

Dutton's Navigation and Piloting

TWELFTH EDITION BY

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The Complete Celestial Solution Using H.O.229

Chapter 27 dealt at length with sight reduction, using H.O. 214 and the *Nautical Almanac*. This appendix covers sight reduction using H.O. 229, *Sight Reduction Tables for Marine Navigation*, again with the *Nautical Almanac*. The H.O. 229 was described in article 2505.

Introduction.

Before proceeding, the student may find it desirable to review articles 2702 and 2703, which discuss the combined coordinate systems and the efficient use of the *Nautical Almanac*.

The arrangement of this appendix differs slightly from that of Chapter 27 in that the reduced celestial observations represent a single day's work for a navigator, and the resulting lines of position are plotted (see page 693). The hypothetical ship is a fleet tug, accompanying a damaged freighter; she is on C 288°.5, S 6.75 K. At 0400 (+1), on 1 August 1972, the tug's DR position is Lat. 41°02'.8 N, Long. 14°38'.0 W.

When observing a planet, the navigator measures the sextant altitude of the center of the body and records the time and date of the observation. He also checks the index error of the instrument.

Complete solution for a planet observation.

He then converts the time to GMT and Greenwich date, and enters the appropriate daily pages of the *Nautical Almanac* to obtain the GHA and declination at the whole hours of GMT, and the v and d' values for the period, noting the sign of the d' value by inspection. The v is always plus except for Venus when it can be either plus or minus. Turning to the appropriate "Increments and Corrections Table," he obtains the increments of GHA for minutes and seconds, and the corrections to GHA and declination for the v and d' values, respectively. Applying these values to those obtained from the daily pages, he obtains the GHA and Dec. of the planet at the time of observation.

The extract from the Nautical Almanac used in this Appendix starts on page 696.

With the *Nautical Almanac* still open, the navigator notes the value of IC (as determined from the sextant), extracts the D and R (plus the "add'l" for Venus and Mars) corrections from the appropriate sections of the almanac, and combines them with h_s to obtain h_a and H_o .

The navigator then selects the AP, based on the best estimate of his position, and uses the aL to determine LHA in whole degrees.

Entering H.O. 229 with integral degrees of LHA, aL , and Dec., he obtains the tabulated altitude for the value of the entering arguments, d , and its sign, and Z. Z is corrected by visual interpolation for the actual value of the declination.

The extract from H.O. 229 begins on page 703.

The correction to the tabulated altitude for Dec. Inc. and d is then taken from a multiplication table inside the cover of H. O. 229 and is applied to h_t , as is the double second difference correction if d is printed in italic type, to obtain H_c .

H_c is then compared with H_o to determine (a). By converting Z to Z_n , the navigator can use Z_n and (a) to plot the LOP from the AP.

Example: On 1 August 1972 the 0447 DR position of the ship is Lat. $41^{\circ}04'.5$ N, Long. $14^{\circ}44'.6$ W. At 04-47-13 ZT the planet Venus is observed from a height of eye of 21 feet, with a sextant having an IC of (+) $0'.2$. The sextant altitude is $31^{\circ}13'.2$.

Required: The (a), Z_n , and AP, using H. O. 229 and the *Nautical Almanac*.

Answer: (Solution shown in column 1, page 689.)

a Away $23'.6$
 Z_n $092'.2$
 aL $41^{\circ}00'.0$ N
 $a\lambda$ $14^{\circ}15'.7$ W

*Complete solution
for a moon
observation.*

When observing the moon, the navigator measures the sextant altitude of either the upper or lower limb of the body, and records the time and date of the observation. He also checks the index error of the instrument.

He then converts the time to GMT and Greenwich date, and enters the appropriate daily pages of the *Nautical Almanac* to obtain the GHA, v value, which for the moon is always (+), declination, d value (noting the sign of the d value by inspection), and HP for the nearest whole hour of GMT. Turning to the appropriate "Increments and Corrections Table," he obtains the increments of GHA for minutes and seconds, and the corrections to GHA and declination for the v and d values, respectively. Applying these values to those obtained from the daily pages, he obtains the GHA and Dec. of the moon at the time of the observation.

With the *Nautical Almanac* still open, the navigator notes the value of IC (as determined from the sextant), and extracts the D correction and the corrections for altitude and HP from the "Altitude Correction Tables—Moon." The latter two corrections are always additive, but if the upper limb is observed, an additional correction of (-) $30'$ is made. These corrections are combined with h_s to obtain h_a and H_o .

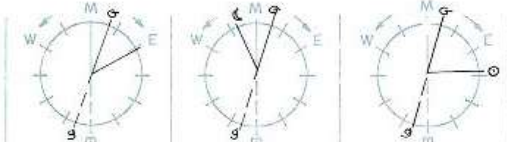
The navigator then selects the AP, based on the best estimate of his position, and uses the $a\lambda$ to determine LHA in whole degrees.

Entering H. O. 229 with integral degrees of LHA, aL and Dec., he obtains the tabulated altitude for the value of the entering arguments, d and its sign, and Z . Z is corrected by visual interpolation for the actual value of the declination. The correction to the tabulated altitude for Dec. Inc. and d is then taken from a multiplication table inside the cover of H. O. 229 and applied to h_t , as is the double second difference correction if d is printed in *italic* type, to obtain H_c .

H_c is then compared with H_o to determine (a). By converting Z to Z_n , the navigator can then use Z_n and (a) to plot the LOP from the AP.

Example: On 1 August 1972, the 0611 DR position of the ship is Lat. $41^{\circ}07'.5$ N, Long. $14^{\circ}56'.3$ W. At 06-11-03 ZT the lower limb of the moon is observed from

Sight Reduction
using H.O. 229
Cus:
Spd:



Body	VENUS	☾	☉
IC	* 0.2	* 0.2	* 0.2
Dip (HT 21')	4.4	4.4	4.4
Sum	-4.2	-4.2	-4.2
hs	31° 13.2	57° 06.5	12° 38.2
ha	31° 09.1	57° 02.3	12° 34.0
Alt. Corr	1.6	41.4	0.1 4.3
Add'l.	0.3		15.8 ∞
H. P. (59.1)		6.1	0.5 78
Corr. to ha	-1.3	+47.5	+12.1
Hc (Obs. Alt)	31° 07.7	57° 49.8	12° 46.1
Date	1 AUG 72	1 AUG 72	1 AUG 72
DR Lat	41° 04.5 N	41° 07.5 N	41° 07.5 N
DR Long	14° 44.6 W	14° 56.3 W	14° 56.3 W
Obs. Time			
WE (S+, F-)			
ZT	04 47 13	06 11 03	06 11 56
ZD (W+, E-)	+1	+1	+1
GMT	05 47 13	07 11 03	07 11 56
Date (GMT)	1 AUG 72	1 AUG 72	1 AUG 72
Tab GHA V	298 26.8 07	33 31.5 96	283 26.2
GHA incr/mr.	11 48.3	2 38.2	2 59.0
SHA or V Corr.	0.6	1.8	
GHA	310° 15.7	36° 11.5	286 25.2
± 360 if needed			
αλ (-W, +E)	14° 15.7 W	15° 11.5 W	15° 25.2 W
LHA	296°	21°	271°
Tab Dec d	N 18° 35.9 10.2	N 14° 41.4 +13.1	N 17° 58.8 -0.6
d Corr (+ or -)	+ 0.2	+ 2.5	- 0.1
True Dec	N 18° 36.1	N 14° 43.6	N 17° 58.7
α Lat (N or S)	N 41 (Comp) Cont.	N 41 (Comp) Cont.	N 41 (Comp) Cont.
Dec inc (±) d	36.1 436.4	43.6 451.6	58.7 438.1
Hc (Obs. Alt.)	31° 09.4	57° 23.5	11° 47.7
tens DS Diff.	18.0	36.3	29.4
units DS Corr	3.9 +	1.2 +	7.9 +
Tot. Corr. (+ or -)	+ 21.9	+ 37.5	37.3
Hc (Comp. Alt.)	31° 31.3	58° 01.0	12° 25.0
Ha (Obs. Alt.)	31° 07.7	57° 49.8	12° 46.1
a (Intercept)	23.6	11.2	21.1
Z	92.2	139.1	76.8
Zn (°T)	092.2	220.9	076.8

H.O. 229
worksheet.

a height of eye of 21 feet with a sextant having an IC of (+) 0'.2. The sextant altitude is 57°06'.5.

Required: The (*a*), Zn, and AP, using H. O. 229 and the *Nautical Almanac*.

Answer: (Solution shown in column 2, page 689.)

a Away 11'.2
Zn 220°.9
*a*L 41°00'.0 N
*a*λ 15°11'.5 W.

*Complete solution
for a sun
observation.*

When observing the sun, the navigator measures the sextant altitude of either the upper or lower limb of the body, and records the time and date of the observation. He also records the index error of the sextant.

He then converts the time to GMT and Greenwich date, and enters the appropriate daily pages of the *Nautical Almanac* to obtain the GHA and declination at the whole hours of GMT, and the *d* value for the period (noting the sign of the *d* value by inspection). If maximum accuracy were desired, he would also note the SD of the sun from the daily pages. The values of *l* and IC, with their appropriate signs, would be entered in the form, as would the correction for *D*, obtained from the *Nautical Almanac*. These would be combined with *hs* to obtain *ha*.

Ordinarily, the *ha* is corrected by means of the sun altitude correction tables inside the front cover of the *Nautical Almanac*, which include corrections for an average value of semi-diameter, refraction, and parallax. Alternatively, the value of the semi-diameter found at the bottom of the sun column in the daily pages of the *Nautical Almanac* may be used together with the value of the refraction correction found under the heading "Stars and Planets," and an additional correction of (+)0'.1 for parallax to be used for altitudes of 65° and less.

Having entered the GHA and declination for the whole hours of GMT, the navigator now turns to the appropriate page of the "Increments and Corrections table," and obtains the increments of GHA for minutes and seconds and the correction to the declination for the *d* value. Applying these values to those obtained from the daily pages, he obtains the GHA and Dec. of the sun at the time of the observation.

With the *Nautical Almanac* still open, the navigator notes the value of IC (as determined from the sextant) and extracts the appropriate value of *D*. These are combined with *hs* to obtain *ha*. The appropriate correction for ☉, or ☿, taken from the Sun Table, is then applied to *ha* to obtain *Ho*.

The navigator then selects the AP, based on the best estimate of his position, and uses the *a*λ to determine LHA in whole degrees.

Entering H. O. 229 with integral degrees of LHA, *a*L, and Dec., he obtains the tabulated altitude for the value of the entering arguments, *d* and its sign, and *Z*. *Z* is corrected by visual interpolation for the actual value of the declination. The correction to the tabulated altitude for Dec. Inc. and *d* is then taken from a multiplication table inside the cover of H. O. 229 and is applied to *ht*, as is the double second difference correction if *d* is printed in *italic* type, to obtain *Hc*.

Hc is then compared with *Ho* to determine (*a*). By converting *Z* to Zn, the navigator can use Zn and (*a*) to plot the LOP from the AP.

Example: On 1 August 1972, the 0611 DR position of the ship is Lat. $41^{\circ}07'.5$ N, Long. $14^{\circ}56'.3$ W. At 06-11-56 ZT the lower limb of the sun is observed from a height of eye of 21 feet with a sextant having an IC of (+) $0'.2$. The sextant altitude is $12^{\circ}38'.2$. The dry bulb temperature is 88° F, and the barometer reads 29.76 inches.

Because of the sun's comparatively low altitude, the individual corrections for refraction, semi-diameter and parallax, as well as the additional correction for nonstandard temperature and barometric pressure are to be applied to h_s in this instance.

Required: The (a), Zn, and AP, using H. O. 229 and the *Nautical Almanac*.

Answer: (Solution shown in column 3, page 689.)

a T 21'.1
Zn 076°.8
 aL $41^{\circ}00'.0$ N
 $a\lambda$ $15^{\circ}25'.2$ W

When observing a star, the navigator measures the sextant altitude of the body and records the time and date of the observation. He also checks the index error of the instrument.

Complete solution for a star observation.

He then converts the time to GMT and Greenwich date, and enters the appropriate daily pages of the *Nautical Almanac* to obtain the GHA of Aries at the whole hours of GMT, and the SHA and declination of the star for that period. Turning to the appropriate "Increments and Corrections" table, he obtains the increments of GHA of Aries for minutes and seconds. Adding this value to the GHA of Aries and SHA of the star obtained from the daily pages, he obtains the star's GHA at the time of the observation. The Dec. is the value tabulated on the daily page.

With the *Nautical Almanac* still open, the navigator notes the value of IC (as determined from the sextant), extracts the D and R corrections from the appropriate sections of the almanac, and applies them to h_s to obtain h_a and H_o .

The navigator then selects the AP, based on the best estimate of his position, and uses the $a\lambda$ to determine LHA in whole degrees.

Entering H. O. 229 with integral degrees of LHA, aL , and Dec., he obtains the tabulated altitude for the value of the entering argument, d and its sign, and Z. The correction to tabulated altitude for d and Dec. Inc. is then taken from the multiplication table in H. O. 229, and applied to h_t , as is the double second difference correction if d is printed in *italic* type, to obtain H_c . He corrects Z by visual interpolation for the actual value of the declination.

H_c is then compared with H_o to determine (a). By converting Z to Zn, the navigator can then use Zn and (a) to plot the LOP from the AP.

Two star observations are included in the following examples. The Vega reduction (Example 2) requires a double second difference correction, while Antares' declination is of contrary name to the observer's latitude.

In the Antares reduction (Example 1), note that the value of d as found in the tables is (-) $60'.0$; this being the case, the full value of Dec. Diff. is applied to h_t to obtain H_c .

