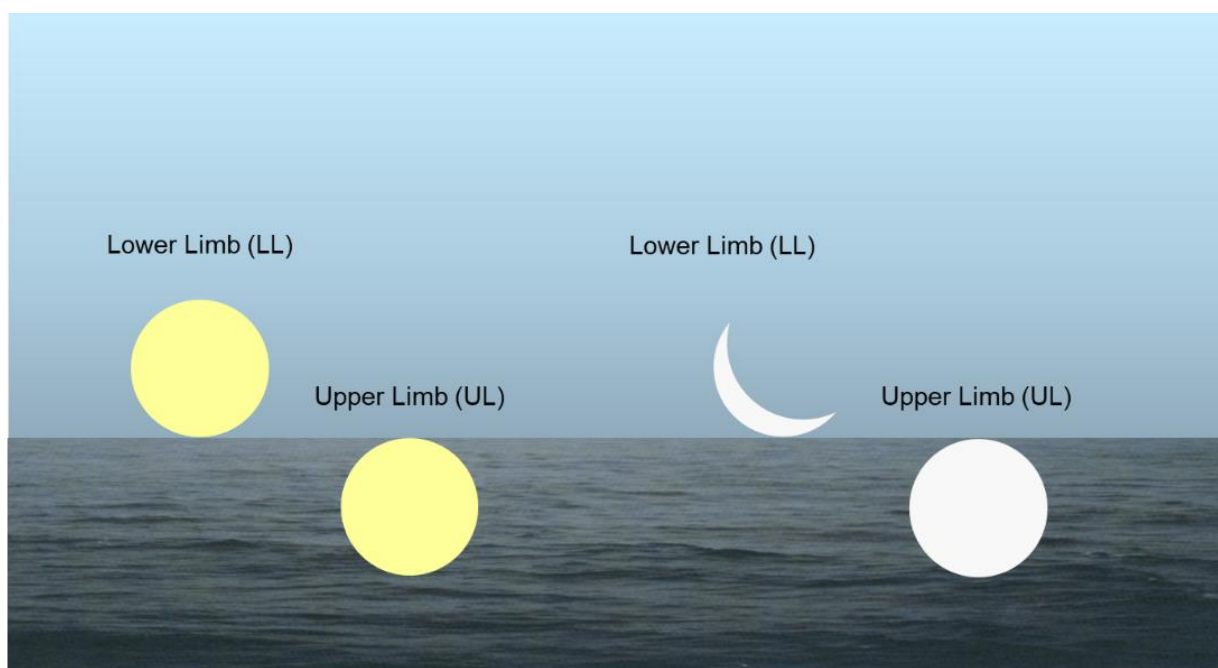


Celestial Navigation

Lesson 1.8

Sextant Altitude Corrections



Note

This Lesson describes the principles of the corrections to be made to the Sextant Altitude to obtain the True Altitude of a body; it is NOT essential that you have a full knowledge of these; just how to apply the corrections which are covered in the next Lesson.

Lesson 1.8

Sextant Altitude Corrections

So far we have learnt how to take an altitude observation of a celestial body to obtain the Sextant Altitude and how to apply the Index Error (IE) to obtain the Observed Altitude.

A number of further corrections need to be made to obtain the True Altitude. The additional corrections are to be found in tables in the Nautical Almanac.

Correction tables are also available in Norie's Nautical Tables but these are seldom used now and will not be referred to in these notes.

Horizons, altitudes and corrections

Figure 1 illustrates the corrections to be applied to the Observed Altitude of a celestial body to obtain the True Altitude of the body.

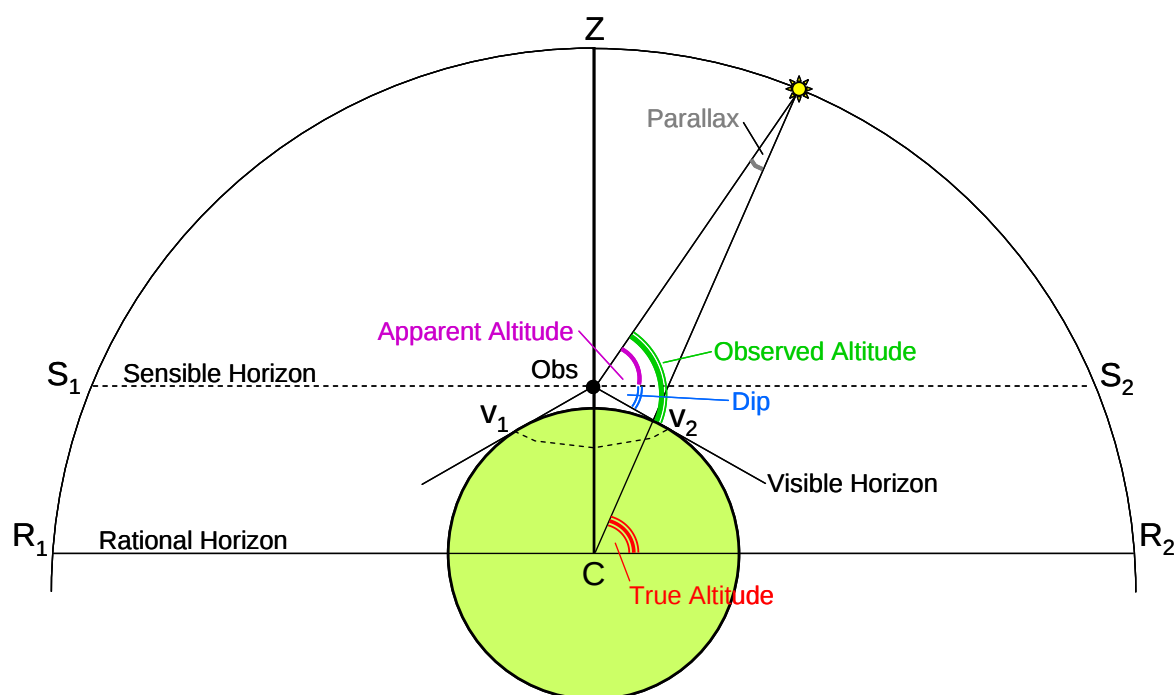


Fig. 1 - Horizons and altitude corrections.

In figure 1:

The Sensible Horizon (S_1S_2) is the circle whose plane passes through the observer at right angles to the vertical (the vertical being a direction directly above the observer to the observer's Zenith).

Refraction

Light rays from the body are refracted in a curved path on passing through the Earth's atmosphere. This results in the body appearing higher in the observer's sky than it really is. The correction for refraction is therefore *always negative* and its magnitude depends on two basic factors:

(1) The altitude of the body

The lower the altitude the more obliquely the light rays strike the atmosphere and the greater is the refraction. Thus; refraction is maximum at altitude 0° and diminishes with altitude until it disappears altogether when the body is at the Observer's Zenith (Z being at altitude 90°) since the light rays then strike the atmosphere at the normal.

(2) Density of the atmosphere

This is governed by two factors:

- (a) Temperature;
- (b) Pressure.

Theoretically allowance should be made for these factors when considering a value for refraction. In practice however, provided that the altitude is not too low the temperature/pressure correction is very small and can be ignored for examination purposes.

The total correction tables A2 and A3 in the Nautical Almanac take the effects of refraction into consideration.

