A CORRECTED MASTER PARALLAX TABLE

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I. Introduction

THIS article will present a Corrected Master Parallax Table which will give correct differential parallax values for any flying height and air base when used with the proper constant multiplier.

The fact that the Present Master Parallax Table contains serious errors has been pointed out in articles by Albert L. Nowicki,[1] Louis Desjardins,[2] and Herman J. Shea.[3] Each of these writers has presented methods of obtaining the correct data but all of these methods either discard the table entirely or correct the tabular values by use of a function which involves just as much work as would be necessary without the table.

The Corrected Parallax Table is similar in form and application to the Present Parallax Table. The only basic differences are:

(a) The Corrected Parallax Table is constructed from the exact parallax equation $\Sigma\Delta p = \frac{Bh}{H-h}$ in lieu of the approximate equation $\Delta p = \frac{B\,\Delta h}{H-h}$;

(b) The constant multiplier $K = \left(\frac{B_m}{100}\right)\left(\frac{H}{25{,}000}\right)$ is used in lieu $\frac{B_m}{100}$.

(c) The Δp column is omitted since it is not required in practice.

II. Construction of Table

The Corrected Parallax Table is constructed by solving the basic parallax equation

$$\Sigma\Delta p = p = \frac{Bh}{H-h} = \frac{100h}{25{,}000-h} \tag{1}$$

for successive values of h in increments of 20′ from $(H-h) = 25{,}000'$ to $(H-h) = 10{,}000'$ and increments of 10′ from $(H-h) = 10{,}000'$ to $(H-h) = 5{,}000'$.

III. Derivation of Constant Multiplier

To adapt the table to any other set of conditions, a constant multiplier, K, such that $\Delta p = (K)(\Delta p \text{ Table})$ may be found as follows:

$$K = \frac{\Delta p}{\Delta p_T}.$$

[1] Nowicki, Albert L., "Practical Applications of the Stereocomparagraph Plotting Machine," Photogrammetric Engineering, April, 1943, or *Manual of Photogrammetry.*

[2] Desjardins, Louis, "Contouring and Elevation Measurements from Vertical Aerial Photographs," Photogrammetric Engineering, October, 1943. "Notes on Parallax and Stereo-Elevations." Photogrammetric Engineering, April, 1944.

[3] Shea, Herman J., "Some Notes on Stereoscopic Parallax," Photogrammetric Engineering, January, 1945.

But

$$\Delta p = \frac{B_m H \Delta h}{(H - h)(H - h - \Delta h)} . \tag{2}$$

Therefore

$$K = \frac{\Delta p}{\Delta p_T} = \frac{B_m H \Delta h}{(H - h)(H - h - \Delta h)} \cdot \frac{(H_T - h_T)(H_T - h_T - \Delta h_T)}{B_T H_T \Delta h_T} .$$

If $(H_T - h_T)$ is taken equal to $(H - h)$, (as is done when entering the table), and $\Delta h_T = \Delta h$.

$$K = \frac{B_m H}{B_T H_T} = \frac{B_m H}{100 \times 25{,}000} = \frac{B_m H}{2{,}500{,}000} . \tag{3}$$

It is important to note that B_m and H, as used in Eq. (3), must correspond; that is, B_m must be the photo base at the ground elevation which is H feet below the camera station. If B is obtained at an elevation other than datum, H must be the flying height above this elevation. This requires the use of $(H - h)$ in lieu of H.

The determination of the photo base and its corresponding effective flying height for a given stereoscopic pair is best done by the method described by Mr. Desjardins.[4]

IV. Comparison with Present Parallax Table

As a means to illustrate the application of the Corrected Parallax Table and for comparative purposes, an example problem in the *Manual of Photogrammetry* will be used:

Given: $H = 19{,}000'$ (above datum)

$B_m = 85.50$ mm (at datum)

To find: Parallax readings for 40′ contour intervals through range 500′ to 1180′.

