TABLES FOR THE COMPUTATION OF HALOS

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Because of the diffuse character of the phenomena, and the difficulties of exact measurement, it is sufficient in general to take values to only the nearest minute of arc.

The range of tables 2 and 3 provides for refracting angles as small as about 23°.

TABLE 1.—*Constants*

$$\mu=1.31 \text{ (yellow-green)}$$
$$\log \mu=0.1172713$$
$$\operatorname{colog} \mu=9.8827287-10$$
$$1/\mu=0.7633588$$
$$\mu^2=1.7161$$
$$\sqrt{(\mu^2-1)}=0.8462269$$
$$\gamma=49°45'40''=49°.76$$
$$2\gamma=99°31'$$

TABLE 2.—*Virtual indices and critical angles in oblique prismatic refraction*

h	$\log \mu'$	μ'	$\sqrt{\mu'^2-1}$	γ' °	′
0°	0.11727	1.310	0.8462	49	46
1°	.11730	1.310	.8462	49	45
2°	.11737	1.310	.8462	49	45
3°	.11753	1.311	.8478	49	43
4°	.11771	1.311	.8478	49	42
5°	.11797	1.312	.8493	49	39
6°	.11827	1.313	.8509	49	36
7°	.11864	1.314	.8524	49	33
8°	.11905	1.315	.8539	49	29
9°	.11952	1.317	.8570	49	25
10°	.12007	1.318	.8586	49	20
11°	.12065	1.320	.8616	49	14
12°	.12133	1.322	.8647	49	8
13°	.12206	1.325	.8693	49	1
14°	.12282	1.327	.8723	48	55
15°	.12368	1.329	.8754	48	47
16°	.12459	1.332	.8799	48	39
17°	.12557	1.335	.8844	48	30
18°	.12662	1.338	.8890	48	20
19°	.12777	1.342	.8950	48	10
20°	.12895	1.346	.9010	48	0
21°	.13021	1.350	.9069	47	49
22°	.13157	1.354	.9129	47	37
23°	.13302	1.358	.9188	47	24
24°	.13454	1.363	.9262	47	11
25°	.13614	1.368	.9335	46	58
26°	.13782	1.374	.9423	46	44

TABLE 2.—*Virtual indices and critical angles in oblique prismatic refraction*—Continued

h	$\log \mu'$	μ'	$\sqrt{\mu'^2-1}$	γ' °	′
27°	0.13963	1.379	0.9496	46	28
28°	.14149	1.385	.9582	46	13
29°	.14348	1.392	.9683	45	57
30°	.14556	1.398	.9769	45	40
31°	.14774	1.405	.9869	45	22
32°	.15003	1.413	.9983	45	4
33°	.15247	1.421	1.0096	44	45
34°	.15503	1.429	1.0208	44	25
35°	.15769	1.438	1.0334	44	4
36°	.16047	1.447	1.0458	43	43
37°	.16342	1.457	1.0596	43	21
38°	.16654	1.467	1.0734	42	58
39°	.16977	1.478	1.0883	42	34
40°	.17322	1.490	1.1046	42	9
41°	.17680	1.502	1.1207	41	44
42°	.18055	1.515	1.1381	41	17
43°	.18452	1.529	1.1566	40	50
44°	.18868	1.544	1.1764	40	22
45°	.19300	1.560	1.1973	39	53
46°	.19761	1.576	1.2181	39	23
47°	.20240	1.593	1.2400	38	52
48°	.20741	1.612	1.2643	38	20
49°	.21272	1.632	1.2897	37	47
50°	.21835	1.653	1.3162	37	13
51°	.22423	1.676	1.3450	36	38
52°	.23037	1.700	1.3748	36	2
53°	.23689	1.725	1.4056	35	25
54°	.24379	1.753	1.4398	34	47
55°	.25101	1.782	1.4750	34	8
56°	.25857	1.814	1.5135	33	28
57°	.26668	1.848	1.5541	32	46
58°	.27518	1.884	1.5967	32	3
59°	.28409	1.924	1.6437	31	19
60°	.29354	1.966	1.6927	30	35
61°	.30357	2.012	1.7459	29	48
62°	.31410	2.061	1.8021	29	1
63°	.32540	2.115	1.8636	28	13
64°	.33731	2.174	1.9304	27	23
65°	.34983	2.238	2.0022	26	33
66°	.36330	2.308	2.0801	25	40
67°	.37764	2.386	2.1663	24	47
68°	.39280	2.471	2.2596	23	53
69°	.40899	2.564	2.3610	22	57
70°	.42630	2.669	2.4746	22	0
71°	.44483	2.785	2.5993	21	3
72°	.46470	2.915	2.7381	20	4
73°	.48606	3.062	2.8841	19	4
74°	.50908	3.229	3.0703	18	2
75°	.53395	3.419	3.2695	17	0
76°	.56092	3.638	3.4978	15	57
77°	.59027	3.893	3.7624	14	53
78°	.62236	4.191	4.0700	13	48
79°	.65765	4.546	4.4346	12	42
80°	.69686	4.976	4.8745	11	36