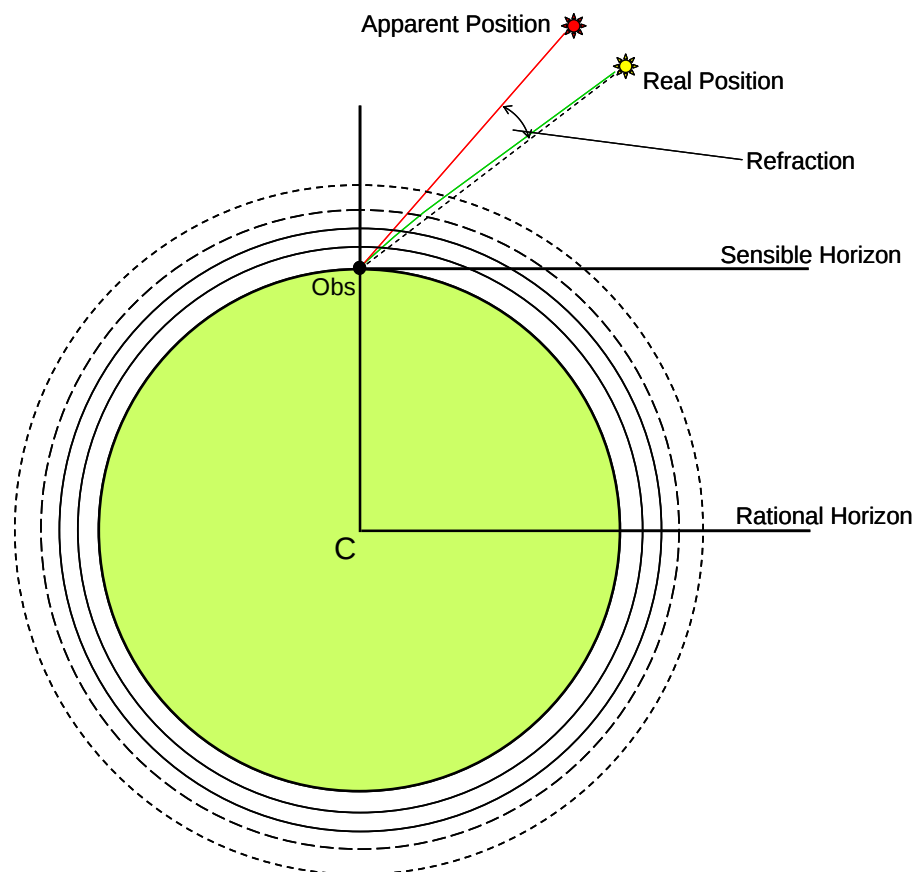


Fig. 3 - Atmospheric refraction.

Semi-diameter (SD)

Stars and planets can be considered as point sources of light and thus have no angular diameter to the observer.

The Sun and Moon have considerable angular size because they are so close. It is not possible to estimate their centres with sufficient accuracy and therefore it is necessary to observe the body's edge or 'limb'. A correction is then applied to the altitude equal to half the body's diameter and thus the altitude of the *centre* of the body is found - see figures 4 and 5.

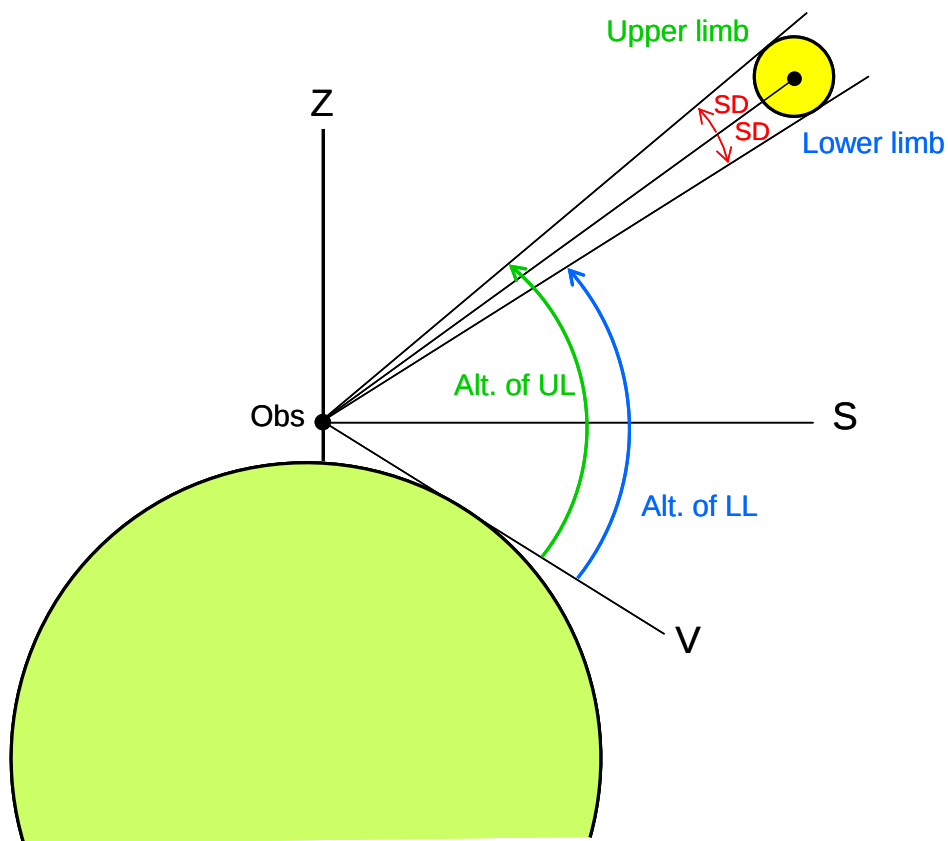


Fig. 4 - Upper and lower limb altitudes.

The sign of application for the correction will depend upon which limb is observed.

The sign of application is accounted for in the altitude correction tables in the Nautical Almanac.

It is usual for the navigator to observe the Lower Limb for observations.

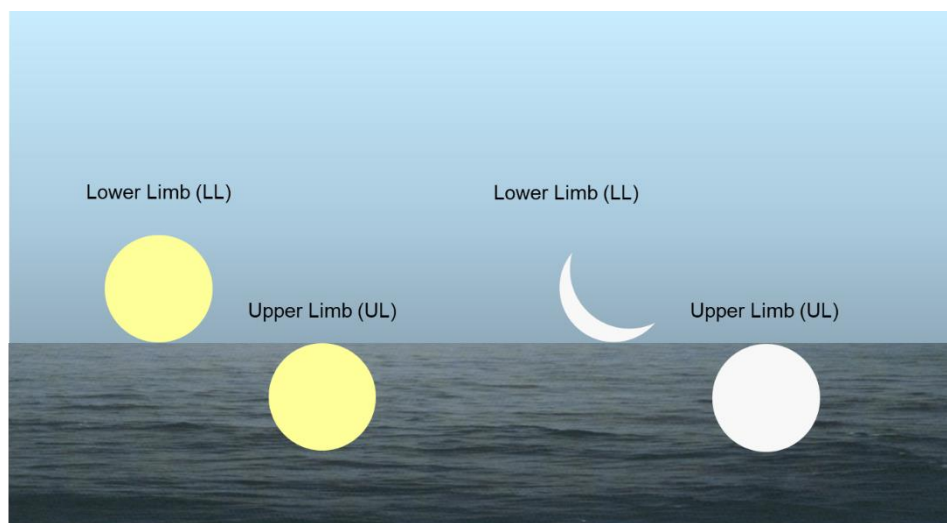


Fig. 5 - Lower and Upper limb sights.