(a) Determine constant multiplier, K:

$$K = \left(\frac{85.50}{100}\right)\left(\frac{19{,}000}{25{,}000}\right) = 0.64980.$$

(b) Read $\Sigma\Delta p$ in Corrected Parallax Table for an $(H - h)$ of 19,000′:

$$\Sigma\Delta p = 31.579 \text{ mm.}$$

(c) Multiply $\Sigma\Delta p$ by K:

$$(31.579)(0.6498) = 20.520.$$

(d) Set 20.520 negatively into the middle dial of calculating machine by means of the minus bar.

(e) Set $K = 0.64980$ in keyboard of calculating machine.

(f) The calculating machine is now set up with two constants that will remain throughout the entire operation. It is now only necessary to multiply by the value of $\Sigma\Delta p$ from the Corrected Parallax Table conforming to the desired $(H - h)$ to obtain the values of Δp.

Results and comparative values are as follows:

[4] Desjardins, *loc. cit.*

H-h	h	Δp From Corrected Parallax Table	Δp From Exact Formula	Δp From Present Parallax Table
19,000	0			
18,500	500	2.311	2.311	2.28
18,460	540	2.501	2.501	2.46
18,420	580	2.692	2.692	2.65
18,380	620	2.884	2.884	2.84
18,340	660	3.077	3.077	3.02
18,300	700	3.270	3.270	3.21
18,260	740	3.465	3.465	3.40
18,220	780	3.660	3.660	3.58
18,180	820	3.857	3.856	3.77
18,140	860	4.053	4.054	3.96
18,100	900	4.252	4.251	4.15
18,060	940	4.450	4.450	4.34
18,020	980	4.650	4.650	4.53
17.980	1020	4.850	4.850	4.72
17.940	1060	5.052	5.052	4.91
17,900	1100	5.254	5.254	5.10
17,860	1140	5.458	5.457	5.28
17,820	1180	5.662	5.662	5.48

It can readily be seen that conversion by means of the Corrected Parallax Table is exact, with the exception, at times, of one micron discrepancy due to three decimal place contraction.

V. Practical Application of Corrected Parallax Table

In actual practice, conditions as outlined in the previous problem may not be so ideal. For instance, the flying height may be given in odd feet, the photo air base may not be effective at datum but determined from a control point above datum and usually there will be some initial stereo-reading on the micrometer due to orientation of the photographs.

To incorporate these practical conditions, assume the following data:

Given:

$H = 19{,}011'$ (above datum)

$B = 87.53$ mm (effective at control point elevation 647′)

13.52 mm = initial micrometer reading for elevation 647′

To find: Micrometer readings for 40′ contour intervals through range 500′ to 700′.

(a) Round off the flying height to the nearest 20′ (the flying height will be taken to the nearest 10′ when $(H-h)$ is less than 10,000′).

$$H = 19{,}020.$$

(b) Determine K:

$$K = \left(\frac{87.53}{100}\right)\left(\frac{19{,}020 - 647}{25{,}000}\right) = 0.64328.$$

Note: When B, 87.53, is effective at elevation 647′ and not at datum, the flying height above this elevation is ratioed.

$$(H - h) = (19{,}020' - 647') = 18{,}373'.$$

(c) Read in Corrected Parallax Table $\Sigma\Delta p$ for $(H-h) = 18{,}373$:

$$\Sigma\Delta p = 36.069 \text{ mm}.$$

As an option, $\Sigma\Delta p$ may be solved for directly:

$$\Sigma\Delta p = \left(\frac{25{,}000 - 18{,}373}{18{,}373}\right)(100) = 36.069 \text{ mm.}$$

(d) Multiply $\Sigma\Delta p$ by K:

$$(\Sigma\Delta p)(K) = (36.069)(0.64328) = 23.202 \text{ mm.}$$

(e) Set in the calculating machine the initial micrometer reading of 13.52 and subtract 23.202. The middle dial will now show a negative number.

(f) Set $K = 0.64328$ in keyboard of calculating machine (with due regard to decimal place).

(g) Multiply by the value of $\Sigma\Delta p$ from the Corrected Parallax Table conforming to the desired $(H-h)$ to obtain the corresponding micrometer readings.

