

Astronomy Department

Ready Reckoner and Altitude Correction Table

Number of minutes a , b , or Δd .

x +					$\frac{1}{\cos x}$																sec x	x -
	0.2	0.4	0.6	0.8		2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'			
0	.20	.40	.60	.80	1.00	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	1.00	180	
10	.20	.39	.59	.79	0.98	2.0	3.0	3.9	4.9	5.9	6.9	7.9	8.9	9.8	10.8	11.8	12.8	13.8	14.8	1.02	170	
20	.19	.39	.58	.78	.97	1.9	2.9	3.9	4.9	5.8	6.8	7.8	8.7	9.7	10.7	11.6	12.6	13.6	14.6	1.03	166	
16	.19	.38	.58	.77	.96	1.9	2.9	3.8	4.8	5.8	6.7	7.7	8.7	9.6	10.6	11.5	12.5	13.5	14.4	1.04	164	
18	.19	.38	.57	.76	.95	1.9	2.9	3.8	4.8	5.7	6.7	7.6	8.6	9.5	10.5	11.4	12.4	13.3	14.3	1.05	162	
20	.19	.38	.56	.75	0.94	1.9	2.8	3.8	4.7	5.6	6.6	7.5	8.5	9.4	10.3	11.3	12.2	13.2	14.1	1.06	160	
22	.19	.37	.56	.74	.93	1.9	2.8	3.7	4.6	5.6	6.5	7.4	8.3	9.3	10.2	11.1	12.1	13.0	13.9	1.08	158	
24	.18	.37	.55	.73	.91	1.8	2.7	3.7	4.6	5.5	6.4	7.3	8.2	9.1	10.0	11.0	11.9	12.8	13.7	1.09	156	
26	.18	.36	.54	.72	.90	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	1.11	154	
28	.18	.35	.53	.71	.88	1.8	2.6	3.5	4.4	5.3	6.2	7.1	7.9	8.8	9.7	10.6	11.5	12.4	13.2	1.13	152	
30	.17	.35	.52	.69	0.87	1.7	2.6	3.5	4.3	5.2	6.1	6.9	7.8	8.7	9.5	10.4	11.3	12.1	13.0	1.15	150	
31	.17	.34	.51	.69	.86	1.7	2.6	3.4	4.3	5.1	6.0	6.9	7.7	8.6	9.4	10.3	11.1	12.0	12.9	1.17	149	
32	.17	.34	.51	.68	.85	1.7	2.5	3.4	4.2	5.1	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	1.18	148	
33	.17	.34	.50	.67	.84	1.7	2.5	3.4	4.2	5.0	5.9	6.7	7.5	8.4	9.2	10.1	10.9	11.7	12.6	1.19	147	
34	.17	.33	.50	.66	.83	1.7	2.5	3.3	4.1	5.0	5.8	6.6	7.5	8.3	9.1	9.9	10.8	11.6	12.4	1.21	146	
35	.16	.33	.49	.66	0.82	1.6	2.5	3.3	4.1	4.9	5.7	6.6	7.4	8.2	9.0	9.8	10.6	11.5	12.3	1.22	145	
36	.16	.32	.49	.65	.81	1.6	2.4	3.2	4.0	4.9	5.7	6.5	7.3	8.1	8.9	9.7	10.5	11.3	12.1	1.24	144	
37	.16	.32	.48	.64	.80	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	1.25	143	
38	.16	.32	.47	.63	.79	1.6	2.4	3.2	3.9	4.7	5.5	6.3	7.1	7.9	8.7	9.5	10.2	11.0	11.8	1.27	142	
39	.16	.31	.47	.62	.78	1.6	2.3	3.1	3.9	4.7	5.4	6.2	7.0	7.8	8.5	9.3	10.1	10.9	11.7	1.29	141	
40	.15	.31	.46	.61	0.77	1.5	2.3	3.1	3.8	4.6	5.4	6.1	6.9	7.7	8.4	9.2	10.0	10.7	11.5	1.31	140	
41	.15	.30	.45	.60	.75	1.5	2.3	3.0	3.8	4.5	5.3	6.0	6.8	7.5	8.3	9.1	9.8	10.6	11.3	1.33	139	
42	.15	.30	.45	.59	.74	1.5	2.2	3.0	3.7	4.5	5.2	5.9	6.7	7.4	8.2	8.9	9.7	10.4	11.1	1.35	138	
43	.15	.29	.44	.59	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.9	6.6	7.3	8.0	8.8	9.5	10.2	11.0	1.37	137	
44	.14	.29	.43	.58	.72	1.4	2.2	2.9	3.6	4.3	5.0	5.8	6.5	7.2	7.9	8.6	9.4	10.1	10.8	1.39	136	
45	.14	.28	.42	.57	0.71	1.4	2.1	2.8	3.5	4.2	4.9	5.7	6.4	7.1	7.8	8.5	9.2	9.9	10.6	1.41	135	
46	.14	.28	.42	.56	.69	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	6.9	7.6	8.3	9.0	9.7	10.4	1.44	134	
47	.14	.27	.41	.55	.68	1.4	2.0	2.7	3.4	4.1	4.8	5.5	6.1	6.8	7.5	8.2	8.9	9.5	10.2	1.47	133	
48	.13	.27	.40	.54	.67	1.3	2.0	2.7	3.3	4.0	4.7	5.4	6.0	6.7	7.4	8.0	8.7	9.4	10.0	1.49	132	
49	.13	.26	.39	.52	.66	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.6	7.2	7.9	8.5	9.2	9.8	1.52	131	
50	.13	.26	.39	.51	0.64	1.3	1.9	2.6	3.2	3.9	4.5	5.1	5.8	6.4	7.1	7.7	8.4	9.0	9.6	1.56	130	
51	.13	.25	.38	.50	.63	1.3	1.9	2.5	3.1	3.8	4.4	5.0	5.7	6.3	6.9	7.6	8.2	8.8	9.4	1.59	129	
52	.12	.25	.37	.49	.62	1.2	1.8	2.5	3.1	3.7	4.3	4.9	5.5	6.2	6.8	7.4	8.0	8.6	9.2	1.62	128	
53	.12	.24	.36	.48	.60	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	1.66	127	
54	.12	.24	.35	.47	.59	1.2	1.8	2.4	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.1	7.6	8.2	8.8	1.70	126	
55	.11	.23	.34	.46	0.57	1.1	1.7	2.3	2.9	3.4	4.0	4.6	5.2	5.7	6.3	6.9	7.5	8.0	8.6	1.74	125	
56	.11	.22	.34	.45	.56	1.1	1.7	2.2	2.8	3.4	3.9	4.5	5.0	5.6	6.2	6.7	7.3	7.8	8.4	1.79	124	
57	.11	.22	.33	.44	.54	1.1	1.6	2.2	2.7	3.3	3.8	4.4	4.9	5.4	6.0	6.5	7.1	7.6	8.2	1.84	123	
58	.11	.21	.32	.42	.53	1.1	1.6	2.1	2.6	3.2	3.7	4.2	4.8	5.3	5.8	6.4	6.9	7.4	7.9	1.89	122	
59	.10	.21	.31	.41	.52	1.0	1.5	2.1	2.6	3.1	3.6	4.1	4.6	5.2	5.7	6.2	6.7	7.2	7.7	1.94	121	
60	.10	.20	.30	.40	0.50	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	2.00	120	
61	.10	.19	.29	.39	.48	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.8	5.3	5.8	6.3	6.8	7.3	2.06	119	
62	.09	.19	.28	.38	.47	0.9	1.4	1.9	2.3	2.8	3.3	3.8	4.2	4.7	5.2	5.6	6.1	6.6	7.0	2.13	118	
63	.09	.18	.27	.36	.45	0.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.4	6.8	2.20	117	
64	.09	.18	.26	.35	.44	0.9	1.3	1.8	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.3	5.7	6.1	6.6	2.28	116	
65	.08	.17	.25	.34	0.42	0.8	1.3	1.7	2.1	2.5	3.0	3.4	3.8	4.2	4.6	5.1	5.5	5.9	6.3	2.37	115	
66	.08	.16	.24	.33	.41	0.8	1.2	1.6	2.0	2.4	2.8	3.3	3.7	4.1	4.5	4.9	5.3	5.7	6.1	2.46	114	
67	.08	.16	.23	.31	.39	0.8	1.2	1.6	2.0	2.3	2.7	3.1	3.5	3.9	4.3	4.7	5.1	5.5	5.9	2.56	113	
68	.07	.15	.22	.30	.37	0.7	1.1	1.5	1.9	2.2	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6	2.67	112	
69	.07	.14	.22	.29	.36	0.7	1.1	1.4	1.8	2.2	2.5	2.9	3.2	3.6	3.9	4.3	4.7	5.0	5.4	2.79	111	
70	.07	.14	.21	.27	0.34	0.7	1.0	1.4	1.7	2.1	2.4	2.7	3.1	3.4	3.8	4.1	4.4	4.8	5.1	2.92	110	
71	.07	.13	.20	.26	.33	0.7	1.0	1.3	1.6	2.0	2.3	2.6	2.9	3.3	3.6	3.9	4.2	4.6	4.9	3.07	109	
72	.06	.12	.19	.25	.31	0.6	0.9	1.2	1.5	1.9	2.2	2.5	2.8	3.1	3.4	3.7	4.0	4.3	4.6	3.24	108	
73	.06	.12	.18	.23	.29	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.4	3.42	107	
74	.06	.11	.17	.22	.28	0.6	0.8	1.1	1.4	1.7	1.9	2.2	2.5	2.8	3.0	3.3	3.6	3.9	4.1	3.63	106	
75	.05	.10	.16	.21	0.26	0.5	0.8	1.0	1.3	1.6	1.8	2.1	2.3	2.6	2.8	3.1	3.4	3.6	3.9	3.86	105	
76	.05	.10	.15	.19	.24	0.5	0.7	1.0	1.2	1.5	1.7	1.9	2.2	2.4	2.7	2.9	3.1	3.4	3.6	4.13	104	
77	.04	.09	.13	.18	.22	0.4	0.7	0.9	1.1	1.3	1.6	1.8	2.0	2.2	2.5	2.7	2.9	3.1	3.4	4.45	103	
78	.04	.08	.12	.17	.21	0.4	0.6	0.8	1.0	1.2	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	4.81	102	
79	.04	.08	.11	.15	.19	0.4	0.6	0.8	1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	5.24	101	
80	.03	.07	.10	.14	0.17	0.3	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	5.76	100	
81	.03	.06	.09	.13	.16	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.3	6.39	99	
82	.03	.06	.08	.11	.14	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.3	1.4	1.5	1.7	1.8	1.9	2.1	7.19	98	
83	.02	.05	.07	.10	.12	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	8.21	97	
84	.02	.04	.06	.08	.10	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	9.57	96	
85	.02	.03	.05	.07	0.09	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	11.5	95	
86	.01	.03	.04	.06	.07	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.0	14.3	94	
87	.01	.02	.03	.04	.05	0.1																

Ready Reckoner and Altitude Correction Table

Number of minutes a , b , or Δd .

x +	cos. x	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	26'	27'	28'	29'	30'	sec. x	x -
0	1.00	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	1.00	180
10	.98	15.8	16.7	17.7	18.7	19.7	20.7	21.7	22.7	23.6	24.6	25.6	26.6	27.6	28.6	29.5	1.02	170
14	.97	15.5	16.5	17.5	18.4	19.4	20.4	21.3	22.3	23.3	24.3	25.2	26.2	27.2	28.1	29.1	1.03	166
16	.96	15.4	16.3	17.3	18.3	19.2	20.2	21.1	22.1	23.1	24.0	25.0	26.0	26.9	27.9	28.8	1.04	164
18	.95	15.2	16.2	17.1	18.1	19.0	20.0	20.9	21.9	22.8	23.8	24.7	25.7	26.6	27.6	28.5	1.05	162
20	.94	15.0	16.0	16.9	17.9	18.8	19.7	20.7	21.6	22.6	23.5	24.4	25.4	26.3	27.3	28.2	1.06	160
22	.93	14.8	15.8	16.7	17.6	18.5	19.5	20.4	21.3	22.3	23.2	24.1	25.0	26.0	26.9	27.8	1.08	158
24	.91	14.6	15.5	16.4	17.4	18.3	19.2	20.1	21.0	21.9	22.8	23.8	24.7	25.6	26.5	27.4	1.09	156
26	.90	14.4	15.3	16.2	17.1	18.0	18.9	19.8	20.7	21.6	22.5	23.4	24.3	25.2	26.1	27.0	1.11	154
28	.88	14.1	15.0	15.9	16.8	17.7	18.5	19.4	20.3	21.2	22.1	23.0	23.8	24.7	25.6	26.5	1.13	152
30	.87	13.9	14.7	15.6	16.5	17.3	18.2	19.1	19.9	20.8	21.7	22.5	23.4	24.2	25.1	26.0	1.15	150
31	.86	13.7	14.6	15.4	16.3	17.1	18.0	18.9	19.7	20.6	21.4	22.3	23.1	24.0	24.9	25.7	1.17	149
32	.85	13.6	14.4	15.3	16.1	17.0	17.8	18.7	19.5	20.4	21.2	22.0	22.9	23.7	24.6	25.4	1.18	148
33	.84	13.4	14.3	15.1	15.9	16.8	17.6	18.5	19.3	20.1	21.0	21.8	22.6	23.5	24.3	25.2	1.19	147
34	.83	13.3	14.1	14.9	15.8	16.6	17.4	18.2	19.1	19.9	20.7	21.6	22.4	23.2	24.0	24.9	1.21	146
35	.82	13.1	13.9	14.7	15.6	16.4	17.2	18.0	18.8	19.7	20.5	21.3	22.1	22.9	23.8	24.6	1.22	145
36	.81	12.9	13.8	14.6	15.4	16.2	17.0	17.8	18.6	19.4	20.2	21.0	21.8	22.7	23.5	24.3	1.24	144
37	.80	12.8	13.6	14.4	15.2	16.0	16.8	17.6	18.4	19.2	20.0	20.8	21.6	22.4	23.2	24.0	1.25	143
38	.79	12.6	13.4	14.2	15.0	15.8	16.5	17.3	18.1	18.9	19.7	20.5	21.3	22.1	22.9	23.6	1.27	142
39	.78	12.4	13.2	14.0	14.8	15.5	16.3	17.1	17.9	18.7	19.4	20.2	21.0	21.8	22.5	23.3	1.29	141
40	.77	12.3	13.0	13.8	14.6	15.3	16.1	16.9	17.6	18.4	19.2	19.9	20.7	21.4	22.2	23.0	1.31	140
41	.75	12.1	12.8	13.6	14.3	15.1	15.8	16.6	17.4	18.1	18.9	19.6	20.4	21.1	21.9	22.6	1.33	139
42	.74	11.9	12.6	13.4	14.1	14.9	15.6	16.3	17.1	17.8	18.6	19.3	20.1	20.8	21.6	22.3	1.35	138
43	.73	11.7	12.4	13.2	13.9	14.6	15.4	16.1	16.8	17.6	18.3	19.0	19.7	20.5	21.2	21.9	1.37	137
44	.72	11.5	12.2	12.9	13.7	14.4	15.1	15.8	16.5	17.3	18.0	18.7	19.4	20.1	20.9	21.6	1.39	136
45	.71	11.3	12.0	12.7	13.4	14.1	14.8	15.6	16.3	17.0	17.7	18.4	19.1	19.8	20.5	21.2	1.41	135
46	.69	11.1	11.8	12.5	13.2	13.9	14.6	15.3	16.0	16.7	17.4	18.1	18.8	19.5	20.2	20.8	1.44	134
47	.68	10.9	11.6	12.3	13.0	13.6	14.3	15.0	15.7	16.4	17.0	17.7	18.4	19.1	19.8	20.5	1.47	133
48	.67	10.7	11.4	12.0	12.7	13.4	14.1	14.7	15.4	16.1	16.7	17.4	18.1	18.7	19.4	20.1	1.49	132
49	.66	10.5	11.2	11.8	12.5	13.1	13.8	14.4	15.1	15.7	16.4	17.1	17.7	18.4	19.0	19.7	1.52	131
50	.64	10.3	10.9	11.6	12.2	12.9	13.5	14.1	14.8	15.4	16.1	16.7	17.4	18.0	18.6	19.3	1.56	130
51	.63	10.1	10.7	11.3	12.0	12.6	13.2	13.8	14.5	15.1	15.7	16.4	17.0	17.6	18.3	18.9	1.59	129
52	.62	9.9	10.5	11.1	11.7	12.3	12.9	13.5	14.2	14.8	15.4	16.0	16.6	17.2	17.9	18.5	1.62	128
53	.60	9.6	10.2	10.8	11.4	12.0	12.6	13.2	13.8	14.4	15.0	15.6	16.2	16.9	17.5	18.1	1.66	127
54	.59	9.4	10.0	10.6	11.2	11.8	12.3	12.9	13.5	14.1	14.7	15.3	15.9	16.5	17.0	17.6	1.70	126
55	.57	9.2	9.8	10.3	10.9	11.5	12.0	12.6	13.2	13.8	14.3	14.9	15.5	16.1	16.6	17.2	1.74	125
56	.56	8.9	9.5	10.1	10.6	11.2	11.7	12.3	12.9	13.4	14.0	14.5	15.1	15.7	16.2	16.8	1.79	124
57	.54	8.7	9.3	9.8	10.3	10.9	11.4	12.0	12.5	13.1	13.6	14.2	14.7	15.2	15.8	16.3	1.84	123
58	.53	8.5	9.0	9.5	10.1	10.6	11.1	11.7	12.2	12.7	13.2	13.8	14.3	14.8	15.4	15.9	1.89	122
59	.52	8.2	8.8	9.3	9.8	10.3	10.8	11.3	11.8	12.4	12.9	13.4	13.9	14.4	14.9	15.5	1.94	121
60	.50	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	2.00	120
61	.48	7.8	8.2	8.7	9.2	9.7	10.2	10.7	11.2	11.6	12.1	12.6	13.1	13.6	14.1	14.5	2.06	119
62	.47	7.5	8.0	8.5	8.9	9.4	9.9	10.3	10.8	11.3	11.7	12.2	12.7	13.1	13.6	14.1	2.13	118
63	.45	7.3	7.7	8.2	8.6	9.1	9.5	10.0	10.4	10.9	11.3	11.8	12.3	12.7	13.2	13.6	2.20	117
64	.44	7.0	7.5	7.9	8.3	8.8	9.2	9.6	10.1	10.5	11.0	11.4	11.8	12.3	12.7	13.2	2.28	116
65	.42	6.8	7.2	7.6	8.0	8.5	8.9	9.3	9.7	10.1	10.6	11.0	11.4	11.8	12.3	12.7	2.37	115
66	.41	6.5	6.9	7.3	7.7	8.1	8.5	8.9	9.4	9.8	10.2	10.6	11.0	11.4	11.8	12.2	2.46	114
67	.39	6.3	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4	9.8	10.2	10.5	10.9	11.3	11.7	2.56	113
68	.37	6.0	6.4	6.7	7.1	7.5	7.9	8.2	8.6	9.0	9.4	9.7	10.1	10.5	10.9	11.2	2.67	112
69	.36	5.7	6.1	6.5	6.8	7.2	7.5	7.9	8.2	8.6	9.0	9.3	9.7	10.0	10.4	10.8	2.79	111
70	.34	5.5	5.8	6.2	6.5	6.8	7.2	7.5	7.9	8.2	8.6	8.9	9.2	9.6	9.9	10.3	2.92	110
71	.33	5.2	5.5	5.9	6.2	6.5	6.8	7.2	7.5	7.8	8.1	8.5	8.8	9.1	9.4	9.8	3.07	109
72	.31	4.9	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.7	8.0	8.3	8.7	9.0	9.3	3.24	108
73	.29	4.7	5.0	5.3	5.6	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.8	3.42	107
74	.28	4.4	4.7	5.0	5.2	5.5	5.8	6.1	6.3	6.6	6.9	7.2	7.4	7.7	8.0	8.3	3.63	106
75	.26	4.1	4.4	4.7	4.9	5.2	5.4	5.7	6.0	6.2	6.5	6.7	7.0	7.2	7.5	7.8	3.86	105
76	.24	3.9	4.1	4.4	4.6	4.8	5.1	5.3	5.6	5.8	6.0	6.3	6.5	6.8	7.0	7.3	4.13	104
77	.22	3.6	3.8	4.0	4.3	4.5	4.7	4.9	5.2	5.4	5.6	5.8	6.1	6.3	6.5	6.7	4.45	103
78	.21	3.3	3.5	3.7	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	4.81	102
79	.19	3.1	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.3	5.5	5.7	5.24	101
80	.17	2.8	3.0	3.1	3.3	3.5	3.6	3.8	4.0	4.2	4.3	4.5	4.7	4.9	5.0	5.2	5.76	100
81	.16	2.5	2.7	2.8	3.0	3.1	3.3	3.4	3.6	3.8	3.9	4.1	4.2	4.4	4.5	4.7	6.39	99
82	.14	2.2	2.4	2.5	2.6	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.8	3.9	4.0	4.2	7.19	98
83	.12	1.9	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5	3.7	8.21	97
84	.10	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	9.57	96
85	.09	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.4	2.5	2.6	11.5	95
86	.07	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.0	2.1	14.3	94
87	.05	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	19.1	93
88	.03	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	28.7	92
89	.02	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	57.3	91
90	.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	∞	90

The "Newest" Navigation Altitude and Azimuth Tables, by Commander Radler de Aquino, Brazilian Navy, second edition, enlarged and improved, London, 1918. Published by J. D. Potter, 145 Minories, London, E. Price 12s. net.

A slightly improved method of finding the Altitude and Azimuth by means of my Tables has been developed recently whereby it is not necessary to *interpolate* and find the true values of b and t for the true value of declination d , as explained on pages xv, xxi, and xxv of my Tables. It is sufficient to find only in column a the values of b (generally a whole degree) and of t that correspond to an approximate value of d . This approximate value of d is *always* the tabular value nearest to the true value, provided t_A is near $t_{D.R.}$ b is combined in the usual way with L_A (also generally the whole degree nearest the dead-reckoning latitude) to find C , and h' and Z' are found corresponding to the a and C . Now as h' and Z' are for the tabular value of d , we must correct them for the difference Δd between this tabular value and the true value of the declination.¹ We know from page xvii that a change of altitude Δh for a given change of declination Δd is given by the formula: $\Delta h = \Delta d \cos M$, where M is the parallactic angle. If we call, in Fig. 2 on page xii, the angle $mMP : a$ and the angle $mMZ : \beta$, we have $M = a + \beta$.

The value of a is found on the same line with b , d , and t (a being practically the same for all three values of a). In the same way β is found on the same line opposite C , h , and Z .

However, instead of finding C with L_A and b , it is in the great majority of cases better to find L_A from b and C , as explained below.

The working out of our typical example on page xix will show the great advantage of this improvement.

$a = 52^\circ 0'$	G. A. T. = 20 ^h 59 ^m 24 ^s	or $t_G = 314^\circ 51'$	Pages 69 and 122, 2d. ed. 1912.
$L_A = 37^\circ \text{ N}$	$d = 10^\circ 27' \text{ S}$		
$b = 17^\circ$	$d' = 10^\circ 22'$	$t_A = 53^\circ 14' \text{ E}$	$a = 76^\circ.5$
	$d - d' = +5'$	$G_A = 8^\circ 5' \text{ W}$	
$C = 54^\circ$	$h' = 21^\circ 13'$	$Z'_A = \text{S } 57^\circ 42' \text{ E}$	$\beta = 60^\circ.4$
	$\Delta h = -3'.7$		$M = 136^\circ.9$
	$h_A = 21^\circ 9'.3$		
	$h = 21^\circ 7'$		
	$h - h_A = -2'.3$		

NOTE.—Numbers taken out of the Tables by Inspection are black-faced in order to distinguish them from data given or found.

In addition to the formulæ given on page xxviii for finding L_A with b and C , we have added those for finding M with a and β .

$$d \text{ and } L_A \text{ same name } \begin{cases} t < 90^\circ & \begin{cases} L_A < b : L_A = b - C \text{ and } M = a + \beta \\ L_A > b : L_A = b + C \text{ and } M = a - \beta \end{cases} \\ t > 90^\circ & : L_A = C + b \text{ and } M = \beta - a \end{cases}$$

$$d \text{ and } L_A \text{ contrary names} : L_A = C - b \text{ and } M = a + \beta$$

When $t > 90^\circ$ the sum $C + b > 90^\circ$ also, and we must subtract it from 180° to obtain L_A .

A simple inspection of these formulæ shows that no different rules are necessary with this new process. A knowledge of the approximate value of L_A is *always* known by dead-reckoning, and therefore, we can immediately find, in view of the fact that b and L_A are generally whole degrees, the value of C that combined with b will give us L_A . The tabular value h' nearest to the true altitude h shows us opposite it also the value of C .

The formulæ show also that when we *subtract* b and C to find L_A , we must add a and β to obtain M . When we *add* b and C to find L_A , we must *subtract* a and β from one another to obtain M .

The "Altitude correction" $\Delta h = 3'.7$ is given immediately by our Table² on the back, where we enter at the top with $\Delta d = 5'$, and with $M = 137^\circ$ on the right hand side. If M is less than 90° , enter the Table on the left hand side. The correction has the same sign as $d - d'$ or Δd when M is less than 90° and the contrary sign to $d - d'$ or Δd when M is greater than 90° .

In this way Altitude and Azimuth from the assumed position are found by means of simple mnemonic rules *without* interpolating.

¹ As Δd is generally only a few minutes of arc, Z' does not need in practice any correction. The formula on page xvii: $\Delta Z = \sin M \sec h \Delta d$ shows us that ΔZ is *always* smaller than $\sec h \Delta d$. Under $h = 60^\circ$, ΔZ is always smaller than $2\Delta d$.

² Also by our Plane Traverse Tables in LAT. column if we enter them with Δd as D and with M or $180^\circ - M$ as Course.

THE "NEWEST" NAVIGATION
ALTITUDE AND AZIMUTH TABLES

ATTENTION!

Would you ever think of going to the trouble of calculating the elements of the NAUTICAL ALMANAC, viz. declination, right ascension, equation of time, &c., by means of formulæ and logarithms, when His Majesty's NAUTICAL ALMANAC Office tabulates these data every year? Certainly not.

Would you ever think of working out your dead-reckoning by means of formulæ and logarithms when the Plane Traverse Tables facilitate the direct solution of all problems related thereto? Not at all!

Why then go to the trouble to solve the astronomical triangle of position by means of complicated formulæ and logarithms when we have tabulated its elements in our "Altitude and Azimuth Tables" (Spherical Traverse Tables) and have given the simplest and readiest methods for solving all problems related thereto?

HOWEVER,

If you do not like the method for finding the *altitude* using an *assumed position*, use then the new Altitude Tables at the end of this book, and methods explained on page xxxviii for the *azimuth*.

They are also the "*simplest and readiest in solution*."

THE "NEWEST" NAVIGATION ALTITUDE AND AZIMUTH TABLES

FOR FACILITATING THE DETERMINATION OF LINES OF
POSITION AND GEOGRAPHICAL POSITION AT SEA
THE SIMPLEST AND READIEST IN SOLUTION

Plane and Spherical Traverse Tables for Solving all Problems of Navigation

By COMMANDER RADLER DE AQUINO
BRAZILIAN NAVY

SECOND STEREOTYPED EDITION

ENLARGED AND IMPROVED

Sights "may be practically worked out so as to give the ship's place as accurately as it can be deduced from the observations, with hardly any calculation.

"One of the advantages in the use of this method is that no logarithmic work is required."

SIR WILLIAM THOMSON (LORD KELVIN). "Tables for Facilitating Sumner's Method at Sea." London, 1876. pp. iv. and v.

"È facile persuadersi che, dopo avere acquistata un po' di pratica, le operazioni descritte possono esser fatte con grande speditezza: l'uso della Tavola è facile e le regole da applicare sono indiscutibilmente semplici."

DOTT. ALBERTO ALESSIO, R.I.N. "Sulla Teoria e la Pratica della Nuova Navigazione Astronomica." *Rivista Marittima* for March 1909, Appendice, p. 59.

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EXPRESSION OF OPINION

NAVY DEPARTMENT.

COPIA.

WASHINGTON.

February 1, 1909.

SIR : Replying to your letter No. 17512, of the 21st ultimo, enclosing a copy of a letter from the Brazilian Ambassador, requesting an expression of the Department's opinion as to the scientific merit of the altitude and azimuth tables prepared by the Naval Attaché to his Embassy, of which you enclosed a copy and description, I have the honor to inform you that the Hydrographer of the U.S. Navy, to whom your letter and enclosures were referred, has submitted the following report, which is quoted for your information :

"Existing tables give the distance and bearing, on the globe or the celestial sphere or any other sphere, of any place from every other place, and consequently the zenith distance and bearing, that any celestial body would have at any given time to an observer situated in any geographical position. So that, an observer in a geographical position as yet unknown, about to measure the altitude of a celestial body for position, may assume beforehand a geographical position in the region of his station and find from the tables the zenith distance and bearing which the celestial body would have if observed from the assumed position; and then, comparing the zenith distance, so taken from the tables, with the zenith distance shown by the measured altitude, may at once find the Sumner line by laying off from the assumed geographical position, in the direction of the bearing, an intercept equal to the difference of these zenith distances and drawing at right angles to the bearing through the point thus found. All cases of *cælo-navigation* are thus brought under a single rule.

"Aquino's purpose is to abridge the extent of the existing tables by tabulating the solutions of the two right-angled spherical triangles, into which the astronomical triangle may always be divided, with values of the argument no nearer together than 30' in one case, and 1° in the other. To make this plan feasible, his purpose is to sacrifice the freedom of choice now existing with reference to the assumed geographical position, and, by short calculation, to find instead an auxiliary geographical position so placed that the proposed tables may be entered without interpolation between the tabular values of the arguments, which are, in fact, designedly spaced too far apart for successful interpolation. The advantage of having one simple rule for the solution of all cases is also somewhat disturbed by necessary variations from the singleness of the rule in order to adapt the proposed tables to varying combinations of data arising from different relative positions of the observer and the observed celestial body.

"The plan of the proposed work, as outlined in the enclosed publications,¹ is sound in principle and scientific in conception; and the tables will possess the merit of being compressed into a small book."

I have the honor to be, Sir,

Very respectfully,

TRUMAN H. NEWBERRY,
Secretary.

THE HONORABLE
THE SECRETARY OF STATE.



Confere.
E. L. CHERMONT.

Conforme com o original no Archivo da
Embaixada do Brazil em Washington.
SYLVINO GURGEL DO AMARAL,
Conselheiro de Embaixada.

¹ "A Navegação sem logarithmos." *Imprensa Nacional*, Rio de Janeiro, 1903, and "Altitude and Azimuth Tables for facilitating the Determination of Lines of Position and Geographical Position at Sea." Reprinted from the *United States Naval Institute Proceedings* for December, 1908.

NOTE.—This expression of opinion is made public by special permission of the Hon. Secretary of the Navy. O.N.I. No. 9864 of 1909.

BOOK NOTICES

Of the U.S. Naval Institute Proceedings, March, 1910

“ALTIMITUDE AND AZIMUTH TABLES,” 1910. By Lieutenant Radler de Aquino, Brazilian Navy.

After a careful examination of this book and of the methods given for the solution of the astronomical triangle there can be no doubt of its practicability and of its claim, “The simplest and readiest in solution.”

In the solution of the line of position for the sun, which is by far the most common of all sights, and employing all figures to get functions as closely as given in the Nautical Almanac, which in practice is not necessary, a comparison of the two methods is as follows :—

	Figures.	Book openings.	Time.
Common to both	177	8	9 ^m 30 ^s
Peculiar to each	$\left\{ \begin{array}{l} 101 \text{ Aquino} \\ 138 \text{ St. Hilaire} \end{array} \right.$	$\left\{ \begin{array}{l} 2 \\ 9 \end{array} \right.$	$\left\{ \begin{array}{l} 4^m \\ 7^m 30^s \end{array} \right.$

Upon examination of the above table it can be immediately seen how much quicker in solution the Aquino is. In point of accuracy of results within the limits of 70 declination, and taking into consideration the errors of observation, there is no choice. There is less chance of making errors in working on account of the fact that only four functions have to be picked out accurately from the tables, whereas in the St. Hilaire eight have to be found. In comparing the two methods the part common to both is not considered.

In the case of the meridian altitudes the ordinary method of combining the zenith distance and declination is better than the method shown in this book, on account of it being necessary to remember one precept instead of four.

The method of finding latitude from a sight of Polaris presents no advantages over that given in the back of the Nautical Almanac for the current year, and has less advantage over that given in the Almanac of 1912.

The determination of the line of position without azimuths is to be commended and, if the altitude is to be determined by the tables of this book, is of great value.

The necessity of the rectification of lines of position occurs very rarely in practice, but when it does happen this method is an excellent one.

The identification of celestial bodies and the finding of the approximate altitude and azimuth before taking a sight are, under the present great interest in the use of stars for navigational purposes, of great value, and when the tables are once thoroughly understood, very easy to find.

Azimuths can be determined with ease and necessary accuracy by means of these tables.

The use of these to find the Great Circle Course is not recommended. Lunar distances have been abandoned by navigators.

Taken as a whole, this book cannot be too highly recommended, and all navigators should possess a copy. It is to be hoped that the author will publish the larger book he is making out for his own use.

G. R. MARVELL,

*Commander, U.S. Navy, Head of the Department of Navigation,
U.S. Naval Academy, Annapolis.*

INTRODUCTION

The determination of lines of position (from which geographical position—latitude and longitude—is deduced at sea), the identification of celestial bodies and the determination of distance and course in Great Circle Sailing are the three principal problems of Navigation depending upon the solution of a spherical triangle.

In each problem we have two sides and the included angle to find the third side and one of the other angles. This means that all the three problems can be solved in the same way, by the same formulæ, by the same method, and by the same tables.

Most of the problems of celestial Navigation depend upon the solution of a right-angled spherical triangle, and as the three principal problems are solved by dividing the spherical triangle into two right-angled triangles, they *all* may be easily and readily solved *without logarithms* by aid of the appended tables,¹ which, however, were especially arranged for facilitating the determination of lines of position and the identification of celestial bodies at sea.

The method used for determining lines of position is general, every sight is worked out the same way; no special classification needs to be made before trying to work it out. Whether the sight is a circum-meridian, an ex-meridian, or a time-sight, it is always worked out the same way. At the same time, no signs or naming of auxiliary data comes in to confuse the navigator. The only calculations involved are two small multiplications (not always necessary), and the finding of C with L and b , by the use of simple formulæ, without giving consideration to algebraic signs or arcs greater than 90° .

The tables will also enable the navigator in latitudes above 45° to

¹ Besides these tables our volume contains tables for converting intervals of mean solar time into those of sidereal time (acceleration); for converting time into arc, and vice versa; for the total correction of altitudes of Stars and Planets, the Sun and the Moon; change of altitude per minute of arc of hour angle, change of azimuth per minute of arc of altitude; for controlling the coincidence of lines of position; azimuths of *Polaris*; change of altitude per minute of time, and for rectifying lines of position. Also Plane Traverse Tables, a Ready Reckoner, &c.

With the exception of the tables for rectifying lines of position, all the others are well known and need no explanation. In the tables for correcting altitudes, the corrections were calculated with data (mean refractions, mean dip of the horizon, parallax in altitude, &c.) tabulated in the *Connaissance des Temps*, published by the Bureau des Longitudes, Paris.

ALTITUDE AND AZIMUTH TABLES

determine with great accuracy lines of position on Mercator's chart without azimuths.

Time-azimuths for compass correction and control are found without interpolation by the same method used for determining lines of position, which, of course, is a decided advantage.

Such questions as : Where are we ? What star is that ? &c., will receive a prompt and accurate reply when the problem is worked out by our methods and our tables.

Fortunately most of the problems do not require great approximation, and for this reason interpolations are practically unnecessary.

The omission of Lunar Distances from the *Nautical Almanac*, as "no longer of sufficient use to justify their retention," has forced upon navigators the necessity of knowing how to calculate them.

This problem is similar to the problem of determining *distance* in Great Circle Sailing, and we believe that from the sailor's point of view our method (and formulæ) will prove more satisfactory than the one given in the *Nautical Almanac*, because it does not involve the use of algebraic signs or arcs greater than 90° , always a cause of difficulty, confusion, and error.

Many valuable suggestions received from Dott. Giuseppe Pesci, of the Royal Italian Naval Academy, Livorno, Italy, have been embodied in this work, and it gives us great pleasure to acknowledge here our grateful thanks.

The author hopes that navigators will appreciate the great advantages these tables present. Indeed, we may safely say : They are "*the simplest and readiest in solution.*"

On board the Brazilian battleship *Minas Geraes*,
NEWCASTLE-UPON-TYNE,
November 11, 1909.

INTRODUCTION TO SECOND EDITION

The addition of the complementary column *c/C* reducing to a *minimum* the work of combining *L* and *b*, of a Plane Traverse Table for distances up to 300 miles, of a Ready Reckoner, of the Sun's upper Limb Correction Table, of the Table giving the change of hour angle per minute of arc of altitude and a most careful and complete revision of the tables and text represent the improvements and further simplifications to be found in this new edition. A new set of Tables for calculating the *Altitude* have been added for use of those people who do not like to use the *assumed position*. They are also "*the simplest and readiest in solution.*"

HYDROGRAPHIC OFFICE, RIO DE JANEIRO,
November 11, 1911.

CIRCLES, CURVES, AND LINES OF POSITION

A line of position is just as valuable as the isolated knowledge of latitude or longitude, and represents the exact and only true interpretation of a sight.

When a navigator at a given instant of Greenwich (known by a chronometer regulated to mean or sidereal time) observes the altitude of a celestial body, he determines *ipso facto* on the celestial sphere a small circle passing through his zenith.¹

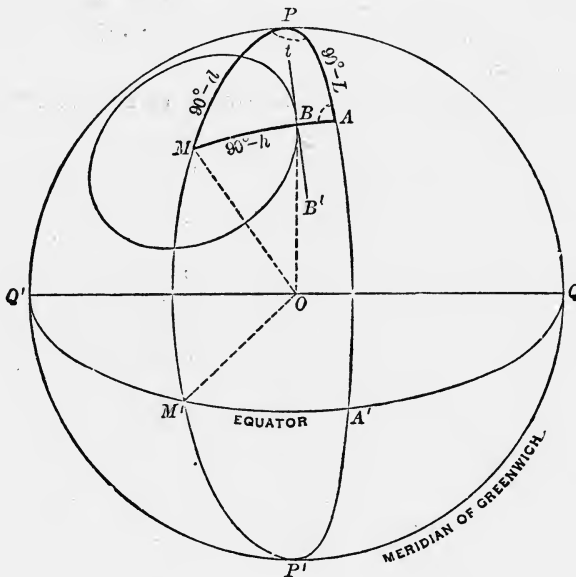


FIG. 1.

This circle is determined by its centre and its radius. The centre of the circle is M , the centre of the celestial body at the moment of the observation, and is determined by the declination d or MM' (sometimes called Geographical Latitude) of the body, and by its

¹ This discovery was first made by Captain THOMAS H. SUMNER, an American shipmaster, in 1837, and was explained on page 42 of his work, "A New and Accurate Method of Finding a Ship's Position at Sea, by Projection on Mercator's Chart," Boston, 1843.

Vide also BARTHET, "Méthode graphique pour faire le point à la mer," published in the *Annales maritimes et coloniales*, Paris, 1847, for an account of Captain Sumner's discovery.

ALTITUDE AND AZIMUTH TABLES

hour angle from Greenwich, QPM' (called its Geographical Longitude). The radius is the body's true zenith distance, MB (the complement of its true altitude). With these elements we could, if practical, draw the circle on a globe. This circle is known as the *circle of position*, because it contains the navigator's zenith corresponding to his position on the surface of the Earth.

The transformation affecting all spherical figures when we pass from the terrestrial globe to Mercator's chart also involves the circle of position, which is transformed into a curve of position, open or closed, according to the position of the poles in relation to the circle.

In order to know his position, it is not necessary for the navigator to draw the whole curve on the chart, and, in view of the difficulty of even drawing a small portion of it in the vicinity of the observer (always indicated by the D. R. position A), it is substituted by a *straight line of position*, BB' , representing practically the necessary part of the curve.

This straight line of position, in order to secure the best results, ought to be always determined on the chart, or elsewhere, by the method invented thirty-five years ago by Admiral A. BLOND DE MARCQ SAINT-HILAIRE,¹ French Navy.

"*The great advantage of this method of obtaining a line of position,*" as Commander W. C. P. MUIR, U.S. Navy, Head of the Department of Navigation of the U.S. Naval Academy, explicitly states in italics in his excellent treatise on "Navigation and Compass Deviations,"² second edition, 1908, p. 640, "*lies in the fact, that since the formulæ make it available practically without limitations as to azimuth, altitude, or hour angle, it furnishes one method equally applicable to all conditions, whether these conditions would otherwise require the formulæ of a time-sight, a $\phi''\phi'$ sight, or that of a body observed near the meridian.*"

It consists in determining a particular point B (known as the "*computed point*") of the circle of position—the intersection of AM , the vertical circle of the celestial body passing through the D. R. position A with the circle of position. These two circles intersect each other at right-angles, and therefore the straight line of position will be also perpendicular to the body's true bearing.

Thus the determination of the line of position, *containing the observer's position*, consists in constructing a straight line drawn through the computed point B at right-angles to the body's true bearing.

In order to determine the computed point B when the position by D. R. A is given, we lay off from this point, as shown in Fig. 1, a

¹ Vide "Calcul du point observé," *Revue maritime et coloniale*, vol. xlvii., 1875, pages 341 and 714.

² Published by the United States Naval Institute, Annapolis, Md., U.S.A., price five dollars gold.

CIRCLES, CURVES, AND LINES OF POSITION

distance, AB , equal to the difference between the two zenith distances: the D. R. AM , and the *true* BM (or between the two altitudes: the *true* and the D. R. with opposite sign). The extremity of this length is the computed point B . This point is *always* nearer to the true position than the position by D. R., and represents the most probable position of the observer, when only one observation is available.

The difference between the two altitudes is called *altitude difference* or *intercept*.

The position by D. R. A , the altitude difference AB , and the body's azimuth PAM are the elements necessary and sufficient for determining a line of position at sea.

The position by D. R. is generally computed up to the time of observation, the true altitude is found by taking and correcting the observed altitude; the calculated altitude and azimuth (from which the true bearing is found) are easily and rapidly determined by our tables as explained hereafter.

In order, however, to do away with interpolations and corrections which otherwise would have had to be made before finding the altitude and azimuth, we take an *assumed* latitude and longitude instead of the latitude and longitude by D. R.¹ Referring to Fig. 4 on page xxvi, we consider A' (the *assumed* position) instead of A (the position by D. R.) for determining the line of position.

The advantages of using an assumed position instead of the position by D. R. have not been fully appreciated by the majority of navigators. No greater accuracy is gained by determining the line of position from A than from A' , while the use of this position, as we will see further on, facilitates and reduces the computations very much, thus minimising the chances of error, &c.

Finally, the problem of determining a line of position at sea reduces itself to find how far (in miles) the line of position is from the ASSUMED position, and in what direction it lies.

¹ "A Navegação sem Logarithmos" (Navigation without Logarithms). *Imprensa Nacional*. Rio de Janeiro, 1903. Published by order of the Minister of Marine. This work was preceded by an article by the author in the *Revista Marítima Brasileira*, Oct. 1902. "Taboas para achar alturas e azimuths, etc." The present tables represent an enlarged, improved, and very simplified edition of "A Navegação sem Logarithmos." *Vide* also "Resolução Nomographica do Triangulo de Posição" by DOTT. G. PESCI. Translated from the Italian into Portuguese by the author of these tables and reprinted from the *Revista Marítima Brasileira*, Nov. and Dec. 1907, and Feb. 1908, and DOTT. PESCI'S recent "Studio critico": Sulle "Tables for facilitating Sumner's Method at Sea," di Lord Kelvin, in the *Rivista Marittima* for January 1909, page 43.

CONSTRUCTION OF THE TABLES

This correspondence is fundamental and must always be remembered.

By Napier's mnemonical rules we find the following equations binding together these elements :

$$\begin{array}{l} \text{(1) } \left\{ \begin{array}{l} \sin d = \cos a \sin b \\ \sin h = \cos a \sin B \end{array} \right. \quad \text{(2) } \left\{ \begin{array}{l} \cot t = \cot a \cos b \\ \cot Z = \cot a \cos B \end{array} \right. \\ \text{and} \\ \text{(3) } \left\{ \begin{array}{l} \sin a = \cos d \sin t \\ \sin a = \cos h \sin Z \end{array} \right. \quad \text{(4) } \left\{ \begin{array}{l} \cot b = \cot d \cos t \\ \cot B = \cot h \cos Z \end{array} \right. \end{array}$$

CONSTRUCTION OF THE TABLES

As a , b and B in groups of equations (1) and (2) can have values between 0° and 90° , we have tabulated the values of d and t corresponding to various values of a for every $30'$ from 0° to 84° and for every 1° from 84° to 90° ($88^\circ 50'$ being especially included on account of *Polaris*) and b for every 1° (and *ipso facto* the values of h and Z corresponding to various values of a and B).

As groups of equations (3) and (4) are respectively similar to (1) and (2), we notice that we have also tabulated the values of a and b corresponding to various values of d and t (and *ipso facto* the values of a and B corresponding to various values of h and Z).

For this reason the tables have two entrances.

The upper one with a and b as arguments giving, by means of the upper equations of groups of equations (1) and (2), d and t (or with a and B as arguments giving, by means of the lower equations of groups (1) and (2), h and Z).

The lower one with d and t as arguments giving, by means of the upper equations of groups of equations (3) and (4), a and b (or with h and Z as arguments giving, by means of the lower equations of groups (3) and (4), a and B , but not considered for greater simplicity in dealing with the principal problem).

For convenience and greater simplicity a complementary column c/C to column b/B is given on each page where c stands for $90^\circ - b$ and C for $90^\circ - B$.

Therefore the tables can also be entered with a and c giving d and t , and also with a and C giving h and Z .

Example I. Entering the tables on page 119 with $a = 48^\circ 0'$ and $b = 59^\circ$ we find $d = 35^\circ 0'$ and $t = 65^\circ 7'$.

Example II. Entering the tables on page 63 with $a = 6^\circ 0'$ and $B = 73^\circ$ or $C = 17^\circ$, we find $h = 72^\circ 0'$ and $Z = 19^\circ 46'$.

Example III. Entering the tables on page 91 with $d = 27^\circ 0'$ and $t = 60^\circ$ we find $a = 50^\circ 30'$ and $b = 45^\circ 32'$.

In columns $\frac{60'}{\Delta}$ and $\frac{\Delta}{60}$, Δ represents the difference between two

ALTITUDE AND AZIMUTH TABLES

successive values and the factors $\frac{60'}{\Delta}$ and $\frac{\Delta}{60'}$ are given in order to facilitate interpolation.

All values designedly appear in our tables,¹ and examples always reduced to the first quadrant with sign *plus* with further simplification in view.

CALLET'S² logarithms with *seven* decimal places were used in the calculations. In many cases VLACQ'S³ *ten* decimal place logarithms were used.

EXAMINATION OF THE TABLES

A mere inspection of the tables shows at a glance how the elements vary in the astronomical triangle of position.

For a given value of a , d and t vary *proportionately* to b throughout the tables, except in a *very few practical cases when the declination of the observed body d is higher than 70°* .⁴ As long as the difference $\left(\frac{\Delta_2}{60'}\right)$ between two successive values of $\frac{\Delta}{60'}$ is equal to or smaller than 0.15, the *maximum* error in t due to second differences is equal to or smaller than 1'. Up to $d=60^\circ$ this *maximum* error is equal to or smaller than 0'.5.

Careful examination, however, of these *Tables* has shown that the error of t when using *simple interpolation* for *any* declination has no practical effect upon the value of h determined by them.

¹ These tables were first described by the author in the *United States Naval Institute Proceedings* for December 1908, page 1299, and in the *Revista Maritima Brasileira* for March 1909, page 1577. A description of them by DOTT. A. ALESSIO, R.I.N., is also found in the *Rivista Marittima* for March 1909, Appendice, page 56.

² "Tables de logarithmes, suivies d'un recueil de Tables nautiques." Editeur Firmin-Didot et Cie, Paris, 1883.

³ "Trigonometria Artificialis sive Magnus Canon Triangulorum Logarithmicus," Gouda, 1633.

⁴ The only relatively important star above 70° declination is β Ursæ Minoris with N $74^\circ 31'$ decreasing. Its magnitude is 2.2. Among the 316 stars above magnitude 4.1 (not including *Polaris*) catalogued in the *Nautical Almanac* for the year 1910, the highest declination is that of β Hydri, magnitude 2.9, with S $77^\circ 46'$ decreasing, and for this reason the differences $\frac{\Delta}{60'}$ only extend to this value of d . Of the 316 stars mentioned above there are only 6 with declinations higher than 70° , and 4 of them are below magnitude 3.0. Of the 486 stars catalogued in the *Nautical Almanac* for 1910 only 24 have higher declinations than $77^\circ 46'$, and their magnitudes range between 4.3 and 8.4, being therefore unsuitable for navigation.

It is noticed that the influence of the second differences only begins to appear in a *few* cases above the extreme limit of declination ($=60^\circ$) adopted by *nearly all* nautical tables, notwithstanding the existence of 36 stars (15 of which are of or above 3.0) above magnitude 4.1, with greater declinations than 60° .

LINES OF POSITION

ALTITUDE AND AZIMUTH FOR LINES OF POSITION

The problem is : Given d , t and L , find h and Z .

DETERMINATION OF h AND Z .

Let us see now how altitude and azimuth can be easily and rapidly determined by these tables.

Entering the tables with d and t as arguments, we will find in columns a and b approximate values of a and b .

Entering the tables again with a and b as arguments, we will find approximately the values of d and t given.¹ The true value of b is then determined for the *exact* value of d and a value of t is found corresponding to this b .

The values of h and Z will then be found in the same column a corresponding to B or to its complement C .

Example. $d=16^{\circ} 27'$, $t=61^{\circ} 10'$ and $L=23^{\circ} 39'.3$.

Entering the tables with $d=16^{\circ} 30'$ and $t=61^{\circ}$ we find $a=57^{\circ} 0'$ and $b=31^{\circ} 26'$. Corresponding to $a=57^{\circ} 0'$ and $b=31^{\circ}$ we find $d=16^{\circ} 17'$ and $t=60^{\circ} 54'$. The true value of b corresponding to $d=16^{\circ} 27'$ is $31^{\circ} 20'.7$ and the value of t corresponding to this value of b is $60^{\circ} 59'.6$.

If $B=35^{\circ}$ (or $C=55^{\circ}$) we will have $h=18^{\circ} 12'$ and $Z=61^{\circ} 59'$.

DETERMINATION OF C .

We will now show how C is determined when L and b are known.

When the perpendicular a falls between P and Z , as it does in Fig. 2 (d and L being of the *same name* and $t < 90^{\circ}$), we have

$$[90^{\circ} - B] + 90^{\circ} - b = 90^{\circ} - L$$

and therefore

$$C = b - L : \text{when } L < b.$$

If the perpendicular fell between Z and Q (d and L being also of the *same name* and $t < 90^{\circ}$), we would have

$$[90^{\circ} - B] + 90^{\circ} - L = 90^{\circ} - b$$

and therefore

$$C = L - b : \text{when } L > b.$$

¹ The value of a shows *immediately* on which two pages of the tables we have to work, and also in which of the three columns. The value of b shows on which of the two pages we have to begin, and also the line on which the approximate values of d and t are found. Although *not strictly necessary* this knowledge of the approximate value of b is convenient.

The value of a is *also not strictly necessary* as long as the values of d and t are found together in the same column a . After a little manipulation of the tables no difficulty will be experienced in finding them together in the same column a .

ALTITUDE AND AZIMUTH TABLES

In case the perpendicular fell between P and N (which only happens when $t > 90^\circ$ and we enter the tables with $180^\circ - t$ instead of t), we would have

$$[90^\circ - B] = 90^\circ - L + 90^\circ - b$$

and therefore

$$C = 180^\circ - (L + b).$$

Finally, when the perpendicular falls between Q and S (d and L are then of *contrary names*), we have

$$[90^\circ - B] + 90^\circ - L = 90^\circ + b$$

$$C = L + b.$$

Thus when

$$\begin{array}{l} d \text{ and } L \text{ same name} \\ d \text{ and } L \text{ contrary names} \end{array} \left\{ \begin{array}{l} t < 90^\circ \left\{ \begin{array}{l} L < b : C = b - L ; Z < 90^\circ \\ L > b : C = L - b ; Z > 90^\circ \end{array} \right. \\ t > 90^\circ \dots \dots : C = L + b ; Z < 90^\circ \\ \dots \dots \dots : C = L + b ; Z > 90^\circ \end{array} \right.$$

By these formulæ C can be obtained from L and b with great simplicity and rapidity.

In the first two cases, the *smaller* of the two quantities L and b , is always subtracted from the *larger* of the two.

In the third and fourth cases L and b are *always* added together. When $t > 90^\circ$ their sum is always greater than 90° , and it is subtracted from 180° . When d and L are of contrary names their sum is always smaller than 90° .

The quadrant in which the observed body is, is also shown for reference and by our method is *always* known *a priori*.

When d and L are of the same name and $t < 90^\circ$, Z is *less* or *greater* than 90° when L is *less* or *greater* than b .

When $t > 90^\circ$, Z is *always less* than 90° ; finally when d and L are of contrary names Z is *always greater* than 90° .

When $Z < 90^\circ$ the value of Z given by the tables is reckoned from the *elevated* pole to East or West, and when $Z > 90^\circ$ from the *depressed* pole to East or West, since the tables only give values up to 90° .

VARIATIONS OF DATA.

A further inspection of the Tables shows that they are also available for determining at sight by inspection "what effect given variations of data will produce in quantities computed from them."¹

If we call Δh , ΔZ , Δd , Δt , and ΔL respectively the variations of altitude, azimuth, declination, hour angle and latitude the following formulæ will give us the errors Δh and ΔZ in the values of h and Z

CHANGES OF ALTITUDE AND AZIMUTH

computed, when d , t and L are affected by small errors Δd , Δt and ΔL respectively:—

$$\Delta h = \cos M \Delta d - \cos L \sin Z \Delta t + \cos Z \Delta L \quad (1)$$

and

$$\cos h \Delta Z = \sin M \Delta d + \cos M \cos d \Delta t - \sin h \sin Z \Delta L \quad (2)$$

where M is the parallactic angle.

CHANGES OF ALTITUDE AND AZIMUTH.

If Δd and ΔL are *nil* we have by (1) $\Delta h = -\cos L \sin Z \Delta t$, or $\frac{\Delta h}{\Delta t} = -\cos L \sin Z$, which gives us the “Change of Altitude per Minute of Arc of Hour Angle” (Table on p. 170).

If Δt and ΔL are *nil* we have by (1) $\Delta h = \cos M \Delta d$, or $\frac{\Delta h}{\Delta d} = \cos M$, which gives us the “Change of Altitude per Minute of Arc of Declination.”

If Δd and Δt are *nil* we have by (1) $\Delta h = \cos Z \Delta L$, or $\frac{\Delta h}{\Delta L} = \cos Z$, which gives us the “Change of Altitude per Minute of Arc of Latitude.”

In the same way we would have by (2)

$$\Delta Z = \cos M \cos d \sec h \Delta t, \text{ or } \frac{\Delta Z}{\Delta t} = \cos M \cos d \sec h$$

$$\Delta Z = \tan h \sin Z \Delta L \quad \text{,,} \quad \frac{\Delta Z}{\Delta L} = \tan h \sin Z$$

$$\Delta Z = \sin M \sec h \Delta d \quad \text{,,} \quad \frac{\Delta Z}{\Delta d} = \sin M \sec h$$

The 1st expression of ΔZ is easily transformed into

$$\Delta Z = \sin L \Delta t - \tan h \cot Z \Delta h$$

as explained on page xxvii later on.

The value of ΔZ from the 2nd expression of ΔZ is given immediately by the Tables in column $\frac{\Delta}{60}$ alongside the value of Z .

Example. If $h = 38^\circ$ and $Z = 62^\circ$ we will find them approximately together in column $a = 44^\circ$ on page 113, and therefore $\frac{\Delta Z}{\Delta L} = 0'.70$ found in column $\frac{\Delta}{60}$ alongside $Z (= 61^\circ 56')$.

The 3rd expression of ΔZ has not any practical importance, as Δd is always smaller than $0'.5$.

¹ and ² CHAUVENET, “A Manual of Spherical and Practical Astronomy,” Philadelphia, 1890. Vol. I. pp. 50, 51.

ALTITUDE AND AZIMUTH TABLES

THE PARALLACTIC ANGLE M .

By interchanging L and d in the tables we can find immediately in column Z the parallax angle M .

THE LONGITUDE FACTOR, OR PAGEL'S COEFFICIENT.

If Δh and Δd in (1) are *nil* we can find immediately the longitude factor or PAGEL'S coefficient the most important of all, as it shows at once the change of hour angle or longitude due to a change of r' in the latitude.

We find from (1) when $\Delta h = \Delta d = 0$

$$\cos L \sin Z \Delta t = \cos Z \Delta L$$

or

$$\cos L \cdot \frac{\Delta t}{\Delta L} = \cot Z$$

In our Tables

$$\cos B \cot a = \cot Z$$

and, therefore, if we enter the Tables with L in the place of B and Z in column Z , the cotangent of a in which Z stands is equal to $\frac{\Delta t}{\Delta L}$, the longitude factor, or PAGEL'S coefficient.

The blackfaced numbers at the head of each four columns represent the $\cot a$ above which they are.

I. *Example.* If $L = 24^\circ$ and $Z = 73^\circ 0'$ we will find on page 148

$$\frac{\Delta t}{\Delta L} = \cot a = \cot 71^\circ 30' = 0'.335.$$

II. *Example.* If $L = 55^\circ$ and $Z = 60^\circ 10'$ we will find on page 115

$$\frac{\Delta t}{\Delta L} = \cot a = \cot 45^\circ = 1'.000.$$

III. *Example.* If $L = 50^\circ$ and $Z = 42^\circ 30'$ we will find on page 95

$$\frac{\Delta t}{\Delta L} = \cot a = \cot 30^\circ 30' = 1'.698.$$

For the sake of simplicity we will call $\frac{\Delta t}{\Delta L} : p$.

LATITUDE FACTOR.

The latitude factor or the change of latitude due to a change of r' in the hour angle or longitude is found immediately by noticing that $\frac{\Delta L}{\Delta t}$ is the reciprocal of $\frac{\Delta t}{\Delta L}$ or of $\cot a$, that is, $\cot (90^\circ - a)$ or $\tan a$.

I. *Example.* If $L = 24^\circ$ and $Z = 73^\circ 0'$ we will find on page 81

$$\frac{\Delta L}{\Delta t} = \tan a = \cot 19^\circ 30' = 2'.824.$$

II. *Example.* If $L = 55^\circ$ and $Z = 60^\circ 10'$ we will find on page 115

$$\frac{\Delta L}{\Delta t} = \tan a = \cot 45^\circ 0' = 1'.000.$$

III. *Example.* If $L = 50^\circ$ and $Z = 42^\circ 30'$ we will find on page 133

$$\frac{\Delta L}{\Delta t} = \tan a = \cot 59^\circ 30' = 0'.589.$$

I. TYPICAL EXAMPLE FOR ALL SIGHTS

(Whether circummeridian, ex-meridian or time sights.)

The following typical example is given in order to illustrate the way in which *all* sights ought to be treated :

SIGHT OF THE SUN.

On February 21, 1910, about 8^h A.M., in Lat. by D. R. 36° 56' N.,¹ and Long. by D. R. 8° 5' W., the observed altitude of the Sun's lower limb, bearing southward and eastward, was 20° 59'.2 at 21^h 6^m 11^s of the chronometer, 6^m 59^s slow of G. M. T. Height of eye 36 ft. Required the line of position.

$$\begin{array}{r}
 C.=21^h 6^m 11^s \\
 \underline{C.C.=+ 6 59} \\
 G. M. T.=21^h 13^m 10^s \\
 \underline{Eq. of T.= - 13 46} \\
 a=52^\circ 0' \quad G. A. T.=20^h 59^m 24^s \text{ or } t_c=3^h 0^m 36^s E=45^\circ 9'.0 E \\
 \hline
 b=17^\circ 8'.4 \quad d=10^\circ 27' S \quad t_A=53 15.3 E \\
 L_A=36 51.6 N \quad G_A=8^\circ 6'.3 W \\
 \hline
 h_o=20^\circ 59'.2 \\
 \underline{Corr.=+ 7.8} \\
 h=21^\circ 7'.0 \\
 C=54^\circ \quad h_A=21 13.0 \quad Z_A=S 57^\circ 42' E \\
 \hline
 h-h_A=- 6'.0
 \end{array}$$

NOTE. This calculation could have been made in advance before taking the sight if it had been decided to observe the Sun at 21^h 6^m 11^s of the chronometer.

Working out this example with 5 decimal place logarithms we would find, with $d=10^\circ 27'$, $t_A=53^\circ 15'.3$ and $L_A=36^\circ 51'.6$:

$$b=17^\circ 8'.0, h_A=21^\circ 13'.1 \text{ and } Z_A=57^\circ 42'.4$$

by means of groups of equations: (2) for Z and (4) for b and h .

¹ As in practice an *assumed* latitude is used instead of the latitude by D. R., it is better, in order to avoid mistakes, not to consider the latitude by D. R. at all, only the longitude by D. R., except when only one observation is available and the ship's most probable position has to be found. The longitude by D. R., itself is only used to find the approximate value of a .

When due to unknown currents or any other reason we have not a reliable D. R. position, a can be determined by means of h and Z . Z is found by compass observation or by the method indicated on page xxxv. Enter the tables with h in the place of d and Z in the place of t .

ALTITUDE AND AZIMUTH TABLES

Group (3) constitutes the *check* group, because it contains d and t given, and h and Z required.

$\log \tan d = 9.26585$ $\log \sec t = 0.22311$ $\log \tan b = 9.48896$ $b = 17^\circ 8'.0$ $Z = 36^\circ 51'.6$ $C = 53^\circ 59'.6$	$\log \tan t = 0.12691$ $\log \cos b = 9.98029$ $\log \operatorname{cosec} C = 0.09208$ $\log \tan Z = 0.19928$ $Z = 57^\circ 42'.4$	$\log \tan C = 0.13863$ $\log \sec Z = 0.27225$ $\log \cot h = 0.41088$ $h = 21^\circ 13'.1$
$\log \cos d = 9.99274$ $\log \sin t = 9.90379$ $\log \sin a = 9.89653$ $a = 52^\circ 0'$	$\log \cos h = 9.96951$ $\log \sin Z = 9.92702$ $\log \sin a = 9.89653$ $a = 52^\circ 0'$	

This development shows the time and trouble our tables save, besides doing away with the turning of pages, lessening the chances of error, and simultaneously checking, *per se*, part of the results. In these calculations advantage has been taken of our precepts, and therefore no algebraic signs or arcs greater than 90° appear.

EXPLANATION.

After the correction is applied to the chronometer time and the equation of time to the G. M. T. we find G. A. T. also called the "Sun's geographical longitude" (\odot 's t_G), because it is the Sun's hour angle from Greenwich. This G. A. T. is *immediately converted into arc*¹ and combined apart with the Longitude by D. R. or $G_{D.R.}$, giving the Sun's hour angle from D. R. or $t_{D.R.}$ in arc:

$$\begin{array}{r} \odot\text{'s } t_G = 45^\circ 9' \text{ E} \\ G_{D.R.} = 8 \quad 5 \text{ W} \\ \hline \odot\text{'s } t_{D.R.} = 53^\circ 14' \text{ E} \end{array}$$

The declination of the Sun, found in the *Nautical Almanac* at the same time as the Eq. of T., is taken to the nearest minute of arc. (It is noticed that no seconds of arc are used in our method nor are they necessary, and the quantities expressed in arc need only be taken within *one-tenth of one minute* when greater accuracy is desired).

Entering the tables on page 69 with $d = 10^\circ 30'$ and $t_{D.R.} = 53^\circ 14'$ as arguments, we find in column a : 52° , which is an approximate value of a , and in column b : 17° , which is an approximate value of b .

Entering the tables again on page 122 with $a = 52^\circ 0'$ and $b = 17^\circ$ as arguments, we find that the Sun's declination $10^\circ 27'$ is comprised between $10^\circ 22'$ and $10^\circ 58'$ respectively corresponding to $b = 17^\circ$ and

¹ This procedure, not usually followed in the text books, has the *triple* advantage of simplifying the determination of t , abolishing the argument in time in the tables and the necessity of dealing with data expressed in time and in arc after G. A. T. is converted.

PLOTTING THE LINE OF POSITION

$b=18^\circ$. Interpolating (here the interpolation is reduced to the multiplication of the factor $\frac{60'}{\Delta}=1.67$, by the difference between $10^\circ 27'$ and $10^\circ 22'$, that is $5'$), we find that $b=17^\circ 8'.4$ and t_A , corresponding to this value of b is $53^\circ 15'.3$. The ready reckoner on pp. 50 to 53 will save the trouble of doing these multiplications.

In order to do away with any corrections, this t_A , which differs from $t_{D.R.}$ *one minute and three-tenths*, is taken as the hour angle. Combining it with the \odot 's $t_a=45^\circ 9'.0$ W., we find a longitude which may be called *assumed*: $G_A=8^\circ 6'.3$ W.

In order to do away with any further interpolations, C is made a whole number of degrees by *assuming* a latitude, nearly the same as the Lat. by D. R., that will make it so. In our particular case it will be seen that $L_A=36^\circ 51'.6$ combined with $b=17^\circ 8'.4$, according to the precepts given, d and L contrary names: $C=L+b$; $Z>90^\circ$, will make C just 54° .

Therefore in the same column $a=52^\circ 0'$ with $C=54^\circ$, we will find $h_A=21^\circ 13'$ and $Z_A=57^\circ 42'$.

CHECK.

The necessary calculations to find h_A and Z_A are so simple and few, and, therefore, the liability to error so small, that we do not think a check is necessary.

However, the correctness of the calculations might be tested *without new data* by proceeding backwards, as explained further on for "identifying celestial bodies" (*vide* page xxxv).

To $h_A=21^\circ 13'$ and $Z_A=57^\circ 42'$ corresponds $B=36^\circ$ in column $a=52^\circ 0'$. If $L_A=36^\circ 51'.6$, c will be found by the precepts on page xxxvi. As $Z>90^\circ$, $c=L_A+B=72^\circ 51'.6<90^\circ$, b will be $17^\circ 8'.4$, and we will find by interpolation (here it is reduced to the division of $8'.4$ by the factor $\frac{60'}{\Delta}=1.67$ giving $5'$) $d=10^\circ 27'$ and $t_A=53^\circ 15'.3$, " d and L contrary names" and " $t<90^\circ$ ".

Of course, if d and t_A , were not the same as used before, the calculations would be in error.

PLOTTING THE LINE OF POSITION.

Fig. 3, representing a section of a chart of the coast of Portugal, shows A the *assumed* position from which the line of position is determined. The *altitude difference* is $AB=-6'.0$. It is $+$ when the true altitude h is *greater* than the assumed altitude h_A , and $-$ when the true altitude is *smaller* than the assumed altitude. It is always taken in the direction of the observed body: *towards*, when $+$ and in the opposite direction: *away from*, when $-$.

LG is the line of position perpendicular to AB . The foot of

ALTITUDE AND AZIMUTH TABLES

the perpendicular dropped from the position by D. R. on the line of position is the ship's most probable position and *must* be taken as the ship's position when only one observation is available.

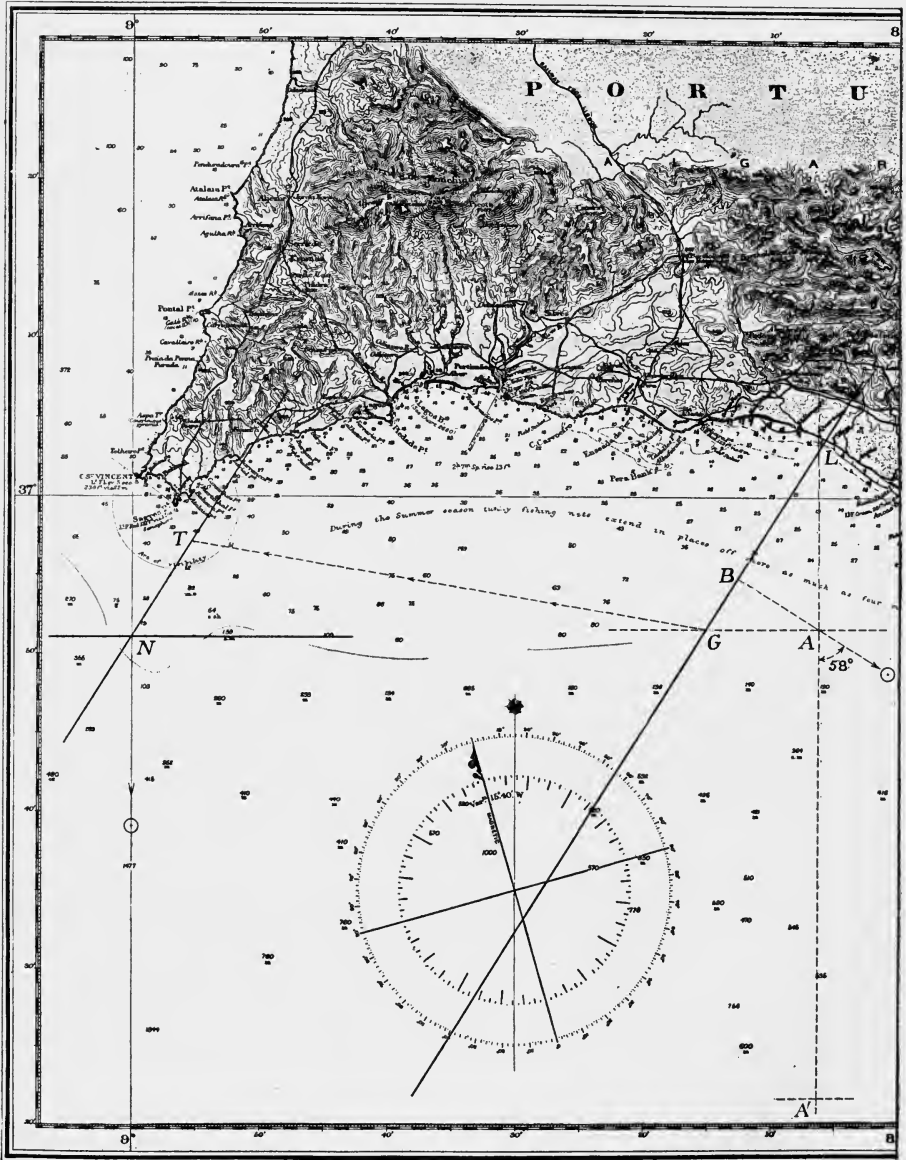


FIG. 3.—Section of a chart of the coast of Portugal showing how line of position is plotted and ship's position AT NOON is found.

This line of position is just as valuable as the isolated knowledge of latitude or longitude, and represents the exact and only true interpretation of the sight.

II. TYPICAL EXAMPLE FOR *ALL* SIGHTS

The following typical example is also given in order to illustrate the way in which *all* sights ought to be treated :

SIGHT OF THE SUN.

On August 21, 1908, about 11^h A.M., in Lat. by D. R. 16° 16' S,¹ and Long. by D. R. 38° 18' W., the observed altitude of the Sun's lower limb, bearing northward and eastward, was 59° 0' at 1^h 19^m 40^s of the chronometer, 26^m 59^s slow of G. M. T. Height of eye 28 ft. Required the line of position and the ship's most probable position.

$$\begin{array}{rcl}
 C. & = & 1^h 19^m 40^s \\
 C. C. & = & + 26 \quad 59 \\
 G. M. T. & = & 1^h 46^m 39^s \\
 Eq. \text{ of } T. & = & - \quad 3 \quad 3 \\
 \hline
 G. A. T. & = & 1^h 43^m 36^s \text{ or } t_G = 25^\circ 54' W \\
 a = 12^\circ 0' & & \\
 \hline
 b = 12^\circ 26'.5 & & d = 12^\circ 10' N \quad t_A = 12 \quad 17 \text{ E} \\
 L_A = 16 \quad 33.5 \text{ S} & & G_A = 38^\circ 11' W
 \end{array}$$

$$\begin{array}{rcl}
 h_o & = & 59^\circ 0' \\
 Corr. & = & + \quad 10 \\
 \hline
 h & = & 59^\circ 10' \\
 C = 29^\circ & & h_A = 58 \quad 49 \quad Z_A = N \quad 23^\circ 41' E \\
 & & h - h_A = + 21'
 \end{array}$$

NOTE. This calculation could have been made in advance before taking the sight if it had been decided to observe the Sun at 1^h 19^m 40^s of the chronometer.

Working out this example with 5 decimal place logarithms we would find, with $d = 12^\circ 10'$, $t_A = 12^\circ 17'$ and $L_A = 16^\circ 33'.5$:

$$b = 12^\circ 26'.6, h_A = 58^\circ 48'.8 \text{ and } Z_A = 23^\circ 40'.8$$

by means of groups of equations : (2) for Z and (4) for b and h .

¹ As in practice an *assumed* latitude is used instead of the latitude by D. R., it is better, in order to avoid mistakes, not to consider the latitude by D. R. at all, only the longitude by D. R., except when only one observation is available and the ship's most probable position has to be found. The longitude by D. R., itself is only used to find the approximate value of a .

When due to unknown currents or any other reason we have not a reliable D.R. position, a can be determined by means of h and Z . Z is found by compass observation or by the method indicated on page xxxv. Enter the tables with h in the place of d and Z in the place of t .

ALTITUDE AND AZIMUTH TABLES

Group (3) constitutes the *check* group, because it contains d and t given, and h and Z required.

log tan $d = 9.33365$	log tan $t = 9.33792$	
log sec $t = 0.01006$	log cos $b = 9.98968$	
log tan $b = 9.34371$	log cosec $C = 0.31441$	log tan $C = 9.74378$
$b = 12^\circ 26'.6$	log tan $Z = 9.64201$	log sec $Z = 0.03820$
$L = 16 \quad 33.5$		log cot $h = 9.78198$
$C = 29^\circ 0'.1$	$Z = 23^\circ 40'.8$	$h = 58^\circ 48'.8$
log cos $d = 9.99013$	log cos $h = 9.71418$	
log sin $t = 9.32786$	log sin $Z = 9.60381$	
log sin $a = 9.31799$	log sin $a = 9.31799$	
$a = 12^\circ 0'$	$a = 12^\circ 0'$	

This development shows the time and trouble our tables save, besides doing away with the turning of pages, lessening the chances of error, and simultaneously checking, *per se*, part of the results. In these calculations advantage has been taken of our precepts, and therefore no algebraic signs or arcs greater than 90° appear.

EXPLANATION.

After the correction is applied to the chronometer time and the equation of time to the G. M. T. we find G. A. T. also called the "Sun's geographical longitude" (\odot 's t_G), because it is the Sun's hour angle from Greenwich. This G. A. T. is *immediately converted into arc*¹ and combined apart with the Long. by D. R., giving the Sun's hour angle from D. R. or $t_{D.R.}$ in *arc*:

$$\begin{array}{r} \odot\text{'s } t_G = 25^\circ 54' \text{ W} \\ \underline{G_{D.R.} = 38 \quad 18 \text{ W}} \\ \odot\text{'s } t_{D.R.} = 12^\circ 24' \text{ E} \end{array}$$

The declination of the Sun, found in the *Nautical Almanac* at the same time as the Eq. of T., is taken to the nearest minute of arc. (It is noticed that no seconds of arc are used in our method nor are they necessary, and the quantities expressed in arc need only be taken within *one-tenth of one minute* when greater accuracy is desired).

Entering the tables with $d = 12^\circ 0'$ and $t_{D.R.} = 12^\circ 24'$ as arguments, we find in column a : 12° , which is an approximate value of a , and in column b : 12° , which is an approximate value of b .

Entering the tables again with $a = 12^\circ 0'$ ² and $b = 12^\circ$ as arguments,

¹ This procedure, not usually followed in the text books, has the *triple* advantage of simplifying the determination of t , abolishing the argument in time in the tables and the necessity of dealing with data expressed in time and in arc after G. A. T. is converted.

² In this particular case by coincidence a is approximately the same as d .

PLOTTING THE LINE OF POSITION

we find that the Sun's declination $12^{\circ} 10'$ is comprised between $11^{\circ} 44'$ and $12^{\circ} 43'$ respectively corresponding to $b=12^{\circ}$ and $b=13^{\circ}$. Interpolating (here the interpolation is reduced to the multiplication of the factor $\frac{60'}{\Delta}=1.02$, by the difference between $12^{\circ} 10'$ and $11^{\circ} 44'$, that is $26'$), we find that $b=12^{\circ} 26'.5$ and t_A , corresponding to this value of b is $12^{\circ} 17'$ (exactly $12^{\circ} 17'.3$). The ready reckoner on pp. 50 to 53 will save the trouble of doing these multiplications.

In order to do away with any corrections, this t_A , which differs from $t_{D.R.}$ seven minutes, is taken as the hour angle. Combining it with the \odot 's $t_G=25^{\circ} 54' W.$, we find a longitude which may be called *assumed*: $G_A=38^{\circ} 11' W.$

In order to do away with any further interpolations, C is made a whole number of degrees by *assuming* a latitude, nearly the same as the Lat. by D. R., that will make it so. In our particular case it will be seen that $L_A=16^{\circ} 33'.5$ combined with $b=12^{\circ} 26'.5$, according to the precepts given, d and L contrary names: $C=L+b$; $Z>90^{\circ}$, will make C just 29° .

Therefore in the same column $a=12^{\circ} 0'$ with $C=29^{\circ}$, we will find $h_A=58^{\circ} 49'$ and $Z_A=23^{\circ} 41'$.

CHECK.

The necessary calculations to find h_A and Z_A are so simple and few, and, therefore, the liability to error so small, that we do not think a check is necessary.

However, the correctness of the calculations might be tested *without new data* by proceeding backwards, as explained further on for "identifying celestial bodies" (*vide* page xxxv).

To $h_A=58^{\circ} 49'$ and $Z_A=23^{\circ} 41'$ corresponds $B=61^{\circ}$ in column $a=12^{\circ} 0'$. If $L_A=16^{\circ} 33'.5$, c will be found by the precepts on page xxxvi. As $Z>90^{\circ}$, $c=L_A+B=77^{\circ} 33'.5<90^{\circ}$, and we will find by interpolation (here it is reduced to the division of $33'.5$ by the factor $\frac{60'}{\Delta}=1.02$ giving $33'$) $d=12^{\circ} 10'$ and $t_A=12^{\circ} 17'$, " d and L contrary names" and " $t<90^{\circ}$ ".

Of course, if d and t_A were not the same as used before, the calculations would be in error.

PLOTTING THE LINE OF POSITION.

Fig. 4, representing a section of a chart of the coast of Brazil, shows A the position by D. R. and A' the *assumed* position from which the line of position is determined. The *altitude difference* is $A'B'=+21'$. It is + when the true altitude h is *greater* than the

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Group (3) constitutes the *check* group, because it contains d and t given, and h and Z required.

$\log \tan d = 9.33365$	$\log \tan t = 9.33792$	
$\log \sec t = 0.01006$	$\log \cos b = 9.98968$	
$\log \tan b = 9.34371$	$\log \operatorname{cosec} C = 0.31441$	$\log \tan C = 9.74378$
$b = 12^\circ 26'.6$	$\log \tan Z = 9.64201$	$\log \sec Z = 0.03820$
$L = 16 \quad 33.5$		$\log \cot h = 9.78198$
$C = 29^\circ 0'.1$	$Z = 23^\circ 40'.8$	$h = 58^\circ 48'.8$

$\log \cos d = 9.99013$	$\log \cos h = 9.71418$
$\log \sin t = 9.32786$	$\log \sin Z = 9.60381$
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$a = 12^\circ 0'$	$a = 12^\circ 0'$

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EXPLANATION.

After the correction is applied to the chronometer time and the equation of time to the G. M. T. we find G. A. T. also called the "Sun's geographical longitude" (\odot 's t_G), because it is the Sun's hour angle from Greenwich. This G. A. T. is *immediately converted into arc*¹ and combined apart with the Long. by D. R., giving the Sun's hour angle from D. R. or $t_{D.R.}$ in arc:

$$\begin{array}{r} \odot\text{'s } t_G = 25^\circ 54' \text{ W} \\ G_{D.R.} = 38 \quad 18 \text{ W} \\ \hline \odot\text{'s } t_{D.R.} = 12^\circ 24' \text{ E} \end{array}$$

The declination of the Sun, found in the *Nautical Almanac* at the same time as the Eq. of T., is taken to the nearest minute of arc. (It is noticed that no seconds of arc are used in our method nor are they necessary, and the quantities expressed in arc need only be taken within *one-tenth of one minute* when greater accuracy is desired).

Entering the tables with $d = 12^\circ 0'$ and $t_{D.R.} = 12^\circ 24'$ as arguments, we find in column a : 12° , which is an approximate value of a , and in column b : 12° , which is an approximate value of b .

Entering the tables again with $a = 12^\circ 0'.2$ and $b = 12^\circ$ as arguments,

¹ This procedure, not usually followed in the text books, has the *triple* advantage of simplifying the determination of t , abolishing the argument in time in the tables and the necessity of dealing with data expressed in time and in arc after G. A. T. is converted.

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PLOTTING THE LINE OF POSITION

we find that the Sun's declination $12^{\circ} 10'$ is comprised between $11^{\circ} 44'$ and $12^{\circ} 43'$ respectively corresponding to $b=12^{\circ}$ and $b=13^{\circ}$. Interpolating (here the interpolation is reduced to the multiplication of the factor $\frac{60'}{\Delta}=1.02$, by the difference between $12^{\circ} 10'$ and $11^{\circ} 44'$, that is $26'$), we find that $b=12^{\circ} 26'.5$ and t_A , corresponding to this value of b is $12^{\circ} 17'$ (exactly $12^{\circ} 17'.3$). The ready reckoner on pp. 50 to 53 will save the trouble of doing these multiplications.

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In order to do away with any further interpolations, C is made a whole number of degrees by *assuming* a latitude, nearly the same as the Lat. by D. R., that will make it so. In our particular case it will be seen that $L_A=16^{\circ} 33'.5$ combined with $b=12^{\circ} 26'.5$, according to the precepts given, d and L contrary names: $C=L+b$; $Z>90^{\circ}$, will make C just 29° .

Therefore in the same column $a=12^{\circ} 0'$ with $C=29^{\circ}$, we will find $h_A=58^{\circ} 49'$ and $Z_A=23^{\circ} 41'$.

CHECK.

The necessary calculations to find h_A and Z_A are so simple and few, and, therefore, the liability to error so small, that we do not think a check is necessary.

However, the correctness of the calculations might be tested *without new data* by proceeding backwards, as explained further on for "identifying celestial bodies" (*vide* page xxxv).

To $h_A=58^{\circ} 49'$ and $Z_A=23^{\circ} 41'$ corresponds $B=61^{\circ}$ in column $a=12^{\circ} 0'$. If $L_A=16^{\circ} 33'.5$, c will be found by the precepts on page xxxvi. As $Z>90^{\circ}$, $c=L_A+B=77^{\circ} 33'.5<90^{\circ}$, and we will find by interpolation (here it is reduced to the division of $33'.5$ by the factor $\frac{60'}{\Delta}=1.02$ giving $33'$) $d=12^{\circ} 10'$ and $t_A=12^{\circ} 17'$, " d and L contrary names" and " $t<90^{\circ}$ ".

Of course, if d and t_A were not the same as used before, the calculations would be in error.

PLOTTING THE LINE OF POSITION.

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assumed altitude h_A , and $-$ when the true altitude is *smaller* than the assumed altitude. It is always taken in the direction of the observed body: *towards*, when $+$ and in the opposite direction: *away from*, when $-$.

$B'B''$ is the line of position perpendicular to $A'B'$. B the foot of

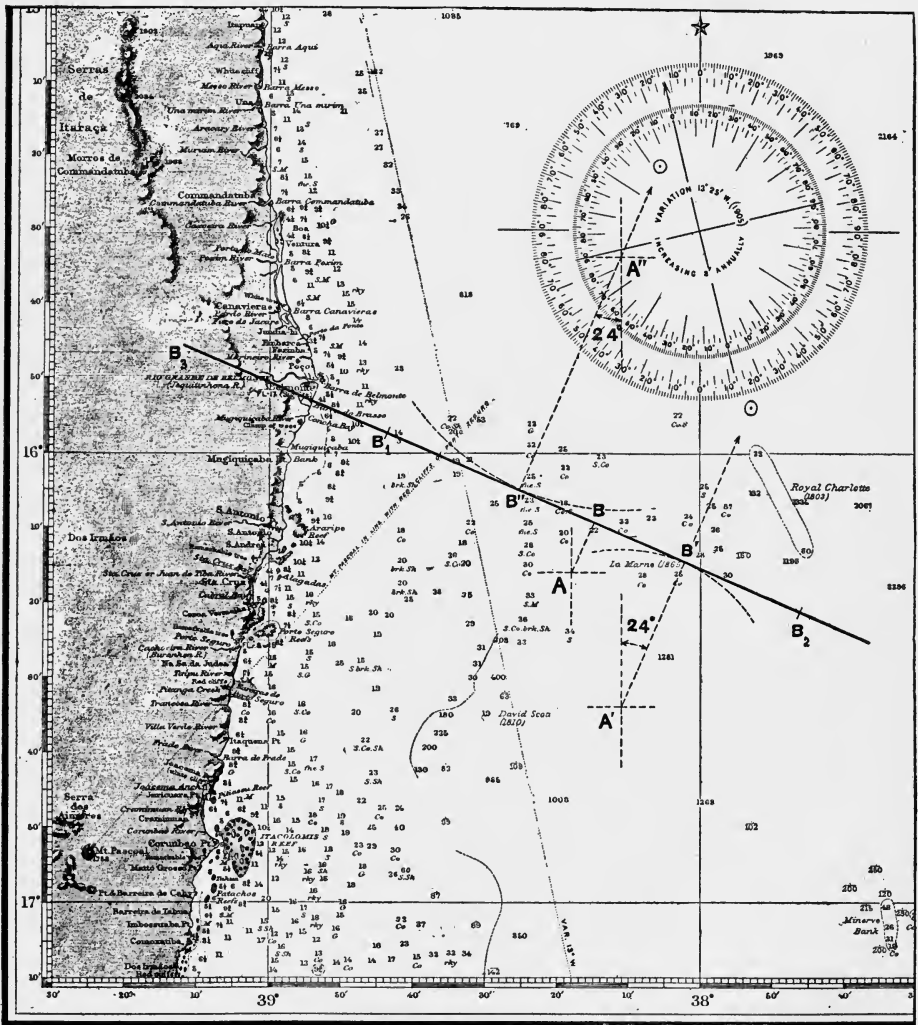


FIG. 4.—Section of a chart of the coast of Brazil showing how line of position is plotted and ship's most probable position found.

the perpendicular dropped from the position by D. R. on the line of position is the ship's most probable position and *must* be taken as the ship's position when only one observation is available.

This line of position is just as valuable as the isolated knowledge of

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*latitude or longitude, and represents the exact and only true interpretation of the sight.*¹

ALTITUDE AND AZIMUTH FROM D. R. POSITION.

When the observer wishes to find $h_{D.R.}$ and $Z_{D.R.}$ corresponding to the position by D. R., instead of taking an assumed position A' (or A'') (and this might be desirable when $t_{D.R.} - t_A$ is large, when the *altitude difference* is greater than the established limits on page xxxii, or when 2, 3, and 4 lines of position have to be plotted simultaneously), it is necessary for him to find :

1st. The value of C with $L_{D.R.}$ and b according to the same precepts given on page xvi and by simple interpolation the corresponding values of h' and Z' (approximate values of $h_{D.R.}$ and $Z_{D.R.}$);

2nd. The corrections Δh and ΔZ to be applied to these values h' and Z' given by the tables due to the difference $t_{D.R.} - t_A = \Delta t$.

These corrections are given by the following formulæ² :

$$\Delta h = \mp \cos L \sin Z' \Delta t \quad \text{or} \quad \frac{\Delta h}{\Delta t} = \mp \cos L \sin Z'$$

and

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

where

$$\Delta_1 Z = \mp \sin L \Delta t \quad \text{or} \quad \frac{\Delta_1 Z}{\Delta t} = \mp \sin L$$

and

$$\Delta_2 Z = -\tan h' \cot Z' \Delta h \quad \text{or} \quad \frac{\Delta_2 Z}{\Delta h} = -\tan h' \cot Z'$$

Our tables on pages 170 and 172 give the absolute values of each one of these co-efficients $\frac{\Delta h}{\Delta t}$, $\frac{\Delta_1 Z}{\Delta t}$ and $\frac{\Delta_2 Z}{\Delta h}$ and at the top of page 170 the signs of the first two for each one of the four cases. $\frac{\Delta_2 Z}{\Delta h}$ is *always negative* provided Z' is smaller than 90° in absolute value, as our tables give it.

The correction ΔZ is generally negligible or unimportant unless Δt is large, but even in this case ΔZ can be small, depending as it does upon $\Delta_1 Z$ and $\Delta_2 Z$ with their signs + and -.

¹ Combinations of lines of position with terrestrial bearings, with lines of soundings or with one or more lines of position are not discussed here, and will be found in any up-to-date text-book on Navigation or Nautical Astronomy.

² *Vide* DOTT. G. PESCI, *Rivista Marittima* for January 1909, page 62. In this article he shows how Δh can be simplified by dividing it by $\cos L$ and then $\frac{\Delta h}{\cos L} = \mp \sin Z' \Delta t$ represents Δh expressed in minutes of longitude. In order to find it then it is only necessary to multiply Δt by $\sin Z'$.

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Taking our typical example it would be worked out as follows :

$$\begin{array}{r} a = 12^\circ \ 0' \\ \hline b = 12^\circ \ 26'.5 \\ \hline L_{D.R.} = 16 \ 16 \ S \end{array} \qquad d = 12^\circ \ 10' \ N \qquad \begin{array}{r} t_{D.R.} = 12^\circ \ 24' \ E \\ t_A = 12 \ 17' \\ \hline \Delta t = + \ 7' \end{array}$$

$$\begin{array}{r} h_o = 59^\circ \ 0' \\ \text{Corr.} = + \ 10 \\ \hline h = 59^\circ \ 10' \end{array} \qquad \begin{array}{r} C = 28^\circ \ 42'.5 \\ h' = 59^\circ \ 5'.1 \\ \Delta h = - \ 2.7 \\ \hline h_{D.R.} = 59^\circ \ 2'.4 \\ h - h_{D.R.} = + \ 7'.6 \end{array} \qquad \begin{array}{r} Z' = 23^\circ \ 53' \\ \Delta_1 Z = + \ 2 \\ \Delta_2 Z = + \ 10 \\ \hline Z_{D.R.} = 24^\circ \ 5' \ NE \end{array} \qquad \begin{array}{r} \frac{\Delta h}{\Delta t} = -0.39 \\ \frac{\Delta_1 Z}{\Delta t} = +0.28 \\ \frac{\Delta_2 Z}{\Delta t} = -3.8 \end{array}$$

With 5 decimal place logarithms we would find $h_{D.R.} = 59^\circ \ 2'.4$ and $Z_{D.R.} = 24^\circ \ 5'$.

The *altitude difference* $+7'.6$ is exactly equal to the distance between A and B on the chart, and shows that "no greater accuracy is gained by determining the line of position from A than from A' ."

The disposition of the arguments of the tables permits us to take, on the *assumed* meridian ($38^\circ \ 11' \ W.$), *any* latitude comprised between $15^\circ \ 33'.5$ and $16^\circ \ 33'.5$ and the computed point will fall between B'' and B' on the line of position.

If we took $L_A = 16^\circ \ 0'$ the *altitude difference* would be small ($=10'$ only), and the computed point would practically coincide with B .

If we took $L_A = 16^\circ \ 10'.6$ the *altitude difference* would be *nil* ($0'$) and the line of position could be *immediately* drawn. This L_A is found by deducing the value of C that corresponds to $h_A = h$. This C combined with b by means of our fundamental precepts gives L_A :

$$\begin{array}{l} d \text{ and } L_A \text{ same name} \\ d \text{ and } L_A \text{ contrary names} \end{array} \left\{ \begin{array}{l} t < 90^\circ \left\{ \begin{array}{l} L_A < b : L_A = b - C ; Z < 90^\circ \\ L_A > b : L_A = b + C ; Z > 90^\circ \end{array} \right. \\ t > 90^\circ \dots : L_A = b + C ; Z < 90^\circ \\ \dots : L_A = C - b ; Z > 90^\circ \end{array} \right.$$

This shows the elasticity of our method whereby a better line of position (if necessary) can be plotted from a different assumed position without much additional calculation.

MERIDIAN SIGHTS.¹

When a celestial body is on the meridian, its hour angle t is either 0° or 180° , according to its position above or below the elevated pole. Its azimuth Z is then also 0° or 180° . It is 0° when the sight is taken with the observer's "face towards the elevated pole," and 180° when he has to turn his "back towards the elevated pole," to take the sight.

Introducing these values in groups of equations (3) and (1) we find that

$$a = 0^\circ \ 0', \ d = b \text{ and } h = B.$$

¹ Sightings can generally be considered as *meridian* when $a < 0^\circ \ 15'$.

PRECEPTS FOR MERIDIAN SIGHTS

This means that meridian sights could be worked out in column $a=0^\circ 0'$ of our tables. It is better, however, to deduce directly from our general precepts, or from those giving L on page xxviii, special precepts giving *immediately* L with h and d .

These precepts will present the advantage, over the usual way of treating meridian sights, of doing away with the necessity of finding the meridian zenith distance, and giving it a confusing name or sign, such as now is in practice (N or + when facing South, and S or - when facing North). They show that even this simple time-honoured problem is capable of further simplification.

PRECEPTS FOR MERIDIAN SIGHTS.

$$\begin{array}{l}
 Z = 0^\circ \left\{ \begin{array}{l} \text{FACE towards} \\ \text{elevated pole} \end{array} \right\} \begin{cases} t = 0^\circ : L = (h+d) - 90^\circ ; d \text{ and } L \text{ same name.} \\ t = 180^\circ : L = (90^\circ + h) - d ; d \text{ and } L \text{ ,, ,,} \end{cases} \\
 \\
 Z = 180^\circ \left\{ \begin{array}{l} \text{BACK towards} \\ \text{elevated pole} \end{array} \right\} \begin{cases} t = 0^\circ : L = (90^\circ + d) - h ; d \text{ and } L \text{ ,, ,,} \\ t = 180^\circ : L = 90^\circ - (h+d) ; d \text{ and } L \text{ contr. names.} \end{cases}
 \end{array}$$

In Fig. 2 the 1st case corresponds to a body between P and Z .

"	"	2nd	"	"	"	P	"	N .
"	"	3rd	"	"	"	Z	"	Q .
"	"	4th	"	"	"	Q	"	S .

1. *Example.* On August 27, 1908, in Lat. by D. R. $2^\circ 40' N.$, and Long. by D. R. $47^\circ 22' W.$, the observed meridian altitude of the sun's lower limb was $82^\circ 21'$. $Z = 0^\circ$ (*face* towards elevated pole and $t = 0^\circ$). Find the latitude.

OUR WAY.	USUAL WAY.
$h \odot = 82^\circ 21'$	$h \odot = 82^\circ 21'$
Corr. = + 10.5	Corr. = + 10.5
<hr style="width: 80%; margin: 0 auto;"/>	<hr style="width: 80%; margin: 0 auto;"/>
$h \odot = 82^\circ 31'.5$	$h \odot = 82^\circ 31'.5$
$d \odot = 10 \quad 7.0 \text{ N}$	$z \odot = 7^\circ 28'.5 \text{ S}$
$L = 92^\circ 38'.5 \text{ N}$	$d \odot = 10 \quad 7.0 \text{ N}$
	$L = 2^\circ 38'.5 \text{ N}$

2. *Example.* On September 5, 1908, in Lat. by D. R. $35^\circ N.$, and Long. by D. R. $70^\circ 30' W.$, the observed meridian altitude of the sun's lower limb was $61^\circ 28'.1$. $Z = 180^\circ$ (*back* towards elevated pole). Find the latitude.

OUR WAY.	USUAL WAY.
$h \odot = 61^\circ 28'.1$	$h \odot = 61^\circ 28'.1$
Corr. = + 10.2	Corr. = + 10.2
<hr style="width: 80%; margin: 0 auto;"/>	<hr style="width: 80%; margin: 0 auto;"/>
$h \odot = 61^\circ 38'.3$	$h \odot = 61^\circ 38'.3$
$90^\circ + d \odot = 9) 6 \quad 48.3 \text{ N}$	$z \odot = 28^\circ 21'.7 \text{ N}$
$L = 35^\circ 10' \text{ N}$	$d \odot = 6 \quad 48.3 \text{ N}$
	$L = 35^\circ 10' \text{ N}$

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SIGHTS OF THE MOON, STARS, AND PLANETS.

Observations of the Moon, Stars, and Planets are worked out the same way as those of the Sun, excepting the way in which the $t_{D.R.}$ is determined. After correcting the chronometer and finding G. M. T. this interval of mean time is converted into an interval of sidereal time to which is added the Sidereal Time at Greenwich Mean Noon (or the R.A.M.S. at the same instant) in order to find G. S. T.¹ This G. S. T. combined with the observed body's R. A. will give us the body's geographical longitude (t_G), or its hour angle from Greenwich. This t_G is converted *immediately* into arc and combined with the Long. by D. R., finally giving the body's $t_{D.R.}$

EXAMPLE.

$$\begin{array}{r}
 C. = 9^h 39^m 43^s \\
 C. C. = - 13 \quad 16 \\
 \hline
 G. M. T. = 9^h 26^m 27^s \\
 \text{Accel.} = + \quad 1 \quad 33 \\
 R. A. M. S. = 10 \quad 17 \quad 20 \\
 \hline
 G. S. T. = 19^h 45^m 20^s \\
 R. A. = 14 \quad 11 \quad 28 \\
 \hline
 t_G = 5^h 33^m 52^s \quad \text{or} \quad t_G \text{ (in arc)} = 83^\circ 28' W \\
 G_{D.R.} = 43 \quad 42 \quad W \\
 t_{D.R.} = 39^\circ 46' W
 \end{array}$$

SIGHTS OF α URSÆ MINORIS (*Polaris*).⁷

Sights of *Polaris* are more easily and rapidly worked out, on account of its high declination: $88^\circ 50'$ in 1910, and the consequent small value of a , always less than $1^\circ 10'$.

For this declination, the tables on pages 168 and 169 show that a and b vary very slowly for large variations of t , and it is then possible to determine immediately their exact values by inspection.

Turning to pages 54 and 55 of the tables, we notice that large variations of a do not sensibly affect the values of h for a given value of B . Whether a is $0^\circ 0'$, $0^\circ 30'$, or $1^\circ 0'$, we have practically always $B=h$ up to $B=70^\circ$. Therefore it is not necessary to determine a exactly.

¹ The use of a sidereal chronometer on board ship would simplify matters and render more attractive observations of the Moon, Stars, and Planets. However, a mean time chronometer may be considered a sidereal chronometer as long as its daily rate is taken as $+3^m 56^s.56 \pm$ daily rate. If the *Nautical Almanac* gave the Sun's, the Moon's, and the Planets' declinations and right ascensions for 0^h G. S. T., only one process for finding t_G would need to be followed in all cases, and no mean time chronometers would be necessary.

LINES OF POSITION WITHOUT AZIMUTHS

As *Polaris* increases in declination (its Annual Variation is only 19''), the exact value of b can be obtained by simple interpolation between $d=88^{\circ} 50'$ and $d=89^{\circ} 0'$.

*Example.*¹ On March 6, 1910, in Longitude 37° W., at $10^{\text{h}} 11^{\text{m}} 35^{\text{s}}$ Greenwich Mean Time, suppose the true altitude of *Polaris* to be $46^{\circ} 17'.5$. Required the latitude (or the line of position).

$$\begin{array}{r}
 \text{G. M. T.} = 10^{\text{h}} 11^{\text{m}} 35^{\text{s}} \\
 \text{Accel.} = + 1 \ 41 \\
 \text{R. A. M. S.} = 22 \ 53 \ 21 \\
 \text{G. S. T.} = 9^{\text{h}} \ 6^{\text{m}} \ 37^{\text{s}} \\
 \text{R. A.} = 1 \ 27 \ 0 \\
 \hline
 t_G = 7^{\text{h}} \ 39^{\text{m}} \ 37^{\text{s}} \quad \text{or} \quad t_G \text{ (in arc)} = 114^{\circ} \ 54' \ \text{W} \\
 \hline
 G_{D.R.} = 37 \ 0 \ \text{W} \\
 t_{D.R.} = 77^{\circ} \ 54' \ \text{W}
 \end{array}$$

Entering the tables with $d=88^{\circ} 50'$, and $t_{D.R.}=77^{\circ} 54'$, we find immediately $a=1^{\circ} 9'$ and $b=89^{\circ} 45'$. (As b corresponds to the *exact* value of d , it is not necessary to re-enter the tables with a and b as arguments, as explained on page xx). Entering the tables again with $a=1^{\circ} 0'$, we find corresponding to $h=46^{\circ} 17'.5$: $B=46^{\circ} 18'.5$ and $Z=1^{\circ} 27'$. Combining this B with b by means of the precepts² for finding L at the bottom of page 168 ($t < 90^{\circ}$), we have

$$L = 46^{\circ} 3'.5 \ \text{N.}$$

With the latitude thus determined and the longitude by D. R., we find a position through which the line of position is drawn, as usual, perpendicular to the Star's true bearing.

As *Polaris*' azimuth is generally very small, the parallel of latitude will in the great majority of cases practically coincide with the line of position.

LINES OF POSITION DETERMINED WITHOUT AZIMUTHS.

If we assumed the latitude as $15^{\circ} 33'.5$, instead of $16^{\circ} 33'.5$, C would be 28° , $h_A=59^{\circ} 44'$, and $Z_A=24^{\circ} 22'$. As the assumed longitude is the same, $38^{\circ} 11' \ \text{W.}$, the assumed position would be A'' (*vide* Fig. 4), and the altitude difference $-34'$.

With the two assumed positions A' and A'' (60' apart on the same meridian) and the two altitude differences $+21'$ and $-34'$ the line of position can be found by drawing a line tangent to the two dotted circles drawn from A' and A'' respectively with $21'$ and $34'$ as radii.

This process appearing now for the first time gives a line of position independent of the observed body's azimuth, and its use

¹ Taken from the *Nautical Almanac* for 1910 for the sake of comparison.

² In the case of *Polaris* the four precepts for finding L with b and B are reduced to two, because L , in practice, is not *greater* than b , and d and L cannot be of *contrary names*.

ALTITUDE AND AZIMUTH TABLES

facilitates the plotting of the line of position. It will prove very useful for plotting with great accuracy lines of position on Mercator's chart when the latitude is higher than 45° , especially when the body is near the prime vertical and the altitude difference large.

No error is committed in the plotting of the line when the altitude difference is $\leq 60'$ up to 75° latitude. With the ordinary process of plotting lines, as described on page xxv, a *maximum* error of 1° is introduced in the direction of the line of position when the azimuth is 90° with an

altitude difference =	60'	when the latitude =	45°		
"	"	48'	"	"	50°
"	"	42'	"	"	55°
"	"	36'	"	"	60°
"	"	28'	"	"	65°

A comparison of the two azimuths will control the coincidence of the straight line of position $B'B''$ and the curve of position (not represented on the chart), as it is evident the greater the difference between the two azimuths less will the two lines coincide.

However, this comparison need only be made when $t < 45^\circ$ and the observed body's declination is smaller than its altitude ($d < h$).¹ When $t > 45^\circ$, and $d < h$, $d > h$, or $d = h$, the curve of position and the straight line of position on Mercator's chart coincide within $1'$ for a distance equal to or greater than $83'$ ($83'\sqrt{\cos L}$ in miles) on each side of the ship's most probable position. (*Vide* "Table for controlling the coincidence of lines of position," on page 173).

In our typical example the line of position $B'B''$ coincides with the corresponding curve of position within 1 mile for a distance of 59.5 miles on each side of the ship's most probable position B . B_1 and B_2 , 30 miles from B , are only 0.2 of a mile distant from the curve of position. B_3 and B_4 (not shown on the chart), 59.5 miles from B , are just 1 mile distant, and limit the *useful* part of the straight line of position.

RECTIFICATION OF LINES OF POSITION.

As the altitude of a celestial body increases, its zenith distance or the radius of the circle of position decreases, so it might happen that at a certain distance from the "computed point" the circle of position (or curve of position on Mercator's chart) and the straight line of position do not practically coincide.

The practical coincidence of the two lines takes place when the extreme points of the two lines are not further apart than 1 mile, as

¹ For details *vide* the author's: "Limites de coincidência da recta Marcq Saint Hilaire com a curva de posição correspondente." (Reprinted from the *Revista Marítima Brasileira*, July 1906, page 41.)

RECTIFICATION OF LINES OF POSITION

in the case considered in Fig. 4. This limit can be increased or decreased according to the accuracy sought by the navigator, since it must not be forgotten that the circle of position is the line that contains the observer's position and that the straight line of position is only a *practical substitute*.

When only one line of position is determined it is generally not necessary to rectify it, that is to change its direction and position so that it will represent better the circle of position in the vicinity desired.

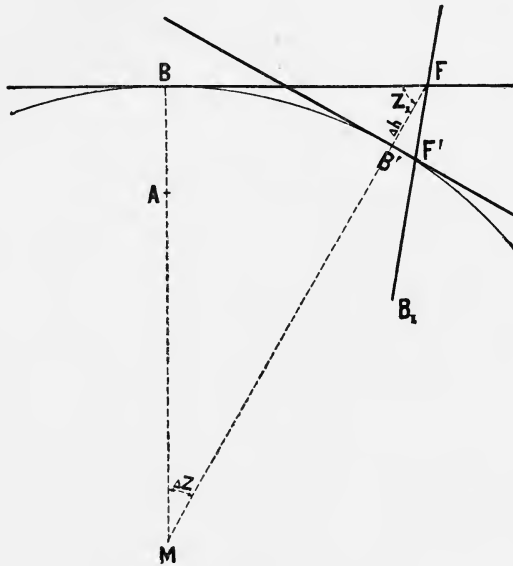


FIG. 5.

Let BF and B_1F in Fig. 5 be two lines of position, and F their intersection generally taken as the ship's position. Let us suppose that the body giving the line B_1F was low enough for us to be sure it is a practical substitute for the circle, meaning that F is less than r' from the circle of position. On the other hand, the body giving BF was very high (above 60°), and F is more than r' from the circle of position BB' . This means that F (the intersection of the two straight lines) is not a practical substitute for the intersection of the two circles of position (only one BB' being represented in the figure for demonstration).

It is then necessary to rectify BF . The tables¹ for rectifying lines

¹ Abridged, by special permission of the author, from those accompanying a very remarkable article, entitled "Sulla Teoria e la Pratica della Nuova Navigazione Astronomica," by DOTT. A. ALESSIO, Tenente di Vascello, Royal Italian Navy, published as a "supplement" to the *Rivista Marittima* for July-August 1908. *Vide* also Professor G. PES' very interesting letter in the *Rivista Marittima* for March 1909, Appendice, page 14.

ALTITUDE AND AZIMUTH TABLES

of position give the values of $FB' = \Delta h$ and Z_1 with the altitude h and the distance $D = BF$, and these are sufficient for determining the new line of position $B'F'$ perpendicular to FB' . This new line intersects the line B_1F in F' , which is taken as the ship's position.

Sometimes it may be necessary to rectify both lines, or to rectify one of them a second time, but this is very rare in practice.

This method recently devised by Lieut. ALESSIO saves the trouble of calculating a new *altitude difference* and *azimuth* for determining the line of position $B'F'$ from F .

We have considered the angle Z_1 instead of the *azimuth difference* ΔZ given by Lieut. ALESSIO, because it saves drawing a perpendicular to BF .

When the altitude is lower than 60° generally it will not be necessary to rectify lines of position.

When the altitude is higher than 60° use a distance D in miles corresponding to which $\Delta h = 0.5, 1', 2'$ or more miles for the given altitude, according to the scale of the chart.

The tables show that the departure (Δh) between the circle and the straight line of position is $\leq 1'$ for

$h \leq 60^\circ$	when	$D \leq 60'$
„ 65°	„	„ $54'$
„ 70°	„	„ $48'$
„ 75°	„	„ $42'$
„ 82°	„	„ $30'$
„ 86°	„	„ $22'$
„ 89°	„	„ $11'$

ALTITUDE AND AZIMUTH FOR SIGHTING

By determining the approximate altitudes and azimuths of several planets and bright stars, such as VENUS and JUPITER, *Sirius*, *Canopus*, *Vega*, *Capella*, *Rigel*, *Arcturus*, *Procyon*, *Achernar*, &c., it is possible to take sights of them in broad daylight, provided their positions are far enough away from the Sun to be visible with the high power inverting telescope.

The previous knowledge of the approximate altitudes and azimuths of these and of many other celestial bodies will also enable the navigator during the twilight to take good sights of them in rapid succession with a daylight¹ horizon, long before it would be possible to locate them with the naked eye alone.

Naturally the problem is the same as explained before on page xv,

¹ A brief account of the possibilities of daytime observations of stars and planets is given by Mr. C. E. MUMFORD (Union Castle Line), in his very interesting little pamphlet, "How to Identify Unknown Stars, &c." London, 1909, 6d.

IDENTIFICATION OF CELESTIAL BODIES

but as not so great accuracy is necessary the required altitudes and azimuths are found by inspection without interpolating.

The following precepts will show when the body is below the horizon, and therefore it cannot be seen at the time :

$$\begin{array}{l}
 d \text{ and } L \text{ same name} \dots \dots t > 90^\circ \dots \dots L + b < 90^\circ \\
 d \text{ and } L \text{ contrary names} \dots \dots \left\{ \begin{array}{l} t < 90^\circ \dots \dots L + b > 90^\circ \\ t > 90^\circ \end{array} \right.
 \end{array}$$

If, for some reason, the bodies were not observed at the time for which the altitudes were calculated, the table giving the rate of "change of altitude per minute of time" on page 174 will enable the observer to find the altitude before or after a certain interval of time.

IDENTIFICATION OF CELESTIAL BODIES

The identification of celestial bodies, or star identification, is of prime importance nowadays, and is strictly indispensable when only one or a few stars are showing at a time. In this case it is impossible to identify the observed stars by alignments.

By rendering "*the star observer independent of any previous knowledge of the name of the star he observes,*" and "*by enabling him to identify it from the data used in his observation together with its approximate true bearing,*"¹ our tables will permit, on account of the great number of arguments, the identification of any one of the 316 stars above magnitude 4.1 catalogued in the *Nautical Almanac*, without doubt or confusion, and practically without interpolation.²

Therefore, the greatest difficulty in the use of stars—the uncertainty or ignorance of the names of the stars observed—will be overcome.

A star is identified in the *Nautical Almanac* by means of its Right Ascension and Declination. The Right Ascension is found by combining the Greenwich Sidereal Time with the star's geographical longitude. This t_G is found by combining the star's hour angle with the longitude by D. R.

We have then to find the star's hour angle t and its declination d . They can be easily and readily obtained from our tables, if we know the star's true altitude and azimuth, or true bearing,³ the

¹ H. W. HARVEY, "What Star is it?" Tables for identifying unknown stars. London, 1909, page 3.

² α Ursæ Minoris (*Polaris*) is not included in this number, but is easily identified without computation. Below 70° latitude its greatest azimuth is $3^\circ.4$, and its altitude is always within $1^\circ 10'$ of the exact latitude of the observer.

³ When this azimuth or true bearing cannot be obtained by compass observation, determine by means of 3 or more altitudes taken in 3 or more minutes the rate of "change of altitude per minute of time," and our "change of altitude table" on page 174 will give approximately the azimuth with the rate of change, and the observer's latitude. Ex. Lat. 32° and rate of change $9'.0$: Azimuth, 45° .

This method of finding the azimuth does not give good results when the body is near the prime vertical, as the table shows.

ALTITUDE AND AZIMUTH TABLES

observer's latitude and longitude by D. R., and the Greenwich time of the observation.

Thus, the problem of identifying celestial bodies is the reverse of the problem of determining altitude and azimuth.

Given h , Z and L , find d and t .

DETERMINATION OF d AND t .

The lower equations of groups of equations (3) and (4) on page xiii are perfectly similar to the upper ones, and show, if we enter the tables with h and Z as arguments in place of d and t respectively, we will find in column a an approximate value of a , and in column b an approximate value of B .

Entering the tables again with a and B as arguments, we will find approximately the values of h and Z given. When greater accuracy is required a more exact value of B can be determined for the *exact* value of h .

The values of d and t will then be found in the same column a corresponding to b or its complement c .

DETERMINATION OF $90^\circ - b$ OR c .

The following precepts deduced from those for determining C facilitate the determination of c given L and B , and present the same advantages as the others. The name of the declination is readily shown.

$$Z < 90^\circ \begin{cases} L < B & \therefore c = B - L & \dots; d \text{ and } L \text{ same name} & t < 90^\circ \\ L > B & \therefore c = L - B & \dots; d \text{ ,, } L \text{ ,, ,, } & t > 90^\circ \end{cases}$$

$$Z > 90^\circ \begin{cases} L + B > 90^\circ & c = 180^\circ - (L + B); d \text{ ,, } L \text{ ,, ,, } & t < 90^\circ \\ L + B < 90^\circ & c = L + B & \dots; d \text{ ,, } L \text{ contrary names} & t < 90^\circ \end{cases}$$

When $Z < 90^\circ$, the *smaller* of the two quantities L and B is always subtracted from the *larger* of the two.

When $Z > 90^\circ$, L and B are always added together. If their sum is greater than 90° , it is subtracted from 180° .

The following example is one of many presenting themselves daily to navigators.

Example. On August 26, 1908, about 6^h 30^m P.M., in Lat. by D. R.

TIME-AZIMUTHS FOR DEVIATION

$0^{\circ} 20' N.$, and Long. by D. R. $44^{\circ} 23' W.$, the weather being cloudy, a bright star appeared and was observed through a break in the clouds in a S.W. direction, bearing true $17^{\circ}.5$ at $9^h 41^m 14^s$ of the Chronometer, $13^m 16^s$ fast of G. M. T. The true altitude at the same instant was $23^{\circ} 48'$. The Sidereal Time at Greenwich Mean Noon (R. A. M. S.), was $10^h 17^m 20^s$. It was doubtful whether the star was α^2 or β Centauri, both being close to one another, and approximately of the same magnitude. What star was it?

$a = 16^{\circ} 0'$		
$B = 24^{\circ} 50'$	$h = 23^{\circ} 48'$	$Z = 17^{\circ}.5 \text{ SW } (Z > 90^{\circ})$
$L = 0 20$		
$c = 25^{\circ} 10'$	$d = 60^{\circ} 28' S$	$t = 33^{\circ} 59' W$
$C. = 9^h 41^m 14^s$		$G_{D.R.} = 44 23. W$
$C.C. = - 13 16$		$t_G = 78^{\circ} 22' W$
$G. M. T. = 9^h 27^m 58^s$		
Accel. = + 1 33	Running through the <i>Nautical Almanac</i> ,	
$R. A. M. S. = 10 17 20$	where stars are catalogued, we find	
$G. S. T. = 19^h 46^m 51^s$	$R. A. = 14^h 33^m 21^s$	} α^2 Centauri.
$t_G = 5 13 28 W$	$d = 60^{\circ} 27' 30''$	
$R. A. = 14^h 33^m 23^s 1$		

Once known that the observed star was α^2 Centauri, we would work out the sight for position, and would find

$$L_A = 0^{\circ} 10' N. \text{ and } G_A = 44^{\circ} 23' W.$$

$$h_A = 23^{\circ} 58' \quad ,, \quad Z_A = 17^{\circ} 34' S.W.$$

with very little extra calculation.

TIME-AZIMUTHS FOR DEVIATION

These tables constitute *ideal time-azimuth tables*, as a little examination and comparison with other tables will show.

For the Sun and other celestial bodies with declinations less than 24° , time-azimuths can be easily and rapidly found without interpolation for every $30'$ (2 minutes of time) hour angles and every 1° of latitude. The hour angle interval increases slowly with the increasing declinations and decreases slowly for increasing values of a , while the latitude interval remains constant throughout.

¹ The determination of the R. A. by means of the G. S. T. and the t_G , instead of determining it (as usually is done) by means of the R. A. M. (A. T. S. + \odot 's R. A.) and the t , might seem longer, but it must be remembered that stars are identified for position (not for pleasure), and G. S. T. and the t_G enter in this calculation, whereas the R. A. M. and the \odot 's R. A. are of no use at all afterwards, and give less accurate results.

ALTITUDE AND AZIMUTH TABLES

Time-azimuths are found by the same method used for determining h and Z for lines of position, and as h is not necessary it is not taken into consideration. Unless great accuracy is required (which is not the case in practice) b can be immediately found by inspection without interpolating.

Example. August 26, 1908, A.M. Lat. by D. R. $0^{\circ} 30'$ S., and Long. by D. R. $41^{\circ} 40'$ W. The Sun's compass bearing was taken at $23^{\text{h}} 3^{\text{m}} 0^{\text{s}}$ Greenwich mean time. What was the Sun's true bearing or azimuth at the same instant?

	G. M. T. = $23^{\text{h}} 3^{\text{m}} 0^{\text{s}}$	
	Eq. of T. = $- 1 56$	
	G. A. T. = $23^{\text{h}} 1^{\text{m}} 4^{\text{s}}$	
	☉'s t_G = $0 58 56$ E	
	☉'s t_G = $14^{\circ} 44'$ E	
	G _{D.R.} = $41 40$ W	
	☉'s $t_{D.R.}$ = $56^{\circ} 24'$ E	
	☉'s Z = $77^{\circ} 9'$ NE	

$a = 55^{\circ} 0'$		
$b = 18^{\circ} 30'$	☉'s $d = 10^{\circ} 29'$ N	
L = $0 30$ S		
C = $19^{\circ} 0'$		

TIME-ALTITUDE-AZIMUTHS

When d , t and h are given to find Z the tables give immediately its value.

Example. Same as above for time-azimuth. Given $d = 10^{\circ} 29'$, $t = 56^{\circ} 24'$, and $h = 32^{\circ} 51'$, find Z .

Entering the tables with d and t as arguments, we will find in column a : $55^{\circ} 0'$, which is an approximate value of a , and in column b : 18° , an approximate value of b . Entering the tables again with $a = 55^{\circ} 0'$ and $b = 18^{\circ}$ as arguments, we will find approximately the values of d and t . In the same column $a = 55^{\circ} 0'$ corresponding to $h = 32^{\circ} 51'$ we will find $Z = 77^{\circ} 9'$.

DISTANCE AND COURSE IN GREAT CIRCLE SAILING

The problem of finding distance and course in Great Circle Sailing may also be easily solved by our tables, because it is the same as determining altitude and azimuth. The distance corresponds to the zenith distance or complement of the altitude and the course to the azimuth. The only difference is that the distance between the two given points can be greater than 90° , whereas the zenith distance cannot be greater than 90° .

In Fig. 1 let A be the port of departure, M be the port of arrival and P the pole nearest to A . $PQ'P'Q'$ the meridian of Greenwich and $QA'M'Q'$ the Equator.

If L is the latitude of the port of departure A , L' the latitude of

LUNAR DISTANCES

the port of arrival M and MPA or t the difference in longitude between the two ports, the following precepts enable us to determine the value of C given L and b and indicate also in the last two columns if the distance D and the course C_1 are smaller or greater than 90° . When $<90^\circ$ the values of D and C_1 given by the tables are the right ones. When $>90^\circ$ subtract the values found from 180° .

$$\begin{array}{l}
 L' \text{ and } L \\
 \text{same name} \\
 \cdot \\
 L' \text{ and } L \\
 \text{contrary names}
 \end{array}
 \left\{
 \begin{array}{l}
 t < 90^\circ \left\{ \begin{array}{l} L < b \dots : C = b - L; D < 90^\circ \text{ and } C_1 < 90^\circ * \\ L > b \dots : C = L - b; D < 90^\circ \text{ ,, } C_1 > 90^\circ * \end{array} \right. \\
 t > 90^\circ \left\{ \begin{array}{l} L + b > 90^\circ : C = L + b; D < 90^\circ \text{ ,, } C_1 < 90^\circ * \\ L + b < 90^\circ : C = L + b; D > 90^\circ \text{ ,, } C_1 < 90^\circ \end{array} \right. \\
 t < 90^\circ \left\{ \begin{array}{l} L + b < 90^\circ : C = L + b; D < 90^\circ \text{ ,, } C_1 > 90^\circ * \\ L + b > 90^\circ : C = L + b; D > 90^\circ \text{ ,, } C_1 > 90^\circ \end{array} \right. \\
 t > 90^\circ \left\{ \begin{array}{l} L > b \dots : C = L - b; D > 90^\circ \text{ ,, } C_1 < 90^\circ \\ L < b \dots : C = b - L; D > 90^\circ \text{ ,, } C_1 > 90^\circ \end{array} \right.
 \end{array}
 \right.$$

* These are the four cases corresponding to those for finding h and Z ($D < 90^\circ$). When $L + b$ is greater than 90° it is subtracted from 180° .

In our tables L' takes the place of d , $90^\circ - D$ the place of h , and C_1 the place of Z .

We are of the opinion, however, that the Great Circle charts¹ offer a more simple and practical solution of the problem, and the tables only ought to be used when they are not at hand.

LUNAR DISTANCES

We have already stated in the INTRODUCTION that the problem of calculating Lunar Distances is similar to the problem of determining Distance in Great Circle Sailing.

In Fig. 1 on page ix, let M be the Moon, A the other body observed, and P the pole nearest to A . MA will be the Lunar Distance. If $QA'M'Q$ is the celestial Equator and Q the first point of Aries or the true vernal equinox, QPA' or QA' will be the Right Ascension of A , QPM' or QM' the Right Ascension of the Moon and $A'PM' = t$ equal to the difference between the two Right Ascensions. If we represent MM' , the declination of the Moon by d_M and AA' the declination of the other body observed by d_A , the following formulæ and precepts will enable us to calculate the Lunar Distance $MA = D$ without dealing with algebraic signs or arcs greater than 90° .

$$\begin{aligned}
 \tan b &= \tan d_M \sec t \\
 \cos D &= \sin d_M \cos C \operatorname{cosec} b
 \end{aligned}$$

¹ Vide "The Development of Great Circle Sailing," by G. W. Littlehales, U.S. Hydrographic Office, Second Edition, Washington, 1899.

ALTITUDE AND AZIMUTH TABLES

$$\begin{array}{l}
 d_M \text{ and } d_A \text{ same name . . . } \left\{ \begin{array}{l}
 t < 90^\circ \begin{cases} d_A < b . . . : C = b - d_A; D < 90^\circ \\
 d_A > b . . . : C = d_A - b; D < 90^\circ \end{cases} \\
 t > 90^\circ \begin{cases} d_A + b > 90^\circ : C = d_A + b; D < 90^\circ \\
 d_A + b < 90^\circ : C = d_A + b; D > 90^\circ \end{cases}
 \end{array} \right. \\
 \\
 d_M \text{ and } d_A \text{ contrary names } \left\{ \begin{array}{l}
 t < 90^\circ \begin{cases} d_A + b < 90^\circ : C = d_A + b; D < 90^\circ \\
 d_A + b > 90^\circ : C = d_A + b; D > 90^\circ \end{cases} \\
 t > 90^\circ \begin{cases} d_A > b . . . : C = d_A - b; D > 90^\circ \\
 d_A < b . . . : C = b - d_A; D > 90^\circ \end{cases}
 \end{array} \right.
 \end{array}$$

For the sake of comparison we will work out the example explained on page 232 of the *Nautical Almanac* for 1910, Part I.

EXAMPLE I.—MOON AND SUN.

To find the *true distance* between the Moon and the Sun at noon, Greenwich Mean Time, on March 8, 1910.

From the *Nautical Almanac*, Part I.

RIGHT ASCENSION.	or	DECLINATION.
Sun 23 ^h 12 ^m 20 ^s .0		5° 7' 9" S (d_A)
Moon 20 41 3.4		23 2 50 S (d_M)
diff. 2 ^h 31 ^m 16 ^s .6		37° 49' 9" = t
log tan d_M = 9.628846		log sin d_M = 9.592720
log sec t = 0.102400		log cos C = 9.963423
log tan b = 9.731246		log cosec b = 0.324059
$b = 28^\circ 18' 21''$		log cos D = 9.880202
$d_A = 5 \quad 7 \quad 9$		$D = 40^\circ 37' 48''$
$C = 23^\circ 11' 12''$		

Therefore, $40^\circ 37' 48''$ is the *true distance* between the Moon and the Sun at noon on March 8, 1910.

ALL OTHER PROBLEMS SOLVED

All the other problems in Nautical Astronomy depending upon the solution of right-angled spherical triangles can be easily solved by these tables.

Some of these problems are: Amplitudes and horizon-azimuths, hour angle of a celestial body in the horizon (approximate time of sunset and sunrise, &c.), altitude and hour angle of a celestial body on the prime vertical, altitude and hour angle of a celestial body when position angle is 90° , &c.

ALTITUDE AND AZIMUTH TABLES

Dec.	Latitude.							
	0°	10°	20°	30°	40°	50°	60°	65°
0°	0°.0	0°.1	0°.2	0°.2	0°.4	0°.5	0°.8	0°.9
10	.0	.1	.2	.3	.4	.6	.8	1.0
20	.0	.1	.2	.3	.4	.6	1.0	1.6
24	.0	.1	.2	.3	.4	.7	1.3	3.4

d and L same name *add* correction to $90^\circ - Z$
 d and L contrary names . . *subtract* „ *from* „

This table will be practically good for heights of the eye varying from 6^m to 15^m (20 ft. to 49 ft.).

To find the hour angle of a body in the true horizon enter the tables with L in the place of d . Run up column b with $90^\circ - d$ opposite which will be found t in column t .

Example. $L = 37^\circ$ N., and $d = 22^\circ$ N. (rising), we will find $t = 108^\circ$ E.

HORIZON-AZIMUTHS.

To find horizon-azimuths enter the tables with d and t (or $180^\circ - t$) as arguments. In column a we will find Z .

Example. $d = 22^\circ$ N., and $t = 108^\circ$ E. We will have $Z = 62^\circ$ N.E. They always take the name of the declination.

BODY ON PRIME VERTICAL.

To find the altitude of a celestial body on the prime vertical enter tables with $90^\circ - L$ in the place of d , and run up column a with d . In column t will be found h .

To find the hour angle of a celestial body on the prime vertical enter tables with d as argument, and run up column b with L . In column t will be found t . In column a will be found $90^\circ - h$.

Example. $d = 8^\circ$ N., and $L = 39^\circ$ N. We will find $h = 12^\circ 47'$, and $t = 80^\circ$.

BODY'S POSITION ANGLE: 90° .

To find the altitude of a celestial body when its position angle is 90° enter tables with $90^\circ - d$ in the place of d , and run up column a with L . In column t will be found h .

To find the hour angle of a celestial body when its position angle is 90° enter tables with L in the place of d , and run up column b with d . In column t will be found t . In column a will be found $90^\circ - h$.

Example. $d = 23^\circ$ S., and $L = 12^\circ$ S. We will find $h = 32^\circ 9'$, and $t = 60^\circ$.

CONCLUSION AND APPENDIX

CONCLUSION

The author since 1908, during a trip from Rio de Janeiro to New York on the s.s. *Voltaire*—Lampart and Holt—has worked out many sights for lines of position taken under various circumstances by his modified tables and the improved methods as explained here, with the most satisfactory results.

Only two openings of the tables are necessary. The first is immediately indicated by the value of d , and the second by the value of a . No time is lost in turning pages. If indexed the desired pages will be found quicker.

The fact that the perpendicular a is common to the two right-angled triangles reduces the bulk of the tables to a *minimum*.

The use of an *assumed* position instead of the position by D. R. greatly simplifies the calculations involved in the determination of h and Z , as we have seen.

In the typical example presented no actual figures used have been suppressed. The tables give h with an approximation of *one minute*, and in the majority of cases with greater approximation. Z is always found with sufficient approximation for practical use.

The simplicity and readiness with which all the other problems are also solved show that: They are "*the simplest and readiest in solution.*"

APPENDIX I

Navigators "ought to be spared the waste of time in making calculations, which can be 'better done once for all by a single computer on dry land.'"

LORD KELVIN. Letter to Lord Ellenborough, R.N., December 4, 1902. ["Stars and Sextants," Published by J. D. Potter, London, 1903.]

It is easier to turn pages than to interpolate.

In order to spare navigators "the waste of time in making calculations," and especially to reduce the chances of error to a *minimum*, the author proposes, as a simple and easy solution of the problem, an extension of his tables where d and t would be tabulated for every *minute of arc* ($1'$) of a and every *thirty minutes of arc* ($30'$) of b .

With such tables, occupying a little over 1000 pages in large 8vo, no interpolation would be necessary, and the only calculation

ALTITUDE AND AZIMUTH TABLES

involved would be the determination of C with L and b by means of our simple precepts.

Thus the problem of determining lines of position at sea would be *nearly* as simple as the problem of determining latitude by a meridian sight.

Our typical example on page xxiii would be solved by such tables as follows :

$$\begin{array}{rcl}
 a = 12^\circ 13' & \text{G. A. T.} = 1^{\text{h}} 43^{\text{m}} 36^{\text{s}} & \text{or } t_G = 25^\circ 54' \text{ W} \\
 \hline
 b = 12^\circ 27' & d = 12^\circ 10' \text{ N} & t_A = 12^\circ 30' \text{ E} \\
 L_A = 16 \quad 3 \text{ S} & & G_A = 38^\circ 24' \text{ W} \\
 \\
 & h_o = 59^\circ 0' \\
 & \text{Corr.} = + 10 \\
 & \hline
 & \hat{h} = 59^\circ 10' \\
 C = 28^\circ 30' & h_A = 59 \quad 12 & Z_A = 24^\circ 24' \text{ NE} \\
 & h - h_A = - \quad 2'
 \end{array}$$

EXPLANATION.

Entering the tables with $d = 12^\circ 10'$, and $t_A = 12^\circ 30'$, as arguments, we would find *immediately* $a = 12^\circ 13'$, and $b = 12^\circ 27'$.

(As b corresponds to the *exact* value of d , it is not necessary to re-enter the tables with a and b as arguments, as explained on page xx.)

Entering the tables again with $a = 12^\circ 13'$ and $C = 28^\circ 30'$, as arguments, we would find *immediately* $h_A = 59^\circ 12'$, and $Z_A = 24^\circ 24'$.¹

Although it is well known that "it is easier to turn pages than to interpolate," the question appears whether it would be worth while to extend the tables as mentioned above in order to do away with the two simple interpolations occurring in our method.

However, it would be convenient to extend the tabulation for every $10'$ of a , and for every 1° of b . The tables would then have 360 pages similar to those published now.

If these tables meet with success, the author will publish the above 360 page tables, which he is already preparing for his own use.²

¹ This method may be advantageously used with the present tables when the hour angle t is near 90° , especially when the declination is large. Hardly any calculation is then necessary to find h and Z .

Example. $d = 30^\circ 15' \text{ S.}$, $t = 89^\circ 0'$, and $L = 10^\circ 17' \text{ S.}$ We would find $a = 59^\circ 44'$, $b = 88^\circ 17'$, $C = 78^\circ 0'$, $h = 6^\circ 1'$, and $Z = 60^\circ 17'$.

² The author has decided to reduce these 360 pages to 166 in view of the fact that the factors $\frac{60'}{\Delta}$ and $\frac{\Delta}{60'}$ are not necessary for every $10'$ of a . (January, 1912.)

APPENDIX II

APPENDIX II

The true spirit of the "Newest Navigation" requires the plotting of each line of position upon Mercator's chart or upon squared paper representing a Plane chart, and for this reason we have given Figs. 3 and 4 showing how these lines are plotted.¹

However, the classical NOON position deduced by combining the morning (or afternoon) sight with the meridian sight of the Sun continues and will continue to render good services to many navigators, and at the request of several friends, we have decided to add this Appendix showing how the NOON position can be easily and rapidly determined with our Tables by *calculation alone*.

This case also applies itself to the combination of a time sight with the meridian sight of any celestial body.

Example.—The same as on page xix. The distance run from 8 A.M. to Noon is represented by *GT* (Fig. 3): 5'.5 N. in latitude and 40'.1 W. in longitude.

The observed meridian altitude of the Sun was 42° 35'.6. BACK towards the elevated pole.

What was the ship's position at NOON ?

$\begin{array}{r} \text{G. M. T.} = 21^{\text{h}} 13^{\text{m}} 10^{\text{s}} \\ \text{Eq. of T.} = - 13 \quad 46 \\ \hline \text{G. A. T.} = 20^{\text{h}} 59^{\text{m}} 24^{\text{s}} \end{array}$	$\text{or } t_G = 45^{\circ} 9'.0 \text{ E}$
$\begin{array}{r} a = 52^{\circ} 0' \\ b = 17^{\circ} 8'.4 \\ \hline L_A = 36 \quad 51.6 \text{ N} \end{array}$	$\begin{array}{r} t_G = 3^{\text{h}} 00^{\text{m}} 36^{\text{s}} \text{ E} \\ d = 10^{\circ} 27' \text{ S} \\ \hline G \text{ at } 8^{\text{h}} \text{ A.M.} = 8^{\circ} 19'.9 \text{ W} \\ g = 40.1 \text{ W} \\ \hline G \text{ at NOON} = 9^{\circ} 0'.0 \text{ W} \end{array}$
$\begin{array}{r} h_o = 20^{\circ} 59'.2 \\ \text{Corr.} = + 7.8 \\ \hline h = 21^{\circ} 7'.0 \\ C = 54^{\circ} 0' \\ \hline h_A = 21 \quad 13.0 \\ h - h_A = - 6'.0 \\ Z_A = \text{S } 58^{\circ} \text{ E} \\ \hline \frac{\Delta t}{\Delta h} = 1.48 \text{ and } p = 0.79 \end{array}$	$\begin{array}{r} t_A = 53 \quad 15'.3 \text{ E} \\ G_A = 8^{\circ} 6'.3 \text{ W} \\ \text{Corr.} = 8'.9 \text{ W} \\ \hline G_A \text{ C.} = 8^{\circ} 15'.2 \text{ W} \\ \text{Pagel} = 4.7 \text{ W} \\ \hline G \text{ at } 8^{\text{h}} \text{ A.M.} = 8^{\circ} 19'.9 \text{ W} \\ g = 40.1 \text{ W} \\ \hline G \text{ at NOON} = 9^{\circ} 0'.0 \text{ W} \end{array}$

$\begin{array}{r} L_A = 36^{\circ} 51'.6 \text{ N} \\ l = 5.5 \text{ N} \\ \hline L_A \text{ at NOON} = 36^{\circ} 57'.1 \text{ N} \\ L \text{ at NOON} = 36 \quad 51.1 \text{ N} \\ \hline \text{True latitude } 6'.0 \text{ to the South} \end{array}$	$\begin{array}{r} h_m \odot = 42^{\circ} 35'.6 \\ \text{Corr.} = + 9.2 \\ \hline h \odot = 42^{\circ} 44'.8 \\ d \odot = 10 \quad 24.1 \text{ S} \\ \hline h + d = 53^{\circ} 8'.9 \\ L \text{ at NOON} = 36^{\circ} 51'.1 \text{ N} \end{array}$
--	---

¹ See also "The New Navigation: Presented in a Familiar Way for Captains and Officers of the Merchant Service." By F. C. Cross, Lieut. R.N.R. Glasgow: James Brown & Son. Price 2s. net.

ALTITUDE AND AZIMUTH TABLES

EXPLANATION.

The first part of the calculation is developed as explained on page xx.

The application of the first correction (Corr.=8'.9 W) to G_A gives us the longitude of the point G where the line of position GBL intersects the assumed parallel of latitude $36^\circ 51'.6$ N. This correction is found by multiplying the coefficient $\frac{\Delta t}{\Delta h} = 1.48$ by $h - h_A = 6'$.

This coefficient $\frac{\Delta t}{\Delta h}$ is taken from the Table¹ on page 171 giving the "Change of Hour Angle per Minute of Arc of Altitude" by extrapolation.

When $h - h_A$ is *plus* (+) the name of the correction is East or West according to the name of the azimuth.

When $h - h_A$ is *minus* (-) the name is contrary to the name of the azimuth, as in our case.

The longitude factor or PAGEL'S coefficient is obtained from the Tables, as explained on page xvii.

Thus, entering the Tables on page 122 with $L = 37^\circ$ in column b/B and with $Z = 58^\circ$ in column Z we would find 0.79, which is the "change of hour angle or of longitude per minute of arc of latitude." The name of the longitude correction or PAGEL'S correction, or simply the PAGEL, 4'.7 (the result of the multiplication of 0.79 by the difference 6'.0 between the two latitudes: the assumed brought up to NOON and the meridian latitude), is easily given by JOHNSON'S well-known rule: "Under the sun's bearing at the time of the observation write the opposite bearing, and suppose the letters to be connected diagonally, then that connected with the name of the correction for latitude will be the name of the correction for the longitude."²

Thus

S	E
	↙
N	W

and as the meridian latitude was 6'.0 to the SOUTH of the assumed latitude, the PAGEL 4'.7 is to W.

The third and last correction is $g = 40'.1$ W for the run in longitude from the time of observation to Noon.³

¹ This Table is limited to azimuths comprised between 60° and 90° . For observations where the azimuth is smaller than 60° a simplification results, and it is better to follow the other method, slightly different, explained further on.

² "On Finding the Latitude and Longitude in Cloudy Weather, &c.," page 7; 32nd edition, London, 1909. Published by Mr. J. D. Potter. Price 5s.

³ In practice it is not necessary to apply *separately* each one of the three corrections to the assumed longitude G_A . They can be combined and the result then applied to G_A . The total correction to be applied to $G_A = 8^\circ 6'.3$ W. would be $53'.7$ W. ($8'.9$ W. + $4'.7$ W. + $40'.1$ W) giving us immediately G at NOON = $9^\circ 0'.0$ W.

APPENDIX II

Therefore N , in Fig. 3, represents the ship's position at NOON.

ANOTHER SIMPLIFIED METHOD.

When the azimuth of the observed body is smaller than 60° we can use with more advantage the process explained on page xxviii, it not being necessary to apply to G_A the correction due to $h-h_A$, reduced to 0 in this case.

Our example would be developed as follows :—

$$\begin{array}{r}
 \begin{array}{l}
 a' = 52^\circ \quad 0' \\
 b = 17^\circ \quad 8'.4 \\
 \hline
 C = 54^\circ \quad 11'.3 \\
 \hline
 L_A = 37^\circ \quad 2'.9 \text{ N} \\
 l = \quad \quad 5.5 \text{ N} \\
 \hline
 L_A \text{ at NOON} = 37^\circ \quad 8.4 \text{ N} \\
 L \text{ at NOON} = 36^\circ \quad 51.1 \text{ N} \\
 \hline
 \text{True latitude} \quad 17'.3 \text{ to the South}
 \end{array}
 &
 \begin{array}{l}
 t_G = 3^{\text{h}} 00^{\text{m}} 36^{\text{s}} \text{ E} \quad \text{or} \quad t_G = 45^\circ \quad 9'.0 \text{ E} \\
 d = 10^\circ \quad 27' \text{ S} \\
 h_o = 20^\circ \quad 59'.2 \\
 \text{Corr.} = + \quad 7.8 \\
 \hline
 h = 21^\circ \quad 7'.0 \\
 Z_A = \text{S } 58^\circ \text{ E} \\
 p = 0.79
 \end{array}
 &
 \begin{array}{l}
 t_A = 53 \quad 15.3 \text{ E} \\
 G_A = 8^\circ \quad 6'.3 \text{ W} \\
 \text{Pagel} = \quad 13'.7 \text{ W} \\
 \hline
 G \text{ at } 8^{\text{h}} \text{ A.M.} = 8^\circ \quad 20'.0 \text{ W} \\
 g = \quad 40'.1 \text{ W} \\
 \hline
 G \text{ at NOON} = 9^\circ \quad 0'.1 \text{ W}
 \end{array}
 \end{array}$$

After finding the values of a , b and t_A as explained before, the assumed longitude $G_A = 8^\circ 6'.3 \text{ W}$. is determined. In order to determine the assumed latitude $L_A = 37^\circ 2'.9$, the latitude of L in Fig. 3, where $h = h_A$ and therefore $h - h_A = 0$, we deduce the value of C corresponding to the true altitude $h = 21^\circ 7'.0$ and we find $C = 54^\circ 11'.3$. This value of C combined with $b = 17^\circ 8'.4$ gives us $L_A = 37^\circ 2'.9$.

The corrections for finding the true longitude at NOON are then found, as explained before on page xlvii. This process, evidently very simple, will always render good services when the azimuth is *smaller* than 60° , especially to those navigating the North Atlantic Ocean from Europe to the United States of America and *vice versa* in winter time.

When the azimuth is *larger* than 60° it is better to use the first process explained in this Appendix, because then to small changes of h correspond large changes of C , and the assumed latitude would sometimes differ *very much* from the true latitude, therefore making the longitude correction or the PAGEL too large and not very exact.

Although the author obtained in 1910 very good results going from England to the United States on board the Brazilian battleship *Minas Geraes* with azimuths as large as 77° and $78^\circ.5$, he would advise the method to be used with care beyond 60° .

For exercise, work out the same examples by both methods with $a = 51^\circ 30'$ instead of $a = 52^\circ 0'$.

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APPENDIX III

An interesting article recently published by Mr. H. B. GOODWIN in the *Nautical Magazine* for February 1912, page 176, describing "A New Form of Table for Calculating Altitude" from an *assumed position*, interpolation being reduced to the odd minutes of declination, has suggested to us this Appendix, where we will show how easily and rapidly the altitude *alone* from an *assumed position* can be found by inspection in our Tables, by simply "interchanging the latitude L and the declination d ."

Only one simple interpolation is required for the odd minutes of declination, as in Mr. GOODWIN'S method.

This interchanging of L and d in our Tables geometrically corresponds to dropping the perpendicular a from Z upon the circle of declination MP (Fig. 2), instead of dropping it from the body M upon the meridian PZQ .

This perpendicular has the disadvantage of dividing the azimuth Z into two parts.

Special Tables for solving the triangle thus divided were published in Paris, in 1893, by Lieut. R. DELAFON, French Navy, and are entitled "Méthode rapide pour déterminer les Droites et Courbes de Hauteur et faire le Point."¹

For the sake of comparison we will take and work out Mr. GOODWIN'S example on page 186 by means of our Tables.

April 22, 1911, at 4^h 12^m Greenwich Apparent Time, in latitude by account, 36° 41' N., longitude 32° 47' W., the Sun's altitude was observed, the declination being 11° 58'.2 N.

Find the position to be assumed, and calculate the zenith distance at that point for the time of observation.

$$\begin{array}{rcl}
 \frac{a = 23^{\circ} 30'}{b = 41^{\circ} 0'.0} & \text{G. A. T.} = 4^{\text{h}} 12^{\text{m}} 00^{\text{s}} & \text{or } t_G = 63^{\circ} 0' \\
 \frac{d = 11 58.2}{C = 29^{\circ} 1'.8} & L_A = 36^{\circ} 59' \text{ N} & \frac{t_A = 29 57}{G_A = 33^{\circ} 3'} \\
 & h_A = 53^{\circ} 18'.7 &
 \end{array}$$

If h_A is reduced to $L = 37^{\circ}$ N. and $t = 30^{\circ}$ (Mr. GOODWIN'S assumed position) we would find

$$h = 53^{\circ} 16'.1 \text{ or } z = 36^{\circ} 43'.9.$$

He found

$$h = 53^{\circ} 15'.6 \text{ or } z = 36^{\circ} 44'.4$$

APPENDIX III

EXPLANATION.

Entering the Tables with $L=37^\circ$ in the place of $d=37^\circ$ and $t=30^\circ$ on page 102, we find in column a approximately $a=23^\circ 30'$. Entering on page 84 in column $a=23^\circ 30'$, we find in column d/h , $L_A=36^\circ 59'$, and in column t/Z , $t_A=29^\circ 57'$.

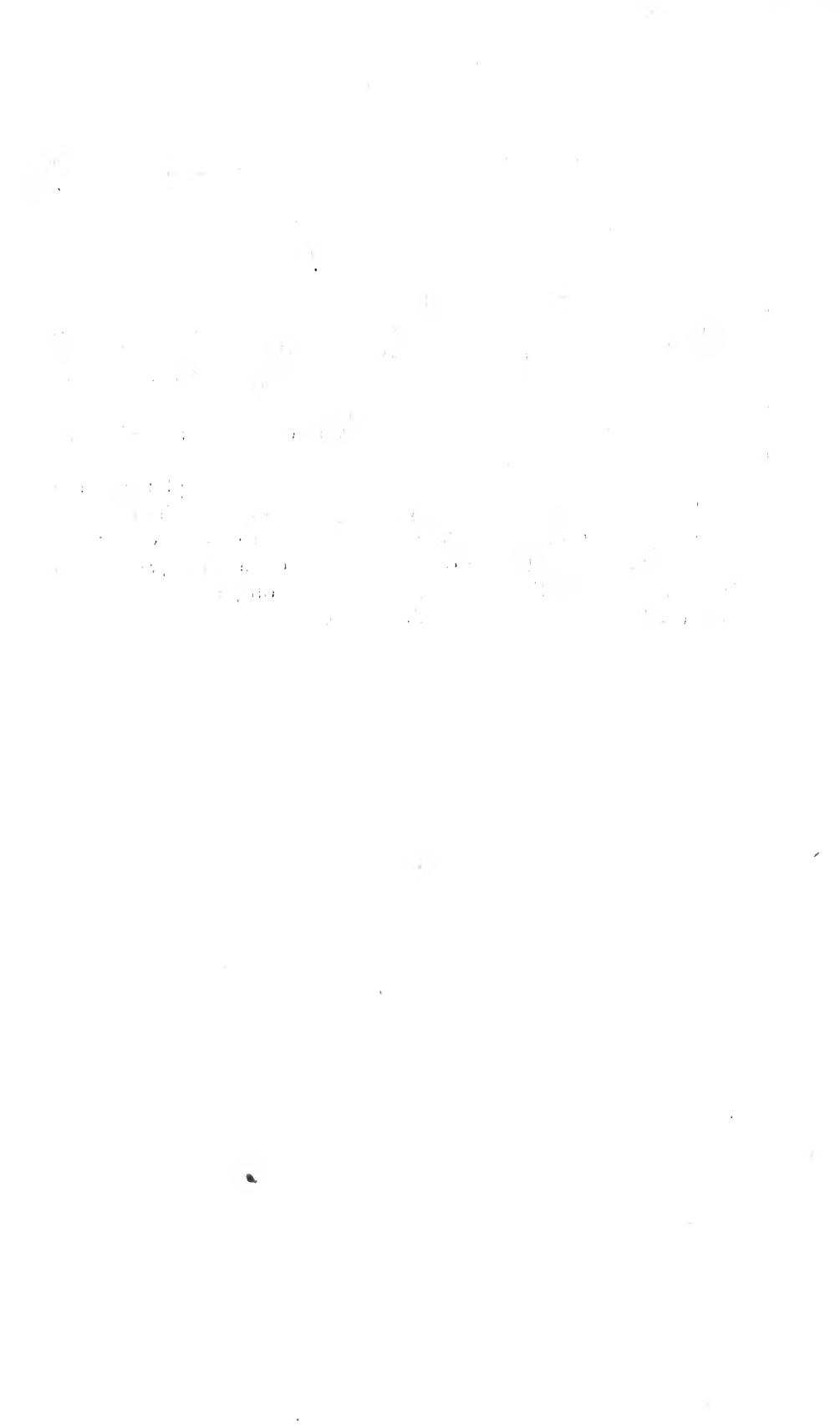
They correspond to $b=41^\circ$. Combining this b with the declination $d=11^\circ 58'.2$ we find $C=29^\circ 1'.8$.

Therefore entering the Tables on the next page 85 in column $a=23^\circ 30'$ we find corresponding to $C=29^\circ 1'.8$: $h_A=53^\circ 18'.7$. If necessary, the position angle would be found alongside this h_A in column t/Z , approximately equal to $41^\circ 53'$.

This is the "simplest and readiest" way of finding altitude *alone* from an *assumed* position.

