22558	35680	.22741	36029	.22863	36375	.23107	9
+ 13'	9.34984	.22379	9.35336	.22561	9.35686	.22744	9.36034	.22857	9.36381	.23110	8
53	34990	.22382	35342	.22564	35692	.22747	36040	.22860	36387	.23114	7
54	34996	.22385	35348	.22567	35698	.22750	36046	.22863	36392	.23117	6
55	35002	.22388	35353	.22570	35703	.22753	36052	.22866	36398	.23120	5
+ 14'	9.35007	.22391	9.35359	.22573	9.35709	.22756	9.36058	.22860	9.36404	.23123	4
57	35013	.22394	35365	.22576	35715	.22759	36063	.22863	36410	.23126	3
58	35019	.22397	35371	.22579	35721	.22762	36069	.22866	36415	.23129	2
59	35025	.22400	35377	.22582	35727	.22765	36075	.22869	36421	.23132	1
+ 15'	9.35031	.22403	9.35383	.22585	9.35733	.22768	9.36081	.22951	9.36427	.23135	0
	20h 14m		20h 13m		20h 12m		20h 11m		20h 10m		



s	3h 50m 57° 30'		3h 51m 57° 45'		3h 52m 58° 0'		3h 53m 58° 15'		3h 54m 58° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.36427	<b>.23135</b>	9.36772	<b>.23319</b>	9.37114	<b>.23504</b>	9.37455	<b>.23689</b>	9.37794	<b>.23875</b>	60
1	.36433	<b>.23138</b>	.36777	<b>.23322</b>	.37120	<b>.23507</b>	.37461	<b>.23692</b>	.37800	<b>.23878</b>	59
2	.36439	<b>.23141</b>	.36783	<b>.23325</b>	.37126	<b>.23510</b>	.37467	<b>.23695</b>	.37806	<b>.23881</b>	58
3	.36444	<b>.23144</b>	.36789	<b>.23329</b>	.37131	<b>.23513</b>	.37472	<b>.23699</b>	.37811	<b>.23884</b>	57
+ 1'	9.36450	<b>.23147</b>	9.36794	<b>.23332</b>	9.37137	<b>.23516</b>	9.37478	<b>.23702</b>	9.37817	<b>.23887</b>	56
5	.36456	<b>.23150</b>	.36800	<b>.23335</b>	.37143	<b>.23519</b>	.37484	<b>.23705</b>	.37823	<b>.23891</b>	55
6	.36462	<b>.23153</b>	.36806	<b>.23338</b>	.37148	<b>.23523</b>	.37489	<b>.23708</b>	.37828	<b>.23894</b>	54
7	.36467	<b>.23156</b>	.36812	<b>.23341</b>	.37154	<b>.23526</b>	.37495	<b>.23711</b>	.37834	<b>.23897</b>	53
+ 2'	9.36473	<b>.23160</b>	9.36817	<b>.23344</b>	9.37160	<b>.23529</b>	9.37501	<b>.23714</b>	9.37840	<b>.23900</b>	52
9	.36479	<b>.23163</b>	.36823	<b>.23347</b>	.37166	<b>.23532</b>	.37506	<b>.23717</b>	.37845	<b>.23903</b>	51
10	.36485	<b>.23166</b>	.36829	<b>.23350</b>	.37171	<b>.23535</b>	.37512	<b>.23720</b>	.37851	<b>.23906</b>	50
11	.36490	<b>.23169</b>	.36834	<b>.23353</b>	.37177	<b>.23538</b>	.37518	<b>.23723</b>	.37856	<b>.23909</b>	49
+ 3'	9.36496	<b>.23172</b>	9.36840	<b>.23356</b>	9.37183	<b>.23541</b>	9.37523	<b>.23726</b>	9.37862	<b>.23912</b>	48
13	.36502	<b>.23175</b>	.36846	<b>.23359</b>	.37188	<b>.23544</b>	.37529	<b>.23729</b>	.37868	<b>.23915</b>	47
14	.36508	<b>.23178</b>	.36852	<b>.23362</b>	.37194	<b>.23547</b>	.37535	<b>.23733</b>	.37873	<b>.23918</b>	46
15	.36513	<b>.23181</b>	.36857	<b>.23365</b>	.37200	<b>.23550</b>	.37540	<b>.23736</b>	.37879	<b>.23922</b>	45
+ 4'	9.36519	<b>.23184</b>	9.36863	<b>.23368</b>	9.37205	<b>.23553</b>	9.37546	<b>.23739</b>	9.37885	<b>.23925</b>	44
17	.36525	<b>.23187</b>	.36869	<b>.23372</b>	.37211	<b>.23556</b>	.37552	<b>.23742</b>	.37890	<b>.23928</b>	43
18	.36531	<b>.23190</b>	.36875	<b>.23375</b>	.37217	<b>.23560</b>	.37557	<b>.23745</b>	.37896	<b>.23931</b>	42
19	.36536	<b>.23193</b>	.36880	<b>.23378</b>	.37222	<b>.23563</b>	.37563	<b>.23748</b>	.37902	<b>.23934</b>	41
+ 5'	9.36542	<b>.23196</b>	9.36886	<b>.23381</b>	9.37228	<b>.23566</b>	9.37569	<b>.23751</b>	9.37907	<b>.23937</b>	40
21	.36548	<b>.23199</b>	.36892	<b>.23384</b>	.37234	<b>.23569</b>	.37574	<b>.23754</b>	.37913	<b>.23940</b>	39
22	.36554	<b>.23203</b>	.36897	<b>.23387</b>	.37239	<b>.23572</b>	.37580	<b>.23757</b>	.37918	<b>.23943</b>	38
23	.36559	<b>.23206</b>	.36903	<b>.23390</b>	.37245	<b>.23575</b>	.37585	<b>.23760</b>	.37924	<b>.23946</b>	37
+ 6'	9.36565	<b>.23209</b>	9.36909	<b>.23393</b>	9.37251	<b>.23578</b>	9.37591	<b>.23764</b>	9.37930	<b>.23950</b>	36
25	.36571	<b>.23212</b>	.36915	<b>.23396</b>	.37257	<b>.23581</b>	.37597	<b>.23767</b>	.37935	<b>.23953</b>	35
26	.36577	<b>.23215</b>	.36920	<b>.23399</b>	.37262	<b>.23584</b>	.37602	<b>.23770</b>	.37941	<b>.23956</b>	34
27	.36582	<b>.23218</b>	.36926	<b>.23402</b>	.37268	<b>.23587</b>	.37608	<b>.23773</b>	.37947	<b>.23959</b>	33
+ 7'	9.36588	<b>.23221</b>	9.36932	<b>.23405</b>	9.37274	<b>.23590</b>	9.37614	<b>.23776</b>	9.37952	<b>.23962</b>	32
29	.36594	<b>.23224</b>	.36937	<b>.23409</b>	.37279	<b>.23594</b>	.37619	<b>.23779</b>	.37958	<b>.23965</b>	31
30	.36599	<b>.23227</b>	.36943	<b>.23412</b>	.37285	<b>.23597</b>	.37625	<b>.23782</b>	.37963	<b>.23968</b>	30
31	.36605	<b>.23230</b>	.36949	<b>.23415</b>	.37291	<b>.23600</b>	.37631	<b>.23785</b>	.37969	<b>.23971</b>	29
+ 8'	9.36611	<b>.23233</b>	9.36955	<b>.23418</b>	9.37296	<b>.23603</b>	9.37636	<b>.23788</b>	9.37975	<b>.23974</b>	28
33	.36617	<b>.23236</b>	.36960	<b>.23421</b>	.37302	<b>.23606</b>	.37642	<b>.23791</b>	.37980	<b>.23977</b>	27
34	.36622	<b>.23239</b>	.36966	<b>.23424</b>	.37308	<b>.23609</b>	.37648	<b>.23795</b>	.37986	<b>.23981</b>	26
35	.36628	<b>.23242</b>	.36972	<b>.23427</b>	.37313	<b>.23612</b>	.37653	<b>.23798</b>	.37992	<b>.23984</b>	25
+ 9'	9.36634	<b>.23246</b>	9.36977	<b>.23430</b>	9.37319	<b>.23615</b>	9.37659	<b>.23801</b>	9.37997	<b>.23987</b>	24
37	.36640	<b>.23249</b>	.36983	<b>.23433</b>	.37325	<b>.23618</b>	.37665	<b>.23804</b>	.38003	<b>.23990</b>	23
38	.36645	<b>.23252</b>	.36989	<b>.23436</b>	.37330	<b>.23621</b>	.37670	<b>.23807</b>	.38008	<b>.23993</b>	22
39	.36651	<b>.23255</b>	.36995	<b>.23439</b>	.37336	<b>.23624</b>	.37676	<b>.23810</b>	.38014	<b>.23996</b>	21
+ 10'	9.36657	<b>.23258</b>	9.37000	<b>.23442</b>	9.37342	<b>.23627</b>	9.37682	<b>.23813</b>	9.38020	<b>.23999</b>	20
41	.36663	<b>.23261</b>	.37006	<b>.23445</b>	.37347	<b>.23631</b>	.37687	<b>.23816</b>	.38025	<b>.24002</b>	19
42	.36668	<b>.23264</b>	.37012	<b>.23449</b>	.37353	<b>.23634</b>	.37693	<b>.23819</b>	.38031	<b>.24005</b>	18
43	.36674	<b>.23267</b>	.37017	<b>.23452</b>	.37359	<b>.23637</b>	.37699	<b>.23822</b>	.38037	<b>.24009</b>	17
+ 11'	9.36680	<b>.23270</b>	9.37023	<b>.23455</b>	9.37364	<b>.23640</b>	9.37704	<b>.23825</b>	9.38042	<b>.24012</b>	16
45	.36686	<b>.23273</b>	.37029	<b>.23458</b>	.37370	<b>.23643</b>	.37710	<b>.23829</b>	.38048	<b>.24015</b>	15
46	.36691	<b>.23276</b>	.37034	<b>.23461</b>	.37376	<b>.23646</b>	.37715	<b>.23832</b>	.38053	<b>.24018</b>	14
47	.36697	<b>.23279</b>	.37040	<b>.23464</b>	.37382	<b>.23649</b>	.37721	<b>.23835</b>	.38059	<b>.24021</b>	13
+ 12'	9.36703	<b>.23282</b>	9.37046	<b>.23467</b>	9.37387	<b>.23652</b>	9.37727	<b>.23838</b>	9.38065	<b>.24024</b>	12
49	.36708	<b>.23285</b>	.37052	<b>.23470</b>	.37393	<b>.23655</b>	.37732	<b>.23841</b>	.38070	<b>.24027</b>	11
50	.36714	<b>.23289</b>	.37057	<b>.23473</b>	.37399	<b>.23658</b>	.37738	<b>.23844</b>	.38076	<b>.24030</b>	10
51	.36720	<b>.23292</b>	.37063	<b>.23476</b>	.37404	<b>.23661</b>	.37744	<b>.23847</b>	.38081	<b>.24033</b>	9
+ 13'	9.36726	<b>.23295</b>	9.37069	<b>.23479</b>	9.37410	<b>.23665</b>	9.37749	<b>.23850</b>	9.38087	<b>.24036</b>	8
53	.36731	<b>.23298</b>	.37074	<b>.23482</b>	.37416	<b>.23668</b>	.37755	<b>.23853</b>	.38093	<b>.24040</b>	7
54	.36737	<b>.23301</b>	.37080	<b>.23486</b>	.37421	<b>.23671</b>	.37761	<b>.23856</b>	.38098	<b>.24043</b>	6
55	.36743	<b>.23304</b>	.37086	<b>.23489</b>	.37427	<b>.23674</b>	.37766	<b>.23860</b>	.38104	<b>.24046</b>	5
+ 14'	9.36749	<b>.23307</b>	9.37091	<b>.23492</b>	9.37433	<b>.23677</b>	9.37772	<b>.23863</b>	9.38110	<b>.24049</b>	4
57	.36754	<b>.23310</b>	.37097	<b>.23495</b>	.37438	<b>.23680</b>	.37778	<b>.23866</b>	.38115	<b>.24052</b>	3
58	.36760	<b>.23313</b>	.37103	<b>.23498</b>	.37444	<b>.23683</b>	.37783	<b>.23869</b>	.38121	<b>.24055</b>	2
59	.36766	<b>.23316</b>	.37109	<b>.23501</b>	.37450	<b>.23686</b>	.37789	<b>.23872</b>	.38126	<b>.24058</b>	1
+ 15'	9.36772	<b>.23319</b>	9.37114	<b>.23504</b>	9.37455	<b>.23689</b>	9.37794	<b>.23875</b>	9.38132	<b>.24061</b>	0
	20h 9m		20h 8m		20h 7m		20h 6m		20h 5m		

TABLE IV.

Haversines.

s	3h 55m 58° 45'		3h 56m 59° 0'		3h 57m 59° 15'		3h 58m 59° 30'		3h 59m 59° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.38132	.24061	9.38468	.24248	9.38802	.24435	9.39134	.24623	9.39465	.24811	60
1	.38138	.24064	.38473	.24251	.38807	.24438	.39140	.24626	.39470	.24814	59
2	.38143	.24068	.38479	.24254	.38813	.24442	.39145	.24629	.39476	.24818	58
3	.38149	.24071	.38485	.24257	.38819	.24445	.39151	.24632	.39481	.24821	57
+ 1'	9.38154	.24074	9.38490	.24261	9.38824	.24448	9.39156	.24636	9.39487	.24824	56
5	.38160	.24077	.38496	.24264	.38830	.24451	.39162	.24639	.39492	.24827	55
6	.38166	.24080	.38501	.24267	.38835	.24454	.39167	.24642	.39498	.24830	54
7	.38171	.24083	.38507	.24270	.38841	.24457	.39173	.24645	.39503	.24833	53
+ 2'	9.38177	.24086	9.38512	.24273	9.38846	.24460	9.39178	.24648	9.39509	.24836	52
9	.38182	.24089	.38518	.24276	.38852	.24463	.39184	.24651	.39514	.24840	51
10	.38188	.24092	.38524	.24279	.38857	.24467	.39189	.24654	.39520	.24843	50
11	.38194	.24096	.38529	.24282	.38863	.24470	.39195	.24658	.39525	.24846	49
+ 3'	9.38199	.24099	9.38535	.24286	9.38868	.24473	9.39201	.24661	9.39531	.24849	48
13	.38205	.24102	.38540	.24289	.38874	.24476	.39206	.24664	.39536	.24852	47
14	.38210	.24105	.38546	.24292	.38880	.24479	.39212	.24667	.39542	.24855	46
15	.38216	.24108	.38551	.24295	.38885	.24482	.39217	.24670	.39547	.24858	45
+ 4'	9.38222	.24111	9.38557	.24298	9.38891	.24485	9.39223	.24673	9.39553	.24862	44
17	.38227	.24114	.38563	.24301	.38896	.24488	.39228	.24676	.39558	.24865	43
18	.38233	.24117	.38568	.24304	.38902	.24492	.39234	.24680	.39564	.24868	42
19	.38239	.24120	.38574	.24307	.38907	.24495	.39239	.24683	.39569	.24871	41
+ 5'	9.38244	.24124	9.38579	.24310	9.38913	.24498	9.39245	.24686	9.39575	.24874	40
21	.38250	.24127	.38585	.24314	.38918	.24501	.39250	.24689	.39580	.24877	39
22	.38255	.24130	.38590	.24317	.38924	.24504	.39256	.24692	.39586	.24880	38
23	.38261	.24133	.38596	.24320	.38929	.24507	.39261	.24695	.39591	.24884	37
+ 6'	9.38267	.24136	9.38602	.24323	9.38935	.24510	9.39267	.24698	9.39597	.24887	36
25	.38272	.24139	.38607	.24326	.38941	.24514	.39272	.24701	.39602	.24890	35
26	.38278	.24142	.38613	.24329	.38946	.24517	.39278	.24705	.39608	.24893	34
27	.38283	.24145	.38618	.24332	.38952	.24520	.39283	.24708	.39613	.24896	33
+ 7'	9.38289	.24148	9.38624	.24335	9.38957	.24523	9.39289	.24711	9.39619	.24899	32
29	.38295	.24152	.38629	.24339	.38963	.24526	.39294	.24714	.39624	.24902	31
30	.38300	.24155	.38635	.24342	.38968	.24529	.39300	.24717	.39630	.24906	30
31	.38306	.24158	.38641	.24345	.38974	.24532	.39305	.24720	.39635	.24909	29
+ 8'	9.38311	.24161	9.38646	.24348	9.38979	.24535	9.39311	.24723	9.39641	.24912	28
33	.38317	.24164	.38652	.24351	.38985	.24539	.39316	.24727	.39646	.24915	27
34	.38322	.24167	.38657	.24354	.38990	.24542	.39322	.24730	.39652	.24918	26
35	.38328	.24170	.38663	.24357	.38996	.24545	.39327	.24733	.39657	.24921	25
+ 9'	9.38334	.24173	9.38668	.24360	9.39002	.24548	9.39333	.24736	9.39663	.24924	24
37	.38339	.24176	.38674	.24364	.39007	.24551	.39338	.24739	.39668	.24928	23
38	.38345	.24180	.38680	.24367	.39013	.24554	.39344	.24742	.39674	.24931	22
39	.38350	.24183	.38685	.24370	.39018	.24557	.39349	.24745	.39679	.24934	21
+ 10'	9.38356	.24186	9.38691	.24373	9.39024	.24560	9.39355	.24749	9.39685	.24937	20
41	.38362	.24189	.38696	.24376	.39029	.24564	.39360	.24752	.39690	.24940	19
42	.38367	.24192	.38702	.24379	.39035	.24567	.39366	.24755	.39695	.24943	18
43	.38373	.24195	.38707	.24382	.39040	.24570	.39371	.24758	.39701	.24946	17
+ 11'	9.38378	.24198	9.38713	.24385	9.39046	.24573	9.39377	.24761	9.39706	.24950	16
45	.38384	.24201	.38719	.24388	.39051	.24576	.39382	.24764	.39712	.24953	15
46	.38390	.24204	.38724	.24392	.39057	.24579	.39388	.24767	.39717	.24956	14
47	.38395	.24208	.38730	.24395	.39062	.24582	.39393	.24770	.39723	.24959	13
+ 12'	9.38401	.24211	9.38735	.24398	9.39068	.24586	9.39399	.24774	9.39728	.24962	12
49	.38406	.24214	.38741	.24401	.39073	.24589	.39404	.24777	.39734	.24965	11
50	.38412	.24217	.38746	.24404	.39079	.24592	.39410	.24780	.39739	.24969	10
51	.38418	.24220	.38752	.24407	.39085	.24595	.39415	.24783	.39745	.24972	9
+ 13'	9.38423	.24223	9.38757	.24410	9.39090	.24598	9.39421	.24786	9.39750	.24975	8
53	.38429	.24226	.38763	.24413	.39096	.24601	.39426	.24789	.39756	.24978	7
54	.38434	.24229	.38769	.24417	.39101	.24604	.39432	.24792	.39761	.24981	6
55	.38440	.24233	.38774	.24420	.39107	.24607	.39437	.24796	.39767	.24984	5
+ 14'	9.38445	.24236	9.38780	.24423	9.39112	.24611	9.39443	.24799	9.39772	.24987	4
57	.38451	.24239	.38785	.24426	.39118	.24614	.39448	.24802	.39778	.24991	3
58	.38457	.24242	.38791	.24429	.39123	.24617	.39454	.24805	.39783	.24994	2
59	.38462	.24245	.38796	.24432	.39129	.24620	.39459	.24808	.39789	.24997	1
+ 15'	9.38468	.24248	9.38802	.24435	9.39134	.24623	9.39465	.24811	9.39794	.25000	0
	20h 4m		20h 3m		20h 2m		20h 1m		20h 0m		



Haversines.

s	4h 0m 60° 0'		4h 1m 60° 15'		4h 2m 60° 30'		4h 3m 60° 45'		4h 4m 61° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.39794	.25000	9.40121	.25189	9.40447	.25379	9.40771	.25569	9.41094	.25760	60
1	.39799	.25003	.40127	.25192	.40453	.25382	.40777	.25572	.41099	.25763	59
2	.39805	.25006	.40132	.25195	.40458	.25385	.40782	.25575	.41105	.25766	58
3	.39810	.25009	.40138	.25199	.40463	.25388	.40787	.25578	.41110	.25769	57
+ 1'	9.39816	.25013	9.40143	.25202	9.40469	.25391	9.40793	.25582	9.41115	.25772	56
5	.39821	.25016	.40149	.25205	.40474	.25395	.40798	.25585	.41121	.25775	55
6	.39827	.25019	.40154	.25208	.40480	.25398	.40804	.25588	.41126	.25779	54
7	.39832	.25022	.40159	.25211	.40485	.25401	.40809	.25591	.41131	.25782	53
+ 2'	9.39838	.25025	9.40165	.25214	9.40490	.25404	9.40814	.25594	9.41137	.25785	52
9	.39843	.25028	.40170	.25218	.40496	.25407	.40820	.25597	.41142	.25788	51
10	.39849	.25032	.40176	.25221	.40501	.25410	.40825	.25601	.41147	.25791	50
11	.39854	.25035	.40181	.25224	.40507	.25414	.40831	.25604	.41153	.25795	49
+ 3'	9.39860	.25038	9.40187	.25227	9.40512	.25417	9.40836	.25607	9.41158	.25798	48
13	.39865	.25041	.40192	.25230	.40518	.25420	.40841	.25610	.41163	.25801	47
14	.39871	.25044	.40198	.25233	.40523	.25423	.40847	.25613	.41169	.25804	46
15	.39876	.25047	.40203	.25237	.40528	.25426	.40852	.25617	.41174	.25807	45
+ 4'	9.39881	.25050	9.40208	.25240	9.40534	.25429	9.40858	.25620	9.41180	.25810	44
17	.39887	.25054	.40214	.25243	.40539	.25433	.40863	.25623	.41185	.25814	43
18	.39892	.25057	.40219	.25246	.40545	.25436	.40868	.25626	.41190	.25817	42
19	.39898	.25060	.40225	.25249	.40550	.25439	.40874	.25629	.41196	.25820	41
+ 5'	9.39903	.25063	9.40230	.25252	9.40555	.25442	9.40879	.25632	9.41201	.25823	40
21	.39909	.25066	.40236	.25255	.40561	.25445	.40884	.25636	.41206	.25826	39
22	.39914	.25069	.40241	.25259	.40566	.25448	.40890	.25639	.41212	.25830	38
23	.39920	.25072	.40246	.25262	.40572	.25452	.40895	.25642	.41217	.25833	37
+ 6'	9.39925	.25076	9.40252	.25265	9.40577	.25455	9.40900	.25645	9.41222	.25836	36
25	.39931	.25079	.40257	.25268	.40582	.25458	.40906	.25648	.41228	.25839	35
26	.39936	.25082	.40263	.25271	.40588	.25461	.40911	.25651	.41233	.25842	34
27	.39942	.25085	.40268	.25274	.40593	.25464	.40917	.25655	.41238	.25845	33
+ 7'	9.39947	.25088	9.40274	.25278	9.40599	.25467	9.40922	.25658	9.41244	.25849	32
29	.39952	.25091	.40279	.25281	.40604	.25471	.40927	.25661	.41249	.25852	31
30	.39958	.25095	.40284	.25284	.40609	.25474	.40933	.25664	.41254	.25855	30
31	.39963	.25098	.40290	.25287	.40615	.25477	.40938	.25667	.41260	.25858	29
+ 8'	9.39969	.25101	9.40295	.25290	9.40620	.25480	9.40943	.25671	9.41265	.25861	28
33	.39974	.25104	.40301	.25293	.40626	.25483	.40949	.25674	.41270	.25865	27
34	.39980	.25107	.40306	.25297	.40631	.25487	.40954	.25677	.41276	.25868	26
35	.39985	.25110	.40312	.25300	.40636	.25490	.40960	.25680	.41281	.25871	25
+ 9'	9.39991	.25113	9.40317	.25303	9.40642	.25493	9.40965	.25683	9.41287	.25874	24
37	.39996	.25117	.40322	.25306	.40647	.25496	.40970	.25686	.41292	.25877	23
38	.40002	.25120	.40328	.25309	.40653	.25499	.40976	.25690	.41297	.25880	22
39	.40007	.25123	.40333	.25312	.40658	.25502	.40981	.25693	.41303	.25884	21
+ 10'	9.40012	.25126	9.40339	.25316	9.40663	.25506	9.40986	.25696	9.41308	.25887	20
41	.40018	.25129	.40344	.25319	.40669	.25509	.40992	.25699	.41313	.25890	19
42	.40023	.25132	.40350	.25322	.40674	.25512	.40997	.25702	.41319	.25893	18
43	.40029	.25136	.40355	.25325	.40680	.25515	.41003	.25705	.41324	.25896	17
+ 11'	9.40034	.25139	9.40360	.25328	9.40685	.25518	9.41008	.25709	9.41329	.25900	16
45	.40040	.25142	.40366	.25331	.40690	.25521	.41013	.25712	.41335	.25903	15
46	.40045	.25145	.40371	.25335	.40696	.25525	.41019	.25715	.41340	.25906	14
47	.40051	.25148	.40377	.25338	.40701	.25528	.41024	.25718	.41345	.25909	13
+ 12'	9.40056	.25151	9.40382	.25341	9.40707	.25531	9.41029	.25721	9.41351	.25912	12
49	.40062	.25154	.40388	.25344	.40712	.25534	.41035	.25724	.41356	.25915	11
50	.40067	.25158	.40393	.25347	.40717	.25537	.41040	.25728	.41361	.25919	10
51	.40072	.25161	.40398	.25350	.40723	.25540	.41046	.25731	.41367	.25922	9
+ 13'	9.40078	.25164	9.40404	.25354	9.40728	.25544	9.41051	.25734	9.41372	.25925	8
53	.40083	.25167	.40409	.25357	.40734	.25547	.41056	.25737	.41377	.25928	7
54	.40089	.25170	.40415	.25360	.40739	.25550	.41062	.25740	.41383	.25931	6
55	.40094	.25173	.40420	.25363	.40744	.25553	.41067	.25744	.41388	.25935	5
+ 14'	9.40100	.25177	9.40425	.25366	9.40750	.25556	9.41072	.25747	9.41393	.25938	4
57	.40105	.25180	.40431	.25369	.40755	.25559	.41078	.25750	.41399	.25941	3
58	.40111	.25183	.40436	.25372	.40761	.25563	.41083	.25753	.41404	.25944	2
59	.40116	.25186	.40442	.25376	.40766	.25566	.41088	.25756	.41409	.25947	1
+ 15'	9.40121	.25189	9.40447	.25379	9.40771	.25569	9.41094	.25760	9.41415	.25951	0
	19h 59m		19h 58m		19h 57m		19h 56m		19h 55m		

TABLE IV.

## Haversines.

s	4h 5m 61° 15'		4h 6m 61° 30'		4h 7m 61° 45'		4h 8m 62° 0'		4h 9m 62° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.41415	<b>.25951</b>	9.41734	<b>.26142</b>	9.42052	<b>.26334</b>	9.42368	<b>.26526</b>	9.42682	<b>.26719</b>	60
1	.41420	<b>.25954</b>	.41739	<b>.26145</b>	.42057	<b>.26337</b>	.42373	<b>.26530</b>	.42688	<b>.26722</b>	59
2	.41425	<b>.25957</b>	.41745	<b>.26148</b>	.42062	<b>.26340</b>	.42378	<b>.26533</b>	.42693	<b>.26726</b>	58
3	.41431	<b>.25960</b>	.41750	<b>.26152</b>	.42068	<b>.26344</b>	.42384	<b>.26536</b>	.42698	<b>.26729</b>	57
+ 1'	9.41436	<b>.25963</b>	9.41755	<b>.26155</b>	9.42073	<b>.26347</b>	9.42389	<b>.26539</b>	9.42703	<b>.26732</b>	56
5	.41441	<b>.25966</b>	.41761	<b>.26158</b>	.42078	<b>.26350</b>	.42394	<b>.26543</b>	.42709	<b>.26735</b>	55
6	.41447	<b>.25970</b>	.41766	<b>.26161</b>	.42083	<b>.26353</b>	.42399	<b>.26546</b>	.42714	<b>.26739</b>	54
7	.41452	<b>.25973</b>	.41771	<b>.26164</b>	.42089	<b>.26356</b>	.42405	<b>.26549</b>	.42719	<b>.26742</b>	53
+ 2'	9.41457	<b>.25976</b>	9.41776	<b>.26168</b>	9.42094	<b>.26360</b>	9.42410	<b>.26552</b>	9.42724	<b>.26745</b>	52
9	.41463	<b>.25979</b>	.41782	<b>.26171</b>	.42099	<b>.26363</b>	.42415	<b>.26555</b>	.42730	<b>.26748</b>	51
10	.41468	<b>.25982</b>	.41787	<b>.26174</b>	.42105	<b>.26366</b>	.42420	<b>.26559</b>	.42735	<b>.26751</b>	50
11	.41473	<b>.25986</b>	.41792	<b>.26177</b>	.42110	<b>.26369</b>	.42426	<b>.26562</b>	.42740	<b>.26755</b>	49
+ 3'	9.41479	<b>.25989</b>	9.41798	<b>.26180</b>	9.42115	<b>.26372</b>	9.42431	<b>.26565</b>	9.42745	<b>.26758</b>	48
13	.41484	<b>.25992</b>	.41803	<b>.26184</b>	.42120	<b>.26376</b>	.42436	<b>.26568</b>	.42750	<b>.26761</b>	47
14	.41489	<b>.25995</b>	.41808	<b>.26187</b>	.42126	<b>.26379</b>	.42441	<b>.26571</b>	.42756	<b>.26764</b>	46
15	.41495	<b>.25998</b>	.41814	<b>.26190</b>	.42131	<b>.26382</b>	.42447	<b>.26575</b>	.42761	<b>.26768</b>	45
+ 4'	9.41500	<b>.26002</b>	9.41819	<b>.26193</b>	9.42136	<b>.26385</b>	9.42452	<b>.26578</b>	9.42766	<b>.26771</b>	44
17	.41505	<b>.26005</b>	.41824	<b>.26196</b>	.42141	<b>.26389</b>	.42457	<b>.26581</b>	.42771	<b>.26774</b>	43
18	.41511	<b>.26008</b>	.41829	<b>.26200</b>	.42147	<b>.26392</b>	.42462	<b>.26584</b>	.42777	<b>.26777</b>	42
19	.41516	<b>.26011</b>	.41835	<b>.26203</b>	.42152	<b>.26395</b>	.42468	<b>.26587</b>	.42782	<b>.26780</b>	41
+ 5'	9.41521	<b>.26014</b>	9.41840	<b>.26206</b>	9.42157	<b>.26398</b>	9.42473	<b>.26591</b>	9.42787	<b>.26784</b>	40
21	.41527	<b>.26017</b>	.41845	<b>.26209</b>	.42163	<b>.26402</b>	.42478	<b>.26594</b>	.42792	<b>.26787</b>	39
22	.41532	<b>.26021</b>	.41851	<b>.26212</b>	.42168	<b>.26405</b>	.42483	<b>.26597</b>	.42797	<b>.26790</b>	38
23	.41537	<b>.26024</b>	.41856	<b>.26216</b>	.42173	<b>.26408</b>	.42489	<b>.26600</b>	.42803	<b>.26793</b>	37
+ 6'	9.41543	<b>.26027</b>	9.41861	<b>.26219</b>	9.42178	<b>.26411</b>	9.42494	<b>.26604</b>	9.42808	<b>.26797</b>	36
25	.41548	<b>.26030</b>	.41867	<b>.26222</b>	.42184	<b>.26414</b>	.42499	<b>.26607</b>	.42813	<b>.26800</b>	35
26	.41553	<b>.26033</b>	.41872	<b>.26225</b>	.42189	<b>.26417</b>	.42504	<b>.26610</b>	.42818	<b>.26803</b>	34
27	.41559	<b>.26037</b>	.41877	<b>.26228</b>	.42194	<b>.26421</b>	.42510	<b>.26613</b>	.42824	<b>.26806</b>	33
+ 7'	9.41564	<b>.26040</b>	9.41882	<b>.26232</b>	9.42199	<b>.26424</b>	9.42515	<b>.26616</b>	9.42829	<b>.26809</b>	32
29	.41569	<b>.26043</b>	.41888	<b>.26235</b>	.42205	<b>.26427</b>	.42520	<b>.26620</b>	.42834	<b>.26813</b>	31
30	.41575	<b>.26046</b>	.41893	<b>.26238</b>	.42210	<b>.26430</b>	.42525	<b>.26623</b>	.42839	<b>.26816</b>	30
31	.41580	<b>.26049</b>	.41898	<b>.26241</b>	.42215	<b>.26433</b>	.42531	<b>.26626</b>	.42844	<b>.26819</b>	29
+ 8'	9.41585	<b>.26053</b>	9.41904	<b>.26244</b>	9.42221	<b>.26437</b>	9.42536	<b>.26629</b>	9.42850	<b>.26822</b>	28
33	.41590	<b>.26056</b>	.41909	<b>.26248</b>	.42226	<b>.26440</b>	.42541	<b>.26632</b>	.42855	<b>.26826</b>	27
34	.41596	<b>.26059</b>	.41914	<b>.26251</b>	.42231	<b>.26443</b>	.42546	<b>.26636</b>	.42860	<b>.26829</b>	26
35	.41601	<b>.26062</b>	.41920	<b>.26254</b>	.42236	<b>.26446</b>	.42552	<b>.26639</b>	.42865	<b>.26832</b>	25
+ 9'	9.41606	<b>.26065</b>	9.41925	<b>.26257</b>	9.42242	<b>.26449</b>	9.42557	<b>.26642</b>	9.42870	<b>.26835</b>	24
37	.41612	<b>.26069</b>	.41930	<b>.26260</b>	.42247	<b>.26453</b>	.42562	<b>.26645</b>	.42876	<b>.26838</b>	23
38	.41617	<b>.26072</b>	.41935	<b>.26264</b>	.42252	<b>.26456</b>	.42567	<b>.26649</b>	.42881	<b>.26842</b>	22
39	.41622	<b>.26075</b>	.41941	<b>.26267</b>	.42257	<b>.26459</b>	.42573	<b>.26652</b>	.42886	<b>.26845</b>	21
+ 10'	9.41628	<b>.26078</b>	9.41946	<b>.26270</b>	9.42263	<b>.26462</b>	9.42578	<b>.26655</b>	9.42891	<b>.26848</b>	20
41	.41633	<b>.26081</b>	.41951	<b>.26273</b>	.42268	<b>.26465</b>	.42583	<b>.26658</b>	.42897	<b>.26851</b>	19
42	.41638	<b>.26085</b>	.41957	<b>.26276</b>	.42273	<b>.26469</b>	.42588	<b>.26661</b>	.42902	<b>.26855</b>	18
43	.41644	<b>.26088</b>	.41962	<b>.26280</b>	.42278	<b>.26472</b>	.42593	<b>.26665</b>	.42907	<b>.26858</b>	17
+ 11'	9.41649	<b>.26091</b>	9.41967	<b>.26283</b>	9.42284	<b>.26475</b>	9.42599	<b>.26668</b>	9.42912	<b>.26861</b>	16
45	.41654	<b>.26094</b>	.41972	<b>.26286</b>	.42289	<b>.26478</b>	.42604	<b>.26671</b>	.42917	<b>.26864</b>	15
46	.41660	<b>.26097</b>	.41978	<b>.26289</b>	.42294	<b>.26481</b>	.42609	<b>.26674</b>	.42923	<b>.26867</b>	14
47	.41665	<b>.26101</b>	.41983	<b>.26292</b>	.42300	<b>.26485</b>	.42614	<b>.26677</b>	.42928	<b>.26871</b>	13
+ 12'	9.41670	<b>.26104</b>	9.41988	<b>.26296</b>	9.42305	<b>.26488</b>	9.42620	<b>.26681</b>	9.42933	<b>.26874</b>	12
49	.41676	<b>.26107</b>	.41994	<b>.26299</b>	.42310	<b>.26491</b>	.42625	<b>.26684</b>	.42938	<b>.26877</b>	11
50	.41681	<b>.26110</b>	.41999	<b>.26302</b>	.42315	<b>.26494</b>	.42630	<b>.26687</b>	.42943	<b>.26880</b>	10
51	.41686	<b>.26113</b>	.42004	<b>.26305</b>	.42321	<b>.26498</b>	.42635	<b>.26690</b>	.42949	<b>.26883</b>	9
+ 13'	9.41692	<b>.26117</b>	9.42009	<b>.26308</b>	9.42326	<b>.26501</b>	9.42641	<b>.26694</b>	9.42954	<b>.26887</b>	8
53	.41697	<b>.26120</b>	.42015	<b>.26312</b>	.42331	<b>.26504</b>	.42646	<b>.26697</b>	.42959	<b>.26890</b>	7
54	.41702	<b>.26123</b>	.42020	<b>.26315</b>	.42336	<b>.26507</b>	.42651	<b>.26700</b>	.42964	<b>.26893</b>	6
55	.41707	<b>.26126</b>	.42025	<b>.26318</b>	.42342	<b>.26510</b>	.42656	<b>.26703</b>	.42969	<b>.26896</b>	5
+ 14'	9.41713	<b>.26129</b>	9.42031	<b>.26321</b>	9.42347	<b>.26514</b>	9.42662	<b>.26706</b>	9.42975	<b>.26900</b>	4
57	.41718	<b>.26132</b>	.42036	<b>.26324</b>	.42352	<b>.26517</b>	.42667	<b>.26710</b>	.42980	<b>.26903</b>	3
58	.41723	<b>.26136</b>	.42041	<b>.26328</b>	.42357	<b>.26520</b>	.42672	<b>.26713</b>	.42985	<b>.26906</b>	2
59	.41729	<b>.26139</b>	.42046	<b>.26331</b>	.42363	<b>.26523</b>	.42677	<b>.26716</b>	.42990	<b>.26909</b>	1
+ 15'	9.41734	<b>.26142</b>	9.42052	<b>.26334</b>	9.42368	<b>.26526</b>	9.42682	<b>.26719</b>	9.42996	<b>.26913</b>	0
	19h 54m		19h 53m		19h 52m		19h 51m		19h 50m		



TABLE IV.

Haversines.

s	4h 10m 62° 30'		4h 11m 62° 45'		4h 12m 63° 0'		4h 13m 63° 15'		4h 14m 63° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.42996	<b>.26913</b>	9.43307	<b>.27106</b>	9.43617	<b>.27300</b>	9.43926	<b>.27495</b>	9.44232	<b>.27690</b>	60
1	.43001	<b>.26916</b>	.43312	<b>.27110</b>	.43622	<b>.27304</b>	.43931	<b>.27498</b>	.44238	<b>.27693</b>	59
2	.43006	<b>.26919</b>	.43317	<b>.27113</b>	.43627	<b>.27307</b>	.43936	<b>.27502</b>	.44243	<b>.27697</b>	58
3	.43011	<b>.26922</b>	.43323	<b>.27116</b>	.43632	<b>.27310</b>	.43941	<b>.27505</b>	.44248	<b>.27700</b>	57
+ 1'	9.43016	<b>.26925</b>	9.43328	<b>.27119</b>	9.43638	<b>.27313</b>	9.43946	<b>.27508</b>	9.44253	<b>.27703</b>	56
5	.43022	<b>.26929</b>	.43333	<b>.27122</b>	.43643	<b>.27317</b>	.43951	<b>.27511</b>	.44258	<b>.27706</b>	55
6	.43027	<b>.26932</b>	.43338	<b>.27126</b>	.43648	<b>.27320</b>	.43956	<b>.27515</b>	.44263	<b>.27710</b>	54
7	.43032	<b>.26935</b>	.43343	<b>.27129</b>	.43653	<b>.27323</b>	.43961	<b>.27518</b>	.44268	<b>.27713</b>	53
+ 2'	9.43037	<b>.26938</b>	9.43348	<b>.27132</b>	9.43658	<b>.27326</b>	9.43967	<b>.27521</b>	9.44273	<b>.27716</b>	52
9	.43042	<b>.26942</b>	.43354	<b>.27135</b>	.43663	<b>.27330</b>	.43972	<b>.27524</b>	.44278	<b>.27719</b>	51
10	.43048	<b>.26945</b>	.43359	<b>.27139</b>	.43669	<b>.27333</b>	.43977	<b>.27528</b>	.44283	<b>.27723</b>	50
11	.43053	<b>.26948</b>	.43364	<b>.27142</b>	.43674	<b>.27336</b>	.43982	<b>.27531</b>	.44289	<b>.27726</b>	49
+ 3'	9.43058	<b>.26951</b>	9.43369	<b>.27145</b>	9.43679	<b>.27339</b>	9.43987	<b>.27534</b>	9.44294	<b>.27729</b>	48
13	.43063	<b>.26955</b>	.43374	<b>.27148</b>	.43684	<b>.27343</b>	.43992	<b>.27537</b>	.44299	<b>.27732</b>	47
14	.43068	<b>.26958</b>	.43380	<b>.27152</b>	.43689	<b>.27346</b>	.43997	<b>.27541</b>	.44304	<b>.27736</b>	46
15	.43074	<b>.26961</b>	.43385	<b>.27155</b>	.43694	<b>.27349</b>	.44002	<b>.27544</b>	.44309	<b>.27739</b>	45
+ 4'	9.43079	<b>.26964</b>	9.43390	<b>.27158</b>	9.43699	<b>.27352</b>	9.44008	<b>.27547</b>	9.44314	<b>.27742</b>	44
17	.43084	<b>.26967</b>	.43395	<b>.27161</b>	.43705	<b>.27356</b>	.44013	<b>.27550</b>	.44319	<b>.27745</b>	43
18	.43089	<b>.26971</b>	.43400	<b>.27165</b>	.43710	<b>.27359</b>	.44018	<b>.27554</b>	.44324	<b>.27749</b>	42
19	.43094	<b>.26974</b>	.43405	<b>.27168</b>	.43715	<b>.27362</b>	.44023	<b>.27557</b>	.44329	<b>.27752</b>	41
+ 5'	9.43100	<b>.26977</b>	9.43411	<b>.27171</b>	9.43720	<b>.27365</b>	9.44028	<b>.27560</b>	9.44334	<b>.27755</b>	40
21	.43105	<b>.26980</b>	.43416	<b>.27174</b>	.43725	<b>.27369</b>	.44033	<b>.27563</b>	.44340	<b>.27758</b>	39
22	.43110	<b>.26984</b>	.43421	<b>.27177</b>	.43730	<b>.27372</b>	.44038	<b>.27567</b>	.44345	<b>.27762</b>	38
23	.43115	<b>.26987</b>	.43426	<b>.27181</b>	.43735	<b>.27375</b>	.44043	<b>.27570</b>	.44350	<b>.27765</b>	37
+ 6'	9.43120	<b>.26990</b>	9.43431	<b>.27184</b>	9.43741	<b>.27378</b>	9.44048	<b>.27573</b>	9.44355	<b>.27768</b>	36
25	.43126	<b>.26993</b>	.43436	<b>.27187</b>	.43746	<b>.27382</b>	.44054	<b>.27576</b>	.44360	<b>.27772</b>	35
26	.43131	<b>.26996</b>	.43442	<b>.27190</b>	.43751	<b>.27385</b>	.44059	<b>.27580</b>	.44365	<b>.27775</b>	34
27	.43136	<b>.27000</b>	.43447	<b>.27194</b>	.43756	<b>.27388</b>	.44064	<b>.27583</b>	.44370	<b>.27778</b>	33
+ 7'	9.43141	<b>.27003</b>	9.43452	<b>.27197</b>	9.43761	<b>.27391</b>	9.44069	<b>.27586</b>	9.44375	<b>.27781</b>	32
29	.43146	<b>.27006</b>	.43457	<b>.27200</b>	.43766	<b>.27394</b>	.44074	<b>.27589</b>	.44380	<b>.27785</b>	31
30	.43151	<b>.27009</b>	.43462	<b>.27203</b>	.43771	<b>.27398</b>	.44079	<b>.27593</b>	.44385	<b>.27788</b>	30
31	.43157	<b>.27013</b>	.43467	<b>.27207</b>	.43777	<b>.27401</b>	.44084	<b>.27596</b>	.44390	<b>.27791</b>	29
+ 8'	9.43162	<b>.27016</b>	9.43473	<b>.27210</b>	9.43782	<b>.27404</b>	9.44089	<b>.27599</b>	9.44396	<b>.27794</b>	28
33	.43167	<b>.27019</b>	.43478	<b>.27213</b>	.43787	<b>.27407</b>	.44095	<b>.27602</b>	.44401	<b>.27798</b>	27
34	.43172	<b>.27022</b>	.43483	<b>.27216</b>	.43792	<b>.27411</b>	.44100	<b>.27606</b>	.44406	<b>.27801</b>	26
35	.43177	<b>.27025</b>	.43488	<b>.27220</b>	.43797	<b>.27414</b>	.44105	<b>.27609</b>	.44411	<b>.27804</b>	25
+ 9'	9.43183	<b>.27029</b>	9.43493	<b>.27223</b>	9.43802	<b>.27417</b>	9.44110	<b>.27612</b>	9.44416	<b>.27807</b>	24
37	.43188	<b>.27032</b>	.43498	<b>.27226</b>	.43807	<b>.27420</b>	.44115	<b>.27615</b>	.44421	<b>.27811</b>	23
38	.43193	<b>.27035</b>	.43504	<b>.27229</b>	.43813	<b>.27424</b>	.44120	<b>.27619</b>	.44426	<b>.27814</b>	22
39	.43198	<b>.27038</b>	.43509	<b>.27232</b>	.43818	<b>.27427</b>	.44125	<b>.27622</b>	.44431	<b>.27817</b>	21
+ 10'	9.43203	<b>.27042</b>	9.43514	<b>.27236</b>	9.43823	<b>.27430</b>	9.44130	<b>.27625</b>	9.44436	<b>.27820</b>	20
41	.43209	<b>.27045</b>	.43519	<b>.27239</b>	.43828	<b>.27433</b>	.44135	<b>.27628</b>	.44441	<b>.27824</b>	19
42	.43214	<b>.27048</b>	.43524	<b>.27242</b>	.43833	<b>.27437</b>	.44141	<b>.27632</b>	.44446	<b>.27827</b>	18
43	.43219	<b>.27051</b>	.43529	<b>.27245</b>	.43838	<b>.27440</b>	.44146	<b>.27635</b>	.44452	<b>.27830</b>	17
+ 11'	9.43224	<b>.27055</b>	9.43535	<b>.27249</b>	9.43843	<b>.27443</b>	9.44151	<b>.27638</b>	9.44457	<b>.27833</b>	16
45	.43229	<b>.27058</b>	.43540	<b>.27252</b>	.43849	<b>.27446</b>	.44156	<b>.27641</b>	.44462	<b>.27837</b>	15
46	.43234	<b>.27061</b>	.43545	<b>.27255</b>	.43854	<b>.27450</b>	.44161	<b>.27645</b>	.44467	<b>.27840</b>	14
47	.43240	<b>.27064</b>	.43550	<b>.27258</b>	.43859	<b>.27453</b>	.44166	<b>.27648</b>	.44472	<b>.27843</b>	13
+ 12'	9.43245	<b>.27068</b>	9.43555	<b>.27262</b>	9.43864	<b>.27456</b>	9.44171	<b>.27651</b>	9.44477	<b>.27846</b>	12
49	.43250	<b>.27071</b>	.43560	<b>.27265</b>	.43869	<b>.27459</b>	.44176	<b>.27654</b>	.44482	<b>.27850</b>	11
50	.43255	<b>.27074</b>	.43565	<b>.27268</b>	.43874	<b>.27463</b>	.44181	<b>.27658</b>	.44487	<b>.27853</b>	10
51	.43260	<b>.27077</b>	.43571	<b>.27271</b>	.43879	<b>.27466</b>	.44187	<b>.27661</b>	.44492	<b>.27856</b>	9
+ 13'	9.43266	<b>.27080</b>	9.43576	<b>.27275</b>	9.43884	<b>.27469</b>	9.44192	<b>.27664</b>	9.44497	<b>.27859</b>	8
53	.43271	<b>.27084</b>	.43581	<b>.27278</b>	.43890	<b>.27472</b>	.44197	<b>.27667</b>	.44502	<b>.27863</b>	7
54	.43276	<b>.27087</b>	.43586	<b>.27281</b>	.43895	<b>.27476</b>	.44202	<b>.27671</b>	.44507	<b>.27866</b>	6
55	.43281	<b>.27090</b>	.43591	<b>.27284</b>	.43900	<b>.27479</b>	.44207	<b>.27674</b>	.44513	<b>.27869</b>	5
+ 14'	9.43286	<b>.27093</b>	9.43596	<b>.27288</b>	9.43905	<b>.27482</b>	9.44212	<b>.27677</b>	9.44518	<b>.27873</b>	4
57	.43291	<b>.27097</b>	.43602	<b>.27291</b>	.43910	<b>.27485</b>	.44217	<b>.27680</b>	.44523	<b>.27876</b>	3
58	.43297	<b>.27100</b>	.43607	<b>.27294</b>	.43915	<b>.27489</b>	.44222	<b>.27684</b>	.44528	<b>.27879</b>	2
59	.43302	<b>.27103</b>	.43612	<b>.27297</b>	.43920	<b>.27492</b>	.44227	<b>.27687</b>	.44533	<b>.27882</b>	1
+ 15'	9.43307	<b>.27106</b>	9.43617	<b>.27300</b>	9.43926	<b>.27495</b>	9.44232	<b>.27690</b>	9.44538	<b>.27886</b>	0
	19h 43m		19h 43m		19h 47m		19h 46m		19h 45m		

TABLE IV.

Haversines.

s	4h 15m 63° 45'		4h 16m 64° 0'		4h 17m 64° 15'		4h 18m 64° 30'		4h 19m 64° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.44538	<b>.27886</b>	9.44842	<b>.28081</b>	9.45144	<b>.28278</b>	9.45446	<b>.28474</b>	9.45745	<b>.28672</b>	60
1	.44543	<b>.27889</b>	.44847	<b>.28085</b>	.45149	<b>.28281</b>	.45451	<b>.28478</b>	.45750	<b>.28675</b>	59
2	.44548	<b>.27892</b>	.44852	<b>.28088</b>	.45155	<b>.28284</b>	.45456	<b>.28481</b>	.45755	<b>.28678</b>	58
3	.44553	<b>.27895</b>	.44857	<b>.28091</b>	.45160	<b>.28288</b>	.45461	<b>.28484</b>	.45760	<b>.28681</b>	57
+ 1'	9.44558	<b>.27899</b>	9.44862	<b>.28095</b>	9.45165	<b>.28291</b>	9.45466	<b>.28488</b>	9.45765	<b>.28685</b>	56
5	.44563	<b>.27902</b>	.44867	<b>.28098</b>	.45170	<b>.28294</b>	.45471	<b>.28491</b>	.45770	<b>.28688</b>	55
6	.44568	<b>.27905</b>	.44872	<b>.28101</b>	.45175	<b>.28297</b>	.45476	<b>.28494</b>	.45775	<b>.28691</b>	54
7	.44573	<b>.27908</b>	.44877	<b>.28104</b>	.45180	<b>.28301</b>	.45481	<b>.28497</b>	.45780	<b>.28695</b>	53
+ 2'	9.44579	<b>.27912</b>	9.44882	<b>.28108</b>	9.45185	<b>.28304</b>	9.45486	<b>.28501</b>	9.45785	<b>.28698</b>	52
9	.44584	<b>.27915</b>	.44887	<b>.28111</b>	.45190	<b>.28307</b>	.45491	<b>.28504</b>	.45790	<b>.28701</b>	51
10	.44589	<b>.27918</b>	.44892	<b>.28114</b>	.45195	<b>.28310</b>	.45496	<b>.28507</b>	.45795	<b>.28704</b>	50
11	.44594	<b>.27921</b>	.44898	<b>.28117</b>	.45200	<b>.28314</b>	.45501	<b>.28511</b>	.45800	<b>.28708</b>	49
+ 3'	9.44599	<b>.27925</b>	9.44903	<b>.28121</b>	9.45205	<b>.28317</b>	9.45506	<b>.28514</b>	9.45805	<b>.28711</b>	48
13	.44604	<b>.27928</b>	.44908	<b>.28124</b>	.45210	<b>.28320</b>	.45511	<b>.28517</b>	.45810	<b>.28714</b>	47
14	.44609	<b>.27931</b>	.44913	<b>.28127</b>	.45215	<b>.28324</b>	.45516	<b>.28520</b>	.45815	<b>.28718</b>	46
15	.44614	<b>.27935</b>	.44918	<b>.28130</b>	.45220	<b>.28327</b>	.45521	<b>.28524</b>	.45820	<b>.28721</b>	45
+ 4'	9.44619	<b>.27938</b>	9.44923	<b>.28134</b>	9.45225	<b>.28330</b>	9.45526	<b>.28527</b>	9.45825	<b>.28724</b>	44
17	.44624	<b>.27941</b>	.44928	<b>.28137</b>	.45230	<b>.28333</b>	.45531	<b>.28530</b>	.45830	<b>.28727</b>	43
18	.44629	<b>.27944</b>	.44933	<b>.28140</b>	.45235	<b>.28337</b>	.45536	<b>.28534</b>	.45835	<b>.28731</b>	42
19	.44634	<b>.27948</b>	.44938	<b>.28144</b>	.45240	<b>.28340</b>	.45541	<b>.28537</b>	.45840	<b>.28734</b>	41
+ 5'	9.44639	<b>.27951</b>	9.44943	<b>.28147</b>	9.45245	<b>.28343</b>	9.45546	<b>.28540</b>	9.45845	<b>.28737</b>	40
21	.44645	<b>.27954</b>	.44948	<b>.28150</b>	.45250	<b>.28347</b>	.45551	<b>.28543</b>	.45850	<b>.28741</b>	39
22	.44650	<b>.27957</b>	.44953	<b>.28153</b>	.45255	<b>.28350</b>	.45556	<b>.28547</b>	.45855	<b>.28744</b>	38
23	.44655	<b>.27961</b>	.44958	<b>.28157</b>	.45260	<b>.28353</b>	.45561	<b>.28550</b>	.45860	<b>.28747</b>	37
+ 6'	9.44660	<b>.27964</b>	9.44963	<b>.28160</b>	9.45265	<b>.28356</b>	9.45566	<b>.28553</b>	9.45865	<b>.28751</b>	36
25	.44665	<b>.27967</b>	.44968	<b>.28163</b>	.45270	<b>.28360</b>	.45571	<b>.28557</b>	.45870	<b>.28754</b>	35
26	.44670	<b>.27970</b>	.44973	<b>.28166</b>	.45275	<b>.28363</b>	.45576	<b>.28560</b>	.45875	<b>.28757</b>	34
27	.44675	<b>.27974</b>	.44978	<b>.28170</b>	.45280	<b>.28366</b>	.45581	<b>.28563</b>	.45879	<b>.28760</b>	33
+ 7'	9.44680	<b>.27977</b>	9.44983	<b>.28173</b>	9.45285	<b>.28369</b>	9.45586	<b>.28566</b>	9.45884	<b>.28764</b>	32
29	.44685	<b>.27980</b>	.44988	<b>.28176</b>	.45290	<b>.28373</b>	.45591	<b>.28570</b>	.45889	<b>.28767</b>	31
30	.44690	<b>.27983</b>	.44993	<b>.28180</b>	.45295	<b>.28376</b>	.45596	<b>.28573</b>	.45894	<b>.28770</b>	30
31	.44695	<b>.27987</b>	.44998	<b>.28183</b>	.45300	<b>.28379</b>	.45601	<b>.28576</b>	.45899	<b>.28774</b>	29
+ 8'	9.44700	<b>.27990</b>	9.45003	<b>.28186</b>	9.45305	<b>.28383</b>	9.45606	<b>.28580</b>	9.45904	<b>.28777</b>	28
33	.44705	<b>.27993</b>	.45009	<b>.28189</b>	.45310	<b>.28386</b>	.45610	<b>.28583</b>	.45909	<b>.28780</b>	27
34	.44710	<b>.27997</b>	.45014	<b>.28193</b>	.45315	<b>.28389</b>	.45615	<b>.28586</b>	.45914	<b>.28783</b>	26
35	.44715	<b>.28000</b>	.45019	<b>.28196</b>	.45320	<b>.28392</b>	.45620	<b>.28589</b>	.45919	<b>.28787</b>	25
+ 9'	9.44721	<b>.28003</b>	9.45024	<b>.28199</b>	9.45325	<b>.28396</b>	9.45625	<b>.28593</b>	9.45924	<b>.28790</b>	24
37	.44726	<b>.28006</b>	.45029	<b>.28202</b>	.45330	<b>.28399</b>	.45630	<b>.28596</b>	.45929	<b>.28793</b>	23
38	.44731	<b>.28010</b>	.45034	<b>.28206</b>	.45335	<b>.28402</b>	.45635	<b>.28599</b>	.45934	<b>.28797</b>	22
39	.44736	<b>.28013</b>	.45039	<b>.28209</b>	.45340	<b>.28406</b>	.45640	<b>.28603</b>	.45939	<b>.28800</b>	21
+ 10'	9.44741	<b>.28016</b>	9.45044	<b>.28212</b>	9.45345	<b>.28409</b>	9.45645	<b>.28606</b>	9.45944	<b>.28803</b>	20
41	.44746	<b>.28019</b>	.45049	<b>.28216</b>	.45350	<b>.28412</b>	.45650	<b>.28609</b>	.45949	<b>.28807</b>	19
42	.44751	<b>.28023</b>	.45054	<b>.28219</b>	.45355	<b>.28415</b>	.45655	<b>.28612</b>	.45954	<b>.28810</b>	18
43	.44756	<b>.28026</b>	.45059	<b>.28222</b>	.45360	<b>.28419</b>	.45660	<b>.28616</b>	.45959	<b>.28813</b>	17
+ 11'	9.44761	<b>.28029</b>	9.45064	<b>.28225</b>	9.45365	<b>.28422</b>	9.45665	<b>.28619</b>	9.45964	<b>.28816</b>	16
45	.44766	<b>.28032</b>	.45069	<b>.28229</b>	.45370	<b>.28425</b>	.45670	<b>.28622</b>	.45969	<b>.28820</b>	15
46	.44771	<b>.28036</b>	.45074	<b>.28232</b>	.45375	<b>.28429</b>	.45675	<b>.28626</b>	.45974	<b>.28823</b>	14
47	.44776	<b>.28039</b>	.45079	<b>.28235</b>	.45380	<b>.28432</b>	.45680	<b>.28629</b>	.45979	<b>.28826</b>	13
+ 12'	9.44781	<b>.28042</b>	9.45084	<b>.28238</b>	9.45385	<b>.28435</b>	9.45685	<b>.28632</b>	9.45984	<b>.28830</b>	12
49	.44786	<b>.28046</b>	.45089	<b>.28242</b>	.45390	<b>.28438</b>	.45690	<b>.28635</b>	.45989	<b>.28833</b>	11
50	.44791	<b>.28049</b>	.45094	<b>.28245</b>	.45395	<b>.28442</b>	.45695	<b>.28639</b>	.45994	<b>.28836</b>	10
51	.44796	<b>.28052</b>	.45099	<b>.28248</b>	.45400	<b>.28445</b>	.45700	<b>.28642</b>	.45999	<b>.28839</b>	9
+ 13'	9.44801	<b>.28055</b>	9.45104	<b>.28252</b>	9.45405	<b>.28448</b>	9.45705	<b>.28645</b>	9.46004	<b>.28843</b>	8
53	.44807	<b>.28059</b>	.45109	<b>.28255</b>	.45410	<b>.28451</b>	.45710	<b>.28649</b>	.46009	<b>.28846</b>	7
54	.44812	<b>.28062</b>	.45114	<b>.28258</b>	.45415	<b>.28455</b>	.45715	<b>.28652</b>	.46014	<b>.28849</b>	6
55	.44817	<b>.28065</b>	.45119	<b>.28261</b>	.45420	<b>.28458</b>	.45720	<b>.28655</b>	.46019	<b>.28853</b>	5
+ 14'	9.44822	<b>.28068</b>	9.45124	<b>.28265</b>	9.45426	<b>.28461</b>	9.45725	<b>.28658</b>	9.46023	<b>.28856</b>	4
57	.44827	<b>.28072</b>	.45129	<b>.28268</b>	.45431	<b>.28465</b>	.45730	<b>.28662</b>	.46028	<b>.28859</b>	3
58	.44832	<b>.28075</b>	.45134	<b>.28271</b>	.45436	<b>.28468</b>	.45735	<b>.28665</b>	.46033	<b>.28863</b>	2
59	.44837	<b>.28078</b>	.45139	<b>.28274</b>	.45441	<b>.28471</b>	.45740	<b>.28668</b>	.46038	<b>.28866</b>	1
+ 15'	9.44842	<b>.28081</b>	9.45144	<b>.28278</b>	9.45446	<b>.28474</b>	9.45745	<b>.28672</b>	9.46043	<b>.28869</b>	0
	19h 44m		19h 43m		19h 42m		19h 41m		19h 40m		



TABLE IV.

Haversines.

s	4h 20m 65° 0'		4h 21m 65° 15'		4h 22m 65° 30'		4h 23m 65° 45'		4h 24m 66° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.46043	.28869	9.46340	.29067	9.46635	.29265	9.46929	.29464	9.47222	.29663	60
1	.46048	.28872	.46345	.29070	.46640	.29269	.46934	.29467	.47227	.29666	59
2	.46053	.28876	.46350	.29074	.46645	.29272	.46939	.29471	.47231	.29670	58
3	.46058	.28879	.46355	.29077	.46650	.29275	.46944	.29474	.47236	.29673	57
+ 1'	9.46063	.28882	9.46360	.29080	9.46655	.29279	9.46949	.29477	9.47241	.29676	56
5	.46068	.28886	.46365	.29084	.46660	.29282	.46954	.29481	.47246	.29680	55
6	.46073	.28889	.46370	.29087	.46665	.29285	.46959	.29484	.47251	.29683	54
7	.46078	.28892	.46375	.29090	.46670	.29289	.46963	.29487	.47256	.29686	53
+ 2'	9.46083	.28895	9.46380	.29093	9.46675	.29292	9.46968	.29491	9.47261	.29690	52
9	.46088	.28899	.46384	.29097	.46680	.29295	.46973	.29494	.47266	.29693	51
10	.46093	.28902	.46389	.29100	.46684	.29298	.46978	.29497	.47270	.29696	50
11	.46098	.28905	.46394	.29103	.46689	.29302	.46983	.29501	.47275	.29700	49
+ 3'	9.46103	.28909	9.46399	.29107	9.46694	.29305	9.46988	.29504	9.47280	.29703	48
13	.46108	.28912	.46404	.29110	.46699	.29308	.46993	.29507	.47285	.29706	47
14	.46113	.28915	.46409	.29113	.46704	.29312	.46998	.29510	.47290	.29710	46
15	.46118	.28918	.46414	.29117	.46709	.29315	.47003	.29514	.47295	.29713	45
+ 4'	9.46123	.28922	9.46419	.29120	9.46714	.29318	9.47007	.29517	9.47300	.29716	44
17	.46128	.28925	.46424	.29123	.46719	.29322	.47012	.29520	.47304	.29720	43
18	.46132	.28928	.46429	.29126	.46724	.29325	.47017	.29524	.47309	.29723	42
19	.46137	.28932	.46434	.29130	.46729	.29328	.47022	.29527	.47314	.29726	41
+ 5'	9.46142	.28935	9.46439	.29133	9.46733	.29332	9.47027	.29530	9.47319	.29730	40
21	.46147	.28938	.46444	.29136	.46738	.29335	.47032	.29534	.47324	.29733	39
22	.46152	.28942	.46448	.29140	.46743	.29338	.47037	.29537	.47329	.29736	38
23	.46157	.28945	.46453	.29143	.46748	.29341	.47042	.29540	.47334	.29740	37
+ 6'	9.46162	.28948	9.46458	.29146	9.46753	.29345	9.47046	.29544	9.47338	.29743	36
25	.46167	.28952	.46463	.29150	.46758	.29348	.47051	.29547	.47343	.29746	35
26	.46172	.28955	.46468	.29153	.46763	.29351	.47056	.29550	.47348	.29750	34
27	.46177	.28958	.46473	.29156	.46768	.29355	.47061	.29554	.47353	.29753	33
+ 7'	9.46182	.28961	9.46478	.29160	9.46773	.29358	9.47066	.29557	9.47358	.29756	32
29	.46187	.28965	.46483	.29163	.46778	.29361	.47071	.29560	.47363	.29760	31
30	.46192	.28968	.46488	.29166	.46782	.29365	.47076	.29564	.47367	.29763	30
31	.46197	.28971	.46493	.29169	.46787	.29368	.47081	.29567	.47372	.29766	29
+ 8'	9.46202	.28975	9.46498	.29173	9.46792	.29371	9.47085	.29570	9.47377	.29770	28
33	.46207	.28978	.46503	.29176	.46797	.29375	.47090	.29573	.47382	.29773	27
34	.46212	.28981	.46508	.29179	.46802	.29378	.47095	.29577	.47387	.29776	26
35	.46217	.28985	.46512	.29183	.46807	.29381	.47100	.29580	.47392	.29779	25
+ 9'	9.46222	.28988	9.46517	.29186	9.46812	.29385	9.47105	.29583	9.47397	.29783	24
37	.46226	.28991	.46522	.29189	.46817	.29388	.47110	.29587	.47401	.29786	23
38	.46231	.28994	.46527	.29193	.46822	.29391	.47115	.29590	.47406	.29789	22
39	.46236	.28998	.46532	.29196	.46827	.29394	.47120	.29593	.47411	.29793	21
+ 10'	9.46241	.29001	9.46537	.29199	9.46831	.29398	9.47124	.29597	9.47416	.29796	20
41	.46246	.29004	.46542	.29202	.46836	.29401	.47129	.29600	.47421	.29799	19
42	.46251	.29008	.46547	.29206	.46841	.29404	.47134	.29603	.47426	.29803	18
43	.46256	.29011	.46552	.29209	.46846	.29408	.47139	.29607	.47431	.29806	17
+ 11'	9.46261	.29014	9.46557	.29212	9.46851	.29411	9.47144	.29610	9.47435	.29809	16
45	.46266	.29017	.46562	.29216	.46856	.29414	.47149	.29613	.47440	.29813	15
46	.46271	.29021	.46567	.29219	.46861	.29418	.47154	.29617	.47445	.29816	14
47	.46276	.29024	.46571	.29222	.46866	.29421	.47159	.29620	.47450	.29819	13
+ 12'	9.46281	.29027	9.46576	.29226	9.46871	.29424	9.47163	.29623	9.47455	.29823	12
49	.46286	.29031	.46581	.29229	.46876	.29428	.47168	.29627	.47460	.29826	11
50	.46291	.29034	.46586	.29232	.46880	.29431	.47173	.29630	.47464	.29829	10
51	.46296	.29037	.46591	.29236	.46885	.29434	.47178	.29633	.47469	.29833	9
+ 13'	9.46301	.29041	9.46596	.29239	9.46890	.29438	9.47183	.29637	9.47474	.29836	8
53	.46305	.29044	.46601	.29242	.46895	.29441	.47188	.29640	.47479	.29839	7
54	.46310	.29047	.46606	.29245	.46900	.29444	.47193	.29643	.47484	.29843	6
55	.46315	.29051	.46611	.29249	.46905	.29447	.47197	.29647	.47489	.29846	5
+ 14'	9.46320	.29054	9.46616	.29252	9.46910	.29451	9.47202	.29650	9.47493	.29849	4
57	.46325	.29057	.46621	.29255	.46915	.29454	.47207	.29653	.47498	.29853	3
58	.46330	.29060	.46626	.29259	.46919	.29457	.47212	.29657	.47503	.29856	2
59	.46335	.29064	.46630	.29262	.46924	.29461	.47217	.29660	.47508	.29859	1
+ 15'	9.46340	.29067	9.46635	.29265	9.46929	.29464	9.47222	.29663	9.47513	.29863	0
	19h 39m		19h 38m		19h 37m		19h 36m		19h 35m		

TABLE IV.

Haversines.

s	4h 25m 66° 15'		4h 26m 66° 30'		4h 27m 66° 45'		4h 28m 67° 0'		4h 29m 67° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.47513	.29863	9.47803	.30063	9.48091	.30263	9.48378	.30463	9.48664	.30664	60
1	.47518	.29866	.47807	.30066	.48096	.30266	.48383	.30467	.48668	.30668	59
2	.47523	.29869	.47812	.30069	.48101	.30269	.48387	.30470	.48673	.30671	58
3	.47527	.29873	.47817	.30073	.48105	.30273	.48392	.30473	.48678	.30675	57
+ 1'	9.47532	.29876	9.47822	.30076	9.48110	.30276	9.48397	.30477	9.48683	.30678	56
5	.47537	.29879	.47827	.30079	.48115	.30280	.48402	.30480	.48687	.30681	55
6	.47542	.29883	.47831	.30083	.48120	.30283	.48407	.30484	.48692	.30685	54
7	.47547	.29886	.47836	.30086	.48124	.30286	.48411	.30487	.48697	.30688	53
+ 2'	9.47552	.29889	9.47841	.30089	9.48129	.30290	9.48416	.30490	9.48702	.30691	52
9	.47556	.29893	.47846	.30093	.48134	.30293	.48421	.30494	.48706	.30695	51
10	.47561	.29896	.47851	.30096	.48139	.30296	.48426	.30497	.48711	.30698	50
11	.47566	.29899	.47856	.30099	.48144	.30300	.48430	.30500	.48716	.30701	49
+ 3'	9.47571	.29903	9.47860	.30103	9.48148	.30303	9.48435	.30504	9.48720	.30705	48
13	.47576	.29906	.47865	.30106	.48153	.30306	.48440	.30507	.48725	.30708	47
14	.47581	.29909	.47870	.30109	.48158	.30310	.48445	.30510	.48730	.30711	46
15	.47585	.29913	.47875	.30113	.48163	.30313	.48449	.30514	.48735	.30715	45
+ 4'	9.47590	.29916	9.47880	.30116	9.48168	.30316	9.48454	.30517	9.48739	.30718	44
17	.47595	.29919	.47884	.30119	.48172	.30320	.48459	.30520	.48744	.30721	43
18	.47600	.29923	.47889	.30123	.48177	.30323	.48464	.30524	.48749	.30725	42
19	.47605	.29926	.47894	.30126	.48182	.30326	.48468	.30527	.48754	.30728	41
+ 5'	9.47610	.29929	9.47899	.30129	9.48187	.30330	9.48473	.30530	9.48758	.30732	40
21	.47614	.29933	.47904	.30133	.48192	.30333	.48478	.30534	.48763	.30735	39
22	.47619	.29936	.47908	.30136	.48196	.30336	.48483	.30537	.48768	.30738	38
23	.47624	.29939	.47913	.30139	.48201	.30340	.48488	.30540	.48773	.30742	37
+ 6'	9.47629	.29943	9.47918	.30143	9.48206	.30343	9.48492	.30544	9.48777	.30745	36
25	.47634	.29946	.47923	.30146	.48211	.30346	.48497	.30547	.48782	.30748	35
26	.47639	.29949	.47928	.30149	.48215	.30350	.48502	.30551	.48787	.30752	34
27	.47643	.29953	.47933	.30153	.48220	.30353	.48507	.30554	.48792	.30755	33
+ 7'	9.47648	.29956	9.47937	.30156	9.48225	.30356	9.48511	.30557	9.48796	.30758	32
29	.47653	.29959	.47942	.30159	.48230	.30360	.48516	.30561	.48801	.30762	31
30	.47658	.29963	.47947	.30163	.48235	.30363	.48521	.30564	.48806	.30765	30
31	.47663	.29966	.47952	.30166	.48239	.30366	.48526	.30567	.48811	.30768	29
+ 8'	9.47668	.29969	9.47957	.30169	9.48244	.30370	9.48530	.30571	9.48815	.30772	28
33	.47672	.29973	.47961	.30173	.48249	.30373	.48535	.30574	.48820	.30775	27
34	.47677	.29976	.47966	.30176	.48254	.30376	.48540	.30577	.48825	.30779	26
35	.47682	.29979	.47971	.30179	.48258	.30380	.48545	.30581	.48830	.30782	25
+ 9'	9.47687	.29983	9.47976	.30183	9.48263	.30383	9.48549	.30584	9.48834	.30785	24
37	.47692	.29986	.47981	.30186	.48268	.30386	.48554	.30587	.48839	.30789	23
38	.47697	.29989	.47985	.30189	.48273	.30390	.48559	.30591	.48844	.30792	22
39	.47701	.29993	.47990	.30193	.48278	.30393	.48564	.30594	.48848	.30795	21
+ 10'	9.47706	.29996	9.47995	.30196	9.48282	.30397	9.48568	.30597	9.48853	.30799	20
41	.47711	.29999	.48000	.30199	.48287	.30400	.48573	.30601	.48858	.30802	19
42	.47716	.30003	.48005	.30203	.48292	.30403	.48578	.30604	.48863	.30805	18
43	.47721	.30006	.48009	.30206	.48297	.30407	.48583	.30607	.48867	.30809	17
+ 11'	9.47725	.30009	9.48014	.30209	9.48302	.30410	9.48587	.30611	9.48872	.30812	16
45	.47730	.30013	.48019	.30213	.48306	.30413	.48592	.30614	.48877	.30815	15
46	.47735	.30016	.48024	.30216	.48311	.30417	.48597	.30618	.48882	.30819	14
47	.47740	.30019	.48029	.30219	.48316	.30420	.48602	.30621	.48886	.30822	13
+ 12'	9.47745	.30023	9.48033	.30223	9.48321	.30423	9.48607	.30624	9.48891	.30826	12
49	.47750	.30026	.48038	.30226	.48325	.30427	.48611	.30628	.48896	.30829	11
50	.47754	.30029	.48043	.30229	.48330	.30430	.48616	.30631	.48901	.30832	10
51	.47759	.30033	.48048	.30233	.48335	.30433	.48621	.30634	.48905	.30836	9
+ 13'	9.47764	.30036	9.48053	.30236	9.48340	.30437	9.48626	.30638	9.48910	.30839	8
53	.47769	.30039	.48057	.30239	.48344	.30440	.48630	.30641	.48915	.30842	7
54	.47774	.30043	.48062	.30243	.48349	.30443	.48635	.30644	.48919	.30846	6
55	.47778	.30046	.48067	.30246	.48354	.30447	.48640	.30648	.48924	.30849	5
+ 14'	9.47783	.30049	9.48072	.30249	9.48359	.30450	9.48645	.30651	9.48929	.30852	4
57	.47788	.30053	.48077	.30253	.48364	.30453	.48649	.30655	.48934	.30856	3
58	.47793	.30056	.48081	.30256	.48368	.30457	.48654	.30658	.48938	.30859	2
59	.47798	.30059	.48086	.30259	.48373	.30460	.48659	.30661	.48943	.30862	1
+ 15'	9.47803	.30063	9.48091	.30263	9.48378	.30463	9.48664	.30664	9.48948	.30866	0
	19h 34m		19h 33m		19h 32m		19h 31m		19h 30m		



## Haversines.

s	4h 30m 67° 30'		4h 31m 67° 45'		4h 32m 68° 0'		4h 33m 68° 15'		4h 34m 68° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.48948	<b>.30866</b>	9.49231	<b>.31068</b>	9.49512	<b>.31270</b>	9.49793	<b>.31472</b>	9.50072	<b>.31675</b>	60
1	.48953	<b>.30869</b>	.49235	<b>.31071</b>	.49517	<b>.31273</b>	.49797	<b>.31475</b>	.50076	<b>.31678</b>	59
2	.48957	<b>.30873</b>	.49240	<b>.31074</b>	.49522	<b>.31276</b>	.49802	<b>.31479</b>	.50081	<b>.31682</b>	58
3	.48962	<b>.30876</b>	.49245	<b>.31078</b>	.49526	<b>.31280</b>	.49807	<b>.31482</b>	.50085	<b>.31685</b>	57
+ 1'	9.48967	<b>.30879</b>	9.49250	<b>.31081</b>	9.49531	<b>.31283</b>	9.49811	<b>.31486</b>	9.50090	<b>.31688</b>	56
5	.48971	<b>.30883</b>	.49254	<b>.31084</b>	.49536	<b>.31287</b>	.49816	<b>.31489</b>	.50095	<b>.31692</b>	55
6	.48976	<b>.30886</b>	.49259	<b>.31088</b>	.49540	<b>.31290</b>	.49821	<b>.31492</b>	.50099	<b>.31695</b>	54
7	.48981	<b>.30889</b>	.49264	<b>.31091</b>	.49545	<b>.31293</b>	.49825	<b>.31496</b>	.50104	<b>.31699</b>	53
+ 2'	9.48986	<b>.30893</b>	9.49268	<b>.31095</b>	9.49550	<b>.31297</b>	9.49830	<b>.31499</b>	9.50109	<b>.31702</b>	52
9	.48990	<b>.30896</b>	.49273	<b>.31098</b>	.49554	<b>.31300</b>	.49835	<b>.31503</b>	.50113	<b>.31705</b>	51
10	.48995	<b>.30899</b>	.49278	<b>.31101</b>	.49559	<b>.31303</b>	.49839	<b>.31506</b>	.50118	<b>.31709</b>	50
11	.49000	<b>.30903</b>	.49282	<b>.31105</b>	.49564	<b>.31307</b>	.49844	<b>.31509</b>	.50123	<b>.31712</b>	49
+ 3'	9.49004	<b>.30906</b>	9.49287	<b>.31108</b>	9.49568	<b>.31310</b>	9.49849	<b>.31513</b>	9.50127	<b>.31716</b>	48
13	.49009	<b>.30910</b>	.49292	<b>.31111</b>	.49573	<b>.31314</b>	.49853	<b>.31516</b>	.50132	<b>.31719</b>	47
14	.49014	<b>.30913</b>	.49297	<b>.31115</b>	.49578	<b>.31317</b>	.49858	<b>.31519</b>	.50136	<b>.31722</b>	46
15	.49019	<b>.30916</b>	.49301	<b>.31118</b>	.49583	<b>.31320</b>	.49862	<b>.31523</b>	.50141	<b>.31726</b>	45
+ 4'	9.49023	<b>.30920</b>	9.49306	<b>.31121</b>	9.49587	<b>.31324</b>	9.49867	<b>.31526</b>	9.50146	<b>.31729</b>	44
17	.49028	<b>.30923</b>	.49311	<b>.31125</b>	.49592	<b>.31327</b>	.49872	<b>.31530</b>	.50150	<b>.31732</b>	43
18	.49033	<b>.30926</b>	.49315	<b>.31128</b>	.49597	<b>.31330</b>	.49876	<b>.31533</b>	.50155	<b>.31736</b>	42
19	.49038	<b>.30930</b>	.49320	<b>.31132</b>	.49601	<b>.31334</b>	.49881	<b>.31536</b>	.50160	<b>.31739</b>	41
+ 5'	9.49042	<b>.30933</b>	9.49325	<b>.31135</b>	9.49606	<b>.31337</b>	9.49886	<b>.31540</b>	9.50164	<b>.31742</b>	40
21	.49047	<b>.30936</b>	.49329	<b>.31138</b>	.49611	<b>.31341</b>	.49890	<b>.31543</b>	.50169	<b>.31746</b>	39
22	.49052	<b>.30940</b>	.49334	<b>.31142</b>	.49615	<b>.31344</b>	.49895	<b>.31546</b>	.50174	<b>.31749</b>	38
23	.49056	<b>.30943</b>	.49339	<b>.31145</b>	.49620	<b>.31347</b>	.49900	<b>.31550</b>	.50178	<b>.31753</b>	37
+ 6'	9.49061	<b>.30946</b>	9.49344	<b>.31148</b>	9.49625	<b>.31351</b>	9.49904	<b>.31553</b>	9.50183	<b>.31756</b>	36
25	.49066	<b>.30950</b>	.49348	<b>.31152</b>	.49629	<b>.31354</b>	.49909	<b>.31557</b>	.50187	<b>.31760</b>	35
26	.49071	<b>.30953</b>	.49353	<b>.31155</b>	.49634	<b>.31357</b>	.49914	<b>.31560</b>	.50192	<b>.31763</b>	34
27	.49075	<b>.30957</b>	.49358	<b>.31158</b>	.49639	<b>.31361</b>	.49918	<b>.31563</b>	.50197	<b>.31766</b>	33
+ 7'	9.49080	<b>.30960</b>	9.49362	<b>.31162</b>	9.49643	<b>.31364</b>	9.49923	<b>.31567</b>	9.50201	<b>.31770</b>	32
29	.49085	<b>.30963</b>	.49367	<b>.31165</b>	.49648	<b>.31367</b>	.49928	<b>.31570</b>	.50206	<b>.31773</b>	31
30	.49089	<b>.30967</b>	.49372	<b>.31169</b>	.49653	<b>.31371</b>	.49932	<b>.31573</b>	.50211	<b>.31776</b>	30
31	.49094	<b>.30970</b>	.49376	<b>.31172</b>	.49657	<b>.31374</b>	.49937	<b>.31577</b>	.50215	<b>.31780</b>	29
+ 8'	9.49099	<b>.30973</b>	9.49381	<b>.31175</b>	9.49662	<b>.31378</b>	9.49942	<b>.31580</b>	9.50220	<b>.31783</b>	28
33	.49104	<b>.30977</b>	.49386	<b>.31179</b>	.49667	<b>.31381</b>	.49946	<b>.31584</b>	.50224	<b>.31787</b>	27
34	.49108	<b>.30980</b>	.49390	<b>.31182</b>	.49671	<b>.31384</b>	.49951	<b>.31587</b>	.50229	<b>.31790</b>	26
35	.49113	<b>.30983</b>	.49395	<b>.31185</b>	.49676	<b>.31388</b>	.49956	<b>.31590</b>	.50234	<b>.31793</b>	25
+ 9'	9.49118	<b>.30987</b>	9.49400	<b>.31189</b>	9.49681	<b>.31391</b>	9.49960	<b>.31594</b>	9.50238	<b>.31797</b>	24
37	.49122	<b>.30990</b>	.49405	<b>.31192</b>	.49685	<b>.31394</b>	.49965	<b>.31597</b>	.50243	<b>.31800</b>	23
38	.49127	<b>.30994</b>	.49409	<b>.31196</b>	.49690	<b>.31398</b>	.49969	<b>.31601</b>	.50248	<b>.31804</b>	22
39	.49132	<b>.30997</b>	.49414	<b>.31199</b>	.49695	<b>.31401</b>	.49974	<b>.31604</b>	.50252	<b>.31807</b>	21
+ 10'	9.49137	<b>.31000</b>	9.49419	<b>.31202</b>	9.49699	<b>.31405</b>	9.49979	<b>.31607</b>	9.50257	<b>.31810</b>	20
41	.49141	<b>.31004</b>	.49423	<b>.31206</b>	.49704	<b>.31408</b>	.49983	<b>.31611</b>	.50261	<b>.31814</b>	19
42	.49146	<b>.31007</b>	.49428	<b>.31209</b>	.49709	<b>.31411</b>	.49988	<b>.31614</b>	.50266	<b>.31817</b>	18
43	.49151	<b>.31010</b>	.49433	<b>.31212</b>	.49713	<b>.31415</b>	.49993	<b>.31617</b>	.50271	<b>.31820</b>	17
+ 11'	9.49155	<b>.31014</b>	9.49437	<b>.31216</b>	9.49718	<b>.31418</b>	9.49997	<b>.31621</b>	9.50275	<b>.31824</b>	16
45	.49160	<b>.31017</b>	.49442	<b>.31219</b>	.49723	<b>.31421</b>	.50002	<b>.31624</b>	.50280	<b>.31827</b>	15
46	.49165	<b>.31020</b>	.49447	<b>.31222</b>	.49727	<b>.31425</b>	.50007	<b>.31628</b>	.50284	<b>.31831</b>	14
47	.49170	<b>.31024</b>	.49451	<b>.31226</b>	.49732	<b>.31428</b>	.50011	<b>.31631</b>	.50289	<b>.31834</b>	13
+ 12'	9.49174	<b>.31027</b>	9.49456	<b>.31229</b>	9.49737	<b>.31432</b>	9.50016	<b>.31634</b>	9.50294	<b>.31837</b>	12
49	.49179	<b>.31031</b>	.49461	<b>.31233</b>	.49741	<b>.31435</b>	.50021	<b>.31638</b>	.50298	<b>.31841</b>	11
50	.49184	<b>.31034</b>	.49465	<b>.31236</b>	.49746	<b>.31438</b>	.50025	<b>.31641</b>	.50303	<b>.31844</b>	10
51	.49188	<b>.31037</b>	.49470	<b>.31239</b>	.49751	<b>.31442</b>	.50030	<b>.31644</b>	.50308	<b>.31848</b>	9
+ 13'	9.49193	<b>.31041</b>	9.49475	<b>.31243</b>	9.49755	<b>.31445</b>	9.50034	<b>.31648</b>	9.50312	<b>.31851</b>	8
53	.49198	<b>.31044</b>	.49480	<b>.31246</b>	.49760	<b>.31448</b>	.50039	<b>.31651</b>	.50317	<b>.31854</b>	7
54	.49202	<b>.31047</b>	.49484	<b>.31249</b>	.49765	<b>.31452</b>	.50044	<b>.31655</b>	.50322	<b>.31858</b>	6
55	.49207	<b>.31051</b>	.49489	<b>.31253</b>	.49769	<b>.31455</b>	.50048	<b>.31658</b>	.50326	<b>.31861</b>	5
+ 14'	9.49212	<b>.31054</b>	9.49494	<b>.31256</b>	9.49774	<b>.31459</b>	9.50053	<b>.31661</b>	9.50331	<b>.31865</b>	4
57	.49217	<b>.31057</b>	.49498	<b>.31260</b>	.49779	<b>.31462</b>	.50058	<b>.31665</b>	.50335	<b>.31868</b>	3
58	.49221	<b>.31061</b>	.49503	<b>.31263</b>	.49783	<b>.31465</b>	.50062	<b>.31668</b>	.50340	<b>.31871</b>	2
59	.49226	<b>.31064</b>	.49508	<b>.31266</b>	.49788	<b>.31469</b>	.50067	<b>.31672</b>	.50345	<b>.31875</b>	1
+ 15'	9.49231	<b>.31068</b>	9.49512	<b>.31270</b>	9.49793	<b>.31472</b>	9.50072	<b>.31675</b>	9.50349	<b>.31878</b>	0
	19h 29m		19h 28m		19h 27m		19h 26m		19h 25m		

TABLE IV.

Haversines.

s	4h 35m 68° 45'		4h 36m 69° 0'		4h 37m 69° 15'		4h 38m 69° 30'		4h 39m 69° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.50349	<b>.31878</b>	9.50626	<b>.32032</b>	9.50901	<b>.32285</b>	9.51174	<b>.32490</b>	9.51447	<b>.32694</b>	60
1	.50354	<b>.31881</b>	.50630	<b>.32035</b>	.50905	<b>.32289</b>	.51179	<b>.32493</b>	.51452	<b>.32698</b>	59
2	.50358	<b>.31885</b>	.50635	<b>.32038</b>	.50910	<b>.32292</b>	.51184	<b>.32496</b>	.51456	<b>.32701</b>	58
3	.50363	<b>.31888</b>	.50639	<b>.32042</b>	.50914	<b>.32296</b>	.51188	<b>.32500</b>	.51461	<b>.32704</b>	57
+ 1'	9.50368	<b>.31892</b>	9.50644	<b>.32095</b>	9.50919	<b>.32299</b>	9.51193	<b>.32503</b>	9.51465	<b>.32708</b>	56
5	.50372	<b>.31895</b>	.50649	<b>.32099</b>	.50924	<b>.32302</b>	.51197	<b>.32507</b>	.51470	<b>.32711</b>	55
6	.50377	<b>.31898</b>	.50653	<b>.32102</b>	.50928	<b>.32306</b>	.51202	<b>.32510</b>	.51474	<b>.32715</b>	54
7	.50382	<b>.31902</b>	.50658	<b>.32105</b>	.50933	<b>.32309</b>	.51206	<b>.32513</b>	.51479	<b>.32718</b>	53
+ 2'	9.50386	<b>.31905</b>	9.50662	<b>.32109</b>	9.50937	<b>.32313</b>	9.51211	<b>.32517</b>	9.51483	<b>.32721</b>	52
9	.50391	<b>.31909</b>	.50667	<b>.32112</b>	.50942	<b>.32316</b>	.51215	<b>.32520</b>	.51488	<b>.32725</b>	51
10	.50395	<b>.31912</b>	.50672	<b>.32116</b>	.50946	<b>.32319</b>	.51220	<b>.32524</b>	.51492	<b>.32728</b>	50
11	.50400	<b>.31915</b>	.50676	<b>.32119</b>	.50951	<b>.32323</b>	.51225	<b>.32527</b>	.51497	<b>.32732</b>	49
+ 3'	9.50405	<b>.31919</b>	9.50681	<b>.32122</b>	9.50956	<b>.32326</b>	9.51229	<b>.32531</b>	9.51501	<b>.32735</b>	48
13	.50409	<b>.31922</b>	.50685	<b>.32126</b>	.50960	<b>.32330</b>	.51234	<b>.32534</b>	.51506	<b>.32738</b>	47
14	.50414	<b>.31926</b>	.50690	<b>.32129</b>	.50965	<b>.32333</b>	.51238	<b>.32537</b>	.51510	<b>.32742</b>	46
15	.50418	<b>.31929</b>	.50694	<b>.32133</b>	.50969	<b>.32336</b>	.51243	<b>.32541</b>	.51515	<b>.32745</b>	45
+ 4'	9.50423	<b>.31932</b>	9.50699	<b>.32136</b>	9.50974	<b>.32340</b>	9.51247	<b>.32544</b>	9.51519	<b>.32749</b>	44
17	.50428	<b>.31936</b>	.50704	<b>.32139</b>	.50978	<b>.32343</b>	.51252	<b>.32547</b>	.51524	<b>.32752</b>	43
18	.50432	<b>.31939</b>	.50708	<b>.32143</b>	.50983	<b>.32347</b>	.51256	<b>.32551</b>	.51529	<b>.32756</b>	42
19	.50437	<b>.31942</b>	.50713	<b>.32146</b>	.50988	<b>.32350</b>	.51261	<b>.32554</b>	.51533	<b>.32759</b>	41
+ 5'	9.50442	<b>.31946</b>	9.50717	<b>.32150</b>	9.50992	<b>.32353</b>	9.51265	<b>.32558</b>	9.51538	<b>.32762</b>	40
21	.50446	<b>.31949</b>	.50722	<b>.32153</b>	.50997	<b>.32357</b>	.51270	<b>.32561</b>	.51542	<b>.32766</b>	39
22	.50451	<b>.31953</b>	.50727	<b>.32156</b>	.51001	<b>.32360</b>	.51275	<b>.32565</b>	.51547	<b>.32769</b>	38
23	.50455	<b>.31956</b>	.50731	<b>.32160</b>	.51006	<b>.32364</b>	.51279	<b>.32568</b>	.51551	<b>.32773</b>	37
+ 6'	9.50460	<b>.31959</b>	9.50736	<b>.32163</b>	9.51010	<b>.32367</b>	9.51284	<b>.32571</b>	9.51556	<b>.32776</b>	36
25	.50465	<b>.31963</b>	.50740	<b>.32166</b>	.51015	<b>.32370</b>	.51288	<b>.32575</b>	.51560	<b>.32779</b>	35
26	.50469	<b>.31966</b>	.50745	<b>.32170</b>	.51019	<b>.32374</b>	.51293	<b>.32578</b>	.51565	<b>.32783</b>	34
27	.50474	<b>.31970</b>	.50750	<b>.32173</b>	.51024	<b>.32377</b>	.51297	<b>.32582</b>	.51569	<b>.32786</b>	33
+ 7'	9.50478	<b>.31973</b>	9.50754	<b>.32177</b>	9.51029	<b>.32381</b>	9.51302	<b>.32585</b>	9.51574	<b>.32790</b>	32
29	.50483	<b>.31976</b>	.50759	<b>.32180</b>	.51033	<b>.32384</b>	.51306	<b>.32588</b>	.51578	<b>.32793</b>	31
30	.50488	<b>.31980</b>	.50763	<b>.32183</b>	.51038	<b>.32388</b>	.51311	<b>.32592</b>	.51583	<b>.32797</b>	30
31	.50492	<b>.31983</b>	.50768	<b>.32187</b>	.51042	<b>.32391</b>	.51315	<b>.32595</b>	.51587	<b>.32800</b>	29
+ 8'	9.50497	<b>.31987</b>	9.50772	<b>.32190</b>	9.51047	<b>.32394</b>	9.51320	<b>.32599</b>	9.51592	<b>.32803</b>	28
33	.50501	<b>.31990</b>	.50777	<b>.32194</b>	.51051	<b>.32398</b>	.51325	<b>.32602</b>	.51596	<b>.32807</b>	27
34	.50506	<b>.31993</b>	.50782	<b>.32197</b>	.51056	<b>.32401</b>	.51329	<b>.32605</b>	.51601	<b>.32810</b>	26
35	.50511	<b>.31997</b>	.50786	<b>.32200</b>	.51061	<b>.32405</b>	.51334	<b>.32609</b>	.51605	<b>.32814</b>	25
+ 9'	9.50515	<b>.32000</b>	9.50791	<b>.32204</b>	9.51065	<b>.32408</b>	9.51338	<b>.32612</b>	9.51610	<b>.32817</b>	24
37	.50520	<b>.32004</b>	.50795	<b>.32207</b>	.51070	<b>.32411</b>	.51343	<b>.32616</b>	.51614	<b>.32820</b>	23
38	.50524	<b>.32007</b>	.50800	<b>.32211</b>	.51074	<b>.32415</b>	.51347	<b>.32619</b>	.51619	<b>.32824</b>	22
39	.50529	<b>.32010</b>	.50805	<b>.32214</b>	.51079	<b>.32418</b>	.51352	<b>.32623</b>	.51623	<b>.32827</b>	21
+ 10'	9.50534	<b>.32014</b>	9.50809	<b>.32217</b>	9.51083	<b>.32422</b>	9.51356	<b>.32626</b>	9.51628	<b>.32831</b>	20
41	.50538	<b>.32017</b>	.50814	<b>.32221</b>	.51088	<b>.32425</b>	.51361	<b>.32629</b>	.51633	<b>.32834</b>	19
42	.50543	<b>.32021</b>	.50818	<b>.32224</b>	.51092	<b>.32428</b>	.51365	<b>.32633</b>	.51637	<b>.32838</b>	18
43	.50547	<b>.32024</b>	.50823	<b>.32228</b>	.51097	<b>.32432</b>	.51370	<b>.32636</b>	.51642	<b>.32841</b>	17
+ 11'	9.50552	<b>.32027</b>	9.50827	<b>.32231</b>	9.51102	<b>.32435</b>	9.51374	<b>.32640</b>	9.51646	<b>.32844</b>	16
45	.50557	<b>.32031</b>	.50832	<b>.32235</b>	.51106	<b>.32438</b>	.51379	<b>.32643</b>	.51651	<b>.32848</b>	15
46	.50561	<b>.32034</b>	.50837	<b>.32238</b>	.51111	<b>.32442</b>	.51384	<b>.32646</b>	.51655	<b>.32851</b>	14
47	.50566	<b>.32037</b>	.50841	<b>.32241</b>	.51115	<b>.32445</b>	.51388	<b>.32650</b>	.51660	<b>.32855</b>	13
+ 12'	9.50570	<b>.32041</b>	9.50846	<b>.32245</b>	9.51120	<b>.32449</b>	9.51393	<b>.32653</b>	9.51664	<b>.32858</b>	12
49	.50575	<b>.32044</b>	.50850	<b>.32248</b>	.51124	<b>.32452</b>	.51397	<b>.32657</b>	.51669	<b>.32861</b>	11
50	.50580	<b>.32048</b>	.50855	<b>.32251</b>	.51129	<b>.32456</b>	.51402	<b>.32660</b>	.51673	<b>.32865</b>	10
51	.50584	<b>.32051</b>	.50860	<b>.32255</b>	.51133	<b>.32459</b>	.51406	<b>.32663</b>	.51678	<b>.32868</b>	9
+ 13'	9.50589	<b>.32054</b>	9.50864	<b>.32258</b>	9.51138	<b>.32462</b>	9.51411	<b>.32667</b>	9.51682	<b>.32872</b>	8
53	.50593	<b>.32058</b>	.50869	<b>.32262</b>	.51143	<b>.32466</b>	.51415	<b>.32670</b>	.51687	<b>.32875</b>	7
54	.50598	<b>.32061</b>	.50873	<b>.32265</b>	.51147	<b>.32469</b>	.51420	<b>.32674</b>	.51691	<b>.32878</b>	6
55	.50603	<b>.32065</b>	.50878	<b>.32268</b>	.51152	<b>.32473</b>	.51424	<b>.32677</b>	.51696	<b>.32882</b>	5
+ 14'	9.50607	<b>.32068</b>	9.50882	<b>.32272</b>	9.51156	<b>.32476</b>	9.51429	<b>.32681</b>	9.51700	<b>.32885</b>	4
57	.50612	<b>.32071</b>	.50887	<b>.32275</b>	.51161	<b>.32479</b>	.51433	<b>.32684</b>	.51705	<b>.32889</b>	3
58	.50616	<b>.32075</b>	.50892	<b>.32279</b>	.51165	<b>.32483</b>	.51438	<b>.32687</b>	.51709	<b>.32892</b>	2
59	.50621	<b>.32078</b>	.50896	<b>.32282</b>	.51170	<b>.32486</b>	.51442	<b>.32691</b>	.51714	<b>.32896</b>	1
+ 15'	9.50626	<b>.32082</b>	9.50901	<b>.32285</b>	9.51174	<b>.32490</b>	9.51447	<b>.32694</b>	9.51718	<b>.32899</b>	0
	19h 24m		19h 23m		19h 22m		19h 21m		19h 20m		



Haversines.

s	4h 40m 70° 0'		4h 41m 70° 15'		4h 42m 70° 30'		4h 43m 70° 45'		4h 44m 71° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.51718	.32899	9.51988	.33104	9.52257	.33310	9.52525	.33515	9.52791	.33722	60
1	.51723	.32902	.51993	.33108	.52261	.33313	.52529	.33519	.52795	.33725	59
2	.51727	.32906	.51997	.33111	.52266	.33317	.52533	.33522	.52800	.33728	58
3	.51732	.32909	.52002	.33114	.52270	.33320	.52538	.33526	.52804	.33732	57
+ 1'	9.51736	.32913	9.52006	.33118	9.52275	.33323	9.52542	.33529	9.52809	.33735	56
5	.51741	.32916	.52011	.33121	.52279	.33327	.52547	.33533	.52813	.33739	55
6	.51745	.32920	.52015	.33125	.52284	.33330	.52551	.33536	.52817	.33742	54
7	.51750	.32923	.52020	.33128	.52288	.33334	.52556	.33540	.52822	.33746	53
+ 2'	9.51754	.32926	9.52024	.33132	9.52293	.33337	9.52560	.33543	9.52826	.33749	52
9	.51759	.32930	.52029	.33135	.52297	.33341	.52565	.33546	.52831	.33753	51
10	.51763	.32933	.52033	.33138	.52302	.33344	.52569	.33550	.52835	.33756	50
11	.51768	.32937	.52038	.33142	.52306	.33347	.52573	.33553	.52839	.33759	49
+ 3'	9.51772	.32940	9.52042	.33145	9.52311	.33351	9.52578	.33557	9.52844	.33763	48
13	.51777	.32943	.52047	.33149	.52315	.33354	.52582	.33560	.52848	.33766	47
14	.51781	.32947	.52051	.33152	.52320	.33358	.52587	.33564	.52853	.33770	46
15	.51786	.32950	.52056	.33156	.52324	.33361	.52591	.33567	.52857	.33773	45
+ 4'	9.51790	.32954	9.52060	.33159	9.52328	.33365	9.52596	.33570	9.52862	.33777	44
17	.51795	.32957	.52065	.33162	.52333	.33368	.52600	.33574	.52866	.33780	43
18	.51799	.32961	.52069	.33166	.52337	.33371	.52605	.33577	.52870	.33783	42
19	.51804	.32964	.52074	.33169	.52342	.33375	.52609	.33581	.52875	.33787	41
+ 5'	9.51808	.32967	9.52078	.33173	9.52346	.33378	9.52613	.33584	9.52879	.33790	40
21	.51813	.32971	.52082	.33176	.52351	.33382	.52618	.33588	.52884	.33794	39
22	.51817	.32974	.52087	.33179	.52355	.33385	.52622	.33591	.52888	.33797	38
23	.51822	.32978	.52091	.33183	.52360	.33389	.52627	.33594	.52893	.33801	37
+ 6'	9.51826	.32981	9.52096	.33186	9.52364	.33392	9.52631	.33598	9.52897	.33804	36
25	.51831	.32984	.52100	.33190	.52369	.33395	.52636	.33601	.52901	.33808	35
26	.51835	.32988	.52105	.33193	.52373	.33399	.52640	.33605	.52906	.33811	34
27	.51840	.32991	.52109	.33197	.52378	.33402	.52645	.33608	.52910	.33814	33
+ 7'	9.51844	.32995	9.52114	.33200	9.52382	.33406	9.52649	.33612	9.52915	.33818	32
29	.51849	.32998	.52118	.33203	.52386	.33409	.52653	.33615	.52919	.33821	31
30	.51853	.33002	.52123	.33207	.52391	.33413	.52658	.33618	.52923	.33825	30
31	.51858	.33005	.52127	.33210	.52395	.33416	.52662	.33622	.52928	.33828	29
+ 8'	9.51862	.33008	9.52132	.33214	9.52400	.33419	9.52667	.33625	9.52932	.33832	28
33	.51867	.33012	.52136	.33217	.52404	.33423	.52671	.33629	.52937	.33835	27
34	.51871	.33015	.52141	.33221	.52409	.33426	.52676	.33632	.52941	.33839	26
35	.51876	.33019	.52145	.33224	.52413	.33430	.52680	.33636	.52946	.33842	25
+ 9'	9.51880	.33022	9.52150	.33227	9.52418	.33433	9.52684	.33639	9.52950	.33845	24
37	.51885	.33025	.52154	.33231	.52422	.33436	.52689	.33642	.52954	.33849	23
38	.51889	.33029	.52159	.33234	.52427	.33440	.52693	.33646	.52959	.33852	22
39	.51894	.33032	.52163	.33238	.52431	.33444	.52698	.33649	.52963	.33856	21
+ 10'	9.51898	.33036	9.52168	.33241	9.52436	.33447	9.52702	.33653	9.52968	.33859	20
41	.51903	.33039	.52172	.33245	.52440	.33450	.52707	.33656	.52972	.33863	19
42	.51907	.33043	.52177	.33248	.52444	.33454	.52711	.33660	.52976	.33866	18
43	.51912	.33046	.52181	.33251	.52449	.33457	.52715	.33663	.52981	.33869	17
+ 11'	9.51916	.33049	9.52185	.33255	9.52453	.33461	9.52720	.33667	9.52985	.33873	16
45	.51921	.33053	.52190	.33258	.52458	.33464	.52724	.33670	.52990	.33876	15
46	.51925	.33056	.52194	.33262	.52462	.33467	.52729	.33673	.52994	.33880	14
47	.51930	.33060	.52199	.33265	.52467	.33471	.52733	.33677	.52999	.33883	13
+ 12'	9.51934	.33063	9.52203	.33269	9.52471	.33474	9.52738	.33680	9.53003	.33887	12
49	.51939	.33067	.52208	.33272	.52476	.33478	.52742	.33684	.53007	.33890	11
50	.51943	.33070	.52212	.33275	.52480	.33481	.52747	.33687	.53012	.33894	10
51	.51948	.33073	.52217	.33279	.52484	.33485	.52751	.33691	.53016	.33897	9
+ 13'	9.51952	.33077	9.52221	.33282	9.52489	.33488	9.52755	.33694	9.53021	.33900	8
53	.51957	.33080	.52226	.33286	.52493	.33491	.52760	.33698	.53025	.33904	7
54	.51961	.33084	.52230	.33289	.52498	.33495	.52764	.33701	.53029	.33907	6
55	.51966	.33087	.52235	.33293	.52502	.33498	.52769	.33704	.53034	.33911	5
+ 14'	9.51970	.33090	9.52239	.33296	9.52507	.33502	9.52773	.33708	9.53038	.33914	4
57	.51975	.33094	.52244	.33299	.52511	.33505	.52778	.33711	.53043	.33918	3
58	.51979	.33097	.52248	.33303	.52516	.33509	.52782	.33715	.53047	.33921	2
59	.51984	.33101	.52253	.33306	.52520	.33512	.52786	.33718	.53051	.33925	1
+ 15'	9.51988	.33104	9.52257	.33310	9.52525	.33515	9.52791	.33722	9.53056	.33928	0
	19h 19m		19h 18m		19h 17m		19h 16m		19h 15m		

TABLE IV.

Haversines.

s	4h 45m 71° 15'		4h 46m 71° 30'		4h 47m 71° 45'		4h 48m 72° 0'		4h 49m 72° 15'		s			
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.				
0	9.53056	<b>.33928</b>	9.53320	<b>.34135</b>	9.53582	<b>.34342</b>	9.53844	<b>.34549</b>	9.54104	<b>.34757</b>	60			
1	53060	<b>.33931</b>	53324	<b>.34138</b>	53587	<b>.34345</b>	53848	<b>.34553</b>	54108	<b>.34760</b>	59			
2	53065	<b>.33935</b>	53328	<b>.34142</b>	53591	<b>.34349</b>	53852	<b>.34556</b>	54113	<b>.34764</b>	58			
3	53069	<b>.33938</b>	53333	<b>.34145</b>	53595	<b>.34352</b>	53857	<b>.34560</b>	54117	<b>.34767</b>	57			
+ 1'	9.53073	<b>.33942</b>	9.53337	<b>.34149</b>	9.53600	<b>.34356</b>	9.53861	<b>.34563</b>	9.54121	<b>.34771</b>	56			
5	53078	<b>.33945</b>	53342	<b>.34152</b>	53604	<b>.34359</b>	53865	<b>.34566</b>	54126	<b>.34774</b>	55			
6	53082	<b>.33949</b>	53346	<b>.34155</b>	53609	<b>.34363</b>	53870	<b>.34570</b>	54130	<b>.34778</b>	54			
7	53087	<b>.33952</b>	53350	<b>.34159</b>	53613	<b>.34366</b>	53874	<b>.34573</b>	54134	<b>.34781</b>	53			
+ 2'	9.53091	<b>.33956</b>	9.53355	<b>.34162</b>	9.53617	<b>.34369</b>	9.53879	<b>.34577</b>	9.54139	<b>.34784</b>	52			
9	53096	<b>.33959</b>	53359	<b>.34166</b>	53622	<b>.34373</b>	53883	<b>.34580</b>	54143	<b>.34788</b>	51			
10	53100	<b>.33962</b>	53364	<b>.34169</b>	53626	<b>.34376</b>	53887	<b>.34584</b>	54147	<b>.34791</b>	50			
11	53104	<b>.33966</b>	53368	<b>.34173</b>	53630	<b>.34380</b>	53892	<b>.34587</b>	54152	<b>.34795</b>	49			
+ 3'	9.53109	<b>.33969</b>	9.53372	<b>.34176</b>	9.53635	<b>.34383</b>	9.53896	<b>.34591</b>	9.54156	<b>.34798</b>	48			
13	53113	<b>.33973</b>	53377	<b>.34180</b>	53639	<b>.34387</b>	53900	<b>.34594</b>	54160	<b>.34802</b>	47			
14	53118	<b>.33976</b>	53381	<b>.34183</b>	53643	<b>.34390</b>	53905	<b>.34598</b>	54165	<b>.34805</b>	46			
15	53122	<b>.33980</b>	53385	<b>.34186</b>	53648	<b>.34394</b>	53909	<b>.34601</b>	54169	<b>.34809</b>	45			
+ 4'	9.53126	<b>.33983</b>	9.53390	<b>.34190</b>	9.53652	<b>.34397</b>	9.53913	<b>.34604</b>	9.54173	<b>.34812</b>	44			
17	53131	<b>.33986</b>	53394	<b>.34193</b>	53657	<b>.34400</b>	53918	<b>.34608</b>	54177	<b>.34816</b>	43			
18	53135	<b>.33990</b>	53399	<b>.34197</b>	53661	<b>.34404</b>	53922	<b>.34611</b>	54182	<b>.34819</b>	42			
19	53140	<b>.33993</b>	53403	<b>.34200</b>	53665	<b>.34407</b>	53926	<b>.34615</b>	54186	<b>.34823</b>	41			
+ 5'	9.53144	<b>.33997</b>	9.53407	<b>.34204</b>	9.53670	<b>.34411</b>	9.53931	<b>.34618</b>	9.54190	<b>.34826</b>	40			
21	53148	<b>.34000</b>	53412	<b>.34207</b>	53674	<b>.34414</b>	53935	<b>.34622</b>	54195	<b>.34830</b>	39			
22	53153	<b>.34004</b>	53416	<b>.34211</b>	53678	<b>.34418</b>	53939	<b>.34625</b>	54199	<b>.34833</b>	38			
23	53157	<b>.34007</b>	53421	<b>.34214</b>	53683	<b>.34421</b>	53944	<b>.34629</b>	54203	<b>.34836</b>	37			
+ 6'	9.53162	<b>.34011</b>	9.53425	<b>.34218</b>	9.53687	<b>.34425</b>	9.53948	<b>.34632</b>	9.54208	<b>.34840</b>	36			
25	53166	<b>.34014</b>	53429	<b>.34221</b>	53691	<b>.34428</b>	53952	<b>.34636</b>	54212	<b>.34843</b>	35			
26	53170	<b>.34018</b>	53434	<b>.34224</b>	53696	<b>.34432</b>	53957	<b>.34639</b>	54216	<b>.34847</b>	34			
27	53175	<b>.34021</b>	53438	<b>.34228</b>	53700	<b>.34435</b>	53961	<b>.34643</b>	54221	<b>.34850</b>	33			
+ 7'	9.53179	<b>.34024</b>	9.53442	<b>.34231</b>	9.53704	<b>.34439</b>	9.53966	<b>.34646</b>	9.54225	<b>.34854</b>	32			
29	53184	<b>.34028</b>	53447	<b>.34235</b>	53709	<b>.34442</b>	53970	<b>.34649</b>	54229	<b>.34857</b>	31			
30	53188	<b>.34031</b>	53451	<b>.34238</b>	53713	<b>.34445</b>	53974	<b>.34653</b>	54234	<b>.34861</b>	30			
31	53192	<b>.34035</b>	53456	<b>.34242</b>	53718	<b>.34449</b>	53978	<b>.34656</b>	54238	<b>.34864</b>	29			
+ 8'	9.53197	<b>.34038</b>	9.53460	<b>.34245</b>	9.53722	<b>.34452</b>	9.53983	<b>.34660</b>	9.54242	<b>.34868</b>	28			
33	53201	<b>.34042</b>	53464	<b>.34249</b>	53726	<b>.34456</b>	53987	<b>.34663</b>	54247	<b>.34871</b>	27			
34	53206	<b>.34045</b>	53469	<b>.34252</b>	53731	<b>.34459</b>	53991	<b>.34667</b>	54251	<b>.34875</b>	26			
35	53210	<b>.34049</b>	53473	<b>.34256</b>	53735	<b>.34463</b>	53996	<b>.34670</b>	54255	<b>.34878</b>	25			
+ 9'	9.53214	<b>.34052</b>	9.53477	<b>.34259</b>	9.53739	<b>.34466</b>	9.54000	<b>.34674</b>	9.54260	<b>.34882</b>	24			
37	53219	<b>.34055</b>	53482	<b>.34262</b>	53744	<b>.34470</b>	54004	<b>.34677</b>	54264	<b>.34885</b>	23			
38	53223	<b>.34059</b>	53486	<b>.34266</b>	53748	<b>.34473</b>	54009	<b>.34681</b>	54268	<b>.34888</b>	22			
39	53228	<b>.34062</b>	53491	<b>.34269</b>	53752	<b>.34477</b>	54013	<b>.34684</b>	54272	<b>.34892</b>	21			
+ 10'	9.53232	<b>.34066</b>	9.53495	<b>.34273</b>	9.53757	<b>.34480</b>	9.54017	<b>.34688</b>	9.54277	<b>.34895</b>	20			
41	53236	<b>.34069</b>	53499	<b>.34276</b>	53761	<b>.34483</b>	54022	<b>.34691</b>	54281	<b>.34899</b>	19			
42	53241	<b>.34073</b>	53504	<b>.34280</b>	53765	<b>.34487</b>	54026	<b>.34694</b>	54285	<b>.34902</b>	18			
43	53245	<b>.34076</b>	53508	<b>.34283</b>	53770	<b>.34490</b>	54030	<b>.34698</b>	54290	<b>.34906</b>	17			
+ 11'	9.53249	<b>.34080</b>	9.53512	<b>.34287</b>	9.53774	<b>.34494</b>	9.54035	<b>.34701</b>	9.54294	<b>.34909</b>	16			
45	53254	<b>.34083</b>	53517	<b>.34290</b>	53778	<b>.34497</b>	54039	<b>.34705</b>	54298	<b>.34913</b>	15			
46	53258	<b>.34087</b>	53521	<b>.34293</b>	53783	<b>.34501</b>	54043	<b>.34708</b>	54303	<b>.34916</b>	14			
47	53263	<b>.34090</b>	53526	<b>.34297</b>	53787	<b>.34504</b>	54048	<b>.34712</b>	54307	<b>.34920</b>	13			
+ 12'	9.53267	<b>.34093</b>	9.53530	<b>.34300</b>	9.53792	<b>.34508</b>	9.54052	<b>.34715</b>	9.54311	<b>.34923</b>	12			
49	53271	<b>.34097</b>	53534	<b>.34304</b>	53796	<b>.34511</b>	54056	<b>.34719</b>	54316	<b>.34927</b>	11			
50	53276	<b>.34100</b>	53539	<b>.34307</b>	53800	<b>.34515</b>	54061	<b>.34722</b>	54320	<b>.34930</b>	10			
51	53280	<b>.34104</b>	53543	<b>.34311</b>	53805	<b>.34518</b>	54065	<b>.34726</b>	54324	<b>.34933</b>	9			
+ 13'	9.53285	<b>.34107</b>	9.53547	<b>.34314</b>	9.53809	<b>.34521</b>	9.54069	<b>.34729</b>	9.54329	<b>.34937</b>	8			
53	53289	<b>.34111</b>	53552	<b>.34318</b>	53813	<b>.34525</b>	54074	<b>.34733</b>	54333	<b>.34940</b>	7			
54	53293	<b>.34114</b>	53556	<b>.34321</b>	53818	<b>.34528</b>	54078	<b>.34736</b>	54337	<b>.34944</b>	6			
55	53298	<b>.34118</b>	53560	<b>.34325</b>	53822	<b>.34532</b>	54082	<b>.34739</b>	54341	<b>.34947</b>	5			
+ 14'	9.53302	<b>.34121</b>	9.53565	<b>.34328</b>	9.53826	<b>.34535</b>	9.54087	<b>.34743</b>	9.54346	<b>.34951</b>	4			
57	53307	<b>.34124</b>	53569	<b>.34331</b>	53831	<b>.34539</b>	54091	<b>.34746</b>	54350	<b>.34954</b>	3			
58	53311	<b>.34128</b>	53574	<b>.34335</b>	53835	<b>.34542</b>	54095	<b>.34750</b>	54354	<b>.34958</b>	2			
59	53315	<b>.34131</b>	53578	<b>.34338</b>	53839	<b>.34546</b>	54100	<b>.34753</b>	54359	<b>.34961</b>	1			
+ 15'	9.53320	<b>.34135</b>	9.53582	<b>.34342</b>	9.53844	<b>.34549</b>	9.54104	<b>.34757</b>	9.54363	<b>.34965</b>	0			
		19h 14m			19h 13m			19h 12m			19h 11m			19h 10m



s	4h 50m 72° 30'		4h 51m 72° 45'		4h 52m 73° 0'		4h 53m 73° 15'		4h 54m 73° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.54363	<b>.34965</b>	9.54621	<b>.35173</b>	9.54878	<b>.35381</b>	9.55133	<b>.35590</b>	9.55387	<b>.35799</b>	60
1	.54367	<b>.34968</b>	.54625	<b>.35176</b>	.54882	<b>.35385</b>	.55137	<b>.35594</b>	.55392	<b>.35803</b>	59
2	.54372	<b>.34972</b>	.54629	<b>.35180</b>	.54886	<b>.35388</b>	.55142	<b>.35597</b>	.55396	<b>.35806</b>	58
3	.54376	<b>.34975</b>	.54634	<b>.35183</b>	.54890	<b>.35392</b>	.55146	<b>.35601</b>	.55400	<b>.35810</b>	57
+ 1'	9.54380	<b>.34979</b>	9.54638	<b>.35187</b>	9.54895	<b>.35395</b>	9.55150	<b>.35604</b>	9.55404	<b>.35813</b>	56
5	.54385	<b>.34982</b>	.54642	<b>.35190</b>	.54899	<b>.35399</b>	.55154	<b>.35608</b>	.55409	<b>.35817</b>	55
6	.54389	<b>.34986</b>	.54647	<b>.35194</b>	.54903	<b>.35402</b>	.55159	<b>.35611</b>	.55413	<b>.35820</b>	54
7	.54393	<b>.34989</b>	.54651	<b>.35197</b>	.54907	<b>.35406</b>	.55163	<b>.35615</b>	.55417	<b>.35824</b>	53
+ 2'	9.54397	<b>.34992</b>	9.54655	<b>.35201</b>	9.54912	<b>.35409</b>	9.55167	<b>.35618</b>	9.55421	<b>.35827</b>	52
9	.54402	<b>.34996</b>	.54659	<b>.35204</b>	.54916	<b>.35413</b>	.55171	<b>.35622</b>	.55425	<b>.35831</b>	51
10	.54406	<b>.34999</b>	.54664	<b>.35208</b>	.54920	<b>.35416</b>	.55176	<b>.35625</b>	.55430	<b>.35834</b>	50
11	.54410	<b>.35003</b>	.54668	<b>.35211</b>	.54924	<b>.35420</b>	.55180	<b>.35628</b>	.55434	<b>.35838</b>	49
+ 3'	9.54415	<b>.35006</b>	9.54672	<b>.35215</b>	9.54929	<b>.35423</b>	9.55184	<b>.35632</b>	9.55438	<b>.35841</b>	48
13	.54419	<b>.35010</b>	.54677	<b>.35218</b>	.54933	<b>.35427</b>	.55188	<b>.35635</b>	.55442	<b>.35845</b>	47
14	.54423	<b>.35013</b>	.54681	<b>.35222</b>	.54937	<b>.35430</b>	.55192	<b>.35639</b>	.55447	<b>.35848</b>	46
15	.54428	<b>.35017</b>	.54685	<b>.35225</b>	.54942	<b>.35434</b>	.55197	<b>.35642</b>	.55451	<b>.35852</b>	45
+ 4'	9.54432	<b>.35020</b>	9.54689	<b>.35228</b>	9.54946	<b>.35437</b>	9.55201	<b>.35646</b>	9.55455	<b>.35855</b>	44
17	.54436	<b>.35024</b>	.54694	<b>.35232</b>	.54950	<b>.35441</b>	.55205	<b>.35649</b>	.55459	<b>.35859</b>	43
18	.54440	<b>.35027</b>	.54698	<b>.35235</b>	.54954	<b>.35444</b>	.55209	<b>.35653</b>	.55463	<b>.35862</b>	42
19	.54445	<b>.35031</b>	.54702	<b>.35239</b>	.54959	<b>.35448</b>	.55214	<b>.35656</b>	.55468	<b>.35865</b>	41
+ 5'	9.54449	<b>.35034</b>	9.54707	<b>.35242</b>	9.54963	<b>.35451</b>	9.55218	<b>.35660</b>	9.55472	<b>.35869</b>	40
21	.54453	<b>.35038</b>	.54711	<b>.35246</b>	.54967	<b>.35454</b>	.55222	<b>.35663</b>	.55476	<b>.35872</b>	39
22	.54458	<b>.35041</b>	.54715	<b>.35249</b>	.54971	<b>.35458</b>	.55226	<b>.35667</b>	.55480	<b>.35876</b>	38
23	.54462	<b>.35044</b>	.54719	<b>.35253</b>	.54976	<b>.35461</b>	.55231	<b>.35670</b>	.55485	<b>.35879</b>	37
+ 6'	9.54466	<b>.35048</b>	9.54724	<b>.35256</b>	9.54980	<b>.35465</b>	9.55235	<b>.35674</b>	9.55489	<b>.35883</b>	36
25	.54471	<b>.35051</b>	.54728	<b>.35260</b>	.54984	<b>.35468</b>	.55239	<b>.35677</b>	.55493	<b>.35886</b>	35
26	.54475	<b>.35055</b>	.54732	<b>.35263</b>	.54988	<b>.35472</b>	.55243	<b>.35681</b>	.55497	<b>.35890</b>	34
27	.54479	<b>.35058</b>	.54736	<b>.35267</b>	.54993	<b>.35475</b>	.55248	<b>.35684</b>	.55501	<b>.35893</b>	33
+ 7'	9.54483	<b>.35062</b>	9.54741	<b>.35270</b>	9.54997	<b>.35479</b>	9.55252	<b>.35688</b>	9.55506	<b>.35897</b>	32
29	.54488	<b>.35065</b>	.54745	<b>.35274</b>	.55001	<b>.35482</b>	.55256	<b>.35691</b>	.55510	<b>.35900</b>	31
30	.54492	<b>.35069</b>	.54749	<b>.35277</b>	.55005	<b>.35486</b>	.55260	<b>.35695</b>	.55514	<b>.35904</b>	30
31	.54496	<b>.35072</b>	.54754	<b>.35281</b>	.55010	<b>.35489</b>	.55265	<b>.35698</b>	.55518	<b>.35907</b>	29
+ 8'	9.54501	<b>.35076</b>	9.54758	<b>.35284</b>	9.55014	<b>.35493</b>	9.55269	<b>.35702</b>	9.55523	<b>.35911</b>	28
33	.54505	<b>.35079</b>	.54762	<b>.35288</b>	.55018	<b>.35496</b>	.55273	<b>.35705</b>	.55527	<b>.35914</b>	27
34	.54509	<b>.35083</b>	.54766	<b>.35291</b>	.55022	<b>.35500</b>	.55277	<b>.35709</b>	.55531	<b>.35918</b>	26
35	.54514	<b>.35086</b>	.54771	<b>.35294</b>	.55027	<b>.35503</b>	.55282	<b>.35712</b>	.55535	<b>.35921</b>	25
+ 9'	9.54518	<b>.35090</b>	9.54775	<b>.35298</b>	9.55031	<b>.35507</b>	9.55286	<b>.35716</b>	9.55539	<b>.35925</b>	24
37	.54522	<b>.35093</b>	.54779	<b>.35301</b>	.55035	<b>.35510</b>	.55290	<b>.35719</b>	.55544	<b>.35928</b>	23
38	.54526	<b>.35097</b>	.54784	<b>.35305</b>	.55039	<b>.35514</b>	.55294	<b>.35723</b>	.55548	<b>.35932</b>	22
39	.54531	<b>.35100</b>	.54788	<b>.35308</b>	.55044	<b>.35517</b>	.55298	<b>.35726</b>	.55552	<b>.35935</b>	21
+ 10'	9.54535	<b>.35103</b>	9.54792	<b>.35312</b>	9.55048	<b>.35521</b>	9.55303	<b>.35730</b>	9.55556	<b>.35939</b>	20
41	.54539	<b>.35107</b>	.54796	<b>.35315</b>	.55052	<b>.35524</b>	.55307	<b>.35733</b>	.55560	<b>.35942</b>	19
42	.54544	<b>.35110</b>	.54801	<b>.35319</b>	.55057	<b>.35528</b>	.55311	<b>.35737</b>	.55565	<b>.35946</b>	18
43	.54548	<b>.35114</b>	.54805	<b>.35322</b>	.55061	<b>.35531</b>	.55315	<b>.35740</b>	.55569	<b>.35949</b>	17
+ 11'	9.54552	<b>.35117</b>	9.54809	<b>.35326</b>	9.55065	<b>.35534</b>	9.55320	<b>.35743</b>	9.55573	<b>.35953</b>	16
45	.54556	<b>.35121</b>	.54813	<b>.35329</b>	.55069	<b>.35538</b>	.55324	<b>.35747</b>	.55577	<b>.35956</b>	15
46	.54561	<b>.35124</b>	.54818	<b>.35333</b>	.55074	<b>.35541</b>	.55328	<b>.35750</b>	.55582	<b>.35960</b>	14
47	.54565	<b>.35128</b>	.54822	<b>.35336</b>	.55078	<b>.35545</b>	.55332	<b>.35754</b>	.55586	<b>.35963</b>	13
+ 12'	9.54569	<b>.35131</b>	9.54826	<b>.35340</b>	9.55082	<b>.35548</b>	9.55337	<b>.35757</b>	9.55590	<b>.35967</b>	12
49	.54574	<b>.35135</b>	.54831	<b>.35343</b>	.55086	<b>.35552</b>	.55341	<b>.35761</b>	.55594	<b>.35970</b>	11
50	.54578	<b>.35138</b>	.54835	<b>.35347</b>	.55091	<b>.35555</b>	.55345	<b>.35764</b>	.55598	<b>.35974</b>	10
51	.54582	<b>.35142</b>	.54839	<b>.35350</b>	.55095	<b>.35559</b>	.55349	<b>.35768</b>	.55603	<b>.35977</b>	9
+ 13'	9.54587	<b>.35145</b>	9.54843	<b>.35354</b>	9.55099	<b>.35562</b>	9.55354	<b>.35771</b>	9.55607	<b>.35981</b>	8
53	.54591	<b>.35149</b>	.54848	<b>.35357</b>	.55103	<b>.35566</b>	.55358	<b>.35775</b>	.55611	<b>.35984</b>	7
54	.54595	<b>.35152</b>	.54852	<b>.35361</b>	.55108	<b>.35569</b>	.55362	<b>.35778</b>	.55615	<b>.35988</b>	6
55	.54599	<b>.35156</b>	.54856	<b>.35364</b>	.55112	<b>.35573</b>	.55366	<b>.35782</b>	.55620	<b>.35991</b>	5
+ 14'	9.54604	<b>.35159</b>	9.54860	<b>.35368</b>	9.55116	<b>.35576</b>	9.55370	<b>.35785</b>	9.55624	<b>.35995</b>	4
57	.54608	<b>.35162</b>	.54865	<b>.35371</b>	.55120	<b>.35580</b>	.55375	<b>.35789</b>	.55628	<b>.35998</b>	3
58	.54612	<b>.35166</b>	.54869	<b>.35374</b>	.55125	<b>.35583</b>	.55379	<b>.35792</b>	.55632	<b>.36002</b>	2
59	.54617	<b>.35169</b>	.54873	<b>.35378</b>	.55129	<b>.35587</b>	.55383	<b>.35796</b>	.55636	<b>.36005</b>	1
+ 15'	9.54621	<b>.35173</b>	9.54878	<b>.35381</b>	9.55133	<b>.35590</b>	9.55387	<b>.35799</b>	9.55641	<b>.36009</b>	0
	19h 9m		19h 8m		19h 7m		19h 6m		19h 5m		

TABLE IV.

## Haversines.

s	4h 55m 73° 45'		4h 56m 74° 0'		4h 57m 74° 15'		4h 58m 74° 30'		4h 59m 74° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.55641	<b>.36009</b>	9.55893	<b>.36218</b>	9.56144	<b>.36428</b>	9.56393	<b>.36638</b>	9.56642	<b>.36848</b>	60
1	.55645	<b>.36012</b>	.55897	<b>.36222</b>	.56148	<b>.36431</b>	.56397	<b>.36642</b>	.56646	<b>.36852</b>	59
2	.55649	<b>.36016</b>	.55901	<b>.36225</b>	.56152	<b>.36435</b>	.56402	<b>.36645</b>	.56650	<b>.36855</b>	58
3	.55653	<b>.36019</b>	.55905	<b>.36229</b>	.56156	<b>.36438</b>	.56406	<b>.36649</b>	.56654	<b>.36859</b>	57
+ 1'	9.55657	<b>.36023</b>	9.55909	<b>.36232</b>	9.56160	<b>.36442</b>	9.56410	<b>.36652</b>	9.56658	<b>.36862</b>	56
5	.55662	<b>.36026</b>	.55914	<b>.36236</b>	.56164	<b>.36445</b>	.56414	<b>.36656</b>	.56663	<b>.36866</b>	55
6	.55666	<b>.36030</b>	.55918	<b>.36239</b>	.56169	<b>.36449</b>	.56418	<b>.36659</b>	.56667	<b>.36869</b>	54
7	.55670	<b>.36033</b>	.55922	<b>.36243</b>	.56173	<b>.36452</b>	.56422	<b>.36663</b>	.56671	<b>.36873</b>	53
+ 2'	9.55674	<b>.36036</b>	9.55926	<b>.36246</b>	9.56177	<b>.36456</b>	9.56426	<b>.36666</b>	9.56675	<b>.36877</b>	52
9	.55678	<b>.36040</b>	.55930	<b>.36250</b>	.56181	<b>.36459</b>	.56431	<b>.36670</b>	.56679	<b>.36880</b>	51
10	.55683	<b>.36043</b>	.55935	<b>.36253</b>	.56185	<b>.36463</b>	.56435	<b>.36673</b>	.56683	<b>.36884</b>	50
11	.55687	<b>.36047</b>	.55939	<b>.36257</b>	.56189	<b>.36466</b>	.56439	<b>.36677</b>	.56687	<b>.36887</b>	49
+ 3'	9.55691	<b>.36050</b>	9.55943	<b>.36260</b>	9.56194	<b>.36470</b>	9.56443	<b>.36680</b>	9.56692	<b>.36891</b>	48
13	.55695	<b>.36054</b>	.55947	<b>.36264</b>	.56198	<b>.36473</b>	.56447	<b>.36684</b>	.56696	<b>.36894</b>	47
14	.55699	<b>.36057</b>	.55951	<b>.36267</b>	.56202	<b>.36477</b>	.56451	<b>.36687</b>	.56700	<b>.36898</b>	46
15	.55704	<b>.36061</b>	.55955	<b>.36271</b>	.56206	<b>.36480</b>	.56456	<b>.36691</b>	.56704	<b>.36901</b>	45
+ 4'	9.55708	<b>.36064</b>	9.55960	<b>.36274</b>	9.56210	<b>.36484</b>	9.56460	<b>.36694</b>	9.56708	<b>.36905</b>	44
17	.55712	<b>.36068</b>	.55964	<b>.36278</b>	.56214	<b>.36487</b>	.56464	<b>.36698</b>	.56712	<b>.36908</b>	43
18	.55716	<b>.36071</b>	.55968	<b>.36281</b>	.56219	<b>.36491</b>	.56468	<b>.36701</b>	.56716	<b>.36912</b>	42
19	.55721	<b>.36075</b>	.55972	<b>.36285</b>	.56223	<b>.36494</b>	.56472	<b>.36705</b>	.56720	<b>.36915</b>	41
+ 5'	9.55725	<b>.36078</b>	9.55976	<b>.36288</b>	9.56227	<b>.36498</b>	9.56476	<b>.36708</b>	9.56725	<b>.36919</b>	40
21	.55729	<b>.36082</b>	.55981	<b>.36292</b>	.56231	<b>.36501</b>	.56480	<b>.36712</b>	.56729	<b>.36922</b>	39
22	.55733	<b>.36085</b>	.55985	<b>.36295</b>	.56235	<b>.36505</b>	.56485	<b>.36715</b>	.56733	<b>.36926</b>	38
23	.55737	<b>.36089</b>	.55989	<b>.36299</b>	.56239	<b>.36508</b>	.56489	<b>.36719</b>	.56737	<b>.36929</b>	37
+ 6'	9.55742	<b>.36092</b>	9.55993	<b>.36302</b>	9.56244	<b>.36512</b>	9.56493	<b>.36722</b>	9.56741	<b>.36933</b>	36
25	.55746	<b>.36096</b>	.55997	<b>.36306</b>	.56248	<b>.36515</b>	.56497	<b>.36726</b>	.56745	<b>.36936</b>	35
26	.55750	<b>.36099</b>	.56001	<b>.36309</b>	.56252	<b>.36519</b>	.56501	<b>.36729</b>	.56749	<b>.36940</b>	34
27	.55754	<b>.36103</b>	.56006	<b>.36313</b>	.56256	<b>.36522</b>	.56505	<b>.36733</b>	.56753	<b>.36943</b>	33
+ 7'	9.55758	<b>.36106</b>	9.56010	<b>.36316</b>	9.56260	<b>.36526</b>	9.56509	<b>.36736</b>	9.56758	<b>.36947</b>	32
29	.55763	<b>.36110</b>	.56014	<b>.36320</b>	.56264	<b>.36529</b>	.56514	<b>.36740</b>	.56762	<b>.36950</b>	31
30	.55767	<b>.36113</b>	.56018	<b>.36323</b>	.56269	<b>.36533</b>	.56518	<b>.36743</b>	.56766	<b>.36954</b>	30
31	.55771	<b>.36117</b>	.56022	<b>.36327</b>	.56273	<b>.36536</b>	.56522	<b>.36747</b>	.56770	<b>.36957</b>	29
+ 8'	9.55775	<b>.36120</b>	9.56027	<b>.36330</b>	9.56277	<b>.36540</b>	9.56526	<b>.36750</b>	9.56774	<b>.36961</b>	28
33	.55779	<b>.36124</b>	.56031	<b>.36334</b>	.56281	<b>.36543</b>	.56530	<b>.36754</b>	.56778	<b>.36964</b>	27
34	.55784	<b>.36127</b>	.56035	<b>.36337</b>	.56285	<b>.36547</b>	.56534	<b>.36757</b>	.56782	<b>.36968</b>	26
35	.55788	<b>.36131</b>	.56039	<b>.36341</b>	.56289	<b>.36551</b>	.56538	<b>.36761</b>	.56786	<b>.36971</b>	25
+ 9'	9.55792	<b>.36134</b>	9.56043	<b>.36344</b>	9.56294	<b>.36554</b>	9.56543	<b>.36764</b>	9.56791	<b>.36975</b>	24
37	.55796	<b>.36138</b>	.56047	<b>.36348</b>	.56298	<b>.36558</b>	.56547	<b>.36768</b>	.56795	<b>.36978</b>	23
38	.55800	<b>.36141</b>	.56052	<b>.36351</b>	.56302	<b>.36561</b>	.56551	<b>.36771</b>	.56799	<b>.36982</b>	22
39	.55805	<b>.36145</b>	.56056	<b>.36355</b>	.56306	<b>.36565</b>	.56555	<b>.36775</b>	.56803	<b>.36985</b>	21
+ 10'	9.55809	<b>.36148</b>	9.56060	<b>.36358</b>	9.56310	<b>.36568</b>	9.56559	<b>.36778</b>	9.56807	<b>.36989</b>	20
41	.55813	<b>.36152</b>	.56064	<b>.36362</b>	.56314	<b>.36572</b>	.56563	<b>.36782</b>	.56811	<b>.36992</b>	19
42	.55817	<b>.36155</b>	.56068	<b>.36365</b>	.56318	<b>.36575</b>	.56567	<b>.36785</b>	.56815	<b>.36996</b>	18
43	.55821	<b>.36159</b>	.56073	<b>.36368</b>	.56323	<b>.36579</b>	.56572	<b>.36789</b>	.56819	<b>.36999</b>	17
+ 11'	9.55826	<b>.36162</b>	9.56077	<b>.36372</b>	9.56327	<b>.36582</b>	9.56576	<b>.36792</b>	9.56824	<b>.37003</b>	16
45	.55830	<b>.36166</b>	.56081	<b>.36376</b>	.56331	<b>.36586</b>	.56580	<b>.36796</b>	.56828	<b>.37006</b>	15
46	.55834	<b>.36169</b>	.56085	<b>.36379</b>	.56335	<b>.36589</b>	.56584	<b>.36799</b>	.56832	<b>.37010</b>	14
47	.55838	<b>.36173</b>	.56089	<b>.36382</b>	.56339	<b>.36593</b>	.56588	<b>.36803</b>	.56836	<b>.37013</b>	13
+ 12'	9.55842	<b>.36176</b>	9.56093	<b>.36386</b>	9.56343	<b>.36596</b>	9.56592	<b>.36806</b>	9.56840	<b>.37017</b>	12
49	.55846	<b>.36180</b>	.56098	<b>.36390</b>	.56348	<b>.36600</b>	.56596	<b>.36810</b>	.56844	<b>.37020</b>	11
50	.55851	<b>.36183</b>	.56102	<b>.36393</b>	.56352	<b>.36603</b>	.56601	<b>.36813</b>	.56848	<b>.37024</b>	10
51	.55855	<b>.36187</b>	.56106	<b>.36396</b>	.56356	<b>.36607</b>	.56605	<b>.36817</b>	.56852	<b>.37027</b>	9
+ 13'	9.55859	<b>.36190</b>	9.56110	<b>.36400</b>	9.56360	<b>.36610</b>	9.56609	<b>.36820</b>	9.56856	<b>.37031</b>	8
53	.55863	<b>.36194</b>	.56114	<b>.36403</b>	.56364	<b>.36614</b>	.56613	<b>.36824</b>	.56861	<b>.37034</b>	7
54	.55867	<b>.36197</b>	.56118	<b>.36407</b>	.56368	<b>.36617</b>	.56617	<b>.36827</b>	.56865	<b>.37038</b>	6
55	.55872	<b>.36201</b>	.56123	<b>.36410</b>	.56373	<b>.36621</b>	.56621	<b>.36831</b>	.56869	<b>.37041</b>	5
+ 14'	9.55876	<b>.36204</b>	9.56127	<b>.36414</b>	9.56377	<b>.36624</b>	9.56625	<b>.36834</b>	9.56873	<b>.37045</b>	4
57	.55880	<b>.36208</b>	.56131	<b>.36417</b>	.56381	<b>.36628</b>	.56629	<b>.36838</b>	.56877	<b>.37049</b>	3
58	.55884	<b>.36211</b>	.56135	<b>.36421</b>	.56385	<b>.36631</b>	.56634	<b>.36841</b>	.56881	<b>.37052</b>	2
59	.55888	<b>.36215</b>	.56139	<b>.36424</b>	.56389	<b>.36635</b>	.56638	<b>.36845</b>	.56885	<b>.37055</b>	1
+ 15'	9.55893	<b>.36218</b>	9.56144	<b>.36428</b>	9.56393	<b>.36638</b>	9.56642	<b>.36848</b>	9.56889	<b>.37059</b>	0
	19h 4m		19h 3m		19h 2m		19h 1m		19h 0m		



TABLE IV.

Haversines.

s	5h 0m 75° 0'		5h 1m 75° 15'		5h 2m 75° 30'		5h 3m 75° 45'		5h 4m 76° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.56889	<b>.37059</b>	9.57136	<b>.37270</b>	9.57381	<b>.37481</b>	9.57625	<b>.37692</b>	9.57868	<b>.37904</b>	60
1	.56893	<b>.37063</b>	.57140	<b>.37273</b>	.57385	<b>.37485</b>	.57629	<b>.37696</b>	.57872	<b>.37907</b>	59
2	.56898	<b>.37066</b>	.57144	<b>.37277</b>	.57389	<b>.37488</b>	.57633	<b>.37699</b>	.57876	<b>.37911</b>	58
3	.56902	<b>.37070</b>	.57148	<b>.37280</b>	.57393	<b>.37492</b>	.57637	<b>.37703</b>	.57881	<b>.37914</b>	57
+ 1'	9.56906	<b>.37073</b>	9.57152	<b>.37284</b>	9.57397	<b>.37495</b>	9.57642	<b>.37706</b>	9.57885	<b>.37918</b>	56
5	.56910	<b>.37077</b>	.57156	<b>.37287</b>	.57402	<b>.37499</b>	.57646	<b>.37710</b>	.57889	<b>.37922</b>	55
6	.56914	<b>.37080</b>	.57160	<b>.37291</b>	.57406	<b>.37502</b>	.57650	<b>.37713</b>	.57893	<b>.37925</b>	54
7	.56918	<b>.37084</b>	.57165	<b>.37295</b>	.57410	<b>.37506</b>	.57654	<b>.37717</b>	.57897	<b>.37929</b>	53
+ 2'	9.56922	<b>.37087</b>	9.57169	<b>.37298</b>	9.57414	<b>.37509</b>	9.57658	<b>.37721</b>	9.57901	<b>.37932</b>	52
9	.56926	<b>.37091</b>	.57173	<b>.37302</b>	.57418	<b>.37513</b>	.57662	<b>.37724</b>	.57905	<b>.37936</b>	51
10	.56931	<b>.37094</b>	.57177	<b>.37305</b>	.57422	<b>.37516</b>	.57666	<b>.37728</b>	.57909	<b>.37939</b>	50
11	.56935	<b>.37098</b>	.57181	<b>.37309</b>	.57426	<b>.37520</b>	.57670	<b>.37731</b>	.57913	<b>.37943</b>	49
+ 3'	9.56939	<b>.37101</b>	9.57185	<b>.37312</b>	9.57430	<b>.37523</b>	9.57674	<b>.37735</b>	9.57917	<b>.37946</b>	48
13	.56943	<b>.37105</b>	.57189	<b>.37316</b>	.57434	<b>.37527</b>	.57678	<b>.37738</b>	.57921	<b>.37950</b>	47
14	.56947	<b>.37108</b>	.57193	<b>.37319</b>	.57438	<b>.37530</b>	.57682	<b>.37742</b>	.57925	<b>.37953</b>	46
15	.56951	<b>.37112</b>	.57197	<b>.37323</b>	.57442	<b>.37534</b>	.57686	<b>.37745</b>	.57929	<b>.37957</b>	45
+ 4'	9.56955	<b>.37115</b>	9.57201	<b>.37326</b>	9.57446	<b>.37537</b>	9.57690	<b>.37749</b>	9.57933	<b>.37960</b>	44
17	.56959	<b>.37119</b>	.57205	<b>.37330</b>	.57450	<b>.37541</b>	.57694	<b>.37752</b>	.57937	<b>.37964</b>	43
18	.56963	<b>.37122</b>	.57210	<b>.37333</b>	.57454	<b>.37544</b>	.57698	<b>.37756</b>	.57941	<b>.37967</b>	42
19	.56968	<b>.37126</b>	.57214	<b>.37337</b>	.57459	<b>.37548</b>	.57702	<b>.37759</b>	.57945	<b>.37971</b>	41
+ 5'	9.56972	<b>.37129</b>	9.57218	<b>.37340</b>	9.57463	<b>.37551</b>	9.57706	<b>.37763</b>	9.57949	<b>.37974</b>	40
21	.56976	<b>.37133</b>	.57222	<b>.37344</b>	.57467	<b>.37555</b>	.57711	<b>.37766</b>	.57953	<b>.37978</b>	39
22	.56980	<b>.37136</b>	.57226	<b>.37347</b>	.57471	<b>.37558</b>	.57715	<b>.37770</b>	.57957	<b>.37982</b>	38
23	.56984	<b>.37140</b>	.57230	<b>.37351</b>	.57475	<b>.37562</b>	.57719	<b>.37773</b>	.57961	<b>.37985</b>	37
+ 6'	9.56988	<b>.37143</b>	9.57234	<b>.37354</b>	9.57479	<b>.37566</b>	9.57723	<b>.37777</b>	9.57965	<b>.37989</b>	36
25	.56992	<b>.37147</b>	.57238	<b>.37358</b>	.57483	<b>.37569</b>	.57727	<b>.37780</b>	.57969	<b>.37992</b>	35
26	.56996	<b>.37150</b>	.57242	<b>.37361</b>	.57487	<b>.37573</b>	.57731	<b>.37784</b>	.57973	<b>.37996</b>	34
27	.57000	<b>.37154</b>	.57246	<b>.37365</b>	.57491	<b>.37576</b>	.57735	<b>.37788</b>	.57977	<b>.37999</b>	33
+ 7'	9.57005	<b>.37157</b>	9.57250	<b>.37368</b>	9.57495	<b>.37580</b>	9.57739	<b>.37791</b>	9.57981	<b>.38003</b>	32
29	.57009	<b>.37161</b>	.57255	<b>.37372</b>	.57499	<b>.37583</b>	.57743	<b>.37794</b>	.57986	<b>.38006</b>	31
30	.57013	<b>.37164</b>	.57259	<b>.37375</b>	.57503	<b>.37587</b>	.57747	<b>.37798</b>	.57990	<b>.38010</b>	30
31	.57017	<b>.37168</b>	.57263	<b>.37379</b>	.57507	<b>.37590</b>	.57751	<b>.37802</b>	.57994	<b>.38013</b>	29
+ 8'	9.57021	<b>.37171</b>	9.57267	<b>.37382</b>	9.57511	<b>.37594</b>	9.57755	<b>.37805</b>	9.57998	<b>.38017</b>	28
33	.57025	<b>.37175</b>	.57271	<b>.37386</b>	.57515	<b>.37597</b>	.57759	<b>.37809</b>	.58002	<b>.38020</b>	27
34	.57029	<b>.37179</b>	.57275	<b>.37389</b>	.57520	<b>.37601</b>	.57763	<b>.37812</b>	.58006	<b>.38024</b>	26
35	.57033	<b>.37182</b>	.57279	<b>.37393</b>	.57524	<b>.37604</b>	.57767	<b>.37816</b>	.58010	<b>.38027</b>	25
+ 9'	9.57037	<b>.37186</b>	9.57283	<b>.37397</b>	9.57528	<b>.37608</b>	9.57771	<b>.37819</b>	9.58014	<b>.38031</b>	24
37	.57042	<b>.37189</b>	.57287	<b>.37400</b>	.57532	<b>.37611</b>	.57775	<b>.37823</b>	.58018	<b>.38034</b>	23
38	.57046	<b>.37193</b>	.57291	<b>.37404</b>	.57536	<b>.37615</b>	.57779	<b>.37826</b>	.58022	<b>.38038</b>	22
39	.57050	<b>.37196</b>	.57295	<b>.37407</b>	.57540	<b>.37618</b>	.57783	<b>.37830</b>	.58026	<b>.38042</b>	21
+ 10'	9.57054	<b>.37200</b>	9.57299	<b>.37411</b>	9.57544	<b>.37622</b>	9.57787	<b>.37833</b>	9.58030	<b>.38045</b>	20
41	.57058	<b>.37203</b>	.57304	<b>.37414</b>	.57548	<b>.37625</b>	.57792	<b>.37837</b>	.58034	<b>.38049</b>	19
42	.57062	<b>.37207</b>	.57308	<b>.37418</b>	.57552	<b>.37629</b>	.57796	<b>.37840</b>	.58038	<b>.38052</b>	18
43	.57066	<b>.37210</b>	.57312	<b>.37421</b>	.57556	<b>.37632</b>	.57800	<b>.37844</b>	.58042	<b>.38056</b>	17
+ 11'	9.57070	<b>.37214</b>	9.57316	<b>.37425</b>	9.57560	<b>.37636</b>	9.57804	<b>.37847</b>	9.58046	<b>.38059</b>	16
45	.57074	<b>.37217</b>	.57320	<b>.37428</b>	.57564	<b>.37639</b>	.57808	<b>.37851</b>	.58050	<b>.38063</b>	15
46	.57078	<b>.37221</b>	.57324	<b>.37432</b>	.57568	<b>.37643</b>	.57812	<b>.37855</b>	.58054	<b>.38066</b>	14
47	.57083	<b>.37224</b>	.57328	<b>.37435</b>	.57572	<b>.37647</b>	.57816	<b>.37858</b>	.58058	<b>.38070</b>	13
+ 12'	9.57087	<b>.37228</b>	9.57332	<b>.37439</b>	9.57577	<b>.37650</b>	9.57820	<b>.37862</b>	9.58062	<b>.38073</b>	12
49	.57091	<b>.37231</b>	.57336	<b>.37442</b>	.57581	<b>.37654</b>	.57824	<b>.37865</b>	.58066	<b>.38077</b>	11
50	.57095	<b>.37235</b>	.57340	<b>.37446</b>	.57585	<b>.37657</b>	.57828	<b>.37869</b>	.58070	<b>.38080</b>	10
51	.57099	<b>.37238</b>	.57344	<b>.37449</b>	.57589	<b>.37661</b>	.57832	<b>.37872</b>	.58074	<b>.38084</b>	9
+ 13'	9.57103	<b>.37242</b>	9.57348	<b>.37453</b>	9.57593	<b>.37664</b>	9.57836	<b>.37876</b>	9.58078	<b>.38087</b>	8
53	.57107	<b>.37245</b>	.57353	<b>.37456</b>	.57597	<b>.37668</b>	.57840	<b>.37879</b>	.58082	<b>.38091</b>	7
54	.57111	<b>.37249</b>	.57357	<b>.37460</b>	.57601	<b>.37671</b>	.57844	<b>.37883</b>	.58086	<b>.38095</b>	6
55	.57115	<b>.37252</b>	.57361	<b>.37463</b>	.57605	<b>.37675</b>	.57848	<b>.37886</b>	.58090	<b>.38098</b>	5
+ 14'	9.57119	<b>.37256</b>	9.57365	<b>.37467</b>	9.57609	<b>.37678</b>	9.57852	<b>.37890</b>	9.58094	<b>.38102</b>	4
57	.57124	<b>.37259</b>	.57369	<b>.37470</b>	.57613	<b>.37682</b>	.57856	<b>.37893</b>	.58098	<b>.38105</b>	3
58	.57128	<b>.37263</b>	.57373	<b>.37474</b>	.57617	<b>.37685</b>	.57860	<b>.37897</b>	.58102	<b>.38109</b>	2
59	.57132	<b>.37266</b>	.57377	<b>.37477</b>	.57621	<b>.37689</b>	.57864	<b>.37900</b>	.58106	<b>.38112</b>	1
+ 15'	9.57136	<b>.37270</b>	9.57381	<b>.37481</b>	9.57625	<b>.37692</b>	9.57868	<b>.37904</b>	9.58110	<b>.38116</b>	0
	18h 59m		18h 58m		18h 57m		18h 56m		18h 55m		

Haversines.

s	5h 5m 76° 15'		5h 6m 76° 30'		5h 7m 76° 45'		5h 8m 77° 0'		5h 9m 77° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.58110	.38116	9.58351	.38328	9.58591	.38540	9.58830	.38752	9.59068	.38965	60
1	.58114	.38119	.58355	.38331	.58595	.38544	.58834	.38756	.59072	.38969	59
2	.58118	.38123	.58359	.38335	.58599	.38547	.58838	.38760	.59076	.38972	58
3	.58122	.38126	.58363	.38338	.58603	.38551	.58842	.38763	.59079	.38976	57
+ 1'	9.58126	.38130	9.58367	.38342	9.58607	.38554	9.58846	.38767	9.59083	.38979	56
5	.58131	.38133	.58371	.38345	.58611	.38558	.58850	.38770	.59087	.38983	55
6	.58135	.38137	.58375	.38349	.58615	.38561	.58854	.38774	.59091	.38986	54
7	.58139	.38140	.58379	.38352	.58619	.38565	.58858	.38777	.59095	.38990	53
+ 2'	9.58143	.38144	9.58383	.38356	9.58623	.38568	9.58862	.38781	9.59099	.38994	52
9	.58147	.38148	.58387	.38360	.58627	.38572	.58866	.38784	.59103	.38997	51
10	.58151	.38151	.58391	.38363	.58631	.38575	.58870	.38788	.59107	.39001	50
11	.58155	.38155	.58395	.38367	.58635	.38579	.58874	.38791	.59111	.39004	49
+ 3'	9.58159	.38159	9.58399	.38370	9.58639	.38582	9.58878	.38795	9.59115	.39008	48
13	.58163	.38162	.58403	.38374	.58643	.38586	.58882	.38799	.59119	.39011	47
14	.58167	.38165	.58407	.38377	.58647	.38590	.58885	.38802	.59123	.39015	46
15	.58171	.38169	.58411	.38381	.58651	.38593	.58889	.38806	.59127	.39018	45
+ 4'	9.58175	.38172	9.58415	.38384	9.58655	.38597	9.58893	.38809	9.59131	.39022	44
17	.58179	.38176	.58419	.38388	.58659	.38600	.58897	.38813	.59135	.39025	43
18	.58183	.38179	.58423	.38391	.58663	.38604	.58901	.38816	.59139	.39029	42
19	.58187	.38183	.58427	.38395	.58667	.38607	.58905	.38820	.59143	.39033	41
+ 5'	9.58191	.38186	9.58431	.38398	9.58671	.38611	9.58909	.38823	9.59147	.39036	40
21	.58195	.38190	.58435	.38402	.58675	.38614	.58913	.38827	.59151	.39040	39
22	.58199	.38193	.58439	.38406	.58679	.38618	.58917	.38830	.59155	.39043	38
23	.58203	.38197	.58443	.38409	.58683	.38621	.58921	.38834	.59158	.39047	37
+ 6'	9.58207	.38200	9.58447	.38413	9.58687	.38625	9.58925	.38837	9.59162	.39050	36
25	.58211	.38204	.58451	.38416	.58691	.38628	.58929	.38841	.59166	.39054	35
26	.58215	.38208	.58455	.38420	.58695	.38632	.58933	.38845	.59170	.39057	34
27	.58219	.38211	.58459	.38423	.58699	.38636	.58937	.38848	.59174	.39061	33
+ 7'	9.58223	.38215	9.58463	.38427	9.58703	.38639	9.58941	.38852	9.59178	.39064	32
29	.58227	.38218	.58467	.38430	.58707	.38643	.58945	.38855	.59182	.39068	31
30	.58231	.38222	.58471	.38434	.58711	.38646	.58949	.38859	.59186	.39072	30
31	.58235	.38225	.58475	.38437	.58715	.38650	.58953	.38862	.59190	.39075	29
+ 8'	9.58239	.38229	9.58479	.38441	9.58719	.38653	9.58957	.38866	9.59194	.39079	28
33	.58243	.38232	.58483	.38444	.58723	.38657	.58961	.38869	.59198	.39082	27
34	.58247	.38236	.58487	.38448	.58727	.38660	.58965	.38873	.59202	.39086	26
35	.58251	.38239	.58491	.38451	.58731	.38664	.58969	.38876	.59206	.39089	25
+ 9'	9.58255	.38243	9.58495	.38455	9.58735	.38667	9.58973	.38880	9.59210	.39093	24
37	.58259	.38246	.58499	.38459	.58739	.38671	.58977	.38884	.59214	.39096	23
38	.58263	.38250	.58503	.38462	.58742	.38675	.58981	.38887	.59218	.39100	22
39	.58267	.38254	.58507	.38466	.58746	.38678	.58985	.38891	.59222	.39103	21
+ 10'	9.58271	.38257	9.58511	.38469	9.58750	.38682	9.58989	.38894	9.59225	.39107	20
41	.58275	.38261	.58515	.38473	.58754	.38685	.58992	.38898	.59229	.39111	19
42	.58279	.38264	.58519	.38476	.58758	.38689	.58996	.38901	.59233	.39114	18
43	.58283	.38268	.58523	.38480	.58762	.38692	.59000	.38905	.59237	.39118	17
+ 11'	9.58287	.38271	9.58527	.38483	9.58766	.38696	9.59004	.38908	9.59241	.39121	16
45	.58291	.38275	.58531	.38487	.58770	.38699	.59008	.38912	.59245	.39125	15
46	.58295	.38278	.58535	.38490	.58774	.38703	.59012	.38915	.59249	.39128	14
47	.58299	.38282	.58539	.38494	.58778	.38706	.59016	.38919	.59253	.39132	13
+ 12'	9.58303	.38285	9.58543	.38498	9.58782	.38710	9.59020	.38923	9.59257	.39135	12
49	.58307	.38289	.58547	.38501	.58786	.38713	.59024	.38926	.59261	.39139	11
50	.58311	.38292	.58551	.38505	.58790	.38717	.59028	.38930	.59265	.39143	10
51	.58315	.38296	.58555	.38508	.58794	.38721	.59032	.38933	.59269	.39146	9
+ 13'	9.58319	.38299	9.58559	.38512	9.58798	.38724	9.59036	.38937	9.59273	.39150	8
53	.58323	.38303	.58563	.38515	.58802	.38728	.59040	.38940	.59277	.39153	7
54	.58327	.38307	.58567	.38519	.58806	.38731	.59044	.38944	.59281	.39157	6
55	.58331	.38310	.58571	.38522	.58810	.38735	.59048	.38947	.59285	.39160	5
+ 14'	9.58335	.38314	9.58575	.38526	9.58814	.38738	9.59052	.38951	9.59289	.39164	4
57	.58339	.38317	.58579	.38529	.58818	.38742	.59056	.38954	.59292	.39167	3
58	.58343	.38321	.58583	.38533	.58822	.38745	.59060	.38958	.59296	.39171	2
59	.58347	.38324	.58587	.38536	.58826	.38749	.59064	.38962	.59300	.39174	1
+ 15'	9.58351	.38328	9.58591	.38540	9.58830	.38752	9.59068	.38965	9.59304	.39178	0
	18h 54m		18h 53m		18h 52m		18h 51m		18h 50m		



## Haversines.

s	5h 10m 77° 30'		5h 11m 77° 45'		5h 12m 78° 0'		5h 13m 78° 15'		5h 14m 78° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.59304	<b>.39178</b>	9.59540	<b>.39391</b>	9.59774	<b>.39604</b>	9.60008	<b>.39818</b>	9.60240	<b>.40032</b>	60
1	.59308	<b>.39182</b>	.59544	<b>.39395</b>	.59778	<b>.39608</b>	.60012	<b>.39821</b>	.60244	<b>.40035</b>	59
2	.59312	<b>.39185</b>	.59548	<b>.39398</b>	.59782	<b>.39612</b>	.60016	<b>.39825</b>	.60248	<b>.40039</b>	58
3	.59316	<b>.39189</b>	.59552	<b>.39402</b>	.59786	<b>.39615</b>	.60020	<b>.39829</b>	.60252	<b>.40042</b>	57
+ 1'	9.59320	<b>.39192</b>	9.59556	<b>.39405</b>	9.59790	<b>.39619</b>	9.60023	<b>.39832</b>	9.60256	<b>.40046</b>	56
5	.59324	<b>.39196</b>	.59559	<b>.39409</b>	.59794	<b>.39622</b>	.60027	<b>.39836</b>	.60260	<b>.40049</b>	55
6	.59328	<b>.39199</b>	.59563	<b>.39412</b>	.59798	<b>.39626</b>	.60031	<b>.39839</b>	.60263	<b>.40053</b>	54
7	.59332	<b>.39203</b>	.59567	<b>.39416</b>	.59802	<b>.39629</b>	.60035	<b>.39843</b>	.60267	<b>.40057</b>	53
+ 2'	9.59336	<b>.39206</b>	9.59571	<b>.39420</b>	9.59806	<b>.39633</b>	9.60039	<b>.39846</b>	9.60271	<b>.40060</b>	52
9	.59340	<b>.39210</b>	.59575	<b>.39423</b>	.59809	<b>.39636</b>	.60043	<b>.39850</b>	.60275	<b>.40064</b>	51
10	.59344	<b>.39214</b>	.59579	<b>.39427</b>	.59813	<b>.39640</b>	.60047	<b>.39854</b>	.60279	<b>.40067</b>	50
11	.59348	<b>.39217</b>	.59583	<b>.39430</b>	.59817	<b>.39644</b>	.60051	<b>.39857</b>	.60283	<b>.40071</b>	49
+ 3'	9.59351	<b>.39221</b>	9.59587	<b>.39434</b>	9.59821	<b>.39647</b>	9.60054	<b>.39861</b>	9.60287	<b>.40074</b>	48
13	.59355	<b>.39224</b>	.59591	<b>.39437</b>	.59825	<b>.39651</b>	.60058	<b>.39864</b>	.60291	<b>.40078</b>	47
14	.59359	<b>.39228</b>	.59595	<b>.39441</b>	.59829	<b>.39654</b>	.60062	<b>.39868</b>	.60294	<b>.40081</b>	46
15	.59363	<b>.39231</b>	.59599	<b>.39444</b>	.59833	<b>.39658</b>	.60066	<b>.39871</b>	.60298	<b>.40085</b>	45
+ 4'	9.59367	<b>.39235</b>	9.59602	<b>.39448</b>	9.59837	<b>.39661</b>	9.60070	<b>.39875</b>	9.60302	<b>.40089</b>	44
17	.59371	<b>.39238</b>	.59606	<b>.39451</b>	.59841	<b>.39665</b>	.60074	<b>.39878</b>	.60306	<b>.40092</b>	43
18	.59375	<b>.39242</b>	.59610	<b>.39455</b>	.59845	<b>.39668</b>	.60078	<b>.39882</b>	.60310	<b>.40096</b>	42
19	.59379	<b>.39245</b>	.59614	<b>.39459</b>	.59848	<b>.39672</b>	.60082	<b>.39886</b>	.60314	<b>.40099</b>	41
+ 5'	9.59383	<b>.39249</b>	9.59618	<b>.39462</b>	9.59852	<b>.39676</b>	9.60085	<b>.39889</b>	9.60318	<b>.40103</b>	40
21	.59387	<b>.39253</b>	.59622	<b>.39466</b>	.59856	<b>.39679</b>	.60089	<b>.39893</b>	.60321	<b>.40106</b>	39
22	.59391	<b>.39256</b>	.59626	<b>.39469</b>	.59860	<b>.39683</b>	.60093	<b>.39896</b>	.60325	<b>.40110</b>	38
23	.59395	<b>.39260</b>	.59630	<b>.39473</b>	.59864	<b>.39686</b>	.60097	<b>.39900</b>	.60329	<b>.40114</b>	37
+ 6'	9.59399	<b>.39263</b>	9.59634	<b>.39476</b>	9.59868	<b>.39690</b>	9.60101	<b>.39903</b>	9.60333	<b>.40117</b>	36
25	.59403	<b>.39267</b>	.59638	<b>.39480</b>	.59872	<b>.39693</b>	.60105	<b>.39907</b>	.60337	<b>.40121</b>	35
26	.59406	<b>.39270</b>	.59642	<b>.39484</b>	.59876	<b>.39697</b>	.60109	<b>.39910</b>	.60341	<b>.40124</b>	34
27	.59410	<b>.39274</b>	.59646	<b>.39487</b>	.59880	<b>.39700</b>	.60113	<b>.39914</b>	.60345	<b>.40128</b>	33
+ 7'	9.59414	<b>.39277</b>	9.59649	<b>.39491</b>	9.59883	<b>.39704</b>	9.60116	<b>.39918</b>	9.60348	<b>.40131</b>	32
29	.59418	<b>.39281</b>	.59653	<b>.39494</b>	.59887	<b>.39708</b>	.60120	<b>.39921</b>	.60352	<b>.40135</b>	31
30	.59422	<b>.39285</b>	.59657	<b>.39498</b>	.59891	<b>.39711</b>	.60124	<b>.39925</b>	.60356	<b>.40139</b>	30
31	.59426	<b>.39288</b>	.59661	<b>.39501</b>	.59895	<b>.39715</b>	.60128	<b>.39928</b>	.60360	<b>.40142</b>	29
+ 8'	9.59430	<b>.39292</b>	9.59665	<b>.39505</b>	9.59899	<b>.39718</b>	9.60132	<b>.39932</b>	9.60364	<b>.40146</b>	28
33	.59434	<b>.39295</b>	.59669	<b>.39508</b>	.59903	<b>.39722</b>	.60136	<b>.39935</b>	.60368	<b>.40149</b>	27
34	.59438	<b>.39299</b>	.59673	<b>.39512</b>	.59907	<b>.39725</b>	.60140	<b>.39939</b>	.60372	<b>.40153</b>	26
35	.59442	<b>.39302</b>	.59677	<b>.39516</b>	.59911	<b>.39729</b>	.60144	<b>.39943</b>	.60376	<b>.40156</b>	25
+ 9'	9.59446	<b>.39306</b>	9.59681	<b>.39519</b>	9.59915	<b>.39732</b>	9.60147	<b>.39946</b>	9.60379	<b>.40160</b>	24
37	.59450	<b>.39309</b>	.59685	<b>.39523</b>	.59918	<b>.39736</b>	.60151	<b>.39950</b>	.60383	<b>.40163</b>	23
38	.59454	<b>.39313</b>	.59688	<b>.39526</b>	.59922	<b>.39739</b>	.60155	<b>.39953</b>	.60387	<b>.40167</b>	22
39	.59458	<b>.39317</b>	.59692	<b>.39530</b>	.59926	<b>.39743</b>	.60159	<b>.39957</b>	.60391	<b>.40171</b>	21
+ 10'	9.59461	<b>.39320</b>	9.59696	<b>.39533</b>	9.59930	<b>.39746</b>	9.60163	<b>.39960</b>	9.60395	<b>.40174</b>	20
41	.59465	<b>.39324</b>	.59700	<b>.39537</b>	.59934	<b>.39750</b>	.60167	<b>.39964</b>	.60399	<b>.40178</b>	19
42	.59469	<b>.39327</b>	.59704	<b>.39540</b>	.59938	<b>.39754</b>	.60171	<b>.39967</b>	.60402	<b>.40181</b>	18
43	.59473	<b>.39331</b>	.59708	<b>.39544</b>	.59942	<b>.39757</b>	.60175	<b>.39971</b>	.60406	<b>.40185</b>	17
+ 11'	9.59477	<b>.39334</b>	9.59712	<b>.39548</b>	9.59946	<b>.39761</b>	9.60178	<b>.39975</b>	9.60410	<b>.40188</b>	16
45	.59481	<b>.39338</b>	.59716	<b>.39551</b>	.59950	<b>.39765</b>	.60182	<b>.39978</b>	.60414	<b>.40192</b>	15
46	.59485	<b>.39341</b>	.59720	<b>.39555</b>	.59953	<b>.39768</b>	.60186	<b>.39982</b>	.60418	<b>.40196</b>	14
47	.59489	<b>.39345</b>	.59724	<b>.39558</b>	.59957	<b>.39772</b>	.60190	<b>.39985</b>	.60422	<b>.40199</b>	13
+ 12'	9.59493	<b>.39348</b>	9.59728	<b>.39562</b>	9.59961	<b>.39775</b>	9.60194	<b>.39989</b>	9.60426	<b>.40203</b>	12
49	.59497	<b>.39352</b>	.59731	<b>.39565</b>	.59965	<b>.39779</b>	.60198	<b>.39992</b>	.60429	<b>.40206</b>	11
50	.59501	<b>.39356</b>	.59735	<b>.39569</b>	.59969	<b>.39782</b>	.60202	<b>.39996</b>	.60433	<b>.40210</b>	10
51	.59505	<b>.39359</b>	.59739	<b>.39572</b>	.59973	<b>.39786</b>	.60206	<b>.40000</b>	.60437	<b>.40213</b>	9
+ 13'	9.59508	<b>.39363</b>	9.59743	<b>.39576</b>	9.59977	<b>.39789</b>	9.60209	<b>.40003</b>	9.60441	<b>.40217</b>	8
53	.59512	<b>.39366</b>	.59747	<b>.39580</b>	.59981	<b>.39793</b>	.60213	<b>.40007</b>	.60445	<b>.40220</b>	7
54	.59516	<b>.39370</b>	.59751	<b>.39583</b>	.59985	<b>.39796</b>	.60217	<b>.40010</b>	.60449	<b>.40224</b>	6
55	.59520	<b>.39373</b>	.59755	<b>.39587</b>	.59988	<b>.39800</b>	.60221	<b>.40014</b>	.60452	<b>.40228</b>	5
+ 14'	9.59524	<b>.39377</b>	9.59759	<b>.39590</b>	9.59992	<b>.39803</b>	9.60225	<b>.40017</b>	9.60456	<b>.40231</b>	4
57	.59528	<b>.39380</b>	.59763	<b>.39594</b>	.59996	<b>.39807</b>	.60229	<b>.40021</b>	.60460	<b>.40235</b>	3
58	.59532	<b>.39384</b>	.59767	<b>.39597</b>	.60000	<b>.39811</b>	.60233	<b>.40024</b>	.60464	<b>.40238</b>	2
59	.59536	<b>.39388</b>	.59770	<b>.39601</b>	.60004	<b>.39814</b>	.60236	<b>.40028</b>	.60468	<b>.40242</b>	1
+ 15'	9.59540	<b>.39391</b>	9.59774	<b>.39604</b>	9.60008	<b>.39818</b>	9.60240	<b>.40032</b>	9.60472	<b>.40245</b>	0
	18h 49m		18h 48m		18h 47m		18h 46m		18h 45m		

Haversines.

s	5h 15m 78° 45'		5h 16m 79° 0'		5h 17m 79° 15'		5h 18m 79° 30'		5h 19m 79° 45'		s										
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.											
0	9.60472	.40245	9.60702	.40460	9.60931	.40674	9.61160	.40888	9.61387	.41103	60										
1	.60476	.40249	.60706	.40463	.60935	.40677	.61164	.40892	.61391	.41106	59										
2	.60479	.40253	.60710	.40467	.60939	.40681	.61167	.40895	.61395	.41110	58										
3	.60483	.40256	.60714	.40470	.60943	.40685	.61171	.40899	.61399	.41114	57										
+ 1'	9.60487	.40260	9.60717	.40474	9.60947	.40688	9.61175	.40903	9.61402	.41117	56										
5	.60491	.40263	.60721	.40477	.60951	.40692	.61179	.40906	.61406	.41121	55										
6	.60495	.40267	.60725	.40481	.60954	.40695	.61183	.40910	.61410	.41124	54										
7	.60499	.40270	.60729	.40485	.60958	.40699	.61186	.40913	.61414	.41128	53										
+ 2'	9.60502	.40274	9.60733	.40488	9.60962	.40702	9.61190	.40917	9.61417	.41131	52										
9	.60506	.40277	.60737	.40492	.60966	.40706	.61194	.40920	.61421	.41135	51										
10	.60510	.40281	.60740	.40495	.60970	.40710	.61198	.40924	.61425	.41139	50										
11	.60514	.40285	.60744	.40499	.60973	.40713	.61202	.40928	.61429	.41142	49										
+ 3'	9.60518	.40288	9.60748	.40502	9.60977	.40717	9.61205	.40931	9.61433	.41146	48										
13	.60522	.40292	.60752	.40506	.60981	.40720	.61209	.40935	.61436	.41149	47										
14	.60526	.40295	.60756	.40510	.60985	.40724	.61213	.40938	.61440	.41153	46										
15	.60529	.40299	.60760	.40513	.60989	.40727	.61217	.40942	.61444	.41156	45										
+ 4'	9.60533	.40303	9.60763	.40517	9.60992	.40731	9.61221	.40945	9.61448	.41160	44										
17	.60537	.40306	.60767	.40520	.60996	.40735	.61224	.40949	.61451	.41164	43										
18	.60541	.40310	.60771	.40524	.61000	.40738	.61228	.40953	.61455	.41167	42										
19	.60545	.40313	.60775	.40527	.61004	.40742	.61232	.40956	.61459	.41171	41										
+ 5'	9.60549	.40317	9.60779	.40531	9.61008	.40745	9.61236	.40960	9.61463	.41174	40										
21	.60552	.40320	.60783	.40535	.61012	.40749	.61240	.40963	.61467	.41178	39										
22	.60556	.40324	.60786	.40538	.61015	.40752	.61243	.40967	.61470	.41182	38										
23	.60560	.40328	.60790	.40542	.61019	.40756	.61247	.40970	.61474	.41185	37										
+ 6'	9.60564	.40331	9.60794	.40545	9.61023	.40760	9.61251	.40974	9.61478	.41189	36										
25	.60568	.40335	.60798	.40549	.61027	.40763	.61255	.40978	.61482	.41192	35										
26	.60572	.40338	.60802	.40552	.61031	.40767	.61258	.40981	.61485	.41196	34										
27	.60576	.40342	.60805	.40556	.61034	.40770	.61262	.40985	.61489	.41199	33										
+ 7'	9.60579	.40345	9.60809	.40560	9.61038	.40774	9.61266	.40988	9.61493	.41203	32										
29	.60583	.40349	.60813	.40563	.61042	.40777	.61270	.40992	.61497	.41207	31										
30	.60587	.40352	.60817	.40567	.61046	.40781	.61274	.40996	.61500	.41210	30										
31	.60591	.40356	.60821	.40570	.61050	.40785	.61277	.40999	.61504	.41214	29										
+ 8'	9.60595	.40360	9.60825	.40574	9.61053	.40788	9.61281	.41003	9.61508	.41217	28										
33	.60599	.40363	.60828	.40577	.61057	.40792	.61285	.41006	.61512	.41221	27										
34	.60602	.40367	.60832	.40581	.61061	.40795	.61289	.41010	.61516	.41225	26										
35	.60606	.40370	.60836	.40585	.61065	.40799	.61293	.41013	.61519	.41228	25										
+ 9'	9.60610	.40374	9.60840	.40588	9.61069	.40802	9.61296	.41017	9.61523	.41232	24										
37	.60614	.40377	.60844	.40592	.61072	.40806	.61300	.41021	.61527	.41235	23										
38	.60618	.40381	.60847	.40595	.61076	.40810	.61304	.41024	.61531	.41239	22										
39	.60622	.40385	.60851	.40599	.61080	.40813	.61308	.41028	.61534	.41242	21										
+ 10'	9.60625	.40388	9.60855	.40602	9.61084	.40817	9.61312	.41031	9.61538	.41246	20										
41	.60629	.40392	.60859	.40606	.61088	.40820	.61315	.41035	.61542	.41250	19										
42	.60633	.40395	.60863	.40610	.61091	.40824	.61319	.41039	.61546	.41253	18										
43	.60637	.40399	.60867	.40613	.61095	.40827	.61323	.41042	.61549	.41257	17										
+ 11'	9.60641	.40402	9.60870	.40617	9.61099	.40831	9.61327	.41046	9.61553	.41260	16										
45	.60645	.40406	.60874	.40620	.61103	.40835	.61330	.41049	.61557	.41264	15										
46	.60648	.40410	.60878	.40624	.61107	.40838	.61334	.41053	.61561	.41267	14										
47	.60652	.40413	.60882	.40627	.61110	.40842	.61338	.41056	.61565	.41271	13										
+ 12'	9.60656	.40417	9.60886	.40631	9.61114	.40845	9.61342	.41060	9.61568	.41275	12										
49	.60660	.40420	.60890	.40635	.61118	.40849	.61346	.41063	.61572	.41278	11										
50	.60664	.40424	.60893	.40638	.61122	.40852	.61349	.41067	.61576	.41282	10										
51	.60668	.40427	.60897	.40642	.61126	.40856	.61353	.41071	.61580	.41285	9										
+ 13'	9.60671	.40431	9.60901	.40645	9.61129	.40860	9.61357	.41074	9.61583	.41289	8										
53	.60675	.40434	.60905	.40649	.61133	.40863	.61361	.41078	.61587	.41293	7										
54	.60679	.40438	.60909	.40652	.61137	.40867	.61364	.41082	.61591	.41296	6										
55	.60683	.40442	.60912	.40656	.61141	.40870	.61368	.41085	.61595	.41300	5										
+ 14'	9.60687	.40445	9.60916	.40660	9.61145	.40874	9.61372	.41089	9.61598	.41303	4										
57	.60691	.40449	.60920	.40663	.61148	.40878	.61376	.41092	.61602	.41307	3										
58	.60694	.40452	.60924	.40667	.61152	.40881	.61380	.41096	.61606	.41310	2										
59	.60698	.40456	.60928	.40670	.61156	.40885	.61383	.41099	.61610	.41314	1										
+ 15'	9.60702	.40460	9.60931	.40674	9.61160	.40888	9.61387	.41103	9.61614	.41318	0										
		18h 44m				18h 43m				18h 42m				18h 41m				18h 40m			



## TABLE IV.

Haversines.

s	5h 20m 80° 0'		5h 21m 80° 15'		5h 22m 80° 30'		5h 23m 80° 45'		5h 24m 81° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.61614	<b>.41318</b>	9.61839	<b>.41533</b>	9.62063	<b>.41748</b>	9.62287	<b>.41963</b>	9.62509	<b>.42178</b>	60
1	.61617	<b>.41321</b>	.61843	<b>.41536</b>	.62067	<b>.41751</b>	.62290	<b>.41966</b>	.62513	<b>.42182</b>	59
2	.61621	<b>.41325</b>	.61846	<b>.41540</b>	.62071	<b>.41755</b>	.62294	<b>.41970</b>	.62516	<b>.42185</b>	58
3	.61625	<b>.41328</b>	.61850	<b>.41543</b>	.62074	<b>.41758</b>	.62298	<b>.41974</b>	.62520	<b>.42189</b>	57
+ 1'	9.61629	<b>.41332</b>	9.61854	<b>.41547</b>	9.62078	<b>.41762</b>	9.62301	<b>.41977</b>	9.62524	<b>.42193</b>	56
5	.61632	<b>.41335</b>	.61858	<b>.41550</b>	.62082	<b>.41766</b>	.62305	<b>.41981</b>	.62527	<b>.42196</b>	55
6	.61636	<b>.41339</b>	.61861	<b>.41554</b>	.62086	<b>.41769</b>	.62309	<b>.41984</b>	.62531	<b>.42200</b>	54
7	.61640	<b>.41343</b>	.61865	<b>.41558</b>	.62089	<b>.41773</b>	.62313	<b>.41988</b>	.62535	<b>.42203</b>	53
+ 2'	9.61644	<b>.41346</b>	9.61869	<b>.41561</b>	9.62093	<b>.41776</b>	9.62316	<b>.41992</b>	9.62538	<b>.42207</b>	52
9	.61647	<b>.41350</b>	.61873	<b>.41565</b>	.62097	<b>.41780</b>	.62320	<b>.41995</b>	.62542	<b>.42211</b>	51
10	.61651	<b>.41353</b>	.61876	<b>.41568</b>	.62100	<b>.41783</b>	.62324	<b>.41999</b>	.62546	<b>.42214</b>	50
11	.61655	<b>.41357</b>	.61880	<b>.41572</b>	.62104	<b>.41787</b>	.62327	<b>.42002</b>	.62550	<b>.42218</b>	49
+ 3'	9.61659	<b>.41361</b>	9.61884	<b>.41576</b>	9.62108	<b>.41791</b>	9.62331	<b>.42006</b>	9.62553	<b>.42221</b>	48
13	.61662	<b>.41364</b>	.61888	<b>.41579</b>	.62112	<b>.41794</b>	.62335	<b>.42010</b>	.62557	<b>.42225</b>	47
14	.61666	<b>.41368</b>	.61891	<b>.41583</b>	.62115	<b>.41798</b>	.62338	<b>.42013</b>	.62561	<b>.42229</b>	46
15	.61670	<b>.41371</b>	.61895	<b>.41586</b>	.62119	<b>.41801</b>	.62342	<b>.42017</b>	.62564	<b>.42232</b>	45
+ 4'	9.61674	<b>.41375</b>	9.61899	<b>.41590</b>	9.62123	<b>.41805</b>	9.62346	<b>.42020</b>	9.62568	<b>.42236</b>	44
17	.61677	<b>.41378</b>	.61903	<b>.41593</b>	.62127	<b>.41809</b>	.62350	<b>.42024</b>	.62572	<b>.42239</b>	43
18	.61681	<b>.41382</b>	.61906	<b>.41597</b>	.62130	<b>.41812</b>	.62353	<b>.42027</b>	.62575	<b>.42243</b>	42
19	.61685	<b>.41386</b>	.61910	<b>.41601</b>	.62134	<b>.41816</b>	.62357	<b>.42031</b>	.62579	<b>.42247</b>	41
+ 5'	9.61689	<b>.41389</b>	9.61914	<b>.41604</b>	9.62138	<b>.41819</b>	9.62361	<b>.42035</b>	9.62583	<b>.42250</b>	40
21	.61692	<b>.41393</b>	.61917	<b>.41608</b>	.62141	<b>.41823</b>	.62364	<b>.42038</b>	.62586	<b>.42254</b>	39
22	.61696	<b>.41396</b>	.61921	<b>.41611</b>	.62145	<b>.41827</b>	.62368	<b>.42042</b>	.62590	<b>.42257</b>	38
23	.61700	<b>.41400</b>	.61925	<b>.41615</b>	.62149	<b>.41830</b>	.62372	<b>.42045</b>	.62594	<b>.42261</b>	37
+ 6'	9.61704	<b>.41404</b>	9.61929	<b>.41619</b>	9.62153	<b>.41834</b>	9.62376	<b>.42049</b>	9.62598	<b>.42264</b>	36
25	.61708	<b>.41407</b>	.61932	<b>.41622</b>	.62156	<b>.41837</b>	.62379	<b>.42053</b>	.62601	<b>.42268</b>	35
26	.61711	<b>.41411</b>	.61936	<b>.41626</b>	.62160	<b>.41841</b>	.62383	<b>.42056</b>	.62605	<b>.42272</b>	34
27	.61715	<b>.41414</b>	.61940	<b>.41629</b>	.62164	<b>.41844</b>	.62387	<b>.42060</b>	.62609	<b>.42275</b>	33
+ 7'	9.61719	<b>.41418</b>	9.61944	<b>.41633</b>	9.62168	<b>.41848</b>	9.62390	<b>.42063</b>	9.62612	<b>.42279</b>	32
29	.61723	<b>.41421</b>	.61947	<b>.41636</b>	.62171	<b>.41852</b>	.62394	<b>.42067</b>	.62616	<b>.42282</b>	31
30	.61726	<b>.41425</b>	.61951	<b>.41640</b>	.62175	<b>.41855</b>	.62398	<b>.42071</b>	.62620	<b>.42286</b>	30
31	.61730	<b>.41429</b>	.61955	<b>.41644</b>	.62179	<b>.41859</b>	.62402	<b>.42074</b>	.62623	<b>.42290</b>	29
+ 8'	9.61734	<b>.41432</b>	9.61959	<b>.41647</b>	9.62182	<b>.41862</b>	9.62405	<b>.42078</b>	9.62627	<b>.42293</b>	28
33	.61738	<b>.41436</b>	.61962	<b>.41651</b>	.62186	<b>.41866</b>	.62409	<b>.42081</b>	.62631	<b>.42297</b>	27
34	.61741	<b>.41439</b>	.61966	<b>.41654</b>	.62190	<b>.41870</b>	.62413	<b>.42085</b>	.62634	<b>.42300</b>	26
35	.61745	<b>.41443</b>	.61970	<b>.41658</b>	.62194	<b>.41873</b>	.62416	<b>.42089</b>	.62638	<b>.42304</b>	25
+ 9'	9.61749	<b>.41447</b>	9.61974	<b>.41662</b>	9.62197	<b>.41877</b>	9.62420	<b>.42092</b>	9.62642	<b>.42308</b>	24
37	.61753	<b>.41450</b>	.61977	<b>.41665</b>	.62201	<b>.41880</b>	.62424	<b>.42096</b>	.62646	<b>.42311</b>	23
38	.61756	<b>.41454</b>	.61981	<b>.41669</b>	.62205	<b>.41884</b>	.62427	<b>.42099</b>	.62649	<b>.42315</b>	22
39	.61760	<b>.41457</b>	.61985	<b>.41672</b>	.62208	<b>.41888</b>	.62431	<b>.42103</b>	.62653	<b>.42318</b>	21
+ 10'	9.61764	<b>.41461</b>	9.61989	<b>.41676</b>	9.62212	<b>.41891</b>	9.62435	<b>.42106</b>	9.62657	<b>.42322</b>	20
41	.61768	<b>.41464</b>	.61992	<b>.41679</b>	.62216	<b>.41895</b>	.62439	<b>.42110</b>	.62660	<b>.42326</b>	19
42	.61771	<b>.41468</b>	.61996	<b>.41683</b>	.62220	<b>.41898</b>	.62442	<b>.42114</b>	.62664	<b>.42329</b>	18
43	.61775	<b>.41472</b>	.62000	<b>.41687</b>	.62223	<b>.41902</b>	.62446	<b>.42117</b>	.62668	<b>.42333</b>	17
+ 11'	9.61779	<b>.41475</b>	9.62003	<b>.41690</b>	9.62227	<b>.41905</b>	9.62450	<b>.42121</b>	9.62671	<b>.42336</b>	16
45	.61783	<b>.41479</b>	.62007	<b>.41694</b>	.62231	<b>.41909</b>	.62453	<b>.42124</b>	.62675	<b>.42340</b>	15
46	.61786	<b>.41482</b>	.62011	<b>.41697</b>	.62234	<b>.41913</b>	.62457	<b>.42128</b>	.62679	<b>.42344</b>	14
47	.61790	<b>.41486</b>	.62015	<b>.41701</b>	.62238	<b>.41916</b>	.62461	<b>.42132</b>	.62682	<b>.42347</b>	13
+ 12'	9.61794	<b>.41490</b>	9.62018	<b>.41705</b>	9.62242	<b>.41920</b>	9.62464	<b>.42135</b>	9.62686	<b>.42351</b>	12
49	.61798	<b>.41493</b>	.62022	<b>.41708</b>	.62246	<b>.41923</b>	.62468	<b>.42139</b>	.62690	<b>.42354</b>	11
50	.61801	<b>.41497</b>	.62026	<b>.41712</b>	.62249	<b>.41927</b>	.62472	<b>.42142</b>	.62693	<b>.42358</b>	10
51	.61805	<b>.41500</b>	.62030	<b>.41715</b>	.62253	<b>.41931</b>	.62476	<b>.42146</b>	.62697	<b>.42361</b>	9
+ 13'	9.61809	<b>.41504</b>	9.62033	<b>.41719</b>	9.62257	<b>.41934</b>	9.62479	<b>.42150</b>	9.62701	<b>.42365</b>	8
53	.61813	<b>.41507</b>	.62037	<b>.41722</b>	.62261	<b>.41938</b>	.62483	<b>.42153</b>	.62704	<b>.42369</b>	7
54	.61816	<b>.41511</b>	.62041	<b>.41726</b>	.62264	<b>.41941</b>	.62487	<b>.42157</b>	.62708	<b>.42372</b>	6
55	.61820	<b>.41515</b>	.62045	<b>.41730</b>	.62268	<b>.41945</b>	.62490	<b>.42160</b>	.62712	<b>.42376</b>	5
+ 14'	9.61824	<b>.41518</b>	9.62048	<b>.41733</b>	9.62272	<b>.41949</b>	9.62494	<b>.42164</b>	9.62716	<b>.42379</b>	4
57	.61828	<b>.41522</b>	.62052	<b>.41737</b>	.62275	<b>.41952</b>	.62498	<b>.42168</b>	.62719	<b>.42383</b>	3
58	.61831	<b>.41525</b>	.62056	<b>.41740</b>	.62279	<b>.41956</b>	.62501	<b>.42171</b>	.62723	<b>.42387</b>	2
59	.61835	<b>.41529</b>	.62059	<b>.41744</b>	.62283	<b>.41959</b>	.62505	<b>.42175</b>	.62727	<b>.42390</b>	1
+ 15'	9.61839	<b>.41533</b>	9.62063	<b>.41748</b>	9.62287	<b>.41963</b>	9.62509	<b>.42178</b>	9.62730	<b>.42394</b>	0
	18h 39m		18h 38m		18h 37m		18h 36m		18h 35m		

Haversines.

s	5h 25m 81° 15'		5h 26m 81° 30'		5h 27m 81° 45'		5h 28m 82° 0'		5h 29m 82° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.62730	.42394	9.62951	.42610	9.63170	.42825	9.63389	.43041	9.63606	.43257	60
1	.62734	.42397	.62954	.42613	.63174	.42829	.63392	.43045	.63610	.43261	59
2	.62738	.42401	.62958	.42617	.63177	.42833	.63396	.43049	.63613	.43265	58
3	.62741	.42405	.62962	.42620	.63181	.42836	.63399	.43052	.63617	.43268	57
+ 1'	9.62745	.42408	9.62965	.42624	9.63185	.42840	9.63403	.43056	9.63621	.43272	56
5	.62749	.42412	.62969	.42628	.63188	.42843	.63407	.43059	.63624	.43275	55
6	.62752	.42415	.62973	.42631	.63192	.42847	.63410	.43063	.63628	.43279	54
7	.62756	.42419	.62976	.42635	.63196	.42851	.63414	.43067	.63631	.43283	53
+ 2'	9.62760	.42423	9.62980	.42638	9.63199	.42854	9.63418	.43070	9.63635	.43286	52
9	.62763	.42426	.62984	.42642	.63203	.42858	.63421	.43074	.63639	.43290	51
10	.62767	.42430	.62987	.42645	.63207	.42861	.63425	.43077	.63642	.43293	50
11	.62771	.42433	.62991	.42649	.63210	.42865	.63429	.43081	.63646	.43297	49
+ 3'	9.62774	.42437	9.62995	.42653	9.63214	.42869	9.63432	.43085	9.63649	.43301	48
13	.62778	.42441	.62998	.42656	.63218	.42872	.63436	.43088	.63653	.43304	47
14	.62782	.42444	.63002	.42660	.63221	.42876	.63439	.43092	.63657	.43308	46
15	.62785	.42448	.63006	.42663	.63225	.42879	.63443	.43095	.63660	.43312	45
+ 4'	9.62789	.42451	9.63009	.42667	9.63228	.42883	9.63447	.43099	9.63664	.43315	44
17	.62793	.42455	.63013	.42671	.63232	.42887	.63450	.43103	.63668	.43319	43
18	.62796	.42459	.63017	.42674	.63236	.42890	.63454	.43106	.63671	.43322	42
19	.62800	.42462	.63020	.42678	.63239	.42894	.63458	.43110	.63675	.43326	41
+ 5'	9.62804	.42466	9.63024	.42681	9.63243	.42897	9.63461	.43113	9.63678	.43330	40
21	.62808	.42469	.63028	.42685	.63247	.42901	.63465	.43117	.63682	.43333	39
22	.62811	.42473	.63031	.42689	.63250	.42905	.63468	.43121	.63686	.43337	38
23	.62815	.42477	.63035	.42692	.63254	.42908	.63472	.43124	.63689	.43340	37
+ 6'	9.62819	.42480	9.63039	.42696	9.63258	.42912	9.63476	.43128	9.63693	.43344	36
25	.62822	.42484	.63042	.42699	.63261	.42915	.63479	.43131	.63696	.43348	35
26	.62826	.42487	.63046	.42703	.63265	.42919	.63483	.43135	.63700	.43351	34
27	.62830	.42491	.63050	.42707	.63269	.42923	.63487	.43139	.63704	.43355	33
+ 7'	9.62833	.42494	9.63063	.42710	9.63272	.42926	9.63490	.43142	9.63707	.43358	32
29	.62837	.42498	.63057	.42714	.63276	.42930	.63494	.43146	.63711	.43362	31
30	.62841	.42502	.63061	.42717	.63279	.42933	.63497	.43149	.63714	.43366	30
31	.62844	.42505	.63064	.42721	.63283	.42937	.63501	.43153	.63718	.43369	29
+ 8'	9.62848	.42509	9.63068	.42725	9.63287	.42941	9.63505	.43157	9.63722	.43373	28
33	.62852	.42512	.63071	.42728	.63290	.42944	.63508	.43160	.63725	.43376	27
34	.62855	.42516	.63075	.42732	.63294	.42948	.63512	.43164	.63729	.43380	26
35	.62859	.42520	.63079	.42735	.63298	.42951	.63516	.43167	.63733	.43384	25
+ 9'	9.62863	.42523	9.63082	.42739	9.63301	.42955	9.63519	.43171	9.63736	.43387	24
37	.62866	.42527	.63086	.42743	.63305	.42959	.63523	.43175	.63740	.43391	23
38	.62870	.42530	.63090	.42746	.63309	.42962	.63526	.43178	.63743	.43394	22
39	.62874	.42534	.63093	.42750	.63312	.42966	.63530	.43182	.63747	.43398	21
+ 10'	9.62877	.42538	9.63097	.42753	9.63316	.42969	9.63534	.43185	9.63751	.43402	20
41	.62881	.42541	.63101	.42757	.63320	.42973	.63537	.43189	.63754	.43405	19
42	.62885	.42545	.63104	.42761	.63323	.42977	.63541	.43193	.63758	.43409	18
43	.62888	.42548	.63108	.42764	.63327	.42980	.63545	.43196	.63761	.43412	17
+ 11'	9.62892	.42552	9.63112	.42768	9.63330	.42984	9.63548	.43200	9.63765	.43416	16
45	.62896	.42556	.63115	.42771	.63334	.42987	.63552	.43203	.63769	.43420	15
46	.62899	.42559	.63119	.42775	.63338	.42991	.63555	.43207	.63772	.43423	14
47	.62903	.42563	.63123	.42779	.63341	.42995	.63559	.43211	.63776	.43427	13
+ 12'	9.62907	.42566	9.63126	.42782	9.63345	.42998	9.63563	.43214	9.63779	.43430	12
49	.62910	.42570	.63130	.42786	.63349	.43002	.63566	.43218	.63783	.43434	11
50	.62914	.42574	.63134	.42789	.63352	.43005	.63570	.43221	.63787	.43438	10
51	.62918	.42577	.63137	.42793	.63356	.43009	.63574	.43225	.63790	.43441	9
+ 13'	9.62921	.42581	9.63141	.42797	9.63360	.43013	9.63577	.43229	9.63794	.43445	8
53	.62925	.42584	.63145	.42800	.63363	.43016	.63581	.43232	.63797	.43448	7
54	.62929	.42588	.63148	.42804	.63367	.43020	.63584	.43236	.63801	.43452	6
55	.62932	.42592	.63152	.42807	.63370	.43023	.63588	.43239	.63805	.43456	5
+ 14'	9.62936	.42595	9.63156	.42811	9.63374	.43027	9.63592	.43243	9.63808	.43459	4
57	.62940	.42599	.63159	.42815	.63378	.43031	.63595	.43247	.63812	.43463	3
58	.62943	.42602	.63163	.42818	.63381	.43034	.63599	.43250	.63815	.43466	2
59	.62947	.42606	.63166	.42822	.63385	.43038	.63602	.43254	.63819	.43470	1
+ 15'	9.62951	.42610	9.63170	.42825	9.63389	.43041	9.63606	.43257	9.63823	.43474	0
		18h 34m		18h 33m		18h 32m		18h 31m		18h 30m	



Haversines.

s	5h 30m 82° 30'		5h 31m 82° 45'		5h 32m 83° 0'		5h 33m 83° 15'		5h 34m 83° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.63823	.43474	9.64038	.43690	9.64253	.43907	9.64467	.44123	9.64679	.44340	60
1	.63826	.43477	.64042	.43694	.64256	.43910	.64470	.44127	.64683	.44343	59
2	.63830	.43481	.64046	.43697	.64260	.43914	.64474	.44130	.64686	.44347	58
3	.63833	.43485	.64049	.43701	.64264	.43917	.64477	.44134	.64690	.44351	57
+ 1'	9.63837	.43488	9.64053	.43704	9.64267	.43921	9.64481	.44138	9.64694	.44354	56
5	.63841	.43492	.64056	.43708	.64271	.43925	.64484	.44141	.64697	.44358	55
6	.63844	.43495	.64060	.43712	.64274	.43928	.64488	.44145	.64701	.44362	54
7	.63848	.43499	.64063	.43715	.64278	.43932	.64492	.44148	.64704	.44365	53
+ 2'	9.63851	.43503	9.64067	.43719	9.64281	.43935	9.64495	.44152	9.64708	.44369	52
9	.63855	.43506	.64071	.43723	.64285	.43939	.64499	.44156	.64711	.44372	51
10	.63859	.43510	.64074	.43726	.64289	.43943	.64502	.44159	.64715	.44376	50
11	.63862	.43513	.64078	.43730	.64292	.43946	.64506	.44163	.64718	.44380	49
+ 3'	9.63866	.43517	9.64081	.43733	9.64296	.43950	9.64509	.44166	9.64722	.44383	48
13	.63869	.43521	.64085	.43737	.64299	.43953	.64513	.44170	.64725	.44387	47
14	.63873	.43524	.64088	.43741	.64303	.43957	.64516	.44174	.64729	.44390	46
15	.63877	.43528	.64092	.43744	.64306	.43961	.64520	.44177	.64732	.44394	45
+ 4'	9.63880	.43531	9.64096	.43748	9.64310	.43964	9.64523	.44181	9.64736	.44398	44
17	.63884	.43535	.64099	.43751	.64314	.43968	.64527	.44185	.64740	.44401	43
18	.63887	.43539	.64102	.43755	.64317	.43972	.64531	.44188	.64743	.44405	42
19	.63891	.43542	.64106	.43759	.64321	.43975	.64534	.44192	.64747	.44408	41
+ 5'	9.63895	.43546	9.64110	.43762	9.64324	.43979	9.64538	.44195	9.64750	.44412	40
21	.63898	.43549	.64113	.43766	.64328	.43982	.64541	.44199	.64754	.44416	39
22	.63902	.43553	.64117	.43769	.64331	.43986	.64545	.44203	.64757	.44419	38
23	.63905	.43557	.64121	.43773	.64335	.43990	.64548	.44206	.64761	.44423	37
+ 6'	9.63909	.43560	9.64124	.43777	9.64339	.43993	9.64552	.44210	9.64764	.44427	36
25	.63913	.43564	.64128	.43780	.64342	.43997	.64555	.44213	.64768	.44430	35
26	.63916	.43567	.64131	.43784	.64346	.44000	.64559	.44217	.64771	.44434	34
27	.63920	.43571	.64135	.43787	.64349	.44004	.64563	.44221	.64775	.44437	33
+ 7'	9.63923	.43575	9.64139	.43791	9.64353	.44008	9.64566	.44224	9.64778	.44441	32
29	.63927	.43578	.64142	.43795	.64356	.44011	.64570	.44228	.64782	.44445	31
30	.63931	.43582	.64146	.43798	.64360	.44015	.64573	.44231	.64785	.44448	30
31	.63934	.43585	.64149	.43802	.64363	.44018	.64577	.44235	.64789	.44452	29
+ 8'	9.63938	.43589	9.64153	.43805	9.64367	.44022	9.64580	.44239	9.64793	.44455	28
33	.63941	.43593	.64156	.43809	.64371	.44026	.64584	.44242	.64796	.44459	27
34	.63945	.43596	.64160	.43813	.64374	.44029	.64587	.44246	.64800	.44463	26
35	.63949	.43600	.64164	.43816	.64378	.44033	.64591	.44250	.64803	.44466	25
+ 9'	9.63952	.43603	9.64167	.43820	9.64381	.44036	9.64594	.44253	9.64807	.44470	24
37	.63956	.43607	.64171	.43824	.64385	.44040	.64598	.44257	.64810	.44474	23
38	.63959	.43611	.64174	.43827	.64388	.44044	.64602	.44260	.64814	.44477	22
39	.63963	.43614	.64178	.43831	.64392	.44047	.64605	.44264	.64817	.44481	21
+ 10'	9.63966	.43618	9.64181	.43834	9.64396	.44051	9.64609	.44268	9.64821	.44484	20
41	.63970	.43622	.64185	.43838	.64399	.44055	.64612	.44271	.64824	.44488	19
42	.63974	.43625	.64189	.43842	.64403	.44058	.64616	.44275	.64828	.44492	18
43	.63977	.43629	.64192	.43845	.64406	.44062	.64619	.44278	.64831	.44495	17
+ 11'	9.63981	.43632	9.64196	.43849	9.64410	.44065	9.64623	.44282	9.64835	.44499	16
45	.63984	.43636	.64199	.43852	.64413	.44069	.64626	.44286	.64838	.44502	15
46	.63988	.43640	.64203	.43856	.64417	.44073	.64630	.44289	.64842	.44506	14
47	.63992	.43643	.64206	.43860	.64420	.44076	.64633	.44293	.64845	.44510	13
+ 12'	9.63995	.43647	9.64210	.43863	9.64424	.44080	9.64637	.44296	9.64849	.44513	12
49	.63999	.43650	.64214	.43867	.64428	.44083	.64640	.44300	.64852	.44517	11
50	.64002	.43654	.64217	.43870	.64431	.44087	.64644	.44304	.64856	.44521	10
51	.64006	.43658	.64221	.43874	.64435	.44091	.64648	.44307	.64860	.44524	9
+ 13'	9.64010	.43661	9.64224	.43878	9.64438	.44094	9.64651	.44311	9.64863	.44528	8
53	.64013	.43665	.64228	.43881	.64442	.44098	.64655	.44315	.64867	.44531	7
54	.64017	.43668	.64231	.43885	.64445	.44101	.64658	.44318	.64870	.44535	6
55	.64020	.43672	.64235	.43888	.64449	.44105	.64662	.44322	.64874	.44539	5
+ 14'	9.64024	.43676	9.64239	.43892	9.64452	.44109	9.64665	.44325	9.64877	.44542	4
57	.64028	.43679	.64242	.43896	.64456	.44112	.64669	.44329	.64881	.44546	3
58	.64031	.43683	.64246	.43899	.64460	.44116	.64672	.44333	.64884	.44549	2
59	.64035	.43686	.64249	.43903	.64463	.44120	.64676	.44336	.64888	.44553	1
+ 15'	9.64038	.43690	9.64253	.43907	9.64467	.44123	9.64679	.44340	9.64891	.44557	0

18h 29m

18h 28m

18h 27m

18h 26m

18h 25m

TABLE IV.