(h) The completed table is as follows:

$(H\text{-}h)$	h	Micrometer Reading
19,020	0	
18,520	500	12.83
18,480	540	13.01
18,440	580	13.20
18,400	620	13.39
18,360	660	13.58
18,320	700	13.77

The above listed micrometer readings are exact to 0.01 mm., in fact, the maximum error does not exceed 0.001 mm.

VI. Accuracy in the Critical Range

As pointed out by Mr. Nowicki,[5] the error in the Present Parallax Table reaches a maximum in the range of $(H-h) = 5{,}000'$. To demonstrate the accuracy of the Corrected Parallax Table in this range, the following tabulation is offered, to compare the values obtained from the Present Parallax Table, Corrected Parallax Table and the exact solution by the basic parallax equation:

Given:

$H = 6{,}000'$ (above datum)

$B_m = 75.000$ mm (at datum)

To find:

Δp from 0′ to 1000′

	Present Parallax Table	Corrected Parallax Table	Exact Equation
Δp	18.232 mm.	15.000 mm.	15.000 mm.
Error in Δp	3.232 mm.	0.000 mm.	—
Comparable Error in Elevation	173.33′	0.00′	—
Elevation Error	17.33%	0.00%	—

[5] Nowicki, *loc. cit.*

VII. Additional Comments

It will be noted that in the Corrected Parallax Table the column "Δp" has been omitted. Its usage is not required as can be seen in the practical problem previously outlined.

The values obtained by multiplying the $\Sigma\Delta p$ (Table) by K are not the true values of $\Sigma\Delta p$ for any flying height and base except those on which the table was based. In fact, they differ from the true values of $\Sigma\Delta p$ by a constant amount equal to K times the $\Sigma\Delta p$ value for $H-h=H$ (i.e. when $h=0$). Obviously when the difference of successive $\Sigma\Delta p$'s is taken, this constant is cancelled out, resulting in correct values of Δp.

The factor, K, may be also expressed as follows:

$$K = \frac{B}{100 + \Sigma\Delta p} \tag{4}$$

where $\Sigma\Delta p$ is the tabular value for $H-h$ corresponding to the elevation at which B is effective. It will be noted that the term $(100+\Sigma\Delta p)$ is in reality the tabular base corresponding to this same elevation.

VIII. Conclusion

The Corrected Parallax Table furnishes a rapid method of obtaining accurate parallax readings for use in contouring photographs with the Stereocomparagraph or similar instruments.

The use of the table is most advantageous when numerous calculations are required, since it is recognized that one or two solutions can be obtained just as expediently by the use of the basic parallax equation.

Corrected Master Parallax Table

For

$$\Sigma\Delta p = p = \frac{Bh}{H - h} = \frac{100h}{25{,}000 - h}$$

for successive values of h in increments of 20 feet from $(H-h)=25{,}000$ feet to $(H-h)=10{,}000$ feet, and increments of 10 feet from $(H-h)=10{,}000$ feet to $(H-h)=5{,}000$ feet, when $B=100$ millimeters at datum.

For any flying height H and the corresponding photo base B_m.

$$\Delta p \text{ (from } h_1 \text{ to } h_2) = (\Sigma\Delta p_1 - \Sigma\Delta p_2)K$$

