



# GAS DYNAMICS TABLES & CHARTS



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# TABLES OF COMPRESSIBLE-FLOW FUNCTIONS

TABLE 1  
ISENTROPIC FLOW  
Perfect Gas,  $k = 1.4$

M	M*	P/P*	$\rho/\rho^*$	T/T*	A/A*	F/F*	$\frac{A}{A^*} \cdot \frac{P}{P^*}$
0	0	1.0000,0	1.0000,0	1.00000	$\infty$	$\infty$	$\infty$
.01	.01096	.9999,3	.9999,5	.99998	5.7.874	4.5.650	5.7.870
.02	.02191	.9997,2	.9998,0	.99992	2.8.942	2.2.834	2.8.934
.03	.03286	.9993,7	.9995,5	.99982	1.9.300	15.,232	1.9.288
.04	.04381	.9988,8	.9992,0	.99968	14.,482	11.,435	14.,465
.05	.05476	.9982,5	.9987,5	.99950	11.5.915	9.,1584	11.,5712
.06	.06570	.9974,8	.9982,0	.99928	9.6.659	7.,6428	9.,6415
.07	.07664	.9965,8	.9975,5	.99902	8.2.915	6.5.620	8.2.631
.08	.08758	.9955,3	.9968,0	.99872	7.2.616	5.7.529	7.2.291
.09	.09851	.9943,5	.9959,6	.99838	6.4.613	5.1.249	6.4.248
.10	.10943	.9930,3	.9950,2	.99800	5.8.218	4.6.236	5.7.812
.11	.12035	.9915,7	.9939,8	.99758	5.2.992	4.2.146	5.2.546
.12	.13126	.9899,8	.9928,4	.99714	4.8.643	3.8.747	4.8.157
.13	.14216	.9882,6	.9916,0	.99664	4.4.968	3.58.80	4.4.440
.14	.15306	.9864,0	.9902,7	.99610	4.18.24	3.34.32	4.12.55
.15	.16395	.9844,1	.9888,4	.99552	3.91.03	3.13.17	3.84.93
.16	.17483	.9822,8	.9873,1	.99490	3.67.27	2.94.74	3.60.76
.17	.18569	.9800,3	.9856,9	.99425	3.46.35	2.78.55	3.39.43
.18	.19654	.9776,5	.9839,8	.99356	3.27.79	2.64.22	3.20.46
.19	.20738	.9751,4	.9821,7	.99283	3.11.22	2.51.46	3.03.48
.20	.21822	.9725,0	.9802,7	.99206	2.96.35	2.40.04	2.88.20
.21	.22904	.9697,3	.9782,8	.99125	2.82.93	2.29.76	2.74.37
.22	.23984	.9668,5	.9762,1	.99041	2.70.76	2.20.46	2.61.78
.23	.25063	.9638,3	.9740,3	.98953	2.59.68	2.12.03	2.50.29
.24	.26141	.9607,0	.9717,7	.98861	2.49.56	2.04.34	2.39.75
.25	.27216	.9574,5	.9694,2	.98765	2.40.27	1.97.82	2.30.05
.26	.28291	.9540,8	.9669,9	.98666	2.31.73	1.90.88	2.21.09
.27	.29364	.9506,0	.9644,6	.98563	2.23.85	1.84.96	2.12.79
.28	.30435	.9470,0	.9618,5	.98456	2.16.56	1.795.0	2.05.08
.29	.31504	.9432,9	.9591,6	.98346	2.09.79	1.744.6	1.97.89
.30	.32572	.9394,7	.9563,8	.98232	2.035.1	1.697.9	1.911.9
.31	.33638	.9355,4	.9535,2	.98114	1.976.5	1.654.6	1.849.1
.32	.34701	.9315,0	.9505,8	.97993	1.921.8	1.614.4	1.790.2
.33	.35762	.9273,6	.9475,6	.97868	1.870.7	1.576.9	1.734.8
.34	.36821	.9231,2	.9444,6	.97740	1.822.9	1.542.0	1.682.8
.35	.37879	.9187,7	.9412,8	.97608	1.778.0	1.509.4	1.633.6
.36	.38935	.9143,3	.9380,3	.97473	1.735.8	1.478.9	1.587.1
.37	.39988	.9097,9	.9347,0	.97335	1.696.1	1.450.3	1.543.1
.38	.41039	.9051,6	.9312,9	.97193	1.658.7	1.423.6	1.501.4
.39	.42087	.9004,4	.9278,2	.97048	1.623.4	1.398.5	1.461.8
.40	.43133	.8956,2	.9242,8	.96899	1.590.1	1.374.9	1.424.1
.41	.44177	.8907,1	.9206,6	.96747	1.558.7	1.352.7	1.388.3
.42	.45218	.8857,2	.9169,7	.96592	1.528.9	1.331.8	1.354.2
.43	.46256	.8806,5	.9132,2	.96434	1.500.7	1.312.2	1.321.6
.44	.47292	.8755,0	.9094,0	.96272	1.474.0	1.293.7	1.290.5

Notes: (1) For values of M from 0 to 5.00, all digits to the left of the comma are valid for linear interpolation. Where no comma is indicated in this region, all digits are valid for linear interpolation.  
(2) The notation 0.429 signifies .000429. The notation 5370, signifies 5.370.000.



TABLE 1 Isentropic Flow (Continued)  
 Perfect Gas,  $k = 1.4$ 

M	M*	$p/p_0$	$\rho/\rho_0$	$T/T_0$	$A/A^*$	$F/F^*$	$\frac{A}{A^*} \cdot \frac{p}{p_0}$
45	48996	8709,7	9055,3	96108	1.448,7	1.276,3	1.260,7
46	49987	8649,6	9016,7	95940	1.424,6	1.259,8	1.232,2
47	50986	8596,8	8975,6	95769	1.401,8	1.244,3	1.205,0
48	51410	8541,8	8934,9	95596	1.380,1	1.229,6	1.178,8
49	52482	8486,1	8893,6	95418	1.359,4	1.215,8	1.153,7
50	53462	8430,2	8851,7	95238	1.339,3	1.202,7	1.129,51
51	54469	8373,7	8809,2	95055	1.321,2	1.190,3	1.106,31
52	55482	8316,6	8766,2	94869	1.303,4	1.178,6	1.083,97
53	56498	8258,9	8722,7	94681	1.286,4	1.167,5	1.062,45
54	57501	8200,6	8678,8	94489	1.270,3	1.157,1	1.041,73
55	58506	8141,6	8634,2	94295	1.255,0	1.147,2	1.021,74
56	59508	8082,2	8589,2	94098	1.240,3	1.137,8	1.002,44
57	60509	8022,4	8543,7	93898	1.226,3	1.128,9	.983,81
58	61500	7962,1	8497,7	93696	1.213,0	1.120,5	.965,81
59	62491	7901,2	8451,3	93491	1.200,3	1.112,6	.948,39
60	63480	7840,0	8404,5	93284	1.188,2	1.1050,4	.931,55
61	64466	7778,4	8357,3	93074	1.176,6	1.0979,3	.915,25
62	65448	7716,4	8309,6	92861	1.165,6	1.0912,0	.899,46
63	66427	7654,0	8261,6	92646	1.155,1	1.0848,5	.884,16
64	67402	7591,3	8213,2	92428	1.145,1	1.0783,3	.869,32
65	68374	7528,3	8164,4	92208	1.1356	1.0731,4	.8549,3
66	69342	7465,0	8115,3	91986	1.1265	1.0677,7	.8409,6
67	70307	7401,4	8065,9	91762	1.1178	1.0627,1	.8274,0
68	71268	7337,6	8016,2	91535	1.1096	1.0579,2	.8142,1
69	72225	7273,5	7966,2	91306	1.1018	1.0534,0	.8014,1
70	73179	7209,2	7915,8	91075	1.0943,7	1.0491,5	.7889,6
71	74129	7144,8	7865,2	90842	1.0872,9	1.0451,4	.7768,5
72	75076	7080,2	7814,3	90606	1.0805,7	1.0413,7	.7650,7
73	76019	7015,5	7763,2	90368	1.0741,9	1.0378,3	.7536,0
74	76958	6950,7	7711,9	90129	1.0681,4	1.0345,0	.7424,3
75	77893	6885,7	7660,3	89888	1.0624,2	1.0313,7	.7315,5
76	78825	6820,7	7608,6	89644	1.0570,0	1.0284,4	.7209,5
77	79753	6755,6	7556,7	89399	1.0518,8	1.0257,0	.7106,2
78	80677	6690,5	7504,6	89152	1.0470,5	1.0231,4	.7005,4
79	81597	6625,4	7452,4	88903	1.0425,0	1.0207,5	.6907,0
80	82514	6560,2	7400,0	88652	1.0382,3	1.0185,3	.6811,0
81	83426	6495,1	7347,4	88400	1.0342,2	1.0164,6	.6717,3
82	84334	6430,0	7294,7	88146	1.0304,6	1.0145,5	.6625,9
83	85239	6365,0	7241,9	87890	1.0269,6	1.0127,8	.6536,6
84	86140	6300,0	7189,0	87633	1.0237,0	1.0111,5	.6449,3
85	87037	6235,1	7136,1	87374	1.0206,7	1.0096,6	.6364,0
86	87929	6170,3	7083,1	87114	1.0178,7	1.0082,9	.6280,6
87	88817	6105,7	7030,0	86852	1.0153,0	1.0070,4	.6199,1
88	89702	6041,2	6976,9	86589	1.0129,4	1.0059,1	.6119,3
89	90583	5976,8	6923,7	86324	1.0108,0	1.0049,0	.6041,3
90	91460	5912,6	6870,4	86058	1.0088,6	1.0039,9	.5965,0
91	92333	5848,6	6817,1	85791	1.0071,3	1.0031,8	.5890,3
92	93201	5784,8	6763,9	85523	1.0056,0	1.0024,8	.5817,1
93	94065	5721,2	6710,7	85253	1.0042,6	1.0018,8	.5745,5
94	94925	5657,3	6657,5	84982	1.0031,1	1.0013,6	.5675,4