Sight Reduction
using H.O. 229

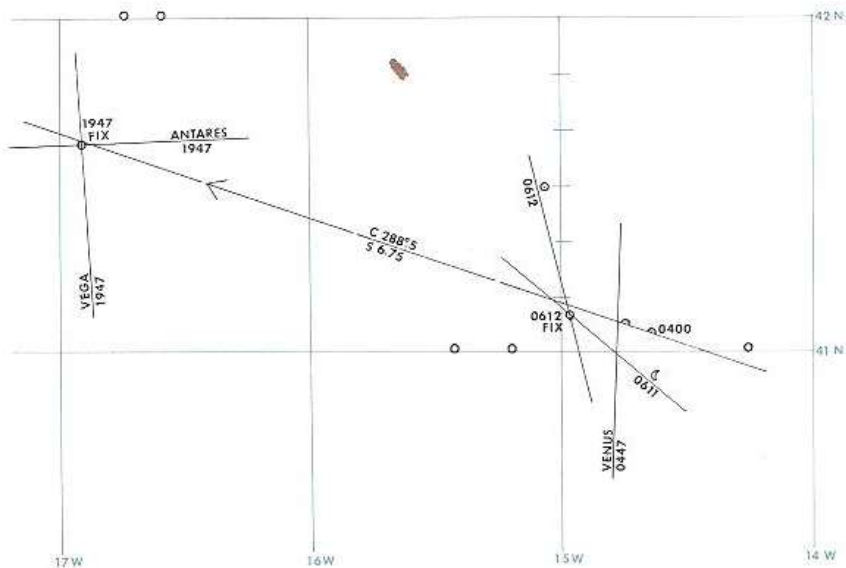
Cus:

Spd:



Body	ANTARES	VEGA	
GC	02	02	
Dip (Ht 21')	4.4	4.4	
Sum	-4.2	-4.2	
hs	22° 06'.5	64° 44'.5	
ha	22° 02'.3	64° 40'.3	
Alt. Corr	2.4	0.5	
Ado'l.			
H. P. ()			
Corr. to ha	-2.4	-0.5	
Ho (Obs. Alt)	21° 59'.9	64° 39'.8	
Date	1 AUG 72	1 AUG 72	
DR Lat	41° 36'.7 N	41° 36'.7 N	
DR Long	16° 52'.8 W	16° 52'.8 W	
Obs. Time			
WE (S+, F-)			
ZT	19 47 56	19 48 50	
ZD (W+, E-)	+1	+1	
GMT	20 47 56	20 48 50	
Date (GMT)	1 AUG 72	1 AUG 72	
Tab GHA V	250° 31'.2	250° 31'.2	
GHA inc' mt.	12 01.0	12 14.5	
SHA or V Corr.	113 03.7	80 59.3	
GHA	375° 35'.9	343° 45'.0	
± 360 if needed	15° 35'.9		
oλ (-W, +E)	W 16° 35'.9	W 16° 45'.0	
LHA	359	327	
Tab Dec d			
d Corr (f or -)			
True Dec	S 26° 22'.5	N 38° 45'.6	
a Lar (N or S)	N 42° Same	N 42° Same Cont.	Same Cont.
Dec inc (±) d	22.5 -60	45.6 +19.1	
Hc (Tab. Alt.)	21° 59'.6	64° 34'.0	
tens DS Diff		7.6 4	
units DS Corr		6.9 +0.2	+
Tot. Corr. (f or -)	-22.5	+14.7	
Hc (Comp. Alt.)	21° 37'.1	64° 48'.7	
Ho (Obs. Alt.)	21° 59'.9	64° 39'.8	
a (Intercept)	22.8	8.9	
Z	N 179	E N 86.3 E	
Zn (°T)	179°	086°3	

H.O. 229
worksheet.



Example 1: On 1 August 1972, the 1947 DR position of the ship is Lat. $41^{\circ}36'.7$ N, Long. $16^{\circ}52'.8$ W. At 19-47-56 the star Antares is observed from a height of eye of 21 feet with a sextant having an IC of (+) $0'.2$. The sextant altitude is $22^{\circ}06'.5$. *LOP plotting sheet.*

Required: The (*a*), Zn, and AP, using H. O. 229, and the *Nautical Almanac*.

Answer: (Solution shown in column 1, page 692.)

- a* Towards $22'.8$
- Zn $179^{\circ}.0$
- a*L $42^{\circ}00'.0$ N
- a*λ $16^{\circ}35'.9$ W

Example 2: On 1 August 1972 the 1948 DR position of the ship is Lat. $41^{\circ}36'.7$ N, Long. $16^{\circ}52'.8$ W. At 19-48-50 ZT the star Vega is observed from a height of eye of 21 feet with a sextant having an IC of (+) $0'.2$. The sextant altitude is $64^{\circ}44'.5$.

Required: The (*a*), Zn, and AP, using H. O. 229, and the *Nautical Almanac*.

Answer: (Solution shown in column 2, page 692.)

- a* Away $8'.9$
- Zn $086^{\circ}.3$
- a*L $42^{\circ}00'.0$ N
- a*λ $16^{\circ}45'.0$ W

The need for regular determination of compass error, and methods of making azimuth observations at sea are described in detail in articles 2901 and 2902. The method of calculating the azimuth by means of H. O. 229 is discussed next.

Exact azimuth
H. O. 229.

H. O. 229 makes an excellent azimuth table. When H. O. 229 is used to determine true azimuth for the purpose of checking the compass, triple linear interpolation usually must be made in order to obtain the required accuracy. The "d" values in H. O. 229 apply only to *altitude*, and should not be used when interpolating for azimuth.

Example: The azimuth of the sun is observed at 06-11-56 ZT on 1 August 1972. The 0612 DR position is Lat. 41°07'.5 N, Long. 14°56'.3 W. The azimuth obtained using a gyro repeater is 077°.5.

Required: Gyro error, using H. O. 229 to obtain true azimuth.

Solution: It is first necessary to determine the exact values of LHA, Dec., and L for the instant of observation of the azimuth. These values are determined as for working a sight, except that the *actual* position of the ship is used rather than an assumed position. Thus the DR longitude, 14°56'.3 W, is used to determine the exact value of LHA at the time of observation. The exact value of Dec. is found to be N 17°58'.7 by consulting the *Nautical Almanac* in the usual manner. The DR latitude is taken as the exact value of L at the time of observation.

With the exact values of LHA, Dec., and L determined, enter the appropriate section of H. O. 229, with the "tab." values, those tabulated entering arguments *nearest* to the exact values. In this case they are LHA 271°, Dec. N 18°, and L 41° N. With these "tab." values as entering arguments, enter the proper section (the "same name" section in this case), and extract and record the tabulated

H.O. 229 Azimuth worksheet.

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EXACT AZIMUTH USING H.O. 229

Body ☉
 DR L 41° 07'.5 N
 DR λ 14° 56'.3 W
 Date (L) 1 AUG. 72
 ZT 06 11 56
 ZD (+ or -) +1
 GMT 07 11 56
 Date (G) 1 AUG 72
 Tab GHA 283° 26'.2
 Inc/Cor 2° 59'.0
 GHA 286° 25'.2
 DR λ 14° 56'.3
 LHA 271° 28'.9
 Tab Dec N 17° 58'.8
 Inc/Cor - 0'.1
 Dec N 17° 58'.7

	EXACT		Z DIFF (+ or -)	CORR (+ or -)
	Deg	Min		
LAT	41	07.5	+0.3	0
LHA	271	28.9	+0.7	+0.3
DEC	17	58.7	+0.8	0
Total (+)				+0.3
Tab Z				76.8
Exact Z				N 77° 1'E
Exact Zn				077.1
Gyro/Compass True				077.5
Gyro/Compass Error				W 0.4

NORTH LAT
 LHA greater than 180° Zn - L
 LHA less than 180° Zn + 360 - L

SOUTH LAT
 LHA greater than 180° Zn - 180 - L
 LHA less than 180° Zn - 180 + L

azimuth angle, $Z 76^{\circ}.8$. This value of Z is the *tabulated* ("tab.") value, to which the corrections resulting from the necessary interpolation are applied to obtain the azimuth angle for the exact values of LHA, Dec., and L at the moment of observation. Interpolation is made separately for the difference between each of the exact values and the corresponding "tab." values of LHA, Dec., and L ; and the algebraic sum of the resulting corrections is applied to the value of tab. Z to obtain the exact azimuth angle at the moment of observation. It is normally considered sufficiently accurate to reduce these corrections to the nearest tenth of a degree.

The LHA is interpolated from 271° ($Z 76^{\circ}.8$) to 272° ($Z 77^{\circ}.5$), indicating a change of $(+) 0^{\circ}.7$ for a change of 1° ($60'$) in the entering value of LHA known as the "LHA diff." Since the exact value of LHA is $271^{\circ}28'.9$, which is $28'.9$ more than the "tab." value of LHA, the difference in the value of Z corresponding to this variation in LHA is $28'.9/60'$ of the change for a 1° change in LHA. Thus, "LHA corr.", which is the correction to apply to the value of tab. Z for the variation of the exact value of LHA from the value of tab. LHA is equal to $(+) 0^{\circ}.7 \times 28'.9/60'$ which equals $(+) 0^{\circ}.3$.

The Dec. is interpolated from 18° ($Z 76^{\circ}.8$) to 17° ($Z 77^{\circ}.6$), indicating a change of $(-) 0^{\circ}.8$ for a change of $60'$ in the entering value of Dec. This is known as the "Dec. diff." Since the exact value of Dec. is $17^{\circ}58'.7$ and is $1'.3$ less than the "tab." value of Dec., the difference in the value of Z corresponding to this variation in Dec. is only $1'.3/60'$ of the change for $60'$ change in Dec. Thus the "Dec. corr." which is the correction to apply to the value of tab. Z for the variation of the exact value of Dec. from the value of tab. Dec., is equal to $(-) 0^{\circ}.8 \times 1'.3/60'$, which, to the nearest tenth of a degree, equals $0^{\circ}.0$.

The L is interpolated from 41° ($Z 76^{\circ}.8$) to 42° ($Z 77^{\circ}.1$), indicating change of $(+) 0^{\circ}.3$ in Z for a change of 1° ($60'$) in the entering value of L . This is known as the "L diff." Since the exact value of L ($41^{\circ}07'.5$) is $7'.5$ greater than the "tab." value of L (41°), the difference in the value of Z corresponding to this change in L is only $7'.5/60'$ of the difference for a 1° change in L . Thus, "L corr.", which is the correction to apply to the value of Tab. Z for the variation of the exact value of L from the value of Tab. L , is equal to $(+) 0^{\circ}.3 \times 7'.5/60'$, which equals $(+) 0^{\circ}.0$.

By applying the algebraic sum of the LHA, Dec., and L corrections, as determined above, to the tab. Z , the value of the exact azimuth angle at the moment of observation is found to be $N 77^{\circ}.1 E$, which converts to a Z_n of $077^{\circ}.1$. The gyro error is determined by comparing this exact azimuth with that obtained by observation, $077^{\circ}.5$.

Answer: Gyro error $0^{\circ}.4 W$

In solving problems for exact azimuth using H. O. 229, the multiplication of the fractional amount by the amount of the "diff." to obtain the appropriate correction can be accomplished most readily by establishing a proportion with dividers on a log scale of speed or distance, such as is found on some charts and on Maneuvering Board paper, and is discussed briefly in article 1304. In establishing the fractions involved, it is well to remember that the denominator of the fractional part of LHA, Dec., and L is always $60'$, since the tabulated entering arguments of LHA, Dec., and L are always 1° apart.