The magnitude of the SD correction depends on two factors:

- (1) The physical size of the body;
- (2) The distance of the body from the observer.

The distance of the Sun from the Earth varies throughout the year (Kepler's Law 1st Law - see Lesson 2.1) and thus the value of the Sun's SD will also vary in an annual cycle. The value of the Sun's SD is tabulated in the Nautical Almanac on a 3-day basis for the middle day in the daily pages.

The Moon's SD changes much more rapidly since its orbit around the Earth has a monthly cycle and is therefore tabulated in the Nautical Almanac on a daily basis.

Augmentation of the Moon's semi-diameter

Since the Moon is so close to the Earth the Earth's radius forms a significant proportion of the Moon's orbital radius (approximately 2%). Thus, the greater the Moon's altitude the closer is the observer and the larger will be its SD (figure 6). The SD tabulated in the Nautical Almanac assumes the observer to be at the centre of the Earth and the distance of the Moon from the centre of the Earth is substantially the same as when its altitude is zero. As the altitude increases so the SD must be augmented (increased).

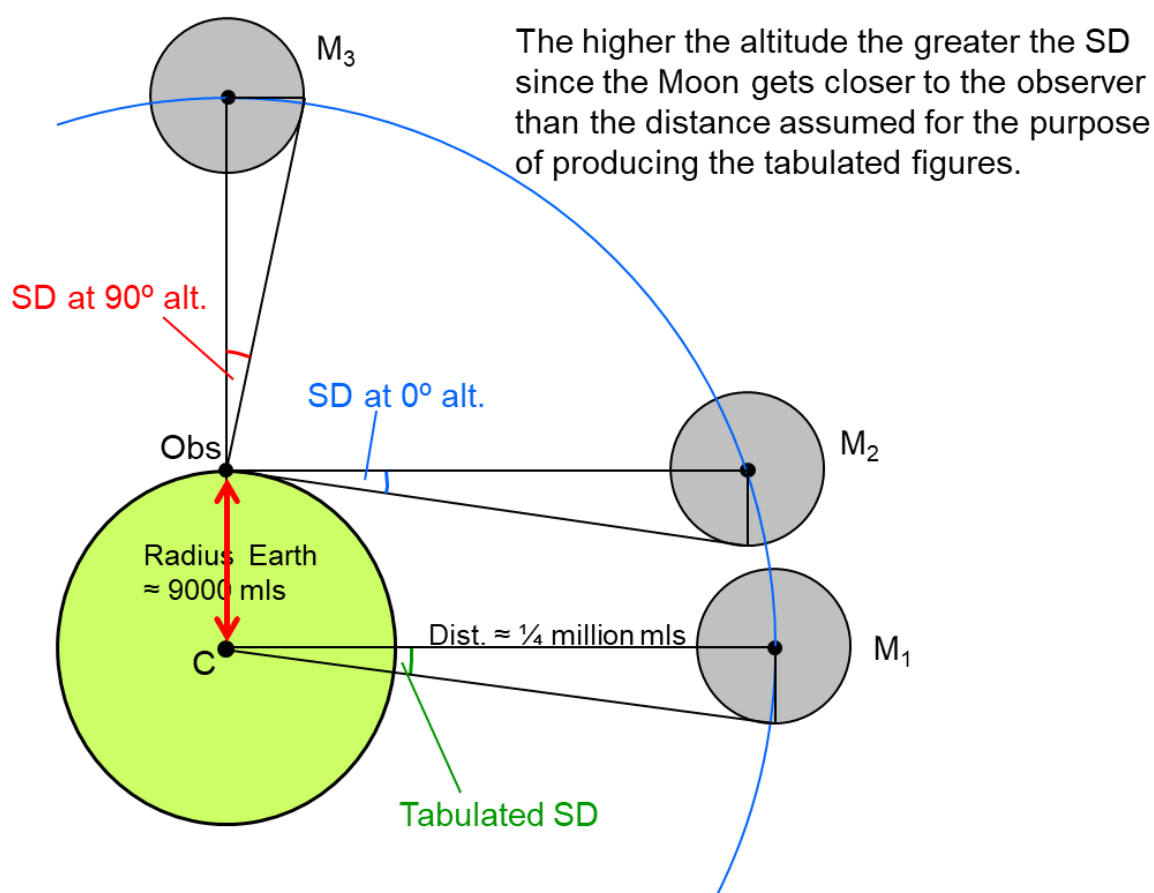


Fig. 6 - Augmentation of the Moon's semi diameter.

Parallax

This is the angle subtended at the centre of the body between the observer and the centre of the Earth. Horizontal Parallax (HP) is the maximum value for parallax and occurs when the body is on the *Sensible Horizon* (apparent altitude = 0°).

As soon as the body rises above the Sensible Horizon the parallax angle becomes known as *parallax in altitude* and its value decreases with increase in altitude and disappears altogether when the body is at the observer's zenith (altitude 90°) - see figure 7.

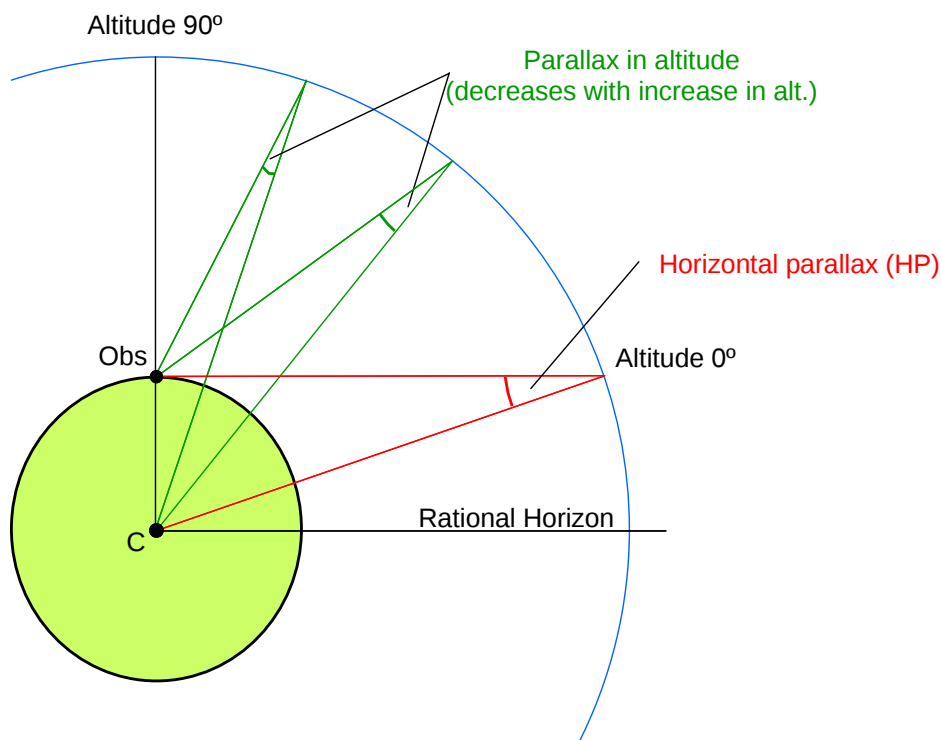


Fig. 7 - Parallax.