See Notes at beginning of this table.



TABLE 1 ISENTROPIC FLOW (Continued)  
Perfect Gas,  $k = 1.4$

M	M*	p/p <sub>0</sub>	p/p <sub>0</sub>	T/T <sub>0</sub>	A/A*	F/F*	$\frac{A}{A^*} \cdot \frac{p}{p_0}$
.95	.95781	.55946	.66044	.84710	1.0021,4	1.0009,3	.5606,6
.96	.96633	.55317	.65513	.84437	1.0013,6	1.0005,9	.5539,2
.97	.97481	.54691	.64982	.84162	1.0007,6	1.0003,3	.5473,2
.98	.98325	.54067	.64452	.83887	1.0003,3	1.0001,4	.5408,5
.99	.99165	.53446	.63923	.83611	1.0000,8	1.0000,3	.5345,0
1.00	1.00000	.52828	.63394	.83333	1.0000,0	1.0000,0	.5282,8
1.01	1.00831	.52213	.62866	.83055	1.0000,8	1.0000,3	.5221,8
1.02	1.01658	.51602	.62339	.82776	1.0003,3	1.0001,3	.5161,9
1.03	1.02481	.50994	.61813	.82496	1.0007,4	1.0003,0	.5103,1
1.04	1.03300	.50389	.61288	.82215	1.0013,0	1.0005,3	.5045,4
1.05	1.04114	.49787	.60765	.81933	1.0020,2	1.0008,2	.4988,8
1.06	1.04924	.49189	.60243	.81651	1.0029,0	1.0011,6	.4933,2
1.07	1.05730	.48595	.59722	.81368	1.0039,4	1.0015,5	.4878,7
1.08	1.06532	.48005	.59203	.81084	1.0051,2	1.0020,0	.4825,1
1.09	1.07330	.47418	.58685	.80800	1.0064,5	1.0025,0	.4772,4
1.10	1.08124	.46835	.58169	.80515	1.0079,3	1.00305	.4720,6
1.11	1.08914	.46256	.57655	.80230	1.0095,5	1.00365	.4669,8
1.12	1.09699	.45682	.57143	.79944	1.0113,1	1.00429	.4619,9
1.13	1.10480	.45112	.56632	.79657	1.0132,2	1.00497	.4570,8
1.14	1.11256	.44545	.56123	.79370	1.0152,7	1.00569	.4522,5
1.15	1.1203	.43983	.55616	.79083	1.0174,6	1.00646	.4475,1
1.16	1.1280	.43425	.55112	.78795	1.0197,8	1.00726	.4428,4
1.17	1.1356	.42872	.54609	.78507	1.0222,4	1.00810	.4382,5
1.18	1.1432	.42323	.54108	.78218	1.0248,4	1.00897	.4337,4
1.19	1.1508	.41778	.53610	.77929	1.0275,7	1.00988	.4293,0
1.20	1.1583	.4123,8	.53114	.77640	1.0304,4	1.01082	.4249,3
1.21	1.1658	.4070,2	.52620	.77350	1.0334,4	1.01178	.4206,3
1.22	1.1732	.4017,1	.52129	.77061	1.0365,7	1.01278	.4164,0
1.23	1.1806	.3964,5	.51640	.76771	1.0398,3	1.01381	.4122,4
1.24	1.1879	.3912,3	.51154	.76481	1.0432,3	1.01486	.4081,4
1.25	1.1952	.3860,6	.50670	.76190	1.0467,6	1.01594	.4041,1
1.26	1.2025	.3809,4	.50189	.75900	1.0504,1	1.01705	.4001,4
1.27	1.2097	.3758,6	.49710	.75610	1.0541,9	1.01818	.3962,2
1.28	1.2169	.3708,3	.49234	.75319	1.0581,0	1.01933	.3923,7
1.29	1.2240	.3658,5	.48761	.75029	1.0621,4	1.02050	.3885,8
1.30	1.2311	.3609,2	.48291	.74738	1.0663,1	1.02170	.3848,4
1.31	1.2382	.3560,3	.47823	.74448	1.0706,0	1.02292	.3811,6
1.32	1.2452	.3511,9	.47358	.74158	1.0750,2	1.02415	.3775,4
1.33	1.2522	.3464,0	.46895	.73867	1.0795,7	1.02540	.3739,7
1.34	1.2591	.3416,6	.46436	.73577	1.0842,4	1.02666	.3704,4
1.35	1.2660	.3369,7	.45980	.73287	1.0890,4	1.02794	.3669,7
1.36	1.2729	.3323,3	.45527	.72997	1.0939,7	1.02924	.3635,5
1.37	1.2797	.3277,4	.45076	.72707	1.0990,2	1.03056	.3601,8
1.38	1.2865	.3231,9	.44628	.72418	1.1042,0	1.03189	.3568,6
1.39	1.2932	.3186,9	.44183	.72128	1.1095,0	1.03323	.3535,9
1.40	1.2999	.3142,4	.43742	.71839	1.1149	1.03458	.35036
1.41	1.3065	.3098,4	.43304	.71550	1.1205	1.03595	.34717
1.42	1.3131	.3054,9	.42869	.71261	1.1262	1.03733	.34403
1.43	1.3197	.3011,9	.42436	.70973	1.1320	1.03872	.34093
1.44	1.3262	.2969,3	.42007	.70685	1.1379	1.04012	.33787

See Notes at beginning of this table.

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TABLE 1 ISENTROPIC FLOW (Continued)  
Perfect Gas,  $k = 1.4$