1972 AUGUST 1, 2, 3 (TUES., WED., THURS.)

GRY.	ARIES		VENUS -40		MARS -30		JUPITER -20		SATURN -10		STARS		
	GHA.	Decl.	GHA.	Decl.	GHA.	Decl.	GHA.	Decl.	GHA.	Decl.	Names	SHA.	Decl.
00	509 41.4	232 23.0	118 35.1	155 50.0	118 37.1	40 21.0	523 20.4	233 21.0	121 10.0		Acuvur	319 42.6	5 42 23.4
01	524 44.4	238 23.7	152	150 50.2	33.0	32 20.9	20.6	200 23.5	10.7		Antamar	325 49.1	5 42 32.1
02	539 47.4	243 24.5	154	135 51.0	25.5	20 20.6	20.6	163 25.5	15.4		Acrux	173 45.3	5 42 57.3
03	554 50.4	248 25.3	155	120 51.7	18.0	18 20.2	17.4	127 27.7	19.9		Adhara	250 34.9	5 43 15.9
04	5 52.0	253 26.0	157	105 52.4	10.5	16 20.0	17.0	91 29.9	23.4		Aldabara	291 24.7	5 43 25.4
05	24 54.1	258 26.8	159	90 53.1	3.0	14 19.7	16.0	55 32.9	26.9				
06	39 56.0	263 27.5	162	75 53.8	15.0	12 19.4	15.0	20 35.9	30.4		Aluka	166 47.5	5 43 35.4
07	54 57.9	268 28.3	164	60 54.5	27.0	10 19.1	14.0	5 38.9	33.9		Akkab	155 29.8	5 43 45.4
08	70 59.7	273 29.1	166	45 55.2	39.0	8 18.8	13.0	33 41.9	37.9		Al Na'ir	76 21.5	5 43 55.4
09	85 54.1	278 29.9	168	30 55.9	51.0	6 18.5	12.0	18 44.9	41.9		Alsham	222 27.5	5 44 5.4
10	100 50.0	283 30.7	170	15 56.6	63.0	4 18.2	11.0	3 47.9	45.9		Alsham	222 27.5	5 44 5.4
11	115 49.0	288 31.5	172	0 57.3	75.0	2 17.9	10.0	30 49.5	49.5				
12	130 51.4	293 32.3	174	15 58.0	87.0	0 17.6	9.0	33 52.5	53.5		Alsham	179 30.6	5 44 53.6
13	145 54.0	298 33.1	176	30 58.7	99.0	32 53.2	52.0	69 55.5	57.5		Alsham	358 15.1	5 44 56.4
14	160 56.6	303 33.9	178	45 59.4	111.0	66 59.7	60.0	105 59.5	61.5		Alsham	62 37.0	5 44 59.2
15	175 59.2	308 34.7	180	60 60.1	123.0	100 63.9	63.0	141 63.5	65.5		Alsham	322 45.5	5 45 2.4
16	190 61.8	313 35.5	182	75 60.8	135.0	176 67.9	67.0	177 67.5	69.5		Alsham	113 63.7	5 45 25.2
17	205 64.4	318 36.3	184	90 61.5	147.0	211 71.9	71.0	213 71.5	73.5				
18	220 67.0	323 37.1	186	105 62.2	159.0	246 75.9	75.0	249 75.5	77.5		Alsham	186 23.4	5 45 28.2
19	235 69.6	328 37.9	188	120 62.9	171.0	281 79.9	79.0	285 79.5	81.5		Alsham	100 32.6	5 45 31.2
20	250 72.2	333 38.7	190	135 63.6	183.0	316 83.9	83.0	321 83.5	85.5		Alsham	279 05.2	5 45 34.2
21	265 74.8	338 39.5	192	150 64.3	195.0	351 87.9	87.0	357 87.5	89.5		Alsham	271 34.7	5 45 37.2
22	280 77.4	343 40.3	194	165 65.0	207.0	386 91.9	91.0	393 91.5	93.5				
23	295 80.0	348 41.1	196	180 65.7	219.0	421 95.9	95.0	429 95.5	97.5				
00	310 82.6	353 41.9	198	195 66.4	231.0	456 99.9	99.0	464 99.5	101.5		Cannara	264 10.7	5 45 40.4
01	325 85.2	358 42.7	200	210 67.1	243.0	491 103.9	103.0	500 103.5	105.5		Cappella	281 20.1	5 45 43.4
02	340 87.8	363 43.5	202	225 67.8	255.0	526 107.9	107.0	539 107.5	109.5		Cernis	48 53.0	5 45 46.4
03	355 90.4	368 44.3	204	240 68.5	267.0	561 111.9	111.0	578 111.5	113.5		Demokle	163 02.0	5 45 49.4
04	370 93.0	373 45.1	206	255 69.2	279.0	596 115.9	115.0	617 115.5	117.5		Diphda	349 28.4	5 45 52.4
05	385 95.6	378 45.9	208	270 69.9	291.0	631 119.9	119.0	656 119.5	121.5				
06	400 98.2	383 46.7	210	285 70.6	303.0	666 123.9	123.0	695 123.5	123.5		Duchs	154 29.4	5 45 55.4
07	415 100.8	388 47.5	212	300 71.3	315.0	701 127.9	127.0	734 127.5	127.5		Erach	271 23.6	5 45 58.4
08	430 103.4	393 48.3	214	315 72.0	327.0	736 131.9	131.0	773 131.5	131.5		Elasax	81 03.0	5 46 1.4
09	445 106.0	398 49.1	216	330 72.7	339.0	771 135.9	135.0	812 135.5	135.5		Euf	34 16.8	5 46 4.4
10	460 108.6	403 49.9	218	345 73.4	351.0	806 139.9	139.0	851 139.5	139.5		Fomalhaut	15 57.5	5 46 7.4
11	475 111.2	408 50.7	220	360 74.1	363.0	841 143.9	143.0	890 143.5	143.5				
12	490 113.8	413 51.5	222	375 74.8	375.0	876 147.9	147.0	929 147.5	147.5		Garnet	177 13.6	5 46 10.4
13	505 116.4	418 52.3	224	390 75.5	387.0	911 151.9	151.0	968 151.5	151.5		Gienn	176 24.1	5 46 13.4
14	520 119.0	423 53.1	226	405 76.2	399.0	946 155.9	155.0	1007 155.5	155.5		Hadar	149 31.7	5 46 16.4
15	535 121.6	428 53.9	228	420 76.9	411.0	981 159.9	159.0	1046 159.5	159.5		Hana	328 39.4	5 46 19.4
16	550 124.2	433 54.7	230	435 77.6	423.0	1016 163.9	163.0	1085 163.5	163.5		Kast-Aur	84 34.1	5 46 22.4
17	565 126.8	438 55.5	232	450 78.3	435.0	1051 167.9	167.0	1124 167.5	167.5				
18	580 129.4	443 56.3	234	465 79.0	447.0	1086 171.9	171.0	1163 171.5	171.5		Kastab	137 18.2	5 46 25.4
19	595 132.0	448 57.1	236	480 79.7	459.0	1121 175.9	175.0	1202 175.5	175.5		Menak	14 03.4	5 46 28.4
20	610 134.6	453 57.9	238	495 80.4	471.0	1156 179.9	179.0	1241 179.5	179.5		Mentak	314 47.1	5 46 31.4
21	625 137.2	458 58.7	240	510 81.1	483.0	1191 183.9	183.0	1280 183.5	183.5		Merkar	148 43.9	5 46 34.4
22	640 139.8	463 59.5	242	525 81.8	495.0	1226 187.9	187.0	1319 187.5	187.5		Phosphor	221 47.4	5 46 37.4
23	655 142.4	468 60.3	244	540 82.5	507.0	1261 191.9	191.0	1358 191.5	191.5				
00	670 145.0	473 61.1	246	555 83.2	519.0	1296 195.9	195.0	1397 195.5	195.5		Mrfak	389 24.5	5 46 40.4
01	685 147.6	478 61.9	248	570 83.9	531.0	1331 199.9	199.0	1436 199.5	199.5		Mura	26 13.6	5 46 43.4
02	700 150.2	483 62.7	250	585 84.6	543.0	1366 203.9	203.0	1475 203.5	203.5		Paros	58 08.6	5 46 46.4
03	715 152.8	488 63.5	252	600 85.3	555.0	1401 207.9	207.0	1514 207.5	207.5		Rafes	244 23.4	5 46 49.4
04	730 155.4	493 64.3	254	615 86.0	567.0	1436 211.9	211.0	1553 211.5	211.5		Progn	342 33.1	5 46 52.4
05	745 158.0	498 65.1	256	630 86.7	579.0	1471 215.9	215.0	1592 215.5	215.5				
06	760 160.6	503 65.9	258	645 87.4	591.0	1506 219.9	219.0	1631 219.5	219.5		Ranfogee	26 24.6	5 46 55.4
07	775 163.2	508 66.7	260	660 88.1	603.0	1541 223.9	223.0	1670 223.5	223.5		Razhuk	228 16.3	5 46 58.4
08	790 165.8	513 67.5	262	675 88.8	615.0	1576 227.9	227.0	1709 227.5	227.5		Rigel	381 41.7	5 47 1.4
09	805 168.4	518 68.3	264	690 89.5	627.0	1611 231.9	231.0	1748 231.5	231.5		Rigel Kant.	140 33.7	5 47 4.4
10	820 171.0	523 69.1	266	705 90.2	639.0	1646 235.9	235.0	1787 235.5	235.5		Sabik	107 43.9	5 47 7.4
11	835 173.6	528 69.9	268	720 90.9	651.0	1681 239.9	239.0	1826 239.5	239.5				
12	850 176.2	533 70.7	270	735 91.6	663.0	1716 243.9	243.0	1865 243.5	243.5		Schadar	350 25.4	5 47 10.4
13	865 178.8	538 71.5	272	750 92.3	675.0	1751 247.9	247.0	1904 247.5	247.5		Shesha	87 03.2	5 47 13.4
14	880 181.4	543 72.3	274	765 93.0	687.0	1786 251.9	251.0	1943 251.5	251.5		Siyes	258 02.0	5 47 16.4
15	895 184.0	548 73.1	276	780 93.7	699.0	1821 255.9	255.0	1982 255.5	255.5		Saleh	158 08.7	5 47 19.4
16	910 186.6	553 73.9	278	795 94.4	711.0	1856 259.9	259.0	2021 259.5	259.5		Schall	223 25.5	5 47 22.4
17	925 189.2	558 74.7	280	810 95.1	723.0	1891 263.9	263.0	2060 263.5	263.5				
18	940 191.8	563 75.5	282	825 95.8	735.0	1926 267.9	267.0	2099 267.5	267.5		Vega	80 29.2	5 47 25.4
19	955 194.4	568 76.3	284	840 96.5	747.0	1961 271.9	271.0	2138 271.5	271.5		Zaken'ab	137 29.4	5 47 28.4
20	970 197.0	573 77.1	286	855 97.2	759.0	1996 275.9	275.0	2177 275.5	275.5				
21	985 199.6	578 77.9	288	870 97.9	771.0	2031 279.9	279.0	2216 279.5	279.5				
22	1000 202.2	583 78.7	290	885 98.6	783.0	2066 283.9	283.0	2255 283.5	283.5				
23	1015 204.8	588 79.5	292	900 99.3	795.0	2101 287.9	287.0	2294 287.5	287.5				
Mer. Pos.	h m		s d		s d		s d		s d			GHA.	Mer. Pos.

1972 AUGUST 1, 2, 3 (TUES. WED. THURS.)

GRT	SUN				MOON				Lk	Twilight		Sun	Planets				
	G.A.	Dec.	G.A.	Dec.	G.A.	Dec.	Δ	PL		Hor.	Nav.		1	2	3	4	
10	138	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
11	139	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
12	140	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
13	141	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
14	142	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
15	143	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
16	144	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
17	145	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
18	146	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
19	147	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
20	148	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
21	149	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
22	150	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
23	151	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
24	152	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
25	153	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
26	154	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
27	155	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
28	156	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
29	157	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
30	158	2	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160

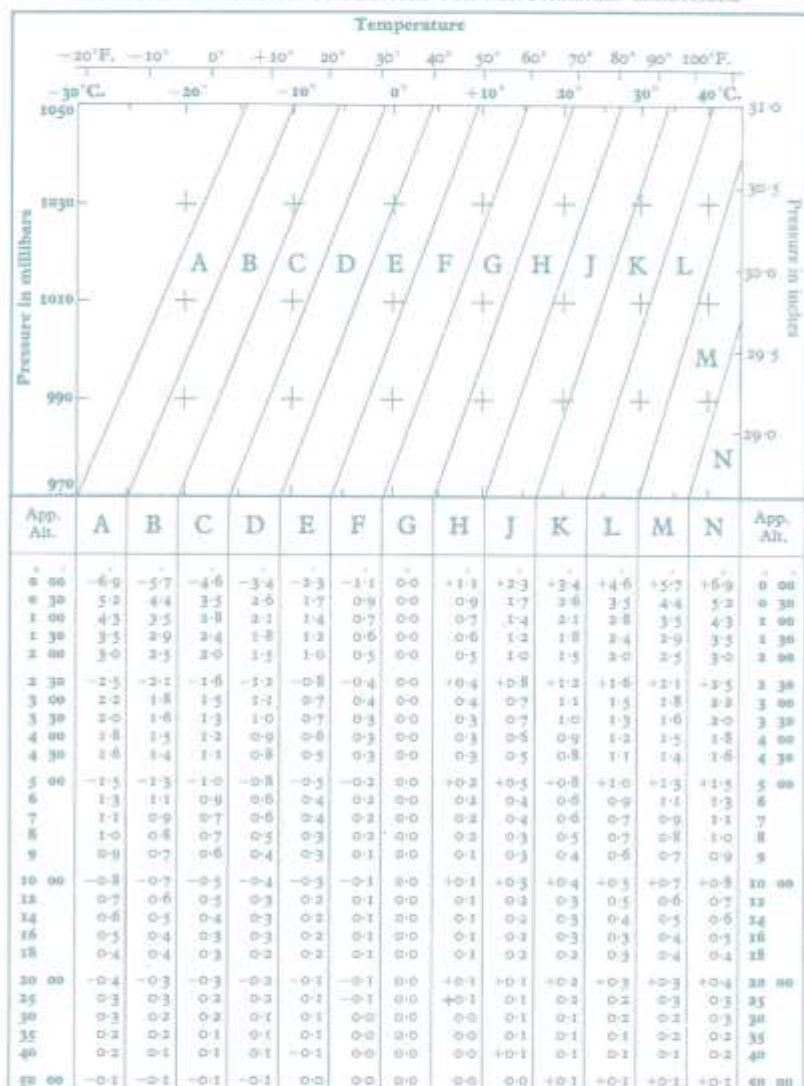
Extract from the Nautical Almanac.