The value of HP depends on the radius of the Earth (which is constant) and the distance the body is away from the Earth. The Moon is very close and therefore has a large HP of approximately 1° and this value changes considerably due to the eccentricity of the Moon's orbit. The Moon's HP is tabulated hourly in the Nautical Almanac.

The Sun is much further away from the Earth and its HP is therefore much smaller ($0.2'$). The Sun's HP can be considered constant since the variation caused by the eccentricity of the Earth's orbit is very small.

The stars are so far away that parallax is infinitely small. The planets generally are also too far away for parallax to be significant however both Mars and Venus can approach close enough to the Earth for parallax to become large enough to need correcting for. An additional correction for parallax in altitude for Venus and Mars can be found in the stars and planets correction table in the Nautical Almanac (Table A2).

Parallax is accounted for in the correction tables in the Nautical Almanac.

Appendix 1

Altitude correction Tables A2 and A3 for the Sun, planets and Stars

A2 ALTITUDE CORRECTION TABLES 10°-90°—SUN, STARS, PLANETS

OCT.—MAR. SUN			APR.—SEPT.			STARS AND PLANETS			DIP		
App. Alt.	Lower Limb	Upper Limb	App. Alt.	Lower Limb	Upper Limb	App. Alt.	Corr ⁿ	App. Alt. Additional Corr ⁿ	Ht. of Eye	Corr ⁿ	Ht. of Eye
9 34	+10.8	-21.5	9 39	+10.6	-21.2	9 56	-5.3	0000	m		ft.
9 45	+10.9	-21.4	9 51	+10.7	-21.1	10 08	-5.2	VENUS	2.4	-2.8	8.0
9 56	+11.0	-21.3	10 03	+10.8	-21.0	10 20	-5.1	Jan. 1-Jan. 29	2.6	-2.9	8.6
10 08	+11.1	-21.2	10 15	+10.9	-20.9	10 33	-5.0	0 + 0.2	2.8	-3.0	9.2
10 21	+11.2	-21.1	10 27	+11.0	-20.8	10 46	-4.9	47 + 0.2	3.0	-3.1	9.8
10 34	+11.3	-21.0	10 40	+11.1	-20.7	11 00	-4.8	Jan. 30-Feb. 26	3.2	-3.1	10.5
10 47	+11.4	-20.9	10 54	+11.2	-20.6	11 14	-4.7	0 + 0.3	3.4	-3.3	11.2
11 01	+11.5	-20.8	11 08	+11.3	-20.5	11 29	-4.6	46 + 0.3	3.6	-3.4	11.9
11 15	+11.6	-20.7	11 23	+11.4	-20.4	11 45	-4.5	Feb. 27-Mar. 14	3.8	-3.5	12.6
11 30	+11.7	-20.6	11 38	+11.5	-20.3	12 01	-4.4	0 + 0.4	4.0	-3.6	13.3
11 46	+11.8	-20.5	11 54	+11.6	-20.2	12 18	-4.3	11 + 0.5	4.3	-3.7	14.1
12 02	+11.9	-20.4	12 10	+11.7	-20.1	12 35	-4.2	41 + 0.5	4.5	-3.8	14.9
12 19	+12.0	-20.3	12 28	+11.8	-20.0	12 54	-4.1	Mar. 15-Mar. 23	4.7	-3.9	15.7
12 37	+12.1	-20.2	12 46	+11.9	-19.9	13 13	-4.0	0 + 0.5	5.0	-4.0	16.5
12 55	+12.2	-20.1	13 05	+12.0	-19.8	13 33	-3.9	6 + 0.5	5.2	-4.1	17.4
13 14	+12.3	-20.0	13 24	+12.1	-19.7	13 54	-3.8	20 + 0.6	5.5	-4.2	18.3
13 35	+12.4	-19.9	13 45	+12.2	-19.6	14 16	-3.7	31 + 0.7	5.8	-4.3	19.1
13 56	+12.5	-19.8	14 07	+12.3	-19.5	14 40	-3.6	Mar. 24-Apr. 19	6.1	-4.4	20.1
14 18	+12.6	-19.7	14 30	+12.4	-19.4	15 04	-3.5	0 + 0.6	6.3	-4.5	21.0
14 42	+12.7	-19.6	15 19	+12.5	-19.3	15 57	-3.4	4 + 0.6	6.6	-4.6	22.0
15 06	+12.8	-19.5	15 46	+12.6	-19.2	16 26	-3.3	12 + 0.7	6.9	-4.7	22.9
15 32	+12.9	-19.4	16 14	+12.8	-19.0	16 56	-3.2	22 + 0.8	7.2	-4.8	23.9
15 59	+13.0	-19.3	16 44	+12.9	-18.9	17 28	-3.1	Apr. 20-Apr. 28	7.5	-4.9	24.9
16 28	+13.1	-19.2	17 15	+13.0	-18.8	18 02	-3.0	0 + 0.5	7.9	-5.0	26.0
16 59	+13.2	-19.1	17 48	+13.1	-18.7	18 38	-2.9	6 + 0.5	8.2	-5.1	27.1
17 32	+13.3	-19.0	18 24	+13.2	-18.6	19 17	-2.8	20 + 0.6	8.5	-5.2	28.1
18 06	+13.4	-18.9	19 01	+13.3	-18.5	19 58	-2.6	31 + 0.7	8.8	-5.3	29.2
18 42	+13.5	-18.8	19 42	+13.4	-18.4	20 42	-2.5	Apr. 29-May 13	9.2	-5.4	30.4
19 21	+13.6	-18.7	20 25	+13.5	-18.3	21 28	-2.4	0 + 0.4	9.5	-5.5	31.5
20 03	+13.7	-18.6	21 11	+13.6	-18.2	22 19	-2.3	11 + 0.5	9.9	-5.6	32.7
20 48	+13.8	-18.5	22 00	+13.7	-18.1	23 13	-2.2	41 + 0.5	10.3	-5.7	33.9
21 35	+13.9	-18.4	22 54	+13.8	-18.0	24 11	-2.1	May 14-June 8	10.6	-5.8	35.1
22 26	+14.0	-18.3	23 51	+13.9	-17.9	25 14	-2.0	0 + 0.3	11.0	-5.9	36.3
24 21	+14.2	-18.1	26 00	+14.0	-17.8	26 22	-1.9	46 + 0.3	11.4	-6.0	37.6
25 26	+14.3	-18.0	27 13	+14.1	-17.7	27 36	-1.8	June 9-July 23	11.8	-6.1	38.9
26 36	+14.4	-17.9	28 33	+14.3	-17.5	28 56	-1.7	0 + 0.2	12.2	-6.2	40.1
27 52	+14.5	-17.8	30 00	+14.4	-17.4	30 24	-1.6	47 + 0.2	12.6	-6.3	41.5
29 15	+14.6	-17.7	31 35	+14.5	-17.3	32 00	-1.5	July 24-Dec. 31	13.0	-6.4	42.8
30 46	+14.7	-17.6	33 20	+14.6	-17.2	33 45	-1.4	0 + 0.1	13.4	-6.5	44.2
32 26	+14.8	-17.5	35 17	+14.7	-17.1	35 40	-1.3	42 + 0.1	13.8	-6.6	45.5
34 17	+14.9	-17.4	37 26	+14.8	-17.0	37 48	-1.2	Nov. 13-Dec. 31	14.2	-6.7	46.9
36 20	+15.0	-17.3	39 50	+14.9	-16.9	40 08	-1.1	0 + 0.1	14.7	-6.8	48.4
38 36	+15.1	-17.2	42 31	+15.0	-16.8	42 44	-1.0	MARS	15.1	-6.9	49.8
41 08	+15.2	-17.1	45 31	+15.1	-16.7	45 36	-0.9	Jan. 1-Nov. 12	15.5	-7.0	51.3
43 59	+15.3	-17.0	48 55	+15.2	-16.6	48 47	-0.8	0 + 0.1	16.0	-7.1	52.8
47 10	+15.4	-16.9	52 44	+15.3	-16.5	52 18	-0.7	60 + 0.1	16.5	-7.2	54.3
50 46	+15.5	-16.8	57 02	+15.4	-16.4	56 11	-0.6	Nov. 13-Dec. 31	16.9	-7.3	55.8
54 49	+15.6	-16.7	61 51	+15.5	-16.3	60 28	-0.5	0 + 0.2	17.4	-7.4	57.4
59 23	+15.7	-16.6	67 17	+15.6	-16.2	65 08	-0.4	41 + 0.2	17.9	-7.5	58.9
64 30	+15.8	-16.5	73 16	+15.7	-16.1	70 11	-0.3	75 + 0.1	18.4	-7.6	60.5
70 12	+15.9	-16.4	79 43	+15.8	-16.0	75 34	-0.2	0 + 0.1	18.8	-7.7	62.1
76 26	+16.0	-16.3	86 32	+15.9	-15.9	81 13	-0.1		19.3	-7.8	63.8
83 05	+16.1	-16.2	90 00			87 03	0.0		19.8	-7.9	65.4
90 00						90 00			20.4	-8.0	67.1
									20.9	-8.1	68.8
									21.4	-8.1	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.