## Haversines.

s	5h 35m 83° 45'		5h 36m 84° 0'		5h 37m 84° 15'		5h 38m 84° 30'		5h 39m 84° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.64891	.44557	9.65102	.44774	9.65312	.44991	9.65521	.45208	9.65729	.45425	60
1	.64895	.44560	.65106	.44777	.65316	.44994	.65525	.45211	.65733	.45429	59
2	.64898	.44564	.65109	.44781	.65319	.44998	.65528	.45215	.65736	.45432	58
3	.64902	.44568	.65113	.44784	.65323	.45001	.65532	.45219	.65740	.45436	57
+ 1'	9.64905	.44571	9.65116	.44788	9.65326	.45005	9.65535	.45222	9.65743	.45439	56
5	.64909	.44575	.65120	.44792	.65330	.45009	.65539	.45226	.65747	.45443	55
6	.64912	.44578	.65123	.44795	.65333	.45012	.65542	.45229	.65750	.45447	54
7	.64916	.44582	.65127	.44799	.65337	.45016	.65546	.45233	.65754	.45450	53
+ 2'	9.64919	.44586	9.65130	.44803	9.65340	.45020	9.65549	.45237	9.65757	.45454	52
9	.64923	.44589	.65134	.44806	.65344	.45023	.65553	.45240	.65761	.45458	51
10	.64926	.44593	.65137	.44810	.65347	.45027	.65556	.45244	.65764	.45461	50
11	.64930	.44596	.65141	.44813	.65351	.45030	.65559	.45248	.65767	.45465	49
+ 3'	9.64934	.44600	9.65144	.44817	9.65354	.45034	9.65563	.45251	9.65771	.45468	48
13	.64937	.44604	.65148	.44821	.65358	.45038	.65566	.45235	.65774	.45472	47
14	.64941	.44607	.65151	.44824	.65361	.45041	.65570	.45258	.65778	.45476	46
15	.64944	.44611	.65155	.44828	.65365	.45045	.65573	.45262	.65781	.45479	45
+ 4'	9.64948	.44614	9.65158	.44831	9.65368	.45048	9.65577	.45266	9.65785	.45483	44
17	.64951	.44618	.65162	.44835	.65372	.45052	.65580	.45269	.65788	.45486	43
18	.64955	.44622	.65165	.44839	.65375	.45056	.65584	.45273	.65792	.45490	42
19	.64958	.44625	.65169	.44842	.65378	.45059	.65587	.45276	.65795	.45494	41
+ 5'	9.64962	.44629	9.65172	.44846	9.65382	.45063	9.65591	.45280	9.65799	.45497	40
21	.64965	.44633	.65176	.44850	.65385	.45067	.65594	.45284	.65802	.45501	39
22	.64969	.44636	.65179	.44853	.65389	.45070	.65598	.45287	.65806	.45505	38
23	.64972	.44640	.65183	.44857	.65392	.45074	.65601	.45291	.65809	.45508	37
+ 6'	9.64976	.44643	9.65186	.44860	9.65396	.45077	9.65605	.45295	9.65812	.45512	36
25	.64979	.44647	.65190	.44864	.65399	.45081	.65608	.45298	.65816	.45515	35
26	.64983	.44651	.65193	.44868	.65403	.45085	.65612	.45302	.65819	.45519	34
27	.64986	.44654	.65197	.44871	.65406	.45088	.65615	.45305	.65823	.45523	33
+ 7'	9.64990	.44658	9.65200	.44875	9.65410	.45092	9.65619	.45309	9.65826	.45526	32
29	.64993	.44661	.65204	.44878	.65413	.45096	.65622	.45313	.65830	.45530	31
30	.64997	.44665	.65207	.44882	.65417	.45099	.65625	.45316	.65833	.45534	30
31	.65000	.44669	.65211	.44886	.65421	.45103	.65629	.45320	.65837	.45537	29
+ 8'	9.65004	.44672	9.65214	.44889	9.65424	.45106	9.65632	.45324	9.65840	.45541	28
33	.65007	.44676	.65218	.44893	.65427	.45110	.65636	.45327	.65844	.45544	27
34	.65011	.44680	.65221	.44897	.65431	.45114	.65639	.45331	.65847	.45548	26
35	.65014	.44683	.65225	.44900	.65434	.45117	.65643	.45334	.65850	.45552	25
+ 9'	9.65018	.44687	9.65228	.44904	9.65438	.45121	9.65646	.45338	9.65854	.45555	24
37	.65021	.44690	.65232	.44907	.65441	.45124	.65650	.45342	.65857	.45559	23
38	.65025	.44694	.65235	.44911	.65445	.45128	.65653	.45345	.65861	.45563	22
39	.65028	.44698	.65239	.44915	.65448	.45132	.65657	.45349	.65864	.45566	21
+ 10'	9.65032	.44701	9.65242	.44918	9.65452	.45135	9.65660	.45353	9.65868	.45570	20
41	.65035	.44705	.65246	.44922	.65455	.45139	.65664	.45356	.65871	.45573	19
42	.65039	.44708	.65249	.44925	.65459	.45143	.65667	.45360	.65875	.45577	18
43	.65043	.44712	.65253	.44929	.65462	.45146	.65671	.45363	.65878	.45581	17
+ 11'	9.65046	.44716	9.65256	.44933	9.65466	.45150	9.65674	.45367	9.65881	.45584	16
45	.65050	.44719	.65260	.44936	.65469	.45153	.65677	.45371	.65885	.45588	15
46	.65053	.44723	.65263	.44940	.65473	.45157	.65681	.45374	.65888	.45592	14
47	.65057	.44727	.65267	.44944	.65476	.45161	.65684	.45378	.65892	.45595	13
+ 12'	9.65060	.44730	9.65270	.44947	9.65480	.45164	9.65688	.45381	9.65895	.45599	12
49	.65064	.44734	.65274	.44951	.65483	.45168	.65691	.45385	.65899	.45602	11
50	.65067	.44737	.65277	.44954	.65486	.45172	.65695	.45389	.65902	.45606	10
51	.65071	.44741	.65281	.44958	.65490	.45175	.65698	.45392	.65906	.45610	9
+ 13'	9.65074	.44745	9.65284	.44962	9.65493	.45179	9.65702	.45396	9.65909	.45613	8
53	.65078	.44748	.65288	.44965	.65497	.45182	.65705	.45400	.65913	.45617	7
54	.65081	.44752	.65291	.44969	.65500	.45186	.65709	.45403	.65916	.45620	6
55	.65085	.44755	.65295	.44973	.65504	.45190	.65712	.45407	.65919	.45624	5
+ 14'	9.65088	.44759	9.65298	.44976	9.65507	.45193	9.65716	.45410	9.65923	.45628	4
57	.65092	.44763	.65302	.44980	.65511	.45197	.65719	.45414	.65926	.45631	3
58	.65095	.44766	.65305	.44983	.65514	.45200	.65722	.45418	.65930	.45635	2
59	.65099	.44770	.65309	.44987	.65518	.45204	.65726	.45421	.65933	.45639	1
+ 15'	9.65102	.44774	9.65312	.44991	9.65521	.45208	9.65729	.45425	9.65937	.45642	0
	18h 24m		18h 23m		18h 22m		18h 21m		18h 20m		



s	5h 40m 85° 0'		5h 41m 85° 15'		5h 42m 85° 30'		5h 43m 85° 45'		5h 44m 86° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.65937	<b>.45642</b>	9.66143	<b>.45860</b>	9.66348	<b>.46077</b>	9.66553	<b>.46295</b>	9.66757	<b>.46512</b>	60
1	.65940	<b>.45646</b>	.66146	<b>.45863</b>	.66352	<b>.46081</b>	.66556	<b>.46298</b>	.66760	<b>.46516</b>	59
2	.65944	<b>.45649</b>	.66150	<b>.45867</b>	.66355	<b>.46084</b>	.66560	<b>.46302</b>	.66763	<b>.46519</b>	58
3	.65947	<b>.45653</b>	.66153	<b>.45870</b>	.66359	<b>.46088</b>	.66563	<b>.46305</b>	.66767	<b>.46523</b>	57
+ 1'	9.65950	<b>.45657</b>	9.66157	<b>.45874</b>	9.66362	<b>.46092</b>	9.66567	<b>.46309</b>	9.66770	<b>.46527</b>	56
5	.65954	<b>.45660</b>	.66160	<b>.45878</b>	.66366	<b>.46095</b>	.66570	<b>.46313</b>	.66774	<b>.46530</b>	55
6	.65957	<b>.45664</b>	.66164	<b>.45881</b>	.66369	<b>.46099</b>	.66573	<b>.46316</b>	.66777	<b>.46534</b>	54
7	.65961	<b>.45668</b>	.66167	<b>.45885</b>	.66372	<b>.46102</b>	.66577	<b>.46320</b>	.66780	<b>.46538</b>	53
+ 2'	9.65964	<b>.45671</b>	9.66170	<b>.45889</b>	9.66376	<b>.46106</b>	9.66580	<b>.46324</b>	9.66784	<b>.46541</b>	52
9	.65968	<b>.45675</b>	.66174	<b>.45892</b>	.66379	<b>.46110</b>	.66584	<b>.46327</b>	.66787	<b>.46545</b>	51
10	.65971	<b>.45678</b>	.66177	<b>.45896</b>	.66383	<b>.46113</b>	.66587	<b>.46331</b>	.66791	<b>.46548</b>	50
11	.65975	<b>.45682</b>	.66181	<b>.45899</b>	.66386	<b>.46117</b>	.66590	<b>.46334</b>	.66794	<b>.46552</b>	49
+ 3'	9.65978	<b>.45686</b>	9.66184	<b>.45903</b>	9.66389	<b>.46121</b>	9.66594	<b>.46338</b>	9.66797	<b>.46556</b>	48
13	.65981	<b>.45689</b>	.66188	<b>.45907</b>	.66393	<b>.46124</b>	.66597	<b>.46342</b>	.66801	<b>.46559</b>	47
14	.65985	<b>.45693</b>	.66191	<b>.45910</b>	.66396	<b>.46128</b>	.66601	<b>.46345</b>	.66804	<b>.46563</b>	46
15	.65988	<b>.45697</b>	.66194	<b>.45914</b>	.66400	<b>.46131</b>	.66604	<b>.46349</b>	.66807	<b>.46567</b>	45
+ 4'	9.65992	<b>.45700</b>	9.66198	<b>.45918</b>	9.66403	<b>.46135</b>	9.66607	<b>.46353</b>	9.66811	<b>.46570</b>	44
17	.65995	<b>.45704</b>	.66201	<b>.45921</b>	.66407	<b>.46139</b>	.66611	<b>.46356</b>	.66814	<b>.46574</b>	43
18	.65999	<b>.45707</b>	.66205	<b>.45925</b>	.66410	<b>.46142</b>	.66614	<b>.46360</b>	.66818	<b>.46577</b>	42
19	.66002	<b>.45711</b>	.66208	<b>.45928</b>	.66413	<b>.46146</b>	.66618	<b>.46363</b>	.66821	<b>.46581</b>	41
+ 5'	9.66006	<b>.45715</b>	9.66212	<b>.45932</b>	9.66417	<b>.46150</b>	9.66621	<b>.46367</b>	9.66824	<b>.46585</b>	40
21	.66009	<b>.45718</b>	.66215	<b>.45936</b>	.66420	<b>.46153</b>	.66624	<b>.46371</b>	.66828	<b>.46588</b>	39
22	.66012	<b>.45722</b>	.66218	<b>.45939</b>	.66424	<b>.46157</b>	.66628	<b>.46374</b>	.66831	<b>.46592</b>	38
23	.66016	<b>.45726</b>	.66222	<b>.45943</b>	.66427	<b>.46161</b>	.66631	<b>.46378</b>	.66835	<b>.46596</b>	37
+ 6'	9.66019	<b>.45729</b>	9.66225	<b>.45947</b>	9.66430	<b>.46164</b>	9.66635	<b>.46382</b>	9.66838	<b>.46599</b>	36
25	.66023	<b>.45733</b>	.66229	<b>.45950</b>	.66434	<b>.46168</b>	.66638	<b>.46385</b>	.66841	<b>.46603</b>	35
26	.66026	<b>.45736</b>	.66232	<b>.45954</b>	.66437	<b>.46171</b>	.66641	<b>.46389</b>	.66845	<b>.46606</b>	34
27	.66030	<b>.45740</b>	.66236	<b>.45957</b>	.66441	<b>.46175</b>	.66645	<b>.46392</b>	.66848	<b>.46610</b>	33
+ 7'	9.66033	<b>.45744</b>	9.66239	<b>.45961</b>	9.66444	<b>.46179</b>	9.66648	<b>.46396</b>	9.66851	<b>.46614</b>	32
29	.66037	<b>.45747</b>	.66242	<b>.45965</b>	.66447	<b>.46182</b>	.66652	<b>.46400</b>	.66855	<b>.46617</b>	31
30	.66040	<b>.45751</b>	.66246	<b>.45968</b>	.66451	<b>.46186</b>	.66655	<b>.46403</b>	.66858	<b>.46621</b>	30
31	.66043	<b>.45755</b>	.66249	<b>.45972</b>	.66454	<b>.46189</b>	.66658	<b>.46407</b>	.66862	<b>.46625</b>	29
+ 8'	9.66047	<b>.45758</b>	9.66253	<b>.45976</b>	9.66458	<b>.46193</b>	9.66662	<b>.46411</b>	9.66865	<b>.46628</b>	28
33	.66050	<b>.45762</b>	.66256	<b>.45979</b>	.66461	<b>.46197</b>	.66665	<b>.46414</b>	.66868	<b>.46632</b>	27
34	.66054	<b>.45765</b>	.66260	<b>.45983</b>	.66464	<b>.46200</b>	.66669	<b>.46418</b>	.66872	<b>.46636</b>	26
35	.66057	<b>.45769</b>	.66263	<b>.45986</b>	.66468	<b>.46204</b>	.66672	<b>.46421</b>	.66875	<b>.46639</b>	25
+ 9'	9.66061	<b>.45773</b>	9.66266	<b>.45990</b>	9.66471	<b>.46208</b>	9.66675	<b>.46425</b>	9.66878	<b>.46643</b>	24
37	.66064	<b>.45776</b>	.66270	<b>.45994</b>	.66475	<b>.46211</b>	.66679	<b>.46429</b>	.66882	<b>.46646</b>	23
38	.66067	<b>.45780</b>	.66273	<b>.45997</b>	.66478	<b>.46215</b>	.66682	<b>.46432</b>	.66885	<b>.46650</b>	22
39	.66071	<b>.45783</b>	.66277	<b>.46001</b>	.66482	<b>.46218</b>	.66685	<b>.46436</b>	.66889	<b>.46654</b>	21
+ 10'	9.66074	<b>.45787</b>	9.66280	<b>.46005</b>	9.66485	<b>.46222</b>	9.66689	<b>.46440</b>	9.66892	<b>.46657</b>	20
41	.66078	<b>.45791</b>	.66284	<b>.46008</b>	.66488	<b>.46226</b>	.66692	<b>.46443</b>	.66895	<b>.46661</b>	19
42	.66081	<b>.45794</b>	.66287	<b>.46012</b>	.66492	<b>.46229</b>	.66696	<b>.46447</b>	.66899	<b>.46665</b>	18
43	.66085	<b>.45798</b>	.66290	<b>.46015</b>	.66495	<b>.46233</b>	.66699	<b>.46451</b>	.66902	<b>.46668</b>	17
+ 11'	9.66088	<b>.45802</b>	9.66294	<b>.46019</b>	9.66499	<b>.46237</b>	9.66702	<b>.46454</b>	9.66905	<b>.46672</b>	16
45	.66092	<b>.45805</b>	.66297	<b>.46023</b>	.66502	<b>.46240</b>	.66706	<b>.46458</b>	.66909	<b>.46675</b>	15
46	.66095	<b>.45809</b>	.66301	<b>.46026</b>	.66505	<b>.46244</b>	.66709	<b>.46461</b>	.66912	<b>.46679</b>	14
47	.66098	<b>.45812</b>	.66304	<b>.46030</b>	.66509	<b>.46247</b>	.66713	<b>.46465</b>	.66916	<b>.46683</b>	13
+ 12'	9.66102	<b>.45816</b>	9.66307	<b>.46034</b>	9.66512	<b>.46251</b>	9.66716	<b>.46469</b>	9.66919	<b>.46686</b>	12
49	.66105	<b>.45820</b>	.66311	<b>.46037</b>	.66516	<b>.46255</b>	.66719	<b>.46472</b>	.66922	<b>.46690</b>	11
50	.66109	<b>.45823</b>	.66314	<b>.46041</b>	.66519	<b>.46258</b>	.66723	<b>.46476</b>	.66926	<b>.46694</b>	10
51	.66112	<b>.45827</b>	.66318	<b>.46044</b>	.66522	<b>.46262</b>	.66726	<b>.46480</b>	.66929	<b>.46697</b>	9
+ 13'	9.66116	<b>.45831</b>	9.66321	<b>.46048</b>	9.66526	<b>.46266</b>	9.66730	<b>.46483</b>	9.66932	<b>.46701</b>	8
53	.66119	<b>.45834</b>	.66325	<b>.46052</b>	.66529	<b>.46269</b>	.66733	<b>.46487</b>	.66936	<b>.46704</b>	7
54	.66122	<b>.45838</b>	.66328	<b>.46055</b>	.66533	<b>.46273</b>	.66736	<b>.46490</b>	.66939	<b>.46708</b>	6
55	.66126	<b>.45841</b>	.66331	<b>.46059</b>	.66536	<b>.46276</b>	.66740	<b>.46494</b>	.66943	<b>.46712</b>	5
+ 14'	9.66129	<b>.45845</b>	9.66335	<b>.46063</b>	9.66539	<b>.46280</b>	9.66743	<b>.46498</b>	9.66946	<b>.46715</b>	4
57	.66133	<b>.45849</b>	.66338	<b>.46066</b>	.66543	<b>.46284</b>	.66747	<b>.46501</b>	.66949	<b>.46719</b>	3
58	.66136	<b>.45852</b>	.66342	<b>.46070</b>	.66546	<b>.46287</b>	.66750	<b>.46505</b>	.66953	<b>.46723</b>	2
59	.66140	<b>.45856</b>	.66345	<b>.46073</b>	.66550	<b>.46291</b>	.66753	<b>.46509</b>	.66956	<b>.46726</b>	1
+ 15'	9.66143	<b>.45860</b>	9.66348	<b>.46077</b>	9.66553	<b>.46295</b>	9.66757	<b>.46512</b>	9.66959	<b>.46730</b>	0
		18h 19m		18h 18m		18h 17m		18h 16m		18h 15m	

TABLE IV.

Haversines.

s	5h 45m 86° 15'		5h 46m 86° 30'		5h 47m 86° 45'		5h 48m 87° 0'		5h 49m 87° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.66959	<b>.46730</b>	9.67161	<b>.46948</b>	9.67362	<b>.47165</b>	9.67562	<b>.47383</b>	9.67762	<b>.47601</b>	60
1	.66963	<b>.46733</b>	.67165	<b>.46951</b>	.67366	<b>.47169</b>	.67566	<b>.47387</b>	.67765	<b>.47605</b>	59
2	.66966	<b>.46737</b>	.67168	<b>.46955</b>	.67369	<b>.47173</b>	.67569	<b>.47390</b>	.67768	<b>.47608</b>	58
3	.66970	<b>.46741</b>	.67171	<b>.46958</b>	.67372	<b>.47176</b>	.67572	<b>.47394</b>	.67772	<b>.47612</b>	57
+ 1'	9.66973	<b>.46744</b>	9.67175	<b>.46962</b>	9.67376	<b>.47180</b>	9.67576	<b>.47398</b>	9.67775	<b>.47616</b>	56
5	.66976	<b>.46748</b>	.67178	<b>.46966</b>	.67379	<b>.47184</b>	.67579	<b>.47401</b>	.67778	<b>.47619</b>	55
6	.66980	<b>.46752</b>	.67181	<b>.46969</b>	.67382	<b>.47187</b>	.67582	<b>.47405</b>	.67782	<b>.47623</b>	54
7	.66983	<b>.46755</b>	.67185	<b>.46973</b>	.67386	<b>.47191</b>	.67586	<b>.47409</b>	.67785	<b>.47627</b>	53
+ 2'	9.66986	<b>.46759</b>	9.67188	<b>.46977</b>	9.67389	<b>.47194</b>	9.67589	<b>.47412</b>	9.67788	<b>.47630</b>	52
9	.66990	<b>.46762</b>	.67192	<b>.46980</b>	.67392	<b>.47198</b>	.67592	<b>.47416</b>	.67792	<b>.47634</b>	51
10	.66993	<b>.46766</b>	.67195	<b>.46984</b>	.67396	<b>.47202</b>	.67596	<b>.47420</b>	.67795	<b>.47637</b>	50
11	.66997	<b>.46770</b>	.67198	<b>.46987</b>	.67399	<b>.47205</b>	.67599	<b>.47423</b>	.67798	<b>.47641</b>	49
+ 3'	9.67000	<b>.46773</b>	9.67202	<b>.46991</b>	9.67402	<b>.47209</b>	9.67602	<b>.47427</b>	9.67801	<b>.47645</b>	48
13	.67003	<b>.46777</b>	.67205	<b>.46995</b>	.67406	<b>.47213</b>	.67606	<b>.47430</b>	.67805	<b>.47648</b>	47
14	.67007	<b>.46781</b>	.67208	<b>.46998</b>	.67409	<b>.47216</b>	.67609	<b>.47434</b>	.67808	<b>.47652</b>	46
15	.67010	<b>.46784</b>	.67212	<b>.47002</b>	.67412	<b>.47220</b>	.67612	<b>.47438</b>	.67811	<b>.47656</b>	45
+ 4'	9.67013	<b>.46788</b>	9.67215	<b>.47006</b>	9.67416	<b>.47223</b>	9.67616	<b>.47441</b>	9.67815	<b>.47659</b>	44
17	.67017	<b>.46792</b>	.67218	<b>.47009</b>	.67419	<b>.47227</b>	.67619	<b>.47445</b>	.67818	<b>.47663</b>	43
18	.67020	<b>.46795</b>	.67222	<b>.47013</b>	.67422	<b>.47231</b>	.67622	<b>.47449</b>	.67821	<b>.47666</b>	42
19	.67023	<b>.46799</b>	.67225	<b>.47017</b>	.67426	<b>.47234</b>	.67626	<b>.47452</b>	.67825	<b>.47670</b>	41
+ 5'	9.67027	<b>.46802</b>	9.67228	<b>.47020</b>	9.67429	<b>.47238</b>	9.67629	<b>.47456</b>	9.67828	<b>.47674</b>	40
21	.67030	<b>.46806</b>	.67232	<b>.47024</b>	.67432	<b>.47242</b>	.67632	<b>.47459</b>	.67831	<b>.47677</b>	39
22	.67034	<b>.46810</b>	.67235	<b>.47027</b>	.67436	<b>.47245</b>	.67636	<b>.47463</b>	.67835	<b>.47681</b>	38
23	.67037	<b>.46813</b>	.67238	<b>.47031</b>	.67439	<b>.47249</b>	.67639	<b>.47467</b>	.67838	<b>.47685</b>	37
+ 6'	9.67040	<b>.46817</b>	9.67242	<b>.47035</b>	9.67443	<b>.47252</b>	9.67642	<b>.47470</b>	9.67841	<b>.47688</b>	36
25	.67044	<b>.46821</b>	.67245	<b>.47038</b>	.67446	<b>.47256</b>	.67646	<b>.47474</b>	.67844	<b>.47692</b>	35
26	.67047	<b>.46824</b>	.67249	<b>.47042</b>	.67449	<b>.47260</b>	.67649	<b>.47478</b>	.67848	<b>.47696</b>	34
27	.67050	<b>.46828</b>	.67252	<b>.47046</b>	.67452	<b>.47263</b>	.67652	<b>.47481</b>	.67851	<b>.47699</b>	33
+ 7'	9.67054	<b>.46831</b>	9.67255	<b>.47049</b>	9.67456	<b>.47267</b>	9.67656	<b>.47485</b>	9.67854	<b>.47703</b>	32
29	.67057	<b>.46835</b>	.67259	<b>.47053</b>	.67459	<b>.47271</b>	.67659	<b>.47489</b>	.67858	<b>.47706</b>	31
30	.67060	<b>.46839</b>	.67262	<b>.47056</b>	.67462	<b>.47274</b>	.67662	<b>.47492</b>	.67861	<b>.47710</b>	30
31	.67064	<b>.46842</b>	.67265	<b>.47060</b>	.67466	<b>.47278</b>	.67666	<b>.47496</b>	.67864	<b>.47714</b>	29
+ 8'	9.67067	<b>.46846</b>	9.67269	<b>.47064</b>	9.67469	<b>.47282</b>	9.67669	<b>.47499</b>	9.67868	<b>.47717</b>	28
33	.67071	<b>.46850</b>	.67272	<b>.47067</b>	.67472	<b>.47285</b>	.67672	<b>.47503</b>	.67871	<b>.47721</b>	27
34	.67074	<b>.46853</b>	.67275	<b>.47071</b>	.67476	<b>.47289</b>	.67676	<b>.47507</b>	.67874	<b>.47725</b>	26
35	.67077	<b>.46857</b>	.67279	<b>.47075</b>	.67479	<b>.47292</b>	.67679	<b>.47510</b>	.67878	<b>.47728</b>	25
+ 9'	9.67081	<b>.46860</b>	9.67282	<b>.47078</b>	9.67483	<b>.47296</b>	9.67682	<b>.47514</b>	9.67881	<b>.47732</b>	24
37	.67084	<b>.46864</b>	.67285	<b>.47082</b>	.67486	<b>.47300</b>	.67685	<b>.47518</b>	.67884	<b>.47735</b>	23
38	.67087	<b>.46868</b>	.67289	<b>.47086</b>	.67489	<b>.47303</b>	.67689	<b>.47521</b>	.67887	<b>.47739</b>	22
39	.67091	<b>.46871</b>	.67292	<b>.47089</b>	.67493	<b>.47307</b>	.67692	<b>.47525</b>	.67891	<b>.47743</b>	21
+ 10'	9.67094	<b>.46875</b>	9.67295	<b>.47093</b>	9.67496	<b>.47311</b>	9.67695	<b>.47528</b>	9.67894	<b>.47746</b>	20
41	.67097	<b>.46879</b>	.67299	<b>.47096</b>	.67499	<b>.47314</b>	.67699	<b>.47532</b>	.67897	<b>.47750</b>	19
42	.67101	<b>.46883</b>	.67302	<b>.47100</b>	.67503	<b>.47318</b>	.67702	<b>.47536</b>	.67901	<b>.47754</b>	18
43	.67104	<b>.46886</b>	.67305	<b>.47104</b>	.67506	<b>.47321</b>	.67705	<b>.47539</b>	.67904	<b>.47757</b>	17
+ 11'	9.67108	<b>.46890</b>	9.67309	<b>.47107</b>	9.67509	<b>.47325</b>	9.67709	<b>.47543</b>	9.67907	<b>.47761</b>	16
45	.67111	<b>.46893</b>	.67312	<b>.47111</b>	.67512	<b>.47329</b>	.67712	<b>.47547</b>	.67911	<b>.47765</b>	15
46	.67114	<b>.46897</b>	.67315	<b>.47115</b>	.67516	<b>.47332</b>	.67715	<b>.47550</b>	.67914	<b>.47768</b>	14
47	.67118	<b>.46900</b>	.67319	<b>.47118</b>	.67519	<b>.47336</b>	.67719	<b>.47554</b>	.67917	<b>.47772</b>	13
+ 12'	9.67121	<b>.46904</b>	9.67322	<b>.47122</b>	9.67522	<b>.47340</b>	9.67722	<b>.47558</b>	9.67920	<b>.47775</b>	12
49	.67124	<b>.46908</b>	.67326	<b>.47125</b>	.67526	<b>.47343</b>	.67725	<b>.47561</b>	.67924	<b>.47779</b>	11
50	.67128	<b>.46911</b>	.67329	<b>.47129</b>	.67529	<b>.47347</b>	.67729	<b>.47565</b>	.67927	<b>.47783</b>	10
51	.67131	<b>.46915</b>	.67332	<b>.47123</b>	.67532	<b>.47351</b>	.67732	<b>.47568</b>	.67930	<b>.47786</b>	9
+ 13'	9.67134	<b>.46919</b>	9.67336	<b>.47136</b>	9.67536	<b>.47354</b>	9.67735	<b>.47572</b>	9.67934	<b>.47790</b>	8
53	.67138	<b>.46922</b>	.67339	<b>.47140</b>	.67539	<b>.47358</b>	.67738	<b>.47576</b>	.67937	<b>.47794</b>	7
54	.67141	<b>.46926</b>	.67342	<b>.47144</b>	.67542	<b>.47361</b>	.67742	<b>.47579</b>	.67940	<b>.47797</b>	6
55	.67145	<b>.46929</b>	.67346	<b>.47147</b>	.67546	<b>.47365</b>	.67745	<b>.47583</b>	.67944	<b>.47801</b>	5
+ 14'	9.67148	<b>.46933</b>	9.67349	<b>.47151</b>	9.67549	<b>.47369</b>	9.67748	<b>.47587</b>	9.67947	<b>.47805</b>	4
57	.67151	<b>.46937</b>	.67352	<b>.47155</b>	.67552	<b>.47372</b>	.67752	<b>.47590</b>	.67950	<b>.47808</b>	3
58	.67155	<b>.46940</b>	.67356	<b>.47158</b>	.67556	<b>.47376</b>	.67755	<b>.47594</b>	.67953	<b>.47812</b>	2
59	.67158	<b>.46944</b>	.67359	<b>.47162</b>	.67559	<b>.47380</b>	.67758	<b>.47597</b>	.67957	<b>.47815</b>	1
+ 15'	9.67161	<b>.46948</b>	9.67362	<b>.47165</b>	9.67562	<b>.47383</b>	9.67762	<b>.47601</b>	9.67960	<b>.47819</b>	0
	18h 14m		18h 13m		18h 12m		18h 11m		18h 10m		



Haversines.

s	5h 50m 87° 30'		5h 51m 87° 45'		5h 52m 88° 0'		5h 53m 88° 15'		5h 54m 88° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.67960	.47819	9.68158	.48037	9.68354	.48255	9.68550	.48473	9.68745	.48691	60
1	.67963	.47823	.68161	.48041	.68358	.48259	.68553	.48477	.68748	.48695	59
2	.67967	.47826	.68164	.48044	.68361	.48262	.68557	.48480	.68751	.48698	58
3	.67970	.47830	.68167	.48048	.68364	.48266	.68560	.48484	.68755	.48702	57
+ 1'	9.67973	.47834	9.68171	.48052	9.68367	.48269	9.68563	.48488	9.68758	.48706	56
5	.67977	.47837	.68174	.48055	.68371	.48273	.68566	.48491	.68761	.48709	55
6	.67980	.47841	.68177	.48059	.68374	.48277	.68570	.48495	.68764	.48713	54
7	.67983	.47844	.68181	.48062	.68377	.48280	.68573	.48499	.68768	.48717	53
+ 2'	9.67986	.47848	9.68184	.48066	9.68380	.48284	9.68576	.48502	9.68771	.48720	52
9	.67990	.47852	.68187	.48070	.68384	.48288	.68579	.48506	.68774	.48724	51
10	.67993	.47855	.68190	.48073	.68387	.48291	.68583	.48509	.68777	.48728	50
11	.67996	.47859	.68194	.48077	.68390	.48295	.68586	.48513	.68781	.48731	49
+ 3'	9.68000	.47863	9.68197	.48081	9.68393	.48299	9.68589	.48517	9.68784	.48735	48
13	.68003	.47866	.68200	.48084	.68397	.48302	.68592	.48520	.68787	.48738	47
14	.68006	.47870	.68204	.48088	.68400	.48306	.68596	.48524	.68790	.48742	46
15	.68010	.47874	.68207	.48092	.68403	.48310	.68599	.48528	.68794	.48746	45
+ 4'	9.68013	.47877	9.68210	.48095	9.68407	.48313	9.68602	.48531	9.68797	.48749	44
17	.68016	.47881	.68213	.48099	.68410	.48317	.68605	.48535	.68800	.48753	43
18	.68019	.47884	.68217	.48102	.68413	.48320	.68609	.48538	.68803	.48757	42
19	.68023	.47888	.68220	.48106	.68416	.48324	.68612	.48542	.68806	.48760	41
+ 5'	9.68026	.47892	9.68223	.48110	9.68420	.48328	9.68615	.48546	9.68810	.48764	40
21	.68029	.47895	.68227	.48113	.68423	.48331	.68618	.48549	.68813	.48767	39
22	.68033	.47899	.68230	.48117	.68426	.48335	.68622	.48553	.68816	.48771	38
23	.68036	.47903	.68233	.48121	.68429	.48339	.68625	.48557	.68820	.48775	37
+ 6'	9.68039	.47906	9.68236	.48124	9.68433	.48342	9.68628	.48560	9.68823	.48778	36
25	.68042	.47910	.68240	.48128	.68436	.48346	.68631	.48564	.68826	.48782	35
26	.68046	.47913	.68243	.48131	.68439	.48350	.68635	.48568	.68829	.48786	34
27	.68049	.47917	.68246	.48135	.68442	.48353	.68638	.48571	.68832	.48789	33
+ 7'	9.68052	.47921	9.68249	.48139	9.68446	.48357	9.68641	.48575	9.68836	.48793	32
29	.68056	.47924	.68253	.48142	.68449	.48360	.68644	.48578	.68839	.48797	31
30	.68059	.47928	.68256	.48146	.68452	.48364	.68648	.48582	.68842	.48800	30
31	.68062	.47932	.68259	.48150	.68456	.48368	.68651	.48586	.68845	.48804	29
+ 8'	9.68066	.47935	9.68263	.48153	9.68459	.48371	9.68654	.48589	9.68849	.48807	28
33	.68069	.47939	.68266	.48157	.68462	.48375	.68657	.48593	.68852	.48811	27
34	.68072	.47943	.68269	.48161	.68465	.48379	.68661	.48597	.68855	.48815	26
35	.68075	.47946	.68272	.48164	.68469	.48382	.68664	.48600	.68858	.48818	25
+ 9'	9.68079	.47950	9.68276	.48168	9.68472	.48386	9.68667	.48604	9.68862	.48822	24
37	.68082	.47953	.68279	.48171	.68475	.48389	.68670	.48608	.68865	.48826	23
38	.68085	.47957	.68282	.48175	.68478	.48393	.68674	.48611	.68868	.48829	22
39	.68089	.47961	.68286	.48179	.68482	.48397	.68677	.48615	.68871	.48833	21
+ 10'	9.68092	.47964	9.68289	.48182	9.68485	.48400	9.68680	.48618	9.68875	.48837	20
41	.68095	.47968	.68292	.48186	.68488	.48404	.68683	.48622	.68878	.48840	19
42	.68098	.47972	.68295	.48190	.68491	.48408	.68687	.48626	.68881	.48844	18
43	.68102	.47975	.68299	.48193	.68495	.48411	.68690	.48629	.68884	.48847	17
+ 11'	9.68105	.47979	9.68302	.48197	9.68498	.48415	9.68693	.48633	9.68887	.48851	16
45	.68108	.47983	.68305	.48201	.68501	.48419	.68696	.48637	.68891	.48855	15
46	.68112	.47986	.68308	.48204	.68504	.48422	.68700	.48640	.68894	.48858	14
47	.68115	.47990	.68312	.48208	.68508	.48426	.68703	.48644	.68897	.48862	13
+ 12'	9.68118	.47993	9.68315	.48211	9.68511	.48429	9.68706	.48648	9.68900	.48866	12
49	.68121	.47997	.68318	.48215	.68514	.48433	.68709	.48651	.68904	.48869	11
50	.68125	.48001	.68322	.48219	.68517	.48437	.68713	.48655	.68907	.48873	10
51	.68128	.48004	.68325	.48222	.68521	.48440	.68716	.48658	.68910	.48877	9
+ 13'	9.68131	.48008	9.68328	.48226	9.68524	.48444	9.68719	.48662	9.68913	.48880	8
53	.68135	.48012	.68331	.48230	.68527	.48448	.68722	.48666	.68917	.48884	7
54	.68138	.48015	.68335	.48233	.68531	.48451	.68726	.48669	.68920	.48887	6
55	.68141	.48019	.68338	.48237	.68534	.48455	.68729	.48673	.68923	.48891	5
+ 14'	9.68144	.48022	9.68341	.48241	9.68537	.48459	9.68732	.48677	9.68926	.48895	4
57	.68148	.48026	.68344	.48244	.68540	.48462	.68735	.48680	.68929	.48898	3
58	.68151	.48030	.68348	.48248	.68544	.48466	.68739	.48684	.68933	.48902	2
59	.68154	.48033	.68351	.48251	.68547	.48469	.68742	.48688	.68936	.48906	1
+ 15'	9.68158	.48037	9.68354	.48255	9.68550	.48473	9.68745	.48691	9.68939	.48909	0
	18h 9m		18h 8m		18h 7m		18h 6m		18h 5m		

Haversines.

s	5h 55m 88° 45'		5h 56m 89° 0'		5h 57m 89° 15'		5h 58m 89° 30'		5h 59m 89° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.68939	.48909	9.69132	.49127	9.69325	.49346	9.69516	.49564	9.69707	.49782	60
1	.68942	.48913	.69136	.49131	.69328	.49349	.69520	.49567	.69710	.49785	59
2	.68946	.48917	.69139	.49135	.69331	.49353	.69523	.49571	.69713	.49789	58
3	.68949	.48920	.69142	.49138	.69334	.49356	.69526	.49575	.69717	.49793	57
+ 1'	9.68952	.48924	9.69145	.49142	9.69338	.49360	9.69529	.49578	9.69720	.49796	56
5	.68955	.48927	.69148	.49146	.69341	.49364	.69532	.49582	.69723	.49800	55
6	.68958	.48931	.69152	.49149	.69344	.49367	.69535	.49585	.69726	.49804	54
7	.68962	.48935	.69155	.49153	.69347	.49371	.69539	.49589	.69729	.49807	53
+ 2'	9.68965	.48938	9.69158	.49156	9.69350	.49375	9.69542	.49593	9.69732	.49811	52
9	.68968	.48942	.69161	.49160	.69354	.49378	.69545	.49596	.69736	.49815	51
10	.68971	.48946	.69164	.49164	.69357	.49382	.69548	.49600	.69739	.49818	50
11	.68975	.48949	.69168	.49167	.69360	.49386	.69551	.49604	.69742	.49822	49
+ 3'	9.68978	.48953	9.69171	.49171	9.69363	.49389	9.69555	.49607	9.69745	.49825	48
13	.68981	.48957	.69174	.49175	.69366	.49393	.69558	.49611	.69748	.49829	47
14	.68984	.48960	.69177	.49178	.69370	.49396	.69561	.49615	.69751	.49833	46
15	.68988	.48964	.69181	.49182	.69373	.49400	.69564	.49618	.69755	.49836	45
+ 4'	9.68991	.48967	9.69184	.49186	9.69376	.49404	9.69567	.49622	9.69758	.49840	44
17	.68994	.48971	.69187	.49189	.69379	.49407	.69570	.49625	.69761	.49844	43
18	.68997	.48975	.69190	.49193	.69382	.49411	.69574	.49629	.69764	.49847	42
19	.69000	.48978	.69193	.49196	.69386	.49415	.69577	.49633	.69767	.49851	41
+ 5'	9.69004	.48982	9.69197	.49200	9.69389	.49418	9.69580	.49636	9.69770	.49855	40
21	.69007	.48986	.69200	.49204	.69392	.49422	.69583	.49640	.69774	.49858	39
22	.69010	.48989	.69203	.49207	.69395	.49426	.69586	.49644	.69777	.49862	38
23	.69013	.48993	.69206	.49211	.69398	.49429	.69590	.49647	.69780	.49865	37
+ 6'	9.69017	.48997	9.69209	.49215	9.69402	.49433	9.69593	.49651	9.69783	.49869	36
25	.69020	.49000	.69213	.49218	.69405	.49436	.69596	.49655	.69786	.49873	35
26	.69023	.49004	.69216	.49222	.69408	.49440	.69599	.49658	.69789	.49876	34
27	.69026	.49007	.69219	.49226	.69411	.49444	.69602	.49662	.69793	.49880	33
+ 7'	9.69029	.49011	9.69222	.49229	9.69414	.49447	9.69605	.49665	9.69796	.49884	32
29	.69033	.49015	.69225	.49233	.69417	.49451	.69609	.49669	.69799	.49887	31
30	.69036	.49018	.69229	.49236	.69421	.49455	.69612	.49673	.69802	.49891	30
31	.69039	.49022	.69232	.49240	.69424	.49458	.69615	.49676	.69805	.49895	29
+ 8'	9.69042	.49026	9.69235	.49244	9.69427	.49462	9.69618	.49680	9.69808	.49898	28
33	.69046	.49029	.69238	.49247	.69430	.49465	.69621	.49684	.69812	.49902	27
34	.69049	.49033	.69242	.49251	.69433	.49469	.69625	.49687	.69815	.49905	26
35	.69052	.49036	.69245	.49255	.69437	.49473	.69628	.49691	.69818	.49909	25
+ 9'	9.69055	.49040	9.69248	.49258	9.69440	.49476	9.69631	.49695	9.69821	.49913	24
37	.69058	.49044	.69251	.49262	.69443	.49480	.69634	.49698	.69824	.49916	23
38	.69062	.49047	.69254	.49266	.69446	.49484	.69637	.49702	.69827	.49920	22
39	.69065	.49051	.69258	.49269	.69449	.49487	.69640	.49705	.69831	.49924	21
+ 10'	9.69068	.49055	9.69261	.49273	9.69453	.49491	9.69644	.49709	9.69834	.49927	20
41	.69071	.49058	.69264	.49276	.69456	.49495	.69647	.49713	.69837	.49931	19
42	.69074	.49062	.69267	.49280	.69459	.49498	.69650	.49716	.69840	.49935	18
43	.69078	.49066	.69270	.49284	.69462	.49502	.69653	.49720	.69843	.49938	17
+ 11'	9.69081	.49069	9.69274	.49287	9.69465	.49506	9.69656	.49724	9.69846	.49942	16
45	.69084	.49073	.69277	.49291	.69469	.49509	.69659	.49727	.69850	.49945	15
46	.69087	.49076	.69280	.49295	.69472	.49513	.69663	.49731	.69853	.49949	14
47	.69091	.49080	.69283	.49298	.69475	.49516	.69666	.49735	.69856	.49953	13
+ 12'	9.69094	.49084	9.69286	.49302	9.69478	.49520	9.69669	.49738	9.69859	.49956	12
49	.69097	.49087	.69290	.49306	.69481	.49524	.69672	.49742	.69862	.49960	11
50	.69100	.49091	.69293	.49309	.69484	.49527	.69675	.49745	.69865	.49964	10
51	.69103	.49095	.69296	.49313	.69488	.49531	.69678	.49749	.69869	.49967	9
+ 13'	9.69107	.49098	9.69299	.49316	9.69491	.49535	9.69682	.49753	9.69872	.49971	8
53	.69110	.49102	.69302	.49320	.69494	.49538	.69685	.49756	.69875	.49975	7
54	.69113	.49106	.69306	.49324	.69497	.49542	.69688	.49760	.69878	.49978	6
55	.69116	.49109	.69309	.49327	.69500	.49545	.69691	.49764	.69881	.49982	5
+ 14'	9.69120	.49113	9.69312	.49331	9.69504	.49549	9.69694	.49767	9.69884	.49985	4
57	.69123	.49116	.69315	.49335	.69507	.49553	.69698	.49771	.69888	.49989	3
58	.69126	.49120	.69318	.49338	.69510	.49556	.69701	.49775	.69891	.49993	2
59	.69129	.49124	.69322	.49342	.69513	.49560	.69704	.49778	.69894	.49997	1
+ 15'	9.69132	.49127	9.69325	.49346	9.69516	.49564	9.69707	.49782	9.69897	.50000	0
	18h 4m		18h 3m		18h 2m		18h 1m		18h 0m		



TABLE IV.

Haversines.

s	6h 0m 90° 0'		6h 1m 90° 15'		6h 2m 90° 30'		6h 3m 90° 45'		6h 4m 91° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.69897	.50000	9.70086	.50218	9.70274	.50436	9.70462	.50654	9.70648	.50873	60
1	.69900	.50004	.70089	.50222	.70277	.50440	.70465	.50658	.70652	.50876	59
2	.69903	.50007	.70092	.50225	.70281	.50444	.70468	.50662	.70655	.50880	58
3	.69906	.50011	.70096	.50229	.70284	.50447	.70471	.50665	.70658	.50884	57
+ 1'	9.69910	.50015	9.70099	.50233	9.70287	.50451	9.70474	.50669	9.70661	.50887	56
5	.69913	.50018	.70102	.50236	.70290	.50455	.70477	.50673	.70664	.50891	55
6	.69916	.50022	.70105	.50240	.70293	.50458	.70480	.50676	.70667	.50894	54
7	.69919	.50025	.70108	.50244	.70296	.50462	.70484	.50680	.70670	.50898	53
+ 2'	9.69922	.50029	9.70111	.50247	9.70299	.50465	9.70487	.50684	9.70673	.50902	52
9	.69925	.50033	.70114	.50251	.70303	.50469	.70490	.50687	.70676	.50905	51
10	.69929	.50036	.70118	.50255	.70306	.50473	.70493	.50691	.70679	.50909	50
11	.69932	.50040	.70121	.50258	.70309	.50476	.70496	.50694	.70683	.50913	49
+ 3'	9.69935	.50044	9.70124	.50262	9.70312	.50480	9.70499	.50698	9.70686	.50916	48
13	.69938	.50047	.70127	.50265	.70315	.50484	.70502	.50702	.70689	.50920	47
14	.69941	.50051	.70130	.50269	.70318	.50487	.70505	.50705	.70692	.50924	46
15	.69944	.50055	.70133	.50273	.70321	.50491	.70509	.50709	.70695	.50927	45
+ 4'	9.69948	.50058	9.70136	.50276	9.70324	.50495	9.70512	.50713	9.70698	.50931	44
17	.69951	.50062	.70140	.50280	.70328	.50498	.70515	.50716	.70701	.50934	43
18	.69954	.50065	.70143	.50284	.70331	.50502	.70518	.50720	.70704	.50938	42
19	.69957	.50069	.70146	.50287	.70334	.50505	.70521	.50724	.70707	.50942	41
+ 5'	9.69960	.50073	9.70149	.50291	9.70337	.50509	9.70524	.50727	9.70710	.50945	40
21	.69963	.50076	.70152	.50295	.70340	.50513	.70527	.50731	.70714	.50949	39
22	.69966	.50080	.70155	.50298	.70343	.50516	.70530	.50734	.70717	.50953	38
23	.69970	.50084	.70158	.50302	.70346	.50520	.70533	.50738	.70720	.50956	37
+ 6'	9.69973	.50087	9.70161	.50305	9.70349	.50524	9.70537	.50742	9.70723	.50960	36
25	.69976	.50091	.70165	.50309	.70353	.50527	.70540	.50745	.70726	.50964	35
26	.69979	.50095	.70168	.50313	.70356	.50531	.70543	.50749	.70729	.50967	34
27	.69982	.50098	.70171	.50316	.70359	.50534	.70546	.50753	.70732	.50971	33
+ 7'	9.69985	.50102	9.70174	.50320	9.70362	.50538	9.70549	.50756	9.70735	.50974	32
29	.69988	.50105	.70177	.50324	.70365	.50542	.70552	.50760	.70738	.50978	31
30	.69992	.50109	.70180	.50327	.70368	.50545	.70555	.50764	.70741	.50982	30
31	.69995	.50113	.70183	.50331	.70371	.50549	.70558	.50767	.70745	.50985	29
+ 8'	9.69998	.50116	9.70187	.50335	9.70374	.50553	9.70561	.50771	9.70748	.50989	28
33	.70001	.50120	.70190	.50338	.70378	.50556	.70565	.50774	.70751	.50993	27
34	.70004	.50124	.70193	.50342	.70381	.50560	.70568	.50778	.70754	.50996	26
35	.70007	.50127	.70196	.50345	.70384	.50564	.70571	.50782	.70757	.51000	25
+ 9'	9.70011	.50131	9.70199	.50349	9.70387	.50567	9.70574	.50785	9.70760	.51004	24
37	.70014	.50135	.70202	.50353	.70390	.50571	.70577	.50789	.70763	.51007	23
38	.70017	.50138	.70205	.50356	.70393	.50574	.70580	.50793	.70766	.51011	22
39	.70020	.50142	.70209	.50360	.70396	.50578	.70583	.50796	.70769	.51014	21
+ 10'	9.70023	.50145	9.70212	.50364	9.70399	.50582	9.70586	.50800	9.70772	.51018	20
41	.70026	.50149	.70215	.50367	.70402	.50585	.70589	.50804	.70775	.51022	19
42	.70029	.50153	.70218	.50371	.70406	.50589	.70593	.50807	.70779	.51025	18
43	.70033	.50156	.70221	.50375	.70409	.50593	.70596	.50811	.70782	.51029	17
+ 11'	9.70036	.50160	9.70224	.50378	9.70412	.50596	9.70599	.50814	9.70785	.51033	16
45	.70039	.50164	.70227	.50382	.70415	.50600	.70602	.50818	.70788	.51036	15
46	.70042	.50167	.70230	.50385	.70418	.50604	.70605	.50822	.70791	.51040	14
47	.70045	.50171	.70234	.50389	.70421	.50607	.70608	.50825	.70794	.51043	13
+ 12'	9.70048	.50175	9.70237	.50393	9.70424	.50611	9.70611	.50829	9.70797	.51047	12
49	.70051	.50178	.70240	.50396	.70427	.50614	.70614	.50833	.70800	.51051	11
50	.70055	.50182	.70243	.50400	.70431	.50618	.70617	.50836	.70803	.51054	10
51	.70058	.50185	.70246	.50404	.70434	.50622	.70620	.50840	.70806	.51058	9
+ 13'	9.70061	.50189	9.70249	.50407	9.70437	.50625	9.70624	.50844	9.70809	.51062	8
53	.70064	.50193	.70252	.50411	.70440	.50629	.70627	.50847	.70813	.51065	7
54	.70067	.50196	.70256	.50415	.70443	.50633	.70630	.50851	.70816	.51069	6
55	.70070	.50200	.70259	.50418	.70446	.50636	.70633	.50854	.70819	.51073	5
+ 14'	9.70074	.50204	9.70262	.50422	9.70449	.50640	9.70636	.50858	9.70822	.51076	4
57	.70077	.50207	.70265	.50425	.70452	.50644	.70639	.50862	.70825	.51080	3
58	.70080	.50211	.70268	.50429	.70456	.50647	.70642	.50865	.70828	.51083	2
59	.70083	.50215	.70271	.50433	.70459	.50651	.70645	.50869	.70831	.51087	1
+ 15'	9.70086	.50218	9.70274	.50436	9.70462	.50654	9.70648	.50873	9.70834	.51091	0
	17h 59m		17h 58m		17h 57m		17h 56m		17h 55m		

TABLE IV.

## Haversines.

s	6h 5m 91° 15'		6h 6m 91° 30'		6h 7m 91° 45'		6h 8m 92° 0'		6h 9m 92° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.70834	<b>.51091</b>	9.71019	<b>.51309</b>	9.71203	<b>.51527</b>	9.71387	<b>.51745</b>	9.71569	<b>.51963</b>	60
1	.70837	<b>.51094</b>	.71022	<b>.51312</b>	.71206	<b>.51531</b>	.71390	<b>.51749</b>	.71572	<b>.51967</b>	59
2	.70840	<b>.51098</b>	.71025	<b>.51316</b>	.71210	<b>.51534</b>	.71393	<b>.51752</b>	.71575	<b>.51970</b>	58
3	.70843	<b>.51102</b>	.71028	<b>.51320</b>	.71213	<b>.51538</b>	.71396	<b>.51756</b>	.71579	<b>.51974</b>	57
+ 1'	9.70847	<b>.51105</b>	9.71032	<b>.51323</b>	9.71216	<b>.51541</b>	9.71399	<b>.51760</b>	9.71582	<b>.51978</b>	56
5	.70850	<b>.51109</b>	.71035	<b>.51327</b>	.71219	<b>.51545</b>	.71402	<b>.51763</b>	.71585	<b>.51981</b>	55
6	.70853	<b>.51113</b>	.71038	<b>.51331</b>	.71222	<b>.51549</b>	.71405	<b>.51767</b>	.71588	<b>.51985</b>	54
7	.70856	<b>.51116</b>	.71041	<b>.51334</b>	.71225	<b>.51552</b>	.71408	<b>.51770</b>	.71591	<b>.51988</b>	53
+ 2'	9.70859	<b>.51120</b>	9.71044	<b>.51338</b>	9.71228	<b>.51556</b>	9.71411	<b>.51774</b>	9.71594	<b>.51992</b>	52
9	.70862	<b>.51123</b>	.71047	<b>.51342</b>	.71231	<b>.51560</b>	.71414	<b>.51778</b>	.71597	<b>.51996</b>	51
10	.70865	<b>.51127</b>	.71050	<b>.51345</b>	.71234	<b>.51563</b>	.71417	<b>.51781</b>	.71600	<b>.51999</b>	50
11	.70868	<b>.51131</b>	.71053	<b>.51349</b>	.71237	<b>.51567</b>	.71420	<b>.51785</b>	.71603	<b>.52003</b>	49
+ 3'	9.70871	<b>.51134</b>	9.71056	<b>.51352</b>	9.71240	<b>.51571</b>	9.71423	<b>.51789</b>	9.71606	<b>.52007</b>	48
13	.70874	<b>.51138</b>	.71059	<b>.51356</b>	.71243	<b>.51574</b>	.71426	<b>.51792</b>	.71609	<b>.52010</b>	47
14	.70877	<b>.51142</b>	.71062	<b>.51360</b>	.71246	<b>.51578</b>	.71430	<b>.51796</b>	.71612	<b>.52014</b>	46
15	.70881	<b>.51145</b>	.71065	<b>.51363</b>	.71249	<b>.51581</b>	.71433	<b>.51799</b>	.71615	<b>.52018</b>	45
+ 4'	9.70884	<b>.51149</b>	9.71068	<b>.51367</b>	9.71252	<b>.51585</b>	9.71436	<b>.51803</b>	9.71618	<b>.52021</b>	44
17	.70887	<b>.51153</b>	.71072	<b>.51371</b>	.71255	<b>.51589</b>	.71439	<b>.51807</b>	.71621	<b>.52025</b>	43
18	.70890	<b>.51156</b>	.71075	<b>.51374</b>	.71259	<b>.51592</b>	.71442	<b>.51810</b>	.71624	<b>.52028</b>	42
19	.70893	<b>.51160</b>	.71078	<b>.51378</b>	.71262	<b>.51596</b>	.71445	<b>.51814</b>	.71627	<b>.52032</b>	41
+ 5'	9.70896	<b>.51163</b>	9.71081	<b>.51382</b>	9.71265	<b>.51600</b>	9.71448	<b>.51818</b>	9.71630	<b>.52036</b>	40
21	.70899	<b>.51167</b>	.71084	<b>.51385</b>	.71268	<b>.51603</b>	.71451	<b>.51821</b>	.71633	<b>.52039</b>	39
22	.70902	<b>.51171</b>	.71087	<b>.51389</b>	.71271	<b>.51607</b>	.71454	<b>.51825</b>	.71636	<b>.52043</b>	38
23	.70905	<b>.51174</b>	.71090	<b>.51392</b>	.71274	<b>.51611</b>	.71457	<b>.51829</b>	.71639	<b>.52047</b>	37
+ 6'	9.70908	<b>.51178</b>	9.71093	<b>.51396</b>	9.71277	<b>.51614</b>	9.71460	<b>.51832</b>	9.71642	<b>.52050</b>	36
25	.70911	<b>.51182</b>	.71096	<b>.51400</b>	.71280	<b>.51618</b>	.71463	<b>.51836</b>	.71645	<b>.52054</b>	35
26	.70914	<b>.51185</b>	.71099	<b>.51403</b>	.71283	<b>.51621</b>	.71466	<b>.51839</b>	.71648	<b>.52057</b>	34
27	.70918	<b>.51189</b>	.71102	<b>.51407</b>	.71286	<b>.51625</b>	.71469	<b>.51843</b>	.71651	<b>.52061</b>	33
+ 7'	9.70921	<b>.51193</b>	9.71105	<b>.51411</b>	9.71289	<b>.51629</b>	9.71472	<b>.51847</b>	9.71654	<b>.52065</b>	32
29	.70924	<b>.51196</b>	.71108	<b>.51414</b>	.71292	<b>.51632</b>	.71475	<b>.51850</b>	.71657	<b>.52068</b>	31
30	.70927	<b>.51200</b>	.71111	<b>.51418</b>	.71295	<b>.51636</b>	.71478	<b>.51854</b>	.71660	<b>.52072</b>	30
31	.70930	<b>.51203</b>	.71114	<b>.51422</b>	.71298	<b>.51640</b>	.71481	<b>.51858</b>	.71663	<b>.52076</b>	29
+ 8'	9.70933	<b>.51207</b>	9.71118	<b>.51425</b>	9.71301	<b>.51643</b>	9.71484	<b>.51861</b>	9.71666	<b>.52079</b>	28
33	.70936	<b>.51211</b>	.71121	<b>.51429</b>	.71304	<b>.51647</b>	.71487	<b>.51865</b>	.71670	<b>.52083</b>	27
34	.70939	<b>.51214</b>	.71124	<b>.51432</b>	.71307	<b>.51650</b>	.71490	<b>.51869</b>	.71673	<b>.52087</b>	26
35	.70942	<b>.51218</b>	.71127	<b>.51436</b>	.71311	<b>.51654</b>	.71493	<b>.51872</b>	.71676	<b>.52090</b>	25
+ 9'	9.70945	<b>.51222</b>	9.71130	<b>.51440</b>	9.71314	<b>.51658</b>	9.71496	<b>.51876</b>	9.71679	<b>.52094</b>	24
37	.70948	<b>.51225</b>	.71133	<b>.51443</b>	.71317	<b>.51661</b>	.71500	<b>.51879</b>	.71682	<b>.52097</b>	23
38	.70951	<b>.51229</b>	.71136	<b>.51447</b>	.71320	<b>.51665</b>	.71503	<b>.51883</b>	.71685	<b>.52101</b>	22
39	.70955	<b>.51233</b>	.71139	<b>.51451</b>	.71323	<b>.51669</b>	.71506	<b>.51887</b>	.71688	<b>.52105</b>	21
+ 10'	9.70958	<b>.51236</b>	9.71142	<b>.51454</b>	9.71326	<b>.51672</b>	9.71509	<b>.51890</b>	9.71691	<b>.52108</b>	20
41	.70961	<b>.51240</b>	.71145	<b>.51458</b>	.71329	<b>.51676</b>	.71512	<b>.51894</b>	.71694	<b>.52112</b>	19
42	.70964	<b>.51243</b>	.71148	<b>.51462</b>	.71332	<b>.51680</b>	.71515	<b>.51898</b>	.71697	<b>.52116</b>	18
43	.70967	<b>.51247</b>	.71151	<b>.51465</b>	.71335	<b>.51683</b>	.71518	<b>.51901</b>	.71700	<b>.52119</b>	17
+ 11'	9.70970	<b>.51251</b>	9.71154	<b>.51469</b>	9.71338	<b>.51687</b>	9.71521	<b>.51905</b>	9.71703	<b>.52123</b>	16
45	.70973	<b>.51254</b>	.71157	<b>.51472</b>	.71341	<b>.51690</b>	.71524	<b>.51908</b>	.71706	<b>.52126</b>	15
46	.70976	<b>.51258</b>	.71161	<b>.51476</b>	.71344	<b>.51694</b>	.71527	<b>.51912</b>	.71709	<b>.52130</b>	14
47	.70979	<b>.51262</b>	.71164	<b>.51480</b>	.71347	<b>.51698</b>	.71530	<b>.51916</b>	.71712	<b>.52134</b>	13
+ 12'	9.70982	<b>.51265</b>	9.71167	<b>.51483</b>	9.71350	<b>.51701</b>	9.71533	<b>.51919</b>	9.71715	<b>.52137</b>	12
49	.70985	<b>.51269</b>	.71170	<b>.51487</b>	.71353	<b>.51705</b>	.71536	<b>.51923</b>	.71718	<b>.52141</b>	11
50	.70988	<b>.51273</b>	.71173	<b>.51491</b>	.71356	<b>.51709</b>	.71539	<b>.51927</b>	.71721	<b>.52145</b>	10
51	.70992	<b>.51276</b>	.71176	<b>.51494</b>	.71359	<b>.51712</b>	.71542	<b>.51930</b>	.71724	<b>.52148</b>	9
+ 13'	9.70995	<b>.51280</b>	9.71179	<b>.51498</b>	9.71362	<b>.51716</b>	9.71545	<b>.51934</b>	9.71727	<b>.52152</b>	8
53	.70998	<b>.51283</b>	.71182	<b>.51501</b>	.71365	<b>.51720</b>	.71548	<b>.51938</b>	.71730	<b>.52156</b>	7
54	.71001	<b>.51287</b>	.71185	<b>.51505</b>	.71369	<b>.51723</b>	.71551	<b>.51941</b>	.71733	<b>.52159</b>	6
55	.71004	<b>.51291</b>	.71188	<b>.51508</b>	.71372	<b>.51727</b>	.71554	<b>.51945</b>	.71736	<b>.52163</b>	5
+ 14'	9.71007	<b>.51294</b>	9.71191	<b>.51512</b>	9.71375	<b>.51730</b>	9.71557	<b>.51948</b>	9.71739	<b>.52166</b>	4
57	.71010	<b>.51298</b>	.71194	<b>.51516</b>	.71378	<b>.51734</b>	.71560	<b>.51952</b>	.71742	<b>.52170</b>	3
58	.71013	<b>.51302</b>	.71197	<b>.51520</b>	.71381	<b>.51738</b>	.71563	<b>.51956</b>	.71745	<b>.52174</b>	2
59	.71016	<b>.51305</b>	.71200	<b>.51523</b>	.71384	<b>.51741</b>	.71566	<b>.51959</b>	.71748	<b>.52177</b>	1
+ 15'	9.71019	<b>.51309</b>	9.71203	<b>.51527</b>	9.71387	<b>.51745</b>	9.71569	<b>.51963</b>	9.71751	<b>.52181</b>	0
		17h 54m		17h 53m		17h 52m		17h 51m		17h 50m	



s	6h 10m 92° 30'		6h 11m 92° 45'		6h 12m 93° 0'		6h 13m 93° 15'		6h 14m 93° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.71751	.52131	9.71932	.52399	9.72112	.52617	9.72292	.52835	9.72471	.53052	60
1	.71754	.52185	.71935	.52403	.72115	.52620	.72295	.52838	.72474	.53056	59
2	.71757	.52188	.71938	.52406	.72118	.52624	.72298	.52842	.72476	.53060	58
3	.71760	.52192	.71941	.52410	.72121	.52628	.72301	.52846	.72479	.53063	57
+ 1'	9.71763	.52196	9.71944	.52413	9.72124	.52631	9.72304	.52849	9.72482	.53067	56
5	.71766	.52199	.71947	.52417	.72127	.52635	.72307	.52853	.72485	.53071	55
6	.71769	.52203	.71950	.52421	.72130	.52639	.72310	.52856	.72488	.53074	54
7	.71772	.52206	.71953	.52424	.72133	.52642	.72313	.52860	.72491	.53078	53
+ 2'	9.71775	.52210	9.71956	.52428	9.72136	.52646	9.72316	.52864	9.72494	.53081	52
9	.71778	.52214	.71959	.52432	.72139	.52649	.72319	.52867	.72497	.53085	51
10	.71781	.52217	.71962	.52435	.72142	.52653	.72322	.52871	.72500	.53089	50
11	.71784	.52221	.71965	.52439	.72145	.52657	.72325	.52875	.72503	.53092	49
+ 3'	9.71787	.52225	9.71968	.52442	9.72148	.52660	9.72328	.52878	9.72506	.53096	48
13	.71791	.52228	.71971	.52446	.72151	.52664	.72331	.52882	.72509	.53100	47
14	.71794	.52232	.71974	.52450	.72154	.52668	.72334	.52885	.72512	.53103	46
15	.71797	.52235	.71977	.52453	.72157	.52671	.72337	.52889	.72515	.53107	45
+ 4'	9.71800	.52239	9.71980	.52457	9.72160	.52675	9.72340	.52893	9.72518	.53110	44
17	.71803	.52243	.71983	.52461	.72163	.52679	.72343	.52896	.72521	.53114	43
18	.71806	.52246	.71986	.52464	.72166	.52682	.72346	.52900	.72524	.53118	42
19	.71809	.52250	.71989	.52468	.72169	.52686	.72349	.52904	.72527	.53121	41
+ 5'	9.71812	.52254	9.71992	.52472	9.72172	.52689	9.72352	.52907	9.72530	.53125	40
21	.71815	.52257	.71995	.52475	.72175	.52693	.72355	.52911	.72533	.53129	39
22	.71818	.52261	.71998	.52479	.72178	.52697	.72357	.52915	.72536	.53132	38
23	.71821	.52264	.72001	.52482	.72181	.52700	.72360	.52918	.72539	.53136	37
+ 6'	9.71824	.52268	9.72004	.52486	9.72184	.52704	9.72363	.52922	9.72542	.53140	36
25	.71827	.52272	.72007	.52490	.72187	.52708	.72366	.52925	.72545	.53143	35
26	.71830	.52275	.72010	.52493	.72190	.52711	.72369	.52929	.72548	.53147	34
27	.71833	.52279	.72013	.52497	.72193	.52715	.72372	.52933	.72551	.53150	33
+ 7'	9.71836	.52283	9.72016	.52501	9.72196	.52718	9.72375	.52936	9.72554	.53154	32
29	.71839	.52286	.72019	.52504	.72199	.52722	.72378	.52940	.72557	.53158	31
30	.71842	.52290	.72022	.52508	.72202	.52726	.72381	.52944	.72560	.53161	30
31	.71845	.52294	.72025	.52511	.72205	.52729	.72384	.52947	.72563	.53165	29
+ 8'	9.71848	.52297	9.72028	.52515	9.72208	.52733	9.72387	.52951	9.72565	.53169	28
33	.71851	.52301	.72031	.52519	.72211	.52737	.72390	.52954	.72568	.53172	27
34	.71854	.52304	.72034	.52522	.72214	.52740	.72393	.52958	.72571	.53176	26
35	.71857	.52308	.72037	.52526	.72217	.52744	.72396	.52962	.72574	.53179	25
+ 9'	9.71860	.52312	9.72040	.52530	9.72220	.52748	9.72399	.52965	9.72577	.53183	24
37	.71863	.52315	.72043	.52533	.72223	.52751	.72402	.52969	.72580	.53187	23
38	.71866	.52319	.72046	.52537	.72226	.52755	.72405	.52973	.72583	.53190	22
39	.71869	.52323	.72049	.52541	.72229	.52758	.72408	.52976	.72586	.53194	21
+ 10'	9.71872	.52326	9.72052	.52544	9.72232	.52762	9.72411	.52980	9.72589	.53198	20
41	.71875	.52330	.72055	.52548	.72235	.52766	.72414	.52983	.72592	.53201	19
42	.71878	.52334	.72058	.52551	.72238	.52769	.72417	.52987	.72595	.53205	18
43	.71881	.52337	.72061	.52555	.72241	.52773	.72420	.52991	.72598	.53208	17
+ 11'	9.71884	.52341	9.72064	.52559	9.72244	.52776	9.72423	.52994	9.72601	.53212	16
45	.71887	.52344	.72067	.52562	.72247	.52780	.72426	.52998	.72604	.53216	15
46	.71890	.52348	.72070	.52566	.72250	.52784	.72429	.53002	.72607	.53219	14
47	.71893	.52352	.72073	.52570	.72253	.52787	.72432	.53005	.72610	.53223	13
+ 12'	9.71896	.52355	9.72076	.52573	9.72256	.52791	9.72435	.53009	9.72613	.53227	12
49	.71899	.52359	.72079	.52577	.72259	.52795	.72438	.53013	.72616	.53230	11
50	.71902	.52363	.72082	.52580	.72262	.52798	.72441	.53016	.72619	.53234	10
51	.71905	.52366	.72085	.52584	.72265	.52802	.72444	.53020	.72622	.53238	9
+ 13'	9.71908	.52370	9.72088	.52588	9.72268	.52806	9.72447	.53023	9.72625	.53241	8
53	.71911	.52373	.72091	.52591	.72271	.52809	.72450	.53027	.72628	.53245	7
54	.71914	.52377	.72094	.52595	.72274	.52813	.72453	.53031	.72631	.53248	6
55	.71917	.52381	.72097	.52599	.72277	.52816	.72456	.53034	.72634	.53252	5
+ 14'	9.71920	.52384	9.72100	.52602	9.72280	.52820	9.72459	.53038	9.72637	.53255	4
57	.71923	.52388	.72103	.52606	.72283	.52824	.72462	.53042	.72640	.53259	3
58	.71926	.52392	.72106	.52610	.72286	.52827	.72465	.53045	.72643	.53263	2
59	.71929	.52395	.72109	.52613	.72289	.52831	.72468	.53049	.72646	.53267	1
+ 15'	9.71932	.52399	9.72112	.52617	9.72292	.52835	9.72471	.53052	9.72648	.53270	0
	17h 49m		17h 48m		17h 47m		17h 46m		17h 45m		

TABLE IV.

Haversines.

s	6h 15m 93° 45'		6h 16m 94° 0'		6h 17m 94° 15'		6h 18m 94° 30'		6h 19m 94° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.72648	<b>.53270</b>	9.72825	<b>.53488</b>	9.73002	<b>.53705</b>	9.73177	<b>.53923</b>	9.73352	<b>.54140</b>	60
1	.72651	<b>.53274</b>	.72828	<b>.53491</b>	.73005	<b>.53709</b>	.73180	<b>.53927</b>	.73355	<b>.54144</b>	59
2	.72654	<b>.53277</b>	.72831	<b>.53495</b>	.73008	<b>.53713</b>	.73183	<b>.53930</b>	.73358	<b>.54148</b>	58
3	.72657	<b>.53281</b>	.72834	<b>.53499</b>	.73011	<b>.53716</b>	.73186	<b>.53934</b>	.73361	<b>.54151</b>	57
+ 1'	9.72660	<b>.53285</b>	9.72837	<b>.53502</b>	9.73014	<b>.53720</b>	9.73189	<b>.53937</b>	9.73364	<b>.54155</b>	56
5	.72663	<b>.53288</b>	.72840	<b>.53506</b>	.73016	<b>.53724</b>	.73192	<b>.53941</b>	.73367	<b>.54159</b>	55
6	.72666	<b>.53292</b>	.72843	<b>.53510</b>	.73019	<b>.53727</b>	.73195	<b>.53945</b>	.73370	<b>.54162</b>	54
7	.72669	<b>.53296</b>	.72846	<b>.53513</b>	.73022	<b>.53731</b>	.73198	<b>.53948</b>	.73373	<b>.54166</b>	53
+ 2'	9.72672	<b>.53299</b>	9.72849	<b>.53517</b>	9.73025	<b>.53734</b>	9.73201	<b>.53952</b>	9.73377	<b>.54169</b>	52
9	.72675	<b>.53303</b>	.72852	<b>.53520</b>	.73028	<b>.53738</b>	.73204	<b>.53956</b>	.73378	<b>.54173</b>	51
10	.72678	<b>.53306</b>	.72855	<b>.53524</b>	.73031	<b>.53742</b>	.73207	<b>.53959</b>	.73381	<b>.54177</b>	50
11	.72681	<b>.53310</b>	.72858	<b>.53528</b>	.73034	<b>.53745</b>	.73209	<b>.53963</b>	.73384	<b>.54180</b>	49
+ 3'	9.72684	<b>.53314</b>	9.72861	<b>.53531</b>	9.73037	<b>.53749</b>	9.73212	<b>.53966</b>	9.73387	<b>.54184</b>	48
13	.72687	<b>.53317</b>	.72864	<b>.53535</b>	.73040	<b>.53753</b>	.73215	<b>.53970</b>	.73390	<b>.54188</b>	47
14	.72690	<b>.53321</b>	.72867	<b>.53539</b>	.73043	<b>.53756</b>	.73218	<b>.53974</b>	.73393	<b>.54191</b>	46
15	.72693	<b>.53325</b>	.72870	<b>.53542</b>	.73046	<b>.53760</b>	.73221	<b>.53977</b>	.73396	<b>.54195</b>	45
+ 4'	9.72696	<b>.53328</b>	9.72873	<b>.53546</b>	9.73049	<b>.53763</b>	9.73224	<b>.53981</b>	9.73399	<b>.54198</b>	44
17	.72699	<b>.53332</b>	.72876	<b>.53549</b>	.73052	<b>.53767</b>	.73227	<b>.53985</b>	.73402	<b>.54202</b>	43
18	.72702	<b>.53335</b>	.72878	<b>.53553</b>	.73055	<b>.53771</b>	.73230	<b>.53988</b>	.73404	<b>.54206</b>	42
19	.72705	<b>.53339</b>	.72881	<b>.53557</b>	.73057	<b>.53774</b>	.73233	<b>.53992</b>	.73407	<b>.54209</b>	41
+ 5'	9.72708	<b>.53343</b>	9.72884	<b>.53560</b>	9.73060	<b>.53778</b>	9.73236	<b>.53995</b>	9.73410	<b>.54213</b>	40
21	.72710	<b>.53346</b>	.72887	<b>.53564</b>	.73063	<b>.53782</b>	.73239	<b>.53999</b>	.73413	<b>.54217</b>	39
22	.72713	<b>.53350</b>	.72890	<b>.53568</b>	.73066	<b>.53785</b>	.73242	<b>.54003</b>	.73416	<b>.54220</b>	38
23	.72716	<b>.53354</b>	.72893	<b>.53571</b>	.73069	<b>.53789</b>	.73244	<b>.54006</b>	.73419	<b>.54224</b>	37
+ 6'	9.72719	<b>.53357</b>	9.72896	<b>.53575</b>	9.73072	<b>.53792</b>	9.73247	<b>.54010</b>	9.73422	<b>.54227</b>	36
25	.72722	<b>.53361</b>	.72899	<b>.53579</b>	.73075	<b>.53796</b>	.73250	<b>.54014</b>	.73425	<b>.54231</b>	35
26	.72725	<b>.53364</b>	.72902	<b>.53582</b>	.73078	<b>.53800</b>	.73253	<b>.54017</b>	.73428	<b>.54235</b>	34
27	.72728	<b>.53368</b>	.72905	<b>.53586</b>	.73081	<b>.53803</b>	.73256	<b>.54021</b>	.73431	<b>.54238</b>	33
+ 7'	9.72731	<b>.53372</b>	9.72908	<b>.53589</b>	9.73084	<b>.53807</b>	9.73259	<b>.54024</b>	9.73433	<b>.54242</b>	32
29	.72734	<b>.53375</b>	.72911	<b>.53593</b>	.73087	<b>.53811</b>	.73262	<b>.54028</b>	.73436	<b>.54245</b>	31
30	.72737	<b>.53379</b>	.72914	<b>.53597</b>	.73090	<b>.53814</b>	.73265	<b>.54032</b>	.73439	<b>.54249</b>	30
31	.72740	<b>.53383</b>	.72917	<b>.53600</b>	.73093	<b>.53818</b>	.73268	<b>.54035</b>	.73442	<b>.54253</b>	29
+ 8'	9.72743	<b>.53386</b>	9.72920	<b>.53604</b>	9.73096	<b>.53821</b>	9.73271	<b>.54039</b>	9.73445	<b>.54256</b>	28
33	.72746	<b>.53390</b>	.72923	<b>.53608</b>	.73098	<b>.53825</b>	.73274	<b>.54043</b>	.73448	<b>.54260</b>	27
34	.72749	<b>.53394</b>	.72926	<b>.53611</b>	.73101	<b>.53829</b>	.73277	<b>.54046</b>	.73451	<b>.54264</b>	26
35	.72752	<b>.53397</b>	.72928	<b>.53615</b>	.73104	<b>.53832</b>	.73280	<b>.54050</b>	.73454	<b>.54267</b>	25
+ 9'	9.72755	<b>.53401</b>	9.72931	<b>.53618</b>	9.73107	<b>.53836</b>	9.73282	<b>.54053</b>	9.73457	<b>.54271</b>	24
37	.72758	<b>.53404</b>	.72934	<b>.53622</b>	.73110	<b>.53840</b>	.73285	<b>.54057</b>	.73460	<b>.54274</b>	23
38	.72761	<b>.53408</b>	.72937	<b>.53626</b>	.73113	<b>.53843</b>	.73288	<b>.54061</b>	.73462	<b>.54278</b>	22
39	.72764	<b>.53412</b>	.72940	<b>.53629</b>	.73116	<b>.53847</b>	.73291	<b>.54064</b>	.73465	<b>.54282</b>	21
+ 10'	9.72767	<b>.53415</b>	9.72943	<b>.53633</b>	9.73119	<b>.53850</b>	9.73294	<b>.54068</b>	9.73468	<b>.54285</b>	20
41	.72770	<b>.53419</b>	.72946	<b>.53637</b>	.73122	<b>.53854</b>	.73297	<b>.54072</b>	.73471	<b>.54289</b>	19
42	.72772	<b>.53423</b>	.72949	<b>.53640</b>	.73125	<b>.53858</b>	.73300	<b>.54075</b>	.73474	<b>.54293</b>	18
43	.72775	<b>.53426</b>	.72952	<b>.53644</b>	.73128	<b>.53861</b>	.73303	<b>.54079</b>	.73477	<b>.54296</b>	17
+ 11'	9.72778	<b>.53430</b>	9.72955	<b>.53647</b>	9.73131	<b>.53865</b>	9.73306	<b>.54082</b>	9.73480	<b>.54300</b>	16
45	.72781	<b>.53433</b>	.72958	<b>.53651</b>	.73134	<b>.53869</b>	.73309	<b>.54086</b>	.73483	<b>.54303</b>	15
46	.72784	<b>.53437</b>	.72961	<b>.53655</b>	.73136	<b>.53872</b>	.73311	<b>.54090</b>	.73486	<b>.54307</b>	14
47	.72787	<b>.53441</b>	.72964	<b>.53658</b>	.73139	<b>.53876</b>	.73314	<b>.54093</b>	.73489	<b>.54311</b>	13
+ 12'	9.72790	<b>.53444</b>	9.72967	<b>.53662</b>	9.73142	<b>.53879</b>	9.73317	<b>.54097</b>	9.73491	<b>.54314</b>	12
49	.72793	<b>.53448</b>	.72970	<b>.53666</b>	.73145	<b>.53883</b>	.73320	<b>.54101</b>	.73494	<b>.54318</b>	11
50	.72796	<b>.53452</b>	.72972	<b>.53669</b>	.73148	<b>.53887</b>	.73323	<b>.54104</b>	.73497	<b>.54322</b>	10
51	.72799	<b>.53455</b>	.72975	<b>.53673</b>	.73151	<b>.53890</b>	.73326	<b>.54108</b>	.73500	<b>.54325</b>	9
+ 13'	9.72802	<b>.53459</b>	9.72978	<b>.53676</b>	9.73154	<b>.53894</b>	9.73329	<b>.54111</b>	9.73503	<b>.54329</b>	8
53	.72805	<b>.53462</b>	.72981	<b>.53680</b>	.73157	<b>.53898</b>	.73332	<b>.54115</b>	.73506	<b>.54332</b>	7
54	.72808	<b>.53466</b>	.72984	<b>.53684</b>	.73160	<b>.53901</b>	.73335	<b>.54119</b>	.73509	<b>.54336</b>	6
55	.72811	<b>.53470</b>	.72987	<b>.53687</b>	.73163	<b>.53905</b>	.73338	<b>.54122</b>	.73512	<b>.54340</b>	5
+ 14'	9.72814	<b>.53473</b>	9.72990	<b>.53691</b>	9.73166	<b>.53908</b>	9.73341	<b>.54126</b>	9.73515	<b>.54343</b>	4
57	.72817	<b>.53477</b>	.72993	<b>.53695</b>	.73169	<b>.53912</b>	.73344	<b>.54130</b>	.73517	<b>.54347</b>	3
58	.72820	<b>.53481</b>	.72996	<b>.53698</b>	.73172	<b>.53916</b>	.73346	<b>.54133</b>	.73520	<b>.54351</b>	2
59	.72823	<b>.53484</b>	.72999	<b>.53702</b>	.73174	<b>.53919</b>	.73349	<b>.54137</b>	.73523	<b>.54354</b>	1
+ 15'	9.72825	<b>.53488</b>	9.73002	<b>.53705</b>	9.73177	<b>.53923</b>	9.73352	<b>.54140</b>	9.73526	<b>.54358</b>	0
	17h 44m		17h 43m		17h 42m		17h 41m		17h 40m		



## Haversines.

s	6h 20m 95° 0'		6h 21m 95° 15'		6h 22m 95° 30'		6h 23m 95° 45'		6h 24m 96° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.73526	.54358	9.73699	.54575	9.73872	.54792	9.74044	.55009	9.74215	.55226	60
1	.73529	.54361	.73702	.54579	.73875	.54796	.74047	.55013	.74218	.55230	59
2	.73532	.54365	.73705	.54582	.73878	.54800	.74049	.55017	.74220	.55234	58
3	.73535	.54369	.73708	.54586	.73881	.54803	.74052	.55020	.74223	.55237	57
+ 1'	9.73538	.54372	9.73711	.54590	9.73883	.54807	9.74055	.55024	9.74226	.55241	56
5	.73541	.54376	.73714	.54593	.73886	.54810	.74058	.55028	.74229	.55245	55
6	.73544	.54380	.73717	.54597	.73889	.54814	.74061	.55031	.74232	.55248	54
7	.73546	.54383	.73720	.54600	.73892	.54818	.74064	.55035	.74235	.55252	53
+ 2'	9.73549	.54387	9.73722	.54604	9.73895	.54821	9.74067	.55038	9.74237	.55255	52
9	.73552	.54390	.73725	.54608	.73898	.54825	.74069	.55042	.74240	.55259	51
10	.73555	.54394	.73728	.54611	.73901	.54828	.74072	.55046	.74243	.55263	50
11	.73558	.54398	.73731	.54615	.73903	.54832	.74075	.55049	.74246	.55266	49
+ 3'	9.73561	.54401	9.73734	.54619	9.73906	.54836	9.74078	.55053	9.74249	.55270	48
13	.73564	.54405	.73737	.54622	.73909	.54839	.74081	.55056	.74252	.55273	47
14	.73567	.54409	.73740	.54626	.73912	.54843	.74084	.55060	.74255	.55277	46
15	.73570	.54412	.73743	.54629	.73915	.54847	.74087	.55064	.74257	.55281	45
+ 4'	9.73572	.54416	9.73746	.54633	9.73918	.54850	9.74089	.55067	9.74260	.55284	44
17	.73575	.54419	.73749	.54637	.73921	.54854	.74092	.55071	.74263	.55288	43
18	.73578	.54423	.73751	.54640	.73924	.54857	.74095	.55075	.74266	.55292	42
19	.73581	.54427	.73754	.54644	.73926	.54861	.74098	.55078	.74269	.55295	41
+ 5'	9.73584	.54430	9.73757	.54647	9.73929	.54865	9.74101	.55082	9.74272	.55299	40
21	.73587	.54434	.73760	.54651	.73932	.54868	.74104	.55085	.74274	.55302	39
22	.73590	.54437	.73763	.54655	.73935	.54872	.74106	.55089	.74277	.55306	38
23	.73593	.54441	.73766	.54658	.73938	.54876	.74109	.55093	.74280	.55310	37
+ 6'	9.73596	.54445	9.73769	.54662	9.73941	.54879	9.74112	.55096	9.74283	.55313	36
25	.73598	.54448	.73771	.54666	.73944	.54883	.74115	.55100	.74286	.55317	35
26	.73601	.54452	.73774	.54669	.73946	.54886	.74118	.55103	.74289	.55320	34
27	.73604	.54456	.73777	.54673	.73949	.54890	.74121	.55107	.74291	.55324	33
+ 7'	9.73607	.54459	9.73780	.54676	9.73952	.54894	9.74124	.55111	9.74294	.55328	32
29	.73610	.54463	.73783	.54680	.73955	.54897	.74126	.55114	.74297	.55331	31
30	.73613	.54466	.73786	.54684	.73958	.54901	.74129	.55118	.74300	.55335	30
31	.73616	.54470	.73789	.54687	.73961	.54904	.74132	.55122	.74303	.55339	29
+ 8'	9.73619	.54474	9.73792	.54691	9.73964	.54908	9.74135	.55125	9.74306	.55342	28
33	.73622	.54477	.73794	.54695	.73967	.54912	.74138	.55129	.74309	.55346	27
34	.73624	.54481	.73797	.54698	.73969	.54915	.74141	.55132	.74311	.55349	26
35	.73627	.54485	.73800	.54702	.73972	.54919	.74144	.55136	.74314	.55353	25
+ 9'	9.73630	.54488	9.73803	.54705	9.73975	.54923	9.74146	.55140	9.74317	.55357	24
37	.73633	.54492	.73806	.54709	.73978	.54926	.74149	.55143	.74320	.55360	23
38	.73636	.54495	.73809	.54713	.73981	.54930	.74152	.55147	.74323	.55364	22
39	.73639	.54499	.73812	.54716	.73984	.54933	.74155	.55150	.74325	.55367	21
+ 10'	9.73642	.54503	9.73815	.54720	9.73987	.54937	9.74158	.55154	9.74328	.55371	20
41	.73645	.54506	.73817	.54724	.73989	.54941	.74161	.55158	.74331	.55375	19
42	.73648	.54510	.73820	.54727	.73992	.54944	.74163	.55161	.74334	.55378	18
43	.73650	.54514	.73823	.54731	.73995	.54948	.74166	.55165	.74337	.55382	17
+ 11'	9.73653	.54517	9.73826	.54734	9.73998	.54952	9.74169	.55169	9.74340	.55386	16
45	.73656	.54521	.73829	.54738	.74001	.54955	.74172	.55172	.74343	.55389	15
46	.73659	.54524	.73832	.54742	.74004	.54959	.74175	.55176	.74345	.55393	14
47	.73662	.54528	.73835	.54745	.74007	.54963	.74178	.55179	.74348	.55396	13
+ 12'	9.73665	.54532	9.73838	.54749	9.74009	.54966	9.74181	.55183	9.74351	.55400	12
49	.73668	.54535	.73840	.54752	.74012	.54970	.74183	.55187	.74354	.55404	11
50	.73671	.54539	.73843	.54756	.74015	.54973	.74186	.55190	.74357	.55407	10
51	.73674	.54542	.73846	.54760	.74018	.54977	.74189	.55194	.74359	.55411	9
+ 13'	9.73676	.54546	9.73849	.54763	9.74021	.54980	9.74192	.55197	9.74362	.55414	8
53	.73679	.54550	.73852	.54767	.74024	.54984	.74195	.55201	.74365	.55418	7
54	.73682	.54553	.73855	.54771	.74027	.54988	.74198	.55205	.74368	.55422	6
55	.73685	.54557	.73858	.54774	.74029	.54991	.74200	.55208	.74371	.55425	5
+ 14'	9.73688	.54561	9.73860	.54778	9.74032	.54995	9.74203	.55212	9.74374	.55429	4
57	.73691	.54564	.73863	.54781	.74035	.54999	.74206	.55216	.74376	.55433	3
58	.73694	.54568	.73866	.54785	.74038	.55002	.74209	.55219	.74379	.55436	2
59	.73697	.54571	.73869	.54789	.74041	.55006	.74212	.55223	.74382	.55440	1
+ 15'	9.73699	.54575	9.73872	.54792	9.74044	.55009	9.74215	.55226	9.74385	.55443	0
	17h 39m		17h 38m		17h 37m		17h 36m		17h 35m		

Haversines.

s	6h 25m 96° 15'		6h 26m 96° 30'		6h 27m 96° 45'		6h 28m 97° 0'		6h 29m 97° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.74385	.55443	9.74554	.55660	9.74723	.55877	9.74891	.56093	9.75059	.56310	60
1	.74388	.55447	.74557	.55664	.74726	.55880	.74894	.56097	.75061	.56314	59
2	.74391	.55451	.74560	.55667	.74729	.55884	.74897	.56101	.75064	.56317	58
3	.74393	.55454	.74563	.55671	.74732	.55888	.74900	.56104	.75067	.56321	57
+ 1'	9.74396	.55458	9.74566	.55675	9.74734	.55891	9.74902	.56108	9.75070	.56324	56
5	.74399	.55461	.74569	.55678	.74737	.55895	.74905	.56112	.75072	.56328	55
6	.74402	.55465	.74571	.55682	.74740	.55899	.74908	.56115	.75075	.56332	54
7	.74405	.55469	.74574	.55685	.74743	.55902	.74911	.56119	.75078	.56335	53
+ 2'	9.74408	.55472	9.74577	.55689	9.74746	.55906	9.74914	.56122	9.75081	.56339	52
9	.74410	.55476	.74580	.55693	.74748	.55909	.74916	.56126	.75084	.56342	51
10	.74413	.55479	.74583	.55696	.74751	.55913	.74919	.56130	.75086	.56346	50
11	.74416	.55483	.74585	.55700	.74754	.55917	.74922	.56133	.75089	.56350	49
+ 3'	9.74419	.55487	9.74588	.55704	9.74757	.55920	9.74925	.56137	9.75092	.56353	48
13	.74422	.55490	.74591	.55707	.74760	.55924	.74928	.56140	.75095	.56357	47
14	.74425	.55494	.74594	.55711	.74762	.55927	.74930	.56144	.75097	.56360	46
15	.74427	.55498	.74597	.55714	.74765	.55931	.74933	.56147	.75100	.56364	45
+ 4'	9.74430	.55501	9.74600	.55718	9.74768	.55935	9.74936	.56151	9.75103	.56368	44
17	.74433	.55505	.74602	.55722	.74771	.55938	.74939	.56155	.75106	.56371	43
18	.74436	.55508	.74605	.55725	.74774	.55942	.74941	.56158	.75109	.56375	42
19	.74439	.55512	.74608	.55729	.74776	.55945	.74944	.56162	.75111	.56378	41
+ 5'	9.74442	.55516	9.74611	.55732	9.74779	.55949	9.74947	.56166	9.75114	.56382	40
21	.74444	.55519	.74614	.55736	.74782	.55953	.74950	.56169	.75117	.56386	39
22	.74447	.55523	.74616	.55740	.74785	.55956	.74953	.56173	.75120	.56389	38
23	.74450	.55526	.74619	.55743	.74788	.55960	.74955	.56176	.75122	.56393	37
+ 6'	9.74453	.55530	9.74622	.55747	9.74791	.55964	9.74958	.56180	9.75125	.56397	36
25	.74456	.55534	.74625	.55750	.74793	.55967	.74961	.56184	.75128	.56400	35
26	.74458	.55537	.74628	.55754	.74796	.55971	.74964	.56187	.75131	.56404	34
27	.74461	.55541	.74630	.55758	.74799	.55974	.74967	.56191	.75134	.56407	33
+ 7'	9.74464	.55545	9.74633	.55761	9.74802	.55978	9.74969	.56195	9.75136	.56411	32
29	.74467	.55548	.74636	.55765	.74805	.55982	.74972	.56198	.75139	.56415	31
30	.74470	.55552	.74639	.55769	.74807	.55985	.74975	.56202	.75142	.56418	30
31	.74473	.55555	.74642	.55772	.74810	.55989	.74978	.56205	.75145	.56422	29
+ 8'	9.74475	.55559	9.74645	.55776	9.74813	.55992	9.74981	.56209	9.75147	.56425	28
33	.74478	.55563	.74647	.55779	.74816	.55996	.74983	.56213	.75150	.56429	27
34	.74481	.55566	.74650	.55783	.74819	.56000	.74986	.56216	.75153	.56433	26
35	.74484	.55570	.74653	.55787	.74821	.56003	.74989	.56220	.75156	.56436	25
+ 9'	9.74487	.55573	9.74656	.55790	9.74824	.56007	9.74992	.56223	9.75159	.56440	24
37	.74490	.55577	.74659	.55794	.74827	.56010	.74994	.56227	.75161	.56443	23
38	.74492	.55581	.74661	.55797	.74830	.56014	.74997	.56231	.75164	.56447	22
39	.74495	.55584	.74664	.55801	.74833	.56018	.75000	.56234	.75167	.56451	21
+ 10'	9.74498	.55588	9.74667	.55805	9.74835	.56021	9.75003	.56238	9.75170	.56454	20
41	.74501	.55592	.74670	.55808	.74838	.56025	.75006	.56241	.75172	.56458	19
42	.74504	.55595	.74673	.55812	.74841	.56029	.75008	.56245	.75175	.56461	18
43	.74506	.55599	.74675	.55815	.74844	.56032	.75011	.56249	.75178	.56465	17
+ 11'	9.74509	.55602	9.74678	.55819	9.74846	.56036	9.75014	.56252	9.75181	.56469	16
45	.74512	.55606	.74681	.55823	.74849	.56039	.75017	.56256	.75183	.56472	15
46	.74515	.55610	.74684	.55826	.74852	.56043	.75020	.56259	.75186	.56476	14
47	.74518	.55613	.74687	.55830	.74855	.56047	.75022	.56263	.75189	.56479	13
+ 12'	9.74521	.55617	9.74690	.55834	9.74858	.56050	9.75025	.56267	9.75192	.56483	12
49	.74523	.55620	.74692	.55837	.74860	.56054	.75028	.56270	.75195	.56487	11
50	.74526	.55624	.74695	.55841	.74863	.56057	.75031	.56274	.75197	.56490	10
51	.74529	.55628	.74698	.55844	.74866	.56061	.75033	.56277	.75200	.56494	9
+ 13'	9.74532	.55631	9.74701	.55848	9.74869	.56065	9.75036	.56281	9.75203	.56497	8
53	.74535	.55635	.74704	.55852	.74872	.56068	.75039	.56285	.75206	.56501	7
54	.74538	.55638	.74706	.55855	.74874	.56072	.75042	.56288	.75208	.56505	6
55	.74540	.55642	.74709	.55859	.74877	.56075	.75045	.56292	.75211	.56508	5
+ 14'	9.74543	.55646	9.74712	.55862	9.74880	.56079	9.75047	.56296	9.75214	.56512	4
57	.74546	.55649	.74715	.55866	.74883	.56083	.75050	.56299	.75217	.56516	3
58	.74549	.55653	.74718	.55870	.74886	.56086	.75053	.56303	.75220	.56519	2
59	.74552	.55657	.74720	.55873	.74888	.56090	.75056	.56306	.75222	.56523	1
+ 15'	9.74554	.55660	9.74723	.55877	9.74891	.56093	9.75059	.56310	9.75225	.56526	0
	17h 34m		17h 33m		17h 32m		17h 31m		17h 30m		



TABLE IV.  
Haversines.

s	6h 30m 97° 30'		6h 31m 97° 45'		6h 32m 98° 0'		6h 33m 98° 15'		6h 34m 98° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.75225	<b>.56526</b>	9.75391	<b>.56743</b>	9.75556	<b>.56959</b>	9.75720	<b>.57175</b>	9.75884	<b>.57390</b>	60
1	.75228	<b>.56530</b>	.75394	<b>.56746</b>	.75559	<b>.56962</b>	.75723	<b>.57178</b>	.75887	<b>.57394</b>	59
2	.75231	<b>.56534</b>	.75396	<b>.56750</b>	.75561	<b>.56966</b>	.75726	<b>.57182</b>	.75889	<b>.57398</b>	58
3	.75233	<b>.56537</b>	.75399	<b>.56753</b>	.75564	<b>.56969</b>	.75729	<b>.57185</b>	.75892	<b>.57401</b>	57
+ 1'	9.75236	<b>.56541</b>	9.75402	<b>.56757</b>	9.75567	<b>.56973</b>	9.75731	<b>.57189</b>	9.75895	<b>.57405</b>	56
5	.75239	<b>.56544</b>	.75405	<b>.56761</b>	.75570	<b>.56977</b>	.75734	<b>.57193</b>	.75898	<b>.57408</b>	55
6	.75242	<b>.56548</b>	.75407	<b>.56764</b>	.75572	<b>.56980</b>	.75737	<b>.57196</b>	.75900	<b>.57412</b>	54
7	.75244	<b>.56552</b>	.75410	<b>.56768</b>	.75575	<b>.56984</b>	.75739	<b>.57200</b>	.75903	<b>.57416</b>	53
+ 2'	9.75247	<b>.56555</b>	9.75413	<b>.56771</b>	9.75578	<b>.56987</b>	9.75742	<b>.57203</b>	9.75906	<b>.57419</b>	52
9	.75250	<b>.56559</b>	.75416	<b>.56775</b>	.75581	<b>.56991</b>	.75745	<b>.57207</b>	.75908	<b>.57423</b>	51
10	.75253	<b>.56562</b>	.75418	<b>.56779</b>	.75583	<b>.56994</b>	.75748	<b>.57211</b>	.75911	<b>.57426</b>	50
11	.75256	<b>.56566</b>	.75421	<b>.56782</b>	.75586	<b>.56998</b>	.75750	<b>.57214</b>	.75914	<b>.57430</b>	49
+ 3'	9.75258	<b>.56570</b>	9.75424	<b>.56786</b>	9.75589	<b>.57002</b>	9.75753	<b>.57218</b>	9.75917	<b>.57434</b>	48
13	.75261	<b>.56573</b>	.75427	<b>.56789</b>	.75592	<b>.57005</b>	.75756	<b>.57221</b>	.75919	<b>.57437</b>	47
14	.75264	<b>.56577</b>	.75429	<b>.56793</b>	.75594	<b>.57009</b>	.75759	<b>.57225</b>	.75922	<b>.57441</b>	46
15	.75267	<b>.56580</b>	.75432	<b>.56797</b>	.75597	<b>.57012</b>	.75761	<b>.57229</b>	.75925	<b>.57444</b>	45
+ 4'	9.75269	<b>.56584</b>	9.75435	<b>.56800</b>	9.75600	<b>.57016</b>	9.75764	<b>.57232</b>	9.75927	<b>.57448</b>	44
17	.75272	<b>.56588</b>	.75438	<b>.56804</b>	.75603	<b>.57020</b>	.75767	<b>.57236</b>	.75930	<b>.57452</b>	43
18	.75275	<b>.56591</b>	.75440	<b>.56807</b>	.75605	<b>.57023</b>	.75770	<b>.57239</b>	.75933	<b>.57455</b>	42
19	.75278	<b>.56595</b>	.75443	<b>.56811</b>	.75608	<b>.57027</b>	.75772	<b>.57243</b>	.75936	<b>.57459</b>	41
+ 5'	9.75280	<b>.56598</b>	9.75446	<b>.56815</b>	9.75611	<b>.57031</b>	9.75775	<b>.57247</b>	9.75938	<b>.57462</b>	40
21	.75283	<b>.56602</b>	.75449	<b>.56818</b>	.75614	<b>.57034</b>	.75778	<b>.57250</b>	.75941	<b>.57466</b>	39
22	.75286	<b>.56606</b>	.75452	<b>.56822</b>	.75616	<b>.57038</b>	.75780	<b>.57254</b>	.75944	<b>.57470</b>	38
23	.75289	<b>.56609</b>	.75454	<b>.56825</b>	.75619	<b>.57041</b>	.75783	<b>.57257</b>	.75947	<b>.57473</b>	37
+ 6'	9.75291	<b>.56613</b>	9.75457	<b>.56829</b>	9.75622	<b>.57045</b>	9.75786	<b>.57261</b>	9.75949	<b>.57477</b>	36
25	.75294	<b>.56616</b>	.75460	<b>.56833</b>	.75625	<b>.57049</b>	.75789	<b>.57265</b>	.75952	<b>.57480</b>	35
26	.75297	<b>.56620</b>	.75463	<b>.56836</b>	.75627	<b>.57052</b>	.75791	<b>.57268</b>	.75955	<b>.57484</b>	34
27	.75300	<b>.56624</b>	.75465	<b>.56840</b>	.75630	<b>.57056</b>	.75794	<b>.57272</b>	.75957	<b>.57488</b>	33
+ 7'	9.75303	<b>.56627</b>	9.75468	<b>.56843</b>	9.75633	<b>.57059</b>	9.75797	<b>.57275</b>	9.75960	<b>.57491</b>	32
29	.75305	<b>.56631</b>	.75471	<b>.56847</b>	.75636	<b>.57063</b>	.75800	<b>.57279</b>	.75963	<b>.57495</b>	31
30	.75308	<b>.56634</b>	.75474	<b>.56851</b>	.75638	<b>.57067</b>	.75802	<b>.57283</b>	.75966	<b>.57498</b>	30
31	.75311	<b>.56638</b>	.75476	<b>.56854</b>	.75641	<b>.57070</b>	.75805	<b>.57286</b>	.75968	<b>.57502</b>	29
+ 8'	9.75314	<b>.56642</b>	9.75479	<b>.56858</b>	9.75644	<b>.57074</b>	9.75808	<b>.57290</b>	9.75971	<b>.57506</b>	28
33	.75316	<b>.56645</b>	.75482	<b>.56861</b>	.75646	<b>.57077</b>	.75810	<b>.57293</b>	.75974	<b>.57509</b>	27
34	.75319	<b>.56649</b>	.75485	<b>.56865</b>	.75649	<b>.57081</b>	.75813	<b>.57297</b>	.75976	<b>.57513</b>	26
35	.75322	<b>.56652</b>	.75487	<b>.56869</b>	.75652	<b>.57085</b>	.75816	<b>.57301</b>	.75979	<b>.57516</b>	25
+ 9'	9.75325	<b>.56656</b>	9.75490	<b>.56872</b>	9.75655	<b>.57088</b>	9.75819	<b>.57304</b>	9.75982	<b>.57520</b>	24
37	.75327	<b>.56660</b>	.75493	<b>.56876</b>	.75657	<b>.57092</b>	.75821	<b>.57308</b>	.75985	<b>.57524</b>	23
38	.75330	<b>.56663</b>	.75496	<b>.56879</b>	.75660	<b>.57095</b>	.75824	<b>.57311</b>	.75988	<b>.57527</b>	22
39	.75333	<b>.56667</b>	.75498	<b>.56883</b>	.75663	<b>.57099</b>	.75827	<b>.57315</b>	.75990	<b>.57531</b>	21
+ 10'	9.75336	<b>.56670</b>	9.75501	<b>.56887</b>	9.75666	<b>.57103</b>	9.75830	<b>.57318</b>	9.75993	<b>.57534</b>	20
41	.75338	<b>.56674</b>	.75504	<b>.56890</b>	.75668	<b>.57106</b>	.75832	<b>.57322</b>	.75995	<b>.57538</b>	19
42	.75341	<b>.56678</b>	.75507	<b>.56894</b>	.75671	<b>.57110</b>	.75835	<b>.57326</b>	.75998	<b>.57541</b>	18
43	.75344	<b>.56681</b>	.75509	<b>.56897</b>	.75674	<b>.57114</b>	.75838	<b>.57329</b>	.76001	<b>.57545</b>	17
+ 11'	9.75347	<b>.56685</b>	9.75512	<b>.56901</b>	9.75677	<b>.57117</b>	9.75840	<b>.57333</b>	9.76004	<b>.57549</b>	16
45	.75350	<b>.56689</b>	.75515	<b>.56905</b>	.75679	<b>.57121</b>	.75843	<b>.57337</b>	.76006	<b>.57552</b>	15
46	.75352	<b>.56692</b>	.75518	<b>.56908</b>	.75682	<b>.57124</b>	.75846	<b>.57340</b>	.76009	<b>.57556</b>	14
47	.75355	<b>.56696</b>	.75520	<b>.56912</b>	.75685	<b>.57128</b>	.75849	<b>.57344</b>	.76012	<b>.57559</b>	13
+ 12'	9.75358	<b>.56699</b>	9.75523	<b>.56915</b>	9.75688	<b>.57131</b>	9.75851	<b>.57347</b>	9.76014	<b>.57563</b>	12
49	.75361	<b>.56703</b>	.75526	<b>.56919</b>	.75690	<b>.57135</b>	.75854	<b>.57351</b>	.76017	<b>.57567</b>	11
50	.75363	<b>.56707</b>	.75529	<b>.56923</b>	.75693	<b>.57139</b>	.75857	<b>.57355</b>	.76020	<b>.57570</b>	10
51	.75366	<b>.56710</b>	.75531	<b>.56926</b>	.75696	<b>.57142</b>	.75859	<b>.57358</b>	.76023	<b>.57574</b>	9
+ 13'	9.75369	<b>.56714</b>	9.75534	<b>.56930</b>	9.75698	<b>.57146</b>	9.75862	<b>.57362</b>	9.76025	<b>.57577</b>	8
53	.75372	<b>.56717</b>	.75537	<b>.56933</b>	.75701	<b>.57149</b>	.75865	<b>.57365</b>	.76028	<b>.57581</b>	7
54	.75374	<b>.56721</b>	.75540	<b>.56937</b>	.75704	<b>.57153</b>	.75868	<b>.57369</b>	.76031	<b>.57585</b>	6
55	.75377	<b>.56725</b>	.75542	<b>.56941</b>	.75707	<b>.57157</b>	.75870	<b>.57373</b>	.76033	<b>.57588</b>	5
+ 14'	9.75380	<b>.56728</b>	9.75545	<b>.56944</b>	9.75709	<b>.57160</b>	9.75873	<b>.57376</b>	9.76036	<b>.57592</b>	4
57	.75383	<b>.56732</b>	.75548	<b>.56948</b>	.75712	<b>.57164</b>	.75876	<b>.57380</b>	.76039	<b>.57595</b>	3
58	.75385	<b>.56735</b>	.75550	<b>.56951</b>	.75715	<b>.57167</b>	.75879	<b>.57383</b>	.76041	<b>.57599</b>	2
59	.75388	<b>.56739</b>	.75553	<b>.56955</b>	.75718	<b>.57171</b>	.75881	<b>.57387</b>	.76044	<b>.57603</b>	1
+ 15'	9.75391	<b>.56743</b>	9.75556	<b>.56959</b>	9.75720	<b>.57175</b>	9.75884	<b>.57390</b>	9.76047	<b>.57606</b>	0
	17h 29m		17h 28m		17h 27m		17h 26m		17h 25m		

TABLE IV.

Haversines.

s	6h 35m 98° 45'		6h 36m 99° 0'		6h 37m 99° 15'		6h 38m 99° 30'		6h 39m 99° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.76047	<b>.57606</b>	9.76209	<b>.57822</b>	9.76371	<b>.58037</b>	9.76531	<b>.58252</b>	9.76691	<b>.58467</b>	60
1	.76050	<b>.57610</b>	.76212	<b>.57825</b>	.76373	<b>.58041</b>	.76534	<b>.58256</b>	.76694	<b>.58471</b>	59
2	.76052	<b>.57613</b>	.76215	<b>.57829</b>	.76376	<b>.58044</b>	.76537	<b>.58260</b>	.76697	<b>.58475</b>	58
3	.76055	<b>.57617</b>	.76217	<b>.57833</b>	.76379	<b>.58048</b>	.76539	<b>.58263</b>	.76699	<b>.58478</b>	57
+ 1'	9.76058	<b>.57621</b>	9.76220	<b>.57836</b>	9.76381	<b>.58051</b>	9.76542	<b>.58267</b>	9.76702	<b>.58482</b>	56
5	.76060	<b>.57624</b>	.76223	<b>.57840</b>	.76384	<b>.58055</b>	.76545	<b>.58270</b>	.76705	<b>.58485</b>	55
6	.76063	<b>.57628</b>	.76225	<b>.57843</b>	.76387	<b>.58059</b>	.76547	<b>.58274</b>	.76707	<b>.58489</b>	54
7	.76066	<b>.57631</b>	.76228	<b>.57847</b>	.76389	<b>.58062</b>	.76550	<b>.58277</b>	.76710	<b>.58493</b>	53
+ 2'	9.76069	<b>.57635</b>	9.76231	<b>.57850</b>	9.76392	<b>.58066</b>	9.76553	<b>.58281</b>	9.76713	<b>.58496</b>	52
9	.76071	<b>.57639</b>	.76233	<b>.57854</b>	.76395	<b>.58069</b>	.76555	<b>.58285</b>	.76715	<b>.58500</b>	51
10	.76074	<b>.57642</b>	.76236	<b>.57858</b>	.76397	<b>.58073</b>	.76558	<b>.58288</b>	.76718	<b>.58503</b>	50
11	.76077	<b>.57646</b>	.76239	<b>.57861</b>	.76400	<b>.58077</b>	.76561	<b>.58292</b>	.76721	<b>.58507</b>	49
+ 3'	9.76079	<b>.57649</b>	9.76241	<b>.57865</b>	9.76403	<b>.58080</b>	9.76563	<b>.58295</b>	9.76723	<b>.58510</b>	48
13	.76082	<b>.57653</b>	.76244	<b>.57868</b>	.76405	<b>.58084</b>	.76566	<b>.58299</b>	.76726	<b>.58514</b>	47
14	.76085	<b>.57656</b>	.76247	<b>.57872</b>	.76408	<b>.58087</b>	.76569	<b>.58303</b>	.76729	<b>.58518</b>	46
15	.76088	<b>.57660</b>	.76250	<b>.57876</b>	.76411	<b>.58091</b>	.76571	<b>.58306</b>	.76731	<b>.58521</b>	45
+ 4'	9.76090	<b>.57664</b>	9.76252	<b>.57879</b>	9.76414	<b>.58095</b>	9.76574	<b>.58310</b>	9.76734	<b>.58525</b>	44
17	.76093	<b>.57667</b>	.76255	<b>.57883</b>	.76416	<b>.58098</b>	.76577	<b>.58313</b>	.76737	<b>.58528</b>	43
18	.76096	<b>.57671</b>	.76258	<b>.57886</b>	.76419	<b>.58102</b>	.76579	<b>.58317</b>	.76739	<b>.58532</b>	42
19	.76098	<b>.57675</b>	.76260	<b>.57890</b>	.76422	<b>.58105</b>	.76582	<b>.58321</b>	.76742	<b>.58536</b>	41
+ 5'	9.76101	<b>.57678</b>	9.76263	<b>.57894</b>	9.76424	<b>.58109</b>	9.76585	<b>.58324</b>	9.76745	<b>.58539</b>	40
21	.76104	<b>.57682</b>	.76266	<b>.57897</b>	.76427	<b>.58112</b>	.76587	<b>.58328</b>	.76747	<b>.58543</b>	39
22	.76106	<b>.57685</b>	.76268	<b>.57901</b>	.76430	<b>.58116</b>	.76590	<b>.58331</b>	.76750	<b>.58546</b>	38
23	.76109	<b>.57689</b>	.76271	<b>.57904</b>	.76432	<b>.58120</b>	.76593	<b>.58335</b>	.76753	<b>.58550</b>	37
+ 6'	9.76112	<b>.57692</b>	9.76274	<b>.57908</b>	9.76435	<b>.58123</b>	9.76595	<b>.58338</b>	9.76755	<b>.58553</b>	36
25	.76115	<b>.57696</b>	.76276	<b>.57911</b>	.76438	<b>.58127</b>	.76598	<b>.58342</b>	.76758	<b>.58557</b>	35
26	.76117	<b>.57700</b>	.76279	<b>.57915</b>	.76440	<b>.58130</b>	.76601	<b>.58346</b>	.76761	<b>.58561</b>	34
27	.76120	<b>.57703</b>	.76282	<b>.57919</b>	.76443	<b>.58134</b>	.76603	<b>.58349</b>	.76763	<b>.58564</b>	33
+ 7'	9.76123	<b>.57707</b>	9.76285	<b>.57922</b>	9.76446	<b>.58138</b>	9.76606	<b>.58353</b>	9.76766	<b>.58568</b>	32
29	.76125	<b>.57710</b>	.76287	<b>.57926</b>	.76448	<b>.58141</b>	.76609	<b>.58356</b>	.76769	<b>.58571</b>	31
30	.76128	<b>.57714</b>	.76290	<b>.57929</b>	.76451	<b>.58145</b>	.76611	<b>.58360</b>	.76771	<b>.58575</b>	30
31	.76131	<b>.57718</b>	.76293	<b>.57933</b>	.76454	<b>.58148</b>	.76614	<b>.58364</b>	.76774	<b>.58579</b>	29
+ 8'	9.76134	<b>.57721</b>	9.76296	<b>.57937</b>	9.76456	<b>.58152</b>	9.76617	<b>.58367</b>	9.76777	<b>.58582</b>	28
33	.76136	<b>.57725</b>	.76298	<b>.57940</b>	.76459	<b>.58156</b>	.76619	<b>.58371</b>	.76779	<b>.58586</b>	27
34	.76139	<b>.57728</b>	.76301	<b>.57944</b>	.76462	<b>.58159</b>	.76622	<b>.58374</b>	.76782	<b>.58589</b>	26
35	.76142	<b>.57732</b>	.76303	<b>.57947</b>	.76464	<b>.58163</b>	.76625	<b>.58378</b>	.76784	<b>.58593</b>	25
+ 9'	9.76144	<b>.57736</b>	9.76306	<b>.57951</b>	9.76467	<b>.58166</b>	9.76627	<b>.58381</b>	9.76787	<b>.58596</b>	24
37	.76147	<b>.57739</b>	.76309	<b>.57955</b>	.76470	<b>.58170</b>	.76630	<b>.58385</b>	.76790	<b>.58600</b>	23
38	.76150	<b>.57743</b>	.76311	<b>.57958</b>	.76473	<b>.58173</b>	.76633	<b>.58389</b>	.76792	<b>.58604</b>	22
39	.76152	<b>.57746</b>	.76314	<b>.57962</b>	.76475	<b>.58177</b>	.76635	<b>.58392</b>	.76795	<b>.58607</b>	21
+ 10'	9.76155	<b>.57750</b>	9.76317	<b>.57965</b>	9.76478	<b>.58181</b>	9.76638	<b>.58396</b>	9.76798	<b>.58611</b>	20
41	.76158	<b>.57753</b>	.76320	<b>.57969</b>	.76481	<b>.58184</b>	.76641	<b>.58399</b>	.76800	<b>.58614</b>	19
42	.76161	<b>.57757</b>	.76322	<b>.57973</b>	.76483	<b>.58188</b>	.76643	<b>.58403</b>	.76803	<b>.58618</b>	18
43	.76163	<b>.57761</b>	.76325	<b>.57976</b>	.76486	<b>.58191</b>	.76646	<b>.58407</b>	.76806	<b>.58622</b>	17
+ 11'	9.76166	<b>.57764</b>	9.76328	<b>.57980</b>	9.76489	<b>.58195</b>	9.76649	<b>.58410</b>	9.76808	<b>.58625</b>	16
45	.76169	<b>.57768</b>	.76330	<b>.57983</b>	.76491	<b>.58199</b>	.76651	<b>.58414</b>	.76811	<b>.58629</b>	15
46	.76171	<b>.57771</b>	.76333	<b>.57987</b>	.76494	<b>.58202</b>	.76654	<b>.58417</b>	.76814	<b>.58632</b>	14
47	.76174	<b>.57775</b>	.76336	<b>.57990</b>	.76497	<b>.58206</b>	.76657	<b>.58421</b>	.76816	<b>.58636</b>	13
+ 12'	9.76177	<b>.57779</b>	9.76338	<b>.57994</b>	9.76499	<b>.58209</b>	9.76659	<b>.58424</b>	9.76819	<b>.58639</b>	12
49	.76179	<b>.57782</b>	.76341	<b>.57998</b>	.76502	<b>.58213</b>	.76662	<b>.58428</b>	.76822	<b>.58643</b>	11
50	.76182	<b>.57786</b>	.76344	<b>.58001</b>	.76505	<b>.58217</b>	.76665	<b>.58432</b>	.76824	<b>.58647</b>	10
51	.76185	<b>.57789</b>	.76346	<b>.58005</b>	.76507	<b>.58220</b>	.76667	<b>.58435</b>	.76827	<b>.58650</b>	9
+ 13'	9.76188	<b>.57793</b>	9.76349	<b>.58008</b>	9.76510	<b>.58224</b>	9.76670	<b>.58439</b>	9.76830	<b>.58654</b>	8
53	.76190	<b>.57797</b>	.76352	<b>.58012</b>	.76513	<b>.58227</b>	.76673	<b>.58442</b>	.76832	<b>.58657</b>	7
54	.76193	<b>.57800</b>	.76354	<b>.58016</b>	.76515	<b>.58231</b>	.76675	<b>.58446</b>	.76835	<b>.58661</b>	6
55	.76196	<b>.57804</b>	.76357	<b>.58019</b>	.76518	<b>.58234</b>	.76678	<b>.58450</b>	.76838	<b>.58665</b>	5
+ 14'	9.76198	<b>.57807</b>	9.76360	<b>.58023</b>	9.76521	<b>.58238</b>	9.76681	<b>.58453</b>	9.76840	<b>.58668</b>	4
57	.76201	<b>.57811</b>	.76363	<b>.58026</b>	.76523	<b>.58242</b>	.76683	<b>.58457</b>	.76843	<b>.58671</b>	3
58	.76204	<b>.57815</b>	.76365	<b>.58030</b>	.76526	<b>.58245</b>	.76686	<b>.58460</b>	.76845	<b>.58675</b>	2
59	.76206	<b>.57818</b>	.76368	<b>.58034</b>	.76529	<b>.58249</b>	.76689	<b>.58464</b>	.76848	<b>.58679</b>	1
+ 15'	9.76209	<b>.57822</b>	9.76371	<b>.58037</b>	9.76531	<b>.58252</b>	9.76691	<b>.58467</b>	9.76851	<b>.58682</b>	0
	17h 24m		17h 23m		17h 22m		17h 21m		17h 20m		



s	6h 40m 100° 0'		6h 41m 100° 15'		6h 42m 100° 30'		6h 43m 100° 45'		6h 44m 101° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.76851	.58682	9.77009	.58897	9.77167	.59112	9.77325	.59326	9.77481	.59540	60
1	.76853	.58686	.77012	.58901	.77170	.59115	.77327	.59330	.77484	.59544	59
2	.76856	.58690	.77015	.58904	.77173	.59119	.77330	.59333	.77486	.59548	58
3	.76859	.58693	.77017	.58908	.77175	.59122	.77333	.59337	.77489	.59551	57
+ 1'	9.76861	.58697	9.77020	.58911	9.77178	.59126	9.77335	.59340	9.77492	.59555	56
5	.76864	.58700	.77023	.58915	.77181	.59130	.77338	.59344	.77494	.59558	55
6	.76867	.58704	.77025	.58919	.77183	.59133	.77340	.59348	.77497	.59562	54
7	.76869	.58707	.77028	.58922	.77186	.59137	.77343	.59351	.77499	.59565	53
+ 2'	9.76872	.58711	9.77031	.58926	9.77188	.59140	9.77346	.59355	9.77502	.59569	52
9	.76875	.58714	.77033	.58929	.77191	.59144	.77348	.59358	.77505	.59573	51
10	.76877	.58718	.77036	.58933	.77194	.59148	.77351	.59362	.77507	.59576	50
11	.76880	.58722	.77038	.58937	.77196	.59151	.77353	.59365	.77510	.59580	49
+ 3'	9.76883	.58725	9.77041	.58940	9.77199	.59155	9.77356	.59369	9.77512	.59583	48
13	.76885	.58729	.77044	.58944	.77202	.59158	.77359	.59373	.77515	.59587	47
14	.76888	.58733	.77046	.58947	.77204	.59162	.77361	.59376	.77518	.59590	46
15	.76891	.58736	.77049	.58951	.77207	.59165	.77364	.59380	.77520	.59594	45
+ 4'	9.76893	.58740	9.77052	.58954	9.77209	.59169	9.77366	.59383	9.77523	.59598	44
17	.76896	.58743	.77054	.58858	.77212	.59173	.77369	.59387	.77525	.59601	43
18	.76898	.58747	.77057	.58962	.77215	.59176	.77372	.59391	.77528	.59605	42
19	.76901	.58750	.77060	.58965	.77217	.59180	.77374	.59394	.77531	.59608	41
+ 5'	9.76904	.58754	9.77062	.58969	9.77220	.59183	9.77377	.59398	9.77533	.59612	40
21	.76906	.58758	.77065	.58972	.77223	.59187	.77380	.59401	.77536	.59615	39
22	.76909	.58761	.77067	.58976	.77225	.59190	.77382	.59405	.77538	.59619	38
23	.76912	.58765	.77070	.58979	.77228	.59194	.77385	.59408	.77541	.59623	37
+ 6'	9.76914	.58768	9.77073	.58983	9.77230	.59198	9.77387	.59412	9.77544	.59626	36
25	.76917	.58772	.77075	.58987	.77233	.59201	.77390	.59416	.77546	.59630	35
26	.76920	.58776	.77078	.58990	.77236	.59205	.77393	.59419	.77549	.59633	34
27	.76922	.58779	.77081	.58994	.77238	.59208	.77395	.59423	.77551	.59637	33
+ 7'	9.76925	.58783	9.77083	.58997	9.77241	.59212	9.77398	.59426	9.77554	.59640	32
29	.76928	.58786	.77086	.59001	.77243	.59215	.77400	.59430	.77557	.59644	31
30	.76930	.58789	.77089	.59005	.77246	.59219	.77403	.59433	.77559	.59648	30
31	.76933	.58793	.77091	.59008	.77249	.59223	.77406	.59437	.77562	.59651	29
+ 8'	9.76936	.58797	9.77094	.59012	9.77251	.59226	9.77408	.59440	9.77564	.59655	28
33	.76938	.58801	.77096	.59015	.77254	.59230	.77411	.59444	.77567	.59658	27
34	.76941	.58804	.77099	.59019	.77257	.59233	.77413	.59448	.77570	.59662	26
35	.76943	.58808	.77102	.59022	.77259	.59237	.77416	.59451	.77572	.59665	25
+ 9'	9.76946	.58811	9.77104	.59026	9.77262	.59240	9.77419	.59455	9.77575	.59669	24
37	.76949	.58815	.77107	.59030	.77264	.59244	.77421	.59458	.77577	.59672	23
38	.76951	.58818	.77110	.59033	.77267	.59248	.77424	.59462	.77580	.59676	22
39	.76954	.58822	.77112	.59037	.77270	.59251	.77427	.59465	.77583	.59680	21
+ 10'	9.76957	.58826	9.77115	.59040	9.77272	.59255	9.77429	.59469	9.77585	.59683	20
41	.76959	.58829	.77117	.59044	.77275	.59258	.77432	.59473	.77588	.59687	19
42	.76962	.58833	.77120	.59047	.77278	.59262	.77434	.59476	.77590	.59690	18
43	.76965	.58836	.77123	.59051	.77280	.59265	.77437	.59480	.77593	.59694	17
+ 11'	9.76967	.58840	9.77125	.59055	9.77283	.59269	9.77440	.59483	9.77596	.59697	16
45	.76970	.58843	.77128	.59058	.77285	.59273	.77442	.59487	.77598	.59701	15
46	.76972	.58847	.77131	.59062	.77288	.59276	.77445	.59490	.77601	.59705	14
47	.76975	.58851	.77133	.59065	.77291	.59280	.77447	.59494	.77603	.59708	13
+ 12'	9.76978	.58854	9.77136	.59069	9.77293	.59283	9.77450	.59498	9.77606	.59712	12
49	.76980	.58858	.77139	.59072	.77296	.59287	.77453	.59501	.77609	.59715	11
50	.76983	.58861	.77141	.59076	.77298	.59290	.77455	.59505	.77611	.59719	10
51	.76986	.58865	.77144	.59080	.77301	.59294	.77458	.59508	.77614	.59722	9
+ 13'	9.76988	.58869	9.77146	.59083	9.77304	.59298	9.77460	.59512	9.77616	.59726	8
53	.76991	.58872	.77149	.59087	.77306	.59301	.77463	.59515	.77619	.59730	7
54	.76994	.58876	.77152	.59090	.77309	.59305	.77466	.59519	.77622	.59733	6
55	.76996	.58879	.77154	.59094	.77312	.59308	.77468	.59523	.77624	.59737	5
+ 14'	9.76999	.58883	9.77157	.59097	9.77314	.59312	9.77471	.59526	9.77627	.59740	4
57	.77002	.58886	.77160	.59101	.77317	.59315	.77473	.59530	.77629	.59744	3
58	.77004	.58890	.77162	.59105	.77319	.59319	.77476	.59533	.77632	.59747	2
59	.77007	.58894	.77165	.59108	.77322	.59323	.77479	.59537	.77634	.59751	1
+ 15'	9.77009	.58897	9.77167	.59112	9.77325	.59326	9.77481	.59540	9.77637	.59755	0
	17h 19m		17h 18m		17h 17m		17h 16m		17h 15m		

TABLE IV.

Haversines.

s	6h 45m 101° 15'		6h 46m 101° 30'		6h 47m 101° 45'		6h 48m 102° 0'		6h 49m 102° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.77637	.59755	9.77792	.59968	9.77947	.60182	9.78101	.60396	9.78254	.60609	60
1	.77640	.59758	.77795	.59972	.77949	.60185	.78103	.60399	.78256	.60612	59
2	.77642	.59762	.77797	.59976	.77952	.60189	.78106	.60403	.78259	.60616	58
3	.77645	.59765	.77800	.59979	.77954	.60193	.78108	.60406	.78261	.60620	57
+ 1'	9.77647	.59769	9.77803	.59983	9.77957	.60196	9.78111	.60410	9.78264	.60623	56
5	.77650	.59772	.77805	.59986	.77960	.60200	.78113	.60414	.78266	.60627	55
6	.77653	.59776	.77808	.59990	.77962	.60203	.78116	.60417	.78269	.60630	54
7	.77655	.59779	.77810	.59993	.77965	.60207	.78118	.60420	.78271	.60634	53
+ 2'	9.77658	.59783	9.77813	.59997	9.77967	.60211	9.78121	.60424	9.78274	.60637	52
9	.77660	.59787	.77815	.60000	.77970	.60214	.78124	.60428	.78277	.60641	51
10	.77663	.59790	.77818	.60004	.77972	.60218	.78126	.60431	.78279	.60644	50
11	.77666	.59794	.77821	.60008	.77975	.60221	.78129	.60435	.78282	.60648	49
+ 3'	9.77668	.59797	9.77823	.60011	9.77978	.60225	9.78131	.60438	9.78284	.60652	48
13	.77671	.59801	.77826	.60015	.77980	.60228	.78134	.60442	.78287	.60655	47
14	.77673	.59804	.77828	.60018	.77983	.60232	.78136	.60445	.78289	.60659	46
15	.77676	.59808	.77831	.60022	.77985	.60235	.78139	.60449	.78292	.60662	45
+ 4'	9.77679	.59812	9.77834	.60025	9.77988	.60239	9.78141	.60452	9.78294	.60666	44
17	.77681	.59815	.77836	.60029	.77990	.60243	.78144	.60456	.78297	.60669	43
18	.77684	.59819	.77839	.60033	.77993	.60246	.78147	.60460	.78299	.60673	42
19	.77686	.59822	.77841	.60036	.77996	.60250	.78149	.60463	.78302	.60676	41
+ 5'	9.77689	.59826	9.77844	.60040	9.77998	.60253	9.78152	.60467	9.78305	.60680	40
21	.77691	.59829	.77846	.60043	.78001	.60257	.78154	.60470	.78307	.60684	39
22	.77694	.59833	.77849	.60047	.78003	.60260	.78157	.60474	.78310	.60687	38
23	.77697	.59837	.77852	.60050	.78006	.60264	.78159	.60477	.78312	.60691	37
+ 6'	9.77699	.59840	9.77854	.60054	9.78008	.60268	9.78162	.60481	9.78315	.60694	36
25	.77702	.59844	.77857	.60057	.78011	.60271	.78164	.60484	.78317	.60698	35
26	.77704	.59847	.77859	.60061	.78013	.60275	.78167	.60488	.78320	.60701	34
27	.77707	.59851	.77862	.60065	.78016	.60278	.78170	.60492	.78322	.60705	33
+ 7'	9.77710	.59854	9.77864	.60068	9.78019	.60282	9.78172	.60495	9.78325	.60708	32
29	.77712	.59858	.77867	.60072	.78021	.60285	.78175	.60499	.78327	.60712	31
30	.77715	.59861	.77870	.60075	.78024	.60289	.78177	.60502	.78330	.60715	30
31	.77717	.59865	.77872	.60079	.78026	.60292	.78180	.60506	.78332	.60719	29
+ 8'	9.77720	.59869	9.77875	.60082	9.78029	.60296	9.78182	.60509	9.78335	.60723	28
33	.77723	.59872	.77877	.60086	.78031	.60300	.78185	.60513	.78338	.60726	27
34	.77725	.59876	.77880	.60090	.78034	.60303	.78187	.60516	.78340	.60730	26
35	.77728	.59879	.77882	.60093	.78037	.60307	.78190	.60520	.78343	.60733	25
+ 9'	9.77730	.59883	9.77885	.60097	9.78039	.60310	9.78192	.60524	9.78345	.60737	24
37	.77733	.59886	.77888	.60100	.78042	.60314	.78195	.60527	.78348	.60740	23
38	.77735	.59890	.77890	.60104	.78044	.60317	.78198	.60531	.78350	.60744	22
39	.77738	.59894	.77893	.60107	.78047	.60321	.78200	.60534	.78353	.60747	21
+ 10'	9.77741	.59897	9.77895	.60111	9.78049	.60324	9.78203	.60538	9.78355	.60751	20
41	.77743	.59901	.77898	.60114	.78052	.60328	.78205	.60541	.78358	.60755	19
42	.77746	.59904	.77900	.60118	.78054	.60332	.78208	.60545	.78360	.60758	18
43	.77748	.59908	.77903	.60122	.78057	.60335	.78210	.60548	.78363	.60762	17
+ 11'	9.77751	.59911	9.77906	.60125	9.78060	.60339	9.78213	.60552	9.78365	.60766	16
45	.77754	.59915	.77908	.60129	.78062	.60342	.78215	.60556	.78368	.60769	15
46	.77756	.59919	.77911	.60133	.78065	.60346	.78218	.60559	.78371	.60772	14
47	.77759	.59922	.77913	.60136	.78067	.60349	.78221	.60563	.78373	.60776	13
+ 12'	9.77761	.59926	9.77916	.60139	9.78070	.60353	9.78223	.60566	9.78376	.60779	12
49	.77764	.59929	.77918	.60143	.78072	.60356	.78226	.60570	.78379	.60783	11
50	.77766	.59933	.77921	.60146	.78075	.60360	.78228	.60573	.78381	.60786	10
51	.77769	.59936	.77924	.60150	.78077	.60364	.78231	.60577	.78383	.60790	9
+ 13'	9.77772	.59940	9.77926	.60154	9.78080	.60367	9.78233	.60580	9.78386	.60794	8
53	.77774	.59943	.77929	.60157	.78083	.60371	.78236	.60584	.78388	.60797	7
54	.77777	.59947	.77931	.60161	.78085	.60374	.78238	.60588	.78391	.60801	6
55	.77779	.59951	.77934	.60164	.78088	.60378	.78241	.60591	.78393	.60804	5
+ 14'	9.77782	.59954	9.77936	.60168	9.78090	.60381	9.78243	.60595	9.78396	.60808	4
57	.77785	.59958	.77939	.60171	.78093	.60385	.78246	.60598	.78398	.60811	3
58	.77787	.59961	.77942	.60175	.78095	.60388	.78249	.60602	.78401	.60815	2
59	.77790	.59965	.77944	.60179	.78098	.60392	.78251	.60605	.78404	.60818	1
+ 15'	9.77792	.59968	9.77947	.60182	9.78101	.60396	9.78254	.60609	9.78406	.60822	0
	17h 14m		17h 13m		17h 12m		17h 11m		17h 10m		



Haversines.

s	6h 50m 102° 30'		6h 51m 102° 45'		6h 52m 103° 0'		6h 53m 103° 15'		6h 54m 103° 30'		s
	Log. Hav.	Nat. Hav.	Hav. Log.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.78406	<b>.60822</b>	9.78558	<b>.61035</b>	9.78709	<b>.61248</b>	9.78859	<b>.61460</b>	9.79009	<b>.61672</b>	60
1	.78409	<b>.60825</b>	.78560	<b>.61038</b>	.78711	<b>.61251</b>	.78862	<b>.61464</b>	.79011	<b>.61676</b>	59
2	.78411	<b>.60829</b>	.78563	<b>.61042</b>	.78714	<b>.61255</b>	.78864	<b>.61467</b>	.79014	<b>.61679</b>	58
3	.78414	<b>.60833</b>	.78565	<b>.61046</b>	.78716	<b>.61258</b>	.78867	<b>.61471</b>	.79016	<b>.61683</b>	57
+ 1'	9.78416	<b>.60836</b>	9.78568	<b>.61049</b>	9.78719	<b>.61262</b>	9.78869	<b>.61474</b>	9.79019	<b>.61686</b>	56
5	.78419	<b>.60840</b>	.78570	<b>.61053</b>	.78721	<b>.61265</b>	.78872	<b>.61478</b>	.79021	<b>.61690</b>	55
6	.78421	<b>.60843</b>	.78573	<b>.61056</b>	.78724	<b>.61269</b>	.78874	<b>.61481</b>	.79024	<b>.61693</b>	54
7	.78424	<b>.60847</b>	.78575	<b>.61060</b>	.78726	<b>.61272</b>	.78877	<b>.61485</b>	.79026	<b>.61697</b>	53
+ 2'	9.78426	<b>.60850</b>	9.78578	<b>.61063</b>	9.78729	<b>.61276</b>	9.78879	<b>.61488</b>	9.79029	<b>.61701</b>	52
9	.78429	<b>.60854</b>	.78581	<b>.61067</b>	.78731	<b>.61279</b>	.78882	<b>.61492</b>	.79031	<b>.61704</b>	51
10	.78431	<b>.60857</b>	.78583	<b>.61070</b>	.78734	<b>.61283</b>	.78884	<b>.61495</b>	.79034	<b>.61708</b>	50
11	.78434	<b>.60861</b>	.78586	<b>.61074</b>	.78737	<b>.61287</b>	.78887	<b>.61499</b>	.79036	<b>.61711</b>	49
+ 3'	9.78436	<b>.60865</b>	9.78588	<b>.61077</b>	9.78739	<b>.61290</b>	9.78889	<b>.61502</b>	9.79039	<b>.61715</b>	48
13	.78439	<b>.60868</b>	.78591	<b>.61081</b>	.78742	<b>.61294</b>	.78892	<b>.61506</b>	.79041	<b>.61718</b>	47
14	.78442	<b>.60872</b>	.78593	<b>.61085</b>	.78744	<b>.61297</b>	.78894	<b>.61510</b>	.79044	<b>.61722</b>	46
15	.78444	<b>.60875</b>	.78596	<b>.61088</b>	.78747	<b>.61301</b>	.78897	<b>.61513</b>	.79046	<b>.61725</b>	45
+ 4'	9.78447	<b>.60879</b>	9.78598	<b>.61092</b>	9.78749	<b>.61304</b>	9.78899	<b>.61517</b>	9.79049	<b>.61729</b>	44
17	.78449	<b>.60882</b>	.78601	<b>.61095</b>	.78752	<b>.61308</b>	.78902	<b>.61520</b>	.79051	<b>.61732</b>	43
18	.78452	<b>.60886</b>	.78603	<b>.61099</b>	.78754	<b>.61311</b>	.78904	<b>.61524</b>	.79054	<b>.61736</b>	42
19	.78454	<b>.60889</b>	.78606	<b>.61102</b>	.78757	<b>.61315</b>	.78907	<b>.61527</b>	.79056	<b>.61739</b>	41
+ 5'	9.78457	<b>.60893</b>	9.78608	<b>.61106</b>	9.78759	<b>.61318</b>	9.78909	<b>.61531</b>	9.79059	<b>.61743</b>	40
21	.78459	<b>.60897</b>	.78611	<b>.61109</b>	.78762	<b>.61322</b>	.78912	<b>.61534</b>	.79061	<b>.61747</b>	39
22	.78462	<b>.60900</b>	.78613	<b>.61113</b>	.78764	<b>.61325</b>	.78914	<b>.61538</b>	.79064	<b>.61750</b>	38
23	.78464	<b>.60904</b>	.78616	<b>.61116</b>	.78767	<b>.61329</b>	.78917	<b>.61541</b>	.79066	<b>.61754</b>	37
+ 6'	9.78467	<b>.60907</b>	9.78618	<b>.61120</b>	9.78769	<b>.61333</b>	9.78919	<b>.61545</b>	9.79069	<b>.61757</b>	36
25	.78469	<b>.60911</b>	.78621	<b>.61124</b>	.78772	<b>.61336</b>	.78922	<b>.61548</b>	.79071	<b>.61761</b>	35
26	.78472	<b>.60914</b>	.78623	<b>.61127</b>	.78774	<b>.61340</b>	.78924	<b>.61552</b>	.79074	<b>.61764</b>	34
27	.78474	<b>.60918</b>	.78626	<b>.61131</b>	.78777	<b>.61343</b>	.78927	<b>.61556</b>	.79076	<b>.61768</b>	33
+ 7'	9.78477	<b>.60921</b>	9.78628	<b>.61134</b>	9.78779	<b>.61347</b>	9.78929	<b>.61559</b>	9.79079	<b>.61771</b>	32
29	.78479	<b>.60925</b>	.78631	<b>.61138</b>	.78782	<b>.61350</b>	.78932	<b>.61563</b>	.79081	<b>.61775</b>	31
30	.78482	<b>.60928</b>	.78633	<b>.61141</b>	.78784	<b>.61354</b>	.78934	<b>.61566</b>	.79084	<b>.61778</b>	30
31	.78485	<b>.60932</b>	.78636	<b>.61145</b>	.78787	<b>.61357</b>	.78937	<b>.61570</b>	.79086	<b>.61782</b>	29
+ 8'	9.78487	<b>.60936</b>	9.78638	<b>.61148</b>	9.78789	<b>.61361</b>	9.78939	<b>.61573</b>	9.79089	<b>.61785</b>	28
33	.78490	<b>.60939</b>	.78641	<b>.61152</b>	.78792	<b>.61364</b>	.78942	<b>.61577</b>	.79091	<b>.61789</b>	27
34	.78492	<b>.60943</b>	.78643	<b>.61155</b>	.78794	<b>.61368</b>	.78944	<b>.61580</b>	.79094	<b>.61792</b>	26
35	.78495	<b>.60946</b>	.78646	<b>.61159</b>	.78797	<b>.61372</b>	.78947	<b>.61584</b>	.79096	<b>.61796</b>	25
+ 9'	9.78497	<b>.60950</b>	9.78649	<b>.61163</b>	9.78799	<b>.61375</b>	9.78949	<b>.61587</b>	9.79099	<b>.61800</b>	24
37	.78500	<b>.60953</b>	.78651	<b>.61166</b>	.78802	<b>.61379</b>	.78952	<b>.61591</b>	.79101	<b>.61803</b>	23
38	.78502	<b>.60957</b>	.78654	<b>.61170</b>	.78804	<b>.61382</b>	.78954	<b>.61594</b>	.79103	<b>.61807</b>	22
39	.78505	<b>.60960</b>	.78656	<b>.61173</b>	.78807	<b>.61386</b>	.78957	<b>.61598</b>	.79106	<b>.61810</b>	21
+ 10'	9.78507	<b>.60964</b>	9.78659	<b>.61177</b>	9.78809	<b>.61389</b>	9.78959	<b>.61602</b>	9.79108	<b>.61814</b>	20
41	.78510	<b>.60967</b>	.78661	<b>.61180</b>	.78812	<b>.61393</b>	.78962	<b>.61605</b>	.79111	<b>.61817</b>	19
42	.78512	<b>.60971</b>	.78664	<b>.61184</b>	.78814	<b>.61396</b>	.78964	<b>.61609</b>	.79113	<b>.61821</b>	18
43	.78515	<b>.60975</b>	.78666	<b>.61187</b>	.78817	<b>.61400</b>	.78967	<b>.61612</b>	.79116	<b>.61824</b>	17
+ 11'	9.78517	<b>.60978</b>	9.78669	<b>.61191</b>	9.78819	<b>.61403</b>	9.78969	<b>.61616</b>	9.79118	<b>.61828</b>	16
45	.78520	<b>.60982</b>	.78671	<b>.61194</b>	.78822	<b>.61407</b>	.78972	<b>.61619</b>	.79121	<b>.61831</b>	15
46	.78522	<b>.60985</b>	.78674	<b>.61198</b>	.78824	<b>.61410</b>	.78974	<b>.61623</b>	.79123	<b>.61835</b>	14
47	.78525	<b>.60989</b>	.78676	<b>.61201</b>	.78827	<b>.61414</b>	.78977	<b>.61626</b>	.79126	<b>.61838</b>	13
+ 12'	9.78528	<b>.60992</b>	9.78679	<b>.61205</b>	9.78829	<b>.61418</b>	9.78979	<b>.61630</b>	9.79128	<b>.61842</b>	12
49	.78530	<b>.60996</b>	.78681	<b>.61209</b>	.78832	<b>.61421</b>	.78982	<b>.61633</b>	.79131	<b>.61845</b>	11
50	.78533	<b>.60999</b>	.78684	<b>.61212</b>	.78834	<b>.61425</b>	.78984	<b>.61637</b>	.79133	<b>.61849</b>	10
51	.78535	<b>.61003</b>	.78686	<b>.61216</b>	.78837	<b>.61428</b>	.78987	<b>.61640</b>	.79136	<b>.61853</b>	9
+ 13'	9.78538	<b>.61007</b>	9.78689	<b>.61219</b>	9.78839	<b>.61432</b>	9.78989	<b>.61644</b>	9.79138	<b>.61856</b>	8
53	.78540	<b>.61010</b>	.78691	<b>.61223</b>	.78842	<b>.61435</b>	.78992	<b>.61648</b>	.79141	<b>.61860</b>	7
54	.78543	<b>.61014</b>	.78694	<b>.61226</b>	.78844	<b>.61439</b>	.78994	<b>.61651</b>	.79143	<b>.61863</b>	6
55	.78545	<b>.61017</b>	.78696	<b>.61230</b>	.78847	<b>.61442</b>	.78997	<b>.61655</b>	.79146	<b>.61867</b>	5
+ 14'	9.78548	<b>.61021</b>	9.78699	<b>.61233</b>	9.78849	<b>.61446</b>	9.78999	<b>.61658</b>	9.79148	<b>.61870</b>	4
57	.78550	<b>.61024</b>	.78701	<b>.61237</b>	.78852	<b>.61449</b>	.79002	<b>.61662</b>	.79151	<b>.61874</b>	3
58	.78553	<b>.61028</b>	.78704	<b>.61240</b>	.78854	<b>.61453</b>	.79004	<b>.61665</b>	.79153	<b>.61877</b>	2
59	.78555	<b>.61032</b>	.78706	<b>.61244</b>	.78857	<b>.61456</b>	.79007	<b>.61669</b>	.79156	<b>.61881</b>	1
+ 15'	9.78558	<b>.61035</b>	9.78709	<b>.61248</b>	9.78859	<b>.61460</b>	9.79009	<b>.61672</b>	9.79158	<b>.61884</b>	0
	17h 9m		17h 8m		17h 7m		17h 6m		17h 5m		

TABLE IV.

Haversines.

s	6h 55m 103° 45'		6h 56m 104° 0'		6h 57m 104° 15'		6h 58m 104° 30'		6h 59m 104° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.79158	.61884	9.79306	.62096	9.79454	.62308	9.79601	.62519	9.79748	.62730	60
1	.79161	.61888	.79309	.62100	.79457	.62311	.79604	.62522	.79750	.62734	59
2	.79163	.61891	.79311	.62103	.79459	.62315	.79606	.62526	.79752	.62737	58
3	.79165	.61895	.79314	.62107	.79462	.62318	.79609	.62530	.79755	.62741	57
+ 1'	9.79168	.61898	9.79316	.62110	9.79464	.62322	9.79611	.62533	9.79757	.62744	56
5	.79170	.61902	.79319	.62114	.79466	.62325	.79613	.62537	.79760	.62748	55
6	.79173	.61905	.79321	.62117	.79469	.62329	.79616	.62540	.79762	.62751	54
7	.79175	.61909	.79324	.62121	.79471	.62332	.79618	.62544	.79765	.62755	53
+ 2'	9.79178	.61913	9.79326	.62124	9.79474	.62336	9.79621	.62547	9.79767	.62758	52
9	.79180	.61916	.79329	.62128	.79476	.62339	.79623	.62551	.79770	.62762	51
10	.79183	.61920	.79331	.62131	.79479	.62343	.79626	.62554	.79772	.62765	50
11	.79185	.61923	.79334	.62135	.79481	.62346	.79628	.62558	.79774	.62769	49
+ 3'	9.79188	.61927	9.79336	.62138	9.79484	.62350	9.79631	.62561	9.79777	.62772	48
13	.79190	.61930	.79339	.62142	.79486	.62353	.79633	.62565	.79779	.62776	47
14	.79193	.61934	.79341	.62145	.79489	.62357	.79635	.62568	.79782	.62779	46
15	.79195	.61937	.79343	.62149	.79491	.62361	.79638	.62572	.79784	.62783	45
+ 4'	9.79198	.61941	9.79346	.62153	9.79493	.62364	9.79640	.62575	9.79787	.62786	44
17	.79200	.61944	.79348	.62156	.79496	.62368	.79643	.62579	.79789	.62790	43
18	.79203	.61948	.79351	.62160	.79498	.62371	.79645	.62582	.79791	.62793	42
19	.79205	.61951	.79353	.62163	.79501	.62375	.79648	.62586	.79794	.62797	41
+ 5'	9.79208	.61955	9.79356	.62167	9.79503	.62378	9.79650	.62589	9.79796	.62800	40
21	.79210	.61958	.79358	.62170	.79506	.62382	.79653	.62593	.79799	.62804	39
22	.79213	.61962	.79361	.62174	.79508	.62385	.79655	.62596	.79801	.62807	38
23	.79215	.61966	.79363	.62177	.79511	.62389	.79657	.62600	.79804	.62811	37
+ 6'	9.79217	.61969	9.79366	.62181	9.79513	.62392	9.79660	.62603	9.79806	.62814	36
25	.79220	.61973	.79368	.62184	.79516	.62396	.79662	.62607	.79808	.62818	35
26	.79222	.61976	.79371	.62188	.79518	.62399	.79665	.62611	.79811	.62822	34
27	.79225	.61980	.79373	.62191	.79520	.62403	.79667	.62614	.79813	.62825	33
+ 7'	9.79227	.61983	9.79376	.62195	9.79523	.62406	9.79670	.62618	9.79816	.62829	32
29	.79230	.61987	.79378	.62198	.79525	.62410	.79672	.62621	.79818	.62832	31
30	.79232	.61990	.79380	.62202	.79528	.62413	.79674	.62625	.79821	.62836	30
31	.79235	.61994	.79383	.62205	.79530	.62417	.79677	.62628	.79823	.62839	29
+ 8'	9.79237	.61997	9.79385	.62209	9.79533	.62420	9.79679	.62632	9.79825	.62843	28
33	.79240	.62001	.79388	.62213	.79535	.62424	.79682	.62635	.79828	.62846	27
34	.79242	.62004	.79390	.62216	.79538	.62427	.79684	.62639	.79830	.62850	26
35	.79245	.62008	.79393	.62220	.79540	.62431	.79687	.62642	.79833	.62853	25
+ 9'	9.79247	.62011	9.79395	.62223	9.79542	.62434	9.79689	.62646	9.79835	.62857	24
37	.79250	.62015	.79398	.62227	.79545	.62438	.79692	.62649	.79838	.62860	23
38	.79252	.62018	.79400	.62230	.79547	.62442	.79694	.62653	.79840	.62864	22
39	.79255	.62022	.79403	.62234	.79550	.62445	.79696	.62656	.79842	.62867	21
+ 10'	9.79257	.62026	9.79405	.62237	9.79552	.62449	9.79699	.62660	9.79845	.62871	20
41	.79260	.62029	.79407	.62241	.79555	.62452	.79701	.62663	.79847	.62874	19
42	.79262	.62033	.79410	.62244	.79557	.62456	.79704	.62667	.79850	.62878	18
43	.79264	.62036	.79412	.62248	.79560	.62459	.79706	.62670	.79852	.62881	17
+ 11'	9.79267	.62040	9.79415	.62251	9.79562	.62463	9.79709	.62674	9.79855	.62885	16
45	.79269	.62043	.79417	.62255	.79565	.62466	.79711	.62677	.79857	.62888	15
46	.79272	.62047	.79420	.62258	.79567	.62470	.79714	.62681	.79859	.62892	14
47	.79274	.62050	.79422	.62262	.79569	.62473	.79716	.62684	.79862	.62895	13
+ 12'	9.79277	.62054	9.79425	.62265	9.79572	.62477	9.79718	.62688	9.79864	.62899	12
49	.79279	.62057	.79427	.62269	.79574	.62480	.79721	.62691	.79867	.62902	11
50	.79282	.62061	.79430	.62272	.79577	.62484	.79723	.62695	.79869	.62906	10
51	.79284	.62064	.79432	.62276	.79579	.62487	.79726	.62698	.79872	.62909	9
+ 13'	9.79287	.62068	9.79434	.62279	9.79582	.62491	9.79728	.62702	9.79874	.62913	8
53	.79289	.62071	.79437	.62283	.79584	.62494	.79731	.62706	.79876	.62916	7
54	.79292	.62075	.79439	.62287	.79587	.62498	.79733	.62709	.79879	.62920	6
55	.79294	.62078	.79442	.62290	.79589	.62501	.79735	.62713	.79881	.62923	5
+ 14'	9.79297	.62082	9.79444	.62294	9.79591	.62505	9.79738	.62716	9.79884	.62927	4
57	.79299	.62086	.79447	.62297	.79594	.62508	.79740	.62720	.79886	.62930	3
58	.79301	.62089	.79449	.62301	.79596	.62512	.79743	.62723	.79888	.62934	2
59	.79304	.62093	.79452	.62304	.79599	.62515	.79745	.62727	.79891	.62937	1
+ 15'	9.79306	.62096	9.79454	.62308	9.79601	.62519	9.79748	.62730	9.79893	.62941	0
	17h 4m		17h 3m		17h 2m		17h 1m		17h 0m		



TABLE IV.

Haversines.

s	7h 0m 105° 0'		7h 1m 105° 15'		7h 2m 105° 30'		7h 3m 105° 45'		7h 4m 106° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.79893	.62941	9.80038	.63152	9.80183	.63362	9.80327	.63572	9.80470	.63782	60
1	.79896	.62944	.80041	.63155	.80185	.63365	.80329	.63575	.80472	.63785	59
2	.79898	.62948	.80043	.63159	.80188	.63369	.80331	.63579	.80474	.63789	58
3	.79901	.62951	.80046	.63162	.80190	.63372	.80334	.63583	.80477	.63792	57
+ 1'	9.79903	.62955	9.80048	.63166	9.80192	.63376	9.80336	.63586	9.80479	.63796	56
5	.79905	.62958	.80050	.63169	.80195	.63379	.80339	.63590	.80482	.63799	55
6	.79908	.62962	.80053	.63173	.80197	.63383	.80341	.63593	.80484	.63803	54
7	.79910	.62965	.80055	.63176	.80200	.63386	.80343	.63597	.80486	.63806	53
+ 2'	9.79913	.62969	9.80058	.63180	9.80202	.63390	9.80346	.63600	9.80489	.63810	52
9	.79915	.62973	.80060	.63183	.80204	.63393	.80348	.63604	.80491	.63813	51
10	.79918	.62976	.80063	.63187	.80207	.63397	.80351	.63607	.80494	.63817	50
11	.79920	.62980	.80065	.63190	.80209	.63400	.80353	.63611	.80496	.63820	49
+ 3'	9.79922	.62983	9.80067	.63194	9.80212	.63404	9.80355	.63614	9.80498	.63824	48
13	.79925	.62987	.80070	.63197	.80214	.63407	.80358	.63618	.80501	.63827	47
14	.79927	.62990	.80072	.63201	.80216	.63411	.80360	.63621	.80503	.63831	46
15	.79930	.62994	.80075	.63204	.80219	.63414	.80362	.63625	.80505	.63834	45
+ 4'	9.79932	.62997	9.80077	.63208	9.80221	.63418	9.80365	.63628	9.80508	.63838	44
17	.79935	.63001	.80079	.63211	.80224	.63421	.80367	.63632	.80510	.63841	43
18	.79937	.63004	.80082	.63215	.80226	.63425	.80370	.63635	.80513	.63845	42
19	.79939	.63008	.80084	.63218	.80228	.63428	.80372	.63639	.80515	.63848	41
+ 5'	9.79942	.63011	9.80087	.63222	9.80231	.63429	9.80374	.63642	9.80517	.63852	40
21	.79944	.63015	.80089	.63225	.80233	.63435	.80377	.63646	.80520	.63855	39
22	.79947	.63018	.80091	.63229	.80236	.63439	.80379	.63649	.80522	.63859	38
23	.79949	.63022	.80094	.63232	.80238	.63442	.80382	.63653	.80524	.63862	37
+ 6'	9.79951	.63025	9.80096	.63236	9.80240	.63446	9.80384	.63656	9.80527	.63866	36
25	.79954	.63029	.80099	.63239	.80243	.63450	.80386	.63660	.80529	.63869	35
26	.79956	.63032	.80101	.63243	.80245	.63453	.80389	.63663	.80532	.63873	34
27	.79959	.63036	.80103	.63246	.80248	.63457	.80391	.63666	.80534	.63876	33
+ 7'	9.79961	.63039	9.80106	.63250	9.80250	.63460	9.80393	.63670	9.80536	.63880	32
29	.79964	.63043	.80108	.63253	.80252	.63464	.80396	.63673	.80539	.63883	31
30	.79966	.63046	.80111	.63257	.80255	.63467	.80398	.63677	.80541	.63887	30
31	.79968	.63050	.80113	.63260	.80257	.63471	.80401	.63680	.80543	.63890	29
+ 8'	9.79971	.63053	9.80116	.63264	9.80260	.63474	9.80403	.63684	9.80546	.63894	28
33	.79973	.63057	.80118	.63267	.80262	.63478	.80405	.63687	.80548	.63897	27
34	.79976	.63060	.80120	.63271	.80264	.63481	.80408	.63691	.80551	.63901	26
35	.79978	.63064	.80123	.63274	.80267	.63485	.80410	.63694	.80553	.63904	25
+ 9'	9.79980	.63067	9.80125	.63278	9.80269	.63488	9.80413	.63698	9.80555	.63908	24
37	.79983	.63071	.80128	.63281	.80272	.63492	.80415	.63701	.80558	.63911	23
38	.79985	.63074	.80130	.63285	.80274	.63495	.80417	.63705	.80560	.63915	22
39	.79988	.63078	.80132	.63288	.80276	.63499	.80420	.63708	.80562	.63918	21
+ 10'	9.79990	.63081	9.80135	.63292	9.80279	.63502	9.80422	.63712	9.80565	.63922	20
41	.79993	.63085	.80137	.63295	.80281	.63506	.80424	.63715	.80567	.63925	19
42	.79995	.63088	.80140	.63299	.80284	.63509	.80427	.63719	.80570	.63929	18
43	.79997	.63092	.80142	.63302	.80286	.63513	.80429	.63722	.80572	.63932	17
+ 11'	9.80000	.63095	9.80144	.63306	9.80288	.63516	9.80432	.63726	9.80574	.63936	16
45	.80002	.63099	.80147	.63309	.80291	.63520	.80434	.63729	.80577	.63939	15
46	.80005	.63102	.80149	.63313	.80293	.63523	.80436	.63733	.80579	.63943	14
47	.80007	.63106	.80152	.63316	.80296	.63527	.80439	.63736	.80581	.63946	13
+ 12'	9.80009	.63109	9.80154	.63320	9.80298	.63530	9.80441	.63740	9.80584	.63950	12
49	.80012	.63113	.80156	.63323	.80300	.63534	.80444	.63743	.80586	.63953	11
50	.80014	.63116	.80159	.63327	.80303	.63537	.80446	.63747	.80589	.63957	10
51	.80017	.63120	.80161	.63330	.80305	.63541	.80448	.63750	.80591	.63960	9
+ 13'	9.80019	.63123	9.80164	.63334	9.80307	.63544	9.80451	.63754	9.80593	.63964	8
53	.80022	.63127	.80166	.63337	.80310	.63548	.80453	.63757	.80596	.63967	7
54	.80024	.63131	.80168	.63341	.80312	.63551	.80455	.63761	.80598	.63971	6
55	.80026	.63134	.80171	.63344	.80315	.63555	.80458	.63764	.80600	.63974	5
+ 14'	9.80029	.63138	9.80173	.63348	9.80317	.63558	9.80460	.63768	9.80603	.63978	4
57	.80031	.63142	.80176	.63351	.80319	.63562	.80463	.63771	.80605	.63981	3
58	.80034	.63145	.80178	.63355	.80322	.63565	.80465	.63775	.80607	.63984	2
59	.80036	.63148	.80180	.63358	.80324	.63569	.80467	.63778	.80610	.63988	1
+ 15'	9.80038	.63152	9.80183	.63362	9.80327	.63572	9.80470	.63782	9.80612	.63991	0
		16h 59m		16h 58m		16h 57m		16h 56m		16h 55m	

TABLE IV.

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Haversines.

	7h 5m 106° 15'		7h 6m 106° 30'		7h 7m 106° 45'		7h 8m 107° 0'		7h 9m 107° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.80612	.63991	9.80754	.64201	9.80895	.64410	9.81036	.64619	9.81176	.64827	60
1	.80615	.63995	.80756	.64204	.80898	.64413	.81038	.64622	.81178	.64831	59
2	.80617	.63998	.80759	.64208	.80900	.64417	.81040	.64626	.81180	.64834	58
3	.80619	.64002	.80761	.64211	.80902	.64420	.81043	.64629	.81183	.64838	57
+ 1'	9.80622	.64005	9.80763	.64215	9.80905	.64424	9.81045	.64632	9.81185	.64841	56
5	.80624	.64009	.80766	.64218	.80907	.64427	.81047	.64636	.81187	.64844	55
6	.80626	.64012	.80768	.64222	.80909	.64431	.81050	.64639	.81190	.64848	54
7	.80629	.64016	.80771	.64225	.80912	.64434	.81052	.64643	.81192	.64851	53
+ 2'	9.80631	.64019	9.80773	.64229	9.80914	.64438	9.81054	.64646	9.81194	.64855	52
9	.80634	.64023	.80775	.64232	.80916	.64441	.81057	.64650	.81197	.64858	51
10	.80636	.64026	.80778	.64236	.80919	.64445	.81059	.64653	.81199	.64862	50
11	.80638	.64030	.80780	.64239	.80921	.64448	.81061	.64657	.81201	.64865	49
+ 3'	9.80641	.64033	9.80782	.64243	9.80923	.64452	9.81064	.64660	9.81204	.64869	48
13	.80643	.64037	.80785	.64246	.80926	.64455	.81066	.64664	.81206	.64872	47
14	.80645	.64040	.80787	.64250	.80928	.64459	.81068	.64667	.81208	.64876	46
15	.80648	.64044	.80789	.64253	.80930	.64462	.81071	.64671	.81211	.64879	45
+ 4'	9.80650	.64047	9.80792	.64257	9.80933	.64466	.81073	.64674	9.81213	.64883	44
17	.80652	.64051	.80794	.64260	.80935	.64469	.81075	.64678	.81215	.64886	43
18	.80655	.64054	.80796	.64264	.80937	.64472	.81078	.64681	.81217	.64890	42
19	.80657	.64058	.80799	.64267	.80940	.64476	.81080	.64685	.81220	.64893	41
+ 5'	9.80660	.64061	9.80801	.64270	9.80942	.64479	9.81082	.64688	9.81222	.64897	40
21	.80662	.64065	.80804	.64274	.80944	.64483	.81085	.64692	.81224	.64900	39
22	.80664	.64068	.80806	.64277	.80947	.64486	.81087	.64695	.81227	.64903	38
23	.80667	.64072	.80808	.64281	.80949	.64490	.81089	.64699	.81229	.64907	37
+ 6'	9.80669	.64075	9.80811	.64284	9.80952	.64493	9.81092	.64702	9.81231	.64910	36
25	.80671	.64079	.80813	.64288	.80954	.64497	.81094	.64705	.81234	.64914	35
26	.80674	.64082	.80815	.64291	.80956	.64500	.81096	.64709	.81236	.64917	34
27	.80676	.64086	.80818	.64295	.80959	.64504	.81099	.64712	.81238	.64921	33
+ 7'	9.80678	.64089	9.80820	.64298	9.80961	.64507	9.81101	.64716	9.81241	.64924	32
29	.80681	.64093	.80822	.64302	.80963	.64511	.81103	.64719	.81243	.64928	31
30	.80683	.64096	.80825	.64305	.80966	.64514	.81106	.64723	.81245	.64931	30
31	.80686	.64100	.80827	.64309	.80968	.64518	.81108	.64726	.81248	.64935	29
+ 8'	9.80688	.64103	9.80829	.64312	9.80970	.64521	9.81110	.64730	9.81250	.64938	28
33	.80690	.64107	.80832	.64316	.80973	.64525	.81113	.64733	.81252	.64942	27
34	.80693	.64110	.80834	.64319	.80975	.64528	.81115	.64737	.81255	.64945	26
35	.80695	.64114	.80836	.64323	.80977	.64532	.81117	.64740	.81257	.64949	25
+ 9'	9.80697	.64117	9.80839	.64326	9.80980	.64535	9.81120	.64744	9.81259	.64952	24
37	.80700	.64121	.80841	.64330	.80982	.64539	.81122	.64747	.81262	.64956	23
38	.80702	.64124	.80844	.64333	.80984	.64542	.81124	.64751	.81264	.64959	22
39	.80704	.64128	.80846	.64337	.80987	.64546	.81127	.64754	.81266	.64962	21
+ 10'	9.80707	.64131	9.80848	.64340	9.80989	.64549	9.81129	.64758	9.81269	.64966	20
41	.80709	.64135	.80851	.64344	.80991	.64552	.81131	.64761	.81271	.64969	19
42	.80712	.64138	.80853	.64347	.80994	.64556	.81134	.64765	.81273	.64973	18
43	.80714	.64142	.80855	.64351	.80996	.64559	.81136	.64768	.81276	.64976	17
+ 11'	9.80716	.64145	9.80858	.64354	9.80998	.64563	9.81138	.64772	9.81278	.64980	16
45	.80719	.64148	.80860	.64358	.81001	.64566	.81141	.64775	.81280	.64983	15
46	.80721	.64152	.80862	.64361	.81003	.64570	.81143	.64778	.81282	.64987	14
47	.80723	.64155	.80865	.64365	.81005	.64573	.81145	.64782	.81285	.64990	13
+ 12'	9.80726	.64159	9.80867	.64368	9.81008	.64577	9.81148	.64785	9.81287	.64994	12
49	.80728	.64162	.80869	.64372	.81010	.64580	.81150	.64789	.81289	.64997	11
50	.80730	.64166	.80872	.64375	.81012	.64584	.81152	.64792	.81292	.65001	10
51	.80733	.64169	.80874	.64378	.81015	.64587	.81155	.64796	.81294	.65004	9
+ 13'	9.80735	.64173	9.80876	.64382	9.81017	.64591	9.81157	.64799	9.81296	.65008	8
53	.80738	.64176	.80879	.64385	.81019	.64594	.81159	.64803	.81299	.65011	7
54	.80740	.64180	.80881	.64389	.81022	.64598	.81162	.64806	.81301	.65014	6
55	.80742	.64183	.80883	.64392	.81024	.64601	.81164	.64810	.81303	.65018	5
+ 14'	9.80745	.64187	9.80886	.64396	9.81026	.64605	9.81166	.64813	9.81306	.65021	4
57	.80747	.64190	.80888	.64399	.81029	.64608	.81169	.64817	.81308	.65025	3
58	.80749	.64194	.80891	.64403	.81031	.64612	.81171	.64820	.81310	.65028	2
59	.80752	.64197	.80893	.64406	.81033	.64615	.81173	.64824	.81313	.65032	1
+ 15'	9.80754	.64201	9.80895	.64410	9.81036	.64619	9.81176	.64827	9.81315	.65035	0
	16h 54m		16h 53m		16h 52m		16h 51m		16h 50m		



Haversines.

s	7h 10m 107° 30'		7h 11m 107° 45'		7h 12m 108° 0'		7h 13m 108° 15'		7h 14m 108° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.81315	<b>.65035</b>	9.81454	<b>.65243</b>	9.81592	<b>.65451</b>	9.81729	<b>.65658</b>	9.81866	<b>.65865</b>	60
1	.81317	<b>.65039</b>	.81456	<b>.65247</b>	.81594	<b>.65454</b>	.81731	<b>.65662</b>	.81868	<b>.65869</b>	59
2	.81320	<b>.65042</b>	.81458	<b>.65250</b>	.81596	<b>.65458</b>	.81733	<b>.65665</b>	.81870	<b>.65872</b>	58
3	.81322	<b>.65046</b>	.81460	<b>.65254</b>	.81598	<b>.65461</b>	.81736	<b>.65668</b>	.81872	<b>.65876</b>	57
+ 1'	9.81324	<b>.65049</b>	9.81463	<b>.65257</b>	9.81601	<b>.65465</b>	9.81738	<b>.65672</b>	9.81875	<b>.65879</b>	56
5	.81326	<b>.65053</b>	.81465	<b>.65261</b>	.81603	<b>.65468</b>	.81740	<b>.65675</b>	.81877	<b>.65882</b>	55
6	.81329	<b>.65056</b>	.81467	<b>.65264</b>	.81605	<b>.65472</b>	.81743	<b>.65679</b>	.81879	<b>.65886</b>	54
7	.81331	<b>.65060</b>	.81470	<b>.65267</b>	.81608	<b>.65475</b>	.81745	<b>.65682</b>	.81882	<b>.65889</b>	53
+ 2'	9.81333	<b>.65063</b>	9.81472	<b>.65271</b>	9.81610	<b>.65479</b>	9.81747	<b>.65686</b>	9.81884	<b>.65893</b>	52
9	.81336	<b>.65066</b>	.81474	<b>.65274</b>	.81612	<b>.65482</b>	.81749	<b>.65689</b>	.81886	<b>.65896</b>	51
10	.81338	<b>.65070</b>	.81477	<b>.65278</b>	.81614	<b>.65485</b>	.81752	<b>.65693</b>	.81888	<b>.65900</b>	50
11	.81340	<b>.65073</b>	.81479	<b>.65281</b>	.81617	<b>.65489</b>	.81754	<b>.65696</b>	.81891	<b>.65903</b>	49
+ 3'	9.81343	<b>.65077</b>	9.81481	<b>.65285</b>	9.81619	<b>.65492</b>	9.81756	<b>.65700</b>	9.81893	<b>.65907</b>	48
13	.81345	<b>.65080</b>	.81483	<b>.65288</b>	.81621	<b>.65496</b>	.81759	<b>.65703</b>	.81895	<b>.65910</b>	47
14	.81347	<b>.65084</b>	.81486	<b>.65292</b>	.81624	<b>.65499</b>	.81761	<b>.65707</b>	.81897	<b>.65914</b>	46
15	.81350	<b>.65087</b>	.81488	<b>.65295</b>	.81626	<b>.65503</b>	.81763	<b>.65710</b>	.81900	<b>.65917</b>	45
+ 4'	9.81352	<b>.65091</b>	9.81490	<b>.65299</b>	9.81628	<b>.65506</b>	9.81765	<b>.65713</b>	9.81902	<b>.65920</b>	44
17	.81354	<b>.65094</b>	.81493	<b>.65302</b>	.81631	<b>.65510</b>	.81768	<b>.65717</b>	.81904	<b>.65924</b>	43
18	.81357	<b>.65098</b>	.81495	<b>.65306</b>	.81633	<b>.65513</b>	.81770	<b>.65720</b>	.81907	<b>.65927</b>	42
19	.81359	<b>.65101</b>	.81497	<b>.65309</b>	.81635	<b>.65516</b>	.81772	<b>.65724</b>	.81909	<b>.65931</b>	41
+ 5'	9.81361	<b>.65105</b>	9.81500	<b>.65312</b>	9.81637	<b>.65520</b>	9.81775	<b>.65727</b>	9.81911	<b>.65934</b>	40
21	.81364	<b>.65108</b>	.81502	<b>.65316</b>	.81640	<b>.65523</b>	.81777	<b>.65731</b>	.81913	<b>.65938</b>	39
22	.81366	<b>.65112</b>	.81505	<b>.65319</b>	.81642	<b>.65527</b>	.81779	<b>.65734</b>	.81916	<b>.65941</b>	38
23	.81368	<b>.65115</b>	.81507	<b>.65323</b>	.81644	<b>.65530</b>	.81781	<b>.65738</b>	.81918	<b>.65944</b>	37
+ 6'	9.81370	<b>.65118</b>	9.81509	<b>.65326</b>	9.81647	<b>.65534</b>	9.81784	<b>.65741</b>	9.81920	<b>.65948</b>	36
25	.81373	<b>.65122</b>	.81511	<b>.65330</b>	.81649	<b>.65537</b>	.81786	<b>.65744</b>	.81922	<b>.65951</b>	35
26	.81375	<b>.65125</b>	.81513	<b>.65333</b>	.81651	<b>.65541</b>	.81788	<b>.65748</b>	.81925	<b>.65955</b>	34
27	.81377	<b>.65129</b>	.81516	<b>.65337</b>	.81653	<b>.65544</b>	.81791	<b>.65751</b>	.81927	<b>.65958</b>	33
+ 7'	9.81380	<b>.65132</b>	9.81518	<b>.65340</b>	9.81656	<b>.65548</b>	9.81793	<b>.65755</b>	9.81929	<b>.65962</b>	32
29	.81382	<b>.65136</b>	.81520	<b>.65344</b>	.81658	<b>.65551</b>	.81795	<b>.65758</b>	.81931	<b>.65965</b>	31
30	.81384	<b>.65139</b>	.81523	<b>.65347</b>	.81660	<b>.65555</b>	.81797	<b>.65762</b>	.81934	<b>.65969</b>	30
31	.81387	<b>.65143</b>	.81525	<b>.65351</b>	.81663	<b>.65558</b>	.81800	<b>.65765</b>	.81936	<b>.65972</b>	29
+ 8'	9.81389	<b>.65146</b>	9.81527	<b>.65354</b>	9.81665	<b>.65561</b>	9.81802	<b>.65769</b>	9.81938	<b>.65976</b>	28
33	.81391	<b>.65150</b>	.81530	<b>.65357</b>	.81667	<b>.65565</b>	.81804	<b>.65772</b>	.81941	<b>.65979</b>	27
34	.81394	<b>.65153</b>	.81532	<b>.65361</b>	.81669	<b>.65568</b>	.81806	<b>.65776</b>	.81943	<b>.65982</b>	26
35	.81396	<b>.65157</b>	.81534	<b>.65364</b>	.81672	<b>.65572</b>	.81809	<b>.65779</b>	.81945	<b>.65986</b>	25
+ 9'	9.81398	<b>.65160</b>	9.81536	<b>.65368</b>	9.81674	<b>.65575</b>	9.81811	<b>.65782</b>	9.81947	<b>.65989</b>	24
37	.81400	<b>.65164</b>	.81539	<b>.65372</b>	.81676	<b>.65579</b>	.81813	<b>.65786</b>	.81950	<b>.65993</b>	23
38	.81403	<b>.65167</b>	.81541	<b>.65375</b>	.81679	<b>.65582</b>	.81816	<b>.65789</b>	.81952	<b>.65996</b>	22
39	.81405	<b>.65171</b>	.81543	<b>.65378</b>	.81681	<b>.65586</b>	.81818	<b>.65793</b>	.81954	<b>.66000</b>	21
+ 10'	9.81407	<b>.65174</b>	9.81546	<b>.65382</b>	9.81683	<b>.65589</b>	9.81820	<b>.65796</b>	9.81956	<b>.66003</b>	20
41	.81410	<b>.65177</b>	.81548	<b>.65385</b>	.81685	<b>.65593</b>	.81822	<b>.65800</b>	.81959	<b>.66006</b>	19
42	.81412	<b>.65181</b>	.81550	<b>.65389</b>	.81688	<b>.65596</b>	.81825	<b>.65803</b>	.81961	<b>.66010</b>	18
43	.81414	<b>.65184</b>	.81552	<b>.65392</b>	.81690	<b>.65599</b>	.81827	<b>.65807</b>	.81963	<b>.66013</b>	17
+ 11'	9.81417	<b>.65188</b>	9.81555	<b>.65396</b>	9.81692	<b>.65603</b>	.81829	<b>.65810</b>	9.81965	<b>.66017</b>	16
45	.81419	<b>.65191</b>	.81557	<b>.65399</b>	.81695	<b>.65606</b>	.81832	<b>.65813</b>	.81968	<b>.66020</b>	15
46	.81421	<b>.65195</b>	.81559	<b>.65402</b>	.81697	<b>.65610</b>	.81834	<b>.65817</b>	.81970	<b>.66024</b>	14
47	.81424	<b>.65198</b>	.81562	<b>.65406</b>	.81699	<b>.65613</b>	.81836	<b>.65820</b>	.81972	<b>.66027</b>	13
+ 12'	9.81426	<b>.65202</b>	9.81564	<b>.65409</b>	9.81701	<b>.65617</b>	9.81838	<b>.65824</b>	9.81975	<b>.66031</b>	12
49	.81428	<b>.65205</b>	.81566	<b>.65413</b>	.81704	<b>.65620</b>	.81841	<b>.65827</b>	.81977	<b>.66034</b>	11
50	.81430	<b>.65209</b>	.81569	<b>.65416</b>	.81706	<b>.65624</b>	.81843	<b>.65831</b>	.81979	<b>.66038</b>	10
51	.81433	<b>.65212</b>	.81571	<b>.65420</b>	.81708	<b>.65627</b>	.81845	<b>.65834</b>	.81981	<b>.66041</b>	9
+ 13'	9.81435	<b>.65216</b>	9.81573	<b>.65423</b>	9.81711	<b>.65630</b>	9.81847	<b>.65838</b>	9.81984	<b>.66044</b>	8
53	.81437	<b>.65219</b>	.81575	<b>.65427</b>	.81713	<b>.65634</b>	.81850	<b>.65841</b>	.81986	<b>.66048</b>	7
54	.81440	<b>.65222</b>	.81578	<b>.65430</b>	.81715	<b>.65637</b>	.81852	<b>.65845</b>	.81988	<b>.66051</b>	6
55	.81442	<b>.65226</b>	.81580	<b>.65434</b>	.81717	<b>.65641</b>	.81854	<b>.65848</b>	.81990	<b>.66055</b>	5
+ 14'	9.81444	<b>.65229</b>	9.81582	<b>.65437</b>	9.81720	<b>.65644</b>	9.81857	<b>.65851</b>	9.81993	<b>.66058</b>	4
57	.81447	<b>.65233</b>	.81585	<b>.65440</b>	.81722	<b>.65648</b>	.81859	<b>.65855</b>	.81995	<b>.66062</b>	3
58	.81449	<b>.65236</b>	.81587	<b>.65444</b>	.81724	<b>.65651</b>	.81861	<b>.65858</b>	.81997	<b>.66065</b>	2
59	.81451	<b>.65240</b>	.81589	<b>.65447</b>	.81727	<b>.65655</b>	.81863	<b>.65862</b>	.81999	<b>.66068</b>	1
+ 15'	9.81454	<b>.65243</b>	9.81592	<b>.65451</b>	9.81729	<b>.65658</b>	9.81866	<b>.65865</b>	9.82002	<b>.66072</b>	0
		16h 49m		16h 48m		16h 47m		16h 46m		16h 45m	

TABLE IV.

Haversines.

s	7h 15m 108° 45'		7h 16m 109° 0'		7h 17m 109° 15'		7h 18m 109° 30'		7h 19m 109° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.82002	.66072	9.82137	.66278	9.82272	.66485	9.82406	.66690	9.82540	.66896	60
1	.82004	.66075	.82139	.66282	.82274	.66488	.82409	.66694	.82542	.66899	59
2	.82006	.66079	.82142	.66285	.82277	.66491	.82411	.66697	.82544	.66903	58
3	.82009	.66082	.82144	.66289	.82279	.66495	.82413	.66701	.82547	.66906	57
+ 1'	9.82011	.66086	9.82146	.66292	9.82281	.66498	9.82415	.66704	9.82549	.66910	56
5	.82013	.66089	.82148	.66296	.82283	.66502	.82417	.66707	.82551	.66913	55
6	.82015	.66093	.82151	.66299	.82286	.66505	.82420	.66711	.82553	.66916	54
7	.82018	.66096	.82153	.66302	.82288	.66508	.82422	.66714	.82555	.66920	53
+ 2'	9.82020	.66100	9.82155	.66306	9.82290	.66512	9.82424	.66718	9.82558	.66923	52
9	.82022	.66103	.82157	.66309	.82292	.66515	.82426	.66721	.82560	.66927	51
10	.82024	.66106	.82160	.66313	.82294	.66519	.82429	.66725	.82562	.66930	50
11	.82027	.66110	.82162	.66316	.82297	.66522	.82431	.66728	.82564	.66933	49
+ 3'	9.82029	.66113	9.82164	.66320	9.82299	.66526	9.82433	.66731	9.82567	.66937	48
13	.82031	.66117	.82166	.66323	.82301	.66529	.82435	.66735	.82569	.66940	47
14	.82033	.66120	.82169	.66327	.82303	.66533	.82438	.66738	.82571	.66944	46
15	.82036	.66124	.82171	.66330	.82306	.66536	.82440	.66742	.82573	.66947	45
+ 4'	9.82038	.66127	9.82173	.66333	9.82308	.66539	9.82442	.66745	9.82575	.66951	44
17	.82040	.66130	.82175	.66337	.82310	.66543	.82444	.66749	.82578	.66954	43
18	.82042	.66134	.82178	.66340	.82312	.66546	.82446	.66752	.82580	.66957	42
19	.82045	.66137	.82180	.66344	.82315	.66550	.82449	.66755	.82582	.66961	41
+ 5'	9.82047	.66141	9.82182	.66347	9.82317	.66553	9.82451	.66759	9.82584	.66964	40
21	.82049	.66144	.82184	.66351	.82319	.66557	.82453	.66762	.82587	.66968	39
22	.82051	.66148	.82187	.66354	.82321	.66560	.82455	.66766	.82589	.66971	38
23	.82054	.66151	.82189	.66357	.82324	.66563	.82458	.66769	.82591	.66975	37
+ 6'	9.82056	.66155	9.82191	.66361	9.82326	.66567	9.82460	.66773	9.82593	.66978	36
25	.82058	.66158	.82193	.66364	.82328	.66570	.82462	.66776	.82595	.66981	35
26	.82061	.66161	.82196	.66368	.82330	.66574	.82464	.66779	.82598	.66985	34
27	.82063	.66165	.82198	.66371	.82333	.66577	.82467	.66783	.82600	.66988	33
+ 7'	9.82065	.66168	9.82200	.66375	9.82335	.66581	9.82469	.66786	9.82602	.66992	32
29	.82067	.66172	.82202	.66378	.82337	.66584	.82471	.66790	.82604	.66995	31
30	.82070	.66175	.82205	.66382	.82339	.66587	.82473	.66793	.82606	.66998	30
31	.82072	.66179	.82207	.66385	.82341	.66591	.82475	.66797	.82609	.67002	29
+ 8'	9.82074	.66182	9.82209	.66388	9.82344	.66594	9.82478	.66800	9.82611	.67005	28
33	.82076	.66186	.82211	.66392	.82346	.66598	.82480	.66803	.82613	.67009	27
34	.82079	.66189	.82214	.66395	.82348	.66601	.82482	.66807	.82615	.67012	26
35	.82081	.66192	.82216	.66399	.82350	.66605	.82484	.66810	.82618	.67016	25
+ 9'	9.82083	.66196	9.82218	.66402	9.82353	.66608	9.82487	.66814	9.82620	.67019	24
37	.82085	.66199	.82220	.66406	.82355	.66611	.82489	.66817	.82622	.67022	23
38	.82088	.66203	.82223	.66409	.82357	.66615	.82491	.66821	.82624	.67026	22
39	.82090	.66206	.82225	.66412	.82359	.66618	.82493	.66824	.82627	.67029	21
+ 10'	9.82092	.66210	9.82227	.66416	9.82362	.66622	9.82495	.66827	9.82629	.67033	20
41	.82094	.66213	.82229	.66419	.82364	.66625	.82498	.66831	.82631	.67036	19
42	.82097	.66217	.82232	.66423	.82366	.66629	.82500	.66834	.82633	.67039	18
43	.82099	.66220	.82234	.66426	.82368	.66632	.82502	.66838	.82635	.67043	17
+ 11'	9.82101	.66223	9.82236	.66430	9.82371	.66635	9.82504	.66841	9.82638	.67046	16
45	.82103	.66227	.82238	.66433	.82373	.66639	.82507	.66844	.82640	.67050	15
46	.82106	.66230	.82241	.66436	.82375	.66642	.82509	.66848	.82642	.67053	14
47	.82108	.66234	.82243	.66440	.82377	.66646	.82511	.66851	.82644	.67057	13
+ 12'	9.82110	.66237	9.82245	.66443	9.82380	.66649	9.82513	.66855	9.82646	.67060	12
49	.82112	.66241	.82247	.66447	.82382	.66653	.82515	.66858	.82649	.67063	11
50	.82115	.66244	.82250	.66450	.82384	.66656	.82518	.66862	.82651	.67067	10
51	.82117	.66247	.82252	.66454	.82386	.66659	.82520	.66865	.82653	.67070	9
+ 13'	9.82119	.66251	9.82254	.66457	9.82388	.66663	9.82522	.66868	9.82655	.67074	8
53	.82121	.66254	.82256	.66460	.82391	.66666	.82524	.66872	.82657	.67077	7
54	.82124	.66258	.82259	.66464	.82393	.66670	.82527	.66875	.82660	.67081	6
55	.82126	.66261	.82261	.66467	.82395	.66673	.82529	.66879	.82662	.67084	5
+ 14'	9.82128	.66265	9.82263	.66471	9.82397	.66677	9.82531	.66882	9.82664	.67087	4
57	.82130	.66268	.82265	.66474	.82400	.66680	.82533	.66886	.82666	.67091	3
58	.82133	.66272	.82268	.66478	.82402	.66683	.82535	.66889	.82668	.67094	2
59	.82135	.66275	.82270	.66481	.82404	.66687	.82538	.66892	.82671	.67098	1
+ 15'	9.82137	.66278	9.82272	.66485	9.82406	.66690	9.82540	.66896	9.82673	.67101	0
	16h 44m		16h 43m		16h 42m		16h 41m		16h 40m		



TABLE IV.  
Haversines.

s	7h 20m 110° 0'		7h 21m 110° 15'		7h 22m 110° 30'		7h 23m 110° 45'		7h 24m 111° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.82673	.67101	9.82805	.67306	9.82937	.67510	9.83068	.67715	9.83199	.67918	60
1	.82675	.67104	.82807	.67309	.82939	.67514	.83070	.67718	.83201	.67922	59
2	.82677	.67108	.82810	.67313	.82941	.67517	.83073	.67721	.83203	.67925	58
3	.82680	.67111	.82812	.67316	.82944	.67521	.83075	.67725	.83205	.67929	57
+ 1'	9.82682	.67115	9.82814	.67320	9.82946	.67524	9.83077	.67728	9.83207	.67932	56
5	.82684	.67118	.82816	.67323	.82948	.67527	.83079	.67732	.83210	.67935	55
6	.82686	.67122	.82818	.67326	.82950	.67531	.83081	.67735	.83212	.67939	54
7	.82688	.67125	.82821	.67330	.82952	.67534	.83083	.67738	.83214	.67942	53
+ 2'	9.82691	.67128	9.82823	.67333	9.82955	.67538	9.83086	.67742	9.83216	.67946	52
9	.82693	.67132	.82825	.67337	.82957	.67541	.83088	.67745	.83218	.67949	51
10	.82695	.67135	.82827	.67340	.82959	.67544	.83090	.67749	.83220	.67952	50
11	.82697	.67139	.82829	.67343	.82961	.67548	.83092	.67752	.83223	.67956	49
+ 3'	9.82699	.67142	9.82832	.67347	9.82963	.67551	9.83094	.67755	9.83225	.67959	48
13	.82702	.67145	.82834	.67350	.82966	.67555	.83097	.67759	.83227	.67963	47
14	.82704	.67149	.82836	.67354	.82968	.67558	.83099	.67762	.83229	.67966	46
15	.82706	.67152	.82838	.67357	.82970	.67561	.83101	.67766	.83231	.67969	45
+ 4'	9.82708	.67156	9.82840	.67360	9.82972	.67565	9.83103	.67769	9.83233	.67973	44
17	.82710	.67159	.82843	.67364	.82974	.67568	.83105	.67772	.83236	.67976	43
18	.82713	.67163	.82845	.67367	.82976	.67572	.83107	.67776	.83238	.67979	42
19	.82715	.67166	.82847	.67371	.82979	.67575	.83110	.67779	.83240	.67983	41
+ 5'	9.82717	.67169	9.82849	.67374	9.82981	.67578	9.83112	.67783	9.83242	.67986	40
21	.82719	.67173	.82851	.67377	.82983	.67582	.83114	.67786	.83244	.67990	39
22	.82722	.67176	.82854	.67381	.82985	.67585	.83116	.67789	.83246	.67993	38
23	.82724	.67180	.82856	.67384	.82987	.67589	.83118	.67793	.83249	.67996	37
+ 6'	9.82726	.67183	9.82858	.67388	9.82990	.67592	9.83120	.67796	9.83251	.68000	36
25	.82728	.67186	.82860	.67391	.82992	.67595	.83123	.67800	.83253	.68003	35
26	.82730	.67190	.82862	.67395	.82994	.67599	.83125	.67803	.83255	.68007	34
27	.82733	.67193	.82865	.67398	.82996	.67602	.83127	.67806	.83257	.68010	33
+ 7'	9.82735	.67197	9.82867	.67401	9.82998	.67606	9.83129	.67810	9.83259	.68013	32
29	.82737	.67200	.82869	.67405	.83001	.67609	.83131	.67813	.83262	.68017	31
30	.82739	.67203	.82871	.67408	.83003	.67613	.83134	.67817	.83264	.68020	30
31	.82741	.67207	.82873	.67412	.83005	.67616	.83136	.67820	.83266	.68024	29
+ 8'	9.82744	.67210	9.82876	.67415	9.83007	.67619	9.83138	.67823	9.83268	.68027	28
33	.82746	.67214	.82878	.67418	.83009	.67623	.83140	.67827	.83270	.68030	27
34	.82748	.67217	.82880	.67422	.83011	.67626	.83142	.67830	.83272	.68034	26
35	.82750	.67221	.82882	.67425	.83014	.67630	.83144	.67834	.83275	.68037	25
+ 9'	9.82752	.67224	9.82884	.67429	9.83016	.67633	9.83147	.67837	9.83277	.68041	24
37	.82755	.67227	.82887	.67432	.83018	.67636	.83149	.67840	.83279	.68044	23
38	.82757	.67231	.82889	.67435	.83020	.67640	.83151	.67844	.83281	.68047	22
39	.82759	.67234	.82891	.67439	.83022	.67643	.83153	.67847	.83283	.68051	21
+ 10'	9.82761	.67238	9.82893	.67442	9.83025	.67647	9.83155	.67850	9.83285	.68054	20
41	.82763	.67241	.82895	.67446	.83027	.67650	.83157	.67854	.83288	.68058	19
42	.82766	.67244	.82898	.67449	.83029	.67653	.83160	.67857	.83290	.68061	18
43	.82768	.67248	.82900	.67452	.83031	.67657	.83162	.67861	.83292	.68064	17
+ 11'	9.82770	.67251	9.82902	.67456	9.83033	.67660	9.83164	.67864	9.83294	.68068	16
45	.82772	.67255	.82904	.67459	.83035	.67664	.83166	.67868	.83296	.68071	15
46	.82774	.67258	.82906	.67463	.83038	.67667	.83168	.67871	.83298	.68074	14
47	.82777	.67261	.82909	.67466	.83040	.67670	.83170	.67874	.83301	.68078	13
+ 12'	9.82779	.67265	9.82911	.67469	9.83042	.67674	9.83173	.67878	9.83303	.68081	12
49	.82781	.67268	.82913	.67473	.83044	.67677	.83175	.67881	.83305	.68085	11
50	.82783	.67272	.82915	.67476	.83046	.67681	.83177	.67884	.83307	.68088	10
51	.82785	.67275	.82917	.67480	.83049	.67684	.83179	.67888	.83309	.68091	9
+ 13'	9.82788	.67279	9.82920	.67483	9.83051	.67687	9.83181	.67891	9.83311	.68095	8
53	.82790	.67282	.82922	.67487	.83053	.67691	.83184	.67895	.83314	.68098	7
54	.82792	.67285	.82924	.67490	.83055	.67694	.83186	.67898	.83316	.68102	6
55	.82794	.67289	.82926	.67493	.83057	.67698	.83188	.67901	.83318	.68105	5
+ 14'	9.82796	.67292	9.82928	.67497	9.83059	.67701	9.83190	.67905	9.83320	.68108	4
57	.82799	.67296	.82930	.67500	.83062	.67704	.83192	.67908	.83322	.68112	3
58	.82801	.67299	.82933	.67504	.83064	.67708	.83194	.67912	.83324	.68115	2
59	.82803	.67302	.82935	.67507	.83066	.67711	.83197	.67915	.83327	.68119	1
+ 15'	9.82805	.67306	9.82937	.67510	9.83068	.67715	9.83199	.67918	9.83329	.68122	0
	16h 39m		16h 38m		16h 37m		16h 36m		16h 35m		

TABLE IV.