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

OCT.—MAR.			SUN APR.—SEPT.			STARS AND PLANETS			DIP						
App. Alt.	Lower Limb	Upper Limb	App. Alt.	Lower Limb	Upper Limb	App. Alt.	Corr.	App. Alt.	Additional Corr.	Ht. of Eye	Corr.	Ht. of Eye	Ht. of Eye	Corr.	
9 34	+10 8	-27.3	9 39	+10 6	-27.4	9 36	-5.3	1972			m	ft.	m		
9 45	+10 9	-27.4	9 51	+10 7	-27.4	10 08	-5.2	VENUS			2.4	-2.8	8.0	1.0	-1.8
9 56	+11 0	-27.5	10 03	+10 8	-27.5	10 20	-5.1	Jan. 1—Feb. 29			2.6	-2.9	8.6	1.5	-2.2
10 08	+11 1	-27.5	10 15	+10 9	-27.6	10 33	-5.0	0°			2.8	-3.0	9.2	2.0	-2.5
10 21	+11 2	-27.6	10 27	+11 0	-27.6	10 45	-4.9	42 +0.1			3.0	-3.1	9.8	2.5	-2.8
10 34	+11 3	-27.6	10 40	+11 1	-27.7	11 00	-4.8	Mar. 1—Apr. 15			3.2	-3.2	10.5	3.0	-3.0
10 47	+11 3	-27.7	10 54	+11 2	-27.8	11 14	-4.7	0°			3.4	-3.3	11.2		See table
11 01	+11 4	-27.8	11 08	+11 3	-27.8	11 29	-4.6	47 +0.2			3.6	-3.4	11.9		←
11 15	+11 5	-27.8	11 23	+11 4	-27.9	11 45	-4.5	Apr. 16—May 12			3.8	-3.5	12.6		m
11 30	+11 7	-27.8	11 38	+11 5	-27.9	12 01	-4.4	0°			4.0	-3.6	13.3		
11 46	+11 8	-27.9	11 54	+11 6	-27.9	12 18	-4.3	46 +0.3			4.3	-3.6	14.1		20 - 7.9
12 02	+11 9	-27.9	12 10	+11 7	-28.0	12 35	-4.2	May 13—May 27			4.5	-3.8	14.9		22 - 8.3
12 17	+12 0	-28.0	12 28	+11 8	-28.0	12 54	-4.1	0°			4.7	-3.9	15.7		24 - 8.6
12 32	+12 1	-28.0	12 46	+11 9	-28.0	13 13	-4.0	11 +0.4			5.0	-4.0	16.5		26 - 9.0
12 55	+12 2	-28.0	13 05	+12 0	-28.0	13 33	-3.9	47 +0.5			5.2	-4.1	17.4		28 - 9.3
13 14	+12 3	-28.0	13 24	+12 1	-28.1	13 54	-3.9	May 28—June 5			5.5	-4.1	18.3		
13 35	+12 4	-28.0	13 45	+12 2	-28.1	14 16	-3.8	0°			5.8	-4.2	19.1		30 - 9.6
13 56	+12 5	-28.0	14 07	+12 3	-28.1	14 40	-3.7	6 +0.5			6.1	-4.3	20.1		32 - 10.0
14 18	+12 6	-28.0	14 30	+12 4	-28.1	15 04	-3.6	20 +0.6			6.3	-4.4	21.0		34 - 10.3
14 41	+12 7	-28.0	14 54	+12 5	-28.1	15 30	-3.4	31 +0.7			6.6	-4.5	22.0		36 - 10.6
15 06	+12 8	-28.0	15 19	+12 6	-28.1	15 57	-3.3	June 6—June 29			6.9	-4.6	22.9		38 - 10.8
15 32	+12 9	-28.0	15 46	+12 7	-28.1	16 26	-3.2	0°			7.2	-4.7	23.9		
15 59	+13 0	-28.0	16 14	+12 8	-28.1	16 56	-3.1	4 +0.6			7.5	-4.8	24.9		40 - 11.1
16 28	+13 1	-28.0	16 44	+12 9	-28.1	17 28	-3.0	12 +0.7			7.9	-4.9	26.0		42 - 11.4
16 59	+13 2	-28.0	17 15	+13 0	-28.1	18 02	-2.9	22 +0.8			8.2	-5.0	27.1		44 - 11.7
17 32	+13 3	-28.0	17 48	+13 1	-28.1	18 38	-2.8	June 30—July 8			8.5	-5.1	28.1		46 - 11.9
18 00	+13 4	-28.0	18 24	+13 2	-28.1	19 17	-2.7	0°			8.8	-5.2	29.2		48 - 12.2
18 42	+13 5	-28.0	19 01	+13 3	-28.1	19 58	-2.6	6 +0.5			9.2	-5.3	30.4		ft.
19 21	+13 6	-28.0	19 42	+13 4	-28.1	20 42	-2.5	20 +0.6			9.5	-5.4	31.5		2 - 1.4
20 03	+13 7	-28.0	20 25	+13 5	-28.1	21 28	-2.4	31 +0.7			9.9	-5.5	32.7		4 - 1.9
20 48	+13 8	-28.0	21 11	+13 6	-28.1	22 19	-2.3	July 9—July 24			10.3	-5.6	33.9		6 - 2.4
21 35	+13 9	-28.0	22 00	+13 7	-28.1	23 13	-2.2	0°			10.6	-5.7	35.1		8 - 2.7
22 26	+14 0	-28.0	22 54	+13 8	-28.1	24 11	-2.1	11 -0.4			11.0	-5.8	36.3		10 - 3.1
23 22	+14 1	-28.0	24 53	+13 9	-28.1	25 14	-2.0	21 -0.3			11.4	-5.9	37.6		See table
24 21	+14 2	-28.0	25 50	+14 0	-28.1	26 22	-1.9	31 -0.2			11.8	-6.0	38.9		←
25 26	+14 3	-28.0	26 50	+14 1	-28.1	27 36	-1.8	July 25—Aug. 19			12.2	-6.2	40.1		ft.
26 36	+14 4	-28.0	27 54	+14 2	-28.1	28 56	-1.7	0°			12.6	-6.3	41.5		70 - 8.1
27 52	+14 5	-28.0	28 33	+14 3	-28.1	30 34	-1.6	46 +0.3			13.0	-6.4	42.8		75 - 8.4
29 15	+14 6	-28.0	30 00	+14 4	-28.1	32 00	-1.6	Aug. 20—Oct. 3			13.4	-6.5	44.2		80 - 8.7
30 46	+14 7	-28.0	31 35	+14 5	-28.1	33 45	-1.5	0°			13.8	-6.5	45.5		85 - 8.9
32 26	+14 8	-28.0	33 20	+14 6	-28.1	35 40	-1.4	47 +0.2			14.2	-6.7	46.9		90 - 9.2
34 17	+14 9	-28.0	35 17	+14 7	-28.1	37 48	-1.3	Oct. 6—Dec. 31			14.7	-6.8	48.4		95 - 9.3
36 20	+15 0	-28.0	37 26	+14 8	-28.0	40 08	-1.1	0°			15.1	-6.9	49.8		
38 36	+15 1	-28.0	39 50	+14 9	-28.0	42 44	-1.1	42 +0.1			15.5	-7.0	51.3		100 - 9.7
41 08	+15 2	-28.0	42 31	+15 0	-28.0	45 36	-1.0	MARS			16.0	-7.0	52.8		105 - 9.9
43 59	+15 3	-28.0	45 31	+15 1	-28.0	48 47	-0.9	Jan. 1—Dec. 31			16.5	-7.1	54.3		110 - 10.2
47 10	+15 4	-28.0	48 55	+15 2	-28.0	52 18	-0.7	0°			16.9	-7.2	55.8		115 - 10.4
50 46	+15 5	-28.0	52 44	+15 3	-28.0	56 11	-0.6	60 +0.1			17.4	-7.4	57.4		120 - 10.6
54 49	+15 6	-28.0	57 02	+15 4	-28.0	60 28	-0.5	0°			17.9	-7.4	58.9		125 - 10.6
59 21	+15 7	-28.0	61 51	+15 5	-28.0	65 08	-0.5	80 +0.1			18.4	-7.5	60.5		
64 30	+15 8	-28.0	67 37	+15 6	-28.0	70 11	-0.4				18.8	-7.6	62.1		130 - 11.1
70 28	+15 9	-28.0	73 10	+15 7	-28.0	75 34	-0.2				19.3	-7.7	63.8		135 - 11.3
76 26	+16 0	-28.0	79 45	+15 8	-28.0	81 13	-0.1				19.8	-7.9	65.4		140 - 11.5
82 05	+16 1	-28.0	86 32	+15 9	-28.0	87 03	0.0				20.4	-8.0	67.1		145 - 11.7
90 00			90 00			90 00	0.0				20.9	-8.1	68.8		150 - 11.9
											21.4		70.5		155 - 12.1

App. Alt. = Apparent altitude = Sextant altitude corrected for index error and dip.
 For daylight observations of Venus, see page 260.

A4 ALTITUDE CORRECTION TABLES—ADDITIONAL CORRECTIONS
ADDITIONAL REFRACTION CORRECTIONS FOR NON-STANDARD CONDITIONS



The graph is entered with arguments temperature and pressure to find a zone letter; using as arguments this zone letter and apparent altitude (sextant altitude corrected for dip), a correction is taken from the table. This correction is to be applied to the sextant altitude in addition to the corrections for standard conditions (for the Sun, stars and planets from page A2 and for the Moon from pages xxxiv and xxxv).

ALTITUDE CORRECTION TABLES 35°-90°—MOON

App. Alt.	35°-39'		40°-44'		45°-49'		50°-54'		55°-59'		60°-64'		65°-69'		70°-74'		75°-79'		80°-84'		85°-89'		App. Alt.
	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'	Corr'		
00	31	35.3	40	33.7	45	30.5	50	26.9	55	23.4	60	20.0	65	16.6	70	13.1	75	9.5	80	6.0	85	2.5	90
10		35.4		33.6		30.4		26.8		22.9		19.4		16.0		12.5		8.9		5.4		1.9	10
20		35.5		33.5		30.3		26.7		22.8		19.3		15.9		12.4		8.8		5.3		1.8	20
30		35.6		33.4		30.1		26.5		22.7		19.1		15.7		12.2		8.6		5.1		1.7	30
40		35.7		33.3		30.0		26.4		22.6		19.0		15.6		12.1		8.5		5.0		1.6	40
50		35.8		33.2		29.9		26.3		22.5		18.9		15.5		12.0		8.4		4.9		1.5	50
60	36	36.0	41	33.1	46	29.8	51	26.2	56	22.4	61	18.8	66	15.4	71	11.9	76	8.3	81	4.8	86	1.4	90
70		35.9		33.0		29.7		26.1		22.3		18.7		15.3		11.8		8.2		4.7		1.3	10
80		35.8		32.8		29.5		25.9		22.0		18.5		15.1		11.6		8.0		4.5		1.2	20
90		35.7		32.7		29.4		25.8		21.9		18.4		15.0		11.5		7.9		4.4		1.1	30
40		35.6		32.6		29.3		25.7		21.8		18.3		14.9		11.4		7.8		4.3		1.0	40
50		35.5		32.5		29.2		25.6		21.7		18.2		14.8		11.3		7.7		4.2		0.9	50
60	37	35.4	42	32.4	47	29.1	52	25.5	57	21.6	62	18.1	67	14.7	72	11.2	77	8.1	82	4.1	87	0.8	90
70		35.3		32.3		29.0		25.4		21.5		18.0		14.6		11.1		8.0		4.0		0.7	10
80		35.2		32.2		28.8		25.2		21.2		17.8		14.4		10.9		7.8		3.8		0.6	20
90		35.1		32.1		28.7		25.1		21.1		17.7		14.3		10.8		7.7		3.7		0.5	30
40		35.0		32.0		28.6		25.0		21.0		17.6		14.2		10.7		7.6		3.6		0.4	40
50		34.9		31.9		28.5		24.9		20.9		17.5		14.1		10.6		7.5		3.5		0.3	50
60	38	34.8	43	31.8	48	28.4	53	24.8	58	20.8	63	17.4	68	14.0	73	10.5	78	7.4	83	3.4	88	0.2	90
70		34.7		31.7		28.3		24.7		20.7		17.3		13.9		10.4		7.3		3.3		0.1	10
80		34.6		31.6		28.2		24.6		20.6		17.2		13.8		10.3		7.2		3.2		0.0	20
90		34.5		31.5		28.1		24.5		20.5		17.1		13.7		10.2		7.1		3.1		0.0	30
40		34.4		31.4		28.0		24.4		20.4		17.0		13.6		10.1		7.0		3.0		0.0	40
50		34.3		31.3		27.9		24.3		20.3		16.9		13.5		10.0		6.9		2.9		0.0	50
60	39	34.2	44	31.2	49	27.8	54	24.2	59	20.2	64	16.8	69	13.4	74	9.9	79	6.8	84	2.8	89	0.0	90
70		34.1		31.1		27.7		24.1		20.1		16.7		13.3		9.8		6.7		2.7		0.0	10
80		34.0		31.0		27.6		24.0		20.0		16.6		13.2		9.7		6.6		2.6		0.0	20
90		33.9		30.9		27.5		23.9		19.9		16.5		13.1		9.6		6.5		2.5		0.0	30
40		33.8		30.8		27.4		23.8		19.8		16.4		13.0		9.5		6.4		2.4		0.0	40
50		33.7		30.7		27.3		23.7		19.7		16.3		12.9		9.4		6.3		2.3		0.0	50
60	40	33.6	45	30.6	50	27.2	55	23.6	60	19.6	65	16.2	70	12.8	75	9.3	80	6.2	85	2.2	90	0.0	90
70		33.5		30.5		27.1		23.5		19.5		16.1		12.7		9.2		6.1		2.1		0.0	10
80		33.4		30.4		27.0		23.4		19.4		16.0		12.6		9.1		6.0		2.0		0.0	20
90		33.3		30.3		26.9		23.3		19.3		15.9		12.5		9.0		5.9		1.9		0.0	30
40		33.2		30.2		26.8		23.2		19.2		15.8		12.4		8.9		5.8		1.8		0.0	40
50		33.1		30.1		26.7		23.1		19.1		15.7		12.3		8.8		5.7		1.7		0.0	50
60	41	33.0	46	30.0	51	26.6	56	23.0	61	19.0	66	15.6	71	12.2	76	8.7	81	5.6	86	1.6	91	0.0	90
70		32.9		29.9		26.5		22.9		18.9		15.5		12.1		8.6		5.5		1.5		0.0	10
80		32.8		29.8		26.4		22.8		18.8		15.4		12.0		8.5		5.4		1.4		0.0	20
90		32.7		29.7		26.3		22.7		18.7		15.3		11.9		8.4		5.3		1.3		0.0	30
40		32.6		29.6		26.2		22.6		18.6		15.2		11.8		8.3		5.2		1.2		0.0	40
50		32.5		29.5		26.1		22.5		18.5		15.1		11.7		8.2		5.1		1.1		0.0	50
60	42	32.4	47	29.4	52	26.0	57	22.4	62	18.4	67	15.0	72	11.6	77	8.1	82	5.0	87	1.0	92	0.0	90
70		32.3		29.3		25.9		22.3		18.3		14.9		11.5		8.0		4.9		0.9		0.0	10
80		32.2		29.2		25.8		22.2		18.2		14.8		11.4		7.9		4.8		0.8		0.0	20
90		32.1		29.1		25.7		22.1		18.1		14.7		11.3		7.8		4.7		0.7		0.0	30
40		32.0		29.0		25.6		22.0		18.0		14.6		11.2		7.7		4.6		0.6		0.0	40
50		31.9		28.9		25.5		21.9		17.9		14.5		11.1		7.6		4.5		0.5		0.0	50
60	43	31.8	48	28.8	53	25.4	58	21.8	63	17.8	68	14.4	73	11.0	78	7.5	83	4.4	88	0.4	93	0.0	90
70		31.7		28.7		25.3		21.7		17.7		14.3		10.9		7.4		4.3		0.3		0.0	10
80		31.6		28.6		25.2		21.6		17.6		14.2		10.8		7.3		4.2		0.2		0.0	20
90		31.5		28.5		25.1		21.5		17.5		14.1		10.7		7.2		4.1		0.1		0.0	30
40		31.4		28.4		25.0		21.4		17.4		14.0		10.6		7.1		4.0		0.0		0.0	40
50		31.3		28.3		24.9		21.3		17.3		13.9		10.5		7.0		3.9		0.0		0.0	50
60	44	31.2	49	28.2	54	24.8	59	21.2	64	17.2	69	13.8	74	10.4	79	6.9	84	3.8	89	0.0	94	0.0	90
70		31.1		28.1		24.7		21.1		17.1		13.7		10.3		6.8		3.7		0.0		0.0	10
80		31.0		28.0		24.6		21.0		17.0		13.6		10.2		6.7		3.6		0.0		0.0	20
90		30.9		27.9		24.5		20.9		16.9		13.5		10.1		6.6		3.5		0.0		0.0	30
40		30.8		27.8		24.4		20.8		16.8		13.4		10.0		6.5		3.4		0.0		0.0	40
50		30.7		27.7		24.3		20.7		16.7		13.3		9.9		6.4		3.3		0.0		0.0	50
60	45	30.6	50	27.6	55	24.2	60	20.6	65	16.6	70	13.2	75	9.8	80	6.3	85	3.2	90	0.0	95	0.0	90
70		30.5		27.5		24.1		20.5		16.5		13.1		9.7		6.2		3.1		0.0		0.0	10
80		30.4		27.4		24.0		20.4		16.4		13.0		9.6		6.1		3.0		0.0		0.0	20
90		30.3		27.3		23.9		20.3		16.3		12.9		9.5		6.0		2.9		0.0		0.0	30
40		30.2		27.2		23.8		20.2		16.2		12.8		9.4		5.9		2.8		0.0		0.0	40
50		30.1		27.1		23.7		20.1		16.1		12.7		9.3		5.8		2.7		0.0		0.0	50
60	46	30.0	51	27.0	56	23.6	61	20.0	66	16.0	71	12.6	76	9.2	81	5.7	86	2.6	91	0.0	96	0.0	90
70		29.9		26.9		23.5		20.0		16.0		12.5		9.1		5.6		2.5		0.0		0.0	10
80		29.8		26.8		23.4		19.9		15.9		12.4		9.0		5.5		2.4		0.0		0.0	20
90		29.7		26.7		23.3		19.8		15.8		12.3		8.9		5.4		2.3		0.0		0.0	30
40		29.6		26.6		23.2		19.7		15.7		12.2		8.8		5.3		2.2		0.0		0.0	40
50		29.5		26.5		23.1		19.6		15.6		12.1		8.7		5.2		2.1		0.0		0.0	50
60	47	29.4	52	26.4	57	23.0	62	19.5	67	15.5	72	12.0	77	8.6	82								