$M$	$M^*$	$p/p_0$	$\rho/\rho_0$	$T/T_0$	$A/A^*$	$F/F^*$	$\frac{A}{A^*} \cdot \frac{p}{p_0}$
1.45	1.3327	.2927, 2	.41581	.70397	1.1440	1.04153	.33486
1.46	1.3392	.2885, 6	.41158	.70110	1.1502	1.04295	.33189
1.47	1.3456	.2844, 5	.40738	.69823	1.1565	1.04438	.32896
1.48	1.3520	.2803, 9	.40322	.69537	1.1629	1.04581	.32607
1.49	1.3583	.2763, 7	.39909	.69251	1.1695	1.04725	.32321
1.50	1.3646	.2724, 0	.39498	.68965	1.1762	1.04870	.32039
1.51	1.3708	.2684, 8	.39091	.68680	1.1830	1.05016	.31761
1.52	1.3770	.2646, 1	.38687	.68396	1.1899	1.05162	.31487
1.53	1.3832	.2607, 8	.38287	.68112	1.1970	1.05309	.31216
1.54	1.3894	.2570, 0	.37890	.67828	1.2042	1.05456	.30948
1.55	1.3955	.2532, 6	.37496	.67545	1.2115	1.05604	.30685
1.56	1.4016	.2495, 7	.37105	.67262	1.2190	1.05752	.30424
1.57	1.4076	.2459, 3	.36717	.66980	1.2266	1.05900	.30167
1.58	1.4135	.2423, 3	.36332	.66699	1.2343	1.06049	.29913
1.59	1.4195	.2387, 8	.35951	.66418	1.2422	1.06198	.29662
1.60	1.4254	.23527	.35573	.66138	1.2502	1.06348	.29414
1.61	1.4313	.23181	.35198	.65858	1.2583	1.06498	.29169
1.62	1.4371	.22839	.34826	.65579	1.2666	1.06648	.28928
1.63	1.4429	.22501	.34458	.65301	1.2750	1.06798	.28690
1.64	1.4487	.22168	.34093	.65023	1.2835	1.06948	.28454
1.65	1.4544	.21839	.33731	.64746	1.2922	1.07098	.28221
1.66	1.4601	.21515	.33372	.64470	1.3010	1.07249	.27991
1.67	1.4657	.21195	.33016	.64194	1.3099	1.07399	.27764
1.68	1.4713	.20879	.32664	.63919	1.3190	1.07550	.27540
1.69	1.4769	.20567	.32315	.63645	1.3282	1.07701	.27318
1.70	1.4825	.20259	.31969	.63372	1.3376	1.07851	.27099
1.71	1.4880	.19955	.31626	.63099	1.3471	1.08002	.26882
1.72	1.4935	.19656	.31286	.62827	1.3567	1.08152	.26668
1.73	1.4989	.19361	.30950	.62556	1.3665	1.08302	.26457
1.74	1.5043	.19070	.30617	.62286	1.3764	1.08453	.26248
1.75	1.5097	.18782	.30287	.62016	1.3865	1.08603	.26042
1.76	1.5150	.18499	.29959	.61747	1.3967	1.08753	.25838
1.77	1.5203	.18220	.29635	.61479	1.4071	1.08903	.25636
1.78	1.5256	.17944	.29314	.61211	1.4176	1.09053	.25436
1.79	1.5308	.17672	.28997	.60945	1.4282	1.09202	.25239
1.80	1.5360	.17404	.28682	.60680	1.4390	1.09352	.25044
1.81	1.5412	.17140	.28370	.60415	1.4499	1.09500	.24851
1.82	1.5463	.16879	.28061	.60151	1.4610	1.09649	.24660
1.83	1.5514	.16622	.27756	.59888	1.4723	1.09798	.24472
1.84	1.5564	.16369	.27453	.59626	1.4837	1.09946	.24286
1.85	1.5614	.16120	.27153	.59365	1.4952	1.1009	.24102
1.86	1.5664	.15874	.26857	.59105	1.5069	1.1024	.23919
1.87	1.5714	.15631	.26563	.58845	1.5188	1.1039	.23739
1.88	1.5763	.15392	.26272	.58586	1.5308	1.1054	.23561
1.89	1.5812	.15156	.25984	.58329	1.5429	1.1068	.23385
1.90	1.5861	.14924	.25699	.58072	1.5552	1.1083	.23211
1.91	1.5909	.14695	.25417	.57816	1.5677	1.1097	.23039
1.92	1.5957	.14469	.25138	.57561	1.5804	1.1112	.22868
1.93	1.6005	.14247	.24862	.57307	1.5932	1.1126	.22699
1.94	1.6052	.14028	.24588	.57054	1.6062	1.1141	.22532

See Notes at beginning of this table.



TABLE I ISENTROPIC FLOW (Continued)

Perfect Gas,  $\gamma = 1.4$ 

M	M*	$p/p_0$	$\rho/\rho_0$	$T/T_0$	$A/A^*$	$F/F^*$	$\frac{A}{A^*} \frac{p}{p_0}$
1.95	1.6099	.13813	.24317	.56902	1.6192	1.1155	.22367
1.96	1.6146	.13600	.24049	.56551	1.6326	1.1170	.22204
1.97	1.6193	.13390	.23784	.56201	1.6461	1.1184	.22042
1.98	1.6239	.13184	.23522	.55851	1.6597	1.1198	.21882
1.99	1.6285	.12981	.23262	.55503	1.6735	1.1213	.21724
2.00	1.6330	.12780	.23005	.55156	1.6875	1.1227	.21567
2.01	1.6375	.12583	.22751	.54810	1.7017	1.1241	.21412
2.02	1.6420	.12389	.22499	.54464	1.7160	1.1255	.21259
2.03	1.6465	.12198	.22250	.54119	1.7305	1.1269	.21107
2.04	1.6509	.12009	.22004	.53775	1.7452	1.1283	.20957
2.05	1.6553	.11823	.21760	.53433	1.7600	1.1297	.20808
2.06	1.6597	.11640	.21519	.53091	1.7750	1.1311	.20661
2.07	1.6640	.11460	.21281	.52750	1.7902	1.1325	.20515
2.08	1.6683	.11282	.21045	.52411	1.8056	1.1339	.20371
2.09	1.6726	.11107	.20811	.52073	1.8212	1.1352	.20228
2.10	1.6769	.10935	.20580	.51735	1.8369	1.1366	.20087
2.11	1.6811	.10766	.20352	.51398	1.8529	1.1380	.19947
2.12	1.6853	.10599	.20126	.51063	1.8690	1.1393	.19809
2.13	1.6895	.10434	.19902	.50728	1.8853	1.1407	.19672
2.14	1.6936	.10272	.19681	.50394	1.9018	1.1420	.19537
2.15	1.6977	.10113	.19463	.50062	1.9185	1.1434	.19403
2.16	1.7018	.09956	.19247	.50730	1.9354	1.1447	.19270
2.17	1.7059	.09802	.19033	.50399	1.9525	1.1460	.19138
2.18	1.7099	.09650	.18821	.50069	1.9698	1.1474	.19008
2.19	1.7139	.09500	.18612	.50741	1.9873	1.1487	.18879
2.20	1.7179	.09352	.18405	.50413	2.0050	1.1500	.18751
2.21	1.7219	.09207	.18200	.50086	2.0229	1.1513	.18624
2.22	1.7258	.09064	.17998	.50361	2.0409	1.1526	.18499
2.23	1.7297	.08923	.17798	.50136	2.0592	1.1539	.18375
2.24	1.7336	.08784	.17600	.49912	2.0777	1.1552	.18252
2.25	1.7374	.08648	.17404	.49689	2.0964	1.1565	.18130
2.26	1.7412	.08514	.17211	.49468	2.1154	1.1578	.18009
2.27	1.7450	.08382	.17020	.49247	2.1345	1.1590	.17890
2.28	1.7488	.08252	.16830	.49027	2.1538	1.1603	.17772
2.29	1.7526	.08123	.16643	.48809	2.1734	1.1616	.17655
2.30	1.7563	.07997	.16458	.48591	2.1931	1.1629	.17539
2.31	1.7600	.07873	.16275	.48374	2.2131	1.1641	.17424
2.32	1.7637	.07751	.16095	.48158	2.2333	1.1653	.17310
2.33	1.7673	.07631	.15916	.47944	2.2537	1.1666	.17197
2.34	1.7709	.07513	.15739	.47730	2.2744	1.1678	.17085
2.35	1.7745	.07396	.15564	.47517	2.2953	1.1690	.16975
2.36	1.7781	.07281	.15391	.47305	2.3164	1.1703	.16866
2.37	1.7817	.07168	.15220	.47095	2.3377	1.1715	.16757
2.38	1.7852	.07057	.15052	.46885	2.3593	1.1727	.16649
2.39	1.7887	.06948	.14885	.46676	2.3811	1.1739	.16543
2.40	1.7922	.06840	.14720	.46468	2.4031	1.1751	.16437
2.41	1.7957	.06734	.14557	.46262	2.4254	1.1763	.16332
2.42	1.7991	.06630	.14396	.46056	2.4479	1.1775	.16229
2.43	1.8025	.06527	.14235	.45851	2.4706	1.1786	.16126
2.44	1.8059	.06426	.14073	.45647	2.4936	1.1798	.16024

See Notes at beginning of this table.