However, as the *azimuth* is *always* necessary (except when the method explained on page xxxi is used) to show the direction of the line of position or to facilitate the calculation of the corrections it is *always* preferable to use our method for determining *simultaneously* the altitude and the azimuth, as explained on pages xix *et seq.*

It is the "*simplest and readiest in solution.*"



THE "NEWEST" NAVIGATION
ALTITUDE AND AZIMUTH TABLES

1 - FACILITY DOCUMENTS

1 - FACILITY DOCUMENTS

PLANE TRAVERSE TABLES

Plane Traverse Table

Course	D=1'		D=2'		D=3'		D=4'		D=5'		D=6'		D=7'		D=8'		D=9'		D=10'		D=11'		Course		
	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP			
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'		°	'
0	1.0	0.0	2.0	0.0	3.0	0.0	4.0	0.0	5.0	0.0	6.0	0.0	7.0	0.0	8.0	0.0	9.0	0.0	10.0	0.0	11.0	0.0	90		
1	1.0	0.0	2.0	0.0	3.0	0.1	4.0	0.1	5.0	0.1	6.0	0.1	7.0	0.1	8.0	0.1	9.0	0.2	10.0	0.2	11.0	0.2	89		
2	1.0	0.0	2.0	0.1	3.0	0.1	4.0	0.1	5.0	0.2	6.0	0.2	7.0	0.2	8.0	0.3	9.0	0.3	10.0	0.3	11.0	0.4	88		
3	1.0	0.1	2.0	0.1	3.0	0.2	4.0	0.2	5.0	0.3	6.0	0.3	7.0	0.4	8.0	0.4	9.0	0.5	10.0	0.5	11.0	0.6	87		
4	1.0	0.1	2.0	0.1	3.0	0.2	4.0	0.3	5.0	0.3	6.0	0.4	7.0	0.5	8.0	0.6	9.0	0.6	10.0	0.7	11.0	0.8	86		
5	1.0	0.1	2.0	0.2	3.0	0.3	4.0	0.3	5.0	0.4	6.0	0.5	7.0	0.6	8.0	0.7	9.0	0.8	10.0	0.9	11.0	1.0	85		
6	1.0	0.1	2.0	0.2	3.0	0.3	4.0	0.4	5.0	0.5	6.0	0.6	7.0	0.7	8.0	0.8	9.0	0.9	10.0	1.0	10.9	1.1	84		
7	1.0	0.1	2.0	0.2	3.0	0.4	4.0	0.5	5.0	0.6	6.0	0.7	7.0	0.9	8.0	1.0	8.9	1.1	9.9	1.2	10.9	1.3	83		
8	1.0	0.1	2.0	0.3	3.0	0.4	4.0	0.6	5.0	0.7	6.0	0.8	7.0	1.0	8.0	1.1	8.9	1.3	9.9	1.4	10.9	1.5	82		
9	1.0	0.2	2.0	0.3	3.0	0.5	4.0	0.6	4.9	0.8	5.9	0.9	6.9	1.1	7.9	1.3	8.9	1.4	9.9	1.6	10.9	1.7	81		
10	1.0	0.2	2.0	0.3	3.0	0.5	3.9	0.7	4.9	0.9	5.9	1.0	6.9	1.2	7.9	1.4	8.9	1.6	9.8	1.7	10.8	1.9	80		
11	1.0	0.2	2.0	0.4	2.9	0.6	3.9	0.8	4.9	1.0	5.9	1.1	6.9	1.3	7.9	1.5	8.8	1.7	9.8	1.9	10.8	2.1	79		
12	1.0	0.2	2.0	0.4	2.9	0.6	3.9	0.8	4.9	1.0	5.9	1.2	6.8	1.5	7.8	1.7	8.8	1.9	9.8	2.1	10.8	2.3	78		
13	1.0	0.2	1.9	0.4	2.9	0.7	3.9	0.9	4.9	1.1	5.8	1.3	6.8	1.6	7.8	1.8	8.8	2.0	9.7	2.2	10.7	2.5	77		
14	1.0	0.2	1.9	0.5	2.9	0.7	3.9	1.0	4.9	1.2	5.8	1.5	6.8	1.7	7.8	1.9	8.7	2.2	9.7	2.4	10.7	2.7	76		
15	1.0	0.3	1.9	0.5	2.9	0.8	3.9	1.0	4.8	1.3	5.8	1.6	6.8	1.8	7.7	2.1	8.7	2.3	9.7	2.6	10.6	2.8	75		
16	1.0	0.3	1.9	0.6	2.9	0.8	3.8	1.1	4.8	1.4	5.8	1.7	6.7	1.9	7.7	2.2	8.7	2.5	9.6	2.8	10.6	3.0	74		
17	1.0	0.3	1.9	0.6	2.9	0.9	3.8	1.2	4.8	1.5	5.7	1.8	6.7	2.0	7.7	2.3	8.6	2.6	9.6	2.9	10.5	3.2	73		
18	1.0	0.3	1.9	0.6	2.9	0.9	3.8	1.2	4.8	1.5	5.7	1.9	6.7	2.2	7.6	2.5	8.6	2.8	9.5	3.1	10.5	3.4	72		
19	0.9	0.3	1.9	0.7	2.8	1.0	3.8	1.3	4.7	1.6	5.7	2.0	6.6	2.3	7.6	2.6	8.5	2.9	9.5	3.3	10.4	3.6	71		
20	0.9	0.3	1.9	0.7	2.8	1.0	3.8	1.4	4.7	1.7	5.6	2.1	6.6	2.4	7.5	2.7	8.5	3.1	9.4	3.4	10.3	3.8	70		
21	0.9	0.4	1.9	0.7	2.8	1.1	3.7	1.4	4.7	1.8	5.6	2.2	6.5	2.5	7.5	2.9	8.4	3.2	9.3	3.6	10.3	3.9	69		
22	0.9	0.4	1.9	0.7	2.8	1.1	3.7	1.5	4.6	1.9	5.6	2.2	6.5	2.6	7.4	3.0	8.3	3.4	9.3	3.7	10.2	4.1	68		
23	0.9	0.4	1.8	0.8	2.8	1.2	3.7	1.6	4.6	2.0	5.5	2.3	6.4	2.7	7.4	3.1	8.3	3.5	9.2	3.5	10.1	4.3	67		
24	0.9	0.4	1.8	0.8	2.7	1.2	3.7	1.6	4.6	2.0	5.5	2.4	6.4	2.8	7.3	3.3	8.2	3.7	9.1	4.1	10.0	4.5	66		
25	0.9	0.4	1.8	0.8	2.7	1.3	3.6	1.7	4.5	2.1	5.4	2.5	6.3	3.0	7.3	3.4	8.2	3.8	9.1	4.2	10.0	4.6	65		
26	0.9	0.4	1.8	0.9	2.7	1.3	3.6	1.8	4.5	2.2	5.4	2.6	6.3	3.1	7.2	3.5	8.1	3.9	9.0	4.4	9.9	4.8	64		
27	0.9	0.5	1.8	0.9	2.7	1.4	3.6	1.8	4.5	2.3	5.3	2.7	6.2	3.2	7.1	3.6	8.0	4.1	8.9	4.5	9.8	5.0	63		
28	0.9	0.5	1.8	0.9	2.6	1.4	3.5	1.9	4.4	2.3	5.3	2.8	6.2	3.3	7.1	3.8	7.9	4.2	8.8	4.7	9.7	5.2	62		
29	0.9	0.5	1.7	1.0	2.6	1.5	3.5	1.9	4.4	2.4	5.2	2.9	6.1	3.4	7.0	3.9	7.9	4.4	8.7	4.8	9.6	5.3	61		
30	0.9	0.5	1.7	1.0	2.6	1.5	3.5	2.0	4.3	2.5	5.2	3.0	6.1	3.5	6.9	4.0	7.8	4.5	8.7	5.0	9.5	5.5	60		
31	0.9	0.5	1.7	1.0	2.6	1.5	3.4	2.1	4.3	2.6	5.1	3.1	6.0	3.6	6.9	4.1	7.7	4.6	8.6	5.2	9.4	5.7	59		
32	0.8	0.5	1.7	1.1	2.5	1.6	3.4	2.1	4.2	2.6	5.1	3.2	5.9	3.7	6.8	4.2	7.6	4.8	8.5	5.3	9.3	5.8	58		
33	0.8	0.5	1.7	1.1	2.5	1.6	3.4	2.2	4.2	2.7	5.0	3.3	5.9	3.8	6.7	4.4	7.5	4.9	8.4	5.4	9.2	6.0	57		
34	0.8	0.6	1.7	1.1	2.5	1.7	3.3	2.2	4.1	2.8	5.0	3.4	5.8	3.9	6.6	4.5	7.5	5.0	8.3	5.6	9.1	6.2	56		
35	0.8	0.6	1.6	1.1	2.5	1.7	3.3	2.3	4.1	2.9	4.9	3.4	5.7	4.0	6.6	4.6	7.4	5.2	8.2	5.7	9.0	6.3	55		
36	0.8	0.6	1.6	1.2	2.4	1.8	3.2	2.4	4.0	2.9	4.9	3.5	5.7	4.1	6.5	4.7	7.3	5.3	8.1	5.9	8.9	6.5	54		
37	0.8	0.6	1.6	1.2	2.4	1.8	3.2	2.4	4.0	3.0	4.8	3.6	5.6	4.2	6.4	4.8	7.2	5.4	8.0	6.0	8.8	6.6	53		
38	0.8	0.6	1.6	1.2	2.4	1.8	3.2	2.5	3.9	3.1	4.7	3.7	5.5	4.3	6.3	4.9	7.1	5.5	7.9	6.2	8.7	6.8	52		
39	0.8	0.6	1.6	1.3	2.3	1.9	3.1	2.5	3.9	3.1	4.7	3.8	5.4	4.4	6.2	5.0	7.0	5.7	7.8	6.3	8.5	6.9	51		
40	0.8	0.6	1.5	1.3	2.3	1.9	3.1	2.6	3.8	3.2	4.6	3.9	5.4	4.5	6.1	5.1	6.9	5.8	7.7	6.4	8.4	7.1	50		
41	0.8	0.7	1.5	1.3	2.3	2.0	3.0	2.6	3.8	3.3	4.5	3.9	5.3	4.6	6.0	5.2	6.8	5.9	7.5	6.6	8.3	7.2	49		
42	0.7	0.7	1.5	1.3	2.2	2.0	3.0	2.7	3.7	3.3	4.5	4.0	5.2	4.7	5.9	5.4	6.7	6.0	7.4	6.7	8.2	7.4	48		
43	0.7	0.7	1.5	1.4	2.2	2.0	2.9	2.7	3.7	3.4	4.4	4.1	5.1	4.8	5.9	5.5	6.6	6.1	7.3	6.8	8.0	7.5	47		
44	0.7	0.7	1.4	1.4	2.2	2.1	2.9	2.8	3.6	3.5	4.3	4.2	5.0	4.9	5.8	5.6	6.5	6.3	7.2	6.9	7.9	7.6	46		
45	0.7	0.7	1.4	1.4	2.1	2.1	2.8	2.8	3.5	3.5	4.2	4.2	4.9	4.9	5.7	5.7	6.4	6.4	7.1	7.1	7.8	7.8	45		
Course	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	DEP	LAT	Course
	D=1'		D=2'		D=3'		D=4'		D=5'		D=6'		D=7'		D=8'		D=9'		D=10'		D=11'				

Plane Traverse Table

Course.	D=12'		D=13'		D=14'		D=15'		D=16'		D=17'		D=18'		D=19'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	12.0	0.0	13.0	0.0	14.0	0.0	15.0	0.0	16.0	0.0	17.0	0.0	18.0	0.0	19.0	0.0	90
1	12.0	0.2	13.0	0.2	14.0	0.2	15.0	0.3	16.0	0.3	17.0	0.3	18.0	0.3	19.0	0.3	89
2	12.0	0.4	13.0	0.5	14.0	0.5	15.0	0.5	16.0	0.6	17.0	0.6	18.0	0.6	19.0	0.7	88
3	12.0	0.6	13.0	0.7	14.0	0.7	15.0	0.8	16.0	0.8	17.0	0.9	18.0	0.9	19.0	1.0	87
4	12.0	0.8	13.0	0.9	14.0	1.0	15.0	1.0	16.0	1.1	17.0	1.2	18.0	1.3	19.0	1.3	86
5	12.0	1.0	13.0	1.1	13.9	1.2	14.9	1.3	15.9	1.4	16.9	1.5	17.9	1.6	18.9	1.7	85
6	11.9	1.3	12.9	1.4	13.9	1.5	14.9	1.6	15.9	1.7	16.9	1.8	17.9	1.9	18.9	2.0	84
7	11.9	1.5	12.9	1.6	13.9	1.7	14.9	1.8	15.9	1.9	16.9	2.1	17.9	2.2	18.9	2.3	83
8	11.9	1.7	12.9	1.8	13.9	1.9	14.9	2.1	15.8	2.2	16.8	2.4	17.8	2.5	18.8	2.6	82
9	11.9	1.9	12.8	2.0	13.8	2.2	14.8	2.3	15.8	2.5	16.8	2.7	17.8	2.8	18.8	3.0	81
10	11.8	2.1	12.8	2.3	13.8	2.4	14.8	2.6	15.8	2.8	16.7	3.0	17.7	3.1	18.7	3.3	80
11	11.8	2.3	12.8	2.5	13.7	2.7	14.7	2.9	15.7	3.1	16.7	3.2	17.7	3.4	18.7	3.6	79
12	11.7	2.5	12.7	2.7	13.7	2.9	14.7	3.1	15.7	3.3	16.6	3.5	17.6	3.7	18.6	4.0	78
13	11.7	2.7	12.7	2.9	13.6	3.1	14.6	3.4	15.6	3.6	16.6	3.8	17.5	4.0	18.5	4.3	77
14	11.6	2.9	12.6	3.1	13.6	3.4	14.6	3.6	15.5	3.9	16.5	4.1	17.5	4.4	18.4	4.6	76
15	11.6	3.1	12.6	3.4	13.5	3.6	14.5	3.9	15.5	4.1	16.4	4.4	17.4	4.7	18.4	4.9	75
16	11.5	3.3	12.5	3.6	13.5	3.9	14.4	4.1	15.4	4.4	16.3	4.7	17.3	5.0	18.3	5.2	74
17	11.5	3.5	12.4	3.8	13.4	4.1	14.3	4.4	15.3	4.7	16.3	5.0	17.2	5.3	18.2	5.6	73
18	11.4	3.7	12.4	4.0	13.4	4.3	14.3	4.6	15.2	4.9	16.2	5.3	17.1	5.6	18.1	5.9	72
19	11.3	3.9	12.3	4.2	13.2	4.6	14.2	4.9	15.1	5.2	16.1	5.5	17.0	5.9	18.0	6.2	71
20	11.3	4.1	12.2	4.4	13.2	4.8	14.1	5.1	15.0	5.5	16.0	5.8	16.9	6.2	17.9	6.5	70
21	11.2	4.3	12.1	4.7	13.1	5.0	14.0	5.4	14.9	5.7	15.9	6.1	16.8	6.5	17.7	6.8	69
22	11.1	4.5	12.1	4.9	13.0	5.2	13.9	5.6	14.8	6.0	15.8	6.4	16.7	6.7	17.6	7.1	68
23	11.0	4.7	12.0	5.1	12.9	5.5	13.8	5.9	14.7	6.3	15.6	6.6	16.6	7.0	17.5	7.4	67
24	11.0	4.9	11.9	5.3	12.8	5.7	13.7	6.1	14.6	6.5	15.5	6.9	16.4	7.3	17.4	7.7	66
25	10.9	5.1	11.8	5.5	12.7	5.9	13.6	6.3	14.5	6.8	15.4	7.2	16.3	7.6	17.2	8.0	65
26	10.8	5.3	11.7	5.7	12.6	6.1	13.5	6.6	14.4	7.0	15.3	7.5	16.2	7.9	17.1	8.3	64
27	10.7	5.4	11.6	5.9	12.5	6.4	13.4	6.8	14.3	7.3	15.1	7.7	16.0	8.2	16.9	8.6	63
28	10.6	5.6	11.5	6.1	12.4	6.6	13.2	7.0	14.1	7.5	15.0	8.0	15.9	8.5	16.8	8.9	62
29	10.5	5.8	11.4	6.3	12.2	6.8	13.1	7.3	14.0	7.8	14.9	8.2	15.7	8.7	16.6	9.2	61
30	10.4	6.0	11.3	6.5	12.1	7.0	13.0	7.5	13.9	8.0	14.7	8.5	15.6	9.0	16.5	9.5	60
31	10.3	6.2	11.1	6.7	12.0	7.2	12.9	7.7	13.7	8.2	14.6	8.8	15.4	9.3	16.3	9.8	59
32	10.2	6.4	11.0	6.9	11.9	7.4	12.7	7.9	13.6	8.5	14.4	9.0	15.3	9.5	16.1	10.1	58
33	10.1	6.5	10.9	7.1	11.7	7.6	12.6	8.2	13.4	8.7	14.3	9.3	15.1	9.8	15.9	10.3	57
34	9.9	6.7	10.8	7.3	11.6	7.8	12.4	8.4	13.3	8.9	14.1	9.5	14.9	10.1	15.8	10.6	56
35	9.8	6.9	10.6	7.5	11.5	8.0	12.3	8.6	13.1	9.2	13.9	9.8	14.7	10.3	15.6	10.9	55
36	9.7	7.1	10.5	7.6	11.3	8.2	12.1	8.8	12.9	9.4	13.8	10.0	14.6	10.6	15.4	11.2	54
37	9.6	7.2	10.4	7.8	11.2	8.4	12.0	9.0	12.8	9.6	13.6	10.2	14.4	10.8	15.2	11.4	53
38	9.5	7.4	10.2	8.0	11.0	8.6	11.8	9.2	12.6	9.9	13.4	10.5	14.2	11.1	15.0	11.7	52
39	9.3	7.6	10.1	8.2	10.9	8.8	11.7	9.4	12.4	10.1	13.2	10.7	14.0	11.3	14.8	12.0	51
40	9.2	7.7	10.0	8.4	10.7	9.0	11.5	9.6	12.3	10.3	13.0	10.9	13.8	11.6	14.6	12.2	50
41	9.1	7.9	9.8	8.5	10.6	9.2	11.3	9.8	12.1	10.5	12.8	11.2	13.6	11.8	14.3	12.5	49
42	8.9	8.0	9.7	8.7	10.4	9.4	11.1	10.0	11.9	10.7	12.6	11.4	13.2	12.0	14.1	12.7	48
43	8.8	8.2	9.5	8.9	10.2	9.5	11.0	10.2	11.7	10.9	12.4	11.6	13.2	12.3	13.9	13.0	47
44	8.6	8.3	9.4	9.0	10.1	9.7	10.8	10.4	11.5	11.1	12.2	11.8	12.9	12.5	13.7	13.2	46
45	8.5	8.5	9.2	9.2	9.9	9.9	10.6	10.6	11.3	11.3	12.0	12.0	12.7	12.7	13.4	13.4	45

Plane Traverse Table

Course	D = 20'		D = 21'		D = 22'		D = 23'		D = 24'		D = 25'		D = 26'		D = 27'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	0.0	0.0	21.0	0.0	22.0	0.0	23.0	0.0	24.0	0.0	25.0	0.0	26.0	0.0	27.0	0.0	90
1	20.0	0.3	21.0	0.4	22.0	0.4	23.0	0.4	24.0	0.4	25.0	0.4	26.0	0.5	27.0	0.5	89
2	20.0	0.7	21.0	0.7	22.0	0.8	23.0	0.8	24.0	0.8	25.0	0.9	26.0	0.9	27.0	0.9	88
3	20.0	1.0	21.0	1.1	22.0	1.2	23.0	1.2	24.0	1.3	25.0	1.3	26.0	1.4	27.0	1.4	87
4	20.0	1.4	20.9	1.5	21.9	1.5	22.9	1.6	23.9	1.7	24.9	1.7	25.9	1.8	26.9	1.9	86
5	19.9	1.7	20.9	1.8	21.9	1.9	22.9	2.0	23.9	2.1	24.9	2.2	25.9	2.3	26.9	2.4	85
6	19.9	2.1	20.9	2.2	21.9	2.3	22.9	2.4	23.9	2.5	24.9	2.6	25.9	2.7	26.9	2.8	84
7	19.9	2.4	20.8	2.6	21.8	2.7	22.8	2.8	23.8	2.9	24.8	3.0	25.8	3.2	26.8	3.3	83
8	19.8	2.8	20.8	2.9	21.8	3.1	22.8	3.2	23.8	3.3	24.8	3.5	25.7	3.6	26.7	3.8	82
9	19.8	3.1	20.7	3.3	21.7	3.4	22.7	3.6	23.7	3.8	24.7	3.9	25.7	4.1	26.7	4.2	81
10	19.7	3.5	20.7	3.6	21.7	3.8	22.7	4.0	23.6	4.2	24.6	4.3	25.6	4.5	26.6	4.7	80
11	19.6	3.8	20.6	4.0	21.6	4.2	22.6	4.4	23.6	4.6	24.5	4.8	25.5	5.0	26.5	5.2	79
12	19.6	4.2	20.5	4.4	21.5	4.6	22.5	4.8	23.5	5.0	24.5	5.2	25.4	5.4	26.4	5.6	78
13	19.5	4.5	20.5	4.7	21.4	4.9	22.4	5.2	23.4	5.4	24.4	5.6	25.3	5.8	26.3	6.1	77
14	19.4	4.8	20.4	5.1	21.3	5.3	22.3	5.6	23.3	5.8	24.3	6.0	25.2	6.3	26.2	6.5	76
15	19.3	5.2	20.3	5.4	21.3	5.7	22.2	6.0	23.2	6.2	24.1	6.5	25.1	6.7	26.1	7.0	75
16	19.2	5.5	20.2	5.8	21.1	6.1	22.1	6.3	23.1	6.6	24.0	6.9	25.0	7.2	26.0	7.4	74
17	19.1	5.8	20.1	6.1	21.0	6.4	22.0	6.7	23.0	7.0	23.9	7.3	24.9	7.6	25.8	7.9	73
18	19.0	6.2	20.0	6.5	20.9	6.8	21.9	7.1	22.8	7.4	23.8	7.7	24.7	8.0	25.7	8.3	72
19	18.9	6.5	19.9	6.8	20.8	7.2	21.7	7.5	22.7	7.8	23.6	8.1	24.6	8.5	25.5	8.8	71
20	18.8	6.8	19.7	7.2	20.7	7.5	21.6	7.9	22.6	8.2	23.5	8.6	24.4	8.9	25.4	9.2	70
21	18.7	7.2	19.6	7.5	20.5	7.9	21.5	8.2	22.4	8.6	23.3	9.0	24.3	9.3	25.2	9.7	69
22	18.5	7.5	19.5	7.9	20.4	8.2	21.3	8.6	22.3	9.0	23.2	9.4	24.1	9.7	25.0	10.1	68
23	18.4	7.8	19.3	8.2	20.3	8.6	21.2	9.0	22.1	9.4	23.0	9.8	23.9	10.2	24.9	10.5	67
24	18.3	8.1	19.2	8.5	20.1	8.9	21.0	9.4	21.9	9.8	22.8	10.2	23.8	10.6	24.7	11.0	66
25	18.1	8.5	19.0	8.9	19.9	9.3	20.8	9.7	21.8	10.1	22.7	10.6	23.6	11.0	24.5	11.4	65
26	18.0	8.8	18.9	9.2	19.8	9.6	20.7	10.1	21.6	10.5	22.5	11.0	23.4	11.4	24.3	11.8	64
27	17.8	9.1	18.7	9.5	19.6	10.0	20.5	10.4	21.4	10.9	22.3	11.3	23.2	11.8	24.1	12.3	63
28	17.7	9.4	18.5	9.9	19.4	10.3	20.3	10.8	21.2	11.3	22.1	11.7	23.0	12.2	23.8	12.7	62
29	17.5	9.7	18.4	10.2	19.2	10.7	20.1	11.2	21.0	11.6	21.9	12.1	22.7	12.6	23.6	13.1	61
30	17.3	10.0	18.2	10.5	19.1	11.0	19.9	11.5	20.8	12.0	21.7	12.5	22.5	13.0	23.4	13.5	60
31	17.1	10.3	18.0	10.8	18.9	11.3	19.7	11.8	20.6	12.4	21.4	12.9	22.3	13.4	23.1	13.9	59
32	17.0	10.6	17.8	11.1	18.7	11.7	19.5	12.2	20.4	12.7	21.2	13.2	22.0	13.8	22.9	14.3	58
33	16.8	10.9	17.6	11.4	18.5	12.0	19.3	12.5	20.1	13.1	21.0	13.6	21.8	14.2	22.6	14.7	57
34	16.6	11.2	17.4	11.7	18.2	12.3	19.1	12.9	19.9	13.4	20.7	14.0	21.6	14.5	22.4	15.1	56
35	16.4	11.5	17.2	12.0	18.0	12.6	18.8	13.2	19.7	13.8	20.5	14.3	21.3	14.9	22.1	15.5	55
36	16.2	11.8	17.0	12.3	17.8	12.9	18.6	13.5	19.4	14.1	20.2	14.7	21.0	15.3	21.8	15.9	54
37	16.0	12.0	16.8	12.6	17.6	13.2	18.4	13.8	19.2	14.4	20.0	15.0	20.8	15.6	21.6	16.2	53
38	15.8	12.3	16.5	12.9	17.3	13.5	18.1	14.2	18.9	14.8	19.7	15.4	20.5	16.0	21.3	16.6	52
39	15.5	12.6	16.3	13.2	17.1	13.8	17.9	14.5	18.7	15.1	19.4	15.7	20.2	16.4	21.0	17.0	51
40	15.3	12.9	16.1	13.5	16.9	14.1	17.6	14.8	18.4	15.4	19.2	16.1	19.9	16.7	20.7	17.4	50
41	15.1	13.1	15.8	13.8	16.6	14.4	17.4	15.1	18.1	15.7	18.9	16.4	19.6	17.1	20.4	17.7	49
42	14.9	13.4	15.6	14.1	16.3	14.7	17.1	15.4	17.8	16.1	18.6	16.7	19.3	17.4	20.1	18.1	48
43	14.6	13.6	15.4	14.3	16.1	15.0	16.8	15.7	17.6	16.4	18.3	17.0	19.0	17.7	19.7	18.4	47
44	14.4	13.9	15.1	14.6	15.8	15.3	16.5	16.0	17.3	16.7	18.0	17.4	18.7	18.1	19.4	18.8	46
45	14.1	14.1	14.8	14.8	15.6	15.6	16.3	16.3	17.0	17.0	17.7	17.7	18.4	18.4	19.1	19.1	45
Course	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course
	D = 20'		D = 21'		D = 22'		D = 23'		D = 24'		D = 25'		D = 26'		D = 27'		

Plane Traverse Table

Course.	D=28'		D=29'		D=30'		D=31'		D=32'		D=33'		D=34'		D=35'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	28.0	0.0	29.0	0.0	30.0	0.0	31.0	0.0	32.0	0.0	33.0	0.0	34.0	0.0	35.0	0.0	90
1	28.0	0.5	29.0	0.5	30.0	0.5	31.0	0.5	32.0	0.6	33.0	0.6	34.0	0.6	35.0	0.6	89
2	28.0	1.0	29.0	1.0	30.0	1.0	31.0	1.1	32.0	1.1	33.0	1.2	34.0	1.2	35.0	1.2	88
3	28.0	1.5	29.0	1.5	30.0	1.6	31.0	1.6	32.0	1.7	33.0	1.7	34.0	1.8	35.0	1.8	87
4	27.9	2.0	28.9	2.0	29.9	2.1	30.9	2.2	31.9	2.2	32.9	2.3	33.9	2.4	34.9	2.4	86
5	27.9	2.4	28.9	2.5	29.9	2.6	30.9	2.7	31.9	2.8	32.9	2.9	33.9	3.0	34.9	3.1	85
6	27.8	2.9	28.8	3.0	29.8	3.1	30.8	3.2	31.8	3.3	32.8	3.4	33.8	3.6	34.8	3.7	84
7	27.8	3.4	28.8	3.5	29.8	3.7	30.8	3.8	31.8	3.9	32.8	4.0	33.7	4.1	34.7	4.3	83
8	27.7	3.9	28.7	4.0	29.7	4.2	30.7	4.3	31.7	4.5	32.7	4.6	33.7	4.7	34.7	4.9	82
9	27.7	4.4	28.6	4.5	29.6	4.7	30.6	4.8	31.6	5.0	32.6	5.2	33.6	5.3	34.6	5.5	81
10	27.6	4.9	28.6	5.0	29.5	5.2	30.5	5.4	31.5	5.6	32.5	5.7	33.5	5.9	34.5	6.1	80
11	27.5	5.3	28.5	5.5	29.4	5.7	30.4	5.9	31.4	6.1	32.4	6.3	33.4	6.5	34.4	6.7	79
12	27.4	5.8	28.4	6.0	29.3	6.2	30.3	6.4	31.3	6.7	32.3	6.9	33.3	7.1	34.2	7.3	78
13	27.3	6.3	28.3	6.5	29.2	6.7	30.2	7.0	31.2	7.2	32.2	7.4	33.1	7.6	34.1	7.9	77
14	27.2	6.8	28.1	7.0	29.1	7.3	30.1	7.5	31.0	7.7	32.0	8.0	33.0	8.2	34.0	8.5	76
15	27.0	7.2	28.0	7.5	29.0	7.8	29.9	8.0	30.9	8.3	31.9	8.5	32.8	8.8	33.8	9.1	75
16	26.9	7.7	27.9	8.0	28.8	8.3	29.8	8.5	30.8	8.8	31.7	9.1	32.7	9.4	33.6	9.6	74
17	26.8	8.2	27.7	8.5	28.7	8.8	29.6	9.1	30.6	9.4	31.6	9.6	32.5	9.9	33.5	10.2	73
18	26.6	8.7	27.6	9.0	28.5	9.3	29.5	9.6	30.4	9.9	31.4	10.2	32.3	10.5	33.3	10.8	72
19	26.5	9.1	27.4	9.4	28.4	9.8	29.3	10.1	30.3	10.4	31.2	10.7	32.1	11.1	33.1	11.4	71
20	26.3	9.6	27.3	9.9	28.2	10.3	29.1	10.6	30.1	10.9	31.0	11.3	31.9	11.6	32.9	12.0	70
21	26.1	10.0	27.1	10.4	28.0	10.8	28.9	11.1	29.9	11.5	30.8	11.8	31.7	12.2	32.7	12.5	69
22	26.0	10.5	26.9	10.9	27.8	11.2	28.7	11.6	29.7	12.0	30.6	12.4	31.5	12.7	32.5	13.1	68
23	25.8	10.9	26.7	11.3	27.6	11.7	28.5	12.1	29.5	12.5	30.4	12.9	31.3	13.3	32.2	13.7	67
24	25.6	11.4	26.5	11.8	27.4	12.2	28.3	12.6	29.2	13.0	30.1	13.4	31.1	13.8	32.0	14.2	66
25	25.4	11.8	26.3	12.3	27.2	12.7	28.1	13.1	29.0	13.5	29.9	13.9	30.8	14.4	31.7	14.8	65
26	25.2	12.3	26.1	12.7	27.0	13.2	27.9	13.6	28.8	14.0	29.7	14.5	30.6	14.9	31.5	15.3	64
27	24.9	12.7	25.8	13.2	26.7	13.6	27.6	14.1	28.5	14.5	29.4	15.0	30.3	15.4	31.2	15.9	63
28	24.7	13.1	25.6	13.6	26.5	14.1	27.4	14.6	28.3	15.0	29.1	15.5	30.0	16.0	30.9	16.4	62
29	24.5	13.6	25.4	14.1	26.2	14.5	27.1	15.0	28.0	15.5	28.9	16.0	29.7	16.5	30.6	17.0	61
30	24.2	14.0	25.1	14.5	26.0	15.0	26.8	15.5	27.7	16.0	28.6	16.5	29.4	17.0	30.3	17.5	60
31	24.0	14.4	24.9	14.9	25.7	15.5	26.6	16.0	27.4	16.5	28.3	17.0	29.1	17.5	30.0	18.0	59
32	23.7	14.8	24.6	15.4	25.4	15.9	26.3	16.4	27.1	17.0	28.0	17.5	28.8	18.0	29.7	18.5	58
33	23.5	15.2	24.3	15.8	25.2	16.3	26.0	16.9	26.8	17.4	27.7	18.0	28.5	18.5	29.4	19.1	57
34	23.2	15.7	24.0	16.2	24.9	16.8	25.7	17.3	26.5	17.9	27.4	18.5	28.2	19.0	29.0	19.6	56
35	22.9	16.1	23.8	16.6	24.6	17.2	25.4	17.8	26.2	18.4	27.0	18.9	27.9	19.5	28.7	20.1	55
36	22.7	16.5	23.5	17.0	24.3	17.6	25.1	18.2	25.9	18.8	26.7	19.4	27.5	20.0	28.3	20.6	54
37	22.4	16.9	23.2	17.5	24.0	18.1	24.8	18.7	25.6	19.3	26.4	19.9	27.2	20.5	28.0	21.1	53
38	22.1	17.2	22.9	17.9	23.6	18.5	24.4	19.1	25.2	19.7	26.0	20.3	26.8	20.9	27.6	21.5	52
39	21.8	17.6	22.5	18.3	23.3	18.9	24.1	19.5	24.9	20.1	25.6	20.8	26.4	21.4	27.2	22.0	51
40	21.4	18.0	22.2	18.6	23.0	19.3	23.7	19.9	24.5	20.6	25.3	21.2	26.0	21.9	26.8	22.5	50
41	21.1	18.4	21.9	19.0	22.6	19.7	23.4	20.3	24.2	21.0	24.9	21.6	25.7	22.3	26.4	23.0	49
42	20.8	18.7	21.6	19.4	22.3	20.1	23.0	20.7	23.8	21.4	24.5	22.1	25.3	22.8	26.0	23.4	48
43	20.5	19.1	21.2	19.8	21.9	20.5	22.7	21.1	23.4	21.8	24.1	22.5	24.9	23.2	25.6	23.9	47
44	20.1	19.5	20.9	20.1	21.6	20.8	22.3	21.5	23.0	22.2	23.7	22.9	24.5	23.6	25.2	24.3	46
45	19.8	19.8	20.5	20.5	21.2	21.2	21.9	21.9	22.6	22.6	23.3	23.3	24.0	24.0	24.7	24.7	45

Plane Traverse Table

Course.	D = 36'		D = 37'		D = 38'		D = 39'		D = 40'		D = 41'		D = 42'		D = 43'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	36.0	0.0	37.0	0.0	38.0	0.0	39.0	0.0	40.0	0.0	41.0	0.0	42.0	0.0	43.0	0.0	90
1	36.0	0.6	37.0	0.6	38.0	0.7	39.0	0.7	40.0	0.7	41.0	0.7	42.0	0.7	43.0	0.8	89
2	36.0	1.3	37.0	1.3	38.0	1.3	39.0	1.4	40.0	1.4	41.0	1.4	42.0	1.5	43.0	1.5	88
3	36.0	1.9	36.9	1.9	37.9	2.0	38.9	2.0	39.9	2.1	40.9	2.1	41.9	2.2	42.9	2.3	87
4	35.9	2.5	36.9	2.6	37.9	2.7	38.9	2.7	39.9	2.8	40.9	2.9	41.9	2.9	42.9	3.0	86
5	35.9	3.1	36.9	3.2	37.9	3.3	38.9	3.4	39.8	3.5	40.8	3.6	41.8	3.7	42.8	3.7	85
6	35.8	3.8	36.8	3.9	37.8	4.0	38.8	4.1	39.8	4.2	40.8	4.3	41.8	4.4	42.8	4.5	84
7	35.7	4.4	36.7	4.5	37.7	4.6	38.7	4.8	39.7	4.9	40.7	5.0	41.7	5.1	42.7	5.2	83
8	35.6	5.0	36.6	5.1	37.6	5.3	38.6	5.4	39.6	5.6	40.6	5.7	41.6	5.8	42.6	6.0	82
9	35.6	5.6	36.5	5.8	37.5	5.9	38.5	6.1	39.5	6.3	40.5	6.4	41.5	6.6	42.5	6.7	81
10	35.5	6.3	36.4	6.4	37.4	6.6	38.4	6.8	39.4	6.9	40.4	7.1	41.4	7.3	42.3	7.5	80
11	35.3	6.9	36.3	7.1	37.3	7.3	38.3	7.4	39.3	7.6	40.2	7.8	41.2	8.0	42.2	8.2	79
12	35.2	7.5	36.2	7.7	37.2	7.9	38.1	8.1	39.1	8.3	40.1	8.5	41.1	8.7	42.1	8.9	78
13	35.1	8.1	36.1	8.3	37.0	8.5	38.0	8.8	39.0	9.0	39.9	9.2	40.9	9.4	41.9	9.7	77
14	34.9	8.7	35.9	9.0	36.9	9.2	37.8	9.4	38.8	9.7	39.8	9.9	40.8	10.2	41.7	10.4	76
15	34.8	9.3	35.7	9.6	36.7	9.8	37.7	10.1	38.6	10.4	39.6	10.6	40.6	10.9	41.5	11.1	75
16	34.6	9.9	35.6	10.2	36.5	10.5	37.5	10.7	38.5	11.0	39.4	11.3	40.4	11.6	41.3	11.9	74
17	34.4	10.5	35.4	10.8	36.3	11.1	37.3	11.4	38.3	11.7	39.2	12.0	40.2	12.3	41.1	12.6	73
18	34.2	11.1	35.2	11.4	36.1	11.7	37.1	12.1	38.0	12.4	39.0	12.7	39.9	13.0	40.9	13.3	72
19	34.0	11.7	35.0	12.0	35.9	12.4	36.9	12.7	37.8	13.0	38.8	13.3	39.7	13.7	40.7	14.0	71
20	33.8	12.3	34.8	12.7	35.7	13.0	36.6	13.3	37.6	13.7	38.5	14.0	39.5	14.4	40.4	14.7	70
21	33.6	12.9	34.5	13.3	35.5	13.6	36.4	14.0	37.3	14.3	38.3	14.7	39.2	15.1	40.1	15.4	69
22	33.4	13.5	34.3	13.9	35.2	14.2	36.2	14.6	37.1	15.0	38.0	15.4	38.9	15.7	39.9	16.1	68
23	33.1	14.1	34.1	14.5	35.0	14.8	35.9	15.2	36.8	15.6	37.7	16.0	38.7	16.4	39.6	16.8	67
24	32.9	14.6	33.8	15.0	34.7	15.5	35.6	15.9	36.5	16.3	37.5	16.7	38.4	17.1	39.3	17.5	66
25	32.6	15.2	33.5	15.6	34.4	16.1	35.3	16.5	36.3	16.9	37.2	17.3	38.1	17.7	39.0	18.2	65
26	32.4	15.8	33.3	16.2	34.2	16.7	35.1	17.1	36.0	17.5	36.9	18.0	37.7	18.4	38.6	18.8	64
27	32.1	16.3	33.0	16.8	33.9	17.3	34.7	17.7	35.6	18.2	36.5	18.6	37.4	19.1	38.3	19.5	63
28	31.8	16.9	32.7	17.4	33.6	17.8	34.4	18.3	35.3	18.8	36.2	19.2	37.1	19.7	38.0	20.2	62
29	31.5	17.5	32.4	17.9	33.2	18.4	34.1	18.9	35.0	19.4	35.9	19.9	36.7	20.4	37.6	20.8	61
30	31.2	18.0	32.0	18.5	32.9	19.0	33.8	19.5	34.6	20.0	35.5	20.5	36.4	21.0	37.2	21.5	60
31	30.9	18.5	31.7	19.1	32.6	19.6	33.4	20.1	34.3	20.6	35.1	21.1	36.0	21.6	36.9	22.1	59
32	30.5	19.1	31.4	19.6	32.2	20.1	33.1	20.7	33.9	21.2	34.8	21.7	35.6	22.3	36.5	22.8	58
33	30.2	19.6	31.0	20.2	31.9	20.7	32.7	21.2	33.5	21.8	34.4	22.3	35.2	22.9	36.1	23.4	57
34	29.8	20.1	30.7	20.7	31.5	21.2	32.3	21.8	33.2	22.4	34.0	22.9	34.8	23.5	35.6	24.0	56
35	29.5	20.6	30.3	21.2	31.1	21.8	31.9	22.4	32.8	22.9	33.6	23.5	34.4	24.1	35.2	24.7	55
36	29.1	21.2	29.9	21.7	30.7	22.3	31.6	22.9	32.4	23.5	34.2	24.1	34.0	24.7	34.8	25.3	54
37	28.8	21.7	29.5	22.3	30.3	22.9	31.1	23.5	31.9	24.1	32.7	24.7	33.5	25.3	34.3	25.9	53
38	28.4	22.2	29.2	22.8	29.9	23.4	30.7	24.0	31.5	24.6	32.3	25.2	33.1	25.9	33.9	26.5	52
39	28.0	22.7	28.8	23.3	29.5	23.9	30.3	24.5	31.1	25.2	31.9	25.8	32.6	26.4	33.4	27.1	51
40	27.6	23.1	28.3	23.8	29.1	24.4	29.9	25.1	30.6	25.7	31.4	26.4	32.2	27.0	32.9	27.6	50
41	27.2	23.6	27.9	24.3	28.7	24.9	29.4	25.6	30.2	26.2	30.9	26.9	31.7	27.6	32.5	28.2	49
42	26.8	24.1	27.5	24.8	28.2	25.4	29.0	26.1	29.7	26.8	30.5	27.4	31.2	28.1	32.0	28.8	48
43	26.3	24.6	27.1	25.2	27.8	25.9	28.5	26.6	29.3	27.3	30.0	28.0	30.7	28.6	31.4	29.3	47
44	25.9	25.0	26.6	25.7	27.3	26.4	28.1	27.1	28.8	27.8	29.5	28.5	30.2	29.2	30.9	29.9	46
45	25.5	25.5	26.2	26.2	26.9	26.9	27.6	27.6	28.3	28.3	29.0	29.0	29.7	29.7	30.4	30.4	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 36'		D = 37'		D = 38'		D = 39'		D = 40'		D = 41'		D = 42'		D = 43'		

Plane Traverse Table

Course.	D=44'		D=45'		D=46'		D=47'		D=48'		D=49'		D=50'		D=51'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	44.0	0.0	45.0	0.0	46.0	0.0	47.0	0.0	48.0	0.0	49.0	0.0	50.0	0.0	51.0	0.0	90
1	44.0	0.8	45.0	0.8	46.0	0.8	47.0	0.8	48.0	0.8	49.0	0.9	50.0	0.9	51.0	0.9	89
2	44.0	1.5	45.0	1.6	46.0	1.6	47.0	1.6	48.0	1.7	49.0	1.7	50.0	1.7	51.0	1.8	88
3	43.9	2.3	44.9	2.4	45.9	2.4	46.9	2.5	47.9	2.5	48.9	2.6	49.9	2.6	50.9	2.7	87
4	43.9	3.1	44.9	3.1	45.9	3.2	46.9	3.3	47.9	3.3	48.9	3.4	49.9	3.5	50.9	3.6	86
5	43.8	3.8	44.8	3.9	45.8	4.0	46.8	4.1	47.8	4.2	48.8	4.3	49.8	4.4	50.8	4.4	85
6	43.8	4.6	44.8	4.7	45.7	4.8	46.7	4.9	47.7	5.0	48.7	5.1	49.7	5.2	50.7	5.3	84
7	43.7	5.4	44.7	5.5	45.7	5.6	46.6	5.7	47.6	5.8	48.6	6.0	49.6	6.1	50.6	6.2	83
8	43.6	6.1	44.6	6.3	45.6	6.4	46.5	6.5	47.5	6.7	48.5	6.8	49.5	7.0	50.5	7.1	82
9	43.5	6.9	44.4	7.0	45.4	7.2	46.4	7.4	47.4	7.5	48.4	7.7	49.4	7.8	50.4	8.0	81
10	43.3	7.6	44.3	7.8	45.3	8.0	46.3	8.2	47.3	8.3	48.3	8.5	49.2	8.7	50.2	8.9	80
11	43.2	8.4	44.2	8.6	45.2	8.8	46.1	9.0	47.1	9.2	48.1	9.3	49.1	9.5	50.1	9.7	79
12	43.0	9.1	44.0	9.4	45.0	9.6	46.0	9.8	47.0	10.0	47.9	10.2	48.9	10.4	49.9	10.6	78
13	42.9	9.9	43.8	10.1	44.8	10.3	45.8	10.6	46.8	10.8	47.7	11.0	48.7	11.2	49.7	11.5	77
14	42.7	10.6	43.7	10.9	44.6	11.1	45.6	11.4	46.6	11.6	47.5	11.9	48.5	12.1	49.5	12.3	76
15	42.5	11.4	43.5	11.6	44.4	11.9	45.4	12.2	46.4	12.4	47.3	12.7	48.3	12.9	49.3	13.2	75
16	42.3	12.1	43.3	12.4	44.2	12.7	45.2	13.0	46.1	13.2	47.1	13.5	48.1	13.8	49.0	14.1	74
17	42.1	12.9	43.0	13.2	44.0	13.4	44.9	13.7	45.9	14.0	46.9	14.3	47.8	14.6	48.8	14.9	73
18	41.8	13.6	42.8	13.9	43.7	14.2	44.7	14.5	45.7	14.8	46.6	15.1	47.6	15.5	48.5	15.8	72
19	41.6	14.3	42.5	14.7	43.5	15.0	44.4	15.3	45.4	15.6	46.3	16.0	47.3	16.3	48.2	16.6	71
20	41.3	15.0	42.3	15.4	43.2	15.7	44.2	16.1	45.1	16.4	46.0	16.8	47.0	17.1	47.9	17.4	70
21	41.1	15.8	42.0	16.1	42.9	16.5	43.9	16.8	44.8	17.2	45.7	17.6	46.7	17.9	47.6	18.3	69
22	40.8	16.5	41.7	16.9	42.7	17.2	43.6	17.6	44.5	18.0	45.4	18.4	46.4	18.7	47.3	19.1	68
23	40.5	17.2	41.4	17.6	42.3	18.0	43.3	18.4	44.2	18.8	45.1	19.1	46.0	19.5	46.9	19.9	67
24	40.2	17.9	41.1	18.3	42.0	18.7	42.9	19.1	43.9	19.5	44.8	19.9	45.7	20.3	46.6	20.7	66
25	39.9	18.6	40.8	19.0	41.7	19.4	42.6	19.9	43.5	20.3	44.4	20.7	45.3	21.1	46.2	21.6	65
26	39.5	19.3	40.4	19.7	41.3	20.2	42.2	20.6	43.1	21.0	44.0	21.5	44.9	21.9	45.8	22.4	64
27	39.2	20.0	40.1	20.4	41.0	20.9	41.9	21.3	42.8	21.8	43.7	22.2	44.6	22.7	45.4	23.2	63
28	38.8	20.7	39.7	21.1	40.6	21.6	41.5	22.1	42.4	22.5	43.3	23.0	44.1	23.5	45.0	23.9	62
29	38.5	21.3	39.4	21.8	40.2	22.3	41.1	22.8	42.0	23.3	42.9	23.8	43.7	24.2	44.6	24.7	61
30	38.1	22.0	39.0	22.5	39.8	23.0	40.7	23.5	41.6	24.0	42.4	24.5	43.3	25.0	44.2	25.5	60
31	37.7	22.7	38.6	23.2	39.4	23.7	40.3	24.2	41.1	24.7	42.0	25.2	42.9	25.8	43.7	26.3	59
32	37.3	23.3	38.2	23.8	39.0	24.4	39.9	24.9	40.7	25.4	41.6	26.0	42.4	26.5	43.3	27.0	58
33	36.9	24.0	37.7	24.5	38.6	25.1	39.4	25.6	40.3	26.1	41.1	26.7	41.9	27.2	42.8	27.8	57
34	36.5	24.6	37.3	25.2	38.1	25.7	39.0	26.3	39.8	26.8	40.6	27.4	41.5	28.0	42.3	28.5	56
35	36.0	25.2	36.9	25.8	37.7	26.4	38.5	27.0	39.3	27.5	40.1	28.1	41.0	28.7	41.8	29.3	55
36	35.6	25.9	36.4	26.5	37.2	27.0	38.0	27.6	38.8	28.2	39.6	28.8	40.5	29.4	41.3	30.0	54
37	35.1	26.5	35.9	27.1	36.7	27.7	37.5	28.3	38.3	28.9	39.1	29.5	39.9	30.1	40.7	30.7	53
38	34.7	27.1	35.5	27.7	36.2	28.3	37.0	28.9	37.8	29.6	38.6	30.2	39.4	30.8	40.2	31.4	52
39	34.2	27.7	35.0	28.3	35.7	28.9	36.5	29.6	37.3	30.2	38.1	30.8	38.9	31.5	39.6	32.1	51
40	33.7	28.3	34.5	28.9	35.2	29.6	36.0	30.2	36.8	30.9	37.5	31.5	38.3	32.1	39.1	32.8	50
41	33.2	28.9	34.0	29.5	34.7	30.2	35.5	30.8	36.2	31.5	37.0	32.1	37.7	32.8	38.5	33.5	49
42	32.7	29.4	33.4	30.1	34.2	30.8	34.9	31.4	35.7	32.1	36.4	32.8	37.2	33.5	37.9	34.1	48
43	32.2	30.0	32.9	30.7	33.6	31.4	34.4	32.1	35.1	32.7	35.8	33.4	36.6	34.1	37.3	34.8	47
44	31.7	30.6	32.4	31.3	33.1	32.0	33.8	32.6	34.5	33.3	35.2	34.0	36.0	34.7	36.7	35.4	46
45	31.1	31.1	31.8	31.8	32.5	32.5	33.2	33.2	33.9	33.9	34.6	34.6	35.4	35.4	36.1	36.1	45

Plane Traverse Table

Course.	D = 52'		D = 53'		D = 54'		D = 55'		D = 56'		D = 57'		D = 58'		D = 59'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0°	52.0	0.0	53.0	0.0	54.0	0.0	55.0	0.0	56.0	0.0	57.0	0.0	58.0	0.0	59.0	0.0	90°
1	52.0	0.9	53.0	0.9	54.0	0.9	55.0	1.0	56.0	1.0	57.0	1.0	58.0	1.0	59.0	1.0	89
2	52.0	1.8	53.0	1.8	54.0	1.9	55.0	1.9	56.0	2.0	57.0	2.0	58.0	2.0	59.0	2.1	88
3	51.9	2.7	52.9	2.8	53.9	2.8	54.9	2.9	55.9	2.9	56.9	3.0	57.9	3.0	58.9	3.1	87
4	51.9	3.6	52.9	3.7	53.9	3.8	54.9	3.8	55.9	3.9	56.9	4.0	57.9	4.0	58.9	4.1	86
5	51.8	4.5	52.8	4.6	53.8	4.7	54.8	4.8	55.8	4.9	56.8	5.0	57.8	5.1	58.8	5.1	85
6	51.7	5.4	52.7	5.5	53.7	5.6	54.7	5.7	55.7	5.9	56.7	6.0	57.7	6.1	58.7	6.2	84
7	51.6	6.3	52.6	6.5	53.6	6.6	54.6	6.7	55.6	6.8	56.6	6.9	57.6	7.1	58.6	7.2	83
8	51.5	7.2	52.5	7.4	53.5	7.5	54.5	7.7	55.5	7.8	56.4	7.9	57.4	8.1	58.4	8.2	82
9	51.4	8.1	52.3	8.3	53.3	8.4	54.3	8.6	55.3	8.8	56.3	8.9	57.3	9.1	58.3	9.2	81
10	51.2	9.0	52.2	9.2	53.2	9.4	54.2	9.6	55.1	9.7	56.1	9.9	57.1	10.1	58.1	10.2	80
11	51.0	9.9	52.0	10.1	53.0	10.3	54.0	10.5	55.0	10.7	56.0	10.9	56.9	11.1	57.9	11.3	79
12	50.9	10.8	51.8	11.0	52.8	11.2	53.8	11.4	54.8	11.6	55.8	11.9	56.7	12.1	57.7	12.3	78
13	50.7	11.7	51.6	11.9	52.6	12.1	53.6	12.4	54.6	12.6	55.5	12.8	56.5	13.0	57.5	13.3	77
14	50.5	12.6	51.4	12.8	52.4	13.1	53.4	13.3	54.3	13.5	55.3	13.8	56.3	14.0	57.2	14.3	76
15	50.2	13.5	51.2	13.7	52.2	14.0	53.1	14.2	54.1	14.5	55.1	14.8	56.0	15.0	57.0	15.3	75
16	50.0	14.3	50.9	14.6	51.9	14.9	52.9	15.2	53.8	15.4	54.8	15.7	55.8	16.0	56.7	16.3	74
17	49.7	15.2	50.7	15.5	51.6	15.8	52.6	16.1	53.6	16.4	54.5	16.7	55.5	17.0	56.4	17.2	73
18	49.5	16.1	50.4	16.4	51.4	16.7	52.3	17.0	53.3	17.3	54.2	17.6	55.2	17.9	56.1	18.2	72
19	49.2	16.9	50.1	17.3	51.1	17.6	52.0	17.9	52.9	18.2	53.9	18.6	54.8	18.9	55.8	19.2	71
20	48.9	17.8	49.8	18.1	50.7	18.5	51.7	18.8	52.6	19.2	53.6	19.5	54.5	19.8	55.4	20.2	70
21	48.5	18.6	49.5	19.0	50.4	19.4	51.3	19.7	52.3	20.1	53.2	20.4	54.1	20.8	55.1	21.1	69
22	48.2	19.5	49.1	19.9	50.1	20.2	51.0	20.6	51.9	21.0	52.8	21.4	53.8	21.7	54.7	22.1	68
23	47.9	20.3	48.8	20.7	49.7	21.1	50.6	21.5	51.5	21.9	52.5	22.3	53.4	22.7	54.3	23.1	67
24	47.5	21.2	48.4	21.6	49.3	22.0	50.2	22.4	51.2	22.8	52.1	23.2	53.0	23.6	53.9	24.0	66
25	47.1	22.0	48.0	22.4	48.9	22.8	49.8	23.2	50.8	23.7	51.7	24.1	52.6	24.5	53.5	24.9	65
26	46.7	22.8	47.6	23.2	48.5	23.7	49.4	24.1	50.3	24.5	51.2	25.0	52.1	25.4	53.0	25.9	64
27	46.3	23.6	47.2	24.1	48.1	24.5	49.0	25.0	49.9	25.4	50.8	25.9	51.7	26.3	52.6	26.8	63
28	45.9	24.4	46.8	24.9	47.7	25.4	48.6	25.8	49.4	26.3	50.3	26.8	51.2	27.2	52.1	27.7	62
29	45.5	25.2	46.4	25.7	47.2	26.2	48.1	26.7	49.0	27.1	49.9	27.6	50.7	28.1	51.6	28.6	61
30	45.0	26.0	45.9	26.5	46.8	27.0	47.6	27.5	48.5	28.0	49.4	28.5	50.2	29.0	51.1	29.5	60
31	44.6	26.8	45.4	27.3	46.3	27.8	47.1	28.3	48.0	28.8	48.9	29.4	49.7	29.9	50.6	30.4	59
32	44.1	27.6	44.9	28.1	45.8	28.6	46.6	29.1	47.5	29.7	48.3	30.2	49.2	30.7	50.0	31.3	58
33	43.6	28.3	44.4	28.9	45.3	29.4	46.1	30.0	47.0	30.5	47.8	31.0	48.6	31.6	49.5	32.1	57
34	43.1	29.1	43.9	29.6	44.8	30.2	45.6	30.8	46.4	31.3	47.3	31.9	48.1	32.4	48.9	33.0	56
35	42.6	29.8	43.4	30.4	44.2	31.0	45.1	31.5	45.9	32.1	46.7	32.7	47.5	33.3	48.3	33.8	55
36	42.1	30.6	42.9	31.2	43.7	31.7	44.5	32.3	45.3	32.9	46.1	33.5	46.9	34.1	47.7	34.7	54
37	41.5	31.3	42.3	31.9	43.1	32.5	43.9	33.1	44.7	33.7	45.5	34.3	46.3	34.9	47.1	35.5	53
38	41.0	32.0	41.8	32.6	42.6	33.2	43.3	33.9	44.1	34.5	44.9	35.1	45.7	35.7	46.5	36.3	52
39	40.4	32.7	41.2	33.4	42.0	34.0	42.7	34.6	43.5	35.2	44.3	35.9	45.1	36.5	45.9	37.1	51
40	39.8	33.4	40.6	34.1	41.4	34.7	42.1	35.4	42.9	36.0	43.7	36.6	44.4	37.3	45.2	37.9	50
41	39.2	34.1	40.0	34.8	40.8	35.4	41.5	36.1	42.3	36.7	43.0	37.4	43.8	38.1	44.5	38.7	49
42	38.6	34.8	39.4	35.5	40.1	36.1	40.9	36.8	41.6	37.5	42.4	38.1	43.1	38.8	43.8	39.5	48
43	38.0	35.5	38.8	36.1	39.5	36.8	40.2	37.5	41.0	38.2	41.7	38.9	42.4	39.6	43.1	40.2	47
44	37.4	36.1	38.1	36.8	38.8	37.5	39.6	38.2	40.3	38.9	41.0	39.6	41.7	40.3	42.4	41.0	46
45	36.8	36.8	37.5	37.5	38.2	38.2	38.9	38.9	39.6	39.6	40.3	40.3	41.0	41.0	41.7	41.7	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 52'		D = 53'		D = 54'		D = 55'		D = 56'		D = 57'		D = 58'		D = 59'		

Plane Traverse Table

Course.	D=60'		D=61'		D=62'		D=63'		D=64'		D=65'		D=66'		D=67'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	60.0	0.0	61.0	0.0	62.0	0.0	63.0	0.0	64.0	0.0	65.0	0.0	66.0	0.0	67.0	0.0	90
1	60.0	1.0	61.0	1.1	62.0	1.1	63.0	1.1	64.0	1.1	65.0	1.1	66.0	1.2	67.0	1.2	89
2	60.0	2.1	61.0	2.1	62.0	2.2	63.0	2.2	64.0	2.2	65.0	2.3	66.0	2.3	67.0	2.3	88
3	59.9	3.1	60.9	3.2	61.9	3.2	62.9	3.3	63.9	3.3	64.9	3.4	65.9	3.5	66.9	3.5	87
4	59.9	4.2	60.9	4.3	61.8	4.3	62.8	4.4	63.8	4.5	64.8	4.5	65.8	4.6	66.8	4.7	86
5	59.8	5.2	60.8	5.3	61.8	5.4	62.8	5.5	63.8	5.6	64.8	5.7	65.7	5.8	66.7	5.8	85
6	59.7	6.3	60.7	6.4	61.7	6.5	62.7	6.6	63.6	6.7	64.6	6.8	65.6	6.9	66.6	7.0	84
7	59.6	7.3	60.5	7.4	61.5	7.6	62.5	7.7	63.5	7.8	64.5	7.9	65.5	8.0	66.5	8.2	83
8	59.4	8.4	60.4	8.5	61.4	8.6	62.4	8.8	63.4	8.9	64.4	9.0	65.4	9.2	66.3	9.3	82
9	59.3	9.4	60.2	9.5	61.2	9.7	62.2	9.9	63.2	10.0	64.2	10.2	65.2	10.3	66.2	10.5	81
10	59.1	10.4	60.1	10.6	61.1	10.8	62.0	10.9	63.0	11.1	64.0	11.3	65.0	11.5	66.0	11.6	80
11	58.9	11.4	59.9	11.6	60.9	11.8	61.8	12.0	62.8	12.2	63.8	12.4	64.8	12.6	65.8	12.8	79
12	58.7	12.5	59.7	12.7	60.6	12.9	61.6	13.1	62.6	13.3	63.6	13.5	64.6	13.7	65.5	13.9	78
13	58.5	13.5	59.4	13.7	60.4	13.9	61.4	14.2	62.4	14.4	63.3	14.6	64.3	14.8	65.3	15.1	77
14	58.2	14.5	59.2	14.8	60.2	15.0	61.1	15.2	62.1	15.5	63.1	15.7	64.0	16.0	65.0	16.2	76
15	58.0	15.5	58.9	15.8	59.9	16.0	60.9	16.3	61.8	16.6	62.8	16.8	63.8	17.1	64.7	17.3	75
16	57.7	16.5	58.6	16.8	59.6	17.1	60.6	17.4	61.5	17.6	62.5	17.9	63.4	18.2	64.4	18.5	74
17	57.4	17.5	58.3	17.8	59.3	18.1	60.2	18.4	61.2	18.7	62.2	19.0	63.1	19.3	64.1	19.6	73
18	57.1	18.5	58.0	18.9	59.0	19.2	59.9	19.5	60.9	19.8	61.8	20.1	62.8	20.4	63.7	20.7	72
19	56.7	19.5	57.7	19.9	58.6	20.2	59.6	20.5	60.5	20.8	61.5	21.2	62.4	21.5	63.3	21.8	71
20	56.4	20.5	57.3	20.9	58.3	21.2	59.2	21.5	60.1	21.9	61.1	22.2	62.0	22.6	63.0	22.9	70
21	56.0	21.5	56.9	21.9	57.9	22.2	58.8	22.6	59.7	22.9	60.7	23.3	61.6	23.7	62.5	24.0	69
22	55.6	22.5	56.6	22.9	57.5	23.2	58.4	23.6	59.3	24.0	60.3	24.3	61.2	24.7	62.1	25.1	68
23	55.2	23.4	56.2	23.8	57.1	24.2	58.0	24.6	58.9	25.0	59.8	25.4	60.8	25.8	61.7	26.2	67
24	54.8	24.4	55.7	24.8	56.6	25.2	57.6	25.6	58.5	26.0	59.4	26.4	60.3	26.8	61.2	27.3	66
25	54.4	25.4	55.3	25.8	56.2	26.2	57.1	26.6	58.0	27.0	58.9	27.5	59.8	27.9	60.7	28.3	65
26	53.9	26.3	54.8	26.7	55.7	27.2	56.6	27.6	57.5	28.1	58.4	28.5	59.3	28.9	60.2	29.4	64
27	53.5	27.2	54.4	27.7	55.2	28.1	56.1	28.6	57.0	29.1	57.9	29.5	58.8	30.0	59.7	30.4	63
28	53.0	28.2	53.9	28.6	54.7	29.1	55.6	29.6	56.5	30.0	57.4	30.5	58.3	31.0	59.2	31.5	62
29	52.5	29.1	53.4	29.6	54.2	30.1	55.1	30.5	56.0	31.0	56.9	31.5	57.7	32.0	58.6	32.5	61
30	52.0	30.0	52.8	30.5	53.7	31.0	54.6	31.5	55.4	32.0	56.3	32.5	57.2	33.0	58.0	33.5	60
31	51.4	30.9	52.3	31.4	53.1	31.9	54.0	32.4	54.9	33.0	55.7	33.5	56.6	34.0	57.4	34.5	59
32	50.9	31.8	51.7	32.3	52.6	32.9	53.4	33.4	54.3	33.9	55.1	34.4	56.0	35.0	56.8	35.5	58
33	50.3	32.7	51.2	33.2	52.0	33.8	52.8	34.3	53.7	34.9	54.5	35.4	55.4	35.9	56.2	36.5	57
34	49.7	33.6	50.6	34.1	51.4	34.7	52.2	35.2	53.1	35.8	53.9	36.3	54.7	36.9	55.5	37.5	56
35	49.1	34.4	50.0	35.0	50.8	35.6	51.6	36.1	52.4	36.7	53.2	37.3	54.1	37.9	54.9	38.4	55
36	48.5	35.3	49.4	35.9	50.2	36.4	51.0	37.0	51.8	37.6	52.6	38.2	53.4	38.8	54.2	39.4	54
37	47.9	36.1	48.7	36.7	49.5	37.3	50.3	37.9	51.1	38.5	51.9	39.1	52.7	39.7	53.5	40.3	53
38	47.3	36.9	48.1	37.6	48.9	38.2	49.6	38.8	50.4	39.4	51.2	40.0	52.0	40.6	52.8	41.2	52
39	46.6	37.8	47.4	38.4	48.2	39.0	49.0	39.6	49.7	40.3	50.5	40.9	51.3	41.5	52.1	42.2	51
40	46.0	38.6	46.7	39.2	47.5	39.9	48.3	40.5	49.0	41.1	49.8	41.8	50.6	42.4	51.3	43.1	50
41	45.3	39.4	46.0	40.0	46.8	40.7	47.5	41.3	48.3	42.0	49.1	42.6	49.8	43.3	50.6	44.0	49
42	44.6	40.1	45.3	40.8	46.1	41.5	46.8	42.2	47.6	42.8	48.3	43.5	49.0	44.2	49.8	44.8	48
43	43.9	40.9	44.6	41.6	45.3	42.3	46.1	43.0	46.8	43.6	47.5	44.3	48.3	45.0	49.0	45.7	47
44	43.2	41.7	43.9	42.4	44.6	43.1	45.3	43.8	46.0	44.5	46.8	45.2	47.5	45.8	48.2	46.5	46
45	42.4	42.4	43.1	43.1	43.8	43.8	44.5	44.5	45.3	45.3	46.0	46.0	46.7	46.7	47.4	47.4	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=60'		D=61'		D=62'		D=63'		D=64'		D=65'		D=66'		D=67'		

Plane Traverse Table

Course.	D=68'		D=69'		D=70'		D=71'		D=72'		D=73'		D=74'		D=75'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	68.0	0.0	69.0	0.0	70.0	0.0	71.0	0.0	72.0	0.0	73.0	0.0	74.0	0.0	75.0	0.0	90
1	68.0	1.2	69.0	1.2	70.0	1.2	71.0	1.2	72.0	1.3	73.0	1.3	74.0	1.3	75.0	1.3	89
2	68.0	2.4	69.0	2.4	70.0	2.4	71.0	2.5	72.0	2.5	73.0	2.5	74.0	2.6	75.0	2.6	88
3	67.9	3.6	68.9	3.6	69.9	3.7	70.9	3.7	71.9	3.8	72.9	3.8	73.9	3.9	74.9	3.9	87
4	67.8	4.7	68.8	4.8	69.8	4.9	70.8	5.0	71.8	5.0	72.8	5.1	73.8	5.2	74.8	5.2	86
5	67.7	5.9	68.7	6.0	69.7	6.1	70.7	6.2	71.7	6.3	72.7	6.4	73.7	6.4	74.7	6.5	85
6	67.6	7.1	68.6	7.2	69.6	7.3	70.6	7.4	71.6	7.5	72.6	7.6	73.6	7.7	74.6	7.8	84
7	67.5	8.3	68.5	8.4	69.5	8.5	70.5	8.7	71.5	8.8	72.5	8.9	73.4	9.0	74.4	9.1	83
8	67.3	9.5	68.3	9.6	69.3	9.7	70.3	9.9	71.3	10.0	72.3	10.2	73.3	10.3	74.3	10.4	82
9	67.2	10.6	68.2	10.8	69.1	11.0	70.1	11.1	71.1	11.3	72.1	11.4	73.1	11.6	74.1	11.7	81
10	67.0	11.8	68.0	12.0	68.9	12.2	69.9	12.3	70.9	12.5	71.9	12.7	72.9	12.8	73.9	13.0	80
11	66.8	13.0	67.7	13.2	68.7	13.4	69.7	13.5	70.7	13.7	71.7	13.9	72.6	14.1	73.6	14.3	79
12	66.5	14.1	67.5	14.3	68.5	14.6	69.4	14.8	70.4	15.0	71.4	15.2	72.4	15.4	73.4	15.6	78
13	66.3	15.3	67.2	15.5	68.2	15.7	69.2	16.0	70.2	16.2	71.1	16.4	72.1	16.6	73.1	16.9	77
14	66.0	16.5	67.0	16.7	67.9	16.9	68.9	17.2	69.9	17.4	70.8	17.7	71.8	17.9	72.8	18.1	76
15	65.7	17.6	66.6	17.9	67.6	18.1	68.6	18.4	69.5	18.6	70.5	18.9	71.5	19.2	72.4	19.4	75
16	65.4	18.7	66.3	19.0	67.3	19.3	68.2	19.6	69.2	19.8	70.2	20.1	71.1	20.4	72.1	20.7	74
17	65.0	19.9	66.0	20.2	66.9	20.5	67.9	20.8	68.9	21.1	69.8	21.3	70.8	21.6	71.7	21.9	73
18	64.7	21.0	65.6	21.3	66.6	21.6	67.5	21.9	68.5	22.2	69.4	22.6	70.4	22.9	71.3	23.2	72
19	64.3	22.1	65.2	22.5	66.2	22.8	67.1	23.1	68.1	23.4	69.0	23.8	70.0	24.1	70.9	24.4	71
20	63.9	23.3	64.8	23.6	65.8	23.9	66.7	24.3	67.7	24.6	68.6	25.0	69.5	25.3	70.5	25.7	70
21	63.5	24.4	64.4	24.7	65.4	25.1	66.3	25.4	67.2	25.8	68.2	26.2	69.1	26.5	70.0	26.9	69
22	63.0	25.5	64.0	25.8	64.9	26.2	65.8	26.6	66.8	27.0	67.7	27.3	68.6	27.7	69.5	28.1	68
23	62.6	26.6	63.5	27.0	64.4	27.4	65.4	27.7	66.3	28.1	67.2	28.5	68.1	28.9	69.0	29.3	67
24	62.1	27.7	63.0	28.1	63.9	28.5	64.9	28.9	65.8	29.3	66.7	29.7	67.6	30.1	68.5	30.5	66
25	61.6	28.7	62.5	29.2	63.4	29.6	64.3	30.0	65.3	30.4	66.2	30.9	67.1	31.3	68.0	31.7	65
26	61.1	29.8	62.0	30.2	62.9	30.7	63.8	31.1	64.7	31.6	65.6	32.0	66.5	32.4	67.4	32.9	64
27	60.6	30.9	61.5	31.3	62.4	31.8	63.3	32.2	64.2	32.7	65.0	33.1	65.9	33.6	66.8	34.0	63
28	60.0	31.9	60.9	32.4	61.8	32.9	62.7	33.3	63.6	33.8	64.5	34.3	65.3	34.7	66.2	35.2	62
29	59.5	33.0	60.3	33.5	61.2	33.9	62.1	34.4	63.0	34.9	63.8	35.4	64.7	35.9	65.6	36.4	61
30	58.9	34.0	59.8	34.5	60.6	35.0	61.5	35.5	62.4	36.0	63.2	36.5	64.1	37.0	65.0	37.5	60
31	58.3	35.0	59.1	35.5	60.0	36.1	60.9	36.6	61.7	37.1	62.6	37.6	63.4	38.1	64.3	38.6	59
32	57.7	36.0	58.5	36.6	59.4	37.1	60.2	37.6	61.1	38.2	61.9	38.7	62.8	39.2	63.6	39.7	58
33	57.0	37.0	57.9	37.6	58.7	38.1	59.5	38.7	60.4	39.2	61.2	39.8	62.1	40.3	62.9	40.8	57
34	56.4	38.0	57.2	38.6	58.0	39.1	58.9	39.7	59.7	40.3	60.5	40.8	61.3	41.4	62.2	41.9	56
35	55.7	39.0	56.5	39.6	57.3	40.2	58.2	40.7	59.0	41.3	59.8	41.9	60.6	42.4	61.4	43.0	55
36	55.0	40.0	55.8	40.6	56.6	41.1	57.4	41.7	58.2	42.3	59.1	42.9	59.9	43.5	60.7	44.1	54
37	54.3	40.9	55.1	41.5	55.9	42.1	56.7	42.7	57.5	43.3	58.3	43.9	59.1	44.5	59.9	45.1	53
38	53.6	41.9	54.4	42.5	55.2	43.1	55.9	43.7	56.7	44.3	57.5	44.9	58.3	45.6	59.1	46.2	52
39	52.8	42.8	53.6	43.4	54.4	44.1	55.2	44.7	56.0	45.3	56.7	45.9	57.5	46.6	58.3	47.2	51
40	52.1	43.7	52.9	44.4	53.6	45.0	54.4	45.6	55.2	46.3	55.9	46.9	56.7	47.6	57.5	48.2	50
41	51.3	44.6	52.1	45.3	52.8	45.9	53.6	46.6	54.3	47.2	55.1	47.9	55.8	48.5	56.6	49.2	49
42	50.5	45.5	51.3	46.2	52.0	46.8	52.8	47.5	53.5	48.2	54.2	48.8	55.0	49.5	55.7	50.2	48
43	49.7	46.4	50.5	47.1	51.2	47.7	51.9	48.4	52.7	49.1	53.4	49.8	54.1	50.5	54.9	51.1	47
44	48.9	47.2	49.6	47.9	50.4	48.6	51.1	49.3	51.8	50.0	52.5	50.7	53.2	51.4	54.0	52.1	46
45	48.1	48.1	48.8	48.8	49.5	49.5	50.2	50.2	50.9	50.9	51.6	51.6	52.3	52.3	53.0	53.0	45

Plane Traverse Table

Course.	D=76'		D=77'		D=78'		D=79'		D=80'		D=81'		D=82'		D=83'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	76.0	0.0	77.0	0.0	78.0	0.0	79.0	0.0	80.0	0.0	81.0	0.0	82.0	0.0	83.0	0.0	90
1	76.0	1.3	77.0	1.3	78.0	1.4	79.0	1.4	80.0	1.4	81.0	1.4	82.0	1.4	83.0	1.4	89
2	76.0	2.7	77.0	2.7	78.0	2.7	79.0	2.8	80.0	2.8	81.0	2.8	82.0	2.9	82.9	2.9	88
3	75.9	4.0	76.9	4.0	77.9	4.1	78.9	4.1	79.9	4.2	80.9	4.2	81.9	4.3	82.9	4.3	87
4	75.8	5.3	76.8	5.4	77.8	5.4	78.8	5.5	79.8	5.6	80.8	5.7	81.8	5.7	82.8	5.8	86
5	75.7	6.6	76.7	6.7	77.7	6.8	78.7	6.9	79.7	7.0	80.7	7.1	81.7	7.1	82.7	7.2	85
6	75.6	7.9	76.6	8.0	77.6	8.2	78.6	8.3	79.6	8.4	80.6	8.5	81.6	8.6	82.5	8.7	84
7	75.4	9.3	76.4	9.4	77.4	9.5	78.4	9.6	79.4	9.7	80.4	9.9	81.4	10.0	82.4	10.1	83
8	75.3	10.6	76.3	10.7	77.2	10.9	78.2	11.0	79.2	11.1	80.2	11.3	81.2	11.4	82.2	11.6	82
9	75.1	11.9	76.1	12.0	77.0	12.2	78.0	12.4	79.0	12.5	80.0	12.7	81.0	12.8	82.0	13.0	81
10	74.8	13.2	75.8	13.4	76.8	13.5	77.8	13.7	78.8	13.9	79.8	14.1	80.8	14.2	81.7	14.4	80
11	74.6	14.5	75.6	14.7	76.6	14.9	77.5	15.1	78.5	15.3	79.5	15.5	80.5	15.6	81.5	15.8	79
12	74.3	15.8	75.3	16.0	76.3	16.2	77.3	16.4	78.3	16.6	79.2	16.8	80.2	17.0	81.2	17.3	78
13	74.1	17.1	75.0	17.3	76.0	17.5	77.0	17.8	77.9	18.0	78.9	18.2	79.9	18.4	80.9	18.7	77
14	73.7	18.4	74.7	18.6	75.7	18.9	76.7	19.1	77.6	19.4	78.6	19.6	79.6	19.8	80.5	20.1	76
15	73.4	19.7	74.4	19.9	75.3	20.2	76.3	20.4	77.3	20.7	78.2	21.0	79.2	21.2	80.2	21.5	75
16	73.1	20.9	74.0	21.2	75.0	21.5	75.9	21.8	76.9	22.1	77.9	22.3	78.8	22.6	79.8	22.9	74
17	72.7	22.2	73.6	22.5	74.6	22.8	75.5	23.1	76.5	23.4	77.5	23.7	78.4	24.0	79.4	24.3	73
18	72.3	23.5	73.2	23.8	74.2	24.1	75.1	24.4	76.1	24.7	77.0	25.0	78.0	25.3	78.9	25.6	72
19	71.9	24.7	72.8	25.1	73.8	25.4	74.7	25.7	75.6	26.0	76.6	26.4	77.5	26.7	78.5	27.0	71
20	71.4	26.0	72.4	26.3	73.3	26.7	74.2	27.0	75.2	27.4	76.1	27.7	77.1	28.0	78.0	28.4	70
21	71.0	27.2	71.9	27.6	72.8	28.0	73.8	28.3	74.7	28.7	75.6	29.0	76.6	29.4	77.5	29.7	69
22	70.5	28.5	71.4	28.8	72.3	29.2	73.2	29.6	74.2	30.0	75.1	30.3	76.0	30.7	77.0	31.1	68
23	70.0	29.7	70.9	30.1	71.8	30.5	72.7	30.9	73.6	31.3	74.6	31.6	75.5	32.0	76.4	32.4	67
24	69.4	30.9	70.3	31.3	71.3	31.7	72.2	32.1	73.1	32.5	74.0	32.9	74.9	33.4	75.8	33.8	66
25	68.9	32.1	69.8	32.5	70.7	33.0	71.6	33.4	72.5	33.8	73.4	34.2	74.3	34.7	75.2	35.1	65
26	68.3	33.3	69.2	33.8	70.1	34.2	71.0	34.6	71.9	35.1	72.8	35.5	73.7	35.9	74.6	36.4	64
27	67.7	34.5	68.6	35.0	69.5	35.4	70.4	35.9	71.3	36.3	72.2	36.8	73.1	37.2	74.0	37.7	63
28	67.1	35.7	68.0	36.1	68.9	36.6	69.8	37.1	70.6	37.6	71.5	38.0	72.4	38.5	73.3	39.0	62
29	66.5	36.8	67.3	37.3	68.2	37.8	69.1	38.3	70.0	38.8	70.8	39.3	71.7	39.8	72.6	40.2	61
30	65.8	38.0	66.7	38.5	67.5	39.0	68.4	39.5	69.3	40.0	70.1	40.5	71.0	41.0	71.9	41.5	60
31	65.1	39.1	66.0	39.7	66.9	40.2	67.7	40.7	68.6	41.2	69.4	41.7	70.3	42.2	71.1	42.7	59
32	64.5	40.3	65.3	40.8	66.1	41.3	67.0	41.9	67.8	42.4	68.7	42.9	69.5	43.5	70.4	44.0	58
33	63.7	41.4	64.6	41.9	65.4	42.5	66.3	43.0	67.1	43.6	67.9	44.1	68.8	44.7	69.6	45.2	57
34	63.0	42.5	63.8	43.1	64.7	43.6	65.5	44.2	66.3	44.7	67.2	45.3	68.0	45.9	68.8	46.4	56
35	62.3	43.6	63.1	44.2	63.9	44.7	64.7	45.3	65.5	45.9	66.4	46.5	67.2	47.0	68.0	47.6	55
36	61.5	44.7	62.3	45.3	63.1	45.8	63.9	46.4	64.7	47.0	65.5	47.6	66.3	48.2	67.1	48.8	54
37	60.7	45.7	61.5	46.3	62.3	46.9	63.1	47.5	63.9	48.1	64.7	48.7	65.5	49.3	66.3	50.0	53
38	59.9	46.8	60.7	47.4	61.5	48.0	62.3	48.6	63.0	49.3	63.8	49.9	64.6	50.5	65.4	51.1	52
39	59.1	47.8	59.8	48.5	60.6	49.1	61.4	49.7	62.2	50.3	62.9	51.0	63.7	51.6	64.5	52.2	51
40	58.2	48.9	59.0	49.5	59.8	50.1	60.5	50.8	61.3	51.4	62.0	52.1	62.8	52.7	63.6	53.4	50
41	57.4	49.9	58.1	50.5	58.9	51.2	59.6	51.8	60.4	52.5	61.1	53.1	61.9	53.8	62.6	54.5	49
42	56.5	50.9	57.2	51.5	58.0	52.2	58.7	52.9	59.5	53.5	60.2	54.2	60.9	54.9	61.7	55.5	48
43	55.6	51.8	56.3	52.5	57.0	53.2	57.8	53.9	58.5	54.6	59.2	55.2	60.0	55.9	60.7	56.6	47
44	54.7	52.8	55.4	53.5	56.1	54.2	56.8	54.9	57.5	55.6	58.3	56.3	59.0	57.0	59.7	57.7	46
45	53.7	53.7	54.4	54.4	55.2	55.2	55.9	55.9	56.6	56.6	57.3	57.3	58.0	58.0	58.7	58.7	45

Plane Traverse Table

Course.	D=84'		D=85'		D=86'		D=87'		D=88'		D=89'		D=90'		D=91'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	84.0	0.0	85.0	0.0	86.0	0.0	87.0	0.0	88.0	0.0	89.0	0.0	90.0	0.0	91.0	0.0	90
1	84.0	1.5	85.0	1.5	86.0	1.5	87.0	1.5	88.0	1.5	89.0	1.6	90.0	1.6	91.0	1.6	89
2	83.9	2.9	84.9	3.0	85.9	3.0	86.9	3.0	87.9	3.1	88.9	3.1	89.9	3.1	90.9	3.2	88
3	83.9	4.4	84.9	4.4	85.9	4.5	86.9	4.6	87.9	4.6	88.9	4.7	89.9	4.7	90.9	4.8	87
4	83.8	5.9	84.8	5.9	85.8	6.0	86.8	6.1	87.8	6.1	88.8	6.2	89.8	6.3	90.8	6.3	86
5	83.7	7.3	84.7	7.4	85.7	7.5	86.7	7.6	87.7	7.7	88.7	7.8	89.7	7.8	90.7	7.9	85
6	83.5	8.8	84.5	8.9	85.5	9.0	86.5	9.1	87.5	9.2	88.5	9.3	89.5	9.4	90.5	9.5	84
7	83.4	10.2	84.4	10.4	85.4	10.5	86.4	10.6	87.3	10.7	88.3	10.8	89.3	11.0	90.3	11.1	83
8	83.2	11.7	84.2	11.8	85.2	12.0	86.2	12.1	87.1	12.2	88.1	12.4	89.1	12.5	90.1	12.7	82
9	83.0	13.1	84.0	13.3	84.9	13.5	85.9	13.6	86.9	13.8	87.9	13.9	88.9	14.1	89.9	14.2	81
10	82.7	14.6	83.7	14.8	84.7	14.9	85.7	15.1	86.7	15.3	87.6	15.5	88.6	15.6	89.6	15.8	80
11	82.5	16.0	83.4	16.2	84.4	16.4	85.4	16.6	86.4	16.8	87.4	17.0	88.3	17.2	89.3	17.4	79
12	82.2	17.5	83.1	17.7	84.1	17.9	85.1	18.1	86.1	18.3	87.1	18.5	88.0	18.7	89.0	18.9	78
13	81.8	18.9	82.8	19.1	83.8	19.3	84.8	19.6	85.7	19.8	86.7	20.0	87.7	20.2	88.7	20.5	77
14	81.5	20.3	82.5	20.6	83.4	20.8	84.4	21.0	85.4	21.3	86.4	21.5	87.3	21.8	88.3	22.0	76
15	81.1	21.7	82.1	22.0	83.1	22.3	84.0	22.5	85.0	22.8	86.0	23.0	86.9	23.3	87.9	23.6	75
16	80.7	23.2	81.7	23.4	82.7	23.7	83.6	24.0	84.6	24.3	85.6	24.5	86.5	24.8	87.5	25.1	74
17	80.3	24.6	81.3	24.9	82.2	25.1	83.2	25.4	84.2	25.7	85.1	26.0	86.1	26.3	87.0	26.6	73
18	79.9	26.0	80.8	26.3	81.8	26.6	82.7	26.9	83.7	27.2	84.6	27.5	85.6	27.8	86.5	28.1	72
19	79.4	27.3	80.4	27.7	81.3	28.0	82.3	28.3	83.2	28.7	84.2	29.0	85.1	29.3	86.0	29.6	71
20	78.9	28.7	79.9	29.1	80.8	29.4	81.8	29.8	82.7	30.1	83.6	30.4	84.6	30.8	85.5	31.1	70
21	78.4	30.1	79.4	30.5	80.3	30.8	81.2	31.2	82.2	31.5	83.1	31.9	84.0	32.3	85.0	32.6	69
22	77.9	31.5	78.8	31.8	79.7	32.2	80.7	32.6	81.6	33.0	82.5	33.3	83.4	33.7	84.4	34.1	68
23	77.3	32.8	78.2	33.2	79.2	33.6	80.1	34.0	81.0	34.4	81.9	34.8	82.8	35.2	83.8	35.6	67
24	76.7	34.2	77.7	34.6	78.6	35.0	79.5	35.4	80.4	35.8	81.3	36.2	82.2	36.6	83.1	37.0	66
25	76.1	35.5	77.0	35.9	77.9	36.3	78.8	36.8	79.8	37.2	80.7	37.6	81.6	38.0	82.5	38.5	65
26	75.5	36.8	76.4	37.3	77.3	37.7	78.2	38.1	79.1	38.6	80.0	39.0	80.9	39.5	81.8	39.9	64
27	74.8	38.1	75.7	38.6	76.6	39.0	77.5	39.5	78.4	40.0	79.3	40.4	80.2	40.9	81.1	41.3	63
28	74.2	39.4	75.1	39.9	75.9	40.4	76.8	40.8	77.7	41.3	78.6	41.8	79.5	42.3	80.3	42.7	62
29	73.5	40.7	74.3	41.2	75.2	41.7	76.1	42.2	77.0	42.7	77.8	43.1	78.7	43.6	79.6	44.1	61
30	72.7	42.0	73.6	42.5	74.5	43.0	75.3	43.5	76.2	44.0	77.1	44.5	77.9	45.0	78.8	45.5	60
31	72.0	43.3	72.9	43.8	73.7	44.3	74.6	44.8	75.4	45.3	76.3	45.8	77.1	46.4	78.0	46.9	59
32	71.2	44.5	72.1	45.0	72.9	45.6	73.8	46.1	74.6	46.6	75.5	47.2	76.3	47.7	77.2	48.2	58
33	70.4	45.7	71.3	46.3	72.1	46.8	73.0	47.4	73.8	47.9	74.6	48.5	75.5	49.0	76.3	49.6	57
34	69.6	47.0	70.5	47.5	71.3	48.1	72.1	48.6	73.0	49.2	73.8	49.8	74.6	50.3	75.4	50.9	56
35	68.8	48.2	69.6	48.8	70.4	49.3	71.3	49.9	72.1	50.5	72.9	51.0	73.7	51.6	74.5	52.2	55
36	68.0	49.4	68.8	50.0	69.6	50.5	70.4	51.1	71.2	51.7	72.0	52.3	72.8	52.9	73.6	53.5	54
37	67.1	50.6	67.9	51.2	68.7	51.8	69.5	52.4	70.3	53.0	71.1	53.6	71.9	54.2	72.7	54.8	53
38	66.2	51.7	67.0	52.3	67.8	52.9	68.6	53.6	69.3	54.2	70.1	54.8	70.9	55.4	71.7	56.0	52
39	65.3	52.9	66.1	53.5	66.8	54.1	67.6	54.8	68.4	55.4	69.2	56.0	69.9	56.6	70.7	57.3	51
40	64.3	54.0	65.1	54.6	65.9	55.3	66.6	55.9	67.4	56.6	68.2	57.2	68.9	57.9	69.7	58.5	50
41	63.4	55.1	64.2	55.8	64.9	56.4	65.7	57.1	66.4	57.7	67.2	58.4	67.9	59.0	68.7	59.7	49
42	62.4	56.2	63.2	56.9	63.9	57.5	64.7	58.2	65.4	58.9	66.1	59.6	66.9	60.2	67.6	60.9	48
43	61.4	57.3	62.2	58.0	62.9	58.7	63.6	59.3	64.4	60.0	65.1	60.7	65.8	61.4	66.6	62.1	47
44	60.4	58.4	61.1	59.0	61.9	59.7	62.6	60.4	63.3	61.1	64.0	61.8	64.7	62.5	65.5	63.2	46
45	59.4	59.4	60.1	60.1	60.8	60.8	61.5	61.5	62.2	62.2	62.9	62.9	63.6	63.6	64.3	64.3	45

Plane Traverse Table

Course	D=92'		D=93'		D=94'		D=95'		D=96'		D=97'		D=98'		D=99'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	92.0	0.0	93.0	0.0	94.0	0.0	95.0	0.0	96.0	0.0	97.0	0.0	98.0	0.0	99.0	0.0	90
1	92.0	1.6	93.0	1.6	94.0	1.6	95.0	1.7	96.0	1.7	97.0	1.7	98.0	1.7	99.0	1.7	89
2	91.9	3.2	92.9	3.2	93.9	3.3	94.9	3.3	95.9	3.4	96.9	3.4	97.9	3.4	98.9	3.5	88
3	91.9	4.8	92.9	4.9	93.9	4.9	94.9	5.0	95.9	5.0	96.9	5.1	97.9	5.1	98.9	5.2	87
4	91.8	6.4	92.8	6.5	93.8	6.6	94.8	6.6	95.8	6.7	96.8	6.8	97.8	6.8	98.8	6.9	86
5	91.6	8.0	92.6	8.1	93.6	8.2	94.6	8.3	95.6	8.4	96.6	8.5	97.6	8.5	98.6	8.6	85
6	91.5	9.6	92.5	9.7	93.5	9.8	94.5	9.9	95.5	10.0	96.5	10.1	97.5	10.2	98.5	10.3	84
7	91.3	11.2	92.3	11.3	93.3	11.5	94.3	11.6	95.3	11.7	96.3	11.8	97.3	11.9	98.3	12.1	83
8	91.1	12.8	92.1	12.9	93.1	13.1	94.1	13.2	95.1	13.4	96.1	13.5	97.0	13.6	98.0	13.8	82
9	90.9	14.4	91.9	14.5	92.8	14.7	93.8	14.9	94.8	15.0	95.8	15.2	96.8	15.3	97.8	15.5	81
10	90.6	16.0	91.6	16.1	92.6	16.3	93.6	16.5	94.5	16.7	95.5	16.8	96.5	17.0	97.5	17.2	80
11	90.3	17.6	91.3	17.7	92.3	17.9	93.3	18.1	94.2	18.3	95.2	18.5	96.2	18.7	97.2	18.9	79
12	90.0	19.1	91.0	19.3	91.9	19.5	92.9	19.8	93.9	20.0	94.9	20.2	95.9	20.4	96.8	20.6	78
13	89.6	20.7	90.6	20.9	91.6	21.1	92.6	21.4	93.5	21.6	94.5	21.8	95.5	22.0	96.5	22.3	77
14	89.3	22.3	90.2	22.5	91.2	22.7	92.2	23.0	93.1	23.2	94.1	23.5	95.1	23.7	96.1	24.0	76
15	88.9	23.8	89.8	24.1	90.8	24.3	91.8	24.6	92.7	24.8	93.7	25.1	94.7	25.4	95.6	25.6	75
16	88.4	25.4	89.4	25.6	90.4	25.9	91.3	26.2	92.3	26.5	93.2	26.7	94.2	27.0	95.2	27.3	74
17	88.0	26.9	88.9	27.2	89.9	27.5	90.8	27.8	91.8	28.1	92.8	28.4	93.7	28.7	94.7	28.9	73
18	87.5	28.4	88.4	28.7	89.4	29.0	90.4	29.4	91.3	29.7	92.3	30.0	93.2	30.3	94.2	30.6	72
19	87.0	30.0	87.9	30.3	88.9	30.6	89.8	30.9	90.8	31.3	91.7	31.6	92.7	31.9	93.6	32.2	71
20	86.5	31.5	87.4	31.8	88.3	32.1	89.3	32.5	90.2	32.8	91.2	33.2	92.1	33.5	93.0	33.9	70
21	85.9	33.0	86.8	33.3	87.8	33.7	88.7	34.0	89.6	34.4	90.6	34.8	91.5	35.1	92.4	35.5	69
22	85.3	34.5	86.2	34.8	87.2	35.2	88.1	35.6	89.0	36.0	89.9	36.3	90.9	36.7	91.8	37.1	68
23	84.7	35.9	85.6	36.3	86.5	36.7	87.4	37.1	88.4	37.5	89.3	37.9	90.2	38.3	91.1	38.7	67
24	84.0	37.4	85.0	37.8	85.9	38.2	86.8	38.6	87.7	39.0	88.6	39.5	89.5	39.9	90.4	40.3	66
25	83.4	38.9	84.3	39.3	85.2	39.7	86.1	40.1	87.0	40.6	87.9	41.0	88.8	41.4	89.7	41.8	65
26	82.7	40.3	83.6	40.8	84.5	41.2	85.4	41.6	86.3	42.1	87.2	42.5	88.1	43.0	89.0	43.4	64
27	82.0	41.8	82.9	42.2	83.8	42.7	84.6	43.1	85.5	43.6	86.4	44.0	87.3	44.5	88.2	44.9	63
28	81.2	43.2	82.1	43.7	83.0	44.1	83.9	44.6	84.8	45.1	85.6	45.5	86.5	46.0	87.4	46.5	62
29	80.5	44.6	81.3	45.1	82.2	45.6	83.1	46.1	84.0	46.5	84.8	47.0	85.7	47.5	86.6	48.0	61
30	79.7	46.0	80.5	46.5	81.4	47.0	82.3	47.5	83.1	48.0	84.0	48.5	84.9	49.0	85.7	49.5	60
31	78.9	47.4	79.7	47.9	80.6	48.4	81.4	48.9	82.3	49.4	83.1	50.0	84.0	50.5	84.9	51.0	59
32	78.0	48.8	78.9	49.3	79.7	49.8	80.6	50.3	81.4	50.9	82.3	51.4	83.1	51.9	84.0	52.5	58
33	77.2	50.1	78.0	50.7	78.8	51.2	79.7	51.7	80.5	52.3	81.4	52.8	82.2	53.4	83.0	53.9	57
34	76.3	51.4	77.1	52.0	77.9	52.6	78.8	53.1	79.6	53.7	80.4	54.2	81.2	54.8	82.1	55.4	56
35	75.4	52.8	76.2	53.3	77.0	53.9	77.8	54.5	78.6	55.1	79.5	55.6	80.3	56.2	81.1	56.8	55
36	74.5	54.1	75.2	54.7	76.0	55.3	76.9	55.8	77.7	56.4	78.5	57.0	79.3	57.6	80.1	58.2	54
37	73.5	55.4	74.3	56.0	75.1	56.6	75.9	57.2	76.7	57.8	77.5	58.4	78.3	59.0	79.1	59.6	53
38	72.5	56.6	73.3	57.3	74.1	57.9	74.9	58.5	75.6	59.1	76.4	59.7	77.2	60.3	78.0	61.0	52
39	71.5	57.9	72.3	58.5	73.1	59.2	73.8	59.8	74.6	60.4	75.4	61.0	76.2	61.7	76.9	62.3	51
40	70.5	59.1	71.2	59.8	72.0	60.4	72.8	61.1	73.5	61.7	74.3	62.4	75.1	63.0	75.8	63.6	50
41	69.4	60.4	70.2	61.0	70.9	61.7	71.7	62.3	72.5	63.0	73.2	63.6	74.0	64.3	74.7	64.9	49
42	68.4	61.6	69.1	62.2	69.9	62.9	70.6	63.6	71.3	64.2	72.1	64.9	72.8	65.6	73.6	66.2	48
43	67.3	62.7	68.0	63.4	68.7	64.1	69.5	64.8	70.2	65.5	70.9	66.2	71.7	66.8	72.4	67.5	47
44	66.2	63.9	66.9	64.6	67.6	65.3	68.3	66.0	69.1	66.7	69.8	67.4	70.5	68.1	71.2	68.8	46
45	65.1	65.1	65.8	65.8	66.5	66.5	67.2	67.2	67.9	67.9	68.6	68.6	69.3	69.3	70.0	70.0	45

Plane Traverse Table

Course.	D = 100'		D = 101'		D = 102'		D = 103'		D = 104'		D = 105'		D = 106'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	100.0	0.0	101.0	0.0	102.0	0.0	103.0	0.0	104.0	0.0	105.0	0.0	106.0	0.0	90
1	100.0	1.7	101.0	1.8	102.0	1.8	103.0	1.8	104.0	1.8	105.0	1.8	106.0	1.8	89
2	99.9	3.5	100.9	3.5	101.9	3.6	102.9	3.6	103.9	3.6	104.9	3.7	105.9	3.7	88
3	99.9	5.2	100.9	5.3	101.9	5.3	102.9	5.4	103.9	5.4	104.9	5.5	105.9	5.5	87
4	99.8	7.0	100.8	7.0	101.8	7.1	102.7	7.2	103.7	7.3	104.7	7.3	105.7	7.4	86
5	99.6	8.7	100.6	8.8	101.6	8.9	102.6	9.0	103.6	9.1	104.6	9.2	105.6	9.2	85
6	99.5	10.5	100.4	10.6	101.4	10.7	102.4	10.8	103.4	10.9	104.4	11.0	105.4	11.1	84
7	99.3	12.2	100.2	12.3	101.2	12.4	102.2	12.6	103.2	12.7	104.2	12.8	105.2	12.9	83
8	99.0	13.9	100.0	14.1	101.0	14.2	102.0	14.3	103.0	14.5	104.0	14.6	105.0	14.8	82
9	98.8	15.6	99.8	15.8	100.7	15.0	101.7	16.1	102.7	16.3	103.7	16.4	104.7	16.6	81
10	98.5	17.4	99.5	17.5	100.5	17.7	101.4	17.9	102.4	18.1	103.4	18.2	104.4	18.4	80
11	98.2	19.1	99.1	19.3	100.1	19.5	101.1	19.7	102.1	19.8	103.1	20.0	104.1	20.2	79
12	97.8	20.8	98.8	21.0	99.8	21.2	100.7	21.4	101.7	21.6	102.7	21.8	103.7	22.0	78
13	97.4	22.5	98.4	22.7	99.4	22.9	100.4	23.2	101.3	23.4	102.3	23.6	103.3	23.8	77
14	97.0	24.2	98.0	24.4	99.0	24.7	99.9	24.9	100.9	25.2	101.9	25.4	102.9	25.6	76
15	96.6	25.9	97.6	26.1	98.5	26.4	99.5	26.7	100.5	26.9	101.4	27.2	102.4	27.4	75
16	96.1	27.6	97.1	27.8	98.0	28.1	99.0	28.4	100.0	28.7	100.9	28.9	101.9	29.2	74
17	95.6	29.2	96.6	29.5	97.5	29.8	98.5	30.1	99.5	30.4	100.4	30.7	101.4	31.0	73
18	95.1	30.9	96.1	31.2	97.0	31.5	98.0	31.8	98.9	32.1	99.9	32.4	100.8	32.8	72
19	94.6	32.6	95.5	32.9	96.4	33.2	97.4	33.5	98.3	33.9	99.3	34.2	100.2	34.5	71
20	94.0	34.2	94.9	34.5	95.8	34.9	96.8	35.2	97.7	35.6	98.7	35.9	99.6	36.3	70
21	93.4	35.8	94.3	36.2	95.2	36.6	96.2	36.9	97.1	37.3	98.0	37.6	99.0	38.0	69
22	92.7	37.5	93.6	37.8	94.6	38.2	95.5	38.6	96.4	39.0	97.4	39.3	98.3	39.7	68
23	92.1	39.1	93.0	39.5	93.9	39.9	94.8	40.2	95.7	40.6	96.7	41.0	97.6	41.4	67
24	91.4	40.7	92.3	41.1	93.2	41.5	94.1	41.9	95.0	42.3	95.9	42.7	96.8	43.1	66
25	90.6	42.3	91.5	42.7	92.4	43.1	93.3	43.5	94.3	44.0	95.2	44.4	96.1	44.8	65
26	89.9	43.8	90.8	44.3	91.7	44.7	92.6	45.2	93.5	45.6	94.4	46.0	95.3	46.5	64
27	89.1	45.4	90.0	45.9	90.9	46.3	91.8	46.8	92.7	47.2	93.6	47.7	94.4	48.1	63
28	88.3	46.9	89.2	47.4	90.1	47.9	90.9	48.4	91.8	48.8	92.7	49.3	93.6	49.8	62
29	87.5	48.5	88.3	49.0	89.2	49.5	90.1	49.9	91.0	50.4	91.8	50.9	92.7	51.4	61
30	86.6	50.0	87.5	50.5	88.3	51.0	89.2	51.5	90.1	52.0	90.9	52.5	91.8	53.0	60
31	85.7	51.5	86.6	52.0	87.4	52.5	88.3	53.0	89.1	53.6	90.0	54.1	90.9	54.6	59
32	84.8	53.0	85.7	53.5	86.5	54.1	87.3	54.6	88.2	55.1	89.0	55.6	89.9	56.2	58
33	83.9	54.5	84.7	55.0	85.5	55.6	86.4	56.1	87.2	56.6	88.1	57.2	88.9	57.7	57
34	82.9	55.9	83.7	56.5	84.6	57.0	85.4	57.6	86.2	58.2	87.0	58.7	87.9	59.3	56
35	81.9	57.4	82.7	57.9	83.6	58.5	84.4	59.1	85.2	59.7	86.0	60.2	86.8	60.8	55
36	80.9	58.8	81.7	59.4	82.5	60.0	83.3	60.5	84.1	61.1	84.9	61.7	85.8	62.3	54
37	79.9	60.2	80.7	60.8	81.5	61.4	82.3	62.0	83.1	62.6	83.9	63.2	84.7	63.8	53
38	78.8	61.6	79.6	62.2	80.4	62.8	81.2	63.4	82.0	64.0	82.7	64.6	83.5	65.3	52
39	77.7	62.9	78.5	63.6	79.3	64.2	80.0	64.8	80.8	65.4	81.6	66.1	82.4	66.7	51
40	76.6	64.3	77.4	64.9	78.1	65.6	78.9	66.2	79.7	66.8	80.4	67.5	81.2	68.1	50
41	75.5	65.6	76.2	66.3	77.0	66.9	77.7	67.6	78.5	68.2	79.2	68.9	80.0	69.5	49
42	74.3	66.9	75.1	67.6	75.8	68.3	76.5	68.9	77.3	69.6	78.0	70.3	78.8	70.9	48
43	73.1	68.2	73.9	68.9	74.6	69.6	75.3	70.2	76.1	70.9	76.8	71.6	77.5	72.3	47
44	71.9	69.5	72.7	70.2	73.4	70.9	74.1	71.5	74.8	72.2	75.5	72.9	76.3	73.6	46
45	70.7	70.7	71.4	71.4	72.1	72.1	72.8	72.8	73.5	73.5	74.2	74.2	75.0	75.0	45

Course.	D = 100'		D = 101'		D = 102'		D = 103'		D = 104'		D = 105'		D = 106'		Course.
	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	

Plane Traverse Table

Course.	D = 107'		D = 108'		D = 109'		D = 110'		D = 111'		D = 112'		D = 113'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	107.0	0.0	108.0	0.0	109.0	0.0	110.0	0.0	111.0	0.0	112.0	0.0	113.0	0.0	90
1	107.0	1.9	108.0	1.9	109.0	1.9	110.0	1.9	111.0	1.9	112.0	2.0	113.0	2.0	89
2	106.9	3.7	107.9	3.8	108.9	3.8	109.9	3.8	110.9	3.9	111.9	3.9	112.9	3.9	88
3	106.9	5.6	107.9	5.7	108.9	5.7	109.8	5.8	110.8	5.8	111.8	5.9	112.8	5.9	87
4	106.7	7.5	107.7	7.5	108.7	7.6	109.7	7.7	110.7	7.7	111.7	7.8	112.7	7.9	86
5	106.6	9.3	107.6	9.4	108.6	9.5	109.6	9.6	110.6	9.7	111.6	9.8	112.6	9.8	85
6	106.4	11.2	107.4	11.3	108.4	11.4	109.4	11.5	110.4	11.6	111.4	11.7	112.4	11.8	84
7	106.2	13.0	107.2	13.2	108.2	13.3	109.2	13.4	110.2	13.5	111.2	13.6	112.2	13.8	83
8	106.0	14.9	106.9	15.0	107.9	15.2	108.9	15.3	109.9	15.4	110.9	15.6	111.9	15.7	82
9	105.7	16.7	106.7	16.9	107.7	17.1	108.6	17.2	109.6	17.4	110.6	17.5	111.6	17.7	81
10	105.4	18.6	106.4	18.8	107.3	18.9	108.3	19.1	109.3	19.3	110.3	19.4	111.3	19.6	80
11	105.0	20.4	106.0	20.6	107.0	20.8	108.0	21.0	109.0	21.2	109.9	21.4	110.9	21.6	79
12	104.7	22.2	105.6	22.5	106.6	22.7	107.6	22.9	108.6	23.1	109.6	23.3	110.5	23.5	78
13	104.3	24.1	105.2	24.3	106.2	24.5	107.2	24.7	108.2	25.0	109.1	25.2	110.1	25.4	77
14	103.8	25.9	104.8	26.1	105.8	26.4	106.7	26.6	107.7	26.9	108.7	27.1	109.6	27.3	76
15	103.4	27.7	104.3	28.0	105.3	28.2	106.3	28.5	107.2	28.7	108.2	29.2	109.1	29.2	75
16	102.9	29.5	103.8	29.8	104.8	30.0	105.7	30.3	106.7	30.6	107.7	30.9	108.6	31.1	74
17	102.3	31.3	103.3	31.6	104.2	31.9	105.2	32.2	106.1	32.5	107.1	32.7	108.1	33.0	73
18	101.8	33.1	102.7	33.4	103.7	33.7	104.6	34.0	105.6	34.3	106.5	34.6	107.5	34.9	72
19	101.2	34.8	102.1	35.2	103.1	35.5	104.0	35.8	105.0	36.1	105.9	36.5	106.8	36.8	71
20	100.5	36.6	101.5	36.9	102.4	37.3	103.4	37.6	104.3	38.0	105.2	38.3	106.2	38.6	70
21	99.9	38.3	100.8	38.7	101.8	39.1	102.7	39.4	103.6	39.8	104.6	40.1	105.5	40.5	69
22	99.2	40.1	100.1	40.5	101.1	40.8	102.0	41.2	102.9	41.6	103.8	42.0	104.8	42.3	68
23	98.5	41.8	99.4	42.2	100.3	42.6	101.3	43.0	102.2	43.4	103.1	43.8	104.0	44.2	67
24	97.7	43.5	98.7	43.9	99.6	44.3	100.5	44.7	101.4	45.1	102.3	45.6	103.2	46.0	66
25	97.0	45.2	97.9	45.6	98.8	46.1	99.7	46.5	100.6	46.9	101.5	47.3	102.4	47.8	65
26	96.2	46.9	97.1	47.3	98.0	47.8	98.9	48.2	99.8	48.7	100.7	49.1	101.6	49.5	64
27	95.3	48.6	96.2	49.0	97.1	49.5	98.0	49.9	98.9	50.4	99.8	50.8	100.7	51.3	63
28	94.5	50.2	95.4	50.7	96.2	51.2	97.1	51.6	98.0	52.1	98.9	52.6	99.8	53.1	62
29	93.5	51.9	94.5	52.4	95.2	52.8	96.2	53.3	97.1	53.8	98.0	54.3	98.8	54.8	61
30	92.7	53.5	93.5	54.0	94.4	54.5	95.3	55.0	96.1	55.5	97.0	56.0	97.9	56.5	60
31	91.7	55.1	92.6	55.6	93.4	56.1	94.3	56.7	95.1	57.2	96.0	57.7	96.9	58.2	59
32	90.7	56.7	91.6	57.2	92.4	57.8	93.3	58.3	94.1	58.8	95.0	59.4	95.8	59.9	58
33	89.7	58.3	90.6	58.8	91.4	59.4	92.3	59.9	93.1	60.5	93.9	61.0	94.8	61.5	57
34	88.7	59.8	89.5	60.4	90.4	61.0	91.2	61.5	92.0	62.1	92.9	62.6	93.7	63.2	56
35	87.6	61.4	88.5	61.9	89.3	62.5	90.1	63.1	90.9	63.7	91.7	64.2	92.6	64.8	55
36	86.6	62.9	87.4	63.5	88.2	64.1	89.0	64.7	89.8	65.2	90.6	65.8	91.4	66.4	54
37	85.5	64.4	86.3	65.0	87.1	65.6	87.8	66.2	88.6	66.8	89.4	67.4	90.2	68.0	53
38	84.3	65.9	85.1	66.5	85.9	67.1	86.7	67.7	87.5	68.3	88.3	69.0	89.0	69.6	52
39	83.2	67.3	83.9	68.0	84.7	68.6	85.5	69.2	86.3	69.9	87.0	70.5	87.8	71.1	51
40	82.0	68.8	82.7	69.4	83.5	70.1	84.3	70.7	85.0	71.3	85.8	72.0	86.6	72.6	50
41	80.8	70.2	81.5	70.9	82.3	71.5	83.0	72.2	83.8	72.8	84.5	73.5	85.3	74.1	49
42	79.5	71.6	80.3	72.3	81.0	72.9	81.7	73.6	82.5	74.3	83.2	74.9	84.0	75.6	48
43	78.3	73.0	79.0	73.7	79.7	74.3	80.4	75.0	81.2	75.7	81.9	76.4	82.6	77.1	47
44	77.0	74.3	77.7	75.0	78.4	75.7	79.1	76.4	79.8	77.1	80.6	77.8	81.3	78.5	46
45	75.7	75.7	76.4	76.4	77.1	77.1	77.8	77.8	78.5	78.5	79.2	79.2	79.9	79.9	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 107'		D = 108'		D = 109'		D = 110'		D = 111'		D = 112'		D = 113'		

Plane Traverse Table

Course.	D=114'		D=115'		D=116'		D=117'		D=118'		D=119'		D=120'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	114.0	0.0	115.0	0.0	116.0	0.0	117.0	0.0	118.0	0.0	119.0	0.0	120.0	0.0	90
1	114.0	2.0	115.0	2.0	116.0	2.0	117.0	2.0	118.0	2.1	119.0	2.1	120.0	2.1	89
2	113.9	4.0	114.9	4.0	115.9	4.0	116.9	4.1	117.9	4.1	118.9	4.2	119.9	4.2	88
3	113.8	6.0	114.8	6.0	115.8	6.1	116.8	6.1	117.8	6.2	118.8	6.2	119.8	6.3	87
4	113.7	8.0	114.7	8.0	115.7	8.1	116.7	8.2	117.7	8.2	118.7	8.3	119.7	8.4	86
5	113.6	9.9	114.6	10.0	115.6	10.1	116.6	10.2	117.6	10.3	118.5	10.4	119.5	10.5	85
6	113.4	11.9	114.4	12.0	115.4	12.1	116.4	12.2	117.4	12.3	118.3	12.4	119.3	12.5	84
7	113.2	13.9	114.1	14.0	115.1	14.1	116.1	14.3	117.1	14.4	118.1	14.5	119.1	14.6	83
8	112.9	15.9	113.9	16.0	114.9	16.1	115.9	16.3	116.9	16.4	117.8	16.6	118.8	16.7	82
9	112.6	17.8	113.6	18.0	114.6	18.1	115.6	18.3	116.5	18.5	117.5	18.6	118.5	18.8	81
10	112.3	19.8	113.3	20.0	114.2	20.1	115.2	20.3	116.2	20.5	117.2	20.7	118.2	20.8	80
11	111.9	21.8	112.9	21.9	113.9	22.1	114.9	22.3	115.8	22.5	116.8	22.7	117.8	22.9	79
12	111.5	23.7	112.5	23.9	113.5	24.1	114.4	24.3	115.4	24.5	116.4	24.7	117.4	24.9	78
13	111.1	25.6	112.1	25.9	113.0	26.1	114.0	26.3	115.0	26.5	116.0	26.8	116.9	27.0	77
14	110.6	27.6	111.6	27.8	112.6	28.1	113.5	28.3	114.5	28.5	115.5	28.8	116.4	29.0	76
15	110.1	29.5	111.1	29.8	112.0	30.0	113.0	30.3	114.0	30.5	114.9	30.8	115.9	31.1	75
16	109.6	31.4	110.5	31.7	111.5	32.0	112.5	32.2	113.4	32.5	114.4	32.8	115.4	33.1	74
17	109.0	33.3	110.0	33.6	111.0	33.9	111.9	34.2	112.8	34.5	113.8	34.8	114.8	35.1	73
18	108.4	35.2	109.4	35.5	110.3	35.8	111.3	36.2	112.2	36.5	113.2	36.8	114.1	37.1	72
19	107.8	37.1	108.7	37.4	109.7	37.8	110.6	38.1	111.6	38.4	112.5	38.7	113.5	39.1	71
20	107.1	39.0	108.1	39.3	109.0	39.7	109.9	40.0	110.9	40.4	111.8	40.7	112.8	41.0	70
21	106.4	40.9	107.4	41.2	108.3	41.6	109.2	41.9	110.2	42.3	111.1	42.6	112.0	43.0	69
22	105.7	42.7	106.6	43.1	107.6	43.5	108.5	43.8	109.4	44.2	110.3	44.6	111.3	45.0	68
23	104.9	44.5	105.9	44.9	106.8	45.3	107.7	45.7	108.6	46.1	109.5	46.5	110.5	46.9	67
24	104.1	46.4	105.1	46.8	106.0	47.2	106.9	47.6	107.8	48.0	108.7	48.4	109.6	48.8	66
25	103.3	48.2	104.2	48.6	105.1	49.0	106.0	49.4	106.9	49.9	107.9	50.3	108.8	50.7	65
26	102.5	50.0	103.4	50.4	104.3	50.9	105.2	51.3	106.1	51.7	107.0	52.2	107.9	52.6	64
27	101.6	51.8	102.5	52.2	103.4	52.7	104.2	53.1	105.1	53.6	106.0	54.0	106.9	54.5	63
28	100.7	53.5	101.5	54.0	102.4	54.5	103.3	54.9	104.2	55.4	105.1	55.9	106.0	56.3	62
29	99.7	55.3	100.6	55.8	101.5	56.2	102.3	56.7	103.2	57.2	104.1	57.7	105.0	58.2	61
30	98.7	57.0	99.6	57.5	100.5	58.0	101.3	58.5	102.2	59.0	103.1	59.5	103.9	60.0	60
31	97.7	58.7	98.6	59.2	99.4	59.7	100.3	60.3	101.1	60.8	102.0	61.3	102.9	61.8	59
32	96.7	60.4	97.5	60.9	98.4	61.5	99.2	62.0	100.1	62.5	100.9	63.1	101.8	63.6	58
33	95.6	62.1	96.4	62.6	97.3	63.2	98.1	63.7	99.0	64.3	99.8	64.8	100.6	65.4	57
34	94.5	63.7	95.3	64.3	96.2	64.9	97.0	65.4	97.8	66.0	98.7	66.5	99.5	67.1	56
35	93.4	65.4	94.2	66.0	95.0	66.5	95.8	67.1	96.7	67.7	97.5	68.3	98.3	68.8	55
36	92.2	67.0	93.0	67.6	93.8	68.2	94.7	68.8	95.5	69.4	96.3	69.9	97.1	70.5	54
37	91.0	68.6	91.8	69.2	92.6	69.8	93.4	70.4	94.2	71.0	95.0	71.6	95.8	72.2	53
38	89.8	70.2	90.6	70.8	91.4	71.4	92.2	72.0	93.0	72.6	93.8	73.3	94.6	73.9	52
39	88.6	71.7	89.4	72.4	90.1	73.0	90.9	73.6	91.7	74.2	92.5	74.9	93.3	75.5	51
40	87.3	73.3	88.1	73.9	88.9	74.6	89.6	75.2	90.4	75.8	91.2	76.5	91.9	77.1	50
41	86.0	74.8	86.8	75.4	87.5	76.1	88.3	76.8	89.1	77.4	89.8	78.1	90.6	78.7	49
42	84.7	76.3	85.5	77.0	86.2	77.6	86.9	78.3	87.7	79.0	88.4	79.6	89.2	80.3	48
43	83.4	77.7	84.1	78.4	84.8	79.1	85.6	79.8	86.3	80.5	87.0	81.2	87.8	81.8	47
44	82.0	79.2	82.7	79.9	83.4	80.6	84.2	81.3	84.9	82.0	85.6	82.7	86.3	83.4	46
45	80.6	80.6	81.3	81.3	82.0	82.0	82.7	82.7	83.4	83.4	84.1	84.1	84.9	84.9	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=114'		D=115'		D=116'		D=117'		D=118'		D=119'		D=120'		

Plane Traverse Table

Course.	D = 121'		D = 122'		D = 123'		D = 124'		D = 125'		D = 126'		D = 127'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	121.0	0.0	122.0	0.0	123.0	0.0	124.0	0.0	125.0	0.0	126.0	0.0	127.0	0.0	90
1	121.0	2.1	122.0	2.1	123.0	2.1	124.0	2.2	125.0	2.2	126.0	2.2	127.0	2.2	89
2	120.9	4.2	121.9	4.3	122.9	4.3	123.9	4.3	124.9	4.4	125.9	4.4	126.9	4.4	88
3	120.8	6.3	121.8	6.4	122.8	6.4	123.8	6.5	124.8	6.5	125.8	6.6	126.8	6.6	87
4	120.7	8.4	121.7	8.5	122.7	8.6	123.7	8.6	124.7	8.7	125.7	8.8	126.7	8.9	86
5	120.5	10.5	121.5	10.6	122.5	10.7	123.5	10.8	124.5	10.9	125.5	11.0	126.5	11.1	85
6	120.3	12.6	121.3	12.8	122.3	12.9	123.3	13.0	124.3	13.1	125.3	13.2	126.3	13.3	84
7	120.1	14.7	121.1	14.9	122.1	15.0	123.1	15.1	124.1	15.2	125.1	15.4	126.1	15.5	83
8	119.8	16.8	120.8	17.0	121.8	17.1	122.8	17.3	123.8	17.4	124.8	17.5	125.8	17.7	82
9	119.5	18.9	120.5	19.1	121.5	19.2	122.5	19.4	123.5	19.6	124.4	19.7	125.4	19.9	81
10	119.2	21.0	120.1	21.2	121.1	21.4	122.1	21.5	123.1	21.7	124.1	21.9	125.1	22.1	80
11	118.8	23.1	119.8	23.3	120.7	23.5	121.7	23.7	122.7	23.9	123.7	24.0	124.7	24.2	79
12	118.4	25.2	119.3	25.4	120.3	25.6	121.3	25.8	122.3	26.0	123.2	26.2	124.2	26.4	78
13	117.9	27.2	118.9	27.4	119.8	27.7	120.8	27.9	121.8	28.1	122.8	28.3	123.7	28.6	77
14	117.4	29.3	118.4	29.5	119.3	29.8	120.3	30.0	121.3	30.2	122.3	30.5	123.2	30.7	76
15	116.9	31.3	117.8	31.6	118.8	31.8	119.8	32.1	120.7	32.4	121.7	32.6	122.7	32.9	75
16	116.3	33.4	117.3	33.6	118.2	33.9	119.2	34.2	120.2	34.5	121.1	34.7	122.1	35.0	74
17	115.7	35.4	116.7	35.7	117.6	36.0	118.6	36.3	119.5	36.5	120.5	36.8	121.5	37.1	73
18	115.1	37.4	116.0	37.7	117.0	38.0	117.9	38.3	118.9	38.6	119.8	38.9	120.8	39.2	72
19	114.4	39.4	115.4	39.7	116.3	40.0	117.2	40.4	118.2	40.7	119.1	41.0	120.1	41.3	71
20	113.7	41.4	114.6	41.7	115.6	42.1	116.5	42.4	117.5	42.8	118.4	43.1	119.3	43.4	70
21	113.0	43.4	113.9	43.7	114.8	44.1	115.8	44.4	116.7	44.8	117.6	45.2	118.6	45.5	69
22	112.2	45.3	113.1	45.7	114.0	46.1	115.0	46.5	115.9	46.8	116.8	47.2	117.8	47.6	68
23	111.4	47.3	112.3	47.7	113.2	48.1	114.1	48.5	115.1	48.8	116.0	49.2	117.0	49.6	67
24	110.5	49.2	111.5	49.6	112.4	50.0	113.3	50.4	114.2	50.8	115.1	51.2	116.0	51.7	66
25	109.7	51.1	110.6	51.6	111.5	52.0	112.4	52.4	113.3	52.8	114.2	53.2	115.1	53.7	65
26	108.8	53.0	109.7	53.5	110.6	53.9	111.5	54.4	112.3	54.8	113.2	55.2	114.1	55.7	64
27	107.8	54.9	108.7	55.4	109.6	55.8	110.5	56.3	111.4	56.7	112.3	57.2	113.2	57.7	63
28	106.8	56.8	107.7	57.3	108.6	57.7	109.5	58.2	110.4	58.7	111.3	59.2	112.1	59.6	62
29	105.8	58.7	106.7	59.1	107.6	59.6	108.5	60.1	109.3	60.6	110.2	61.1	111.1	61.6	61
30	104.8	60.5	105.7	61.0	106.5	61.5	107.4	62.0	108.3	62.5	109.1	63.0	110.0	63.5	60
31	103.7	62.3	104.6	62.8	105.4	63.3	106.3	63.9	107.1	64.4	108.0	64.9	108.9	65.4	59
32	102.6	64.1	103.5	64.7	104.3	65.2	105.2	65.7	106.0	66.2	106.9	66.8	107.7	67.3	58
33	101.5	65.9	102.3	66.4	103.2	67.0	104.0	67.5	104.8	68.1	105.7	68.6	106.5	69.2	57
34	100.3	67.7	101.1	68.2	102.0	68.8	102.8	69.3	103.6	69.9	104.5	70.5	105.3	71.0	56
35	99.1	69.4	99.9	70.0	100.8	70.5	101.6	71.1	102.4	71.7	103.2	72.3	104.0	72.8	55
36	97.9	71.1	98.7	71.7	99.5	72.3	100.3	72.9	101.1	73.5	101.9	74.1	102.7	74.6	54
37	96.6	72.8	97.4	73.4	98.2	74.0	99.0	74.6	99.8	75.2	100.6	75.8	101.4	76.4	53
38	95.3	74.5	96.1	75.1	96.9	75.7	97.7	76.3	98.5	77.0	99.3	77.6	100.1	78.2	52
39	94.0	76.1	94.8	76.8	95.6	77.4	96.4	78.0	97.1	78.7	97.9	79.3	98.7	79.9	51
40	92.7	77.8	93.5	78.4	94.2	79.1	95.0	79.7	95.8	80.3	96.5	81.0	97.3	81.6	50
41	91.3	79.4	92.1	80.0	92.8	80.7	93.6	81.4	94.3	82.0	95.1	82.7	95.8	83.3	49
42	89.9	81.0	90.7	81.6	91.4	82.3	92.1	83.0	92.9	83.6	93.6	84.3	94.4	85.0	48
43	88.5	82.5	89.2	83.2	90.0	83.9	90.7	84.6	91.4	85.2	92.2	85.9	92.9	86.6	47
44	87.0	84.1	87.8	84.7	88.5	85.4	89.2	86.1	89.9	86.8	90.6	87.5	91.4	88.2	46
45	85.6	85.6	86.3	86.3	87.0	87.0	87.7	87.7	88.4	88.4	89.1	89.1	89.8	89.8	45
Course	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 121'		D = 122'		D = 123'		D = 124'		D = 125'		D = 126'		D = 127'		

Plane Traverse Table

Course.	D=128'		D=129'		D=130'		D=131'		D=132'		D=133'		D=134'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	128.0	0.0	129.0	0.0	130.0	0.0	131.0	0.0	132.0	0.0	133.0	0.0	134.0	0.0	90
1	128.0	2.2	129.0	2.3	130.0	2.3	131.0	2.3	132.0	2.3	133.0	2.3	134.0	2.3	89
2	127.9	4.5	128.9	4.5	129.9	4.5	130.9	4.6	131.9	4.6	132.9	4.6	133.9	4.7	88
3	127.8	6.7	128.8	6.8	129.8	6.8	130.8	6.9	131.8	6.9	132.8	7.0	133.8	7.0	87
4	127.7	8.9	128.7	9.0	129.7	9.1	130.7	9.1	131.7	9.2	132.7	9.3	133.7	9.3	86
5	127.5	11.2	128.5	11.2	129.5	11.3	130.5	11.4	131.5	11.5	132.5	11.6	133.5	11.7	85
6	127.3	13.4	128.3	13.5	129.3	13.6	130.3	13.7	131.3	13.8	132.3	13.9	133.3	14.0	84
7	127.0	15.6	128.0	15.7	129.0	15.8	130.0	16.0	131.0	16.1	132.0	16.2	133.0	16.3	83
8	126.8	17.8	127.7	18.0	128.7	18.1	129.7	18.2	130.7	18.4	131.7	18.5	132.7	18.6	82
9	126.4	20.0	127.4	20.2	128.4	20.3	129.4	20.5	130.4	20.6	131.4	20.8	132.4	21.0	81
10	126.1	22.2	127.0	22.4	128.0	22.6	129.0	22.7	130.0	22.9	131.0	23.1	132.0	23.3	80
11	125.6	24.4	126.6	24.6	127.6	24.8	128.6	25.0	129.6	25.2	130.6	25.4	131.5	25.6	79
12	125.2	26.6	126.2	26.8	127.2	27.0	128.1	27.2	129.1	27.4	130.1	27.7	131.1	27.9	78
13	124.7	28.8	125.7	29.0	126.7	29.2	127.6	29.5	128.6	29.7	129.6	29.9	130.6	30.1	77
14	124.2	31.0	125.2	31.2	126.1	31.4	127.1	31.7	128.1	31.9	129.0	32.2	130.0	32.4	76
15	123.6	33.1	124.6	33.4	125.6	33.6	126.5	33.9	127.5	34.2	128.5	34.4	129.4	34.7	75
16	123.0	35.3	124.0	35.6	125.0	35.8	125.9	36.1	126.9	36.4	127.8	36.7	128.8	36.9	74
17	122.4	37.4	123.4	37.7	124.3	38.0	125.3	38.3	126.2	38.6	127.2	38.9	128.1	39.2	73
18	121.7	39.6	122.7	39.9	123.6	40.2	124.6	40.5	125.5	40.8	126.5	41.1	127.4	41.4	72
19	121.0	41.7	122.0	42.0	122.9	42.3	123.9	42.6	124.8	43.0	125.8	43.3	126.7	43.6	71
20	120.3	43.8	121.2	44.1	122.2	44.5	123.1	44.8	124.0	45.1	125.0	45.5	125.9	45.8	70
21	119.5	45.9	120.4	46.2	121.4	46.6	122.3	46.9	123.2	47.3	124.2	47.7	125.1	48.0	69
22	118.7	47.9	119.6	48.3	120.5	48.7	121.5	49.1	122.4	49.4	123.3	49.8	124.2	50.2	68
23	117.8	50.0	118.7	50.4	119.7	50.8	120.6	51.2	121.5	51.6	122.4	52.0	123.3	52.4	67
24	116.9	52.1	117.8	52.5	118.8	52.9	119.7	53.3	120.6	53.7	121.5	54.1	122.4	54.5	66
25	116.0	54.1	116.9	54.5	117.8	54.9	118.7	55.4	119.6	55.8	120.5	56.2	121.4	56.6	65
26	115.0	56.1	115.9	56.5	116.8	57.0	117.7	57.4	118.6	57.9	119.5	58.3	120.4	58.7	64
27	114.0	58.1	114.9	58.6	115.8	59.0	116.7	59.5	117.6	59.9	118.5	60.4	119.4	60.8	63
28	113.0	60.1	113.9	60.6	114.8	61.0	115.7	61.5	116.5	62.0	117.4	62.4	118.3	62.9	62
29	112.0	62.1	112.8	62.5	113.7	63.0	114.6	63.5	115.4	64.0	116.3	64.5	117.2	65.0	61
30	110.9	64.0	111.7	64.5	112.6	65.0	113.4	65.5	114.3	66.0	115.2	66.5	116.0	67.0	60
31	109.7	65.9	110.6	66.4	111.4	67.0	112.3	67.5	113.1	68.0	114.0	68.5	114.9	69.0	59
32	108.6	67.8	109.4	68.4	110.2	68.9	111.1	69.4	111.9	69.9	112.8	70.5	113.6	71.0	58
33	107.3	69.7	108.2	70.3	109.0	70.8	109.9	71.3	110.7	71.9	111.5	72.4	112.4	73.0	57
34	106.1	71.6	106.9	72.1	107.8	72.7	108.6	73.3	109.4	73.8	110.3	74.4	111.1	74.9	56
35	104.9	73.4	105.7	74.0	106.5	74.6	107.3	75.1	108.1	75.7	108.9	76.3	109.8	76.9	55
36	103.6	75.2	104.4	75.8	105.2	76.4	106.0	77.0	106.8	77.6	107.6	78.2	108.4	78.8	54
37	102.2	77.0	103.0	77.6	103.8	78.2	104.6	78.8	105.4	79.4	106.2	80.0	107.0	80.6	53
38	100.9	78.8	101.7	79.4	102.4	80.0	103.2	80.7	104.0	81.3	104.8	81.9	105.6	82.5	52
39	99.5	80.6	100.3	81.2	101.0	81.8	101.8	82.4	102.6	83.1	103.4	83.7	104.1	84.3	51
40	98.1	82.3	98.8	82.9	99.6	83.6	100.4	84.2	101.1	84.8	101.9	85.5	102.6	86.1	50
41	96.6	84.0	97.4	84.6	98.1	85.3	98.9	85.9	99.6	86.6	100.4	87.3	101.1	87.9	49
42	95.1	85.6	95.9	86.3	96.6	87.0	97.4	87.7	98.1	88.3	98.8	89.0	99.6	89.7	48
43	93.6	87.3	94.3	88.0	95.1	88.7	95.8	89.3	96.5	90.0	97.3	90.7	98.0	91.4	47
44	92.1	88.9	92.8	89.6	93.5	90.3	94.2	91.0	95.0	91.7	95.7	92.4	96.4	93.1	46
45	90.5	90.5	91.2	91.2	91.9	91.9	92.6	92.6	93.3	93.3	94.0	94.0	94.8	94.8	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=128'		D=129'		D=130'		D=131'		D=132'		D=133'		D=134'		

Plane Traverse Table

Course.	D=135'		D=136'		D=137'		D=138'		D=139'		D=140'		D=141'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	135.0	0.0	136.0	0.0	137.0	0.0	138.0	0.0	139.0	0.0	140.0	0.0	141.0	0.0	90
1	135.0	2.4	136.0	2.4	137.0	2.4	138.0	2.4	139.0	2.4	140.0	2.4	141.0	2.5	89
2	134.9	4.7	135.9	4.7	136.9	4.8	137.9	4.8	138.9	4.9	139.9	4.9	140.9	4.9	88
3	134.8	7.1	135.8	7.1	136.8	7.2	137.8	7.2	138.8	7.3	139.8	7.3	140.8	7.4	87
4	134.7	9.4	135.7	9.5	136.7	9.6	137.7	9.6	138.7	9.7	139.7	9.8	140.7	9.8	86
5	134.5	11.8	135.5	11.9	136.5	11.9	137.5	12.0	138.5	12.1	139.5	12.2	140.5	12.3	85
6	134.3	14.1	135.3	14.2	136.2	14.3	137.2	14.4	138.2	14.5	139.2	14.6	140.2	14.7	84
7	134.0	16.5	135.0	16.6	136.0	16.7	137.0	16.8	138.0	16.9	139.0	17.1	139.9	17.2	83
8	133.7	18.8	134.7	18.9	135.7	19.1	136.7	19.2	137.7	19.3	138.6	19.5	139.6	19.6	82
9	133.3	21.1	134.3	21.3	135.3	21.4	136.3	21.6	137.3	21.7	138.3	21.9	139.3	22.1	81
10	132.9	23.4	133.9	23.6	134.9	23.8	135.9	24.0	136.9	24.1	137.9	24.3	138.9	24.5	80
11	132.5	25.8	133.5	26.0	134.5	26.1	135.5	26.3	136.4	26.5	137.4	26.7	138.4	26.9	79
12	132.0	28.1	133.0	28.3	134.0	28.5	135.0	28.7	136.0	28.9	136.9	29.1	137.9	29.3	78
13	131.5	30.4	132.5	30.6	133.5	30.8	134.5	31.0	135.4	31.3	136.4	31.5	137.4	31.7	77
14	131.0	32.7	132.0	32.9	132.9	33.1	133.9	33.4	134.9	33.6	135.8	33.9	136.8	34.1	76
15	130.4	34.9	131.4	35.2	132.3	35.5	133.3	35.7	134.3	36.0	135.2	36.2	136.2	36.5	75
16	129.8	37.2	130.7	37.5	131.7	37.8	132.7	38.0	133.6	38.3	134.6	38.6	135.5	38.9	74
17	129.1	39.5	130.1	39.8	131.0	40.1	132.0	40.3	132.9	40.6	133.9	40.9	134.8	41.2	73
18	128.4	41.7	129.3	42.0	130.3	42.3	131.2	42.6	132.2	43.0	133.1	43.3	134.1	43.6	72
19	127.6	44.0	128.6	44.3	129.5	44.6	130.5	44.9	131.4	45.3	132.4	45.6	133.3	45.9	71
20	126.9	46.2	127.8	46.5	128.7	46.9	129.7	47.2	130.6	47.5	131.6	47.9	132.5	48.2	70
21	126.0	48.4	127.0	48.7	127.9	49.1	128.8	49.5	129.8	49.8	130.7	50.2	131.6	50.5	69
22	125.2	50.6	126.1	50.9	127.0	51.3	128.0	51.7	128.9	52.1	129.8	52.4	130.7	52.8	68
23	124.3	52.7	125.2	53.1	126.1	53.5	127.0	53.9	128.0	54.3	128.9	54.7	129.8	55.1	67
24	123.3	54.9	124.2	55.3	125.2	55.7	126.1	56.1	127.0	56.5	127.9	56.9	128.8	57.3	66
25	122.4	57.1	123.3	57.5	124.2	57.9	125.1	58.3	126.0	58.7	126.9	59.2	127.8	59.6	65
26	121.3	59.2	122.2	59.6	123.1	60.1	124.0	60.5	124.9	60.9	125.8	61.4	126.7	61.8	64
27	120.3	61.3	121.2	61.7	122.1	62.2	123.0	62.7	123.8	63.1	124.7	63.6	125.6	64.0	63
28	119.2	63.4	120.1	63.8	121.0	64.3	121.8	64.8	122.7	65.3	123.6	65.7	124.5	66.2	62
29	118.1	65.4	118.9	65.9	119.8	66.4	120.7	66.9	121.6	67.4	122.4	67.9	123.3	68.4	61
30	116.9	67.5	117.8	68.0	118.6	68.5	119.5	69.0	120.4	69.5	121.2	70.0	122.1	70.5	60
31	115.7	69.5	116.6	70.0	117.4	70.6	118.3	71.1	119.1	71.6	120.0	72.1	120.9	72.6	59
32	114.5	71.5	115.3	72.1	116.2	72.6	117.0	73.1	117.9	73.7	118.7	74.2	119.6	74.7	58
33	113.2	73.5	114.1	74.1	114.9	74.6	115.7	75.2	116.6	75.7	117.4	76.2	118.3	76.8	57
34	111.9	75.5	112.7	76.1	113.6	76.6	114.4	77.2	115.2	77.7	116.1	78.3	116.9	78.8	56
35	110.6	77.4	111.4	78.0	112.2	78.6	113.0	79.2	113.9	79.7	114.7	80.3	115.5	80.9	55
36	109.2	79.4	110.0	79.9	110.8	80.5	111.6	81.1	112.5	81.7	113.3	82.3	114.1	82.9	54
37	107.8	81.2	108.6	81.8	109.4	82.4	110.2	83.1	111.0	83.7	111.8	84.3	112.6	84.9	53
38	106.4	83.1	107.2	83.7	108.0	84.3	108.7	85.0	109.5	85.6	110.3	86.2	111.1	86.8	52
39	104.9	85.0	105.7	85.6	106.5	86.2	107.2	86.8	108.0	87.5	108.8	88.1	109.6	88.7	51
40	103.4	86.8	104.2	87.4	104.9	88.1	105.7	88.7	106.5	89.3	107.2	90.0	108.0	90.6	50
41	101.9	88.6	102.6	89.2	103.4	89.9	104.1	90.5	104.9	91.2	105.7	91.8	106.4	92.5	49
42	100.3	90.3	101.1	91.0	101.8	91.7	102.6	92.3	103.3	93.0	104.0	93.7	104.8	94.3	48
43	98.7	92.1	99.5	92.8	100.2	93.4	100.9	94.1	101.7	94.8	102.4	95.5	103.1	96.2	47
44	97.1	93.8	97.8	94.5	98.5	95.2	99.3	95.9	100.0	96.6	100.7	97.3	101.4	97.9	46
45	95.5	95.5	96.2	96.2	96.9	96.9	97.6	97.6	98.3	98.3	99.0	99.0	99.7	99.7	45
Course.	D=135'		D=136'		D=137'		D=138'		D=139'		D=140'		D=141'		Course.
	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	

Plane Traverse Table

Course.	D=142'		D=143'		D=144'		D=145'		D=146'		D=147'		D=148'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	142.0	0.0	143.0	0.0	144.0	0.0	145.0	0.0	146.0	0.0	147.0	0.0	148.0	0.0	90
1	142.0	2.5	143.0	2.5	144.0	2.5	145.0	2.5	146.0	2.5	147.0	2.6	148.0	2.6	89
2	141.9	5.0	142.9	5.0	143.9	5.0	144.9	5.1	145.9	5.1	146.9	5.1	147.9	5.2	88
3	141.8	7.4	142.8	7.5	143.8	7.5	144.8	7.6	145.8	7.6	146.8	7.7	147.8	7.7	87
4	141.7	9.9	142.7	10.0	143.6	10.0	144.6	10.1	145.6	10.2	146.6	10.3	147.6	10.3	86
5	141.5	12.4	142.5	12.5	143.5	12.6	144.4	12.6	145.4	12.7	146.4	12.8	147.4	12.9	85
6	141.2	14.8	142.2	14.9	143.2	15.1	144.2	15.2	145.2	15.3	146.2	15.4	147.2	15.5	84
7	140.9	17.3	141.9	17.4	142.9	17.5	143.9	17.7	144.9	17.8	145.9	17.9	146.9	18.0	83
8	140.6	19.8	141.6	19.9	142.6	20.0	143.6	20.2	144.6	20.3	145.6	20.5	146.6	20.6	82
9	140.3	22.2	141.2	22.4	142.2	22.5	143.2	22.7	144.2	22.8	145.2	23.0	146.2	23.2	81
10	139.8	24.7	140.8	24.8	141.8	25.0	142.8	25.2	143.8	25.4	144.8	25.5	145.8	25.7	80
11	139.4	27.1	140.4	27.3	141.4	27.5	142.3	27.7	143.3	27.9	144.3	28.0	145.3	28.2	79
12	138.9	29.5	139.9	29.7	140.9	29.9	141.8	30.1	142.8	30.4	143.8	30.6	144.8	30.8	78
13	138.4	31.9	139.3	32.2	140.3	32.4	141.3	32.6	142.3	32.8	143.2	33.1	144.2	33.3	77
14	137.8	34.4	138.8	34.6	139.7	34.8	140.7	35.1	141.7	35.3	142.6	35.6	143.6	35.8	76
15	137.2	36.8	138.1	37.0	139.1	37.3	140.1	37.5	141.0	37.8	142.0	38.0	143.0	38.3	75
16	136.5	39.1	137.5	39.4	138.4	39.7	139.4	40.0	140.3	40.2	141.3	40.5	142.3	40.8	74
17	135.8	41.5	136.8	41.8	137.7	42.1	138.7	42.4	139.6	42.7	140.6	43.0	141.5	43.3	73
18	135.1	43.9	136.0	44.2	137.0	44.5	137.9	44.8	138.9	45.1	139.8	45.4	140.8	45.7	72
19	134.3	46.2	135.2	46.6	136.2	46.9	137.1	47.2	138.0	47.5	139.0	47.9	139.9	48.2	71
20	133.4	48.6	134.4	48.9	135.3	49.3	136.3	49.6	137.2	49.9	138.1	50.3	139.1	50.6	70
21	132.6	50.9	133.5	51.2	134.4	51.6	135.4	52.0	136.3	52.3	137.2	52.7	138.2	53.0	69
22	131.7	53.2	132.6	53.6	133.5	53.9	134.4	54.3	135.4	54.7	136.3	55.1	137.2	55.4	68
23	130.7	55.5	131.6	55.9	132.6	56.3	133.5	56.7	134.4	57.0	135.3	57.4	136.2	57.8	67
24	129.7	57.8	130.6	58.2	131.6	58.6	132.5	59.0	133.4	59.4	134.3	59.8	135.2	60.2	66
25	128.7	60.0	129.6	60.4	130.5	60.9	131.4	61.3	132.3	61.7	133.2	62.1	134.1	62.5	65
26	127.6	62.2	128.5	62.7	129.4	63.1	130.3	63.6	131.2	64.0	132.1	64.4	133.0	64.9	64
27	126.5	64.5	127.4	64.9	128.3	65.4	129.2	65.8	130.1	66.3	131.0	66.7	131.9	67.2	63
28	125.4	66.7	126.3	67.1	127.1	67.6	128.0	68.1	128.9	68.5	129.8	69.0	130.7	69.5	62
29	124.2	68.8	125.1	69.3	125.9	69.8	126.8	70.3	127.7	70.8	128.6	71.3	129.4	71.8	61
30	123.0	71.0	123.8	71.5	124.7	72.0	125.6	72.5	126.4	73.0	127.3	73.5	128.2	74.0	60
31	121.7	73.1	122.6	73.7	123.4	74.2	124.3	74.7	125.1	75.2	126.0	75.7	126.9	76.2	59
32	120.4	75.2	121.3	75.8	122.1	76.3	123.0	76.8	123.8	77.4	124.7	77.9	125.5	78.4	58
33	119.1	77.3	119.9	77.9	120.8	78.4	121.6	79.0	122.4	79.5	123.3	80.1	124.1	80.6	57
34	117.7	79.4	118.6	80.0	119.4	80.5	120.2	81.1	121.0	81.6	121.9	82.2	122.7	82.8	56
35	116.3	81.4	117.1	82.0	118.0	82.6	118.8	83.2	119.6	83.7	120.4	84.3	121.2	84.9	55
36	114.9	83.5	115.7	84.1	116.5	84.6	117.3	85.2	118.1	85.8	118.9	86.4	119.7	87.0	54
37	113.4	85.5	114.2	86.1	115.0	86.7	115.8	87.3	116.6	87.9	117.4	88.5	118.2	89.1	53
38	111.9	87.4	112.7	88.0	113.5	88.7	114.3	89.3	115.0	89.9	115.8	90.5	116.6	91.1	52
39	110.4	89.4	111.1	90.0	111.9	90.6	112.7	91.3	113.5	91.9	114.2	92.5	115.0	93.1	51
40	108.8	91.3	109.5	91.9	110.3	92.6	111.1	93.2	111.8	93.8	112.6	94.5	113.4	95.1	50
41	107.2	93.2	107.9	93.8	108.7	94.5	109.4	95.1	110.2	95.8	110.9	96.4	111.7	97.1	49
42	105.5	95.0	106.3	95.7	107.0	96.4	107.8	97.0	108.5	97.7	109.2	98.4	110.0	99.0	48
43	103.9	96.8	104.6	97.5	105.3	98.2	106.0	98.9	106.8	99.6	107.5	100.3	108.2	100.9	47
44	102.1	98.6	102.9	99.3	103.6	100.0	104.3	100.7	105.0	101.4	105.7	102.1	106.5	102.8	46
45	100.4	100.4	101.1	101.1	101.8	101.8	102.5	102.5	103.2	103.2	103.9	103.9	104.7	104.7	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=142'		D=143'		D=144'		D=145'		D=146'		D=147'		D=148'		

Plane Traverse Table

Course.	D = 149'		D = 150'		D = 151'		D = 152'		D = 153'		D = 154'		D = 155'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	149.0	0.0	150.0	0.0	151.0	0.0	152.0	0.0	153.0	0.0	154.0	0.0	155.0	0.0	90
1	149.0	2.6	150.0	2.6	151.0	2.6	152.0	2.7	153.0	2.7	154.0	2.7	155.0	2.7	89
2	148.9	5.2	149.9	5.2	150.9	5.3	151.9	5.3	152.9	5.3	153.9	5.4	154.9	5.4	88
3	148.8	7.8	149.8	7.9	150.8	7.9	151.8	8.0	152.8	8.0	153.8	8.1	154.8	8.1	87
4	148.6	10.4	149.6	10.5	150.6	10.5	151.6	10.6	152.6	10.7	153.6	10.7	154.6	10.8	86
5	148.4	13.0	149.4	13.1	150.4	13.2	151.4	13.2	152.4	13.3	153.4	13.4	154.4	13.5	85
6	148.2	15.6	149.2	15.7	150.2	15.8	151.2	15.9	152.2	16.0	153.2	16.1	154.2	16.2	84
7	147.9	18.2	148.9	18.3	149.9	18.4	150.9	18.5	151.9	18.6	152.9	18.8	153.8	18.9	83
8	147.5	20.7	148.5	20.9	149.5	21.0	150.5	21.2	151.5	21.3	152.5	21.4	153.5	21.6	82
9	147.2	23.3	148.2	23.5	149.1	23.6	150.1	23.8	151.1	23.9	152.1	24.1	153.1	24.2	81
10	146.7	25.9	147.7	26.0	148.7	26.2	149.7	26.4	150.7	26.6	151.7	26.7	152.6	26.9	80
11	146.3	28.4	147.2	28.6	148.2	28.8	149.2	29.0	150.2	29.2	151.2	29.4	152.2	29.6	79
12	145.7	31.0	146.7	31.2	147.7	31.4	148.7	31.6	149.7	31.8	150.6	32.0	151.6	32.2	78
13	145.2	33.5	146.2	33.7	147.1	34.0	148.1	34.2	149.1	34.4	150.1	34.6	151.0	34.9	77
14	144.6	36.0	145.5	36.3	146.5	36.5	147.5	36.8	148.5	37.0	149.4	37.3	150.4	37.5	76
15	143.9	38.6	144.9	38.8	145.9	39.1	146.8	39.3	147.8	39.6	148.8	39.9	149.7	40.1	75
16	143.2	41.1	144.2	41.3	145.2	41.6	146.1	41.9	147.1	42.2	148.0	42.4	149.0	42.7	74
17	142.5	43.6	143.4	43.9	144.4	44.1	145.4	44.4	146.3	44.7	147.3	45.0	148.2	45.3	73
18	141.7	46.0	142.7	46.4	143.6	46.7	144.6	47.0	145.5	47.3	146.5	47.6	147.4	47.9	72
19	140.9	48.5	141.8	48.8	142.8	49.2	143.7	49.5	144.7	49.8	145.6	50.1	146.6	50.5	71
20	140.0	51.0	141.0	51.3	141.9	51.6	142.8	52.0	143.8	52.3	144.7	52.7	145.7	53.0	70
21	139.1	53.4	140.0	53.8	141.0	54.1	141.9	54.5	142.8	54.8	143.8	55.2	144.7	55.5	69
22	138.2	55.8	139.1	56.2	140.0	56.6	140.9	56.9	141.9	57.3	142.8	57.7	143.7	58.1	68
23	137.2	58.2	138.1	58.6	139.0	59.0	139.9	59.4	140.8	59.8	141.8	60.2	142.7	60.6	67
24	136.1	60.6	137.0	61.0	137.9	61.4	138.9	61.8	139.8	62.2	140.7	62.6	141.6	63.0	66
25	135.0	63.0	135.9	63.4	136.9	63.8	137.8	64.2	138.7	64.7	139.6	65.1	140.5	65.5	65
26	133.9	65.3	134.8	65.8	135.7	66.2	136.6	66.6	137.5	67.1	138.4	67.5	139.3	67.9	64
27	132.8	67.6	133.7	68.1	134.5	68.6	135.4	69.0	136.3	69.5	137.2	69.9	138.1	70.4	63
28	131.6	70.0	132.4	70.4	133.3	70.9	134.2	71.4	135.1	71.8	136.0	72.3	136.9	72.8	62
29	130.3	72.2	131.2	72.7	132.1	73.2	132.9	73.7	133.8	74.2	134.7	74.7	135.6	75.1	61
30	129.0	74.5	129.9	75.0	130.8	75.5	131.6	76.0	132.5	76.5	133.4	77.0	134.2	77.5	60
31	127.7	76.7	128.6	77.3	129.4	77.8	130.3	78.3	131.1	78.8	132.0	79.3	132.9	79.8	59
32	126.4	79.0	127.2	79.5	128.1	80.0	128.9	80.5	129.8	81.1	130.6	81.6	131.4	82.1	58
33	125.0	81.2	125.8	81.7	126.6	82.2	127.5	82.8	128.3	83.3	129.2	83.9	130.0	84.4	57
34	123.5	83.3	124.4	83.9	125.2	84.4	126.0	85.0	126.8	85.6	127.7	86.1	128.5	86.7	56
35	122.1	85.5	122.9	86.0	123.7	86.6	124.5	87.2	125.3	87.8	126.1	88.3	127.0	88.9	55
36	120.5	87.6	121.4	88.2	122.2	88.8	123.0	89.3	123.8	89.9	124.6	90.5	125.4	91.1	54
37	119.0	89.7	119.8	90.3	120.6	90.9	121.4	91.5	122.2	92.1	123.0	92.7	123.8	93.3	53
38	117.4	91.7	118.2	92.3	119.0	93.0	119.8	93.6	120.6	94.2	121.4	94.8	122.2	95.4	52
39	115.8	93.8	116.6	94.4	117.3	95.0	118.1	95.7	118.9	96.3	119.7	96.9	120.5	97.5	51
40	114.1	95.8	114.9	96.4	115.7	97.1	116.4	97.7	117.2	98.3	118.0	99.0	118.7	99.6	50
41	112.5	97.7	113.2	98.4	114.0	99.1	114.7	99.7	115.5	100.4	116.2	101.0	117.0	101.7	49
42	110.7	99.7	111.5	100.4	112.2	101.0	113.0	101.7	113.7	102.4	114.4	103.0	115.2	103.7	48
43	109.0	101.6	109.7	102.3	110.4	103.0	111.2	103.7	111.9	104.3	112.6	105.0	113.4	105.7	47
44	107.2	103.5	107.9	104.2	108.6	104.9	109.3	105.6	110.1	106.3	110.8	107.0	111.5	107.7	46
45	105.4	105.4	106.1	106.1	106.8	106.8	107.5	107.5	108.2	108.2	108.9	108.9	109.6	109.6	45