10°	SUN PLANETS			ARIES			MOON			° of Corr		
	°	'	"	°	'	"	°	'	"	°	'	"
00	2 300	2 304	2 312	04	00	04	11	10	12	00	00	00
01	2 300	2 307	2 314	04	00	04	11	10	12	00	00	00
02	2 300	2 309	2 316	04	00	04	11	10	12	00	00	00
03	2 300	2 310	2 318	04	00	04	11	10	12	00	00	00
04	2 300	2 314	2 321	04	00	04	11	10	12	00	00	00
05	2 315	2 317	2 324	04	00	04	11	10	12	00	00	00
06	2 315	2 319	2 326	04	00	04	11	10	12	00	00	00
07	2 315	2 321	2 328	04	00	04	11	10	12	00	00	00
08	2 315	2 324	2 331	04	00	04	11	10	12	00	00	00
09	2 315	2 327	2 334	04	00	04	11	10	12	00	00	00
10	2 325	2 328	2 335	04	00	04	11	10	12	00	00	00
11	2 325	2 331	2 338	04	00	04	11	10	12	00	00	00
12	2 325	2 334	2 341	04	00	04	11	10	12	00	00	00
13	2 325	2 337	2 344	04	00	04	11	10	12	00	00	00
14	2 325	2 340	2 347	04	00	04	11	10	12	00	00	00
15	2 335	2 342	2 349	04	00	04	11	10	12	00	00	00
16	2 335	2 345	2 352	04	00	04	11	10	12	00	00	00
17	2 335	2 348	2 355	04	00	04	11	10	12	00	00	00
18	2 335	2 351	2 358	04	00	04	11	10	12	00	00	00
19	2 335	2 354	2 361	04	00	04	11	10	12	00	00	00
20	2 350	2 354	2 361	04	00	04	11	10	12	00	00	00
21	2 350	2 357	2 364	04	00	04	11	10	12	00	00	00
22	2 350	2 360	2 367	04	00	04	11	10	12	00	00	00
23	2 350	2 363	2 370	04	00	04	11	10	12	00	00	00
24	2 350	2 366	2 373	04	00	04	11	10	12	00	00	00
25	2 360	2 368	2 375	04	00	04	11	10	12	00	00	00
26	2 360	2 371	2 378	04	00	04	11	10	12	00	00	00
27	2 360	2 374	2 381	04	00	04	11	10	12	00	00	00
28	2 360	2 377	2 384	04	00	04	11	10	12	00	00	00
29	2 360	2 380	2 387	04	00	04	11	10	12	00	00	00
30	2 375	2 379	2 386	04	00	04	11	10	12	00	00	00
31	2 375	2 382	2 389	04	00	04	11	10	12	00	00	00
32	2 375	2 385	2 392	04	00	04	11	10	12	00	00	00
33	2 375	2 388	2 395	04	00	04	11	10	12	00	00	00
34	2 375	2 391	2 398	04	00	04	11	10	12	00	00	00
35	2 385	2 393	2 400	04	00	04	11	10	12	00	00	00
36	2 385	2 396	2 403	04	00	04	11	10	12	00	00	00
37	2 385	2 399	2 406	04	00	04	11	10	12	00	00	00
38	2 385	2 402	2 409	04	00	04	11	10	12	00	00	00
39	2 385	2 405	2 412	04	00	04	11	10	12	00	00	00
40	2 400	2 408	2 415	04	00	04	11	10	12	00	00	00
41	2 400	2 411	2 418	04	00	04	11	10	12	00	00	00
42	2 400	2 414	2 421	04	00	04	11	10	12	00	00	00
43	2 400	2 417	2 424	04	00	04	11	10	12	00	00	00
44	2 400	2 420	2 427	04	00	04	11	10	12	00	00	00
45	2 415	2 423	2 430	04	00	04	11	10	12	00	00	00
46	2 415	2 426	2 433	04	00	04	11	10	12	00	00	00
47	2 415	2 429	2 436	04	00	04	11	10	12	00	00	00
48	2 415	2 432	2 439	04	00	04	11	10	12	00	00	00
49	2 415	2 435	2 442	04	00	04	11	10	12	00	00	00
50	2 425	2 437	2 444	04	00	04	11	10	12	00	00	00
51	2 425	2 440	2 447	04	00	04	11	10	12	00	00	00
52	2 425	2 443	2 450	04	00	04	11	10	12	00	00	00
53	2 425	2 446	2 453	04	00	04	11	10	12	00	00	00
54	2 425	2 449	2 456	04	00	04	11	10	12	00	00	00
55	2 435	2 451	2 458	04	00	04	11	10	12	00	00	00
56	2 435	2 454	2 461	04	00	04	11	10	12	00	00	00
57	2 435	2 457	2 464	04	00	04	11	10	12	00	00	00
58	2 435	2 460	2 467	04	00	04	11	10	12	00	00	00
59	2 435	2 463	2 470	04	00	04	11	10	12	00	00	00
60	2 450	2 465	2 472	04	00	04	11	10	12	00	00	00

47	SUN PLANETS			ARIES	MOON	° or Corr		
	h	m	s			h	m	s
00	11 450	11 460	11 150	04 00	04 40	04 95		
01	11 453	11 470	11 151	04 01	04 40	04 96		
02	11 456	11 474	11 152	04 02	04 40	04 97		
03	11 459	11 477	11 153	04 02	04 50	04 97		
04	11 461	11 479	11 154	04 05	04 51	04 98		
05	11 465	11 480	11 155	04 04	04 51	04 98		
06	11 465	11 484	11 153	04 05	04 52	04 100		
07	11 468	11 482	11 154	04 06	04 53	04 101		
08	11 470	11 489	11 154	04 06	04 54	04 101		
09	11 473	11 490	11 155	04 07	04 55	04 102		
10	11 475	11 494	11 153	04 08	04 55	04 103		
11	11 476	11 497	11 155	04 09	04 56	04 104		
12	11 480	11 499	11 157	04 10	04 57	04 105		
13	11 483	11 502	11 160	04 10	04 58	04 105		
14	11 485	11 504	11 162	04 11	04 59	04 106		
15	11 488	11 507	11 165	04 12	04 59	04 107		
16	11 490	11 509	11 167	04 13	04 60	04 106		
17	11 493	11 513	11 169	04 13	04 61	04 108		
18	11 495	11 514	11 172	04 14	04 62	04 109		
19	11 498	11 517	11 174	04 15	04 63	04 110		
20	11 500	11 519	11 177	04 16	04 63	04 111		
21	11 503	11 522	11 179	04 17	04 64	04 112		
22	11 505	11 524	11 181	04 17	04 65	04 112		
23	11 508	11 527	11 184	04 18	04 64	04 113		
24	11 510	11 529	11 186	04 19	04 67	04 114		
25	11 513	11 532	11 188	04 20	04 67	04 115		
26	11 515	11 534	11 190	04 21	04 68	04 116		
27	11 518	11 537	11 193	04 21	04 68	04 116		
28	11 520	11 539	11 196	04 22	04 70	04 117		
29	11 523	11 542	11 198	04 23	04 70	04 118		
30	11 525	11 545	11 200	04 24	04 71	04 119		
31	11 528	11 547	11 203	04 25	04 72	04 120		
32	11 530	11 550	11 205	04 26	04 73	04 120		
33	11 533	11 552	11 208	04 26	04 74	04 121		
34	11 535	11 555	11 210	04 27	04 74	04 122		
35	11 538	11 557	11 213	04 28	04 75	04 123		
36	11 540	11 560	11 215	04 28	04 76	04 124		
37	11 543	11 562	11 217	04 29	04 77	04 124		
38	11 545	11 565	11 220	04 30	04 78	04 125		
39	11 548	11 567	11 222	04 31	04 78	04 126		
40	11 550	11 570	11 224	04 32	04 79	04 127		
41	11 553	11 572	11 227	04 32	04 80	04 127		
42	11 555	11 575	11 229	04 33	04 81	04 128		
43	11 558	11 577	11 231	04 34	04 82	04 129		
44	11 560	11 580	11 234	04 35	04 82	04 130		
45	11 563	11 582	11 236	04 36	04 83	04 131		
46	11 565	11 585	11 239	04 36	04 84	04 131		
47	11 568	11 587	11 242	04 37	04 85	04 132		
48	11 570	11 590	11 245	04 38	04 84	04 133		
49	11 573	11 592	11 246	04 38	04 86	04 134		
50	11 575	11 595	11 248	04 40	04 87	04 135		
51	11 578	11 597	11 251	04 40	04 88	04 135		
52	11 580	12 000	11 253	04 41	04 89	04 136		
53	11 583	12 002	11 255	04 42	04 90	04 137		
54	11 585	12 005	11 258	04 43	04 90	04 138		
55	11 588	12 007	11 260	04 44	04 91	04 139		
56	11 590	12 010	11 262	04 44	04 92	04 139		
57	11 593	12 012	11 265	04 45	04 93	04 140		
58	11 595	12 015	11 267	04 46	04 93	04 141		
59	11 598	12 017	11 270	04 47	04 94	04 142		
60	12 000	12 020	11 272	04 48	04 95	04 143		

48	SUN PLANETS			ARIES	MOON	° or Corr		
	h	m	s			h	m	s
00	12 000	12 020	11 272	04 00	04 40	04 95		
01	12 003	12 022	11 274	04 01	04 40	04 96		
02	12 005	12 025	11 277	04 02	04 50	04 96		
03	12 008	12 027	11 279	04 02	04 51	04 96		
04	12 010	12 030	11 280	04 03	04 52	04 100		
05	12 013	12 032	11 284	04 04	04 53	04 101		
06	12 015	12 035	11 286	04 05	04 53	04 102		
07	12 018	12 037	11 289	04 06	04 54	04 103		
08	12 020	12 040	11 291	04 06	04 55	04 105		
09	12 023	12 042	11 293	04 07	04 56	04 104		
10	12 025	12 045	11 296	04 08	04 57	04 105		
11	12 028	12 047	11 298	04 09	04 57	04 104		
12	12 030	12 050	11 301	04 10	04 58	04 107		
13	12 033	12 052	11 303	04 11	04 59	04 108		
14	12 035	12 055	11 305	04 12	04 60	04 108		
15	12 038	12 057	11 308	04 12	04 61	04 109		
16	12 040	12 060	11 310	04 13	04 61	04 110		
17	12 043	12 062	11 313	04 14	04 62	04 111		
18	12 045	12 065	11 315	04 15	04 63	04 110		
19	12 048	12 067	11 317	04 15	04 64	04 112		
20	12 050	12 070	11 320	04 16	04 65	04 110		
21	12 053	12 072	11 322	04 17	04 65	04 114		
22	12 055	12 075	11 324	04 18	04 66	04 115		
23	12 058	12 077	11 327	04 18	04 67	04 116		
24	12 060	12 080	11 329	04 19	04 68	04 116		
25	12 063	12 082	11 332	04 20	04 69	04 117		
26	12 065	12 085	11 334	04 21	04 70	04 118		
27	12 068	12 087	11 336	04 22	04 70	04 119		
28	12 070	12 090	11 338	04 23	04 71	04 120		
29	12 073	12 092	11 341	04 23	04 72	04 120		
30	12 075	12 095	11 344	04 24	04 73	04 121		
31	12 078	12 097	11 346	04 25	04 74	04 122		
32	12 080	12 100	11 348	04 26	04 74	04 123		
33	12 083	12 102	11 351	04 27	04 75	04 124		
34	12 085	12 105	11 353	04 27	04 76	04 124		
35	12 088	12 107	11 356	04 28	04 77	04 125		
36	12 090	12 110	11 358	04 29	04 78	04 126		
37	12 093	12 112	11 360	04 30	04 78	04 127		
38	12 095	12 115	11 363	04 31	04 79	04 128		
39	12 098	12 117	11 365	04 32	04 80	04 129		
40	12 100	12 120	11 367	04 32	04 81	04 129		
41	12 103	12 122	11 370	04 33	04 82	04 130		
42	12 105	12 125	11 372	04 34	04 82	04 131		
43	12 108	12 128	11 375	04 35	04 83	04 132		
44	12 110	12 130	11 377	04 36	04 84	04 133		
45	12 113	12 133	11 379	04 36	04 85	04 133		
46	12 115	12 135	11 382	04 37	04 86	04 134		
47	12 118	12 138	11 384	04 38	04 86	04 135		
48	12 120	12 140	11 387	04 39	04 87	04 136		
49	12 123	12 143	11 389	04 40	04 88	04 137		
50	12 125	12 145	11 391	04 40	04 89	04 137		
51	12 128	12 148	11 394	04 41	04 90	04 138		
52	12 130	12 150	11 396	04 42	04 91	04 139		
53	12 133	12 153	11 398	04 43	04 91	04 140		
54	12 135	12 155	11 401	04 44	04 92	04 141		
55	12 138	12 158	11 403	04 44	04 93	04 141		
56	12 140	12 160	11 406	04 45	04 94	04 142		
57	12 143	12 163	11 408	04 46	04 95	04 143		
58	12 145	12 165	11 410	04 47	04 95	04 144		
59	12 148	12 168	11 413	04 48	04 96	04 145		
60	12 150	12 170	11 415	04 49	04 97	04 146		

21°, 339° L.H.A.