Haversines.

s	7h 25m 111° 15'		7h 26m 111° 30'		7h 27m 111° 45'		7h 28m 112° 0'		7h 29m 112° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.83329	.68122	9.83458	.68325	9.83587	.68528	9.83715	.68730	9.83842	.68932	60
1	.83331	.68125	.83460	.68328	.83589	.68531	.83717	.68734	.83844	.68936	59
2	.83333	.68129	.83462	.68332	.83591	.68535	.83719	.68737	.83847	.68939	58
3	.83335	.68132	.83464	.68335	.83593	.68538	.83721	.68740	.83849	.68943	57
+ 1'	9.83337	.68135	9.83467	.68339	9.83595	.68541	9.83723	.68744	9.83851	.68946	56
5	.83339	.68139	.83469	.68342	.83597	.68545	.83725	.68747	.83853	.68949	55
6	.83342	.68142	.83471	.68345	.83600	.68548	.83728	.68751	.83855	.68953	54
7	.83344	.68146	.83473	.68349	.83602	.68552	.83730	.68754	.83857	.68956	53
+ 2'	9.83346	.68149	9.83475	.68352	9.83604	.68555	9.83732	.68757	9.83859	.68959	52
9	.83348	.68152	.83477	.68356	.83606	.68558	.83734	.68761	.83861	.68963	51
10	.83350	.68156	.83480	.68359	.83608	.68562	.83736	.68764	.83864	.68966	50
11	.83352	.68159	.83482	.68362	.83610	.68565	.83738	.68767	.83866	.68969	49
+ 3'	9.83355	.68163	9.83484	.68366	9.83612	.68568	9.83740	.68771	9.83868	.68973	48
13	.83357	.68166	.83486	.68369	.83615	.68572	.83743	.68774	.83870	.68976	47
14	.83359	.68169	.83488	.68372	.83617	.68575	.83745	.68778	.83872	.68980	46
15	.83361	.68173	.83490	.68376	.83619	.68579	.83747	.68781	.83874	.68983	45
+ 4'	9.83363	.68176	9.83492	.68379	9.83621	.68582	9.83749	.68784	9.83876	.68986	44
17	.83365	.68180	.83495	.68383	.83623	.68585	.83751	.68788	.83878	.68990	43
18	.83368	.68183	.83497	.68386	.83625	.68589	.83753	.68791	.83881	.68993	42
19	.83370	.68186	.83499	.68389	.83627	.68592	.83755	.68794	.83883	.68996	41
+ 5'	9.83372	.68190	9.83501	.68393	9.83630	.68595	9.83757	.68798	9.83885	.69000	40
21	.83374	.68193	.83503	.68396	.83632	.68599	.83760	.68801	.83887	.69003	39
22	.83376	.68196	.83505	.68399	.83634	.68602	.83762	.68804	.83889	.69006	38
23	.83378	.68200	.83507	.68403	.83636	.68606	.83764	.68808	.83891	.69010	37
+ 6'	9.83380	.68203	9.83510	.68406	9.83638	.68609	9.83766	.68811	9.83893	.69013	36
25	.83383	.68207	.83512	.68410	.83640	.68612	.83768	.68815	.83895	.69017	35
26	.83385	.68210	.83514	.68413	.83642	.68616	.83770	.68818	.83897	.69020	34
27	.83387	.68213	.83516	.68416	.83644	.68619	.83772	.68821	.83900	.69023	33
+ 7'	9.83389	.68217	9.83518	.68420	9.83647	.68622	9.83774	.68825	9.83902	.69027	32
29	.83391	.68220	.83520	.68423	.83649	.68626	.83777	.68828	.83904	.69030	31
30	.83393	.68224	.83522	.68427	.83651	.68629	.83779	.68831	.83906	.69033	30
31	.83396	.68227	.83525	.68430	.83653	.68633	.83781	.68835	.83908	.69037	29
+ 8'	9.83398	.68230	9.83527	.68433	9.83655	.68636	9.83783	.68838	9.83910	.69040	28
33	.83400	.68234	.83529	.68437	.83657	.68639	.83785	.68842	.83912	.69044	27
34	.83402	.68237	.83531	.68440	.83659	.68643	.83787	.68845	.83914	.69047	26
35	.83404	.68240	.83533	.68443	.83662	.68646	.83789	.68848	.83916	.69050	25
+ 9'	9.83406	.68244	9.83535	.68447	9.83664	.68649	9.83791	.68852	9.83919	.69054	24
37	.83409	.68247	.83537	.68450	.83666	.68653	.83794	.68855	.83921	.69057	23
38	.83411	.68251	.83540	.68454	.83668	.68656	.83796	.68858	.83923	.69060	22
39	.83413	.68254	.83542	.68457	.83670	.68660	.83798	.68862	.83925	.69064	21
+ 10'	9.83415	.68257	9.83544	.68460	9.83672	.68663	9.83800	.68865	9.83927	.69067	20
41	.83417	.68261	.83546	.68464	.83674	.68666	.83802	.68869	.83929	.69070	19
42	.83419	.68264	.83548	.68467	.83676	.68670	.83804	.68872	.83931	.69074	18
43	.83421	.68268	.83550	.68470	.83679	.68673	.83806	.68875	.83933	.69077	17
+ 11'	9.83424	.68271	9.83552	.68474	9.83681	.68676	9.83808	.68879	9.83935	.69080	16
45	.83426	.68274	.83555	.68477	.83683	.68680	.83811	.68882	.83938	.69084	15
46	.83428	.68278	.83557	.68481	.83685	.68683	.83813	.68885	.83940	.69087	14
47	.83430	.68281	.83559	.68484	.83687	.68687	.83815	.68889	.83942	.69091	13
+ 12'	9.83432	.68284	9.83561	.68487	9.83689	.68690	9.83817	.68892	9.83944	.69094	12
49	.83434	.68288	.83563	.68491	.83691	.68693	.83819	.68895	.83946	.69097	11
50	.83436	.68291	.83565	.68494	.83694	.68697	.83821	.68899	.83948	.69101	10
51	.83439	.68295	.83567	.68497	.83696	.68700	.83823	.68902	.83950	.69104	9
+ 13'	9.83441	.68298	9.83570	.68501	9.83698	.68703	9.83825	.68906	9.83952	.69107	8
53	.83443	.68301	.83572	.68504	.83700	.68707	.83828	.68909	.83955	.69111	7
54	.83445	.68305	.83574	.68508	.83702	.68710	.83830	.68912	.83957	.69114	6
55	.83447	.68308	.83576	.68511	.83704	.68713	.83832	.68916	.83959	.69117	5
+ 14'	9.83449	.68312	9.83578	.68515	9.83706	.68717	9.83834	.68919	9.83961	.69121	4
57	.83452	.68315	.83580	.68518	.83708	.68720	.83836	.68922	.83963	.69124	3
58	.83454	.68318	.83582	.68521	.83711	.68724	.83838	.68926	.83965	.69127	2
59	.83456	.68322	.83585	.68525	.83713	.68727	.83840	.68929	.83967	.69131	1
+ 15'	9.83458	.68325	9.83587	.68528	9.83715	.68730	9.83842	.68932	9.83969	.69134	0
	16h 34m		16h 33m		16h 32m		16h 31m		16h 30m		



Haversines.

s	7h 30m 112° 30'		7h 31m 112° 45'		7h 32m 113° 0'		7h 33m 113° 15'		7h 34m 113° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.83969	.69134	9.84096	.69336	9.84221	.69537	9.84346	.69737	9.84471	.69937	60
1	.83971	.69138	.84098	.69339	.84223	.69540	.84349	.69741	.84473	.69941	59
2	.83974	.69141	.84100	.69342	.84226	.69543	.84351	.69744	.84475	.69944	58
3	.83976	.69144	.84102	.69346	.84228	.69547	.84353	.69747	.84477	.69947	57
+ 1'	9.83978	.69148	9.84104	.69349	9.84230	.69550	9.84355	.69751	9.84479	.69951	56
5	.83980	.69151	.84106	.69352	.84232	.69553	.84357	.69754	.84481	.69954	55
6	.83982	.69154	.84108	.69356	.84234	.69557	.84359	.69757	.84483	.69957	54
7	.83984	.69158	.84110	.69359	.84236	.69560	.84361	.69761	.84485	.69961	53
+ 2'	9.83986	.69161	9.84112	.69362	9.84238	.69563	9.84363	.69764	9.84488	.69964	52
9	.83988	.69164	.84114	.69366	.84240	.69567	.84365	.69767	.84490	.69967	51
10	.83990	.69168	.84117	.69369	.84242	.69570	.84367	.69771	.84492	.69971	50
11	.83992	.69171	.84119	.69372	.84244	.69573	.84369	.69774	.84494	.69974	49
+ 3'	9.83995	.69174	9.84121	.69376	9.84246	.69577	9.84371	.69777	9.84496	.69977	48
13	.83997	.69178	.84123	.69379	.84248	.69580	.84373	.69781	.84498	.69981	47
14	.83999	.69181	.84125	.69382	.84251	.69583	.84376	.69784	.84500	.69984	46
15	.84001	.69185	.84127	.69386	.84253	.69587	.84378	.69787	.84502	.69987	45
+ 4'	9.84003	.69188	9.84129	.69389	9.84255	.69590	9.84380	.69791	9.84504	.69991	44
17	.84005	.69191	.84131	.69393	.84257	.69593	.84382	.69794	.84506	.69994	43
18	.84007	.69195	.84133	.69396	.84259	.69597	.84384	.69797	.84508	.69997	42
19	.84009	.69198	.84135	.69399	.84261	.69600	.84386	.69801	.84510	.70001	41
+ 5'	9.84011	.69201	9.84138	.69403	9.84263	.69603	9.84388	.69804	9.84512	.70004	40
21	.84014	.69205	.84140	.69406	.84265	.69607	.84390	.69807	.84514	.70007	39
22	.84016	.69208	.84142	.69409	.84267	.69610	.84392	.69811	.84517	.70011	38
23	.84018	.69211	.84144	.69413	.84269	.69614	.84394	.69814	.84519	.70014	37
+ 6'	9.84020	.69215	9.84146	.69416	9.84271	.69617	9.84396	.69817	9.84521	.70017	36
25	.84022	.69218	.84148	.69419	.84274	.69620	.84398	.69821	.84523	.70021	35
26	.84024	.69221	.84150	.69423	.84276	.69624	.84400	.69824	.84525	.70024	34
27	.84026	.69225	.84152	.69426	.84278	.69627	.84403	.69827	.84527	.70027	33
+ 7'	9.84028	.69228	9.84154	.69429	9.84280	.69630	9.84405	.69831	9.84529	.70031	32
29	.84030	.69232	.84156	.69433	.84282	.69634	.84407	.69834	.84531	.70034	31
30	.84033	.69235	.84159	.69436	.84284	.69637	.84409	.69837	.84533	.70037	30
31	.84035	.69238	.84161	.69439	.84286	.69640	.84411	.69841	.84535	.70041	29
+ 8'	9.84037	.69242	9.84163	.69443	9.84288	.69644	9.84413	.69844	9.84537	.70044	28
33	.84039	.69245	.84165	.69446	.84290	.69647	.84415	.69847	.84539	.70047	27
34	.84041	.69248	.84167	.69450	.84292	.69650	.84417	.69851	.84541	.70051	26
35	.84043	.69252	.84169	.69453	.84294	.69654	.84419	.69854	.84543	.70054	25
+ 9'	9.84045	.69255	9.84171	.69456	9.84296	.69657	9.84421	.69857	9.84545	.70057	24
37	.84047	.69258	.84173	.69460	.84299	.69660	.84423	.69861	.84547	.70061	23
38	.84049	.69262	.84175	.69463	.84301	.69664	.84425	.69864	.84550	.70064	22
39	.84051	.69265	.84177	.69466	.84303	.69667	.84427	.69867	.84552	.70067	21
+ 10'	9.84054	.69268	9.84179	.69470	9.84305	.69670	9.84430	.69871	9.84554	.70071	20
41	.84056	.69272	.84182	.69473	.84307	.69674	.84432	.69874	.84556	.70074	19
42	.84058	.69275	.84184	.69476	.84309	.69677	.84434	.69877	.84558	.70077	18
43	.84060	.69279	.84186	.69480	.84311	.69680	.84436	.69881	.84560	.70081	17
+ 11'	9.84062	.69282	9.84188	.69483	9.84313	.69684	9.84438	.69884	9.84562	.70084	16
45	.84064	.69285	.84190	.69486	.84315	.69687	.84440	.69887	.84564	.70087	15
46	.84066	.69289	.84192	.69490	.84317	.69690	.84442	.69891	.84566	.70091	14
47	.84068	.69292	.84194	.69493	.84319	.69694	.84444	.69894	.84568	.70094	13
+ 12'	9.84070	.69295	9.84196	.69496	9.84321	.69697	9.84446	.69897	9.84570	.70097	12
49	.84072	.69299	.84198	.69500	.84324	.69700	.84448	.69901	.84572	.70101	11
50	.84075	.69302	.84200	.69503	.84326	.69704	.84450	.69904	.84574	.70104	10
51	.84077	.69305	.84203	.69506	.84328	.69707	.84452	.69907	.84576	.70107	9
+ 13'	9.84079	.69309	9.84205	.69510	9.84330	.69710	9.84454	.69911	9.84578	.70111	8
53	.84081	.69312	.84207	.69513	.84332	.69714	.84456	.69914	.84581	.70114	7
54	.84083	.69315	.84209	.69516	.84334	.69717	.84459	.69917	.84583	.70117	6
55	.84085	.69319	.84211	.69520	.84336	.69720	.84461	.69921	.84585	.70121	5
+ 14'	9.84087	.69322	9.84213	.69523	9.84338	.69724	9.84463	.69924	9.84587	.70124	4
57	.84089	.69326	.84215	.69527	.84340	.69727	.84465	.69927	.84589	.70127	3
58	.84091	.69329	.84217	.69530	.84342	.69731	.84467	.69931	.84591	.70131	2
59	.84093	.69332	.84219	.69533	.84344	.69734	.84469	.69934	.84593	.70134	1
+ 15'	9.84096	.69336	9.84221	.69537	9.84346	.69737	9.84471	.69937	9.84595	.70137	0
	16h 29m		16h 28m		16h 27m		16h 26m		16h 25m		

Haversines.

s	7h 35m 113° 45'		7h 36m 114° 0'		7h 37m 114° 15'		7h 38m 114° 30'		7h 39m 114° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.84595	<b>.70137</b>	9.84718	<b>.70337</b>	9.84841	<b>.70536</b>	9.84963	<b>.70735</b>	9.85085	<b>.70933</b>	60
1	.84597	<b>.70141</b>	.84720	<b>.70340</b>	.84843	<b>.70539</b>	.84965	<b>.70738</b>	.85087	<b>.70936</b>	59
2	.84599	<b>.70144</b>	.84722	<b>.70343</b>	.84845	<b>.70543</b>	.84967	<b>.70741</b>	.85089	<b>.70940</b>	58
3	.84601	<b>.70147</b>	.84724	<b>.70347</b>	.84847	<b>.70546</b>	.84969	<b>.70745</b>	.85091	<b>.70943</b>	57
+ 1'	9.84603	<b>.70151</b>	9.84726	<b>.70350</b>	9.84849	<b>.70549</b>	9.84971	<b>.70748</b>	9.85093	<b>.70946</b>	56
5	.84605	<b>.70154</b>	.84729	<b>.70353</b>	.84851	<b>.70553</b>	.84973	<b>.70751</b>	.85095	<b>.70950</b>	55
6	.84607	<b>.70157</b>	.84731	<b>.70357</b>	.84853	<b>.70556</b>	.84975	<b>.70755</b>	.85097	<b>.70953</b>	54
7	.84609	<b>.70161</b>	.84733	<b>.70360</b>	.84855	<b>.70559</b>	.84977	<b>.70758</b>	.85099	<b>.70956</b>	53
+ 2'	9.84611	<b>.70164</b>	9.84735	<b>.70363</b>	9.84857	<b>.70562</b>	9.84979	<b>.70761</b>	9.85101	<b>.70959</b>	52
9	.84613	<b>.70167</b>	.84737	<b>.70367</b>	.84859	<b>.70566</b>	.84982	<b>.70764</b>	.85103	<b>.70963</b>	51
10	.84616	<b>.70171</b>	.84739	<b>.70370</b>	.84861	<b>.70569</b>	.84984	<b>.70768</b>	.85105	<b>.70966</b>	50
11	.84618	<b>.70174</b>	.84741	<b>.70373</b>	.84863	<b>.70572</b>	.84986	<b>.70771</b>	.85107	<b>.70969</b>	49
+ 3'	9.84620	<b>.70177</b>	9.84743	<b>.70377</b>	9.84866	<b>.70576</b>	9.84988	<b>.70774</b>	9.85109	<b>.70973</b>	48
13	.84622	<b>.70181</b>	.84745	<b>.70380</b>	.84868	<b>.70579</b>	.84990	<b>.70778</b>	.85111	<b>.70976</b>	47
14	.84624	<b>.70184</b>	.84747	<b>.70383</b>	.84870	<b>.70582</b>	.84992	<b>.70781</b>	.85113	<b>.70979</b>	46
15	.84626	<b>.70187</b>	.84749	<b>.70387</b>	.84872	<b>.70586</b>	.84994	<b>.70784</b>	.85115	<b>.70983</b>	45
+ 4'	9.84628	<b>.70191</b>	9.84751	<b>.70390</b>	9.84874	<b>.70589</b>	9.84996	<b>.70788</b>	9.85117	<b>.70986</b>	44
17	.84630	<b>.70194</b>	.84753	<b>.70393</b>	.84876	<b>.70592</b>	.84998	<b>.70791</b>	.85119	<b>.70989</b>	43
18	.84632	<b>.70197</b>	.84755	<b>.70397</b>	.84878	<b>.70596</b>	.85000	<b>.70794</b>	.85121	<b>.70992</b>	42
19	.84634	<b>.70201</b>	.84757	<b>.70400</b>	.84880	<b>.70599</b>	.85002	<b>.70798</b>	.85123	<b>.70996</b>	41
+ 5'	9.84636	<b>.70204</b>	9.84759	<b>.70403</b>	9.84882	<b>.70602</b>	9.85004	<b>.70801</b>	9.85125	<b>.70999</b>	40
21	.84638	<b>.70207</b>	.84761	<b>.70407</b>	.84884	<b>.70606</b>	.85006	<b>.70804</b>	.85127	<b>.71002</b>	39
22	.84640	<b>.70211</b>	.84763	<b>.70410</b>	.84886	<b>.70609</b>	.85008	<b>.70807</b>	.85129	<b>.71006</b>	38
23	.84642	<b>.70214</b>	.84765	<b>.70413</b>	.84888	<b>.70612</b>	.85010	<b>.70811</b>	.85131	<b>.71009</b>	37
+ 6'	9.84644	<b>.70217</b>	9.84767	<b>.70417</b>	9.84890	<b>.70615</b>	9.85012	<b>.70814</b>	9.85133	<b>.71012</b>	36
25	.84646	<b>.70221</b>	.84770	<b>.70420</b>	.84892	<b>.70619</b>	.85014	<b>.70817</b>	.85135	<b>.71016</b>	35
26	.84648	<b>.70224</b>	.84772	<b>.70423</b>	.84894	<b>.70622</b>	.85016	<b>.70821</b>	.85137	<b>.71019</b>	34
27	.84651	<b>.70227</b>	.84774	<b>.70426</b>	.84896	<b>.70625</b>	.85018	<b>.70824</b>	.85139	<b>.71022</b>	33
+ 7'	9.84653	<b>.70230</b>	9.84776	<b>.70430</b>	9.84898	<b>.70629</b>	9.85020	<b>.70827</b>	9.85141	<b>.71025</b>	32
29	.84655	<b>.70234</b>	.84778	<b>.70433</b>	.84900	<b>.70632</b>	.85022	<b>.70831</b>	.85143	<b>.71029</b>	31
30	.84657	<b>.70237</b>	.84780	<b>.70436</b>	.84902	<b>.70635</b>	.85024	<b>.70834</b>	.85145	<b>.71032</b>	30
31	.84659	<b>.70240</b>	.84782	<b>.70440</b>	.84904	<b>.70639</b>	.85026	<b>.70837</b>	.85147	<b>.71035</b>	29
+ 8'	9.84661	<b>.70244</b>	9.84784	<b>.70443</b>	9.84906	<b>.70642</b>	9.85028	<b>.70840</b>	9.85149	<b>.71039</b>	28
33	.84663	<b>.70247</b>	.84786	<b>.70446</b>	.84908	<b>.70645</b>	.85030	<b>.70844</b>	.85151	<b>.71042</b>	27
34	.84665	<b>.70250</b>	.84788	<b>.70450</b>	.84910	<b>.70649</b>	.85032	<b>.70847</b>	.85153	<b>.71045</b>	26
35	.84667	<b>.70254</b>	.84790	<b>.70453</b>	.84912	<b>.70652</b>	.85034	<b>.70850</b>	.85155	<b>.71049</b>	25
+ 9'	9.84669	<b>.70257</b>	9.84792	<b>.70456</b>	9.84914	<b>.70655</b>	9.85036	<b>.70854</b>	9.85158	<b>.71052</b>	24
37	.84671	<b>.70260</b>	.84794	<b>.70460</b>	.84916	<b>.70659</b>	.85038	<b>.70857</b>	.85160	<b>.71055</b>	23
38	.84673	<b>.70264</b>	.84796	<b>.70463</b>	.84919	<b>.70662</b>	.85040	<b>.70860</b>	.85162	<b>.71058</b>	22
39	.84675	<b>.70267</b>	.84798	<b>.70466</b>	.84921	<b>.70665</b>	.85042	<b>.70864</b>	.85164	<b>.71062</b>	21
+ 10'	9.84677	<b>.70270</b>	9.84800	<b>.70470</b>	9.84923	<b>.70668</b>	9.85044	<b>.70867</b>	9.85166	<b>.71065</b>	20
41	.84679	<b>.70274</b>	.84802	<b>.70473</b>	.84925	<b>.70672</b>	.85046	<b>.70870</b>	.85168	<b>.71068</b>	19
42	.84681	<b>.70277</b>	.84804	<b>.70476</b>	.84927	<b>.70675</b>	.85048	<b>.70874</b>	.85170	<b>.71072</b>	18
43	.84683	<b>.70280</b>	.84806	<b>.70480</b>	.84929	<b>.70678</b>	.85050	<b>.70877</b>	.85172	<b>.71075</b>	17
+ 11'	9.84685	<b>.70284</b>	9.84808	<b>.70483</b>	9.84931	<b>.70682</b>	9.85052	<b>.70880</b>	9.85174	<b>.71078</b>	16
45	.84688	<b>.70287</b>	.84810	<b>.70486</b>	.84933	<b>.70685</b>	.85054	<b>.70884</b>	.85176	<b>.71082</b>	15
46	.84690	<b>.70290</b>	.84812	<b>.70490</b>	.84935	<b>.70688</b>	.85057	<b>.70887</b>	.85178	<b>.71085</b>	14
47	.84692	<b>.70294</b>	.84815	<b>.70493</b>	.84937	<b>.70692</b>	.85059	<b>.70890</b>	.85180	<b>.71088</b>	13
+ 12'	9.84694	<b>.70297</b>	9.84817	<b>.70496</b>	9.84939	<b>.70695</b>	9.85061	<b>.70893</b>	9.85182	<b>.71091</b>	12
49	.84696	<b>.70300</b>	.84819	<b>.70499</b>	.84941	<b>.70699</b>	.85063	<b>.70897</b>	.85184	<b>.71095</b>	11
50	.84698	<b>.70304</b>	.84821	<b>.70503</b>	.84943	<b>.70702</b>	.85065	<b>.70900</b>	.85186	<b>.71098</b>	10
51	.84700	<b>.70307</b>	.84823	<b>.70506</b>	.84945	<b>.70705</b>	.85067	<b>.70903</b>	.85188	<b>.71101</b>	9
+ 13'	9.84702	<b>.70310</b>	9.84825	<b>.70509</b>	9.84947	<b>.70708</b>	9.85069	<b>.70907</b>	9.85190	<b>.71105</b>	8
53	.84704	<b>.70314</b>	.84827	<b>.70513</b>	.84949	<b>.70712</b>	.85071	<b>.70910</b>	.85192	<b>.71108</b>	7
54	.84706	<b>.70317</b>	.84829	<b>.70516</b>	.84951	<b>.70715</b>	.85073	<b>.70913</b>	.85 94	<b>.71111</b>	6
55	.84708	<b>.70320</b>	.84831	<b>.70519</b>	.84953	<b>.70718</b>	.85075	<b>.70916</b>	.85196	<b>.71114</b>	5
+ 14'	9.84710	<b>.70324</b>	9.84833	<b>.70523</b>	9.84955	<b>.70721</b>	9.85077	<b>.70920</b>	9.85198	<b>.71118</b>	4
57	.84712	<b>.70327</b>	.84835	<b>.70526</b>	.84957	<b>.70725</b>	.85079	<b>.70923</b>	.85200	<b>.71121</b>	3
58	.84714	<b>.70330</b>	.84837	<b>.70529</b>	.84959	<b>.70729</b>	.85081	<b>.70926</b>	.85202	<b>.71124</b>	2
59	.84716	<b>.70333</b>	.84839	<b>.70533</b>	.84961	<b>.70731</b>	.85083	<b>.70930</b>	.85204	<b>.71128</b>	1
+ 15'	9.84718	<b>.70337</b>	9.84841	<b>.70536</b>	9.84963	<b>.70735</b>	9.85085	<b>.70933</b>	9.85206	<b>.71131</b>	0
	16h 24m		16h 23m		16h 22m		16h 21m		16h 20m		



Haversines.

s	7h 40m 115° 0'		7h 41m 115° 15'		7h 42m 115° 30'		7h 43m 115° 45'		7h 44m 116° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.85206	.71131	9.85326	.71328	9.85446	.71526	9.85565	.71722	9.85684	.71919	60
1	.85208	.71134	.85328	.71332	.85448	.71529	.85567	.71726	.85686	.71922	59
2	.85210	.71138	.85330	.71335	.85450	.71532	.85569	.71729	.85688	.71925	58
3	.85212	.71141	.85332	.71338	.85452	.71535	.85571	.71732	.85690	.71928	57
+ 1'	9.85214	.71144	9.85334	.71342	9.85454	.71539	9.85573	.71735	9.85692	.71932	56
5	.85216	.71147	.85336	.71345	.85456	.71542	.85575	.71739	.85694	.71935	55
6	.85218	.71151	.85338	.71348	.85458	.71545	.85577	.71742	.85696	.71938	54
7	.85220	.71154	.85340	.71351	.85460	.71549	.85579	.71745	.85698	.71941	53
+ 2'	9.85222	.71157	9.85342	.71355	9.85462	.71552	9.85581	.71748	9.85700	.71945	52
9	.85224	.71161	.85344	.71358	.85464	.71555	.85583	.71752	.85702	.71948	51
10	.85226	.71164	.85346	.71361	.85466	.71558	.85585	.71755	.85704	.71951	50
11	.85228	.71167	.85348	.71365	.85468	.71562	.85587	.71758	.85706	.71955	49
+ 3'	9.85230	.71170	9.85350	.71368	9.85470	.71565	9.85589	.71762	9.85708	.71958	48
13	.85232	.71174	.85352	.71371	.85472	.71568	.85591	.71765	.85710	.71961	47
14	.85234	.71177	.85354	.71374	.85474	.71571	.85593	.71768	.85712	.71964	46
15	.85236	.71180	.85356	.71378	.85476	.71575	.85595	.71771	.85714	.71968	45
+ 4'	9.85238	.71184	9.85358	.71381	9.85478	.71578	9.85597	.71775	9.85716	.71971	44
17	.85240	.71187	.85360	.71384	.85480	.71581	.85599	.71778	.85718	.71974	43
18	.85242	.71190	.85362	.71388	.85482	.71585	.85601	.71781	.85720	.71977	42
19	.85244	.71194	.85364	.71391	.85484	.71588	.85603	.71784	.85722	.71981	41
+ 5'	9.85246	.71197	9.85366	.71394	9.85486	.71591	9.85605	.71788	9.85724	.71984	40
21	.85248	.71200	.85368	.71397	.85488	.71594	.85607	.71791	.85726	.71987	39
22	.85250	.71203	.85370	.71401	.85490	.71598	.85609	.71794	.85727	.71990	38
23	.85252	.71207	.85372	.71404	.85492	.71601	.85611	.71798	.85729	.71994	37
+ 6'	9.85254	.71210	9.85374	.71407	9.85494	.71604	9.85613	.71801	9.85731	.71997	36
25	.85256	.71213	.85376	.71411	.85496	.71608	.85615	.71804	.85733	.72000	35
26	.85258	.71217	.85378	.71414	.85498	.71611	.85617	.71807	.85735	.72003	34
27	.85260	.71220	.85380	.71417	.85500	.71614	.85619	.71811	.85737	.72007	33
+ 7'	9.85262	.71223	9.85382	.71420	9.85502	.71617	9.85621	.71814	9.85739	.72010	32
29	.85264	.71226	.85384	.71424	.85504	.71621	.85623	.71817	.85741	.72013	31
30	.85266	.71230	.85386	.71427	.85506	.71624	.85625	.71820	.85743	.72017	30
31	.85268	.71233	.85388	.71430	.85508	.71627	.85627	.71824	.85745	.72020	29
+ 8'	9.85270	.71236	9.85390	.71434	9.85510	.71631	9.85629	.71827	9.85747	.72023	28
33	.85272	.71240	.85392	.71437	.85512	.71634	.85631	.71830	.85749	.72026	27
34	.85274	.71243	.85394	.71440	.85514	.71637	.85633	.71834	.85751	.72030	26
35	.85276	.71246	.85396	.71443	.85516	.71640	.85635	.71837	.85753	.72033	25
+ 9'	9.85278	.71249	9.85398	.71447	9.85518	.71644	9.85637	.71840	9.85755	.72036	24
37	.85280	.71253	.85400	.71450	.85520	.71647	.85639	.71843	.85757	.72039	23
38	.85282	.71256	.85402	.71453	.85522	.71650	.85641	.71847	.85759	.72043	22
39	.85284	.71259	.85404	.71456	.85524	.71653	.85643	.71850	.85761	.72046	21
+ 10'	9.85286	.71263	9.85406	.71460	9.85526	.71657	9.85645	.71853	9.85763	.72049	20
41	.85288	.71266	.85408	.71463	.85528	.71660	.85647	.71856	.85765	.72052	19
42	.85290	.71269	.85410	.71466	.85530	.71663	.85649	.71860	.85767	.72056	18
43	.85292	.71273	.85412	.71470	.85532	.71667	.85651	.71863	.85769	.72059	17
+ 11'	9.85294	.71276	9.85414	.71473	9.85534	.71670	9.85653	.71866	9.85771	.72062	16
45	.85296	.71279	.85416	.71476	.85536	.71673	.85654	.71870	.85773	.72066	15
46	.85298	.71282	.85418	.71480	.85538	.71676	.85656	.71873	.85775	.72069	14
47	.85300	.71286	.85420	.71483	.85540	.71680	.85658	.71876	.85777	.72072	13
+ 12'	9.85302	.71289	9.85422	.71486	9.85542	.71683	9.85660	.71879	9.85779	.72075	12
49	.85304	.71292	.85424	.71489	.85544	.71686	.85662	.71883	.85781	.72079	11
50	.85306	.71296	.85426	.71493	.85546	.71690	.85664	.71886	.85783	.72082	10
51	.85308	.71299	.85428	.71496	.85548	.71693	.85666	.71889	.85785	.72085	9
+ 13'	9.85310	.71302	9.85430	.71499	9.85550	.71696	9.85668	.71892	9.85787	.72088	8
53	.85312	.71305	.85432	.71503	.85552	.71699	.85670	.71896	.85788	.72092	7
54	.85314	.71309	.85434	.71506	.85554	.71703	.85672	.71899	.85790	.72095	6
55	.85316	.71312	.85436	.71509	.85555	.71706	.85674	.71902	.85792	.72098	5
+ 14'	9.85318	.71315	9.85438	.71512	9.85557	.71709	9.85676	.71905	9.85794	.72101	4
57	.85320	.71319	.85440	.71516	.85559	.71712	.85678	.71909	.85796	.72105	3
58	.85322	.71322	.85442	.71519	.85561	.71716	.85680	.71912	.85798	.72108	2
59	.85324	.71325	.85444	.71522	.85563	.71719	.85682	.71915	.85800	.72111	1
+ 15'	9.85326	.71328	9.85446	.71526	9.85565	.71722	9.85684	.71919	9.85802	.72114	0
	16h 19m		16h 18m		16h 17m		16h 16m		16h 15m		

Haversines.

s	7h 45m 116° 15'		7h 46m 116° 30'		7h 47m 116° 45'		7h 48m 117° 0'		7h 49m 117° 15'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.85802	<b>.72114</b>	9.85920	<b>.72310</b>	9.86037	<b>.72505</b>	9.86153	<b>.72700</b>	9.86269	<b>.72894</b>	60
1	.85804	<b>.72118</b>	.85922	<b>.72313</b>	.86039	<b>.72508</b>	.86155	<b>.72703</b>	.86271	<b>.72897</b>	59
2	.85806	<b>.72121</b>	.85924	<b>.72316</b>	.86041	<b>.72511</b>	.86157	<b>.72706</b>	.86273	<b>.72900</b>	58
3	.85808	<b>.72124</b>	.85926	<b>.72320</b>	.86043	<b>.72515</b>	.86159	<b>.72709</b>	.86275	<b>.72903</b>	57
+ 1'	9.85810	<b>.72127</b>	9.85928	<b>.72323</b>	9.86045	<b>.72518</b>	9.86161	<b>.72712</b>	9.86277	<b>.72907</b>	56
5	.85812	<b>.72131</b>	.85930	<b>.72326</b>	.86046	<b>.72521</b>	.86163	<b>.72716</b>	.86279	<b>.72910</b>	55
6	.85814	<b>.72134</b>	.85931	<b>.72329</b>	.86048	<b>.72524</b>	.86165	<b>.72719</b>	.86281	<b>.72913</b>	54
7	.85816	<b>.72137</b>	.85933	<b>.72333</b>	.86050	<b>.72528</b>	.86167	<b>.72722</b>	.86282	<b>.72916</b>	53
+ 2'	9.85818	<b>.72141</b>	9.85935	<b>.72336</b>	9.86052	<b>.72531</b>	9.86169	<b>.72725</b>	9.86284	<b>.72920</b>	52
9	.85820	<b>.72144</b>	.85937	<b>.72339</b>	.86054	<b>.72534</b>	.86171	<b>.72729</b>	.86286	<b>.72923</b>	51
10	.85822	<b>.72147</b>	.85939	<b>.72342</b>	.86056	<b>.72537</b>	.86173	<b>.72732</b>	.86288	<b>.72926</b>	50
11	.85824	<b>.72150</b>	.85941	<b>.72346</b>	.86058	<b>.72541</b>	.86174	<b>.72735</b>	.86290	<b>.72929</b>	49
+ 3'	9.85826	<b>.72154</b>	9.85943	<b>.72349</b>	9.86060	<b>.72544</b>	9.86176	<b>.72738</b>	9.86292	<b>.72932</b>	48
13	.85828	<b>.72157</b>	.85945	<b>.72352</b>	.86062	<b>.72547</b>	.86178	<b>.72742</b>	.86294	<b>.72936</b>	47
14	.85830	<b>.72160</b>	.85947	<b>.72355</b>	.86064	<b>.72550</b>	.86180	<b>.72745</b>	.86296	<b>.72939</b>	46
15	.85832	<b>.72163</b>	.85949	<b>.72359</b>	.86066	<b>.72554</b>	.86182	<b>.72748</b>	.86298	<b>.72942</b>	45
+ 4'	9.85834	<b>.72167</b>	9.85951	<b>.72362</b>	9.86068	<b>.72557</b>	9.86184	<b>.72751</b>	9.86300	<b>.72945</b>	44
17	.85836	<b>.72170</b>	.85953	<b>.72365</b>	.86070	<b>.72560</b>	.86186	<b>.72755</b>	.86302	<b>.72949</b>	43
18	.85838	<b>.72173</b>	.85955	<b>.72368</b>	.86072	<b>.72563</b>	.86188	<b>.72758</b>	.86304	<b>.72953</b>	42
19	.85840	<b>.72176</b>	.85957	<b>.72372</b>	.86074	<b>.72567</b>	.86190	<b>.72761</b>	.86306	<b>.72955</b>	41
+ 5'	9.85841	<b>.72180</b>	9.85959	<b>.72375</b>	9.86076	<b>.72570</b>	9.86192	<b>.72764</b>	9.86307	<b>.72958</b>	40
21	.85843	<b>.72183</b>	.85961	<b>.72378</b>	.86078	<b>.72573</b>	.86194	<b>.72768</b>	.86309	<b>.72962</b>	39
22	.85845	<b>.72186</b>	.85963	<b>.72381</b>	.86080	<b>.72576</b>	.86196	<b>.72771</b>	.86311	<b>.72965</b>	38
23	.85847	<b>.72189</b>	.85965	<b>.72385</b>	.86081	<b>.72580</b>	.86198	<b>.72774</b>	.86313	<b>.72968</b>	37
+ 6'	9.85849	<b>.72193</b>	9.85967	<b>.72388</b>	9.86083	<b>.72583</b>	9.86200	<b>.72777</b>	9.86315	<b>.72971</b>	36
25	.85851	<b>.72196</b>	.85969	<b>.72391</b>	.86085	<b>.72586</b>	.86201	<b>.72780</b>	.86317	<b>.72974</b>	35
26	.85853	<b>.72199</b>	.85971	<b>.72394</b>	.86087	<b>.72589</b>	.86203	<b>.72784</b>	.86319	<b>.72978</b>	34
27	.85855	<b>.72202</b>	.85972	<b>.72398</b>	.86089	<b>.72593</b>	.86205	<b>.72787</b>	.86321	<b>.72981</b>	33
+ 7'	9.85857	<b>.72206</b>	9.85974	<b>.72401</b>	9.86091	<b>.72596</b>	9.86207	<b>.72790</b>	9.86323	<b>.72984</b>	32
29	.85859	<b>.72209</b>	.85976	<b>.72404</b>	.86093	<b>.72599</b>	.86209	<b>.72793</b>	.86325	<b>.72987</b>	31
30	.85861	<b>.72212</b>	.85978	<b>.72407</b>	.86095	<b>.72602</b>	.86211	<b>.72797</b>	.86327	<b>.72991</b>	30
31	.85863	<b>.72215</b>	.85980	<b>.72411</b>	.86097	<b>.72606</b>	.86213	<b>.72800</b>	.86329	<b>.72994</b>	29
+ 8'	9.85865	<b>.72219</b>	9.85982	<b>.72414</b>	9.86099	<b>.72609</b>	9.86215	<b>.72803</b>	9.86331	<b>.72997</b>	28
33	.85867	<b>.72222</b>	.85984	<b>.72417</b>	.86101	<b>.72612</b>	.86217	<b>.72806</b>	.86332	<b>.73000</b>	27
34	.85869	<b>.72225</b>	.85986	<b>.72420</b>	.86103	<b>.72615</b>	.86219	<b>.72810</b>	.86334	<b>.73004</b>	26
35	.85871	<b>.72229</b>	.85988	<b>.72424</b>	.86105	<b>.72618</b>	.86221	<b>.72813</b>	.86336	<b>.73007</b>	25
+ 9'	9.85873	<b>.72232</b>	9.85990	<b>.72427</b>	9.86107	<b>.72622</b>	9.86223	<b>.72816</b>	9.86338	<b>.73010</b>	24
37	.85875	<b>.72235</b>	.85992	<b>.72430</b>	.86109	<b>.72625</b>	.86225	<b>.72819</b>	.86340	<b>.73013</b>	23
38	.85877	<b>.72238</b>	.85994	<b>.72433</b>	.86111	<b>.72628</b>	.86227	<b>.72823</b>	.86342	<b>.73016</b>	22
39	.85879	<b>.72242</b>	.85996	<b>.72437</b>	.86112	<b>.72631</b>	.86229	<b>.72826</b>	.86344	<b>.73020</b>	21
+ 10'	9.85881	<b>.72245</b>	9.85998	<b>.72440</b>	9.86114	<b>.72635</b>	9.86230	<b>.72829</b>	9.86346	<b>.73023</b>	20
41	.85883	<b>.72248</b>	.86000	<b>.72443</b>	.86116	<b>.72638</b>	.86232	<b>.72832</b>	.86348	<b>.73026</b>	19
42	.85885	<b>.72251</b>	.86002	<b>.72446</b>	.86118	<b>.72641</b>	.86234	<b>.72835</b>	.86350	<b>.73029</b>	18
43	.85887	<b>.72255</b>	.86004	<b>.72450</b>	.86120	<b>.72644</b>	.86236	<b>.72839</b>	.86352	<b>.73033</b>	17
+ 11'	9.85888	<b>.72258</b>	9.86006	<b>.72453</b>	9.86122	<b>.72648</b>	9.86238	<b>.72842</b>	9.86354	<b>.73036</b>	16
45	.85890	<b>.72261</b>	.86008	<b>.72456</b>	.86124	<b>.72651</b>	.86240	<b>.72845</b>	.86355	<b>.73039</b>	15
46	.85892	<b>.72264</b>	.86010	<b>.72459</b>	.86126	<b>.72654</b>	.86242	<b>.72848</b>	.86357	<b>.73042</b>	14
47	.85894	<b>.72268</b>	.86011	<b>.72463</b>	.86128	<b>.72657</b>	.86244	<b>.72852</b>	.86359	<b>.73046</b>	13
+ 12'	9.85896	<b>.72271</b>	9.86013	<b>.72466</b>	9.86130	<b>.72661</b>	9.86246	<b>.72855</b>	9.86361	<b>.73049</b>	12
49	.85898	<b>.72274</b>	.86015	<b>.72469</b>	.86132	<b>.72664</b>	.86248	<b>.72858</b>	.86363	<b>.73052</b>	11
50	.85900	<b>.72277</b>	.86017	<b>.72472</b>	.86134	<b>.72667</b>	.86250	<b>.72861</b>	.86365	<b>.73055</b>	10
51	.85902	<b>.72281</b>	.86019	<b>.72476</b>	.86136	<b>.72670</b>	.86252	<b>.72865</b>	.86367	<b>.73058</b>	9
+ 13'	9.85904	<b>.72284</b>	9.86021	<b>.72479</b>	9.86138	<b>.72674</b>	9.86254	<b>.72868</b>	9.86369	<b>.73062</b>	8
53	.85906	<b>.72287</b>	.86023	<b>.72482</b>	.86140	<b>.72677</b>	.86256	<b>.72871</b>	.86371	<b>.73065</b>	7
54	.85908	<b>.72290</b>	.86025	<b>.72485</b>	.86142	<b>.72680</b>	.86258	<b>.72874</b>	.86373	<b>.73068</b>	6
55	.85910	<b>.72294</b>	.86027	<b>.72489</b>	.86143	<b>.72683</b>	.86259	<b>.72878</b>	.86375	<b>.73071</b>	5
+ 14'	9.85912	<b>.72297</b>	9.86029	<b>.72492</b>	9.86145	<b>.72687</b>	9.86261	<b>.72881</b>	9.86377	<b>.73074</b>	4
57	.85914	<b>.72300</b>	.86031	<b>.72495</b>	.86147	<b>.72690</b>	.86263	<b>.72884</b>	.86379	<b>.73078</b>	3
58	.85916	<b>.72303</b>	.86033	<b>.72498</b>	.86149	<b>.72693</b>	.86265	<b>.72887</b>	.86380	<b>.73081</b>	2
59	.85918	<b>.72307</b>	.86035	<b>.72502</b>	.86151	<b>.72696</b>	.86267	<b>.72890</b>	.86382	<b>.73084</b>	1
+ 15'	9.85920	<b>.72310</b>	9.86037	<b>.72505</b>	9.86153	<b>.72700</b>	9.86269	<b>.72894</b>	9.86384	<b>.73087</b>	0
	16h 14m		16h 13m		16h 12m		16h 11m		16h 10m		



Haversines.

s	7h 50m 117° 30'		7h 51m 117° 45'		7h 52m 118° 0'		7h 53m 118° 15'		7h 54m 118° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.86384	<b>.73087</b>	9.86499	<b>.73281</b>	9.86613	<b>.73474</b>	9.86727	<b>.73666</b>	9.86840	<b>.73858</b>	60
1	.86386	<b>.73091</b>	.86501	<b>.73284</b>	.86615	<b>.73477</b>	.86729	<b>.73669</b>	.86842	<b>.73861</b>	59
2	.86388	<b>.73094</b>	.86503	<b>.73287</b>	.86617	<b>.73480</b>	.86730	<b>.73672</b>	.86843	<b>.73864</b>	58
3	.86390	<b>.73097</b>	.86505	<b>.73290</b>	.86619	<b>.73483</b>	.86732	<b>.73676</b>	.86845	<b>.73868</b>	57
+ 1'	9.86392	<b>.73100</b>	9.86507	<b>.73294</b>	9.86621	<b>.73486</b>	9.86734	<b>.73679</b>	9.86847	<b>.73871</b>	56
5	.86394	<b>.73104</b>	.86509	<b>.73297</b>	.86623	<b>.73490</b>	.86736	<b>.73682</b>	.86849	<b>.73874</b>	55
6	.86396	<b>.73107</b>	.86510	<b>.73300</b>	.86625	<b>.73493</b>	.86738	<b>.73685</b>	.86851	<b>.73877</b>	54
7	.86398	<b>.73110</b>	.86512	<b>.73303</b>	.86626	<b>.73496</b>	.86740	<b>.73688</b>	.86853	<b>.73880</b>	53
+ 2'	9.86400	<b>.73113</b>	9.86514	<b>.73306</b>	9.86628	<b>.73499</b>	9.86742	<b>.73692</b>	9.86855	<b>.73884</b>	52
9	.86401	<b>.73116</b>	.86516	<b>.73310</b>	.86630	<b>.73502</b>	.86744	<b>.73695</b>	.86857	<b>.73887</b>	51
10	.86403	<b>.73120</b>	.86518	<b>.73313</b>	.86632	<b>.73506</b>	.86746	<b>.73698</b>	.86859	<b>.73890</b>	50
11	.86405	<b>.73123</b>	.86520	<b>.73316</b>	.86634	<b>.73509</b>	.86747	<b>.73701</b>	.86860	<b>.73893</b>	49
+ 3'	9.86407	<b>.73126</b>	9.86522	<b>.73319</b>	9.86636	<b>.73512</b>	9.86749	<b>.73704</b>	9.86862	<b>.73896</b>	48
13	.86409	<b>.73129</b>	.86524	<b>.73323</b>	.86638	<b>.73515</b>	.86751	<b>.73708</b>	.86864	<b>.73899</b>	47
14	.86411	<b>.73133</b>	.86526	<b>.73326</b>	.86640	<b>.73519</b>	.86753	<b>.73711</b>	.86866	<b>.73903</b>	46
15	.86413	<b>.73136</b>	.86528	<b>.73329</b>	.86642	<b>.73522</b>	.86755	<b>.73714</b>	.86868	<b>.73906</b>	45
+ 4'	9.86415	<b>.73139</b>	9.86529	<b>.73332</b>	9.86643	<b>.73525</b>	9.86757	<b>.73717</b>	9.86870	<b>.73909</b>	44
17	.86417	<b>.73142</b>	.86531	<b>.73335</b>	.86645	<b>.73528</b>	.86759	<b>.73720</b>	.86872	<b>.73912</b>	43
18	.86419	<b>.73145</b>	.86533	<b>.73339</b>	.86647	<b>.73531</b>	.86761	<b>.73724</b>	.86874	<b>.73915</b>	42
19	.86421	<b>.73149</b>	.86535	<b>.73342</b>	.86649	<b>.73535</b>	.86763	<b>.73727</b>	.86875	<b>.73919</b>	41
+ 5'	9.86423	<b>.73152</b>	9.86537	<b>.73345</b>	9.86651	<b>.73538</b>	9.86764	<b>.73730</b>	9.86877	<b>.73922</b>	40
21	.86424	<b>.73155</b>	.86539	<b>.73348</b>	.86653	<b>.73541</b>	.86766	<b>.73733</b>	.86879	<b>.73925</b>	59
22	.86426	<b>.73158</b>	.86541	<b>.73351</b>	.86655	<b>.73544</b>	.86768	<b>.73736</b>	.86881	<b>.73928</b>	38
23	.86428	<b>.73162</b>	.86543	<b>.73355</b>	.86657	<b>.73547</b>	.86770	<b>.73740</b>	.86883	<b>.73931</b>	37
+ 6'	9.86430	<b>.73165</b>	9.86545	<b>.73358</b>	9.86659	<b>.73551</b>	9.86772	<b>.73743</b>	9.86885	<b>.73935</b>	36
25	.86432	<b>.73168</b>	.86547	<b>.73361</b>	.86661	<b>.73554</b>	.86774	<b>.73746</b>	.86887	<b>.73938</b>	35
26	.86434	<b>.73171</b>	.86549	<b>.73364</b>	.86662	<b>.73557</b>	.86776	<b>.73749</b>	.86889	<b>.73941</b>	34
27	.86436	<b>.73174</b>	.86550	<b>.73368</b>	.86664	<b>.73560</b>	.86778	<b>.73752</b>	.86890	<b>.73944</b>	33
+ 7'	9.86438	<b>.73178</b>	9.86552	<b>.73371</b>	9.86666	<b>.73563</b>	9.86780	<b>.73756</b>	9.86892	<b>.73947</b>	32
29	.86440	<b>.73181</b>	.86554	<b>.73374</b>	.86668	<b>.73567</b>	.86781	<b>.73759</b>	.86894	<b>.73951</b>	31
30	.86442	<b>.73184</b>	.86556	<b>.73377</b>	.86670	<b>.73570</b>	.86783	<b>.73762</b>	.86896	<b>.73954</b>	30
31	.86444	<b>.73187</b>	.86558	<b>.73380</b>	.86672	<b>.73573</b>	.86785	<b>.73765</b>	.86898	<b>.73957</b>	29
+ 8'	9.86446	<b>.73191</b>	9.86560	<b>.73384</b>	9.86674	<b>.73576</b>	9.86787	<b>.73768</b>	9.86900	<b>.73960</b>	28
33	.86447	<b>.73194</b>	.86562	<b>.73387</b>	.86676	<b>.73579</b>	.86789	<b>.73772</b>	.86902	<b>.73963</b>	27
34	.86449	<b>.73197</b>	.86564	<b>.73390</b>	.86678	<b>.73583</b>	.86791	<b>.73775</b>	.86904	<b>.73967</b>	26
35	.86451	<b>.73200</b>	.86566	<b>.73393</b>	.86679	<b>.73586</b>	.86793	<b>.73778</b>	.86905	<b>.73970</b>	25
+ 9'	9.86453	<b>.73203</b>	9.86568	<b>.73396</b>	9.86681	<b>.73589</b>	9.86795	<b>.73781</b>	9.86907	<b>.73973</b>	24
37	.86455	<b>.73207</b>	.86569	<b>.73400</b>	.86683	<b>.73592</b>	.86796	<b>.73784</b>	.86909	<b>.73976</b>	23
38	.86457	<b>.73210</b>	.86571	<b>.73403</b>	.86685	<b>.73595</b>	.86798	<b>.73788</b>	.86911	<b>.73979</b>	22
39	.86459	<b>.73213</b>	.86573	<b>.73406</b>	.86687	<b>.73599</b>	.86800	<b>.73791</b>	.86913	<b>.73982</b>	21
+ 10'	9.86461	<b>.73216</b>	9.86575	<b>.73409</b>	9.86689	<b>.73602</b>	9.86802	<b>.73794</b>	9.86915	<b>.73986</b>	20
41	.86463	<b>.73220</b>	.86577	<b>.73413</b>	.86691	<b>.73605</b>	.86804	<b>.73797</b>	.86917	<b>.73989</b>	19
42	.86465	<b>.73223</b>	.86579	<b>.73416</b>	.86693	<b>.73608</b>	.86806	<b>.73800</b>	.86919	<b>.73992</b>	18
43	.86467	<b>.73226</b>	.86581	<b>.73419</b>	.86695	<b>.73611</b>	.86808	<b>.73804</b>	.86920	<b>.73995</b>	17
+ 11'	9.86468	<b>.73229</b>	9.86583	<b>.73422</b>	9.86696	<b>.73615</b>	9.86810	<b>.73807</b>	9.86922	<b>.73998</b>	16
45	.86470	<b>.73232</b>	.86585	<b>.73425</b>	.86698	<b>.73618</b>	.86812	<b>.73810</b>	.86924	<b>.74002</b>	15
46	.86472	<b>.73236</b>	.86587	<b>.73429</b>	.86700	<b>.73621</b>	.86813	<b>.73813</b>	.86926	<b>.74005</b>	14
47	.86474	<b>.73239</b>	.86588	<b>.73432</b>	.86702	<b>.73624</b>	.86815	<b>.73816</b>	.86928	<b>.74008</b>	13
+ 12'	9.86476	<b>.73242</b>	9.86590	<b>.73435</b>	9.86704	<b>.73628</b>	9.86817	<b>.73820</b>	9.86930	<b>.74011</b>	12
49	.86478	<b>.73245</b>	.86592	<b>.73438</b>	.86706	<b>.73631</b>	.86819	<b>.73823</b>	.86932	<b>.74014</b>	11
50	.86480	<b>.73249</b>	.86594	<b>.73441</b>	.86708	<b>.73634</b>	.86821	<b>.73826</b>	.86933	<b>.74018</b>	10
51	.86482	<b>.73252</b>	.86596	<b>.73445</b>	.86710	<b>.73637</b>	.86823	<b>.73829</b>	.86935	<b>.74021</b>	9
+ 13'	9.86484	<b>.73255</b>	9.86598	<b>.73448</b>	9.86712	<b>.73640</b>	9.86825	<b>.73832</b>	9.86937	<b>.74024</b>	8
53	.86486	<b>.73258</b>	.86600	<b>.73451</b>	.86713	<b>.73644</b>	.86827	<b>.73836</b>	.86939	<b>.74027</b>	7
54	.86488	<b>.73261</b>	.86602	<b>.73454</b>	.86715	<b>.73647</b>	.86828	<b>.73839</b>	.86941	<b>.74030</b>	6
55	.86489	<b>.73265</b>	.86604	<b>.73458</b>	.86717	<b>.73650</b>	.86830	<b>.73842</b>	.86943	<b>.74033</b>	5
+ 14'	9.86491	<b>.73268</b>	9.86606	<b>.73461</b>	9.86719	<b>.73653</b>	9.86832	<b>.73845</b>	9.86945	<b>.74037</b>	4
57	.86493	<b>.73271</b>	.86607	<b>.73464</b>	.86721	<b>.73656</b>	.86834	<b>.73848</b>	.86947	<b>.74040</b>	3
58	.86495	<b>.73274</b>	.86609	<b>.73467</b>	.86723	<b>.73660</b>	.86836	<b>.73852</b>	.86948	<b>.74043</b>	2
59	.86497	<b>.73278</b>	.86611	<b>.73470</b>	.86725	<b>.73663</b>	.86838	<b>.73855</b>	.86950	<b>.74046</b>	1
+ 15'	9.86499	<b>.73281</b>	9.86613	<b>.73474</b>	9.86727	<b>.73666</b>	9.86840	<b>.73858</b>	9.86952	<b>.74049</b>	0
	16h 9m		16h 8m		16h 7m		16h 6m		16h 5m		

TABLE IV.

Haversines.

s	7h 55m 118° 45'		7h 56m 119° 0'		7h 57m 119° 15'		7h 58m 119° 30'		7h 59m 119° 45'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	9.86952	<b>.74049</b>	9.87064	<b>.74240</b>	9.87175	<b>.74431</b>	9.87286	<b>.74621</b>	9.87396	<b>.74811</b>	60
1	.86954	<b>.74052</b>	.87066	<b>.74244</b>	.87177	<b>.74434</b>	.87288	<b>.74624</b>	.87398	<b>.74814</b>	59
2	.86956	<b>.74056</b>	.87068	<b>.74247</b>	.87179	<b>.74437</b>	.87290	<b>.74628</b>	.87400	<b>.74817</b>	58
3	.86958	<b>.74059</b>	.87070	<b>.74250</b>	.87181	<b>.74441</b>	.87292	<b>.74631</b>	.87402	<b>.74820</b>	57
+ 1'	9.86960	<b>.74062</b>	9.87072	<b>.74253</b>	9.87183	<b>.74444</b>	9.87294	<b>.74634</b>	9.87404	<b>.74823</b>	56
5	.86962	<b>.74065</b>	.87073	<b>.74256</b>	.87185	<b>.74447</b>	.87295	<b>.74637</b>	.87406	<b>.74827</b>	55
6	.86963	<b>.74069</b>	.87075	<b>.74260</b>	.87187	<b>.74450</b>	.87297	<b>.74640</b>	.87407	<b>.74830</b>	54
7	.86965	<b>.74072</b>	.87077	<b>.74263</b>	.87188	<b>.74453</b>	.87299	<b>.74643</b>	.87409	<b>.74833</b>	53
+ 2'	9.86967	<b>.74075</b>	9.87079	<b>.74266</b>	9.87190	<b>.74456</b>	9.87301	<b>.74646</b>	9.87411	<b>.74836</b>	52
9	.86989	<b>.74078</b>	.87081	<b>.74269</b>	.87192	<b>.74459</b>	.87303	<b>.74650</b>	.87413	<b>.74839</b>	51
10	.86971	<b>.74081</b>	.87083	<b>.74272</b>	.87194	<b>.74463</b>	.87305	<b>.74653</b>	.87415	<b>.74842</b>	50
11	.86973	<b>.74084</b>	.87085	<b>.74275</b>	.87196	<b>.74466</b>	.87306	<b>.74656</b>	.87417	<b>.74846</b>	49
+ 3'	9.86975	<b>.74088</b>	9.87086	<b>.74279</b>	9.87198	<b>.74469</b>	9.87308	<b>.74659</b>	9.87418	<b>.74849</b>	48
13	.86977	<b>.74091</b>	.87088	<b>.74282</b>	.87199	<b>.74472</b>	.87310	<b>.74662</b>	.87420	<b>.74852</b>	47
14	.86978	<b>.74094</b>	.87090	<b>.74285</b>	.87201	<b>.74475</b>	.87312	<b>.74665</b>	.87422	<b>.74855</b>	46
15	.86980	<b>.74097</b>	.87092	<b>.74288</b>	.87203	<b>.74479</b>	.87314	<b>.74669</b>	.87424	<b>.74858</b>	45
+ 4'	9.86982	<b>.74100</b>	9.87094	<b>.74291</b>	9.87205	<b>.74482</b>	9.87316	<b>.74672</b>	9.87426	<b>.74861</b>	44
17	.86984	<b>.74104</b>	.87096	<b>.74294</b>	.87207	<b>.74485</b>	.87318	<b>.74675</b>	.87428	<b>.74864</b>	43
18	.86986	<b>.74107</b>	.87098	<b>.74298</b>	.87209	<b>.74488</b>	.87319	<b>.74678</b>	.87429	<b>.74868</b>	42
19	.86988	<b>.74110</b>	.87100	<b>.74301</b>	.87211	<b>.74491</b>	.87321	<b>.74681</b>	.87431	<b>.74871</b>	41
+ 5'	9.86990	<b>.74113</b>	9.87101	<b>.74304</b>	9.87212	<b>.74494</b>	9.87323	<b>.74684</b>	9.87433	<b>.74874</b>	40
21	.86991	<b>.74116</b>	.87103	<b>.74307</b>	.87214	<b>.74498</b>	.87325	<b>.74688</b>	.87435	<b>.74877</b>	39
22	.86993	<b>.74120</b>	.87105	<b>.74310</b>	.87216	<b>.74501</b>	.87327	<b>.74691</b>	.87437	<b>.74880</b>	38
23	.86995	<b>.74123</b>	.87107	<b>.74314</b>	.87218	<b>.74504</b>	.87329	<b>.74694</b>	.87439	<b>.74883</b>	37
+ 6'	9.86997	<b>.74126</b>	9.87109	<b>.74317</b>	9.87220	<b>.74507</b>	9.87330	<b>.74697</b>	9.87440	<b>.74887</b>	36
25	.86999	<b>.74129</b>	.87111	<b>.74320</b>	.87222	<b>.74510</b>	.87332	<b>.74700</b>	.87442	<b>.74890</b>	35
26	.87001	<b>.74132</b>	.87112	<b>.74323</b>	.87224	<b>.74514</b>	.87334	<b>.74703</b>	.87444	<b>.74893</b>	34
27	.87003	<b>.74135</b>	.87114	<b>.74326</b>	.87225	<b>.74517</b>	.87336	<b>.74707</b>	.87446	<b>.74896</b>	33
+ 7'	9.87004	<b>.74139</b>	9.87116	<b>.74329</b>	9.87227	<b>.74520</b>	9.87338	<b>.74710</b>	9.87448	<b>.74899</b>	32
29	.87006	<b>.74142</b>	.87118	<b>.74333</b>	.87229	<b>.74523</b>	.87340	<b>.74713</b>	.87450	<b>.74902</b>	31
30	.87008	<b>.74145</b>	.87120	<b>.74336</b>	.87231	<b>.74526</b>	.87341	<b>.74716</b>	.87451	<b>.74905</b>	30
31	.87010	<b>.74148</b>	.87122	<b>.74339</b>	.87233	<b>.74529</b>	.87343	<b>.74719</b>	.87453	<b>.74908</b>	29
+ 8'	9.87012	<b>.74151</b>	9.87124	<b>.74342</b>	9.87235	<b>.74533</b>	9.87345	<b>.74722</b>	9.87455	<b>.74912</b>	28
33	.87014	<b>.74155</b>	.87125	<b>.74345</b>	.87236	<b>.74536</b>	.87347	<b>.74726</b>	.87457	<b>.74915</b>	27
34	.87016	<b>.74158</b>	.87127	<b>.74349</b>	.87238	<b>.74539</b>	.87349	<b>.74729</b>	.87459	<b>.74918</b>	26
35	.87018	<b>.74161</b>	.87129	<b>.74352</b>	.87240	<b>.74542</b>	.87351	<b>.74732</b>	.87460	<b>.74921</b>	25
+ 9'	9.87019	<b>.74164</b>	9.87131	<b>.74355</b>	9.87242	<b>.74545</b>	9.87352	<b>.74735</b>	9.87462	<b>.74924</b>	24
37	.87021	<b>.74167</b>	.87133	<b>.74358</b>	.87244	<b>.74548</b>	.87354	<b>.74738</b>	.87464	<b>.74928</b>	23
38	.87023	<b>.74170</b>	.87135	<b>.74361</b>	.87246	<b>.74552</b>	.87356	<b>.74741</b>	.87466	<b>.74931</b>	22
39	.87025	<b>.74174</b>	.87137	<b>.74364</b>	.87248	<b>.74555</b>	.87358	<b>.74744</b>	.87468	<b>.74934</b>	21
+ 10'	9.87027	<b>.74177</b>	9.87138	<b>.74368</b>	9.87249	<b>.74558</b>	9.87360	<b>.74748</b>	9.87470	<b>.74937</b>	20
41	.87029	<b>.74180</b>	.87140	<b>.74371</b>	.87251	<b>.74561</b>	.87362	<b>.74751</b>	.87471	<b>.74940</b>	19
42	.87031	<b>.74183</b>	.87142	<b>.74374</b>	.87253	<b>.74564</b>	.87363	<b>.74754</b>	.87473	<b>.74943</b>	18
43	.87032	<b>.74186</b>	.87144	<b>.74377</b>	.87255	<b>.74567</b>	.87365	<b>.74757</b>	.87475	<b>.74946</b>	17
+ 11'	9.87034	<b>.74190</b>	9.87146	<b>.74380</b>	9.87257	<b>.74571</b>	9.87367	<b>.74760</b>	9.87477	<b>.74950</b>	16
45	.87036	<b>.74193</b>	.87148	<b>.74383</b>	.87259	<b>.74574</b>	.87369	<b>.74763</b>	.87479	<b>.74953</b>	15
46	.87038	<b>.74196</b>	.87149	<b>.74387</b>	.87260	<b>.74577</b>	.87371	<b>.74767</b>	.87481	<b>.74956</b>	14
47	.87040	<b>.74199</b>	.87151	<b>.74390</b>	.87262	<b>.74580</b>	.87373	<b>.74770</b>	.87482	<b>.74959</b>	13
+ 12'	9.87042	<b>.74202</b>	9.87153	<b>.74393</b>	9.87264	<b>.74583</b>	9.87374	<b>.74773</b>	9.87484	<b>.74962</b>	12
49	.87044	<b>.74205</b>	.87155	<b>.74396</b>	.87266	<b>.74586</b>	.87376	<b>.74776</b>	.87486	<b>.74965</b>	11
50	.87045	<b>.74209</b>	.87157	<b>.74399</b>	.87268	<b>.74590</b>	.87378	<b>.74779</b>	.87488	<b>.74969</b>	10
51	.87047	<b>.74212</b>	.87159	<b>.74402</b>	.87270	<b>.74593</b>	.87380	<b>.74782</b>	.87490	<b>.74972</b>	9
+ 13'	9.87049	<b>.74215</b>	9.87161	<b>.74406</b>	9.87271	<b>.74596</b>	9.87382	<b>.74786</b>	9.87492	<b>.74975</b>	8
53	.87051	<b>.74218</b>	.87162	<b>.74409</b>	.87273	<b>.74599</b>	.87384	<b>.74789</b>	.87493	<b>.74978</b>	7
54	.87053	<b>.74221</b>	.87164	<b>.74412</b>	.87275	<b>.74602</b>	.87385	<b>.74792</b>	.87495	<b>.74981</b>	6
55	.87055	<b>.74225</b>	.87166	<b>.74415</b>	.87277	<b>.74605</b>	.87387	<b>.74795</b>	.87497	<b>.74984</b>	5
+ 14'	9.87057	<b>.74228</b>	9.87168	<b>.74418</b>	9.87279	<b>.74609</b>	9.87389	<b>.74798</b>	9.87499	<b>.74987</b>	4
57	.87059	<b>.74231</b>	.87170	<b>.74422</b>	.87281	<b>.74612</b>	.87391	<b>.74801</b>	.87501	<b>.74991</b>	3
58	.87060	<b>.74234</b>	.87172	<b>.74425</b>	.87283	<b>.74615</b>	.87393	<b>.74805</b>	.87502	<b>.74994</b>	2
59	.87062	<b>.74237</b>	.87174	<b>.74428</b>	.87284	<b>.74618</b>	.87395	<b>.74808</b>	.87504	<b>.74997</b>	1
+ 15'	9.87064	<b>.74240</b>	9.87175	<b>.74431</b>	9.87286	<b>.74621</b>	9.87396	<b>.74811</b>	9.87506	<b>.75000</b>	0
		16h 4m		16h 3m		16h 2m		16h 1m		16h 0m	



TABLE IV.

Haversines.

s	Sh 0m 120° 0'		Sh 2m 120° 30'		Sh 4m 121° 0'		Sh 6m 121° 30'		Sh 8m 122° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	9.87506	<b>0.75000</b>	9.87724	<b>0.75377</b>	9.87939	<b>0.75752</b>	9.88153	<b>0.76125</b>	9.88364	<b>0.76496</b>	60
2	.87510	<b>.75006</b>	.87727	<b>.75383</b>	.87943	<b>.75758</b>	.88156	<b>.76131</b>	.88367	<b>.76502</b>	58
4+1	.87513	<b>.75013</b>	.87731	<b>.75389</b>	.87947	<b>.75764</b>	.88160	<b>.76137</b>	.88371	<b>.76508</b>	56
6	.87517	<b>.75019</b>	.87735	<b>.75396</b>	.87950	<b>.75771</b>	.88163	<b>.76144</b>	.88374	<b>.76514</b>	54
8+2	9.87521	<b>0.75025</b>	9.87738	<b>0.75402</b>	9.87954	<b>0.75777</b>	9.88167	<b>0.76150</b>	9.88378	<b>0.76521</b>	52
10	.87524	<b>.75032</b>	.87742	<b>.75408</b>	.87957	<b>.75783</b>	.88170	<b>.76156</b>	.88381	<b>.76527</b>	50
12+3	.87528	<b>.75038</b>	.87745	<b>.75415</b>	.87961	<b>.75789</b>	.88174	<b>.76162</b>	.88385	<b>.76533</b>	48
14	.87532	<b>.75044</b>	.87749	<b>.75421</b>	.87964	<b>.75795</b>	.88177	<b>.76168</b>	.88388	<b>.76539</b>	46
16+4	9.87535	<b>0.75050</b>	9.87753	<b>0.75427</b>	9.87968	<b>0.75802</b>	9.88181	<b>0.76175</b>	9.88392	<b>0.76545</b>	44
18	.87539	<b>.75057</b>	.87756	<b>.75433</b>	.87971	<b>.75808</b>	.88185	<b>.76181</b>	.88395	<b>.76551</b>	42
20+5	.87543	<b>.75063</b>	.87760	<b>.75440</b>	.87975	<b>.75814</b>	.88188	<b>.76187</b>	.88399	<b>.76558</b>	40
22	.87546	<b>.75069</b>	.87764	<b>.75446</b>	.87979	<b>.75820</b>	.88192	<b>.76193</b>	.88402	<b>.76564</b>	38
24+6	9.87550	<b>0.75075</b>	9.87767	<b>0.75452</b>	9.87982	<b>0.75827</b>	9.88195	<b>0.76199</b>	9.88406	<b>0.76570</b>	36
26	.87553	<b>.75082</b>	.87771	<b>.75458</b>	.87986	<b>.75833</b>	.88199	<b>.76205</b>	.88409	<b>.76576</b>	34
28+7	.87557	<b>.75088</b>	.87774	<b>.75465</b>	.87989	<b>.75839</b>	.88202	<b>.76212</b>	.88413	<b>.76582</b>	32
30	.87561	<b>.75094</b>	.87778	<b>.75471</b>	.87993	<b>.75845</b>	.88206	<b>.76218</b>	.88416	<b>.76588</b>	30
32+8	9.87564	<b>0.75101</b>	9.87782	<b>0.75477</b>	9.87996	<b>0.75852</b>	9.88209	<b>0.76224</b>	9.88420	<b>0.76595</b>	28
34	.87568	<b>.75107</b>	.87785	<b>.75483</b>	.88000	<b>.75858</b>	.88213	<b>.76230</b>	.88423	<b>.76601</b>	26
36+9	.87572	<b>.75113</b>	.87789	<b>.75490</b>	.88004	<b>.75864</b>	.88216	<b>.76236</b>	.88427	<b>.76607</b>	24
38	.87575	<b>.75120</b>	.87792	<b>.75496</b>	.88007	<b>.75870</b>	.88220	<b>.76243</b>	.88430	<b>.76613</b>	22
40+10	9.87579	<b>0.75126</b>	9.87796	<b>0.75502</b>	9.88011	<b>0.75876</b>	9.88223	<b>0.76249</b>	9.88434	<b>0.76619</b>	20
42	.87583	<b>.75132</b>	.87800	<b>.75508</b>	.88014	<b>.75883</b>	.88227	<b>.76255</b>	.88437	<b>.76625</b>	18
44+11	.87586	<b>.75138</b>	.87803	<b>.75515</b>	.88018	<b>.75889</b>	.88230	<b>.76261</b>	.88441	<b>.76632</b>	16
46	.87590	<b>.75145</b>	.87807	<b>.75521</b>	.88021	<b>.75895</b>	.88234	<b>.76267</b>	.88444	<b>.76638</b>	14
48+12	9.87593	<b>0.75151</b>	9.87810	<b>0.75527</b>	9.88025	<b>0.75901</b>	9.88237	<b>0.76274</b>	9.88448	<b>0.76644</b>	12
50	.87597	<b>.75157</b>	.87814	<b>.75533</b>	.88029	<b>.75908</b>	.88241	<b>.76280</b>	.88451	<b>.76650</b>	10
52+13	.87601	<b>.75164</b>	.87818	<b>.75540</b>	.88032	<b>.75914</b>	.88244	<b>.76286</b>	.88455	<b>.76656</b>	8
54	.87604	<b>.75170</b>	.87821	<b>.75546</b>	.88036	<b>.75920</b>	.88248	<b>.76292</b>	.88458	<b>.76662</b>	6
56+14	9.87608	<b>0.75176</b>	9.87825	<b>0.75552</b>	9.88039	<b>0.75926</b>	9.88252	<b>0.76298</b>	9.88462	<b>0.76668</b>	4
58	9.87612	<b>0.75182</b>	9.87828	<b>0.75558</b>	9.88043	<b>0.75932</b>	9.88255	<b>0.76305</b>	9.88465	<b>0.76675</b>	2
	15h 59m		15h 57m		15h 55m		15h 53m		15h 51m		
B	Sh 1m 120° 0'		Sh 3m 120° 30'		Sh 5m 121° 0'		Sh 7m 121° 30'		Sh 9m 122° 0'		s
0+15	9.87615	<b>0.75189</b>	9.87832	<b>0.75565</b>	9.88046	<b>0.75939</b>	9.88259	<b>0.76311</b>	9.88469	<b>0.76681</b>	60
2	.87619	<b>.75195</b>	.87835	<b>.75571</b>	.88050	<b>.75945</b>	.88262	<b>.76317</b>	.88472	<b>.76687</b>	58
4+16	.87623	<b>.75201</b>	.87839	<b>.75577</b>	.88053	<b>.75951</b>	.88266	<b>.76323</b>	.88476	<b>.76693</b>	56
6	.87626	<b>.75208</b>	.87843	<b>.75583</b>	.88057	<b>.75957</b>	.88269	<b>.76329</b>	.88479	<b>.76699</b>	54
8+17	9.87630	<b>0.75214</b>	9.87846	<b>0.75590</b>	9.88061	<b>0.75964</b>	9.88273	<b>0.76335</b>	9.88483	<b>0.76705</b>	52
10	.87633	<b>.75220</b>	.87850	<b>.75596</b>	.88064	<b>.75970</b>	.88276	<b>.76342</b>	.88486	<b>.76711</b>	50
12+18	.87637	<b>.75226</b>	.87853	<b>.75602</b>	.88068	<b>.75976</b>	.88280	<b>.76348</b>	.88490	<b>.76718</b>	48
14	.87641	<b>.75233</b>	.87857	<b>.75608</b>	.88071	<b>.75982</b>	.88283	<b>.76354</b>	.88493	<b>.76724</b>	46
16+19	9.87644	<b>0.75239</b>	9.87861	<b>0.75615</b>	9.88075	<b>0.75988</b>	9.88287	<b>0.76360</b>	9.88496	<b>0.76730</b>	44
18	.87648	<b>.75245</b>	.87864	<b>.75621</b>	.88078	<b>.75995</b>	.88290	<b>.76366</b>	.88500	<b>.76736</b>	42
20+20	.87652	<b>.75251</b>	.87868	<b>.75627</b>	.88082	<b>.76001</b>	.88294	<b>.76373</b>	.88503	<b>.76742</b>	40
22	.87655	<b>.75258</b>	.87871	<b>.75633</b>	.88085	<b>.76007</b>	.88297	<b>.76379</b>	.88507	<b>.76748</b>	38
24+21	9.87659	<b>0.75264</b>	9.87875	<b>0.75640</b>	9.88089	<b>0.76013</b>	9.88301	<b>0.76385</b>	9.88510	<b>0.76754</b>	36
26	.87662	<b>.75270</b>	.87879	<b>.75646</b>	.88092	<b>.76019</b>	.88304	<b>.76391</b>	.88514	<b>.76761</b>	34
28+22	.87666	<b>.75277</b>	.87882	<b>.75652</b>	.88096	<b>.76026</b>	.88308	<b>.76397</b>	.88517	<b>.76767</b>	32
30	.87670	<b>.75283</b>	.87886	<b>.75658</b>	.88100	<b>.76032</b>	.88311	<b>.76403</b>	.88521	<b>.76773</b>	30
32+23	9.87673	<b>0.75289</b>	9.87889	<b>0.75665</b>	9.88103	<b>0.76038</b>	9.88315	<b>0.76410</b>	9.88524	<b>0.76779</b>	28
34	.87677	<b>.75295</b>	.87893	<b>.75671</b>	.88107	<b>.76044</b>	.88318	<b>.76416</b>	.88528	<b>.76785</b>	26
36+24	.87680	<b>.75302</b>	.87896	<b>.75677</b>	.88110	<b>.76050</b>	.88322	<b>.76422</b>	.88531	<b>.76791</b>	24
38	.87684	<b>.75308</b>	.87900	<b>.75683</b>	.88114	<b>.76057</b>	.88325	<b>.76428</b>	.88535	<b>.76797</b>	22
40+25	9.87688	<b>0.75314</b>	9.87904	<b>0.75690</b>	9.88117	<b>0.76063</b>	9.88329	<b>0.76434</b>	9.88528	<b>0.76804</b>	20
42	.87691	<b>.75321</b>	.87907	<b>.75696</b>	.88121	<b>.76069</b>	.88332	<b>.76440</b>	.88542	<b>.76810</b>	18
44+26	.87695	<b>.75327</b>	.87911	<b>.75702</b>	.88124	<b>.76075</b>	.88336	<b>.76447</b>	.88545	<b>.76816</b>	16
46	.87699	<b>.75333</b>	.87914	<b>.75708</b>	.88128	<b>.76082</b>	.88339	<b>.76453</b>	.88549	<b>.76822</b>	14
48+27	9.87702	<b>0.75339</b>	9.87918	<b>0.75714</b>	9.88131	<b>0.76088</b>	9.88343	<b>0.76459</b>	9.88552	<b>0.76828</b>	12
50	.87706	<b>.75346</b>	.87921	<b>.75721</b>	.88135	<b>.76094</b>	.88346	<b>.76465</b>	.88556	<b>.76834</b>	10
52+28	.87709	<b>.75352</b>	.87925	<b>.75727</b>	.88139	<b>.76100</b>	.88350	<b>.76471</b>	.88559	<b>.76840</b>	8
54	.87713	<b>.75358</b>	.87929	<b>.75733</b>	.88142	<b>.76106</b>	.88353	<b>.76477</b>	.88562	<b>.76847</b>	6
56+29	9.87717	<b>0.75364</b>	9.87932	<b>0.75739</b>	9.88146	<b>0.76113</b>	9.88357	<b>0.76484</b>	9.88566	<b>0.76853</b>	4
58	.87720	<b>.75371</b>	.87936	<b>.75746</b>	.88149	<b>.76119</b>	.88360	<b>.76490</b>	.88569	<b>.76859</b>	2
60+30	9.87724	<b>0.75377</b>	9.87939	<b>0.75752</b>	9.88153	<b>0.76125</b>	9.88364	<b>0.76496</b>	9.88573	<b>0.76865</b>	0
	15h 58m		15h 56m		15h 54m		15h 52m		15h 50m		

TABLE IV.

Haversines.

s	8h 10m 122° 30'		8h 12m 123° 0'		8h 14m 123° 30'		8h 16m 124° 0'		8h 18m 124° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	9.88573	<b>0.76865</b>	9.88780	<b>0.77232</b>	9.88984	<b>0.77597</b>	9.89187	<b>0.77960</b>	9.89387	<b>0.78320</b>	60
2	.88576	<b>.76871</b>	.88783	<b>.77238</b>	.88988	<b>.77603</b>	.89190	<b>.77966</b>	.89391	<b>.78326</b>	58
4+1	.88580	<b>.76877</b>	.88787	<b>.77244</b>	.88991	<b>.77609</b>	.89194	<b>.77972</b>	.89394	<b>.78332</b>	56
6	.88583	<b>.76883</b>	.88790	<b>.77250</b>	.88995	<b>.77615</b>	.89197	<b>.77978</b>	.89397	<b>.78338</b>	54
8+2	9.88587	<b>0.76890</b>	9.88793	<b>0.77256</b>	9.88998	<b>0.77621</b>	9.89200	<b>0.77984</b>	9.89400	<b>0.78344</b>	52
10	.88590	<b>.76896</b>	.88797	<b>.77262</b>	.89001	<b>.77627</b>	.89204	<b>.77990</b>	.89404	<b>.78350</b>	50
12+3	.88594	<b>.76902</b>	.88800	<b>.77269</b>	.89005	<b>.77633</b>	.89207	<b>.77996</b>	.89407	<b>.78356</b>	48
14	.88597	<b>.76908</b>	.88804	<b>.77275</b>	.89008	<b>.77639</b>	.89210	<b>.78002</b>	.89411	<b>.78362</b>	46
16+4	9.88600	<b>0.76914</b>	9.88807	<b>0.77281</b>	9.89012	<b>0.77645</b>	9.89214	<b>0.78008</b>	9.89414	<b>0.78368</b>	44
18	.88604	<b>.76920</b>	.88811	<b>.77287</b>	.89015	<b>.77651</b>	.89217	<b>.78014</b>	.89417	<b>.78374</b>	42
20+5	.88607	<b>.76926</b>	.88814	<b>.77293</b>	.89018	<b>.77657</b>	.89221	<b>.78020</b>	.89421	<b>.78380</b>	40
22	.88611	<b>.76932</b>	.88817	<b>.77299</b>	.89022	<b>.77664</b>	.89224	<b>.78026</b>	.89424	<b>.78386</b>	38
24+6	9.88614	<b>0.76939</b>	9.88821	<b>0.77305</b>	9.89025	<b>0.77670</b>	9.89227	<b>0.78032</b>	9.89427	<b>0.78392</b>	36
26	.88618	<b>.76945</b>	.88824	<b>.77311</b>	.89028	<b>.77676</b>	.89231	<b>.78038</b>	.89431	<b>.78398</b>	34
28+7	.88621	<b>.76951</b>	.88828	<b>.77317</b>	.89032	<b>.77682</b>	.89234	<b>.78044</b>	.89434	<b>.78404</b>	32
30	.88625	<b>.76957</b>	.88831	<b>.77323</b>	.89035	<b>.77688</b>	.89237	<b>.78050</b>	.89437	<b>.78410</b>	30
32+8	9.88628	<b>0.76963</b>	9.88835	<b>0.77329</b>	9.89039	<b>0.77694</b>	9.89241	<b>0.78056</b>	9.89441	<b>0.78416</b>	28
34	.88632	<b>.76969</b>	.88838	<b>.77336</b>	.89042	<b>.77700</b>	.89244	<b>.78062</b>	.89444	<b>.78422</b>	26
36+9	.88635	<b>.76975</b>	.88841	<b>.77342</b>	.89045	<b>.77706</b>	.89247	<b>.78068</b>	.89447	<b>.78428</b>	24
38	.88639	<b>.76981</b>	.88845	<b>.77348</b>	.89049	<b>.77712</b>	.89251	<b>.78074</b>	.89450	<b>.78434</b>	22
40+10	9.88642	<b>0.76988</b>	9.88848	<b>0.77354</b>	9.89052	<b>0.77718</b>	9.89254	<b>0.78080</b>	9.89454	<b>0.78440</b>	20
42	.88645	<b>.76994</b>	.88852	<b>.77360</b>	.89056	<b>.77724</b>	.89257	<b>.78086</b>	.89457	<b>.78446</b>	18
44+11	.88649	<b>.77000</b>	.88855	<b>.77366</b>	.89059	<b>.77730</b>	.89261	<b>.78092</b>	.89460	<b>.78452</b>	16
46	.88652	<b>.77006</b>	.88858	<b>.77372</b>	.89062	<b>.77736</b>	.89264	<b>.78098</b>	.89464	<b>.78458</b>	14
48+12	9.88656	<b>0.77012</b>	9.88862	<b>0.77378</b>	9.89066	<b>0.77742</b>	9.89267	<b>0.78104</b>	9.89467	<b>0.78464</b>	12
50	.88659	<b>.77018</b>	.88865	<b>.77384</b>	.89069	<b>.77748</b>	.89271	<b>.78110</b>	.89470	<b>.78470</b>	10
52+13	.88663	<b>.77024</b>	.88869	<b>.77390</b>	.89072	<b>.77754</b>	.89274	<b>.78116</b>	.89474	<b>.78476</b>	8
54	.88666	<b>.77030</b>	.88872	<b>.77396</b>	.89076	<b>.77760</b>	.89277	<b>.78122</b>	.89477	<b>.78482</b>	6
56+14	9.88670	<b>0.77036</b>	9.88876	<b>0.77403</b>	9.89079	<b>0.77766</b>	9.89281	<b>0.78128</b>	9.89480	<b>0.78488</b>	4
58	9.88673	<b>0.77043</b>	9.88879	<b>0.77409</b>	9.89083	<b>0.77772</b>	9.89284	<b>0.78134</b>	9.89484	<b>0.78494</b>	2
	15h 49m		15h 47m		15h 45m		15h 43m		15h 41m		
s	8h 11m 122° 30'		8h 13m 123° 0'		8h 15m 123° 30'		8h 17m 124° 0'		8h 19m 124° 30'		s
0+15	9.88677	<b>0.77049</b>	9.88882	<b>0.77415</b>	9.89086	<b>0.77779</b>	9.89287	<b>0.78140</b>	9.89487	<b>0.78500</b>	60
2	.88680	<b>.77055</b>	.88886	<b>.77421</b>	.89089	<b>.77785</b>	.89291	<b>.78146</b>	.89490	<b>.78506</b>	58
4+16	.88683	<b>.77061</b>	.88889	<b>.77427</b>	.89093	<b>.77791</b>	.89294	<b>.78152</b>	.89493	<b>.78512</b>	56
6	.88687	<b>.77067</b>	.88893	<b>.77433</b>	.89096	<b>.77797</b>	.89298	<b>.78158</b>	.89497	<b>.78518</b>	54
8+17	9.88690	<b>0.77073</b>	9.88896	<b>0.77439</b>	9.89099	<b>0.77803</b>	9.89301	<b>0.78164</b>	9.89500	<b>0.78524</b>	52
10	.88694	<b>.77079</b>	.88899	<b>.77445</b>	.89102	<b>.77809</b>	.89304	<b>.78170</b>	.89503	<b>.78530</b>	50
12+18	.88697	<b>.77085</b>	.88903	<b>.77451</b>	.89106	<b>.77815</b>	.89308	<b>.78176</b>	.89507	<b>.78536</b>	48
14	.88701	<b>.77092</b>	.88906	<b>.77457</b>	.89110	<b>.77821</b>	.89311	<b>.78182</b>	.89510	<b>.78542</b>	46
16+19	9.88704	<b>0.77098</b>	9.88910	<b>0.77463</b>	9.89113	<b>0.77827</b>	9.89314	<b>0.78188</b>	9.89513	<b>0.78548</b>	44
18	.88708	<b>.77104</b>	.88913	<b>.77469</b>	.89116	<b>.77833</b>	.89318	<b>.78194</b>	.89517	<b>.78554</b>	42
20+20	.88711	<b>.77110</b>	.88916	<b>.77475</b>	.89120	<b>.77839</b>	.89321	<b>.78200</b>	.89520	<b>.78560</b>	40
22	.88714	<b>.77116</b>	.88920	<b>.77482</b>	.89123	<b>.77845</b>	.89324	<b>.78206</b>	.89523	<b>.78566</b>	38
24+21	9.88718	<b>0.77122</b>	9.88923	<b>0.77488</b>	9.89126	<b>0.77851</b>	9.89328	<b>0.78212</b>	9.89527	<b>0.78572</b>	36
26	.88721	<b>.77128</b>	.88927	<b>.77494</b>	.89130	<b>.77857</b>	.89331	<b>.78218</b>	.89530	<b>.78577</b>	34
28+22	.88725	<b>.77134</b>	.88930	<b>.77500</b>	.89133	<b>.77863</b>	.89334	<b>.78224</b>	.89533	<b>.78583</b>	32
30	.88728	<b>.77140</b>	.88933	<b>.77506</b>	.89137	<b>.77869</b>	.89338	<b>.78230</b>	.89536	<b>.78589</b>	30
32+23	9.88732	<b>0.77147</b>	9.88937	<b>0.77512</b>	9.89140	<b>0.77875</b>	9.89341	<b>0.78236</b>	9.89540	<b>0.78595</b>	28
34	.88735	<b>.77153</b>	.88940	<b>.77518</b>	.89143	<b>.77881</b>	.89344	<b>.78242</b>	.89543	<b>.78601</b>	26
36+24	.88739	<b>.77159</b>	.88944	<b>.77524</b>	.89147	<b>.77887</b>	.89348	<b>.78248</b>	.89546	<b>.78607</b>	24
38	.88742	<b>.77165</b>	.88947	<b>.77530</b>	.89150	<b>.77893</b>	.89351	<b>.78254</b>	.89550	<b>.78613</b>	22
40+25	9.88745	<b>0.77171</b>	9.88950	<b>0.77536</b>	9.89153	<b>0.77899</b>	9.89354	<b>0.78260</b>	9.89553	<b>0.78619</b>	20
42	.88749	<b>.77177</b>	.88954	<b>.77542</b>	.89157	<b>.77905</b>	.89358	<b>.78266</b>	.89556	<b>.78625</b>	18
44+26	.88752	<b>.77183</b>	.88957	<b>.77548</b>	.89160	<b>.77911</b>	.89361	<b>.78272</b>	.89559	<b>.78631</b>	16
46	.88756	<b>.77189</b>	.88961	<b>.77554</b>	.89163	<b>.77917</b>	.89364	<b>.78278</b>	.89563	<b>.78637</b>	14
48+27	9.88759	<b>0.77195</b>	9.88964	<b>0.77560</b>	9.89167	<b>0.77923</b>	9.89368	<b>0.78284</b>	9.89566	<b>0.78643</b>	12
50	.88763	<b>.77201</b>	.88967	<b>.77567</b>	.89170	<b>.77929</b>	.89371	<b>.78290</b>	.89569	<b>.78649</b>	10
52+28	.88766	<b>.77208</b>	.88971	<b>.77573</b>	.89174	<b>.77936</b>	.89374	<b>.78296</b>	.89573	<b>.78655</b>	8
54	.88769	<b>.77214</b>	.88974	<b>.77579</b>	.89177	<b>.77942</b>	.89378	<b>.78302</b>	.89576	<b>.78661</b>	6
56+29	9.88773	<b>0.77220</b>	9.88978	<b>0.77585</b>	9.89180	<b>0.77948</b>	9.89381	<b>0.78308</b>	9.89579	<b>0.78667</b>	4
58	.88776	<b>.77226</b>	.88981	<b>.77591</b>	.89184	<b>.77954</b>	.89384	<b>.78314</b>	.89583	<b>.78673</b>	2
60+30	9.88780	<b>0.77232</b>	9.88984	<b>0.77597</b>	9.89187	<b>0.77960</b>	9.89387	<b>0.78320</b>	9.89586	<b>0.78679</b>	0
	15h 48m		15h 46m		15h 44m		15h 42m		15h 40m		



TABLE IV.

Haversines.

s	8h 20m 125° 0'		8h 22m 125° 30'		8h 24m 126° 0'		8h 26m 126° 30'		8h 28m 127° 0'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	9.89586	<b>0.78679</b>	9.89782	<b>0.79035</b>	9.89976	<b>0.79389</b>	9.90168	<b>0.79741</b>	9.90358	<b>0.80091</b>	60
2	.89589	<b>.78685</b>	.89785	<b>.79041</b>	.89979	<b>.79395</b>	.90171	<b>.79747</b>	.90361	<b>.80097</b>	58
4+1	.89592	<b>.78691</b>	.89789	<b>.79047</b>	.89983	<b>.79401</b>	.90175	<b>.79753</b>	.90365	<b>.80102</b>	56
6	.89596	<b>.78697</b>	.89792	<b>.79053</b>	.89986	<b>.79407</b>	.90178	<b>.79759</b>	.90368	<b>.80108</b>	54
8+2	9.89599	<b>0.78703</b>	9.89795	<b>0.79059</b>	9.89989	<b>0.79413</b>	9.90181	<b>0.79765</b>	9.90371	<b>0.80114</b>	52
10	.89602	<b>.78709</b>	.89798	<b>.79065</b>	.89992	<b>.79419</b>	.90184	<b>.79770</b>	.90374	<b>.80120</b>	50
12+3	.89606	<b>.78715</b>	.89802	<b>.79071</b>	.89995	<b>.79425</b>	.90187	<b>.79776</b>	.90377	<b>.80126</b>	48
14	.89609	<b>.78721</b>	.89805	<b>.79077</b>	.89999	<b>.79430</b>	.90191	<b>.79782</b>	.90380	<b>.80131</b>	46
16+4	9.89612	<b>0.78726</b>	9.89808	<b>0.79082</b>	9.90002	<b>0.79436</b>	9.90194	<b>0.79788</b>	9.90383	<b>0.80137</b>	44
18	.89615	<b>.78732</b>	.89811	<b>.79088</b>	.90005	<b>.79442</b>	.90197	<b>.79794</b>	.90387	<b>.80143</b>	42
20+5	.89619	<b>.78738</b>	.89815	<b>.79094</b>	.90008	<b>.79448</b>	.90200	<b>.79800</b>	.90390	<b>.80149</b>	40
22	.89622	<b>.78744</b>	.89818	<b>.79100</b>	.90012	<b>.79454</b>	.90203	<b>.79805</b>	.90393	<b>.80155</b>	38
24+6	9.89625	<b>0.78750</b>	9.89821	<b>0.79106</b>	9.90015	<b>0.79460</b>	9.90206	<b>0.79811</b>	9.90396	<b>0.80160</b>	36
26	.89628	<b>.78756</b>	.89824	<b>.79112</b>	.90018	<b>.79466</b>	.90210	<b>.79817</b>	.90399	<b>.80166</b>	34
28+7	.89632	<b>.78762</b>	.89828	<b>.79118</b>	.90021	<b>.79471</b>	.90213	<b>.79823</b>	.90402	<b>.80172</b>	32
30	.89635	<b>.78768</b>	.89831	<b>.79124</b>	.90024	<b>.79477</b>	.90216	<b>.79829</b>	.90405	<b>.80178</b>	30
32+8	9.89638	<b>0.78774</b>	9.89834	<b>0.79130</b>	9.90028	<b>0.79483</b>	9.90219	<b>0.79835</b>	9.90409	<b>0.80184</b>	28
34	.89642	<b>.78780</b>	.89837	<b>.79136</b>	.90031	<b>.79489</b>	.90222	<b>.79840</b>	.90412	<b>.80189</b>	26
36+9	.89645	<b>.78786</b>	.89840	<b>.79142</b>	.90034	<b>.79495</b>	.90225	<b>.79846</b>	.90415	<b>.80195</b>	24
38	.89648	<b>.78792</b>	.89844	<b>.79148</b>	.90037	<b>.79501</b>	.90229	<b>.79852</b>	.90418	<b>.80201</b>	22
40+10	9.89651	<b>0.78798</b>	9.89847	<b>0.79153</b>	9.90040	<b>0.79507</b>	9.90232	<b>0.79858</b>	9.90421	<b>0.80207</b>	20
42	.89655	<b>.78804</b>	.89850	<b>.79159</b>	.90044	<b>.79513</b>	.90235	<b>.79864</b>	.90425	<b>.80213</b>	18
44+11	.89658	<b>.78810</b>	.89853	<b>.79165</b>	.90047	<b>.79519</b>	.90238	<b>.79870</b>	.90428	<b>.80218</b>	16
46	.89661	<b>.78816</b>	.89857	<b>.79171</b>	.90050	<b>.79524</b>	.90241	<b>.79875</b>	.90431	<b>.80224</b>	14
48+12	9.89665	<b>0.78822</b>	9.89860	<b>0.79177</b>	9.90053	<b>0.79530</b>	9.90244	<b>0.79881</b>	9.90434	<b>0.80230</b>	12
50	.89668	<b>.78828</b>	.89863	<b>.79183</b>	.90056	<b>.79536</b>	.90248	<b>.79887</b>	.90437	<b>.80236</b>	10
52+13	.89671	<b>.78834</b>	.89866	<b>.79189</b>	.90060	<b>.79542</b>	.90251	<b>.79893</b>	.90440	<b>.80242</b>	8
54	.89674	<b>.78839</b>	.89870	<b>.79195</b>	.90063	<b>.79548</b>	.90254	<b>.79899</b>	.90443	<b>.80247</b>	6
56+14	9.89678	<b>0.78845</b>	9.89873	<b>0.79201</b>	9.90066	<b>0.79554</b>	9.90257	<b>0.79905</b>	9.90446	<b>0.80253</b>	4
58	9.89681	<b>0.78851</b>	9.89876	<b>0.79207</b>	9.90069	<b>0.79560</b>	9.90260	<b>0.79910</b>	9.90449	<b>0.80259</b>	2
	15h 39m		15h 37m		15h 35m		15h 33m		15h 31m		
s	8h 21m 125° 0'		8h 23m 125° 30'		8h 25m 126° 0'		8h 27m 126° 30'		8h 29m 127° 0'		s
0+15	9.89684	<b>0.78857</b>	9.89879	<b>0.79212</b>	9.90072	<b>0.79565</b>	9.90264	<b>0.79916</b>	9.90452	<b>0.80265</b>	60
2	.89687	<b>.78863</b>	.89883	<b>.79218</b>	.90076	<b>.79571</b>	.90267	<b>.79922</b>	.90456	<b>.80270</b>	58
4+16	.89691	<b>.78869</b>	.89886	<b>.79224</b>	.90079	<b>.79577</b>	.90270	<b>.79928</b>	.90459	<b>.80276</b>	56
6	.89694	<b>.78875</b>	.89889	<b>.79230</b>	.90082	<b>.79583</b>	.90273	<b>.79934</b>	.90462	<b>.80282</b>	54
8+17	9.89697	<b>0.78881</b>	9.89892	<b>0.79236</b>	9.90085	<b>0.79589</b>	9.90276	<b>0.79940</b>	9.90465	<b>0.80288</b>	52
10	.89701	<b>.78887</b>	.89896	<b>.79242</b>	.90088	<b>.79595</b>	.90279	<b>.79945</b>	.90468	<b>.80294</b>	50
12+18	.89704	<b>.78893</b>	.89899	<b>.79248</b>	.90092	<b>.79601</b>	.90282	<b>.79951</b>	.90471	<b>.80299</b>	48
14	.89707	<b>.78899</b>	.89902	<b>.79254</b>	.90095	<b>.79607</b>	.90286	<b>.79957</b>	.90475	<b>.80305</b>	46
16+19	9.89710	<b>0.78905</b>	9.89905	<b>0.79260</b>	9.90098	<b>0.79612</b>	9.90289	<b>0.79963</b>	9.90478	<b>0.80311</b>	44
18	.89714	<b>.78911</b>	.89908	<b>.79266</b>	.90101	<b>.79618</b>	.90292	<b>.79969</b>	.90481	<b>.80317</b>	42
20+20	.89717	<b>.78917</b>	.89912	<b>.79271</b>	.90104	<b>.79624</b>	.90295	<b>.79974</b>	.90484	<b>.80323</b>	40
22	.89720	<b>.78923</b>	.89915	<b>.79277</b>	.90108	<b>.79630</b>	.90298	<b>.79980</b>	.90487	<b>.80328</b>	38
24+21	9.89723	<b>0.78928</b>	9.89918	<b>0.79283</b>	9.90111	<b>0.79636</b>	9.90301	<b>0.79986</b>	9.90490	<b>0.80334</b>	36
26	.89727	<b>.78934</b>	.89921	<b>.79289</b>	.90114	<b>.79642</b>	.90305	<b>.79992</b>	.90493	<b>.80340</b>	34
28+22	.89730	<b>.78940</b>	.89925	<b>.79295</b>	.90117	<b>.79648</b>	.90308	<b>.79998</b>	.90496	<b>.80346</b>	32
30	.89733	<b>.78946</b>	.89928	<b>.79301</b>	.90120	<b>.79653</b>	.90311	<b>.80004</b>	.90499	<b>.80351</b>	30
32+23	9.89736	<b>0.78952</b>	9.89931	<b>0.79307</b>	9.90124	<b>0.79659</b>	9.90314	<b>0.80009</b>	9.90503	<b>0.80357</b>	28
34	.89740	<b>.78958</b>	.89934	<b>.79313</b>	.90127	<b>.79665</b>	.90317	<b>.80015</b>	.90506	<b>.80363</b>	26
36+24	.89743	<b>.78964</b>	.89938	<b>.79319</b>	.90130	<b>.79671</b>	.90320	<b>.80021</b>	.90509	<b>.80369</b>	24
38	.89746	<b>.78970</b>	.89941	<b>.79325</b>	.90133	<b>.79677</b>	.90324	<b>.80027</b>	.90512	<b>.80375</b>	22
40+15	9.89749	<b>0.78976</b>	9.89944	<b>0.79330</b>	9.90136	<b>0.79683</b>	9.90327	<b>0.80033</b>	9.90515	<b>0.80380</b>	20
42	.89753	<b>.78982</b>	.89947	<b>.79336</b>	.90140	<b>.79689</b>	.90330	<b>.80038</b>	.90518	<b>.80386</b>	18
44+26	.89756	<b>.78988</b>	.89950	<b>.79342</b>	.90143	<b>.79694</b>	.90333	<b>.80044</b>	.90521	<b>.80392</b>	16
46	.89759	<b>.78994</b>	.89954	<b>.79348</b>	.90146	<b>.79700</b>	.90336	<b>.80050</b>	.90524	<b>.80398</b>	14
48+27	9.89763	<b>0.79000</b>	9.89957	<b>0.79354</b>	9.90149	<b>0.79706</b>	9.90339	<b>0.80056</b>	9.90527	<b>0.80403</b>	12
50	.89766	<b>.79006</b>	.89960	<b>.79360</b>	.90152	<b>.79712</b>	.90342	<b>.80062</b>	.90531	<b>.80409</b>	10
52+28	.89769	<b>.79011</b>	.89963	<b>.79366</b>	.90356	<b>.79718</b>	.90346	<b>.80068</b>	.90534	<b>.80415</b>	8
54	.89772	<b>.79017</b>	.89966	<b>.79372</b>	.90159	<b>.79724</b>	.90349	<b>.80073</b>	.90537	<b>.80421</b>	6
56+29	9.89776	<b>0.79023</b>	9.89970	<b>0.79377</b>	9.90162	<b>0.79729</b>	9.90352	<b>0.80079</b>	9.90540	<b>0.80427</b>	4
58	.89779	<b>.79029</b>	.89973	<b>.79383</b>	.90165	<b>.79735</b>	.90355	<b>.80085</b>	.90543	<b>.80432</b>	2
60+30	9.89782	<b>0.79035</b>	9.89976	<b>0.79389</b>	9.90168	<b>0.79741</b>	9.90358	<b>0.80091</b>	9.90546	<b>0.80438</b>	0
	15h 38m		15h 36m		15h 34m		15h 32m		15h 30m		

TABLE IV.

Haversines.

s	8h 30m 127° 30'		8h 32m 128° 0'		8h 34m 128° 30'		8h 36m 129° 0'		8h 38m 129° 30'		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	9.90546	<b>0.80438</b>	9.90732	<b>0.80783</b>	9.90916	<b>0.81126</b>	9.91098	<b>0.81466</b>	9.91277	<b>0.81804</b>	60
2	.90549	<b>.80444</b>	.90735	<b>.80789</b>	.90919	<b>.81131</b>	.91101	<b>.81472</b>	.91280	<b>.81810</b>	58
4+1	.90552	<b>.80450</b>	.90738	<b>.80795</b>	.90922	<b>.81137</b>	.91104	<b>.81477</b>	.91283	<b>.81815</b>	56
6	.90556	<b>.80455</b>	.90741	<b>.80800</b>	.90925	<b>.81143</b>	.91107	<b>.81483</b>	.91286	<b>.81821</b>	54
8+2	9.90559	<b>0.80461</b>	9.90744	<b>0.80806</b>	9.90928	<b>0.81148</b>	9.91110	<b>0.81489</b>	9.91289	<b>0.81826</b>	52
10	.90562	<b>.80467</b>	.90747	<b>.80812</b>	.90931	<b>.81154</b>	.91113	<b>.81494</b>	.91292	<b>.81832</b>	50
12+3	.90565	<b>.80473</b>	.90751	<b>.80817</b>	.90934	<b>.81160</b>	.91116	<b>.81500</b>	.91295	<b>.81838</b>	48
14	.90568	<b>.80478</b>	.90754	<b>.80823</b>	.90937	<b>.81165</b>	.91119	<b>.81506</b>	.91298	<b>.81843</b>	46
16+4	9.90571	<b>0.80484</b>	9.90757	<b>0.80829</b>	9.90940	<b>0.81171</b>	9.91122	<b>0.81511</b>	9.91301	<b>0.81849</b>	44
18	.90574	<b>.80490</b>	.90760	<b>.80835</b>	.90943	<b>.81177</b>	.91125	<b>.81517</b>	.91304	<b>.81854</b>	42
20+5	.90577	<b>.80496</b>	.90763	<b>.80840</b>	.90946	<b>.81183</b>	.91128	<b>.81523</b>	.91307	<b>.81860</b>	40
22	.90580	<b>.80502</b>	.90766	<b>.80846</b>	.90949	<b>.81188</b>	.91131	<b>.81528</b>	.91310	<b>.81866</b>	38
24+6	9.90584	<b>0.80507</b>	9.90769	<b>0.80852</b>	9.90952	<b>0.81194</b>	9.91134	<b>0.81534</b>	9.91313	<b>0.81871</b>	36
26	.90587	<b>.80513</b>	.90772	<b>.80858</b>	.90955	<b>.81200</b>	.91137	<b>.81539</b>	.91316	<b>.81877</b>	34
28+7	.90590	<b>.80519</b>	.90775	<b>.80863</b>	.90958	<b>.81205</b>	.91140	<b>.81545</b>	.91319	<b>.81882</b>	32
30	.90593	<b>.80525</b>	.90778	<b>.80869</b>	.90962	<b>.81211</b>	.91143	<b>.81551</b>	.91322	<b>.81888</b>	30
32+8	9.90596	<b>0.80530</b>	9.90781	<b>0.80875</b>	9.90965	<b>0.81217</b>	9.91146	<b>0.81556</b>	9.91325	<b>0.81894</b>	28
34	.90599	<b>.80536</b>	.90784	<b>.80880</b>	.90968	<b>.81222</b>	.91149	<b>.81562</b>	.91328	<b>.81899</b>	26
36+9	.90602	<b>.80542</b>	.90787	<b>.80886</b>	.90971	<b>.81228</b>	.91152	<b>.81568</b>	.91331	<b>.81905</b>	24
38	.90605	<b>.80548</b>	.90790	<b>.80892</b>	.90974	<b>.81234</b>	.91155	<b>.81573</b>	.91334	<b>.81910</b>	22
40+10	9.90608	<b>0.80553</b>	9.90794	<b>0.80898</b>	9.90977	<b>0.81239</b>	9.91158	<b>0.81579</b>	9.91337	<b>0.81916</b>	20
42	.90611	<b>.80559</b>	.90797	<b>.80903</b>	.90980	<b>.81245</b>	.91161	<b>.81585</b>	.91340	<b>.81922</b>	18
44+11	.90615	<b>.80565</b>	.90800	<b>.80909</b>	.90983	<b>.81251</b>	.91164	<b>.81590</b>	.91343	<b>.81927</b>	16
46	.90618	<b>.80571</b>	.90803	<b>.80915</b>	.90986	<b>.81256</b>	.91167	<b>.81596</b>	.91346	<b>.81933</b>	14
48+12	9.90621	<b>0.80576</b>	9.90806	<b>0.80920</b>	9.90989	<b>0.81262</b>	9.91170	<b>0.81601</b>	9.91349	<b>0.81938</b>	12
50	.90624	<b>.80582</b>	.90809	<b>.80926</b>	.90992	<b>.81268</b>	.91173	<b>.81607</b>	.91352	<b>.81944</b>	10
52+13	.90627	<b>.80588</b>	.90812	<b>.80932</b>	.90995	<b>.81273</b>	.91176	<b>.81613</b>	.91355	<b>.81950</b>	8
54	.90630	<b>.80594</b>	.90815	<b>.80938</b>	.90998	<b>.81279</b>	.91179	<b>.81618</b>	.91358	<b>.81955</b>	6
56+14	9.90633	<b>0.80599</b>	9.90818	<b>0.80943</b>	9.91001	<b>0.81285</b>	9.91182	<b>0.81624</b>	9.91361	<b>0.81961</b>	4
58	.90636	<b>.80605</b>	.90821	<b>.80949</b>	.91004	<b>.81291</b>	.91185	<b>.81630</b>	.91364	<b>.81966</b>	2
	15h 29m		15h 27m		15h 25m		15h 23m		15h 21m		
s	8h 31m 127° 30'		8h 33m 128° 0'		8h 35m 128° 30'		8h 37m 129° 0'		8h 39m 129° 30'		s
0+15	9.90639	<b>0.80611</b>	9.90824	<b>0.80955</b>	9.91007	<b>0.81296</b>	9.91188	<b>0.81635</b>	9.91367	<b>0.81972</b>	60
2	.90642	<b>.80617</b>	.90827	<b>.80960</b>	.91010	<b>.81302</b>	.91191	<b>.81641</b>	.91369	<b>.81978</b>	58
4+16	.90646	<b>.80622</b>	.90830	<b>.80966</b>	.91013	<b>.81308</b>	.91194	<b>.81647</b>	.91372	<b>.81983</b>	56
6	.90646	<b>.80628</b>	.90833	<b>.80972</b>	.91016	<b>.81313</b>	.91197	<b>.81652</b>	.91375	<b>.81989</b>	54
8+17	9.90652	<b>0.80634</b>	9.90836	<b>0.80978</b>	9.91019	<b>0.81319</b>	9.91200	<b>0.81658</b>	9.91378	<b>0.81994</b>	52
10	.90655	<b>.80640</b>	.90840	<b>.80983</b>	.91022	<b>.81325</b>	.91203	<b>.81663</b>	.91381	<b>.82000</b>	50
12+18	.90658	<b>.80645</b>	.90843	<b>.80989</b>	.91025	<b>.81330</b>	.91206	<b>.81669</b>	.91384	<b>.82005</b>	48
14	.90661	<b>.80651</b>	.90846	<b>.80995</b>	.91028	<b>.81336</b>	.91209	<b>.81675</b>	.91387	<b>.82011</b>	46
16+19	9.90664	<b>0.80657</b>	9.90849	<b>0.81000</b>	9.91031	<b>0.81342</b>	9.91212	<b>0.81680</b>	9.91390	<b>0.82017</b>	44
18	.90667	<b>.80663</b>	.90852	<b>.81006</b>	.91034	<b>.81347</b>	.91215	<b>.81686</b>	.91393	<b>.82022</b>	42
20+20	.90670	<b>.80668</b>	.90855	<b>.81012</b>	.91037	<b>.81353</b>	.91218	<b>.81692</b>	.91396	<b>.82028</b>	40
22	.90673	<b>.80674</b>	.90858	<b>.81017</b>	.91040	<b>.81359</b>	.91221	<b>.81697</b>	.91399	<b>.82033</b>	38
24+21	9.90676	<b>0.80680</b>	9.90861	<b>0.81023</b>	9.91043	<b>0.81364</b>	9.91224	<b>0.81703</b>	9.91402	<b>0.82039</b>	36
26	.90680	<b>.80686</b>	.90864	<b>.81029</b>	.91046	<b>.81370</b>	.91227	<b>.81708</b>	.91405	<b>.82045</b>	34
28+22	.90683	<b>.80691</b>	.90867	<b>.81035</b>	.91049	<b>.81376</b>	.91230	<b>.81714</b>	.91408	<b>.82050</b>	32
30	.90686	<b>.80697</b>	.90870	<b>.81040</b>	.91052	<b>.81381</b>	.91233	<b>.81720</b>	.91411	<b>.82056</b>	30
32+23	9.90689	<b>0.80703</b>	9.90873	<b>0.81046</b>	9.91055	<b>0.81387</b>	9.91236	<b>0.81725</b>	9.91414	<b>0.82061</b>	28
34	.90692	<b>.80709</b>	.90876	<b>.81052</b>	.91058	<b>.81392</b>	.91239	<b>.81731</b>	.91417	<b>.82067</b>	26
36+24	.90695	<b>.80714</b>	.90879	<b>.81057</b>	.91061	<b>.81398</b>	.91242	<b>.81737</b>	.91420	<b>.82072</b>	24
38	.90698	<b>.80720</b>	.90882	<b>.81063</b>	.91064	<b>.81404</b>	.91245	<b>.81742</b>	.91423	<b>.82078</b>	22
40+25	9.90701	<b>0.80726</b>	9.90885	<b>0.81068</b>	9.91067	<b>0.81409</b>	9.91248	<b>0.81748</b>	9.91426	<b>0.82084</b>	20
42	.90704	<b>.80731</b>	.90888	<b>.81074</b>	.91071	<b>.81415</b>	.91251	<b>.81753</b>	.91429	<b>.82089</b>	18
44+26	.90707	<b>.80737</b>	.90892	<b>.81080</b>	.91074	<b>.81421</b>	.91254	<b>.81759</b>	.91432	<b>.82095</b>	16
46	.90710	<b>.80743</b>	.90895	<b>.81086</b>	.91077	<b>.81426</b>	.91257	<b>.81765</b>	.91435	<b>.82100</b>	14
48+27	9.90714	<b>0.80749</b>	9.90898	<b>0.81092</b>	9.91080	<b>0.81432</b>	9.91260	<b>0.81770</b>	9.91437	<b>0.82106</b>	12
50	.90717	<b>.80754</b>	.90901	<b>.81097</b>	.91083	<b>.81438</b>	.91263	<b>.81776</b>	.91440	<b>.82112</b>	10
52+28	.90720	<b>.80760</b>	.90904	<b>.81103</b>	.91086	<b>.81443</b>	.91265	<b>.81781</b>	.91443	<b>.82117</b>	8
54	.90723	<b>.80766</b>	.90907	<b>.81109</b>	.91089	<b>.81449</b>	.91268	<b>.81787</b>	.91446	<b>.82123</b>	6
56+29	9.90726	<b>0.80772</b>	9.90910	<b>0.81114</b>	9.91092	<b>0.81455</b>	9.91271	<b>0.81793</b>	9.91449	<b>0.82128</b>	4
58	.90729	<b>.80777</b>	.90913	<b>.81120</b>	.91095	<b>.81460</b>	.91274	<b>.81798</b>	.91452	<b>.82134</b>	2
60+30	9.90732	<b>0.80783</b>	9.90916	<b>0.81126</b>	9.91098	<b>0.81466</b>	9.91277	<b>0.81804</b>	9.91455	<b>0.82139</b>	0
	15h 28m		15h 26m		15h 24m		15h 22m		15h 20m		



s	8h 40m 130° 0'		8h 42m 130° 30'		8h 44m 131° 0'		8h 46m 131° 30'		8h 48m 132° 0'		s		
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.			
0	9.91455	<b>0.82139</b>	9.91631	<b>0.82472</b>	9.91805	<b>0.82803</b>	9.91976	<b>0.83131</b>	9.92146	<b>0.83457</b>	60		
2	.91458	<b>.82145</b>	.91634	<b>.82478</b>	.91807	<b>.82808</b>	.91979	<b>.83136</b>	.92149	<b>.83462</b>	58		
4+1	.91461	<b>.82151</b>	.91637	<b>.82483</b>	.91810	<b>.82814</b>	.91982	<b>.83142</b>	.92152	<b>.83467</b>	56		
6	.91464	<b>.82156</b>	.91640	<b>.82489</b>	.91813	<b>.82819</b>	.91985	<b>.83147</b>	.92154	<b>.83473</b>	54		
8+2	9.91467	<b>0.82162</b>	9.91643	<b>0.82495</b>	9.91816	<b>0.82825</b>	9.91988	<b>0.83153</b>	9.92157	<b>0.83478</b>	52		
10	.91470	<b>.82167</b>	.91645	<b>.82500</b>	.91819	<b>.82830</b>	.91991	<b>.83158</b>	.92160	<b>.83484</b>	50		
12+4	.91473	<b>.82173</b>	.91648	<b>.82506</b>	.91822	<b>.82836</b>	.91993	<b>.83164</b>	.92163	<b>.83489</b>	48		
14	.91476	<b>.82178</b>	.91651	<b>.82511</b>	.91825	<b>.82841</b>	.91996	<b>.83169</b>	.92166	<b>.83494</b>	46		
16+4	9.91479	<b>0.82184</b>	9.91654	<b>0.82517</b>	9.91828	<b>0.82847</b>	9.91999	<b>0.83175</b>	9.92169	<b>0.83500</b>	44		
18	.91482	<b>.82189</b>	.91657	<b>.82522</b>	.91830	<b>.82852</b>	.92002	<b>.83180</b>	.92171	<b>.83505</b>	42		
20+5	.91485	<b>.82195</b>	.91660	<b>.82528</b>	.91833	<b>.82858</b>	.92005	<b>.83185</b>	.92174	<b>.83511</b>	40		
22	.91488	<b>.82200</b>	.91663	<b>.82533</b>	.91836	<b>.82863</b>	.92008	<b>.83191</b>	.92177	<b>.83516</b>	38		
24+6	9.91490	<b>0.82206</b>	9.91666	<b>0.82539</b>	9.91839	<b>0.82869</b>	9.92010	<b>0.83196</b>	9.92180	<b>0.83521</b>	36		
26	.91493	<b>.82212</b>	.91669	<b>.82544</b>	.91842	<b>.82874</b>	.92013	<b>.83202</b>	.92183	<b>.83527</b>	34		
28+7	.91496	<b>.82217</b>	.91672	<b>.82550</b>	.91845	<b>.82880</b>	.92016	<b>.83207</b>	.92185	<b>.83532</b>	32		
30	.91499	<b>.82223</b>	.91674	<b>.82555</b>	.91848	<b>.82885</b>	.92019	<b>.83213</b>	.92188	<b>.83538</b>	30		
32+8	9.91502	<b>0.82228</b>	9.91677	<b>0.82561</b>	9.91851	<b>0.82891</b>	9.92022	<b>0.83218</b>	9.92191	<b>0.83543</b>	28		
34	.91505	<b>.82234</b>	.91680	<b>.82566</b>	.91853	<b>.82896</b>	.92025	<b>.83224</b>	.92194	<b>.83548</b>	26		
36+9	.91508	<b>.82240</b>	.91683	<b>.82572</b>	.91856	<b>.82902</b>	.92027	<b>.83229</b>	.92197	<b>.83554</b>	24		
38	.91511	<b>.82245</b>	.91686	<b>.82577</b>	.91859	<b>.82907</b>	.92030	<b>.83234</b>	.92199	<b>.83559</b>	22		
40+10	9.91514	<b>0.82251</b>	9.91689	<b>0.82583</b>	9.91862	<b>0.82913</b>	9.92033	<b>0.83240</b>	9.92202	<b>0.83564</b>	20		
42	.91517	<b>.82256</b>	.91692	<b>.82588</b>	.91865	<b>.82918</b>	.92036	<b>.83245</b>	.92205	<b>.83570</b>	18		
44+11	.91520	<b>.82262</b>	.91695	<b>.82594</b>	.91868	<b>.82924</b>	.92039	<b>.83251</b>	.92208	<b>.83575</b>	16		
46	.91523	<b>.82267</b>	.91698	<b>.82599</b>	.91871	<b>.82929</b>	.92042	<b>.83256</b>	.92211	<b>.83581</b>	14		
48+12	9.91526	<b>0.82273</b>	9.91701	<b>0.82605</b>	9.91874	<b>0.82934</b>	9.92044	<b>0.83262</b>	9.92213	<b>0.83586</b>	12		
50	.91529	<b>.82278</b>	.91703	<b>.82610</b>	.91876	<b>.82940</b>	.92047	<b>.83267</b>	.92216	<b>.83591</b>	10		
52+13	.91532	<b>.82284</b>	.91706	<b>.82616</b>	.91879	<b>.82945</b>	.92050	<b>.83272</b>	.92219	<b>.83597</b>	8		
54	.91534	<b>.82290</b>	.91709	<b>.82621</b>	.91882	<b>.82951</b>	.92053	<b>.83278</b>	.92222	<b>.83602</b>	6		
56+14	9.91537	<b>0.82295</b>	9.91712	<b>0.82627</b>	9.91885	<b>0.82956</b>	9.92056	<b>0.83283</b>	9.92225	<b>0.83608</b>	4		
58	.91540	<b>.82301</b>	.91715	<b>.82632</b>	.91888	<b>.82962</b>	.92059	<b>.83289</b>	.92227	<b>.83613</b>	2		
		15h 19m		15h 17m		15h 15m		15h 13m		15h 11m			
s	8h 41m 130° 0'		8h 43m 130° 30'		8h 45m 131° 0'		8h 47m 131° 30'		8h 49m 132° 0'		s		
0+15	9.91543	<b>0.82306</b>	9.91718	<b>0.82638</b>	9.91891	<b>0.82967</b>	9.92061	<b>0.83294</b>	9.92230	<b>0.83618</b>	60		
2	.91546	<b>.82312</b>	.91721	<b>.82644</b>	.91894	<b>.82973</b>	.92064	<b>.83300</b>	.92233	<b>.83624</b>	58		
4+16	.91549	<b>.82317</b>	.91724	<b>.82649</b>	.91896	<b>.82978</b>	.92067	<b>.83305</b>	.92236	<b>.83629</b>	56		
6	.91552	<b>.82323</b>	.91727	<b>.82655</b>	.91899	<b>.82984</b>	.92070	<b>.83310</b>	.92239	<b>.83635</b>	54		
8+17	9.91555	<b>0.82328</b>	9.91730	<b>0.82660</b>	9.91902	<b>0.82989</b>	9.92073	<b>0.83316</b>	9.92241	<b>0.83640</b>	52		
10	.91558	<b>.82334</b>	.91732	<b>.82666</b>	.91905	<b>.82995</b>	.92076	<b>.83321</b>	.92244	<b>.83645</b>	50		
12+18	.91561	<b>.82339</b>	.91735	<b>.82671</b>	.91908	<b>.83000</b>	.92078	<b>.83327</b>	.92247	<b>.83651</b>	48		
14	.91564	<b>.82345</b>	.91738	<b>.82677</b>	.91911	<b>.83006</b>	.92081	<b>.83332</b>	.92250	<b>.83656</b>	46		
16+19	9.91567	<b>0.82351</b>	9.91741	<b>0.82682</b>	9.91914	<b>0.83011</b>	9.92084	<b>0.83337</b>	9.92253	<b>0.83661</b>	44		
18	.91570	<b>.82356</b>	.91744	<b>.82688</b>	.91916	<b>.83016</b>	.92087	<b>.83343</b>	.92255	<b>.83667</b>	42		
20+20	.91573	<b>.82362</b>	.91747	<b>.82693</b>	.91919	<b>.83022</b>	.92090	<b>.83348</b>	.92258	<b>.83672</b>	40		
22	.91575	<b>.82367</b>	.91750	<b>.82699</b>	.91922	<b>.83027</b>	.92093	<b>.83354</b>	.92261	<b>.83678</b>	38		
24+21	9.91578	<b>0.82373</b>	9.91753	<b>0.82704</b>	9.91925	<b>0.83033</b>	9.92095	<b>0.83359</b>	9.92264	<b>0.83683</b>	36		
26	.91581	<b>.82378</b>	.91756	<b>.82710</b>	.91928	<b>.83038</b>	.92098	<b>.83365</b>	.92266	<b>.83688</b>	34		
28+22	.91584	<b>.82384</b>	.91758	<b>.82715</b>	.91931	<b>.83044</b>	.92101	<b>.83370</b>	.92269	<b>.83694</b>	32		
30	.91587	<b>.82389</b>	.91761	<b>.82721</b>	.91934	<b>.83049</b>	.92104	<b>.83375</b>	.92272	<b>.83699</b>	30		
32+23	9.91590	<b>0.82395</b>	9.91764	<b>0.82726</b>	9.91936	<b>0.83055</b>	9.92107	<b>0.83381</b>	9.92275	<b>0.83704</b>	28		
34	.91593	<b>.82400</b>	.91767	<b>.82732</b>	.91939	<b>.83060</b>	.92109	<b>.83386</b>	.92278	<b>.83710</b>	26		
36+24	.91596	<b>.82406</b>	.91770	<b>.82737</b>	.91942	<b>.83066</b>	.92112	<b>.83392</b>	.92280	<b>.83715</b>	24		
38	.91599	<b>.82412</b>	.91773	<b>.82743</b>	.91945	<b>.83071</b>	.92115	<b>.83397</b>	.92283	<b>.83720</b>	22		
40+25	9.91602	<b>0.82417</b>	9.91776	<b>0.82748</b>	9.91948	<b>0.83077</b>	9.92118	<b>0.83402</b>	9.92286	<b>0.83726</b>	20		
42	.91605	<b>.82423</b>	.91779	<b>.82754</b>	.91951	<b>.83082</b>	.92121	<b>.83408</b>	.92289	<b>.83731</b>	18		
44+26	.91608	<b>.82428</b>	.91782	<b>.82759</b>	.91954	<b>.83087</b>	.92124	<b>.83413</b>	.92292	<b>.83737</b>	16		
46	.91610	<b>.82434</b>	.91784	<b>.82765</b>	.91956	<b>.83093</b>	.92126	<b>.83419</b>	.92294	<b>.83742</b>	14		
48+27	9.91613	<b>0.82439</b>	9.91787	<b>0.82770</b>	9.91959	<b>0.83098</b>	9.92129	<b>0.83424</b>	9.92297	<b>0.83747</b>	12		
50	.91616	<b>.82445</b>	.91790	<b>.82776</b>	.91962	<b>.83104</b>	.92132	<b>.83430</b>	.92300	<b>.83753</b>	10		
52+28	.91619	<b>.82450</b>	.91793	<b>.82781</b>	.91965	<b>.83109</b>	.92135	<b>.83435</b>	.92303	<b>.83758</b>	8		
54	.91622	<b>.82456</b>	.91796	<b>.82786</b>	.91968	<b>.83115</b>	.92138	<b>.83440</b>	.92305	<b>.83763</b>	6		
56+29	9.91625	<b>0.82461</b>	9.91799	<b>0.82792</b>	9.91971	<b>0.83120</b>	9.92140	<b>0.83446</b>	9.92308	<b>0.83769</b>	4		
58	.91628	<b>.82467</b>	.91802	<b>.82797</b>	.91973	<b>.83126</b>	.92143	<b>.83451</b>	.92311	<b>.83774</b>	2		
60+30	9.91631	<b>0.82472</b>	9.91805	<b>0.82803</b>	9.91976	<b>0.83131</b>	9.92146	<b>0.83457</b>	9.92314	<b>0.83780</b>	0		
		15h 18m		15h 16m		15h 14m		15h 12m		15h 10m			

Haversines.

		8h 50m 132° 30'		8h 52m 133° 0'		8h 54m 133° 30'		8h 56m 134° 0'		8h 58m 134° 30'		
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.92314	<b>0.83780</b>	9.92480	<b>0.84100</b>	9.92643	<b>0.84418</b>	9.92805	<b>0.84733</b>	9.92965	<b>0.85045</b>	60
2		.92317	<b>.83785</b>	.92482	<b>.84105</b>	.92646	<b>.84423</b>	.92808	<b>.84738</b>	.92968	<b>.85051</b>	58
4	+1	.92319	<b>.83790</b>	.92485	<b>.84111</b>	.92649	<b>.84428</b>	.92811	<b>.84743</b>	.92970	<b>.85056</b>	56
6		.92322	<b>.83796</b>	.92488	<b>.84116</b>	.92652	<b>.84434</b>	.92813	<b>.84749</b>	.92973	<b>.85061</b>	54
8	+2	9.92325	<b>0.83801</b>	9.92491	<b>0.84121</b>	9.92654	<b>0.84439</b>	9.92816	<b>0.84754</b>	9.92975	<b>0.85066</b>	52
10		.92328	<b>.83806</b>	.92493	<b>.84127</b>	.92657	<b>.84444</b>	.92819	<b>.84759</b>	.92978	<b>.85071</b>	50
12	+3	.92330	<b>.83812</b>	.92496	<b>.84132</b>	.92660	<b>.84449</b>	.92821	<b>.84764</b>	.92981	<b>.85077</b>	48
14		.92333	<b>.83817</b>	.92499	<b>.84137</b>	.92662	<b>.84455</b>	.92824	<b>.84770</b>	.92984	<b>.85082</b>	46
16	+4	9.92336	<b>0.83822</b>	9.92502	<b>0.84142</b>	9.92665	<b>0.84460</b>	9.92827	<b>0.84775</b>	9.92986	<b>0.85087</b>	44
18		.92339	<b>.83828</b>	.92504	<b>.84148</b>	.92668	<b>.84465</b>	.92829	<b>.84780</b>	.92989	<b>.85092</b>	42
20	+5	.92342	<b>.83833</b>	.92507	<b>.84153</b>	.92670	<b>.84470</b>	.92832	<b>.84785</b>	.92992	<b>.85097</b>	40
22		.92344	<b>.83838</b>	.92510	<b>.84158</b>	.92673	<b>.84476</b>	.92835	<b>.84790</b>	.92994	<b>.85102</b>	38
24	+6	9.92347	<b>0.83844</b>	9.92512	<b>0.84164</b>	9.92676	<b>0.84481</b>	9.92837	<b>0.84796</b>	9.92997	<b>0.85108</b>	36
26		.92350	<b>.83849</b>	.92515	<b>.84169</b>	.92679	<b>.84486</b>	.92840	<b>.84801</b>	.93001	<b>.85113</b>	34
28	+7	.92353	<b>.83855</b>	.92518	<b>.84174</b>	.92681	<b>.84492</b>	.92843	<b>.84806</b>	.93002	<b>.85118</b>	32
30		.92355	<b>.83860</b>	.92521	<b>.84180</b>	.92684	<b>.84497</b>	.92845	<b>.84811</b>	.93005	<b>.85123</b>	30
32	+8	9.92358	<b>0.83865</b>	9.92523	<b>0.84185</b>	9.92687	<b>0.84502</b>	9.92848	<b>0.84817</b>	9.93007	<b>0.85128</b>	28
34		.92361	<b>.83871</b>	.92526	<b>.84190</b>	.92689	<b>.84507</b>	.92851	<b>.84822</b>	.93010	<b>.85134</b>	26
36	+9	.92364	<b>.83876</b>	.92529	<b>.84196</b>	.92692	<b>.84513</b>	.92853	<b>.84827</b>	.93013	<b>.85139</b>	24
38		.92366	<b>.83881</b>	.92532	<b>.84201</b>	.92695	<b>.84518</b>	.92856	<b>.84832</b>	.93015	<b>.85144</b>	22
40	+10	9.92369	<b>0.83887</b>	9.92534	<b>0.84206</b>	9.92698	<b>0.84523</b>	9.92859	<b>0.84837</b>	9.93018	<b>0.85149</b>	20
42		.92372	<b>.83892</b>	.92537	<b>.84211</b>	.92700	<b>.84528</b>	.92861	<b>.84843</b>	.93021	<b>.85154</b>	18
44	+11	.92375	<b>.83897</b>	.92540	<b>.84217</b>	.92703	<b>.84534</b>	.92864	<b>.84848</b>	.93023	<b>.85159</b>	16
46		.92378	<b>.83903</b>	.92543	<b>.84222</b>	.92706	<b>.84539</b>	.92867	<b>.84853</b>	.93026	<b>.85165</b>	14
48	+12	9.92380	<b>0.83908</b>	9.92545	<b>0.84227</b>	9.92708	<b>0.84544</b>	9.92869	<b>0.84858</b>	9.93029	<b>0.85170</b>	12
50		.92383	<b>.83913</b>	.92548	<b>.84233</b>	.92711	<b>.84549</b>	.92872	<b>.84863</b>	.93031	<b>.85175</b>	10
52	+13	.92386	<b>.83919</b>	.92551	<b>.84238</b>	.92714	<b>.84555</b>	.92875	<b>.84869</b>	.93034	<b>.85180</b>	8
54		.92389	<b>.83924</b>	.92554	<b>.84243</b>	.92716	<b>.84560</b>	.92877	<b>.84874</b>	.93036	<b>.85185</b>	6
56	+14	9.92391	<b>0.83929</b>	9.92556	<b>0.84249</b>	9.92719	<b>0.84565</b>	9.92880	<b>0.84879</b>	9.93039	<b>0.85190</b>	4
58		9.92394	<b>0.83935</b>	9.92559	<b>0.84254</b>	9.92722	<b>0.84570</b>	9.92883	<b>0.84884</b>	9.93042	<b>0.85196</b>	2
		15h 9m		15h 7m		15h 5m		15h 3m		15h 1m		
s	'	8h 51m 132° 30'		8h 53m 133° 0'		8h 55m 133° 30'		8h 57m 134° 0'		8h 59m 134° 30'		s
0	+15	9.92397	<b>0.83940</b>	9.92562	<b>0.84259</b>	9.92725	<b>0.84576</b>	9.92885	<b>0.84890</b>	9.93044	<b>0.85201</b>	60
2		.92400	<b>.83945</b>	.92564	<b>.84264</b>	.92727	<b>.84581</b>	.92888	<b>.84895</b>	.93047	<b>.85206</b>	58
4	+16	.92402	<b>.83951</b>	.92567	<b>.84270</b>	.92730	<b>.84586</b>	.92891	<b>.84900</b>	.93050	<b>.85211</b>	56
6		.92405	<b>.83956</b>	.92570	<b>.84275</b>	.92733	<b>.84591</b>	.92893	<b>.84905</b>	.93052	<b>.85216</b>	54
8	+17	9.92408	<b>0.83961</b>	9.92573	<b>0.84280</b>	9.92735	<b>0.84597</b>	9.92896	<b>0.84910</b>	9.93055	<b>0.85221</b>	52
10		.92411	<b>.83967</b>	.92575	<b>.84286</b>	.92738	<b>.84602</b>	.92899	<b>.84916</b>	.93057	<b>.85227</b>	50
12	+18	.92413	<b>.83972</b>	.92578	<b>.84291</b>	.92741	<b>.84607</b>	.92901	<b>.84921</b>	.93060	<b>.85232</b>	48
14		.92416	<b>.83977</b>	.92581	<b>.84296</b>	.92743	<b>.84612</b>	.92904	<b>.84926</b>	.93063	<b>.85237</b>	46
16	+19	9.92419	<b>0.83983</b>	9.92584	<b>0.84302</b>	9.92746	<b>0.84618</b>	9.92907	<b>0.84931</b>	9.93065	<b>0.85242</b>	44
18		.92422	<b>.83988</b>	.92586	<b>.84307</b>	.92749	<b>.84623</b>	.92909	<b>.84936</b>	.93068	<b>.85247</b>	42
20	+20	.92425	<b>.83993</b>	.92589	<b>.84312</b>	.92751	<b>.84628</b>	.92912	<b>.84942</b>	.93071	<b>.85252</b>	40
22		.92427	<b>.83999</b>	.92592	<b>.84317</b>	.92754	<b>.84633</b>	.92915	<b>.84947</b>	.93073	<b>.85258</b>	38
24	+21	9.92430	<b>0.84004</b>	9.92594	<b>0.84323</b>	9.92757	<b>0.84639</b>	9.92917	<b>0.84952</b>	9.93076	<b>0.85263</b>	36
26		.92433	<b>.84009</b>	.92597	<b>.84328</b>	.92760	<b>.84644</b>	.92920	<b>.84957</b>	.93079	<b>.85268</b>	34
28	+22	.92436	<b>.84015</b>	.92600	<b>.84333</b>	.92762	<b>.84649</b>	.92923	<b>.84962</b>	.93081	<b>.85273</b>	32
30		.92438	<b>.84020</b>	.92603	<b>.84339</b>	.92765	<b>.84654</b>	.92925	<b>.84968</b>	.93084	<b>.85278</b>	30
32	+23	9.92441	<b>0.84025</b>	9.92605	<b>0.84344</b>	9.92768	<b>0.84660</b>	9.92928	<b>0.84973</b>	9.93086	<b>0.85283</b>	28
34		.92444	<b>.84031</b>	.92608	<b>.84349</b>	.92770	<b>.84665</b>	.92931	<b>.84978</b>	.93089	<b>.85288</b>	26
36	+24	.92447	<b>.84036</b>	.92611	<b>.84354</b>	.92773	<b>.84670</b>	.92933	<b>.84983</b>	.93092	<b>.85294</b>	24
38		.92449	<b>.84041</b>	.92613	<b>.84360</b>	.92776	<b>.84675</b>	.92936	<b>.84988</b>	.93094	<b>.85299</b>	22
40	+25	9.92452	<b>0.84047</b>	9.92616	<b>0.84365</b>	9.92778	<b>0.84681</b>	9.92939	<b>0.84994</b>	9.93097	<b>0.85304</b>	20
42		.92455	<b>.84052</b>	.92619	<b>.84370</b>	.92781	<b>.84686</b>	.92941	<b>.84999</b>	.93100	<b>.85309</b>	18
44	+26	.92458	<b>.84057</b>	.92622	<b>.84376</b>	.92784	<b>.84691</b>	.92944	<b>.85004</b>	.93102	<b>.85314</b>	16
46		.92460	<b>.84063</b>	.92624	<b>.84381</b>	.92786	<b>.84696</b>	.92947	<b>.85009</b>	.93105	<b>.85319</b>	14
48	+27	9.92463	<b>0.84068</b>	9.92627	<b>0.84386</b>	9.92789	<b>0.84702</b>	9.92949	<b>0.85014</b>	9.93107	<b>0.85324</b>	12
50		.92466	<b>.84073</b>	.92630	<b>.84391</b>	.92792	<b>.84707</b>	.92952	<b>.85020</b>	.93110	<b>.85330</b>	10
52	+28	.92469	<b>.84079</b>	.92633	<b>.84397</b>	.92794	<b>.84712</b>	.92955	<b>.85025</b>	.93113	<b>.85335</b>	8
54		.92471	<b>.84084</b>	.92635	<b>.84402</b>	.92797	<b>.84717</b>	.92957	<b>.85030</b>	.93115	<b>.85340</b>	6
56	+29	9.92474	<b>0.84089</b>	9.92638	<b>0.84407</b>	9.92800	<b>0.84722</b>	9.92960	<b>0.85035</b>	9.93118	<b>0.85345</b>	4
58		.92477	<b>.84095</b>	.92641	<b>.84412</b>	.92802	<b>.84728</b>	.92962	<b>.85040</b>	.93120	<b>.85350</b>	2
60	+30	9.92480	<b>0.84100</b>	9.92643	<b>0.84418</b>	9.92805	<b>0.84733</b>	9.92965	<b>0.85045</b>	9.93123	<b>0.85355</b>	0
		15h 8m		15h 6m		15h 4m		15h 2m		15h 0m		



Haversines.

		9h 0m 135°		9h 4m 136°		9h 8m 137°		9h 12m 138°		9h 16m 139°		
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.93123	<b>0.85355</b>	9.93433	<b>0.85967</b>	9.93736	<b>0.86568</b>	9.94030	<b>0.87157</b>	9.94318	<b>0.87735</b>	60
4	1	.93128	<b>.85366</b>	.93438	<b>.85977</b>	.93741	<b>.86578</b>	.94035	<b>.87167</b>	.94322	<b>.87745</b>	56
8	2	.93134	<b>.85376</b>	.93443	<b>.85987</b>	.93746	<b>.86588</b>	.94040	<b>.87177</b>	.94327	<b>.87755</b>	52
12	3	.93139	<b>.85386</b>	.93448	<b>.85997</b>	.93751	<b>.86599</b>	.94045	<b>.87186</b>	.94332	<b>.87764</b>	48
16	4	9.93144	<b>0.85396</b>	9.93454	<b>0.86007</b>	9.93755	<b>0.86607</b>	9.94050	<b>0.87196</b>	9.94336	<b>0.87774</b>	44
20	5	.93149	<b>.85407</b>	.93459	<b>.86017</b>	.93760	<b>.86617</b>	.94055	<b>.87206</b>	.94341	<b>.87783</b>	40
24	6	.93154	<b>.85417</b>	.93464	<b>.86028</b>	.93765	<b>.86627</b>	.94059	<b>.87216</b>	.94346	<b>.87793</b>	36
28	7	.93160	<b>.85427</b>	.93469	<b>.86038</b>	.93770	<b>.86637</b>	.94064	<b>.87225</b>	.94351	<b>.87802</b>	32
32	8	9.93165	<b>0.85438</b>	9.93474	<b>0.86048</b>	9.93775	<b>0.86647</b>	9.94069	<b>0.87235</b>	9.94355	<b>0.87812</b>	28
36	9	.93170	<b>.85448</b>	.93479	<b>.86058</b>	.93780	<b>.86657</b>	.94074	<b>.87245</b>	.94360	<b>.87821</b>	24
40	10	.93175	<b>.85458</b>	.93484	<b>.86068</b>	.93785	<b>.86667</b>	.94079	<b>.87254</b>	.94365	<b>.87831</b>	20
44	11	.93181	<b>.85468</b>	.93489	<b>.86078</b>	.93790	<b>.86677</b>	.94084	<b>.87264</b>	.94369	<b>.87840</b>	16
48	12	9.93186	<b>0.85479</b>	9.93494	<b>0.86088</b>	9.93795	<b>0.86686</b>	9.94088	<b>0.87274</b>	9.94374	<b>0.87850</b>	12
52	13	.93191	<b>.85489</b>	.93499	<b>.86098</b>	.93800	<b>.86696</b>	.94093	<b>.87283</b>	.94379	<b>.87859</b>	8
56	14	9.93196	<b>0.85499</b>	9.93504	<b>0.86108</b>	9.93805	<b>0.86706</b>	9.94098	<b>0.87293</b>	9.94383	<b>0.87869</b>	4
		14h 59m		14h 55m		14h 51m		14h 47m		14h 43m		
s	'	9h 1m 135°		9h 5m 136°		9h 9m 137°		9h 13m 138°		9h 17m 139°		s
0	15	9.93201	<b>0.85509</b>	9.93509	<b>0.86118</b>	9.93810	<b>0.86716</b>	9.94103	<b>0.87303</b>	9.94388	<b>0.87878</b>	60
4	16	.93207	<b>.85520</b>	.93515	<b>.86128</b>	.93815	<b>.86726</b>	.94108	<b>.87313</b>	.94393	<b>.87888</b>	56
8	17	.93212	<b>.85530</b>	.93520	<b>.86138</b>	.93820	<b>.86736</b>	.94112	<b>.87322</b>	.94398	<b>.87897</b>	52
12	18	.93217	<b>.85540</b>	.93525	<b>.86148</b>	.93825	<b>.86746</b>	.94117	<b>.87332</b>	.94402	<b>.87907</b>	48
16	19	9.93222	<b>0.85550</b>	9.93530	<b>0.86158</b>	9.93830	<b>0.86756</b>	9.94122	<b>0.87342</b>	9.94407	<b>0.87916</b>	44
20	20	.93227	<b>.85560</b>	.93535	<b>.86168</b>	.93835	<b>.86765</b>	.94127	<b>.87351</b>	.94412	<b>.87926</b>	40
24	21	.93232	<b>.85571</b>	.93540	<b>.86178</b>	.93840	<b>.86775</b>	.94132	<b>.87361</b>	.94416	<b>.87935</b>	36
28	22	.93238	<b>.85581</b>	.93545	<b>.86189</b>	.93845	<b>.86785</b>	.94137	<b>.87371</b>	.94421	<b>.87945</b>	32
32	23	9.93243	<b>0.85591</b>	9.93550	<b>0.86199</b>	9.93849	<b>0.86795</b>	9.94141	<b>0.87380</b>	9.94426	<b>0.87954</b>	28
36	24	.93248	<b>.85601</b>	.93555	<b>.86209</b>	.93854	<b>.86805</b>	.94146	<b>.87390</b>	.94430	<b>.87964</b>	24
40	25	.93253	<b>.85612</b>	.93560	<b>.86219</b>	.93859	<b>.86815</b>	.94151	<b>.87400</b>	.94435	<b>.87973</b>	20
44	26	.93258	<b>.85622</b>	.93565	<b>.86229</b>	.93864	<b>.86825</b>	.94156	<b>.87409</b>	.94440	<b>.87983</b>	16
48	27	9.93264	<b>0.85632</b>	9.93570	<b>0.86239</b>	9.93869	<b>0.86834</b>	9.94161	<b>0.87419</b>	9.94444	<b>0.87992</b>	12
52	28	.93269	<b>.85642</b>	.93575	<b>.86249</b>	.93874	<b>.86844</b>	.94166	<b>.87428</b>	.94449	<b>.88001</b>	8
56	29	9.93274	<b>0.85652</b>	9.93580	<b>0.86259</b>	9.93879	<b>0.86854</b>	9.94170	<b>0.87438</b>	9.94454	<b>0.88011</b>	4
		14h 58m		14h 54m		14h 50m		14h 46m		14h 42m		
s	'	9h 2m 135°		9h 6m 136°		9h 10m 137°		9h 14m 138°		9h 18m 139°		s
0	30	9.93279	<b>0.85663</b>	9.93585	<b>0.86269</b>	9.93884	<b>0.86864</b>	9.94175	<b>0.87448</b>	9.94458	<b>0.88020</b>	60
4	31	.93284	<b>.85673</b>	.93590	<b>.86279</b>	.93889	<b>.86874</b>	.94180	<b>.87457</b>	.94463	<b>.88030</b>	56
8	32	.93289	<b>.85683</b>	.93595	<b>.86289</b>	.93894	<b>.86884</b>	.94184	<b>.87467</b>	.94468	<b>.88039</b>	52
12	33	.93295	<b>.85693</b>	.93600	<b>.86299</b>	.93899	<b>.86893</b>	.94189	<b>.87477</b>	.94472	<b>.88049</b>	48
16	34	9.93300	<b>0.85703</b>	9.93605	<b>0.86309</b>	9.93904	<b>0.86903</b>	9.94194	<b>0.87486</b>	9.94477	<b>0.88058</b>	44
20	35	.93305	<b>.85713</b>	.93611	<b>.86319</b>	.93908	<b>.86913</b>	.94199	<b>.87496</b>	.94482	<b>.88068</b>	40
24	36	.93310	<b>.85724</b>	.93616	<b>.86329</b>	.93913	<b>.86923</b>	.94204	<b>.87505</b>	.94486	<b>.88077</b>	36
28	37	.93315	<b>.85734</b>	.93621	<b>.86339</b>	.93918	<b>.86933</b>	.94208	<b>.87515</b>	.94491	<b>.88086</b>	32
32	38	9.93320	<b>0.85744</b>	9.93626	<b>0.86349</b>	9.93923	<b>0.86942</b>	9.94213	<b>0.87525</b>	9.94496	<b>0.88096</b>	28
36	39	.93326	<b>.85754</b>	.93631	<b>.86359</b>	.93928	<b>.86952</b>	.94218	<b>.87534</b>	.94500	<b>.88105</b>	24
40	40	.93331	<b>.85764</b>	.93636	<b>.86369</b>	.93933	<b>.86962</b>	.94223	<b>.87544</b>	.94505	<b>.88115</b>	20
44	41	.93336	<b>.85774</b>	.93641	<b>.86379</b>	.93938	<b>.86972</b>	.94227	<b>.87554</b>	.94509	<b>.88124</b>	16
48	42	9.93341	<b>0.85785</b>	9.93646	<b>0.86389</b>	9.93943	<b>0.86982</b>	9.94232	<b>0.87563</b>	9.94514	<b>0.88133</b>	12
52	43	.93346	<b>.85795</b>	.93651	<b>.86399</b>	.93948	<b>.86991</b>	.94237	<b>.87573</b>	.94519	<b>.88143</b>	8
56	44	9.93351	<b>0.85805</b>	9.93656	<b>0.86409</b>	9.93952	<b>0.87001</b>	9.94242	<b>0.87582</b>	9.94523	<b>0.88152</b>	4
		14h 57m		14h 53m		14h 49m		14h 45m		14h 41m		
s	'	9h 3m 135°		9h 7m 136°		9h 11m 137°		9h 15m 138°		9h 19m 139°		s
0	45	9.93356	<b>0.85815</b>	9.93661	<b>0.86419</b>	9.93957	<b>0.87011</b>	9.94246	<b>0.87592</b>	9.94528	<b>0.88162</b>	60
4	46	.93362	<b>.85825</b>	.93666	<b>.86429</b>	.93962	<b>.87021</b>	.94251	<b>.87602</b>	.94533	<b>.88171</b>	56
8	47	.93367	<b>.85835</b>	.93671	<b>.86438</b>	.93967	<b>.87030</b>	.94256	<b>.87611</b>	.94537	<b>.88180</b>	52
12	48	.93372	<b>.85846</b>	.93676	<b>.86448</b>	.93972	<b>.87040</b>	.94261	<b>.87621</b>	.94542	<b>.88190</b>	48
16	49	9.93377	<b>0.85856</b>	9.93681	<b>0.86458</b>	9.93977	<b>0.87050</b>	9.94265	<b>0.87630</b>	9.94546	<b>0.88199</b>	44
20	50	.93382	<b>.85866</b>	.93686	<b>.86468</b>	.93982	<b>.87060</b>	.94270	<b>.87640</b>	.94551	<b>.88209</b>	40
24	51	.93387	<b>.85876</b>	.93691	<b>.86478</b>	.93987	<b>.87070</b>	.94275	<b>.87649</b>	.94556	<b>.88218</b>	36
28	52	.93392	<b>.85886</b>	.93696	<b>.86488</b>	.93991	<b>.87079</b>	.94280	<b>.87659</b>	.94560	<b>.88227</b>	32
32	53	9.93397	<b>0.85896</b>	9.93701	<b>0.86498</b>	9.93996	<b>0.87089</b>	9.94284	<b>0.87669</b>	9.94565	<b>0.88237</b>	28
36	54	.93403	<b>.85906</b>	.93706	<b>.86508</b>	.94001	<b>.87099</b>	.94289	<b>.87678</b>	.94570	<b>.88246</b>	24
40	55	.93408	<b>.85916</b>	.93711	<b>.86518</b>	.94006	<b>.87109</b>	.94294	<b>.87688</b>	.94574	<b>.88255</b>	20
44	56	.93413	<b>.85926</b>	.93716	<b>.86528</b>	.94011	<b>.87118</b>	.94299	<b>.87697</b>	.94579	<b>.88265</b>	16
48	57	9.93418	<b>0.85937</b>	9.93721	<b>0.86538</b>	9.94016	<b>0.87128</b>	9.94303	<b>0.87707</b>	9.94583	<b>0.88274</b>	12
52	58	.93423	<b>.85947</b>	.93726	<b>.86548</b>	.94021	<b>.87138</b>	.94308	<b>.87716</b>	.94588	<b>.88284</b>	8
56	59	.93428	<b>.85957</b>	.93731	<b>.86558</b>	.94026	<b>.87148</b>	.94313	<b>.87726</b>	.94593	<b>.88293</b>	4
60	60	9.93433	<b>0.85967</b>	9.93736	<b>0.86568</b>	9.94030	<b>0.87157</b>	9.94318	<b>0.87735</b>	9.94597	<b>0.88302</b>	0
		14h 56m		14h 52m		14h 48m		14h 44m		14h 40m		



TABLE IV.

Haversines.

		9h 20m 140°		9h 24m 141°		9h 28m 142°		9h 32m 143°		9h 36m 144°		
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.94597	<b>0.88302</b>	9.94869	<b>0.88557</b>	9.95134	<b>0.89401</b>	9.95391	<b>0.89932</b>	9.95641	<b>0.90451</b>	60
4	1	.94602	<b>.88312</b>	.94874	<b>.88866</b>	.95138	<b>.89409</b>	.95396	<b>.89941</b>	.95645	<b>.90459</b>	56
8	2	.94606	<b>.88321</b>	.94878	<b>.88876</b>	.95143	<b>.89418</b>	.95400	<b>.89949</b>	.95649	<b>.90468</b>	52
12	3	.94611	<b>.88330</b>	.94883	<b>.88885</b>	.95147	<b>.89427</b>	.95404	<b>.89958</b>	.95654	<b>.90476</b>	48
16	4	9.94616	<b>0.88340</b>	9.94887	<b>0.88894</b>	9.95151	<b>0.89436</b>	9.95408	<b>0.89967</b>	9.95658	<b>0.90485</b>	44
20	5	.94620	<b>.88349</b>	.94892	<b>.88903</b>	.95156	<b>.89445</b>	.95412	<b>.89976</b>	.95662	<b>.90494</b>	40
24	6	.94625	<b>.88358</b>	.94896	<b>.88912</b>	.95160	<b>.89454</b>	.95417	<b>.89984</b>	.95666	<b>.90502</b>	36
28	7	.94629	<b>.88368</b>	.94901	<b>.88921</b>	.95164	<b>.89463</b>	.95421	<b>.89993</b>	.95670	<b>.90511</b>	32
32	8	9.94634	<b>0.88377</b>	9.94905	<b>0.88930</b>	9.95169	<b>0.89472</b>	9.95425	<b>0.90002</b>	9.95674	<b>0.90519</b>	28
36	9	.94638	<b>.88386</b>	.94909	<b>.88940</b>	.95173	<b>.89481</b>	.95429	<b>.90010</b>	.95678	<b>.90528</b>	24
40	10	.94643	<b>.88396</b>	.94914	<b>.88949</b>	.95177	<b>.89490</b>	.95433	<b>.90019</b>	.95682	<b>.90537</b>	20
44	11	.94648	<b>.88405</b>	.94918	<b>.88958</b>	.95182	<b>.89499</b>	.95438	<b>.90028</b>	.95686	<b>.90545</b>	16
48	12	9.94652	<b>0.88414</b>	9.94923	<b>0.88967</b>	9.95186	<b>0.89508</b>	9.95442	<b>0.90037</b>	9.95690	<b>0.90553</b>	12
52	13	.94657	<b>.88423</b>	.94927	<b>.88976</b>	.95190	<b>.89517</b>	.95446	<b>.90045</b>	.95694	<b>.90562</b>	8
56	14	9.94661	<b>0.88433</b>	9.94932	<b>0.88985</b>	9.95195	<b>0.89526</b>	9.95450	<b>0.90054</b>	9.95699	<b>0.90570</b>	4
		14h 39m		14h 35m		14h 31m		14h 27m		14h 23m		
s	'	9h 21m 140°		9h 25m 141°		9h 29m 142°		9h 33m 143°		9h 37m 144°		s
0	15	9.94666	<b>0.88442</b>	9.94936	<b>0.88994</b>	9.95199	<b>0.89534</b>	9.95454	<b>0.90063</b>	9.95703	<b>0.90579</b>	60
4	16	.94670	<b>.88451</b>	.94941	<b>.89003</b>	.95203	<b>.89543</b>	.95459	<b>.90071</b>	.95707	<b>.90588</b>	56
8	17	.94675	<b>.88461</b>	.94945	<b>.89012</b>	.95208	<b>.89552</b>	.95463	<b>.90080</b>	.95711	<b>.90596</b>	52
12	18	.94680	<b>.88470</b>	.94950	<b>.89022</b>	.95212	<b>.89561</b>	.95467	<b>.90089</b>	.95715	<b>.90604</b>	48
16	19	9.94684	<b>0.88479</b>	9.94954	<b>0.89031</b>	9.95216	<b>0.89570</b>	9.95471	<b>0.90097</b>	9.95719	<b>0.90613</b>	44
20	20	.94689	<b>.88489</b>	.94958	<b>.89040</b>	.95221	<b>.89579</b>	.95475	<b>.90106</b>	.95723	<b>.90621</b>	40
24	21	.94693	<b>.88498</b>	.94963	<b>.89049</b>	.95225	<b>.89588</b>	.95480	<b>.90115</b>	.95727	<b>.90630</b>	36
28	22	.94698	<b>.88507</b>	.94967	<b>.89058</b>	.95229	<b>.89597</b>	.95484	<b>.90124</b>	.95731	<b>.90638</b>	32
32	23	9.94702	<b>0.88516</b>	9.94972	<b>0.89067</b>	0.95234	<b>0.89606</b>	9.95488	<b>0.90132</b>	9.95735	<b>0.90647</b>	28
36	24	.94707	<b>.88526</b>	.94976	<b>.89076</b>	.95238	<b>.89614</b>	.95492	<b>.90141</b>	.95739	<b>.90655</b>	24
40	25	.94711	<b>.88535</b>	.94981	<b>.89085</b>	.95242	<b>.89623</b>	.95496	<b>.90150</b>	.95743	<b>.90664</b>	20
44	26	.94716	<b>.88544</b>	.94985	<b>.89094</b>	.95246	<b>.89632</b>	.95501	<b>.90158</b>	.95747	<b>.90672</b>	16
48	27	9.94721	<b>0.88553</b>	9.94989	<b>0.89103</b>	9.95251	<b>0.89641</b>	9.95505	<b>0.90167</b>	9.95751	<b>0.90680</b>	12
52	28	.94725	<b>.88563</b>	.94994	<b>.89112</b>	.95255	<b>.89650</b>	.95509	<b>.90176</b>	.95755	<b>.90689</b>	8
56	29	9.94730	<b>0.88572</b>	9.94998	<b>0.89121</b>	9.95259	<b>0.89659</b>	9.95513	<b>0.90184</b>	9.95759	<b>0.90697</b>	4
		14h 38m		14h 34m		14h 30m		14h 26m		14h 22m		
s	'	9h 22m 140°		9h 26m 141°		9h 30m 142°		9h 34m 143°		9h 38m 144°		s
0	30	9.94734	<b>0.88581</b>	9.95003	<b>0.89130</b>	9.95264	<b>0.89668</b>	9.95517	<b>0.90193</b>	9.95763	<b>0.90706</b>	60
4	31	.94739	<b>.88590</b>	.95007	<b>.89139</b>	.95268	<b>.89677</b>	.95521	<b>.90201</b>	.95768	<b>.90714</b>	56
8	32	.94743	<b>.88600</b>	.95011	<b>.89149</b>	.95272	<b>.89685</b>	.95526	<b>.90210</b>	.95772	<b>.90723</b>	52
12	33	.94748	<b>.88609</b>	.95016	<b>.89158</b>	.95276	<b>.89694</b>	.95530	<b>.90219</b>	.95776	<b>.90731</b>	48
16	34	9.94752	<b>0.88618</b>	9.95020	<b>0.89167</b>	9.95281	<b>0.89703</b>	9.95534	<b>0.90227</b>	9.95780	<b>0.90740</b>	44
20	35	.94757	<b>.88627</b>	.95025	<b>.89176</b>	.95285	<b>.89712</b>	.95538	<b>.90236</b>	.95784	<b>.90748</b>	40
24	36	.94761	<b>.88637</b>	.95029	<b>.89185</b>	.95289	<b>.89721</b>	.95542	<b>.90245</b>	.95788	<b>.90756</b>	36
28	37	.94766	<b>.88646</b>	.95033	<b>.89194</b>	.95294	<b>.89730</b>	.95546	<b>.90253</b>	.95792	<b>.90765</b>	32
32	38	9.94770	<b>0.88655</b>	9.95038	<b>0.89203</b>	9.95298	<b>0.89738</b>	9.95550	<b>0.90262</b>	9.95796	<b>0.90773</b>	28
36	39	.94774	<b>.88664</b>	.95042	<b>.89212</b>	.95302	<b>.89747</b>	.95555	<b>.90271</b>	.95800	<b>.90782</b>	24
40	40	.94779	<b>.88674</b>	.95047	<b>.89221</b>	.95306	<b>.89756</b>	.95559	<b>.90279</b>	.95804	<b>.90790</b>	20
44	41	.94784	<b>.88683</b>	.95051	<b>.89230</b>	.95311	<b>.89765</b>	.95563	<b>.90288</b>	.95808	<b>.90798</b>	16
48	42	9.94788	<b>0.88692</b>	9.95055	<b>0.89239</b>	9.95315	<b>0.89774</b>	9.95567	<b>0.90296</b>	9.95812	<b>0.90807</b>	12
52	43	.94793	<b>.88701</b>	.95060	<b>.89248</b>	.95319	<b>.89783</b>	.95571	<b>.90305</b>	.95816	<b>.90815</b>	8
56	44	9.94797	<b>0.88710</b>	9.95064	<b>0.89257</b>	9.95323	<b>0.89791</b>	9.95575	<b>0.90314</b>	9.95820	<b>0.90824</b>	4
		14h 37m		14h 33m		14h 29m		14h 25m		14h 21m		
s	'	9h 23m 140°		9h 27m 141°		9h 31m 142°		9h 35m 143°		9h 39m 144°		s
0	45	9.94802	<b>0.88720</b>	9.95069	<b>0.89266</b>	9.95328	<b>0.89800</b>	9.95579	<b>0.90322</b>	9.95824	<b>0.90832</b>	60
4	46	.94806	<b>.88729</b>	.95073	<b>.89275</b>	.95332	<b>.89809</b>	.95584	<b>.90331</b>	.95828	<b>.90840</b>	56
8	47	.94811	<b>.88738</b>	.95077	<b>.89284</b>	.95336	<b>.89818</b>	.95588	<b>.90339</b>	.95832	<b>.90849</b>	52
12	48	.94815	<b>.88747</b>	.95082	<b>.89293</b>	.95340	<b>.89827</b>	.95592	<b>.90348</b>	.95836	<b>.90857</b>	48
16	49	9.94820	<b>0.88756</b>	9.95086	<b>0.89302</b>	9.95345	<b>0.89835</b>	9.95596	<b>0.90357</b>	9.95840	<b>0.90866</b>	44
20	50	.94824	<b>.88766</b>	.95090	<b>.89311</b>	.95349	<b>.89844</b>	.95600	<b>.90365</b>	.95844	<b>.90874</b>	40
24	51	.94829	<b>.88775</b>	.95095	<b>.89320</b>	.95353	<b>.89853</b>	.95604	<b>.90374</b>	.95848	<b>.90882</b>	36
28	52	.94833	<b>.88784</b>	.95099	<b>.89329</b>	.95357	<b>.89862</b>	.95608	<b>.90382</b>	.95852	<b>.90891</b>	32
32	53	9.94838	<b>0.88793</b>	9.95104	<b>0.89338</b>	9.95362	<b>0.89870</b>	9.95613	<b>0.90391</b>	9.95856	<b>0.90899</b>	28
36	54	.94842	<b>.88802</b>	.95108	<b>.89347</b>	.95366	<b>.89879</b>	.95617	<b>.90399</b>	.95860	<b>.90907</b>	24
40	55	.94847	<b>.88811</b>	.95112	<b>.89356</b>	.95370	<b>.89888</b>	.95621	<b>.90408</b>	.95864	<b>.90916</b>	20
44	56	.94851	<b>.88821</b>	.95117	<b>.89365</b>	.95374	<b>.89897</b>	.95625	<b>.90417</b>	.95868	<b>.90924</b>	16
48	57	9.94856	<b>0.88830</b>	9.95121	<b>0.89374</b>	9.95379	<b>0.89906</b>	9.95629	<b>0.90425</b>	9.95872	<b>0.90933</b>	12
52	58	.94860	<b>.88839</b>	.95125	<b>.89383</b>	.95383	<b>.89914</b>	.95633	<b>.90434</b>	.95876	<b>.90941</b>	8
56	59	.94865	<b>.88848</b>	.95130	<b>.89392</b>	.95387	<b>.89923</b>	.95637	<b>.90442</b>	.95880	<b>.90949</b>	4
60	60	9.94869	<b>0.88857</b>	9.95134	<b>0.89401</b>	9.95391	<b>0.89932</b>	9.95641	<b>0.90451</b>	9.95884	<b>0.90958</b>	0
		14h 36m		14h 32m		14h 28m		14h 24m		14h 20m		



Haversines.

		9h 40m 145°		9h 44m 146°		9h 48m 147°		9h 52m 148°		9h 56m 149°				
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.95884	<b>0.90958</b>	9.96119	<b>0.91452</b>	9.96347	<b>0.91934</b>	9.96568	<b>0.92402</b>	9.96782	<b>0.92858</b>	9.96782	<b>0.92858</b>	60
4	1	.95888	<b>.90966</b>	.96123	<b>.91469</b>	.96351	<b>.91941</b>	.96572	<b>.92410</b>	.96786	<b>.92866</b>	.96786	<b>.92866</b>	56
8	2	.95892	<b>.90974</b>	.96127	<b>.91468</b>	.96355	<b>.91949</b>	.96576	<b>.92418</b>	.96789	<b>.92873</b>	.96789	<b>.92873</b>	52
12	3	.95896	<b>.90983</b>	.96131	<b>.91476</b>	.96359	<b>.91957</b>	.96579	<b>.92426</b>	.96793	<b>.92881</b>	.96793	<b>.92881</b>	48
16	4	9.95900	<b>0.90991</b>	9.96135	<b>0.91484</b>	9.96362	<b>0.91965</b>	9.96583	<b>0.92433</b>	9.96796	<b>0.92888</b>	9.96796	<b>0.92888</b>	44
20	5	.95904	<b>.90999</b>	.96139	<b>.91493</b>	.96366	<b>.91973</b>	.96586	<b>.92441</b>	.96800	<b>.92896</b>	.96800	<b>.92896</b>	40
24	6	.95908	<b>.91008</b>	.96142	<b>.91501</b>	.96370	<b>.91981</b>	.96590	<b>.92449</b>	.96803	<b>.92903</b>	.96803	<b>.92903</b>	36
28	7	.95912	<b>.91016</b>	.96146	<b>.91509</b>	.96374	<b>.91989</b>	.96594	<b>.92456</b>	.96807	<b>.92911</b>	.96807	<b>.92911</b>	32
32	8	9.95916	<b>0.91024</b>	9.96150	<b>0.91517</b>	9.96377	<b>0.91997</b>	9.96597	<b>0.92464</b>	9.96810	<b>0.92918</b>	9.96810	<b>0.92918</b>	28
36	9	.95920	<b>.91033</b>	.96154	<b>.91525</b>	.96381	<b>.92005</b>	.96601	<b>.92472</b>	.96814	<b>.92926</b>	.96814	<b>.92926</b>	24
40	10	.95924	<b>.91041</b>	.96158	<b>.91533</b>	.96385	<b>.92013</b>	.96604	<b>.92479</b>	.96817	<b>.92933</b>	.96817	<b>.92933</b>	20
44	11	.95928	<b>.91049</b>	.96162	<b>.91541</b>	.96388	<b>.92020</b>	.96608	<b>.92487</b>	.96821	<b>.92941</b>	.96821	<b>.92941</b>	16
48	12	9.95932	<b>0.91057</b>	9.96165	<b>0.91549</b>	9.96392	<b>0.92028</b>	9.96612	<b>0.92495</b>	9.96824	<b>0.92948</b>	9.96824	<b>0.92948</b>	12
52	13	.95936	<b>.91066</b>	.96169	<b>.91557</b>	.96396	<b>.92036</b>	.96615	<b>.92502</b>	.96827	<b>.92955</b>	.96827	<b>.92955</b>	8
56	14	9.95939	<b>0.91074</b>	9.96173	<b>0.91565</b>	9.96400	<b>0.92044</b>	9.96619	<b>0.92510</b>	9.96831	<b>0.92963</b>	9.96831	<b>0.92963</b>	4
		14h 19m		14h 15m		14h 11m		14h 7m		14h 3m				
		9h 41m 145°		9h 45m 146°		9h 49m 147°		9h 53m 148°		9h 57m 149°				
0	15	9.95943	<b>0.91082</b>	9.96177	<b>0.91574</b>	9.96403	<b>0.92052</b>	9.96622	<b>0.92518</b>	9.96834	<b>0.92970</b>	9.96834	<b>0.92970</b>	60
4	16	.95947	<b>.91091</b>	.96181	<b>.91582</b>	.96407	<b>.92060</b>	.96626	<b>.92525</b>	.96837	<b>.92978</b>	.96837	<b>.92978</b>	56
8	17	.95951	<b>.91099</b>	.96185	<b>.91590</b>	.96411	<b>.92068</b>	.96630	<b>.92533</b>	.96841	<b>.92985</b>	.96841	<b>.92985</b>	52
12	18	.95955	<b>.91107</b>	.96188	<b>.91598</b>	.96412	<b>.92076</b>	.96633	<b>.92541</b>	.96845	<b>.92993</b>	.96845	<b>.92993</b>	48
16	19	9.95959	<b>0.91115</b>	9.96192	<b>0.91606</b>	9.96418	<b>0.92083</b>	9.96637	<b>0.92548</b>	9.96848	<b>0.93000</b>	9.96848	<b>0.93000</b>	44
20	20	.95963	<b>.91124</b>	.96196	<b>.91614</b>	.96422	<b>.92091</b>	.96640	<b>.92556</b>	.96852	<b>.93007</b>	.96852	<b>.93007</b>	40
24	21	.95967	<b>.91132</b>	.96200	<b>.91622</b>	.96426	<b>.92099</b>	.96644	<b>.92563</b>	.96855	<b>.93015</b>	.96855	<b>.93015</b>	36
28	22	.95971	<b>.91140</b>	.96204	<b>.91630</b>	.96429	<b>.92107</b>	.96648	<b>.92571</b>	.96859	<b>.93022</b>	.96859	<b>.93022</b>	32
32	23	9.95975	<b>0.91149</b>	9.96208	<b>0.91638</b>	9.96433	<b>0.92115</b>	9.96651	<b>0.92579</b>	9.96862	<b>0.93030</b>	9.96862	<b>0.93030</b>	28
36	24	.95979	<b>.91157</b>	.96211	<b>.91646</b>	.96437	<b>.92123</b>	.96655	<b>.92586</b>	.96866	<b>.93037</b>	.96866	<b>.93037</b>	24
40	25	.95983	<b>.91165</b>	.96215	<b>.91654</b>	.96440	<b>.92130</b>	.96658	<b>.92594</b>	.96869	<b>.93045</b>	.96869	<b>.93045</b>	20
44	26	.95987	<b>.91173</b>	.96219	<b>.91662</b>	.96444	<b>.92138</b>	.96662	<b>.92602</b>	.96873	<b>.93052</b>	.96873	<b>.93052</b>	16
48	27	9.95991	<b>0.91182</b>	9.96223	<b>0.91670</b>	9.96448	<b>0.92146</b>	9.96665	<b>0.92609</b>	9.96876	<b>0.93059</b>	9.96876	<b>0.93059</b>	12
52	28	.95995	<b>.91190</b>	.96227	<b>.91678</b>	.96451	<b>.92154</b>	.96669	<b>.92617</b>	.96879	<b>.93067</b>	.96879	<b>.93067</b>	8
56	29	9.95999	<b>0.91198</b>	9.96230	<b>0.91686</b>	9.96455	<b>0.92162</b>	9.96673	<b>0.92624</b>	9.96883	<b>0.93074</b>	9.96883	<b>0.93074</b>	4
		14h 18m		14h 14m		14h 10m		14h 6m		14h 2m				
		9h 42m 145°		9h 46m 146°		9h 50m 147°		9h 54m 148°		9h 58m 149°				
0	30	9.96002	<b>0.91206</b>	9.96234	<b>0.91694</b>	9.96459	<b>0.92170</b>	9.96676	<b>0.92632</b>	9.96886	<b>0.93081</b>	9.96886	<b>0.93081</b>	60
4	31	.96006	<b>.91215</b>	.96238	<b>.91702</b>	.96462	<b>.92177</b>	.96680	<b>.92640</b>	.96890	<b>.93089</b>	.96890	<b>.93089</b>	56
8	32	.96010	<b>.91223</b>	.96242	<b>.91710</b>	.96466	<b>.92185</b>	.96683	<b>.92647</b>	.96894	<b>.93096</b>	.96894	<b>.93096</b>	52
12	33	.96014	<b>.91231</b>	.96246	<b>.91718</b>	.96470	<b>.92193</b>	.96687	<b>.92655</b>	.96897	<b>.93104</b>	.96897	<b>.93104</b>	48
16	34	9.96018	<b>0.91239</b>	9.96249	<b>0.91726</b>	9.96473	<b>0.92201</b>	9.96690	<b>0.92662</b>	9.96900	<b>0.93111</b>	9.96900	<b>0.93111</b>	44
20	35	.96022	<b>.91247</b>	.96253	<b>.91734</b>	.96477	<b>.92209</b>	.96694	<b>.92670</b>	.96904	<b>.93118</b>	.96904	<b>.93118</b>	40
24	36	.96026	<b>.91256</b>	.96257	<b>.91742</b>	.96481	<b>.92216</b>	.96697	<b>.92678</b>	.96907	<b>.93126</b>	.96907	<b>.93126</b>	36
28	37	.96030	<b>.91264</b>	.96261	<b>.91750</b>	.96484	<b>.92224</b>	.96701	<b>.92685</b>	.96910	<b>.93133</b>	.96910	<b>.93133</b>	32
32	38	9.96034	<b>0.91272</b>	9.96265	<b>0.91758</b>	9.96488	<b>0.92232</b>	9.96705	<b>0.92693</b>	9.96914	<b>0.93140</b>	9.96914	<b>0.93140</b>	28
36	39	.96038	<b>.91280</b>	.96268	<b>.91766</b>	.96492	<b>.92240</b>	.96708	<b>.92700</b>	.96917	<b>.93148</b>	.96917	<b>.93148</b>	24
40	40	.96042	<b>.91289</b>	.96272	<b>.91774</b>	.96495	<b>.92248</b>	.96712	<b>.92708</b>	.96921	<b>.93155</b>	.96921	<b>.93155</b>	20
44	41	.96046	<b>.91297</b>	.96276	<b>.91782</b>	.96499	<b>.92255</b>	.96715	<b>.92715</b>	.96924	<b>.93162</b>	.96924	<b>.93162</b>	16
48	42	9.96049	<b>0.91305</b>	9.96280	<b>0.91790</b>	9.96503	<b>0.92263</b>	9.96719	<b>0.92723</b>	9.96928	<b>0.93170</b>	9.96928	<b>0.93170</b>	12
52	43	.96053	<b>.91313</b>	.96283	<b>.91798</b>	.96506	<b>.92271</b>	.96722	<b>.92731</b>	.96931	<b>.93177</b>	.96931	<b>.93177</b>	8
56	44	9.96057	<b>0.91321</b>	9.96287	<b>0.91806</b>	9.96510	<b>0.92279</b>	9.96726	<b>0.92738</b>	9.96934	<b>0.93184</b>	9.96934	<b>0.93184</b>	4
		14h 17m		14h 13m		14h 9m		14h 5m		14h 1m				
		9h 43m 145°		9h 47m 146°		9h 51m 147°		9h 55m 148°		9h 59m 149°				
0	45	9.96061	<b>0.91329</b>	9.96291	<b>0.91814</b>	9.96514	<b>0.92286</b>	9.96729	<b>0.92746</b>	9.96938	<b>0.93192</b>	9.96938	<b>0.93192</b>	60
4	46	.96065	<b>.91338</b>	.96295	<b>.91822</b>	.96517	<b>.92294</b>	.96733	<b>.92753</b>	.96941	<b>.93199</b>	.96941	<b>.93199</b>	56
8	47	.96069	<b>.91346</b>	.96299	<b>.91830</b>	.96521	<b>.92302</b>	.96736	<b>.92761</b>	.96945	<b>.93206</b>	.96945	<b>.93206</b>	52
12	48	.96073	<b>.91354</b>	.96302	<b>.91838</b>	.96525	<b>.92310</b>	.96740	<b>.92768</b>	.96948	<b>.93214</b>	.96948	<b>.93214</b>	48
16	49	9.96077	<b>0.91362</b>	9.96306	<b>0.91846</b>	9.96528	<b>0.92317</b>	9.96743	<b>0.92776</b>	9.96951	<b>0.93221</b>	9.96951	<b>0.93221</b>	44
20	50	.96081	<b>.91370</b>	.96310	<b>.91854</b>	.96532	<b>.92325</b>	.96747	<b>.92783</b>	.96955	<b>.93228</b>	.96955	<b>.93228</b>	40
24	51	.96084	<b>.91379</b>	.96314	<b>.91862</b>	.96536	<b>.92333</b>	.96750	<b>.92791</b>	.96958	<b>.93236</b>	.96958	<b>.93236</b>	36
28	52	.96088	<b>.91387</b>	.96317	<b>.91870</b>	.96539	<b>.92341</b>	.96754	<b>.92798</b>	.96962	<b>.93243</b>	.96962	<b>.93243</b>	32
32	53	9.96092	<b>0.91395</b>	9.96321	<b>0.91878</b>	9.96543	<b>0.92348</b>	9.96758	<b>0.92806</b>	9.96965	<b>0.93250</b>	9.96965	<b>0.93250</b>	28
36	54	.96096	<b>.91403</b>	.96325	<b>.91886</b>	.96547	<b>.92356</b>	.96761	<b>.92813</b>	.96968	<b>.93258</b>	.96968	<b>.93258</b>	24
40	55	.96100	<b>.91411</b>	.96329	<b>.91894</b>	.96550	<b>.92364</b>	.96765	<b>.92821</b>	.96972	<b>.93265</b>	.96972	<b>.93265</b>	20
44	56	.96104	<b>.91419</b>	.96332	<b>.91902</b>	.96554	<b>.92372</b>	.96768	<b>.92828</b>	.96975	<b>.93272</b>	.96975	<b>.93272</b>	16
48	57	9.96108	<b>0.91427</b>	9.96336	<b>0.91910</b>	9.96557	<b>0.92379</b>	9.96772	<b>0.92836</b>	9.96979	<b>0.93279</b>	9.96979	<b>0.93279</b>	12
52	58	.96112	<b>.91436</b>	.96340	<b>.91918</b>	.96561	<b>.92387</b>	.96775	<b>.92843</b>	.96982	<b>.93287</b>	.96982	<b>.93287</b>	8
50	59	.96115	<b>.91444</b>	.96344	<b>.91926</b>	.96565	<b>.92394</b>	.96779	<b>.92851</b>	.96985	<b>.93294</b>	.96985	<b>.93294</b>	4
60	60	9.96119	<b>0.91452</b>	9.96347	<b>0.91934</b>	9.96568	<b>0.92402</b>	9.96782	<b>0.92858</b>	9.96989	<b>0.93301</b>	9.96989	<b>0.93301</b>	0
		14h 16m		14h 12m		14h 8m		14h 4m		14h 0m				



TABLE IV.

Haversines.

s	10h 0m 150°		10h 4m 151°		10h 8m 152°		10h 12m 153°		10h 16m 154°		s		
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.			
0	0	9.96989	<b>0.93301</b>	9.97188	<b>0.93731</b>	9.97381	<b>0.94147</b>	9.97566	<b>0.94550</b>	9.97745	<b>0.94940</b>	60	
4	1	.96992	<b>.93309</b>	.97192	<b>.93738</b>	.97384	<b>.94154</b>	.97569	<b>.94557</b>	.97748	<b>.94946</b>	56	
8	2	.96996	<b>.93316</b>	.97195	<b>.93745</b>	.97387	<b>.94161</b>	.97572	<b>.94564</b>	.97751	<b>.94952</b>	52	
12	3	.96999	<b>.93323</b>	.97198	<b>.93752</b>	.97390	<b>.94168</b>	.97575	<b>.94570</b>	.97754	<b>.94959</b>	48	
16	4	9.97002	<b>0.93330</b>	9.97201	<b>0.93759</b>	9.97393	<b>0.94175</b>	9.97578	<b>0.94577</b>	9.97756	<b>0.94965</b>	44	
20	5	.97006	<b>.93338</b>	.97205	<b>.93766</b>	.97397	<b>.94181</b>	.97581	<b>.94583</b>	.97759	<b>.94972</b>	40	
24	6	.97009	<b>.93345</b>	.97208	<b>.93773</b>	.97400	<b>.94188</b>	.97584	<b>.94590</b>	.97762	<b>.94978</b>	36	
28	7	.97012	<b>.93352</b>	.97211	<b>.93780</b>	.97403	<b>.94195</b>	.97587	<b>.94596</b>	.97765	<b>.94984</b>	32	
32	8	9.97016	<b>0.93359</b>	9.97214	<b>0.93787</b>	9.97406	<b>0.94202</b>	9.97591	<b>0.94603</b>	9.97768	<b>0.94991</b>	28	
36	9	.97019	<b>.93367</b>	.97218	<b>.93794</b>	.97409	<b>.94209</b>	.97594	<b>.94610</b>	.97771	<b>.94997</b>	24	
40	10	.97022	<b>.93374</b>	.97221	<b>.93801</b>	.97412	<b>.94215</b>	.97597	<b>.94616</b>	.97774	<b>.95003</b>	20	
44	11	.97026	<b>.93381</b>	.97224	<b>.93808</b>	.97415	<b>.94222</b>	.97600	<b>.94623</b>	.97777	<b>.95010</b>	16	
48	12	9.97029	<b>0.93388</b>	9.97227	<b>0.93815</b>	9.97418	<b>0.94229</b>	9.97603	<b>0.94629</b>	9.97780	<b>0.95016</b>	12	
52	13	.97033	<b>.93395</b>	.97231	<b>.93822</b>	.97422	<b>.94236</b>	.97606	<b>.94636</b>	.97783	<b>.95022</b>	8	
56	14	9.97036	<b>0.93403</b>	9.97234	<b>0.93829</b>	9.97425	<b>0.94243</b>	9.97609	<b>0.94642</b>	9.97785	<b>0.95029</b>	4	
		13h 59m		13h 55m		13h 51m		13h 47m		13h 43m			
s		10h 1m 150°		10h 5m 151°		10h 9m 152°		10h 13m 153°		10h 17m 154°		s	
0	15	9.97039	<b>0.93410</b>	9.97237	<b>0.93836</b>	9.97428	<b>0.94249</b>	9.97612	<b>0.94649</b>	9.97788	<b>0.95035</b>	60	
4	16	.97043	<b>.93417</b>	.97240	<b>.93843</b>	.97431	<b>.94256</b>	.97615	<b>.94655</b>	.97791	<b>.95041</b>	56	
8	17	.97046	<b>.93424</b>	.97244	<b>.93850</b>	.97434	<b>.94263</b>	.97618	<b>.94662</b>	.97794	<b>.95048</b>	52	
12	18	.97049	<b>.93432</b>	.97247	<b>.93857</b>	.97437	<b>.94270</b>	.97621	<b>.94669</b>	.97797	<b>.95054</b>	48	
16	19	9.97052	<b>0.93439</b>	9.97250	<b>0.93864</b>	9.97440	<b>0.94276</b>	9.97624	<b>0.94675</b>	9.97800	<b>0.95060</b>	44	
20	20	.97056	<b>.93446</b>	.97253	<b>.93871</b>	.97443	<b>.94283</b>	.97627	<b>.94682</b>	.97803	<b>.95066</b>	40	
24	21	.97059	<b>.93453</b>	.97257	<b>.93878</b>	.97447	<b>.94290</b>	.97630	<b>.94688</b>	.97806	<b>.95073</b>	36	
28	22	.97063	<b>.93460</b>	.97260	<b>.93885</b>	.97450	<b>.94297</b>	.97633	<b>.94695</b>	.97808	<b>.95079</b>	32	
32	23	9.97066	<b>0.93468</b>	9.97263	<b>0.93892</b>	9.97453	<b>0.94303</b>	9.97636	<b>0.94701</b>	9.97811	<b>0.95085</b>	28	
36	24	.97069	<b>.93475</b>	.97266	<b>.93899</b>	.97456	<b>.94310</b>	.97639	<b>.94708</b>	.97814	<b>.95092</b>	24	
40	25	.97073	<b>.93482</b>	.97269	<b>.93906</b>	.97459	<b>.94317</b>	.97642	<b>.94714</b>	.97817	<b>.95098</b>	20	
44	26	.97076	<b>.93489</b>	.97273	<b>.93913</b>	.97462	<b>.94324</b>	.97645	<b>.94721</b>	.97820	<b>.95104</b>	16	
48	27	9.97079	<b>0.93496</b>	9.97276	<b>0.93920</b>	9.97465	<b>0.94330</b>	9.97647	<b>0.94727</b>	9.97823	<b>0.95111</b>	12	
52	28	.97083	<b>.93503</b>	.97279	<b>.93927</b>	.97468	<b>.94337</b>	.97650	<b>.94734</b>	.97826	<b>.95117</b>	8	
56	29	9.97086	<b>0.93511</b>	9.97282	<b>0.93934</b>	9.97471	<b>0.94344</b>	9.97653	<b>0.94740</b>	9.97829	<b>0.95123</b>	4	
		13h 58m		13h 54m		13h 50m		13h 46m		13h 42m			
s		10h 2m 150°		10h 6m 151°		10h 10m 152°		10h 14m 153°		10h 18m 154°		s	
0	30	9.97089	<b>0.93518</b>	9.97285	<b>0.93941</b>	9.97474	<b>0.94351</b>	9.97656	<b>0.94747</b>	9.97831	<b>0.95129</b>	60	
4	31	.97093	<b>.93525</b>	.97289	<b>.93948</b>	.97478	<b>.94357</b>	.97659	<b>.94753</b>	.97834	<b>.95136</b>	56	
8	32	.97096	<b>.93532</b>	.97292	<b>.93955</b>	.97481	<b>.94364</b>	.97662	<b>.94760</b>	.97837	<b>.95142</b>	52	
12	33	.97099	<b>.93539</b>	.97295	<b>.93962</b>	.97484	<b>.94371</b>	.97665	<b>.94766</b>	.97840	<b>.95148</b>	48	
16	34	9.97103	<b>0.93546</b>	9.97298	<b>0.93969</b>	9.97487	<b>0.94377</b>	9.97668	<b>0.94773</b>	9.97843	<b>0.95154</b>	44	
20	35	.97106	<b>.93554</b>	.97301	<b>.93976</b>	.97490	<b>.94384</b>	.97671	<b>.94779</b>	.97846	<b>.95161</b>	40	
24	36	.97109	<b>.93561</b>	.97305	<b>.93982</b>	.97493	<b>.94391</b>	.97674	<b>.94786</b>	.97849	<b>.95167</b>	36	
28	37	.97113	<b>.93568</b>	.97308	<b>.93989</b>	.97496	<b>.94397</b>	.97677	<b>.94792</b>	.97851	<b>.95173</b>	32	
32	38	9.97116	<b>0.93575</b>	9.97311	<b>0.93996</b>	9.97499	<b>0.94404</b>	9.97680	<b>0.94799</b>	9.97854	<b>0.95179</b>	28	
36	39	.97119	<b>.93582</b>	.97314	<b>.94003</b>	.97502	<b>.94411</b>	.97683	<b>.94805</b>	.97857	<b>.95185</b>	24	
40	40	.97123	<b>.93589</b>	.97317	<b>.94010</b>	.97505	<b>.94418</b>	.97686	<b>.94811</b>	.97860	<b>.95192</b>	20	
44	41	.97126	<b>.93596</b>	.97321	<b>.94017</b>	.97508	<b>.94424</b>	.97689	<b>.94818</b>	.97863	<b>.95198</b>	16	
48	42	9.97129	<b>0.93603</b>	9.97324	<b>0.94024</b>	9.97511	<b>0.94431</b>	9.97692	<b>0.94824</b>	9.97866	<b>0.95204</b>	12	
52	43	.97132	<b>.93611</b>	.97327	<b>.94031</b>	.97514	<b>.94438</b>	.97695	<b>.94831</b>	.97868	<b>.95210</b>	8	
56	44	9.97136	<b>0.93618</b>	9.97330	<b>0.94038</b>	9.97518	<b>0.94444</b>	9.97698	<b>0.94837</b>	9.97871	<b>0.95217</b>	4	
		13h 57m		13h 53m		13h 49m		13h 45m		13h 41m			
s		10h 3m 150°		10h 7m 151°		10h 11m 152°		10h 15m 153°		10h 19m 154°		s	
0	45	9.97139	<b>0.93625</b>	9.97333	<b>0.94045</b>	9.97521	<b>0.94451</b>	9.97701	<b>0.94844</b>	9.97874	<b>0.95223</b>	60	
4	46	.97142	<b>.93632</b>	.97337	<b>.94051</b>	.97524	<b>.94458</b>	.97704	<b>.94850</b>	.97877	<b>.95229</b>	56	
8	47	.97146	<b>.93639</b>	.97340	<b>.94058</b>	.97527	<b>.94464</b>	.97707	<b>.94857</b>	.97880	<b>.95235</b>	52	
12	48	.97149	<b>.93646</b>	.97343	<b>.94065</b>	.97530	<b>.94471</b>	.97710	<b>.94863</b>	.97883	<b>.95241</b>	48	
16	49	9.97152	<b>0.93653</b>	9.97346	<b>0.94072</b>	9.97533	<b>0.94477</b>	9.97713	<b>0.94869</b>	9.97885	<b>0.95248</b>	44	
20	50	.97156	<b>.93660</b>	.97349	<b>.94079</b>	.97536	<b>.94484</b>	.97716	<b>.94876</b>	.97888	<b>.95254</b>	40	
24	51	.97159	<b>.93667</b>	.97352	<b>.94086</b>	.97539	<b>.94491</b>	.97719	<b>.94882</b>	.97891	<b>.95260</b>	36	
28	52	.97162	<b>.93674</b>	.97356	<b>.94093</b>	.97542	<b>.94497</b>	.97722	<b>.94889</b>	.97894	<b>.95266</b>	32	
32	53	9.97165	<b>0.93682</b>	9.97359	<b>0.94099</b>	9.97545	<b>0.94504</b>	9.97724	<b>0.94895</b>	9.97897	<b>0.95272</b>	28	
36	54	.97169	<b>.93689</b>	.97362	<b>.94106</b>	.97548	<b>.94511</b>	.97727	<b>.94901</b>	.97899	<b>.95278</b>	24	
40	55	.97172	<b>.93696</b>	.97365	<b>.94113</b>	.97551	<b>.94517</b>	.97730	<b>.94908</b>	.97902	<b>.95284</b>	20	
44	56	.97175	<b>.93703</b>	.97368	<b>.94120</b>	.97554	<b>.94524</b>	.97733	<b>.94914</b>	.97905	<b>.95290</b>	16	
48	57	9.97179	<b>0.93710</b>	9.97371	<b>0.94127</b>	9.97557	<b>0.94531</b>	9.97736	<b>0.94921</b>	9.97908	<b>0.95297</b>	12	
52	58	.97182	<b>.93717</b>	.97375	<b>.94134</b>	.97560	<b>.94537</b>	.97739	<b>.94927</b>	.97911	<b>.95303</b>	8	
56	59	.97185	<b>.93724</b>	.97378	<b>.94141</b>	.97563	<b>.94544</b>	.97742	<b>.94933</b>	.97914	<b>.95309</b>	4	
60	60	9.97188	<b>0.93731</b>	9.97381	<b>0.94147</b>	9.97566	<b>0.94550</b>	9.97745	<b>0.94940</b>	9.97916	<b>0.95315</b>	0	
		13h 56m		13h 52m		13h 48m		13h 44m		13h 40m			



TABLE IV.