Plane Traverse Table

Course.	D = 156'		D = 157'		D = 158'		D = 159'		D = 160'		D = 161'		D = 162'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	156.0	0.0	157.0	0.0	158.0	0.0	159.0	0.0	160.0	0.0	161.0	0.0	162.0	0.0	90
1	156.0	2.7	157.0	2.7	158.0	2.8	159.0	2.8	160.0	2.8	161.0	2.8	162.0	2.8	89
2	155.9	5.4	156.9	5.5	157.9	5.5	158.9	5.5	159.9	5.6	160.9	5.6	161.9	5.7	88
3	155.8	8.2	156.8	8.2	157.8	8.3	158.8	8.3	159.8	8.4	160.8	8.4	161.8	8.5	87
4	155.6	10.9	156.6	11.0	157.6	11.0	158.6	11.1	159.6	11.2	160.6	11.2	161.6	11.3	86
5	155.4	13.6	156.4	13.7	157.4	13.8	158.4	13.9	159.4	13.9	160.4	14.0	161.4	14.1	85
6	155.1	16.3	156.1	16.4	157.1	16.5	158.1	16.6	159.1	16.7	160.1	16.8	161.1	16.9	84
7	154.8	19.0	155.8	19.1	156.8	19.3	157.8	19.4	158.8	19.5	159.8	19.6	160.8	19.7	83
8	154.5	21.7	155.5	21.9	156.5	22.0	157.5	22.1	158.4	22.3	159.4	22.4	160.4	22.5	82
9	154.1	24.4	155.1	24.6	156.1	24.7	157.0	24.9	158.0	25.0	159.0	25.2	160.0	25.3	81
10	153.6	27.1	154.6	27.3	155.6	27.4	156.6	27.6	157.6	27.8	158.6	28.0	159.5	28.1	80
11	153.1	29.8	154.1	30.0	155.1	30.1	156.1	30.3	157.1	30.5	158.0	30.7	159.0	30.9	79
12	152.6	32.4	153.6	32.6	154.5	32.9	155.5	33.1	156.5	33.3	157.5	33.5	158.5	33.7	78
13	152.0	35.1	153.0	35.3	154.0	35.5	154.9	35.8	155.9	36.0	156.9	36.2	157.8	36.4	77
14	151.4	37.7	152.3	38.0	153.3	38.2	154.3	38.5	155.2	38.7	156.2	38.9	157.2	39.2	76
15	150.7	40.4	151.7	40.6	152.6	40.9	153.6	41.2	154.5	41.4	155.5	41.7	156.5	41.9	75
16	150.0	43.0	150.9	43.3	151.9	43.6	152.8	43.8	153.8	44.1	154.8	44.4	155.7	44.7	74
17	149.2	45.6	150.1	45.9	151.1	46.2	152.1	46.5	153.0	46.8	154.0	47.1	154.9	47.4	73
18	148.4	48.2	149.3	48.5	150.3	48.8	151.2	49.1	152.2	49.4	153.1	49.8	154.1	50.1	72
19	147.5	50.8	148.4	51.1	149.4	51.4	150.3	51.8	151.3	52.1	152.2	52.4	153.2	52.7	71
20	146.6	53.4	147.5	53.7	148.5	54.0	149.4	54.4	150.4	54.7	151.3	55.1	152.2	55.4	70
21	145.6	55.9	146.6	56.3	147.5	56.6	148.4	57.0	149.4	57.3	150.3	57.7	151.2	58.1	69
22	144.6	58.4	145.6	58.8	146.5	59.2	147.4	59.6	148.3	59.9	149.3	60.3	150.2	60.7	68
23	143.6	61.0	144.5	61.3	145.4	61.7	146.4	62.1	147.3	62.5	148.2	62.9	149.1	63.3	67
24	142.5	63.5	143.4	63.9	144.3	64.3	145.3	64.7	146.2	65.1	147.1	65.5	148.0	65.9	66
25	141.4	65.9	142.3	66.4	143.2	66.8	144.1	67.2	145.0	67.6	145.9	68.0	146.8	68.5	65
26	140.2	68.4	141.1	68.8	142.0	69.3	142.9	69.7	143.8	70.1	144.7	70.6	145.6	71.0	64
27	139.0	70.8	139.9	71.3	140.8	71.7	141.7	72.2	142.6	72.6	143.5	73.1	144.3	73.5	63
28	137.7	73.2	138.6	73.7	139.5	74.2	140.4	74.6	141.3	75.1	142.2	75.6	143.0	76.1	62
29	136.4	75.6	137.3	76.1	138.2	76.6	139.1	77.1	139.9	77.6	140.8	78.1	141.7	78.5	61
30	135.1	78.0	136.0	78.5	136.8	79.0	137.7	79.5	138.6	80.0	139.4	80.5	140.3	81.0	60
31	133.7	80.3	134.6	80.9	135.4	81.4	136.3	81.9	137.1	82.4	138.0	82.9	138.9	83.4	59
32	132.3	82.7	133.1	83.2	134.0	83.7	134.8	84.3	135.7	84.8	136.5	85.3	137.4	85.8	58
33	130.8	85.0	131.7	85.5	132.5	86.1	133.3	86.6	134.2	87.1	135.0	87.7	135.9	88.2	57
34	129.3	87.2	130.2	87.8	131.0	88.4	131.8	88.9	132.6	89.5	133.5	90.0	134.3	90.6	56
35	127.8	89.5	128.6	90.1	129.4	90.6	130.2	91.2	131.1	91.8	131.9	92.3	132.7	92.9	55
36	126.2	91.7	127.0	92.3	127.8	92.9	128.6	93.5	129.4	94.0	130.3	94.6	131.1	95.2	54
37	124.6	93.9	125.4	94.5	126.2	95.1	127.0	95.7	127.8	96.3	128.6	96.9	129.4	97.5	53
38	122.9	96.0	123.7	96.7	124.5	97.3	125.3	97.9	126.1	98.5	126.9	99.1	127.7	99.7	52
39	121.2	98.2	122.0	98.8	122.8	99.4	123.6	100.1	124.3	100.7	125.1	101.3	125.9	101.9	51
40	119.5	100.3	120.3	100.9	121.0	101.6	121.8	102.2	122.6	102.8	123.3	103.5	124.1	104.1	50
41	117.7	102.3	118.5	103.0	119.2	103.7	120.0	104.3	120.8	105.0	121.5	105.6	122.3	106.3	49
42	115.9	104.4	116.7	105.1	117.4	105.7	118.2	106.4	118.9	107.1	119.6	107.7	120.4	108.4	48
43	114.1	106.4	114.8	107.1	115.6	107.8	116.3	108.4	117.0	109.1	117.7	109.8	120.5	110.5	47
44	112.2	108.4	113.0	109.1	113.7	109.8	114.4	110.5	115.1	111.1	115.8	111.8	116.5	112.5	46
45	110.3	110.3	111.0	111.0	111.7	111.7	112.4	112.4	113.1	113.1	113.8	113.8	114.6	114.6	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 156'		D = 157'		D = 158'		D = 159'		D = 160'		D = 161'		D = 162'		

Plane Traverse Table

Course.	D=163'		D=164'		D=165'		D=166'		D=167'		D=168'		D=169'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	163.0	0.0	164.0	0.0	165.0	0.0	166.0	0.0	167.0	0.0	168.0	0.0	169.0	0.0	90
1	163.0	2.8	164.0	2.9	165.0	2.9	166.0	2.9	167.0	2.9	168.0	2.9	169.0	2.9	89
2	162.9	5.7	163.9	5.7	164.9	5.8	165.9	5.8	166.9	5.8	167.9	5.9	168.9	5.9	88
3	162.8	8.5	163.8	8.6	164.8	8.6	165.8	8.7	166.8	8.7	167.8	8.8	168.8	8.8	87
4	162.6	11.4	163.6	11.4	164.6	11.5	165.6	11.6	166.6	11.6	167.6	11.7	168.6	11.8	86
5	162.4	14.2	163.4	14.3	164.4	14.4	165.4	14.5	166.4	14.6	167.4	14.6	168.4	14.7	85
6	162.1	17.0	163.1	17.1	164.1	17.2	165.1	17.4	166.1	17.5	167.1	17.6	168.1	17.7	84
7	161.8	19.9	162.8	20.0	163.8	20.1	164.8	20.2	165.8	20.4	166.7	20.5	167.7	20.6	83
8	161.4	22.7	162.4	22.8	163.4	23.0	164.4	23.1	165.4	23.1	166.4	23.4	167.4	23.5	82
9	161.0	25.5	162.0	25.7	163.0	25.8	164.0	26.0	164.9	26.2	165.9	26.3	166.9	26.4	81
10	160.5	28.3	161.5	28.5	162.5	28.7	163.5	28.8	164.5	29.0	165.4	29.2	166.4	29.3	80
11	160.0	31.1	161.0	31.3	162.0	31.5	163.0	31.7	163.9	31.9	164.9	32.1	165.9	32.2	79
12	159.4	33.9	160.4	34.1	161.4	34.3	162.4	34.5	163.4	34.7	164.3	34.9	165.3	35.1	78
13	158.8	36.7	159.8	36.9	160.8	37.1	161.7	37.3	162.7	37.6	163.7	37.8	164.7	38.0	77
14	158.2	39.4	159.1	39.7	160.1	39.9	161.1	40.2	162.0	40.4	163.0	40.6	164.0	40.9	76
15	157.4	42.2	158.4	42.4	159.4	42.7	160.3	43.0	161.3	43.2	162.3	43.5	163.2	43.7	75
16	156.7	44.9	157.6	45.2	158.6	45.5	159.6	45.8	160.5	46.0	161.5	46.3	162.5	46.6	74
17	155.9	47.7	156.8	47.9	157.8	48.2	158.7	48.5	159.7	48.8	160.7	49.1	161.6	49.4	73
18	155.0	50.4	156.0	50.7	156.9	51.0	157.9	51.3	158.8	51.6	159.8	51.9	160.7	52.2	72
19	154.1	53.1	155.1	53.4	156.0	53.7	157.0	54.0	157.9	54.4	158.8	54.7	159.8	55.0	71
20	153.2	55.7	154.1	56.1	155.0	56.4	156.0	56.8	156.9	57.1	157.9	57.5	158.8	57.8	70
21	152.2	58.4	153.1	58.8	154.0	59.1	155.0	59.5	155.9	59.8	156.8	60.2	157.8	60.6	69
22	151.1	61.1	152.1	61.4	153.0	61.8	153.9	62.2	154.8	62.6	155.8	62.9	156.7	63.3	68
23	150.0	63.7	151.0	64.1	151.9	64.5	152.8	64.9	153.7	65.3	154.6	65.6	155.6	66.0	67
24	148.9	66.3	149.8	66.7	150.7	67.1	151.6	67.5	152.6	67.9	153.5	68.3	154.4	68.7	66
25	147.7	68.9	148.6	69.3	149.5	69.7	150.4	70.2	151.4	70.6	152.3	71.0	153.2	71.4	65
26	146.5	71.5	147.4	71.9	148.3	72.3	149.2	72.8	150.1	73.2	151.0	73.6	151.9	74.1	64
27	145.2	74.0	146.1	74.5	147.0	74.9	147.9	75.4	148.8	75.8	149.7	76.3	150.6	76.7	63
28	143.9	76.5	144.8	77.0	145.7	77.5	146.6	77.9	147.5	78.4	148.3	78.9	149.2	79.3	62
29	142.6	79.0	143.4	79.5	144.3	80.0	145.2	80.5	146.1	81.0	146.9	81.4	147.8	81.9	61
30	141.2	81.5	142.0	82.0	142.9	82.5	143.8	83.0	144.6	83.5	145.5	84.0	146.4	84.5	60
31	139.7	84.0	140.6	84.5	141.4	85.0	142.3	85.5	143.1	86.0	144.0	86.5	144.9	87.0	59
32	138.2	86.4	139.1	86.9	139.9	87.4	140.8	88.0	141.6	88.5	142.5	89.0	143.3	89.6	58
33	136.7	88.8	137.5	89.3	138.4	89.9	139.2	90.4	140.1	91.0	140.9	91.5	141.7	92.0	57
34	135.1	91.1	136.0	91.7	136.8	92.3	137.6	92.8	138.4	93.4	139.3	93.9	140.1	94.5	56
35	133.5	93.5	134.3	94.1	135.2	94.6	136.0	95.2	136.8	95.8	137.6	96.4	138.4	96.9	55
36	131.9	95.8	132.7	96.4	133.5	97.0	134.3	97.6	135.1	98.2	135.9	98.7	136.7	99.3	54
37	130.2	98.1	131.0	98.7	131.8	99.3	132.6	99.9	133.4	100.5	134.2	101.1	135.0	101.7	53
38	128.4	100.4	129.2	101.0	130.0	101.6	130.8	102.2	131.6	102.8	132.4	103.4	133.2	104.0	52
39	126.7	102.6	127.5	103.2	128.2	103.8	129.0	104.5	129.8	105.1	130.6	105.7	131.3	106.4	51
40	124.9	104.8	125.6	105.4	126.4	106.1	127.2	106.7	127.9	107.3	128.7	108.0	129.5	108.6	50
41	123.0	106.9	123.8	107.6	124.5	108.2	125.3	108.9	126.0	109.6	126.8	110.2	127.5	110.9	49
42	121.1	109.1	121.9	109.7	122.6	110.4	123.4	111.1	124.1	111.7	124.8	112.4	125.6	113.1	48
43	119.2	111.2	119.9	111.8	120.7	112.5	121.4	113.2	122.1	113.9	122.9	114.6	123.6	115.3	47
44	117.3	113.2	118.0	113.9	118.7	114.6	119.4	115.3	120.1	116.0	120.8	116.7	121.6	117.4	46
45	115.3	115.3	116.0	116.0	116.7	116.7	117.4	117.4	118.1	118.1	118.8	118.8	119.5	119.5	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
		D=163'		D=164'		D=165'		D=166'		D=167'		D=168'		D=169'	

Plane Traverse Table

Course.	D=170'		D=171'		D=172'		D=173'		D=174'		D=175'		D=176'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	170.0	0.0	171.0	0.0	172.0	0.0	173.0	0.0	174.0	0.0	175.0	0.0	176.0	0.0	0
1	170.0	3.0	171.0	3.0	172.0	3.0	173.0	3.0	174.0	3.0	175.0	3.1	176.0	3.1	89
2	169.9	5.9	170.9	6.0	171.9	6.0	172.9	6.0	173.9	6.1	174.9	6.1	175.9	6.1	88
3	169.8	8.9	170.8	8.9	171.8	9.0	172.8	9.1	173.8	9.1	174.8	9.2	175.8	9.2	87
4	169.6	11.9	170.6	11.9	171.6	12.0	172.6	12.1	173.6	12.1	174.6	12.2	175.6	12.3	86
5	169.4	14.8	170.3	14.9	171.3	15.0	172.3	15.1	173.3	15.2	174.3	15.3	175.3	15.3	85
6	169.1	17.8	170.1	17.9	171.1	18.0	172.1	18.1	173.0	18.2	174.0	18.3	175.0	18.4	84
7	168.7	20.7	169.7	20.8	170.7	21.0	171.7	21.1	172.7	21.2	173.7	21.3	174.7	21.4	83
8	168.3	23.7	169.3	23.8	170.3	23.9	171.3	24.1	172.3	24.2	173.3	24.4	174.3	24.5	82
9	167.9	26.6	168.9	26.8	169.9	26.9	170.9	27.1	171.9	27.2	172.8	27.4	173.8	27.5	81
10	167.4	29.5	168.4	29.7	169.4	29.9	170.4	30.0	171.4	30.2	172.3	30.4	173.3	30.6	80
11	166.9	32.4	167.9	32.6	168.8	32.8	169.8	33.0	170.8	33.2	171.8	33.4	172.8	33.6	79
12	166.3	35.3	167.3	35.6	168.2	35.8	169.2	36.0	170.2	36.2	171.2	36.4	172.2	36.6	78
13	165.6	38.2	166.6	38.5	167.6	38.7	168.6	38.9	169.5	39.1	170.5	39.4	171.5	39.6	77
14	165.0	41.1	165.9	41.4	166.9	41.6	167.9	41.9	168.8	42.1	169.8	42.3	170.8	42.6	76
15	164.2	44.0	165.2	44.3	166.1	44.5	167.1	44.8	168.1	45.0	169.0	45.3	170.0	45.6	75
16	163.4	46.9	164.4	47.1	165.3	47.4	166.3	47.7	167.3	48.0	168.2	48.2	169.2	48.5	74
17	162.6	49.7	163.5	50.0	164.5	50.3	165.4	50.6	166.4	50.9	167.4	51.2	168.3	51.5	73
18	161.7	52.5	162.6	52.8	163.6	53.2	164.5	53.5	165.5	53.8	166.4	54.1	167.4	54.4	72
19	160.7	55.3	161.7	55.7	162.6	56.0	163.6	56.3	164.5	56.6	165.5	57.0	166.4	57.3	71
20	159.7	58.1	160.7	58.5	161.6	58.8	162.6	59.2	163.5	59.5	164.4	59.9	165.4	60.2	70
21	158.7	60.9	159.6	61.3	160.6	61.6	161.5	62.0	162.4	62.4	163.4	62.7	164.3	63.1	69
22	157.6	63.7	158.5	64.1	159.5	64.4	160.4	64.8	161.3	65.2	162.3	65.6	163.2	65.9	68
23	156.5	66.4	157.4	66.8	158.3	67.2	159.2	67.6	160.2	68.0	161.1	68.4	162.0	68.8	67
24	155.3	69.1	156.2	69.6	157.1	70.0	158.0	70.4	159.0	70.8	159.9	71.2	160.8	71.6	66
25	154.1	71.8	155.0	72.3	155.9	72.7	156.8	73.1	157.7	73.5	158.6	74.0	159.5	74.4	65
26	152.8	74.5	153.7	75.0	154.6	75.4	155.5	75.8	156.4	76.3	157.3	76.7	158.2	77.2	64
27	151.5	77.2	152.4	77.6	153.3	78.1	154.1	78.5	155.0	79.0	155.9	79.4	156.8	79.9	63
28	150.1	79.8	151.0	80.3	151.9	80.7	152.7	81.2	153.6	81.7	154.5	82.2	155.4	82.6	62
29	148.7	82.4	149.6	82.9	150.4	83.4	151.3	83.9	152.2	84.4	153.1	84.8	153.9	85.3	61
30	147.2	85.0	148.1	85.5	149.0	86.0	149.8	86.5	150.7	87.0	151.6	87.5	152.4	88.0	60
31	145.7	87.6	146.6	88.1	147.4	88.6	148.3	89.1	149.1	89.6	150.0	90.1	150.9	90.6	59
32	144.2	90.1	145.0	90.6	145.9	91.1	146.7	91.7	147.6	92.2	148.4	92.7	149.3	93.3	58
33	142.6	92.6	143.4	93.1	144.3	93.7	145.1	94.2	145.9	94.8	146.8	95.3	147.6	95.9	57
34	140.9	95.1	141.8	95.6	142.6	96.2	143.4	96.7	144.3	97.3	145.1	97.9	145.9	98.4	56
35	139.3	97.5	140.1	98.1	140.9	98.7	141.7	99.2	142.5	99.8	143.4	100.4	144.2	100.9	55
36	137.5	99.9	138.3	100.5	139.2	101.1	140.0	101.7	140.8	102.3	141.6	102.9	142.4	103.5	54
37	135.8	102.3	136.6	102.9	137.4	103.5	138.2	104.1	139.0	104.7	139.8	105.3	140.6	105.9	53
38	134.0	104.7	134.7	105.3	135.5	105.9	136.3	106.5	137.1	107.1	137.9	107.7	138.7	108.4	52
39	132.1	107.0	132.9	107.6	133.7	108.2	134.4	108.9	135.2	109.5	136.0	110.1	136.8	110.8	51
40	130.2	109.3	131.0	109.9	131.8	110.6	132.5	111.2	133.3	111.8	134.1	112.5	134.8	113.1	50
41	128.3	111.5	129.1	112.2	129.8	112.8	130.6	113.5	131.3	114.2	132.1	114.8	132.8	115.5	49
42	126.3	113.8	127.1	114.4	127.8	115.1	128.6	115.8	129.3	116.4	130.1	117.1	130.8	117.8	48
43	124.3	115.9	125.1	116.6	125.8	117.3	126.5	118.0	127.3	118.7	128.0	119.3	128.7	120.0	47
44	122.3	118.1	123.0	118.8	123.7	119.5	124.4	120.2	125.2	120.9	125.9	121.6	126.6	122.3	46
45	120.2	120.2	120.9	120.9	121.6	121.6	122.3	122.3	123.0	123.0	123.7	123.7	124.5	124.5	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=170'		D=171'		D=172'		D=173'		D=174'		D=175'		D=176'		

Plane Traverse Table

Course.	D=177'		D=178'		D=179'		D=180'		D=181'		D=182'		D=183'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	177.0	0.0	178.0	0.0	179.0	0.0	180.0	0.0	181.0	0.0	182.0	0.0	183.0	0.0	90
1	177.0	3.1	178.0	3.1	179.0	3.1	180.0	3.1	181.0	3.2	182.0	3.2	183.0	3.2	89
2	176.9	6.2	177.9	6.2	178.9	6.2	179.9	6.3	180.9	6.3	181.9	6.4	182.9	6.4	88
3	176.8	9.3	177.8	9.3	178.8	9.4	179.8	9.4	180.8	9.5	181.8	9.5	182.7	9.6	87
4	176.6	12.3	177.6	12.4	178.6	12.5	179.6	12.6	180.6	12.6	181.6	12.7	182.6	12.8	86
5	176.3	15.4	177.3	15.5	178.3	15.6	179.3	15.7	180.3	15.8	181.3	15.9	182.3	15.9	85
6	176.0	18.5	177.0	18.6	178.0	18.7	179.0	18.8	180.0	18.9	181.0	19.0	182.0	19.1	84
7	175.7	21.6	176.7	21.7	177.7	21.8	178.7	21.9	179.7	22.1	180.6	22.2	181.6	22.3	83
8	175.3	24.6	176.3	24.8	177.3	24.9	178.2	25.1	179.2	25.2	180.2	25.3	181.2	25.5	82
9	174.8	27.7	175.8	27.8	176.8	28.0	177.8	28.2	178.8	28.3	179.8	28.5	180.7	28.6	81
10	174.3	30.7	175.3	30.9	176.3	31.1	177.3	31.3	178.3	31.4	179.2	31.6	180.2	31.8	80
11	173.7	33.8	174.7	34.0	175.7	34.2	176.7	34.3	177.7	34.5	178.7	34.7	179.6	34.9	79
12	173.1	36.8	174.1	37.0	175.1	37.2	176.1	37.4	177.0	37.6	178.0	37.8	179.0	38.0	78
13	172.5	39.8	173.4	40.0	174.4	40.3	175.4	40.5	176.4	40.7	177.3	40.9	178.3	41.2	77
14	171.7	42.8	172.7	43.1	173.7	43.3	174.7	43.5	175.6	43.8	176.6	44.0	177.6	44.3	76
15	171.0	45.8	171.9	46.1	172.9	46.3	173.9	46.6	174.8	46.8	175.8	47.1	176.8	47.4	75
16	170.1	48.8	171.1	49.1	172.1	49.3	173.0	49.6	174.0	49.9	174.9	50.2	175.9	50.4	74
17	169.3	51.7	170.2	52.0	171.2	52.3	172.1	52.6	173.1	52.9	174.0	53.2	175.0	53.5	73
18	168.3	54.7	169.3	55.0	170.2	55.3	171.2	55.6	172.1	55.9	173.1	56.2	174.0	56.6	72
19	167.4	57.6	168.3	58.0	169.2	58.3	170.2	58.6	171.1	58.9	172.1	59.3	173.0	59.6	71
20	166.3	60.5	167.3	60.9	168.2	61.2	169.1	61.6	170.1	61.9	171.0	62.2	172.0	62.6	70
21	165.2	63.4	166.2	63.8	167.1	64.1	168.0	64.5	169.0	64.9	169.9	65.2	170.8	65.6	69
22	164.1	66.3	165.0	66.7	166.0	67.1	166.9	67.4	167.8	67.8	168.7	68.2	169.7	68.6	68
23	162.9	69.2	163.8	69.6	164.8	69.9	165.7	70.3	166.6	70.7	167.5	71.1	168.5	71.5	67
24	161.7	72.0	162.6	72.4	163.5	72.8	164.4	73.2	165.4	73.6	166.3	74.0	167.2	74.4	66
25	160.4	74.8	161.3	75.2	162.2	75.6	163.1	76.1	164.0	76.5	164.9	76.9	165.9	77.3	65
26	159.1	77.6	160.0	78.0	160.9	78.5	161.8	78.9	162.7	79.3	163.6	79.8	164.5	80.2	64
27	157.7	80.4	158.6	80.8	159.5	81.3	160.4	81.7	161.3	82.2	162.2	82.6	163.1	83.1	63
28	156.3	83.1	157.2	83.6	158.0	84.0	158.9	84.5	159.8	85.0	160.7	85.4	161.6	85.9	62
29	154.8	85.8	155.7	86.3	156.6	86.8	157.4	87.3	158.3	87.8	159.2	88.2	160.1	88.7	61
30	153.3	88.5	154.2	89.0	155.0	89.5	155.9	90.0	156.8	90.5	157.6	91.0	158.5	91.5	60
31	151.7	91.2	152.6	91.7	153.4	92.2	154.3	92.7	155.1	93.2	156.0	93.7	156.9	94.3	59
32	150.1	93.8	151.0	94.3	151.8	94.9	152.6	95.4	153.5	95.9	154.3	96.4	155.2	97.0	58
33	148.4	96.4	149.3	96.9	150.1	97.5	151.0	98.0	151.8	98.6	152.6	99.1	153.5	99.7	57
34	146.7	99.0	147.6	99.5	148.4	100.1	149.2	100.7	150.1	101.2	150.9	101.8	151.7	102.3	56
35	145.0	101.5	145.8	102.1	146.6	102.7	147.4	103.2	148.3	103.8	149.1	104.4	149.9	105.0	55
36	143.2	104.0	144.0	104.6	144.8	105.2	145.6	105.8	146.4	106.4	147.2	107.0	148.1	107.6	54
37	141.4	106.5	142.2	107.1	143.0	107.7	143.8	108.3	144.6	108.9	145.4	109.5	146.2	110.1	53
38	139.5	109.0	140.3	109.6	141.1	110.2	141.8	110.8	142.6	111.4	143.4	112.1	144.2	112.7	52
39	137.6	111.4	138.3	112.0	139.1	112.6	139.9	113.3	140.7	113.9	141.4	114.5	142.2	115.2	51
40	135.6	113.8	136.4	114.4	137.1	115.1	137.9	115.7	138.7	116.3	139.4	117.0	140.2	117.6	50
41	133.6	116.1	134.3	116.8	135.1	117.4	135.8	118.1	136.6	118.7	137.4	119.4	138.1	120.1	49
42	131.5	118.4	132.3	119.1	133.0	119.8	133.8	120.4	134.5	121.1	135.3	121.8	136.0	122.5	48
43	129.4	120.7	130.2	121.4	131.0	122.1	131.6	122.8	132.4	123.4	133.1	124.1	133.8	124.8	47
44	127.3	123.0	128.0	123.6	128.8	124.3	129.5	125.0	130.2	125.7	130.9	126.4	131.6	127.1	46
45	125.2	125.2	125.9	125.9	126.6	126.6	127.3	127.3	128.0	128.0	128.7	128.7	129.4	129.4	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=177'		D=178'		D=179'		D=180'		D=181'		D=182'		D=183'		

Plane Traverse Table

Course.	D = 184'		D = 185'		D = 186'		D = 187'		D = 188'		D = 189'		D = 190'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	184.0	0.0	185.0	0.0	186.0	0.0	187.0	0.0	188.0	0.0	189.0	0.0	190.0	0.0	90
1	184.0	3.2	185.0	3.2	186.0	3.2	187.0	3.3	188.0	3.3	189.0	3.3	190.0	3.3	89
2	183.9	6.4	184.9	6.5	185.9	6.5	186.9	6.5	187.9	6.6	188.9	6.6	189.9	6.6	88
3	183.7	9.6	184.7	9.7	185.7	9.7	186.7	9.8	187.7	9.8	188.7	9.9	189.7	9.9	87
4	183.6	12.8	184.5	12.9	185.5	13.0	186.5	13.0	187.5	13.1	188.5	13.2	189.5	13.3	86
5	183.3	16.0	184.3	16.1	185.3	16.2	186.3	16.3	187.3	16.4	188.3	16.5	189.3	16.6	85
6	183.0	19.2	184.0	19.3	185.0	19.4	186.0	19.5	187.0	19.7	188.0	19.8	189.0	19.9	84
7	182.6	22.4	183.6	22.5	184.6	22.7	185.6	22.8	186.6	22.9	187.6	23.0	188.6	23.2	83
8	182.2	25.6	183.2	25.7	184.2	25.9	185.2	26.0	186.2	26.2	187.2	26.3	188.2	26.4	82
9	181.7	28.8	182.7	28.9	183.7	29.1	184.7	29.3	185.7	29.4	186.7	29.6	187.7	29.7	81
10	181.2	32.0	182.2	32.1	183.2	32.3	184.2	32.5	185.1	32.6	186.1	32.8	187.1	33.0	80
11	180.6	35.1	181.6	35.3	182.6	35.5	183.6	35.7	184.5	35.9	185.5	36.1	186.5	36.3	79
12	180.0	38.3	181.0	38.5	181.9	38.7	182.9	38.9	183.9	39.1	184.9	39.3	185.8	39.5	78
13	179.3	41.4	180.3	41.6	181.2	41.8	182.2	42.1	183.2	42.3	184.2	42.5	185.1	42.7	77
14	178.5	44.5	179.5	44.8	180.5	45.0	181.4	45.2	182.4	45.5	183.4	45.7	184.4	46.0	76
15	177.7	47.6	178.7	47.9	179.7	48.1	180.6	48.4	181.6	48.7	182.6	48.9	183.5	49.2	75
16	176.9	50.7	177.8	51.0	178.8	51.3	179.8	51.5	180.7	51.8	181.7	52.1	182.6	52.4	74
17	176.0	53.8	176.9	54.1	177.9	54.4	178.8	54.7	179.8	55.0	180.7	55.3	181.7	55.6	73
18	175.0	56.9	175.9	57.2	176.9	57.5	177.8	57.8	178.8	58.1	179.7	58.4	180.7	58.7	72
19	174.0	59.9	174.9	60.2	175.9	60.6	176.8	60.9	177.8	61.2	178.7	61.5	179.6	61.9	71
20	172.9	62.9	173.8	63.3	174.8	63.6	175.7	64.0	176.7	64.3	177.6	64.6	178.5	65.0	70
21	171.8	65.9	172.7	66.3	173.6	66.7	174.6	67.0	175.5	67.4	176.4	67.7	177.4	68.1	69
22	170.6	68.9	171.5	69.3	172.5	69.7	173.4	70.1	174.3	70.4	175.2	70.8	176.2	71.2	68
23	169.4	71.9	170.3	72.3	171.2	72.7	172.1	73.1	173.1	73.5	174.0	73.8	174.9	74.2	67
24	168.1	74.8	169.0	75.2	170.9	75.7	170.8	76.1	171.7	76.5	172.7	76.9	173.6	77.3	66
25	166.8	77.8	167.7	78.2	168.6	78.6	169.5	79.0	170.4	79.5	171.3	79.9	172.2	80.3	65
26	165.4	80.7	166.3	81.1	167.2	81.5	168.1	82.0	169.0	82.4	169.9	82.9	170.8	83.3	64
27	163.9	83.5	164.8	84.0	165.7	84.4	166.6	84.9	167.5	85.4	168.4	85.8	169.3	86.3	63
28	162.5	86.4	163.3	86.9	164.2	87.3	165.1	87.8	166.0	88.3	169.7	88.7	167.8	89.2	62
29	160.9	89.2	161.8	89.7	162.7	90.2	163.6	90.7	164.4	91.1	165.3	91.6	166.2	92.1	61
30	159.3	92.0	160.2	92.5	161.1	93.0	161.9	93.5	162.8	94.0	163.7	94.5	164.5	95.0	60
31	157.7	94.8	158.6	95.3	159.4	95.8	160.3	96.3	161.1	96.8	162.0	97.3	162.9	97.9	59
32	156.0	97.5	156.9	98.0	157.7	98.6	158.6	99.1	159.4	99.6	160.3	100.2	161.1	100.7	58
33	154.3	100.2	155.2	100.8	156.0	101.3	156.8	101.8	157.7	102.4	158.5	102.9	159.3	103.5	57
34	152.5	102.9	153.4	103.5	154.2	104.0	155.0	104.6	155.9	105.1	156.7	105.7	157.5	106.2	56
35	150.7	105.5	151.5	106.1	152.4	106.7	153.2	107.3	154.0	107.8	154.8	108.4	155.6	109.0	55
36	148.9	108.2	149.7	108.7	150.5	109.3	151.3	109.9	152.1	110.5	152.9	111.1	153.7	111.7	54
37	146.9	110.7	147.7	111.3	148.5	111.9	149.3	112.5	150.1	113.1	150.9	113.7	151.7	114.3	53
38	145.0	113.3	145.8	113.9	146.6	114.5	147.4	115.1	148.1	115.7	148.9	116.4	149.7	117.0	52
39	143.0	115.8	143.8	116.4	144.5	117.1	145.3	117.7	146.1	118.3	146.9	118.9	147.7	119.6	51
40	141.0	118.3	141.7	118.9	142.5	119.6	143.3	120.2	144.0	120.8	144.8	121.5	145.5	122.1	50
41	138.9	120.7	139.6	121.4	140.4	122.0	141.1	122.7	141.9	123.3	142.6	124.0	143.4	124.7	49
42	136.7	123.1	137.5	123.8	138.2	124.5	139.0	125.1	139.7	125.8	140.5	126.5	141.2	127.1	48
43	134.6	125.5	135.3	126.2	136.0	126.9	136.8	127.5	137.5	128.2	138.2	128.9	139.0	129.6	47
44	132.4	127.8	133.1	128.5	133.8	129.2	134.5	129.9	135.2	130.6	131.3	131.9	132.6	132.0	46
45	130.1	130.1	130.8	130.8	131.5	131.5	132.2	132.2	132.9	132.9	133.6	133.6	134.4	134.4	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D = 184'		D = 185'		D = 186'		D = 187'		D = 188'		D = 189'		D = 190'		

Plane Traverse Table

Course	D = 191'		D = 192'		D = 193'		D = 194'		D = 195'		D = 196'		D = 197'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	191.0	0.0	192.0	0.0	193.0	0.0	194.0	0.0	195.0	0.0	196.0	0.0	197.0	0.0	90
1	191.0	3.3	192.0	3.4	193.0	3.4	194.0	3.4	195.0	3.4	196.0	3.4	197.0	3.4	89
2	190.9	6.7	191.9	6.7	192.9	6.7	193.9	6.7	194.9	6.8	195.9	6.8	196.9	6.9	88
3	190.7	10.0	191.7	10.0	192.7	10.1	193.7	10.2	194.7	10.2	195.7	10.3	196.7	10.3	87
4	190.5	13.3	191.5	13.4	192.5	13.5	193.5	13.5	194.5	13.6	195.5	13.7	196.5	13.7	86
5	190.3	16.6	191.3	16.7	192.3	16.8	193.3	16.9	194.3	17.0	195.3	17.1	196.3	17.2	85
6	190.0	20.0	190.9	20.1	191.9	20.2	192.9	20.3	193.9	20.4	194.9	20.5	195.9	20.6	84
7	189.6	23.3	190.6	23.4	191.6	23.5	192.6	23.6	193.5	23.8	194.5	23.9	195.5	24.0	83
8	189.1	26.6	190.1	26.7	191.1	26.9	192.1	27.0	193.1	27.1	194.1	27.3	195.1	27.4	82
9	188.6	29.9	189.6	30.0	190.6	30.2	191.6	30.3	192.6	30.5	193.6	30.7	194.6	30.8	81
10	188.1	33.2	189.1	33.3	190.1	33.5	191.1	33.7	192.0	33.9	193.0	34.0	194.0	34.2	80
11	187.5	36.4	188.5	36.6	189.5	36.8	190.4	37.0	191.4	37.2	192.4	37.4	193.4	37.6	79
12	186.8	39.7	187.8	39.9	188.8	40.1	189.8	40.3	190.7	40.5	191.7	40.8	192.7	41.0	78
13	186.1	43.0	187.1	43.2	188.1	43.4	189.0	43.6	190.0	43.9	191.0	44.1	192.0	44.3	77
14	185.3	46.2	186.3	46.4	187.3	46.7	188.2	46.9	189.2	47.2	190.2	47.4	191.1	47.7	76
15	184.5	49.4	185.5	49.7	186.4	50.0	187.4	50.2	188.4	50.5	189.3	50.7	190.3	51.0	75
16	183.6	52.6	184.6	52.9	185.5	53.2	186.5	53.5	187.4	53.7	188.4	54.0	189.4	54.3	74
17	182.7	55.8	183.6	56.1	184.6	56.4	185.5	56.7	186.5	57.0	187.4	57.3	188.4	57.6	73
18	181.9	59.0	182.6	59.3	183.6	59.6	184.5	59.9	185.5	60.3	186.4	60.6	187.4	60.9	72
19	180.6	62.2	181.5	62.5	182.5	62.8	183.4	63.2	184.4	63.5	185.3	63.8	186.3	64.1	71
20	179.5	65.3	180.4	65.7	181.4	66.0	182.3	66.4	183.2	66.7	184.2	67.0	185.1	67.4	70
21	178.3	68.4	179.2	68.8	180.2	69.2	181.1	69.5	182.0	69.9	183.0	70.2	183.9	70.6	69
22	177.1	71.5	178.0	71.9	178.9	72.3	179.9	72.7	180.8	73.0	181.7	73.4	182.7	73.8	68
23	175.8	74.6	176.7	75.0	177.7	75.4	178.6	75.8	179.5	76.2	180.4	76.6	181.3	77.0	67
24	174.5	77.7	175.4	78.1	176.3	78.5	177.2	78.9	178.1	79.3	179.1	79.7	180.0	80.1	66
25	173.1	80.7	174.0	81.1	174.9	81.6	175.8	82.0	176.7	82.4	177.6	82.8	178.5	83.3	65
26	171.7	83.7	172.6	84.2	173.5	84.6	174.4	85.0	175.3	85.5	176.2	85.9	177.1	86.4	64
27	170.2	86.7	171.1	87.2	172.0	87.6	172.9	88.1	173.7	88.5	174.6	89.0	175.5	89.4	63
28	168.6	89.7	169.5	90.1	170.4	90.6	171.3	91.1	172.2	91.5	173.1	92.0	173.9	92.5	62
29	167.1	92.6	167.9	93.1	168.8	93.6	169.7	94.1	170.6	94.5	171.4	95.0	172.3	95.5	61
30	165.4	95.5	166.3	96.0	167.1	96.5	168.0	97.0	168.9	97.5	169.7	98.0	170.6	98.5	60
31	163.7	98.4	164.6	98.9	165.4	99.4	166.3	99.9	167.1	100.4	168.0	100.9	168.9	101.5	59
32	162.0	101.2	162.8	101.7	163.7	102.3	164.5	102.8	165.4	103.3	166.2	103.9	167.1	104.4	58
33	160.2	104.0	161.0	104.6	161.9	105.1	162.7	105.7	163.5	106.2	164.4	106.7	165.2	107.3	57
34	158.3	106.8	159.2	107.4	160.0	107.9	160.8	108.5	161.7	109.0	162.5	109.6	163.3	110.2	56
35	156.5	109.6	157.3	110.1	158.1	110.7	158.9	111.3	159.7	111.8	160.6	112.4	161.4	113.0	55
36	154.4	112.3	155.3	112.9	156.1	113.4	156.9	114.0	157.8	114.6	158.6	115.2	159.4	115.8	54
37	152.5	114.9	153.3	115.5	154.1	116.2	154.9	116.8	155.7	117.4	156.5	118.0	157.3	118.6	53
38	150.5	117.6	151.3	118.2	152.1	118.8	152.9	119.4	153.7	120.1	154.5	120.7	155.2	121.3	52
39	148.4	120.2	149.2	120.8	150.0	121.5	150.8	122.1	151.5	122.7	152.3	123.3	153.1	124.0	51
40	146.3	122.8	147.1	123.4	147.8	124.1	148.6	124.7	149.4	125.3	150.1	126.0	150.9	126.6	50
41	144.1	125.3	144.9	126.0	145.7	126.6	146.4	127.3	147.2	127.9	147.9	128.6	148.7	129.2	49
42	141.9	127.8	142.7	128.5	143.4	129.1	144.2	129.8	144.9	130.5	145.7	131.1	146.4	131.8	48
43	139.7	130.3	140.4	130.9	141.2	131.6	141.9	132.3	142.6	133.0	143.3	133.7	144.1	134.4	47
44	137.4	132.7	138.1	133.4	138.8	134.1	139.6	134.8	140.3	135.5	141.0	136.2	141.7	136.8	46
45	135.1	135.1	135.8	135.8	136.5	136.5	137.2	137.2	137.9	137.9	138.6	138.6	139.3	139.3	45

Plane Traverse Table

Course.	D = 198'		D = 199'		D = 200'		D = 201'		D = 202'		D = 203'		D = 204'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	198.0	0.0	199.0	0.0	200.0	0.0	201.0	0.0	202.0	0.0	203.0	0.0	204.0	0.0	90
1	198.0	3.5	199.0	3.5	200.0	3.5	201.0	3.5	202.0	3.5	203.0	3.5	204.0	3.6	89
2	197.9	6.9	198.9	6.9	199.9	7.0	200.9	7.0	201.9	7.0	202.9	7.1	203.9	7.1	88
3	197.7	10.4	198.7	10.4	199.7	10.5	200.7	10.5	201.7	10.6	202.7	10.6	203.7	10.7	87
4	197.5	13.8	198.5	13.9	199.5	14.0	200.5	14.0	201.5	14.1	202.5	14.2	203.5	14.2	86
5	197.2	17.3	198.2	17.3	199.2	17.4	200.2	17.5	201.2	17.6	202.2	17.7	203.2	17.8	85
6	196.9	20.7	197.9	20.8	198.9	20.9	199.9	21.0	200.9	21.1	201.9	21.2	202.9	21.3	84
7	196.5	24.1	197.5	24.3	198.5	24.4	199.5	24.5	200.5	24.6	201.5	24.7	202.5	24.9	83
8	196.1	27.6	197.1	27.7	198.1	27.8	199.0	28.0	200.0	28.1	201.0	28.3	202.0	28.4	82
9	195.6	31.0	196.5	31.1	197.5	31.3	198.5	31.4	199.5	31.6	200.5	31.8	201.5	31.9	81
10	195.0	34.4	196.0	34.6	197.0	34.7	197.9	34.9	198.9	35.1	199.9	35.3	200.9	35.4	80
11	194.4	37.8	195.3	38.0	196.3	38.2	197.3	38.4	198.3	38.5	199.3	38.7	200.3	38.9	79
12	193.7	41.2	194.7	41.4	195.6	41.6	196.6	41.8	197.6	42.0	198.6	42.2	199.5	42.4	78
13	192.9	44.5	193.9	44.8	194.9	45.0	195.8	45.2	196.8	45.4	197.8	45.7	198.8	45.9	77
14	192.1	47.9	193.1	48.1	194.1	48.4	195.0	48.6	196.0	48.9	197.0	49.1	197.9	49.4	76
15	191.3	51.2	192.2	51.5	193.2	51.8	194.2	52.0	195.1	52.3	196.1	52.5	197.0	52.8	75
16	190.3	54.6	191.3	54.9	192.3	55.1	193.2	55.4	194.2	55.7	195.1	56.0	196.1	56.2	74
17	189.3	57.9	190.3	58.2	191.3	58.5	192.2	58.8	193.2	59.1	194.1	59.4	195.1	59.6	73
18	188.3	61.2	189.3	61.5	190.2	61.8	191.2	62.1	192.1	62.4	193.1	62.7	194.0	63.0	72
19	187.2	64.5	188.2	64.8	189.1	65.1	190.0	65.4	191.0	65.8	191.9	66.1	192.9	66.4	71
20	186.1	67.7	187.0	68.1	187.9	68.4	188.9	68.7	189.8	69.1	190.8	69.4	191.7	69.8	70
21	184.8	71.0	185.8	71.3	186.7	71.7	187.6	72.0	188.6	72.4	189.5	72.7	190.5	73.1	69
22	183.6	74.2	184.5	74.5	185.4	74.9	186.4	75.3	187.3	75.7	188.2	76.0	189.1	76.4	68
23	182.3	77.4	183.2	77.8	184.1	78.1	185.0	78.5	185.9	78.9	186.9	79.3	187.8	79.7	67
24	180.9	80.5	181.8	80.9	182.7	81.3	183.6	81.8	184.5	82.2	185.4	82.6	186.4	83.0	66
25	179.4	83.7	180.4	84.1	181.3	84.5	182.2	84.9	183.1	85.4	184.0	85.8	184.9	86.2	65
26	178.0	86.8	178.9	87.2	179.8	87.7	180.7	88.1	181.6	88.6	182.5	89.0	183.4	89.4	64
27	176.4	89.9	177.3	90.3	178.2	90.8	179.1	91.3	180.0	91.7	180.9	92.2	181.8	92.6	63
28	174.8	93.0	175.7	93.4	176.6	93.9	177.5	94.4	178.4	94.8	179.2	95.3	180.1	95.8	62
29	173.2	96.0	174.0	96.5	174.9	97.0	175.8	97.4	176.7	97.9	177.5	98.4	178.4	98.9	61
30	171.5	99.0	172.3	99.5	173.2	100.0	174.1	100.5	174.9	101.0	175.8	101.5	176.7	102.0	60
31	169.7	102.0	170.6	102.5	171.4	103.0	172.3	103.5	173.1	104.0	174.0	104.6	174.9	105.1	59
32	167.9	104.9	168.8	105.5	169.6	106.0	170.5	106.5	171.3	107.0	172.2	107.6	173.0	108.1	58
33	166.1	107.8	166.9	108.4	167.7	108.9	168.6	109.5	169.4	110.0	170.3	110.6	171.1	111.1	57
34	164.1	110.7	165.0	111.3	165.8	111.8	166.6	112.4	167.5	113.0	168.3	113.5	169.1	114.1	56
35	162.2	113.6	163.0	114.1	163.8	114.7	164.6	115.3	165.5	115.9	166.3	116.4	167.1	117.0	55
36	160.2	116.4	161.0	117.0	161.8	117.6	162.6	118.1	163.4	118.7	164.2	119.3	165.0	119.9	54
37	158.1	119.2	158.9	119.8	159.7	120.4	160.5	121.0	161.3	121.6	162.1	122.2	162.9	122.8	53
38	156.0	121.9	156.8	122.5	157.6	123.1	158.4	123.7	159.2	124.4	160.0	125.0	160.8	125.6	52
39	153.9	124.6	154.7	125.2	155.4	125.9	156.2	126.5	157.0	127.1	157.8	127.8	158.5	128.4	51
40	151.7	127.3	152.4	127.9	153.2	128.6	154.0	129.2	154.7	129.8	155.5	130.5	156.3	131.1	50
41	149.4	129.9	150.2	130.6	150.9	131.2	151.7	131.9	152.5	132.5	153.2	133.2	154.0	133.8	49
42	147.1	132.5	147.9	133.2	148.6	133.8	149.4	134.5	150.1	135.2	150.9	135.8	151.6	136.5	48
43	144.8	135.0	145.5	135.7	146.3	136.4	147.0	137.1	147.7	137.8	148.5	138.4	149.2	139.1	47
44	142.4	137.5	143.1	138.2	143.9	138.9	144.6	139.6	145.3	140.3	146.0	141.0	146.7	141.7	46
45	140.0	140.0	140.7	140.7	141.4	141.4	142.1	142.1	142.8	142.8	143.5	143.5	144.2	144.2	45
Course.	D = 198'		D = 199'		D = 200'		D = 201'		D = 202'		D = 203'		D = 204'		Course.
	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	

Plane Traverse Table

Course.	D=205'		D=206'		D=207'		D=208'		D=209'		D=210'		D=211'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	205.0	0.0	206.0	0.0	207.0	0.0	208.0	0.0	209.0	0.0	210.0	0.0	211.0	0.0	0
1	205.0	3.6	206.0	3.6	207.0	3.6	208.0	3.6	209.0	3.6	210.0	3.7	211.0	3.7	89
2	204.9	7.2	205.9	7.2	206.9	7.2	207.9	7.3	208.9	7.3	209.9	7.3	210.9	7.4	88
3	204.7	10.7	205.7	10.8	206.7	10.8	207.7	10.9	208.7	10.9	209.7	11.0	210.7	11.0	87
4	204.5	14.3	205.5	14.4	206.5	14.4	207.5	14.5	208.5	14.6	209.5	14.6	210.5	14.7	86
5	204.2	17.9	205.2	18.0	206.2	18.0	207.2	18.1	208.2	18.2	209.2	18.3	210.2	18.4	85
6	203.9	21.4	204.9	21.5	205.9	21.6	206.9	21.7	207.9	21.8	208.8	22.0	209.8	22.1	84
7	203.5	25.0	204.5	25.1	205.5	25.2	206.4	25.3	207.4	25.5	208.4	25.6	209.4	25.7	83
8	203.0	28.5	204.0	28.7	205.0	28.8	206.0	28.9	207.0	29.1	208.0	29.2	209.0	29.4	82
9	202.5	32.1	203.5	32.2	204.5	32.4	205.4	32.5	206.4	32.7	207.4	32.9	208.4	33.0	81
10	201.9	35.6	202.9	35.8	203.9	35.9	204.8	36.1	205.8	36.3	206.8	36.5	207.8	36.6	80
11	201.2	39.1	202.2	39.3	203.2	39.5	204.2	39.7	205.2	39.9	206.1	40.1	207.1	40.3	79
12	200.5	42.6	201.5	42.8	202.5	43.0	203.5	43.2	204.4	43.5	205.4	43.7	206.4	43.9	78
13	199.7	46.1	200.7	46.3	201.7	46.6	202.7	46.8	203.6	47.0	204.6	47.2	205.6	47.5	77
14	198.9	49.6	199.9	49.8	200.9	50.1	201.8	50.3	202.8	50.6	203.8	50.8	204.7	51.0	76
15	198.0	53.1	199.0	53.3	199.9	53.6	200.9	53.8	201.9	54.1	202.8	54.4	203.8	54.6	75
16	197.1	56.5	198.0	56.8	199.0	57.1	199.9	57.3	200.9	57.6	201.9	57.9	202.8	58.2	74
17	196.0	59.9	197.0	60.2	198.0	60.5	198.9	60.8	199.9	61.1	200.8	61.4	201.8	61.7	73
18	195.0	63.3	195.9	63.7	196.9	64.0	197.8	64.3	198.8	64.6	199.7	64.9	200.7	65.2	72
19	193.8	66.7	194.8	67.1	195.7	67.4	196.7	67.7	197.6	68.0	198.6	68.4	199.5	68.7	71
20	192.6	70.1	193.6	70.5	194.5	70.8	195.5	71.1	196.4	71.5	197.3	71.8	198.3	72.2	70
21	191.4	73.5	192.3	73.8	193.3	74.2	194.2	74.5	195.1	74.9	196.1	75.3	197.0	75.6	69
22	190.1	76.8	191.0	77.2	191.9	77.5	192.9	77.9	193.8	78.3	194.7	78.7	195.6	79.0	68
23	188.7	80.1	189.6	80.5	190.5	80.9	191.5	81.3	192.4	81.7	193.3	82.1	194.2	82.4	67
24	187.3	83.4	188.2	83.8	189.1	84.2	190.0	84.6	190.9	85.0	191.8	85.4	192.8	85.8	66
25	185.8	86.6	186.7	87.1	187.6	87.5	188.5	87.9	189.4	88.3	190.3	88.7	191.2	89.2	65
26	184.3	89.9	185.2	90.3	186.1	90.7	186.9	91.2	187.8	91.6	188.7	92.1	189.6	92.5	64
27	182.7	93.1	183.5	93.5	184.4	94.0	185.3	94.4	186.2	94.9	187.1	95.3	188.0	95.8	63
28	181.0	96.2	181.9	96.7	182.8	97.2	183.7	97.7	184.5	98.1	185.4	98.6	186.3	99.1	62
29	179.3	99.4	180.2	99.9	181.0	100.4	181.9	100.8	182.8	101.3	183.7	101.8	184.5	102.3	61
30	177.5	102.5	178.4	103.0	179.3	103.5	180.1	104.0	181.0	104.5	181.9	105.0	182.7	105.5	60
31	175.7	105.6	176.6	106.1	177.4	106.6	178.3	107.1	179.1	107.6	180.0	108.2	180.9	108.7	59
32	173.8	108.6	174.7	109.2	175.5	109.7	176.4	110.2	177.2	110.8	178.1	111.3	178.9	111.8	58
33	171.9	111.7	172.8	112.2	173.6	112.7	174.4	113.3	175.3	113.8	176.1	114.4	177.0	114.9	57
34	170.0	114.6	170.8	115.2	171.6	115.8	172.4	116.3	173.3	116.9	174.1	117.4	174.9	118.0	56
35	167.9	117.6	168.7	118.2	169.6	118.7	170.4	119.3	171.2	119.9	172.0	120.5	172.8	121.0	55
36	165.8	120.5	166.7	121.1	167.5	121.7	168.3	122.3	169.1	122.8	169.9	123.4	170.7	124.0	54
37	163.7	123.4	164.5	124.0	165.3	124.6	166.1	125.2	166.9	125.8	167.7	126.4	168.5	127.0	53
38	161.5	126.2	162.3	126.8	163.1	127.4	163.9	128.1	164.7	128.7	165.5	129.3	166.3	129.9	52
39	159.3	129.0	160.1	129.6	160.9	130.3	161.6	130.9	162.4	131.5	163.2	132.2	164.0	132.8	51
40	157.0	131.8	157.8	132.4	158.6	133.1	159.3	133.7	160.1	134.3	160.9	135.0	161.6	135.6	50
41	154.7	134.5	155.5	135.1	156.2	135.8	157.0	136.5	157.7	137.1	158.5	137.8	159.2	138.4	49
42	152.3	137.2	153.1	137.8	153.8	138.5	154.6	139.2	155.3	139.8	156.1	140.5	156.8	141.2	48
43	149.9	139.8	150.7	140.5	151.4	141.2	152.1	141.9	152.9	142.5	153.6	143.2	154.3	143.9	47
44	147.5	142.4	148.2	143.1	148.9	143.8	149.6	144.5	150.3	145.2	151.1	145.9	151.8	146.6	46
45	145.0	145.0	145.7	145.7	146.4	146.4	147.1	147.1	147.8	147.8	148.5	148.5	149.2	149.2	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=205'		D=206'		D=207'		D=208'		D=209'		D=210'		D=211'		

Plane Traverse Table

Course.	D=212'		D=213'		D=214'		D=215'		D=216'		D=217'		D=218'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	212.0	0.0	213.0	0.0	214.0	0.0	215.0	0.0	216.0	0.0	217.0	0.0	218.0	0.0	90
1	212.0	3.7	213.0	3.7	214.0	3.7	215.0	3.8	216.0	3.8	217.0	3.8	218.0	3.8	89
2	211.9	7.4	212.9	7.4	213.9	7.5	214.9	7.5	215.9	7.5	216.9	7.6	217.9	7.6	88
3	211.7	11.1	212.7	11.1	213.7	11.2	214.7	11.3	215.7	11.3	216.7	11.4	217.7	11.4	87
4	211.5	14.8	212.5	14.9	213.5	14.9	214.5	15.0	215.5	15.1	216.5	15.1	217.5	15.2	86
5	211.2	18.5	212.2	18.6	213.2	18.7	214.2	18.7	215.2	18.8	216.2	18.9	217.2	19.0	85
6	210.8	22.2	211.8	22.3	212.8	22.4	213.8	22.5	214.8	22.6	215.8	22.7	216.8	22.8	84
7	210.4	25.8	211.4	26.0	212.4	26.1	213.4	26.2	214.4	26.3	215.4	26.4	216.4	26.6	83
8	209.9	29.5	210.9	29.6	211.9	29.8	212.9	29.9	213.9	30.1	214.9	30.2	215.9	30.3	82
9	209.4	33.2	210.4	33.3	211.4	33.5	212.4	33.6	213.3	33.8	214.3	33.9	215.3	34.1	81
10	208.8	36.8	209.8	37.0	210.7	37.2	211.7	37.3	212.7	37.5	213.7	37.7	214.7	37.9	80
11	208.1	40.5	209.1	40.6	210.1	40.8	211.0	41.0	212.0	41.2	213.0	41.4	214.0	41.6	79
12	207.4	44.1	208.3	44.3	209.3	44.5	210.3	44.7	211.3	44.9	212.3	45.1	213.2	45.3	78
13	206.6	47.7	207.5	47.9	208.5	48.1	209.5	48.4	210.5	48.6	211.4	48.8	212.4	49.0	77
14	205.7	51.3	206.7	51.5	207.6	51.8	208.6	52.0	209.6	52.3	210.6	52.5	211.5	52.7	76
15	204.8	54.9	205.7	55.1	206.7	55.4	207.7	55.6	208.6	55.9	209.6	56.2	210.6	56.4	75
16	203.8	58.4	204.7	58.7	205.7	59.0	206.7	59.3	207.6	59.5	208.6	59.8	209.6	60.1	74
17	202.7	62.0	203.7	62.3	204.6	62.6	205.6	62.9	206.6	63.2	207.5	63.4	208.5	63.7	73
18	201.6	65.5	202.6	65.8	203.5	66.1	204.5	66.4	205.4	66.7	206.4	67.1	207.3	67.4	72
19	200.4	69.0	201.4	69.3	202.3	69.7	203.3	70.0	204.2	70.3	205.2	70.6	206.1	71.0	71
20	199.2	72.5	200.2	72.9	201.1	73.2	202.0	73.5	203.0	73.9	203.9	74.2	204.9	74.6	70
21	197.9	76.0	198.9	76.3	199.8	76.7	200.7	77.0	201.7	77.4	202.6	77.8	203.5	78.1	69
22	196.6	79.4	197.5	79.8	198.4	80.2	199.3	80.5	200.3	80.9	201.2	81.3	202.1	81.7	68
23	195.1	82.8	196.1	83.2	197.0	83.6	197.9	84.0	198.8	84.4	199.7	84.8	200.7	85.2	67
24	193.7	86.2	194.6	86.6	195.5	87.0	196.4	87.4	197.3	87.9	198.2	88.3	199.2	88.7	66
25	192.1	89.6	193.0	90.0	193.9	90.4	194.9	90.9	195.8	91.3	196.7	91.7	197.6	92.1	65
26	190.5	92.9	191.4	93.4	192.3	93.8	193.2	94.2	194.1	94.7	195.0	95.1	195.9	95.6	64
27	188.9	96.2	189.8	96.7	190.7	97.2	191.6	97.6	192.5	98.1	193.3	98.5	194.2	99.0	63
28	187.2	99.5	188.1	100.0	189.0	100.5	189.8	100.9	190.7	101.4	191.6	101.9	192.5	102.3	62
29	185.4	102.8	186.3	103.3	187.2	103.7	188.0	104.2	188.9	104.7	189.8	105.2	190.7	105.7	61
30	183.6	106.0	184.5	106.5	185.3	107.0	186.2	107.5	187.1	108.0	187.9	108.5	188.8	109.0	60
31	181.7	109.2	182.6	109.7	183.4	110.2	184.3	110.7	185.1	111.2	186.0	111.8	186.9	112.3	59
32	179.8	112.3	180.6	112.9	181.5	113.4	182.3	113.9	183.2	114.5	184.0	115.0	184.9	115.5	58
33	177.8	115.5	178.6	116.0	179.5	116.6	180.3	117.1	181.2	117.6	182.0	118.2	182.8	118.7	57
34	175.8	118.5	176.6	119.1	177.4	119.7	178.2	120.2	179.1	120.8	179.9	121.3	180.7	121.9	56
35	173.7	121.6	174.5	122.2	175.3	122.7	176.1	123.3	176.9	123.9	177.8	124.5	178.6	125.0	55
36	171.5	124.6	172.3	125.2	173.1	125.8	173.9	126.4	174.7	127.0	175.6	127.5	176.4	128.1	54
37	169.3	127.6	170.1	128.2	170.9	128.8	171.7	129.4	172.5	130.0	173.3	130.6	174.1	131.2	53
38	167.1	130.5	167.8	131.1	168.6	131.8	169.4	132.4	170.2	133.0	171.0	133.6	171.8	134.2	52
39	164.8	133.4	165.5	134.0	166.3	134.7	167.1	135.3	167.9	135.9	168.6	136.6	169.4	137.2	51
40	162.4	136.3	163.2	136.9	163.9	137.6	164.7	138.2	165.5	138.8	166.2	139.5	167.0	140.1	50
41	160.0	139.1	160.8	139.7	161.5	140.4	162.3	141.1	163.0	141.7	163.8	142.4	164.5	143.0	49
42	157.5	141.9	158.3	142.5	159.0	143.2	159.8	143.9	160.5	144.5	161.3	145.2	162.0	145.9	48
43	155.0	144.6	155.8	145.3	156.5	145.9	157.2	146.6	158.0	147.3	158.7	148.0	159.4	148.7	47
44	152.5	147.3	153.2	148.0	153.9	148.7	154.7	149.4	155.4	150.0	156.1	150.7	156.8	151.4	46
45	149.9	149.9	150.6	150.6	151.3	151.3	152.0	152.0	152.7	152.7	153.4	153.4	154.1	154.1	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=212'		D=213'		D=214'		D=215'		D=216'		D=217'		D=218'		

Plane Traverse Table

Course.	D=219'		D=220'		D=221'		D=222'		D=223'		D=224'		D=225'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	219.0	0.0	220.0	0.0	221.0	0.0	222.0	0.0	223.0	0.0	224.0	0.0	225.0	0.0	90
1	219.0	3.8	220.0	3.8	221.0	3.9	222.0	3.9	223.0	3.9	224.0	3.9	225.0	3.9	89
2	218.9	7.6	219.9	7.7	220.9	7.7	221.9	7.7	222.9	7.8	223.9	7.8	224.9	7.9	88
3	218.7	11.5	219.7	11.5	220.7	11.6	221.7	11.6	222.7	11.7	223.7	11.7	224.7	11.8	87
4	218.5	15.3	219.5	15.3	220.5	15.4	221.5	15.5	222.5	15.6	223.5	15.6	224.5	15.7	86
5	218.2	19.1	219.2	19.2	220.2	19.3	221.2	19.3	222.2	19.4	223.1	19.5	224.1	19.6	85
6	217.8	22.9	218.8	23.0	219.8	23.1	220.8	23.2	221.8	23.3	222.8	23.4	223.8	23.5	84
7	217.4	26.7	218.4	26.8	219.4	26.9	220.3	27.1	221.3	27.2	222.3	27.3	223.3	27.4	83
8	216.9	30.5	217.9	30.6	218.8	30.8	219.8	30.9	220.8	31.0	221.8	31.2	222.8	31.3	82
9	216.3	34.3	217.3	34.4	218.3	34.6	219.3	34.7	220.3	34.9	221.2	35.0	222.2	35.2	81
10	215.7	38.0	216.7	38.2	217.6	38.4	218.6	38.5	219.6	38.7	220.6	38.9	221.6	39.1	80
11	215.0	41.8	216.0	42.0	216.9	42.2	217.9	42.4	218.9	42.6	219.9	42.7	220.9	42.9	79
12	214.2	45.5	215.2	45.7	216.2	45.9	217.1	46.2	218.1	46.4	219.1	46.6	220.1	46.8	78
13	213.4	49.3	214.4	49.5	215.3	49.7	216.3	49.9	217.3	50.2	218.3	50.4	219.2	50.6	77
14	212.5	53.0	213.5	53.2	214.4	53.5	215.4	53.7	216.4	53.9	217.3	54.2	218.3	54.4	76
15	211.5	56.7	212.5	56.9	213.4	57.2	214.4	57.5	215.4	57.7	216.4	58.0	217.3	58.2	75
16	210.5	60.4	211.5	60.6	212.4	60.9	213.4	61.2	214.4	61.5	215.3	61.7	216.3	62.0	74
17	209.4	64.0	210.4	64.3	211.3	64.6	212.3	64.9	213.3	65.2	214.2	65.5	215.2	65.8	73
18	208.3	67.7	209.2	68.0	210.2	68.3	211.1	68.6	212.1	68.9	213.0	69.2	214.0	69.5	72
19	207.1	71.3	208.0	71.6	209.0	72.0	209.9	72.3	210.9	72.6	211.8	72.9	212.7	73.3	71
20	205.8	74.9	206.7	75.2	207.7	75.6	208.6	75.9	209.6	76.3	210.5	76.6	211.4	77.0	70
21	204.5	78.5	205.4	78.8	206.3	79.2	207.3	79.6	208.2	79.9	209.1	80.3	210.1	80.6	69
22	203.1	82.0	204.0	82.4	204.9	82.8	205.8	83.2	206.8	83.5	207.7	83.9	208.6	84.3	68
23	201.6	85.6	202.5	86.0	203.4	86.4	204.4	86.7	205.3	87.1	206.2	87.5	207.1	87.9	67
24	200.1	89.1	201.0	89.5	201.9	89.9	202.8	90.3	203.7	90.7	204.6	91.1	205.5	91.5	66
25	198.5	92.6	199.4	93.0	200.3	93.4	201.2	93.8	202.1	94.2	203.0	94.7	203.9	95.1	65
26	196.8	96.0	197.7	96.4	198.6	96.9	199.5	97.3	200.4	97.8	201.3	98.2	202.2	98.6	64
27	195.1	99.4	196.0	99.9	196.9	100.3	197.8	100.8	198.7	101.2	199.6	101.7	200.5	102.1	63
28	193.4	102.8	194.2	103.3	195.1	103.8	196.0	104.2	196.9	104.7	197.8	105.2	198.7	105.6	62
29	191.5	106.2	192.4	106.7	193.3	107.1	194.2	107.6	195.0	108.1	195.9	108.6	196.8	109.1	61
30	189.7	109.5	190.5	110.0	191.4	110.5	192.3	111.0	193.1	111.5	194.0	112.0	194.9	112.5	60
31	187.7	112.8	188.6	113.3	189.4	113.8	190.3	114.3	191.1	114.9	192.0	115.4	192.9	115.9	59
32	185.7	116.1	186.6	116.6	187.4	117.1	188.3	117.6	189.1	118.2	190.0	118.7	190.8	119.2	58
33	183.7	119.3	184.5	119.8	185.3	120.4	186.2	120.9	187.0	121.5	187.9	122.0	188.7	122.5	57
34	181.6	122.5	182.4	123.0	183.2	123.6	184.0	124.1	184.9	124.7	185.7	125.3	186.5	125.8	56
35	179.4	125.6	180.2	126.2	181.0	126.8	181.9	127.3	182.7	127.9	183.5	128.5	184.3	129.1	55
36	177.2	128.7	178.0	129.3	178.8	129.9	179.6	130.5	180.4	131.1	181.2	131.7	182.0	132.3	54
37	174.9	131.8	175.7	132.4	176.5	133.0	177.3	133.6	178.1	134.2	178.9	134.8	179.7	135.4	53
38	172.6	134.8	173.4	135.4	174.2	136.1	174.9	136.7	175.7	137.3	176.5	137.9	177.3	138.5	52
39	170.2	137.8	171.0	138.5	171.7	139.1	172.5	139.7	173.3	140.3	174.1	141.0	174.9	141.6	51
40	167.8	140.8	168.5	141.4	169.3	142.1	170.1	142.7	170.8	143.3	171.6	144.0	172.4	144.6	50
41	165.3	143.7	166.0	144.3	166.8	145.0	167.5	145.6	168.3	146.3	169.1	147.0	169.8	147.6	49
42	162.7	146.5	163.5	147.2	164.2	147.9	165.0	148.5	165.7	149.2	166.5	149.9	167.2	150.6	48
43	160.2	149.4	160.9	150.0	161.6	150.7	162.4	151.4	163.1	152.1	163.8	152.8	164.6	153.4	47
44	157.5	152.1	158.3	152.8	159.0	153.5	159.7	154.2	160.4	154.9	161.1	155.6	161.9	156.3	46
45	154.9	154.9	155.6	155.6	156.3	156.3	157.0	157.0	157.7	157.7	158.4	158.4	159.1	159.1	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=219'		D=220'		D=221'		D=222'		D=223'		D=224'		D=225'		

Plane Traverse Table

Course.	D=226'		D=227'		D=228'		D=229'		D=230'		D=231'		D=232'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	226.0	0.0	227.0	0.0	228.0	0.0	229.0	0.0	230.0	0.0	231.0	0.0	232.0	0.0	90
1	226.0	3.9	227.0	4.0	228.0	4.0	229.0	4.0	230.0	4.0	231.0	4.0	232.0	4.0	89
2	225.9	7.9	226.9	7.9	227.9	8.0	228.9	8.0	229.9	8.0	230.9	8.1	231.9	8.1	88
3	225.7	11.8	226.7	11.9	227.7	11.9	228.7	12.0	229.7	12.0	230.7	12.1	231.7	12.1	87
4	225.4	15.7	226.4	15.8	227.4	15.9	228.4	16.0	229.4	16.0	230.4	16.1	231.4	16.2	86
5	225.1	19.8	226.1	19.8	227.1	19.9	228.1	20.0	229.1	20.0	230.1	20.1	231.1	20.2	85
6	224.8	23.6	225.8	23.7	226.8	23.8	227.7	23.9	228.7	24.0	229.7	24.1	230.7	24.3	84
7	224.3	27.5	225.3	27.7	226.3	27.8	227.3	27.9	228.3	28.0	229.3	28.1	230.3	28.3	83
8	223.8	31.5	224.8	31.6	225.8	31.7	226.8	31.9	227.8	32.0	228.8	32.1	229.7	32.3	82
9	223.2	35.4	224.2	35.5	225.2	35.7	226.2	35.8	227.2	36.0	228.2	36.1	229.1	36.3	81
10	222.6	39.2	223.6	39.4	224.5	39.6	225.5	39.8	226.5	39.9	227.5	40.1	228.5	40.3	80
11	221.8	43.1	222.8	43.3	223.8	43.5	224.8	43.7	225.8	43.9	226.8	44.1	227.7	44.3	79
12	221.1	47.0	222.0	47.2	223.0	47.4	224.0	47.6	225.0	47.8	226.0	48.0	226.9	48.2	78
13	220.2	50.8	221.2	51.1	222.2	51.3	223.1	51.5	224.1	51.7	225.1	52.0	226.1	52.2	77
14	219.3	54.7	220.3	54.9	221.2	55.2	222.2	55.4	223.2	55.6	224.1	55.9	225.1	56.1	76
15	218.3	58.5	219.3	58.8	220.2	59.0	221.2	59.3	222.2	59.5	223.1	59.8	224.1	60.0	75
16	217.2	62.3	218.2	62.6	219.2	62.8	220.1	63.1	221.1	63.4	222.1	63.7	223.0	63.9	74
17	216.1	66.1	217.1	66.4	218.0	66.7	219.0	67.0	220.0	67.2	220.9	67.5	221.9	67.8	73
18	214.9	69.8	215.9	70.1	216.8	70.5	217.8	70.8	218.7	71.1	219.7	71.4	220.6	71.7	72
19	213.7	73.6	214.6	73.9	215.6	74.2	216.5	74.6	217.5	74.9	218.4	75.2	219.4	75.5	71
20	212.4	77.3	213.3	77.6	214.2	78.0	215.2	78.3	216.1	78.7	217.1	79.0	218.0	79.3	70
21	211.0	81.0	211.9	81.3	212.9	81.7	213.8	82.1	214.7	82.4	215.7	82.8	216.6	83.1	69
22	209.5	84.7	210.5	85.0	211.4	85.4	212.3	85.8	213.3	86.2	214.2	86.5	215.1	86.9	68
23	208.0	88.3	209.0	88.7	209.9	89.1	210.8	89.5	211.7	89.9	212.6	90.3	213.6	90.6	67
24	206.5	91.9	207.4	92.3	208.3	92.7	209.2	93.1	210.1	93.5	211.0	94.0	211.9	94.4	66
25	204.8	95.5	205.7	95.9	206.6	96.4	207.5	96.8	208.5	97.2	209.4	97.6	210.3	98.0	65
26	203.1	99.1	204.0	99.5	204.9	99.9	205.8	100.4	206.7	100.8	207.6	101.3	208.5	101.7	64
27	201.4	102.6	202.3	103.1	203.1	103.5	204.0	104.0	204.9	104.4	205.8	104.9	206.7	105.3	63
28	199.5	106.1	200.4	106.6	201.3	107.0	202.2	107.5	203.1	108.0	204.0	108.4	204.8	108.9	62
29	197.7	109.6	198.5	110.1	199.4	110.5	200.3	111.0	201.2	111.5	202.0	112.0	202.9	112.5	61
30	195.7	113.0	196.6	113.5	197.5	114.0	198.3	114.5	199.2	115.0	200.1	115.5	200.9	116.0	60
31	193.7	116.4	194.6	116.9	195.4	117.4	196.3	117.9	197.1	118.5	198.0	119.0	198.9	119.5	59
32	191.7	119.8	192.5	120.3	193.4	120.8	194.2	121.4	195.1	121.9	195.9	122.4	196.7	122.9	58
33	189.5	123.1	190.4	123.6	191.2	124.2	192.1	124.7	192.9	125.3	193.7	125.8	194.6	126.4	57
34	187.4	126.4	188.2	126.9	189.0	127.5	189.8	128.1	190.7	128.6	191.5	129.2	192.3	129.7	56
35	185.1	129.6	185.9	130.2	186.8	130.8	187.6	131.3	188.4	131.9	189.2	132.5	190.0	133.1	55
36	182.8	132.8	183.6	133.4	184.5	134.0	185.3	134.6	186.1	135.2	186.9	135.8	187.7	136.4	54
37	180.5	136.0	181.3	136.6	182.1	137.2	182.9	137.8	184.5	138.3	184.5	139.0	185.3	139.6	53
38	178.1	139.1	178.9	139.8	179.7	140.4	180.5	141.0	181.2	141.6	182.0	142.2	182.8	142.8	52
39	175.6	142.2	176.4	142.9	177.2	143.5	178.0	144.1	178.7	144.7	179.5	145.4	180.3	146.0	51
40	173.1	145.3	173.9	145.9	174.7	146.6	175.4	147.2	176.2	147.8	177.0	148.5	177.7	149.1	50
41	170.6	148.3	171.3	148.9	172.1	149.6	172.8	150.2	173.6	150.9	174.3	151.5	175.1	152.2	49
42	168.0	151.2	168.7	151.9	169.4	152.6	170.2	153.2	170.9	153.9	171.7	154.6	172.4	155.2	48
43	165.3	154.1	166.0	154.8	166.7	155.5	167.5	156.2	168.2	156.9	168.9	157.5	169.7	158.2	47
44	162.6	157.0	163.3	157.7	164.0	158.4	164.7	159.1	165.4	159.8	166.2	160.5	166.9	161.2	46
45	159.8	159.8	160.5	160.5	161.2	161.2	161.9	161.9	162.6	162.6	163.3	163.3	164.0	164.0	45

Plane Traverse Table

Course.	D=233'		D=234'		D=235'		D=236'		D=237'		D=238'		D=239'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	233.0	0.0	234.0	0.0	235.0	0.0	236.0	0.0	237.0	0.0	238.0	0.0	239.0	0.0	90
1	233.0	4.1	234.0	4.1	235.0	4.1	236.0	4.1	237.0	4.1	238.0	4.2	239.0	4.2	89
2	232.9	8.1	233.9	8.2	234.9	8.2	235.9	8.2	236.9	8.3	237.9	8.3	238.9	8.3	88
3	232.7	12.2	233.7	12.2	234.7	12.3	235.7	12.4	236.7	12.4	237.7	12.5	238.7	12.5	87
4	232.4	16.3	233.4	16.3	234.4	16.4	235.4	16.5	236.4	16.5	237.4	16.6	238.4	16.7	86
5	232.1	20.3	233.1	20.4	234.1	20.5	235.1	20.6	236.1	20.7	237.1	20.7	238.1	20.8	85
6	231.7	24.4	232.7	24.5	233.7	24.6	234.7	24.7	235.7	24.8	236.7	24.9	237.7	25.0	84
7	231.3	28.4	232.3	28.5	233.2	28.6	234.2	28.8	235.2	28.9	236.2	29.0	237.2	29.1	83
8	230.7	32.4	231.7	32.6	232.7	32.7	233.7	32.8	234.7	33.0	235.7	33.1	236.7	33.3	82
9	230.1	36.4	231.1	36.6	232.1	36.8	233.1	36.9	234.1	37.1	235.1	37.2	236.1	37.4	81
10	229.5	40.5	230.4	40.6	231.4	40.8	232.4	41.0	233.4	41.2	234.4	41.3	235.4	41.5	80
11	228.7	44.5	229.7	44.6	230.7	44.8	231.7	45.0	232.6	45.2	233.6	45.4	234.6	45.6	79
12	227.9	48.4	228.9	48.7	229.9	48.9	230.8	49.1	231.8	49.3	232.8	49.5	233.8	49.7	78
13	227.0	52.4	228.0	52.6	229.0	52.9	230.0	53.1	230.9	53.3	231.9	53.5	232.9	53.8	77
14	226.1	56.4	227.0	56.6	228.0	56.9	229.0	57.1	230.0	57.3	230.9	57.6	231.9	57.8	76
15	225.1	60.3	226.0	60.6	227.0	60.8	228.0	61.1	228.9	61.3	229.9	61.6	230.9	61.9	75
16	224.0	64.2	224.9	64.5	225.9	64.8	226.9	65.1	227.8	65.3	228.8	65.6	229.7	65.9	74
17	222.8	68.1	223.8	68.4	224.7	68.7	225.7	69.0	226.6	69.3	227.6	69.6	228.6	69.9	73
18	221.6	72.0	222.5	72.3	223.5	72.6	224.4	72.9	225.4	73.2	226.4	73.5	227.3	73.9	72
19	220.3	75.9	221.3	76.2	222.2	76.5	223.1	76.8	224.1	77.2	225.0	77.5	226.0	77.8	71
20	218.9	79.7	219.9	80.0	220.8	80.4	221.8	80.7	222.7	81.1	223.6	81.4	224.6	81.7	70
21	217.5	83.5	218.5	83.9	219.4	84.2	220.3	84.6	221.3	84.9	222.2	85.3	223.1	85.6	69
22	216.0	87.3	217.0	87.7	217.9	88.0	218.8	88.4	219.7	88.8	220.7	89.2	221.6	89.5	68
23	214.5	91.0	215.4	91.4	216.3	91.8	217.2	92.2	218.2	92.6	219.1	93.0	220.0	93.4	67
24	212.9	94.8	213.8	95.2	214.7	95.6	215.6	96.0	216.5	96.4	217.4	96.8	218.3	97.2	66
25	211.2	98.5	212.1	98.9	213.0	99.3	213.9	99.7	214.8	100.2	215.7	100.6	216.6	101.0	65
26	209.4	102.1	210.3	102.6	211.2	103.0	212.1	103.5	213.0	103.9	213.9	104.3	214.8	104.8	64
27	207.6	105.8	208.5	106.2	209.4	106.7	210.3	107.1	211.2	107.6	212.1	108.0	213.0	108.5	63
28	205.7	109.4	206.6	109.9	207.5	110.3	208.4	110.8	209.3	111.3	210.1	111.7	211.0	112.2	62
29	203.8	113.0	204.7	113.4	205.5	113.9	206.4	114.4	207.3	114.9	208.2	115.4	209.0	115.9	61
30	201.8	116.5	202.6	117.0	203.5	117.5	204.4	118.0	205.2	118.5	206.1	119.0	207.0	119.5	60
31	199.7	120.0	200.6	120.5	201.4	121.0	202.3	121.5	203.1	122.1	204.0	122.6	204.9	123.1	59
32	197.6	123.5	198.4	124.0	199.3	124.5	200.1	125.1	201.0	125.6	201.8	126.1	202.7	126.7	58
33	195.4	126.9	196.2	127.4	197.1	128.0	197.9	128.5	198.8	129.1	199.6	129.6	200.4	130.2	57
34	193.2	130.3	194.0	130.9	194.8	131.4	195.7	132.0	196.5	132.5	197.3	133.1	198.1	133.6	56
35	190.9	133.6	191.7	134.2	192.5	134.8	193.3	135.4	194.1	135.9	195.0	136.5	195.8	137.1	55
36	188.5	137.0	189.3	137.5	190.1	138.1	190.9	138.7	191.7	139.3	192.5	139.9	193.4	140.5	54
37	186.1	140.2	186.9	140.8	187.7	141.4	188.5	142.0	189.3	142.6	190.1	143.2	190.9	143.8	53
38	183.6	143.4	184.1	144.1	185.2	144.7	186.0	145.3	186.8	145.9	187.5	146.5	188.3	147.1	52
39	181.1	146.6	181.9	147.3	182.6	147.9	183.4	148.5	184.2	149.1	185.0	149.8	185.7	150.4	51
40	178.5	149.8	179.3	150.4	180.0	151.1	180.8	151.7	181.6	152.3	182.3	153.0	183.1	153.6	50
41	175.8	152.9	176.6	153.5	177.4	154.2	178.1	154.8	178.9	155.5	179.6	156.1	180.4	156.8	49
42	173.2	155.9	173.9	156.6	174.6	157.2	175.4	157.9	176.1	158.6	176.9	159.3	177.6	159.9	48
43	170.4	158.9	171.1	159.6	171.9	160.3	172.6	161.0	173.3	161.6	174.1	162.3	174.8	163.0	47
44	167.6	161.9	168.3	162.6	169.0	163.2	169.8	163.9	170.5	164.6	171.2	165.3	171.9	166.0	46
45	164.8	164.8	165.5	165.5	166.2	166.2	166.9	166.9	167.6	167.6	168.3	168.3	169.0	169.0	45

Plane Traverse Table

Course.	D=240'		D=241'		D=242'		D=243'		D=244'		D=245'		D=246'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	240.0	0.0	241.0	0.0	242.0	0.0	243.0	0.0	244.0	0.0	245.0	0.0	246.0	0.0	90
1	240.0	4.2	241.0	4.2	242.0	4.2	243.0	4.2	244.0	4.3	245.0	4.3	246.0	4.3	89
2	239.9	8.4	240.9	8.4	241.9	8.4	242.9	8.5	243.9	8.5	244.9	8.6	245.9	8.6	88
3	239.7	12.6	240.7	12.6	241.7	12.7	242.7	12.7	243.7	12.8	244.7	12.8	245.7	12.9	87
4	239.4	16.7	240.4	16.8	241.4	16.9	242.4	17.0	243.4	17.0	244.4	17.1	245.4	17.2	86
5	239.1	20.9	240.1	21.0	241.1	21.1	242.1	21.2	243.1	21.3	244.1	21.4	245.1	21.4	85
6	238.7	25.1	239.7	25.2	240.7	25.3	241.7	25.4	242.7	25.5	243.7	25.6	244.7	25.7	84
7	238.2	29.2	239.2	29.4	240.2	29.5	241.2	29.6	242.2	29.7	243.2	29.9	244.2	30.0	83
8	237.7	33.4	238.7	33.5	239.6	33.7	240.6	33.8	241.6	34.0	242.6	34.1	243.6	34.2	82
9	237.0	37.5	238.0	37.7	239.0	37.9	240.0	38.0	241.0	38.2	242.0	38.3	243.0	38.5	81
10	236.4	41.7	237.3	41.8	238.3	42.0	239.3	42.2	240.3	42.4	241.3	42.5	242.3	42.7	80
11	235.6	45.8	236.6	46.0	237.6	46.2	238.5	46.4	239.5	46.6	240.5	46.7	241.5	46.9	79
12	234.8	49.9	235.7	50.1	236.7	50.3	237.7	50.5	238.7	50.7	239.6	50.9	240.6	51.1	78
13	233.8	54.0	234.8	54.2	235.8	54.4	236.8	54.7	237.7	54.9	238.7	55.1	239.7	55.3	77
14	232.9	58.1	233.8	58.3	234.8	58.5	235.8	58.8	236.8	59.0	237.7	59.3	238.7	59.5	76
15	231.8	62.1	232.8	62.4	233.8	62.6	234.7	62.9	235.7	63.2	236.7	63.4	237.6	63.7	75
16	230.7	66.2	231.7	66.4	232.6	66.7	233.6	67.0	234.5	67.3	235.5	67.5	236.5	67.8	74
17	229.5	70.2	230.5	70.5	231.4	70.8	232.4	71.0	233.3	71.3	234.3	71.6	235.3	71.9	73
18	228.3	74.2	229.2	74.5	230.2	74.8	231.1	75.1	232.1	75.4	233.0	75.7	234.0	76.0	72
19	226.9	78.1	227.9	78.5	228.8	78.8	229.8	79.1	230.7	79.4	231.7	79.8	232.6	80.1	71
20	225.5	82.1	226.5	82.4	227.4	82.8	228.3	83.1	229.3	83.5	230.2	83.8	231.2	84.1	70
21	224.1	86.0	225.0	86.4	225.9	86.7	226.9	87.1	227.8	87.4	228.7	87.8	229.7	88.2	69
22	222.5	89.9	223.5	90.3	224.4	90.7	225.3	91.0	226.2	91.4	227.2	91.8	228.1	92.2	68
23	220.9	93.8	221.8	94.2	222.8	94.6	223.7	94.9	224.6	95.3	225.5	95.7	226.4	96.1	67
24	219.3	97.6	220.2	98.0	221.1	98.4	222.0	98.8	222.9	99.2	223.8	99.7	224.7	100.1	66
25	217.5	101.4	218.4	101.9	219.3	102.3	220.2	102.7	221.1	103.1	222.0	103.5	223.0	104.0	65
26	215.7	105.2	216.6	105.6	217.5	106.1	218.4	106.5	219.3	107.0	220.2	107.4	221.1	107.8	64
27	213.8	109.0	214.7	109.4	215.6	109.9	216.5	110.3	217.4	110.8	218.3	111.2	219.2	111.7	63
28	211.9	112.7	212.8	113.1	213.7	113.6	214.6	114.1	215.4	114.6	216.3	115.0	217.2	115.5	62
29	209.9	116.4	210.8	116.8	211.7	117.3	212.5	117.8	213.4	118.3	214.3	118.8	215.2	119.3	61
30	207.8	120.0	208.7	120.5	209.6	121.0	210.4	121.5	211.3	122.0	212.2	122.5	213.0	123.0	60
31	205.7	123.6	206.6	124.1	207.4	124.6	208.3	125.2	209.1	125.7	210.2	126.2	210.9	126.7	59
32	203.5	127.2	204.4	127.7	205.2	128.2	206.1	128.8	206.9	129.3	207.8	129.8	208.6	130.4	58
33	201.3	130.7	202.1	131.3	203.0	131.8	203.8	132.3	204.6	132.9	205.5	133.4	206.3	134.0	57
34	199.0	134.2	199.8	134.8	200.6	135.3	201.5	135.9	202.3	136.4	203.1	137.0	203.9	137.6	56
35	196.6	137.7	197.4	138.2	198.2	138.8	199.1	139.4	199.9	140.0	200.7	140.5	201.5	141.1	55
36	194.2	141.1	195.0	141.7	195.8	142.2	196.6	142.8	197.4	143.4	198.2	144.0	199.0	144.6	54
37	191.7	144.4	192.5	145.0	193.3	145.6	194.1	146.2	194.9	146.8	195.7	147.4	196.5	148.0	53
38	189.1	147.8	189.9	148.4	190.7	149.0	191.5	149.6	192.3	150.2	193.1	150.8	193.9	151.5	52
39	186.5	151.0	187.3	151.7	188.1	152.3	188.8	152.9	189.6	153.6	190.4	154.2	191.2	154.8	51
40	183.9	154.3	184.6	154.9	185.4	155.6	186.1	156.2	186.9	156.8	187.7	157.5	188.4	158.1	50
41	181.1	157.5	181.9	158.1	182.6	158.8	183.4	159.4	184.1	160.1	184.9	160.7	185.7	161.4	49
42	178.4	160.6	179.1	161.3	179.8	161.9	180.6	162.6	181.3	163.3	182.1	163.9	182.8	164.6	48
43	175.5	163.7	176.3	164.4	177.0	165.0	177.7	165.7	178.5	166.4	179.2	167.1	179.9	167.8	47
44	172.6	166.7	173.4	167.4	174.1	168.1	174.8	168.8	175.5	169.5	176.2	170.2	177.0	170.9	46
45	169.7	169.7	170.4	170.4	171.1	171.1	171.8	171.8	172.5	172.5	173.2	173.2	173.9	173.9	45

Plane Traverse Table

Course	D=247'		D=248'		D=249'		D=250'		D=251'		D=252'		D=253'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	247.0	0.0	248.0	0.0	249.0	0.0	250.0	0.0	251.0	0.0	252.0	0.0	253.0	0.0	90
1	247.0	4.3	248.0	4.3	249.0	4.3	250.0	4.4	251.0	4.4	252.0	4.4	253.0	4.4	89
2	246.8	8.6	247.8	8.7	248.8	8.7	249.8	8.7	250.8	8.8	251.8	8.8	252.8	8.8	88
3	246.7	12.9	247.7	13.0	248.7	13.0	249.7	13.1	250.7	13.1	251.7	13.2	252.7	13.2	87
4	246.4	17.2	247.4	17.3	248.4	17.4	249.4	17.4	250.4	17.5	251.4	17.6	252.4	17.6	86
5	246.1	21.5	247.1	21.6	248.1	21.7	249.0	21.8	250.0	21.9	251.0	22.0	252.0	22.1	85
6	245.6	25.8	246.6	25.9	247.6	26.0	248.6	26.1	249.6	26.2	250.6	26.3	251.6	26.4	84
7	245.2	30.1	246.2	30.2	247.1	30.3	248.1	30.5	249.1	30.6	250.1	30.7	251.1	30.8	83
8	244.6	34.4	245.6	34.5	246.6	34.7	247.6	34.8	248.6	34.9	249.5	35.1	250.5	35.2	82
9	244.0	38.6	244.9	38.8	245.9	39.0	246.9	39.1	247.9	39.3	248.9	39.4	249.9	39.6	81
10	243.2	42.9	244.2	43.1	245.2	43.2	246.2	43.4	247.2	43.6	248.2	43.8	249.2	43.9	80
11	242.5	47.1	243.4	47.3	244.4	47.5	245.4	47.7	246.4	47.9	247.4	48.1	248.4	48.3	79
12	241.6	51.4	242.6	51.6	243.6	51.8	244.5	52.0	245.5	52.2	246.5	52.4	247.5	52.6	78
13	240.7	55.6	241.6	55.8	242.6	56.0	243.6	56.2	244.6	56.5	245.5	56.7	246.5	56.9	77
14	239.7	59.8	240.6	60.0	241.6	60.2	242.6	60.5	243.5	60.7	244.5	61.0	245.5	61.2	76
15	238.6	63.9	239.5	64.2	240.5	64.4	241.5	64.7	242.4	65.0	243.4	65.2	244.4	65.5	75
16	237.4	68.1	238.4	68.4	239.4	68.6	240.3	68.9	241.3	69.2	242.2	69.5	243.2	69.7	74
17	236.2	72.2	237.2	72.5	238.1	72.8	239.1	73.1	240.0	73.4	241.0	73.7	241.9	74.0	73
18	234.9	76.3	235.9	76.6	236.8	76.9	237.8	77.3	238.7	77.6	239.7	77.9	240.6	78.2	72
19	233.5	80.4	234.5	80.7	235.4	81.1	236.4	81.4	237.3	81.7	238.3	82.0	239.2	82.4	71
20	232.1	84.5	233.0	84.8	234.0	85.2	234.9	85.5	235.9	85.8	236.8	86.2	237.7	86.5	70
21	230.6	88.5	231.5	88.9	232.5	89.2	233.4	89.6	234.3	90.0	235.3	90.3	236.2	90.7	69
22	229.0	92.5	229.9	92.9	230.9	93.3	231.8	93.7	232.7	94.0	233.7	94.4	234.6	94.8	68
23	227.4	96.5	228.3	96.9	229.2	97.3	230.1	97.7	231.0	98.1	232.0	98.5	232.9	98.9	67
24	225.6	100.5	226.6	100.9	227.5	101.3	228.4	101.7	229.3	102.1	230.2	102.5	231.1	102.9	66
25	223.9	104.4	224.8	104.8	225.7	105.2	226.6	105.7	227.5	106.1	228.4	106.5	229.3	106.9	65
26	222.0	108.3	222.9	108.7	223.8	109.2	224.7	109.6	225.6	110.0	226.5	110.5	227.4	110.9	64
27	220.1	112.1	221.0	112.6	221.9	113.0	222.8	113.5	223.6	114.0	224.5	114.4	225.4	114.9	63
28	218.1	116.0	219.0	116.4	219.9	116.9	220.7	117.4	221.6	117.8	222.5	118.3	223.4	118.8	62
29	216.0	119.7	216.9	120.2	217.8	120.7	218.7	121.2	219.5	121.7	220.4	122.2	221.3	122.7	61
30	213.9	123.5	214.8	124.0	215.6	124.5	216.5	125.0	217.4	125.5	218.2	126.0	219.1	126.5	60
31	211.7	127.2	212.6	127.7	213.4	128.2	214.3	128.8	215.1	129.3	216.0	129.8	216.9	130.3	59
32	209.5	130.9	210.3	131.4	211.2	131.9	212.0	132.5	212.9	133.0	213.7	133.5	214.6	134.1	58
33	207.2	134.5	208.0	135.1	208.8	135.6	209.7	136.2	210.5	136.7	211.3	137.2	212.2	137.8	57
34	204.8	138.1	205.6	138.7	206.4	139.2	207.3	139.8	208.1	140.4	208.9	140.9	209.7	141.5	56
35	202.3	141.7	203.1	142.2	204.0	142.8	204.8	143.4	205.6	144.0	206.4	144.5	207.2	145.1	55
36	199.8	145.2	200.6	145.8	201.4	146.4	202.3	146.9	203.1	147.5	203.9	148.1	204.7	148.7	54
37	197.3	148.6	198.1	149.3	198.9	149.9	199.7	150.5	200.5	151.1	201.3	151.7	202.1	152.3	53
38	194.6	152.1	195.4	152.7	196.2	153.3	197.0	153.9	197.8	154.5	198.6	155.1	199.4	155.8	52
39	192.0	155.4	192.7	156.1	193.5	156.7	194.3	157.3	195.1	158.0	195.8	158.6	196.6	159.2	51
40	189.2	158.8	190.0	159.4	190.7	160.1	191.5	160.7	192.3	161.3	193.0	162.0	193.8	162.6	50
41	186.4	162.0	187.2	162.7	187.9	163.4	188.7	164.0	189.4	164.7	190.2	165.3	190.9	166.0	49
42	183.6	165.3	184.3	165.9	185.0	166.6	185.8	167.3	186.5	168.0	187.3	168.6	188.0	169.3	48
43	180.6	168.5	181.4	169.1	182.1	169.8	182.8	170.5	183.6	171.2	184.3	171.9	185.0	172.5	47
44	177.7	171.6	178.4	172.3	179.1	173.0	179.8	173.7	180.6	174.4	181.3	175.1	182.0	175.7	46
45	174.7	174.7	175.4	175.4	176.1	176.1	176.8	176.8	177.5	177.5	178.2	178.2	178.9	178.9	45

Plane Traverse Table

Course	D=254'		D=255'		D=256'		D=257'		D=258'		D=259'		D=260'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	254.0	0.0	255.0	0.0	256.0	0.0	257.0	0.0	258.0	0.0	259.0	0.0	260.0	0.0	90
1	254.0	4.4	255.0	4.5	256.0	4.5	257.0	4.5	258.0	4.5	259.0	4.5	260.0	4.5	89
2	253.8	8.9	254.8	8.9	255.8	8.9	256.8	8.9	257.8	9.0	258.8	9.0	259.8	9.1	88
3	253.7	13.3	254.7	13.3	255.6	13.4	256.6	13.5	257.6	13.5	258.6	13.6	259.6	13.6	87
4	253.4	17.7	254.4	17.8	255.4	17.9	256.4	17.9	257.4	18.0	258.4	18.1	259.4	18.1	86
5	253.0	22.1	254.0	22.2	255.0	22.3	256.0	22.4	257.0	22.5	258.0	22.6	259.0	22.7	85
6	252.6	26.6	253.6	26.7	254.6	26.8	255.6	26.9	256.6	27.0	257.6	27.1	258.6	27.2	84
7	252.1	31.0	253.1	31.1	254.1	31.2	255.1	31.3	256.1	31.4	257.1	31.6	258.1	31.7	83
8	251.5	35.3	252.5	35.5	253.5	35.6	254.5	35.8	255.5	35.9	256.5	36.0	257.5	36.2	82
9	250.9	39.7	251.9	39.9	252.8	40.0	253.8	40.2	254.8	40.4	255.8	40.5	256.8	40.7	81
10	250.1	44.1	251.1	44.3	252.1	44.5	253.1	44.6	254.1	44.8	255.1	45.0	256.1	45.1	80
11	249.3	48.5	250.3	48.7	251.3	48.8	252.3	49.0	253.3	49.2	254.2	49.4	255.2	49.6	79
12	248.4	52.8	249.4	53.0	250.4	53.2	251.4	53.4	252.4	53.6	253.3	53.8	254.3	54.1	78
13	247.5	57.1	248.5	57.4	249.4	57.6	250.4	57.8	251.4	58.0	252.4	58.3	253.3	58.5	77
14	246.5	61.4	247.4	61.7	248.4	61.9	249.4	62.2	250.3	62.4	251.3	62.7	252.3	62.9	76
15	245.3	65.7	246.3	66.0	247.3	66.3	248.2	66.5	249.2	66.8	250.2	67.0	251.1	67.3	75
16	244.2	70.0	245.1	70.3	246.1	70.6	247.0	70.8	248.0	71.1	249.0	71.4	249.9	71.7	74
17	242.9	74.3	243.9	74.6	244.8	74.8	245.8	75.1	246.7	75.4	247.7	75.7	248.6	76.0	73
18	241.6	78.5	242.5	78.8	243.5	79.1	244.4	79.4	245.4	79.7	246.3	80.0	247.3	80.3	72
19	240.2	82.7	241.1	83.0	242.1	83.3	243.0	83.7	243.9	84.0	244.9	84.3	245.8	84.6	71
20	238.7	86.9	239.6	87.2	240.6	87.6	241.5	87.9	242.4	88.2	243.4	88.6	244.3	88.9	70
21	237.1	91.0	238.1	91.4	239.0	91.7	239.9	92.1	240.9	92.5	241.8	92.8	242.7	93.2	69
22	235.5	95.2	236.4	95.5	237.4	95.9	238.3	96.3	239.2	96.6	240.1	97.0	241.1	97.4	68
23	233.8	99.2	234.7	99.6	235.6	100.0	236.6	100.4	237.5	100.8	238.4	101.2	239.3	101.6	67
24	232.0	103.3	233.0	103.7	233.9	104.1	234.8	104.5	235.7	104.9	236.6	105.3	237.5	105.8	66
25	230.2	107.3	231.1	107.8	232.0	108.2	232.9	108.6	233.8	109.0	234.7	109.5	235.6	109.9	65
26	228.3	111.3	229.2	111.8	230.1	112.2	231.0	112.7	231.9	113.1	232.8	113.5	233.7	114.0	64
27	226.3	115.3	227.2	115.8	228.1	116.2	229.0	116.7	229.9	117.1	230.8	117.6	231.7	118.0	63
28	224.3	119.2	225.2	119.7	226.0	120.2	226.9	120.7	227.8	121.1	228.7	121.6	229.6	122.1	62
29	222.2	123.1	223.0	123.6	223.9	124.1	224.8	124.6	225.7	125.1	226.5	125.6	227.4	126.1	61
30	220.0	127.0	220.8	127.5	221.7	128.0	222.6	128.5	223.4	129.0	224.3	129.5	225.2	130.0	60
31	217.7	130.8	218.6	131.3	219.4	131.8	220.3	132.4	221.1	132.9	222.0	133.4	222.9	133.9	59
32	215.4	134.6	216.3	135.1	217.1	135.7	217.9	136.2	218.8	136.7	219.6	137.2	220.5	137.8	58
33	213.0	138.3	213.9	138.9	214.7	139.4	215.5	140.0	216.4	140.5	217.2	141.1	218.1	141.6	57
34	210.6	142.0	211.4	142.6	212.2	143.2	213.1	143.7	213.9	144.3	214.7	144.8	215.5	145.4	56
35	208.1	145.7	208.9	146.3	209.7	146.8	210.5	147.4	211.3	148.0	212.2	148.6	213.0	149.1	55
36	205.5	149.3	206.3	149.9	207.1	150.5	207.9	151.1	208.7	151.6	209.5	152.2	210.3	152.8	54
37	202.9	152.9	203.7	153.5	204.5	154.1	205.2	154.7	206.0	155.3	206.8	155.9	207.6	156.5	53
38	200.2	156.4	200.9	157.0	201.7	157.6	202.5	158.2	203.3	158.8	204.1	159.5	204.9	160.1	52
39	197.4	159.8	198.2	160.5	198.9	161.1	199.7	161.7	200.5	162.4	201.3	163.0	202.1	163.6	51
40	194.6	163.3	195.3	163.9	196.1	164.6	196.9	165.2	197.6	165.8	198.4	166.5	199.2	167.1	50
41	191.7	166.6	192.5	167.3	193.2	168.0	194.0	168.6	194.7	169.3	195.5	169.9	196.2	170.6	49
42	188.8	170.0	189.5	170.6	190.2	171.3	191.0	172.0	191.7	172.6	192.5	173.3	193.2	174.0	48
43	185.8	173.2	186.5	173.9	187.2	174.6	188.0	175.3	188.7	176.0	189.4	176.6	190.2	177.3	47
44	182.7	176.4	183.4	177.1	184.2	177.8	184.9	178.5	185.6	179.2	186.3	179.9	187.0	180.6	46
45	179.6	179.6	180.3	180.3	181.0	181.0	181.7	181.7	182.4	182.4	183.1	183.1	183.8	183.8	45
Course	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course
	D=254'		D=255'		D=256'		D=257'		D=258'		D=259'		D=260'		

Plane Traverse Table

Course.	D=261'		D=262'		D=263'		D=264'		D=265'		D=266'		D=267'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0															0
1	261.0	0.0	262.0	0.0	263.0	0.0	264.0	0.0	265.0	0.0	266.0	0.0	267.0	0.0	90
2	261.0	4.6	262.0	4.6	263.0	4.6	264.0	4.6	265.0	4.6	266.0	4.6	267.0	4.7	89
3	260.8	9.1	261.8	9.1	262.8	9.2	263.8	9.2	264.8	9.2	265.8	9.3	266.8	9.3	88
4	260.6	13.7	261.6	13.7	262.6	13.8	263.6	13.8	264.6	13.9	265.6	13.9	266.6	14.0	87
5	260.4	18.2	261.4	18.3	262.4	18.3	263.4	18.4	264.4	18.5	265.4	18.6	266.3	18.6	86
6	260.0	22.7	261.0	22.8	262.0	22.9	263.0	23.0	264.0	23.1	265.0	23.2	266.0	23.3	85
7	259.6	27.3	260.6	27.4	261.6	27.5	262.6	27.6	263.5	27.7	264.5	27.8	265.5	27.9	84
8	259.1	31.8	260.0	31.9	261.0	32.1	262.0	32.2	263.0	32.3	264.0	32.4	265.0	32.5	83
9	258.5	36.3	259.5	36.5	260.4	36.6	261.4	36.7	262.4	36.9	263.4	37.0	264.4	37.2	82
10	257.8	40.8	258.8	41.0	259.8	41.1	260.7	41.3	261.7	41.5	262.7	41.6	263.7	41.8	81
11	257.0	45.3	258.0	45.5	259.0	45.7	260.0	45.8	261.0	46.0	262.0	46.2	262.9	46.4	80
12	256.2	49.8	257.2	50.0	258.2	50.2	259.1	50.4	260.1	50.6	261.1	50.8	262.1	50.9	79
13	255.3	54.3	256.3	54.5	257.3	54.7	258.2	54.9	259.2	55.1	260.2	55.3	261.2	55.5	78
14	254.3	58.7	255.3	58.9	256.3	59.2	257.2	59.4	258.2	59.6	259.2	59.8	260.2	60.1	77
15	253.2	63.1	254.2	63.4	255.2	63.6	256.2	63.9	257.1	64.1	258.1	64.4	259.1	64.6	76
16	252.1	67.6	253.1	67.8	254.0	68.1	255.0	68.3	256.0	68.6	256.9	68.8	257.9	69.1	75
17	250.9	71.9	251.9	72.2	252.8	72.5	253.8	72.8	254.7	73.0	255.7	73.3	256.7	73.6	74
18	249.6	76.3	250.6	76.6	251.5	76.9	252.5	77.2	253.4	77.5	254.4	77.8	255.3	78.1	73
19	248.2	80.7	249.2	81.0	250.1	81.3	251.1	81.6	252.0	81.9	253.0	82.2	253.9	82.5	72
20	246.8	85.0	247.7	85.3	248.7	85.6	249.6	86.0	250.6	86.3	251.5	86.6	252.5	86.9	71
21	245.3	89.3	246.2	89.6	247.1	90.0	248.1	90.3	249.0	90.6	250.0	91.0	250.9	91.3	70
22	243.7	93.5	244.6	93.9	245.5	94.3	246.5	94.6	247.4	95.0	248.3	95.3	249.3	95.7	69
23	242.0	97.8	242.9	98.1	243.8	98.5	244.8	98.9	245.7	99.3	246.6	99.6	247.6	100.0	68
24	240.3	102.0	241.2	102.4	242.1	102.8	243.0	103.2	243.9	103.5	244.9	103.9	245.8	104.3	67
25	238.4	106.2	239.3	106.6	240.3	107.0	241.2	107.4	242.1	107.8	243.0	108.2	243.9	108.6	66
26	236.5	110.3	237.5	110.7	238.4	111.1	239.3	111.6	240.2	112.0	241.1	112.4	242.0	112.8	65
27	234.6	114.4	235.5	114.9	236.4	115.3	237.3	115.7	238.2	116.2	239.1	116.6	240.0	117.0	64
28	232.6	118.5	233.4	118.9	234.3	119.4	235.2	119.9	236.1	120.3	237.0	120.8	237.9	121.2	63
29	230.4	122.5	231.3	123.0	232.2	123.5	233.1	123.9	234.0	124.4	234.9	124.9	235.7	125.3	62
30	228.3	126.5	229.2	127.0	230.0	127.5	230.9	128.0	231.8	128.5	232.6	129.0	233.5	129.4	61
31	226.0	130.5	226.9	131.0	227.8	131.5	228.6	132.0	229.5	132.5	230.4	133.0	231.2	133.5	60
32	223.7	134.4	224.6	134.9	225.4	135.5	226.3	136.0	227.1	136.5	228.0	137.0	228.9	137.5	59
33	221.3	138.3	222.2	138.8	223.0	139.4	223.9	139.9	224.7	140.4	225.6	141.0	226.4	141.5	58
34	218.9	142.2	219.7	142.7	220.6	143.2	221.4	143.8	222.2	144.3	223.1	144.9	223.9	145.4	57
35	216.4	145.9	217.2	146.5	218.0	147.1	218.9	147.6	219.7	148.2	220.5	148.7	221.4	149.3	56
36	213.8	149.7	214.6	150.3	215.4	150.9	216.3	151.4	217.1	152.0	217.9	152.6	218.7	153.1	55
37	211.2	153.4	212.0	154.0	212.8	154.6	213.6	155.2	214.4	155.8	215.2	156.4	216.0	156.9	54
38	208.4	157.1	209.2	157.7	210.0	158.3	210.8	158.9	211.6	159.5	212.4	160.1	213.2	160.7	53
39	205.7	160.7	206.5	161.3	207.2	161.9	208.0	162.5	208.8	163.2	209.6	163.8	210.4	164.4	52
40	202.8	164.3	203.6	164.9	204.4	165.5	205.2	166.1	205.9	166.8	206.7	167.4	207.5	168.0	51
41	199.9	167.8	200.7	168.4	201.5	169.1	202.2	169.7	203.0	170.3	203.8	171.0	204.5	171.6	50
42	197.0	171.2	197.7	171.9	198.5	172.5	199.2	173.2	200.0	173.9	200.8	174.5	201.5	175.2	49
43	194.0	174.6	194.7	175.3	195.4	176.0	196.2	176.7	196.9	177.3	197.7	178.0	198.4	178.7	48
44	190.9	178.0	191.6	178.7	192.3	179.4	193.1	180.0	193.8	180.7	194.5	181.4	195.3	182.1	47
45	187.7	181.3	188.5	182.0	189.2	182.7	189.9	183.4	190.6	184.1	191.3	184.8	192.1	185.5	46
46	184.6	184.6	185.3	185.3	186.0	186.0	186.7	186.7	187.4	187.4	188.1	188.1	188.8	188.8	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=261'		D=262'		D=263'		D=264'		D=265'		D=266'		D=267'		

Plane Traverse Table

Course.	D=268'		D=269'		D=270'		D=271'		D=272'		D=273'		D=274'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	268.0	0.0	269.0	0.0	270.0	0.0	271.0	0.0	272.0	0.0	273.0	0.0	274.0	0.0	90
1	268.0	4.7	269.0	4.7	270.0	4.7	271.0	4.7	272.0	4.7	273.0	4.8	274.0	4.8	89
2	267.8	9.4	268.8	9.4	269.8	9.4	270.8	9.5	271.8	9.5	272.8	9.5	273.8	9.6	88
3	267.6	14.0	268.6	14.1	269.6	14.1	270.6	14.2	271.6	14.2	272.6	14.3	273.6	14.3	87
4	267.3	18.7	268.3	18.8	269.3	18.8	270.3	18.9	271.3	19.0	272.3	19.0	273.3	19.1	86
5	267.0	23.4	268.0	23.4	269.0	23.5	270.0	23.6	271.0	23.7	272.0	23.8	273.0	23.9	85
6	266.5	28.0	267.5	28.1	268.5	28.2	269.5	28.3	270.5	28.4	271.5	28.5	272.5	28.6	84
7	266.0	32.7	267.0	32.8	268.0	32.9	269.0	33.0	270.0	33.1	271.0	33.3	272.0	33.4	83
8	265.4	37.3	266.4	37.4	267.4	37.6	268.4	37.7	269.4	37.9	270.3	38.0	271.3	38.1	82
9	264.7	41.9	265.7	42.1	266.7	42.2	267.7	42.4	268.7	42.6	269.6	42.7	270.6	42.9	81
10	263.9	46.5	264.9	46.7	265.9	46.9	266.9	47.1	267.9	47.2	268.9	47.4	269.8	47.6	80
11	263.1	51.1	264.1	51.3	265.0	51.5	266.0	51.7	267.0	51.9	268.0	52.1	269.0	52.3	79
12	262.1	55.7	263.1	55.9	264.1	56.1	265.1	56.3	266.1	56.6	267.0	56.8	268.0	57.0	78
13	261.1	60.3	262.1	60.5	263.1	60.7	264.1	61.0	265.0	61.2	266.0	61.4	267.0	61.6	77
14	260.0	64.8	261.0	65.1	262.0	65.3	263.0	65.6	263.9	65.8	264.9	66.0	265.9	66.3	76
15	258.9	69.4	259.8	69.6	260.8	69.9	261.8	70.1	262.7	70.4	263.7	70.7	264.7	70.9	75
16	257.6	73.9	258.6	74.1	259.5	74.4	260.5	74.7	261.5	75.0	262.4	75.2	263.4	75.5	74
17	256.3	78.4	257.2	78.6	258.2	78.9	259.2	79.2	260.1	79.5	261.1	79.8	262.0	80.1	73
18	254.9	82.8	255.8	83.1	256.8	83.4	257.7	83.7	258.7	84.1	259.6	84.4	260.6	84.7	72
19	253.4	87.3	254.3	87.6	255.3	87.9	256.2	88.2	257.2	88.6	258.1	88.9	259.1	89.2	71
20	251.8	91.7	252.8	92.0	253.7	92.3	254.7	92.7	255.6	93.0	256.5	93.4	257.5	93.7	70
21	250.2	96.0	251.1	96.4	252.1	96.8	253.0	97.1	253.9	97.5	254.9	97.8	255.8	98.2	69
22	248.5	100.4	249.4	100.8	250.3	101.1	251.3	101.5	252.2	101.9	253.1	102.3	254.0	102.6	68
23	246.7	104.7	247.6	105.1	248.5	105.5	249.5	105.9	250.4	106.3	251.3	106.7	252.2	107.1	67
24	244.8	109.0	245.7	109.4	246.7	109.8	247.6	110.2	248.5	110.6	249.4	111.0	250.3	111.4	66
25	242.9	113.3	243.8	113.7	244.7	114.1	245.6	114.5	246.5	115.0	247.4	115.4	248.3	115.8	65
26	240.9	117.5	241.8	117.9	242.7	118.4	243.6	118.8	244.5	119.2	245.4	119.7	246.3	120.1	64
27	238.8	121.7	239.7	122.1	240.6	122.6	241.5	123.0	242.4	123.5	243.2	123.9	244.1	124.4	63
28	236.6	125.8	237.5	126.3	238.4	126.8	239.3	127.2	240.2	127.7	241.0	128.2	241.9	128.6	62
29	234.4	129.9	235.3	130.4	236.1	130.9	237.0	131.4	237.9	131.9	238.8	132.4	239.6	132.8	61
30	232.1	134.0	233.0	134.5	233.8	135.0	234.7	135.5	235.6	136.0	236.4	136.5	237.3	137.0	60
31	229.7	138.0	230.6	138.5	231.4	139.1	232.3	139.6	233.1	140.1	234.0	140.6	234.9	141.1	59
32	227.3	142.0	228.1	142.5	229.0	143.1	229.8	143.6	230.7	144.1	231.5	144.7	232.4	145.2	58
33	224.8	146.0	225.6	146.5	226.4	147.1	227.3	147.6	228.1	148.1	229.0	148.7	229.8	149.2	57
34	222.2	149.9	223.0	150.4	223.8	151.0	224.7	151.5	225.5	152.1	226.3	152.7	227.2	153.2	56
35	219.5	153.7	220.4	154.3	221.2	154.9	222.0	155.4	222.8	156.0	223.6	156.6	224.4	157.2	55
36	216.8	157.5	217.6	158.1	218.4	158.7	219.2	159.3	220.1	159.9	220.9	160.5	221.7	161.1	54
37	214.0	161.3	214.8	161.9	215.6	162.5	216.4	163.1	217.2	163.7	218.0	164.3	218.8	164.9	53
38	211.2	165.0	212.0	165.6	212.8	166.2	213.6	166.8	214.3	167.5	215.1	168.1	215.9	168.7	52
39	208.3	168.7	209.1	169.3	209.8	169.9	210.6	170.5	211.4	171.2	212.2	171.8	212.9	172.4	51
40	205.3	172.3	206.1	172.9	206.8	173.6	207.6	174.2	208.4	174.8	209.1	175.5	209.9	176.1	50
41	202.3	175.8	203.0	176.5	203.8	177.1	204.5	177.8	205.3	178.4	206.0	179.1	206.8	179.8	49
42	199.2	179.3	199.9	180.0	200.6	180.7	201.4	181.3	202.1	182.0	202.9	182.7	203.6	183.3	48
43	196.0	182.8	196.7	183.5	197.5	184.1	198.2	184.8	198.9	185.5	199.7	186.2	200.4	186.9	47
44	192.8	186.2	193.5	186.9	194.2	187.6	194.9	188.3	195.7	188.9	196.4	189.6	197.1	190.3	46
45	189.5	189.5	190.2	190.2	190.9	190.9	191.6	191.6	192.3	192.3	193.0	193.0	193.7	193.7	45

Plane Traverse Table

Course	D=275'		D=276'		D=277'		D=278'		D=279'		D=280'		D=281'		Course
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	275.0	0.0	276.0	0.0	277.0	0.0	278.0	0.0	279.0	0.0	280.0	0.0	281.0	0.0	90
1	275.0	4.8	276.0	4.8	277.0	4.8	278.0	4.9	279.0	4.9	280.0	4.9	281.0	4.9	89
2	274.8	9.6	275.8	9.6	276.8	9.7	277.8	9.7	278.8	9.7	279.8	9.8	280.8	9.8	88
3	274.6	14.4	275.6	14.4	276.6	14.5	277.6	14.5	278.6	14.6	279.6	14.7	280.6	14.7	87
4	274.3	19.2	275.3	19.3	276.3	19.3	277.3	19.4	278.3	19.5	279.3	19.5	280.3	19.6	86
5	274.0	24.0	274.9	24.1	275.9	24.1	276.9	24.2	277.9	24.3	278.9	24.4	279.9	24.5	85
6	273.5	28.7	274.5	28.8	275.5	29.0	276.5	29.1	277.5	29.2	278.5	29.3	279.5	29.4	84
7	273.0	33.5	273.9	33.6	274.9	33.8	275.9	33.9	276.9	34.0	277.9	34.1	278.9	34.2	83
8	272.3	38.3	273.3	38.4	274.3	38.6	275.3	38.7	276.3	38.8	277.3	39.0	278.3	39.1	82
9	271.6	43.0	272.6	43.2	273.6	43.3	274.6	43.5	275.6	43.6	276.6	43.8	277.5	44.0	81
10	270.8	47.8	271.8	47.9	272.8	48.1	273.8	48.3	274.8	48.4	275.7	48.6	276.7	48.8	80
11	269.9	52.5	270.9	52.7	271.9	52.9	272.9	53.0	273.9	53.2	274.9	53.4	275.8	53.6	79
12	269.0	57.2	270.0	57.4	270.9	57.6	271.9	57.8	272.9	58.0	273.9	58.2	274.9	58.4	78
13	268.0	61.9	268.9	62.1	269.9	62.3	270.9	62.5	271.8	62.8	272.8	63.0	273.8	63.2	77
14	266.8	66.5	267.8	66.8	268.8	67.0	269.7	67.3	270.7	67.5	271.7	67.7	272.7	68.0	76
15	265.6	71.2	266.6	71.4	267.6	71.7	268.5	72.0	269.5	72.2	270.5	72.5	271.4	72.7	75
16	264.3	75.8	265.3	76.1	266.3	76.4	267.2	76.6	268.2	76.9	269.2	77.2	270.1	77.5	74
17	263.0	80.4	263.9	80.7	264.9	81.0	265.9	81.3	266.8	81.6	267.8	81.9	268.7	82.2	73
18	261.5	85.0	262.5	85.3	263.4	85.6	264.4	85.9	265.3	86.2	266.3	86.5	267.2	86.8	72
19	260.0	89.5	261.0	89.9	261.9	90.2	262.9	90.5	263.8	90.8	264.7	91.2	265.7	91.5	71
20	258.4	94.1	259.4	94.4	260.3	94.7	261.2	95.1	262.2	95.4	263.1	95.8	264.1	96.1	70
21	256.7	98.6	257.7	98.9	258.6	99.3	259.5	99.6	260.5	100.0	261.4	100.3	262.3	100.7	69
22	255.0	103.0	255.9	103.4	256.8	103.8	257.8	104.1	258.7	104.5	259.6	104.9	260.5	105.3	68
23	253.1	107.5	254.1	107.8	255.0	108.2	255.9	108.6	256.8	109.0	257.7	109.4	258.7	109.8	67
24	251.2	111.9	252.1	112.3	253.1	112.7	254.0	113.1	254.9	113.5	255.8	113.9	256.7	114.3	66
25	249.2	116.2	250.1	116.6	251.0	117.1	252.0	117.5	252.9	117.9	253.8	118.3	254.7	118.8	65
26	247.2	120.6	248.1	121.0	249.0	121.4	249.9	121.9	250.8	122.3	251.7	122.7	252.6	123.2	64
27	245.0	124.8	245.9	125.3	246.8	125.8	247.7	126.2	248.6	126.7	249.5	127.1	250.4	127.6	63
28	242.8	129.1	243.7	129.6	244.6	130.0	245.5	130.5	246.3	131.0	247.2	131.5	248.1	131.9	62
29	240.5	133.3	241.4	133.8	242.3	134.3	243.1	134.8	244.0	135.3	244.9	135.7	245.8	136.2	61
30	238.2	137.5	239.0	138.0	239.9	138.5	240.8	139.0	241.6	139.5	242.5	140.0	243.4	140.5	60
31	235.7	141.6	236.6	142.2	237.4	142.7	238.3	143.2	239.1	143.7	240.0	144.2	240.9	144.7	59
32	233.2	145.7	234.1	146.3	234.9	146.8	235.8	147.3	236.6	147.8	237.5	148.4	238.3	148.9	58
33	230.6	149.8	231.5	150.3	232.3	150.9	233.2	151.4	234.0	152.0	234.8	152.5	235.7	153.0	57
34	228.0	153.8	228.8	154.3	229.6	154.9	230.5	155.5	231.3	156.0	232.1	156.6	233.0	157.1	56
35	225.3	157.7	226.1	158.3	226.9	158.9	227.7	159.5	228.5	160.0	229.4	160.6	230.2	161.2	55
36	222.5	161.6	223.3	162.2	224.1	162.8	224.9	163.4	225.7	164.0	226.5	164.6	227.3	165.2	54
37	219.6	165.5	220.4	166.1	221.2	166.7	222.0	167.3	222.8	167.9	223.6	168.5	224.4	169.1	53
38	216.7	169.3	217.5	169.9	218.3	170.5	219.1	171.2	219.9	171.8	220.6	172.4	221.4	173.0	52
39	213.7	173.1	214.5	173.7	215.3	174.3	216.0	175.0	216.8	175.6	217.6	176.2	218.4	176.8	51
40	210.7	176.8	211.4	177.4	212.2	178.1	213.0	178.7	213.7	179.3	214.5	180.0	215.3	180.6	50
41	207.5	180.4	208.3	181.1	209.1	181.7	209.8	182.4	210.6	183.0	211.3	183.7	212.1	184.4	49
42	204.4	184.0	205.1	184.7	205.9	185.3	206.6	186.0	207.3	186.7	208.1	187.4	208.8	188.0	48
43	201.1	187.5	201.9	188.2	202.6	188.9	203.3	189.6	204.0	190.3	204.8	191.0	205.5	191.6	47
44	197.8	191.0	198.5	191.7	199.3	192.4	200.0	193.1	200.7	193.8	201.4	194.5	202.1	195.2	46
45	194.5	194.5	195.2	195.2	195.9	195.9	196.6	196.6	197.3	197.3	198.0	198.0	198.7	198.7	45

Plane Traverse Table

Course.	D=282'		D=283'		D=284'		D=285'		D=286'		D=287'		D=288'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	282.0	0.0	283.0	0.0	284.0	0.0	285.0	0.0	286.0	0.0	287.0	0.0	288.0	0.0	90
1	282.0	4.9	283.0	4.9	284.0	5.0	285.0	5.0	286.0	5.0	287.0	5.0	288.0	5.0	89
2	281.8	9.8	282.8	9.9	283.8	9.9	284.8	9.9	285.8	10.0	286.8	10.0	287.8	10.1	88
3	281.6	14.8	282.6	14.8	283.6	14.9	284.6	14.9	285.6	15.0	286.6	15.0	287.6	15.1	87
4	281.3	19.7	282.3	19.7	283.3	19.8	284.3	19.9	285.3	20.0	286.3	20.0	287.3	20.1	86
5	280.9	24.6	281.9	24.7	282.9	24.8	283.9	24.8	284.9	24.9	285.9	25.0	286.9	25.1	85
6	280.5	29.5	281.4	29.6	282.4	29.7	283.4	29.8	284.4	29.9	285.4	30.0	286.4	30.1	84
7	279.9	34.4	280.9	34.5	281.9	34.6	282.9	34.7	283.9	34.9	284.9	35.0	285.9	35.1	83
8	279.3	39.2	280.2	39.4	281.2	39.5	282.2	39.7	283.2	39.8	284.2	39.9	285.2	40.1	82
9	278.5	44.1	279.5	44.3	280.5	44.4	281.5	44.6	282.5	44.7	283.5	44.9	284.5	45.1	81
10	277.7	49.0	278.7	49.1	279.7	49.3	280.7	49.5	281.7	49.7	282.6	49.8	283.6	50.0	80
11	276.8	53.8	277.8	54.0	278.8	54.2	279.8	54.4	280.7	54.6	281.7	54.8	282.7	55.0	79
12	275.8	58.6	276.8	58.8	277.8	59.0	278.8	59.3	279.8	59.5	280.7	59.7	281.7	59.9	78
13	274.8	63.4	275.7	63.7	276.7	63.9	277.7	64.1	278.7	64.3	279.6	64.6	280.6	64.8	77
14	273.6	68.2	274.6	68.5	275.6	68.7	276.5	68.9	277.5	69.2	278.5	69.4	279.4	69.7	76
15	272.4	73.0	273.4	73.2	274.3	73.5	275.3	73.8	276.3	74.0	277.2	74.3	278.2	74.5	75
16	271.1	77.7	272.0	78.0	273.0	78.3	274.0	78.6	274.9	78.8	275.9	79.1	276.8	79.4	74
17	269.7	82.4	270.6	82.7	271.6	83.0	272.5	83.3	273.5	83.6	274.5	83.9	275.4	84.2	73
18	268.2	87.1	269.1	87.5	270.1	87.8	271.1	88.1	272.0	88.4	273.0	88.7	273.9	89.0	72
19	266.6	91.8	267.6	92.1	268.5	92.5	269.5	92.8	270.4	93.1	271.4	93.4	272.3	93.8	71
20	265.0	96.4	265.9	96.8	266.9	97.1	267.8	97.5	268.8	97.8	269.7	98.2	270.6	98.5	70
21	263.3	101.1	264.2	101.4	265.1	101.8	266.1	102.1	267.0	102.5	267.9	102.9	268.9	103.2	69
22	261.5	105.6	262.4	106.0	263.3	106.4	264.2	106.8	265.2	107.1	266.1	107.5	267.0	107.9	68
23	259.6	110.2	260.5	110.6	261.4	111.0	262.3	111.4	263.3	111.7	264.2	112.1	265.1	112.5	67
24	257.6	114.7	258.5	115.1	259.4	115.5	260.4	115.9	261.3	116.3	262.2	116.7	263.1	117.1	66
25	255.6	119.2	256.5	119.6	257.4	120.0	258.3	120.4	259.2	120.9	260.1	121.3	261.0	121.7	65
26	253.5	123.6	254.4	124.1	255.3	124.5	256.2	124.9	257.1	125.4	258.0	125.8	258.9	126.3	64
27	251.3	128.0	252.2	128.5	253.0	128.9	253.9	129.4	254.8	129.8	255.7	130.3	256.6	130.7	63
28	249.0	132.4	249.9	132.9	250.8	133.3	251.6	133.8	252.5	134.3	253.4	134.7	254.3	135.2	62
29	246.6	136.7	247.5	137.2	248.4	137.7	249.3	138.2	250.1	138.7	251.0	139.1	251.9	139.6	61
30	244.2	141.0	245.1	141.5	246.0	142.0	246.8	142.5	247.7	143.0	248.5	143.5	249.4	144.0	60
31	241.7	145.2	242.6	145.8	243.4	146.3	244.3	146.8	245.1	147.3	246.0	147.8	246.9	148.3	59
32	239.1	149.4	240.0	150.0	240.8	150.5	241.7	151.0	242.5	151.6	243.4	152.1	244.2	152.6	58
33	236.5	153.6	237.3	154.1	238.2	154.7	239.0	155.2	239.9	155.8	240.7	156.3	241.5	156.9	57
34	233.8	157.7	234.6	158.3	235.4	158.8	236.3	159.4	237.1	159.9	237.9	160.5	238.8	161.0	56
35	231.0	161.7	231.8	162.3	232.6	162.9	233.5	163.5	234.3	164.0	235.1	164.6	235.9	165.2	55
36	228.1	165.8	229.0	166.3	229.8	166.9	230.6	167.5	231.4	168.1	232.2	168.7	233.0	169.3	54
37	225.2	169.7	226.0	170.3	226.8	170.9	227.6	171.5	228.4	172.1	229.2	172.7	230.0	173.3	53
38	222.2	173.6	223.0	174.2	223.8	174.8	224.6	175.5	225.4	176.1	226.2	176.7	226.9	177.3	52
39	219.2	177.5	219.9	178.1	220.7	178.7	221.5	179.4	222.3	180.0	223.0	180.6	223.8	181.2	51
40	216.0	181.3	216.8	181.9	217.6	182.6	218.3	183.2	219.1	183.8	219.9	184.5	220.6	185.1	50
41	212.8	185.0	213.6	185.7	214.3	186.3	215.1	187.0	215.8	187.6	216.6	188.3	217.4	188.9	49
42	209.6	188.7	210.3	189.4	211.1	190.0	211.8	190.7	212.5	191.4	213.3	192.0	214.0	192.7	48
43	206.2	192.3	207.0	193.0	207.7	193.7	208.4	194.4	209.2	195.1	209.9	195.7	210.6	196.4	47
44	202.9	195.9	203.6	196.6	204.3	197.3	205.0	198.0	205.7	198.7	206.5	199.4	207.2	200.1	46
45	199.4	199.4	200.1	200.1	200.8	200.8	201.5	201.5	202.2	202.2	202.9	202.9	203.6	203.6	45
Course.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	Course.
	D=282'		D=283'		D=284'		D=285'		D=286'		D=287'		D=288'		

Plane Traverse Table

Course.	D=289'		D=290'		D=291'		D=292'		D=293'		D=294'		D=295'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	289.0	0.0	290.0	0.0	291.0	0.0	292.0	0.0	293.0	0.0	294.0	0.0	295.0	0.0	90
1	289.0	5.0	290.0	5.1	291.0	5.1	292.0	5.1	293.0	5.1	294.0	5.1	295.0	5.1	89
2	288.8	10.1	289.8	10.1	290.8	10.2	291.8	10.2	292.8	10.2	293.8	10.3	294.8	10.3	88
3	288.6	15.1	289.6	15.2	290.6	15.2	291.6	15.3	292.6	15.3	293.6	15.4	294.6	15.4	87
4	288.3	20.2	289.3	20.2	290.3	20.3	291.3	20.4	292.3	20.4	293.3	20.5	294.3	20.6	86
5	287.9	25.2	288.9	25.3	289.9	25.4	290.9	25.4	291.9	25.5	292.9	25.6	293.9	25.7	85
6	287.4	30.2	288.4	30.3	289.4	30.4	290.4	30.5	291.4	30.6	292.4	30.7	293.4	30.8	84
7	286.8	35.2	287.8	35.3	288.8	35.5	289.8	35.6	290.8	35.7	291.8	35.8	292.8	36.0	83
8	286.2	40.2	287.2	40.4	288.2	40.5	289.2	40.6	290.1	40.8	291.1	40.9	292.1	41.1	82
9	285.4	45.2	286.4	45.4	287.4	45.5	288.4	45.7	289.4	45.8	290.4	46.0	291.4	46.1	81
10	284.6	50.2	285.6	50.4	286.6	50.5	287.6	50.7	288.5	50.9	289.5	51.1	290.5	51.2	80
11	283.7	55.1	284.7	55.3	285.7	55.5	286.6	55.7	287.6	55.9	288.6	56.1	289.6	56.3	79
12	282.7	60.1	283.7	60.3	284.6	60.5	285.6	60.7	286.6	60.9	287.6	61.1	288.6	61.3	78
13	281.6	65.0	282.6	65.2	283.5	65.5	284.5	65.7	285.5	65.9	286.5	66.1	287.4	66.4	77
14	280.4	69.9	281.4	70.2	282.4	70.4	283.3	70.6	284.3	70.9	285.3	71.1	286.2	71.4	76
15	279.2	74.8	280.1	75.1	281.1	75.3	282.1	75.6	283.0	75.8	284.0	76.1	284.9	76.4	75
16	277.8	79.7	278.8	79.9	279.7	80.2	280.7	80.5	281.6	80.8	282.6	81.0	283.6	81.3	74
17	276.4	84.5	277.3	84.8	278.3	85.1	279.2	85.4	280.2	85.7	281.2	86.0	282.1	86.2	73
18	274.9	89.3	275.8	89.6	276.8	89.9	277.7	90.2	278.7	90.5	279.6	90.9	280.6	91.2	72
19	273.3	94.1	274.2	94.4	275.1	94.7	276.1	95.1	277.0	95.4	278.0	95.7	278.9	96.0	71
20	271.6	98.8	272.5	99.2	273.5	99.5	274.4	99.9	275.3	100.2	276.3	100.6	277.2	100.9	70
21	269.8	103.6	270.7	103.9	271.7	104.3	272.6	104.6	273.5	105.0	274.5	105.4	275.4	105.7	69
22	268.0	108.3	268.9	108.6	269.8	109.0	270.7	109.4	271.7	109.8	272.6	110.1	273.5	110.5	68
23	266.0	112.9	266.9	113.3	267.9	113.7	268.8	114.1	269.7	114.5	270.6	114.9	271.5	115.3	67
24	264.0	117.5	264.9	118.0	265.8	118.4	266.8	118.8	267.7	119.2	268.6	119.6	269.5	120.0	66
25	261.9	122.1	262.8	122.6	263.7	123.0	264.6	123.4	265.5	123.8	266.5	124.2	267.4	124.7	65
26	259.8	126.7	260.7	127.1	261.5	127.6	262.4	128.0	263.3	128.4	264.2	128.9	265.1	129.3	64
27	257.5	131.2	258.4	131.7	259.3	132.1	260.2	132.6	261.1	133.0	262.0	133.5	262.8	133.9	63
28	255.2	135.7	256.1	136.1	256.9	136.6	257.8	137.1	258.7	137.6	259.6	138.0	260.5	138.5	62
29	252.8	140.1	253.6	140.6	254.5	141.1	255.4	141.6	256.3	142.0	257.1	142.5	258.0	143.0	61
30	250.3	144.5	251.1	145.0	252.0	145.5	252.9	146.0	253.7	146.5	254.6	147.0	255.5	147.5	60
31	247.7	148.8	248.6	149.4	249.4	149.9	250.3	150.4	251.2	150.9	252.0	151.4	252.9	151.9	59
32	245.1	153.1	245.9	153.7	246.8	154.2	247.6	154.7	248.5	155.3	249.3	155.8	250.2	156.3	58
33	242.4	157.4	243.2	157.9	244.1	158.5	244.9	159.0	245.7	159.6	246.6	160.1	247.4	160.7	57
34	239.6	161.6	240.4	162.2	241.2	162.7	242.1	163.3	242.9	163.8	243.7	164.4	244.6	165.0	56
35	236.7	165.8	237.6	166.3	238.4	166.9	239.2	167.5	240.0	168.1	240.8	168.6	241.6	169.2	55
36	233.8	169.9	234.6	170.5	235.4	171.0	236.2	171.6	237.0	172.2	237.9	172.8	238.7	173.4	54
37	230.8	173.9	231.6	174.5	232.4	175.1	233.2	175.7	234.0	176.3	234.8	176.9	235.6	177.5	53
38	227.7	177.9	228.5	178.5	229.3	179.2	230.1	179.8	230.9	180.4	231.7	181.0	232.5	181.6	52
39	224.6	181.9	225.4	182.5	226.1	183.1	226.9	183.8	227.7	184.4	228.5	185.0	229.3	185.6	51
40	221.4	185.8	222.2	186.4	222.9	187.1	223.7	187.7	224.5	188.3	225.2	189.0	226.0	189.6	50
41	218.1	189.6	218.9	190.3	219.6	190.9	220.4	191.6	221.1	192.2	221.9	192.9	222.6	193.5	49
42	214.8	193.4	215.5	194.0	216.3	194.7	217.0	195.4	217.7	196.1	218.5	196.7	219.2	197.4	48
43	211.4	197.1	212.1	197.8	212.8	198.5	213.6	199.1	214.3	199.8	215.0	200.5	215.7	201.2	47
44	207.9	200.8	208.6	201.5	209.3	202.1	210.0	202.8	210.8	203.5	211.5	204.2	212.2	204.9	46
45	204.4	204.4	205.1	205.1	205.8	205.8	206.5	206.5	207.2	207.2	207.9	207.9	208.6	208.6	45

Plane Traverse Table

Course.	D=296'		D=297'		D=298'		D=299'		D=300'		D=400'		D=500'		Course.
	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	LAT.	DEP.	
0	296.0	0.0	297.0	0.0	298.0	0.0	299.0	0.0	300.0	0.0	400.0	0.0	500.0	0.0	90
1	296.0	5.2	297.0	5.2	298.0	5.2	299.0	5.2	300.0	5.2	399.9	7.0	499.9	8.8	89
2	295.8	10.3	296.8	10.4	297.8	10.4	298.8	10.4	299.8	10.5	399.8	13.9	499.7	17.4	88
3	295.6	15.5	296.6	15.5	297.6	15.6	298.6	15.6	299.6	15.7	399.4	20.9	499.3	26.2	87
4	295.3	20.6	296.3	20.7	297.3	20.8	298.3	20.9	299.3	20.9	399.0	27.9	498.8	34.8	86
5	294.9	25.8	295.9	25.9	296.9	26.0	297.9	26.1	298.9	26.1	398.5	34.9	498.1	43.6	85
6	294.4	30.9	295.4	31.0	296.4	31.1	297.4	31.3	298.4	31.4	397.8	41.8	497.3	52.3	84
7	293.8	36.1	294.8	36.2	295.8	36.3	296.8	36.4	297.8	36.6	397.0	48.7	496.3	61.0	83
8	293.1	41.2	294.1	41.3	295.1	41.5	296.1	41.6	297.1	41.8	396.1	55.7	495.1	69.6	82
9	292.4	46.3	293.3	46.5	294.3	46.6	295.3	46.8	296.3	46.9	395.1	62.6	493.8	78.2	81
10	291.5	51.4	292.5	51.6	293.5	51.7	294.5	51.9	295.4	52.1	393.9	69.5	492.4	86.8	80
11	290.6	56.5	291.5	56.7	292.5	56.9	293.5	57.1	294.5	57.2	392.6	76.3	490.8	95.4	79
12	289.5	61.5	290.5	61.7	291.5	62.0	292.5	62.2	293.4	62.4	391.3	83.1	489.1	104.0	78
13	288.4	66.6	289.4	66.8	290.4	67.0	291.3	67.3	292.3	67.5	389.8	90.0	487.2	112.4	77
14	287.2	71.6	288.2	71.9	289.1	72.1	290.1	72.3	291.1	72.6	388.1	96.7	485.1	121.0	76
15	285.9	76.6	286.9	76.9	287.8	77.1	288.8	77.4	289.8	77.6	386.3	103.5	483.0	129.4	75
16	284.5	81.6	285.5	81.9	286.5	82.1	287.4	82.4	288.4	82.7	384.5	110.2	480.6	137.8	74
17	283.1	86.5	284.0	86.8	285.0	87.1	285.9	87.4	286.9	87.7	382.5	117.0	478.1	146.2	73
18	281.5	91.5	282.5	91.8	283.4	92.1	284.4	92.4	285.3	92.7	380.4	123.6	475.5	154.5	72
19	279.9	96.4	280.8	96.7	281.8	97.0	282.7	97.3	283.7	97.7	378.2	130.2	472.8	162.8	71
20	278.1	101.2	279.1	101.6	280.0	101.9	281.0	102.3	281.9	102.6	375.9	136.8	469.9	171.0	70
21	276.3	106.1	277.3	106.4	278.2	106.8	279.1	107.2	280.1	107.5	373.4	143.4	466.8	179.2	69
22	274.4	110.9	275.4	111.3	276.3	111.6	277.2	112.0	278.2	112.4	370.9	149.8	463.8	187.3	68
23	272.5	115.7	273.4	116.0	274.3	116.4	275.2	116.8	276.2	117.2	368.2	156.3	460.2	195.4	67
24	270.4	120.4	271.3	120.8	272.2	121.2	273.2	121.6	274.1	122.0	365.4	162.7	456.8	203.4	66
25	268.3	125.1	269.2	125.5	270.1	125.9	271.0	126.4	271.9	126.8	362.5	169.0	453.1	211.3	65
26	266.0	129.8	266.9	130.2	267.8	130.6	268.7	131.1	269.6	131.5	359.5	175.4	449.4	219.2	64
27	263.7	134.4	264.6	134.8	265.5	135.3	266.4	135.7	267.3	136.2	356.4	181.6	445.5	227.0	63
28	261.3	139.0	262.2	139.4	263.1	139.9	264.0	140.4	264.9	140.8	353.1	187.8	441.5	234.7	62
29	258.9	143.5	259.8	144.0	260.6	144.5	261.5	145.0	262.4	145.4	349.8	193.9	437.3	242.4	61
30	256.3	148.0	257.2	148.5	258.1	149.0	258.9	149.5	259.8	150.0	346.4	200.0	433.0	250.0	60
31	253.7	152.5	254.6	153.0	255.4	153.5	256.3	154.0	257.1	154.5	342.9	206.0	428.6	257.5	59
32	251.0	156.9	251.9	157.4	252.7	157.9	253.6	158.4	254.4	159.0	339.2	211.9	424.0	265.0	58
33	248.2	161.2	249.1	161.8	249.9	162.3	250.8	162.8	251.6	163.4	335.5	217.8	419.3	272.3	57
34	245.4	165.5	246.2	166.1	247.1	166.6	247.9	167.2	248.7	167.8	331.6	223.7	414.5	279.6	56
35	242.5	169.8	243.3	170.4	244.1	170.9	244.9	171.5	245.7	172.1	327.7	229.4	409.6	286.8	55
36	239.5	174.0	240.3	174.6	241.1	175.2	241.9	175.7	242.7	176.3	323.6	235.1	404.5	293.9	54
37	236.4	178.1	237.2	178.7	238.0	179.3	238.8	179.9	239.6	180.5	319.4	240.7	399.3	300.9	53
38	233.3	182.2	234.0	182.9	234.8	183.5	235.6	184.1	236.4	184.7	315.2	246.3	394.0	307.8	52
39	230.0	186.3	230.8	186.9	231.6	187.5	232.4	188.2	233.1	188.8	310.9	251.7	388.6	314.7	51
40	226.7	190.3	227.5	190.9	228.3	191.6	229.0	192.2	229.8	192.8	306.4	257.1	383.0	321.4	50
41	223.4	194.2	224.1	194.8	224.9	195.5	225.7	196.2	226.4	196.8	301.9	262.4	377.3	328.0	49
42	220.0	198.1	220.7	198.7	221.5	199.4	222.2	200.1	222.9	200.7	297.3	267.7	371.6	334.6	48
43	216.5	201.9	217.2	202.6	217.9	203.2	218.7	203.9	219.4	204.6	292.6	272.8	365.7	341.0	47
44	212.9	205.6	213.6	206.3	214.4	207.0	215.1	207.7	215.8	208.4	287.7	277.9	359.7	347.3	46
45	209.3	209.3	210.0	210.0	210.7	210.7	211.4	211.4	212.1	212.1	282.8	282.8	353.5	353.5	45

★ Total correction of the observed altitude of a Star or Planet.

Star's Altitude	Height of the eye above the sea in metres and feet. [Correction to be subtracted from the observed altitude of Star or Planet.]														Star's Altitude
	3 ^m	4 ^m	5 ^m	6 ^m	7 ^m	8 ^m	9 ^m	10 ^m	11 ^m	12 ^m	13 ^m	14 ^m	15 ^m		
	10'	13'	16'	20'	23'	26'	30'	33'	36'	39'	43'	46'	49'		
8° 0'	9.8	10.3	10.7	11.1	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.6	13.8	8° 0'	
10	9.6	10.1	10.5	10.9	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.6	10	
20	9.5	10.0	10.4	10.8	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.3	13.5	20	
30	9.4	9.9	10.3	10.7	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.4	30	
40	9.3	9.8	10.2	10.6	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1	13.3	40	
50	9.2	9.7	10.1	10.5	10.9	11.2	11.5	11.8	12.1	12.4	12.7	13.0	13.2	50	
9° 0'	9.1	9.6	10.0	10.4	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.1	9° 0'	
20	8.9	9.4	9.8	10.2	10.6	10.9	11.2	11.5	11.8	12.1	12.4	12.7	12.9	20	
40	8.7	9.2	9.6	10.0	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.5	12.7	40	
10° 0'	8.5	9.0	9.4	9.8	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.5	10° 0'	
20	8.4	8.9	9.3	9.7	10.1	10.4	10.7	11.0	11.3	11.6	11.9	12.2	12.4	20	
40	8.2	8.7	9.1	9.5	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.2	40	
11° 0'	8.0	8.5	8.9	9.3	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.0	11° 0'	
30	7.8	8.3	8.7	9.1	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.6	11.8	30	
12° 0'	7.7	8.2	8.6	9.0	9.4	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.7	12° 0'	
30	7.5	8.0	8.4	8.8	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.5	30	
13° 0'	7.3	7.8	8.2	8.6	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.3	13° 0'	
30	7.2	7.7	8.1	8.5	8.9	9.2	9.5	9.8	10.1	10.4	10.7	11.0	11.2	30	
14° 0'	7.0	7.5	7.9	8.3	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.0	14° 0'	
30	6.9	7.4	7.8	8.2	8.6	8.9	9.2	9.5	9.8	10.1	10.4	10.7	10.9	30	
15° 0'	6.8	7.3	7.7	8.1	8.5	8.8	9.1	9.4	9.7	10.0	10.3	10.6	10.8	15° 0'	
30	6.7	7.2	7.6	8.0	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.7	30	
16° 0'	6.5	7.0	7.4	7.8	8.2	8.5	8.8	9.1	9.4	9.7	10.0	10.3	10.5	16° 0'	
17° 0'	6.3	6.8	7.2	7.6	8.0	8.3	8.6	8.9	9.2	9.5	9.8	10.1	10.3	17° 0'	
18° 0'	6.1	6.6	7.0	7.4	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.1	18° 0'	
19° 0'	6.0	6.5	6.9	7.3	7.7	8.0	8.3	8.6	8.9	9.2	9.5	9.8	10.0	19° 0'	
20° 0'	5.8	6.3	6.7	7.1	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.8	20° 0'	
22° 0'	5.6	6.1	6.5	6.9	7.3	7.6	7.9	8.2	8.5	8.8	9.1	9.4	9.6	22° 0'	
24° 0'	5.4	5.9	6.3	6.7	7.1	7.4	7.7	8.0	8.3	8.6	8.9	9.2	9.4	24° 0'	
26° 0'	5.2	5.7	6.1	6.5	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.2	26° 0'	
28° 0'	5.0	5.5	5.9	6.3	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.8	9.0	28° 0'	
30° 0'	4.9	5.4	5.8	6.2	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	8.9	30° 0'	
32° 0'	4.7	5.2	5.6	6.0	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.7	32° 0'	
34° 0'	4.6	5.1	5.5	5.9	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.6	34° 0'	
36° 0'	4.5	5.0	5.4	5.8	6.2	6.5	6.8	7.1	7.4	7.7	8.0	8.3	8.5	36° 0'	
38° 0'	4.4	4.9	5.3	5.7	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.4	38° 0'	
40° 0'	4.3	4.8	5.2	5.6	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.3	40° 0'	
45° 0'	4.2	4.7	5.1	5.5	5.9	6.2	6.5	6.8	7.1	7.4	7.7	8.0	8.2	45° 0'	
50° 0'	4.0	4.5	4.9	5.3	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.0	50° 0'	
55° 0'	3.9	4.4	4.8	5.2	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.7	7.9	55° 0'	
60° 0'	3.7	4.2	4.6	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.7	60° 0'	
65° 0'	3.6	4.1	4.5	4.9	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.6	65° 0'	
70° 0'	3.5	4.0	4.4	4.8	5.2	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.5	70° 0'	
75° 0'	3.4	3.9	4.3	4.7	5.1	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.4	75° 0'	
80° 0'	3.4	3.9	4.3	4.7	5.1	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.4	80° 0'	
85° 0'	3.3	3.8	4.2	4.6	5.0	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.3	85° 0'	
90° 0'	3.2	3.7	4.1	4.5	4.9	5.2	5.5	5.8	6.1	6.4	6.7	7.0	7.2	90° 0'	
Dip of Sea														Horizon.	

Correction for parallax to be subtracted from Star's Correction	Planet's Altitude	Planet's horizontal parallax.										Planet's Altitude	Additional Correction to be added to Correction given for 15 ^m	
		6''	9''	12''	15''	18''	21''	24''	27''	30''	33''			
		10°	30	50	70	90								
	10°	0'.1	0'.1	0'.2	0'.2	0'.3	0'.3	0'.4	0'.4	0'.5	0'.5	10°	16 ^m or 52	'.2
	30	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	30	17	'' 56 .4
	50	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	50	18	'' 59 .6
	70	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	70	19	'' 62 .8
	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90	20	'' 66 1.0

Conversion of Intervals of Mean Solar Time into Equivalent Intervals of Sidereal Time.

A

[Correction to be added to the Interval of Mean Time.]

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

This table gives the *Acceleration* of { Sidereal on Mean Solar Time.
the R.A.M.S. (Sidereal Time at Greenwich Mean Noon).

Conversion of Time into Arc and vice-versa

	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	0m	1m	2m	3m	
m	0	15	30	45	60	75	90	105	120	135	150	165	s	0	15	30	45
4	1	16	31	46	61	76	91	106	121	136	151	166	4	1	16	31	46
8	2	17	32	47	62	77	92	107	122	137	152	167	8	2	17	32	47
12	3	18	33	48	63	78	93	108	123	138	153	168	12	3	18	33	48
16	4	19	34	49	64	79	94	109	124	139	154	169	16	4	19	34	49
20	5	20	35	50	65	80	95	110	125	140	155	170	20	5	20	35	50
24	6	21	36	51	66	81	96	111	126	141	156	171	24	6	21	36	51
28	7	22	37	52	67	82	97	112	127	142	157	172	28	7	22	37	52
32	8	23	38	53	68	83	98	113	128	143	158	173	32	8	23	38	53
36	9	24	39	54	69	84	99	114	129	144	159	174	36	9	24	39	54
40	10	25	40	55	70	85	100	115	130	145	160	175	40	10	25	40	55
44	11	26	41	56	71	86	101	116	131	146	161	176	44	11	26	41	56
48	12	27	42	57	72	87	102	117	132	147	162	177	48	12	27	42	57
52	13	28	43	58	73	88	103	118	133	148	163	178	52	13	28	43	58
56	14	29	44	59	74	89	104	119	134	149	164	179	56	14	29	44	59

Sidereal Time

R

Conversion of Intervals of Sidereal Time into Equivalent Intervals of Mean Solar Time.

[Correction to be subtracted from the Interval of Sidereal Time.]

Sidereal Time

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

This table gives the *Retardation* of Mean Solar on Sidereal Time.

Conversion of Time into Arc and vice-versa.

	12 ^h	13 ^h	14 ^h	15 ^h	16 ^h	17 ^h	18 ^h	19 ^h	20 ^h	21 ^h	22 ^h	23 ^h	0 ^m	1 ^m	2 ^m	3 ^m
m	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
0	180	195	210	225	240	255	270	285	300	315	330	345	0	15	30	45
4	181	196	211	226	241	256	271	286	301	316	331	346	4	16	31	46
8	182	197	212	227	242	257	272	287	302	317	332	347	8	17	32	47
12	183	198	213	228	243	258	273	288	303	318	333	348	12	18	33	48
16	184	199	214	229	244	259	274	289	304	319	334	349	16	19	34	49
20	185	200	215	230	245	260	275	290	305	320	335	350	20	20	35	50
24	186	201	216	231	246	261	276	291	306	321	336	351	24	21	36	51
28	187	202	217	232	247	262	277	292	307	322	337	352	28	22	37	52
32	188	203	218	233	248	263	278	293	308	323	338	353	32	23	38	53
36	189	204	219	234	249	264	279	294	309	324	339	354	36	24	39	54
40	190	205	220	235	250	265	280	295	310	325	340	355	40	25	40	55
44	191	206	221	236	251	266	281	296	311	326	341	356	44	26	41	56
48	192	207	222	237	252	267	282	297	312	327	342	357	48	27	42	57
52	193	208	223	238	253	268	283	298	313	328	343	358	52	28	43	58
56	194	209	224	239	254	269	284	299	314	329	344	359	56	29	44	59

☉ Total correction of the observed altitude of the Sun's lower limb.