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TABLE 1    ISENTROPIC FLOW (Continued)  
Perfect Gas,  $k = 1.4$

$M$	$M^*$	$p/p_0$	$\rho/\rho_0$	$T/T_0$	$A/A^*$	$F/F^*$	$\frac{A}{A^*} \cdot \frac{p}{p_0}$
2.45	1.8093	.06327	.13922	.45444	2.5168	1.1810	.15923
2.46	1.8126	.06229	.13768	.45242	2.5403	1.1821	.15823
2.47	1.8159	.06133	.13616	.45041	2.5640	1.1833	.15724
2.48	1.8192	.06038	.13465	.44841	2.5880	1.1844	.15626
2.49	1.8225	.05945	.13316	.44642	2.6122	1.1856	.15528
2.50	1.8258	.05853	.13169	.44444	2.6367	1.1867	.15432
2.51	1.8290	.05763	.13023	.44247	2.6615	1.1879	.15337
2.52	1.8322	.05674	.12879	.44051	2.6865	1.1890	.15242
2.53	1.8354	.05586	.12737	.43856	2.7117	1.1901	.15148
2.54	1.8386	.05500	.12597	.43662	2.7372	1.1912	.15055
2.55	1.8417	.05415	.12458	.43469	2.7630	1.1923	.14963
2.56	1.8448	.05332	.12321	.43277	2.7891	1.1934	.14871
2.57	1.8479	.05250	.12185	.43085	2.8154	1.1945	.14780
2.58	1.8510	.05169	.12051	.42894	2.8420	1.1956	.14691
2.59	1.8541	.05090	.11918	.42705	2.8689	1.1967	.14601
2.60	1.8572	.05012	.11787	.42517	2.8960	1.1978	.14513
2.61	1.8602	.04935	.11658	.42330	2.9234	1.1989	.14426
2.62	1.8632	.04859	.11530	.42143	2.9511	1.2000	.14339
2.63	1.8662	.04784	.11403	.41957	2.9791	1.2011	.14253
2.64	1.8692	.04711	.11278	.41772	3.0074	1.2021	.14168
2.65	1.8721	.04639	.11154	.41589	3.0359	1.2031	.14083
2.66	1.8750	.04568	.11032	.41406	3.0647	1.2042	.13999
2.67	1.8779	.04498	.10911	.41224	3.0938	1.2052	.13916
2.68	1.8808	.04429	.10792	.41043	3.1233	1.2062	.13834
2.69	1.8837	.04361	.10674	.40863	3.1530	1.2073	.13752
2.70	1.8865	.04295	.10557	.40684	3.1830	1.2083	.13671
2.71	1.8894	.04230	.10442	.40505	3.2133	1.2093	.13591
2.72	1.8922	.04166	.10328	.40327	3.2440	1.2103	.13511
2.73	1.8950	.04102	.10215	.40151	3.2749	1.2113	.13432
2.74	1.8978	.04039	.10104	.39976	3.3061	1.2123	.13354
2.75	1.9005	.03977	.09994	.39801	3.3376	1.2133	.13276
2.76	1.9032	.03917	.09885	.39627	3.3695	1.2143	.13199
2.77	1.9060	.03858	.09777	.39454	3.4017	1.2153	.13123
2.78	1.9087	.03800	.09671	.39282	3.4342	1.2163	.13047
2.79	1.9114	.03742	.09566	.39111	3.4670	1.2173	.12972
2.80	1.9140	.03685	.09462	.38941	3.5001	1.2182	.12897
2.81	1.9167	.03629	.09360	.38771	3.5336	1.2192	.12823
2.82	1.9193	.03574	.09259	.38603	3.5674	1.2202	.12750
2.83	1.9220	.03520	.09158	.38435	3.6015	1.2211	.12678
2.84	1.9246	.03467	.09059	.38268	3.6359	1.2221	.12605
2.85	1.9271	.03415	.08962	.38102	3.6707	1.2230	.12534
2.86	1.9297	.03363	.08865	.37937	3.7058	1.2240	.12463
2.87	1.9322	.03312	.08769	.37773	3.7413	1.2249	.12393
2.88	1.9348	.03262	.08674	.37610	3.7771	1.2258	.12323
2.89	1.9373	.03213	.08581	.37448	3.8133	1.2268	.12254
2.90	1.9398	.03165	.08489	.37286	3.8498	1.2277	.12185
2.91	1.9423	.03118	.08398	.37125	3.8866	1.2286	.12117
2.92	1.9448	.03071	.08308	.36965	3.9238	1.2295	.12049
2.93	1.9472	.03025	.08218	.36806	3.9614	1.2304	.11982
2.94	1.9497	.02980	.08130	.36648	3.9993	1.2313	.11916

See Notes at beginning of this table.



TABLE 1    ISENTROPIC FLOW (*Concluded*)  
Perfect Gas,  $k = 1.4$

$M$	$M^*$	$p/p_0$	$\rho/\rho_0$	$T/T_0$	$A/A^*$	$F/F^*$	$\frac{A}{A^*} \cdot \frac{p}{p_0}$
2.95	1.9521	.02935	.08043	.36490	4.0376	1.2322	.11850
2.96	1.9545	.02891	.07957	.36333	4.0763	1.2331	.11785
2.97	1.9569	.02848	.07872	.36177	4.1153	1.2340	.11720
2.98	1.9593	.02805	.07788	.36022	4.1547	1.2348	.11656
2.99	1.9616	.02764	.07705	.35868	4.1944	1.2357	.11591
3.00	1.964,0	.027,22	.076,23	.357,14	4.23,46	1.2366	.115,28
3.10	1.986,6	.023,45	.068,52	.342,23	4.65,73	1.2450	.109,21
3.20	2.007,9	.020,23	.061,65	.328,08	5.12,10	1.2530	.1035,9
3.30	2.027,9	.0174,8	.055,54	.314,66	5.6,287	1.2605	.0983,7
3.40	2.046,6	.0151,2	.050,09	.301,93	6.1,837	1.2676	.0935,3
3.50	2.064,2	.0131,1	.045,23	.289,86	6.7,896	1.2743	.0890,2
3.60	2.080,8	.0113,8	.040,89	.278,40	7.4,501	1.2807	.0848,2
3.70	2.096,4	.0099,0	.0370,2	.267,52	8.1,691	1.2867	.0809,0
3.80	2.111,1	.0086,3	.0335,5	.257,20	8.9,506	1.2924	.0772,3
3.90	2.125,0	.0075,3	.0304,4	.247,40	9.7,990	1.2978	.0738,0
4.00	2.138,1	.0065,8	.0276,6	.238,10	10.7,19	1.3029	.0705,9
4.10	2.150,5	.0057,7	.0251,6	.229,25	11.7,15	1.3077	.0675,8
4.20	2.162,2	.0050,6	.0229,2	.2208,5	12.7,92	1.3123	.0647,5
4.30	2.173,2	.0044,5	.0209,0	.2128,6	13.9,55	1.3167	.0620,9
4.40	2.183,7	.0039,2	.0190,9	.2052,5	15.2,10	1.3208	.0595,9
4.50	2.193,6	.0034,6	.0174,5	.1980,2	16.5,62	1.3247	.0572,3
4.60	2.203,0	.0030,5	.0159,7	.1911,3	18.0,18	1.3284	.0550,0
4.70	2.211,9	.0027,0	.0146,3	.1845,7	19.5,83	1.3320	.0528,9
4.80	2.220,4	.0024,0	.0134,3	.1783,2	21.2,64	1.3354	.0509,1
4.90	2.228,4	.0021,3	.0123,3	.1723,5	23.0,67	1.3386	.0490,4
5.00	2.2361	.00189	.01134	.16667	25.000	1.3416	.04725
6.00	2.2953	.0,633	.00519	.12195	53.180	1.3655	.03368
7.00	2.3333	.0,242	.00261	.09259	104.143	1.3810	.02516
8.00	2.3591	.0,102	.00141	.07246	190.109	1.3915	.01947
9.00	2.3772	.0,474	.0,815	.05814	327.189	1.3989	.01550
10.00	2.3904	.0,236	.0,495	.04762	535.938	1.4044	.01263
$\infty$	2.4495	0	0	0	$\infty$	1.4289	0

See Notes at beginning of this table.