Haversines.

		10h 20m 155°		10h 24m 156°		10h 28m 157°		10h 32m 158°		10h 36m 159°		
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.97916	<b>0.95315</b>	9.98081	<b>0.95677</b>	9.98239	<b>0.96025</b>	9.98389	<b>0.96359</b>	9.98533	<b>0.96679</b>	60
4	1	.97919	<b>.95322</b>	.98084	<b>.95683</b>	.98241	<b>.96031</b>	.98392	<b>.96365</b>	.98536	<b>.96684</b>	56
8	2	.97922	<b>.95328</b>	.98086	<b>.95689</b>	.98244	<b>.96037</b>	.98394	<b>.96370</b>	.98538	<b>.96689</b>	52
12	3	.97925	<b>.95334</b>	.98089	<b>.95695</b>	.98246	<b>.96042</b>	.98397	<b>.96376</b>	.98540	<b>.96695</b>	48
16	4	9.97927	<b>0.95340</b>	9.98092	<b>0.95701</b>	9.98249	<b>0.96048</b>	9.98399	<b>0.96381</b>	9.98543	<b>0.96700</b>	44
20	5	.97930	<b>.95346</b>	.98094	<b>.95707</b>	.98251	<b>.96054</b>	.98402	<b>.96386</b>	.98545	<b>.96705</b>	40
24	6	.97933	<b>.95352</b>	.98097	<b>.95713</b>	.98254	<b>.96059</b>	.98404	<b>.96392</b>	.98547	<b>.96710</b>	36
28	7	.97936	<b>.95358</b>	.98100	<b>.95719</b>	.98256	<b>.96065</b>	.98406	<b>.96397</b>	.98550	<b>.96715</b>	32
32	8	9.97939	<b>0.95364</b>	9.98102	<b>0.95724</b>	9.98259	<b>0.96071</b>	9.98409	<b>0.96403</b>	9.98552	<b>0.96721</b>	28
36	9	.97941	<b>.95371</b>	.98105	<b>.95730</b>	.98262	<b>.96076</b>	.98411	<b>.96408</b>	.98554	<b>.96726</b>	24
40	10	.97944	<b>.95377</b>	.98108	<b>.95736</b>	.98264	<b>.96082</b>	.98414	<b>.96413</b>	.98557	<b>.96731</b>	20
44	11	.97947	<b>.95383</b>	.98110	<b>.95742</b>	.98267	<b>.96088</b>	.98416	<b>.96419</b>	.98559	<b>.96736</b>	16
48	12	9.97950	<b>0.95389</b>	9.98113	<b>0.95748</b>	9.98269	<b>0.96093</b>	9.98419	<b>0.96424</b>	9.98561	<b>0.96741</b>	12
52	13	.97953	<b>.95395</b>	.98116	<b>.95754</b>	.98272	<b>.96099</b>	.98421	<b>.96430</b>	.98564	<b>.96746</b>	8
56	14	9.97955	<b>0.95401</b>	9.98118	<b>0.95760</b>	9.98274	<b>0.96104</b>	9.98424	<b>0.96435</b>	9.98566	<b>0.96752</b>	4
		13h 39m		13h 35m		13h 31m		13h 27m		13h 23m		
s	'	10h 21m 155°		10h 25m 156°		10h 29m 157°		10h 33m 158°		10h 37m 159°		s
0	15	9.97958	<b>0.95407</b>	9.98121	<b>0.95766</b>	9.98277	<b>0.96110</b>	9.98426	<b>0.96440</b>	9.98568	<b>0.96757</b>	60
4	16	.97961	<b>.95413</b>	.98124	<b>.95771</b>	.98279	<b>.96116</b>	.98428	<b>.96446</b>	.98570	<b>.96762</b>	56
8	17	.97964	<b>.95419</b>	.98126	<b>.95777</b>	.98282	<b>.96121</b>	.98431	<b>.96451</b>	.98573	<b>.96767</b>	52
12	18	.97966	<b>.95425</b>	.98129	<b>.95783</b>	.98285	<b>.96127</b>	.98433	<b>.96457</b>	.98575	<b>.96772</b>	48
16	19	9.97969	<b>0.95431</b>	9.98132	<b>0.95789</b>	9.98287	<b>0.96133</b>	9.98436	<b>0.96462</b>	9.98577	<b>0.96777</b>	44
20	20	.97972	<b>.95438</b>	.98134	<b>.95795</b>	.98290	<b>.96138</b>	.98438	<b>.96467</b>	.98580	<b>.96782</b>	40
24	21	.97975	<b>.95444</b>	.98137	<b>.95801</b>	.98292	<b>.96144</b>	.98440	<b>.96473</b>	.98582	<b>.96788</b>	36
28	22	.97977	<b>.95450</b>	.98139	<b>.95806</b>	.98295	<b>.96149</b>	.98443	<b>.96478</b>	.98584	<b>.96793</b>	32
32	23	9.97980	<b>0.95456</b>	9.98142	<b>0.95812</b>	9.98297	<b>0.96155</b>	9.98455	<b>0.96483</b>	9.98587	<b>0.96798</b>	28
36	24	.97983	<b>.95462</b>	.98145	<b>.95818</b>	.98300	<b>.96161</b>	.98448	<b>.96489</b>	.98589	<b>.96803</b>	24
40	25	.97986	<b>.95468</b>	.98147	<b>.95824</b>	.98302	<b>.96166</b>	.98450	<b>.96494</b>	.98591	<b>.96808</b>	20
44	26	.97988	<b>.95474</b>	.98150	<b>.95830</b>	.98305	<b>.96172</b>	.98453	<b>.96500</b>	.98593	<b>.96813</b>	16
48	27	9.97991	<b>0.95480</b>	9.98153	<b>0.95836</b>	9.98307	<b>0.96177</b>	9.98455	<b>0.96505</b>	9.98596	<b>0.96818</b>	12
52	28	.97994	<b>.95486</b>	.98155	<b>.95841</b>	.98310	<b>.96183</b>	.98457	<b>.96510</b>	.98598	<b>.96823</b>	8
56	29	9.97997	<b>0.95492</b>	9.98158	<b>0.95847</b>	9.98312	<b>0.96188</b>	9.98460	<b>0.96516</b>	9.98600	<b>0.96828</b>	4
		13h 38m		13h 34m		13h 30m		13h 26m		13h 22m		
s	'	10h 22m 155°		10h 26m 156°		10h 30m 157°		10h 34m 158°		10h 38m 159°		s
0	30	9.97999	<b>0.95498</b>	9.98161	<b>0.95853</b>	9.98315	<b>0.96194</b>	9.98462	<b>0.96521</b>	9.98603	<b>0.96834</b>	60
4	31	.98002	<b>.95504</b>	.98163	<b>.95859</b>	.98317	<b>.96200</b>	.98465	<b>.96526</b>	.98605	<b>.96839</b>	56
8	32	.98005	<b>.95510</b>	.98166	<b>.95865</b>	.98320	<b>.96205</b>	.98467	<b>.96532</b>	.98607	<b>.96844</b>	52
12	33	.98008	<b>.95516</b>	.98168	<b>.95870</b>	.98322	<b>.96211</b>	.98469	<b>.96537</b>	.98609	<b>.96849</b>	48
16	34	9.98010	<b>0.95522</b>	9.98171	<b>0.95876</b>	9.98325	<b>0.96216</b>	9.98472	<b>0.96542</b>	9.98612	<b>0.96854</b>	44
20	35	.98013	<b>.95528</b>	.98174	<b>.95882</b>	.98327	<b>.96222</b>	.98474	<b>.96547</b>	.98614	<b>.96859</b>	40
24	36	.98016	<b>.95534</b>	.98176	<b>.95888</b>	.98330	<b>.96227</b>	.98476	<b>.96553</b>	.98616	<b>.96864</b>	36
28	37	.98019	<b>.95540</b>	.98179	<b>.95894</b>	.98332	<b>.96232</b>	.98479	<b>.96558</b>	.98619	<b>.96869</b>	32
32	38	9.98021	<b>0.95546</b>	9.98182	<b>0.95899</b>	9.98335	<b>0.96238</b>	9.98481	<b>0.96563</b>	9.98621	<b>0.96874</b>	28
36	39	.98024	<b>.95552</b>	.98184	<b>.95905</b>	.98337	<b>.96244</b>	.98484	<b>.96569</b>	.98623	<b>.96879</b>	24
40	40	.98027	<b>.95558</b>	.98187	<b>.95911</b>	.98340	<b>.96249</b>	.98486	<b>.96574</b>	.98625	<b>.96884</b>	20
44	41	.98030	<b>.95564</b>	.98189	<b>.95917</b>	.98342	<b>.96255</b>	.98488	<b>.96579</b>	.98628	<b>.96889</b>	16
48	42	9.98032	<b>0.95570</b>	9.98192	<b>0.95922</b>	9.98345	<b>0.96260</b>	9.98491	<b>0.96585</b>	9.98630	<b>0.96894</b>	12
52	43	.98035	<b>.95576</b>	.98195	<b>.95928</b>	.98347	<b>.96266</b>	.98493	<b>.96590</b>	.98632	<b>.96899</b>	8
56	44	9.98038	<b>0.95582</b>	9.98197	<b>0.95934</b>	9.98350	<b>0.96272</b>	9.98496	<b>0.96595</b>	9.98634	<b>0.96905</b>	4
		13h 37m		13h 33m		13h 29m		13h 25m		13h 21m		
s	'	10h 23m 155°		10h 27m 156°		10h 31m 157°		10h 35m 158°		10h 39m 159°		s
0	45	9.98040	<b>0.95588</b>	9.98200	<b>0.95940</b>	9.98352	<b>0.96277</b>	9.98498	<b>0.96600</b>	9.98637	<b>0.96910</b>	60
4	46	.98043	<b>.95594</b>	.98202	<b>.95945</b>	.98355	<b>.96283</b>	.98500	<b>.96606</b>	.98639	<b>.96915</b>	56
8	47	.98046	<b>.95600</b>	.98205	<b>.95951</b>	.98357	<b>.96288</b>	.98503	<b>.96611</b>	.98641	<b>.96920</b>	52
12	48	.98049	<b>.95606</b>	.98208	<b>.95957</b>	.98360	<b>.96294</b>	.98505	<b>.96616</b>	.98643	<b>.96925</b>	48
16	49	9.98051	<b>0.95612</b>	9.98210	<b>0.95962</b>	9.98362	<b>0.96299</b>	9.98507	<b>0.96621</b>	9.98646	<b>0.96930</b>	44
20	50	.98054	<b>.95618</b>	.98213	<b>.95968</b>	.98365	<b>.96305</b>	.98510	<b>.96627</b>	.98648	<b>.96935</b>	40
24	51	.98057	<b>.95624</b>	.98215	<b>.95974</b>	.98367	<b>.96310</b>	.98512	<b>.96632</b>	.98650	<b>.96940</b>	36
28	52	.98059	<b>.95630</b>	.98218	<b>.95980</b>	.98370	<b>.96315</b>	.98514	<b>.96637</b>	.98652	<b>.96945</b>	32
32	53	9.98062	<b>0.95636</b>	9.98221	<b>0.95985</b>	9.98372	<b>0.96321</b>	9.98517	<b>0.96642</b>	9.98655	<b>0.96950</b>	28
36	54	.98065	<b>.95642</b>	.98223	<b>.95991</b>	.98375	<b>.96326</b>	.98519	<b>.96648</b>	.98657	<b>.96955</b>	24
40	55	.98067	<b>.95648</b>	.98226	<b>.95997</b>	.98377	<b>.96332</b>	.98521	<b>.96653</b>	.98659	<b>.96960</b>	20
44	56	.98070	<b>.95654</b>	.98228	<b>.96002</b>	.98379	<b>.96337</b>	.98524	<b>.96658</b>	.98661	<b>.96965</b>	16
48	57	9.98073	<b>0.95660</b>	9.98231	<b>0.96008</b>	9.98382	<b>0.96343</b>	9.98526	<b>0.96663</b>	9.98664	<b>0.96970</b>	12
52	58	.98076	<b>.95665</b>	.98233	<b>.96014</b>	.98384	<b>.96348</b>	.98529	<b>.96669</b>	.98666	<b>.96975</b>	8
56	59	.98078	<b>.95671</b>	.98236	<b>.96020</b>	.98387	<b>.96354</b>	.98531	<b>.96674</b>	.98668	<b>.96980</b>	4
60	60	9.98081	<b>0.95677</b>	9.98239	<b>0.96025</b>	9.98389	<b>0.96359</b>	9.98533	<b>0.96679</b>	9.98670	<b>0.96985</b>	0
		13h 36m		13h 32m		13h 28m		13h 24m		13h 20m		



TABLE IV.

Haversines.

s	'	10 <sup>h</sup> 40 <sup>m</sup> 160°		10 <sup>h</sup> 44 <sup>m</sup> 161°		10 <sup>h</sup> 48 <sup>m</sup> 162°		10 <sup>h</sup> 52 <sup>m</sup> 163°		10 <sup>h</sup> 56 <sup>m</sup> 164°		s
		Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0	0	9.98670	<b>0.96985</b>	9.98801	<b>0.97276</b>	9.98924	<b>0.97553</b>	9.99041	<b>0.97815</b>	9.99151	<b>0.98063</b>	60
4	1	.98673	<b>.96990</b>	.98803	<b>.97281</b>	.98926	<b>.97557</b>	.99043	<b>.97819</b>	.99152	<b>.98067</b>	56
8	2	.98675	<b>.96995</b>	.98805	<b>.97285</b>	.98928	<b>.97562</b>	.99044	<b>.97824</b>	.99154	<b>.98071</b>	52
12	3	.98677	<b>.97000</b>	.98807	<b>.97290</b>	.98930	<b>.97566</b>	.99046	<b>.97828</b>	.99156	<b>.98075</b>	48
16	4	9.98679	<b>0.97005</b>	9.98809	<b>0.97295</b>	9.98932	<b>0.97571</b>	9.99048	<b>0.97832</b>	9.99158	<b>0.98079</b>	44
20	5	.98681	<b>.97009</b>	.98811	<b>.97300</b>	.98934	<b>.97575</b>	.99050	<b>.97836</b>	.99159	<b>.98083</b>	40
24	6	.98684	<b>.97014</b>	.98813	<b>.97304</b>	.98936	<b>.97580</b>	.99052	<b>.97841</b>	.99161	<b>.98087</b>	36
28	7	.98686	<b>.97019</b>	.98815	<b>.97309</b>	.98938	<b>.97584</b>	.99054	<b>.97845</b>	.99163	<b>.98091</b>	32
32	8	9.98688	<b>0.97024</b>	9.98817	<b>0.97314</b>	9.98940	<b>0.97589</b>	9.99056	<b>0.97849</b>	9.99165	<b>0.98095</b>	28
36	9	.98690	<b>.97029</b>	.98819	<b>.97318</b>	.98942	<b>.97593</b>	.99058	<b>.97853</b>	.99166	<b>.98099</b>	24
40	10	.98692	<b>.97034</b>	.98822	<b>.97323</b>	.98944	<b>.97598</b>	.99059	<b>.97858</b>	.99168	<b>.98103</b>	20
44	11	.98695	<b>.97039</b>	.98824	<b>.97328</b>	.98946	<b>.97602</b>	.99061	<b>.97862</b>	.99170	<b>.98107</b>	16
48	12	9.98697	<b>0.97044</b>	9.98826	<b>0.97332</b>	9.98948	<b>0.97606</b>	9.99063	<b>0.97866</b>	9.99172	<b>0.98111</b>	12
52	13	.98699	<b>.97049</b>	.98828	<b>.97337</b>	.98950	<b>.97611</b>	.99065	<b>.97870</b>	.99173	<b>.98115</b>	8
56	14	9.98701	<b>0.97054</b>	9.98830	<b>0.97342</b>	9.98952	<b>0.97615</b>	9.99067	<b>0.97874</b>	9.99175	<b>0.98119</b>	4
		13 <sup>h</sup> 19 <sup>m</sup>		13 <sup>h</sup> 15 <sup>m</sup>		13 <sup>h</sup> 11 <sup>m</sup>		13 <sup>h</sup> 7 <sup>m</sup>		13 <sup>h</sup> 3 <sup>m</sup>		
s	'	10 <sup>h</sup> 41 <sup>m</sup> 160°		10 <sup>h</sup> 45 <sup>m</sup> 161°		10 <sup>h</sup> 49 <sup>m</sup> 162°		10 <sup>h</sup> 53 <sup>m</sup> 163°		10 <sup>h</sup> 57 <sup>m</sup> 164°		s
0	15	9.98703	<b>0.97059</b>	9.98832	<b>0.97347</b>	9.98954	<b>0.97620</b>	9.99069	<b>0.97879</b>	9.99177	<b>0.98123</b>	60
4	16	.98706	<b>.97064</b>	.98834	<b>.97351</b>	.98956	<b>.97624</b>	.99071	<b>.97883</b>	.99179	<b>.98127</b>	56
8	17	.98708	<b>.97069</b>	.98836	<b>.97356</b>	.98958	<b>.97629</b>	.99072	<b>.97887</b>	.99180	<b>.98131</b>	52
12	18	.98710	<b>.97074</b>	.98838	<b>.97361</b>	.98960	<b>.97633</b>	.99074	<b>.97891</b>	.99182	<b>.98135</b>	48
16	19	9.98712	<b>0.97078</b>	9.98840	<b>0.97365</b>	9.98962	<b>0.97637</b>	9.99076	<b>0.97895</b>	9.99184	<b>0.98139</b>	44
20	20	.98714	<b>.97083</b>	.98842	<b>.97370</b>	.98964	<b>.97642</b>	.99078	<b>.97899</b>	.99186	<b>.98142</b>	40
24	21	.98717	<b>.97088</b>	.98845	<b>.97374</b>	.98966	<b>.97646</b>	.99080	<b>.97904</b>	.99187	<b>.98146</b>	36
28	22	.98719	<b>.97093</b>	.98847	<b>.97379</b>	.98968	<b>.97651</b>	.99082	<b>.97908</b>	.99189	<b>.98150</b>	32
32	23	9.98721	<b>0.97098</b>	9.98849	<b>0.97384</b>	9.98970	<b>0.97655</b>	9.99084	<b>0.97912</b>	9.99191	<b>0.98154</b>	28
36	24	.98723	<b>.97103</b>	.98851	<b>.97388</b>	.98971	<b>.97660</b>	.99085	<b>.97916</b>	.99193	<b>.98158</b>	24
40	25	.98725	<b>.97108</b>	.98853	<b>.97393</b>	.98973	<b>.97664</b>	.99087	<b>.97920</b>	.99194	<b>.98162</b>	20
44	26	.98728	<b>.97113</b>	.98855	<b>.97398</b>	.98975	<b>.97668</b>	.99089	<b>.97924</b>	.99196	<b>.98166</b>	16
48	27	9.98730	<b>0.97117</b>	9.98857	<b>0.97402</b>	9.98977	<b>0.97673</b>	9.99091	<b>0.97929</b>	9.99198	<b>0.98170</b>	12
52	28	.98732	<b>.97122</b>	.98859	<b>.97407</b>	.98979	<b>.97677</b>	.99093	<b>.97933</b>	.99200	<b>.98174</b>	8
56	29	9.98734	<b>0.97127</b>	9.98861	<b>0.97412</b>	9.98981	<b>0.97681</b>	9.99095	<b>0.97937</b>	9.99201	<b>0.98178</b>	4
		13 <sup>h</sup> 18 <sup>m</sup>		13 <sup>h</sup> 14 <sup>m</sup>		13 <sup>h</sup> 10 <sup>m</sup>		13 <sup>h</sup> 6 <sup>m</sup>		13 <sup>h</sup> 2 <sup>m</sup>		
s	'	10 <sup>h</sup> 42 <sup>m</sup> 160°		10 <sup>h</sup> 46 <sup>m</sup> 161°		10 <sup>h</sup> 50 <sup>m</sup> 162°		10 <sup>h</sup> 54 <sup>m</sup> 163°		10 <sup>h</sup> 58 <sup>m</sup> 164°		s
0	30	9.98736	<b>0.97132</b>	9.98863	<b>0.97416</b>	9.98983	<b>0.97686</b>	9.99096	<b>0.97941</b>	9.99203	<b>0.98182</b>	60
4	31	.98738	<b>.97137</b>	.98865	<b>.97421</b>	.98985	<b>.97690</b>	.99098	<b>.97945</b>	.99205	<b>.98185</b>	56
8	32	.98741	<b>.97142</b>	.98867	<b>.97425</b>	.98987	<b>.97695</b>	.99100	<b>.97949</b>	.99206	<b>.98189</b>	52
12	33	.98743	<b>.97147</b>	.98869	<b>.97430</b>	.98989	<b>.97699</b>	.99102	<b>.97953</b>	.99208	<b>.98193</b>	48
16	34	9.98745	<b>0.97151</b>	9.98871	<b>0.97435</b>	9.98991	<b>0.97703</b>	9.99104	<b>0.97957</b>	9.99210	<b>0.98197</b>	44
20	35	.98747	<b>.97156</b>	.98873	<b>.97439</b>	.98993	<b>.97708</b>	.99106	<b>.97962</b>	.99212	<b>.98201</b>	40
24	36	.98749	<b>.97161</b>	.98875	<b>.97444</b>	.98995	<b>.97712</b>	.99107	<b>.97966</b>	.99213	<b>.98205</b>	36
28	37	.98751	<b>.97166</b>	.98877	<b>.97448</b>	.98997	<b>.97716</b>	.99109	<b>.97970</b>	.99215	<b>.98209</b>	32
32	38	9.98754	<b>0.97171</b>	9.98880	<b>0.97453</b>	9.98999	<b>0.97721</b>	9.99111	<b>0.97974</b>	9.99217	<b>0.98212</b>	28
36	39	.98756	<b>.97176</b>	.98882	<b>.97458</b>	.99001	<b>.97725</b>	.99113	<b>.97978</b>	.99218	<b>.98216</b>	24
40	40	.98758	<b>.97180</b>	.98884	<b>.97462</b>	.99003	<b>.97729</b>	.99115	<b>.97982</b>	.99220	<b>.98220</b>	20
44	41	.98760	<b>.97185</b>	.98886	<b>.97467</b>	.99004	<b>.97734</b>	.99116	<b>.97986</b>	.99222	<b>.98224</b>	16
48	42	9.98762	<b>0.97190</b>	9.98888	<b>0.97471</b>	9.99006	<b>0.97738</b>	9.99118	<b>0.97990</b>	9.99223	<b>0.98228</b>	12
52	43	.98764	<b>.97195</b>	.98890	<b>.97476</b>	.99008	<b>.97742</b>	.99120	<b>.97994</b>	.99225	<b>.98232</b>	8
56	44	9.98766	<b>0.97200</b>	9.98892	<b>0.97480</b>	9.99010	<b>0.97747</b>	9.99122	<b>0.97998</b>	9.99227	<b>0.98236</b>	4
		13 <sup>h</sup> 17 <sup>m</sup>		13 <sup>h</sup> 13 <sup>m</sup>		13 <sup>h</sup> 9 <sup>m</sup>		13 <sup>h</sup> 5 <sup>m</sup>		13 <sup>h</sup> 1 <sup>m</sup>		
s	'	10 <sup>h</sup> 43 <sup>m</sup> 160°		10 <sup>h</sup> 47 <sup>m</sup> 161°		10 <sup>h</sup> 51 <sup>m</sup> 162°		10 <sup>h</sup> 55 <sup>m</sup> 163°		10 <sup>h</sup> 59 <sup>m</sup> 164°		s
0	45	9.98769	<b>0.97204</b>	9.98894	<b>0.97485</b>	9.99012	<b>0.97751</b>	9.99124	<b>0.98002</b>	9.99229	<b>0.98239</b>	60
4	46	.98771	<b>.97209</b>	.98896	<b>.97490</b>	.99014	<b>.97755</b>	.99126	<b>.98007</b>	.99230	<b>.98243</b>	56
8	47	.98773	<b>.97214</b>	.98898	<b>.97494</b>	.99016	<b>.97760</b>	.99127	<b>.98011</b>	.99232	<b>.98247</b>	52
12	48	.98775	<b>.97219</b>	.98900	<b>.97499</b>	.99018	<b>.97764</b>	.99129	<b>.98015</b>	.99234	<b>.98251</b>	48
16	49	9.98777	<b>0.97224</b>	9.98902	<b>0.97503</b>	9.99020	<b>0.97768</b>	9.99131	<b>0.98019</b>	9.99235	<b>0.98255</b>	44
20	50	.98779	<b>.97228</b>	.98904	<b>.97508</b>	.99022	<b>.97773</b>	.99133	<b>.98023</b>	.99237	<b>.98258</b>	40
24	51	.98781	<b>.97233</b>	.98906	<b>.97512</b>	.99024	<b>.97777</b>	.99135	<b>.98027</b>	.99239	<b>.98262</b>	36
28	52	.98784	<b>.97238</b>	.98908	<b>.97517</b>	.99026	<b>.97781</b>	.99136	<b>.98031</b>	.99240	<b>.98266</b>	32
32	53	9.98786	<b>0.97243</b>	9.98910	<b>0.97521</b>	9.99027	<b>0.97785</b>	9.99138	<b>0.98035</b>	9.99242	<b>0.98270</b>	28
36	54	.98788	<b>.97247</b>	.98912	<b>.97526</b>	.99029	<b>.97790</b>	.99140	<b>.98039</b>	.99244	<b>.98274</b>	24
40	55	.98790	<b>.97252</b>	.98914	<b>.97530</b>	.99031	<b>.97794</b>	.99142	<b>.98043</b>	.99245	<b>.98277</b>	20
44	56	.98792	<b>.97257</b>	.98916	<b>.97535</b>	.99033	<b>.97798</b>	.99143	<b>.98047</b>	.99247	<b>.98281</b>	16
48	57	9.98794	<b>0.97262</b>	9.98918	<b>0.97539</b>	9.99035	<b>0.97802</b>	9.99145	<b>0.98051</b>	9.99249	<b>0.98285</b>	12
52	58	.98796	<b>.97266</b>	.98920	<b>.97544</b>	.99037	<b>.97807</b>	.99147	<b>.98055</b>	.99250	<b>.98289</b>	8
56	59	.98798	<b>.97271</b>	.98922	<b>.97548</b>	.99039	<b>.97811</b>	.99149	<b>.98059</b>	.99252	<b>.98293</b>	4
60	60	9.98801	<b>0.97276</b>	9.98924	<b>0.97553</b>	9.99041	<b>0.97815</b>	9.99151	<b>0.98063</b>	9.99254	<b>0.98296</b>	0
		13 <sup>h</sup> 16 <sup>m</sup>		13 <sup>h</sup> 12 <sup>m</sup>		13 <sup>h</sup> 8 <sup>m</sup>		13 <sup>h</sup> 4 <sup>m</sup>		13 <sup>h</sup> 0 <sup>m</sup>		



TABLE IV.

Haversines.

s	11h 0m 165°		11h 4m 166°		11h 8m 167°		11h 12m 168°		11h 16m 169°		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 0	9.99254	<b>0.98296</b>	9.99350	<b>0.98515</b>	9.99440	<b>0.98719</b>	9.99523	<b>0.98907</b>	9.99599	<b>0.99081</b>	60
4 1	.99255	<b>0.98300</b>	.99352	<b>0.98518</b>	.99441	<b>0.98722</b>	.99524	<b>0.98910</b>	.99600	<b>0.99084</b>	56
8 2	.99257	<b>0.98304</b>	.99353	<b>0.98522</b>	.99443	<b>0.98725</b>	.99526	<b>0.98913</b>	.99602	<b>0.99087</b>	52
12 3	.99259	<b>0.98308</b>	.99355	<b>0.98525</b>	.99444	<b>0.98728</b>	.99527	<b>0.98916</b>	.99603	<b>0.99090</b>	48
16 4	9.99260	<b>0.98311</b>	9.99356	<b>0.98529</b>	9.99446	<b>0.98732</b>	9.99528	<b>0.98919</b>	9.99604	<b>0.99092</b>	44
20 5	.99262	<b>0.98315</b>	.99358	<b>0.98532</b>	.99447	<b>0.98735</b>	.99529	<b>0.98922</b>	.99605	<b>0.99095</b>	40
24 6	.99264	<b>0.98319</b>	.99359	<b>0.98536</b>	.99448	<b>0.98738</b>	.99531	<b>0.98925</b>	.99606	<b>0.99098</b>	36
28 7	.99265	<b>0.98323</b>	.99361	<b>0.98539</b>	.99450	<b>0.98741</b>	.99532	<b>0.98928</b>	.99608	<b>0.99101</b>	32
32 8	9.99267	<b>0.98326</b>	9.99362	<b>0.98543</b>	9.99451	<b>0.98745</b>	9.99533	<b>0.98931</b>	9.99609	<b>0.99103</b>	28
36 9	.99269	<b>0.98330</b>	.99364	<b>0.98546</b>	.99453	<b>0.98748</b>	.99535	<b>0.98934</b>	.99610	<b>0.99106</b>	24
40 10	.99270	<b>0.98334</b>	.99366	<b>0.98550</b>	.99454	<b>0.98751</b>	.99536	<b>0.98937</b>	.99611	<b>0.99109</b>	20
44 11	.99272	<b>0.98337</b>	.99367	<b>0.98553</b>	.99456	<b>0.98754</b>	.99537	<b>0.98940</b>	.99612	<b>0.99112</b>	16
48 12	9.99274	<b>0.98341</b>	9.99369	<b>0.98557</b>	9.99457	<b>0.98757</b>	9.99539	<b>0.98943</b>	9.99614	<b>0.99114</b>	12
52 13	.99275	<b>0.98345</b>	.99370	<b>0.98560</b>	.99458	<b>0.98761</b>	.99540	<b>0.98946</b>	.99615	<b>0.99117</b>	8
56 14	9.99277	<b>0.98349</b>	9.99372	<b>0.98564</b>	9.99460	<b>0.98764</b>	9.99541	<b>0.98949</b>	9.99616	<b>0.99120</b>	4
		12h 59m	12h 55m		12h 51m		12h 47m		12h 43m		
s	11h 1m 165°		11h 5m 166°		11h 9m 167°		11h 13m 168°		11h 17m 169°		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 15	9.99278	<b>0.98352</b>	9.99373	<b>0.98567</b>	9.99461	<b>0.98767</b>	9.99543	<b>0.98952</b>	9.99617	<b>0.99123</b>	60
4 16	.99280	<b>0.98356</b>	.99375	<b>0.98571</b>	.99463	<b>0.98770</b>	.99544	<b>0.98955</b>	.99618	<b>0.99125</b>	56
8 17	.99282	<b>0.98360</b>	.99376	<b>0.98574</b>	.99464	<b>0.98774</b>	.99545	<b>0.98958</b>	.99620	<b>0.99128</b>	52
12 18	.99283	<b>0.98363</b>	.99378	<b>0.98577</b>	.99465	<b>0.98777</b>	.99546	<b>0.98961</b>	.99621	<b>0.99131</b>	48
16 19	9.99285	<b>0.98367</b>	9.99379	<b>0.98581</b>	9.99467	<b>0.98780</b>	9.99548	<b>0.98964</b>	9.99622	<b>0.99133</b>	44
20 20	.99287	<b>0.98371</b>	.99381	<b>0.98584</b>	.99468	<b>0.98783</b>	.99549	<b>0.98967</b>	.99623	<b>0.99136</b>	40
24 21	.99288	<b>0.98374</b>	.99382	<b>0.98588</b>	.99470	<b>0.98786</b>	.99550	<b>0.98970</b>	.99624	<b>0.99139</b>	36
28 22	.99290	<b>0.98378</b>	.99384	<b>0.98591</b>	.99471	<b>0.98789</b>	.99552	<b>0.98973</b>	.99626	<b>0.99141</b>	32
32 23	9.99291	<b>0.98382</b>	9.99385	<b>0.98595</b>	9.99472	<b>0.98793</b>	9.99553	<b>0.98976</b>	9.99627	<b>0.99144</b>	28
36 24	.99293	<b>0.98385</b>	.99387	<b>0.98598</b>	.99474	<b>0.98796</b>	.99554	<b>0.98979</b>	.99628	<b>0.99147</b>	24
40 25	.99295	<b>0.98389</b>	.99388	<b>0.98601</b>	.99475	<b>0.98799</b>	.99555	<b>0.98982</b>	.99629	<b>0.99149</b>	20
44 26	.99296	<b>0.98393</b>	.99390	<b>0.98605</b>	.99477	<b>0.98802</b>	.99557	<b>0.98985</b>	.99630	<b>0.99152</b>	16
48 27	9.99298	<b>0.98396</b>	9.99391	<b>0.98608</b>	9.99478	<b>0.98805</b>	9.99558	<b>0.98987</b>	9.99631	<b>0.99155</b>	12
52 28	.99300	<b>0.98400</b>	.99393	<b>0.98611</b>	.99479	<b>0.98809</b>	.99559	<b>0.98990</b>	.99633	<b>0.99157</b>	8
56 29	9.99301	<b>0.98404</b>	9.99394	<b>0.98615</b>	9.99481	<b>0.98812</b>	9.99561	<b>0.98993</b>	9.99634	<b>0.99160</b>	4
		12h 58m	12h 54m		12h 50m		12h 46m		12h 42m		
s	11h 2m 165°		11h 6m 166°		11h 10m 167°		11h 14m 168°		11h 18m 169°		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 30	9.99303	<b>0.98407</b>	9.99396	<b>0.98619</b>	9.99482	<b>0.98815</b>	9.99562	<b>0.98996</b>	9.99635	<b>0.99163</b>	60
4 31	.99304	<b>0.98411</b>	.99397	<b>0.98622</b>	.99484	<b>0.98818</b>	.99563	<b>0.98999</b>	.99636	<b>0.99165</b>	56
8 32	.99306	<b>0.98415</b>	.99399	<b>0.98625</b>	.99485	<b>0.98821</b>	.99564	<b>0.99002</b>	.99637	<b>0.99168</b>	52
12 33	.99308	<b>0.98418</b>	.99400	<b>0.98629</b>	.99486	<b>0.98824</b>	.99566	<b>0.99005</b>	.99638	<b>0.99171</b>	48
16 34	9.99309	<b>0.98422</b>	9.99402	<b>0.98632</b>	9.99488	<b>0.98827</b>	9.99567	<b>0.99008</b>	9.99639	<b>0.99173</b>	44
20 35	.99311	<b>0.98426</b>	.99403	<b>0.98635</b>	.99489	<b>0.98830</b>	.99568	<b>0.99011</b>	.99641	<b>0.99176</b>	40
24 36	.99312	<b>0.98429</b>	.99405	<b>0.98639</b>	.99490	<b>0.98834</b>	.99569	<b>0.99014</b>	.99642	<b>0.99179</b>	36
28 37	.99314	<b>0.98433</b>	.99406	<b>0.98642</b>	.99492	<b>0.98837</b>	.99571	<b>0.99016</b>	.99643	<b>0.99181</b>	32
32 38	9.99316	<b>0.98436</b>	9.99408	<b>0.98646</b>	9.99493	<b>0.98840</b>	9.99572	<b>0.99019</b>	9.99644	<b>0.99184</b>	28
36 39	.99317	<b>0.98440</b>	.99409	<b>0.98649</b>	.99495	<b>0.98843</b>	.99573	<b>0.99022</b>	.99645	<b>0.99186</b>	24
40 40	.99319	<b>0.98444</b>	.99411	<b>0.98652</b>	.99496	<b>0.98846</b>	.99575	<b>0.99025</b>	.99646	<b>0.99189</b>	20
44 41	.99320	<b>0.98447</b>	.99412	<b>0.98656</b>	.99497	<b>0.98849</b>	.99576	<b>0.99028</b>	.99648	<b>0.99192</b>	16
48 42	9.99322	<b>0.98451</b>	9.99414	<b>0.98659</b>	9.99499	<b>0.98852</b>	9.99577	<b>0.99031</b>	9.99649	<b>0.99194</b>	12
52 43	.99324	<b>0.98454</b>	.99415	<b>0.98662</b>	.99500	<b>0.98855</b>	.99578	<b>0.99034</b>	.99650	<b>0.99197</b>	8
56 44	9.99325	<b>0.98458</b>	9.99417	<b>0.98666</b>	9.99501	<b>0.98858</b>	9.99580	<b>0.99036</b>	9.99651	<b>0.99199</b>	4
		12h 57m	12h 53m		12h 49m		12h 45m		12h 41m		
s	11h 3m 165°		11h 7m 166°		11h 11m 167°		11h 15m 168°		11h 19m 169°		s
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	
0 45	9.99327	<b>0.98462</b>	9.99418	<b>0.98669</b>	9.99503	<b>0.98862</b>	9.99581	<b>0.99039</b>	9.99652	<b>0.99202</b>	60
4 46	.99328	<b>0.98465</b>	.99420	<b>0.98672</b>	.99504	<b>0.98865</b>	.99582	<b>0.99042</b>	.99653	<b>0.99205</b>	56
8 47	.99330	<b>0.98469</b>	.99421	<b>0.98676</b>	.99505	<b>0.98868</b>	.99583	<b>0.99045</b>	.99654	<b>0.99207</b>	52
12 48	.99331	<b>0.98472</b>	.99422	<b>0.98679</b>	.99507	<b>0.98871</b>	.99584	<b>0.99048</b>	.99655	<b>0.99210</b>	48
16 49	9.99333	<b>0.98476</b>	9.99424	<b>0.98682</b>	9.99508	<b>0.98874</b>	9.99586	<b>0.99051</b>	9.99657	<b>0.99212</b>	44
20 50	.99335	<b>0.98479</b>	.99425	<b>0.98686</b>	.99510	<b>0.98877</b>	.99587	<b>0.99053</b>	.99658	<b>0.99215</b>	40
24 51	.99336	<b>0.98483</b>	.99427	<b>0.98689</b>	.99511	<b>0.98880</b>	.99588	<b>0.99056</b>	.99659	<b>0.99217</b>	36
28 52	.99338	<b>0.98487</b>	.99429	<b>0.98692</b>	.99512	<b>0.98883</b>	.99589	<b>0.99059</b>	.99660	<b>0.99220</b>	32
32 53	9.99339	<b>0.98490</b>	9.99430	<b>0.98696</b>	9.99514	<b>0.98886</b>	9.99591	<b>0.99062</b>	9.99661	<b>0.99223</b>	28
36 54	.99341	<b>0.98494</b>	.99431	<b>0.98699</b>	.99515	<b>0.98889</b>	.99592	<b>0.99065</b>	.99662	<b>0.99225</b>	24
40 55	.99342	<b>0.98497</b>	.99433	<b>0.98702</b>	.99516	<b>0.98892</b>	.99593	<b>0.99067</b>	.99663	<b>0.99228</b>	20
44 56	.99344	<b>0.98501</b>	.99434	<b>0.98705</b>	.99518	<b>0.98895</b>	.99594	<b>0.99070</b>	.99664	<b>0.99230</b>	16
48 57	9.99345	<b>0.98504</b>	9.99436	<b>0.98709</b>	9.99519	<b>0.98898</b>	9.99596	<b>0.99073</b>	9.99666	<b>0.99233</b>	12
52 58	.99347	<b>0.98508</b>	.99437	<b>0.98712</b>	.99520	<b>0.98901</b>	.99597	<b>0.99076</b>	.99667	<b>0.99235</b>	8
56 59	.99349	<b>0.98511</b>	.99438	<b>0.98715</b>	.99522	<b>0.98904</b>	.99598	<b>0.99079</b>	.99668	<b>0.99238</b>	4
60 60	9.99350	<b>0.98515</b>	9.99440	<b>0.98719</b>	9.99523	<b>0.98907</b>	9.99599	<b>0.99081</b>	9.99669	<b>0.99240</b>	0
		12h 56m	12h 52m		12h 48m		12h 44m		12h 40m		



TABLE IV.

Haversines.

s	11h 20m 170°		11h 24m 171°		11h 28m 172°		11h 32m 173°		11h 36m 174°		s		
	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.			
0	0	9.99669	0.99240	9.99732	0.99384	9.99788	0.99513	9.99838	0.99627	9.99881	0.99726	60	
4	1	.99670	.99243	.99733	.99387	.99789	.99515	.99839	.99629	.99882	.99728	56	
8	2	.99671	.99245	.99734	.99389	.99790	.99517	.99839	.99631	.99882	.99729	52	
12	3	.99672	.99248	.99735	.99391	.99791	.99519	.99840	.99633	.99883	.99731	48	
16	4	9.99673	0.99250	9.99736	0.99393	9.99792	0.99521	9.99841	0.99634	9.99884	0.99732	44	
20	5	.99674	.99253	.99737	.99396	.99793	.99523	.99842	.99636	.99884	.99734	40	
24	6	.99675	.99255	.99738	.99398	.99793	.99525	.99842	.99638	.99885	.99735	36	
28	7	.99677	.99258	.99739	.99400	.99794	.99527	.99843	.99640	.99885	.99737	32	
32	8	9.99678	0.99260	9.99740	0.99402	9.99795	0.99529	9.99844	0.99641	9.99886	0.99738	28	
36	9	.99679	.99263	.99741	.99405	.99796	.99531	.99845	.99643	.99887	.99740	24	
40	10	.99680	.99265	.99742	.99407	.99797	.99533	.99845	.99645	.99887	.99741	20	
44	11	.99681	.99268	.99743	.99409	.99798	.99535	.99846	.99647	.99888	.99743	16	
48	12	9.99682	0.99270	9.99744	0.99411	9.99799	0.99537	9.99847	0.99648	9.99889	0.99744	12	
52	13	.99683	.99273	.99745	.99414	.99800	.99539	.99848	.99650	.99889	.99746	8	
56	14	9.99684	0.99275	9.99746	0.99416	9.99800	0.99541	9.99848	0.99652	9.99890	0.99747	4	
		12h 39m		12h 35m		12h 31m		12h 27m		12h 23m			
s	'	11h 21m 170°		11h 25m 171°		11h 29m 172°		11h 33m 173°		11h 37m 174°		s	
0	15	9.99685	0.99278	9.99747	0.99418	9.99801	0.99543	9.99849	0.99653	9.99891	0.99748	60	
4	16	.99686	.99280	.99748	.99420	.99802	.99545	.99850	.99655	.99891	.99750	56	
8	17	.99687	.99283	.99748	.99422	.99803	.99547	.99851	.99657	.99892	.99751	52	
12	18	.99688	.99285	.99749	.99425	.99804	.99549	.99851	.99659	.99893	.99753	48	
16	19	9.99690	0.99288	9.99750	0.99427	9.99805	0.99551	9.99852	0.99660	9.99893	0.99754	44	
20	20	.99691	.99290	.99751	.99429	.99805	.99553	.99853	.99662	.99894	.99756	40	
24	21	.99692	.99293	.99752	.99431	.99806	.99555	.99854	.99664	.99894	.99757	36	
28	22	.99693	.99295	.99753	.99433	.99807	.99557	.99854	.99665	.99895	.99759	32	
32	23	9.99694	0.99297	9.99754	0.99436	9.99808	0.99559	9.99855	0.99667	9.99896	0.99760	28	
36	24	.99695	.99300	.99755	.99438	.99809	.99561	.99856	.99669	.99896	.99761	24	
40	25	.99696	.99302	.99756	.99440	.99810	.99563	.99857	.99670	.99897	.99763	20	
44	26	.99697	.99305	.99757	.99442	.99811	.99565	.99857	.99672	.99897	.99764	16	
48	27	9.99698	0.99307	9.99758	0.99444	9.99811	0.99567	9.99858	0.99674	9.99898	0.99766	12	
52	28	.99699	.99309	.99759	.99446	.99812	.99568	.99859	.99675	.99899	.99767	8	
56	29	9.99700	0.99312	9.99760	0.99449	9.99813	0.99570	9.99859	0.99677	9.99899	0.99768	4	
		12h 38m		12h 34m		12h 30m		12h 26m		12h 22m			
s	'	11h 22m 170°		11h 26m 171°		11h 30m 172°		11h 34m 173°		11h 38m 174°		s	
0	30	9.99701	0.99314	9.99761	0.99451	9.99814	0.99572	9.99860	0.99679	9.99900	0.99770	60	
4	31	.99702	.99317	.99762	.99453	.99815	.99574	.99861	.99680	.99901	.99771	56	
8	32	.99703	.99319	.99763	.99455	.99815	.99576	.99862	.99682	.99901	.99773	52	
12	33	.99704	.99321	.99764	.99457	.99816	.99578	.99862	.99684	.99902	.99774	48	
16	34	9.99705	0.99324	9.99765	0.99459	9.99817	0.99580	9.99863	0.99685	9.99902	0.99775	44	
20	35	.99706	.99326	.99766	.99461	.99818	.99582	.99864	.99687	.99903	.99777	40	
24	36	.99707	.99329	.99766	.99464	.99819	.99584	.99864	.99688	.99904	.99778	36	
28	37	.99708	.99331	.99767	.99466	.99820	.99585	.99865	.99690	.99904	.99780	32	
32	38	9.99710	0.99333	9.99768	0.99468	9.99820	0.99587	9.99866	0.99692	9.99905	0.99781	28	
36	39	.99711	.99336	.99769	.99470	.99821	.99589	.99867	.99693	.99905	.99782	24	
40	40	.99712	.99338	.99770	.99472	.99822	.99591	.99867	.99695	.99906	.99784	20	
44	41	.99713	.99340	.99771	.99474	.99823	.99593	.99868	.99696	.99906	.99785	16	
48	42	9.99714	0.99343	9.99772	0.99476	9.99824	0.99595	9.99869	0.99698	9.99907	0.99786	12	
52	43	.99715	.99345	.99773	.99478	.99824	.99597	.99869	.99700	.99908	.99788	8	
56	44	9.99716	0.99347	9.99774	0.99480	9.99825	0.99598	9.99870	0.99701	9.99908	0.99789	4	
		12h 37m		12h 33m		12h 29m		12h 25m		12h 21m			
s	'	11h 23m 170°		11h 27m 171°		11h 31m 172°		11h 35m 173°		11h 39m 174°		s	
0	45	9.99717	0.99350	9.99774	0.99483	9.99826	0.99600	9.99871	0.99703	9.99909	0.99790	60	
4	46	.99718	.99352	.99775	.99485	.99827	.99602	.99871	.99704	.99909	.99792	56	
8	47	.99719	.99354	.99776	.99487	.99828	.99604	.99872	.99706	.99910	.99793	52	
12	48	.99720	.99357	.99777	.99489	.99828	.99606	.99873	.99708	.99911	.99794	48	
16	49	9.99721	0.99359	9.99778	0.99491	9.99829	0.99608	9.99874	0.99709	9.99911	0.99796	44	
20	50	.99722	.99361	.99779	.99493	.99830	.99609	.99874	.99711	.99912	.99797	40	
24	51	.99723	.99364	.99780	.99495	.99831	.99611	.99875	.99712	.99912	.99798	36	
28	52	.99724	.99366	.99781	.99497	.99832	.99613	.99876	.99714	.99913	.99799	32	
32	53	9.99725	0.99368	9.99782	0.99499	9.99832	0.99615	9.99876	0.99715	9.99913	0.99801	28	
36	54	.99726	.99371	.99783	.99501	.99833	.99617	.99877	.99717	.99914	.99802	24	
40	55	.99727	.99373	.99784	.99503	.99834	.99618	.99878	.99719	.99915	.99803	20	
44	56	.99728	.99375	.99785	.99505	.99835	.99620	.99878	.99720	.99915	.99805	16	
48	57	9.99729	0.99378	9.99786	0.99507	9.99836	0.99622	9.99879	0.99722	9.99916	0.99806	12	
52	58	.99730	.99380	.99786	.99509	.99836	.99624	.99880	.99723	.99916	.99807	8	
56	59	.99731	.99382	.99787	.99511	.99837	.99626	.99880	.99725	.99917	.99808	4	
60	60	9.99732	0.99384	9.99788	0.99513	9.99838	0.99627	9.99881	0.99726	9.99917	0.99810	0	
		12h 36m		12h 32m		12h 28m		12h 24m		12h 20m			



TABLE IV.

Haversines.

		11h 40m 175°		11h 44m 176°		11h 48m 177°		11h 52m 178°		11h 56m 179°		
s	'	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	Log. Hav.	Nat. Hav.	s
0	0	9.99917	<b>.99810</b>	9.99947	<b>.99878</b>	9.99970	<b>.99931</b>	9.99987	<b>.99970</b>	9.99997	<b>.99992</b>	60
4	1	.99918	<b>.99811</b>	.99948	<b>.99879</b>	.99971	<b>.99932</b>	.99987	<b>.99971</b>	.99997	<b>.99993</b>	56
8	2	.99918	<b>.99812</b>	.99948	<b>.99880</b>	.99971	<b>.99933</b>	.99987	<b>.99971</b>	.99997	<b>.99993</b>	52
12	3	.99919	<b>.99814</b>	.99948	<b>.99881</b>	.99971	<b>.99934</b>	.99987	<b>.99971</b>	.99997	<b>.99993</b>	48
16	4	9.99919	<b>.99815</b>	9.99949	<b>.99882</b>	9.99972	<b>.99934</b>	9.99988	<b>.99972</b>	9.99997	<b>.99994</b>	44
20	5	.99920	<b>.99816</b>	.99949	<b>.99883</b>	.99972	<b>.99935</b>	.99988	<b>.99972</b>	.99997	<b>.99994</b>	40
24	6	.99921	<b>.99817</b>	.99950	<b>.99884</b>	.99972	<b>.99936</b>	.99988	<b>.99973</b>	.99997	<b>.99994</b>	36
28	7	.99921	<b>.99819</b>	.99950	<b>.99885</b>	.99973	<b>.99937</b>	.99988	<b>.99973</b>	.99997	<b>.99994</b>	32
32	8	9.99922	<b>.99820</b>	9.99951	<b>.99886</b>	9.99973	<b>.99937</b>	9.99988	<b>.99973</b>	9.99998	<b>.99994</b>	28
36	9	.99922	<b>.99821</b>	.99951	<b>.99887</b>	.99973	<b>.99938</b>	.99989	<b>.99974</b>	.99998	<b>.99995</b>	24
40	10	.99923	<b>.99822</b>	.99951	<b>.99888</b>	.99973	<b>.99939</b>	.99989	<b>.99974</b>	.99998	<b>.99995</b>	20
44	11	.99923	<b>.99823</b>	.99952	<b>.99889</b>	.99974	<b>.99940</b>	.99989	<b>.99975</b>	.99998	<b>.99995</b>	16
48	12	9.99924	<b>.99825</b>	9.99952	<b>.99890</b>	9.99974	<b>.99940</b>	9.99989	<b>.99975</b>	9.99998	<b>.99995</b>	12
52	13	.99924	<b>.99826</b>	.99953	<b>.99891</b>	.99974	<b>.99941</b>	.99989	<b>.99976</b>	.99998	<b>.99995</b>	8
56	14	9.99925	<b>.99827</b>	9.99953	<b>.99892</b>	9.99975	<b>.99942</b>	9.99990	<b>.99976</b>	9.99998	<b>.99996</b>	4
		12h 19m		12h 15m		12h 11m		12h 7m		12h 3m		
s	'	11h 41m 175°	11h 45m 176°	11h 49m 177°	11h 53m 178°	11h 57m 179°					s	
0	15	9.99925	<b>.99828</b>	9.99953	<b>.99893</b>	9.99975	<b>.99942</b>	9.99990	<b>.99977</b>	9.99998	<b>.99996</b>	60
4	16	.99926	<b>.99829</b>	.99954	<b>.99894</b>	.99975	<b>.99943</b>	.99990	<b>.99977</b>	.99998	<b>.99996</b>	56
8	17	.99926	<b>.99831</b>	.99954	<b>.99895</b>	.99976	<b>.99944</b>	.99990	<b>.99978</b>	.99998	<b>.99996</b>	52
12	18	.99927	<b>.99832</b>	.99954	<b>.99896</b>	.99976	<b>.99944</b>	.99990	<b>.99978</b>	.99998	<b>.99996</b>	48
16	19	9.99927	<b>.99833</b>	9.99955	<b>.99897</b>	9.99976	<b>.99945</b>	9.99991	<b>.99978</b>	9.99998	<b>.99996</b>	44
20	20	.99928	<b>.99834</b>	.99955	<b>.99898</b>	.99976	<b>.99946</b>	.99991	<b>.99979</b>	.99999	<b>.99997</b>	40
24	21	.99928	<b>.99835</b>	.99956	<b>.99899</b>	.99977	<b>.99947</b>	.99991	<b>.99979</b>	.99999	<b>.99997</b>	36
28	22	.99929	<b>.99837</b>	.99956	<b>.99900</b>	.99977	<b>.99947</b>	.99991	<b>.99980</b>	.99999	<b>.99997</b>	32
32	23	9.99929	<b>.99838</b>	9.99957	<b>.99900</b>	9.99977	<b>.99948</b>	9.99991	<b>.99980</b>	9.99999	<b>.99997</b>	28
36	24	.99930	<b>.99839</b>	.99957	<b>.99901</b>	.99978	<b>.99949</b>	.99992	<b>.99981</b>	.99999	<b>.99997</b>	24
40	25	.99931	<b>.99840</b>	.99958	<b>.99902</b>	.99978	<b>.99949</b>	.99992	<b>.99981</b>	.99999	<b>.99997</b>	20
44	26	.99931	<b>.99841</b>	.99958	<b>.99903</b>	.99978	<b>.99950</b>	.99992	<b>.99981</b>	.99999	<b>.99998</b>	16
48	27	9.99932	<b>.99842</b>	9.99958	<b>.99904</b>	9.99978	<b>.99950</b>	9.99992	<b>.99982</b>	9.99999	<b>.99998</b>	12
52	28	.99932	<b>.99844</b>	.99959	<b>.99905</b>	.99979	<b>.99951</b>	.99992	<b>.99982</b>	.99999	<b>.99998</b>	8
56	29	9.99933	<b>.99845</b>	9.99959	<b>.99906</b>	9.99979	<b>.99952</b>	9.99992	<b>.99982</b>	9.99999	<b>.99998</b>	4
		12h 18m		12h 14m		12h 10m		12h 6m		12h 2m		
s	'	11h 42m 175°	11h 46m 176°	11h 50m 177°	11h 54m 178°	11h 58m 179°					s	
0	30	9.99933	<b>.99846</b>	9.99959	<b>.99907</b>	9.99979	<b>.99952</b>	9.99993	<b>.99983</b>	9.99999	<b>.99998</b>	60
4	31	.99934	<b>.99847</b>	.99960	<b>.99908</b>	.99980	<b>.99953</b>	.99993	<b>.99983</b>	.99999	<b>.99998</b>	56
8	32	.99934	<b>.99848</b>	.99960	<b>.99909</b>	.99980	<b>.99954</b>	.99993	<b>.99984</b>	.99999	<b>.99998</b>	52
12	33	.99935	<b>.99849</b>	.99961	<b>.99909</b>	.99980	<b>.99954</b>	.99993	<b>.99984</b>	.99999	<b>.99998</b>	48
16	34	9.99935	<b>.99850</b>	9.99961	<b>.99910</b>	9.99980	<b>.99955</b>	9.99993	<b>.99984</b>	9.99999	<b>.99999</b>	44
20	35	.99935	<b>.99851</b>	.99961	<b>.99911</b>	.99981	<b>.99956</b>	.99993	<b>.99985</b>	.99999	<b>.99999</b>	40
24	36	.99936	<b>.99853</b>	.99962	<b>.99912</b>	.99981	<b>.99956</b>	.99994	<b>.99985</b>	9.99999	<b>.99999</b>	36
28	37	.99936	<b>.99854</b>	.99962	<b>.99913</b>	.99981	<b>.99957</b>	.99994	<b>.99985</b>	0.00000	<b>.99999</b>	32
32	38	9.99937	<b>.99855</b>	9.99963	<b>.99914</b>	9.99981	<b>.99957</b>	9.99994	<b>.99986</b>	0.00000	<b>.99999</b>	28
36	39	.99937	<b>.99856</b>	.99963	<b>.99915</b>	.99982	<b>.99958</b>	.99994	<b>.99986</b>	.00000	<b>.99999</b>	24
40	40	.99938	<b>.99857</b>	.99963	<b>.99915</b>	.99982	<b>.99959</b>	.99994	<b>.99986</b>	.00000	<b>.99999</b>	20
44	41	.99938	<b>.99858</b>	.99964	<b>.99916</b>	.99982	<b>.99959</b>	.99994	<b>.99987</b>	.00000	<b>.99999</b>	16
48	42	9.99939	<b>.99859</b>	9.99964	<b>.99917</b>	9.99983	<b>.99960</b>	9.99994	<b>.99987</b>	0.00000	<b>.99999</b>	12
52	43	.99939	<b>.99860</b>	.99964	<b>.99918</b>	.99983	<b>.99960</b>	.99995	<b>.99987</b>	.00000	<b>.99999</b>	8
56	44	9.99940	<b>.99861</b>	9.99965	<b>.99919</b>	9.99983	<b>.99961</b>	9.99995	<b>.99988</b>	0.00000	<b>.99999</b>	4
		12h 17m		12h 13m		12h 9m		12h 5m		12h 1m		
s	'	11h 43m 175°	11h 47m 176°	11h 51m 177°	11h 55m 178°	11h 59m 179°					s	
0	45	9.99940	<b>.99863</b>	9.99965	<b>.99920</b>	9.99983	<b>.99961</b>	9.99995	<b>.99988</b>	0.00000	<b>1.00000</b>	60
4	46	.99941	<b>.99864</b>	.99965	<b>.99920</b>	.99983	<b>.99962</b>	.99995	<b>.99988</b>	.00000	<b>.00000</b>	56
8	47	.99941	<b>.99865</b>	.99966	<b>.99921</b>	.99984	<b>.99963</b>	.99995	<b>.99989</b>	.00000	<b>.00000</b>	52
12	48	.99942	<b>.99866</b>	.99966	<b>.99922</b>	.99984	<b>.99963</b>	.99995	<b>.99989</b>	.00000	<b>.00000</b>	48
16	49	9.99942	<b>.99867</b>	9.99966	<b>.99923</b>	9.99984	<b>.99964</b>	9.99995	<b>.99989</b>	0.00000	<b>1.00000</b>	44
20	50	.99943	<b>.99868</b>	.99967	<b>.99924</b>	.99984	<b>.99964</b>	.99996	<b>.99990</b>	.00000	<b>.00000</b>	40
24	51	.99943	<b>.99869</b>	.99967	<b>.99924</b>	.99985	<b>.99965</b>	.99996	<b>.99990</b>	.00000	<b>.00000</b>	36
28	52	.99943	<b>.99870</b>	.99968	<b>.99925</b>	.99985	<b>.99965</b>	.99996	<b>.99990</b>	.00000	<b>.00000</b>	32
32	53	9.99944	<b>.99871</b>	9.99968	<b>.99926</b>	9.99985	<b>.99966</b>	9.99996	<b>.99991</b>	0.00000	<b>1.00000</b>	28
36	54	.99944	<b>.99872</b>	.99968	<b>.99927</b>	.99985	<b>.99966</b>	.99996	<b>.99991</b>	.00000	<b>.00000</b>	24
40	55	.99945	<b>.99873</b>	.99969	<b>.99928</b>	.99986	<b>.99967</b>	.99996	<b>.99991</b>	.00000	<b>.00000</b>	20
44	56	.99945	<b>.99874</b>	.99969	<b>.99928</b>	.99986	<b>.99967</b>	.99996	<b>.99991</b>	.00000	<b>.00000</b>	16
48	57	9.99946	<b>.99875</b>	9.99969	<b>.99929</b>	9.99986	<b>.99968</b>	9.99996	<b>.99992</b>	0.00000	<b>1.00000</b>	12
52	58	.99946	<b>.99876</b>	.99970	<b>.99930</b>	.99986	<b>.99969</b>	.99996	<b>.99992</b>	.00000	<b>.00000</b>	8
56	59	.99947	<b>.99877</b>	.99970	<b>.99931</b>	.99987	<b>.99969</b>	.99997	<b>.99992</b>	.00000	<b>.00000</b>	4
60	60	9.99947	<b>.99878</b>	9.99970	<b>.99931</b>	9.99987	<b>.99970</b>	9.99997	<b>.99992</b>	0.00000	<b>1.00000</b>	0
		12h 16m		12h 12m		12h 8m		12h 4m		12h 0m		





## TO FIND THE HOUR ANGLE OF CROSSING THE PRIME VERTICAL

Mark the latitude on the latitude scale at the left-hand boundary and, with a pair of compasses, take out the horizontal distance from that point to the curve whose number represents the declination. Apply this distance to the scale of hour angles, and the resulting reading, taken in the same manner as the divisions and proportional parts are read from the ordinary diagonal scale of equal parts, will be the hour angle of crossing the prime vertical.

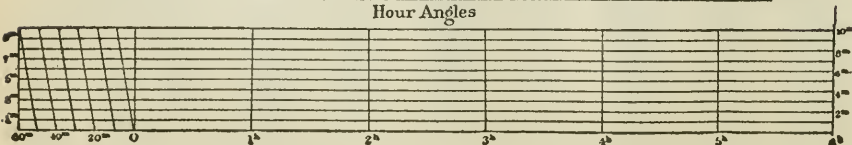
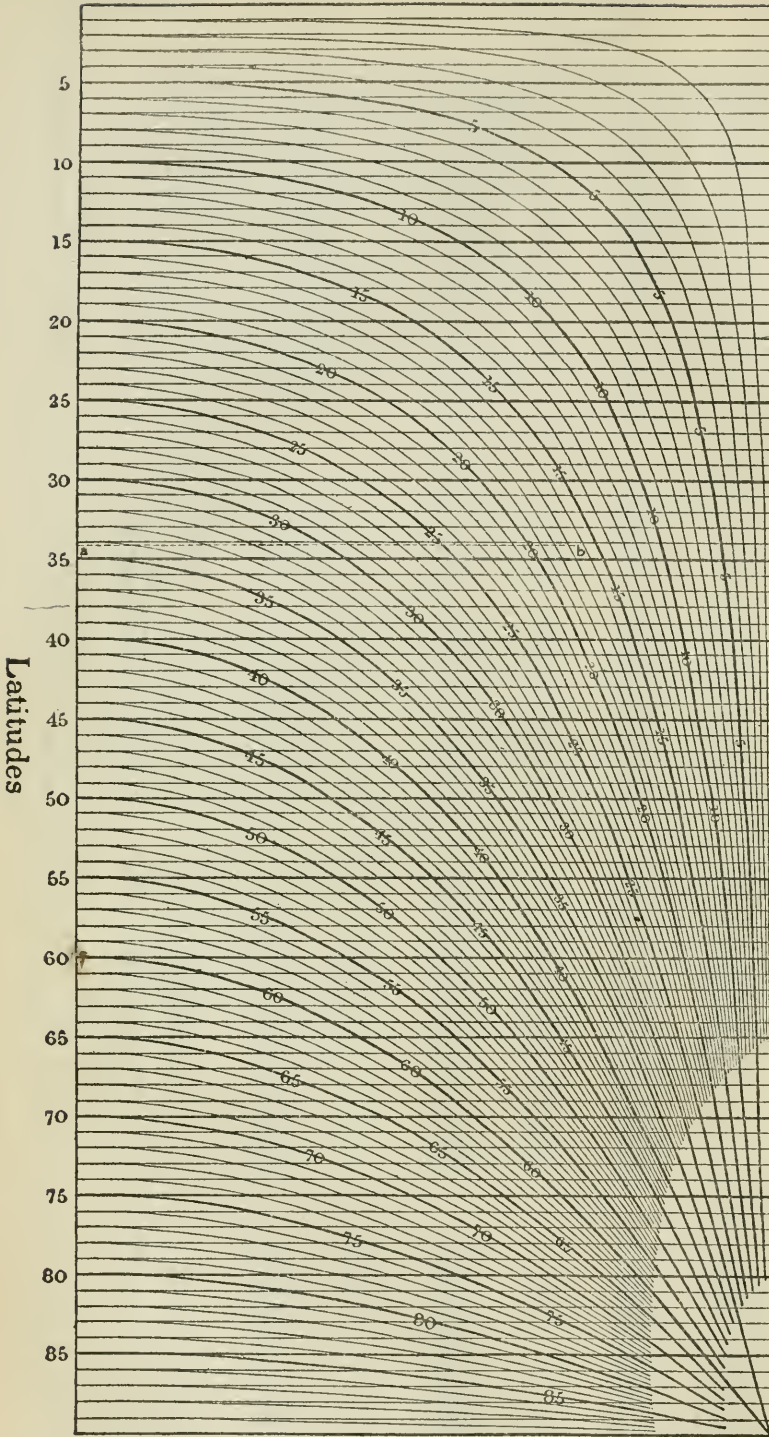
### ILLUSTRATION

From the second example at the beginning of this book—

L, the latitude = S.  $34^{\circ} 10'$

d, the declination = S.  $16^{\circ} 36'$

The line of dashes (a b) indicates the horizontal distance from (a), the point on the latitude scale marking the latitude  $34^{\circ} 10'$  to (b), the point between the declination curve  $16^{\circ}$  and the declination curve  $17^{\circ}$  marking the declination  $16^{\circ} 36'$ . The distance (a b), being applied to the scale of hour angles, gives the reading  $4^{\text{h}} 16^{\text{m}}$  as the value of the hour angle of crossing the prime vertical.



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## TABLE V

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# FOR FINDING THE AZIMUTH

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### RULE.

Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

### MARKING THE AZIMUTH.

The azimuth found from the table is always marked east (E.) or west (W.) according as the observed body is to the eastward or westward of the meridian of the observer.

If the latitude and declination are of different name the azimuth is marked from the pole of opposite name to the latitude.

If the latitude and declination are of the same name and the latitude is less than the declination, the azimuth is marked from the pole of the same name as the latitude. If the latitude and declination are of the same name and the latitude is greater than the declination, the azimuth is marked from the pole of the same name as the latitude when the hour-angle is greater than the hour-angle of crossing the prime vertical, and from the pole of opposite name when the hour-angle is less than the hour-angle of crossing the prime vertical. The hour-angle of crossing the prime vertical may be found from the diagram facing this page.

### ILLUSTRATION.

From the first example worked at the beginning of this book—

$d$ , the declination = S.  $21^{\circ} 19'$ .

$t$ , the hour-angle =  $3^h 30^m 11^s$ .

$h$ , the calculated altitude =  $17^{\circ} 53'$ .

Take out the tabulated number corresponding to the declination  $21^{\circ} 19'$  and the hour-angle  $3^h 30^m$ , which is 9.86885. Then in that declination column which has at its head a value equal to the altitude,  $17^{\circ} 53'$  or, to the nearest degree,  $18^{\circ}$ , find the number 9.86885 again, and opposite to it in the hour-angle column will be  $51^{\circ}$ , which is the azimuth reckoned from the south pole toward the eastward, S.  $51^{\circ}$  E.



TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.			
		0° 00'	0° 30'	1° 00'	1° 30'	2° 00'	2° 30'	3° 00'	3° 30'	4° 00'	4° 30'	5° 00'	5° 30'			6° 00'	6° 30'
<i>h.</i>	<i>m.</i>													<i>h.</i>	<i>m.</i>		
0	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	0
0	4	8.24186	8.24179	8.24171	8.24165	8.24160	8.24155	8.24150	8.24145	8.24140	8.24135	8.24130	8.24125	8.24120	8.24115	0	4
0	8	8.54280	8.54275	8.54270	8.54265	8.54260	8.54255	8.54250	8.54245	8.54240	8.54235	8.54230	8.54225	8.54220	8.54215	0	8
0	12	8.71880	8.71878	8.71876	8.71874	8.71872	8.71870	8.71868	8.71866	8.71864	8.71862	8.71860	8.71858	8.71856	8.71854	0	12
0	16	8.84358	8.84356	8.84354	8.84352	8.84350	8.84348	8.84346	8.84344	8.84342	8.84340	8.84338	8.84336	8.84334	8.84332	0	16
0	20	8.94030	8.94028	8.94026	8.94024	8.94022	8.94020	8.94018	8.94016	8.94014	8.94012	8.94010	8.94008	8.94006	8.94004	0	20
0	24	8.91023	8.91021	8.91019	8.91017	8.91015	8.91013	8.91011	8.91009	8.91007	8.91005	8.91003	8.91001	8.90999	8.90997	0	24
0	28	8.08590	8.08587	8.08584	8.08582	8.08580	8.08578	8.08576	8.08574	8.08572	8.08570	8.08568	8.08566	8.08564	8.08562	0	28
0	32	8.14356	8.14354	8.14352	8.14350	8.14348	8.14346	8.14344	8.14342	8.14340	8.14338	8.14336	8.14334	8.14332	8.14330	0	32
0	36	8.19433	8.19431	8.19429	8.19427	8.19425	8.19423	8.19421	8.19419	8.19417	8.19415	8.19413	8.19411	8.19409	8.19407	0	36
0	40	8.23677	8.23665	8.23663	8.23661	8.23659	8.23657	8.23655	8.23653	8.23651	8.23649	8.23647	8.23645	8.23643	8.23641	0	40
0	44	8.28060	8.28058	8.28056	8.28054	8.28052	8.28050	8.28048	8.28046	8.28044	8.28042	8.28040	8.28038	8.28036	8.28034	0	44
0	48	8.31788	8.31786	8.31784	8.31782	8.31780	8.31778	8.31776	8.31774	8.31772	8.31770	8.31768	8.31766	8.31764	8.31762	0	48
0	52	8.35209	8.35207	8.35205	8.35203	8.35201	8.35199	8.35197	8.35195	8.35193	8.35191	8.35189	8.35187	8.35185	8.35183	0	52
0	56	8.38368	8.38366	8.38364	8.38362	8.38360	8.38358	8.38356	8.38354	8.38352	8.38350	8.38348	8.38346	8.38344	8.38342	0	56
1	00	8.41300	8.41298	8.41296	8.41294	8.41292	8.41290	8.41288	8.41286	8.41284	8.41282	8.41280	8.41278	8.41276	8.41274	1	00
1	04	8.44034	8.44032	8.44030	8.44028	8.44026	8.44024	8.44022	8.44020	8.44018	8.44016	8.44014	8.44012	8.44010	8.44008	1	04
1	08	8.46504	8.46502	8.46500	8.46498	8.46496	8.46494	8.46492	8.46490	8.46488	8.46486	8.46484	8.46482	8.46480	8.46478	1	08
1	12	8.48998	8.48996	8.48994	8.48992	8.48990	8.48988	8.48986	8.48984	8.48982	8.48980	8.48978	8.48976	8.48974	8.48972	1	12
1	16	8.51264	8.51262	8.51260	8.51258	8.51256	8.51254	8.51252	8.51250	8.51248	8.51246	8.51244	8.51242	8.51240	8.51238	1	16
1	20	8.53405	8.53403	8.53401	8.53399	8.53397	8.53395	8.53393	8.53391	8.53389	8.53387	8.53385	8.53383	8.53381	8.53379	1	20
1	24	8.55433	8.55431	8.55429	8.55427	8.55425	8.55423	8.55421	8.55419	8.55417	8.55415	8.55413	8.55411	8.55409	8.55407	1	24
1	28	8.57358	8.57356	8.57354	8.57352	8.57350	8.57348	8.57346	8.57344	8.57342	8.57340	8.57338	8.57336	8.57334	8.57332	1	28
1	32	8.59188	8.59186	8.59184	8.59182	8.59180	8.59178	8.59176	8.59174	8.59172	8.59170	8.59168	8.59166	8.59164	8.59162	1	32
1	36	8.60931	8.60929	8.60927	8.60925	8.60923	8.60921	8.60919	8.60917	8.60915	8.60913	8.60911	8.60909	8.60907	8.60905	1	36
1	40	8.62595	8.62593	8.62591	8.62589	8.62587	8.62585	8.62583	8.62581	8.62579	8.62577	8.62575	8.62573	8.62571	8.62569	1	40
1	44	8.64184	8.64182	8.64180	8.64178	8.64176	8.64174	8.64172	8.64170	8.64168	8.64166	8.64164	8.64162	8.64160	8.64158	1	44
1	48	8.65705	8.65703	8.65701	8.65699	8.65697	8.65695	8.65693	8.65691	8.65689	8.65687	8.65685	8.65683	8.65681	8.65679	1	48
1	52	8.67161	8.67159	8.67157	8.67155	8.67153	8.67151	8.67149	8.67147	8.67145	8.67143	8.67141	8.67139	8.67137	8.67135	1	52
1	56	8.68557	8.68555	8.68553	8.68551	8.68549	8.68547	8.68545	8.68543	8.68541	8.68539	8.68537	8.68535	8.68533	8.68531	1	56
2	00	8.69895	8.69893	8.69891	8.69889	8.69887	8.69885	8.69883	8.69881	8.69879	8.69877	8.69875	8.69873	8.69871	8.69869	2	00
2	04	8.71184	8.71182	8.71180	8.71178	8.71176	8.71174	8.71172	8.71170	8.71168	8.71166	8.71164	8.71162	8.71160	8.71158	2	04
2	08	8.72421	8.72419	8.72417	8.72415	8.72413	8.72411	8.72409	8.72407	8.72405	8.72403	8.72401	8.72399	8.72397	8.72395	2	08
2	12	8.73611	8.73609	8.73607	8.73605	8.73603	8.73601	8.73599	8.73597	8.73595	8.73593	8.73591	8.73589	8.73587	8.73585	2	12
2	16	8.74756	8.74754	8.74752	8.74750	8.74748	8.74746	8.74744	8.74742	8.74740	8.74738	8.74736	8.74734	8.74732	8.74730	2	16
2	20	8.75857	8.75855	8.75853	8.75851	8.75849	8.75847	8.75845	8.75843	8.75841	8.75839	8.75837	8.75835	8.75833	8.75831	2	20
2	24	8.76922	8.76920	8.76918	8.76916	8.76914	8.76912	8.76910	8.76908	8.76906	8.76904	8.76902	8.76900	8.76898	8.76896	2	24
2	28	8.77946	8.77944	8.77942	8.77940	8.77938	8.77936	8.77934	8.77932	8.77930	8.77928	8.77926	8.77924	8.77922	8.77920	2	28
2	32	8.78934	8.78932	8.78930	8.78928	8.78926	8.78924	8.78922	8.78920	8.78918	8.78916	8.78914	8.78912	8.78910	8.78908	2	32
2	36	8.79887	8.79885	8.79883	8.79881	8.79879	8.79877	8.79875	8.79873	8.79871	8.79869	8.79867	8.79865	8.79863	8.79861	2	36
2	40	8.80805	8.80803	8.80801	8.80799	8.80797	8.80795	8.80793	8.80791	8.80789	8.80787	8.80785	8.80783	8.80781	8.80779	2	40
2	44	8.81694	8.81692	8.81690	8.81688	8.81686	8.81684	8.81682	8.81680	8.81678	8.81676	8.81674	8.81672	8.81670	8.81668	2	44
2	48	8.82557	8.82555	8.82553	8.82551	8.82549	8.82547	8.82545	8.82543	8.82541	8.82539	8.82537	8.82535	8.82533	8.82531	2	48
2	52	8.83378	8.83376	8.83374	8.83372	8.83370	8.83368	8.83366	8.83364	8.83362	8.83360	8.83358	8.83356	8.83354	8.83352	2	52
2	56	8.84177	8.84175	8.84173	8.84171	8.84169	8.84167	8.84165	8.84163	8.84161	8.84159	8.84157	8.84155	8.84153	8.84151	2	56
3	00	8.84949	8.84947	8.84945	8.84943	8.84941	8.84939	8.84937	8.84935	8.84933	8.84931	8.84929	8.84927	8.84925	8.84923	3	00

NOTE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.





TABLE V.  
The Finding of the Azimuth.

RULE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the declination column, will be the required azimuth.

Hour Angle.		Declination.												Hour Angle.			
<i>h. m.</i>	<i>°</i>	6° 30'	7° 00'	7° 30'	8° 00'	8° 30'	9° 00'	9° 30'	10° 00'	10° 30'	11° 00'	11° 30'	12° 00'	12° 30'	13° 00'	<i>°</i>	<i>m.</i>
0	0	8.23906	8.23861	8.23813	8.23761	8.23706	8.23648	8.23586	8.23521	8.23453	8.23381	8.23305	8.23226	8.23144	8.23058	0	0
0	1	8.24006	8.23959	8.23911	8.23858	8.23800	8.23737	8.23673	8.23608	8.23543	8.23477	8.23408	8.23335	8.23258	8.23176	1	04
0	2	8.24106	8.24058	8.24010	8.23956	8.23897	8.23833	8.23768	8.23703	8.23638	8.23572	8.23504	8.23431	8.23354	8.23272	2	08
0	3	8.24206	8.24157	8.24108	8.24053	8.23994	8.23930	8.23865	8.23800	8.23735	8.23669	8.23601	8.23528	8.23451	8.23369	3	12
0	4	8.24306	8.24256	8.24206	8.24151	8.24092	8.24028	8.23963	8.23898	8.23833	8.23767	8.23700	8.23633	8.23556	8.23474	4	16
0	5	8.24406	8.24355	8.24304	8.24248	8.24189	8.24125	8.24060	8.23995	8.23930	8.23864	8.23797	8.23730	8.23653	8.23571	5	20
0	6	8.24506	8.24454	8.24402	8.24345	8.24286	8.24222	8.24157	8.24092	8.24027	8.23961	8.23894	8.23827	8.23750	8.23668	6	24
0	7	8.24606	8.24553	8.24500	8.24442	8.24383	8.24319	8.24254	8.24189	8.24124	8.24058	8.23991	8.23924	8.23847	8.23765	7	28
0	8	8.24706	8.24652	8.24600	8.24541	8.24482	8.24418	8.24353	8.24288	8.24223	8.24157	8.24090	8.24023	8.23946	8.23864	8	32
0	9	8.24806	8.24751	8.24700	8.24641	8.24582	8.24518	8.24453	8.24388	8.24323	8.24257	8.24190	8.24123	8.24046	8.23964	9	36
0	10	8.24906	8.24850	8.24800	8.24741	8.24682	8.24618	8.24553	8.24488	8.24423	8.24357	8.24290	8.24223	8.24146	8.24064	10	40
0	11	8.25006	8.24949	8.24900	8.24841	8.24782	8.24718	8.24653	8.24588	8.24523	8.24457	8.24390	8.24323	8.24246	8.24164	11	44
0	12	8.25106	8.25048	8.25000	8.24941	8.24882	8.24818	8.24753	8.24688	8.24623	8.24557	8.24490	8.24423	8.24346	8.24264	12	48
0	13	8.25206	8.25147	8.25100	8.25041	8.24982	8.24918	8.24853	8.24788	8.24723	8.24657	8.24590	8.24523	8.24446	8.24364	13	52
0	14	8.25306	8.25246	8.25200	8.25141	8.25082	8.25018	8.24953	8.24888	8.24823	8.24757	8.24690	8.24623	8.24546	8.24464	14	56
0	15	8.25406	8.25345	8.25300	8.25241	8.25182	8.25118	8.25053	8.24988	8.24923	8.24857	8.24790	8.24723	8.24646	8.24564	15	00
0	16	8.25506	8.25444	8.25400	8.25341	8.25282	8.25218	8.25153	8.25088	8.25023	8.24957	8.24890	8.24823	8.24746	8.24664	16	04
0	17	8.25606	8.25543	8.25500	8.25441	8.25382	8.25318	8.25253	8.25188	8.25123	8.25057	8.24990	8.24923	8.24846	8.24764	17	08
0	18	8.25706	8.25642	8.25600	8.25541	8.25482	8.25418	8.25353	8.25288	8.25223	8.25157	8.25090	8.25023	8.24946	8.24864	18	12
0	19	8.25806	8.25741	8.25700	8.25641	8.25582	8.25518	8.25453	8.25388	8.25323	8.25257	8.25190	8.25123	8.25046	8.24964	19	16
0	20	8.25906	8.25840	8.25800	8.25741	8.25682	8.25618	8.25553	8.25488	8.25423	8.25357	8.25290	8.25223	8.25146	8.25064	20	20
0	21	8.26006	8.25939	8.25900	8.25841	8.25782	8.25718	8.25653	8.25588	8.25523	8.25457	8.25390	8.25323	8.25246	8.25164	21	24
0	22	8.26106	8.26038	8.26000	8.25941	8.25882	8.25818	8.25753	8.25688	8.25623	8.25557	8.25490	8.25423	8.25346	8.25264	22	28
0	23	8.26206	8.26137	8.26100	8.26041	8.25982	8.25918	8.25853	8.25788	8.25723	8.25657	8.25590	8.25523	8.25446	8.25364	23	32
0	24	8.26306	8.26235	8.26200	8.26141	8.26082	8.26018	8.25953	8.25888	8.25823	8.25757	8.25690	8.25623	8.25546	8.25464	24	36
0	25	8.26406	8.26333	8.26300	8.26241	8.26182	8.26118	8.26053	8.25988	8.25923	8.25857	8.25790	8.25723	8.25646	8.25564	25	40
0	26	8.26506	8.26431	8.26400	8.26341	8.26282	8.26218	8.26153	8.26088	8.26023	8.25957	8.25890	8.25823	8.25746	8.25664	26	44
0	27	8.26606	8.26529	8.26500	8.26441	8.26382	8.26318	8.26253	8.26188	8.26123	8.26057	8.25990	8.25923	8.25846	8.25764	27	48
0	28	8.26706	8.26627	8.26600	8.26541	8.26482	8.26418	8.26353	8.26288	8.26223	8.26157	8.26090	8.26023	8.25946	8.25864	28	52
0	29	8.26806	8.26725	8.26700	8.26641	8.26582	8.26518	8.26453	8.26388	8.26323	8.26257	8.26190	8.26123	8.26046	8.25964	29	56
0	30	8.26906	8.26823	8.26800	8.26741	8.26682	8.26618	8.26553	8.26488	8.26423	8.26357	8.26290	8.26223	8.26146	8.26064	30	00
0	31	8.27006	8.26921	8.26900	8.26841	8.26782	8.26718	8.26653	8.26588	8.26523	8.26457	8.26390	8.26323	8.26246	8.26164	31	04
0	32	8.27106	8.27019	8.27000	8.26941	8.26882	8.26818	8.26753	8.26688	8.26623	8.26557	8.26490	8.26423	8.26346	8.26264	32	08
0	33	8.27206	8.27117	8.27100	8.27041	8.26982	8.26918	8.26853	8.26788	8.26723	8.26657	8.26590	8.26523	8.26446	8.26364	33	12
0	34	8.27306	8.27215	8.27200	8.27141	8.27082	8.27018	8.26953	8.26888	8.26823	8.26757	8.26690	8.26623	8.26546	8.26464	34	16
0	35	8.27406	8.27313	8.27300	8.27241	8.27182	8.27118	8.27053	8.26988	8.26923	8.26857	8.26790	8.26723	8.26646	8.26564	35	20
0	36	8.27506	8.27411	8.27400	8.27341	8.27282	8.27218	8.27153	8.27088	8.27023	8.26957	8.26890	8.26823	8.26746	8.26664	36	24
0	37	8.27606	8.27509	8.27500	8.27441	8.27382	8.27318	8.27253	8.27188	8.27123	8.27057	8.26990	8.26923	8.26846	8.26764	37	28
0	38	8.27706	8.27607	8.27600	8.27541	8.27482	8.27418	8.27353	8.27288	8.27223	8.27157	8.27090	8.27023	8.26946	8.26864	38	32
0	39	8.27806	8.27705	8.27700	8.27641	8.27582	8.27518	8.27453	8.27388	8.27323	8.27257	8.27190	8.27123	8.27046	8.26964	39	36
0	40	8.27906	8.27803	8.27800	8.27741	8.27682	8.27618	8.27553	8.27488	8.27423	8.27357	8.27290	8.27223	8.27146	8.27064	40	40
0	41	8.28006	8.27901	8.27900	8.27841	8.27782	8.27718	8.27653	8.27588	8.27523	8.27457	8.27390	8.27323	8.27246	8.27164	41	44
0	42	8.28106	8.28000	8.28000	8.27941	8.27882	8.27818	8.27753	8.27688	8.27623	8.27557	8.27490	8.27423	8.27346	8.27264	42	48
0	43	8.28206	8.28100	8.28100	8.28041	8.27982	8.27918	8.27853	8.27788	8.27723	8.27657	8.27590	8.27523	8.27446	8.27364	43	52
0	44	8.28306	8.28200	8.28200	8.28141	8.28082	8.28018	8.27953	8.27888	8.27823	8.27757	8.27690	8.27623	8.27546	8.27464	44	56
0	45	8.28406	8.28300	8.28300	8.28241	8.28182	8.28118	8.28053	8.27988	8.27923	8.27857	8.27790	8.27723	8.27646	8.27564	45	00
3	00	8.28506	8.28400	8.28400	8.28341	8.28282	8.28218	8.28153	8.28088	8.28023	8.27957	8.27890	8.27823	8.27746	8.27664	3	00

TABLE V.  
The Finding of the Azimuth.

Hour Angle, h. m.	Declination.													
	6° 30'	7° 00'	7° 30'	8° 00'	8° 30'	9° 00'	9° 30'	10° 00'	10° 30'	11° 00'	11° 30'	12° 00'	12° 30'	13° 00'
0	9.84669	9.84624	9.84576	9.84524	9.84469	9.84411	9.84349	9.84284	9.84216	9.84144	9.84068	9.83989	9.83907	9.83821
1	9.84613	9.84568	9.84520	9.84468	9.84413	9.84355	9.84293	9.84228	9.84160	9.84088	9.84012	9.83931	9.83848	9.83762
2	9.84557	9.84512	9.84464	9.84412	9.84357	9.84299	9.84237	9.84172	9.84104	9.84032	9.83957	9.83876	9.83793	9.83707
3	9.84501	9.84456	9.84408	9.84356	9.84301	9.84243	9.84181	9.84116	9.84048	9.83976	9.83901	9.83820	9.83737	9.83651
4	9.84445	9.84400	9.84352	9.84300	9.84245	9.84187	9.84125	9.84060	9.83992	9.83920	9.83845	9.83764	9.83681	9.83595
5	9.84389	9.84344	9.84296	9.84244	9.84189	9.84131	9.84069	9.84004	9.83936	9.83864	9.83790	9.83709	9.83626	9.83540
6	9.84333	9.84288	9.84240	9.84188	9.84133	9.84075	9.84013	9.83948	9.83880	9.83808	9.83734	9.83653	9.83570	9.83484
7	9.84277	9.84232	9.84184	9.84132	9.84077	9.84019	9.83957	9.83892	9.83824	9.83752	9.83679	9.83598	9.83515	9.83429
8	9.84221	9.84176	9.84128	9.84076	9.84021	9.83963	9.83901	9.83836	9.83768	9.83696	9.83623	9.83542	9.83459	9.83373
9	9.84165	9.84120	9.84072	9.84020	9.83965	9.83907	9.83845	9.83780	9.83712	9.83640	9.83567	9.83486	9.83403	9.83317
10	9.84109	9.84064	9.84016	9.83964	9.83909	9.83851	9.83789	9.83724	9.83656	9.83584	9.83511	9.83430	9.83347	9.83261
11	9.84053	9.84008	9.83960	9.83908	9.83853	9.83795	9.83733	9.83668	9.83600	9.83528	9.83455	9.83374	9.83291	9.83205
12	9.84000	9.83954	9.83906	9.83854	9.83799	9.83741	9.83679	9.83614	9.83546	9.83474	9.83401	9.83320	9.83237	9.83151
13	9.83944	9.83898	9.83850	9.83798	9.83743	9.83685	9.83623	9.83558	9.83490	9.83418	9.83345	9.83264	9.83181	9.83095
14	9.83889	9.83843	9.83795	9.83743	9.83687	9.83629	9.83567	9.83502	9.83434	9.83362	9.83290	9.83209	9.83126	9.83040
15	9.83833	9.83787	9.83739	9.83687	9.83631	9.83573	9.83511	9.83446	9.83378	9.83306	9.83234	9.83153	9.83070	9.82984
16	9.83777	9.83731	9.83683	9.83631	9.83575	9.83517	9.83455	9.83390	9.83322	9.83250	9.83178	9.83097	9.83014	9.82928
17	9.83721	9.83675	9.83627	9.83575	9.83519	9.83461	9.83400	9.83335	9.83267	9.83195	9.83123	9.83042	9.82959	9.82873
18	9.83665	9.83619	9.83571	9.83519	9.83463	9.83405	9.83343	9.83278	9.83210	9.83138	9.83066	9.82985	9.82902	9.82816
19	9.83609	9.83563	9.83515	9.83463	9.83407	9.83349	9.83287	9.83222	9.83154	9.83082	9.83010	9.82929	9.82846	9.82760
20	9.83553	9.83507	9.83459	9.83407	9.83351	9.83293	9.83231	9.83166	9.83098	9.83026	9.82954	9.82873	9.82790	9.82704
21	9.83497	9.83451	9.83403	9.83351	9.83295	9.83237	9.83175	9.83110	9.83042	9.82970	9.82900	9.82819	9.82736	9.82650
22	9.83441	9.83395	9.83347	9.83295	9.83239	9.83181	9.83119	9.83054	9.82986	9.82914	9.82842	9.82761	9.82678	9.82592
23	9.83385	9.83339	9.83291	9.83239	9.83183	9.83125	9.83063	9.82998	9.82930	9.82858	9.82786	9.82705	9.82622	9.82536
24	9.83329	9.83283	9.83235	9.83183	9.83127	9.83069	9.83007	9.82942	9.82874	9.82802	9.82730	9.82649	9.82566	9.82480
25	9.83273	9.83227	9.83179	9.83127	9.83071	9.83013	9.82951	9.82886	9.82818	9.82746	9.82674	9.82593	9.82510	9.82424
26	9.83217	9.83171	9.83123	9.83071	9.83015	9.82957	9.82895	9.82830	9.82762	9.82690	9.82618	9.82537	9.82454	9.82368
27	9.83161	9.83115	9.83067	9.83015	9.82959	9.82901	9.82839	9.82774	9.82706	9.82634	9.82562	9.82481	9.82398	9.82312
28	9.83105	9.83059	9.83011	9.82959	9.82903	9.82845	9.82783	9.82718	9.82650	9.82578	9.82506	9.82425	9.82342	9.82256
29	9.83049	9.83003	9.82955	9.82903	9.82847	9.82789	9.82727	9.82662	9.82594	9.82522	9.82450	9.82369	9.82286	9.82200
30	9.82993	9.82947	9.82899	9.82847	9.82791	9.82733	9.82671	9.82606	9.82538	9.82466	9.82394	9.82313	9.82230	9.82144
31	9.82937	9.82891	9.82843	9.82791	9.82735	9.82677	9.82615	9.82550	9.82482	9.82410	9.82338	9.82257	9.82174	9.82088
32	9.82881	9.82835	9.82787	9.82735	9.82679	9.82621	9.82559	9.82494	9.82426	9.82354	9.82282	9.82201	9.82118	9.82032
33	9.82825	9.82779	9.82731	9.82679	9.82623	9.82565	9.82503	9.82438	9.82370	9.82300	9.82228	9.82147	9.82064	9.81978
34	9.82769	9.82723	9.82675	9.82623	9.82567	9.82509	9.82447	9.82382	9.82314	9.82242	9.82170	9.82089	9.82006	9.81920
35	9.82713	9.82667	9.82619	9.82567	9.82511	9.82453	9.82391	9.82326	9.82258	9.82186	9.82114	9.82033	9.81950	9.81864
36	9.82657	9.82611	9.82563	9.82511	9.82455	9.82397	9.82335	9.82270	9.82202	9.82130	9.82058	9.81977	9.81894	9.81808
37	9.82601	9.82555	9.82507	9.82455	9.82399	9.82341	9.82279	9.82214	9.82146	9.82074	9.81992	9.81910	9.81826	9.81740
38	9.82545	9.82499	9.82451	9.82399	9.82343	9.82285	9.82223	9.82158	9.82090	9.82018	9.81946	9.81864	9.81780	9.81694
39	9.82489	9.82443	9.82395	9.82343	9.82287	9.82229	9.82167	9.82102	9.82034	9.81962	9.81890	9.81808	9.81724	9.81638
40	9.82433	9.82387	9.82339	9.82287	9.82231	9.82173	9.82111	9.82046	9.81978	9.81906	9.81834	9.81752	9.81668	9.81582
41	9.82377	9.82331	9.82283	9.82231	9.82175	9.82117	9.82055	9.81990	9.81922	9.81850	9.81778	9.81696	9.81612	9.81526
42	9.82321	9.82275	9.82227	9.82175	9.82119	9.82061	9.81999	9.81934	9.81866	9.81794	9.81722	9.81640	9.81556	9.81470
43	9.82265	9.82219	9.82171	9.82119	9.82063	9.81995	9.81933	9.81868	9.81800	9.81728	9.81656	9.81574	9.81490	9.81404
44	9.82209	9.82163	9.82115	9.82063	9.82007	9.81949	9.81887	9.81822	9.81754	9.81682	9.81610	9.81528	9.81444	9.81358
45	9.82153	9.82107	9.82059	9.82007	9.81951	9.81893	9.81831	9.81766	9.81698	9.81626	9.81554	9.81472	9.81388	9.81302
46	9.82097	9.82051	9.81993	9.81941	9.81885	9.81827	9.81765	9.81700	9.81632	9.81560	9.81488	9.81406	9.81322	9.81236
47	9.82041	9.81995	9.81937	9.81885	9.81829	9.81771	9.81709	9.81644	9.81576	9.81504	9.81432	9.81350	9.81266	9.81180
48	9.81985	9.81939	9.81881	9.81829	9.81773	9.81715	9.81653	9.81588	9.81520	9.81448	9.81376	9.81294	9.81210	9.81124
49	9.81929	9.81883	9.81825	9.81773	9.81717	9.81659	9.81597	9.81532	9.81464	9.81392	9.81320	9.81238	9.81154	9.81068
50	9.81873	9.81827	9.81769	9.81717	9.81661	9.81603	9.81541	9.81476	9.81408	9.81336	9.81264	9.81182	9.81098	9.81012
51	9.81817	9.81771	9.81713	9.81661	9.81605	9.81547	9.81485	9.81420	9.81352	9.81280	9.81208	9.81126	9.81042	9.80956
52	9.81761	9.81715	9.81657	9.81605	9.81549	9.81491	9.81429	9.81364	9.81296	9.81224	9.81152	9.81070	9.80986	9.80900
53	9.81705	9.81659	9.81601	9.81549	9.81493	9.81435	9.81373	9.81308	9.81240	9.81168	9.81096	9.81014	9.80930	9.80844
54	9.81649	9.81603	9.81545	9.81493	9.81437	9.81379	9.81317	9.81252	9.81184	9.81112	9.81040	9.80958	9.80874	9.80788
55	9.81593	9.81547	9.81489	9.81437	9.81381	9.81323	9.81261	9.81196	9.81128	9.81056	9.80984	9.80902	9.80818	9.80732
56	9.81537	9.81491	9.81433	9.81381	9.81325	9.81267	9.81205	9.81140	9.81072	9.80990	9.80918	9.80836	9.80752	9.80666
57	9.81481	9.81435	9.81377	9.81325	9.81269	9.81211	9.81149	9.81084	9.81016	9.80944	9.80872	9.80790	9.80706	9.80620
58	9.81425	9.81379	9.81321	9.81269	9.81213	9.81155	9.81093	9.81028	9.80960	9.80888	9.80816	9.80734	9.80650	9.80564
59	9.81369	9.81323	9.81265	9.81213	9.81157	9.81099	9.81037	9.80972	9.80904	9.80832	9.80760	9.80678	9.80594	9.80508
60	9.81313	9.81267	9.81209	9.81157	9.81101	9.81043	9.80981	9.80916	9.80848	9.80776	9.80704	9.80622	9.80538	9.80452
61	9.81257	9.81211												



TABLE V.  
The Finding of the Azimuth.

Hour Angle.	Declination.												Hour Angle.		
	13° 00'	13° 30'	14° 00'	14° 30'	15° 00'	15° 30'	16° 00'	16° 30'	17° 00'	17° 30'	18° 00'	18° 30'		19° 00'	19° 30'
h. m.													h. m.		
0 0															0 0
0 1															0 1
0 2															0 2
0 3															0 3
0 4															0 4
0 5															0 5
0 6															0 6
0 7															0 7
0 8															0 8
0 9															0 9
0 10															0 10
0 11															0 11
0 12															0 12
0 13															0 13
0 14															0 14
0 15															0 15
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0 25															0 25
0 26															0 26
0 27															0 27
0 28															0 28
0 29															0 29
0 30															0 30
1 0															1 0
1 1															1 1
1 2															1 2
1 3															1 3
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2 30															2 30
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3 30															3 30

RULE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.







TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.		
h. m.	°	19° 30'	20° 00'	21° 00'	21° 30'	22° 00'	22° 30'	23° 00'	23° 30'	24° 00'	24° 30'	25° 00'	25° 30'	26° 00'	°	h. m.
		3	00	9.82384	9.82246	9.81964	9.81511	9.81066	9.80552	9.80000	9.79352	9.78622	9.77822	9.76966		
4	00	9.83128	9.82992	9.82708	9.82151	9.81506	9.80752	9.80000	9.79152	9.78222	9.77222	9.76166	9.75056	9.73896	46	04
5	00	9.83872	9.83736	9.83452	9.82895	9.82150	9.81306	9.80452	9.79504	9.78472	9.77366	9.76206	9.75006	9.73756	47	08
6	00	9.84616	9.84480	9.84196	9.83639	9.82894	9.82050	9.81106	9.80058	9.78932	9.77726	9.76466	9.75166	9.73816	48	12
7	00	9.85360	9.85224	9.84940	9.84383	9.83638	9.82794	9.81750	9.80606	9.79380	9.78074	9.76714	9.75314	9.73864	49	16
8	00	9.86104	9.85968	9.85684	9.85127	9.84282	9.83238	9.82094	9.80850	9.79544	9.78168	9.76732	9.75252	9.73722	50	20
9	00	9.86848	9.86712	9.86428	9.85871	9.84926	9.83782	9.82538	9.81194	9.79818	9.78362	9.76846	9.75286	9.73686	51	24
10	00	9.87592	9.87456	9.87172	9.86615	9.85570	9.84326	9.82982	9.81536	9.80080	9.78524	9.76908	9.75248	9.73548	52	28
11	00	9.88336	9.88200	9.87916	9.87359	9.86314	9.85070	9.83626	9.82080	9.80424	9.78668	9.76812	9.74956	9.73056	53	32
12	00	9.89080	9.88944	9.88660	9.88103	9.87058	9.85714	9.84170	9.82524	9.80768	9.78912	9.76956	9.74900	9.72750	54	36
13	00	9.89824	9.89688	9.89404	9.88847	9.87802	9.86358	9.84714	9.82958	9.81102	9.79146	9.77090	9.74934	9.72684	55	40
14	00	9.90568	9.90432	9.90148	9.89591	9.88546	9.87102	9.85258	9.83302	9.81246	9.79090	9.76834	9.74478	9.72022	56	44
15	00	9.91312	9.91176	9.90892	9.90335	9.89290	9.87846	9.85902	9.83846	9.81690	9.79434	9.77078	9.74622	9.72066	57	48
16	00	9.92056	9.91920	9.91636	9.91079	9.90034	9.88590	9.86646	9.84490	9.82234	9.79878	9.77422	9.74866	9.72210	58	52
17	00	9.92800	9.92664	9.92380	9.91823	9.90778	9.89334	9.87390	9.85234	9.82878	9.80422	9.77866	9.75210	9.72454	59	56
18	00	9.93544	9.93408	9.93124	9.92567	9.91522	9.89978	9.87934	9.85678	9.83222	9.80666	9.77910	9.75054	9.72198	60	00
19	00	9.94288	9.94152	9.93868	9.93311	9.92266	9.90722	9.88678	9.86322	9.83766	9.81110	9.78254	9.75398	9.72442	01	04
20	00	9.95032	9.94896	9.94612	9.94055	9.93010	9.91466	9.89422	9.87066	9.84510	9.81754	9.78898	9.75942	9.72886	02	08
21	00	9.95776	9.95640	9.95356	9.94799	9.93754	9.92210	9.90166	9.87710	9.85054	9.82198	9.79242	9.76186	9.73030	03	12
22	00	9.96520	9.96384	9.96100	9.95543	9.94498	9.92954	9.90910	9.88460	9.85804	9.82948	9.79992	9.76936	9.73780	04	16
23	00	9.97264	9.97128	9.96844	9.96287	9.95242	9.93698	9.91654	9.89204	9.86548	9.83692	9.80636	9.77480	9.74224	05	20
24	00	9.98008	9.97872	9.97588	9.97031	9.95986	9.94442	9.92398	9.89948	9.87192	9.84236	9.81080	9.77824	9.74468	06	24
25	00	9.98752	9.98616	9.98332	9.97775	9.96730	9.95186	9.93142	9.90692	9.87936	9.84980	9.81824	9.78568	9.75212	07	28
26	00	9.99496	9.99360	9.99076	9.98519	9.97474	9.95930	9.93886	9.91436	9.88680	9.85724	9.82568	9.79312	9.75956	08	32
27	00	1.00240	1.00104	9.99820	9.99263	9.98218	9.96674	9.94630	9.92180	9.89424	9.86468	9.83312	9.79956	9.76500	09	36
28	00	1.00984	1.00848	9.99564	9.99007	9.97962	9.96418	9.94374	9.91924	9.89168	9.86212	9.82956	9.79500	9.75944	10	40
29	00	1.01728	1.01592	9.99272	9.98715	9.97670	9.96126	9.94082	9.91632	9.88876	9.85920	9.82664	9.79108	9.75452	11	44
30	00	1.02472	1.02336	9.98516	9.97959	9.96914	9.95370	9.93326	9.90876	9.88120	9.85164	9.81908	9.78352	9.74596	12	48
31	00	1.03216	1.03080	9.97760	9.97203	9.96158	9.94614	9.92570	9.90120	9.87364	9.84408	9.81152	9.77596	9.73740	13	52
32	00	1.03960	1.03824	9.97004	9.96447	9.95402	9.93858	9.91814	9.89364	9.86608	9.83652	9.80396	9.76840	9.72984	14	56
33	00	1.04704	1.04568	9.96248	9.95691	9.94646	9.93102	9.91058	9.88608	9.85852	9.82896	9.79640	9.76184	9.72328	15	00
34	00	1.05448	1.05312	9.95492	9.94935	9.93890	9.92346	9.90302	9.87852	9.85196	9.82240	9.78984	9.75528	9.71672	16	04
35	00	1.06192	1.06056	9.94736	9.94179	9.93134	9.91590	9.89546	9.87096	9.84340	9.81384	9.78128	9.74672	9.70816	17	08
36	00	1.06936	1.06800	9.93980	9.93423	9.92378	9.90834	9.88790	9.86340	9.83584	9.80628	9.77372	9.73916	9.70060	18	12
37	00	1.07680	1.07544	9.93224	9.92667	9.91622	9.90078	9.88034	9.85584	9.82828	9.79872	9.76616	9.73160	9.69304	19	16
38	00	1.08424	1.08288	9.92468	9.91911	9.90866	9.89322	9.87278	9.84828	9.82072	9.79116	9.75860	9.72404	9.68548	20	20
39	00	1.09168	1.09032	9.91712	9.91155	9.90110	9.88566	9.86522	9.84072	9.81316	9.78360	9.75104	9.71648	9.67792	21	24
40	00	1.09912	1.09776	9.90956	9.90400	9.89355	9.87811	9.85767	9.83317	9.80561	9.77605	9.74349	9.70793	9.66937	22	28
41	00	1.10656	1.10520	9.90200	9.89643	9.88598	9.87054	9.85010	9.82560	9.79804	9.76848	9.73592	9.70136	9.66280	23	32
42	00	1.11400	1.11264	9.89444	9.88887	9.87842	9.86298	9.84254	9.81804	9.79048	9.76092	9.72836	9.69380	9.65524	24	36
43	00	1.12144	1.12008	9.88688	9.88131	9.87086	9.85542	9.83498	9.81048	9.78292	9.75336	9.72080	9.68624	9.64768	25	40
44	00	1.12888	1.12752	9.87932	9.87375	9.86330	9.84786	9.82742	9.80292	9.77536	9.74580	9.71324	9.67868	9.64012	26	44
45	00	1.13632	1.13496	9.87176	9.86619	9.85574	9.84030	9.81986	9.79536	9.76780	9.73824	9.70568	9.67112	9.63256	27	48
46	00	1.14376	1.14240	9.86420	9.85863	9.84818	9.83274	9.81230	9.78780	9.76024	9.73068	9.69812	9.66356	9.62500	28	52
47	00	1.15120	1.14984	9.85664	9.85107	9.84062	9.82518	9.80474	9.78024	9.75268	9.72312	9.69056	9.65600	9.61744	29	56
48	00	1.15864	1.15728	9.84908	9.84351	9.83306	9.81762	9.79718	9.77268	9.74512	9.71556	9.68300	9.64844	9.61088	30	00
49	00	1.16608	1.16472	9.84152	9.83595	9.82550	9.81006	9.78962	9.76512	9.73756	9.70800	9.67544	9.64088	9.60332	01	04
50	00	1.17352	1.17216	9.83396	9.82839	9.81794	9.80250	9.78206	9.75756	9.73000	9.70044	9.66788	9.63332	9.59576	02	08
51	00	1.18096	1.17960	9.82640	9.82083	9.81038	9.79494	9.77450	9.75000	9.72244	9.69288	9.66032	9.62576	9.58820	03	12
52	00	1.18840	1.18704	9.81884	9.81327	9.80282	9.78738	9.76694	9.74244	9.71488	9.68532	9.65276	9.61820	9.58064	04	16
53	00	1.19584	1.19448	9.81128	9.80571	9.79526	9.77982	9.75938	9.73488	9.70732	9.67776	9.64520	9.61064	9.57308	05	20
54	00	1.20328	1.20192	9.80372	9.79815	9.78770	9.77226	9.75182	9.72732	9.69976	9.66920	9.63664	9.60208	9.56452	06	24
55	00	1.21072	1.20936	9.79616	9.79059	9.78014	9.76470	9.74426	9.71976	9.69220	9.66264	9.63008	9.59552	9.55796	07	28
56	00	1.21816	1.21680	9.78860	9.78303	9.77258	9.75714	9.73670	9.71220	9.68464	9.65508	9.62252	9.58796	9.55040	08	32
57	00	1.22560	1.22424	9.78104	9.77547	9.76502	9.74958	9.72914	9.70464	9.67708	9.64752	9.61496	9.58040	9.54284	09	36
58	00	1.23304	1.23168	9.77348	9.76791	9.75746	9.74202	9.72158	9.69708	9.67052	9.64096	9.60840	9.57384	9.53628	10	40
59	00	1.24048	1.23912	9.76592	9.76035	9.74990	9.73446	9.71402	9.68952	9.66296	9.63340	9.60084	9.56628	9.52872	11	44
60	00	1.24792	1.24656	9.75836	9.75279	9.74234	9.72690	9.70646	9.68196	9.65540	9.62584	9.59				



TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
		26° 00'	26° 30'	27° 00'	27° 30'	28° 00'	28° 30'	29° 00'	29° 30'	30° 00'	30° 30'	31° 00'	31° 30'			32° 00'	32° 30'																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
h. m.	°	-∞												°	h. m.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
		0	0	8.19552	8.19174	8.18779	8.18368	8.17946	8.17516	8.17078	8.16633	8.16183	8.15728			8.15268	8.14803	8.14333	8.13858	8.13378	8.12893	8.12403	8.11908	8.11413	8.10918	8.10423	8.09928	8.09433	8.08938	8.08443	8.07948	8.07453	8.06958	8.06463	8.05968	8.05473	8.04978	8.04483	8.03988	8.03493	8.02998	8.02503	8.02008	8.01513	8.01018	8.00523	8.00028	7.99533	7.99038	7.98543	7.98048	7.97553	7.97058	7.96563	7.96068	7.95573	7.95078	7.94583	7.94088	7.93593	7.93098	7.92603	7.92108	7.91613	7.91118	7.90623	7.90128	7.89633	7.89138	7.88643	7.88148	7.87653	7.87158	7.86663	7.86168	7.85673	7.85178	7.84683	7.84188	7.83693	7.83198	7.82703	7.82208	7.81713	7.81218	7.80723	7.80228	7.79733	7.79238	7.78743	7.78248	7.77753	7.77258	7.76763	7.76268	7.75773	7.75278	7.74783	7.74288	7.73793	7.73298	7.72803	7.72308	7.71813	7.71318	7.70823	7.70328	7.69833	7.69338	7.68843	7.68348	7.67853	7.67358	7.66863	7.66368	7.65873	7.65378	7.64883	7.64388	7.63893	7.63398	7.62903	7.62408	7.61913	7.61418	7.60923	7.60428	7.59933	7.59438	7.58943	7.58448	7.57953	7.57458	7.56963	7.56468	7.55973	7.55478	7.54983	7.54488	7.53993	7.53498	7.53003	7.52508	7.52013	7.51518	7.51023	7.50528	7.50033	7.49538	7.49043	7.48548	7.48053	7.47558	7.47063	7.46568	7.46073	7.45578	7.45083	7.44588	7.44093	7.43598	7.43103	7.42608	7.42113	7.41618	7.41123	7.40628	7.40133	7.39638	7.39143	7.38648	7.38153	7.37658	7.37163	7.36668	7.36173	7.35678	7.35183	7.34688	7.34193	7.33698	7.33203	7.32708	7.32213	7.31718	7.31223	7.30728	7.30233	7.29738	7.29243	7.28748	7.28253	7.27758	7.27263	7.26768	7.26273	7.25778	7.25283	7.24788	7.24293	7.23798	7.23303	7.22808	7.22313	7.21818	7.21323	7.20828	7.20333	7.19838	7.19343	7.18848	7.18353	7.17858	7.17363	7.16868	7.16373	7.15878	7.15383	7.14888	7.14393	7.13898	7.13403	7.12908	7.12413	7.11918	7.11423	7.10928	7.10433	7.09938	7.09443	7.08948	7.08453	7.07958	7.07463	7.06968	7.06473	7.05978	7.05483	7.04988	7.04493	7.03998	7.03503	7.03008	7.02513	7.02018	7.01523	7.01028	7.00533	7.00038	6.99543	6.99048	6.98553	6.98058	6.97563	6.97068	6.96573	6.96078	6.95583	6.95088	6.94593	6.94098	6.93603	6.93108	6.92613	6.92118	6.91623	6.91128	6.90633	6.90138	6.89643	6.89148	6.88653	6.88158	6.87663	6.87168	6.86673	6.86178	6.85683	6.85188	6.84693	6.84198	6.83703	6.83208	6.82713	6.82218	6.81723	6.81228	6.80733	6.80238	6.79743	6.79248	6.78753	6.78258	6.77763	6.77268	6.76773	6.76278	6.75783	6.75288	6.74793	6.74298	6.73803	6.73308	6.72813	6.72318	6.71823	6.71328	6.70833	6.70338	6.69843	6.69348	6.68853	6.68358	6.67863	6.67368	6.66873	6.66378	6.65883	6.65388	6.64893	6.64398	6.63903	6.63408	6.62913	6.62418	6.61923	6.61428	6.60933	6.60438	6.59943	6.59448	6.58953	6.58458	6.57963	6.57468	6.56973	6.56478	6.55983	6.55488	6.54993	6.54498	6.54003	6.53508	6.53013	6.52518	6.52023	6.51528	6.51033	6.50538	6.50043	6.49548	6.49053	6.48558	6.48063	6.47568	6.47073	6.46578	6.46083	6.45588	6.45093	6.44598	6.44103	6.43608	6.43113	6.42618	6.42123	6.41628	6.41133	6.40638	6.40143	6.39648	6.39153	6.38658	6.38163	6.37668	6.37173	6.36678	6.36183	6.35688	6.35193	6.34698	6.34203	6.33708	6.33213	6.32718	6.32223	6.31728	6.31233	6.30738	6.30243	6.29748	6.29253	6.28758	6.28263	6.27768	6.27273	6.26778	6.26283	6.25788	6.25293	6.24798	6.24303	6.23808	6.23313	6.22818	6.22323	6.21828	6.21333	6.20838	6.20343	6.19848	6.19353	6.18858	6.18363	6.17868	6.17373	6.16878	6.16383	6.15888	6.15393	6.14898	6.14403	6.13908	6.13413	6.12918	6.12423	6.11928	6.11433	6.10938	6.10443	6.09948	6.09453	6.08958	6.08463	6.07968	6.07473	6.06978	6.06483	6.05988	6.05493	6.04998	6.04503	6.04008	6.03513	6.03018	6.02523	6.02028	6.01533	6.01038	6.00543	6.00048	5.99553	5.99058	5.98563	5.98068	5.97573	5.97078	5.96583	5.96088	5.95593	5.95098	5.94603	5.94108	5.93613	5.93118	5.92623	5.92128	5.91633	5.91138	5.90643	5.90148	5.89653	5.89158	5.88663	5.88168	5.87673	5.87178	5.86683	5.86188	5.85693	5.85198	5.84703	5.84208	5.83713	5.83218	5.82723	5.82228	5.81733	5.81238	5.80743	5.80248	5.79753	5.79258	5.78763	5.78268	5.77773	5.77278	5.76783	5.76288	5.75793	5.75298	5.74803	5.74308	5.73813	5.73318	5.72823	5.72328	5.71833	5.71338	5.70843	5.70348	5.69853	5.69358	5.68863	5.68368	5.67873	5.67378	5.66883	5.66388	5.65893	5.65398	5.64903	5.64408	5.63913	5.63418	5.62923	5.62428	5.61933	5.61438	5.60943	5.60448	5.59953	5.59458	5.58963	5.58468	5.57973	5.57478	5.56983	5.56488	5.55993	5.55498	5.55003	5.54508	5.54013	5.53518	5.53023	5.52528	5.52033	5.51538	5.51043	5.50548	5.50053	5.49558	5.49063	5.48568	5.48073	5.47578	5.47083	5.46588	5.46093	5.45598	5.45103	5.44608	5.44113	5.43618	5.43123	5.42628	5.42133	5.41638	5.41143	5.40648	5.40153	5.39658	5.39163	5.38668	5.38173	5.37678	5.37183	5.36688	5.36193	5.35698	5.35203	5.34708	5.34213	5.33718	5.33223	5.32728	5.32233	5.31738	5.31243	5.30748	5.30253	5.29758	5.29263	5.28768	5.28273	5.27778	5.27283	5.26788	5.26293	5.25798	5.25303	5.24808	5.24313	5.23818	5.23323	5.22828	5.22333	5.21838	5.21343	5.20848	5.20353	5.19858	5.19363	5.18868	5.18373	5.17878	5.17383	5.16888	5.16393	5.15898	5.15403	5.14908	5.14413	5.13918	5.13423	5.12928	5.12433	5.11938	5.11443	5.10948	5.10453	5.09958	5.09463	5.08968	5.08473	5.07978	5.07483	5.06988	5.06493	5.05998	5.05503	5.05008	5.04513	5.04018	5.03523	5.03028	5.02533	5.02038	5.01543	5.01048	5.00553	5.00058	4.99563	4.99068	4.98573	4.98078	4.97583	4.97088	4.96593	4.96098	4.95603	4.95108	4.94613	4.94118	4.93623	4.93128	4.92633	4.92138	4.91643	4.91148	4.90653	4.90158	4.89663	4.89168	4.88673	4.88178	4.87683	4.87188	4.86693	4.86198	4.85703	4.85208	4.84713	4.84218	4.83723	4.83228	4.82733	4.82238	4.81743	4.81248	4.80753	4.80258	4.79763	4.79268	4.78773	4.78278	4.77783	4.77288	4.76793	4.76298	4.75803	4.75308	4.74813	4.74318	4.73823	4.73328	4.72833	4.72338	4.71843	4.71348	4.70853	4.70358	4.69863	4.69368	4.68873	4.68378	4.67883	4.67388	4.66893	4.66398	4.65903	4.65408	4.64913	4.64418	4.63923	4.63428	4.62933	4.62438	4.61943	4.61448	4.60953	4.60458	4.59963	4.59468	4.58973	4.58478	4.57983	4.57488	4.56993	4.56498	4.56003	4.55508	4.55013	4.54518	4.54023	4.53528	4.53033	4.52538	4.52043	4.51548	4.51053	4.50558	4.50063	4.49568	4.49073	4.48578	4.48083	4.47588	4.47093	4.46598	4.46103	4.45608	4.45113	4.44618	4.44123	4.43628	4.43133	4.42638	4.42143	4.41648	4.41153	4.40658	4.40163	4.39668	4.39173	4.38678	4.38183	4.37688	4.37193	4.36698	4.36203	4.35708	4.35213	4.34718	4.34223	4.33728	4.33233	4.32738	4.32243	4.31748	4.31253	4.30758	4.30263	4.29768	4.29273	4.28778	4.28283	4.27788	4.27293	4.26798	4.26303	4.25808	4.25313	4.24818	4.24323	4.23828	4.23333	4.22838	4.22343	4.21848	4.21353	4.20858	4.20363	4.19868	4.19373	4.18878	4.18383	4.17888	4.17393	4.16898	4.16403	4.15908	4.15413	4.14918	4.14423	4.13928	4.13433	4.12938	4.12443	4.11948	4.11453	4.10958	4.10463	4.09968	4.09473	4.08978	4.08483	4.07988	4.07493	4.06998	4.06503	4.06008	4.05513	4.05018	4.04523	4.04028	4.03533	4.03038	4.02543	4.02048	4.01553	4.01058	4.00563	4.00068	3.99573	3.99078	3.98583	3.98088	3.97593	3.97098	3.96603	3.96108	3.95613	3.95118	3.94623	3.94128	3.93633	3.93138	3.92643	3.92148	3.91653	3.91158	3.90663	3.90168	3.89673	3.89178	3.88683	3.88188	3.87693	3.87198	3.86703	3.86208	3.85713	3.85218	3.84723	3.84228	3.83733	3.83238	3.82743	3.82248	3.81753	3.81258	3.80763	3.80268	3.79773	3.79278	3.78783	3.78288	3.77793	3.77298	3.76803	3.76308	3.75813	3.75318	3.74823	3.74328	3.73833	3.73338	3.72843	3.72348	3.71853	3.71358	3.70863	3.70368	3.69873	3.69378	3.68883	3.68388	3.67893

TABLE V.

The Finding of the Azimuth.

Hour Angle.	Declination.												Hour Angle.		
	26° 00'	26° 30'	27° 00'	27° 30'	28° 00'	28° 30'	29° 00'	29° 30'	30° 00'	30° 30'	31° 00'	31° 30'		32° 00'	32° 30'
h. m.	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
3 04	9.80315	9.79637	9.79037	9.78443	9.77856	9.77275	9.76699	9.76128	9.75557	9.74986	9.74415	9.73844	9.73273	9.72702	9.72131
4 04	9.81059	9.80381	9.79703	9.79025	9.78347	9.77669	9.76991	9.76313	9.75635	9.74957	9.74279	9.73601	9.72923	9.72245	9.71567
5 04	9.81779	9.81101	9.80423	9.79745	9.79067	9.78389	9.77711	9.77033	9.76355	9.75677	9.74999	9.74321	9.73643	9.72965	9.72287
6 04	9.82473	9.81795	9.81117	9.80439	9.79761	9.79083	9.78405	9.77727	9.77049	9.76371	9.75693	9.75015	9.74337	9.73659	9.72981
7 04	9.83144	9.82466	9.81788	9.81110	9.80432	9.79754	9.79076	9.78398	9.77720	9.77042	9.76364	9.75686	9.75008	9.74330	9.73652
8 04	9.83791	9.83113	9.82435	9.81757	9.81079	9.80401	9.79723	9.79045	9.78367	9.77689	9.77011	9.76333	9.75655	9.74977	9.74299
9 04	9.84416	9.83738	9.83060	9.82382	9.81704	9.81026	9.80348	9.79670	9.78992	9.78314	9.77636	9.76958	9.76280	9.75602	9.74924
10 04	9.85019	9.84341	9.83663	9.82985	9.82307	9.81629	9.80951	9.80273	9.79595	9.78917	9.78239	9.77561	9.76883	9.76205	9.75527
11 04	9.85594	9.84916	9.84238	9.83560	9.82882	9.82204	9.81526	9.80848	9.80170	9.79492	9.78814	9.78136	9.77458	9.76780	9.76102
12 04	9.86142	9.85464	9.84786	9.84108	9.83430	9.82752	9.82074	9.81396	9.80718	9.80040	9.79362	9.78684	9.78006	9.77328	9.76650
13 04	9.86670	9.85992	9.85314	9.84636	9.83958	9.83280	9.82602	9.81924	9.81246	9.80568	9.79890	9.79212	9.78534	9.77856	9.77178
14 04	9.87189	9.86511	9.85833	9.85155	9.84477	9.83799	9.83121	9.82443	9.81765	9.81087	9.80409	9.79731	9.79053	9.78375	9.77697
15 04	9.87690	9.87012	9.86334	9.85656	9.84978	9.84300	9.83622	9.82944	9.82266	9.81588	9.80910	9.80232	9.79554	9.78876	9.78198
16 04	9.88174	9.87496	9.86818	9.86140	9.85462	9.84784	9.84106	9.83428	9.82750	9.82072	9.81394	9.80716	9.80038	9.79360	9.78682
17 04	9.88641	9.87963	9.87285	9.86607	9.85929	9.85251	9.84573	9.83895	9.83217	9.82539	9.81861	9.81183	9.80505	9.79827	9.79149
18 04	9.89090	9.88412	9.87734	9.87056	9.86378	9.85700	9.85022	9.84344	9.83666	9.82988	9.82310	9.81632	9.80954	9.80276	9.79598
19 04	9.89521	9.88843	9.88165	9.87487	9.86809	9.86131	9.85453	9.84775	9.84097	9.83419	9.82741	9.82063	9.81385	9.80707	9.80029
20 04	9.89934	9.89256	9.88578	9.87900	9.87222	9.86544	9.85866	9.85188	9.84510	9.83832	9.83154	9.82476	9.81798	9.81120	9.80442
21 04	9.90330	9.89652	9.88974	9.88296	9.87618	9.86940	9.86262	9.85584	9.84906	9.84228	9.83550	9.82872	9.82194	9.81516	9.80838
22 04	9.90713	9.90035	9.89357	9.88679	9.88001	9.87323	9.86645	9.85967	9.85289	9.84611	9.83933	9.83255	9.82577	9.81899	9.81221
23 04	9.91080	9.90402	9.89724	9.89046	9.88368	9.87690	9.87012	9.86334	9.85656	9.84978	9.84300	9.83622	9.82944	9.82266	9.81588
24 04	9.91423	9.90745	9.90067	9.89389	9.88711	9.88033	9.87355	9.86677	9.85999	9.85321	9.84643	9.83965	9.83287	9.82609	9.81931
25 04	9.91746	9.91068	9.90390	9.89712	9.89034	9.88356	9.87678	9.87000	9.86322	9.85644	9.84966	9.84288	9.83610	9.82932	9.82254
26 04	9.92050	9.91372	9.90694	9.90016	9.89338	9.88660	9.87982	9.87304	9.86626	9.85948	9.85270	9.84592	9.83914	9.83236	9.82558
27 04	9.92335	9.91657	9.90979	9.90301	9.89623	9.88945	9.88267	9.87589	9.86911	9.86233	9.85555	9.84877	9.84199	9.83521	9.82843
28 04	9.92600	9.91922	9.91244	9.90566	9.89888	9.89210	9.88532	9.87854	9.87176	9.86498	9.85820	9.85142	9.84464	9.83786	9.83108
29 04	9.92845	9.92167	9.91489	9.90811	9.90133	9.89455	9.88777	9.88099	9.87421	9.86743	9.86065	9.85387	9.84709	9.84031	9.83353
30 04	9.93070	9.92392	9.91714	9.91036	9.90358	9.89680	9.89002	9.88324	9.87646	9.86968	9.86290	9.85612	9.84934	9.84256	9.83578
31 04	9.93275	9.92597	9.91919	9.91241	9.90563	9.89885	9.89207	9.88529	9.87851	9.87173	9.86495	9.85817	9.85139	9.84461	9.83783
32 04	9.93460	9.92782	9.92104	9.91426	9.90748	9.90070	9.89392	9.88714	9.88036	9.87358	9.86680	9.86002	9.85324	9.84646	9.83968
33 04	9.93625	9.92947	9.92269	9.91591	9.90913	9.90235	9.89557	9.88879	9.88201	9.87523	9.86845	9.86167	9.85489	9.84811	9.84133
34 04	9.93770	9.93092	9.92414	9.91736	9.91058	9.90380	9.89702	9.89024	9.88346	9.87668	9.86990	9.86312	9.85634	9.84956	9.84278
35 04	9.93905	9.93227	9.92549	9.91871	9.91193	9.90515	9.89837	9.89159	9.88481	9.87803	9.87125	9.86447	9.85769	9.85091	9.84413
36 04	9.94020	9.93342	9.92664	9.91986	9.91308	9.90630	9.89952	9.89274	9.88596	9.87918	9.87240	9.86562	9.85884	9.85206	9.84528
37 04	9.94125	9.93447	9.92769	9.92091	9.91413	9.90735	9.90057	9.89379	9.88701	9.88023	9.87345	9.86667	9.85989	9.85311	9.84633
38 04	9.94220	9.93542	9.92864	9.92186	9.91508	9.90830	9.90152	9.89474	9.88796	9.88118	9.87440	9.86762	9.86084	9.85406	9.84728
39 04	9.94305	9.93627	9.92949	9.92271	9.91593	9.90915	9.90237	9.89559	9.88881	9.88203	9.87525	9.86847	9.86169	9.85491	9.84813
40 04	9.94370	9.93692	9.93014	9.92336	9.91658	9.90980	9.90302	9.89624	9.88946	9.88268	9.87590	9.86912	9.86234	9.85556	9.84878
41 04	9.94425	9.93747	9.93069	9.92391	9.91713	9.91035	9.90357	9.89679	9.89001	9.88323	9.87645	9.86967	9.86289	9.85611	9.84933
42 04	9.94470	9.93792	9.93114	9.92436	9.91758	9.91080	9.90402	9.89724	9.89046	9.88368	9.87690	9.87012	9.86334	9.85656	9.84978
43 04	9.94505	9.93827	9.93149	9.92471	9.91793	9.91115	9.90437	9.89759	9.89081	9.88403	9.87725	9.87047	9.86369	9.85691	9.85013
44 04	9.94530	9.93852	9.93174	9.92496	9.91818	9.91140	9.90462	9.89784	9.89106	9.88428	9.87750	9.87072	9.86394	9.85716	9.85038
45 04	9.94545	9.93867	9.93189	9.92511	9.91833	9.91155	9.90477	9.89799	9.89121	9.88443	9.87765	9.87087	9.86409	9.85731	9.85053
46 04	9.94550	9.93872	9.93194	9.92516	9.91838	9.91160	9.90482	9.89804	9.89126	9.88448	9.87770	9.87092	9.86414	9.85736	9.85058
47 04	9.94555	9.93877	9.93199	9.92521	9.91843	9.91165	9.90487	9.89809	9.89131	9.88453	9.87775	9.87097	9.86419	9.85741	9.85063
48 04	9.94555	9.93877	9.93199	9.92521	9.91843	9.91165	9.90487	9.89809	9.89131	9.88453	9.87775	9.87097	9.86419	9.85741	9.85063
49 04	9.94550	9.93872	9.93194	9.92516	9.91838	9.91160	9.90482	9.89804	9.89126	9.88448	9.87770	9.87092	9.86414	9.85736	9.85058
50 04	9.94540	9.93862	9.93184	9.92506	9.91828	9.91150	9.90472	9.89794	9.89116	9.88438	9.87760	9.87082	9.86404	9.85726	9.85048
51 04	9.94520	9.93842	9.93164	9.92486	9.91808	9.91130	9.90452	9.89774	9.89096	9.88418	9.87740	9.87062	9.86384	9.85706	9.85028
52 04	9.94490	9.93812	9.93134	9.92456	9.91778	9.91100	9.90422	9.89744	9.89066	9.88388	9.87710	9.87032	9.86354	9.85676	9.84998
53 04	9.94450	9.93772	9.93094	9.92416	9.91738	9.91060	9.90382	9.89704	9.89026	9.88348	9.87670	9.86992	9.86314	9.85636	9.84958
54 04	9.94400	9.93722	9.93044	9.92366	9.91688	9.91010	9.90332	9.89654	9.88976	9.88298	9.87620	9.86942	9.86264	9.85586	9.84908
55 04	9.94340	9.93662	9.92984	9.92306	9.91628	9.90950	9.90272	9.89594	9.88916	9.88238	9.87560	9.86882	9.86204	9.85526	9.84848
56 04	9.94270	9.93582	9.92904	9.92226	9.91548	9.90870	9.90192	9.89514	9.88836	9.88158	9.87480	9.86802	9.86124	9.85446	9.84768
57 04	9.94190	9.93494	9.92816	9.92138	9.91460	9.90782	9.90104	9.89426	9.88748	9.88070	9.87392	9.86714	9.86036	9.85358	9.84680
58 04	9.94100	9.93396	9.92718	9.92040	9.91362	9.90684	9.90006	9.89328	9.88650	9.87972	9.87294	9.86616	9.8		









TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.													
		39° 00'	39° 30'	40° 00'	40° 30'	41° 00'	41° 30'	42° 00'	42° 30'	43° 00'	43° 30'	44° 00'	44° 30'	45° 00'	45° 30'
<i>h. m.</i>	°	8.13236	8.12927	8.12611	8.12291	8.11964	8.11632	8.11293	8.10949	8.10599	8.10243	8.99879	8.99510	8.99135	8.98752
0	0	8.43332	8.42707	8.42084	8.41459	8.40834	8.40209	8.39584	8.38958	8.38333	8.37708	8.37083	8.36458	8.35833	8.35208
1	0	8.69300	8.68621	8.67942	8.67263	8.66584	8.65905	8.65226	8.64547	8.63868	8.63189	8.62510	8.61831	8.61152	8.60473
2	0	8.73408	8.72783	8.72158	8.71533	8.70908	8.70283	8.69658	8.69033	8.68408	8.67783	8.67158	8.66533	8.65908	8.65283
3	0	8.83080	8.82455	8.81830	8.81205	8.80580	8.80000	8.79420	8.78840	8.78260	8.77680	8.77100	8.76520	8.75940	8.75360
4	0	8.90973	8.90348	8.89723	8.89098	8.88473	8.87848	8.87223	8.86598	8.85973	8.85348	8.84723	8.84098	8.83473	8.82848
5	0	8.97639	8.97014	8.96389	8.95764	8.95139	8.94514	8.93889	8.93264	8.92639	8.92014	8.91389	8.90764	8.90139	8.89514
6	0	9.03406	9.02781	9.02156	9.01531	9.00906	9.00281	8.99656	8.99031	8.98406	8.97781	8.97156	8.96531	8.95906	8.95281
7	0	9.08483	9.07858	9.07233	9.06608	9.05983	9.05358	9.04733	9.04108	9.03483	9.02858	9.02233	9.01608	9.00983	9.00358
8	0	9.13017	9.12392	9.11767	9.11142	9.10517	9.09892	9.09267	9.08642	9.08017	9.07392	9.06767	9.06142	9.05517	9.04892
9	0	9.17110	9.16485	9.15860	9.15235	9.14610	9.13985	9.13360	9.12735	9.12110	9.11485	9.10860	9.10235	9.09610	9.08985
10	0	9.20838	9.20213	9.19588	9.18963	9.18338	9.17713	9.17088	9.16463	9.15838	9.15213	9.14588	9.13963	9.13338	9.12713
11	0	9.24259	9.23634	9.23009	9.22384	9.21759	9.21134	9.20509	9.19884	9.19259	9.18634	9.18009	9.17384	9.16759	9.16134
12	0	9.27418	9.26793	9.26168	9.25543	9.24918	9.24293	9.23668	9.23043	9.22418	9.21793	9.21168	9.20543	9.19918	9.19293
13	0	9.30350	9.29725	9.29100	9.28475	9.27850	9.27225	9.26600	9.25975	9.25350	9.24725	9.24100	9.23475	9.22850	9.22225
14	0	9.33084	9.32459	9.31834	9.31209	9.30584	9.29959	9.29334	9.28709	9.28084	9.27459	9.26834	9.26209	9.25584	9.24959
15	0	9.35644	9.35019	9.34394	9.33769	9.33144	9.32519	9.31894	9.31269	9.30644	9.30019	9.29394	9.28769	9.28144	9.27519
16	0	9.38048	9.37423	9.36798	9.36173	9.35548	9.34923	9.34298	9.33673	9.33048	9.32423	9.31798	9.31173	9.30548	9.29923
17	0	9.40381	9.39756	9.39131	9.38506	9.37881	9.37256	9.36631	9.36006	9.35381	9.34756	9.34131	9.33506	9.32881	9.32256
18	0	9.42655	9.42030	9.41405	9.40780	9.40155	9.39530	9.38905	9.38280	9.37655	9.37030	9.36405	9.35780	9.35155	9.34530
19	0	9.44858	9.44233	9.43608	9.42983	9.42358	9.41733	9.41108	9.40483	9.39858	9.39233	9.38608	9.37983	9.37358	9.36733
20	0	9.46981	9.46356	9.45731	9.45106	9.44481	9.43856	9.43231	9.42606	9.41981	9.41356	9.40731	9.40106	9.39481	9.38856
21	0	9.49034	9.48409	9.47784	9.47159	9.46534	9.45909	9.45284	9.44659	9.44034	9.43409	9.42784	9.42159	9.41534	9.40909
22	0	9.51017	9.50392	9.49767	9.49142	9.48517	9.47892	9.47267	9.46642	9.46017	9.45392	9.44767	9.44142	9.43517	9.42892
23	0	9.52930	9.52305	9.51680	9.51055	9.50430	9.49805	9.49180	9.48555	9.47930	9.47305	9.46680	9.46055	9.45430	9.44805
24	0	9.54783	9.54158	9.53533	9.52908	9.52283	9.51658	9.51033	9.50408	9.49783	9.49158	9.48533	9.47908	9.47283	9.46658
25	0	9.56586	9.55961	9.55336	9.54711	9.54086	9.53461	9.52836	9.52211	9.51586	9.50961	9.50336	9.49711	9.49086	9.48461
26	0	9.58339	9.57714	9.57089	9.56464	9.55839	9.55214	9.54589	9.53964	9.53339	9.52714	9.52089	9.51464	9.50839	9.50214
27	0	9.60052	9.59427	9.58802	9.58177	9.57552	9.56927	9.56302	9.55677	9.55052	9.54427	9.53802	9.53177	9.52552	9.51927
28	0	9.61715	9.61090	9.60465	9.59840	9.59215	9.58590	9.57965	9.57340	9.56715	9.56090	9.55465	9.54840	9.54215	9.53590
29	0	9.63328	9.62703	9.62078	9.61453	9.60828	9.60203	9.59578	9.58953	9.58328	9.57703	9.57078	9.56453	9.55828	9.55203
30	0	9.64891	9.64266	9.63641	9.63016	9.62391	9.61766	9.61141	9.60516	9.59891	9.59266	9.58641	9.58016	9.57391	9.56766
31	0	9.66404	9.65779	9.65154	9.64529	9.63904	9.63279	9.62654	9.62029	9.61404	9.60779	9.60154	9.59529	9.58904	9.58279
32	0	9.67867	9.67242	9.66617	9.65992	9.65367	9.64742	9.64117	9.63492	9.62867	9.62242	9.61617	9.60992	9.60367	9.59742
33	0	9.69280	9.68655	9.68030	9.67405	9.66780	9.66155	9.65530	9.64905	9.64280	9.63655	9.63030	9.62405	9.61780	9.61155
34	0	9.70743	9.70118	9.69493	9.68868	9.68243	9.67618	9.66993	9.66368	9.65743	9.65118	9.64493	9.63868	9.63243	9.62618
35	0	9.72156	9.71531	9.70906	9.70281	9.69656	9.69031	9.68406	9.67781	9.67156	9.66531	9.65906	9.65281	9.64656	9.64031
36	0	9.73519	9.72894	9.72269	9.71644	9.71019	9.70394	9.69769	9.69144	9.68519	9.67894	9.67269	9.66644	9.66019	9.65394
37	0	9.74832	9.74207	9.73582	9.72957	9.72332	9.71707	9.71082	9.70457	9.69832	9.69207	9.68582	9.67957	9.67332	9.66707
38	0	9.76095	9.75470	9.74845	9.74220	9.73595	9.72970	9.72345	9.71720	9.71095	9.70470	9.69845	9.69220	9.68595	9.67970
39	0	9.77308	9.76683	9.76058	9.75433	9.74808	9.74183	9.73558	9.72933	9.72308	9.71683	9.71058	9.70433	9.69808	9.69183
40	0	9.78471	9.77846	9.77221	9.76596	9.75971	9.75346	9.74721	9.74096	9.73471	9.72846	9.72221	9.71596	9.70971	9.70346
41	0	9.79584	9.78959	9.78334	9.77709	9.77084	9.76459	9.75834	9.75209	9.74584	9.73959	9.73334	9.72709	9.72084	9.71459
42	0	9.80647	9.80022	9.79397	9.78772	9.78147	9.77522	9.76897	9.76272	9.75647	9.75022	9.74397	9.73772	9.73147	9.72522
43	0	9.81660	9.81035	9.80410	9.79785	9.79160	9.78535	9.77910	9.77285	9.76660	9.76035	9.75410	9.74785	9.74160	9.73535
44	0	9.82623	9.82000	9.81375	9.80750	9.80125	9.79500	9.78875	9.78250	9.77625	9.77000	9.76375	9.75750	9.75125	9.74500
45	0	9.83536	9.82911	9.82286	9.81661	9.81036	9.80411	9.79786	9.79161	9.78536	9.77911	9.77286	9.76661	9.76036	9.75411
1	00	9.84400	9.83775	9.83150	9.82525	9.81900	9.81275	9.80650	9.80025	9.79400	9.78775	9.78150	9.77525	9.76900	9.76275
2	00	9.85213	9.84588	9.83963	9.83338	9.82713	9.82088	9.81463	9.80838	9.80213	9.79588	9.78963	9.78338	9.77713	9.77088
3	00	9.85976	9.85351	9.84726	9.84101	9.83476	9.82851	9.82226	9.81601	9.80976	9.80351	9.79726	9.79101	9.78476	9.77851
4	00	9.86689	9.86064	9.85439	9.84814	9.84189	9.83564	9.82939	9.82314	9.81689	9.81064	9.80439	9.79814	9.79189	9.78564
5	00	9.87352	9.86727	9.86102	9.85477	9.84852	9.84227	9.83602	9.82977	9.82352	9.81727	9.81102	9.80477	9.79852	9.79227
6	00	9.87965	9.87340	9.86715	9.86090	9.85465	9.84840	9.84215	9.83590	9.82965	9.82340	9.81715	9.81090	9.80465	9.79840
7	00	9.88528	9.87903	9.87278	9.86653	9.86028	9.85403	9.84778	9.84153	9.83528	9.82903	9.82278	9.81653	9.81028	9.80403
8	00	9.89041	9.88416	9.87791	9.87166	9.86541	9.85916	9.85291	9.84666	9.84041	9.83416	9.82791	9.82166	9.81541	9.80916
9	00	9.89504	9.88879	9.88254	9.87629	9.87004	9.86379	9.85754	9.85129	9.84504	9.83879	9.83254	9.82629	9.82004	9.81379
10	00	9.89917	9.89292	9.88667	9.88042	9.87417	9.86792	9.86167	9.85542	9.84917	9.84292	9.83667	9.83042	9.82417	9.81792
11	00	9.90280	9.89655	9.89030	9.88405	9.87780	9.87155	9.86530	9.85905	9.85280	9.84655	9.84030	9.83405	9.82780	9.82155
12	00	9.90593	9.90000	9.89407	9.88814	9.88221	9.87628	9.87035	9.86442	9.85849	9.85256	9.84663	9.84070	9.83477	9.82884
13															

TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.		
		39° 00'	39° 30'	40° 00'	40° 30'	41° 00'	41° 30'	42° 00'	42° 30'	43° 00'	43° 30'	44° 00'	44° 30'		45° 00'	45° 30'
h. m.	°															
		3 00	45	9.73999	9.73680	9.73374	9.73064	9.72757	9.72453	9.72152	9.71853	9.71556	9.71262	9.70970	9.70680	9.70392
3 00	46	9.74743	9.74434	9.74130	9.73828	9.73529	9.73232	9.72938	9.72646	9.72356	9.72068	9.71782	9.71498	9.71216	9.70936	9.70642
3 00	47	9.75463	9.75154	9.74851	9.74553	9.74261	9.73970	9.73681	9.73393	9.73107	9.72822	9.72538	9.72256	9.71976	9.71692	9.71398
3 00	48	9.76157	9.75853	9.75556	9.75264	9.74974	9.74686	9.74400	9.74116	9.73833	9.73551	9.73270	9.72990	9.72711	9.72432	9.72154
3 00	49	9.76823	9.76519	9.76223	9.75932	9.75644	9.75358	9.75074	9.74792	9.74511	9.74231	9.73952	9.73674	9.73397	9.73121	9.72846
3 00	50	9.77475	9.77166	9.76865	9.76570	9.76280	9.75992	9.75706	9.75422	9.75139	9.74857	9.74576	9.74296	9.74017	9.73738	9.73460
3 00	51	9.78100	9.77791	9.77487	9.77188	9.76893	9.76600	9.76309	9.76020	9.75732	9.75445	9.75159	9.74874	9.74590	9.74306	9.74023
3 00	52	9.78703	9.78394	9.78091	9.77792	9.77497	9.77204	9.76913	9.76623	9.76334	9.76046	9.75759	9.75473	9.75188	9.74903	9.74619
3 00	53	9.79285	9.78976	9.78673	9.78375	9.78080	9.77786	9.77494	9.77204	9.76915	9.76627	9.76340	9.76054	9.75769	9.75484	9.75199
3 00	54	9.79846	9.79537	9.79234	9.78936	9.78641	9.78347	9.78054	9.77762	9.77471	9.77181	9.76891	9.76602	9.76313	9.76024	9.75735
3 00	55	9.80386	9.80077	9.79774	9.79476	9.79181	9.78887	9.78594	9.78302	9.78011	9.77720	9.77430	9.77140	9.76850	9.76560	9.76270
3 00	56	9.80907	9.80598	9.80294	9.79994	9.79696	9.79400	9.79105	9.78811	9.78518	9.78225	9.77933	9.77641	9.77350	9.77058	9.76766
3 00	57	9.81409	9.81100	9.80796	9.80496	9.80198	9.79901	9.79605	9.79310	9.79016	9.78722	9.78429	9.78136	9.77843	9.77550	9.77257
3 00	58	9.81892	9.81583	9.81279	9.80978	9.80679	9.80381	9.80084	9.79788	9.79493	9.79198	9.78904	9.78610	9.78316	9.78022	9.77728
3 00	59	9.82357	9.82048	9.81743	9.81442	9.81143	9.80845	9.80548	9.80252	9.79957	9.79662	9.79367	9.79072	9.78778	9.78483	9.78188
3 00	60	9.82800	9.82491	9.82186	9.81884	9.81584	9.81285	9.80987	9.80690	9.80394	9.80098	9.79803	9.79508	9.79213	9.78918	9.78623
3 00	61	9.83232	9.82923	9.82617	9.82314	9.82013	9.81713	9.81414	9.81116	9.80819	9.80523	9.80227	9.79932	9.79637	9.79342	9.79047
3 00	62	9.83643	9.83334	9.83029	9.82726	9.82425	9.82125	9.81826	9.81528	9.81231	9.80935	9.80640	9.80345	9.80050	9.79755	9.79460
3 00	63	9.84038	9.83729	9.83423	9.83119	9.82816	9.82514	9.82213	9.81912	9.81612	9.81313	9.81014	9.80716	9.80418	9.80121	9.79824
3 00	64	9.84416	9.84107	9.83801	9.83496	9.83192	9.82889	9.82587	9.82286	9.81986	9.81687	9.81388	9.81090	9.80793	9.80496	9.80199
3 00	65	9.84778	9.84469	9.84163	9.83858	9.83554	9.83251	9.82949	9.82648	9.82348	9.82048	9.81749	9.81450	9.81152	9.80854	9.80557
3 00	66	9.85123	9.84814	9.84508	9.84203	9.83900	9.83598	9.83297	9.82996	9.82696	9.82396	9.82097	9.81798	9.81499	9.81200	9.80902
3 00	67	9.85453	9.85144	9.84838	9.84533	9.84229	9.83926	9.83624	9.83322	9.83021	9.82720	9.82420	9.82120	9.81820	9.81520	9.81220
3 00	68	9.85767	9.85458	9.85152	9.84847	9.84542	9.84238	9.83934	9.83631	9.83328	9.83025	9.82723	9.82421	9.82120	9.81818	9.81516
3 00	69	9.86065	9.85756	9.85450	9.85145	9.84841	9.84537	9.84234	9.83931	9.83628	9.83325	9.83023	9.82721	9.82419	9.82117	9.81815
3 00	70	9.86349	9.86040	9.85734	9.85429	9.85125	9.84821	9.84518	9.84215	9.83912	9.83610	9.83308	9.83006	9.82704	9.82402	9.82100
3 00	71	9.86617	9.86308	9.85999	9.85692	9.85386	9.85081	9.84776	9.84472	9.84168	9.83864	9.83561	9.83258	9.82955	9.82652	9.82349
3 00	72	9.86871	9.86562	9.86254	9.85947	9.85641	9.85336	9.85031	9.84727	9.84423	9.84119	9.83815	9.83512	9.83208	9.82905	9.82602
3 00	73	9.87110	9.86801	9.86493	9.86186	9.85880	9.85574	9.85269	9.84964	9.84659	9.84355	9.84051	9.83747	9.83443	9.83139	9.82835
3 00	74	9.87334	9.87025	9.86717	9.86410	9.86104	9.85798	9.85493	9.85188	9.84883	9.84578	9.84273	9.83968	9.83663	9.83358	9.83053
3 00	75	9.87544	9.87235	9.86927	9.86620	9.86314	9.86008	9.85703	9.85398	9.85093	9.84788	9.84483	9.84178	9.83873	9.83568	9.83263
3 00	76	9.87740	9.87431	9.87123	9.86816	9.86510	9.86204	9.85899	9.85594	9.85289	9.84984	9.84679	9.84374	9.84069	9.83764	9.83459
3 00	77	9.87922	9.87613	9.87305	9.86998	9.86692	9.86386	9.86081	9.85776	9.85471	9.85166	9.84861	9.84556	9.84251	9.83946	9.83641
3 00	78	9.88090	9.87781	9.87473	9.87166	9.86860	9.86554	9.86249	9.85944	9.85639	9.85334	9.85029	9.84724	9.84419	9.84114	9.83809
3 00	79	9.88245	9.87936	9.87628	9.87321	9.87015	9.86710	9.86405	9.86100	9.85795	9.85490	9.85185	9.84880	9.84575	9.84270	9.83965
3 00	80	9.88385	9.88076	9.87768	9.87461	9.87155	9.86849	9.86544	9.86239	9.85934	9.85629	9.85324	9.85019	9.84714	9.84409	9.84104
3 00	81	9.88512	9.88203	9.87895	9.87588	9.87282	9.86976	9.86671	9.86366	9.86061	9.85756	9.85451	9.85146	9.84841	9.84536	9.84231
3 00	82	9.88625	9.88316	9.88009	9.87702	9.87396	9.87090	9.86785	9.86480	9.86175	9.85870	9.85565	9.85260	9.84955	9.84650	9.84345
3 00	83	9.88725	9.88416	9.88109	9.87802	9.87496	9.87190	9.86885	9.86580	9.86275	9.85970	9.85665	9.85360	9.85055	9.84750	9.84445
3 00	84	9.88811	9.88502	9.88195	9.87888	9.87581	9.87275	9.86969	9.86663	9.86358	9.86052	9.85747	9.85441	9.85136	9.84831	9.84526
3 00	85	9.88884	9.88575	9.88268	9.87961	9.87654	9.87348	9.87042	9.86736	9.86430	9.86124	9.85818	9.85512	9.85206	9.84900	9.84594
3 00	86	9.88944	9.88635	9.88328	9.88021	9.87714	9.87408	9.87102	9.86796	9.86490	9.86184	9.85878	9.85572	9.85266	9.84960	9.84654
3 00	87	9.88990	9.88681	9.88374	9.88067	9.87760	9.87453	9.87146	9.86839	9.86532	9.86225	9.85918	9.85611	9.85304	9.85000	9.84693
3 00	88	9.89024	9.88715	9.88408	9.88101	9.87794	9.87487	9.87180	9.86873	9.86566	9.86259	9.85952	9.85645	9.85338	9.85031	9.84724
3 00	89	9.89043	9.88734	9.88427	9.88120	9.87813	9.87506	9.87199	9.86892	9.86585	9.86278	9.85971	9.85664	9.85357	9.85050	9.84743
3 00	90	9.89050	9.88741	9.88434	9.88127	9.87820	9.87513	9.87206	9.86899	9.86592	9.86285	9.85978	9.85671	9.85364	9.85057	9.84750

MARKING THE AZIMUTH.—The azimuth found from the table is always marked east (E.) or west (W.) according as the observed body is to the eastward or westward of the meridian of the observer. If the latitude and declination are of different name the azimuth is marked from the pole of opposite name to the latitude. If the latitude and declination are of the same name and the latitude is less than the declination, the azimuth is marked from the pole of the same name as the latitude. If the latitude and declination are of the same name and the latitude is greater than the declination, the azimuth is marked from the pole of the same name as the latitude when the hour-angle is greater than the hour-angle of crossing the prime vertical, and from the pole of opposite name when the hour-angle is less than the hour-angle of crossing the prime vertical. The hour-angle of crossing the prime vertical may be found from the diagram facing page 155.



RULE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
		45° 30'	46° 00'	46° 30'	47° 00'	47° 30'	48° 00'	48° 30'	49° 00'	49° 30'	50° 00'	50° 30'	51° 00'		51° 30'	52° 00'																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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0	0	—∞	8.07564	8.07154	8.06737	8.06312	8.05880	8.05440	8.04993	8.04537	8.04073	8.03601	8.03120	8.02634	8.02145	8.01652	8.01155	8.00654	8.00149	7.99639	7.99124	7.98604	7.98079	7.97549	7.97014	7.96474	7.95929	7.95379	7.94824	7.94264	7.93700	7.93131	7.92557	7.91979	7.91396	7.90809	7.90218	7.89623	7.89024	7.88420	7.87812	7.87200	7.86584	7.85964	7.85340	7.84712	7.84080	7.83444	7.82804	7.82160	7.81507	7.80855	7.80204	7.79554	7.78904	7.78254	7.77604	7.76954	7.76304	7.75654	7.75004	7.74354	7.73704	7.73054	7.72404	7.71754	7.71104	7.70454	7.69804	7.69154	7.68504	7.67854	7.67204	7.66554	7.65904	7.65254	7.64604	7.63954	7.63304	7.62654	7.62004	7.61354	7.60704	7.60054	7.59404	7.58754	7.58104	7.57454	7.56804	7.56154	7.55504	7.54854	7.54204	7.53554	7.52904	7.52254	7.51604	7.50954	7.50304	7.49654	7.49004	7.48354	7.47704	7.47054	7.46404	7.45754	7.45104	7.44454	7.43804	7.43154	7.42504	7.41854	7.41204	7.40554	7.39904	7.39254	7.38604	7.37954	7.37304	7.36654	7.36004	7.35354	7.34704	7.34054	7.33404	7.32754	7.32104	7.31454	7.30804	7.30154	7.29504	7.28854	7.28204	7.27554	7.26904	7.26254	7.25604	7.24954	7.24304	7.23654	7.23004	7.22354	7.21704	7.21054	7.20404	7.19754	7.19104	7.18454	7.17804	7.17154	7.16504	7.15854	7.15204	7.14554	7.13904	7.13254	7.12604	7.11954	7.11304	7.10654	7.10004	7.09354	7.08704	7.08054	7.07404	7.06754	7.06104	7.05454	7.04804	7.04154	7.03504	7.02854	7.02204	7.01554	7.00904	7.00254	6.99604	6.98954	6.98304	6.97654	6.97004	6.96354	6.95704	6.95054	6.94404	6.93754	6.93104	6.92454	6.91804	6.91154	6.90504	6.89854	6.89204	6.88554	6.87904	6.87254	6.86604	6.85954	6.85304	6.84654	6.84004	6.83354	6.82704	6.82054	6.81404	6.80754	6.80104	6.79454	6.78804	6.78154	6.77504	6.76854	6.76204	6.75554	6.74904	6.74254	6.73604	6.72954	6.72304	6.71654	6.71004	6.70354	6.69704	6.69054	6.68404	6.67754	6.67104	6.66454	6.65804	6.65154	6.64504	6.63854	6.63204	6.62554	6.61904	6.61254	6.60604	6.59954	6.59304	6.58654	6.58004	6.57354	6.56704	6.56054	6.55404	6.54754	6.54104	6.53454	6.52804	6.52154	6.51504	6.50854	6.50204	6.49554	6.48904	6.48254	6.47604	6.46954	6.46304	6.45654	6.45004	6.44354	6.43704	6.43054	6.42404	6.41754	6.41104	6.40454	6.39804	6.39154	6.38504	6.37854	6.37204	6.36554	6.35904	6.35254	6.34604	6.33954	6.33304	6.32654	6.32004	6.31354	6.30704	6.30054	6.29404	6.28754	6.28104	6.27454	6.26804	6.26154	6.25504	6.24854	6.24204	6.23554	6.22904	6.22254	6.21604	6.20954	6.20304	6.19654	6.19004	6.18354	6.17704	6.17054	6.16404	6.15754	6.15104	6.14454	6.13804	6.13154	6.12504	6.11854	6.11204	6.10554	6.09904	6.09254	6.08604	6.07954	6.07304	6.06654	6.06004	6.05354	6.04704	6.04054	6.03404	6.02754	6.02104	6.01454	6.00804	6.00154	5.99504	5.98854	5.98204	5.97554	5.96904	5.96254	5.95604	5.94954	5.94304	5.93654	5.93004	5.92354	5.91704	5.91054	5.90404	5.89754	5.89104	5.88454	5.87804	5.87154	5.86504	5.85854	5.85204	5.84554	5.83904	5.83254	5.82604	5.81954	5.81304	5.80654	5.80004	5.79354	5.78704	5.78054	5.77404	5.76754	5.76104	5.75454	5.74804	5.74154	5.73504	5.72854	5.72204	5.71554	5.70904	5.70254	5.69604	5.68954	5.68304	5.67654	5.67004	5.66354	5.65704	5.65054	5.64404	5.63754	5.63104	5.62454	5.61804	5.61154	5.60504	5.59854	5.59204	5.58554	5.57904	5.57254	5.56604	5.55954	5.55304	5.54654	5.54004	5.53354	5.52704	5.52054	5.51404	5.50754	5.50104	5.49454	5.48804	5.48154	5.47504	5.46854	5.46204	5.45554	5.44904	5.44254	5.43604	5.42954	5.42304	5.41654	5.41004	5.40354	5.39704	5.39054	5.38404	5.37754	5.37104	5.36454	5.35804	5.35154	5.34504	5.33854	5.33204	5.32554	5.31904	5.31254	5.30604	5.29954	5.29304	5.28654	5.28004	5.27354	5.26704	5.26054	5.25404	5.24754	5.24104	5.23454	5.22804	5.22154	5.21504	5.20854	5.20204	5.19554	5.18904	5.18254	5.17604	5.16954	5.16304	5.15654	5.15004	5.14354	5.13704	5.13054	5.12404	5.11754	5.11104	5.10454	5.09804	5.09154	5.08504	5.07854	5.07204	5.06554	5.05904	5.05254	5.04604	5.03954	5.03304	5.02654	5.02004	5.01354	5.00704	5.00054	4.99404	4.98754	4.98104	4.97454	4.96804	4.96154	4.95504	4.94854	4.94204	4.93554	4.92904	4.92254	4.91604	4.90954	4.90304	4.89654	4.89004	4.88354	4.87704	4.87054	4.86404	4.85754	4.85104	4.84454	4.83804	4.83154	4.82504	4.81854	4.81204	4.80554	4.79904	4.79254	4.78604	4.77954	4.77304	4.76654	4.76004	4.75354	4.74704	4.74054	4.73404	4.72754	4.72104	4.71454	4.70804	4.70154	4.69504	4.68854	4.68204	4.67554	4.66904	4.66254	4.65604	4.64954	4.64304	4.63654	4.63004	4.62354	4.61704	4.61054	4.60404	4.59754	4.59104	4.58454	4.57804	4.57154	4.56504	4.55854	4.55204	4.54554	4.53904	4.53254	4.52604	4.51954	4.51304	4.50654	4.50004	4.49354	4.48704	4.48054	4.47404	4.46754	4.46104	4.45454	4.44804	4.44154	4.43504	4.42854	4.42204	4.41554	4.40904	4.40254	4.39604	4.38954	4.38304	4.37654	4.37004	4.36354	4.35704	4.35054	4.34404	4.33754	4.33104	4.32454	4.31804	4.31154	4.30504	4.29854	4.29204	4.28554	4.27904	4.27254	4.26604	4.25954	4.25304	4.24654	4.24004	4.23354	4.22704	4.22054	4.21404	4.20754	4.20104	4.19454	4.18804	4.18154	4.17504	4.16854	4.16204	4.15554	4.14904	4.14254	4.13604	4.12954	4.12304	4.11654	4.11004	4.10354	4.09704	4.09054	4.08404	4.07754	4.07104	4.06454	4.05804	4.05154	4.04504	4.03854	4.03204	4.02554	4.01904	4.01254	4.00604	3.99954	3.99304	3.98654	3.98004	3.97354	3.96704	3.96054	3.95404	3.94754	3.94104	3.93454	3.92804	3.92154	3.91504	3.90854	3.90204	3.89554	3.88904	3.88254	3.87604	3.86954	3.86304	3.85654	3.85004	3.84354	3.83704	3.83054	3.82404	3.81754	3.81104	3.80454	3.79804	3.79154	3.78504	3.77854	3.77204	3.76554	3.75904	3.75254	3.74604	3.73954	3.73304	3.72654	3.72004	3.71354	3.70704	3.70054	3.69404	3.68754	3.68104	3.67454	3.66804	3.66154	3.65504	3.64854	3.64204	3.63554	3.62904	3.62254	3.61604	3.60954	3.60304	3.59654	3.59004	3.58354	3.57704	3.57054	3.56404	3.55754	3.55104	3.54454	3.53804	3.53154	3.52504	3.51854	3.51204	3.50554	3.49904	3.49254	3.48604	3.47954	3.47304	3.46654	3.46004	3.45354	3.44704	3.44054	3.43404	3.42754	3.42104	3.41454	3.40804	3.40154	3.39504	3.38854	3.38204	3.37554	3.36904	3.36254	3.35604	3.34954	3.34304	3.33654	3.33004	3.32354	3.31704	3.31054	3.30404	3.29754	3.29104	3.28454	3.27804	3.27154	3.26504	3.25854	3.25204	3.24554	3.23904	3.23254	3.22604	3.21954	3.21304	3.20654	3.20004	3.19354	3.18704	3.18054	3.17404	3.16754	3.16104	3.15454	3.14804	3.14154	3.13504	3.12854	3.12204	3.11554	3.10904	3.10254	3.09604	3.08954	3.08304	3.07654	3.07004	3.06354	3.05704	3.05054	3.04404	3.03754	3.03104	3.02454	3.01804	3.01154	3.00504	2.99854	2.99204	2.98554	2.97904	2.97254	2.96604	2.95954	2.95304	2.94654	2.94004	2.93354	2.92704	2.92054	2.91404	2.90754	2.90104	2.89454	2.88804	2.88154	2.87504	2.86854	2.86204	2.85554	2.84904	2.84254	2.83604	2.82954	2.82304	2.81654	2.81004	2.80354	2.79704	2.79054	2.78404	2.77754	2.77104	2.76454	2.75804	2.75154	2.74504	2.73854	2.73204	2.72554	2.71904	2.71254	2.70604	2.69954	2.69304	2.68654	2.68004	2.67354	2.66704	2.66054	2.65404	2.64754	2.64104	2.63454	2.62804	2.62154	2.61504	2.60854	2.60204	2.59554	2.58904	2.58254	2.57604	2.56954	2.56304	2.55654	2.55004	2.54354	2.53704	2.53054	2.52404	2.51754	2.51104	2.50454	2.49804	2.49154	2.48504	2.47854	2.47204	2.46554	2.45904	2.45254	2.44604	2.43954	2.43304	2.42654	2.42004	2.41354	2.40704	2.40054	2.39404	2.38754	2.38104	2.37454	2.36804	2.36154	2.35504	2.34854	2.34204	2.33554	2.32904	2.32254	2.31604	2.30954	2.30304	2.29654	2.29004	2.28354	2.27704	2.27054	2.26404	2.25754	2.25104	2.24454	2.23804	2.23154	2.22504	2.21854	2.21204	2.20554	2.19904

TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		45° 30'	46° 00'	47° 00'	47° 30'	48° 00'	48° 30'	49° 00'	49° 30'	50° 00'	50° 30'	51° 00'	51° 30'			52° 00'																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
h. m.	°	9. 69126	9. 68730	9. 68327	9. 67917	9. 67500	9. 67075	9. 66643	9. 66203	9. 65756	9. 65300	9. 64836	9. 64364	9. 63883	3 00	9. 63404	9. 62922	9. 62431	9. 61930	9. 61419	9. 60908	9. 60387	9. 59866	9. 59345	9. 58824	9. 58303	9. 57782	9. 57261	9. 56740	9. 56219	9. 55698	9. 55177	9. 54656	9. 54135	9. 53614	9. 53093	9. 52572	9. 52051	9. 51530	9. 51009	9. 50488	9. 49967	9. 49446	9. 48925	9. 48404	9. 47883	9. 47362	9. 46841	9. 46320	9. 45799	9. 45278	9. 44757	9. 44236	9. 43715	9. 43194	9. 42673	9. 42152	9. 41631	9. 41110	9. 40589	9. 40068	9. 39547	9. 39026	9. 38505	9. 37984	9. 37463	9. 36942	9. 36421	9. 35900	9. 35379	9. 34858	9. 34337	9. 33816	9. 33295	9. 32774	9. 32253	9. 31732	9. 31211	9. 30690	9. 30169	9. 29648	9. 29127	9. 28606	9. 28085	9. 27564	9. 27043	9. 26522	9. 26001	9. 25480	9. 24959	9. 24438	9. 23917	9. 23396	9. 22875	9. 22354	9. 21833	9. 21312	9. 20791	9. 20270	9. 19749	9. 19228	9. 18707	9. 18186	9. 17665	9. 17144	9. 16623	9. 16102	9. 15581	9. 15060	9. 14539	9. 14018	9. 13497	9. 12976	9. 12455	9. 11934	9. 11413	9. 10892	9. 10371	9. 9850	9. 9329	9. 8808	9. 8287	9. 7766	9. 7245	9. 6724	9. 6203	9. 5682	9. 5161	9. 4640	9. 4119	9. 3598	9. 3077	9. 2556	9. 2035	9. 1514	9. 993	9. 472	9. 10	9. 58	9. 106	9. 605	9. 1104	9. 1603	9. 2102	9. 2601	9. 3100	9. 3599	9. 4098	9. 4597	9. 5096	9. 5595	9. 6094	9. 6593	9. 7092	9. 7591	9. 8090	9. 8589	9. 9088	9. 9587	9. 10086	9. 10585	9. 11084	9. 11583	9. 12082	9. 12581	9. 13080	9. 13579	9. 14078	9. 14577	9. 15076	9. 15575	9. 16074	9. 16573	9. 17072	9. 17571	9. 18070	9. 18569	9. 19068	9. 19567	9. 20066	9. 20565	9. 21064	9. 21563	9. 22062	9. 22561	9. 23060	9. 23559	9. 24058	9. 24557	9. 25056	9. 25555	9. 26054	9. 26553	9. 27052	9. 27551	9. 28050	9. 28549	9. 29048	9. 29547	9. 30046	9. 30545	9. 31044	9. 31543	9. 32042	9. 32541	9. 33040	9. 33539	9. 34038	9. 34537	9. 35036	9. 35535	9. 36034	9. 36533	9. 37032	9. 37531	9. 38030	9. 38529	9. 39028	9. 39527	9. 40026	9. 40525	9. 41024	9. 41523	9. 42022	9. 42521	9. 43020	9. 43519	9. 44018	9. 44517	9. 45016	9. 45515	9. 46014	9. 46513	9. 47012	9. 47511	9. 48010	9. 48509	9. 49008	9. 49507	9. 50006	9. 50505	9. 51004	9. 51503	9. 52002	9. 52501	9. 53000	9. 53499	9. 53998	9. 54497	9. 54996	9. 55495	9. 55994	9. 56493	9. 56992	9. 57491	9. 57990	9. 58489	9. 58988	9. 59487	9. 59986	9. 60485	9. 60984	9. 61483	9. 61982	9. 62481	9. 62980	9. 63479	9. 63978	9. 64477	9. 64976	9. 65475	9. 65974	9. 66473	9. 66972	9. 67471	9. 67970	9. 68469	9. 68968	9. 69467	9. 69966	9. 70465	9. 70964	9. 71463	9. 71962	9. 72461	9. 72960	9. 73459	9. 73958	9. 74457	9. 74956	9. 75455	9. 75954	9. 76453	9. 76952	9. 77451	9. 77950	9. 78449	9. 78948	9. 79447	9. 79946	9. 80445	9. 80944	9. 81443	9. 81942	9. 82441	9. 82940	9. 83439	9. 83938	9. 84437	9. 84936	9. 85435	9. 85934	9. 86433	9. 86932	9. 87431	9. 87930	9. 88429	9. 88928	9. 89427	9. 89926	9. 90425	9. 90924	9. 91423	9. 91922	9. 92421	9. 92920	9. 93419	9. 93918	9. 94417	9. 94916	9. 95415	9. 95914	9. 96413	9. 96912	9. 97411	9. 97910	9. 98409	9. 98908	9. 99407	9. 99906	10. 00405	10. 00904	10. 01403	10. 01902	10. 02401	10. 02900	10. 03399	10. 03898	10. 04397	10. 04896	10. 05395	10. 05894	10. 06393	10. 06892	10. 07391	10. 07890	10. 08389	10. 08888	10. 09387	10. 09886	10. 10385	10. 10884	10. 11383	10. 11882	10. 12381	10. 12880	10. 13379	10. 13878	10. 14377	10. 14876	10. 15375	10. 15874	10. 16373	10. 16872	10. 17371	10. 17870	10. 18369	10. 18868	10. 19367	10. 19866	10. 20365	10. 20864	10. 21363	10. 21862	10. 22361	10. 22860	10. 23359	10. 23858	10. 24357	10. 24856	10. 25355	10. 25854	10. 26353	10. 26852	10. 27351	10. 27850	10. 28349	10. 28848	10. 29347	10. 29846	10. 30345	10. 30844	10. 31343	10. 31842	10. 32341	10. 32840	10. 33339	10. 33838	10. 34337	10. 34836	10. 35335	10. 35834	10. 36333	10. 36832	10. 37331	10. 37830	10. 38329	10. 38828	10. 39327	10. 39826	10. 40325	10. 40824	10. 41323	10. 41822	10. 42321	10. 42820	10. 43319	10. 43818	10. 44317	10. 44816	10. 45315	10. 45814	10. 46313	10. 46812	10. 47311	10. 47810	10. 48309	10. 48808	10. 49307	10. 49806	10. 50305	10. 50804	10. 51303	10. 51802	10. 52301	10. 52800	10. 53299	10. 53798	10. 54297	10. 54796	10. 55295	10. 55794	10. 56293	10. 56792	10. 57291	10. 57790	10. 58289	10. 58788	10. 59287	10. 59786	10. 60285	10. 60784	10. 61283	10. 61782	10. 62281	10. 62780	10. 63279	10. 63778	10. 64277	10. 64776	10. 65275	10. 65774	10. 66273	10. 66772	10. 67271	10. 67770	10. 68269	10. 68768	10. 69267	10. 69766	10. 70265	10. 70764	10. 71263	10. 71762	10. 72261	10. 72760	10. 73259	10. 73758	10. 74257	10. 74756	10. 75255	10. 75754	10. 76253	10. 76752	10. 77251	10. 77750	10. 78249	10. 78748	10. 79247	10. 79746	10. 80245	10. 80744	10. 81243	10. 81742	10. 82241	10. 82740	10. 83239	10. 83738	10. 84237	10. 84736	10. 85235	10. 85734	10. 86233	10. 86732	10. 87231	10. 87730	10. 88229	10. 88728	10. 89227	10. 89726	10. 90225	10. 90724	10. 91223	10. 91722	10. 92221	10. 92720	10. 93219	10. 93718	10. 94217	10. 94716	10. 95215	10. 95714	10. 96213	10. 96712	10. 97211	10. 97710	10. 98209	10. 98708	10. 99207	10. 99706	10. 100205	10. 100704	10. 101203	10. 101702	10. 102201	10. 102700	10. 103199	10. 103698	10. 104197	10. 104696	10. 105195	10. 105694	10. 106193	10. 106692	10. 107191	10. 107690	10. 108189	10. 108688	10. 109187	10. 109686	10. 110185	10. 110684	10. 111183	10. 111682	10. 112181	10. 112680	10. 113179	10. 113678	10. 114177	10. 114676	10. 115175	10. 115674	10. 116173	10. 116672	10. 117171	10. 117670	10. 118169	10. 118668	10. 119167	10. 119666	10. 120165	10. 120664	10. 121163	10. 121662	10. 122161	10. 122660	10. 123159	10. 123658	10. 124157	10. 124656	10. 125155	10. 125654	10. 126153	10. 126652	10. 127151	10. 127650	10. 128149	10. 128648	10. 129147	10. 129646	10. 130145	10. 130644	10. 131143	10. 131642	10. 132141	10. 132640	10. 133139	10. 133638	10. 134137	10. 134636	10. 135135	10. 135634	10. 136133	10. 136632	10. 137131	10. 137630	10. 138129	10. 138628	10. 139127	10. 139626	10. 140125	10. 140624	10. 141123	10. 141622	10. 142121	10. 142620	10. 143119	10. 143618	10. 144117	10. 144616	10. 145115	10. 145614	10. 146113	10. 146612	10. 147111	10. 147610	10. 148109	10. 148608	10. 149107	10. 149606	10. 150105	10. 150604	10. 151103	10. 151602	10. 152101	10. 152600	10. 153099	10. 153598	10. 154097	10. 154596	10. 155095	10. 155594	10. 156093	10. 156592	10. 157091	10. 157590	10. 158089	10. 158588	10. 159087	10. 159586	10. 160085	10. 160584	10. 161083	10. 161582	10. 162081	10. 162580	10. 163079	10. 163578	10. 164077	10. 164576	10. 165075	10. 165574	10. 166073	10. 166572	10. 167071	10. 167570	10. 168069	10. 168568	10. 169067	10. 169566	10. 170065	10. 170564	10. 171063	10. 171562	10. 172061	10. 172560	10. 173059	10. 173558	10. 174057	10. 174556	10. 175055	10. 175554	10. 176053	10. 176552	10. 177051	10. 177550	10. 178049	10. 178548	10. 179047	10. 179546	10. 180045	10. 180544	10. 181043	10. 181542	10. 182041	10. 182540	10. 183039	10. 183538	10. 184037	10. 184536	10. 185035	10. 185534	10. 186033	10. 186532	10. 187031	10. 187530	10. 188029	10. 188528	10. 189027	10. 189526	10. 190025	10. 190524	10. 191023	10. 191522	10. 192021	10. 192520	10. 193019	10. 193518	10. 194017	10. 194516	10. 195015	10. 195514	10. 196013	10. 196512	10. 197011	10. 197510	10. 198009	10. 198508	10. 199007	10. 199506	20. 0005	20. 0054	20. 0103	20. 0152	20. 0201	20. 0250	20. 0299	20. 0348	20. 0397	20. 0446	20. 0495	20. 0544	20. 0593	20. 0642	20. 0691	20. 0740	20. 0789	20. 0838	20. 0887	20. 0936	20. 0985	20. 1034	20. 1083	20. 1132	20. 1181	20. 1230	20. 1279	20. 1328	20. 1377	20. 1426	20. 1475	20. 1524	20. 1573	20. 1622	20. 1671	20. 1720	20. 1769	20. 1818	20. 1867	20. 1916	20. 1965	20. 2014	20. 2063	20. 2112	20. 2161	20. 2210	20. 2259	20. 2308	20. 2357	20. 2406	20. 2455	20. 2504	20. 2553	20. 2602	20. 2651	20. 2700	20. 2749	20. 2798	20. 2847	20. 2896	20. 2945	20. 2994	20. 3043	20. 3092	20. 3141	20. 3190	20. 3239	20. 3288	20. 3337	20. 3386	20. 3435	20. 3484	20. 3533	20. 3582	20. 3631	20. 3680	20. 3729	20. 3778	20. 3827	20. 3876	20. 3



The Finding of the Azimuth.

RULE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

Hour Angle. Declination.

Hour Angle.	Declination.												Hour Angle.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	h. m.	0	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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
52° 00'	—∞	8.03120	8.33216	8.53084	8.62893	8.71976	8.80485	8.88357	8.95723	9.02601	9.09004	9.14943	9.20428	9.25469	9.30076	9.34259	9.38028	9.41393	9.45364	9.48941	9.52124	9.54913	9.57308	9.59309	9.60916	9.62129	9.62948	9.63373	9.63404	9.63041	9.62284	9.61135	9.59594	9.57671	9.55376	9.52709	9.49670	9.46287	9.42560	9.38499	9.34114	9.29405	9.24382	9.19055	9.13429	9.07504	8.91291	8.84800	8.78541	8.72524	8.66759	8.61246	8.55985	8.50986	8.46249	8.41776	8.37567	8.33616	8.29923	8.26487	8.23308	8.20386	8.17721	8.15312	8.13159	8.11262	8.09611	8.08206	8.07047	8.06134	8.05467	8.05046	8.04861	8.04912	8.05195	8.05710	8.06357	8.07136	8.08047	8.09090	8.10265	8.11572	8.13011	8.14582	8.16285	8.18120	8.20087	8.22186	8.24417	8.26780	8.29275	8.31902	8.34651	8.37522	8.40515	8.43630	8.46867	8.50226	8.53707	8.57310	8.61035	8.64882	8.68851	8.72942	8.77155	8.81490	8.85947	8.90526	8.95227	9.00050	9.04995	9.10062	9.15251	9.20562	9.25995	9.31550	9.37227	9.43027	9.48950	9.54995	9.61162	9.67451	9.73862	9.80395	9.87050	9.93827	10.00726	10.07747	10.14890	10.22155	10.29542	10.37051	10.44682	10.52435	10.60310	10.68307	10.76426	10.84667	10.93030	11.01515	11.10122	11.18851	11.27702	11.36675	11.45770	11.54987	11.64326	11.73787	11.83370	11.93075	12.02902	12.12851	12.22922	12.33115	12.43430	12.53867	12.64426	12.75107	12.85910	12.96835	13.07882	13.19051	13.30342	13.41755	13.53290	13.64947	13.76726	13.88627	14.00650	14.12795	14.25062	14.37451	14.50062	14.62795	14.75650	14.88627	15.01726	15.14947	15.28290	15.41755	15.55342	15.69051	15.82882	15.96835	16.10910	16.25107	16.39426	16.53867	16.68430	16.83147	16.98010	17.13027	17.28190	17.43507	17.58980	17.74617	17.90420	18.06387	18.22510	18.38797	18.55250	18.71867	18.88650	19.05607	19.22740	19.40047	19.57530	19.75187	19.93020	20.11027	20.29200	20.47537	20.66040	20.84707	21.03540	21.22537	21.41690	21.61007	21.80490	22.00137	22.19950	22.39927	22.60070	22.80387	23.00880	23.21547	23.42380	23.63377	23.84530	24.05857	24.27360	24.48937	24.70680	24.92587	25.14650	25.36887	25.59290	25.81857	26.04590	26.27487	26.50540	26.73757	26.97130	27.20657	27.44340	27.68187	27.92190	28.16357	28.40680	28.65167	28.89810	29.14617	29.39580	29.64707	29.89990	30.15437	30.41050	30.66827	30.92760	31.18867	31.45140	31.71577	31.98180	32.24947	32.51870	32.78957	33.06200	33.33617	33.61200	33.88957	34.16880	34.44977	34.73240	35.01677	35.30290	35.59087	35.88060	36.17207	36.46520	36.76007	37.05660	37.35487	37.65490	37.95667	38.26010	38.56527	38.87210	39.18067	39.49090	39.80287	40.11650	40.43187	40.74890	41.06757	41.38780	41.70967	42.03310	42.35827	42.68510	43.01367	43.34390	43.67587	44.00940	44.34457	44.68130	45.01967	45.35960	45.70117	46.04440	46.38937	46.73590	47.08407	47.43390	47.78547	48.13870	48.49367	48.85030	49.20867	49.56880	49.93067	50.29420	50.65947	51.02650	51.39527	51.76570	52.13797	52.51200	52.88787	53.26550	53.64487	54.02590	54.40867	54.79300	55.17907	55.56680	55.95627	56.34740	56.74027	57.13480	57.53107	57.92900	58.32867	58.72990	59.13277	59.53720	59.94337	60.35120	60.76077	61.17200	61.58497	61.99960	62.41597	62.83400	63.25377	63.67520	64.09847	64.52350	64.95037	65.37890	65.80917	66.24120	66.67507	67.11070	67.54817	67.98740	68.42847	68.87130	69.31597	69.76240	70.21067	70.66080	71.11287	71.56680	72.02267	72.48040	72.94007	73.40160	73.86507	74.33040	74.79767	75.26680	75.73787	76.21080	76.68567	77.16240	77.64107	78.12160	78.60407	79.08840	79.57467	80.06290	80.55327	81.04570	81.54027	82.03690	82.53577	83.03680	83.53997	84.04530	84.55287	85.06260	85.57457	86.08870	86.60517	87.12390	87.64497	88.16830	88.69397	89.22180	89.75187	90.28410	90.81857	91.35520	91.89407	92.43520	92.97867	93.52440	94.07257	94.62310	95.17607	95.73140	96.28927	96.84960	97.41257	97.97810	98.54637	99.11740	99.69127	100.26780	100.84707	101.42907	102.01380	102.60137	103.19170	103.78487	104.38080	104.97957	105.58107	106.18540	106.79267	107.40280	108.01587	108.63180	109.25067	109.87240	110.49707	111.12460	111.75507	112.38840	113.02467	113.66380	114.30597	114.95110	115.59927	116.25050	116.90487	117.56240	118.22317	118.88710	119.55437	120.22490	120.89887	121.57620	122.25707	122.94050	123.62767	124.31850	125.01307	125.71140	126.41367	127.11980	127.82997	128.54420	129.26257	129.98500	130.71157	131.44230	132.17737	132.91670	133.66047	134.40860	135.16127	135.91850	136.68047	137.44710	138.21857	138.99480	139.77597	140.56210	141.35337	142.14980	142.95157	143.75870	144.57137	145.37960	146.19357	147.01330	147.83897	148.67060	149.50837	150.35230	151.20257	152.05920	152.92247	153.79240	154.66917	155.55280	156.44347	157.34120	158.24617	159.15840	160.07827	160.99580	161.92117	162.85440	163.79567	164.74400	165.69957	166.66250	167.63307	168.61140	169.59777	170.59220	171.59487	172.60580	173.62517	174.65300	175.68947	176.73460	177.78857	178.85140	179.92337	180.00450	181.09497	182.19480	183.30427	184.42340	185.55237	186.69130	187.84037	189.00000	190.17047	191.35190	192.54457	193.74850	194.96387	196.19080	197.42947	198.67990	199.94257	201.21750	202.50497	203.80500	205.11787	206.44380	207.78307	209.13580	210.50237	211.88290	213.27767	214.68680	216.11067	217.54940	219.00337	220.47280	221.94807	223.42950	224.91757	226.42250	227.94517	229.48480	231.04187	232.60670	234.18977	235.79140	237.31197	238.85180	240.40137	241.96100	243.53107	245.11180	246.70357	248.30670	249.92167	251.54880	253.18857	254.84130	256.50747	258.18740	259.88157	261.59030	263.30497	265.03590	266.78367	268.54850	270.33187	272.13420	273.95607	275.79790	277.66037	279.54390	281.44907	283.37540	285.32357	287.29400	289.28737	291.30420	293.34507	295.41050	297.50127	299.61800	301.76147	303.93230	306.13117	308.35860	310.61527	312.89170	315.18867	317.50680	319.84687	322.20940	324.59627	327.00820	329.44617	331.91000	334.39057	336.88867	339.40430	341.93747	344.48820	347.05687	349.64380	352.24957	354.87450	357.51897	360.18350	362.86857	365.57460	368.30247	371.05280	373.82617	376.62300	379.44397	382.28960	385.16167	388.06057	390.98700	393.94177	396.92460	399.93647	402.97800	406.04997	409.15320	412.28757	415.45380	418.65197	421.88290	425.14737	428.44580	431.77817	435.14540	438.54857	441.98750	445.46327	448.97580	452.52517	456.11240	459.73837	463.40390	467.11027	470.85850	474.64987	478.48450	482.36307	486.28690	490.25767	494.27590	498.34247	502.45800	506.62347	510.83960	515.10727	519.42700	523.79977	528.22640	532.70797	537.24540	541.83987	546.49240	551.20417	555.97600	560.80917	565.70480	570.66417	575.68850	580.77917	585.93640	591.16187	596.45690	601.82297	607.26150	612.76417	618.33250	623.96747	629.67060	635.44377	641.28780	647.20367	653.19240	659.25617	665.39590	671.61267	677.90750	684.28247	690.73960	697.28017	703.90640	710.61987	717.42280	724.31757	731.30650	738.39207	745.47680	752.66247	759.85090	767.14387	774.54300	781.94997	789.46660	797.09497	804.83700	812.59487	820.46050	828.43607	836.52360	844.72517	853.04380	861.48187	870.04150	878.71507	887.50480	896.41307	905.44200	914.59397	923.87040	933.27497	942.80910	952.47547	962.27660	972.20517	982.26390	992.45567	1002.78200	1013.24567	1023.84940	1034.59517	1045.48500	1056.52117	1067.70580	1079.04147	1090.53090	1102.17747	1113.98400	1125.95307	1138.08710	1150.38887	1162.85090	1175.47607	1188.26710	1201.22697	1214.35850	1227.56467	1240.94850	1254.51317	1268.26180	1282.19807	1296.32500	1310.74607	1325.36450	1340.18417	1355.20850	1370.54147	1386.18600	1402.14617	1418.42590	1435.02917	1451.85900	1468.91857	1486.21100	1503.74057	1521.51150	1539.52747	1557.79200	1576.31017	1595.08590	1614.12347	1633.42750	1652.99217	1672.82150	1692.92017	1713.29200	1733.94147	1754.87300	1776.09097	1797.60000	1819.40567	1841.51300	1863.92747	1886.65400	1909.69717	1933.06150	1956.74207





TABLE V.  
The Finding of the Azimuth.

Hour Angle.	Declination.													
	58° 30'	59° 00'	59° 30'	60° 00'	60° 30'	61° 00'	61° 30'	62° 00'	62° 30'	63° 00'	63° 30'	64° 00'	64° 30'	65° 00'
h. m.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	7.95270	7.94733	7.94200	7.93659	7.93114	7.92565	7.92012	7.91455	7.90894	7.90329	7.89759	7.89184	7.88604	7.88019
1	7.95065	7.94529	7.93992	7.93441	7.92886	7.92327	7.91764	7.91197	7.90626	7.90051	7.89471	7.88886	7.88296	7.87701
2	7.94860	7.94324	7.93784	7.93239	7.92690	7.92137	7.91580	7.91019	7.90454	7.89885	7.89311	7.88732	7.88148	7.87559
3	7.94655	7.94119	7.93576	7.93029	7.92478	7.91923	7.91364	7.90801	7.90234	7.89663	7.89088	7.88508	7.87924	7.87335
4	7.94450	7.93914	7.93369	7.92820	7.92267	7.91710	7.91149	7.90584	7.90015	7.89442	7.88865	7.88284	7.87699	7.87109
5	7.94245	7.93709	7.93162	7.92611	7.92056	7.91497	7.90934	7.90367	7.89796	7.89221	7.88642	7.88059	7.87472	7.86881
6	7.94040	7.93504	7.92956	7.92403	7.91846	7.91285	7.90720	7.90151	7.89578	7.89001	7.88419	7.87832	7.87241	7.86645
7	7.93835	7.93299	7.92750	7.92195	7.91636	7.91073	7.90506	7.89935	7.89360	7.88781	7.88198	7.87611	7.87019	7.86422
8	7.93630	7.93094	7.92543	7.91987	7.91427	7.90863	7.90295	7.89723	7.89147	7.88567	7.87982	7.87392	7.86797	7.86197
9	7.93425	7.92889	7.92337	7.91780	7.91219	7.90655	7.90087	7.89515	7.88939	7.88359	7.87774	7.87184	7.86589	7.85989
10	7.93220	7.92684	7.92131	7.91573	7.91011	7.90446	7.89877	7.89304	7.88727	7.88146	7.87560	7.86969	7.86373	7.85772
11	7.93015	7.92479	7.91920	7.91361	7.90798	7.90232	7.89662	7.89088	7.88511	7.87930	7.87344	7.86753	7.86157	7.85556
12	7.92810	7.92274	7.91714	7.91155	7.90592	7.90025	7.89455	7.88881	7.88304	7.87723	7.87137	7.86546	7.85950	7.85349
13	7.92605	7.92069	7.91502	7.90943	7.90380	7.89812	7.89240	7.88664	7.88084	7.87503	7.86917	7.86326	7.85730	7.85129
14	7.92400	7.91864	7.91297	7.90737	7.90174	7.89606	7.89034	7.88458	7.87878	7.87293	7.86703	7.86108	7.85508	7.84903
15	7.92195	7.91659	7.91092	7.90532	7.89969	7.89399	7.88825	7.88247	7.87665	7.87078	7.86486	7.85889	7.85287	7.84681
16	7.91990	7.91454	7.90887	7.90327	7.89764	7.89192	7.88616	7.88036	7.87452	7.86864	7.86271	7.85673	7.85070	7.84463
17	7.91785	7.91249	7.90682	7.90122	7.89559	7.88986	7.88409	7.87827	7.87241	7.86650	7.86054	7.85453	7.84847	7.84236
18	7.91580	7.91044	7.90477	7.89917	7.89354	7.88777	7.88195	7.87608	7.87016	7.86419	7.85817	7.85210	7.84598	7.83981
19	7.91375	7.90839	7.90272	7.89712	7.89149	7.88572	7.87989	7.87401	7.86808	7.86210	7.85607	7.85000	7.84387	7.83769
20	7.91170	7.90634	7.90067	7.89507	7.88944	7.88367	7.87784	7.87195	7.86601	7.86002	7.85398	7.84789	7.84175	7.83556
21	7.90965	7.90429	7.89862	7.89302	7.88739	7.88162	7.87579	7.86990	7.86395	7.85795	7.85190	7.84581	7.83967	7.83348
22	7.90760	7.90224	7.89657	7.89097	7.88534	7.87957	7.87374	7.86785	7.86190	7.85590	7.84985	7.84376	7.83762	7.83143
23	7.90555	7.90019	7.89452	7.88892	7.88329	7.87752	7.87169	7.86580	7.85985	7.85385	7.84780	7.84171	7.83557	7.82938
24	7.90350	7.89814	7.89247	7.88687	7.88124	7.87547	7.86964	7.86375	7.85780	7.85180	7.84575	7.83966	7.83352	7.82733
25	7.90145	7.89609	7.89042	7.88482	7.87919	7.87342	7.86759	7.86170	7.85575	7.84975	7.84370	7.83761	7.83147	7.82528
26	7.89940	7.89404	7.88837	7.88277	7.87714	7.87137	7.86554	7.85965	7.85370	7.84770	7.84165	7.83556	7.82942	7.82323
27	7.89735	7.89199	7.88632	7.88072	7.87509	7.86932	7.86349	7.85760	7.85165	7.84565	7.83960	7.83351	7.82737	7.82118
28	7.89530	7.88994	7.88427	7.87867	7.87304	7.86727	7.86144	7.85555	7.84960	7.84360	7.83755	7.83146	7.82532	7.81913
29	7.89325	7.88789	7.88222	7.87662	7.87099	7.86522	7.85939	7.85350	7.84755	7.84155	7.83550	7.82941	7.82327	7.81708
30	7.89120	7.88584	7.88017	7.87457	7.86894	7.86317	7.85734	7.85145	7.84550	7.83950	7.83345	7.82736	7.82122	7.81503
31	7.88915	7.88379	7.87812	7.87252	7.86689	7.86112	7.85529	7.84940	7.84345	7.83745	7.83140	7.82531	7.81917	7.81298
32	7.88710	7.88174	7.87607	7.87047	7.86484	7.85907	7.85324	7.84735	7.84140	7.83540	7.82935	7.82326	7.81712	7.81093
33	7.88505	7.87969	7.87402	7.86842	7.86279	7.85702	7.85119	7.84530	7.83935	7.83335	7.82730	7.82121	7.81507	7.80888
34	7.88300	7.87764	7.87197	7.86637	7.86074	7.85497	7.84914	7.84325	7.83730	7.83130	7.82525	7.81916	7.81302	7.80683
35	7.88095	7.87559	7.86992	7.86432	7.85869	7.85292	7.84709	7.84120	7.83525	7.82925	7.82320	7.81711	7.81097	7.80478
36	7.87890	7.87354	7.86787	7.86227	7.85664	7.85087	7.84504	7.83915	7.83320	7.82720	7.82115	7.81506	7.80892	7.80273
37	7.87685	7.87149	7.86582	7.86022	7.85459	7.84882	7.84299	7.83710	7.83115	7.82515	7.81910	7.81301	7.80687	7.80068
38	7.87480	7.86944	7.86377	7.85817	7.85254	7.84677	7.84084	7.83485	7.82880	7.82270	7.81655	7.81036	7.80412	7.79783
39	7.87275	7.86739	7.86172	7.85612	7.85049	7.84472	7.83879	7.83280	7.82675	7.82065	7.81450	7.80831	7.80207	7.79578
40	7.87070	7.86534	7.85967	7.85407	7.84844	7.84267	7.83674	7.83075	7.82470	7.81860	7.81245	7.80626	7.79992	7.79353
41	7.86865	7.86329	7.85762	7.85202	7.84639	7.84062	7.83469	7.82870	7.82265	7.81655	7.81040	7.80421	7.79797	7.79168
42	7.86660	7.86124	7.85557	7.84997	7.84434	7.83857	7.83264	7.82665	7.82060	7.81450	7.80835	7.80216	7.79592	7.78963
43	7.86455	7.85919	7.85352	7.84792	7.84229	7.83652	7.83059	7.82460	7.81855	7.81245	7.80630	7.80011	7.79387	7.78758
44	7.86250	7.85714	7.85147	7.84587	7.84024	7.83447	7.82854	7.82255	7.81650	7.81040	7.80425	7.79806	7.79182	7.78553
45	7.86045	7.85509	7.84942	7.84382	7.83819	7.83242	7.82649	7.82050	7.81445	7.80835	7.80220	7.79601	7.78977	7.78348
46	7.85840	7.85304	7.84737	7.84177	7.83614	7.83037	7.82444	7.81845	7.81240	7.80630	7.80015	7.79396	7.78772	7.78143
47	7.85635	7.85099	7.84532	7.83972	7.83409	7.82832	7.82239	7.81640	7.81035	7.80425	7.79810	7.79191	7.78567	7.77938
48	7.85430	7.84894	7.84327	7.83767	7.83204	7.82627	7.82034	7.81435	7.80830	7.80220	7.79605	7.78986	7.78362	7.77733
49	7.85225	7.84689	7.84122	7.83562	7.82999	7.82422	7.81829	7.81230	7.80625	7.80015	7.79400	7.78781	7.78157	7.77528
50	7.85020	7.84484	7.83917	7.83357	7.82794	7.82217	7.81624	7.81025	7.80420	7.79810	7.79195	7.78576	7.77952	7.77323
51	7.84815	7.84279	7.83712	7.83152	7.82589	7.82012	7.81419	7.80820	7.80215	7.79605	7.78990	7.78371	7.77747	7.77118
52	7.84610	7.84074	7.83507	7.82947	7.82384	7.81807	7.81214	7.80615	7.80010	7.79395	7.78775	7.78151	7.77522	7.76888
53	7.84405	7.83869	7.83302	7.82742	7.82179	7.81602	7.81009	7.80410	7.79805	7.79195	7.78580	7.77960	7.77335	7.76706
54	7.84200	7.83664	7.83097	7.82537	7.81974	7.81397	7.80804	7.80205	7.79600	7.78990	7.78375	7.77755	7.77130	7.76501
55	7.84000	7.83464	7.82897	7.82337	7.81774	7.81197	7.80604	7.80005	7.79400	7.78790	7.78175	7.77555	7.76930	7.76291
56	7.83800	7.83264	7.82707	7.82147	7.81584	7.81007	7.80414	7.79815	7.79210	7.78600	7.77985	7.77365	7.76740	7.76101
57	7.83600	7.83064	7.82507	7.81947	7.81384	7.80807	7.80214	7.79615	7.79010	7.78400	7.77785	7.77165	7.76540	7.75901
58	7.83400	7.82864	7.82307	7.81747	7.81184	7.80607	7.80014	7.79415	7.78810	7.78200	7.77585	7.76965	7.76340	7.75691
59	7.83200	7.82664	7.82107	7.81547	7.80984	7.80407	7.79814	7.79215	7.78610	7.78000	7.77385	7.76765	7.76140	7.75491
60	7.83000	7.82464	7.81907	7.81347	7.80784	7.80207	7.79614	7.79015	7.78					

TABLE V.  
The Finding of the Azimuth.