ALTITUDE CORRECTION TABLES 0°-10°-SUN, STARS, PLANETS A₃

App. Alt.	OCT.-MAR. SUN		APR.-SEPT.		STARS PLANETS
	Lower Limb	Upper Limb	Lower Limb	Upper Limb	
0 00	-18.2	-50.5	-18.4	-50.2	-34.5
03	17.5	49.8	17.8	49.6	33.8
06	16.9	49.2	17.1	48.9	33.2
09	16.3	48.6	16.5	48.3	32.6
12	15.7	48.0	15.9	47.7	32.0
15	15.1	47.4	15.3	47.1	31.4
0 18	-14.5	-46.8	-14.8	-46.6	-30.8
21	14.0	46.3	14.2	46.0	30.3
24	13.5	45.8	13.7	45.5	29.8
27	12.9	45.2	13.2	45.0	29.2
30	12.4	44.7	12.7	44.5	28.7
33	11.9	44.2	12.2	44.0	28.2
0 36	-11.5	-43.8	-11.7	-43.5	-27.8
39	11.0	43.3	11.2	43.0	27.3
42	10.5	42.8	10.8	42.6	26.8
45	10.1	42.4	10.3	42.1	26.4
48	9.6	41.9	9.9	41.7	25.9
51	9.2	41.5	9.5	41.3	25.5
0 54	- 8.8	-41.1	- 9.1	-40.9	-25.1
0 57	8.4	40.7	8.7	40.5	24.7
1 00	8.0	40.3	8.3	40.1	24.3
03	7.7	40.0	7.9	39.7	24.0
06	7.3	39.6	7.5	39.3	23.6
09	6.9	39.2	7.2	39.0	23.2
1 12	- 6.6	-38.9	- 6.8	-38.6	-22.9
15	6.2	38.5	6.5	38.3	22.5
18	5.9	38.2	6.2	38.0	22.2
21	5.6	37.9	5.8	37.6	21.9
24	5.3	37.6	5.5	37.3	21.6
27	4.9	37.2	5.2	37.0	21.2
1 30	- 4.6	-36.9	- 4.9	-36.7	-20.9
35	4.2	36.5	4.4	36.2	20.5
40	3.7	36.0	4.0	35.8	20.0
45	3.2	35.5	3.5	35.3	19.5
50	2.8	35.1	3.1	34.9	19.1
1 55	2.4	34.7	2.6	34.4	18.7
2 00	- 2.0	-34.3	- 2.2	-34.0	-18.3
05	1.6	33.9	1.8	33.6	17.9
10	1.2	33.5	1.5	33.3	17.5
15	0.9	33.2	1.1	32.9	17.2
20	0.5	32.8	0.8	32.6	16.8
25	- 0.2	32.5	0.4	32.2	16.5
2 30	+ 0.2	-32.1	- 0.1	-31.9	-16.1
35	0.5	31.8	+ 0.2	31.6	15.8
40	0.8	31.5	0.5	31.3	15.5
45	1.1	31.2	0.8	31.0	15.2
50	1.4	30.9	1.1	30.7	14.9
2 55	1.6	30.7	1.4	30.4	14.7
3 00	+ 1.9	-30.4	+ 1.7	-30.1	-14.4
05	2.2	30.1	1.9	29.9	14.1
10	2.4	29.9	2.1	29.7	13.9
15	2.6	29.7	2.4	29.4	13.7
20	2.9	29.4	2.6	29.2	13.4
25	3.1	29.2	2.9	28.9	13.2
3 30	+ 3.3	-29.0	+ 3.1	-28.7	-13.0