LATITUDE SAME NAME AS DECLINATION

Dec.	38°			39°			40°			41°			42°			43°			44°			Dec.		
	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z			
0	47	21.8	143	46	20.8	142.7	45	19.8	141.7	44	18.8	140.7	43	17.8	139.7	42	16.8	138.7	41	15.8	137.7	40	14.8	136.7
1	47	18.2	142.4	47	17.2	141.4	46	16.2	140.4	45	15.2	139.4	44	14.2	138.4	43	13.2	137.4	42	12.2	136.4	41	11.2	135.4
2	47	14.6	141.5	47	13.6	140.5	46	12.6	139.5	45	11.6	138.5	44	10.6	137.5	43	9.6	136.5	42	8.6	135.5	41	7.6	134.5
3	47	11.0	140.6	47	10.0	139.6	46	9.0	138.6	45	8.0	137.6	44	7.0	136.6	43	6.0	135.6	42	5.0	134.6	41	4.0	133.6
4	47	7.4	139.7	47	6.4	138.7	46	5.4	137.7	45	4.4	136.7	44	3.4	135.7	43	2.4	134.7	42	1.4	133.7	41	0.4	132.7
5	47	3.8	138.8	47	2.8	137.8	46	1.8	136.8	45	0.8	135.8	44	-0.2	134.8	43	-1.2	133.8	42	-2.2	132.8	41	-3.2	131.8
6	47	0.2	137.9	47	-0.8	136.9	46	-1.8	135.9	45	-2.8	134.9	44	-3.8	133.9	43	-4.8	132.9	42	-5.8	131.9	41	-6.8	130.9
7	46	56.2	137.0	46	55.2	136.0	45	54.2	135.0	44	53.2	134.0	43	52.2	133.0	42	51.2	132.0	41	50.2	131.0	40	49.2	130.0
8	46	52.6	136.1	46	51.6	135.1	45	50.6	134.1	44	49.6	133.1	43	48.6	132.1	42	47.6	131.1	41	46.6	130.1	40	45.6	129.1
9	46	49.0	135.2	46	48.0	134.2	45	47.0	133.2	44	46.0	132.2	43	45.0	131.2	42	44.0	130.2	41	43.0	129.2	40	42.0	128.2
10	46	45.4	134.3	46	44.4	133.3	45	43.4	132.3	44	42.4	131.3	43	41.4	130.3	42	40.4	129.3	41	39.4	128.3	40	38.4	127.3
11	46	41.8	133.4	46	40.8	132.4	45	39.8	131.4	44	38.8	130.4	43	37.8	129.4	42	36.8	128.4	41	35.8	127.4	40	34.8	126.4
12	46	38.2	132.5	46	37.2	131.5	45	36.2	130.5	44	35.2	129.5	43	34.2	128.5	42	33.2	127.5	41	32.2	126.5	40	31.2	125.5
13	46	34.6	131.6	46	33.6	130.6	45	32.6	129.6	44	31.6	128.6	43	30.6	127.6	42	29.6	126.6	41	28.6	125.6	40	27.6	124.6
14	46	31.0	130.7	46	30.0	129.7	45	29.0	128.7	44	28.0	127.7	43	27.0	126.7	42	26.0	125.7	41	25.0	124.7	40	24.0	123.7
15	46	27.4	129.8	46	26.4	128.8	45	25.4	127.8	44	24.4	126.8	43	23.4	125.8	42	22.4	124.8	41	21.4	123.8	40	20.4	122.8
16	46	23.8	128.9	46	22.8	127.9	45	21.8	126.9	44	20.8	125.9	43	19.8	124.9	42	18.8	123.9	41	17.8	122.9	40	16.8	121.9
17	46	20.2	128.0	46	19.2	127.0	45	18.2	126.0	44	17.2	125.0	43	16.2	124.0	42	15.2	123.0	41	14.2	122.0	40	13.2	121.0
18	46	16.6	127.1	46	15.6	126.1	45	14.6	125.1	44	13.6	124.1	43	12.6	123.1	42	11.6	122.1	41	10.6	121.1	40	9.6	120.1
19	46	13.0	126.2	46	12.0	125.2	45	11.0	124.2	44	10.0	123.2	43	9.0	122.2	42	8.0	121.2	41	7.0	120.2	40	6.0	119.2
20	46	9.4	125.3	46	8.4	124.3	45	7.4	123.3	44	6.4	122.3	43	5.4	121.3	42	4.4	120.3	41	3.4	119.3	40	2.4	118.3
21	46	5.8	124.4	46	4.8	123.4	45	3.8	122.4	44	2.8	121.4	43	1.8	120.4	42	0.8	119.4	41	-0.2	118.4	40	-1.2	117.4
22	46	2.2	123.5	46	1.2	122.5	45	0.2	121.5	44	-0.8	120.5	43	-1.8	119.5	42	-2.8	118.5	41	-3.8	117.5	40	-4.8	116.5
23	46	-1.4	122.6	46	-2.4	121.6	45	-3.4	120.6	44	-4.4	119.6	43	-5.4	118.6	42	-6.4	117.6	41	-7.4	116.6	40	-8.4	115.6
24	46	-5.0	121.7	46	-6.0	120.7	45	-7.0	119.7	44	-8.0	118.7	43	-9.0	117.7	42	-10.0	116.7	41	-11.0	115.7	40	-12.0	114.7
25	46	-8.6	120.8	46	-9.6	119.8	45	-10.6	118.8	44	-11.6	117.8	43	-12.6	116.8	42	-13.6	115.8	41	-14.6	114.8	40	-15.6	113.8
26	46	-12.2	119.9	46	-13.2	118.9	45	-14.2	117.9	44	-15.2	116.9	43	-16.2	115.9	42	-17.2	114.9	41	-18.2	113.9	40	-19.2	112.9
27	46	-15.8	119.0	46	-16.8	118.0	45	-17.8	117.0	44	-18.8	116.0	43	-19.8	115.0	42	-20.8	114.0	41	-21.8	113.0	40	-22.8	112.0
28	46	-19.4	118.1	46	-20.4	117.1	45	-21.4	116.1	44	-22.4	115.1	43	-23.4	114.1	42	-24.4	113.1	41	-25.4	112.1	40	-26.4	111.1
29	46	-23.0	117.2	46	-24.0	116.2	45	-25.0	115.2	44	-26.0	114.2	43	-27.0	113.2	42	-28.0	112.2	41	-29.0	111.2	40	-30.0	110.2
30	46	-26.6	116.3	46	-27.6	115.3	45	-28.6	114.3	44	-29.6	113.3	43	-30.6	112.3	42	-31.6	111.3	41	-32.6	110.3	40	-33.6	109.3
31	46	-30.2	115.4	46	-31.2	114.4	45	-32.2	113.4	44	-33.2	112.4	43	-34.2	111.4	42	-35.2	110.4	41	-36.2	109.4	40	-37.2	108.4
32	46	-33.8	114.5	46	-34.8	113.5	45	-35.8	112.5	44	-36.8	111.5	43	-37.8	110.5	42	-38.8	109.5	41	-39.8	108.5	40	-40.8	107.5
33	46	-37.4	113.6	46	-38.4	112.6	45	-39.4	111.6	44	-40.4	110.6	43	-41.4	109.6	42	-42.4	108.6	41	-43.4	107.6	40	-44.4	106.6
34	46	-41.0	112.7	46	-42.0	111.7	45	-43.0	110.7	44	-44.0	109.7	43	-45.0	108.7	42	-46.0	107.7	41	-47.0	106.7	40	-48.0	105.7
35	46	-44.6	111.8	46	-45.6	110.8	45	-46.6	109.8	44	-47.6	108.8	43	-48.6	107.8	42	-49.6	106.8	41	-50.6	105.8	40	-51.6	104.8
36	46	-48.2	110.9	46	-49.2	109.9	45	-50.2	108.9	44	-51.2	107.9	43	-52.2	106.9	42	-53.2	105.9	41	-54.2	104.9	40	-55.2	103.9
37	46	-51.8	110.0	46	-52.8	109.0	45	-53.8	108.0	44	-54.8	107.0	43	-55.8	106.0	42	-56.8	105.0	41	-57.8	104.0	40	-58.8	103.0
38	46	-55.4	109.1	46	-56.4	108.1	45	-57.4	107.1	44	-58.4	106.1	43	-59.4	105.1	42	-60.4	104.1	41	-61.4	103.1	40	-62.4	102.1
39	46	-59.0	108.2	46	-60.0	107.2	45	-61.0	106.2	44	-62.0	105.2	43	-63.0	104.2	42	-64.0	103.2	41	-65.0	102.2	40	-66.0	101.2
40	46	-62.6	107.3	46	-63.6	106.3	45	-64.6	105.3	44	-65.6	104.3	43	-66.6	103.3	42	-67.6	102.3	41	-68.6	101.3	40	-69.6	100.3
41	46	-66.2	106.4	46	-67.2	105.4	45	-68.2	104.4	44	-69.2	103.4	43	-70.2	102.4	42	-71.2	101.4	41	-72.2	100.4	40	-73.2	99.4
42	46	-69.8	105.5	46	-70.8	104.5	45	-71.8	103.5	44	-72.8	102.5	43	-73.8	101.5	42	-74.8	100.5	41	-75.8	99.5	40	-76.8	98.5
43	46	-73.4	104.6	46	-74.4	103.6	45	-75.4	102.6	44	-76.4	101.6	43	-77.4	100.6	42	-78.4	99.6	41	-79.4	98.6	40	-80.4	97.6
44	46	-77.0	103.7	46	-78.0	102.7	45	-79.0	101.7	44	-80.0	100.7	43	-81.0	99.7	42	-82.0	98.7	41	-83.0	97.7	40	-84.0	96.7
45	46	-80.6	102.8	46	-81.6	101.8	45	-82.6	100.8	44	-83.6	99.8	43	-84.6	98.8	42	-85.6	97.8	41	-86.6	96.8	40	-87.6	95.8
46	46	-84.2	101.9	46	-85.2	100.9	45	-86.2	99.9	44	-87.2	98.9	43	-88.2	97.9	42	-89.2	96.9	41	-90.2	95.9	40	-91.2	94.9
47	46	-87.8	101.0	46	-88.8	100.0	45	-89.8	99.0	44	-90.8	98.0	43	-91.8	97.0	42	-92.8	96.0	41	-93.8	95.0	40	-94.8	94.0
48	46	-91.4	100.1	46	-92.4	99.1	45	-93.4	98.1	44	-94.4	97.1	43	-95.4	96.1	42	-96.4	95.1	41	-97.4	94.1	40	-98.4	93.1
49	46	-95.0	99.2	46	-96.0	98.2	45	-97.0	97.2	44	-98.0	96.2	43	-99.0	95.2	42	-100.0	94.2	41	-101.0	93.2	40	-102.0	92.2
50	46	-98.6	98.3	46	-99.6	97.3	45	-100.6	96.3	44	-101.6	95.3	43	-102.6	94.3	42	-103.6	93.3	41	-104.6	92.3	40	-105.6	91.3
51	46	-102.2	97.4	46	-103.2	96.4	45	-104.2	95.4	44	-105.2	94.4	43	-106.2	93.4	42	-107.2	92.4	41	-108.2	91.4	40	-109.2	90.4
52	46	-105.8	96.5	46	-106.8	95.5	45	-107.8	94.5	44	-108.8	93.5	43	-109.8	92.5	42	-110.8	91.5	41	-111.8	90.5	40	-112.8	89.5
53	46	-109.4	95.6	46	-110.4	94.6	45	-111.4	93.6	44	-112.4	92.6	43	-113.4	91.6	42	-114.4	90.6	41	-115.4	89.6	40	-116.4	88.6
54	46	-113.0	94.7	46	-114.0	93.7	45	-115.0	92.7	44	-116.0	91.7	43	-117.0	90.7	42	-118.0	89.7	41	-119.0	88.7	40	-120.0	87.7
55	46	-116.6	93.																					

89°, 271° L.H.A.