Hour Angle.	Declination.												Hour Angle.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	h. m.	3	4	5	6	7	8	9	10	11	12	13																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
0 00	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
0 00	9.47544	9.48349	9.49135	9.49904	9.50656	9.51392	9.52112	9.52816	9.53506	9.54183	9.54846	9.55494	9.56128	9.56748	9.57354	9.57946	9.58524	9.59088	9.59638	9.60174	9.60696	9.61204	9.61698	9.62178	9.62644	9.63096	9.63534	9.63954	9.64356	9.64740	9.65106	9.65454	9.65794	9.66126	9.66440	9.66746	9.67034	9.67304	9.67556	9.67790	9.68006	9.68204	9.68384	9.68546	9.68690	9.68816	9.68924	9.69014	9.69086	9.69140	9.69176	9.69204	9.69224	9.69236	9.69240	9.69244	9.69248	9.69252	9.69256	9.69260	9.69264	9.69268	9.69272	9.69276	9.69280	9.69284	9.69288	9.69292	9.69296	9.69300	9.69304	9.69308	9.69312	9.69316	9.69320	9.69324	9.69328	9.69332	9.69336	9.69340	9.69344	9.69348	9.69352	9.69356	9.69360	9.69364	9.69368	9.69372	9.69376	9.69380	9.69384	9.69388	9.69392	9.69396	9.69400	9.69404	9.69408	9.69412	9.69416	9.69420	9.69424	9.69428	9.69432	9.69436	9.69440	9.69444	9.69448	9.69452	9.69456	9.69460	9.69464	9.69468	9.69472	9.69476	9.69480	9.69484	9.69488	9.69492	9.69496	9.69500	9.69504	9.69508	9.69512	9.69516	9.69520	9.69524	9.69528	9.69532	9.69536	9.69540	9.69544	9.69548	9.69552	9.69556	9.69560	9.69564	9.69568	9.69572	9.69576	9.69580	9.69584	9.69588	9.69592	9.69596	9.69600	9.69604	9.69608	9.69612	9.69616	9.69620	9.69624	9.69628	9.69632	9.69636	9.69640	9.69644	9.69648	9.69652	9.69656	9.69660	9.69664	9.69668	9.69672	9.69676	9.69680	9.69684	9.69688	9.69692	9.69696	9.69700	9.69704	9.69708	9.69712	9.69716	9.69720	9.69724	9.69728	9.69732	9.69736	9.69740	9.69744	9.69748	9.69752	9.69756	9.69760	9.69764	9.69768	9.69772	9.69776	9.69780	9.69784	9.69788	9.69792	9.69796	9.69800	9.69804	9.69808	9.69812	9.69816	9.69820	9.69824	9.69828	9.69832	9.69836	9.69840	9.69844	9.69848	9.69852	9.69856	9.69860	9.69864	9.69868	9.69872	9.69876	9.69880	9.69884	9.69888	9.69892	9.69896	9.69900	9.69904	9.69908	9.69912	9.69916	9.69920	9.69924	9.69928	9.69932	9.69936	9.69940	9.69944	9.69948	9.69952	9.69956	9.69960	9.69964	9.69968	9.69972	9.69976	9.69980	9.69984	9.69988	9.69992	9.69996	9.70000	9.70004	9.70008	9.70012	9.70016	9.70020	9.70024	9.70028	9.70032	9.70036	9.70040	9.70044	9.70048	9.70052	9.70056	9.70060	9.70064	9.70068	9.70072	9.70076	9.70080	9.70084	9.70088	9.70092	9.70096	9.70100	9.70104	9.70108	9.70112	9.70116	9.70120	9.70124	9.70128	9.70132	9.70136	9.70140	9.70144	9.70148	9.70152	9.70156	9.70160	9.70164	9.70168	9.70172	9.70176	9.70180	9.70184	9.70188	9.70192	9.70196	9.70200	9.70204	9.70208	9.70212	9.70216	9.70220	9.70224	9.70228	9.70232	9.70236	9.70240	9.70244	9.70248	9.70252	9.70256	9.70260	9.70264	9.70268	9.70272	9.70276	9.70280	9.70284	9.70288	9.70292	9.70296	9.70300	9.70304	9.70308	9.70312	9.70316	9.70320	9.70324	9.70328	9.70332	9.70336	9.70340	9.70344	9.70348	9.70352	9.70356	9.70360	9.70364	9.70368	9.70372	9.70376	9.70380	9.70384	9.70388	9.70392	9.70396	9.70400	9.70404	9.70408	9.70412	9.70416	9.70420	9.70424	9.70428	9.70432	9.70436	9.70440	9.70444	9.70448	9.70452	9.70456	9.70460	9.70464	9.70468	9.70472	9.70476	9.70480	9.70484	9.70488	9.70492	9.70496	9.70500	9.70504	9.70508	9.70512	9.70516	9.70520	9.70524	9.70528	9.70532	9.70536	9.70540	9.70544	9.70548	9.70552	9.70556	9.70560	9.70564	9.70568	9.70572	9.70576	9.70580	9.70584	9.70588	9.70592	9.70596	9.70600	9.70604	9.70608	9.70612	9.70616	9.70620	9.70624	9.70628	9.70632	9.70636	9.70640	9.70644	9.70648	9.70652	9.70656	9.70660	9.70664	9.70668	9.70672	9.70676	9.70680	9.70684	9.70688	9.70692	9.70696	9.70700	9.70704	9.70708	9.70712	9.70716	9.70720	9.70724	9.70728	9.70732	9.70736	9.70740	9.70744	9.70748	9.70752	9.70756	9.70760	9.70764	9.70768	9.70772	9.70776	9.70780	9.70784	9.70788	9.70792	9.70796	9.70800	9.70804	9.70808	9.70812	9.70816	9.70820	9.70824	9.70828	9.70832	9.70836	9.70840	9.70844	9.70848	9.70852	9.70856	9.70860	9.70864	9.70868	9.70872	9.70876	9.70880	9.70884	9.70888	9.70892	9.70896	9.70900	9.70904	9.70908	9.70912	9.70916	9.70920	9.70924	9.70928	9.70932	9.70936	9.70940	9.70944	9.70948	9.70952	9.70956	9.70960	9.70964	9.70968	9.70972	9.70976	9.70980	9.70984	9.70988	9.70992	9.70996	9.71000	9.71004	9.71008	9.71012	9.71016	9.71020	9.71024	9.71028	9.71032	9.71036	9.71040	9.71044	9.71048	9.71052	9.71056	9.71060	9.71064	9.71068	9.71072	9.71076	9.71080	9.71084	9.71088	9.71092	9.71096	9.71100	9.71104	9.71108	9.71112	9.71116	9.71120	9.71124	9.71128	9.71132	9.71136	9.71140	9.71144	9.71148	9.71152	9.71156	9.71160	9.71164	9.71168	9.71172	9.71176	9.71180	9.71184	9.71188	9.71192	9.71196	9.71200	9.71204	9.71208	9.71212	9.71216	9.71220	9.71224	9.71228	9.71232	9.71236	9.71240	9.71244	9.71248	9.71252	9.71256	9.71260	9.71264	9.71268	9.71272	9.71276	9.71280	9.71284	9.71288	9.71292	9.71296	9.71300	9.71304	9.71308	9.71312	9.71316	9.71320	9.71324	9.71328	9.71332	9.71336	9.71340	9.71344	9.71348	9.71352	9.71356	9.71360	9.71364	9.71368	9.71372	9.71376	9.71380	9.71384	9.71388	9.71392	9.71396	9.71400	9.71404	9.71408	9.71412	9.71416	9.71420	9.71424	9.71428	9.71432	9.71436	9.71440	9.71444	9.71448	9.71452	9.71456	9.71460	9.71464	9.71468	9.71472	9.71476	9.71480	9.71484	9.71488	9.71492	9.71496	9.71500	9.71504	9.71508	9.71512	9.71516	9.71520	9.71524	9.71528	9.71532	9.71536	9.71540	9.71544	9.71548	9.71552	9.71556	9.71560	9.71564	9.71568	9.71572	9.71576	9.71580	9.71584	9.71588	9.71592	9.71596	9.71600	9.71604	9.71608	9.71612	9.71616	9.71620	9.71624	9.71628	9.71632	9.71636	9.71640	9.71644	9.71648	9.71652	9.71656	9.71660	9.71664	9.71668	9.71672	9.71676	9.71680	9.71684	9.71688	9.71692	9.71696	9.71700	9.71704	9.71708	9.71712	9.71716	9.71720	9.71724	9.71728	9.71732	9.71736	9.71740	9.71744	9.71748	9.71752	9.71756	9.71760	9.71764	9.71768	9.71772	9.71776	9.71780	9.71784	9.71788	9.71792	9.71796	9.71800	9.71804	9.71808	9.71812	9.71816	9.71820	9.71824	9.71828	9.71832	9.71836	9.71840	9.71844	9.71848	9.71852	9.71856	9.71860	9.71864	9.71868	9.71872	9.71876	9.71880	9.71884	9.71888	9.71892	9.71896	9.71900	9.71904	9.71908	9.71912	9.71916	9.71920	9.71924	9.71928	9.71932	9.71936	9.71940	9.71944	9.71948	9.71952	9.71956	9.71960	9.71964	9.71968	9.71972	9.71976	9.71980	9.71984	9.71988	9.71992	9.71996	9.72000	9.72004	9.72008	9.72012	9.72016	9.72020	9.72024	9.72028	9.72032	9.72036	9.72040	9.72044	9.72048	9.72052	9.72056	9.72060	9.72064	9.72068	9.72072	9.72076	9.72080	9.72084	9.72088	9.72092	9.72096	9.72100	9.72104	9.72108	9.72112	9.72116	9.72120	9.72124	9.72128	9.72132	9.72136	9.72140	9.72144	9.72148	9.72152	9.72156	9.72160	9.72164	9.72168	9.72172	9.72176	9.72180	9.72184	9.72188	9.72192	9.72196	9.72200	9.72204	9.72208	9.72212	9.72216	9.72220	9.72224	9.72228	9.72232	9.72236	9.72240	9.72244	9.72248	9.72252	9.72256	9.72260	9.72264	9.72268	9.72272	9.72276	9.72280	9.72284	9.72288	9.72292	9.72296	9.72300	9.72304	9.72308	9.72312	9.72316	9.72320	9.72324	9.72328	9.72332	9.72336	9.72340	9.72344	9.72348	9.72352	9.72356	9.72360	9.72364	9.72368	9.72372	9.72376	9.72380	9.72384	9.72388	9.72392	9.72396	9.72400	9.72404	9.72408	9.72412	9.72416	9.72420	9.72424	9.72428	9.72432	9.72436	9.72440	9.72444	9.72448	9.72452	9.72456	9.72460	9.72464	9.72468	9.72472	9.72476	9.72480	9.72484	9.72488	9.72492	9.72496	9.72500	9.72504	9.72508	9.72512	9.72516	9.72520	9.72524	9.72528	9.72532	9.72536	9.72540	9.72544	9.72548	9.72552	9.72556	9.72560	9.72564	9.72568	9.72572	9.72576	9.72580	9.72584	9.72588	9.72592	9.72596	9.72600	9.72604	9.72608	9.72612	9.72616	9.72620	9.72624	



The Finding of the Azimuth.

RULE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

Hour Angle.		Declination.												Hour Angle.		
		65° 00'	65° 30'	66° 00'	66° 30'	67° 00'	67° 30'	68° 00'	68° 30'	69° 00'	69° 30'	70° 00'	70° 30'			71° 00'
<i>h.</i>	<i>m.</i>													<i>h.</i>	<i>m.</i>	
0	0	7.85659	7.85117	7.84576	7.84035	7.83494	7.82953	7.82412	7.81871	7.81330	7.80789	7.80248	7.79707	7.79166	7.78625	7.78084
0	1	7.86781	7.86239	7.85698	7.85157	7.84616	7.84075	7.83534	7.82993	7.82452	7.81911	7.81370	7.80829	7.80288	7.79747	7.79206
0	2	7.87903	7.87361	7.86820	7.86279	7.85738	7.85197	7.84656	7.84115	7.83574	7.83033	7.82492	7.81951	7.81410	7.80869	7.80328
0	3	7.89025	7.88483	7.87942	7.87401	7.86860	7.86319	7.85778	7.85237	7.84696	7.84155	7.83614	7.83073	7.82532	7.81991	7.81450
0	4	7.90147	7.89605	7.89064	7.88523	7.87982	7.87441	7.86900	7.86359	7.85818	7.85277	7.84736	7.84195	7.83654	7.83113	7.82572
0	5	7.91269	7.90727	7.90186	7.89645	7.89104	7.88563	7.88022	7.87481	7.86940	7.86399	7.85858	7.85317	7.84776	7.84235	7.83694
0	6	7.92391	7.91849	7.91308	7.90767	7.90226	7.89685	7.89144	7.88603	7.88062	7.87521	7.86980	7.86439	7.85898	7.85357	7.84816
0	7	7.93513	7.92971	7.92430	7.91889	7.91348	7.90807	7.90266	7.89725	7.89184	7.88643	7.88102	7.87561	7.87020	7.86479	7.85938
0	8	7.94635	7.94093	7.93552	7.93011	7.92470	7.91929	7.91388	7.90847	7.90306	7.89765	7.89224	7.88683	7.88142	7.87601	7.87060
0	9	7.95757	7.95215	7.94674	7.94133	7.93592	7.93051	7.92510	7.91969	7.91428	7.90887	7.90346	7.89805	7.89264	7.88723	7.88182
0	10	7.96879	7.96337	7.95796	7.95255	7.94714	7.94173	7.93632	7.93091	7.92550	7.92009	7.91468	7.90927	7.90386	7.89845	7.89304
0	11	7.97999	7.97457	7.96916	7.96375	7.95834	7.95293	7.94752	7.94211	7.93670	7.93129	7.92588	7.92047	7.91506	7.90965	7.90424
0	12	7.99119	7.98577	7.98036	7.97495	7.96954	7.96413	7.95872	7.95331	7.94790	7.94249	7.93708	7.93167	7.92626	7.92085	7.91544
0	13	8.00239	7.99697	7.99156	7.98615	7.98074	7.97533	7.96992	7.96451	7.95910	7.95369	7.94828	7.94287	7.93746	7.93205	7.92664
0	14	8.01359	8.00817	8.00276	7.99735	7.99194	7.98653	7.98112	7.97571	7.97030	7.96489	7.95948	7.95407	7.94866	7.94325	7.93784
0	15	8.02479	8.01937	8.01396	8.00855	8.00314	7.99773	7.99232	7.98691	7.98150	7.97609	7.97068	7.96527	7.95986	7.95445	7.94904
0	16	8.03599	8.03057	8.02516	8.01975	8.01434	8.00893	8.00352	7.99811	7.99270	7.98729	7.98188	7.97647	7.97106	7.96565	7.96024
0	17	8.04719	8.04177	8.03636	8.03095	8.02554	8.02013	8.01472	8.00931	8.00390	7.99849	7.99308	7.98767	7.98226	7.97685	7.97144
0	18	8.05839	8.05297	8.04756	8.04215	8.03674	8.03133	8.02592	8.02051	8.01510	8.00969	8.00428	7.99887	7.99346	7.98805	7.98264
0	19	8.06959	8.06417	8.05876	8.05335	8.04794	8.04253	8.03712	8.03171	8.02630	8.02089	8.01548	8.01007	8.00466	7.99925	7.99384
0	20	8.08079	8.07537	8.06996	8.06455	8.05914	8.05373	8.04832	8.04291	8.03750	8.03209	8.02668	8.02127	8.01586	8.01045	8.00504
0	21	8.09199	8.08657	8.08116	8.07575	8.07034	8.06493	8.05952	8.05411	8.04870	8.04329	8.03788	8.03247	8.02706	8.02165	8.01624
0	22	8.10319	8.09777	8.09236	8.08695	8.08154	8.07613	8.07072	8.06531	8.05990	8.05449	8.04908	8.04367	8.03826	8.03285	8.02744
0	23	8.11439	8.10897	8.10356	8.09815	8.09274	8.08733	8.08192	8.07651	8.07110	8.06569	8.06028	8.05487	8.04946	8.04405	8.03864
0	24	8.12559	8.12017	8.11476	8.10935	8.10394	8.09853	8.09312	8.08771	8.08230	8.07689	8.07148	8.06607	8.06066	8.05525	8.04984
0	25	8.13679	8.13137	8.12596	8.12055	8.11514	8.10973	8.10432	8.09891	8.09350	8.08809	8.08268	8.07727	8.07186	8.06645	8.06104
0	26	8.14799	8.14257	8.13716	8.13175	8.12634	8.12093	8.11552	8.11011	8.10470	8.09929	8.09388	8.08847	8.08306	8.07765	8.07224
0	27	8.15919	8.15377	8.14836	8.14295	8.13754	8.13213	8.12672	8.12131	8.11590	8.11049	8.10508	8.09967	8.09426	8.08885	8.08344
0	28	8.17039	8.16497	8.15956	8.15415	8.14874	8.14333	8.13792	8.13251	8.12710	8.12169	8.11628	8.11087	8.10546	8.09999	8.09458
0	29	8.18159	8.17617	8.17076	8.16535	8.15994	8.15453	8.14912	8.14371	8.13830	8.13289	8.12748	8.12207	8.11666	8.11125	8.10584
0	30	8.19279	8.18737	8.18196	8.17655	8.17114	8.16573	8.16032	8.15491	8.14950	8.14409	8.13868	8.13327	8.12786	8.12245	8.11704
0	31	8.20399	8.19857	8.19316	8.18775	8.18234	8.17693	8.17152	8.16611	8.16070	8.15529	8.14988	8.14447	8.13906	8.13365	8.12824
0	32	8.21519	8.20977	8.20436	8.19895	8.19354	8.18813	8.18272	8.17731	8.17190	8.16649	8.16108	8.15567	8.15026	8.14485	8.13944
0	33	8.22639	8.22097	8.21556	8.21015	8.20474	8.19933	8.19392	8.18851	8.18310	8.17769	8.17228	8.16687	8.16146	8.15605	8.15064
0	34	8.23759	8.23217	8.22676	8.22135	8.21594	8.21053	8.20512	8.19971	8.19430	8.18889	8.18348	8.17807	8.17266	8.16725	8.16184
0	35	8.24879	8.24337	8.23796	8.23255	8.22714	8.22173	8.21632	8.21091	8.20550	8.20009	8.19468	8.18927	8.18386	8.17845	8.17304
0	36	8.25999	8.25457	8.24916	8.24375	8.23834	8.23293	8.22752	8.22211	8.21670	8.21129	8.20588	8.20047	8.19506	8.18965	8.18424
0	37	8.27119	8.26577	8.26036	8.25495	8.24954	8.24413	8.23872	8.23331	8.22790	8.22249	8.21708	8.21167	8.20626	8.20085	8.19544
0	38	8.28239	8.27697	8.27156	8.26615	8.26074	8.25533	8.24992	8.24451	8.23910	8.23369	8.22828	8.22287	8.21746	8.21205	8.20664
0	39	8.29359	8.28817	8.28276	8.27735	8.27194	8.26653	8.26112	8.25571	8.25030	8.24489	8.23948	8.23407	8.22866	8.22325	8.21784
0	40	8.30479	8.29937	8.29396	8.28855	8.28314	8.27773	8.27232	8.26691	8.26150	8.25609	8.25068	8.24527	8.23986	8.23445	8.22904
0	41	8.31599	8.31057	8.30516	8.29975	8.29434	8.28893	8.28352	8.27811	8.27270	8.26729	8.26188	8.25647	8.25106	8.24565	8.24024
0	42	8.32719	8.32177	8.31636	8.31095	8.30554	8.30013	8.29472	8.28931	8.28390	8.27849	8.27308	8.26767	8.26226	8.25685	8.25144
0	43	8.33839	8.33297	8.32756	8.32215	8.31674	8.31133	8.30592	8.30051	8.29510	8.28969	8.28428	8.27887	8.27346	8.26805	8.26264
0	44	8.34959	8.34417	8.33876	8.33335	8.32794	8.32253	8.31712	8.31171	8.30630	8.30089	8.29548	8.29007	8.28466	8.27925	8.27384
0	45	8.36079	8.35537	8.34996	8.34455	8.33914	8.33373	8.32832	8.32291	8.31750	8.31209	8.30668	8.30127	8.29586	8.29045	8.28504
0	46	8.37199	8.36657	8.36116	8.35575	8.35034	8.34493	8.33952	8.33411	8.32870	8.32329	8.31788	8.31247	8.30706	8.30165	8.29624
0	47	8.38319	8.37777	8.37236	8.36695	8.36154	8.35613	8.35072	8.34531	8.33990	8.33449	8.32908	8.32367	8.31826	8.31285	8.30744
0	48	8.39439	8.38897	8.38356	8.37815	8.37274	8.36733	8.36192	8.35651	8.35110	8.34569	8.34028	8.33487	8.32946	8.32405	8.31864
0	49	8.40559	8.39997	8.39456	8.38915	8.38374	8.37833	8.37292	8.36751	8.36210	8.35669	8.35128	8.34587	8.34046	8.33505	8.32964
0	50	8.41679	8.41137	8.40596	8.40055	8.39514	8.38973	8.38432	8.37891	8.37350	8.36809	8.36268	8.35727	8.35186	8.34645	8.34104
0	51	8.42799	8.42257	8.41716	8.41175	8.40634	8.40093	8.39552	8.39011	8.38470	8.37929	8.37388	8.36847	8.36306	8.35765	8.35224
0	52	8.43919	8.43377	8.42836	8.42295	8.41754	8.41213	8.40672	8.40131	8.39590	8.39049	8.38508	8.37967	8.37426	8.36885	8.36344
0	53	8.45039	8.44497	8.43956	8.43415	8.42874	8.42333	8.41792	8.41251	8.40710	8.40169	8.39628	8.39087	8.38546	8.38005	8.37464
0	54	8.46159	8.45617	8.45076	8.44535	8.43994	8.43453	8.42912	8.42371	8.41830	8.41289	8.40748	8.40207	8.39666	8.39125	8.38584
0	55	8.47279	8.46737	8.46196	8.45655	8.45114	8.44573	8.44032	8.43491	8.42950	8.42409	8.41868	8.41327	8.40786	8.40245	8.39704
0	56	8.48399	8.47857	8.47316	8.46775	8.46234	8.45693	8.45152	8.44611	8.44070	8.43529	8.42988	8.42447	8.41906	8.41365	8.40824
0	57	8.49519	8.48977	8.48436	8.47895	8.47354	8.46813	8.46272	8.45731	8.45190	8.44649	8.44108	8.43567	8.43026	8.42485	8.41944
0	58	8.50639	8.50097	8.49556	8.49015	8.48474	8.47933	8.47392	8.46851	8.46310	8.45769	8.45228	8.44687	8.44146	8.43605	8.43064
0	59	8.51759	8.51217	8.50676	8.50135	8.49594	8.49053	8.48512	8.47971	8.47430	8.46889	8.46348	8.45807	8.45266	8.44725	8.44184





NOTE.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												Hour Angle.		
		71° 30'	72° 00'	72° 30'	73° 00'	73° 30'	74° 00'	74° 30'	75° 00'	75° 30'	76° 00'	76° 30'	77° 00'			77° 30'
h. m.	°	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞	—∞
		0	0	7.74334	7.72000	7.69520	7.66820	7.63486	7.59286	7.54258	7.48462	7.41962	7.34822	7.27102	7.18872	7.10202
0	1	7.74340	7.72006	7.69526	7.66826	7.63492	7.59292	7.54264	7.48468	7.41968	7.34828	7.27108	7.18878	7.10208	7.01158	6.91708
0	2	7.74346	7.72012	7.69532	7.66832	7.63498	7.59298	7.54270	7.48474	7.41974	7.34834	7.27114	7.18884	7.10214	7.01164	6.91714
0	3	7.74352	7.72018	7.69538	7.66838	7.63504	7.59304	7.54276	7.48480	7.41980	7.34840	7.27120	7.18890	7.10220	7.01170	6.91720
0	4	7.74358	7.72024	7.69544	7.66844	7.63510	7.59310	7.54282	7.48486	7.41986	7.34846	7.27126	7.18896	7.10226	7.01176	6.91726
0	5	7.74364	7.72030	7.69550	7.66850	7.63516	7.59316	7.54288	7.48492	7.41992	7.34852	7.27132	7.18902	7.10232	7.01182	6.91732
0	6	7.74370	7.72036	7.69556	7.66856	7.63522	7.59322	7.54290	7.48498	7.41998	7.34858	7.27138	7.18908	7.10238	7.01188	6.91738
0	7	7.74376	7.72042	7.69562	7.66862	7.63528	7.59328	7.54292	7.48504	7.42004	7.34864	7.27144	7.18914	7.10244	7.01194	6.91744
0	8	7.74382	7.72048	7.69568	7.66868	7.63534	7.59334	7.54294	7.48510	7.42010	7.34870	7.27150	7.18920	7.10250	7.01200	6.91750
0	9	7.74388	7.72054	7.69574	7.66874	7.63540	7.59340	7.54296	7.48516	7.42016	7.34876	7.27156	7.18926	7.10256	7.01206	6.91756
0	10	7.74394	7.72060	7.69580	7.66880	7.63546	7.59346	7.54298	7.48522	7.42022	7.34882	7.27162	7.18932	7.10262	7.01212	6.91762
0	11	7.74400	7.72066	7.69586	7.66886	7.63552	7.59352	7.54300	7.48528	7.42028	7.34888	7.27168	7.18938	7.10268	7.01218	6.91768
0	12	7.74406	7.72072	7.69592	7.66892	7.63558	7.59358	7.54302	7.48534	7.42034	7.34894	7.27174	7.18944	7.10274	7.01224	6.91774
0	13	7.74412	7.72078	7.69598	7.66898	7.63564	7.59364	7.54304	7.48540	7.42040	7.34900	7.27180	7.18950	7.10280	7.01230	6.91780
0	14	7.74418	7.72084	7.69604	7.66904	7.63570	7.59370	7.54306	7.48546	7.42046	7.34906	7.27186	7.18956	7.10286	7.01236	6.91786
0	15	7.74424	7.72090	7.69610	7.66910	7.63576	7.59376	7.54308	7.48552	7.42052	7.34912	7.27192	7.18962	7.10292	7.01242	6.91792
0	16	7.74430	7.72096	7.69616	7.66916	7.63582	7.59382	7.54310	7.48558	7.42058	7.34918	7.27198	7.18968	7.10298	7.01248	6.91798
0	17	7.74436	7.72102	7.69622	7.66922	7.63588	7.59388	7.54312	7.48564	7.42064	7.34924	7.27204	7.18974	7.10304	7.01254	6.91804
0	18	7.74442	7.72108	7.69628	7.66928	7.63594	7.59394	7.54314	7.48570	7.42070	7.34930	7.27210	7.18980	7.10310	7.01260	6.91810
0	19	7.74448	7.72114	7.69634	7.66934	7.63600	7.59400	7.54316	7.48576	7.42076	7.34936	7.27216	7.18986	7.10316	7.01266	6.91816
0	20	7.74454	7.72120	7.69640	7.66940	7.63606	7.59406	7.54318	7.48582	7.42082	7.34942	7.27222	7.18992	7.10322	7.01272	6.91822
0	21	7.74460	7.72126	7.69646	7.66946	7.63612	7.59412	7.54320	7.48588	7.42088	7.34948	7.27228	7.18998	7.10328	7.01278	6.91828
0	22	7.74466	7.72132	7.69652	7.66952	7.63618	7.59418	7.54322	7.48594	7.42094	7.34954	7.27234	7.19004	7.10334	7.01284	6.91834
0	23	7.74472	7.72138	7.69658	7.66958	7.63624	7.59424	7.54324	7.48600	7.42100	7.34960	7.27240	7.19010	7.10340	7.01290	6.91840
0	24	7.74478	7.72144	7.69664	7.66964	7.63630	7.59430	7.54326	7.48606	7.42106	7.34966	7.27246	7.19016	7.10346	7.01296	6.91846
0	25	7.74484	7.72150	7.69670	7.66970	7.63636	7.59436	7.54328	7.48612	7.42112	7.34972	7.27252	7.19022	7.10352	7.01302	6.91852
0	26	7.74490	7.72156	7.69676	7.66976	7.63642	7.59442	7.54330	7.48618	7.42118	7.34978	7.27258	7.19028	7.10358	7.01308	6.91858
0	27	7.74496	7.72162	7.69682	7.66982	7.63648	7.59448	7.54332	7.48624	7.42124	7.34984	7.27264	7.19034	7.10364	7.01314	6.91864
0	28	7.74502	7.72168	7.69688	7.66988	7.63654	7.59454	7.54334	7.48630	7.42130	7.34990	7.27270	7.19040	7.10370	7.01320	6.91870
0	29	7.74508	7.72174	7.69694	7.66994	7.63660	7.59460	7.54336	7.48636	7.42136	7.34996	7.27276	7.19046	7.10376	7.01326	6.91876
0	30	7.74514	7.72180	7.69700	7.67000	7.63666	7.59466	7.54338	7.48642	7.42142	7.35002	7.27282	7.19052	7.10382	7.01332	6.91882
0	31	7.74520	7.72186	7.69706	7.67006	7.63672	7.59472	7.54340	7.48648	7.42148	7.35008	7.27288	7.19058	7.10388	7.01338	6.91888
0	32	7.74526	7.72192	7.69712	7.67012	7.63678	7.59478	7.54342	7.48654	7.42154	7.35014	7.27294	7.19064	7.10394	7.01344	6.91894
0	33	7.74532	7.72198	7.69718	7.67018	7.63684	7.59484	7.54344	7.48660	7.42160	7.35020	7.27300	7.19070	7.10400	7.01350	6.91900
0	34	7.74538	7.72204	7.69724	7.67024	7.63690	7.59490	7.54346	7.48666	7.42166	7.35026	7.27306	7.19076	7.10406	7.01356	6.91906
0	35	7.74544	7.72210	7.69730	7.67030	7.63696	7.59496	7.54348	7.48672	7.42172	7.35032	7.27312	7.19082	7.10412	7.01362	6.91912
0	36	7.74550	7.72216	7.69736	7.67036	7.63702	7.59502	7.54350	7.48678	7.42178	7.35038	7.27318	7.19088	7.10418	7.01368	6.91918
0	37	7.74556	7.72222	7.69742	7.67042	7.63708	7.59508	7.54352	7.48684	7.42184	7.35044	7.27324	7.19094	7.10424	7.01374	6.91924
0	38	7.74562	7.72228	7.69748	7.67048	7.63714	7.59514	7.54354	7.48690	7.42190	7.35050	7.27330	7.19100	7.10430	7.01380	6.91930
0	39	7.74568	7.72234	7.69754	7.67054	7.63720	7.59520	7.54356	7.48696	7.42196	7.35056	7.27336	7.19106	7.10436	7.01386	6.91936
0	40	7.74574	7.72240	7.69760	7.67060	7.63726	7.59526	7.54358	7.48702	7.42202	7.35062	7.27342	7.19112	7.10442	7.01392	6.91942
0	41	7.74580	7.72246	7.69766	7.67066	7.63732	7.59532	7.54360	7.48708	7.42208	7.35068	7.27348	7.19118	7.10448	7.01398	6.91948
0	42	7.74586	7.72252	7.69772	7.67072	7.63738	7.59538	7.54362	7.48714	7.42214	7.35074	7.27354	7.19124	7.10454	7.01404	6.91954
0	43	7.74592	7.72258	7.69778	7.67078	7.63744	7.59544	7.54364	7.48720	7.42220	7.35080	7.27360	7.19130	7.10460	7.01410	6.91960
0	44	7.74598	7.72264	7.69784	7.67084	7.63750	7.59550	7.54366	7.48726	7.42226	7.35086	7.27366	7.19136	7.10466	7.01416	6.91966
0	45	7.74604	7.72270	7.69790	7.67090	7.63756	7.59556	7.54368	7.48732	7.42232	7.35092	7.27372	7.19142	7.10472	7.01422	6.91972
3	00	7.74610	7.72276	7.69796	7.67096	7.63762	7.59562	7.54370	7.48738	7.42238	7.35098	7.27378	7.19148	7.10478	7.01428	6.91978

TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.										Hour Angle.						
<i>A. m.</i>	<i>o.</i>	71° 30'	72° 00'	72° 30'	73° 00'	73° 30'	74° 00'	74° 30'	75° 00'	75° 30'	75° 00'	76° 30'	77° 00'	77° 30'	78° 00'	<i>h. m.</i>	<i>o.</i>	
3	00	0.35007	0.32763	0.31543	0.30283	0.29039	0.27839	0.26689	0.25589	0.24529	0.23469	0.22409	0.21349	0.20289	0.19229	0.18169	3	00
3	04	0.35011	0.32767	0.31547	0.30287	0.29043	0.27843	0.26693	0.25593	0.24533	0.23473	0.22413	0.21353	0.20293	0.19233	0.18173	3	04
3	08	0.35015	0.32771	0.31551	0.30291	0.29047	0.27847	0.26697	0.25597	0.24537	0.23477	0.22417	0.21357	0.20297	0.19237	0.18177	3	08
3	12	0.35019	0.32775	0.31555	0.30295	0.29051	0.27851	0.26701	0.25601	0.24541	0.23481	0.22421	0.21361	0.20301	0.19241	0.18181	3	12
3	16	0.35023	0.32779	0.31559	0.30300	0.29056	0.27856	0.26706	0.25606	0.24546	0.23486	0.22426	0.21366	0.20306	0.19246	0.18186	3	16
3	20	0.35027	0.32783	0.31563	0.30304	0.29060	0.27860	0.26710	0.25610	0.24550	0.23490	0.22430	0.21370	0.20310	0.19250	0.18190	3	20
3	24	0.35031	0.32787	0.31567	0.30308	0.29064	0.27864	0.26714	0.25614	0.24554	0.23494	0.22434	0.21374	0.20314	0.19254	0.18194	3	24
3	28	0.35035	0.32791	0.31571	0.30312	0.29068	0.27868	0.26718	0.25618	0.24558	0.23498	0.22438	0.21378	0.20318	0.19258	0.18198	3	28
3	32	0.35039	0.32795	0.31575	0.30316	0.29072	0.27872	0.26722	0.25622	0.24562	0.23502	0.22442	0.21382	0.20322	0.19262	0.18202	3	32
3	36	0.35043	0.32799	0.31579	0.30320	0.29076	0.27876	0.26726	0.25626	0.24566	0.23506	0.22446	0.21386	0.20326	0.19266	0.18206	3	36
3	40	0.35047	0.32803	0.31583	0.30324	0.29080	0.27880	0.26730	0.25630	0.24570	0.23510	0.22450	0.21390	0.20330	0.19270	0.18210	3	40
3	44	0.35051	0.32807	0.31587	0.30328	0.29084	0.27884	0.26734	0.25634	0.24574	0.23514	0.22454	0.21394	0.20334	0.19274	0.18214	3	44
3	48	0.35055	0.32811	0.31591	0.30332	0.29088	0.27888	0.26738	0.25638	0.24578	0.23518	0.22458	0.21398	0.20338	0.19278	0.18218	3	48
3	52	0.35059	0.32815	0.31595	0.30336	0.29092	0.27892	0.26742	0.25642	0.24582	0.23522	0.22462	0.21402	0.20342	0.19282	0.18222	3	52
3	56	0.35063	0.32819	0.31599	0.30340	0.29096	0.27896	0.26746	0.25646	0.24586	0.23526	0.22466	0.21406	0.20346	0.19286	0.18226	3	56
3	60	0.35067	0.32823	0.31603	0.30344	0.29100	0.27900	0.26750	0.25650	0.24590	0.23530	0.22470	0.21410	0.20350	0.19290	0.18230	3	60
4	00	0.35071	0.32827	0.31607	0.30348	0.29104	0.27904	0.26754	0.25654	0.24594	0.23534	0.22474	0.21414	0.20354	0.19294	0.18234	4	00
4	04	0.35075	0.32831	0.31611	0.30352	0.29108	0.27908	0.26758	0.25658	0.24598	0.23538	0.22478	0.21418	0.20358	0.19298	0.18238	4	04
4	08	0.35079	0.32835	0.31615	0.30356	0.29112	0.27912	0.26762	0.25662	0.24602	0.23542	0.22482	0.21422	0.20362	0.19302	0.18242	4	08
4	12	0.35083	0.32839	0.31619	0.30360	0.29116	0.27916	0.26766	0.25666	0.24606	0.23546	0.22486	0.21426	0.20366	0.19306	0.18246	4	12
4	16	0.35087	0.32843	0.31623	0.30364	0.29120	0.27920	0.26770	0.25670	0.24610	0.23550	0.22490	0.21430	0.20370	0.19310	0.18250	4	16
4	20	0.35091	0.32847	0.31627	0.30368	0.29124	0.27924	0.26774	0.25674	0.24614	0.23554	0.22494	0.21434	0.20374	0.19314	0.18254	4	20
4	24	0.35095	0.32851	0.31631	0.30372	0.29128	0.27928	0.26778	0.25678	0.24618	0.23558	0.22498	0.21438	0.20378	0.19318	0.18258	4	24
4	28	0.35099	0.32855	0.31635	0.30376	0.29132	0.27932	0.26782	0.25682	0.24622	0.23562	0.22502	0.21442	0.20382	0.19322	0.18262	4	28
4	32	0.35103	0.32859	0.31639	0.30380	0.29136	0.27936	0.26786	0.25686	0.24626	0.23566	0.22506	0.21446	0.20386	0.19326	0.18266	4	32
4	36	0.35107	0.32863	0.31643	0.30384	0.29140	0.27940	0.26790	0.25690	0.24630	0.23570	0.22510	0.21450	0.20390	0.19330	0.18270	4	36
4	40	0.35111	0.32867	0.31647	0.30388	0.29144	0.27944	0.26794	0.25694	0.24634	0.23574	0.22514	0.21454	0.20394	0.19334	0.18274	4	40
4	44	0.35115	0.32871	0.31651	0.30392	0.29148	0.27948	0.26798	0.25698	0.24638	0.23578	0.22518	0.21458	0.20398	0.19338	0.18278	4	44
4	48	0.35119	0.32875	0.31655	0.30396	0.29152	0.27952	0.26802	0.25702	0.24642	0.23582	0.22522	0.21462	0.20402	0.19342	0.18282	4	48
4	52	0.35123	0.32879	0.31659	0.30400	0.29156	0.27956	0.26806	0.25706	0.24646	0.23586	0.22526	0.21466	0.20406	0.19346	0.18286	4	52
4	56	0.35127	0.32883	0.31663	0.30404	0.29160	0.27960	0.26810	0.25710	0.24650	0.23590	0.22530	0.21470	0.20410	0.19350	0.18290	4	56
4	60	0.35131	0.32887	0.31667	0.30408	0.29164	0.27964	0.26814	0.25714	0.24654	0.23594	0.22534	0.21474	0.20414	0.19354	0.18294	4	60
5	00	0.35135	0.32891	0.31671	0.30412	0.29168	0.27968	0.26818	0.25718	0.24658	0.23598	0.22538	0.21478	0.20418	0.19358	0.18298	5	00
5	04	0.35139	0.32895	0.31675	0.30416	0.29172	0.27972	0.26822	0.25722	0.24662	0.23602	0.22542	0.21482	0.20422	0.19362	0.18302	5	04
5	08	0.35143	0.32899	0.31679	0.30420	0.29176	0.27976	0.26826	0.25726	0.24666	0.23606	0.22546	0.21486	0.20426	0.19366	0.18306	5	08
5	12	0.35147	0.32903	0.31683	0.30424	0.29180	0.27980	0.26830	0.25730	0.24670	0.23610	0.22550	0.21490	0.20430	0.19370	0.18310	5	12
5	16	0.35151	0.32907	0.31687	0.30428	0.29184	0.27984	0.26834	0.25734	0.24674	0.23614	0.22554	0.21494	0.20434	0.19374	0.18314	5	16
5	20	0.35155	0.32911	0.31691	0.30432	0.29188	0.27988	0.26838	0.25738	0.24678	0.23618	0.22558	0.21498	0.20438	0.19378	0.18318	5	20
5	24	0.35159	0.32915	0.31695	0.30436	0.29192	0.27992	0.26842	0.25742	0.24682	0.23622	0.22562	0.21502	0.20442	0.19382	0.18322	5	24
5	28	0.35163	0.32919	0.31699	0.30440	0.29196	0.27996	0.26846	0.25746	0.24686	0.23626	0.22566	0.21506	0.20446	0.19386	0.18326	5	28
5	32	0.35167	0.32923	0.31703	0.30444	0.29200	0.28000	0.26850	0.25750	0.24690	0.23630	0.22570	0.21510	0.20450	0.19390	0.18330	5	32
5	36	0.35171	0.32927	0.31707	0.30448	0.29204	0.28004	0.26854	0.25754	0.24694	0.23634	0.22574	0.21514	0.20454	0.19394	0.18334	5	36
5	40	0.35175	0.32931	0.31711	0.30452	0.29208	0.28008	0.26858	0.25758	0.24698	0.23638	0.22578	0.21518	0.20458	0.19398	0.18338	5	40
5	44	0.35179	0.32935	0.31715	0.30456	0.29212	0.28012	0.26862	0.25762	0.24702	0.23642	0.22582	0.21522	0.20462	0.19402	0.18342	5	44
5	48	0.35183	0.32939	0.31719	0.30460	0.29216	0.28016	0.26866	0.25766	0.24706	0.23646	0.22586	0.21526	0.20466	0.19406	0.18346	5	48
5	52	0.35187	0.32943	0.31723	0.30464	0.29220	0.28020	0.26870	0.25770	0.24710	0.23650	0.22590	0.21530	0.20470	0.19410	0.18350	5	52
5	56	0.35191	0.32947	0.31727	0.30468	0.29224	0.28024	0.26874	0.25774	0.24714	0.23654	0.22594	0.21534	0.20474	0.19414	0.18354	5	56
5	60	0.35195	0.32951	0.31731	0.30472	0.29228	0.28028	0.26878	0.25778	0.24718	0.23658	0.22598	0.21538	0.20478	0.19418	0.18358	5	60
6	00	0.35199	0.32955	0.31735	0.30476	0.29232	0.28032	0.26882	0.25782	0.24722	0.23662	0.22602	0.21542	0.20482	0.19422	0.18362	6	00
6	04	0.35203	0.32959	0.31739	0.30480	0.29236	0.28036	0.26886	0.25786	0.24726	0.23666	0.22606	0.21546	0.20486	0.19426	0.18366	6	04
6	08	0.35207	0.32963	0.31743	0.30484	0.29240	0.28040	0.26890	0.25790	0.24730	0.23670	0.22610	0.21550	0.20490	0.19430	0.18370	6	08
6	12	0.35211	0.32967	0.31747	0.30488	0.29244	0.28044	0.26894	0.25794	0.24734	0.23674	0.226						



The Finding of the Azimuth.

Rule.—Take out the tabulated number corresponding to the given declination and hour-angle, then find this number again in that declination column which has at its head a value equal to the altitude, and, in the hour-angle column, opposite to the number thus found again in the declination column, will be the required azimuth.

Hour Angle.		Declination.												Hour Angle									
		75° 00'	75° 30'	76° 00'	76° 30'	77° 00'	77° 30'	78° 00'	78° 30'	79° 00'	79° 30'	80° 00'	80° 30'		81° 00'	81° 30'	82° 00'	82° 30'	83° 00'	83° 30'	84° 00'	84° 30'	
h. m.	°	°																					
0	0	7.55974	7.52246	7.48519	7.44792	7.41065	7.37338	7.33611	7.29884	7.26157	7.22430	7.18703	7.14976	7.11249	7.07522	7.03795	7.00068	6.96341	6.92614	6.88887	6.85160	6.81433	6.77706
0	1	7.56070	7.52342	7.48615	7.44888	7.41161	7.37434	7.33707	7.29980	7.26253	7.22526	7.18799	7.15072	7.11345	7.07618	7.03891	7.00164	6.96437	6.92710	6.88983	6.85256	6.81529	6.77802
0	2	7.56166	7.52438	7.48711	7.44984	7.41257	7.37530	7.33803	7.30076	7.26349	7.22622	7.18895	7.15168	7.11441	7.07714	7.03987	7.00260	6.96533	6.92806	6.89079	6.85352	6.81625	6.77898
0	3	7.56262	7.52534	7.48807	7.45080	7.41353	7.37626	7.33899	7.30172	7.26445	7.22718	7.18991	7.15264	7.11537	7.07810	7.04083	7.00356	6.96629	6.92902	6.89175	6.85448	6.81721	6.77994
0	4	7.56358	7.52630	7.48903	7.45176	7.41449	7.37722	7.33995	7.30268	7.26541	7.22814	7.19087	7.15360	7.11633	7.07906	7.04179	7.00452	6.96725	6.92998	6.89271	6.85544	6.81817	6.78090
0	5	7.56454	7.52726	7.49000	7.45273	7.41546	7.37819	7.34092	7.30365	7.26638	7.22911	7.19184	7.15457	7.11730	7.08003	7.04276	7.00549	6.96822	6.93095	6.89368	6.85641	6.81914	6.78187
0	6	7.56550	7.52822	7.49100	7.45373	7.41646	7.37919	7.34192	7.30465	7.26738	7.23011	7.19284	7.15557	7.11830	7.08103	7.04376	7.00649	6.96922	6.93195	6.89468	6.85741	6.82014	6.78287
0	7	7.56646	7.52918	7.49200	7.45473	7.41746	7.38019	7.34292	7.30565	7.26838	7.23111	7.19384	7.15657	7.11930	7.08203	7.04476	7.00749	6.97022	6.93295	6.89568	6.85841	6.82114	6.78387
0	8	7.56742	7.53014	7.49300	7.45573	7.41846	7.38119	7.34392	7.30665	7.26938	7.23211	7.19484	7.15757	7.12030	7.08303	7.04576	7.00849	6.97122	6.93395	6.89668	6.85941	6.82214	6.78487
0	9	7.56838	7.53110	7.49400	7.45673	7.41946	7.38219	7.34492	7.30765	7.27038	7.23311	7.19584	7.15857	7.12130	7.08403	7.04676	7.00949	6.97222	6.93495	6.89768	6.86041	6.82314	6.78587
0	10	7.56934	7.53206	7.49500	7.45773	7.42046	7.38319	7.34592	7.30865	7.27138	7.23411	7.19684	7.15957	7.12230	7.08503	7.04776	7.01049	6.97322	6.93595	6.89868	6.86141	6.82414	6.78687
0	11	7.57030	7.53302	7.49600	7.45873	7.42146	7.38419	7.34692	7.30965	7.27238	7.23511	7.19784	7.16057	7.12330	7.08603	7.04876	7.01149	6.97422	6.93695	6.89968	6.86241	6.82514	6.78787
0	12	7.57126	7.53398	7.49700	7.45973	7.42246	7.38519	7.34792	7.31065	7.27338	7.23611	7.19884	7.16157	7.12430	7.08703	7.04976	7.01249	6.97522	6.93795	6.90068	6.86341	6.82614	6.78887
0	13	7.57222	7.53494	7.49800	7.46073	7.42346	7.38619	7.34892	7.31165	7.27438	7.23711	7.19984	7.16257	7.12530	7.08803	7.05076	7.01349	6.97622	6.93895	6.90168	6.86441	6.82714	6.78987
0	14	7.57318	7.53590	7.49900	7.46173	7.42446	7.38719	7.34992	7.31265	7.27538	7.23811	7.20084	7.16357	7.12630	7.08903	7.05176	7.01449	6.97722	6.93995	6.90268	6.86541	6.82814	6.79087
0	15	7.57414	7.53686	7.50000	7.46273	7.42546	7.38819	7.35092	7.31365	7.27638	7.23911	7.20184	7.16457	7.12730	7.09003	7.05276	7.01549	6.97822	6.94095	6.90368	6.86641	6.82914	6.79187
0	16	7.57510	7.53782	7.50100	7.46373	7.42646	7.38919	7.35192	7.31465	7.27738	7.24011	7.20284	7.16557	7.12830	7.09103	7.05376	7.01649	6.97922	6.94195	6.90468	6.86741	6.83014	6.79287
0	17	7.57606	7.53878	7.50200	7.46473	7.42746	7.39019	7.35292	7.31565	7.27838	7.24111	7.20384	7.16657	7.12930	7.09203	7.05476	7.01749	6.98022	6.94295	6.90568	6.86841	6.83114	6.79387
0	18	7.57702	7.53974	7.50300	7.46573	7.42846	7.39119	7.35392	7.31665	7.27938	7.24211	7.20484	7.16757	7.13030	7.09303	7.05576	7.01849	6.98122	6.94395	6.90668	6.86941	6.83214	6.79487
0	19	7.57798	7.54070	7.50400	7.46673	7.42946	7.39219	7.35492	7.31765	7.28038	7.24311	7.20584	7.16857	7.13130	7.09403	7.05676	7.01949	6.98222	6.94495	6.90768	6.87041	6.83314	6.79587
0	20	7.57894	7.54166	7.50500	7.46773	7.43046	7.39319	7.35592	7.31865	7.28138	7.24411	7.20684	7.16957	7.13230	7.09503	7.05776	7.02049	6.98322	6.94595	6.90868	6.87141	6.83414	6.79687
0	21	7.57990	7.54262	7.50600	7.46873	7.43146	7.39419	7.35692	7.31965	7.28238	7.24511	7.20784	7.17057	7.13330	7.09603	7.05876	7.02149	6.98422	6.94695	6.90968	6.87241	6.83514	6.79787
0	22	7.58086	7.54358	7.50700	7.46973	7.43246	7.39519	7.35792	7.32065	7.28338	7.24611	7.20884	7.17157	7.13430	7.09703	7.05976	7.02249	6.98522	6.94795	6.91068	6.87341	6.83614	6.79887
0	23	7.58182	7.54454	7.50800	7.47073	7.43346	7.39619	7.35892	7.32165	7.28438	7.24711	7.20984	7.17257	7.13530	7.09803	7.06076	7.02349	6.98622	6.94895	6.91168	6.87441	6.83714	6.79987
0	24	7.58278	7.54550	7.50900	7.47173	7.43446	7.39719	7.35992	7.32265	7.28538	7.24811	7.21084	7.17357	7.13630	7.09903	7.06176	7.02449	6.98722	6.94995	6.91268	6.87541	6.83814	6.80087
0	25	7.58374	7.54646	7.51000	7.47273	7.43546	7.39819	7.36092	7.32365	7.28638	7.24911	7.21184	7.17457	7.13730	7.10003	7.06276	7.02549	6.98822	6.95095	6.91368	6.87641	6.83914	6.80187
0	26	7.58470	7.54742	7.51100	7.47373	7.43646	7.39919	7.36192	7.32465	7.28738	7.25011	7.21284	7.17557	7.13830	7.10103	7.06376	7.02649	6.98922	6.95195	6.91468	6.87741	6.84014	6.80287
0	27	7.58566	7.54838	7.51200	7.47473	7.43746	7.39919	7.36192	7.32465	7.28738	7.25011	7.21284	7.17557	7.13830	7.10103	7.06376	7.02649	6.98922	6.95195	6.91468	6.87741	6.84014	6.80287
0	28	7.58662	7.54934	7.51300	7.47573	7.43846	7.40019	7.36292	7.32565	7.28838	7.25111	7.21384	7.17657	7.13930	7.10203	7.06476	7.02749	6.99022	6.95295	6.91568	6.87841	6.84114	6.80387
0	29	7.58758	7.55030	7.51400	7.47673	7.43946	7.40119	7.36392	7.32665	7.28938	7.25211	7.21484	7.17757	7.14030	7.10303	7.06576	7.02849	6.99122	6.95395	6.91668	6.87941	6.84214	6.80487
0	30	7.58854	7.55126	7.51500	7.47773	7.44046	7.40219	7.36492	7.32765	7.29038	7.25311	7.21584	7.17857	7.14130	7.10403	7.06676	7.02949	6.99222	6.95495	6.91768	6.88041	6.84314	6.80587
0	31	7.58950	7.55222	7.51600	7.47873	7.44146	7.40319	7.36592	7.32865	7.29138	7.25411	7.21684	7.17957	7.14230	7.10503	7.06776	7.03049	6.99322	6.95595	6.91868	6.88141	6.84414	6.80687
0	32	7.59046	7.55318	7.51700	7.47973	7.44246	7.40419	7.36692	7.32965	7.29238	7.25511	7.21784	7.18057	7.14330	7.10603	7.06876	7.03149	6.99422	6.95695	6.91968	6.88241	6.84514	6.80787
0	33	7.59142	7.55414	7.51800	7.48073	7.44346	7.40519	7.36792	7.33065	7.29338	7.25611	7.21884	7.18157	7.14430	7.10703	7.06976	7.03249	6.99522	6.95795	6.92068	6.88341	6.84614	6.80887
0	34	7.59238	7.55510	7.51900	7.48173	7.44446	7.40619	7.36892	7.33165	7.29438	7.25711	7.21984	7.18257	7.14530	7.10803	7.07076	7.03349	6.99622	6.95895	6.92168	6.88441	6.84714	6.80987
0	35	7.59334	7.55606	7.52000	7.48273	7.44546	7.40719	7.36992	7.33265	7.29538	7.25811	7.22084	7.18357	7.14630	7.10903	7.07176	7.03449	6.99722	6.95995	6.92268	6.88541	6.84814	6.81087
0	36	7.59430	7.55702	7.52100	7.48373	7.44646	7.40819	7.37092	7.33365	7.29638	7.25911	7.22184	7.18457	7.14730	7.11003	7.07276	7.03549	6.99822	6.96095	6.92368	6.88641	6.84914	6.81187
0	37	7.59526	7.55798	7.52200	7.48473	7.44746	7.40919	7.37192	7.33465	7.29738	7.26011	7.22284	7.18557	7.14830	7.11103	7.07376	7.03649	6.99922	6.96195	6.92468	6.88741	6.85014	6.81287
0	38	7.59622	7.55894	7.52300	7.48573	7.44846	7.41019																

TABLE V.

The Finding of the Azimuth.

Hour Angle.	Declination.												Hour Angle.						
	78° 00'	78° 30'	79° 00'	79° 30'	80° 00'	80° 30'	81° 00'	81° 30'	82° 00'	82° 30'	83° 00'	83° 30'		84° 00'	84° 30'				
h. m.	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
0	9.16737	9.14915	9.13009	9.11012	9.08916	9.06710	9.04352	9.01919	8.99305	8.96519	8.93538	8.90353	8.86972	8.83406	8.79654	8.75721	8.71604	8.67302	8.62814
5	9.17481	9.15659	9.13753	9.11756	9.09660	9.07454	9.05096	9.02663	9.00049	8.97263	8.94282	8.91097	8.87716	8.84150	8.79402	8.74471	8.69354	8.64052	8.58564
10	9.18201	9.16379	9.14473	9.12476	9.10380	9.08174	9.05816	9.03383	9.00869	8.98283	8.95626	8.92899	8.89992	8.86904	8.83636	8.80197	8.76586	8.72802	8.68844
15	9.18895	9.17073	9.15167	9.13170	9.11074	9.08868	9.06549	9.04126	9.01609	8.99092	8.96485	8.93788	8.90991	8.88004	8.84826	8.81467	8.77926	8.74202	8.70294
20	9.19566	9.17744	9.15838	9.13841	9.11745	9.09539	9.07221	9.04804	9.02287	8.99670	8.96963	8.94166	8.91279	8.88202	8.84934	8.81485	8.77954	8.74241	8.70344
25	9.20213	9.18391	9.16485	9.14488	9.12392	9.10186	9.07868	9.05451	9.02934	8.99317	8.96610	8.93803	8.90896	8.87899	8.84712	8.81344	8.77895	8.74364	8.70751
30	9.20838	9.19016	9.17110	9.15113	9.13017	9.10811	9.08493	9.06076	9.03559	8.99942	8.97235	8.94428	8.91521	8.88514	8.85407	8.82100	8.78703	8.75226	8.71669
35	9.21447	9.19625	9.17719	9.15722	9.13626	9.11420	9.09003	9.06486	9.03869	8.99252	8.96545	8.93838	8.90931	8.87924	8.84817	8.81510	8.78113	8.74636	8.71079
40	9.22043	9.20221	9.18315	9.16318	9.14222	9.12026	9.09709	9.07292	9.04775	8.99158	8.96451	8.93744	8.90837	8.87830	8.84723	8.81416	8.77919	8.74342	8.70685
45	9.22628	9.20806	9.18900	9.16903	9.14807	9.12611	9.10294	9.07877	9.05360	8.99743	8.97036	8.94329	8.91322	8.88215	8.84908	8.81401	8.77794	8.74117	8.70360
50	9.23203	9.21381	9.19475	9.17478	9.15382	9.13186	9.10869	9.08452	9.05935	8.99318	8.96611	8.93904	8.90897	8.87790	8.84483	8.80976	8.77279	8.73502	8.69645
55	9.23768	9.21946	9.19990	9.17993	9.15897	9.13701	9.11384	9.08967	9.06450	8.99833	8.97126	8.94419	8.91312	8.88105	8.84798	8.81291	8.77594	8.73817	8.69960
60	9.24323	9.22501	9.20545	9.18548	9.16452	9.14256	9.11939	9.09522	9.07005	8.99388	8.96681	8.93974	8.90867	8.87660	8.84253	8.80646	8.76849	8.72972	8.69015
65	9.24868	9.23046	9.21090	9.19093	9.16997	9.14801	9.12484	9.10067	9.07550	8.99933	8.97226	8.94519	8.91412	8.88205	8.84798	8.81191	8.77394	8.73417	8.69360
70	9.25403	9.23581	9.21625	9.19628	9.17532	9.15336	9.13019	9.10602	9.08085	8.99468	8.96761	8.94054	8.90947	8.87740	8.84333	8.80726	8.76829	8.72752	8.68605
75	9.25928	9.24106	9.22150	9.20153	9.18057	9.15861	9.13544	9.11127	9.08610	8.99993	8.97286	8.94579	8.91472	8.88265	8.84758	8.81051	8.77154	8.73077	8.68830
80	9.26443	9.24621	9.22665	9.20668	9.18572	9.16376	9.14059	9.11642	9.09125	8.99508	8.96801	8.94094	8.91087	8.87880	8.84273	8.80466	8.76469	8.72392	8.68145
85	9.26958	9.25136	9.23180	9.21183	9.19087	9.16891	9.14574	9.12157	9.09640	8.99023	8.96316	8.93609	8.90602	8.87395	8.83788	8.79981	8.75804	8.71547	8.67210
90	9.27473	9.25651	9.23695	9.21698	9.19602	9.17406	9.15089	9.12672	9.10155	8.99538	8.96831	8.94124	8.91117	8.87910	8.84503	8.80896	8.76999	8.72822	8.68475

MARKING THE AZIMUTH.—The azimuth found from the table is always marked east (E.) or west (W.) according as the observed body is to the eastward or westward of the meridian of the observer. If the latitude and declination are of different name the azimuth is marked from the pole of opposite name to the latitude. If the latitude and declination are of the same name and the latitude is less than the declination, the azimuth is marked from the pole of the same name as the latitude. If the latitude and declination are of the same name and the latitude is greater than the declination, the azimuth is marked from the pole of the same name as the latitude when the hour-angle is greater than the hour-angle of crossing the prime vertical, and from the pole of opposite name when the hour-angle is less than the hour-angle of crossing the prime vertical. The hour-angle of crossing the prime vertical may be found from the diagram facing page 155.





TABLE V.  
The Finding of the Azimuth.

Hour Angle.		Declination.												
		84° 30'	85° 00'	85° 30'	86° 00'	86° 30'	87° 00'	87° 30'	88° 00'	88° 30'	88° 50'	89° 00'	89° 30'	90° 00'
h, m.	°													
		45	3											
45	4													
45	5													
45	6													
45	7													
45	8													
45	9													
45	10													
45	11													
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45	82													
45	83													
45	84													
45	85													
45	86													
45	87													
45	88													
45	89													
45	90													

MARKING THE AZIMUTH.—The azimuth found from the table is always marked east (E.) or west (W.) according as the observed body is to the eastward or westward of the meridian of the observer. If the latitude and declination are of different name the azimuth is marked from the pole of opposite name to the latitude. If the latitude and declination are of the same name and the latitude is less than the declination, the azimuth is marked from the pole of the same name as the latitude. If the latitude and declination are of the same name and the latitude is greater than the declination, the azimuth is marked from the pole of the same name as the latitude when the hour-angle is greater than the hour-angle of crossing the prime vertical, and from the pole of opposite name when the hour-angle is less than the hour-angle of crossing the prime vertical. The hour-angle of crossing the prime vertical may be found from the diagram facing page 155.





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TABLE VI

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ALTITUDE AND AZIMUTH TABLES

FOR FACILITATING THE DETERMINATION OF LINES OF POSITION AND  
GEOGRAPHICAL POSITION AT SEA

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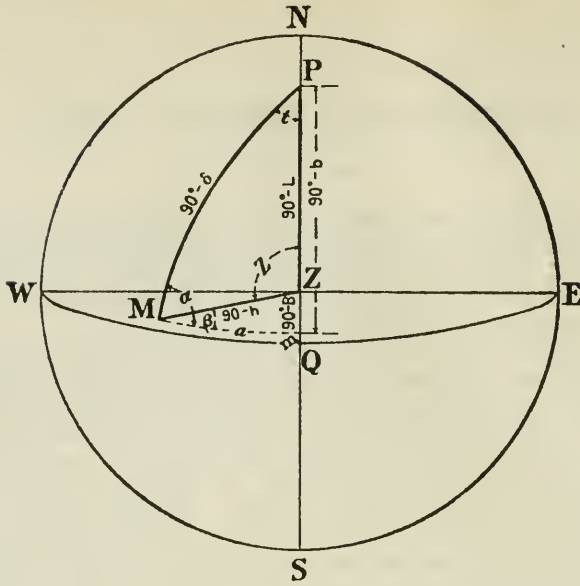


Fig. 2

(2) The point *m* will fall between *Z* and *Q* when *d* and *L* are of the same name, if  $t < 90^\circ$  and  $L > b$ . Hence (fig. 2)  $Z > 90^\circ$ ;  $M = \alpha - \beta$ ; and  $C = 90^\circ - B = (90^\circ - b) - (90^\circ - L) = L - b$ .

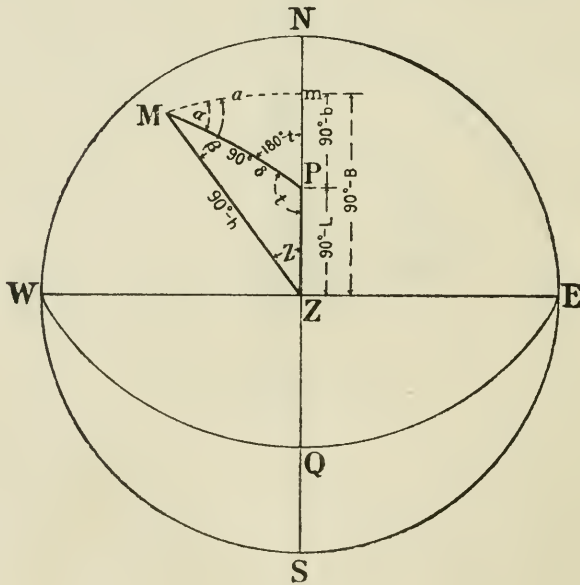


Fig. 3

(3) The point *m* will fall between *P* and *N* when *d* and *L* are of the same name, if  $t > 90^\circ$  (and then the tables must be entered with  $180^\circ - t$ , instead of *t*). Hence (fig. 3)  $Z < 90^\circ$ ;  $M = \beta - \alpha$ ; and  $C = 90^\circ - B = (90^\circ - L) + (90^\circ - b) = 180^\circ - (L + b)$ .

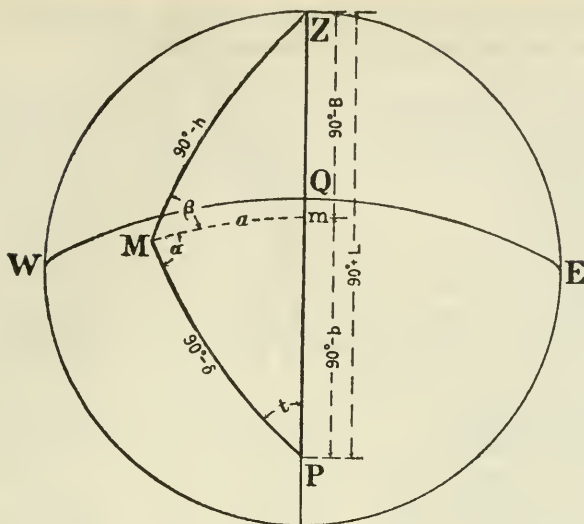


Fig. 4

(4) When  $d$  and  $L$  are of opposite sign or name, the point  $m$  will fall between  $Q$ , the equator, and  $P'$ , the depressed pole, and reckoning from the depressed pole in order that the value of  $90 - d$  shall remain within the range of the table, which is  $90^\circ$  in declination, by fig. 4  $Z > 90^\circ$  (from the elevated pole);  $M = \alpha + \beta$ ; and  $C = 90^\circ - B = (90 + L) - (90 - b) = L + b$ .

SUMMARY.

- (1)  $d$  and  $L$  same name,  $t < 90^\circ$ ,  $L < b$ , then  $C = b - L$ ,  $Z < 90^\circ$ , and  $M = \alpha + \beta$ .
- (2)  $d$  and  $L$  same name,  $t < 90^\circ$ ,  $L > b$ , then  $C = L - b$ ,  $Z > 90^\circ$ , and  $M = \alpha - \beta$ .
- (3)  $d$  and  $L$  same name,  $t > 90^\circ$  ..... then  $C = 180^\circ - (L + b)$ ,  $Z < 90^\circ$ , and  $M = \beta - \alpha$ .
- (4)  $d$  and  $L$  contrary names ..... then  $C = L + b$ ,  $Z > 90^\circ$ , and  $M = \alpha + \beta$ .

In the first two precepts the smaller of the quantities  $L$  and  $b$  is subtracted from the larger to get  $C$ , and in the last two they are added. In the third precept, when  $t$  is greater than  $90^\circ$ , their sum is greater than  $90^\circ$  and it is subtracted from  $180^\circ$ . When  $d$  and  $L$  are of contrary names their sum is always less than  $90^\circ$ . By a glance at the figures it will be seen that when  $Z$  is less than  $90^\circ$  in the precepts its value as given by the table is reckoned from the elevated pole to east or west according as the body is east or west of the meridian; and when greater than  $90^\circ$ , in like manner from the depressed pole.

The position angle  $M$  may vary in value from  $0^\circ$  to  $180^\circ$ . In the first and fourth precepts  $\alpha$  and  $\beta$  are added to find  $M$ ; and, in the second and third, the smaller is subtracted from the larger.

The precepts will be referred to as occasion may arise. It is unnecessary to commit them to memory, as they will, with a little use, become familiar.

In order to avoid making the tables too voluminous,  $a$ , for the most part, is tabulated for every  $30'$  only, and  $b$  and  $C$  for every  $1^\circ$  only. The double interpolating that this would seem to necessitate may be done away with by any one of the three methods which will be explained and illustrated in detail.

In the descriptions of the methods about to be given and in the solution of the examples, the following abbreviations, almost all of which are in common use among



American navigators, are employed to supplement the designations already used in the statement of the precepts and in the illustrative figures:

a. m. ....	Ante meridian.	$L_A$ .....	Latitude assumed.
C. C. ....	Chronometer correction.	$L_{D.R.}$ .....	Latitude by dead reckoning.
C. T. ....	Chronometer time.	L. A. noon.....	Local apparent noon.
C - W. ....	Chronometer minus watch.	L. M. noon.....	Local mean noon.
Corr. ....	Correction.	L. A. T. ....	Local apparent time.
d. ....	Declination.	L. M. T. ....	Local mean time.
Dev. ....	Deviation.	L. S. T. ....	Local sidereal time.
Diff. ....	Difference.	$\lambda$ .....	Longitude.
D. R. ....	Dead reckoning.	$\lambda_A$ .....	Longitude assumed.
Eq. t. ....	Equation of time.	$\lambda_{D.R.}$ .....	Longitude by dead reckoning.
$h$ .....	Altitude.	p. m. ....	Post meridian.
$h'$ .....	Approximate altitude.	p. s. c. ....	Per standard compass.
$h_c$ .....	Calculated altitude from tables.	R. A. ....	Right ascension.
$h_o$ .....	Observed altitude (corrected).	R. A. M. S. ....	Right ascension of mean sun.
$h_s$ .....	Sextant altitude.	$t$ .....	Local hour angle.
H. D. ....	Hourly difference.	$t_A$ .....	Assumed local hour angle.
I. C. ....	Index correction.	$t_G$ .....	Greenwich hour angle.
G. A. noon.....	Greenwich apparent noon.	$t_{D.R.}$ .....	Hour angle from dead reckoning meridian.
G. M. noon.....	Greenwich mean noon.	Var .....	Variation.
G. A. T. ....	Greenwich apparent time.	W. T. ....	Watch time.
G. M. T. ....	Greenwich mean time.	Z. ....	True azimuth.
G. S. T. ....	Greenwich sidereal time.	Z' .....	Approximate azimuth.
L. ....	Latitude.	* .....	Star or planet.

**FIRST METHOD.**—Using an assumed position and simple interpolations. The usual procedure by the Saint Hilaire method of fixing a line of position has been to determine the distance from the D. R. position to the line. The line may be just as accurately fixed by determining its distance from any assumed position near the D. R. position. In the first two methods advantage is taken of this choice in position by assuming a position such as will give a value to  $a$  of an even half degree and to C a whole degree. The solution of the triangle by means of the tables is thus simplified by having tabulated values of  $a$  and C with which to work.

The method of determining the assumed position appears in the description of the procedure which follows: Given  $d$ ,  $L_{D.R.}$ , and  $t_{D.R.}$ , to find  $h$ , Z,  $\lambda_A$ , and  $L_A$ . Enter the tables from below with the nearest value of  $d$  as tabulated, and  $t_{D.R.}$ , take out  $a$  to the nearest 30'. Reentering the tables from above with this  $a$  and with the given  $d$ , by a simple interpolation the corresponding values of  $b$  and  $t$  are obtained. These are exact values of  $a$  and  $b$  corresponding to the given  $d$  and an approximate  $t$ . Now, taking this  $t$  as  $t_A$  and combining it with the  $t_G$  (Greenwich hour angle) gives  $\lambda_A$  near the D. R. position. Assuming this new longitude from which to plot the line, proceed with the above values of  $a$  and  $b$ . As previously explained,  $b$  is combined with L to get C. C is only tabulated to whole degrees, so, in order to again avoid interpolating, assume as the latitude from which to plot the line the nearest value to the D. R. latitude that will, when combined with  $b$ , give C in whole degrees. Having for the assumed position exact tabulated values of  $a$  and C, take directly from the tables the corresponding values of  $h$  and Z.

Comparing this  $h_c$  with the observed  $h$ , gives the altitude difference and the line is plotted from the assumed position for which  $h_c$  was obtained.

*Example 1.*—A. M., December 30, 1916, sextant altitude of sun's lower limb is  $23^\circ 54'$ , bearing south and east. W. T.,  $9^h 25^m 18^s$ ; C - W,  $4^h 58^m 00^s$ ; C. C.,  $+3^m 45^s$ ; height of eye, 37 feet; I. C.,  $+2'.0$ ; D. R. position, L. =  $29^\circ 11' N.$ ,  $\lambda = 78^\circ 29' W.$  Solve for line of position.

Solution in detail: See page 192 (Form 1). Enter all the given data in the proper places as indicated in the form. Start with the W. T. in line 1 and work down until G. M. T. with date is found in line 5.

From the Nautical Almanac enter, for December 30, G. M. T.  $2^h$ , the equation of time and declination with their proper signs on lines 4 and 11, respectively, and their respective hourly differences for the day with their signs on lines 1 and 8 (second column). Correct the equation of time and declination for the difference in G. M. T. ( $27^m$ ), getting the corrected values in lines 5 and 12. Enter the equation of time in line 7. Applying it to the G. M. T. gives the G. H. A. in line 12. This is immediately converted into arc and entered in both columns, line 14. Combine the G. H. A. with  $\lambda_{D.R.}$  (lines 14 and 15, left-hand column) and obtain  $t_{D.R.}$ . Now enter Table VI from

below with  $d=23^\circ$  and  $t_{D.R.}=42^\circ 23'$ ; taking out  $a$  to the nearest half degree, enter in line 18,  $a=38^\circ 30'$ . Reenter the tables from above with  $a=38^\circ 30'$  and  $d=23^\circ 10'.3$ , and by interpolating\* take out  $b=30^\circ 11'.3$  and  $t_A=42^\circ 37'.4$  and enter them in right-hand column, lines 21 and 15, respectively.

The declination and latitude being of different names, the problem comes under the fourth precept, so  $C=b+L$ . It is seen at once that the value nearest to  $L_{D.R.}$  that will give  $C$  in whole degrees is  $28^\circ 48'.7$ . This is entered as the  $L_A$  in line 18.  $C$  is now found to be  $59^\circ 00'$ . Turning again to Table VI where  $a=38^\circ 30'$  and  $C=59^\circ 00'$ , take out  $h_c=23^\circ 46'$  and  $Z=42^\circ 52'$  and enter them in line 25. From Table I enter in line 21 the combined altitude correction. With this and the I. C. the total correction is obtained for line 22. Applying the same to  $h_o$  gives  $h_o=24^\circ 04'.3$ . The altitude difference ( $h_o-h_c$ ) is  $18'.3$ , which, since the observed altitude is the greater, must be reckoned toward the observed body from the assumed position in order to find the point through which the line of position passes at right angles to the bearing of the observed body.

The azimuth of the body being greater than  $90^\circ$  (see precept 4) and  $t$  being east,  $Z$  as taken from the tables is S.  $42^\circ 52'$  E, or the body bears  $137^\circ$  from north.

Combining lines 14 and 15 (right-hand column) gives as the assumed longitude  $78^\circ 43'.2$  W.

The assumed position, then, from which to plot the line is:

$$\begin{aligned} L_A &= 28^\circ 48'.7 \text{ N.} \\ \lambda_A &= 78^\circ 43'.2 \text{ W.} \end{aligned}$$

The altitude difference is 18.3 miles toward the body bearing  $137^\circ$ , and the line of position is at right angles to the bearing.

*Example 2.*—May 23, 1916, during p. m. twilight, sextant altitude of star  $\alpha$  Leonis (Regulus) is  $66^\circ 18'.2$ , bearing S. and W.; W. T.,  $6^h 45^m 18^s$ ; C—W,  $4^h 18^m 02.0^s$ ; C. C.— $3^m 45.5^s$ ; I. C., 0.0; height of eye, 39 feet; D. R. position, L.  $34^\circ 38'$  N,  $\lambda$   $65^\circ 12'$  W. Solve for line of position.

See page 192 (Form 1). Enter in the form all the given data and get out the G. M. T. and date as before. From the Almanac enter the star's R. A. in line 11;  $d$  in line 12 (right-hand column); R. A. M. S. for noon 23d in line 8; and the correction to the R. A. M. S. for G. M. T. in line 9. The G. S. T. (adding lines 5, 8, and 9) is found to be  $15^h 04^m 26.5^s$ . Subtracting from the G. S. T. the star's R. A. gives G. H. A. =  $5^h 00^m 30.3^s$ . Convert the G. H. A. into arc and enter in both columns line 14. Combining the G. H. A. with  $\lambda_{D.R.}$  gives  $t_{D.R.}$  (line 16) =  $9^\circ 55'.6$ .

Enter Table VI from below with  $d=12^\circ 30'$  and  $t_{D.R.}=9^\circ 55'.6$  and take out  $a=9^\circ 30'$  (nearest  $30'$ ). Now enter same table from above with  $a=9^\circ 30'$  and  $d=12^\circ 22'.6$  and by interpolating take out  $b=12^\circ 33'.3$  and  $t_A=9^\circ 44'.0$ . Enter them in lines 21 and 15, respectively. The latitude and declination are of the same name,  $t$  is less than  $90^\circ$ , and  $L$  is greater than  $b$ , so this problem comes under the second precept and  $C=L-b$ . It is seen at once that the nearest value to  $L_{D.R.}$  that will give  $C$  in whole degrees is  $34^\circ 33'.3$ . Enter this as  $L_A$  in line 18.  $C=22^\circ 00'$ .

Turning again to Table VI where  $a=9^\circ 30'$ , opposite  $C=22^\circ 00'$  take out  $h_c=66^\circ 08'$ , and  $Z=24^\circ 04'$  and enter them in line 25.

From Table I enter in line 21 the combined altitude correction and obtain  $h_o=66^\circ 11'.6$ . The altitude difference ( $h_o-h_c$ ) is  $3'.6$ , and as the observed altitude is the greater the line of position is toward the body. The azimuth of the body being greater than  $90^\circ$  and  $t$  being west,  $Z$  as taken from the tables is S.  $24^\circ 04'$  W., or the body bears  $204^\circ$ . Combining lines 14 and 15 (right-hand column) gives as the assumed longitude  $65^\circ 23'.6$  W.

The assumed position, then, from which to plot the line is:

$$\begin{aligned} L_A &= 34^\circ 33'.3 \text{ N.} \\ \lambda_A &= 65^\circ 23'.6 \text{ W.} \end{aligned}$$

The altitude difference is 3.6 miles toward the body bearing  $204^\circ$ , and the line of position is at right angles to the bearing.

\* To make the interpolation easy, the columns headed  $\frac{60'}{\Delta}$  and  $\frac{\Delta}{60'}$  are supplied. Thus,  $b$  is first interpolated from  $d$  using column  $\frac{60'}{\Delta}$ ; and then, using this value of  $b$ , column  $\frac{\Delta}{60'}$  is employed in interpolating the value of  $t_A$ .

The procedure in the present example is as follows:

$$\begin{aligned} 8.3 \times 1.36 + 30^\circ &\text{ gives } b \ 30^\circ 11'.3 \\ \text{and } 11.3 \times 0.30 + 42^\circ &\text{ gives } t_A \ 42^\circ 37'.4 \end{aligned}$$



Form I.

EXAMPLE 1.

Date: Dec. 30, 1916.  
 Obs. body: Sun.  
 Lat. D. R.: 29° 11' N.

Date: May 23, 1916.  
 Obs. body: \*Regulus.  
 Lat. D. R.: 34° 38' N.

Time: 9.30 a. m.  
 Bearing: S. and E.  
 Long. D. R.: 78° 29' W.

Time: 6.30 p. m.  
 Bearing: S. and W.  
 Long. D. R.: 65° 12' W.

1. W. T.	9 <sup>h</sup> 25 <sup>m</sup> 18 <sup>s</sup>	R. A. (Eq. t.)	h	m	s
2. C-W.	4 58 00	H. D.	1 <sup>s</sup> 2		
3. C. T.		G. M. T.	.45		
4. C. C.	+	Corr.	.5		
5. G. M. T., 30th	2 27 03.0	R. A. (Eq. t.) 2 hrs.	2 39.4		
6.		R. A. (Eq. t.)	2 39.9		
7. Eq. t.	2 39.9	Declination.			
8. R. A., M. S.		H. D.	+ ° 0'.2		
9. Corr.		G. M. T.	.45		
10. G. S. T.		Corr.	+ .1		
11. R. A.	2 24 23.1	Dec. 2 hours	23 10.4		
12. G. H. A.	2 24 23.1	d	S. 23 10.3		
13.					
14. Arc.	36° 05'.8 W.	Arc	36° 05'.8 W.		
15. $\lambda_p, R.$	78 29.0 W.	$\iota_A$	42 37.4 E.		
16. $\iota_p, R.$	42 23.2 E.	$\lambda_A$	78 43.2 W.		} Pos. A
17.		$\iota_A$	28 48.7 N.		
18. a.	38 30	$\iota_A$			
19.					
20. I. C.	+				
21. Corr. table	+	b	30 11.3		
22. Corr.	+	C	59 00.0		
23. $h_s$	23 54.0				
24. $h_o$	24 04.3				
25. $h_c$	23 46.0	Z	S. 42° 52' E.		
26. Diff.	18.3 toward body bearing 137°				

EXAMPLE 2.

Date: May 23, 1916.  
 Obs. body: \*Regulus.  
 Lat. D. R.: 34° 38' N.

Time: 6.30 p. m.  
 Bearing: S. and W.  
 Long. D. R.: 65° 12' W.

W. T.	6 <sup>h</sup> 45 <sup>m</sup> 18 <sup>s</sup>	R. A. (Eq. t.)	h	m	s
C-W.	4 18 02	H. D.			
C. T.	11 03 20.0	G. M. T.			
C. C.	3 45.5	Corr.			
G. M. T., 23d	10 59 34.5	R. A. (Eq. t.) hours			
Eq. t.		R. A. (Eq. t.)			
R. A., M. S.	4 03 03.6	Declination.			
Corr.	+ 1 48.4	H. D.			
G. S. T.	15 04 26.5	G. M. T.			
R. A.	10 03 56.2	Corr.			
G. H. A.	5 00 30.3	Dec. hours			
		d	N. 12 22.6		
Arc	75° 07'.6 W.	Arc	75° 07'.6 W.		
$\lambda_p, R.$	65 12.0 W.	$\iota_A$	9 44.0 W.		
$\iota_p, R.$	9 55.6 W.	$\lambda_A$	65 23.6 W.		} Pos. A
a	9 30	$\iota_A$	34 33.3 N.		
I. C.	0.0				
Corr. table	6.6	b	12 33.3		
Corr.	6.6	C.	22 00.0		
$h_s$	66 18.2				
$h_o$	66 11.6				
$h_c$	66 08.0	Z	24° 04' W.		
Diff.	3.6 toward body bearing S. 204°				

EXAMPLE 3.

Date: October 15, 1916.  
Obs. body: Saturn.  
Lat. D. R.: 41° 45' N.

Time: 6.00 a. m.  
Bearing: S. and E.  
Long. D. R.: 32° 10' W.

1. W. T.	5 <sup>h</sup> 50 <sup>m</sup> 22.5	H. D.	R. A. (Eq. t.)	h	m	•	R. A. (Eq. t.)	h	m	•
2. C-W	2 15 10.0	G. M. T.								
3. C. T.		Corr.								
4. C. C.	+ 1 15.5	R. A. (Eq. t.)	0 hours	8	08	20.0				
5. G. M. T.	8 06 48.0	R. A. (Eq. t.)		8	08	17.7				
6.	14th 20 06 48.0	Declination.								
7. Eq. t.		H. D.					Eq. t.			
8. R. A. M. S.	13 30 47.6	G. M. T.					R. A. M. S.			° /
9. Corr.	+ 3 18.1	Corr.								
10. G. S. T.	9 40 53.7	G. S. T.								
11. R. A.	8 08 17.7	Dec. 0 hours					R. A.			
12. G. H. A.	1 32 36.0	d					G. H. A.			

13.										
14. Arc	23° 09' W.	Arc.	23° 09' 0 W.				Arc			° /
15. λ <sub>D.R.</sub>	32 10 W.	λ <sub>A</sub>	9 03.9 E.				λ <sub>D.R.</sub>			λ <sub>A</sub>
16. t <sub>D.R.</sub>	9 01 E.	λ <sub>A</sub>	32 12.9 W.				t <sub>D.R.</sub>			λ <sub>A</sub> } Pos. <sub>A</sub>
17.		L <sub>A</sub>	41 26.7 N.				a			I <sub>A</sub> } Pos. <sub>A</sub>
18. a	8 30	b					I. C.			
19.		c					Corr. tables			b
20. I. C.	1.5	Corr.					Corr.			c
21. Corr. tables	6.8	h <sub>s</sub>					h <sub>s</sub>			
22. Corr.	- 8.3	h <sub>o</sub>					h <sub>o</sub>			
23. h <sub>s</sub>	+ 67 29.0	h <sub>c</sub>					h <sub>c</sub>			
24. h <sub>o</sub>	67 20.7	Z					Z			° /
25. h <sub>c</sub>	67 25.0									
26.		Diff.					Diff.			{ from } body bearing ° { toward }

4.3 from body bearing 157½°.



*Example 3.*—October 15, 1916, during a. m. twilight, the sextant altitude of Saturn, bearing S. and E., is  $67^{\circ} 29'$ ; W. T.,  $5^{\text{h}} 50^{\text{m}} 22.5^{\text{s}}$ ; C-W,  $2^{\text{h}} 15^{\text{m}} 10^{\text{s}}$ ; C. C.,  $+1^{\text{m}} 15.5^{\text{s}}$ ; height of eye, 42 feet; I. C.,  $-1'.5$ ; D. R. position, L.  $41^{\circ} 45'$ ,  $\lambda$   $32^{\circ} 10' \text{ W}$ . Solve for line of position.

See page 193 (Form 1). Enter in the form all the given data and find the G. M. T. and date as before. Take from the Almanac and enter Saturn's R. A. and  $d$  for G. M. noon 15th, the corrections for G. M. T. from Table IV of Almanac, the R. A. M. S. for G. M. noon 14th, and its correction for the G. M. T.

Correct the R. A. and the  $d$  and enter the corrected R. A. in line 11. Now work down the form as in example 2 and find in line 16,  $t_{\text{p. r.}} = 9^{\circ} 01'$ . Enter Table VI from below with  $d = 20^{\circ} 00'$  and  $t = 9^{\circ} 00'$ , take out  $a = 8^{\circ} 30'$  (nearest half degree). Reenter same table from above with  $a = 8^{\circ} 30'$  and  $d = 20^{\circ} 12'.7$  and by interpolating take out  $b = 20^{\circ} 26'.7$  and  $t_{\lambda} = 9^{\circ} 03'.9$ . Notice that this problem also comes under the second precept, so  $C = L - b$ . Taking  $L_{\lambda} = 41^{\circ} 26'.7$ ,  $C = 21^{\circ} 00'$ .

Turning again to Table VI, where  $a = 8^{\circ} 30'$  and  $C = 21^{\circ} 00'$  take out  $h_c = 67^{\circ} 25'$  and  $Z = 22^{\circ} 38'$ . The altitude difference obtained as before is  $4'.3$  from the body.  $Z$  as obtained is S  $22^{\circ} 18' \text{ E}$  (greater than  $90^{\circ}$  and  $t$  is east) or body bears  $157\frac{1}{2}^{\circ}$ . The  $\lambda_{\lambda}$  is found as before and is  $32^{\circ} 12'.9 \text{ W}$ .

The assumed position then from which to plot the line is:

$$\begin{aligned} L_{\lambda} & 41^{\circ} 26'.7 \text{ N.} \\ \lambda_{\lambda} & 32^{\circ} 12'.9 \text{ W.} \end{aligned}$$

The altitude difference is 4.3 miles away from the body bearing  $157\frac{1}{2}^{\circ}$  and the line of position is at right angles to the bearing.

**SECOND METHOD.**—Using an assumed position without interpolating. In this method  $a$  is found to the nearest half degree as in the first method. Now instead of entering with  $a$  and the given  $d$  and interpolating for  $b$  and  $t$ , enter with  $a$  and take out  $b$  and  $t$  as found opposite that tabulated value of  $d$  which is nearest to the given  $d$ . This tabulated value is taken out as the assumed  $d$  and marked  $d'$ .  $C$  is obtained by combining  $b$  and  $L$  in the usual way. As  $b$  in this method will be in whole degrees,  $L_{\lambda}$  is taken as the nearest whole degree to  $L_{\text{p. r.}}$ . Now with  $a$  and  $C$  take out  $h'$  and  $Z'$  (approximate values of  $h$  and  $Z$ ). The values of  $h'$  and  $Z'$  are in error by an amount depending on the effect of  $\Delta d = d - d'$ , the difference between the assumed and the true declination.

The correction to  $Z'$ ,  $\Delta Z$ , is always so small it may be neglected in practical work.

The correction to  $h'$ ,  $\Delta h$ , is given by the formula:

$$\Delta h = \Delta d \cos M$$

$M$ , as previously shown, is a combination of  $\alpha$  and  $\beta$ . So when taking out  $b$  and  $t$  from the tables also take out the corresponding  $\alpha$ ; and likewise  $\beta$  when taking out  $h'$  and  $Z'$ . The manner in which  $\alpha$  and  $\beta$  must be combined to give  $M$  is shown in the precepts.

To find the value of  $\Delta h$  per minute of declination, or its equivalent  $\cos M$ , enter the second column of Table VII with  $90^{\circ} - M$  instead of  $Z'$  in the first column. The sign of  $\Delta h$  is determined as follows:

When  $M$  is less than  $90^{\circ}$ ,  $\Delta h$  has the same sign as  $\Delta d$ ; and for  $M$  greater than  $90^{\circ}$ , the opposite sign.

The three examples worked out by the first method will now be used to illustrate the second method.

*Example 1.*—See page 196 (Form 2). The procedure is the same as in the first method, down to and including the determination of  $a$ . Now enter Table VI with  $a = 38^{\circ} 30'$  and find  $d' = 23^{\circ} 02'$  (the tabulated value nearest to the given  $d$ ). Enter it in the form, line 12, and take out and enter the values of  $b$ ,  $t_{\lambda}$ , and  $\alpha$  as found opposite  $d'$ . Now take  $L_{\lambda} = 29^{\circ} 00'$  (the nearest whole degree to  $L_{\text{p. r.}}$ ).  $C$  is now obtained by combining  $b$  and  $L_{\lambda}$  as before, and this gives  $C = 59^{\circ} 00'$ .

With  $a = 38^{\circ} 30'$  and  $C = 59^{\circ} 00'$ , take out  $h'$ ,  $Z'$ , and  $\beta$ . As this example comes under the fourth precept,  $M = \alpha + \beta = 140^{\circ}.1$ ,  $\Delta d = d - d' = 8'.3$ .

Entering the first column of Table VII with  $90^{\circ} - M = 90^{\circ} - 140^{\circ}.1 = 50^{\circ}.1$ ,  $\cos M$  is found to be 0.77, and this multiplied by  $\Delta d = 8'.3$  gives  $6'.3$  as the value of  $\Delta h$ .

Referring to the rule given above for determining the sign of  $\Delta h$ , it is seen that as  $M$  is greater than  $90^\circ$ , and  $\Delta d$  is plus,  $\Delta h$  is minus. Applying  $\Delta h$  to  $h'$  gives  $h_c = 23^\circ 39'.7$ . The altitude difference is  $24'.6$ . Neglecting  $\Delta Z$ , the bearing of the body is  $S 42^\circ 52' E$ , or  $137^\circ$ . The longitude,  $\lambda_A$ , is found to be  $78^\circ 39'.8$ .

The assumed position, then, from which to plot the line is:

$$\begin{aligned} L_A & 29^\circ 00' N \\ \lambda_A & 78^\circ 39'.8 W \end{aligned}$$

The altitude difference is 24.6 miles toward the body bearing  $137^\circ$ , and the line of position is at right angles to the bearing.

*Example 2.*—See page 196 (Form 2). Entering Table VI from above with  $a = 9^\circ 30'$ , take out  $d' = 12^\circ 49'$ ; also the corresponding  $t_A$ ,  $b$ , and  $a$ .  $L_A$  is taken as  $35^\circ 00'$ ; then  $C = L_A - b = 22^\circ 00'$ . Now with  $a = 9^\circ 30'$  and  $C = 22^\circ 00'$ , take out  $h'$ ,  $Z'$ , and  $\beta$ . By the precepts,  $M = a - \beta = 20^\circ 00'$ .  $\Delta d = d - d' = -26'.4$ . From Table VII,  $\cos M$  is  $0'.94$ ; and hence  $\Delta d \times \cos M = \Delta h = 26.4 \times 0.94 = 24'.8$ .

In this example, since  $M$  is less than  $90^\circ$ ,  $\Delta h$  is minus like  $\Delta d$ . Applying  $\Delta h$  to  $h'$  gives  $h_c = 65^\circ 43'.2$ ; and the altitude difference is  $28'.4$  toward the body bearing  $S 24^\circ 04' W$ , or  $204^\circ$ . The  $\lambda_A$  is found to be  $65^\circ 22'.6 W$ .

The assumed position, then, from which to plot the line is:

$$\begin{aligned} L_A & 35^\circ 00' N \\ \lambda_A & 65^\circ 22'.6 W \end{aligned}$$

The altitude difference is 28.4 miles toward the body bearing  $204^\circ$  and the line of position is at right angles to the bearing.

*Example 3.*—See page 197 (Form 2). Entering the tables from above with  $a = 8^\circ 30'$ , take out  $d' = 19^\circ 46'$ , also the corresponding  $t_A$ ,  $b$ , and  $a$ . Take  $L_A = 42^\circ 00'$ , and combining it with  $b$ , gives  $C = 22^\circ 00'$ . Now enter with  $a = 8^\circ 30'$  and  $C = 22^\circ 00'$  and take out  $h'$ ,  $Z'$ , and  $\beta$ . By the precept,  $M = a - \beta = 16^\circ .1$ .  $\Delta d = 26.7$ . From Table VII  $\cos M$  is  $0.96$ ; and hence  $\Delta d \times \cos M = \Delta h = 26.7 \times 0.96 = 25'.7$ . Since  $M$  is less than  $90^\circ$ ,  $\Delta h$  is plus like  $\Delta d$ . Applying  $\Delta h$  to  $h'$  gives  $h_c = 66^\circ 54'.7$ , and the altitude difference is 26.0 toward the body bearing  $S 21^\circ 45' E$ , or  $158^\circ$ . The  $\lambda_A$  is found to be  $32^\circ 11' W$ .

The assumed position, then, from which to plot the line is:

$$\begin{aligned} L_A & 42^\circ 00' N \\ \lambda_A & 32^\circ 11' W \end{aligned}$$

The altitude difference is 26.0 miles toward the body bearing  $158^\circ$ , and the line of position runs at right angles to the bearing.

**THIRD METHOD.**—Using the D. R. position. This method is the least desirable for the practical navigator in that it involves interpolating and also the correcting of the  $h$  and  $Z$  obtained. It is given here because the line is plotted from the D. R. position, and its use may be desirable when  $t_{D.R.} - t$  is large, when the altitude difference is large, or when two or more lines of position are to be plotted simultaneously.

The values of  $a$  and  $b$  are obtained by using  $t_A$  instead of  $t_{D.R.}$  as in the first method. Then  $b$  is combined with  $L_{D.R.}$  to get  $C$ .  $C$  will seldom come out in whole degrees, so entering the tables with  $a$  and  $C$  it will be necessary to interpolate for  $h'$  and  $Z'$ . Since the  $h'$  and  $Z'$  obtained are for  $L_{D.R.}$  and  $t_A$ , they must now be corrected for the effect of  $t_{D.R.} - t_A$ , or  $\Delta t$ .

The formulas are:

$$\Delta h = \Delta t \times \frac{\Delta h}{\Delta t}, \text{ in which } \frac{\Delta h}{\Delta t} = \pm \cos L \sin Z'.$$

$$\Delta_1 Z = \Delta t \times \frac{\Delta_1 Z}{\Delta t}, \text{ in which } \frac{\Delta_1 Z}{\Delta t} = -\sin L.$$

$$\Delta_2 Z = \Delta h \times \frac{\Delta_2 Z}{\Delta h}, \text{ in which } \frac{\Delta_2 Z}{\Delta h} = -\tan h' \cot Z'.$$

$$\Delta Z = \Delta_1 Z + \Delta_2 Z.$$

In Tables VII and VIII are given the values of the coefficients  $\frac{\Delta h}{\Delta t}$ ,  $\frac{\Delta_1 Z}{\Delta t}$ , and  $\frac{\Delta_2 Z}{\Delta h}$ , the arguments being the elements shown in the above formulas. Above the tables are



Form 2.

EXAMPLE 2.

Date: May 23, 1916.  
 Obs. body: \* Regulus.  
 Lat. D. R.: 34° 38' N.  
 Time: 6.30 p. m.  
 Bearing: S. and W.  
 Long. D. R.: 65° 12' W.

1. W. T.	9 <sup>h</sup> 25 <sup>m</sup> 18 <sup>s</sup> . 0	R. A. (Eq. t.)	6 <sup>h</sup> 45 <sup>m</sup> 18 <sup>s</sup> . 0	H. D.		R. A. (Eq. t.)	
2. C-W	4 58 00.0	H. D.	4 18 02.0	G. M. T.		H. D.	
3. C. T.		G. M. T.	11 03 20.0	Corr.		G. M. T.	
4. C. C.	+ 3 45.0	Corr.	- 3 45.5	R. A. (Eq. t.)	hrs	Corr.	
5. G. M. T. 30th	2 27 03.0	R. A. (Eq. t.)	10 59 34.5	R. A. (Eq. t.)		R. A. (Eq. t.)	
6.		Declination.				Declination.	
7. Eq. t.	- 2 39.9	H. D.	4 03 03.6	H. D.			
8. R. A. M. S.		G. M. T.		G. M. T.			
9. Corr.		Corr.	+ 1 48.4	Corr.			
10. G. S. T.		dec. 2 hrs	15 04 26.5	dec. hrs			
11. R. A.		d	10 03 56.2	d		N. 12 22.6	
12. G. H. A.	2 24 23.1	d'	5 00 30.3	d'		12 49.0	
13.		Δd		Δd		- 26.4	

Date: December 30, 1916.  
 Obs. body: Sun.  
 Lat. D. R.: 29° 11' N.  
 Time: 9.30 a. m.  
 Bearing: S. and E.  
 Long. D. R.: 78° 29' W.

14. Arc	36° 05'. 8 W.	R. A. (Eq. t.)	36° 05'. 8 W.	Arc	75° 07'. 6 W.	Pos. <sup>A</sup>	
15. λ <sub>D, E.</sub>	78 29.0 W.	H. D.	42 34.0 E.	λ <sub>D, E.</sub>	65 12.0 W.	} Pos. <sup>A</sup>	
16. λ <sub>D, E.</sub>	42 23.2 E.	G. M. T.	78 39.8 W.	λ <sub>D, E.</sub>	9 55.6 W.		
17.		Corr.		a	9 30	L <sub>A</sub>	35 00 N.
18. a	38 30	dec. 2 hrs	-23 10.4	b		b	13 00
19.		d	S. 23 10.3	I. C.	0.0	C	22 00
20. I. C.	+ 2.0	d'	23 02	Corr. table	- 6.6		
21. Corr. table	+ 8.3	Δd	+ 8.3	Corr.		α	87.8
22. Corr.	+ 10.3			h <sub>s</sub>	66 18.2	β	67.8
23. h <sub>s</sub>	23 54.0			h <sub>0</sub>	66 11.6	M	20.0
24. h <sub>0</sub>	24 04.3			h'	66 08.0		
25. h'	23 46.0			Δh	- 24.8		
26. Δh	- 6.3			h <sub>c</sub>	65 43.2	Z	S. 24° 04' W.
27. h <sub>c</sub>	23 39.7			Diff.	28.4 toward body bearing 204°		
28.							

EXAMPLE 1.

Date: December 30, 1916.  
 Obs. body: Sun.  
 Lat. D. R.: 29° 11' N.  
 Time: 9.30 a. m.  
 Bearing: S. and E.  
 Long. D. R.: 78° 29' W.

1. W. T.	9 <sup>h</sup> 25 <sup>m</sup> 18 <sup>s</sup> . 0	R. A. (Eq. t.)	6 <sup>h</sup> 45 <sup>m</sup> 18 <sup>s</sup> . 0	H. D.		R. A. (Eq. t.)	
2. C-W	4 58 00.0	H. D.	4 18 02.0	G. M. T.		H. D.	
3. C. T.		G. M. T.	11 03 20.0	Corr.		G. M. T.	
4. C. C.	+ 3 45.0	Corr.	- 3 45.5	R. A. (Eq. t.)	hrs	Corr.	
5. G. M. T. 30th	2 27 03.0	R. A. (Eq. t.)	10 59 34.5	R. A. (Eq. t.)		R. A. (Eq. t.)	
6.		Declination.				Declination.	
7. Eq. t.	- 2 39.9	H. D.	4 03 03.6	H. D.			
8. R. A. M. S.		G. M. T.		G. M. T.			
9. Corr.		Corr.	+ 1 48.4	Corr.			
10. G. S. T.		dec. 2 hrs	15 04 26.5	dec. hrs			
11. R. A.		d	10 03 56.2	d		N. 12 22.6	
12. G. H. A.	2 24 23.1	d'	5 00 30.3	d'		12 49.0	
13.		Δd		Δd		- 26.4	

Date: December 30, 1916.  
 Obs. body: Sun.  
 Lat. D. R.: 29° 11' N.  
 Time: 9.30 a. m.  
 Bearing: S. and E.  
 Long. D. R.: 78° 29' W.

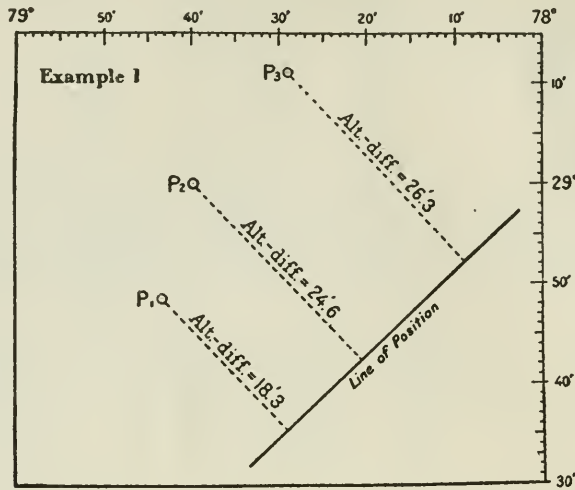
14. Arc	36° 05'. 8 W.	R. A. (Eq. t.)	36° 05'. 8 W.	Arc	75° 07'. 6 W.	Pos. <sup>A</sup>	
15. λ <sub>D, E.</sub>	78 29.0 W.	H. D.	42 34.0 E.	λ <sub>D, E.</sub>	65 12.0 W.	} Pos. <sup>A</sup>	
16. λ <sub>D, E.</sub>	42 23.2 E.	G. M. T.	78 39.8 W.	λ <sub>D, E.</sub>	9 55.6 W.		
17.		Corr.		a	9 30	L <sub>A</sub>	35 00 N.
18. a	38 30	dec. 2 hrs	-23 10.4	b		b	13 00
19.		d	S. 23 10.3	I. C.	0.0	C	22 00
20. I. C.	+ 2.0	d'	23 02	Corr. table	- 6.6		
21. Corr. table	+ 8.3	Δd	+ 8.3	Corr.		α	87.8
22. Corr.	+ 10.3			h <sub>s</sub>	66 18.2	β	67.8
23. h <sub>s</sub>	23 54.0			h <sub>0</sub>	66 11.6	M	20.0
24. h <sub>0</sub>	24 04.3			h'	66 08.0		
25. h'	23 46.0			Δh	- 24.8		
26. Δh	- 6.3			h <sub>c</sub>	65 43.2	Z	S. 24° 04' W.
27. h <sub>c</sub>	23 39.7			Diff.	28.4 toward body bearing 204°		
28.							





also given the precepts for determining their signs. The correction  $\Delta Z$  is generally negligible, unless  $\Delta t$  is large. The same examples which were solved by the first and second methods will now be worked out to illustrate the third method.

*Example 1.*—See page 200 (Form 3). The value of  $a$  is determined as before, and is



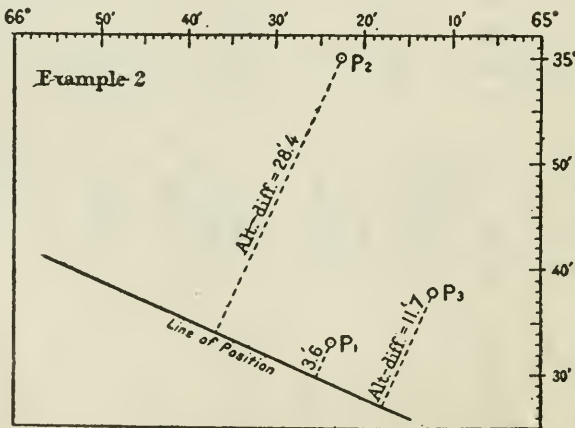
$38^\circ 30'$ . Now entering the tables with this  $a$  and  $d = 23^\circ 10'.3$ , take out  $b = 30^\circ 11'.3$  and  $t_A = 42^\circ 37'.4$ .  $b$  is combined with  $L_{D.R.}$  and gives  $C = 59^\circ 22'.3$ . Enter with  $a$  and  $C$  and by interpolation take out  $h' = 23^\circ 29'.6$  and  $Z' = 42^\circ 45'$ . Now  $\Delta t = t_{D.R.} - t_A = -14.2$ . Turn to Tables VII and VIII and take out  $\frac{\Delta h}{\Delta t}$ ,  $\frac{\Delta_1 Z}{\Delta t}$ , and  $\frac{\Delta_2 Z}{\Delta h}$ , and enter them with their proper signs in lines 19, 24, and 26, respectively.

$$\Delta h = \Delta t \times \frac{\Delta h}{\Delta t} = -14'.2 \times -.59 = +8'.4 \quad \Delta_1 Z = \Delta t \times \frac{\Delta_1 Z}{\Delta t} = -14'.2 \times +.49 = -7'$$

$$\Delta_2 Z = \Delta h \times \frac{\Delta_2 Z}{\Delta h} = +8'.4 \times -.48 = -4'$$

Applying  $\Delta h$  to  $h'$  gives  $h_c = 23^\circ 38'.0$ , and applying  $\Delta_1 Z$  and  $\Delta_2 Z$  to  $Z'$  gives  $Z = 42^\circ 34'$ . The altitude difference is 26.3 miles toward the body bearing  $S 42^\circ 34' E$ , or  $137\frac{1}{2}^\circ$ , and the line is plotted from the D. R. position.

*Example 2.*—See page 200 (Form 3).—Entering the tables with  $a = 9^\circ 30'$  and

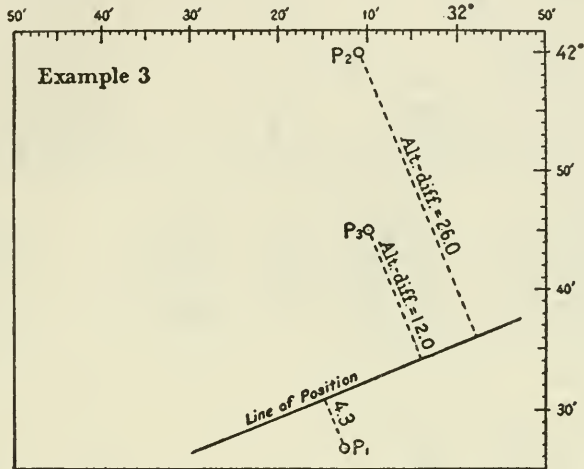


$d = 12^\circ 22'.6$ , take out  $b = 12^\circ 33'.3$  and  $t_A = 9^\circ 44'$ .  $C = L_{D.R.} - b = 22^\circ 04'.7$ . Enter with  $a$  and  $C$  and by interpolation find  $h' = 66^\circ 03'.7$  and  $Z' = 23^\circ 59'$ .  $\Delta t = +11'.6$ .

From Tables VII and VIII take out  $\frac{\Delta h}{\Delta t}$ ,  $\frac{\Delta_1 Z}{\Delta t}$ , and  $\frac{\Delta_2 Z}{\Delta h}$  with their proper signs. The corrections  $\Delta h$ ,  $\Delta_1 Z$ , and  $\Delta_2 Z$  are obtained as explained in example 1; applying them to  $h'$  and  $Z'$  we find  $h_c = 65^\circ 59'.9$  and  $Z = 24^\circ 25'$ .

The altitude difference is  $11'.7$  toward the body bearing  $S 24^\circ 25' W$ , or  $204\frac{1}{2}^\circ$ , and the line is plotted from the D. R. position.

*Example 3.*—See page 201 (Form 3). Entering Table VI with  $a = 8^\circ 30'$  and



$d = 20^\circ 12'.7$ , take out  $b = 20^\circ 26'.7$  and  $t_A = 9^\circ 03'.9$ .  $C = L_{D.R.} - b = 21^\circ 18'.3$ . Enter with  $a$  and  $C$  and by interpolating take out  $h' = 67^\circ 07'.9$  and  $Z' = 22^\circ 22'$ .  $\Delta t = -2'.9$ . From Tables VII and VIII take out  $\frac{\Delta h}{\Delta t}$ ,  $\frac{\Delta_1 Z}{\Delta t}$ , and  $\frac{\Delta_2 Z}{\Delta h}$  with their proper signs. The corrections  $\Delta h$ ,  $\Delta_1 Z$ , and  $\Delta_2 Z$  are obtained as before. Applying them to  $h'$  and  $Z'$  gives  $h_c = 67^\circ 08'.7$  and  $Z = 22^\circ 15'$ .

The altitude difference is  $12.0$  miles toward the body bearing  $S 22^\circ 15' E$ , or  $157\frac{3}{4}^\circ$ , and the line is plotted from the D. R. position.

The three lines of position, determined by the solutions of the three foregoing examples, are charted in the accompanying diagrams. The line of position from each example falls in the same place—as of course it should—whether laid down from  $p_1$ ,  $p_2$ , or  $p_3$ , the respective points indicating the geographical positions from which the altitude differences are to be reckoned in the three solutions of each example by the three different methods.





EXAMPLE 3.

Date: October 15, 1916.  
 Obs. body: Saturn.  
 Lat. D. R.: 41° 45' N.

Time: 6.00 a. m.  
 Bearing: S. and E.  
 Long. D. R.: 32° 10' W.

		R. A. (Eq. t.)		Date:		Time:	
		H. D.	h m s	W. T.	h m s	Bearing:	R. A. (Eq. t.)
		G. M. T.		C-W		Long. D. R.:	(Eq. t.)
1.	W. T.	5 <sup>b</sup> 50 <sup>m</sup> 22 <sup>s</sup> . 5				° /	
2.	C-W	2 15 10.0				° /	
3.	C. T.			C. T.			Declination.
4.	C. C.	+ 1 15.5	2.3	C. C.			
5.	G. M. T.	8 06 48.0	8 08 20.0	G. M. T.			
6.	14th	20 06 48.0	8 08 17.7				
7.	Eq. t.			Eq. t.			
8.	R. A. M. S.	13 30 47.6		R. A. M. S.			
9.	Corr.	+ 3 18.1	.1	Corr.			
10.	G. S. T.	9 40 53.7	+20 12.6	G. S. T.			
11.	R. A.	8 08 17.7	N. 20 12.7	R. A.			
12.	G. H. A.	1 32 36.0	41° 45'	G. H. A.			
13.			20 26.7				
14.	Arc	23° 09' W.	21 18.3	Arc			
15.	$\lambda_{D,R}$	32 10 W.		$\lambda_{D,R}$			
16.	$t_{D,R}$	9 01 E.	9 01	$t_{D,R}$			
17.			9 03.9	$t_A$			
18.	a	8 30	2.9	a			
19.	I. C.	- 1.5	.28	I. C.			
20.	Corr. table	- 6.8	.8	Corr. table			
21.	Corr.	- 8.3		Corr.			
22.	$h_s$	67 29.0	Z'... 22' 22'	$h_s$			
24.	$h_o$	67 20.7	$\Delta_1 Z$ ... + ' 65, $\Delta_1 Z$ ... - 2	$h_o$			
25.	$h'$	67 07.9	$\Delta t$	$h'$			
26.	$\Delta h$	+ 0.8	$\Delta_2 Z$ ... -5.80, $\Delta_2 Z$ ... - 5	$\Delta h$			
27.	$h_c$	67 08.7	$\Delta h$	$h_c$			
28.	Diff.	12.0 toward body bearing 157 $\frac{1}{2}$ °	Z=S. 22 15 E.	Diff.			

$\left. \begin{matrix} \Delta h \\ \text{from} \\ \text{toward} \end{matrix} \right\}$  body bearing °



b	a = 0° 0'					a = 0° 30'					a = 1° 0'					c	α		
	B	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$			Z	t
0	0	0	1	0	0	0	0	1	0	0	0.00	0	0	1	0	0	0.00	00	90.0
1	1	0	1	0	0	1	0	1	0	0	.00	1	0	1	0	0	.00	89	90.0
2	2	0	1	0	0	2	0	1	0	0	.00	2	0	1	0	0	.00	88	90.0
3	3	0	1	0	0	3	0	1	0	0	.00	3	0	1	0	0	.00	87	90.0
4	4	0	1	0	0	4	0	1	0	0	.00	4	0	1	0	0	.00	86	90.0
5	5	0	1	0	0	5	0	1	0	0	.00	5	0	1	0	0	.00	85	90.0
6	6	0	1	0	0	6	0	1	0	0	.00	6	0	1	0	0	.00	84	89.9
7	7	0	1	0	0	7	0	1	0	0	.00	7	0	1	0	0	.02	83	89.9
8	8	0	1	0	0	8	0	1	0	0	.00	8	0	1	1	0	.00	82	89.9
9	9	0	1	0	0	9	0	1	0	0	.02	9	0	1	1	0	.00	81	89.9
10	10	0	1	0	0	10	0	1	0	0	.00	10	0	1	1	0	.00	80	89.9
11	11	0	1	0	0	11	0	1	0	0	.00	11	0	1	1	0	.00	79	89.9
12	12	0	1	0	0	12	0	1	0	0	.00	12	0	1	1	0	.02	78	89.9
13	13	0	1	0	0	13	0	1	0	0	.00	13	0	1	2	0	.00	77	89.9
14	14	0	1	0	0	14	0	1	0	0	.00	14	0	1	2	0	.00	76	89.9
15	15	0	1	0	0	15	0	1	0	0	.00	15	0	1	2	0	.00	75	89.9
16	16	0	1	0	0	16	0	1	0	0	.00	16	0	1	2	0	.02	74	89.9
17	17	0	1	0	0	17	0	1	0	0	.02	17	0	1	3	0	.00	73	89.8
18	18	0	1	0	0	18	0	1	0	0	.00	18	0	1	3	0	.00	72	89.8
19	19	0	1	0	0	19	0	1	0	0	.00	19	0	1	3	0	.02	71	89.8
20	20	0	1	0	0	20	0	1	0	0	.00	20	0	1	4	0	.00	70	89.8
21	21	0	1	0	0	21	0	1	0	0	.00	21	0	1	4	0	.02	69	89.8
22	22	0	1	0	0	22	0	1	0	0	.02	22	0	1	5	0	.00	68	89.8
23	23	0	1	0	0	23	0	1	0	0	.00	23	0	1	5	0	.02	67	89.8
24	24	0	1	0	0	24	0	1	0	0	.00	24	0	1	6	0	.00	66	89.8
25	25	0	1	0	0	25	0	1	0	0	.00	25	0	1	6	0	.02	65	89.8
26	26	0	1	0	0	26	0	1	0	0	.02	26	0	1	7	0	.00	64	89.8
27	27	0	1	0	0	27	0	1	0	0	.00	27	0	1	7	0	.02	63	89.7
28	28	0	1	0	0	28	0	1	0	0	.00	28	0	1	8	0	.02	62	89.7
29	29	0	1	0	0	29	0	1	0	0	.02	29	0	1	9	0	.00	61	89.7
30	30	0	1	0	0	30	0	1	0	0	.00	30	0	1	9	0	.02	60	89.7
31	31	0	1	0	0	31	0	1	0	0	.00	31	0	1	10	0	.02	59	89.7
32	32	0	1	0	0	32	0	1	0	0	.02	32	0	1	11	0	.02	58	89.7
33	33	0	1	0	0	33	0	1	0	0	.00	33	0	1	12	0	.00	57	89.7
34	34	0	1	0	0	34	0	1	0	0	.02	34	0	1	12	0	.02	56	89.7
35	35	0	1	0	0	35	0	1	0	0	.00	35	0	1	13	0	.02	55	89.7
36	36	0	1	0	0	36	0	1	0	0	.02	36	0	1	14	0	.02	54	89.6
37	37	0	1	0	0	37	0	1	0	0	.00	37	0	1	15	0	.02	53	89.6
38	38	0	1	0	0	38	0	1	0	0	.02	38	0	1	16	0	.02	52	89.6
39	39	0	1	0	0	39	0	1	0	0	.00	39	0	1	17	0	.02	51	89.6
40	40	0	1	0	0	40	0	1	0	0	.02	40	0	1	18	0	.02	50	89.6
41	41	0	1	0	0	41	0	1	0	0	.00	41	0	1	19	0	.03	49	89.6
42	42	0	1	0	0	42	0	1	0	0	.02	42	0	1	21	0	.02	48	89.6
43	43	0	1	0	0	43	0	1	0	0	.02	43	0	1.02	22	0	.02	47	89.5
44	44	0	1	0	0	44	0	1	0	0	.00	44	59	1	23	0	.03	46	89.5
45	45	0	1	0	0	45	0	1	0	0	.00	44	59	1	25	0		45	89.5
t	a	$\frac{60'}{\Delta}$	b			a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$			a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$				a
	d = 0° 0'					d = 0° 30'					d = 1° 0'								

b	a = 0° 0'					a = 0° 30'					a = 1° 0'					c	a				
	B	h	d	60'	t	h	d	60'	Z	t	Δ	h	d	60'	Z			t	Δ	C	β
			Δ	Z	60'			60'	60'	60'	60'			60'							
45	45	0	1	0	0	45	0	1	0	0	0.02	44	59	1	1	25	0.02	45	89.5		
46	46	0	1	0	0	46	0	1	0	0	0.02	45	59	1	1	26	0.03	44	89.5		
47	47	0	1	0	0	47	0	1	0	0	0.02	46	59	1	1	28	0.03	43	89.5		
48	48	0	1	0	0	48	0	1	0	0	0.02	47	59	1	1	30	0.02	42	89.4		
49	49	0	1	0	0	49	0	1	0	0	0.02	48	59	1	1	31	0.03	41	89.4		
50	50	0	1	0	0	50	0	1	0	0	0.02	49	59	1	1	33	0.03	40	89.4		
51	51	0	1	0	0	51	0	1	0	0	0.02	50	59	1	1	35	0.03	39	89.4		
52	52	0	1	0	0	52	0	1	0	0	0.02	51	59	1	1	37	0.05	38	89.4		
53	53	0	1	0	0	53	0	1	0	0	0.02	52	59	1	1	40	0.03	37	89.3		
54	54	0	1	0	0	54	0	1	0	0	0.02	53	59	1	1	42	0.05	36	89.3		
55	55	0	1	0	0	55	0	1	0	0	0.03	54	59	1	1	45	0.03	35	89.3		
56	56	0	1	0	0	56	0	1	0	0	0.02	55	59	1	1	47	0.05	34	89.3		
57	57	0	1	0	0	57	0	1	0	0	0.03	56	59	1	1	50	0.05	33	89.2		
58	58	0	1	0	0	58	0	1	0	0	0.02	57	59	1	1	53	0.05	32	89.2		
59	59	0	1	0	0	59	0	1	0	0	0.03	58	59	1	1	56	0.07	31	89.2		
60	60	0	1	0	0	60	0	1	1	0	0.03	59	59	1	2	0	0.07	30	89.1		
61	61	0	1	0	0	61	0	1	2	0	0.03	60	59	1	4	0	0.07	29	89.1		
62	62	0	1	0	0	62	0	1	4	0	0.03	61	59	1	8	0	0.07	28	89.1		
63	63	0	1	0	0	63	0	1	6	0	0.03	62	59	1	12	0	0.08	27	89.0		
64	64	0	1	0	0	64	0	1	8	0	0.05	63	59	1	17	0	0.08	26	89.0		
65	65	0	1	0	0	65	0	1	11	0	0.05	64	59	1	22	0	0.08	25	88.9		
66	66	0	1	0	0	66	0	1	14	0	0.05	65	59	1	27	0	0.10	24	88.9		
67	67	0	1	0	0	67	0	1	17	0	0.05	66	59	1	33	0	0.12	23	88.8		
68	68	0	1	0	0	68	0	1	20	0	0.07	67	59	1	40	0	0.12	22	88.8		
69	69	0	1	0	0	69	0	1	24	0	0.07	68	59	1	47	0	0.13	21	88.7		
70	70	0	1	0	0	70	0	1	28	0	0.07	69	59	1.02	55	0	0.15	20	88.6		
71	71	0	1	0	0	71	0	1	32	0	0.08	70	58	1	3	4	0.17	19	88.5		
72	72	0	1	0	0	72	0	1	37	0	0.10	71	58	1	14	0	0.18	18	88.5		
73	73	0	1	0	0	73	0	1	43	0	0.10	72	58	1	25	0	0.20	17	88.4		
74	74	0	1	0	0	74	0	1	49	0	0.12	73	58	1	37	0	0.23	16	88.3		
75	75	0	1	0	0	75	0	1.02	56	0	0.13	74	58	1	51	0	0.28	15	88.1		
76	76	0	1	0	0	59	59	1	2	4	0.15	75	58	1	4	8	0.30	14	88.0		
77	77	0	1	0	0	76	59	1	13	0	0.18	76	58	1	26	0	0.37	13	87.8		
78	78	0	1	0	0	77	59	1	24	0	0.22	77	58	1.02	48	0	0.43	12	87.6		
79	79	0	1	0	0	78	59	1	37	0	0.22	78	57	1	5	14	0	0	11	87.4	
80	80	0	1	0	0	79	59	1	53	0	0.22	79	57	1	44	0	0	10	87.2		
81	81	0	1	0	0	80	59	1	3	12	0.22	80	57	1.02	6	22	0	0	9	86.8	
82	82	0	1	0	0	81	59	1	35	0	0.22	81	56	1	7	9	0	0	8	86.4	
83	83	0	1	0	0	82	59	1	4	6	0.22	82	56	1.02	8	9	0	0	7	85.9	
84	84	0	1	0	0	83	59	1	46	0	0.22	83	55	1.02	9	29	0	0	6	85.3	
85	85	0	1	0	0	84	59	1.02	5	43	0.22	84	54	1.02	11	20	0	0	5	84.3	
86	86	0	1	0	0	85	58	1	7	8	0.22	85	53	1.05	14	3	0	0	4	82.9	
87	87	0	1	0	0	86	58	1.03	9	28	0.22	86	50	1.07	18	27	0	0	3	80.5	
88	88	0	1	0	0	87	56	1.05	14	2	0.22	87	46	1.22	26	34	0	0	2	76.0	
89	89	0	1	0	0	88	53	1.62	26	34	0.22	88	35	2.40	45	0	0	0	1	63.4	
90	90	0	1	0	0	89	30	0	90	0	0.22	89	0	0	90	0	0	0	0	0	0.0

t	a = 0° 0'		a = 0° 30'			a = 1° 0'			a
	a	60'	b	Δ	b	Δ	b	Δ	
		Δ							
	d = 0° 0'		d = 0° 30'			d = 1° 0'			



B	$a = 1^\circ 30'$					$a = 2^\circ 0'$					$a = 2^\circ 30'$					C	$\beta$		
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t				
		$\frac{\Delta}{60'}$					$\frac{\Delta}{60'}$					$\frac{\Delta}{60'}$							
0	0	0	1	1	30	0.00	0	0	1	2	0	0	1	2	30	0.00	90	90.0	
1	1	0	1	1	30	.00	1	0	1	0	0	1	0	1	30	.00	89	90.0	
2	2	0	1	1	30	.00	2	0	1	0	.00	2	0	1	30	.00	88	89.9	
3	3	0	1	1	30	.00	3	0	1	0	.00	3	0	1	30	.00	87	89.9	
4	4	0	1	1	30	.00	4	0	1	0	.00	4	0	1	30	.02	86	89.9	
5	5	0	1	1	30	.00	5	0	1	0	.02	5	0	1	31	.00	85	89.8	
6	6	0	1	1	30	.02	6	0	1	1	.00	6	0	1	31	.00	84	89.8	
7	7	0	1	1	31	.00	7	0	1	1	.00	7	0	1	31	.00	83	89.8	
8	8	0	1	1	31	.00	8	0	1	1	.00	8	0	1	31	.02	82	89.7	
9	9	0	1	1	31	.00	9	0	1	1	.02	59	1	1	32	.00	81	89.7	
10	10	0	1	1	31	.02	10	0	1	2	.00	9	59	1	32	.02	80	89.6	
11	11	0	1	1	32	.00	11	0	1	2	.02	10	59	1	33	.00	79	89.6	
12	12	0	1	1	32	.00	12	0	1	3	.00	11	59	1	33	.02	78	89.6	
13	13	0	1	1	32	.02	13	0	1.02	3	.02	12	59	1	34	.02	77	89.5	
14	14	0	1	1	33	.00	59	1	4	.00	13	59	1	35	.00	76	89.5		
15	15	0	1	1	33	.02	14	59	1	4	.02	14	59	1	35	.02	75	89.5	
16	16	0	1	1	34	.00	15	59	1	5	.00	15	59	1	36	.02	74	89.4	
17	17	0	1	1	34	.02	16	59	1	5	.02	16	59	1	37	.02	73	89.4	
18	18	0	1	1	35	.00	17	59	1	6	.02	17	59	1	38	.02	72	89.4	
19	19	0	1	1	35	.02	18	59	1	7	.02	18	59	1	39	.02	71	89.3	
20	20	0	1	1	36	.00	19	59	1	8	.02	19	59	1	40	.02	70	89.3	
21	21	0	1	1	36	.02	20	59	1	9	.00	20	59	1	41	.02	69	89.2	
22	22	0	1.02	1	37	.02	21	59	1	9	.02	21	59	1	42	.02	68	89.2	
23	59	1	1	1	38	.02	22	59	1	10	.02	22	59	1	43	.02	67	89.2	
24	23	59	1	1	39	.00	23	59	1	11	.02	23	59	1.02	44	.02	66	89.1	
25	24	59	1	1	39	.02	24	59	1	12	.02	24	58	1	45	.03	65	89.1	
26	25	59	1	1	40	.02	25	59	1	13	.03	25	58	1	47	.02	64	89.0	
27	26	59	1	1	41	.02	26	59	1	15	.02	26	58	1	48	.03	63	89.0	
28	27	59	1	1	42	.02	27	59	1	16	.02	27	58	1	50	.02	62	88.9	
29	28	59	1	1	43	.02	28	59	1	17	.03	28	58	1	51	.03	61	88.9	
30	29	59	1	1	44	.02	29	59	1	19	.02	29	58	1	53	.03	60	88.8	
31	30	59	1	1	45	.02	30	59	1	20	.02	30	58	1	55	.03	59	88.8	
32	31	59	1	1	46	.02	31	59	1	21	.03	31	58	1	57	.03	58	88.8	
33	32	59	1	1	47	.03	32	59	1	23	.03	32	58	1	59	.03	57	88.7	
34	33	59	1	1	49	.02	33	59	1	25	.02	33	58	1	3	1	.03	56	88.7
35	34	59	1	1	50	.02	34	59	1.02	26	.03	34	58	1	3	.03	55	88.6	
36	35	59	1	1	51	.03	35	58	1	28	.03	35	58	1	5	.05	54	88.5	
37	36	59	1	1	53	.02	36	58	1	30	.03	36	58	1.02	8	.03	53	88.5	
38	37	59	1	1	54	.03	37	58	1	32	.03	37	57	1	10	.05	52	88.4	
39	38	59	1	1	56	.02	38	58	1	34	.05	38	57	1	13	.05	51	88.4	
40	39	59	1	1	57	.03	39	58	1	37	.03	39	57	1	16	.05	50	88.3	
41	40	59	1	1	59	.03	40	58	1	39	.03	40	57	1	19	.05	49	88.3	
42	41	59	1	1	2	1	.03	41	58	1	41	.05	41	57	1	22	.05	48	88.2
43	42	59	1	1	3	.03	42	58	1	44	.05	42	57	1	25	.05	47	88.1	
44	43	59	1	1	5	.03	43	58	1	47	.05	43	57	1	28	.07	46	88.1	
45	44	59	1	1	7		44	58		50		44	57		32		45	88.0	

t	$d = 1^\circ 30'$		$d = 2^\circ 0'$		$d = 2^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	

b	a = 1° 30'					a = 2° 0'					a = 2° 30'					c	a				
	B	h	d	t	Δ	h	d	t	Δ	h	d	t	Δ	C	β						
			60'															60'	60'	60'	60'
45	44	50	1	2	7	0.03	44	58	1	2	50	0.05	44	57	1	3	32	0.07	45	88.0	
46	45	59	1		9	.05	45	58	1		53	.05	45	57	1.02	36	.07	44	87.9		
47	46	59	1		12	.03	46	58	1		56	.05	46	56	1	40	.07	43	87.9		
48	47	59	1		14	.05	47	58	1		59	.07	47	56	1	44	.07	42	87.8		
49	48	59	1		17	.05	48	58	1		3	3	.07	48	56	1	44	.08	41	87.7	
50	49	59	1		20	0.05	49	58	1.02		7	0.07	49	56	1	53	0.08	40	87.6		
51	50	59	1.02		23	.05	50	57	1		11	.07	50	56	1	58	.08	39	87.5		
52	51	58	1		26	.05	51	57	1		15	.07	51	56	1	4	3	.10	38	87.4	
53	52	58	1		29	.07	52	57	1		19	.08	52	56	1	9	.10	37	87.3		
54	53	58	1		33	.07	53	57	1		24	.08	53	56	1.02	15	.10	36	87.2		
55	54	58	1		37	0.07	54	57	1		29	0.08	54	55	1	21	0.12	35	87.1		
56	55	58	1		41	.07	55	57	1		34	.10	55	55	1	28	.12	34	87.0		
57	56	58	1		45	.08	56	57	1		40	.10	56	55	1	35	.13	33	86.9		
58	57	58	1		50	.08	57	57	1		46	.12	57	55	1	43	.13	32	86.8		
59	58	58	1		55	.08	58	57	1.02		53	.12	58	55	1.02	51	.15	31	86.7		
60	59	58	1	3	0	0.10	59	56	1	4	0	0.12	59	54	1	5	0	0.15	30	86.5	
61	60	58	1		6	.10	60	56	1		7	.13	60	54	1	9	.17	29	86.4		
62	61	58	1		12	.10	61	56	1		15	.15	61	54	1	19	.18	28	86.2		
63	62	58	1		18	.12	62	56	1		24	.15	62	54	1.02	30	.18	27	86.1		
64	63	58	1.02		25	.13	63	56	1		33	.17	63	53	1	41	.22	26	85.9		
65	64	57	1		33	0.13	64	56	1.02		43	0.18	64	53	1	54	0.23	25	85.7		
66	65	57	1		41	.15	65	55	1		54	.20	65	53	1.02	6	8	.25	24	85.5	
67	66	57	1		50	.17	66	55	1	5	6	.22	66	52	1	23	.27	23	85.3		
68	67	57	1	4	0	.18	67	55	1		19	.25	67	52	1	39	.30	22	85.1		
69	68	57	1		11	.20	68	55	1.02		34	.27	68	52	1.02	57	.32	21	84.8		
70	69	57	1		23	0.22	69	54	1		50	0.28	69	51	1	7	16	0.37	20	84.5	
71	70	57	1.02		36	.25	70	54	1	6	7	.33	70	51	1.02	8	38	.42	19	84.2	
72	71	56	1		51	.27	71	54	1.02		27	.37	71	50	1.02	8	3	.45	18	83.9	
73	72	56	1	5	7	.32	72	53	1		49	.40	72	49	1	30	.50	17	83.5		
74	73	56	1		26	.35	73	53	1.02		7	13	.47	73	49	1.02	9	0	.58	16	83.1
75	74	56	1.02		47	0.40	74	52	1		41	0.53	74	48	1.02	35	0.65	15	82.6		
76	75	55	1	6	11	.47	75	52	1.02		8	13	.62	75	47	1.02	10	14	.75	14	82.0
77	76	55	1.02		39	.53	76	51	1.02		50	.70	76	46	1.02	59	.88	13	81.4		
78	77	54	1	7	11	.63	77	50	1.02		9	32	.83	77	45	1.03	11	52	1.02	12	80.7
79	78	54	1.02		49		78	49	1.02		10	22		78	43	1.02	12	53	1.23	11	79.8
80	79	53	1	8	35		79	48	1.02		11	22		79	42	1.03	14	7		10	78.8
81	80	53	1.02		9	30	80	47	1.03		12	35		80	40	1.05	15	36		9	77.6
82	81	52	1.02	10	39		81	45	1.03		14	5		81	37	1.05	17	25		8	76.1
83	82	51	1.03		12	8	82	43	1.03		15	59		82	34	1.07	19	43		7	74.1
84	83	49	1.03		14	4	83	41	1.07		18	28		83	30	1.09	22	40		6	71.6
85	84	47	1.05		16	43	84	37	1.09		21	50		84	25	1.15	26	37		5	68.3
86	85	44	1.09		20	35	85	32	1.15		26	36		85	17	1.22	32	3		4	63.5
87	86	39	1.18		26	35	86	24	1.30		33	43		86	6	1.43	39	50		3	56.3
88	87	30	1.43		36	53	87	10	1.67		45	1			48	2.00	51	22		2	45.0
89	88	12	3.33		56	19		46	4.29		63	27		87	18	5.00	68	13		1	26.6
90		30			90	0	88	0		90	0			30			90	0		0	0.0
t	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a								
	d = 1° 30'		d = 2° 0'		d = 2° 30'																



b	a = 3° 0'					a = 3° 30'					a = 4° 0'					c	a			
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t
0	0	0	1	3	0	0.00	0	0	1	3	30	0.00	0	0	1	4	0	0.00	00	90.0
1	1	0	1		0	.00	1	0	1	3	30	.00	1	0	1	0	0	.00	89	89.9
2	2	0	1		0	.00	2	0	1	3	30	.00	2	0	1	0	0	.00	88	89.9
3	3	0	1		0	.00	3	0	1	3	30	.02	3	0	1.02	0	0	.02	87	89.8
4	4	0	1		0	.02	4	0	1.02	3	31	.00	4	0	1	1	0	.00	86	89.8
5	5	0	1		1	0.00		59	1		31	0.00	4	59	1	1	0.00	85	89.7	
6	6	0	1.02		1	.00		5	59	1	31	.02	5	59	1	1	.02	84	89.6	
7		59	1		1	.02	6	59	1		32	.00	6	59	1	2	.00	83	89.6	
8	7	59	1		2	.00	7	59	1		32	.02	7	59	1	2	.02	82	89.5	
9	8	59	1		2	.02	8	59	1		33	.00	8	59	1	3	.02	81	89.4	
10	9	59	1		3	0.00	9	59	1		33	0.02	9	59	1.02	4	0.00	80	89.4	
11	10	59	1		3	.02	10	59	1		34	.02	10	58	1	4	.02	79	89.3	
12	11	59	1		4	.02	11	59	1		35	.02	11	58	1	5	.02	78	89.3	
13	12	59	1		5	.00	12	59	1.02		36	.00	12	58	1	6	.02	77	89.2	
14	13	59	1		5	.02	13	58	1		36	.02	13	58	1	7	.02	76	89.1	
15	14	59	1		6	0.02	14	58	1		37	0.02	14	58	1	8	0.03	75	89.1	
16	15	59	1		7	.02	15	58	1		38	.02	15	58	1.02	10	.02	74	89.0	
17	16	59	1.02		8	.02	16	58	1		39	.03	16	57	1	11	.02	73	88.9	
18	17	58	1		9	.02	17	58	1		41	.02	17	57	1	12	.03	72	88.9	
19	18	58	1		10	.02	18	58	1		42	.02	18	57	1	14	.02	71	88.8	
20	19	58	1		11	0.03	19	58	1		43	0.03	19	57	1	15	0.03	70	88.7	
21	20	58	1		13	.02	20	58	1.02		45	.02	20	57	1	17	.03	69	88.7	
22	21	58	1		14	.02	21	57	1		46	.03	21	57	1.02	19	.03	68	88.6	
23	22	58	1		15	.03	22	57	1		48	.03	22	56	1	21	.03	67	88.5	
24	23	58	1		17	.02	23	57	1		50	.03	23	56	1	23	.03	66	88.4	
25	24	58	1		18	0.03	24	57	1		52	0.03	24	56	1	25	0.03	65	88.4	
26	25	58	1		20	.03	25	57	1		54	.03	25	56	1	27	.03	64	88.3	
27	26	58	1.02		22	.03	26	57	1		56	.03	26	56	1	29	.05	63	88.2	
28	27	57	1		24	.03	27	57	1.02		58	.03	27	56	1.02	32	.03	62	88.1	
29	28	57	1		26	.03	28	56	1	4	0	.03	28	55	1	34	.05	61	88.1	
30	29	57	1		28	0.03	29	56	1		2	0.05	29	55	1	37	0.05	60	88.0	
31	30	57	1		30	.03	30	56	1		5	.05	30	55	1	40	.05	59	87.9	
32	31	57	1		32	.03	31	56	1		8	.03	31	55	1	43	.05	58	87.8	
33	32	57	1		34	.05	32	56	1		10	.05	32	55	1.02	46	.05	57	87.7	
34	33	57	1		37	.05	33	56	1		13	.05	33	54	1	49	.07	56	87.6	
35	34	57	1		40	0.03	34	56	1.02		16	0.05	34	54	1	53	0.05	55	87.6	
36	35	57	1.02		42	.05	35	55	1		19	.07	35	54	1	56	.07	54	87.5	
37	36	56	1		45	.05	36	55	1		23	.05	36	54	1.02	5	0	.07	53	87.4
38	37	56	1		48	.05	37	55	1		26	.07	37	53	1	4	.07	52	87.3	
39	38	56	1		51	.07	38	55	1		30	.07	38	53	1	8	.08	51	87.2	
40	39	56	1		55	0.05	39	55	1.02		34	0.07	39	53	1	13	0.08	50	87.1	
41	40	56	1		58	.07	40	54	1		38	.07	40	53	1.02	18	.08	49	87.0	
42	41	56	1	4	2	.07	41	54	1		42	.08	41	52	1	23	.08	48	86.9	
43	42	56	1.02		6	.07	42	54	1		47	.08	42	52	1	28	.08	47	86.7	
44	43	55	1		10	.07	43	54	1		52	.08	43	52	1	33	.10	46	86.6	
45	44	55			14		44	54			57		44	52		39		45	86.5	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a			
	d = 3° 0'				d = 3° 30'				d = 4° 0'											

b	a = 3° 0'					a = 3° 30'					a = 4° 0'					c	a						
	B	h	d	60'	t	h	d	60'	t	h	d	60'	t	C	β								
			Δ	Δ	Δ		Δ	Δ	Δ		Δ	Δ											
45	44	55	1	4	14	0.08	44	54	1.02	4	57	0.08	44	52	1.02	5	39	0.10	45	86.5			
46	45	55	1	19	.08	45	53	1	5	2	.08	45	51	1	45	.10	44	.10	44	86.4			
47	46	55	1	24	.08	46	53	1	7	7	.10	46	51	1	51	.12	43	.12	43	86.3			
48	47	55	1	29	.08	47	53	1	13	13	.10	47	51	1.02	58	.12	42	.12	42	86.1			
49	48	55	1.02	34	.10	48	53	1.02	19	19	.12	48	50	1	6	5	.13	41	.13	41	86.0		
50	49	54	1	40	0.10	49	52	1	26	26	0.12	49	50	1	13	0.13	40	0.13	40	85.8			
51	50	54	1	46	.10	50	52	1	33	33	.12	50	50	1.02	21	.13	39	.13	39	85.7			
52	51	54	1	52	.12	51	52	1.02	40	40	.13	51	49	1	29	.15	38	.15	38	85.5			
53	52	54	1	59	.12	52	51	1	48	48	.13	52	49	1	38	.15	37	.15	37	85.4			
54	53	54	1.02	5	6	.12	53	51	1	56	.15	53	49	1.02	47	.17	36	.17	36	85.2			
55	54	53	1	13	0.13	54	51	1.02	6	5	0.15	54	48	1	57	0.18	35	0.18	35	85.0			
56	55	53	1	21	.15	55	50	1	14	14	.17	55	48	1.02	7	8	.18	34	.18	34	84.8		
57	56	53	1.02	30	.15	56	50	1	24	24	.18	56	47	1	19	.20	33	.20	33	84.6			
58	57	52	1	39	.17	57	50	1.02	35	35	.18	57	47	1.02	31	.22	32	.22	32	84.4			
59	58	52	1	49	.17	58	49	1	46	46	.20	58	46	1	44	.23	31	.23	31	84.2			
60	59	52	1	59	0.18	59	49	1.02	58	58	0.22	59	46	1.02	58	0.25	30	0.25	30	84.0			
61	60	52	1.02	6	10	.20	60	48	1	7	11	.23	60	45	1.02	8	13	.25	29	.25	29	83.7	
62	61	51	1	22	.22	61	48	1.02	25	25	.25	61	44	1	28	.28	28	.28	28	83.5			
63	62	51	1.02	35	.23	62	47	1	40	40	.27	62	44	1.02	45	.32	27	.32	27	83.2			
64	63	50	1	49	.25	63	47	1.02	56	56	.30	63	43	1.02	9	4	.33	26	.33	26	82.9		
65	64	50	1.02	7	4	0.27	64	46	1	8	14	0.32	64	42	1.02	24	0.35	25	0.35	25	82.5		
66	65	49	1	20	.30	65	46	1.02	33	33	.35	65	41	1.02	45	.40	24	.40	24	82.2			
67	66	49	1.02	38	.33	66	45	1.02	54	54	.37	66	40	1.02	10	9	.42	23	.42	23	81.8		
68	67	48	1	58	.35	67	44	1.02	9	16	.42	67	39	1.02	34	.47	22	.47	22	81.4			
69	68	48	1.02	8	19	.40	68	43	1.02	41	.45	68	38	1.02	11	2	.52	21	.52	21	81.0		
70	69	47	1.02	43	0.43	69	42	1.02	10	8	0.50	69	37	1.02	33	0.57	20	0.57	20	80.5			
71	70	46	1	9	.48	70	41	1.02	38	38	.57	70	36	1.02	12	7	.63	19	.63	19	79.9		
72	71	46	1.02	38	.53	71	40	1.02	11	12	.62	71	35	1.03	45	.70	18	.70	18	79.4			
73	72	45	1.02	10	10	.60	72	39	1.02	49	.70	72	33	1.03	13	27	.78	17	.78	17	78.7		
74	73	44	1.02	46	.68	73	38	1.03	12	31	.78	73	31	1.03	14	14	.88	16	.88	16	78.0		
75	74	43	1.03	11	27	0.77	74	36	1.02	13	18	0.88	74	29	1.03	15	7	1.00	15	1.00	15	77.2	
76	75	41	1.02	12	13	.90	75	35	1.03	14	11	1.03	75	27	1.03	16	7	1.15	14	1.15	14	76.2	
77	76	40	1.03	13	7	1.03	76	33	1.05	15	13	1.18	76	25	1.05	17	16	1.32	13	1.32	13	75.2	
78	77	38	1.03	14	9	1.22	77	30	1.03	16	24	1.37	77	22	1.07	18	35	1.55	12	1.55	12	74.0	
79	78	36	1.03	15	22	1.43	78	28	1.05	17	46	1.63	78	18	1.07	20	8	1.80	11	1.80	11	72.6	
80	79	34	1.05	16	48		79	25	1.07	19	24		79	14	1.09	21	56		10		10	70.9	
81	80	31	1.05	18	31		80	21	1.09	21	21		80	9	1.09	24	5		9		9	68.9	
82	81	28	1.09	20	38		81	16	1.09	23	43		81	4	1.13	26	41		8		8	66.5	
83	82	23	1.09	23	16		82	11	1.15	26	39		82	57	1.18	29	51		7		7	63.6	
84	83	18	1.15	26	38		83	3	1.18	30	20		82	48	1.25	33	47		6		6	59.9	
85	84	10	1.20	31	1		54	1.28	35	4		83	36	1.33	38	44		5		5	55.1		
86	85	0	1.33	36	55		84	41	1.43	41	15		84	21	1.54	45	4		4		4	48.9	
87	85	45	1.54	45	2		85	23	1.71	49	27		85	0	1.88	53	11		3		3	40.6	
88	86	24	2.31	56	20		58	2.50	60	17		32	2.86	63	29		2		2		2	29.8	
89	87	50	6.00	71	35		86	22	7.50	74	4		53	8.57	75	59		1		1		1	16.0
90	87	0		90	0		30		90	0		86	0		90	0		0		0		0	0.0

t	d = 3° 0'				d = 3° 30'				d = 4° 0'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
		Δ		60'		Δ		60'					



b	a = 4° 30'					a = 5° 0'					a = 5° 30'					c	a			
	B	h	d	60'	Z	t	Δ	60'	Z	t	Δ	60'	Z	t	Δ			60'	C	β
			Δ	Δ																
0	0	0	1	4	30	0.00	0	0	1	5	0	0.00	0	0	1	5	30	0.00	90	90.0
1	1	0	1		30	.00	1	0	1		0	.00	1	0	1.02		30	.00	89	89.9
2	2	0	1.02		30	.00	2	0	1.02		0	.00	5	9	1		30	.00	88	89.8
3		59	1		30	.02		59	1		0	.02	2	59	1		30	.02	87	89.7
4	3	59	1		31	.00	3	59	1		1	.00	3	59	1		31	.00	86	89.7
5	4	59	1		31	0.00	4	59	1		1	0.02	4	59	1.02		31	0.02	85	89.6
6	5	59	1		31	.02	5	59	1.02		2	.02	5	58	1		32	.02	84	89.5
7	6	59	1		32	.02	6	58	1		2	.02	6	58	1		32	.02	83	89.4
8	7	59	1.02		33	.00	7	58	1		3	.02	7	58	1		33	.02	82	89.3
9	8	58	1		33	.02	8	58	1		4	.02	8	58	1.02		34	.02	81	89.2
10	9	58	1		34	0.02	9	58	1.02		5	0.02	9	57	1		35	0.02	80	89.1
11	10	58	1		35	.02	10	57	1		6	.02	10	57	1		36	.02	79	89.0
12	11	58	1		36	.02	11	57	1		7	.02	11	57	1.02		37	.02	78	88.9
13	12	58	1.02		37	.02	12	57	1		8	.02	12	56	1		39	.02	77	88.8
14	13	57	1		38	.02	13	57	1.02		9	.02	13	56	1		40	.03	76	88.8
15	14	57	1		39	0.03	14	56	1		10	0.03	14	56	1.02		42	0.02	75	88.7
16	15	57	1		41	.02	15	56	1		12	.03	15	55	1		43	.03	74	88.6
17	16	57	1		42	.03	16	56	1		14	.02	16	55	1		45	.03	73	88.5
18	17	57	1.02		44	.02	17	56	1.02		15	.03	17	55	1		47	.03	72	88.4
19	18	56	1		45	.03	18	55	1		17	.03	18	55	1.02		49	.03	71	88.3
20	19	56	1		47	0.03	19	55	1		19	0.03	19	54	1		51	0.03	70	88.2
21	20	56	1		49	.03	20	55	1		21	.03	20	54	1		53	.05	69	88.1
22	21	56	1		51	.03	21	55	1.02		23	.05	21	54	1.02		56	.03	68	88.0
23	22	56	1.02		53	.03	22	54	1		26	.03	22	53	1		58	.05	67	87.9
24	23	55	1		55	.05	23	54	1		28	.05	23	53	1	6	1	.05	66	87.8
25	24	55	1		58	0.03	24	54	1		31	0.05	24	53	1.02		4	0.05	65	87.7
26	25	55	1	5	0	.05	25	54	1.02		34	.05	25	52	1		7	.05	64	87.6
27	26	55	1.02		3	.05	26	53	1		37	.05	26	52	1		10	.05	63	87.5
28	27	54	1		6	.05	27	53	1		40	.05	27	52	1.02		13	.07	62	87.3
29	28	54	1		9	.05	28	53	1.02		43	.05	28	51	1		17	.07	61	87.2
30	29	54	1		12	0.05	29	52	1		46	0.07	29	51	1.02		21	0.07	60	87.1
31	30	54	1.02		15	.05	30	52	1		50	.05	30	50	1		25	.07	59	87.0
32	31	53	1		18	.07	31	52	1		53	.07	31	50	1		29	.07	58	86.9
33	32	53	1		22	.05	32	52	1.02		57	.07	32	50	1.02		33	.07	57	86.8
34	33	53	1		25	.07	33	51	1	6	1	.08	33	49	1		37	.08	56	86.6
35	34	53	1.02		29	0.07	34	51	1		6	0.07	34	49	1		42	0.08	55	86.5
36	35	52	1		33	.08	35	51	1.02		10	.08	35	49	1.02		47	.08	54	86.4
37	36	52	1		38	.07	36	50	1		15	.08	36	48	1		52	.10	53	86.2
38	37	52	1.02		42	.08	37	50	1.02		20	.08	37	48	1.02		58	.10	52	86.1
39	38	51	1		47	.08	38	49	1		25	.10	38	47	1	7	4	.10	51	86.0
40	39	51	1		52	0.08	39	49	1		31	0.10	39	47	1.02		10	0.10	50	85.8
41	40	51	1.02		57	.10	40	49	1.02		37	.10	40	46	1		16	.12	49	85.7
42	41	50	1	6	3	.10	41	48	1		43	.10	41	46	1.02		23	.12	48	85.5
43	42	50	1		9	.10	42	48	1.02		49	.12	42	45	1		30	.12	47	85.4
44	43	50	1.02		15	.10	43	47	1		56	.12	43	45	1.02		37	.13	46	85.2
45	44	49			21		44	47		7	3		44	44			45		45	85.0
t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a				
	d = 4° 30'					d = 5° 0'					d = 5° 30'									

b	a = 4° 30'					a = 5° 0'					a = 5° 30'					c	a
	B	h	d	t	Δ	h	d	t	Δ	h	d	t	Δ	C	β		
			60'				Δ				60'						
0	0					0					0					0	
45	44 49	1	0 21	0.12	44 47	1.02	7 3	0.13	44 44	1	7 45	0.13	45	85.0			
46	45 49	1	28	.12	45 46	1	11	.13	45 44	1.02	53	.15	44	84.8			
47	46 49	1.02	35	.12	46 46	1.02	19	.13	46 43	1.02	8 2	.15	43	84.7			
48	47 48	1	42	.13	47 45	1	27	.15	47 42	1	11	.17	42	84.5			
49	48 48	1.02	50	.15	48 45	1.02	36	.15	48 42	1.02	21	.17	41	84.3			
50	49 47	1	59	0.15	49 44	1	45	0.17	49 41	1	31	0.18	40	84.1			
51	50 47	1.02	7 8	.15	50 44	1.02	55	.17	50 41	1.02	42	.18	39	83.9			
52	51 46	1	17	.17	51 43	1	8 5	.18	51 40	1.02	53	.20	38	83.6			
53	52 46	1.02	27	.18	52 43	1.02	16	.20	52 39	1.02	9 5	.22	37	83.4			
54	53 45	1	38	.18	53 42	1.02	28	.20	53 38	1	18	.23	36	83.2			
55	54 45	1.02	49	0.20	54 41	1	40	0.22	54 38	1.02	32	0.23	35	82.9			
56	55 44	1	8 1	.20	55 41	1.02	53	.23	55 37	1.02	46	.27	34	82.6			
57	56 44	1.02	13	.23	56 40	1.02	9 7	.25	56 36	1.02	10 2	.27	33	82.4			
58	57 43	1.02	27	.25	57 39	1.02	22	.27	57 35	1.02	18	.28	32	82.1			
59	58 42	1	42	.25	58 38	1.02	38	.30	58 34	1.02	35	.32	31	81.7			
60	59 42	1.02	57	0.27	59 37	1.02	56	0.30	59 33	1.02	54	0.33	30	81.4			
61	60 41	1.02	9 13	.30	60 36	1.02	10 14	.32	60 32	1.03	11 14	.35	29	81.1			
62	61 40	1.02	31	.32	61 35	1.02	33	.35	61 30	1.02	35	.38	28	80.7			
63	62 39	1.02	50	.35	62 34	1.02	54	.38	62 29	1.02	58	.42	27	80.3			
64	63 38	1.02	10 11	.37	63 33	1.02	11 17	.42	63 28	1.03	12 23	.45	26	79.9			
65	64 37	1.02	33	0.40	64 32	1.02	42	0.43	64 26	1.02	50	0.48	25	79.4			
66	65 36	1.02	57	.43	65 31	1.03	12 8	.48	65 25	1.03	13 19	.53	24	78.9			
67	66 35	1.02	11 23	.48	66 29	1.02	37	.53	66 23	1.03	51	.57	23	78.4			
68	67 34	1.02	52	.52	67 28	1.03	13 9	.57	67 21	1.03	14 25	.62	22	77.8			
69	68 33	1.03	12 23	.57	68 26	1.02	43	.63	68 19	1.03	15 2	.68	21	77.2			
70	69 31	1.02	57	0.63	69 25	1.03	14 21	0.68	69 17	1.03	43	0.75	20	76.5			
71	70 30	1.03	13 35	.70	70 23	1.05	15 2	.77	70 15	1.05	16 28	.83	19	75.8			
72	71 28	1.03	14 17	.78	71 20	1.03	48	.87	71 12	1.05	17 18	.93	18	75.0			
73	72 26	1.03	15 4	.87	72 18	1.05	16 40	.95	72 9	1.05	18 14	1.02	17	74.1			
74	73 24	1.05	56	.98	73 15	1.05	17 37	1.07	73 6	1.05	19 15	1.15	16	73.1			
75	74 21	1.05	16 55	1.10	74 12	1.05	18 41	1.20	74 3	1.07	20 24	1.30	15	72.0			
76	75 18	1.05	18 1	1.27	75 9	1.07	19 53	1.37	75 59	1.09	21 42	1.47	14	70.7			
77	76 15	1.05	19 17	1.45	76 5	1.07	21 15	1.57	76 54	1.09	23 10	1.68	13	69.3			
78	77 12	1.07	20 44	1.68	77 1	1.09	22 49	1.82	77 49	1.11	24 51	1.93	12	67.7			
79	78 8	1.09	22 25	1.97	78 56	1.11	24 38	2.10	78 43	1.13	26 47	2.23	11	65.9			
80	79 3	1.11	24 23		78 50	1.13	26 44		78 36	1.15	29 1	2.60	10	63.7			
81	57	1.13	26 42		79 43	1.18	29 13		79 28	1.20	31 37		9	61.2			
82	80 50	1.18	29 29		80 34	1.20	32 9		80 18	1.25	34 41		8	58.2			
83	81 41	1.22	32 51		81 24	1.25	35 40		81 6	1.30	38 19		7	54.6			
84	82 30	1.28	36 59		82 12	1.36	39 56		82 52	1.43	42 39		6	50.3			
85	83 17	1.43	42 5		83 56	1.50	45 7		82 34	1.58	47 51		5	45.1			
86	59	1.62	48 27		84 36	1.76	51 26		83 12	1.88	54 5		4	38.7			
87	84 36	2.07	56 23		84 10	2.22	59 7		84 44	2.40	61 28		3	31.0			
88	85 5	3.33	66 5		37	3.53	68 15		84 9	3.75	70 5		2	21.8			
89	23	8.57	77 30		54	10.0	78 43		25	12.0	79 44		1	11.3			
90	30		90 0		85 0		90 0		30		90 0		0	0.0			

t	a = 4° 30'				a = 5° 0'				a = 5° 30'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
		Δ				Δ				Δ			
	d = 4° 30'				d = 5° 0'				d = 5° 30'				



B	$a = 6^\circ 0'$				$a = 6^\circ 30'$				$a = 7^\circ 0'$				C	c	$\beta$	
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z				C
		t	$\frac{\Delta}{60'}$	t		$\frac{\Delta}{60'}$	t	$\frac{\Delta}{60'}$		t	$\frac{\Delta}{60'}$					
0	0 0	1	6 0	0.00	0 0	1	6 30	0.00	0 0	1	7 0	0.00	90	90.0		
1	1 0	1.02	0	.00	1 0	1.02	30	.00	1 0	1.02	0	.00	89	89.9		
2	59	1	0	.00	59	1	30	.02	59	1	0	.02	88	89.8		
3	2 59	1	0	.02	2 59	1.02	31	.00	2 59	1.02	1	.00	87	89.7		
4	3 59	1.02	1	.00	3 58	1	31	.00	3 58	1	1	.02	86	89.5		
5	4 58	1	1	0.02	4 58	1	31	0.02	4 58	1.02	2	0.00	85	89.4		
6	5 58	1	2	.02	5 58	1.02	32	.02	5 57	1	2	.02	84	89.3		
7	6 58	1.02	3	.02	6 57	1	33	.02	6 57	1.02	3	.02	83	89.2		
8	7 57	1	4	.02	7 57	1	34	.02	7 56	1	4	.02	82	89.1		
9	8 57	1	5	.02	8 57	1.02	35	.02	8 56	1.02	5	.02	81	89.0		
10	9 57	1.02	6	0.02	9 56	1	36	0.02	9 55	1	6	0.03	80	88.9		
11	10 56	1	7	.02	10 56	1.02	37	.03	10 55	1	8	.02	79	88.7		
12	11 56	1	8	.02	11 55	1	39	.02	11 55	1.02	9	.03	78	88.6		
13	12 56	1.02	9	.03	12 55	1.02	40	.03	12 54	1	11	.03	77	88.5		
14	13 55	1	11	.03	13 54	1	42	.03	13 54	1.02	13	.03	76	88.4		
15	14 55	1	13	0.02	14 54	1	44	0.03	14 53	1	15	0.03	75	88.3		
16	15 55	1.02	14	.03	15 54	1.02	46	.03	15 53	1.02	17	.03	74	88.1		
17	16 54	1	16	.03	16 53	1	48	.03	16 52	1	19	.03	73	88.0		
18	17 54	1	18	.05	17 53	1.02	50	.03	17 52	1.02	21	.05	72	87.9		
19	18 54	1.02	21	.03	18 52	1	52	.05	18 51	1	24	.05	71	87.8		
20	19 53	1	23	0.03	19 52	1	55	0.03	19 51	1.02	27	0.05	70	87.6		
21	20 53	1.02	25	.05	20 52	1.02	57	.05	20 50	1	30	.05	69	87.5		
22	21 52	1	28	.05	21 51	1	7 0	.05	21 50	1.02	33	.05	68	87.4		
23	22 52	1	31	.05	22 51	1.02	3	.05	22 49	1	36	.05	67	87.2		
24	23 52	1.02	34	.05	23 50	1	6	.07	23 49	1.02	39	.07	66	87.1		
25	24 51	1	37	0.05	24 50	1.02	10	0.05	24 48	1	43	0.07	65	87.0		
26	25 51	1.02	40	.07	25 49	1	13	.07	25 48	1.02	47	.07	64	86.8		
27	26 50	1	44	.05	26 49	1.02	17	.07	26 47	1.02	51	.07	63	86.7		
28	27 50	1	47	.07	27 48	1	21	.07	27 46	1	55	.07	62	86.6		
29	28 50	1.02	51	.07	28 48	1.02	25	.08	28 46	1.02	59	.08	61	86.4		
30	29 49	1	55	0.07	29 47	1	30	0.07	29 45	1	8 4	0.08	60	86.3		
31	30 49	1.02	59	.08	30 47	1.02	34	.08	30 45	1.02	9	.08	59	86.1		
32	31 48	1	7 4	.08	31 46	1	39	.08	31 44	1.02	14	.10	58	86.0		
33	32 48	1.02	9	.08	32 46	1.02	44	.08	32 43	1	20	.10	57	85.8		
34	33 47	1	14	.08	33 45	1	49	.10	33 43	1.02	26	.10	56	85.6		
35	34 47	1.02	19	0.08	34 45	1.02	55	0.10	34 42	1.02	32	0.10	55	85.5		
36	35 46	1	24	.10	35 44	1.02	8 1	.10	35 41	1	38	.12	54	85.3		
37	36 46	1.02	30	.10	36 43	1	7	.12	36 41	1.02	45	.12	53	85.1		
38	37 45	1	36	.10	37 43	1.02	14	.12	37 40	1.02	52	.12	52	84.9		
39	38 45	1.02	42	.12	38 42	1.02	21	.12	38 39	1	59	.12	51	84.8		
40	39 44	1	49	0.12	39 41	1	28	0.12	39 39	1.02	9 6	0.13	50	84.6		
41	40 44	1.02	56	.12	40 41	1.02	35	.13	40 38	1.02	14	.15	49	84.4		
42	41 43	1.02	8 3	.13	41 40	1.02	43	.13	41 37	1.02	23	.15	48	84.2		
43	42 42	1	11	.13	42 39	1	51	.15	42 36	1.02	32	.15	47	84.0		
44	43 42	1.02	19	.13	43 39	1.02	9 0	.15	43 35	1.02	41	.17	46	83.8		
45	44 41		27		44 38		9		44 34		51		45	83.5		
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a			
	$d = 6^\circ 0'$				$d = 6^\circ 30'$				$d = 7^\circ 0'$							

b	a = 6° 0'					a = 6° 30'					a = 7° 0'					c	a									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ							Δ															
45	44	41	1	8	27	0.15	44	38	1.02	9	9	0.17	44	34	1	9	51	0.17	45	83.5						
46	45	41	1.02	36	.17	45	37	1.02	19	.17	45	34	1.02	10	51	.18	44	.18	44	83.3						
47	46	40	1.02	46	.17	46	36	1	29	.18	46	33	1.02	12	.20	43	.20	43	83.1							
48	47	39	1.02	56	.17	47	36	1.02	40	.18	47	32	1.02	24	.20	42	.20	42	82.8							
49	48	38	1	9	6	.18	48	35	1.02	51	.20	48	31	1.02	36	.22	41	.22	41	82.6						
50	49	38	1.02	17	0.20	49	34	1.02	10	3	0.22	49	30	1.02	49	0.22	40	0.22	40	82.3						
51	50	37	1.02	29	.20	50	33	1.02	16	.22	50	29	1.03	11	2	.25	39	.25	39	82.0						
52	51	36	1.02	41	.22	51	32	1.02	29	.23	51	27	1.02	17	.25	38	.25	38	81.8							
53	52	35	1.02	54	.23	52	31	1.02	43	.25	52	26	1.02	32	.27	37	.27	37	81.5							
54	53	34	1.02	10	8	.25	53	30	1.02	58	.27	53	25	1.02	48	.28	36	.28	36	81.1						
55	54	33	1.02	23	0.27	54	29	1.03	11	14	0.28	54	24	1.03	12	5	0.30	35	0.30	35	80.8					
56	55	32	1.02	39	.27	55	27	1.02	31	.30	55	22	1.02	23	.32	34	.32	34	80.5							
57	56	31	1.02	55	.30	56	26	1.02	49	.32	56	21	1.03	42	.35	33	.35	33	80.1							
58	57	30	1.02	11	13	.32	57	25	1.02	12	8	.33	57	19	1.02	13	3	.37	32	.37	32	79.7				
59	58	29	1.02	32	.33	58	24	1.03	28	.37	58	18	1.03	25	.38	31	.38	31	79.3							
60	59	28	1.03	52	0.37	59	22	1.02	50	0.38	59	16	1.03	48	0.42	30	0.42	30	78.9							
61	60	26	1.02	12	14	.38	60	21	1.03	13	13	.42	60	14	1.03	14	13	.43	29	.43	29	78.5				
62	61	25	1.03	37	.42	61	19	1.03	38	.45	61	12	1.03	39	.48	28	.48	28	78.0							
63	62	23	1.02	13	2	.45	62	17	1.03	14	5	.48	62	10	1.03	15	8	.52	27	.52	27	77.5				
64	63	22	1.03	29	.48	63	15	1.03	34	.52	63	8	1.03	39	.55	26	.55	26	76.9							
65	64	20	1.03	58	0.52	64	13	1.03	15	5	0.57	64	6	1.03	16	12	0.60	25	0.60	25	76.4					
66	65	18	1.03	14	29	.57	65	11	1.03	16	39	.60	65	4	1.05	48	.65	24	.65	24	75.7					
67	66	16	1.03	15	3	.62	66	9	1.05	16	15	.67	66	1	1.05	17	27	.70	23	.70	23	75.1				
68	67	14	1.03	40	.68	67	6	1.03	55	.72	67	58	1.05	18	9	.77	22	.77	22	74.3						
69	68	12	1.05	16	21	.73	68	4	1.05	17	38	.78	67	55	1.05	55	.83	21	.83	21	73.6					
70	69	9	1.05	17	5	0.82	69	1	1.05	18	25	0.87	68	52	1.07	19	45	0.92	20	0.92	20	72.7				
71	70	6	1.05	54	.88	70	58	1.07	19	17	.95	69	48	1.07	20	40	1.00	19	1.00	19	71.8					
72	71	3	1.05	18	47	.98	70	54	1.07	20	14	1.05	70	44	1.09	21	40	1.12	18	1.12	18	70.8				
73	72	0	1.07	19	46	1.10	71	50	1.07	21	17	1.17	71	39	1.09	22	47	1.23	17	1.23	17	69.7				
74	71	56	1.07	20	52	1.23	72	46	1.09	22	27	1.30	72	34	1.09	24	1	1.37	16	1.37	16	68.5				
75	73	52	1.09	22	6	1.38	73	41	1.09	23	45	1.47	73	29	1.11	25	23	1.53	15	1.53	15	67.1				
76	74	47	1.09	23	29	1.57	74	36	1.11	25	13	1.65	74	23	1.13	26	55	1.72	14	1.72	14	65.6				
77	75	42	1.11	25	3	1.77	75	30	1.13	26	52	1.85	75	16	1.15	28	38	1.93	13	1.93	13	63.9				
78	76	36	1.13	26	49	2.03	76	23	1.15	28	43	2.12	76	8	1.18	30	34	2.20	12	2.20	12	62.0				
79	77	29	1.15	28	51	2.33	77	15	1.18	30	50	2.43	77	59	1.20	32	46	2.50	11	2.50	11	59.8				
80	78	21	1.18	31	11	2.72	78	6	1.22	33	16	2.80	77	49	1.25	35	16	2.87	10	2.87	10	57.3				
81	79	12	1.22	33	54		55	1.28	36	4		78	37	1.30	38	8		9		9	54.4					
82	80	1	1.30	37	4		79	42	1.30	39	18		79	23	1.36	41	25		8		8	51.1				
83	81	47	1.36	40	47		80	28	1.43	43	4		80	7	1.50	45	13		7		7	47.3				
84	81	31	1.46	45	9		81	10	1.58	47	28		47	1.62	49	36		6		6	42.9					
85	82	12	1.67	50	20		48	1.76	52	35		81	24	1.82	54	38		5		5	37.7					
86	82	48	2.00	56	26		82	22	2.07	58	31		57	2.31	60	24		4		4	31.7					
87	83	18	2.61	63	32		51	2.86	65	20		82	23	3.00	66	55		3		3	24.8					
88	84	41	4.29	71	38		83	12	4.62	72	58		43	4.62	74	8		2		2	17.1					
89	85	55	12.0	80	34		25	12.0	81	17		56	15.0	81	55		1		1		1	8.8				
90	84	0		90	0		30		90	0		83	0		90	0		0		0		0	0.0			

t	a = 6° 0'		a = 6° 30'		a = 7° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 6° 0'		d = 6° 30'		d = 7° 0'		



B	$a = 7^\circ 30'$					$a = 8^\circ 0'$					$a = 8^\circ 30'$					C	$\beta$								
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t										
		$\Delta$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$			$\frac{\Delta}{60'}$							
0	0	0	1.02	7	30	0.00	0	0	1.02	8	0	0	0.00	0	0	1.02	8	30	0.00	90	90.0				
1		59	1		30	.00		59	1		0		59	1		0		59	1.02	89	89.9				
2		1 59	1.02		30	.02		1 59	1.02		0		1 59	1.02		1		59	1.02	30	.02	88	89.7		
3		2 58	1		31	.02		2 58	1		1		2 58	1.02		1		58	1.02	31	.00	87	89.6		
4		3 58	1.02		31	.02		3 58	1.02		1		3 57	1		1		57	1	31	.02	86	89.4		
5		4 57	1		32	0.00		4 57	1.02		2	0.02	4 57	1.02		2	0.02	57	1.02	32	0.02	85	89.3		
6		5 56	1.02		32	.02		5 56	1		3	.02	5 56	1.02		3	.02	56	1.02	33	.02	84	89.2		
7		6 56	1		33	.02		6 56	1.02		4	.02	6 55	1		4	.02	55	1	34	.02	83	89.0		
8		7 56	1.02		34	.02		7 55	1		5	.02	7 55	1.02		5	.02	55	1.02	35	.02	82	88.9		
9		8 55	1		35	.03		8 55	1.02		6	.02	8 54	1.02		6	.02	54	1.02	36	.03	81	88.7		
10		9 55	1.02		37	0.02		9 54	1.02		7	0.03	9 53	1		7	0.03	53	1	38	0.02	80	88.6		
11		10 54	1		38	.03		10 53	1		9	.03	10 53	1.02		9	.03	53	1.02	39	.03	79	88.5		
12		11 54	1.02		40	.03		11 53	1.02		11	.03	11 52	1.02		11	.03	52	1.02	41	.03	78	88.3		
13		12 53	1		42	.03		12 52	1		13	.03	12 51	1		13	.03	51	1	43	.03	77	88.2		
14		13 53	1.02		44	.03		13 52	1.02		15	.03	13 51	1.02		15	.03	51	1.02	45	.05	76	88.0		
15		14 52	1		46	0.03		14 51	1.02		17	0.03	14 50	1.02		17	0.03	50	1.02	48	0.03	75	87.9		
16		15 52	1.02		48	.03		15 50	1		19	.05	15 49	1.02		19	.05	49	1.02	50	.05	74	87.7		
17		16 51	1.02		50	.05		16 50	1.02		22	.05	16 48	1		22	.05	48	1	53	.05	73	87.6		
18		17 50	1		53	.05		17 49	1.02		24	.05	17 48	1.02		24	.05	48	1.02	56	.05	72	87.4		
19		18 50	1.02		56	.05		18 48	1		27	.05	18 47	1.02		27	.05	47	1.02	59	.05	71	87.3		
20		19 49	1		59	0.05		19 48	1.02		30	0.07	19 46	1		30	0.07	46	1	9	2	0.07	70	87.1	
21		20 49	1.02		8	2	.05	20 47	1.02		34	.05	20 46	1.02		34	.05	46	1.02	6	.05	69	86.9		
22		21 48	1		5	.05		21 46	1		37	.07	21 45	1.02		37	.07	45	1.02	9	.07	68	86.8		
23		22 48	1.02		8	.07		22 46	1.02		41	.07	22 44	1.02		41	.07	44	1.02	13	.07	67	86.6		
24		23 47	1.02		12	.07		23 45	1.02		45	.07	23 43	1.02		45	.07	43	1.02	17	.08	66	86.5		
25		24 46	1		16	0.07		24 44	1		49	0.07	24 42	1		49	0.07	42	1	22	0.07	65	86.3		
26		25 46	1.02		20	.07		25 44	1.02		53	.08	25 42	1.02		53	.08	42	1.02	26	.08	64	86.1		
27		26 45	1.02		24	.08		26 43	1.02		58	.08	26 41	1.02		58	.08	41	1.02	31	.08	63	85.9		
28		27 44	1		29	.08		27 42	1.02		9	3	.08	27 40	1.02		9	3	.08	40	1.02	36	.10	62	85.8
29		28 44	1.02		34	.08		28 41	1		8	.08	28 39	1.02		8	.08	39	1.02	42	.10	61	85.6		
30		29 43	1.02		39	0.08		29 41	1.02		13	0.10	29 38	1.02		13	0.10	38	1.02	48	0.10	60	85.4		
31		30 42	1		44	.08		30 40	1.02		19	.10	30 37	1.02		19	.10	37	1.02	54	.10	59	85.2		
32		31 42	1.02		49	.10		31 39	1.02		25	.10	31 36	1		25	.10	36	1	10	0	.10	58	85.0	
33		32 41	1.02		55	.10		32 38	1.02		31	.10	32 36	1.02		31	.10	36	1.02	6	.12	57	84.8		
34		33 40	1.02		9	1	.12	33 37	1		37	.12	33 35	1.02		37	.12	35	1.02	13	.12	56	84.6		
35		34 39	1		8	.12		34 37	1.02		44	0.12	34 34	1.02		44	0.12	34	1.02	20	0.13	55	84.4		
36		35 39	1.02		15	.12		35 36	1.02		51	.13	35 33	1.02		51	.13	33	1.02	28	.13	54	84.2		
37		36 38	1.02		22	.12		36 35	1.02		59	.13	36 32	1.02		59	.13	32	1.02	36	.13	53	84.0		
38		37 37	1.02		29	.13		37 34	1.02		10	7	.13	37 31	1.02		10	7	.13	31	1.02	44	.15	52	83.8
39		38 36	1.02		37	.13		38 33	1.02		15	.15	38 30	1.03		15	.15	30	1.03	53	.15	51	83.5		
40		39 35	1		45	0.15		39 32	1.02		24	0.15	39 28	1.02		24	0.15	28	1.02	11	2	0.17	50	83.3	
41		40 35	1.02		54	.15		40 31	1.02		33	.17	40 27	1.02		33	.17	27	1.02	12	.17	49	83.1		
42		41 34	1.02		10	3	.15	41 30	1.02		43	.17	41 26	1.02		43	.17	26	1.02	22	.18	48	82.9		
43		42 33	1.02		12	.17		42 29	1.02		53	.17	42 25	1.02		53	.17	25	1.02	33	.18	47	82.6		
44		43 32	1.02		22	.18		43 28	1.02		11	3	.18	43 24	1.03		11	3	.18	44	.20	46	82.3		
45		44 31			33			44 27			14		44 22			14		22		56		45	82.1		

t	$a = 7^\circ 30'$		$a = 8^\circ 0'$		$a = 8^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 7^\circ 30'$		$d = 8^\circ 0'$		$d = 8^\circ 30'$		

b	a = 7° 30'					a = 8° 0'					a = 8° 30'					c	α									
	B	h	d	60'	t	Z	Δ	60'	h	d	60'	t	Z	Δ	60'			h	d	60'	t	Z	Δ	60'	C	β
			Δ	Δ							Δ															
45	44	31	1.02	10	33	0.18	44	27	1.02	11	14	0.20	44	22	1.02	11	56	0.22	45	0	82.1					
46	45	30	1.02	44	.20	45	26	1.03	26	.22	45	21	1.02	12	9	.22	44	.22	44	44	81.8					
47	46	29	1.02	56	.20	46	24	1.02	39	.22	46	20	1.03	22	.23	43	.23	43	.23	43	81.5					
48	47	28	1.03	11	8	.22	47	23	1.02	52	.23	47	18	1.02	36	.23	42	.23	42	.23	42	81.2				
49	48	26	1.02	21	.23	48	22	1.03	12	6	.23	48	17	1.03	50	.25	41	.25	41	.25	41	80.9				
50	49	25	1.02	35	0.23	49	20	1.02	20	0.25	49	15	1.02	13	5	0.28	40	0.28	40	5	80.6					
51	50	24	1.02	49	.25	50	19	1.02	35	.28	50	14	1.03	22	.28	39	.28	39	.28	39	80.2					
52	51	23	1.03	12	4	.27	51	18	1.03	52	.28	51	12	1.03	39	.30	38	.30	38	.30	38	79.9				
53	52	21	1.02	20	.28	52	16	1.03	13	9	.30	52	10	1.02	57	.32	37	.32	37	.32	37	79.5				
54	53	20	1.03	37	.32	53	14	1.02	27	.32	53	9	1.03	14	16	.33	36	.33	36	.33	36	79.2				
55	54	18	1.02	56	0.32	54	13	1.03	46	0.33	54	7	1.03	36	0.37	35	0.37	35	0.37	35	78.8					
56	55	17	1.03	13	15	.33	55	11	1.03	14	6	.37	55	5	1.03	58	.38	34	.38	34	.38	34	78.3			
57	56	15	1.03	35	.37	56	9	1.03	28	.38	56	3	1.05	15	21	.40	33	.40	33	.40	33	77.9				
58	57	13	1.02	57	.38	57	7	1.03	51	.42	57	0	1.03	45	.43	32	.43	32	.43	32	.43	32	77.4			
59	58	12	1.03	14	20	.42	58	5	1.03	15	16	.43	58	1.03	16	11	.47	31	.47	31	.47	31	77.0			
60	59	10	1.03	45	0.45	59	3	1.03	42	0.47	58	56	1.05	39	0.48	30	0.48	30	0.48	30	0.48	30	76.4			
61	60	8	1.05	15	12	.47	60	1	1.05	16	10	.50	59	53	1.05	17	8	.52	29	.52	29	.52	29	75.9		
62	61	5	1.03	40	.50	61	58	1.03	40	.53	60	50	1.05	39	.57	28	.57	28	.57	28	.57	28	75.3			
63	62	3	1.03	16	10	.55	61	56	1.05	17	12	.58	61	47	1.05	18	13	.62	27	.62	27	.62	27	74.7		
64	63	1	1.05	43	.58	62	53	1.05	47	.62	62	44	1.05	50	.65	26	.65	26	.65	26	.65	26	74.1			
65	64	58	1.05	17	18	0.63	63	50	1.05	18	24	0.67	63	41	1.07	19	29	0.70	25	0.70	25	0.70	25	73.4		
66	64	55	1.05	56	.68	64	47	1.07	19	4	.72	64	37	1.07	20	11	.75	24	.75	24	.75	24	72.6			
67	65	52	1.05	18	37	.75	65	43	1.07	47	.78	65	33	1.07	56	.82	23	.82	23	.82	23	.82	23	71.8		
68	66	49	1.05	19	22	.80	66	39	1.07	20	34	.85	66	29	1.07	21	45	.88	22	.88	22	.88	22	71.0		
69	67	46	1.07	20	10	.88	67	35	1.07	21	25	.92	67	25	1.09	22	38	.97	21	.97	21	.97	21	70.1		
70	68	42	1.07	21	3	0.97	68	31	1.09	22	20	1.02	68	20	1.09	23	36	1.05	20	1.05	20	1.05	20	69.1		
71	69	38	1.09	22	1	1.07	69	26	1.09	23	21	1.10	69	15	1.11	24	39	1.15	19	1.15	19	1.15	19	68.0		
72	70	33	1.09	23	5	1.17	70	21	1.09	24	27	1.22	70	9	1.11	25	48	1.27	18	1.27	18	1.27	18	66.8		
73	71	28	1.11	24	15	1.28	71	16	1.11	25	40	1.35	71	3	1.13	27	4	1.40	17	1.40	17	1.40	17	65.5		
74	72	22	1.11	25	32	1.43	72	10	1.13	27	1	1.48	72	56	1.15	28	28	1.53	16	1.53	16	1.53	16	64.1		
75	73	16	1.13	26	58	1.58	73	3	1.15	28	30	1.65	72	48	1.15	30	0	1.70	15	1.70	15	1.70	15	62.6		
76	74	9	1.15	28	33	1.78	74	55	1.18	30	9	1.85	73	40	1.20	31	42	1.90	14	1.90	14	1.90	14	60.8		
77	75	1	1.15	30	20	2.00	74	46	1.18	32	0	2.07	74	30	1.20	33	36	2.12	13	2.12	13	2.12	13	58.9		
78	75	53	1.20	32	20	2.27	75	37	1.22	34	4	2.32	75	20	1.25	35	43	2.35	12	2.35	12	2.35	12	56.8		
79	76	43	1.25	34	36	2.57	76	26	1.28	36	23	2.60	76	8	1.30	38	4	2.65	11	2.65	11	2.65	11	54.4		
80	77	31	1.28	37	10	2.92	77	13	1.30	38	59	2.95	77	54	1.33	40	43	2.97	10	2.97	10	2.97	10	51.7		
81	78	18	1.33	40	5	3.33	78	59	1.40	41	56	3.35	78	39	1.43	43	41	3.35	9	3.35	9	3.35	9	48.7		
82	79	3	1.43	43	25		78	42	1.46	45	17		78	21	1.54	47	2	3.77	8	3.77	8	3.77	8	45.3		
83	80	45	1.54	47	13		79	23	1.58	49	4		79	0	1.62	50	48		7		7		7	41.4		
84	80	24	1.67	51	33		80	1	1.76	53	22		80	37	1.88	55	2		6		6		6	37.1		
85	81	0	2.00	56	30		81	35	2.07	58	12		80	9	2.14	59	45		5		5		5	32.2		
86	82	30	2.31	62	5		81	4	2.50	63	36		81	37	2.73	64	59		4		4		4	26.7		
87	82	56	3.33	68	19		82	28	3.53	69	35		82	59	3.53	70	42		3		3		3	20.6		
88	82	14	5.00	75	9		82	45	5.45	76	3		81	16	5.45	76	51		2		2		2	14.1		
89	82	26	15.0	82	27		82	56	15.0	82	55		82	27	20.0	83	20		1		1		1	7.1		
90	30			90	0		82	0		90	0		30			90	0		0		0		0	0.0		

t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a
	d = 7° 30'				d = 8° 0'				d = 8° 30'				a			