App. Alt.	OCT.-MAR. SUN		APR.-SEPT.		STARS PLANETS
	Lower Limb	Upper Limb	Lower Limb	Upper Limb	
3 30	+ 3.3	-29.0	+ 3.1	-28.7	-13.0
35	3.6	28.7	3.3	28.5	12.7
40	3.8	28.5	3.5	28.3	12.5
45	4.0	28.3	3.7	28.1	12.3
50	4.2	28.1	3.9	27.9	12.1
3 55	4.4	27.9	4.1	27.7	11.9
4 00	+ 4.5	-27.8	+ 4.3	-27.5	-11.8
05	4.7	27.6	4.5	27.3	11.6
10	4.9	27.4	4.6	27.2	11.4
15	5.1	27.2	4.8	27.0	11.2
20	5.2	27.1	5.0	26.8	11.1
25	5.4	26.9	5.1	26.7	10.9
4 30	+ 5.6	-26.7	+ 5.3	-26.5	-10.7
35	5.7	26.6	5.5	26.3	10.6
40	5.9	26.4	5.6	26.2	10.4
45	6.0	26.3	5.8	26.0	10.3
50	6.2	26.1	5.9	25.9	10.1
4 55	6.3	26.0	6.0	25.8	10.0
5 00	+ 6.4	-25.9	+ 6.2	-25.6	- 9.9
05	6.6	25.7	6.3	25.5	9.7
10	6.7	25.6	6.4	25.4	9.6
15	6.8	25.5	6.6	25.2	9.5
20	6.9	25.4	6.7	25.1	9.4
25	7.1	25.2	6.8	25.0	9.2
5 30	+ 7.2	-25.1	+ 6.9	-24.9	- 9.1
35	7.3	25.0	7.0	24.8	9.0
40	7.4	24.9	7.2	24.6	8.9
45	7.5	24.8	7.3	24.5	8.8
50	7.6	24.7	7.4	24.4	8.7
5 55	7.7	24.6	7.5	24.3	8.6
6 00	+ 7.8	-24.5	+ 7.6	-24.2	- 8.5
10	8.0	24.3	7.8	24.0	8.3
20	8.2	24.1	8.0	23.8	8.1
30	8.4	23.9	8.1	23.7	7.9
40	8.6	23.7	8.3	23.5	7.7
6 50	8.7	23.6	8.5	23.3	7.6
7 00	+ 8.9	-23.4	+ 8.6	-23.2	- 7.4
10	9.1	23.2	8.8	23.0	7.2
20	9.2	23.1	9.0	22.8	7.1
30	9.3	23.0	9.1	22.7	7.0
40	9.5	22.8	9.2	22.6	6.8
7 50	9.6	22.7	9.4	22.4	6.7
8 00	+ 9.7	-22.6	+ 9.5	-22.3	- 6.6
10	9.9	22.4	9.6	22.2	6.4
20	10.0	22.3	9.7	22.1	6.3
30	10.1	22.2	9.8	22.0	6.2
40	10.2	22.1	10.0	21.8	6.1
8 50	10.3	22.0	10.1	21.7	6.0
9 00	+ 10.4	-21.9	+ 10.2	-21.6	- 5.9
10	10.5	21.8	10.3	21.5	5.8
20	10.6	21.7	10.4	21.4	5.7
30	10.7	21.6	10.5	21.3	5.6
40	10.8	21.5	10.6	21.2	5.5
9 50	10.9	21.4	10.6	21.2	5.4
10 00	+ 11.0	-21.3	+ 10.7	-21.1	- 5.3

Additional corrections for temperature and pressure are given on the following page.

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

Appendix 2

Altitude correction for the Moon

ALTITUDE CORRECTION TABLES 0°-35°-MOON

App. Alt.	0°-4°	5°-9°	10°-14°	15°-19°	20°-24°	25°-29°	30°-34°	App. Alt.
	Corr ^a	Corr ^a	Corr ^a	Corr ^a	Corr ^a	Corr ^a	Corr ^a	
00	33.8	58.2	62.1	62.8	62.2	60.8	58.9	00
10	35.9	58.5	62.2	62.8	62.1	60.8	58.8	10
20	37.8	58.7	62.2	62.8	62.1	60.7	58.8	20
30	39.6	58.9	62.3	62.8	62.1	60.7	58.7	30
40	41.2	59.1	62.3	62.8	62.0	60.6	58.6	40
50	42.6	59.3	62.4	62.7	62.0	60.6	58.5	50
00	44.0	59.5	62.4	62.7	61.9	60.5	58.5	00
10	45.2	59.7	62.4	62.7	61.9	60.4	58.4	10
20	46.3	59.9	62.5	62.7	61.9	60.4	58.3	20
30	47.3	60.0	62.5	62.7	61.9	60.3	58.2	30
40	48.3	60.2	62.5	62.7	61.8	60.3	58.2	40
50	49.2	60.3	62.6	62.7	61.8	60.2	58.1	50
00	50.0	60.5	62.6	62.7	61.7	60.1	58.0	00
10	50.8	60.6	62.6	62.6	61.7	60.1	57.9	10
20	51.4	60.7	62.6	62.6	61.6	60.0	57.8	20
30	52.1	60.9	62.7	62.6	61.6	59.9	57.8	30
40	52.7	61.0	62.7	62.6	61.5	59.9	57.7	40
50	53.3	61.1	62.7	62.6	61.5	59.8	57.6	50
00	53.8	61.2	62.7	62.5	61.5	59.7	57.5	00
10	54.3	61.3	62.7	62.5	61.4	59.7	57.4	10
20	54.8	61.4	62.7	62.5	61.4	59.6	57.4	20
30	55.2	61.5	62.8	62.5	61.3	59.6	57.3	30
40	55.6	61.6	62.8	62.4	61.3	59.5	57.2	40
50	56.0	61.6	62.8	62.4	61.2	59.4	57.1	50
00	56.4	61.7	62.8	62.4	61.2	59.3	57.0	00
10	56.7	61.8	62.8	62.3	61.1	59.3	56.9	10
20	57.1	61.9	62.8	62.3	61.1	59.2	56.9	20
30	57.4	61.9	62.8	62.3	61.0	59.1	56.8	30
40	57.7	62.0	62.8	62.2	60.9	59.1	56.7	40
50	57.9	62.1	62.8	62.2	60.9	59.0	56.6	50
H.P.	L U	L U	L U	L U	L U	L U	L U	H.P.
54.0	0.3 0.9	0.3 0.9	0.4 1.0	0.5 1.1	0.6 1.2	0.7 1.3	0.9 1.5	54.0
54.3	0.7 1.1	0.7 1.2	0.7 1.2	0.8 1.3	0.9 1.4	1.1 1.5	1.2 1.7	54.3
54.6	1.1 1.4	1.1 1.4	1.1 1.4	1.2 1.5	1.3 1.6	1.4 1.7	1.5 1.8	54.6
54.9	1.4 1.6	1.5 1.6	1.5 1.6	1.6 1.7	1.6 1.8	1.8 1.9	1.9 2.0	54.9
55.2	1.8 1.8	1.8 1.8	1.9 1.9	1.9 1.9	2.0 2.0	2.1 2.1	2.2 2.2	55.2
55.5	2.2 2.0	2.2 2.0	2.3 2.1	2.3 2.1	2.4 2.2	2.4 2.3	2.5 2.4	55.5
55.8	2.6 2.2	2.6 2.2	2.6 2.3	2.7 2.3	2.7 2.4	2.8 2.4	2.9 2.5	55.8
56.1	3.0 2.4	3.0 2.5	3.0 2.5	3.0 2.5	3.1 2.6	3.1 2.6	3.2 2.7	56.1
56.4	3.4 2.7	3.4 2.7	3.4 2.7	3.4 2.7	3.4 2.8	3.5 2.8	3.5 2.9	56.4
56.7	3.7 2.9	3.7 2.9	3.8 2.9	3.8 2.9	3.8 3.0	3.8 3.0	3.9 3.0	56.7
57.0	4.1 3.1	4.1 3.1	4.1 3.1	4.1 3.1	4.2 3.1	4.2 3.2	4.2 3.2	57.0
57.3	4.5 3.3	4.5 3.3	4.5 3.3	4.5 3.3	4.5 3.3	4.5 3.4	4.6 3.4	57.3
57.6	4.9 3.5	4.9 3.5	4.9 3.5	4.9 3.5	4.9 3.5	4.9 3.5	4.9 3.6	57.6
57.9	5.3 3.8	5.3 3.8	5.2 3.8	5.2 3.7	5.2 3.7	5.2 3.7	5.2 3.7	57.9
58.2	5.6 4.0	5.6 4.0	5.6 4.0	5.6 4.0	5.6 3.9	5.6 3.9	5.6 3.9	58.2
58.5	6.0 4.2	6.0 4.2	6.0 4.2	6.0 4.2	6.0 4.1	5.9 4.1	5.9 4.1	58.5
58.8	6.4 4.4	6.4 4.4	6.4 4.4	6.3 4.4	6.3 4.3	6.3 4.3	6.2 4.2	58.8
59.1	6.8 4.6	6.8 4.6	6.7 4.6	6.7 4.6	6.7 4.5	6.6 4.5	6.6 4.4	59.1
59.4	7.2 4.8	7.1 4.8	7.1 4.8	7.1 4.8	7.0 4.7	7.0 4.7	6.9 4.6	59.4
59.7	7.5 5.1	7.5 5.0	7.5 5.0	7.5 5.0	7.4 4.9	7.3 4.8	7.2 4.7	59.7
60.0	7.9 5.3	7.9 5.3	7.9 5.2	7.8 5.2	7.8 5.1	7.7 5.0	7.6 4.9	60.0
60.3	8.3 5.5	8.3 5.5	8.2 5.4	8.2 5.4	8.1 5.3	8.0 5.2	7.9 5.1	60.3
60.6	8.7 5.7	8.7 5.7	8.6 5.7	8.6 5.6	8.5 5.5	8.4 5.4	8.2 5.3	60.6
60.9	9.1 5.9	9.0 5.9	9.0 5.9	8.9 5.8	8.8 5.7	8.7 5.6	8.6 5.4	60.9
61.2	9.5 6.2	9.4 6.1	9.4 6.1	9.3 6.0	9.2 5.9	9.1 5.8	8.9 5.6	61.2
61.5	9.8 6.4	9.8 6.3	9.7 6.3	9.7 6.2	9.5 6.1	9.4 5.9	9.2 5.8	61.5