TABLE 3.—*Law of Refraction*, $\mu=1.31$

i \ r	h=0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
90°	49 46	49 39	49 20	48 47	48 00	46 58	45 40	44 04	42 09	39 53	37 13	34 08	30 35	26 33	22 00	17 00	11 36
89°	45	38	19	46	47 59	57	39	04	09	52	13	07	34	32	22 00	17 00	36
88°	43	37	17	44	58	56	38	02	07	51	12	06	33	31	22 00	17 00	35
87°	40	34	14	41	55	53	35	44 00	05	49	10	04	32	30	21 59	16 59	35
86°	36	29	10	37	50	49	31	43 56	02	46	07	02	30	28	57	58	34
85°	30	24	05	32	45	44	26	51	41 57	42	03	33 59	27	26	55	57	33
84°	23	17	48 58	25	39	38	20	46	52	37	36 59	55	24	23	53	55	32
83°	15	09	50	18	31	30	14	39	46	32	54	50	20	20	50	52	30
82°	06	49 00	41	09	23	22	06	32	39	25	48	45	15	16	47	50	29
81°	48 56	48 50	31	47 59	13	13	44 57	23	31	18	41	39	10	11	43	47	27
80°	44	38	20	48	02	02	47	14	22	10	34	32	04	06	39	44	25
79°	32	26	07	36	46 50	45 50	36	04	12	01	25	25	29 57	01	35	41	23
78°	18	12	47 54	22	37	38	24	42 52	02	38 51	16	17	50	25 55	30	37	20
77°	03	47 57	39	08	23	25	11	40	40 50	40	07	08	43	49	25	33	18
76°	47 47	41	23	46 52	08	10	43 57	27	38	28	35 56	32 59	35	42	19	29	15
75°	30	24	06	36	45 52	44 55	42	12	24	16	45	40	26	34	13	25	12
74°	12	06	46 49	18	35	38	26	41 57	10	03	33	38	17	26	07	20	08
73°	46 53	46 48	30	46 00	17	21	09	42	39 55	37 49	20	27	07	18	21 00	14	05
72°	33	28	10	45 40	44 58	02	42 52	25	40	35	07	15	28 56	09	20 53	09	01
71°	12	07	45 49	20	38	43 43	33	07	23	19	34 53	02	45	25 00	45	03	10 57
70°	45 50	45 45	28	44 59	17	23	14	40 49	06	03	38	31 49	33	24 50	37	15 57	53
69°	27	22	05	36	43 56	02	41 53	29	38 48	36 46	23	35	21	39	29	51	49
68°	03	44 58	44 41	13	33	42 40	32	09	29	29	07	21	09	28	20	44	44
67°	44 38	33	17	43 49	10	17	11	39 49	09	10	33 50	06	27 56	17	11	37	40
66°	13	08	43 52	24	42 45	41 53	40 48	27	37 49	35 51	33	30 50	42	06	01	30	35
65°	43 47	43 41	26	42 59	20	29	24	05	28	32	15	34	27	23 54	19 51	22	30
64°	19	14	42 59	32	41 55	04	40 00	38 42	06	12	32 56	17	12	41	41	14	10 24
63°	42 51	42 46	31	05	28	40 38	39 35	18	36 43	34 51	37	30 00	26 57	28	30	06	--------
62°	23	18	03	41 37	41 00	11	10	37 53	20	29	17	29 42	41	14	19	14 58	--------
61°	41 53	41 48	41 34	08	40 32	39 44	38 43	28	35 56	07	31 56	23	25	23 00	08	49	--------
60°	23	18	04	40 39	03	16	16	02	32	33 44	35	04	08	22 46	18 56	40	--------
59°	40 52	40 48	40 33	09	39 34	38 48	37 49	36 36	07	20	14	28 45	25 51	31	44	31	--------
58°	20	16	02	39 38	04	18	20	09	34 41	32 56	30 52	25	33	16	32	22	--------
57°	39 48	39 44	39 30	07	38 33	37 48	36 51	35 41	15	32	29	04	15	01	19	12	--------