TABLE 2

~~NORMAL SHOCK~~  
Perfect Gas,  $\gamma = 1.4$

$M_x$	$M_y$	$p_y/p_x$	$V_x/V_y$ and $\rho_y/\rho_x$	$T_y/T_x$	$A_x^*/A_y^*$ and $p_{0y}/p_{0x}$	$p_{0y}/p_x$
1.00	1.0000,0	1.0000,0	1.0000,0	1.0000,0	1.00000	1.8929
1.01	.9901,3	1.0234,5	1.0166,9	1.0066,5	.99999	1.9152
1.02	.9805,2	1.0471,3	1.0334,4	1.01325	.99998	1.9379
1.03	.9711,5	1.0710,5	1.0502,4	1.01981	.99997	1.9610
1.04	.9620,2	1.0952,0	1.0670,9	1.02634	.99994	1.9845
1.05	.9531,2	1.1196	1.0839,8	1.03284	.99987	2.0063
1.06	.9444,4	1.1442	1.10092	1.03931	.99976	2.0325
1.07	.9359,8	1.1690	1.11790	1.04575	.99962	2.0570
1.08	.9277,2	1.1941	1.13492	1.05217	.9994,4	2.0819
1.09	.9196,5	1.2194	1.15199	1.05856	.9992,1	2.1072
1.10	.9117,7	1.2450	1.1691	1.06494	.9989,2	2.1328
1.11	.9040,8	1.2708	1.1862	1.07130	.9985,8	2.1588
1.12	.8965,6	1.2968	1.2034	1.07764	.9982,0	2.1851
1.13	.8892,2	1.3230	1.2206	1.08396	.9977,6	2.2118
1.14	.8820,4	1.3495	1.2378	1.09027	.9972,6	2.2388
1.15	.8750,2	1.3762	1.2550	1.09657	.9966,9	2.2661
1.16	.8681,6	1.4032	1.2723	1.10287	.9960,5	2.2937
1.17	.8614,5	1.4304	1.2896	1.10916	.9953,4	2.3217
1.18	.8548,8	1.4578	1.3069	1.11544	.9945,5	2.3499
1.19	.8484,6	1.4854	1.3243	1.12172	.9937,1	2.3786
1.20	.8421,7	1.5133	1.3416	1.1280	.9928,0	2.4075
1.21	.8360,1	1.5414	1.3590	1.1343	.9918,0	2.4367
1.22	.8299,8	1.5698	1.3764	1.1405	.9907,3	2.4662
1.23	.8240,8	1.5984	1.3938	1.1468	.9895,7	2.4961
1.24	.8183,0	1.6272	1.4112	1.1531	.9883,5	2.5263
1.25	.8126,4	1.6562	1.4286	1.1594	.9870,6	2.5568
1.26	.8070,9	1.6855	1.4460	1.1657	.9856,8	2.5876
1.27	.8015,5	1.7150	1.4634	1.1720	.9842,2	2.6187
1.28	.7961,1	1.7443	1.4808	1.1782	.9826,8	2.6500
1.29	.7908,8	1.7743	1.4983	1.1846	.9810,6	2.6816
1.30	.7859,6	1.8050	1.5157	1.1909	.9793,5	2.7135
1.31	.7809,3	1.8354	1.5331	1.1972	.9775,8	2.7457
1.32	.7760,0	1.8661	1.5506	1.2035	.9757,4	2.7783
1.33	.7711,6	1.8970	1.5680	1.2099	.9738,2	2.8112
1.34	.7664,1	1.9282	1.5854	1.2162	.9718,1	2.8444
1.35	.7617,5	1.9596	1.6028	1.2226	.9697,2	2.8778
1.36	.7571,8	1.9912	1.6202	1.2290	.9675,6	2.9115
1.37	.7526,9	2.0230	1.6376	1.2354	.9653,4	2.9455
1.38	.7482,8	2.0551	1.6550	1.2418	.9630,4	2.9798
1.39	.7439,6	2.0874	1.6723	1.2482	.9606,5	3.0144
1.40	.7397,1	2.1200	1.6896	1.2547	.9581,9	3.0493
1.41	.7355,4	2.1528	1.7070	1.2612	.9556,6	3.0844
1.42	.7314,4	2.1858	1.7243	1.2676	.9530,6	3.1198
1.43	.7274,1	2.2190	1.7416	1.2742	.9503,9	3.1555
1.44	.7234,5	2.2525	1.7589	1.2807	.9476,5	3.1915

Notes: (1) For values of  $M$  from 1.00 to 3.00, all digits to the left of the comma are valid for linear interpolation. Where no comma is indicated in this region, all digits are valid for linear interpolation.



TABLE 2 NORMAL SHOCK (Continued)

Perfect Gas,  $k = 1.4$ 

$M_x$	$M_y$	$P_y/P_x$	$V_x/V_y$ and $\rho_y/\rho_x$	$T_y/T_x$	$A_x^*/A_y^*$ and $P_{0y}/P_{0x}$	$P_{0y}/P_x$
1.45	.7195,6	2.2862	1.7761	1.2872	.9448,3	3.2278
1.46	.7157,4	2.3202	1.7934	1.2938	.9419,6	3.2643
1.47	.7119,8	2.3544	1.8106	1.3004	.9390,1	3.3011
1.48	.7082,9	2.3888	1.8278	1.3070	.9360,0	3.3382
1.49	.7046,6	2.4234	1.8449	1.3136	.9239,2	3.3756
1.50	.7010,9	2.4583	1.8621	1.3202	.9297,8	3.4133
1.51	.6975,8	2.4934	1.8792	1.3269	.9265,8	3.4512
1.52	.6941,3	2.5288	1.8962	1.3336	.9233,1	3.4894
1.53	.6907,3	2.5644	1.9133	1.3403	.9199,9	3.5279
1.54	.6873,9	2.6003	1.9303	1.3470	.9166,2	3.5667
1.55	.6841,0	2.6363	1.9473	1.3538	.9131,9	3.6058
1.56	.6808,6	2.6725	1.9643	1.3606	.9097,0	3.6451
1.57	.6776,8	2.7090	1.9812	1.3674	.9061,5	3.6847
1.58	.6745,5	2.7458	1.9981	1.3742	.9025,5	3.7245
1.59	.6714,7	2.7828	2.0149	1.3811	.8988,9	3.7645
1.60	.66844	2.8201	2.0317	1.3880	.8952,0	3.8049
1.61	.66545	2.8575	2.0485	1.3949	.8914,4	3.8456
1.62	.66251	2.8951	2.0652	1.4018	.8876,4	3.8866
1.63	.65962	2.9330	2.0820	1.4088	.8838,0	3.9278
1.64	.65677	2.9712	2.0986	1.4158	.8799,2	3.9693
1.65	.65396	3.0096	2.1152	1.4228	.87598	4.0111
1.66	.65119	3.0482	2.1318	1.4298	.87201	4.0531
1.67	.64847	3.0870	2.1484	1.4369	.86800	4.0954
1.68	.64579	3.1261	2.1649	1.4440	.86396	4.1379
1.69	.64315	3.1654	2.1813	1.4512	.85987	4.1807
1.70	.64055	3.2050	2.1977	1.4583	.85573	4.2238
1.71	.63798	3.2448	2.2141	1.4655	.85155	4.2672
1.72	.63545	3.2848	2.2304	1.4727	.84735	4.3108
1.73	.63296	3.3250	2.2467	1.4800	.84312	4.3547
1.74	.63051	3.3655	2.2629	1.4873	.83886	4.3989
1.75	.62809	3.4062	2.2791	1.4946	.83456	4.4433
1.76	.62570	3.4472	2.2952	1.5019	.83024	4.4880
1.77	.62335	3.4884	2.3113	1.5093	.82589	4.5330
1.78	.62104	3.5298	2.3273	1.5167	.82152	4.5783
1.79	.61875	3.5714	2.3433	1.5241	.81711	4.6238
1.80	.61650	3.6133	2.3592	1.5316	.81268	4.6695
1.81	.61428	3.6554	2.3751	1.5391	.80823	4.7155
1.82	.61209	3.6978	2.3909	1.5466	.80376	4.7618
1.83	.60993	3.7404	2.4067	1.5542	.79926	4.8083
1.84	.60780	3.7832	2.4224	1.5617	.79474	4.8551
1.85	.60570	3.8262	2.4381	1.5694	.79021	4.9022
1.86	.60363	3.8695	2.4537	1.5770	.78567	4.9498
1.87	.60159	3.9130	2.4693	1.5847	.78112	4.9974
1.88	.59957	3.9568	2.4848	1.5924	.77656	5.0453
1.89	.59758	4.0008	2.5003	1.6001	.77197	5.0934

See Notes at beginning of this table.



TABLE 2 NORMAL SHOCK (Continued)