where

$$K = \left(\frac{B_m}{100}\right)\left(\frac{H}{25{,}000}\right).$$

$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.
25,000	0	24,000	4.167	23,000	8.696	22,000	13.636	21,000	19.048
24,980	0.080	23,980	4.254	22,980	8.790	21,980	13.740	20,980	19.161
60	0.160	60	4.341	60	8.885	60	13.843	60	19.275
40	0.241	40	4.428	40	8.980	40	13.947	40	19.389
20	0.321	20	4.515	20	9.075	20	14.051	20	19.503
24,900	0.402	23,900	4.603	22,900	9.170	21,900	14.155	20,900	19.617
24,880	0.482	23,880	4.690	22,880	9.266	21,880	14.260	20,880	19.732
60	0.563	60	4.778	60	9.361	60	13.364	60	19.847
40	0.644	40	4.866	40	9.457	40	14.469	40	19.962
20	0.725	20	4.954	20	9.553	20	14.574	20	20.077
24,800	0.806	23,800	5.042	22,800	9.649	21,800	14.679	20,800	20.192
24,780	0.888	23,780	5.130	22,780	9.745	21,780	14.784	20,780	20.308
60	0.969	60	5.219	60	9.842	60	14.890	60	20.424
40	1.051	40	5.307	40	9.938	40	14.995	40	20.540
20	1.133	20	5.396	20	10.055	20	15.101	20	20.656
24,700	1.215	23,700	5.485	22,700	10.132	21,700	15.207	20,700	20.773
24,680	1.297	23,680	5.574	22,680	10.229	21,680	15.314	20,680	20.890
60	1.379	60	5.664	60	10.327	60	15.420	60	21.007
40	1.461	40	5.753	40	10.424	40	15.527	40	21.124
20	1.543	20	5.843	20	10.522	20	15.634	20	21.242
24,600	1.626	23,600	5.932	22,600	10.619	21,600	15.741	20,600	21.359
24,580	1.709	23,580	6.022	22,580	10.717	21,580	15.848	20,580	21.477
60	1.792	60	6.112	60	10.816	60	15.955	60	21.595
40	1.874	40	6.202	40	10.914	40	16.063	40	21.714
20	1.958	20	6.293	20	11.012	20	16.171	20	21.832
24,500	2.041	23,500	6.383	22,500	11.111	21,500	16.279	20,500	21.951
24,480	2.124	23,480	6.474	22,480	11.210	21,480	16.387	20,480	22.070
60	2.208	60	6.564	60	11.309	60	16.496	60	22.190
40	2.291	40	6.655	40	11.408	40	16.604	40	22.309
20	2.375	20	6.746	20	11.508	20	16.713	20	22.429
24,400	2.459	23,400	6.838	22,400	11.607	21,400	16.822	20,400	22.549
24,380	2.543	23,380	6.929	22,380	11.707	21,380	16.932	20,380	22.669
60	2.627	60	7.021	60	11.807	60	17.041	60	22.790
40	2.712	40	7.112	40	11.907	40	17.151	40	22.911
20	2.796	20	7.204	20	12.007	20	17.261	20	23.031
24,300	2.881	23,300	7.296	22,300	12.108	21,300	17.371	20,300	23.153
24,280	2.965	23,280	7.388	22,280	12.208	21,280	17.481	20,280	23.274
60	3.050	60	7.481	60	12.309	60	17.592	60	23.396
40	3.135	40	7.573	40	12.410	40	17.702	40	23.518
20	3.220	20	7.666	20	12.511	20	17.813	20	23.640
24,200	3.306	23,200	7.759	22,200	12.613	21,200	17.925	20,200	23.762
24,180	3.391	23,180	7.852	22,180	12.714	21,180	18.036	20,180	23.885
60	3.477	60	7.945	60	12.816	60	18.147	60	24.008
40	3.563	40	8.038	40	12.918	40	18.259	40	24.131
20	3.648	20	8.131	20	13.020	20	18.371	20	24.254
24,100	3.734	23,100	8.225	22,100	13.122	21,100	18.483	20,100	24.378
24,080	3.821	23,080	8.319	22,080	13.225	21,080	18.596	20,080	24.502
60	3.907	60	8.413	60	13.327	60	18.708	60	24.626
40	3.993	40	8.507	40	13.430	40	18.821	40	24.750
20	4.080	20	8.601	20	13.533	20	18.934	20	24.875