B	$a = 9^\circ 0'$					$a = 9^\circ 30'$					$a = 10^\circ 0'$					C	$\alpha$						
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$			Z	t	$\frac{\Delta}{60'}$			
																					b	$\frac{60'}{\Delta}$	b
0	0	0	1.02	9	0	0.00	0	0	1.02	9	30	0.00	0	0	1.02	10	0	0.00	90	90.0			
1		59	1		0	.00		59	1.02		30	.00		59	1.02		0	.00	89	89.8			
2		1	59	1.02		.02		1	58	1.02		30	.02		1	58	1.02		0	.02	88	89.7	
3		2	58	1.02		.02		2	57	1.02		31	.02		2	57	1.02		1	.02	87	89.5	
4		3	57	1.02		.02		3	57	1.02		31	.02		3	56	1.02		1	.02	86	89.3	
5		4	56	1		2	0.02		4	56	1.02		32	0.02		4	55	1		2	0.02	85	89.2
6		5	56	1.02		.02		5	55	1.02		33	.02		5	55	1.02		3	.02	84	89.0	
7		6	55	1.02		.02		6	54	1.02		34	.02		6	54	1.02		4	.02	83	88.8	
8		7	54	1.02		.03		7	53	1		35	.03		7	53	1.02		6	.02	82	88.7	
9		8	53	1		.02		8	53	1.02		37	.03		8	52	1.02		7	.03	81	88.5	
10		9	53	1.02		.03		9	52	1.02		39	0.03		9	51	1.02		9	0.03	80	88.3	
11		10	52	1.02		.03		10	51	1.02		41	.03		10	50	1.02		11	.03	79	88.1	
12		11	51	1.02		.03		11	50	1.02		43	.03		11	49	1.02		13	.03	78	88.0	
13		12	50	1.02		.03		12	49	1.02		45	.03		12	48	1.02		15	.05	77	87.8	
14		13	49	1		.05		13	48	1.02		47	.05		13	47	1.02		18	.05	76	87.6	
15		14	49	1.02		.03		14	47	1.02		50	0.05		14	46	1.02		21	0.05	75	87.5	
16		15	48	1.02		.05		15	46	1		53	.05		15	45	1.02		24	.05	74	87.3	
17		16	47	1.02		.05		16	46	1.02		56	.05		16	44	1.02		27	.05	73	87.1	
18		17	46	1.02		.05		17	45	1.02		59	.05		17	43	1.02		30	.07	72	86.9	
19		18	45	1		.07		18	44	1.02		10	2	.07	18	42	1.02		34	.07	71	86.7	
20		19	45	1.02		.07		19	43	1.02		6	0.07		19	41	1.02		38	0.07	70	86.6	
21		20	44	1.02		.07		20	42	1.02		10	.07		20	40	1.02		42	.07	69	86.4	
22		21	43	1.02		.07		21	41	1.02		14	.07		21	39	1.02		46	.08	68	86.2	
23		22	42	1.02		.07		22	40	1.02		18	.08		22	38	1.02		51	.08	67	86.0	
24		23	41	1.02		.08		23	39	1.02		23	.08		23	37	1.02		56	.08	66	85.8	
25		24	40	1.02		.08		24	38	1.02		28	0.08		24	36	1.02		11	1	0.08	65	85.6
26		25	39	1.02		.08		25	37	1.02		33	.08		25	35	1.03		6	.10	64	85.4	
27		26	38	1		.08		26	36	1.02		38	.10		26	33	1.02		12	.10	63	85.2	
28		27	38	1.02		.10		27	35	1.02		44	.10		27	32	1.02		18	.10	62	85.0	
29		28	37	1.02		.10		28	34	1.02		50	.10		28	31	1.02		24	.12	61	84.8	
30		29	36	1.02		.10		29	33	1.02		56	0.12		29	30	1.02		31	0.12	60	84.6	
31		30	35	1.02		.12		30	32	1.02		3	.12		30	29	1.03		38	.12	59	84.3	
32		31	34	1.02		.12		31	31	1.03		10	.12		31	27	1.02		45	.12	58	84.1	
33		32	33	1.02		.12		32	29	1.02		17	.13		32	26	1.02		52	.13	57	83.9	
34		33	32	1.03		.13		33	28	1.02		25	.13		33	25	1.02		12	0	.15	56	83.6
35		34	30	1.02		.13		34	27	1.02		33	0.13		34	24	1.03		9	0.15	55	83.4	
36		35	29	1.02		.13		35	26	1.02		41	.15		35	22	1.02		18	.15	54	83.2	
37		36	28	1.02		.15		36	25	1.03		50	.15		36	21	1.03		27	.17	53	82.9	
38		37	27	1.02		.15		37	23	1.02		59	.17		37	19	1.02		37	.17	52	82.7	
39		38	26	1.02		.17		38	22	1.02		12	9	.17	38	18	1.03		47	.18	51	82.4	
40		39	25	1.03		.17		39	21	1.03		19	0.18		39	16	1.02		58	0.18	50	82.1	
41		40	23	1.02		.18		40	19	1.02		30	.18		40	15	1.03		13	9	.20	49	81.8
42		41	22	1.02		.18		41	18	1.03		41	.20		41	13	1.02		21	.20	48	81.5	
43		42	21	1.03		.20		42	16	1.02		53	.22		42	12	1.03		33	.22	47	81.3	
44		43	19	1.02		.22		43	15	1.03		13	6	.22	43	10	1.03		46	.23	46	80.9	
45		44	18			.38		44	13			19			44	8			14	0		45	80.6

t	$d = 9^\circ 0'$		$d = 9^\circ 30'$		$d = 10^\circ 0'$		$\alpha$
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	

b	a = 9° 0'					a = 9° 30'					a = 10° 0'					c	a										
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	h	d			60' / Δ	Z	t	Δ / 60'	C	β				
45	0	44	18	1.03	12	38	0.22	0	44	13	1.02	13	10	0.23	0	44	8	1.03	14	0	0.25	0	45	80.6			
46	44	16	1.02		51	.23	44	12	1.03		33	.23	45	6	1.03		15	.25	44	15	.25	44	80.3				
47	46	15	1.03		13	5	.23	46	10	1.03		47	.25	46	4	1.03		30	.27	43	30	.27	43	80.0			
48	47	13	1.02		19	.25	47	8	1.03		14	2	.27	47	2	1.03		46	.28	42	46	.28	42	79.6			
49	48	12	1.03		34	.28	48	6	1.03		18	.28	48	0	1.03		15	3	.28	41	15	3	.28	41	79.3		
50	49	10	1.03		51	0.28	49	4	1.03		35	0.30	49	58	1.03		20	0.32	40	20	0.32	40	78.9				
51	50	8	1.03		14	8	.30	50	2	1.03		53	.32	49	56	1.03		39	.33	39	39	.33	39	78.5			
52	51	6	1.03		26	.32	51	0	1.03		15	12	.33	50	54	1.03		50	.35	38	50	.35	38	78.1			
53	52	4	1.03		45	.33	52	58	1.03		32	.35	51	52	1.05		16	20	.37	37	16	20	.37	37	77.6		
54	53	2	1.03		15	5	.35	52	56	1.03		53	.38	52	49	1.03		42	.38	36	42	.38	36	77.2			
55	54	0	1.03		26	0.38	53	54	1.05		16	16	0.40	53	47	1.05		17	5	0.42	35	17	5	0.42	35	76.7	
56	55	58	1.03		49	.40	54	51	1.03		40	.42	54	44	1.05		30	.43	34	30	.43	34	76.2				
57	55	56	1.05		16	13	.43	55	49	1.05		17	5	.45	55	41	1.05		56	.47	33	56	.47	33	75.7		
58	56	53	1.03		39	.45	56	46	1.05		32	.47	56	38	1.05		18	24	.50	32	18	24	.50	32	75.2		
59	57	51	1.05		17	6	.48	57	43	1.05		18	0	.50	57	35	1.05		54	.53	31	54	.53	31	74.6		
60	58	48	1.05		35	0.52	58	40	1.05		30	0.55	58	32	1.07		19	26	0.55	30	19	26	0.55	30	74.0		
61	59	45	1.05		18	6	.55	59	37	1.07		19	3	.57	59	28	1.07		59	.60	29	59	.60	29	73.4		
62	60	42	1.05		39	.58	60	33	1.05		37	.62	60	24	1.07		20	35	.65	28	20	35	.65	28	72.8		
63	61	39	1.05		19	14	.63	61	30	1.07		20	14	.67	61	20	1.07		21	14	.68	21	14	.68	27	72.1	
64	62	36	1.07		52	.68	62	26	1.07		54	.70	62	16	1.07		55	.73	26	55	.73	26	71.3				
65	63	32	1.07		20	33	0.73	63	22	1.07		21	36	0.77	63	12	1.09		22	39	0.78	25	22	39	0.78	25	70.5
66	64	28	1.07		21	17	.78	64	18	1.09		22	22	.82	64	7	1.09		23	26	.85	24	23	26	.85	24	69.8
67	65	24	1.09		22	4	.85	65	13	1.09		23	11	.88	65	2	1.11		24	17	.92	23	24	17	.92	23	68.8
68	66	19	1.09		55	.93	66	8	1.11		24	4	.97	66	56	1.11		25	12	1.00	22	25	12	1.00	22	67.8	
69	67	14	1.09		23	51	1.00	67	2	1.11		25	2	1.03	66	50	1.11		26	12	1.07	21	26	12	1.07	21	66.7
70	68	9	1.11		24	51	1.08	56	1.11		26	4	1.13	67	44	1.13		27	16	1.17	20	27	16	1.17	20	65.6	
71	69	3	1.11		25	56	1.20	68	50	1.13		27	12	1.23	68	37	1.15		28	26	1.28	19	28	26	1.28	19	64.4
72	57	57	1.13		27	8	1.32	69	43	1.13		28	26	1.35	69	29	1.15		29	43	1.38	18	29	43	1.38	18	63.1
73	70	50	1.15		28	27	1.43	70	36	1.18		29	47	1.48	70	21	1.18		31	6	1.50	17	31	6	1.50	17	61.6
74	71	42	1.15		29	53	1.57	71	27	1.18		31	16	1.62	71	12	1.20		32	36	1.67	16	32	36	1.67	16	60.1
75	72	34	1.20		31	28	1.75	72	18	1.20		32	53	1.78	72	2	1.22		34	16	1.82	15	34	16	1.82	15	58.4
76	73	24	1.20		33	13	1.93	73	8	1.22		34	40	1.98	51	1.25		36	5	2.00	14	36	5	2.00	14	56.5	
77	74	14	1.25		35	9	2.15	57	1.28		36	39	2.18	73	39	1.28		38	5	2.22	13	38	5	2.22	13	54.4	
78	75	2	1.28		37	18	2.40	74	44	1.30		38	50	2.42	74	26	1.33		40	18	2.43	12	40	18	2.43	12	52.2
79	49	49	1.30		39	42	2.67	75	30	1.36		41	15	2.68	75	11	1.40		42	44	2.70	11	42	44	2.70	11	49.7
80	76	35	1.40		42	22	2.98	76	14	1.40		43	56	3.00	54	1.46		45	26	2.98	10	45	26	2.98	10	46.9	
81	77	18	1.46		45	21	3.35	57	1.54		46	56	3.32	76	35	1.58		48	25	3.30	9	48	25	3.30	9	43.8	
82	59	59	1.58		48	42	3.72	77	36	1.62		50	15	3.68	77	13	1.67		51	43	3.63	8	51	43	3.63	8	40.4
83	78	37	1.71		52	25		78	13	1.76		53	56	4.08	49	1.88		55	21	3.98	7	55	21	3.98	7	36.6	
84	79	12	1.94		56	35		47	2.00		58	1		78	21	2.07		59	20		6	59	20		6	32.5	
85	43	2.31		61	11			79	17	2.40		62	29		50	2.50		63	42		5	63	42		5	27.9	
86	80	9	2.73		66	14		42	2.86		67	22		79	14	3.00		68	25		4	68	25		4	23.0	
87	31	3.75		71	43			80	3	4.00		72	38		34	4.29		73	28		3	73	28		3	17.6	
88	47	6.00		77	34			18	6.67		78	13		48	6.67		78	48		2	78	48		2	11.9		
89	57	20.0		83	43			27	20.0		84	3		57	20.0		84	21		1	84	21		1	6.0		
90	81	0		90	0			30			90	0		30			90	0		0	90	0		0	0.0		

t	a = 9° 0'				a = 9° 30'				a = 10° 0'				a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	
	d = 9° 0'				d = 9° 30'				d = 10° 0'				



b	a = 10° 30'				a = 11° 0'				a = 11° 30'				c	α							
	B	d	$\frac{60'}{\Delta}$	t	Z	d	$\frac{60'}{\Delta}$	t	Z	d	$\frac{60'}{\Delta}$	t			C	β					
		h	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$		$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$					$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$			
0	0	0	1.02	10	30	0.00	0	0	1.02	11	0	0.00	0	0	1.02	11	30	0.00	90	90.0	
1		59	1.02		30	.00		59	1.02		0	.00		59	1.02		30	.00	89	89.8	
2	1	58	1.02		30	.02	1	58	1.02		0	.02	1	58	1.03		30	.02	88	89.6	
3	2	57	1.02		31	.02	2	57	1.02		1	.02	2	56	1.02		31	.02	87	89.4	
4	3	56	1.02		32	.00	3	56	1.03		2	.02	3	55	1.02		32	.02	86	89.2	
5	4	55	1.02		32	.02	4	54	1.02		3	.02	4	54	1.02		33	.02	85	89.0	
6	5	54	1.02		33	.03	5	53	1.02		4	.02	5	53	1.02		34	.02	84	88.9	
7	6	53	1.02		35	.02	6	52	1.02		5	.02	6	52	1.03		35	.03	83	88.7	
8	7	52	1.02		36	.03	7	51	1.02		6	.03	7	50	1.02		37	.02	82	88.5	
9	8	51	1.02		38	.03	8	50	1.02		8	.03	8	49	1.02		38	.03	81	88.3	
10	9	50	1.02		40	.03	9	49	1.02		10	.03	9	48	1.02		40	.03	80	88.1	
11	10	49	1.02		42	.03	10	48	1.02		12	.03	10	47	1.03		42	.05	79	87.9	
12	11	48	1.02		44	.03	11	47	1.03		14	.05	11	45	1.02		45	.05	78	87.7	
13	12	47	1.02		46	.05	12	45	1.02		17	.05	12	44	1.02		48	.05	77	87.5	
14	13	46	1.02		49	.05	13	44	1.02		20	.05	13	43	1.02		51	.05	76	87.3	
15	14	45	1.02		52	.05	14	43	1.02		23	.05	14	42	1.03		54	.05	75	87.1	
16	15	44	1.03		55	.05	15	42	1.02		26	.05	15	40	1.02		57	.07	74	86.9	
17	16	42	1.02		58	.07	16	41	1.03		29	.07	16	39	1.02		12	1	.07	73	86.7
18	17	41	1.02	11	2	.07	17	39	1.02		33	.07	17	38	1.03		5	.07	72	86.5	
19	18	40	1.02		6	.07	18	38	1.02		37	.07	18	36	1.02		9	.07	71	86.2	
20	19	39	1.02		10	.07	19	37	1.02		41	.08	19	35	1.02		13	.08	70	86.0	
21	20	38	1.02		14	.07	20	36	1.02		46	.08	20	34	1.03		18	.08	69	85.8	
22	21	37	1.02		18	.08	21	35	1.03		51	.08	21	32	1.02		23	.08	68	85.6	
23	22	36	1.03		23	.08	22	33	1.02		56	.08	22	31	1.03		28	.08	67	85.4	
24	23	34	1.02		28	.08	23	32	1.02	12	1	.08	23	29	1.02		33	.10	66	85.1	
25	24	33	1.02		33	.10	24	31	1.03		6	.10	24	28	1.03		39	.10	65	84.9	
26	25	32	1.02		39	.10	25	29	1.02		12	.10	25	26	1.02		45	.12	64	84.7	
27	26	31	1.03		45	.10	26	28	1.02		18	.12	26	25	1.03		52	.12	63	84.5	
28	27	29	1.02		51	.12	27	27	1.03		25	.12	27	23	1.02		59	.12	62	84.2	
29	28	28	1.02		58	.12	28	25	1.02		32	.12	28	22	1.03	13	6	.12	61	84.0	
30	29	27	1.02	12	5	.12	29	24	1.03		39	.13	29	20	1.02		13	.13	60	83.7	
31	30	26	1.03		12	.13	30	22	1.02		47	.13	30	19	1.03		21	.13	59	83.5	
32	31	24	1.02		20	.13	31	21	1.03		55	.13	31	17	1.03		29	.15	58	83.2	
33	32	23	1.03		28	.13	32	19	1.02	13	3	.15	32	15	1.02		38	.15	57	82.9	
34	33	21	1.02		36	.15	33	18	1.03		12	.15	33	14	1.03		47	.17	56	82.7	
35	34	20	1.03		45	.15	34	16	1.03		21	.17	34	12	1.03		57	.17	55	82.4	
36	35	18	1.02		54	.17	35	14	1.02		31	.17	35	10	1.03	14	7	.18	54	82.1	
37	36	17	1.03	13	4	.17	36	13	1.03		41	.17	36	8	1.03		18	.18	53	81.8	
38	37	15	1.02		14	.18	37	11	1.03		51	.18	37	6	1.03		29	.18	52	81.5	
39	38	14	1.03		25	.18	38	9	1.03	14	2	.20	38	4	1.03		40	.20	51	81.2	
40	39	12	1.03		36	.20	39	7	1.03		14	.22	39	2	1.03		52	.22	50	80.9	
41	40	10	1.02		48	.20	40	5	1.03		27	.22	40	0	1.03	15	5	.23	49	80.6	
42	41	9	1.03	14	0	.22	41	3	1.03		40	.22	58	1.03		19	.23	48	80.3		
43	42	7	1.03		13	.23	42	1	1.03		53	.23	41	56	1.03		33	.23	47	79.9	
44	43	5	1.03		27	.23	59	1.03	15	7	.25	42	54	1.03		48	.25	46	79.6		
45	44	3			41		43	57			22		43	52		16	3		45	79.2	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a								
	d = 10° 30'				d = 11° 0'				d = 11° 30'				a								

b	a = 10° 30'				a = 11° 0'				a = 11° 30'				c	α									
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t			Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	C	β
45	44	3	1.03	14	41	0.25	43	57	1.03	15	22	0.27	43	52	1.05	16	3	0.28	45	79.2			
46	45	1	1.03		56	.27	44	55	1.03		38	.28	44	49	1.03		20	.28	44	78.8			
47	47	59	1.03	15	12	.28	45	53	1.03		55	.28	45	47	1.05		37	.30	43	78.4			
48	46	57	1.05		29	.30	46	51	1.05	16	12	.30	46	44	1.03		55	.32	42	78.0			
49	47	54	1.03		47	.30	47	48	1.03		30	.33	47	42	1.05	17	14	.33	41	77.6			
50	48	52	1.03	16	5	0.33	48	46	1.05		50	0.33	48	39	1.05		34	0.35	40	77.2			
51	49	50	1.05		25	.33	49	43	1.05	17	10	.35	40	36	1.05		55	.37	39	76.7			
52	50	47	1.03		45	.37	50	40	1.05		31	.38	50	33	1.05	18	17	.40	38	76.3			
53	51	45	1.05	17	7	.38	51	37	1.05		54	.40	51	30	1.05		41	.42	37	75.8			
54	52	42	1.05		30	.40	52	34	1.05	18	18	.42	52	27	1.07	19	6	.43	36	75.3			
55	53	39	1.05		54	0.43	53	31	1.05		43	0.45	53	23	1.05		32	0.47	35	74.8			
56	54	36	1.05	18	20	.47	54	28	1.05	19	10	.48	54	20	1.07	20	0	.48	34	74.2			
57	55	33	1.05		48	.48	55	25	1.07		39	.50	55	16	1.07		29	.52	33	73.6			
58	56	30	1.05	19	17	.50	56	21	1.07	20	9	.53	56	12	1.07	21	0	.55	32	73.0			
59	57	27	1.07		47	.55	57	17	1.07		41	.57	57	8	1.07		33	.58	31	72.4			
60	58	23	1.07	20	20	0.58	58	13	1.07	21	15	0.60	58	4	1.09	22	8	0.63	30	71.7			
61	59	19	1.07		55	.63	59	9	1.07		51	.65	59	1.09		46	.67	29	71.0				
62	60	15	1.07	21	33	.65	60	5	1.09	22	30	.68	59	54	1.09	23	26	.70	28	70.3			
63	61	11	1.09		22	12	.72	61	0	1.09	23	11	.73	60	49	1.09	24	8	.77	27	69.5		
64	62	6	1.09		55	.77		55	1.09		55	.78	61	44	1.11		54	.80	26	68.6			
65	63	1	1.09	23	41	0.82	62	50	1.11	24	42	0.85	62	38	1.11	25	42	0.87	25	67.7			
66	64	56	1.11		24	30	.88	63	44	1.11	25	33	.90	63	32	1.11	26	34	.93	24	66.8		
67	64	50	1.11		25	23	.95	64	38	1.11	26	27	.98	64	26	1.13	27	30	1.00	23	65.8		
68	65	44	1.11	26	20	1.02	65	32	1.13	27	26	1.05	65	19	1.15	28	30	1.08	22	64.7			
69	66	38	1.13		27	21	1.10	66	25	1.15	28	29	1.13	66	11	1.15	29	35	1.17	21	63.6		
70	67	31	1.15	28	27	1.20	67	17	1.15	29	37	1.22	67	3	1.18	30	45	1.25	20	62.3			
71	68	23	1.15		29	39	1.30	68	9	1.18	30	50	1.33		54	1.18	32	0	1.37	19	61.0		
72	69	15	1.18		30	57	1.42	69	0	1.20	32	10	1.45	68	45	1.22	33	22	1.47	18	59.6		
73	70	6	1.20		32	22	1.55		50	1.20	33	37	1.58	69	34	1.22	34	50	1.60	17	58.0		
74		56	1.20		33	55	1.68	70	40	1.25	35	12	1.72	70	23	1.25	36	26	1.73	16	56.4		
75	71	46	1.25	35	36	1.85	71	28	1.25	36	55	1.87	71	11	1.30	38	10	1.90	15	54.5			
76	72	34	1.28		37	27	2.03	72	16	1.30	38	47	2.05		57	1.30	40	4	2.07	14	52.6		
77	73	21	1.33		39	29	2.23	73	2	1.33	40	50	2.23	72	43	1.40	42	8	2.25	13	50.4		
78	74	6	1.36		41	43	2.45		47	1.40	43	4	2.47	73	26	1.43	44	23	2.45	12	48.1		
79		50	1.43		44	10	2.70	74	30	1.46	45	32	2.68	74	8	1.50	46	50	2.68	11	45.5		
80	75	32	1.50	46	52	2.97	75	11	1.58	48	13	2.95		48	1.58	49	31	2.93	10	42.7			
81	76	12	1.58		49	50	3.27	49	1.62	51	10	3.23	75	26	1.71	52	27	3.18	9	39.7			
82		50	1.76		53	6	3.57	76	26	1.82	54	24	3.52	76	1	1.82	55	38	3.45	8	36.4		
83	77	24	1.94		56	40	3.92	59	2.00	57	55	3.82		34	2.07	59	5	3.73	7	32.8			
84		55	2.14		60	35	4.23	77	29	2.22	61	44	4.12	77	3	2.40	62	49	4.00	6	28.8		
85	78	23	2.61	64	49			56	2.73	65	51	4.42		28	2.73	66	49	4.27	5	24.6			
86		46	3.16		69	23		78	18	3.33	70	16		50	3.53	71	5	4.48	4	20.1			
87	79	5	4.29		74	14		36	4.62	74	56		78	7	4.62	75	34		3	15.4			
88		19	7.50		79	20		49	7.50	79	49			20	8.57	80	16		2	10.4			
89		27	20.0		84	37		57	20.0	84	52			27	20.0	85	6		1	5.2			
90		30			90	0		79	0		90	0			30		90	0		0	0.0		

t	a = 10° 30'		a = 11° 0'		a = 11° 30'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 10° 30'		d = 11° 0'		d = 11° 30'		



B	a = 12° 0'				a = 12° 30'				a = 13° 0'				C	c	β						
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t				C					
		Δ	Z	60'		Z	Z	60'		Z	60'										
0	0	0	1.02	12	0	0.00	0	0	1.02	12	30	0.00	0	0	1.03	13	0	0.00	90	90.0	
1		59	1.03		0	.00	59	1.03		30	.00	58	1.02		0	0	.00	89	89.8		
2	1	57	1.02		0	.02	1	57	1.02		30	.02	1	57	1.03		0	.02	88	89.6	
3	2	56	1.02		1	.02	2	56	1.03		31	.02	2	55	1.02		1	.02	87	89.4	
4	3	55	1.03		2	.02	3	54	1.02		32	.02	3	54	1.03		2	.02	86	89.1	
5	4	53	1.02		3	0.02	4	53	1.03		33	0.02	4	52	1.02		3	0.02	85	88.9	
6	5	52	1.02		4	.02	5	51	1.02		34	.02	5	51	1.03		4	.03	84	88.7	
7	6	51	1.03		5	.03	6	50	1.02		35	.03	6	49	1.02		6	.03	83	88.5	
8	7	49	1.02		7	.03	7	49	1.03		37	.03	7	48	1.03		8	.03	82	88.3	
9	8	48	1.02		9	.03	8	47	1.02		39	.03	8	46	1.03		10	.03	81	88.0	
10	9	47	1.03		11	0.03	9	46	1.03		41	0.03	9	44	1.02		12	0.03	80	87.8	
11	10	45	1.02		13	.05	10	44	1.02		43	.05	10	43	1.03		14	.05	79	87.6	
12	11	44	1.02		16	.05	11	43	1.03		46	.05	11	41	1.02		17	.05	78	87.4	
13	12	43	1.03		19	.05	12	41	1.02		49	.05	12	40	1.03		20	.05	77	87.1	
14	13	41	1.02		22	.05	13	40	1.03		52	.07	13	38	1.03		23	.05	76	86.9	
15	14	40	1.03		25	0.05	14	38	1.02		56	0.05	14	36	1.02		26	0.07	75	86.7	
16	15	38	1.02		28	.07	15	37	1.03		59	.07	15	35	1.03		30	.07	74	86.4	
17	16	37	1.02		32	.07	16	35	1.02	13	3	.07	16	33	1.03		34	.08	73	86.2	
18	17	36	1.03		36	.07	17	34	1.03		7	.08	17	31	1.02		39	.07	72	86.0	
19	18	34	1.02		40	.08	18	32	1.03		12	.08	18	30	1.03		43	.08	71	85.7	
20	19	33	1.03		45	0.08	19	30	1.02		17	0.08	19	28	1.03		48	0.08	70	85.5	
21	20	31	1.02		50	.08	20	29	1.03		22	.08	20	26	1.03		53	.10	69	85.3	
22	21	30	1.03		55	.08	21	27	1.03		27	.10	21	24	1.02		59	.10	68	85.0	
23	22	28	1.02		6	.10	22	25	1.02		33	.10	22	23	1.03	14	5	.10	67	84.8	
24	23	27	1.03	13	6	.10	23	24	1.03		39	.10	23	21	1.03		11	.10	66	84.5	
25	24	25	1.03		12	0.10	24	22	1.03		45	0.10	24	19	1.03		17	0.12	65	84.2	
26	25	23	1.02		18	.12	25	20	1.02		51	.12	25	17	1.03		24	.12	64	84.0	
27	26	22	1.03		25	.12	26	19	1.03		58	.13	26	15	1.03		31	.13	63	83.7	
28	27	20	1.03		32	.13	27	17	1.03	14	6	.13	27	13	1.03		39	.13	62	83.4	
29	28	18	1.02		40	.13	28	15	1.03		14	.13	28	11	1.03		47	.15	61	83.2	
30	29	17	1.03		48	0.13	29	13	1.03		22	0.13	29	9	1.03		56	0.15	60	82.9	
31	30	15	1.03		56	.13	30	11	1.03		30	.15	30	7	1.03	15	5	.15	59	82.6	
32	31	13	1.03		4	.15	31	9	1.03		39	.15	31	5	1.03		14	.17	58	82.3	
33	32	11	1.02	14	13	.17	32	7	1.03		48	.17	32	3	1.03		24	.17	57	82.0	
34	33	10	1.03		23	.17	33	5	1.03		58	.18	33	1	1.03		34	.17	56	81.7	
35	34	8	1.03		33	0.17	34	3	1.03	15	9	0.18		59	1.05		44	0.18	55	81.4	
36	35	6	1.03		43	.18	35	1	1.03		20	.18	34	56	1.03		55	.20	54	81.1	
37	36	4	1.03		54	.20		59	1.03		31	.20	35	54	1.03	16	7	.22	53	80.7	
38	37	2	1.03		6	.20	36	57	1.03		43	.20	36	52	1.05		20	.22	52	80.4	
39	38	0	1.05	15	18	.22	37	55	1.05		55	.22	37	49	1.03		33	.22	51	80.1	
40		57	1.03		31	0.22	38	52	1.03		16	8	0.23	38	47	1.05		46	0.23	50	79.7
41	39	55	1.03		44	.23	39	50	1.05		22	.25	39	44	1.05	17	0	.25	49	79.3	
42	40	53	1.03		58	.23	40	47	1.03		37	.25	40	41	1.03		15	.27	48	79.0	
43	41	51	1.05		16	12	.27	41	45	1.05		52	.27	41	39	1.05		31	.28	47	78.6
44	42	48	1.03		28	.27	42	42	1.05	17	8	.28	42	36	1.05		48	.28	46	78.2	
45	43	46			44		43	39			25		43	33		18	5		45	77.8	
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a								
	d = 12° 0'				d = 12° 30'				d = 13° 0'				a								

b	a = 12° 0'					a = 12° 30'					a = 13° 0'					c	a			
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β
		Δ	Z	60'	60'	Δ		Δ	Z	60'	60'		Δ	Δ	Z			60'		
45	43	46	1.05	16	44	0.28	43	39	1.03	17	25	0.28	43	33	1.05	18	5	0.30	45	77.8
46	44	43	1.05	17	1	.30	44	37	1.05	17	42	.30	44	30	1.05	23	.32	.32	44	77.4
47	45	40	1.03	19	.30	.30	45	34	1.05	18	0	.33	45	27	1.05	42	.33	.33	43	76.9
48	46	38	1.05	37	.33	.33	46	31	1.05	20	.33	.33	46	24	1.07	19	2	.35	42	76.5
49	47	35	1.05	57	.35	.35	47	28	1.07	40	.37	.37	47	20	1.05	23	.37	.37	41	76.0
50	48	32	1.05	18	18	0.37	48	24	1.05	19	2	0.37	48	17	1.07	45	0.40	0.40	40	75.5
51	49	29	1.05	40	.38	.38	49	21	1.05	24	.40	.40	49	13	1.07	20	9	.40	39	75.0
52	50	26	1.07	19	3	.40	50	18	1.07	48	.42	.42	50	9	1.07	33	.43	.43	38	74.5
53	51	22	1.05	27	.43	.43	51	14	1.07	20	13	.45	51	5	1.07	59	.47	.47	37	74.0
54	52	19	1.07	53	.45	.45	52	10	1.07	40	.47	.47	52	1	1.07	21	27	.48	36	73.4
55	53	15	1.07	20	20	0.48	53	6	1.07	21	8	0.50	57	1.07	56	0.50	0.50	35	72.8	
56	54	11	1.07	49	.50	.50	54	2	1.07	38	.52	.52	53	53	1.09	22	26	.53	34	72.2
57	55	7	1.07	21	19	.53	55	58	1.09	22	9	.55	54	48	1.09	58	.58	.58	33	71.6
58	56	3	1.07	51	.58	.58	55	53	1.09	42	.58	.58	55	43	1.09	23	33	.60	32	70.9
59	59	59	1.09	22	26	.60	56	48	1.09	23	17	.63	56	38	1.09	24	9	.63	31	70.2
60	57	54	1.09	23	2	0.65	57	43	1.09	55	0.67	0.67	57	33	1.11	47	0.68	0.68	30	69.5
61	58	49	1.09	41	.68	.68	58	38	1.09	24	35	.70	58	27	1.11	25	28	.72	29	68.7
62	59	44	1.11	24	22	.72	59	33	1.11	25	17	.75	59	21	1.11	26	11	.77	28	67.9
63	60	38	1.11	25	5	.78	60	27	1.11	26	2	.80	60	15	1.13	57	.82	.82	27	67.0
64	61	32	1.11	52	.83	.83	61	21	1.13	50	.85	.85	61	8	1.13	27	46	.88	26	66.1
65	62	26	1.11	26	42	0.90	62	14	1.13	27	41	0.92	62	1	1.15	28	39	0.93	25	65.1
66	63	20	1.13	27	36	.95	63	7	1.15	28	36	.97	63	53	1.15	29	35	1.00	24	64.1
67	64	13	1.15	28	33	1.02	64	59	1.15	29	34	1.05	63	45	1.15	30	35	1.07	23	63.0
68	65	5	1.15	29	34	1.10	64	51	1.18	30	37	1.13	64	37	1.18	31	39	1.13	22	61.8
69	66	57	1.18	30	40	1.20	65	42	1.18	31	45	1.20	65	28	1.20	32	47	1.23	21	60.6
70	66	48	1.18	31	52	1.27	66	33	1.20	32	57	1.30	66	18	1.22	34	1	1.32	20	59.3
71	67	39	1.20	33	8	1.38	67	23	1.22	34	15	1.40	67	7	1.25	35	20	1.43	19	57.8
72	68	29	1.22	34	31	1.50	68	12	1.25	35	39	1.52	68	55	1.25	36	46	1.53	18	56.3
73	69	18	1.25	36	1	1.62	69	0	1.25	37	10	1.65	68	43	1.28	38	18	1.65	17	54.7
74	70	6	1.28	37	38	1.77	70	48	1.30	38	49	1.77	69	30	1.33	39	57	1.78	16	53.0
75	71	53	1.33	39	24	1.90	70	34	1.33	40	35	1.92	70	15	1.36	41	44	1.93	15	51.1
76	71	38	1.33	41	18	2.08	71	19	1.40	42	30	2.08	71	59	1.40	43	40	2.08	14	49.0
77	72	23	1.40	43	23	2.25	72	2	1.43	44	35	2.25	71	42	1.46	45	45	2.25	13	46.8
78	73	6	1.46	45	38	2.45	73	44	1.50	46	50	2.45	72	23	1.54	48	0	2.43	12	44.5
79	74	47	1.54	48	5	2.67	73	24	1.58	49	17	2.65	73	2	1.62	50	26	2.62	11	41.9
80	74	26	1.67	50	45	2.90	74	2	1.67	51	56	2.87	74	39	1.71	53	3	2.83	10	39.2
81	75	2	1.71	53	39	3.13	75	38	1.76	54	48	3.08	74	14	1.88	55	53	3.03	9	36.2
82	76	37	1.94	56	47	3.38	75	12	2.00	57	53	3.32	75	46	2.00	58	55	3.25	8	33.0
83	76	8	2.14	60	10	3.65	76	42	2.22	61	12	3.55	75	16	2.31	62	10	3.47	7	29.6
84	77	36	2.40	63	49	3.88	76	9	2.50	64	45	3.78	76	42	2.61	65	38	3.68	6	25.9
85	77	1	2.86	67	42	4.13	77	33	3.00	68	32	4.00	76	5	3.00	69	19	3.87	5	22.0
86	78	22	3.75	71	50	4.33	77	53	3.75	72	32	4.18	77	25	4.00	73	11	4.05	4	17.9
87	78	38	5.00	76	10	4.52	77	9	5.00	76	43	4.33	77	40	5.45	77	14	4.17	3	13.6
88	79	50	7.50	80	41	4.62	78	21	8.57	81	3	4.45	78	51	8.57	81	24	4.28	2	9.2
89	79	58	30.0	85	18		78	28	30.0	85	30	4.50	78	58	30.0	85	41	4.32	1	4.6
90	78	0		90	0		78	30		90	0		77	0		90	0		0	0.0
t	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a	
	d = 12° 0'					d = 12° 30'					d = 13° 0'					a				
	d = 12° 0'					d = 12° 30'					d = 13° 0'					a				



b	a = 13° 30'					a = 14° 0'					a = 14° 30'					c	a				
	B	h	d		Z	h	d		Z	h	d		Z	C	β						
			60'	Δ			60'	Δ			60'	Δ						60'	Δ		
0	0	0	1.03	13	30	0.00	0	0	1.03	14	0	0.00	0	0	1.03	14	30	0.00	90	90.0	
1		58	1.02		30	.00		58	1.03		0	.00		58	1.03		30	.02	89	89.8	
2		1 57	1.03		30	.02		1 56	1.02		0	.02		1 56	1.03		31	.00	88	89.5	
3		2 55	1.03		31	.02		2 55	1.03		1	.02		2 54	1.03		31	.02	87	89.3	
4		3 53	1.02		32	.02		3 53	1.03		2	.02		3 52	1.03		32	.02	86	89.0	
5		4 52	1.03		33	0.02		4 51	1.03		3	0.02		4 50	1.03		33	0.03	85	88.8	
6		5 50	1.03		34	.03		5 49	1.03		4	.03		5 48	1.02		35	.02	84	88.5	
7		6 48	1.02		36	.03		6 47	1.02		6	.03		6 47	1.03		36	.03	83	88.3	
8		7 47	1.03		38	.03		7 46	1.03		8	.03		7 45	1.03		38	.03	82	88.1	
9		8 45	1.03		40	.03		8 44	1.03		10	.03		8 43	1.03		40	.05	81	87.8	
10		9 43	1.02		42	0.05		9 42	1.03		12	0.05		9 41	1.03		43	0.05	80	87.6	
11		10 42	1.03		45	.05		10 40	1.03		15	.05		10 39	1.03		46	.05	79	87.3	
12		11 40	1.03		48	.05		11 38	1.03		18	.05		11 37	1.03		49	.05	78	87.1	
13		12 38	1.03		51	.05		12 36	1.02		21	.07		12 35	1.03		52	.05	77	86.8	
14		13 36	1.02		54	.07		13 35	1.03		25	.05		13 33	1.03		55	.07	76	86.5	
15		14 35	1.03		58	0.07		14 33	1.03		28	0.07		14 31	1.03		59	0.07	75	86.3	
16		15 33	1.03		2	.07		15 31	1.03		32	.08		15 29	1.03		3	.08	74	86.0	
17		16 31	1.03	14	6	.07		16 29	1.03		37	.07		16 27	1.05		8	.08	73	85.8	
18		17 29	1.03		10	.08		17 27	1.03		41	.08		17 24	1.03		13	.08	72	85.5	
19		18 27	1.03		15	.08		18 25	1.03		46	.10		18 22	1.03		18	.08	71	85.2	
20		19 25	1.02		20	0.08		19 23	1.03		52	0.08		19 20	1.03		23	0.10	70	85.0	
21		20 24	1.03		25	.10		20 21	1.03		57	.10		20 18	1.03		29	.10	69	84.7	
22		21 22	1.03		31	.10		21 19	1.03	15	3	.10		21 16	1.03		35	.12	68	84.4	
23		22 20	1.03		37	.10		22 17	1.03		9	.12		22 14	1.05		42	.10	67	84.1	
24		23 18	1.03		43	.12		23 15	1.03		16	.12		23 11	1.03		48	.12	66	83.9	
25		24 16	1.03		50	0.12		24 13	1.05		23	0.12		24 9	1.03		55	0.13	65	83.6	
26		25 14	1.03		57	.13		25 10	1.03		30	.13		25 7	1.05		3	.13	64	83.3	
27		26 12	1.03		5	.13		26 8	1.03		38	.13		26 4	1.03		11	.13	63	83.0	
28		27 10	1.03	15	13	.13		27 6	1.03		46	.15		27 2	1.03		19	.15	62	82.7	
29		28 8	1.05		21	.15		28 4	1.05		55	.15		28 0	1.05		28	.15	61	82.4	
30		29 5	1.03		30	0.15		29 1	1.03	16	4	0.15		29	1.03		37	0.17	60	82.0	
31		30 3	1.03		39	.15		30	1.03		13	.17		30 55	1.05		47	.17	59	81.7	
32		31 1	1.03		48	.17		30 57	1.05		23	.17		30 52	1.05		57	.18	58	81.4	
33		32 59	1.05		58	.18		31 54	1.03		33	.18		31 49	1.03		8	.18	57	81.1	
34		32 56	1.03	16	9	.18		32 52	1.05		44	.20		32 47	1.05		19	.20	56	80.7	
35		33 54	1.05		20	0.20		33 49	1.05		56	0.20		33 44	1.05		31	0.22	55	80.4	
36		34 51	1.03		32	.20		34 46	1.03		8	.20		34 41	1.05		44	.22	54	80.0	
37		35 49	1.05		44	.22		35 44	1.05	17	20	.22		35 38	1.05		57	.22	53	79.7	
38		36 46	1.03		57	.22		36 41	1.05		33	.23		36 35	1.05		18	0.23	52	79.3	
39		37 44	1.05	17	10	.23		37 38	1.05		47	.25		37 32	1.05		24	.25	51	78.9	
40		38 41	1.05		24	0.25		38 35	1.05		18	2	0.25		38 29	1.05		39	0.27	50	78.5
41		39 38	1.05		39	.25		39 32	1.05		17	.27		39 26	1.05		55	.27	49	78.1	
42		40 35	1.05		54	.27		40 29	1.05		33	.28		40 23	1.07		19	0.28	48	77.7	
43		41 32	1.05	18	10	.28		41 26	1.05		50	.28		41 19	1.05		28	.30	47	77.3	
44		42 29	1.05		27	.30		42 23	1.07		19	7	.30		42 16	1.07		46	.32	46	76.9
45		43 26			45			43 19			25			43 12			20	5	45	76.4	
t	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a		
	d = 13° 30'					d = 14° 0'					d = 14° 30'										

b	a = 13° 30'					a = 14° 0'					a = 14° 30'					c	a						
	B	h	d	60' Δ	Z	t	Δ 60'	h	d	60' Δ	Z	t	Δ 60'	h	d			60' Δ	Z	t	Δ 60'	C	β
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
45	43	26	1.05	18	45	0.32	43	19	1.05	19	25	0.33	43	12	1.07	20	5	0.33	45	76.4			
46	44	23	1.05	19	4	.33	44	16	1.07	45	33	.33	44	8	1.07	25	25	.35	44	75.9			
47	45	20	1.07	24	.33	45	12	1.07	20	5	.35	45	4	1.07	46	8	.37	43	75.5				
48	46	16	1.05	44	.37	46	8	1.07	26	.37	46	0	1.07	21	8	.38	42	75.0					
49	47	13	1.07	20	6	.38	47	4	1.07	48	.40	56	1.07	31	.40	41	74.4						
50	48	9	1.07	29	0.40	48	0	1.07	21	12	0.42	47	52	1.07	55	0.42	40	73.9					
51	49	5	1.07	53	.42	56	1.07	37	.43	48	48	1.09	22	20	.45	39	73.4						
52	50	1	1.07	21	18	.45	49	52	1.07	22	3	.45	49	43	1.09	47	.47	38	72.8				
53	57	1.07	45	.47	50	48	1.09	30	.48	50	38	1.09	23	15	.50	37	72.2						
54	51	53	1.09	22	13	.50	51	43	1.09	59	.52	51	33	1.09	45	.52	36	71.6					
55	52	48	1.09	43	0.52	52	38	1.09	23	30	0.53	52	28	1.09	24	16	0.55	35	70.9				
56	53	43	1.09	23	14	.55	53	33	1.09	24	2	.57	53	23	1.11	49	.58	34	70.3				
57	54	38	1.09	47	.58	54	28	1.11	36	.60	54	17	1.11	25	24	.62	33	69.6					
58	55	33	1.09	24	22	.63	55	22	1.11	25	12	.63	55	11	1.11	26	1	.65	32	68.8			
59	56	28	1.11	25	0	.65	56	16	1.11	50	.67	56	5	1.11	40	.68	31	68.1					
60	57	22	1.11	39	0.70	57	10	1.11	26	30	0.72	59	1.13	27	21	0.73	30	67.3					
61	58	16	1.13	26	21	.73	58	4	1.13	27	13	.77	57	52	1.13	28	5	.77	29	66.4			
62	59	9	1.13	27	5	.78	57	1.13	59	.80	58	45	1.15	51	.82	28	65.5						
63	60	2	1.13	52	.83	59	50	1.15	28	47	.85	59	37	1.15	29	40	.87	27	64.6				
64	55	1.13	28	42	.90	60	42	1.15	29	38	.90	60	29	1.18	30	32	.93	26	63.6				
65	61	48	1.15	29	36	0.95	61	34	1.18	30	32	0.98	61	20	1.18	31	28	0.98	25	62.6			
66	62	40	1.18	30	33	1.02	62	25	1.18	31	31	1.03	62	11	1.20	32	27	1.05	24	61.5			
67	63	31	1.18	31	34	1.08	63	16	1.18	32	33	1.10	63	1	1.20	33	30	1.12	23	60.3			
68	64	22	1.20	32	39	1.17	64	7	1.22	33	39	1.18	51	1.22	34	37	1.20	22	59.1				
69	65	12	1.20	33	49	1.25	56	1.22	34	50	1.25	64	40	1.25	35	49	1.28	21	57.8				
70	66	2	1.25	35	4	1.33	65	45	1.25	36	5	1.37	65	28	1.25	37	6	1.37	20	56.4			
71	50	1.25	36	24	1.45	66	33	1.28	37	27	1.45	66	16	1.30	38	28	1.47	19	54.9				
72	67	38	1.28	37	51	1.55	67	20	1.28	38	54	1.55	67	2	1.30	39	56	1.57	18	53.3			
73	68	25	1.30	39	24	1.65	68	7	1.33	40	27	1.68	48	1.36	41	30	1.68	17	51.6				
74	69	11	1.36	41	3	1.80	52	1.36	42	8	1.80	68	32	1.40	43	11	1.80	16	49.8				
75	55	1.36	42	51	1.93	69	36	1.43	43	56	1.93	69	15	1.43	44	59	1.93	15	47.9				
76	70	39	1.43	44	47	2.08	70	18	1.46	45	52	2.08	57	1.50	46	55	2.07	14	45.9				
77	71	21	1.50	46	52	2.23	59	1.54	47	57	2.23	70	37	1.54	48	59	2.22	13	43.7				
78	72	1	1.58	49	6	2.42	71	38	1.58	50	11	2.40	71	16	1.67	51	12	2.38	12	41.3			
79	39	1.67	51	31	2.60	72	16	1.71	52	35	2.57	52	1.71	53	35	2.53	11	38.8					
80	73	15	1.76	54	7	2.80	51	1.82	55	9	2.75	72	27	1.88	56	7	2.72	10	36.1				
81	49	1.88	56	55	2.98	73	24	1.94	57	54	2.93	59	2.00	58	50	2.88	9	33.2					
82	74	21	2.14	59	54	3.18	55	2.14	60	50	3.12	73	29	2.22	61	43	3.05	8	30.2				
83	49	2.31	63	5	3.38	74	23	2.40	63	57	3.30	56	2.50	64	46	3.22	7	26.9					
84	75	15	2.73	66	28	3.58	48	2.86	67	15	3.48	74	20	2.86	67	59	3.38	6	23.5				
85	37	3.16	70	3	3.75	75	9	3.23	70	44	3.63	41	3.53	71	22	3.53	5	19.9					
86	56	4.00	73	48	3.90	27	4.29	74	22	3.78	75	12	6.00	74	54	3.67	4	16.1					
87	76	11	6.00	77	42	4.03	41	5.45	78	9	3.88	75	12	6.00	78	34	3.75	3	12.2				
88	21	8.57	81	44	4.12	52	10.0	82	2	3.97	22	10.0	82	19	3.82	2	8.2						
89	28	30.0	85	51	4.15	58	30.0	86	0	4.00	28	30.0	86	8	3.87	1	4.1						
90	30	90	0	76	0	90	0	90	0	30	90	0	90	0	0	0	0	0	0	0			
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a										
	d = 13° 30'				d = 14° 0'				d = 14° 30'				a										
													a										



b		a = 15° 0'				a = 15° 30'				a = 16° 0'				c	a
		d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$		
B	h		Z		h		Z		h		Z		C		
0	0 0	1.03	15 0	0.00	0 0	1.03	15 30	0.00	0 0	1.03	16 0	0.00	00	90.0	
1	1 58	1.03	0	.02	1 58	1.03	30	.02	1 58	1.05	0	.02	86	89.7	
2	2 56	1.03	1	.00	2 56	1.05	31	.00	2 56	1.03	1	.00	88	89.5	
3	3 54	1.03	1	.02	3 54	1.03	31	.02	3 54	1.03	1	.02	87	89.2	
4	4 52	1.03	2	.02	4 52	1.03	32	.02	4 52	1.05	2	.02	86	88.9	
5	5 50	1.03	3	.03	5 50	1.03	33	.03	5 50	1.03	3	.03	85	88.7	
6	6 48	1.03	5	.03	6 48	1.03	35	.03	6 48	1.03	5	.03	84	88.4	
7	7 46	1.03	7	.03	7 46	1.05	37	.03	7 46	1.05	7	.03	83	88.1	
8	8 44	1.05	9	.03	8 44	1.03	39	.03	8 44	1.03	9	.03	82	87.8	
9	9 42	1.03	11	.03	9 42	1.03	41	.05	9 42	1.03	11	.05	81	87.6	
10	10 39	1.03	13	.05	10 39	1.03	44	.05	10 39	1.05	14	.05	80	87.3	
11	11 37	1.03	16	.05	11 37	1.05	47	.05	11 37	1.03	17	.05	79	87.0	
12	12 35	1.03	19	.05	12 35	1.03	50	.05	12 35	1.05	20	.07	78	86.7	
13	13 33	1.03	22	.07	13 33	1.03	53	.07	13 33	1.03	24	.07	77	86.5	
14	14 31	1.03	26	.07	14 31	1.03	57	.07	14 31	1.05	28	.07	76	86.2	
15	15 29	1.05	30	.08	15 29	1.05	16 1	.07	15 29	1.03	32	.08	75	85.9	
16	16 27	1.03	35	.07	16 27	1.03	5	.08	16 27	1.05	37	.08	74	85.6	
17	17 24	1.03	39	.08	17 24	1.03	10	.08	17 24	1.03	42	.08	73	85.3	
18	18 22	1.03	44	.08	18 22	1.05	15	.10	18 22	1.05	47	.08	72	85.0	
19	19 20	1.05	49	.10	19 20	1.03	21	.10	19 20	1.03	52	.10	71	84.7	
20	20 17	1.03	55	.10	20 17	1.05	27	.10	20 17	1.05	58	.10	70	84.4	
21	21 15	1.03	16 1	.10	21 15	1.03	33	.10	21 15	1.05	17 4	.12	69	84.1	
22	22 13	1.05	7	.12	22 13	1.05	39	.12	22 13	1.03	11	.12	68	83.8	
23	23 10	1.03	14	.12	23 10	1.03	46	.12	23 10	1.05	18	.13	67	83.5	
24	24 8	1.03	21	.12	24 8	1.05	53	.13	24 8	1.05	26	.13	66	83.2	
25	25 6	1.05	28	.13	25 6	1.05	17 1	.13	25 6	1.05	34	.13	65	82.9	
26	26 3	1.03	36	.13	26 3	1.03	9	.13	26 3	1.05	42	.13	64	82.6	
27	27 1	1.05	44	.15	27 1	1.05	17	.15	27 1	1.03	50	.15	63	82.2	
28	28 58	1.05	53	.15	28 58	1.05	26	.15	28 58	1.05	59	.17	62	81.9	
29	29 55	1.03	17 2	.17	29 55	1.05	35	.17	29 55	1.05	18 9	.17	61	81.6	
30	30 53	1.05	12	.17	30 53	1.05	45	.18	30 53	1.05	19	.18	60	81.2	
31	31 50	1.05	22	.17	31 50	1.05	56	.18	31 50	1.07	30	.18	59	80.9	
32	32 47	1.05	32	.18	32 47	1.05	18 7	.18	32 47	1.05	41	.20	58	80.5	
33	33 44	1.03	43	.20	33 44	1.05	18	.20	33 44	1.05	53	.20	57	80.2	
34	34 42	1.05	55	.20	34 42	1.05	30	.20	34 42	1.05	19 5	.22	56	79.8	
35	35 39	1.05	18 7	.22	35 39	1.05	42	.22	35 39	1.07	18	.22	55	79.4	
36	36 36	1.05	20	.22	36 36	1.05	55	.23	36 36	1.05	31	.23	54	79.0	
37	37 33	1.07	33	.23	37 33	1.07	19 9	.23	37 33	1.07	45	.25	53	78.6	
38	38 30	1.05	47	.23	38 30	1.05	23	.25	38 30	1.07	20 0	.25	52	78.2	
39	39 26	1.05	19 1	.27	39 26	1.07	38	.27	39 26	1.05	15	.27	51	77.8	
40	40 23	1.07	17	.27	40 23	1.05	54	.28	40 23	1.07	31	.28	50	77.4	
41	41 19	1.05	33	.28	41 19	1.07	20 11	.28	41 19	1.07	48	.30	49	76.9	
42	42 16	1.07	50	.28	42 16	1.07	28	.30	42 16	1.07	21 6	.32	48	76.5	
43	43 12	1.05	20 7	.32	43 12	1.05	46	.32	43 12	1.07	25	.32	47	76.0	
44	44 9	1.07	26	.32	44 9	1.07	21 5	.33	44 9	1.05	44	.33	46	75.5	
45	45 5		45		45 5		25		45 5		22 4		45	75.0	

t.	d = 15° 0'		d = 15° 30'		d = 16° 0'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	

b	a = 15° 0'					a = 15° 30'					a = 16° 0'					c	a									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ							Δ															
45	43	5	1.07	20	45	0.35	42	57	1.07	21	25	0.35	42	49	1.07	22	4	0.37	45	75.0						
46	44	1	1.07	21	6	.35	43	53	1.07	22	46	.37	43	45	1.09	26	26	.37	44	74.5						
47		57	1.07		27	.38	44	49	1.09	22	8	.38	44	40	1.09	48		.40	43	74.0						
48	45	53	1.09		49	.40	45	44	1.09		31	.40	45	35	1.09	23	12	.42	42	73.5						
49	46	48	1.07	22	13	.42	46	39	1.09		55	.42	46	30	1.09		37	.43	41	72.9						
50	47	44	1.09		38	.43	47	34	1.09	23	20	.45	47	25	1.09	24	3	.45	40	72.3						
51	48	39	1.09	23	4	.45	48	29	1.09		47	.47	48	20	1.09		30	.48	39	71.7						
52	49	34	1.09		31	.48	49	24	1.09	24	15	.48	49	15	1.11		59	.50	38	71.1						
53	50	29	1.09	24	0	.50	50	19	1.11		44	.52	50	9	1.11	25	29	.52	37	70.5						
54	51	24	1.11		30	.53	51	13	1.11	25	15	.55	51	3	1.11	26	0	.57	36	69.8						
55	52	18	1.11	25	2	.57	52	7	1.11		48	.58		57	1.13		34	.58	35	69.1						
56	53	12	1.11		36	.60	53	1	1.11	26	23	.60	52	50	1.13	27	9	.62	34	68.4						
57	54	6	1.11	26	12	.62		55	1.13		59	.63	53	43	1.13		46	.65	33	67.6						
58	55	0	1.13		49	.67	54	48	1.13	27	37	.68	54	36	1.13	28	25	.68	32	66.8						
59		53	1.13	27	29	.70	55	41	1.13	28	18	.72	55	29	1.15	29	6	.73	31	66.0						
60	56	46	1.13	28	11	.75	56	34	1.15	29	1	.75	56	21	1.15		50	.77	30	65.2						
61	57	39	1.15		56	.78	57	26	1.15		46	.80	57	13	1.18	30	36	.82	29	64.3						
62	58	31	1.15	29	43	.83	58	18	1.15	30	34	.85	58	4	1.18		31	.87	28	63.3						
63	59	23	1.15		30	.88	59	10	1.18		31	.90		55	1.18		32	.90	27	62.3						
64	60	15	1.18	31	26	.95	60	1	1.20	32	19	.95	59	46	1.20	33	11	.97	26	61.3						
65	61	6	1.20	32	23	1.00		51	1.20	33	16	1.02	60	36	1.22	34	9	1.03	25	60.2						
66		56	1.20	33	23	1.07	61	41	1.22	34	17	1.08	61	25	1.22	35	11	1.10	24	59.0						
67	62	46	1.22	34	27	1.13	62	30	1.22	35	22	1.15	62	14	1.25	36	17	1.15	23	57.8						
68	63	35	1.25	35	35	1.20	63	19	1.25	36	31	1.22	63	2	1.28		37	1.23	22	56.5						
69	64	23	1.25	36	47	1.28	64	7	1.28	37	44	1.30		49	1.28	38	40	1.30	21	55.2						
70	65	11	1.28	38	4	1.38		54	1.30	39	2	1.38	64	36	1.33	39	58	1.40	20	53.7						
71		58	1.30	39	27	1.48	65	40	1.33	40	25	1.48	65	21	1.33	41	22	1.50	19	52.2						
72	66	44	1.33	40	56	1.57	66	25	1.36	41	54	1.58	66	6	1.40		42	1.58	18	50.6						
73	67	29	1.40		42	30	1.68	67	9	1.40	43	29	1.70		49	1.43	44	27	1.68	17	48.8					
74	68	12	1.40	44	11	1.80		52	1.43	45	11	1.80	67	31	1.46	46	8	1.80	16	47.0						
75		55	1.46	45	59	1.93	68	34	1.50	46	59	1.92	68	12	1.50	47	56	1.92	15	45.1						
76	69	36	1.54	47	55	2.07	69	14	1.58	48	54	2.05		52	1.58	49	51	2.03	14	43.0						
77	70	15	1.58	49	59	2.22		52	1.62	50	57	2.18	69	30	1.67	51	53	2.17	13	40.8						
78		53	1.71	52	12	2.35	70	29	1.71	53	8	2.33	70	6	1.76	54	3	2.30	12	38.5						
79	71	28	1.76	54	33	2.50	71	4	1.82	55	28	2.48		40	1.88	56	21	2.45	11	36.0						
80	72	2	1.88	57	3	2.67		37	1.94	57	57	2.62	71	12	2.00	58	48	2.58	10	33.4						
81		34	2.07	59	43	2.83	72	8	2.14	60	34	2.98		42	2.22	61	23	2.73	9	30.7						
82	73	3	2.31	62	33	2.98		36	2.31	63	21	2.93	72	9	2.40	64	7	2.87	8	27.7						
83		29	2.61	65	32	3.15	73	2	2.73	66	17	3.07		34	2.73	66	59	3.00	7	24.7						
84		52	3.00	68	41	3.30		24	3.00	69	21	3.20		56	3.16	69	59	3.12	6	21.5						
85	74	12	3.53	71	59	3.43		44	3.75	72	33	3.33	73	15	3.75	73	6	3.23	5	18.1						
86		29	4.29	75	25	3.53	74	0	4.62	75	53	3.43		31	4.62	76	20	3.32	4	14.7						
87		43	6.67	78	57	3.63		13	6.67	79	19	3.52		44	6.67	79	39	3.42	3	11.1						
88		52	10.0	82	35	3.68		22	10.0	82	50	3.57		53	12.0	83	4	3.45	2	7.4						
89		58	30.0	86	16	3.73		28	30.0	86	24	3.60		58	30.0	86	31	3.48	1	3.7						
90	75	0		90	0			30		90	0			74	0		90	0		0	0.0					

t	a = 15° 0'		a = 15° 30'		a = 16° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 15° 0'		d = 15° 30'		d = 16° 0'		





b	a = 16° 30'					a = 17° 0'					a = 17° 30'					c	a					
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β		
			Δ	Δ					Δ													
45	42	41	1.09	22	44	0.37	42	33	1.09	23	23	0.37	42	24	1.09	24	2	0.38	45	73.7		
46	43	36	1.09	23	6	.38	43	28	1.09	45	.40	43	19	1.09	25	.40	44	.40	44	73.2		
47	44	31	1.09	29	.40	.40	44	23	1.09	24	9	.40	44	14	1.11	49	.42	43	.42	43	72.6	
48	45	26	1.09	53	.42	.42	45	18	1.11	33	.43	45	8	1.11	25	14	.43	42	.43	42	72.0	
49	46	21	1.09	24	18	.43	46	12	1.11	59	.45	46	2	1.11	40	.47	41	.47	41	71.4		
50	47	16	1.11	44	.47	.47	47	6	1.11	25	26	.48	56	1.11	26	8	.48	40	.48	40	70.8	
51	48	10	1.11	25	12	.50	48	0	1.11	55	.50	47	50	1.11	37	.50	39	.50	39	70.1		
52	49	4	1.11	42	.50	.50	54	1.11	26	25	.52	48	44	1.13	27	7	.53	38	.53	38	69.5	
53	50	58	1.11	26	12	.55	49	48	1.13	56	.55	49	37	1.13	39	.57	37	.57	37	68.8		
54	50	52	1.11	45	.57	.57	50	41	1.13	27	29	.58	50	30	1.13	28	13	.58	36	.58	36	68.1
55	51	46	1.13	27	19	.60	51	34	1.13	28	4	.60	51	23	1.15	48	.62	35	.62	35	67.3	
56	52	39	1.13	55	.62	.62	52	27	1.13	40	.63	52	15	1.15	29	25	.65	34	.65	34	66.6	
57	53	32	1.15	28	32	.67	53	20	1.15	29	18	.68	53	7	1.15	30	4	.68	33	.68	33	65.8
58	54	24	1.15	29	12	.70	54	12	1.15	59	.72	59	1.18	45	.72	32	.72	32	.72	32	64.9	
59	55	16	1.15	54	.75	.75	55	4	1.18	30	42	.75	54	50	1.18	31	28	.77	31	.77	31	64.1
60	56	8	1.15	30	39	.78	55	1.18	31	27	.78	55	41	1.18	32	14	.80	30	.80	30	63.1	
61	57	0	1.18	31	26	.82	56	40	1.20	32	14	.83	56	32	1.20	33	2	.85	29	.85	29	62.2
62	58	51	1.20	32	15	.87	57	36	1.20	33	4	.88	57	22	1.22	53	.90	28	.90	28	61.2	
63	58	41	1.20	33	7	.93	58	26	1.20	57	.93	58	11	1.22	34	47	.95	27	.95	27	60.2	
64	59	31	1.22	34	3	.98	59	16	1.22	34	53	1.00	59	0	1.25	35	44	1.00	26	1.00	26	59.1
65	60	20	1.22	35	2	1.03	60	5	1.25	35	53	1.05	60	48	1.25	36	44	1.05	25	1.05	25	57.9
66	61	9	1.25	36	4	1.10	61	53	1.25	36	56	1.12	60	36	1.28	37	47	1.12	24	1.12	24	56.7
67	62	57	1.25	37	10	1.17	61	41	1.28	38	3	1.17	61	23	1.28	38	54	1.18	23	1.18	23	55.4
68	62	45	1.28	38	20	1.25	62	28	1.30	39	13	1.25	62	10	1.33	40	5	1.25	22	1.25	22	54.1
69	63	32	1.33	39	35	1.32	63	14	1.33	40	28	1.33	55	1.33	41	20	1.33	21	1.33	21	52.7	
70	64	17	1.33	40	54	1.40	64	59	1.36	41	48	1.40	63	40	1.40	42	40	1.42	20	1.42	20	51.2
71	65	2	1.36	42	18	1.48	64	43	1.40	43	12	1.50	64	23	1.40	44	5	1.50	19	1.50	19	49.7
72	66	46	1.40	43	47	1.58	65	26	1.43	44	42	1.58	65	6	1.46	45	35	1.58	18	1.58	18	48.0
73	66	29	1.46	45	22	1.68	66	8	1.46	46	17	1.68	66	47	1.50	47	10	1.67	17	1.67	17	46.3
74	67	10	1.50	47	3	1.80	67	49	1.50	47	58	1.78	66	27	1.54	48	50	1.78	16	1.78	16	44.4
75	68	50	1.54	48	51	1.92	67	29	1.58	49	45	1.90	67	6	1.62	50	37	1.88	15	1.88	15	42.5
76	68	29	1.62	50	46	2.02	68	7	1.67	51	39	2.00	68	43	1.67	52	30	2.00	14	2.00	14	40.5
77	69	6	1.67	52	47	2.15	69	43	1.71	53	39	2.13	68	19	1.76	54	30	2.10	13	2.10	13	38.3
78	70	42	1.82	54	56	2.28	69	18	1.88	55	47	2.25	69	53	1.88	56	36	2.22	12	2.22	12	36.0
79	70	15	1.88	57	13	2.40	70	50	1.94	58	2	2.37	69	25	2.00	58	49	2.35	11	2.35	11	33.6
80	71	47	2.07	59	37	2.55	70	21	2.07	60	24	2.50	70	55	2.14	61	10	2.45	10	2.45	10	31.1
81	71	16	2.22	62	10	2.67	71	16	2.31	62	54	2.62	70	23	2.31	63	37	2.57	9	2.57	9	28.4
82	72	43	2.50	64	50	2.80	71	50	2.61	65	31	2.75	71	49	2.61	66	11	2.68	8	2.68	8	25.7
83	72	7	2.86	67	38	2.93	72	39	2.86	68	16	2.85	71	12	3.00	68	52	2.80	7	2.80	7	22.8
84	73	28	3.16	70	34	3.03	72	0	3.33	71	7	2.97	72	32	3.53	71	40	2.88	6	2.88	6	19.8
85	73	47	4.00	73	36	3.15	73	18	4.00	74	5	3.07	73	49	4.00	74	33	2.98	5	2.98	5	16.7
86	73	2	5.00	76	45	3.23	73	33	5.00	77	9	3.13	72	4	5.45	77	32	3.05	4	3.05	4	13.5
87	74	14	6.67	79	59	3.30	74	45	7.50	80	17	3.20	73	15	7.50	80	35	3.10	3	3.10	3	10.2
88	74	23	12.0	83	17	3.35	75	12.0	83	29	3.25	74	23	12.0	83	41	3.15	2	3.15	2	6.8	
89	75	28	30.0	86	38	3.37	75	58	30.0	86	44	3.27	74	28	30.0	86	50	3.17	1	3.17	1	3.4
90	75	30		90	0		73	0		90	0		30			90	0		0		0	0.0

t	a = 16° 30'		a = 17° 0'		a = 17° 30'		a
	a	Δ	a	Δ	a	Δ	
	d	60'	d	60'	d	60'	



B	a = 18° 0'				a = 18° 30'				a = 19° 0'				C	c	α		
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t				C	β
		Δ	Z	60'		Δ	Z	60'		Δ	Z	60'					
0	0 0	1.05	18 0	0.00	0 0	1.05	18 30	0.00	0 0	1.05	19 0	0.00	90	90.0			
1	0 57	1.05	0	.02	0 57	1.05	30	.02	0 57	1.05	0	.02	89	89.7			
2	1 54	1.05	1	.00	1 54	1.05	31	.02	1 54	1.07	1	.02	88	89.4			
3	2 51	1.05	1	.02	2 51	1.05	32	.02	2 50	1.05	2	.02	87	89.0			
4	3 48	1.05	2	.03	3 48	1.05	33	.02	3 47	1.05	3	.02	86	88.7			
5	4 45	1.05	4	0.03	4 45	1.07	34	0.03	4 44	1.07	4	0.03	85	88.4			
6	5 42	1.05	6	.03	5 41	1.05	36	.03	5 40	1.05	6	.03	84	88.1			
7	6 39	1.05	8	.03	6 38	1.05	38	.03	6 37	1.05	8	.03	83	87.8			
8	7 36	1.05	10	.05	7 35	1.05	40	.05	7 34	1.07	10	.05	82	87.4			
9	8 33	1.05	13	.05	8 32	1.05	43	.05	8 30	1.05	13	.05	81	87.1			
10	9 30	1.05	16	0.05	9 29	1.05	46	0.05	9 27	1.05	16	0.07	80	86.8			
11	10 27	1.05	19	.07	10 26	1.07	49	.07	10 24	1.07	20	.07	79	86.5			
12	11 24	1.05	23	.07	11 22	1.05	53	.07	11 20	1.05	24	.07	78	86.1			
13	12 21	1.05	27	.07	12 19	1.05	57	.07	12 17	1.07	28	.07	77	85.8			
14	13 18	1.05	31	.08	13 16	1.07	19 1	.08	13 13	1.05	32	.08	76	85.5			
15	14 15	1.05	36	0.08	14 12	1.05	6	0.08	14 10	1.07	37	0.08	75	85.1			
16	15 12	1.05	41	.08	15 9	1.05	11	.10	15 6	1.05	42	.10	74	84.8			
17	16 9	1.05	46	.10	16 6	1.07	17	.10	16 3	1.07	48	.10	73	84.5			
18	17 6	1.07	52	.10	17 2	1.05	23	.10	59	1.05	54	.12	72	84.1			
19	18 2	1.05	58	.10	59	1.05	29	.12	17 56	1.07	20 1	.12	71	83.8			
20	59	1.05	19 4	0.12	18 56	1.07	36	0.12	18 52	1.07	8	0.12	70	83.4			
21	19 56	1.07	11	.13	19 52	1.05	43	.13	19 48	1.05	15	.12	69	83.1			
22	20 52	1.05	19	.13	20 49	1.07	51	.13	20 45	1.07	22	.13	68	82.7			
23	21 49	1.07	27	.13	21 45	1.07	59	.13	21 41	1.07	30	.15	67	82.3			
24	22 45	1.05	35	.13	22 41	1.05	20 7	.15	22 37	1.07	39	.15	66	82.0			
25	23 42	1.07	43	0.15	23 38	1.07	16	0.15	23 33	1.07	48	0.17	65	81.6			
26	24 38	1.05	52	.17	24 34	1.07	25	.17	24 29	1.07	58	.17	64	81.2			
27	25 35	1.07	20 2	.17	25 30	1.07	35	.17	25 25	1.07	21 8	.17	63	80.8			
28	26 31	1.07	12	.18	26 26	1.07	45	.18	26 21	1.07	18	.18	62	80.4			
29	27 27	1.05	23	.18	27 22	1.07	50	.18	27 17	1.07	29	.20	61	80.0			
30	28 24	1.07	34	0.20	28 18	1.07	21 7	0.20	28 13	1.07	41	0.20	60	79.6			
31	29 20	1.07	46	.20	29 14	1.07	19	.22	29 9	1.09	53	.22	59	79.2			
32	30 16	1.07	58	.22	30 10	1.07	32	.22	30 4	1.07	22 6	.22	58	78.8			
33	31 12	1.07	21 11	.22	31 6	1.07	45	.23	31 0	1.09	19	.23	57	78.4			
34	32 8	1.07	24	.23	32 2	1.09	59	.23	55	1.07	33	.25	56	77.9			
35	33 4	1.09	38	0.25	57	1.07	22 13	0.25	32 51	1.09	48	0.25	55	77.5			
36	34 59	1.07	53	.25	33 53	1.09	28	.27	33 46	1.09	23 3	.27	54	77.0			
37	34 55	1.09	22 8	.27	34 48	1.09	44	.28	34 41	1.09	19	.28	53	76.6			
38	35 50	1.07	24	.28	35 43	1.09	23 1	.28	35 36	1.09	36	.30	52	76.1			
39	36 46	1.09	41	.30	36 38	1.09	18	.30	36 31	1.09	54	.30	51	75.6			
40	37 41	1.09	59	0.32	37 33	1.09	36	0.32	37 26	1.11	24 12	0.33	50	75.1			
41	38 36	1.09	23 18	.32	38 28	1.09	55	.32	38 20	1.09	32	.33	49	74.6			
42	39 31	1.09	37	.33	39 23	1.09	24 14	.35	39 15	1.11	52	.35	48	74.1			
43	40 26	1.09	57	.35	40 18	1.11	35	.37	40 9	1.11	25 13	.37	47	73.5			
44	41 21	1.09	24 18	.38	41 12	1.09	57	.37	41 3	1.11	35	.38	46	73.0			
45	42 16		41		42 7		25 19		57		58		45	72.4			

t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a
	d = 18° 0'				d = 18° 30'				d = 19° 0'				

B	a = 18° 0'					a = 18° 30'					a = 19° 0'					C	c	a		
	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t	Δ					
		Δ	Z	60'	60'		Z	60'	60'	Z		60'	Z	60'	60'				60'	
45	42	16	1.11	24	41	0.38	42	7	1.11	25	19	0.40	41	57	1.11	25	58	0.40	45	72.4
46	43	10	1.11	25	4	.40	43	1	1.11	26	8	.42	42	51	1.11	26	22	.42	44	71.8
47	44	4	1.11	28	.43		44	5	1.11	26	8	.43	43	45	1.11	27	47	.45	43	71.2
48		58	1.11		54	.45	44	49	1.13	34		.45	44	39	1.13	27	14	.47	42	70.6
49	45	52	1.11	26	21	.47	45	42	1.13	27	1	.48	45	32	1.13	42		.48	41	69.9
50	46	46	1.13		49	0.48	46	35	1.13	30	0.50	46	25	1.13	28	11	0.50	40	69.3	
51	47	39	1.13	27	18	.52	47	28	1.13	28	0	.52	47	18	1.15	41	51	.53	39	68.6
52	48	32	1.13	27	49	.55	48	21	1.13	31		.55	48	10	1.15	29	13	.57	38	67.9
53	49	25	1.13	28	22	.57	49	14	1.15	29	4	.58	49	2	1.15	47	47	.58	37	67.2
54	50	18	1.15	30	36	.60	50	6	1.15	39		.60	50	54	1.15	30	22	.62	36	66.4
55	51	10	1.15	29	32	0.63		58	1.15	30	15	0.65	50	46	1.18		59	0.63	35	65.6
56	52	2	1.15	30	10	.65	51	50	1.18	54		.67	51	37	1.18	31	37	.68	34	64.8
57		54	1.15		49	.70	52	41	1.18	31	34	.70	52	28	1.20	32	18	.72	33	64.0
58	53	46	1.18	31	31	.73	53	32	1.18	32	16	.75	53	18	1.20	33	1	.75	32	63.1
59	54	37	1.20	32	15	.77	54	23	1.20	33	1	.77	54	8	1.20	46		.78	31	62.2
60	55	27	1.20	33	1	0.82	55	13	1.22		47	0.83		58	1.22	34	33	0.83	30	61.2
61	56	17	1.20		50	.85	56	2	1.22	34	37	.87	55	47	1.22	35	23	.88	29	60.2
62	57	7	1.22	34	41	.90	57	51	1.22	35	29	.90	56	36	1.25	36	16	.92	28	59.2
63		56	1.25	35	35	.97	57	40	1.25	36	23	.97	57	24	1.28	37	11	.97	27	58.1
64	58	44	1.25	36	33	1.00	58	28	1.28	37	21	1.02	58	11	1.28	38	9	1.02	26	57.0
65	59	32	1.28	37	33	1.07	59	15	1.28	38	22	1.07		58	1.30	39	10	1.08	25	55.8
66	60	19	1.28	38	37	1.13	60	2	1.30	39	26	1.13	59	44	1.30	40	15	1.13	24	54.5
67	61	6	1.30	39	45	1.18		48	1.33	40	34	1.20	60	30	1.33	41	23	1.20	23	53.2
68		52	1.33	40	56	1.27	61	33	1.33	41	46	1.27	61	15	1.40	42	35	1.27	22	51.9
69	62	37	1.36	42	12	1.33	62	18	1.40	43	2	1.33		58	1.40	43	51	1.33	21	50.4
70	63	21	1.40	43	32	1.40	63	1	1.43	44	22	1.42	62	41	1.43	45	11	1.42	20	48.9
71	64	4	1.46	44	56	1.50		43	1.43	45	47	1.50	63	23	1.46	46	36	1.50	19	47.3
72		45	1.46	46	26	1.58	64	25	1.50	47	17	1.57	64	4	1.54	48	6	1.57	18	45.7
73	65	26	1.50	48	1	1.68	65	5	1.54	48	51	1.67		43	1.58	49	40	1.65	17	43.9
74	66	6	1.58	49	42	1.77		44	1.62	50	31	1.77	65	21	1.62	51	19	1.75	16	42.1
75		44	1.67	51	28	1.87	66	21	1.67	52	17	1.85		58	1.71	53	4	1.85	15	40.2
76	67	20	1.71	53	20	1.97		57	1.76	54	8	1.95	66	33	1.76	54	55	1.93	14	38.2
77		55	1.76	55	18	2.08	67	31	1.82	56	5	2.05	67	7	1.88	56	51	2.03	13	36.0
78	68	29	1.94	57	23	2.20	68	4	1.94	58	8	2.17		39	2.00	58	53	2.12	12	33.8
79	69	0	2.07	59	35	2.30		35	2.14	60	18	2.27	68	9	2.14	61	0	2.23	11	31.5
80		29	2.22	61	53	2.42	69	3	2.22	62	34	2.38		37	2.31	63	14	2.33	10	29.1
81	56		2.40	64	18	2.52		30	2.50	64	57	2.47	69	3	2.50	65	34	2.43	9	26.5
82	70	21	2.61	66	49	2.62		54	2.73	67	25	2.57		27	2.86	68	0	2.52	8	23.9
83		44	3.16	69	26	2.73	70	16	3.16	69	59	2.67		48	3.16	70	31	2.60	7	21.2
84	71	3	3.53	72	10	2.82		35	3.53	72	39	2.75	70	7	3.75	73	7	2.68	6	18.3
85		20	4.00	74	59	2.90		52	4.62	75	24	2.82		23	4.62	75	48	2.75	5	15.4
86		35	5.45	77	53	2.97	71	5	5.45	78	13	2.90		36	6.00	78	33	2.82	4	12.4
87		46	7.50	80	51	3.02		16	7.50	81	7	2.93		46	7.50	81	22	2.85	3	9.4
88		54	15.0	83	52	3.05		24	15.0	84	3	2.97		54	15.0	84	13	2.88	2	6.3
89		58	30.0	86	55	3.08		28	30.0	87	1	2.98		58	30.0	87	6	2.90	1	3.1
90	72	0		90	0		30			90	0		71	0		90	0		0	0.0

t	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a
	Δ	Δ	60'	60'	Δ	Δ	60'	60'	Δ	Δ	60'	60'	Δ
	d = 18° 0'				d = 18° 30'				d = 19° 0'				



b	a = 19° 30'						a = 20° 0'						a = 20° 30'						c	a							
	B	h	d		Z	t	Δ	60'	h	d		Z	t	Δ	60'	h	d				Z	t	Δ	60'	C	β	
			o'	Δ						o'	Δ						o'	Δ									
0	0	0	1.05	19	30	0.00	0	0	1.07	20	0	0.00	0	0	1.07	20	30	0.00	0	0	1.07	20	30	0.00	90	90.0	
1	57	1.07	30	.02	56	1.05	20	0	.02	56	1.07	30	.02	56	1.07	30	.02	56	1.07	30	.02	56	1.07	30	.02	89	89.7
2	1 53	1.05	31	.02	1 53	1.07	1	.02	1 52	1.05	31	.02	1 52	1.05	31	.02	1 52	1.05	31	.02	1 52	1.05	31	.02	88	89.3	
3	2 50	1.07	32	.02	2 49	1.05	2	.02	2 49	1.07	32	.02	2 49	1.07	32	.02	2 49	1.07	32	.02	2 49	1.07	32	.02	87	89.0	
4	3 46	1.05	33	.02	3 46	1.07	3	.02	3 45	1.07	33	.02	3 45	1.07	33	.02	3 45	1.07	33	.02	3 45	1.07	33	.02	86	88.6	
5	4 43	1.07	34	.03	4 42	1.07	4	0.03	4 41	1.07	34	.03	4 41	1.07	34	.03	4 41	1.07	34	.03	4 41	1.07	34	.03	85	88.3	
6	5 39	1.05	36	.03	5 38	1.05	6	.03	5 37	1.07	36	.03	5 37	1.07	36	.03	5 37	1.07	36	.03	5 37	1.07	36	.03	84	87.9	
7	6 36	1.07	38	.05	6 35	1.07	8	.05	6 33	1.07	38	.05	6 33	1.07	38	.05	6 33	1.07	38	.05	6 33	1.07	38	.05	83	87.6	
8	7 32	1.05	41	.05	7 31	1.07	11	.05	7 29	1.05	41	.05	7 29	1.05	41	.05	7 29	1.05	41	.05	7 29	1.05	41	.05	82	87.2	
9	8 29	1.07	44	.05	8 27	1.07	14	.05	8 26	1.07	44	.05	8 26	1.07	44	.05	8 26	1.07	44	.05	8 26	1.07	44	.05	81	86.9	
10	9 25	1.05	47	0.05	9 23	1.05	17	0.07	9 22	1.07	47	0.07	9 22	1.07	47	0.07	9 22	1.07	47	0.07	9 22	1.07	47	0.07	80	86.5	
11	10 22	1.07	50	.07	10 20	1.07	21	.07	10 18	1.07	51	.07	10 18	1.07	51	.07	10 18	1.07	51	.07	10 18	1.07	51	.07	79	86.2	
12	11 18	1.05	54	.07	11 16	1.07	25	.07	11 14	1.07	55	.08	11 14	1.07	55	.08	11 14	1.07	55	.08	11 14	1.07	55	.08	78	85.8	
13	12 15	1.07	58	.08	12 12	1.07	29	.08	12 10	1.07	58	.08	12 10	1.07	58	.08	12 10	1.07	58	.08	12 10	1.07	58	.08	77	85.5	
14	13 11	1.07	20	3	.08	13 8	1.05	34	.08	13 6	1.07	21	0	.08	13 6	1.07	21	0	.08	13 6	1.07	21	0	.08	76	85.1	
15	14 7	1.05	8	.08	14 5	1.07	39	0.08	14 2	1.07	10	0.08	14 2	1.07	10	0.08	14 2	1.07	10	0.08	14 2	1.07	10	0.08	75	84.8	
16	15 4	1.07	13	.10	15 1	1.07	44	.10	15 0	1.07	15	.10	15 0	1.07	15	.10	15 0	1.07	15	.10	15 0	1.07	15	.10	74	84.4	
17	16 0	1.07	19	.10	16 0	1.07	50	.10	15 54	1.09	21	.12	15 54	1.09	21	.12	15 54	1.09	21	.12	15 54	1.09	21	.12	73	84.0	
18	17 56	1.07	25	.12	17 53	1.07	56	.12	17 49	1.07	28	.12	17 49	1.07	28	.12	17 49	1.07	28	.12	17 49	1.07	28	.12	72	83.7	
19	18 52	1.07	32	.12	18 49	1.07	21	3	.12	18 45	1.07	35	.12	18 45	1.07	35	.12	18 45	1.07	35	.12	18 45	1.07	35	.12	71	83.3
20	19 48	1.05	39	0.12	19 45	1.07	10	0.13	19 41	1.07	42	0.13	19 41	1.07	42	0.13	19 41	1.07	42	0.13	19 41	1.07	42	0.13	70	82.9	
21	20 45	1.07	46	.13	20 41	1.07	18	.13	20 37	1.09	50	.13	20 37	1.09	50	.13	20 37	1.09	50	.13	20 37	1.09	50	.13	69	82.5	
22	21 41	1.07	54	.13	21 37	1.09	26	.13	21 32	1.07	58	.13	21 32	1.07	58	.13	21 32	1.07	58	.13	21 32	1.07	58	.13	68	82.1	
23	22 37	1.07	21	2	.15	21 32	1.07	34	.15	21 28	1.07	22	6	.15	21 28	1.07	22	6	.15	21 28	1.07	22	6	.15	67	81.7	
24	23 33	1.07	11	.15	23 28	1.07	43	.17	23 24	1.09	15	.17	23 24	1.09	15	.17	23 24	1.09	15	.17	23 24	1.09	15	.17	66	81.3	
25	24 29	1.07	20	0.17	24 24	1.07	53	0.17	24 19	1.07	25	0.17	24 19	1.07	25	0.17	24 19	1.07	25	0.17	24 19	1.07	25	0.17	65	80.9	
26	25 25	1.09	30	.17	25 20	1.09	22	3	.17	25 15	1.09	35	.18	25 15	1.09	35	.18	25 15	1.09	35	.18	25 15	1.09	35	.18	64	80.5
27	26 20	1.07	40	.18	26 15	1.07	13	.18	26 10	1.09	46	.18	26 10	1.09	46	.18	26 10	1.09	46	.18	26 10	1.09	46	.18	63	80.1	
28	27 16	1.07	51	.18	27 11	1.09	24	.20	27 5	1.09	57	.20	27 5	1.09	57	.20	27 5	1.09	57	.20	27 5	1.09	57	.20	62	79.7	
29	28 12	1.09	22	2	.20	28 6	1.07	36	.20	28 0	1.09	23	9	.20	28 0	1.09	23	9	.20	28 0	1.09	23	9	.20	61	79.3	
30	29 8	1.07	14	0.22	29 2	1.09	48	0.22	29 0	1.09	21	0.22	29 0	1.09	21	0.22	29 0	1.09	21	0.22	29 0	1.09	21	0.22	60	78.8	
31	30 3	1.09	27	.22	30 0	1.09	23	1	.22	30 0	1.09	34	.23	30 0	1.09	34	.23	30 0	1.09	34	.23	30 0	1.09	34	.23	59	78.4
32	31 58	1.07	40	.23	31 52	1.09	14	.23	31 45	1.09	48	.23	31 45	1.09	48	.23	31 45	1.09	48	.23	31 45	1.09	48	.23	58	77.9	
33	32 54	1.09	54	.23	32 47	1.09	28	.23	32 40	1.09	24	2	.25	32 40	1.09	24	2	.25	32 40	1.09	24	2	.25	57	77.5		
34	33 49	1.09	23	8	.25	33 42	1.09	42	.25	33 35	1.09	17	.25	33 35	1.09	17	.25	33 35	1.09	17	.25	33 35	1.09	17	.25	56	77.0
35	34 44	1.09	23	0.27	34 37	1.09	57	0.27	34 30	1.11	32	0.27	34 30	1.11	32	0.27	34 30	1.11	32	0.27	34 30	1.11	32	0.27	55	76.5	
36	35 39	1.09	39	.27	35 32	1.11	24	13	.28	35 24	1.09	48	.28	35 24	1.09	48	.28	35 24	1.09	48	.28	35 24	1.09	48	.28	54	76.0
37	36 34	1.09	55	.28	36 26	1.09	30	.30	36 19	1.11	25	5	.30	36 19	1.11	25	5	.30	36 19	1.11	25	5	.30	53	75.5		
38	37 29	1.11	24	12	.30	37 21	1.11	48	.30	37 13	1.11	23	32	.32	37 13	1.11	23	32	.32	37 13	1.11	23	32	.32	52	75.0	
39	38 23	1.09	30	.32	38 15	1.11	25	6	.32	38 7	1.11	42	.32	38 7	1.11	42	.32	38 7	1.11	42	.32	38 7	1.11	42	.32	51	74.5
40	39 18	1.11	49	0.32	39 9	1.11	25	0.33	39 1	1.11	26	1	0.33	39 1	1.11	26	1	0.33	39 1	1.11	26	1	0.33	50	74.0		
41	40 12	1.11	25	8	.35	40 3	1.11	45	.35	40 0	1.11	21	.35	40 0	1.11	21	.35	40 0	1.11	21	.35	40 0	1.11	21	.35	49	73.4
42	41 6	1.11	29	.35	41 0	1.11	26	6	.35	41 0	1.11	42	.38	41 0	1.11	42	.38	41 0	1.11	42	.38	41 0	1.11	42	.38	48	72.9
43	42 0	1.11	50	.38	42 0	1.11	27	.38	42 0	1.11	27	5	.38	42 0	1.11	27	5	.38	42 0	1.11	27	5	.38	47	72.3		
44	43 54	1.11	26	13	.38	43 45	1.11	50	.40	43 36	1.13	28	.40	43 36	1.13	28	.40	43 36	1.13	28	.40	43 36	1.13	28	.40	46	71.7
45	44 48		36		44 39		27	14		44 29		52		44 29		52		44 29		52		44 29		52		45	71.1
t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	
	d = 19° 30'				d = 20° 0'				d = 20° 30'								a										
																	a										

B	$a = 19^\circ 30'$				$a = 20^\circ 0'$				$a = 20^\circ 30'$				C	$\beta$
	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$		
	$h$				$h$				$h$					
45	41 48	1.11	26 36	0.42	41 39	1.13	27 14	0.42	41 29	1.13	27 52	0.42	45	71.1
46	42 42	1.13	27 1	.42	42 32	1.13	27 39	.43	42 22	1.13	28 17	.45	44	70.5
47	43 35	1.13	26	.45	43 25	1.13	28 5	.47	43 15	1.15	28 44	.47	43	69.9
48	44 28	1.13	53	.48	44 18	1.15	33	.47	44 7	1.15	29 12	.48	42	69.2
49	45 21	1.13	28 22	.48	45 10	1.15	29 1	.50	45 59	1.15	31 41	.50	41	68.5
50	46 14	1.15	51	0.52	46 2	1.15	31	0.53	45 51	1.15	30 11	0.53	40	67.8
51	47 6	1.15	29 22	.53	47 54	1.15	30 3	.55	46 43	1.18	31 43	.55	39	67.1
52	48 58	1.15	54	.57	47 46	1.15	36	.57	47 34	1.18	31 16	.58	38	66.4
53	48 50	1.15	30 28	.60	48 38	1.18	31 10	.60	48 25	1.18	51 51	.62	37	65.6
54	49 42	1.18	31 4	.63	49 29	1.18	46	.63	49 16	1.18	32 28	.63	36	64.8
55	50 33	1.18	42	0.65	50 20	1.20	32 24	0.65	50 7	1.20	33 6	0.67	35	64.0
56	51 24	1.20	32 21	.68	51 10	1.20	33 3	.70	51 57	1.22	34 46	.70	34	63.1
57	52 14	1.20	33 2	.72	52 0	1.20	45	.73	51 46	1.22	34 28	.73	33	62.2
58	53 4	1.20	45	.77	53 50	1.22	34 29	.77	52 35	1.22	35 12	.78	32	61.3
59	54	1.22	34 31	.80	53 39	1.22	35 15	.80	53 24	1.22	59	.80	31	60.3
60	54 43	1.22	35 19	0.83	54 28	1.25	36 3	0.85	54 13	1.25	36 47	0.85	30	59.3
61	55 32	1.25	36 9	.88	55 16	1.25	54	.88	55 1	1.28	37 38	.90	29	58.3
62	56 20	1.25	37 2	.92	56 4	1.28	37 47	.93	56 48	1.30	38 32	.95	28	57.2
63	57 8	1.28	57	.98	57 51	1.28	38 43	.98	56 34	1.30	39 29	.98	27	56.1
64	58 55	1.30	38 56	1.03	57 38	1.30	39 42	1.03	57 20	1.30	40 28	1.03	26	55.0
65	58 41	1.30	39 58	1.08	58 24	1.33	40 44	1.08	58 6	1.36	41 30	1.08	25	53.7
66	59 27	1.33	41 3	1.13	59 9	1.36	41 49	1.15	59 50	1.36	42 35	1.15	24	52.5
67	60 12	1.36	42 11	1.20	53	1.40	42 58	1.22	59 34	1.40	43 44	1.22	23	51.1
68	56 1.40	43 23	1.27	60 36	1.40	44 11	1.27	60 17	1.43	44 57	1.27	22	49.7	
69	61 39	1.43	44 39	1.35	61 19	1.43	45 27	1.33	59	1.46	46 13	1.33	21	48.3
70	62 21	1.46	46 0	1.40	62 1	1.50	46 47	1.40	61 40	1.50	47 33	1.40	20	46.8
71	63 2	1.50	47 24	1.48	41 1.50	48 11	1.48	62 20	1.54	48 57	1.48	19	45.2	
72	42 1.54	48 53	1.57	63 21	1.58	49 40	1.57	59	1.62	50 26	1.55	18	43.5	
73	64 21	1.58	50 27	1.65	59 1.62	51 14	1.63	63 36	1.67	51 59	1.62	17	41.8	
74	59 1.67	52 6	1.73	64 36	1.71	52 52	1.72	64 12	1.71	53 36	1.70	16	40.0	
75	65 35	1.76	53 50	1.83	65 11	1.76	54 35	1.80	47	1.76	55 18	1.80	15	38.1
76	66 9	1.82	55 40	1.92	45 1.82	56 23	1.90	65 21	1.88	57 6	1.87	14	36.1	
77	42 1.88	57 35	2.00	66 18	2.00	58 17	1.98	53	2.00	58 58	1.95	13	34.0	
78	67 14	2.07	59 35	2.10	48 2.07	60 16	2.07	66 23	2.14	60 55	2.05	12	31.9	
79	43 2.14	61 41	2.20	67 17	2.22	62 20	2.17	51	2.31	62 58	2.12	11	29.6	
80	68 11	2.40	63 53	2.28	44 2.40	64 30	2.25	67 17	2.50	65 5	2.22	10	27.3	
81	36 2.61	66 10	2.38	68 9	2.73	66 45	2.33	41	2.73	67 18	2.28	9	24.8	
82	59 2.86	68 33	2.47	31 3.00	69 5	2.40	69 5	2.40	3	3.00	69 35	2.37	8	22.3
83	69 20	3.33	71 1	2.53	51 3.33	71 29	2.50	23	3.33	71 57	2.43	7	19.7	
84	38 3.75	73 33	2.62	69 9	3.75	73 59	2.55	41	4.00	74 23	2.50	6	17.1	
85	54 4.62	76 10	2.68	25 5.00	76 32	2.62	56	5.00	76 53	2.55	5	14.3		
86	7 6.00	78 51	2.75	37 6.00	79 9	2.67	69	6.67	79 26	2.60	4	11.6		
87	17 8.57	81 36	2.77	47 8.57	81 49	2.70	17	8.57	82 2	2.63	3	8.7		
88	24 12.0	84 22	2.82	54 12.0	84 31	2.73	24	12.0	84 40	2.67	2	5.8		
89	29 60.0	87 11	2.82	59 60.0	87 15	2.75	29	60.0	87 20	2.67	1	2.9		
90	30	90 0	70 0	90 0	30	90 0	90 0	90 0	90 0	90 0	90 0	90 0	0	0.0

t	$a = 19^\circ 30'$		$a = 20^\circ 0'$		$a = 20^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 19^\circ 30'$		$d = 20^\circ 0'$		$d = 20^\circ 30'$		





b	a = 21° 0'				a = 21° 30'				a = 22° 0'				c	α							
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t			Δ / 60'	C	β				
																		h	d	60' / Δ	Z
45	41	19	1.15	28	30	0.42	41	8	1.13	29	7	0.43	40	58	1.15	29	44	0.45	45	69.9	
46	42	11	1.13		55	.45	42	1	1.15		33	.47	41	50	1.15	30	11	.47	44	69.2	
47	43	4	1.15	29	22	.47		53	1.15	30	1	.47	42	42	1.18		39	.48	43	68.5	
48		56	1.15		50	.50	43	45	1.18		29	.50	43	33	1.18	31	8	.50	42	67.8	
49	44	48	1.15	30	20	.52	44	36	1.18		59	.52	44	24	1.18		38	.52	41	67.1	
50	45	40	1.18		51	0.53	45	27	1.18	31	30	0.55	45	15	1.18	32	9	0.55	40	66.4	
51	46	31	1.18	31	23	.57	46	18	1.18	32	3	.57	46	6	1.20		42	.58	39	65.6	
52	47	22	1.18		57	.58	47	9	1.18		37	.58	56	56	1.20	33	17	.60	38	64.9	
53	48	13	1.20	32	32	.62	48	0	1.20	33	12	.63	47	46	1.20		53	.62	37	64.1	
54	49	3	1.20	33	9	.65	50		1.22		50	.65	48	36	1.22	34	30	.67	36	63.2	
55		53	1.20		48	0.67	49	39	1.22	34	29	0.68	49	25	1.22	35	10	0.68	35	62.4	
56	50	43	1.22	34	28	.72	50	28	1.22	35	10	.72	50	14	1.25		51	.72	34	61.5	
57	51	32	1.22	35	11	.73	51	17	1.22		53	.75	51	2	1.25	36	34	.75	33	60.6	
58	52	21	1.25		55	.78	52	6	1.25	36	38	.78		50	1.25	37	19	.80	32	59.6	
59	53	9	1.25	36	42	.82	54		1.28	37	25	.82	52	38	1.28	38	7	.82	31	58.6	
60		57	1.28		37	31	0.85	53	41	1.28	38	14	0.87	53	25	1.30		56	0.87	30	57.6
61	54	44	1.28	38	22	.90	54	28	1.30	39	6	.90	54	11	1.30	39	48	.92	29	56.5	
62	55	31	1.30	39	16	.95	55	14	1.30	40	0	.95	57		1.33	40	43	.95	28	55.4	
63	56	17	1.30	40	13	1.00	56	0	1.33		57	1.00	55	42	1.33	41	40	1.00	27	54.3	
64	57	3	1.33	41	13	1.03	57	45	1.36	41	57	1.03	56	27	1.36	42	40	1.05	26	53.1	
65		48	1.36		42	15	1.10	57	29	1.40	42	59	1.10	57	11	1.40	43	43	1.10	25	51.8
66	58	32	1.40	43	21	1.15	58	12	1.40	44	5	1.15	54	1.43	1.43	44	49	1.15	24	50.5	
67	59	15	1.43	44	30	1.20	59	55	1.43	45	14	1.20	58	36	1.46	45	58	1.20	23	49.2	
68		57	1.43		45	42	1.27	59	37	1.46	46	26	1.27	59	17	1.50	47	10	1.27	22	47.8
69	60	39	1.50	46	58	1.33	60	18	1.50	47	42	1.33	57		1.54	48	26	1.32	21	46.3	
70		61	1.54		48	18	1.40		58	1.54	49	2	1.40	60	36	1.58	49	45	1.38	20	44.8
71	61	58	1.58	49	42	1.47	61	37	1.62	50	26	1.45	61	14	1.62	51	8	1.45	19	43.2	
72	62	36	1.62	51	10	1.53	62	14	1.62	51	53	1.53	51	1.67	1.67	52	35	1.53	18	41.6	
73	63	13	1.67	52	42	1.62	51	1.71	1.71	53	25	1.60	62	27	1.71	54	7	1.58	17	39.8	
74		49	1.76		54	19	1.70	63	26	1.82	55	1	1.68	63	2	1.82	55	42	1.65	16	38.0
75	64	23	1.82	56	1	1.77	59	1.82	1.82	56	42	1.75	64	35	1.88	57	21	1.73	15	36.2	
76		56	1.94		57	47	1.85	64	32	2.00	58	27	1.82	64	7	2.00	59	5	1.80	14	34.2
77	65	27	2.00	59	38	1.93	65	2	2.07	60	16	1.90		37	2.14	60	53	1.88	13	32.2	
78		57	2.14		61	34	2.00		31	2.22	62	10	1.98	65	5	2.22	62	46	1.95	12	30.1
79	66	25	2.40	63	34	2.10	58	2.40	2.40	64	9	2.07		32	2.50	64	43	2.02	11	27.9	
80		50	2.50		65	40	2.17	66	23	2.61	66	13	2.12	56	2.61	66	44	2.10	10	25.7	
81	67	14	2.73	67	50	2.23	46	2.73	2.73	68	20	2.20	66	19	2.86	68	50	2.17	9	23.4	
82		36	3.16		70	4	2.32	67	8	3.33	70	32	2.27	40	3.33	71	0	2.22	8	21.0	
83		55	3.53		72	23	2.38	26	3.53	72	48	2.33	58	3.75	73	13	2.28	7	18.5		
84	68	12	4.29	74	46	2.43	43	4.29	4.29	75	8	2.38	67	14	4.29	75	30	2.33	6	16.0	
85		26	5.00		77	12	2.50	57	5.00	77	31	2.43	28	5.45	77	50	2.37	5	13.4		
86		38	6.00		79	42	2.53	68	9	6.67	79	57	2.48	39	6.67	80	12	2.42	4	10.8	
87		48	8.57		82	14	2.57	18	8.57	82	26	2.50	48	8.57	82	37	2.45	3	8.1		
88		55	15.0		84	48	2.60	25	15.0	84	56	2.53	55	15.0	85	4	2.47	2	5.4		
89		59	60.0		87	24	2.60	29	60.0	87	28	2.53	59	60.0	87	32	2.47	1	2.7		
90	69	0		90	c			30		90	0		68	0		90	0		0	0.0	
t	a = 21° 0'				a = 21° 30'				a = 22° 0'				α								
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'									
	d = 21° 0'				d = 21° 30'				d = 22° 0'												



b	a = 22° 30'					a = 23° 0'					a = 23° 30'					c	a			
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t
0	0	0	1.09	22	30	0.00	0	0	1.09	23	0	0.00	0	0	1.09	23	30	0.00	90	90.0
1	0	55	1.07	30	.02	0	55	1.07	23	0	.02	0	55	1.09	30	.02	80	89.6		
2	1	51	1.09	31	.02	1	51	1.09	1	.02	1	50	1.09	31	.02	88	89.2			
3	2	46	1.07	32	.02	2	46	1.09	2	.02	2	45	1.09	32	.02	87	88.8			
4	3	42	1.09	33	.03	3	41	1.09	3	.03	3	40	1.09	33	.03	86	88.4			
5	4	37	1.07	35	0.03	4	36	1.09	5	0.03	4	35	1.09	35	0.03	85	88.0			
6	5	33	1.09	37	.03	5	31	1.09	7	.03	5	30	1.09	37	.03	84	87.6			
7	6	28	1.09	39	.05	6	26	1.07	9	.05	6	25	1.09	39	.05	83	87.3			
8	7	23	1.07	42	.05	7	22	1.09	12	.05	7	20	1.09	42	.07	82	86.9			
9	8	19	1.09	45	.07	8	17	1.09	15	.07	8	15	1.09	46	.05	81	86.5			
10	9	14	1.09	49	0.07	9	12	1.09	19	0.07	9	10	1.09	49	0.07	80	86.1			
11	10	9	1.09	53	.07	10	7	1.09	23	.07	10	5	1.09	53	.08	79	85.7			
12	11	4	1.07	57	.08	11	2	1.09	27	.08	11	0	1.11	58	.08	78	85.3			
13	12	0	1.09	23	2	.08	57	1.09	32	.10	12	54	1.09	24	3	.08	77	84.8		
14	13	55	1.09	7	1.10	12	52	1.09	38	.08	12	49	1.09	8	1.10	76	84.4			
15	13	50	1.09	13	0.10	13	47	1.09	43	0.10	13	44	1.09	14	0.10	75	84.0			
16	14	45	1.09	19	.10	14	42	1.09	49	.12	14	39	1.11	20	.12	74	83.6			
17	15	40	1.09	25	.12	15	37	1.09	56	.12	15	33	1.09	27	.12	73	83.2			
18	16	35	1.09	32	.12	16	32	1.11	24	3	.13	16	28	1.11	34	.13	72	82.8		
19	17	30	1.09	39	.13	17	26	1.09	11	.13	17	22	1.09	42	.13	71	82.3			
20	18	25	1.09	47	0.13	18	21	1.09	19	0.13	18	17	1.11	50	0.13	70	81.9			
21	19	20	1.09	55	.15	19	16	1.11	27	.15	19	11	1.09	58	.15	69	81.5			
22	20	15	1.09	24	4	.17	20	10	36	.15	20	6	1.11	25	7	.17	68	81.0		
23	21	10	1.11	14	.17	21	5	1.11	45	.17	21	0	1.11	17	.17	67	80.6			
24	22	4	1.09	24	.17	22	59	1.09	55	.18	22	54	1.11	27	.18	66	80.1			
25	25	59	1.09	34	0.18	22	54	1.11	25	6	0.18	22	48	1.11	38	0.18	65	79.7		
26	23	54	1.11	45	.18	23	48	1.11	17	.18	23	42	1.11	49	.20	64	79.2			
27	24	48	1.11	56	.20	24	42	1.11	28	.20	24	36	1.11	26	1	.20	63	78.7		
28	25	42	1.09	25	8	.22	25	36	40	.22	25	30	1.11	13	.22	62	78.3			
29	26	37	1.11	21	.22	26	30	1.11	53	.23	26	24	1.11	26	.23	61	77.8			
30	27	31	1.11	34	0.23	27	24	1.11	26	7	0.23	27	18	1.13	40	0.23	60	77.3		
31	28	25	1.11	48	.23	28	18	1.11	21	.23	28	11	1.11	54	.25	59	76.8			
32	29	19	1.11	26	2	.25	29	12	35	.27	29	5	1.13	27	9	.25	58	76.3		
33	30	13	1.11	17	.27	30	5	1.11	51	.27	30	58	1.13	24	.27	57	75.8			
34	31	7	1.13	33	.28	31	59	1.13	27	7	.28	30	51	1.13	40	.28	56	75.2		
35	32	0	1.11	50	0.28	31	52	1.13	24	0.28	31	44	1.13	57	0.30	55	74.7			
36	33	54	1.13	27	7	.30	32	45	41	.30	32	37	1.13	28	15	.32	54	74.2		
37	33	47	1.13	25	.32	33	38	1.13	59	.32	33	30	1.13	34	.32	53	73.6			
38	34	40	1.13	44	.33	34	31	1.13	28	18	.33	34	23	1.15	53	.35	52	73.0		
39	35	33	1.13	28	4	.33	35	24	38	.35	35	15	1.15	29	14	.35	51	72.4		
40	36	26	1.13	24	0.35	36	17	1.15	59	0.37	36	7	1.15	35	0.37	50	71.8			
41	37	19	1.15	45	.38	37	9	1.15	29	21	.38	59	1.15	57	.38	49	71.2			
42	38	11	1.15	29	8	.40	38	1	44	.40	37	51	1.15	30	20	.40	48	70.6		
43	39	3	1.15	32	.40	39	53	1.15	30	8	.42	38	43	1.18	44	.42	47	70.0		
44	40	55	1.15	56	.43	39	45	1.15	33	.43	39	34	1.15	31	9	.43	46	69.3		
45	40	47		30	22		40	37	59		40	26		35		45		68.7		

t	a = 22° 30'		a = 23° 0'		a = 23° 30'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 22° 30'		d = 23° 0'		d = 23° 30'		

b	a = 22° 30'				a = 23° 0'				a = 23° 30'				c	α									
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t			Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	C	β
45	40	47	1.15	30	22	0.43	40	37	1.18	30	59	0.45	40	26	1.18	31	35	0.47	45	68.7			
46	41	39	1.15	48	.47	41	28	1.18	31	26	.47	41	17	1.20	32	3	.47	44	68.0				
47	42	31	1.18	31	16	.48	42	19	1.18	54	.48	42	7	1.18	31	31	.50	43	67.3				
48	43	22	1.18	45	.52	43	10	1.20	32	23	.52	43	58	1.20	33	1	.52	42	66.5				
49	44	13	1.20	32	16	.53	44	0	1.20	54	.53	43	48	1.20	32	32	.55	41	65.8				
50	45	3	1.20	48	.55	50	1.20	33	26	.57	44	38	1.22	34	5	.57	40	65.0					
51	51	53	1.20	33	21	.58	45	40	1.20	34	0	.58	45	27	1.22	35	39	.58	39	64.2			
52	46	43	1.20	56	.60	46	30	1.22	35	35	.62	46	16	1.22	35	14	.62	38	63.4				
53	47	33	1.22	34	32	.63	47	19	1.22	35	12	.63	47	5	1.22	51	.65	37	62.6				
54	48	22	1.22	35	10	.67	48	8	1.25	50	.67	54	1.25	36	30	.67	36	61.7					
55	49	11	1.25	50	.70	56	1.25	36	30	.70	48	42	1.28	37	10	.70	35	60.8					
56	50	59	1.25	36	32	.72	49	44	1.25	37	12	.73	49	29	1.28	52	.73	34	59.9				
57	50	47	1.25	37	15	.77	50	32	1.28	56	.77	50	16	1.28	38	36	.77	33	59.0				
58	51	35	1.28	38	1	.78	51	19	1.28	38	42	.80	51	3	1.30	39	22	.80	32	58.0			
59	52	22	1.30	48	.83	52	6	1.30	39	30	.83	49	1.30	40	10	.85	31	57.0					
60	53	8	1.30	39	38	.88	52	1.33	40	20	.87	52	35	1.33	41	1	.87	30	55.9				
61	54	1.30	40	31	.90	53	37	1.33	41	12	.92	53	20	1.36	53	.92	29	54.8					
62	54	40	1.36	41	25	.97	54	22	1.36	42	7	.97	54	4	1.36	42	48	.97	28	53.7			
63	55	24	1.36	42	23	1.00	55	6	1.40	43	5	1.00	54	48	1.40	43	46	1.00	27	52.5			
64	56	8	1.40	43	23	1.05	49	1.40	44	5	1.05	55	31	1.43	44	46	1.05	26	51.3				
65	51	1.40	44	26	1.08	56	32	1.43	45	8	1.08	56	13	1.46	45	49	1.10	25	50.0				
66	57	34	1.43	45	31	1.15	57	14	1.46	46	13	1.15	54	1.46	46	55	1.13	24	48.7				
67	58	16	1.50	46	40	1.20	55	1.50	47	22	1.20	57	35	1.50	48	3	1.20	23	47.4				
68	56	1.50	47	52	1.27	58	35	1.50	48	34	1.27	58	15	1.58	49	15	1.25	22	46.0				
69	59	36	1.54	49	8	1.32	59	15	1.58	49	50	1.30	53	1.58	50	30	1.32	21	44.5				
70	60	15	1.62	50	27	1.38	53	1.62	51	8	1.38	59	31	1.62	51	49	1.37	20	43.0				
71	52	1.62	51	50	1.45	60	30	1.67	52	31	1.43	60	8	1.71	53	11	1.42	19	41.4				
72	61	29	1.71	53	17	1.50	61	6	1.71	53	57	1.50	43	1.76	54	36	1.48	18	39.7				
73	62	4	1.76	54	47	1.57	41	1.82	55	27	1.55	61	17	1.82	56	5	1.55	17	38.0				
74	38	1.82	56	21	1.65	62	14	1.88	57	0	1.63	50	1.94	57	38	1.60	16	36.3					
75	63	11	1.94	58	0	1.72	46	2.00	58	38	1.68	62	21	2.00	59	14	1.68	15	34.4				
76	42	2.07	59	43	1.78	63	16	2.07	60	19	1.77	51	2.14	60	55	1.73	14	32.5					
77	64	11	2.14	61	30	1.85	45	2.14	62	5	1.82	63	19	2.22	62	39	1.80	13	30.6				
78	39	2.31	63	21	1.92	64	13	2.40	63	54	1.90	46	2.40	64	27	1.85	12	28.5					
79	65	5	2.50	65	16	1.98	38	2.50	65	48	1.95	64	11	2.61	66	18	1.93	11	26.4				
80	29	2.73	67	15	2.07	65	2	2.86	67	45	2.02	34	2.73	68	14	1.98	10	24.3					
81	51	3.00	69	19	2.12	23	3.00	69	46	2.08	56	3.16	70	13	2.03	9	22.1						
82	66	11	3.33	71	26	2.17	43	3.33	71	51	2.13	65	15	3.53	72	15	2.10	8	19.8				
83	29	3.75	73	36	2.23	66	1	4.00	73	59	2.18	32	4.00	74	21	2.13	7	17.4					
84	45	4.29	75	50	2.28	16	4.62	76	10	2.23	47	4.62	76	29	2.18	6	15.1						
85	59	5.45	78	7	2.32	29	5.45	78	24	2.27	66	0	5.45	78	40	2.22	5	12.6					
86	67	10	6.67	80	26	2.37	40	6.67	80	40	2.30	11	7.50	80	53	2.25	4	10.1					
87	19	10.0	82	48	2.38	49	10.0	82	58	2.33	19	10.0	83	8	2.28	3	7.6						
88	25	15.0	85	11	2.40	55	15.0	85	18	2.35	25	15.0	85	25	2.28	2	5.1						
89	29	60.0	87	35	2.42	59	60.0	87	39	2.35	29	60.0	87	42	2.30	1	2.6						
90	30		90	0		67	0		90	0		30		90	0		0	0.0					
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a										
	d = 22° 30'				d = 23° 0'				d = 23° 30'				a										



B	a = 24° 0'					a = 24° 30'					a = 25° 0'					C	c	α
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t			
		Δ	60'		Δ		60'	Δ		60'		Δ	60'					
0	0	0	1.09	24	0	0	1.09	24	30	0.00	0	0	1.11	25	0	0.00	90	90.0
1		55	1.09		0	.02	55	1.11		30	.02	54	1.09		0	.02	89	89.6
2		1 50	1.11		1	.02	1 49	1.09		31	.02	1 49	1.11		1	.02	88	89.2
3		2 44	1.09		2	.02	2 44	1.11		32	.02	2 43	1.09		2	.02	87	88.8
4		3 39	1.09		3	.03	3 38	1.09		33	.03	3 38	1.11		3	.03	86	88.3
5		4 34	1.09		5	.03	4 33	1.11		35	.03	4 32	1.11		5	.03	85	87.9
6		5 29	1.09		7	.05	5 27	1.09		37	.05	5 26	1.11		7	.05	84	87.5
7		6 24	1.11		10	.05	6 22	1.09		40	.05	6 20	1.09		10	.05	83	87.1
8		7 18	1.09		13	.05	7 17	1.11		43	.05	7 15	1.11		13	.05	82	86.7
9		8 13	1.09		16	.07	8 11	1.11		46	.07	8 9	1.11		16	.07	81	86.2
10		9 8	1.11		20	.07	9 5	1.09		50	.07	9 3	1.11		20	.07	80	85.8
11		10 2	1.09		24	.07	10 0	1.11		54	.08	57	1.09		24	.08	79	85.4
12		57	1.09		28	.08	54	1.09		59	.08	10 52	1.11		29	.08	78	85.0
13		11 52	1.11		33	.10	11 49	1.11	25	4	.08	11 46	1.11		34	.10	77	84.5
14		12 46	1.09		39	.10	12 43	1.11		9	.10	12 40	1.11		40	.10	76	84.1
15		13 41	1.11		45	.10	13 37	1.09		15	.12	13 34	1.11		46	.12	75	83.7
16		14 35	1.11		51	.12	14 32	1.11		22	.12	14 28	1.11		53	.12	74	83.2
17		15 29	1.09		58	.12	15 26	1.11		29	.12	15 22	1.11	26	0	.12	73	82.8
18		16 24	1.11	25	5	.13	16 20	1.11		36	.13	16 16	1.11		7	.13	72	82.3
19		17 18	1.11		13	.13	17 14	1.11		44	.13	17 10	1.13		15	.13	71	81.9
20		18 12	1.09		21	.15	18 8	1.11		52	.15	18 3	1.11		23	.15	70	81.4
21		19 7	1.11		30	.15	19 2	1.11	26	1	.15	57	1.11		32	.17	69	81.0
22		20 1	1.11		39	.17	56	1.11		10	.17	19 51	1.13		42	.17	68	80.5
23		55	1.11		49	.17	20 50	1.13		20	.18	20 44	1.11		52	.18	67	80.0
24		21 49	1.11		59	.18	21 43	1.11		31	.18	21 38	1.13		27	.18	66	79.5
25		22 43	1.11	26	10	.18	22 37	1.11		42	.18	22 31	1.11		14	.18	65	79.1
26		23 37	1.13		21	.20	23 31	1.13		53	.20	23 25	1.13		25	.20	64	78.6
27		24 30	1.11		33	.22	24 24	1.13	27	5	.22	24 18	1.13		37	.22	63	78.1
28		25 24	1.13		46	.22	25 17	1.11		18	.22	25 11	1.13		50	.23	62	77.6
29		26 17	1.11		59	.23	26 11	1.13		31	.23	26 4	1.13	28	4	.23	61	77.1
30		27 11	1.13	27	13	.23	27 4	1.13		45	.25	57	1.13		18	.25	60	76.5
31		28 4	1.13		27	.25	57	1.13	28	0	.25	27 50	1.15		33	.25	59	76.0
32		57	1.13		42	.27	28 50	1.13		15	.27	28 42	1.13		48	.27	58	75.5
33		29 50	1.13		58	.27	29 43	1.15		31	.28	29 35	1.15	29	4	.28	57	74.9
34		30 43	1.13		28	.28	30 35	1.13		48	.28	30 27	1.15		21	.30	56	74.4
35		31 36	1.13		31	.30	31 28	1.15	29	5	.30	31 19	1.15		39	.32	55	73.8
36		32 29	1.15		49	.32	32 20	1.15		23	.33	32 11	1.15		58	.32	54	73.2
37		33 21	1.15	29	8	.33	33 12	1.15		43	.33	33 3	1.15	30	17	.33	53	72.6
38		34 13	1.15		28	.35	34 4	1.15	30	3	.35	55	1.15		37	.35	52	72.0
39		35 5	1.15		49	.35	56	1.15		24	.35	34 47	1.18		58	.37	51	71.4
40		57	1.15	30	10	.37	35 48	1.18		45	.37	35 38	1.18	31	20	.38	50	70.8
41		36 49	1.15		32	.40	36 39	1.18	31	7	.40	36 29	1.18		43	.40	49	70.2
42		37 41	1.18		56	.40	37 30	1.18		31	.42	37 20	1.18	32	7	.40	48	69.5
43		38 32	1.18		31	.42	38 21	1.18		56	.42	38 11	1.20		31	.43	47	68.9
44		39 23	1.18		45	.45	39 12	1.18	32	21	.45	39 1	1.20		57	.45	46	68.2
45		40 14			32	.45	40 3			48		51			33	.45	45	67.5

t	a = 24° 0'		a = 24° 30'		a = 25° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 24° 0'		d = 24° 30'		d = 25° 0'		

b	$a = 24^\circ 0'$					$a = 24^\circ 30'$					$a = 25^\circ 0'$					c	$\alpha$																		
	B	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z			$\frac{\Delta}{60'}$	C	$\beta$															
45	40	14	1.18	32	12	0.45	40	3	1.20	32	48	0.47	39	51	1.20	33	24	0.47	40	67.5															
46	41	5	1.20		39	.48	53	1.20	33	16	.48	40	41	1.20		52	.50	44	66.8																
47	55		1.20	33	8	.50	41	43	1.20		45	.50	41	31	1.22	34	22	.50	43	66.0															
48	42	45	1.20		38	.53	42	33	1.22	34	15	.53	42	20	1.22		52	.53	42	65.3															
49	43	35	1.20	34	10	.55	43	22	1.22		47	.55	43	9	1.22	35	24	.55	41	64.5															
50	44	25	1.22		43	0.57	44	11	1.22	35	20	0.58	58		1.22		57	0.58	40	63.7															
51	45	14	1.22	35	17	.60	45	0	1.22		55	.60	44	47	1.25	36	32	.60	39	62.9															
52	46	3	1.25		53	.62	49	1.25	36	31	.62	45	35	1.28		37	8	.63	38	62.0															
53	51		1.25	36	30	.65	46	37	1.25		37	.65	46	22	1.28		46	.67	37	61.2															
54	47	39	1.25	37	9	.67	47	25	1.28		47	.68	47	9	1.28	38	26	.68	36	60.3															
55	48	27	1.28		49	0.72	48	12	1.30	38	28	0.72	56	1.30	39	7	0.70	35	59.4																
56	49	14	1.28	38	32	.73	58	1.30	39	11	.73	48	42	1.30		49	.75	34	58.4																
57	50	1	1.30	39	16	.77	49	44	1.30		55	.78	49	28	1.30	40	34	.78	33	57.4															
58	47		1.30	40	2	.80	50	30	1.33	40	42	.80	50	14	1.33	41	21	.80	32	56.4															
59	51	33	1.33		50	.85	51	15	1.33	41	30	.85	59		1.36		42	0	.85	31	55.4														
60	52	18	1.36	41	41	0.88	52	0	1.36	42	21	0.88	51	43	1.40	43	0	0.88	30	54.3															
61	53	2	1.36	42	34	.92	53	44	1.40	43	14	.92	52	26	1.40		53	.92	29	53.2															
62	46		1.40	43	29	.97	53	27	1.40	44	9	.97	53	9	1.43	44	48	.97	28	52.0															
63	54	29	1.43	44	27	1.00	54	10	1.43	45	7	1.00	51	1.43	45	46	1.00	27	50.9																
64	55	11	1.43	45	27	1.05	54	52	1.46	46	7	1.05	54	33	1.50	46	46	1.05	26	49.6															
65	53		1.46	46	30	1.08	55	33	1.46	47	10	1.08	55	13	1.50	47	49	1.08	25	48.4															
66	56	34	1.50	47	35	1.15	56	14	1.54	48	15	1.15	53	1.54	48	54	1.13	24	47.0																
67	57	14	1.54	48	44	1.18	53	1.54	49	24	1.18	56	32	1.58		50	2	1.18	23	45.7															
68	53		1.58	49	55	1.25	57	32	1.62	50	35	1.23	57	10	1.62	51	13	1.23	22	44.3															
69	58	31	1.62	51	10	1.30	58	9	1.62	51	49	1.30	47	1.67	52	27	1.28	21	42.8																
70	59	8	1.67	52	28	1.35	46	1.67	53	7	1.35	58	23	1.71	53	44	1.35	20	41.3																
71	44		1.71	53	49	1.42	59	22	1.76	54	28	1.40	58	1.76	55	5	1.38	19	39.7																
72	60	19	1.76	55	14	1.47	56	1.82	55	52	1.45	59	32	1.82	56	28	1.45	18	38.1																
73	53		1.88	56	42	1.53	60	29	1.88	57	19	1.52	60	5	1.94	57	55	1.50	17	36.4															
74	61	25	1.94	58	14	1.60	61	1	2.00	58	50	1.57	36	2.00	59	25	1.55	16	34.7																
75	56		2.00	59	50	1.65	31	2.07	60	24	1.63	61	6	2.14	60	58	1.62	15	32.9																
76	62	26	2.14	61	29	1.72	62	0	2.22	62	2	1.70	34	2.22	62	35	1.67	14	31.0																
77	54		2.31	63	12	1.77	27	2.31	63	44	1.75	62	1	2.40	64	15	1.72	13	29.1																
78	63	20	2.50	64	58	1.83	53	2.50	65	29	1.80	26	2.50	65	58	1.78	12	27.1																	
79	44		2.61	66	48	1.90	63	17	2.73	67	17	1.87	50	2.73	67	45	1.83	11	25.1																
80	64	7	2.86	68	42	1.95	39	2.86	69	9	1.90	63	12	3.00	69	35	1.87	10	23.0																
81	28		3.16	70	39	2.00	64	0	3.33	71	3	1.97	32	3.33	71	27	1.93	9	20.9																
82	47		3.75	72	39	2.05	18	3.53	73	1	2.02	50	3.75	73	23	1.97	8	18.7																	
83	65	3	4.00	74	42	2.08	35	4.29	75	2	2.05	64	6	4.29	75	21	2.02	7	16.5																
84	18		4.62	76	47	2.13	49	4.62	77	5	2.08	20	5.00	77	22	2.05	6	14.2																	
85	31		6.00	78	55	2.18	65	2	6.00	79	10	2.13	32	6.00	79	25	2.08	5	11.9																
86	41		7.50	81	6	2.20	12	7.50	81	18	2.15	42	7.50	81	30	2.10	4	9.6																	
87	49		10.0	83	18	2.22	20	12.0	83	27	2.17	50	10.0	83	36	2.12	3	7.2																	
88	55		15.0	85	31	2.23	25	15.0	85	37	2.18	56	20.0	85	43	2.13	2	4.8																	
89	59		60.0	87	45	2.25	29	60.0	87	48	2.20	59	60.0	87	51	2.15	1	2.4																	
90	66	0		90	0		30		90	0		65	0		90	0		0	0.0																
t	$a = 24^\circ 0'$				$a = 24^\circ 30'$				$a = 25^\circ 0'$				a																						
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$																							
	$d = 24^\circ 0'$													$d = 24^\circ 30'$												$d = 25^\circ 0'$									



B	a = 25° 30'					a = 26° 0'					a = 26° 30'					C	c	α		
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t				C	β
		Δ	Δ		60'		60'	Δ		Δ		60'	60'		Δ					
0	0	0	1.11	25	30	0.00	0	0	1.11	26	0	0.00	0	0	1.11	26	30	0.00	90	90.0
1		54	1.11		30	.02		54	1.11		0	.02		54	1.13		30	.02	89	89.6
2	1	48	1.09		31	.02	1	48	1.11		1	.02	1	47	1.11		31	.02	88	89.1
3	2	43	1.11		32	.02	2	42	1.11		2	.02	2	41	1.11		32	.02	87	88.7
4	3	37	1.11		33	.03	3	36	1.11		3	.03	3	35	1.13		33	.03	86	88.2
5	4	31	1.11		35	.03	4	30	1.13		5	.03	4	28	1.11		35	.03	85	87.8
6	5	25	1.11		37	.05	5	23	1.11		7	.05	5	22	1.11		37	.05	84	87.4
7	6	19	1.11		40	.05	6	17	1.11		10	.05	6	16	1.13		40	.05	83	86.9
8	7	13	1.11		43	.07	7	11	1.11		13	.07	7	9	1.11		43	.07	82	86.5
9	8	7	1.11		47	.07	8	5	1.11		17	.07	8	3	1.13		47	.07	81	86.1
10	9	1	1.11		51	.07	9	59	1.11		21	.07	9	56	1.11		51	.08	80	85.6
11		55	1.11		55	.08		53	1.13		25	.08		50	1.13		56	.08	79	85.1
12	10	49	1.11	26	0	.08	10	46	1.11		30	.08	10	43	1.11	27	1	.08	78	84.7
13	11	43	1.11		5	.10	11	40	1.11		35	.10	11	37	1.13		6	.10	77	84.2
14	12	37	1.11		11	.10	12	34	1.13		41	.10	12	30	1.11		12	.10	76	83.8
15	13	31	1.13		17	.12	13	27	1.11		47	.12	13	24	1.13		18	.12	75	83.3
16	14	24	1.11		24	.12	14	21	1.13		54	.12	14	17	1.13		25	.12	74	82.8
17	15	18	1.11		31	.12	15	14	1.11	27	1	.13	15	10	1.13		32	.13	73	82.4
18	16	12	1.13		38	.13	16	8	1.13		9	.13	16	3	1.13		40	.13	72	81.9
19	17	5	1.11		46	.15	17	1	1.13		17	.15		56	1.13		48	.15	71	81.4
20		59	1.13		55	.15		54	1.13		26	.15	17	49	1.13		57	.15	70	80.9
21	18	52	1.11	27	4	.15	18	47	1.13		35	.17	18	42	1.13	28	6	.17	69	80.4
22	19	46	1.13		13	.17	19	40	1.13		45	.17	19	35	1.13		16	.17	68	80.0
23	20	39	1.13		23	.18	20	33	1.13		55	.18	20	28	1.13		26	.18	67	79.5
24	21	32	1.13		34	.18	21	26	1.13	28	6	.18	21	21	1.15		37	.20	66	79.0
25	22	25	1.13		45	.20	22	19	1.13		17	.20	22	13	1.13		49	.20	65	78.4
26	23	18	1.13		57	.22	23	12	1.13		29	.22	23	6	1.15	29	1	.22	64	77.9
27	24	11	1.13	28	10	.22	24	5	1.15		42	.22		58	1.13		14	.22	63	77.4
28	25	4	1.13		23	.23	23	57	1.13		55	.23	24	51	1.15		27	.23	62	76.9
29		57	1.13		37	.23	25	50	1.15	29	9	.23	25	43	1.15		41	.25	61	76.3
30	26	50	1.15		51	.25	26	42	1.15		23	.25	26	35	1.15		56	.25	60	75.8
31	27	42	1.13	29	6	.27	27	34	1.15		38	.27	27	27	1.15	30	11	.27	59	75.2
32	28	35	1.15		22	.27	28	26	1.15		54	.28	28	19	1.18		27	.28	58	74.7
33	29	27	1.15		38	.28	29	18	1.15	30	11	.28	29	10	1.15		44	.28	57	74.1
34	30	19	1.15		55	.30	30	10	1.15		28	.30	30	2	1.18	31	1	.32	56	73.5
35	31	11	1.15	30	13	.30	31	2	1.18		46	.32		53	1.18		20	.32	55	72.9
36	32	3	1.18		31	.33	32	53	1.15	31	5	.33	31	44	1.18		39	.33	54	72.3
37		54	1.18		51	.33	32	45	1.18		25	.33	32	35	1.18		59	.33	53	71.7
38	33	45	1.18	31	11	.35	33	36	1.18		45	.37	33	26	1.18	32	19	.37	52	71.1
39	34	36	1.18		32	.38	34	27	1.18	32	7	.37	34	17	1.20		41	.38	51	70.5
40	35	27	1.18		55	.38	35	18	1.20		29	.38	35	7	1.20	33	4	.38	50	69.8
41	36	18	1.18	32	18	.40	36	8	1.20		52	.42		57	1.20		27	.40	49	69.1
42	37	9	1.18		42	.42		58	1.20	33	17	.42	36	47	1.20		51	.43	48	68.5
43	38	0	1.20	33	7	.43	37	48	1.20		42	.43	37	37	1.22	34	17	.45	47	67.8
44		50	1.20		33	.45	38	38	1.20	34	8	.47	38	26	1.22		44	.45	46	67.1
45	39	40		34	0		39	28			36		39	15		35	11		45	66.3
t	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a	60'		
	d = 25° 30'	d = 26° 0'		d = 26° 30'																

b		a = 25° 30'				a = 26° 0'				a = 26° 30'				c	a					
		h	d	60'	Δ	Z	t	60'	Δ	Z	t	60'	Δ			Z	t	60'	Δ	
B															C	β				
45	39	40	1.22	34	0	0.47	39	28	1.22	34	36	0.47	39	15	1.22	35	11	0.48	45	66.3
46	40	29	1.22	28		.50	40	17	1.22	35	4	.50	40	4	1.22	36	40	.50	44	65.6
47	41	18	1.22	58		.52	41	6	1.22	34	52	.52	40	53	1.25	36	10	.52	43	64.8
48	42	7	1.22	35	29	.53	55		1.25	36	5	.53	41	41	1.25	41	41	.55	42	64.0
49		56	1.22	36	1	.57	42	43	1.25	37		.57	42	29	1.25	37	14	.57	41	63.2
50	43	45	1.25	35		0.58	43	31	1.28	37	11	0.58	43	17	1.28	38	48	0.58	40	62.4
51	44	33	1.28	37	10	.60	44	18	1.28	46		.62	44	4	1.28	38	23	.62	39	61.6
52	45	20	1.28	46		.63	45	5	1.28	38	23	.63	51		1.30	39	0	.63	38	60.7
53	46	7	1.28	38	24	.67	52		1.28	39	1	.67	45	37	1.30	38		.67	37	59.8
54		54	1.28	39	4	.68	46	39	1.30	41		.70	46	23	1.30	40	18	.70	36	58.9
55	47	41	1.30	45		0.72	47	25	1.33	40	23	0.72	47	9	1.33	41	0	0.72	35	58.0
56	48	27	1.33	40	28	.75	48	10	1.33	41	6	.75	54		1.36	42	43	.75	34	57.0
57	49	12	1.33	41	13	.77	55		1.33	51		.78	48	38	1.36	42	28	.78	33	56.0
58		57	1.36	51	59	.82	49	40	1.36	42	38	.80	49	22	1.36	43	15	.82	32	54.9
59	50	41	1.36	42	48	.85	50	24	1.40	43	26	.85	50	6	1.40	44	4	.85	31	53.9
60	51	25	1.40	43	39	0.88	51	7	1.43	44	17	0.88	49		1.43	55		0.88	30	52.8
61	52	8	1.43	44	32	.92	49		1.43	45	10	.93	51	31	1.46	45	48	.92	29	51.7
62		50	1.43	45	27	.97	52	31	1.43	46	6	.95	52	12	1.46	46	43	.97	28	50.5
63	53	32	1.46	46	25	1.00	53	13	1.50	47	3	1.00	53		1.50	47	41	1.00	27	49.3
64	54	13	1.50	47	25	1.05	53		1.50	48	3	1.03	53	33	1.54	48	41	1.03	26	48.1
65		53	1.50	48	28	1.08	54	33	1.54	49	5	1.08	54	12	1.58	49	43	1.08	25	46.8
66	55	33	1.58	49	33	1.13	55	12	1.58	50	10	1.13	50		1.58	50	48	1.12	24	45.4
67	56	11	1.58	50	41	1.17	50		1.62	51	18	1.17	55	28	1.67	51	55	1.17	23	44.1
68		49	1.67	51	51	1.23	56	27	1.67	52	28	1.23	56	4	1.67	53	5	1.22	22	42.7
69	57	25	1.67	53	5	1.27	57	3	1.71	53	42	1.27	40		1.71	54	18	1.25	21	41.2
70	58	1	1.76	54	21	1.33	38		1.76	54	58	1.32	57	15	1.82	55	33	1.30	20	39.7
71		35	1.82	55	41	1.38	58	12	1.88	56	17	1.37	48		1.88	56	51	1.37	19	38.1
72	59	8	1.88	57	4	1.43	44		1.88	57	39	1.42	58	20	1.94	58	13	1.40	18	36.5
73		40	1.94	58	30	1.48	59	16	2.00	59	4	1.47	51		2.00	59	37	1.45	17	34.9
74	60	11	2.07	59	59	1.53	46		2.07	60	32	1.52	59	21	2.14	61	4	1.50	16	33.2
75		40	2.14	61	31	1.58	60	15	2.22	62	3	1.57	49		2.22	62	34	1.55	15	31.4
76	61	8	2.22	63	6	1.65	42		2.31	63	37	1.62	60	16	2.40	64	7	1.60	14	29.6
77		35	2.50	64	45	1.70	61	8	2.50	65	14	1.68	41		2.50	65	43	1.65	13	27.8
78		59	2.61	66	27	1.75	32		2.61	66	55	1.72	61	5	2.61	67	22	1.70	12	25.9
79	62	22	2.73	68	12	1.80	55		2.86	68	38	1.77	28		3.00	69	4	1.73	11	23.9
80		44	3.00	70	0	1.85	62	16	3.16	70	24	1.82	48		3.16	70	48	1.78	10	21.9
81	63	4	3.53	71	51	1.88	35		3.33	72	13	1.85	62	7	3.53	72	35	1.82	9	19.9
82		21	3.75	73	44	1.93	53		4.00	74	4	1.90	24		4.00	74	24	1.87	8	17.8
83		37	4.29	75	40	1.97	63	8	4.29	75	58	1.93	39		4.29	76	16	1.90	7	15.6
84		51	5.00	77	38	2.02	22		5.45	77	54	1.97	53		5.45	78	10	1.92	6	13.5
85	64	3	6.00	79	39	2.03	33		6.00	79	52	2.00	63	4	6.67	80	5	1.95	5	11.3
86		13	8.57	81	41	2.05	43		8.57	81	52	2.02	13		8.57	82	2	1.97	4	9.1
87		20	10.0	83	44	2.08	50		10.0	83	53	2.03	20		10.0	84	0	2.00	3	6.8
88		26	20.0	85	49	2.08	56		20.0	85	55	2.03	26		20.0	86	0	2.00	2	4.6
89		29	60.0	87	54	2.10	59		60.0	87	57	2.05	29		60.0	88	0	2.00	1	2.3
90		30		90	0		64		0	90	0		30			90	0		0	0.0

t	a = 25° 30'		a = 26° 0'		a = 26° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 25° 30'		d = 26° 0'		d = 26° 30'		



b	a = 27° 0'				a = 27° 30'				a = 28° 0'				c	a					
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z			t	$\frac{\Delta}{60'}$	C	$\beta$	
0	0	0	1.13	27	0	0	0.00	0	0	1.13	27	0	0	0.00	0	90.0			
1	0	53	1.11	0	0	.02	53	1.13	30	.02	53	1.13	0	.02	89	89.5			
2	1	47	1.13	1	.02	1	46	1.11	31	.02	1	46	1.13	1	.02	88	89.1		
3	2	40	1.11	2	.02	2	40	1.13	32	.02	2	39	1.13	2	.02	87	88.6		
4	3	34	1.13	3	.03	3	33	1.13	33	.03	3	32	1.13	3	.03	86	88.2		
5	4	27	1.11	5	0.05	4	26	1.13	35	0.05	4	25	1.13	5	0.05	85	87.7		
6	5	21	1.13	8	.05	5	19	1.13	38	.05	5	18	1.13	8	.05	84	87.2		
7	6	14	1.13	11	.05	6	12	1.13	41	.05	6	11	1.13	11	.05	83	86.8		
8	7	7	1.11	14	.05	7	5	1.11	44	.07	7	4	1.15	14	.07	82	86.3		
9	8	1	1.13	17	.07	5	59	1.13	48	.07	5	56	1.13	18	.07	81	85.8		
10	54	1.13	21	0.08	8	52	1.13	52	0.07	8	49	1.13	22	0.08	80	85.3			
11	9	47	1.11	26	.08	9	45	1.13	56	.08	9	42	1.13	27	.08	79	84.9		
12	10	41	1.13	31	.08	10	38	1.13	28	1	.10	10	35	1.15	32	.08	78	84.4	
13	11	34	1.13	36	.10	11	31	1.15	7	.10	11	27	1.13	37	.10	77	83.9		
14	12	27	1.13	42	.12	12	23	1.13	13	.10	12	20	1.13	43	.12	76	83.4		
15	13	20	1.13	49	0.12	13	16	1.13	19	0.12	13	13	1.15	50	0.12	75	82.9		
16	14	13	1.13	56	.12	14	9	1.13	26	.13	14	5	1.13	57	.12	74	82.5		
17	15	6	1.13	28	3	.13	15	2	1.13	34	.13	5	58	1.15	29	4	.13	73	82.0
18	15	59	1.13	11	.13	5	55	1.15	42	.13	15	50	1.15	12	.15	72	81.5		
19	16	52	1.13	19	.15	16	47	1.13	50	.15	16	42	1.13	21	.15	71	81.0		
20	17	45	1.15	28	0.15	17	40	1.15	59	0.17	17	35	1.15	30	0.17	70	80.5		
21	18	37	1.13	37	.17	18	32	1.15	29	9	.17	18	27	1.15	40	.17	69	79.9	
22	19	30	1.15	47	.18	19	24	1.13	19	.18	19	19	1.15	50	.18	68	79.4		
23	20	22	1.13	58	.18	20	17	1.15	30	.18	20	11	1.15	30	1	.18	67	78.9	
24	21	15	1.15	29	9	.20	21	9	1.15	41	.20	21	3	1.15	30	12	.20	66	78.4
25	22	7	1.13	21	0.20	22	1	1.15	53	0.20	5	55	1.18	24	0.22	65	77.8		
26	23	0	1.15	33	.22	23	53	1.15	30	5	.22	22	46	1.15	37	.22	64	77.3	
27	27	52	1.15	46	.22	23	45	1.15	18	.23	23	38	1.18	50	.22	63	76.8		
28	24	44	1.15	59	.23	24	37	1.18	32	.23	24	29	1.15	31	3	.25	62	76.2	
29	25	36	1.18	30	13	.25	25	28	1.15	46	.25	25	21	1.18	18	.25	61	75.6	
30	26	27	1.15	28	0.27	26	20	1.18	31	1	0.25	26	12	1.18	33	0.27	60	75.1	
31	27	19	1.15	44	.27	27	11	1.18	16	.28	27	3	1.18	49	.27	59	74.5		
32	28	11	1.18	31	0	.28	28	2	1.18	33	.28	5	54	1.18	32	5	.28	58	73.9
33	29	2	1.18	17	.30	29	53	1.18	50	.30	28	45	1.20	22	.30	57	73.3		
34	53	1.18	35	.30	29	44	1.18	32	8	.30	29	35	1.18	40	.32	56	72.7		
35	30	44	1.18	53	0.32	30	35	1.18	26	0.33	30	26	1.20	59	0.33	55	72.1		
36	31	35	1.18	32	12	.33	31	26	1.20	46	.33	31	16	1.20	33	19	.33	54	71.5
37	32	26	1.20	32	.35	32	16	1.20	33	6	.35	32	6	1.20	39	.37	53	70.8	
38	33	16	1.20	53	.37	33	6	1.20	27	.37	37	56	1.20	34	1	.37	52	70.2	
39	34	6	1.20	33	15	.38	56	1.20	49	.38	33	46	1.22	23	.38	51	69.5		
40	56	1.20	38	0.38	34	46	1.22	34	12	0.40	34	35	1.22	46	0.40	50	68.8		
41	35	46	1.20	34	1	.42	35	35	1.22	36	.42	35	24	1.22	35	10	.42	49	68.1
42	36	36	1.20	26	.43	36	24	1.22	35	1	.43	36	13	1.22	35	.43	48	67.4	
43	37	25	1.22	52	.45	37	13	1.22	27	.45	37	2	1.25	36	1	.45	47	66.7	
44	38	14	1.22	35	19	.47	38	2	1.22	54	.47	50	1.25	28	.48	46	66.0		
45	39	3	1.22	47	51	36	22	1.22	38	38	57	45	65.2						

t	a = 27° 0'		a = 27° 30'		a = 28° 0'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 27° 0'		d = 27° 30'		d = 28° 0'		

b	a = 27° 0'				a = 27° 30'				a = 28° 0'				c	a					
	B	d	60' / Δ	t	Δ / 60'	h	d	60' / Δ	t	Δ / 60'	h	d			60' / Δ	t	Δ / 60'	C	β
		h	Z	Z	Z		Z	Z	Z	Z		Z			Z				
45	39 3	1.22	35 47	0.48	38 51	1.25	36 22	0.48	38 38	1.25	36 57	0.48	45	65.2					
46	52	1.25	36 16	.50	39 39	1.25	51	.50	39 26	1.28	37 26	.50	44	64.4					
47	40 40	1.25	46	.52	40 27	1.28	37 21	.53	40 13	1.28	56	.53	43	63.7					
48	41 28	1.28	37 17	.55	41 14	1.28	53	.55	41 0	1.28	38 28	.55	42	62.9					
49	42 15	1.28	50	.57	42 1	1.28	38 26	.57	47	1.28	39 1	.58	41	62.0					
50	43 2	1.28	38 24	0.60	48	1.28	39 0	0.60	42 34	1.30	40 36	0.60	40	61.2					
51	49	1.28	39 0	.62	43 35	1.30	36	.62	43 20	1.33	40 12	.62	39	60.3					
52	44 36	1.33	37	.63	44 21	1.33	40 13	.65	44 5	1.33	40	.65	38	59.4					
53	45 22	1.33	40 15	.67	45 6	1.33	52	.67	50	1.33	41 28	.67	37	58.5					
54	46 7	1.33	55	.70	51	1.33	41 32	.70	45 35	1.36	42 8	.70	36	57.6					
55	52	1.33	41 37	0.72	46 36	1.36	42 14	0.72	46 19	1.36	50	0.73	35	56.6					
56	47 37	1.36	42 20	.75	47 20	1.36	57	.75	47 3	1.40	43 34	.75	34	55.6					
57	48 21	1.36	43 5	.78	48 4	1.40	43 42	.78	46 4	1.40	44 19	.78	33	54.6					
58	49 5	1.40	52	.82	47	1.43	44 29	.82	48 29	1.43	45 6	.82	32	53.5					
59	48	1.43	44 41	.85	49 29	1.43	45 18	.85	49 11	1.46	55	.85	31	52.5					
60	50 30	1.43	45 32	0.88	50 11	1.46	45 9	0.88	52	1.46	46 46	0.87	30	51.3					
61	51 12	1.46	46 25	.93	52	1.46	47 2	.92	50 33	1.50	47 38	.92	29	50.2					
62	53	1.50	47 21	.95	51 33	1.50	57	.95	51 13	1.50	48 33	.95	28	49.0					
63	52 33	1.50	48 18	1.00	52 13	1.54	48 54	1.00	53	1.58	49 30	1.00	27	47.8					
64	53 13	1.58	49 18	1.03	52	1.58	49 54	1.03	52 31	1.58	50 30	1.02	26	46.6					
65	51	1.58	50 20	1.07	53 30	1.58	50 56	1.07	53 9	1.62	51 31	1.07	25	45.3					
66	54 29	1.62	51 24	1.12	54 8	1.67	52 0	1.12	46	1.67	52 35	1.10	24	44.0					
67	55 6	1.67	52 31	1.17	44	1.67	53 7	1.15	54 22	1.71	53 41	1.15	23	42.6					
68	42	1.71	53 41	1.20	55 20	1.76	54 16	1.18	57	1.76	54 50	1.18	22	41.2					
69	56 17	1.76	54 53	1.25	54	1.76	55 27	1.25	55 31	1.82	56 1	1.23	21	39.7					
70	51	1.82	56 8	1.28	56 28	1.88	56 42	1.28	56 4	1.88	57 15	1.27	20	38.2					
71	57 24	1.88	57 25	1.35	57 0	1.94	57 59	1.32	36	1.94	58 31	1.32	19	36.7					
72	56	2.00	58 46	1.38	31	2.00	59 18	1.38	57 7	2.07	59 50	1.37	18	35.1					
73	58 26	2.07	60 9	1.43	58 1	2.07	60 41	1.42	36	2.14	61 12	1.40	17	33.5					
74	55	2.14	61 35	1.48	30	2.22	62 6	1.47	58 4	2.22	62 36	1.45	16	31.8					
75	59 23	2.22	63 4	1.53	57	2.31	63 34	1.52	31	2.31	64 3	1.48	15	30.1					
76	50	2.40	64 36	1.58	59 23	2.40	65 5	1.55	57	2.50	65 32	1.53	14	28.4					
77	60 15	2.61	66 11	1.62	48	2.61	66 38	1.60	59 21	2.61	67 4	1.58	13	26.6					
78	38	2.73	67 48	1.67	60 11	2.86	68 14	1.63	44	2.86	68 39	1.62	12	24.7					
79	61 0	3.00	69 28	1.72	32	3.00	69 52	1.68	60 5	3.16	70 16	1.65	11	22.8					
80	20	3.16	71 11	1.75	52	3.33	71 33	1.72	24	3.33	71 55	1.68	10	20.9					
81	39	3.53	72 56	1.78	61 10	3.53	73 16	1.77	42	3.75	73 36	1.73	9	18.9					
82	56	4.29	74 43	1.83	27	4.29	75 2	1.80	58	4.29	75 20	1.77	8	16.9					
83	62 10	4.62	76 33	1.85	41	4.62	76 50	1.82	61 12	4.62	77 6	1.77	7	14.9					
84	23	5.00	78 24	1.90	54	5.45	78 39	1.85	25	5.45	78 53	1.82	6	12.8					
85	35	6.67	80 18	1.90	62 5	6.67	80 30	1.87	36	7.50	80 42	1.83	5	10.7					
86	44	8.57	82 12	1.93	14	8.57	82 22	1.90	44	8.57	82 32	1.85	4	8.6					
87	51	12.0	84 8	1.95	21	12.0	84 16	1.90	51	12.0	84 23	1.87	3	6.5					
88	56	20.0	86 5	1.95	26	20.0	86 10	1.92	56	20.0	86 15	1.87	2	4.3					
89	59	60.0	88 2	1.97	29	60.0	88 5	1.92	59	60.0	88 7	1.88	1	2.2					
90	63 0		90 0		30		90 0		62 0		90 0		0	0.0					

t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'
		d = 27° 0'				d = 27° 30'				d = 28° 0'		



B	$a = 28^\circ 30'$				$a = 29^\circ 0'$				$a = 29^\circ 30'$				C	$\beta$						
	$d$		$t$	$\frac{\Delta}{60'}$	$d$		$t$	$\frac{\Delta}{60'}$	$d$		$t$	$\frac{\Delta}{60'}$								
	$h$	$\frac{60'}{\Delta}$			$h$	$\frac{60'}{\Delta}$			$h$	$\frac{60'}{\Delta}$										
0	0	0	1.13	28	30	0.00	0	0	1.15	29	0	0.00	0	0	1.15	29	30	0.00	90	90.0
1	0	53	1.13	30	.02	52	1.13	0	.02	52	1.15	30	.02	89	89.5					
2	1	46	1.15	31	.02	1	45	1.15	1	.02	1	44	1.13	31	.02	88	89.0			
3	2	38	1.13	32	.03	2	37	1.13	2	.03	2	37	1.15	32	.03	87	88.5			
4	3	31	1.13	34	.03	3	30	1.15	4	.03	3	29	1.15	34	.03	86	88.1			
5	4	24	1.15	36	.03	4	22	1.13	6	.03	4	21	1.15	36	.03	85	87.6			
6	5	16	1.13	38	.05	5	15	1.15	8	.05	5	13	1.15	38	.05	84	87.1			
7	6	9	1.13	41	.05	6	7	1.15	11	.05	6	5	1.15	41	.05	83	86.6			
8	7	2	1.15	44	.07	59	1.13	14	.07	57	1.15	44	.07	82	.07	82	86.1			
9	54	1.13	48	.07	7	52	1.15	18	.07	7	49	1.15	48	.08	81	85.6				
10	8	47	1.15	52	.08	8	44	1.15	22	.08	8	41	1.15	53	.08	80	85.1			
11	9	39	1.13	57	.08	9	36	1.13	27	.08	9	33	1.15	58	.08	79	84.6			
12	10	32	1.15	29	2	10	29	1.15	32	.10	10	25	1.15	30	3	.10	78	84.1		
13	11	24	1.13	8	.10	11	21	1.15	38	.10	11	17	1.15	9	.10	77	83.6			
14	12	17	1.15	14	.12	12	13	1.15	44	.12	12	9	1.15	15	.12	76	83.1			
15	13	9	1.15	21	.12	13	5	1.15	51	.12	13	1	1.15	22	.12	75	82.6			
16	14	1	1.15	28	.12	14	57	1.15	58	.13	14	53	1.15	29	.13	74	82.1			
17	53	1.15	35	.13	14	49	1.15	30	6	.13	14	45	1.18	37	.13	73	81.6			
18	15	45	1.15	43	.15	15	41	1.15	14	.15	15	36	1.15	45	.15	72	81.0			
19	16	37	1.15	52	.15	16	33	1.18	23	.15	16	28	1.18	54	.15	71	80.5			
20	17	29	1.15	30	1	17	24	1.15	32	.17	17	19	1.15	31	3	.17	70	80.0		
21	18	21	1.15	11	.17	18	16	1.15	42	.17	18	11	1.18	13	.18	69	79.5			
22	19	13	1.15	21	.18	19	8	1.18	52	.18	19	2	1.18	24	.18	68	78.9			
23	20	5	1.15	32	.20	20	59	1.18	31	3	.20	53	1.18	35	.18	67	78.4			
24	57	1.18	44	.20	20	50	1.18	31	15	.20	20	44	1.18	46	.20	66	77.8			
25	21	48	1.15	56	.20	21	41	1.18	27	.22	21	35	1.18	58	.22	65	77.3			
26	22	40	1.18	31	8	.22	22	32	1.18	40	.22	22	26	1.20	32	11	.23	64	76.7	
27	23	31	1.18	21	.23	23	23	1.18	53	.23	23	16	1.20	25	.23	63	76.1			
28	24	22	1.18	35	.25	24	14	1.18	32	7	.25	24	7	1.20	39	.25	62	75.5		
29	25	13	1.18	50	.25	25	5	1.18	32	22	.25	57	1.18	54	.27	61	75.0			
30	26	4	1.18	32	5	.27	56	1.18	37	.27	25	48	1.20	33	10	.27	60	74.4		
31	55	1.20	21	.28	26	47	1.20	53	.28	26	38	1.20	26	.28	59	73.8				
32	27	45	1.18	38	.28	27	37	1.20	33	10	.30	27	28	1.20	43	.28	58	73.1		
33	28	36	1.20	55	.30	28	27	1.20	28	.30	28	18	1.22	34	0	.32	57	72.5		
34	29	26	1.20	33	13	.32	29	17	1.20	46	.32	29	7	1.20	34	19	.32	56	71.9	
35	30	16	1.20	32	.33	30	7	1.22	34	5	.33	57	1.22	38	.33	55	71.3			
36	31	6	1.20	52	.35	56	1.20	25	.35	30	46	1.22	58	.35	54	70.6				
37	56	1.22	34	13	.35	31	46	1.22	46	.35	31	35	1.22	35	19	.37	53	69.9		
38	32	45	1.22	34	.38	32	35	1.22	35	7	.38	32	24	1.22	41	.37	52	69.3		
39	33	34	1.22	57	.38	33	24	1.22	30	.38	33	13	1.25	36	3	.40	51	68.6		
40	34	23	1.22	35	20	.40	34	13	1.25	53	.42	34	1	1.25	27	.40	50	67.9		
41	35	12	1.22	44	.42	35	1	1.25	36	18	.42	49	1.25	51	.43	49	67.1			
42	36	1	1.25	36	9	.45	49	1.25	35	43	.45	35	37	1.25	37	17	.45	48	66.4	
43	49	1.25	36	.45	36	37	1.25	37	10	.45	36	25	1.28	44	.45	47	65.7			
44	37	37	1.25	37	3	.47	37	25	1.28	37	.47	37	12	1.28	38	11	.48	46	64.9	
45	38	25		31		38	12		38	5		59		40		45		64.1		

t	$a = 28^\circ 30'$		$a = 29^\circ 0'$		$a = 29^\circ 30'$		a
	$a$	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 28^\circ 30'$		$d = 29^\circ 0'$		$d = 29^\circ 30'$		

B	a = 28° 30'					a = 29° 0'					a = 29° 30'					C	a			
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t					
		$\Delta$	$\Delta$	$\Delta$	$\Delta$		$\Delta$	$\Delta$	$\Delta$	$\Delta$		$\Delta$	$\Delta$	$\Delta$	$\Delta$			$\Delta$	$\Delta$	
45	38	25	1.25	37	31	0.50	38	12	1.28	38	5	0.50	37	59	1.28	38	40	0.50	45	64.1
46	39	13	1.28	38	1	.50	38	59	1.28	38	35	.52	38	46	1.30	39	10	.52	44	63.3
47	40	0	1.28	39	31	.53	39	46	1.30	39	6	.53	39	32	1.30	40	41	.53	43	62.5
48	47		1.30	39	3	.57	40	32	1.30	38	55	.40	18	1.30	40	13	.55	42	61.7	
49	41	33	1.30	37	57	.57	41	18	1.30	40	11	.58	41	4	1.33	46	.58	41	60.9	
50	42	19	1.30	40	11	0.60	42	4	1.33	46	0.60	49	1.33	41	21	0.60	40	60.0		
51	43	5	1.33	47	.62	49	1.33	41	22	.63	42	34	1.36	42	57	.63	39	59.1		
52	50		1.33	41	24	.77	43	34	1.36	42	0	.65	43	18	1.36	42	35	.65	38	58.2
53	44	35	1.36	42	3	.68	44	18	1.36	39	.67	44	2	1.36	43	14	.67	37	57.2	
54	45	19	1.36	44	.70	45	2	1.36	43	19	.70	46	1.40	54	.70	36	56.3			
55	46	3	1.40	43	26	0.72	46	1.40	44	1	0.73	45	29	1.43	44	36	0.73	35	55.3	
56	46	46	1.40	44	9	.77	46	29	1.43	45	.75	46	11	1.43	45	20	.75	34	54.3	
57	47	29	1.43	55	.78	47	11	1.43	45	30	.78	53	1.46	46	5	.78	33	53.3		
58	48	11	1.43	45	42	.82	53	1.46	46	17	.82	47	34	1.46	52	.82	32	52.2		
59	53		1.46	46	31	.85	48	34	1.50	47	6	.85	48	15	1.50	47	41	.85	31	51.1
60	49	34	1.50	47	22	0.87	49	14	1.50	57	0.88	55	1.54	48	32	0.88	30	50.0		
61	50	14	1.54	48	14	.92	54	1.54	48	50	.90	49	34	1.54	49	25	.90	29	48.8	
62	53		1.54	49	9	.95	50	33	1.54	49	44	.95	50	13	1.58	50	19	.93	28	47.6
63	51	32	1.58	50	6	.98	51	12	1.62	50	41	.98	51	1.62	51	15	.98	27	46.4	
64	52	10	1.58	51	5	1.02	49	1.62	51	40	1.02	51	28	1.67	52	14	1.00	26	45.2	
65	48		1.67	52	6	1.07	52	26	1.67	52	41	1.05	52	4	1.67	53	14	1.05	25	43.9
66	53	24	1.71	53	10	1.10	53	2	1.71	53	44	1.08	40	1.76	54	17	1.08	24	42.6	
67	59		1.71	54	16	1.13	37	1.76	54	49	1.13	53	14	1.76	55	22	1.12	23	41.2	
68	54	34	1.76	55	24	1.18	54	11	1.82	55	57	1.17	48	1.82	56	29	1.17	22	39.8	
69	55	8	1.88	56	35	1.22	44	1.88	57	7	1.20	54	21	1.94	57	39	1.20	21	38.4	
70	40		1.88	57	48	1.25	55	16	1.94	58	19	1.25	52	1.94	58	51	1.23	20	36.9	
71	56	12	2.00	59	3	1.30	47	2.00	59	34	1.30	55	23	2.07	60	5	1.27	19	35.4	
72	42		2.07	60	21	1.35	56	17	2.07	60	52	1.33	52	2.14	61	21	1.32	18	33.8	
73	57	11	2.14	61	42	1.38	46	2.22	62	12	1.37	56	20	2.22	62	40	1.37	17	32.2	
74	39		2.31	63	5	1.43	57	13	2.31	63	34	1.40	47	2.31	64	2	1.38	16	30.6	
75	58	5	2.40	64	31	1.47	39	2.40	64	58	1.45	57	13	2.50	65	25	1.43	15	28.9	
76	30		2.50	65	59	1.50	58	4	2.61	66	25	1.48	37	2.61	66	51	1.47	14	27.2	
77	54		2.73	67	29	1.55	27	2.73	67	54	1.53	58	0	2.86	68	19	1.50	13	25.5	
78	59	16	2.86	69	2	1.60	49	3.00	69	26	1.57	21	3.00	69	49	1.55	12	23.7		
79	37		3.16	70	38	1.63	59	9	3.16	71	0	1.60	41	3.16	71	22	1.57	11	21.8	
80	56		3.33	72	16	1.67	28	3.53	72	36	1.63	59	0	3.53	72	56	1.62	10	20.0	
81	60	14	4.00	73	56	1.68	45	4.00	74	14	1.67	17	4.00	74	33	1.63	9	18.1		
82	29		4.29	75	37	1.73	60	0	4.29	75	54	1.70	32	4.62	76	11	1.67	8	16.2	
83	43		4.62	77	21	1.75	14	5.00	77	36	1.72	45	5.00	77	51	1.68	7	14.2		
84	56		6.00	79	6	1.78	26	6.00	79	19	1.75	57	6.00	79	32	1.70	6	12.2		
85	61	6	6.67	80	53	1.80	36	6.67	81	4	1.77	60	7	7.50	81	14	1.73	5	10.2	
86	15		10.0	82	41	1.82	45	10.0	82	50	1.77	15	8.57	82	58	1.75	4	8.2		
87	21		12.0	84	30	1.82	51	12.0	84	36	1.80	22	15.0	84	43	1.75	3	6.2		
88	26		20.0	86	19	1.83	56	20.0	86	24	1.80	26	20.0	86	28	1.77	2	4.1		
89	29		60.0	88	9	1.85	59	60.0	88	12	1.80	29	60.0	88	14	1.77	1	2.1		
90	30			90	0		61	0		90	0		30		90	0		0	0.0	

t	a = 28° 30'		a = 29° 0'		a = 29° 30'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 28° 30'		d = 29° 0'		d = 29° 30'		



B	a = 30° 0'					a = 30° 30'					a = 31° 0'					C	c	a	β
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t				
0	0	0	1.15	30	0	0	0	1.15	30	0	0	0	1.18	31	0	0.00	90	90.0	
1		52	1.15		0	.02	52	1.18		30	.02	51	1.15		0	.02	89	89.5	
2	1	44	1.15		1	.02	1 43	1.15		31	.02	1 43	1.18		1	.02	88	89.0	
3	2	36	1.15		2	.03	2 35	1.15		32	.03	2 34	1.15		2	.03	87	88.5	
4	3	28	1.15		4	.03	3 27	1.18		34	.03	3 26	1.18		4	.03	86	88.0	
5	4	20	1.15		6	.03	4 18	1.15		36	.03	4 17	1.18		6	.03	85	87.5	
6	5	12	1.15		8	.05	5 10	1.15		38	.05	5 8	1.15		8	.05	84	86.9	
7	6	4	1.18		11	.07	6 2	1.18		41	.07	6 0	1.18		11	.07	83	86.4	
8		55	1.15		15	.07	53	1.15		45	.07	51	1.15		15	.07	82	85.9	
9	7	47	1.15		19	.07	7 45	1.18		49	.07	7 43	1.18		19	.07	81	85.4	
10	8	39	1.15		23	.08	8 36	1.15		53	.08	8 34	1.18		23	.08	80	84.9	
11	9	31	1.18		28	.08	9 28	1.18		58	.08	9 25	1.18		28	.10	79	84.4	
12	10	22	1.15		33	.10	10 19	1.15	31	3	.10	10 16	1.18		34	.10	78	83.8	
13	11	14	1.15		39	.10	11 11	1.18		9	.12	11 7	1.18		40	.10	77	83.3	
14	12	6	1.18		45	.12	12 2	1.18		16	.12	58	1.18		46	.12	76	82.8	
15		57	1.15		52	.12	53	1.18		23	.12	12 49	1.18		53	.13	75	82.3	
16	13	49	1.18		59	.13	13 44	1.18		30	.13	13 40	1.18		32	1	.13	74	81.7
17	14	40	1.18	31	7	.15	14 35	1.18		38	.13	14 31	1.18		9	.13	73	81.2	
18	15	31	1.15		16	.15	15 26	1.18		46	.15	15 22	1.20		17	.15	72	80.6	
19	16	23	1.18		25	.15	16 17	1.18		55	.17	16 12	1.18		26	.17	71	80.1	
20	17	14	1.18		34	.17	17 8	1.18		32	5	.17	17 3	1.20	36	.17	70	79.5	
21	18	5	1.18		44	.18	59	1.18		15	.18	15	1.18		46	.18	69	79.0	
22		56	1.18		55	.18	18 50	1.18		26	.18	18 44	1.20		57	.18	68	78.4	
23	19	47	1.20		6	.20	19 41	1.20		37	.20	19 34	1.20		8	.20	67	77.8	
24	20	37	1.18	32	18	.20	20 31	1.20		49	.20	20 24	1.20		20	.22	66	77.3	
25	21	28	1.18		30	.22	21 21	1.20		33	1	.22	21 14	1.20	33	.22	65	76.7	
26	22	19	1.20		43	.23	22 11	1.20		14	.23	22 4	1.20		46	.23	64	76.1	
27	23	9	1.20		57	.23	23 1	1.20		28	.23	54	1.20		10	.23	63	75.5	
28	24	59	1.20	33	11	.25	51	1.20		42	.25	23 44	1.22	34	14	.25	62	74.9	
29	24	49	1.20		26	.25	24 41	1.20		57	.27	24 33	1.20		29	.27	61	74.3	
30	25	39	1.20		41	.28	25 31	1.20		34	13	.28	25 23	1.22	45	.28	60	73.7	
31	26	29	1.20		58	.28	26 21	1.22		30	.28	26 12	1.22		35	2	.28	59	73.0
32	27	19	1.20	34	15	.30	27 10	1.22		47	.30	27 1	1.22		19	.30	58	72.4	
33	28	9	1.22		33	.30	59	1.22		35	5	.32	50	1.22	37	.32	57	71.8	
34		58	1.22		51	.33	28 48	1.22		24	.32	28 39	1.25		56	.33	56	71.1	
35	29	47	1.22	35	11	.33	29 37	1.22		43	.35	29 27	1.25		36	16	.33	55	70.4
36	30	36	1.22		31	.35	30 26	1.25		36	4	.35	30 15	1.25	36	.35	54	69.8	
37	31	25	1.25		52	.37	31 14	1.25		25	.37	31 3	1.25		57	.38	53	69.1	
38	32	13	1.25	36	14	.38	32 2	1.25		47	.38	51	1.25		37	20	.38	52	68.4
39	33	1	1.25		37	.38	50	1.25		37	10	.40	32 39	1.28	43	.40	51	67.7	
40		49	1.25	37	0	.42	33 38	1.28		34	.40	33 26	1.28		38	7	.40	50	66.9
41	34	37	1.25		25	.43	34 25	1.28		58	.43	34 13	1.28		31	.43	49	66.2	
42	35	25	1.28		51	.43	35 12	1.28		38	24	.45	35 0	1.30	57	.45	48	65.4	
43	36	12	1.28	38	17	.47	57	1.28		51	.47	46	1.28		39	24	.47	47	64.7
44		59	1.28		45	.48	36 46	1.30		39	19	.48	36 33	1.30	52	.48	46	63.9	
45	37	46		39	14		37 32			48		37 19			40	21		45	63.1
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a						
	d = 30° 0'				d = 30° 30'				d = 31° 0'				a						

B	$a = 30^\circ 0'$				$a = 30^\circ 30'$				$a = 31^\circ 0'$				C	$\beta$
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		
		d		t		d		t		d		t		
45	37 46	1.30	39 14	0.50	37 32	1.30	39 48	0.50	37 19	1.33	40 21	0.52	45	63.1
46	38 32	1.30	40 44	.52	38 18	1.30	40 18	.52	38 4	1.33	41 23	.52	44	62.3
47	39 18	1.30	41 15	.53	39 4	1.33	41 49	.53	39 19	1.33	42 23	.53	43	61.4
48	40 4	1.33	42 47	.57	40 49	1.33	42 55	.57	40 34	1.33	43 55	.57	42	60.6
49	41 49	1.33	44 21	.58	42 34	1.36	44 55	.58	42 19	1.36	45 29	.58	41	59.7
50	42 34	1.36	45 56	0.60	43 18	1.36	45 30	0.60	43 4	1.40	46 40	0.60	40	58.8
51	43 18	1.36	47 32	.63	44 2	1.36	46 6	.63	44 46	1.40	47 40	.63	39	57.9
52	44 3	1.36	49 10	.65	45 46	1.40	47 44	.65	45 29	1.40	48 58	.65	38	57.0
53	45 46	1.40	50 49	.67	46 43	1.40	48 23	.68	46 43	1.43	49 57	.68	37	56.0
54	47 29	1.43	52 29	.70	47 44	1.43	49 4	.70	47 54	1.43	51 38	.70	36	55.1
55	48 11	1.43	54 11	0.73	48 54	1.46	50 46	0.73	48 44	1.46	52 20	0.73	35	54.1
56	49 53	1.43	55 55	.75	49 35	1.46	51 30	.75	49 17	1.46	53 47	.75	34	53.0
57	51 35	1.46	57 40	.78	50 16	1.46	52 15	.78	50 58	1.50	54 49	.78	33	52.0
58	53 16	1.50	59 27	.82	51 57	1.50	53 2	.80	51 46	1.54	56 35	.82	32	50.9
59	55 56	1.50	61 16	.83	52 47	1.54	54 50	.83	52 47	1.54	58 24	.83	31	49.8
60	58 36	1.54	63 49	0.88	54 18	1.58	56 40	0.88	54 56	1.58	60 14	0.87	30	48.7
61	61 15	1.58	65 59	.90	55 54	1.58	58 33	.90	56 48	1.62	62 6	.90	29	47.5
62	63 53	1.62	68 53	.93	57 32	1.62	60 27	.93	58 49	1.62	64 0	.93	28	46.3
63	66 30	1.62	71 49	.98	59 9	1.67	62 23	.97	60 48	1.67	66 56	.95	27	45.1
64	69 17	1.67	75 28	1.00	61 45	1.71	65 21	1.00	62 50	1.71	69 53	1.00	26	43.9
65	72 43	1.71	79 48	1.03	63 20	1.71	68 21	1.03	65 59	1.76	73 53	1.03	25	42.6
66	75 18	1.76	83 50	1.08	65 55	1.76	72 23	1.07	68 51	1.82	77 55	1.05	24	41.3
67	78 52	1.82	88 55	1.10	68 29	1.88	76 27	1.10	71 52	1.88	82 58	1.08	23	39.9
68	82 25	1.88	94 1	1.15	71 53	1.88	80 33	1.13	75 38	1.94	88 3	1.13	22	38.5
69	86 57	1.94	100 10	1.18	75 33	1.94	84 41	1.18	79 53	2.00	94 11	1.17	21	37.1
70	91 28	2.00	106 21	1.23	79 4	2.07	89 52	1.20	84 39	2.07	100 21	1.20	20	35.6
71	95 58	2.07	112 35	1.27	83 33	2.07	94 4	1.25	88 54	2.14	106 33	1.23	19	34.2
72	100 27	2.14	119 51	1.30	87 55	2.22	100 19	1.28	93 36	2.22	112 47	1.27	18	32.6
73	105 55	2.31	127 9	1.33	92 29	2.31	107 36	1.32	98 55	2.31	119 3	1.30	17	31.1
74	111 21	2.40	135 29	1.37	97 55	2.40	114 55	1.37	104 29	2.50	126 21	1.35	16	29.5
75	116 46	2.50	144 51	1.42	103 26	2.61	122 17	1.38	110 53	2.61	134 42	1.37	15	27.8
76	122 10	2.61	154 16	1.45	109 43	2.73	131 40	1.43	117 56	2.73	144 4	1.42	14	26.2
77	127 33	2.86	164 43	1.48	116 57	2.86	141 6	1.45	125 38	3.00	154 29	1.43	13	24.5
78	133 54	3.16	175 12	1.52	124 26	3.16	151 33	1.50	133 58	3.16	164 55	1.47	12	22.7
79	140 13	3.33	187 43	1.55	132 45	3.33	162 3	1.52	141 57	3.33	175 23	1.50	11	21.0
80	146 31	3.53	200 16	1.57	141 58	3.75	173 34	1.55	150 35	3.75	187 53	1.52	10	19.2
81	152 48	4.00	214 50	1.62	151 19	4.00	185 7	1.58	159 51	4.29	203 24	1.55	9	17.3
82	159 3	4.62	230 27	1.63	161 34	4.62	202 42	1.60	168 5	4.62	219 57	1.58	8	15.5
83	166 16	5.00	247 5	1.65	172 47	5.45	219 18	1.63	178 18	5.45	237 32	1.60	7	13.6
84	173 28	6.00	267 44	1.68	184 58	6.00	239 56	1.65	190 29	6.67	257 8	1.62	6	11.7
85	180 38	7.50	289 25	1.70	197 59	7.50	261 35	1.67	203 38	7.50	281 45	1.63	5	9.8
86	188 46	10.0	313 7	1.70	212 16	10.0	283 15	1.67	218 46	10.0	303 23	1.63	4	7.8
87	197 52	15.0	340 49	1.72	228 22	15.0	308 55	1.68	235 52	15.0	328 1	1.65	3	5.9
88	208 56	20.0	371 32	1.73	246 26	20.0	336 36	1.70	254 56	20.0	364 40	1.67	2	3.9
89	221 59	60.0	408 16	1.73	267 29	60.0	368 18	1.70	275 59	60.0	406 20	1.67	1	2.0
90	60 0		90 0		30		90 0		59 0		90 0		0	0.0
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	
	$d = 30^\circ 0'$				$d = 30^\circ 30'$				$d = 31^\circ 0'$					



b	a = 31° 30'					a = 32° 0'					a = 32° 30'					c	α					
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	C
0	0	0	1.18	31	0	0.00	0	0	1.18	32	0	0.00	0	0	1.18	32	0	0.00	0	0	90	90.0
1		51	1.18	30	.02		0	51	1.18	0	.02		0	51	1.20	30	.02		89		89.5	89.5
2		1 42	1.15	31	.02		1	42	1.18	1	.02		1	41	1.18	31	.02		88		88.9	88.9
3		2 34	1.18	32	.03		2	33	1.20	2	.03		2	32	1.20	32	.03		87		88.4	88.4
4		3 25	1.18	34	.03		3	23	1.18	4	.03		3	22	1.18	34	.03		86		87.9	87.9
5		4 16	1.18	36	.03		4	14	1.18	6	.03		4	13	1.20	36	.05		85		87.3	87.3
6		5 7	1.18	38	.05		5	5	1.18	8	.05		5	3	1.18	39	.05		84		86.8	86.8
7		5 58	1.18	41	.07		6	56	1.18	11	.07		6	54	1.20	42	.05		83		86.3	86.3
8		6 49	1.18	45	.07		6	47	1.20	15	.07		6	44	1.18	45	.07		82		85.7	85.7
9		7 40	1.18	49	.08		7	37	1.18	19	.08		7	35	1.20	49	.08		81		85.2	85.2
10		8 31	1.18	54	.08		8	28	1.18	24	.08		8	25	1.18	54	.08		80		84.7	84.7
11		9 22	1.18	59	.08		9	19	1.20	29	.08		9	16	1.20	59	.10		79		84.1	84.1
12		10 13	1.18	32	4	.10	10	9	1.18	34	.10		10	6	1.20	33	5	.10	78		83.6	83.6
13		11 4	1.20	10	.12		11	0	1.20	40	.12		11	56	1.20	11	.10		77		83.0	83.0
14		12 45	1.18	17	.12		50	1.18	47	.12		11	46	1.20	17	.12		76		82.5	82.5	
15		12 45	1.18	24	.12		12	41	1.20	54	.13		12	36	1.20	24	.13		75		81.9	81.9
16		13 36	1.20	31	.13		13	31	1.20	33	.13		13	26	1.20	32	.13		74		81.4	81.4
17		14 26	1.18	39	.15		14	21	1.18	10	.13		14	16	1.20	40	.15		73		80.8	80.8
18		15 17	1.20	48	.15		15	12	1.20	18	.15		15	6	1.20	49	.15		72		80.2	80.2
19		16 7	1.20	57	.17		16	2	1.20	27	.17		16	56	1.20	58	.17		71		79.7	79.7
20		57	1.20	33	7	.17	52	1.20	37	.18		16	46	1.20	34	8	.18	70		79.1	79.1	
21		17 47	1.20	17	.18		17	42	1.22	48	.18		17	36	1.22	19	.18	69		78.5	78.5	
22		18 37	1.20	28	.18		18	31	1.20	59	.18		18	25	1.22	30	.18	68		77.9	77.9	
23		19 27	1.20	39	.20		19	21	1.20	34	10	.20	19	14	1.20	41	.20	67		77.3	77.3	
24		20 17	1.20	51	.22		20	11	1.22	22	.22		20	4	1.22	53	.22	66		76.7	76.7	
25		21 7	1.20	34	4	.22	21	0	1.22	35	.22		53	1.22	35	6	.23	65		76.1	76.1	
26		57	1.20	17	.23		22	49	1.22	48	.23		21	42	1.22	20	.23	64		75.5	75.5	
27		22 47	1.22	31	.25		22	38	1.22	35	2	.25	22	31	1.22	34	.25	63		74.9	74.9	
28		23 36	1.22	46	.25		23	27	1.22	17	.27		23	20	1.25	49	.25	62		74.3	74.3	
29		24 25	1.22	35	1	.27	24	16	1.22	33	.27		24	8	1.22	36	4	.27	61		73.6	73.6
30		25 14	1.22	17	.28		25	5	1.22	49	.28		57	1.25	20	.28	60		73.0		73.0	73.0
31		26 3	1.22	34	.28		54	1.25	36	6	.28		25	45	1.25	37	.30	59		72.3	72.3	
32		52	1.25	51	.30		26	42	1.25	23	.30		26	33	1.25	55	.30	58		71.7	71.7	
33		27 40	1.22	36	9	.32	27	30	1.25	41	.32		27	21	1.28	37	13	.32	57		71.0	71.0
34		28 29	1.25	28	.33		28	18	1.25	37	0	.33	28	8	1.25	32	.33	56		70.3	70.3	
35		29 17	1.25	48	.35		29	6	1.25	20	.35		56	1.28	52	.35	55		69.6		69.6	69.6
36		30 5	1.25	37	9	.35	54	1.28	41	.35		29	43	1.28	38	13	.37	54		68.9	68.9	
37		53	1.28	30	.37		30	41	1.28	38	2	.38	30	30	1.28	35	.37	53		68.2	68.2	
38		31 40	1.28	52	.38		31	28	1.28	25	.38		31	17	1.28	57	.40	52		67.5	67.5	
39		32 27	1.28	38	15	.40	32	15	1.28	48	.40		32	4	1.30	39	21	.40	51		66.8	66.8
40		33 14	1.28	39	.43		33	2	1.30	39	12	.42	50	1.30	45	.42	50		66.0		66.0	66.0
41		34 1	1.30	39	5	.43	48	1.30	41	.37	.45		33	36	1.30	40	10	.43	49		65.3	65.3
42		47	1.30	31	.45		34	34	1.30	40	4	.45	34	22	1.33	36	.47	48		64.5	64.5	
43		35 33	1.30	58	.47		35	20	1.30	31	.47		35	7	1.33	41	4	.47	47		63.7	63.7
44		36 19	1.30	40	26	.48	36	6	1.33	59	.48		52	1.33	32	.48	46		62.9		62.9	62.9
45		37 5		55			51			41	28		36	37		42	1		45		62.1	62.1
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a									
	d = 31° 30'				d = 32° 0'				d = 32° 30'				a									

B	a = 31° 30'				a = 32° 0'				a = 32° 30'				C	c	a	β				
	h	d	60'	t	h	d	60'	t	h	d	60'	t					C	c	a	β
		Δ	Z	60'		Δ	Z	60'		Δ	Z	60'								
45	37	5	1.33	40	55	0.50	36	51	1.33	41	28	0.50	36	37	1.36	42	1	0.50	45	62.1
46	38	5	1.33	41	25	.52	37	36	1.36	42	58	.53	37	21	1.36	43	31	.53	44	61.2
47	38	35	1.36	56	.55	38	20	1.36	42	30	.53	38	5	1.36	43	3	.55	43	60.4	
48	39	19	1.36	42	29	.57	39	4	1.36	43	2	.57	49	1.40	49	36	.57	42	59.5	
49	40	3	1.36	43	3	.58	48	1.40	43	36	.58	39	32	1.40	44	10	.58	41	58.6	
50	47	1.40	38	0.60	40	31	1.40	44	11	0.62	40	15	1.43	45	45	0.60	40	57.7		
51	41	30	1.40	44	14	.63	41	14	1.43	48	.63	57	1.43	45	21	.63	39	56.8		
52	42	13	1.43	52	.65	38	20	1.43	45	26	.65	41	39	1.43	59	.65	38	55.9		
53	55	1.43	45	31	.68	42	38	1.46	46	5	.67	42	21	1.46	46	38	.67	37	54.9	
54	43	37	1.46	46	12	.70	43	19	1.46	45	.70	43	2	1.50	47	18	.70	36	53.9	
55	44	18	1.46	54	0.72	44	0	1.50	47	27	0.72	42	1.50	48	0	0.72	35	52.9		
56	59	1.50	47	37	.75	40	1.50	48	10	.75	44	22	1.54	44	43	.75	34	51.8		
57	45	39	1.50	48	22	.78	45	20	1.54	55	.78	45	1	1.54	49	28	.78	33	50.8	
58	46	19	1.54	49	9	.80	50	1.54	49	42	.80	40	1.58	50	15	.80	32	49.7		
59	58	1.58	57	.83	46	38	1.58	50	30	.83	46	18	1.62	51	3	.83	31	48.6		
60	47	36	1.62	50	47	0.87	47	16	1.62	51	20	0.87	55	1.62	53	0.85	30	47.5		
61	48	13	1.62	51	39	.90	53	1.67	52	12	.88	47	32	1.67	52	44	.88	29	46.3	
62	50	1.67	52	33	.92	48	29	1.67	53	5	.92	48	8	1.71	53	37	.92	28	45.1	
63	49	26	1.71	53	28	.95	49	5	1.71	54	0	.95	43	1.76	54	32	.93	27	43.9	
64	50	1	1.71	54	25	.98	40	1.76	57	.98	49	17	1.76	55	28	.97	26	42.6		
65	36	1.76	55	24	1.03	50	14	1.82	55	56	1.00	51	1.82	56	26	1.02	25	41.3		
66	51	10	1.88	56	26	1.05	47	1.88	56	56	1.05	50	24	1.88	57	27	1.03	24	40.0	
67	42	1.88	57	29	1.08	51	19	1.94	57	59	1.08	56	1.94	58	29	1.07	23	38.7		
68	52	14	1.94	58	34	1.12	50	1.94	59	4	1.10	51	27	2.07	59	33	1.10	22	37.3	
69	45	2.00	59	41	1.15	52	21	2.07	60	10	1.13	56	2.07	60	39	1.12	21	35.9		
70	53	15	2.07	60	50	1.18	50	2.14	61	18	1.18	52	25	2.14	61	46	1.17	20	34.5	
71	44	2.22	62	1	1.22	53	18	2.22	62	29	1.20	53	2.22	62	56	1.20	19	33.0		
72	54	11	2.22	63	14	1.27	45	2.31	63	41	1.25	53	20	2.31	64	8	1.22	18	31.5	
73	38	2.40	64	30	1.28	54	11	2.40	64	56	1.27	46	2.50	65	21	1.25	17	30.0		
74	55	3	2.50	65	47	1.32	36	2.50	66	12	1.30	54	10	2.61	66	36	1.28	16	28.4	
75	27	2.61	67	6	1.35	55	0	2.73	67	30	1.33	33	2.73	67	53	1.32	15	26.8		
76	50	2.86	68	27	1.38	22	2.86	68	50	1.37	55	2.86	69	12	1.35	14	25.2			
77	56	11	3.00	69	50	1.42	43	3.00	70	12	1.40	55	16	3.16	70	33	1.38	13	23.5	
78	31	3.33	71	15	1.45	56	3	3.33	71	36	1.42	35	3.33	71	56	1.40	12	21.9		
79	49	3.53	72	42	1.48	21	3.53	73	1	1.45	53	3.53	73	20	1.42	11	20.1			
80	57	6	3.75	74	11	1.50	38	4.00	74	28	1.48	56	10	4.00	74	45	1.45	10	18.4	
81	22	4.29	75	41	1.52	53	4.29	75	57	1.50	25	4.62	76	12	1.48	9	16.6			
82	36	4.62	77	12	1.55	57	5.00	77	27	1.52	38	5.00	77	41	1.48	8	14.9			
83	49	5.45	78	45	1.57	19	5.45	78	58	1.53	50	5.45	79	10	1.52	7	13.0			
84	58	0	6.67	80	19	1.58	30	6.67	80	30	1.57	57	1	6.67	80	41	1.53	6	11.2	
85	9	8.57	81	54	1.60	39	7.50	82	4	1.57	10	8.57	82	13	1.53	5	9.4			
86	16	10.0	83	30	1.62	47	10.0	83	38	1.58	17	10.0	83	45	1.55	4	7.5			
87	22	12.0	85	7	1.62	53	15.0	85	13	1.58	23	15.0	85	18	1.57	3	5.6			
88	27	30.0	86	44	1.63	57	30.0	86	48	1.60	27	30.0	86	52	1.57	2	3.8			
89	29	60.0	88	22	1.63	59	60.0	88	24	1.60	29	60.0	88	26	1.57	1	1.9			
90	30		90	0		58	0	90	0		30		90	0		0	0	0.0		

t	a = 31° 30'		a = 32° 0'		a = 32° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 31° 30'		d = 32° 0'		d = 32° 30'		



b	a = 33° 0'				a = 33° 30'				a = 34° 0'				c	α			
	B	h	$\frac{60'}{\Delta}$	Z	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$			C	β	
0	0	0	1.20	33	0	0.00	0	0	0	0	0.00	0	0	90	90.0		
1	50	1.18		0	.02	50	1.20	33	30	.02	50	1.22	0	.02	80	89.4	
2	1 41	1.20		1	.02	1 40	1.20	31	.02	1 39	1.20	1	.02	88	88.9		
3	2 31	1.20		2	.03	2 30	1.20	32	.03	2 29	1.20	2	.03	87	88.3		
4	3 21	1.18		4	.03	3 20	1.20	34	.03	3 19	1.20	4	.03	86	87.8		
5	4 12	1.20		6	0.05	4 10	1.20	36	0.05	4 9	1.22	6	0.05	85	87.2		
6	5 2	1.20		9	.05	5 0	1.20	39	.05	5 8	1.20	9	.05	84	86.7		
7	5 52	1.20		12	.05	5 50	1.20	42	.07	5 48	1.20	12	.07	83	86.1		
8	6 42	1.20		15	.07	6 40	1.20	46	.07	6 38	1.22	16	.07	82	85.6		
9	7 32	1.20		19	.08	7 30	1.20	50	.07	7 27	1.20	20	.08	81	85.0		
10	8 22	1.20		24	0.08	8 20	1.22	54	0.08	8 17	1.22	25	0.08	80	84.4		
11	9 12	1.20		29	.10	9 9	1.20	59	.10	9 6	1.20	30	.08	79	83.9		
12	10 2	1.20		35	.10	59	1.20	34	5	.10	56	1.22	35	.10	78	83.3	
13	5 52	1.20		41	.12	10 49	1.22	11	.12	10 45	1.22	41	.12	77	82.7		
14	11 42	1.20		48	.12	11 38	1.20	18	.12	11 34	1.22	48	.13	76	82.2		
15	12 32	1.20		55	0.13	12 28	1.22	25	0.13	12 23	1.20	56	0.13	75	81.6		
16	13 22	1.20		34	3	.13	13 17	1.20	33	.13	13 13	1.22	35	4	.13	74	81.0
17	14 12	1.22		11	.15	14 7	1.22	41	.15	14 2	1.22	12	.15	73	80.4		
18	15 1	1.20		20	.15	56	1.22	50	.17	51	1.22	21	.15	72	79.8		
19	5 1	1.22		29	.17	15 45	1.22	35	0	.17	15 40	1.25	30	.17	71	79.2	
20	16 40	1.22		39	0.17	16 34	1.22	10	0.17	16 28	1.22	40	0.18	70	78.6		
21	17 29	1.20		49	.18	17 23	1.22	20	.18	17 17	1.22	51	.18	69	78.0		
22	18 19	1.22		35	0	.20	18 12	1.22	31	.20	18 6	1.25	36	2	.20	68	77.4
23	19 8	1.22		12	.20	19 1	1.22	43	.20	54	1.25	14	.20	67	76.8		
24	5 7	1.22		24	.22	50	1.25	55	.22	19 42	1.25	26	.22	66	76.2		
25	20 46	1.25		37	0.23	20 38	1.22	36	8	0.23	20 30	1.25	39	0.23	65	75.6	
26	21 34	1.22		51	.23	21 27	1.25	22	.23	21 18	1.25	53	.25	64	74.9		
27	22 23	1.25		36	5	.25	22 15	1.25	36	.25	22 6	1.25	37	8	.25	63	74.3
28	23 11	1.25		20	.27	23 3	1.25	51	.27	54	1.25	23	.25	62	73.6		
29	5 9	1.25		36	.27	51	1.25	37	7	.27	23 42	1.28	38	.28	61	73.0	
30	24 47	1.25		52	0.28	24 39	1.28	23	0.28	24 29	1.28	55	0.28	60	72.3		
31	25 35	1.25		37	9	.30	25 26	1.28	40	.30	25 16	1.28	38	12	.30	59	71.7
32	26 23	1.25		27	.30	26 13	1.28	58	.32	26 3	1.28	30	.32	58	71.0		
33	27 11	1.28		45	.32	27 0	1.28	38	17	.32	50	1.28	49	.32	57	70.3	
34	5 8	1.28		38	4	.33	47	1.28	36	.33	27 37	1.28	39	8	.33	56	69.6
35	28 45	1.28		24	0.35	28 34	1.28	56	0.35	28 24	1.30	28	0.35	55	68.9		
36	29 32	1.28		45	.37	29 21	1.30	39	17	.37	29 10	1.30	49	.37	54	68.1	
37	30 19	1.30		39	7	.38	30 7	1.30	39	.38	56	1.30	40	11	.38	53	67.4
38	31 5	1.30		30	.38	53	1.30	40	2	.38	30 42	1.33	34	.38	52	66.7	
39	5 1	1.30		53	.40	31 39	1.30	25	.42	31 27	1.33	57	.42	51	65.9		
40	32 37	1.30		40	17	.43	32 25	1.33	50	.42	32 12	1.33	41	22	.42	50	65.2
41	33 23	1.33		43	.43	33 10	1.33	41	15	.43	57	1.33	47	.45	49	64.4	
42	34 8	1.33		41	9	.45	55	1.33	41	.47	33 42	1.36	42	14	.45	48	63.6
43	5 53	1.33		36	.48	34 40	1.36	42	9	.47	34 26	1.36	41	.48	47	62.8	
44	35 38	1.36		42	5	.48	35 24	1.36	37	.48	35 10	1.40	43	10	.48	46	61.9
45	36 22			34			36 8		43	6		53		39		45	61.1
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a				
	d = 33° 0'				d = 33° 30'				d = 34° 0'								

b	a = 33° 0'					a = 33° 30'					a = 34° 0'					c	α									
	B	h	d	60'	t	Z	Δ	60'	h	d	60'	t	Z	Δ	60'			h	d	60'	t	Z	Δ	60'	C	β
			Δ	Δ							Δ															
45	36	22	1.36	42	34	0.50	36	8	1.36	43	6	0.52	35	53	1.40	43	39	0.50	45	61.1						
46	37	6	1.36	43	4	.53	36	52	1.40	37	52	.52	36	36	1.40	44	9	.53	44	60.3						
47	47	50	1.40	44	36	.55	37	35	1.40	44	8	.55	37	19	1.40	41	51	.55	43	59.4						
48	38	33	1.40	44	9	.57	38	18	1.43	41	41	.57	38	2	1.43	45	14	.57	42	58.5						
49	39	16	1.40	43	58	.58	39	0	1.43	45	15	.58	44	1.43	48	48	.58	41	57.6							
50	59	1.43	45	18	0.60	42	42	1.43	50	0.62	39	26	1.46	46	23	0.60	40	56.7								
51	40	41	1.46	54	34	.63	40	24	1.46	46	27	.62	40	7	1.46	59	59	.63	39	55.7						
52	41	22	1.46	46	32	.65	41	5	1.50	47	4	.65	41	48	1.50	47	37	.65	38	54.8						
53	42	3	1.46	47	11	.67	42	45	1.50	43	43	.67	41	28	1.54	48	16	.67	37	53.8						
54	44	1.50	51	70	.70	42	25	1.50	48	23	.70	42	7	1.54	56	68	.68	36	52.8							
55	43	24	1.54	48	33	0.72	43	5	1.54	49	5	0.72	43	46	1.54	49	37	0.72	35	51.8						
56	44	3	1.54	49	16	.75	44	44	1.58	48	48	.75	43	25	1.58	50	20	.75	34	50.7						
57	42	1.58	50	1	.77	44	22	1.58	50	33	.77	44	3	1.62	51	5	.77	33	49.6							
58	45	20	1.58	47	80	.80	45	0	1.62	51	19	.80	40	1.62	51	51	.78	32	48.5							
59	58	1.62	51	35	.82	45	37	1.62	52	7	.82	45	17	1.67	52	38	.82	31	47.4							
60	46	35	1.67	52	24	0.85	46	14	1.67	56	0.85	53	1.71	53	27	0.85	30	46.3								
61	47	11	1.71	53	15	.88	50	1.71	53	47	.87	46	28	1.71	54	18	.87	29	45.1							
62	46	1.71	54	8	.92	47	25	1.76	54	39	.90	47	3	1.76	55	10	.90	28	43.9							
63	48	21	1.76	55	3	.93	48	59	1.76	55	33	.93	37	1.82	56	4	.92	27	42.7							
64	55	1.82	59	.97	48	33	1.88	56	29	.95	48	10	1.88	59	.95	26	41.5									
65	49	28	1.82	56	57	1.00	49	5	1.88	57	26	1.00	42	1.88	57	56	0.98	25	40.2							
66	50	1	1.94	57	57	1.02	50	37	1.94	58	26	1.02	49	14	2.00	58	55	1.00	24	38.9						
67	32	2.00	58	58	1.05	50	8	2.00	59	27	1.05	44	2.00	59	55	1.03	23	37.6								
68	51	2	2.00	60	1	1.08	38	2.07	60	30	1.07	50	14	2.07	60	57	1.07	22	36.2							
69	32	2.07	61	6	1.12	51	7	2.14	61	34	1.10	43	2.22	62	1	1.10	21	34.8								
70	52	1	2.22	62	13	1.15	35	2.22	62	40	1.13	51	10	2.22	63	7	1.12	20	33.4							
71	28	2.31	63	22	1.18	52	2	2.31	63	48	1.17	37	2.31	64	14	1.15	19	32.0								
72	54	2.40	64	33	1.22	28	2.40	64	58	1.20	52	3	2.50	65	23	1.18	18	30.5								
73	53	19	2.50	65	40	1.23	53	2.50	66	10	1.22	27	2.61	66	34	1.20	17	29.0								
74	43	2.61	67	0	1.27	53	17	2.73	67	24	1.25	50	2.73	67	46	1.23	16	27.5								
75	54	6	2.73	68	16	1.30	39	2.73	68	39	1.27	53	12	2.86	69	0	1.27	15	25.9							
76	28	3.00	69	34	1.33	54	1	3.00	69	55	1.32	33	3.00	70	16	1.28	14	24.3								
77	48	3.16	70	54	1.35	21	3.33	71	14	1.33	53	3.33	71	33	1.32	13	22.7									
78	55	7	3.33	72	15	1.38	39	3.53	72	34	1.35	54	11	3.53	72	52	1.33	12	21.1							
79	25	3.75	73	38	1.40	56	3.75	73	55	1.38	28	3.75	74	12	1.37	11	19.4									
80	41	4.00	75	2	1.42	55	12	4.00	75	18	1.40	44	4.29	75	34	1.38	10	17.7								
81	56	4.62	76	27	1.45	27	4.62	76	42	1.42	58	4.62	76	57	1.42	9	16.0									
82	9	5.00	77	54	1.47	40	5.00	78	7	1.45	55	11	5.45	78	21	1.42	8	14.3								
83	21	6.00	79	22	1.48	52	6.00	79	34	1.47	22	6.00	79	46	1.43	7	12.5									
84	31	6.67	80	51	1.50	56	2	7.50	81	2	1.47	32	6.67	81	12	1.43	6	10.8								
85	40	8.57	82	21	1.52	10	8.57	82	30	1.48	41	8.57	82	38	1.47	5	9.0									
86	47	10.0	83	52	1.52	17	10.0	83	59	1.50	48	12.0	84	6	1.47	4	7.2									
87	53	15.0	85	23	1.53	23	15.0	85	29	1.50	53	15.0	85	34	1.47	3	5.4									
88	57	30.0	86	55	1.53	27	30.0	86	59	1.50	57	30.0	87	2	1.48	2	3.6									
89	59	60.0	88	27	1.55	29	60.0	88	29	1.52	59	60.0	88	31	1.48	1	1.8									
90	57	0	90	0		30		90	0		56	0	90	0		0	0.0									

t	a = 33° 0'		a = 33° 30'		a = 34° 0'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 33° 0'		d = 33° 30'		d = 34° 0'		



b	a = 34° 30'					a = 35° 0'					a = 35° 30'					c	a					
	B	h	d	t	Δ	h	d	t	Δ	h	d	t	Δ	C	β							
			$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$									
0	0	0	1.22	34	30	0.00	0	0	1.22	35	0	0.00	0	0	1.22	35	30	0.00	90	90.0		
1		49	1.20		30	.02		49	1.22		0	.02		49	1.22		30	.02	89	89.4		
2	1	39	1.22		31	.02	1	38	1.22		1	.02	1	38	1.22		31	.02	88	88.0		
3	2	28	1.20		32	.03	2	27	1.20		2	.03	2	27	1.25		32	.03	87	88.3		
4	3	18	1.22		34	.03	3	17	1.22		4	.03	3	15	1.22		34	.03	86	87.7		
5	4	7	1.20		36	0.05	4	6	1.22		6	0.05	4	4	1.22		36	0.05	85	87.1		
6		57	1.22		39	.05		55	1.22		9	.05		53	1.22		39	.05	84	86.6		
7	5	46	1.22		42	.07	5	44	1.22		12	.07	5	42	1.25		42	.07	83	86.0		
8	6	35	1.22		46	.07	6	33	1.22		16	.07	6	30	1.22		46	.07	82	85.4		
9	7	24	1.20		50	.08	7	22	1.22		20	.08	7	19	1.22		50	.08	81	84.8		
10	8	14	1.22		55	0.08	8	11	1.22		25	0.08	8	8	1.25		55	0.08	80	84.2		
11	9	3	1.22		35	0	.10	9	0	1.25		30	.10		56	1.22	36	0	.10	79	83.6	
12		52	1.22		6	.10		48	1.22		36	.10		9	45	1.25	6	.10		78	83.0	
13	10	41	1.22		12	.12	10	37	1.22		42	.12	10	33	1.22		12	.12		77	82.5	
14	11	30	1.22		19	.12	11	26	1.25		49	.12	11	22	1.25		19	.13		76	81.9	
15	12	19	1.22		26	0.13	12	14	1.22		56	0.13	12	10	1.25		27	0.13		75	81.3	
16	13	8	1.22		34	.13	13	3	1.25		36	4	.15		58	1.25	35	.13		74	80.7	
17		57	1.25		42	.15		51	1.22		36	4	.15	13	46	1.25	43	.15		73	80.1	
18	14	45	1.22		51	.17	14	40	1.25		22	.15	14	34	1.25		52	.17		72	79.4	
19	15	34	1.25		36	1	.17	15	28	1.25		31	.17	15	22	1.25		37	2	.17	71	78.8
20	16	22	1.22		11	0.18	16	16	1.25		41	0.18	16	10	1.25		12	0.18		70	78.2	
21	17	11	1.25		22	.18	17	4	1.25		52	.20		58	1.28		23	.18		69	77.6	
22		59	1.25		33	.20		52	1.25		37	4	.20	17	45	1.25	34	.20		68	77.0	
23	18	47	1.25		45	.20	18	40	1.25		16	.20	18	33	1.28		46	.22		67	76.3	
24	19	35	1.25		57	.22	19	28	1.28		28	.22	19	20	1.28		59	.22		66	75.7	
25	20	23	1.25		37	10	0.23	20	15	1.25		41	0.23	20	7	1.28		38	12	0.23	65	75.0
26	21	11	1.28		24	.25	21	3	1.28		55	.25		54	1.28		26	.25		64	74.4	
27		58	1.25		39	.25		50	1.28		38	10	.25	21	41	1.28	41	.25		63	73.7	
28	22	46	1.28		54	.27	22	37	1.28		25	.27	22	28	1.28		56	.27		62	73.0	
29	23	33	1.28		38	10	.27	23	24	1.28		41	.27	23	15	1.30		39	12	.28	61	72.4
30	24	20	1.28		26	0.28	24	11	1.30		57	0.30	24	1	1.30		29	0.28		60	71.7	
31	25	7	1.28		43	.30		57	1.28		39	15	.30		47	1.30	46	.30		59	71.0	
32		54	1.30		39	1	.32	25	44	1.30		33	.32	25	33	1.30	40	4	.32	58	70.3	
33	26	40	1.30		20	.33	26	30	1.30		52	.32	26	19	1.30		23	.33		57	69.6	
34	27	26	1.30		40	.33	27	16	1.30		40	11	.33	27	5	1.33	43	.33		56	68.9	
35	28	12	1.30		40	0	0.35	28	2	1.33		31	0.35		50	1.33	41	3	0.35	55	68.1	
36		58	1.30		21	.37		47	1.33		52	.37		35	1.33		24	.37		54	67.4	
37	29	44	1.33		43	.38	29	32	1.33		41	14	.38	29	20	1.33	46	.38		53	66.6	
38	30	29	1.33		41	6	.40	30	17	1.33		37	.40	30	5	1.36	42	9	.40	52	65.9	
39	31	14	1.33		30	.40	31	2	1.36		42	1	.42		49	1.36	33	.42		51	65.1	
40		59	1.33		54	0.42		46	1.36		26	0.42	31	33	1.36		58	0.42		50	64.3	
41	32	44	1.36		42	19	.45	32	30	1.36		51	.45	32	17	1.40	43	23	.45	49	63.5	
42		33	1.36		46	.45	33	14	1.36		43	18	.45	33	0	1.40	50	.45		48	62.7	
43	34	12	1.36		43	13	.48		58	1.40		45	.48		43	1.40	44	17	.47	47	61.9	
44		56	1.40		42	.48	34	41	1.40		44	14	.48	34	26	1.40	45	.50		46	61.0	
45	35	39			44	11		35	24			43		35	9		45	15		45	60.2	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a									
	d = 34° 30'				d = 35° 0'				d = 35° 30'				a									

b	a = 34° 30'					a = 35° 0'					a = 35° 30'					c	a				
	B	h	d	60'	t	Δ	60'	Z	t	Δ	60'	Z	t	Δ	60'			Z	t	C	β
			Δ	Δ	Δ																
45	35	39	1.40	44	11	0.52	35	24	1.43	44	43	0.52	35	9	1.43	45	15	0.50	45	60.2	
46	36	22	1.43	44	42	.52	36	6	1.43	45	14	.52	36	51	1.43	45	45	.53	44	59.3	
47	37	4	1.43	45	13	.55	48	1.43	45	45	.55	36	33	1.46	46	17	.55	43	58.4		
48	46	1.43	46	57	37	30	1.46	46	18	.57	37	14	1.46	50	.57	42	57.5				
49	38	28	1.46	46	20	.58	38	11	1.46	52	.58	37	14	1.50	47	24	.58	41	56.6		
50	39	9	1.46	55	0.60	52	1.50	47	27	0.60	38	35	1.50	59	0.60	40	55.6				
51	50	1.50	47	31	.63	39	32	1.50	48	3	.63	39	15	1.54	48	35	.62	39	54.7		
52	40	30	1.50	48	9	.65	40	12	1.50	41	.63	54	1.54	49	12	.65	38	53.7			
53	41	10	1.54	48	.67	52	1.54	49	19	.67	40	33	1.54	51	.67	37	52.7				
54	49	1.54	49	28	.68	41	31	1.58	59	.70	41	12	1.58	50	31	.68	36	51.7			
55	42	28	1.58	50	9	.72	42	9	1.58	50	41	0.70	50	1.62	51	12	0.70	35	50.7		
56	43	6	1.62	52	.73	47	1.62	51	23	.73	42	27	1.62	54	.73	34	49.6				
57	43	1.62	51	36	.77	43	24	1.67	52	7	.77	43	4	1.67	52	38	.75	33	48.5		
58	44	20	1.67	52	22	.78	44	0	1.67	53	.78	40	1.71	53	23	.78	32	47.4			
59	56	1.67	53	9	.82	44	36	1.71	53	40	.80	44	15	1.71	54	10	.80	31	46.3		
60	45	32	1.71	58	0.83	45	11	1.71	54	28	0.83	50	1.76	58	0.83	30	45.2				
61	46	7	1.76	54	48	.87	46	1.76	55	18	.87	45	24	1.82	55	48	.85	28	44.0		
62	47	1.76	55	40	.88	46	20	1.82	56	10	.88	57	1.82	56	39	.88	28	42.8			
63	41	15	1.82	56	33	.92	53	1.88	57	3	.90	46	30	1.88	57	32	.90	27	41.6		
64	48	1.88	57	28	.95	47	25	1.94	57	.93	47	2	1.94	58	26	.92	26	40.4			
65	48	20	1.94	58	25	0.97	56	1.94	58	53	0.97	48	33	2.00	50	21	0.95	25	39.1		
66	51	2.00	59	23	1.00	48	27	2.07	59	51	.98	48	3	2.07	60	18	.98	24	37.8		
67	49	21	2.07	60	23	1.03	56	2.07	60	50	1.02	32	2.07	61	17	1.02	23	36.5			
68	50	2.14	61	25	1.05	49	25	2.14	61	51	1.05	49	1	2.22	62	18	1.03	22	35.2		
69	50	18	2.22	62	28	1.08	53	2.22	62	54	1.07	28	2.22	63	20	1.05	21	33.8			
70	45	2.31	63	33	1.10	50	20	2.31	63	58	1.10	55	2.40	64	23	1.08	20	32.4			
71	51	11	2.40	64	39	1.13	46	2.50	65	4	1.12	50	20	2.50	65	28	1.12	19	31.0		
72	36	2.50	65	47	1.17	51	10	2.50	66	11	1.15	44	2.50	66	35	1.13	18	29.5			
73	52	0	2.61	66	57	1.20	34	2.61	67	20	1.18	51	8	2.73	67	43	1.15	17	28.1		
74	23	2.73	68	9	1.22	57	2.86	68	31	1.20	68	31	1.20	30	2.86	68	43	1.18	16	26.6	
75	45	2.86	69	22	1.25	52	18	3.00	69	43	1.22	51	3.00	70	3	1.22	15	25.0			
76	53	6	3.16	70	37	1.27	38	3.16	70	56	1.25	52	11	3.16	71	16	1.23	14	23.5		
77	25	3.33	71	53	1.28	57	3.33	72	11	1.28	40	3.53	72	30	1.25	13	21.9				
78	43	3.53	73	10	1.32	53	15	3.75	73	28	1.28	37	3.75	73	45	1.27	12	20.3			
79	54	0	4.00	74	29	1.33	31	4.00	74	45	1.32	53	3	4.00	75	1	1.30	11	18.7		
80	15	4.29	75	49	1.37	46	4.29	76	4	1.33	18	4.62	76	19	1.32	10	17.1				
81	29	4.62	77	11	1.37	54	0	4.62	77	24	1.37	31	5.00	77	38	1.33	9	15.4			
82	42	5.45	78	33	1.40	13	5.45	78	46	1.37	43	5.45	78	58	1.33	8	13.8				
83	53	6.00	79	57	1.40	24	6.67	80	8	1.38	54	6.00	80	18	1.37	7	12.1				
84	55	3	7.50	81	21	1.42	33	7.50	81	31	1.38	54	4	7.50	81	40	1.37	6	10.4		
85	11	8.57	82	46	1.43	41	8.57	82	54	1.42	12	10.0	83	2	1.38	5	8.7				
86	18	12.0	84	12	1.45	48	12.0	84	19	1.42	18	12.0	84	25	1.38	4	7.0				
87	23	15.0	85	39	1.45	53	15.0	85	44	1.42	23	15.0	85	48	1.40	3	5.2				
88	27	30.0	87	6	1.45	57	30.0	87	9	1.42	27	30.0	87	12	1.40	2	3.5				
89	29	60.0	88	33	1.45	59	60.0	88	34	1.43	29	60.0	88	36	1.40	1	1.7				
90	30		90	0		55	0		90	0		30		90	0		0	0.0			
t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a					
	d = 34° 30'					d = 35° 0'					d = 35° 30'					a					