DIP			
Ht. of Eye	Corr ^a	Ht. of Eye	Ht. of Eye
m	ft.	m	ft.
2.4	-2.8	8.0	9.5
2.6	-2.9	8.6	9.9
2.8	-3.0	9.2	10.3
3.0	-3.1	9.8	10.6
3.2	-3.2	10.5	11.0
3.4	-3.3	11.2	11.4
3.6	-3.4	11.9	11.8
3.8	-3.5	12.6	12.2
4.0	-3.6	13.3	12.6
4.3	-3.7	14.1	13.0
4.5	-3.8	14.9	13.4
4.7	-3.9	15.7	13.8
5.0	-4.0	16.5	14.2
5.2	-4.1	17.4	14.7
5.5	-4.2	18.3	15.1
5.8	-4.3	19.1	15.5
6.1	-4.4	20.1	16.0
6.3	-4.5	21.0	16.5
6.6	-4.6	22.0	16.9
6.9	-4.7	22.9	17.4
7.2	-4.8	23.9	17.9
7.5	-4.9	24.9	18.4
7.9	-5.0	26.0	18.8
8.2	-5.1	27.1	19.3
8.5	-5.2	28.1	19.8
8.8	-5.3	29.2	20.4
9.2	-5.4	30.4	20.9
9.5	-5.4	31.5	21.4

MOON CORRECTION TABLE

The correction is in two parts; the first correction is taken from the upper part of the table with argument apparent altitude, and the second from the lower part, with argument H.P., in the same column as that from which the first correction was taken. Separate corrections are given in the lower part for lower (L) and upper (U) limbs. All corrections are to be added to apparent altitude, but 30' is to be subtracted from the altitude of the upper limb.

For corrections for pressure and temperature see page A4.

For bubble sextant observations ignore dip, take the mean of upper and lower limb corrections and subtract 15' from the altitude.