$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.
20,000	25.000	19,000	31.579	18,000	38.889	17,000	47.059	16,000	56.250
19,980	25.125	18,980	31.718	17,980	39,043	16,980	47.232	15,980	56.446
60	25.251	60	31.857	60	39.198	60	47.406	60	56.642
40	25.376	40	31.996	40	39.353	40	47.580	40	56.838
20	25.502	20	32.135	20	39.509	20	47.754	20	57.035
19,900	25.628	18,900	32.275	17,900	39.665	16,900	47.929	15,900	57.233
19,880	25,755	18.880	32,415	17,880	39.821	16,880	48.104	15,880	57.431
60	25.881	60	32.556	60	39.978	60	48.280	60	57.629
40	26.008	40	32.696	40	40.135	40	48.456	40	57.828
20	26.135	20	32.837	20	40.292	20	48.633	20	58.028
19,800	26.263	18,800	32.979	17,800	40.449	16,800	48.810	15,800	58.228
19,780	26.390	18,780	33.120	17,780	40.607	16,780	48.978	15,780	58.428
60	26.518	60	33.262	60	40.766	60	49.165	60	58.629
40	26.646	40	33.404	40	40.924	40	49.343	40	58.831
20	26.775	20	33.547	20	41.084	20	49.522	20	59.033
19,700	26.904	18,700	33.690	17,700	41.243	16,700	49.701	15,700	59.236
19,680	27,033	18,680	33.833	17,680	41.403	16,680	49.880	15,680	59.439
60	27.162	60	33.976	60	41.563	60	50.060	60	59.642
40	27.291	40	34.120	40	41.723	40	50.240	40	59.847
20	27.421	20	34.264	20	41.884	20	50.421	20	60.051
19,600	27.551	18,600	34.409	17,600	42.045	16,600	50.602	15,600	60.256
19,580	27.681	18,580	34.553	17,580	42.207	16,580	50.784	15,580	60.462
60	27.812	60	34.698	60	42.369	60	50.966	60	60.668
40	27.943	40	34.844	40	42.531	40	51.149	40	60.875
20	28.074	20	34.989	20	42.694	20	51.332	20	61.082
19,500	28.205	18,500	35.135	17,500	42.857	16,500	51.515	15,500	61.290
19,480	28.337	18,480	35.281	17,480	43.021	16,480	51.699	15,480	61.499
60	28.469	60	35.428	60	43.184	60	51.883	60	61.708
40	28.601	40	35.575	40	43.349	40	52.068	40	61.917
20	28.733	20	35.722	20	43.513	20	52.253	20	62.127
19,400	28.866	18,400	35.870	17,400	43.678	16,400	52.439	15,400	62.338
19,380	28,999	18,380	36.017	17,380	43.843	16,380	52.625	15,380	62.549
60	29.132	60	36.166	60	44.009	60	52.812	60	62.760
40	29.266	40	36.314	40	44.175	40	52.999	40	62.973
20	29.400	20	36.463	20	44.342	20	53.186	20	63.185
19,300	29.534	18,300	36.612	17,300	44.509	16,300	53.374	15,300	63.399
19,280	29.668	18,280	36.761	17,280	44.676	16,280	53.563	15,280	63.613
60	29.803	60	36.911	60	44.844	60	53.752	60	63.827
40	29.938	40	37.061	40	45.012	40	53.941	40	64.042
20	30.073	20	37.212	20	45.180	20	54.131	20	64.258
19,200	30.208	18,200	37.363	17,200	45.349	16,200	54.321	15,200	64.474
19,180	30.344	18,180	37.514	17,180	45.518	16,180	54.512	15,180	64.690
60	30.480	60	37.665	60	45.688	60	54.703	60	64.908
40	30.617	40	37.817	40	45.858	40	54.895	40	65.125
20	30.753	20	37.969	20	46.028	20	55.087	20	65.344
19,100	30.890	18,100	38.122	17,100	46.199	16,100	55.280	15,100	65.563
19,080	31.027	18,080	38.274	17,080	46.370	16,080	55.473	15,080	65.782
60	31.165	60	38.427	60	46.542	60	55.666	60	66.003
40	31.303	40	38.581	40	46.714	40	55.860	40	66.223
20	31.441	20	38.735	20	46.886	20	56.055	20	66.445