Sun's Altitude	Height of the eye above the sea in metres and feet. [Correction to be added to the observed altitude of Sun's lower limb.]															Sun's Altitude
	3 ^m	4 ^m	5 ^m	6 ^m	7 ^m	8 ^m	9 ^m	10 ^m	11 ^m	12 ^m	13 ^m	14 ^m	15 ^m			
	10'	13'	16'	20'	23'	26'	30'	33'	36'	39'	43'	46'	49'			
8° 0'	6.4	5.9	5.5	5.1	4.7	4.4	4.1	3.8	3.5	3.2	2.9	2.6	2.4	8° 0'		
10	6.5	6.0	5.6	5.2	4.8	4.5	4.2	3.9	3.6	3.3	3.0	2.7	2.5	10		
20	6.6	6.1	5.7	5.3	4.9	4.6	4.3	4.0	3.7	3.4	3.1	2.8	2.6	20		
30	6.7	6.2	5.8	5.4	5.0	4.7	4.4	4.1	3.8	3.5	3.2	2.9	2.7	30		
40	6.9	6.4	6.0	5.6	5.2	4.9	4.6	4.3	4.0	3.7	3.4	3.1	2.9	40		
50	7.0	6.5	6.1	5.7	5.3	5.0	4.7	4.4	4.1	3.8	3.5	3.2	3.0	50		
9 0	7.1	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	3.9	3.6	3.3	3.1	9 0		
20	7.3	6.8	6.4	6.0	5.6	5.3	5.0	4.7	4.4	4.1	3.8	3.5	3.3	20		
40	7.5	7.0	6.6	6.2	5.8	5.5	5.2	4.9	4.6	4.3	4.0	3.7	3.5	40		
10 0	7.6	7.1	6.7	6.3	5.9	5.6	5.3	5.0	4.7	4.4	4.1	3.8	3.6	10 0		
20	7.8	7.3	6.9	6.5	6.1	5.8	5.5	5.2	4.9	4.6	4.3	4.0	3.8	20		
40	8.0	7.5	7.1	6.7	6.3	6.0	5.7	5.4	5.1	4.8	4.5	4.2	4.0	40		
11 0	8.1	7.6	7.2	6.8	6.4	6.1	5.8	5.5	5.2	4.9	4.6	4.3	4.1	11 0		
30	8.3	7.8	7.4	7.0	6.6	6.3	6.0	5.7	5.4	5.1	4.8	4.5	4.3	30		
12 0	8.5	8.0	7.6	7.2	6.8	6.5	6.2	5.9	5.6	5.3	5.0	4.7	4.5	12 0		
30	8.7	8.2	7.8	7.4	7.0	6.7	6.4	6.1	5.8	5.5	5.2	4.9	4.7	30		
13 0	8.8	8.3	7.9	7.5	7.1	6.8	6.5	6.2	5.9	5.6	5.3	5.0	4.8	13 0		
30	9.0	8.5	8.1	7.7	7.3	7.0	6.7	6.4	6.1	5.8	5.5	5.2	5.0	30		
14 0	9.1	8.6	8.2	7.8	7.4	7.1	6.8	6.5	6.2	5.9	5.6	5.3	5.1	14 0		
30	9.2	8.7	8.3	7.9	7.5	7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.2	30		
15 0	9.3	8.8	8.4	8.0	7.6	7.3	7.0	6.7	6.4	6.1	5.8	5.5	5.3	15 0		
30	9.4	8.9	8.5	8.1	7.7	7.4	7.1	6.8	6.5	6.2	5.9	5.6	5.4	30		
16 0	9.6	9.1	8.7	8.3	7.9	7.6	7.3	7.0	6.7	6.4	6.1	5.8	5.6	16 0		
17 0	9.8	9.3	8.9	8.5	8.1	7.8	7.5	7.2	6.9	6.6	6.3	6.0	5.8	17 0		
18 0	10.0	9.5	9.1	8.7	8.3	8.0	7.7	7.4	7.1	6.8	6.5	6.2	6.0	18 0		
19 0	10.2	9.7	9.3	8.9	8.5	8.2	7.9	7.6	7.3	7.0	6.7	6.4	6.2	19 0		
20 0	10.3	9.8	9.4	9.0	8.6	8.3	8.0	7.7	7.4	7.1	6.8	6.5	6.3	20 0		
22 0	10.6	10.1	9.7	9.3	8.9	8.6	8.3	8.0	7.7	7.4	7.1	6.8	6.6	22 0		
24 0	10.8	10.3	9.9	9.5	9.1	8.8	8.5	8.2	7.9	7.6	7.3	7.0	6.8	24 0		
26 0	10.9	10.4	10.0	9.6	9.2	8.9	8.6	8.3	8.0	7.7	7.4	7.1	6.9	26 0		
28 0	11.1	10.6	10.2	9.8	9.4	9.1	8.8	8.5	8.2	7.9	7.6	7.3	7.1	28 0		
30 0	11.3	10.8	10.4	10.0	9.6	9.3	9.0	8.7	8.4	8.1	7.8	7.5	7.3	30 0		
32 0	11.4	10.9	10.5	10.1	9.7	9.4	9.1	8.8	8.5	8.2	7.9	7.6	7.4	32 0		
34 0	11.5	11.0	10.6	10.2	9.8	9.5	9.2	8.9	8.6	8.3	8.0	7.7	7.5	34 0		
36 0	11.6	11.1	10.7	10.3	9.9	9.6	9.3	9.0	8.7	8.4	8.1	7.8	7.6	36 0		
38 0	11.7	11.2	10.8	10.4	10.0	9.7	9.4	9.1	8.8	8.5	8.2	7.9	7.7	38 0		
40 0	11.8	11.3	10.9	10.5	10.1	9.8	9.5	9.2	8.9	8.6	8.3	8.0	7.8	40 0		
45 0	11.9	11.4	11.0	10.6	10.2	9.9	9.6	9.3	9.0	8.7	8.4	8.1	7.9	45 0		
50 0	12.1	11.6	11.2	10.8	10.4	10.1	9.8	9.5	9.2	8.9	8.6	8.3	8.1	50 0		
55 0	12.2	11.7	11.3	10.9	10.5	10.2	9.9	9.6	9.3	9.0	8.7	8.4	8.2	55 0		
60 0	12.3	11.8	11.4	11.0	10.6	10.3	10.0	9.7	9.4	9.1	8.8	8.5	8.3	60 0		
65 0	12.4	11.9	11.5	11.1	10.7	10.4	10.1	9.8	9.5	9.2	8.9	8.6	8.4	65 0		
70 0	12.5	12.0	11.6	11.2	10.8	10.5	10.2	9.9	9.6	9.3	9.0	8.7	8.5	70 0		
75 0	12.6	12.1	11.7	11.3	10.9	10.6	10.3	10.0	9.7	9.4	9.1	8.8	8.6	75 0		
80 0	12.7	12.2	11.8	11.4	11.0	10.7	10.4	10.1	9.8	9.5	9.2	8.9	8.7	80 0		
85 0	12.7	12.2	11.8	11.4	11.0	10.7	10.4	10.1	9.8	9.5	9.2	8.9	8.7	85 0		
90 0	12.8	12.3	11.9	11.5	11.1	10.8	10.5	10.2	9.9	9.6	9.3	9.0	8.8	90 0		

Distance of 3.6 4.2 4.7 5.2 5.6 6.0 6.3 6.7 7.0 7.3 7.6 7.9 8.1 Sea Horizon

Additional Correction for Variation of Sun's Semidiameter	Jan. 1	Feb. 1	Mar. 1	April 1	May 1	June 1	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1
		+0'.3	+0'.3	+0'.2	0	-0'.1	-0'.2	-0'.2	-0'.2	-0'.1	0	+0'.1
Additional Correction to be subtracted from Correction given for 15 ^m	16 ^m	17 ^m	18 ^m	19 ^m	20 ^m	21 ^m	22 ^m	23 ^m	24 ^m	25 ^m	26 ^m	27 ^m
	52'	56'	59'	62'	66'	69'	72'	76'	79'	82'	85'	89'
	-0'.2	-0'.4	-0'.6	-0'.8	-1'.0	-1'.2	-1'.4	-1'.6	-1'.8	-1'.9	-2'.0	-2'.1

☉ Total correction of the observed altitude of the Sun's upper limb.

Sun's Altitude	Height of the eye above the sea in metres and feet. [Correction to be subtracted from the observed altitude of Sun's upper limb.]													Sun's Altitude
	3 ^m	4 ^m	5 ^m	6 ^m	7 ^m	8 ^m	9 ^m	10 ^m	11 ^m	12 ^m	13 ^m	14 ^m	15 ^m	
	10'	13'	16'	20'	23'	26'	30'	33'	36'	39'	43'	46'	49'	
8° 0'	25.6	26.1	26.5	26.9	27.3	27.6	27.9	28.2	28.5	28.8	29.1	29.4	29.6	8° 0'
10	25.5	26.0	26.4	26.8	27.2	27.5	27.8	28.1	28.4	28.7	29.0	29.3	29.5	10
20	25.4	25.9	26.3	26.7	27.1	27.4	27.7	28.0	28.3	28.6	28.9	29.2	29.4	20
30	25.3	25.8	26.2	26.6	27.0	27.3	27.6	27.9	28.2	28.5	28.8	29.1	29.3	30
40	25.1	25.6	26.0	26.4	26.8	27.1	27.4	27.7	28.0	28.3	28.6	28.9	29.1	40
50	25.0	25.5	25.9	26.3	26.7	27.0	27.3	27.6	27.9	28.2	28.5	28.8	29.0	50
9 0	24.9	25.4	25.8	26.2	26.6	26.9	27.2	27.5	27.8	28.1	28.4	28.7	28.9	9 0
20	24.7	25.2	25.6	26.0	26.4	26.7	27.0	27.3	27.6	27.9	28.2	28.5	28.7	20
40	24.5	25.0	25.4	25.8	26.2	26.5	26.8	27.1	27.4	27.7	28.0	28.3	28.5	40
10 0	24.4	24.9	25.3	25.7	26.1	26.4	26.7	27.0	27.3	27.6	27.9	28.2	28.4	10 0
20	24.2	24.7	25.1	25.5	25.9	26.2	26.5	26.8	27.1	27.4	27.7	28.0	28.2	20
40	24.0	24.5	24.9	25.3	25.7	26.0	26.3	26.6	26.9	27.2	27.5	27.8	28.0	40
11 0	23.9	24.4	24.8	25.2	25.6	25.9	26.2	26.5	26.8	27.1	27.4	27.7	27.9	11 0
30	23.7	24.2	24.6	25.0	25.4	25.7	26.0	26.3	26.6	26.9	27.2	27.5	27.7	30
12 0	23.5	24.0	24.4	24.8	25.2	25.5	25.8	26.1	26.4	26.7	27.0	27.3	27.5	12 0
30	23.3	23.8	24.2	24.6	25.0	25.3	25.6	25.9	26.2	26.5	26.8	27.1	27.3	30
13 0	23.2	23.7	24.1	24.5	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.0	27.2	13 0
30	23.0	23.5	23.9	24.3	24.7	25.0	25.3	25.6	25.9	26.2	26.5	26.8	27.0	30
14 0	22.9	23.4	23.8	24.2	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	26.9	14 0
30	22.8	23.3	23.7	24.1	24.5	24.8	25.1	25.4	25.7	26.0	26.3	26.6	26.8	30
15 0	22.7	23.2	23.6	24.0	24.4	24.7	25.0	25.3	25.6	25.9	26.2	26.5	26.7	15 0
30	22.6	23.1	23.5	23.9	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.6	30
16 0	22.4	22.9	23.3	23.7	24.1	24.4	24.7	25.0	25.3	25.6	25.9	26.2	26.4	16 0
17 0	22.2	22.7	23.1	23.5	23.9	24.2	24.5	24.8	25.1	25.4	25.7	26.0	26.2	17 0
18 0	22.0	22.5	22.9	23.3	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.0	18 0
19 0	21.8	22.3	22.7	23.1	23.5	23.8	24.1	24.4	24.7	25.0	25.3	25.6	25.8	19 0
20 0	21.7	22.2	22.6	23.0	23.4	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.7	20 0
22 0	21.5	22.0	22.4	22.8	23.2	23.5	23.8	24.1	24.4	24.7	25.0	25.3	25.5	22 0
24 0	21.3	21.8	22.2	22.6	23.0	23.3	23.6	23.9	24.2	24.5	24.8	25.1	25.3	24 0
26 0	21.1	21.6	22.0	22.4	22.8	23.1	23.4	23.7	24.0	24.3	24.6	24.9	25.1	26 0
28 0	20.9	21.4	21.8	22.2	22.6	22.9	23.2	23.5	23.8	24.1	24.4	24.7	24.9	28 0
30 0	20.7	21.2	21.6	22.0	22.4	22.7	23.0	23.3	23.6	23.9	24.2	24.5	24.7	30 0
32 0	20.6	21.1	21.5	21.9	22.3	22.6	22.9	23.2	23.5	23.8	24.1	24.4	24.6	32 0
34 0	20.5	21.0	21.4	21.8	22.2	22.5	22.8	23.1	23.4	23.7	24.0	24.3	24.5	34 0
36 0	20.4	20.9	21.3	21.7	22.1	22.4	22.7	23.0	23.3	23.6	23.9	24.2	24.4	36 0
38 0	20.3	20.8	21.2	21.6	22.0	22.3	22.6	22.9	23.2	23.5	23.8	24.1	24.3	38 0
40 0	20.2	20.7	21.1	21.5	21.9	22.2	22.5	22.8	23.1	23.4	23.7	24.0	24.2	40 0
45 0	20.1	20.6	21.0	21.4	21.8	22.1	22.4	22.7	23.0	23.3	23.6	23.9	24.1	45 0
50 0	19.9	20.4	20.8	21.2	21.6	21.9	22.2	22.5	22.8	23.1	23.4	23.7	23.9	50 0
55 0	19.8	20.3	20.7	21.1	21.5	21.8	22.1	22.4	22.7	23.0	23.3	23.6	23.8	55 0
60 0	19.7	20.2	20.6	21.0	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.5	23.7	60 0
65 0	19.6	20.1	20.5	20.9	21.3	21.6	21.9	22.2	22.5	22.8	23.1	23.4	23.6	65 0
70 0	19.5	20.0	20.4	20.8	21.2	21.5	21.8	22.1	22.4	22.7	23.0	23.3	23.5	70 0
75 0	19.4	19.9	20.3	20.7	21.1	21.4	21.7	22.0	22.3	22.6	22.9	23.2	23.4	75 0
80 0	19.3	19.8	20.2	20.6	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1	23.3	80 0
85 0	19.3	19.8	20.2	20.6	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1	23.3	85 0
90 0	19.2	19.7	20.1	20.5	20.9	21.2	21.5	21.8	22.1	22.4	22.7	23.0	23.2	90 0

Distance of 3.6 4.2 4.7 5.2 5.6 6.0 6.3 6.7 7.0 7.3 7.6 7.9 8.1 Sea Horizon

Additional Correction for Variation of Sun's Semidiameter	Jan. 1	Feb. 1	Mar. 1	April 1	May 1	June 1	July 1	Aug. 1	Sept. 1	Oct. 1	Nov. 1	Dec. 1
		-0'.3	-0'.3	-0'.2	0	+0'.1	+0'.2	+0'.2	+0'.2	+0'.1	0	-0'.1
Additional Correction to be added to Correction for 15 ^m	16 ^m	17 ^m	18 ^m	19 ^m	20 ^m	21 ^m	22 ^m	23 ^m	24 ^m	25 ^m	26 ^m	27 ^m
	52'	56'	59'	62'	66'	69'	72'	76'	79'	82'	85'	89'
	+0'.2	+0'.4	+0'.6	+0'.8	+1'.0	+1'.2	+1'.4	+1'.6	+1'.8	+1'.9	+2'.0	+2'.1

☾ Total correction of the observed altitude of the Moon's lower limb.

Moon's Altitude.	Height of the eye above the sea : 6 metres (20 feet). [Correction to be added to the observed altitude of Moon's lower limb.]														Moon's Altitude.
	Horizontal Semidiameter from <i>Nautical Almanac</i> .														
	14'		15'						16'						
	40''	50''	0''	10''	20''	30''	40''	50''	0''	10''	20''	30''	40''	50''	
8°	57.0	57.8	58.6	59.3	60.1	60.9	61.7	62.4	63.2	64.0	64.7	65.5	66.3	67.1	8°
9	57.6	58.3	59.1	59.8	60.6	61.4	62.2	62.9	63.7	64.5	65.3	66.1	66.8	67.6	9
10	58.0	58.8	59.5	60.3	61.0	61.8	62.6	63.3	64.1	64.9	65.6	66.4	67.2	68.0	10
11	58.3	59.0	59.8	60.6	61.3	62.1	62.9	63.6	64.3	65.2	65.9	66.7	67.5	68.2	11
12	58.5	59.3	60.0	60.8	61.5	62.3	63.1	63.8	64.6	65.4	66.1	66.9	67.7	68.4	12
13	58.6	59.4	60.1	60.9	61.6	62.4	63.2	63.9	64.7	65.5	66.2	67.0	67.8	68.5	13
14	58.7	59.5	60.2	61.0	61.7	62.5	63.3	64.0	64.8	65.6	66.3	67.0	67.8	68.6	14
15	58.7	59.5	60.2	61.0	61.7	62.5	63.3	64.0	64.8	65.5	66.3	67.1	67.8	68.6	15
16	58.7	59.5	60.2	61.0	61.7	62.5	63.2	64.0	64.7	65.5	66.2	67.0	67.7	68.5	16
17	58.6	59.4	60.1	60.9	61.6	62.4	63.1	63.9	64.6	65.4	66.1	66.9	67.6	68.4	17
18	58.5	59.3	60.0	60.8	61.5	62.3	63.0	63.8	64.5	65.3	66.0	66.8	67.5	68.2	18
19	58.4	59.1	59.9	60.6	61.3	62.1	62.9	63.6	64.4	65.1	65.8	66.6	67.3	68.1	19
20	58.2	59.0	59.7	60.5	61.2	61.9	62.7	63.4	64.2	64.9	65.6	66.4	67.1	67.9	20
21	58.0	58.8	59.5	60.3	61.0	61.7	62.5	63.2	63.9	64.7	65.4	66.1	66.9	67.6	21
22	57.8	58.6	59.3	60.0	60.7	61.5	62.2	63.0	63.7	64.4	65.1	65.9	66.6	67.4	22
23	57.6	58.3	59.0	59.7	60.5	61.2	61.9	62.7	63.4	64.1	64.8	65.6	66.3	67.0	23
24	57.3	58.0	58.7	59.5	60.2	60.9	61.6	62.4	63.1	63.8	64.5	65.3	66.0	66.7	24
25	57.0	57.7	58.4	59.2	59.9	60.6	61.3	62.0	62.8	63.5	64.2	64.9	65.7	66.4	25
26	56.7	57.4	58.1	58.9	59.6	60.3	61.0	61.7	62.4	63.2	63.9	64.6	65.3	66.0	26
27	56.4	57.1	57.8	58.5	59.2	59.9	60.6	61.3	62.0	62.8	63.5	64.2	64.9	65.6	27
28	56.0	56.7	57.4	58.1	58.8	59.6	60.3	61.0	61.7	62.4	63.1	63.8	64.5	65.2	28
29	55.6	56.3	57.0	57.7	58.4	59.1	59.8	60.5	61.2	61.9	62.6	63.4	64.0	64.7	29
30	55.2	55.9	56.6	57.3	58.0	58.7	59.4	60.1	60.8	61.5	62.2	62.9	63.6	64.3	30
31	54.8	55.5	56.2	56.9	57.6	58.3	59.0	59.6	60.3	61.0	61.7	62.4	63.1	63.8	31
32	54.4	55.1	55.8	56.5	57.1	57.8	58.5	59.2	59.9	60.6	61.3	61.9	62.6	63.3	32
33	54.0	54.6	55.3	56.0	56.7	57.4	58.0	58.7	59.4	60.1	60.7	61.4	62.1	62.8	33
34	53.5	54.2	54.8	55.5	56.2	56.9	57.5	58.2	58.9	59.6	60.2	60.9	61.6	62.2	34
35	53.0	53.7	54.4	55.0	55.7	56.4	57.0	57.7	58.4	59.0	59.7	60.4	61.0	61.7	35
36	52.5	53.2	53.9	54.5	55.1	55.8	56.5	57.2	57.8	58.5	59.1	59.8	60.5	61.1	36
37	52.0	52.6	53.3	54.0	54.6	55.3	55.9	56.6	57.3	57.9	58.6	59.2	59.9	60.5	37
38	51.5	52.1	52.8	53.4	54.1	54.7	55.4	56.0	56.7	57.3	58.0	58.6	59.3	59.9	38
39	51.0	51.6	52.2	52.9	53.5	54.2	54.8	55.4	56.1	56.7	57.4	58.0	58.7	59.3	39
40	50.4	51.0	51.7	52.3	52.9	53.6	54.2	54.8	55.5	56.1	56.8	57.4	58.0	58.7	40
41	49.8	50.4	51.1	51.7	52.3	53.0	53.6	54.2	54.8	55.5	56.1	56.7	57.4	58.0	41
42	49.2	49.9	50.5	51.1	51.7	52.4	53.0	53.6	54.2	54.8	55.4	56.1	56.7	57.3	42
43	48.6	49.3	49.9	50.5	51.1	51.7	52.3	52.9	53.5	54.2	54.8	55.4	56.0	56.6	43
44	48.0	48.7	49.3	49.9	50.4	51.1	51.7	52.3	52.9	53.5	54.1	54.7	55.3	55.9	44
45	47.4	48.0	48.6	49.2	49.8	50.4	51.0	51.6	52.2	52.8	53.4	54.0	54.6	55.2	45
46	46.8	47.4	48.0	48.6	49.1	49.8	50.3	50.9	51.5	52.1	52.7	53.3	53.9	54.5	46
47	46.1	46.7	47.3	47.9	48.5	49.1	49.6	50.2	50.8	51.4	52.0	52.6	53.1	53.7	47
48	45.5	46.1	46.6	47.2	47.8	48.4	48.9	49.5	50.1	50.7	51.2	51.8	52.4	53.0	48
49	44.8	45.4	45.9	46.5	47.1	47.6	48.2	48.8	49.3	49.9	50.5	51.1	51.6	52.2	49

Height of eye	3 ^m	4 ^m	5 ^m	7 ^m	8 ^m	9 ^m	10 ^m	11 ^m	12 ^m	13 ^m	14 ^m	15 ^m	16 ^m	17 ^m	18 ^m	19 ^m	20 ^m
	10'	13'	16'	23'	26'	30'	33'	36'	39'	43'	46'	49'	52'	56'	59'	62'	66'
Additional correction	+1.3	+0.8	+0.4	-0.4	-0.7	-1.0	-1.3	-1.6	-1.9	-2.2	-2.5	-2.7	-2.9	-3.1	-3.3	-3.5	-3.7

Observation. For ☾ *subtract* the Moon's Diameter from values given for ☾.

⌋ Total correction of the observed altitude of the Moon's lower limb.

Height of the eye above the sea : 6 metres (20 feet).

[Correction to be added to the observed altitude of Moon's lower limb.]

Horizontal Semidiameter from *Nautical Almanac*.

Moon's Altitude.	Horizontal Semidiameter from <i>Nautical Almanac</i> .															Moon's Altitude.
	14'		15'					16'								
	40"	50"	0"	10"	20"	30"	40"	50"	0"	10"	20"	30"	40"	50"		
49°	44.8	45.4	45.9	46.5	47.1	47.6	48.2	48.8	49.3	49.9	50.5	51.1	51.6	52.2	49°	
50	44.1	44.7	45.3	45.8	46.4	46.9	47.5	48.0	48.6	49.2	49.7	50.3	50.9	51.4	50	
51	43.4	44.0	44.5	45.1	45.6	46.2	46.7	47.3	47.8	48.4	48.9	49.5	50.0	50.6	51	
52	42.7	43.3	43.8	44.3	44.9	45.5	46.0	46.5	47.1	47.6	48.1	48.7	49.2	49.8	52	
53	42.0	42.5	43.1	43.6	44.1	44.7	45.2	45.7	46.3	46.8	47.3	47.9	48.4	48.9	53	
54	41.3	41.8	42.3	42.8	43.4	43.9	44.4	44.9	45.5	46.0	46.5	47.1	47.6	48.1	54	
55	40.5	41.0	41.6	42.1	42.6	43.1	43.6	44.1	44.7	45.2	45.7	46.2	46.7	47.3	55	
56	39.8	40.3	40.8	41.3	41.8	42.3	42.8	43.3	43.9	44.4	44.9	45.4	45.9	46.4	56	
57	39.0	39.5	40.0	40.5	41.0	41.5	42.0	42.5	43.0	43.5	44.0	44.5	45.0	45.5	57	
58	38.3	38.8	39.2	39.7	40.2	40.7	41.2	41.7	42.2	42.7	43.2	43.7	44.2	44.6	58	
59	37.5	38.0	38.4	38.9	39.4	39.9	40.4	40.8	41.3	41.8	42.3	42.8	43.3	43.7	59	
60	36.7	37.2	37.6	38.1	38.6	39.1	39.5	40.0	40.5	41.0	41.4	41.9	42.4	42.8	60	
61	35.9	36.4	36.8	37.3	37.8	38.2	38.7	39.1	39.6	40.1	40.5	41.0	41.5	41.9	61	
62	35.1	35.6	36.0	36.5	36.9	37.4	37.8	38.3	38.7	39.2	39.6	40.1	40.6	41.0	62	
63	34.3	34.7	35.2	35.6	36.1	36.5	37.0	37.4	37.8	38.3	38.7	39.2	39.6	40.1	63	
64	33.5	33.9	34.3	34.8	35.2	35.7	36.1	36.5	37.0	37.4	37.8	38.3	38.7	39.1	64	
65	32.7	33.1	33.5	33.9	34.4	34.8	35.2	35.6	36.1	36.5	36.9	37.3	37.8	38.2	65	
66	31.8	32.2	32.6	33.1	33.5	33.9	34.3	34.7	35.1	35.6	36.0	36.4	36.8	37.2	66	
67	31.0	31.4	31.8	32.2	32.6	33.0	33.4	33.8	34.2	34.6	35.0	35.5	35.9	36.3	67	
68	30.2	30.5	30.9	31.3	31.7	32.1	32.5	32.9	33.3	33.7	34.1	34.5	34.9	35.3	68	
69	29.3	29.7	30.1	30.4	30.8	31.2	31.6	32.0	32.4	32.8	33.2	33.5	33.9	34.3	69	
70	28.4	28.8	29.2	29.6	29.9	30.3	30.7	31.0	31.4	31.8	32.2	32.6	32.9	33.3	70	
71	27.5	27.9	28.3	28.6	29.0	29.4	29.7	30.1	30.5	30.9	31.2	31.6	31.9	32.3	71	
72	26.7	27.0	27.4	27.7	28.1	28.5	28.8	29.2	29.5	29.9	30.2	30.6	30.9	31.3	72	
73	25.8	26.1	26.5	26.8	27.2	27.5	27.9	28.2	28.6	28.9	29.3	29.6	29.9	30.3	73	
74	24.9	25.3	25.6	25.9	26.3	26.6	26.9	27.3	27.6	27.9	28.3	28.6	28.9	29.3	74	
75	24.0	24.4	24.7	25.0	25.3	25.7	26.0	26.3	26.6	27.0	27.3	27.6	27.9	28.3	75	
76	23.1	23.5	23.8	24.1	24.4	24.7	25.0	25.3	25.7	26.0	26.3	26.6	26.9	27.2	76	
77	22.3	22.6	22.9	23.2	23.5	23.8	24.1	24.4	24.7	25.0	25.3	25.6	25.9	26.2	77	
78	21.4	21.7	21.9	22.2	22.5	22.8	23.1	23.4	23.7	24.0	24.3	24.6	24.9	25.2	78	
79	20.4	20.7	21.0	21.3	21.6	21.9	22.1	22.4	22.7	23.0	23.3	23.6	23.9	24.1	79	
80	19.5	19.8	20.1	20.4	20.6	20.9	21.2	21.5	21.7	22.0	22.3	22.6	22.8	23.1	80	
81	18.6	18.9	19.2	19.4	19.7	20.0	20.2	20.5	20.7	21.0	21.3	21.5	21.8	22.1	81	
82	17.7	18.0	18.2	18.5	18.7	19.0	19.3	19.5	19.8	20.0	20.3	20.5	20.8	21.0	82	
83	16.8	17.0	17.3	17.5	17.8	18.0	18.3	18.5	18.8	19.0	19.2	19.5	19.7	20.0	83	
84	15.9	16.1	16.4	16.6	16.8	17.1	17.3	17.5	17.8	18.0	18.2	18.5	18.7	18.9	84	
85	15.0	15.2	15.4	15.6	15.9	16.1	16.3	16.5	16.8	17.0	17.2	17.4	17.6	17.9	85	
86	14.1	14.3	14.5	14.7	14.9	15.1	15.3	15.5	15.8	16.0	16.2	16.4	16.6	16.8	86	
87	13.1	13.3	13.5	13.7	13.9	14.2	14.3	14.5	14.7	14.9	15.1	15.3	15.5	15.7	87	
88	12.2	12.4	12.6	12.8	13.0	13.2	13.4	13.5	13.7	13.9	14.1	14.3	14.5	14.7	88	
89	11.3	11.5	11.7	11.8	12.0	12.2	12.4	12.6	12.7	12.9	13.1	13.3	13.4	13.6	89	
90	10.4	10.5	10.7	10.9	11.1	11.2	11.4	11.6	11.7	11.9	12.1	12.2	12.4	12.6	90	

Height of eye	3 ^m	4 ^m	5 ^m	7 ^m	8 ^m	9 ^m	10 ^m	11 ^m	12 ^m	13 ^m	14 ^m	15 ^m	16 ^m	17 ^m	18 ^m	19 ^m	20 ^m
	10'	13'	16'	23'	26'	30'	33'	36'	39'	43'	46'	49'	52'	55'	59'	62'	66'
Additional correction	+1.3	+0.8	+0.4	-0.4	-0.7	-1.0	-1.3	-1.6	-1.9	-2.2	-2.5	-2.7	-2.9	-3.1	-3.3	-3.5	-3.7

Observation. For ⌋ subtract the Moon's Diameter from values given for ⌋.

Number of Minutes of b

$\frac{60'}{\Delta}$	Number of Minutes of b															$\frac{\Delta}{60'}$
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	
1.00	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	1.00
1.02	1.0	2.0	3.0	4.0	5.0	5.9	6.9	7.9	8.9	9.8	10.8	11.8	12.8	13.8	14.7	0.98
1.03	1.0	2.0	2.9	3.9	4.9	5.8	6.8	7.7	8.7	9.7	10.6	11.6	12.6	13.5	14.5	.97
1.05	1.0	1.9	2.9	3.8	4.8	5.7	6.7	7.6	8.6	9.5	10.5	11.4	12.3	13.3	14.2	.95
1.07	0.9	1.9	2.8	3.8	4.7	5.6	6.6	7.4	8.4	9.3	10.3	11.2	12.1	13.1	14.0	.93
1.09	0.9	1.9	2.8	3.7	4.6	5.5	6.5	7.3	8.3	9.2	10.1	11.0	11.9	12.8	13.7	0.92
1.11	.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	.90
1.13	.9	1.8	2.7	3.6	4.5	5.3	6.2	7.1	8.0	8.8	9.7	10.6	11.5	12.4	13.2	.88
1.15	.9	1.8	2.6	3.5	4.4	5.2	6.1	6.9	7.8	8.7	9.5	10.4	11.2	12.1	13.0	.87
1.18	.8	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	9.4	10.2	11.0	11.9	12.7	.85
1.20	0.8	1.7	2.5	3.4	4.2	5.0	5.9	6.7	7.5	8.3	9.2	10.0	10.8	11.7	12.5	0.83
1.22	.8	1.6	2.5	3.4	4.1	4.9	5.7	6.5	7.4	8.2	9.0	9.8	10.6	11.4	12.2	.82
1.25	.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	.80
1.28	.8	1.6	2.4	3.2	4.0	4.7	5.5	6.3	7.1	7.8	8.6	9.4	10.2	11.0	11.7	.78
1.30	.8	1.6	2.3	3.1	3.9	4.6	5.4	6.1	6.9	7.7	8.4	9.2	10.0	10.7	11.5	.77
1.33	0.8	1.5	2.3	3.0	3.8	4.5	5.3	6.0	6.8	7.5	8.3	9.0	9.7	10.5	11.2	0.75
1.36	.7	1.5	2.2	3.0	3.7	4.4	5.2	5.9	6.6	7.3	8.1	8.8	9.5	10.3	11.0	.73
1.40	.7	1.4	2.2	2.9	3.6	4.3	5.0	5.7	6.5	7.2	7.9	8.6	9.3	10.0	10.7	.72
1.43	.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	.70
1.46	.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5	6.2	6.8	7.5	8.2	8.9	9.6	10.2	.68
1.50	0.7	1.3	2.0	2.7	3.4	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.3	10.0	0.67
1.54	.7	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.5	7.2	7.8	8.4	9.1	9.7	.65
1.58	.6	1.3	1.9	2.6	3.2	3.8	4.5	5.1	5.7	6.3	7.0	7.6	8.2	8.9	9.5	.63
1.62	.6	1.2	1.9	2.5	3.1	3.7	4.3	4.9	5.6	6.2	6.8	7.4	8.0	8.6	9.2	.62
1.67	.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	.60
1.71	0.6	1.2	1.8	2.4	2.9	3.5	4.1	4.7	5.3	5.8	6.4	7.0	7.6	8.2	8.7	.58
1.76	.6	1.1	1.7	2.3	2.9	3.4	4.0	4.5	5.1	5.7	6.2	6.8	7.4	7.9	8.5	.57
1.82	.6	1.1	1.7	2.2	2.8	3.3	3.9	4.4	5.0	5.5	6.1	6.6	7.1	7.7	8.2	.55
1.88	.5	1.1	1.6	2.2	2.7	3.2	3.8	4.3	4.8	5.3	5.9	6.4	6.9	7.5	8.0	.53
1.94	.5	1.0	1.6	2.1	2.6	3.1	3.6	4.1	4.7	5.2	5.7	6.2	6.7	7.2	7.7	.52
2.00	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	0.50
2.07	.5	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.8	5.3	5.8	6.3	6.8	7.2	.48
2.14	.5	0.9	1.4	1.9	2.4	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.1	6.5	7.0	.47
2.22	.5	.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.8	6.3	6.7	.45
2.31	.4	.9	1.3	1.7	2.2	2.6	3.1	3.5	3.9	4.3	4.8	5.2	5.6	6.1	6.5	.43
2.40	0.4	0.8	1.3	1.7	2.1	2.5	2.9	3.3	3.8	4.2	4.6	5.0	5.4	5.8	6.2	0.42
2.50	.4	.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	.40
2.61	.4	.8	1.2	1.5	1.9	2.3	2.7	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.7	.38
2.73	.4	.7	1.1	1.5	1.9	2.2	2.6	2.9	3.3	3.7	4.0	4.4	4.8	5.1	5.5	.37
2.86	.4	.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.2	4.5	4.9	5.2	.35
3.00	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.3	4.7	5.0	0.33
3.16	.3	.6	1.0	1.3	1.6	1.9	2.2	2.5	2.9	3.2	3.5	3.8	4.1	4.4	4.7	.32
3.33	.3	.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	.30
3.53	.3	.6	.9	1.1	1.4	1.7	2.0	2.3	2.6	2.8	3.1	3.4	3.7	4.0	4.2	.28
3.75	.3	.5	.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4.0	.27
4.00	0.3	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.2	3.5	3.7	0.25
4.29	.2	.5	.7	0.9	1.2	1.4	1.6	1.9	2.1	2.3	2.6	2.8	3.0	3.3	3.5	.23
4.62	.2	.4	.7	.9	1.1	1.3	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.2	.22
5.00	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	.20
5.45	.2	.4	.6	.7	0.9	1.1	1.3	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.7	.18
6.00	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5	0.17
6.67	.2	.3	.5	.6	.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	.15
7.50	.1	.3	.4	.5	.7	.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	.13
8.57	.1	.2	.4	.5	.6	.7	.8	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	.12
10.0	.1	.2	.3	.4	.5	.6	.7	.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	.10
12.0	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2	0.08
15.0	.1	.1	.2	.3	.3	.4	.5	.5	.6	.7	.7	0.8	0.9	0.9	1.0	.07
20.0	.1	.1	.2	.2	.3	.3	.4	.4	.5	.5	.6	.6	.7	.7	0.7	.05
30.0	.1	.1	.1	.1	.2	.2	.2	.3	.3	.3	.4	.4	.4	.5	.5	.03
60.0	.0	.0	.1	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2	.02

60' Δ	Number of Minutes of δ														Δ 60'	
	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	26'	27'	28'	29'		30'
1.00	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	1.00
1.02	15.7	16.7	17.7	18.7	19.7	20.7	21.6	22.6	23.6	24.6	25.6	26.6	27.5	28.5	29.5	0.98
1.03	15.5	16.5	17.4	18.4	19.3	20.3	21.3	22.2	23.2	24.2	25.1	26.1	27.1	28.0	29.0	.97
1.05	15.2	16.2	17.1	18.1	19.0	20.0	20.9	21.9	22.8	23.8	24.7	25.7	26.6	27.6	28.5	.95
1.07	14.9	15.9	16.8	17.7	18.7	19.6	20.5	21.5	22.4	23.3	24.3	25.2	26.1	27.1	28.0	.93
1.09	14.7	15.6	16.5	17.4	18.3	19.3	20.2	21.1	22.0	22.9	23.8	24.8	25.7	26.6	27.5	0.92
1.11	14.4	15.3	16.2	17.1	18.0	18.9	19.8	20.7	21.6	22.5	23.4	24.3	25.2	26.1	27.0	.90
1.13	14.1	15.0	15.9	16.8	17.7	18.6	19.4	20.3	21.2	22.1	23.0	23.9	24.7	25.6	26.5	.88
1.15	13.9	14.8	15.6	16.5	17.3	18.2	19.1	19.9	20.8	21.7	22.5	23.4	24.3	25.1	26.0	.87
1.18	13.6	14.5	15.3	16.2	17.0	17.9	18.7	19.6	20.4	21.3	22.1	23.0	23.8	24.7	25.5	.85
1.20	13.3	14.2	15.0	15.8	16.7	17.5	18.3	19.2	20.0	20.8	21.7	22.5	23.3	24.2	25.0	0.83
1.22	13.1	13.9	14.7	15.5	16.3	17.2	18.0	18.8	19.6	20.4	21.2	22.1	22.9	23.7	24.5	.82
1.25	12.8	13.6	14.4	15.2	16.0	16.8	17.6	18.4	19.2	20.0	20.8	21.6	22.4	23.2	24.0	.80
1.28	12.5	13.3	14.1	14.9	15.7	16.5	17.2	18.0	18.8	19.6	20.4	21.2	21.9	22.7	23.5	.78
1.30	12.3	13.0	13.8	14.6	15.3	16.1	16.9	17.6	18.4	19.2	19.9	20.7	21.5	22.2	23.0	.77
1.33	12.0	12.8	13.5	14.3	15.0	15.8	16.5	17.3	18.0	18.8	19.5	20.3	21.0	21.8	22.5	0.75
1.36	11.7	12.5	13.2	13.9	14.7	15.4	16.1	16.9	17.6	18.3	19.1	19.8	20.5	21.3	22.0	.73
1.40	11.5	12.2	12.9	13.6	14.3	15.1	15.8	16.5	17.2	17.9	18.6	19.4	20.1	20.8	21.5	.72
1.43	11.2	11.9	12.6	13.3	14.0	14.7	15.4	16.1	16.8	17.5	18.2	18.9	19.6	20.3	21.0	.70
1.46	10.9	11.6	12.3	13.0	13.7	14.4	15.0	15.7	16.4	17.1	17.8	18.5	19.1	19.8	20.5	.68
1.50	10.7	11.3	12.0	12.7	13.3	14.0	14.7	15.3	16.0	16.7	17.3	18.0	18.7	19.3	20.0	0.67
1.54	10.4	11.1	11.7	12.4	13.0	13.7	14.3	15.0	15.6	16.3	16.9	17.6	18.2	18.9	19.5	.65
1.58	10.1	10.8	11.4	12.0	12.7	13.3	13.9	14.6	15.2	15.8	16.5	17.1	17.7	18.4	19.0	.63
1.62	9.9	10.5	11.1	11.7	12.3	13.0	13.6	14.2	14.8	15.4	16.0	16.7	17.3	17.9	18.5	.62
1.67	9.6	10.2	10.8	11.4	12.0	12.6	13.2	13.8	14.4	15.0	15.6	16.2	16.8	17.4	18.0	.60
1.71	9.3	9.9	10.5	11.1	11.7	12.3	12.8	13.4	14.0	14.6	15.2	15.8	16.3	16.9	17.5	0.58
1.76	9.1	9.6	10.2	10.8	11.3	11.9	12.5	13.0	13.6	14.2	14.7	15.3	15.9	16.4	17.0	.57
1.82	8.8	9.4	9.9	10.5	11.0	11.6	12.1	12.7	13.2	13.8	14.3	14.9	15.4	16.0	16.5	.55
1.88	8.5	9.1	9.6	10.1	10.7	11.2	11.7	12.3	12.8	13.3	13.9	14.4	14.9	15.5	16.0	.53
1.94	8.3	8.8	9.3	9.8	10.3	10.9	11.4	11.9	12.4	12.9	13.4	14.0	14.5	15.0	15.5	.52
2.00	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	0.50
2.07	7.7	8.2	8.7	9.2	9.7	10.2	10.6	11.1	11.6	12.1	12.6	13.1	13.5	14.0	14.5	.48
2.14	7.5	7.9	8.4	8.9	9.3	9.8	10.3	10.7	11.2	11.7	12.1	12.6	13.1	13.5	14.0	.47
2.22	7.2	7.7	8.1	8.6	9.0	9.5	9.9	10.4	10.8	11.3	11.7	12.2	12.6	13.1	13.5	.45
2.31	6.9	7.4	7.8	8.2	8.7	9.1	9.5	10.0	10.4	10.8	11.3	11.7	12.1	12.6	13.0	.43
2.40	6.7	7.1	7.5	7.9	8.3	8.8	9.2	9.6	10.0	10.4	10.8	11.3	11.7	12.1	12.5	0.42
2.50	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.2	9.6	10.0	10.4	10.8	11.2	11.6	12.0	.40
2.61	6.1	6.5	6.9	7.3	7.7	8.1	8.4	8.8	9.2	9.6	10.0	10.4	10.7	11.1	11.5	.38
2.73	5.9	6.2	6.6	7.0	7.3	7.7	8.1	8.4	8.8	9.2	9.5	9.9	10.3	10.6	11.0	.37
2.86	5.6	6.0	6.3	6.7	7.0	7.4	7.7	8.1	8.4	8.8	9.1	9.5	9.8	10.2	10.5	.35
3.00	5.3	5.7	6.0	6.3	6.7	7.0	7.3	7.7	8.0	8.3	8.7	9.0	9.3	9.7	10.0	0.33
3.16	5.1	5.4	5.7	6.0	6.3	6.7	7.0	7.3	7.6	7.9	8.2	8.6	8.9	9.2	9.5	.32
3.33	4.8	5.1	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	.30
3.53	4.5	4.8	5.1	5.4	5.7	6.0	6.2	6.5	6.8	7.1	7.4	7.7	7.9	8.2	8.5	.28
3.75	4.3	4.6	4.8	5.1	5.3	5.6	5.9	6.1	6.4	6.7	6.9	7.2	7.5	7.7	8.0	.27
4.00	4.0	4.3	4.5	4.8	5.0	5.3	5.5	5.8	6.0	6.3	6.5	6.8	7.0	7.3	7.5	0.25
4.29	3.7	4.0	4.2	4.4	4.7	4.9	5.1	5.4	5.6	5.8	6.1	6.3	6.5	6.8	7.0	.23
4.62	3.5	3.7	3.9	4.1	4.3	4.6	4.8	5.0	5.2	5.4	5.6	5.9	6.1	6.3	6.5	.22
5.00	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	.20
5.45	2.9	3.1	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.6	4.8	5.0	5.1	5.3	5.5	.18
6.00	2.7	2.8	3.0	3.2	3.3	3.5	3.7	3.8	4.0	4.2	4.3	4.5	4.7	4.8	5.0	0.17
6.67	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	4.5	.15
7.50	2.1	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.7	3.9	4.0	.13
8.57	1.9	2.0	2.1	2.2	2.3	2.5	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5	.12
10.0	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	.10
12.0	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	0.08
15.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	.07
20.0	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	.05
30.0	.5	.6	.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	.03
60.0	.3	.3	.3	.3	.3	.4	.4	.4	.4	.4	.4	.5	.5	0.5	0.5	.02

60' Δ	Number of Minutes of δ															Δ 60'
	31'	32'	33'	34'	35'	36'	37'	38'	39'	40'	41'	42'	43'	44'	45'	
I.00	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	I.00
I.02	30.5	31.5	32.5	33.4	34.4	35.4	36.4	37.4	38.4	39.3	40.3	41.3	42.3	43.3	44.3	0.98
I.03	30.0	30.9	31.9	32.9	33.8	34.8	35.8	36.7	37.7	38.7	39.6	40.6	41.6	42.5	43.5	.97
I.05	29.5	30.4	31.4	32.3	33.3	34.2	35.2	36.1	37.1	38.0	39.0	39.9	40.9	41.8	42.8	.95
I.07	28.9	29.9	30.8	31.7	32.7	33.6	34.5	35.5	36.4	37.3	38.3	39.2	40.1	41.1	42.0	.93
I.09	28.4	29.3	30.3	31.2	32.1	33.0	33.9	34.8	35.8	36.7	37.6	38.5	39.4	40.3	41.3	0.92
I.11	27.9	28.8	29.7	30.6	31.5	32.4	33.3	34.2	35.1	36.0	36.9	37.8	38.7	39.6	40.5	.90
I.13	27.4	28.3	29.2	30.0	30.9	31.8	32.7	33.6	34.5	35.3	36.2	37.1	38.0	38.9	39.8	.88
I.15	26.9	27.7	28.6	29.5	30.3	31.2	32.1	32.9	33.8	34.7	35.5	36.4	37.3	38.1	39.0	.87
I.18	26.4	27.2	28.1	28.9	29.8	30.6	31.5	32.3	33.2	34.0	34.9	35.7	36.6	37.4	38.3	.85
I.20	25.8	26.7	27.5	28.3	29.2	30.0	30.8	31.7	32.5	33.3	34.2	35.0	35.8	36.7	37.5	0.83
I.22	25.3	26.1	27.0	27.8	28.6	29.4	30.2	31.0	31.9	32.7	33.5	34.3	35.1	35.9	36.8	.82
I.25	24.8	25.6	26.4	27.2	28.0	28.8	29.6	30.4	31.2	32.0	32.8	33.6	34.4	35.2	36.0	.80
I.28	24.3	25.1	25.9	26.6	27.4	28.2	29.0	29.8	30.6	31.3	32.1	32.9	33.7	34.5	35.3	.78
I.30	23.8	24.5	25.3	26.1	26.8	27.6	28.4	29.1	29.9	30.7	31.4	32.2	33.0	33.7	34.5	.77
I.33	23.3	24.0	24.8	25.5	26.3	27.0	27.8	28.5	29.3	30.0	30.8	31.5	32.3	33.0	33.8	0.75
I.36	22.8	23.5	24.2	24.9	25.7	26.4	27.1	27.9	28.6	29.3	30.1	30.8	31.5	32.3	33.0	.73
I.40	22.3	22.9	23.7	24.4	25.1	25.8	26.5	27.2	28.0	28.7	29.4	30.1	30.8	31.5	32.3	.72
I.43	21.8	22.4	23.1	23.8	24.5	25.2	25.9	26.6	27.3	28.0	28.7	29.4	30.1	30.8	31.5	.70
I.46	21.3	21.9	22.6	23.2	23.9	24.6	25.3	26.0	26.7	27.3	28.0	28.7	29.4	30.1	30.8	.68
I.50	20.7	21.3	22.0	22.7	23.3	24.0	24.7	25.3	26.0	26.7	27.3	28.0	28.7	29.3	30.0	0.67
I.54	20.2	20.8	21.5	22.1	22.8	23.4	24.1	24.7	25.4	26.0	26.7	27.3	28.0	28.6	29.3	.65
I.58	19.6	20.3	20.9	21.5	22.2	22.8	23.4	24.1	24.7	25.3	26.0	26.6	27.2	27.9	28.5	.63
I.62	19.1	19.7	20.4	21.0	21.6	22.2	22.8	23.4	24.1	24.7	25.3	25.9	26.5	27.1	27.8	.62
I.67	18.6	19.2	19.8	20.4	21.0	21.6	22.2	22.8	23.4	24.0	24.6	25.2	25.8	26.4	27.0	60
I.71	18.1	18.7	19.3	19.8	20.4	21.0	21.6	22.2	22.8	23.3	23.9	24.5	25.1	25.7	26.3	0.58
I.76	17.6	18.1	18.7	19.3	19.8	20.4	21.0	21.5	22.1	22.7	23.2	23.8	24.4	24.9	25.5	.57
I.82	17.1	17.6	18.2	18.7	19.3	19.8	20.4	20.9	21.5	22.0	22.6	23.1	23.7	24.2	24.8	.55
I.88	16.5	17.1	17.6	18.1	18.7	19.2	19.7	20.3	20.8	21.3	21.9	22.4	22.9	23.5	24.0	.53
I.94	16.0	16.5	17.1	17.6	18.1	18.6	19.1	19.6	20.2	20.7	21.2	21.7	22.2	22.7	23.3	.52
2.00	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	0.50
2.07	15.0	15.5	16.0	16.4	16.9	17.4	17.9	18.4	18.9	19.3	19.8	20.3	20.8	21.3	21.8	.48
2.14	14.5	14.9	15.4	15.9	16.3	16.8	17.3	17.7	18.2	18.7	19.1	19.6	20.1	20.5	21.0	.47
2.22	14.0	14.4	14.9	15.3	15.8	16.2	16.7	17.1	17.6	18.0	18.5	18.9	19.4	19.8	20.3	.45
2.31	13.4	13.9	14.3	14.7	15.2	15.6	16.0	16.5	16.9	17.3	17.8	18.2	18.6	19.1	19.5	.43
2.40	12.9	13.3	13.8	14.2	14.6	15.0	15.4	15.8	16.3	16.7	17.1	17.5	17.9	18.3	18.8	0.42
2.50	12.4	12.8	13.2	13.6	14.0	14.4	14.8	15.2	15.6	16.0	16.4	16.8	17.2	17.6	18.0	.40
2.61	11.9	12.3	12.7	13.0	13.4	13.8	14.2	14.6	15.0	15.3	15.7	16.1	16.5	16.9	17.3	.38
2.73	11.4	11.7	12.1	12.5	12.8	13.2	13.6	13.9	14.3	14.7	15.0	15.4	15.8	16.1	16.5	.37
2.86	10.9	11.2	11.6	11.9	12.3	12.6	13.0	13.3	13.7	14.0	14.4	14.7	15.1	15.4	15.8	.35
3.00	10.3	10.7	11.0	11.3	11.7	12.0	12.3	12.7	13.0	13.3	13.7	14.0	14.3	14.7	15.0	0.33
3.16	9.8	10.1	10.5	10.8	11.1	11.4	11.7	12.0	12.4	12.7	13.0	13.3	13.6	13.9	14.3	.32
3.33	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	.30
3.53	8.8	9.1	9.4	9.6	9.9	10.2	10.5	10.8	11.1	11.3	11.6	11.9	12.2	12.5	12.8	.28
3.75	8.3	8.5	8.8	9.1	9.3	9.6	9.9	10.1	10.4	10.7	10.9	11.2	11.5	11.7	12.0	.27
4.00	7.8	8.0	8.3	8.5	8.8	9.0	9.3	9.5	9.8	10.0	10.3	10.5	10.8	11.0	11.3	0.25
4.29	7.2	7.5	7.7	7.9	8.2	8.4	8.6	8.9	9.1	9.3	9.6	9.8	10.0	10.3	10.5	.23
4.62	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.5	8.7	8.9	9.1	9.3	9.5	9.8	.22
5.00	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	.20
5.45	5.7	5.9	6.1	6.2	6.4	6.6	6.8	7.0	7.2	7.3	7.5	7.7	7.9	8.1	8.3	.18
6.00	5.2	5.3	5.5	5.7	5.8	6.0	6.2	6.3	6.5	6.7	6.8	7.0	7.2	7.3	7.5	0.17
6.67	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	6.0	6.2	6.3	6.5	6.6	6.8	.15
7.50	4.1	4.3	4.4	4.5	4.7	4.8	4.9	5.1	5.2	5.3	5.5	5.6	5.7	5.9	6.0	.13
8.57	3.6	3.7	3.9	4.0	4.1	4.2	4.3	4.4	4.6	4.7	4.8	4.9	5.0	5.1	5.3	.12
10.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	.10
12.0	2.6	2.7	2.8	2.8	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8	0.08
15.0	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	2.9	3.0	.07
20.0	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	.05
30.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	.03
60.0	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.8	.02

Number of Minutes of δ

$\frac{60'}{\Delta}$	Number of Minutes of δ															$\frac{\Delta}{60'}$
	46'	47'	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	58'	59'	60'	
1.00	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	1.00
1.02	45.2	46.2	47.2	48.2	49.2	50.2	51.1	52.1	53.1	54.1	55.1	56.0	57.0	58.0	59.0	0.98
1.03	44.5	45.4	46.4	47.4	48.3	49.3	50.3	51.2	52.2	53.2	54.1	55.1	56.1	57.0	58.0	.97
1.05	43.7	44.7	45.6	46.6	47.5	48.5	49.4	50.4	51.2	52.3	53.2	54.1	55.1	56.1	57.0	.95
1.07	42.9	43.9	44.8	45.7	46.7	47.6	48.5	49.5	50.4	51.3	52.3	53.2	54.1	55.1	56.0	.93
1.09	42.2	43.1	44.0	44.9	45.8	46.7	47.7	48.6	49.5	50.4	51.3	52.2	53.2	54.1	55.0	0.92
1.11	41.4	42.3	43.2	44.1	45.0	45.9	46.8	47.7	48.6	49.5	50.4	51.3	52.2	53.1	54.0	.90
1.13	40.6	41.5	42.4	43.3	44.2	45.1	45.9	46.8	47.7	48.6	49.5	50.3	51.2	52.1	53.0	.88
1.15	39.9	40.7	41.6	42.5	43.3	44.2	45.1	45.9	46.8	47.7	48.5	49.4	50.3	51.1	52.0	.87
1.18	39.1	40.0	40.8	41.7	42.5	43.4	44.2	45.1	45.9	46.8	47.6	48.4	49.3	50.2	51.0	.85
1.20	38.3	39.2	40.0	40.8	41.7	42.5	43.3	44.2	45.0	45.8	46.7	47.5	48.3	49.2	50.0	0.83
1.22	37.6	38.4	39.2	40.0	40.8	41.7	42.5	43.3	44.1	44.9	45.7	46.5	47.4	48.2	49.0	.82
1.25	36.8	37.6	38.4	39.2	40.0	40.8	41.6	42.4	43.2	44.0	44.8	45.6	46.4	47.2	48.0	.80
1.28	36.0	36.8	37.6	38.4	39.2	40.0	40.7	41.5	42.3	43.1	43.9	44.6	45.4	46.2	47.0	.78
1.30	35.3	36.0	36.8	37.6	38.3	39.1	39.9	40.6	41.4	42.2	42.9	43.7	44.5	45.2	46.0	.77
1.33	34.5	35.3	36.0	36.8	37.5	38.3	39.0	39.8	40.5	41.3	42.0	42.7	43.5	44.3	45.0	0.75
1.36	33.7	34.5	35.2	35.9	36.7	37.4	38.1	38.9	39.6	40.3	41.1	41.8	42.5	43.3	44.0	.73
1.40	33.0	33.7	34.4	35.1	35.8	36.6	37.3	38.0	38.7	39.4	40.1	40.8	41.6	42.3	43.0	.72
1.43	32.2	32.9	33.6	34.3	35.0	35.7	36.4	37.1	37.8	38.5	39.2	39.9	40.6	41.3	42.0	.70
1.46	31.4	32.1	32.8	33.5	34.2	34.9	35.5	36.2	36.9	37.6	38.3	38.9	39.6	40.3	41.0	.68
1.50	30.7	31.3	32.0	32.7	33.3	34.0	34.7	35.3	36.0	36.7	37.3	38.0	38.7	39.3	40.0	0.67
1.54	29.9	30.6	31.2	31.9	32.5	33.2	33.8	34.5	35.1	35.8	36.4	37.0	37.7	38.4	39.0	.65
1.58	29.1	29.8	30.4	31.0	31.7	32.3	32.9	33.6	34.2	34.8	35.5	36.1	36.7	37.4	38.0	.63
1.62	28.4	29.0	29.6	30.2	30.8	31.5	32.1	32.7	33.3	33.9	34.5	35.1	35.8	36.4	37.0	.62
1.67	27.6	28.2	28.8	29.4	30.0	30.6	31.2	31.8	32.4	33.0	33.6	34.2	34.8	35.4	36.0	.60
1.71	26.8	27.4	28.0	28.6	29.2	29.8	30.3	30.9	31.5	32.1	32.7	33.2	33.8	34.4	35.0	0.58
1.76	26.1	26.6	27.2	27.8	28.3	28.9	29.5	30.0	30.6	31.2	31.7	32.3	32.9	33.4	34.0	.57
1.82	25.3	25.9	26.4	27.0	27.5	28.1	28.6	29.2	29.7	30.3	30.8	31.3	31.9	32.5	33.0	.55
1.88	24.5	25.1	25.6	26.1	26.7	27.2	27.7	28.3	28.8	29.3	29.9	30.4	30.9	31.5	32.0	.53
1.94	23.8	24.3	24.8	25.3	25.8	26.4	26.9	27.4	27.9	28.4	28.9	29.4	30.0	30.5	31.0	.52
2.00	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0	0.50
2.07	22.2	22.7	23.2	23.7	24.2	24.7	25.1	25.6	26.1	26.6	27.1	27.5	28.0	28.5	29.0	.48
2.14	21.5	21.9	22.4	22.9	23.3	23.8	24.3	24.7	25.2	25.7	26.1	26.6	27.1	27.5	28.0	.47
2.22	20.7	21.2	21.6	22.1	22.5	23.0	23.4	23.9	24.3	24.8	25.2	25.6	26.1	26.6	27.0	.45
2.31	19.9	20.4	20.8	21.2	21.7	22.1	22.5	23.0	23.4	23.8	24.3	24.7	25.1	25.6	26.0	.43
2.40	19.2	19.6	20.0	20.4	20.8	21.3	21.7	22.1	22.5	22.9	23.3	23.7	24.2	24.6	25.0	0.42
2.50	18.4	18.8	19.2	19.6	20.0	20.4	20.8	21.2	21.6	22.0	22.4	22.8	23.2	23.6	24.0	.40
2.61	17.6	18.0	18.4	18.8	19.2	19.6	19.9	20.3	20.7	21.1	21.5	21.8	22.2	22.6	23.0	.38
2.73	16.9	17.2	17.6	18.0	18.3	18.7	19.1	19.4	19.8	20.2	20.5	20.9	21.3	21.6	22.0	.37
2.86	16.1	16.5	16.8	17.2	17.5	17.9	18.2	18.6	18.9	19.3	19.6	19.9	20.3	20.7	21.0	.35
3.00	15.3	15.7	16.0	16.3	16.7	17.0	17.3	17.7	18.0	18.3	18.7	19.0	19.3	19.7	20.0	0.33
3.16	14.6	14.9	15.2	15.5	15.8	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.4	18.7	19.0	.32
3.33	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	.30
3.53	13.0	13.3	13.6	13.9	14.2	14.5	14.7	15.0	15.3	15.6	15.9	16.1	16.4	16.7	17.0	.28
3.75	12.3	12.5	12.8	13.1	13.3	13.6	13.9	14.1	14.4	14.7	14.9	15.2	15.5	15.7	16.0	.27
4.00	11.5	11.8	12.0	12.3	12.5	12.8	13.0	13.3	13.5	13.8	14.0	14.2	14.5	14.8	15.0	0.25
4.29	10.7	11.0	11.2	11.4	11.7	11.9	12.1	12.4	12.6	12.8	13.1	13.3	13.5	13.8	14.0	.23
4.62	10.0	10.2	10.4	10.6	10.8	11.1	11.3	11.5	11.7	11.9	12.1	12.3	12.5	12.8	13.0	.22
5.00	9.2	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0	.20
5.45	8.4	8.6	8.8	9.0	9.2	9.4	9.5	9.7	9.9	10.1	10.3	10.4	10.6	10.8	11.0	.18
6.00	7.7	7.8	8.0	8.2	8.3	8.5	8.7	8.8	9.0	9.2	9.3	9.5	9.7	9.8	10.0	0.17
6.67	6.9	7.1	7.2	7.4	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.5	8.7	8.9	9.0	.15
7.50	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.7	7.9	8.0	.13
8.57	5.4	5.5	5.6	5.7	5.8	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.8	6.9	7.0	.12
10.0	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	.10
12.0	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.7	4.7	4.8	4.9	5.0	0.08
15.0	3.1	3.1	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.7	3.8	3.9	3.9	4.0	.07
20.0	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.9	3.0	3.0	.05
30.0	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	.03
60.0	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	.02

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

b	a = 0° 0'					a = 0° 30'					a = 1° 0'					c	α			
	B	h	d	60' Δ	Z	t	h	d	60' Δ	Z	t	Δ 60'	h	d	60' Δ			Z	t	Δ 60'
45	45	0	1	0	0	45	0	1	0	42	0.02	44	59	1	1	25	0.02	45	0	89.5
46	46	0	1	0	0	46	0	1	0	43	.02	45	59	1	1	26	.03	44	0	89.5
47	47	0	1	0	0	47	0	1	0	44	.02	46	59	1	1	28	.03	43	0	89.5
48	48	0	1	0	0	48	0	1	0	45	.02	47	59	1	1	30	.02	42	0	89.4
49	49	0	1	0	0	49	0	1	0	46	.02	48	59	1	1	31	.03	41	0	89.4
50	50	0	1	0	0	50	0	1	0	47	0.02	49	59	1	1	33	0.03	40	0	89.4
51	51	0	1	0	0	51	0	1	0	48	.02	50	59	1	1	35	.03	39	0	89.4
52	52	0	1	0	0	52	0	1	0	49	.02	51	59	1	1	37	.05	38	0	89.4
53	53	0	1	0	0	53	0	1	0	50	.02	52	59	1	1	40	.03	37	0	89.3
54	54	0	1	0	0	54	0	1	0	51	.02	53	59	1	1	42	.05	36	0	89.3
55	55	0	1	0	0	55	0	1	0	52	0.03	54	59	1	1	45	0.03	35	0	89.3
56	56	0	1	0	0	56	0	1	0	54	.02	55	59	1	1	47	.05	34	0	89.3
57	57	0	1	0	0	57	0	1	0	55	.03	56	59	1	1	50	.05	33	0	89.2
58	58	0	1	0	0	58	0	1	0	57	.02	57	59	1	1	53	.05	32	0	89.2
59	59	0	1	0	0	59	0	1	0	58	.03	58	59	1	1	56	.07	31	0	89.2
60	60	0	1	0	0	60	0	1	1	0	0.03	59	59	1	2	0	0.07	30	0	89.1
61	61	0	1	0	0	61	0	1	2	0	.03	60	59	1	4	0	.07	29	0	89.1
62	62	0	1	0	0	62	0	1	4	0	.03	61	59	1	8	0	.07	28	0	89.1
63	63	0	1	0	0	63	0	1	6	0	.03	62	59	1	12	0	.08	27	0	89.0
64	64	0	1	0	0	64	0	1	8	0	.05	63	59	1	17	0	.08	26	0	89.0
65	65	0	1	0	0	65	0	1	11	0	0.05	64	59	1	22	0	0.08	25	0	88.9
66	66	0	1	0	0	66	0	1	14	0	.05	65	59	1	27	0	.10	24	0	88.9
67	67	0	1	0	0	67	0	1	17	0	.05	66	59	1	33	0	.12	23	0	88.8
68	68	0	1	0	0	68	0	1	20	0	.07	67	59	1	40	0	.12	22	0	88.8
69	69	0	1	0	0	69	0	1	24	0	.07	68	59	1	47	0	.13	21	0	88.7
70	70	0	1	0	0	70	0	1	28	0	0.07	69	59	1.02	55	0	0.15	20	0	88.6
71	71	0	1	0	0	71	0	1	32	0	.08	70	58	1	3	4	.17	19	0	88.5
72	72	0	1	0	0	72	0	1	37	0	.10	71	58	1	14	0	.18	18	0	88.5
73	73	0	1	0	0	73	0	1	43	0	.10	72	58	1	25	0	.20	17	0	88.4
74	74	0	1	0	0	74	0	1	49	0	.12	73	58	1	37	0	.23	16	0	88.3
75	75	0	1	0	0	75	0	1.02	56	0	0.13	74	58	1	51	0	0.28	15	0	88.1
76	76	0	1	0	0	59	1	2	4	0	.15	75	58	1	4	8	.30	14	0	88.0
77	77	0	1	0	0	76	59	1	13	0	.18	76	58	1	26	0	.37	13	0	87.8
78	78	0	1	0	0	77	59	1	24	0	.22	77	58	1.02	48	0	.43	12	0	87.6
79	79	0	1	0	0	78	59	1	37	0		78	57	1	5	14		11	0	87.4
80	80	0	1	0	0	79	59	1	53	0		79	57	1	0	44		10	0	87.2
81	81	0	1	0	0	80	59	1	3	12		80	57	1.02	6	22		9	0	86.8
82	82	0	1	0	0	81	59	1	35	0		81	56	1	7	9		8	0	86.4
83	83	0	1	0	0	82	59	1	4	6		82	56	1.02	8	9		7	0	85.9
84	84	0	1	0	0	83	59	1	4	6		83	55	1.02	9	29		6	0	85.3
85	85	0	1	0	0	84	59	1.02	5	43		84	54	1.02	11	20		5	0	84.3
86	86	0	1	0	0	85	58	1	7	8		85	53	1.05	14	3		4	0	82.9
87	87	0	1	0	0	86	58	1.03	9	28		86	50	1.07	18	27		3	0	80.5
88	88	0	1	0	0	87	56	1.05	14	2		87	46	1.22	26	34		2	0	76.0
89	89	0	1	0	0	88	53	1.62	26	34		88	35	2.40	45	0		1	0	63.4
90	90	0	1	0	0	89	30		90	0		89	0		90	0		0	0	0.0
t	a	60' Δ	b			a	60' Δ	b	Δ 60'			a	60' Δ	b	Δ 60'					a
	d = 0° 0'					d = 0° 30'					d = 1° 0'									

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

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

B	$a = 3^\circ 0'$					$a = 3^\circ 30'$					$a = 4^\circ 0'$					C	β
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		
0	0	0	1	0	0.00	0	0	1	0	0.00	0	0	1	0	0.00	90	90.0
1	1	0	1	3	0.00	1	0	1	3	0.00	1	0	1	4	0.00	89	89.9
2	2	0	1	0	0.00	2	0	1	0	0.00	2	0	1	0	0.00	88	89.9
3	3	0	1	0	0.00	3	0	1	30	0.02	3	0	1	0	0.02	87	89.8
4	4	0	1	0	0.02	4	0	1.02	31	0.00	59	1	1	0.00	86	89.8	
5	5	0	1	1	0.00	5	59	1	31	0.00	4	59	1	1	0.00	85	89.7
6	6	0	1.02	1	0.00	5	59	1	31	0.02	5	59	1	1	0.02	84	89.6
7	59	1	1	1	0.02	6	59	1	32	0.00	6	59	1	2	0.00	83	89.6
8	7	59	1	2	0.00	7	59	1	32	0.02	7	59	1	2	0.02	82	89.5
9	8	59	1	2	0.02	8	59	1	33	0.00	8	59	1	3	0.02	81	89.4
10	9	59	1	3	0.00	9	59	1	33	0.02	9	59	1.02	4	0.00	80	89.4
11	10	59	1	3	0.02	10	59	1	34	0.02	10	58	1	4	0.02	79	89.3
12	11	59	1	4	0.02	11	59	1	35	0.02	11	58	1	5	0.02	78	89.3
13	12	59	1	5	0.00	12	59	1.02	36	0.00	12	58	1	6	0.02	77	89.2
14	13	59	1	5	0.02	13	58	1	36	0.02	13	58	1	7	0.02	76	89.1
15	14	59	1	6	0.02	14	58	1	37	0.02	14	58	1	8	0.03	75	89.1
16	15	59	1	7	0.02	15	58	1	38	0.02	15	58	1.02	10	0.02	74	89.0
17	16	59	1.02	8	0.02	16	58	1	39	0.03	16	57	1	11	0.02	73	88.9
18	17	58	1	9	0.02	17	58	1	41	0.02	17	57	1	12	0.03	72	88.9
19	18	58	1	10	0.02	18	58	1	42	0.02	18	57	1	14	0.02	71	88.8
20	19	58	1	11	0.03	19	58	1	43	0.03	19	57	1	15	0.03	70	88.7
21	20	58	1	13	0.02	20	58	1.02	45	0.02	20	57	1	17	0.03	69	88.7
22	21	58	1	14	0.02	21	57	1	46	0.03	21	57	1.02	19	0.03	68	88.6
23	22	58	1	15	0.03	22	57	1	48	0.03	22	56	1	21	0.03	67	88.5
24	23	58	1	17	0.02	23	57	1	50	0.03	23	56	1	23	0.03	66	88.4
25	24	58	1	18	0.03	24	57	1	52	0.03	24	56	1	25	0.03	65	88.4
26	25	58	1	20	0.03	25	57	1	54	0.03	25	56	1	27	0.03	64	88.3
27	26	58	1.02	22	0.03	26	57	1	56	0.03	26	56	1	29	0.03	63	88.2
28	27	57	1	24	0.03	27	57	1.02	58	0.03	27	56	1.02	32	0.03	62	88.1
29	28	57	1	26	0.03	28	56	1	4	0.03	28	55	1	34	0.05	61	88.1
30	29	57	1	28	0.03	29	56	1	2	0.05	29	55	1	37	0.05	60	88.0
31	30	57	1	30	0.03	30	56	1	5	0.05	30	55	1	40	0.05	59	87.9
32	31	57	1	32	0.03	31	56	1	8	0.03	31	55	1	43	0.05	58	87.8
33	32	57	1	34	0.05	32	56	1	10	0.05	32	55	1.02	46	0.05	57	87.7
34	33	57	1	37	0.05	33	56	1	13	0.05	33	54	1	49	0.07	56	87.6
35	34	57	1	40	0.03	34	56	1.02	16	0.05	34	54	1	53	0.05	55	87.6
36	35	57	1.02	42	0.05	35	55	1	19	0.07	35	54	1	56	0.07	54	87.5
37	36	56	1	45	0.05	36	55	1	23	0.05	36	54	1.02	0	0.07	53	87.4
38	37	56	1	48	0.05	37	55	1	26	0.07	37	53	1	4	0.07	52	87.3
39	38	56	1	51	0.07	38	55	1	30	0.07	38	53	1	8	0.08	51	87.2
40	39	56	1	55	0.05	39	55	1.02	34	0.07	39	53	1	13	0.08	50	87.1
41	40	56	1	58	0.07	40	54	1	38	0.07	40	53	1.02	18	0.08	49	87.0
42	41	56	1	4	0.07	41	54	1	42	0.08	41	52	1	23	0.08	48	86.9
43	42	56	1.02	6	0.07	42	54	1	47	0.08	42	52	1	28	0.08	47	86.7
44	43	55	1	10	0.07	43	54	1	52	0.08	43	52	1	33	0.10	46	86.6
45	44	55	1	14	0.07	44	54	1	57	0.08	44	52	1	39	0.10	45	86.5
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a
	$d = 3^\circ 0'$					$d = 3^\circ 30'$					$d = 4^\circ 0'$						

B	$a = 3^{\circ} 0'$				$a = 3^{\circ} 30'$				$a = 4^{\circ} 0'$				C	β						
	h	d	t	$\frac{\Delta}{60'}$	h	d	t	$\frac{\Delta}{60'}$	h	d	t	$\frac{\Delta}{60'}$								
		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$								
45	44	55	1	4	14	0.08	44	54	1.02	4	57	0.08	44	52	1.02	5	39	0.10	45	86.5
46	45	55	1		19	.08	45	53	1	5	2	.08	45	51	1		45	.10	44	86.4
47	46	55	1		24	.08	46	53	1	7		.10	46	51	1		51	.12	43	86.3
48	47	55	1		29	.08	47	53	1	13		.10	47	51	1.02		58	.12	42	86.1
49	48	55	1.02		34	.10	48	53	1.02	19		.12	48	50	1	6	5	.13	41	86.0
50	49	54	1		40	0.10	49	52	1	26	0.12	49	50	1		13	0.13	40	85.8	
51	50	54	1		46	.10	50	52	1	33	.12	50	50	1.02		21	.13	39	85.7	
52	51	54	1		52	.12	51	52	1.02	40	.13	51	49	1		29	.15	38	85.5	
53	52	54	1		59	.12	52	51	1	48	.13	52	49	1		38	.15	37	85.4	
54	53	54	1.02	5	6	.12	53	51	1	56	.15	53	49	1.02		47	.17	36	85.2	
55	54	53	1		13	0.13	54	51	1.02	6	5	0.15	54	48	1		57	0.18	35	85.0
56	55	53	1		21	.15	55	50	1	14	.17	55	48	1.02	7	8	.18	34	84.8	
57	56	53	1.02		30	.15	56	50	1	24	.18	56	47	1		19	.20	33	84.6	
58	57	52	1		39	.17	57	50	1.02	35	.18	57	47	1.02		31	.22	32	84.4	
59	58	52	1		49	.17	58	49	1	46	.20	58	46	1		44	.23	31	84.2	
60	59	52	1		59	0.18	59	49	1.02	58	0.22	59	46	1.02		58	0.25	30	84.0	
61	60	52	1.02	6	10	.20	60	48	1	7	11	.23	60	45	1.02	8	13	.25	29	83.7
62	61	51	1		22	.22	61	48	1.02	25	.25	61	44	1		28	.28	28	83.5	
63	62	51	1.02		35	.23	62	47	1	40	.27	62	44	1.02		45	.32	27	83.2	
64	63	50	1		49	.25	63	47	1.02	56	.30	63	43	1.02	9	4	.33	26	82.9	
65	64	50	1.02	7	4	0.27	64	46	1	8	14	0.32	64	42	1.02		24	0.35	25	82.5
66	65	49	1		20	.30	65	46	1.02	33	.35	65	41	1.02		45	.40	24	82.2	
67	66	49	1.02		38	.33	66	45	1.02	54	.37	66	40	1.02	10	9	.42	23	81.8	
68	67	48	1		58	.35	67	44	1.02	9	16	.42	67	39	1.02		34	.47	22	81.4
69	68	48	1.02	8	19	.40	68	43	1.02	41	.45	68	38	1.02	11	2	.52	21	81.0	
70	69	47	1.02		43	0.43	69	42	1.02	10	8	0.50	69	37	1.02		33	0.57	20	80.5
71	70	46	1		9	.48	70	41	1.02	38	.57	70	36	1.02	12	7	.63	19	79.9	
72	71	46	1.02		38	.53	71	40	1.02	11	12	.62	71	35	1.03		45	.70	18	79.4
73	72	45	1.02	10	10	.60	72	39	1.02	49	.70	72	33	1.03	13	27	.78	17	78.7	
74	73	44	1.02		46	.68	73	38	1.03	12	31	.78	73	31	1.03	14	14	.88	16	78.0
75	74	43	1.03	11	27	0.77	74	36	1.02	13	18	0.88	74	29	1.03	15	7	1.00	15	77.2
76	75	41	1.02	12	13	.90	75	35	1.03	14	11	1.03	75	27	1.03	16	7	1.15	14	76.2
77	76	40	1.03	13	7	1.03	76	33	1.05	15	13	1.18	76	25	1.05	17	16	1.32	13	75.2
78	77	38	1.03	14	9	1.22	77	30	1.03	16	24	1.37	77	22	1.07	18	35	1.55	12	74.0
79	78	36	1.03	15	22	1.43	78	28	1.05	17	46	1.63	78	18	1.07	20	8	1.80	11	72.6
80	79	34	1.05	16	48		79	25	1.07	19	24		79	14	1.09	21	56		10	70.9
81	80	31	1.05	18	31		80	21	1.09	21	21		80	9	1.09	24	5		9	68.9
82	81	28	1.09	20	38		81	16	1.09	23	43		81	4	1.13	26	41		8	66.5
83	82	23	1.09	23	16		82	11	1.15	26	39			57	1.18	29	51		7	63.6
84	83	18	1.15	26	38		83	3	1.18	30	20		82	48	1.25	33	47		6	59.9
85	84	10	1.20	31	1			54	1.28	35	4		83	36	1.33	38	44		5	55.1
86	85	0	1.33	36	55		84	41	1.43	41	15		84	21	1.54	45	4		4	48.9
87		45	1.54	45	2		85	23	1.71	49	27		85	0	1.88	53	11		3	40.6
88	86	24	2.31	56	20			58	2.50	60	17			32	2.86	63	29		2	29.8
89		50	6.00	71	35		86	22	7.50	74	4			53	8.57	75	59		1	10.0
90	87	0		90	0			30		90	0		86	0		90	0		0	0.0

t	$a = 3^{\circ} 0'$		$a = 3^{\circ} 30'$		$a = 4^{\circ} 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 3^{\circ} 0'$		$d = 3^{\circ} 30'$		$d = 4^{\circ} 0'$		

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

B	$a = 4^\circ 30'$					$a = 5^\circ 0'$					$a = 5^\circ 30'$					C	β				
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$						
45	44	49	1	6	21	0.12	44	47	1.02	7	3	0.13	44	44	1	7	45	0.13	45	85.0	
46	45	49	1		28	.12	45	46	1	11	.13	45	44	1.02	53	.15	44	.15	44	84.8	
47	46	49	1.02		35	.12	46	46	1.02	19	.13	46	43	1.02	8	2	.15	43	.15	43	84.7
48	47	48	1		42	.13	47	45	1	27	.15	47	42	1	11	.17	42	.17	42	84.5	
49	48	48	1.02		50	.15	48	45	1.02	36	.15	48	42	1.02	21	.17	41	.17	41	84.3	
50	49	47	1		59	0.15	49	44	1	45	0.17	49	41	1	31	0.18	40	0.18	40	84.1	
51	50	47	1.02		7	.15	50	44	1.02	55	.17	50	41	1.02	42	.18	39	.18	39	83.9	
52	51	46	1		17	.17	51	43	1	8	.18	51	40	1.02	53	.20	38	.20	38	83.6	
53	52	46	1.02		27	.18	52	43	1.02	16	.20	52	39	1.02	9	5	.22	37	.22	37	83.4
54	53	45	1		38	.18	53	42	1.02	28	.20	53	38	1	18	.23	36	.23	36	83.2	
55	54	45	1.02		49	0.20	54	41	1	40	0.22	54	38	1.02	32	0.23	35	0.23	35	82.9	
56	55	44	1		8	.20	55	41	1.02	53	.23	55	37	1.02	46	.27	34	.27	34	82.6	
57	56	44	1.02		13	.23	56	40	1.02	9	.25	56	36	1.02	10	2	.27	33	.27	33	82.4
58	57	43	1.02		27	.25	57	39	1.02	22	.27	57	35	1.02	18	.28	32	.28	32	82.1	
59	58	42	1		42	.25	58	38	1.02	38	.30	58	34	1.02	35	.32	31	.32	31	81.7	
60	59	42	1.02		57	0.27	59	37	1.02	56	0.30	59	33	1.02	54	0.33	30	0.33	30	81.4	
61	60	41	1.02		9	.30	60	36	1.02	10	.32	60	32	1.03	11	14	.35	29	.35	29	81.1
62	61	40	1.02		31	.32	61	35	1.02	33	.35	61	30	1.02	35	.38	28	.38	28	80.7	
63	62	39	1.02		50	.35	62	34	1.02	54	.38	62	29	1.02	58	.42	27	.42	27	80.3	
64	63	38	1.02		10	.37	63	33	1.02	11	.42	63	28	1.03	12	23	.45	26	.45	26	79.9
65	64	37	1.02		33	0.40	64	32	1.02	42	0.43	64	26	1.02	50	0.48	25	0.48	25	79.4	
66	65	36	1.02		57	.43	65	31	1.03	12	.48	65	25	1.03	13	19	.53	24	.53	24	78.9
67	66	35	1.02		11	.48	66	29	1.02	37	.53	66	23	1.03	51	.57	23	.57	23	78.4	
68	67	34	1.02		52	.52	67	28	1.03	13	.57	67	21	1.03	14	25	.62	22	.62	22	77.8
69	68	33	1.02		12	.57	68	26	1.02	43	.63	68	19	1.03	15	2	.68	21	.68	21	77.2
70	69	31	1.02		57	0.63	69	25	1.03	14	0.68	69	17	1.03	43	0.75	20	0.75	20	76.5	
71	70	30	1.03		13	.70	70	23	1.05	15	.77	70	15	1.05	16	28	.83	19	.83	19	75.8
72	71	28	1.03		14	.78	71	20	1.03	48	.87	71	12	1.05	17	18	.93	18	.93	18	75.0
73	72	26	1.03		15	.87	72	18	1.05	16	.95	72	9	1.05	18	14	1.02	17	1.02	17	74.1
74	73	24	1.05		56	.98	73	15	1.05	17	1.07	73	6	1.05	19	15	1.15	16	1.15	16	73.1
75	74	21	1.05		16	1.10	74	12	1.05	18	1.20	74	3	1.07	20	24	1.30	15	1.30	15	72.0
76	75	18	1.05		18	1.27	75	9	1.07	19	1.37	75	1	1.09	21	42	1.47	14	1.47	14	70.7
77	76	15	1.05		19	1.45	76	5	1.07	21	1.57	75	54	1.09	23	10	1.68	13	1.68	13	69.3
78	77	12	1.07		20	1.68	77	1	1.09	22	1.82	76	49	1.11	24	51	1.93	12	1.93	12	67.7
79	78	8	1.09		22	1.97	56	1.11	24	38	2.10	77	43	1.13	26	47	2.23	11	2.23	11	65.9
80	79	3	1.11		24	2.3	78	50	1.13	26	44	78	36	1.15	29	1	2.60	10	2.60	10	63.7
81	80	57	1.13		26	42	79	43	1.18	29	13	79	28	1.20	31	37		9		9	61.2
82	80	50	1.18		29	29	80	34	1.20	32	9	80	18	1.25	34	41		8		8	58.2
83	81	41	1.22		32	51	81	24	1.25	35	40	81	6	1.30	38	19		7		7	54.6
84	82	30	1.28		36	59	82	12	1.36	39	56	82	12	1.43	42	39		6		6	50.3
85	83	17	1.43		42	5	56	1.50	45	7		82	34	1.58	47	51		5		5	45.1
86	84	59	1.62		48	27	83	36	1.76	51	26	83	12	1.88	54	5		4		4	38.7
87	84	36	2.07		56	23	84	10	2.22	59	7	84	44	2.40	61	28		3		3	31.0
88	85	5	3.33		66	5	37	3.53	68	15		84	9	3.75	70	5		2		2	21.8
89	85	23	8.57		77	30	54	10.0	78	43		25	12.0		79	44		1		1	11.3
90	30				90	0	85	0		90	0	30			90	0		0		0	0.0

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

t	$a = 6^\circ 0'$		$a = 6^\circ 30'$		$a = 7^\circ 0'$		α
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 6^\circ 0'$		$d = 6^\circ 30'$		$d = 7^\circ 0'$		

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

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

B	a = 7° 30'					a = 8° 0'					a = 8° 30'					C	β				
	h	d	60'		t	h	d	60'		t	h	d	60'		t						
			Δ	Z				Δ	Z				Δ	Z							
45	44	31	1.02	10	33	0.18	44	27	1.02	11	14	0.20	44	22	1.02	11	56	0.22	45	82.0	
46	45	30	1.02		44	.20	45	26	1.03		26	.22	45	21	1.02	12	9	.22	44	81.8	
47	46	29	1.02		56	.20	46	24	1.02		39	.22	46	20	1.03		22	.23	43	81.5	
48	47	28	1.03	11	8	.22	47	23	1.02		52	.23	47	18	1.02		36	.23	42	81.2	
49	48	26	1.02		21	.23	48	22	1.03	12	6	.23	48	17	1.03		50	.25	41	80.9	
50	49	25	1.02		35	0.23	49	20	1.02		20	0.25	49	15	1.02	13	5	0.28	40	80.6	
51	50	24	1.02		49	.25	50	19	1.02		35	.28	50	14	1.03		22	.28	39	80.2	
52	51	23	1.03	12	4	.27	51	18	1.03		52	.28	51	12	1.03		39	.30	38	79.9	
53	52	21	1.02		20	.28	52	16	1.03	13	9	.30	52	10	1.02		57	.32	37	79.5	
54	53	20	1.03		37	.32	53	14	1.02		27	.32	53	9	1.03	14	16	.33	36	79.2	
55	54	18	1.02		56	0.32	54	13	1.03		46	0.33	54	7	1.03		36	0.37	35	78.8	
56	55	17	1.03	13	15	.33	55	11	1.03	14	6	.37	55	5	1.03		58	.38	34	78.3	
57	56	15	1.03		35	.37	56	9	1.03		28	.38	56	3	1.05	15	21	.40	33	77.9	
58	57	13	1.02		57	.38	57	7	1.03		51	.42	57	0	1.03		45	.43	32	77.4	
59	58	12	1.03	14	20	.42	58	5	1.03	15	16	.43	58	1.03		16	11	.47	31	77.0	
60	59	10	1.03		45	0.45	59	3	1.03		42	0.47	58	56	1.05		39	0.48	30	76.4	
61	60	8	1.05	15	12	.47	60	1	1.05	16	10	.50	59	53	1.05	17	8	.52	29	75.9	
62	61	5	1.03		40	.50		58	1.03		40	.53	60	50	1.05		39	.57	28	75.3	
63	62	3	1.03	16	10	.55	61	56	1.05	17	12	.58	61	47	1.05	18	13	.62	27	74.7	
64	63	1	1.05		43	.58	62	53	1.05		47	.62	62	44	1.05		50	.65	26	74.1	
65		58	1.05	17	18	0.63	63	50	1.05	18	24	0.67	63	41	1.07	19	29	0.70	25	73.4	
66	64	55	1.05		56	.68	64	47	1.07	19	4	.72	64	37	1.07	20	11	.75	24	72.6	
67	65	52	1.05		18	.75	65	43	1.07		47	.78	65	33	1.07		56	.82	23	71.8	
68	66	49	1.05	19	22	.80	66	39	1.07	20	34	.85	66	29	1.07	21	45	.88	22	71.0	
69	67	46	1.07		20	.88	67	35	1.07	21	25	.92	67	25	1.09	22	38	.97	21	70.1	
70	68	42	1.07	21	3	0.97	68	31	1.09	22	20	1.02	68	20	1.09	23	36	1.05	20	69.1	
71	69	38	1.09	22	1	1.07	69	26	1.09	23	21	1.10	69	15	1.11	24	39	1.15	19	68.0	
72	70	33	1.09		23	5	1.17	70	21	1.09	24	27	1.22	70	9	1.11	25	48	1.27	18	66.8
73	71	28	1.11		24	15	1.28	71	16	1.11	25	40	1.35	71	3	1.13	27	4	1.40	17	65.5
74	72	22	1.11		25	32	1.43	72	10	1.13	27	1	1.48		56	1.15	28	28	1.53	16	64.1
75	73	16	1.13		26	58	1.58	73	3	1.15	28	30	1.65	72	48	1.15	30	0	1.70	15	62.6
76	74	9	1.15		28	33	1.78		55	1.18	30	9	1.85	73	40	1.20	31	42	1.90	14	60.8
77	75	1	1.15		30	20	2.00	74	46	1.18	32	0	2.07	74	30	1.20	33	36	2.12	13	58.9
78		53	1.20		32	20	2.27	75	37	1.22	34	4	2.32	75	20	1.25	35	43	2.35	12	56.8
79	76	43	1.25		34	36	2.57	76	26	1.28	36	23	2.60	76	8	1.30	38	4	2.65	11	54.4
80	77	31	1.28		37	10	2.92	77	13	1.30	38	59	2.95	54	1.33	40	43	2.97	10	51.7	
81	78	18	1.33		40	5	3.33		59	1.40	41	56	3.35	77	39	1.43	43	41	3.35	9	48.7
82	79	3	1.43		43	25		78	42	1.46	45	17		78	21	1.54	47	2	3.77	8	45.3
83		45	1.54		47	13		79	23	1.58	49	4		79	0	1.62	50	48		7	41.4
84	80	24	1.67		51	33		80	1	1.76	53	22			37	1.88	55	2		6	37.1
85	81	0	2.00		56	30			35	2.07	58	12		80	9	2.14	59	45		5	32.2
86		30	2.31		62	5		81	4	2.50	63	36			37	2.73	64	59		4	26.7
87		56	3.33		68	19			28	3.53	69	35			59	3.53	70	42		3	20.6
88	82	14	5.00		75	9			45	5.45	76	3		81	16	5.45	76	51		2	14.1
89		26	15.0		82	27			56	15.0	82	55			27	20.0	83	20		1	7.1
90		30			90	0		82	0		90	0			30		90	0		0	0.0

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

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

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

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

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

<i>t</i>	<i>a</i>	$\frac{60'}{\Delta}$	<i>b</i>	$\frac{\Delta}{60'}$	<i>a</i>	$\frac{60'}{\Delta}$	<i>b</i>	$\frac{\Delta}{60'}$	<i>a</i>	$\frac{60'}{\Delta}$	<i>b</i>	$\frac{\Delta}{60'}$	<i>a</i>
	<i>d</i> = 10° 30'				<i>d</i> = 11° 0'				<i>d</i> = 11° 30'				<i>a</i>

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

b B	a = 12° 0'					a = 12° 30'					a = 13° 0'					c C	α β		
	h	d	60' Δ	Z	t	h	d	60' Δ	Z	t	h	d	60' Δ	Z	t			C	β
		Δ	60'	60'	60'		60'	Δ	60'	60'		60'	Δ	60'	60'				
45	43 46	1.05	16 44	0.28	43 39	1.03	17 25	0.28	43 33	1.05	18 5	0.30	45	77.8					
46	44 43	1.05	17 1	.30	44 37	1.05	18 42	.30	44 30	1.05	23	-.32	44	77.4					
47	45 40	1.03	19	-.30	45 34	1.05	18 0	.33	45 27	1.05	42	-.33	43	76.9					
48	46 38	1.05	37	-.33	46 31	1.05	20	.33	46 24	1.07	19 2	-.35	42	76.5					
49	47 35	1.05	57	-.35	47 28	1.07	40	-.37	47 20	1.05	23	-.37	41	76.0					
50	48 32	1.05	18 18	0.37	48 24	1.05	19 2	0.37	48 17	1.07	45	0.40	40	75.5					
51	49 29	1.05	40	.38	49 21	1.05	24	.40	49 13	1.07	20 9	.40	39	75.0					
52	50 26	1.07	19 3	.40	50 18	1.07	48	.42	50 9	1.07	33	.43	38	74.5					
53	51 22	1.05	27	-.43	51 14	1.07	20 13	-.45	51 5	1.07	59	-.47	37	74.0					
54	52 19	1.07	53	-.45	52 10	1.07	40	-.47	52 1	1.07	21 27	-.48	36	73.4					
55	53 15	1.07	20 20	0.48	53 6	1.07	21 8	0.50	57	1.07	56	0.50	35	72.8					
56	54 11	1.07	49	.58	54 2	1.07	38	.52	53 53	1.09	22 26	-.53	34	72.2					
57	55 7	1.07	21 19	-.53	58	1.09	22 9	-.55	54 48	1.09	58	-.58	33	71.6					
58	56 3	1.07	51	-.58	55 53	1.09	42	-.58	55 43	1.09	23 33	-.60	32	70.9					
59	59	1.09	22 26	.60	56 48	1.09	23 17	.63	56 38	1.09	24 9	.63	31	70.2					
60	57 54	1.09	23 2	0.65	57 43	1.09	55	0.67	57 33	1.11	47	0.68	30	69.5					
61	58 49	1.09	41	.68	58 38	1.09	24 35	.70	58 27	1.11	25 28	.72	29	6.7					
62	59 44	1.11	24 22	.72	59 33	1.11	25 17	.75	59 21	1.11	26 11	.77	28	67.9					
63	60 38	1.11	25 5	.78	60 27	1.11	26 2	.80	60 15	1.13	27 46	.82	27	67.0					
64	61 32	1.11	52	.83	61 21	1.13	50	.85	61 8	1.13	27 47	.88	26	66.1					
65	62 26	1.11	26 42	0.90	62 14	1.13	27 41	0.92	62 1	1.15	28 39	0.93	25	65.1					
66	63 20	1.13	27 36	.95	63 7	1.15	28 36	.97	53	1.15	29 35	1.00	24	64.1					
67	64 13	1.15	28 33	1.02	59	1.15	29 34	1.05	63 45	1.15	30 35	1.07	23	63.0					
68	65 5	1.15	29 34	1.10	64 51	1.18	30 37	1.13	64 37	1.18	31 39	1.13	22	61.8					
69	57	1.18	30 40	1.20	65 42	1.18	31 45	1.20	65 28	1.20	32 47	1.23	21	60.6					
70	66 48	1.18	31 52	1.27	66 33	1.20	32 57	1.30	66 18	1.22	34 1	1.32	20	59.3					
71	67 39	1.20	33 8	1.38	67 23	1.22	34 15	1.40	67 7	1.25	35 20	1.43	19	57.8					
72	68 29	1.22	34 31	1.50	68 12	1.25	35 39	1.52	55	1.25	36 46	1.53	18	56.3					
73	69 18	1.25	36 1	1.62	69 0	1.25	37 10	1.65	68 43	1.28	38 18	1.65	17	54.7					
74	70 6	1.28	37 38	1.77	48	1.30	38 49	1.77	69 30	1.33	39 57	1.78	16	53.0					
75	53	1.33	39 24	1.90	70 34	1.33	40 35	1.92	70 15	1.36	41 44	1.93	15	51.1					
76	71 38	1.33	41 18	2.08	71 19	1.40	42 30	2.08	59	1.40	43 40	2.08	14	49.0					
77	72 23	1.40	43 23	2.25	72 2	1.43	44 35	2.25	71 42	1.46	45 45	2.25	13	46.8					
78	73 6	1.46	45 38	2.45	44	1.50	46 50	2.45	72 23	1.54	48 0	2.43	12	44.5					
79	47	1.54	48 5	2.67	73 24	1.58	49 17	2.65	73 2	1.62	50 26	2.62	11	41.9					
80	74 26	1.67	50 45	2.90	74 2	1.67	51 56	2.87	39	1.71	53 3	2.83	10	39.2					
81	75 2	1.71	53 39	3.13	38	1.76	54 48	3.08	74 14	1.88	55 53	3.03	9	36.2					
82	37	1.94	56 47	3.38	75 12	2.00	57 53	3.32	46	2.00	58 55	3.25	8	33.0					
83	76 8	2.14	60 10	3.65	42	2.22	61 12	3.55	75 16	2.31	62 10	3.47	7	29.6					
84	36	2.40	63 49	3.88	76 9	2.50	64 45	3.78	42	2.61	65 38	3.68	6	25.9					
85	77 1	2.86	67 42	4.13	33	3.00	68 32	4.00	76 5	3.00	69 19	3.87	5	22.0					
86	22	3.75	71 50	4.33	53	3.75	72 32	4.18	25	4.00	73 11	4.05	4	17.9					
87	38	5.00	76 10	4.52	77 9	5.00	76 43	4.33	40	5.45	77 14	4.17	3	13.6					
88	50	7.50	80 41	4.62	21	8.57	81 3	4.45	51	8.57	81 24	4.28	2	9.2					
89	58	30.0	85 18		28	30.0	85 30	4.50	58	30.0	85 41	4.32	1	4.6					
90	78 0		90 0		30		90 0		77 0		90 0		0	0.0					
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a						
	d = 12° 0'				d = 12° 30'				d = 13° 0'										

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

t	a = 13° 30'		a = 14° 0'		a = 14° 30'		α
	a	b	a	b	a	b	
	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$	

B	$a = 13^{\circ} 30'$					$a = 14^{\circ} 0'$					$a = 14^{\circ} 30'$					C	α				
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t						
		Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ			Δ	Δ		
45	43	26	1.05	18	45	0.32	43	19	1.05	19	25	0.33	43	12	1.07	20	5	0.33	45	76.4	
46	44	23	1.05	19	4	.33	44	16	1.07	45	.33	44	8	1.07	25	.35	44	.35	44	75.9	
47	45	20	1.07	24	.33	45	12	1.07	20	5	.35	45	4	1.07	46	.37	43	.37	43	75.5	
48	46	16	1.05	44	.37	46	8	1.07	26	.37	46	0	1.07	21	8	.38	42	.38	42	75.0	
49	47	13	1.07	20	6	.38	47	4	1.07	48	.40	56	1.07	31	.40	41	.40	41	74.4		
50	48	9	1.07	29	0.40	48	0	1.07	21	12	0.42	47	52	1.07	55	0.42	40	0.42	40	73.9	
51	49	5	1.07	53	.42	56	1.07	37	.43	48	48	1.09	22	20	.45	39	.45	39	73.4		
52	50	1	1.07	21	18	.45	49	52	1.07	22	3	.45	49	43	1.09	47	.47	38	72.8		
53	51	57	1.07	45	.47	50	48	1.09	30	.48	50	38	1.09	23	15	.50	37	.50	37	72.2	
54	51	53	1.09	22	13	.50	51	43	1.09	59	.52	51	33	1.09	45	.52	36	.52	36	71.6	
55	52	48	1.09	43	0.52	52	38	1.09	23	30	0.53	52	28	1.09	24	16	.55	35	70.9		
56	53	43	1.09	23	14	.55	53	33	1.09	24	2	.57	53	23	1.11	49	.58	34	70.3		
57	54	38	1.09	47	.58	54	28	1.11	36	.60	54	17	1.11	25	24	.62	33	.62	33	69.6	
58	55	33	1.09	24	22	.63	55	22	1.11	25	12	.63	55	11	1.11	26	1	.65	32	68.8	
59	56	28	1.11	25	0	.65	56	16	1.11	50	.67	56	5	1.11	40	.68	31	.68	31	68.1	
60	57	22	1.11	39	0.70	57	10	1.11	26	30	0.72	59	1.13	27	21	.73	30	.73	30	67.3	
61	58	16	1.13	26	21	.73	58	4	1.13	27	13	.77	57	52	1.13	28	5	.77	29	66.4	
62	59	9	1.13	27	5	.78	59	57	1.13	59	.80	58	45	1.15	51	.82	28	.82	28	65.5	
63	60	2	1.13	52	.83	59	50	1.15	28	47	.85	59	37	1.15	29	40	.87	27	.87	27	64.6
64	60	55	1.13	28	42	.90	60	42	1.15	29	38	.90	60	29	1.18	30	32	.93	26	63.6	
65	61	48	1.15	29	36	0.95	61	34	1.18	30	32	0.98	61	20	1.18	31	28	0.98	25	62.6	
66	62	40	1.18	30	33	1.02	62	25	1.18	31	31	1.03	62	11	1.20	32	27	1.05	24	61.5	
67	63	31	1.18	31	34	1.08	63	16	1.18	32	33	1.10	63	1	1.20	33	30	1.12	23	60.3	
68	64	22	1.20	32	39	1.17	64	7	1.22	33	39	1.18	51	1.22	34	37	1.20	22	59.1		
69	65	12	1.20	33	49	1.25	56	1.22	34	50	1.25	64	40	1.25	35	49	1.28	21	57.8		
70	66	2	1.25	35	4	1.33	65	45	1.25	36	5	1.37	65	28	1.25	37	6	1.37	20	56.4	
71	50	1.25	36	24	1.45	66	33	1.28	37	27	1.45	66	16	1.30	38	28	1.47	19	54.9		
72	67	38	1.28	37	51	1.55	67	20	1.28	38	54	1.55	67	2	1.30	39	56	1.57	18	53.3	
73	68	25	1.30	39	24	1.65	68	7	1.33	40	27	1.68	48	1.36	41	30	1.68	17	51.6		
74	69	11	1.36	41	3	1.80	52	1.36	42	8	1.80	68	32	1.40	43	11	1.80	16	49.8		
75	55	1.36	42	51	1.93	69	36	1.43	43	56	1.93	69	15	1.43	44	59	1.93	15	47.9		
76	70	39	1.43	44	47	2.08	70	18	1.46	45	52	2.08	57	1.50	46	55	2.07	14	45.9		
77	71	21	1.50	46	52	2.23	59	1.54	47	57	2.23	70	37	1.54	48	59	2.22	13	43.7		
78	72	1	1.58	49	6	2.42	71	38	1.58	50	11	2.40	71	16	1.67	51	12	2.38	12	41.3	
79	39	1.67	51	31	2.60	72	16	1.71	52	35	2.57	52	1.71	53	35	2.53	11	38.8			
80	73	15	1.76	54	7	2.80	51	1.82	55	9	2.75	72	27	1.88	56	7	2.72	10	36.1		
81	49	1.88	56	55	2.98	73	24	1.94	57	54	2.93	59	2.00	58	50	2.88	9	33.2			
82	74	21	2.14	59	54	3.18	55	2.14	60	50	3.12	73	29	2.22	61	43	3.05	8	30.2		
83	49	2.31	63	5	3.38	74	23	2.40	63	57	3.30	56	2.50	64	40	3.22	7	26.9			
84	75	15	2.73	66	28	3.58	48	2.86	67	15	3.48	74	20	2.86	67	59	3.38	6	23.5		
85	37	3.16	70	3	3.75	75	9	3.33	70	44	3.63	41	3.53	71	22	3.53	5	19.9			
86	56	4.00	73	48	3.90	27	4.29	74	22	3.78	58	4.29	74	54	3.67	4	16.1				
87	76	11	6.00	77	42	4.03	41	5.45	78	9	3.88	75	12	6.00	78	34	3.75	3	12.2		
88	21	8.57	81	44	4.12	52	10.0	82	2	3.97	22	10.0	82	19	3.82	2	8.2				
89	28	30.0	85	51	4.15	58	30.0	86	0	4.00	28	30.0	86	8	3.87	1	4.1				
90	30		90	0		76	0	90	0		30		90	0		0	0.0				

b	a = 15° 0'					a = 15° 30'					a = 16° 0'					c	α						
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	h	d			60' / Δ	Z	t	Δ / 60'	C	β
0	0	0	1.03	15	0	0.00	0	0	1.03	15	30	0.00	0	0	1.03	16	0	0.00	0	0	0.00	90	90.0
1		58	1.03		0	.02	0	58	1.03		30	.02	0	58	1.05		0	.02				89	89.7
2	1	56	1.03	1		.00	1	56	1.05	1		.00	1	55	1.03	1		.00				88	89.5
3	2	54	1.03	1		.02	2	53	1.03	31		.02	2	53	1.03	1		.02				87	89.2
4	3	52	1.03	2		.02	3	51	1.03	32		.02	3	51	1.05	2		.02				86	88.9
5	4	50	1.03	3		.03	4	49	1.03	33		.03	4	48	1.03	3		.03				85	88.7
6	5	48	1.03	5		.03	5	47	1.03	35		.03	5	46	1.03	5		.03				84	88.4
7	6	46	1.03	7		.03	6	45	1.05	37		.03	6	44	1.05	7		.03				83	88.1
8	7	44	1.05	9		.03	7	42	1.03	39		.03	7	41	1.03	9		.03				82	87.8
9	8	41	1.03	11		.03	8	40	1.03	41		.05	8	39	1.03	11		.05				81	87.6
10	9	39	1.03	13		.05	9	38	1.03	44		.05	9	37	1.05	14		.05				80	87.3
11	10	37	1.03	16		.05	10	36	1.05	47		.05	10	34	1.03	17		.05				79	87.0
12	11	35	1.03	19		.05	11	33	1.03	50		.05	11	32	1.05	20		.07				78	86.7
13	12	33	1.03	22		.07	12	31	1.03	53		.07	12	29	1.03	24		.07				77	86.5
14	13	31	1.03	26		.07	13	29	1.03	57		.07	13	27	1.05	28		.07				76	86.2
15	14	29	1.05	30		.08	14	27	1.05	16		.07	14	24	1.03	32		.08				75	85.9
16	15	26	1.03	35		.07	15	24	1.03	5		.08	15	22	1.05	37		.08				74	85.6
17	16	24	1.03	39		.08	16	22	1.03	10		.08	16	19	1.03	42		.08				73	85.3
18	17	22	1.03	44		.08	17	20	1.05	15		.10	17	17	1.05	47		.08				72	85.0
19	18	20	1.05	49		.10	18	17	1.03	21		.10	18	14	1.03	52		.10				71	84.7
20	19	17	1.03	55		.10	19	15	1.05	27		.10	19	12	1.05	58		.10				70	84.4
21	20	15	1.03	16		.10	20	12	1.03	33		.10	20	9	1.05	17		.12				69	84.1
22	21	13	1.05	7		.12	21	10	1.05	39		.12	21	6	1.03	11		.12				68	83.8
23	22	10	1.03	14		.12	22	7	1.03	46		.12	22	4	1.05	18		.13				67	83.5
24	23	8	1.03	21		.12	23	5	1.05	53		.13	23	1	1.05	26		.13				66	83.2
25	24	6	1.05	28		.13	24	2	1.05	17		.13	24	58	1.05	34		.13				65	82.9
26	25	3	1.03	36		.13	25	59	1.03	9		.13	24	55	1.05	42		.13				64	82.6
27	26	1	1.05	44		.15	25	57	1.05	17		.15	25	52	1.03	50		.15				63	82.2
28	26	58	1.05	53		.15	26	54	1.05	26		.15	26	50	1.05	59		.17				62	81.9
29	27	55	1.03	17		.17	27	51	1.05	35		.17	27	47	1.05	18		.17				61	81.6
30	28	53	1.05	12		.17	28	48	1.05	45		.18	28	44	1.05	19		.18				60	81.2
31	29	50	1.05	22		.17	29	45	1.05	56		.18	29	41	1.07	30		.18				59	80.9
32	30	47	1.05	32		.18	30	42	1.05	7		.18	30	37	1.05	41		.20				58	80.5
33	31	44	1.03	43		.20	31	39	1.05	18		.20	31	34	1.05	53		.20				57	80.2
34	32	42	1.05	55		.20	32	36	1.05	30		.20	32	31	1.05	19		.22				56	79.8
35	33	39	1.05	18		.22	33	33	1.05	42		.22	33	28	1.07	18		.22				55	79.4
36	34	36	1.05	20		.22	34	30	1.05	55		.23	34	24	1.05	31		.23				54	79.0
37	35	33	1.07	33		.23	35	27	1.07	19		.23	35	21	1.07	45		.25				53	78.6
38	36	29	1.05	47		.23	36	23	1.05	23		.25	36	17	1.07	20		.25				52	78.2
39	37	26	1.05	19		.27	37	20	1.07	38		.27	37	13	1.05	15		.27				51	77.8
40	38	23	1.07	17		.27	38	16	1.05	54		.28	38	10	1.07	31		.28				50	77.4
41	39	19	1.05	33		.28	39	13	1.07	11		.28	39	6	1.07	48		.30				49	76.9
42	40	16	1.07	50		.28	40	9	1.07	28		.30	40	2	1.07	21		.32				48	76.5
43	41	12	1.05	20		.32	41	5	1.07	46		.32	41	58	1.07	25		.32				47	76.0
44	42	9	1.07	26		.32	42	1	1.07	21		.33	41	54	1.09	44		.33				46	75.5
45	43	5		45			57			25			42	49		22		4				45	75.0

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

B	$a = 15^\circ 0'$				$a = 15^\circ 30'$				$a = 16^\circ 0'$				C	β								
	h	d	$\frac{60'}{\Delta}$	t	h	d	$\frac{60'}{\Delta}$	t	h	d	$\frac{60'}{\Delta}$	t			$\frac{\Delta}{60'}$							
		Δ	Z	$\frac{\Delta}{60'}$		Δ	Z	$\frac{\Delta}{60'}$		Δ	Z	$\frac{\Delta}{60'}$										
45	43	5	1.07	20	45	0.35	42	57	1.07	21	25	0.35	42	49	1.07	22	4	0.37	45	75.0		
46	44	1	1.07	21	6	.35	43	53	1.07	46	.37	43	45	1.09	26	.37	44	.37	44	74.5		
47	57		1.07	27	.38	44	49	1.09	22	8	.38	44	40	1.09	48	.40	43	.40	43	74.0		
48	45	53	1.09	49	.40	45	44	1.09	31	.40	45	35	1.09	23	12	.42	42	.42	42	73.5		
49	46	48	1.07	22	13	.42	46	39	1.09	55	.42	46	30	1.09	37	.43	41	.43	41	72.9		
50	47	44	1.09		38	0.43	47	34	1.09	23	20	0.45	47	25	1.09	24	3	0.45	40	72.3		
51	48	39	1.09	23	4	.45	48	29	1.09	47	.47	48	20	1.09	30	.48	39	.48	39	71.7		
52	49	34	1.09	31	.48	49	24	1.09	24	15	.48	49	15	1.11	59	.50	38	.50	38	71.1		
53	50	29	1.09	24	0	.50	50	19	1.11	44	.52	50	9	1.11	25	29	.52	37	.52	37	70.5	
54	51	24	1.11		30	.53	51	13	1.11	25	15	.55	51	3	1.11	26	0	.57	36	69.8		
55	52	18	1.11	25	2	0.57	52	7	1.11		48	0.58	57	1.13	34	0.58	35	0.58	35	69.1		
56	53	12	1.11		36	.60	53	1	1.11	26	23	.60	52	50	1.13	27	9	.62	34	68.4		
57	54	6	1.11	26	12	.62	55	1.13	59	59	.63	53	43	1.13	46	.65	33	.65	33	67.6		
58	55	0	1.13	49	.67	54	48	1.13	27	37	.68	54	36	1.13	28	25	.68	32	.68	32	66.8	
59	53		1.13	27	29	.70	55	41	1.13	28	18	.72	55	29	1.15	29	6	.73	31	66.0		
60	56	46	1.13	28	11	0.75	56	34	1.15	29	1	0.75	56	21	1.15	50	0.77	30	0.77	30	65.2	
61	57	39	1.15	56	.78	57	26	1.15	30	46	.80	57	13	1.18	30	36	.82	29	.82	29	64.3	
62	58	31	1.15	29	43	.83	58	18	1.15	30	34	.85	58	4	1.18	31	25	.87	28	63.3		
63	59	23	1.15	30	33	.88	59	10	1.18	31	25	.90	55	1.18	32	17	.90	27	.90	27	62.3	
64	60	15	1.18	31	26	.95	60	1	1.20	32	19	.95	59	46	1.22	33	11	.97	26	.97	26	61.3
65	61	6	1.20	32	23	1.00	51	1.20	33	16	1.02	60	36	1.22	34	9	1.03	25	1.03	25	60.2	
66	56		1.20	33	23	1.07	61	41	1.22	34	17	1.08	61	25	1.22	35	11	1.10	24	1.10	24	59.0
67	62	46	1.22	34	27	1.13	62	30	1.22	35	22	1.15	62	14	1.25	36	17	1.15	23	1.15	23	57.8
68	63	35	1.25	35	35	1.20	63	19	1.25	36	31	1.22	63	2	1.28	37	26	1.23	22	1.23	22	56.5
69	64	23	1.25	36	47	1.28	64	7	1.28	37	44	1.30	49	1.28	38	40	1.30	21	1.30	21	55.2	
70	65	11	1.28	38	4	1.38	54	1.30	39	2	1.38	64	36	1.33	39	58	1.40	20	1.40	20	53.7	
71	58		1.30	39	27	1.48	65	40	1.33	40	25	1.48	65	21	1.33	41	22	1.50	19	1.50	19	52.2
72	66	44	1.33	40	56	1.57	66	25	1.36	41	54	1.58	66	6	1.44	42	52	1.58	18	1.58	18	50.6
73	67	29	1.40	42	30	1.68	67	9	1.40	43	29	1.70	49	1.43	44	27	1.68	17	1.68	17	48.8	
74	68	12	1.40	44	11	1.80	52	1.43	45	11	1.80	67	31	1.46	46	8	1.80	16	1.80	16	47.0	
75	55		1.46	45	59	1.93	68	34	1.50	46	59	1.92	68	12	1.50	47	56	1.92	15	1.92	15	45.1
76	69	36	1.54	47	55	2.07	69	14	1.58	48	54	2.05	52	1.58	49	51	2.03	14	2.03	14	43.0	
77	70	15	1.58	49	59	2.22	52	1.62	50	57	2.18	69	30	1.67	51	53	2.17	13	2.17	13	40.8	
78	53		1.71	52	12	2.35	70	29	1.71	53	8	2.33	70	6	1.76	54	3	2.30	12	2.30	12	38.5
79	71	28	1.76	54	33	2.50	71	4	1.82	55	28	2.48	40	1.88	56	21	2.45	11	2.45	11	36.0	
80	72	2	1.88	57	3	2.67	37	1.94	57	57	2.62	71	12	2.00	58	48	2.58	10	2.58	10	33.4	
81	34		2.07	59	43	2.83	72	8	2.14	60	34	2.78	42	2.22	61	23	2.73	9	2.73	9	30.7	
82	73	3	2.31	62	33	2.98	36	2.31	63	21	2.93	72	9	2.40	64	7	2.87	8	2.87	8	27.7	
83	29		2.61	65	32	3.15	73	2	2.73	66	17	3.07	34	2.73	66	59	3.00	7	3.00	7	24.7	
84	52		3.00	68	41	3.30	24	3.00	69	21	3.20	56	3.16	69	59	3.12	6	3.12	6	21.5		
85	74	12	3.53	71	59	3.43	44	3.75	72	33	3.33	73	15	3.75	73	6	3.23	5	3.23	5	18.1	
86	29		4.29	75	25	3.53	74	0	4.62	75	53	3.43	31	4.62	76	20	3.32	4	3.32	4	14.7	
87	43		6.67	78	57	3.63	13	6.67	79	19	3.52	44	6.67	79	39	3.42	3	3.42	3	11.1		
88	52		10.0	82	35	3.68	22	10.0	82	50	3.57	53	12.0	83	4	3.45	2	3.45	2	7.4		
89	58		30.0	86	16	3.73	28	30.0	86	24	3.60	58	30.0	86	31	3.48	1	3.48	1	3.7		
90	75	0		90	0		30		90	0		74	0		90	0		0		0	0.0	

b	a = 16° 30'				a = 17° 0'				a = 17° 30'				c	α						
	B	h	d 60' Δ	t Z	Δ 60'	h	d 60' Δ	t Z	Δ 60'	h	d 60' Δ	t Z			Δ 60'	C	β			
0	0	0	1.03	16	30	0.00	0	0	1.05	17	0	0.00	0	0	1.05	17	30	0.00	90	90.0
1	1	58	1.05	30	.02	57	1.03	0	.02	57	1.05	30	.02	89	89.7					
2	2	55	1.03	31	.00	1	55	1.05	1	.00	1	54	1.03	31	.00	88	89.4			
3	3	53	1.05	31	.02	2	52	1.05	1	.02	2	52	1.05	31	.02	87	89.1			
4	4	50	1.03	32	.03	3	49	1.03	2	.03	3	49	1.05	32	.03	86	88.8			
5	5	48	1.05	34	0.02	4	47	1.05	4	0.02	4	46	1.05	34	0.02	85	88.5			
6	6	45	1.03	35	.03	5	44	1.03	5	.03	5	43	1.05	35	.03	84	88.2			
7	7	43	1.05	37	.05	6	42	1.05	7	.05	6	40	1.03	37	.05	83	87.9			
8	8	40	1.03	39	.05	7	39	1.05	9	.05	7	38	1.05	40	.05	82	87.6			
9	9	38	1.05	42	.05	8	36	1.03	12	.05	8	35	1.05	42	.05	81	87.3			
10	10	35	1.03	45	0.05	9	34	1.05	15	0.05	9	32	1.05	45	0.05	80	87.0			
11	11	33	1.05	48	.05	10	31	1.05	18	.05	10	29	1.05	48	.07	79	86.7			
12	12	30	1.05	51	.07	11	28	1.05	21	.07	11	26	1.05	52	.07	78	86.4			
13	13	27	1.03	55	.07	12	25	1.03	25	.07	12	23	1.05	56	.07	77	86.1			
14	14	25	1.05	59	.07	13	23	1.05	29	.08	13	20	1.05	18	0	.08	76	85.8		
15	15	22	1.05	17	3	0.08	14	20	1.05	34	0.08	14	17	1.05	5	0.08	75	85.5		
16	16	19	1.03	8	.08	15	17	1.05	39	.08	15	14	1.05	10	.08	74	85.2			
17	17	17	1.05	13	.08	16	14	1.05	44	.08	16	11	1.05	15	.10	73	84.9			
18	18	14	1.05	18	.10	17	11	1.05	49	.10	17	8	1.05	21	.10	72	84.6			
19	19	11	1.03	24	.10	18	8	1.05	55	.10	18	5	1.05	27	.10	71	84.3			
20	20	9	1.05	30	0.10	19	5	1.05	18	1	0.12	19	2	1.05	33	0.12	70	83.9		
21	21	6	1.05	36	.12	20	2	1.05	8	.12	20	59	1.05	40	.12	69	83.6			
22	22	3	1.05	43	.12	59	1.05	15	15	.12	20	56	1.05	47	.12	68	83.3			
23	23	0	1.05	50	.13	21	56	1.05	22	.13	21	53	1.07	54	.13	67	82.9			
24	24	57	1.05	58	.13	22	53	1.05	30	.13	22	49	1.05	19	2	.15	66	82.6		
25	25	54	1.05	18	6	0.13	23	50	1.05	38	0.15	23	46	1.05	11	0.15	65	82.2		
26	26	51	1.05	14	.15	24	47	1.05	47	.15	24	43	1.07	20	.15	64	81.9			
27	27	48	1.05	23	.17	25	44	1.05	56	.17	25	39	1.05	29	.17	63	81.5			
28	28	45	1.05	33	.17	26	41	1.05	19	6	.17	26	36	1.07	39	.17	62	81.2		
29	29	42	1.05	43	.17	27	37	1.07	16	.18	27	32	1.05	49	.18	61	80.8			
30	30	39	1.05	53	0.18	28	34	1.07	27	0.18	28	29	1.07	20	0	0.20	60	80.4		
31	31	36	1.07	19	4	.18	29	30	1.05	38	.20	29	25	1.07	12	.20	59	80.0		
32	32	30	1.05	15	.20	30	27	1.07	50	.20	30	21	1.05	24	.20	58	79.6			
33	33	29	1.07	27	.22	31	23	1.05	20	2	.22	31	18	1.07	36	.22	57	79.2		
34	34	25	1.05	40	.22	32	20	1.07	15	.22	32	14	1.07	49	.23	56	78.8			
35	35	22	1.07	53	0.23	33	16	1.07	28	0.23	33	10	1.07	21	3	0.25	55	78.4		
36	36	18	1.05	20	7	.23	34	12	1.07	42	.25	34	6	1.07	18	.25	54	78.0		
37	37	15	1.07	21	.25	35	8	1.07	57	.25	35	2	1.07	33	.27	53	77.6			
38	38	11	1.07	36	.27	36	4	1.07	21	12	.27	58	1.09	49	.27	52	77.1			
39	39	7	1.07	52	.28	37	0	1.07	28	.28	36	53	1.07	22	5	.28	51	76.7		
40	40	3	1.07	21	9	0.28	56	1.07	45	0.30	37	49	1.09	22	0.30	50	76.2			
41	41	59	1.07	26	.30	38	52	1.09	22	3	.32	38	44	1.09	40	.32	49	75.7		
42	42	55	1.09	44	.32	39	47	1.09	22	.32	39	39	1.09	59	.33	48	75.2			
43	43	50	1.07	22	3	.33	40	42	1.07	41	.35	40	34	1.09	23	19	.35	47	74.7	
44	44	46	1.09	23	.35	41	38	1.09	23	2	.35	41	29	1.09	40	.37	46	74.2		
45	45	41		44		42	33		23		42	24		24	2		45	73.7		
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a							
	d = 16° 30'				d = 17° 0'				d = 17° 30'				a							

b	a = 16° 30'					a = 17° 0'					a = 17° 30'					c	a			
	B	h	d	60'	t	Δ	h	d	60'	t	Δ	h	d	60'	t			Δ	C	β
			Δ	Z					Δ					Z						
45	42	41	1.09	22	44	0.37	42	33	1.09	23	23	0.37	42	24	1.09	24	2	0.38	45	73.7
46	43	36	1.09	23	6	.38	43	28	1.09	45	45	.40	43	19	1.09	25	25	.40	44	73.2
47	44	31	1.09	29		.40	44	23	1.09	24	9	.40	44	14	1.11	49	49	.42	43	72.6
48	45	26	1.09	53		.42	45	18	1.11	33	43	.43	45	8	1.11	25	14	.43	42	72.0
49	46	21	1.09	24	18	.43	46	12	1.11	59	45	.45	46	2	1.11	40	40	.47	41	71.4
50	47	16	1.11		44	0.47	47	6	1.11	25	26	0.48		56	1.11	26	8	0.48	40	70.8
51	48	10	1.11	25	12	.50	48	0	1.11	55	55	.50	47	50	1.11	37	37	.50	39	70.1
52	49	4	1.11	42		.50		54	1.11	26	25	.52	48	44	1.13	27	7	.53	38	69.5
53		58	1.11	26	12	.55	49	48	1.13	56	55	.55	49	37	1.13	39	39	.57	37	68.8
54	50	52	1.11		45	.57	50	41	1.13	27	29	.58	50	30	1.13	28	13	.58	36	68.1
55	51	46	1.13	27	19	0.60	51	34	1.13	28	4	0.60	51	23	1.15	48	48	0.62	35	67.3
56	52	39	1.13	55		.62	52	27	1.13	40	63	.63	52	15	1.15	29	25	.65	34	66.6
57	53	32	1.15	28	32	.67	53	20	1.15	29	18	.68	53	7	1.15	30	4	.68	33	65.8
58	54	24	1.15	29	12	.70	54	12	1.15	59	72	.72	59	1.18	45	45	.72	32	64.9	
59	55	16	1.15		54	.75	55	4	1.18	30	42	.75	54	50	1.18	31	28	.77	31	64.1
60	56	8	1.15	30	39	0.78		55	1.18	31	27	0.78	55	41	1.18	32	14	0.80	30	63.1
61	57	0	1.18	31	26	.82	56	46	1.20	32	14	.83	56	32	1.20	33	2	.85	29	62.2
62		51	1.20	32	15	.87	57	36	1.20	33	4	.88	57	22	1.22	53	53	.90	28	61.2
63	58	41	1.20	33	7	.93	58	26	1.20	57	93	.93	58	11	1.22	34	47	.95	27	60.2
64	59	31	1.22	34	3	.98	59	16	1.22	34	53	1.00	59	0	1.25	35	44	1.00	26	59.1
65	60	20	1.22	35	2	1.03	60	5	1.25	35	53	1.05		48	1.25	36	44	1.05	25	57.9
66	61	9	1.25	36	4	1.10		53	1.25	36	56	1.12	60	36	1.28	37	47	1.12	24	56.7
67		57	1.25	37	10	1.17	61	41	1.28	38	3	1.17	61	23	1.28	38	54	1.18	23	55.4
68	62	45	1.28	38	20	1.25	62	28	1.30	39	13	1.25	62	10	1.33	40	5	1.25	22	54.1
69	63	32	1.33	39	35	1.32	63	14	1.33	40	28	1.33		55	1.33	41	20	1.33	21	52.7
70	64	17	1.33	40	54	1.40		59	1.36	41	48	1.40	63	40	1.40	42	40	1.42	20	51.2
71	65	2	1.36	42	18	1.48	64	43	1.40	43	12	1.50	64	23	1.40	44	5	1.50	19	49.7
72		46	1.40	43	47	1.58	65	26	1.43	44	42	1.58	65	6	1.46	45	35	1.58	18	48.0
73	66	29	1.46	45	22	1.68	66	8	1.46	46	17	1.68		47	1.50	47	10	1.67	17	46.3
74	67	10	1.50	47	3	1.80		49	1.50	47	58	1.78	66	27	1.54	48	50	1.78	16	44.4
75		50	1.54	48	51	1.92	67	29	1.58	49	45	1.90	67	6	1.62	50	37	1.88	15	42.5
76	68	29	1.62	50	46	2.02	68	7	1.67	51	39	2.00		43	1.67	52	30	2.00	14	40.5
77	69	6	1.67	52	47	2.15		43	1.71	53	39	2.13	68	19	1.76	54	30	2.10	13	38.3
78		42	1.82	54	56	2.28	69	18	1.88	55	47	2.25		53	1.88	56	36	2.22	12	36.0
79	70	15	1.88	57	13	2.40		50	1.94	58	2	2.37	69	25	2.00	58	49	2.35	11	33.6
80		47	2.07	59	37	2.55	70	21	2.07	60	24	2.50		55	2.14	61	10	2.45	10	31.1
81	71	16	2.22	62	10	2.67		50	2.31	62	54	2.62	70	23	2.31	63	37	2.57	9	28.4
82		43	2.50	64	50	2.80	71	16	2.61	65	31	2.75		49	2.61	66	11	2.68	8	25.7
83	72	7	2.86	67	38	2.93		39	2.86	68	16	2.85	71	12	3.00	68	52	2.80	7	22.8
84		28	3.16	70	34	3.03	72	0	3.33	71	7	2.97		32	3.53	71	40	2.88	6	19.8
85		47	4.00	73	36	3.15		18	4.00	74	5	3.07		49	4.00	74	33	2.98	5	16.7
86	73	2	5.00	76	45	3.23		33	5.00	77	9	3.13	72	4	5.45	77	32	3.05	4	13.5
87		14	6.67	79	59	3.30		45	7.50	80	17	3.20		15	7.50	80	35	3.10	3	10.2
88		23	12.0	83	17	3.35		53	12.0	83	29	3.25		23	12.0	83	41	3.15	2	6.8
89		28	30.0	86	38	3.37		58	30.0	86	44	3.27		28	30.0	86	50	3.17	1	3.4
90		30		90	0		73	0		90	0			30		90	0		0	0.0

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

b	a = 18° 0'					a = 18° 30'					a = 19° 0'					c	α									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ						Δ	Δ								Δ	Δ						
45	42	16	1.11	24	41	0.38	42	7	1.11	25	19	0.40	41	57	1.11	25	58	0.40	45	72.0						
46	43	10	1.11	25	4	.40	43	1	1.11	26	43	.42	42	51	1.11	26	22	.42	44	71.8						
47	44	4	1.11		28	.43		55	1.11	26	8	.43	43	45	1.11		47	.45	43	71.2						
48		58	1.11		54	.45	44	49	1.13		34	.45	44	39	1.13		27	14	.47	42	70.6					
49	45	52	1.11	26	21	.47	45	42	1.13	27	1	.48	45	32	1.13		42	.48	41	69.9						
50	46	46	1.13		49	0.48	46	35	1.13		30	0.50	46	25	1.13	28	11	0.50	40	69.3						
51	47	39	1.13	27	18	.52	47	28	1.13	28	0	.52	47	18	1.15	41		.53	39	68.6						
52	48	32	1.13		49	.55	48	21	1.13		31	.55	48	10	1.15	29	13	.57	38	67.9						
53	49	25	1.13	28	22	.57	49	14	1.15	29	4	.58	49	2	1.15	47		.58	37	67.2						
54	50	18	1.15		56	.60	50	6	1.15		39	.60		54	1.15	30	22	.62	36	66.4						
55	51	10	1.15	29	32	0.63		58	1.15	30	15	0.65	50	46	1.18		59	0.63	35	65.6						
56	52	2	1.15	30	10	.65	51	50	1.18		54	.67	51	37	1.18	31	37	.68	34	64.8						
57		54	1.15		49	.70	52	41	1.18	31	34	.70	52	28	1.20	32	18	.72	33	64.0						
58	53	46	1.18	31	31	.73	53	32	1.18	32	16	.75	53	18	1.20	33	1	.75	32	63.1						
59	54	37	1.20	32	15	.77	54	23	1.20	33	1	.77	54	8	1.20		46	.78	31	62.2						
60	55	27	1.20	33	1	0.82	55	13	1.22		47	0.83		58	1.22	34	33	0.83	30	61.2						
61	56	17	1.20		50	.85	56	2	1.22	34	37	.87	55	47	1.22	35	23	.88	29	60.2						
62	57	7	1.22	34	41	.90		51	1.22	35	29	.90	56	36	1.25	36	16	.92	28	59.2						
63		56	1.25		35	.95	57	40	1.25	36	23	.97	57	24	1.28	37	11	.97	27	58.1						
64	58	44	1.25	36	33	1.00	58	28	1.28	37	21	1.02	58	11	1.28	38	9	1.02	26	57.0						
65	59	32	1.28		37	1.07	59	15	1.28	38	22	1.07		58	1.30	39	10	1.08	25	55.8						
66	60	19	1.28	38	37	1.13	60	2	1.30	39	26	1.13	59	44	1.30	40	15	1.13	24	54.5						
67	61	6	1.30		39	1.18		48	1.33	40	34	1.20	60	30	1.33	41	23	1.20	23	53.2						
68		52	1.33	40	56	1.27	61	33	1.33	41	46	1.27	61	15	1.40	42	35	1.27	22	51.9						
69	62	37	1.36	42	12	1.33	62	18	1.40	43	2	1.33		58	1.40	43	51	1.33	21	50.4						
70	63	21	1.40		43	1.40	63	1	1.43	44	22	1.42	62	41	1.43	45	11	1.42	20	48.9						
71	64	4	1.46	44	56	1.50		43	1.43	45	47	1.50	63	23	1.46	46	36	1.50	19	47.3						
72		45	1.46	46	26	1.58	64	25	1.50	47	17	1.57	64	4	1.54	48	6	1.57	18	45.7						
73	65	26	1.50	48	1	1.68	65	5	1.54	48	51	1.67		43	1.58	49	40	1.65	17	43.9						
74	66	6	1.58	49	42	1.77	44		1.62	50	31	1.77	65	21	1.62	51	19	1.75	16	42.1						
75		44	1.67		51	1.87	66	21	1.67	52	17	1.85		58	1.71	53	4	1.85	15	40.2						
76	67	20	1.71	53	20	1.97	57	1.76	54	8	1.95	66	33	1.76	54	55	1.93	14	38.2							
77		55	1.76		55	1.88	67	31	1.82	56	5	2.05	67	7	1.88	56	51	2.03	13	36.0						
78	68	29	1.94	57	23	2.20	68	4	1.94	58	8	2.17		39	2.00	58	53	2.12	12	33.8						
79	69	0	2.07	59	35	2.30	35		2.14	60	18	2.27	68	9	2.14	61	0	2.23	11	31.5						
80		29	2.22		61	2.42	69	3	2.22	62	34	2.38		37	2.31	63	14	2.33	10	29.1						
81	56	2.40		64	18	2.52	30	2.50	64	57	2.47	69	3	2.50	65	34	2.43	9	26.5							
82	70	21	2.61		66	2.62		54	2.73	67	25	2.57		27	2.86	68	0	2.52	8	23.9						
83		44	3.16		69	2.67	70	16	3.16	69	59	2.67		48	3.16	70	31	2.60	7	21.2						
84	71	3	3.53	72	10	2.82	35	3.53	72	39	2.75		70	7	3.75	73	7	2.68	6	18.3						
85		20	4.00		74	2.90		52	4.62	75	24	2.82		23	4.62	75	48	2.75	5	15.4						
86	35	5.45		77	53	2.97	71	5	5.45	78	13	2.90		36	6.00	78	33	2.82	4	12.4						
87	46	7.50		80	51	3.02	16	7.50	81	7	2.93		46	7.50	81	22	2.85	3	9.4							
88	54	15.0		83	52	3.05	24	15.0	84	3	2.97		54	15.0	84	13	2.88	2	6.3							
89		58	30.0	86	55	3.08	28	30.0	87	1	2.98		58	30.0	87	6	2.90	1	3.1							
90	72	0		90	0		30		90	0			71	0		90	0		0	0.0						

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

b	a = 19° 30'				a = 20° 0'				a = 20° 30'				c	a					
	B	d	60' / Δ	Z	Δ / 60'	h	d	60' / Δ	Z	Δ / 60'	h	d			60' / Δ	Z	Δ / 60'	C	β
		h																	
45	41 48	1.11	26 36	0.42	41 39	1.13	27 14	0.42	41 29	1.13	27 52	0.42	45	71.1					
46	42 42	1.13	27 1	.42	42 32	1.13	28 39	.43	42 22	1.13	28 17	.45	44	70.5					
47	43 35	1.13	26	.45	43 25	1.13	28 5	.47	43 15	1.15	28 44	.47	43	69.9					
48	44 28	1.13	53	.48	44 18	1.15	33	.47	44 7	1.15	29 12	.48	42	69.2					
49	45 21	1.13	28 22	.48	45 10	1.15	29 1	.50	59	1.15	41	.50	41	68.5					
50	46 14	1.15	51	.52	46 2	1.15	31	.53	45 51	1.15	30 11	.53	40	67.8					
51	47 6	1.15	29 22	.53	47 54	1.15	30 3	.55	46 43	1.18	43	.55	39	67.1					
52	58	1.15	54	.57	47 46	1.15	30 36	.57	47 34	1.18	31 16	.58	38	66.4					
53	48 50	1.15	30 28	.60	48 38	1.18	31 10	.60	48 25	1.18	51	.62	37	65.6					
54	49 42	1.18	31 4	.63	49 29	1.18	46	.63	49 16	1.18	32 28	.63	36	64.8					
55	50 33	1.18	42	.65	50 20	1.20	32 24	.65	50 7	1.20	33 6	.67	35	64.0					
56	51 24	1.20	32 21	.68	51 10	1.20	33 3	.70	57	1.22	46	.70	34	63.1					
57	52 14	1.20	33 2	.72	52 0	1.20	45	.73	51 46	1.22	34 28	.73	33	62.2					
58	53 4	1.20	45	.77	50	1.22	34 29	.77	52 35	1.22	35 12	.78	32	61.3					
59	54	1.22	34 31	.80	53 39	1.22	35 15	.80	53 24	1.22	59	.80	31	60.3					
60	54 43	1.22	35 19	.83	54 28	1.25	36 3	.85	54 13	1.25	36 47	.85	30	59.3					
61	55 32	1.25	36 9	.88	55 16	1.25	54	.88	55 1	1.28	37 38	.90	29	58.3					
62	56 20	1.25	37 2	.92	56 4	1.28	37 47	.93	56 48	1.30	38 32	.95	28	57.2					
63	57 8	1.28	57	.98	51	1.28	38 43	.98	56 34	1.30	39 29	.98	27	56.1					
64	55	1.30	38 56	1.03	57 38	1.30	39 42	1.03	57 20	1.30	40 28	1.03	26	55.0					
65	58 41	1.30	39 58	1.08	58 24	1.33	40 44	1.08	58 6	1.36	41 30	1.08	25	53.7					
66	59 27	1.33	41 3	1.13	59 9	1.36	41 49	1.15	59	1.36	42 35	1.15	24	52.5					
67	60 12	1.36	42 11	1.20	53	1.40	42 58	1.22	59 34	1.40	43 44	1.22	23	51.1					
68	56	1.40	43 23	1.27	60 36	1.40	44 11	1.27	60 17	1.43	44 57	1.27	22	49.7					
69	61 39	1.43	44 39	1.35	61 19	1.43	45 27	1.33	59	1.46	46 13	1.33	21	48.3					
70	62 21	1.46	46 0	1.40	62 1	1.50	46 47	1.40	61 40	1.50	47 33	1.40	20	46.8					
71	63 2	1.50	47 24	1.48	41	1.50	48 11	1.48	62 20	1.54	48 57	1.48	19	45.2					
72	42	1.54	48 53	1.57	63 21	1.58	49 40	1.57	59	1.62	50 26	1.55	18	43.5					
73	64 21	1.58	50 27	1.65	59	1.62	51 14	1.63	63 36	1.67	51 59	1.62	17	41.8					
74	59	1.67	52 6	1.73	64 36	1.71	52 52	1.72	64 12	1.71	53 36	1.70	16	40.0					
75	65 35	1.76	53 50	1.83	65 11	1.76	54 35	1.80	47	1.76	55 18	1.80	15	38.1					
76	66 9	1.82	55 40	1.92	45	1.82	56 23	1.90	65 21	1.88	57 6	1.87	14	36.1					
77	42	1.88	57 35	2.00	66 18	2.00	58 17	1.98	53	2.00	58 58	1.95	13	34.0					
78	67 14	2.07	59 35	2.10	48	2.07	60 16	2.07	66 23	2.14	60 55	2.05	12	31.9					
79	43	2.14	61 41	2.20	67 17	2.22	62 20	2.17	51	2.31	62 58	2.12	11	29.6					
80	68 11	2.40	63 53	2.28	44	2.40	64 30	2.25	67 17	2.50	65 5	2.22	10	27.3					
81	36	2.61	66 10	2.38	68 9	2.73	66 45	2.33	41	2.73	67 18	2.28	9	24.8					
82	59	2.86	68 33	2.47	31	3.00	69 5	2.40	68 3	3.00	69 35	2.37	8	22.3					
83	69 20	3.33	71 1	2.53	51	3.33	71 29	2.50	23	3.33	71 57	2.43	7	19.7					
84	38	3.75	73 33	2.62	69 9	3.75	73 59	2.55	41	4.00	74 23	2.50	6	17.1					
85	54	4.62	76 10	2.68	25	5.00	76 32	2.62	56	5.00	76 53	2.55	5	14.3					
86	70 7	6.00	78 51	2.75	37	6.00	79 9	2.67	69 8	6.67	79 26	2.60	4	11.6					
87	17	8.57	81 36	2.77	47	8.57	81 49	2.70	17	8.57	82 2	2.63	3	8.7					
88	24	12.0	84 22	2.82	54	12.0	84 31	2.73	24	12.0	84 40	2.67	2	5.8					
89	29	60.0	87 11	2.82	59	60.0	87 15	2.75	29	60.0	87 20	2.67	1	2.9					
90	30		90 0		70 0		90 0		30		90 0		0	0.0					
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a						
	d = 19° 30'				d = 20° 0'				d = 20° 30'										

b	a = 21° 0'					a = 21° 30'					a = 22° 0'					c	α									
	B	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t	Δ	60'			h	d	60'	Z	t	Δ	60'	C	β
			Δ	Δ						Δ	Δ								Δ	Δ						
0	0	0	1.07	21	0	0.00	0	0	1.07	21	30	0.00	0	0	1.07	22	0	0.00	0	0	0.00	0	0	90	90.0	
1		56	1.07		0	.02		56	1.07		30	.02		56	1.09		0	.02		89		.02	89	89.6		
2		1 52	1.07		1	.02		1 52	1.09		31	.02		1 51	1.07		1	.02		88		.02	88	89.3		
3		2 48	1.07		2	.02		2 47	1.07		32	.02		2 47	1.09		2	.02		87		.02	87	88.9		
4		3 44	1.07		3	.02		3 43	1.07		33	.02		3 42	1.07		3	.03		86		.03	86	88.5		
5		4 40	1.07		4	.03		4 39	1.07		34	.03		4 38	1.07		5	.03		85		.03	85	88.2		
6		5 36	1.07		6	.05		5 35	1.07		36	.05		5 34	1.09		7	.03		84		.03	84	87.4		
7		6 32	1.07		9	.03		6 31	1.09		39	.05		6 29	1.07		9	.05		83		.05	83	87.8		
8		7 28	1.07		11	.05		7 26	1.07		42	.05		7 25	1.09		12	.05		82		.05	82	87.1		
9		8 24	1.07		14	.07		8 22	1.07		45	.05		8 20	1.07		15	.05		81		.05	81	86.7		
10		9 20	1.07		18	.07		9 18	1.07		48	.07		9 16	1.09		18	.07		80		.07	80	86.3		
11		10 16	1.07		22	.07		10 14	1.09		52	.07		10 11	1.07		22	.07		79		.07	79	85.9		
12		11 12	1.09		26	.07		11 9	1.07		56	.08		11 7	1.09		26	.08		78		.08	78	85.5		
13		12 7	1.07		30	.08		12 5	1.09	22	1	.08		12 2	1.07		31	.08		77		.08	77	85.2		
14		13 3	1.07		35	.08		13 0	1.07		6	.08		58	1.09		36	.10		76		.10	76	84.8		
15		14 59	1.07		40	.10		14 56	1.07		11	.10		13 53	1.09		42	.10		75		.10	75	84.4		
16		15 55	1.09		46	.10		15 52	1.09		17	.10		14 48	1.07		48	.10		74		.10	74	84.0		
17		16 50	1.07		52	.12		16 47	1.07		23	.12		15 44	1.09		54	.12		73		.12	73	83.6		
18		17 46	1.07		59	.12		17 43	1.09		30	.12		16 39	1.09	23	1	.12	72		.12	72	83.2			
19		18 42	1.09	22	6	.12		18 38	1.09		37	.13		17 34	1.09		8	.13		71		.13	71	82.8		
20		19 37	1.07		13	.13		19 33	1.07		45	.13		18 29	1.09		16	.13		70		.13	70	82.4		
21		20 33	1.09		21	.13		20 29	1.09		53	.13		19 24	1.09		24	.15		69		.15	69	82.0		
22		21 28	1.07		29	.15		21 24	1.09	23	1	.15		20 19	1.09		33	.15		68		.15	68	81.6		
23		22 24	1.09		38	.15		22 19	1.09		10	.17		21 14	1.09		42	.17		67		.17	67	81.2		
24		23 19	1.09		47	.17		23 14	1.09		20	.17		22 9	1.09		52	.17		66		.17	66	80.7		
25		24 14	1.09		57	.18		24 9	1.09		30	.17		23 4	1.09	24	2	.17	65		.17	65	80.3			
26		25 9	1.09	23	8	.18		25 4	1.09		40	.18		24 59	1.09		12	.18		64		.18	64	79.9		
27		26 4	1.09		19	.18		26 59	1.09		51	.20		25 54	1.11		23	.20		63		.20	63	79.4		
28		27 59	1.09		30	.20		27 54	1.09	24	3	.20		26 48	1.09		35	.22		62		.22	62	79.0		
29		28 54	1.09		42	.20		28 49	1.11		15	.22		27 43	1.11		48	.22		61		.22	61	78.5		
30		29 49	1.09		54	.22		29 43	1.09		28	.22		28 37	1.09	25	1	.22	60		.22	60	78.1			
31		30 44	1.09	24	7	.23		30 38	1.09		41	.23		28 32	1.11		14	.23		59		.23	59	77.6		
32		31 39	1.09		21	.25		31 33	1.11		55	.25		29 26	1.11		28	.25		58		.25	58	77.1		
33		32 34	1.11		36	.25		32 27	1.11	25	10	.25		30 20	1.11		43	.27		57		.27	57	76.6		
34		33 28	1.09		51	.27		33 21	1.11		25	.27		31 14	1.11		59	.27		56		.27	56	76.1		
35		34 23	1.11	25	7	.27		34 15	1.11		41	.28		32 8	1.13	26	15	.28	55		.28	55	75.6			
36		35 17	1.11		23	.28		35 9	1.11		58	.28		33 1	1.11		32	.30		54		.30	54	75.1		
37		36 11	1.11		40	.30		36 3	1.11		26	.30		34 55	1.13		50	.32		53		.32	53	74.6		
38		37 5	1.11		58	.32		37 57	1.13		33	.33		35 48	1.11		27	.32		52		.32	52	74.0		
39		38 59	1.11	26	17	.33		38 50	1.11		53	.33		36 42	1.13		28	.33		51		.33	51	73.5		
40		39 53	1.13		37	.35		39 44	1.13	27	13	.35		37 35	1.13		48	.37		50		.37	50	72.9		
41		40 46	1.11		58	.35		40 37	1.13		34	.37		38 28	1.13	28	10	.37	49		.37	49	72.3			
42		41 40	1.13	27	19	.38		41 30	1.13		56	.37		39 21	1.15		32	.38		48		.38	48	71.7		
43		42 33	1.13		42	.38		42 23	1.13	28	18	.40		40 13	1.13		55	.40		47		.40	47	71.1		
44		43 26	1.13	28	5	.42		43 16	1.15		42	.42		41 6	1.15	29	19	.42	46		.42	46	70.5			
45		44 19			30			44 8		29	7			58			44			45			45	69.9		

t	a = 21° 0'				a = 21° 30'				a = 22° 0'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
		Δ		Δ		Δ		Δ					
	d = 21° 0'				d = 21° 30'				d = 22° 0'				

b	a = 21° 0'				a = 21° 30'				a = 22° 0'				c	a						
	B	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	h			d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	C	β
			$\frac{60'}{\Delta}$	$\frac{60'}{\Delta}$					$\frac{60'}{\Delta}$											
45	41	19	1.15	28	30	0.42	41	8	1.13	29	7	0.43	40	58	1.15	29	44	0.45	45	69.9
40	42	11	1.13	55	45	0.45	42	1	1.15	33	33	0.47	41	50	1.15	30	11	0.47	44	69.2
47	43	4	1.15	29	22	0.47	43	53	1.15	30	1	0.47	42	42	1.18	31	39	0.48	43	68.5
48	44	56	1.15	50	50	0.50	43	45	1.18	29	59	0.50	43	33	1.18	31	8	0.50	42	67.8
49	44	48	1.15	30	20	0.52	44	36	1.18	59	59	0.52	44	24	1.18	31	38	0.52	41	67.1
50	45	40	1.18	51	0.53	45	27	1.18	31	30	0.55	45	15	1.18	32	9	0.55	40	66.4	
51	46	31	1.18	31	23	0.57	46	18	1.18	32	3	0.57	46	6	1.20	42	0.58	39	65.6	
52	47	22	1.18	57	0.58	47	9	1.18	37	58	37	0.58	47	56	1.20	33	17	0.60	38	64.9
53	48	13	1.20	32	32	0.62	48	0	1.20	33	12	0.63	47	46	1.20	53	17	0.62	37	64.1
54	49	3	1.20	33	9	0.65	50	1.22	50	50	0.65	48	36	1.22	34	30	0.67	36	63.2	
55	53	48	1.20	0.67	49	39	1.22	34	29	0.68	49	25	1.22	35	10	0.68	35	0.68	35	62.4
56	50	43	1.22	34	28	0.72	50	28	1.22	35	10	0.72	50	14	1.25	51	72	0.72	34	61.5
57	51	32	1.22	35	11	0.73	51	17	1.22	53	53	0.75	51	2	1.25	36	34	0.75	33	60.6
58	52	21	1.25	55	0.78	52	6	1.25	36	38	0.78	50	50	1.25	37	19	0.80	32	59.6	
59	53	9	1.25	36	42	0.82	54	1.28	37	25	0.82	52	38	1.28	38	7	0.82	31	58.6	
60	57	48	1.28	37	31	0.85	53	41	1.28	38	14	0.87	53	25	1.30	56	0.87	30	57.6	
61	54	44	1.28	38	22	0.90	54	28	1.30	39	6	0.90	54	11	1.30	39	48	0.92	29	56.5
62	55	31	1.30	39	16	0.95	55	14	1.30	40	0	0.95	57	1.33	40	43	0.95	28	55.4	
63	56	17	1.30	40	13	1.00	56	0	1.33	57	1.00	55	42	1.33	41	40	1.00	27	54.3	
64	57	3	1.33	41	13	1.03	45	1.36	41	57	1.03	56	27	1.36	42	40	1.05	26	53.1	
65	58	48	1.36	42	15	1.10	57	29	1.40	42	59	1.10	57	11	1.40	43	43	1.10	25	51.8
66	58	32	1.40	43	21	1.15	58	12	1.40	44	5	1.15	54	1.43	44	49	1.15	24	50.5	
67	59	15	1.43	44	30	1.20	55	1.43	45	14	1.20	58	36	1.46	45	58	1.20	23	49.2	
68	57	1.43	45	42	1.27	59	37	1.46	46	26	1.27	59	17	1.50	47	10	1.27	22	47.8	
69	60	39	1.50	46	58	1.33	60	18	1.50	47	42	1.33	57	1.54	48	26	1.32	21	46.3	
70	61	19	1.54	48	18	1.40	58	1.54	49	2	1.40	60	36	1.58	49	45	1.38	20	44.8	
71	58	1.58	49	42	1.47	61	37	1.62	50	26	1.45	61	14	1.62	51	8	1.45	19	43.2	
72	62	36	1.62	51	10	1.53	62	14	1.62	51	53	1.53	51	1.67	52	35	1.53	18	41.6	
73	63	13	1.67	52	42	1.62	51	1.71	53	25	1.60	62	27	1.71	54	7	1.58	17	39.8	
74	49	1.76	54	19	1.70	63	26	1.82	55	1	1.68	63	2	1.82	55	42	1.65	16	38.0	
75	64	23	1.82	56	1	1.77	59	1.82	56	42	1.75	35	1.88	57	21	1.73	15	36.2		
76	56	1.94	57	47	1.85	64	32	2.00	58	27	1.82	64	7	2.00	59	5	1.80	14	34.2	
77	65	27	2.00	59	38	1.93	65	2	2.07	60	16	1.90	37	2.14	60	53	1.88	13	32.2	
78	57	2.14	61	34	2.00	31	2.22	62	10	1.98	65	5	2.22	62	46	1.95	12	30.1		
79	66	25	2.40	63	34	2.10	58	2.40	64	9	2.07	32	2.50	64	43	2.02	11	27.9		
80	50	2.50	65	40	2.17	66	23	2.61	66	13	2.12	56	2.61	66	44	2.10	10	25.7		
81	67	14	2.73	67	50	2.23	46	2.73	68	20	2.20	66	19	2.86	68	50	2.17	9	23.4	
82	36	3.16	70	4	2.32	67	8	3.33	70	32	2.27	40	3.33	71	0	2.22	8	21.0		
83	55	3.53	72	23	2.38	26	3.53	72	48	2.33	58	3.75	73	13	2.28	7	18.5			
84	68	12	4.29	74	46	2.43	43	4.29	75	8	2.38	67	14	4.29	75	30	2.33	6	16.0	
85	26	5.00	77	12	2.50	57	5.00	77	31	2.43	28	5.45	77	50	2.37	5	13.4			
86	38	6.00	79	42	2.53	68	9	6.67	79	57	2.48	39	6.67	80	12	2.42	4	10.8		
87	48	8.57	82	14	2.57	18	8.57	82	26	2.50	48	8.57	82	37	2.45	3	8.1			
88	55	15.0	84	48	2.60	25	15.0	84	56	2.53	55	15.0	85	4	2.47	2	5.4			
89	59	60.0	87	24	2.60	29	60.0	87	28	2.53	59	60.0	87	32	2.47	1	2.7			
90	69	0	90	0		30		90	0		68	0	90	0		0	0	0	0.0	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a			
	d = 21° 0'				d = 21° 30'				d = 22° 0'				a							