LATITUDE SAME NAME AS DECLINATION

Dec.	38°			39°			40°			41°			42°			43°			44°			Dec.
	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s	
0	0	47.3	164	0	46.6	178	0	46.0	193	0	45.3	208	0	44.6	223	0	43.9	238	0	43.2	253	0
1	1	3.2	165	1	3.4	167	1	3.7	170	1	4.0	174	1	4.3	178	1	4.6	182	1	4.9	186	1
2	2	6.5	166	2	6.8	169	2	7.1	172	2	7.4	176	2	7.7	180	2	8.0	184	2	8.3	188	2
3	3	9.8	167	3	10.1	170	3	10.4	174	3	10.7	178	3	11.0	182	3	11.3	186	3	11.6	190	3
4	4	13.1	168	4	13.4	171	4	13.7	175	4	14.0	179	4	14.3	183	4	14.6	187	4	14.9	191	4
5	5	16.4	169	5	16.7	172	5	17.0	176	5	17.3	180	5	17.6	184	5	17.9	188	5	18.2	192	5
6	6	19.7	170	6	20.0	173	6	20.3	177	6	20.6	181	6	20.9	185	6	21.2	189	6	21.5	193	6
7	7	23.0	171	7	23.3	174	7	23.6	178	7	23.9	182	7	24.2	186	7	24.5	190	7	24.8	194	7
8	8	26.3	172	8	26.6	175	8	26.9	179	8	27.2	183	8	27.5	187	8	27.8	191	8	28.1	195	8
9	9	29.6	173	9	29.9	176	9	30.2	180	9	30.5	184	9	30.8	188	9	31.1	192	9	31.4	196	9
10	10	32.9	174	10	33.2	177	10	33.5	181	10	33.8	185	10	34.1	189	10	34.4	193	10	34.7	197	10
11	11	36.2	175	11	36.5	178	11	36.8	182	11	37.1	186	11	37.4	190	11	37.7	194	11	38.0	198	11
12	12	39.5	176	12	39.8	179	12	40.1	183	12	40.4	187	12	40.7	191	12	41.0	195	12	41.3	199	12
13	13	42.8	177	13	43.1	180	13	43.4	184	13	43.7	188	13	44.0	192	13	44.3	196	13	44.6	200	13
14	14	46.1	178	14	46.4	181	14	46.7	185	14	47.0	189	14	47.3	193	14	47.6	197	14	47.9	201	14
15	15	49.4	179	15	49.7	182	15	50.0	186	15	50.3	190	15	50.6	194	15	50.9	198	15	51.2	202	15
16	16	52.7	180	16	53.0	183	16	53.3	187	16	53.6	191	16	53.9	195	16	54.2	199	16	54.5	203	16
17	17	56.0	181	17	56.3	184	17	56.6	188	17	56.9	192	17	57.2	196	17	57.5	200	17	57.8	204	17
18	18	59.3	182	18	59.6	185	18	59.9	189	18	60.2	193	18	60.5	197	18	60.8	201	18	61.1	205	18
19	19	62.6	183	19	62.9	186	19	63.2	190	19	63.5	194	19	63.8	198	19	64.1	202	19	64.4	206	19
20	20	65.9	184	20	66.2	187	20	66.5	191	20	66.8	195	20	67.1	199	20	67.4	203	20	67.7	207	20
21	21	69.2	185	21	69.5	188	21	69.8	192	21	70.1	196	21	70.4	200	21	70.7	204	21	71.0	208	21
22	22	72.5	186	22	72.8	189	22	73.1	193	22	73.4	197	22	73.7	201	22	74.0	205	22	74.3	209	22
23	23	75.8	187	23	76.1	190	23	76.4	194	23	76.7	198	23	77.0	202	23	77.3	206	23	77.6	210	23
24	24	79.1	188	24	79.4	191	24	79.7	195	24	80.0	199	24	80.3	203	24	80.6	207	24	80.9	211	24
25	25	82.4	189	25	82.7	192	25	83.0	196	25	83.3	200	25	83.6	204	25	83.9	208	25	84.2	212	25
26	26	85.7	190	26	86.0	193	26	86.3	197	26	86.6	201	26	86.9	205	26	87.2	209	26	87.5	213	26
27	27	89.0	191	27	89.3	194	27	89.6	198	27	89.9	202	27	90.2	206	27	90.5	210	27	90.8	214	27
28	28	92.3	192	28	92.6	195	28	92.9	199	28	93.2	203	28	93.5	207	28	93.8	211	28	94.1	215	28
29	29	95.6	193	29	95.9	196	29	96.2	200	29	96.5	204	29	96.8	208	29	97.1	212	29	97.4	216	29
30	30	98.9	194	30	99.2	197	30	99.5	201	30	99.8	205	30	100.1	209	30	100.4	213	30	100.7	217	30
31	31	102.2	195	31	102.5	198	31	102.8	202	31	103.1	206	31	103.4	210	31	103.7	214	31	104.0	218	31
32	32	105.5	196	32	105.8	199	32	106.1	203	32	106.4	207	32	106.7	211	32	107.0	215	32	107.3	219	32
33	33	108.8	197	33	109.1	200	33	109.4	204	33	109.7	208	33	110.0	212	33	110.3	216	33	110.6	220	33
34	34	112.1	198	34	112.4	201	34	112.7	205	34	113.0	209	34	113.3	213	34	113.6	217	34	113.9	221	34
35	35	115.4	199	35	115.7	202	35	116.0	206	35	116.3	210	35	116.6	214	35	116.9	218	35	117.2	222	35
36	36	118.7	200	36	119.0	203	36	119.3	207	36	119.6	211	36	119.9	215	36	120.2	219	36	120.5	223	36
37	37	122.0	201	37	122.3	204	37	122.6	208	37	122.9	212	37	123.2	216	37	123.5	220	37	123.8	224	37
38	38	125.3	202	38	125.6	205	38	125.9	209	38	126.2	213	38	126.5	217	38	126.8	221	38	127.1	225	38
39	39	128.6	203	39	128.9	206	39	129.2	210	39	129.5	214	39	129.8	218	39	130.1	222	39	130.4	226	39
40	40	131.9	204	40	132.2	207	40	132.5	211	40	132.8	215	40	133.1	219	40	133.4	223	40	133.7	227	40
41	41	135.2	205	41	135.5	208	41	135.8	212	41	136.1	216	41	136.4	220	41	136.7	224	41	137.0	228	41
42	42	138.5	206	42	138.8	209	42	139.1	213	42	139.4	217	42	139.7	221	42	140.0	225	42	140.3	229	42
43	43	141.8	207	43	142.1	210	43	142.4	214	43	142.7	218	43	143.0	222	43	143.3	226	43	143.6	230	43
44	44	145.1	208	44	145.4	211	44	145.7	215	44	146.0	219	44	146.3	223	44	146.6	227	44	146.9	231	44
45	45	148.4	209	45	148.7	212	45	149.0	216	45	149.3	220	45	149.6	224	45	149.9	228	45	150.2	232	45
46	46	151.7	210	46	152.0	213	46	152.3	217	46	152.6	221	46	152.9	225	46	153.2	229	46	153.5	233	46
47	47	155.0	211	47	155.3	214	47	155.6	218	47	155.9	222	47	156.2	226	47	156.5	230	47	156.8	234	47
48	48	158.3	212	48	158.6	215	48	158.9	219	48	159.2	223	48	159.5	227	48	159.8	231	48	160.1	235	48
49	49	161.6	213	49	161.9	216	49	162.2	220	49	162.5	224	49	162.8	228	49	163.1	232	49	163.4	236	49
50	50	164.9	214	50	165.2	217	50	165.5	221	50	165.8	225	50	166.1	229	50	166.4	233	50	166.7	237	50
51	51	168.2	215	51	168.5	218	51	168.8	222	51	169.1	226	51	169.4	230	51	169.7	234	51	170.0	238	51
52	52	171.5	216	52	171.8	219	52	172.1	223	52	172.4	227	52	172.7	231	52	173.0	235	52	173.3	239	52
53	53	174.8	217	53	175.1	220	53	175.4	224	53	175.7	228	53	176.0	232	53	176.3	236	53	176.6	240	53
54	54	178.1	218	54	178.4	221	54	178.7	225	54	179.0	229	54	179.3	233	54	179.6	237	54	179.9	241	54
55	55	181.4	219	55	181.7	222	55	182.0	226	55	182.3	230	55	182.6	234	55	182.9	238	55	183.2	242	55
56	56	184.7	220	56	185.0	223	56	185.3	227	56	185.6	231	56	185.9	235	56	186.2	239	56	186.5	243	56
57	57	188.0	221	57	188.3	224	57	188.6	228	57	188.9	232	57	189.2	236	57	189.5	240	57	189.8	244	57
58	58	191.3	222	58	191.6	225	58	191.9	229	58	192.2	233	58	192.5	237	58	192.8	241	58	193.1	245	58
59	59	194.6	223	59	194.9	226	59	195.2	230	59	195.5	234	59	195.8	238	59	196.1	242	59	196.4	246	59
60	60	197.9	224	60	198.2	227	60	198.5	231	60	198.8	235	60	199.1	239	60	199.4	243	60	199.7	247	60
61	61	201.2	225	61	201.5	228	61	201.8	232	61	202.1	236	61	202.4	240	61	202.7	244	61	203.0	248	61
62	62	204.5	226	62	204.8	229	62	205.1	233	62	205.4	237	62	205.7	241	62	206.0	245	62	206.3	249	62
63	63	207.8	227	63	208.1	230	63	208.4	234	63												

33°, 327° L.H.A.

LATITUDE SAME NAME AS DECLINATION

Dec.	38°			39°			40°			41°			42°			43°			44°			Dec.
	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z	H	d	Z	
0	41 22.8	41	122.2	42 40.2	41	124.1	43 58.6	41	126.0	45 17.0	41	127.9	46 35.4	41	129.8	47 53.8	41	131.7	49 12.2	41	133.6	50 30.6
1	42 11.1	41	133.7	43 30.2	41	135.6	44 49.7	41	137.5	46 09.2	41	139.4	47 28.7	41	141.3	48 48.2	41	143.2	50 07.7	41	145.1	51 27.2
2	42 39.9	41	137.3	43 59.3	41	139.4	45 18.8	41	141.3	46 38.3	41	143.2	47 57.8	41	145.1	49 17.3	41	147.0	50 36.8	41	148.9	51 56.3
3	43 08.7	41	140.9	44 28.0	41	142.0	45 47.5	41	143.9	47 06.9	41	145.8	48 26.4	41	147.7	49 45.9	41	149.6	51 05.4	41	151.5	52 24.9
4	43 37.5	41	144.5	44 57.2	41	145.1	46 16.9	41	147.0	47 36.4	41	148.9	48 55.9	41	150.8	50 15.4	41	152.7	51 34.9	41	154.6	52 54.4
5	44 06.3	41	148.1	45 26.0	41	148.7	46 46.1	41	150.6	48 05.6	41	152.5	49 25.1	41	154.4	50 44.6	41	156.3	52 03.9	41	158.2	53 23.4
6	44 35.1	41	151.7	45 54.8	41	152.3	47 05.6	41	154.5	49 24.1	41	156.4	50 42.6	41	158.3	52 01.4	41	160.2	53 20.9	41	162.1	54 42.9
7	45 03.9	41	155.3	46 23.6	41	155.9	47 25.1	41	157.8	50 42.6	41	159.7	52 00.9	41	161.6	53 19.4	41	163.5	54 38.4	41	165.4	56 00.4
8	45 32.7	41	158.9	46 52.4	41	159.5	48 24.6	41	161.4	52 00.9	41	163.3	53 18.9	41	165.2	54 37.9	41	167.1	55 57.9	41	169.0	57 20.4
9	46 01.5	41	162.5	47 21.2	41	163.1	49 03.8	41	163.3	53 18.9	41	165.2	54 37.9	41	167.1	55 57.9	41	169.0	57 20.4	41	170.9	58 42.9
10	46 30.3	41	166.1	47 50.0	41	166.7	49 45.7	41	165.2	54 37.9	41	167.1	55 57.9	41	169.0	57 20.4	41	170.9	58 42.9	41	172.8	59 27.4
11	46 59.1	41	169.7	48 18.8	41	170.3	50 26.6	41	166.7	49 45.7	41	167.1	55 57.9	41	169.0	57 20.4	41	170.9	58 42.9	41	172.8	60 12.4
12	47 27.9	41	173.3	48 47.6	41	173.9	51 07.5	41	168.2	50 46.6	41	168.6	56 39.3	41	170.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4
13	47 56.7	41	176.9	49 16.4	41	176.5	51 28.4	41	170.7	51 28.4	41	170.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	176.2	61 42.4
14	48 25.5	41	180.5	49 45.2	41	181.1	52 09.3	41	174.9	52 09.3	41	174.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	176.1	62 27.4
15	48 54.3	41	184.1	50 14.0	41	184.7	52 30.2	41	179.3	52 30.2	41	179.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	176.0	63 12.4
16	49 23.1	41	187.7	50 42.8	41	188.3	53 11.1	41	183.9	53 11.1	41	183.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.9	63 57.4
17	49 51.9	41	191.3	51 11.6	41	191.9	53 52.0	41	189.5	53 52.0	41	189.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.8	64 42.4
18	50 20.7	41	194.9	51 40.4	41	195.5	54 32.9	41	195.1	54 32.9	41	195.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.7	65 27.4
19	50 49.5	41	198.5	52 09.2	41	199.1	55 13.8	41	200.7	55 13.8	41	200.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.6	66 12.4
20	51 18.3	41	202.1	52 38.0	41	202.7	55 54.7	41	206.3	55 54.7	41	206.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.5	66 57.4
21	51 47.1	41	205.7	53 06.8	41	206.3	56 35.6	41	210.9	56 35.6	41	210.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.4	67 42.4
22	52 15.9	41	209.3	53 35.6	41	210.9	57 16.5	41	215.5	57 16.5	41	215.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.3	68 27.4
23	52 44.7	41	212.9	54 04.4	41	214.5	57 57.4	41	220.1	57 57.4	41	220.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.2	69 12.4
24	53 13.5	41	216.5	54 33.2	41	218.1	58 38.3	41	224.7	58 38.3	41	224.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.1	69 57.4
25	53 42.3	41	220.1	55 02.0	41	221.7	59 19.2	41	229.3	59 19.2	41	229.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	175.0	70 42.4
26	54 11.1	41	223.7	55 30.8	41	225.3	60 00.1	41	233.9	60 00.1	41	233.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.9	71 27.4
27	54 39.9	41	227.3	56 00.0	41	228.9	60 41.0	41	238.5	60 41.0	41	238.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.8	72 12.4
28	55 08.7	41	230.9	56 28.8	41	232.5	61 21.9	41	243.1	61 21.9	41	243.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.7	72 57.4
29	55 37.5	41	234.5	56 57.6	41	236.1	62 02.8	41	247.7	62 02.8	41	247.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.6	73 42.4
30	56 06.3	41	238.1	57 26.4	41	239.7	62 43.7	41	252.3	62 43.7	41	252.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.5	74 27.4
31	56 35.1	41	241.7	57 55.2	41	243.3	63 24.6	41	256.9	63 24.6	41	256.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.4	75 12.4
32	57 03.9	41	245.3	58 24.0	41	246.9	64 05.5	41	261.5	64 05.5	41	261.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.3	75 57.4
33	57 32.7	41	248.9	58 52.8	41	250.5	64 46.4	41	266.1	64 46.4	41	266.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.2	76 42.4
34	58 01.5	41	252.5	59 21.6	41	254.1	65 27.3	41	270.7	65 27.3	41	270.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.1	77 27.4
35	58 30.3	41	256.1	59 50.4	41	257.7	66 08.2	41	275.3	66 08.2	41	275.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	174.0	78 12.4
36	58 59.1	41	259.7	60 19.2	41	261.3	66 49.1	41	280.9	66 49.1	41	280.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.9	78 57.4
37	59 27.9	41	263.3	60 48.0	41	264.9	67 30.0	41	285.5	67 30.0	41	285.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.8	79 42.4
38	59 56.7	41	266.9	61 16.8	41	268.5	68 10.9	41	290.1	68 10.9	41	290.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.7	80 27.4
39	60 25.5	41	270.5	61 45.6	41	272.1	68 91.8	41	294.7	68 91.8	41	294.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.6	81 12.4
40	60 54.3	41	274.1	62 14.4	41	275.7	69 72.7	41	299.3	69 72.7	41	299.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.5	81 57.4
41	61 23.1	41	277.7	62 43.2	41	279.3	70 53.6	41	303.9	70 53.6	41	303.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.4	82 42.4
42	61 51.9	41	281.3	63 12.0	41	282.9	71 34.5	41	308.5	71 34.5	41	308.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.3	83 27.4
43	62 20.7	41	284.9	63 40.8	41	286.5	72 15.4	41	313.1	72 15.4	41	313.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.2	84 12.4
44	62 49.5	41	288.5	64 09.6	41	290.1	72 56.3	41	317.7	72 56.3	41	317.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.1	84 57.4
45	63 18.3	41	292.1	64 38.4	41	293.7	73 37.2	41	322.3	73 37.2	41	322.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	173.0	85 42.4
46	63 47.1	41	295.7	65 07.2	41	297.3	74 18.1	41	326.9	74 18.1	41	326.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.9	86 27.4
47	64 15.9	41	299.3	65 36.0	41	300.9	74 99.0	41	331.5	74 99.0	41	331.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.8	87 12.4
48	64 44.7	41	302.9	66 04.8	41	304.5	75 39.9	41	336.1	75 39.9	41	336.1	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.7	87 57.4
49	65 13.5	41	306.5	66 33.6	41	308.1	76 20.8	41	340.7	76 20.8	41	340.7	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.6	88 42.4
50	65 42.3	41	310.1	67 02.4	41	311.7	77 01.7	41	345.3	77 01.7	41	345.3	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.5	89 27.4
51	66 11.1	41	313.7	67 31.2	41	315.3	77 82.6	41	349.9	77 82.6	41	349.9	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.4	90 12.4
52	66 39.9	41	317.3	68 00.0	41	318.9	78 63.5	41	354.5	78 63.5	41	354.5	58 00.8	41	172.4	59 11.3	41	174.3	60 57.4	41	172.3	