56°	16	11	38 58	38 35	02	18	22	13	33 48	07	06	27 43	24 57	21 45	06	02	--------
55°	38 42	38 38	25	02	37 30	36 47	35 52	34 44	21	31 41	29 42	22	38	28	17 53	13 52	--------
54°	08	04	37 51	37 29	36 57	15	21	15	32 53	15	18	27 00	18	12	39	41	--------
53°	37 34	37 30	17	36 55	24	35 43	34 50	33 45	25	30 48	28 53	26 37	23 58	20 55	25	30	--------
52°	36 59	36 55	36 42	21	35 51	10	18	14	31 56	21	28	14	38	37	10	19	--------
51°	23	19	07	35 46	16	34 37	33 46	32 43	26	29 53	02	25 51	17	19	16 56	08	--------
50°	35 47	35 43	35 31	11	34 41	03	13	12	30 56	25	27 36	27	22 56	01	41	12 57	--------
49°	11	07	34 55	34 35	06	33 29	32 40	31 40	26	28 56	10	03	35	19 43	26	45	--------
48°	34 34	34 30	19	33 59	33 31	32 54	06	08	29 55	27	26 43	24 38	13	24	10	33	--------
47°	33 56	33 53	33 41	22	32 55	19	31 32	30 35	24	27 58	15	13	21 50	05	15 54	21	--------
46°	18	15	04	32 45	19	31 43	30 58	01	28 52	28	25 47	23 48	28	18 46	38	09	--------
45°	32 40	32 37	32 26	08	31 42	07	23	29 27	20	26 58	19	22	05	25	22	11 56	--------
44°	01	31 58	31 48	31 30	05	30 31	29 47	28 53	27 47	27	24 51	22 56	20 42	05	05	43	--------
43°	31 22	19	09	30 52	30 27	29 54	12	19	14	25 56	22	30	18	17 45	14 48	30	--------
42°	30 43	30 40	30 30	13	29 49	17	28 36	27 44	26 41	24	23 52	03	19 54	24	31	17	--------
41°	03	30 00	29 50	29 34	11	28 39	27 59	09	07	24 52	23	21 36	30	03	14	04	--------
40°	29 23	29 20	11	28 55	28 32	01	22	26 33	25 33	20	22 53	08	05	16 42	13 56	10 50	--------
39°	28 43	28 40	28 31	15	27 53	27 23	26 45	25 57	24 59	23 48	22	20 41	18 40	20	38	36	--------
38°	02	27 59	27 50	27 35	14	26 45	07	21	24	15	21 52	13	15	15 58	20	22	--------
37°	27 21	18	10	26 55	26 34	06	25 30	24 45	23 49	22 42	21	19 44	17 50	36	02	08	--------
36°	26 40	26 37	26 29	14	25 54	25 27	24 52	08	14	08	20 50	15	24	14	12 43	9 54	--------
35°	25 58	25 55	25 47	25 33	14	24 47	13	23 31	22 38	21 35	18	18 46	16 58	14 51	25	39	--------
34°	16	14	06	24 52	24 33	07	23 34	22 53	02	01	19 46	17	32	28	06	25	--------
33°	24 34	24 32	24 24	11	23 52	23 27	22 55	16	21 26	20 26	14	17 48	05	05	11 47	10	--------
32°	23 52	23 49	23 42	23 29	11	22 47	16	21 38	20 50	19 52	18 42	18	15 38	13 42	27	8 55	--------
31°	09	07	23 00	22 47	22 30	07	21 37	20 59	13	17	09	16 48	11	18	08	40	--------
30°	22 26	22 24	22 17	05	21 49	21 26	20 57	21	19 36	18 42	17 36	17	14 44	12 55	10 48	25	--------
29°	21 43	21 41	21 34	21 23	07	20 45	17	19 42	18 59	07	03	15 47	17	31	28	09	--------