B	a = 22° 30'					a = 23° 0'					a = 23° 30'					C	β			
	h	d	60'		t	h	d	60'		t	h	d	60'		t					
			Δ	Z				Δ	Z				Δ	Z						
0	0	0	1.09	22	30	0.00	0	0	1.09	23	0	0.00	0	0	1.09	23	30	0.00	90	90.0
1		55	1.07		30	.02	0	55	1.07		0	.02	55	1.09		30	.02	89	89.6	
2	1	51	1.09		31	.02	1	51	1.09		1	.02	1	50	1.09		31	.02	88	89.2
3	2	46	1.07		32	.02	2	46	1.09		2	.02	2	45	1.09		32	.02	87	88.8
4	3	42	1.09		33	.03	3	41	1.09		3	.03	3	40	1.09		33	.03	86	88.4
5	4	37	1.07		35	.03	4	36	1.09		5	.03	4	35	1.09		35	.03	85	88.0
6	5	33	1.09		37	.03	5	31	1.09		7	.03	5	30	1.09		37	.03	84	87.6
7	6	28	1.09		39	.05	6	26	1.07		9	.05	6	25	1.09		39	.05	83	87.3
8	7	23	1.07		42	.05	7	22	1.09		12	.05	7	20	1.09		42	.07	82	86.9
9	8	19	1.09		45	.07	8	17	1.09		15	.07	8	15	1.09		46	.05	81	86.5
10	9	14	1.09		49	.07	9	12	1.09		19	.07	9	10	1.09		49	.07	80	86.1
11	10	9	1.09		53	.07	10	7	1.09		23	.07	10	5	1.09		53	.08	79	85.7
12	11	4	1.07		57	.08	11	2	1.09		27	.08	11	0	1.11		58	.08	78	85.3
13	12	0	1.09	23	2	.08		57	1.09		32	.10		54	1.09	24	3	.08	77	84.8
14		55	1.09		7	.10	12	52	1.09		38	.08	12	49	1.09		8	.10	76	84.4
15	13	50	1.09		13	.10	13	47	1.09		43	.10	13	44	1.09		14	.10	75	84.0
16	14	45	1.09		19	.10	14	42	1.09		49	.12	14	39	1.11		20	.12	74	83.6
17	15	40	1.09		25	.12	15	37	1.09		56	.12	15	33	1.09		27	.12	73	83.2
18	16	35	1.09		32	.12	16	32	1.11	24	3	.13	16	28	1.11		34	.13	72	82.8
19	17	30	1.09		39	.13	17	26	1.09		11	.13	17	22	1.09		42	.13	71	82.3
20	18	25	1.09		47	.13	18	21	1.09		19	.13	18	17	1.11		50	.13	70	81.9
21	19	20	1.09		55	.15	19	16	1.11		27	.15	19	11	1.09		58	.15	69	81.5
22	20	15	1.09	24	4	.17	20	10	1.09		36	.15	20	6	1.11	25	7	.17	68	81.0
23	21	10	1.11		14	.17	21	5	1.11		45	.17	21	0	1.11		17	.17	67	80.6
24	22	4	1.09		24	.17	59	1.09		55	.18	54	1.11		27	.18	27	.18	66	80.1
25		59	1.09		34	.18	22	54	1.11	25	6	.18	22	48	1.11		38	.18	65	79.7
26	23	54	1.11		45	.18	23	48	1.11		17	.18	23	42	1.11		49	.20	64	79.2
27	24	48	1.11		56	.20	24	42	1.11		28	.20	24	36	1.11	26	1	.20	63	78.7
28	25	42	1.09	25	8	.22	25	36	1.11		40	.22	25	30	1.11		13	.22	62	78.3
29	26	37	1.11		21	.22	26	30	1.11		53	.23	26	24	1.11		26	.23	61	77.8
30	27	31	1.11		34	.23	27	24	1.11	26	7	.23	27	18	1.13		40	.23	60	77.3
31	28	25	1.11		48	.23	28	18	1.11		21	.23	28	11	1.11		54	.25	59	76.8
32	29	19	1.11	26	2	.25	29	12	1.13		35	.27	29	5	1.13	27	9	.25	58	76.3
33	30	13	1.11		17	.27	30	5	1.11		51	.27	58	1.13		24	.27	57	75.8	
34	31	7	1.13		33	.28	59	1.13	27	7	.28	30	51	1.13		40	.28	56	75.2	
35	32	0	1.11		50	.28	31	52	1.13		24	.28	31	44	1.13		57	.30	55	74.7
36		54	1.13	27	7	.30	32	45	1.13		41	.30	32	37	1.13	28	15	.32	54	74.2
37	33	47	1.13		25	.32	33	38	1.13		59	.32	33	30	1.13		34	.32	53	73.6
38	34	40	1.13		44	.33	34	31	1.13	28	18	.33	34	23	1.15		53	.35	52	73.0
39	35	33	1.13	28	4	.33	35	24	1.13		38	.35	35	15	1.15	29	14	.35	51	72.4
40	36	26	1.13		24	.35	36	17	1.15		59	.37	36	7	1.15		35	.37	50	71.8
41	37	19	1.15		45	.38	37	9	1.15	29	21	.38	59	1.15		57	.38	49	71.2	
42	38	11	1.15	29	8	.40	38	1	1.15		44	.40	37	51	1.15	30	20	.40	48	70.6
43	39	3	1.15		32	.40	53	1.15	30	8	.42	38	43	1.18		44	.42	47	70.0	
44		55	1.15		56	.43	39	45	1.15		33	.43	39	34	1.15	31	9	.43	46	69.3
45	40	47		30	22		40	37		59		40	26			35		45		68.7

t	a = 22° 30'		a = 23° 0'		a = 23° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 22° 30'		d = 23° 0'		d = 23° 30'		

b	a = 22° 30'				a = 23° 0'				a = 23° 30'				c	α						
	B	d	60' / Δ	Z	Δ / 60'	h	d	60' / Δ	Z	Δ / 60'	h	d			60' / Δ	Z	Δ / 60'	C	β	
																				h
45	40	47	1.15	30	22	0.43	40	37	1.18	30	59	0.45	40	26	1.18	31	35	0.47	45	68.7
46	41	39	1.15	48	.47	41	28	1.18	31	26	.47	41	17	1.20	32	3	.47	44	68.0	
47	42	31	1.18	31	16	.48	42	19	1.18	54	.48	42	7	1.18	31	31	.50	43	67.3	
48	43	22	1.18	45	.52	43	10	1.20	32	23	.52	43	58	1.20	33	1	.52	42	66.5	
49	44	13	1.20	32	16	.53	44	0	1.20	54	.53	44	48	1.20	32	32	.55	41	65.8	
50	45	3	1.20	48	.55	45	50	1.20	33	26	.57	44	38	1.22	34	5	.57	40	65.0	
51	51	53	1.20	33	21	.58	45	40	1.20	34	0	.58	45	27	1.22	39	.58	39	64.2	
52	46	43	1.20	56	.60	46	30	1.22	35	.62	46	16	1.22	35	14	.62	38	63.4		
53	47	33	1.22	34	32	.63	47	19	1.22	35	12	.63	47	5	1.22	51	.65	37	62.6	
54	48	22	1.22	35	10	.67	48	8	1.25	50	.67	54	54	1.25	36	30	.67	36	61.7	
55	49	11	1.25	50	.70	56	1.25	36	30	.70	48	42	1.28	37	10	.70	35	60.8		
56	56	59	1.25	36	32	.72	49	44	1.25	37	12	.73	49	29	1.28	52	.73	34	59.9	
57	50	47	1.25	37	15	.77	50	32	1.28	56	.77	50	16	1.28	38	36	.77	33	59.0	
58	51	35	1.28	38	1	.78	51	19	1.28	38	42	.80	51	3	1.30	39	22	.80	32	58.0
59	52	22	1.30	48	.83	52	6	1.30	39	30	.83	49	1.30	40	10	.85	31	57.0		
60	53	8	1.30	39	38	.88	52	1.33	40	20	.87	52	35	1.33	41	1	.87	30	55.9	
61	54	1.30	40	31	.90	53	37	1.33	41	12	.92	53	20	1.36	53	.92	29	54.8		
62	54	40	1.36	41	25	.97	54	22	1.36	42	7	.97	54	4	1.36	42	48	.97	28	53.7
63	55	24	1.36	42	23	1.00	55	6	1.40	43	5	1.00	48	1.40	43	46	1.00	27	52.5	
64	56	8	1.40	43	23	1.05	49	1.40	44	5	1.05	55	31	1.43	44	46	1.05	26	51.3	
65	57	34	1.43	44	26	1.08	56	32	1.43	45	8	1.08	56	13	1.46	45	49	1.10	25	50.0
66	58	16	1.50	45	31	1.15	57	14	1.46	46	13	1.15	54	1.46	46	55	1.13	24	48.7	
67	58	56	1.50	46	40	1.20	55	55	1.50	47	22	1.20	57	35	1.50	48	3	1.20	23	47.4
68	59	36	1.54	47	52	1.27	58	35	1.50	48	34	1.27	58	15	1.58	49	15	1.25	22	46.0
69	59	36	1.54	49	8	1.32	59	15	1.58	49	50	1.30	53	1.58	50	30	1.32	21	44.5	
70	60	15	1.62	50	27	1.38	53	1.62	51	8	1.38	59	31	1.62	51	49	1.37	20	43.0	
71	61	29	1.71	51	50	1.45	60	30	1.67	52	31	1.43	60	8	1.71	53	11	1.42	19	41.4
72	61	29	1.71	53	17	1.50	61	6	1.71	53	57	1.50	43	1.76	54	36	1.48	18	39.7	
73	62	4	1.82	54	47	1.57	41	1.82	55	27	1.55	61	17	1.82	56	5	1.55	17	38.0	
74	62	4	1.82	56	21	1.65	62	14	1.88	57	0	1.93	50	1.94	57	38	1.60	16	36.3	
75	63	11	1.94	58	0	1.72	46	2.00	58	38	1.68	62	21	2.00	59	14	1.68	15	34.4	
76	64	11	2.07	59	43	1.78	63	16	2.07	60	19	1.77	51	2.14	60	55	1.73	14	32.5	
77	64	11	2.14	61	30	1.85	45	2.14	62	5	1.82	63	19	2.22	62	39	1.80	13	30.6	
78	65	5	2.50	63	21	1.92	64	13	2.40	63	54	1.90	46	2.40	64	27	1.85	12	28.5	
79	65	5	2.50	65	16	1.98	38	2.50	65	48	1.95	64	11	2.61	66	18	1.93	11	26.4	
80	29	2.73	67	15	2.07	65	2	2.86	67	45	2.02	34	2.73	68	14	1.98	10	24.3		
81	51	3.00	69	19	2.12	23	3.00	69	46	2.08	56	3.16	70	13	2.03	9	22.1			
82	66	11	3.33	71	26	2.17	43	3.33	71	51	2.13	65	15	3.53	72	15	2.10	8	19.8	
83	29	3.75	73	36	2.23	66	1	4.00	73	59	2.18	32	4.00	74	21	2.13	7	17.4		
84	45	4.29	75	50	2.28	16	4.62	76	10	2.23	47	4.62	76	29	2.18	6	15.1			
85	59	5.45	78	7	2.32	29	5.45	78	24	2.27	66	0	5.45	78	40	2.22	5	12.0		
86	67	10	6.67	80	26	2.37	40	6.67	80	40	2.30	11	7.50	80	53	2.25	4	10.1		
87	19	10.0	82	48	2.38	49	10.0	82	58	2.33	19	10.0	83	8	2.28	3	7.6			
88	25	15.0	85	11	2.40	55	15.0	85	18	2.35	25	15.0	85	25	2.28	2	5.1			
89	29	60.0	87	35	2.42	59	60.0	87	39	2.35	29	60.0	87	42	2.30	1	2.6			
90	30		90	0		67	0		90	0		30		90	0		0	0.0		
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'							α	
	d = 22° 30'				d = 23° 0'				d = 23° 30'											

b	a = 24° 0'					a = 24° 30'					a = 25° 0'					c	α						
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'	h	d			60' / Δ	Z	t	Δ / 60'	C	β
0	0	0	1.09	24	0	0.00	0	0	1.09	24	30	0.00	0	0	1.11	25	0	0.00	90	90.0			
1	55	1.09		0	.02	55	1.11	30	.02	54	1.09		0	.02	89	89.6							
2	1 50	1.11		1	.02	1 49	1.09	31	.02	1 49	1.11		1	.02	88	89.2							
3	2 44	1.09		2	.02	2 44	1.11	32	.02	2 43	1.09		2	.02	87	88.8							
4	3 39	1.09		3	.03	3 38	1.09	33	.03	3 38	1.11		3	.03	86	88.3							
5	4 34	1.09		5	0.03	4 33	1.11	35	0.03	4 32	1.11		5	0.03	85	87.9							
6	5 29	1.09		7	.05	5 27	1.09	37	.05	5 26	1.11		7	.05	84	87.5							
7	6 24	1.11		10	.05	6 22	1.09	40	.05	6 20	1.09		10	.05	83	87.1							
8	7 18	1.09		13	.05	7 17	1.11	43	.05	7 15	1.11		13	.05	82	86.7							
9	8 13	1.09		16	.07	8 11	1.11	46	.07	8 9	1.11		16	.07	81	86.2							
10	9 8	1.11		20	0.07	9 5	1.09	50	0.07	9 3	1.11		20	0.07	80	85.8							
11	10 2	1.09		24	.08	10 0	1.11	54	.08	10 57	1.09		24	.08	79	85.4							
12	11 57	1.09		28	.08	11 54	1.09	59	.08	11 52	1.11		29	.08	78	85.0							
13	12 52	1.11		33	.10	12 49	1.11	25 4	.08	12 46	1.11		34	.10	77	84.5							
14	14 46	1.09		39	.10	14 43	1.11	9	.10	14 40	1.11		40	.10	76	84.1							
15	16 41	1.11		45	0.10	16 37	1.09	15	0.12	16 34	1.11		46	0.12	75	83.7							
16	18 35	1.11		51	.12	18 32	1.11	22	.12	18 28	1.11		53	.12	74	83.2							
17	20 29	1.09		58	.12	20 26	1.11	29	.12	20 22	1.11		26 0	.12	73	82.8							
18	22 24	1.11		25 5	.13	22 20	1.11	36	.13	22 16	1.11		7	.13	72	82.3							
19	24 18	1.11		13	.13	24 14	1.11	44	.13	24 10	1.13		15	.13	71	81.9							
20	26 12	1.09		21	0.15	26 8	1.11	52	0.15	26 3	1.11		23	0.15	70	81.4							
21	28 7	1.11		30	.15	28 2	1.11	26 1	.15	28 57	1.11		32	.17	69	81.0							
22	30 1	1.11		39	.17	30 56	1.11	10	.17	30 51	1.13		42	.17	68	80.5							
23	32 55	1.11		49	.17	32 50	1.13	20	.18	32 44	1.11		52	.18	67	80.0							
24	35 49	1.11		59	.18	35 43	1.11	31	.18	35 38	1.13		27 3	.18	66	79.5							
25	38 43	1.11		26 10	0.18	38 37	1.11	42	0.18	38 31	1.11		14	0.18	65	79.1							
26	41 37	1.13		21	.20	41 31	1.13	53	.20	41 25	1.13		25	.20	64	78.6							
27	44 30	1.11		33	.22	44 24	1.13	27 5	.22	44 18	1.13		37	.22	63	78.1							
28	47 24	1.13		46	.22	47 17	1.13	18	.22	47 11	1.13		50	.23	62	77.6							
29	50 17	1.11		59	.23	50 11	1.13	31	.23	50 4	1.13		28 4	.23	61	77.1							
30	53 11	1.13		27 13	0.23	53 4	1.13	45	0.25	53 57	1.13		18	0.25	60	76.5							
31	56 4	1.13		27	.25	56 57	1.13	28 0	.25	56 50	1.15		33	.25	59	76.0							
32	59 57	1.13		42	.27	59 50	1.13	15	.27	59 42	1.13		48	.27	58	75.5							
33	62 50	1.13		58	.27	62 43	1.15	31	.28	62 35	1.15		29 4	.28	57	74.9							
34	65 43	1.13		28 14	.28	65 35	1.13	48	.28	65 27	1.15		21	.30	56	74.4							
35	68 36	1.13		31	0.30	68 28	1.15	29 5	0.30	68 19	1.15		39	0.32	55	73.8							
36	71 29	1.15		49	.32	71 20	1.15	23	.33	71 11	1.15		58	.32	54	73.2							
37	74 21	1.15		29 8	.33	74 12	1.15	43	.33	74 3	1.15		30 17	.33	53	72.6							
38	77 13	1.15		28	.35	77 4	1.15	30 3	.35	77 55	1.15		37	.35	52	72.0							
39	80 5	1.15		49	.35	80 56	1.15	24	.35	80 47	1.18		58	.37	51	71.4							
40	83 57	1.15		30 10	0.37	83 48	1.18	45	0.37	83 38	1.18		31 20	0.38	50	70.8							
41	86 49	1.15		32	.40	86 39	1.18	31 7	.40	86 29	1.18		43	.40	49	70.2							
42	89 41	1.18		56	.40	89 30	1.18	31	.42	89 20	1.18		32 7	.40	48	69.5							
43	92 32	1.18		31 20	.42	92 21	1.18	56	.42	92 11	1.20		31	.43	47	68.9							
44	95 23	1.18		45	.45	95 12	1.18	32 21	.45	95 9	1.20		57	.45	46	68.2							
45	98 14			32 12		98 3		48		98 51			33 24		45	67.5							
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a						
	d = 24° 0'					d = 24° 30'					d = 25° 0'												

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

t	$a = 24^\circ 0'$		$a = 24^\circ 30'$		$a = 25^\circ 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 24^\circ 0'$		$d = 24^\circ 30'$		$d = 25^\circ 0'$		

b	a = 25° 30'				a = 26° 0'				a = 26° 30'				c	a								
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$			C	β						
0	0	0	1.11	25	30	0.00	0	0	1.11	26	0	0.00	0	0	1.11	26	30	0.00	90	90.0		
1		54	1.11		30	.02		54	1.11		0	.02		54	1.13		30	.02	89	89.6		
2	1	48	1.09		31	.02	1	48	1.11		1	.02	1	47	1.11		31	.02	88	89.1		
3	2	43	1.11		32	.02	2	42	1.11		2	.02	2	41	1.11		32	.02	87	88.7		
4	3	37	1.11		33	.03	3	36	1.11		3	.03	3	35	1.13		33	.03	86	88.2		
5	4	31	1.11		35	.03	4	30	1.13		5	.03	4	28	1.11		35	.03	85	87.8		
6	5	25	1.11		37	.05	5	23	1.11		7	.05	5	22	1.11		37	.05	84	87.4		
7	6	19	1.11		40	.05	6	17	1.11		10	.05	6	16	1.13		40	.05	83	86.9		
8	7	13	1.11		43	.07	7	11	1.11		13	.07	7	9	1.11		43	.07	82	86.5		
9	8	7	1.11		47	.07	8	5	1.11		17	.07	8	3	1.13		47	.07	81	86.1		
10	9	1	1.11		51	.07	9	5	1.11		21	.07	9	5	1.11		51	.08	80	85.6		
11		55	1.11		55	.08		9	53	1.13		25	.08	9	50	1.13		56	.08	79	85.1	
12	10	49	1.11	26	0	.08	10	46	1.11		30	.08	10	43	1.11		27	1	.08	78	84.7	
13	11	43	1.11		5	.10	11	40	1.11		35	.10	11	37	1.13		6	.10	77	84.2		
14	12	37	1.11		11	.10	12	34	1.13		41	.10	12	30	1.11		12	.10	76	83.8		
15	13	31	1.13		17	.12	13	27	1.11		47	.12	13	24	1.13		18	.12	75	83.3		
16	14	24	1.11		24	.12	14	21	1.13		54	.12	14	17	1.13		25	.12	74	82.8		
17	15	18	1.11		31	.12	15	14	1.11		27	1	.13	15	10	1.13		32	.13	73	82.4	
18	16	12	1.13		38	.13	16	8	1.13		9	.13	16	3	1.13		40	.13	72	81.9		
19	17	5	1.11		46	.15	17	1	1.13		17	.15	17	5	1.13		48	.15	71	81.4		
20		59	1.13		55	.15		54	1.13		26	.15	17	49	1.13		57	.15	70	80.9		
21	18	52	1.11	27	4	.15	18	47	1.13		35	.17	18	42	1.13		28	6	.17	69	80.4	
22	19	46	1.13		13	.17	19	40	1.13		45	.17	19	35	1.13		16	.17	68	80.0		
23	20	39	1.13		23	.18	20	33	1.13		55	.18	20	28	1.13		26	.18	67	79.5		
24	21	32	1.13		34	.18	21	26	1.13		28	6	.18	21	21	1.15		37	.20	66	79.0	
25	22	25	1.13		45	.20	22	19	1.13		17	.20	22	13	1.13		49	.20	65	78.4		
26	23	18	1.13		57	.22	23	12	1.13		29	.22	23	6	1.15		29	1	.22	64	77.9	
27	24	11	1.13	28	10	.22	24	5	1.15		42	.22	24	5	1.13		14	.22	63	77.4		
28	25	4	1.13		23	.23	25	5	1.13		55	.23	24	5	1.15		27	.23	62	76.9		
29	29	57	1.13		37	.23	25	50	1.15		29	9	.23	25	43	1.15		41	.23	61	76.3	
30	26	50	1.15		51	.25	26	42	1.15		23	.25	26	35	1.15		56	.25	60	75.8		
31	27	42	1.13	29	6	.27	27	34	1.15		38	.27	27	27	1.15		30	11	.27	59	75.2	
32	28	35	1.15		22	.27	28	26	1.15		54	.28	28	19	1.18		27	.28	58	74.7		
33	29	27	1.15		38	.28	29	18	1.15		30	11	.28	29	10	1.15		44	.28	57	74.1	
34	30	19	1.15		55	.30	30	10	1.15		28	.30	30	2	1.18		31	1	.32	56	73.5	
35	31	11	1.15	30	13	.30	31	2	1.18		46	.32	31	53	1.18		20	.32	55	72.9		
36	32	3	1.18		31	.33	32	53	1.15		31	5	.33	31	44	1.18		39	.33	54	72.3	
37	37	54	1.18		51	.33	32	45	1.18		25	.33	32	35	1.18		59	.33	53	71.7		
38	33	45	1.18	31	11	.35	33	36	1.18		45	.37	33	26	1.18		32	19	.37	52	71.1	
39	34	36	1.18		32	.38	34	27	1.18		32	7	.37	34	17	1.20		41	.38	51	70.5	
40	35	27	1.18		55	.38	35	18	1.20		29	.38	35	7	1.20		33	4	.38	50	69.8	
41	41	36	1.18	32	18	.40	36	8	1.20		52	.42	36	57	1.20		27	.40	49	69.1		
42	42	37	1.18		42	.42	36	58	1.20		33	17	.42	36	47	1.20		51	.43	48	68.5	
43	43	38	1.20	33	7	.43	37	48	1.20		42	.43	37	37	1.22		34	17	.45	47	67.8	
44		50	1.20		33	.45	38	38	1.20		34	8	.47	38	26	1.22		44	.45	46	67.1	
45	39	40			34	0		39	28			36		39	15			35	11		45	66.3

t	a = 25° 30'		a = 26° 0'		a = 26° 30'		a
	$\frac{a}{\Delta}$	b	$\frac{a}{\Delta}$	b	$\frac{a}{\Delta}$	b	
	$\frac{a}{\Delta}$	b	$\frac{a}{\Delta}$	b	$\frac{a}{\Delta}$	b	

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

b	a = 27° 0'				a = 27° 30'				a = 28° 0'				c	a					
	B	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t			Δ / 60'	C	β		
																		h	d
0	0	0	1.13	27	0	0.00	0	0	1.13	27	30	0.00	0	0	0.00	90	90.0		
1	0	53	1.11	0	0	.02	53	1.13	30	.02	53	1.13	0	0	.02	89	89.5		
2	1	47	1.13	1	.02	1	46	1.11	31	.02	1	46	1.13	1	.02	88	89.1		
3	2	40	1.11	2	.02	2	40	1.13	32	.02	2	39	1.13	2	.02	87	88.6		
4	3	34	1.13	3	.03	3	33	1.13	33	.03	3	32	1.13	3	.03	86	88.2		
5	4	27	1.11	5	0.05	4	26	1.13	35	0.05	4	25	1.13	5	0.05	85	87.7		
6	5	21	1.13	8	.05	5	19	1.13	38	.05	5	18	1.13	8	.05	84	87.2		
7	6	14	1.13	11	.05	6	12	1.13	41	.05	6	11	1.13	11	.05	83	86.8		
8	7	7	1.11	14	.05	7	5	1.11	44	.07	7	4	1.15	14	.07	82	86.3		
9	8	1	1.13	17	.07	8	59	1.13	48	.07	8	56	1.13	18	.07	81	85.8		
10		54	1.13	21	0.08	8	52	1.13	52	0.07	8	49	1.13	22	0.08	80	85.3		
11	9	47	1.11	26	.08	9	45	1.13	56	.08	9	42	1.13	27	.08	79	84.9		
12	10	41	1.13	31	.08	10	38	1.13	28	1	10	35	1.15	32	.08	78	84.4		
13	11	34	1.13	36	.10	11	31	1.15	7	.10	11	27	1.13	37	.10	77	83.9		
14	12	27	1.13	42	.12	12	23	1.13	13	.10	12	20	1.13	43	.12	76	83.4		
15	13	20	1.13	49	0.12	13	16	1.13	19	0.12	13	13	1.15	50	0.12	75	82.9		
16	14	13	1.13	56	.12	14	9	1.13	26	.13	14	5	1.13	57	.12	74	82.5		
17	15	6	1.13	28	3	.13	15	2	1.13	34	.13	5	1.15	29	4	.13	73	82.0	
18	16	59	1.13	11	.13	55	1.15	42	.13	15	50	1.15	12	.15	72	81.5			
19	16	52	1.13	19	.15	16	47	1.13	50	.15	16	42	1.13	21	.15	71	81.0		
20	17	45	1.15	28	0.15	17	40	1.15	59	0.17	17	35	1.15	30	0.17	70	80.5		
21	18	37	1.13	37	.17	18	32	1.15	29	9	17	27	1.15	40	.17	69	79.9		
22	19	30	1.15	47	.18	19	24	1.13	19	.18	19	19	1.15	50	.18	68	79.4		
23	20	22	1.13	58	.18	20	17	1.15	30	.18	20	11	1.15	30	1	.18	67	78.9	
24	21	15	1.15	29	9	.20	21	9	1.15	41	.20	21	3	1.15	12	.20	66	78.4	
25	22	7	1.13	21	0.20	22	1	1.15	53	0.20	55	1.18	24	0.22	65	77.8			
26	23	0	1.15	33	.22	53	1.15	30	5	.22	22	46	1.15	37	.22	64	77.3		
27		52	1.15	46	.22	23	45	1.15	18	.23	23	38	1.18	50	.22	63	76.8		
28	24	44	1.15	59	.23	24	37	1.18	32	.23	24	29	1.15	31	3	.25	62	76.2	
29	25	36	1.18	30	13	.25	25	28	1.15	46	.25	25	21	1.18	18	.25	61	75.6	
30	26	27	1.15	28	0.27	26	20	1.18	31	1	0.25	26	12	1.18	33	0.27	60	75.1	
31	27	19	1.15	44	.27	27	11	1.18	16	.28	27	3	1.18	49	.27	59	74.5		
32	28	11	1.18	31	0	.28	28	2	1.18	33	.28	54	1.18	32	5	.28	58	73.9	
33	29	2	1.18	17	.30	53	1.18	50	.30	28	45	1.20	2	.30	57	.30	57	73.3	
34		53	1.18	35	.30	29	44	1.18	32	8	.30	29	35	1.18	40	.32	56	72.7	
35	30	44	1.18	53	0.32	30	35	1.18	26	0.33	30	26	1.20	59	0.33	55	72.1		
36	31	35	1.18	32	12	.33	31	26	1.20	46	.33	31	16	1.20	33	19	.33	54	71.5
37	32	26	1.20	32	.35	32	16	1.20	33	6	.35	32	6	1.20	39	.37	53	70.8	
38	33	16	1.20	53	.37	33	6	1.20	27	.37	56	1.20	34	1	.37	52	70.2		
39	34	6	1.20	33	15	.38	56	1.20	49	.38	33	46	1.22	23	.38	51	69.5		
40		56	1.20	38	0.38	34	46	1.22	34	12	0.40	34	35	1.22	46	0.40	50	68.8	
41	35	46	1.20	34	1	.42	35	35	1.22	36	.42	35	24	1.22	35	10	.42	49	68.1
42	36	36	1.22	26	.43	36	24	1.22	35	1	.43	36	13	1.22	35	.43	48	67.4	
43	37	25	1.22	52	.45	37	13	1.22	27	.45	37	2	1.25	36	1	.45	47	66.7	
44	38	14	1.22	35	19	.47	38	2	1.22	54	.47	50	1.25	28	.48	46	66.0		
45	39	3		47			51		36	22		38	38		57		45	65.2	
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a		
	d = 27° 0'				d = 27° 30'				d = 28° 0'										

b	a = 27° 0'					a = 27° 30'					a = 28° 0'					c	a			
	h	d	60'	Z	Δ	h	d	60'	Z	Δ	h	d	60'	Z	Δ			C	β	
		Δ	Δ				Δ	Δ				Δ	Δ							Δ
45	39	3	1.22	35	47	0.48	38	51	1.25	36	22	0.48	38	38	1.25	36	57	0.48	45	65.2
46		52	1.25	36	16	.50	39	39	1.25	51	.50	39	26	1.28	37	26	.50	44	44	64.4
47	40	40	1.25		46	.52	40	27	1.28	37	21	.53	40	13	1.28		56	.53	43	63.7
48	41	28	1.28	37	17	.55	41	14	1.28	53	.55	41	0	1.28	38	28	.55	42	41	62.9
49	42	15	1.28		50	.57	42	1	1.28	38	26	.57		47	1.28	39	1	.58	42	62.0
50	43	2	1.28	38	24	0.60	48	1.28	39	0	0.60	42	34	1.30		36	0.60	40	40	61.2
51		49	1.28	39	0	.62	43	35	1.30	36	.62	43	20	1.33	40	12	.62	39	39	60.3
52	44	37	1.30		37	.63	44	21	1.33	40	13	.65	44	5	1.33		49	.65	38	59.4
53	45	22	1.33	40	15	.67	45	6	1.33	52	.67		50	1.33	41	28	.67	37	58.5	
54	46	7	1.33		55	.70	51	1.33	41	32	.70	45	35	1.36	42	8	.70	36	57.6	
55		52	1.33	41	37	0.72	46	36	1.36	42	14	0.72	46	19	1.36		50	0.73	35	56.6
56	47	37	1.36		42	20	.75	47	20	1.36	57	.75	47	3	1.40	43	34	.75	34	55.6
57	48	21	1.36	43	5	.78	48	4	1.40	43	42	.78	46	1.40	44	19	.78	33	54.6	
58	49	5	1.40		52	.82	47	1.43	44	29	.82	48	29	1.43	45	6	.82	32	53.5	
59		48	1.43	44	41	.85	49	29	1.43	45	18	.85	49	11	1.46		55	.85	31	52.5
60	50	30	1.43	45	32	0.88	50	11	1.46	46	9	0.88		52	1.46	46	46	0.87	30	51.3
61	51	12	1.46		46	25	.93	52	1.46	47	2	.92	50	33	1.50	47	38	.92	29	50.2
62		53	1.50	47	21	.95	51	33	1.50	57	.95	51	13	1.50	48	33	.95	28	49.0	
63	52	33	1.50		48	18	1.00	52	13	1.54	48	54	1.00	53	1.58	49	30	1.00	27	47.8
64	53	13	1.58	49	18	1.03	52	1.58	49	54	1.03	52	31	1.58	50	30	1.02	26	46.6	
65		51	1.58	50	20	1.07	53	30	1.58	50	56	1.07	53	9	1.62	51	31	1.07	25	45.3
66	54	29	1.62		51	24	1.12	54	8	1.67	52	0	1.12	46	1.67	52	35	1.10	24	44.0
67	55	6	1.67	52	31	1.17	44	1.67	53	7	1.15	54	22	1.71	53	41	1.15	23	42.6	
68		42	1.71	53	41	1.20	55	20	1.76	54	16	1.18	57	1.76	54	50	1.18	22	41.2	
69	56	17	1.76		54	53	1.25	54	1.76	55	27	1.25	55	31	1.82	56	1	1.23	21	39.7
70		51	1.82	56	8	1.28	56	28	1.88	56	42	1.28	56	4	1.88	57	15	1.27	20	38.2
71	57	24	1.88		57	25	1.35	57	0	1.94	57	59	1.32	36	1.94	58	31	1.32	19	36.7
72		56	2.00	58	46	1.43	31	2.00	59	18	1.38	57	7	2.07	59	50	1.37	18	35.1	
73	58	26	2.07		60	9	1.48	58	1	2.07	60	41	1.42	36	2.14	61	12	1.40	17	33.5
74		55	2.14	61	35	1.48	30	2.22	62	6	1.47	58	4	2.22	62	36	1.45	16	31.8	
75	59	23	2.22		63	4	1.53	57	2.31	63	34	1.52		31	2.31	64	3	1.48	15	30.1
76		50	2.40	64	36	1.58	59	23	2.40	65	5	1.55	57	2.50	65	32	1.53	14	28.4	
77	60	15	2.61		66	11	1.62	48	2.61	66	38	1.60	59	21	2.61	67	4	1.58	13	26.6
78		38	2.73	67	48	1.67	60	11	2.86	68	14	1.63	44	2.86	68	39	1.62	12	24.7	
79	61	0	3.00		69	28	1.72	32	3.00	69	52	1.68	60	5	3.16	70	16	1.65	11	22.8
80		20	3.16	71	11	1.75		52	3.33	71	33	1.72	24	3.33	71	55	1.68	10	20.9	
81	39	3.53	72	56	1.78	61	10	3.53	73	16	1.77	42	3.75	73	36	1.73	9	18.9		
82		56	4.29	74	43	1.83	27	4.29	75	2	1.80	58	4.29	75	20	1.77	8	16.9		
83	62	10	4.62		76	33	1.85	41	4.62	76	50	1.82	61	12	4.62	77	6	1.78	7	14.9
84		23	5.00	78	24	1.90	54	5.45	78	39	1.85		25	5.45	78	53	1.82	6	12.8	
85		35	6.67	80	18	1.90	62	5	6.67	80	30	1.87	36	7.50	80	42	1.83	5	10.7	
86	44	8.57	82	12	1.93		14	8.57	82	22	1.90	44	8.57	82	32	1.85	4	8.6		
87		51	12.0	84	8	1.95	21	12.0	84	16	1.90	51	12.0	84	23	1.87	3	6.5		
88	56	20.0		86	5	1.95	26	20.0	86	10	1.92	56	20.0	86	15	1.87	2	4.3		
89		59	60.0	88	2	1.97	29	60.0	88	5	1.92	59	60.0	88	7	1.88	1	2.2		
90	63	0		90	0		30		90	0		62	0		90	0		0	0.0	

B	a = 28° 30'				a = 29° 0'				a = 29° 30'				C	a	β						
	h	60' / Δ		Z	t	Δ / 60'	h	60' / Δ		Z	t	Δ / 60'				h	60' / Δ		Z	t	Δ / 60'
		d	60'					Δ	d								60'	Δ			
0	0	0	1.13	28	30	0.00	0	0	1.15	29	0	0.00	0	0	1.15	29	30	0.00	90	90.0	
1		53	1.13		30	.02		52	1.13		0	.02		52	1.13		30	.02	89	89.5	
2	1	46	1.15		31	.02	1	45	1.15		1	.02	1	44	1.13		31	.02	88	89.0	
3	2	38	1.13		32	.03	2	37	1.13		2	.03	2	37	1.15		32	.03	87	88.5	
4	3	31	1.13		34	.03	3	30	1.15		4	.03	3	29	1.15		34	.03	86	88.1	
5	4	24	1.15		36	0.03	4	22	1.13		6	0.03	4	21	1.15		36	0.03	85	87.6	
6	5	16	1.13		38	.05	5	15	1.15		8	.05	5	13	1.15		38	.05	84	87.1	
7	6	9	1.13		41	.05	6	7	1.15		11	.05	6	5	1.15		41	.05	83	86.6	
8	7	2	1.15		44	.07	7	59	1.13		14	.07	7	57	1.15		44	.07	82	86.1	
9		54	1.13		48	.07	7	52	1.15		18	.07	7	49	1.15		48	.07	81	85.6	
10	8	47	1.15		52	0.08	8	44	1.15		22	0.08	8	41	1.15		53	0.08	80	85.1	
11	9	39	1.13		57	.08	9	36	1.13		27	.08	9	33	1.15		58	.08	79	84.6	
12	10	32	1.15	29	2	.10	10	29	1.15		32	.10	10	25	1.15	30	3	.10	78	84.1	
13	11	24	1.13		8	.10	11	21	1.15		38	.10	11	17	1.15		9	.10	77	83.6	
14	12	17	1.15		14	.12	12	13	1.15		44	.12	12	9	1.15		15	.12	76	83.1	
15	13	9	1.15		21	0.12	13	5	1.15		51	0.12	13	1	1.15		22	0.12	75	82.6	
16	14	1	1.15		28	.12		57	1.15		58	.13		53	1.15		29	.13	74	82.1	
17		53	1.15		35	.13	14	49	1.15	30	6	.13	14	45	1.18		37	.13	73	81.6	
18	15	45	1.15		43	.15	15	41	1.15		14	.15	15	36	1.15		45	.15	72	81.0	
19	16	37	1.15		52	.15	16	33	1.18		23	.15	16	28	1.18		54	.15	71	80.5	
20	17	29	1.15	30	1	0.17	17	24	1.15		32	0.17	17	19	1.15	31	3	0.17	70	80.0	
21	18	21	1.15		11	.17	18	16	1.15		42	.17	18	11	1.18		13	.18	69	79.5	
22	19	13	1.15		21	.18	19	8	1.18		52	.18	19	2	1.18		24	.18	68	78.9	
23	20	5	1.15		32	.20	20	59	1.18	31	3	.20		53	1.18		35	.18	67	78.4	
24		57	1.18		44	.20	20	50	1.18		15	.20	20	44	1.18		46	.20	66	77.8	
25	21	48	1.15		56	0.20	21	41	1.18		27	0.22	21	35	1.18		58	0.22	65	77.3	
26	22	40	1.18	31	8	.22	22	32	1.18		40	.22	22	26	1.20	32	11	.23	64	76.7	
27	23	31	1.18		21	.23	23	23	1.18		53	.23	23	16	1.18		25	.23	63	76.1	
28	24	22	1.18		35	.25	24	14	1.18		32	7	.25	24	7	1.20	39	.25	62	75.5	
29	25	13	1.18		50	.25	25	5	1.18		22	.25		57	1.18		54	.27	61	75.0	
30	26	4	1.18	32	5	0.27		56	1.18		37	0.27	25	48	1.20	33	10	0.27	60	74.4	
31		55	1.20		21	.28	26	47	1.20		53	.28	26	38	1.20		26	.28	59	73.8	
32	27	45	1.18		38	.28	27	37	1.20	33	10	.30	27	28	1.20		43	.28	58	73.1	
33	28	36	1.20		55	.30	28	27	1.20		28	.30	28	18	1.22	34	0	.32	57	72.5	
34	29	26	1.20	33	13	.32	29	17	1.20		46	.32	29	7	1.20		19	.32	56	71.9	
35	30	16	1.20		32	0.33	30	7	1.22	34	5	0.33		57	1.22		38	0.33	55	71.3	
36	31	6	1.20		52	.35		56	1.20		25	.35	30	46	1.22		58	.35	54	70.6	
37		56	1.22	34	13	.35	31	46	1.22		46	.35	31	35	1.22	35	19	.37	53	69.9	
38	32	45	1.22		34	.38	32	35	1.22	35	7	.38	32	24	1.22		41	.37	52	69.3	
39	33	34	1.22		57	.38	33	24	1.22		30	.38	33	13	1.25	36	3	.40	51	68.6	
40	34	23	1.22	35	20	0.40	34	13	1.25		53	0.42	34	1	1.25		27	0.40	50	67.9	
41	35	12	1.22		44	.42	35	1	1.25	36	18	.42		49	1.25		51	.43	49	67.1	
42	36	1	1.25	36	9	.45		49	1.25		43	.45	35	37	1.25	37	17	.45	48	66.4	
43		49	1.25		36	.45	36	37	1.25	37	10	.45	36	25	1.28		44	.45	47	65.7	
44	37	37	1.25	37	3	.47	37	25	1.28		37	.47	37	12	1.28	38	11	.48	46	64.9	
45	38	25			31		38	12		38	5			59			40		45	64.1	
t	a	60' / Δ		b	Δ / 60'	a	60' / Δ		b	Δ / 60'	a	60' / Δ		b	Δ / 60'	a					
	d = 28° 30'					d = 29° 0'					d = 29° 30'										

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

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

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

B	$a = 30^\circ 0'$					$a = 30^\circ 30'$					$a = 31^\circ 0'$					C	α			
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t					
		Δ	$\frac{60'}{\Delta}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$			$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$
45	37	46	1.30	39	14	0.50	37	32	1.30	39	48	0.50	37	19	1.33	40	21	0.52	45	63.0
46	38	32	1.30	40	44	.52	38	18	1.30	40	18	.52	38	4	1.33	41	52	.52	44	62.3
47	39	18	1.30	40	15	.53	39	4	1.33	49	53	.53	39	49	1.33	41	23	.53	43	61.4
48	40	4	1.33	41	27	.57	40	49	1.33	41	21	.57	39	34	1.33	55	57	.57	42	60.6
49	49	49	1.33	41	21	.58	40	34	1.36	55	.58	.58	40	19	1.36	42	29	.58	41	59.7
50	41	34	1.36	56	0.60	41	18	1.36	42	30	0.60	41	3	1.40	43	4	0.60	40	58.8	
51	42	18	1.36	42	32	.63	42	2	1.36	43	6	.63	42	46	1.40	40	.63	.63	39	57.9
52	43	2	1.36	43	10	.65	43	46	1.40	44	23	.65	42	29	1.40	44	18	.65	38	57.0
53	46	46	1.40	49	.67	43	29	1.40	44	23	.68	43	12	1.43	57	.68	.68	37	56.0	
54	44	29	1.43	44	29	.70	44	12	1.43	45	4	.70	54	1.43	45	38	.70	36	55.1	
55	45	11	1.43	45	11	0.73	54	1.46	46	0.73	44	36	1.46	46	20	0.73	35	54.1		
56	46	53	1.43	55	.75	45	35	1.46	46	30	.75	45	17	1.46	47	4	.75	34	53.0	
57	46	35	1.46	46	40	.78	46	16	1.46	47	15	.78	48	1.50	49	.77	.77	33	52.0	
58	47	16	1.50	47	27	.82	57	1.50	48	2	.80	46	38	1.54	48	35	.82	32	50.9	
59	56	56	1.50	48	16	.83	47	37	1.54	50	.83	47	17	1.54	49	24	.83	31	49.8	
60	48	36	1.54	49	6	0.88	48	16	1.58	49	40	0.88	56	1.58	50	14	0.87	30	48.7	
61	49	15	1.58	59	.90	54	54	1.58	50	33	.90	48	34	1.62	51	6	.90	29	47.5	
62	53	53	1.62	50	53	.93	49	32	1.62	51	27	.93	49	11	1.62	52	0	.93	28	46.3
63	50	30	1.62	51	49	.98	50	9	1.67	52	23	.97	48	1.67	56	.95	.95	27	45.1	
64	51	7	1.67	52	48	1.00	45	1.71	53	21	1.00	50	24	1.71	53	53	1.00	26	43.9	
65	43	43	1.71	53	48	1.03	51	20	1.71	54	21	1.03	59	1.76	54	53	1.03	25	42.6	
66	52	18	1.76	54	50	1.08	55	1.76	55	23	1.07	51	33	1.82	55	55	1.05	24	41.3	
67	52	52	1.82	55	55	1.10	52	29	1.88	56	27	1.10	52	6	1.88	56	58	1.08	23	39.9
68	53	25	1.88	57	1	1.15	53	1	1.88	57	33	1.13	38	1.94	58	3	1.13	22	38.5	
69	57	57	1.94	58	10	1.18	33	1.94	58	41	1.18	53	9	2.00	59	11	1.17	21	37.1	
70	54	28	2.00	59	21	1.23	54	4	2.07	59	52	1.20	39	2.07	60	21	1.20	20	35.6	
71	58	58	2.07	60	35	1.27	33	2.07	61	4	1.25	54	8	2.14	61	33	1.23	19	34.2	
72	55	27	2.14	61	51	1.30	55	2	2.22	62	19	1.28	36	2.22	62	47	1.27	18	32.6	
73	55	55	2.31	63	9	1.33	29	2.31	63	36	1.32	55	3	2.31	64	3	1.30	17	31.1	
74	56	21	2.40	64	29	1.37	55	2.40	64	55	1.37	29	2.50	65	21	1.35	16	29.5		
75	46	2.50	65	51	1.42	56	20	2.61	66	17	1.38	53	2.61	66	42	1.37	15	27.8		
76	57	10	2.61	67	16	1.45	43	2.73	67	40	1.43	56	16	2.73	68	4	1.42	14	26.2	
77	33	2.86	68	43	1.48	57	5	2.86	69	6	1.45	38	3.00	69	29	1.43	13	24.5		
78	54	3.16	70	12	1.52	26	3.16	70	33	1.50	58	3.16	70	55	1.47	12	22.7			
79	58	13	3.33	71	43	1.55	45	3.33	72	3	1.52	57	17	3.33	72	23	1.50	11	21.0	
80	31	3.53	73	16	1.57	58	3	3.75	73	34	1.55	35	3.75	73	53	1.52	10	19.2		
81	48	4.00	74	50	1.62	19	4.00	75	7	1.58	51	4.29	75	24	1.55	9	17.3			
82	59	3	4.62	76	27	1.63	34	4.62	76	42	1.60	58	5	4.62	76	57	1.58	8	15.5	
83	16	5.00	78	5	1.65	47	5.45	78	18	1.63	18	5.45	78	32	1.62	7	13.6			
84	28	6.00	79	44	1.68	58	6.00	79	56	1.65	29	6.67	80	8	1.60	6	11.7			
85	38	7.50	81	25	1.70	59	8	7.50	81	35	1.67	38	7.50	81	45	1.63	5	9.8		
86	46	10.0	83	7	1.70	16	10.0	83	15	1.67	46	10.0	83	23	1.63	4	7.8			
87	52	15.0	84	49	1.72	22	15.0	84	55	1.68	52	15.0	85	1	1.65	3	5.9			
88	56	20.0	86	32	1.73	26	20.0	86	36	1.70	56	20.0	86	40	1.67	2	3.9			
89	59	60.0	88	16	1.73	29	60.0	88	18	1.70	59	60.0	88	20	1.67	1	2.0			
90	60	0	90	0		30		90	0		59	0	90	0		0		0	0.0	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$		a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$		a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$		a				
	$d = 30^\circ 0'$					$d = 30^\circ 30'$					$d = 31^\circ 0'$									
	$d = 30^\circ 0'$					$d = 30^\circ 30'$					$d = 31^\circ 0'$									

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

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

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

b	a = 33° 0'				a = 33° 30'				a = 34° 0'				c	α							
	B	h	60'	t	Δ	h	60'	Z	Δ	h	60'	Z			Δ	C	β				
			Δ				60'				60'							60'			
0	0	0	1.20	33	0	0.00	0	0	1.20	33	30	0.00	0	0	1.20	34	0	0.00	90	90.0	
1		50	1.18		0	.02		50	1.20		30	.02		50	1.22		0	.02	89	89.4	
2	1	41	1.20		1	.02	1	40	1.20		31	.02	1	39	1.20		1	.02	88	88.9	
3	2	31	1.20		2	.03	2	30	1.20		32	.03	2	29	1.20		2	.03	87	88.3	
4	3	21	1.18		4	.03	3	20	1.20		34	.03	3	19	1.20		4	.03	86	87.8	
5	4	12	1.20		6	0.05	4	10	1.20		36	0.05	4	9	1.22		6	0.05	85	87.2	
6	5	2	1.20		9	.05	5	0	1.20		39	.05	5	58	1.20		9	.05	84	86.7	
7	5	52	1.20		12	.05	5	50	1.20		42	.07	5	48	1.20		12	.07	83	86.1	
8	6	42	1.20		15	.07	6	40	1.20		46	.07	6	38	1.22		16	.07	82	85.6	
9	7	32	1.20		19	.08	7	30	1.20		50	.07	7	27	1.20		20	.08	81	85.0	
10	8	22	1.20		24	0.08	8	20	1.22		54	0.08	8	17	1.22		25	0.08	80	84.4	
11	9	12	1.20		29	.10	9	9	1.20		59	.10	9	6	1.20		30	.08	79	83.9	
12	10	2	1.20		35	.10	10	59	1.20	34	5	.10	10	56	1.22		35	.10	78	83.3	
13	11	52	1.20		41	.12	10	49	1.22		11	.12	10	45	1.22		41	.12	77	82.7	
14	11	42	1.20		48	.12	11	38	1.20		18	.12	11	34	1.22		48	.13	76	82.2	
15	12	32	1.20		55	0.13	12	28	1.22		25	0.13	12	23	1.20		56	0.13	75	81.6	
16	13	22	1.20	34	3	.13	13	17	1.20		33	.13	13	13	1.22		35	4	.13	74	81.0
17	14	12	1.22		11	.15	14	7	1.22		41	.15	14	2	1.22		12	.15	73	80.4	
18	15	1	1.20		20	.15	15	56	1.22		50	.17	15	51	1.22		21	.15	72	79.8	
19		51	1.22		29	.17	15	45	1.22	35	0	.17	15	40	1.25		30	.17	71	79.2	
20	16	40	1.22		39	0.17	16	34	1.22		10	0.17	16	28	1.22		40	0.18	70	78.6	
21	17	29	1.20		49	.18	17	23	1.22		20	.18	17	17	1.22		51	.18	69	78.0	
22	18	19	1.22	35	0	.20	18	12	1.22		31	.20	18	6	1.25	36	2	.20	68	77.4	
23	19	8	1.22		12	.20	19	1	1.22		43	.20	19	54	1.25		14	.20	67	76.8	
24		57	1.22		24	.22	20	50	1.25		55	.22	19	42	1.25		26	.22	66	76.2	
25	20	46	1.25		37	.23	20	38	1.22		36	8	0.23	20	30	1.25		39	0.23	65	75.6
26	21	34	1.22		51	.23	21	27	1.25		22	.23	21	18	1.25		53	.25	64	74.9	
27	22	23	1.25	36	5	.25	22	15	1.25		36	.25	22	6	1.25	37	8	.25	63	74.3	
28	23	11	1.25		20	.27	23	3	1.25		51	.27	23	54	1.25		23	.25	62	73.6	
29	29	59	1.25		36	.27	23	51	1.25		37	7	.27	23	42	1.28		38	.28	61	73.0
30	24	47	1.25		52	0.28	24	39	1.28		23	0.28	24	29	1.28		55	0.28	60	72.3	
31	25	35	1.25	37	9	.30	25	26	1.28		40	.30	25	16	1.28	38	12	.30	59	71.7	
32	26	23	1.25		27	.30	26	13	1.28		58	.32	26	3	1.28		30	.32	58	71.0	
33	27	11	1.28		45	.32	27	0	1.28		38	17	.32	50	1.28		49	.32	57	70.3	
34		58	1.28	38	4	.33	27	47	1.28		36	.33	27	37	1.28	39	8	.33	56	69.6	
35	28	45	1.28		24	0.35	28	34	1.28		56	0.35	28	24	1.30		28	0.35	55	68.9	
36	29	32	1.28		45	.37	29	21	1.30		39	17	.37	29	10	1.30		49	.37	54	68.1
37	30	19	1.30	39	7	.38	30	7	1.30		39	.38	30	56	1.30	40	11	.38	53	67.4	
38	31	5	1.30		30	.38	30	53	1.30		40	2	.38	30	42	1.33		34	.38	52	66.7
39		51	1.30		53	.40	31	39	1.30		25	.42	31	27	1.33		57	.42	51	65.9	
40	32	37	1.30	40	17	0.43	32	25	1.33		50	0.42	32	12	1.33	41	22	0.42	50	65.2	
41	33	23	1.33		43	.43	33	10	1.33		41	15	.43	33	57	1.33		47	.45	49	64.4
42	34	8	1.33	41	9	.45	33	55	1.33		41	.47	33	42	1.36	42	14	.45	48	63.6	
43		53	1.33		36	.48	34	40	1.36		42	9	.47	34	26	1.36		41	.48	47	62.8
44	35	38	1.36	42	5	.48	35	24	1.36		37	.48	35	10	1.40	43	10	.48	46	61.9	
45	36	22			34		36	8			43	6		53			39		45	61.1	
t	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a	60'	Δ	b	Δ	60'	a		
	d = 33° 0'				d = 33° 30'				d = 34° 0'												

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

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

B	$a = 34^\circ 30'$				$a = 35^\circ 0'$				$a = 35^\circ 30'$				C	α							
	h	d	$\frac{60'}{\Delta}$	Z	h	d	$\frac{60'}{\Delta}$	Z	h	d	$\frac{60'}{\Delta}$	Z			C	β					
		$\frac{\Delta}{60'}$	t	$\frac{\Delta}{60'}$		$\frac{\Delta}{60'}$	$\frac{\Delta}{60'}$	t		$\frac{\Delta}{60'}$	t	$\frac{\Delta}{60'}$									
0	0	0	1.22	34	30	0.00	0	0	1.22	35	0	0.00	0	0	1.22	35	30	0.00	90	90.0	
1		49	1.20		30	.02		49	1.22		0	.02		49	1.22		30	.02	89	89.4	
2	1	39	1.22		31	.02	1	38	1.22		1	.02	1	38	1.22		31	.02	88	88.9	
3	2	28	1.20		32	.03	2	27	1.20		2	.03	2	27	1.25		32	.03	87	88.3	
4	3	18	1.22		34	.03	3	17	1.22		4	.03	3	15	1.22		34	.03	86	87.7	
5	4	7	1.20		36	0.05	4	6	1.22		6	0.05	4	4	1.22		36	0.05	85	87.1	
6		57	1.22		39	.05		55	1.22		9	.05		53	1.22		39	.05	84	86.6	
7	5	46	1.22		42	.07	5	44	1.22		12	.07	5	42	1.25		42	.07	83	86.0	
8	6	35	1.22		46	.07	6	33	1.22		16	.07	6	30	1.22		46	.07	82	85.4	
9	7	24	1.20		50	.08	7	22	1.22		20	.08	7	19	1.22		50	.08	81	84.8	
10	8	14	1.22		55	0.08	8	11	1.22		25	0.08	8	8	1.25		55	0.08	80	84.2	
11	9	3	1.22	35	0	.10	9	0	1.25		30	.10		56	1.22	36	0	.10	79	83.6	
12		52	1.22		6	.10		48	1.22		36	.10	9	45	1.25		6	.10	78	83.0	
13	10	41	1.22		12	.12	10	37	1.22		42	.12	10	33	1.22		12	.12	77	82.5	
14	11	30	1.22		19	.12	11	26	1.25		49	.12	11	22	1.25		19	.13	76	81.9	
15	12	19	1.22		26	0.13	12	14	1.22		56	0.13	12	10	1.25		27	0.13	75	81.3	
16	13	8	1.22		34	.13	13	3	1.25	36	4	.15		58	1.25		35	.13	74	80.7	
17		57	1.25		42	.15		51	1.22		13	.15		13	46	1.25		43	.15	73	80.1
18	14	45	1.22		51	.17	14	40	1.25		22	.15	14	34	1.25		52	.17	72	79.4	
19	15	34	1.25	36	1	.17	15	28	1.25		31	.17	15	22	1.25		37	2	.17	71	78.8
20	16	22	1.22		11	.18	16	16	1.25		41	0.18	16	10	1.25		12	0.18	70	78.2	
21	17	11	1.25		22	.18	17	4	1.25		52	.20		58	1.28		23	.18	69	77.6	
22		59	1.25		33	.20		52	1.25	37	4	.20		17	45	1.25		34	.20	68	77.0
23	18	47	1.25		45	.20	18	40	1.25		16	.20	18	33	1.28		46	.22	67	76.3	
24	19	35	1.25		57	.22	19	28	1.28		28	.22	19	20	1.28		59	.22	66	75.7	
25	20	23	1.25	37	10	0.23	20	15	1.25		41	0.23	20	7	1.28		38	12	0.23	65	75.0
26	21	11	1.28		24	.25	21	3	1.28		55	.25		54	1.28		26	.25	64	74.4	
27		58	1.25		39	.25		50	1.28	38	10	.25		21	41	1.28		41	.25	63	73.7
28	22	46	1.28		54	.27	22	37	1.28		25	.27	22	28	1.28		56	.27	62	73.0	
29	23	33	1.28	38	10	.27	23	24	1.28		41	.27	23	15	1.30		39	12	.28	61	72.4
30	24	20	1.28		26	0.28	24	11	1.30		57	0.30	24	1	1.30		29	0.28	60	71.7	
31	25	7	1.28		43	.30		57	1.28	39	15	.30		47	1.30		46	.30	59	71.0	
32		54	1.30	39	1	.32	25	44	1.30		33	.32	25	33	1.30		40	4	.32	58	70.3
33	26	40	1.30		20	.33	26	30	1.30		52	.32	26	19	1.30		23	.33	57	69.6	
34	27	26	1.30		40	.33	27	16	1.30	40	11	.33		27	5	1.33		43	.33	56	68.9
35	28	12	1.30	40	0	0.35	28	2	1.33		31	0.35		50	1.33	41	3	0.35	55	68.1	
36		58	1.30		21	.37		47	1.33		52	.37	28	35	1.33		24	.37	54	67.4	
37	29	44	1.33		43	.38	29	32	1.33	41	14	.38		29	20	1.33		46	.38	53	66.6
38	30	29	1.33	41	6	.40	30	17	1.33		37	.40	30	5	1.36		42	9	.40	52	65.9
39	31	14	1.33		30	.40	31	2	1.36	42	1	.42		49	1.36		33	.42	51	65.1	
40		59	1.33		54	0.42		46	1.36		26	0.42	31	33	1.36		58	0.42	50	64.3	
41	32	44	1.36	42	19	.45	32	30	1.36		51	.45	32	17	1.40		43	23	.45	49	63.5
42	33	28	1.36		46	.45	33	14	1.36	43	18	.45		33	0	1.40		50	.45	48	62.7
43	34	12	1.36	43	13	.48		58	1.40		45	.48		43	1.40	44	17	.47	47	61.9	
44		56	1.40		42	.48	34	41	1.40	44	14	.48		34	26	1.40		45	.50	46	61.0
45	35	39		44	11		35	24			43		35	9		45	15		45	60.2	

t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a
		$d = 34^\circ 30'$				$d = 35^\circ 0'$				$d = 35^\circ 30'$			

b	a = 34° 30'				a = 35° 0'				a = 35° 30'				c	α						
	B	d	60' / Δ	t	Δ / 60'	h	d	60' / Δ	t	Δ / 60'	h	d			60' / Δ	t	Δ / 60'	C	β	
		h	Z				Z			Z					Z					
45	35	39	1.40	44	11	0.52	35	24	1.43	44	43	0.52	35	9	1.43	45	15	0.50	45	60.2
46	36	22	1.43	42	52	.52	36	6	1.43	45	14	.52	51	1.43	45	45	.53	44	59.3	
47	37	4	1.43	45	13	.55	48	1.43	45	45	.55	36	33	1.46	46	17	.55	43	58.4	
48	38	46	1.43	46	46	.57	37	30	1.46	46	18	.57	37	14	1.46	50	.57	42	57.5	
49	38	28	1.46	46	20	.58	38	11	1.46	52	52	.58	55	1.50	47	24	.58	41	56.6	
50	39	9	1.46	55	0.60	52	1.50	47	27	0.60	38	35	1.50	59	0.60	40	55.6			
51	50	1.50	47	31	.63	39	32	1.50	48	3	.63	39	15	1.54	48	35	.62	39	54.7	
52	40	30	1.50	48	9	.65	40	12	1.50	50	41	.63	54	1.54	49	12	.65	38	53.7	
53	41	10	1.54	48	48	.67	50	1.54	49	19	.67	40	33	1.54	51	51	.67	37	52.7	
54	49	1.54	49	28	.68	41	31	1.58	59	.70	41	12	1.58	50	31	.68	36	51.7		
55	42	28	1.58	50	9	0.72	42	9	1.58	50	41	0.70	50	1.62	51	12	0.70	35	50.7	
56	43	6	1.62	52	.73	47	1.62	51	23	.73	42	27	1.62	54	.73	34	49.6			
57	43	1.62	51	36	.77	43	24	1.67	52	7	.77	43	4	1.67	52	38	.75	33	48.5	
58	44	20	1.67	52	22	.78	44	0	1.67	53	.78	40	53	1.71	53	23	.78	32	47.4	
59	56	1.67	53	9	.82	36	1.71	53	40	.80	44	15	1.71	54	10	.80	31	46.3		
60	45	32	1.71	58	0.83	45	11	1.71	54	28	0.83	50	1.76	58	0.83	30	45.2			
61	46	7	1.76	54	48	.87	46	1.76	55	18	.87	45	24	1.82	55	48	.85	29	44.0	
62	47	1.76	55	40	.88	46	20	1.82	56	10	.88	57	1.82	56	39	.88	28	42.8		
63	47	15	1.82	56	33	.92	53	1.88	57	3	.90	46	30	1.88	57	32	.90	27	41.6	
64	48	1.88	57	28	.95	47	25	1.94	57	.93	47	2	1.94	58	26	.92	26	40.4		
65	48	20	1.94	58	25	0.97	56	1.94	58	53	0.97	33	2.00	59	21	0.95	25	39.1		
66	51	2.00	59	23	1.00	48	27	2.07	59	51	.98	48	3	2.07	60	18	.98	24	37.8	
67	49	21	2.07	60	23	1.03	56	2.07	60	50	1.02	32	2.07	61	17	1.02	23	36.5		
68	50	2.14	61	25	1.05	49	25	2.14	61	51	1.05	49	1	2.22	62	18	1.03	22	35.2	
69	50	18	2.22	62	28	1.08	53	2.22	62	54	1.07	28	2.22	63	20	1.05	21	33.8		
70	45	2.31	63	33	1.10	50	20	2.31	63	58	1.10	55	2.40	64	23	1.08	20	32.4		
71	51	11	2.40	64	39	1.13	46	2.50	65	4	1.12	50	20	2.50	65	28	1.12	19	31.0	
72	36	2.50	65	47	1.17	51	10	2.50	66	11	1.15	44	2.50	66	35	1.13	18	29.5		
73	52	0	2.61	66	57	1.20	34	2.61	67	20	1.18	51	8	2.73	67	43	1.15	17	28.1	
74	23	2.73	68	9	1.22	57	2.86	68	31	1.20	68	31	1.20	30	2.86	68	52	1.18	16	26.6
75	45	2.86	69	22	1.25	52	18	3.00	69	43	1.22	51	3.00	70	3	1.22	15	25.0		
76	53	6	3.16	70	37	1.27	38	3.16	70	56	1.25	52	11	3.16	71	16	1.23	14	23.5	
77	25	3.33	71	53	1.28	57	3.33	72	11	1.28	30	3.53	72	30	1.25	13	21.9			
78	43	3.53	73	10	1.32	53	15	3.75	73	28	1.28	47	3.75	73	45	1.27	12	20.3		
79	54	0	4.00	74	29	1.33	31	4.00	74	45	1.32	53	3	4.00	75	1	1.30	11	18.7	
80	15	4.29	75	49	1.37	46	4.29	76	4	1.33	18	4.62	76	19	1.32	10	17.1			
81	29	4.62	77	11	1.37	54	0	4.62	77	24	1.37	31	5.00	77	38	1.33	9	15.4		
82	42	5.45	78	33	1.40	13	5.45	78	46	1.37	43	5.45	78	58	1.33	8	13.8			
83	53	6.00	79	57	1.40	24	6.67	80	8	1.38	54	6.00	80	18	1.37	7	12.1			
84	55	3	7.50	81	21	1.42	33	7.50	81	31	1.38	54	4	7.50	81	40	1.37	6	10.4	
85	11	8.57	82	46	1.43	41	8.57	82	54	1.42	12	10.0	83	2	1.38	5	8.7			
86	18	12.0	84	12	1.45	48	12.0	84	19	1.42	18	12.0	84	25	1.38	4	7.0			
87	23	15.0	85	39	1.45	53	15.0	85	44	1.42	23	15.0	85	48	1.40	3	5.2			
88	27	30.0	87	6	1.45	57	30.0	87	9	1.42	27	30.0	87	12	1.40	2	3.5			
89	29	60.0	88	33	1.45	59	60.0	88	34	1.43	29	60.0	88	36	1.40	1	1.7			
90	30		90	0		55	0		90	0		30		90	0		0	0.0		
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a			
	d = 34° 30'				d = 35° 0'				d = 35° 30'											

B	a = 36° 0'				a = 36° 30'				a = 37° 0'				C	c	β									
	h	d	60'	t	h	d	60'	t	h	d	60'	t				C								
		Δ	Z	60'		Δ	Z	60'		Δ	Z	60'												
0	0	0	1.22	36	0	0	0.00	0	0	1.25	36	30	0.00	0	0	1.25	37	0	0.00	90	90.0			
1		49	1.25		0	.02		48	1.25		30	.02		48	1.25		0	.02		89	89.4			
2	1	37	1.22		1	.02		1	36	1.22		31	.02		1	36	1.25		1	.02	88	88.8		
3	2	26	1.25		2	.03		2	25	1.25		32	.03		2	24	1.25		2	.03	87	88.2		
4	3	14	1.22		4	.03		3	13	1.25		34	.03		3	12	1.28		4	.03	86	87.6		
5	4	3	1.25		6	0.05		4	1	1.25		36	0.05		59	1.25		6	0.05		85	87.0		
6	5	51	1.25		9	.05		49	1.25		39	.05		4	47	1.25		9	.05		84	86.4		
7	5	39	1.22		12	.07		5	37	1.25		42	.07		5	35	1.25		12	.07	83	85.8		
8	6	28	1.25		16	.07		6	25	1.25		46	.07		6	23	1.25		16	.07	82	85.2		
9	7	16	1.22		20	.08		7	13	1.25		50	.08		7	11	1.28		20	.08	81	84.6		
10	8	5	1.25		25	0.08		8	1	1.25		55	0.10		58	1.25		25	0.10		80	84.0		
11		53	1.25		30	.10		49	1.25		37	1	.10		8	46	1.25		31	.10	79	83.4		
12	9	41	1.25		36	.12		9	37	1.25		7	.10		9	34	1.28		37	.10	78	82.8		
13	10	29	1.25		43	.12		10	25	1.25		13	.12		10	21	1.28		43	.12	77	82.2		
14	11	17	1.25		50	.12		11	13	1.28		20	.12		11	8	1.25		50	.12	76	81.6		
15	12	5	1.25		57	0.13		12	0	1.25		27	0.13		56	1.28		57	0.13		75	80.9		
16		53	1.25		37	5	.13		48	1.25		35	.15		12	43	1.28		38	5	.15	74	80.3	
17	13	41	1.25		13	.15		13	36	1.28		44	.15		13	30	1.28		14	.15	73	79.7		
18	14	29	1.28		22	.17		14	23	1.28		53	.17		14	17	1.28		23	.17	72	79.1		
19	15	16	1.25		32	.18		15	10	1.28		38	3	.17	15	4	1.28		33	.18	71	78.4		
20	16	4	1.28		43	0.18		57	1.28		13	0.18		51	1.28		44	0.18		70	77.8			
21		51	1.28		54	.18		16	44	1.28		24	.20		16	38	1.28		55	.18	69	77.1		
22	17	38	1.28		38	5	.20		17	31	1.28		36	.20		17	25	1.30		39	6	.20	68	76.5
23	18	25	1.28		17	.22		18	18	1.28		48	.22		18	11	1.30		18	.22	67	75.8		
24	19	12	1.28		30	.22		19	5	1.28		39	1	.22	57	1.30		31	.23		66	75.2		
25		59	1.28		43	0.23		52	1.30		14	0.23		19	43	1.30		45	0.23		65	74.5		
26	20	46	1.28		57	.25		20	38	1.30		28	.25		20	29	1.30		59	.23	64	73.8		
27	21	33	1.30		39	12	.25		21	24	1.30		43	.25		21	15	1.30		40	13	.27	63	73.1
28	22	19	1.30		27	.27		22	10	1.30		58	.27		22	1	1.30		29	.27	62	72.5		
29	23	5	1.30		43	.28		56	1.30		40	14	.28		47	1.33		45	.28		61	71.8		
30		51	1.30		40	0	.28		23	42	1.33		31	0.28		23	32	1.33		41	2	.28	60	71.0
31	24	37	1.30		17	.30		24	27	1.30		48	.30		24	17	1.33		19	.30	59	70.3		
32	25	23	1.30		35	.33		25	13	1.33		41	6	.32	25	2	1.33		37	.32	58	69.6		
33	26	9	1.33		54	.33		58	1.33		25	.33		47	1.33		56	.33		57	57	68.9		
34		54	1.33		41	14	.33		26	43	1.33		45	.35		26	32	1.36		42	16	.35	56	68.1
35	27	39	1.33		34	0.37		27	28	1.36		42	6	0.35	27	16	1.36		37	0.35	55	67.4		
36	28	24	1.36		56	.37		28	12	1.36		27	.37		28	0	1.36		58	.37	54	66.6		
37	29	8	1.36		42	18	.38		56	1.36		49	.38		44	1.40		43	20	.38	53	65.9		
38		52	1.36		41	.38		29	40	1.36		43	12	.40	29	27	1.40		43	.40	52	65.1		
39	30	36	1.36		43	4	.42		30	24	1.40		36	.42		30	10	1.40		44	7	.42	51	64.3
40		31	1.40		29	0.43		31	7	1.40		44	1	0.42	53	1.40		32	0.43		50	63.5		
41	32	3	1.40		55	.43		50	1.40		26	.45		31	36	1.43		58	.43		49	62.7		
42	33	46	1.40		44	21	.47		32	33	1.43		53	.45		32	18	1.43		45	24	.47	48	61.8
43	33	29	1.40		49	.47		33	15	1.43		45	20	.48	33	0	1.43		52	.47	47	61.0		
44	34	12	1.43		45	17	.48		57	1.43		49	.48		42	1.46		46	20	.48	46	60.1		
45		54			46			34	39			46	18		34	23			49		45	59.3		

t	a = 36° 0'				a = 36° 30'				a = 37° 0'				a
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
	d = 36° 0'				d = 36° 30'				d = 37° 0'				

B	a = 36° 0'				a = 36° 30'				a = 37° 0'				C	β						
	h	d	Z	Δ	h	d	Z	Δ	h	d	Z	Δ								
		60'	t	60'		t	60'	t		60'	t	60'			t					
45	34	54	1.46	45	46	0.52	34	39	1.46	46	18	0.50	34	23	1.46	46	49	0.52	45	59.3
46	35	35	1.46	46	17	.53	35	20	1.46	48	.53	35	4	1.50	47	20	.52	44	58.4	
47	36	16	1.46	49	.53	36	1	1.50	47	20	.55	36	44	1.50	51	.55	43	57.5		
48	57	1.46	47	21	.57	41	1.50	53	.55	36	24	1.50	48	24	.55	42	56.6			
49	37	38	1.50	55	.58	37	21	1.50	48	26	.58	37	4	1.54	57	.58	41	55.6		
50	38	18	1.54	48	30	0.60	38	1	1.54	49	1	0.60	43	1.54	49	32	0.60	40	54.7	
51	51	57	1.54	49	6	.62	40	1.58	49	37	.62	38	22	1.58	50	8	.62	39	53.7	
52	39	36	1.54	43	.65	39	18	1.58	50	14	.63	39	0	1.58	45	.63	38	52.7		
53	40	15	1.58	50	22	.67	56	1.58	52	.67	38	38	1.62	51	23	.67	37	51.7		
54	53	1.62	51	2	.68	40	34	1.62	51	32	.68	40	15	1.62	52	3	.67	36	50.7	
55	41	30	1.62	43	0.70	41	11	1.67	52	13	0.70	52	1.67	43	0.70	35	49.7			
56	42	7	1.67	52	25	.73	47	1.67	55	.73	41	28	1.71	53	25	.72	34	48.6		
57	43	43	1.67	53	9	.75	42	23	1.71	53	39	.75	42	3	1.71	54	8	.75	33	47.5
58	43	19	1.71	54	.77	58	1.71	54	24	.77	43	12	1.76	53	.77	32	46.4			
59	54	1.71	54	40	.80	43	33	1.76	55	10	.78	43	18	1.76	55	39	.78	31	45.3	
60	44	29	1.82	55	28	0.82	44	7	1.82	57	0.82	46	1.82	56	26	0.82	30	44.1		
61	45	2	1.82	56	17	.85	40	1.82	56	46	.83	44	19	1.88	57	15	.83	29	43.0	
62	35	1.88	57	8	.87	45	13	1.88	57	36	.87	51	1.94	58	5	.85	28	41.8		
63	46	7	1.88	58	0	.90	45	1.94	58	28	.88	45	22	2.00	56	.88	27	40.6		
64	39	2.00	54	.92	46	16	2.00	59	21	.92	52	2.00	59	49	.90	26	39.4			
65	47	9	2.00	59	49	0.95	46	2.07	60	16	0.93	46	22	2.07	60	43	0.93	25	38.1	
66	39	2.07	60	46	.97	47	15	2.14	61	12	.97	51	2.14	61	39	.95	24	36.8		
67	48	8	2.14	61	44	1.00	43	2.14	62	10	.98	47	19	2.22	62	36	.97	23	35.5	
68	36	2.22	62	44	1.02	48	11	2.22	63	9	1.02	46	2.22	63	34	1.00	22	34.2		
69	49	3	2.31	63	45	1.05	38	2.40	64	10	1.03	48	13	2.40	64	34	1.02	21	32.8	
70	29	2.40	64	48	1.07	49	3	2.40	65	12	1.05	38	2.50	65	35	1.05	20	31.5		
71	54	2.50	65	52	1.10	28	2.50	66	15	1.08	49	2	2.50	66	38	1.07	19	30.1		
72	50	1.81	66	58	1.12	52	2.73	67	20	1.10	26	2.73	67	42	1.10	18	28.6			
73	41	2.73	68	5	1.15	50	14	2.73	68	26	1.13	48	2.86	68	48	1.12	17	27.2		
74	51	3	2.86	69	14	1.17	36	3.00	69	34	1.15	50	9	3.00	69	55	1.13	16	25.7	
75	24	3.16	70	24	1.18	56	3.16	70	43	1.18	29	3.16	71	3	1.15	15	24.3			
76	43	3.33	71	35	1.22	51	15	3.33	71	54	1.18	48	3.33	72	12	1.18	14	22.7		
77	52	1	3.53	72	48	1.23	33	3.53	73	5	1.22	51	6	3.75	73	23	1.20	13	21.2	
78	18	3.75	74	2	1.25	50	3.75	74	18	1.25	22	4.00	74	35	1.20	12	19.7			
79	34	4.00	75	17	1.27	52	6	4.29	75	33	1.25	37	4.29	75	47	1.23	11	18.1		
80	49	4.62	76	33	1.30	20	4.62	76	48	1.27	51	4.62	77	1	1.25	10	16.5			
81	53	2	5.00	77	51	1.30	33	5.00	78	4	1.28	52	4	5.00	78	16	1.27	9	14.9	
82	14	5.45	79	9	1.33	45	5.45	79	21	1.30	16	6.00	79	32	1.28	8	13.3			
83	25	6.67	80	29	1.33	56	6.67	80	39	1.32	26	6.67	80	49	1.28	7	11.7			
84	34	7.50	81	49	1.35	53	7.50	81	58	1.32	35	7.50	82	6	1.30	6	10.0			
85	42	8.57	83	10	1.35	13	10.0	83	17	1.33	43	10.0	83	24	1.32	5	8.4			
86	49	12.0	84	31	1.37	19	12.0	84	37	1.33	49	12.0	84	43	1.32	4	6.7			
87	54	20.0	85	53	1.37	24	20.0	85	57	1.35	54	20.0	86	2	1.32	3	5.0			
88	57	30.0	87	15	1.37	27	30.0	87	18	1.35	57	30.0	87	21	1.32	2	3.4			
89	59	60.0	88	37	1.38	29	60.0	88	39	1.35	59	60.0	88	40	1.33	1	1.7			
90	54	0	90	0		30		90	0		53	0	90	0		0	0.0			

B	$a = 37^\circ 30'$					$a = 38^\circ 0'$					$a = 38^\circ 30'$					C	β				
	h	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	t	$\frac{\Delta}{60'}$						
		Z	Z	Z	Z		Z	Z	Z												
0	0	0	1.25	37	30	0.00	0	0	1.28	38	0	0.00	0	0	1.28	38	0	0.00	90	90.0	
1		48	1.28		30	.02		47	1.25		0	.02		47	1.28		30	.02	89	89.4	
2	1	35	1.25		31	.02	1	35	1.28		1	.02	1	34	1.28		31	.02	88	88.8	
3	2	23	1.28		32	.03	2	22	1.28		2	.03	2	21	1.28		32	.03	87	88.2	
4	3	10	1.25		34	.03	3	9	1.28		4	.03	3	8	1.28		34	.03	86	87.5	
5		58	1.25		36	0.05		56	1.25		6	0.05		55	1.28		36	0.05	85	86.9	
6	4	46	1.28		39	.05	4	44	1.28		9	.05	4	42	1.30		39	.05	84	86.3	
7	5	33	1.28		42	.07	5	31	1.28		12	.07	5	28	1.28		42	.07	83	85.7	
8	6	20	1.25		46	.08	6	18	1.28		16	.08	6	15	1.28		46	.08	82	85.1	
9	7	8	1.28		51	.08	7	5	1.28		21	.08	7	2	1.28		51	.08	81	84.4	
10		55	1.28		56	0.08		52	1.28		26	0.08		49	1.30		56	0.08	80	83.8	
11	8	42	1.25	38	1	.10	8	39	1.28		31	.10	8	35	1.28	39	1	.10	79	83.2	
12	9	30	1.28		7	.10	9	26	1.28		37	.10	9	22	1.30		7	.12	78	82.5	
13	10	17	1.28		13	.12	10	13	1.30		43	.12	10	8	1.28		14	.12	77	81.9	
14	11	4	1.28		20	.13	11	59	1.28		50	.13	11	55	1.30		21	.12	76	81.3	
15		51	1.28		28	0.13	11	46	1.28		58	0.13	11	41	1.28		28	0.13	75	80.6	
16	12	38	1.28		36	.15	12	33	1.30	39	6	.15	12	28	1.30		36	.15	74	80.0	
17	13	25	1.28		45	.15	13	19	1.28		15	.15	13	14	1.30		45	.15	73	79.3	
18	14	12	1.30		54	.17	14	6	1.30		24	.17	14	0	1.30		54	.17	72	78.7	
19		58	1.28	39	4	.17		52	1.30		34	.17		46	1.30	40	4	.18	71	78.0	
20	15	45	1.30		14	0.18	15	38	1.30		44	0.18	15	32	1.33		15	0.18	70	77.4	
21	16	31	1.30		25	.20	16	24	1.30		55	.20	16	17	1.33		25	.20	69	76.7	
22	17	17	1.30		37	.20	17	10	1.30	40	7	.20	17	3	1.30	38	.20	68	76.0		
23	18	3	1.30		49	.22		56	1.30		19	.22		48	1.30		50	.22	67	75.4	
24		49	1.30	40	2	.22		42	1.33		32	.23		34	1.33	41	3	.22	66	74.7	
25	19	35	1.30		15	0.23	19	27	1.30		46	0.23	19	19	1.33		16	0.23	65	74.0	
26	20	21	1.30		29	.25	20	13	1.33	41	0	.25	20	4	1.33		30	.25	64	73.3	
27	21	7	1.33		44	.27		58	1.33		15	.25		49	1.33		45	.27	63	72.6	
28		52	1.33	41	0	.27		43	1.33		30	.27		34	1.36	42	1	.27	62	71.9	
29	22	37	1.33		16	.28	22	28	1.36		46	.28	22	18	1.36		17	.28	61	71.2	
30	23	22	1.33		33	0.28	23	12	1.33	42	3	0.30	23	2	1.36		34	0.30	60	70.4	
31	24	7	1.33		50	.30		57	1.36		21	.30		46	1.36		52	.30	59	69.7	
32		52	1.36	42	8	.32		41	1.36		39	.32		30	1.36	43	10	.32	58	69.0	
33	25	36	1.36		27	.33	25	25	1.36		58	.33	25	14	1.40		29	.33	57	68.2	
34	26	20	1.36		47	.35	26	9	1.40	43	18	.35		57	1.40		49	.35	56	67.4	
35	27	4	1.36	43	8	0.35		52	1.40		39	0.35	26	40	1.40	44	10	0.35	55	66.7	
36		48	1.40		29	.37	27	35	1.40	44	0	.37	27	23	1.40		31	.37	54	65.9	
37	28	31	1.40		51	.38	28	18	1.40		22	.38	28	6	1.43		53	.38	53	65.1	
38	29	14	1.40	44	14	.40	29	1	1.40		45	.40		48	1.43	45	16	.40	52	64.3	
39		57	1.40		38	.42		44	1.43	45	9	.42	29	30	1.43		40	.42	51	63.5	
40	30	40	1.43	45	3	0.42	30	26	1.43		34	0.43	30	12	1.43	46	5	0.43	50	62.7	
41	31	22	1.43		28	.45	31	8	1.46	46	0	.43		54	1.46		31	.43	49	61.8	
42	32	4	1.46		55	.47		49	1.46		26	.45	31	35	1.46		57	.45	48	61.0	
43	33	45	1.46	46	23	.47	32	30	1.46		53	.48	32	16	1.50	47	24	.48	47	60.1	
44		33	1.46		51	.48	33	11	1.46	47	22	.48		56	1.50		53	.48	46	59.3	
45	34	7			47	20		52			51		33	36			48	22		45	58.4
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a				
	$d = 37^\circ 30'$				$d = 38^\circ 0'$				$d = 38^\circ 30'$												

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

B	$a = 39^\circ 0'$				$a = 39^\circ 30'$				$a = 40^\circ 0'$				C	β								
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$										
		d		t		d		t		d		t										
0	0	0	1.28	39	0	0.00	0	0	1.30	39	30	0.00	0	0	1.30	40	0	0.00	90	90.0		
1	1	47	1.30	0	.02	1	46	1.28	30	.02	1	46	1.30	0	.02	1	46	1.30	89	89.4		
2	1	33	1.28	1	.02	1	33	1.30	31	.02	1	32	1.30	1	.02	1	32	1.30	88	88.7		
3	2	20	1.28	2	.03	2	19	1.30	32	.03	2	18	1.30	2	.03	2	18	1.30	87	88.1		
4	3	7	1.30	4	.03	3	5	1.30	34	.03	3	4	1.30	4	.03	3	4	1.30	86	87.5		
5	5	53	1.28	6	0.05	5	51	1.28	36	0.05	5	50	1.30	6	0.05	5	50	1.30	85	86.8		
6	4	40	1.30	9	.07	4	38	1.30	39	.07	4	36	1.33	9	.07	4	36	1.33	84	86.2		
7	5	26	1.28	13	.07	5	24	1.30	43	.07	5	21	1.30	13	.07	5	21	1.30	83	85.5		
8	6	13	1.30	17	.07	6	10	1.30	47	.07	6	7	1.30	17	.07	6	7	1.30	82	84.9		
9	5	59	1.30	21	.08	5	56	1.30	51	.08	5	53	1.30	21	.08	5	53	1.30	81	84.2		
10	7	45	1.28	26	0.08	7	42	1.30	56	0.08	7	39	1.33	26	0.08	7	39	1.33	80	83.6		
11	8	32	1.30	31	.10	8	28	1.30	40	1	.10	8	24	1.30	31	.10	8	24	1.30	79	83.0	
12	9	18	1.30	37	.12	9	14	1.30	7	.12	9	10	1.33	37	.12	9	10	1.33	78	82.3		
13	10	4	1.30	44	.12	10	0	1.30	14	.12	10	5	1.30	44	.12	10	5	1.30	77	81.6		
14	5	50	1.30	51	.13	4	46	1.33	21	.13	10	41	1.33	51	.13	10	41	1.33	76	81.0		
15	11	36	1.30	59	0.13	11	31	1.30	29	0.13	11	26	1.33	59	0.13	11	26	1.33	75	80.3		
16	12	22	1.30	40	.15	12	17	1.33	37	.15	12	11	1.33	41	.15	12	11	1.33	74	79.7		
17	13	8	1.30	16	.15	13	2	1.30	46	.15	13	5	1.33	16	.15	13	5	1.33	73	79.0		
18	5	54	1.30	25	.17	4	48	1.33	55	.17	13	41	1.33	25	.17	13	41	1.33	72	78.3		
19	14	40	1.33	35	.17	14	33	1.33	41	.18	14	26	1.33	35	.18	14	26	1.33	71	77.6		
20	15	25	1.33	45	0.18	15	18	1.33	16	0.18	15	11	1.33	46	0.18	15	11	1.33	70	77.0		
21	16	10	1.33	56	.20	16	3	1.33	27	.20	16	5	1.33	57	.20	16	5	1.33	69	76.3		
22	5	55	1.33	41	.20	5	48	1.33	39	.20	16	41	1.36	42	.20	16	41	1.36	68	75.6		
23	17	40	1.33	20	.22	17	33	1.33	51	.22	17	25	1.36	21	.22	17	25	1.36	67	74.9		
24	18	25	1.33	33	.23	18	18	1.36	42	.22	18	9	1.36	34	.23	18	9	1.36	66	74.2		
25	19	10	1.33	47	0.23	19	2	1.36	17	0.23	19	5	1.40	48	0.23	19	5	1.40	65	73.5		
26	5	55	1.33	42	1	.25	46	1.36	31	.25	19	37	1.36	43	2	.25	19	37	1.36	64	72.8	
27	20	40	1.36	16	.27	20	30	1.36	46	.27	20	21	1.36	17	.27	20	21	1.36	63	72.0		
28	21	24	1.36	32	.27	21	14	1.36	43	2	.27	21	5	1.40	33	.27	21	5	1.40	62	71.3	
29	22	8	1.36	48	.28	5	58	1.36	18	.28	18	48	1.40	49	.28	18	48	1.40	61	70.6		
30	5	52	1.36	43	5	0.28	22	1.40	35	0.30	22	31	1.40	44	6	0.28	22	31	1.40	60	69.8	
31	23	36	1.40	22	.32	23	25	1.40	53	.30	23	14	1.40	23	.32	23	14	1.40	59	69.1		
32	24	19	1.40	41	.32	24	8	1.40	44	11	.32	57	1.40	42	.32	24	8	1.40	58	68.3		
33	25	2	1.40	44	0	.33	5	1.40	30	.33	24	40	1.43	45	1	.33	24	40	1.43	57	67.6	
34	4	45	1.40	20	.33	25	34	1.43	50	.35	25	22	1.43	21	.33	25	22	1.43	56	66.8		
35	26	28	1.40	40	0.37	26	16	1.43	45	11	0.35	26	4	1.43	41	0.37	26	4	1.43	55	66.0	
36	27	11	1.43	45	2	.37	58	1.43	32	.37	27	46	1.46	46	3	.37	27	46	1.46	54	65.2	
37	28	53	1.43	24	.38	27	40	1.43	54	.38	27	27	1.46	25	.38	27	27	1.46	53	64.4		
38	28	35	1.43	47	.40	28	22	1.46	46	17	.40	28	8	1.46	48	.40	28	8	1.46	52	63.6	
39	29	17	1.46	46	11	.40	29	3	1.46	41	.42	49	1.46	47	12	.40	29	3	1.46	51	62.7	
40	5	58	1.46	35	0.43	44	1.46	47	6	0.43	29	30	1.50	36	0.43	29	30	1.50	50	61.9		
41	30	39	1.46	47	1	.45	30	25	1.50	32	.43	30	10	1.50	48	2	.43	30	10	1.50	49	61.1
42	31	26	1.50	28	.45	31	5	1.50	58	.45	30	50	1.50	28	.45	30	50	1.50	48	60.2		
43	32	0	1.50	55	.47	45	1.50	48	25	.48	31	30	1.54	55	.48	31	30	1.54	47	59.3		
44	40	1.50	48	23	.48	32	25	1.54	54	.48	32	9	1.54	49	24	.48	32	9	1.54	46	58.4	
45	33	20	1.50	52	1.50	33	4	1.54	49	23	1.50	48	1.54	52	1.50	33	4	1.54	45	57.5		
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a					
	$d = 39^\circ 0'$				$d = 39^\circ 30'$				$d = 40^\circ 0'$													

b	a = 39° 0'					a = 39° 30'					a = 40° 0'					c	α			
	B	h	d	60' / Δ	Z	Δ / 60'	h	d	60' / Δ	Z	Δ / 60'	h	d	60' / Δ	Z			Δ / 60'	C	β
45	33	20	1.54	48	52	0.52	33	4	1.54	49	23	0.50	32	48	1.58	49	53	0.50	45	57.5
46	59	1.54	49	23	.52	43	1.58	53	.52	33	26	1.58	50	23	.52	44	56.6			
47	34	38	1.54	54	.53	34	21	1.58	50	24	.53	34	4	1.58	54	.53	43	55.7		
48	35	17	1.58	50	26	.55	59	1.58	56	.55	42	1.62	51	26	.55	42	54.8			
49	55	1.62	59	.57	35	37	1.62	51	29	.57	35	19	1.62	59	.57	41	53.8			
50	36	32	1.62	51	33	0.60	36	14	1.62	52	3	0.60	56	1.67	52	33	0.58	40	52.8	
51	37	9	1.62	52	9	.60	51	1.67	39	.60	36	32	1.67	53	8	.60	39	51.9		
52	46	1.67	45	.63	37	27	1.67	53	15	.62	37	8	1.71	44	.62	38	50.9			
53	38	22	1.71	53	23	.65	38	3	1.71	52	.63	43	1.71	54	21	.63	37	49.8		
54	57	1.71	54	2	.65	38	1.76	54	30	.67	38	18	1.76	59	.67	36	48.8			
55	39	32	1.71	41	0.68	39	12	1.76	55	10	0.68	52	1.76	55	39	0.67	35	47.7		
56	40	7	1.76	55	22	.70	46	1.82	51	.70	39	26	1.82	56	19	.70	34	46.7		
57	41	1.82	56	4	.73	40	19	1.82	56	33	.72	59	1.88	57	1	.72	33	45.6		
58	41	14	1.88	48	.75	52	1.88	57	16	.73	40	31	1.88	58	44	.73	32	44.5		
59	46	1.88	57	33	.77	41	24	1.88	58	0	.77	41	3	1.94	58	28	.75	31	43.4	
60	42	18	1.94	58	19	0.78	56	1.94	46	0.77	34	2.00	59	13	0.77	30	42.2			
61	49	1.94	59	6	.80	42	27	2.00	59	32	.80	42	4	2.00	59	.80	29	41.1		
62	43	20	2.00	54	.82	57	2.07	60	20	.82	34	2.07	60	47	.80	28	39.9			
63	50	2.07	60	43	.85	43	26	2.14	61	9	.85	43	3	2.14	61	35	.83	27	38.7	
64	44	19	2.14	61	34	.87	54	2.14	62	0	.85	31	2.22	62	25	.85	26	37.5		
65	47	2.22	62	26	0.90	44	22	2.22	51	0.88	58	2.22	63	16	0.87	25	36.2			
66	45	14	2.31	63	20	.92	49	2.31	63	44	.90	44	25	2.31	64	8	.90	24	35.0	
67	40	2.31	64	15	.93	45	15	2.31	64	38	.93	51	2.40	65	2	.92	23	33.7		
68	46	6	2.40	65	11	.95	41	2.50	65	34	.93	45	16	2.50	66	57	.93	22	32.4	
69	31	2.50	66	8	.97	46	5	2.50	66	30	.97	40	2.61	66	53	.95	21	31.1		
70	55	2.73	67	6	1.00	29	2.73	67	28	0.98	46	3	2.73	67	50	0.97	20	29.8		
71	47	17	2.73	68	6	1.02	51	2.86	68	27	1.00	25	2.86	68	48	.98	19	28.4		
72	39	2.86	69	7	1.03	47	12	2.86	69	27	1.02	46	3.00	69	47	1.00	18	27.1		
73	48	3.00	70	9	1.05	33	3.00	70	28	1.05	47	6	3.00	70	47	1.03	17	25.7		
74	20	3.16	71	12	1.07	53	3.33	71	31	1.05	26	3.33	71	49	1.03	16	24.3			
75	39	3.33	72	16	1.10	48	11	3.33	72	34	1.08	44	3.53	72	51	1.07	15	22.8		
76	57	3.75	73	22	1.12	29	3.75	73	39	1.08	48	1	3.75	73	55	1.08	14	21.4		
77	49	13	3.75	74	29	1.12	45	4.00	74	44	1.12	17	4.00	75	0	1.08	13	19.9		
78	29	4.29	75	36	1.15	49	0	4.29	75	51	1.12	32	4.29	76	5	1.10	12	18.5		
79	43	4.62	76	45	1.15	14	4.62	76	58	1.13	46	5.00	77	11	1.12	11	17.0			
80	56	5.00	77	54	1.17	27	5.00	78	6	1.15	58	5.00	78	18	1.13	10	15.5			
81	50	8	5.45	79	4	1.18	39	5.45	79	15	1.17	49	10	6.00	79	26	1.15	9	14.0	
82	19	6.00	80	15	1.20	50	6.67	80	25	1.17	20	6.67	80	35	1.15	8	12.5			
83	29	7.50	81	27	1.20	59	7.50	81	35	1.18	29	7.50	81	44	1.17	7	10.9			
84	37	8.57	82	39	1.22	50	7	8.57	82	46	1.20	37	8.57	82	54	1.17	6	9.4		
85	44	10.0	83	52	1.22	14	10.0	83	58	1.20	44	10.0	84	4	1.18	5	7.8			
86	50	15.0	85	5	1.22	20	15.0	85	10	1.20	50	15.0	85	15	1.18	4	6.3			
87	54	20.0	86	18	1.23	24	20.0	86	22	1.20	54	20.0	86	26	1.18	3	4.7			
88	57	30.0	87	32	1.23	27	30.0	87	34	1.22	57	30.0	87	37	1.18	2	3.1			
89	59	60.0	88	46	1.23	29	60.0	88	47	1.22	59	60.0	88	48	1.20	1	1.6			
90	51	0	90	0		30		90	0		50	0	90	0		0	0.0			

b	a = 40° 30'					a = 41° 0'					a = 41° 30'					c	α				
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t			C	β		
		Δ	Δ	60'	60'		60'	Δ	Δ	60'		60'	60'	Δ	Δ					60'	60'
0	0	0	1.30	40	30	0.00	0	0	1.33	41	0	0	0.00	0	0	1.33	41	30	0.00	90	90.0
1	0	46	1.33		30	.02	0	45	1.30		0	0	.02	0	45	1.33		30	.02	89	89.3
2	1	31	1.30		31	.03	1	31	1.33		1	.02	1	30	1.33		31	.02	88	88.7	
3	2	17	1.33		32	.03	2	16	1.33		2	.03	2	15	1.33		32	.03	87	88.0	
4	3	2	1.30		34	.03	3	1	1.33		4	.03	3	0	1.33		34	.03	86	87.4	
5		48	1.30		36	.05		46	1.33		6	0.05		45	1.36		36	0.05	85	86.7	
6	4	34	1.33		39	.07	4	31	1.30		9	.07	4	29	1.33		39	.07	84	86.1	
7	5	19	1.30		43	.07	5	17	1.33		13	.07	5	14	1.33		43	.07	83	85.4	
8	6	5	1.33		47	.07	6	2	1.33		17	.07	5	9	1.33		47	.07	82	84.7	
9		50	1.33		51	.08		47	1.33		21	.08		6	44	1.36		51	.08	81	84.1
10	7	35	1.30		56	.10	7	32	1.33		26	.10	7	28	1.33		56	.10	80	83.4	
11	8	21	1.33	41	2	.10	8	17	1.33		32	.10	8	13	1.33	42	2	.10	79	82.7	
12	9	6	1.33		8	.10	9	2	1.33		38	.10	8	5	1.36		8	.10	78	82.1	
13		51	1.33		14	.12		47	1.36		44	.12		9	42	1.36		14	.12	77	81.4
14	10	36	1.33		21	.13	10	31	1.33		51	.13	10	26	1.33		21	.13	76	80.7	
15	11	21	1.33		29	.13	11	16	1.36		59	.13	11	11	1.36		29	.13	75	80.0	
16	12	6	1.33		37	.15	12	0	1.33	42	7	.15	55	55	1.36		37	.15	74	79.3	
17		51	1.36		40	.15		45	1.36		16	.17	12	39	1.36		46	.17	73	78.7	
18	13	35	1.33		55	.17	13	29	1.36		26	.17	13	23	1.36		56	.17	72	78.0	
19	14	20	1.36	42	5	.18	14	13	1.36		36	.17	14	7	1.36	43	6	.18	71	77.3	
20	15	4	1.33		16	.18		57	1.36		46	.18		51	1.40		17	.18	70	76.6	
21		49	1.36		27	.20	15	41	1.36		57	.20	15	34	1.36		28	.20	69	75.9	
22	16	33	1.36		39	.20	16	25	1.36	43	9	.22	16	18	1.40		40	.20	68	75.2	
23	17	17	1.36		51	.22	17	9	1.36		22	.22	17	1	1.40		52	.22	67	74.4	
24	18	1	1.36	43	4	.23		53	1.40		35	.22		44	1.40	44	5	.23	66	73.7	
25		45	1.36		18	.23	18	36	1.40		48	.25	18	27	1.40		19	.23	65	73.0	
26	19	29	1.40		32	.25	19	19	1.40	44	3	.25	19	10	1.40		33	.25	64	72.3	
27	20	12	1.40		47	.27	20	2	1.40		18	.25		53	1.43		48	.27	63	71.5	
28		55	1.40	44	3	.27		45	1.40		33	.27	20	35	1.43	45	4	.27	62	70.8	
29	21	38	1.40		19	.28	21	28	1.43		49	.28	21	17	1.43		20	.28	61	70.0	
30	22	21	1.40		36	.30	22	10	1.43	45	6	.30		59	1.43		37	.30	60	69.3	
31	23	4	1.43		54	.30		52	1.43	24	.32	22	41	1.43		55	.30	59	68.5		
32		46	1.43	45	12	.32	23	34	1.43	43	.32	23	23	1.46	46	13	.32	58	67.7		
33	24	28	1.43		31	.33	24	16	1.43	46	2	.33	24	4	1.46		32	.33	57	66.9	
34	25	10	1.43		51	.35		58	1.46	22	.33		45	1.46		52	.33	56	66.1		
35		52	1.46	46	12	.35	25	39	1.46	42	.35	25	26	1.46	47	12	.37	55	65.3		
36	26	33	1.46		33	.37	26	20	1.46	47	3	.37	26	7	1.50		34	.37	54	64.5	
37	27	14	1.46		55	.38	27	1	1.50		25	.38		47	1.50		56	.38	53	63.7	
38		55	1.46	47	18	.40		41	1.50	48	.40	27	27	1.50	48	19	.38	52	62.9		
39	28	36	1.50		42	.42	28	21	1.50	48	12	.42	28	7	1.50		42	.42	51	62.0	
40	29	16	1.50	48	7	.42	29	1	1.50	37	.42		47	1.54	49	7	.42	50	61.2		
41		56	1.54		32	.43		41	1.54	49	2	.43	29	26	1.54		32	.43	49	60.3	
42	30	35	1.54		58	.45	30	20	1.54		28	.45	30	5	1.58		58	.45	48	59.4	
43	31	14	1.54	49	25	.48		59	1.58	55	.47		43	1.58	50	25	.47	47	58.5		
44		53	1.54		54	.48	31	37	1.58	50	23	.48	31	21	1.58		53	.48	46	57.6	
45	32	32			50	23	32	15		52			59			51	22		45	56.7	

b	a = 40° 30'				a = 41° 0'				a = 41° 30'				c	α						
	B	h	d Δ	60' Δ	Z	Δ 60'	h	d Δ	60' Δ	Z	Δ 60'	h			d Δ	60' Δ	Z	Δ 60'	C	β
45	32	32	1.58	50	23	0.50	32	15	1.58	50	52	0.50	31	59	1.62	51	22	0.50	45	56.7
46	33	10	1.62	53	53	.52	33	53	1.62	51	22	.52	32	36	1.62	52	22	.50	44	55.8
47	47	1.62	51	24	.52	33	30	1.62	53	53	33	13	1.67	52	22	.53	43	54.9		
48	34	24	1.62	55	55	.55	34	7	1.67	52	25	.53	34	49	1.67	54	54	.53	42	53.9
49	35	1	1.62	52	28	.57	34	43	1.67	57	57	34	25	1.67	53	26	.57	41	53.0	
50	38	1.67	53	2	0.58	35	19	1.67	53	31	0.58	35	1	1.71	54	0	0.58	40	52.0	
51	36	14	1.71	37	.60	35	55	1.71	54	6	.60	36	36	1.76	35	35	.58	39	51.0	
52	49	1.71	54	13	.62	36	30	1.76	42	.60	36	10	1.76	55	10	.60	38	50.0		
53	37	24	1.76	50	.63	37	4	1.76	55	18	.63	44	14	1.76	46	.63	37	49.0		
54	58	1.76	55	28	.65	38	38	1.82	56	.65	37	18	1.82	56	24	.65	36	47.9		
55	38	32	1.82	56	7	0.67	38	11	1.82	56	35	0.67	51	1.88	57	3	0.65	35	46.9	
56	39	5	1.88	47	.68	44	1.88	57	15	.68	38	23	1.88	42	42	.68	34	45.8		
57	37	1.88	57	28	.72	39	16	1.88	56	.70	55	1.94	58	23	.70	33	44.7			
58	40	9	1.94	58	11	.72	48	1.94	58	38	.72	39	26	2.00	59	5	.72	32	43.6	
59	40	1.94	54	7.5	40	19	2.00	59	21	.75	56	2.00	48	.73	31	42.5				
60	41	11	2.00	59	39	0.77	49	2.07	60	6	0.75	40	26	2.07	60	32	0.75	30	41.3	
61	41	2.00	60	25	.78	41	18	2.07	51	.78	55	2.07	61	17	.77	29	40.2			
62	42	11	2.14	61	12	.80	47	2.14	61	38	.78	41	24	2.14	62	3	.78	28	39.0	
63	39	2.14	62	0	.83	42	15	2.14	62	25	.82	52	2.22	50	.80	27	37.8			
64	43	7	2.22	50	.83	43	2.31	63	14	.83	42	19	2.31	63	38	.83	26	36.6		
65	34	2.31	63	40	0.87	43	9	2.31	64	4	0.85	45	2.40	64	28	0.85	25	35.4		
66	44	0	2.40	64	32	.88	35	2.40	55	.88	43	10	2.40	65	19	.85	24	34.2		
67	25	2.40	65	25	.90	44	0	2.50	65	48	.88	35	2.50	66	10	.88	23	32.9		
68	50	2.50	66	19	.92	24	2.50	66	41	.92	52	2.61	67	3	.90	22	31.6			
69	45	14	2.73	67	14	.95	48	2.73	67	36	.92	44	22	2.73	57	.92	21	30.3		
70	36	2.73	68	11	0.95	45	10	2.73	68	31	0.95	44	2.86	68	52	0.93	20	29.0		
71	58	2.86	69	8	.97	32	3.00	69	28	.97	45	5	3.00	69	48	.95	19	27.7		
72	46	19	3.00	70	6	1.00	52	3.00	70	26	.98	25	3.00	70	45	.97	18	26.3		
73	39	3.16	71	6	1.02	46	12	3.33	71	25	1.00	45	3.33	71	43	.98	17	25.0		
74	58	3.33	72	7	1.02	30	3.33	72	25	1.00	46	3	3.53	72	42	1.00	16	23.6		
75	47	16	3.53	73	8	1.05	48	3.53	73	25	1.03	20	3.53	73	42	1.00	15	22.2		
76	33	4.00	74	11	1.07	47	5	4.00	74	27	1.05	37	4.00	74	42	1.03	14	20.8		
77	48	4.00	75	15	1.07	20	4.00	75	30	1.05	52	4.29	75	44	1.05	13	19.4			
78	48	3	4.29	76	19	1.08	35	4.62	76	33	1.07	47	6	4.62	76	47	1.05	12	18.0	
79	17	5.00	77	24	1.10	48	5.00	77	37	1.08	19	5.00	77	50	1.07	11	16.5			
80	29	5.00	78	30	1.12	48	0	5.00	78	42	1.10	31	5.45	78	54	1.07	10	15.0		
81	41	6.00	79	37	1.13	12	6.00	79	48	1.10	42	6.00	79	58	1.08	9	13.6			
82	51	6.67	80	45	1.13	22	6.67	80	54	1.12	52	6.67	81	3	1.10	8	12.1			
83	49	0	7.50	81	53	1.13	31	7.50	82	1	1.13	48	1	7.50	82	9	1.12	7	10.6	
84	8	8.57	83	1	1.15	39	10.0	83	9	1.13	9	10.0	83	16	1.12	6	9.1			
85	15	12.0	84	10	1.17	45	12.0	84	17	1.13	15	12.0	84	23	1.12	5	7.6			
86	20	15.0	85	20	1.17	50	15.0	85	25	1.13	20	15.0	85	30	1.12	4	6.1			
87	24	20.0	86	30	1.17	54	20.0	86	33	1.15	24	20.0	86	37	1.12	3	4.6			
88	27	30.0	87	40	1.17	57	30.0	87	42	1.15	27	30.0	87	44	1.13	2	3.0			
89	29	60.0	88	50	1.17	59	60.0	88	51	1.15	29	60.0	88	52	1.13	1	1.5			
90	30	90	0	49	0	90	0	30	90	0	0	0	90	0	0	0	0	0.0		

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

b	a = 42° 0'				a = 42° 30'				a = 43° 0'				c	a							
	B	h	d Δ	60' Z	t Δ	60'	h	d Δ	60' Z	t Δ	60'	h			d Δ	60' Z	t Δ	60'	C	β	
0	0	0	1.33	42	0	0.00	0	0	1.36	42	30	0.00	0	0	1.36	43	0	0.00	90	90.0	
1	0	45	1.36		0	.02	0	44	1.33		30	.02	0	44	1.36		0	.02	89	89.3	
2	1	29	1.33		1	.02	1	29	1.36		31	.02	1	28	1.36		1	.02	88	88.6	
3	2	14	1.36		2	.03	2	13	1.36		32	.03	2	12	1.40		2	.03	87	88.0	
4	3	58	1.33		4	.03	5	57	1.36		34	.03	5	55	1.36		4	.03	86	87.3	
5	3	43	1.36		6	0.05	3	41	1.36		36	0.05	3	39	1.36		6	0.05	85	86.6	
6	4	27	1.33		9	.07	4	25	1.36		39	.07	4	23	1.36		9	.07	84	85.9	
7	5	12	1.36		13	.07	5	9	1.36		43	.07	5	7	1.36		13	.07	83	85.3	
8	5	56	1.33		17	.07	5	53	1.36		47	.07	5	51	1.40		17	.07	82	84.6	
9	6	41	1.36		21	.08	6	37	1.36		51	.08	6	34	1.36		21	.08	81	83.9	
10	7	25	1.36		26	0.10	7	21	1.36		56	0.10	7	18	1.40		26	0.10	80	83.2	
11	8	9	1.36		32	.10	8	5	1.36		43	2	.10	8	1	1.36		32	.10	79	82.5
12	8	53	1.36		38	.12	8	49	1.36		8	.12	8	45	1.40		38	.12	78	81.8	
13	9	37	1.36		45	.12	9	33	1.40		15	.12	9	28	1.40		45	.12	77	81.1	
14	10	21	1.36		52	.12	10	16	1.36		22	.13	10	11	1.36		52	.13	76	80.4	
15	11	5	1.36		59	0.15	11	0	1.36		30	0.13	11	55	1.40		44	0	0.13	75	79.7
16	10	49	1.36	43	8	.15	12	44	1.40		38	.25	11	38	1.40		8	.15	74	79.0	
17	12	33	1.36		17	.15	12	27	1.40		47	.15	12	21	1.40		17	.15	73	78.3	
18	13	17	1.40		26	.17	13	10	1.40		56	.17	13	4	1.43		26	.17	72	77.6	
19	14	0	1.36		36	.18	14	53	1.40	44	6	.18	14	46	1.40		36	.18	71	76.9	
20	14	44	1.40		47	0.18	14	36	1.40		17	0.18	14	29	1.40		47	0.18	70	76.2	
21	15	27	1.40		58	.20	15	19	1.40		28	.20	15	12	1.43		58	.20	69	75.5	
22	16	10	1.40	44	10	.20	16	2	1.40		40	.20	16	54	1.43	45	10	.20	68	74.7	
23	16	53	1.40		22	.22	16	45	1.43		52	.22	16	36	1.43		22	.22	67	74.0	
24	17	36	1.40		35	.23	17	27	1.43	45	5	.23	17	18	1.43		35	.23	66	73.3	
25	18	19	1.43		49	0.23	18	9	1.43		19	0.23	18	0	1.43		49	0.23	65	72.5	
26	19	1	1.43	45	3	.25	19	51	1.43		33	.25	19	42	1.43	46	3	.25	64	71.8	
27	20	43	1.43		18	.27	19	33	1.43		48	.27	19	24	1.46		18	.27	63	71.0	
28	20	25	1.43		34	.27	20	15	1.43	46	4	.27	20	5	1.46		34	.27	62	70.2	
29	21	7	1.43		50	.28	21	57	1.46		20	.28	21	46	1.46		50	.28	61	69.5	
30	21	49	1.46	46	7	0.30	21	38	1.46		37	0.30	21	27	1.46		47	7	0.30	60	68.7
31	22	30	1.46		25	.30	22	19	1.46		55	.30	22	8	1.50		25	.30	59	67.9	
32	23	11	1.46		43	.32	23	0	1.46	47	13	.32	23	48	1.50		43	.32	58	67.1	
33	23	52	1.46	47	2	.33	23	41	1.50		32	.33	23	28	1.50	48	2	.33	57	66.3	
34	24	33	1.46		22	.33	24	21	1.50		52	.33	24	8	1.50		22	.33	56	65.5	
35	25	14	1.50		42	0.37	25	1	1.50	48	12	0.35	25	48	1.50		42	0.35	55	64.7	
36	25	54	1.50	48	4	.37	25	41	1.50		33	.37	25	28	1.54	49	3	.37	54	63.9	
37	26	34	1.50		26	.38	26	21	1.54		55	.38	26	7	1.54		26	.38	53	63.0	
38	27	14	1.54		49	.38	27	0	1.54	49	18	.40	27	46	1.58		49	.40	52	62.2	
39	27	53	1.54	49	12	.42	27	39	1.58		42	.40	27	24	1.58	50	12	.40	51	61.3	
40	28	32	1.54		37	0.42	28	17	1.58	50	6	0.42	28	2	1.58		37	0.42	50	60.5	
41	29	11	1.58	50	2	.43	28	55	1.58		31	.43	28	40	1.58	51	1	.43	49	59.6	
42	29	49	1.58		28	.45	29	33	1.58		57	.45	29	18	1.62		28	.45	48	58.7	
43	30	27	1.58		55	.47	30	11	1.62	51	24	.47	30	55	1.62		55	.47	47	57.8	
44	31	5	1.62	51	23	.47	31	48	1.62		52	.48	30	32	1.62	52	21	.48	46	56.9	
45	31	42			51		31	25			52	21		31	9		50		45	56.0	
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a				
	d = 42° 0'				d = 42° 30'				d = 43° 0'				a								

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

t	a = 42° 0'				a = 42° 30'				a = 43° 0'				α
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
		Δ				Δ				Δ			
	d = 42° 0'				d = 42° 30'				d = 43° 0'				

b B	a = 43° 30'				a = 44° 0'				a = 44° 30'				c C	α β									
	h	d	60' Δ	t	Z	Δ 60'	t	Δ 60'	h	d	60' Δ	t			Δ 60'								
		Δ	Z	Δ						Δ	Δ	Δ											
0	0	0	1.36	43	30	0.00	0	0	1.40	44	0	0.00	0	0	1.40	44	30	0.00	90	90.0			
1		44	1.40		30	.02		43	1.40		0	.02		43	1.40		30	.02	89	89.3			
2		1	27	1.36		31	.02	1	26	1.36		0	.02	1	26	1.43		31	.02	88	88.6		
3		2	11	1.40		32	.03	2	10	1.40		2	.03	2	8	1.40		32	.03	87	87.9		
4			54	1.36		34	.03		53	1.40		4	.03		51	1.40		34	.03	86	87.2		
5		3	38	1.40		36	0.05		3	36	1.40		6	0.05	3	34	1.40		36	0.05	85	86.5	
6		4	21	1.40		39	.07		4	19	1.40		9	.07	4	17	1.43		39	.07	84	85.8	
7		5	4	1.36		43	.07		5	2	1.40		13	.07	5	59	1.40		43	.07	83	85.1	
8			48	1.40		47	.07		5	45	1.40		17	.07	5	42	1.43		47	.07	82	84.4	
9		6	31	1.40		51	.08		6	28	1.40		21	.08	6	24	1.40		51	.08	81	83.7	
10		7	14	1.40		56	0.10		7	11	1.43		26	0.10	7	7	1.43		56	0.10	80	83.0	
11			57	1.40	44	2	.10		53	1.40		32	.10	49	1.40		45	2	.10	79	82.3		
12		8	40	1.40		8	.12		8	36	1.40		38	.12	8	32	1.43		8	.12	78	81.6	
13		9	23	1.40		15	.12		9	19	1.43		45	.12	9	14	1.43		15	.12	77	80.9	
14		10	6	1.40		22	.13		10	1	1.40		52	.13	5	56	1.43		22	.13	76	80.2	
15			49	1.40		30	0.13		44	1.43		45	0.13	10	38	1.43		30	0.13	75	79.5		
16		11	32	1.40		38	.15		11	26	1.43		8	.15	11	20	1.43		38	.15	74	78.7	
17		12	15	1.43		47	.15		12	8	1.43		17	.15	12	2	1.43		47	.15	73	78.0	
18			57	1.40		56	.17		5	50	1.43		26	.17	44	1.43		56	.17	72	77.3		
19		13	40	1.43	45	6	.18		13	32	1.43		36	.18	13	26	1.46		46	6	.18	71	76.5
20		14	22	1.43		17	0.18		14	14	1.43		47	0.18	14	7	1.43		17	0.18	70	75.8	
21		15	4	1.43		28	.20		5	56	1.43		58	.20	49	1.46		28	.20	69	75.1		
22			46	1.43		40	.20		15	38	1.46		46	0.20	15	30	1.46		40	.20	68	74.3	
23		16	28	1.43		52	.22		16	19	1.43		22	.22	16	11	1.46		52	.22	67	73.6	
24		17	10	1.46	46	5	.23		17	1	1.46		35	.23	5	52	1.46		47	5	.23	66	72.8
25			51	1.46		19	0.23		42	1.46		49	0.23	17	33	1.50		19	0.23	65	72.1		
26		18	32	1.46		33	.25		18	23	1.46		47	0.25	18	13	1.46		33	.25	64	71.3	
27		19	13	1.46		48	.27		19	4	1.50		18	.27	54	1.50		48	.27	63	70.5		
28			54	1.46	47	4	.27		20	44	1.46		34	.27	19	34	1.50		48	4	.27	62	69.7
29		20	35	1.46		20	.28		20	25	1.50		50	.28	20	14	1.50		20	.28	61	68.9	
30		21	16	1.50		37	0.30		21	5	1.50		48	0.30	5	54	1.54		37	0.28	60	68.1	
31			56	1.50		55	.30		45	1.50		25	.30	21	33	1.54		54	.30	59	67.3		
32		22	36	1.50	48	13	.32		22	25	1.54		43	.32	22	12	1.54		49	12	.32	58	66.5
33		23	16	1.50		32	.33		23	4	1.54		49	2	.32	51	1.54		31	.33	57	65.7	
34			56	1.54		52	.33		43	1.54		21	.35	23	30	1.54		51	.33	56	64.9		
35		24	35	1.54	49	12	0.35		24	22	1.54		42	0.35	24	9	1.58		50	11	0.35	55	64.1
36		25	14	1.54		33	.37		25	1	1.58		50	3	.37	47	1.58		32	.37	54	63.2	
37			53	1.54		55	.38		39	1.58		25	.37	25	25	1.58		54	.38	53	62.4		
38		26	32	1.58	50	18	.38		26	17	1.58		47	.40	26	3	1.62		51	17	.38	52	61.5
39		27	10	1.58		41	.40		55	1.62		51	11	.40	40	1.62		40	.40	51	60.6		
40			48	1.62		51	5	0.42	27	32	1.62		35	0.42	27	17	1.62		52	4	0.42	50	59.8
41		28	25	1.62		30	.43		28	9	1.62		52	0	.42	54	1.67		29	.42	49	58.9	
42			29	2	1.62		56	.45	46	1.62		25	.45	28	30	1.67		54	.45	48	58.0		
43		39	1	1.67	52	23	.45		29	23	1.67		52	.45	29	6	1.67		53	21	.45	47	57.1
44		30	15	1.67		50	.48		59	1.71		53	19	.47	42	1.71		48	.47	46	56.1		
45			51			53	19		30	34			47		30	17			54	16		45	55.2

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

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

b	a = 45° 0'					a = 45° 30'					a = 46° 0'					c	α			
	B	h	d	60'	Z	t	Δ	60'	Z	t	Δ	60'	Z	t	Δ			60'	C	β
			Δ	Δ																
45	30	0	1.76	54	44	0.48	29	43	1.76	55	12	0.48	29	25	1.76	55	40	0.48	45	54.5
46		34	1.76	55	13	.48	30	17	1.82	55	41	.48	29	59	1.82	56	9	.48	44	53.6
47	31	8	1.76	42	42	.52	50	1.82	56	10	.50	30	32	1.82	38	38	.50	43	52.6	
48		42	1.82	56	13	.52	31	23	1.82	40	.52	31	5	1.88	57	8	.52	42	51.6	
49	32	15	1.82	44	44	.53	56	1.88	57	11	.53	37	37	1.88	39	39	.52	41	50.6	
50		48	1.88	57	16	0.55	32	28	1.88	43	0.55	32	9	1.94	58	10	0.55	40	49.6	
51	33	20	1.88	49	49	.57	33	0	1.88	58	16	.57	40	1.94	43	43	.55	39	48.6	
52		52	1.94	58	23	.58	32	1.94	50	50	.57	33	11	1.94	59	16	.57	38	47.6	
53	34	23	1.94	58	58	.58	34	3	2.00	59	24	.58	42	2.00	50	50	.58	37	46.6	
54		54	2.00	59	33	.62	33	2.00	59	59	.62	34	12	2.07	60	25	.60	36	45.5	
55	35	24	2.07	60	10	0.62	35	3	2.07	60	36	0.62	41	2.07	61	1	0.62	35	44.5	
56		53	2.07	47	47	.65	32	2.14	61	13	.63	35	10	2.14	38	38	.62	34	43.4	
57	36	22	2.07	61	26	.65	36	0	2.14	51	.65	38	38	2.14	62	15	.65	33	42.3	
58		51	2.14	62	5	.67	28	2.14	62	30	.65	36	6	2.22	54	54	.65	32	41.2	
59	37	19	2.22	45	45	.68	56	2.22	63	9	.68	33	2.31	63	33	.68	31	40.1		
60		46	2.31	63	26	0.70	37	2.31	50	50	0.70	59	59	2.31	64	14	0.68	30	39.0	
61	38	12	2.31	64	8	.72	49	2.40	64	32	.70	37	25	2.40	55	55	.70	29	37.9	
62		38	2.40	51	73	.73	38	14	2.40	65	14	.72	50	2.50	65	37	.72	28	36.7	
63	39	3	2.50	65	35	.75	39	2.50	57	57	.75	38	14	2.50	66	20	.72	27	35.5	
64		27	2.50	66	20	.75	39	3	2.61	66	42	.75	38	2.61	67	3	.75	26	34.4	
65		51	2.61	67	5	0.78	26	2.61	67	27	0.77	39	1	2.73	48	48	0.75	25	33.2	
66	40	14	2.73	52	80	.80	49	2.73	68	13	.78	23	2.73	68	33	.78	24	32.0		
67		36	2.73	68	40	.80	40	11	2.86	69	0	.80	45	2.86	69	20	.78	23	30.8	
68	41	58	2.86	69	28	.82	32	3.00	52	48	.80	40	6	3.00	70	7	.80	22	29.5	
69		19	3.00	70	17	.83	52	3.00	70	36	.82	40	26	3.16	55	55	.80	21	28.3	
70		39	3.16	71	7	0.85	41	12	3.33	71	25	0.83	45	3.33	71	43	0.83	20	27.0	
71		58	3.33	58	87	.87	30	3.33	72	15	.85	41	3	3.33	72	33	.83	19	25.8	
72	42	16	3.33	72	50	.87	48	3.53	73	6	.87	21	3.53	73	23	.85	18	24.5		
73		33	3.75	73	42	.88	42	5	3.75	58	.88	38	3.75	74	14	.87	17	23.2		
74		49	3.75	74	35	.90	21	3.75	74	51	.88	54	4.00	75	6	.87	16	21.9		
75	43	5	4.29	75	29	0.92	37	4.29	75	44	0.90	42	9	4.29	58	58	0.88	15	20.6	
76		19	4.29	76	24	.92	51	4.29	76	38	.90	23	4.62	76	51	.90	14	19.3		
77		33	4.62	77	19	.93	43	5	5.00	77	32	.92	36	5.00	77	45	.90	13	17.9	
78		46	5.45	78	15	.95	17	5.00	78	27	.93	48	5.00	78	39	.92	12	16.6		
79		57	5.45	79	12	.95	29	6.00	79	23	.93	43	0	6.00	79	34	.92	11	15.2	
80	44	8	6.00	80	9	0.97	39	6.00	80	19	0.95	10	6.00	80	29	0.93	10	13.9		
81		18	6.67	81	7	.97	49	7.50	81	16	.95	20	7.50	81	25	.93	9	12.5		
82		27	8.57	82	5	.97	57	7.50	82	13	.95	28	8.57	82	21	.93	8	11.2		
83		34	8.57	83	3	.98	44	5	8.57	83	10	.97	35	8.57	83	17	.95	7	9.8	
84		41	10.0	84	2	.98	12	12.0	84	8	.97	42	12.0	84	14	.95	6	8.4		
85		47	12.0	85	1	0.98	17	12.0	85	6	0.98	47	12.0	85	11	0.97	5	7.0		
86		52	20.0	86	0	1.00	22	20.0	86	5	.97	52	20.0	86	9	.95	4	5.6		
87		55	20.0	87	0	1.00	25	20.0	87	3	.98	55	20.0	87	6	.97	3	4.2		
88		58	60.0	88	0	1.00	28	60.0	88	2	.98	58	60.0	88	4	.97	2	2.8		
89		59	60.0	89	0	1.00	29	60.0	89	1	.98	59	60.0	89	2	.97	1	1.4		
90	45	0		90	0		30		90	0		44	0		90	0		0	0.0	

t	a = 45° 0'				a = 45° 30'				a = 46° 0'				α
	a	60'	b	Δ	a	60'	b	Δ	a	60'	b	Δ	
	d = 45° 0'				d = 45° 30'				d = 46° 0'				

b	a = 46° 30'					a = 47° 0'					a = 47° 30'					c	α			
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t
0	0	0	1.46	46	30	0.00	0	0	1.46	47	0	0.00	0	0	1.46	47	30	0.00	90	90.0
1		41	1.43		30	.02	41	1.46		0	.02		41	1.50		30	.02		89	89.3
2		1 23	1.46		31	.02	1 22	1.46		1	.02		1 21	1.46		31	.02		88	88.5
3		2 4	1.46		32	.03	2 3	1.46		2	.03		2 2	1.50		32	.03		87	87.8
4		45	1.46		34	.03	44	1.46		4	.03		42	1.46		34	.03		86	87.1
5		3 26	1.43		36	0.05	3 25	1.50		6	0.05		3 23	1.50		36	0.05		85	86.3
6		4 8	1.46		39	.07	4 5	1.46		9	.07		4 3	1.50		39	.07		84	85.6
7		49	1.46		43	.07	46	1.46		13	.07		43	1.46		43	.07		83	84.9
8		5 30	1.46		47	.07	5 27	1.50		17	.07		5 24	1.50		47	.07		82	84.1
9		6 11	1.46		51	.08	6 7	1.46		21	.08		6 4	1.50		51	.08		81	83.4
10		52	1.46		56	0.10	48	1.46		26	0.10		44	1.50		56	0.10		80	82.7
11		7 33	1.46	47	2	.10	7 29	1.50		32	.10		7 24	1.50	48	2	.10		79	81.9
12		8 14	1.46		8	.12	8 9	1.50		38	.12		8 4	1.50		8	.10		78	81.2
13		55	1.50		15	.12	49	1.46		45	.12		44	1.50		14	.12		77	80.4
14		9 35	1.46		22	.13	9 30	1.50		52	.13		9 24	1.50		21	.13		76	79.7
15		10 16	1.50		30	0.13	10 10	1.50	48	0.13		10 4	1.50		29	0.13		75	78.9	
16		56	1.46		38	.15	50	1.50		8	.15		44	1.50		37	.15		74	78.2
17		11 37	1.50		47	.15	11 30	1.50		17	.15		11 24	1.54		46	.17		73	77.4
18		12 17	1.50		56	.17	12 10	1.50		26	.17		12 3	1.50		56	.17		72	76.6
19		57	1.50	48	6	.18	50	1.54		36	.17		43	1.54	49	6	.17		71	75.9
20		13 37	1.50		17	0.18	13 29	1.50		46	0.18		13 22	1.54		16	0.18		70	75.1
21		14 17	1.50		28	.20	14 9	1.54		57	.20		14 1	1.54		27	.20		69	74.3
22		57	1.54		40	.20	48	1.54	49	0.20		40	1.54		39	.20		68	73.5	
23		15 36	1.50		52	.22	15 27	1.54		21	.22		15 19	1.58		51	.22		67	72.8
24		16 16	1.54	49	5	.22	16 6	1.54		34	.23		57	1.58	50	4	.23		66	72.0
25		55	1.54		18	0.23	45	1.54		48	0.23		16 35	1.58		18	0.23		65	71.2
26		17 34	1.54		32	.25	17 24	1.58	50	0.25		17 13	1.58		32	.23		64	70.4	
27		18 13	1.58		47	.25	18 2	1.58		17	.25		51	1.58		46	.25		63	69.6
28		51	1.54	50	2	.27	40	1.58		32	.27		18 29	1.58	51	1	.27		62	68.8
29		19 30	1.58		18	.28	19 18	1.58		48	.28		19 7	1.58		17	.28		61	67.9
30		20 8	1.58		35	0.28	56	1.58	51	0.28		45	1.62		34	0.28		60	67.1	
31		46	1.58		52	.30	20 34	1.62		2	.30		20 22	1.62		51	.30		59	66.3
32		21 24	1.62	51	10	.32	21 11	1.62		40	.30		59	1.62	52	9	.32		58	65.4
33		22 1	1.62		29	.32	48	1.62		58	.32		21 36	1.67		28	.32		57	64.6
34		38	1.62		48	.33	22 25	1.62	52	0.33		22 12	1.67		47	.33		56	63.7	
35		23 15	1.62	52	8	0.35	23 2	1.67		37	0.35		48	1.67	53	7	0.33		55	62.9
36		52	1.67		29	.37	38	1.67		58	.35		23 24	1.67		27	.35		54	62.0
37		24 28	1.67		51	.37	24 14	1.67	53	0.37		24 0	1.71		48	.37		53	61.1	
38		25 4	1.67	53	13	.38	50	1.71		41	.38		35	1.71	54	10	.38		52	60.3
39		40	1.67		36	.38	25 25	1.71	54	0.40		25 10	1.76		33	.38		51	59.4	
40		26 16	1.71		59	0.40	26 0	1.71		28	0.40		44	1.76		56	0.40		50	58.5
41		51	1.71		54	.42	35	1.76		52	.42		26 18	1.76	55	20	.42		49	57.6
42		27 26	1.76		48	.43	27 9	1.76	55	0.42		52	1.76		45	.42		48	56.6	
43		28 0	1.76	55	14	.45	43	1.76		42	.45		27 26	1.82	56	10	.43		47	55.7
44		34	1.76		41	.45	28 17	1.82	56	0.45		59	1.82		36	.45		46	54.8	
45		29 8		56	8		50			36			28 32		57	3		45	53.8	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a			
	d = 46° 30'				d = 47° 0'				d = 47° 30'											

B	a = 46° 30'				a = 47° 0'				a = 47° 30'				C	a							
	h	d	60'	Z	t	Δ	60'	h	d	60'	Z	t			Δ	60'					
		Δ	Δ						Δ	Δ											
45	29	8	1.82	50	8	0.47	28	50	1.82	50	36	0.47	28	32	1.82	57	3	0.47	45	53.8	
46		41	1.82		36	.48	29	23	1.88	57	4	.48	29	5	1.88		31	.48	44	52.9	
47	30	14	1.88	57	5	.52	30	55	1.88	58	33	.48	30	37	1.94	58	0	.48	43	51.9	
48		46	1.88		35	.52	30	27	1.88	58	2	.52	30	8	1.94		29	.50	42	50.9	
49	31	18	1.94	58	6	.52	31	59	1.94	59	33	.52	31	39	1.94	59	59	.52	41	49.9	
50		49	1.94		37	0.53	31	30	2.00	59	4	0.53	31	10	2.00	59	30	0.53	40	48.9	
51	32	20	2.00	59	9	.55	32	0	2.00	60	36	.53	32	40	2.00	60	2	.53	39	47.9	
52		51	2.00		42	.57	32	30	2.00	60	8	.57	32	10	2.07		34	.55	38	46.9	
53	33	21	2.07	60	16	.58	33	0	2.07	61	42	.57	33	39	2.07	61	7	.57	37	45.9	
54		50	2.07		51	.58	33	29	2.07	61	16	.60	33	8	2.14		41	.58	36	44.8	
55	34	19	2.07	61	26	0.62	34	58	2.14	62	52	0.60	34	36	2.14	62	16	0.60	35	43.8	
56		48	2.14		62	3	.62	34	26	2.22	62	28	.60	34	4	2.22	52	.62	34	42.7	
57	35	16	2.22	62	40	.63	35	53	2.22	63	4	.63	35	31	2.31	63	29	.62	33	41.6	
58		43	2.22		63	18	.65	35	20	2.31	64	42	.65	35	57	2.31	64	6	.63	32	40.5
59	36	10	2.31	63	27	.67	36	46	2.31	64	21	.65	36	23	2.40	64	44	.65	31	39.4	
60		36	2.40		64	37	0.68	36	12	2.40	65	0	0.67	36	48	2.40	65	23	0.67	30	38.3
01	37	1	2.40	65	18	.68	37	37	2.50	66	40	.68	36	13	2.50	66	3	.67	29	37.2	
62		26	2.50		59	.70	37	1	2.50	66	21	.70	37	37	2.61	67	43	.70	28	36.0	
63	38	13	2.61	66	41	.73	38	25	2.61	67	3	.72	37	0	2.61	67	25	.70	27	34.9	
64		50	2.61		67	25	.73	38	48	2.73	46	.73	38	23	2.73	68	7	.72	26	33.7	
65		36	2.73		68	9	0.75	38	10	2.73	68	30	0.73	45	2.86	50	0.73	25	32.5		
66		58	2.86		54	.75	39	32	2.86	69	14	.75	38	6	2.86	69	34	.73	24	31.3	
67	39	19	3.00	69	39	.78	40	53	3.00	70	59	.77	39	27	3.00	70	18	.75	23	30.1	
68		39	3.00		70	26	.78	39	13	3.00	70	45	.77	47	3.16	71	3	.77	22	28.9	
69		59	3.16		71	13	.80	40	33	3.33	71	31	.80	39	6	3.33	49	.78	21	27.7	
70	40	18	3.33	72	1	0.82	41	51	3.33	72	19	0.80	40	24	3.33	72	36	0.78	20	26.5	
71		36	3.53		50	.82	40	9	3.53	73	7	.82	42	4	3.53	73	23	.80	19	25.2	
72		53	3.53		73	39	.83	40	26	3.75	56	.82	41	59	3.75	74	11	.82	18	24.0	
73	41	10	3.75	74	29	.85	42	42	3.75	74	45	.83	40	15	4.00	75	0	.82	17	22.7	
74		26	4.29		75	20	.87	42	58	4.29	75	35	.85	30	4.29	49	.83	16	21.4		
75		40	4.29		76	12	0.87	41	12	4.29	76	26	0.85	44	4.29	76	39	0.85	15	20.1	
76		54	4.62		77	4	.88	42	26	4.62	77	17	.87	58	5.00	77	30	.85	14	18.8	
77	42	7	5.00	78	57	.88	43	39	5.00	78	9	.88	41	10	5.00	78	21	.87	13	17.5	
78		19	5.00		78	50	.90	43	51	5.45	79	2	.88	22	5.45	79	13	.87	12	16.2	
79		31	6.00		79	44	.90	42	2	6.00	55	.88	33	6.00	80	5	.88	11	14.9		
80		41	6.67		80	38	0.92	42	12	6.67	80	48	0.90	43	6.67	58	0.88	10	13.6		
81		50	7.50		81	33	.93	43	21	7.50	81	42	.90	52	7.50	81	51	.88	9	12.2	
82		58	7.50		82	29	.92	43	29	8.57	82	36	.92	42	0	8.75	82	44	.90	8	10.9
83	43	6	10.0	83	24	.93	44	36	10.0	83	31	.92	42	7	10.0	83	38	.90	7	9.5	
84		12	10.0		84	20	.93	44	42	10.0	84	26	.92	13	12.0	84	32	.90	6	8.2	
85		18	15.0		85	16	0.95	44	48	15.0	85	21	0.93	18	15.0	85	26	0.90	5	6.8	
86		22	15.0		86	13	.93	45	52	15.0	86	17	.92	22	15.0	86	20	.92	4	5.5	
87		30	30.0		87	9	.95	45	56	30.0	87	12	.93	26	30.0	87	15	.92	3	4.1	
88		28	30.0		88	6	.95	45	58	30.0	88	8	.93	28	30.0	88	10	.92	2	2.7	
89		30	—		89	3	.95	43	0	—	89	4	.93	30	—	89	5	.92	1	1.4	
90		30	—		90	0	—	43	0	—	90	0	—	30	—	90	0	—	0	0.0	

0.900

0.885

0.869

b	a = 48° 0'					a = 48° 30'					a = 49° 0'					c	a					
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	C
0	0	0	1.50	48	0	0.00	0	0	1.50	48	30	0.00	0	0	1.54	49	0	0.00	0	0	90	90.0
1		40	1.50		0	.02	0	40	1.50		30	.02		39	1.50		0	.02		89	89.3	
2		1	20	1.50		1	.02	1	20	1.54		31	.02	1	19	1.54		1	.02		88	88.5
3		2	0	1.50		2	.03	2	0	1.50		32	.03	2	58	1.54		2	.03		87	87.8
4		40	1.50		4	.03		2	39	1.50		34	.03	2	37	1.50		4	.03		86	87.0
5		3	20	1.50		6	.05	3	19	1.54		36	.05	3	17	1.54		6	.05		85	86.3
6		4	0	1.50		9	.07	4	58	1.50		39	.07	4	56	1.54		9	.07		84	85.5
7		40	1.50		13	.07		4	38	1.54		43	.07	4	35	1.54		13	.07		83	84.7
8		5	20	1.50		17	.07	5	17	1.50		47	.07	5	14	1.54		17	.07		82	84.0
9		6	0	1.50		21	.08		5	7	1.54		51	.08	5	53	1.54		21	.08	81	83.2
10		40	1.50		26	.10		6	36	1.50		56	.10	6	32	1.54		26	.10		80	82.5
11		7	20	1.50		32	.10		7	16	1.54		59	.10	7	11	1.54		32	.10	79	81.7
12		8	0	1.54		38	.10		8	5	1.54		62	.10	7	50	1.54		38	.10	78	81.0
13		39	1.50		44	.12		8	34	1.54		14	.12	8	29	1.54		44	.12		77	80.2
14		9	19	1.54		51	.13		9	13	1.54		21	.13	9	8	1.54		51	.13	76	79.4
15		58	1.50		59	.13		10	52	1.54		29	.13	10	47	1.58		59	.13		75	78.7
16		10	38	1.54		7	.15	10	31	1.54		37	.15	10	25	1.54		7	.15		74	77.9
17		11	17	1.54		16	.15	11	10	1.54		46	.15	11	4	1.58		16	.15		73	77.1
18		56	1.54		25	.17		12	49	1.54		55	.17	12	42	1.58		25	.17		72	76.3
19		12	35	1.54		35	.18		12	28	1.58		60	.18	12	20	1.58		35	.17	71	75.5
20		13	14	1.54		46	.18	13	6	1.58		16	.18		58	1.58		46	.18		70	74.8
21		53	1.58		57	.20		14	44	1.58		27	.18	13	36	1.58		57	.20		69	74.0
22		14	31	1.58		9	.20	14	22	1.58		38	.20	14	14	1.62		9	.20		68	73.2
23		15	9	1.58		21	.22	15	0	1.58		50	.22	15	5	1.58		21	.22		67	72.4
24		47	1.58		34	.22		16	38	1.58		51	.23	15	29	1.62		34	.22		66	71.6
25		16	25	1.58		47	.23	16	16	1.62		17	.23	16	6	1.62		47	.23		65	70.7
26		17	3	1.58		51	.25	17	53	1.62		31	.23	16	43	1.62		51	.23		64	69.9
27		41	1.58		16	.25		17	30	1.62		45	.25	17	20	1.67		16	.25		63	69.1
28		18	19	1.62		31	.27	18	7	1.62		52	.27	18	56	1.62		31	.27		62	68.3
29		56	1.62		47	.27		19	44	1.62		16	.27	18	33	1.67		47	.27		61	67.5
30		19	33	1.62		52	.28	19	21	1.67		32	.28	19	9	1.67		52	.28		60	66.6
31		20	10	1.67		20	.30		57	1.67		49	.30	20	45	1.67		20	.30		59	65.8
32		46	1.67		38	.30		20	33	1.67		53	.30	20	21	1.71		38	.30		58	64.9
33		21	22	1.67		56	.32	21	9	1.67		25	.32	21	56	1.71		56	.32		57	64.1
34		58	1.67		53	.33		21	45	1.71		44	.33	21	31	1.71		53	.33		56	63.2
35		22	34	1.67		35	.35	22	20	1.71		54	.33	22	6	1.71		35	.33		55	62.3
36		23	10	1.71		56	.35		55	1.71		24	.35	22	41	1.76		56	.35		54	61.4
37		45	1.71		54	.37		23	30	1.71		45	.37	23	15	1.76		54	.37		53	60.6
38		24	20	1.76		39	.37	24	5	1.76		55	.37	24	49	1.76		39	.37		52	59.7
39		54	1.76		55	.38		24	39	1.76		29	.38	24	23	1.76		55	.38		51	58.8
40		25	28	1.76		24	.40	25	13	1.82		52	.40	25	57	1.82		24	.40		50	57.9
41		26	2	1.76		48	.42		46	1.82		56	.42	25	30	1.82		48	.42		49	56.9
42		36	1.82		56	.42		26	19	1.82		41	.42	26	3	1.88		56	.42		48	56.0
43		27	9	1.82		38	.43		52	1.88		57	.43	27	35	1.88		38	.43		47	55.1
44		42	1.88		57	.45		27	24	1.88		32	.43	27	7	1.94		57	.43		46	54.1
45		28	14		31			56				58		38				58	25		45	53.2
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a					
	d = 48° 0'				d = 48° 30'				d = 49° 0'				a									

0.900

0.885

0.869

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

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

b		a = 49° 30'				a = 50° 0'				a = 50° 30'				c	α							
		d	60' / Δ	t	Δ / 60'	d	60' / Δ	t	Δ / 60'	d	60' / Δ	t	Δ / 60'									
B	h													C	β							
		h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'			h	d	60' / Δ	Z	t	Δ / 60'	
0	0	0	1.54	49	30	0.00	0	0	1.54	50	0	0.00	0	0	1.58	50	30	0.00	90	90.0		
1		39	1.54		30	.02		39	1.58		0	.02		38	1.58		30	.02	89	90.2		
2	1	18	1.54		31	.02	1	17	1.54		1	.02	1	16	1.58		31	.02	88	88.5		
3		57	1.54		32	.03		56	1.58		2	.03		54	1.54		32	.03	87	87.7		
4	2	36	1.54		34	.03	2	34	1.54		4	.03	2	33	1.58		34	.03	86	86.9		
5		15	1.54		36	.05		13	1.58		6	.05		11	1.58		36	.05	85	86.2		
6	3	54	1.58		39	.07	3	51	1.54		9	.07	3	49	1.58		39	.07	84	85.4		
7		32	1.54		43	.07		30	1.58		13	.07		27	1.58		43	.07	83	84.6		
8	4	11	1.54		47	.07	4	8	1.58		17	.07	4	5	1.58		47	.07	82	83.9		
9		50	1.54		51	.08		46	1.54		21	.08		43	1.62		51	.08	81	83.1		
10	6	29	1.58		56	.08	6	25	1.58		26	.08	6	20	1.58		56	.08	80	82.3		
11		7	1.54		1	.10		7	3	1.58		31	.10		58	1.58	51	1	.10	79	81.5	
12	7	46	1.58		7	.12		41	1.58		37	.12		36	1.58		7	.12	78	80.8		
13		24	1.58		14	.12	8	19	1.58		44	.12	8	14	1.62		14	.12	77	80.0		
14	8	2	1.58		21	.13		57	1.58		51	.13		51	1.58		21	.12	76	79.2		
15		40	1.58		29	.13		35	1.62		59	.13		29	1.62		28	.13	75	78.4		
16	10	18	1.58		37	.15	10	12	1.58		51	.13	10	6	1.62		36	.15	74	77.6		
17		56	1.58		46	.15		50	1.58		15	.15		43	1.62		45	.15	73	76.8		
18	11	34	1.58		55	.17	11	28	1.62		24	.17	11	20	1.62		54	.17	72	76.0		
19		12	1.58		51	.17		5	1.62		34	.18		57	1.62		52	4	.17	71	75.2	
20		50	1.58		15	.18		42	1.62		45	.18		34	1.62		14	.18	70	74.4		
21	13	28	1.62		26	.20	13	19	1.62		56	.18	13	11	1.67		25	.20	69	73.6		
22		14	1.62		38	.20		56	1.62		52	.20		47	1.67		37	.20	68	72.8		
23	14	42	1.62		50	.20	14	33	1.67		19	.22	14	23	1.67		49	.20	67	72.0		
24		15	1.62		52	.22		15	9	1.62		32	.22		59	1.67	53	1	.22	66	71.2	
25		56	1.62		15	.23		46	1.67		45	.23		35	1.67		14	.23	65	70.3		
26	16	33	1.67		29	.25	16	22	1.67		59	.23	16	11	1.67		28	.23	64	69.5		
27		17	1.67		44	.25		58	1.67		53	.25		47	1.67		42	.25	63	68.7		
28	17	45	1.67		59	.27	17	34	1.67		28	.27	17	23	1.71		57	.27	62	67.8		
29		18	1.67		53	.27		18	10	1.71		44	.27		58	1.71	54	13	.27	61	67.0	
30		57	1.67		31	.28		45	1.71		54	.28		33	1.71		29	.28	60	66.1		
31	19	33	1.71		48	.28	19	20	1.71		17	.28	19	8	1.76		46	.28	59	65.3		
32		8	1.71		5	.30		55	1.71		34	.30		42	1.76		55	3	.30	58	64.4	
33	20	43	1.71		23	.32	20	30	1.76		52	.32	20	16	1.76		21	.30	57	63.6		
34		18	1.76		42	.32		21	4	1.76		55	.32		50	1.76	39	.32	56	62.7		
35		52	1.76		1	.33		38	1.76		30	.33		24	1.82		58	.33	55	61.8		
36	22	26	1.76		21	.35	22	12	1.76		50	.33		57	1.82		56	18	.35	54	60.9	
37		23	0	1.76	42	.35		46	1.82		56	.37		30	1.82		39	.35	53	60.0		
38	23	34	1.82		3	.37	23	19	1.82		32	.37	23	3	1.82		57	0	.37	52	59.1	
39		7	1.82		25	.38		52	1.88		54	.37		36	1.88		22	.37	51	58.2		
40		40	1.82		48	.40		24	24	1.88		57	.38		8	1.88		44	.38	50	57.3	
41	25	13	1.88		12	.40		56	1.88		39	.40		40	1.94		58	7	.40	49	56.3	
42		45	1.88		36	.42		25	28	1.88		58	.42		11	1.94		31	.40	48	55.4	
43	26	17	1.88		1	.42		26	0	1.94		28	.42		42	1.94		55	.42	47	54.5	
44		49	1.94		26	.43		31	1.94		53	.43		26	13	1.94		59	20	.43	46	53.5
45	27	20			52		27	2			59	19		44			46		45	52.5		

t	a = 49° 30'		a = 50° 0'		a = 50° 30'		a
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 49° 30'		d = 50° 0'		d = 50° 30'		

b	a = 49° 30'				a = 50° 0'				a = 50° 30'				c	a					
	B	d	60' Δ	Z	Δ 60'	h	d	60' Δ	Z	Δ 60'	h	d			60' Δ	Z	Δ 60'	C	β
		h																	
45	27	20	1.94	58 52	0.45	27	2	2.00	59 19	0.45	26	44	2.00	59 46	0.43	45	52.5		
46	51	2.00	59 19	.47	32	2.00	46	.45	27 14	2.07	60 12	.45	44	51.6					
47	28	21	2.00	47	.47	28	2	2.00	60 13	.47	43	39	.47	43	50.6				
48	51	2.00	60 15	.48	32	2.07	41	.48	28 12	2.07	61 7	.48	42	49.6					
49	29	21	2.07	44	.50	29	1	2.07	61 10	.50	41	36	.48	41	48.6				
50	50	2.07	61 14	0.52	30	2.14	40	0.50	29 10	2.14	62 5	0.50	40	47.6					
51	30	19	2.14	45	.52	58	2.14	46	62 10	.52	38	35	.52	39	46.6				
52	47	2.14	62 16	.53	30	2.22	41	.53	30 5	2.22	63 6	.52	38	45.6					
53	31	15	2.22	48	.55	53	2.22	43	63 13	.53	32	2.31	37	.53	37	44.5			
54	42	2 22	63 21	.55	31	2.0	2.31	45	58	2.31	64 9	.55	36	43.5					
55	32	9	2.31	54	0.57	46	2.31	48	64 18	0.57	31	24	2.40	42	0.55	35	42.4		
56	35	2.40	64 28	.58	32	12	2.40	52	49	2.40	65 15	.57	34	41.4					
57	33	0	2.40	65 3	.60	37	2.40	65	65 26	.60	32	14	2.40	49	.58	33	40.3		
58	25	2.40	69 39	.60	33	2	2.50	66	66 2	.60	39	2.50	66	24	.60	32	39.2		
59	50	2.50	66 15	.62	26	2.50	38	.60	33 3	2.61	67 0	.60	31	38.1					
60	34	14	2.61	52	0.63	50	2.61	67	67 14	0.63	26	2.73	36	0.62	30	37.0			
61	37	2.61	67 30	.65	34	13	2.73	63	52	.63	48	2.73	68	13	.63	29	35.9		
62	35	0	2.73	68 9	.65	35	2.86	68	30	.65	34	10	2.86	51	.63	28	34.8		
63	22	2.86	69 48	.67	56	2.86	69	.65	69 9	.65	31	2.86	69	29	.65	27	33.6		
64	43	2.86	69 28	.68	35	17	2.86	48	52	3.00	70 8	.67	26	32.5					
65	36	4	3.00	70 9	0.70	38	3.00	70	28	0.68	35	12	3.16	48	0.67	25	31.3		
66	24	3.16	71 51	.70	58	3.16	71	.70	31	3.16	71 28	.68	24	30.2					
67	43	3.16	71 33	.72	36	17	3.33	51	71 9	.70	50	3.33	72	9	.68	23	29.0		
68	37	2	3.33	72 16	.72	35	3.33	72	33	.72	36	8	3.33	50	.70	22	27.8		
69	20	3.53	59	.73	53	3.53	73	16	73 16	.72	26	3.75	73	32	.72	21	26.6		
70	37	3.75	73 43	0.75	37	10	3.75	59	59	0.73	42	3.75	74	15	0.73	20	25.4		
71	53	3.75	74 28	.75	26	4.00	74	43	74 43	.75	58	4.00	59	.73	19	24.2			
72	38	9	4.00	75 13	.77	41	4.00	75	28	.75	37	13	4.00	75	43	.73	18	23.0	
73	24	4.29	59	.77	56	4.29	76	13	76 13	.77	28	4.29	76	27	.75	17	21.8		
74	38	4.62	76 45	.78	38	10	4.62	59	76 18	.77	42	4.62	77	12	.75	16	20.5		
75	51	4.62	77 32	0.80	23	5.00	77	45	77 45	0.78	55	5.00	57	0.77	15	19.3			
76	39	4	5.00	78 20	.80	35	5.00	78	32	.78	38	7	5.45	78	43	.78	14	18.0	
77	16	5.45	79 8	.80	47	6.00	79	19	79 19	.78	18	6.00	79	30	.78	13	16.8		
78	27	6.00	80 56	.82	57	6.00	80	6	80 6	.80	28	6.00	80	17	.78	12	15.5		
79	37	6.67	80 45	.82	39	7	6.67	54	80 6	.80	38	6.67	81	4	.78	11	14.2		
80	46	7.50	81 34	0.82	16	7.50	81	42	81 42	0.82	47	7.50	51	0.80	10	13.0			
81	54	7.50	82 23	.83	24	7.50	82	31	82 31	.82	55	7.50	82	39	.80	9	11.7		
82	40	2	10.0	83 13	.83	32	10.0	83	20	.83	39	3	10.0	83	27	.82	8	10.4	
83	8	10.0	84 3	.85	38	10.0	84	10	84 10	.82	9	10.0	84	16	.82	7	9.1		
84	14	12.0	54	.85	44	12.0	59	.83	59	.83	15	15.0	85	5	.82	6	7.8		
85	19	15.0	85 45	0.85	49	15.0	85	49	85 49	0.83	19	15.0	54	0.82	5	6.5			
86	23	20.0	86 36	.85	53	20.0	86	39	86 39	.83	23	20.0	86	43	.82	4	5.2		
87	26	30.0	87 27	.85	56	30.0	87	29	87 29	.83	26	30.0	87	32	.82	3	3.9		
88	28	30.0	88 18	.85	58	30.0	88	19	88 19	.85	28	30.0	88	21	.82	2	2.6		
89	30	—	89 9	.85	40	0	—	89	10	.83	30	—	89	10	.83	1	1.3		
90	30	—	90 0	—	0	0	—	90	0	—	30	—	90	0	—	0	0.0		

t	d = 49° 30'				d = 50° 0'				d = 50° 30'				a
	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	