B	$a = 36^\circ 0'$				$a = 36^\circ 30'$				$a = 37^\circ 0'$				C	$\beta$						
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z								
		$t$	$\frac{\Delta}{60'}$	$t$		$\frac{\Delta}{60'}$	$t$	$\frac{\Delta}{60'}$		$t$	$\frac{\Delta}{60'}$									
0	0	0	1.22	36	0	0.00	0	0	1.25	36	30	0.00	0	0	1.25	37	0	0.00	90	90.0
1	1	49	1.25	0	.02	48	1.25	36	30	.02	48	1.25	37	0	.02	48	1.25	0.02	89	89.4
2	2	37	1.22	1	.02	36	1.22	31	.02	36	1.25	1	.02	36	1.25	1	.02	88	88.8	
3	3	26	1.25	2	.03	25	1.25	32	.03	24	1.25	2	.03	24	1.25	2	.03	87	88.2	
4	4	14	1.22	4	.03	13	1.25	34	.03	12	1.28	4	.03	12	1.28	4	.03	86	87.6	
5	5	3	1.25	6	.05	1	1.25	36	.05	59	1.25	6	.05	59	1.25	6	.05	85	87.0	
6	6	51	1.25	9	.05	49	1.25	39	.05	47	1.25	9	.05	47	1.25	9	.05	84	86.4	
7	7	39	1.22	12	.07	37	1.25	42	.07	35	1.25	12	.07	35	1.25	12	.07	83	85.8	
8	8	28	1.25	16	.07	25	1.25	46	.07	23	1.25	16	.07	23	1.25	16	.07	82	85.2	
9	9	16	1.22	20	.08	13	1.25	50	.08	11	1.28	20	.08	11	1.28	20	.08	81	84.6	
10	10	5	1.25	25	.08	1	1.25	55	.10	58	1.25	25	.10	58	1.25	25	.10	80	84.0	
11	11	53	1.25	30	.10	49	1.25	37	.10	46	1.25	31	.10	46	1.25	31	.10	79	83.4	
12	12	41	1.25	36	.12	37	1.25	7	.10	34	1.28	37	.10	34	1.28	37	.10	78	82.8	
13	13	29	1.25	43	.12	25	1.25	13	.12	21	1.28	43	.12	21	1.28	43	.12	77	82.2	
14	14	17	1.25	50	.12	13	1.28	20	.12	8	1.25	50	.12	8	1.25	50	.12	76	81.6	
15	15	5	1.25	57	.13	0	1.25	27	.13	56	1.28	57	.13	56	1.28	57	.13	75	80.9	
16	16	53	1.25	37	.13	48	1.25	35	.15	43	1.28	38	.15	43	1.28	38	.15	74	80.3	
17	17	41	1.25	43	.15	36	1.28	44	.15	30	1.28	44	.15	30	1.28	44	.15	73	79.7	
18	18	29	1.28	22	.17	23	1.28	53	.17	17	1.28	23	.17	17	1.28	23	.17	72	79.1	
19	19	16	1.25	32	.18	10	1.28	38	.17	4	1.28	33	.18	4	1.28	33	.18	71	78.4	
20	20	4	1.28	43	.18	57	1.28	13	.18	51	1.28	44	.18	51	1.28	44	.18	70	77.8	
21	21	51	1.28	54	.18	44	1.28	24	.20	38	1.28	55	.18	38	1.28	55	.18	69	77.1	
22	22	38	1.28	38	.20	31	1.28	36	.20	25	1.30	39	.20	25	1.30	39	.20	68	76.5	
23	23	25	1.28	17	.22	18	1.28	48	.22	11	1.30	18	.22	11	1.30	18	.22	67	75.8	
24	24	12	1.28	30	.22	5	1.28	39	.22	57	1.30	31	.23	57	1.30	31	.23	66	75.2	
25	25	59	1.28	43	.23	52	1.30	14	.23	43	1.30	45	.23	43	1.30	45	.23	65	74.5	
26	26	46	1.28	57	.25	38	1.30	28	.25	29	1.30	59	.23	29	1.30	59	.23	64	73.8	
27	27	33	1.30	39	.25	24	1.30	43	.25	15	1.30	40	.27	15	1.30	40	.27	63	73.1	
28	28	19	1.30	27	.27	10	1.30	58	.27	1	1.30	29	.27	1	1.30	29	.27	62	72.5	
29	29	5	1.30	43	.28	56	1.30	40	.28	47	1.33	45	.28	47	1.33	45	.28	61	71.8	
30	30	51	1.30	40	0	42	1.33	31	.28	32	1.33	41	2	32	1.33	41	2	60	71.0	
31	31	37	1.30	17	.30	24	1.30	48	.30	17	1.33	19	.30	17	1.33	19	.30	59	70.3	
32	32	23	1.30	35	.32	13	1.33	41	.32	6	1.33	37	.32	6	1.33	37	.32	58	69.6	
33	33	9	1.33	54	.33	58	1.33	25	.33	47	1.33	56	.33	47	1.33	56	.33	57	68.9	
34	34	54	1.33	41	.33	26	1.33	45	.33	26	1.36	42	.35	26	1.36	42	.35	56	68.1	
35	35	39	1.33	34	.37	27	1.36	42	.35	6	1.36	37	.35	6	1.36	37	.35	55	67.4	
36	36	24	1.36	56	.37	12	1.36	27	.37	28	1.36	58	.37	28	1.36	58	.37	54	66.6	
37	37	8	1.36	42	.38	56	1.36	49	.38	44	1.40	43	.20	44	1.40	43	.20	53	65.9	
38	38	52	1.36	41	.38	29	1.36	43	.40	29	1.40	43	.40	29	1.40	43	.40	52	65.1	
39	39	36	1.36	43	.42	24	1.40	36	.42	30	1.40	44	.42	30	1.40	44	.42	51	64.3	
40	40	20	1.40	29	.43	7	1.40	44	.42	53	1.40	32	.43	53	1.40	32	.43	50	63.5	
41	41	3	1.40	55	.43	50	1.40	26	.45	31	1.43	58	.43	31	1.43	58	.43	49	62.7	
42	42	46	1.40	44	.47	32	1.43	53	.45	18	1.43	45	.24	18	1.43	45	.24	48	61.8	
43	43	29	1.40	49	.47	15	1.43	45	.48	33	1.43	52	.47	33	1.43	52	.47	47	61.0	
44	44	12	1.43	45	.48	57	1.43	49	.48	42	1.46	46	.20	42	1.46	46	.20	46	60.1	
45	45	54	1.43	46		34	1.43	46		23	1.46	45		23	1.46	45		45	59.3	

t	$d = 36^\circ 0'$				$d = 36^\circ 30'$				$d = 37^\circ 0'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	

B	a = 36° 0'					a = 36° 30'					a = 37° 0'					C	a			
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t					
		$\Delta$	$\Delta$		$\Delta$		$\Delta$	$\Delta$		$\Delta$		$\Delta$	$\Delta$		$\Delta$			$\Delta$	$\Delta$	
45	34	54	1.46	45	46	0.52	34	39	1.46	46	18	0.50	34	23	1.46	46	49	0.52	45	59.3
46	35	35	1.46	46	17	.53	35	20	1.46	48	.53	35	4	1.50	47	20	.52	44	58.4	
47	36	16	1.46	47	49	.53	36	1	1.50	47	20	.55	36	44	1.50	48	51	.55	43	57.5
48	57	1.46	47	21	.57	41	1.50	53	.55	36	24	1.50	48	24	1.50	48	24	.55	42	56.6
49	37	38	1.50	55	.58	37	21	1.50	48	26	.58	37	4	1.54	48	57	.58	41	55.6	
50	38	18	1.54	48	30	0.60	38	1	1.54	49	1	0.60	43	1.54	49	32	0.60	40	54.7	
51	57	1.54	49	6	.62	40	1.58	37	.62	38	22	1.58	50	8	1.58	50	8	.62	39	53.7
52	39	36	1.54	43	.65	39	18	1.58	50	14	.63	39	0	1.58	45	.63	38	52.7		
53	40	15	1.58	50	22	.67	56	1.58	52	.67	38	1.62	51	23	.67	37	51.7			
54	53	1.62	51	2	.68	40	34	1.62	51	32	.68	40	15	1.62	52	3	.67	36	50.7	
55	41	30	1.62	43	0.70	41	11	1.67	52	13	0.70	45	1.67	43	.70	35	49.7			
56	42	7	1.67	52	25	.73	47	1.67	55	.73	41	28	1.71	53	25	.72	34	48.6		
57	43	1.67	53	9	.75	42	23	1.71	53	39	.75	42	3	1.71	54	8	.75	33	47.5	
58	43	19	1.71	54	54	.77	58	1.71	54	24	.77	38	1.76	53	53	.77	32	46.4		
59	54	1.71	54	40	.80	43	33	1.76	55	10	.78	43	12	1.76	55	39	.78	31	45.3	
60	44	29	1.82	55	28	0.82	44	7	1.82	57	0.82	46	1.82	56	26	0.82	30	44.1		
61	45	2	1.82	56	17	.85	40	1.82	56	46	.83	44	19	1.88	57	15	.83	29	43.0	
62	35	1.88	57	8	.87	45	13	1.88	57	36	.87	51	1.94	58	5	.85	28	41.8		
63	46	7	1.88	58	0	.90	45	1.94	58	28	.88	45	22	2.00	56	.88	27	40.6		
64	39	2.00	54	54	.92	46	16	2.00	59	21	.92	45	52	2.00	59	49	.90	26	39.4	
65	47	9	2.00	59	49	0.95	46	2.07	60	16	0.93	46	22	2.07	60	43	0.93	25	38.1	
66	39	2.07	60	46	.97	47	15	2.14	61	12	.97	51	2.14	61	39	.95	24	36.8		
67	48	8	2.14	61	44	1.00	43	2.14	62	10	.98	47	19	2.22	62	36	.97	23	35.5	
68	36	2.22	62	44	1.02	48	11	2.22	63	9	1.02	46	2.22	63	34	1.00	22	34.2		
69	49	3	2.31	63	45	1.05	38	2.40	64	10	1.03	48	13	2.40	64	34	1.02	21	32.8	
70	29	2.40	64	48	1.07	49	3	2.40	65	12	1.05	38	2.50	65	35	1.05	20	31.5		
71	54	2.50	65	52	1.10	28	2.50	66	15	1.08	49	2	2.50	66	38	1.07	19	30.1		
72	50	18	2.61	66	58	1.12	52	2.73	67	20	1.10	26	2.73	67	42	1.10	18	28.6		
73	41	2.73	68	5	1.15	50	14	2.73	68	26	1.13	48	2.86	68	48	1.12	17	27.2		
74	51	3	2.86	69	14	1.17	36	3.00	69	34	1.15	50	9	3.00	69	55	1.13	16	25.7	
75	24	3.16	70	24	1.18	56	3.16	70	43	1.18	29	3.16	71	3	1.15	15	24.3			
76	43	3.33	71	35	1.22	51	15	3.33	71	54	1.18	48	3.33	72	12	1.18	14	22.7		
77	52	1	3.53	72	48	1.23	33	3.53	73	5	1.22	51	6	3.75	73	23	1.20	13	21.2	
78	18	3.75	74	2	1.25	50	3.75	74	18	1.25	22	4.00	74	35	1.20	12	19.7			
79	34	4.00	75	17	1.27	52	6	4.29	75	33	1.25	37	4.29	75	47	1.23	11	18.1		
80	49	4.62	76	33	1.30	20	4.62	76	48	1.27	51	4.62	77	1	1.25	10	16.5			
81	53	2	5.00	77	51	1.30	33	5.00	78	4	1.28	52	4	5.00	78	16	1.27	9	14.9	
82	14	5.45	79	9	1.33	45	5.45	79	21	1.30	16	6.00	79	32	1.28	8	13.3			
83	25	6.67	80	29	1.33	56	6.67	80	39	1.32	26	6.67	80	49	1.28	7	11.7			
84	34	7.50	81	49	1.35	53	7.50	81	58	1.32	35	7.50	82	6	1.30	6	10.0			
85	42	8.57	83	10	1.35	13	10.0	83	17	1.33	43	10.0	83	24	1.32	5	8.4			
86	49	12.0	84	31	1.37	19	12.0	84	37	1.33	49	12.0	84	43	1.32	4	6.7			
87	54	20.0	85	53	1.37	24	20.0	85	57	1.35	54	20.0	86	2	1.32	3	5.0			
88	57	30.0	87	15	1.37	27	30.0	87	18	1.35	57	30.0	87	21	1.32	2	3.4			
89	59	60.0	88	37	1.38	29	60.0	88	39	1.35	59	60.0	88	40	1.33	1	1.7			
90	54	0	90	0		30		90	0		53	0	90	0		0		0	0.0	

t	a = 36° 0'				a = 36° 30'				a = 37° 0'				a
	a	60'	b	$\Delta$	a	60'	b	$\Delta$	a	60'	b	$\Delta$	
		$\Delta$		$\Delta$		$\Delta$		$\Delta$		$\Delta$		$\Delta$	
	d = 36° 0'				d = 36° 30'				d = 37° 0'				



B	$a = 37^\circ 30'$				$a = 38^\circ 0'$				$a = 38^\circ 30'$				C	$\beta$							
	$h$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$h$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$h$	$d$			$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$				
0	0	0	1.25	37	30	0.00	0	0	1.28	38	0	0.00	0	0	1.28	38	30	0.00	90	90.0	
1		48	1.28		30	.02		47	1.25		0	.02		47	1.28		30	.02	89	89.4	
2	1	35	1.25		31	.02	1	35	1.28		1	.02	1	34	1.28		31	.02	88	88.8	
3	2	23	1.28		32	.03	2	22	1.28		2	.03	2	21	1.28		32	.03	87	88.2	
4	3	10	1.25		34	.03	3	9	1.28		4	.03	3	8	1.28		34	.03	86	87.5	
5		58	1.25		36	0.05		56	1.25		6	0.05		55	1.28		36	0.05	85	86.9	
6	4	46	1.28		39	.05	4	44	1.28		9	.05	4	42	1.30		39	.05	84	86.3	
7	5	33	1.28		42	.07	5	31	1.28		12	.07	5	28	1.28		42	.07	83	85.7	
8	6	20	1.25		46	.08	6	18	1.28		16	.08	6	15	1.28		46	.08	82	85.1	
9	7	8	1.28		51	.08	7	5	1.28		21	.08	7	2	1.28		51	.08	81	84.4	
10		55	1.28		56	0.08		52	1.28		26	0.08		49	1.30		56	0.08	80	83.8	
11	8	42	1.25	38	1	.10	8	39	1.28		31	.10	8	35	1.28	39	1	.10	79	83.2	
12	9	30	1.28		7	.10	9	26	1.28		37	.10	9	22	1.30		7	.12	78	82.5	
13	10	17	1.28		13	.12	10	13	1.30		43	.12	10	8	1.28		13	.12	77	81.9	
14	11	4	1.28		20	.13		59	1.28		50	.13		55	1.30		20	.12	76	81.3	
15		51	1.28		28	0.13	11	46	1.28		58	0.13	11	41	1.28		28	0.13	75	80.6	
16	12	38	1.28		36	.15	12	33	1.30	39	6	.15	12	28	1.30		36	.15	74	80.0	
17	13	25	1.28		45	.15	13	19	1.28		15	.15	13	14	1.30		45	.15	73	79.3	
18	14	12	1.30		54	.17	14	6	1.30		24	.17	14	0	1.30		54	.17	72	78.7	
19		58	1.28	39	4	.17		52	1.30		34	.17		46	1.30	40	4	.18	71	78.0	
20	15	45	1.30		14	0.18	15	38	1.30		44	0.18	15	32	1.33		14	0.18	70	77.4	
21	16	31	1.30		25	.20	16	24	1.30		55	.20	16	17	1.30		25	.20	69	76.7	
22	17	17	1.30		37	.20	17	10	1.30	40	7	.20	17	3	1.33		37	.20	68	76.0	
23	18	3	1.30		49	.22		56	1.30		19	.22		48	1.30		49	.22	67	75.4	
24		49	1.30	40	2	.22		18	42	1.33		32	.23	18	34	1.33	41	3	.22	66	74.7
25	19	35	1.30		15	0.23	19	27	1.30		46	0.23	19	19	1.33		15	0.23	65	74.0	
26	20	21	1.30		29	.25	20	13	1.33	41	0	.25	20	4	1.33		29	.25	64	73.3	
27	21	7	1.33		44	.27		58	1.33		15	.25		49	1.33		44	.27	63	72.6	
28		52	1.33	41	0	.27	21	43	1.33		30	.27	21	34	1.36	42	1	.27	62	71.9	
29	22	37	1.33		16	.28	22	28	1.36		46	.28	22	18	1.36		16	.28	61	71.2	
30	23	22	1.33		33	0.28	23	12	1.33	42	3	0.30	23	2	1.36		33	0.30	60	70.4	
31	24	7	1.33		50	.30		57	1.36		21	.30		46	1.36		50	.30	59	69.7	
32		52	1.36	42	8	.32	24	41	1.36		39	.32	24	30	1.36	43	10	.32	58	69.0	
33	25	36	1.36		27	.33	25	25	1.36		58	.33	25	14	1.40		27	.33	57	68.2	
34	26	20	1.36		47	.35	26	9	1.40	43	18	.35		57	1.40		47	.35	56	67.4	
35	27	4	1.36	43	8	0.35		52	1.40		39	0.35		26	40	1.40	44	10	0.35	55	66.7
36		48	1.40		29	.37	27	35	1.40	44	0	.37	27	23	1.40		29	.37	54	65.9	
37	28	31	1.40		51	.38	28	18	1.40		22	.38	28	6	1.43		51	.38	53	65.1	
38	29	14	1.40	44	14	.40	29	1	1.40		45	.40		48	1.43	45	16	.40	52	64.3	
39		57	1.40		38	.42		44	1.43	45	9	.42	29	30	1.43		38	.42	51	63.5	
40	30	40	1.43	45	3	0.42	30	26	1.43		34	0.43	30	12	1.43	46	5	0.43	50	62.7	
41	31	22	1.43		28	.45	31	8	1.46	46	0	.43		54	1.46		28	.43	49	61.8	
42	32	4	1.46		55	.47		49	1.46		26	.45		31	35	1.46	55	.45	48	61.0	
43		45	1.46	46	23	.47	32	30	1.46		53	.48	32	16	1.50	47	24	.48	47	60.1	
44	33	26	1.46		51	.48	33	11	1.46	47	22	.48		56	1.50		51	.48	46	59.3	
45	34	7		47	20			52			51		33	36			48	22		45	58.4

t	$a = 37^\circ 30'$		$a = 38^\circ 0'$		$a = 38^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 37^\circ 30'$		$d = 38^\circ 0'$		$d = 38^\circ 30'$		

*Handwritten notes:*  
 $h \sin \Delta$   
 $\sin$

b	a = 37° 30'					a = 38° 0'					a = 38° 30'					c	a				
	B	h	d	60'	t	Δ	60'	Z	t	Δ	60'	Z	t	Δ	60'			C	β		
			Δ	Δ																Δ	
45	34	7	1.46	47	20	0.52	33	52	1.50	47	51	0.52	33	36	1.50	48	22	0.50	45	58.4	
46		48	1.50		51	.52	34	32	1.50	48	22	.52	34	16	1.54		52	.53	44	57.5	
47	35	28	1.50	48	22	.55	35	12	1.54		53	.53	35	55	1.54	49	24	.53	43	56.6	
48	36	8	1.54		55	.55	51		1.54	49	25	.57	35	34	1.58		56	.55	42	55.6	
49		47	1.54	49	28	.58	36	30	1.58		59	.57	36	12	1.58	50	29	.58	41	54.7	
50	37	26	1.58	50	3	0.60	37	8	1.58	50	33	0.60	50		1.58	51	4	0.58	40	53.7	
51	38	4	1.58		39	.62	38	46	1.62	51	9	.62	37	28	1.62		39	.62	39	52.8	
52		42	1.62	51	16	.63	38	23	1.62		46	.63	38	5	1.67	52	16	.62	38	51.8	
53	39	19	1.62		54	.65	39	0	1.67	52	24	.65	39	41	1.67		53	.65	37	50.8	
54		56	1.67	52	33	.67	36		1.67	53	3	.67	39	17	1.71	53	32	.67	36	49.7	
55	40	32	1.67	53	13	0.70	40	12	1.71		43	0.68	52		1.71	54	12	0.70	35	48.7	
56	41	8	1.71		55	.72	47		1.71	54	24	.72	40	27	1.76		54	.70	34	47.6	
57		43	1.76	54	38	.73	41	22	1.76	55	7	.73	41	1	1.76	55	36	.73	33	46.5	
58	42	17	1.76		55	.77	42	56	1.82		51	.75	35		1.82	56	20	.75	32	45.4	
59		51	1.82	56	8	.78	42	29	1.82	56	36	.78	42	8	1.88		57	5	.77	31	44.3
60	43	24	1.88		55	0.80	43	2	1.88	57	23	0.80	40		1.88		51	0.78	30	43.2	
61		56	1.88	57	43	.82	44	34	1.94	58	11	.82	43	12	1.94	58	38	.82	29	42.0	
62	44	28	1.94		58	.85	44	5	1.94	59	0	.83	43		2.00	59	27	.83	28	40.8	
63		59	2.00	59	23	.88	36		2.00		50	.87	44	13	2.07	60	17	.85	27	39.6	
64	45	29	2.07	60	16	.88	45	6	2.07	60	42	.88	42		2.07	61	8	.88	26	38.4	
65		58	2.07	61	9	0.92	35		2.14	61	35	0.92	45	11	2.22	62	1	0.90	25	37.1	
66	46	27	2.14		62	4	46	3	2.22	62	30	.93	38		2.22		55	.92	24	35.9	
67		55	2.31	63	1	.97	30		2.31	63	26	.95	46	5	2.31	63	50	.95	23	34.6	
68	47	21	2.31		59	.98	56		2.31	64	23	.98	31		2.40	64	47	.97	22	33.3	
69		47	2.40	64	58	1.02	47	22	2.50	65	22	1.00	56		2.50	65	45	.98	21	31.9	
70	48	12	2.50	65	59	1.03	46		2.50	66	22	1.02	47	20	2.50	66	44	1.00	20	30.6	
71		36	2.61		67	1	48	10	2.61	67	23	1.03	44		2.73	67	44	1.03	19	29.2	
72		59	2.73	68	4	1.08	33		2.86	68	25	1.07	48	6	2.86	68	46	1.05	18	27.8	
73	49	21	2.86		69	9	54		2.86	69	29	1.08	27		3.00	69	49	1.07	17	26.4	
74		42	3.00	70	15	1.12	49	15	3.16	70	34	1.10	47		3.16	70	53	1.08	16	25.0	
75	50	2	3.33	71	22	1.13	34		3.33	71	40	1.13	49	6	3.33	71	58	1.12	15	23.5	
76		20	3.33	72	30	1.17	52		3.53	72	48	1.13	24		3.53	73	5	1.13	14	22.0	
77		38	3.75	73	40	1.17	50	9	3.75	73	56	1.17	41		3.75	74	13	1.13	13	20.5	
78		54	4.00	74	50	1.20	25		4.00	75	6	1.18	57		4.00	75	21	1.17	12	19.0	
79	51	9	4.29	76	2	1.22	40		4.29	76	17	1.18	50	12	4.62	76	31	1.17	11	17.5	
80		23	4.62	77	15	1.23	54		5.00	77	28	1.22	25		5.00	77	41	1.18	10	16.0	
81		36	5.45	78	29	1.23	51	6	5.45	78	41	1.22	37		5.45	78	52	1.20	9	14.4	
82		47	6.00	79	43	1.25	17		6.00	79	54	1.23	48		6.00	80	4	1.22	8	12.9	
83		57	6.67	80	58	1.27	27		6.67	81	8	1.25	58		7.50	81	17	1.23	7	11.3	
84	52	6	8.57	82	14	1.28	36		8.57	82	23	1.25	51	6	8.57	82	31	1.23	6	9.7	
85		13	10.0	83	31	1.28	43		10.0	83	38	1.27	13		10.0	83	45	1.23	5	8.1	
86		19	12.0	84	48	1.30	49		12.0	84	54	1.27	19		12.0	84	59	1.25	4	6.5	
87		24	20.0	86	6	1.30	54		20.0	86	10	1.27	24		20.0	86	14	1.25	3	4.9	
88		27	30.0	87	24	1.30	57		30.0	87	26	1.28	27		30.0	87	29	1.25	2	3.2	
89		29	60.0	88	42	1.30	59		60.0	88	43	1.28	29		60.0	88	44	1.27	1	1.6	
90		30		90	0		52	0		90	0		30			90	0		0	0.0	

t	d = 37° 30'				d = 38° 0'				d = 38° 30'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	



B	$a = 39^\circ 0'$				$a = 39^\circ 30'$				$a = 40^\circ 0'$				C	$\alpha$							
	h	d	t	$\frac{\Delta}{60'}$	h	d	t	$\frac{\Delta}{60'}$	h	d	t	$\frac{\Delta}{60'}$									
		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$									
0	0	0	1.28	39	0	0	0.00	0	0	1.30	39	30	0.00	0	0	1.30	40	0	0.00	90	90.0
1	0	47	1.30	0	0	46	1.28	0	46	1.28	30	0.02	0	46	1.30	0	0.02	89	89.0		
2	1	33	1.28	1	1	33	1.30	1	33	1.30	31	0.02	1	32	1.30	1	0.02	88	88.7		
3	2	20	1.28	2	2	19	1.30	2	19	1.30	32	0.03	2	18	1.30	2	0.03	87	88.1		
4	3	7	1.30	4	3	5	1.30	3	5	1.30	34	0.03	3	4	1.30	4	0.03	86	87.5		
5	5	53	1.28	6	5	51	1.28	6	51	1.28	36	0.05	5	50	1.30	6	0.05	85	86.8		
6	4	40	1.30	9	4	38	1.30	9	4	38	1.30	39	0.07	4	36	1.33	9	0.07	84	86.2	
7	5	26	1.28	13	5	24	1.30	13	5	24	1.30	43	0.07	5	21	1.30	13	0.07	83	85.5	
8	6	13	1.30	17	6	10	1.30	17	6	10	1.30	47	0.07	6	7	1.30	17	0.07	82	84.9	
9	5	59	1.30	21	5	56	1.30	21	5	56	1.30	51	0.08	5	53	1.30	21	0.08	81	84.2	
10	7	45	1.28	26	7	42	1.30	26	7	42	1.30	56	0.08	7	39	1.33	26	0.08	80	83.6	
11	8	32	1.30	31	8	28	1.30	31	8	28	1.30	40	1	8	24	1.30	31	1	10	79	83.0
12	9	18	1.30	37	9	14	1.30	37	9	14	1.30	7	7	10	1.33	37	7	12	78	82.3	
13	10	4	1.30	44	10	0	1.30	44	10	0	1.30	14	12	14	1.30	44	12	12	77	81.6	
14	50	50	1.30	51	10	46	1.33	51	10	46	1.33	21	13	10	41	1.33	51	13	13	76	81.0
15	11	36	1.30	59	11	31	1.30	59	11	31	1.30	29	0.13	11	26	1.33	59	0.13	75	80.3	
16	12	22	1.30	40	12	17	1.33	40	12	17	1.33	37	0.15	12	11	1.33	41	7	15	74	79.7
17	13	8	1.30	16	13	2	1.30	46	13	2	1.30	46	0.15	13	5	1.33	16	0.15	73	79.0	
18	54	54	1.30	25	13	48	1.33	55	13	48	1.33	55	0.17	13	41	1.33	25	0.17	72	78.3	
19	14	40	1.33	35	14	33	1.33	41	14	33	1.33	5	18	14	26	1.33	35	0.18	71	77.6	
20	15	25	1.33	45	15	18	1.33	16	15	18	1.33	16	0.18	15	11	1.33	46	0.18	70	77.0	
21	16	10	1.33	56	20	16	1.33	27	20	16	1.33	27	0.20	16	5	1.33	57	0.20	69	76.3	
22	55	55	1.33	41	8	48	1.33	39	20	48	1.33	39	0.20	16	41	1.36	42	9	20	68	75.6
23	17	40	1.33	20	17	33	1.33	51	20	33	1.33	51	0.22	17	25	1.36	21	0.22	67	74.9	
24	18	25	1.33	33	18	18	1.36	42	4	18	1.36	42	0.22	18	9	1.36	34	0.23	66	74.2	
25	19	10	1.33	47	19	2	1.36	17	19	2	1.36	17	0.23	19	53	1.36	48	0.23	65	73.5	
26	55	55	1.33	42	1	46	1.36	31	25	46	1.36	31	0.25	19	37	1.36	43	2	25	64	72.8
27	20	40	1.36	16	20	30	1.36	46	27	30	1.36	46	0.27	20	21	1.36	17	0.27	63	72.0	
28	21	24	1.36	32	27	21	1.36	43	2	21	1.36	43	0.27	21	5	1.40	33	0.27	62	71.3	
29	22	8	1.36	48	28	58	1.36	18	28	58	1.36	18	0.28	22	48	1.40	49	0.28	61	70.6	
30	52	52	1.36	43	5	22	1.40	35	30	22	1.40	35	0.30	22	31	1.40	44	6	0.28	60	69.8
31	23	36	1.40	22	32	23	1.40	53	30	23	1.40	53	0.30	23	14	1.40	23	0.32	59	69.1	
32	24	19	1.40	41	33	24	1.40	44	11	32	1.40	44	0.32	24	57	1.40	42	0.32	58	68.3	
33	25	2	1.40	44	0	51	1.40	30	33	24	1.40	30	0.33	24	40	1.43	45	1	0.33	57	67.6
34	45	45	1.40	20	33	25	1.43	50	35	25	1.43	50	0.35	25	22	1.43	21	0.33	56	66.8	
35	26	28	1.40	40	0.37	26	1.43	45	11	0.35	26	4	1.43	41	0.37	55	66.0				
36	27	11	1.43	45	2	37	1.43	32	37	37	1.46	46	3	46	1.46	46	3	0.37	54	65.2	
37	53	53	1.43	24	38	27	1.43	54	38	27	1.46	54	0.38	27	27	1.46	25	0.38	53	64.4	
38	28	35	1.43	47	40	28	1.46	46	17	40	1.46	46	0.40	28	8	1.46	48	0.40	52	63.6	
39	29	17	1.46	46	11	29	1.46	41	42	29	1.46	41	0.42	29	49	1.46	47	12	0.40	51	62.7
40	58	58	1.46	35	0.43	44	1.46	47	6	0.43	29	30	1.50	48	36	0.43	50	61.9			
41	30	39	1.46	47	1	45	1.50	30	25	1.50	32	0.43	30	10	1.50	48	2	0.43	49	61.1	
42	31	20	1.50	28	45	31	1.50	58	45	58	1.54	58	0.45	31	50	1.50	28	0.45	48	60.2	
43	32	0	1.50	55	47	45	1.50	48	25	48	1.54	48	0.48	31	30	1.54	55	0.48	47	59.3	
44	40	40	1.50	48	23	32	1.54	54	48	54	1.54	54	0.48	32	9	1.54	49	24	0.48	46	58.4
45	33	20	1.50	52	33	4	1.54	49	23	49	1.54	49	0.48	33	48	1.54	45	53	45	57.5	

t	$a = 39^\circ 0'$				$a = 39^\circ 30'$				$a = 40^\circ 0'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	$d = 39^\circ 0'$				$d = 39^\circ 30'$				$d = 40^\circ 0'$				

b	a = 39° 0'					a = 39° 30'					a = 40° 0'					c	a			
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β
			Δ	Z	60'				Z	60'				Z	60'					
45	33	20	1.54	48	52	0.52	33	4	1.54	49	23	0.50	32	48	1.58	49	53	0.50	45	57.5
46		59	1.54	49	23	.52	33	43	1.58	53	.52	33	26	1.58	50	23	.52	44	56.6	
47	34	38	1.54	54	.53		34	21	1.58	50	24	.53	34	4	1.58	54	.53	43	55.7	
48	35	17	1.58	50	26	.55		59	1.58	56	.55		42	1.62	51	26	.55	42	54.8	
49		55	1.62		59	.57	35	37	1.62	51	29	.57	35	19	1.62		59	.57	41	53.8
50	36	32	1.62	51	33	0.60	36	14	1.62	52	3	0.60		56	1.67	52	33	0.58	40	52.8
51	37	9	1.62	52	9	.60		51	1.67	39	.60	36	32	1.67	53	8	.60	39	51.9	
52		46	1.67		45	.63	37	27	1.67	53	15	.62	37	8	1.71		44	.62	38	50.9
53	38	22	1.71	53	23	.65	38	3	1.71	52	.63		43	1.71	54	21	.63	37	49.8	
54		57	1.71	54	2	.65		38	1.76	54	30	.67	38	18	1.76		59	.67	36	48.8
55	39	32	1.71		41	0.68	39	12	1.76	55	10	0.68		52	1.76	55	39	0.67	35	47.7
56	40	7	1.76	55	22	.70		46	1.82	51	.70	39	26	1.82	56	19	.70	34	46.7	
57		41	1.82	56	4	.73	40	19	1.82	56	33	.72		59	1.88	57	1	.72	33	45.6
58	41	14	1.88		48	.75		52	1.88	57	16	.73	40	31	1.88		44	.73	32	44.5
59		46	1.88	57	33	.77	41	24	1.88	58	0	.77	41	3	1.94	58	28	.75	31	43.4
60	42	18	1.94	58	19	0.78		56	1.94	46	0.77		34	2.00	59	13	0.77	30	42.2	
61		49	1.94	59	6	.80	42	27	2.00	59	32	.80	42	4	2.00		59	.80	29	41.1
62	43	20	2.00		54	.82		57	2.07	60	20	.82		34	2.07	60	47	.80	28	39.9
63		50	2.07	60	43	.85	43	26	2.14	61	9	.85	43	3	2.14	61	35	.83	27	38.7
64	44	19	2.14	61	34	.87		54	2.14	62	0	.85		31	2.22	62	25	.85	26	37.5
65		47	2.22	62	26	0.90	44	22	2.22		51	0.88		58	2.22	63	16	0.87	25	36.2
66	45	14	2.31	63	20	.92		49	2.31	63	44	.90	44	25	2.31	64	8	.90	24	35.0
67		40	2.31	64	15	.93	45	15	2.31	64	38	.93		51	2.40	65	2	.92	23	33.7
68	46	6	2.40	65	11	.95		41	2.50	65	34	.93	45	16	2.50		57	.93	22	32.4
69		31	2.50	66	8	.97	46	5	2.50	66	30	.97		40	2.61	66	53	.95	21	31.1
70		55	2.73	67	6	1.00	29	2.73	67	28	0.98	46	3	2.73	67	50	0.97	20	29.8	
71	47	17	2.73	68	6	1.02		51	2.86	68	27	1.00		25	2.86	68	48	.98	19	28.4
72		39	2.86	69	7	1.03	47	12	2.86	69	27	1.02		46	3.00	69	47	1.00	18	27.1
73	48	0	3.00	70	9	1.05		33	3.00	70	28	1.05	47	6	3.00	70	47	1.03	17	25.7
74		20	3.16	71	12	1.07		53	3.33	71	31	1.05		26	3.33	71	49	1.03	16	24.3
75		39	3.33	72	16	1.10	48	11	3.33	72	34	1.08		44	3.53	72	51	1.07	15	22.8
76		57	3.75	73	22	1.12		29	3.75	73	39	1.08	48	1	3.75	73	55	1.08	14	21.4
77	49	13	3.75	74	29	1.12		45	4.00	74	44	1.12		17	4.00	75	0	1.08	13	19.9
78		29	4.29	75	36	1.15	49	0	4.29	75	51	1.12		32	4.29	76	5	1.10	12	18.5
79		43	4.62	76	45	1.15		14	4.62	76	58	1.13		46	5.00	77	11	1.12	11	17.0
80		56	5.00	77	54	1.17		27	5.00	78	6	1.15		58	5.00	78	18	1.13	10	15.5
81	50	8	5.45	79	4	1.18		39	5.45	79	15	1.17	49	10	6.00	79	26	1.15	9	14.0
82		19	6.00	80	15	1.20		50	6.67	80	25	1.17		20	6.67	80	35	1.15	8	12.5
83		29	7.50	81	27	1.20		59	7.50	81	35	1.18		29	7.50	81	44	1.17	7	10.9
84		37	8.57	82	39	1.22	50	7	8.57	82	46	1.20		37	8.57	82	54	1.17	6	9.4
85		44	10.0	83	52	1.22		14	10.0	83	58	1.20		44	10.0	84	4	1.18	5	7.8
86		50	15.0	85	5	1.22		20	15.0	85	10	1.20		50	15.0	85	15	1.18	4	6.3
87		54	20.0	86	18	1.23		24	20.0	86	22	1.20		54	20.0	86	26	1.18	3	4.7
88		57	30.0	87	32	1.23		27	30.0	87	34	1.22		57	30.0	87	37	1.18	2	3.1
89		59	60.0	88	46	1.23		29	60.0	88	47	1.22		59	60.0	88	48	1.20	1	1.6
90	51	0		90	0			30		90	0			50	0	90	0		0	0.0

t	d = 39° 0'				d = 39° 30'				d = 40° 0'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	





b	a = 40° 30'				a = 41° 0'				a = 41° 30'				c	a						
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z			t	Δ	60'	C	β	
			Δ	Δ		Δ	Δ				Δ				Δ					
45	32	32	1.58	50	23	0.50	32	15	1.58	50	52	0.50	31	59	1.62	51	22	0.50	45	56.7
46	33	10	1.62	51	53	.52	33	53	1.62	51	22	.52	32	36	1.62	52	52	.50	44	55.8
47	47	47	1.62	51	24	.52	33	30	1.62	53	53	.53	33	13	1.67	52	22	.53	43	54.9
48	34	24	1.62	55	55	.55	34	7	1.67	52	25	.53	34	49	1.67	54	54	.53	42	53.9
49	35	1	1.62	52	28	.57	43	1.67	57	57	.57	34	25	1.67	53	26	.57	41	53.0	
50	38	38	1.67	53	2	0.58	35	19	1.67	53	31	0.58	35	1	1.71	54	0	0.58	40	52.0
51	36	14	1.71	54	37	.60	35	55	1.71	54	6	.60	36	36	1.76	55	35	.58	39	51.0
52	49	49	1.71	54	13	.62	36	30	1.76	54	42	.60	36	10	1.76	55	10	.60	38	50.0
53	37	24	1.76	55	50	.63	37	4	1.76	55	18	.63	37	18	1.82	56	24	.63	37	49.0
54	58	58	1.76	55	28	.65	38	38	1.82	56	37	.65	37	18	1.82	56	24	.65	36	47.9
55	38	32	1.82	56	7	0.67	38	11	1.82	56	35	0.67	38	23	1.88	57	3	0.65	35	46.9
56	39	5	1.88	57	47	.68	39	16	1.88	57	15	.68	38	23	1.88	57	3	.68	34	45.8
57	37	1.88	57	28	.72	39	16	1.88	56	56	.70	39	26	2.00	59	5	.72	33	44.7	
58	40	9	1.94	58	11	.72	40	19	1.94	58	38	.72	39	26	2.00	59	5	.72	32	43.6
59	40	1.94	58	54	.75	40	19	2.00	59	21	.75	40	19	2.00	59	21	.75	31	42.5	
60	41	11	2.00	59	39	0.77	41	18	2.07	60	6	0.75	40	26	2.07	60	32	0.75	30	41.3
61	41	2.00	60	25	.78	41	18	2.07	61	51	.78	41	24	2.14	61	17	.77	29	40.2	
62	42	11	2.14	61	12	.80	42	15	2.14	61	38	.78	41	24	2.14	62	3	.78	28	39.0
63	39	39	2.14	62	0	.83	42	15	2.14	62	25	.82	42	19	2.31	63	38	.80	27	37.8
64	43	7	2.22	50	.83	43	3	2.31	63	14	.83	42	19	2.31	63	38	.83	26	36.6	
65	34	2.31	63	40	0.87	43	9	2.31	64	4	0.85	43	10	2.40	64	28	0.85	25	35.4	
66	44	0	2.40	64	32	.88	44	35	2.40	65	55	.88	43	10	2.40	65	10	.85	24	34.2
67	25	2.40	65	25	.90	44	0	2.50	65	48	.88	43	10	2.40	65	10	.88	23	32.9	
68	50	2.50	66	19	.92	44	24	2.50	66	41	.92	44	22	2.73	67	3	.90	22	31.6	
69	45	14	2.73	67	14	.95	48	2.73	67	36	.92	44	22	2.73	67	36	.92	21	30.3	
70	36	2.73	68	11	0.95	45	10	2.73	68	31	0.95	44	2.86	68	52	0.93	20	29.0		
71	58	2.86	69	8	.97	45	32	3.00	69	28	.97	45	5	3.00	69	48	.95	19	27.7	
72	46	19	3.00	70	6	1.00	46	12	3.33	71	25	1.00	45	3.33	71	43	.98	18	26.3	
73	39	3.16	71	6	1.02	46	12	3.33	71	25	1.00	45	3.33	71	43	.98	17	25.0		
74	58	3.33	72	7	1.02	30	3.33	72	25	1.00	46	3	3.53	72	42	1.00	16	23.6		
75	47	16	3.53	73	8	1.05	48	3.53	73	25	1.03	20	3.53	73	42	1.00	15	22.2		
76	33	4.00	74	11	1.07	47	5	4.00	74	27	1.05	37	4.00	74	42	1.03	14	20.8		
77	48	4.00	75	15	1.07	20	4.00	75	30	1.05	52	4.29	75	44	1.05	13	19.4			
78	48	3	4.29	76	19	1.08	35	4.62	76	33	1.07	47	6	4.62	76	47	1.05	12	18.0	
79	17	5.00	77	24	1.10	48	5.00	77	37	1.08	19	5.00	77	50	1.07	11	16.5			
80	29	5.00	78	30	1.12	48	0	5.00	78	42	1.10	31	5.45	78	54	1.07	10	15.0		
81	41	6.00	79	37	1.13	12	6.00	79	48	1.10	42	6.00	79	58	1.08	9	13.6			
82	51	6.67	80	45	1.13	22	6.67	80	54	1.12	52	6.67	81	3	1.10	8	12.1			
83	49	0	7.50	81	53	1.13	31	7.50	82	1	1.13	48	1	7.50	82	9	1.12	7	10.6	
84	8	8.57	83	1	1.15	39	10.0	83	9	1.13	9	10.0	83	16	1.12	6	9.1			
85	15	12.0	84	10	1.17	45	12.0	84	17	1.13	15	12.0	84	23	1.12	5	7.6			
86	20	15.0	85	20	1.17	50	15.0	85	25	1.13	20	15.0	85	30	1.12	4	6.1			
87	24	20.0	86	30	1.17	54	20.0	86	33	1.15	24	20.0	86	37	1.12	3	4.6			
88	27	30.0	87	40	1.17	57	30.0	87	42	1.15	27	30.0	87	44	1.13	2	3.0			
89	29	60.0	88	50	1.17	59	60.0	88	51	1.15	29	60.0	88	52	1.13	1	1.5			
90	30		90	0		49	0	90	0		30		90	0		0	0.0			

t	a = 40° 30'				a = 41° 0'				a = 41° 30'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
	d = 40° 30'				d = 41° 0'				d = 41° 30'				



B	$a = 42^\circ 0'$				$a = 42^\circ 30'$				$a = 43^\circ 0'$				C	$\alpha$ $\beta$			
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z					
		$\Delta$	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$		$\Delta$	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$		$\Delta$	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$					
0	0	0	1.33	42	0	0	1.36	42	30	0	0	1.36	43	0	0	90	90.0
1	45	1.36			44	1.33		30	.02	44	1.36		0	.02	89	89.3	
2	1 29	1.33		1	.02	1 29	1.36	31	.02	1 28	1.36		1	.02	88	88.6	
3	2 14	1.36		2	.03	2 13	1.36	32	.03	2 12	1.40		2	.03	87	88.0	
4	58	1.33		4	.03	57	1.36	34	.03	55	1.36		4	.03	86	87.3	
5	3 43	1.36		6	.05	3 41	1.36	36	.05	3 39	1.36		6	.05	85	86.6	
6	4 27	1.33		9	.07	4 25	1.36	39	.07	4 23	1.36		9	.07	84	85.9	
7	5 12	1.36		13	.07	5 9	1.36	43	.07	5 7	1.36		13	.07	83	85.3	
8	56	1.33		17	.07	56	1.36	47	.07	5 51	1.40		17	.07	82	84.6	
9	6 41	1.36		21	.08	6 37	1.36	51	.08	6 34	1.36		21	.08	81	83.9	
10	7 25	1.36		26	.10	7 21	1.36	56	.10	7 18	1.40		26	.10	80	83.2	
11	8 9	1.36		32	.10	8 5	1.36	43	2	.10	8 1	1.36	32	.10	79	82.5	
12	53	1.36		38	.12	49	1.36	8	.12	45	1.40		38	.12	78	81.8	
13	9 37	1.36		45	.12	9 33	1.40	15	.12	9 28	1.40		45	.12	77	81.1	
14	10 21	1.36		52	.12	10 16	1.36	22	.13	10 11	1.36		52	.13	76	80.4	
15	11 5	1.36		59	.15	11 0	1.36	30	.13	55	1.40		44	0	.13	75	79.7
16	49	1.36	43	8	.15	44	1.40	38	.15	11 38	1.40		8	.15	74	79.0	
17	12 33	1.36		17	.15	12 27	1.40	47	.15	12 21	1.40		17	.15	73	78.3	
18	13 17	1.40		26	.17	13 10	1.40	56	.17	13 4	1.43		26	.17	72	77.6	
19	14 0	1.36		36	.18	53	1.40	44	6	.18	46	1.40	36	.18	71	76.9	
20	44	1.40		47	.18	14 36	1.40	17	.18	14 29	1.40		47	.18	70	76.2	
21	15 27	1.40		58	.20	15 19	1.40	28	.20	15 12	1.43		58	.20	69	75.5	
22	16 10	1.40	44	10	.20	16 2	1.40	40	.20	54	1.43		45	10	.20	68	74.7
23	53	1.40		22	.22	45	1.43	52	.22	16 36	1.43		22	.22	67	74.0	
24	17 36	1.40		35	.23	17 27	1.43	45	5	.23	17 18	1.43	35	.23	66	73.3	
25	18 19	1.43		49	.23	18 9	1.43	19	.23	18 0	1.43		49	.23	65	72.5	
26	19 1	1.43	45	3	.25	51	1.43	33	.25	42	1.43		46	3	.25	64	71.8
27	43	1.43		18	.27	19 33	1.43	48	.27	19 24	1.46		18	.27	63	71.0	
28	20 25	1.43		34	.27	20 15	1.43	46	4	.27	20 5	1.46	34	.27	62	70.2	
29	21 7	1.43		50	.28	57	1.46	20	.28	46	1.46		50	.28	61	69.5	
30	49	1.46	46	7	.30	21 38	1.46	37	.30	21 27	1.46		47	7	.30	60	68.7
31	22 30	1.46		25	.30	22 19	1.46	55	.30	22 8	1.50		25	.30	59	67.9	
32	23 11	1.46		43	.32	23 0	1.46	47	13	.32	48	1.50	43	.32	58	67.1	
33	52	1.46	47	2	.33	41	1.50	32	.33	23 28	1.50		48	2	.33	57	66.3
34	24 33	1.46		22	.33	24 21	1.50	52	.33	24 8	1.50		22	.33	56	65.5	
35	25 14	1.50		42	.37	25 1	1.50	48	12	.35	48	1.50	42	.35	55	64.7	
36	54	1.50	48	4	.37	41	1.50	33	.37	25 28	1.54		49	3	.37	54	63.9
37	26 34	1.50		26	.38	26 21	1.54	55	.38	26 7	1.54		25	.38	53	63.0	
38	27 14	1.54		49	.38	27 0	1.54	49	18	.40	46	1.58	48	.40	52	62.2	
39	53	1.54	49	12	.42	39	1.58	42	.40	27 24	1.58		50	12	.40	51	61.3
40	28 32	1.54		37	.42	28 17	1.58	50	6	.42	28 2	1.58	36	.42	50	60.5	
41	29 11	1.58	50	2	.43	55	1.58	31	.43	40	1.58		51	1	.43	49	59.6
42	49	1.58		28	.45	29 33	1.58	57	.45	29 18	1.62		27	.45	48	58.7	
43	30 27	1.58		55	.47	30 11	1.62	51	24	.47	55	1.62	54	.45	47	57.8	
44	31 5	1.62	51	23	.47	48	1.62	52	.48	30 32	1.62		52	21	.48	46	56.9
45	42			51		31 25		52	21		31 9		50		45	56.0	

t	$a = 42^\circ 0'$		$a = 42^\circ 30'$		$a = 43^\circ 0'$		$\alpha$
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 42^\circ 0'$		$d = 42^\circ 30'$		$d = 43^\circ 0'$		

B	a = 42° 0'					a = 42° 30'					a = 43° 0'					C	c	a	β				
	h	d	60'	Z	t	Δ	h	d	60'	Z	t	Δ	h	d	60'					Z	t	Δ	60'
	d		60'	Z	t	Δ	d		60'	Z	t	Δ	d		60'					Z	t	Δ	60'
45	31	42	1.62	51	51	0.50	31	25	1.62	52	21	0.48	31	9	1.67	52	50	0.48	45	56.0			
46	32	19	1.67	52	21	.52	32	2	1.67	50	.50		45	1.71	53	19	.50		44	55.0			
47	55		1.67	52		.52	38	1.71	53	20	.53	32	20	1.71	49	.52			43	54.1			
48	33	31	1.67	53	23	.53	33	13	1.71	52	.53	33	55	1.71	54	20	.53		42	53.1			
49	34	7	1.71	55		.57	48	1.71	54	24	.55	33	30	1.76	52	.55			41	52.1			
50	42		1.71	54	29	0.57	34	23	1.76	57	0.57	34	4	1.76	55	25	0.57		40	51.2			
51	35	17	1.76	55	3	.58	55	57	1.76	55	31	.58	38	1.82	56	59	.58		39	50.2			
52	51		1.82	58	38	.62	35	31	1.82	56	6	.60	35	11	1.82	56	34	.60	38	49.2			
53	36	24	1.82	56	15	.62	36	4	1.82	42	.62	36	44	1.82	57	10	.62		37	48.1			
54	57		1.82	52		.63	37	1.88	57	19	.63	36	17	1.94	47	.62			36	47.1			
55	37	30	1.88	57	30	0.65	37	9	1.88	57	0.65	48	1.94	58	24	0.65			35	46.0			
56	38	2	1.94	58	9	.68	41	1.94	58	36	.68	37	19	1.94	59	3	.67		34	45.0			
57	33		1.94	50		.68	38	12	2.00	59	17	.68	50	2.00	43	.68			33	43.9			
58	39	4	2.00	59	31	.72	42	2.00	58	70	.70	38	20	2.07	60	24	.68		32	42.8			
59	34		2.00	60	14	.72	39	12	2.07	60	40	.72	49	2.07	61	5	.72		31	41.7			
60	40	4	2.07	57		0.75	41	2.14	61	23	0.73	39	18	2.14	48	0.73			30	40.5			
61	33		2.14	61	42	.77	40	9	2.14	62	7	.75	46	2.22	62	32	.75		29	39.4			
62	41	1	2.22	62	28	.78	37	2.22	52	.78		40	13	2.22	63	17	.75		28	38.2			
63	28		2.31	63	15	.78	41	4	2.31	63	39	.78	40	2.31	64	2	.78		27	37.0			
64	54		2.31	64	2	.82	30	2.31	64	26	.82	41	6	2.40	49	.80			26	35.8			
65	42	20	2.40	51		0.83	56	2.40	65	15	0.82	31	2.50	65	37	0.82			25	34.6			
66	45		2.40	65	41	.85	42	21	2.50	66	4	.83	55	2.50	66	26	.83		24	33.4			
67	43	10	2.61	66	32	.88	45	2.61	54	.87		42	19	2.61	67	16	.85		23	32.1			
68	33		2.61	67	25	.88	43	8	2.73	67	46	.88	42	2.73	68	7	.87		22	30.9			
69	56		2.73	68	18	.90	30	2.86	68	39	.88	43	4	2.86	59	.88			21	29.6			
70	44	18	2.86	69	12	0.92	51	2.86	69	32	0.90	25	3.00	69	52	0.88			20	28.3			
71	39		3.00	70	7	.93	44	12	3.16	70	26	.93	45	3.16	70	45	.92		19	27.0			
72	59		3.16	71	3	.97	31	3.16	71	22	.93	44	4	3.33	71	40	.93		18	25.7			
73	45	18	3.33	72	1	.97	50	3.33	72	18	.95	22	3.33	72	36	.93			17	24.3			
74	36		3.53	59		.98	45	8	3.53	73	15	.98	40	3.53	73	32	.95		16	23.0			
75	53		3.75	73	58	1.00	25	4.00	74	14	0.98	57	4.00	74	29	0.97			15	21.6			
76	46	9	4.00	74	58	1.00	40	4.00	75	13	1.00	45	12	4.00	75	27	.98		14	20.3			
77	24		4.29	75	58	1.03	55	4.29	76	13	1.00	27	4.29	76	26	1.00			13	18.9			
78	38		4.62	77	0	1.03	46	9	4.62	77	13	1.02	41	5.00	77	26	1.00		12	17.5			
79	51		5.00	78	2	1.05	22	5.00	78	14	1.03	53	5.00	78	26	1.02			11	16.1			
80	47	3	6.00	79	5	1.07	34	6.00	79	16	1.05	46	5	6.00	79	27	1.03		10	14.6			
81	13		6.00	80	9	1.07	44	6.00	80	19	1.05	15	6.67	80	29	1.03			9	13.2			
82	23		6.67	81	13	1.08	54	7.50	81	22	1.07	24	7.50	81	31	1.03			8	11.8			
83	32		8.57	82	18	1.08	47	2	7.50	82	26	1.07	32	7.50	82	33	1.05		7	10.3			
84	39		8.57	83	23	1.08	10	10.0	83	30	1.07	40	10.0	83	36	1.05			6	8.8			
85	46		12.0	84	28	1.10	16	12.0	84	34	1.08	46	12.0	84	39	1.07			5	7.4			
86	51		15.0	85	34	1.10	21	15.0	85	39	1.08	51	15.0	85	43	1.07			4	5.9			
87	55		20.0	86	40	1.12	25	20.0	86	44	1.08	55	20.0	86	47	1.07			3	4.4			
88	58		60.0	87	47	1.10	28	60.0	87	49	1.08	58	60.0	87	51	1.08			2	3.0			
89	59		60.0	88	53	1.12	29	60.0	88	54	1.10	59	60.0	88	56	1.07			1	1.5			
90	48	0		90	0		30		90	0		47	0		90	0			0	0.0			
t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a							
	d = 42° 0'					d = 42° 30'					d = 43° 0'					a							



B	$a = 43^\circ 30'$				$a = 44^\circ 0'$				$a = 44^\circ 30'$				C	$\beta$					
	h	$d$	$\frac{60'}{\Delta}$	$t$	h	$d$	$\frac{60'}{\Delta}$	$t$	h	$d$	$\frac{60'}{\Delta}$	$t$			C				
		$\Delta$	Z	$\frac{\Delta}{60'}$		$\Delta$	Z	$\frac{\Delta}{60'}$		$\Delta$	Z	$\frac{\Delta}{60'}$							
0	0	0	1.36	43	30	0.00	0	0	1.40	44	0	0.00	0	0	90.0				
1	44	1.40	30	.02	43	1.40	0	.02	43	1.40	30	.02	80	89.3					
2	1	27	1.36	31	.02	1	26	1.36	1	.02	1	26	1.43	31	.02	88	88.6		
3	2	11	1.40	32	.03	2	10	1.40	2	.03	2	8	1.40	32	.03	87	87.9		
4	54	1.36	34	.03	53	1.40	4	.03	51	1.40	34	.03	86	87.2					
5	3	38	1.40	36	.05	3	36	1.40	6	.05	3	34	1.40	36	.05	85	86.5		
6	4	21	1.40	39	.07	4	19	1.40	9	.07	4	17	1.43	39	.07	84	85.8		
7	5	4	1.36	43	.07	5	2	1.40	13	.07	5	59	1.40	43	.07	83	85.1		
8	5	48	1.40	47	.07	5	45	1.40	17	.07	5	42	1.43	47	.07	82	84.4		
9	6	31	1.40	51	.08	6	28	1.40	21	.08	6	24	1.40	51	.08	81	83.7		
10	7	14	1.40	56	.10	7	11	1.43	26	.10	7	7	1.43	56	.10	80	83.0		
11	57	1.40	44	2	.10	53	1.40	32	.10	49	1.40	45	2	.10	79	82.3			
12	8	40	1.40	8	.12	8	30	1.40	38	.12	8	32	1.43	8	.12	78	81.6		
13	9	23	1.40	15	.12	9	19	1.43	45	.12	9	14	1.43	15	.12	77	80.9		
14	10	6	1.40	22	.13	10	1	1.40	52	.13	56	1.43	22	.13	76	80.2			
15	49	1.40	30	.13	44	1.43	45	0	.13	10	38	1.43	30	.13	75	79.5			
16	11	32	1.40	38	.15	11	26	1.43	8	.15	11	20	1.43	38	.15	74	78.7		
17	12	15	1.43	47	.15	12	8	1.43	17	.15	12	2	1.43	47	.15	73	78.0		
18	57	1.40	56	.17	50	1.43	26	.17	44	1.43	56	.17	72	.17	72	77.3			
19	13	40	1.43	45	6	.18	13	32	1.43	36	.18	13	26	1.46	46	6	.18	71	76.5
20	14	22	1.43	17	.18	14	14	1.43	47	.18	14	7	1.43	17	.18	70	75.8		
21	15	4	1.43	28	.20	15	56	1.43	58	.20	15	49	1.46	28	.20	69	75.1		
22	46	1.43	40	.20	15	38	1.46	46	10	.20	15	30	1.46	40	.20	68	74.3		
23	16	28	1.43	52	.22	16	19	1.43	22	.22	16	11	1.46	52	.22	67	73.6		
24	17	10	1.46	46	5	.23	17	1	1.46	35	.23	52	1.46	47	5	.23	66	72.8	
25	51	1.46	19	.23	42	1.46	49	.23	17	33	1.50	19	.23	65	.23	65	72.1		
26	18	32	1.46	33	.25	18	23	1.46	47	3	.25	18	13	1.46	33	.25	64	71.3	
27	19	13	1.46	48	.27	19	4	1.50	18	.27	19	54	1.50	48	.27	63	70.5		
28	54	1.46	47	4	.27	44	1.46	34	.27	19	34	1.50	48	4	.27	62	69.7		
29	20	35	1.46	20	.28	20	25	1.50	50	.28	20	14	1.50	20	.28	61	68.9		
30	21	16	1.50	37	.30	21	5	1.50	48	7	.30	54	1.54	37	.28	60	68.1		
31	56	1.50	55	.30	45	1.50	25	.30	21	33	1.54	54	.30	59	.30	59	67.3		
32	22	36	1.50	48	13	.32	22	25	1.54	43	.32	22	12	1.54	49	12	.32	58	66.5
33	23	16	1.50	32	.33	23	4	1.54	49	2	.32	51	1.54	31	.33	57	65.7		
34	56	1.54	52	.33	43	1.54	21	.35	23	30	1.54	51	.33	56	.33	56	64.9		
35	24	35	1.54	49	12	.35	24	22	1.54	42	.35	24	9	1.58	50	11	.35	55	64.1
36	25	14	1.54	33	.37	25	1	1.58	50	3	.37	47	1.58	32	.37	54	63.2		
37	53	1.54	55	.38	39	1.58	25	.37	25	25	1.58	54	.38	53	.38	53	62.4		
38	26	32	1.58	50	18	.38	26	17	1.58	47	.40	26	3	1.62	51	17	.38	52	61.5
39	27	10	1.58	41	.40	55	1.62	51	11	.40	40	1.62	40	.40	51	.40	51	60.6	
40	48	1.62	51	5	.42	27	32	1.62	35	.42	27	17	1.62	52	4	.42	50	59.8	
41	28	25	1.62	30	.43	28	9	1.62	52	0	.42	54	1.67	29	.42	49	58.9		
42	29	2	1.62	56	.45	46	1.62	25	.45	28	30	1.67	54	.45	48	.45	48	58.0	
43	39	1.67	52	23	.45	29	23	1.67	52	.45	29	6	1.67	53	21	.45	47	57.1	
44	30	15	1.67	50	.48	59	1.71	53	19	.47	42	1.71	48	.47	40	.47	40	56.1	
45	51		53	19		30	34		47		30	17		54	16		45	55.2	

t	$a = 43^\circ 30'$		$a = 44^\circ 0'$		$a = 44^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 43^\circ 30'$		$d = 44^\circ 0'$		$d = 44^\circ 30'$		

b		a = 43° 30'				a = 44° 0'				a = 44° 30'				c	a					
		d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$			C	$\beta$			
B	h		Z		h		Z		h		Z									
45	30	51	1.67	53	19	0.48	30	34	1.67	53	47	0.48	30	17	1.71	54	16	0.48	45	55.2
40	31	27	1.71	48	.50	31	10	1.71	54	16	.50	31	52	1.76	45	.48	44	44	44	54.3
47	32	2	1.76	54	18	.52	32	45	1.76	46	.52	31	26	1.76	55	14	.52	43	43	53.3
48	37	1.76	55	49	.53	32	19	1.76	55	17	.53	32	0	1.76	45	.52	42	42	42	52.4
49	33	11	1.76	55	21	.53	33	53	1.82	49	.53	34	34	1.82	56	16	.55	41	41	51.4
50	45	1.76	53	0.57	33	26	1.82	56	21	0.57	33	7	1.82	49	0.55	40	40	40	50.4	
51	34	19	1.82	56	27	.58	34	59	1.82	55	.57	40	1.88	57	22	.57	39	39	39	49.4
52	52	1.88	57	2	.58	34	32	1.88	57	29	.58	34	12	1.88	56	.58	38	38	38	48.4
53	35	24	1.88	57	37	.60	35	4	1.94	58	4	.60	44	1.94	58	31	.60	37	37	47.3
54	56	1.94	58	13	.63	35	35	1.94	40	.62	35	15	2.00	59	7	.62	36	36	36	46.3
55	36	27	1.94	51	0.65	36	6	2.00	59	17	0.65	45	2.00	44	0.62	35	35	35	45.2	
56	58	2.00	59	30	.65	36	36	2.00	56	.65	36	15	2.07	60	21	.65	34	34	34	44.2
57	37	28	2.00	60	9	.67	37	6	2.07	60	35	.67	44	2.07	61	0	.67	33	33	43.1
58	58	2.07	49	.70	38	35	2.07	61	15	.68	37	13	2.14	40	.68	32	32	32	42.0	
59	38	27	2.14	61	31	.70	38	4	2.14	56	.70	41	2.14	62	21	.68	31	31	31	40.9
60	55	2.14	62	13	0.72	32	2.22	62	38	0.72	38	9	2.22	63	2	0.70	30	30	30	39.7
61	39	23	2.22	56	.75	39	59	2.22	63	21	.72	36	2.31	44	.73	29	29	29	38.6	
62	50	2.31	63	41	.75	39	26	2.31	64	4	.75	39	2	2.40	64	.73	28	28	28	37.4
63	40	16	2.40	64	26	.77	40	52	2.40	49	.77	27	2.40	65	12	.75	27	27	27	36.3
64	41	2.40	65	12	.80	40	17	2.50	65	35	.78	52	2.50	57	.78	26	26	26	35.1	
65	41	6	2.50	66	0	0.80	41	2.50	66	22	0.80	40	16	2.50	66	44	0.78	25	25	33.9
66	30	2.61	48	.82	41	5	2.61	67	10	.80	40	40	2.73	67	31	.80	24	24	24	32.7
67	53	2.61	67	37	.85	28	2.73	58	.83	41	2	2.73	68	19	.82	23	23	23	31.4	
68	42	16	2.86	68	28	.85	50	2.86	68	48	.83	24	2.86	69	8	.83	22	22	22	30.2
69	37	2.86	69	19	.87	42	11	3.00	69	38	.87	45	3.00	58	.85	21	21	21	28.9	
70	58	3.00	70	11	0.88	31	3.00	70	30	0.87	42	5	3.16	70	49	0.85	20	20	20	27.7
71	43	18	3.16	71	4	.90	51	3.16	71	22	.88	24	3.16	71	40	.88	19	19	19	26.4
72	37	3.33	58	.92	43	10	3.33	72	15	.90	43	3.53	72	33	.88	18	18	18	25.1	
73	55	3.33	72	53	.92	28	3.53	73	9	.92	43	0	3.53	73	26	.90	17	17	17	23.8
74	44	13	3.75	73	48	.95	45	3.75	74	4	.93	17	3.75	74	20	.92	16	16	16	22.4
75	29	4.00	74	45	0.95	44	1	4.00	75	0	0.93	33	4.00	75	15	0.92	15	15	15	21.1
76	44	4.29	75	42	.97	16	4.29	56	.95	44	4.29	48	4.62	76	10	.93	14	14	14	19.7
77	58	4.29	76	40	.98	30	4.62	76	53	.97	44	1	4.62	77	6	.95	13	13	13	18.4
78	45	12	5.00	77	39	.98	43	5.00	77	51	.97	14	5.00	78	3	.97	12	12	12	17.0
79	24	5.45	78	38	1.00	55	5.45	78	49	.98	26	5.45	79	1	.97	11	11	11	15.6	
80	35	5.45	79	38	1.00	45	6	6.00	79	48	1.00	37	6.00	59	0.97	10	10	10	14.2	
81	46	6.67	80	38	1.02	16	6.00	80	48	1.00	47	6.67	80	57	.98	9	9	9	12.8	
82	55	7.50	81	39	1.03	26	7.50	81	48	1.00	56	7.50	81	56	1.00	8	8	8	11.4	
83	46	3	8.57	82	41	1.03	34	8.57	82	48	1.00	45	8.57	82	56	1.00	7	7	7	10.0
84	10	10.0	83	43	1.03	41	10.0	83	49	1.02	11	10.0	83	56	1.00	6	6	6	8.6	
85	16	12.0	84	45	1.05	47	15.0	84	50	1.03	17	15.0	84	56	1.00	5	5	5	7.2	
86	21	15.0	85	48	1.05	51	15.0	85	52	1.03	21	15.0	85	56	1.02	4	4	4	5.7	
87	25	20.0	86	51	1.05	55	20.0	86	54	1.03	25	20.0	86	57	1.02	3	3	3	4.3	
88	28	60.0	87	54	1.05	58	60.0	87	56	1.03	28	60.0	87	58	1.02	2	2	2	2.9	
89	29	60.0	88	57	1.05	59	60.0	88	58	1.03	29	60.0	88	59	1.02	1	1	1	1.4	
90	30		90	0		46	0		90	0		30		90	0		0	0	0	0.0

t	a = 43° 30'				a = 44° 0'				a = 44° 30'				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	d = 43° 30'				d = 44° 0'				d = 44° 30'				



B	$a = 45^\circ 0'$				$a = 45^\circ 30'$				$a = 46^\circ 0'$				C	c	$\beta$				
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z				C			
		$\Delta$	t	$\frac{\Delta}{60'}$		$\Delta$	t	$\frac{\Delta}{60'}$		$\Delta$	t	$\frac{\Delta}{60'}$							
0	0	0	1.43	45	0	0	1.43	45	0	0	1.43	46	0	90	90.0				
1	0	42	1.40	0	.02	42	1.43	30	.02	42	1.46	0	.02	89	89.3				
2	1	25	1.43	1	.02	1	24	1.43	31	.02	1	23	1.43	1	.02	88	88.6		
3	2	7	1.40	2	.03	2	6	1.43	32	.03	2	5	1.43	2	.03	87	87.9		
4	5	0	1.43	4	.03	4	8	1.43	34	.03	4	7	1.46	4	.03	86	87.1		
5	3	32	1.43	6	.05	3	30	1.43	36	.05	3	28	1.43	6	.05	85	86.4		
6	4	14	1.40	9	.07	4	12	1.43	39	.07	4	10	1.46	9	.07	84	85.7		
7	5	57	1.43	13	.07	5	54	1.43	43	.07	5	51	1.43	13	.07	83	85.0		
8	5	39	1.43	17	.07	5	36	1.43	47	.07	5	33	1.46	17	.07	82	84.3		
9	6	21	1.43	21	.08	6	18	1.43	51	.08	6	14	1.43	21	.08	81	83.6		
10	7	3	1.43	26	.10	7	0	1.46	56	.10	7	0	1.46	26	.10	80	82.8		
11	8	45	1.43	32	.10	8	41	1.43	46	.10	8	37	1.46	32	.10	79	82.1		
12	8	27	1.43	38	.12	8	23	1.46	8	.12	8	18	1.46	38	.12	78	81.4		
13	9	9	1.43	45	.12	9	4	1.43	15	.12	9	59	1.46	45	.12	77	80.7		
14	9	51	1.43	52	.13	9	46	1.46	22	.13	9	40	1.46	52	.13	76	79.9		
15	10	33	1.43	46	0	.13	10	27	1.46	30	.13	10	21	1.46	47	0	.13	75	79.2
16	11	15	1.46	8	.15	11	8	1.46	38	.15	11	2	1.46	8	.15	74	78.4		
17	11	56	1.46	17	.15	49	1.46	47	.15	43	1.46	17	.15	73	77.7				
18	12	37	1.46	26	.17	12	30	1.46	56	.17	12	24	1.50	26	.17	72	77.0		
19	13	18	1.46	36	.18	13	11	1.46	47	.18	13	4	1.46	36	.18	71	76.2		
20	14	0	1.46	47	.18	52	1.46	17	.18	45	1.50	47	.18	70	75.4				
21	14	40	1.46	58	.20	14	33	1.50	28	.20	14	25	1.50	58	.20	69	74.7		
22	15	21	1.46	47	.20	15	13	1.46	40	.20	15	5	1.50	48	.20	68	73.9		
23	16	2	1.46	22	.22	54	1.50	52	.22	45	1.50	22	.22	67	73.2				
24	16	43	1.50	35	.23	16	34	1.50	48	.23	16	25	1.50	35	.23	66	72.4		
25	17	23	1.50	49	.23	17	14	1.50	19	.23	17	5	1.54	49	.23	65	71.6		
26	18	3	1.50	48	.25	54	1.54	33	.25	44	1.54	49	.23	64	70.8				
27	18	43	1.50	18	.25	18	33	1.50	48	.25	18	23	1.54	17	.27	63	70.0		
28	19	23	1.50	33	.27	19	13	1.54	49	.27	19	3	1.54	33	.27	62	69.2		
29	20	3	1.54	49	.28	52	1.54	19	.28	41	1.54	49	.28	61	68.4				
30	21	21	1.54	49	.30	20	31	1.54	36	.30	20	20	1.58	50	.28	60	67.6		
31	21	21	1.54	24	.30	21	10	1.58	54	.30	58	1.58	23	.30	59	66.8			
32	22	0	1.54	42	.32	48	1.58	50	.30	21	36	1.58	41	.32	58	66.0			
33	23	39	1.54	50	.32	22	26	1.58	30	.33	22	14	1.58	51	.32	57	65.1		
34	23	18	1.58	20	.35	23	4	1.58	50	.33	52	1.62	19	.33	56	64.3			
35	24	34	1.62	51	.35	24	20	1.62	31	.37	24	6	1.62	52	.37	55	63.5		
36	24	34	1.62	51	.35	24	20	1.62	31	.37	24	6	1.62	52	.37	54	62.6		
37	25	11	1.62	23	.38	57	1.62	53	.37	43	1.67	22	.37	53	61.7				
38	25	48	1.62	46	.38	25	34	1.62	52	.38	25	19	1.67	44	.38	52	60.9		
39	26	25	1.62	52	.40	26	11	1.67	38	.40	55	1.67	53	.40	51	60.0			
40	27	2	1.67	33	.42	47	1.67	53	.40	26	31	1.67	31	.40	50	59.1			
41	28	38	1.67	58	.42	27	23	1.71	26	.43	27	7	1.71	55	.42	49	58.2		
42	28	14	1.67	53	.43	58	1.71	52	.43	42	1.71	54	.43	48	.43	47	57.3		
43	29	50	1.71	49	.45	28	33	1.71	54	.45	28	17	1.76	46	.45	47	56.4		
44	29	25	1.71	54	.47	29	8	1.71	45	.45	51	1.76	55	.45	46	55.4			
45	30	0		44		43		55	1.2	29	25		40		45		54.5		

t	$a = 45^\circ 0'$				$a = 45^\circ 30'$				$a = 46^\circ 0'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	$d = 45^\circ 0'$				$d = 45^\circ 30'$				$d = 46^\circ 0'$				

b	a = 45° 0'				a = 45° 30'				a = 46° 0'				c	α						
	B	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	Z			$\frac{\Delta}{60'}$	C	β			
		h	o	'	o	'	o	'	o	'	o	'			o			'		
45	30	0	1.76	54	44	0.48	29	43	1.76	55	12	0.48	29	25	1.76	55	40	0.48	45	54.5
46	34	1.76	55	13	.48	30	17	1.82	41	.48	59	59	1.82	56	9	.48	44	44	53.6	
47	31	8	1.76	42	.52	50	10	1.82	56	10	.50	30	32	1.82	56	38	.50	43	52.6	
48	42	1.82	56	13	.52	31	23	1.82	40	.52	31	5	1.88	57	8	.52	42	51.6		
49	32	15	1.82	44	.53	56	11	1.88	57	11	.53	37	37	1.88	57	39	.52	41	50.6	
50	48	1.88	57	16	.55	32	28	1.88	43	.55	32	9	1.94	58	10	.55	40	49.6		
51	33	20	1.88	49	.57	33	0	1.88	58	16	.57	40	40	1.94	43	.55	39	48.6		
52	52	1.94	58	23	.58	34	32	1.94	50	.57	33	11	1.94	59	16	.57	38	47.6		
53	34	23	1.94	58	.58	34	3	2.00	59	24	.58	42	2.00	50	.58	37	46.6			
54	54	2.00	59	33	.62	33	2.00	59	.62	34	12	2.07	60	25	.60	36	45.5			
55	35	24	2.07	60	10	.62	35	3	2.07	60	36	.62	41	2.07	61	1	.62	35	44.5	
56	53	2.07	47	.65	32	2.14	61	13	.63	35	10	2.14	38	15	.65	34	43.4			
57	36	22	2.07	61	26	.65	36	0	2.14	51	.65	38	2.14	62	15	.65	33	42.3		
58	51	2.14	62	5	.67	28	2.14	62	30	.65	36	6	2.22	54	.65	32	41.2			
59	37	19	2.22	45	.68	56	2.22	63	9	.68	33	2.31	63	33	.68	31	40.1			
60	46	2.31	63	26	.70	37	23	2.31	50	.70	59	2.31	64	14	.68	30	39.0			
61	38	12	2.31	64	8	.72	49	2.40	64	32	.70	37	25	2.40	55	.70	29	37.9		
62	38	2.40	51	.73	38	14	2.40	65	14	.72	50	2.50	65	37	.72	28	36.7			
63	39	3	2.50	65	35	.75	39	2.50	57	.75	38	14	2.50	66	20	.72	27	35.5		
64	27	2.50	66	20	.75	39	3	2.61	66	42	.75	38	2.61	67	3	.75	26	34.4		
65	51	2.61	67	5	.78	26	2.61	67	27	.77	39	1	2.73	48	.75	25	33.2			
66	40	14	2.73	52	.80	49	2.73	68	13	.78	23	2.73	68	33	.78	24	32.0			
67	36	2.73	68	40	.80	40	11	2.86	69	0	.80	45	2.86	69	20	.78	23	30.8		
68	58	2.86	69	28	.82	32	3.00	48	.80	40	6	3.00	70	7	.80	22	29.5			
69	41	19	3.00	70	17	.83	52	3.00	70	36	.82	26	3.16	55	.80	21	28.3			
70	39	3.16	71	7	.85	41	12	3.33	71	25	.83	45	3.33	71	43	.83	20	27.0		
71	58	3.33	58	.87	30	3.33	72	15	.85	41	3	3.33	72	33	.83	19	25.8			
72	42	16	3.53	72	50	.87	48	3.53	73	6	.87	21	3.53	73	23	.85	18	24.5		
73	33	3.75	73	42	.88	42	5	3.75	58	.88	38	3.75	74	14	.87	17	23.2			
74	49	3.75	74	35	.90	21	3.75	74	51	.88	54	4.00	75	6	.87	16	21.9			
75	43	5	4.29	75	29	.92	37	4.29	75	44	.90	42	9	4.29	58	.88	15	20.6		
76	19	4.29	76	24	.92	51	4.29	76	38	.90	23	4.62	76	51	.90	14	19.3			
77	33	4.62	77	19	.93	43	5	5.00	77	32	.92	36	5.00	77	45	.90	13	17.9		
78	46	5.45	78	15	.95	17	5.00	78	27	.93	48	5.00	78	39	.92	12	16.6			
79	57	5.45	79	12	.95	29	6.00	79	23	.93	43	0	6.00	79	34	.92	11	15.2		
80	44	8	6.00	80	9	.97	39	6.00	80	19	.95	10	6.00	80	29	.93	10	13.9		
81	18	6.67	81	7	.97	49	7.50	81	16	.95	20	7.50	81	25	.93	9	12.5			
82	27	8.57	82	5	.97	57	7.50	82	13	.95	28	8.57	82	21	.93	8	11.2			
83	34	8.57	83	3	.98	44	5	8.57	83	10	.97	35	8.57	83	17	.95	7	9.8		
84	41	10.0	84	2	.98	12	12.0	84	8	.97	42	12.0	84	14	.95	6	8.4			
85	47	12.0	85	1	.98	17	12.0	85	6	.98	47	12.0	85	11	.97	5	7.0			
86	52	20.0	86	0	1.00	22	20.0	86	5	.97	52	20.0	86	9	.95	4	5.6			
87	55	20.0	87	0	1.00	25	20.0	87	3	.98	55	20.0	87	6	.97	3	4.2			
88	58	60.0	88	0	1.00	28	60.0	88	2	.98	58	60.0	88	4	.97	2	2.8			
89	59	60.0	89	0	1.00	29	60.0	89	1	.98	59	60.0	89	2	.97	1	1.4			
90	45	0	90	0		30		90	0		44	0	90	0		0	0.0			
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a							
	d = 45° 0'				d = 45° 30'				d = 46° 0'											



b		a = 46° 30'				a = 47° 0'				a = 47° 30'				c	α		
		d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$			C	β
0	0 0	1.46	46	30	0.00	0 0	1.46	47	0	0.00	0 0	1.46	47	30	0.00	90	90.0
1	0 41	1.43	30	.02	0 41	1.46	0	.02	0 41	1.50	30	.02	80	89.3			
2	1 23	1.46	31	.02	1 22	1.46	1	.02	1 21	1.46	31	.02	88	88.5			
3	2 4	1.46	32	.03	2 3	1.46	2	.03	2 2	1.50	32	.03	87	87.8			
4	4 45	1.46	34	.03	4 44	1.46	4	.03	4 42	1.46	34	.03	86	87.1			
5	3 26	1.43	36	0.05	3 25	1.50	6	0.05	3 23	1.50	36	0.05	85	86.3			
6	4 8	1.46	39	.07	4 5	1.46	9	.07	4 3	1.50	39	.07	84	85.6			
7	49	1.46	43	.07	46	1.46	13	.07	43	1.46	43	.07	83	84.9			
8	5 30	1.46	47	.07	5 27	1.50	17	.07	5 24	1.50	47	.07	82	84.1			
9	6 11	1.46	51	.08	6 7	1.46	21	.08	6 4	1.50	51	.08	81	83.4			
10	52	1.46	56	0.10	48	1.46	26	0.10	44	1.50	56	0.10	80	82.7			
11	7 33	1.46	47	2 .10	7 29	1.50	32	.10	7 24	1.50	48	2 .10	79	81.9			
12	8 14	1.46	8	.12	8 9	1.50	38	.12	8 4	1.50	8	.10	78	81.2			
13	55	1.50	15	.12	49	1.46	45	.12	44	1.50	14	.12	77	80.4			
14	9 35	1.46	22	.13	9 30	1.50	52	.13	9 24	1.50	21	.13	76	79.7			
15	10 16	1.50	30	0.13	10 10	1.50	48	0	10 4	1.50	29	0.13	75	78.9			
16	56	1.46	38	.15	50	1.50	8	.15	44	1.50	37	.15	74	78.2			
17	11 37	1.50	47	.15	11 30	1.50	17	.15	11 24	1.54	46	.17	73	77.4			
18	12 17	1.50	56	.17	12 10	1.50	26	.17	12 3	1.50	56	.17	72	76.6			
19	57	1.50	48	6 .18	50	1.54	36	.17	43	1.54	49	6 .17	71	75.9			
20	13 37	1.50	17	0.18	13 29	1.50	46	0.18	13 22	1.54	16	0.18	70	75.1			
21	14 17	1.50	28	.20	14 9	1.54	57	.20	14 1	1.54	27	.20	69	74.3			
22	57	1.54	40	.20	48	1.54	49	9 .20	40	1.54	39	.20	68	73.5			
23	15 36	1.50	52	.22	15 27	1.54	21	.22	15 19	1.58	51	.22	67	72.8			
24	16 16	1.54	49	5 .22	16 6	1.54	34	.23	57	1.58	50	4 .23	66	72.0			
25	55	1.54	18	0.23	45	1.54	48	0.23	16 35	1.58	18	0.23	65	71.2			
26	17 34	1.54	32	.25	17 24	1.58	50	2 .25	17 13	1.58	32	.23	64	70.4			
27	18 13	1.58	47	.25	18 2	1.58	17	.25	51	1.58	46	.25	63	69.6			
28	51	1.54	50	2 .27	40	1.58	32	.27	18 29	1.58	51	1 .27	62	68.8			
29	19 30	1.58	18	.28	19 18	1.58	48	.28	19 7	1.58	17	.28	61	67.9			
30	20 8	1.58	35	0.28	56	1.58	51	5 0.28	45	1.62	34	0.28	60	67.1			
31	46	1.58	52	.30	20 34	1.62	22	.30	20 22	1.62	51	.30	59	66.3			
32	21 24	1.62	51	10 .32	21 11	1.62	40	.30	59	1.62	52	9 .32	58	65.4			
33	22 1	1.62	29	.32	48	1.62	58	.32	21 36	1.67	28	.32	57	64.6			
34	38	1.62	48	.33	22 25	1.62	52	17 .33	22 12	1.67	47	.33	56	63.7			
35	23 15	1.62	52	8 0.35	23 2	1.67	37	0.35	48	1.67	53	7 0.33	55	62.9			
36	52	1.67	29	.37	38	1.67	58	.35	23 24	1.67	27	.35	54	62.0			
37	24 28	1.67	51	.37	24 14	1.67	53	19 .37	24 0	1.71	48	.37	53	61.1			
38	25 4	1.67	53	13 .38	50	1.71	41	.38	35	1.71	54	10 .38	52	60.3			
39	40	1.67	36	.38	25 25	1.71	54	4 .40	25 10	1.76	33	.38	51	59.4			
40	26 16	1.71	59	0.40	26 0	1.71	28	0.40	44	1.76	56	0.40	50	58.5			
41	51	1.71	54	23 .42	35	1.76	52	.42	26 18	1.76	55	20 .42	49	57.6			
42	27 26	1.76	48	.43	27 9	1.76	55	17 .42	52	1.76	45	.42	48	56.6			
43	28 0	1.76	55	14 .45	43	1.76	42	.45	27 26	1.82	56	10 .43	47	55.7			
44	34	1.76	41	.45	28 17	1.82	56	9 .45	59	1.82	36	.45	46	54.8			
45	29 8		56	8	50		36		28 32		57	3	45	53.8			

t	a = 46° 30'				a = 47° 0'				a = 47° 30'				α
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	d = 46° 30'				d = 47° 0'				d = 47° 30'				

b	a = 46° 30'					a = 47° 0'					a = 47° 30'					c	a					
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β		
			Δ	Z					Δ					Z							Δ	Z
0																						
45	29	8	1.82	56	8	0.47	28	50	1.82	56	36	0.47	28	32	1.82	57	3	0.47	45	53.8		
46		41	1.82		36	.48	29	23	1.88		4	.48	29	5	1.88		31	.48	44	52.9		
47	30	14	1.88	57	5	.50		55	1.88		33	.48		37	1.94	58	0	.48	43	51.9		
48		46	1.88		35	.52	30	27	1.88		58	2	.52	30	8	1.94	29	.50	42	50.9		
49	31	18	1.94	58	6	.52		59	1.94		33	.52		39	1.94	59	.52	41	49.9			
50		49	1.94		37	.53	31	30	2.00		59	4	.53	31	10	2.00	59	30	.53	40	48.9	
51	32	20	1.94	59	9	.55		32	0	2.00		36	.53		40	2.00	60	2	.53	39	47.9	
52		51	2.00		42	.57	32	0	2.00		60	8	.57	32	10	2.07		34	.55	38	46.9	
53	33	21	2.07	60	16	.58		33	0	2.07		42	.57		39	2.07	61	7	.57	37	45.9	
54		50	2.07		51	.58	29	2	2.07		61	16	.60	33	8	2.14		41	.58	36	44.8	
55	34	19	2.07	61	26	.62		58	2.14		52	.60		36	2.14	62	16	.60	35	43.8		
56		48	2.14		3	.62	34	26	2.22		62	28	.60	34	4	2.22		52	.62	34	42.7	
57	35	16	2.22	62	3	.63		53	2.22		63	4	.63		31	2.31	63	29	.62	33	41.6	
58		43	2.22		18	.65	35	20	2.31		42	.65		57	2.31	64	6	.63	32	40.5		
59	36	10	2.31	63	18	.65		46	2.31		64	21	.65	35	23	2.40		44	.65	31	39.4	
60		36	2.40		37	.68	36	12	2.40		65	0	.67		48	2.40	65	23	.67	30	38.3	
61	37	1	2.40	64	37	.68		37	2.50		40	.68		36	13	2.50		3	.67	29	37.2	
62		26	2.50		59	.70	37	1	2.50		66	21	.70		37	2.61		43	.70	28	36.0	
63	38	13	2.61	66	41	.73		25	2.61		67	3	.72	37	0	2.61	67	25	.70	27	34.9	
64		38	2.61		25	.73	48	4	2.73		46	.73		23	2.73	68	7	.72	26	33.7		
65	39	19	2.73	68	9	.75		38	2.73		68	30	.73		45	2.86		50	.73	25	32.5	
66		58	2.86		54	.75	32	2.86		69	14	.75		38	6	2.86		34	.73	24	31.3	
67	39	19	3.00	69	39	.78		53	3.00		59	.77		27	3.00	70	18	.75	23	30.1		
68		39	3.00		26	.78	39	13	3.00		70	45	.77		47	3.16		3	.77	22	28.9	
69	40	59	3.16	71	13	.80		33	3.33		71	31	.80	39	6	3.33		49	.78	21	27.7	
70		18	3.33		72	1	51	3.33		72	19	.80		24	3.33		36	.78	20	26.5		
71	40	36	3.53	72	1	.82		9	3.53		73	7	.82		42	3.53		23	.80	19	25.2	
72		53	3.53		39	.83	40	26	3.75		56	.82		59	3.75		11	.82	18	24.0		
73	41	10	3.75	74	29	.85		42	3.75		74	45	.83		15	4.00		0	.82	17	22.7	
74		26	4.29		20	.87	58	4	4.29		75	35	.85	40	30	4.29		49	.83	16	21.4	
75	42	7	4.29	76	12	.87		12	4.29		76	26	.85		44	4.29		39	.85	15	20.1	
76		54	4.62		4	.88	41	26	4.62		77	17	.87		58	5.00		30	.85	14	18.8	
77	42	7	5.00	77	4	.88		39	5.00		78	9	.88		41	10	5.00		21	.87	13	17.5
78		19	5.00		50	.90	51	5	5.45		79	2	.88		22	5.45		13	.87	12	16.2	
79	43	31	6.00	79	44	.90		2	6.00		55	.88		33	6.00		5	.88	11	14.9		
80		41	6.67		38	.92	12	6.67		80	48	.90		43	6.67		58	.88	10	13.6		
81	43	50	7.50	80	38	.93		21	7.50		81	42	.90		52	7.50		51	.88	9	12.2	
82		58	7.50		29	.92	20	8.57		82	36	.92		42	8.75		44	.90	8	10.9		
83	43	6	10.0	83	24	.93		36	10.0		83	31	.92		7	10.0		38	.90	7	9.5	
84		12	10.0		20	.93	42	10.0		84	26	.92		13	12.0		32	.90	6	8.2		
85	44	18	15.0	85	16	.95		48	15.0		85	21	.93		18	15.0		26	.90	5	6.8	
86		22	15.0		13	.93	52	15.0		86	17	.92		22	15.0		20	.92	4	5.5		
87	44	26	30.0	87	9	.95		56	30.0		87	12	.93		26	30.0		15	.92	3	4.1	
88		28	30.0		6	.95	58	30.0		88	8	.93		28	30.0		10	.92	2	2.7		
89	45	30	—	89	3	.95		0	—		89	4	.93		30	—		5	.92	1	1.4	
90		30	—		0	—	43	0	—		90	0	—		30	—		0	—	0	0.0	

t	a = 46° 30'		a = 47° 0'		a = 47° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 46° 30'		d = 47° 0'		d = 47° 30'		



B	a = 48° 0'				a = 48° 30'				a = 49° 0'				C	a						
	h	d	60'	Z	h	d	60'	Z	h	d	60'	Z			C	β				
		Δ	t			Δ	t			Δ	t						Δ	t		
0	0	0	1.50	48	0	0.00	0	0	1.50	48	30	0.00	0	0	1.54	49	0	0.00	90	90.0
1		40	1.50		0	.02	40	1.50		30	.02		39	1.50		0	.02		89	89.3
2	1	20	1.50		1	.02	1	20	1.54		31	.02	1	19	1.54		1	.02	88	88.5
3		2	0	1.50		2	.03	59	1.50		32	.03		58	1.54		2	.03	87	87.8
4		40	1.50		4	.03	2	39	1.50		34	.03	2	37	1.50		4	.03	86	87.0
5	3	20	1.50		6	0.05	3	19	1.54		36	0.05	3	17	1.54		6	0.05	85	86.3
6	4	0	1.50		9	.07	58	1.50		39	.07		56	1.54		9	.07		84	85.5
7		40	1.50		13	.07	4	38	1.54		43	.07	4	35	1.54		13	.07	83	84.7
8	5	20	1.50		17	.07	5	17	1.50		47	.07	5	14	1.54		17	.07	82	84.0
9		6	0	1.50		21	.08	57	1.54		51	.08		53	1.54		21	.08	81	83.2
10		40	1.50		26	0.10	6	36	1.50		56	0.10	6	32	1.54		26	0.10	80	82.5
11	7	20	1.50		32	.10	7	16	1.54	49	2	.10	7	11	1.54		32	.10	79	81.7
12		8	0	1.54		38	.10	5	55	1.54		8	.10	50	1.54		38	.10	78	81.0
13		39	1.50		44	.12	8	34	1.54		14	.12	8	29	1.54		44	.12	77	80.2
14	9	19	1.54		51	.13	9	13	1.54		21	.13	9	8	1.54		51	.13	76	79.4
15		58	1.50		59	0.13	52	1.54		29	0.13		47	1.58		59	0.13	75	78.7	
16	10	38	1.54	49	7	.15	10	31	1.54		37	.15	10	25	1.54	50	7	.15	74	77.9
17	11	17	1.54		16	.15	11	10	1.54		46	.15	11	4	1.58		16	.15	73	77.1
18		56	1.54		25	.17	49	1.54		55	.17		42	1.58		25	.17	72	76.3	
19	12	35	1.54		35	.18	12	28	1.58	50	5	.18	12	20	1.58		35	.17	71	75.5
20	13	14	1.54		46	0.18	13	6	1.58		16	0.18		58	1.58		45	0.18	70	74.8
21		53	1.58		57	.20	44	1.58		27	.18		13	36	1.58		56	.20	69	74.0
22	14	31	1.58	50	9	.20	14	22	1.58		38	.20	14	14	1.62	51	8	.20	68	73.2
23	15	9	1.58		21	.22	15	0	1.58		50	.22		51	1.58		20	.22	67	72.4
24		47	1.58		34	.22	38	1.58		51	3	.23	15	29	1.62		33	.22	66	71.6
25	16	25	1.58		47	0.23	16	16	1.62		17	0.23	16	6	1.62		46	0.23	65	70.7
26	17	3	1.58	51	1	.25	53	1.62		31	.23		43	1.62	52	0	.23	64	69.9	
27		41	1.58		16	.25	17	30	1.62		45	.25	17	20	1.67		14	.25	63	69.1
28	18	19	1.62		31	.27	18	7	1.62	52	0	.27		56	1.62		29	.27	62	68.3
29		56	1.62		47	.27	44	1.62		16	.27	18	33	1.67		45	.28	61	67.5	
30	19	33	1.62	52	3	0.28	19	21	1.67		32	0.28	19	9	1.67	53	2	0.28	60	66.6
31	20	10	1.67		20	.30	57	1.67		49	.30		45	1.67		19	.28	59	65.8	
32		46	1.67		38	.30	20	33	1.67	53	7	.30	20	21	1.71		36	.30	58	64.9
33	21	22	1.67		56	.32	21	9	1.67		25	.32		56	1.71		54	.32	57	64.1
34		58	1.67	53	15	.33	45	1.71		44	.33	21	31	1.71	54	13	.33	56	63.2	
35	22	34	1.67		35	0.35	22	20	1.71	54	4	0.33	22	6	1.71		33	0.33	55	62.3
36	23	10	1.71		56	.35	55	1.71		24	.35		41	1.76		53	.35	54	61.4	
37		45	1.71	54	17	.37	23	30	1.71		45	.37	23	15	1.76	55	14	.35	53	60.6
38	24	20	1.76		39	.37	24	5	1.76	55	7	.37		49	1.76		35	.37	52	59.7
39		54	1.76	55	1	.38	39	1.76		29	.38	24	23	1.76		57	.38	51	58.8	
40	25	28	1.76		24	0.40	25	13	1.82		52	0.40		57	1.82	56	20	0.40	50	57.9
41	26	2	1.76		48	.42	46	1.82	56	16	.42	25	30	1.82		44	.40	49	56.9	
42		36	1.82	56	13	.42	26	19	1.82		41	.42	26	3	1.88	57	8	.42	48	56.0
43	27	9	1.82		38	.43	52	1.88		57	6	.43		35	1.88		33	.43	47	55.1
44		42	1.88	57	4	.45	27	24	1.88		32	.43	27	7	1.94		59	.43	46	54.1
45	28	14			31		56			58			38			58	25		45	53.2

t	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a
	Δ	t	Δ	t	Δ	t	Δ	t	Δ	t	Δ	t	
	d = 48° 0'				d = 48° 30'				d = 49° 0'				

b		a = 48° 0'					a = 48° 30'					a = 49° 0'					c	a		
		B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z
45	28	14	1.88	57	31	0.47	27	56	1.88	57	58	0.47	27	38	1.94	58	25	0.45	45	53.2
46		46	1.88	57	59	.47	28	28	1.94	58	26	.47	28	9	1.94	58	52	.47	44	52.2
47	29	18	1.94	58	27	.48	29	59	1.94	59	54	.48	29	40	1.94	59	20	.48	43	51.2
48		49	1.94	58	56	.50	29	30	2.00	59	23	.48	29	11	2.00	59	49	.48	42	50.2
49	30	20	2.00	59	26	.50	30	0	2.00	30	0	.50	30	41	2.07	60	18	.50	41	49.3
50		50	2.00	60	56	0.53		30	2.00	60	22	0.52	30	10	2.07		48	0.52	40	48.2
51	31	20	2.07	60	28	.53	31	0	2.07	53	53	.53	31	39	2.07	61	19	.53	39	47.2
52		49	2.07	61	0	.55	29	29	2.14	61	25	.55	31	8	2.14	51	51	.53	38	46.2
53	32	18	2.14	62	33	.57	29	57	2.14	58	57	.57	31	36	2.22	62	23	.55	37	45.2
54		46	2.14	62	7	.57	32	25	2.22	62	32	.57	32	3	2.22	56	56	.57	36	44.1
55	33	14	2.22	63	41	0.60		52	2.22	63	6	0.58	30	2.22	63	30	0.58	35	43.1	
56		41	2.22	63	17	.60	33	19	2.31	41	6	.58	30	57	2.31	64	5	.58	34	42.0
57	34	8	2.31	64	53	.62	34	45	2.31	64	16	.62	33	23	2.40	40	40	.60	33	40.9
58		34	2.31	64	30	.62	34	11	2.40	53	62	.62	34	48	2.40	65	16	.62	32	39.8
59	35	0	2.40	65	7	.65	34	36	2.40	65	30	.63	34	13	2.50	53	53	.63	31	38.7
60		25	2.50	66	46	.65	35	1	2.50	66	8	0.65	37	2.50	66	31	0.63	30	37.6	
61		49	2.50	66	25	.67	25	25	2.61	47	67	.67	35	1	2.61	67	9	.65	29	36.5
62	36	13	2.61	67	5	.68	36	48	2.61	67	27	.67	24	2.73	68	28	.67	28	35.4	
63		36	2.73	67	46	.70	36	11	2.73	68	7	.68	46	2.73	68	28	.67	27	34.2	
64		58	2.73	68	28	.70	33	33	2.86	48	48	.70	36	8	2.86	69	8	.70	26	33.1
65	37	20	2.86	69	10	0.72		54	2.86	69	30	0.72	29	3.00		50	0.70	25	31.9	
66		41	3.00	70	53	.73	37	15	3.00	70	13	.72	49	3.00	70	32	.70	24	30.7	
67	38	1	3.00	70	37	.75	35	35	3.16	56	56	.73	37	9	3.16	71	14	.73	23	29.5
68		21	3.16	71	22	.75	38	54	3.16	71	40	.75	28	3.33	72	58	.73	22	28.3	
69		40	3.33	72	7	.77	38	13	3.33	72	25	.75	46	3.53	72	42	.75	21	27.1	
70		58	3.53	73	53	0.78		31	3.53	73	10	0.77	38	3	3.53	73	27	0.75	20	25.9
71	39	15	3.75	73	40	.78	39	48	3.75	56	56	.78	20	3.75	74	12	.77	19	24.7	
72		31	3.75	74	27	.80	39	4	4.00	74	43	.78	36	4.00	75	58	.77	18	23.5	
73		47	4.00	75	15	.82		19	4.00	75	30	.80	51	4.00	75	44	.78	17	22.2	
74	40	2	4.29	76	4	.82	34	4.29	76	18	18	.80	39	6	4.62	76	31	.80	16	21.0
75		16	4.62	77	53	0.83		48	4.62	77	6	0.82	19	4.62	77	19	0.80	15	19.7	
76		29	5.00	77	43	.83	40	1	5.00	55	55	.83	32	5.00	78	7	.82	14	18.4	
77		41	5.00	78	33	.85		13	5.45	78	45	.83	44	5.45	78	56	.82	13	17.1	
78		53	6.00	79	24	.85	24	6.00	79	35	35	.83	55	6.00	79	45	.83	12	15.8	
79	41	3	6.00	80	15	.87	34	6.00	80	25	25	.85	40	5	6.00	80	35	.83	11	14.6
80		13	6.67	81	7	0.87		44	6.67	81	16	0.85	15	7.50	81	25	0.83	10	13.2	
81		22	7.50	82	59	.88	41	53	7.50	82	7	.87	23	7.50	82	15	.85	9	11.9	
82		30	8.57	82	52	.88		1	8.57	59	59	.87	31	8.57	83	6	.85	8	10.6	
83		37	10.0	83	45	.88	8	8	10.0	83	51	.87	38	10.0		57	.85	7	9.3	
84		43	12.0	84	38	.88	14	14	12.0	84	43	.87	44	12.0	84	48	.87	6	8.0	
85		48	15.0	85	31	0.88		19	15.0	85	35	0.88	49	15.0	85	40	0.87	5	6.7	
86		52	15.0	86	24	.90	23	23	20.0	86	28	.88	53	20.0	86	32	.87	4	5.3	
87		56	30.0	87	18	.90	26	26	30.0	87	21	.88	56	30.0	87	24	.87	3	4.0	
88		58	30.0	88	12	.90	28	28	30.0	88	14	.88	58	30.0	88	16	.87	2	2.7	
89	42	0	—	89	6	.90	30	—	—	89	7	.88	41	0	—	89	8	.87	1	1.3
90		0		90	0		30			90	0			0		90	0		0	0.0

t	a = 48° 0'		a = 48° 30'		a = 49° 0'		a
	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	b	$\frac{60'}{\Delta}$	b	
	d = 48° 0'		d = 48° 30'		d = 49° 0'		



B	$a = 49^\circ 30'$				$a = 50^\circ 0'$				$a = 50^\circ 30'$				C	$\alpha$		
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$			C	$\beta$
		b		t		b		t		b		t				
0	0	0	49	0	0	50	0	0	0	50	0	0	90	90.0		
1	39	1.54	30	.02	39	1.58	0	.02	38	1.58	30	.02	80	89.2		
2	18	1.54	31	.02	17	1.54	1	.02	16	1.58	31	.02	88	88.5		
3	57	1.54	32	.03	56	1.58	2	.03	54	1.54	32	.03	87	87.7		
4	36	1.54	34	.03	34	1.54	4	.03	33	1.58	34	.03	86	86.9		
5	15	1.54	36	.05	13	1.58	6	.05	11	1.58	36	.05	85	86.2		
6	54	1.58	39	.07	51	1.54	9	.07	49	1.58	39	.07	84	85.4		
7	32	1.54	43	.07	30	1.58	13	.07	27	1.58	43	.07	83	84.6		
8	11	1.54	47	.07	8	1.58	17	.07	5	1.58	47	.07	82	83.9		
9	50	1.54	51	.08	46	1.54	21	.08	43	1.62	51	.08	81	83.1		
10	29	1.58	56	.08	25	1.58	26	.08	20	1.58	56	.08	80	82.3		
11	7	1.54	50	.10	7	1.58	31	.10	58	1.58	51	.10	79	81.5		
12	46	1.58	7	.12	41	1.58	37	.12	36	1.58	7	.12	78	80.8		
13	24	1.58	14	.12	19	1.58	44	.12	14	1.62	14	.12	77	80.0		
14	2	1.58	21	.13	57	1.58	51	.13	51	1.58	21	.12	76	79.2		
15	40	1.58	29	.13	35	1.62	59	.13	29	1.62	28	.13	75	78.4		
16	18	1.58	37	.15	10	1.58	51	.13	6	1.62	36	.15	74	77.6		
17	56	1.58	46	.15	50	1.58	15	.15	43	1.62	45	.15	73	76.8		
18	34	1.58	55	.17	28	1.62	24	.17	20	1.62	54	.17	72	76.0		
19	12	1.58	51	.17	12	1.62	34	.18	57	1.62	52	.17	71	75.2		
20	50	1.58	15	.18	42	1.62	45	.18	12	1.62	14	.18	70	74.4		
21	28	1.62	26	.20	19	1.62	56	.18	13	1.67	25	.20	69	73.6		
22	5	1.62	38	.20	56	1.62	52	.20	47	1.67	37	.20	68	72.8		
23	42	1.62	50	.20	14	1.67	19	.22	14	1.67	49	.20	67	72.0		
24	19	1.62	52	.22	15	1.62	32	.22	59	1.67	53	.22	66	71.2		
25	56	1.62	15	.23	46	1.67	45	.23	15	1.67	14	.23	65	70.3		
26	33	1.67	29	.25	16	1.67	59	.23	16	1.67	28	.23	64	69.5		
27	9	1.67	44	.25	58	1.67	53	.25	47	1.67	42	.25	63	68.7		
28	45	1.67	59	.27	17	1.67	28	.27	17	1.71	57	.27	62	67.8		
29	18	1.67	53	.27	18	1.71	44	.27	58	1.71	54	.27	61	67.0		
30	57	1.67	31	.28	45	1.71	54	.28	18	1.71	29	.28	60	66.1		
31	19	1.71	48	.28	19	1.71	17	.28	19	1.76	46	.28	59	65.3		
32	38	1.71	54	.30	55	1.71	34	.30	42	1.76	55	.30	58	64.4		
33	43	1.71	23	.32	30	1.76	52	.32	20	1.76	21	.30	57	63.6		
34	21	1.71	42	.32	21	1.76	55	.32	50	1.76	39	.32	56	62.7		
35	52	1.76	55	.33	38	1.76	30	.33	21	1.82	58	.33	55	61.8		
36	22	1.76	21	.35	22	1.76	50	.33	57	1.82	56	.35	54	60.9		
37	23	1.76	42	.35	46	1.82	56	.37	22	1.82	39	.35	53	60.0		
38	34	1.82	56	.37	23	1.82	32	.37	23	1.82	57	.37	52	59.1		
39	24	1.82	25	.38	52	1.88	54	.37	30	1.88	22	.37	51	58.2		
40	40	1.82	48	.40	24	1.88	57	.38	24	1.88	44	.38	50	57.3		
41	25	1.88	57	.40	56	1.88	39	.40	40	1.94	58	.40	49	56.3		
42	45	1.88	36	.42	25	1.88	58	.42	25	1.94	31	.40	48	55.4		
43	26	1.88	58	.42	26	1.94	28	.42	42	1.94	55	.42	47	54.5		
44	49	1.94	26	.43	31	1.94	53	.43	26	1.94	59	.43	46	53.5		
45	27	2.00	52	.45	27	2.00	59	.45	44	2.00	46	.45	45	52.5		

t	$a = 49^\circ 30'$		$a = 50^\circ 0'$		$a = 50^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 49^\circ 30'$		$d = 50^\circ 0'$		$d = 50^\circ 30'$		

b		a = 49° 30'					a = 50° 0'					a = 50° 30'					c	a		
		B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z
45	27	23	1.94	58	52	.45	27	2	2.00	59	19	.45	27	4	2.00	60	12	.45	45	52.5
40	51	2.00	59	19	.47	32	2.00	46	.45	27	14	2.07	60	12	.45	44	51.6			
47	28	21	2.00	47	.47	28	2	2.00	60	13	.47	43	2.07	61	7	.48	43	50.6		
48	51	2.00	60	15	.48	32	2.07	41	.48	28	12	2.07	61	7	.48	42	49.6			
49	29	21	2.07	44	.50	29	1	2.07	61	10	.50	41	2.07	36	.48	41	48.6			
50	50	2.07	61	14	.52	30	2.14	40	.50	29	10	2.14	62	5	.50	40	47.6			
51	30	19	2.14	45	.52	58	2.14	62	10	.52	38	2.22	35	.52	39	46.6				
52	47	2.14	62	16	.53	30	2.22	41	.53	30	5	2.22	63	6	.52	38	45.6			
53	31	15	2.22	48	.55	53	2.22	63	13	.53	32	2.31	37	.53	37	44.5				
54	42	2.22	63	21	.55	31	2.0	2.31	45	.55	58	2.31	64	9	.55	36	43.5			
55	32	9	2.31	54	.57	46	2.31	64	18	.57	31	24	2.40	42	.55	35	42.4			
56	35	2.40	64	28	.58	32	12	2.40	.57	52	29	2.40	65	15	.57	34	41.4			
57	33	0	2.40	65	.60	37	2.40	65	26	.60	32	14	2.40	49	.58	33	40.3			
58	25	2.40	69	39	.60	33	2	2.50	66	2	.60	39	2.50	66	24	.60	32	39.2		
59	50	2.50	66	15	.62	26	2.50	38	.60	33	3	2.61	67	0	.60	31	38.1			
60	34	14	2.61	52	.63	50	2.61	67	14	.63	26	2.73	36	.62	30	37.0				
61	37	2.61	67	30	.65	34	13	2.73	52	.63	48	2.73	68	13	.63	29	35.9			
62	35	0	2.73	68	.65	35	2.86	68	30	.65	34	10	2.86	51	.63	28	34.8			
63	22	2.86	48	.67	56	2.86	69	9	.65	31	2.86	69	29	.65	27	33.6				
64	43	2.86	69	28	.68	35	17	2.86	48	.67	52	3.00	70	8	.67	26	32.5			
65	36	4	3.00	70	.70	38	3.00	70	28	.68	35	12	3.16	48	.67	25	31.3			
66	24	3.16	51	.70	58	3.16	71	9	.70	31	3.16	71	28	.68	24	30.2				
67	43	3.16	71	33	.72	36	17	3.33	51	.70	50	3.33	72	9	.68	23	29.0			
68	37	2	3.33	72	.72	35	3.33	72	33	.72	36	8	3.33	50	.70	22	27.8			
69	20	3.53	59	.73	53	3.53	73	16	.72	26	3.75	73	32	.72	21	26.6				
70	37	3.75	73	43	.75	37	10	3.75	59	.73	42	3.75	74	15	.73	20	25.4			
71	53	3.75	74	28	.75	26	4.00	74	43	.75	58	4.00	75	59	.73	19	24.2			
72	9	4.00	75	13	.77	41	4.00	75	28	.75	37	13	4.00	75	43	.73	18	23.0		
73	24	4.29	59	.77	56	4.29	76	13	.77	28	4.29	76	27	.75	17	21.8				
74	38	4.62	76	45	.78	38	10	4.62	59	.77	42	4.62	77	12	.75	16	20.5			
75	51	4.62	77	32	.80	23	5.00	77	45	.78	55	5.00	78	43	.78	15	19.3			
76	39	4	5.00	78	.80	35	5.00	78	32	.78	38	7	5.45	78	43	.78	14	18.0		
77	16	5.45	79	.80	47	6.00	79	19	.78	18	6.00	79	30	.78	13	16.8				
78	27	6.00	56	.82	57	6.00	80	6	.80	28	6.00	80	17	.78	12	15.5				
79	37	6.67	80	45	.82	39	7	6.67	54	.80	38	6.67	81	4	.78	11	14.2			
80	46	7.50	81	34	.82	16	7.50	81	42	.82	47	7.50	82	51	.80	10	13.0			
81	54	7.50	82	23	.83	24	7.50	82	31	.82	55	7.50	82	39	.80	9	11.7			
82	2	10.0	83	13	.83	32	10.0	83	20	.83	39	3	10.0	83	27	.82	8	10.4		
83	8	10.0	84	3	.85	38	10.0	84	10	.82	9	10.0	84	16	.82	7	9.1			
84	14	12.0	54	.85	44	12.0	59	.83	15	15.0	85	5	.82	6	7.8					
85	19	15.0	85	45	.85	49	15.0	85	49	.83	19	15.0	86	54	.82	5	6.5			
86	23	20.0	86	36	.85	53	20.0	86	39	.83	23	20.0	86	43	.82	4	5.2			
87	26	30.0	87	27	.85	56	30.0	87	29	.83	26	30.0	87	32	.82	3	3.9			
88	28	30.0	88	18	.85	58	30.0	88	19	.85	28	30.0	88	21	.82	2	2.6			
89	30	—	89	9	.85	40	—	89	10	.83	30	—	89	10	.83	1	1.3			
90	30	—	90	0	—	0	—	90	0	—	30	—	90	0	—	0	0.0			

t	a = 49° 30'				a = 50° 0'				a = 50° 30'				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	d = 49° 30'				d = 50° 0'				d = 50° 30'				



B	$a = 51^\circ 0'$				$a = 51^\circ 30'$				$a = 52^\circ 0'$				C	$\beta$	
	$d$	$\frac{60'}{\Delta}$	$t$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$t$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$t$	$\frac{\Delta}{60'}$			
	$h$		Z		$h$		Z		$h$		Z				
0	0	0	51	0	0	0	51	30	0	0	0	52	0	90	90.0
1	38	1.58		0	37	1.58		30	37	1.62		0	0	80	80.2
2	1 16	1.62		1	15	1.62		31	1 14	1.62		1	1	88	88.4
3	53	1.58		2	52	1.62		32	51	1.62		2	2	87	87.7
4	2 31	1.58		4	2 29	1.58		34	2 28	1.62		4	4	86	86.9
5	3 9	1.58		6	3 7	1.62		36	3 5	1.67		6	6	85	86.1
6	47	1.62		9	44	1.62		39	41	1.62		9	9	84	85.3
7	4 24	1.58		13	4 21	1.62		42	4 18	1.62		12	12	83	84.5
8	5 2	1.62		17	5 8	1.62		46	5 5	1.62		16	16	82	83.7
9	39	1.62		21	5 35	1.62		51	5 32	1.67		21	21	81	82.9
10	6 16	1.58		26	6 12	1.62		56	6 8	1.62		26	26	80	82.1
11	54	1.62		31	49	1.62		52	1	1.62		31	31	79	81.4
12	7 31	1.62		37	7 26	1.62		7	7 21	1.62		37	37	78	80.6
13	8 8	1.62		44	8 3	1.62		13	8 34	1.67		43	43	77	79.8
14	45	1.62		51	40	1.67		20	8 34	1.67		50	50	76	79.0
15	9 22	1.62		58	9 16	1.62		28	9 10	1.67		58	58	75	78.2
16	59	1.62		52	53	1.67		36	46	1.67		53	6	74	77.4
17	10 36	1.62		15	10 29	1.67		45	10 22	1.67		14	14	73	76.5
18	11 13	1.67		24	11 5	1.67		54	11 5	1.67		23	23	72	75.7
19	49	1.62		34	41	1.67		53	11 34	1.71		33	33	71	74.9
20	12 26	1.67		44	12 17	1.67		13	12 9	1.67		43	43	70	74.1
21	13 2	1.67		55	53	1.67		24	45	1.71		54	54	69	73.3
22	38	1.67		53	13 29	1.67		35	13 20	1.71		54	5	68	72.5
23	14 14	1.67		18	14 5	1.71		47	55	1.71		17	20	67	71.6
24	50	1.67		30	40	1.71		54	14 30	1.71		29	22	66	70.8
25	15 26	1.71		43	15 15	1.71		13	15 5	1.71		42	42	65	70.0
26	16 1	1.71		57	50	1.71		26	40	1.76		55	23	64	69.1
27	36	1.71		54	16 25	1.71		40	16 14	1.76		55	9	63	68.3
28	17 11	1.71		26	17 0	1.76		55	48	1.76		24	24	62	67.4
29	46	1.76		42	34	1.76		55	17 22	1.76		39	39	61	66.5
30	18 20	1.71		58	18 8	1.76		26	56	1.82		55	55	60	65.7
31	55	1.76		55	42	1.76		43	18 29	1.82		56	11	59	64.8
32	19 29	1.76		31	19 16	1.82		56	19 2	1.82		28	30	58	63.9
33	20 3	1.76		49	20 49	1.82		18	35	1.82		46	46	57	63.1
34	37	1.82		56	20 22	1.82		36	20 8	1.82		57	4	56	62.2
35	21 10	1.82		26	55	1.82		55	41	1.88		23	23	55	61.3
36	43	1.82		46	21 28	1.88		57	21 13	1.88		42	42	54	60.4
37	22 16	1.88		57	22 0	1.88		34	45	1.88		58	2	53	59.5
38	48	1.88		28	32	1.88		55	22 17	1.94		23	35	52	58.6
39	23 20	1.88		49	23 4	1.94		58	48	1.94		44	44	51	57.6
40	52	1.94		58	35	1.94		39	23 19	1.94		59	6	50	56.7
41	24 23	1.94		34	24 6	1.94		59	2	2.00		29	38	49	55.8
42	54	1.94		58	37	2.00		25	24 20	2.00		52	38	48	54.8
43	25 25	2.00		59	25 7	2.00		49	50	2.07		60	15	47	53.9
44	55	2.00		47	37	2.00		60	25 19	2.07		40	42	46	52.9
45	26 25			60	26 7			39	48			61	5	45	52.0

t	$a = 51^\circ 0'$		$a = 51^\circ 30'$		$a = 52^\circ 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 51^\circ 0'$		$d = 51^\circ 30'$		$d = 52^\circ 0'$		

B	a = 51° 0'					a = 51° 30'					a = 52° 0'					C	a				
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t						
		$\frac{60'}{\Delta}$	Z	t	$\frac{60'}{\Delta}$		Z	t	$\frac{60'}{\Delta}$	Z		t	$\frac{60'}{\Delta}$	Z	t						
45	26	25	2.00	60	12	0.43	26	7	2.07	60	39	0.43	25	48	2.07	61	5	0.43	45	52.0	
46		55	2.07		38	.45		36	2.07		61	5	.43	26	17	2.07		31	.43	44	51.0
47	27	24	2.07	61	5	.47	27	5	2.14	31	45	.45	27	46	2.14	57	57	.45	43	50.0	
48		53	2.14		33	.47		33	2.14		58	.47	27	14	2.22	62	24	.47	42	49.0	
49	28	21	2.14	62	1	.48	28	1	2.14	62	26	.48		41	2.22		52	.47	41	48.0	
50		49	2.14		30	.50		29	2.22		55	.48	28	8	2.22	63	20	.48	40	47.0	
51	29	17	2.22	63	0	.50	29	17	2.22	63	24	.50		35	2.31		49	.50	39	46.0	
52		44	2.31		30	.50	29	23	2.31		54	.50	29	1	2.31	64	19	.50	38	45.0	
53	30	10	2.31	64	1	.53	30	10	2.31	64	25	.52		27	2.40		49	.52	37	43.9	
54		36	2.31		33	.53	30	15	2.40		56	.53		52	2.40	65	20	.53	36	42.9	
55	31	2	2.40	65	5	.55	31	2	2.50	65	28	.55	30	17	2.50		52	.53	35	41.8	
56		27	2.50		38	.57	31	4	2.50	66	1	.57		41	2.50	66	24	.55	34	40.8	
57	32	15	2.50	66	12	.58	32	15	2.50		35	.57	31	5	2.61		57	.57	33	39.7	
58		51	2.50		47	.58	32	20	2.61	67	9	.57		28	2.61	67	31	.57	32	38.6	
59	33	6	2.61	67	22	.60	33	6	2.73		43	.60		51	2.73	68	5	.58	31	37.5	
60		24	2.73		58	.60	33	13	2.73	68	19	.60	32	13	2.73		40	.58	30	36.4	
61	34	2	2.86	68	34	.62	34	2	2.86	69	15	.60		35	2.86	69	15	.60	29	35.3	
62		45	2.86		69	.63	34	20	2.86	69	31	.63		56	3.00		51	.62	28	34.2	
63	35	6	2.86	69	49	.63	35	6	3.00	70	9	.63	33	16	3.00	70	28	.63	27	33.1	
64		27	3.00		70	.65	35	15	3.00		47	.63		36	3.16	71	6	.63	26	31.9	
65	36	15	3.16	71	6	.67	36	15	3.16	71	25	.65		55	3.33		44	.63	25	30.8	
66		6	3.33		46	.67	36	3	3.33	72	4	.67	34	13	3.33	72	22	.65	24	29.6	
67	37	24	3.33	72	26	.68	37	24	3.33	73	44	.67		31	3.53	73	1	.67	23	28.5	
68		42	3.53		73	.70	37	18	3.53	73	24	.68		48	3.53		41	.67	22	27.3	
69	38	9	3.75	73	7	.70	38	9	3.75	74	5	.70	35	5	3.75	74	21	.68	21	26.1	
70		15	3.75		31	.72	38	15	3.75		47	.70		21	4.00	75	2	.70	20	24.9	
71	39	31	4.00	75	14	.72	39	31	4.00	75	29	.70		36	4.29		44	.70	19	23.7	
72		46	4.29		57	.73	39	18	4.29	76	11	.72		50	4.29	76	26	.70	18	22.5	
73	40	6	4.62	76	41	.73	40	6	4.62	76	54	.73	36	4	4.62	77	8	.72	17	21.3	
74		13	4.62		25	.75	40	13	4.62	77	38	.73		17	5.00		51	.72	16	20.1	
75	41	26	5.00	78	10	.75	41	26	5.00	78	22	.73		29	5.00	78	34	.73	15	18.9	
76		38	5.45		55	.77	41	10	5.45	79	6	.75		41	5.45	79	18	.73	14	17.7	
77	42	49	6.00	79	41	.77	42	49	6.00	80	51	.75		52	6.00	80	2	.73	13	16.5	
78		59	6.00		27	.77	42	59	6.00	80	36	.77	37	2	6.67		46	.75	12	15.2	
79	43	9	6.67	81	13	.78	43	9	6.67	81	22	.77		11	7.50	81	31	.75	11	13.9	
80		18	7.50		0	.78	43	18	7.50	82	8	.77		19	7.50	82	16	.77	10	12.7	
81	44	26	8.57	82	0	.78	44	26	8.57	83	54	.78		27	8.57	83	2	.77	9	11.4	
82		33	10.0		34	.80	44	33	10.0	83	41	.78		34	10.0		48	.77	8	10.2	
83	45	39	10.0	84	22	.80	45	39	10.0	84	28	.78		40	12.0	84	34	.77	7	8.9	
84		45	15.0		10	.80	45	45	15.0	85	15	.78		45	12.0	85	20	.77	6	7.6	
85	46	49	15.0	85	10	.80	46	49	15.0	86	2	.78		50	20.0	86	6	.78	5	6.4	
86		53	20.0		46	.80	46	53	20.0	87	49	.80		53	20.0	87	53	.77	4	5.1	
87	47	56	30.0	87	34	.82	47	56	30.0	87	37	.78		56	30.0	87	39	.78	3	3.8	
88		58	30.0		23	.80	47	58	30.0	88	24	.80		58	30.0	88	26	.78	2	2.6	
89	48	0	—	89	11	.82	48	0	—	89	12	.80		38	0	—	89	13	.78	1	1.3
90		0			0		48	0		90	0			0		90	0		0	0.0	

t	a = 51° 0'				a = 51° 30'				a = 52° 0'				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	d = 51° 0'				d = 51° 30'				d = 52° 0'				



b	a = 52° 30'				a = 53° 0'				a = 53° 30'				c	α	
	B	h	d	t	h	d	t	h	d	t	C	β			
			60' / Δ	Δ / 60'		60' / Δ	Δ / 60'		60' / Δ	Δ / 60'					
0	0	0	1.62	52	30	0.00	0	0	1.67	53	0	0.00	0	0	90.0
1		37	1.67		30	.02	0	36	1.67		0	.02	36	30	89.2
2	I	13	1.62		31	.02	I	12	1.67		I	.02	11	31	88.4
3		50	1.67		32	.03		48	1.67			.03	47	32	87.6
4	2	26	1.62		34	.03	2	24	1.67		2	.03	23	34	86.8
5	3	3	1.67		36	.05	3	0	1.67		6	.05	58	36	85.0
6		39	1.67		39	.05		36	1.67		9	.05	34	39	84.2
7	4	15	1.62		42	.07	4	12	1.67		12	.07	4	42	83.4
8		52	1.67		46	.07		48	1.67		16	.07	45	46	82.6
9	5	28	1.67		50	.08	5	24	1.67		20	.08	5	50	81.8
10	6	4	1.67		55	.10	6	0	1.67		25	.08	56	55	80.0
11		40	1.67	53	1	.10		36	1.71		30	.10	6	31	79.2
12	7	16	1.67		7	.10	7	11	1.67		36	.12	7	6	78.4
13		52	1.67		13	.12		47	1.71		43	.12	41	12	77.6
14	8	28	1.67		20	.12	8	22	1.67		50	.12	8	16	76.8
15	9	4	1.67		27	.13		58	1.71		57	.13	51	27	75.0
16		40	1.71		35	.15	9	33	1.71		54	.13	9	26	74.2
17	10	15	1.67		44	.15	10	8	1.71		13	.15	10	1	73.4
18		51	1.71		53	.15		43	1.71		22	.17	36	17	72.6
19	11	26	1.71	54	2	.17	11	11	1.71		32	.17	11	10	71.8
20	12	1	1.71		12	.18		53	1.76		42	.17	44	11	70.0
21		36	1.71		23	.18	12	27	1.71		52	.18	12	18	69.2
22	13	11	1.71		34	.20	13	2	1.76	55	3	.20	52	33	68.4
23		46	1.76		46	.20		36	1.76		15	.20	13	26	67.6
24	14	20	1.76		58	.22	14	10	1.76		27	.22	14	0	66.8
25		54	1.76	55	11	.22		44	1.76		40	.22	34	9	65.0
26	15	28	1.76		24	.23	15	18	1.82		53	.23	15	7	64.2
27		16	1.76		38	.25		51	1.76	56	7	.25	40	18	63.4
28	16	36	1.76		53	.25	16	25	1.82		22	.25	16	13	62.6
29		10	1.82	56	8	.27		58	1.82		37	.25	46	18	61.8
30	17	10	1.82		8	.27		58	1.82		37	.25	46	18	61.0
31	18	16	1.82		40	.28	17	31	1.88		52	.27	17	18	60.2
32		49	1.82		57	.28	18	3	1.82	57	8	.28	50	37	59.4
33	19	22	1.88		14	.30	19	8	1.88		25	.28	18	22	58.6
34		54	1.88	57	14	.32		40	1.88		42	.30	54	18	57.8
35	20	26	1.88		51	.32	20	12	1.94		19	.32	19	26	57.0
36		58	1.88	58	10	.33		43	1.94		38	.33	20	28	56.2
37	21	30	1.94		30	.33	21	14	1.94		58	.33	59	25	55.4
38		1	1.94		50	.35		45	2.00	59	18	.35	21	29	54.6
39	22	32	2.00	59	11	.37	22	15	2.00		39	.35	59	20	53.8
40	23	2	2.00		33	.37		45	2.00	60	0	.37	22	29	53.0
41		32	2.00		55	.38	23	15	2.00		22	.38	58	27	52.2
42	24	2	2.00	60	18	.40		45	2.07		45	.38	23	27	51.4
43		32	2.07		42	.40	24	14	2.07	61	8	.40	56	35	50.6
44	25	1	2.07	61	6	.42		43	2.14		32	.42	24	24	49.8
45		30			31		25	11			57		52	23	49.0

t	a = 52° 30'		a = 53° 0'		a = 53° 30'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 52° 30'		d = 53° 0'		d = 53° 30'		

b		a = 52° 30'					a = 53° 0'					a = 53° 30'					c	α											
		B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	C	β					
45	25	30	2.14	61	31	0.43	25	11	2.14	61	57	0.42	24	52	2.14	62	23	0.42	45	51.4									
40		58	2.14		57	.43		39	2.14		62	22	.43	25	20	2.22		48	.42	44	50.4								
47	26	26	2.14	62	23	.45	26	7	2.22		48	.45		47	2.22	63	13	.43	43	49.4									
48		54	2.22		50	.45		34	2.22		63	15	.45	26	14	2.31		39	.45	42	48.4								
49	27	21	2.22	63	17	.47	27	1	2.31		42	.45		40	2.31	64	6	.47	41	47.4									
50		48	2.31		45	0.48		27	2.31		64	9	0.48	27	6	2.31		34	0.47	40	46.4								
51	28	14	2.31	64	14	.48		53	2.31		38	.48		32	2.40	65	2	.48	39	45.4									
52		40	2.40		43	.50		28	19	2.40		65	7	.48		57	31	.48	38	44.4									
53	29	5	2.40	65	13	.52		44	2.50		36	.50		28	22	2.50		66	0	.50	37	43.3							
54		30	2.40		44	.52		29	8	2.50		66	6	.52		46	2.50		30	.50	36	42.3							
55		55	2.50		66	15	0.53		32	2.50		37	0.53		29	10	2.61		67	0	0.52	35	41.2						
56	30	19	2.61		47	.53		56	2.61		67	9	.53		33	2.61		31	.53	34	40.2								
57		42	2.61		67	19	.55		30	19	2.73		41	.55		56	2.73		68	3	.55	33	39.1						
58	31	5	2.73		52	.57		41	2.73		68	14	.55		30	18	2.86		35	.55	32	38.0							
59		27	2.73		68	26	.58		31	3	2.73		47	.57		39	2.86		69	8	.57	31	37.0						
60		49	2.86		69	1	0.58		25	2.86		69	21	0.58		31	0	2.86		42	0.57	30	35.9						
61	32	10	2.86		36	.58		46	3.00		56	.58		21	3.00	70	16	.58	29		29	34.8							
62		31	3.00		70	11	.60		32	6	3.00		70	31	.60		41	3.16		51	.58	28	33.7						
63		51	3.16		47	.62		26	3.16		71	7	.60		32	0	3.16		71	26	.60	27	32.5						
64	33	10	3.16		71	24	.63		45	3.33		43	.62		19	3.33	72	2	.60	26		26	31.4						
65		29	3.33		72	2	0.63		33	3	3.33		72	20	0.63		37	3.33		38	0.62	25	30.3						
66		47	3.33		40	.65		21	3.53		58	.63		33	55	3.53		73	15	.62	24	29.1							
67	34	5	3.53		73	19	.65		38	3.53		73	36	.63		33	12	3.75		52	.63	23	28.0						
68		22	3.75		58	.65		55	3.75		74	14	.65		28	3.75	74	30	.65	22		22	26.8						
69		38	3.75		74	37	.68		34	11	4.00		53	.67		44	4.00	75	9	.65	21		21	25.7					
70		54	4.00		75	18	0.68		26	4.00		75	33	0.67		59	4.29		48	0.65	20		20	24.5					
71	35	9	4.29		59	.68		41	4.29		76	13	.68		34	13	4.29		76	27	.67	19		19	23.3				
72		23	4.62		76	40	.68		55	4.62		54	.68		27	4.62	77	7	.67	18		18		18	22.1				
73		36	4.62		77	21	.70		35	8	4.62		77	35	.68		40	5.00		47	.68	17		17	20.9				
74		49	5.00		78	3	.72		21	5.00		78	16	.70		52	5.00	78	28	.68	16		16		16	19.7			
75	36	1	5.45		46	0.72		33	5.45		58	0.70		35	4	5.45		79	9	0.70	15		15		15	18.5			
76		12	5.45		79	29	.72		44	6.00		79	40	.72		15	6.00		51	.70	14		14		14	17.3			
77		23	6.00		80	12	.73		54	6.00		80	23	.72		25	6.00		80	33	.70	13		13		13	16.1		
78		33	6.67		56	.73		36	4	6.67		81	6	.72		35	6.67		81	15	.72	12		12		12	14.9		
79		42	7.50		81	40	.75		13	7.50		49	.73		44	7.50		58	.72	11		11		11		11	13.7		
80		50	8.57		82	25	0.73		21	8.57		82	33	0.73		52	8.57		82	41	0.72	10		10		10	12.5		
81		57	8.57		83	9	.75		28	8.57		83	17	.73		59	10.0		83	24	.72	9		9		9	11.2		
82	37	4	10.0		54	.75		35	10.0		84	1	.73		36	5	10.0		84	7	.73	8		8		8	10.0		
83		10	12.0		84	39	.77		41	12.0		45	.75		11	12.0		51	.73	7		7		7		7	8.7		
84		15	12.0		85	25	.75		46	15.0		85	30	.75		16	15.0		85	35	.73	6		6		6	7.5		
85		20	15.0		86	10	0.77		50	15.0		86	15	0.75		20	15.0		86	19	0.73	5		5		5	6.3		
86		24	20.0		56	.77		54	20.0		87	0	.75		24	20.0		87	3	.73	4		4		4		4	5.0	
87		27	30.0		87	42	.77		57	30.0		45	.75		27	30.0		47	.73	3		3		3		3	3.8		
88		29	60.0		88	28	.77		59	60.0		88	30	.75		29	60.0		88	31	.75	2		2		2		2	2.5
89		30	—		89	14	.77		37	0		89	15	.75		30	—		89	16	.73	1		1		1		1	1.3
90		30			90	0			0			90	0			30			90	0		0		0		0		0	0.0



B	a = 54° 0'				a = 54° 30'				a = 55° 0'				C	β								
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t										
		Z	Δ / 60'	Z		Δ / 60'	Z	Δ / 60'		Z	Δ / 60'											
0	0	0	1.71	54	0	0.00	0	0	1.71	54	30	0.00	0	0	1.76	55	0	0.00	90	90.0		
1	1	35	1.67	0	.02	0	.02	35	1.71	30	.02	34	1.71	1	.02	34	1.71	1	.02	89	89.2	
2	2	11	1.71	1	.02	1	.02	10	1.76	31	.02	9	1.76	1	.02	31	1.76	1	.02	88	88.4	
3	3	46	1.71	2	.03	2	.03	44	1.71	32	.03	43	1.71	2	.03	43	1.71	2	.03	87	87.6	
4	4	21	1.71	4	.03	4	.03	21	1.71	34	.03	21	1.76	4	.03	21	1.76	4	.03	86	86.7	
5	5	56	1.71	6	.05	5	.05	54	1.71	36	.05	52	1.76	6	.05	52	1.76	6	.05	85	85.9	
6	6	31	1.71	9	.05	3	.05	29	1.76	39	.05	26	1.76	9	.05	26	1.76	9	.05	84	85.1	
7	4	6	1.71	12	.07	4	.07	3	1.71	42	.07	0	1.71	12	.07	0	1.71	12	.07	83	84.3	
8	4	41	1.71	16	.07	3	.07	38	1.71	46	.07	35	1.76	16	.07	35	1.76	16	.07	82	83.5	
9	5	16	1.71	20	.08	5	.08	13	1.76	50	.08	9	1.76	20	.08	9	1.76	20	.08	81	82.7	
10	5	1	1.71	25	.08	4	.08	47	1.71	55	.08	43	1.76	25	.08	43	1.76	25	.08	80	81.8	
11	6	26	1.71	30	.10	6	.10	22	1.76	55	.10	17	1.76	30	.10	17	1.76	30	.10	79	81.0	
12	7	1	1.71	36	.10	5	.10	56	1.76	6	.10	51	1.76	36	.10	51	1.76	36	.10	78	80.2	
13	8	36	1.71	42	.12	7	.12	30	1.76	12	.12	25	1.76	42	.12	25	1.76	42	.12	77	79.4	
14	8	11	1.76	49	.12	8	.12	4	1.76	19	.12	59	1.82	49	.12	59	1.82	49	.12	76	78.5	
15	9	45	1.76	56	.13	8	.13	38	1.76	26	.13	8	32	1.76	56	.12	56	.12	75	77.7		
16	9	19	1.71	55	.13	9	.13	12	1.76	34	.13	9	6	1.82	56	.13	3	.13	74	76.9		
17	10	54	1.76	12	.15	10	.15	46	1.76	42	.15	39	1.76	12	.15	39	1.76	12	.15	73	76.0	
18	10	28	1.76	21	.17	10	.17	20	1.76	51	.15	10	13	1.82	20	.15	13	1.82	20	.15	72	75.2
19	11	2	1.76	31	.17	11	.17	54	1.82	56	.17	46	1.82	29	.17	46	1.82	29	.17	71	74.3	
20	12	36	1.76	41	.17	11	.17	27	1.76	10	.17	11	19	1.82	39	.17	19	1.82	39	.17	70	73.5
21	12	10	1.82	51	.18	12	.18	1	1.82	20	.18	52	1.82	49	.18	52	1.82	49	.18	69	72.6	
22	13	43	1.76	56	.20	12	.20	34	1.82	31	.20	12	25	1.88	57	.20	25	1.88	57	.20	68	71.8
23	13	17	1.82	14	.20	13	.20	7	1.82	43	.20	57	1.82	12	.20	57	1.82	12	.20	67	70.9	
24	14	50	1.82	26	.20	14	.20	40	1.82	55	.20	13	30	1.88	24	.20	30	1.88	24	.20	66	70.1
25	14	23	1.82	38	.22	14	.22	13	1.88	57	.22	14	2	1.88	36	.22	2	1.88	36	.22	65	69.2
26	15	56	1.82	51	.23	15	.23	45	1.88	20	.23	34	1.88	49	.22	49	1.88	49	.22	64	68.3	
27	15	29	1.88	57	.23	15	.23	17	1.88	34	.23	15	6	1.94	58	.23	6	1.94	58	.23	63	67.5
28	16	1	1.88	19	.25	16	.25	49	1.88	48	.25	37	1.88	16	.25	37	1.88	16	.25	62	66.6	
29	17	33	1.88	34	.25	16	.25	21	1.88	58	.25	16	9	1.94	31	.25	9	1.94	31	.25	61	65.7
30	17	5	1.88	49	.27	17	.27	53	1.94	18	.27	40	1.94	46	.27	40	1.94	46	.27	60	64.8	
31	18	37	1.88	58	.28	17	.28	24	1.94	34	.27	17	11	1.94	59	.28	11	1.94	59	.28	59	63.9
32	18	9	1.94	22	.28	18	.28	55	1.94	50	.28	42	2.00	18	.28	42	2.00	18	.28	58	63.0	
33	19	40	1.94	39	.28	18	.28	26	1.94	59	.28	18	12	2.00	35	.28	12	2.00	35	.28	57	62.1
34	19	11	1.94	56	.30	19	.30	57	2.00	24	.30	42	2.00	52	.30	42	2.00	52	.30	56	61.2	
35	20	42	1.94	59	.32	19	.32	27	2.00	42	.32	19	12	2.00	60	.30	12	2.00	60	.30	55	60.3
36	20	13	2.00	33	.32	20	.32	57	2.00	60	.32	42	2.00	28	.32	42	2.00	28	.32	54	59.4	
37	21	43	2.00	52	.33	20	.33	27	2.00	20	.33	20	12	2.07	47	.33	12	2.07	47	.33	53	58.5
38	21	13	2.00	60	.35	21	.35	57	2.07	40	.33	41	2.07	61	.33	41	2.07	61	.33	52	57.5	
39	22	43	2.07	33	.35	21	.35	26	2.07	61	.35	21	10	2.14	27	.35	10	2.14	27	.35	51	56.6
40	22	12	2.07	54	.37	22	.37	55	2.07	21	.35	38	2.14	48	.35	38	2.14	48	.35	50	55.7	
41	23	41	2.07	61	.37	22	.37	24	2.14	42	.37	22	6	2.14	62	.37	6	2.14	62	.37	49	54.7
42	23	10	2.14	38	.38	23	.38	52	2.14	62	.38	34	2.14	31	.37	34	2.14	31	.37	48	53.8	
43	24	38	2.14	62	.40	23	.40	20	2.14	27	.38	23	2	2.22	53	.38	2	2.22	53	.38	47	52.8
44	24	6	2.14	25	.40	24	.40	48	2.22	50	.40	29	2.22	63	.40	29	2.22	63	.40	46	51.8	
45	24	34		49		24		15		63		14		56		40		45		45		50.9
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a									
	d = 54° 0'				d = 54° 30'				d = 55° 0'				a									

B	<i>a</i> = 54° 0'				<i>a</i> = 54° 30'				<i>a</i> = 55° 0'				C	<i>c</i>	<i>a</i>	<i>β</i>										
	<i>h</i>	<i>d</i>	$\frac{60'}{\Delta}$	<i>t</i>	$\frac{\Delta}{60'}$	<i>h</i>	<i>d</i>	$\frac{60'}{\Delta}$	<i>t</i>	$\frac{\Delta}{60'}$	<i>h</i>	<i>d</i>					$\frac{60'}{\Delta}$	<i>t</i>	$\frac{\Delta}{60'}$							
																				<i>Z</i>	<i>Z</i>	<i>Z</i>				
45	24	34	2.22	62	49	0.40	24	15	2.22	63	14	0.40	23	56	2.31	63	40	0.40	45	50.9						
46	25	1	2.22	63	13	.42	42	2.31	38	.42	24	22	2.31	64	4	.42	24	22	2.31	64	4	.42	44	49.9		
47		28	2.31	38	.43	25	8	2.31	64	3	.43	48	2.31	29	.42	43	44	48.9						43	48.9	
48		54	2.31	64	4	.45	34	2.31	29	.43	25	14	2.40	54	.43	42	47.9							42	47.9	
49	26	20	2.31	31	.45	26	0	2.40	55	.45	39	2.40	65	20	.43	41	46.9							41	46.9	
50		46	2.40	58	.47	25	2.40	65	22	.45	26	4	2.50	46	.45	40	45.9							40	45.9	
51	27	11	2.40	65	26	.47	50	2.50	49	.47	28	2.50	66	13	.47	39	44.8							39	44.8	
52		36	2.50	54	.48	27	14	2.50	66	17	.48	52	2.50	41	.47	38	43.8							38	43.8	
53	28	0	2.50	66	23	.48	38	2.61	46	.48	27	16	2.61	67	9	.48	37	42.8						37	42.8	
54		24	2.61	52	.50	28	1	2.61	67	15	.50	39	2.61	38	.48	36	41.7							36	41.7	
55		47	2.61	67	22	.52	24	2.61	45	.50	28	2	2.73	68	7	.50	35	40.7						35	40.7	
56	29	10	2.73	53	.53	47	2.73	68	15	.52	24	2.86	37	.52	34	39.6								34	39.6	
57		32	2.73	68	25	.53	29	2.86	46	.53	45	2.86	69	8	.52	33	38.6							33	38.6	
58		54	2.86	57	.53	30	2.86	69	18	.53	29	6	2.86	39	.52	32	37.5							32	37.5	
59	30	15	2.86	69	29	.55	51	3.00	50	.53	27	3.00	70	10	.53	31	36.4							31	36.4	
60		36	3.00	70	2	.57	30	3.00	70	22	.55	47	3.00	42	.55	30	35.3							30	35.3	
61		56	3.00	36	.57	31	3.00	55	55	.57	30	7	3.16	71	15	.55	29	34.3						29	34.3	
62	31	16	3.16	71	10	.58	51	3.16	71	29	.57	26	3.33	48	.57	28	33.1							28	33.1	
63		35	3.33	45	.58	31	10	3.33	72	3	.58	44	3.33	72	22	.57	27	32.0						27	32.0	
64		53	3.33	72	20	.60	28	3.53	38	.58	31	2	3.53	56	.58	26	30.9							26	30.9	
65	32	11	3.53	56	.60	45	3.53	73	13	.60	19	3.53	73	31	.58	25	29.8							25	29.8	
66		28	3.53	73	32	.62	32	3.53	49	.60	36	3.75	74	6	.60	24	28.7							24	28.7	
67		45	3.75	74	9	.62	19	3.75	74	25	.62	52	3.75	42	.60	23	27.5							23	27.5	
68	33	1	3.75	46	.63	35	4.00	75	2	.62	32	8	4.00	75	18	.62	22	26.4						22	26.4	
69		17	4.00	75	24	.65	50	4.29	39	.63	23	4.29	55	.62	21	25.2								21	25.2	
70		32	4.29	76	3	.65	33	4	4.29	76	17	.63	37	4.29	76	32	.62	20	24.1						20	24.1
71		46	4.62	42	.65	18	4.62	55	55	.65	51	4.62	77	9	.63	19	22.9							19	22.9	
72		59	4.62	77	21	.67	31	4.62	77	34	.65	33	4	5.00	47	.65	18	21.8						47	21.8	
73	34	12	5.00	78	1	.67	44	5.00	78	13	.67	16	5.00	78	26	.65	17	20.6						78	20.6	
74		24	5.45	41	.67	56	5.45	53	.67	28	5.45	79	5	.65	16	19.4								16	19.4	
75		35	5.45	79	21	.68	34	7	5.45	79	33	.67	39	6.00	44	.65	15	18.2						44	18.2	
76		46	6.00	80	2	.68	18	6.00	80	13	.67	49	6.00	80	23	.67	14	17.0						80	17.0	
77		56	6.00	43	.70	28	6.67	53	.68	59	8.57	81	3	.67	13	15.8								81	15.8	
78	35	6	7.50	81	25	.70	37	7.50	81	34	.68	34	8	7.50	43	.67	12	14.6						81	14.6	
79		14	7.50	82	7	.70	45	7.50	82	15	.68	16	7.50	82	23	.68	11	13.4						82	13.4	
80		22	8.57	49	.70	53	8.57	56	.70	24	8.57	83	4	.68	10	12.2								83	12.2	
81		29	8.57	83	31	.70	35	10.0	83	38	.70	31	10.0	45	.68	9	11.0							84	11.0	
82		36	12.0	84	13	.72	6	10.0	84	20	.70	37	12.0	84	26	.68	8	9.8						85	9.8	
83		41	12.0	56	.72	12	12.0	85	2	.70	42	12.0	85	7	.70	7	8.6							86	8.6	
84		46	15.0	85	39	.73	17	15.0	44	.70	47	15.0	49	.68	6	7.4								87	7.4	
85		50	15.0	86	23	.72	21	20.0	86	26	.72	51	20.0	86	30	.70	5	6.1						88	6.1	
86		54	20.0	87	6	.72	24	20.0	87	9	.72	54	20.0	87	12	.70	4	4.9						89	4.9	
87		57	30.0	49	.73	27	30.0	52	.70	57	30.0	57	30.0	54	.70	3	3.7							90	3.7	
88		59	60.0	88	33	.72	29	60.0	88	34	.72	59	60.0	88	36	.70	2	2.5						91	2.5	
89	36	0	—	89	16	.73	30	—	89	17	.72	35	0	—	1	1.2								92	1.2	
90		0		90	0		30		90	0		0		90	0		0	0.0							93	0.0

<i>t</i>	<i>a</i> = 54° 0'		<i>a</i> = 54° 30'		<i>a</i> = 55° 0'		<i>a</i>
	<i>a</i>	$\frac{60'}{\Delta}$	<i>b</i>	$\frac{\Delta}{60'}$	<i>a</i>	$\frac{60'}{\Delta}$	
	<i>d</i> = 54° 0'		<i>d</i> = 54° 30'		<i>d</i> = 55° 0'		



B	$a = 55^\circ 30'$				$a = 56^\circ 0'$				$a = 56^\circ 30'$				C	c	$\alpha$						
	h	$d$	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	$d$	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$				h	$d$	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
		$\beta$																			
0	0	0	1.76	55	30	0.00	0	0	1.76	56	0	0.00	0	0	1.82	56	30	0.00	90	90.0	
1		34	1.76		30	.02		34	1.82		0	.02		33	1.82		30	.02	89	89.2	
2	1	8	1.76		31	.02	1	7	1.76		1	.02	1	6	1.82		31	.02	88	88.3	
3		42	1.76		32	.03		41	1.82		2	.03		39	1.82		32	.03	87	87.5	
4	2	16	1.76		34	.03	2	14	1.76		4	.03	2	12	1.82		34	.03	86	86.7	
5		50	1.76		36	.05		48	1.82		6	.05		45	1.82		36	.05	85	85.9	
6	3	24	1.82		39	.05	3	21	1.82		9	.05	3	18	1.82		39	.05	84	85.0	
7		57	1.76		42	.07		54	1.76		12	.07		51	1.82		42	.07	83	84.2	
8	4	31	1.76		46	.07	4	28	1.82		16	.07	4	24	1.82		46	.07	82	83.4	
9	5	5	1.76		50	.08	5	1	1.82		20	.07	5	7	1.82		50	.07	81	82.5	
10		39	1.82		55	0.08		34	1.82		24	0.08	5	30	1.82		54	0.08	80	81.7	
11	6	12	1.76		56	0.08	6	7	1.82		29	.10	6	3	1.88		59	.10	79	80.8	
12		46	1.82		5	.10		40	1.82		35	.10		35	1.82		57	.10	78	80.0	
13	7	19	1.76		11	.12	7	13	1.82		41	.12	7	8	1.88		11	.12	77	79.2	
14		53	1.82		18	.12		46	1.82		48	.12		40	1.82		18	.12	76	78.3	
15	8	26	1.82		25	0.13	8	19	1.82		55	0.13	8	13	1.88		25	0.12	75	77.5	
16		59	1.82		33	.13		52	1.82		57	.13		45	1.88		32	.13	74	76.6	
17	9	32	1.82		41	.15	9	25	1.88		11	.13	9	17	1.88		40	.15	73	75.8	
18	10	5	1.82		50	.15	10	57	1.88		19	.15	10	49	1.88		49	.15	72	74.9	
19		38	1.88		59	.17	10	29	1.88		28	.17	10	21	1.88		58	.15	71	74.1	
20	11	10	1.82		57	0.17	11	1	1.88		38	0.17		53	1.88		57	0.17	70	73.2	
21		43	1.88		19	.18		33	1.88		48	.18	11	25	1.94		17	.18	69	72.3	
22	12	15	1.88		30	.18	12	5	1.88		59	.18		56	1.94		28	.18	68	71.5	
23		47	1.88		41	.20		37	1.88		58	0.20	12	27	1.94		39	.18	67	70.6	
24	13	19	1.88		53	.20	13	9	1.94		22	.20	12	27	1.94		50	.20	66	69.7	
25		51	1.88		58	0.22		40	1.94		34	0.22	13	29	1.94		59	0.22	65	68.9	
26	14	23	1.94		18	.22	14	11	1.94		47	.22	14	0	1.94		15	.22	64	68.0	
27		54	1.94		31	.23		42	1.94		59	0.23		31	2.00		28	.23	63	67.1	
28	15	25	1.94		45	.23	15	13	1.94		14	.23	15	1	2.00		42	.23	62	66.2	
29		56	1.94		59	.25		44	2.00		28	.25		31	2.00		56	.25	61	65.3	
30	16	27	1.94		59	0.27	16	14	2.00		43	0.25	16	1	2.00		60	0.25	60	64.4	
31		58	2.00		30	.27		44	2.00		58	.27		31	2.00		26	.27	59	63.5	
32	17	28	2.00		46	.28	17	14	2.00		60	0.27	17	1	2.07		42	.27	58	62.6	
33		58	2.00		60	0.28		44	2.07		30	.28		30	2.07		58	.28	57	61.7	
34	18	28	2.00		20	.28	18	13	2.07		47	.30	18	28	2.07		61	0.28	56	60.8	
35		58	2.07		37	0.30		42	2.07		61	0.30		18	2.14		32	0.30	55	59.9	
36	19	27	2.07		55	.32	19	11	2.07		23	.30		56	2.14		50	.30	54	58.9	
37		56	2.07		61	0.33		40	2.14		41	.32	19	24	2.14		62	0.32	53	58.0	
38	20	25	2.14		34	.33	20	8	2.14		62	0.33		52	2.14		27	.33	52	57.1	
39		53	2.14		54	.33		36	2.14		20	.33	20	20	2.22		47	.33	51	56.1	
40	21	21	2.14		62	0.35	21	4	2.22		40	0.35		47	2.22		63	0.33	50	55.2	
41		49	2.22		35	.37		31	2.22		63	0.37	21	14	2.22		27	.35	49	54.2	
42	22	16	2.22		57	.37		58	2.22		23	.37		41	2.31		48	.37	48	53.3	
43		43	2.22		63	0.38		22	2.31		45	.37	22	7	2.31		64	0.37	47	52.3	
44	23	10	2.22		42	.38		51	2.31		64	0.38		33	2.40		32	.38	46	51.3	
45		37			64	0.38		23	17		30			58			55		45	50.3	

t	$a = 55^\circ 30'$				$a = 56^\circ 0'$				$a = 56^\circ 30'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	$d = 55^\circ 30'$				$d = 56^\circ 0'$				$d = 56^\circ 30'$				

b	a = 55° 30'				a = 56° 0'				a = 56° 30'				c	a						
	B	h	d Δ	t Z	Δ 60'	h	d Δ	t Z	Δ 60'	h	d Δ	t Z			Δ 60'	C	β			
45	23	37	2.31	64	5	0.40	23	17	2.31	64	30	0.40	22	58	2.40	64	55	0.38	45	50.3
46	24	3	2.40	29	.40		43	43	2.40	54	54	.40	23	23	2.40	65	18	.40	44	49.4
47		28	2.40	53	.42		24	8	2.40	65	18	.42	24	48	2.40	48	42	.42	43	48.4
48		53	2.40	65	18	.43	33	33	2.40	43	43	.42	24	13	2.50	66	7	.42	42	47.4
49	25	18	2.40	44	.43		58	2.50	66	8	.43		37	2.50		32	.42	41	46.4	
50		43	2.50	66	10	0.45	25	22	2.50		34	0.43	25	1	2.61	57	0.43	40	45.3	
51	26	7	2.50	37	.45		46	2.61	67	0	.45		24	2.61	67	23	.45	39	44.3	
52		31	2.61	67	4	.47	26	9	2.61	27	.45		47	2.73	57	50	.45	38	43.3	
53		54	2.73	32	.47		32	2.73	54	.47			26	9	2.73	68	17	.47	37	42.3
54	27	16	2.73	68	0	.48	54	2.73	68	22	.48		31	2.73		45	.47	36	41.2	
55		38	2.73	29	0.50		27	16	2.86	51	0.48		53	2.86	69	13	0.47	35	40.2	
56	28	0	2.73	59	.50		37	2.86	69	20	.50		27	14	3.00	40	.48	34	39.1	
57		22	2.86	69	29	.50	58	3.00	50	.50			34	3.00	70	10	.50	33	38.1	
58		43	3.00	59	.52		28	18	3.00	70	20	.52	28	54	3.00	40	.50	32	37.0	
59	29	3	3.00	70	30	.53	38	3.00	51	.52			28	14	3.16	71	10	.52	31	35.9
60		23	3.16	71	2	0.53	58	3.16	71	22	0.53		33	3.16		41	0.52	30	34.9	
61		42	3.33	34	.55		29	17	3.33	54	.53		52	3.33	72	12	.53	29	33.8	
62	30	0	3.33	72	7	.55	53	3.33	72	26	.55		29	10	3.53	44	.53	28	32.7	
63		18	3.33	40	.57		35	3.53	59	.55			27	3.53	73	16	.55	27	31.6	
64		36	3.53	73	14	.57	30	10	3.53	73	32	.55	44	3.53		49	.55	26	30.5	
65		53	3.53	48	0.58		27	3.75	74	5	0.57		30	1	3.75	74	22	0.57	25	29.4
66	31	10	3.75	74	23	.58	43	3.75	39	.58			17	4.00		56	.57	24	28.2	
67		26	4.00	58	.60		59	4.00	75	14	.58		32	4.00	75	30	.57	23	27.1	
68		41	4.29	75	34	.60	31	14	4.29	49	.60		47	4.29	76	4	.58	22	26.0	
69		55	4.29	76	10	.60	28	4.29	76	25	.60		31	1	4.62	39	.60	21	24.8	
70		9	4.29	46	0.62		42	4.62	77	1	0.60		14	4.62	77	15	0.58	20	23.7	
71	32	23	4.62	77	23	.62	55	4.62	37	.62			27	4.62	56	20	.60	19	22.6	
72		36	5.00	78	0.63		32	5.00	78	14	.62		40	5.00	78	26	.62	18	21.4	
73		48	5.45	38	.63		20	5.45	51	.62			52	5.45	79	3	.62	17	20.2	
74		59	5.45	79	16	.65	31	5.45	79	28	.63		32	3	6.00	40	.62	16	19.1	
75		10	6.00	55	0.65		42	6.00	80	6	0.63		13	6.00	80	17	0.62	15	17.9	
76	33	20	6.00	80	34	.65	52	6.67	44	.63			23	6.67	54	.63	14	16.7		
77		30	6.67	81	13	.65	33	1	6.67	81	22	.65	32	7.50	81	32	.63	13	15.6	
78		39	7.50	52	.67		10	7.50	82	1	.65		40	7.50	82	10	.63	12	14.4	
79		47	8.57	82	32	.67	18	8.57	40	.65			48	8.57	48	.63	11	13.2		
80		54	8.57	83	12	0.67	25	8.57	83	19	0.67		55	8.57	83	26	0.65	10	12.0	
81	34	1	10.0	52	.67		32	10.0	59	.65			33	2	10.0	84	5	.65	9	10.8
82		7	12.0	84	32	.68	38	12.0	84	38	.67		8	12.0	44	.65	8		8	9.6
83		12	12.0	85	13	.67	43	15.0	85	18	.67		13	15.0	85	23	.67	7	8.4	
84		17	15.0	53	.68		47	15.0	58	.67			17	15.0	86	3	.65	6	7.2	
85		21	20.0	86	34	0.68	51	20.0	86	38	0.67		21	20.0		42	0.65	5	6.0	
86		24	20.0	87	15	.68	54	20.0	87	18	.68		24	20.0	87	21	.67	4	4.8	
87		27	30.0	56	.70		57	30.0	59	.67			27	30.0	88	1	.67	3	3.6	
88		29	60.0	88	38	.68	59	60.0	88	39	.67		29	60.0		41	.65	2	2.4	
89		30	—	89	19	.68	34	0	—	89	19	.68	30	—	89	20	.67	1	1.2	
90		30	—	90	0		0	0	—	90	0		30	—	90	0		0	0	0.0
t	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a	60'	b	Δ	60'	a				
	d = 55° 30'				d = 56° 0'				d = 56° 30'				a							



B	$a = 57^\circ 0'$				$a = 57^\circ 30'$				$a = 58^\circ 0'$				C	$\beta$		
	h	d	$\frac{60'}{\Delta}$	Z	h	d	$\frac{60'}{\Delta}$	Z	h	d	$\frac{60'}{\Delta}$	Z				
		t	$\frac{\Delta}{60'}$	t		$\frac{\Delta}{60'}$	t	$\frac{\Delta}{60'}$		t	$\frac{\Delta}{60'}$					
0	0	0	1.82	57	0	0	0.00	0	0	1.88	57	0	0.00	0	90.0	
1		33	1.88		0	32	1.88		0	32	1.88		0	0.02	89	89.2
2	I	5	1.82	I	4	1.82		I	4	1.94		I	0.02	88	88.3	
3		38	1.82		3	1.88		3	35	1.88		2	0.03	87	87.5	
4	2	11	1.88	2	9	1.88		2	34	1.88		4	0.03	86	86.6	
5		43	1.82		6	0.05			39	1.88		6	0.03	85	85.8	
6	3	16	1.88	3	9	0.05		3	11	1.94		8	0.05	84	84.9	
7		48	1.82		12	0.05			42	1.88		11	0.07	83	84.1	
8	4	21	1.88	4	15	0.07		4	17	1.88		15	0.07	82	83.2	
9		53	1.82		19	0.08			49	1.88		19	0.08	81	82.4	
10	5	26	1.88	5	21	0.08		5	17	1.94		24	0.08	80	81.5	
11		58	1.88		29	0.10			59	0.08		29	0.08	79	80.7	
12	6	30	1.88	6	25	0.10		6	20	1.94		34	0.10	78	79.8	
13		7	1.88		41	0.10			57	1.94		40	0.10	77	79.0	
14	7	34	1.88	7	28	0.12		7	22	1.94		46	0.12	76	78.2	
15	8	6	1.88	8	0	0.13		8	0	1.94		53	0.12	75	77.3	
16		38	1.88		54	0.13			31	1.94		59	0.13	74	76.4	
17	9	10	1.88	9	2	0.13		9	2	1.94		55	0.15	73	75.5	
18		42	1.94		18	0.15			33	1.94		47	0.15	72	74.7	
19	10	13	1.94	10	4	0.15		10	4	1.94		56	0.15	71	73.8	
20		44	1.94		36	0.17			35	1.94		59	0.17	70	72.9	
21	11	15	1.94	11	6	0.18		11	6	1.94		16	0.17	69	72.1	
22		46	1.94		57	0.18			37	2.00		26	0.18	68	71.2	
23	12	17	1.94	12	7	0.18		12	7	2.00		37	0.18	67	70.3	
24		48	1.94		19	0.20			37	2.00		48	0.20	66	69.4	
25	13	19	2.00	13	7	0.22		13	7	2.00		60	0.20	65	68.5	
26		49	2.00		44	0.22			37	2.00		12	0.22	64	67.6	
27	14	19	2.00	14	7	0.22		14	7	2.00		25	0.22	63	66.7	
28		49	2.00		57	0.23			37	2.07		38	0.23	62	65.8	
29	15	19	2.07	15	6	0.25		15	6	2.07		52	0.25	61	64.9	
30		48	2.07		39	0.25			35	2.07		61	0.25	60	64.0	
31	16	17	2.07	16	4	0.27		16	4	2.07		22	0.25	59	63.1	
32		46	2.07		54	0.27			33	2.14		37	0.27	58	62.2	
33	17	15	2.07	17	1	0.27		17	1	2.14		53	0.28	57	61.3	
34		44	2.14		42	0.28			29	2.14		62	0.28	56	60.4	
35	18	12	2.14	18	25	0.30		18	25	2.22		44	0.30	55	59.4	
36		40	2.14		17	0.30			44	0.30		18	0.30	54	58.5	
37	19	8	2.14	19	2	0.32		19	2	2.22		36	0.32	53	57.6	
38		36	2.22		54	0.32			21	2.22		21	0.32	52	56.6	
39	20	3	2.22	20	13	0.33		20	13	2.31		40	0.32	51	55.7	
40		30	2.31		33	0.33			12	2.31		59	0.33	50	54.7	
41	21	22	2.31	21	4	0.35		21	4	2.31		19	0.35	49	53.8	
42		56	2.31		53	0.35			38	2.31		64	0.35	48	52.8	
43	22	14	2.40	22	14	0.37		22	14	2.40		40	0.37	47	51.8	
44		48	2.40		58	0.37			55	2.40		23	0.37	46	50.8	
45	39			39	20			39	20			45		45	49.9	

t	$a = 57^\circ 0'$		$a = 57^\circ 30'$		$a = 58^\circ 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 57^\circ 0'$		$d = 57^\circ 30'$		$d = 58^\circ 0'$		

b		a = 57° 0'				a = 57° 30'				a = 58° 0'				c	a							
		h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$			C	$\beta$					
45	22	39	2.40	65	20	0.38	22	20	2.50	65	45	0.38	22	0	2.50	66	10	0.37	45	49.9		
46	23	4	2.50	43	.40	44	2.50	66	8	.38	24	2.50	32	.38	44	48.9			44	48.9		
47	28	2.50	66	7	.40	23	8	2.50	31	.40	48	2.61	55	.38	43	47.9			43	47.9		
48	52	2.50	31	.40	32	2.61	55	.40	23	11	2.61	67	18	.40	42	46.9			42	46.9		
49	24	16	2.61	55	.42	55	2.61	67	19	.42	34	2.61	42	.42	41	45.9			41	45.9		
50	39	2.61	67	20	0.43	24	18	2.61	44	0.42	57	2.73	68	7	0.42	40	44.9			40	44.9	
51	25	2	2.61	46	.43	41	2.73	68	9	.43	24	19	2.73	32	.42	39	43.8			39	43.8	
52	25	2.73	68	12	.45	25	3	2.73	35	.43	41	2.86	57	.43	38	42.8			38	42.8		
53	47	2.73	39	.45	25	2.86	69	1	.45	25	2	2.86	69	23	.45	37	41.8			37	41.8	
54	26	9	2.86	69	.47	46	2.86	28	.47	23	2	2.86	50	.45	36	40.7			36	40.7		
55	30	2.86	34	0.47	26	7	3.00	56	0.47	44	3.00	70	17	0.45	35	39.7			35	39.7		
56	51	3.00	70	2	.48	27	3.00	70	24	.47	26	4	3.16	.47	34	38.7			34	38.7		
57	27	11	3.00	31	.50	47	3.16	52	.48	23	3.16	71	12	.48	33	37.6			33	37.6		
58	31	3.16	71	1	.50	27	6	3.16	71	21	.48	42	3.16	41	.48	32	36.5			32	36.5	
59	50	3.16	31	.50	25	3.16	50	.50	27	1	3.33	72	10	.48	31	35.5			31	35.5		
60	28	9	3.33	72	1	0.52	44	3.33	72	20	0.50	19	3.33	39	0.50	30	34.4			30	34.4	
61	27	3.33	32	.52	28	2	3.53	50	.52	37	3.53	73	9	.50	29	33.3			29	33.3		
62	45	3.53	73	3	.53	19	3.53	73	21	.52	54	3.53	39	.52	28	32.2			28	32.2		
63	29	2	3.53	35	.53	36	3.53	52	.53	28	11	3.75	74	10	.52	27	31.1			27	31.1	
64	19	3.75	74	7	.53	53	3.75	74	24	.53	27	4.00	41	.52	26	30.0			26	30.0		
65	35	4.00	39	0.55	29	9	4.00	56	0.53	42	4.00	75	12	0.53	25	28.9			25	28.9		
66	50	4.00	75	12	.57	24	4.00	75	28	.55	57	4.00	44	.55	24	27.8			24	27.8		
67	30	5	4.00	46	.57	39	4.29	76	1	.57	29	12	4.29	76	17	.55	23	26.7			23	26.7
68	20	4.29	76	20	.57	53	4.62	35	.55	26	4.62	50	.55	22	25.6			22	25.6			
69	34	4.62	54	.58	30	6	4.62	77	8	.57	39	4.62	77	23	.55	21	24.5			21	24.5	
70	47	4.62	77	29	0.58	19	4.62	42	0.58	52	5.00	56	0.57	20	23.3			20	23.3			
71	31	0	78	4	.58	32	5.00	78	17	.58	30	4	5.00	78	30	.57	19	22.2			19	22.2
72	12	5.45	39	.60	44	5.45	52	.58	16	5.45	79	4	.58	18	21.1			18	21.1			
73	23	5.45	79	15	.60	55	5.45	79	27	.58	27	6.00	39	.58	17	19.9			17	19.9		
74	34	6.00	51	.60	31	6	6.00	80	2	.60	37	6.00	80	14	.58	16	18.8			16	18.8	
75	44	6.00	80	27	0.62	16	6.67	38	0.60	47	6.67	49	0.58	15	17.6			15	17.6			
76	54	6.67	81	4	.62	25	6.67	81	14	.62	56	6.67	81	24	.60	14	16.5			14	16.5	
77	3	7.50	41	.63	34	7.50	51	.60	31	5	7.50	82	0	.60	13	15.3			13	15.3		
78	11	7.50	82	19	.62	42	7.50	82	27	.62	13	7.50	36	.60	12	14.1			12	14.1		
79	19	8.57	56	.63	50	8.57	83	4	.62	21	8.57	83	12	.60	11	13.0			11	13.0		
80	26	10.0	83	34	0.63	57	10.0	41	0.62	28	10.0	48	0.62	10	11.8			10	11.8			
81	32	10.0	84	12	.63	32	3	10.0	84	18	.63	34	12.0	84	25	.62	9	10.6			9	10.6
82	38	12.0	50	.63	9	12.0	56	.63	39	12.0	85	2	.62	8	9.5			8	9.5			
83	43	12.0	85	28	.65	14	15.0	85	34	.62	44	15.0	39	.62	7	8.3			7	8.3		
84	48	15.0	86	7	.65	18	15.0	86	11	.63	48	15.0	86	16	.62	6	7.1			6	7.1	
85	52	20.0	46	0.63	22	20.0	49	0.63	52	20.0	53	0.62	5	5.9			5	5.9			5	5.9
86	55	30.0	87	24	.65	25	30.0	87	27	.63	55	30.0	87	30	.63	4	4.7			4	4.7	
87	57	30.0	88	3	.65	27	30.0	88	5	.65	57	30.0	88	8	.62	3	3.6			3	3.6	
88	59	60.0	42	.65	29	60.0	44	.63	59	60.0	45	.63	2	2.4			2	2.4			2	2.4
89	33	0	89	21	.65	30	—	89	22	.63	32	0	—	89	23	.62	1	1.2			1	1.2
90	0	—	90	0	—	30	—	90	0	—	0	—	90	0	—	0	0.0			0	0.0	

t	a = 57° 0'				a = 57° 30'				a = 58° 0'				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	d = 57° 0'				d = 57° 30'				d = 58° 0'				



b	a = 58° 30'				a = 59° 0'				a = 59° 30'				c	α								
	B	h	d / 60' / Δ	t / Z / 60'	h	d / 60' / Δ	t / Z / 60'	h	d / 60' / Δ	t / Z / 60'	C	β										
0	0	0	1.94	58	30	0.00	0	0	1.94	59	0	0.00	0	0	2.00	59	30	0.00	90	90.0		
1		31	1.88		30	.02		31	1.94		0	.02		30	1.94		30	.02	89	89.1		
2		1	3	1.94		31	.02		1	2	1.94		1	1	2.00		31	.02	88	88.3		
3		34	1.94		32	.03		33	1.94		2	.03		31	1.94		32	.03	87	87.4		
4		2	5	1.88		34	.03		2	4	2.00		4	.03	2	2	2.00		34	.03	86	86.6
5		37	1.94		36	.03		34	1.94		6	.03		3	2	2.00		36	.03	85	85.7	
6		3	8	1.94		38	.05		3	5	1.94		8	.05	3	2	1.94		38	.05	84	84.9
7		39	1.94		41	.07		36	1.94		11	.07		3	3	2.00		41	.07	83	84.0	
8		4	10	1.94		45	.07		4	7	2.00		15	.07	4	3	2.00		45	.07	82	83.1
9		41	1.94		49	.07		37	1.94		19	.07		4	3	2.00		49	.07	81	82.3	
10		5	12	1.94		53	.08		5	8	2.00		23	.08	5	3	2.00		53	.08	80	81.4
11		43	1.94		58	.10		38	1.94		28	.08		6	3	2.00		58	.08	79	80.5	
12		6	14	1.94	59	4	.10		6	9	2.00		33	.10	6	3	2.00	60	3	.10	78	79.7
13		45	1.94		10	.10		39	2.00		39	.10		3	3	2.00		9	.10	77	78.8	
14		7	16	1.94		16	.12		7	9	2.00		45	.12	7	3	2.00		15	.12	76	77.9
15		47	2.00		23	.12		39	2.00		52	.12		8	3	2.00		22	.12	75	77.1	
16		8	17	2.00		30	.13		8	9	2.00		59	.13	8	3	2.07		29	.13	74	76.2
17		47	2.00		38	.13		39	2.00	60	7	.13		3	2	2.07		37	.13	73	75.3	
18		9	17	2.00		46	.15		9	9	2.00		15	.15	9	1	2.00		45	.13	72	74.4
19		47	2.00		55	.15		39	2.00		24	.15		3	1	2.07		53	.15	71	73.6	
20		10	17	2.00	60	4	.17		10	9	2.07		33	.17	10	0	2.07	61	2	.17	70	72.7
21		47	2.00		14	.17		38	2.07		43	.17		2	2	2.07		12	.17	69	71.8	
22		11	17	2.00		24	.17		11	7	2.07		53	.17	11	5	2.14		22	.17	68	70.9
23		47	2.07		34	.18		36	2.07	61	3	.18		3	2	2.07		32	.18	67	70.0	
24		12	16	2.07		45	.20		12	5	2.07		14	.20	11	5	2.14		43	.18	66	69.1
25		45	2.07		57	.20		34	2.07		26	.20		12	2	2.14		54	.20	65	68.2	
26		13	14	2.07	61	9	.22		13	3	2.14		38	.20	13	1	2.14	62	6	.20	64	67.3
27		43	2.07		22	.22		31	2.14		50	.22		13	1	2.14		18	.22	63	66.4	
28		14	12	2.07		35	.23		59	2.14	62	3	.23		4	2.14		31	.22	62	65.5	
29		41	2.14		49	.23		14	27	2.14		17	.23	14	1	2.22		44	.23	61	64.6	
30		15	9	2.14	62	3	.23		55	2.14		31	.23		4	2.22		58	.25	60	63.7	
31		37	2.14		17	.25		15	23	2.22		45	.25	15	9	2.22	63	13	.25	59	62.8	
32		16	5	2.22		32	.27		50	2.22	63	0	.25		3	2.22		28	.25	58	61.8	
33		32	2.22		48	.27		16	17	2.22		15	.27	16	3	2.31		43	.25	57	60.9	
34		59	2.22		63	4	.28		44	2.22		31	.28	29	2	2.31		58	.27	56	60.0	
35		17	26	2.22		21	.28		17	11	2.31		48	.28	55	2	2.31	64	14	.28	55	59.0
36		53	2.22		38	.28		37	2.31	64	5	.28		17	2	2.31		31	.28	54	58.1	
37		18	20	2.31		55	.30		18	3	2.31		22	.30	47	2	2.40		48	.30	53	57.1
38		46	2.31		64	13	.32		29	2	2.31		40	.30	18	1	2.40	65	6	.30	52	56.2
39		19	12	2.31		32	.32		55	2	2.40		58	.32	37	2	2.40		24	.32	51	55.2
40		38	2.40		51	.33		19	20	2.40	65	17	.32	19	2	2.40		43	.32	50	54.3	
41		20	3	2.40	65	11	.33		45	2.40		36	.33	27	2	2.50	66	2	.33	49	53.3	
42		28	2.40		31	.35		20	10	2.50		56	.35	51	2	2.50		22	.33	48	52.3	
43		53	2.50		52	.35		34	2.50	66	17	.35		20	1	2.50		42	.33	47	51.4	
44		21	17	2.50	66	13	.35		58	2.50		38	.35	39	2	2.61	67	2	.35	46	50.4	
45		41			34			21	22		59			21	2		23		45		45	49.4
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a					
	d = 58° 30'				d = 59° 0'				d = 59° 30'													

b	a = 58° 30'					a = 59° 0'					a = 59° 30'					c	a			
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β
			Δ	Z				Δ	Z				Δ	Z						
0																				
45	21	41	2.50	66	34	0.37	21	22	2.61	66	59	0.37	21	2	2.61	67	23	0.37	45	49.4
46	22	5	2.61	56	38	.38	45	2.61	67	21	.37	25	25	2.73	45	45	.37	44	48.4	
47		28	2.61	67	19	.38	22	8	2.73	43	.38	47	27	2.73	68	7	.37	43	47.4	
48		51	2.61	42	40	.40	30	2.73	68	6	.38	22	9	2.73	29	.38	42	46.4		
49	23	14	2.73	68	6	.40	52	2.73	29	.40	31	2.73	52	.40	41	45.4				
50		36	2.73	30	42	0.42	23	14	2.73	53	0.40	53	2.86	69	16	0.40	40	44.4		
51		58	2.86	55	42	.42	36	2.86	69	17	.42	23	14	2.86	40	.40	39	43.4		
52	24	19	2.86	69	20	.42	57	3.00	42	.42	35	3.00	70	4	.42	38	42.3			
53		40	3.00	45	43	.43	24	17	3.00	70	7	.43	55	3.00	29	.42	37	41.3		
54	25	0	3.00	70	11	.45	37	3.00	33	.43	24	15	3.16	54	.43	36	40.3			
55		20	3.00	38	45	0.45	57	3.00	59	0.45	34	3.16	71	20	0.43	35	39.2			
56	40	3.16	71	5	.47	25	17	3.16	71	26	.45	53	3.16	46	.45	34	38.2			
57		59	3.16	33	47	.47	36	3.33	53	.45	25	12	3.33	72	13	.45	33	37.1		
58	26	18	3.33	72	1	.47	54	3.33	72	20	.47	30	3.53	40	.45	32	36.1			
59		36	3.33	29	48	.48	26	12	3.53	48	.48	47	3.53	73	7	.47	31	35.0		
60		54	3.33	58	48	0.48	29	3.53	73	17	0.48	26	4	3.53	35	0.48	30	34.0		
61	27	12	3.53	73	27	.50	46	3.53	46	.48	21	3.75	74	4	.48	29	32.9			
62		29	3.75	57	50	.50	27	3	3.75	74	15	.50	37	3.75	33	.48	28	31.8		
63		45	3.75	74	27	.52	19	3.75	45	.50	53	4.00	75	2	.48	27	30.7			
64	28	1	4.00	58	52	.52	35	4.00	75	15	.50	27	8	4.00	31	.50	26	29.6		
65		16	4.00	75	29	0.52	50	4.29	45	0.52	23	4.29	76	1	0.50	25	28.5			
66		31	4.29	76	0	.53	28	4	4.29	76	16	.52	37	4.29	31	.52	24	27.4		
67		45	4.29	32	53	.53	18	4.62	47	.53	51	4.62	77	2	.52	23	26.3			
68		59	4.62	77	4	.55	31	4.62	77	19	.53	28	4	4.62	33	.53	22	25.2		
69	29	12	5.00	37	55	.55	44	4.62	51	.53	17	5.00	78	5	.53	21	24.1			
70		24	5.00	78	10	0.55	57	5.00	78	23	0.55	29	5.00	37	0.53	20	23.0			
71		36	5.00	43	57	.57	29	9	5.45	56	.55	41	5.45	79	9	.53	19	21.9		
72		48	5.45	79	17	.57	20	6.00	79	29	.55	52	6.00	41	.55	18	20.8			
73		59	6.00	51	57	.57	30	6.00	80	2	.57	29	2	6.00	80	14	.55	17	19.6	
74	30	9	6.00	80	25	.57	40	6.00	36	.57	12	6.67	47	.55	16	18.5				
75		19	6.67	59	58	0.58	50	6.67	81	10	0.57	21	6.67	81	20	0.55	15	17.4		
76		28	7.50	81	34	.58	59	7.50	44	.57	30	7.50	53	.57	14	16.2				
77		36	7.50	82	9	.58	30	7	7.50	82	18	.58	38	7.50	82	27	.57	13	15.1	
78		44	8.57	44	60	.60	15	8.57	53	.58	46	8.57	83	1	.57	12	13.9			
79		51	8.57	83	20	.60	22	8.57	83	28	.58	53	10.0	35	.58	11	12.8			
80		58	10.0	56	0.60	0.60	29	10.0	84	3	0.58	59	10.0	84	10	0.57	10	11.6		
81	31	4	12.0	84	32	.60	35	12.0	38	.60	30	5	12.0	44	.58	9	10.5			
82		9	12.0	85	8	.60	40	12.0	85	13	.60	10	12.0	85	19	.58	8	9.3		
83		14	15.0	44	60	.60	45	15.0	49	.58	15	15.0	54	.58	7	8.2				
84		18	15.0	86	20	.60	49	20.0	86	24	.60	19	20.0	86	29	.58	6	7.0		
85		22	20.0	56	0.62	0.62	52	20.0	87	0	0.60	22	20.0	87	4	0.58	5	5.8		
86		25	30.0	87	33	.62	55	30.0	36	.60	25	30.0	39	.58	4	4.7				
87		27	30.0	88	10	.60	57	30.0	88	12	.60	27	30.0	88	14	.58	3	3.5		
88		29	60.0	46	.62	.62	59	60.0	48	.60	29	60.0	49	.60	2	2.3				
89		30	—	89	23	.62	31	0	—	89	24	.60	30	—	89	25	.58	1	1.2	
90		30	—	90	0	—	0	—	90	0	—	30	—	90	0	—	0	0.0		

t	a = 58° 30'		a = 59° 0'		a = 59° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 58° 30'		d = 59° 0'		d = 59° 30'		



B	a = 60° 0'				a = 60° 30'				a = 61° 0'				C	c	α											
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t				C	β									
		Δ	Z	60'		Δ	Z	60'		Δ	Z	60'														
0	0	0	2.00	60	0	0	0.00	0	0	0	2.07	61	0	90	90.0											
1		30	2.00		0	30	2.00	60	30	0	0.02		0	80	80.1											
2	1	0	2.00	1	.02	30	2.07	30	.02	29	2.07	1	.02	88	88.3											
3		30	2.00	2	.03	59	2.00	31	.02	58	2.07	1	.02	87	87.4											
4	2	0	2.00	4	.03	1	29	2.07	32	.03	1	27	2.07	2	.03	86	86.5									
						58	2.00	34	.03	56	2.07	4	.03													
5		30	2.00	6	0.03	2	28	2.07	36	0.03	2	25	2.07	6	0.03	85	85.6									
6	3	0	2.00	8	.05	57	2.07	38	.05	54	2.07	8	.05	84	84.8											
7		30	2.07	11	.05	3	26	2.00	41	.05	3	23	2.07	11	.05	83	83.9									
8		59	2.00	14	.07	56	2.07	44	.07	52	2.07	14	.07	82	83.0											
9	4	29	2.00	18	.08	4	25	2.07	48	.07	4	21	2.07	18	.07	81	82.2									
10		59	2.00	23	0.08	54	2.07	52	0.08	50	2.07	22	0.08	80	81.3											
11	5	29	2.07	28	.08	5	23	2.07	57	.08	5	19	2.14	27	.08	79	80.4									
12		58	2.00	33	.08	5	22	2.07	61	2	1.10	47	2.07	32	.10	78	79.5									
13	6	28	2.07	38	.10	6	21	2.07	8	1.10	6	17	2.14	38	.10	77	78.6									
14		57	2.07	44	.12	50	2.07	14	.12	44	2.07	44	.10	76	.10	76	77.8									
15	7	26	2.07	51	0.12	7	19	2.07	21	0.12	7	13	2.14	50	0.12	75	76.9									
16		55	2.07	58	.13	48	2.07	28	.12	41	2.14	57	.12	74	.12	74	76.0									
17	8	24	2.07	61	.13	8	17	2.14	35	.13	8	9	2.14	62	.13	73	75.1									
18		53	2.07	14	.13	45	2.07	43	.13	37	2.14	12	.13	72	.13	72	74.2									
19	9	22	2.07	22	.15	9	14	2.14	51	.15	9	5	2.14	20	.15	71	73.3									
20		51	2.14	31	0.15	42	2.14	62	0	0.15	33	2.22	29	0.15	70	.15	70	72.4								
21	10	19	2.07	40	.17	10	10	2.14	9	0.17	10	0	2.14	38	.17	69	.17	69	71.5							
22		48	2.14	50	.18	8	8	2.14	19	.17	28	2.22	48	.17	68	.17	68	70.6								
23	11	16	2.14	62	.18	11	6	2.22	29	.18	55	2.22	58	.18	67	.18	67	69.7								
24		44	2.14	12	.18	33	2.14	40	.18	11	22	2.22	63	.18	66	.18	66	68.8								
25	12	12	2.14	23	0.20	12	1	2.22	51	0.20	49	2.22	20	0.18	65	.18	65	67.9								
26		40	2.22	35	.20	28	2.22	63	.20	12	16	2.22	31	.20	64	.20	64	67.0								
27	13	7	2.22	47	.20	55	2.22	15	.20	43	2.31	43	.20	63	.20	63	.20	63	66.1							
28		34	2.22	59	.22	13	22	2.22	27	.22	13	9	2.31	55	.22	62	.22	62	65.2							
29	14	1	2.22	63	.23	49	2.31	40	.23	36	2.31	64	.22	61	.22	61	.22	61	64.2							
30		28	2.22	26	0.23	14	15	2.31	54	0.23	14	2	2.31	21	0.23	60	.23	60	63.3							
31	15	55	2.22	40	.25	41	2.31	64	.23	28	2.40	35	.23	59	.23	59	.23	59	62.4							
32		22	2.31	55	.25	15	7	2.31	22	.25	53	2.31	49	.25	58	.25	58	.25	58	61.5						
33	16	48	2.31	64	.25	33	2.31	37	.25	15	19	2.40	65	.25	57	.25	57	.25	57	60.5						
34		14	2.31	10	.27	59	2.40	52	.27	44	2.40	19	.27	56	.27	56	.27	56	.27	56	59.6					
35	17	40	2.31	41	0.28	16	24	2.40	65	0.27	16	9	2.40	35	0.27	55	.27	55	.27	55	58.6					
36		6	2.40	58	.28	49	2.40	24	.28	34	2.50	51	.27	54	.27	54	.27	54	.27	54	57.7					
37	18	31	2.40	65	.28	17	14	2.40	41	.28	58	2.50	66	.28	53	.28	53	.28	53	.28	53	56.7				
38		56	2.40	32	.30	39	2.50	58	.30	17	22	2.50	24	.30	52	.30	52	.30	52	.30	52	55.8				
39	18	21	2.50	50	.30	18	3	2.50	66	.30	16	46	2.50	42	.30	51	.30	51	.30	51	.30	51	54.8			
40		45	2.50	66	0.32	27	2.50	34	0.32	18	10	2.61	67	0	50	0.30	50	.30	50	.30	50	53.9				
41	19	9	2.50	27	.33	51	2.61	53	.32	33	2.61	18	.32	49	.32	49	.32	49	.32	49	.32	49	52.9			
42		33	2.61	47	.33	19	14	2.61	67	.32	56	2.61	37	.32	48	.32	48	.32	48	.32	48	.32	48	51.9		
43	20	56	2.61	67	.33	37	2.61	31	.33	19	19	2.73	56	.33	47	.33	47	.33	47	.33	47	.33	47	50.9		
44		19	2.61	27	.35	20	0	2.61	51	.35	41	2.73	68	.33	46	.33	46	.33	46	.33	46	.33	46	50.0		
45		42		48		23		68	12	20	3		36		45		45		45		45		45		45	49.0
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a													
	d = 60° 0'				d = 60° 30'				d = 61° 0'				a													

B	a = 60° 0'					a = 60° 30'					a = 61° 0'					C	a			
	h	d	60'		Δ	h	d	60'		Δ	h	d	60'		Δ					
			Z	t				Z	t				Z	t						
45	20	42	2.61	67	48	0.35	20	23	2.73	68	12	0.35	20	3	2.73	68	36	0.33	45	49.0
46	21	5	2.73	68	9	.37	21	7	2.86	69	16	.37	21	7	2.86	69	17	.37	44	48.0
47	27	2.73	31	.37	21	7	2.86	69	16	.37	21	7	2.86	69	17	.37	42	47.0		
48	49	2.86	53	.37	28	2.86	69	16	.37	21	7	2.86	69	17	.37	42	46.0			
49	22	10	2.86	69	15	.38	49	2.86	38	.38	28	3.00	70	1	.37	41	45.0			
50	31	2.86	38	0.40	22	10	3.00	70	1	0.38	28	3.00	23	0.38	40	44.0				
51	52	3.00	70	2	.40	30	3.00	24	.40	22	8	3.00	46	.38	39	42.9				
52	23	12	3.00	26	.40	50	3.00	48	.40	28	8	3.16	71	9	.40	38	41.9			
53	32	3.00	50	.42	23	10	3.16	71	12	.40	47	3.16	33	.40	37	40.9				
54	52	3.16	71	15	.43	29	3.33	36	.42	23	6	3.33	57	.42	36	39.9				
55	24	11	3.33	41	0.43	47	3.33	72	1	0.43	24	3.33	72	22	0.42	35	38.8			
56	29	3.33	72	7	.43	24	5	3.33	27	.43	42	3.33	47	.42	34	37.8				
57	47	3.33	33	.43	23	3.33	53	.43	24	0	3.53	73	12	.43	33	36.7				
58	25	5	3.33	59	.45	41	3.53	73	19	.43	17	3.75	3	.43	32	35.7				
59	23	3.53	73	26	.47	58	3.53	45	.45	33	3.75	74	4	.43	31	34.6				
60	40	3.75	54	0.47	25	15	3.75	74	12	0.47	49	3.75	30	0.45	30	33.6				
61	56	3.75	74	22	.47	31	4.00	40	.47	25	5	3.75	57	.47	29	32.5				
62	26	12	4.00	50	.48	46	4.00	75	8	.47	21	4.00	75	25	.47	28	31.4			
63	27	4.00	75	19	.48	26	1	4.00	36	.47	36	4.29	53	.47	27	30.3				
64	42	4.00	48	.48	16	4.29	76	4	.48	50	4.29	76	21	.47	26	29.3				
65	57	4.29	76	17	0.50	30	4.29	33	0.48	26	4	4.62	49	0.48	25	28.2				
66	27	11	4.62	47	.50	44	4.62	77	2	.50	17	4.62	77	18	.48	24	27.1			
67	24	4.62	77	17	.52	57	4.62	32	.50	30	4.62	47	47	.48	23	26.0				
68	37	4.62	48	.52	27	10	5.00	78	2	.50	43	5.00	78	16	.50	22	24.9			
69	50	5.00	78	19	.52	22	5.00	32	.52	55	5.45	46	.50	21	23.8					
70	28	2	5.45	50	0.52	34	5.45	79	3	0.52	27	6	5.45	79	16	0.50	20	22.7		
71	13	5.45	79	21	.53	45	5.45	34	.52	17	6.00	46	.52	19	21.6					
72	24	6.00	53	.53	56	6.00	80	5	.52	27	6.00	80	17	.52	18	20.5				
73	34	6.00	80	25	.53	6	6.67	36	.53	37	6.67	48	.52	17	19.4					
74	44	6.67	57	.55	15	6.67	81	8	.53	46	6.67	81	19	.52	16	18.2				
75	53	7.50	81	30	0.55	24	7.50	40	0.53	55	7.50	50	0.53	15	17.1					
76	29	1	7.50	82	3	.55	32	7.50	82	12	.55	28	3	7.50	82	22	.53	14	16.0	
77	9	7.50	36	.55	40	8.57	45	.53	11	8.57	54	54	.53	13	14.9					
78	17	8.57	83	9	.57	47	8.57	83	17	.55	18	8.57	83	26	.53	12	13.7			
79	24	10.0	43	.55	54	10.0	50	.55	25	10.0	58	.53	11	12.6						
80	30	10.0	84	16	0.57	29	0	10.0	84	23	0.55	31	10.0	84	30	0.55	10	11.5		
81	36	12.0	50	.57	6	12.0	56	.57	37	12.0	85	3	.53	9	10.3					
82	41	15.0	85	24	.57	11	15.0	85	30	.55	42	15.0	35	.55	8	9.2				
83	45	15.0	58	.58	15	15.0	86	3	.57	46	15.0	86	8	.55	7	8.0				
84	49	20.0	86	33	.57	19	20.0	37	.57	50	20.0	41	.55	6	6.9					
85	52	20.0	87	7	0.58	22	20.0	87	11	0.55	53	30.0	87	14	0.55	5	5.7			
86	55	30.0	42	.57	25	30.0	44	.57	25	30.0	44	.57	53	30.0	47	.55	4	4.6		
87	57	30.0	88	16	.58	27	30.0	88	18	.57	57	30.0	88	20	.55	3	3.4			
88	59	60.0	51	.57	29	60.0	52	.57	29	60.0	52	.57	59	60.0	53	.57	2	2.3		
89	0	—	89	25	.58	30	—	89	26	.57	29	0	—	89	27	.55	1	1.1		
90	0	—	90	0	—	30	—	90	0	—	29	0	—	90	0	—	0	0.0		

t	a = 60° 0'		a = 60° 30'		a = 61° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 60° 0'		d = 60° 30'		d = 61° 0'		