Perfect Gas,  $k = 1.4$ 

$M_x$	$M_y$	$p_y/p_x$	$V_x/V_y$ and $\rho_y/\rho_x$	$T_y/T_x$	$A_x^*/A_y^*$ and $p_{0y}/p_{0x}$	$p_{0y}/p_x$
1.90	.59562	4.0450	2.5157	1.6079	.76735	5.1417
1.91	.59368	4.0894	2.5310	1.6157	.76273	5.1904
1.92	.59177	4.1341	2.5463	1.6236	.75812	5.2394
1.93	.58988	4.1790	2.5615	1.6314	.75347	5.2886
1.94	.58802	4.2242	2.5767	1.6394	.74883	5.3381
1.95	.58618	4.2696	2.5919	1.6473	.74418	5.3878
1.96	.58437	4.3152	2.6070	1.6553	.73954	5.4378
1.97	.58258	4.3610	2.6220	1.6633	.73487	5.4880
1.98	.58081	4.4071	2.6369	1.6713	.73021	5.5385
1.99	.57907	4.4534	2.6518	1.6794	.72554	5.5894
2.00	.57735	4.5000	2.6666	1.6875	.72088	5.6405
2.01	.57565	4.5468	2.6814	1.6956	.71619	5.6918
2.02	.57397	4.5938	2.6962	1.7038	.71152	5.7434
2.03	.57231	4.6411	2.7109	1.7120	.70686	5.7952
2.04	.57068	4.6886	2.7255	1.7203	.70218	5.8473
2.05	.56907	4.7363	2.7400	1.7286	.69752	5.8997
2.06	.56747	4.7842	2.7545	1.7369	.69284	5.9523
2.07	.56589	4.8324	2.7690	1.7452	.68817	6.0052
2.08	.56433	4.8808	2.7834	1.7536	.68351	6.0584
2.09	.56280	4.9295	2.7977	1.7620	.67886	6.1118
2.10	.56128	4.9784	2.8119	1.7704	.67422	6.1655
2.11	.55978	5.0275	2.8261	1.7789	.66957	6.2194
2.12	.55830	5.0768	2.8402	1.7874	.66492	6.2736
2.13	.55683	5.1264	2.8543	1.7960	.66029	6.3280
2.14	.55538	5.1762	2.8683	1.8046	.65567	6.3827
2.15	.55395	5.2262	2.8823	1.8132	.65105	6.4377
2.16	.55254	5.2765	2.8962	1.8219	.64644	6.4929
2.17	.55114	5.3270	2.9100	1.8306	.64185	6.5484
2.18	.54976	5.3778	2.9238	1.8393	.63728	6.6042
2.19	.54841	5.4288	2.9376	1.8481	.63270	6.6602
2.20	.54706	5.4800	2.9512	1.8569	.62812	6.7163
2.21	.54572	5.5314	2.9648	1.8657	.62358	6.7730
2.22	.54440	5.5831	2.9783	1.8746	.61905	6.8299
2.23	.54310	5.6350	2.9918	1.8835	.61453	6.8869
2.24	.54182	5.6872	3.0052	1.8924	.61002	6.9442
2.25	.54055	5.7396	3.0186	1.9014	.60554	7.0018
2.26	.53929	5.7922	3.0319	1.9104	.60106	7.0597
2.27	.53805	5.8451	3.0452	1.9194	.59659	7.1178
2.28	.53683	5.8982	3.0584	1.9285	.59214	7.1762
2.29	.53561	5.9515	3.0715	1.9376	.58772	7.2348
2.30	.53441	6.0050	3.0846	1.9468	.58331	7.2937
2.31	.53322	6.0588	3.0976	1.9560	.57891	7.3529
2.32	.53205	6.1128	3.1105	1.9652	.57452	7.4123
2.33	.53089	6.1670	3.1234	1.9745	.57015	7.4720
2.34	.52974	6.2215	3.1362	1.9838	.56580	7.5319

See Notes at beginning of this table.



TABLE 2 : NORMAL SHOCK (Continued)

Perfect Gas,  $k = 1.4$ 

$M_x$	$M_y$	$p_y/p_x$	$V_x/V_y$ and $\rho_y/\rho_x$	$T_y/T_x$	$A_x^*/A_y^*$ and $p_{0y}/p_{0x}$	$p_{0y}/p_x$
2.35	.52861	6.2762	3.1490	1.9931	.56148	7.5920
2.36	.52749	6.3312	3.1617	2.0025	.55717	7.6524
2.37	.52638	6.3864	3.1743	2.0119	.55288	7.7131
2.38	.52528	6.4418	3.1869	2.0213	.54862	7.7741
2.39	.52419	6.4974	3.1994	2.0308	.54438	7.8354
2.40	.52312	6.5533	3.2119	2.0403	.54015	7.8969
2.41	.52206	6.6094	3.2243	2.0499	.53594	7.9587
2.42	.52100	6.6658	3.2366	2.0595	.53175	8.0207
2.43	.51996	6.7224	3.2489	2.0691	.52758	8.0830
2.44	.51894	6.7792	3.2611	2.0788	.52344	8.1455
2.45	.51792	6.8362	3.2733	2.0885	.51932	8.2083
2.46	.51691	6.8935	3.2854	2.0982	.51521	8.2714
2.47	.51592	6.9510	3.2975	2.1080	.51112	8.3347
2.48	.51493	7.0088	3.3095	2.1178	.50706	8.3983
2.49	.51395	7.0668	3.3214	2.1276	.50303	8.4622
2.50	.51299	7.1250	3.3333	2.1375	.49902	8.5262
2.51	.51204	7.1834	3.3451	2.1474	.49502	8.5904
2.52	.51109	7.2421	3.3569	2.1574	.49104	8.6549
2.53	.51015	7.3010	3.3686	2.1674	.48709	8.7198
2.54	.50923	7.3602	3.3802	2.1774	.48317	8.7850
2.55	.50831	7.4196	3.3918	2.1875	.47927	8.8505
2.56	.50740	7.4792	3.4034	2.1976	.47540	8.9162
2.57	.50651	7.5391	3.4149	2.2077	.47155	8.9821
2.58	.50562	7.5992	3.4263	2.2179	.46772	9.0482
2.59	.50474	7.6595	3.4376	2.2281	.46391	9.1146
2.60	.50387	7.7200	3.4489	2.2383	.46012	9.1813
2.61	.50301	7.7808	3.4602	2.2486	.45636	9.2481
2.62	.50216	7.8418	3.4714	2.2589	.45262	9.3154
2.63	.50132	7.9030	3.4825	2.2693	.44891	9.3829
2.64	.50048	7.9645	3.4936	2.2797	.44522	9.4507
2.65	.49965	8.0262	3.5047	2.2901	.44155	9.5187
2.66	.49883	8.0882	3.5157	2.3006	.43791	9.5869
2.67	.49802	8.1504	3.5266	2.3111	.43429	9.6553
2.68	.49722	8.2128	3.5374	2.3217	.43070	9.7241
2.69	.49642	8.2754	3.5482	2.3323	.42713	9.7932
2.70	.49563	8.3383	3.5590	2.3429	.42359	9.8625
2.71	.49485	8.4014	3.5697	2.3536	.42007	9.9320
2.72	.49408	8.4648	3.5803	2.3643	.41657	10.0017
2.73	.49332	8.5284	3.5909	2.3750	.41310	10.0718
2.74	.49256	8.5922	3.6014	2.3858	.40965	10.1421
2.75	.49181	8.6562	3.6119	2.3966	.40622	10.212
2.76	.49107	8.7205	3.6224	2.4074	.40282	10.283
2.77	.49033	8.7850	3.6328	2.4183	.39945	10.354
2.78	.48960	8.8497	3.6431	2.4292	.39610	10.426
2.79	.48888	8.9147	3.6533	2.4402	.39276	10.498

See Notes at beginning of this table.