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

ALTITUDE CORRECTION TABLES 35°-90°-MOON

App. Alt.	35°-39° Corr ⁿ	40°-44° Corr ⁿ	45°-49° Corr ⁿ	50°-54° Corr ⁿ	55°-59° Corr ⁿ	60°-64° Corr ⁿ	65°-69° Corr ⁿ	70°-74° Corr ⁿ	75°-79° Corr ⁿ	80°-84° Corr ⁿ	85°-89° Corr ⁿ	App. Alt.
00	35 56.5	40 53.7	45 50.5	50 46.9	55 43.1	60 38.9	65 34.6	70 30.1	75 25.3	80 20.5	85 15.6	00
10	56.4	53.6	50.4	46.8	42.9	38.8	34.4	29.9	25.2	20.4	15.5	10
20	56.3	53.5	50.2	46.7	42.8	38.7	34.3	29.7	25.0	20.2	15.3	20
30	56.2	53.4	50.1	46.5	42.7	38.5	34.1	29.6	24.9	20.0	15.1	30
40	56.2	53.3	50.0	46.4	42.5	38.4	34.0	29.4	24.7	19.9	15.0	40
50	56.1	53.2	49.9	46.3	42.4	38.2	33.8	29.3	24.5	19.7	14.8	50
00	36 56.0	41 53.1	46 49.8	51 46.2	56 42.3	61 38.1	66 33.7	71 29.1	76 24.4	81 19.6	86 14.6	00
10	55.9	53.0	49.7	46.0	42.1	37.9	33.5	29.0	24.2	19.4	14.5	10
20	55.8	52.8	49.5	45.9	42.0	37.8	33.4	28.8	24.1	19.2	14.3	20
30	55.7	52.7	49.4	45.8	41.8	37.7	33.2	28.7	23.9	19.1	14.1	30
40	55.6	52.6	49.3	45.7	41.7	37.5	33.1	28.5	23.8	18.9	14.0	40
50	55.5	52.5	49.2	45.5	41.6	37.4	32.9	28.3	23.6	18.7	13.8	50
00	37 55.4	42 52.4	47 49.1	52 45.4	57 41.4	62 37.2	67 32.8	72 28.2	77 23.4	82 18.6	87 13.7	00
10	55.3	52.3	49.0	45.3	41.3	37.1	32.6	28.0	23.3	18.4	13.5	10
20	55.2	52.2	48.8	45.2	41.2	36.9	32.5	27.9	23.1	18.2	13.3	20
30	55.1	52.1	48.7	45.0	41.0	36.8	32.3	27.7	22.9	18.1	13.2	30
40	55.0	52.0	48.6	44.9	40.9	36.6	32.2	27.6	22.8	17.9	13.0	40
50	55.0	51.9	48.5	44.8	40.8	36.5	32.0	27.4	22.6	17.8	12.8	50
00	38 54.9	43 51.8	48 48.4	53 44.6	58 40.6	63 36.4	68 31.9	73 27.2	78 22.5	83 17.6	88 12.7	00
10	54.8	51.7	48.2	44.5	40.5	36.2	31.7	27.1	22.3	17.4	12.5	10
20	54.7	51.6	48.1	44.4	40.3	36.1	31.6	26.9	22.1	17.3	12.3	20
30	54.6	51.5	48.0	44.2	40.2	35.9	31.4	26.8	22.0	17.1	12.2	30
40	54.5	51.4	47.9	44.1	40.1	35.8	31.3	26.6	21.8	16.9	12.0	40
50	54.4	51.2	47.8	44.0	39.9	35.6	31.1	26.5	21.7	16.8	11.8	50
00	39 54.3	44 51.1	49 47.6	54 43.9	59 39.8	64 35.5	69 31.0	74 26.3	79 21.5	84 16.6	89 11.7	00
10	54.2	51.0	47.5	43.7	39.6	35.3	30.8	26.1	21.3	16.5	11.5	10
20	54.1	50.9	47.4	43.6	39.5	35.2	30.7	26.0	21.2	16.3	11.4	20
30	54.0	50.8	47.3	43.5	39.4	35.0	30.5	25.8	21.0	16.1	11.2	30
40	53.9	50.7	47.2	43.3	39.2	34.9	30.4	25.7	20.9	16.0	11.0	40
50	53.8	50.6	47.0	43.2	39.1	34.7	30.2	25.5	20.7	15.8	10.9	50
H.P.	L U	L U	L U	L U	L U	L U	L U	L U	L U	L U	L U	H.P.
54.0	1.1 1.7	1.3 1.9	1.5 2.1	1.7 2.4	2.0 2.6	2.3 2.9	2.6 3.2	2.9 3.5	3.2 3.8	3.5 4.1	3.8 4.5	54.0
54.3	1.4 1.8	1.6 2.0	1.8 2.2	2.0 2.5	2.3 2.7	2.5 3.0	2.8 3.2	3.0 3.5	3.3 3.8	3.6 4.1	3.9 4.4	54.3
54.6	1.7 2.0	1.9 2.2	2.1 2.4	2.3 2.6	2.5 2.8	2.7 3.0	3.0 3.3	3.2 3.5	3.5 3.8	3.7 4.1	4.0 4.3	54.6
54.9	2.0 2.2	2.2 2.3	2.3 2.5	2.5 2.7	2.7 2.9	2.9 3.1	3.2 3.3	3.4 3.5	3.6 3.8	3.9 4.0	4.1 4.3	54.9
55.2	2.3 2.3	2.5 2.4	2.6 2.6	2.8 2.8	3.0 2.9	3.2 3.1	3.4 3.3	3.6 3.5	3.8 3.7	4.0 4.0	4.2 4.2	55.2
55.5	2.7 2.5	2.8 2.6	2.9 2.7	3.1 2.9	3.2 3.0	3.4 3.2	3.6 3.4	3.7 3.5	3.9 3.7	4.1 3.9	4.3 4.1	55.5
55.8	3.0 2.6	3.1 2.7	3.2 2.8	3.3 3.0	3.5 3.1	3.6 3.3	3.8 3.4	3.9 3.6	4.1 3.7	4.2 3.9	4.4 4.0	55.8
56.1	3.3 2.8	3.4 2.9	3.5 3.0	3.6 3.1	3.7 3.2	3.8 3.3	4.0 3.4	4.1 3.6	4.2 3.7	4.4 3.8	4.5 4.0	56.1
56.4	3.6 2.9	3.7 3.0	3.8 3.1	3.9 3.2	3.9 3.3	4.0 3.4	4.1 3.5	4.3 3.6	4.4 3.7	4.5 3.8	4.6 3.9	56.4
56.7	3.9 3.1	4.0 3.1	4.1 3.2	4.1 3.3	4.2 3.3	4.3 3.4	4.3 3.5	4.4 3.6	4.5 3.7	4.6 3.8	4.7 3.8	56.7
57.0	4.3 3.2	4.3 3.3	4.3 3.3	4.4 3.4	4.4 3.4	4.5 3.5	4.5 3.5	4.6 3.6	4.7 3.6	4.7 3.7	4.8 3.8	57.0
57.3	4.6 3.4	4.6 3.4	4.6 3.4	4.6 3.5	4.7 3.5	4.7 3.5	4.7 3.6	4.8 3.6	4.8 3.6	4.8 3.7	4.9 3.7	57.3
57.6	4.9 3.6	4.9 3.6	4.9 3.6	4.9 3.6	4.9 3.6	4.9 3.6	4.9 3.6	4.9 3.6	5.0 3.6	5.0 3.6	5.0 3.6	57.6
57.9	5.2 3.7	5.2 3.7	5.2 3.7	5.2 3.7	5.2 3.7	5.1 3.6	5.1 3.6	5.1 3.6	5.1 3.6	5.1 3.6	5.1 3.6	57.9
58.2	5.5 3.9	5.5 3.8	5.5 3.8	5.4 3.8	5.4 3.7	5.4 3.7	5.3 3.7	5.3 3.6	5.2 3.6	5.2 3.5	5.2 3.5	58.2
58.5	5.9 4.0	5.8 4.0	5.8 3.9	5.7 3.9	5.6 3.8	5.6 3.8	5.5 3.7	5.5 3.6	5.4 3.6	5.3 3.5	5.3 3.4	58.5
58.8	6.2 4.2	6.1 4.1	6.0 4.1	6.0 4.0	5.9 3.9	5.8 3.8	5.7 3.7	5.6 3.6	5.5 3.5	5.4 3.5	5.3 3.4	58.8
59.1	6.5 4.3	6.4 4.3	6.3 4.2	6.2 4.1	6.1 4.0	6.0 3.9	5.9 3.8	5.8 3.6	5.7 3.5	5.6 3.4	5.4 3.3	59.1
59.4	6.8 4.5	6.7 4.4	6.6 4.3	6.5 4.2	6.4 4.1	6.2 3.9	6.1 3.8	6.0 3.7	5.8 3.5	5.7 3.4	5.5 3.2	59.4
59.7	7.1 4.6	7.0 4.5	6.9 4.4	6.8 4.3	6.6 4.1	6.5 4.0	6.3 3.8	6.2 3.7	6.0 3.5	5.8 3.3	5.6 3.2	59.7
60.0	7.5 4.8	7.3 4.7	7.2 4.5	7.0 4.4	6.9 4.2	6.7 4.0	6.5 3.9	6.3 3.7	6.1 3.5	5.9 3.3	5.7 3.1	60.0
60.3	7.8 5.0	7.6 4.8	7.5 4.7	7.3 4.5	7.1 4.3	6.9 4.1	6.7 3.9	6.5 3.7	6.3 3.5	6.0 3.2	5.8 3.0	60.3
60.6	8.1 5.1	7.9 5.0	7.7 4.8	7.6 4.6	7.3 4.4	7.1 4.2	6.9 3.9	6.7 3.7	6.4 3.4	6.2 3.2	5.9 2.9	60.6
60.9	8.4 5.3	8.2 5.1	8.0 4.9	7.8 4.7	7.6 4.5	7.3 4.2	7.1 4.0	6.8 3.7	6.6 3.4	6.3 3.2	6.0 2.9	60.9
61.2	8.7 5.2	8.5 5.2	8.3 5.0	8.1 4.8	7.8 4.5	7.6 4.3	7.3 4.0	7.0 3.7	6.7 3.4	6.4 3.1	6.1 2.8	61.2
61.5	9.1 5.6	8.8 5.4	8.6 5.1	8.3 4.9	8.1 4.6	7.8 4.3	7.5 4.0	7.2 3.7	6.9 3.4	6.5 3.1	6.2 2.7	61.5