28°	21 00	20 58	20 51	20 41	20 25	07	19 37	03	22	17 31	16 30	16	13 49	07	08	7 53	--------
27°	20 16	15	08	19 58	19 43	19 23	18 57	18 24	17 44	16 55	15 56	14 45	21	11 42	9 48	38	--------
26°	19 33	19 31	19 25	15	01	18 41	16	17 45	07	19	23	14	12 53	18	27	22	--------
25°	18 49	18 47	18 42	18 32	18 18	18 00	17 36	06	16 29	15 43	14 49	13 43	25	10 53	07	06	--------
24°	05	03	17 58	17 49	17 35	17 18	16 55	16 26	15 50	07	14	11	11 56	28	8 46	6 50	--------
23°	17 21	17 19	14	06	16 53	16 36	14	15 46	12	14 31	13 40	12 40	28	03	25	34	--------
22°	16 37	16 35	16 30	16 22	10	15 53	15 32	06	14 34	13 54	06	08	10 59	9 38	04	17	--------
21°	15 53	15 51	15 46	15 38	15 27	11	14 51	14 26	13 55	17	12 31	11 36	30	13	7 43	01	--------
20°	08	07	02	14 54	14 43	14 29	10	13 46	16	12 40	11 56	04	01	8 47	22	5 44	--------
19°	14 23	14 22	14 18	10	14 00	13 46	13 28	05	12 37	03	21	10 32	9 32	22	7 00	28	--------
18°	13 39	13 37	13 33	13 26	13 17	03	12 46	12 25	11 58	11 26	10 46	9 59	03	7 56	6 39	11	--------
17°	12 54	12 53	12 49	12 42	12 33	12 20	04	11 44	19	10 48	11	26	8 33	30	17	4 54	--------
16°	09	08	04	11 58	11 49	11 37	11 22	03	10 40	11	9 36	8 54	04	04	5 56	--------	--------
15°	11 24	11 23	11 19	14	05	10 54	10 40	10 22	10 00	9 33	9 00	21	7 34	6 38	34	--------	--------
14°	10 39	10 37	10 34	10 29	10 21	11	9 58	9 41	9 21	8 55	8 25	7 48	04	12	12	--------	--------
13°	9 53	9 52	9 49	9 44	9 37	9 28	16	9 00	8 41	18	7 49	15	6 34	5 46	4 50	--------	--------
12°	08	07	04	9 00	8 53	8 44	8 33	8 19	01	7 40	13	6 42	04	20	28	--------	--------
11°	8 23	8 22	8 19	8 15	09	01	7 51	7 38	7 21	02	6 38	09	5 34	4 54	06	--------	--------
10°	7 37	7 36	7 34	7 30	7 25	7 17	08	6 56	6 42	6 24	02	5 35	04	27	3 44	--------	--------
9°	6 52	6 51	6 49	6 45	6 41	6 34	6 26	15	02	5 45	5 26	02	4 34	4 00	22	--------	--------
8°	06	05	04	01	5 56	5 50	5 43	5 33	5 22	07	4 50	4 29	04	3 34	2 59	--------	--------
7°	5 20	5 20	5 18	5 16	12	07	5 00	4 52	4 41	4 29	14	3 55	3 33	07	37	--------	--------
6°	4 35	4 34	4 33	4 31	4 27	4 23	4 17	10	01	3 51	3 37	22	03	2 41	15	--------	--------
5°	3 49	3 49	3 47	3 46	3 43	3 39	3 34	3 29	3 21	12	01	2 48	2 33	14	1 52	--------	--------
4°	03	03	02	01	2 58	2 55	2 52	2 47	2 41	2 34	2 25	15	02	1 47	30	--------	--------
3°	2 17	2 17	2 16	2 15	14	12	09	05	01	1 55	1 49	1 41	1 32	20	07	--------	--------
2°	1 32	1 31	1 31	1 30	1 29	1 28	1 26	1 23	1 21	17	12	07	01	0 54	0 45	--------	--------
1°	0 46	0 46	0 45	0 45	0 45	0 44	0 43	0 42	0 40	0 38	0 36	0 33	0 31	0 27	0 22	--------	--------