B	a = 51° 0'				a = 51° 30'				a = 52° 0'				C	a						
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
0	0	0	1.58	51	0	0.00	0	0	1.62	51	30	0.00	0	0	1.62	52	0	0.00	0	0.00
1	1	38	1.58	0	.02	37	1.58	30	.02	37	1.62	0	.02	37	1.62	0	.02	89	89.2	
2	1	16	1.62	1	.02	1	1.62	31	.02	1	1.62	1	.02	1	1.62	1	.02	88	88.4	
3	2	53	1.58	2	.03	52	1.62	32	.03	51	1.62	2	.03	51	1.62	2	.03	87	87.7	
4	2	31	1.58	4	.03	2	1.58	34	.03	2	1.62	4	.03	2	1.62	4	.03	86	86.9	
5	3	9	1.58	6	0.05	3	1.62	36	0.05	3	1.67	6	0.05	3	1.67	6	0.05	85	86.1	
6	3	47	1.62	9	.07	44	1.62	39	.05	41	1.62	9	.05	41	1.62	9	.05	84	85.3	
7	4	24	1.58	13	.07	4	1.62	42	.07	4	1.62	12	.07	4	1.62	12	.07	83	84.5	
8	5	2	1.62	17	.07	58	1.62	46	.08	55	1.62	16	.08	55	1.62	16	.08	82	83.7	
9	5	39	1.62	21	.08	5	1.62	51	.08	5	1.67	21	.08	5	1.67	21	.08	81	82.9	
10	6	16	1.58	26	0.08	6	1.62	56	0.08	6	1.62	26	0.08	6	1.62	26	0.08	80	82.1	
11	5	54	1.62	31	.10	49	1.62	52	.10	45	1.67	31	.10	45	1.67	31	.10	79	81.4	
12	7	31	1.62	37	.12	7	1.62	7	.10	7	1.62	37	.10	7	1.62	37	.10	78	80.6	
13	8	8	1.62	44	.12	8	1.62	13	.12	8	1.67	43	.12	8	1.67	43	.12	77	79.8	
14	4	45	1.62	51	.12	4	1.67	20	.13	8	1.67	50	.13	8	1.67	50	.13	76	79.0	
15	9	22	1.62	58	0.13	9	1.62	28	0.13	9	1.67	58	0.13	9	1.67	58	0.13	75	78.2	
16	10	59	1.62	52	.15	53	1.67	36	.15	46	1.67	53	.13	46	1.67	53	.13	74	77.4	
17	10	36	1.62	15	.15	10	1.67	45	.15	10	1.67	14	.15	10	1.67	14	.15	73	76.5	
18	11	13	1.67	24	.17	11	1.67	54	.15	58	1.67	23	.17	58	1.67	23	.17	72	75.7	
19	4	49	1.62	34	.17	4	1.67	53	.17	11	1.71	33	.17	11	1.71	33	.17	71	74.9	
20	12	26	1.67	44	0.18	12	1.67	13	0.18	12	1.67	43	0.18	12	1.67	43	0.18	70	74.1	
21	13	2	1.67	55	.18	53	1.67	24	.18	45	1.71	54	.18	45	1.71	54	.18	69	73.3	
22	3	38	1.67	53	.20	13	1.67	35	.20	13	1.71	54	.20	13	1.71	54	.20	68	72.5	
23	14	14	1.67	18	.20	14	1.71	47	.22	55	1.71	17	.20	55	1.71	17	.20	67	71.6	
24	5	50	1.67	30	.22	4	1.71	54	.22	14	1.71	29	.22	14	1.71	29	.22	66	70.8	
25	15	26	1.71	43	0.23	15	1.71	13	0.23	15	1.71	42	0.22	15	1.71	42	0.22	65	70.0	
26	16	1	1.71	57	.23	50	1.71	26	.22	40	1.76	55	.23	40	1.76	55	.23	64	69.1	
27	3	36	1.71	54	.25	16	1.71	40	.25	16	1.76	55	.23	16	1.76	55	.23	63	68.3	
28	17	11	1.71	26	.27	17	1.76	55	.25	48	1.76	24	.25	48	1.76	24	.25	62	67.4	
29	4	46	1.76	42	.27	4	1.76	55	.27	17	1.76	39	.27	17	1.76	39	.27	61	66.5	
30	18	20	1.71	58	0.27	18	1.76	26	0.28	56	1.82	55	0.27	56	1.82	55	0.27	60	65.7	
31	5	55	1.76	55	.28	42	1.76	43	.28	18	1.82	56	.28	18	1.82	56	.28	59	64.8	
32	19	29	1.76	31	.30	19	1.82	56	.30	19	1.82	28	.30	19	1.82	28	.30	58	63.9	
33	20	3	1.76	49	.30	4	1.82	18	.30	35	1.82	46	.30	35	1.82	46	.30	57	63.1	
34	7	37	1.82	56	.32	20	1.82	36	.32	20	1.82	57	.32	20	1.82	57	.32	56	62.2	
35	21	10	1.82	26	0.33	55	1.82	55	0.32	41	1.88	23	0.32	41	1.88	23	0.32	55	61.3	
36	30	43	1.82	46	.35	21	1.88	57	.33	21	1.88	44	.33	21	1.88	44	.33	54	60.4	
37	2	16	1.88	57	.35	22	1.88	34	.35	45	1.88	58	.35	45	1.88	58	.35	53	59.5	
38	4	48	1.88	28	.35	32	1.88	55	.37	22	1.94	23	.35	22	1.94	23	.35	52	58.6	
39	23	20	1.88	49	.37	23	1.94	58	.37	48	1.94	44	.37	48	1.94	44	.37	51	57.6	
40	5	52	1.94	58	0.38	35	1.94	39	0.38	23	1.94	59	0.38	23	1.94	59	0.38	50	56.7	
41	24	23	1.94	34	.40	24	1.94	59	.38	50	2.00	29	.38	50	2.00	29	.38	49	55.8	
42	5	54	1.94	58	.40	37	2.00	25	.40	24	2.00	52	.38	24	2.00	52	.38	48	54.8	
43	25	25	2.00	59	.42	25	2.00	49	.40	50	2.07	60	.42	50	2.07	60	.42	47	53.9	
44	7	55	2.00	47	.42	37	2.00	60	.43	25	2.07	40	.42	25	2.07	40	.42	46	52.9	
45	26	25		60	12	26	7	39		48		61	5	45		45		45	52.0	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a							
	d = 51° 0'				d = 51° 30'				d = 52° 0'				a							

B	a = 51° 0'				a = 51° 30'				a = 52° 0'				C	β							
	h	d	60'	t	h	d	60'	t	h	d	60'	t			C						
		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$									
45	26	25	2.00	60	12	0.43	26	7	2.07	60	39	0.43	25	48	2.07	61	5	0.43	45	52.0	
46		55	2.07		38	.45		36	2.07		5	.43		17	2.07		31	.43		44	51.0
47	27	24	2.07	61	5	.47	27	5	2.14	31	.45		26	17	2.14	46	57	.45	43	50.0	
48		53	2.14		33	.47		33	2.14		58	.47		14	2.22	62	24	.47	42	49.0	
49	28	21	2.14	62	1	.48	28	1	2.14	62	26	.48	27	14	2.22	41	2.22	52	.47	41	48.0
50		49	2.14		30	0.50		29	2.22		55	0.48		8	2.22	63	20	0.48	40	47.0	
51	29	17	2.22	63	0	.50		56	2.22	63	24	.50	28	35	2.31	35	2.31	49	.50	39	46.0
52		44	2.31		30	.52		23	2.31		54	.52		1	2.31	64	19	.50	38	45.0	
53	30	10	2.31	64	1	.53		49	2.31	64	25	.52	29	1	2.31	27	2.40	49	.52	37	43.9
54		36	2.31		33	.53		15	2.40		56	.53		2	2.40	52	2.40	52	.53	36	42.9
55	31	2	2.40	65	5	0.55		40	2.50	65	28	0.55	30	17	2.50			52	0.53	35	41.8
56		27	2.50		38	.57		4	2.50		66	1	.57	41	2.50	66	24	.55	34	40.8	
57	32	15	2.50	66	12	.58		28	2.50		35	.57	31	5	2.61			57	.57	33	39.7
58		51	2.50		47	.58		52	2.61		67	9	.57	28	2.61	67	31	.57	32	38.6	
59	39	3	2.61	67	22	.60		15	2.73		43	.60	32	15	2.73	51	2.73	68	.58	31	37.5
60		33	2.73		58	0.60		37	2.73	68	19	0.60	32	13	2.73			40	0.58	30	36.4
61	24	2.86		68	34	.62		59	2.86		55	.60		35	2.86	69	15	.60	29	35.3	
62	45	2.86		69	11	.63		33	20	2.86	69	31	.63		56	3.00		51	.62	28	34.2
63	34	6	2.86	69	49	.63		41	3.00	70	9	.63	33	16	3.00	70	28	.63	27	33.1	
64		27	3.00		70	.65		1	3.00		47	.63		36	3.16	71	6	.63	26	31.9	
65	47	3.16		71	6	0.67		21	3.16	71	25	0.65		55	3.33			44	0.63	25	30.8
66	35	6	3.33	72	46	.67		40	3.33	72	4	.67	34	13	3.33	72	22	.65	24	29.6	
67		24	3.33		26	.68		58	3.53		44	.67		31	3.53	73	1	.67	23	28.5	
68	42	3.53		73	7	.70		15	3.53	73	24	.68		48	3.53			41	.67	22	27.3
69	59	3.75		49		.70		32	3.75	74	5	.70	35	5	3.75	74	21	.68	21	26.1	
70		15	3.75		74	31	0.72		48	4.00	47	0.70		21	4.00			75	2	20	24.9
71	31	4.00		75	14	.72		36	4.00		75	29	.70		36	4.29		44	.70	19	23.7
72		46	4.29		57	.73		18	4.29	76	11	.72		50	4.29	76	26	.70	18	22.5	
73	37	0	4.62	76	41	.73		32	4.62		54	.73	36	4	4.62	77	8	.72	17	21.3	
74		13	4.62		77	25	.75		45	4.62	77	38	.73		17	5.00		51	.72	16	20.1
75	26	5.00		78	10	0.75		58	5.00	78	22	0.73		29	5.00	78	34	0.73	15	18.9	
76		38	5.45		55	.77		10	5.45	79	6	.75		41	5.45	79	18	.73	14	17.7	
77	49	6.00		79	41	.77		21	6.00		51	.75		52	6.00	80	2	.73	13	16.5	
78		59	6.00		80	27	.77		31	6.67	80	36	.77	37	2	6.67	46	.75	12	15.2	
79	38	9	6.67	81	13	.78		40	6.67	81	22	.77		11	7.50	81	31	.75	11	13.9	
80		18	7.50		82	0	0.78		49	7.50	82	8	0.77		19	7.50	82	16	0.77	10	12.7
81	26	8.57		47		.78		57	8.57		54	.78		27	8.57	83	2	.77	9	11.4	
82		33	10.0		83	34	.80		4	10.0	83	41	.78		34	10.0		48	.77	8	10.2
83	39	10.0		84	22	.80		10	12.0	84	28	.78		40	12.0	84	34	.77	7	8.9	
84		45	15.0		85	10	.80		15	15.0	85	15	.78		45	12.0	85	20	.77	6	7.6
85	49	15.0		58		0.80		19	15.0	86	2	0.78		50	20.0	86	6	0.78	5	6.4	
86		53	20.0		86	46	.80		23	20.0	49	.80		53	20.0			53	.77	4	5.1
87	56	30.0		87	34	.82		26	30.0	87	37	.78		56	30.0	87	39	.78	3	3.8	
88		58	30.0		88	23	.80		28	30.0	88	24	.80		58	30.0	88	26	.78	2	2.6
89	39	0	—	89	11	.82		30	—	89	12	.80		38	0	—	89	13	.78	1	1.3
90		0		90	0			30		90	0			0			90	0		0	0.0

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

b	a = 52° 30'					a = 53° 0'					a = 53° 30'					c	α				
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
0	0	0	1.62	52	30	0.00	0	0	1.67	53	0	0.00	0	0	1.67	53	30	0.00	90	90.0	
1		37	1.67		30	.02		36	1.67		0	.02		36	1.71		30	.02	89	89.2	
2	1	13	1.62		31	.02	1	12	1.67		1	.02	1	11	1.67		31	.02	88	88.4	
3		50	1.67		32	.03		48	1.67		2	.03		47	1.67		32	.03	87	87.6	
4	2	26	1.62		34	.03	2	24	1.67		4	.03	2	23	1.71		34	.03	86	86.8	
5	3	3	1.67		36	.05	3	0	1.67		6	.05		58	1.67		36	.05	85	86.0	
6		39	1.67		39	.05		36	1.67		9	.05	3	34	1.71		39	.05	84	85.2	
7	4	15	1.62		42	.07	4	12	1.67		12	.07	4	9	1.67		42	.07	83	84.4	
8		52	1.67		46	.07		48	1.67		16	.07		45	1.71		46	.07	82	83.6	
9	5	28	1.67		50	.08	5	24	1.67		20	.08	5	20	1.67		50	.08	81	82.8	
10	6	4	1.67		55	.10	6	0	1.67		25	.08		56	1.71		55	.08	80	82.0	
11		40	1.67	53	1	.10		36	1.71		30	.10	6	31	1.71	54	0	.10	79	81.2	
12	7	16	1.67		7	.10	7	11	1.67		36	.12	7	6	1.71		6	.10	78	80.4	
13		52	1.67		13	.12		47	1.71		43	.12		41	1.71		12	.12	77	79.6	
14	8	28	1.67		20	.12	8	22	1.67		50	.12	8	16	1.71		19	.13	76	78.7	
15	9	4	1.67		27	.13		58	1.71		57	.13		51	1.71		27	.13	75	77.9	
16		40	1.71		35	.15	9	33	1.71		54	.13	9	26	1.71		35	.13	74	77.1	
17	10	15	1.67		44	.15	10	8	1.71		13	.15	10	1	1.71		43	.15	73	76.3	
18		51	1.71		53	.15		43	1.71		22	.17		36	1.76		52	.15	72	75.5	
19	11	26	1.71	54	2	.17	11	18	1.71		32	.17	11	10	1.76	55	1	.17	71	74.6	
20	12	1	1.71		12	.18		53	1.76		42	.18		44	1.76		11	.18	70	73.8	
21		36	1.71		23	.18	12	27	1.71		52	.17	12	18	1.76		22	.18	69	73.0	
22	13	11	1.71		34	.20	13	2	1.76	55	3	.20		52	1.76		33	.18	68	72.1	
23		46	1.76		46	.20		36	1.76		15	.20	13	26	1.76		44	.20	67	71.3	
24	14	20	1.76		58	.22	14	10	1.76		27	.22	14	0	1.76		56	.22	66	70.4	
25		54	1.76	55	11	.22		44	1.76		40	.22		34	1.82	56	9	.22	65	69.6	
26	15	28	1.76		24	.23	15	18	1.82		53	.23	15	7	1.82		22	.23	64	68.7	
27		16	2		38	.25		51	1.76	56	7	.25		40	1.82		36	.23	63	67.9	
28	16	36	1.76		53	.25	16	25	1.82		22	.25	16	13	1.82		50	.25	62	67.0	
29	17	10	1.82	56	8	.27		58	1.82		37	.25		46	1.88	57	5	.27	61	66.1	
30		43	1.82		24	.27	17	31	1.88		52	.27	17	18	1.88		21	.27	60	65.2	
31	18	16	1.82		40	.28	18	3	1.82	57	8	.28		50	1.88		37	.28	59	64.4	
32		49	1.82		57	.28		36	1.88		25	.28	18	22	1.88		54	.28	58	63.5	
33	19	22	1.88	57	14	.30	19	8	1.88		42	.30		54	1.88	58	11	.30	57	62.6	
34		54	1.88		32	.32		40	1.88	58	0	.32	19	26	1.94		29	.30	56	61.7	
35	20	26	1.88		51	.32	20	12	1.94		19	.32		57	1.94		47	.32	55	60.8	
36		58	1.88	58	10	.33		43	1.94		38	.33	20	28	1.94	59	6	.32	54	59.9	
37	21	30	1.94		30	.33	21	14	1.94		58	.33		59	2.00		25	.33	53	59.0	
38		1	1.94		50	.35		45	2.00	59	18	.35	21	29	2.00		45	.35	52	58.0	
39	22	32	2.00	59	11	.37	22	15	2.00		39	.35		59	2.00	60	6	.35	51	57.1	
40		23	2		33	.37		45	2.00	60	0	.37	22	29	2.07		27	.37	50	56.2	
41	23	32	2.00		55	.38	23	15	2.00		22	.38		58	2.07		49	.38	49	55.2	
42		24	2	60	18	.40		45	2.07		45	.38	23	27	2.07	61	12	.38	48	54.3	
43		32	2.07		42	.40	24	14	2.07	61	8	.40		56	2.14		35	.40	47	53.3	
44	25	1	2.07	61	6	.42		43	2.14		32	.42	24	24	2.14		59	.40	46	52.4	
45		30			31		25	11			57			52			62	23		45	51.4

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

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

b	a = 54° 0'				a = 54° 30'				a = 55° 0'				c	α										
	B	h	d	60' / Δ	Z	Δ / 60'	h	d	60' / Δ	Z	Δ / 60'	h			d	60' / Δ	Z	Δ / 60'	C	β				
45	24	34	2.22		62	49	0.40	24	15	2.22		63	14	0.40	23	56	2.31		63	40	0.40	45	50.9	
40	25	I	2.22		63	13	.42		42	2.31			38	.42	24	22	2.31		64	4	.42	44	49.9	
47		28	2.31			38	.43	25	8	2.31		64	3	.43		48	2.31			29	.42	43	48.9	
48		54	2.31		64	4	.45		34	2.31			29	.43	25	14	2.40			54	.43	42	47.9	
49	26	20	2.31			31	.45	26	0	2.40			55	.45		39	2.40		65	20	.43	41	46.9	
50		46	2.40			58	.47		25	2.40		65	22	.45	26	4	2.50			46	.45	40	45.9	
51	27	11	2.40		65	26	.47		50	2.50			49	.47	28	2.50			66	13	.47	39	44.8	
52		36	2.50			54	.48	27	14	2.50		66	17	.48		52	2.50			41	.47	38	43.8	
53	28	0	2.50		66	23	.48		38	2.61			46	.48	27	16	2.61			67	9	.48	37	42.8
54		24	2.61			52	.50	28	1	2.61		67	15	.50		39	2.61			38	.48	36	41.7	
55		47	2.61		67	22	.52		24	2.61			45	.50	28	2	2.73		68	7	.50	35	40.7	
56	29	10	2.73			53	.53		47	2.73		68	15	.52		24	2.86			37	.52	34	39.6	
57		32	2.73		68	25	.53	29	9	2.86			46	.53	45	2.86			69	8	.52	33	38.6	
58	58	54	2.86			57	.53		30	2.86		69	18	.53	29	6	2.86			39	.52	32	37.5	
59	30	15	2.86		69	29	.55		51	3.00			50	.53	27	3.00			70	10	.53	31	36.4	
60		36	3.00		70	2	.57	30	11	3.00		70	22	.55		47	3.00			42	.55	30	35.3	
61	61	56	3.00			36	.57		31	3.00			55	.57	30	7	3.16			71	15	.55	29	34.3
62	31	16	3.16		71	10	.58		51	3.16		71	29	.57		26	3.33			48	.57	28	33.1	
63		35	3.33			45	.58	31	10	3.33			3	.58		44	3.33			72	22	.57	27	32.0
64		53	3.33		72	20	.60		28	3.53			38	.58	31	2	3.53			56	.58	26	30.9	
65	32	11	3.53			56	.60	32	45	3.53		73	13	.60		19	3.53			73	31	.58	25	29.8
66		28	3.53		73	32	.62		2	3.53			49	.60	36	3.75				74	6	.60	24	28.7
67	67	45	3.75			9	.62		19	3.75		74	25	.62		52	3.75			42	.60	23	27.5	
68	33	1	3.75			46	.63		35	4.00			25	.62	32	8	4.00			75	18	.62	22	26.4
69		17	4.00		75	24	.65		50	4.29		39	39	.63		23	4.29			55	.62	21	25.2	
70		32	4.29			3	.65	33	4	4.29		76	17	.63		37	4.29			76	32	.62	20	24.1
71	71	46	4.62			42	.65		18	4.62			55	.65	33	51	4.62			77	9	.63	19	22.9
72		59	4.62		77	21	.67		31	4.62		77	34	.65		33	4	5.00			47	.65	18	21.8
73	34	12	5.00			1	.67		44	5.00			13	.67	33	16	5.00			78	26	.65	17	20.6
74		24	5.45			41	.67		56	5.45		53	53	.67		28	5.45			79	5	.65	16	19.4
75		35	5.45		79	21	.68	34	7	5.45		79	33	.67		39	6.00			44	.65	15	18.2	
76	76	46	6.00			2	.68		18	6.00			13	.67	34	49	6.00			80	23	.67	14	17.0
77		56	6.00		80	2	.70		28	6.67		53	53	.68		59	8.57			81	3	.67	13	15.8
78	35	6	7.50			25	.70		37	7.50		81	34	.68	34	8	7.50			43	.67	12	14.6	
79		14	7.50		82	7	.70		45	7.50		82	15	.68		16	7.50			82	23	.68	11	13.4
80		22	8.57			49	.70		53	8.57			56	.70	24	8.57				83	4	.68	10	12.2
81	81	29	8.57		83	31	.70	35	0	10.0		83	38	.70		31	10.0			45	.68	9	11.0	
82		36	12.0			13	.72		6	10.0		84	20	.70		37	12.0			84	26	.68	8	9.8
83	83	41	12.0			56	.72		12	12.0			2	.70		42	12.0			85	7	.70	7	8.6
84		46	15.0		85	39	.73		17	15.0		44	44	.70		47	15.0			49	.68	6	7.4	
85		50	15.0		86	23	.72		21	20.0		86	26	.72		51	20.0			86	30	.70	5	6.1
86	86	54	20.0			6	.72		24	20.0			9	.72	54	20.0				87	12	.70	4	4.9
87		57	30.0		87	6	.73		27	30.0		52	52	.70		57	30.0			54	.70	3	3.7	
88	88	59	60.0		88	33	.72		29	60.0		88	34	.72		59	60.0			88	36	.70	2	2.5
89		0	—		89	16	.73		30	—		89	17	.72	35	0	—			89	18	.70	1	1.2
90		0	—		90	0	—		30	—		90	0	—		0	—			90	0	—	0	0.0

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

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

B	a = 57° 0'				a = 57° 30'				a = 58° 0'				C	a									
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$			
0	0	0	1.82	57	0	0.00	0	0	1.88	57	30	0.00	0	0	1.88	58	0	0.00	90	90.0			
1		33	1.88		0	.02		32	1.88		30	.02		32	1.88		0	.02	89	89.2			
2		1	5	1.82		1	.02		1	4	1.82		31	.02		1	4	1.94	1	.02	88	88.3	
3		38	1.82		2	.03		37	1.88		31	.03		35	1.88		2	.03	87	87.5			
4		2	11	1.88		4	.03		2	9	1.88		34	.03		2	7	1.88	4	.03	86	86.6	
5		43	1.82		6	0.05		41	1.88		36	0.05		39	1.88		6	0.03	85	85.8			
6		3	16	1.88		9	.05		3	13	1.88		39	.05		3	11	1.94	8	.05	84	84.9	
7		48	1.82		12	.05		45	1.88		42	.05		42	1.88		11	.07	83	84.1			
8		4	21	1.88		15	.07		4	17	1.88		45	.07		4	14	1.94	15	.07	82	83.2	
9		53	1.82		19	.08		49	1.88		49	.08		45	1.88		19	.08	81	82.4			
10		5	26	1.88		24	0.08		5	21	1.88		54	0.08		5	17	1.94	24	0.08	80	81.5	
11		58	1.88		29	.10		53	1.88		54	.08		5	18	1.88		29	.08	79	80.7		
12		6	30	1.88		35	.10		6	25	1.88		59	0.10		6	20	1.94	34	.10	78	79.8	
13		7	2	1.88		41	.10		57	1.94		10	.12		51	1.94		40	.10	77	79.0		
14		34	1.88		47	.12		7	28	1.88		17	.12		7	22	1.94	46	.12	76	78.1		
15		8	6	1.88		54	0.13		8	0	1.94		24	0.12		53	1.94	53	0.12	75	77.3		
16		38	1.88	58	2	.13		31	1.94		31	.13		8	24	1.94	59	0	.13	74	76.4		
17		9	10	1.88		10	.13		9	2	1.94		39	.13		55	1.94	8	.15	73	75.5		
18		42	1.94		18	.15		33	1.94		47	.15		9	26	2.00	17	.15	72	74.7			
19		10	13	1.94		27	.15		10	4	1.94		56	.17		56	1.94	26	.15	71	73.8		
20		44	1.94		36	0.17		35	1.94		59	6	0.17		10	27	2.00	35	0.17	70	72.9		
21		11	15	1.94		46	.18		11	6	1.94		16	.17		57	2.00	45	.17	69	72.1		
22		46	1.94		57	.18		37	2.00		26	.18		11	27	2.00	55	.18	68	71.2			
23		12	17	1.94	59	8	.18		12	7	2.00		37	.18		57	2.00	60	6	.18	67	70.3	
24		48	1.94		19	.20		37	2.00		48	.20		12	27	2.00	17	.20	66	69.4			
25		13	19	2.00		31	0.22		13	7	2.00		60	0	0.20	57	2.07	29	0.20	65	68.5		
26		49	2.00		44	.22		37	2.00		12	.22		13	26	2.07	41	.22	64	67.6			
27		14	19	2.00		57	.22		14	7	2.00		25	.22		55	2.07	54	.22	63	66.7		
28		49	2.00	60	10	.23		37	2.07		38	.23		14	24	2.07	61	7	.23	62	65.8		
29		15	19	2.07		24	.25		15	6	2.07		52	.25		53	2.07	21	.23	61	64.9		
30		48	2.07		39	0.25		35	2.07		61	7	0.25		15	22	2.14	35	0.25	60	64.0		
31		16	17	2.07		54	.27		16	4	2.07		22	.25		50	2.14	50	.25	59	63.1		
32		46	2.07	61	10	.27		33	2.14		37	.27		16	18	2.14	62	5	.27	58	62.2		
33		17	15	2.07		26	.27		17	1	2.14		53	.28		46	2.14	21	.27	57	61.3		
34		44	2.14		42	.28		29	2.14		62	10	.28		17	14	2.14	37	.28	56	60.4		
35		18	12	2.14		59	0.30		18	25	2.22		44	.30		18	9	2.22	63	11	.30	55	59.4
36		40	2.14	62	17	.30		18	25	2.22		44	.30		18	9	2.22	63	11	.30	54	58.5	
37		19	8	2.14		35	.32		52	2.22		63	2	.32		36	2.22	29	.30	53	57.6		
38		36	2.22		54	.32		19	19	2.22		21	.32		19	3	2.31	47	.32	52	56.6		
39		20	3	2.22	63	13	.33		46	2.31		40	.32		29	2.31	64	6	.32	51	55.7		
40		30	2.31		33	0.33		20	12	2.31		59	0.33		55	2.31		25	0.33	50	54.7		
41		56	2.31		53	.35		38	2.31		64	19	.35		20	21	2.40	45	.33	49	53.8		
42		21	22	2.31	64	14	.37		21	4	2.31		40	.35		46	2.40	65	5	.35	48	52.8	
43		48	2.31		36	.37		30	2.40		65	1	.37		21	11	2.40	26	.37	47	51.8		
44		22	14	2.40		58	.37		55	2.40		23	.37		36	2.50		48	.37	46	50.8		
45		39			65	20		22	20			45			22	0		66	10		45	49.9	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a						
	d = 57° 0'				d = 57° 30'				d = 58° 0'														

0.649

0.637

0.625

b	a = 57° 0'				a = 57° 30'				a = 58° 0'				c	α							
	B	d	60' Δ	Z	Δ 60'	h	60' Δ	Z	Δ 60'	h	60' Δ	Z			Δ 60'	C	β				
																		h	60' Δ	Z	Δ 60'
45	22	39	2.40	65	20	0.38	22	20	2.50	65	45	0.38	22	0	2.50	66	10	0.37	45	49.9	
46	23	4	2.50	43	.40		23	44	2.50	66	8	.38	24	2.50		32	.38	44	48.9		
47		28	2.50	66	7	.40	23	8	2.50	31	.40		48	2.61		55	.38	43	47.9		
48		52	2.50		31	.40		32	2.61	55	.40		23	11	2.61	67	18	.40	42	46.9	
49	24	16	2.61	55	.42		55	2.61	67	19	.42		34	2.61		42	.42	41	45.9		
50		39	2.61	67	20	0.43	24	18	2.61	44	0.42		57	2.73		68	7	0.42	40	44.9	
51	25	2	2.61	46	.43		41	2.73	68	9	.43		24	19	2.73	32	.42	39	43.8		
52		25	2.73	68	12	.45	25	3	2.73	35	.43		41	2.86		57	.43	38	42.8		
53		47	2.73	39	.45		25	2.86	69	1	.45		25	2	2.86	69	23	.45	37	41.8	
54	26	9	2.86	69	6	.47	46	2.86	28	.47			23	2.86		50	.45	36	40.7		
55		30	2.86	34	0.47		26	7	3.00	56	0.47		44	3.00		70	17	0.45	35	39.7	
56		51	3.00	70	2	.48	27	3.00	70	24	.47		26	4	3.16	44	.47	34	38.7		
57	27	11	3.00		31	.50	47	3.16	52	.48			23	3.16		71	12	.48	33	37.6	
58		31	3.16	71	1	.50	27	6	3.16	71	21	.48		42	3.16		41	.48	32	36.5	
59		50	3.16	31	.50		25	3.16	50	.50			27	1	3.33	72	10	.48	31	35.5	
60	28	9	3.33	72	1	0.52	44	3.33	72	20	0.50		19	3.33		39	0.50	30	34.4		
61		27	3.33	32	.52		28	2	3.53	50	.52		37	3.53		73	9	.50	29	33.3	
62		45	3.53	73	3	.53	19	3.53	73	21	.52		54	3.53		39	.52	28	32.2		
63	29	2	3.53	35	.53		36	3.53	52	.53			28	11	3.75	74	10	.52	27	31.1	
64		19	3.75	74	7	.53	53	3.75	74	24	.53		27	4.00		41	.52	26	30.0		
65		35	4.00	39	0.55		29	9	4.00	56	0.53		42	4.00		75	12	0.53	25	28.9	
66		50	4.00	75	12	.57	24	4.00	75	28	.55		57	4.00		44	.55	24	27.8		
67	30	5	4.00	46	.57		39	4.29	76	1	.57		29	12	4.29	76	17	.55	23	26.7	
68		20	4.29	76	20	.57	53	4.62	35	.55			26	4.62		50	.55	22	25.6		
69		34	4.62	54	.58		30	6	4.62	77	8	.57		39	4.62		77	23	.55	21	24.5
70		47	4.62	77	29	0.58	19	4.62	42	0.58			52	5.00		56	0.57	20	23.3		
71	31	0	5.00	78	4	.58	32	5.00	78	17	.58		30	4	5.00	78	30	.57	19	22.2	
72		12	5.45	39	.60		44	5.45	52	.58			16	5.45		79	4	.58	18	21.1	
73		23	5.45	79	15	.60	55	5.45	79	27	.58		27	6.00		80	39	.58	17	19.9	
74		34	6.00	51	.60		31	6	6.00	80	2	.60		37	6.00		80	14	.58	16	18.8
75		44	6.00	80	27	0.62	16	6.67		38	0.60		47	6.67		49	0.58	15	17.6		
76		54	6.67	81	4	.62	25	6.67	81	14	.62		56	6.67		81	24	.60	14	16.5	
77	32	3	7.50	41	.63		34	7.50	51	.60			31	5	7.50	82	0	.60	13	15.3	
78		11	7.50	82	19	.62	42	7.50	82	27	.62		13	7.50		36	.60	12	14.1		
79		19	8.57	56	.63		50	8.57	83	4	.62		21	8.57		83	12	.60	11	13.0	
80		26	10.0	83	34	0.63	57	10.0	41	0.62			28	10.0		48	0.62	10	11.8		
81		32	10.0	84	12	.63	32	3	10.0	84	18	.63		34	12.0		84	25	.62	9	10.6
82		38	12.0	50	.63		9	12.0	56	.63			39	12.0		85	2	.62	8	9.5	
83		43	12.0	85	28	.65	14	15.0	85	34	.62		44	15.0		39	.62	7	8.3		
84		48	15.0	86	7	.65	18	15.0	86	11	.63		48	15.0		86	16	.62	6	7.1	
85		52	20.0	46	0.63		22	20.0	49	0.63			52	20.0		53	0.62	5	5.9		
86		55	30.0	87	24	.65	25	30.0	87	27	.63		55	30.0		87	30	.63	4	4.7	
87		57	30.0	88	3	.65	27	30.0	88	5	.65		57	30.0		88	8	.62	3	3.6	
88		59	60.0	42	.65		29	60.0	44	.63			59	60.0		45	.63	2	2.4		
89	33	0	—	89	21	.65	30	—	89	22	.63		32	0	—	89	23	.62	1	1.2	
90		0		90	0		30		90	0			0			90	0		0	0.0	
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a								
	d = 57° 0'				d = 57° 30'				d = 58° 0'												

0.613

0.601

0.589

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

B	a = 58° 30'					a = 59° 0'					a = 59° 30'					C	β			
	h	d	60' Δ	Z	t	h	d	60' Δ	Z	t	h	d	60' Δ	Z	t					
		Δ	60'	Δ	60'		Δ	60'	Δ	60'		Δ	60'	Δ	60'					
45	21	41	2.50	66	34	0.37	21	22	2.61	66	59	0.37	21	2	2.61	67	23	0.37	45	49.0
46	22	5	2.61	56	38	.38	45	2.61	67	21	.37	25	2.73	47	2.73	68	45	.37	44	48.4
47	28	2.61	67	19	.38	22	8	2.73	43	.38	47	2.73	68	7	.37	47	2.73	.37	43	47.4
48	51	2.61	42	42	.40	30	2.73	68	6	.38	22	9	2.73	29	.38	42	2.73	.38	42	46.4
49	23	14	2.73	68	6	.40	52	2.73	29	.40	31	2.73	52	.40	41	2.73	.40	41	45.4	
50	36	2.73	30	0.42	23	14	2.73	53	0.40	23	14	2.86	69	16	0.40	40	2.86	0.40	40	44.4
51	58	2.86	55	.42	36	2.86	69	17	.42	23	14	2.86	69	40	.40	39	2.86	.40	39	43.4
52	24	19	2.86	69	20	.42	57	3.00	42	.42	35	3.00	70	4	.42	38	3.00	.42	38	42.3
53	40	3.00	45	.43	24	17	3.00	70	7	.43	55	3.00	29	.42	37	3.00	.42	37	41.3	
54	25	0	3.00	70	11	.45	37	3.00	33	.43	24	15	3.16	54	.43	36	3.16	.43	36	40.3
55	20	3.00	38	0.45	57	3.00	57	3.00	59	0.45	34	3.16	71	20	0.43	35	3.16	0.43	35	39.2
56	40	3.16	71	5	.47	25	17	3.16	71	26	.45	53	3.16	46	.45	34	3.16	.45	34	38.2
57	59	3.16	33	.47	36	3.33	53	.45	25	12	3.33	72	13	.45	33	3.33	.45	33	37.1	
58	26	18	3.33	72	1	.47	54	3.33	72	20	.47	30	3.53	40	.45	32	3.53	.45	32	36.1
59	36	3.33	29	.48	26	12	3.53	48	.48	47	3.53	73	7	.47	31	3.53	.47	31	35.0	
60	54	3.33	58	0.48	29	3.53	73	17	0.48	26	4	3.53	35	0.48	30	3.53	0.48	30	34.0	
61	27	12	3.53	73	27	.50	46	3.53	46	.48	21	3.75	74	4	.48	29	3.75	.48	29	32.9
62	29	3.75	57	.50	27	3	3.75	74	15	.50	37	3.75	33	.48	28	3.75	.48	28	31.8	
63	45	3.75	74	27	.52	19	3.75	45	.50	53	4.00	75	2	.48	27	3.75	.48	27	30.7	
64	28	1	4.00	58	.52	35	4.00	75	15	.50	27	8	4.00	31	.50	26	4.00	.50	26	29.6
65	16	4.00	75	29	0.52	50	4.29	45	0.52	23	4.29	76	1	0.50	25	4.29	0.50	25	28.5	
66	31	4.29	76	0	.53	28	4	4.29	76	16	.52	37	4.29	31	.52	24	4.29	.52	24	27.4
67	45	4.29	32	.53	18	4.62	47	.53	28	4	4.62	77	2	.52	23	4.62	.52	23	26.3	
68	59	4.62	77	4	.55	31	4.62	77	19	.53	28	4	4.62	33	.53	22	4.62	.53	22	25.2
69	29	12	5.00	37	.55	44	4.62	51	.53	17	5.00	78	5	.53	21	5.00	.53	21	24.1	
70	24	5.00	78	10	0.55	57	5.00	78	23	0.55	29	5.00	37	0.53	20	5.00	0.53	20	23.0	
71	36	5.00	43	.57	29	9	5.45	56	.55	41	5.45	79	9	.53	19	5.45	.53	19	21.9	
72	48	5.45	79	17	.57	20	6.00	79	29	.55	52	6.00	41	.55	18	6.00	.55	18	20.8	
73	59	6.00	51	.57	30	6.00	80	2	.57	29	2	6.00	80	14	.55	17	6.00	.55	17	19.6
74	30	9	6.00	80	25	.57	40	6.00	36	.57	12	6.67	47	.55	16	6.67	.55	16	18.5	
75	19	6.67	59	0.58	50	6.67	81	10	0.57	21	6.67	81	20	0.55	15	6.67	0.55	15	17.4	
76	28	7.50	81	34	.58	59	7.50	44	.57	30	7.50	53	53	.57	14	7.50	.57	14	16.2	
77	36	7.50	82	9	.58	30	7	7.50	82	18	.58	38	7.50	82	27	.57	38	.57	13	15.1
78	44	8.57	83	20	.60	15	8.57	53	.58	46	8.57	83	1	.57	12	8.57	.57	12	13.9	
79	51	8.57	83	20	.60	22	8.57	83	28	.58	53	10.0	35	.58	11	10.0	.58	11	12.8	
80	58	10.0	56	0.60	29	10.0	84	3	0.58	59	10.0	84	10	0.57	10	10.0	0.57	10	11.6	
81	31	4	84	32	.60	35	12.0	38	.58	30	5	12.0	44	.58	9	12.0	.58	9	10.5	
82	9	12.0	85	8	.60	40	12.0	85	13	.60	10	12.0	85	19	.58	8	12.0	.58	8	9.3
83	14	15.0	44	.60	45	15.0	49	.58	15	15.0	15	15.0	54	.58	7	15.0	.58	7	8.2	
84	18	15.0	86	20	.60	49	20.0	86	24	.60	19	20.0	86	29	.58	6	20.0	.58	6	7.0
85	22	20.0	56	0.62	52	20.0	87	0	0.60	22	20.0	87	4	0.58	5	20.0	0.58	5	5.8	
86	25	30.0	87	33	.62	55	30.0	36	.60	25	30.0	39	39	.58	4	30.0	.58	4	4.7	
87	27	30.0	88	10	.60	57	30.0	88	12	.60	27	30.0	88	14	.58	3	30.0	.58	3	3.5
88	29	60.0	46	.62	59	60.0	48	.60	29	60.0	49	49	.60	2	2	60.0	.60	2	2.3	
89	30	—	89	23	.62	31	0	—	89	24	.60	30	—	1	1	—	.60	1	1	1.2
90	30	—	90	0	—	0	0	—	90	0	—	30	—	0	0	—	—	—	0	0.0
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a			
	d = 58° 30'				d = 59° 0'				d = 59° 30'				a							

B	a = 60° 0'				a = 60° 30'				a = 61° 0'				C	β								
	h	d	60' / Δ	Z	t	Δ / 60'	h	d	60' / Δ	Z	t	Δ / 60'			h	d	60' / Δ	Z	t	Δ / 60'		
																					b	
0	0	0	2.00	60	0	0.00	0	0	2.00	60	30	0.00	0	0	2.07	61	0	0.00	60	90.0		
1	30	2.00	0	.02	30	2.07	30	30	.02	29	2.07	0	0	.02	88	88.3	88.3	88.3	88.3	89.1		
2	1	0	2.00	1	.02	59	2.00	31	.02	58	2.07	1	0	.02	87	87.4	87.4	87.4	87.4	88.0		
3	30	2.00	2	.03	1	29	2.07	32	.03	1	27	2.07	2	.03	86	86.5	86.5	86.5	86.5	87.0		
4	2	0	2.00	4	.03	58	2.00	34	.03	56	2.07	4	0	.03	85	85.6	85.6	85.6	85.6	86.2		
5	30	2.00	6	0.03	2	28	2.07	36	0.03	2	25	2.07	6	0.03	84	84.8	84.8	84.8	84.8	85.4		
6	3	0	2.00	8	.05	57	2.07	38	.05	54	2.07	8	0	.05	83	83.9	83.9	83.9	83.9	84.6		
7	30	2.07	11	.05	3	26	2.00	41	.05	3	23	2.07	11	.05	82	82.2	82.2	82.2	82.2	83.0		
8	59	2.00	14	.07	56	2.07	44	.07	52	2.07	14	.07	14	.07	81	81.3	81.3	81.3	81.3	82.2		
9	4	29	2.00	18	.08	4	25	2.07	48	.07	4	21	2.07	18	.08	80	80.4	80.4	80.4	80.4	81.3	
10	59	2.00	23	0.08	54	2.07	52	0.08	50	2.07	22	0.08	80	81.3	81.3	81.3	81.3	81.3	82.2	83.0		
11	5	29	2.07	28	.08	5	23	2.07	57	.08	5	19	2.14	27	.08	79	79.5	79.5	79.5	79.5	80.4	
12	58	2.00	33	.08	52	2.07	61	2	.10	47	2.07	32	.10	78	78.6	78.6	78.6	78.6	78.6	79.5		
13	6	28	2.07	38	.10	6	21	2.07	8	.10	6	16	2.14	38	.10	77	77.8	77.8	77.8	77.8	78.6	
14	57	2.07	44	.12	50	2.07	14	.12	44	2.07	44	.10	76	77.8	77.8	77.8	77.8	77.8	77.8	78.6		
15	7	26	2.07	51	.12	7	19	2.07	21	.12	7	13	2.14	50	.12	75	76.9	76.9	76.9	76.9	77.8	
16	55	2.07	58	.13	48	2.07	28	.12	41	2.14	57	.12	74	76.0	76.0	76.0	76.0	76.0	76.0	76.9		
17	8	24	2.07	61	6	13	8	17	2.14	35	.13	8	9	2.14	62	4	.13	73	75.1	75.1	75.1	76.0
18	53	2.07	14	.13	45	2.07	43	.13	37	2.14	12	.13	72	74.2	74.2	74.2	74.2	74.2	74.2	75.1		
19	9	22	2.07	22	.15	9	14	2.14	51	.15	9	5	2.14	20	.15	71	73.3	73.3	73.3	73.3	74.2	
20	51	2.14	31	0.15	42	2.14	62	0	0.15	33	2.22	29	0.15	70	72.4	72.4	72.4	72.4	72.4	73.3		
21	10	19	2.07	40	.17	10	10	2.14	9	.17	10	0	2.14	38	.17	69	71.5	71.5	71.5	71.5	72.4	
22	48	2.14	50	.18	38	2.14	19	.17	19	2.22	48	.17	68	70.6	70.6	70.6	70.6	70.6	70.6	71.5		
23	11	16	2.14	62	1	.18	11	6	2.22	29	.18	55	2.22	58	.18	67	69.7	69.7	69.7	69.7	70.6	
24	44	2.14	12	.18	33	2.14	40	.18	11	22	2.22	63	9	.18	66	68.8	68.8	68.8	68.8	69.7		
25	12	12	2.14	23	0.20	12	1	2.22	51	0.20	49	2.22	20	0.18	65	67.9	67.9	67.9	67.9	68.8		
26	40	2.22	35	.20	28	2.22	63	3	.20	12	16	2.22	31	.20	64	67.0	67.0	67.0	67.0	67.9		
27	13	7	2.22	47	.20	55	2.22	15	.20	43	2.31	43	.20	63	66.1	66.1	66.1	66.1	66.1	67.0		
28	34	2.22	59	.22	13	22	2.22	27	.22	13	9	2.31	55	.22	62	65.2	65.2	65.2	65.2	66.1		
29	14	1	2.22	63	12	.23	14	49	2.31	40	.23	36	2.31	64	8	.22	61	64.2	64.2	64.2	65.2	
30	28	2.22	26	0.23	14	15	2.31	54	0.23	14	2	2.31	21	0.23	60	63.3	63.3	63.3	63.3	64.2		
31	55	2.22	40	.25	41	2.31	64	8	.23	28	2.40	35	.23	59	62.4	62.4	62.4	62.4	62.4	63.3		
32	15	22	2.31	55	.25	15	7	2.31	22	.25	53	2.31	49	.25	58	61.5	61.5	61.5	61.5	62.4		
33	48	2.31	64	10	.25	33	2.31	37	.25	15	19	2.40	65	4	.25	57	60.5	60.5	60.5	60.5	61.5	
34	16	14	2.31	25	.27	59	2.40	52	.27	44	2.40	19	.27	56	59.6	59.6	59.6	59.6	59.6	60.5		
35	40	2.31	41	0.28	16	24	2.40	65	8	0.27	16	9	2.40	35	0.27	55	58.6	58.6	58.6	58.6	59.6	
36	17	6	2.40	58	.28	49	2.40	24	.28	34	2.50	51	.27	54	57.7	57.7	57.7	57.7	57.7	58.6		
37	31	2.40	65	15	.28	17	14	2.40	41	.28	58	2.50	66	7	.28	53	56.7	56.7	56.7	56.7	57.7	
38	56	2.40	32	.30	39	2.50	58	.30	17	22	2.50	24	.30	52	55.8	55.8	55.8	55.8	55.8	56.7		
39	18	21	2.50	50	.30	18	3	2.50	66	16	.30	46	.30	51	54.8	54.8	54.8	54.8	54.8	55.8		
40	45	2.50	66	8	0.32	27	2.50	34	0.32	18	10	2.61	67	0	0.30	50	53.9	53.9	53.9	53.9	54.8	
41	19	9	2.50	27	.33	51	2.61	53	.32	33	2.61	18	.32	49	52.9	52.9	52.9	52.9	52.9	53.9		
42	33	2.61	47	.33	19	14	2.61	67	12	.32	56	2.61	37	.32	48	51.9	51.9	51.9	51.9	52.9		
43	56	2.61	67	7	.33	37	2.61	31	.33	19	19	2.73	56	.33	47	50.9	50.9	50.9	50.9	51.9		
44	20	19	2.61	27	.35	20	0	2.61	51	.35	41	2.73	68	16	.33	46	50.0	50.0	50.0	50.0	50.9	
45	42		48		23			68	12		20	3		45		49.0	49.0	49.0	49.0	49.0	50.0	

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

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

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

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

B	$a = 61^\circ 30'$					$a = 62^\circ 0'$					$a = 62^\circ 30'$					C	β															
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$																	
		t	t	t	t		t	t	t	t		t																				
45	19	43	2.86	69	0	0.33	19	23	2.86	69	24	0.33	19	3	2.86	69	47	0.33	45	48.6												
46	20	4	2.86	20	0	.35	44	2.86	44	24	.33	24	3.00	70	7	.33	44	.33	44	47.6												
47	25	4	2.86	41	.35		20	5	3.00	70	4	.35	44	3.00	27	.35	43	.35	43	46.6												
48	46	4	3.00	70	2	.37	25	3.00	25	.35	.35	20	4	3.00	48	.35	42	.35	42	45.6												
49	21	6	3.00	24	.37		45	3.00	45	.37		24	3.16	71	9	.35	41	.35	41	44.6												
50		26	3.00	46	0.37		21	5	3.16	71	8	0.37	43	3.16	30	0.37	40	0.37	40	43.5												
51		46	3.16	71	8	.38	24	3.16	30	.37		21	2	3.33	52	.37	39	.37	39	42.5												
52	22	5	3.16	31	.38		43	3.33	52	.38		20	3.33	72	14	.37	38	.37	38	41.5												
53	24	5	3.16	54	.40		22	1	3.33	72	15	.40	38	3.33	36	.38	37	.38	37	40.5												
54		43	3.33	72	18	.40	19	3.33	39	.38		56	3.53	59	.38	36	.38	36	.38	36	39.5											
55	23	1	3.53	42	0.42		37	3.53	73	2	0.40	22	13	3.53	73	22	0.40	35	0.40	35	38.4											
56		18	3.53	73	7	.42	54	3.53	26	.42		30	3.53	46	.40	34	.40	34	.40	34	37.4											
57		35	3.53	32	.42		23	11	3.53	51	.42	47	3.75	74	10	.42	33	.42	33	.42	33	36.3										
58		52	3.75	57	.43		28	3.75	74	16	.42	23	3	3.75	35	.42	32	.42	32	.42	32	35.3										
59	24	8	3.75	74	23	.43	44	4.00	41	.43		19	4.00	75	0	.42	31	.42	31	.42	31	34.2										
60		24	3.75	49	0.43		59	4.00	75	7	0.43	34	4.00	25	0.42	30	0.42	30	0.42	30	33.2											
61		40	4.00	75	15	.45	24	14	4.00	33	.43	49	4.00	50	.43	29	.43	29	.43	29	32.1											
62		55	4.00	42	.45		29	4.00	59	.45		24	4	4.29	76	16	.43	28	.43	28	31.0											
63	25	10	4.29	76	9	.47	44	4.29	76	26	.45	18	4.62	42	.45	27	.45	27	.45	27	30.0											
64		24	4.29	37	.47		58	4.62	53	.45		31	4.62	77	9	.45	26	.45	26	.45	26	28.9										
65		38	4.62	77	5	0.47	25	11	4.62	77	20	0.47	44	4.62	36	0.45	25	0.45	25	0.45	25	27.8										
66		51	5.00	33	.47		24	5.00	48	.47		44	5.00	78	3	.45	24	.45	24	.45	24	26.8										
67	26	3	5.00	78	1	.48	36	5.00	78	16	.47	25	9	5.00	30	.47	23	.47	23	.47	23	25.7										
68		15	5.00	30	.48		48	5.00	44	.48		21	5.45	58	.47	22	.47	22	.47	22	.47	22	24.6									
69		27	5.45	59	.50		26	0	5.45	79	13	.48	32	5.45	79	26	.47	21	.47	21	.47	21	23.5									
70		38	5.45	79	29	0.50	11	6.00	42	0.48		43	6.00	54	0.48	20	0.48	20	0.48	20	0.48	20	22.4									
71		49	6.00	59	.50		21	6.00	80	11	.48	26	53	6.00	80	23	.48	19	.48	19	.48	19	21.3									
72		59	6.00	80	29	.50	31	6.00	40	.50		26	3	6.67	52	.48	18	.48	18	.48	18	.48	18	20.2								
73	27	9	6.67	59	.50		41	6.67	81	10	.50	12	6.67	81	21	.48	17	.48	17	.48	17	.48	17	19.1								
74		18	6.67	81	29	.52	50	7.50	40	.50		21	7.50	50	.50	16	.50	16	.50	16	.50	16	.50	16	18.0							
75		27	7.50	82	0	0.52	58	7.50	82	10	0.50	29	7.50	82	20	0.48	15	0.48	15	0.48	15	0.48	15	0.48	15	16.9						
76		35	8.57	31	.52		27	6	8.57	40	.52	37	8.57	49	.50	14	.50	14	.50	14	.50	14	.50	14	.50	14	15.8					
77		42	8.57	83	2	.52	13	8.57	83	11	.50	44	8.57	83	19	.50	13	.50	13	.50	13	.50	13	.50	13	.50	13	14.7				
78		49	8.57	33	.53		20	10.0	41	.52		51	10.0	49	.52	12	.52	12	.52	12	.52	12	.52	12	.52	12	.52	12	13.5			
79		56	10.0	84	5	.53	26	10.0	84	12	.52	57	10.0	84	20	.50	11	.50	11	.50	11	.50	11	.50	11	.50	11	.50	11	12.4		
80	28	2	12.0	37	0.53		32	12.0	43	0.53		27	3	12.0	50	0.52	10	0.52	10	0.52	10	0.52	10	0.52	10	0.52	10	0.52	10	11.3		
81		7	12.0	85	9	.53	37	12.0	85	15	.52	8	12.0	85	21	.50	9	.50	9	.50	9	.50	9	.50	9	.50	9	.50	9	10.2		
82		12	15.0	41	.53		42	15.0	46	.53		13	15.0	51	.52	8	.52	8	.52	8	.52	8	.52	8	.52	8	.52	8	9.0			
83		16	15.0	86	13	.53	46	15.0	86	18	.52	17	20.0	86	22	.52	7	.52	7	.52	7	.52	7	.52	7	.52	7	.52	7	7.9		
84		20	20.0	45	.53		50	20.0	49	.53		20	20.0	53	.52	6	.52	6	.52	6	.52	6	.52	6	.52	6	.52	6	.52	6	6.8	
85		23	30.0	87	17	0.55	53	20.0	87	21	0.52	23	20.0	87	24	0.52	5	0.52	5	0.52	5	0.52	5	0.52	5	0.52	5	0.52	5	5.7		
86		25	30.0	50	.55		56	30.0	52	.53		26	30.0	55	.52	4	.52	4	.52	4	.52	4	.52	4	.52	4	.52	4	.52	4	4.5	
87		27	30.0	88	22	.55	58	60.0	88	24	.53	28	60.0	88	26	.53	3	.53	3	.53	3	.53	3	.53	3	.53	3	.53	3	3.4		
88		29	60.0	55	.53		59	60.0	56	.53		29	60.0	58	.52	2	.52	2	.52	2	.52	2	.52	2	.52	2	.52	2	.52	2	2.3	
89		30	—	89	27	.55	28	0	—	89	28	.53	30	—	89	29	.52	1	.52	1	.52	1	.52	1	.52	1	.52	1	.52	1	1.1	
90		30		90	0		0		90	0		30		90	0		0		0		0		0		0		0		0		0	0.0

b	a = 63° 0'					a = 63° 30'					a = 64° 0'					c	α			
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t
0	0	0	2.22	63	0	0.00	0	0	2.22	63	30	0.00	0	0	2.31	64	0	0.00	90	90.0
1		27	2.22		0	.02	0	27	2.22		30	.02	0	26	2.22		0	.02	89	89.1
2		54	2.14		1	.02		54	2.31		31	.02		53	2.31		1	.02	88	88.2
3	1	22	2.22	2		.02	1	20	2.22	2		.02	1	19	2.31	2		.02	87	87.3
4		49	2.22		3	.03		47	2.22		33	.03		45	2.31		3	.03	86	86.4
5	2	16	2.22		5	0.03	2	14	2.31		35	0.03	2	11	2.22		5	0.03	85	85.5
6		43	2.22		7	.05		40	2.22		37	.05		38	2.31		7	.05	84	84.6
7	3	10	2.22	10		.05	3	7	2.22	40		.05	3	4	2.31	10		.05	83	83.7
8		37	2.22		13	.07		34	2.31		43	.07		30	2.31		13	.07	82	82.8
9	4	4	2.22		17	.07	4	0	2.22		47	.07		56	2.31		17	.07	81	81.9
10		31	2.22		21	0.08		27	2.31		51	0.07	4	22	2.31	21		0.07	80	81.0
11		58	2.22		26	.08		53	2.22		55	.08		48	2.31		25	.08	79	80.1
12	5	25	2.22	31		.08	5	20	2.31	64		.08	5	14	2.31	30		.08	78	79.2
13		52	2.31		36	.10		46	2.31		5	.10		40	2.40		35	.08	77	78.3
14	6	18	2.22		42	.10	6	12	2.31		11	.10		6	5	2.31	40	.10	76	77.4
15		45	2.31		48	0.10		38	2.31		17	0.12		31	2.40		46	0.12	75	76.5
16	7	11	2.22		54	.12	7	4	2.31		24	.12		56	2.31		53	.12	74	75.6
17		38	2.31	64		.13		30	2.31		31	.12	7	22	2.40		50	.12	73	74.7
18	8	4	2.31		9	.13		56	2.40		38	.13		47	2.40		7	.13	72	73.8
19		30	2.31		17	.13	8	21	2.31		46	.13		8	12	2.40	15	.13	71	72.9
20		56	2.31		25	0.15		47	2.40		54	0.13		37	2.40		23	0.13	70	72.0
21	9	22	2.31		34	.15	9	12	2.40	65		.15	9	2	2.40	31		.15	69	71.0
22		48	2.40		43	.15		37	2.40		11	.17		27	2.40		40	.15	68	70.1
23	10	13	2.31		52	.17	10	2	2.40		21	.17		52	2.50		49	.17	67	69.2
24		39	2.40	65		.18		27	2.40		31	.17		10	16	2.40	59	.17	66	68.3
25	11	4	2.40		13	0.18		52	2.40		41	0.18		41	2.50	66		0.18	65	67.3
26		29	2.40		24	.18	11	17	2.50		52	.18		11	5	2.50	20	.18	64	66.4
27		54	2.40		35	.20		41	2.50	66		.18		29	2.50		31	.18	63	65.5
28	12	19	2.50		47	.20	12	5	2.50		14	.20		53	2.61	42		.20	62	64.6
29		43	2.50		59	.20		29	2.50		26	.22		12	16	2.50	54	.20	61	63.6
30	13	7	2.50	66		0.22		53	2.50		39	0.22		40	2.61	67		0.22	60	62.7
31		31	2.50		24	.23	13	17	2.50		52	.22		13	3	2.61	19	.22	59	61.7
32		55	2.50		38	.23		41	2.61	67		.23		26	2.61		32	.22	58	60.8
33	14	19	2.50		52	.23	14	4	2.61		19	.23		49	2.61		45	.23	57	59.8
34		43	2.61	67		.25		27	2.61		33	.23		14	12	2.73	59	.23	56	58.9
35	15	6	2.61		21	0.25		50	2.73		47	0.25		34	2.73	68		0.25	55	57.9
36		29	2.61		36	.25	15	12	2.73	68		.25		56	2.73		28	.25	54	57.0
37		52	2.73		51	.27		34	2.73		17	.27		15	18	2.73	43	.27	53	56.0
38	16	14	2.73	68		.28		56	2.73		33	.27		40	2.86		59	.27	52	55.0
39		36	2.73		24	.28	16	18	2.73		49	.28		16	1	2.86	69	.27	51	54.1
40		58	2.73		41	0.28		40	2.86	69		0.28		22	2.86		31	0.28	50	53.1
41	17	20	2.86		58	.30	17	1	2.86		23	.28		43	2.86		48	.28	49	52.1
42		41	2.86	69		.30		22	2.86		40	.30		17	4	3.00	70	.28	48	51.1
43	18	2	2.86		34	.30		43	3.00		58	.30		24	3.00		22	.30	47	50.2
44		23	2.86		52	.32	18	3	3.00	70		.32		44	3.00		40	.30	46	49.2
45		44		70				23						18	4				58	48.2

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

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

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

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

B	a = 66° 0'					a = 66° 30'					a = 67° 0'					C	c	α			
	h	d	60'	Z	t	h	d	60'	Z	t	h	d	60'	Z	t						
		Δ	60'		Δ		60'	Δ		60'		Δ	60'								
0	0	0	2.50	66	0	0.00	0	0	2.50	66	30	0.00	0	0	2.61	67	0	0.00	90	90.0	
1		24	2.40		0	.02	24	2.50		30	.02		23	2.50		0	.02		89	89.1	
2		49	2.50		1	.02	48	2.50		31	.02		47	2.61		1	.02		88	88.2	
3	1	13	2.40		2	.02	1	12	2.50		32	.02	1	10	2.50		2	.02	87	87.2	
4		38	2.50		3	.03	36	2.50		33	.03		34	2.61		3	.03		86	86.3	
5	2	2	2.50		5	0.03	2	0	2.61		35	0.03		57	2.61		5	0.03	85	85.4	
6		26	2.50		7	.03	23	2.50		37	.03	2	20	2.50		7	.03		84	84.5	
7		50	2.40		9	.05	47	2.50		39	.05		44	2.61		9	.05		83	83.6	
8	3	15	2.50		12	.07	3	11	2.50		42	.05	3	7	2.61		12	.05	82	82.7	
9		39	2.50		16	.07	35	2.61		45	.07		30	2.61		15	.07		81	81.7	
10	4	3	2.50		20	0.07	58	2.50		49	0.07		53	2.61		19	0.07		80	80.8	
11		27	2.50		24	.07	4	22	2.61		53	.07	4	16	2.61		23	.07	79	79.9	
12		51	2.50		28	.08	45	2.50		57	.08		39	2.61		27	.08		79	79.0	
13	5	15	2.50		33	.08	5	9	2.61		67	2	.08	5	2	2.61		32	.08	77	78.0
14		39	2.50		38	.10	32	2.61		7	.10		25	2.61		37	.08		76	77.1	
15	6	3	2.61		44	0.10	55	2.61		13	0.10		48	2.61		42	0.10		75	76.2	
16		26	2.50		50	.10	6	18	2.61		19	.10	6	11	2.61		48	.10	74	75.3	
17		50	2.61		56	.12	4	1	2.61		25	.12		34	2.73		54	.12	73	74.3	
18	7	13	2.50		67	3	.12	7	4	2.61		32	.12	5	19	2.61		1	.12	72	73.4
19		37	2.61		10	.13	27	2.61		39	.12		7	16	2.73		8	.12	71	72.5	
20	8	0	2.61		18	0.13	50	2.61		46	0.13		41	2.73		15	0.13		70	71.5	
21		23	2.61		26	.13	8	13	2.61		54	.13	8	3	2.73		23	.13	69	70.6	
22		46	2.61		34	.15	36	2.73		68	2	.15		25	2.73		31	.13	68	69.7	
23	9	9	2.73		43	.15	58	2.73		11	.15		47	2.73		39	.15	67	68.7		
24		31	2.61		52	.17	9	20	2.73		20	.15	9	9	2.86		48	.15	66	67.8	
25	54	2.73		68	2	0.17	42	2.73		29	0.17		30	2.73		57	0.17		65	66.8	
26	10	16	2.73		12	.17	10	4	2.73		39	.17		52	2.86		7	.17	64	65.9	
27		38	2.73		22	.17	26	2.73		49	.18	10	13	2.86		17	.17	63	65.0		
28	11	0	2.73		32	.18	48	2.86		69	0	.18		34	2.86		27	.18	62	64.0	
29		22	2.73		43	.20	11	9	2.86		11	.18		55	2.86		38	.18	61	63.1	
30	44	2.73		55	0.20		30	2.86		22	0.20	11	16	2.86		49	0.18		60	62.1	
31	12	6	2.86		69	7	.20	51	2.86		34	.20		37	3.00		70	0	.20	59	61.1
32		27	2.86		19	.20	12	12	2.86		46	.20		57	3.00		12	.20	58	60.2	
33		48	2.86		31	.22	33	3.00		58	.22	12	17	3.00		24	.22	57	59.2		
34	13	9	2.86		44	.23	53	3.00		70	11	.22		37	3.00		37	.22	56	58.3	
35	30	3.00		58	0.23	13	13	3.00		24	0.22		57	3.00		50	0.22		55	57.3	
36		50	3.00		70	12	.23	33	3.00		37	.23	13	17	3.16		71	3	.22	54	56.3
37	14	10	3.00		26	.23	53	3.00		51	.23		36	3.16		16	.23	53	55.4		
38		30	3.00		40	.25	14	13	3.16		71	5	.25	55	3.16		30	.23	52	54.4	
39	3	50	3.16		55	.25	32	3.16		20	.25	14	14	3.16		44	.25	51	53.4		
40	15	9	3.16		71	10	0.27	51	3.16		35	0.25		33	3.33		59	0.25	50	52.4	
41		28	3.16		26	.27	15	10	3.16		50	.27		51	3.33		72	14	.25	49	51.4
42		47	3.16		42	.27	29	3.33		72	6	.27	15	9	3.33		29	.27	48	50.5	
43	16	6	3.16		58	.27	47	3.33		22	.27		27	3.33		45	.27	47	49.5		
44		25	3.33		72	14	.28	16	5	3.33		38	.28	45	3.53		73	1	.28	46	48.5
45		43			31		23			55			16	2			18		45	47.5	

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

B	$a = 66^\circ 0'$					$a = 66^\circ 30'$					$a = 67^\circ 0'$					C	α	β		
	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t	h	d	$\frac{60'}{\Delta}$	Z	t				$\frac{\Delta}{60'}$	
		Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ		Δ	Δ	Δ	Δ					Δ
45	16	43	3.33	72	31	0.30	16	23	3.53	72	55	0.28	16	2	3.53	73	18	0.27	45	47.5
46	17	1	3.53	49	30	0.30	17	40	3.53	73	12	0.28	17	9	3.53	34	28	0.28	44	46.5
47	18	18	3.53	73	7	0.30	18	57	3.53	29	30	0.30	18	16	3.53	51	28	0.28	43	45.5
48	35	3.53	25	30	0.30	17	14	3.53	47	30	0.30	17	53	3.75	74	8	0.30	42	44.5	
49	52	3.53	43	32	0.32	31	3.75	74	5	0.30	17	9	3.75	26	0.30	41	43.5			
50	18	9	3.75	74	2	0.32	18	47	3.75	23	0.32	18	25	3.75	44	0.32	40	42.5		
51	25	3.75	21	32	0.32	18	3	3.75	42	0.32	41	4.00	75	3	0.32	39	41.4			
52	41	3.75	40	33	0.33	19	19	4.00	75	1	0.32	18	56	4.00	21	0.32	38	40.4		
53	57	3.75	75	0	0.33	34	4.00	20	20	0.33	18	11	4.00	40	0.32	37	39.4			
54	19	13	4.00	20	0.33	49	4.00	40	40	0.33	26	4.29	59	0.33	36	38.4				
55	28	4.00	40	0.35	19	4	4.29	76	0	0.33	40	4.29	76	19	0.33	35	37.4			
56	43	4.29	76	1	0.35	18	4.29	20	20	0.35	54	4.29	39	0.33	34	36.3				
57	57	4.29	22	0.35	32	4.29	41	0.35	19	8	4.62	59	0.33	33	35.3					
58	20	11	4.62	43	0.37	46	4.62	77	2	0.35	21	4.62	77	19	0.35	32	34.3			
59	24	4.62	77	5	0.37	59	4.62	23	23	0.35	34	4.62	40	0.35	31	33.2				
60	37	4.62	27	0.37	20	12	4.62	44	0.37	47	5.00	78	1	0.35	30	32.2				
61	50	4.62	49	0.37	25	5.00	78	6	0.37	59	5.00	22	0.37	29	31.2					
62	21	3	5.00	78	11	0.38	37	5.00	28	0.37	20	11	5.00	44	0.37	28	30.1			
63	15	5.00	34	0.38	49	5.45	50	0.37	23	5.45	79	6	0.37	27	29.1					
64	27	5.45	57	0.38	21	0	5.45	79	12	0.38	34	5.45	28	0.37	26	28.0				
65	38	5.45	79	20	0.40	11	5.45	35	0.38	45	6.00	50	0.37	25	27.0					
66	49	6.00	44	0.40	22	6.00	58	0.38	55	6.00	80	12	0.38	24	25.9					
67	59	6.00	80	8	0.40	32	6.00	80	21	0.40	21	5	6.00	35	0.38	23	24.8			
68	22	9	6.00	32	0.40	42	6.67	45	0.40	15	6.67	58	0.38	22	23.8					
69	19	6.67	56	0.40	51	6.67	81	9	0.40	24	6.67	81	21	0.38	21	22.7				
70	28	6.67	81	20	0.42	22	0	6.67	33	0.40	33	7.50	44	0.40	20	21.6				
71	37	7.50	45	0.42	9	7.50	57	0.40	41	7.50	82	8	0.40	19	20.6					
72	45	7.50	82	10	0.42	17	7.50	82	21	0.40	49	7.50	32	0.40	18	19.5				
73	53	7.50	35	0.42	25	8.57	45	0.42	57	8.57	56	0.40	17	18.4						
74	23	1	8.57	83	0	32	8.57	83	10	0.42	22	4	8.57	83	20	0.40	16	17.4		
75	8	8.57	26	0.42	39	8.57	35	0.42	11	10.0	44	0.40	15	16.3						
76	15	10.0	51	0.43	46	10.0	84	0	17	10.0	84	8	0.42	14	15.2					
77	21	10.0	84	17	0.43	52	10.0	25	0.42	23	12.0	33	0.40	13	14.1					
78	27	12.0	43	0.43	58	12.0	50	0.42	28	12.0	57	0.42	12	13.1						
79	32	12.0	85	9	0.43	23	3	12.0	85	15	43	85	22	11	12.0					
80	37	15.0	35	0.43	8	15.0	41	0.42	38	15.0	47	0.42	10	10.9						
81	41	15.0	86	1	0.43	12	15.0	86	6	0.43	42	15.0	86	12	0.42	9	9.8			
82	45	15.0	27	0.45	16	20.0	32	0.43	46	20.0	37	0.42	8	8.7						
83	49	20.0	54	0.43	19	20.0	58	0.43	49	20.0	87	2	0.43	7	7.6					
84	52	30.0	87	20	0.45	22	30.0	87	24	0.43	52	30.0	28	0.42	6	6.5				
85	54	30.0	47	0.43	24	30.0	50	0.43	54	30.0	53	0.42	5	5.5						
86	56	30.0	88	13	0.45	26	30.0	88	16	0.43	56	30.0	88	18	0.43	4	4.4			
87	58	60.0	40	0.45	28	60.0	42	0.43	58	60.0	44	0.42	3	3.3						
88	59	60.0	89	7	0.43	29	60.0	89	8	0.43	59	60.0	89	9	0.42	2	2.2			
89	24	0	33	0.45	30	—	34	0.43	23	0	34	0.43	1	1.1						
90	0	—	90	0	—	30	—	90	0	—	0	—	90	0	—	0	0.0			

t	$a = 66^\circ 0'$		$a = 66^\circ 30'$		$a = 67^\circ 0'$		a
	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	
	$d = 66^\circ 0'$		$d = 66^\circ 30'$		$d = 67^\circ 0'$		

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

b	a = 67° 30'				a = 68° 0'				a = 68° 30'				c	α								
	h	d 60' Δ	Z	t 60'	h	d 60' Δ	Z	t 60'	h	d 60' Δ	Z	t 60'			C	β						
45	15	42	3.53	73	41	0.27	15	22	3.75	74	3	0.27	15	1	3.75	74	26	0.27	45	47.2		
46		59	3.75		57	.28		38	3.75		19	.28		17	3.75		42	.27	44	46.2		
47	16	15	3.75	74	14	.28		54	3.75	36	.27			33	4.00		58	.27	43	45.2		
48		31	3.75		31	.28	16	10	3.75	52	.28			48	4.00		75	14	.28	42	44.2	
49		47	3.75		48	.30		26	4.00	75	9	.28		16	3	4.00		31	.28	41	43.2	
50	17	3	4.00	75	6	0.30		41	4.00		26	0.30		18	4.00		48	0.28	40	42.1		
51		18	4.00		24	.30		56	4.29	44	.30			33	4.29		76	5	.28	39	41.1	
52		33	4.00		42	.30	17	10	4.29	76	2	.30		47	4.29		22	.30	38	40.1		
53		48	4.29	76	0	.32		24	4.29	20	.30			17	1	4.29		40	.30	37	39.1	
54	18	2	4.29		19	.32		38	4.29	38	.32			15	4.62		58	.30	36	38.1		
55		16	4.29		38	0.32		52	4.29	57	0.32			28	4.62		77	16	0.32	35	37.1	
56		30	4.62		57	.33	18	8	4.62	77	16	.32		41	4.62		35	.32	34	36.0		
57		43	4.62	77	17	.33		19	4.62	35	.33			54	5.00		54	.32	33	35.0		
58		56	4.62		37	.33		32	5.00	55	.33			18	6	5.00		78	13	.32	32	34.0
59	19	9	5.00		57	.35		44	5.00	78	15	.33		18	5	5.00		32	.32	31	32.9	
60		21	5.00	78	18	0.35		56	5.00	35	0.33			30	5.00		51	0.33	30	31.9		
61		33	5.00		39	.35	19	8	5.45	55	.35			42	5.45		79	11	.33	29	30.9	
62		45	5.45	79	0	.35		19	5.45	79	16	.35		53	5.45		31	.33	28	29.8		
63		56	5.45		21	.35		30	5.45	37	.35			19	4	6.00		51	.35	27	28.8	
64	20	7	5.45		42	.37		41	6.00	58	.35			14	6.00		80	12	.35	26	27.7	
65		18	6.00	80	4	0.37		51	6.00	80	19	0.35		24	6.00		33	0.35	25	26.7		
66		28	6.00		26	.37	20	1	6.67	40	.37			34	6.67		54	.35	24	25.7		
67		38	6.67		48	.38		10	6.67	81	2	.37		43	6.67		81	15	.35	23	24.6	
68		47	6.67	81	11	.37		19	6.67	24	.37			52	6.67		36	.37	22	23.5		
69		56	6.67		33	.38		28	6.67	46	.37			20	1	7.50		58	.37	21	22.5	
70	21	5	7.50		56	0.38		37	7.50	82	8	0.37		9	7.50		82	20	0.37	20	21.4	
71		13	7.50	82	19	.38		45	8.57	30	.38			17	8.57		42	.37	19	20.4		
72		21	8.57		42	.40		52	8.57	53	.38			24	8.57		83	4	.37	18	19.3	
73		28	8.57	83	6	.38		59	8.57	83	16	.38		31	8.57		26	.37	17	18.3		
74		35	8.57		29	.40	21	6	8.57	39	.38			38	10.0		48	.38	16	17.2		
75		42	10.0		53	0.40		13	10.0	84	2	0.38		44	10.0		84	11	0.37	15	16.1	
76		48	10.0	84	17	.40		19	10.0	25	.38			50	12.0		33	.38	14	15.1		
77		54	12.0		41	.40		25	12.0	48	.40			55	12.0		56	.38	13	14.0		
78		59	12.0	85	5	.40		30	12.0	85	12	.40		21	0	12.0		85	19	.38	12	12.9
79	22	4	15.0		29	.40		35	15.0	36	.38			5	15.0		42	.38	11	11.8		
80		8	15.0		53	0.40		39	15.0	59	0.40			9	15.0		86	5	0.38	10	10.8	
81		12	15.0	86	17	.42		43	15.0	86	23	.40		13	15.0		28	.40	9	9.7		
82		16	20.0		42	.42		47	20.0	47	.40			17	20.0		52	.38	8	8.6		
83		19	20.0	87	7	.40		50	20.0	87	11	.40		20	20.0		87	15	.40	7	7.5	
84		22	20.0		31	.42		53	30.0	35	.40			23	30.0		39	.38	6	6.5		
85		25	30.0		56	0.42		55	30.0	59	0.40			25	30.0		88	2	0.40	5	5.4	
86		27	60.0	88	21	.40		57	60.0	88	23	.40		27	60.0		26	.38	4	4.3		
87		28	60.0		45	.42		58	60.0	47	.42			28	60.0		49	.40	3	3.2		
88		29	60.0	89	10	.42		59	60.0	89	12	.40		29	60.0		89	13	.38	2	2.2	
89		30	—		35	.42	22	0	—	36	.40			30	—		36	.40	1	1.1		
90		30	—	90	0	—		0	—	90	0	—		30	—		90	0	0	0.0		

B	a = 69° 0'				a = 69° 30'				a = 70° 0'				C	β						
	h	d	60' / Δ	t / Z	Δ / 60'	h	d	60' / Δ	t / Z	Δ / 60'	h	d			60' / Δ	t / Z	Δ / 60'			
0	0	0	2.73	69	0	0.00	0	0	2.86	69	30	0.00	0	0	2.86	70	0	0.00	90	90.0
1		22	2.86		0	.02	21	2.86	30	.02	21	3.00	0	0	.02	89	.02	89	89.1	
2		43	2.73		1	.02	42	2.86	31	.02	41	2.86		1	.02	88		88	88.1	
3	I	5	2.86		2	.02	I 3	2.86	32	.02	I 2	3.00		2	.02	87		87	87.2	
4		26	2.86		3	.02	24	2.86	33	.02	22	2.86		3	.02	86		86	86.3	
5		47	2.73		4	0.03	45	2.86	34	0.03	43	3.00		4	0.03	85		85	85.3	
6	2	9	2.86		6	.03	2 6	2.86	36	.03	2 3	3.00		6	.03	84		84	84.4	
7		30	2.73		8	.05	27	2.86	38	.05	23	2.86		8	.05	83		83	83.4	
8		52	2.86		11	.05	48	2.86	41	.05	44	3.00		11	.05	82		82	82.5	
9	3	13	2.86		14	.05	3 9	3.00	44	.05	3 4	3.00		14	.05	81		81	81.6	
10		34	2.86		17	0.07	29	2.86	47	0.07	24	2.86		17	0.07	80		80	80.6	
11		55	2.86		21	.07	50	2.86	51	.07	45	3.00		21	.07	79		79	79.7	
12	4	16	2.86		25	.07	4 11	3.00	55	.07	4 5	3.00		24	.07	78		78	78.7	
13		37	2.86		29	.08	31	2.86	59	.08	25	3.00		28	.08	77		77	77.8	
14		58	2.86		34	.08	52	3.00	70	.08	45	3.00		33	.08	76		76	76.8	
15	5	19	2.86		39	0.10	5 12	2.86	9	0.08	5 5	3.00		38	0.08	75		75	75.9	
16		40	2.86		45	.10	33	3.00	14	.10	25	3.16		43	.10	74		74	75.0	
17	6	1	2.86		51	.10	53	3.00	20	.10	44	3.00		49	.10	73		73	74.0	
18		22	3.00		57	.10	6 13	3.00	26	.10	6 4	3.00		55	.10	72		72	73.1	
19		42	2.86	70	3	.12	33	3.00	32	.12	24	3.16	71	1	.10	71		71	72.1	
20	7	3	3.00		10	0.12	53	3.00	39	0.12	43	3.00		7	0.12	70		70	71.2	
21		23	3.00		17	.12	7 13	3.16	46	.12	7 3	3.16		14	.12	69		69	70.2	
22		43	3.00		24	.13	32	3.00	53	.13	22	3.16		21	.13	68		68	69.3	
23	8	3	3.00		32	.13	52	3.00	71	.13	41	3.16		29	.13	67		67	68.3	
24		23	3.00		40	.15	8 12	3.16	9	.13	8 0	3.16		37	.13	66		66	67.4	
25		43	3.16		49	0.15	51	3.16	17	0.15	19	3.16		45	0.13	65		65	66.4	
26	9	2	3.00		58	.15	30	3.16	26	.15	38	3.33		53	.15	64		64	65.4	
27		22	3.16	71	7	.17	9 9	3.16	35	.15	56	3.16	72	2	.15	63		63	64.5	
28		41	3.16		17	.17	28	3.16	44	.17	9 15	3.33		11	.15	62		62	63.5	
29	10	0	3.16		27	.17	47	3.33	54	.17	33	3.33		20	.17	61		61	62.6	
30		19	3.16		37	0.17	10 5	3.33	72	.17	4 17	3.33		30	0.17	60		60	61.6	
31		38	3.16		47	.18	23	3.33	14	.18	10 9	3.33		40	.18	59		59	60.6	
32		57	3.33		58	.18	41	3.33	25	.18	27	3.53		51	.18	58		58	59.7	
33	11	15	3.33	72	9	.20	59	3.33	36	.18	44	3.33	73	2	.18	57		57	58.7	
34		33	3.33		21	.20	11 17	3.33	47	.18	11 2	3.53		13	.18	56		56	57.7	
35		51	3.33		33	0.20	35	3.33	58	0.20	19	3.53		24	0.20	55		55	56.7	
36	12	9	3.33		45	.20	53	3.53	73	.20	36	3.53		36	.20	54		54	55.8	
37		27	3.33		57	.22	12 10	3.53	22	.22	53	3.75		48	.20	53		53	54.8	
38		45	3.53	73	10	.22	27	3.53	35	.22	12 9	3.53	74	0	.20	52		52	53.8	
39	13	2	3.53		23	.23	44	3.53	48	.22	26	3.75		12	.22	51		51	52.8	
40		19	3.53		37	0.23	13 1	3.75	74	.22	42	3.75		25	0.22	50		50	51.8	
41		36	3.53		51	.23	17	3.75	14	.23	58	3.75		38	.23	49		49	50.8	
42		53	3.75	74	5	.23	33	3.75	28	.23	13 14	4.00		52	.23	48		48	49.9	
43	14	9	3.75		19	.25	49	3.75	42	.25	29	4.00	75	6	.23	47		47	48.9	
44		25	3.75		34	.25	14 5	4.00	57	.23	44	4.00		20	.23	46		46	47.9	
45		41			49		20		75	11	59			34		45		45	46.9	
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a							
	d = 69° 0'				d = 69° 30'				d = 70° 0'				a							

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

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

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

b	a = 72° 0'				a = 72° 30'				a = 73° 0'				c	α									
	B	h	d 60' Δ	Z	t	Δ 60'	h	d 60' Δ	Z	t	Δ 60'	h			d 60' Δ	Z	t	Δ 60'	C	β			
0	0	0	3.16	72	0	0.00	0	0	3.33	72	30	0.00	0	0	3.33	73	0	0.00	90	90.0			
1		19	3.33	0	.02	18	3.33	30	.02	18	3.33	0	.02	18	3.33	0	.02	89	89.0				
2		37	3.16	1	.00	36	3.33	31	.00	35	3.33	1	.00	35	3.33	1	.00	88	88.1				
3		56	3.33	1	.02	54	3.33	31	.02	53	3.53	1	.02	53	3.53	1	.02	87	87.1				
4	I	14	3.16	2	.03	1	12	3.33	32	.03	1	10	3.33	2	.03	2	.03	86	86.2				
5		33	3.33	4	0.03	30	3.33	34	0.02	28	3.53	4	0.02	28	3.53	4	0.02	85	85.2				
6		51	3.33	6	.03	48	3.33	35	.03	45	3.33	5	.03	45	3.33	5	.03	84	84.3				
7	2	9	3.16	8	.03	2	6	3.33	37	.03	2	3	3.53	7	.03	7	.03	83	83.3				
8		28	3.33	10	.05	24	3.33	39	.05	20	3.53	9	.05	20	3.53	9	.05	82	82.4				
9		46	3.16	13	.05	42	3.33	42	.05	37	3.33	12	.05	37	3.33	12	.05	81	81.4				
10		3	5	3.33	16	0.05	3	0	3.53	45	0.05	55	3.53	15	0.05	80	80.5						
11		23	3.33	19	.05	17	3.33	48	.05	3	12	3.53	18	.05	18	.05	79	79.5					
12		41	3.33	22	.07	35	3.33	51	.07	29	3.53	21	.07	29	3.53	21	.07	78	78.5				
13		59	3.33	26	.07	53	3.53	55	.07	4	6	3.53	25	.07	4	6	3.53	77	77.6				
14	4	17	3.33	30	.07	4	10	3.33	59	.07	4	3	3.53	29	.07	4	3	3.53	76	76.6			
15		35	3.33	34	0.08	28	3.53	73	3	20	3.53	33	0.07	20	3.53	33	0.07	75	75.7				
16		53	3.33	39	.08	45	3.33	8	.08	37	3.53	37	.08	37	3.53	37	.08	74	74.7				
17	5	11	3.33	44	.08	5	3	3.53	13	.08	54	3.53	42	.08	54	3.53	42	.08	73	73.7			
18		29	3.53	49	.10	20	3.53	18	.10	5	11	3.53	47	.08	72	72.8							
19		46	3.33	55	.10	37	3.53	24	.10	28	3.75	52	.10	28	3.75	52	.10	71	71.8				
20	6	4	3.53	73	1	0.10	6	54	3.53	30	0.10	6	44	3.53	58	0.10	70	70.9					
21		21	3.33	7	.12	6	11	3.53	36	.10	6	1	3.75	74	4	.10	69	69.9					
22		39	3.53	14	.12	28	3.53	42	.12	17	3.53	10	.12	17	3.53	10	.12	68	68.9				
23		56	3.53	21	.12	45	3.53	49	.12	34	3.75	17	.12	34	3.75	17	.12	67	68.0				
24	7	13	3.53	28	.12	7	2	3.75	56	.12	50	3.75	24	.12	50	3.75	24	.12	66	67.0			
25		30	3.53	35	0.13	18	3.53	74	3	7	6	3.75	31	0.12	7	6	3.75	65	66.0				
26		47	3.53	43	.13	35	3.75	11	.13	22	3.75	38	.13	22	3.75	38	.13	64	65.1				
27	8	4	3.53	51	.13	51	3.75	19	.13	38	3.75	46	.13	38	3.75	46	.13	63	64.1				
28		21	3.75	59	.15	8	7	3.75	27	.13	54	4.00	54	.13	54	4.00	54	.13	62	63.1			
29		37	3.75	74	8	.15	23	3.75	35	.15	8	9	3.75	75	2	.13	61	62.1					
30		53	3.75	17	0.15	39	3.75	44	0.15	25	4.00	10	0.15	25	4.00	10	0.15	60	61.2				
31	9	9	3.75	26	.17	55	4.00	53	.15	40	4.00	19	.15	40	4.00	19	.15	59	60.2				
32		25	3.75	36	.17	9	10	3.75	75	2	55	4.00	28	.15	55	4.00	28	.15	58	59.2			
33		41	3.75	46	.17	26	4.00	11	.17	9	10	4.00	37	.15	9	10	4.00	37	.15	57	58.2		
34		57	3.75	56	.17	41	4.00	21	.17	25	4.29	46	.17	25	4.29	46	.17	56	57.2				
35	10	13	4.00	75	6	0.17	56	4.00	31	0.17	39	4.00	56	0.17	39	4.00	56	0.17	55	56.3			
36		28	4.00	16	.18	10	11	4.00	41	.18	54	4.29	76	6	54	4.29	76	6	54	55.3			
37		43	4.00	27	.18	26	4.29	52	.18	10	8	4.29	17	.17	10	8	4.29	17	.17	53	54.3		
38		58	4.00	38	.20	40	4.29	76	3	22	4.29	27	.18	22	4.29	27	.18	52	53.3				
39	11	13	4.00	50	.18	54	4.29	14	.18	36	4.29	38	.18	36	4.29	38	.18	51	52.3				
40		28	4.29	76	1	0.20	11	8	4.29	25	0.20	50	4.29	77	49	0.18	50	4.29	77	49	0.18	50	51.3
41		42	4.29	13	.22	22	4.29	37	.20	11	4	4.62	77	0	11	4	4.62	77	0	49	50.3		
42		56	4.29	26	.20	36	4.29	49	.20	17	4.62	12	.20	17	4.62	12	.20	48	49.3				
43	12	10	4.29	38	.22	50	4.62	77	1	30	4.62	24	.20	30	4.62	24	.20	47	48.4				
44		24	4.29	51	.22	12	3	4.62	13	.22	43	4.62	36	.20	43	4.62	36	.20	46	47.4			
45		38		77	4		16		26		56		48		56		48		45	46.4			
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a						
	d = 72° 0'				d = 72° 30'				d = 73° 0'				a										

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

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

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

B	$a = 75^\circ 0'$					$a = 75^\circ 30'$					$a = 76^\circ 0'$					C	β				
	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$						
		$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	$\frac{60'}{\Delta}$		Z	$\frac{\Delta}{60'}$	$\frac{60'}{\Delta}$	Z		$\frac{\Delta}{60'}$	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$						
0	0	0	3.75	75	0	0	0	4.00	75	30	0	0	0	4.00	76	0	0	0	0	90	90.0
1	0	16	4.00		0	0	15	4.00		30	0	0	15	4.29		0	0	0	0	89	89.0
2		31	3.75		1		30	4.00		31	0		29	4.00		0		0	0	88	88.1
3		47	4.00		1		45	4.00		31	0		44	4.29		1		0	0	87	87.1
4	I	2	3.75		2	I	0	4.00		32	0		58	4.00		2		0	0	86	86.1
5		18	4.00		3		15	4.00		33	0		I 13	4.29		3	0	0	0	85	85.2
6		33	3.75		5		30	4.00		34	0		27	4.29		4	0	0	0	84	84.2
7		49	4.00		6		45	4.00		36	0		41	4.00		6	0	0	0	83	83.2
8	2	4	4.00		8	2	0	4.00		38	0		56	4.29		8	0	0	0	82	82.3
9		19	3.75		10		15	4.00		40	0		2 10	4.00		10	0	0	0	81	81.3
10		35	4.00		13		30	4.29		43	0		25	4.29		12	0	0	0	80	80.3
11		50	4.00		16		44	4.00		45	0		39	4.29		15	0	0	0	79	79.3
12	3	5	4.00		19	3	0	4.00		48	0		53	4.29		18	0	0	0	78	78.4
13		20	4.00		22		3 14	4.29		51	0		3 7	4.29		21	0	0	0	77	77.4
14		35	4.00		25		28	4.00		55	0		21	4.29		24	0	0	0	76	76.4
15		50	4.00		29		43	4.29		58	0		35	4.29		27	0	0	0	75	75.5
16	4	5	4.00		33	4	0	4.00		57	0		49	4.29		31	0	0	0	74	74.5
17		20	4.00		38		4 12	4.29		7 7	0		4 3	4.29		35	0	0	0	73	73.5
18		35	4.00		42		26	4.00		11	0		17	4.29		40	0	0	0	72	72.5
19		50	4.00		47		41	4.29		16	0		31	4.29		44	0	0	0	71	71.6
20	5	5	4.29		52	5	0	4.29		20	0		45	4.29		49	0	0	0	70	70.6
21		19	4.00		57		5 9	4.29		25	0		59	4.62		54	0	0	0	69	69.6
22		34	4.29		76	3	0	4.29		31	0		5 12	4.29		59	0	0	0	68	68.6
23		48	4.00		9		37	4.29		37	0		26	4.62		77	4	0	0	67	67.7
24	6	3	4.29		15	6	0	4.62		43	0		39	4.62		10	0	0	0	66	66.7
25		17	4.29		21		6 4	4.29		49	0		52	4.62		16	0	0	0	65	65.7
26		31	4.29		27		18	4.29		55	0		6 5	4.62		22	0	0	0	64	64.7
27		45	4.29		34		32	4.62		77	1		18	4.62		28	0	0	0	63	63.7
28		59	4.29		41		45	4.62		8	0		31	4.62		35	0	0	0	62	62.8
29	7	13	4.62		48	7	0	4.62		15	0		44	4.62		42	0	0	0	61	61.8
30		26	4.29		56		7 11	4.62		22	0		57	4.62		49	0	0	0	60	60.8
31		40	4.62		77	4	0	4.62		30	0		7 10	5.00		56	0	0	0	59	59.8
32		53	4.62		12		37	4.62		38	0		22	5.00		78	4	0	0	58	58.8
33	8	6	4.62		20	8	0	4.62		46	0		34	5.00		11	0	0	0	57	57.8
34		19	4.62		28		8 3	4.62		54	0		46	5.00		19	0	0	0	56	56.9
35		32	4.62		37		16	5.00		78	2		58	5.00		27	0	0	0	55	55.9
36		45	4.62		46		28	5.00		11	0		8 10	5.00		36	0	0	0	54	54.9
37		58	5.00		55		40	5.00		20	0		22	5.00		44	0	0	0	53	53.9
38	9	10	5.00		78	4	0	5.00		29	0		34	5.00		53	0	0	0	52	52.9
39		22	5.00		14		9 4	5.00		38	0		46	5.45		79	2	0	0	51	51.9
40		34	5.00		24		16	5.45		47	0		57	5.45		11	0	0	0	50	50.9
41		46	5.00		34		27	5.00		57	0		9 8	5.45		21	0	0	0	49	49.9
42		58	5.00		44		39	5.45		79	7		19	5.45		30	0	0	0	48	48.0
43	10	10	5.00		55	10	0	5.45		17	0		30	5.45		40	0	0	0	47	47.9
44		22	5.45		79	5	0	5.45		28	0		41	6.00		50	0	0	0	46	46.9
45		33			16		12			38			51			80	0			45	45.9

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

B	$a = 76^\circ 30'$				$a = 77^\circ 0'$				$a = 77^\circ 30'$				C	α								
	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$	h	$\frac{60'}{\Delta}$	Z	$\frac{\Delta}{60'}$										
		$\frac{60'}{\Delta}$		Z		$\frac{\Delta}{60'}$		$\frac{60'}{\Delta}$		Z		$\frac{\Delta}{60'}$										
0	0	0	4.29	76	30	0.00	0	0	4.29	77	0	0.00	0	0	4.62	77	30	0.00	90	90.0		
1		14	4.29		30	.00		14	4.62		0	.00		13	4.62		30	.00	80	89.0		
2		28	4.29		30	.02		27	4.29		0	.02		26	4.62		30	.02	88	88.1		
3		42	4.29		31	.02		41	4.62		1	.02		39	4.62		31	.02	87	87.1		
4		56	4.29		32	.02		54	4.62		2	.02		52	4.62		32	.02	86	86.1		
5		1	4.29		33	0.02		1	7	4.29		3	0.02		1	5	4.62		33	0.02	85	85.1
6		14	4.29		34	.03		1	21	4.62		4	.03		18	4.62		34	.02	84	84.2	
7		28	4.29		36	.03		34	4.29		6	.02		31	4.62		35	.03	83	83.2		
8		42	4.29		38	.03		48	4.62		7	.03		44	5.00		37	.03	82	82.2		
9		56	4.62		40	.03		2	1	4.62		9	.03		56	4.62		39	.03	81	81.2	
10		19	4.29		42	0.03		14	4.29		11	0.05		2	9	4.62		41	0.03	80	80.3	
11		33	4.29		44	.05		28	4.62		14	.03		22	4.62		43	.05	79	79.3		
12		47	4.29		47	.05		41	4.62		16	.05		35	5.00		46	.05	78	78.3		
13		3	4.62		50	.05		54	4.62		19	.05		47	4.62		49	.05	77	77.3		
14		14	4.29		53	.07		3	7	4.62		22	.07		3	0	4.62		52	.05	76	76.3
15		28	4.29		57	0.05		20	4.62		26	0.05		13	5.00		55	0.05	75	75.4		
16		42	4.62	77	0	.07		33	4.62		29	.07		25	4.62		58	.07	74	74.4		
17		55	4.62		4	.07		46	4.62		33	.07		38	5.00		2	.07	73	73.4		
18		8	4.29		8	.08		59	4.62		37	.07		50	5.00		6	.07	72	72.4		
19		22	4.62		13	.07		4	12	4.62		41	.07		4	2	4.62		10	.07	71	71.5
20		35	4.62		17	0.08		25	5.00		45	0.08		15	5.00		14	0.07	70	70.5		
21		48	4.62		22	.08		37	4.62		50	.08		27	5.00		18	.08	69	69.5		
22		5	4.62		27	.08		50	4.62		55	.08		39	5.00		23	.08	68	68.5		
23		14	4.62		32	.10		5	3	5.00	78	0	.08	51	5.00		28	.08	67	67.5		
24		27	4.62		38	.10		15	5.00		5	.10		5	3	5.00		33	.08	66	66.5	
25		40	4.62		44	0.10		27	5.00		11	0.10		15	5.00		38	0.10	65	65.6		
26		53	5.00		50	.10		39	5.00		17	.10		27	5.45		44	.10	64	64.6		
27		5	4.62		56	.10		51	5.00		23	.10		38	5.00		50	.10	63	63.6		
28		18	5.00		2	.10		6	3	5.00		29	.10		50	5.00		56	.10	62	62.6	
29		30	5.00		8	.12		15	5.00		35	.10		6	2	5.45	79	2	.10	61	61.6	
30		42	5.00		15	0.12		27	5.00		41	0.12		13	5.45		8	0.10	60	60.6		
31		54	5.00		22	.13		39	5.00		48	.12		24	5.45		14	.12	59	59.7		
32		6	5.00		30	.12		51	5.45		55	.13		35	5.45		21	.12	58	58.7		
33		18	5.00		37	.13		7	2	5.00	79	3	.12	46	5.45		28	.12	57	57.7		
34		30	5.00		45	.12		14	5.45		10	.12		57	5.45		35	.12	56	56.7		
35		42	5.45		52	0.13		25	5.45		17	0.13		7	8	5.45		42	0.13	55	55.7	
36		53	5.00		0	.15		36	5.45		25	.13		19	6.00		50	.13	54	54.7		
37		5	5.45		9	.13		47	5.45		33	.13		29	5.45		58	.12	53	53.7		
38		16	5.45		17	.15		58	6.00		41	.15		40	6.00		5	.13	52	52.7		
39		27	5.45		26	.15		8	8	5.45		50	.13		50	6.00		13	.15	51	51.7	
40		38	5.45		35	0.15		19	6.00		58	0.15		8	0	6.00		22	0.13	50	50.7	
41		49	6.00		44	.15		29	6.00	80	7	.15		10	6.00		30	.15	49	49.7		
42		59	5.45		53	.15		39	6.00		16	.15		20	6.67		39	.13	48	48.7		
43		9	6.00		2	.17		49	6.00		25	.15		29	6.00		47	.15	47	47.7		
44		20	6.00		12	.17		59	6.00		34	.15		39	6.67		56	.15	46	46.7		
45		30			22			9	9		43			48			81	5		45	45.7	
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a									
	$d = 76^\circ 30'$				$d = 77^\circ 0'$				$d = 77^\circ 30'$				a									

b	a = 76° 30'				a = 77° 0'				a = 77° 30'				c	α						
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	B	h	d	$\frac{60'}{\Delta}$	Z			t	$\frac{\Delta}{60'}$	C	β		
45	9	30	6.00	80	22	0.17	9	9	6.00	80	43	0.17	8	48	6.67	81	5	0.17	45	45.7
46		40	6.00		32	.17		19	6.67		53	.17		57	6.67		15	.15	44	44.7
47		50	6.00		42	.17		28	6.67	81	3	.17	9	6	6.67		24	.17	43	43.7
48	10	0	6.67		52	.18		37	6.67		13	.17		15	6.67		34	.15	42	42.7
49		9	6.67	81	3	.18		46	6.67		23	.17		24	6.67		43	.17	41	41.7
50		18	6.67		14	0.18		55	6.67		33	0.18		33	7.50		53	0.17	40	40.7
51		27	6.67		25	.18	10	4	6.67		44	.18		41	7.50	82	3	.18	39	39.7
52		36	6.67		36	.18		13	7.50		55	.18		49	7.50		14	.17	38	38.7
53		45	7.50		47	.18		21	7.50	82	6	.18		57	7.50		24	.18	37	37.7
54		53	7.50		58	.18		29	7.50		17	.18	10	5	7.50		35	.17	36	36.7
55	11	1	7.50	82	9	0.20		37	7.50		28	0.18		13	8.57		45	0.18	35	35.7
56		9	7.50		21	.20		45	7.50		39	.18		20	8.57		56	.18	34	34.7
57		17	7.50		33	.20		53	8.57		50	.18		27	8.57	83	7	.18	33	33.7
58		25	7.50		45	.20	11	0	8.57	83	1	.20		34	8.57		18	.18	32	32.7
59		33	8.57		57	.20		7	8.57		13	.20		41	8.57		29	.18	31	31.7
60		40	8.57	83	9	0.22		14	8.57		25	0.20		48	8.57		40	0.20	30	30.6
61		47	8.57		22	.20		21	8.57		37	.20		55	10.0		52	.18	29	29.6
62		54	8.57		34	.22		28	10.0		49	.20	11	1	10.0	84	3	.20	28	28.6
63	12	1	10.0		47	.20		34	10.0	84	1	.20		7	10.0		15	.20	27	27.6
64		7	10.0		59	.22		40	10.0		13	.20		13	10.0		27	.20	26	26.6
65		13	10.0	84	12	0.22		46	10.0		25	0.22		19	12.0		39	0.20	25	25.6
66		19	10.0		25	.22		52	12.0		38	.22		24	12.0		51	.20	24	24.6
67		25	12.0		38	.23		57	12.0		51	.20		29	12.0	85	3	.20	23	23.5
68		30	12.0		52	.22	12	2	12.0	85	3	.22		34	12.0		15	.20	22	22.5
69		35	12.0	85	5	.22		7	12.0		16	.22		39	12.0		27	.22	21	21.5
70		40	12.0		18	0.23		12	12.0		29	0.22		44	12.0		40	0.20	20	20.5
71		45	12.0		32	.22		17	15.0		42	.22		49	15.0		52	.22	19	19.5
72		50	15.0		45	.23		21	15.0		55	.22		53	15.0	86	5	.20	18	18.4
73		54	15.0		59	.23		25	15.0	86	8	.23		57	15.0		17	.22	17	17.4
74		58	15.0	86	13	.23		29	15.0		22	.22	12	1	20.0		30	.22	16	16.4
75	13	2	15.0		27	0.23		33	15.0		35	0.22		4	20.0		43	0.22	15	15.4
76		6	20.0		41	.23		37	20.0		48	.23		7	20.0		56	.22	14	14.4
77		9	20.0		55	.23		40	20.0	87	2	.22		10	20.0	87	9	.22	13	13.3
78		12	20.0	87	9	.23		43	20.0		15	.23		13	20.0		22	.22	12	12.3
79		15	20.0		23	.23		46	30.0		29	.22		16	30.0		35	.22	11	11.3
80		18	30.0		37	0.23		48	30.0		42	0.23		18	30.0		48	0.22	10	10.3
81		20	30.0		51	.23		50	30.0		56	.23		20	30.0	88	1	.22	9	9.2
82		22	30.0	88	5	.23		52	30.0	88	10	.22		22	30.0		14	.22	8	8.2
83		24	30.0		19	.25		54	30.0		23	.23		24	30.0		27	.22	7	7.2
84		26	60.0		34	.23		56	60.0		37	.23		26	60.0		40	.23	6	6.2
85		27	60.0		48	0.23		57	60.0		51	0.23		27	60.0		54	0.22	5	5.1
86		28	60.0	89	2	.25		58	60.0	89	5	.22		28	60.0	89	7	.22	4	4.1
87		29	60.0		17	.23		59	60.0		18	.23		29	60.0		20	.22	3	3.1
88		30	—		31	.23	13	0	—		32	.23		30	—		33	.23	2	2.1
89		30	—		45	.25		0	—		46	.23		30	—		47	.22	1	1.0
90		30		90	0			0		90	0			30		90	0		0	0.0

B	a=78° 0'				a=78° 30'				a=79° 0'				C	c	β							
	h	d	60' Δ	Z	t	Δ 60'	Z	t	Δ 60'	Z	t	Δ 60'										
		0	0	0												0	0	0	0	0		
0	0	0	5.00	78°	0	0.00	0	0	5.00	78°	30	0.00	0	0	5.45	79°	0	0.00	90	90.0		
1	12	4.62	0	0.00	12	5.00	30	0.00	11	5.00	0	0.00	80	80.0	5.00	0	0.00	89	89.0			
2	25	5.00	0	.02	24	5.00	30	.02	23	5.45	0	.02	88	88.0	5.45	0	.02	88	88.0			
3	37	4.62	1	.02	36	5.00	31	.02	34	5.00	1	.02	87	87.1	5.00	1	.02	87	87.1			
4	50	5.00	2	.02	48	5.00	32	.02	46	5.45	2	.02	86	86.1	5.45	2	.02	86	86.1			
5	1	2	4.62	3	0.02	1	0	5.00	33	0.02	57	5.00	3	0.02	85	85.1	5.00	3	0.02	85	85.1	
6	15	5.00	4	.02	12	5.00	34	.02	1	9	5.45	4	.02	84	84.1	5.45	4	.02	84	84.1		
7	27	5.00	5	.03	24	5.45	35	.03	20	5.45	5	.03	83	83.1	5.00	5	.03	83	83.1			
8	39	4.62	7	.03	35	5.00	37	.02	31	5.00	6	.03	82	82.2	5.00	6	.03	82	82.2			
9	52	5.00	9	.03	47	5.00	38	.03	43	5.45	8	.03	81	81.2	5.45	8	.03	81	81.2			
10	2	4	4.62	11	0.03	59	5.00	40	0.03	5	5.45	10	0.03	80	80.2	5.45	10	0.03	80	80.2		
11	17	5.00	13	.03	2	11	5.00	42	.05	2	5	5.45	12	.03	79	79.2	5.00	12	.03	79	79.2	
12	29	5.00	15	.05	23	5.45	45	.03	16	5.00	14	.03	78	78.2	5.00	14	.03	78	78.2			
13	41	5.00	18	.05	34	5.00	47	.05	28	5.45	16	.05	77	77.3	5.00	16	.05	77	77.3			
14	53	5.00	21	.05	46	5.00	50	.05	39	5.45	19	.05	76	76.3	5.00	19	.05	76	76.3			
15	3	5	5.00	24	0.05	58	5.45	53	0.05	50	5.45	22	0.05	75	75.3	5.45	22	0.05	75	75.3		
16	17	5.00	27	.05	9	5.00	56	.05	3	1	5.45	25	.05	74	74.3	5.00	25	.05	74	74.3		
17	29	5.00	30	.07	21	5.45	59	.07	12	5.45	28	.05	73	73.3	5.00	28	.05	73	73.3			
18	41	5.00	34	.07	32	5.45	79	3	.07	23	5.45	31	.07	72	72.3	5.00	31	.07	72	72.3		
19	53	5.00	38	.07	43	5.00	7	.07	34	5.45	35	.07	71	71.4	5.00	35	.07	71	71.4			
20	4	5	5.00	42	0.07	55	5.45	11	0.07	45	6.00	39	0.07	70	70.4	5.45	39	0.07	70	70.4		
21	17	5.45	46	.08	4	6	5.45	15	.07	55	5.45	43	.07	69	69.4	5.45	43	.07	69	69.4		
22	28	5.00	51	.08	17	5.45	19	.08	4	6	5.45	47	.07	68	68.4	5.00	47	.07	68	68.4		
23	40	5.45	56	.08	28	5.45	24	.07	17	6.00	51	.08	67	67.4	5.45	51	.08	67	67.4			
24	51	5.00	79	1	.08	39	5.45	28	.08	27	5.45	56	.08	66	66.4	5.00	56	.08	66	66.4		
25	5	3	5.45	6	0.08	50	5.45	33	0.08	38	6.00	80	1	0.08	65	65.4	5.45	80	1	0.08	65	65.4
26	14	5.45	11	.08	5	1	5.45	38	.08	48	6.00	6	.08	64	64.5	5.45	6	.08	64	64.5		
27	25	5.45	16	.10	12	6.00	43	.10	58	6.00	11	.08	63	63.5	5.45	11	.08	63	63.5			
28	36	5.45	22	.10	22	5.45	49	.08	5	8	6.00	16	.08	62	62.5	5.45	16	.08	62	62.5		
29	47	5.45	28	.10	33	6.00	54	.10	18	6.00	21	.10	61	61.5	5.45	21	.10	61	61.5			
30	58	5.45	34	0.10	43	5.45	80	0	0.10	28	6.00	27	0.10	60	60.5	5.45	27	0.10	60	60.5		
31	6	9	5.45	40	.12	54	6.00	6	.10	38	6.00	33	.10	59	59.5	5.45	33	.10	59	59.5		
32	20	6.00	47	.12	6	4	6.00	12	.12	48	6.00	39	.10	58	58.5	6.00	39	.10	58	58.5		
33	30	5.45	54	.12	14	6.00	19	.10	58	6.00	45	.10	57	57.5	5.45	45	.10	57	57.5			
34	41	6.00	80	1	.12	24	6.00	25	.12	6	8	6.67	51	.10	56	56.5	6.00	51	.10	56	56.5	
35	51	6.00	8	0.12	34	6.00	32	0.12	17	6.00	57	0.12	55	55.5	6.00	57	0.12	55	55.5			
36	7	1	6.00	15	.12	44	6.00	39	.12	27	6.67	81	4	.12	54	54.6	6.00	4	.12	54	54.6	
37	11	6.00	22	.12	54	6.67	46	.12	36	6.67	11	.12	53	53.6	6.00	11	.12	53	53.6			
38	21	6.00	29	.13	7	3	6.00	53	.13	45	6.67	18	.12	52	52.6	6.00	18	.12	52	52.6		
39	31	6.00	37	.13	13	6.67	81	1	.12	54	6.67	25	.12	51	51.6	6.00	25	.12	51	51.6		
40	41	6.00	45	0.13	22	6.67	8	0.13	7	3	6.67	32	0.12	50	50.6	6.00	32	0.12	50	50.6		
41	51	6.67	53	.13	31	6.67	16	.13	12	7.50	39	.13	49	49.6	6.67	39	.13	49	49.6			
42	8	0	6.67	1	.15	40	6.67	24	.13	20	6.67	47	.13	48	48.6	6.67	47	.13	48	48.6		
43	9	6.67	10	.13	49	6.67	32	.13	29	7.50	55	.12	47	47.6	6.67	55	.12	47	47.6			
44	18	6.67	18	.15	58	7.50	40	.15	37	7.50	82	2	.13	46	46.6	6.67	2	.13	46	46.6		
45	27		27		8	6	49		45		10		45	45.6				45		45	45.6	
t	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a	60' Δ	b	Δ 60'	a									
	d=78° 0'				d=78° 30'				d=79° 0'				a									

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

B	a = 79° 30'				a = 80° 0'				a = 80° 30'				C	β						
	h	d	60' / Δ	t	h	d	60' / Δ	t	h	d	60' / Δ	t			C	β				
		Z	Δ / 60'	Z		Δ / 60'	Z	Δ / 60'		Z	Δ / 60'									
0	0	0	5.45	79	30	0.00	0	0	6.00	80	0	0.00	0	0	90.0					
1		11	5.45		30	.00	10	5.45		0	0.00	10	6.00		30	.00	89	89.0		
2		22	5.45		30	.02	21	6.00		0	.02	20	6.00		30	.02	88	88.0		
3		33	5.45		31	.00	31	5.45		1	.00	30	6.00		31	.00	87	87.0		
4		44	5.45		31	.02	42	6.00		1	.02	40	6.00		31	.02	86	86.1		
5		55	5.45		32	.02	52	6.00		2	.02	50	6.67		32	.02	85	85.1		
6	I	6	5.45		33	.02	I	2	5.45		3	.02	59	6.00		33	.02	84	84.1	
7		17	6.00		34	.03		13	6.00		4	.03	I	9	6.00		34	.02	83	83.1
8		27	5.45		36	.03		23	6.00		6	.02	19	6.00		35	.03	82	82.1	
9		38	5.45		38	.02		33	5.45		7	.03	29	6.00		37	.02	81	81.1	
10		49	5.45		39	.03		44	6.00		9	.03	39	6.67		38	.03	80	80.1	
11	2	0	6.00		41	.03		54	6.00		11	.03	48	6.00		40	.03	79	79.2	
12		10	5.45		43	.05	2	4	6.00		13	.03	58	6.00		42	.03	78	78.2	
13		21	5.45		46	.03		14	6.00		15	.03	8	6.67		44	.03	77	77.2	
14		32	6.00		48	.05		24	6.00		17	.05	2	17	6.00		46	.05	76	76.2
15		42	5.45		51	.05		34	6.00		20	.05	27	6.67		49	.05	75	75.2	
16		53	6.00		54	.05		44	6.00		23	.05	36	6.00		52	.03	74	74.2	
17	3	3	5.45		57	.05		54	6.00		26	.05	46	6.67		54	.05	73	73.2	
18		14	6.00	80	0	.05	3	4	6.00		29	.05	55	6.00		57	.05	72	72.3	
19		24	6.00		3	.07		14	6.00		32	.05	3	5	6.67	81	0	.07	71	71.3
20		34	5.45		7	.07		24	6.00		35	.07	14	6.00		4	.05	70	70.3	
21		45	6.00		11	.07		34	6.00		39	.07	24	6.67		7	.07	69	69.3	
22		55	6.00		15	.07		44	6.67		43	.07	33	6.67		11	.07	68	68.3	
23	4	5	6.00		19	.07		53	6.00		47	.07	42	6.67		15	.07	67	67.3	
24		15	6.00		23	.08	4	3	6.00		51	.07	51	6.67		19	.07	66	66.3	
25		25	6.00		28	.08		13	6.67		55	.08	4	0	6.67		23	.07	65	65.3
26		35	6.00		33	.07		22	6.67	81	0	.07	9	6.67		27	.07	64	64.3	
27		45	6.00		37	.08		31	6.00		4	.08	18	6.67		31	.08	63	63.4	
28		55	6.67		42	.08		41	6.67		9	.08	27	6.67		36	.07	62	62.4	
29	5	4	6.00		47	.10		50	6.67		14	.08	36	7.50		40	.08	61	61.4	
30		14	6.67		53	.08		59	6.67		19	.08	44	6.67		45	.08	60	60.4	
31		23	6.00		58	.10	5	8	6.67		24	.10	53	7.50		50	.08	59	59.4	
32		33	6.67	81	4	.10		17	6.67		30	.08	5	1	7.50		55	.10	58	58.4
33		42	6.67		10	.10		26	7.50		35	.10	9	6.67	82	1	.08	57	57.4	
34		51	6.67		16	.10		34	6.67		41	.10	18	7.50		6	.10	56	56.4	
35	6	0	6.67		22	.10		43	6.67		47	.10	26	7.50		12	.08	55	55.4	
36		9	6.67		28	.12		52	7.50		53	.10	34	7.50		17	.10	54	54.4	
37		18	6.67		35	.10	6	0	7.50		59	.10	42	7.50		23	.10	53	53.4	
38		27	7.50		41	.12		8	7.50	82	5	.12	50	7.50		29	.10	52	52.4	
39		35	6.67		48	.12		16	7.50		12	.10	58	8.57		35	.12	51	51.4	
40		44	7.50		55	.12		24	7.50		18	.12	6	5	7.50		42	.10	50	50.4
41		52	7.50	82	2	.12		32	7.50		25	.12	13	8.57		48	.12	49	49.4	
42	7	0	7.50		9	.13		40	7.50		32	.12	20	7.50		55	.10	48	48.4	
43		8	7.50		17	.12		48	7.50		39	.12	28	8.57	83	1	.12	47	47.4	
44		16	7.50		24	.13		56	8.57		46	.13	35	8.57		8	.12	46	46.4	
45		24			32		7	3			54		42			15		45	45.4	
t	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a	60' / Δ	b	Δ / 60'	a			
	d = 79° 30'				d = 80° 0'				d = 80° 30'											

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

b	a = 81° 0'					a = 81° 30'					a = 82° 0'					c	α				
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$
0	0	0	6.67	81	0	0.00	0	0	6.67	81	30	0.00	0	0	7.50	82	0	0.00	90	90.0	
1		9	6.00		0	.00	0	9	6.67		30	.00		8	6.67		0	.00	89	89.0	
2		19	6.67		0	.02		18	6.67		30	.02		17	7.50		0	.02	88	88.0	
3		28	6.00		1	.00		27	7.50		31	.00		25	7.50		1	.00	87	87.0	
4		38	6.67		1	.02		35	6.67		31	.02		33	6.67		1	.02	86	86.0	
5		47	6.67		2	0.02		44	6.67		32	0.02		42	7.50		2	0.02	85	85.1	
6		56	6.00		3	.02		53	6.67		33	.02		50	7.50		3	.02	84	84.1	
7	I	6	6.67		4	.02	I	2	6.67		34	.02	I	58	6.67		4	.02	83	83.1	
8		15	6.67		5	.02		11	6.67		35	.02	I	7	7.50		5	.02	82	82.1	
9		24	6.67		6	.03		20	7.50		36	.03		15	7.50		6	.02	81	81.1	
10		33	6.00		8	0.03		28	6.67		38	0.02		23	7.50		7	0.03	80	80.1	
11		43	6.67		10	.03		37	6.67		39	.03		31	6.67		9	.02	79	79.1	
12		52	6.67		12	.03		46	7.50		41	.03		40	7.50		10	.03	78	78.1	
13	2	1	6.67		14	.03		54	6.67		43	.03		48	7.50		12	.03	77	77.1	
14		10	6.67		16	.03	2	3	6.67		45	.03		56	7.50		14	.03	76	76.1	
15		19	6.67		18	0.03		12	7.50		47	0.03		2	7.50		16	0.03	75	75.2	
16		28	6.67		20	.05		20	6.67		49	.05		12	7.50		18	.05	74	74.2	
17		37	6.67		23	.05		29	7.50		52	.05		20	7.50		21	.03	73	73.2	
18		46	6.67		26	.05		37	6.67		55	.03		28	7.50		23	.05	72	72.2	
19		55	6.67		29	.05		46	7.50		57	.05		36	7.50		26	.05	71	71.2	
20	3	4	6.67		32	0.05		54	7.50	82	0	0.05		44	7.50		29	0.05	70	70.2	
21		13	6.67		35	.07	3	2	7.50		3	.07		52	8.57		32	.05	69	69.2	
22		22	7.50		39	.05		10	6.67		7	.05		59	7.50		35	.05	68	68.2	
23		30	6.67		42	.07		19	7.50		10	.05	3	7	7.50		38	.05	67	67.2	
24		39	7.50		46	.07		27	7.50		13	.07		15	8.57		41	.05	66	66.2	
25		47	6.67		50	0.07		35	7.50		17	0.07		22	7.50		44	0.07	65	65.2	
26		56	6.67		54	.07		43	7.50		21	.07		30	8.57		48	.07	64	64.2	
27	4	5	7.50		58	.07		51	7.50		25	.07		37	7.50		52	.07	63	63.3	
28		13	7.50	82	2	.08		59	7.50		29	.07		45	8.57		56	.07	62	62.3	
29		21	7.50		7	.07	4	7	8.57		33	.07		52	8.57	83	0	.07	61	61.3	
30		29	7.50		11	0.08		14	7.50		37	0.08		59	7.50		4	0.07	60	60.3	
31		37	7.50		16	.08		22	7.50		42	.08		4	7.57		8	.07	59	59.3	
32		45	7.50		21	.08		30	8.57		47	.07		14	8.57		12	.08	58	58.3	
33		53	7.50		26	.08		37	7.50		51	.08		21	8.57		17	.07	57	57.3	
34	5	1	7.50		31	.08		45	8.57		56	.08		28	8.57		21	.08	56	56.3	
35		9	7.50		36	0.10		52	8.57	83	1	0.08		35	8.57		26	0.08	55	55.3	
36		17	8.57		42	.08		59	8.57		6	.10		42	10.0		31	.08	54	54.3	
37		24	7.50		47	.10	5	6	8.57		12	.08		48	8.57		36	.08	53	53.3	
38		32	8.57		53	.10		13	8.57		17	.08		55	8.57		41	.08	52	52.3	
39		39	8.57		59	.10		20	8.57		22	.10		5	2	10.0		46	.08	51	51.3
40		46	8.57	83	5	0.10		27	8.57		28	0.10		8	10.0		51	0.10	50	50.3	
41		53	8.57		11	.10		34	8.57		34	.10		14	8.57		57	.08	49	49.3	
42	6	0	8.57		17	.10		41	10.0		40	.10		21	10.0	84	2	.10	48	48.3	
43		7	8.57		23	.12		47	8.57		46	.10		27	10.0		8	.10	47	47.3	
44		14	8.57		30	.12		54	10.0		52	.10		33	10.0		14	.10	46	46.3	
45		21			37		6	0			58			39			20		45	45.3	

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

t	a = 81° 0'		a = 81° 30'		a = 82° 0'		α
	a	60' / Δ	b	Δ / 60'	a	60' / Δ	
	d = 81° 0'		d = 81° 30'		d = 82° 0'		

B	$a = 82^\circ 30'$					$a = 83^\circ 0'$					$a = 83^\circ 30'$					C	β				
	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$			Z	t	$\frac{\Delta}{60'}$	
0	0	0	7.50	82	30	0.00	0	0	8.57	83	0	0.00	0	0	8.57	83	30	0.00	90	90.0	
1	0	8	7.50		30	0.00	7	7.50		0	0.00	7	8.57		30	0.00	30	0.00	89	89.0	
2		16	7.50		30	0.02	15	8.57		0	0.02	14	10.0		30	0.02	30	0.02	88	88.0	
3		24	8.57		31	0.00	22	8.57		1	0.00	20	8.57		31	0.00	31	0.00	87	87.0	
4		31	7.50		31	0.02	29	7.50		1	0.02	27	8.57		31	0.00	31	0.00	86	86.0	
5		39	7.50		32	0.00	37	8.57		2	0.00	34	8.57		31	0.02	31	0.02	85	85.0	
6		47	7.50		32	0.02	44	8.57		2	0.02	41	10.0		32	0.02	32	0.02	84	84.0	
7		55	7.50		33	0.02	51	8.57		3	0.02	47	8.57		33	0.02	33	0.02	83	83.1	
8	I	3	8.57		34	0.02	58	7.50		4	0.02	54	8.57		34	0.02	34	0.02	82	82.1	
9		10	7.50		35	0.03	I	6	8.57		5	0.02	I	1	8.57		35	0.02	81	81.1	
10		18	7.50		37	0.02	13	8.57		6	0.03	8	10.0		36	0.02	36	0.02	80	80.1	
11		26	8.57		38	0.03	20	8.57		8	0.02	14	8.57		37	0.02	37	0.02	79	79.1	
12		33	7.50		40	0.02	27	8.57		9	0.03	21	8.57		38	0.03	38	0.03	78	78.1	
13		41	7.50		41	0.03	34	8.57		11	0.02	28	10.0		40	0.02	40	0.02	77	77.1	
14		49	8.57		43	0.03	41	8.57		12	0.03	34	8.57		41	0.03	41	0.03	76	76.1	
15		56	7.50		45	0.03	48	8.57		14	0.03	41	10.0		43	0.03	43	0.03	75	75.1	
16	2	4	8.57		47	0.03	55	8.57		16	0.03	47	8.57		45	0.03	45	0.03	74	74.1	
17		11	7.50		49	0.05	2	8.57		18	0.03	54	10.0		47	0.03	47	0.03	73	73.1	
18		19	8.57		52	0.03	9	8.57		20	0.05	2	0	8.57		49	0.03	49	0.03	72	72.1
19		26	7.50		54	0.05	16	8.57		23	0.03	17	10.0		51	0.03	51	0.03	71	71.1	
20		34	8.57		57	0.03	23	8.57		25	0.05	13	8.57		53	0.05	53	0.05	70	70.1	
21		41	8.57		59	0.05	30	8.57		28	0.03	20	10.0		56	0.03	56	0.03	69	69.1	
22		48	8.57	83	2	0.05	37	8.57		30	0.05	26	10.0		58	0.05	58	0.05	68	68.1	
23		55	7.50		5	0.05	44	10.0		33	0.05	32	10.0		1	0.03	67	0.03	67	67.2	
24	3	3	8.57		8	0.07	50	8.57		36	0.05	38	8.57	84	3	0.05	66	0.05	66	66.2	
25		10	8.57		12	0.05	57	8.57		39	0.05	45	10.0		6	0.05	65	0.05	65	65.2	
26		17	8.57		15	0.05	3	4	10.0		42	0.05	51	10.0		9	0.05	64	0.05	64	64.2
27		24	8.57		18	0.07	10	8.57		45	0.07	57	10.0		12	0.05	63	0.05	63	63.2	
28		31	8.57		22	0.07	17	10.0		49	0.05	3	3	10.0		15	0.05	62	0.05	62	62.2
29		38	8.57		26	0.07	23	8.57		52	0.07	9	10.0		18	0.07	61	0.07	61	61.2	
30		45	10.0		30	0.07	30	10.0		56	0.07	15	10.0		22	0.05	60	0.05	60	60.2	
31		51	8.57		34	0.07	36	10.0	84	0	0.05	21	12.0		25	0.07	59	0.07	59	59.2	
32		58	8.57		38	0.07	42	10.0		3	0.07	26	10.0		29	0.05	58	0.05	58	58.2	
33	4	5	10.0		42	0.07	48	10.0		7	0.07	32	10.0		32	0.07	57	0.07	57	57.2	
34		11	8.57		46	0.08	54	10.0		11	0.07	38	12.0		36	0.07	56	0.07	56	56.2	
35		18	10.0		51	0.07	4	0	10.0		15	0.08	43	10.0		40	0.07	55	0.07	55	55.2
36		24	10.0		55	0.08	6	10.0		20	0.07	49	12.0		44	0.07	54	0.07	54	54.2	
37		30	8.57	84	5	0.08	12	10.0		24	0.07	54	10.0		48	0.07	53	0.07	53	53.2	
38		37	10.0		5	0.07	18	10.0		28	0.08	4	0	12.0		52	0.07	52	0.07	52	52.2
39		43	10.0		9	0.08	24	10.0		33	0.08	5	12.0		56	0.08	51	0.08	51	51.2	
40		49	10.0		14	0.08	30	12.0		38	0.07	10	10.0	85	1	0.07	50	0.07	50	50.2	
41		55	10.0		19	0.10	35	10.0		42	0.08	16	12.0		5	0.08	49	0.08	49	49.2	
42	5	1	12.0		25	0.08	41	12.0		47	0.08	21	12.0		10	0.07	48	0.07	48	48.2	
43		6	10.0		30	0.08	46	10.0		52	0.08	26	12.0		14	0.08	47	0.08	47	47.2	
44		12	10.0		35	0.10	52	12.0		57	0.08	31	12.0		19	0.08	46	0.08	46	46.2	
45		18			41		57		85	2		36			24		45		45	45.2	

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

0.105

0.087

0.070

b	a = 84° 0'					a = 85° 0'					a = 86° 0'					c	α					
	B	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d	$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	h	d			$\frac{60'}{\Delta}$	Z	t	$\frac{\Delta}{60'}$	C
0	0	0	10.0	84	0	0.00	0	0	12.0	85	0	0.00	0	0	15.0	86	0	0.00	90	90.0		
1	0	6	8.57	0	0.00	0	5	12.0	0	0.00	0	4	15.0	0	0.00	89	0	0.00	89	89.0		
2	0	13	10.0	0	0.00	0	10	10.0	0	0.00	0	8	12.0	0	0.00	88	0	0.00	88	88.0		
3	0	19	10.0	0	0.02	0	16	12.0	0	0.02	0	13	15.0	0	0.02	87	0	0.02	87	87.0		
4	0	25	10.0	1	0.00	0	21	12.0	1	0.00	0	17	15.0	1	0.00	86	1	0.00	86	86.0		
5	0	31	8.57	1	0.02	0	26	12.0	1	0.02	0	21	15.0	1	0.00	85	1	0.00	85	85.0		
6	0	38	10.0	2	0.02	0	31	10.0	2	0.00	0	25	15.0	1	0.02	84	1	0.02	84	84.0		
7	0	44	10.0	3	0.00	0	37	12.0	2	0.02	0	29	15.0	2	0.00	83	2	0.00	83	83.0		
8	0	50	10.0	3	0.02	0	42	12.0	3	0.02	0	33	12.0	2	0.02	82	2	0.02	82	82.0		
9	0	56	10.0	4	0.02	0	47	12.0	4	0.02	0	38	15.0	3	0.02	81	3	0.02	81	81.0		
10	I	2	8.57	5	0.03	I	52	12.0	5	0.02	I	42	15.0	4	0.00	80	4	0.00	80	80.0		
11	I	9	10.0	7	0.02	I	57	12.0	6	0.02	I	46	15.0	4	0.02	79	4	0.02	79	79.0		
12	I	15	10.0	8	0.02	I	2	12.0	7	0.02	I	50	15.0	5	0.02	78	5	0.02	78	78.0		
13	I	21	10.0	9	0.03	I	7	12.0	8	0.02	I	54	15.0	6	0.02	77	6	0.02	77	77.0		
14	I	27	10.0	11	0.02	I	12	10.0	9	0.02	I	58	15.0	7	0.02	76	7	0.02	76	76.1		
15	I	33	10.0	12	0.03	I	18	12.0	10	0.03	I	2	15.0	8	0.02	75	8	0.02	75	75.1		
16	I	39	10.0	14	0.03	I	23	12.0	12	0.02	I	6	15.0	9	0.02	74	9	0.02	74	74.1		
17	I	45	10.0	16	0.03	I	28	12.0	13	0.03	I	10	15.0	10	0.03	73	10	0.03	73	73.1		
18	I	51	10.0	18	0.03	I	33	12.0	15	0.02	I	14	15.0	12	0.02	72	12	0.02	72	72.1		
19	I	57	10.0	20	0.03	I	38	12.0	16	0.03	I	18	15.0	13	0.02	71	13	0.02	71	71.1		
20	2	3	10.0	22	0.03	2	43	12.0	18	0.03	2	22	15.0	14	0.03	70	14	0.03	70	70.1		
21	2	9	10.0	24	0.03	2	48	15.0	20	0.03	2	26	15.0	16	0.02	69	16	0.02	69	69.1		
22	2	15	12.0	26	0.03	2	52	12.0	22	0.03	2	30	15.0	17	0.03	68	17	0.03	68	68.1		
23	2	20	10.0	28	0.05	2	57	12.0	24	0.03	2	34	15.0	19	0.03	67	19	0.03	67	67.1		
24	2	26	10.0	31	0.05	2	2	12.0	26	0.03	2	38	20.0	21	0.02	66	21	0.02	66	66.1		
25	2	32	10.0	34	0.03	2	7	15.0	28	0.03	2	41	15.0	22	0.03	65	22	0.03	65	65.1		
26	2	38	12.0	36	0.05	2	11	12.0	30	0.05	2	45	15.0	24	0.03	64	24	0.03	64	64.1		
27	2	43	10.0	39	0.05	2	16	12.0	33	0.03	2	49	15.0	26	0.03	63	26	0.03	63	63.1		
28	2	49	12.0	42	0.05	2	21	15.0	35	0.03	2	53	20.0	28	0.03	62	28	0.03	62	62.1		
29	2	54	10.0	45	0.05	2	25	12.0	37	0.05	2	56	15.0	30	0.03	61	30	0.03	61	61.1		
30	3	0	12.0	48	0.05	3	30	12.0	40	0.05	3	2	15.0	32	0.03	60	32	0.03	60	60.1		
31	3	5	10.0	51	0.05	3	35	15.0	43	0.03	3	4	20.0	34	0.03	59	34	0.03	59	59.1		
32	3	11	12.0	54	0.07	3	39	15.0	45	0.05	3	7	15.0	36	0.05	58	36	0.05	58	58.1		
33	3	16	12.0	58	0.05	3	43	12.0	48	0.05	3	11	20.0	39	0.03	57	39	0.03	57	57.1		
34	3	21	12.0	85	1	0.07	48	15.0	51	0.05	3	14	15.0	41	0.03	56	41	0.03	56	56.1		
35	3	26	12.0	5	0.05	3	52	15.0	54	0.05	3	18	20.0	43	0.05	55	43	0.05	55	55.1		
36	3	31	12.0	8	0.07	3	56	15.0	57	0.05	3	21	20.0	46	0.03	54	46	0.03	54	54.1		
37	3	36	12.0	12	0.07	3	0	12.0	86	0	0.05	24	15.0	48	0.05	53	48	0.05	53	53.1		
38	3	41	12.0	16	0.07	3	5	15.0	3	0.07	3	28	20.0	51	0.03	52	51	0.03	52	52.1		
39	3	46	12.0	20	0.07	3	9	15.0	7	0.05	3	31	20.0	53	0.05	51	53	0.05	51	51.1		
40	4	51	12.0	24	0.07	4	13	15.0	10	0.05	4	34	20.0	56	0.05	50	56	0.05	50	50.1		
41	4	56	12.0	28	0.07	4	17	15.0	13	0.07	4	37	15.0	59	0.03	49	59	0.03	49	49.1		
42	4	1	15.0	32	0.07	4	21	15.0	17	0.05	4	41	20.0	87	2	0.03	48	87	2	0.03	48	48.1
43	4	5	12.0	36	0.08	4	25	20.0	20	0.07	4	44	20.0	4	0.05	47	4	0.05	47	47.1		
44	4	10	15.0	41	0.07	4	28	15.0	24	0.07	4	47	20.0	7	0.05	46	7	0.05	46	46.1		
45	4	14		45		4	32		28		4	50		10		45	10		45	45.1		
t	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a	$\frac{60'}{\Delta}$	b	$\frac{\Delta}{60'}$	a					
	d = 84° 0'				d = 85° 0'				d = 86° 0'													

0.105

0.087

0.070

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

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

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

0.052

0.035

0.020

0.017

0.000

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

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

Change of Hour Angle per Minute of Arc of Altitude

$$\frac{\Delta t}{\Delta h} = \sec L \operatorname{cosec} Z$$

Z L	60°	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	82°	84°	87°	90°	Z L
0	1.15	1.13	1.11	1.09	1.08	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.01	1.00	1.00	0
2	1.16	1.13	1.11	1.09	1.08	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.01	1.00	1.00	2
4	1.16	1.14	1.12	1.10	1.08	1.07	1.05	1.04	1.03	1.02	1.02	1.01	1.01	1.00	1.00	4
6	1.16	1.14	1.12	1.10	1.08	1.07	1.05	1.04	1.03	1.02	1.02	1.01	1.01	1.01	1.01	6
8	1.17	1.14	1.12	1.10	1.09	1.08	1.06	1.05	1.04	1.03	1.03	1.02	1.02	1.01	1.01	8
10	1.17	1.15	1.13	1.11	1.10	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.02	1.02	1.02	10
11	1.18	1.15	1.13	1.11	1.10	1.08	1.07	1.06	1.05	1.04	1.03	1.03	1.03	1.02	1.02	11
12	1.18	1.16	1.14	1.12	1.10	1.09	1.08	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	12
13	1.19	1.16	1.14	1.12	1.11	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.03	13
14	1.19	1.17	1.15	1.13	1.11	1.10	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.03	1.03	14
15	1.20	1.17	1.15	1.13	1.12	1.10	1.09	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.04	15
16	1.20	1.18	1.16	1.14	1.12	1.11	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	16
17	1.21	1.18	1.16	1.14	1.13	1.11	1.10	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.05	17
18	1.21	1.19	1.17	1.15	1.13	1.12	1.11	1.09	1.08	1.07	1.07	1.06	1.06	1.05	1.05	18
19	1.22	1.20	1.18	1.16	1.14	1.13	1.11	1.10	1.09	1.08	1.07	1.07	1.06	1.06	1.06	19
20	1.23	1.21	1.18	1.16	1.15	1.13	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.07	1.06	20
21	1.24	1.21	1.19	1.17	1.16	1.14	1.13	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.07	21
22	1.24	1.22	1.20	1.18	1.16	1.15	1.13	1.12	1.11	1.10	1.10	1.09	1.08	1.08	1.08	22
23	1.25	1.23	1.21	1.19	1.17	1.16	1.14	1.13	1.12	1.11	1.10	1.10	1.09	1.09	1.09	23
24	1.26	1.24	1.22	1.20	1.18	1.17	1.15	1.14	1.13	1.12	1.11	1.11	1.10	1.10	1.09	24
25	1.27	1.25	1.23	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.11	1.10	1.10	25
26	1.28	1.26	1.24	1.22	1.20	1.18	1.17	1.16	1.15	1.14	1.13	1.12	1.12	1.11	1.11	26
27	1.30	1.27	1.25	1.23	1.21	1.19	1.18	1.17	1.16	1.15	1.14	1.13	1.13	1.12	1.12	27
28	1.31	1.28	1.26	1.24	1.22	1.20	1.19	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.13	28
29	1.32	1.30	1.27	1.25	1.23	1.22	1.20	1.19	1.18	1.17	1.16	1.15	1.15	1.14	1.14	29
30	1.33	1.31	1.28	1.26	1.24	1.23	1.21	1.20	1.19	1.18	1.17	1.17	1.16	1.16	1.15	30
31	1.35	1.32	1.30	1.28	1.26	1.24	1.23	1.21	1.20	1.19	1.18	1.18	1.17	1.17	1.17	31
32	1.36	1.34	1.31	1.29	1.27	1.26	1.24	1.23	1.22	1.21	1.20	1.19	1.19	1.18	1.18	32
33	1.38	1.35	1.33	1.31	1.29	1.27	1.25	1.24	1.23	1.22	1.21	1.20	1.20	1.19	1.19	33
34	1.39	1.37	1.34	1.32	1.30	1.28	1.27	1.26	1.24	1.23	1.22	1.22	1.21	1.21	1.21	34
35	1.41	1.38	1.36	1.34	1.32	1.30	1.28	1.27	1.26	1.25	1.24	1.23	1.23	1.22	1.22	35
36	1.43	1.40	1.38	1.35	1.33	1.31	1.30	1.29	1.27	1.26	1.25	1.25	1.24	1.24	1.24	36
37	1.45	1.42	1.39	1.37	1.35	1.33	1.32	1.30	1.29	1.28	1.27	1.26	1.26	1.25	1.25	37
38	1.47	1.44	1.41	1.39	1.37	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.28	1.27	1.27	38
39	1.49	1.46	1.43	1.41	1.39	1.37	1.35	1.34	1.33	1.32	1.31	1.30	1.29	1.29	1.29	39
40	1.51	1.48	1.45	1.43	1.41	1.39	1.37	1.36	1.35	1.34	1.33	1.32	1.31	1.31	1.31	40
41	1.53	1.50	1.47	1.45	1.43	1.41	1.39	1.38	1.37	1.36	1.35	1.34	1.33	1.33	1.32	41
42	1.55	1.52	1.50	1.47	1.45	1.43	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.35	1.35	42
43	1.58	1.55	1.52	1.50	1.48	1.46	1.44	1.42	1.41	1.40	1.39	1.38	1.37	1.37	1.37	43
44	1.60	1.57	1.55	1.52	1.50	1.48	1.46	1.45	1.43	1.42	1.41	1.40	1.40	1.39	1.39	44
45	1.63	1.60	1.57	1.55	1.53	1.51	1.49	1.47	1.46	1.45	1.44	1.43	1.42	1.42	1.41	45
46	1.66	1.63	1.60	1.58	1.55	1.53	1.51	1.50	1.48	1.47	1.46	1.45	1.45	1.44	1.44	46
47	1.69	1.66	1.63	1.61	1.58	1.56	1.54	1.53	1.51	1.50	1.49	1.48	1.47	1.47	1.47	47
48	1.73	1.69	1.66	1.64	1.61	1.59	1.57	1.56	1.54	1.53	1.52	1.51	1.50	1.50	1.49	48
49	1.76	1.73	1.70	1.67	1.64	1.62	1.60	1.59	1.57	1.56	1.55	1.54	1.53	1.53	1.52	49
50	1.80	1.76	1.73	1.70	1.68	1.66	1.64	1.62	1.60	1.59	1.58	1.57	1.56	1.56	1.56	50
51	1.84	1.80	1.77	1.74	1.71	1.69	1.67	1.65	1.64	1.63	1.61	1.60	1.60	1.59	1.59	51
52	1.88	1.84	1.81	1.78	1.75	1.73	1.71	1.69	1.67	1.66	1.65	1.64	1.63	1.63	1.62	52
53	1.92	1.88	1.85	1.82	1.79	1.77	1.75	1.73	1.71	1.70	1.69	1.68	1.67	1.66	1.66	53
54	1.96	1.93	1.89	1.86	1.83	1.81	1.79	1.77	1.75	1.74	1.73	1.72	1.71	1.70	1.70	54
55	2.01	1.98	1.94	1.91	1.88	1.85	1.83	1.81	1.80	1.78	1.77	1.76	1.75	1.75	1.74	55
56	2.06	2.03	1.99	1.96	1.93	1.90	1.88	1.86	1.84	1.83	1.82	1.81	1.80	1.79	1.79	56
57	2.12	2.08	2.04	2.01	1.98	1.95	1.93	1.91	1.89	1.88	1.86	1.85	1.85	1.84	1.84	57
58	2.18	2.14	2.10	2.07	2.04	2.01	1.98	1.96	1.94	1.93	1.92	1.91	1.90	1.89	1.89	58
59	2.24	2.20	2.16	2.13	2.10	2.07	2.04	2.02	2.00	1.99	1.97	1.96	1.95	1.94	1.94	59
60	2.31	2.27	2.23	2.19	2.16	2.13	2.10	2.08	2.06	2.05	2.03	2.02	2.01	2.00	2.00	60

Change of Azimuth per Minute of Arc of Altitude.

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

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

Table for Controlling the Coincidence of Lines of Position.

Giving D ($\frac{1}{2}$ of the useful length of the line of position)
in minutes of the Equator.

d or t	True Altitude of Celestial Body.															t
	0°	10°	20°	30°	40°	50°	55°	60°	65°	70°	75°	80°	83°	86°	89°	
0°	83	82	80	77	73	67	63	59	54	49	42	35	29	22	11	180°
10	84	83	81	78	73	67	63	59	54	49	43	35	29	22	11	170
20	86	85	83	80	75	69	65	61	56	50	44	36	30	23	11	160
30	89	88	86	83	78	71	67	63	58	52	45	37	31	24	12	150
40	95	94	92	88	83	76	72	67	62	55	48	39	33	25	13	140
50	103	103	100	96	91	83	78	73	67	60	53	43	36	27	14	130
60	117	116	114	109	103	94	89	83	76	67	60	49	41	31	15	120
70	142	141	137	132	124	114	107	100	92	83	72	59	49	37	19	110
80	199	198	193	185	174	159	151	141	129	116	101	83	69	53	26	100
90	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	90

To find D ($\frac{1}{2}$ of the useful length of the line of position on Mercator's chart: BB_3 in Fig. 3) enter the table with the declination in column d and corresponding to the altitude h will be found D_0 ($\frac{1}{2}$ of the useful length if t was 0°). Entering the table again with D_0 in the first horizontal line corresponding to $d=0^\circ$ and with t in column t we will find crossing the value of D , expressed in minutes of longitude.

Ex. $d=50^\circ$, $h=60^\circ$ and $t=40^\circ$. First we would find $D_0=73'$ and afterwards $D=83'$.

Azimuths of *Polaris*.

Local Sidereal Time	Name.	Latitude.											Name.	Local Sidereal Time.
		0°	10°	20°	30°	40°	45°	50°	55°	60°	65°	70°		
0 ^h	E	.4	.4	.5	.5	.6	.6	.7	.8	.9	1.0	1.2	W	12 ^h
1	E	.1	.1	.1	.2	.2	.2	.2	.2	.3	.3	.3	W	13
2	W	.2	.2	.2	.2	.2	.2	.3	.3	.3	.4	.6	E	14
3	W	.5	.5	.5	.5	.6	.6	.7	.8	.9	1.1	1.5	E	15
4	W	.7	.7	.8	.8	.9	1.0	1.1	1.3	1.4	1.7	2.1	E	16
5	W	.9	.9	1.0	1.1	1.2	1.3	1.5	1.7	1.9	2.2	2.7	E	17
6	W	1.1	1.1	1.2	1.3	1.4	1.5	1.7	1.9	2.2	2.6	3.2	E	18
7	W	1.2	1.2	1.2	1.3	1.5	1.6	1.8	2.0	2.3	2.7	3.4	E	19
8	W	1.2	1.2	1.2	1.3	1.5	1.6	1.8	2.0	2.3	2.7	3.4	E	20
9	W	1.1	1.1	1.1	1.2	1.4	1.5	1.7	1.9	2.1	2.5	3.2	E	21
10	W	.9	.9	1.0	1.1	1.2	1.3	1.4	1.6	1.8	2.2	2.7	E	22
11	W	.7	.7	.7	.8	.9	1.0	1.1	1.2	1.4	1.7	2.1	E	23

This table will be very useful for finding the deviation of the compass in the northern hemisphere. It was computed assuming the Star's Right Ascension 1^h 27^m and its Declination 88° 50' N. by the following formula: $Z \cos L = \rho \sin t$, where ρ represents the Star's Polar Distance = 70', the other terms being negligible within the limits of the table.

Change of Altitude per Minute of Time.