$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.
15,000	66.667	14,000	78.571	13,000	92.308	12,000	108.333	11,000	127.273
14,980	66.889	13,980	78.827	12,980	92.604	11,980	108.681	10,980	127.687
60	67.112	60	79.083	60	92.901	60	109.030	60	128.102
40	67.336	40	79.340	40	93.199	40	109.380	40	128.519
20	67.560	20	79.598	20	93.498	20	109.732	20	128.938
14,900	67.785	13,900	79.856	12,900	93.798	11,900	110.084	10,900	129.358
14,880	68.011	13,880	80.115	12,880	94.099	11,880	110.438	10,880	129.779
60	68.237	60	80.375	60	94.401	60	110.793	60	130.203
40	68.464	40	80.636	40	94.704	40	111.149	40	130.627
20	68.691	20	80.897	20	95.008	20	111.506	20	131.054
14,800	68.919	13,800	81.159	12,800	95.313	11,800	111.864	10,800	131.481
14,780	69.147	13,780	81.422	12,780	95.618	11,780	112.224	10,780	131.911
60	69.377	60	81.686	60	95.925	50	112.585	60	132.342
40	69.607	40	81.951	40	96.232	40	112.947	40	132.775
20	69.837	20	82.216	20	96.541	20	113.311	20	133.209
14,700	70.068	13,700	82.482	12,700	96.850	11,700	113.675	10,700	133.645
14,680	70.300	13,680	82.749	12,680	97.161	11,680	114.041	10,680	134.082
60	70.532	60	83.016	60	97.472	60	114.408	60	134.522
40	70.765	40	83.284	40	97.785	40	114.777	40	134.962
20	70.999	20	83.554	20	98.098	20	115.146	20	135.405
14,600	71.233	13,600	83.824	12,600	98.413	11,600	115.517	10,600	135.849
14,580	71.468	13,580	84.094	12,580	98.728	11,580	115.889	10,580	136.295
60	71.703	60	84.366	60	99.045	60	116.263	60	136.742
40	71.939	40	84.638	40	99.362	40	116.638	40	137.192
20	72.176	20	84.911	20	99.681	20	117.014	20	137.643
14,500	72.414	13,500	85.185	12,500	100.000	11,500	117.391	10,500	138.095
14,480	72.652	13,480	85.460	12,480	100.321	11,480	118.770	10,480	138.550
60	72.891	60	85.736	60	100.642	60	118.150	60	139.006
40	73.130	40	86.012	40	100.965	40	118.531	40	139.464
20	73.370	20	86.289	20	101.288	20	118.914	20	139.923
14,400	73.611	13,400	86.567	12,400	101.613	11,400	119.298	10,400	140.385
14,380	73.853	13,380	86.846	12,380	101.939	11,380	119.684	10,380	140.848
60	74.095	60	87.126	60	102.265	60	120.070	60	141.313
40	74.338	40	87.406	40	102.593	40	120.459	40	141.779
20	74.581	20	87.688	20	102.922	20	120.848	20	142.248
14,300	74.825	13,300	87.970	12,300	103.252	11,300	121.239	10,300	142.718
14,280	75.070	13,280	88.253	12,280	103.583	11,280	121.631	10,280	143.191
60	75.316	60	88.537	60	103.915	60	122.025	60	143.665
40	75.562	40	88.822	40	104.248	40	122.420	40	144.141
20	75.809	20	89.107	20	104.583	20	122.816	20	144.618
14,200	76.056	13,200	89.394	12,200	104.918	11,200	123.214	10,200	145.098
14,180	76.305	13,180	89.681	12,180	105.255	11,180	123.614	10,180	145.580
60	76.554	60	89.970	60	105.592	60	124.014	60	146.063
40	76.803	40	90.259	40	105.931	40	124.417	40	146.548
20	77.054	20	90.549	20	106.271	20	124.820	20	147.036
14,100	77.305	13,100	90.840	12,100	106.612	11,100	125.225	10,100	147.525
14,080	77.557	13,080	91.131	12,080	106.954	11,080	125.632	10,080	148.016
60	77.809	60	91.424	60	107.297	60	126.040	60	148.509
40	78.063	40	91.718	40	107.641	40	126.449	40	149.004
20	78.317	20	92.012	20	107.987	20	126.860	20	149.501