# FANNO LINE TABLE

## (FRICTION)



D-1

Fanno-line flow

Perfect gas

K = 1.4

M	T/T*	P/P*	Po/Po*	V/V*	F/F*	4fL/D
0.01	1.19998	109.54340	57.87384	0.01095	45.64948	7134.40500
0.02	1.19990	54.77007	28.94213	0.02191	22.83364	1778.45000
0.03	1.19978	36.51155	19.30054	0.03286	15.23232	787.08140
0.04	1.19962	27.38175	14.48149	0.04381	11.43462	440.35220
0.05	1.19940	21.90343	11.59144	0.05476	9.15837	280.02030
0.06	1.19914	18.25085	9.66591	0.06570	7.64285	193.03110
0.07	1.19883	15.64155	8.29113	0.07664	6.56202	140.65500
0.08	1.19847	13.68431	7.26161	0.08758	5.75288	106.71820
0.09	1.19806	12.16177	6.46134	0.09851	5.12487	83.49611
0.10	1.19761	10.94351	5.82183	0.10944	4.62363	66.92155
0.11	1.19710	9.94656	5.29923	0.12035	4.21461	54.68790
0.12	1.19655	9.11559	4.86432	0.13126	3.87473	45.40796
0.13	1.19596	8.41230	4.49686	0.14217	3.58806	38.20700
0.14	1.19531	7.80932	4.18240	0.15306	3.34317	32.51131
0.15	1.19462	7.28659	3.91034	0.16395	3.13172	27.93196
0.16	1.19389	6.82907	3.67274	0.17482	2.94743	24.19783
0.17	1.19310	6.42525	3.46351	0.18569	2.78551	21.11518
0.18	1.19227	6.06618	3.27793	0.19654	2.64223	18.54265
0.19	1.19140	5.74480	3.11226	0.20739	2.51464	16.37516
0.20	1.19048	5.45545	2.96352	0.21822	2.40040	14.53327
0.21	1.18951	5.19355	2.82929	0.22904	2.29758	12.95602
0.22	1.18850	4.95537	2.70760	0.23984	2.20464	11.59605
0.23	1.18744	4.73781	2.59681	0.25063	2.12029	10.41609
0.24	1.18633	4.53829	2.49556	0.26141	2.04344	9.38648
0.25	1.18519	4.35465	2.40271	0.27217	1.97320	8.48341
0.26	1.18399	4.18506	2.31729	0.28291	1.90880	7.68757
0.27	1.18276	4.02795	2.23847	0.29364	1.84960	6.98317
0.28	1.18147	3.88199	2.16555	0.30435	1.79503	6.35721
0.29	1.18015	3.74602	2.09793	0.31504	1.74462	5.79891
0.30	1.17878	3.61906	2.03507	0.32572	1.69794	5.29925
0.31	1.17737	3.50022	1.97651	0.33637	1.65464	4.85066
0.32	1.17592	3.38874	1.92185	0.34701	1.61440	4.44674
0.33	1.17442	3.28396	1.87075	0.35762	1.57693	4.08205
0.34	1.17288	3.18529	1.82288	0.36822	1.54200	3.75195
0.35	1.17130	3.09219	1.77797	0.37879	1.50938	3.45245
0.36	1.16968	3.00422	1.73578	0.38935	1.47888	3.18012
0.37	1.16802	2.92095	1.69609	0.39988	1.45032	2.93198
0.38	1.16632	2.84200	1.65870	0.41039	1.42362	2.70545
0.39	1.16457	2.76706	1.62343	0.42087	1.39845	2.49828
0.40	1.16279	2.69582	1.59014	0.43133	1.37487	2.30849
0.41	1.16097	2.62801	1.55867	0.44177	1.35270	2.13436
0.42	1.15911	2.56338	1.52891	0.45218	1.33185	1.97437
0.43	1.15721	2.50171	1.50072	0.46257	1.31221	1.82715
0.44	1.15527	2.44281	1.47401	0.47293	1.29371	1.69153
0.45	1.15329	2.38648	1.44867	0.48326	1.27627	1.56643
0.46	1.15128	2.33256	1.42463	0.49357	1.25981	1.45091
0.47	1.14923	2.28089	1.40180	0.50385	1.24429	1.34414
0.48	1.14714	2.23135	1.38010	0.51410	1.22962	1.24534
0.49	1.14502	2.18378	1.35947	0.52433	1.21577	1.15385



## Fanno-line flow

Perfect gas

K = 1.4

M	T/T*	P/P*	Po/Po*	V/V*	F/F*	$\frac{4fL^*}{D}$
0.50	1.14286	2.13809	1.33984	0.53452	1.20268	1.06906
0.51	1.14066	2.09415	1.32117	0.54469	1.19030	0.99041
0.52	1.13843	2.05187	1.30339	0.55483	1.17860	0.91742
0.53	1.13617	2.01116	1.28645	0.56493	1.16753	0.84962
0.54	1.13387	1.97192	1.27032	0.57501	1.15705	0.78663
0.55	1.13154	1.93407	1.25495	0.58506	1.14715	0.72805
0.56	1.12918	1.89755	1.24029	0.59507	1.13777	0.67357
0.57	1.12678	1.86228	1.22633	0.60505	1.12890	0.62287
0.58	1.12435	1.82820	1.21301	0.61501	1.12050	0.57568
0.59	1.12189	1.79525	1.20031	0.62493	1.11256	0.53174
0.60	1.11940	1.76336	1.18820	0.63481	1.10504	0.49082
0.61	1.11688	1.73250	1.17665	0.64466	1.09793	0.45271
0.62	1.11433	1.70261	1.16565	0.65448	1.09120	0.41720
0.63	1.11175	1.67364	1.15515	0.66427	1.08484	0.38412
0.64	1.10914	1.64556	1.14515	0.67402	1.07883	0.35330
0.65	1.10650	1.61831	1.13562	0.68374	1.07314	0.32459
0.66	1.10383	1.59187	1.12654	0.69342	1.06777	0.29785
0.67	1.10114	1.56620	1.11789	0.70307	1.06270	0.27295
0.68	1.09842	1.54126	1.10966	0.71268	1.05792	0.24977
0.69	1.09567	1.51702	1.10182	0.72225	1.05341	0.22820
0.70	1.09290	1.49345	1.09437	0.73179	1.04915	0.20814
0.71	1.09010	1.47053	1.08729	0.74129	1.04514	0.18948
0.72	1.08727	1.44823	1.08057	0.75076	1.04137	0.17215
0.73	1.08442	1.42652	1.07419	0.76019	1.03783	0.15605
0.74	1.08155	1.40537	1.06814	0.76958	1.03449	0.14112
0.75	1.07865	1.38478	1.06242	0.77894	1.03137	0.12728
0.76	1.07573	1.36470	1.05700	0.78825	1.02844	0.11447
0.77	1.07279	1.34514	1.05188	0.79753	1.02570	0.10262
0.78	1.06982	1.32606	1.04705	0.80677	1.02314	0.09167
0.79	1.06684	1.30744	1.04251	0.81597	1.02075	0.08158
0.80	1.06383	1.28928	1.03823	0.82514	1.01853	0.07229
0.81	1.06080	1.27155	1.03422	0.83426	1.01646	0.06376
0.82	1.05775	1.25423	1.03046	0.84335	1.01455	0.05593
0.83	1.05469	1.23732	1.02696	0.85239	1.01278	0.04878
0.84	1.05160	1.22080	1.02370	0.86140	1.01115	0.04226
0.85	1.04849	1.20466	1.02067	0.87037	1.00965	0.03633
0.86	1.04537	1.18888	1.01787	0.87929	1.00829	0.03097
0.87	1.04223	1.17344	1.01530	0.88818	1.00704	0.02613
0.88	1.03907	1.15835	1.01294	0.89703	1.00591	0.02179
0.89	1.03589	1.14358	1.01080	0.90583	1.00490	0.01793
0.90	1.03270	1.12913	1.00886	0.91460	1.00399	0.01451
0.91	1.02950	1.11499	1.00713	0.92332	1.00318	0.01151
0.92	1.02627	1.10114	1.00560	0.93201	1.00248	0.00891
0.93	1.02304	1.08758	1.00426	0.94065	1.00187	0.00669
0.94	1.01978	1.07430	1.00311	0.94925	1.00136	0.00482
0.95	1.01652	1.06129	1.00215	0.95781	1.00093	0.00328
0.96	1.01324	1.04854	1.00137	0.96633	1.00059	0.00206
0.97	1.00995	1.03604	1.00076	0.97481	1.00033	0.00113
0.98	1.00664	1.02379	1.00034	0.98325	1.00014	0.00049
0.99	1.00333	1.01178	1.00008	0.99165	1.00004	0.00012