INTERPOLATION TABLE

Dec. Inc.	Altitude Difference (ft)										Double Second Diff. and Corr.						
	Tens					Decimals						Units					
	10'	20'	30'	40'	50'	0	1	2	3	4			5	6	7	8	9
36.0	6.0	12.0	18.0	24.0	30.0	.0	0.0	0.6	1.2	1.8	2.4	3.0	3.6	4.3	4.9	5.5	
36.1	6.0	12.0	18.0	24.0	30.1	.1	0.1	0.7	1.3	1.9	2.5	3.1	3.7	4.3	4.9	5.5	0.8
36.2	6.0	12.0	18.1	24.1	30.1	.2	0.1	0.7	1.3	1.9	2.6	3.2	3.8	4.4	5.0	5.6	2.2
36.3	6.0	12.1	18.1	24.2	30.2	.3	0.2	0.8	1.4	2.0	2.6	3.2	3.8	4.4	5.0	5.7	4.2
36.4	6.1	12.1	18.2	24.3	30.3	.4	0.2	0.9	1.5	2.1	2.7	3.3	3.9	4.5	5.1	5.7	3.9
36.5	6.1	12.2	18.3	24.3	30.4	.5	0.3	0.9	1.5	2.1	2.7	3.3	4.0	4.6	5.2	5.8	7.6
36.6	6.1	12.2	18.3	24.4	30.5	.6	0.4	1.0	1.6	2.2	2.8	3.4	4.0	4.6	5.2	5.8	9.3
36.7	6.1	12.3	18.4	24.5	30.6	.7	0.4	1.0	1.6	2.3	2.9	3.5	4.1	4.7	5.3	5.9	11.0
36.8	6.2	12.3	18.4	24.6	30.7	.8	0.5	1.1	1.7	2.3	2.9	3.5	4.1	4.7	5.4	6.0	12.7
36.9	6.2	12.3	18.5	24.6	30.8	.9	0.5	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	14.4
																	16.1
43.0	7.1	14.3	21.5	28.6	35.8	.0	0.0	0.7	1.4	2.2	2.9	3.6	4.3	5.1	5.8	6.5	18.7
43.1	7.2	14.3	21.5	28.7	35.9	.1	0.1	0.8	1.5	2.2	3.0	3.7	4.4	5.1	5.9	6.6	20.7
43.2	7.2	14.4	21.6	28.8	36.0	.2	0.1	0.9	1.6	2.3	3.0	3.8	4.5	5.2	5.9	6.7	22.7
43.3	7.2	14.4	21.6	28.9	36.1	.3	0.2	0.9	1.7	2.4	3.1	3.8	4.6	5.3	6.0	6.7	24.6
43.4	7.2	14.5	21.7	28.9	36.2	.4	0.2	1.0	1.7	2.5	3.2	3.9	4.6	5.4	6.1	6.8	26.6
43.5	7.3	14.5	21.8	29.0	36.3	.5	0.4	1.1	1.8	2.5	3.3	4.0	4.7	5.4	6.2	6.9	28.6
43.6	7.3	14.5	21.8	29.1	36.3	.6	0.4	1.2	1.9	2.6	3.3	4.1	4.8	5.5	6.2	7.0	30.3
43.7	7.3	14.6	21.9	29.2	36.4	.7	0.5	1.2	2.0	2.7	3.4	4.1	4.9	5.6	6.3	7.0	32.3
43.8	7.3	14.6	21.9	29.2	36.5	.8	0.6	1.3	2.0	2.8	3.5	4.2	4.9	5.7	6.4	7.1	34.5
43.9	7.4	14.7	22.0	29.3	36.6	.9	0.7	1.4	2.1	2.8	3.6	4.3	5.0	5.7	6.5	7.2	
44.0	7.3	14.6	22.0	29.3	36.6	.0	0.0	0.7	1.5	2.2	3.0	3.7	4.4	5.2	5.9	6.7	
44.1	7.3	14.7	22.0	29.4	36.7	.1	0.1	0.8	1.6	2.3	3.0	3.8	4.5	5.3	6.0	6.7	
44.2	7.3	14.7	22.1	29.4	36.8	.2	0.1	0.9	1.6	2.4	3.1	3.9	4.6	5.3	6.1	6.8	
44.3	7.4	14.8	22.1	29.5	36.9	.3	0.2	1.0	1.7	2.4	3.2	3.9	4.7	5.4	6.2	6.9	1.1
44.4	7.4	14.8	22.2	29.6	37.0	.4	0.3	1.0	1.8	2.5	3.3	4.0	4.7	5.5	6.2	7.0	3.2
44.5	7.4	14.8	22.3	29.7	37.1	.5	0.4	1.1	1.9	2.6	3.3	4.1	4.8	5.6	6.3	7.0	5.3
44.6	7.4	14.9	22.3	29.7	37.2	.6	0.4	1.2	1.9	2.7	3.4	4.2	4.9	5.6	6.4	7.1	7.5
44.7	7.5	14.9	22.4	29.8	37.3	.7	0.5	1.3	2.0	2.7	3.5	4.2	5.0	5.7	6.5	7.2	9.6
44.8	7.5	15.0	22.4	29.9	37.4	.8	0.6	1.3	2.1	2.8	3.6	4.3	5.0	5.8	6.5	7.3	11.7
44.9	7.5	15.0	22.5	30.0	37.5	.9	0.7	1.4	2.2	2.9	3.6	4.4	5.1	5.9	6.6	7.3	13.9
45.0	7.5	15.0	22.5	30.0	37.5	.0	0.0	0.8	1.5	2.3	3.0	3.8	4.5	5.3	6.1	6.8	16.0
45.1	7.5	15.0	22.5	30.0	37.6	.1	0.1	0.8	1.6	2.4	3.1	3.9	4.6	5.4	6.1	6.9	18.1
45.2	7.5	15.0	22.6	30.1	37.6	.2	0.2	0.9	1.7	2.4	3.2	3.9	4.7	5.5	6.2	7.0	20.3
45.3	7.5	15.1	22.6	30.2	37.7	.3	0.2	1.0	1.7	2.5	3.3	4.0	4.8	5.5	6.3	7.1	22.4
45.4	7.6	15.1	22.7	30.3	37.8	.4	0.3	1.1	1.8	2.6	3.3	4.1	4.9	5.6	6.4	7.1	24.5
45.5	7.6	15.2	22.8	30.3	37.9	.5	0.4	1.1	1.9	2.7	3.4	4.2	4.9	5.7	6.4	7.2	26.7
45.6	7.6	15.2	22.8	30.4	38.0	.6	0.5	1.2	2.0	2.7	3.5	4.2	5.0	5.8	6.5	7.3	28.8
45.7	7.6	15.3	22.9	30.5	38.1	.7	0.5	1.3	2.0	2.8	3.6	4.3	5.1	5.8	6.6	7.4	30.9
45.8	7.7	15.3	22.9	30.6	38.2	.8	0.6	1.4	2.1	2.9	3.6	4.4	5.2	5.9	6.7	7.4	33.1
45.9	7.7	15.3	23.0	30.6	38.3	.9	0.7	1.4	2.2	3.0	3.7	4.5	5.2	6.0	6.7	7.5	35.2
58.0	9.6	19.3	29.0	38.6	48.3	.0	0.0	1.0	1.9	2.9	3.9	4.9	5.8	6.8	7.8	8.8	
58.1	9.7	19.3	29.0	38.7	48.4	.1	0.1	1.1	2.0	3.0	4.0	5.0	5.9	6.9	7.9	8.9	8.2
58.2	9.7	19.4	29.1	38.8	48.5	.2	0.2	1.2	2.1	3.1	4.1	5.1	6.0	7.0	8.0	9.0	24.6
58.3	9.7	19.4	29.1	38.9	48.6	.3	0.3	1.3	2.2	3.2	4.2	5.2	6.1	7.1	8.1	9.1	41.0
58.4	9.7	19.5	29.2	38.9	48.7	.4	0.4	1.4	2.3	3.3	4.3	5.3	6.2	7.2	8.2	9.2	8.2
58.5	9.8	19.5	29.3	39.0	48.8	.5	0.5	1.5	2.4	3.4	4.4	5.4	6.3	7.3	8.3	9.3	24.6
58.6	9.8	19.5	29.3	39.1	48.8	.6	0.6	1.6	2.5	3.5	4.5	5.5	6.4	7.4	8.4	9.4	41.0
58.7	9.8	19.6	29.4	39.2	48.9	.7	0.7	1.7	2.6	3.6	4.6	5.6	6.5	7.5	8.5	9.5	
58.8	9.8	19.6	29.4	39.2	49.0	.8	0.8	1.8	2.7	3.7	4.7	5.7	6.6	7.6	8.6	9.6	
58.9	9.9	19.7	29.5	39.3	49.1	.9	0.9	1.9	2.8	3.8	4.8	5.8	6.7	7.7	8.7	9.7	
59.0	9.8	19.6	29.5	39.3	49.1	.0	0.0	1.0	2.0	3.0	4.0	5.0	5.9	6.9	7.9	8.9	
59.1	9.8	19.7	29.5	39.4	49.2	.1	0.1	1.1	2.1	3.1	4.1	5.1	6.0	7.0	8.0	9.0	16.2
59.2	9.8	19.7	29.6	39.4	49.3	.2	0.2	1.2	2.2	3.2	4.2	5.2	6.1	7.1	8.1	9.1	48.6
59.3	9.9	19.8	29.6	39.5	49.4	.3	0.3	1.3	2.3	3.3	4.3	5.3	6.2	7.2	8.2	9.2	
59.4	9.9	19.8	29.7	39.6	49.5	.4	0.4	1.4	2.4	3.4	4.4	5.4	6.3	7.3	8.3	9.3	
59.5	9.9	19.8	29.8	39.7	49.6	.5	0.5	1.5	2.5	3.5	4.5	5.5	6.4	7.4	8.4	9.4	
59.6	9.9	19.9	29.8	39.7	49.7	.6	0.6	1.6	2.6	3.6	4.6	5.6	6.5	7.5	8.5	9.5	
59.7	10.0	19.9	29.9	39.8	49.8	.7	0.7	1.7	2.7	3.7	4.7	5.7	6.6	7.6	8.6	9.6	0.0
59.8	10.0	20.0	29.9	39.9	49.9	.8	0.8	1.8	2.8	3.8	4.8	5.8	6.7	7.7	8.7	9.7	48.2
59.9	10.0	20.0	30.0	40.0	50.0	.9	0.9	1.9	2.9	3.9	4.9	5.9	6.8	7.8	8.8	9.8	
	10'	20'	30'	40'	50'		0	1	2	3	4	5	6	7	8	9	

The Double-Second-Difference correction (Corr.) is always to be added to the tabulated altitude.