LAT.	Azimuth.																	
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	90°
0	0	1.3	2.6	3.9	5.1	6.3	7.5	8.6	9.6	10.6	11.5	12.3	13.0	13.6	14.1	14.5	14.8	15.0
4	0	1.3	2.6	3.9	5.1	6.3	7.5	8.6	9.6	10.6	11.5	12.3	13.0	13.6	14.1	14.5	14.7	15.0
8	0	1.3	2.6	3.8	5.1	6.3	7.4	8.5	9.5	10.5	11.4	12.2	12.9	13.5	14.0	14.4	14.6	14.9
12	0	1.3	2.5	3.8	5.0	6.2	7.3	8.4	9.4	10.4	11.2	12.0	12.7	13.3	13.8	14.2	14.4	14.7
16	0	1.3	2.5	3.7	4.9	6.1	7.2	8.3	9.3	10.2	11.0	11.8	12.5	13.1	13.5	13.9	14.2	14.4
20	0	1.2	2.4	3.6	4.8	6.0	7.0	8.1	9.1	10.0	10.8	11.5	12.2	12.8	13.2	13.6	13.9	14.1
24	0	1.2	2.4	3.5	4.7	5.8	6.9	7.9	8.8	9.7	10.5	11.2	11.9	12.4	12.9	13.2	13.5	13.7
28	0	1.2	2.3	3.5	4.6	5.7	6.7	7.7	8.7	9.5	10.3	11.0	11.7	12.2	12.7	13.0	13.3	13.5
30	0	1.2	2.3	3.4	4.5	5.6	6.6	7.6	8.5	9.4	10.1	10.8	11.5	12.0	12.4	12.8	13.1	13.2
30	0	1.1	2.3	3.4	4.4	5.5	6.5	7.4	8.3	9.2	9.9	10.6	11.2	11.8	12.2	12.5	12.8	13.0
32	0	1.1	2.2	3.3	4.4	5.4	6.4	7.3	8.2	9.0	9.7	10.4	11.0	11.5	12.0	12.3	12.5	12.7
34	0	1.1	2.2	3.2	4.3	5.3	6.2	7.1	8.0	8.8	9.5	10.2	10.8	11.3	11.7	12.0	12.3	12.4
36	0	1.1	2.1	3.1	4.2	5.1	6.1	7.0	7.8	8.6	9.3	9.9	10.5	11.0	11.4	11.7	12.0	12.1
38	0	1.0	2.1	3.1	4.0	5.0	5.9	6.8	7.6	8.4	9.1	9.7	10.2	10.7	11.1	11.4	11.6	11.8
40	0	1.0	2.0	3.0	3.9	4.9	5.7	6.6	7.4	8.1	8.8	9.4	10.0	10.4	10.8	11.1	11.3	11.5
42	0	1.0	1.9	2.9	3.8	4.7	5.6	6.4	7.2	7.9	8.5	9.1	9.7	10.1	10.5	10.8	11.0	11.1
44	0	.9	1.9	2.8	3.7	4.6	5.4	6.2	6.9	7.6	8.3	8.8	9.3	9.8	10.1	10.4	10.6	10.8
46	0	.9	1.8	2.7	3.6	4.4	5.2	6.0	6.7	7.4	8.0	8.5	9.0	9.4	9.8	10.1	10.3	10.4
48	0	.9	1.7	2.6	3.4	4.3	5.0	5.8	6.5	7.1	7.7	8.2	8.7	9.1	9.4	9.7	9.9	10.0
50	0	.8	1.7	2.5	3.3	4.1	4.8	5.5	6.2	6.8	7.4	7.9	8.3	8.7	9.1	9.3	9.5	9.6
52	0	.8	1.6	2.4	3.2	3.9	4.6	5.3	5.9	6.5	7.1	7.6	8.0	8.4	8.7	8.9	9.1	9.2
54	0	.8	1.5	2.3	3.0	3.7	4.4	5.1	5.7	6.2	6.8	7.2	7.6	8.0	8.3	8.5	8.7	8.8
56	0	.7	1.5	2.2	2.9	3.5	4.2	4.8	5.4	5.9	6.4	6.9	7.3	7.6	7.9	8.1	8.3	8.4
58	0	.7	1.4	2.1	2.7	3.4	4.0	4.6	5.1	5.6	6.1	6.5	6.9	7.2	7.5	7.7	7.8	7.9
60	0	.7	1.3	1.9	2.6	3.2	3.8	4.3	4.8	5.3	5.7	6.1	6.5	6.8	7.0	7.2	7.4	7.5
62	0	.6	1.2	1.8	2.4	3.0	3.5	4.0	4.5	5.0	5.4	5.8	6.1	6.4	6.6	6.8	6.9	7.0
64	0	.6	1.1	1.7	2.2	2.8	3.3	3.8	4.2	4.6	5.0	5.4	5.7	6.0	6.2	6.4	6.5	6.6
66	0	.5	1.1	1.6	2.1	2.6	3.1	3.5	3.9	4.3	4.7	5.0	5.3	5.5	5.7	5.9	6.0	6.1
68	0	.5	1.0	1.5	1.9	2.4	2.8	3.2	3.6	4.0	4.3	4.6	4.9	5.1	5.3	5.4	5.6	5.6
70	0	.4	.9	1.3	1.8	2.2	2.6	2.9	3.3	3.6	3.9	4.2	4.4	4.6	4.8	5.0	5.1	5.1

Table for Rectifying Lines of Position.

h	D=30'		D=36'		D=42'		D=48'		D=54'		D=60'		h
	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	
20	0.0	89.8	0.1	89.8	0.1	89.7	0.1	89.7	0.2	89.7	0.2	89.6	20
30	.1	89.7	.1	89.7	.1	89.6	.2	89.5	.2	89.5	.3	89.4	30
40	.1	89.6	.2	89.5	.2	89.4	.3	89.3	.4	89.2	.4	89.2	40
45	0.1	89.5	0.2	89.4	0.3	89.3	0.3	89.2	0.4	89.1	0.5	89.0	45
50	.2	89.4	.2	89.3	.3	89.2	.4	89.0	.5	88.9	.6	88.8	50
55	.2	89.3	.3	89.1	.4	89.0	.5	88.9	.6	88.7	.7	88.6	55
60	0.2	89.1	0.3	89.0	0.4	88.8	0.6	88.6	0.7	88.4	0.9	88.3	60
61	.2	89.1	.3	88.9	.5	88.7	.6	88.6	.8	88.4	.9	88.2	61
62	.2	89.1	.4	88.9	.5	88.7	.6	88.5	.8	88.3	1.0	88.1	62
63	.3	89.0	.4	88.8	.5	88.6	.7	88.4	.8	88.2	1.0	88.0	63
64	.3	89.0	.4	88.8	.5	88.6	.7	88.4	.9	88.2	1.1	88.0	64
65	0.3	88.9	0.4	88.7	0.6	88.5	0.7	88.3	0.9	88.1	1.1	87.9	65
66	.3	88.9	.4	88.7	.6	88.4	.8	88.2	1.0	88.0	1.2	87.8	66
67	.3	88.8	.4	88.6	.6	88.4	.8	88.1	1.0	87.9	1.2	87.6	67
68	.3	88.8	.5	88.5	.6	88.3	.8	88.0	1.0	87.8	1.3	87.5	68
69	.3	88.7	.5	88.4	.7	88.2	.9	87.9	1.1	87.7	1.4	87.4	69
70	0.4	88.6	0.5	88.4	0.7	88.1	0.9	87.8	1.2	87.5	1.4	87.3	70
71	.4	88.5	.5	88.3	.7	88.0	1.0	87.7	1.2	87.4	1.5	87.1	71
72	.4	88.5	.6	88.2	.8	87.8	1.0	87.5	1.3	87.2	1.6	86.9	72
73	.4	88.4	.6	88.0	.8	87.7	1.1	87.4	1.4	87.1	1.7	86.7	73
74	.5	88.3	.7	87.9	.9	87.6	1.2	87.2	1.5	86.9	1.8	86.5	74
75	0.5	88.1	0.7	87.8	1.0	87.4	1.3	87.0	1.6	86.6	2.0	86.3	75

Table for Rectifying Lines of Position

h	D=6'		D=10'		D=14'		D=18'		D=22'		D=26'		D=30'		h
	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	Δh	Z ₁	
75 0	0.0	89.6	0.1	89.4	0.1	89.1	0.2	88.9	0.3	88.6	0.4	88.4	0.5	88.1	75 0
76 0	.0	89.6	.1	89.3	.1	89.1	.2	88.8	.3	88.5	.4	88.3	.5	88.0	76 0
77 0	.0	89.6	.1	89.3	.1	89.0	.2	88.7	.3	88.4	.4	88.1	.6	87.8	77 0
78 0	.0	89.5	.1	89.2	.1	88.9	.2	88.6	.3	88.3	.5	88.0	.6	87.6	78 0
79 0	.0	89.5	.1	89.1	.1	88.8	.2	88.5	.4	88.1	.5	87.8	.7	87.4	79 0
80 0	0.0	89.5	0.1	89.0	0.2	88.7	0.3	88.3	0.4	87.9	0.6	87.5	0.7	87.1	80 0
81 0	.0	89.4	.1	88.9	.2	88.5	.3	88.1	.4	87.7	.6	87.2	.8	86.8	81 0
82 0	.0	89.3	.1	88.8	.2	88.3	.3	87.9	.5	87.4	.7	86.9	.9	86.4	82 0
83 0	.0	89.2	.1	88.6	.2	88.1	.4	87.5	.6	87.0	.8	86.5	1.1	85.9	83 0
84 0	.0	89.0	.1	88.4	.3	87.8	.5	87.1	.7	86.5	.9	85.9	1.2	85.2	84 0
30	.1	89.0	.1	88.3	.3	87.6	.5	86.9	.7	86.2	1.0	85.5	1.4	84.8	30
85 0	0.1	88.9	0.2	88.1	0.3	87.3	0.5	86.6	0.8	85.8	1.1	85.0	1.5	84.3	85 0
20	.1	88.8	.2	88.0	.3	87.1	.6	86.3	.9	85.5	1.2	84.7	1.6	83.9	20
40	.1	88.7	.2	87.8	.4	86.9	.6	86.0	.9	85.2	1.3	84.3	1.7	83.4	40
86 0	.1	88.6	.2	87.6	.4	86.7	.7	85.7	1.0	84.8	1.4	83.8	1.9	82.9	86 0
20	.1	88.4	.2	87.4	.4	86.4	.7	85.3	1.1	84.3	1.5	83.3	2.0	82.2	20
40	.1	88.3	.2	87.1	.5	86.0	.8	84.9	1.2	83.7	1.7	82.6	2.2	81.5	40
87 0	0.1	88.1	0.3	86.8	0.5	85.6	0.9	84.3	1.3	83.0	1.9	81.8	2.5	80.5	87 0
10	.1	88.0	.3	86.7	.6	85.3	.9	84.0	1.4	82.6	2.0	81.3	2.6	80.0	10
20	.1	87.9	.3	86.4	.6	85.0	1.0	83.6	1.5	82.2	2.1	80.8	2.8	79.4	20
30	.1	87.7	.3	86.2	.7	84.7	1.1	83.2	1.6	81.7	2.2	80.2	3.0	78.7	30
40	.1	87.5	.4	85.9	.7	84.3	1.1	82.7	1.7	81.1	2.4	79.5	3.2	77.9	40
50	.1	87.4	.4	85.6	.8	83.9	1.2	82.1	1.8	80.4	2.6	78.7	3.4	77.0	50
88 0	0.1	87.1	0.4	85.2	0.8	83.3	1.3	81.5	2.0	79.6	2.8	77.8	3.7	76.0	88 0
5	.2	87.0	.4	85.0	.8	83.1	1.4	81.1	2.1	79.2	2.9	77.3	3.8	75.4	5
10	.2	86.9	.5	84.8	.9	82.7	1.5	80.7	2.2	78.7	3.0	76.7	4.0	74.7	10
15	.2	86.7	.5	84.6	.9	82.4	1.5	80.3	2.3	78.2	3.2	76.1	4.2	74.1	15
20	.2	86.6	.5	84.3	1.0	82.0	1.6	79.8	2.4	77.6	3.3	75.4	4.4	73.3	20
25	.2	86.4	.5	84.0	1.0	81.6	1.7	79.3	2.5	77.0	3.5	74.7	4.6	72.5	25
30	0.2	86.2	0.6	83.7	1.1	81.2	1.8	78.7	2.7	76.3	3.7	73.9	4.9	71.6	30
35	.2	86.0	.6	83.3	1.1	80.6	1.9	78.0	2.8	75.5	3.9	73.0	5.1	70.6	35
40	.2	85.7	.6	82.9	1.2	80.1	2.0	77.3	3.0	74.6	4.1	72.0	5.4	69.4	40
45	.2	85.4	.7	82.4	1.3	79.4	2.1	76.5	3.2	73.7	4.4	70.9	5.8	68.2	45
50	.3	85.1	.7	81.9	1.4	78.7	2.3	75.6	3.4	72.6	4.7	69.6	6.2	66.8	50
55	.3	84.7	.8	81.3	1.5	77.8	2.4	74.5	3.6	71.3	5.0	68.2	6.6	65.2	55
89 0	0.3	84.3	0.8	80.5	1.6	76.9	2.6	73.3	3.9	69.9	5.4	66.6	7.0	63.4	89 0
3	.3	84.0	.9	80.0	1.7	76.2	2.8	72.5	4.1	68.9	5.7	65.5	7.4	62.2	3
6	.3	83.7	.9	79.5	1.8	75.5	2.9	71.6	4.3	67.8	5.9	64.3	7.8	60.9	6
9	.4	83.3	1.0	78.9	1.9	74.6	3.1	70.6	4.5	66.7	6.3	63.0	8.2	59.5	9
12	0.4	82.9	1.0	78.2	2.0	73.7	3.3	69.4	4.8	65.4	6.6	61.6	8.6	58.0	12
15	.4	82.4	1.1	77.5	2.1	72.7	3.5	68.2	5.1	63.9	7.0	60.0	9.1	56.3	15
18	.4	81.9	1.2	76.6	2.3	71.6	3.7	66.8	5.4	62.4	7.4	58.3	9.6	54.5	18
21	.5	81.3	1.3	75.6	2.4	70.3	3.9	65.2	5.8	60.6	7.9	56.3	10.2	52.4	21
24	0.5	80.5	1.4	74.5	2.6	68.7	4.2	63.4	6.2	58.6	8.4	54.2	10.9	50.2	24
26	.5	80.0	1.5	73.6	2.8	67.6	4.5	62.1	6.5	57.1	8.8	52.6	11.3	48.6	26
28	.6	79.4	1.5	72.6	2.9	66.6	4.7	60.6	6.8	55.5	9.2	50.9	11.9	46.8	28
30	.6	78.7	1.6	71.6	3.1	65.0	5.0	59.0	7.2	53.7	9.7	49.1	12.4	45.0	30

NEW ALTITUDE TABLES

A description of these Tables in Portuguese will be found in the *Revista Maritima Brasileira* for February, 1912, page 1335.

NEW ALTITUDE TABLES

HOW TO COMPUTE THE ALTITUDE OF A CELESTIAL BODY BY MEANS OF THE FOLLOWING TABLES

When the Hour Angle (t) and the Declination (d) of a celestial body are given and also the Latitude (L) of the observer we may calculate very easily, very rapidly and with as great accuracy as necessary the Altitude (h) of a celestial body as follows :

In the fundamental equation

$$(1) \quad \cos(90^\circ - h) \text{ or } \sin h = \sin L \sin d + \cos L \cos d \cos t$$

we make

$$\cos t = 1 - 2 \sin^2 \frac{t}{2}$$

and we have

$$(2) \quad \cos(90^\circ - h) = \cos(L - d) - 2 \cos L \cos d \sin^2 \frac{t}{2}$$

$$\text{or } 1 - \cos(90^\circ - h) = 1 - \cos(L - d) + 2 \cos L \cos d \sin^2 \frac{t}{2}$$

If we make

$$(3) \quad 2 \cos L \cos d \sin^2 \frac{t}{2} = \text{versine } \theta = 2 \sin^2 \frac{\theta}{2}$$

we will have finally

$$(4) \quad \text{versine}(90^\circ - h) = \text{versine}(L - d) + \text{versine } \theta$$

Inverting equation (3), viz. :

$$2 \cos L \cos d \sin^2 \frac{t}{2} = 2 \sin^2 \frac{\theta}{2}$$

and multiplying both members by 2 we have

$$\sec L \sec d \text{ cosec}^2 \frac{t}{2} = \text{cosec}^2 \frac{\theta}{2}$$

Applying logarithms to both members and dividing by 2 we have

$$(5) \quad 1/2 \log \sec L + 1/2 \log \sec d + \log \text{cosec} \frac{t}{2} = \log \text{cosec} \frac{\theta}{2}$$

Therefore by means of formulæ (4) and (5) we can determine the Altitude with the aid of the following Tables.

The Tables on pages 2* to 9* give us $1/2 \log \sec L$ or $1/2 \log \sec d$.

The Tables on pages 10* to 27* give us in columns marked "*Hour Angle*" the $\log \text{cosec} \frac{t}{2}$ or $\log \text{cosec} \frac{\theta}{2}$ when we enter with t or θ as arguments.

In columns marked "*Sum or Diff.*" we find $\text{versine}(L - d)$ and also in the same columns $\text{versine } \theta$ corresponding to the $\log \text{cosec} \frac{\theta}{2}$ given in columns marked "*Hour Angle.*"

The Tables on pages 28* to 36* give us $\log \text{cosec} \frac{t}{2}$ when t is comprised between 90° and 270° .

The Altitude corresponding to $\text{versine}(90^\circ - h)$ will be found from below in columns marked "*Alt.*" the minutes of which are to be found on the right hand side of the pages.

Each versine and logarithm has been multiplied by 10^6 in order to reduce it to a whole number. On this account no characteristics appear and no periods also.

The numbers given correspond to six decimal places. When only five decimal place accuracy is desired drop the figure after the space or round up the fifth figure.

EXAMPLE I

GREENWICH HOUR ANGLE WEST.

The following expressions give us the value of t_a —the *Greenwich Hour Angle West*:

$$t_a = \text{G. M. T.} - \text{Eq. of T. for the } \odot$$

$$t_a = \text{G. M. T.} + \text{R. A. M. S} - \text{R. A. for } *, \uparrow, \text{ and planets.}$$

LOCAL HOUR ANGLE WEST.

Once known t_a , the *local hour angle west* (t) is given by the expression

$$t = t_a \mp G$$

(– when G is West and + when G is East) G standing for Longitude.

When t_a is smaller than G add 360° to t_a . If $t_a + G$ is larger than 360° drop 360° from it.

EXAMPLE I.

On February 21, 1910, about 8^h A.M. in Lat. by D. R. = $36^\circ 52'$ N and Long. by D. R. = $8^\circ 6'$ W the Sun's true altitude was $21^\circ 7'$ at $21^{\text{h}} 6^{\text{m}} 11^{\text{s}}$ of the chronometer, $6^{\text{m}} 59^{\text{s}}$ slow of G. M. T. Required the D. R. altitude.

$$\begin{array}{r} C. = 21^{\text{h}} \ 6^{\text{m}} \ 11^{\text{s}} \\ C. C. = + \ 6 \ 59 \\ \hline \text{G. M. T.} = 21^{\text{h}} \ 13^{\text{m}} \ 10^{\text{s}} \\ \text{Eq. of T.} = - \ 13 \ 46 \\ \hline \text{G. A. T.} = 20^{\text{h}} \ 59^{\text{m}} \ 24^{\text{s}} \end{array} \quad \text{or} \quad \begin{array}{r} t_a = 314^\circ \ 51' \\ G_w = \ 8 \ 6 \\ \hline t = 306^\circ \ 45' \end{array}$$

$$\begin{array}{r} t = 306^\circ \ 45' \quad [\log \operatorname{cosec} \frac{t}{2}] \quad 34858 \\ L = 36 \ 52 \ \text{N} \quad [1/2 \log \sec L] \quad 4845 \\ d = 10 \ 27 \ \text{S} \quad [1/2 \log \sec d] \quad 363 \\ \hline \quad \quad \quad [\log \operatorname{cosec} \frac{\theta}{2}] \quad 40066 \quad \dots \quad 31609 \quad [\operatorname{versine} \theta] \\ L + d = 47^\circ \ 19' \quad \dots \quad \dots \quad \dots \quad 32205 \quad [\operatorname{versine} (L + d)] \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad 63814 \quad [\operatorname{versine} (90^\circ - h)] \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad h = 21^\circ \ 13' \end{array}$$

EXPLANATION.

After applying the correction to the chronometer time and the equation of time to the G. M. T. we find the G. A. T. or t_a —the Sun's Greenwich Hour Angle West— t_a being G. A. T. converted into arc.¹ The longitude by D. R. is combined with this t_a giving us t : the local hour angle west. Thus we have $t = 306^\circ 45'$.

¹ This procedure, not usually followed in the text books, has the *triple* advantage of simplifying the determination of t , abolishing the argument in time in the tables and the necessity of dealing with data expressed in time and in arc after G. A. T. is converted.

NEW ALTITUDE TABLES

The declination of the Sun, found in the *Nautical Almanac* at the same time as the Eq. of T., is taken to the nearest minute of arc. It is combined with the latitude, as shown.

When L and d are of the *same name*, both N or both S , subtract the smaller of the two from the larger. If they are of *contrary names*, as in our Examples, one N and the other S , add them together. We find $L+d=47^{\circ} 19'$.

Entering the "Latitude or Declination" Tables with $L=36^{\circ} 52'$ we find on page 5*: 4845, and with $d=10^{\circ} 27'$ we find on page 3*: 363.

Entering the tables on page 20* from below¹ with $t=306^{\circ} 45'$ in the "Hour Angle" column we find 34858, which, added to the numbers corresponding to L and d , gives us 40066.

We look for this number 40066 on page 19* in the same "Hour Angle" column, and opposite it in column "Sum or Diff." we find 31609. Adding to this number 31609 the number 32205 found on page 19* corresponding to $47^{\circ} 19'$ in "Sum or Diff." column we have 63814. This number corresponds to $21^{\circ} 13'$ in the "Alt." column on page 23*.

Therefore the altitude from D. R. is $21^{\circ} 13'$.

EXAMPLE II.

On August 21, 1908, about 11^h A.M. in Lat. by D. R. = $16^{\circ} 34'$ S. and Long. by D. R. = $38^{\circ} 11'$ W. the Sun's true altitude was $59^{\circ} 10'$ at 1^h 19^m 40^s of the chronometer 26^m 50^s slow of G. M. T. Required the D. R. altitude.

	C. = 1 ^h 19 ^m 40 ^s	
	C. C. = + 26 59	
	G. M. T. = 1 ^h 46 ^m 39 ^s	
	Eq. of T. = - 3 3	
	G. A. T. = 1 ^h 43 ^m 36 ^s or $t_a = 25^{\circ} 54'$	
	$360^{\circ} + t_a = 385^{\circ} 54'$	
	$G_m = 38 11$	
	$t = 347^{\circ} 43'$	
$t = 347^{\circ} 43'$	97067	
$L = 16 34 S$	921	
$d = 12 10 N$	493	
	98481 . . . 2143	
$L+d = 28^{\circ} 44'$	12313	
	14456	
	$h = 58^{\circ} 49'$	

HOW TO FIND THE AZIMUTH.

The Azimuth can be readily and easily found by methods explained on pages xxxvii and xxxviii of the "Altitude and Azimuth Tables."

For the sake of further exercise we will find the Azimuth in one of the two examples above.

Example. Given $t=53^{\circ} 15'$ E, $d=10^{\circ} 27'$ S and $L=36^{\circ} 52'$ N. Find the Azimuth.

¹ When t is smaller than 180° we enter the tables at the top and the body is West of the meridian; when t is greater than 180° we enter the tables from below and the body is East of the meridian.

HOW TO FIND THE AZIMUTH

Entering the tables with $d=10^{\circ} 30'$ and $t=53^{\circ}$ we find on page 69: $a=52^{\circ} 0'$ and $b=17^{\circ}$. Combining b with L we have $C=54^{\circ}$ and entering the tables again with $a=52^{\circ} 0'$ and $C=54^{\circ}$ we find $Z=57^{\circ} 42'$.

Generally (when $Z < 70^{\circ}$) it will not be necessary to combine b and L . It is only necessary to run down column $\begin{matrix} d \\ \diagdown \\ h \end{matrix}$ corresponding to $a=52^{\circ} 0'$ until we find $h=21^{\circ} 13$ and alongside the value of the altitude we would find $Z=57^{\circ} 42'$.

In the same way we would find $Z=23^{\circ} 41'$ in the second example.

NOTE.—It is evident that the Hour Angle t can be found given L , d and h by using backwards the process for finding h given L , d and t .

The author takes this opportunity to thank his good friend Lieutenant Renato Bayardino, Brazilian Navy, for his kindness in organising the "Latitude or Declination" Tables and for carefully revising with him these new Altitude Tables.

Latitude or Declination

	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	
0	00	33	133	298	530	828	1193	1625	2124	2690	0
1	00	34	135	301	534	833	1200	1632	2133	2700	1
2	00	35	137	304	539	839	1206	1640	2141	2710	2
3	00	36	139	308	543	845	1213	1648	2150	2720	3
4	00	38	141	311	547	850	1220	1656	2159	2730	4
5	00	39	144	315	552	856	1226	1664	2168	2740	5
6	00	40	146	318	557	862	1233	1672	2177	2750	6
7	00	41	148	322	561	867	1240	1679	2186	2761	7
8	01	43	151	325	566	873	1247	1687	2195	2771	8
9	01	44	153	328	570	878	1253	1695	2204	2781	9
10	01	45	155	332	575	884	1260	1703	2213	2791	10
11	01	46	157	335	579	890	1267	1711	2222	2801	11
12	01	48	160	339	584	896	1274	1719	2232	2811	12
13	02	49	163	342	589	902	1281	1727	2241	2822	13
14	02	50	165	346	593	907	1288	1735	2250	2832	14
15	02	52	168	350	598	913	1295	1743	2259	2842	15
16	02	53	170	353	603	919	1301	1751	2268	2853	16
17	03	54	173	357	607	925	1308	1759	2277	2863	17
18	03	56	175	360	612	930	1315	1767	2286	2873	18
19	03	57	178	364	617	936	1322	1775	2296	2884	19
20	04	59	180	368	622	942	1329	1784	2305	2894	20
21	04	60	183	372	627	948	1336	1792	2314	2904	21
22	04	62	185	375	631	954	1343	1800	2323	2915	22
23	05	63	188	379	636	960	1350	1808	2333	2925	23
24	05	65	191	383	641	966	1358	1816	2342	2936	24
25	06	66	193	386	646	972	1365	1825	2351	2946	25
26	06	68	196	390	651	978	1372	1833	2361	2957	26
27	07	70	199	394	656	984	1379	1841	2370	2967	27
28	07	71	201	398	661	990	1386	1849	2380	2978	28
29	08	73	204	402	665	996	1393	1857	2389	2988	29
30	08	74	207	405	670	1002	1400	1866	2398	2999	30
31	09	76	210	409	675	1008	1408	1874	2408	3009	31
32	09	78	212	413	680	1014	1415	1882	2417	3020	32
33	10	79	215	417	685	1020	1422	1891	2427	3030	33
34	11	81	218	421	690	1027	1429	1899	2436	3041	34
35	11	83	221	425	696	1033	1437	1908	2446	3052	35
36	12	85	224	429	701	1039	1444	1916	2455	3062	36
37	13	86	227	433	706	1045	1451	1924	2465	3073	37
38	14	88	229	437	711	1051	1459	1933	2475	3084	38
39	14	90	232	441	716	1058	1466	1941	2484	3095	39
40	15	92	235	445	721	1064	1473	1950	2494	3105	40
41	15	94	238	449	726	1070	1481	1958	2503	3116	41
42	16	96	241	453	731	1076	1488	1967	2513	3127	42
43	17	98	244	457	737	1083	1496	1975	2523	3138	43
44	18	99	247	461	742	1089	1503	1984	2532	3149	44
45	19	101	250	465	747	1095	1510	1993	2542	3159	45
46	19	103	253	470	753	1102	1518	2001	2552	3170	46
47	20	105	256	474	758	1108	1525	2010	2562	3181	47
48	21	107	259	478	763	1115	1533	2018	2571	3192	48
49	22	109	262	482	768	1121	1540	2027	2581	3203	49
50	23	111	266	486	774	1127	1548	2036	2591	3214	50
51	24	113	269	491	779	1134	1556	2044	2601	3225	51
52	25	115	272	495	784	1140	1563	2053	2611	3236	52
53	26	117	275	499	790	1147	1571	2062	2620	3247	53
54	27	119	278	503	795	1154	1578	2071	2630	3258	54
55	28	122	282	508	801	1160	1586	2080	2640	3269	55
56	29	124	285	512	806	1166	1594	2088	2650	3280	56
57	30	126	288	517	812	1173	1601	2097	2660	3291	57
58	31	128	291	521	817	1180	1609	2106	2670	3302	58
59	32	130	295	525	822	1186	1617	2115	2680	3313	59
60	33	133	298	530	828	1193	1625	2124	2690	3324	60

Latitude or Declination

Latitude or Declination

	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	
0	332 4	402 7	479 8	563 8	654 8	752 8	857 9	970 2	1089 7	1216 5	0
1	333 5	403 9	481 1	565 3	656 4	754 5	859 7	972 1	1091 7	1218 7	1
2	334 7	405 1	482 5	566 7	658 0	756 2	861 5	974 1	1093 8	1220 9	2
3	335 8	406 4	483 8	568 2	659 5	757 9	863 4	976 0	1095 9	1223 0	3
4	336 9	407 6	485 2	569 7	661 1	759 6	865 2	977 9	1097 9	1225 2	4
5	338 0	408 8	486 5	571 1	662 7	761 3	867 0	979 9	1100 0	1227 4	5
6	339 1	410 1	487 9	572 6	664 3	763 0	868 8	981 8	1102 0	1229 6	6
7	340 3	411 3	489 2	574 1	665 9	764 7	870 6	983 8	1104 1	1231 8	7
8	341 4	412 6	490 6	575 5	667 5	766 4	872 5	985 7	1106 2	1234 0	8
9	342 5	413 8	491 9	577 0	669 0	768 1	874 3	987 6	1108 2	1236 2	9
10	343 7	415 0	493 3	578 5	670 6	769 8	876 1	989 6	1110 3	1238 4	10
11	344 8	416 3	494 7	580 0	672 2	771 6	878 0	991 6	1112 4	1240 6	11
12	345 9	417 5	496 0	581 4	673 8	773 3	879 8	993 5	1114 5	1242 8	12
13	347 1	418 8	497 4	582 9	675 4	775 0	881 6	995 5	1116 5	1245 0	13
14	348 2	420 1	498 8	584 4	677 0	776 7	883 5	997 4	1118 6	1247 2	14
15	349 3	421 3	500 1	585 9	678 6	778 4	885 3	999 4	1120 7	1249 4	15
16	350 5	422 6	501 5	587 4	680 2	780 1	887 2	1001 4	1122 8	1251 6	16
17	351 7	423 8	502 9	588 9	681 9	781 9	889 0	1003 3	1124 9	1253 8	17
18	352 8	425 1	504 3	590 4	683 5	783 6	890 8	1005 3	1127 0	1256 0	18
19	353 9	426 3	505 6	591 9	685 1	785 3	892 7	1007 2	1129 0	1258 2	19
20	355 1	427 6	507 0	593 4	686 7	787 1	894 5	1009 2	1131 1	1260 4	20
21	356 2	428 9	508 4	594 9	688 3	788 8	896 4	1011 2	1133 2	1262 6	21
22	357 4	430 1	509 8	596 4	689 9	790 5	898 2	1013 2	1135 3	1264 8	22
23	358 5	431 4	511 2	597 9	691 5	792 3	900 1	1015 2	1137 4	1267 1	23
24	359 7	432 7	512 6	599 4	693 2	794 0	902 0	1017 1	1139 5	1269 3	24
25	360 9	434 0	513 9	600 9	694 8	795 7	903 8	1019 1	1141 6	1271 5	25
26	362 0	435 2	515 3	602 4	696 4	797 5	905 7	1021 1	1143 7	1273 7	26
27	363 2	436 5	516 7	603 9	698 0	799 2	907 6	1023 1	1145 8	1276 0	27
28	364 4	437 8	518 1	605 4	699 7	801 0	909 4	1025 0	1148 0	1278 2	28
29	365 5	439 1	519 5	606 9	701 3	802 7	911 3	1027 0	1150 1	1280 4	29
30	366 7	440 4	520 9	608 4	702 9	804 5	913 2	1029 0	1152 2	1282 7	30
31	367 9	441 7	522 3	609 9	704 6	806 2	915 0	1031 0	1154 3	1284 9	31
32	369 0	442 9	523 7	611 5	706 2	808 0	916 9	1033 0	1156 4	1287 2	32
33	370 2	444 2	525 1	613 0	707 8	809 7	918 8	1035 0	1158 5	1289 4	33
34	371 4	445 5	526 5	614 5	709 5	811 5	920 7	1037 0	1160 6	1291 6	34
35	372 6	446 8	528 0	616 0	711 1	813 3	922 5	1039 0	1162 8	1293 9	35
36	373 8	448 1	529 4	617 6	712 8	815 0	924 4	1041 0	1164 9	1296 1	36
37	374 9	449 4	530 8	619 1	714 4	816 8	926 3	1043 0	1167 0	1298 4	37
38	376 1	450 7	532 2	620 6	716 1	818 6	928 2	1045 0	1169 1	1300 6	38
39	377 3	452 0	533 6	622 2	717 7	820 3	930 1	1047 0	1171 3	1302 9	39
40	378 5	453 3	535 0	623 7	719 4	822 1	932 0	1049 0	1173 4	1305 1	40
41	379 7	454 6	536 4	625 2	721 0	823 9	933 9	1051 1	1175 5	1307 4	41
42	380 9	455 9	537 9	626 8	722 7	825 6	935 8	1053 1	1177 7	1309 7	42
43	382 1	457 2	539 3	628 3	724 3	827 4	937 7	1055 1	1179 8	1311 9	43
44	383 3	458 5	540 7	629 8	726 0	829 2	939 6	1057 1	1182 0	1314 2	44
45	384 5	459 9	542 1	631 4	727 6	831 0	941 5	1059 1	1184 1	1316 5	45
46	385 7	461 2	543 6	632 9	729 3	832 8	943 4	1061 2	1186 3	1318 7	46
47	386 9	462 5	545 0	634 5	731 0	834 6	945 3	1063 2	1188 4	1321 0	47
48	388 1	463 8	546 4	636 0	732 6	836 3	947 2	1065 2	1190 5	1323 3	48
49	389 3	465 1	547 9	637 6	734 3	838 1	949 1	1067 2	1192 7	1325 5	49
50	390 5	466 5	549 3	639 1	736 0	839 9	951 0	1069 3	1194 9	1327 8	50
51	391 7	467 8	550 8	640 7	737 7	841 7	952 9	1071 3	1197 0	1330 1	51
52	392 9	469 1	552 2	642 3	739 3	843 5	954 8	1073 3	1199 2	1332 4	52
53	394 1	470 4	553 6	643 8	741 0	845 3	956 7	1075 4	1201 3	1334 7	53
54	395 3	471 8	555 1	645 4	742 7	847 1	958 6	1077 4	1203 5	1337 0	54
55	396 6	473 1	556 5	646 9	744 4	848 9	960 6	1079 4	1205 7	1339 2	55
56	397 8	474 4	558 0	648 5	746 1	850 7	962 5	1081 5	1207 8	1341 5	56
57	399 0	475 8	559 4	650 1	747 7	852 5	964 4	1083 5	1210 0	1343 8	57
58	400 2	477 1	560 9	651 7	749 4	854 3	966 3	1085 6	1212 2	1346 1	58
59	401 4	478 4	562 3	653 2	751 1	856 1	968 3	1087 6	1214 3	1348 4	59
60	402 7	479 8	563 8	654 8	752 8	857 9	970 2	1089 7	1216 5	1350 7	60

Latitude or Declination

Latitude or Declination

	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	
0	1350 7	1492 4	1641 7	1798 7	1963 5	2136 2	2317 0	2506 0	2703 3	2909 0	0
1	1353 0	1494 8	1644 3	1801 4	1966 3	2139 2	2320 1	2509 2	2706 6	2912 5	1
2	1355 3	1497 3	1646 8	1804 1	1969 1	2142 1	2323 2	2512 4	2710 0	2916 0	2
3	1357 6	1499 7	1649 4	1806 8	1971 9	2145 1	2326 2	2515 6	2713 3	2919 6	3
4	1359 9	1502 1	1651 9	1809 4	1974 8	2148 0	2329 3	2518 9	2716 7	2923 1	4
5	1362 2	1504 6	1654 5	1812 1	1977 6	2151 0	2332 4	2522 1	2720 1	2926 6	5
6	1364 5	1507 0	1657 1	1814 8	1980 4	2153 9	2335 5	2525 3	2723 5	2930 1	6
7	1366 9	1509 4	1659 6	1817 5	1983 2	2156 9	2338 6	2528 5	2726 8	2933 6	7
8	1369 2	1511 9	1662 2	1820 2	1986 1	2159 9	2341 7	2531 8	2730 2	2937 1	8
9	1371 5	1514 3	1664 8	1822 9	1988 9	2162 8	2344 8	2535 0	2733 6	2940 6	9
10	1373 8	1516 8	1667 3	1825 6	1991 8	2165 8	2347 9	2538 3	2737 0	2944 2	10
11	1376 1	1519 2	1669 9	1828 3	1994 6	2168 8	2351 0	2541 5	2740 3	2947 7	11
12	1378 5	1521 7	1672 5	1831 0	1997 4	2171 7	2354 1	2544 8	2743 7	2951 2	12
13	1380 8	1524 1	1675 1	1833 7	2000 2	2174 7	2357 2	2548 0	2747 1	2954 8	13
14	1383 1	1526 6	1677 6	1836 4	2003 1	2177 7	2360 3	2551 2	2750 5	2958 3	14
15	1385 4	1529 0	1680 2	1839 2	2005 9	2180 7	2363 5	2554 5	2753 9	2961 8	15
16	1387 8	1531 5	1682 8	1841 9	2008 8	2183 6	2366 6	2557 8	2757 3	2965 4	16
17	1390 1	1533 9	1685 4	1844 6	2011 6	2186 6	2369 7	2561 0	2760 7	2968 9	17
18	1392 4	1536 4	1688 0	1847 3	2014 5	2189 6	2372 8	2564 3	2764 1	2972 5	18
19	1394 8	1538 9	1690 6	1850 0	2017 3	2192 6	2375 9	2567 5	2767 5	2976 0	19
20	1397 1	1541 3	1693 2	1852 8	2020 2	2195 6	2379 1	2570 8	2770 9	2979 5	20
21	1399 5	1543 8	1695 8	1855 5	2023 0	2198 6	2382 2	2574 1	2774 3	2983 1	21
22	1401 8	1546 3	1698 4	1858 2	2025 9	2201 6	2385 3	2577 3	2777 7	2986 7	22
23	1404 1	1548 7	1701 0	1860 9	2028 8	2204 6	2388 5	2580 6	2781 1	2990 2	23
24	1406 5	1551 2	1703 6	1863 7	2031 6	2207 6	2391 6	2583 9	2784 5	2993 8	24
25	1408 8	1553 7	1706 2	1866 4	2034 5	2210 6	2394 7	2587 1	2788 0	2997 3	25
26	1411 2	1556 2	1708 8	1869 1	2037 4	2213 6	2397 9	2590 4	2791 4	3000 9	26
27	1413 5	1558 7	1711 4	1871 9	2040 2	2216 6	2401 0	2593 7	2794 8	3004 5	27
28	1415 9	1561 1	1714 0	1874 6	2043 1	2219 6	2404 1	2597 0	2798 2	3008 0	28
29	1418 3	1563 6	1716 6	1877 4	2046 0	2222 6	2407 3	2600 3	2801 6	3011 6	29
30	1420 6	1566 1	1719 2	1880 1	2048 9	2225 6	2410 4	2603 6	2805 1	3015 2	30
31	1423 0	1568 6	1721 9	1882 9	2051 7	2228 6	2413 6	2606 8	2808 5	3018 7	31
32	1425 3	1571 1	1724 5	1885 6	2054 6	2231 6	2416 7	2610 1	2811 9	3022 3	32
33	1427 7	1573 6	1727 1	1888 4	2057 5	2234 6	2419 9	2613 4	2815 4	3025 9	33
34	1430 1	1576 1	1729 7	1891 1	2060 4	2237 7	2423 1	2616 7	2818 8	3029 5	34
35	1432 5	1578 6	1732 3	1893 9	2063 3	2240 7	2426 2	2620 0	2822 3	3033 1	35
36	1434 8	1581 1	1735 0	1896 6	2066 2	2243 7	2429 4	2623 3	2825 7	3036 6	36
37	1437 2	1583 6	1737 6	1899 4	2069 1	2246 7	2432 5	2626 6	2829 1	3040 2	37
38	1439 6	1586 1	1740 2	1902 2	2072 0	2249 8	2435 7	2629 9	2832 6	3043 8	38
39	1442 0	1588 6	1742 9	1904 9	2074 9	2252 8	2438 9	2633 2	2836 0	3047 4	39
40	1444 3	1591 1	1745 5	1907 7	2077 8	2255 8	2442 1	2636 6	2839 5	3051 0	40
41	1446 7	1593 6	1748 1	1910 5	2080 7	2258 9	2445 2	2639 9	2842 9	3054 6	41
42	1449 1	1596 1	1750 8	1913 2	2083 6	2261 9	2448 4	2643 2	2846 4	3058 2	42
43	1451 5	1598 6	1753 4	1916 0	2086 5	2265 0	2451 6	2646 5	2849 9	3061 8	43
44	1453 9	1601 1	1756 1	1918 8	2089 4	2268 0	2454 8	2649 8	2853 3	3065 4	44
45	1456 3	1603 7	1758 7	1921 6	2092 3	2271 0	2457 9	2653 1	2856 8	3069 0	45
46	1458 7	1606 2	1761 4	1924 3	2095 2	2274 1	2461 1	2656 5	2860 3	3072 7	46
47	1461 1	1608 7	1764 0	1927 1	2098 1	2277 1	2464 3	2659 8	2863 7	3076 3	47
48	1463 5	1611 2	1766 7	1929 9	2101 0	2280 2	2467 5	2663 1	2867 2	3079 9	48
49	1465 9	1613 8	1769 3	1932 7	2104 0	2283 2	2470 7	2666 5	2870 7	3083 5	49
50	1468 3	1616 3	1772 0	1935 5	2106 9	2286 3	2473 9	2669 8	2874 1	3087 1	50
51	1470 7	1618 8	1774 7	1938 3	2109 8	2289 4	2477 1	2673 1	2877 6	3090 7	51
52	1473 1	1621 4	1777 3	1941 1	2112 7	2292 4	2480 3	2676 5	2881 1	3094 4	52
53	1475 5	1623 9	1780 0	1943 9	2115 7	2295 5	2483 5	2679 8	2884 6	3098 0	53
54	1477 9	1626 4	1782 7	1946 7	2118 6	2298 5	2486 7	2683 1	2888 1	3101 6	54
55	1480 3	1629 0	1785 3	1949 5	2121 5	2301 6	2489 9	2686 5	2891 6	3105 3	55
56	1482 7	1631 5	1788 0	1952 3	2124 5	2304 7	2493 1	2689 8	2895 1	3108 9	56
57	1485 2	1634 1	1790 7	1955 1	2127 4	2307 8	2496 3	2693 2	2898 5	3112 5	57
58	1487 6	1636 6	1793 3	1957 9	2130 3	2310 8	2499 5	2696 5	2902 0	3116 2	58
59	1490 0	1639 2	1796 0	1960 7	2133 3	2313 9	2502 7	2699 9	2905 5	3119 8	59
60	1492 4	1641 7	1798 7	1963 5	2136 2	2317 0	2506 0	2703 3	2909 0	3123 5	60
	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	

Latitude or Declination

Latitude or Declination

	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	
0	3123 5	3346 7	3579 0	3820 4	4071 3	4331 8	4602 1	4882 6	5173 4	5474 9	0
1	3127 1	3350 5	3582 9	3824 5	4075 6	4332 2	4606 7	4887 3	5178 3	5480 0	1
2	3130 7	3354 3	3586 9	3828 6	4079 8	4340 6	4611 3	4892 1	5183 3	5485 1	2
3	3134 4	3358 1	3590 8	3832 8	4084 1	4345 1	4615 9	4896 9	5188 2	5490 2	3
4	3138 1	3361 9	3594 8	3836 9	4088 4	4349 5	4620 5	4901 6	5193 2	5495 4	4
5	3141 7	3365 7	3598 7	3841 0	4092 6	4353 9	4625 1	4906 4	5198 1	5500 5	5
6	3145 4	3369 5	3602 7	3845 1	4096 9	4358 4	4629 7	4911 2	5203 1	5505 6	6
7	3149 1	3373 4	3606 7	3849 2	4101 2	4362 8	4634 3	4916 0	5208 0	5510 8	7
8	3152 7	3377 2	3610 6	3853 3	4105 5	4367 2	4638 9	4920 7	5213 0	5515 9	8
9	3156 4	3381 0	3614 6	3857 5	4109 7	4371 7	4643 5	4925 5	5217 9	5521 0	9
10	3160 1	3384 8	3618 6	3861 6	4114 0	4376 1	4648 2	4930 3	5222 9	5526 2	10
11	3163 7	3388 6	3622 6	3865 7	4118 3	4380 6	4652 8	4935 1	5227 9	5531 3	11
12	3167 4	3392 4	3626 5	3869 8	4122 6	4385 0	4657 4	4939 9	5232 8	5536 5	12
13	3171 1	3396 3	3630 5	3874 0	4126 9	4389 5	4662 0	4944 7	5237 8	5541 6	13
14	3174 8	3400 1	3634 5	3878 1	4131 2	4394 0	4666 6	4949 5	5242 8	5546 8	14
15	3178 4	3403 9	3638 5	3882 3	4135 5	4398 4	4671 3	4954 3	5247 8	5551 9	15
16	3182 1	3407 8	3642 5	3886 4	4139 8	4402 9	4675 9	4959 1	5252 7	5557 1	16
17	3185 8	3411 6	3646 4	3890 5	4144 1	4407 4	4680 5	4963 9	5257 7	5562 3	17
18	3189 5	3415 4	3650 4	3894 7	4148 4	4411 8	4685 2	4968 7	5262 7	5567 4	18
19	3193 2	3419 3	3654 4	3898 8	4152 7	4416 3	4689 8	4973 5	5267 7	5572 6	19
20	3196 9	3423 1	3658 4	3903 0	4157 0	4420 8	4694 5	4978 3	5272 7	5577 8	20
21	3200 6	3427 0	3662 4	3907 2	4161 4	4425 3	4699 1	4983 2	5277 7	5583 0	21
22	3204 3	3430 8	3666 4	3911 3	4165 7	4429 7	4703 8	4988 0	5282 7	5588 1	22
23	3208 0	3434 7	3670 4	3915 5	4170 0	4434 2	4708 4	4992 8	5287 7	5593 3	23
24	3211 7	3438 5	3674 4	3919 6	4174 3	4438 7	4713 1	4997 6	5292 7	5598 5	24
25	3215 4	3442 4	3678 5	3923 8	4178 6	4443 2	4717 7	5002 5	5297 7	5603 7	25
26	3219 1	3446 3	3682 5	3928 0	4183 0	4447 7	4722 4	5007 3	5302 7	5608 9	26
27	3222 8	3450 1	3686 5	3932 1	4187 3	4452 2	4727 1	5012 1	5307 7	5614 1	27
28	3226 5	3454 0	3690 5	3936 3	4191 6	4456 7	4731 7	5017 0	5312 7	5619 3	28
29	3230 3	3457 8	3694 5	3940 5	4196 0	4461 2	4736 4	5021 8	5317 8	5624 5	29
30	3234 0	3461 7	3698 5	3944 7	4200 3	4465 7	4741 1	5026 7	5322 8	5629 7	30
31	3237 7	3465 6	3702 6	3948 9	4204 7	4470 2	4745 7	5031 5	5327 8	5634 9	31
32	3241 4	3469 5	3706 6	3953 0	4209 0	4474 7	4750 4	5036 4	5332 8	5640 1	32
33	3245 2	3473 3	3710 6	3957 2	4213 4	4479 2	4755 1	5041 2	5337 9	5645 3	33
34	3248 9	3477 2	3714 7	3961 4	4217 7	4483 7	4759 8	5046 1	5342 9	5650 6	34
35	3252 6	3481 1	3718 7	3965 6	4222 1	4488 3	4764 5	5050 9	5347 9	5655 8	35
36	3256 4	3485 0	3722 7	3969 8	4226 4	4492 8	4769 2	5055 8	5353 0	5661 0	36
37	3260 1	3488 9	3726 8	3974 0	4230 8	4497 3	4773 9	5060 7	5358 0	5666 2	37
38	3263 8	3492 8	3730 8	3978 2	4235 1	4501 8	4778 5	5065 5	5363 1	5671 5	38
39	3267 6	3496 7	3734 9	3982 4	4239 5	4506 4	4783 2	5070 4	5368 1	5676 7	39
40	3271 3	3500 5	3738 9	3986 6	4243 9	4510 9	4787 9	5075 3	5373 2	5681 9	40
41	3275 1	3504 4	3743 0	3990 8	4248 2	4515 4	4792 7	5080 2	5378 2	5687 2	41
42	3278 8	3508 3	3747 0	3995 0	4252 6	4520 0	4797 4	5085 0	5383 3	5692 4	42
43	3282 6	3512 2	3751 1	3999 2	4257 0	4524 5	4802 1	5089 9	5388 4	5697 7	43
44	3286 3	3516 2	3755 1	4003 5	4261 4	4529 1	4806 8	5094 8	5393 4	5702 9	44
45	3290 1	3520 1	3759 2	4007 7	4265 7	4533 6	4811 5	5099 7	5398 5	5708 2	45
46	3293 8	3524 0	3763 3	4011 9	4270 1	4538 1	4816 2	5104 6	5403 6	5713 4	46
47	3297 6	3527 9	3767 3	4016 1	4274 5	4542 7	4820 9	5109 5	5408 6	5718 7	47
48	3301 4	3531 8	3771 4	4020 4	4278 9	4547 3	4825 7	5114 4	5413 7	5723 9	48
49	3305 1	3535 7	3775 5	4024 6	4283 3	4551 8	4830 4	5119 3	5418 8	5729 2	49
50	3308 9	3539 6	3779 5	4028 8	4287 7	4556 4	4835 1	5124 2	5423 9	5734 5	50
51	3312 7	3543 6	3783 6	4033 1	4292 1	4560 9	4839 8	5129 1	5429 0	5739 7	51
52	3316 4	3547 5	3787 7	4037 3	4296 5	4565 5	4844 6	5134 0	5434 0	5745 0	52
53	3320 2	3551 4	3791 8	4041 5	4300 9	4570 1	4849 3	5138 9	5439 1	5750 3	53
54	3324 0	3555 3	3795 9	4045 8	4305 3	4574 6	4854 1	5143 8	5444 2	5755 6	54
55	3327 8	3559 3	3800 0	4050 0	4309 7	4579 2	4858 8	5148 8	5449 3	5760 8	55
56	3331 6	3563 2	3804 0	4054 3	4314 1	4583 8	4863 6	5153 7	5454 4	5766 1	56
57	3335 3	3567 1	3808 1	4058 5	4318 5	4588 4	4868 3	5158 6	5459 5	5771 4	57
58	3339 1	3571 1	3812 2	4062 8	4322 9	4592 9	4873 1	5163 5	5464 6	5776 7	58
59	3342 9	3575 0	3816 3	4067 0	4327 4	4597 5	4877 8	5168 5	5469 8	5782 0	59
60	3346 7	3579 0	3820 4	4071 3	4331 8	4602 1	4882 6	5173 4	5474 9	5787 3	60

Latitude or Declination

Latitude or Declination

	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	
0	5787 3	6111 0	6446 3	6793 6	7153 3	7525 8	7911 4	8310 8	8724 5	9152 9	0
1	5792 6	6116 5	6452 0	6799 5	7159 4	7532 1	7918 0	8317 6	8731 5	9160 1	1
2	5797 9	6122 0	6457 7	6805 4	7165 5	7538 4	7924 5	8324 4	8738 5	9167 4	2
3	5803 2	6127 5	6463 4	6811 3	7171 6	7544 7	7931 1	8331 2	8745 5	9174 7	3
4	5808 5	6133 0	6469 1	6817 2	7177 7	7551 0	7937 6	8338 0	8752 6	9182 0	4
5	5813 8	6138 5	6474 8	6823 1	7183 8	7557 4	7944 2	8344 8	8759 6	9189 2	5
6	5819 2	6144 0	6480 5	6829 0	7190 0	7563 7	7950 8	8351 6	8766 6	9196 5	6
7	5824 5	6149 5	6486 2	6834 9	7196 1	7570 1	7957 3	8358 4	8773 7	9203 8	7
8	5829 8	6155 0	6491 9	6840 9	7202 2	7576 4	7963 9	8365 2	8780 7	9211 1	8
9	5835 1	6160 6	6497 7	6846 8	7208 3	7582 8	7970 5	8372 0	8787 8	9218 4	9
10	5840 5	6166 1	6503 4	6852 7	7214 5	7589 1	7977 0	8378 8	8794 8	9225 7	10
11	5845 8	6171 6	6509 1	6858 6	7220 6	7595 5	7983 6	8385 6	8801 9	9233 0	11
12	5851 1	6177 1	6514 8	6864 6	7226 8	7601 8	7990 2	8392 4	8808 9	9240 4	12
13	5856 5	6182 7	6520 5	6870 5	7232 9	7608 2	7996 8	8399 2	8816 0	9247 7	13
14	5861 8	6188 2	6526 3	6876 4	7239 0	7614 5	8003 4	8406 1	8823 1	9255 0	14
15	5867 2	6193 7	6532 0	6882 4	7245 2	7620 9	8010 0	8412 9	8830 1	9262 3	15
16	5872 5	6199 3	6537 8	6888 3	7251 4	7627 3	8016 6	8419 7	8837 2	9269 7	16
17	5877 9	6204 8	6543 5	6894 3	7257 5	7633 7	8023 2	8426 6	8844 3	9277 0	17
18	5883 3	6210 4	6549 2	6900 2	7263 7	7640 0	8029 8	8433 4	8851 4	9284 3	18
19	5888 6	6215 9	6555 0	6906 2	7269 8	7646 4	8036 4	8440 3	8858 5	9291 7	19
20	5893 9	6221 5	6560 7	6912 1	7276 0	7652 8	8043 0	8447 1	8865 6	9299 0	20
21	5899 3	6227 0	6566 5	6918 1	7282 2	7659 2	8049 6	8454 0	8872 7	9306 4	21
22	5904 7	6232 6	6572 3	6924 1	7288 4	7665 6	8056 3	8460 8	8879 8	9313 8	22
23	5910 0	6238 2	6578 0	6930 0	7294 5	7672 0	8062 9	8467 7	8886 9	9321 1	23
24	5915 4	6243 7	6583 8	6936 0	7300 7	7678 4	8069 5	8474 5	8894 0	9328 5	24
25	5920 8	6249 3	6589 6	6942 0	7306 9	7684 8	8076 2	8481 4	8901 1	9335 9	25
26	5926 2	6254 9	6595 3	6947 9	7313 1	7691 2	8082 8	8488 3	8908 2	9343 2	26
27	5931 6	6260 4	6601 1	6953 9	7319 3	7697 6	8089 4	8495 2	8915 4	9350 6	27
28	5936 9	6266 0	6606 9	6959 9	7325 5	7704 1	8096 1	8502 1	8922 5	9358 0	28
29	5942 3	6271 6	6612 7	6965 9	7331 7	7710 5	8102 7	8508 9	8929 6	9365 4	29
30	5947 7	6277 2	6618 5	6971 9	7337 9	7716 9	8109 4	8515 8	8936 8	9372 8	30
31	5953 1	6282 8	6624 2	6977 9	7344 1	7723 3	8116 1	8522 7	8943 9	9380 2	31
32	5958 5	6288 4	6630 0	6983 9	7350 3	7729 8	8122 7	8529 6	8951 1	9387 6	32
33	5963 9	6294 0	6635 8	6989 9	7356 5	7736 2	8129 4	8536 5	8958 2	9395 0	33
34	5969 3	6299 6	6641 6	6995 9	7362 8	7742 7	8136 0	8543 4	8965 4	9402 4	34
35	5974 7	6305 2	6647 4	7001 9	7369 0	7749 1	8142 7	8550 4	8972 5	9409 8	35
36	5980 2	6310 8	6653 2	7007 9	7375 2	7755 5	8149 4	8557 3	8979 7	9417 2	36
37	5985 6	6316 4	6659 1	7013 9	7381 4	7762 0	8156 1	8564 2	8986 9	9424 7	37
38	5991 0	6322 0	6664 9	7020 0	7387 7	7768 5	8162 8	8571 1	8994 0	9432 1	38
39	5996 4	6327 6	6670 7	7026 0	7393 9	7774 9	8169 5	8578 0	9001 2	9439 5	39
40	6001 8	6333 2	6676 5	7032 0	7400 2	7781 4	8176 1	8585 0	9008 4	9447 0	40
41	6007 3	6338 9	6682 3	7038 0	7406 4	7787 8	8182 8	8591 9	9015 6	9454 4	41
42	6012 7	6344 5	6688 2	7044 1	7412 6	7794 3	8189 5	8598 8	9022 8	9461 8	42
43	6018 1	6350 1	6694 0	7050 1	7418 9	7800 8	8196 3	8605 8	9029 9	9469 3	43
44	6023 6	6355 8	6699 8	7056 2	7425 2	7807 3	8203 0	8612 8	9037 1	9476 8	44
45	6029 0	6361 4	6705 7	7062 2	7431 4	7813 8	8209 7	8619 7	9044 3	9484 2	45
46	6034 5	6367 0	6711 5	7068 2	7437 7	7820 2	8216 4	8626 6	9051 5	9491 7	46
47	6039 9	6372 7	6717 3	7074 3	7444 0	7826 7	8223 1	8633 6	9058 8	9499 1	47
48	6045 4	6378 3	6723 2	7080 4	7450 2	7833 2	8229 8	8640 6	9066 0	9506 6	48
49	6050 8	6384 0	6729 0	7086 4	7456 5	7839 7	8236 6	8647 5	9073 2	9514 1	49
50	6056 3	6389 6	6734 9	7092 5	7462 8	7846 2	8243 3	8654 5	9080 4	9521 6	50
51	6061 7	6395 3	6740 8	7098 5	7469 1	7852 7	8250 0	8661 5	9087 6	9529 1	51
52	6067 2	6400 9	6746 6	7104 6	7475 3	7859 2	8256 8	8668 5	9094 9	9536 5	52
53	6072 7	6406 6	6752 5	7110 7	7481 6	7865 7	8263 5	8675 5	9102 1	9544 0	53
54	6078 1	6412 3	6758 3	7116 8	7487 9	7872 3	8270 3	8682 4	9109 3	9551 5	54
55	6083 6	6417 9	6764 2	7122 8	7494 2	7878 8	8277 0	8689 4	9116 6	9559 0	55
56	6089 1	6423 6	6770 1	7128 9	7500 5	7885 3	8283 8	8696 4	9123 8	9566 6	56
57	6094 6	6429 3	6776 0	7135 0	7506 8	7891 8	8290 5	8703 4	9131 1	9574 1	57
58	6100 0	6435 0	6781 9	7141 1	7513 1	7898 4	8297 3	8710 4	9138 3	9581 6	58
59	6105 5	6440 6	6787 7	7147 2	7519 4	7904 9	8304 1	8717 4	9145 6	9589 1	59
60	6111 0	6446 3	6793 6	7153 3	7525 8	7911 4	8310 8	8724 5	9152 9	9596 6	60

40° 41° 42° 43° 44° 45° 46° 47° 48° 49°

Latitude or Declination

Latitude or Declination

	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	
0	9596 6	10056 4	10532 9	11026 9	11539 1	12070 4	12621 9	13194 6	13789 5	14408 0	0
1	9604 2	10064 2	10541 0	11035 2	11547 8	12079 5	12631 3	13204 3	13799 6	14418 6	1
2	9611 7	10072 0	10549 1	11043 6	11556 5	12088 5	12640 7	13214 0	13809 7	14429 1	2
3	9619 2	10079 8	10557 2	11052 0	11565 2	12097 5	12650 5	13223 8	13819 9	14439 6	3
4	9626 8	10087 7	10565 3	11060 4	11573 9	12106 6	12659 4	13233 5	13830 0	14450 1	4
5	9634 3	10095 5	10573 4	11068 8	11582 6	12115 6	12668 8	13243 3	13840 1	14460 7	5
6	9641 9	10103 3	10581 5	11077 2	11591 3	12124 7	12678 2	13253 0	13850 3	14471 2	6
7	9649 4	10111 1	10589 6	11085 7	11600 1	12133 7	12687 6	13262 8	13860 4	14481 8	7
8	9657 0	10119 0	10597 7	11094 1	11608 8	12142 8	12697 0	13272 6	13870 6	14492 4	8
9	9664 6	10126 8	10605 9	11102 5	11617 5	12151 9	12706 4	13282 4	13880 8	14502 9	9
10	9672 1	10134 6	10614 0	11110 9	11626 3	12160 9	12715 9	13292 1	13890 9	14513 5	10
11	9679 7	10142 5	10622 1	11119 4	11635 0	12170 0	12725 3	13301 9	13901 1	14524 1	11
12	9687 3	10150 4	10630 3	11127 8	11643 8	12179 1	12734 7	13311 7	13911 3	14534 7	12
13	9694 9	10158 2	10638 4	11136 3	11652 5	12188 2	12744 2	13321 5	13921 5	14545 3	13
14	9702 5	10166 1	10646 6	11144 7	11661 3	12197 3	12753 6	13331 3	13931 7	14555 9	14
15	9710 1	10173 9	10654 7	11153 2	11670 1	12206 4	12763 1	13341 2	13941 9	14566 5	15
16	9717 7	10181 8	10662 9	11161 6	11678 9	12215 5	12772 5	13351 0	13952 1	14577 1	16
17	9725 3	10189 7	10671 0	11170 1	11687 6	12224 6	12782 0	13360 8	13962 3	14587 8	17
18	9732 9	10197 6	10679 2	11178 6	11696 4	12233 7	12791 4	13370 7	13972 5	14598 4	18
19	9740 5	10205 5	10687 4	11187 0	11705 2	12242 8	12800 9	13380 5	13982 8	14609 0	19
20	9748 1	10213 4	10695 6	11195 5	11714 0	12252 0	12810 4	13390 3	13993 0	14619 7	20
21	9755 7	10221 2	10703 8	11204 0	11722 8	12261 3	12819 9	13400 2	14003 3	14630 3	21
22	9763 3	10229 1	10712 0	11212 5	11731 6	12270 3	12829 4	13410 1	14013 5	14641 0	22
23	9770 9	10237 1	10720 2	11221 0	11740 4	12279 4	12838 9	13419 9	14023 8	14651 7	23
24	9778 6	10245 0	10728 4	11229 5	11749 3	12288 6	12848 4	13429 8	14034 0	14662 3	24
25	9786 2	10252 9	10736 6	11238 0	11758 1	12297 7	12857 9	13439 7	14044 3	14673 0	25
26	9793 9	10260 8	10744 8	11246 5	11766 9	12306 9	12867 4	13449 6	14054 6	14683 7	26
27	9801 5	10268 7	10753 0	11255 0	11775 8	12316 1	12876 9	13459 5	14064 9	14694 4	27
28	9809 2	10276 7	10761 2	11263 6	11784 6	12325 2	12886 5	13469 4	14075 1	14705 1	28
29	9816 8	10284 6	10769 4	11272 1	11793 4	12334 4	12896 0	13479 3	14085 4	14715 8	29
30	9824 5	10292 5	10777 6	11280 6	11802 3	12343 6	12905 5	13489 2	14095 7	14726 6	30
31	9832 1	10300 5	10785 9	11289 2	11811 2	12352 8	12915 1	13499 1	14106 1	14737 3	31
32	9839 8	10308 4	10794 1	11297 7	11820 0	12362 0	12924 6	13509 0	14116 4	14748 0	32
33	9847 5	10316 4	10802 4	11306 3	11828 9	12371 2	12934 2	13518 9	14126 7	14758 8	33
34	9855 2	10324 3	10810 6	11314 8	11837 8	12380 4	12943 7	13528 9	14137 0	14769 5	34
35	9862 8	10332 3	10818 9	11323 4	11846 6	12389 6	12953 3	13538 8	14147 4	14780 3	35
36	9870 5	10340 3	10827 1	11331 9	11855 5	12398 8	12962 9	13548 8	14157 7	14791 0	36
37	9878 2	10348 2	10835 4	11340 5	11864 4	12408 1	12972 5	13558 7	14168 1	14801 8	37
38	9885 9	10356 2	10843 6	11349 1	11873 3	12417 3	12982 1	13568 7	14178 4	14812 6	38
39	9893 6	10364 2	10851 9	11357 7	11882 2	12426 5	12991 7	13578 7	14188 8	14823 4	39
40	9901 3	10372 2	10860 2	11366 2	11891 1	12435 8	13001 3	13588 6	14199 2	14834 2	40
41	9909 0	10380 2	10868 5	11374 8	11900 0	12445 0	13010 9	13598 6	14209 5	14845 0	41
42	9916 8	10388 2	10876 8	11383 4	11909 0	12454 3	13020 5	13608 6	14219 9	14855 8	42
43	9924 5	10396 2	10885 1	11392 0	11917 9	12463 6	13030 1	13618 6	14230 3	14866 6	43
44	9932 2	10404 2	10893 4	11400 6	11926 8	12472 8	13039 7	13628 6	14240 7	14877 4	44
45	9939 9	10412 2	10901 7	11409 3	11935 7	12482 1	13049 4	13638 6	14251 1	14888 2	45
46	9947 7	10420 2	10910 0	11417 9	11944 7	12491 4	13059 0	13648 6	14261 5	14899 1	46
47	9955 4	10428 2	10918 3	11426 5	11953 6	12500 7	13068 6	13658 7	14272 0	14909 9	47
48	9963 1	10436 2	10926 6	11435 1	11962 6	12510 0	13078 3	13668 7	14282 4	14920 7	48
49	9970 9	10444 3	10935 0	11443 8	11971 5	12519 3	13087 9	13678 7	14292 8	14931 6	49
50	9978 6	10452 3	10943 3	11452 4	11980 5	12528 6	13097 6	13688 8	14303 3	14942 5	50
51	9986 4	10460 3	10951 6	11461 0	11989 5	12537 9	13107 3	13698 8	14313 7	14953 3	51
52	9994 2	10468 4	10960 0	11469 7	11998 4	12547 2	13116 9	13708 9	14324 2	14964 2	52
53	10001 9	10476 4	10968 3	11478 3	12007 4	12556 5	13126 6	13718 9	14334 6	14975 1	53
54	10009 7	10484 5	10976 6	11487 0	12016 4	12565 8	13136 3	13729 0	14345 1	14986 0	54
55	10017 5	10492 5	10985 0	11495 7	12025 4	12575 2	13146 0	13739 1	14355 6	14996 9	55
56	10025 2	10500 6	10993 4	11504 3	12034 4	12584 5	13155 7	13749 1	14366 0	15007 8	56
57	10033 0	10508 7	10001 7	11513 0	12043 4	12593 9	13165 4	13759 2	14376 5	15018 7	57
58	10040 8	10516 7	10101 0	11521 7	12052 4	12603 2	13175 1	13769 3	14387 0	15029 6	58
59	10048 6	10524 8	10108 5	11530 4	12061 4	12612 6	13184 8	13779 4	14397 5	15040 6	59
60	10056 4	10532 9	10106 9	11539 1	12070 4	12621 9	13194 6	13789 5	14408 0	15051 5	60

Latitude or Declination

Latitude or Declination

	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	
0	15051 5	15721 4	16419 5	17147 7	17907 9	18702 6	19534 3	20406 1	21321 2	22283 5	0
1	15062 4	15732 8	16431 4	17160 1	17920 9	18716 1	19548 5	20421 0	21336 9	22300 0	1
2	15073 4	15744 2	16443 3	17172 5	17933 8	18729 7	19562 7	20435 9	21352 5	22316 5	2
3	15084 4	15755 7	16455 2	17184 9	17946 8	18743 3	19576 9	20450 8	21368 2	22333 0	3
4	15095 3	15767 1	16467 1	17197 3	17959 8	18756 9	19591 2	20465 7	21383 9	22349 5	4
5	15106 3	15778 5	16479 0	17209 8	17972 8	18770 5	19605 4	20480 7	21399 6	22366 0	5
6	15117 3	15790 0	16491 0	17222 2	17985 8	18784 1	19619 7	20495 6	21415 3	22382 5	6
7	15128 3	15801 4	16502 9	17234 7	17998 8	18797 7	19633 9	20510 6	21431 0	22399 1	7
8	15139 3	15812 9	16514 8	17247 1	18011 8	18811 3	19648 2	20525 5	21446 7	22415 6	8
9	15150 3	15824 3	16526 8	17259 6	18024 9	18824 9	19662 5	20540 5	21462 5	22432 2	9
10	15161 3	15835 8	16538 8	17272 1	18037 9	18838 6	19676 8	20555 5	21478 2	22448 8	10
11	15172 3	15847 3	16550 7	17284 6	18050 9	18852 2	19691 1	20570 5	21494 0	22465 4	11
12	15183 3	15858 8	16562 7	17297 1	18064 0	18865 9	19705 4	20585 5	21509 8	22482 0	12
13	15194 4	15870 3	16574 7	17309 6	18077 1	18879 6	19719 7	20600 6	21525 6	22498 7	13
14	15205 4	15881 8	16586 7	17322 1	18090 2	18893 2	19734 1	20615 6	21541 4	22515 3	14
15	15216 4	15893 3	16598 7	17334 6	18103 3	18906 9	19748 4	20630 7	21557 2	22532 0	15
16	15227 5	15904 8	16610 7	17347 2	18116 4	18920 6	19762 8	20645 7	21573 1	22548 7	16
17	15238 6	15916 3	16622 7	17359 7	18129 5	18934 4	19777 1	20660 8	21588 9	22565 4	17
18	15249 6	15927 8	16634 7	17372 3	18142 6	18948 1	19791 5	20675 9	21604 8	22582 1	18
19	15260 7	15939 4	16646 8	17384 8	18155 7	18961 8	19805 9	20691 0	21620 7	22598 8	19
20	15271 8	15950 9	16658 8	17397 4	18168 8	18975 6	19820 3	20706 1	21636 6	22615 5	20
21	15282 9	15962 5	16670 9	17410 0	18182 0	18989 3	19834 7	20721 3	21652 5	22632 3	21
22	15294 0	15974 0	16682 9	17422 6	18195 2	19003 1	19849 2	20736 4	21668 4	22649 1	22
23	15305 1	15985 6	16695 0	17435 2	18208 3	19016 9	19863 6	20751 6	21684 3	22665 8	23
24	15316 2	15997 2	16707 1	17447 8	18221 5	19030 7	19878 1	20766 7	21700 3	22682 6	24
25	15327 3	16008 8	16719 2	17460 4	18234 7	19044 5	19892 5	20781 9	21716 2	22699 5	25
26	15338 5	16020 4	16731 3	17473 0	18247 9	19058 3	19907 0	20797 1	21732 2	22716 3	26
27	15349 6	16032 0	16743 4	17485 7	18261 1	19072 1	19921 5	20812 3	21748 2	22733 1	27
28	15360 7	16043 6	16755 5	17498 3	18274 3	19086 0	19936 0	20827 5	21764 2	22750 0	28
29	15371 9	16055 2	16767 6	17511 0	18287 5	19099 8	19950 5	20842 8	21780 2	22766 8	29
30	15383 1	16066 9	16779 7	17523 6	18300 8	19113 7	19965 0	20858 0	21796 2	22783 7	30
31	15394 2	16078 5	16791 9	17536 3	18314 0	19127 5	19979 6	20873 3	21812 3	22800 6	31
32	15405 4	16090 1	16804 0	17549 0	18327 3	19141 4	19994 1	20888 5	21828 3	22817 6	32
33	15416 6	16101 8	16816 2	17561 7	18340 6	19155 3	20008 7	20903 8	21844 4	22834 5	33
34	15427 8	16113 5	16828 3	17574 4	18353 8	19169 2	20023 2	20919 1	21860 5	22851 4	34
35	15439 0	16125 1	16840 5	17587 1	18367 1	19183 1	20037 8	20934 4	21876 6	22868 4	35
36	15450 2	16136 8	16852 7	17599 8	18380 4	19197 0	20052 4	20949 7	21892 7	22885 4	36
37	15461 4	16148 5	16864 9	17612 5	18393 7	19210 9	20067 0	20965 1	21908 8	22902 4	37
38	15472 6	16160 2	16877 1	17625 3	18407 0	19224 9	20081 6	20980 4	21925 0	22919 4	38
39	15483 8	16171 9	16889 3	17638 0	18420 4	19238 8	20096 2	20995 8	21941 1	22936 4	39
40	15495 1	16183 6	16901 5	17650 8	18433 7	19252 8	20110 9	21011 1	21957 3	22953 4	40
41	15506 3	16195 3	16913 7	17663 6	18447 1	19266 8	20125 5	21026 5	21973 5	22970 5	41
42	15517 6	16207 0	16926 0	17676 3	18460 4	19280 8	20140 2	21041 9	21989 7	22987 6	42
43	15528 8	16218 8	16938 2	17689 1	18473 8	19294 8	20154 9	21057 3	22005 9	23004 6	43
44	15540 1	16230 5	16950 4	17701 9	18487 2	19308 8	20169 5	21072 8	22022 1	23021 7	44
45	15551 4	16242 3	16962 7	17714 7	18500 6	19322 8	20184 2	21088 2	22038 3	23038 8	45
46	15562 7	16254 0	16975 0	17727 5	18514 0	19336 8	20198 9	21103 6	22054 6	23056 0	46
47	15574 0	16265 8	16987 2	17740 3	18527 4	19350 8	20213 7	21119 1	22070 8	23073 1	47
48	15585 3	16277 6	16999 5	17753 2	18540 8	19364 9	20228 4	21134 6	22087 1	23090 3	48
49	15596 6	16289 4	17011 8	17766 0	18554 2	19378 9	20243 1	21150 0	22103 4	23107 5	49
50	15607 9	16301 2	17024 1	17779 8	18567 6	19393 0	20257 9	21165 5	22119 7	23124 7	50
51	15619 2	16313 0	17036 5	17791 7	18581 1	19407 1	20272 7	21181 0	22136 0	23141 9	51
52	15630 5	16324 8	17048 8	17804 6	18594 6	19421 2	20287 4	21196 6	22152 4	23159 1	52
53	15641 9	16336 6	17061 1	17817 5	18608 0	19435 3	20302 2	21212 1	22168 7	23176 3	53
54	15653 2	16348 4	17073 4	17830 4	18621 5	19449 4	20317 0	21227 7	22185 1	23193 6	54
55	15664 6	16360 2	17085 8	17843 3	18635 0	19463 5	20331 8	21243 2	22201 4	23210 8	55
56	15675 9	16372 1	17098 1	17856 2	18648 5	19477 7	20346 7	21258 8	22217 8	23228 1	56
57	15687 3	16383 9	17110 5	17869 1	18662 0	19491 8	20361 5	21274 4	22234 2	23245 4	57
58	15698 7	16395 8	17122 9	17882 0	18675 5	19506 0	20376 4	21290 0	22250 7	23262 7	58
59	15710 0	16407 7	17135 3	17895 0	18689 0	19520 2	20391 2	21305 6	22267 1	23280 1	59
60	15721 4	16419 5	17147 7	17907 9	18702 6	19534 3	20406 1	21321 2	22283 5	23297 4	60

60°	61°	62°	63°	64°	65°	66°	67°	68°	69°
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Latitude or Declination

Latitude or Declination

	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	
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1	23314 8	24386 3	25520 3	26723 9	28005 1	29373 8	30841 6	32423 0	34135 8	36002 6	1
2	23332 2	24404 6	25539 8	26744 6	28027 2	29397 4	30867 0	32450 4	34165 6	36035 2	2
3	23349 6	24423 0	25559 3	26765 3	28049 3	29421 0	30892 4	32477 8	34195 4	36067 8	3
4	23367 0	24441 4	25578 8	26786 0	28071 4	29444 7	30917 8	32505 3	34225 3	36100 5	4
5	23384 4	24459 8	25598 3	26806 8	28093 5	29468 4	30943 3	32532 8	34255 2	36133 2	5
6	23401 8	24478 3	25617 9	26827 6	28115 7	29492 1	30968 8	32560 4	34285 1	36166 0	6
7	23419 3	24496 7	25637 4	26848 4	28137 9	29515 9	30994 4	32588 0	34315 1	36198 8	7
8	23436 8	24515 2	25657 0	26869 2	28160 1	29539 7	31020 0	32615 6	34345 2	36231 7	8
9	23454 2	24533 7	25676 6	26890 0	28182 3	29563 5	31045 6	32643 3	34375 3	36264 6	9
10	23471 8	24552 2	25696 3	26910 9	28204 6	29587 3	31071 2	32671 0	34405 4	36297 6	10
11	23489 3	24570 8	25715 9	26931 8	28226 9	29611 2	31096 9	32698 8	34435 6	36330 6	11
12	23506 8	24589 3	25735 6	26952 7	28249 2	29635 1	31122 7	32726 6	34465 8	36363 7	12
13	23524 4	24607 9	25755 3	26973 6	28271 5	29659 0	31148 3	32754 4	34496 0	36396 8	13
14	23541 9	24626 4	25775 0	26994 6	28293 9	29682 9	31174 1	32782 3	34526 3	36430 0	14
15	23559 5	24645 0	25794 7	27015 6	28316 3	29706 9	31199 9	32810 2	34556 7	36463 3	15
16	23577 1	24663 7	25814 4	27036 6	28338 7	29730 9	31225 7	32838 1	34587 1	36496 6	16
17	23594 7	24682 3	25834 2	27057 6	28361 1	29755 0	31251 5	32866 1	34617 5	36529 9	17
18	23612 4	24700 9	25854 0	27078 6	28383 6	29779 0	31277 4	32894 1	34648 0	36563 3	18
19	23630 0	24719 6	25873 8	27099 7	28406 1	29803 1	31303 3	32922 1	34678 5	36596 8	19
20	23647 7	24738 3	25893 6	27120 8	28428 6	29827 2	31329 3	32950 2	34709 1	36630 3	20
21	23665 4	24757 0	25913 4	27141 9	28451 1	29851 4	31355 3	32978 3	34739 7	36663 9	21
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26	23754 0	24850 8	26012 9	27247 8	28564 2	29972 6	31485 8	33119 5	34893 4	36832 5	26
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28	23789 6	24888 5	26052 9	27290 3	28609 6	30021 2	31538 2	33176 3	34955 2	36900 3	28
29	23807 4	24907 3	26072 9	27311 6	28632 3	30045 6	31564 5	33204 7	34986 2	36934 3	29
30	23825 2	24926 2	26092 9	27332 9	28655 1	30070 0	31590 8	33233 2	35017 2	36968 4	30
31	23843 1	24945 1	26113 0	27354 2	28677 9	30094 5	31617 1	33261 7	35048 3	37002 5	31
32	23861 0	24964 0	26133 0	27375 6	28700 7	30118 9	31643 4	33290 2	35079 4	37036 6	32
33	23878 8	24982 8	26153 1	27397 0	28723 5	30143 4	31669 8	33318 8	35110 6	37070 8	33
34	23896 7	25001 8	26173 2	27418 4	28746 4	30167 9	31696 2	33347 4	35141 8	37105 1	34
35	23914 6	25020 8	26193 3	27439 8	28769 3	30192 5	31722 7	33376 1	35173 1	37139 4	35
36	23932 6	25039 8	26213 5	27461 3	28792 2	30217 1	31749 2	33404 8	35204 4	37173 8	36
37	23950 5	25058 8	26233 7	27482 8	28815 1	30241 7	31775 7	33433 6	35235 7	37208 3	37
38	23968 5	25077 8	26253 9	27504 3	28838 1	30266 4	31802 3	33462 4	35267 1	37242 8	38
39	23986 4	25096 8	26274 1	27525 8	28861 1	30291 1	31828 9	33491 2	35298 5	37277 4	39
40	24004 4	25115 9	26294 3	27547 3	28884 1	30315 8	31855 5	33520 1	35330 0	37312 0	40
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43	24058 5	25173 2	26355 1	27612 1	28953 4	30390 1	31935 6	33606 9	35424 8	37416 2	43
44	24076 6	25192 3	26375 4	27633 7	28976 5	30414 9	31962 4	33635 9	35456 5	37451 0	44
45	24094 7	25211 4	26395 7	27655 4	28999 6	30439 7	31989 2	33665 0	35488 2	37485 9	45
46	24112 8	25230 6	26416 1	27677 1	29022 8	30464 6	32016 1	33694 1	35520 0	37520 9	46
47	24130 9	25249 8	26436 5	27698 8	29046 0	30489 5	32043 0	33723 3	35551 8	37555 9	47
48	24149 0	25269 0	26456 9	27720 5	29069 3	30514 5	32069 9	33752 5	35583 7	37591 0	48
49	24167 2	25288 2	26477 3	27742 2	29092 5	30539 5	32096 8	33781 7	35615 6	37626 1	49
50	24185 3	25307 4	26497 7	27764 0	29115 8	30564 5	32123 8	33811 0	35647 6	<i>Polaris</i> 88°	50
51	24203 5	25326 7	26518 2	27785 8	29139 1	30589 5	32150 8	33840 3	35679 6	84872 7	51
52	24221 7	25346 0	26538 3	27807 6	29162 5	30614 6	32177 9	33869 7	35711 7	85189 7	52
53	24239 9	25365 3	26559 2	27829 5	29185 9	30639 7	32205 0	33899 1	35743 8	85511 3	53
54	24258 1	25384 6	26579 7	27851 4	29209 3	30664 8	32232 1	33928 5	35776 0	85837 8	54
55	24276 4	25403 9	26600 2	27873 3	29232 7	30690 0	32259 0	33958 0	35808 2	86169 3	55
56	24294 7	25423 3	26620 8	27895 2	29256 1	30715 2	32286 5	33987 5	35840 5	86506 0	56
57	24313 0	25442 6	26641 4	27917 1	29279 6	30740 4	32313 7	34017 1	35872 8	86847 9	57
58	24331 3	25462 0	26662 0	27939 1	29303 1	30765 6	32341 0	34046 7	35905 2	87195 3	58
59	24349 6	25481 4	26682 6	27961 1	29326 6	30790 9	32368 3	34076 4	35937 6	87548 3	59
60	24367 9	25500 9	26703 2	27983 1	29350 2	30816 2	32395 6	34106 1	35970 1	87907 2	60
	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	

Latitude or Declination

	0°		1°		2°		3°		4°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	00	∞	15 2	205915 8	60 9	175814 5	137 0	158208 1	243 6	145718 1	60
1	00	383730 4	15 7	205198 0	61 9	175454 1	138 6	157967 5	245 6	145537 6	59
2	00	353627 4	16 3	204491 8	63 0	175096 7	140 1	157728 3	247 7	145357 8	58
3	00	336018 4	16 8	203796 9	64 0	174742 2	141 6	157490 4	249 7	145178 8	57
4	01	323524 4	17 3	203113 0	65 0	174390 6	143 2	157253 8	251 8	145000 5	56
5	01	313833 4	17 9	202439 7	66 1	174041 8	144 8	157018 5	253 8	144823 0	55
6	01	305915 3	18 4	201776 7	67 2	173695 8	146 3	156784 4	255 9	144646 1	54
7	02	299220 6	19 0	201123 6	68 2	173352 5	147 9	156551 6	258 0	144470 0	53
8	03	293421 4	19 6	200480 2	69 3	173011 9	149 5	156320 0	260 1	144294 6	52
9	03	288306 1	20 1	199846 2	70 4	172674 0	151 1	156089 7	262 2	144119 9	51
10	04	283730 4	20 7	199221 3	71 5	172338 6	152 7	155860 6	264 3	143946 0	50
11	05	279591 1	21 3	198605 3	72 6	172005 9	154 3	155632 6	266 4	143772 7	49
12	06	275812 3	21 9	197997 9	73 7	171675 7	155 9	155405 9	268 5	143600 1	48
13	07	272336 1	22 6	197398 9	74 8	171347 9	157 5	155180 4	270 7	143428 1	47
14	08	269117 6	23 2	196808 1	76 0	171022 7	159 2	154956 0	272 8	143256 9	46
15	09	266121 3	23 8	196225 1	77 1	170699 8	160 8	154732 7	275 0	143086 3	45
16	11	263318 4	24 4	195649 9	78 2	170379 3	162 5	154510 7	277 1	142916 4	44
17	12	260685 5	25 1	195082 2	79 4	170061 2	164 1	154289 7	279 3	142747 2	43
18	14	258203 2	25 7	194521 9	80 6	169745 4	165 8	154069 9	281 5	142578 6	42
19	15	255855 1	26 4	193968 6	81 7	169431 9	167 5	153851 1	283 7	142410 7	41
20	17	253627 5	27 1	193422 4	82 9	169120 6	169 2	153633 5	285 9	142243 4	40
21	19	251508 5	27 8	192882 9	84 1	168811 5	170 9	153417 0	288 1	142076 8	39
22	20	249488 2	28 4	192350 0	85 3	168504 6	172 6	153201 5	290 3	141910 8	38
23	22	247557 7	29 1	191823 6	86 5	168199 9	174 3	152987 1	292 5	141745 4	37
24	24	245709 4	29 9	191303 5	87 7	167897 3	176 0	152773 7	294 7	141580 7	36
25	26	243936 5	30 6	190793 6	88 9	167596 8	177 7	152561 4	297 0	141416 6	35
26	29	242233 2	31 3	190281 7	90 2	167298 4	179 5	152350 2	299 2	141253 1	34
27	31	240594 1	32 0	189779 6	91 4	167002 0	181 2	152139 9	301 5	141090 2	33
28	33	239014 7	32 8	189282 3	92 7	166707 6	183 0	151930 7	303 7	140927 9	32
29	36	237490 7	33 5	188793 6	93 9	166415 2	184 7	151722 4	306 0	140766 2	31
30	38	236018 4	34 3	188307 4	95 2	166124 7	186 5	151515 2	308 3	140605 2	30
31	41	234594 4	35 0	187827 5	96 4	165836 2	188 3	151309 0	310 5	140444 7	29
32	43	233215 5	35 8	187352 9	97 7	165549 6	190 1	151103 7	312 8	140284 8	28
33	46	231879 2	36 6	186883 4	99 0	165264 8	191 9	150899 4	315 1	140125 5	27
34	49	230582 7	37 4	186419 0	100 3	164981 9	193 7	150696 0	317 5	139966 8	26
35	52	229323 8	38 2	185959 4	101 6	164700 9	195 5	150493 6	319 8	139808 7	25
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37	58	226910 4	39 8	185054 7	104 3	164144 2	199 2	150091 6	324 4	139494 2	23
38	61	225752 2	40 6	184609 3	105 6	163868 5	201 0	149892 0	326 8	139337 7	22
39	64	224624 2	41 5	184168 4	106 9	163594 5	202 8	149693 3	329 1	139181 9	21
40	68	223524 6	42 3	183731 9	108 3	163322 3	204 7	149495 5	331 5	139026 6	20
41	71	222452 3	43 2	183299 8	109 6	163051 8	206 6	149298 6	333 9	138871 8	19
42	75	221405 7	44 0	182872 0	111 0	162782 9	208 4	149102 6	336 3	138717 7	18
43	78	220383 8	44 9	182448 3	112 4	162515 7	210 3	148907 5	338 6	138564 0	17
44	82	219385 4	45 8	182028 7	113 8	162250 1	212 2	148713 3	341 0	138410 9	16
45	86	218409 4	46 6	181613 1	115 2	161986 2	214 1	148519 9	343 4	138258 3	15
46	89	217454 9	47 5	181201 5	116 6	161723 8	216 0	148327 4	345 9	138106 3	14
47	93	216520 9	48 4	180793 8	118 0	161463 0	217 9	148135 7	348 3	137954 8	13
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49	102	214711 1	50 3	179989 6	120 8	160946 1	221 8	147754 9	353 1	137653 4	11
50	106	213833 8	51 2	179593 0	122 2	160689 9	223 7	147565 7	355 6	137503 5	10
51	110	212973 8	52 1	179200 0	123 7	160435 2	225 7	147377 4	358 0	137354 1	9
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55	128	209694 6	55 9	177662 6	129 5	159431 3	233 5	146632 1	368 0	136761 5	5
56	133	208912 1	56 9	177286 6	131 0	159183 9	235 5	146447 7	370 5	136614 6	4
57	137	208143 4	57 9	176913 9	132 5	158937 9	237 5	146264 2	373 0	136468 3	3
58	142	207388 1	58 9	176544 3	134 0	158693 2	239 5	146081 4	375 5	136322 4	2
59	147	206645 7	59 9	176177 9	135 5	158450 0	241 6	145899 3	378 0	136177 0	1
60	152	205915 8	60 9	175814 5	137 0	158208 1	243 6	145718 1	380 5	136032 0	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	89°	359°	88°	358°	87°	357°	86°	356°	85°	355°	

	5°		6°		7°		8°		9°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	380 5	136032 0	547 8	128120 0	745 4	121432 5	973 2	115641 5	1231 2	110535 7	60
1	383 1	135887 6	550 9	127999 6	748 9	121329 3	977 2	115551 3	1235 7	110455 5	59
2	385 6	135743 7	553 9	127879 6	752 5	121226 4	981 3	115461 3	1240 3	110375 4	58
3	388 2	135600 2	557 0	127759 9	756 1	121123 8	985 4	115371 4	1244 9	110295 6	57
4	390 7	135457 2	560 0	127640 5	759 6	121021 3	989 4	115281 7	1249 4	110215 8	56
5	393 3	135314 6	563 1	127521 5	763 2	120919 2	993 5	115192 2	1254 0	110136 2	55
6	395 9	135172 6	566 2	127402 8	766 8	120817 2	997 6	115102 9	1258 6	110056 8	54
7	398 5	135031 0	569 3	127284 4	770 4	120715 5	1001 7	115013 8	1263 2	109977 5	53
8	401 1	134889 8	572 4	127166 3	774 0	120614 1	1005 8	114924 9	1267 8	109898 3	52
9	403 7	134749 2	575 5	127048 6	777 6	120512 8	1010 0	114836 1	1272 5	109819 3	51
10	406 3	134608 9	578 6	126931 2	781 3	120411 9	1014 1	114747 5	1277 1	109740 4	50
11	408 9	134469 2	581 8	126814 1	784 9	120311 1	1018 2	114659 2	1281 7	109661 7	49
12	411 6	134329 8	584 9	126697 3	788 5	120210 6	1022 4	114570 9	1286 4	109583 1	48
13	414 2	134191 0	588 0	126580 8	792 2	120110 3	1026 5	114482 9	1291 0	109504 7	47
14	416 8	134052 5	591 2	126464 6	795 8	120010 3	1030 7	114395 1	1295 7	109426 4	46
15	419 5	133914 5	594 4	126348 8	799 5	119910 4	1034 9	114307 4	1300 4	109348 3	45
16	422 2	133777 0	597 5	126233 3	803 2	119810 8	1039 0	114219 9	1305 0	109270 3	44
17	424 8	133639 8	600 7	126118 0	806 9	119711 5	1043 2	114132 6	1309 7	109192 4	43
18	427 5	133503 2	603 9	126003 1	810 6	119612 4	1047 4	114045 4	1314 4	109114 7	42
19	430 2	133366 9	607 1	125888 5	814 3	119513 4	1051 6	113958 5	1319 1	109037 1	41
20	432 9	133231 1	610 3	125774 1	818 0	119414 8	1055 8	113871 7	1323 8	108959 6	40
21	435 6	133095 7	613 5	125660 1	821 7	119316 3	1060 1	113785 1	1328 6	108882 3	39
22	438 3	132960 7	616 7	125546 4	825 4	119218 1	1064 3	113698 6	1333 3	108805 1	38
23	441 1	132826 1	620 0	125433 0	829 1	119120 1	1068 5	113612 3	1338 0	108728 1	37
24	443 8	132692 0	623 2	125319 8	832 9	119022 3	1072 8	113526 2	1342 8	108651 2	36
25	446 5	132558 2	626 4	125207 0	836 6	118924 7	1077 0	113440 3	1347 5	108574 4	35
26	449 3	132424 9	629 7	125094 5	840 4	118827 4	1081 3	113354 5	1352 3	108497 8	34
27	452 0	132292 0	633 0	124982 2	844 2	118730 2	1085 5	113269 0	1357 1	108421 3	33
28	454 8	132159 5	636 2	124870 3	847 9	118633 3	1089 8	113183 5	1361 8	108345 0	32
29	457 6	132027 4	639 5	124758 6	851 7	118536 6	1094 1	113098 3	1366 6	108268 7	31
30	460 4	131895 7	642 8	124647 2	855 5	118440 1	1098 4	113013 2	1371 4	108192 7	30
31	463 2	131764 4	646 1	124536 1	859 3	118343 9	1102 7	112928 3	1376 2	108116 7	29
32	466 0	131633 5	649 4	124425 3	863 1	118247 8	1107 0	112843 5	1381 1	108040 9	28
33	468 8	131502 9	652 7	124314 8	866 9	118152 0	1111 3	112759 0	1385 9	107965 2	27
34	471 6	131372 8	656 0	124204 5	870 8	118056 4	1115 7	112674 5	1390 7	107889 7	26
35	474 4	131243 1	659 4	124094 6	874 6	117961 0	1120 0	112590 3	1395 5	107814 2	25
36	477 3	131113 7	662 7	123984 9	878 4	117865 7	1124 4	112506 2	1400 4	107739 0	24
37	480 1	130984 8	666 1	123875 5	882 3	117770 8	1128 7	112422 3	1405 2	107663 8	23
38	482 9	130856 2	669 4	123766 3	886 2	117676 0	1133 1	112338 5	1410 1	107588 8	22
39	485 8	130728 0	672 8	123657 5	890 0	117581 4	1137 4	112254 9	1415 0	107513 9	21
40	488 7	130600 2	676 2	123548 9	893 9	117487 0	1141 8	112171 5	1419 9	107439 1	20
41	491 6	130472 8	679 5	123440 6	897 8	117392 8	1146 2	112088 2	1424 8	107364 5	19
42	494 4	130345 5	682 9	123332 5	901 7	117298 9	1150 6	112005 1	1429 6	107290 0	18
43	497 3	130219 0	686 3	123224 8	905 6	117205 1	1155 0	111922 1	1434 6	107215 6	17
44	500 2	130092 7	689 7	123117 2	909 5	117111 6	1159 4	111839 3	1439 5	107141 3	16
45	503 1	129966 7	693 1	123010 0	913 4	117018 2	1163 8	111756 7	1444 4	107067 2	15
46	506 1	129841 1	696 6	122903 0	917 3	116925 1	1168 3	111674 2	1449 3	106993 2	14
47	509 0	129715 9	700 0	122796 3	921 3	116832 1	1172 7	111591 9	1454 3	106919 4	13
48	511 9	129591 0	703 4	122689 9	925 2	116739 3	1177 2	111509 7	1459 2	106845 6	12
49	514 9	129466 5	706 9	122583 7	929 2	116646 8	1181 6	111427 7	1464 2	106772 0	11
50	517 8	129342 3	710 3	122477 7	933 1	116554 4	1186 1	111345 8	1469 1	106698 5	10
51	520 8	129218 5	713 8	122372 1	937 1	116462 3	1190 5	111264 1	1474 1	106625 1	9
52	523 7	129095 1	717 3	122266 7	941 1	116370 3	1195 0	111182 6	1479 1	106551 9	8
53	526 7	128972 0	720 8	122161 5	945 1	116278 5	1199 5	111101 2	1484 1	106478 8	7
54	529 7	128849 3	724 3	122056 6	949 0	116187 0	1204 0	111019 9	1489 1	106405 8	6
55	532 7	128726 8	727 8	121952 0	953 1	116095 6	1208 5	110938 8	1494 1	106332 9	5
56	535 7	128604 8	731 3	121847 6	957 1	116004 4	1213 0	110857 9	1499 1	106260 2	4
57	538 7	128483 1	734 8	121743 4	961 1	115913 4	1217 5	110777 1	1504 1	106187 5	3
58	541 7	128361 7	738 3	121639 5	965 1	115822 6	1222 1	110696 5	1509 1	106115 0	2
59	544 8	128240 6	741 8	121535 9	969 1	115732 0	1226 6	110616 0	1514 2	106042 7	1
60	547 8	128120 0	745 4	121432 5	973 2	115641 5	1231 2	110535 7	1519 2	105970 4	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	84°	354°	83°	353°	82°	352°	81°	351°	80°	350°	

	10°		11°		12°		13°		14°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	1519 2	105970 4	1837 3	101842 7	2185 2	98076 5	2563 0	94614 1	2970 4	91410 6	60
1	1524 3	105898 3	1842 8	101777 2	2191 3	98016 5	2569 5	94558 7	2977 5	91359 1	59
2	1529 3	105826 2	1848 4	101711 7	2197 3	97956 5	2576 1	94503 4	2984 5	91307 8	58
3	1534 4	105754 3	1854 0	101646 4	2203 4	97896 6	2582 7	94448 1	2991 6	91256 5	57
4	1539 5	105682 6	1859 5	101581 1	2209 5	97836 8	2589 2	94392 9	2998 6	91205 3	56
5	1544 6	105610 9	1865 1	101516 0	2215 6	97777 1	2595 8	94337 8	3005 7	91154 1	55
6	1549 7	105539 4	1870 7	101450 9	2221 7	97717 5	2602 4	94282 8	3012 8	91103 0	54
7	1554 8	105467 9	1876 3	101385 9	2227 8	97657 9	2609 0	94227 8	3019 9	91052 0	53
8	1559 9	105396 6	1881 9	101321 1	2233 9	97598 4	2615 6	94172 9	3027 0	91001 0	52
9	1565 0	105325 5	1887 6	101256 3	2240 0	97539 0	2622 2	94118 0	3034 1	90950 0	51
10	1570 1	105254 4	1893 2	101191 7	2246 1	97479 7	2628 8	94063 3	3041 2	90899 2	50
11	1575 3	105183 4	1898 8	101127 1	2252 3	97420 5	2635 5	94008 6	3048 3	90848 4	49
12	1580 4	105112 6	1904 5	101062 6	2258 4	97361 4	2642 1	93954 0	3055 5	90797 6	48
13	1585 6	105041 9	1910 1	100998 3	2264 6	97302 3	2648 8	93899 4	3062 6	90747 0	47
14	1590 8	104971 3	1915 8	100934 0	2270 7	97243 3	2655 4	93844 9	3069 7	90696 3	46
15	1595 9	104900 8	1921 5	100869 8	2276 9	97184 4	2662 1	93790 5	3076 9	90645 8	45
16	1601 1	104830 4	1927 1	100805 7	2283 1	97125 6	2668 7	93736 1	3084 1	90595 3	44
17	1606 3	104760 2	1932 8	100741 7	2289 2	97066 8	2675 4	93681 9	3091 2	90544 8	43
18	1611 5	104690 0	1938 5	100677 8	2295 4	97008 2	2682 1	93627 6	3098 4	90494 4	42
19	1616 7	104620 0	1944 2	100614 0	2301 6	96949 6	2688 8	93573 5	3105 6	90444 1	41
20	1621 9	104550 1	1949 9	100550 3	2307 8	96891 1	2695 5	93519 4	3112 8	90393 8	40
21	1627 1	104480 3	1955 7	100486 7	2314 1	96832 7	2702 2	93465 4	3120 0	90343 6	39
22	1632 4	104410 6	1961 4	100423 2	2320 3	96774 3	2708 9	93411 5	3127 2	90293 5	38
23	1637 6	104341 0	1967 1	100359 8	2326 5	96716 1	2715 7	93357 6	3134 4	90243 4	37
24	1642 8	104271 6	1972 9	100296 4	2332 8	96657 9	2722 4	93303 8	3141 7	90193 4	36
25	1648 1	104202 2	1978 6	100233 2	2339 0	96599 8	2729 2	93250 1	3148 9	90143 4	35
26	1653 4	104133 0	1984 4	100170 1	2345 3	96541 8	2735 9	93196 4	3156 2	90093 5	34
27	1658 6	104063 8	1990 2	100107 0	2351 5	96483 8	2742 7	93142 8	3163 4	90043 6	33
28	1663 9	103994 8	1995 9	100044 0	2357 8	96425 9	2749 4	93089 3	3170 7	89993 8	32
29	1669 2	103925 9	2001 7	99981 2	2364 1	96368 1	2756 2	93035 8	3178 0	89944 1	31
30	1674 5	103857 1	2007 5	99918 4	2370 4	96310 4	2763 0	92982 4	3185 2	89894 4	30
31	1679 8	103788 4	2013 3	99855 7	2376 7	96252 8	2769 8	92929 1	3192 5	89844 8	29
32	1685 1	103719 9	2019 1	99793 1	2383 0	96195 2	2776 6	92875 8	3199 8	89795 2	28
33	1690 4	103651 4	2025 0	99730 6	2389 3	96137 7	2783 4	92822 6	3207 1	89745 7	27
34	1695 8	103583 0	2030 8	99668 2	2395 6	96080 3	2790 2	92769 4	3214 4	89696 3	26
35	1701 1	103514 8	2036 6	99605 9	2402 0	96023 0	2797 1	92716 4	3221 7	89646 9	25
36	1706 5	103446 6	2042 5	99543 7	2408 3	95965 8	2803 9	92663 4	3229 1	89597 5	24
37	1711 8	103378 6	2048 3	99481 5	2414 7	95908 6	2810 7	92610 4	3236 4	89548 3	23
38	1717 2	103310 7	2054 2	99419 5	2421 0	95851 5	2817 6	92557 6	3243 8	89499 9	22
39	1722 6	103242 8	2060 1	99357 5	2427 4	95794 5	2824 5	92504 7	3251 1	89449 9	21
40	1727 9	103175 1	2065 9	99295 6	2433 8	95737 5	2831 3	92452 0	3258 5	89400 8	20
41	1733 3	103107 5	2071 8	99233 9	2440 1	95680 6	2838 2	92399 3	3265 8	89351 7	19
42	1738 7	103040 0	2077 7	99172 2	2446 5	95623 8	2845 1	92346 7	3273 2	89302 7	18
43	1744 1	102972 6	2083 6	99110 6	2452 9	95567 1	2852 0	92294 2	3280 6	89253 8	17
44	1749 5	102905 3	2089 5	99049 0	2459 3	95510 5	2858 9	92241 7	3288 0	89204 9	16
45	1755 0	102838 1	2095 4	98987 6	2465 8	95453 9	2865 8	92189 3	3295 4	89156 1	15
46	1760 4	102771 1	2101 4	98926 3	2472 2	95397 4	2872 7	92136 9	3302 8	89107 3	14
47	1765 8	102704 1	2107 3	98865 0	2478 6	95341 0	2879 6	92084 6	3310 2	89058 6	13
48	1771 3	102637 2	2113 3	98803 8	2485 1	95284 6	2886 6	92032 4	3317 7	89009 9	12
49	1776 7	102570 4	2119 2	98742 8	2491 5	95228 3	2893 5	91980 2	3325 1	88961 3	11
50	1782 2	102503 8	2125 2	98681 8	2498 0	95172 1	2900 5	91928 1	3332 5	88912 7	10
51	1787 7	102437 2	2131 1	98620 9	2504 4	95116 0	2907 4	91876 1	3340 0	88864 2	9
52	1793 1	102370 7	2137 1	98560 0	2510 9	95060 0	2914 4	91824 1	3347 4	88815 8	8
53	1798 6	102304 4	2143 1	98499 3	2517 4	95004 0	2921 4	91772 2	3354 9	88767 4	7
54	1804 1	102238 1	2149 1	98438 7	2523 9	94948 1	2928 3	91720 3	3362 4	88719 1	6
55	1809 6	102172 0	2155 1	98378 1	2530 4	94892 2	2935 3	91668 5	3369 9	88670 8	5
56	1815 1	102105 9	2161 1	98317 6	2536 9	94836 5	2942 3	91616 8	3377 4	88622 6	4
57	1820 7	102040 0	2167 1	98257 2	2543 4	94780 8	2949 3	91565 2	3384 9	88574 4	3
58	1826 2	101974 1	2173 2	98196 9	2549 9	94725 1	2956 4	91513 6	3392 4	88526 3	2
59	1831 7	101908 4	2179 2	98136 7	2556 4	94669 6	2963 4	91462 0	3399 9	88478 2	1
60	1837 3	101842 7	2185 2	98076 5	2563 0	94614 1	2970 4	91410 6	3407 4	88430 2	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	79°	349°	78°	348°	77°	347°	76°	346°	75°	345°	

	15°		16°		17°		18°		19°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	3407 4	88430 2	3873 8	85644 5	4369 5	83029 8	4894 3	80566 8	5448 1	78239 1	60
1	3414 9	88382 3	3881 8	85599 5	4378 0	82987 5	4903 3	80526 9	5457 6	78201 3	59
2	3422 5	88334 4	3889 9	85554 7	4386 5	82945 3	4912 3	80487 1	5467 1	78163 7	58
3	3430 0	88286 5	3897 9	85509 8	4395 1	82903 2	4921 3	80447 3	5476 6	78126 0	57
4	3437 6	88238 7	3906 0	85465 1	4403 6	82861 1	4930 4	80407 5	5486 1	78088 4	56
5	3445 2	88191 0	3914 0	85420 3	4412 1	82819 0	4939 4	80367 8	5495 6	78050 8	55
6	3452 7	88143 3	3922 1	85375 7	4420 7	82777 0	4948 4	80328 1	5505 1	78013 2	54
7	3460 3	88095 7	3930 2	85331 0	4429 3	82735 0	4957 5	80288 5	5514 6	77975 7	53
8	3467 9	88048 1	3938 2	85286 4	4437 8	82693 0	4966 5	80248 9	5524 2	77938 2	52
9	3475 5	88000 6	3946 3	85241 9	4446 4	82651 1	4975 6	80209 3	5533 7	77900 7	51
10	3483 1	87953 1	3954 4	85197 4	4455 0	82609 2	4984 6	80169 8	5542 2	77863 3	50
11	3490 7	87905 7	3962 5	85152 9	4463 6	82567 4	4993 7	80130 3	5552 8	77825 9	49
12	3498 3	87858 3	3970 6	85108 5	4472 2	82525 6	5002 8	80090 9	5562 4	77788 5	48
13	3506 0	87811 0	3978 7	85064 2	4480 8	82483 9	5011 9	80051 4	5571 9	77751 2	47
14	3513 6	87763 8	3986 9	85019 8	4489 4	82442 2	5021 0	80012 1	5581 5	77713 9	46
15	3521 3	87716 5	3995 0	84975 6	4498 0	82400 5	5030 1	79972 7	5591 1	77676 6	45
16	3528 9	87669 4	4003 2	84931 4	4506 6	82358 9	5039 2	79933 4	5600 7	77639 4	44
17	3536 6	87622 3	4011 3	84887 2	4515 3	82317 3	5048 3	79894 1	5610 3	77602 2	43
18	3544 3	87575 2	4019 5	84843 1	4523 9	82275 8	5057 4	79854 9	5619 9	77565 1	42
19	3551 9	87528 2	4027 6	84799 0	4532 6	82234 3	5066 6	79815 7	5629 5	77527 9	41
20	3559 6	87481 3	4035 8	84754 9	4541 2	82192 8	5075 7	79776 6	5639 1	77490 8	40
21	3567 3	87434 4	4044 0	84710 9	4549 9	82151 4	5084 9	79737 4	5648 8	77453 8	39
22	3575 0	87387 5	4052 2	84667 0	4558 6	82110 0	5094 0	79698 3	5658 4	77416 7	38
23	3582 7	87340 7	4060 4	84623 1	4567 3	82068 7	5103 2	79659 3	5668 1	77379 7	37
24	3590 5	87294 0	4068 6	84579 2	4576 0	82027 4	5112 4	79620 3	5677 7	77342 7	36
25	3598 2	87247 3	4076 8	84535 4	4584 7	81986 1	5121 6	79581 3	5687 4	77305 8	35
26	3605 9	87200 7	4085 0	84491 7	4593 4	81944 9	5130 8	79542 3	5697 1	77268 9	34
27	3613 7	87154 1	4093 3	84447 9	4602 1	81903 7	5140 0	79503 4	5706 8	77232 0	33
28	3621 4	87107 5	4101 5	84404 3	4610 8	81862 6	5149 2	79464 6	5716 4	77195 2	32
29	3629 2	87061 0	4109 8	84360 6	4619 6	81821 5	5158 4	79425 7	5726 1	77158 4	31
30	3636 9	87014 6	4118 0	84317 0	4628 3	81780 4	5167 6	79386 9	5735 8	77121 6	30
31	3644 7	86968 2	4126 3	84273 5	4637 1	81739 4	5176 9	79348 1	5745 6	77084 9	29
32	3652 5	86921 9	4134 6	84230 0	4645 8	81698 4	5186 1	79309 4	5755 3	77048 2	28
33	3660 3	86875 6	4142 8	84186 5	4654 6	81657 5	5195 4	79270 7	5765 0	77011 5	27
34	3668 1	86829 4	4151 1	84143 1	4663 4	81616 6	5204 6	79232 1	5774 7	76974 8	26
35	3675 9	86783 2	4159 4	84099 8	4672 1	81575 7	5213 9	79193 4	5784 5	76938 2	25
36	3683 7	86737 0	4167 7	84056 5	4680 9	81534 9	5223 2	79154 8	5794 2	76901 6	24
37	3691 6	86690 9	4176 1	84013 2	4689 7	81494 1	5232 4	79116 3	5804 0	76865 1	23
38	3699 4	86644 9	4184 4	83969 9	4698 5	81453 4	5241 7	79077 8	5813 8	76828 5	22
39	3707 2	86598 9	4192 7	83926 8	4707 4	81412 6	5251 0	79039 3	5823 6	76792 1	21
40	3715 1	86553 0	4201 0	83883 6	4716 2	81372 0	5260 3	79000 8	5833 3	76755 6	20
41	3723 0	86507 1	4209 4	83840 5	4725 0	81331 4	5269 6	78962 4	5843 1	76719 2	19
42	3730 8	86461 3	4217 7	83797 5	4733 8	81290 8	5279 0	78924 0	5852 9	76682 8	18
43	3738 7	86415 5	4226 1	83754 4	4742 7	81250 2	5288 3	78885 7	5862 8	76646 4	17
44	3746 6	86369 7	4234 5	83711 5	4751 6	81209 7	5297 6	78847 4	5872 6	76610 1	16
45	3754 5	86324 0	4242 9	83668 5	4760 4	81169 2	5307 0	78809 1	5882 4	76573 8	15
46	3762 4	86278 4	4251 2	83625 7	4769 3	81128 8	5316 3	78770 9	5892 2	76537 5	14
47	3770 3	86232 8	4259 6	83582 8	4778 2	81088 4	5325 7	78732 6	5902 1	76501 3	13
48	3778 2	86187 2	4268 0	83540 0	4787 1	81048 1	5335 1	78694 5	5911 9	76465 1	12
49	3786 1	86141 8	4276 5	83497 3	4796 0	81007 7	5344 4	78656 3	5921 8	76428 9	11
50	3794 1	86096 3	4284 9	83454 6	4804 9	80967 5	5353 8	78618 2	5931 6	76392 7	10
51	3802 0	86050 9	4293 3	83411 9	4813 8	80927 2	5363 2	78580 2	5941 5	76356 6	9
52	3809 9	86005 6	4301 7	83369 3	4822 7	80887 0	5372 6	78542 1	5951 4	76320 5	8
53	3817 9	85960 2	4310 2	83326 7	4831 6	80846 8	5382 0	78504 1	5961 3	76284 5	7
54	3825 9	85915 0	4318 6	83284 1	4840 6	80806 7	5391 5	78466 2	5971 2	76248 5	6
55	3833 8	85869 8	4327 1	83241 6	4849 5	80766 6	5400 9	78428 2	5981 1	76212 5	5
56	3841 8	85824 6	4335 6	83199 2	4858 5	80726 6	5410 3	78390 3	5991 0	76176 5	4
57	3849 8	85779 5	4344 0	83156 8	4867 4	80686 6	5419 8	78352 5	6000 9	76140 6	3
58	3857 8	85734 5	4352 5	83114 4	4876 4	80646 6	5429 2	78314 6	6010 9	76104 7	2
59	3865 8	85689 4	4361 0	83072 1	4885 4	80606 7	5438 7	78276 8	6020 8	76068 8	1
60	3873 8	85644 5	4369 5	83029 8	4894 3	80566 8	5448 1	78239 1	6030 7	76033 0	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	74°	344°	73°	343°	72°	342°	71°	341°	70°	340°	

	20°		21°		22°		23°		24°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	6030 7	76033 0	6642 0	73936 7	7281 6	71940 1	7949 5	70034 5	8645 4	68212 1	60
1	6040 7	75997 2	6652 4	73902 6	7292 5	71907 6	7960 9	70003 4	8657 3	68182 4	59
2	6050 6	75961 4	6662 8	73868 6	7303 4	71875 2	7972 3	69972 4	8669 1	68152 7	58
3	6060 6	75925 6	6673 3	73834 6	7314 3	71842 7	7983 6	69941 4	8681 0	68123 1	57
4	6070 6	75889 9	6683 7	73800 6	7325 3	71810 3	7995 0	69910 5	8692 8	68093 4	56
5	6080 6	75854 2	6694 2	73766 6	7336 2	71778 0	8006 4	69879 5	8704 7	68063 8	55
6	6090 6	75818 6	6704 6	73732 7	7347 1	71745 6	8017 8	69848 6	8716 6	68034 2	54
7	6100 6	75783 0	6715 1	73698 8	7358 1	71713 3	8029 3	69817 7	8728 5	68004 6	53
8	6110 6	75747 4	6725 6	73664 9	7369 0	71681 0	8040 7	69786 8	8740 3	67975 1	52
9	6120 6	75711 8	6736 1	73631 1	7380 0	71648 7	8052 1	69756 0	8752 2	67945 5	51
10	6130 6	75676 3	6746 6	73597 3	7391 0	71616 4	8063 6	69725 2	8764 2	67916 0	50
11	6140 7	75640 8	6757 1	73563 5	7401 9	71584 2	8075 0	69694 3	8776 1	67886 5	49
12	6150 7	75605 3	6767 6	73529 7	7412 9	71552 0	8086 5	69663 6	8788 0	67857 0	48
13	6160 7	75569 8	6778 1	73496 0	7423 9	71519 8	8097 9	69632 8	8799 9	67827 6	47
14	6170 8	75534 4	6788 7	73462 3	7434 9	71487 6	8109 4	69602 1	8811 8	67798 1	46
15	6180 9	75499 0	6799 2	73428 6	7445 9	71455 5	8120 9	69571 3	8823 8	67768 7	45
16	6190 9	75463 7	6809 8	73394 9	7457 0	71423 4	8132 4	69540 7	8835 7	67739 3	44
17	6201 0	75428 3	6820 3	73361 3	7468 0	71391 3	8143 9	69510 0	8847 7	67710 0	43
18	6211 1	75393 1	6830 9	73327 7	7479 0	71359 2	8155 4	69479 3	8859 7	67680 6	42
19	6221 2	75357 8	6841 4	73294 1	7490 1	71327 2	8166 9	69448 7	8871 6	67651 3	41
20	6231 3	75322 5	6852 0	73260 5	7501 1	71295 2	8178 4	69418 1	8883 6	67622 0	40
21	6241 4	75287 3	6862 6	73227 0	7512 2	71263 2	8189 9	69387 5	8895 6	67592 7	39
22	6251 5	75252 2	6873 2	73193 5	7523 2	71231 2	8201 4	69357 0	8907 6	67563 4	38
23	6261 7	75217 0	6883 8	73160 1	7534 3	71199 3	8213 0	69326 4	8919 6	67534 2	37
24	6271 8	75181 9	6894 4	73126 6	7545 4	71167 4	8224 5	69295 9	8931 6	67505 0	36
25	6281 9	75146 8	6905 0	73093 2	7556 5	71135 5	8236 1	69265 4	8943 6	67475 7	35
26	6292 1	75111 7	6915 7	73059 8	7567 6	71103 6	8247 7	69235 0	8955 7	67446 6	34
27	6302 3	75076 7	6926 3	73026 4	7578 7	71071 8	8259 2	69204 5	8967 7	67417 4	33
28	6312 4	75041 7	6936 9	72993 1	7589 8	71039 9	8270 8	69174 1	8979 8	67388 3	32
29	6322 6	75006 7	6947 6	72959 8	7600 9	71008 2	8282 4	69143 7	8991 8	67359 1	31
30	6332 8	74971 8	6958 2	72926 5	7612 0	70976 4	8294 0	69113 3	9003 9	67330 0	30
31	6343 0	74936 9	6968 9	72893 3	7623 2	70944 7	8305 6	69083 0	9015 9	67300 9	29
32	6353 2	74902 0	6979 6	72860 0	7634 3	70913 0	8317 2	69052 6	9028 0	67271 9	28
33	6363 4	74867 1	6990 3	72826 8	7645 5	70881 3	8328 8	69022 3	9040 1	67242 8	27
34	6373 6	74832 3	7000 9	72793 6	7656 6	70849 6	8340 4	68992 0	9052 2	67213 8	26
35	6383 8	74797 5	7011 6	72760 5	7667 8	70818 0	8352 1	68961 8	9064 3	67184 8	25
36	6394 0	74762 7	7022 3	72727 4	7679 0	70786 3	8363 7	68931 5	9076 4	67155 8	24
37	6404 3	74728 0	7033 1	72694 3	7690 2	70754 7	8375 4	68901 3	9088 5	67126 9	23
38	6414 5	74693 3	7043 8	72661 2	7701 3	70723 2	8387 0	68871 1	9100 6	67097 9	22
39	6424 8	74658 6	7054 5	72628 2	7712 5	70691 6	8398 7	68840 9	9112 7	67069 0	21
40	6435 0	74623 9	7065 2	72595 1	7723 8	70660 1	8410 4	68810 7	9124 9	67040 1	20
41	6445 3	74589 3	7076 0	72562 1	7735 0	70628 6	8422 0	68780 6	9137 0	67011 2	19
42	6455 6	74554 7	7086 7	72529 2	7746 2	70597 1	8433 7	68750 5	9149 2	66982 4	18
43	6465 9	74520 1	7097 5	72496 2	7757 4	70565 6	8445 4	68720 4	9161 3	66953 5	17
44	6476 2	74485 6	7108 3	72463 3	7768 7	70534 2	8457 1	68690 3	9173 5	66924 7	16
45	6486 5	74451 0	7119 0	72430 4	7779 9	70502 8	8468 8	68660 3	9185 7	66895 9	15
46	6496 8	74416 6	7129 8	72397 5	7791 2	70471 4	8480 6	68630 2	9197 9	66867 1	14
47	6507 1	74382 1	7140 6	72364 7	7802 4	70440 0	8492 3	68600 2	9210 0	66838 4	13
48	6517 4	74347 7	7151 4	72331 9	7813 7	70408 7	8504 0	68570 3	9222 2	66809 7	12
49	6527 8	74313 3	7162 2	72299 1	7825 0	70377 4	8515 8	68540 3	9234 5	66780 9	11
50	6538 1	74278 9	7173 0	72266 3	7836 2	70346 1	8527 5	68510 3	9246 7	66752 2	10
51	6548 5	74244 6	7183 9	72233 6	7847 5	70314 8	8539 3	68480 4	9258 9	66723 6	9
52	6558 8	74210 2	7194 7	72200 9	7858 8	70283 6	8551 0	68450 5	9271 1	66694 9	8
53	6569 2	74175 9	7205 5	72168 2	7870 1	70252 4	8562 8	68420 7	9283 3	66666 3	7
54	6579 5	74141 7	7216 4	72135 5	7881 5	70221 2	8574 6	68390 8	9295 6	66637 6	6
55	6589 9	74107 4	7227 2	72102 9	7892 8	70190 0	8586 4	68361 0	9307 8	66609 0	5
56	6600 3	74073 2	7238 1	72070 3	7904 1	70158 8	8598 2	68331 1	9320 1	66580 5	4
57	6610 7	74039 1	7249 0	72037 7	7915 4	70127 7	8610 0	68301 4	9332 4	66551 9	3
58	6621 1	74004 9	7259 8	72005 2	7926 8	70096 6	8621 8	68271 6	9344 6	66523 3	2
59	6631 5	73970 8	7270 7	71972 6	7938 1	70065 5	8633 6	68241 8	9356 9	66494 8	1
60	6642 0	73936 7	7281 6	71940 1	7949 5	70034 5	8645 4	68212 1	9369 2	66466 3	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	69°	339°	68°	338°	67°	337°	66°	336°	65°	335°	

	25°		26°		27°		28°		29°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	9369 2	66466 3	10120 6	64791 2	10899 3	63181 5	11705 2	61632 5	12538 0	60140 0	60
1	9381 5	66437 8	10133 3	64763 8	10912 6	63155 2	11718 9	61607 2	12552 1	60115 6	59
2	9393 8	66409 4	10146 1	64736 5	10925 8	63128 9	11732 6	61581 8	12566 2	60092 2	58
3	9406 1	66380 9	10158 9	64709 2	10939 0	63102 6	11746 2	61556 5	12580 4	60066 8	57
4	9418 5	66352 5	10171 7	64681 9	10952 2	63076 4	11759 9	61531 3	12594 5	60042 5	56
5	9430 8	66324 1	10184 4	64654 6	10965 5	63050 1	11773 6	61506 0	12608 6	60018 1	55
6	9443 1	66295 7	10197 2	64627 4	10978 7	63023 9	11787 3	61480 8	12622 8	59993 8	54
7	9455 5	66267 4	10210 0	64600 1	10992 0	62997 7	11801 0	61455 5	12636 9	59969 4	53
8	9467 8	66239 0	10222 8	64572 9	11005 2	62971 5	11814 7	61430 3	12651 1	59945 1	52
9	9480 2	66210 7	10235 7	64545 7	11018 5	62945 4	11828 4	61405 1	12665 2	59920 8	51
10	9492 5	66182 4	10248 5	64518 5	11031 8	62919 2	11842 2	61379 9	12679 4	59896 5	50
11	9504 9	66154 1	10261 3	64491 3	11045 1	62893 1	11855 9	61354 8	12693 6	59872 3	49
12	9517 3	66125 8	10274 2	64464 2	11058 4	62867 0	11869 6	61329 6	12707 8	59848 0	48
13	9529 7	66097 6	10287 0	64437 0	11071 7	62840 9	11883 4	61304 5	12722 0	59823 8	47
14	9542 1	66069 3	10299 9	64409 9	11085 0	62814 8	11897 2	61279 3	12736 2	59799 5	46
15	9554 5	66041 1	10312 7	64382 8	11098 3	62788 7	11910 9	61254 2	12750 4	59775 3	45
16	9566 9	66012 9	10325 6	64355 7	11111 6	62762 7	11924 7	61229 1	12764 6	59751 1	44
17	9579 3	65984 8	10338 5	64328 7	11124 9	62736 6	11938 5	61204 1	12778 8	59726 9	43
18	9591 7	65956 6	10351 4	64301 6	11138 3	62710 6	11952 3	61179 0	12793 1	59702 8	42
19	9604 2	65928 5	10364 2	64274 6	11151 6	62684 6	11966 1	61153 9	12807 3	59678 6	41
20	9616 6	65900 4	10377 1	64247 6	11165 0	62658 6	11979 9	61128 9	12821 6	59654 5	40
21	9629 0	65872 3	10390 1	64220 6	11178 3	62632 6	11993 7	61103 9	12835 8	59630 3	39
22	9641 5	65844 2	10403 0	64193 5	11191 7	62606 7	12007 5	61078 9	12850 1	59606 2	38
23	9654 0	65816 1	10415 9	64166 7	11205 1	62580 8	12021 3	61053 9	12864 3	59582 1	37
24	9666 5	65788 1	10428 8	64139 7	11218 5	62554 8	12035 1	61028 9	12878 6	59558 0	36
25	9678 9	65760 1	10441 8	64112 8	11231 8	62528 9	12049 0	61004 0	12892 9	59534 0	35
26	9691 4	65732 1	10454 7	64085 9	11245 2	62503 0	12062 8	60979 0	12907 2	59509 9	34
27	9703 8	65704 1	10467 7	64059 0	11258 7	62477 2	12076 7	60954 1	12921 5	59485 9	33
28	9716 4	65676 1	10480 6	64032 2	11272 1	62451 3	12090 5	60929 2	12935 8	59461 8	32
29	9728 9	65648 2	10493 6	64005 3	11285 5	62425 5	12104 4	60904 3	12950 1	59437 8	31
30	9741 5	65620 3	10506 6	63978 5	11298 9	62399 7	12118 3	60879 4	12964 4	59413 8	30
31	9754 0	65592 4	10519 5	63951 6	11312 3	62373 9	12132 2	60854 6	12978 8	59389 8	29
32	9766 5	65564 5	10532 5	63924 8	11325 8	62348 1	12146 1	60829 7	12993 1	59365 9	28
33	9779 1	65536 6	10545 5	63898 1	11339 2	62322 3	12160 0	60804 9	13007 4	59341 9	27
34	9791 6	65508 8	10558 5	63871 3	11352 7	62296 5	12173 9	60780 1	13021 8	59318 0	26
35	9804 2	65480 9	10571 6	63844 6	11366 2	62270 8	12187 8	60755 3	13036 1	59294 0	25
36	9816 7	65453 1	10584 6	63817 8	11379 6	62245 1	12201 7	60730 5	13050 5	59270 1	24
37	9829 3	65425 3	10597 6	63791 1	11393 1	62219 4	12215 6	60705 7	13064 9	59246 2	23
38	9841 9	65397 6	10610 6	63764 4	11406 6	62193 7	12229 6	60680 9	13079 3	59222 3	22
39	9854 5	65369 8	10623 7	63737 7	11420 1	62168 0	12243 5	60656 2	13093 6	59198 5	21
40	9867 1	65342 1	10636 7	63711 1	11433 6	62142 3	12257 5	60631 5	13108 0	59174 6	20
41	9879 7	65314 3	10649 8	63684 4	11447 1	62116 7	12271 4	60606 8	13122 4	59150 8	19
42	9892 3	65286 6	10662 9	63657 8	11460 6	62091 1	12285 4	60582 1	13136 8	59126 9	18
43	9904 9	65259 0	10675 9	63631 2	11474 2	62065 4	12299 4	60557 4	13151 3	59103 1	17
44	9917 5	65231 3	10689 0	63604 6	11487 7	62039 9	12313 3	60532 7	13165 7	59079 3	16
45	9930 1	65203 7	10702 1	63578 0	11501 2	62014 3	12327 3	60508 1	13180 1	59055 5	15
46	9942 8	65176 0	10715 2	63551 5	11514 8	61988 7	12341 3	60483 4	13194 6	59031 8	14
47	9955 5	65148 4	10728 3	63524 9	11528 3	61963 2	12355 3	60458 8	13209 0	59008 0	13
48	9968 1	65120 8	10741 4	63498 4	11541 9	61937 6	12369 3	60434 2	13223 4	58984 3	12
49	9980 8	65093 3	10754 5	63471 9	11555 5	61912 1	12383 3	60409 6	13237 9	58960 5	11
50	9993 5	65065 7	10767 7	63445 4	11569 0	61886 6	12397 4	60385 0	13252 4	58936 8	10
51	10006 1	65038 2	10780 8	63419 0	11582 6	61861 1	12411 4	60360 5	13266 9	58913 1	9
52	10018 8	65010 7	10793 9	63392 5	11596 2	61835 7	12425 4	60335 9	13281 3	58889 4	8
53	10031 5	64983 2	10807 1	63366 1	11609 8	61810 2	12439 5	60311 4	13295 8	58865 7	7
54	10044 2	64955 7	10820 2	63339 6	11623 4	61784 8	12453 5	60286 8	13310 3	58842 1	6
55	10056 9	64928 2	10833 4	63313 2	11637 0	61759 4	12467 6	60262 3	13324 8	58818 4	5
56	10069 6	64900 8	10846 6	63286 9	11650 7	61733 9	12481 7	60237 9	13339 3	58794 8	4
57	10082 4	64873 4	10859 8	63260 5	11664 3	61708 6	12495 8	60213 4	13353 9	58771 2	3
58	10095 1	64846 0	10872 9	63234 1	11677 9	61683 2	12509 8	60188 9	13368 4	58747 6	2
59	10107 8	64818 6	10886 1	63207 8	11691 6	61657 8	12523 9	60164 5	13382 9	58724 0	1
60	10120 6	64791 2	10899 3	63181 5	11705 2	61632 5	12538 0	60140 0	13397 5	58700 4	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	64°	334°	63°	333°	62°	332°	61°	331°	60°	330°	

	30°		31°		32°		33°		34°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	13397 5	58700 4	14283 3	57310 1	15195 2	55966 2	16132 9	54665 8	17096 2	53406 5	60
1	13412 0	58676 8	14298 3	57287 3	15210 6	55944 1	16148 8	54644 5	17112 5	53385 8	59
2	13426 6	58653 3	14313 2	57264 6	15226 0	55922 2	16164 6	54623 2	17128 8	53365 2	58
3	13441 1	58629 7	14328 2	57241 8	15241 5	55900 2	16180 5	54601 9	17145 1	53344 5	57
4	13455 7	58606 2	14343 3	57219 1	15256 9	55878 2	16196 4	54580 6	17161 4	53323 9	56
5	13470 3	58582 7	14358 3	57196 4	15272 3	55856 2	16212 2	54559 3	17177 7	53303 3	55
6	13484 9	58559 2	14373 3	57173 7	15287 8	55834 2	16228 1	54538 1	17194 0	53282 7	54
7	13499 4	58535 7	14388 3	57151 0	15303 3	55812 3	16244 0	54516 8	17210 3	53262 1	53
8	13514 0	58512 2	14403 4	57128 3	15318 7	55790 4	16259 9	54495 6	17226 6	53241 5	52
9	13528 7	58488 8	14418 4	57105 6	15334 2	55768 4	16275 8	54474 4	17242 9	53221 0	51
10	13543 3	58465 3	14433 4	57083 0	15349 7	55746 5	16291 7	54453 1	17259 3	53200 4	50
11	13557 9	58441 9	14448 5	57060 3	15365 2	55724 6	16307 6	54431 9	17275 6	53179 8	49
12	13572 5	58418 5	14463 6	57037 7	15380 7	55702 7	16323 6	54410 7	17291 9	53159 3	48
13	13587 2	58395 1	14478 6	57015 1	15396 2	55680 8	16339 5	54389 6	17308 3	53138 7	47
14	13601 8	58371 7	14493 7	56992 5	15411 7	55659 0	16355 4	54368 4	17324 7	53118 3	46
15	13616 4	58348 3	14508 8	56969 9	15427 2	55637 1	16371 4	54347 2	17341 0	53097 8	45
16	13631 1	58324 9	14523 9	56947 3	15442 7	55615 3	16387 3	54326 1	17357 4	53077 3	44
17	13645 8	58301 6	14539 0	56924 8	15458 3	55593 4	16403 3	54304 9	17373 8	53056 8	43
18	13660 4	58278 3	14554 1	56902 2	15473 8	55571 6	16419 3	54283 8	17390 2	53036 3	42
19	13675 1	58254 9	14569 2	56879 7	15489 4	55549 8	16435 2	54262 7	17406 6	53015 8	41
20	13689 8	58231 6	14584 4	56857 1	15504 9	55528 0	16451 2	54241 6	17423 0	52995 4	40
21	13704 5	58208 3	14599 5	56834 6	15520 5	55506 2	16467 2	54220 5	17439 4	52974 9	39
22	13719 1	58185 0	14614 6	56812 1	15536 0	55484 5	16483 2	54199 4	17455 8	52954 5	38
23	13733 9	58161 8	14629 8	56789 6	15551 6	55462 7	16499 2	54178 3	17472 2	52934 1	37
24	13748 6	58138 5	14644 9	56767 1	15567 2	55441 0	16515 2	54157 3	17488 7	52913 7	36
25	13763 4	58115 3	14660 1	56744 7	15582 8	55419 2	16531 2	54136 2	17505 1	52893 3	35
26	13777 8	58092 1	14675 2	56722 2	15598 4	55397 5	16547 3	54115 2	17521 5	52872 9	34
27	13792 8	58068 8	14690 4	56699 8	15614 0	55375 8	16563 3	54094 2	17538 0	52852 5	33
28	13807 6	58045 6	14705 6	56677 4	15629 6	55354 1	16579 3	54073 2	17554 4	52832 1	32
29	13822 3	58022 4	14720 8	56654 9	15645 2	55332 4	16595 4	54052 2	17570 9	52811 8	31
30	13837 1	57999 3	14736 0	56632 5	15660 9	55310 7	16611 4	54031 2	17587 4	52791 4	30
31	13851 8	57976 1	14751 2	56610 2	15676 5	55289 1	16627 5	54010 2	17603 9	52771 1	29
32	13866 6	57953 0	14766 4	56587 8	15692 1	55267 4	16643 5	53989 2	17620 3	52750 8	28
33	13881 4	57929 8	14781 6	56565 4	15707 8	55245 8	16659 6	53968 3	17636 8	52730 5	27
34	13896 2	57906 7	14796 8	56543 1	15723 4	55224 1	16675 7	53947 3	17653 3	52710 2	26
35	13911 0	57883 6	14812 1	56520 7	15739 1	55202 5	16691 8	53926 4	17669 8	52689 9	25
36	13925 8	57860 5	14827 3	56498 4	15754 8	55180 9	16707 9	53905 4	17686 4	52669 6	24
37	13940 6	57837 4	14842 5	56476 1	15770 4	55159 3	16724 0	53884 5	17702 9	52649 3	23
38	13955 4	57814 3	14857 8	56453 8	15786 1	55137 7	16740 1	53863 6	17719 4	52629 0	22
39	13970 2	57791 3	14873 1	56431 5	15801 8	55116 2	16756 2	53842 7	17735 9	52608 8	21
40	13985 1	57768 2	14888 3	56409 2	15817 5	55094 6	16772 3	53821 8	17752 5	52588 5	20
41	13999 9	57745 2	14903 6	56386 9	15833 2	55073 1	16788 5	53801 0	17769 0	52568 3	19
42	14014 8	57722 2	14918 9	56364 7	15848 9	55051 5	16804 6	53780 1	17785 6	52548 1	18
43	14029 6	57699 2	14934 2	56342 4	15864 6	55030 0	16820 7	53759 3	17802 2	52527 9	17
44	14044 5	57676 2	14949 5	56320 2	15880 4	55008 5	16836 9	53738 4	17818 7	52507 7	16
45	14059 4	57653 2	14964 8	56298 0	15896 1	54987 0	16853 0	53717 6	17835 3	52487 5	15
46	14074 2	57630 3	14980 1	56275 8	15911 8	54965 5	16869 2	53696 8	17851 9	52467 3	14
47	14089 1	57607 3	14995 4	56253 6	15927 6	54944 0	16885 4	53676 0	17868 5	52447 1	13
48	14104 0	57584 4	15010 7	56231 4	15943 3	54922 5	16901 6	53655 2	17885 1	52427 0	12
49	14118 9	57561 4	15026 1	56209 2	15959 1	54901 1	16917 7	53634 4	17901 7	52406 8	11
50	14133 8	57538 5	15041 4	56187 1	15974 9	54879 6	16933 9	53613 6	17918 3	52386 7	10
51	14148 7	57515 6	15056 7	56164 9	15990 6	54858 2	16950 1	53592 8	17934 9	52366 5	9
52	14163 6	57492 7	15072 1	56142 8	16006 4	54836 8	16966 3	53572 1	17951 5	52346 4	8
53	14178 6	57469 9	15087 5	56120 7	16022 2	54815 4	16982 6	53551 4	17968 2	52326 3	7
54	14193 5	57447 0	15102 8	56098 6	16038 0	54794 0	16998 8	53530 6	17984 8	52306 2	6
55	14208 4	57424 2	15118 2	56076 5	16053 8	54772 6	17015 0	53509 9	18001 5	52286 1	5
56	14223 4	57401 3	15133 6	56054 4	16069 6	54751 2	17031 2	53489 2	18018 1	52266 0	4
57	14238 4	57378 5	15149 0	56032 3	16085 4	54729 8	17047 5	53468 5	18034 8	52246 0	3
58	14253 3	57355 7	15164 4	56010 2	16101 3	54708 5	17063 7	53447 8	18051 4	52225 9	2
59	14268 3	57332 9	15179 8	55988 2	16117 1	54687 1	17080 0	53427 1	18068 1	52205 9	1
60	14283 3	57310 1	15195 2	55966 2	16132 9	54665 8	17096 2	53406 5	18084 8	52185 8	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	59°	329°	58°	328°	57°	327°	56°	326°	55°	325°	

	35°		36°		37°		38°		39°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	18084 8	52185 8	19098 3	51001 8	20136 4	49852 4	21198 9	48735 8	22285 4	47650 5	60
1	18101 5	52165 8	19115 4	50982 3	20154 0	49833 5	21216 8	48717 5	22303 7	47632 6	59
2	18118 2	52145 8	19132 5	50962 9	20171 5	49814 6	21234 8	48699 1	22322 0	47614 8	58
3	18134 9	52125 8	19149 6	50943 5	20189 0	49795 8	21252 7	48680 8	22340 4	47597 0	57
4	18151 6	52105 8	19166 7	50924 1	20206 5	49776 9	21270 6	48662 5	22358 7	47579 2	56
5	18168 3	52085 8	19183 9	50904 7	20224 1	49758 1	21288 6	48644 2	22377 0	47561 4	55
6	18185 0	52065 8	19201 0	50885 3	20241 6	49739 3	21306 5	48625 9	22395 4	47543 6	54
7	18201 8	52045 8	19218 1	50865 9	20259 2	49720 4	21324 4	48607 6	22413 7	47525 8	53
8	18218 5	52025 9	19235 3	50846 5	20276 7	49701 6	21342 4	48589 3	22432 1	47508 0	52
9	18235 2	52005 9	19252 5	50827 2	20294 3	49682 8	21360 4	48571 1	22450 4	47490 3	51
10	18252 0	51986 0	19269 6	50807 8	20311 8	49664 0	21378 3	48552 8	22468 8	47472 5	50
11	18268 7	51966 1	19286 8	50788 8	20329 4	49645 2	21396 3	48534 5	22487 2	47454 8	49
12	18285 5	51946 1	19304 0	50769 2	20347 0	49626 5	21414 3	48516 3	22505 6	47437 0	48
13	18302 3	51926 2	19321 1	50749 8	20364 6	49607 7	21432 3	48498 1	22523 9	47419 3	47
14	18319 1	51906 3	19338 3	50730 5	20382 2	49589 0	21450 3	48479 8	22542 3	47401 6	46
15	18335 8	51886 5	19355 5	50711 2	20399 8	49570 2	21468 3	48461 6	22560 7	47383 8	45
16	18352 6	51866 6	19372 7	50691 9	20417 4	49551 5	21486 3	48443 4	22579 1	47366 1	44
17	18369 4	51846 7	19389 9	50672 7	20435 0	49532 7	21504 3	48425 2	22597 6	47348 4	43
18	18386 2	51826 9	19407 2	50653 4	20452 7	49514 0	21522 4	48407 0	22616 0	47330 7	42
19	18403 0	51807 0	19424 4	50634 1	20470 3	49495 3	21540 4	48388 8	22634 4	47313 0	41
20	18419 9	51787 2	19441 6	50614 9	20487 9	49476 6	21558 4	48370 6	22652 8	47295 4	40
21	18436 7	51767 3	19458 9	50595 6	20505 6	49457 9	21576 5	48352 5	22671 3	47277 7	39
22	18453 5	51747 5	19476 1	50576 4	20523 2	49439 2	21594 5	48334 3	22689 7	47260 0	38
23	18470 4	51727 7	19493 4	50557 2	20540 9	49420 6	21612 6	48316 2	22708 2	47242 4	37
24	18487 2	51707 9	19510 6	50537 9	20558 5	49401 9	21630 6	48298 0	22726 6	47224 7	36
25	18504 1	51688 1	19527 9	50518 7	20576 2	49383 2	21648 7	48279 9	22745 1	47207 1	35
26	18520 9	51668 4	19545 2	50499 5	20593 9	49364 6	21666 8	48261 8	22763 6	47189 5	34
27	18537 8	51648 6	19562 4	50480 4	20611 6	49345 9	21684 9	48243 6	22782 1	47171 8	33
28	18554 7	51628 8	19579 7	50461 2	20629 3	49327 3	21703 0	48225 5	22800 5	47154 2	32
29	18571 6	51609 1	19597 0	50442 0	20647 0	49308 7	21721 1	48207 4	22819 0	47136 6	31
30	18588 4	51589 3	19614 3	50422 8	20664 7	49290 1	21739 2	48189 3	22837 5	47119 0	30
31	18605 3	51569 6	19631 6	50403 7	20682 4	49271 5	21757 3	48171 3	22856 0	47101 4	29
32	18622 2	51549 9	19648 9	50384 6	20700 1	49252 9	21775 4	48153 2	22874 6	47083 9	28
33	18639 2	51530 2	19666 2	50365 4	20717 8	49234 3	21793 5	48135 1	22893 1	47066 3	27
34	18656 1	51510 5	19683 6	50346 3	20735 6	49215 7	21811 7	48117 1	22911 6	47048 7	26
35	18673 0	51490 8	19700 9	50327 2	20753 3	49197 2	21829 8	48099 0	22930 1	47031 2	25
36	18689 9	51471 1	19718 2	50308 1	20771 0	49178 6	21848 0	48081 0	22948 7	47013 6	24
37	18706 9	51451 5	19735 6	50289 0	20788 8	49160 0	21866 1	48062 9	22967 2	46991 1	23
38	18723 8	51431 8	19752 9	50269 9	20806 5	49141 5	21884 3	48044 9	22985 8	46978 5	22
39	18740 8	51412 1	19770 3	50250 8	20824 3	49123 0	21902 4	48026 9	23004 3	46961 0	21
40	18757 7	51392 5	19787 7	50231 8	20842 1	49104 4	21920 6	48008 9	23022 9	46943 5	20
41	18774 7	51372 9	19805 0	50212 7	20859 9	49085 9	21938 8	47990 9	23041 5	46926 0	19
42	18791 6	51353 3	19822 4	50193 6	20877 6	49067 4	21957 0	47972 9	23060 0	46908 5	18
43	18808 6	51333 6	19839 8	50174 6	20895 4	49048 9	21975 5	47954 9	23078 6	46891 0	17
44	18825 6	51314 0	19857 2	50155 6	20913 2	49030 4	21993 3	47936 9	23097 2	46873 5	16
45	18842 6	51294 5	19874 6	50136 6	20931 0	49012 0	22011 6	47919 0	23115 8	46856 0	15
46	18859 6	51274 9	19892 0	50117 5	20948 8	48993 5	22029 8	47901 0	23134 4	46838 6	14
47	18876 6	51255 3	19909 4	50098 5	20966 7	48975 0	22048 0	47883 1	23153 0	46821 1	13
48	18893 6	51235 7	19926 9	50079 6	20984 5	48956 6	22066 2	47865 1	23171 6	46803 7	12
49	18910 6	51216 2	19944 3	50060 6	21002 3	48938 1	22084 4	47847 2	23190 3	46786 2	11
50	18927 7	51196 6	19961 7	50041 6	21020 2	48919 7	22102 7	47829 3	23208 9	46768 8	10
51	18944 7	51177 1	19979 2	50022 6	21038 0	48901 3	22120 9	47811 3	23227 5	46751 3	9
52	18961 7	51157 6	19996 6	50003 7	21055 9	48882 8	22139 2	47793 4	23246 2	46733 9	8
53	18978 8	51138 1	20014 1	49984 8	21073 7	48864 4	22157 4	47775 5	23264 8	46716 5	7
54	18995 8	51118 6	20031 5	49965 8	21091 6	48846 0	22175 7	47757 6	23283 5	46699 1	6
55	19012 9	51099 1	20049 0	49946 9	21109 5	48827 6	22194 0	47739 8	23302 1	46681 7	5
56	19030 0	51079 6	20066 5	49927 9	21127 3	48809 3	22212 2	47721 9	23320 8	46664 3	4
57	19047 0	51060 1	20084 0	49909 0	21145 2	48790 9	22230 5	47704 0	23339 5	46646 9	3
58	19064 1	51040 7	20101 5	49890 1	21163 1	48772 5	22248 8	47686 2	23358 2	46629 6	2
59	19081 2	51021 2	20118 9	49871 2	21181 0	48754 2	22267 1	47668 3	23376 9	46612 2	1
60	19098 3	51001 8	20136 4	49852 4	21198 9	48735 8	22285 4	47650 5	23395 6	46594 8	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	54°	324°	53°	323°	52°	322°	51°	321°	50°	320°	

/	40°		41°		42°		43°		44°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	23395 6	46594 8	24529 0	45567 5	25685 5	44567 1	26864 6	43592 5	28066 0	42642 5	60
1	23414 3	46577 5	24548 1	45550 6	25705 0	44550 6	26884 5	43576 4	28086 2	42626 8	59
2	23433 0	46560 1	24567 2	45533 7	25724 5	44534 2	26903 2	43560 4	28106 4	42611 2	58
3	23451 7	46542 8	24586 3	45516 8	25743 9	44517 8	26924 2	43544 4	28126 7	42595 6	57
4	23470 4	46525 5	24605 4	45500 0	25763 4	44501 3	26944 0	43528 4	28146 9	42580 0	56
5	23489 1	46508 2	24624 5	45483 1	25782 9	44484 9	26963 9	43512 4	28167 1	42564 4	55
6	23507 6	46490 8	24643 7	45466 2	25802 4	44468 5	26983 8	43496 4	28187 4	42548 8	54
7	23526 6	46473 5	24662 8	45449 4	25821 9	44452 1	27003 7	43480 4	28207 6	42533 2	53
8	23545 3	46456 2	24681 9	45432 6	25841 4	44435 7	27023 5	43464 4	28227 9	42517 6	52
9	23564 0	46439 0	24701 1	45415 7	25860 9	44419 3	27043 4	43448 4	28248 1	42502 0	51
10	23582 9	46421 7	24720 2	45398 9	25880 5	44402 9	27063 3	43432 4	28268 4	42486 4	50
11	23601 6	46404 4	24739 4	45382 1	25900 0	44386 5	27083 2	43416 5	28288 7	42470 9	49
12	23620 4	46387 1	24758 5	45365 3	25919 5	44370 1	27103 1	43400 5	28308 9	42455 3	48
13	23639 2	46369 9	24777 7	45348 5	25939 1	44353 8	27123 0	43384 6	28329 2	42439 8	47
14	23658 0	46352 6	24796 8	45331 7	25958 6	44337 4	27143 0	43368 6	28349 5	42424 2	46
15	23676 8	46335 4	24816 0	45314 9	25978 2	44321 1	27162 9	43352 7	28369 8	42408 7	45
16	23695 6	46318 2	24835 2	45298 1	25997 7	44304 7	27182 8	43336 8	28390 1	42393 1	44
17	23714 4	46300 9	24854 4	45281 3	26017 3	44288 4	27202 8	43320 8	28410 4	42377 6	43
18	23733 2	46283 7	24873 6	45264 6	26036 9	44272 0	27222 7	43304 9	28430 7	42362 1	42
19	23752 0	46266 5	24892 8	45247 8	26056 5	44255 7	27242 7	43289 0	28451 0	42346 6	41
20	23770 8	46249 3	24912 0	45231 1	26076 1	44239 4	27262 6	43273 1	28471 4	42331 1	40
21	23789 6	46232 1	24931 2	45214 3	26095 7	44223 1	27282 6	43257 2	28491 7	42315 6	39
22	23808 5	46214 9	24950 4	45197 6	26115 2	44206 8	27302 6	43241 3	28512 0	42300 1	38
23	23827 3	46197 7	24969 7	45180 9	26134 9	44190 5	27322 5	43225 4	28532 4	42284 6	37
24	23846 2	46180 6	24988 9	45164 1	26154 5	44174 2	27342 5	43209 6	28552 7	42269 1	36
25	23865 0	46163 4	25008 1	45147 4	26174 1	44157 9	27362 5	43193 7	28573 1	42253 6	35
26	23883 9	46146 2	25027 4	45130 7	26193 7	44141 7	27382 5	43177 8	28593 4	42238 2	34
27	23902 8	46129 0	25046 6	45114 0	26213 3	44125 4	27402 5	43162 0	28613 8	42222 7	33
28	23921 6	46112 0	25065 9	45097 3	26233 0	44109 1	27422 5	43146 1	28634 2	42207 3	32
29	23940 5	46094 8	25085 2	45080 7	26252 6	44092 9	27442 5	43130 3	28654 6	42191 8	31
30	23959 4	46077 7	25104 4	45064 0	26272 3	44076 6	27462 6	43114 4	28675 0	42176 4	30
31	23978 3	46060 6	25123 7	45047 3	26291 9	44060 4	27482 6	43098 6	28695 3	42160 9	29
32	23997 2	46043 5	25143 0	45030 7	26311 6	44044 2	27502 6	43082 8	28715 7	42145 5	28
33	24016 1	46026 4	25162 3	45014 0	26331 3	44027 9	27522 7	43067 0	28736 1	42130 1	27
34	24035 0	46009 3	25181 6	44997 4	26350 9	44011 7	27542 7	43051 2	28756 6	42114 7	26
35	24053 9	45992 2	25200 9	44980 7	26370 6	43995 5	27562 8	43035 4	28777 0	42099 2	25
36	24072 9	45975 1	25220 2	44964 1	26390 3	43979 3	27582 8	43019 6	28797 4	42083 8	24
37	24091 8	45958 0	25239 5	44947 5	26410 0	43963 1	27602 9	43003 8	28817 8	42068 4	23
38	24110 7	45941 0	25258 8	44930 8	26429 7	43946 9	27622 9	42988 0	28838 3	42053 0	22
39	24129 7	45923 9	25278 2	44914 2	26449 4	43930 7	27643 0	42972 2	28858 7	42037 7	21
40	24148 6	45906 9	25297 5	44897 6	26469 1	43914 5	27663 1	42956 5	28879 1	42022 3	20
41	24167 6	45889 8	25316 8	44881 0	26488 8	43898 4	27683 2	42940 7	28899 6	42006 9	19
42	24186 6	45872 8	25336 2	44864 4	26508 5	43882 2	27703 3	42924 9	28920 1	41991 5	18
43	24205 5	45855 8	25355 5	44847 9	26528 3	43866 1	27723 4	42909 2	28940 5	41976 2	17
44	24224 5	45838 7	25374 9	44831 3	26548 0	43849 9	27743 5	42893 4	28961 0	41960 8	16
45	24243 5	45821 7	25394 3	44814 7	26567 7	43833 8	27763 6	42877 7	28981 5	41945 5	15
46	24262 5	45804 7	25413 6	44798 2	26587 5	43817 6	27783 7	42862 0	29001 9	41930 1	14
47	24281 5	45787 7	25433 0	44781 6	26607 3	43801 5	27803 8	42846 3	29022 4	41914 8	13
48	24300 5	45770 7	25452 4	44765 1	26627 0	43785 4	27824 0	42830 5	29042 9	41899 5	12
49	24319 5	45753 8	25471 8	44748 5	26646 8	43769 3	27844 1	42814 8	29063 4	41884 2	11
50	24338 5	45736 8	25491 2	44732 0	26666 6	43753 2	27864 3	42799 1	29083 9	41868 8	10
51	24357 5	45719 8	25510 6	44715 5	26686 3	43737 1	27884 4	42783 4	29104 4	41853 5	9
52	24376 6	45702 9	25530 0	44699 0	26706 1	43721 0	27904 6	42767 7	29125 0	41838 2	8
53	24395 6	45685 9	25549 4	44682 4	26725 9	43704 9	27924 7	42752 1	29145 5	41822 9	7
54	24414 6	45669 0	25568 8	44665 9	26745 7	43688 8	27944 9	42736 4	29166 0	41807 6	6
55	24433 7	45652 0	25588 3	44649 4	26765 5	43672 7	27965 1	42720 7	29186 5	41792 4	5
56	24452 8	45635 1	25607 7	44633 0	26785 3	43656 7	27985 2	42705 0	29207 1	41777 1	4
57	24471 8	45618 2	25627 2	44616 5	26805 1	43640 6	28005 4	42689 4	29227 6	41761 8	3
58	24490 9	45601 3	25646 6	44600 0	26825 0	43624 5	28025 6	42673 7	29248 2	41746 5	2
59	24510 0	45584 4	25666 1	44583 5	26844 8	43608 5	28045 8	42658 1	29268 8	41731 3	1
60	24529 0	45567 5	25685 5	44567 1	26864 6	43592 5	28066 0	42642 5	29289 3	41716 0	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	,
	49°	319°	48°	318°	47°	317°	46°	316°	45°	315°	