B	a = 61° 30'				a = 62° 0'				a = 62° 30'				C	a									
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			
0	0	0	2.07	61	30	0.00	0	0	2.14	62	0	0.00	0	0	2.14	62	30	0.00	90	90.0			
1		29	2.14	30	.02		28	2.14	0	.02		28	2.22	30	.02		30	.02	89	89.1			
2		57	2.07	31	.02		56	2.07	1	.02		55	2.14	31	.02		31	.02	88	88.2			
3	1	26	2.14	32	.02	1	25	2.14	2	.02	1	23	2.14	32	.02		32	.02	87	87.4			
4		54	2.07	33	.03		53	2.14	3	.03		51	2.22	33	.03		33	.03	86	86.5			
5	2	23	2.07	35	0.05	2	21	2.14	5	0.05	2	18	2.14	35	0.05		35	0.05	85	85.6			
6		52	2.14	38	.05		49	2.14	8	.05		46	2.14	38	.05		38	.05	84	84.7			
7	3	20	2.07	41	.05	3	17	2.14	11	.05	3	14	2.22	41	.05		41	.05	83	83.8			
8		49	2.14	44	.07		45	2.14	14	.07		41	2.14	44	.07		44	.07	82	82.9			
9	4	17	2.14	48	.07	4	13	2.14	18	.07	4	9	2.22	47	.07		47	.07	81	82.0			
10		45	2.14	52	0.08		41	2.22	22	0.07		36	2.22	51	0.08		51	0.08	80	81.2			
11	5	13	2.14	57	.08	5	8	2.14	26	.08	5	3	2.14	56	.08		56	.08	79	80.3			
12		41	2.14	62	2	.08	36	2.14	31	.10		31	2.22	63	1	.08		63	1	.08	78	79.4	
13	6	9	2.14	7	.10	6	4	2.22	37	.10	6	4	2.22	58	2.22		58	2.22	77	78.5			
14		37	2.14	13	.10		31	2.14	43	.10		6	25	2.22	12	.10		12	.10	76	77.6		
15	7	5	2.14	19	0.12	7	2	2.22	49	0.12	7	1	2.22	52	2.22		52	2.22	75	76.7			
16		33	2.14	26	.12		26	2.22	56	.12		7	19	2.22	25	.12		25	.12	74	75.8		
17	8	1	2.14	33	.13	8	1	2.22	63	.13	8	1	2.22	46	2.31		46	2.31	73	74.9			
18		29	2.22	41	.13		20	2.22	11	.13		8	12	2.22	40	.13		40	.13	72	74.0		
19		56	2.14	49	.15		47	2.22	19	.13		39	2.31	48	.13		48	.13	71	73.1			
20	9	24	2.22	58	0.15	9	14	2.22	27	0.15	9	5	2.31	56	0.15		56	0.15	70	72.2			
21		51	2.22	63	7	.17	41	2.22	36	.15		31	2.31	64	5	.15		64	5	.15	69	71.3	
22	10	18	2.22	17	.17	10	8	2.31	45	.17	10	8	2.31	57	2.31		57	2.31	68	70.4			
23		45	2.22	27	.17		34	2.31	55	.17		10	23	2.31	24	.17		24	.17	67	69.5		
24	11	12	2.31	37	.18	11	0	2.31	64	.18	11	0	2.31	49	2.31		49	2.31	66	68.5			
25		38	2.31	48	0.18		26	2.31	16	0.18		11	15	2.31	45	0.18		45	0.18	65	67.6		
26	12	4	2.31	59	.20	12	4	2.31	27	.20	12	4	2.40	56	.18		56	.18	64	66.7			
27		30	2.31	64	11	.20	12	18	2.31	39	.20	12	6	2.40	65	7	.20		65	7	.20	63	65.8
28		56	2.31	23	.22		44	2.40	51	.22		31	2.40	19	.20		19	.20	62	64.9			
29	13	22	2.31	36	.22	13	9	2.40	65	.22	13	9	2.40	56	2.40		56	2.40	61	63.9			
30		48	2.31	49	0.23		34	2.40	17	0.22		13	21	2.40	44	0.22		44	0.22	60	63.0		
31	14	14	2.40	65	3	.23	59	2.40	30	.23	14	14	2.50	57	.23		57	.23	59	62.1			
32		39	2.40	17	.23		14	24	2.40	44	.23	14	10	2.50	66	11	.23		66	11	.23	58	61.1
33	15	4	2.40	31	.25	15	4	2.50	58	.25	15	4	2.50	34	2.50		34	2.50	57	60.2			
34		29	2.50	46	.25		15	13	2.50	66	.25		58	2.50	39	.25		39	.25	56	59.2		
35		53	2.50	66	1	0.27	37	2.50	28	0.27		15	22	2.61	54	0.27		54	0.27	55	58.3		
36	16	17	2.50	17	.27	16	1	2.50	44	.27	16	1	2.61	67	10	.27		67	10	.27	54	57.3	
37		41	2.50	33	.28		25	2.61	67	0	.27	16	8	2.61	26	.27		26	.27	53	56.4		
38	17	5	2.50	50	.28	17	5	2.61	16	.28	17	5	2.61	31	2.61		31	2.61	52	55.4			
39		29	2.61	67	7	.30	17	11	2.61	33	.28		54	2.73	59	.28		59	.28	51	54.4		
40		52	2.61	25	0.30		34	2.73	50	0.30		17	16	2.73	68	16	0.28		68	16	0.28	50	53.5
41	18	15	2.73	43	.32	18	15	2.73	68	.30	18	15	2.73	33	.30		33	.30	49	52.5			
42		37	2.73	68	2	.32	18	18	2.73	26	.32	18	0	2.86	51	.30		51	.30	48	51.5		
43		59	2.73	21	.32		40	2.73	45	.32		21	2.86	69	9	.32		69	9	.32	47	50.5	
44	19	21	2.73	40	.33	19	2	2.86	69	.33	19	2	2.86	42	2.86		42	2.86	46	49.5			
45		43		69	0		23		24			19	3		47			47		45	48.6		

t	a = 61° 30'		a = 62° 0'		a = 62° 30'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 61° 30'		d = 62° 0'		d = 62° 30'		

b	a = 61° 30'					a = 62° 0'					a = 62° 30'					c	a									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ						Δ	Δ															
45	19	43	2.86	69	0	0.33	19	23	2.86	69	24	0.33	19	3	2.86	69	47	0.33	45	0	48.6					
46	20	4	2.86	20	.35	44	2.86	44	.33	24	3.00	70	7	.33	44	2.86	44	.33	44	47.6						
47	25	2.86	41	.35	20	5	3.00	70	4	.35	44	3.00	27	.35	43	46.6										
48	46	3.00	70	2	.37	25	3.00	25	.35	20	4	3.00	48	.35	42	45.6										
49	21	6	3.00	24	.37	45	3.00	46	.37	24	3.16	71	9	.35	41	44.6										
50	26	3.00	46	0	.37	21	5	3.16	71	8	0.37	43	3.16	30	0.37	40	43.5									
51	4	3.16	71	8	.38	24	3.16	30	.37	21	2	3.33	52	.37	39	42.5										
52	5	3.16	31	.38	24	43	3.33	52	.38	20	3.33	72	14	.37	38	41.5										
53	24	3.16	54	.40	22	1	3.33	72	15	.40	38	3.33	36	.38	37	40.5										
54	43	3.33	72	18	.40	19	3.33	39	.38	56	3.53	59	.38	36	39.5											
55	23	1	3.53	42	.42	37	3.53	73	2	0.40	22	13	3.53	73	22	0.40	35	38.4								
56	18	3.53	73	7	.42	54	3.53	26	.42	30	3.53	46	.40	34	37.4											
57	35	3.53	32	.42	23	11	3.53	51	.42	47	3.75	74	10	.42	33	36.3										
58	52	3.75	57	.43	28	3.75	74	16	.42	23	3	3.75	35	.42	32	35.3										
59	24	8	3.75	74	23	.43	44	4.00	.43	19	4.00	75	0	.42	31	34.2										
60	24	3.75	49	0.43	59	4.00	75	7	0.43	34	4.00	25	0.42	30	33.2											
61	40	4.00	75	15	.45	24	14	4.00	.43	49	4.00	50	.43	29	32.1											
62	55	4.00	42	.45	29	4.00	59	.45	24	4	4.29	76	16	.43	28	31.0										
63	25	10	4.29	76	9	.47	44	4.29	76	26	.45	18	4.62	42	27	30.0										
64	24	4.29	37	.47	58	4.62	53	.45	31	4.62	77	9	.45	26	28.9											
65	38	4.62	77	5	.47	25	11	4.62	77	20	.47	44	4.62	36	25	27.8										
66	51	5.00	33	.47	24	5.00	48	.47	25	9	5.00	78	3	.45	24	26.8										
67	26	3	5.00	78	1	.48	36	5.00	78	16	.47	25	9	5.00	30	25.7										
68	15	5.00	30	.48	48	5.00	44	.48	21	5.45	58	.47	22	24.6												
69	27	5.45	59	.50	26	0	5.45	79	13	.48	32	5.45	79	26	21	23.5										
70	38	5.45	79	29	.50	11	6.00	42	0.48	43	6.00	54	0.48	20	22.4											
71	49	6.00	59	.50	21	6.00	80	11	.48	53	6.00	80	23	.48	19	21.3										
72	59	6.00	80	29	.50	31	6.00	40	.50	26	3	6.67	52	.48	18	20.2										
73	27	9	6.67	59	.50	41	6.67	81	10	.50	12	6.67	81	21	.48	17	19.1									
74	18	6.67	81	29	.52	50	7.50	40	.50	21	7.50	50	.50	16	18.0											
75	27	7.50	82	0	.52	58	7.50	82	10	0.50	29	7.50	82	20	0.48	15	16.9									
76	35	8.57	31	.52	27	6	8.57	40	.52	37	8.57	49	.50	14	15.8											
77	42	8.57	83	2	.52	13	8.57	83	11	.50	44	8.57	83	19	.50	13	14.7									
78	49	8.57	33	.53	20	10.0	41	.52	51	10.0	49	.52	12	13.5												
79	56	10.0	84	5	.53	26	10.0	84	12	.52	57	10.0	84	20	.50	11	12.4									
80	28	2	12.0	37	.53	32	12.0	43	0.53	27	3	12.0	50	0.52	10	11.3										
81	7	12.0	85	9	.53	37	12.0	85	15	.52	8	12.0	85	21	.50	9	10.2									
82	12	15.0	41	.53	42	15.0	46	.53	13	15.0	51	.52	7	9.0												
83	16	15.0	86	13	.53	46	15.0	86	18	.52	17	20.0	86	22	.52	6	7.9									
84	20	20.0	45	.53	50	20.0	49	.53	20	20.0	53	.52	6	6.8												
85	23	30.0	87	17	0.55	53	20.0	87	21	0.52	23	20.0	87	24	0.52	5	5.7									
86	25	30.0	50	.53	56	30.0	52	.53	26	30.0	55	.52	4	4.5												
87	27	30.0	88	22	.55	58	60.0	88	24	.53	28	60.0	88	26	.53	3	3.4									
88	29	60.0	55	.53	59	60.0	56	.53	29	60.0	58	.52	2	2.3												
89	30	—	89	27	.55	28	0	—	89	28	.53	30	—	1	1.1											
90	30	—	90	0	—	0	—	—	90	0	—	30	—	0	0.0											

t	a = 61° 30'		a = 62° 0'		a = 62° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 61° 30'		d = 62° 0'		d = 62° 30'		



B	$a = 63^\circ 0'$				$a = 63^\circ 30'$				$a = 64^\circ 0'$				C	$\beta$						
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
0	0	0	2.22	63	0	0.00	0	0	2.22	63	30	0.00	0	0	2.31	64	0	0.00	90	90.0
1	0	27	2.22		0	.02	27	2.22		30	.02	26	2.22		0	0	.02	89	89.1	
2	1	54	2.14		1	.02	54	2.31		31	.02	53	2.31		1	0	.02	88	88.2	
3	1	22	2.22		2	.03	1	20	2.22		32	.02	1	19	2.31	2	.02	87	87.3	
4	4	49	2.22		3	.03	47	2.22		33	.03	45	2.31		3	0	.03	86	86.4	
5	2	16	2.22		5	0.03	2	14	2.31		35	0.03	2	11	2.22	5	0.03	85	85.5	
6	43	2.22		7	.05	40	2.22		37	.05	38	2.31		7	0	.05	84	84.6		
7	3	10	2.22		10	.05	3	7	2.22		40	.05	3	4	2.31	10	.05	83	83.7	
8	37	2.22		13	.07	34	2.31		43	.07	30	2.31		13	0	.07	82	82.8		
9	4	4	2.22		17	.07	4	0	2.22		47	.07	56	2.31		17	.07	81	81.9	
10	31	2.22		21	0.08	27	2.31		51	0.07	4	22	2.31		21	0.07	80	81.0		
11	58	2.22		26	.08	53	2.22		55	.08	48	2.31		25	.08	79	80.1			
12	5	25	2.22		31	.08	5	20	2.31	64	0	.08	5	14	2.31	30	.08	78	79.2	
13	52	2.31		36	.10	46	2.31		5	.10	40	2.40		35	.08	77	78.3			
14	6	18	2.22		42	.10	6	12	2.31		11	.10	6	5	2.31	40	.10	76	77.4	
15	45	2.31		48	0.10	38	2.31		17	0.12	31	2.40		46	0.12	75	76.5			
16	7	11	2.22		54	.12	7	4	2.31		24	.12	56	2.31		53	.12	74	75.6	
17	38	2.31		64	1	.13	30	2.31		31	.12	7	22	2.40		65	0	.12	73	74.7
18	8	4	2.31		9	.13	56	2.40		38	.13	47	2.40		7	.13	72	73.8		
19	30	2.31		17	.13	8	21	2.31		46	.13	8	12	2.40		15	.13	71	72.9	
20	56	2.31		25	0.15	47	2.40		54	0.13	37	2.40		23	0.13	70	72.0			
21	9	22	2.31		34	.15	9	12	2.40	65	2	.15	9	2	2.40	31	.15	69	71.0	
22	48	2.40		43	.15	37	2.40		11	.17	27	2.40		40	.15	68	67.7			
23	10	13	2.31		52	.17	10	2	2.40		21	.17	52	2.50		49	.17	67	69.2	
24	39	2.40		65	2	.18	27	2.40		31	.17	10	16	2.40		59	.17	66	68.3	
25	11	4	2.40		13	0.18	52	2.40		41	0.18	41	2.50		66	9	0.18	65	67.3	
26	29	2.40		24	.18	11	17	2.50		52	.18	11	5	2.50		20	.18	64	66.4	
27	54	2.40		35	.20	41	2.50		66	3	.18	29	2.50		31	.18	63	65.5		
28	12	19	2.50		47	.20	12	5	2.50		14	.20	53	2.61		42	.20	62	64.6	
29	43	2.50		59	.20	29	2.50		26	.22	12	16	2.50		54	.20	61	63.6		
30	13	7	2.50		66	11	53	2.50		39	0.22	40	2.61		67	6	0.22	60	62.7	
31	31	2.50		24	.23	13	17	2.50		52	.22	13	3	2.61		19	.22	59	61.7	
32	55	2.50		38	.23	41	2.61		67	5	.23	26	2.61		32	.22	58	60.8		
33	14	19	2.50		52	.23	14	4	2.61		19	.23	49	2.61		45	.23	57	59.8	
34	43	2.61		67	6	.25	27	2.61		33	.23	14	12	2.73		59	.23	56	58.9	
35	15	6	2.61		21	0.25	50	2.73		47	0.25	34	2.73		68	13	0.25	55	57.9	
36	29	2.61		36	.25	15	12	2.73		68	2	.25	56	2.73		28	.25	54	57.0	
37	52	2.73		51	.27	34	2.73		17	.27	15	18	2.73		43	.27	53	56.0		
38	16	14	2.73		68	7	56	2.73		33	.27	40	2.86		59	.27	52	55.0		
39	36	2.73		24	.28	16	18	2.73		49	.28	16	1	2.86		69	15	.27	51	54.1
40	58	2.73		41	0.28	40	2.86		69	6	0.28	22	2.86		31	0.28	50	53.1		
41	17	20	2.86		58	.30	17	1	2.86		23	.28	43	2.86		48	.28	49	52.1	
42	41	2.86		69	16	.30	22	2.86		40	.30	17	4	3.00		70	5	.28	48	51.1
43	18	2	2.86		34	.30	43	3.00		58	.30	24	3.00		22	.30	47	50.2		
44	23	2.86		52	.32	18	3	3.00		70	16	.32	44	3.00		40	.30	46	49.2	
45	44			70	11		23			35		18	4			58		45	48.2	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a							
	$d = 63^\circ 0'$				$d = 63^\circ 30'$				$d = 64^\circ 0'$				a							

B	a = 63° 0'				a = 63° 30'				a = 64° 0'				C	α						
	h	d	60' Δ	Z	h	d	60' Δ	Z	h	d	60' Δ	Z			C	β				
		t	Δ 60'	t		Δ 60'	t	Δ 60'		t	Δ 60'									
45	18	44	3.00	70	11	0.32	18	23	3.00	70	35	0.32	18	4	3.16	70	58	0.32	45	48.2
46	19	4	3.00	30	.33	43	3.00	54	.32	23	3.16	71	17	.32	44	47.2				
47	24	3.16	50	.33	19	3	3.16	71	13	.33	42	3.16	36	.32	43	46.2				
48	43	3.16	71	10	.35	22	3.16	33	.33	19	1	3.33	55	.33	42	45.2				
49	20	2	3.16	31	.35	41	3.33	53	.35	19	3.33	72	15	.35	41	44.2				
50	21	3.16	52	0.35	59	3.33	72	14	0.35	37	3.33	36	0.33	40	43.2					
51	40	3.33	72	13	.37	20	17	3.33	35	.35	55	3.53	56	.35	39	42.1				
52	58	3.33	35	.37	35	3.53	56	.37	20	12	3.53	73	17	.35	38	41.1				
53	21	16	3.53	57	.38	52	3.53	73	18	.37	29	3.53	38	.37	37	40.1				
54	33	3.53	73	20	.38	21	9	3.53	40	.37	46	3.53	74	0	37	39.1				
55	50	3.53	43	0.38	26	3.75	74	2	0.38	21	3	3.75	22	0.38	35	38.0				
56	22	7	3.75	74	6	.40	42	3.75	25	.38	19	4.00	45	.37	34	37.0				
57	23	3.75	30	.40	58	3.75	48	.40	34	4.00	75	7	.38	33	36.0					
58	39	4.00	54	.40	22	14	4.00	75	12	.40	49	4.00	30	.40	32	34.9				
59	54	4.00	75	18	.40	29	4.00	36	.40	22	4	4.00	54	.40	31	33.9				
60	23	9	4.00	42	0.42	44	4.29	76	0	0.42	19	4.29	76	18	0.40	30	32.8			
61	24	4.29	76	7	.43	58	4.29	25	.42	33	4.62	42	.40	29	31.8					
62	38	4.29	33	.43	23	12	4.29	50	.42	46	4.62	77	6	.42	28	30.7				
63	52	4.62	59	.43	26	4.62	77	15	.42	59	4.62	31	.42	27	29.7					
64	24	5	4.62	77	25	.43	39	5.00	40	.43	23	12	5.00	56	.42	26	28.6			
65	18	5.00	51	0.45	51	5.00	78	6	0.43	24	5.00	78	21	0.43	25	27.5				
66	30	5.00	78	18	.45	24	3	5.00	32	.43	36	5.00	47	.43	24	26.5				
67	42	5.00	45	.45	15	5.45	58	.45	48	5.45	79	13	.43	23	25.4					
68	54	5.45	79	12	.45	26	5.45	79	25	.45	59	5.45	39	.43	22	24.3				
69	25	5	6.00	39	.47	37	6.00	52	.45	24	10	6.00	80	5	.45	21	23.2			
70	15	6.00	80	7	0.47	47	6.00	80	19	0.47	20	6.67	32	0.45	20	22.1				
71	25	6.00	35	.47	57	6.00	47	.47	29	6.67	59	.45	19	21.0						
72	35	6.67	81	3	.48	25	7	6.67	81	15	.47	38	6.67	81	26	.45	18	20.0		
73	44	6.67	32	.48	16	7.50	43	.47	47	7.50	53	.45	17	18.9						
74	53	7.50	82	0	.48	24	7.50	82	11	.47	55	7.50	82	20	.47	16	17.8			
75	26	1	8.57	29	0.48	32	8.57	39	0.47	25	3	8.57	48	0.47	15	16.7				
76	8	8.57	58	.50	39	8.57	83	7	.48	10	8.57	83	16	.47	14	15.6				
77	15	8.57	83	28	.48	46	8.57	36	.48	17	10.0	44	.48	13	14.5					
78	22	10.0	57	.50	53	10.0	84	5	.48	23	10.0	84	13	.47	12	13.4				
79	28	12.0	84	27	.50	59	12.0	34	.48	29	12.0	41	.47	11	12.3					
80	33	12.0	57	0.50	26	4	12.0	85	3	0.48	34	12.0	85	9	0.48	10	11.1			
81	38	12.0	85	27	.50	9	15.0	32	.50	39	15.0	38	.48	9	10.0					
82	43	15.0	57	.50	13	15.0	86	2	.48	43	15.0	86	7	.48	8	8.9				
83	47	20.0	86	27	.50	17	15.0	31	.50	47	15.0	36	.48	7	7.8					
84	50	20.0	57	.50	21	20.0	87	1	.50	51	20.0	87	5	.48	6	6.7				
85	53	20.0	87	27	0.52	24	30.0	31	0.48	54	30.0	34	0.48	5	5.6					
86	56	30.0	58	.50	26	30.0	88	0	.50	56	30.0	88	3	.48	4	4.5				
87	58	30.0	88	28	.52	28	60.0	30	.50	58	60.0	32	.48	3	3.4					
88	59	60.0	59	.50	29	60.0	89	0	.50	59	60.0	89	1	.50	2	2.2				
89	27	0	89	29	.52	30	—	30	.50	26	0	—	31	.48	1	1.1				
90	0	—	90	0	—	30	—	90	0	—	0	—	90	0	—	0	0.0			

t	a = 63° 0'		a = 63° 30'		a = 64° 0'		α
	a	60' Δ	b	Δ 60'	a	60' Δ	
	d = 63° 0'		d = 63° 30'		d = 64° 0'		



B	$a = 64^\circ 30'$					$a = 65^\circ 0'$					$a = 65^\circ 30'$					C	$\beta$			
	$h$	$d$	$\frac{60'}{\Delta}$	$Z$	$t$	$\frac{\Delta}{60'}$	$h$	$d$	$\frac{60'}{\Delta}$	$Z$	$t$	$\frac{\Delta}{60'}$	$h$	$d$	$\frac{60'}{\Delta}$			$Z$	$t$	$\frac{\Delta}{60'}$
0	0	0	2.31	64	30	0.00	0	0	2.40	65	0	0.00	0	0	2.40	65	30	0.00	90	90.0
1	26	2.31	30	.02	25	2.31	0	.02	25	2.40	30	.02	25	2.40	30	.02	89	.02	89	89.1
2	52	2.31	31	.02	51	2.40	1	.02	50	2.40	31	.02	50	2.40	31	.02	88	.02	88	88.2
3	1 18	2.40	32	.02	1 16	2.40	2	.02	1 15	2.50	32	.02	1 15	2.50	32	.02	87	.02	87	87.3
4	43	2.31	33	.03	41	2.31	3	.03	39	2.40	33	.03	39	2.40	33	.03	86	.03	86	86.4
5	2 9	2.31	35	0.03	2 7	2.40	5	0.03	2 4	2.40	35	0.03	2 4	2.40	35	0.03	85	0.03	85	85.5
6	35	2.40	37	.05	32	2.40	7	.05	29	2.40	37	.05	29	2.40	37	.05	84	.05	84	84.6
7	3 0	2.31	40	.05	57	2.40	10	.05	54	2.40	40	.05	54	2.40	40	.05	83	.05	83	83.7
8	26	2.31	43	.05	3 22	2.40	13	.05	3 19	2.50	43	.05	3 19	2.50	43	.05	82	.05	82	82.7
9	52	2.40	46	.07	47	2.40	16	.07	43	2.40	46	.07	43	2.40	46	.07	81	.07	81	81.8
10	4 17	2.31	50	0.07	4 12	2.40	20	0.07	4 8	2.50	50	0.07	4 8	2.50	50	0.07	80	0.07	80	80.9
11	43	2.40	54	.08	37	2.40	24	.08	32	2.40	54	.08	32	2.40	54	.08	79	.08	79	80.0
12	5 8	2.40	59	.08	5 2	2.40	29	.08	57	2.50	58	.08	57	2.50	58	.08	78	.08	78	79.1
13	33	2.31	65	4	27	2.40	34	.08	5 21	2.50	66	3	5 21	2.50	66	3	77	.10	77	78.2
14	59	2.40	4	.10	52	2.40	39	.10	45	2.40	3	.10	45	2.40	3	.10	76	.10	76	77.3
15	6 24	2.40	16	0.10	6 17	2.50	45	0.10	6 10	2.50	15	0.10	6 10	2.50	15	0.10	75	0.10	75	76.4
16	49	2.40	22	.12	41	2.40	51	.12	34	2.50	21	.10	34	2.50	21	.10	74	.10	74	75.4
17	7 14	2.40	29	.12	7 6	2.50	58	.12	58	2.50	27	.12	58	2.50	27	.12	73	.12	73	74.5
18	39	2.40	36	.13	30	2.50	66	5	7 22	2.50	34	.12	7 22	2.50	34	.12	72	.12	72	73.6
19	8 4	2.50	44	.13	54	2.50	12	.13	46	2.61	41	.13	46	2.61	41	.13	71	.13	71	72.7
20	28	2.40	52	0.13	8 18	2.50	20	0.13	8 9	2.50	49	0.13	8 9	2.50	49	0.13	70	0.13	70	71.7
21	53	2.50	66	0	42	2.50	28	.15	33	2.61	57	.15	33	2.61	57	.15	69	.15	69	70.8
22	9 17	2.50	9	.15	9 6	2.50	37	.15	56	2.61	67	6	56	2.61	67	6	68	.15	68	69.9
23	41	2.50	18	.15	30	2.50	46	.17	9 19	2.61	15	.15	9 19	2.61	15	.15	67	.15	67	69.0
24	10 5	2.50	27	.17	54	2.61	56	.17	42	2.61	24	.17	42	2.61	24	.17	66	.17	66	68.0
25	29	2.50	37	.18	10 17	2.50	67	6	10 5	2.61	34	.17	10 5	2.61	34	.17	65	.17	65	67.1
26	53	2.50	48	.18	41	2.61	16	.17	28	2.61	44	.17	28	2.61	44	.17	64	.17	64	66.2
27	11 17	2.61	59	.18	11 4	2.61	26	.18	51	2.61	54	.18	51	2.61	54	.18	63	.18	63	65.2
28	40	2.61	67	10	27	2.61	37	.20	11 14	2.73	68	5	11 14	2.73	68	5	62	.18	62	64.3
29	12 3	2.61	21	.20	50	2.73	49	.20	36	2.73	16	.20	36	2.73	16	.20	61	.20	61	63.3
30	26	2.61	33	0.22	12 12	2.73	68	1	58	2.73	28	0.20	58	2.73	28	0.20	60	0.20	60	62.4
31	49	2.73	46	.22	34	2.73	13	.20	12 20	2.73	40	.20	12 20	2.73	40	.20	59	.20	59	61.4
32	13 11	2.61	59	.22	56	2.73	25	.22	42	2.86	52	.22	42	2.86	52	.22	58	.22	58	60.5
33	34	2.73	68	12	13 18	2.73	38	.23	13 3	2.86	69	5	13 3	2.86	69	5	57	.22	57	59.5
34	56	2.73	26	.23	40	2.73	52	.23	24	2.86	18	.23	24	2.86	18	.23	56	.23	56	58.6
35	14 18	2.73	40	0.23	14 2	2.86	69	6	45	2.86	32	0.23	45	2.86	32	0.23	55	0.23	55	57.6
36	40	2.86	54	.25	23	2.86	20	.23	14 6	2.86	46	.23	14 6	2.86	46	.23	54	.23	54	56.6
37	15 1	2.86	69	9	44	2.86	34	.25	27	2.86	70	0	27	2.86	70	0	53	.25	53	55.7
38	22	2.86	24	.27	15 5	2.86	49	.27	48	3.00	15	.25	48	3.00	15	.25	52	.25	52	54.7
39	43	2.86	40	.27	26	3.00	70	5	15 8	3.00	30	.25	15 8	3.00	30	.25	51	.25	51	53.7
40	16 4	3.00	56	0.27	46	3.00	21	0.27	28	3.16	45	0.27	28	3.16	45	0.27	50	0.27	50	52.7
41	24	3.00	70	12	16 6	3.00	37	.27	47	3.16	71	1	47	3.16	71	1	49	.27	49	51.8
42	44	3.00	29	.28	26	3.16	53	.28	16 6	3.16	17	.28	16 6	3.16	17	.28	48	.28	48	50.8
43	17 4	3.00	46	.30	45	3.16	71	10	25	3.16	34	.28	25	3.16	34	.28	47	.28	47	49.8
44	24	3.16	71	4	17 4	3.16	27	.30	44	3.16	51	.28	44	3.16	51	.28	46	.28	46	48.8
45	43		22		23		45		17 3		72 8		17 3		72 8		45		45	47.8

t	$d = 64^\circ 30'$				$d = 65^\circ 0'$				$d = 65^\circ 30'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	

b	a = 64° 30'					a = 65° 0'					a = 65° 30'					c	α									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ							Δ															
45	17	43	3.16	71	22	0.30	17	23	3.16	71	45	0.30	17	3	3.33	72	8	0.30	45	47.8						
40	18	2	3.16	40	.32	42	3.33	72	3	.30	21	3.33	26	.30	44	46.8										
47	21	3.16	59	.32	18	0	3.33	21	.32	39	3.33	44	.30	43	45.8											
48	40	3.33	72	18	.32	18	3.33	40	.32	57	3.53	73	2	.32	42	44.8										
49	58	3.33	37	.33	36	3.53	59	.33	18	14	3.53	21	.32	41	43.8											
50	19	16	3.53	57	0.33	53	3.53	73	19	0.33	31	3.53	40	0.33	40	42.8										
51	33	3.53	73	17	.35	19	10	3.53	39	.33	48	3.75	74	0	.33	39	41.8									
52	50	3.53	38	.35	27	3.75	59	.33	19	4	3.75	20	.33	38	40.8											
53	20	7	3.75	59	.35	43	3.75	74	19	.35	20	3.75	40	.33	37	39.7										
54	23	3.75	74	20	.37	59	3.75	40	.35	36	3.75	75	0	.33	36	38.7										
55	39	3.75	42	0.37	20	15	4.00	75	1	0.37	52	4.00	21	0.35	35	37.7										
56	55	4.00	75	4	.37	30	4.00	23	.37	20	7	4.29	42	.37	34	36.7										
57	21	10	4.00	26	.38	45	4.00	45	.37	21	4.29	76	4	.37	33	35.6										
58	25	4.29	49	.38	21	0	4.29	76	7	.38	35	4.29	26	.37	32	34.6										
59	39	4.29	76	12	.38	14	4.29	30	.38	49	4.29	48	.37	31	33.5											
60	53	4.29	35	0.40	28	4.29	53	0.38	21	3	4.62	77	10	0.37	30	32.5										
61	22	7	4.62	59	.40	42	4.62	77	16	.38	16	4.62	32	.38	29	31.5										
62	20	4.62	77	23	.40	55	5.00	39	.40	29	5.00	55	.40	28	30.4											
63	33	4.62	47	.40	22	7	5.00	78	3	.40	41	5.00	78	19	.38	27	29.3									
64	46	5.00	78	11	.42	19	5.00	27	.40	53	5.00	42	.40	26	28.3											
65	58	5.00	36	0.42	31	5.00	51	0.42	22	5	5.45	79	6	0.40	25	27.2										
66	23	10	5.45	79	1	.42	43	5.45	79	16	.42	16	5.45	30	.40	24	26.2									
67	21	5.45	26	.43	54	6.00	41	.42	27	6.00	54	.42	23	.42	23	25.1										
68	32	6.00	52	.43	23	4	6.00	80	6	.42	37	6.00	80	19	.42	22	24.0									
69	42	6.00	80	18	.43	14	6.00	31	.42	47	6.67	44	.42	21	23.0											
70	52	6.67	44	0.43	24	6.67	56	0.43	56	6.67	81	9	0.42	20	21.9											
71	24	1	6.67	81	10	.45	33	6.67	81	22	.43	23	5	6.67	34	.42	19	20.8								
72	10	6.67	37	.45	42	7.50	48	.43	14	7.50	59	.43	17	.43	17	19.7										
73	19	7.50	82	4	.45	50	7.50	82	14	.43	22	7.50	82	25	.43	17	18.6									
74	27	8.57	31	.45	58	7.50	40	.45	30	8.57	51	.43	16	.43	16	17.6										
75	34	8.57	58	0.45	24	6	8.57	83	7	0.45	37	8.57	83	17	0.43	15	16.5									
76	41	8.57	83	25	.45	13	10.0	34	.45	44	10.0	43	.43	14	15.4											
77	48	10.0	52	.47	19	10.0	84	1	.45	50	10.0	84	9	.43	13	14.3										
78	54	10.0	84	20	.47	25	10.0	28	.45	56	12.0	35	.45	12	13.2											
79	25	0	12.0	48	.47	31	12.0	55	.45	24	1	12.0	85	2	.45	11	12.1									
80	5	12.0	85	16	0.47	36	15.0	85	22	0.47	6	12.0	29	0.43	10	11.0										
81	10	15.0	44	.47	40	15.0	50	.45	11	15.0	55	.45	9	.45	9	9.9										
82	14	15.0	86	12	.47	44	15.0	86	17	.47	15	20.0	86	22	.45	8	8.8									
83	18	20.0	40	.48	48	20.0	45	.45	18	20.0	49	.45	7	.45	7	7.7										
84	21	20.0	87	9	.47	51	20.0	87	12	.47	21	20.0	87	16	.47	6	6.6									
85	24	30.0	37	0.48	54	30.0	40	0.47	24	30.0	44	0.45	5	5.5												
86	26	30.0	88	6	.47	56	30.0	88	8	.47	26	30.0	88	11	.45	4	4.4									
87	28	60.0	34	.48	58	60.0	36	.47	28	60.0	38	.45	3	3.3												
88	29	60.0	89	3	.47	59	60.0	89	4	.47	29	60.0	89	5	.47	2	2.2									
89	30	—	31	.48	25	0	—	32	.47	30	—	33	.45	1	1.1											
90	30	—	90	0	—	0	—	90	0	—	30	—	90	0	—	0	0.0									

t	a = 64° 30'				a = 65° 0'				a = 65° 30'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
	d = 64° 30'				d = 65° 0'				d = 65° 30'				



B	a = 66° 0'				a = 66° 30'				a = 67° 0'				C	β							
	h	d	60' / Δ	t / Z	Δ / 60'	h	d	60' / Δ	t / Z	Δ / 60'	h	d			60' / Δ	t / Z	Δ / 60'				
																		b	a	b	a
0	0	0	2.50	66	0	0.00	0	0	2.50	66	30	0.00	0	0	2.61	67	0	0.00	90	90.0	
1		24	2.40		0	.02		24	2.50		30	.02		23	2.50		0	.02	89	89.1	
2		49	2.50		1	.02		48	2.50		31	.02		47	2.61		1	.02	88	88.2	
3	1	13	2.40		2	.02	1	12	2.50		32	.02	1	10	2.50		2	.02	87	87.2	
4		38	2.50		3	.03		36	2.50		33	.03		34	2.61		3	.03	86	86.3	
5	2	2	2.50		5	.03	2	0	2.61		35	.03		57	2.61		5	.03	85	85.4	
6		26	2.50		7	.03		23	2.50		37	.03	2	20	2.50		7	.03	84	84.5	
7		50	2.40		9	.05		47	2.50		39	.05		44	2.61		9	.05	83	83.6	
8	3	15	2.50		12	.07	3	11	2.50		42	.05	3	7	2.61		12	.05	82	82.7	
9		39	2.50		16	.07		35	2.61		45	.07		30	2.61		15	.07	81	81.7	
10	4	3	2.50		20	0.07		58	2.50		49	0.07		53	2.61		19	0.07	80	80.8	
11		27	2.50		24	.07	4	22	2.61		53	.07	4	16	2.61		23	.07	79	79.9	
12		51	2.50		28	.08		45	2.50		57	.08		39	2.61		27	.08	78	79.0	
13	5	15	2.50		33	.08	5	9	2.61	67	2	.08	5	2	2.61		32	.08	77	78.0	
14		39	2.50		38	.10		32	2.61		7	.10		25	2.61		37	.08	76	77.1	
15	6	3	2.61		44	0.10		55	2.61		13	0.10		48	2.61		42	0.10	75	76.2	
16		26	2.50		50	.10	6	18	2.61		19	.10	6	11	2.61		48	.10	74	75.3	
17		50	2.61		56	.12		41	2.61		25	.12		34	2.73		54	.12	73	74.3	
18	7	13	2.50	67	7	.12	7	4	2.61		32	.12		56	2.61	68	8	.12	72	73.4	
19		37	2.61		10	.13		27	2.61		39	.12		7	19	2.73		8	.12	71	72.5
20	8	0	2.61		18	0.13		50	2.61		46	0.13		41	2.73		15	.13	70	71.5	
21		23	2.61		26	.13	8	13	2.61		54	.13	8	3	2.73		23	.13	69	70.6	
22		46	2.61		34	.15		36	2.73	68	2	.15		25	2.73		31	.13	68	69.7	
23	9	9	2.73		43	.15		58	2.73		11	.15		47	2.73		39	.15	67	68.7	
24		31	2.61		52	.17	9	20	2.73		20	.15	9	9	2.86		48	.15	66	67.8	
25		54	2.73	68	2	0.17		42	2.73		29	0.17		30	2.73		57	0.17	65	66.8	
26	10	16	2.73		12	.17	10	4	2.73		39	.17		52	2.86	69	7	.17	64	65.9	
27		38	2.73		22	.17		26	2.73		49	.18		10	13	2.86		17	.17	63	65.0
28	11	0	2.73		32	.18		48	2.86	69	0	.18		34	2.86		27	.18	62	64.0	
29		22	2.73		43	.20	11	9	2.86		11	.18		55	2.86		38	.18	61	63.1	
30		44	2.73	68	55	0.20		30	2.86		22	0.20	11	16	2.86		49	0.18	60	62.1	
31	12	6	2.86	69	7	.20		51	2.86		34	.20		37	3.00	70	0	.20	59	61.1	
32		27	2.86		19	.20	12	12	2.86		46	.20		57	3.00		12	.20	58	60.2	
33		48	2.86		31	.22		33	3.00		58	.22	12	17	3.00		24	.22	57	59.2	
34	13	9	2.86		44	.23		53	3.00	70	11	.22		37	3.00		37	.22	56	58.3	
35		30	3.00		58	0.23	13	13	3.00		24	0.22		57	3.00		50	0.22	55	57.3	
36		50	3.00	70	12	.23		33	3.00		37	.23	13	17	3.16	71	3	.22	54	56.3	
37	14	10	3.00		26	.23		53	3.00		51	.23		36	3.16		16	.23	53	55.4	
38		30	3.00		40	.25	14	13	3.16		71	5	.25	55	3.16		30	.23	52	54.4	
39		50	3.16		55	.25		32	3.16		20	.25	14	14	3.16		44	.25	51	53.4	
40	15	9	3.16	71	10	0.27		51	3.16		35	0.25		33	3.33		59	0.25	50	52.4	
41		28	3.16		26	.27	15	10	3.16		50	.27		51	3.33	72	14	.25	49	51.4	
42		47	3.16		42	.27		29	3.33		72	6	.27	15	9	3.33		29	.27	48	50.5
43	16	6	3.16		58	.27		47	3.33		22	.27		27	3.33		45	.27	47	49.5	
44		25	3.33	72	14	.28	16	5	3.33		38	.28		45	3.53	73	1	.28	46	48.5	
45		43			31			23			55			16	2		18		45	47.5	

t	a = 66° 0'		a = 66° 30'		a = 67° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 66° 0'		d = 66° 30'		d = 67° 0'		

b	a = 66° 0'					a = 66° 30'					a = 67° 0'					c	α									
	B	h	d	60'	t	Z	Δ	60'	h	d	60'	t	Z	Δ	60'			h	d	60'	t	Z	Δ	60'	C	β
			Δ	Δ							Δ															
45	16	43	3.33	72	31	.30	16	23	3.53	72	55	.28	16	2	3.53	73	18	.27	45	47.5						
46	17	1	3.53	49	.30	40	3.53	73	12	.28	19	3.53	34	.28	44	46.5										
47	18	3.53	73	7	.30	57	3.53	29	.30	36	3.53	51	.28	43	45.5											
48	35	3.53	25	.30	17	14	3.53	47	.30	53	3.75	74	8	.30	42	44.5										
49	52	3.53	43	.32	31	3.75	74	5	.30	17	9	3.75	26	.30	41	43.5										
50	18	9	3.75	74	2	.32	47	3.75	23	.32	25	3.75	44	.32	40	42.5										
51	25	3.75	21	.32	18	3	3.75	42	.32	41	4.00	75	3	.30	39	41.4										
52	41	3.75	40	.33	19	4.00	75	1	.32	56	4.00	21	.32	38	40.4											
53	57	3.75	75	0	.33	34	4.00	20	.33	18	11	4.00	40	.32	37	39.4										
54	19	13	4.00	20	.33	49	4.00	40	.33	26	4.29	59	.33	36	38.4											
55	28	4.00	76	40	.35	19	4	4.29	76	0	.33	40	4.29	76	19	.33	35	37.4								
56	43	4.29	41	.35	18	4.29	20	.35	54	4.29	39	.33	34	.33	34	36.3										
57	57	4.29	22	.35	32	4.29	41	.35	19	8	4.62	59	.33	33	35.3											
58	20	11	4.62	43	.37	46	4.62	77	2	.35	21	4.62	77	19	.35	32	34.3									
59	24	4.62	77	5	.37	59	4.62	23	.35	34	4.62	40	.35	31	33.2											
60	37	4.62	27	.37	20	12	4.62	44	.37	47	5.00	78	1	.35	30	32.2										
61	50	4.62	49	.37	25	5.00	78	6	.37	59	5.00	22	.37	29	31.2											
62	21	3	5.00	11	.38	37	5.00	28	.37	20	11	5.00	44	.37	28	30.1										
63	15	5.00	34	.38	49	5.45	50	.37	23	5.45	79	6	.37	27	29.1											
64	27	5.45	57	.38	21	0	5.45	79	12	.38	34	5.45	28	.37	26	28.0										
65	38	5.45	79	20	.40	11	5.45	35	.38	45	6.00	50	.37	25	27.0											
66	49	6.00	44	.40	22	6.00	58	.38	55	6.00	80	12	.38	24	25.9											
67	59	6.00	80	.40	32	6.00	80	21	.40	21	5	6.00	35	.38	23	24.8										
68	22	9	6.00	32	.40	42	6.67	45	.40	15	6.67	58	.38	22	23.8											
69	19	6.67	56	.40	51	6.67	81	9	.40	24	6.67	81	21	.38	21	22.7										
70	28	6.67	81	20	.42	22	0	6.67	33	.40	33	7.50	44	.40	20	21.6										
71	37	7.50	45	.42	9	7.50	57	.40	41	7.50	82	8	.40	19	20.6											
72	45	7.50	82	10	.42	17	7.50	82	21	.40	49	7.50	32	.40	18	19.5										
73	53	7.50	35	.42	25	8.57	45	.42	57	8.57	56	.40	17	.40	17	18.4										
74	23	1	8.57	83	.43	32	8.57	83	10	.42	22	4	8.57	83	20	.40	16	17.4								
75	8	8.57	26	.42	39	8.57	35	.42	11	10.0	44	.40	15	16.3												
76	15	10.0	51	.43	46	10.0	84	0	.42	17	10.0	84	8	.42	14	15.2										
77	21	10.0	84	17	.43	52	10.0	25	.42	23	12.0	33	.40	13	14.1											
78	27	12.0	43	.43	58	12.0	50	.42	28	12.0	57	.42	12	13.1												
79	32	12.0	85	9	.43	23	3	12.0	85	15	.43	33	12.0	85	22	.42	11	12.0								
80	37	15.0	35	.43	8	15.0	41	.42	38	15.0	47	.42	10	10.9												
81	41	15.0	86	1	.43	12	15.0	86	6	.43	42	15.0	86	12	.42	9	9.8									
82	45	15.0	27	.45	16	20.0	32	.43	46	20.0	37	.42	8	8.7												
83	49	20.0	54	.43	19	20.0	58	.43	49	20.0	87	2	.43	7	7.6											
84	52	30.0	87	20	.45	22	30.0	87	24	.43	52	30.0	28	.42	6	6.5										
85	54	30.0	47	.43	24	30.0	50	.43	54	30.0	53	.42	5	5.5												
86	56	30.0	88	13	.45	26	30.0	88	16	.43	56	30.0	88	18	.43	4	4.4									
87	58	60.0	40	.45	28	60.0	42	.43	58	60.0	44	.42	3	3.3												
88	59	60.0	89	7	.43	29	60.0	89	8	.43	59	60.0	89	9	.42	2	2.2									
89	24	0	—	33	.45	30	—	34	.43	23	0	34	.43	1	1.1											
90	0	—	90	0	—	30	—	90	0	—	0	—	90	0	—	0	0.0									

t	d = 66° 0'				d = 66° 30'				d = 67° 0'				α
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	



B	a = 67° 30'				a = 68° 0'				a = 68° 30'				C	α							
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t			C	β					
		Z	Δ / 60'	Z		Z	Z	Z		Z											
0	0	0	2.61	67	30	0.00	0	0	2.73	68	0	0.00	0	0	2.73	68	30	0.00	90	90.0	
1		23	2.61		30	.02		22	2.61		0	.02		22	2.73		30	.02	89	89.1	
2		46	2.61		31	.02		45	2.73		1	.02		44	2.73		31	.02	88	88.1	
3	1	9	2.61		32	.02		1	7	2.61	2	.02		1	6	2.73	32	.02	87	87.2	
4		32	2.61		33	.03		30	2.73		3	.03		28	2.73		33	.03	86	86.3	
5		55	2.61		35	.03		52	2.61		5	.03		50	2.73		35	.03	85	85.4	
6	2	18	2.73		37	.03		2	15	2.73	7	.03		2	12	2.73	37	.03	84	84.4	
7		40	2.61		39	.05		37	2.73		9	.05		34	2.86		39	.03	83	83.5	
8	3	3	2.61		42	.05		59	2.61		12	.05		55	2.73		41	.05	82	82.6	
9		26	2.61		45	.05		3	22	2.73	15	.05		3	17	2.73	44	.07	81	81.6	
10		49	2.73		48	.07		44	2.73		18	.07		39	2.73		48	.07	80	80.7	
11	4	11	2.61		52	.07		4	6	2.73	22	.07		4	1	2.86	52	.07	79	79.8	
12		34	2.73		56	.08		28	2.73		26	.08		22	2.73		56	.07	78	78.9	
13		56	2.61	68	1	.08		50	2.73		31	.08		44	2.86	69	0	.08	77	77.9	
14	5	19	2.73		6	.10		5	12	2.73	36	.08		5	5	2.73	5	.08	76	77.0	
15		41	2.73		12	.10		34	2.73		41	.10		27	2.86		10	.10	75	76.0	
16	6	3	2.73		18	.10		56	2.86		47	.10		48	2.86		16	.10	74	75.1	
17		25	2.73		24	.10		6	17	2.73	53	.10		6	9	2.86	22	.10	73	74.2	
18		47	2.73		30	.12		39	2.86		59	.12		30	2.86		28	.10	72	73.2	
19	7	9	2.73		37	.12		7	0	2.73	69	.12		51	2.86		34	.12	71	72.3	
20		31	2.73		44	.13		22	2.86		13	.12		7	12	2.86	41	.12	70	71.4	
21		53	2.73		52	.13		43	2.86		20	.13		33	2.86		48	.13	69	70.4	
22	8	15	2.86	69	0	.13		8	4	2.86	28	.13		54	3.00		56	.13	68	69.5	
23		36	2.86		8	.13		25	2.86		36	.13		8	14	3.00	70	4	.13	67	68.5
24		57	2.86		16	.15		46	2.86		44	.15		34	3.00		12	.15	66	67.6	
25	9	18	2.86		25	.17		9	7	3.00	53	.15		54	3.00		21	.15	65	66.6	
26		39	2.86		35	.17		27	2.86		70	.17		9	14	3.00	30	.15	64	65.7	
27	10	0	2.86		45	.17		48	3.00		12	.17		34	3.00		39	.17	63	64.7	
28		21	2.86		55	.17		10	8	3.00	22	.17		54	3.00		49	.17	62	63.8	
29		42	3.00	70	5	.18		28	3.00		32	.18		10	14	3.00	59	.18	61	62.8	
30	11	2	3.00		16	.18		48	3.00		43	.18		34	3.16	71	10	.18	60	61.8	
31		22	3.00		27	.20		11	8	3.16	54	.18		53	3.16		21	.18	59	60.9	
32		42	3.00		39	.20		27	3.16		71	.20		11	12	3.16	32	.18	58	59.9	
33	12	2	3.00		51	.20		46	3.16		17	.20		31	3.16		43	.20	57	58.9	
34		22	3.16	71	3	.20		12	5	3.16	29	.20		50	3.33		55	.20	56	58.0	
35		41	3.16		15	.22		24	3.16		41	.22		12	8	3.33	72	7	.20	55	57.0
36	13	0	3.16		28	.22		43	3.16		54	.22		26	3.33		19	.22	54	56.0	
37		19	3.16		41	.23		13	2	3.33	72	.22		44	3.33		32	.22	53	55.1	
38		38	3.33		55	.23		20	3.33		20	.23		13	2	3.33	45	.23	52	54.1	
39		56	3.33	72	9	.25		38	3.33		34	.23		20	3.33		59	.23	51	53.1	
40	14	14	3.33		24	.25		56	3.33		48	.23		38	3.53	73	13	.23	50	52.1	
41		32	3.33		39	.25		14	14	3.53	73	.25		55	3.53		27	.23	49	51.1	
42		50	3.33		54	.25		31	3.53		17	.25		14	12	3.53	41	.25	48	50.1	
43	15	8	3.53	73	9	.27		48	3.53		32	.27		29	3.75		56	.25	47	49.2	
44		25	3.53		25	.27		15	5	3.53	48	.25		45	3.75	74	11	.25	46	48.2	
45		42			41			22			74	3		15	1		26		45	47.2	

t	a = 67° 30'		a = 68° 0'		a = 68° 30'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 67° 30'		d = 68° 0'		d = 68° 30'		

b		a = 67° 30'					a = 68° 0'					a = 68° 30'					c	a		
		B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z
45	15	42	3.53	73	41	0.27	15	22	3.75	74	3	0.27	15	1	3.75	74	26	0.27	45	47.2
46	16	59	3.75	57	28	.28	15	38	3.75	19	.28	15	17	3.75	42	.27	44	46.2		
47	16	15	3.75	74	14	.28	16	10	3.75	52	.28	16	33	4.00	58	.27	43	45.2		
48	31	3.75	31	.28			16	10	3.75	52	.28	16	48	4.00	75	14	.28	42	44.2	
49	47	3.75	48	.30			16	26	4.00	75	9	.28	16	3	4.00	31	.28	41	43.2	
50	17	3	4.00	75	6	0.30	17	10	4.29	76	2	.30	17	1	4.29	40	.30	37	39.1	
51	18	4.00	24	.30			17	10	4.29	76	2	.30	17	47	4.29	22	.30	38	40.1	
52	33	4.00	42	.30			17	24	4.29	20	.30	17	1	4.29	40	.30	37	39.1		
53	48	4.29	76	0	.32		17	24	4.29	20	.30	17	1	4.29	40	.30	37	39.1		
54	18	2	4.29	19	.32		18	6	4.62	77	16	.32	18	4	6.00	51	.33	30	31.9	
55	16	4.29	38	0.32			18	6	4.62	77	16	.32	18	4	6.00	51	.33	30	31.9	
56	30	4.62	57	.33			18	19	4.62	35	.33	18	54	5.00	54	.32	33	35.0		
57	43	4.62	77	17	.33		18	19	4.62	35	.33	18	54	5.00	54	.32	33	35.0		
58	56	4.62	37	.33			18	32	5.00	55	.33	18	78	13	.32	32	31	32.9		
59	19	9	5.00	57	.35		18	44	5.00	78	15	.33	18	5	5.00	32	.32	31	32.9	
60	21	5.00	78	18	0.35		19	8	5.45	55	.35	19	42	5.45	79	11	.33	29	30.9	
61	33	5.00	39	.35			19	8	5.45	55	.35	19	42	5.45	79	11	.33	29	30.9	
62	45	5.45	79	0	.35		19	19	5.45	79	10	.35	19	53	5.45	31	.33	28	29.8	
63	56	5.45	21	.35			19	30	5.45	37	.35	19	4	6.00	51	.35	27	28.8		
64	20	7	5.45	42	.37		19	41	6.00	58	.35	19	14	6.00	80	12	.35	26	27.7	
65	18	6.00	80	4	0.37		20	1	6.67	81	2	.37	20	34	6.67	54	.35	24	26.7	
66	28	6.00	26	.37			20	1	6.67	81	2	.37	20	34	6.67	54	.35	24	26.7	
67	38	6.67	48	.38			20	10	6.67	81	2	.37	20	43	6.67	81	15	.35	23	24.6
68	47	6.67	81	11	.37		20	19	6.67	24	.37	20	52	6.67	36	.37	22	23.5		
69	56	6.67	33	.38			20	28	6.67	46	.37	20	1	7.50	58	.37	21	22.5		
70	21	5	7.50	56	0.38		21	6	8.57	39	.38	21	9	7.50	82	20	0.37	20	21.4	
71	13	7.50	82	19	.38		21	37	7.50	82	8	0.37	21	9	7.50	82	20	0.37	20	21.4
72	21	8.57	42	.40			21	45	8.57	30	.38	21	17	8.57	42	.37	19	20.4		
73	28	8.57	83	6	.38		21	52	8.57	53	.38	21	24	8.57	83	4	.37	18	19.3	
74	35	8.57	29	.40			21	59	8.57	83	16	.38	21	31	8.57	26	.37	17	18.3	
75	42	10.0	53	0.40			21	6	8.57	39	.38	21	38	10.0	48	.38	16	17.2		
76	48	10.0	84	17	.40		21	13	10.0	84	2	0.38	21	44	10.0	84	11	0.37	15	16.1
77	54	12.0	41	.40			21	19	10.0	25	.38	21	50	12.0	33	.38	14	15.1		
78	59	12.0	85	5	.40		21	25	12.0	48	.40	21	55	12.0	50	.38	13	14.0		
79	22	4	15.0	29	.40		21	30	12.0	85	12	.40	21	1	12.0	85	19	.38	12	12.9
80	8	15.0	53	0.40			21	35	15.0	36	.38	21	5	15.0	42	.38	11	11.8		
81	12	15.0	86	17	.42		22	39	15.0	59	0.40	22	9	15.0	86	5	0.38	10	10.8	
82	16	20.0	42	.42			22	43	15.0	86	23	.40	22	13	15.0	28	.40	9	9.7	
83	19	20.0	87	7	.40		22	47	20.0	47	.40	22	17	20.0	52	.38	8	8.6		
84	22	20.0	31	.42			22	50	20.0	87	11	.40	22	20	20.0	87	15	.40	7	7.5
85	25	30.0	56	0.42			22	53	30.0	35	.40	22	23	30.0	39	.38	6	6.5		
86	27	60.0	88	21	.40		22	55	30.0	59	0.40	22	25	30.0	88	2	0.40	5	5.4	
87	28	60.0	45	.42			22	57	60.0	88	23	.40	22	27	60.0	26	.38	4	4.3	
88	29	60.0	89	10	.42		22	58	60.0	47	.42	22	28	60.0	49	.40	3	3.2		
89	30	—	35	.42			22	59	60.0	89	12	.40	22	28	60.0	89	13	.38	2	2.2
90	30	—	90	0			22	0	—	36	.40	22	30	—	36	.40	1	1.1		
90	30	—	90	0			22	0	—	36	.40	22	30	—	36	.40	0	0	0.0	

t	a = 67° 30'		a = 68° 0'		a = 68° 30'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 67° 30'		d = 68° 0'		d = 68° 30'		



b	a = 69° 0'				a = 69° 30'				a = 70° 0'				c	α					
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t			Δ / 60'	C	β		
0	0	0	2.73	69	0	0.00	0	0	2.86	69	30	0.00	0	0	90	90.0			
1		22	2.86		0	.02	21	2.86	30	.02	21	3.00	0	.02	89	89.1			
2		43	2.73		1	.02	42	2.86	31	.02	41	2.86	1	.02	88	88.1			
3	I	5	2.86		2	.02	I	3	2.86	32	.02	I	2	3.00	2	.02	87	87.2	
4		26	2.86		3	.02	24	2.86	33	.02	22	2.86	3	.02	86	86.3			
5		47	2.73		4	.03	45	2.86	34	.03	43	3.00	4	.03	85	85.3			
6	2	9	2.86		6	.03	2	6	2.86	36	.03	2	3	3.00	6	.03	84	84.4	
7		30	2.73		8	.05	27	2.86	38	.05	23	2.86	8	.05	83	83.4			
8		52	2.86		11	.05	48	2.86	41	.05	44	3.00	11	.05	82	82.5			
9	3	13	2.86		14	.05	3	9	3.00	44	.05	3	4	3.00	14	.05	81	81.6	
10		34	2.86		17	.07	29	2.86	47	.07	24	2.86	17	.05	80	80.6			
11		55	2.86		21	.07	50	2.86	51	.07	45	3.00	20	.07	79	79.7			
12	4	16	2.86		25	.07	4	11	3.00	55	.07	4	5	3.00	24	.07	78	78.7	
13		37	2.86		29	.08	31	2.86	59	.08	25	3.00	28	.08	77	77.8			
14		58	2.86		34	.08	52	3.00	70	4	.08	45	3.00	33	.08	76	76.8		
15	5	19	2.86		39	.10	5	12	2.86	9	.08	5	5	3.00	38	.08	75	75.9	
16		40	2.86		45	.10	33	3.00	14	.10	25	3.16	43	.10	74	75.0			
17	6	1	2.86		51	.10	53	3.00	20	.10	44	3.00	49	.10	73	74.0			
18		22	3.00		57	.10	6	13	3.00	26	.10	6	4	3.00	55	.10	72	73.1	
19		42	2.86	70	3	.12	33	3.00	32	.12	24	3.16	71	1	71	72.1			
20	7	3	3.00		10	.12	53	3.00	39	.12	43	3.00	7	.12	70	71.2			
21		23	3.00		17	.12	7	13	3.16	46	.12	7	3	3.16	14	.12	69	70.2	
22		43	3.00		24	.13	32	3.00	53	.13	22	3.16	21	.13	68	69.3			
23	8	3	3.00		32	.13	52	3.00	71	1	.13	41	3.16	29	.13	67	68.3		
24		23	3.00		40	.15	8	12	3.16	9	.13	8	0	3.16	37	.13	66	67.4	
25		43	3.16		49	.15	31	3.16	17	.15	19	3.16	45	.13	65	66.4			
26	9	2	3.00		58	.15	50	3.16	26	.15	38	3.33	53	.15	64	65.4			
27		22	3.16	71	7	.17	9	9	3.16	35	.15	56	3.16	72	2	.15	63	64.5	
28		41	3.16		17	.17	28	3.16	44	.17	9	15	3.33	11	.15	62	63.5		
29	10	0	3.16		27	.17	47	3.33	54	.17	33	3.33	20	.17	61	62.6			
30		19	3.16		37	.17	10	5	3.33	72	4	.17	51	3.33	30	.17	60	61.6	
31		38	3.16		47	.18	23	3.33	14	.18	10	9	3.33	40	.18	59	60.6		
32		57	3.33		58	.18	41	3.33	25	.18	27	3.53	51	.18	58	59.7			
33	11	15	3.33	72	9	.20	59	3.33	36	.18	44	3.33	73	2	.18	57	58.7		
34		33	3.33		21	.20	11	17	3.33	47	.18	11	2	3.53	13	.18	56	57.7	
35		51	3.33		33	.20	35	3.33	58	.20	19	3.53	24	.20	55	56.7			
36	12	9	3.33		45	.20	53	3.53	73	10	.20	36	3.53	36	.20	54	55.8		
37		27	3.33		57	.22	12	10	3.53	22	.22	53	3.75	48	.20	53	54.8		
38		45	3.53	73	10	.22	27	3.53	35	.22	12	9	3.53	74	0	.20	52	53.8	
39	13	2	3.53		23	.23	44	3.53	48	.22	26	3.75	12	.22	51	.22	51	52.8	
40		19	3.53		37	.23	13	1	3.75	74	1	.22	42	3.75	25	.22	50	51.8	
41		36	3.53		51	.23	17	3.75	14	.23	58	3.75	38	.23	49	.23	49	50.8	
42		53	3.75	74	5	.23	33	3.75	28	.23	13	14	4.00	52	.23	48	.23	48	49.9
43	14	9	3.75		19	.25	49	3.75	42	.25	29	4.00	75	6	.23	47	.23	47	48.9
44		25	3.75		34	.25	14	5	4.00	57	.23	44	4.00	20	.23	46	.23	46	47.9
45		41			49		20		75	11		59		34		45		45	46.9
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a						
	d = 69° 0'				d = 69° 30'				d = 70° 0'				a						
													a						

B	a = 69° 0'				a = 69° 30'				a = 70° 0'				C	α			
	h	60' / Δ		Z	Δ / 60'	h	60' / Δ		Z	Δ / 60'	h	60' / Δ			Z	Δ / 60'	
		d	t				d	t				d					t
45	14 41	4.00	74 49	0.25	14 20	4.00	75 11	0.25	13 59	4.00	75 34	0.25	44	46.9			
46	56	4.00	75 4	.27	35	4.00	26	.27	14 14	4.00	76 49	.25	44	45.9			
47	15 11	4.00	20	.27	50	4.00	42	.25	29	4.29	76 4	.25	43	44.9			
48	26	4.00	36	.27	15 5	4.29	57	.27	43	4.29	19	.25	42	43.9			
49	41	4.00	52	.27	19	4.29	76 13	.27	57	4.29	34	.27	41	42.9			
50	56	4.29	76 8	0.28	33	4.29	29	0.27	15 11	4.29	50	0.27	40	41.9			
51	16 10	4.29	25	.28	47	4.29	45	.28	25	4.62	77 6	.27	39	40.8			
52	24	4.29	42	.28	16 1	4.62	77 2	.28	38	4.62	22	.28	38	39.8			
53	38	4.62	59	.30	14	4.62	19	.28	51	4.62	30	.27	37	38.8			
54	51	4.62	77 17	.30	27	4.62	36	.30	16 4	5.00	55	.28	36	37.8			
55	17 4	4.62	35	0.30	40	4.62	54	0.30	16	5.00	78 12	0.30	35	36.8			
56	17	5.00	53	.30	53	5.00	78 12	.30	28	5.00	30	.28	34	35.8			
57	29	5.00	78 11	.32	17 5	5.00	30	.30	40	5.00	47	.30	33	34.7			
58	41	5.00	30	.32	17	5.45	48	.30	52	5.45	79 5	.30	32	33.7			
59	53	5.00	49	.32	28	5.45	79 6	.32	17 3	5.45	23	.30	31	32.7			
60	18 5	5.45	79 8	0.32	39	5.45	25	0.32	14	6.00	80 0	0.32	30	31.6			
61	16	5.45	27	.33	50	5.45	44	.32	24	6.00	80 41	.30	29	30.6			
62	27	6.00	47	.33	18 1	6.00	80 3	.32	34	6.00	18	.32	28	29.6			
63	37	6.00	80 7	.33	11	6.00	22	.33	44	6.00	37	.32	27	28.5			
64	47	6.00	27	.33	21	6.67	42	.32	54	6.67	56	.32	26	27.5			
65	57	6.00	47	0.35	30	6.67	81 1	0.33	18 3	6.67	81 15	0.33	25	26.5			
66	19 7	6.67	81 8	.33	39	6.67	21	.33	12	6.67	35	.32	24	25.4			
67	16	6.67	28	.35	48	6.67	41	.33	21	7.50	54	.33	23	24.4			
68	25	7.50	49	.35	57	7.50	82 1	.35	20	7.50	82 14	.33	22	23.3			
69	33	7.50	82 10	.35	19 5	7.50	22	.35	37	7.50	34	.33	21	22.3			
70	41	7.50	31	0.37	13	8.57	43	0.35	45	8.57	54	0.35	20	21.2			
71	49	8.57	53	.35	20	8.57	83 4	.35	52	8.57	83 15	.33	19	20.2			
72	56	8.57	83 14	.37	27	8.57	25	.35	59	8.57	35	.35	18	19.1			
73	20 3	10.0	36	.37	34	10.0	46	.35	19 6	10.0	56	.33	17	18.1			
74	9	10.0	58	.37	40	10.0	84 7	.35	12	10.0	84 16	.35	16	17.0			
75	15	10.0	84 20	0.37	46	10.0	28	0.37	18	12.0	37	0.35	15	16.0			
76	21	12.0	42	.37	52	12.0	50	.35	23	12.0	58	.35	14	14.9			
77	26	12.0	85 4	.37	57	12.0	85 11	.37	28	12.0	85 19	.35	13	13.8			
78	31	12.0	26	.38	20 2	15.0	33	.37	33	15.0	40	.37	12	12.8			
79	36	15.0	49	.37	6	15.0	55	.37	37	15.0	86 2	.35	11	11.7			
80	40	15.0	86 11	0.38	10	15.0	86 17	0.37	41	15.0	23	0.35	10	10.7			
81	44	20.0	34	.38	14	20.0	39	.37	45	20.0	44	.37	9	9.6			
82	47	20.0	57	.37	17	20.0	87 1	.37	48	20.0	87 6	.37	8	8.5			
83	50	20.0	87 19	.38	20	20.0	23	.38	51	30.0	28	.35	7	7.5			
84	53	30.0	42	.38	23	30.0	46	.37	53	30.0	49	.37	6	6.4			
85	55	30.0	88 5	0.38	25	30.0	88 8	0.37	55	30.0	88 11	0.37	5	5.3			
86	57	60.0	28	.38	27	60.0	30	.38	57	60.0	33	.37	4	4.3			
87	58	60.0	51	.38	28	60.0	53	.37	58	60.0	55	.35	3	3.2			
88	59	60.0	89 14	.38	29	60.0	89 15	.37	59	60.0	89 16	.37	2	2.1			
89	21 0	—	37	.38	30	—	37	.38	20 0	—	38	.37	1	1.1			
90	0	—	90 0	—	30	—	90 0	—	0	—	90 0	—	0	0.0			

t	a = 69° 0'		a = 69° 30'		a = 70° 0'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 69° 0'		d = 69° 30'		d = 70° 0'		



B	$a = 70^\circ 30'$					$a = 71^\circ 0'$					$a = 71^\circ 30'$					C	$\beta$				
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$			Z	t	$\frac{\Delta}{60'}$	
																					b
0	0	0	3.00	70	30	0.00	0	0	3.00	71	0	0.00	0	0	3.16	71	30	0.00	90	90.0	
1	0	20	3.00		30	.02	0	20	3.16		0	.02	0	19	3.16		30	.02	89	89.1	
2		40	3.00		31	.02		39	3.00		1	.02		38	3.16		31	.02	88	88.1	
3	1	0	3.00		32	.02		59	3.16		2	.02		57	3.16		32	.02	87	87.2	
4		20	3.00		33	.02	1	18	3.00		3	.02	1	16	3.16		33	.02	86	86.2	
5		40	3.00		34	.03		38	3.16		4	.03		35	3.16		34	.03	85	85.3	
6	2	0	3.00		36	.03		57	3.00		6	.03		54	3.16		36	.03	84	84.3	
7		20	3.00		38	.03	2	17	3.16		8	.03	2	13	3.16		38	.03	83	83.4	
8		40	3.00		40	.05		36	3.16		10	.05		32	3.16		40	.05	82	82.4	
9	3	0	3.00		43	.05		55	3.00		13	.05		51	3.16		43	.05	81	81.5	
10		20	3.16		46	.07	3	15	3.16		16	.05	3	10	3.33		46	.05	80	80.5	
11		39	3.00		50	.07		34	3.16		19	.07		28	3.16		49	.07	79	79.6	
12		59	3.16		54	.07		53	3.16		23	.07		47	3.16		53	.07	78	78.6	
13	4	18	3.00		58	.07	4	12	3.16		27	.07	4	6	3.33		57	.07	77	77.7	
14		38	3.16	71	2	.08		31	3.16		31	.08		24	3.16	72	1	.07	76	76.7	
15		57	3.00		7	.08		50	3.16		36	.08		43	3.33		5	.08	75	75.8	
16	5	17	3.16		12	.08	5	9	3.16		41	.08	5	1	3.33		10	.08	74	74.8	
17		36	3.16		17	.10		28	3.33		46	.10		19	3.16		15	.10	73	73.9	
18		55	3.16		23	.10		46	3.16		52	.10		38	3.33		21	.10	72	72.9	
19	6	14	3.16		29	.10	6	5	3.16		58	.10	6	5	3.33		27	.10	71	72.0	
20		33	3.16		35	.12		24	3.33	72	4	.12	6	14	3.33		33	.10	70	71.0	
21		52	3.16		42	.12		42	3.33		11	.12		32	3.33		39	.12	69	70.1	
22	7	11	3.16		49	.13	7	0	3.33		18	.12		50	3.53		46	.12	68	69.1	
23		30	3.33		57	.13		18	3.33		25	.12	7	7	3.33		53	.12	67	68.1	
24		48	3.16	72	5	.13		36	3.33		32	.13		25	3.53	73	0	.13	66	67.2	
25	8	7	3.33		13	.13		54	3.33		40	.13		42	3.33		8	.13	65	66.2	
26		25	3.33		21	.13	8	12	3.33		48	.13	8	0	3.53		16	.13	64	65.2	
27		43	3.33		29	.15		30	3.33		56	.15		17	3.53		24	.13	63	64.3	
28	9	1	3.33		38	.15		48	3.53	73	5	.15		34	3.53		32	.15	62	63.3	
29		19	3.33		47	.17	9	5	3.53		14	.17		51	3.53		41	.15	61	62.3	
30		37	3.53		57	.17		22	3.53		24	.17	9	8	3.75		50	.17	60	61.4	
31		54	3.53	73	7	.17		39	3.53		34	.17		24	3.53	74	0	.17	59	60.4	
32	10	11	3.53		17	.17		56	3.53		44	.17		41	3.75		10	.17	58	59.4	
33		28	3.53		27	.18	10	13	3.53		54	.17		57	3.75		20	.17	57	58.4	
34		45	3.53		38	.18		30	3.75	74	4	.18	10	13	3.75		30	.17	56	57.5	
35	11	2	3.53		49	.20		46	3.75		15	.18		29	3.75		40	.18	55	56.5	
36		19	3.75	74	1	.20	11	2	3.75		26	.18		45	3.75		51	.18	54	55.5	
37		35	3.75		13	.20		18	3.75		37	.20	11	1	4.00		75	2	.20	53	54.5
38		51	3.75		25	.20		34	3.75		49	.20		16	4.00		14	.20	52	53.5	
39	12	7	3.75		37	.20		50	4.00	75	1	.20		31	4.00		26	.20	51	52.6	
40		23	3.75		49	.22	12	5	4.00		13	.22		46	4.00		38	.20	50	51.6	
41		39	4.00	75	2	.22		20	4.00		26	.22	12	1	4.00		50	.20	49	50.6	
42		54	4.00		15	.23		35	4.00		39	.22		16	4.29	76	2	.22	48	49.6	
43	13	9	4.00		29	.23		50	4.29		52	.22		30	4.29		15	.22	47	48.6	
44		24	4.00		43	.23	13	4	4.29	76	5	.23		44	4.29		28	.22	46	47.6	
45		39			57			18			19			58			41		45	46.6	

t	$a = 70^\circ 30'$		$a = 71^\circ 0'$		$a = 71^\circ 30'$		a
	$\frac{60'}{\Delta}$	b	$\frac{60'}{\Delta}$	b	$\frac{60'}{\Delta}$	b	
	$d = 70^\circ 30'$		$d = 71^\circ 0'$		$d = 71^\circ 30'$		

b	a = 70° 30'					a = 71° 0'					a = 71° 30'					c	α									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ		Δ	Δ				Δ		Δ	Δ						Δ		Δ	Δ			
45	13	39	4.00	75	57	0.23	13	18	4.29	76	19	0.23	12	58	4.29	76	41	0.23	45	46.6						
46		54	4.29	76	11	.23		32	4.29		33	.23	13	12	4.62		55	.23	44	45.6						
47	14	8	4.29		25	.25		46	4.29		47	.23		25	4.62		77	9	.23	43	44.6					
48		22	4.29		40	.25	14	0	4.62		77	1	.25		38	4.62		23	.23	42	43.6					
49		36	4.62		55	.25		13	4.62		16	.25		51	4.62		37	.25	41	42.6						
50		49	4.62	77	10	0.27		26	4.62		31	0.25	14	4	4.62		52	0.25	40	41.6						
51	15	2	4.62		26	.27		39	4.62		46	.27		17	5.00		78	7	.25	39	40.6					
52		15	4.62		42	.27		52	5.00		78	2	.27		29	5.00		22	.25	38	39.6					
53		28	5.00		58	.28	15	4	5.00		18	.27		41	5.00		37	.25	37	38.6						
54		40	5.00		78	15	.27		16	5.00		34	.27		53	5.45		52	.27	36	37.5					
55		52	5.00		31	0.28		28	5.00		50	0.27	15	4	5.45		79	8	0.27	35	36.5					
56	16	4	5.00		48	.28		40	5.45		79	6	.28		15	5.45		24	.27	34	35.5					
57		16	5.45		79	5	.28		51	5.45		23	.28		26	5.45		40	.28	33	34.5					
58		27	5.45		22	.30	16	2	6.00		40	.28		37	6.00		57	.27	32	33.5						
59		38	6.00		40	.30		12	6.00		57	.28		47	6.00		80	13	.28	31	32.4					
60		48	6.00		58	0.30		22	6.00		80	14	0.28		57	6.00		30	0.28	30	31.4					
61		58	6.00	80	16	.30		32	6.00		31	.30	16	7	6.67		47	.28	29	30.4						
62	17	8	6.00		34	.30		42	6.00		49	.30		16	6.67		81	4	.30	28	29.4					
63		18	6.67		52	.30		52	6.67		81	7	.30		25	6.67		22	.28	27	28.3					
64		27	6.67		81	10	.32	17	1	6.67		25	.30		34	6.67		39	.30	26	27.3					
65		36	6.67		29	0.32		10	7.50		43	0.32		43	7.50		57	0.30	25	26.3						
66		45	6.67		48	.32		18	7.50		82	2	.30		51	7.50		82	15	.30	24	25.2				
67		54	7.50		82	7	.33		26	7.50		20	.32		59	7.50		33	.30	23	24.2					
68	18	2	7.50		27	.33		34	7.50		39	.32		17	8.57		51	.32	22	23.1						
69		10	8.57		46	.33		42	8.57		58	.32		7	8.57		83	10	.30	21	22.1					
70		17	8.57		83	6	0.32		49	8.57		83	17	0.32		21	8.57		28	0.32	20	21.1				
71		24	8.57		25	.33		56	10.0		36	.33		28	10.0		47	.32	19	20.0						
72		31	10.0		45	.33	18	2	10.0		56	.32		34	10.0		84	6	.32	18	19.0					
73		37	10.0		84	5	.35		8	10.0		84	15	.33		40	10.0		25	.32	17	17.9				
74		43	10.0		26	.33		14	10.0		35	.32		46	12.0		44	.32	16	16.9						
75		49	12.0		46	0.33		20	12.0		54	0.33		51	12.0		85	3	0.32	15	15.8					
76		54	12.0		85	6	.35		25	12.0		85	14	.33		56	12.0		22	.33	14	14.8				
77		59	12.0		27	.33		30	15.0		34	.33		18	1	15.0		42	.32	13	13.7					
78	19	4	15.0		47	.35		34	15.0		54	.33		5	15.0		86	1	.33	12	12.7					
79		8	15.0		86	8	.35		38	15.0		86	14	.35		9	15.0		21	.32	11	11.6				
80		12	20.0		29	0.35		42	20.0		35	0.33		13	20.0		40	0.33	10	10.6						
81		15	20.0		50	.35		45	20.0		55	.33		16	20.0		87	0	.33	9	9.5					
82		18	20.0	87	11	.35		48	20.0		87	15	.35		19	20.0		20	.33	8	8.5					
83		21	30.0		32	.35		51	30.0		36	.33		22	30.0		40	.33	7	7.4						
84		23	30.0		53	.35		53	30.0		56	.35		24	30.0		88	0	.33	6	6.3					
85		25	30.0	88	14	0.35		55	30.0		88	17	0.33		26	60.0		20	0.33	5	5.3					
86		27	60.0		35	.35		57	60.0		37	.35		27	60.0		40	.33	4	4.2						
87		28	60.0		56	.37		58	60.0		58	.35		28	60.0		89	0	.33	3	3.2					
88		29	60.0		89	18	.35		59	60.0		89	19	.33		29	60.0		20	.33	2	2.1				
89		30	—		39	.35	19	0	—		39	.35		30	—		40	.33	1	1.1						
90		30	—		90	0		0	—		90	0		30	—		90	0	0	0.0						

t	a = 70° 30'		a = 71° 0'		a = 71° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 70° 30'		d = 71° 0'		d = 71° 30'		



b	a = 72° 0'				a = 72° 30'				a = 73° 0'				c	a			
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t			$\frac{\Delta}{60'}$	C	$\beta$
0	0	0	3.16	72	0	0	0.00	0	0	3.33	72	0	0.00	0	90	90.0	
1		19	3.33		0	18	0.02	0	18	3.33	30	0	0.02	0	89	89.0	
2		37	3.16		1	36	0.00	0	35	3.33	31	0	0.00	1	88	88.1	
3		56	3.33		1	54	0.02	0	53	3.33	31	0	0.02	1	87	87.1	
4	I	14	3.16		2	12	0.03	I	10	3.33	32	0	0.03	2	86	86.2	
5		33	3.33		4	30	0.03		28	3.53	34	0	0.02	4	85	85.2	
6		51	3.33		6	48	0.03		45	3.33	35	0	0.03	5	84	84.3	
7	2	9	3.16		8	6	0.03	2	3	3.53	37	0	0.03	7	83	83.3	
8		28	3.33		10	24	0.05		20	3.53	39	0	0.05	9	82	82.4	
9		46	3.16		13	42	0.05		37	3.33	42	0	0.05	12	81	81.4	
10	3	5	3.33		16	3	0.05	3	0	3.53	45	0	0.05	15	80	80.5	
11		23	3.33		19	17	0.05		3	12	3.53	18	0	0.05	18	79.5	
12		41	3.33		22	35	0.07		51	3.33	51	0	0.07	21	78	78.5	
13		59	3.33		26	53	0.07		46	3.53	55	0	0.07	25	77	77.6	
14	4	17	3.33		30	4	0.07	4	3	3.53	59	0	0.07	29	76	76.6	
15		35	3.33		34	28	0.08		20	3.53	3	0	0.08	33	75.7	75.7	
16		53	3.33		39	45	0.08		37	3.53	8	0	0.08	37	74.7	74.7	
17	5	11	3.33		44	5	0.08	5	3	3.53	13	0	0.08	42	73	73.7	
18		29	3.53		49	20	0.10		18	3.53	18	0	0.10	47	72.8	72.8	
19		46	3.33		55	37	0.10		28	3.75	24	0	0.10	52	71	71.8	
20	6	4	3.53	73	1	54	0.10		44	3.53	30	0	0.10	58	70	70.9	
21		21	3.33		7	6	0.12	6	1	3.75	36	0	0.10	4	69	69.9	
22		39	3.53		14	28	0.12		17	3.53	42	0	0.12	10	68	68.9	
23		56	3.53		21	45	0.12		34	3.75	49	0	0.12	17	67	68.0	
24	7	13	3.53		28	7	0.12	7	2	3.75	56	0	0.12	24	66	67.0	
25		30	3.53		35	18	0.13		7	6	3.75	3	0	0.12	31	65	66.0
26		47	3.53		43	35	0.13		22	3.75	11	0	0.13	38	64	65.1	
27	8	4	3.53		51	51	0.13		38	3.75	19	0	0.13	46	63	64.1	
28		21	3.75		59	8	0.15	8	7	3.75	27	0	0.13	54	62	63.1	
29		37	3.75	74	8	23	0.15		8	9	3.75	35	0	0.15	61	62.1	
30		53	3.75		17	39	0.15		25	4.00	44	0	0.15	75	60	61.2	
31	9	9	3.75		26	55	0.17		40	4.00	53	0	0.15	10	59	60.2	
32		25	3.75		36	9	0.17	9	10	3.75	2	0	0.15	19	58	59.2	
33		41	3.75		46	26	0.17		55	4.00	11	0	0.17	28	57	58.2	
34		57	3.75		56	41	0.17		11	4.00	17	0	0.17	37	56	57.2	
35	10	13	4.00	75	6	56	0.17		25	4.29	21	0	0.17	46	55	56.3	
36		28	4.00		16	10	0.18	10	11	4.00	31	0	0.17	56	54	55.3	
37		43	4.00		27	40	0.18		54	4.29	41	0	0.18	6	53	54.3	
38		58	4.00		38	26	0.18		8	4.29	52	0	0.18	17	53	54.3	
39	11	13	4.00		50	40	0.18	76	3	4.29	3	0	0.18	27	52	53.3	
40		28	4.29	76	1	54	0.20		36	4.29	14	0	0.18	38	51	52.3	
41		42	4.29		13	11	0.20	11	8	4.29	25	0	0.20	49	50	51.3	
42		56	4.29		26	22	0.20		50	4.29	37	0	0.20	0	49	50.3	
43	12	10	4.29		38	36	0.20		17	4.62	49	0	0.20	12	48	49.3	
44		24	4.29		51	50	0.22	77	1	4.62	1	0	0.20	24	47	48.4	
45		38		77	4	12	0.22		43	4.62	13	0	0.22	36	46	47.4	
						16			56		26			48	45	46.4	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a				
	d = 72° 0'				d = 72° 30'				d = 73° 0'								

b		a = 72° 0'				a = 72° 30'				a = 73° 0'				c	a						
		h	d 60' Δ	Z	t 60' Δ	h	d 60' Δ	Z	t 60' Δ	h	d 60' Δ	Z	t 60' Δ								
45	12	38	4.62	77	4	0.22	12	16	4.62	77	26	0.22	11	56	4.62	77	48	0.22	45	46.4	
46		51	4.62		17	.22		29	4.62		39	.22		12	9	5.00	78	1	.20	44	45.4
47		4	4.62		30	.23		42	4.62		52	.22		21	5.00		13	.22	43	44.4	
48		17	5.00		44	.23		55	5.00	78	5	.23		33	5.00		26	.22	42	43.4	
49		29	5.00		58	.23	13	7	5.00		19	.23		45	5.00		39	.23	41	42.3	
50		41	5.00	78	12	0.23		19	5.00		33	0.23		57	5.45	53	0.23	40	41.3		
51		53	5.00		26	.25		31	5.00		47	.23	13	8	5.45	79	7	.23	39	40.3	
52		5	5.00		41	.25		43	5.45	79	1	.23		19	5.45		21	.23	38	39.3	
53		17	5.00		56	.25		54	5.45		15	.25		30	5.45		35	.23	37	38.3	
54		29	5.45	79	11	0.25	14	5	5.45		30	0.25		41	5.45		49	.23	36	37.3	
55		40	5.45		26	0.27		16	6.00		45	0.25		52	6.00	80	3	0.25	35	36.3	
56		51	6.00		42	.27		26	6.00	80	0	.25	14	2	6.00		18	.25	34	35.3	
57		1	6.00		58	.27		36	6.00		15	.27		12	6.00		33	.25	33	34.3	
58		11	6.00	80	14	0.27		46	6.00		31	.27		22	6.67		48	.25	32	33.2	
59		21	6.00		30	.27		56	6.00		47	.27		31	6.67	81	3	.25	31	32.2	
60		31	6.00		46	0.28	15	6	6.67	81	3	0.27		40	6.67		18	0.27	30	31.2	
61		41	6.67	81	3	.28		15	6.67		19	.27		49	6.67		34	.27	29	30.2	
62		50	6.67		20	.28		24	6.67		35	.27		58	7.50		50	.27	28	29.1	
63		59	6.67		37	.28		33	7.50		51	.28	15	6	7.50	82	6	.27	27	28.1	
64	16	8	7.50		54	.28		41	7.50	82	8	.28		14	7.50		22	.27	26	27.1	
65		16	7.50	82	11	0.28		49	7.50		25	0.28		22	7.50		38	0.28	25	26.1	
66		24	7.50		28	.30		57	8.57		42	.28		30	8.57		55	.27	24	25.0	
67		32	8.57		46	.30	16	4	8.57		59	.28		37	8.57	83	11	.28	23	24.0	
68		39	8.57	83	4	0.30		11	8.57	83	16	.28		44	8.57		28	.28	22	23.0	
69		46	8.57		22	.30		18	8.57		33	.30		51	10.0		45	.28	21	21.9	
70		53	10.0		40	0.30		25	10.0		51	0.28		57	10.0	84	2	0.28	20	20.9	
71		59	10.0		58	.30		31	10.0	84	8	.30	16	3	10.0		19	.28	19	19.9	
72		5	10.0	84	16	.30		37	10.0		26	.30		9	12.0		36	.28	18	18.8	
73		11	10.0		34	.32		43	12.0		44	.30		14	12.0		53	.30	17	17.8	
74		17	12.0		53	.32		48	12.0	85	2	.30		19	12.0	85	11	.28	16	16.7	
75		22	12.0	85	12	0.30		53	12.0		20	0.30		24	12.0		28	0.30	15	15.7	
76		27	15.0		30	.32		58	15.0		38	.30		29	15.0		46	.30	14	14.7	
77		31	15.0		49	.32	17	2	15.0		56	.32		33	15.0	86	4	.30	13	13.6	
78		35	15.0	86	8	.32		6	15.0	86	15	.30		37	15.0		22	.30	12	12.6	
79		39	15.0		27	.32		10	15.0		33	.32		41	20.0		40	.30	11	11.5	
80		43	20.0		46	0.32		14	20.0		52	0.30		44	20.0		58	0.30	10	10.5	
81		46	20.0	87	5	.33		17	20.0	87	10	.32		47	20.0	87	16	.30	9	9.4	
82		49	20.0		25	.32		20	30.0		29	.32		50	30.0		34	.30	8	8.4	
83		52	30.0		44	.32		22	30.0		48	.32		52	30.0		52	.30	7	7.3	
84		54	30.0	88	3	.33		24	30.0	88	7	.30		54	30.0	88	10	.30	6	6.3	
85		56	60.0		23	0.32		26	60.0		25	0.32		56	60.0		28	0.32	5	5.2	
86		57	60.0		42	.32		27	60.0		44	.32		57	60.0		47	.30	4	4.2	
87		58	60.0	89	1	.33		28	60.0	89	3	.32		58	60.0	89	5	.30	3	3.1	
88		59	60.0		21	.32		29	60.0		22	.32		59	60.0		23	.32	2	2.1	
89	18	0	—		40	.33		30	—		41	.32	17	0	—		42	.30	1	1.0	
90		0		90	0			30		90	0			0			90	0	0	0.0	

t	a = 72° 0'		a = 72° 30'		a = 73° 0'		a
	a	60' Δ	b	60' Δ	a	60' Δ	
	d = 72° 0'		d = 72° 30'		d = 73° 0'		



B	$a = 73^\circ 30'$				$a = 74^\circ 0'$				$a = 74^\circ 30'$				C	$\beta$			
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$					
		d	t	d		t	d	t		d	t						
0	0	0	3.53	73	30	0.00	0	0	3.53	74	0	0.00	0	0	90	90.0	
1	17	3.53	30	.02	17	3.75	0	.02	16	3.75	30	.02	89	89.0			
2	34	3.53	31	.00	33	3.53	1	.00	32	3.75	31	.00	88	88.1			
3	51	3.53	31	.02	50	3.75	1	.02	48	3.75	31	.02	87	87.1			
4	1	8	3.53	32	.02	1	6	3.53	2	.02	1	4	3.75	32	.02	86	86.2
5	25	3.53	33	.03	23	3.75	3	.03	20	3.75	33	.03	85	85.2			
6	42	3.53	35	.03	39	3.53	5	.03	36	3.75	35	.03	84	84.2			
7	59	3.53	37	.03	56	3.75	7	.03	52	3.75	37	.03	83	83.3			
8	2	16	3.53	39	.03	2	12	3.75	9	.03	2	8	3.75	39	.03	82	82.3
9	33	3.53	41	.05	28	3.53	11	.05	24	3.75	41	.03	81	81.3			
10	50	3.75	44	.05	45	3.75	14	.05	40	4.00	43	.05	80	80.4			
11	3	6	3.53	47	.05	3	1	3.75	17	.05	55	3.75	46	.05	79	79.4	
12	23	3.53	50	.07	17	3.75	20	.05	3	11	3.75	49	.07	78	78.5		
13	40	3.75	54	.07	33	3.75	23	.07	27	4.00	53	.05	77	77.5			
14	56	3.53	58	.07	49	3.75	27	.07	42	3.75	56	.07	76	76.5			
15	4	13	3.75	74	2	.07	4	5	3.75	31	.07	58	3.75	75	0	75	75.6
16	29	3.53	6	.08	21	3.75	35	.08	4	14	4.00	4	.08	74	74.6		
17	46	3.75	11	.08	37	3.75	40	.08	29	4.00	9	.07	73	73.6			
18	5	2	3.75	16	.08	53	3.75	45	.08	44	4.00	13	.08	72	72.7		
19	18	3.75	21	.10	5	9	3.75	50	.08	59	4.00	18	.08	71	71.7		
20	34	3.75	27	.10	25	4.00	55	.10	5	14	4.00	23	.10	70	70.7		
21	50	3.75	33	.10	40	3.75	75	1	.10	29	4.00	29	.10	69	69.7		
22	6	6	3.75	39	.10	56	4.00	7	.10	44	4.00	35	.10	68	68.8		
23	22	3.75	45	.10	6	11	4.00	13	.10	59	4.00	41	.10	67	67.8		
24	38	3.75	51	.12	26	4.00	19	.12	6	14	4.00	47	.10	66	66.8		
25	54	4.00	58	.12	41	4.00	26	.12	29	4.00	53	.12	65	65.9			
26	7	9	3.75	75	5	.13	56	4.00	33	.12	44	4.29	76	0	64	64.9	
27	25	4.00	13	.13	7	11	4.00	40	.13	58	4.29	7	.12	63	63.9		
28	40	4.00	21	.13	26	4.00	48	.12	7	12	4.29	14	.13	62	62.9		
29	55	4.00	29	.13	41	4.29	55	.13	26	4.29	22	.13	61	62.0			
30	8	10	4.00	37	.13	55	4.00	76	3	.13	40	4.29	30	.13	60	61.0	
31	25	4.00	45	.15	8	10	4.29	11	.15	54	4.29	38	.13	59	60.0		
32	40	4.29	54	.15	24	4.29	20	.15	8	8	4.29	46	.13	58	59.0		
33	54	4.29	76	3	.15	38	4.29	29	.15	22	4.29	54	.15	57	58.0		
34	9	8	4.29	12	.17	52	4.29	38	.15	36	4.62	77	3	.15	56	57.0	
35	22	4.29	22	.17	9	6	4.62	47	.15	49	4.62	12	.15	55	56.1		
36	36	4.29	32	.17	19	4.29	77	56	.17	9	2	4.62	21	.17	54	55.1	
37	50	4.29	42	.17	33	4.62	77	6	.17	15	4.62	31	.15	53	54.1		
38	10	4	4.29	52	.17	46	4.62	16	.17	28	4.62	40	.17	52	53.1		
39	18	4.62	77	2	.18	59	4.62	26	.18	41	4.62	50	.17	51	52.1		
40	31	4.62	13	.18	10	12	4.62	37	.17	54	5.00	78	0	.18	50	51.1	
41	44	4.62	24	.18	25	4.62	47	.18	10	6	5.00	11	.17	49	50.1		
42	57	4.62	35	.18	38	5.00	58	.18	18	5.00	21	.18	48	49.1			
43	11	10	4.62	46	.20	50	5.00	78	9	.20	30	5.00	32	.18	47	48.1	
44	23	5.00	58	.20	11	2	5.00	21	.18	42	5.00	43	.18	46	47.1		
45	35		78	10		14		32		54		54		45		46.1	

t	$a = 73^\circ 30'$		$a = 74^\circ 0'$		$a = 74^\circ 30'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 73^\circ 30'$		$d = 74^\circ 0'$		$d = 74^\circ 30'$		

b	a = 73° 30'					a = 74° 0'					a = 74° 30'					c	a									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ							Δ															
45	11	35	5.00	78	10	0.20	11	14	5.00	78	32	0.20	10	54	5.45	78	54	0.20	45	46.1						
46		47	5.00		22	.20		26	5.00		44	.20	11	5	5.45	79	6	.18	44	45.1						
47		59	5.00		34	.22		38	5.45		56	.20		16	5.45		17	.20	43	44.1						
48	12	11	5.00		47	.22	49	5.45	79	8	.22	27	5.45		29	.20	42	.20	42	43.1						
49		23	5.45	79	0	.22	12	0	5.45		21	.20		38	5.45		41	.20	41	42.1						
50		34	5.45		13	0.22	11	5.45		33	0.22	49	6.00		53	0.22	40	.22	40	41.1						
51		45	5.45		26	.23	22	5.45		46	.22	59	6.00	80	6	.22	39	.22	39	40.1						
52		56	5.45		40	.23	33	6.00		59	.23	12	9	6.00		19	.22	38	.22	38	39.1					
53	13	7	6.00		54	.22	43	6.00	80	13	.22	19	6.00		32	.22	37	.22	37	38.1						
54		17	6.00	80	7	.23	53	6.00		26	.23	29	6.00		45	.22	36	.22	36	37.1						
55		27	6.00		21	.23	13	3	6.00		40	.23	39	6.67		58	.22	35	.22	35	36.1					
56		37	6.00		36	.25	13	6.67		54	.23	48	6.67	81	11	.23	34	.23	34	35.1						
57		47	6.67		50	.25	22	6.67	81	8	.23	57	6.67		25	.22	33	.22	33	34.0						
58		56	6.67	81	5	.25	31	6.67		22	.23	13	6	6.67		38	.23	32	.23	32	33.0					
59	14	5	6.67		20	.25	40	6.67		36	.23	15	7.50		52	.23	31	.23	31	32.0						
60		14	6.67		35	0.25	49	7.50		50	0.25	23	7.50	82	6	0.23	30	0.23	30	31.0						
61		23	7.50		50	.25	57	7.50	82	5	.25	31	7.50		20	.25	29	.25	29	30.0						
62		31	7.50	82	5	.25	14	5	7.50		20	.25	39	7.50		35	.23	28	.23	28	29.0					
63		39	7.50		20	.27	13	7.50		35	.25	47	8.57		49	.25	27	.25	27	27.9						
64		47	7.50		36	.27	21	8.57		50	.25	54	8.57	83	4	.25	26	.25	26	26.9						
65		55	8.57		52	0.27	28	8.57	83	5	0.27	14	1	8.57		19	.25	25	.25	25	25.9					
66	15	2	8.57	83	8	.27	35	8.57		21	.25	15	8	8.57		34	.25	24	.25	24	24.9					
67		9	8.57		24	.27	42	8.57		36	.27	15	10.0		49	.25	23	.25	23	23.8						
68		16	8.57		40	.27	49	10.0		52	.27	21	10.0	84	4	.25	22	.25	22	22.8						
69		23	10.0		56	.28	55	10.0	84	8	.27	27	10.0		19	.25	21	.25	21	21.8						
70		29	10.0	84	13	0.27	15	1	10.0		24	0.27	33	12.0		35	0.25	20	0.25	20	20.7					
71		35	12.0		29	.28	7	12.0		40	.27	38	12.0		50	.27	19	.27	19	19.7						
72		40	12.0		46	.28	12	12.0		56	.27	43	12.0	85	6	.27	18	.27	18	18.7						
73		45	12.0	85	3	.28	17	12.0	85	12	.28	48	12.0		22	.27	17	.27	17	17.6						
74		50	12.0		20	.28	22	12.0		29	.27	53	12.0		38	.27	16	.27	16	16.6						
75		55	12.0		37	0.28	27	15.0		45	0.28	15	58	15.0		54	0.27	15	0.27	15	15.6					
76	16	0	15.0		54	.28	31	15.0	86	2	.28	15	2	15.0	86	10	.27	14	.27	14	14.5					
77		4	15.0	86	11	.28	35	15.0		19	.27	6	20.0		26	.27	13	.27	13	13.5						
78		8	20.0		28	.30	39	20.0		35	.28	9	20.0		42	.27	12	.27	12	12.5						
79		11	20.0		46	.28	42	20.0		52	.28	12	20.0		58	.27	11	.27	11	11.4						
80		14	20.0	87	3	0.30	45	20.0	87	9	0.28	15	20.0	87	14	0.28	10	0.28	10	10.4						
81		17	20.0		21	.28	48	20.0		26	.28	18	20.0		31	.27	9	.27	9	9.4						
82		20	30.0		38	.30	51	30.0		43	.28	21	30.0		47	.28	8	.28	8	8.3						
83		22	30.0		56	.28	53	30.0	88	0	.28	23	30.0	88	4	.27	7	.27	7	7.3						
84		24	30.0	88	13	.30	55	60.0		17	.28	25	30.0		20	.28	6	.28	6	6.2						
85		26	60.0		31	0.30	56	60.0		34	0.28	27	60.0		37	0.27	5	0.27	5	5.2						
86		27	60.0		49	.30	57	60.0		51	.28	28	60.0		53	.28	4	.28	4	4.2						
87		28	60.0	89	7	.28	58	60.0	89	8	.30	29	60.0	89	10	.28	3	.28	3	3.1						
88		29	60.0		24	.30	59	60.0		26	.28	30	—		27	.27	2	.27	2	2.1						
89		30	—		42	.30	16	0		43	.28	30	—		43	.28	1	.28	1	1.0						
90		30		90	0		0		90	0		30		90	0		0		0	0.0						

t	a = 73° 30'		a = 74° 0'		a = 74° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 73° 30'		d = 74° 0'		d = 74° 30'		



B	$a = 75^\circ 0'$				$a = 75^\circ 30'$				$a = 76^\circ 0'$				C	$\alpha$ $\beta$			
	h	$d$	$\frac{60'}{\Delta}$	$t$	h	$d$	$\frac{60'}{\Delta}$	$t$	h	$d$	$\frac{60'}{\Delta}$	$t$			C		
		$\Delta$	Z	$\frac{\Delta}{60'}$		$\Delta$	Z	$\frac{\Delta}{60'}$		$\Delta$	Z	$\frac{\Delta}{60'}$					
0	0	0	3.75	75	0	0.00	0	0	0	0	4.00	76	0	0.00	90	90.0	
1	0	16	4.00	0	.02	0	15	4.00	30	0.02	0	15	4.29	0	.00	89	89.0
2		31	3.75	1	.00	30	4.00	31	.00	29	4.00	0	0	.00	88	88.1	
3		47	4.00	1	.02	45	4.00	31	.02	44	4.29	1	.02	87	87.1		
4	I	2	3.75	2	.02	I	0	4.00	32	.02	58	4.00	2	.02	86	86.1	
5		18	4.00	3	0.03	15	4.00	33	0.02	I	13	4.29	3	0.02	85	85.2	
6		33	3.75	5	.02	30	4.00	34	.03	27	4.29	4	.03	84	84.2		
7		49	4.00	6	.03	45	4.00	36	.03	41	4.00	6	.03	83	83.2		
8	2	4	4.00	8	.03	2	0	4.00	38	.03	56	4.29	8	.03	82	82.3	
9		19	3.75	10	.05	15	4.00	40	.05	2	10	4.00	10	.03	81	81.3	
10		35	4.00	13	0.05	30	4.29	43	0.03	25	4.29	12	0.05	80	80.3		
11		50	4.00	16	.05	44	4.00	45	.05	39	4.29	15	.05	79	79.3		
12	3	5	4.00	19	.05	59	4.00	48	.05	53	4.29	18	.05	78	78.4		
13		20	4.00	22	.05	3	14	4.29	51	.07	3	7	4.29	21	.05	77	77.4
14		35	4.00	25	.07	28	4.00	55	.05	21	4.29	24	.05	76	76.4		
15		50	4.00	29	0.07	43	4.29	58	0.07	35	4.29	27	0.07	75	75.5		
16	4	5	4.00	33	.08	57	4.00	76	2	.08	49	4.29	31	.07	74	74.5	
17		20	4.00	38	.07	4	12	4.29	7	.07	4	3	4.29	35	.07	73	73.5
18		35	4.00	42	.08	26	4.00	11	.08	17	4.29	40	.07	72	72.5		
19		50	4.00	47	.08	41	4.29	16	.07	31	4.29	44	.08	71	71.6		
20	5	5	4.29	52	0.08	55	4.29	20	0.08	45	4.29	49	0.08	70	70.6		
21		19	4.00	57	.10	5	9	4.29	25	.10	59	4.62	54	.08	69	69.6	
22		34	4.29	76	3	.10	23	4.29	31	.10	5	12	4.29	59	.08	68	68.6
23		48	4.00	9	.10	37	4.29	37	.10	26	4.62	77	4	.10	67	67.7	
24	6	3	4.29	15	.10	51	4.62	43	.10	39	4.62	10	.10	66	66.7		
25		17	4.29	21	0.10	6	4	4.29	49	0.10	52	4.62	16	0.10	65	65.7	
26		31	4.29	27	.12	18	4.29	55	.10	6	5	4.62	22	.10	64	64.7	
27		45	4.29	34	.12	32	4.62	77	1	.12	18	4.62	28	.12	63	63.7	
28		59	4.29	41	.12	45	4.62	8	.12	31	4.62	35	.12	62	62.8		
29	7	13	4.62	48	.13	58	4.62	15	.12	44	4.62	42	.12	61	61.8		
30		26	4.29	56	0.13	7	11	4.62	22	0.13	57	4.62	49	0.12	60	60.8	
31		40	4.62	77	4	.13	24	4.62	30	.13	7	10	5.00	56	.13	59	59.8
32		53	4.62	12	.13	37	4.62	38	.13	22	5.00	78	4	.12	58	58.8	
33	8	6	4.62	20	.13	50	4.62	46	.13	34	5.00	11	.13	57	57.8		
34		19	4.62	28	.15	8	3	4.62	54	.13	46	5.00	19	.13	56	56.9	
35		32	4.62	37	0.15	16	5.00	78	2	0.15	58	5.00	27	0.15	55	55.9	
36		45	4.62	46	.15	28	5.00	11	.15	8	10	5.00	36	.13	54	54.9	
37		58	5.00	55	.15	40	5.00	20	.15	22	5.00	44	.15	53	53.9		
38	9	10	5.00	78	4	.17	52	5.00	29	.15	34	5.00	53	.15	52	52.9	
39		22	5.00	14	.17	9	4	5.00	38	.15	46	5.45	79	2	.15	51	51.9
40		34	5.00	24	0.17	16	5.45	47	0.17	57	5.45	11	0.17	50	50.9		
41		46	5.00	34	.17	27	5.00	57	.17	9	8	5.45	21	.15	49	49.9	
42		58	5.00	44	.18	39	5.45	79	7	.17	19	5.45	30	.17	48	48.9	
43	10	10	5.00	55	.17	50	5.45	17	.18	30	5.45	40	.17	47	47.9		
44		22	5.45	79	5	.18	10	1	5.45	28	.17	41	6.00	50	.17	46	46.9
45		33		16		12		38		51		80	0		45	45.9	

t	$a = 75^\circ 0'$				$a = 75^\circ 30'$				$a = 76^\circ 0'$				$\alpha$
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	$d = 75^\circ 0'$				$d = 75^\circ 30'$				$d = 76^\circ 0'$				

B	a = 75° 0'					a = 75° 30'					a = 76° 0'					C	c	a	β		
	h	d	60'/Δ	Z	t	h	d	60'/Δ	Z	t	h	d	60'/Δ	Z	t					Δ	60'
		Δ	60'	60'	60'		Δ	60'	60'	60'		Δ	60'	60'	60'						
45	10	33	5.45	79	16	0.18	10	12	5.45	79	38	0.18	9	51	6.00	80	0	0.17	45	45.9	
46		44	5.45		27	.20		23	6.00		49	.18	10	1	6.00		10	.18	44	44.9	
47		55	5.45		39	.18		33	6.00		80	0	.18	11	6.00		21	.18	43	43.9	
48	11	6	6.00		50	.20		43	6.00		11	.18	21	6.00		32	.18	42	42.9		
49		16	6.00		80	.20		53	6.00		22	.20	31	6.00		43	.18	41	41.9		
50		26	6.00		14	0.20	11	3	6.00		34	0.18	41	6.67		54	0.18	40	40.9		
51		36	6.00		26	.20		13	6.00		45	.20	50	6.67		81	5	.18	39	39.9	
52		46	6.00		38	.20		23	6.67		57	.20	59	6.67		16	.20	38	38.9		
53		56	6.67		50	.22		32	6.67		81	9	.20	11	8	6.67		28	.20	37	37.9
54	12	5	6.67		81	.22	41	3	6.67		21	.22	17	6.67		40	.20	36	36.9		
55		14	6.67		16	0.22	50	6.67		34	0.20	26	7.50		52	0.20	35	35.9			
56		23	6.67		29	.22		59	7.50		46	.22	34	7.50		82	4	.20	34	34.9	
57		32	6.67		42	.22		7	7.50		59	.22	42	7.50		16	.20	33	33.9		
58		41	7.50		55	.23		15	7.50		82	12	.22	50	7.50		28	.22	32	32.8	
59		49	7.50		82	.22		23	7.50		25	.22	58	7.50		41	.22	31	31.8		
60		57	7.50		22	0.23		31	7.50		38	0.22	12	6	8.57		54	0.22	30	30.8	
61	13	5	7.50		36	.23		39	8.57		51	.23	13	8.57		83	7	.22	29	29.8	
62		13	8.57		50	.23		46	8.57		83	5	.22	20	8.57		20	.22	28	28.8	
63		20	8.57		83	.23		53	8.57		18	.23	27	8.57		33	.22	27	27.8		
64		27	8.57		18	.23	13	0	8.57		32	.23	34	10.0		46	.22	26	26.7		
65		34	8.57		32	0.25		7	10.0		46	0.23	40	10.0		59	0.22	25	25.7		
66		41	10.0		47	.23		13	10.0		84	0	.23	46	10.0		84	12	.23	24	24.7
67		47	10.0		84	.25		19	10.0		14	.23	52	10.0		26	.23	23	23.7		
68		53	10.0		16	.25		25	10.0		28	.23	58	12.0		40	.23	22	22.7		
69		59	10.0		31	.25		31	12.0		42	.25	13	3	12.0		54	.23	21	21.6	
70	14	5	12.0		46	0.25		36	12.0		57	0.23	8	12.0		85	8	0.23	20	20.6	
71		10	12.0		85	.25		41	12.0		85	11	.25	13	12.0		22	.23	19	19.6	
72		15	12.0		16	.25		46	12.0		26	.23	18	12.0		36	.23	18	18.6		
73		20	12.0		31	.27		51	12.0		40	.25	23	15.0		50	.23	17	17.5		
74		25	15.0		47	.25		56	15.0		55	.25	27	15.0		86	4	.23	16	16.5	
75		29	15.0		86	0.25	14	0	15.0		86	10	0.25	31	15.0		18	0.25	15	15.5	
76		33	15.0		17	.27		4	20.0		25	.25	35	20.0		33	.23	14	14.4		
77		37	20.0		33	.27		7	20.0		40	.25	38	20.0		47	.25	13	13.4		
78		40	20.0		49	.25		10	20.0		55	.25	41	20.0		87	2	.25	12	12.4	
79		43	20.0		87	.27		13	20.0		87	10	.27	44	20.0		17	.23	11	11.4	
80		46	20.0		20	0.27		16	20.0		26	0.25	47	20.0		31	0.25	10	10.3		
81		49	30.0		36	.27		19	30.0		41	.25	50	30.0		46	.25	9	9.3		
82		51	30.0		52	.27		21	30.0		56	.27	52	30.0		88	1	.23	8	8.3	
83		53	30.0		88	.27		23	30.0		88	12	.25	54	30.0		15	.25	7	7.2	
84		55	30.0		24	.27		25	30.0		27	.25	56	60.0		30	.25	6	6.2		
85		57	60.0		40	0.27		27	60.0		42	0.27	57	60.0		45	0.25	5	5.2		
86		58	60.0		56	.27		28	60.0		58	.25	58	60.0		89	0	.25	4	4.1	
87		59	60.0		89	.27		29	60.0		89	13	.27	59	60.0		15	.25	3	3.1	
88	15	0	—		28	.27		30	—		29	.25	14	0	—		30	.25	2	2.1	
89		0	—		44	.27		30	—		44	.27	0	—		45	.25	1	1.0		
90		0	—		90	0		30	—		90	0		0	—		90	0	0	0.0	

t	a = 75° 0'				a = 75° 30'				a = 76° 0'				a
	a	60'/Δ	b	Δ/60'	a	60'/Δ	b	Δ/60'	a	60'/Δ	b	Δ/60'	
	d = 75° 0'				d = 75° 30'				d = 76° 0'				



B	$a = 76^\circ 30'$				$a = 77^\circ 0'$				$a = 77^\circ 30'$				C	$\beta$						
	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$	$d$	$\frac{60'}{\Delta}$	$Z$	$\frac{\Delta}{60'}$								
	$h$				$h$				$h$											
0	0	0	4.29	76	30	0.00	0	0	4.29	77	0	0.00	0	0	4.62	77	30	0.00	80	90.0
1		14	4.29		30	.00		14	4.62		0	.00		13	4.62		30	.00	89	89.0
2		28	4.29		30	.02		27	4.29		0	.02		26	4.62		30	.02	88	88.1
3		42	4.29		31	.02		41	4.62		1	.02		39	4.62		31	.02	87	87.1
4		56	4.29		32	.02		54	4.62		2	.02		52	4.62		32	.02	86	86.1
5	1	10	4.29		33	.02	1	7	4.29		3	.02	1	5	4.62		33	.02	85	85.1
6		24	4.29		34	.03		21	4.62		4	.03		18	4.62		34	.02	84	84.2
7		38	4.29		36	.03		34	4.29		6	.02		31	4.62		35	.03	83	83.2
8		52	4.29		38	.03		48	4.62		7	.03		44	5.00		37	.03	82	82.2
9	2	6	4.62		40	.03	2	1	4.62		9	.03	2	1	4.62		39	.03	81	81.2
10		19	4.29		42	.03		14	4.29		11	.05	2	9	4.62		41	.03	80	80.3
11		33	4.29		44	.05		28	4.62		14	.03		22	4.62		43	.05	79	79.3
12		47	4.29		47	.05		41	4.62		16	.05		35	5.00		46	.05	78	78.3
13	3	1	4.62		50	.05	3	5	4.62		19	.05	3	1	4.62		49	.05	77	77.3
14		14	4.29		53	.07	3	7	4.62		22	.07	3	0	4.62		52	.05	76	76.3
15		28	4.29		57	.05		20	4.62		26	.05		13	5.00		55	.05	75	75.4
16		42	4.62	77	0	.07		33	4.62		29	.07		25	4.62		58	.07	74	74.4
17		55	4.62		4	.07		46	4.62		33	.07		38	5.00	78	2	.07	73	73.4
18	4	8	4.29		8	.08	4	12	4.62		37	.07	4	2	4.62		6	.07	72	72.4
19		22	4.62		13	.07	4	12	4.62		41	.07	4	2	4.62		10	.07	71	71.5
20		35	4.62		17	.08		25	5.00		45	.08		15	5.00		14	.07	70	70.5
21		48	4.62		22	.08		37	4.62		50	.08		27	5.00		18	.08	69	69.5
22	5	1	4.62		27	.08	5	5	4.62		55	.08	5	3	5.00		23	.08	68	68.5
23		14	4.62		32	.10	5	3	5.00	78	0	.08	5	1	5.00		28	.08	67	67.5
24		27	4.62		38	.10	5	15	5.00		5	.10	5	3	5.00		33	.08	66	66.5
25		40	4.62		44	.10		27	5.00		11	.10		15	5.00		38	.10	65	65.6
26		53	5.00		50	.10		39	5.00		17	.10		27	5.45		44	.10	64	64.6
27	6	5	4.62		56	.10	6	3	5.00		23	.10	6	2	5.45		50	.10	63	63.6
28		18	5.00	78	2	.10	6	3	5.00		29	.10	6	2	5.45		56	.10	62	62.6
29		30	5.00		8	.12	15	5.00		35	.10	6	2	5.45	79	2	.10	61	61.6	
30		42	5.00		15	.12	27	5.00		41	.12		13	5.45		8	.10	60	60.6	
31		54	5.00		22	.13	39	5.00		48	.12		24	5.45		14	.12	59	59.7	
32	7	6	5.00		30	.12	51	5.45		55	.13		35	5.45		21	.12	58	58.7	
33		18	5.00		37	.13	7	2	5.00	79	3	.12	46	5.45		28	.12	57	57.7	
34		30	5.00		45	.12	14	5.45		10	.12		57	5.45		35	.12	56	56.7	
35		42	5.45		52	.13	25	5.45		17	.13	7	8	5.45		42	.13	55	55.7	
36		53	5.00	79	0	.15	36	5.45		25	.13		19	6.00		50	.13	54	54.7	
37	8	5	5.45		9	.13	47	5.45		33	.13		29	5.45		58	.12	53	53.7	
38		16	5.45		17	.15	58	6.00		41	.15		40	6.00	80	5	.13	52	52.7	
39		27	5.45		26	.15	8	8	5.45		50	.13		50	6.00		13	.15	51	51.7
40		38	5.45		35	.15	19	6.00		58	.15	8	0	6.00		22	.13	50	50.7	
41		49	6.00		44	.15	29	6.00	80	7	.15		10	6.00		30	.15	49	49.7	
42		59	5.45		53	.15	39	6.00		16	.15		20	6.67		39	.13	48	48.7	
43	9	10	6.00	80	2	.17	49	6.00		25	.15		29	6.00		47	.15	47	47.7	
44		20	6.00		12	.17	59	6.00		34	.15		39	6.67		56	.15	46	46.7	
45		30			22		9	9		43			48		81	5		45	45.7	

$t$	$a = 76^\circ 30'$		$a = 77^\circ 0'$		$a = 77^\circ 30'$		$a$
	$a$	$\frac{60'}{\Delta}$	$b$	$\frac{\Delta}{60'}$	$a$	$\frac{60'}{\Delta}$	
	$d = 76^\circ 30'$		$d = 77^\circ 0'$		$d = 77^\circ 30'$		

B	$a = 76^\circ 30'$					$a = 77^\circ 0'$					$a = 77^\circ 30'$					C	$\beta$				
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$						
45	9	30	6.00	30	22	0.17	9	9	6.00	80	43	0.17	8	48	6.67	81	5	0.17	45	45.7	
46		40	6.00	32	.17		19	6.67		53	.17		57	6.67		15	.15	.44		44.7	
47		50	6.00	42	.17		28	6.67	81	3	.17		9	6	6.67	24	.17	.43		43.7	
48	10	0	6.67	52	.18		37	6.67		13	.17		15	6.67		34	.15	.42		42.7	
49		9	6.67	81	3	.18		46	6.67		23	.17		24	6.67		43	.17	.41		41.7
50		18	6.67		14	0.18		55	6.67		33	0.18		33	7.50		53	0.17	.40		40.7
51		27	6.67		25	.18	10	4	6.67		44	.18		41	7.50	82	3	.18	39		39.7
52		36	6.67		36	.18		13	7.50		55	.18		49	7.50		14	.17	.38		38.7
53		45	7.50		47	.18		21	7.50	82	6	.18		57	7.50		24	.18	.37		37.7
54		53	7.50		58	.18		29	7.50		17	.18	10	5	7.50		35	.17	.36		36.7
55	11	1	7.50	82	9	0.20		37	7.50		28	0.18		13	8.57		45	0.18	.35		35.7
56		9	7.50		21	.20		45	7.50		39	.18		20	8.57		56	.18	.34		34.7
57		17	7.50		33	.20		53	8.57		50	.18		27	8.57	83	7	.18	33		33.7
58		25	7.50		45	.20	11	0	8.57	83	1	.20		34	8.57		18	.18	.32		32.7
59		33	8.57		57	.20		7	8.57		13	.20		41	8.57		29	.18	.31		31.7
60		40	8.57	83	9	0.22		14	8.57		25	0.20		48	8.57		40	0.20	.30		30.6
61		47	8.57		22	.20		21	8.57		37	.20		55	10.0		52	.18	.29		29.6
62		54	8.57		34	.22		28	10.0		49	.20	11	1	10.0	84	3	.20	28		28.6
63	12	1	10.0		47	.20		34	10.0	84	1	.20		7	10.0		15	.20	.27		27.6
64		7	10.0		59	.22		40	10.0		13	.20		13	10.0		27	.20	.26		26.6
65		13	10.0	84	12	0.22		46	10.0		25	0.22		19	12.0		39	0.20	.25		25.6
66		19	10.0		25	.22		52	12.0		38	.22		24	12.0		51	.20	.24		24.6
67		25	12.0		38	.23		57	12.0		51	.20		29	12.0	85	3	.20	23		23.5
68		30	12.0		52	.22	12	2	12.0	85	3	.22		34	12.0		15	.20	.22		22.5
69		35	12.0	85	5	.22		7	12.0		16	.22		39	12.0		27	.22	.21		21.5
70		40	12.0		18	0.23		12	12.0		29	0.22		44	12.0		40	0.20	.20		20.5
71		45	12.0		32	.22		17	15.0		42	.22		49	15.0		52	.22	.19		19.5
72		50	15.0		45	.23		21	15.0		55	.22		53	15.0	86	5	.20	18		18.4
73		54	15.0		59	.23		25	15.0	86	8	.23		57	15.0		17	.22	.17		17.4
74		58	15.0	86	13	.23		29	15.0		22	.22	12	1	20.0		30	.22	.16		16.4
75	13	2	15.0		27	0.23		33	15.0		35	0.22		4	20.0		43	0.22	.15		15.4
76		6	20.0		41	.23		37	20.0		48	.23		7	20.0		56	.22	.14		14.4
77		9	20.0		55	.23		40	20.0	87	2	.22		10	20.0	87	9	.22	.13		13.3
78		12	20.0	87	9	.23		43	20.0		15	.23		13	20.0		22	.22	.12		12.3
79		15	20.0		23	.23		46	30.0		29	.22		16	30.0		35	.22	.11		11.3
80		18	30.0		37	0.23		48	30.0		42	0.23		18	30.0		48	0.22	.10		10.3
81		20	30.0		51	.23		50	30.0		56	.23		20	30.0	88	1	.22	.9		9.2
82		22	30.0	88	5	.23		52	30.0	88	10	.22		22	30.0		14	.22	.8		8.2
83		24	30.0		19	.25		54	30.0		23	.23		24	30.0		27	.22	.7		7.2
84		26	60.0		34	.23		56	60.0		37	.23		26	60.0		40	.23	.6		6.2
85		27	60.0		48	0.23		57	60.0		51	0.23		27	60.0		54	0.22	.5		5.1
86		28	60.0	89	2	.25		58	60.0	89	5	.22		28	60.0	89	7	.22	.4		4.1
87		29	60.0		17	.23		59	60.0		18	.23		29	60.0		20	.22	.3		3.1
88		30	—		31	.23	13	0	—		32	.23		30	—		33	.23	.2		2.1
89		30	—		45	.25		0	—		46	.23		30	—		47	.22	.1		1.0
90		30	—	90	0	—		0	—	90	0	—		30	—		90	0	0		0.0



B	$a = 78^\circ 0'$					$a = 78^\circ 30'$					$a = 79^\circ 0'$					C	$\beta$				
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$						
		t	$\Delta$	t	$\Delta$		t	$\Delta$	t	$\Delta$		t	$\Delta$								
0	0	0	5.00	78	0	0.00	0	0	5.00	78	30	0.00	0	0	5.45	79	0	0.00	90	90.0	
1		12	4.62		0	.00	12		5.00		30	.00	11		5.00		0	.00	89	89.0	
2		25	5.00		0	.02	24		5.00		30	.02	23		5.45		0	.02	88	88.0	
3		37	4.62		1	.02	36		5.00		31	.02	34		5.00		1	.02	87	87.1	
4		50	5.00		2	.02	48		5.00		32	.02	46		5.45		2	.02	86	86.1	
5	1	2	4.62		3	0.02	1	0	5.00		33	0.02	57		5.00		3	0.02	85	85.1	
6		15	5.00		4	.02	12		5.00		30	.02	1	9	5.45		4	.02	84	84.1	
7		27	5.00		5	.03	24		5.45		35	.03	20		5.45		5	.02	83	83.1	
8		39	4.62		7	.03	35		5.00		37	.02	31		5.00		6	.03	82	82.2	
9		52	5.00		9	.03	47		5.00		38	.03	43		5.45		8	.03	81	81.2	
10	2	4	4.62		11	0.03	59		5.00		40	0.03	54		5.45		10	0.03	80	80.2	
11		17	5.00		13	.03	2	11	5.00		42	.05	2	5	5.45		12	.03	79	79.2	
12		29	5.00		15	.05	23		5.45		45	.03	16		5.00		14	.03	78	78.2	
13		41	5.00		18	.05	34		5.00		47	.05	28		5.45		16	.05	77	77.3	
14		53	5.00		21	.05	46		5.00		50	.05	39		5.45		19	.05	76	76.3	
15	3	5	5.00		24	0.05	58		5.45		53	0.05	50		5.45		22	0.05	75	75.3	
16		17	5.00		27	.05	3	9	5.00		56	.05	3	1	5.45		25	.05	74	74.3	
17		29	5.00		30	.07	21		5.45		59	.07	12		5.45		28	.05	73	73.3	
18		41	5.00		34	.07	32		5.45	79	3	.07	23		5.45		31	.07	72	72.3	
19		53	5.00		38	.07	43		5.00		7	.07	34		5.45		35	.07	71	71.4	
20	4	5	5.00		42	0.07	55		5.45		11	0.07	45		6.00		39	0.07	70	70.4	
21		17	5.45		46	.08	4	6	5.45		15	.07	55		5.45		43	.07	69	69.4	
22		28	5.00		51	.08	17		5.45		19	.08	4	6	5.45		47	.07	68	68.4	
23		40	5.45		56	.08	28		5.45		24	.07	17		6.00		51	.08	67	67.4	
24		51	5.00	79	1	.08	39		5.45		28	.08	27		5.45		56	.08	66	66.4	
25	5	3	5.45		6	0.08	50		5.45		33	0.08	38		6.00	80	1	0.08	65	65.4	
26		14	5.45		11	.08	5	10	5.45		38	.08	48		6.00		6	.08	64	64.5	
27		25	5.45		16	.10	12		6.00		43	.10	58		6.00		11	.08	63	63.5	
28		36	5.45		22	.10	22		5.45		49	.08	5	8	6.00		16	.08	62	62.5	
29		47	5.45		28	.10	33		6.00		54	.10	18		6.00		21	.10	61	61.5	
30	6	58	5.45		34	0.10	43		5.45	80	0	0.10	28		6.00		27	0.10	60	60.5	
31		9	5.45		40	.12	54		6.00		6	.10	38		6.00		33	.10	59	59.5	
32		20	6.00		47	.12	6	4	6.00		12	.12	48		6.00		39	.10	58	58.5	
33		30	5.45		54	.12	14		6.00		19	.10	58		6.00		45	.10	57	57.5	
34		41	6.00	80	1	.12	24		6.00		25	.12	6	8	6.67		51	.10	56	56.5	
35	7	51	6.00		8	0.12	34		6.00		32	0.12	17		6.00		57	0.12	55	55.5	
36		1	6.00		15	.12	44		6.00		39	.12	27		6.67	81	4	.12	54	54.6	
37		11	6.00		22	.12	54		6.67		46	.12	36		6.67		11	.12	53	53.6	
38		21	6.00		29	.13	7	3	6.00		53	.13	45		6.67		18	.12	52	52.6	
39		31	6.00		37	.13	13		6.67	81	1	.12	54		6.67		25	.12	51	51.6	
40	8	41	6.00		45	0.13	22		6.67		8	0.13	7	3	6.67		32	0.12	50	50.6	
41		51	6.67		53	.13	31		6.67		16	.13	12		7.50		39	.13	49	49.6	
42		0	6.67	81	1	.15	40		6.67		24	.13	20		6.67		47	.13	48	48.6	
43		9	6.67		10	.15	49		6.67		32	.13	29		7.50		55	.12	47	47.6	
44		18	6.67		18	.15	58		7.50		40	.15	37		7.50		82	2	.13	46	46.6
45		27			27		8	6			49		45				10			45	45.6

t	$a = 78^\circ 0'$				$a = 78^\circ 30'$				$a = 79^\circ 0'$				a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	
	$d = 78^\circ 0'$				$d = 78^\circ 30'$				$d = 79^\circ 0'$				

b	a = 78° 0'					a = 78° 30'					a = 79° 0'					c	α									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ		Δ	Δ			Δ	Δ		Δ	Δ					Δ	Δ		Δ	Δ			
45	8	27	6.67	81	27	0.15	8	6	6.67	81	49	0.13	7	45	7.50	82	10	0.15	8	0	0.15	8	0	0.15	45	45.6
46		36	6.67		36	.15		15	7.50		57	.15		53	7.50		19	.13	44		.13	44		.13	44	44.6
47		45	7.50		45	.15		23	7.50	82	6	.15	8	1	7.50		27	.13	43		.13	43		.13	43	43.6
48		53	6.67		54	.17		31	7.50		15	.15		9	7.50		35	.15	42		.15	42		.15	42	42.6
49	9	2	7.50	82	4	.15		39	7.50		24	.15		17	8.57		44	.15	41		.15	41		.15	41	41.6
50		10	7.50		13	0.17		47	7.50		33	0.15		24	7.50		53	0.15	40		.15	40		.15	40	40.6
51		18	7.50		23	.17		55	7.50		42	.15		32	8.57	83	2	.15	39		.15	39		.15	39	39.6
52		26	7.50		33	.17	9	3	8.57		51	.17		39	8.57		11	.15	38		.15	38		.15	38	38.6
53		34	8.57		43	.17		10	8.57	83	1	.17		46	8.57		20	.15	37		.15	37		.15	37	37.6
54		41	8.57		53	.17		17	8.57		11	.17		53	8.57		29	.15	36		.15	36		.15	36	36.6
55		48	8.57	83	3	0.17		24	8.57		21	0.17	9	0	10.0		38	0.17	35		.17	35		.17	35	35.5
56		55	8.57		13	.18		31	8.57		31	.17		6	8.57		48	.15	34		.15	34		.15	34	34.5
57	10	2	8.57		24	.17		38	10.0		41	.17		13	10.0		57	.17	33		.17	33		.17	33	33.5
58		9	8.57		34	.18		44	10.0		51	.17		19	10.0	84	7	.17	32		.17	32		.17	32	32.5
59		16	8.57		45	.18		50	10.0	84	1	.17		25	10.0		17	.17	31		.17	31		.17	31	31.5
60		23	10.0		56	0.18		56	10.0		11	0.18		31	10.0		27	0.17	30		.17	30		.17	30	30.5
61		29	10.0	84	7	.18	10	2	10.0		22	.18		37	12.0		37	.17	29		.17	29		.17	29	29.5
62		35	10.0		18	.18		8	10.0		33	.17		42	12.0		47	.17	28		.17	28		.17	28	28.5
63		41	12.0		29	.20		14	12.0		43	.18		47	12.0		57	.18	27		.18	27		.18	27	27.5
64		46	10.0		41	.18		19	12.0		54	.18		52	12.0	85	8	.17	26		.17	26		.17	26	26.5
65		52	12.0		52	0.20		24	12.0	85	5	0.18		57	12.0		18	0.18	25		.18	25		.18	25	25.4
66		57	12.0	85	4	.18		29	12.0		16	.18	10	2	12.0		29	.17	24		.17	24		.17	24	24.4
67	11	2	12.0		15	.20		34	12.0		27	.18		7	15.0		39	.18	23		.18	23		.18	23	23.4
68		7	12.0		27	.20		39	12.0		38	.20		11	15.0		50	.18	22		.18	22		.18	22	22.4
69		12	15.0		39	.20		44	15.0		50	.18		15	15.0	86	1	.18	21		.18	21		.18	21	21.4
70		16	15.0		51	0.20		48	15.0	86	1	0.20		19	15.0		12	0.18	20		.18	20		.18	20	20.4
71		20	15.0	86	3	.20		52	15.0		13	.18		23	15.0		23	.18	19		.18	19		.18	19	19.4
72		24	15.0		15	.20		56	15.0		24	.20		27	15.0		34	.18	18		.18	18		.18	18	18.3
73		28	15.0		27	.20	11	0	20.0		36	.18		31	20.0		45	.18	17		.18	17		.18	17	17.3
74		32	20.0		39	.20		3	20.0		47	.20		34	20.0		56	.18	16		.18	16		.18	16	16.3
75		35	20.0		51	0.20		6	20.0		59	0.20		37	20.0	87	7	0.18	15		.18	15		.18	15	15.3
76		38	20.0	87	3	.22		9	20.0	87	11	.20		40	20.0		18	.20	14		.20	14		.20	14	14.3
77		41	20.0		16	.20		12	20.0		23	.20		43	20.0		30	.18	13		.18	13		.18	13	13.3
78		44	20.0		28	.22		15	30.0		35	.20		46	30.0		41	.20	12		.20	12		.20	12	12.2
79		47	30.0		41	.20		17	30.0		47	.20		48	30.0		53	.18	11		.18	11		.18	11	11.2
80		49	30.0		53	0.22		19	30.0		59	0.20		50	30.0	88	4	0.18	10		.18	10		.18	10	10.2
81		51	30.0	88	6	.20		21	30.0	88	11	.20		52	30.0		15	.20	9		.20	9		.20	9	9.2
82		53	30.0		18	.22		23	30.0		23	.20		54	60.0		27	.20	8		.20	8		.20	8	8.2
83		55	60.0		31	.22		25	60.0		35	.20		55	60.0		39	.18	7		.18	7		.18	7	7.1
84		56	60.0		44	.20		26	60.0		47	.20		56	60.0		50	.20	6		.20	6		.20	6	6.1
85		57	60.0		56	0.22		27	60.0		59	0.20		57	60.0	89	2	0.18	5		.18	5		.18	5	5.1
86		58	60.0	89	9	.22		28	60.0	89	11	.20		58	60.0		13	.20	4		.20	4		.20	4	4.1
87		59	60.0		22	.20		29	60.0		23	.20		59	60.0		25	.20	3		.20	3		.20	3	3.1
88	12	0	—		34	.22		30	—		35	.22	11	0	—		37	.18	2		.18	2		.18	2	2.0
89		0	—		47	.22		30	—		48	.20		0	—		48	.20	1		.20	1		.20	1	1.0
90		0		90	0			30		90	0			0			90	0	0			0			0	0.0
t	a	60'		b	Δ		a	60'		b	Δ		a	60'		b	Δ		a							
		Δ			60'			Δ			60'			Δ			Δ									
	d = 78° 0'					d = 78° 30'					d = 79° 0'															



B	$a = 79^\circ 30'$				$a = 80^\circ 0'$				$a = 80^\circ 30'$				C	$\beta$						
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
0	0	0	5.45	79	30	0.00	0	0	6.00	80	0	0.00	0	0	6.00	80	30	0.00	90	90.0
1		11	5.45		30	.00	10	5.45		0	0.00		10	6.00		30	0.00	80	89.0	
2		22	5.45		30	.02	21	6.00		0	.02		20	6.00		30	.02	88	88.0	
3		33	5.45		31	.00	31	5.45		1	.00		30	6.00		31	.00	87	87.0	
4		44	5.45		31	.02	42	6.00		1	.02		40	6.00		31	.02	86	86.1	
5		55	5.45		32	0.02	52	6.00	2	0.02		50	6.67	32	0.02	85	85.1			
6	1	6	5.45		33	.02	1	5.45	3	.02		59	6.00	33	.02	84	84.1			
7		17	6.00		34	.03	13	6.00	4	.03		1	9	6.00	34	.02	83	83.1		
8		27	5.45		36	.03	23	6.00	6	.02		19	6.00	35	.03	82	82.1			
9		38	5.45		38	.02	33	5.45	7	.03		29	6.00	37	.02	81	81.1			
10		49	5.45		39	0.03	44	6.00	9	0.03		39	6.67	38	0.03	80	80.1			
11	2	0	6.00		41	.03	54	6.00	11	.03		48	6.00	40	.03	79	79.2			
12		10	5.45		43	.05	2	4	6.00	13	.03		58	6.00	42	.03	78	78.2		
13		21	5.45		46	.03	14	6.00	15	.03	2	8	6.67	44	.03	77	77.2			
14		32	6.00		48	.05	24	6.00	17	.05	2	17	6.00	46	.05	76	76.2			
15		42	5.45		51	0.05	34	6.00	20	0.05		27	6.67	49	0.05	75	75.2			
16		53	6.00		54	.05	44	6.00	23	.05		36	6.00	52	.03	74	74.2			
17	3	3	5.45		57	.05	54	6.00	26	.05		46	6.67	54	.05	73	73.2			
18		14	6.00	80	0	.05	3	4	6.00	29	.05		55	6.00	57	.05	72	72.3		
19		24	6.00		3	.07	14	6.00	32	.05	3	5	6.67	81	0.07	71	71.3			
20		34	5.45		7	0.07	24	6.00	35	0.07		14	6.00	4	0.05	70	70.3			
21		45	6.00		11	.07	34	6.00	39	.07		24	6.67	7	.07	69	69.3			
22		55	6.00		15	.07	44	6.67	43	.07		33	6.67	11	.07	68	68.3			
23	4	5	6.00		19	.07	53	6.00	47	.07		42	6.67	15	.07	67	67.3			
24		15	6.00		23	.08	4	3	6.00	51	.07	4	51	6.67	19	.07	66	66.3		
25		25	6.00		28	0.08	13	6.67	55	0.08	4	0	6.67	23	0.07	65	65.3			
26		35	6.00		33	.07	22	6.67	81	0	.07	9	6.67	27	.07	64	64.3			
27		45	6.00		37	.08	31	6.00	4	.08		18	6.67	31	.08	63	63.4			
28		55	6.67		42	.08	41	6.67	9	.08		27	6.67	36	.07	62	62.4			
29	5	4	6.00		47	.10	50	6.67	14	.08		36	7.50	40	.08	61	61.4			
30		14	6.67		53	0.08	59	6.67	19	0.08		44	6.67	45	0.08	60	60.4			
31		23	6.00		58	.10	5	8	6.67	24	.10	5	53	7.50	50	.08	59	59.4		
32		33	6.67	81	4	.10	17	6.67	30	.08	5	1	7.50	55	.10	58	58.4			
33		42	6.67		10	.10	26	7.50	35	.10		9	6.67	82	1	.08	57	57.4		
34		51	6.67		16	.10	34	6.67	41	.10		18	7.50	6	.10	56	56.4			
35	6	0	6.67		22	0.10	43	6.67	47	0.10		26	7.50	12	0.08	55	55.4			
36		9	6.67		28	.12	52	7.50	53	.10		34	7.50	17	.10	54	54.4			
37		18	6.67		35	.10	6	0	7.50	59	.10	42	7.50	23	.10	53	53.4			
38		27	7.50		41	.12	8	7.50	82	5	.12	50	7.50	29	.10	52	52.4			
39		35	6.67		48	.12	16	7.50	12	.10		58	8.57	35	.12	51	51.4			
40		44	7.50		55	0.12	24	7.50	18	0.12	6	5	7.50	42	0.10	50	50.4			
41		52	7.50	82	2	.12	32	7.50	25	.12		13	8.57	48	.12	49	49.4			
42	7	0	7.50		9	.13	40	7.50	32	.12		20	7.50	55	.10	48	48.4			
43		8	7.50		17	.12	48	7.50	39	.12		28	8.57	83	1	.12	47	47.4		
44		16	7.50		24	.13	56	8.57	46	.13		35	8.57	8	.12	46	46.4			
45		24			32		7	3				42		15		45	45.4			

t	$a = 79^\circ 30'$		$a = 80^\circ 0'$		$a = 80^\circ 30'$		$\alpha$
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 79^\circ 30'$		$d = 80^\circ 0'$		$d = 80^\circ 30'$		

B	a = 79° 30'					a = 80° 0'					a = 80° 30'					C	c	α				
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t				C	β		
				Δ			$\frac{\Delta}{60'}$			Δ			$\frac{\Delta}{60'}$								Δ	
45	7	24	7.50	82	32	0.13	7	3	7.50	82	54	0.12	6	42	8.57	83	15	0.12	45	45.4		
46		32	7.50		40	.13		11	8.57		83	1	.13		49	8.57		22	.12	44	44.4	
47		40	8.57		48	.13		18	8.57			9	.12		56	8.57		29	.12	43	43.4	
48		47	8.57		56	.13		25	8.57			16	.13		7	3	10.0		37	.12	42	42.4
49		54	8.57	83	4	.13		32	8.57			24	.13		9	8.57		44	.13	41	41.4	
50	8	1	8.57		12	0.15		39	10.0			32	0.13		16	10.0		52	0.12	40	40.4	
51		8	8.57		21	.15		45	8.57			40	.13		22	10.0		59	.13	39	39.4	
52		15	8.57		29	.15		52	10.0			48	.15		28	10.0	84	7	.13	38	38.4	
53		22	8.57		38	.15		58	10.0			57	.13		34	10.0		15	.13	37	37.4	
54		29	10.0		47	.15	8	4	10.0		84	5	.13		40	10.0		23	.13	36	36.4	
55		35	10.0		56	0.15		10	10.0			13	0.15		46	10.0		31	.13	35	35.4	
56		41	10.0	84	5	.15		16	10.0			22	.15		52	10.0		39	.13	34	34.4	
57		47	10.0		14	.15		22	10.0			31	.15		58	12.0		47	.15	33	33.4	
58		53	10.0		23	.17		28	10.0			40	.15	8	3	12.0		56	.13	32	32.4	
59		59	10.0		33	.15		34	12.0			49	.15	8	8	12.0	85	4	.15	31	31.4	
60	9	5	10.0		42	0.17		39	12.0			58	0.15		13	12.0		13	0.15	30	30.4	
61		11	12.0		52	.15		44	12.0		85	7	.15		18	12.0		22	.13	29	29.4	
62		16	12.0		1	.17		49	12.0			16	.15		23	12.0		30	.15	28	28.4	
63		21	12.0	85	11	.17		54	12.0			25	.17		28	15.0		39	.15	27	27.4	
64		26	12.0		21	.17		59	12.0			35	.15		32	15.0		48	.15	26	26.3	
65		31	15.0		31	0.17	9	4	15.0			44	0.17		36	15.0		57	0.15	25	25.3	
66		35	15.0		41	.17		8	15.0			54	.17		40	15.0	86	6	.15	24	24.3	
67		39	15.0		51	.18		12	15.0		86	4	.15		44	15.0		15	.17	23	23.3	
68		43	15.0		2	.17		16	15.0			13	.17		48	15.0		25	.15	22	22.3	
69		47	15.0	86	12	.17		20	15.0			23	.17		52	15.0		34	.15	21	21.3	
70		51	15.0		22	0.18		24	20.0			33	0.17		56	20.0		43	0.17	20	20.3	
71		55	15.0		33	.17		27	20.0			43	.17		59	20.0		53	.15	19	19.3	
72		59	20.0		43	.18		30	20.0			53	.17	9	2	20.0		2	.17	18	18.3	
73	10	2	20.0		54	.17		33	20.0		87	3	.17		5	20.0		12	.17	17	17.2	
74		5	20.0	87	4	.18		36	20.0			13	.17		8	20.0		22	.15	16	16.2	
75		8	20.0		15	0.18		39	20.0			23	0.17		11	30.0		31	0.17	15	15.2	
76		11	20.0		26	.18		42	20.0			33	.18		13	30.0		41	.17	14	14.2	
77		14	30.0		37	.17		45	30.0			44	.17		15	30.0		51	.15	13	13.2	
78		16	30.0		47	.18		47	30.0			54	.17		17	30.0	88	0	.17	12	12.2	
79		18	30.0		58	.18		49	30.0		88	4	.18		19	30.0		10	.17	11	11.2	
80		20	30.0	88	9	0.18		51	30.0			15	0.17		21	30.0		20	0.17	10	10.2	
81		22	30.0		20	.18		53	60.0			25	.18		23	30.0		30	.17	9	9.1	
82		24	60.0		31	.18		54	60.0			36	.17		25	60.0		40	.17	8	8.1	
83		25	60.0		42	.18		55	60.0			46	.18		26	60.0		50	.17	7	7.1	
84		26	60.0		53	.18		56	60.0			57	.17		27	60.0	89	0	.17	6	6.1	
85		27	60.0	89	4	0.18		57	60.0		89	7	0.18		28	60.0		10	0.17	5	5.1	
86		28	60.0		15	.20		58	60.0			18	.17		29	—		20	.17	4	4.1	
87		29	60.0		27	.18		59	60.0			28	.18		29	60.0		30	.17	3	3.0	
88		30	—		38	.18	10	0	—			39	.17		30	—		40	.17	2	2.0	
89		30	—		49	.18		0	—			49	.18		30	—		50	.17	1	1.0	
90		30		90	0			0			90	0			30		90	0		0	0.0	

t	a = 79° 30'		a = 80° 0'		a = 80° 30'		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	d = 79° 30'		d = 80° 0'		d = 80° 30'		



B	$a = 81^\circ 0'$				$a = 81^\circ 30'$				$a = 82^\circ 0'$				C	$\beta$	
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z			
		$\Delta$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\Delta$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\Delta$	$\frac{\Delta}{60'}$			$\frac{\Delta}{60'}$
0	0	0	6.67	81	0	0	6.67	81	30	0	0	7.50	82	0	90
1		9	6.00	0	0	9	6.67	30	0.00	8	6.67	0	0	0.00	89.0
2		19	6.67	0	18	6.67	30	0.02	17	7.50	0	0.02	88	88.0	
3		28	6.00	1	27	7.50	31	0.00	25	7.50	1	0.00	87	87.0	
4		38	6.67	1	35	6.67	31	0.02	33	6.67	1	0.02	86	86.0	
5		47	6.67	2	44	6.67	32	0.02	42	7.50	2	0.02	85	85.1	
6		56	6.00	3	53	6.67	33	0.02	50	7.50	3	0.02	84	84.1	
7	1	6	6.67	4	1	2	6.67	34	0.02	58	6.67	4	0.02	83	83.1
8		15	6.67	5	11	6.67	35	0.02	1	7.50	5	0.02	82	82.1	
9		24	6.67	6	20	7.50	36	0.03	15	7.50	6	0.02	81	81.1	
10		33	6.00	8	28	6.67	38	0.02	23	7.50	7	0.03	80	80.1	
11		43	6.67	10	37	6.67	39	0.03	31	6.67	9	0.02	79	79.1	
12		52	6.67	12	46	7.50	41	0.03	40	7.50	10	0.03	78	78.1	
13	2	1	6.67	14	54	6.67	43	0.03	48	7.50	12	0.03	77	77.1	
14		10	6.67	16	2	3	6.67	45	0.03	56	7.50	14	0.03	76	76.1
15		19	6.67	18	12	7.50	47	0.03	2	4	7.50	16	0.03	75	75.2
16		28	6.67	20	20	6.67	49	0.05	12	7.50	18	0.05	74	74.2	
17		37	6.67	23	29	7.50	52	0.05	20	7.50	21	0.03	73	73.2	
18		46	6.67	26	37	6.67	55	0.03	28	7.50	23	0.05	72	72.2	
19		55	6.67	29	46	7.50	57	0.05	36	7.50	26	0.05	71	71.2	
20	3	4	6.67	32	54	7.50	82	0	44	7.50	29	0.05	70	70.2	
21		13	6.67	35	3	2	7.50	3	52	8.57	32	0.05	69	69.2	
22		22	7.50	39	10	6.67	7	0.05	59	7.50	35	0.05	68	68.2	
23		30	6.67	42	19	7.50	10	0.05	3	7	7.50	38	0.05	67	67.2
24		39	7.50	46	27	7.50	13	0.07	15	8.57	41	0.05	66	66.2	
25		47	6.67	50	35	7.50	17	0.07	22	7.50	44	0.07	65	65.2	
26		56	6.67	54	43	7.50	21	0.07	30	8.57	48	0.07	64	64.2	
27	4	5	7.50	58	51	7.50	25	0.07	37	7.50	52	0.07	63	63.3	
28		13	7.50	82	59	7.50	29	0.07	45	8.57	56	0.07	62	62.3	
29		21	7.50	7	4	7	8.57	33	0.07	52	8.57	83	0	61	61.3
30		29	7.50	11	14	7.50	37	0.08	59	7.50	4	0.07	60	60.3	
31		37	7.50	16	22	7.50	42	0.08	4	7	8.57	8	0.07	59	59.3
32		45	7.50	21	30	8.57	47	0.07	14	8.57	12	0.08	58	58.3	
33		53	7.50	26	37	7.50	51	0.08	21	8.57	17	0.07	57	57.3	
34	5	1	7.50	31	45	8.57	56	0.08	28	8.57	21	0.08	56	56.3	
35		9	7.50	36	52	8.57	83	1	35	8.57	26	0.08	55	55.3	
36		17	8.57	42	59	8.57	6	0.10	42	10.0	31	0.08	54	54.3	
37		24	7.50	47	6	8.57	12	0.08	48	8.57	36	0.08	53	53.3	
38		32	8.57	53	13	8.57	17	0.08	55	8.57	41	0.08	52	52.3	
39		39	8.57	59	20	8.57	22	0.10	5	2	10.0	46	0.08	51	51.3
40		46	8.57	83	27	8.57	28	0.10	8	10.0	51	0.10	50	50.3	
41		53	8.57	11	34	8.57	34	0.10	14	8.57	57	0.08	49	49.3	
42	6	0	8.57	17	41	10.0	40	0.10	21	10.0	2	0.10	48	48.3	
43		7	8.57	23	47	8.57	46	0.10	27	10.0	8	0.10	47	47.3	
44		14	8.57	30	54	10.0	52	0.10	33	10.0	14	0.10	46	46.3	
45		21		37	6	0	58		39		20		45	45.3	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a		
	$d = 81^\circ 0'$				$d = 81^\circ 30'$				$d = 82^\circ 0'$						

B	$a = 81^\circ 0'$				$a = 81^\circ 30'$				$a = 82^\circ 0'$				C	$\beta$							
	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z	h	$d$	$\frac{60'}{\Delta}$	Z									
		$\frac{\Delta}{60'}$	t	$\frac{\Delta}{60'}$		t	$\frac{\Delta}{60'}$	t		$\frac{\Delta}{60'}$	t										
45	6	21	8.57	83	37	0.10	6	0	10.0	83	58	0.10	5	39	10.0	84	20	0.10	45	45.3	
46		28	10.0		43	.12		6	10.0		84	4	.12		45	10.0		26	.10	44	44.3
47		34	8.57		50	.12		12	10.0			11	.10		51	12.0		32	.10	43	43.3
48		41	10.0		57	.12		18	10.0			17	.12		56	10.0		38	.10	42	42.3
49		47	4	84	4	.12		24	10.0			24	.12	6	2	12.0		44	.10	41	41.3
50		53	10.0		11	0.12		30	10.0			31	0.12		7	10.0		50	0.12	40	40.3
51		59	10.0		18	.13		36	12.0			38	.12		13	12.0		57	.10	39	39.3
52	7	5	10.0		26	.12		41	10.0			45	.12		18	12.0	85	3	.12	38	38.3
53		11	12.0		33	.13		47	12.0			52	.12		23	12.0		10	.12	37	37.3
54		16	10.0		41	.13		52	12.0			59	.12		28	12.0		17	.10	36	36.3
55		22	12.0		49	0.12		57	12.0	85	6	0.12		33	12.0		23	0.12	35	35.3	
56		27	12.0		56	.13	7	2	12.0		13	.13		38	15.0		30	.12	34	34.3	
57		32	12.0	85	4	.13		7	12.0		21	.12		42	12.0		37	.12	33	33.3	
58		37	12.0		12	.13		12	12.0		28	.13		47	15.0		44	.13	32	32.3	
59		42	12.0		20	.13		17	12.0		36	.13		51	15.0		52	.12	31	31.3	
60		47	12.0		28	0.15		22	15.0		44	0.12		55	15.0		59	0.12	30	30.3	
61		52	12.0		37	.13		26	15.0		51	.13		59	15.0	86	6	.12	29	29.3	
62		57	15.0		45	.13		30	15.0		59	.13	7	3	15.0		13	.13	28	28.3	
63	8	1	15.0		53	.15		34	15.0	86	7	.13		7	15.0		21	.12	27	27.3	
64		5	15.0	86	2	.13		38	15.0		15	.13		11	15.0		28	.13	26	26.3	
65		9	15.0		10	0.15		42	15.0		23	0.13		15	15.0		36	0.13	25	25.2	
66		13	15.0		19	.15		46	20.0		31	.13		19	20.0		44	.12	24	24.2	
67		17	15.0		28	.13		49	15.0		39	.15		22	20.0		51	.13	23	23.2	
68		21	20.0		36	.15		53	20.0		48	.13		25	20.0		59	.13	22	22.2	
69		24	20.0		45	.15		56	20.0		56	.13		28	20.0	87	7	.13	21	21.2	
70		27	20.0		54	0.15		59	20.0	87	4	0.15		31	20.0		15	0.13	20	20.2	
71		30	20.0	87	3	.15	8	2	20.0		13	.13		34	20.0		23	.13	19	19.2	
72		33	20.0		12	.15		5	20.0		21	.15		37	30.0		31	.13	18	18.2	
73		36	20.0		21	.15		8	30.0		30	.13		39	30.0		39	.13	17	17.2	
74		39	20.0		30	.15		10	20.0		38	.15		41	30.0		47	.13	16	16.2	
75		42	30.0		39	0.15		13	30.0		47	0.15		43	30.0		55	0.13	15	15.2	
76		44	30.0		48	.17		15	30.0		56	.13		45	30.0	88	3	.13	14	14.2	
77		46	30.0		58	.15		17	30.0	88	4	.15		47	30.0		11	.15	13	13.1	
78		48	30.0	88	7	.15		19	30.0		13	.15		49	30.0		20	.13	12	12.1	
79		50	30.0		16	.15		21	60.0		22	.15		51	30.0		28	.13	11	11.1	
80		52	30.0		25	0.17		22	30.0		31	0.15		53	60.0		36	0.13	10	10.1	
81		54	60.0		35	.15		24	60.0		40	.13		54	60.0		44	.15	9	9.1	
82		55	60.0		44	.17		25	60.0		48	.15		55	60.0		53	.13	8	8.1	
83		56	60.0		54	.15		26	60.0		57	.15		56	60.0	89	1	.15	7	7.1	
84		57	60.0	89	3	.17		27	60.0	89	6	.15		57	60.0		10	.13	6	6.1	
85		58	60.0		13	0.15		28	60.0		15	0.15		58	60.0		18	0.13	5	5.1	
86		59	—		22	.15		29	—		24	.15		59	—		26	.15	4	4.0	
87		59	60.0		31	.17		29	60.0		33	.15		59	60.0		35	.13	3	3.0	
88	9	0	—		41	.15		30	—		42	.15		0	—		43	.15	2	2.0	
89		0	—		50	.17		30	—		51	.15		0	—		52	.13	1	1.0	
90		0	—	90	0	—		30	—	90	0	—		0	—	90	0	—	0	0.0	

t	$a = 81^\circ 0'$		$a = 81^\circ 30'$		$a = 82^\circ 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 81^\circ 0'$		$d = 81^\circ 30'$		$d = 82^\circ 0'$		



B	a = 82° 30'				a = 83° 0'				a = 83° 30'				C	α						
	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'			h	d	60' / Δ	Z	t	Δ / 60'
0	0	0	7.50	82	30	0.00	0	0	8.57	83	0	0.00	0	0	8.57	83	30	0.00	90	90.0
1		8	7.50		30	.00		7	7.50		0	.00		7	8.57		30	.00	89	89.0
2		16	7.50		30	.02		15	8.57		0	.02		14	10.0		30	.02	88	88.0
3		24	8.57		31	.00		22	8.57		1	.00		20	8.57		31	.00	87	87.0
4		31	7.50		31	.02		29	7.50		1	.02		27	8.57		31	.00	86	86.0
5		39	7.50		32	0.00		37	8.57		2	0.00		34	8.57		31	0.02	85	85.0
6		47	7.50		32	.02		44	8.57		2	.02		41	10.0		32	.02	84	84.0
7		55	7.50		33	.02		51	8.57		3	.02		47	8.57		33	.02	83	83.1
8		1	8.57		34	.02		58	7.50		4	.02		54	8.57		34	.02	82	82.1
9	1	10	7.50		35	.03	1	6	8.57		5	.02	1	1	8.57		35	.02	81	81.1
10		18	7.50		37	0.02		13	8.57		6	0.03		8	10.0		36	0.02	80	80.1
11		26	8.57		38	.03		20	8.57		8	.02		14	8.57		37	.02	79	79.1
12		33	7.50		40	.02		27	8.57		9	.03		21	8.57		38	.03	78	78.1
13		41	7.50		41	.03		34	8.57		11	.02		28	10.0		40	.02	77	77.1
14		49	8.57		43	.03		41	8.57		12	.03		34	8.57		41	.03	76	76.1
15		56	7.50		45	0.03		48	8.57		14	0.03		41	10.0		43	0.03	75	75.1
16	2	4	8.57		47	.03		55	8.57		16	.03		47	8.57		45	.03	74	74.1
17		11	7.50		49	.05	2	2	8.57		18	.03		54	10.0		47	.03	73	73.1
18		19	8.57		52	.03		9	8.57		20	.05	2	0	8.57		49	.03	72	72.1
19		26	7.50		54	.05		16	8.57		23	.03		7	10.0		51	.03	71	71.1
20		34	8.57		57	0.03		23	8.57		25	0.05		13	8.57		53	0.05	70	70.1
21		41	8.57		59	.05		30	8.57		28	.03		20	10.0		56	.03	69	69.1
22		48	8.57	83	2	.05		37	8.57		30	.05		26	10.0		58	.05	68	68.1
23		55	7.50		5	.05		44	10.0		33	.05		32	10.0	84	1	.03	67	67.2
24	3	3	8.57		8	.07		50	8.57		36	.05		38	8.57		3	.05	66	66.2
25		10	8.57		12	0.05		57	8.57		39	0.05		45	10.0		6	0.05	65	65.2
26		17	8.57		15	.05	3	4	10.0		42	.05		51	10.0		9	.05	64	64.2
27		24	8.57		18	.07		10	8.57		45	.07		57	10.0		12	.05	63	63.2
28		31	8.57		22	.07		17	10.0		49	.05	3	3	10.0		15	.05	62	62.2
29		38	8.57		26	.07		23	8.57		52	.07		9	10.0		18	.07	61	61.2
30		45	10.0		30	0.07		30	10.0		56	0.07		15	10.0		22	0.05	60	60.2
31		51	8.57		34	.07		36	10.0	0	.05		21	12.0		25	.07	59	59.2	
32		58	8.57		38	.07		42	10.0		3	.07		26	10.0		29	.05	58	58.2
33	4	5	10.0		42	.07		48	10.0		7	.07		32	10.0		32	.07	57	57.2
34		11	8.57		46	.08		54	10.0		11	.07		38	12.0		36	.07	56	56.2
35		18	10.0		51	0.07	4	0	10.0		15	0.08		43	10.0		40	0.07	55	55.2
36		24	10.0		55	.08		6	10.0		20	.07		49	12.0		44	.07	54	54.2
37		30	8.57	84	0	.08		12	10.0		24	.07		54	10.0		48	.07	53	53.2
38		37	10.0		5	.07		18	10.0		28	.08	4	0	12.0		52	.07	52	52.2
39		43	10.0		9	.08		24	10.0		33	.08		5	12.0		56	.08	51	51.2
40		49	10.0		14	0.08		30	12.0		38	0.07		10	10.0	85	1	0.07	50	50.2
41		55	10.0		19	.10		35	10.0		42	.08		16	12.0		5	.08	49	49.2
42	5	1	12.0		25	.08		41	12.0		47	.08		21	12.0		10	.07	48	48.2
43		6	10.0		30	.08		46	10.0		52	.08		26	12.0		14	.08	47	47.2
44		12	10.0		35	.10		52	12.0		57	.08		31	12.0		19	.08	46	46.2
45		18			41			57		85	2			36			24		45	45.2
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a			
	d = 82° 30'				d = 83° 0'				d = 83° 30'											

b	a = 82° 30'				a = 83° 0'				a = 83° 30'				c	a						
	B	h	d	t	h	d	t	h	d	t	C	β								
			60'	Δ		Z	60'		Δ	Z					60'	Δ	Z	60'		
45	5	18	12.0	84	41	0.08	4	57	12.0	85	2	0.08	4	36	15.0	85	24	0.07	45	45.2
46		23	10.0	46	.10	5	2	12.0	7	.10	40	12.0	28	.08	44	44.2				
47		29	12.0	52	.10	7	7	12.0	13	.08	45	12.0	33	.08	43	43.2				
48		34	12.0	58	.10	12	12.0	18	.10	50	15.0	38	.08	42	42.2					
49		39	12.0	85	4	.10	17	15.0	24	.08	54	15.0	43	.10	41	41.2				
50		44	12.0	10	0.10	21	12.0	29	0.10	58	12.0	49	0.08	40	40.2					
51		49	12.0	16	.10	26	12.0	35	.10	5	3	15.0	54	.08	39	39.2				
52		54	12.0	22	.10	31	15.0	41	.08	7	7	15.0	59	.10	38	38.2				
53		59	12.0	28	.10	35	12.0	46	.10	11	15.0	86	5	.08	37	37.2				
54	6	4	15.0	34	.12	40	15.0	52	.10	15	15.0	10	.10	36	36.2					
55		8	12.0	41	0.10	44	15.0	58	0.10	19	15.0	16	0.08	35	35.2					
56		13	15.0	47	.12	48	15.0	86	4	.10	23	15.0	21	.10	34	34.2				
57		17	15.0	54	.10	52	15.0	10	.12	27	15.0	27	.10	33	33.2					
58		21	15.0	86	0	.12	56	15.0	17	.10	31	20.0	33	.08	32	32.2				
59		25	15.0	7	.12	6	0	15.0	23	.10	34	15.0	38	.10	31	31.2				
60		29	15.0	14	0.12	4	20.0	29	0.12	38	20.0	44	0.10	30	30.2					
61		33	15.0	21	.12	7	15.0	36	.10	41	20.0	50	.10	29	29.2					
62		37	15.0	28	.12	11	20.0	42	.12	44	20.0	56	.10	28	28.2					
63		41	20.0	35	.12	14	20.0	49	.10	47	20.0	87	2	.10	27	27.2				
64		44	15.0	42	.12	17	20.0	55	.12	50	20.0	8	.12	26	26.2					
65		48	20.0	49	0.12	20	20.0	87	2	0.10	53	20.0	15	0.10	25	25.2				
66		51	20.0	56	.12	23	20.0	8	.12	56	20.0	21	.10	24	24.2					
67		54	20.0	87	3	.12	26	20.0	15	.12	59	30.0	27	.10	23	23.2				
68		57	20.0	10	.13	29	20.0	22	.12	6	1	20.0	33	.12	22	22.2				
69	7	0	20.0	18	.12	32	20.0	29	.12	4	20.0	40	.10	21	21.1					
70		3	20.0	25	0.13	35	30.0	36	0.12	7	30.0	46	0.12	20	20.1					
71		6	30.0	33	.12	37	30.0	43	.12	9	30.0	53	.10	19	19.1					
72		8	30.0	40	.13	39	20.0	50	.12	11	30.0	59	.12	18	18.1					
73		10	20.0	48	.12	42	30.0	57	.12	13	30.0	88	6	.10	17	17.1				
74		13	30.0	55	.13	44	30.0	88	4	.12	15	30.0	12	.12	16	16.1				
75		15	30.0	88	3	0.12	46	30.0	11	0.12	17	30.0	19	0.10	15	15.1				
76		17	30.0	10	.13	48	60.0	18	.12	19	60.0	25	.12	14	14.1					
77		19	60.0	18	.13	49	30.0	25	.12	20	30.0	32	.12	13	13.1					
78		20	30.0	26	.13	51	60.0	32	.12	22	60.0	39	.10	12	12.1					
79		22	60.0	34	.12	52	30.0	39	.13	23	60.0	45	.12	11	11.1					
80		23	60.0	41	0.13	54	60.0	47	0.12	24	60.0	52	0.12	10	10.1					
81		24	60.0	49	.13	55	60.0	54	.12	25	60.0	59	.10	9	9.1					
82		25	60.0	57	.13	56	60.0	89	1	.13	26	60.0	89	5	.12	8	8.1			
83		26	60.0	89	5	.13	57	60.0	9	.12	27	60.0	12	.12	7	7.1				
84		27	60.0	13	.13	58	—	16	.12	28	60.0	19	.12	6	6.0					
85		28	60.0	21	0.12	58	60.0	23	0.13	29	—	26	0.10	5	5.0					
86		29	—	28	.13	59	—	31	.12	29	—	32	.12	4	4.0					
87		29	60.0	36	.13	59	60.0	38	.12	29	60.0	39	.12	3	3.0					
88		30	—	44	.13	7	0	—	.13	30	—	46	.12	2	2.0					
89		30	—	52	.13	0	—	53	.12	30	—	53	.12	1	1.0					
90		30	—	90	0	0	—	90	0	30	—	90	0	0	0.0					

t	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	a
		Δ		60'		Δ		60'		Δ		60'	
	d = 82° 30'				d = 83° 0'				d = 83° 30'				



b		a = 84° 0'					a = 85° 0'					a = 86° 0'					c	a			
		B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	h	d			60' / Δ	Z	t
0	0	0	10.0	84	0	0.00	0	0	12.0	85	0	0.00	0	0	15.0	86	0	0.00	90	0	90.0
1	0	6	8.57	0	0.00	0	5	12.0	0	0.00	0	4	15.0	0	0.00	89	0	0.00	89	0	89.0
2	0	13	10.0	0	0.00	0	10	10.0	0	0.00	0	8	12.0	0	0.00	88	0	0.00	88	0	88.0
3	0	19	10.0	0	0.02	0	16	12.0	0	0.02	0	13	15.0	0	0.02	87	0	0.02	87	0	87.0
4	0	25	10.0	1	0.00	0	21	12.0	1	0.00	0	17	15.0	1	0.00	86	0	0.00	86	0	86.0
5	0	31	8.57	1	0.02	0	26	12.0	1	0.02	0	21	15.0	1	0.00	85	0	0.00	85	0	85.0
6	0	38	10.0	2	0.02	0	31	10.0	2	0.00	0	25	15.0	1	0.02	84	0	0.02	84	0	84.0
7	0	44	10.0	3	0.00	0	37	12.0	2	0.02	0	29	15.0	2	0.00	83	0	0.00	83	0	83.0
8	0	50	10.0	3	0.02	0	42	12.0	3	0.02	0	33	12.0	2	0.02	82	0	0.02	82	0	82.0
9	0	56	10.0	4	0.02	0	47	12.0	4	0.02	0	38	15.0	3	0.02	81	0	0.02	81	0	81.0
10	1	2	8.57	5	0.03	0	52	12.0	5	0.02	0	42	15.0	4	0.00	80	0	0.00	80	0	80.0
11	1	9	10.0	7	0.02	0	57	12.0	6	0.02	0	46	15.0	4	0.02	79	0	0.02	79	0	79.0
12	1	15	10.0	8	0.02	0	62	12.0	7	0.02	0	50	15.0	5	0.02	78	0	0.02	78	0	78.0
13	1	21	10.0	9	0.03	0	67	12.0	8	0.02	0	54	15.0	6	0.02	77	0	0.02	77	0	77.0
14	1	27	10.0	11	0.02	0	72	10.0	9	0.02	0	58	15.0	7	0.02	76	0	0.02	76	0	76.0
15	1	33	10.0	12	0.03	0	77	12.0	10	0.03	0	62	15.0	8	0.02	75	0	0.02	75	0	75.0
16	1	39	10.0	14	0.03	0	82	12.0	12	0.02	0	66	15.0	9	0.02	74	0	0.02	74	0	74.0
17	1	45	10.0	16	0.03	0	87	12.0	13	0.03	0	70	15.0	10	0.03	73	0	0.03	73	0	73.0
18	1	51	10.0	18	0.03	0	92	12.0	15	0.02	0	74	15.0	12	0.02	72	0	0.02	72	0	72.0
19	1	57	10.0	20	0.03	0	97	12.0	16	0.03	0	78	15.0	13	0.02	71	0	0.02	71	0	71.0
20	2	3	10.0	22	0.03	0	102	12.0	18	0.03	0	82	15.0	14	0.03	70	0	0.03	70	0	70.0
21	2	9	10.0	24	0.03	0	107	15.0	20	0.03	0	86	15.0	16	0.02	69	0	0.02	69	0	69.0
22	2	15	12.0	26	0.03	0	112	12.0	22	0.03	0	90	15.0	17	0.03	68	0	0.03	68	0	68.0
23	2	20	10.0	28	0.05	0	117	12.0	24	0.03	0	94	15.0	19	0.03	67	0	0.03	67	0	67.0
24	2	26	10.0	31	0.05	0	122	12.0	26	0.03	0	98	20.0	21	0.02	66	0	0.02	66	0	66.0
25	2	32	10.0	34	0.03	0	127	15.0	28	0.03	0	102	15.0	22	0.03	65	0	0.03	65	0	65.0
26	2	38	12.0	36	0.05	0	132	12.0	30	0.05	0	106	15.0	24	0.03	64	0	0.03	64	0	64.0
27	2	43	10.0	39	0.05	0	137	12.0	33	0.03	0	110	15.0	26	0.03	63	0	0.03	63	0	63.0
28	2	49	12.0	42	0.05	0	142	15.0	35	0.03	0	114	20.0	28	0.03	62	0	0.03	62	0	62.0
29	2	54	10.0	45	0.05	0	147	12.0	37	0.05	0	118	15.0	30	0.03	61	0	0.03	61	0	61.0
30	3	0	12.0	48	0.05	0	152	12.0	40	0.05	0	122	15.0	32	0.03	60	0	0.03	60	0	60.0
31	3	5	10.0	51	0.05	0	157	15.0	43	0.03	0	126	20.0	34	0.03	59	0	0.03	59	0	59.0
32	3	11	12.0	54	0.07	0	162	15.0	45	0.05	0	130	15.0	36	0.05	58	0	0.05	58	0	58.0
33	3	16	12.0	58	0.05	0	167	12.0	48	0.05	0	134	20.0	39	0.03	57	0	0.03	57	0	57.0
34	3	21	12.0	85	1	0.07	172	15.0	51	0.05	0	138	15.0	41	0.03	56	0	0.03	56	0	56.0
35	3	26	12.0	5	0.05	0	177	15.0	54	0.05	0	142	20.0	43	0.05	55	0	0.05	55	0	55.0
36	3	31	12.0	8	0.07	0	182	15.0	57	0.05	0	146	20.0	46	0.03	54	0	0.03	54	0	54.0
37	3	36	12.0	12	0.07	0	187	15.0	60	0.05	0	150	15.0	48	0.05	53	0	0.05	53	0	53.0
38	3	41	12.0	16	0.07	0	192	15.0	63	0.07	0	154	20.0	51	0.03	52	0	0.03	52	0	52.0
39	3	46	12.0	20	0.07	0	197	15.0	66	0.05	0	158	20.0	53	0.05	51	0	0.05	51	0	51.0
40	4	51	12.0	24	0.07	0	202	15.0	70	0.05	0	162	15.0	56	0.05	50	0	0.05	50	0	50.0
41	4	56	12.0	28	0.07	0	207	15.0	73	0.07	0	166	15.0	59	0.05	49	0	0.05	49	0	49.0
42	4	1	15.0	32	0.07	0	212	15.0	76	0.05	0	170	20.0	62	0.03	48	0	0.03	48	0	48.0
43	4	5	12.0	36	0.08	0	217	20.0	79	0.07	0	174	20.0	65	0.05	47	0	0.05	47	0	47.0
44	4	10	15.0	41	0.07	0	222	15.0	82	0.07	0	178	20.0	68	0.05	46	0	0.05	46	0	46.0
45	4	14		45			227		85			182		71		45			45		45.0

t	a = 84° 0'		a = 85° 0'		a = 86° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	

b	a = 84° 0'				a = 85° 0'				a = 86° 0'				c	a								
	B	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'			h	d	60' / Δ	Z	t	Δ / 60'	C	β
		h																				
45	4	14	12.0	85	45	0.07	3	32	15.0	86	28	0.05	2	50	20.0	87	10	0.05	45	45.1		
46		19	15.0		49	.08		36	20.0		31	.07		53	30.0		13	.05	44	44.1		
47		23	15.0		54	.08		39	15.0		35	.07		55	20.0		16	.05	43	43.1		
48		27	15.0		59	.07		43	20.0		39	.07		58	20.0		19	.05	42	42.1		
49		31	15.0	86	3	.08		46	15.0		43	.07	3	1	20.0		22	.07	41	41.1		
50		35	15.0		8	0.08		50	20.0		47	0.07		4	20.0		26	0.05	40	40.1		
51		39	15.0		13	.08		53	20.0		51	.07		7	30.0		29	.05	39	39.1		
52		43	15.0		18	.08		56	20.0		55	.07		9	20.0		32	.05	38	38.1		
53		47	15.0		23	.08		59	20.0		59	.07		12	30.0		35	.07	37	37.1		
54		51	15.0		28	.08	4	2	20.0	87	3	.08		14	20.0		39	.05	36	36.1		
55		55	20.0		33	0.08		5	20.0		8	0.07		17	30.0		42	0.07	35	35.1		
56		58	15.0		38	.08		8	20.0		12	.07		19	30.0		46	.05	34	34.1		
57	5	2	20.0		43	.10		11	20.0		16	.08		21	20.0		49	.07	33	33.1		
58		5	20.0		49	.08		14	20.0		21	.07		24	30.0		53	.05	32	32.1		
59		8	20.0		54	.10		17	20.0		25	.08		26	30.0		56	.07	31	31.1		
60		11	20.0	87	0	0.08		20	30.0		30	0.07		28	30.0	88	0	0.05	30	30.1		
61		14	20.0		5	.10		22	20.0		34	.08		30	30.0		3	.07	29	29.1		
62		17	20.0		11	.08		25	30.0		39	.08		32	30.0		7	.07	28	28.1		
63		20	20.0		16	.10		27	20.0		44	.07		34	30.0		11	.07	27	27.1		
64		23	20.0		22	.08		30	30.0		48	.08		36	30.0		15	.05	26	26.1		
65		26	20.0		27	0.10		32	30.0		53	0.08		38	60.0		18	.07	25	25.1		
66		29	30.0		33	.10		34	30.0		58	.08		39	30.0		22	.07	24	24.1		
67		31	20.0		39	.10		36	30.0	88	3	.07		41	60.0		26	.07	23	23.1		
68		34	30.0		45	.10		38	30.0		7	.08		42	30.0		30	.07	22	22.1		
69		36	30.0		51	.08		40	30.0		12	.08		44	30.0		34	.07	21	21.1		
70		38	30.0		56	0.10		42	30.0		17	0.08		46	60.0		38	0.07	20	20.1		
71		40	30.0	88	2	.10		44	60.0		22	.08		47	60.0		42	.07	19	19.1		
72		42	30.0		8	.10		45	30.0		27	.08		48	30.0		46	.07	18	18.1		
73		44	30.0		14	.10		47	30.0		32	.08		50	60.0		50	.07	17	17.1		
74		46	30.0		20	.12		49	60.0		37	.08		51	60.0		54	.07	16	16.1		
75		48	60.0		27	0.10		50	60.0		42	0.08		52	60.0		58	0.07	15	15.1		
76		49	30.0		33	.10		51	60.0		47	.08		53	60.0	89	2	.07	14	14.1		
77		51	60.0		39	.10		52	60.0		52	.08		54	60.0		6	.07	13	13.0		
78		52	60.0		45	.10		53	60.0		57	.10		55	60.0		10	.07	12	12.0		
79		53	60.0		51	.10		54	60.0	89	3	.08		56	—		14	.07	11	11.0		
80		54	60.0		57	0.10		55	60.0		8	0.08		56	60.0		18	0.07	10	10.0		
81		55	60.0	89	3	.12		56	60.0		13	.08		57	60.0		22	.08	9	9.0		
82		56	60.0		10	.10		57	60.0		18	.08		58	—		27	.07	8	8.0		
83		57	60.0		16	.10		58	—		23	.10		58	60.0		31	.07	7	7.0		
84		58	60.0		22	.12		58	60.0		29	.08		59	—		35	.07	6	6.0		
85		59	—		29	0.10		59	—		34	0.08		59	—		39	0.07	5	5.0		
86		59	60.0		35	.10		59	60.0		39	.08		59	60.0		43	.07	4	4.0		
87	6	0	—		41	.10		5	0	—	44	.10	4	0	—		47	.08	3	3.0		
88		0	—		47	.12		0	—		50	.08		0	—		52	.07	2	2.0		
89		0	—		54	.10		0	—		55	.08		0	—		56	.07	1	1.0		
90		0	—	90	0	—		0	—	90	0	—		0	—	90	0	—	0	0.0		

t	a = 84° 0'		a = 85° 0'		a = 86° 0'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 84° 0'		d = 85° 0'		d = 86° 0'		



B	a = 87° 0'		a = 88° 0'		a = 88° 50'		a = 89° 0'		a = 90° 0'		C
	h	Z	h	Z	h	Z	h	Z	h	Z	
0	0	0	0	0	0	0	0	0	0	0	0
1	3	0	2	0	1	0	1	0	0	0	0
2	6	0	4	0	2	0	2	0	0	0	0
3	9	0	6	0	4	0	4	0	0	0	0
4	13	0	8	0	5	0	5	0	0	0	0
5	16	1	10	0	6	0	5	0	0	0	0
6	19	1	13	1	7	0	6	0	0	0	0
7	22	1	15	1	9	0	7	0	0	0	0
8	25	2	17	1	10	0	8	1	0	0	0
9	28	2	19	1	11	0	9	1	0	0	0
10	31	3	21	2	12	0	10	1	0	0	0
11	34	3	23	2	13	0	11	1	0	0	0
12	37	4	25	3	15	0	13	1	0	0	0
13	40	5	27	3	16	0	14	2	0	0	0
14	44	5	29	4	17	0	15	2	0	0	0
15	47	6	31	4	18	0	16	2	0	0	0
16	50	7	33	5	19	0	17	2	0	0	0
17	53	8	35	5	21	0	18	3	0	0	0
18	56	9	37	6	22	0	19	3	0	0	0
19	59	10	39	7	23	0	20	4	0	0	0
20	I 2	11	41	7	24	0	21	4	0	0	0
21	4	12	43	8	25	0	22	4	0	0	0
22	7	13	45	9	26	0	22	4	0	0	0
23	10	14	47	10	27	0	23	5	0	0	0
24	13	16	49	10	28	0	24	5	0	0	0
25	16	17	51	11	30	0	25	6	0	0	0
26	19	18	53	12	31	0	26	6	0	0	0
27	22	20	54	13	32	0	27	7	0	0	0
28	24	21	56	14	33	0	28	7	0	0	0
29	27	23	58	15	34	0	29	8	0	0	0
30	30	24	I 0	16	35	0	30	8	0	0	0
31	33	26	2	17	36	89	31	9	0	0	0
32	35	27	4	18	37	0	32	9	0	0	0
33	38	29	5	19	38	1	33	10	0	0	0
34	41	31	7	20	39	2	34	10	0	0	0
35	43	33	9	22	40	3	34	11	0	0	0
36	46	34	11	23	41	3	35	11	0	0	0
37	48	36	12	24	42	4	36	12	0	0	0
38	51	38	14	25	43	5	37	13	0	0	0
39	53	40	16	27	44	6	38	14	0	0	0
40	56	42	17	28	45	6	39	14	0	0	0
41	58	44	19	29	46	7	39	15	0	0	0
42	2 0	46	20	31	47	8	40	15	0	0	0
43	3	48	22	32	48	9	41	16	0	0	0
44	5	50	23	34	49	10	42	17	0	0	0
45	7	53	25	35	50	11	43	18	0	0	0
t	a	b	a	b	a	b	a	b	a	b	
	d = 87° 0'		d = 88° 0'		d = 88° 50' (Polaris in 1910)		d = 89° 0'		d = 90° 0'		

When Polaris'  $t < 90^\circ$  :  $L = (b + B) - 90^\circ$ .

B	a = 87° 0'		a = 88° 0'		a = 88° 50'		a = 89° 0'		a = 90° 0'		c
	h	d Z t	h	d Z t	h	d Z t	h	d Z t	h	d Z t	
45	2	7 87 53	1 25 88 35	0 50 89 11	0 43 89 18	0 0 90 0	0 0 90 0	0 0 90 0	0 0 90 0	0 0 90 0	45
46		9 55 26	37 37 37	50 50 50	11 43 43	18 18 18	0 0 0	0 0 0	0 0 0	0 0 0	44
47		12 57 28	38 38 38	51 51 51	12 44 44	19 19 19	0 0 0	0 0 0	0 0 0	0 0 0	43
48		14 59 29	40 40 40	52 52 52	13 45 45	20 20 20	0 0 0	0 0 0	0 0 0	0 0 0	42
49		16 88 2	31 41 41	53 53 53	14 45 45	21 21 21	0 0 0	0 0 0	0 0 0	0 0 0	41
50		18 4	32 43 43	54 54 54	15 46 46	22 22 22	0 0 0	0 0 0	0 0 0	0 0 0	40
51		20 7	33 44 44	54 54 54	16 46 46	23 23 23	0 0 0	0 0 0	0 0 0	0 0 0	39
52		22 9	35 46 46	55 55 55	17 47 47	24 24 24	0 0 0	0 0 0	0 0 0	0 0 0	38
53		24 12	36 48 48	56 56 56	18 48 48	25 25 25	0 0 0	0 0 0	0 0 0	0 0 0	37
54		26 14	37 49 49	57 57 57	19 49 49	26 26 26	0 0 0	0 0 0	0 0 0	0 0 0	36
55		27 17	38 51 51	57 57 57	20 49 49	27 27 27	0 0 0	0 0 0	0 0 0	0 0 0	35
56		29 19	39 53 53	58 58 58	21 50 50	28 28 28	0 0 0	0 0 0	0 0 0	0 0 0	34
57		31 22	41 55 55	59 59 59	22 50 50	29 29 29	0 0 0	0 0 0	0 0 0	0 0 0	33
58		33 25	42 56 56	I 0 0	23 51 51	30 30 30	0 0 0	0 0 0	0 0 0	0 0 0	32
59		34 27	43 58 58	0 0 0	24 51 51	31 31 31	0 0 0	0 0 0	0 0 0	0 0 0	31
60		36 30	44 89 0	1 25 52	30 52 52	32 32 32	0 0 0	0 0 0	0 0 0	0 0 0	30
61		37 33	45 2	I 26 52	31 52 52	33 33 33	0 0 0	0 0 0	0 0 0	0 0 0	29
62		39 35	46 4	2 27 53	32 53 53	34 34 34	0 0 0	0 0 0	0 0 0	0 0 0	28
63		40 38	47 5	2 28 53	33 53 53	35 35 35	0 0 0	0 0 0	0 0 0	0 0 0	27
64		42 41	48 7	3 29 54	34 54 54	36 36 36	0 0 0	0 0 0	0 0 0	0 0 0	26
65		43 44	49 9	3 30 54	35 54 54	37 37 37	0 0 0	0 0 0	0 0 0	0 0 0	25
66		44 47	50 11	4 32 55	36 55 55	38 38 38	0 0 0	0 0 0	0 0 0	0 0 0	24
67		46 50	50 13	4 33 55	37 55 55	39 39 39	0 0 0	0 0 0	0 0 0	0 0 0	23
68		47 53	51 15	5 34 56	38 56 56	40 40 40	0 0 0	0 0 0	0 0 0	0 0 0	22
69		48 55	52 17	5 35 56	39 56 56	41 41 41	0 0 0	0 0 0	0 0 0	0 0 0	21
70		49 58	53 19	6 36 56	40 56 56	42 42 42	0 0 0	0 0 0	0 0 0	0 0 0	20
71		50 89 1	53 21	6 37 56	41 56 56	43 43 43	0 0 0	0 0 0	0 0 0	0 0 0	19
72		51 4	54 23	7 38 57	42 57 57	44 44 44	0 0 0	0 0 0	0 0 0	0 0 0	18
73		52 7	55 25	7 40 57	43 57 57	45 45 45	0 0 0	0 0 0	0 0 0	0 0 0	17
74		53 10	55 27	8 41 58	44 58 58	46 46 46	0 0 0	0 0 0	0 0 0	0 0 0	16
75		54 13	56 29	8 42 58	45 58 58	47 47 47	0 0 0	0 0 0	0 0 0	0 0 0	15
76		55 16	56 31	8 43 58	46 58 58	48 48 48	0 0 0	0 0 0	0 0 0	0 0 0	14
77		55 19	57 33	8 44 58	47 58 58	49 49 49	0 0 0	0 0 0	0 0 0	0 0 0	13
78		56 23	57 35	9 45 59	48 59 59	50 50 50	0 0 0	0 0 0	0 0 0	0 0 0	12
79		57 26	58 37	9 47 59	49 59 59	51 51 51	0 0 0	0 0 0	0 0 0	0 0 0	11
80		57 29	58 39	9 48 59	50 59 59	52 52 52	0 0 0	0 0 0	0 0 0	0 0 0	10
81		58 32	59 41	9 49 59	51 59 59	53 53 53	0 0 0	0 0 0	0 0 0	0 0 0	9
82		58 35	59 43	9 50 59	52 59 59	54 54 54	0 0 0	0 0 0	0 0 0	0 0 0	8
83		59 38	59 45	10 51 59	I 0 53	55 55 55	0 0 0	0 0 0	0 0 0	0 0 0	7
84		59 41	59 47	10 53 59	0 54 54	56 56 56	0 0 0	0 0 0	0 0 0	0 0 0	6
85		59 44	2 50 50	10 54 54	0 55 55	57 57 57	0 0 0	0 0 0	0 0 0	0 0 0	5
86		3 0 47	0 52 52	10 55 55	0 56 56	58 58 58	0 0 0	0 0 0	0 0 0	0 0 0	4
87		0 51 0	0 54 54	10 56 56	0 57 57	59 59 59	0 0 0	0 0 0	0 0 0	0 0 0	3
88		0 54 0	0 56 56	10 58 58	0 58 58	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	2
89		0 57 0	0 58 58	10 59 59	0 59 59	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	1
90		0 90 0	0 90 0	10 90 0	0 90 0	0 90 0	0 0 0	0 0 0	0 0 0	0 0 0	0
t	a	b	a	b	a	b	a	b	a	b	
	d = 87° 0'		d = 88° 0'		d = 88° 50' (Polaris in 1910)		d = 89° 0'		d = 90° 0'		

When Polaris'  $t > 90^\circ$ :  $L = (90^\circ + B) - b$ .





Change of Azimuth per Minute of Arc of Altitude.

$$\frac{\Delta_2 Z}{\Delta h} = - \tan h' \cot Z' \text{ (- always with } Z' \text{ less than } 90^\circ).$$

Z' h'	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	70°	80°	90°	Z'
0°	<i>ind.</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90°
2	∞	.40	.20	.13	.10	.07	.06	.05	.04	.03	.03	.02	.01	.01	.00	88
4	∞	.80	.40	.26	.19	.15	.12	.10	.08	.07	.06	.04	.03	.01	.00	86
6	∞	1.20	.60	.39	.29	.23	.18	.15	.13	.11	.09	.06	.04	.02	.00	84
8	∞	1.61	.80	.52	.39	.30	.24	.20	.17	.14	.12	.08	.05	.02	.00	82
10	∞	2.02	1.00	0.66	0.48	0.38	0.31	0.25	0.21	0.18	0.15	0.10	0.06	0.03	0.00	80
12	∞	2.43	1.21	.79	.58	.46	.37	.30	.25	.21	.18	.12	.08	.04	.00	78
14	∞	2.85	1.41	.93	.69	.53	.43	.36	.30	.25	.21	.14	.09	.04	.00	76
16	∞	3.28	1.63	1.07	.79	.61	.50	.41	.34	.29	.24	.17	.10	.05	.00	74
18	∞	3.71	1.84	1.21	.89	.70	.56	.46	.39	.32	.27	.19	.12	.06	.00	72
20	∞	4.16	2.06	1.36	1.00	0.78	0.63	0.52	0.43	0.36	0.31	0.21	0.13	0.06	0.00	70
22	∞	4.62	2.29	1.51	1.11	.87	.70	.58	.48	.40	.34	.23	.15	.07	.00	68
24	∞	5.09	2.53	1.66	1.22	.95	.77	.64	.53	.45	.37	.26	.16	.08	.00	66
26	∞	5.57	2.77	1.82	1.34	1.05	.84	.70	.58	.49	.41	.28	.18	.09	.00	64
28	∞	6.08	3.02	1.98	1.46	1.14	.92	.76	.63	.53	.45	.31	.19	.09	.00	62
30	∞	6.60	3.27	2.15	1.59	1.24	1.00	0.82	0.69	0.58	0.48	0.33	0.21	0.10	0.00	60
32	∞	7.14	3.54	2.33	1.72	1.34	1.08	.89	.74	.62	.52	.36	.23	.11	.00	58
34	∞	7.71	3.83	2.52	1.85	1.45	1.17	.96	.80	.67	.57	.39	.25	.12	.00	56
36	∞	8.30	4.12	2.71	2.00	1.56	1.26	1.04	.87	.73	.61	.42	.26	.13	.00	54
38	∞	8.93	4.43	2.92	2.15	1.68	1.35	1.12	.93	.78	.66	.45	.28	.14	.00	52
40	∞	9.59	4.76	3.13	2.31	1.80	1.45	1.20	1.00	0.84	0.70	0.48	0.31	0.15	0.00	50
42	∞	10.29	5.11	3.36	2.47	1.93	1.56	1.29	1.07	.90	.76	.52	.33	.16	.00	48
44	∞	11.04	5.48	3.60	2.65	2.07	1.67	1.38	1.15	.97	.81	.56	.35	.17	.00	46
46	∞	11.84	5.87	3.86	2.85	2.22	1.79	1.48	1.23	1.04	.87	.60	.38	.18	.00	44
48	∞	12.69	6.30	4.14	3.05	2.38	1.92	1.59	1.32	1.11	.93	.64	.40	.20	.00	42
50	∞	13.62	6.76	4.45	3.27	2.56	2.06	1.70	1.42	1.19	1.00	0.69	0.43	0.21	0.00	40
52	∞	14.63	7.26	4.78	3.52	2.74	2.22	1.83	1.53	1.28	1.07	.74	.47	.23	.00	38
54	∞	15.73	7.81	5.14	3.78	2.95	2.38	1.97	1.64	1.38	1.15	.80	.50	.24	.00	36
56	∞	16.95	8.41	5.53	4.07	3.18	2.57	2.12	1.77	1.48	1.24	.86	.54	.26	.00	34
58	∞	18.29	9.08	5.97	4.40	3.43	2.77	2.29	1.91	1.60	1.34	.92	.58	.28	.00	32
60	∞	19.80	9.82	6.46	4.76	3.71	3.00	2.47	2.06	1.73	1.45	1.00	0.63	0.31	0.00	30
62	∞	21.50	10.67	7.02	5.17	4.03	3.26	2.69	2.24	1.88	1.58	1.09	.68	.33	.00	28
64	∞	23.44	11.63	7.65	5.63	4.40	3.55	2.93	2.44	2.05	1.72	1.19	.75	.36	.00	26
66	∞	25.67	12.74	8.38	6.17	4.82	3.89	3.21	2.68	2.25	1.88	1.30	.82	.40	.00	24
68	∞	28.29	14.04	9.24	6.80	5.31	4.29	3.53	2.95	2.48	2.08	1.43	.90	.44	.00	22
70	∞	31.40	15.58	10.25	7.55	5.89	4.76	3.92	3.27	2.75	2.31	1.59	1.00	0.48	0.00	20
72	∞	35.18	17.45	11.49	8.46	6.60	5.33	4.40	3.67	3.08	2.58	1.78	1.12	.54	.00	18
74	∞	39.86	19.78	13.01	9.58	7.48	6.04	4.98	4.16	3.49	2.93	2.01	1.27	.61	.00	16
76	∞	45.84	22.75	14.97	11.02	8.60	6.95	5.73	4.78	4.01	3.37	2.32	1.46	.71	.00	14
78	∞	53.77	26.68	17.56	12.93	10.09	8.15	6.72	5.61	4.70	3.95	2.72	1.71	.83	.00	12
80	∞	64.82	32.16	21.17	15.58	12.16	9.82	8.10	6.76	5.67	4.76	3.27	2.06	1.00	0.00	10
82	∞	86.68	40.35	26.56	19.55	15.26	12.32	10.16	8.48	7.12	5.97	4.11	2.59	1.25	.00	8
84	∞	—	53.96	35.51	26.14	20.40	16.48	13.59	11.34	9.51	7.98	5.49	3.46	1.68	.00	6
86	∞	—	81.10	53.37	39.29	30.67	24.77	20.42	17.04	14.30	12.00	8.26	5.21	2.52	.00	4
88	∞	—	—	—	78.68	61.41	49.60	40.90	34.13	28.64	24.03	16.53	10.42	5.05	.00	2
90	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	<i>ind.</i>	0
h'	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	30°	20°	10°	0°	Z'



For converting Arc into Time, and the reverse.

°	H. M.	°	H. M.	°	H. M.	°	H. M.	°	H. M.	°	H. M.
'	M. S.	'	M. S.	'	M. S.	'	M. S.	'	M. S.	'	M. S.
"	S. $\frac{1}{2}$	"	S. $\frac{1}{2}$	"	S. $\frac{1}{2}$	"	S. $\frac{1}{2}$	"	S. $\frac{1}{2}$	"	S. $\frac{1}{2}$
1	0 4	61	4 4	121	8 4	181	12 4	241	16 4	301	20 4
2	0 8	62	4 8	122	8 8	182	12 8	242	16 8	302	20 8
3	0 12	63	4 12	123	8 12	183	12 12	243	16 12	303	20 12
4	0 16	64	4 16	124	8 16	184	12 16	244	16 16	304	20 16
5	0 20	65	4 20	125	8 20	185	12 20	245	16 20	305	20 20
6	0 24	66	4 24	126	8 24	186	12 24	246	16 24	306	20 24
7	0 28	67	4 28	127	8 28	187	12 28	247	16 28	307	20 28
8	0 32	68	4 32	128	8 32	188	12 32	248	16 32	308	20 32
9	0 36	69	4 36	129	8 36	189	12 36	249	16 36	309	20 36
10	0 40	70	4 40	130	8 40	190	12 40	250	16 40	310	20 40
11	0 44	71	4 44	131	8 44	191	12 44	251	16 44	311	20 44
12	0 48	72	4 48	132	8 48	192	12 48	252	16 48	312	20 48
13	0 52	73	4 52	133	8 52	193	12 52	253	16 52	313	20 52
14	0 56	74	4 56	134	8 56	194	12 56	254	16 56	314	20 56
15	1 0	75	5 0	135	9 0	195	13 0	255	17 0	315	21 0
16	1 4	76	5 4	136	9 4	196	13 4	256	17 4	316	21 4
17	1 8	77	5 8	137	9 8	197	13 8	257	17 8	317	21 8
18	1 12	78	5 12	138	9 12	198	13 12	258	17 12	318	21 12
19	1 16	79	5 16	139	9 16	199	13 16	259	17 16	319	21 16
20	1 20	80	5 20	140	9 20	200	13 20	260	17 20	320	21 20
21	1 24	81	5 24	141	9 24	201	13 24	261	17 24	321	21 24
22	1 28	82	5 28	142	9 28	202	13 28	262	17 28	322	21 28
23	1 32	83	5 32	143	9 32	203	13 32	263	17 32	323	21 32
24	1 36	84	5 36	144	9 36	204	13 36	264	17 36	324	21 36
25	1 40	85	5 40	145	9 40	205	13 40	265	17 40	325	21 40
26	1 44	86	5 44	146	9 44	206	13 44	266	17 44	326	21 44
27	1 48	87	5 48	147	9 48	207	13 48	267	17 48	327	21 48
28	1 52	88	5 52	148	9 52	208	13 52	268	17 52	328	21 52
29	1 56	89	5 56	149	9 56	209	13 56	269	17 56	329	21 56
30	2 0	90	6 0	150	10 0	210	14 0	270	18 0	330	22 0
31	2 4	91	6 4	151	10 4	211	14 4	271	18 4	331	22 4
32	2 8	92	6 8	152	10 8	212	14 8	272	18 8	332	22 8
33	2 12	93	6 12	153	10 12	213	14 12	273	18 12	333	22 12
34	2 16	94	6 16	154	10 16	214	14 16	274	18 16	334	22 16
35	2 20	95	6 20	155	10 20	215	14 20	275	18 20	335	22 20
36	2 24	96	6 24	156	10 24	216	14 24	276	18 24	336	22 24
37	2 28	97	6 28	157	10 28	217	14 28	277	18 28	337	22 28
38	2 32	98	6 32	158	10 32	218	14 32	278	18 32	338	22 32
39	2 36	99	6 36	159	10 36	219	14 36	279	18 36	339	22 36
40	2 40	100	6 40	160	10 40	220	14 40	280	18 40	340	22 40
41	2 44	101	6 44	161	10 44	221	14 44	281	18 44	341	22 44
42	2 48	102	6 48	162	10 48	222	14 48	282	18 48	342	22 48
43	2 52	103	6 52	163	10 52	223	14 52	283	18 52	343	22 52
44	2 56	104	6 56	164	10 56	224	14 56	284	18 56	344	22 56
45	3 0	105	7 0	165	11 0	225	15 0	285	19 0	345	23 0
46	3 4	106	7 4	166	11 4	226	15 4	286	19 4	346	23 4
47	3 8	107	7 8	167	11 8	227	15 8	287	19 8	347	23 8
48	3 12	108	7 12	168	11 12	228	15 12	288	19 12	348	23 12
49	3 16	109	7 16	169	11 16	229	15 16	289	19 16	349	23 16
50	3 20	110	7 20	170	11 20	230	15 20	290	19 20	350	23 20
51	3 24	111	7 24	171	11 24	231	15 24	291	19 24	351	23 24
52	3 28	112	7 28	172	11 28	232	15 28	292	19 28	352	23 28
53	3 32	113	7 32	173	11 32	233	15 32	293	19 32	353	23 32
54	3 36	114	7 36	174	11 36	234	15 36	294	19 36	354	23 36
55	3 40	115	7 40	175	11 40	235	15 40	295	19 40	355	23 40
56	3 44	116	7 44	176	11 44	236	15 44	296	19 44	356	23 44
57	3 48	117	7 48	177	11 48	237	15 48	297	19 48	357	23 48
58	3 52	118	7 52	178	11 52	238	15 52	298	19 52	358	23 52
59	3 56	119	7 56	179	11 56	239	15 56	299	19 56	359	23 56
60	4 0	120	8 0	180	12 0	240	16 0	300	20 0	360	24 0

NOTE.—When turning seconds of arc into time, and vice versa, it should be remembered that the fractions are sixtieths; thus, the value in time of 42" is not 2.48 seconds, but  $2\frac{1}{2}$  seconds=2.8.













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