$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.
10,000	150.000	9,500	163.158	9,000	177.778	8,500	194.118	8,000	212.500
9,990	150.250	9,490	163.435	8,990	178.087	8,490	194.464	7,990	212.891
80	150.501	80	163.713	80	178.396	80	194.811	80	213.283
70	150.752	70	163.992	70	178.707	70	195.159	70	213.676
60	151.004	60	164.271	60	179.018	60	195.508	60	214.070
50	151.256	50	164.550	50	179.330	50	195.858	50	214.465
40	151.509	40	164.831	40	179.642	40	196.209	40	214.861
30	151.762	30	165.111	30	179.955	30	196.560	30	215.259
20	152.016	20	165.393	20	180.269	20	196.912	20	215.657
10	152.270	10	165.675	10	180.584	10	197.265	10	216.056
9,900	152.525	9,400	165.957	8,900	180.899	8,400	197.619	7,900	216.456
9,890	152.781	9,390	166.241	8,890	181.215	8,390	197.974	7,890	216.857
80	153.036	80	166.525	80	181.532	80	198.329	80	217.259
70	153.293	70	166.809	70	181.849	70	198.686	70	217.662
60	153.550	60	167.094	60	182.167	60	199.043	60	218.066
50	153.807	50	167.380	50	182.486	50	199.401	50	218.471
40	154.065	40	167.666	40	182.805	40	199.760	40	218.878
30	154.323	30	167.953	30	183.126	30	200.120	30	219.285
20	154.582	20	168.240	20	183.447	20	200.481	20	219.693
10	154.842	10	168.528	10	183.768	10	200.842	10	220.102
9,800	155.102	9,300	168.817	8,800	184.091	8,300	201.205	7,800	220.513
9,790	155.363	9,290	169.107	8,790	184.414	8,290	201.568	7,790	220.924
80	155.624	80	169.397	80	184.738	80	201.932	80	221.337
70	155.885	70	169.687	70	185.063	70	202.297	70	221.750
60	156.148	60	169.978	60	185.388	60	202.663	60	222.165
50	156.410	50	170.270	50	185.714	50	203.030	50	222.581
40	156.674	40	170.563	40	186.041	40	203.398	40	222.997
30	156.937	30	170.856	30	186.369	30	203.767	30	223.415
20	157.202	20	171.150	20	186.697	20	204.136	20	223.834
10	157.467	10	171.444	10	187.026	10	204.507	10	224.254
9,700	157.732	9,200	171.739	8,700	187,356	8,200	204.878	7,700	224.675
9,690	157.998	9,190	172.035	8,690	187.687	8,190	205.250	7,690	225.098
80	158.264	80	172.331	80	188.018	80	205.623	80	225.521
70	158.532	70	172.628	70	188.351	70	205.998	70	225.945
60	158.799	60	172.926	60	188.684	60	206.373	60	226.371
50	159.067	50	173.224	50	189.017	50	206.748	50	226.797
40	159.336	40	173.523	40	189.352	40	207.125	40	227.225
30	159.605	30	173.823	30	189.687	30	207.503	30	227.654
20	159.875	20	174.123	20	190.023	20	207.882	20	228.084
10	160.146	10	174.424	10	190.360	10	208.261	10	228.515
9,600	160.417	9,100	174.725	8,600	190.698	8,100	208.642	7,600	228.947
9,590	160.688	9,090	175.028	8,590	191.036	8,090	209.023	7,590	229.381
80	160.960	80	175.330	80	191.375	80	209.406	80	229.815
70	161.233	70	175.634	70	191.715	70	209.789	70	230.251
60	161.506	60	175.938	60	192.056	60	210.174	60	230.688
50	161.780	50	176.243	50	192.398	50	210.559	50	231.126
40	162.055	40	176.549	40	192.740	40	210.945	40	231.565
30	162.329	30	176.855	30	193.083	30	211.333	30	232.005
20	162.605	20	177.162	20	193.427	20	211.721	20	232.447
10	162.881	10	177.469	10	193.772	10	212.110	10	232.889