	45°		46°		47°		48°		49°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	29289 3	41716 0	30534 2	40812 2	31800 2	39930 0	33086 9	39068 7	34394 1	38227 3	60
1	29309 9	41700 8	30555 1	40797 3	31821 4	39915 5	33108 6	39054 5	34416 0	38213 4	59
2	29330 5	41685 5	30576 0	40782 4	31842 7	39901 0	33130 2	39040 3	34438 0	38199 6	58
3	29351 1	41670 3	30597 0	40767 6	31864 0	39886 5	33151 8	39026 1	34460 0	38185 7	57
4	29371 6	41655 1	30617 9	40752 7	31885 3	39872 0	33173 5	39012 0	34482 0	38171 9	56
5	29392 2	41639 9	30639 9	40737 9	31906 6	39857 5	33195 1	38997 8	34503 9	38158 1	55
6	29412 8	41624 6	30659 8	40723 0	31927 9	39843 0	33216 7	38983 6	34525 9	38144 2	54
7	29433 4	41609 4	30680 8	40708 2	31949 2	39828 5	33238 4	38969 5	34547 9	38130 4	53
8	29454 1	41594 2	30701 7	40693 3	31970 5	39814 0	33260 1	38955 3	34569 9	38116 6	52
9	29474 7	41579 0	30722 7	40678 5	31991 9	39799 5	33281 7	38941 2	34591 9	38102 8	51
10	29495 3	41563 9	30743 7	40663 7	32013 2	39785 0	33303 4	38927 1	34613 9	38089 0	50
11	29515 9	41548 7	30764 7	40648 9	32034 5	39770 6	33325 1	38912 9	34635 9	38075 2	49
12	29536 6	41533 5	30785 7	40634 1	32055 9	39756 1	33346 8	38898 8	34657 9	38061 4	48
13	29557 2	41518 3	30806 7	40619 3	32077 2	39741 7	33368 4	38884 7	34680 0	38047 6	47
14	29577 9	41503 2	30827 7	40604 5	32098 6	39727 2	33390 1	38870 6	34702 0	38033 8	46
15	29598 5	41488 0	30848 7	40589 7	32119 9	39712 8	33411 8	38856 5	34724 0	38020 0	45
16	29619 2	41472 8	30869 7	40574 9	32141 3	39698 3	33433 5	38842 4	34746 1	38006 2	44
17	29639 9	41457 7	30890 7	40560 1	32162 7	39683 9	33455 2	38828 3	34768 1	37992 4	43
18	29660 5	41442 6	30911 8	40545 3	32184 0	39669 5	33477 0	38814 2	34790 2	37978 7	42
19	29681 2	41427 4	30932 8	40530 5	32205 4	39655 1	33498 7	38800 1	34812 2	37964 9	41
20	29701 9	41412 3	30953 8	40515 8	32226 8	39640 6	33520 4	38786 0	34834 3	37951 2	40
21	29722 6	41397 2	30974 9	40501 0	32248 2	39626 2	33542 1	38772 0	34856 3	37937 4	39
22	29743 3	41382 1	30995 9	40486 3	32269 6	39611 8	33563 9	38757 9	34878 4	37923 7	38
23	29764 0	41366 9	31017 0	40471 5	32291 0	39597 4	33585 6	38743 8	34900 5	37909 9	37
24	29784 7	41351 8	31038 0	40456 8	32312 4	39583 0	33607 4	38729 8	34922 6	37896 2	36
25	29805 4	41336 7	31059 1	40442 0	32333 8	39568 7	33629 1	38715 7	34944 7	37882 5	35
26	29826 1	41321 6	31080 2	40427 3	32355 2	39554 3	33650 9	38701 7	34966 8	37868 7	34
27	29846 9	41306 6	31101 3	40412 6	32376 7	39539 9	33672 7	38687 6	34988 9	37855 0	33
28	29867 6	41291 5	31122 4	40397 9	32398 1	39525 5	33694 4	38673 6	35011 0	37841 3	32
29	29888 3	41276 4	31143 4	40383 2	32419 5	39511 2	33716 2	38659 6	35033 1	37827 6	31
30	29909 1	41261 4	31164 5	40368 5	32441 0	39496 8	33738 0	38645 5	35055 2	37813 9	30
31	29929 8	41246 3	31185 6	40353 8	32462 4	39482 4	33759 8	38631 5	35077 3	37800 2	29
32	29950 6	41231 2	31206 6	40339 1	32483 9	39468 1	33781 6	38617 5	35099 4	37786 5	28
33	29971 3	41216 2	31227 9	40324 4	32505 3	39453 8	33803 4	38603 5	35121 6	37772 8	27
34	29992 1	41201 1	31249 0	40309 7	32526 8	39439 4	33825 2	38589 5	35143 7	37759 1	26
35	30012 9	41186 1	31270 1	40295 0	32548 3	39425 1	33847 0	38575 5	35165 9	37745 4	25
36	30033 7	41171 1	31291 2	40280 4	32569 8	39410 8	33868 8	38561 5	35188 0	37731 8	24
37	30054 5	41156 1	31312 4	40265 7	32591 2	39396 5	33890 6	38547 5	35210 2	37718 1	23
38	30075 2	41141 0	31333 5	40251 0	32612 7	39382 1	33912 5	38533 5	35232 3	37704 4	22
39	30096 0	41126 0	31354 7	40236 4	32634 2	39367 8	33934 3	38519 6	35254 5	37690 8	21
40	30116 8	41111 0	31375 8	40221 7	32655 7	39353 5	33956 1	38505 6	35276 7	37677 1	20
41	30137 7	41096 0	31397 0	40207 1	32677 2	39339 2	33978 0	38491 6	35298 8	37663 5	19
42	30158 5	41081 0	31418 2	40192 5	32698 7	39324 9	33999 8	38477 7	35321 0	37649 8	18
43	30179 3	41066 0	31439 3	40177 8	32720 3	39310 7	34021 7	38463 7	35343 2	37636 2	17
44	30200 1	41051 1	31460 5	40163 2	32741 8	39296 4	34043 5	38449 8	35365 4	37622 6	16
45	30221 0	41036 1	31481 7	40148 6	32763 3	39282 1	34065 4	38435 8	35387 6	37608 9	15
46	30241 8	41021 1	31502 9	40134 0	32784 9	39267 8	34087 3	38421 9	35409 8	37595 3	14
47	30262 6	41006 2	31524 1	40119 4	32806 4	39253 6	34109 2	38407 9	35432 0	37581 7	13
48	30283 5	40991 2	31545 3	40104 8	32827 9	39239 3	34131 0	38394 0	35454 2	37568 1	12
49	30304 3	40976 3	31566 5	40090 2	32849 5	39225 1	34152 9	38380 1	35476 4	37554 5	11
50	30325 2	40961 3	31587 7	40075 6	32871 0	39210 8	34174 8	38366 2	35498 7	37540 9	10
51	30346 1	40946 4	31608 9	40061 0	32892 6	39196 6	34196 7	38352 3	35520 9	37527 3	9
52	30367 0	40931 4	31630 2	40046 4	32914 2	39182 3	34218 6	38338 4	35543 1	37513 7	8
53	30387 8	40916 5	31651 4	40031 9	32935 8	39168 1	34240 6	38324 5	35565 4	37500 1	7
54	30408 7	40901 6	31672 6	40017 3	32957 3	39153 9	34262 5	38310 6	35587 6	37486 5	6
55	30429 6	40886 7	31693 9	40002 7	32978 9	39139 7	34284 4	38296 7	35609 9	37473 0	5
56	30450 5	40871 8	31715 1	39988 2	33000 5	39125 5	34306 3	38282 8	35632 1	37459 4	4
57	30471 4	40856 9	31736 4	39973 6	33022 1	39111 3	34328 3	38268 9	35654 4	37445 8	3
58	30492 3	40842 0	31757 6	39959 1	33043 7	39097 1	34350 2	38255 0	35676 7	37432 3	2
59	30513 2	40827 1	31778 9	39944 6	33065 3	39082 9	34372 1	38241 1	35699 0	37418 7	1
60	30534 2	40812 2	31800 2	39930 0	33086 9	39068 7	34394 1	38227 3	35721 2	37405 2	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	44°	314°	43°	313°	42°	312°	41°	311°	40°	310°	

/	50°		51°		52°		53°		54°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	35721	2 37405	2 37068	0 36601	6 38433	9 35815	8 39818	5 35047	3 41221	5 34295	3 60
1	35743	5 37391	6 37090	6 36588	3 38456	8 35802	9 39841	7 35034	6 41245	0 34282	9 59
2	35765	8 37378	1 37113	2 36575	1 38479	7 35789	9 39865	0 35021	9 41268	5 34270	5 54
3	35788	1 37364	6 37135	8 36561	9 38502	6 35777	0 39888	2 35009	3 41292	1 34258	2 57
4	35810	4 37351	0 37158	4 36548	6 38525	6 35764	0 39911	5 34996	6 41315	6 34245	8 56
5	35832	7 37337	5 37181	1 36535	4 38548	5 35751	1 39934	7 34984	0 41339	2 34233	4 55
6	35855	0 37324	0 37203	7 36522	2 38571	5 35738	2 39958	0 34971	3 41362	8 34221	0 54
7	35877	4 37310	5 37226	3 36509	0 38594	4 35725	3 39981	2 34958	7 41386	3 34208	7 53
8	35899	7 37297	0 37249	0 36495	8 38617	4 35712	3 40004	5 34946	1 41409	9 34196	3 52
9	35922	0 37283	5 37271	6 36482	6 38640	4 35699	4 40027	8 34933	4 41433	5 34183	9 51
10	35944	3 37270	0 37294	3 36469	4 38663	3 35686	5 40051	1 34920	8 41457	1 34171	6 50
11	35966	7 37256	5 37317	0 36456	2 38686	3 35673	6 40074	4 34908	2 41480	6 34159	2 49
12	35989	0 37243	0 37339	6 36443	0 38709	3 35660	7 40097	6 34895	6 41504	2 34146	9 48
13	36011	4 37229	5 37362	3 36429	8 38732	3 35647	8 40120	9 34882	9 41527	8 34134	5 47
14	36033	7 37216	0 37385	0 36416	6 38755	3 35635	0 40144	2 34870	3 41551	4 34122	2 46
15	36056	1 37202	6 37407	7 36403	5 38778	3 35622	1 40167	5 34857	7 41575	0 34109	9 45
16	36078	5 37189	1 37430	3 36390	3 38801	3 35609	2 40190	8 34845	1 41598	6 34097	5 44
17	36100	8 37175	6 37453	0 36377	1 38824	3 35596	3 40214	2 34832	5 41622	3 34085	2 43
18	36123	2 37162	2 37475	7 36364	0 38847	3 35583	5 40237	5 34820	0 41645	9 34072	9 42
19	36145	6 37148	7 37498	4 36350	8 38870	3 35570	6 40260	8 34807	4 41669	5 34060	6 41
20	36168	0 37135	3 37521	1 36337	7 38893	3 35557	7 40284	1 34794	8 41693	1 34048	3 40
21	36190	4 37121	8 37543	9 36324	6 38916	4 35544	9 40307	5 34782	2 41716	8 34036	0 39
22	36212	8 37108	4 37566	6 36311	4 38939	4 35532	0 40330	8 34769	6 41740	4 34023	7 38
23	36235	2 37095	0 37589	3 36298	3 38962	4 35519	2 40354	2 34757	1 41764	0 34011	7 37
24	36257	6 37081	5 37612	0 36285	2 38985	5 35506	4 40377	5 34744	5 41787	7 33999	1 36
25	36280	0 37068	1 37634	8 36272	0 39008	5 35493	5 40400	9 34732	0 41811	4 33986	8 35
26	36302	4 37054	7 37657	5 36258	9 39031	6 35480	7 40424	2 34719	4 41835	0 33974	5 34
27	36324	9 37041	3 37680	3 36245	8 39054	6 35467	9 40447	6 34706	9 41858	7 33962	2 33
28	36347	3 37027	9 37703	0 36232	7 39077	7 35455	0 40471	0 34694	3 41882	4 33949	9 32
29	36369	7 37014	5 37725	8 36219	6 39100	8 35442	2 40494	3 34681	8 41906	0 33937	7 31
30	36392	2 37001	1 37748	5 36206	5 39123	9 35429	4 40517	7 34669	4 41929	7 33925	4 30
31	36414	6 36987	7 37771	3 36193	4 39146	6 35416	6 40541	1 34656	7 41953	4 33913	1 29
32	36437	1 36974	3 37794	1 36180	3 39170	0 35403	8 40564	5 34644	2 41977	1 33900	8 28
33	36459	5 36960	9 37816	9 36167	2 39193	1 35391	0 40587	9 34631	7 42000	8 33888	6 27
34	36482	0 36947	6 37839	6 36154	2 39216	2 35378	2 40611	3 34619	2 42024	5 33876	4 26
35	36504	5 36934	2 37862	4 36141	1 39239	3 35365	4 40634	7 34606	6 42048	2 33864	1 25
36	36526	9 36920	8 37885	2 36128	0 39262	4 35352	6 40658	1 34594	1 42071	9 33851	9 24
37	36549	4 36907	5 37908	0 36114	9 39285	5 35339	9 40681	5 34581	6 42095	6 33839	7 23
38	36571	9 36894	1 37930	8 36101	9 39308	6 35327	1 40704	9 34569	1 42119	3 33827	4 22
39	36594	4 36880	8 37953	6 36088	8 39331	8 35314	3 40728	4 34556	6 42143	0 33815	2 21
40	36616	9 36867	4 37976	5 36075	8 39354	9 35301	6 40751	8 34544	2 42166	8 33803	0 20
41	36639	4 36854	1 37999	3 36062	7 39378	0 35288	8 40775	2 34531	7 42190	5 33790	8 19
42	36661	9 36840	7 38022	1 36049	7 39401	2 35276	0 40798	7 34519	2 42214	2 33778	6 18
43	36684	4 36827	4 38044	9 36036	7 39424	3 35263	3 40822	1 34506	7 42238	0 33766	3 17
44	36706	9 36814	1 38067	8 36023	6 39447	4 35250	6 40845	6 34494	2 42261	7 33754	1 16
45	36729	5 36800	8 38090	6 36010	6 39470	6 35237	8 40869	0 34481	8 42285	5 33741	9 15
46	36752	0 36787	5 38113	5 35997	6 39493	8 35225	1 40892	5 34469	3 42309	2 33729	7 14
47	36774	5 36774	1 38136	3 35984	6 39516	9 35212	3 40916	0 34456	9 42333	0 33717	5 13
48	36797	1 36760	8 38159	2 35971	6 39540	1 35199	6 40939	4 34444	4 42356	8 33705	4 12
49	36819	6 36747	5 38182	0 35958	6 39563	3 35186	9 40962	9 34432	0 42380	5 33693	2 11
50	36842	2 36734	2 38204	9 35945	6 39586	4 35174	2 40986	4 34419	5 42404	3 33681	0 10
51	36864	7 36721	0 38227	8 35932	6 39609	6 35161	5 41009	9 34407	1 42428	1 33668	8 9
52	36887	3 36707	7 38250	6 35919	6 39632	8 35148	8 41033	4 34394	6 42451	9 33656	7 8
53	36909	8 36694	4 38273	5 35906	6 39656	0 35136	1 41056	9 34382	2 42475	7 33644	5 7
54	36932	4 36681	1 38296	4 35893	6 39679	2 35123	4 41080	4 34369	8 42499	5 33632	3 6
55	36955	0 36667	8 38319	3 35880	6 39702	4 35110	7 41103	9 34357	4 42523	3 33620	2 5
56	36977	6 36654	2 38342	2 35867	6 39725	6 35098	0 41127	4 34344	9 42547	1 33608	0 4
57	37000	2 36641	3 38365	1 35854	7 39748	8 35085	3 41150	9 34332	5 42570	9 33595	9 3
58	37022	8 36628	1 38388	0 35841	7 39772	0 35072	6 41174	4 34320	1 42594	7 33583	7 2
59	37045	4 36614	8 38410	9 35828	8 39795	3 35059	9 41197	9 34307	7 42618	5 33571	6 1
60	37068	0 36601	6 38433	9 35815	8 39818	5 35047	3 41221	5 34295	3 42642	4 33559	4 0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	39°	309°	38°	308°	37°	307°	36°	306°	35°	305°	

	55°		56°		57°		58°		59°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	42642 4	33559 4	44080 7	32839 1	45536 1	32133 7	47008 1	31442 9	48496 2	30766 1	60
1	42666 2	33547 3	44104 8	32827 2	45560 5	32122 1	47032 7	31431 5	48521 1	30755 0	59
2	42690 0	33535 2	44129 0	32815 3	45584 8	32110 5	47057 4	31420 1	48546 1	30743 8	58
3	42713 9	33523 1	44153 1	32803 5	45609 3	32098 8	47082 1	31408 7	48571 0	30732 6	57
4	42737 7	33510 9	44177 2	32791 6	45633 7	32087 2	47106 8	31397 3	48596 0	30721 5	56
5	42761 6	33498 8	44201 3	32779 7	45658 1	32075 6	47131 5	31385 9	48620 9	30710 3	55
6	42785 4	33486 7	44225 5	32767 9	45682 6	32064 0	47156 2	31374 6	48645 9	30699 2	54
7	42809 3	33474 6	44249 6	32756 0	45707 0	32052 4	47180 9	31363 2	48670 8	30688 1	53
8	42833 1	33462 5	44273 8	32744 2	45731 4	32040 8	47205 6	31351 8	48695 8	30676 9	52
9	42857 0	33450 4	44297 9	32732 3	45755 8	32029 2	47230 3	31340 5	48720 8	30665 8	51
10	42880 9	33438 3	44321 1	32720 5	45780 3	32017 6	47255 0	31329 1	48745 7	30654 7	50
11	42904 8	33426 2	44346 3	32708 6	45804 7	32006 0	47279 7	31317 8	48770 7	30643 5	49
12	42928 6	33414 1	44370 4	32696 8	45829 2	31994 4	47304 4	31306 4	48795 7	30632 4	48
13	42952 5	33402 1	44394 6	32685 0	45853 6	31982 8	47329 1	31295 1	48820 7	30621 3	47
14	42976 4	33390 0	44418 8	32673 2	45878 1	31971 2	47353 9	31283 7	48845 7	30610 2	46
15	43000 3	33377 9	44443 0	32661 3	45902 5	31959 7	47378 6	31272 4	48870 7	30599 1	45
16	43024 2	33365 8	44467 2	32649 5	45927 0	31948 1	47403 3	31261 1	48895 7	30588 0	44
17	43048 1	33353 8	44491 4	32637 7	45951 5	31936 5	47428 1	31249 7	48920 7	30576 9	43
18	43072 0	33341 7	44515 6	32625 5	45976 0	31925 0	47452 8	31238 4	48945 7	30565 8	42
19	43096 0	33329 7	44539 8	32614 1	46000 4	31913 4	47477 6	31227 1	48970 7	30554 7	41
20	43119 9	33317 6	44564 0	32602 3	46024 9	31901 8	47502 3	31215 7	48995 7	30543 6	40
21	43143 8	33305 6	44588 2	32590 5	46049 4	31890 3	47527 1	31204 4	49020 8	30532 5	39
22	43167 7	33293 5	44612 4	32578 7	46073 9	31878 7	47551 9	31193 1	49045 8	30521 4	38
23	43191 7	33281 5	44636 6	32566 9	46098 4	31867 2	47576 6	31181 8	49070 8	30510 3	37
24	43215 6	33269 5	44660 8	32555 2	46122 9	31855 7	47601 4	31170 5	49095 9	30499 3	36
25	43239 6	33257 4	44685 1	32543 4	46147 4	31844 1	47626 2	31159 2	49120 9	30488 2	35
26	43263 5	33245 4	44709 3	32531 6	46171 9	31832 6	47651 0	31147 9	49145 9	30477 1	34
27	43287 5	33233 4	44733 6	32519 8	46196 5	31821 1	47675 8	31136 6	49171 0	30466 1	33
28	43311 4	33221 4	44757 8	32508 1	46221 0	31809 5	47700 5	31125 3	49196 0	30455 0	32
29	43335 4	33209 4	44782 0	32496 3	46245 5	31798 0	47725 3	31114 0	49221 1	30443 9	31
30	43359 4	33197 3	44806 3	32484 5	46270 0	31786 5	47750 1	31102 8	49246 2	30432 9	30
31	43383 4	33185 3	44830 6	32472 8	46294 6	31775 0	47774 9	31091 5	49271 2	30421 8	29
32	43407 3	33173 3	44854 8	32461 0	46319 1	31763 5	47799 8	31080 2	49296 3	30410 8	28
33	43431 3	33161 4	44879 1	32449 3	46343 7	31752 0	47824 6	31068 9	49321 4	30399 7	27
34	43455 3	33149 4	44903 4	32437 6	46368 2	31740 5	47849 4	31057 7	49346 4	30388 7	26
35	43479 3	33137 4	44927 6	32425 8	46392 8	31729 0	47874 2	31046 4	49371 5	30377 7	25
36	43503 3	33125 4	44951 9	32414 1	46417 3	31717 5	47899 0	31035 2	49396 6	30366 6	24
37	43527 3	33113 4	44976 2	32402 4	46441 9	31706 0	47923 9	31023 9	49421 7	30355 6	23
38	43551 3	33101 4	45000 5	32390 6	46466 4	31694 5	47948 7	31012 7	49446 8	30344 6	22
39	43575 3	33089 5	45024 8	32378 9	46491 0	31683 0	47973 5	31001 4	49471 9	30333 6	21
40	43599 3	33077 5	45049 1	32367 2	46515 6	31671 6	47998 4	30990 2	49497 0	30322 5	20
41	43623 4	33065 5	45073 4	32355 5	46540 2	31660 1	48023 2	30978 9	49522 1	30311 5	19
42	43647 4	33053 6	45097 7	32343 8	46564 8	31648 6	48048 1	30967 7	49547 2	30300 5	18
43	43671 4	33041 6	45122 0	32332 1	46589 3	31637 2	48072 9	30956 5	49572 3	30289 5	17
44	43695 5	33029 7	45146 4	32320 4	46613 9	31625 7	48097 8	30945 2	49597 5	30278 5	16
45	43719 5	33017 7	45170 7	32308 7	46638 5	31614 2	48122 7	30934 0	49622 6	30267 5	15
46	43743 6	33005 8	45195 0	32297 0	46663 1	31602 8	48147 5	30922 8	49647 7	30256 5	14
47	43767 6	32993 9	45219 3	32285 3	46687 8	31591 3	48172 4	30911 6	49672 9	30245 5	13
48	43791 7	32981 9	45243 6	32273 6	46712 4	31579 9	48197 3	30900 4	49698 0	30234 6	12
49	43815 7	32970 0	45268 0	32261 9	46737 0	31568 5	48222 2	30889 2	49723 1	30223 6	11
50	43839 8	32958 1	45292 4	32250 2	46761 6	31557 0	48247 1	30878 0	49748 3	30212 6	10
51	43863 9	32946 2	45316 7	32238 6	46786 2	31545 6	48272 0	30866 8	49773 4	30201 6	9
52	43887 9	32934 3	45341 1	32227 0	46810 9	31534 2	48296 9	30855 6	49798 6	30190 6	8
53	43912 0	32922 3	45365 4	32215 2	46835 5	31522 7	48321 8	30844 4	49823 8	30179 7	7
54	43936 1	32910 4	45389 8	32203 6	46860 1	31511 3	48346 7	30833 2	49848 9	30168 7	6
55	43960 2	32898 5	45414 2	32191 9	46884 8	31499 9	48371 6	30822 0	49874 1	30157 7	5
56	43984 3	32886 6	45438 5	32180 3	46909 4	31488 5	48396 5	30810 8	49899 3	30146 8	4
57	44008 4	32874 7	45462 9	32168 6	46934 1	31477 1	48421 4	30799 6	49924 4	30135 8	3
58	44032 5	32862 8	45487 3	32157 0	46958 7	31465 7	48446 3	30788 5	49949 6	30124 9	2
59	44056 6	32851 0	45511 7	32145 3	46983 4	31454 3	48471 3	30777 3	49974 8	30113 9	1
60	44080 7	32839 1	45536 1	32133 7	47008 1	31442 9	48496 2	30766 1	50000 0	30103 0	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	34°	304°	33°	303°	32°	302°	31°	301°	30°	300°	

	60°		61°		62°		63°		64		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	50000 0	30103 0	51519 0	29453 1	53052 8	28816 1	54600 9	28191 5	56162 9	27579 0	60
1	50025 2	30092 1	51544 5	29442 4	53078 5	28805 6	54626 9	28181 2	56189 0	27568 9	59
2	50050 4	30081 1	51569 9	29431 7	53104 2	28795 0	54652 8	28170 9	56215 2	27558 8	58
3	50075 6	30070 2	51595 4	29421 0	53129 9	28784 5	54678 7	28160 6	56241 3	27548 7	57
4	50100 8	30059 3	51620 8	29410 2	53155 6	28774 0	54704 6	28150 3	56267 5	27538 6	56
5	50126 0	30048 3	51646 3	29399 5	53181 3	28763 5	54730 6	28140 0	56293 7	27528 5	55
6	50151 2	30037 4	51671 8	29388 8	53207 0	28753 1	54756 5	28129 7	56319 8	27518 4	54
7	50176 4	30026 5	51697 2	29378 1	53232 7	28742 6	54782 5	28119 4	56346 0	27508 3	53
8	50201 7	30015 6	51722 7	29367 4	53258 4	28732 1	54808 4	28109 1	56372 2	27498 3	52
9	50226 9	30004 7	51748 2	29356 7	53284 2	28721 6	54834 4	28098 9	56398 3	27488 2	51
10	50252 1	29993 8	51773 7	29346 1	53309 9	28711 1	54860 3	28088 6	56424 5	27478 1	50
11	50277 4	29982 9	51799 1	29335 4	53335 6	28700 6	54886 3	28078 3	56450 7	27468 0	49
12	50302 6	29972 0	51824 6	29324 7	53361 3	28690 2	54912 2	28068 0	56476 9	27458 0	48
13	50327 8	29961 1	51850 1	29314 0	53387 1	28679 7	54938 2	28057 8	56503 1	27447 9	47
14	50353 1	29950 2	51875 6	29303 3	53412 8	28669 2	54964 2	28047 5	56529 3	27437 8	46
15	50378 3	29939 3	51901 1	29292 7	53438 5	28658 8	54990 2	28037 2	56555 5	27427 8	45
16	50403 6	29928 4	51926 6	29282 0	53464 3	28648 3	55016 1	28027 0	56581 7	27417 7	44
17	50428 9	29917 5	51952 1	29271 3	53490 0	28637 9	55042 1	28016 7	56607 9	27407 6	43
18	50454 1	29906 7	51977 6	29260 7	53515 8	28627 4	55068 1	28006 5	56634 1	27397 6	42
19	50479 4	29895 8	52003 2	29250 0	53541 5	28616 9	55094 1	27996 2	56660 3	27387 5	41
20	50504 7	29884 9	52028 7	29239 4	53567 3	28606 5	55120 1	27986 0	56686 5	27377 5	40
21	50529 9	29874 1	52054 2	29228 7	53593 1	28596 1	55146 1	27975 8	56712 7	27367 5	39
22	50555 2	29863 2	52079 7	29218 1	53618 8	28585 6	55172 1	27965 5	56739 0	27357 4	38
23	50580 5	29852 3	52105 3	29207 4	53644 6	28575 2	55198 1	27955 3	56765 2	27347 4	37
24	50605 8	29841 5	52130 8	29196 8	53670 4	28564 8	55224 1	27945 1	56791 4	27337 4	36
25	50631 1	29830 6	52156 4	29186 1	53696 2	28554 3	55250 1	27934 8	56817 7	27327 3	35
26	50656 4	29819 8	52181 9	29175 5	53722 0	28543 9	55276 1	27924 6	56843 9	27317 3	34
27	50681 7	29808 9	52207 4	29164 9	53747 7	28533 5	55302 1	27914 4	56870 1	27307 3	33
28	50707 0	29798 1	52233 0	29154 2	53773 5	28523 1	55328 2	27904 2	56896 4	27297 3	32
29	50732 3	29787 3	52258 6	29143 6	53799 3	28512 7	55354 2	27894 0	56922 6	27287 2	31
30	50757 6	29776 4	52284 1	29133 0	53825 1	28502 2	55380 2	27883 8	56948 9	27277 2	30
31	50783 0	29765 6	52309 7	29122 4	53850 9	28491 8	55406 2	27873 6	56975 1	27267 2	29
32	50808 3	29754 8	52335 3	29111 8	53876 7	28481 4	55432 3	27863 4	57001 4	27257 2	28
33	50833 6	29743 9	52360 8	29101 2	53902 6	28471 0	55458 3	27853 2	57027 7	27247 2	27
34	50858 9	29733 1	52386 4	29090 6	53928 4	28460 6	55484 4	27843 0	57053 9	27237 2	26
35	50884 3	29722 3	52412 0	29080 0	53954 2	28450 2	55510 4	27832 8	57080 2	27227 2	25
36	50909 6	29711 5	52437 6	29069 4	53980 0	28439 8	55536 5	27822 6	57106 5	27217 2	24
37	50935 0	29700 7	52463 2	29058 8	54005 8	28429 5	55562 6	27812 4	57132 8	27207 2	23
38	50960 3	29689 9	52488 8	29048 2	54031 7	28419 1	55588 6	27802 2	57159 0	27197 2	22
39	50985 7	29679 1	52514 4	29037 6	54057 5	28408 7	55614 7	27792 0	57185 3	27187 3	21
40	51011 0	29668 3	52540 0	29027 0	54083 3	28398 3	55640 7	27781 9	57211 6	27177 3	20
41	51036 4	29657 5	52565 6	29016 4	54109 2	28387 9	55666 8	27771 7	57237 9	27167 3	19
42	51061 7	29646 7	52591 2	29005 9	54135 0	28377 6	55692 9	27761 5	57264 2	27157 3	18
43	51087 1	29635 9	52616 8	28995 3	54160 9	28367 2	55719 0	27751 3	57290 5	27147 4	17
44	51112 5	29625 1	52642 4	28984 7	54186 7	28356 8	55745 0	27741 2	57316 8	27137 4	16
45	51137 9	29614 4	52668 0	28974 1	54212 6	28346 5	55771 1	27731 0	57343 1	27127 4	15
46	51163 3	29603 6	52693 7	28963 6	54238 5	28336 1	55797 2	27720 9	57369 4	27117 5	14
47	51188 6	29592 8	52719 3	28953 0	54264 3	28325 8	55823 3	27710 7	57395 7	27107 5	13
48	51214 0	29582 1	52744 9	28942 5	54290 2	28315 4	55849 4	27700 6	57422 2	27097 6	12
49	51239 4	29571 3	52770 6	28931 9	54316 1	28305 1	55875 5	27690 4	57448 4	27087 6	11
50	51264 8	29560 5	52796 2	28921 4	54342 0	28294 7	55901 6	27680 3	57474 7	27077 7	10
51	51290 2	29549 8	52821 8	28910 8	54367 8	28284 4	55927 7	27670 1	57501 0	27067 7	9
52	51315 6	29539 0	52847 4	28899 3	54393 7	28274 1	55953 8	27660 0	57527 4	27057 8	8
53	51341 0	29528 3	52873 1	28889 7	54419 6	28263 7	55980 0	27649 9	57553 7	27047 8	7
54	51366 5	29517 5	52898 8	28879 2	54445 5	28253 4	56006 1	27639 7	57580 1	27037 9	6
55	51391 9	29506 8	52924 5	28868 7	54471 4	28243 1	56032 2	27629 6	57606 4	27028 0	5
56	51417 3	29496 0	52950 1	28858 1	54497 3	28232 7	56058 3	27619 5	57632 7	27018 0	4
57	51442 7	29485 3	52975 8	28847 6	54523 2	28222 4	56084 5	27609 4	57659 1	27008 1	3
58	51468 2	29474 6	53001 5	28837 1	54549 1	28212 1	56110 6	27599 3	57685 4	26998 2	2
59	51493 6	29463 8	53027 2	28826 6	54575 0	28201 8	56136 7	27589 1	57711 8	26988 3	1
60	51519 0	29453 1	53052 8	28816 1	54600 9	28191 5	56162 9	27579 0	57738 2	26978 4	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	29°	299°	28°	298°	27°	297°	26°	296°	25°	295°	

	65°		66°		67°		68°		69°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	57738 2	26978 3	59326 3	26389 1	60926 9	25811 1	62539 3	25243 8	64163 2	24687 2	60
1	57764 5	26968 4	59352 9	26379 4	60953 7	25801 5	62566 3	25234 5	64190 4	24678 0	59
2	57790 9	26958 5	59379 5	26369 7	60980 4	25792 0	62593 3	25225 1	64217 5	24668 8	58
3	57817 3	26948 6	59406 1	26360 0	61007 2	25782 4	62620 3	25215 8	64244 7	24659 6	57
4	57843 7	26938 7	59432 7	26350 2	61034 0	25772 9	62647 2	25206 4	64271 9	24650 5	56
5	57870 0	26928 8	59459 2	26340 5	61060 8	25763 4	62674 2	25197 0	64299 0	24641 3	55
6	57896 4	26918 9	59485 8	26330 8	61087 6	25753 8	62701 2	25187 7	64326 2	24632 1	54
7	57922 8	26909 0	59512 4	26321 1	61114 4	25744 3	62728 2	25178 4	64353 4	24622 9	53
8	57949 2	26899 1	59539 0	26311 4	61141 2	25734 8	62755 2	25169 0	64380 6	24613 8	52
9	57975 6	26889 2	59565 6	26301 7	61168 0	25725 3	62782 2	25159 7	64407 7	24604 6	51
10	58002 0	26879 4	59592 2	26292 0	61194 8	25715 8	62809 2	25150 3	64434 9	24595 4	50
11	58028 4	26869 5	59618 9	26282 3	61221 6	25706 3	62836 2	25141 0	64462 1	24586 3	49
12	58054 8	26859 5	59645 5	26272 6	61248 4	25696 7	62863 2	25131 7	64489 3	24577 1	48
13	58081 2	26849 7	59672 1	26262 9	61275 3	25687 2	62890 2	25122 3	64516 5	24568 0	47
14	58107 6	26839 8	59698 7	26253 3	61302 1	25677 7	62917 2	25113 0	64543 7	24558 8	46
15	58134 0	26830 0	59725 3	26243 6	61328 9	25668 2	62944 3	25103 7	64570 9	24549 7	45
16	58160 4	26820 1	59752 0	26233 9	61355 7	25658 7	62971 3	25094 4	64598 1	24540 5	44
17	58186 9	26810 2	59778 6	26224 2	61382 6	25649 2	62998 3	25085 1	64625 3	24531 4	43
18	58213 3	26800 4	59805 2	26214 5	61409 4	25639 8	63025 3	25075 7	64652 5	24522 2	42
19	58239 7	26790 5	59831 9	26204 9	61436 2	25630 3	63052 3	25066 4	64679 7	24513 1	41
20	58266 1	26780 7	59858 5	26195 2	61463 1	25620 8	63079 4	25057 1	64706 9	24504 0	40
21	58292 6	26770 8	59885 1	26185 5	61489 9	25611 3	63106 4	25047 8	64734 2	24494 8	39
22	58319 0	26761 0	59911 8	26175 9	61516 8	25601 8	63133 5	25038 5	64761 4	24485 7	38
23	58345 5	26751 1	59938 4	26166 2	61543 6	25592 3	63160 5	25029 2	64788 6	24476 6	37
24	58371 9	26741 3	59965 1	26156 6	61570 5	25582 9	63187 5	25019 9	64815 8	24467 4	36
25	58398 4	26731 5	59991 7	26146 9	61597 3	25573 4	63214 6	25010 6	64843 1	24458 3	35
26	58424 8	26721 6	60018 4	26137 3	61624 2	25563 9	63241 6	25001 3	64870 3	24449 2	34
27	58451 3	26711 8	60045 1	26127 6	61651 0	25554 5	63268 7	24992 1	64897 5	24440 1	33
28	58477 7	26702 0	60071 7	26118 0	61677 9	25545 0	63295 7	24982 8	64924 8	24431 0	32
29	58504 2	26692 1	60098 4	26108 3	61704 8	25535 6	63322 8	24973 5	64952 0	24421 9	31
30	58530 6	26682 3	60125 1	26098 7	61731 7	25526 1	63349 9	24964 2	64979 3	24412 8	30
31	58557 1	26672 5	60151 8	26089 1	61758 5	25516 7	63376 9	24954 9	65006 5	24403 7	29
32	58583 6	26662 7	60178 4	26079 4	61785 4	25507 2	63404 0	24945 7	65033 8	24394 6	28
33	58610 1	26652 9	60205 1	26069 8	61812 3	25497 8	63431 1	24936 4	65061 0	24385 5	27
34	58636 6	26643 1	60231 8	26060 2	61839 2	25488 3	63458 2	24927 1	65088 3	24376 4	26
35	58663 1	26633 3	60258 5	26050 6	61866 1	25478 9	63485 2	24917 9	65115 5	24367 3	25
36	58689 6	26623 5	60285 2	26041 0	61893 0	25469 4	63512 3	24908 6	65142 8	24358 2	24
37	58716 0	26613 7	60311 9	26031 3	61919 9	25460 0	63539 4	24899 3	65170 1	24349 1	23
38	58742 5	26603 9	60338 6	26021 7	61946 8	25450 6	63566 5	24890 1	65197 3	24340 0	22
39	58769 0	26594 1	60365 3	26012 1	61973 7	25441 1	63593 6	24880 8	65224 6	24330 9	21
40	58795 5	26584 3	60392 0	26002 5	62000 6	25431 7	63620 7	24871 6	65251 9	24321 8	20
41	58822 0	26574 5	60418 7	25992 9	62027 5	25422 3	63647 8	24862 3	65279 1	24312 8	19
42	58848 6	26564 7	60445 4	25983 3	62054 4	25412 9	63674 9	24853 1	65306 4	24303 7	18
43	58875 1	26554 9	60472 2	25973 7	62081 3	25403 5	63702 0	24843 9	65333 7	24294 6	17
44	58901 6	26545 1	60498 9	25964 1	62108 2	25394 0	63729 1	24834 6	65361 0	24285 6	16
45	58928 1	26535 4	60525 6	25954 5	62135 1	25384 6	63756 2	24825 4	65388 3	24276 5	15
46	58954 6	26525 6	60552 3	25945 0	62162 1	25375 2	63783 3	24816 1	65415 6	24267 4	14
47	58981 1	26515 8	60579 1	25935 4	62189 0	25365 8	63810 4	24806 9	65442 9	24258 3	13
48	59007 7	26506 1	60605 8	25925 8	62215 9	25356 4	63837 5	24797 7	65470 2	24249 3	12
49	59034 2	26496 3	60632 5	25916 2	62242 9	25347 0	63864 7	24788 5	65497 5	24240 3	11
50	59060 8	26486 5	60659 3	25906 6	62269 8	25337 6	63891 8	24779 2	65524 8	24231 2	10
51	59087 3	26476 8	60686 0	25897 0	62296 7	25328 2	63918 9	24770 0	65552 1	24222 2	9
52	59113 8	26467 0	60712 8	25887 5	62323 7	25318 8	63946 0	24760 8	65579 4	24213 1	8
53	59140 4	26457 3	60739 5	25877 9	62350 6	25309 5	63973 2	24751 6	65606 7	24204 1	7
54	59166 9	26447 5	60766 3	25868 4	62377 6	25300 1	64000 3	24742 4	65634 0	24195 0	6
55	59193 5	26437 8	60793 0	25858 8	62404 5	25290 7	64027 5	24733 2	65661 3	24186 0	5
56	59220 1	26428 1	60819 8	25849 2	62431 5	25281 3	64054 6	24724 0	65688 7	24177 0	4
57	59246 6	26418 3	60846 6	25839 7	62458 4	25271 9	64081 7	24714 8	65716 0	24167 9	3
58	59273 2	26408 6	60873 3	25830 1	62485 4	25262 6	64108 9	24705 6	65743 3	24158 9	2
59	59299 8	26398 9	60900 1	25820 6	62512 4	25253 2	64136 0	24696 4	65770 6	24149 9	1
60	59326 3	26389 1	60926 9	25811 1	62539 3	25243 8	64163 2	24687 2	65798 0	24140 9	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	24°	294°	23°	293°	22°	292°	21°	291°	20°	290°	

°	70°		71°		72°		73°		74°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	65798 0	24140 9	67443 2	23604 6	69098 3	23078 1	70762 8	22561 2	72436 3	22053 7	60
1	65825 3	24131 9	67470 7	23595 7	69126 0	23069 4	70790 6	22552 7	72464 2	22045 3	59
2	65852 7	24122 8	67498 2	23586 9	69153 6	23060 7	70818 5	22544 2	72492 2	22036 9	58
3	65880 0	24113 8	67525 7	23578 0	69181 3	23052 1	70846 3	22535 6	72520 2	22028 6	57
4	65907 3	24104 8	67553 2	23569 2	69209 0	23043 4	70874 1	22527 1	72548 1	22020 2	56
5	65934 7	24095 8	67580 7	23560 4	69236 7	23034 7	70901 9	22518 6	72576 1	22011 8	55
6	65962 0	24086 8	67608 3	23551 5	69264 3	23026 0	70929 8	22510 1	72604 1	22003 4	54
7	65989 4	24077 8	67635 8	23542 7	69292 0	23017 3	70957 6	22501 5	72632 1	21995 1	53
8	66016 7	24068 8	67663 3	23533 8	69319 7	23008 7	70985 4	22493 0	72660 0	21987 6	52
9	66044 1	24059 8	67690 8	23525 0	69347 4	23000 0	71013 3	22484 5	72688 0	21978 4	51
10	66071 5	24050 8	67718 4	23516 2	69375 1	22991 3	71041 1	22476 0	72716 0	21970 0	50
11	66098 8	24041 8	67745 9	23507 4	69402 8	22982 7	71069 0	22467 5	72744 0	21961 6	49
12	66126 2	24032 8	67773 4	23498 5	69430 5	22974 0	71096 8	22459 0	72772 0	21953 3	48
13	66153 6	24023 8	67801 0	23489 7	69458 2	22965 3	71124 7	22450 5	72800 0	21944 9	47
14	66180 9	24014 8	67828 5	23480 9	69485 9	22956 7	71152 5	22442 0	72828 0	21936 6	46
15	66208 3	24005 9	67856 0	23472 1	69513 6	22948 0	71180 4	22433 5	72856 0	21928 2	45
16	66235 7	23996 9	67883 6	23463 3	69541 3	22939 4	71208 2	22425 0	72883 9	21919 9	44
17	66263 1	23987 9	67911 1	23454 4	69569 0	22930 7	71236 1	22416 5	72911 9	21911 6	43
18	66290 5	23978 9	67938 7	23445 6	69596 7	22922 1	71263 9	22408 0	72940 0	21903 2	42
19	66317 9	23970 0	67966 3	23436 8	69624 4	22913 4	71291 8	22399 5	72968 0	21894 9	41
20	66345 2	23961 0	67993 8	23428 0	69652 1	22904 8	71319 7	22391 0	72996 0	21886 6	40
21	66372 6	23952 0	68021 4	23419 2	69679 8	22896 1	71347 5	22382 5	73024 0	21878 2	39
22	66400 0	23943 1	68048 9	23410 4	69707 6	22887 5	71375 4	22374 1	73052 0	21869 9	38
23	66427 4	23934 1	68076 5	23401 6	69735 3	22878 9	71403 3	22365 6	73080 0	21861 6	37
24	66454 8	23925 2	68104 1	23392 8	69763 0	22870 2	71431 2	22357 1	73108 0	21853 2	36
25	66482 2	23916 2	68131 6	23384 1	69790 7	22861 6	71459 0	22348 6	73136 0	21844 9	35
26	66509 7	23907 3	68159 2	23375 3	69818 5	22853 0	71486 9	22340 2	73164 1	21836 6	34
27	66537 1	23898 3	68186 8	23366 5	69846 2	22844 4	71514 8	22331 7	73192 1	21828 3	33
28	66564 5	23889 4	68214 4	23357 7	69874 0	22835 7	71542 7	22323 2	73220 1	21820 0	32
29	66591 9	23880 4	68241 9	23348 9	69901 7	22827 1	71570 6	22314 8	73248 1	21811 7	31
30	66619 3	23871 5	68269 5	23340 2	69929 4	22818 5	71598 5	22306 3	73276 2	21803 4	30
31	66646 7	23862 6	68297 1	23331 4	69957 2	22809 9	71626 4	22297 9	73304 2	21795 1	29
32	66674 2	23853 6	68324 7	23322 6	69984 9	22801 3	71654 2	22289 4	73332 2	21786 8	28
33	66701 6	23844 7	68352 3	23313 8	70012 7	22792 7	71682 1	22280 9	73360 3	21778 5	27
34	66729 0	23835 8	68379 9	23305 1	70040 4	22784 1	71710 0	22272 5	73388 3	21770 2	26
35	66756 4	23826 8	68407 5	23296 3	70068 2	22775 5	71737 9	22264 1	73416 3	21761 9	25
36	66783 9	23817 9	68435 1	23287 6	70095 9	22766 9	71765 8	22255 6	73444 4	21753 6	24
37	66811 3	23809 0	68462 7	23278 8	70123 7	22757 3	71793 8	22247 2	73472 4	21745 3	23
38	66838 8	23800 1	68490 3	23270 0	70151 4	22749 7	71821 7	22238 7	73500 5	21737 0	22
39	66866 2	23791 2	68517 9	23261 3	70179 2	22741 1	71849 6	22230 3	73528 5	21728 7	21
40	66893 7	23782 3	68545 5	23252 5	70207 0	22732 5	71877 5	22221 9	73556 6	21720 4	20
41	66921 1	23773 3	68573 1	23243 8	70234 7	22723 9	71905 4	22213 4	73584 6	21712 1	19
42	66948 6	23764 4	68600 7	23235 1	70262 5	22715 3	71933 3	22205 0	73612 7	21703 9	18
43	66976 0	23755 5	68628 4	23226 3	70290 3	22706 7	71961 2	22196 6	73640 7	21695 6	17
44	67003 5	23746 6	68656 0	23217 6	70318 1	22698 2	71989 2	22188 1	73668 8	21687 3	16
45	67030 9	23737 7	68683 6	23208 8	70345 8	22689 6	72017 1	22179 7	73696 9	21679 0	15
46	67058 4	23728 8	68711 2	23200 1	70373 6	22681 0	72045 0	22171 3	73724 9	21670 8	14
47	67085 9	23719 9	68738 9	23191 4	70401 4	22672 4	72073 0	22162 9	73753 0	21662 5	13
48	67113 3	23711 1	68766 5	23182 7	70429 2	22663 9	72100 9	22154 5	73781 1	21654 2	12
49	67140 8	23702 2	68794 1	23173 9	70457 0	22655 3	72128 8	22146 1	73809 1	21646 0	11
50	67168 3	23693 3	68821 8	23165 2	70484 8	22646 7	72156 8	22137 6	73837 2	21637 7	10
51	67195 8	23684 4	68849 4	23156 5	70512 6	22638 2	72184 7	22129 2	73865 3	21629 5	9
52	67223 2	23675 5	68877 1	23147 8	70540 4	22629 6	72212 6	22120 8	73893 4	21621 2	8
53	67250 7	23666 7	68904 7	23139 1	70568 2	22621 1	72240 6	22112 4	73921 5	21613 0	7
54	67278 2	23657 8	68932 4	23130 3	70596 0	22612 5	72268 5	22104 0	73949 5	21604 7	6
55	67305 7	23648 9	68960 0	23121 6	70623 8	22604 0	72296 5	22095 6	73977 6	21596 5	5
56	67333 2	23640 0	68987 7	23112 9	70651 6	22595 4	72324 4	22087 2	74005 7	21588 2	4
57	67360 7	23631 2	69015 3	23104 2	70679 4	22586 9	72352 4	22078 9	74033 8	21580 0	3
58	67388 2	23622 3	69043 0	23095 5	70707 2	22578 3	72380 3	22070 5	74061 9	21571 8	2
59	67415 7	23613 5	69070 6	23086 8	70735 0	22569 8	72408 3	22062 1	74090 0	21563 5	1
60	67443 2	23604 6	69098 3	23078 1	70762 8	22561 2	72436 3	22053 7	74118 1	21555 3	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	19°	289°	18°	288°	17°	287°	16°	286°	15°	285°	

	75°		76°		77°		78°		79°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	74118 1	21555 3	75807 8	21065 8	77504 9	20585 0	79208 8	20112 8	80919 1	19648 9	60
1	74146 2	21547 1	75836 0	21057 7	77533 2	20577 1	79237 3	20105 0	80947 7	19641 3	59
2	74174 3	21538 8	75864 3	21049 6	77561 6	20569 2	79265 7	20097 2	80976 2	19633 6	58
3	74202 4	21530 6	75892 5	21041 6	77589 9	20561 2	79294 2	20089 4	81004 3	19626 0	57
4	74230 5	21522 4	75920 7	21033 5	77618 3	20553 3	79322 7	20081 6	81033 3	19618 3	56
5	74258 6	21514 2	75949 7	21025 4	77646 6	20545 4	79351 1	20073 8	81061 9	19610 7	55
6	74286 7	21505 9	75977 2	21017 3	77675 0	20537 4	79379 6	20066 1	81090 5	19603 0	54
7	74314 8	21497 7	76005 4	21009 3	77703 3	20529 5	79408 0	20058 3	81119 0	19595 4	53
8	74342 9	21489 5	76033 7	21001 2	77731 7	20521 6	79436 5	20050 5	81147 6	19587 7	52
9	74371 1	21481 3	76061 9	20993 1	77760 1	20513 7	79465 0	20042 7	81176 1	19580 1	51
10	74399 2	21473 1	76090 2	20985 1	77788 4	20505 8	79493 4	20034 9	81204 7	19572 4	50
11	74427 3	21464 9	76118 4	20977 0	77816 8	20497 8	79521 9	20027 2	81233 3	19564 8	49
12	74455 4	21456 7	76146 6	20969 0	77845 1	20489 9	79550 4	20019 4	81261 9	19557 2	48
13	74483 5	21448 5	76174 9	20960 9	77873 5	20482 0	79578 9	20011 6	81290 4	19549 5	47
14	74511 7	21440 3	76203 2	20952 9	77901 9	20474 1	79607 3	20003 8	81319 0	19541 9	46
15	74539 8	21432 1	76231 4	20944 8	77930 3	20466 2	79635 8	19996 1	81347 6	19534 3	45
16	74567 9	21423 9	76259 7	20936 8	77958 6	20458 3	79664 3	19988 3	81376 2	19526 6	44
17	74596 1	21415 7	76287 9	20928 7	77987 0	20450 4	79692 8	19980 5	81404 8	19519 0	43
18	74624 2	21407 5	76316 2	20920 7	78015 4	20442 5	79721 3	19972 8	81433 3	19511 4	42
19	74652 3	21399 3	76344 4	20912 6	78043 8	20434 6	79749 8	19965 0	81461 9	19503 8	41
20	74680 5	21391 1	76372 7	20904 6	78072 1	20426 7	79778 2	19957 3	81490 5	19496 1	40
21	74708 6	21383 0	76401 0	20896 6	78100 5	20418 8	79806 7	19949 5	81519 1	19488 5	39
22	74736 8	21374 8	76429 2	20888 5	78128 9	20410 9	79835 2	19941 8	81547 7	19480 9	38
23	74764 9	21366 6	76457 5	20880 5	78157 3	20403 0	79863 7	19934 0	81576 3	19473 3	37
24	74793 1	21358 4	76485 8	20872 5	78185 7	20395 1	79892 2	19926 3	81604 9	19465 7	36
25	74821 2	21350 3	76514 1	20864 4	78214 1	20387 3	79920 7	19918 5	81633 5	19458 1	35
26	74849 4	21342 1	76542 3	20856 4	78242 5	20379 4	79949 2	19910 8	81662 0	19450 5	34
27	74877 5	21333 9	76570 6	20848 4	78270 8	20371 5	79977 7	19903 1	81690 6	19442 9	33
28	74905 7	21325 8	76598 9	20840 4	78299 2	20363 6	80006 2	19895 3	81719 2	19435 3	32
29	74933 8	21317 6	76627 2	20832 4	78327 6	20355 7	80034 7	19887 6	81747 8	19427 7	31
30	74962 0	21309 4	76655 5	20824 3	78356 0	20347 9	80063 2	19879 9	81776 4	19420 1	30
31	74990 2	21301 3	76683 7	20816 3	78384 4	20340 0	80091 7	19872 1	81805 0	19412 5	29
32	75018 3	21293 1	76712 0	20808 3	78412 8	20332 1	80120 2	19864 4	81833 6	19404 9	28
33	75046 5	21285 0	76740 3	20800 3	78441 2	20324 3	80148 7	19856 7	81862 3	19397 3	27
34	75074 7	21276 8	76768 6	20792 3	78469 6	20316 4	80177 2	19848 9	81890 9	19389 7	26
35	75102 8	21268 7	76796 9	20784 3	78498 1	20308 6	80205 7	19841 2	81919 5	19382 1	25
36	75131 0	21260 5	76825 2	20776 3	78526 5	20300 7	80234 3	19833 5	81948 1	19374 6	24
37	75159 2	21252 4	76853 5	20768 3	78554 9	20292 8	80262 8	19825 8	81976 7	19367 0	23
38	75187 4	21244 3	76881 8	20760 3	78583 3	20285 0	80291 3	19818 1	82005 3	19359 4	22
39	75215 5	21236 1	76910 1	20752 3	78611 7	20277 1	80319 8	19810 4	82033 9	19351 8	21
40	75243 7	21228 0	76938 4	20744 3	78640 1	20269 3	80348 3	19802 7	82062 5	19344 3	20
41	75271 9	21219 9	76966 7	20736 4	78668 5	20261 4	80376 9	19794 9	82091 2	19336 7	19
42	75300 1	21211 7	76995 0	20728 4	78697 0	20253 6	80405 4	19787 2	82119 8	19329 1	18
43	75328 3	21203 6	77023 3	20720 4	78725 4	20245 8	80433 9	19779 5	82148 4	19321 5	17
44	75356 5	21195 5	77051 6	20712 4	78753 8	20237 9	80462 4	19771 8	82177 0	19314 0	16
45	75384 7	21187 3	77080 0	20704 4	78782 2	20230 1	80491 0	19764 1	82205 6	19306 4	15
46	75412 9	21179 2	77108 3	20696 6	78810 7	20222 3	80519 5	19756 4	82234 3	19298 9	14
47	75441 1	21171 1	77136 6	20688 5	78839 1	20214 4	80548 0	19748 8	82262 9	19291 3	13
48	75469 3	21163 0	77164 9	20680 5	78867 5	20206 6	80576 6	19741 1	82291 5	19283 7	12
49	75497 5	21154 9	77193 2	20672 5	78896 0	20198 8	80605 1	19733 4	82320 2	19276 2	11
50	75525 7	21146 8	77221 6	20664 6	78924 4	20190 9	80633 6	19725 7	82348 8	19268 6	10
51	75553 9	21138 7	77249 9	20656 6	78952 8	20183 1	80662 2	19718 0	82377 4	19261 1	9
52	75582 1	21130 6	77278 2	20648 6	78981 3	20175 3	80690 7	19710 3	82406 0	19253 5	8
53	75610 3	21122 5	77306 5	20640 7	79009 7	20167 5	80719 3	19702 6	82434 7	19246 0	7
54	75638 5	21114 4	77334 9	20632 7	79038 1	20159 7	80747 8	19695 0	82463 3	19238 5	6
55	75666 7	21106 3	77363 2	20624 8	79066 6	20151 8	80776 3	19687 3	82492 0	19230 9	5
56	75694 9	21098 2	77391 5	20616 8	79095 0	20144 0	80804 9	19679 6	82520 6	19223 4	4
57	75723 1	21090 1	77419 9	20608 9	79123 5	20136 2	80833 4	19671 9	82549 2	19215 8	3
58	75751 4	21082 0	77448 2	20600 9	79151 9	20128 4	80862 0	19664 3	82577 9	19208 3	2
59	75779 6	21073 9	77476 5	20593 0	79180 4	20120 6	80890 5	19656 6	82606 5	19200 8	1
60	75807 8	21065 8	77504 9	20585 0	79208 8	20112 8	80919 1	19648 9	82635 2	19193 3	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	14°	284°	13°	283°	12°	282°	11°	281°	10°	280°	

	80°		81°		82°		83°		84°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	82635 2	19193 3	84356 5	18745 6	86082 7	18305 7	87813 1	17873 5	89547 1	17448 9	60
1	82663 8	19185 7	84385 3	18738 2	86111 5	18298 4	87849 1	17866 4	89576 1	17441 9	59
2	82692 5	19178 2	84414 0	18730 8	86140 3	18291 2	87870 8	17859 3	89605 0	17434 9	58
3	82721 1	19170 7	84442 7	18723 4	86169 1	18283 9	87899 7	17852 1	89633 9	17427 9	57
4	82749 8	19163 2	84471 5	18716 0	86197 9	18276 7	87928 6	17845 0	89662 9	17420 9	56
5	82778 4	19155 6	84500 2	18708 6	86226 7	18269 4	87957 4	17837 9	89691 8	17413 9	55
6	82807 1	19148 1	84529 0	18701 2	86255 5	18262 1	87986 3	17830 7	89720 7	17406 9	54
7	82835 7	19140 6	84557 7	18693 8	86284 4	18254 9	88015 2	17823 6	89749 7	17399 9	53
8	82864 4	19133 1	84586 4	18686 5	86313 2	18247 6	88044 1	17816 5	89778 6	17392 9	52
9	82893 1	19125 6	84615 2	18679 1	86342 0	18240 4	88073 0	17809 4	89807 5	17385 9	51
10	82921 7	19118 1	84643 9	18671 7	86370 8	18233 2	88101 8	17802 3	89836 5	17378 9	50
11	82950 4	19110 6	84672 7	18664 3	86399 6	18225 9	88130 7	17795 1	89865 4	17371 9	49
12	82979 0	19103 1	84701 4	18657 0	86428 4	18218 7	88159 6	17788 0	89894 4	17364 9	48
13	83007 7	19095 6	84730 2	18649 6	86457 2	18211 4	88188 5	17780 9	89923 3	17357 9	47
14	83036 4	19088 1	84758 9	18642 2	86486 1	18204 2	88217 4	17773 8	89952 2	17350 9	46
15	83065 0	19080 6	84787 7	18634 9	86514 9	18197 0	88246 3	17766 7	89981 2	17343 9	45
16	83093 7	19073 1	84816 4	18627 5	86543 7	18189 7	88275 1	17759 6	90010 1	17336 9	44
17	83122 4	19065 6	84845 2	18620 1	86572 6	18182 5	88304 0	17752 5	90039 1	17329 9	43
18	83151 1	19058 1	84873 9	18612 8	86601 4	18175 3	88332 9	17745 4	90068 0	17323 0	42
19	83179 7	19050 6	84902 7	18605 4	86630 2	18168 0	88361 8	17738 3	90097 0	17316 0	41
20	83208 4	19043 1	84931 4	18598 1	86659 0	18160 8	88390 7	17731 2	90125 9	17309 0	40
21	83237 1	19035 6	84960 2	18590 7	86687 9	18153 6	88419 6	17724 1	90154 9	17302 0	39
22	83265 8	19028 1	84988 9	18583 4	86716 7	18146 4	88448 5	17717 0	90183 8	17295 1	38
23	83294 4	19020 7	85017 7	18576 0	86745 5	18139 1	88477 4	17709 9	90212 8	17288 1	37
24	83323 1	19013 2	85046 5	18568 7	86774 4	18131 9	88506 3	17702 8	90241 7	17281 1	36
25	83351 8	19005 7	85075 2	18561 3	86803 2	18124 7	88535 2	17695 7	90270 7	17274 2	35
26	83380 5	18998 3	85104 0	18554 0	86832 0	18117 5	88564 1	17688 6	90299 6	17267 2	34
27	83409 2	18990 8	85132 8	18546 7	86860 9	18110 3	88593 0	17681 5	90328 6	17260 2	33
28	83437 9	18983 3	85161 5	18539 3	86889 7	18103 1	88621 9	17674 4	90357 5	17253 3	32
29	83466 5	18975 9	85190 3	18532 0	86918 5	18095 9	88650 8	17667 4	90386 4	17246 3	31
30	83495 2	18968 4	85219 1	18524 7	86947 4	18088 7	88679 7	17660 3	90415 4	17239 4	30
31	83523 9	18961 0	85247 8	18517 3	86976 2	18081 5	88708 6	17653 2	90444 4	17232 4	29
32	83552 6	18953 5	85276 6	18510 0	87005 1	18074 3	88737 5	17646 1	90473 3	17225 5	28
33	83581 3	18946 0	85305 4	18502 7	87033 9	18067 1	88766 4	17639 1	90502 3	17218 5	27
34	83610 0	18938 6	85334 1	18495 4	87062 7	18059 9	88795 3	17632 0	90531 2	17211 6	26
35	83638 7	18931 1	85362 9	18488 0	87091 6	18052 7	88824 2	17624 9	90560 2	17204 6	25
36	83667 4	18923 7	85391 7	18480 7	87120 4	18045 5	88853 1	17617 9	90589 2	17197 7	24
37	83696 1	18916 2	85420 5	18473 4	87149 3	18038 3	88882 0	17610 8	90618 1	17190 7	23
38	83724 8	18908 8	85449 2	18466 1	87178 1	18031 1	88910 9	17603 7	90647 1	17183 8	22
39	83753 5	18901 4	85478 0	18458 8	87207 0	18023 9	88939 8	17596 7	90676 0	17176 9	21
40	83782 2	18893 9	85506 8	18451 5	87235 8	18016 8	88968 7	17589 6	90705 0	17169 9	20
41	83810 9	18886 5	85535 6	18444 2	87264 7	18009 6	88997 6	17582 6	90734 0	17163 0	19
42	83839 6	18879 0	85564 4	18436 8	87293 5	18002 4	89026 6	17575 5	90762 9	17156 1	18
43	83868 3	18871 6	85593 2	18429 5	87322 4	17995 2	89055 5	17568 5	90791 9	17149 1	17
44	83897 0	18864 2	85621 9	18422 2	87351 2	17988 0	89084 4	17561 4	90820 9	17142 2	16
45	83925 7	18856 7	85650 7	18414 9	87380 1	17980 9	89113 3	17554 4	90849 8	17135 3	15
46	83954 4	18849 3	85679 5	18407 6	87409 0	17973 7	89142 2	17547 3	90878 8	17128 4	14
47	83983 1	18841 9	85708 3	18400 4	87437 8	17966 5	89171 1	17540 3	90907 8	17121 4	13
48	84011 9	18834 5	85737 1	18393 1	87466 7	17959 4	89200 1	17533 2	90936 7	17114 5	12
49	84040 6	18827 0	85765 9	18385 8	87495 5	17952 2	89229 0	17526 2	90965 7	17107 6	11
50	84069 3	18819 6	85794 7	18378 5	87524 4	17945 0	89257 9	17519 2	90994 7	17100 7	10
51	84098 0	18812 2	85823 5	18371 2	87553 3	17937 9	89286 8	17512 1	91023 6	17093 8	9
52	84126 7	18804 8	85852 3	18363 9	87582 1	17930 7	89315 7	17505 1	91052 6	17086 9	8
53	84155 5	18797 4	85881 1	18356 6	87611 0	17923 6	89344 7	17498 1	91081 6	17080 0	7
54	84184 2	18790 0	85909 9	18349 3	87639 8	17916 4	89373 6	17491 0	91110 6	17073 1	6
55	84212 9	18782 6	85938 7	18342 1	87668 7	17909 3	89402 5	17484 0	91139 5	17066 2	5
56	84241 6	18775 2	85967 5	18334 8	87697 6	17902 1	89431 4	17477 0	91168 5	17059 3	4
57	84270 4	18767 8	85996 3	18327 5	87726 4	17895 0	89460 3	17470 0	91197 5	17052 4	3
58	84299 1	18760 4	86025 1	18320 2	87755 3	17887 8	89489 3	17462 9	91226 5	17045 5	2
59	84327 8	18753 0	86053 9	18313 0	87784 2	17880 7	89518 2	17455 9	91255 4	17038 6	1
60	84356 5	18745 6	86082 7	18305 7	87813 1	17873 5	89547 1	17448 9	91284 4	17031 7	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	9°	279°	8°	278°	7°	277°	6°	276°	5°	275°	

	85°		86°		87°		88°		89°		
	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	Sum or Diff.	Hour Angle	
0	91284 4	17031 7	93024 3	16621 7	94766 4	16218 8	96510 1	15822 9	98254 8	15433 8	60
1	91313 4	17024 8	93053 4	16614 9	94795 4	16212 1	96539 1	15816 3	98283 8	15427 4	59
2	91342 4	17017 9	93082 4	16608 1	94824 5	16205 5	96568 2	15809 8	98312 9	15421 0	58
3	91371 4	17011 0	93111 4	16601 4	94853 5	16198 8	96597 3	15803 3	98342 0	15414 5	57
4	91400 3	17004 1	93140 4	16594 6	94882 6	16192 2	96626 3	15796 7	98371 1	15408 1	56
5	91429 3	16997 2	93169 4	16587 8	94911 6	16185 5	96655 4	15790 2	98400 2	15401 7	55
6	91458 3	16990 3	93198 5	16581 1	94940 7	16178 9	96684 5	15783 7	98429 3	15395 3	54
7	91487 3	16983 5	93227 5	16574 3	94969 8	16172 2	96713 6	15777 1	98458 3	15388 9	53
8	91516 3	16976 6	93256 5	16567 5	94998 8	16165 6	96742 6	15770 6	98487 4	15382 5	52
9	91545 3	16969 7	93285 5	16560 8	95027 9	16159 0	96771 7	15764 1	98516 5	15376 0	51
10	91574 2	16962 8	93314 6	16554 0	95056 9	16152 3	96800 8	15757 6	98545 6	15369 6	50
11	91603 2	16956 0	93343 6	16547 3	95086 0	16145 7	96829 8	15751 0	98574 7	15363 2	49
12	91632 2	16949 1	93372 6	16540 5	95115 0	16139 0	96858 9	15744 5	98603 8	15356 8	48
13	91661 2	16942 2	93401 6	16533 8	95144 1	16132 4	96888 0	15738 0	98632 9	15350 4	47
14	91690 2	16935 4	93430 7	16527 0	95173 1	16125 8	96917 1	15731 5	98661 9	15344 0	46
15	91719 2	16928 5	93459 7	16520 3	95202 2	16119 2	96946 1	15725 0	98690 1	15337 6	45
16	91748 2	16921 6	93488 7	16513 5	95231 2	16112 5	96975 2	15718 5	98720 1	15331 2	44
17	91777 2	16914 8	93517 7	16506 8	95260 3	16105 9	97004 3	15712 0	98749 2	15324 8	43
18	91806 1	16907 9	93546 8	16500 0	95289 3	16099 3	97033 4	15705 4	98778 3	15318 4	42
19	91835 1	16901 1	93575 8	16493 3	95318 4	16092 7	97062 4	15698 9	98807 4	15312 0	41
20	91864 1	16894 2	93604 8	16486 6	95347 5	16086 0	97091 5	15692 4	98836 5	15305 6	40
21	91893 1	16887 3	93633 9	16479 9	95376 5	16079 4	97120 6	15685 9	98865 6	15299 2	39
22	91922 1	16880 5	93662 9	16473 1	95405 6	16072 8	97149 7	15679 4	98894 6	15292 9	38
23	91951 1	16873 6	93691 9	16466 4	95434 6	16066 2	97178 8	15672 9	98923 7	15286 5	37
24	91980 1	16866 8	93720 9	16459 7	95463 7	16059 6	97207 8	15666 4	98952 8	15280 1	36
25	92009 1	16860 0	93750 0	16452 9	95492 8	16053 0	97236 9	15659 9	98981 9	15273 7	35
26	92038 1	16853 1	93779 0	16446 2	95521 8	16046 4	97266 0	15653 4	99011 0	15267 3	34
27	92067 1	16846 3	93808 0	16439 5	95550 9	16039 8	97295 1	15647 0	99040 1	15260 9	33
28	92096 1	16839 4	93837 1	16432 8	95579 9	16033 2	97324 1	15640 5	99069 2	15254 6	32
29	92125 1	16832 6	93866 1	16426 1	95609 0	16026 6	97353 2	15634 0	99098 3	15248 2	31
30	92154 1	16825 8	93895 1	16419 3	95638 1	16020 0	97382 3	15627 5	99127 3	15241 8	30
31	92183 1	16818 9	93924 2	16412 6	95667 1	16013 4	97411 4	15621 0	99156 4	15235 4	29
32	92212 1	16812 1	93953 2	16405 9	95696 2	16006 8	97440 5	15614 5	99185 5	15229 1	28
33	92241 1	16805 3	93982 2	16399 2	95725 2	16000 2	97469 5	15608 1	99214 6	15222 7	27
34	92270 1	16798 5	94011 3	16392 5	95754 3	15993 6	97498 6	15601 6	99243 7	15216 4	26
35	92299 1	16791 6	94040 3	16385 8	95783 4	15987 0	97527 7	15595 1	99272 8	15210 0	25
36	92328 1	16784 8	94069 4	16379 1	95812 4	15980 4	97556 8	15588 6	99301 9	15203 6	24
37	92357 1	16778 0	94098 4	16372 4	95841 5	15973 8	97585 9	15582 2	99331 0	15197 3	23
38	92386 1	16771 2	94127 4	16365 7	95870 6	15967 2	97614 9	15575 7	99360 1	15190 9	22
39	92415 1	16764 3	94156 5	16359 0	95899 6	15960 7	97644 0	15569 2	99389 1	15184 5	21
40	92444 1	16757 5	94185 5	16352 3	95928 7	15954 1	97673 1	15562 8	99418 2	15178 2	20
41	92473 1	16750 7	94214 6	16345 6	95957 8	15947 5	97702 2	15556 3	99447 3	15171 8	19
42	92502 1	16743 9	94243 6	16338 9	95986 8	15940 9	97731 3	15549 8	99476 4	15165 5	18
43	92531 1	16737 1	94272 6	16332 2	96015 9	15934 3	97760 3	15543 4	99505 5	15159 1	17
44	92560 1	16730 3	94301 7	16325 5	96044 9	15927 8	97789 4	15536 9	99534 6	15152 8	16
45	92589 1	16723 5	94330 7	16318 8	96074 0	15921 2	97818 5	15530 4	99563 7	15146 5	15
46	92618 2	16716 7	94359 8	16312 2	96103 1	15914 6	97847 6	15524 0	99592 8	15140 1	14
47	92647 2	16709 9	94388 8	16305 5	96132 1	15908 0	97876 7	15517 5	99621 8	15133 8	13
48	92676 2	16703 1	94417 8	16298 8	96161 2	15901 5	97905 8	15511 1	99650 9	15127 4	12
49	92705 2	16696 3	94446 9	16292 1	96190 3	15894 9	97934 8	15504 6	99680 0	15121 1	11
50	92734 2	16689 5	94475 9	16285 4	96219 3	15888 4	97963 9	15498 2	99709 1	15114 8	10
51	92763 2	16682 7	94505 0	16278 8	96248 4	15881 8	97993 0	15491 7	99738 2	15108 4	9
52	92792 2	16675 9	94534 0	16272 1	96277 5	15875 3	98022 1	15485 3	99767 3	15102 1	8
53	92821 2	16669 1	94563 1	16265 4	96306 6	15868 7	98051 2	15478 9	99796 4	15095 8	7
54	92850 3	16662 3	94592 1	16258 8	96335 6	15862 2	98080 3	15472 4	99825 5	15089 4	6
55	92879 3	16655 6	94621 2	16252 1	96364 7	15855 6	98109 3	15466 0	99854 6	15083 1	5
56	92908 3	16648 8	94650 2	16245 4	96393 8	15849 1	98138 4	15459 5	99883 6	15076 8	4
57	92937 3	16642 0	94679 3	16238 8	96422 8	15842 5	98167 5	15453 1	99912 7	15070 4	3
58	92966 3	16635 2	94708 3	16232 1	96451 9	15836 0	98196 6	15446 7	99941 8	15064 1	2
59	92995 3	16628 4	94737 4	16225 4	96481 0	15829 4	98225 7	15440 2	99970 9	15057 8	1
60	93024 3	16621 7	94766 4	16218 8	96510 1	15822 9	98254 8	15433 8	100000 0	15051 5	0
	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	Alt.	Hour Angle	
	4°	274°	3°	273°	2°	272°	1°	271°	0°	270°	

Hour Angle

	90°	91°	92°	93°	94°	95°	96°	97°	98°	99°	
0	15051 5	14675 8	14306 6	13943 8	13587 3	13236 9	12892 7	12554 4	12222 0	11895 4	60
1	15045 2	14669 6	14300 5	13937 8	13581 4	13231 1	12887 0	12548 8	12216 5	11890 1	59
2	15038 9	14663 4	14294 4	13931 8	13575 5	13225 3	12881 3	12543 2	12211 0	11884 7	58
3	15032 6	14657 2	14288 3	13925 8	13569 6	13219 6	12875 6	12537 6	12205 5	11879 3	57
4	15026 2	14651 0	14282 2	13919 8	13563 7	13213 8	12869 9	12532 0	12200 1	11873 9	56
5	15019 9	14644 8	14276 1	13913 8	13557 8	13208 0	12864 2	12526 5	12194 6	11868 5	55
6	15013 6	14638 4	14270 0	13907 8	13551 9	13202 2	12858 6	12520 9	12189 1	11863 1	54
7	15007 3	14632 4	14263 9	13901 9	13546 1	13196 4	12852 9	12515 3	12183 6	11857 7	53
8	15001 0	14626 2	14257 8	13895 9	13540 2	13190 7	12847 2	12509 7	12178 1	11852 3	52
9	14994 7	14620 0	14251 8	13889 9	13534 3	13184 9	12841 5	12504 2	12172 7	11847 0	51
10	14988 4	14613 8	14245 7	13883 9	13528 4	13179 1	12835 9	12498 6	12167 2	11841 6	50
11	14982 1	14607 6	14239 6	13877 9	13522 6	13173 3	12830 2	12493 0	12161 7	11836 2	49
12	14975 8	14601 4	14233 5	13872 0	13516 7	13167 6	12824 5	12487 4	12156 2	11830 8	48
13	14969 5	14595 3	14227 4	13866 0	13510 8	13161 8	12818 9	12481 9	12150 8	11825 4	47
14	14963 2	14589 1	14221 4	13860 0	13505 0	13156 0	12813 2	12476 3	12145 3	11820 1	46
15	14957 0	14582 9	14215 3	13854 1	13499 1	13150 3	12807 5	12470 7	12139 8	11814 7	45
16	14950 7	14576 7	14209 2	13848 1	13493 2	13144 5	12801 9	12465 2	12134 4	11809 3	44
17	14944 4	14570 5	14203 2	13842 1	13487 4	13138 8	12796 2	12459 6	12128 9	11804 0	43
18	14938 1	14564 4	14197 1	13836 2	13481 5	13133 0	12790 5	12454 1	12123 4	11798 6	42
19	14931 8	14558 2	14191 0	13830 2	13475 6	13127 2	12784 9	12448 5	12118 0	11793 2	41
20	14925 5	14552 0	14184 9	13824 2	13469 8	13121 5	12779 2	12442 9	12112 5	11787 9	40
21	14919 3	14545 8	14178 9	13818 3	13463 9	13115 7	12773 6	12437 4	12107 1	11782 5	39
22	14913 0	14539 7	14172 8	13812 3	13458 1	13110 0	12767 9	12431 8	12101 6	11777 1	38
23	14906 7	14533 5	14166 8	13806 4	13452 2	13104 2	12762 3	12426 3	12096 1	11771 8	37
24	14900 4	14527 3	14160 7	13800 4	13446 4	13098 5	12756 6	12420 7	12090 7	11766 4	36
25	14894 2	14521 2	14154 6	13794 5	13440 5	13092 7	12751 0	12415 2	12085 2	11761 1	35
26	14887 9	14515 0	14148 6	13788 5	13434 7	13087 0	12745 3	12409 6	12079 8	11755 7	34
27	14881 6	14508 9	14142 5	13782 6	13428 8	13081 2	12739 7	12404 1	12074 3	11750 4	33
28	14875 4	14502 7	14136 5	13776 6	13423 0	13075 5	12734 1	12398 6	12068 9	11745 0	32
29	14869 1	14496 5	14130 4	13770 7	13417 2	13069 8	12728 4	12393 0	12063 5	11739 7	31
30	14862 8	14490 4	14124 4	13764 7	13411 3	13064 0	12722 8	12387 5	12058 0	11734 3	30
31	14856 6	14484 2	14118 3	13758 8	13405 5	13058 3	12717 1	12381 9	12052 6	11729 0	29
32	14850 3	14478 1	14112 3	13752 9	13399 6	13052 6	12711 5	12376 4	12047 1	11723 6	28
33	14844 1	14471 9	14106 3	13746 9	13393 8	13046 8	12705 9	12370 9	12041 7	11718 3	27
34	14837 8	14465 8	14100 2	13741 0	13388 0	13041 1	12700 2	12365 3	12036 3	11712 9	26
35	14831 5	14459 6	14094 2	13735 0	13382 1	13035 4	12694 6	12359 8	12030 8	11707 6	25
36	14825 3	14453 5	14088 1	13729 1	13376 3	13029 6	12689 0	12354 3	12025 4	11702 3	24
37	14819 0	14447 4	14082 1	13723 2	13370 5	13023 9	12683 4	12348 7	12020 0	11696 9	23
38	14812 8	14441 2	14076 1	13717 3	13364 7	13018 2	12677 7	12343 2	12014 5	11691 6	22
39	14806 6	14435 1	14070 0	13711 3	13358 8	13012 5	12672 1	12337 7	12009 1	11686 3	21
40	14800 3	14428 9	14064 0	13705 4	13353 0	13006 7	12666 5	12332 2	12003 7	11680 9	20
41	14794 1	14422 8	14058 0	13699 5	13347 2	13001 0	12660 9	12326 6	11998 2	11675 6	19
42	14787 8	14416 7	14052 0	13693 6	13341 4	12995 3	12655 2	12321 1	11992 8	11670 3	18
43	14781 6	14410 6	14045 9	13687 7	13335 6	12989 6	12649 6	12315 6	11987 4	11664 9	17
44	14775 3	14404 4	14039 9	13681 7	13329 7	12983 9	12644 0	12310 1	11982 0	11659 6	16
45	14769 1	14398 3	14033 9	13675 8	13323 9	12978 2	12638 4	12304 6	11976 6	11654 3	15
46	14762 9	14392 2	14027 9	13669 9	13318 1	12972 4	12632 8	12299 0	11971 1	11649 0	14
47	14756 6	14386 0	14021 9	13664 0	13312 3	12966 7	12627 2	12293 5	11965 7	11643 6	13
48	14750 4	14379 9	14015 8	13658 1	13306 5	12961 0	12621 6	12288 0	11960 3	11638 3	12
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50	14738 0	14367 7	14003 8	13646 2	13294 9	12949 6	12610 4	12277 0	11949 5	11627 7	10
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53	14719 3	14349 3	13985 8	13628 5	13277 5	12932 5	12593 5	12260 5	11933 3	11611 7	7
54	14713 1	14343 2	13979 8	13622 6	13271 7	12926 8	12587 9	12255 0	11927 8	11606 4	6
55	14706 9	14337 1	13973 8	13616 7	13265 9	12921 1	12582 3	12249 5	11922 4	11601 1	5
56	14700 6	14331 0	13967 8	13610 8	13260 1	12915 4	12576 8	12244 0	11917 0	11595 8	4
57	14694 4	14324 9	13961 8	13604 9	13254 3	12909 7	12571 2	12238 5	11911 6	11590 5	3
58	14688 2	14318 8	13955 8	13599 0	13248 5	12904 0	12565 6	12233 0	11906 2	11585 2	2
59	14682 0	14312 7	13949 8	13593 1	13242 7	12898 3	12560 0	12227 5	11900 8	11579 9	1
60	14675 8	14306 6	13943 8	13587 3	13236 9	12892 7	12554 4	12222 0	11895 4	11574 6	0

269°	268°	267°	266°	265°	264°	263°	262°	261°	260°
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Hour Angle

Hour Angle

	100°	101°	102°	103°	104°	105°	106°	107°	108°	109°	
0	11574 6	11259 4	10949 7	10645 6	10346 8	10053 3	9765 1	9482 1	9204 2	8931 4	60
1	11569 3	11254 2	10944 6	10640 5	10341 9	10048 5	9760 4	9477 5	9199 7	8926 9	59
2	11564 0	11249 0	10939 5	10635 5	10336 9	10043 6	9755 6	9472 8	9195 1	8922 4	58
3	11558 7	11243 8	10934 4	10630 5	10332 0	10038 8	9750 9	9468 1	9190 5	8917 9	57
4	11553 4	11238 6	10929 3	10625 5	10327 1	10034 0	9745 1	9463 4	9185 9	8913 4	56
5	11548 1	11233 4	10924 2	10620 5	10322 1	10029 1	9741 4	9458 8	9181 3	8908 9	55
6	11542 8	11228 2	10919 1	10615 4	10317 2	10024 3	9736 6	9454 1	9176 7	8904 4	54
7	11537 5	11223 0	10914 0	10610 4	10312 3	10019 4	9731 9	9449 4	9172 1	8899 9	53
8	11532 3	11217 8	10908 9	10605 4	10307 4	10014 6	9727 1	9444 8	9167 6	8895 4	52
9	11527 0	11212 6	10903 8	10600 4	10302 4	10009 8	9722 4	9440 1	9163 0	8890 9	51
10	11521 7	11207 4	10898 7	10595 4	10297 5	10004 9	9717 6	9435 5	9158 4	8886 4	50
11	11516 4	11202 2	10893 6	10590 4	10292 6	10000 1	9712 9	9430 8	9153 8	8881 9	49
12	11511 1	11197 0	10888 5	10585 4	10287 7	9995 3	9708 1	9426 1	9149 3	8877 4	48
13	11505 8	11191 8	10883 4	10580 4	10282 8	9990 4	9703 4	9421 5	9144 7	8872 9	47
14	11500 6	11186 6	10878 3	10575 4	10277 8	9985 6	9698 6	9416 8	9140 1	8868 5	46
15	11495 3	11181 5	10873 2	10570 4	10272 9	9980 8	9693 9	9412 2	9135 6	8864 0	45
16	11490 0	11176 3	10868 1	10565 4	10268 0	9976 0	9689 2	9407 5	9131 0	8859 5	44
17	11484 7	11171 1	10863 0	10560 4	10263 1	9971 1	9684 4	9402 9	9126 4	8855 0	43
18	11479 5	11165 9	10857 9	10555 4	10258 2	9966 3	9679 7	9398 2	9121 9	8850 5	42
19	11474 2	11160 7	10852 8	10550 4	10253 3	9961 5	9675 0	9393 6	9117 3	8846 0	41
20	11468 9	11155 6	10847 7	10545 4	10248 4	9956 7	9670 2	9388 9	9112 7	8841 6	40
21	11463 6	11150 4	10842 7	10540 4	10243 5	9951 9	9665 5	9384 3	9108 2	8837 1	39
22	11458 4	11145 2	10837 6	10535 4	10238 6	9947 1	9660 8	9379 6	9103 6	8832 6	38
23	11453 1	11140 0	10832 5	10530 4	10233 7	9942 2	9656 0	9375 0	9099 1	8828 1	37
24	11447 8	11134 9	10827 4	10525 4	10228 8	9937 4	9651 3	9370 4	9094 5	8823 7	36
25	11442 6	11129 7	10822 3	10520 4	10223 9	9932 6	9646 6	9365 7	9089 9	8819 2	35
26	11437 3	11124 5	10817 3	10515 4	10219 0	9927 8	9641 9	9361 1	9085 4	8814 7	34
27	11432 1	11119 4	10812 2	10510 4	10214 1	9923 0	9637 1	9356 4	9080 8	8810 3	33
28	11426 8	11114 2	10807 1	10505 5	10209 2	9918 2	9632 4	9351 8	9076 3	8805 8	32
29	11421 6	11109 0	10802 0	10500 5	10204 3	9913 4	9627 7	9347 2	9071 7	8801 3	31
30	11416 3	11103 9	10797 0	10495 5	10199 4	9908 6	9623 0	9342 5	9067 2	8796 9	30
31	11411 0	11098 7	10791 9	10490 5	10194 5	9903 8	9618 3	9337 9	9062 6	8792 4	29
32	11405 8	11093 6	10786 8	10485 5	10189 6	9899 0	9613 6	9333 3	9058 1	8787 9	28
33	11400 5	11088 4	10781 8	10480 6	10184 7	9894 2	9608 8	9328 7	9053 6	8783 5	27
34	11395 3	11083 2	10776 7	10475 6	10179 8	9889 4	9604 1	9324 0	9049 0	8779 0	26
35	11390 1	11078 1	10771 6	10470 6	10175 0	9884 6	9599 4	9319 4	9044 5	8774 6	25
36	11384 8	11072 9	10766 6	10465 7	10170 1	9879 8	9594 7	9314 8	9039 9	8770 1	24
37	11379 6	11067 8	10761 5	10460 7	10165 2	9875 0	9590 0	9310 2	9035 4	8765 6	23
38	11374 3	11062 6	10756 5	10455 7	10160 3	9870 2	9585 3	9305 5	9030 9	8761 2	22
39	11369 1	11057 5	10751 4	10450 7	10155 4	9865 4	9580 6	9300 9	9026 3	8756 7	21
40	11363 8	11052 3	10746 4	10445 8	10150 6	9860 6	9575 9	9296 3	9021 8	8752 3	20
41	11358 6	11047 2	10741 3	10440 8	10145 7	9855 8	9571 2	9291 7	9017 3	8747 8	19
42	11353 4	11042 1	10736 2	10435 9	10140 8	9851 0	9566 5	9287 1	9012 7	8743 4	18
43	11348 1	11036 9	10731 2	10430 9	10135 9	9846 3	9561 8	9282 5	9008 2	8738 9	17
44	11342 9	11031 8	10726 1	10425 9	10131 1	9841 5	9557 1	9277 8	9003 7	8734 5	16
45	11337 7	11026 6	10721 1	10421 0	10126 2	9836 7	9552 4	9273 2	8999 1	8730 0	15
46	11332 4	11021 5	10716 1	10416 0	10121 3	9831 9	9547 7	9268 6	8994 6	8725 6	14
47	11327 2	11016 4	10711 0	10411 1	10116 5	9827 1	9543 0	9264 0	8990 1	8721 2	13
48	11322 0	11011 2	10706 0	10406 1	10111 6	9822 4	9538 3	9259 4	8985 6	8716 7	12
49	11316 8	11006 1	10700 9	10401 2	10106 7	9817 6	9533 6	9254 8	8981 0	8712 3	11
50	11311 5	11001 0	10695 9	10396 2	10101 9	9812 8	9528 9	9250 2	8976 5	8707 8	10
51	11306 3	10995 8	10690 8	10391 3	10097 0	9808 0	9524 3	9245 6	8972 0	8703 4	9
52	11301 1	10990 7	10685 8	10386 3	10092 2	9803 3	9519 6	9241 0	8967 5	8699 0	8
53	11295 9	10985 6	10680 8	10381 4	10087 3	9798 5	9514 9	9236 4	8963 0	8694 5	7
54	11290 7	10980 5	10675 7	10376 4	10082 4	9793 7	9510 2	9231 8	8958 5	8690 1	6
55	11285 4	10975 3	10670 7	10371 5	10077 6	9789 0	9505 5	9227 2	8953 9	8685 7	5
56	11280 2	10970 2	10665 7	10366 5	10072 7	9784 2	9500 8	9222 6	8949 4	8681 3	4
57	11275 0	10965 1	10660 6	10361 6	10067 9	9779 4	9496 2	9218 0	8944 9	8676 8	3
58	11269 8	10960 0	10655 6	10356 7	10063 0	9774 7	9491 5	9213 4	8940 4	8672 4	2
59	11264 6	10954 9	10650 6	10351 7	10058 2	9769 9	9486 8	9208 8	8935 9	8668 0	1
60	11259 4	10949 7	10645 6	10346 8	10053 3	9765 1	9482 1	9204 2	8931 4	8663 5	0
	259°	258°	257°	256°	255°	254°	253°	252°	251°	250°	

Hour Angle

Hour Angle

	II0°	III°	II2°	II3°	II4°	II5°	II6°	II7°	II8°	II9°	
0	8663 5	8400 6	8142 6	7889 3	7640 9	7397 1	7158 0	6923 4	6693 4	6468 0	60
1	8659 1	8396 3	8138 3	7885 2	7636 8	7393 1	7154 0	6919 6	6689 6	6464 2	59
2	8654 7	8392 0	8134 1	7881 0	7632 7	7389 0	7150 1	6915 7	6685 9	6460 5	58
3	8650 3	8387 6	8129 8	7876 8	7628 6	7385 0	7146 1	6911 8	6682 1	6456 8	57
4	8645 9	8383 3	8125 5	7872 6	7624 5	7381 0	7142 2	6907 9	6678 3	6453 1	56
5	8641 5	8378 9	8121 3	7868 5	7620 4	7377 0	7138 2	6904 1	6674 5	6449 4	55
6	8637 0	8374 6	8117 0	7864 3	7616 3	7373 0	7134 3	6900 2	6670 7	6445 7	54
7	8632 6	8370 3	8112 8	7860 1	7612 2	7368 9	7130 4	6896 4	6666 9	6441 9	53
8	8628 2	8365 9	8108 5	7855 9	7608 1	7364 9	7126 4	6892 5	6663 1	6438 2	52
9	8623 8	8361 6	8104 3	7851 8	7604 0	7360 9	7122 5	6888 6	6659 3	6434 5	51
10	8619 4	8357 3	8100 0	7847 6	7599 9	7356 9	7118 5	6884 8	6655 5	6430 8	50
11	8615 0	8353 0	8095 8	7843 4	7595 8	7352 9	7114 6	6880 9	6651 8	6427 1	49
12	8610 6	8348 6	8091 5	7839 3	7591 7	7348 9	7110 7	6877 1	6648 0	6423 4	48
13	8606 2	8344 3	8087 3	7835 1	7587 6	7344 9	7106 8	6873 2	6644 2	6419 7	47
14	8601 8	8340 0	8083 1	7830 9	7583 6	7340 9	7102 8	6869 4	6640 4	6416 0	46
15	8597 4	8335 7	8078 8	7826 8	7579 5	7336 9	7098 9	6865 5	6636 7	6412 3	45
16	8593 0	8331 3	8074 6	7822 6	7575 4	7332 9	7095 0	6861 7	6632 9	6408 6	44
17	8588 6	8327 0	8070 3	7818 5	7571 3	7328 9	7091 0	6857 8	6629 1	6404 9	43
18	8584 2	8322 7	8066 1	7814 3	7567 2	7324 9	7087 1	6854 0	6625 3	6401 2	42
19	8579 8	8318 4	8061 9	7810 1	7563 2	7320 9	7083 2	6850 1	6621 6	6397 5	41
20	8575 4	8314 1	8057 6	7806 0	7559 1	7316 9	7079 3	6846 3	6617 8	6393 8	40
21	8571 0	8309 8	8053 4	7801 8	7555 0	7312 9	7075 4	6842 4	6614 0	6390 1	39
22	8566 6	8305 4	8049 2	7797 7	7550 9	7308 9	7071 4	6838 6	6610 2	6386 4	38
23	8562 2	8301 1	8044 9	7793 5	7546 9	7304 9	7067 5	6834 7	6606 5	6382 7	37
24	8557 8	8296 8	8040 7	7789 4	7542 8	7300 9	7063 6	6830 9	6602 7	6379 0	36
25	8553 4	8292 5	8036 5	7785 2	7538 7	7296 9	7059 7	6827 0	6598 9	6375 3	35
26	8549 0	8288 2	8032 3	7781 1	7534 6	7292 9	7055 8	6823 2	6595 2	6371 6	34
27	8544 6	8283 9	8028 0	7776 9	7530 6	7288 9	7051 9	6819 4	6591 4	6368 0	33
28	8540 2	8279 6	8023 8	7772 8	7526 5	7284 9	7047 9	6815 5	6587 7	6364 3	32
29	8535 8	8275 3	8019 6	7768 7	7522 4	7280 9	7044 0	6811 7	6583 9	6360 6	31
30	8531 5	8271 0	8015 4	7764 5	7518 4	7276 9	7040 1	6807 9	6580 1	6356 9	30
31	8527 1	8266 7	8011 1	7760 4	7514 3	7272 9	7036 2	6804 0	6576 4	6353 2	29
32	8522 7	8262 4	8006 9	7756 2	7510 3	7269 0	7032 3	6800 2	6572 6	6349 5	28
33	8518 3	8258 1	8002 7	7752 1	7506 2	7265 0	7028 4	6796 4	6568 9	6345 8	27
34	8514 0	8253 8	7998 5	7748 0	7502 1	7261 0	7024 5	6792 5	6565 1	6342 2	26
35	8509 6	8249 5	7994 3	7743 8	7498 1	7257 0	7020 6	6788 7	6561 4	6338 5	25
36	8505 2	8245 2	7990 1	7739 7	7494 0	7253 0	7016 7	6784 9	6557 6	6334 8	24
37	8500 8	8240 9	7985 9	7735 6	7490 0	7249 1	7012 8	6781 1	6553 9	6331 1	23
38	8496 5	8236 6	7981 6	7731 4	7485 9	7245 1	7008 9	6777 2	6550 1	6327 5	22
39	8492 1	8232 4	7977 4	7727 3	7481 9	7241 1	7005 0	6773 4	6546 4	6323 8	21
40	8487 7	8228 1	7973 2	7723 2	7477 8	7237 1	7001 1	6769 6	6542 6	6320 1	20
41	8483 4	8223 8	7969 0	7719 0	7473 8	7233 2	6997 2	6765 8	6538 9	6316 4	19
42	8479 0	8219 5	7964 8	7714 9	7469 7	7229 2	6993 3	6762 0	6535 1	6312 8	18
43	8474 6	8215 2	7960 6	7710 8	7465 7	7225 2	6989 4	6758 1	6531 4	6309 1	17
44	8470 3	8210 9	7956 4	7706 7	7461 6	7221 3	6985 5	6754 3	6527 7	6305 4	16
45	8465 9	8206 6	7952 2	7702 5	7457 6	7217 3	6981 6	6750 5	6523 9	6301 8	15
46	8461 5	8202 4	7948 0	7698 4	7453 5	7213 3	6977 7	6746 7	6520 2	6298 1	14
47	8457 2	8198 1	7943 8	7694 3	7449 5	7209 4	6973 9	6742 9	6516 4	6294 4	13
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49	8448 5	8189 5	7935 4	7686 1	7441 4	7201 5	6966 1	6735 3	6509 0	6287 1	11
50	8444 1	8185 3	7931 2	7681 9	7437 4	7197 5	6962 2	6731 5	6505 2	6283 5	10
51	8439 8	8181 0	7927 0	7677 8	7433 3	7193 5	6958 3	6727 6	6501 5	6279 8	9
52	8435 4	8176 7	7922 8	7673 7	7429 3	7189 6	6954 4	6723 8	6497 8	6276 2	8
53	8431 1	8172 4	7918 6	7669 6	7425 3	7185 6	6950 6	6720 0	6494 0	6272 5	7
54	8426 7	8168 2	7914 4	7665 5	7421 2	7181 7	6946 7	6716 2	6490 3	6268 8	6
55	8422 4	8163 9	7910 3	7661 4	7417 2	7177 7	6942 8	6712 4	6486 6	6265 2	5
56	8418 0	8159 6	7906 1	7657 3	7413 2	7173 7	6938 9	6708 6	6482 9	6261 5	4
57	8413 7	8155 4	7901 9	7653 2	7409 2	7169 8	6935 0	6704 8	6479 1	6257 9	3
58	8409 3	8151 1	7897 7	7649 1	7405 1	7165 8	6931 2	6701 0	6475 4	6254 2	2
59	8405 0	8146 8	7893 5	7645 0	7401 1	7161 9	6927 3	6697 2	6471 7	6250 6	1
60	8400 6	8142 6	7889 3	7640 9	7397 1	7158 0	6923 4	6693 4	6468 0	6246 9	0
	249°	248°	247°	246°	245°	244°	243°	242°	241°	240°	

Hour Angle

Hour Angle

	120°	121°	122°	123°	124°	125°	126°	127°	128°	129°	
0	6246 9	6030 3	5818 1	5610 1	5406 5	5207 1	5011 9	4820 9	4634 0	4451 2	60
1	6243 3	6026 7	5814 6	5606 7	5403 1	5203 8	5008 7	4817 7	4630 9	4448 2	59
2	6239 6	6023 2	5811 1	5603 3	5399 8	5200 5	5005 5	4814 6	4627 8	4445 2	58
3	6236 0	6019 6	5807 6	5599 9	5396 4	5197 2	5002 3	4811 4	4624 7	4442 1	57
4	6232 4	6016 0	5804 1	5596 4	5393 1	5194 0	4999 0	4808 3	4621 7	4439 1	56
5	6228 7	6012 5	5800 6	5593 0	5389 7	5190 7	4995 8	4805 1	4618 6	4436 1	55
6	6225 1	6008 9	5797 1	5589 6	5386 4	5187 4	4992 6	4802 0	4615 5	4433 1	54
7	6221 4	6005 3	5793 6	5586 2	5383 0	5184 1	4989 4	4798 9	4612 4	4430 1	53
8	6217 8	6001 8	5790 1	5582 8	5379 7	5180 8	4986 2	4795 7	4609 4	4427 1	52
9	6214 2	5998 2	5786 6	5579 3	5376 3	5177 6	4983 0	4792 6	4606 3	4424 1	51
10	6210 5	5994 6	5783 1	5575 9	5373 0	5174 3	4979 8	4789 4	4603 2	4421 1	50
11	6206 9	5991 1	5779 6	5572 5	5369 6	5171 0	4976 6	4786 3	4600 2	4418 1	49
12	6203 3	5987 5	5776 1	5569 1	5366 3	5167 7	4973 4	4783 2	4597 1	4415 1	48
13	6199 6	5984 0	5772 7	5565 7	5362 9	5164 5	4970 2	4780 0	4594 0	4412 1	47
14	6196 0	5980 4	5769 2	5562 3	5359 6	5161 2	4967 0	4776 9	4591 0	4409 1	46
15	6192 4	5976 9	5765 7	5558 8	5356 3	5157 9	4963 8	4773 8	4587 9	4406 1	45
16	6188 7	5973 3	5762 2	5555 4	5352 9	5154 6	4960 6	4770 6	4584 8	4403 1	44
17	6185 1	5969 7	5758 7	5552 0	5349 6	5151 4	4957 4	4767 5	4581 8	4400 1	43
18	6181 5	5966 2	5755 2	5548 6	5346 2	5148 1	4954 2	4764 4	4578 7	4397 1	42
19	6177 9	5962 6	5751 8	5545 2	5342 9	5144 8	4951 0	4761 3	4575 7	4394 1	41
20	6174 2	5959 1	5748 3	5541 8	5339 6	5141 6	4947 8	4758 1	4572 6	4391 1	40
21	6170 6	5955 5	5744 8	5538 4	5336 2	5138 3	4944 6	4755 0	4569 5	4388 2	39
22	6167 0	5952 0	5741 3	5535 0	5332 9	5135 0	4941 4	4751 9	4566 5	4385 2	38
23	6163 4	5948 4	5737 9	5531 6	5329 6	5131 8	4938 2	4748 8	4563 4	4382 2	37
24	6159 8	5944 9	5734 4	5528 2	5326 2	5128 5	4935 0	4745 6	4560 4	4379 2	36
25	6156 1	5941 4	5730 9	5524 8	5322 9	5125 3	4931 8	4742 5	4557 3	4376 2	35
26	6152 5	5937 8	5727 4	5521 4	5319 6	5122 0	4928 6	4739 4	4554 3	4373 2	34
27	6148 9	5934 3	5724 0	5518 0	5316 3	5118 8	4925 4	4736 3	4551 2	4370 2	33
28	6145 3	5930 7	5720 5	5514 6	5312 9	5115 5	4922 2	4733 1	4548 2	4367 3	32
29	6141 7	5927 2	5717 0	5511 2	5309 6	5112 2	4919 1	4730 0	4545 1	4364 3	31
30	6138 1	5923 7	5713 6	5507 8	5306 3	5109 0	4915 9	4726 9	4542 1	4361 3	30
31	6134 5	5920 1	5710 1	5504 4	5303 0	5105 7	4912 7	4723 8	4539 0	4358 3	29
32	6130 9	5916 6	5706 6	5501 0	5299 6	5102 5	4909 5	4720 7	4536 0	4355 3	28
33	6127 3	5913 0	5703 2	5497 6	5296 3	5099 2	4906 3	4717 6	4532 9	4352 4	27
34	6123 7	5909 5	5699 7	5494 2	5293 0	5096 0	4903 2	4714 5	4529 9	4349 4	26
35	6120 0	5906 0	5696 3	5490 8	5289 7	5092 7	4900 0	4711 4	4526 8	4346 4	25
36	6116 4	5902 5	5692 8	5487 5	5286 4	5089 5	4896 8	4708 2	4523 8	4343 4	24
37	6112 8	5898 9	5689 3	5484 1	5283 0	5086 2	4893 6	4705 1	4520 8	4340 5	23
38	6109 2	5895 4	5685 9	5480 7	5279 7	5083 0	4890 4	4702 0	4517 7	4337 5	22
39	6105 6	5891 9	5682 4	5477 3	5276 4	5079 8	4887 3	4698 9	4514 7	4334 5	21
40	6102 0	5888 3	5679 0	5473 9	5273 1	5076 5	4884 1	4695 8	4511 7	4331 6	20
41	6098 4	5884 8	5675 5	5470 5	5269 8	5073 3	4880 9	4692 7	4508 6	4328 6	19
42	6094 8	5881 3	5672 1	5467 2	5266 5	5070 0	4877 8	4689 6	4505 6	4325 6	18
43	6091 3	5877 8	5668 6	5463 8	5263 2	5066 8	4874 6	4686 5	4502 6	4322 7	17
44	6087 7	5874 2	5665 2	5460 4	5259 9	5063 6	4871 4	4683 4	4499 5	4319 7	16
45	6084 1	5870 7	5661 7	5457 0	5256 6	5060 3	4868 3	4680 3	4496 5	4316 7	15
46	6080 5	5867 2	5658 3	5453 6	5253 3	5057 1	4865 1	4677 2	4493 5	4313 8	14
47	6076 9	5863 7	5654 8	5450 3	5250 0	5053 8	4861 9	4674 1	4490 4	4310 8	13
48	6073 3	5860 2	5651 4	5446 9	5246 7	5050 6	4858 8	4671 0	4487 4	4307 9	12
49	6069 7	5856 7	5647 9	5443 5	5243 3	5047 4	4855 6	4667 9	4484 4	4304 9	11
50	6066 1	5853 1	5644 5	5440 2	5240 0	5044 2	4852 4	4664 8	4481 4	4301 9	10
51	6062 5	5849 6	5641 1	5436 8	5236 7	5040 9	4849 3	4661 8	4478 3	4299 0	9
52	6059 0	5846 1	5637 6	5433 4	5233 5	5037 7	4846 1	4658 7	4475 3	4296 0	8
53	6055 4	5842 6	5634 2	5430 0	5230 2	5034 5	4843 0	4655 6	4472 3	4293 1	7
54	6051 8	5839 1	5630 7	5426 7	5226 9	5031 2	4839 8	4652 5	4469 3	4290 1	6
55	6048 2	5835 6	5627 3	5423 3	5223 6	5028 0	4836 6	4649 4	4466 3	4287 2	5
56	6044 6	5832 1	5623 9	5420 0	5220 3	5024 8	4833 5	4646 3	4463 2	4284 2	4
57	6041 0	5828 6	5620 4	5416 6	5217 0	5021 6	4830 3	4643 2	4460 2	4281 3	3
58	6037 5	5825 1	5617 0	5413 2	5213 7	5018 4	4827 2	4640 1	4457 2	4278 3	2
59	6033 9	5821 6	5613 6	5409 9	5210 4	5015 1	4824 0	4637 1	4454 2	4275 4	1
60	6030 3	5818 1	5610 1	5406 5	5207 1	5011 9	4820 9	4634 0	4451 2	4272 4	0
	239°	238°	237°	236°	235°	234°	233°	232°	231°	230°	

Hour Angle

Hour Angle

	130°	131°	132°	133°	134°	135°	136°	137°	138°	139°	
0	4272 4	4097 7	3927 0	3760 2	3597 4	3438 5	3283 4	3132 2	2984 8	2841 2	60
1	4269 5	4094 8	3924 2	3757 5	3594 7	3435 8	3280 9	3129 7	2982 4	2838 9	59
2	4266 5	4092 0	3921 4	3754 7	3592 0	3433 2	3278 3	3127 2	2980 0	2836 5	58
3	4263 6	4089 1	3918 6	3752 0	3589 4	3430 6	3275 8	3124 8	2977 6	2834 2	57
4	4260 7	4086 2	3915 7	3749 2	3586 7	3428 0	3273 2	3122 3	2975 1	2831 8	56
5	4257 7	4083 3	3912 9	3746 5	3584 0	3425 4	3270 7	3119 8	2972 7	2829 4	55
6	4254 8	4080 5	3910 1	3743 8	3581 3	3422 8	3268 1	3117 3	2970 3	2827 1	54
7	4251 8	4077 6	3907 3	3741 0	3578 6	3420 2	3265 6	3114 8	2967 9	2824 7	53
8	4248 9	4074 7	3904 5	3738 3	3576 0	3417 6	3263 0	3112 3	2965 5	2822 4	52
9	4246 0	4071 8	3901 7	3735 5	3573 3	3415 0	3260 5	3109 9	2963 0	2820 0	51
10	4243 0	4069 0	3898 9	3732 8	3570 6	3412 4	3257 9	3107 4	2960 6	2817 7	50
11	4240 1	4066 1	3896 1	3730 1	3568 0	3409 8	3255 4	3104 9	2958 2	2815 3	49
12	4237 2	4063 2	3893 3	3727 3	3565 3	3407 1	3252 9	3102 4	2955 8	2813 0	48
13	4234 2	4060 4	3890 5	3724 6	3562 6	3404 5	3250 3	3100 0	2953 4	2810 6	47
14	4231 3	4057 5	3887 7	3721 9	3560 0	3401 9	3247 8	3097 5	2951 0	2808 3	46
15	4228 4	4054 7	3884 9	3719 1	3557 3	3399 3	3245 3	3095 0	2948 6	2805 9	45
16	4225 4	4051 8	3882 1	3716 4	3554 6	3396 7	3242 7	3092 5	2946 2	2803 6	44
17	4222 5	4048 9	3879 3	3713 7	3552 0	3394 1	3240 2	3090 1	2943 8	2801 2	43
18	4219 6	4046 1	3876 5	3711 0	3549 3	3391 5	3237 6	3087 6	2941 4	2798 9	42
19	4216 7	4043 2	3873 7	3708 2	3546 6	3389 0	3235 1	3085 1	2938 9	2796 6	41
20	4213 7	4040 4	3871 0	3705 5	3544 0	3386 4	3232 6	3082 7	2936 5	2794 2	40
21	4210 8	4037 5	3868 2	3702 8	3541 3	3383 8	3230 1	3080 2	2934 1	2791 9	39
22	4207 9	4034 6	3865 4	3700 1	3538 7	3381 2	3227 5	3077 7	2931 7	2789 5	38
23	4205 0	4031 8	3862 6	3697 3	3536 0	3378 6	3225 0	3075 3	2929 3	2787 2	37
24	4202 1	4028 9	3859 8	3694 6	3533 4	3376 0	3222 5	3072 8	2926 9	2784 9	36
25	4199 1	4026 1	3857 0	3691 9	3530 7	3373 4	3219 9	3070 3	2924 5	2782 5	35
26	4196 2	4023 2	3854 2	3689 2	3528 0	3370 8	3217 4	3067 9	2922 1	2780 2	34
27	4193 3	4020 4	3851 5	3686 5	3525 4	3368 2	3214 9	3065 4	2919 7	2777 9	33
28	4190 4	4017 5	3848 7	3683 7	3522 7	3365 6	3212 4	3063 0	2917 3	2775 5	32
29	4187 5	4014 7	3845 9	3681 0	3520 1	3363 0	3209 9	3060 5	2915 0	2773 2	31
30	4184 6	4011 8	3843 1	3678 3	3517 4	3360 5	3207 3	3058 0	2912 6	2770 9	30
31	4181 7	4009 0	3840 3	3675 6	3514 8	3357 9	3204 8	3055 6	2910 2	2768 5	29
32	4178 7	4006 2	3837 6	3672 9	3512 1	3355 3	3202 3	3053 1	2907 8	2766 2	28
33	4175 8	4003 3	3834 8	3670 2	3509 5	3352 7	3199 8	3050 7	2905 4	2763 9	27
34	4172 9	4000 5	3832 0	3667 5	3506 9	3350 1	3197 3	3048 2	2903 0	2761 5	26
35	4170 0	3997 6	3829 2	3664 8	3504 2	3347 5	3194 7	3045 8	2900 6	2759 2	25
36	4167 1	3994 8	3826 5	3662 1	3501 6	3345 0	3192 2	3043 3	2898 2	2756 9	24
37	4164 2	3992 0	3823 7	3659 3	3498 9	3342 4	3189 7	3040 9	2895 8	2754 6	23
38	4161 3	3989 1	3820 9	3656 6	3496 3	3339 8	3187 2	3038 4	2893 4	2752 2	22
39	4158 4	3986 3	3818 1	3653 9	3493 6	3337 2	3184 7	3036 0	2891 1	2749 9	21
40	4155 5	3983 5	3815 4	3651 2	3491 0	3334 7	3182 2	3033 5	2888 7	2747 6	20
41	4152 6	3980 6	3812 6	3648 5	3488 4	3332 1	3179 7	3031 1	2886 3	2745 3	19
42	4149 7	3977 8	3809 8	3645 8	3485 7	3329 5	3177 2	3028 6	2883 9	2743 0	18
43	4146 8	3975 0	3807 1	3643 1	3483 1	3327 0	3174 7	3026 2	2881 5	2740 7	17
44	4143 9	3972 1	3804 3	3640 4	3480 5	3324 4	3172 2	3023 8	2879 2	2738 3	16
45	4141 0	3969 3	3801 5	3637 7	3477 8	3321 8	3169 7	3021 3	2876 8	2736 0	15
46	4138 1	3966 5	3798 8	3635 0	3475 2	3319 2	3167 1	3018 9	2874 4	2733 7	14
47	4135 2	3963 6	3796 0	3632 3	3472 6	3316 7	3164 6	3016 4	2872 0	2731 4	13
48	4132 3	3960 8	3793 3	3629 6	3469 9	3314 1	3162 1	3014 0	2869 7	2729 1	12
49	4129 4	3958 0	3790 5	3627 0	3467 3	3311 6	3159 6	3011 6	2867 3	2726 8	11
50	4126 6	3955 2	3787 7	3624 3	3464 7	3309 0	3157 1	3009 1	2864 9	2724 5	10
51	4123 7	3952 3	3785 0	3621 6	3462 1	3306 4	3154 6	3006 7	2862 5	2722 2	9
52	4120 8	3949 5	3782 2	3618 9	3459 4	3303 9	3152 1	3004 3	2860 2	2719 8	8
53	4117 9	3946 7	3779 5	3616 2	3456 8	3301 3	3149 7	3001 8	2857 8	2717 5	7
54	4115 0	3943 9	3776 7	3613 5	3454 2	3298 7	3147 2	2999 4	2855 4	2715 2	6
55	4112 1	3941 1	3774 0	3610 8	3451 6	3296 2	3144 7	2997 0	2853 1	2712 9	5
56	4109 2	3938 2	3771 2	3608 1	3448 9	3293 6	3142 2	2994 5	2850 7	2710 6	4
57	4106 3	3935 4	3768 5	3605 4	3446 3	3291 1	3139 7	2992 1	2848 3	2708 3	3
58	4103 5	3932 6	3765 7	3602 8	3443 7	3288 5	3137 2	2989 7	2846 0	2706 0	2
59	4100 6	3929 8	3763 0	3600 1	3441 1	3286 0	3134 7	2987 3	2843 6	2703 7	1
60	4097 7	3927 0	3760 2	3597 4	3438 5	3283 4	3132 2	2984 8	2841 2	2701 4	0
	220°	228°	227°	226°	225°	224°	223°	222°	221°	220°	

Hour Angle

Hour Angle

	I40°	I41°	I42°	I43°	I44°	I45°	I46°	I47°	I48°	I49°	
0	2701 4	2565 3	2433 0	2304 3	2179 4	2058 0	1940 4	1826 3	1715 8	1608 9	60
1	2699 1	2563 1	2430 8	2302 2	2177 3	2056 1	1938 4	1824 4	1714 0	1607 2	59
2	2696 8	2560 9	2428 6	2300 1	2175 3	2054 1	1936 5	1822 6	1712 2	1605 4	58
3	2694 5	2558 6	2426 5	2298 0	2173 2	2052 1	1934 6	1820 7	1710 4	1603 7	57
4	2692 2	2556 4	2424 3	2295 9	2171 2	2050 1	1932 7	1818 8	1708 6	1601 9	56
5	2689 9	2554 2	2422 1	2293 8	2169 1	2048 1	1930 7	1817 0	1706 8	1600 2	55
6	2687 6	2551 9	2420 0	2291 7	2167 1	2046 1	1928 8	1815 1	1705 0	1598 5	54
7	2685 4	2549 7	2417 8	2289 6	2165 0	2044 1	1926 9	1813 2	1703 2	1596 7	53
8	2683 1	2547 5	2415 6	2287 5	2163 0	2042 1	1925 0	1811 4	1701 4	1595 0	52
9	2680 8	2545 3	2413 5	2285 4	2160 9	2040 2	1923 0	1809 5	1699 6	1593 2	51
10	2678 5	2543 0	2411 3	2283 3	2158 9	2038 2	1921 1	1807 6	1697 8	1591 5	50
11	2676 2	2540 8	2409 1	2281 2	2156 9	2036 2	1919 2	1805 8	1696 0	1589 7	49
12	2673 9	2538 6	2407 0	2279 1	2154 8	2034 2	1917 3	1803 9	1694 2	1588 0	48
13	2671 6	2536 4	2404 8	2277 0	2152 8	2032 2	1915 3	1802 1	1692 4	1586 3	47
14	2669 3	2534 1	2402 6	2274 9	2150 7	2030 3	1913 4	1800 2	1690 6	1584 5	46
15	2667 1	2531 9	2400 5	2272 8	2148 7	2028 3	1911 5	1798 4	1688 8	1582 8	45
16	2664 8	2529 7	2398 3	2270 7	2146 7	2026 3	1909 6	1796 5	1687 0	1581 0	44
17	2662 5	2527 5	2396 2	2268 6	2144 6	2024 3	1907 7	1794 6	1685 2	1579 3	43
18	2660 2	2525 2	2394 0	2266 5	2142 6	2022 4	1905 8	1792 8	1683 4	1577 6	42
19	2657 9	2523 0	2391 9	2264 4	2140 6	2020 4	1903 9	1790 9	1681 6	1575 8	41
20	2655 6	2520 8	2389 7	2262 3	2138 5	2018 4	1901 9	1789 1	1679 8	1574 1	40
21	2653 4	2518 6	2387 5	2260 2	2136 5	2016 4	1900 0	1787 2	1678 0	1572 4	39
22	2651 1	2516 4	2385 4	2258 1	2134 5	2014 5	1898 1	1785 4	1676 2	1570 6	38
23	2648 8	2514 2	2383 2	2256 0	2132 4	2012 5	1896 2	1783 5	1674 4	1568 9	37
24	2646 5	2512 0	2381 1	2253 9	2130 4	2010 5	1894 3	1781 7	1672 7	1567 2	36
25	2644 3	2509 8	2378 9	2251 8	2128 4	2008 6	1892 4	1779 8	1670 9	1565 5	35
26	2642 0	2507 5	2376 8	2249 7	2126 3	2006 6	1890 5	1778 0	1669 1	1563 7	34
27	2639 7	2505 3	2374 6	2247 6	2124 3	2004 6	1888 6	1776 1	1667 3	1562 0	33
28	2637 5	2503 1	2372 5	2245 6	2122 3	2002 7	1886 7	1774 3	1665 5	1560 3	32
29	2635 2	2500 9	2370 4	2243 5	2120 3	2000 7	1884 8	1772 5	1663 7	1558 6	31
30	2632 9	2498 7	2368 2	2241 4	2118 3	1998 8	1882 9	1770 6	1661 9	1556 8	30
31	2630 7	2496 5	2366 1	2239 3	2116 2	1996 8	1881 0	1768 8	1660 2	1555 1	29
32	2628 4	2494 3	2363 9	2237 2	2114 2	1994 8	1879 1	1766 9	1658 4	1553 4	28
33	2626 1	2492 1	2361 8	2235 2	2112 2	1992 9	1877 2	1765 1	1656 6	1551 7	27
34	2623 9	2489 9	2359 6	2233 1	2110 2	1990 9	1875 3	1763 3	1654 8	1550 0	26
35	2621 6	2487 7	2357 5	2231 0	2108 2	1989 0	1873 4	1761 4	1653 1	1548 2	25
36	2619 3	2485 5	2355 4	2228 9	2106 1	1987 0	1871 5	1759 6	1651 3	1546 5	24
37	2617 1	2483 3	2353 2	2226 8	2104 1	1985 1	1869 6	1757 8	1649 5	1544 8	23
38	2614 8	2481 1	2351 1	2224 8	2102 1	1983 1	1867 7	1755 9	1647 7	1543 1	22
39	2612 6	2478 9	2349 0	2222 7	2100 1	1981 1	1865 8	1754 1	1646 0	1541 4	21
40	2610 3	2476 7	2346 8	2220 6	2098 1	1979 2	1863 9	1752 3	1644 2	1539 7	20
41	2608 0	2474 5	2344 7	2218 5	2096 1	1977 2	1862 0	1750 4	1642 4	1538 0	19
42	2605 8	2472 3	2342 6	2216 5	2094 1	1975 3	1860 1	1748 6	1640 6	1536 2	18
43	2603 5	2470 1	2340 4	2214 4	2092 1	1973 3	1858 3	1746 8	1638 9	1534 5	17
44	2601 3	2467 9	2338 3	2212 3	2090 0	1971 4	1856 4	1744 9	1637 1	1532 8	16
45	2599 0	2465 7	2336 2	2210 3	2088 0	1969 4	1854 5	1743 1	1635 3	1531 1	15
46	2596 8	2463 5	2334 0	2208 2	2086 0	1967 5	1852 6	1741 3	1633 6	1529 4	14
47	2594 5	2461 4	2331 9	2206 1	2084 0	1965 6	1850 7	1739 5	1631 8	1527 7	13
48	2592 3	2459 2	2329 8	2204 1	2082 0	1963 6	1848 8	1737 6	1630 0	1526 0	12
49	2590 0	2457 0	2327 7	2202 0	2080 0	1961 7	1846 9	1735 8	1628 3	1524 3	11
50	2587 8	2454 8	2325 5	2199 9	2078 0	1959 7	1845 1	1734 0	1626 5	1522 6	10
51	2585 5	2452 6	2323 4	2197 9	2076 0	1957 8	1843 2	1732 2	1624 8	1520 9	9
52	2583 3	2450 4	2321 3	2195 8	2074 0	1955 8	1841 3	1730 4	1623 0	1519 2	8
53	2581 0	2448 2	2319 2	2193 8	2072 0	1953 9	1839 4	1728 5	1621 2	1517 5	7
54	2578 8	2446 1	2317 0	2191 7	2070 0	1952 0	1837 5	1726 7	1619 5	1515 8	6
55	2576 5	2443 9	2314 9	2189 6	2068 0	1950 0	1835 7	1724 9	1617 7	1514 1	5
56	2574 3	2441 7	2312 8	2187 6	2066 0	1948 1	1833 8	1723 1	1616 0	1512 4	4
57	2572 1	2439 5	2310 7	2185 5	2064 0	1946 2	1831 9	1721 3	1614 2	1510 7	3
58	2569 8	2437 3	2308 6	2183 5	2062 0	1944 2	1830 0	1719 5	1612 5	1509 0	2
59	2567 6	2435 2	2306 5	2181 4	2060 0	1942 3	1828 2	1717 6	1610 7	1507 3	1
60	2565 3	2433 0	2304 3	2179 4	2058 0	1940 4	1826 3	1715 8	1608 9	1505 6	0
	219°	218°	217°	216°	215°	214°	213°	212°	211°	210°	

Hour Angle

Hour Angle

	150°	151°	152°	153°	154°	155°	156°	157°	158°	159°	
0	1505 6	1405 8	1309 6	1216 8	1127 6	1041 8	959 6	880 7	805 3	733 4	60
1	1503 9	1404 2	1308 0	1215 3	1126 1	1040 4	958 2	879 4	804 1	732 2	59
2	1502 2	1402 6	1306 4	1213 8	1124 7	1039 0	956 9	878 2	802 9	731 0	58
3	1500 5	1400 9	1304 9	1212 3	1123 2	1037 7	955 5	876 9	801 7	729 9	57
4	1498 9	1399 3	1303 3	1210 8	1121 8	1036 3	954 2	875 6	800 4	728 7	56
5	1497 2	1397 7	1301 7	1209 3	1120 3	1034 9	952 9	874 3	799 2	727 6	55
6	1495 5	1396 1	1300 2	1207 8	1118 9	1033 5	951 5	873 0	798 0	726 5	54
7	1493 8	1394 4	1298 6	1206 3	1117 4	1032 1	950 2	871 8	796 8	725 2	53
8	1492 1	1392 8	1297 0	1204 7	1116 0	1030 7	948 9	870 5	795 6	724 1	52
9	1490 4	1391 2	1295 5	1203 2	1114 5	1029 3	947 5	869 2	794 3	722 9	51
10	1488 7	1389 6	1293 9	1201 7	1113 1	1027 9	946 2	867 9	793 1	721 7	50
11	1487 1	1387 9	1292 3	1200 2	1111 6	1026 5	944 9	866 7	791 9	720 6	49
12	1485 4	1386 3	1290 8	1198 7	1110 2	1025 1	943 5	865 4	790 7	719 4	48
13	1483 7	1384 7	1289 2	1197 2	1108 7	1023 7	942 2	864 1	789 5	718 2	47
14	1482 0	1383 1	1287 6	1195 7	1107 3	1022 3	940 9	862 8	788 2	717 1	46
15	1480 3	1381 4	1286 1	1194 2	1105 8	1021 0	939 5	861 6	787 0	715 9	45
16	1478 7	1379 8	1284 5	1192 7	1104 4	1019 6	938 2	860 3	785 8	714 8	44
17	1477 0	1378 2	1283 0	1191 2	1103 0	1018 2	936 9	859 0	784 6	713 6	43
18	1475 3	1376 6	1281 4	1189 7	1101 5	1016 8	935 5	857 8	783 4	712 5	42
19	1473 6	1375 0	1279 8	1188 2	1100 1	1015 4	934 2	856 5	782 2	711 3	41
20	1472 0	1373 4	1278 3	1186 7	1098 6	1014 0	932 9	855 2	781 0	710 2	40
21	1470 3	1371 8	1276 7	1185 2	1097 2	1012 7	931 6	854 0	779 8	709 0	39
22	1468 6	1370 2	1275 2	1183 7	1095 8	1011 3	930 3	852 7	778 6	707 9	38
23	1467 0	1368 5	1273 6	1182 2	1094 3	1009 9	928 9	851 4	777 4	706 7	37
24	1465 3	1366 9	1272 1	1180 7	1092 9	1008 5	927 6	850 2	776 1	705 6	36
25	1463 6	1365 3	1270 5	1179 2	1091 5	1007 1	926 3	848 9	774 9	704 4	35
26	1461 9	1363 7	1269 0	1177 7	1090 0	1005 8	925 0	847 6	773 7	703 3	34
27	1460 3	1362 1	1267 4	1176 3	1088 6	1004 4	923 7	846 4	772 5	702 1	33
28	1458 6	1360 5	1265 9	1174 8	1087 2	1003 0	922 3	845 1	771 3	701 0	32
29	1457 0	1358 9	1264 3	1173 3	1085 7	1001 6	921 0	843 9	770 1	699 8	31
30	1455 3	1357 3	1262 8	1171 8	1084 3	1000 3	919 7	842 6	768 9	698 7	30
31	1453 6	1355 7	1261 2	1170 3	1082 9	998 9	918 4	841 4	767 7	697 6	29
32	1452 0	1354 1	1259 7	1168 8	1081 4	997 5	917 1	840 1	766 5	696 4	28
33	1450 3	1352 5	1258 1	1167 3	1080 0	996 2	915 8	838 8	765 3	695 3	27
34	1448 6	1350 9	1256 6	1165 8	1078 6	994 8	914 5	837 6	764 1	694 1	26
35	1447 0	1349 3	1255 1	1164 4	1077 2	993 4	913 2	836 3	763 0	693 0	25
36	1445 3	1347 7	1253 5	1162 9	1075 7	992 1	911 8	835 1	761 8	691 9	24
37	1443 7	1346 1	1252 0	1161 4	1074 3	990 7	910 5	833 8	760 6	690 7	23
38	1442 0	1344 5	1250 4	1159 9	1072 9	989 3	909 2	832 6	759 4	689 6	22
39	1440 4	1342 9	1248 9	1158 4	1071 5	988 0	907 9	831 3	758 2	688 5	21
40	1438 7	1341 3	1247 4	1157 0	1070 0	986 6	906 6	830 1	757 0	687 3	20
41	1437 1	1339 7	1245 8	1155 5	1068 6	985 2	905 3	828 8	755 8	686 2	19
42	1435 4	1338 1	1244 3	1154 0	1067 2	983 9	904 0	827 6	754 6	685 1	18
43	1433 8	1336 5	1242 8	1152 5	1065 8	982 5	902 7	826 4	753 4	683 9	17
44	1432 1	1334 9	1241 2	1151 1	1064 4	981 2	901 4	825 1	752 2	682 8	16
45	1430 5	1333 3	1239 7	1149 6	1063 0	979 8	900 1	823 9	751 1	681 7	15
46	1428 8	1331 7	1238 2	1148 1	1061 5	978 5	898 8	822 6	749 9	680 5	14
47	1427 2	1330 1	1236 6	1146 6	1060 1	977 1	897 5	821 4	748 7	679 4	13
48	1425 5	1328 6	1235 1	1145 2	1058 7	975 7	896 2	820 1	747 5	678 3	12
49	1423 9	1327 0	1233 6	1143 7	1057 3	974 4	894 9	818 9	746 3	677 2	11
50	1422 2	1325 4	1232 1	1142 2	1055 9	973 0	893 6	817 7	745 1	676 0	10
51	1420 6	1323 8	1230 5	1140 8	1054 5	971 7	892 3	816 4	744 0	674 9	9
52	1418 9	1322 2	1229 0	1139 3	1053 1	970 3	891 0	815 2	742 8	673 8	8
53	1417 3	1320 6	1227 5	1137 8	1051 7	969 0	889 7	814 0	741 6	672 7	7
54	1415 7	1319 1	1226 0	1136 4	1050 3	967 6	888 5	812 7	740 4	671 6	6
55	1414 0	1317 5	1224 4	1134 9	1048 9	966 3	887 2	811 5	739 3	670 4	5
56	1412 4	1315 9	1222 9	1133 4	1047 5	964 9	885 9	810 3	738 1	669 3	4
57	1410 7	1314 3	1221 4	1132 0	1046 1	963 6	884 6	809 0	736 9	668 2	3
58	1409 1	1312 7	1219 9	1130 5	1044 7	962 2	883 3	807 8	735 7	667 1	2
59	1407 5	1311 2	1218 4	1129 1	1043 2	960 9	882 0	806 6	734 6	666 0	1
60	1405 8	1309 6	1216 8	1127 6	1041 8	959 6	880 7	805 3	733 4	664 9	0
	209°	208°	207°	206°	205°	204°	203°	202°	201°	200°	

Hour Angle

Hour Angle

	160°	161°	162°	163°	164°	165°	166°	167°	168°	169°	
0	664 9	599 7	538 0	479 7	424 7	373 1	324 9	280 1	238 6	200 4	60
1	663 7	598 7	537 0	478 7	423 8	372 3	324 2	279 4	237 9	199 8	59
2	662 6	597 6	536 0	477 8	422 9	371 5	323 4	278 6	237 2	199 2	58
3	661 5	596 6	535 0	476 9	422 1	370 7	322 6	277 9	236 6	198 6	57
4	660 4	595 5	534 0	475 9	421 2	369 8	321 8	277 2	235 9	198 0	56
5	659 3	594 5	533 0	475 0	420 3	369 0	321 1	276 5	235 3	197 4	55
6	658 2	593 4	532 0	474 0	419 4	368 2	320 3	275 8	234 6	196 8	54
7	657 1	592 4	531 0	473 1	418 5	367 4	319 5	275 1	233 9	196 2	53
8	656 0	591 3	530 0	472 2	417 7	366 5	318 8	274 3	233 3	195 6	52
9	654 9	590 3	529 0	471 2	416 8	365 7	318 0	273 6	232 6	195 0	51
10	653 8	589 2	528 0	470 3	415 9	364 9	317 2	272 9	232 0	194 4	50
11	652 7	588 2	527 1	469 4	415 0	364 1	316 5	272 2	231 3	193 8	49
12	651 6	587 1	526 1	468 4	414 1	363 2	315 7	271 5	230 7	193 2	48
13	650 5	586 1	525 1	467 5	413 3	362 4	314 9	270 8	230 0	192 6	47
14	649 4	585 0	524 1	466 6	412 4	361 6	314 2	270 1	229 4	192 0	46
15	648 3	584 0	523 1	465 6	411 5	360 8	313 4	269 4	228 7	191 4	45
16	647 2	582 9	522 1	464 7	410 6	360 0	312 6	268 7	228 1	190 8	44
17	646 1	581 9	521 1	463 8	409 8	359 1	311 9	268 0	227 4	190 2	43
18	645 0	580 9	520 2	462 8	408 9	358 3	311 1	267 3	226 8	189 6	42
19	643 9	579 8	519 2	461 9	408 0	357 5	310 4	266 6	226 1	189 0	41
20	642 8	578 8	518 2	461 0	407 2	356 7	309 6	265 9	225 5	188 4	40
21	641 7	577 7	517 2	460 1	406 3	355 9	308 9	265 2	224 8	187 8	39
22	640 6	576 7	516 2	459 1	405 4	355 1	308 1	264 5	224 2	187 2	38
23	639 5	575 7	515 3	458 2	404 6	354 3	307 3	263 8	223 5	186 7	37
24	638 4	574 6	514 3	457 3	403 7	353 5	306 6	263 1	222 9	186 1	36
25	637 3	573 6	513 3	456 4	402 8	352 7	305 8	262 4	222 3	185 5	35
26	636 2	572 6	512 3	455 4	402 0	351 8	305 1	261 7	221 6	184 9	34
27	635 1	571 5	511 3	454 5	401 1	351 0	304 3	261 0	221 0	184 3	33
28	634 0	570 5	510 4	453 6	400 2	350 2	303 6	260 3	220 3	183 7	32
29	633 0	569 5	509 4	452 7	399 4	349 4	302 8	259 6	219 7	183 2	31
30	631 9	568 4	508 4	451 8	398 5	348 6	302 1	258 9	219 1	182 6	30
31	630 8	567 4	507 5	450 9	397 7	347 8	301 3	258 2	218 4	182 0	29
32	629 7	566 4	506 5	449 9	396 8	347 0	300 6	257 5	217 8	181 4	28
33	628 6	565 4	505 5	449 0	395 9	346 2	299 8	256 8	217 2	180 8	27
34	627 5	564 3	504 5	448 1	395 1	345 4	299 1	256 1	216 5	180 3	26
35	626 5	563 3	503 6	447 2	394 2	344 6	298 4	255 5	215 9	179 7	25
36	625 4	562 3	502 6	446 3	393 4	343 8	297 6	254 8	215 3	179 1	24
37	624 3	561 3	501 6	445 4	392 5	343 0	296 9	254 1	214 6	178 5	23
38	623 2	560 2	500 7	444 5	391 7	342 2	296 1	253 4	214 0	178 0	22
39	622 1	559 2	499 7	443 6	390 8	341 4	295 4	252 7	213 4	177 4	21
40	621 1	558 2	498 7	442 7	390 0	340 6	294 7	252 0	212 8	176 8	20
41	620 0	557 2	497 8	441 8	389 1	339 8	293 9	251 3	212 1	176 2	19
42	618 9	556 2	496 8	440 9	388 3	339 0	293 2	250 7	211 5	175 7	18
43	617 8	555 2	495 9	440 0	387 4	338 3	292 4	250 0	210 9	175 1	17
44	616 8	554 1	494 9	439 0	386 6	337 5	291 7	249 3	210 3	174 5	16
45	615 7	553 1	493 9	438 1	385 7	336 7	291 0	248 6	209 6	174 0	15
46	614 6	552 1	493 0	437 2	384 9	335 9	290 2	248 0	209 0	173 4	14
47	613 6	551 1	492 0	436 3	384 0	335 1	289 5	247 3	208 4	172 8	13
48	612 5	550 1	491 1	435 4	383 2	334 3	288 8	246 6	207 8	172 3	12
49	611 4	549 1	490 1	434 5	382 3	333 5	288 0	245 9	207 1	171 7	11
50	610 3	548 1	489 2	433 6	381 5	332 7	287 3	245 3	206 5	171 1	10
51	609 3	547 0	488 2	432 8	380 7	332 0	286 6	244 6	205 9	170 6	9
52	608 2	546 0	487 3	431 9	379 8	331 2	285 9	243 9	205 3	170 0	8
53	607 2	545 0	486 3	431 0	379 0	330 4	285 1	243 2	204 7	169 5	7
54	606 1	544 0	485 4	430 1	378 1	329 6	284 4	242 6	204 1	168 9	6
55	605 0	543 0	484 4	429 2	377 3	328 8	283 7	241 9	203 5	168 4	5
56	604 0	542 0	483 5	428 3	376 5	328 0	283 0	241 2	202 8	167 8	4
57	602 9	541 0	482 5	427 4	375 6	327 3	282 2	240 6	202 2	167 2	3
58	601 8	540 0	481 6	426 5	374 8	326 5	281 5	239 9	201 6	166 7	2
59	600 8	539 0	480 6	425 6	374 0	325 7	280 8	239 2	201 0	166 0	1
60	599 7	538 0	479 7	424 7	373 1	324 9	280 1	238 6	200 4	165 6	0
	199°	198°	197°	196°	195°	194°	193°	192°	191°	190°	

Hour Angle

Hour Angle

	170°	171°	172°	173°	174°	175°	176°	177°	178°	179°	
0	165 6	134 1	105 9	81 1	59 6	41 4	26 5	14 9	6 6	1 7	60
1	165 0	133 6	105 5	80 7	59 2	41 1	26 2	14 7	6 5	1 6	59
2	164 5	133 1	105 0	80 3	58 9	40 8	26 0	14 6	6 4	1 5	58
3	163 9	132 6	104 6	79 9	58 6	40 5	25 8	14 4	6 3	1 5	57
4	163 4	132 1	104 2	79 5	58 2	40 3	25 6	14 2	6 2	1 4	56
5	162 8	131 6	103 7	79 2	57 9	40 0	25 4	14 1	6 1	1 4	55
6	162 3	131 1	103 3	78 8	57 6	39 7	25 2	13 9	6 0	1 3	54
7	161 7	130 6	102 9	78 4	57 3	39 4	24 9	13 7	5 9	1 3	53
8	161 2	130 1	102 4	78 0	56 9	39 2	24 7	13 6	5 8	1 2	52
9	160 6	129 6	102 0	77 6	56 6	38 9	24 5	13 4	5 7	1 2	51
10	160 1	129 2	101 6	77 3	56 3	38 6	24 3	13 3	5 6	1 1	50
11	159 6	128 7	101 1	76 9	56 0	38 4	24 1	13 1	5 5	1 1	49
12	159 0	128 2	100 7	76 5	55 7	38 1	23 9	13 0	5 4	1 1	48
13	158 5	127 7	100 3	76 1	55 3	37 8	23 7	12 8	5 3	1 0	47
14	157 9	127 2	99 8	75 8	55 0	37 6	23 5	12 7	5 2	1 0	46
15	157 4	126 7	99 4	75 4	54 7	37 3	23 3	12 5	5 1	0 9	45
16	156 9	126 2	99 0	75 0	54 4	37 1	23 1	12 4	5 0	0 9	44
17	156 3	125 8	98 5	74 6	54 1	36 8	22 8	12 2	4 9	0 9	43
18	155 8	125 3	98 1	74 3	53 7	36 5	22 6	12 1	4 8	0 8	42
19	155 2	124 8	97 7	73 9	53 4	36 3	22 4	11 9	4 7	0 8	41
20	154 7	124 3	97 3	73 5	53 1	36 0	22 2	11 8	4 6	0 7	40
21	154 2	123 8	96 8	73 2	52 8	35 8	22 0	11 6	4 5	0 7	39
22	153 6	123 4	96 4	72 8	52 5	35 5	21 8	11 5	4 4	0 7	38
23	153 1	122 9	96 0	72 4	52 2	35 3	21 6	11 3	4 3	0 6	37
24	152 6	122 4	95 6	72 1	51 9	35 0	21 4	11 2	4 2	0 6	36
25	152 1	121 9	95 2	71 7	51 6	34 7	21 2	11 0	4 1	0 6	35
26	151 5	121 5	94 7	71 3	51 3	34 5	21 0	10 9	4 1	0 5	34
27	151 0	121 0	94 3	71 0	51 0	34 2	20 8	10 8	4 0	0 5	33
28	150 5	120 5	93 9	70 6	50 7	34 0	20 6	10 6	3 9	0 5	32
29	149 9	120 1	93 5	70 3	50 3	33 7	20 5	10 5	3 8	0 4	31
30	149 4	119 6	93 1	69 9	50 0	33 5	20 3	10 3	3 7	0 4	30
31	148 9	119 1	92 7	69 5	49 7	33 2	20 1	10 2	3 6	0 4	29
32	148 4	118 7	92 3	69 2	49 4	33 0	19 9	10 1	3 6	0 4	28
33	147 8	118 2	91 8	68 8	49 1	32 8	19 7	9 9	3 5	0 3	27
34	147 3	117 7	91 4	68 5	48 8	32 5	19 5	9 8	3 4	0 3	26
35	146 8	117 3	91 0	68 1	48 5	32 3	19 3	9 7	3 3	0 3	25
36	146 3	116 8	90 6	67 8	48 2	32 0	19 1	9 5	3 2	0 3	24
37	145 8	116 3	90 2	67 4	47 9	31 8	18 9	9 4	3 2	0 2	23
38	145 2	115 9	89 8	67 1	47 6	31 5	18 7	9 3	3 1	0 2	22
39	144 7	115 4	89 4	66 7	47 3	31 3	18 6	9 1	3 0	0 2	21
40	144 2	114 9	89 0	66 4	47 1	31 1	18 4	9 0	2 9	0 2	20
41	143 7	114 5	88 6	66 0	46 8	30 8	18 2	8 9	2 9	0 2	19
42	143 2	114 0	88 2	65 7	46 5	30 6	18 0	8 7	2 8	0 1	18
43	142 7	113 6	87 8	65 3	46 2	30 4	17 8	8 6	2 7	0 1	17
44	142 2	113 1	87 4	65 0	45 9	30 1	17 6	8 5	2 7	0 1	16
45	141 6	112 7	87 0	64 6	45 6	29 9	17 5	8 4	2 6	0 1	15
46	141 1	112 2	86 6	64 3	45 3	29 6	17 3	8 2	2 5	0 1	14
47	140 6	111 7	86 2	63 9	45 0	29 4	17 1	8 1	2 4	0 1	13
48	140 1	111 3	85 8	63 6	44 7	29 2	16 9	8 0	2 4	0 1	12
49	139 6	110 8	85 4	63 3	44 4	28 9	16 8	7 9	2 3	0 1	11
50	139 1	110 4	85 0	62 9	44 2	28 7	16 6	7 8	2 3	0 0	10
51	138 6	109 9	84 6	62 6	43 9	28 5	16 4	7 6	2 2	0 0	9
52	138 1	109 5	84 2	62 2	43 6	28 3	16 2	7 5	2 1	0 0	8
53	137 6	109 0	83 8	61 9	43 3	28 0	16 1	7 4	2 1	0 0	7
54	137 1	108 6	83 4	61 6	43 0	27 8	15 9	7 3	2 0	0 0	6
55	136 6	108 1	83 0	61 2	42 7	27 6	15 7	7 2	1 9	0 0	5
56	136 1	107 7	82 6	60 9	42 5	27 4	15 6	7 1	1 9	0 0	4
57	135 6	107 3	82 2	60 6	42 2	27 1	15 4	6 9	1 8	0 0	3
58	135 1	106 8	81 9	60 2	41 9	26 9	15 2	6 8	1 8	0 0	2
59	134 6	106 4	81 5	59 9	41 6	26 7	15 1	6 7	1 7	0 0	1
60	134 1	105 9	81 1	59 6	41 4	26 5	14 9	6 6	1 7	0 0	0
	189°	188°	187°	186°	185°	184°	183°	182°	181°	180°	

Hour Angle

A FEW VALUABLE OPINIONS.

RIVISTA MARITTIMA ITALIANA, *February* 1910.

BIBLIOGRAFIA.

“Il procedimento del de Aquino è ingegnossissimo, poichè, spezzando in due triangoli sferici rettangoli il noto triangolo SPZ, conducendo l'arco normale all'arco PZ, dà una serie di relazioni ben note, che abilmente utilizzate, per mezzo di una tavola di altezza ad azimut e tavole ausiliarie (pagg. 3-128), rende il conteggio pratico così semplice ed esatto per le esigenze nautiche da destare in verità meraviglia.”—E. MILOSEVICH, *Director of the Observatory of Rome, Italy.*

ALMIRANTE GARCIA MANSILLA, DETERMINACIÓN DEL PUNTO
EN LA MAR, BUENOS AIRES, 1910.

“Sea como fuera, debo mencionar en primer término y con especial satisfacción, las tablas de Altura y Azimut, del señor Radler de Aquino por ser, sin duda alguna, la mejor solución del problema que yo conozco.”—*From Paper read before the Congreso Científico Internacional held at Buenos Aires, 1910.*

ANNALEN DER HYDROGRAPHIE UND MARITIMEN
METEOROLOGIE, *November* 1910.

RADLER DE AQUINO: Altitude and azimuth tables for facilitating the determination of lines of position and geographical position at sea. The simplest and readiest in solution. Spherical traverse tables for solving all problems of navigation. 8vo. 128 pp. London, 1910. J. D. Potter, and Rio de Janeiro, 1910. Radler de Aquino. Preis 10s. 6d.

Die Höhen- und Azimut-Tafeln des Leutnants RADLER DE AQUINO der brasilianischen Kriegs-Marine liefern ein recht bequemes Hilfsmittel, um die für Anwendung der Marq St. Hilaireschen Methode notwendigen Berechnungen der Höhe und des Azimuts ohne logarithmische Rechnung durchzuführen. Durch Zerlegung des Poldreiecks in zwei rechtwinklige sphärische Dreiecke (durch Fällen eines Lots vom Gestirnsort auf den Meridian) wird ermöglicht, dass die Lösung der Hauptaufgaben der nautischen Astronomie mit den Tafeln nach einheitlicher Methode zu erreichen ist. Um die Höhe und das Azimut eines Gestirns zu finden, geht man mit der Abweichung und dem Stundenwinkel in die Tafel und entnimmt zunächst Näherungswerte zweier Hilfsgrößen (a und b). Mit diesen findet man durch nochmaligen Eingang den der Abweichung entsprechenden Wert von b und aus diesem den Wert eines Stundenwinkels, der anstatt des aus der gegissten Länge hergeleiteten Stundenwinkels benutzt wird. Das gefundene b und die zweckentsprechend geänderte Breite geben Höhe und Azimut, die also nicht für den gegissten Ort, sondern für einen Hilfspunkt gelten. Es ist jedoch nach den in den Tafeln gegebenen Anweisungen nur mit wenig Mehrarbeit verknüpft, wenn man Höhe und Azimut für das gegisste Besteck ermitteln will. Die Tafeln lassen sich, wie in der Gebrauchsanweisung ausführlich auseinander gesetzt wird, auch zur Lösung anderer Aufgaben der nautischen Astronomie mit Vorteil verwenden. So lässt sich mit den Tafeln leicht ermitteln, wenn Höhe und Azimut eines Gestirnes beobachtet sind, zu welchem Gestirne diese Größen gehören. Auch die Ermittlung des Zeit- und des Zeithöhen-Azimuts, der Amplitude und der Höhe eines Gestirns im Ersten Vertikal usw. lässt an Bequemlichkeit nichts zu wünschen übrig, so dass sich diese Tafeln bald Freunde unter den Nautikern erwerben werden, die Höhenberechnungen ohne Benutzung der Logarithmentafeln bevorzugen. Sk.

NAUTICAL MAGAZINE, *February* 1910.

“Whether or no any marked simplification results from the use of the new processes is a point which the navigator may easily determine for himself, but we have no hesitation in endorsing the verdict of the Hydrographer of the U.S. Navy, that ‘the plan of the work is sound in principle and scientific in conception.’ The central idea is distinctly original, and the work forms an interesting addition to the literature of Nautical Astronomy.”

“Altogether the book is a remarkable triumph of ingenuity, and does credit to designer and printer and publisher.”—Rev. WILLIAM HALL, R.N., in the *Nautical Magazine for November, 1910, page 486.*

BRAZILIAN NAVY OFFICIAL OPINIONS

PARECERES OFFICIAES.

Cópia.—Ministerio da Marinha. Estado Maior da Armada. Em 15 de setembro de 1910.—Ao Sr. Vice-almirante Ministro da Marinha. Passo ás vossas mãos com os presentes papéis o parecer apresentado pelo capitão-tenente Augusto Cesar Burlamaqui, membro da commissão nomeada pelo capitão de mar e guerra João Baptista das Neves, commandante do encouraçado *Minas Geraes*, para estudar o trabalho apresentado pelo capitão-tenente Radler de Aquino, intitulado *Altitude and Azimuth Tables*. Não só pela leitura do referido parecer, como pela opinião daquelle commandante, que diz que o uso dessas taboas tornou-se generalisado a bordo durante a longa commissão emprehendida pelo mesmo encouraçado, do porto de Newcastle-on-Tyne ao desta Capital, facto este que demonstra a sua utilidade e o modo facil e pratico do seu emprego, podereis verificar que o trabalho desse intelligente e operoso official é digno de ser adoptado, pois torna de extrema facilidade o traçado da recta de posição e resolve com um grau de precisão acceitavel para a navegação um numeroso grupo de problemas. Saude e fraternidade. (Assignado) H. PINHEIRO GUEDES, Vice-almirante, Chefe do Estado Maior da Armada.

Cópia.—Commando do encouraçado *Minas Geraes*. Rio de Janeiro, 9 de setembro de 1910. N. 264.—Sr. Contra-almirante Commandante da Divisão de Encouraçados. Cumpre-me enviar-vos o parecer apresentado pelo Sr. capitão-tenente Augusto Cesar Burlamaqui sobre o trabalho intitulado *Altitude and Azimuth Tables*, do Sr. capitão tenente Radler de Aquino. Tendo apparecido este trabalho antes da partida deste encouraçado do porto de Newcastle, nomeei uma commissão de tres officiaes do navio para dar parecer sobre o seu valor e utilidade; esta commissão era composta dos Srs. capitães-tenentes Augusto Cesar Burlamaqui, Alfredo Dodsworth e Leopoldo Nobrega Moreira. Pela leitura do parecer, podereis verificar a opinião favoravel da commissão, cabendo pela minha parte accrescentar que o uso dessas taboas tornou-se generalisado a bordo durante a commissão, facto este que demonstra a sua utilidade e o modo facil e pratico do seu emprego. Estas taboas representam mais um importante trabalho dado á publicidade pelo seu illustre e operoso autor. Saude e fraternidade. JOÃO BAPTISTA DAS NEVES, capitão de mar e guerra.

Ilha Grande, 10 de abril de 1910.—Passo ás vossas mãos o parecer elaborado pela commissão por vós nomeada para emittir juizo sobre o trabalho da lavra do Sr. capitão-tenente Radler de Aquino, intitulado *Altitude and Azimuth Tables*. Em abono das referidas taboas do estudioso official da nossa marinha de guerra vem a longa commissão desempenhada pelo couraçado *Minas Geraes*, sob o vosso commando, durante a qual foram verificados á saciedade os magnificos resultados fornecidos pelas taboas em comparação com os varios processos utilizados a bordo para o mesmo fim. O methodo Marcq, hoje definitivamente adoptado, encontra no inestimavel livro do Sr. capitão-tenente Radler de Aquino a sua resolução simples, rapida e segura, tornando de extrema facilidade o traçado da recta de posição e resolvendo com um gráo de precisão acceitavel para a navegação um numeroso grupo de problemas. Julgo que as taboas de 360 paginas, que o Sr. capitão-tenente Radler de Aquino promete publicar, facilitarão de modo tal o calculo das coordenadas da posição do navio, que affirmo esperar o mais favoravel acolhimento por todos os que se interessam pelos progressos da navegação.—*Augusto Cesar Burlamaqui*, capitão-tenente, instructor de navegação. Ao Sr. capitão de mar e guerra commandante do couraçado *Minas Geraes*, João Baptista das Neves.

OTHER WORKS OF THE AUTHOR NOT MENTIONED
IN THESE TABLES

O Methodo de Marcq Saint Hilaire para um observador determinar a sua posição no mar, com taboas para a sua applicação. *Imprensa Nacional*, Rio de Janeiro, 1902. This work was printed by order of the Minister of Marine, and was first published in the *Revista Maritima Brasileira* for November, 1899, January, 1900, and October, 1900.

Tipos de calculo para o methodo de Marcq Saint Hilaire pela modificação do Dr. Otto Fulst de Hamburgo. *Imprensa Nacional*, Rio de Janeiro, 1902. Reprinted from the *Revista Maritima Brasileira* for December, 1901.

Estudo theorico e pratico dos Instrumentos Nauticos de Lord Kelvin. Descripção e theoria da agulha de Lord Kelvin. Magnetismo dos navios. Theoria geral dos desvios das agulhas e de sua compensação. *Imprensa Nacional*, Rio de Janeiro, 1902. Reprinted by order of the Minister of Marine from the *Revista Maritima Brasileira*, August-September, 1900, January, 1901, and April-May, 1901.

Causas da instabilidade do caracter magnetico de um navio. Prisma azimuthal de Lord Kelvin. Regulação das agulhas por meio de azimuths. Determinação do caracter magnetico de um navio. Compensação horizontal das agulhas com azmuths. Balança magnetica de Lord Kelvin. Compensação vertical do desvio de banda. Machina de sondar de Lord Kelvin. Indicadores : mecanico e chimico. Theoria e manejo pratico. *Imprensa Nacional*, Rio de Janeiro, 1903. Reprinted from the *Revista Maritima Brasileira*, May and July, 1903, pages 1291 and 8, and March, 1902, page 1202.

Compensação e regulação das agulhas sem azimuths. Deflector de Lord Kelvin. Theoria e manejo pratico. Methodo do Kaptain Clausen. *Imprensa Nacional*, Rio de Janeiro, 1903. Reprinted from the *Revista Maritima Brasileira*, June, 1903. This work has been recently translated into English by Commander L. H. Chandler, U.S. Navy and published in the *United States Naval Institute Proceedings* for December, 1909.

Estudo theorico e pratico dos Instrumentos Nauticos de Lord Kelvin. Magnetismo dos navios. Compensação e regulação das agulhas com e sem azimuths. Sondagens no mar. New edition of above three works, by order of the Minister of Marine. *Imprensa Nacional*, Rio de Janeiro, 1910.

A Signaria Naval. Reprinted from the *Revista Maritima Brasileira*, January, 1903.

Estudo elementar de Trigonometria Espherica e algumas das suas applicações á Astronomia Espherica, Navegação e Geographia, edited by H. Garnier, Paris and Rio de Janeiro, 1903. Price 4s.

Relatorio annual da Associação Protectora dos Homens do Mar de 1903-1904. Rio de Janeiro, 1904.

JIU-JITSU. Educação Physica Japoneza, pelo Mr. H. Irving Hancock. Joint translation from English with the late Capitão de corveta J. A. dos Santos Porto. Rio de Janeiro, 1905. Price 4s.

Nomograms for Deducing Altitude and Azimuth and for Star Identification and Finding Course and Distance in Great Circle Sailing. Reprinted from the *United States Naval Institute Proceedings* for June, 1908.

Nomogrammas para achar alturas e azimuths, &c. Reprinted from the *Revista Maritima Brasileira*, July, 1908.

Taboas para achar alturas e azimuths facilitando a determinação de rectas de posição e o ponto observado no mar. *Imprensa Nacional*, 1910. Reprinted from the *Revista Maritima Brasileira*, August, 1910.

A Nomogram for Compass Deviations, with an Elementary Exposition of the Two Parallel Scale Nomograms. By Professor Guiseppe Pesci, Italian Navy. Translated from the original manuscript in Italian by Lieutenant Radler de Aquino. Reprinted from the *United States Naval Institute Proceedings* for December, 1910.

And many other articles in the *Revista Maritima Brasileira* since 1899.

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Altitude and Azimuth Tables, for Facilitating the Determination of Lines of Position and Geographical Position at Sea. The simplest and readiest in solution. Plane and Spherical Traverse Tables for solving all problems of navigation. By *Lieut. Radler de Aquino* (Brazilian Navy). All sights for position are worked out by the same method *without logarithms*, with hardly any calculation. All the other problems in navigation are easily and rapidly solved by inspection without interpolation. This work has received the favourable endorsement of the United States Hydrographic Office. 2nd Stereotyped Edition 10 6

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