$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	$\Sigma\Delta p$ mm.	$(H-h)$ ft.	Σnp mm.
7,500	233.333	7,000	257.143	6,500	284.615	6,000	316.667	5,500	354.545
7,490	233.778	6,990	257.654	6,490	285.208	5,990	317.362	5,490	355.373
80	234.225	80	258.166	80	285.802	80	318.060	80	356.204
70	234.672	70	258.680	70	286.399	70	318.760	70	357.038
60	235.121	60	259.195	60	286.997	60	319.463	60	357.875
50	235.570	50	259.712	50	287.597	50	320.168	50	358.716
40	236.022	40	260.231	40	288.199	40	320.875	40	359.559
30	236.474	30	260.750	30	288.802	30	321.585	30	360.405
20	236.927	20	261.272	20	289.408	20	322.297	20	361.255
10	237.382	10	261.795	10	290.016	10	323.012	10	362.107
7,400	237.838	6,900	262.319	6,400	290.625	5,900	323.729	5,400	362.963
7,390	238.295	6,890	262.845	6,390	291.236	5,890	324.448	5,390	363.822
80	238.753	80	263.372	80	291.850	80	325.170	80	364.684
70	239.213	70	263.901	70	292.465	70	325.894	70	365.549
60	239.674	60	264.431	60	293.082	60	326.612	60	366.418
50	240.136	50	264.964	50	293.701	50	327.350	50	367.290
40	240.599	40	265.497	40	294.322	40	328.082	40	368.165
30	241.064	30	266.032	30	294.945	30	328.816	30	369.043
20	241.530	20	266.569	20	295.570	20	329.553	20	369.925
10	241.997	10	267.107	10	296.197	10	330.293	10	370.810
7,300	242.466	6,800	267.647	6,300	296.825	5,800	331.034	5,300	371.698
7,290	242.936	6,790	268.189	6,290	297.456	5,790	331.779	5,290	372.590
80	243.407	80	268.732	80	298.089	80	332.526	80	373.485
70	243.879	70	269.276	70	298.724	70	333.276	70	374.383
60	244.353	60	269.822	60	299.361	60	334.028	60	375.285
50	244.828	50	270.370	50	300.000	50	334.783	50	376.190
40	245.304	40	270.920	40	300.641	40	335.540	40	377.099
30	245.781	30	271.471	30	301.284	30	336.300	30	378.011
20	246.260	20	272.024	20	301.929	20	337.063	20	378.927
10	246.741	10	272.578	10	302.576	10	337.828	10	379.846
7,200	247.222	6,700	273.134	6,200	303.266	5,700	338.596	5,200	380.769
7,190	247.705	6,690	273.692	6,190	303.877	5,690	339.367	5,190	381.696
80	248.189	80	274.251	80	304.531	80	340.141	80	382.625
70	248.675	70	274.813	70	305.186	70	340.917	70	383.559
60	249.162	60	275.375	60	305.844	60	341.696	60	384.496
50	249.650	50	275.940	50	306.504	50	342.478	50	385.437
40	250.140	40	276.506	40	307.166	40	343.262	40	386.381
30	250.631	30	277.074	30	307.830	30	344.050	30	387.329
20	251.124	20	277.644	20	308.497	20	344.840	20	388.281
10	251.617	10	278.215	10	309.165	10	345.633	10	389.237
7,100	252.113	6,600	278.788	6,100	309.836	5,600	346.429	5,100	390.196
7,090	252.609	6,590	279.363	6,090	310.509	5,590	347.227	5,090	391.159
80	253.107	80	279.939	80	311.184	80	348.029	80	392.126
70	253.607	70	280.518	70	311.862	70	348.833	70	393.097
60	254.108	60	281.098	60	312.541	60	349.640	60	394.071
50	254.610	50	281.679	50	313.223	50	350.450	50	395.050
40	255.114	40	282.263	40	313.907	40	351.264	40	396.032
30	255.619	30	282.848	30	314.594	30	352.080	30	397.018
20	256.125	20	283.436	20	315.282	20	352.899	20	398.008
10	256.633	10	284.025	10	315.973	10	353.721	10	399.002
								5,000	400.000