D-3

## Fanno-line flow

M	T/T*	P/P*	Perfect gas		K = 1.4	
			Po/Po*	V/V*	F/F*	4f/L*
1.00	1.00000	1.00000	1.00000	1.00000	1.00000	0.00000
1.01	0.99666	0.98844	1.00008	1.00831	1.00003	0.00012
1.02	0.99331	0.97711	1.00033	1.01658	1.00014	0.00046
1.03	0.98995	0.96598	1.00074	1.02481	1.00030	0.00101
1.04	0.98658	0.95507	1.00131	1.03300	1.00053	0.00177
1.05	0.98320	0.94435	1.00203	1.04114	1.00081	0.00271
1.06	0.97982	0.93383	1.00291	1.04925	1.00116	0.00384
1.07	0.97642	0.92349	1.00394	1.05731	1.00155	0.00513
1.08	0.97302	0.91335	1.00512	1.06533	1.00200	0.00658
1.09	0.96960	0.90338	1.00645	1.07331	1.00250	0.00819
1.10	0.96618	0.89359	1.00793	1.08124	1.00305	0.00993
1.11	0.96276	0.88397	1.00955	1.08913	1.00365	0.01182
1.12	0.95932	0.87451	1.01131	1.09699	1.00429	0.01382
1.13	0.95589	0.86522	1.01322	1.10479	1.00497	0.01595
1.14	0.95244	0.85608	1.01527	1.11256	1.00569	0.01819
1.15	0.94899	0.84710	1.01745	1.12029	1.00646	0.02053
1.16	0.94554	0.83826	1.01978	1.12797	1.00726	0.02298
1.17	0.94208	0.82958	1.02224	1.13561	1.00810	0.02552
1.18	0.93861	0.82104	1.02484	1.14321	1.00897	0.02814
1.19	0.93515	0.81263	1.02757	1.15077	1.00988	0.03085
1.20	0.93168	0.80436	1.03044	1.15828	1.01082	0.03364
1.21	0.92820	0.79623	1.03344	1.16575	1.01178	0.03650
1.22	0.92473	0.78822	1.03657	1.17319	1.01278	0.03943
1.23	0.92125	0.78034	1.03984	1.18058	1.01381	0.04242
1.24	0.91777	0.77258	1.04323	1.18792	1.01486	0.04547
1.25	0.91429	0.76495	1.04675	1.19523	1.01594	0.04858
1.26	0.91080	0.75743	1.05041	1.20249	1.01705	0.05174
1.27	0.90732	0.75003	1.05419	1.20972	1.01818	0.05495
1.28	0.90383	0.74274	1.05810	1.21690	1.01933	0.05820
1.29	0.90035	0.73556	1.06214	1.22404	1.02050	0.06150
1.30	0.89686	0.72848	1.06630	1.23114	1.02170	0.06483
1.31	0.89338	0.72152	1.07060	1.23819	1.02291	0.06820
1.32	0.88989	0.71465	1.07502	1.24521	1.02414	0.07161
1.33	0.88641	0.70789	1.07957	1.25218	1.02539	0.07504
1.34	0.88292	0.70122	1.08424	1.25912	1.02666	0.07850
1.35	0.87944	0.69466	1.08904	1.26601	1.02795	0.08199
1.36	0.87596	0.68818	1.09396	1.27286	1.02925	0.08550
1.37	0.87249	0.68180	1.09902	1.27968	1.03056	0.08904
1.38	0.86901	0.67551	1.10419	1.28645	1.03189	0.09259
1.39	0.86554	0.66931	1.10950	1.29318	1.03323	0.09615
1.40	0.86207	0.66320	1.11493	1.29987	1.03459	0.09974
1.41	0.85860	0.65717	1.12048	1.30652	1.03596	0.10334
1.42	0.85514	0.65122	1.12616	1.31313	1.03733	0.10694
1.43	0.85168	0.64536	1.13197	1.31970	1.03872	0.11056
1.44	0.84822	0.63958	1.13790	1.32623	1.04012	0.11419
1.45	0.84477	0.63387	1.14396	1.33272	1.04153	0.11782
1.46	0.84133	0.62825	1.15015	1.33917	1.04295	0.12146
1.47	0.83788	0.62269	1.15646	1.34558	1.04438	0.12511
1.48	0.83445	0.61722	1.16290	1.35195	1.04581	0.12875
1.49	0.83101	0.61181	1.16947	1.35828	1.04725	0.13240



## Fanno-line flow

M	T/T*	P/P*	Perfect gas		K = 1.4	
			Po/Po*	V/V*	F/F*	4fL*/D
1.50	0.82759	0.60648	1.17617	1.36458	1.04870	0.13605
1.51	0.82416	0.60122	1.18299	1.37083	1.05016	0.13970
1.52	0.82075	0.59602	1.18994	1.37705	1.05162	0.14335
1.53	0.81734	0.59089	1.19702	1.38322	1.05309	0.14699
1.54	0.81393	0.58583	1.20423	1.38936	1.05456	0.15063
1.55	0.81054	0.58084	1.21157	1.39546	1.05604	0.15427
1.56	0.80715	0.57591	1.21904	1.40152	1.05752	0.15790
1.57	0.80376	0.57104	1.22664	1.40755	1.05900	0.16152
1.58	0.80038	0.56623	1.23438	1.41353	1.06049	0.16514
1.59	0.79701	0.56148	1.24224	1.41948	1.06198	0.16875
1.60	0.79365	0.55679	1.25024	1.42539	1.06348	0.17236
1.61	0.79030	0.55216	1.25836	1.43127	1.06497	0.17595
1.62	0.78695	0.54759	1.26663	1.43710	1.06647	0.17954
1.63	0.78361	0.54308	1.27502	1.44290	1.06798	0.18311
1.64	0.78027	0.53862	1.28355	1.44866	1.06948	0.18667
1.65	0.77695	0.53421	1.29222	1.45439	1.07098	0.19023
1.66	0.77363	0.52986	1.30102	1.46008	1.07249	0.19377
1.67	0.77033	0.52556	1.30996	1.46573	1.07399	0.19729
1.68	0.76703	0.52131	1.31904	1.47135	1.07550	0.20081
1.69	0.76374	0.51711	1.32825	1.47693	1.07700	0.20431
1.70	0.76046	0.51297	1.33761	1.48247	1.07851	0.20780
1.71	0.75718	0.50887	1.34710	1.48798	1.08002	0.21128
1.72	0.75392	0.50482	1.35674	1.49345	1.08152	0.21474
1.73	0.75067	0.50082	1.36651	1.49889	1.08303	0.21819
1.74	0.74742	0.49686	1.37643	1.50429	1.08453	0.22162
1.75	0.74419	0.49295	1.38649	1.50966	1.08603	0.22504
1.76	0.74096	0.48909	1.39670	1.51499	1.08753	0.22844
1.77	0.73774	0.48527	1.40705	1.52029	1.08903	0.23182
1.78	0.73454	0.48149	1.41755	1.52555	1.09053	0.23519
1.79	0.73134	0.47776	1.42819	1.53078	1.09202	0.23855
1.80	0.72816	0.47407	1.43898	1.53598	1.09351	0.24189
1.81	0.72498	0.47042	1.44992	1.54114	1.09500	0.24521
1.82	0.72181	0.46681	1.46101	1.54627	1.09649	0.24851
1.83	0.71866	0.46324	1.47226	1.55136	1.09798	0.25180
1.84	0.71551	0.45972	1.48365	1.55642	1.09946	0.25507
1.85	0.71238	0.45623	1.49519	1.56145	1.10094	0.25832
1.86	0.70925	0.45278	1.50689	1.56644	1.10242	0.26156
1.87	0.70614	0.44937	1.51875	1.57140	1.10389	0.26478
1.88	0.70304	0.44600	1.53076	1.57633	1.10536	0.26798
1.89	0.69995	0.44266	1.54293	1.58123	1.10682	0.27116
1.90	0.69686	0.43936	1.55526	1.58609	1.10829	0.27433
1.91	0.69379	0.43610	1.56774	1.59092	1.10974	0.27748
1.92	0.69074	0.43287	1.58039	1.59572	1.11120	0.28061
1.93	0.68769	0.42967	1.59320	1.60049	1.11265	0.28372
1.94	0.68465	0.42651	1.60617	1.60523	1.11410	0.28681
1.95	0.68162	0.42339	1.61931	1.60993	1.11554	0.28989
1.96	0.67861	0.42029	1.63261	1.61461	1.11698	0.29295
1.97	0.67561	0.41724	1.64608	1.61925	1.11841	0.29599
1.98	0.67262	0.41421	1.65972	1.62386	1.11984	0.29901
1.99	0.66964	0.41121	1.67352	1.62844	1.12126	0.30201



D-5

Fanno-line flow

Perfect gas

K = 1.4

M	T/T*	P/P*	Po/Po*	V/V*	F/F*	$\frac{4fL}{D}$
2.00	0.66667	0.40825	1.68750	1.63299	1.12268	0.30500
2.01	0.66371	0.40532	1.70165	1.63751	1.12410	0.30796
2.02	0.66076	0.40241	1.71597	1.64201	1.12551	0.31091
2.03	0.65783	0.39954	1.73047	1.64647	1.12691	0.31384
2.04	0.65491	0.39670	1.74514	1.65090	1.12831	0.31676
2.05	0.65200	0.39388	1.75999	1.65530	1.12971	0.31965
2.06	0.64910	0.39110	1.77502	1.65967	1.13110	0.32253
2.07	0.64621	0.38834	1.79023	1.66402	1.13249	0.32538
2.08	0.64334	0.38562	1.80561	1.66833	1.13387	0.32822
2.09	0.64047	0.38292	1.82119	1.67262	1.13524	0.33105
2.10	0.63762	0.38024	1.83694	1.67687	1.13661	0.33385
2.11	0.63478	0.37760	1.85289	1.68110	1.13798	0.33664
2.12	0.63195	0.37498	1.86902	1.68530	1.13933	0.33940
2.13	0.62914	0.37239	1.88533	1.68947	1.14069	0.34216
2.14	0.62633	0.36982	1.90184	1.69362	1.14204	0.34489
2.15	0.62354	0.36728	1.91854	1.69774	1.14338	0.34760
2.16	0.62076	0.36476	1.93544	1.70183	1.14472	0.35030
2.17	0.61799	0.36227	1.95253	1.70589	1.14605	0.35298
2.18	0.61523	0.35980	1.96981	1.70992	1.14737	0.35564
2.19	0.61249	0.35736	1.98729	1.71393	1.14869	0.35828
2.20	0.60976	0.35494	2.00498	1.71791	1.15001	0.36091
2.21	0.60704	0.35255	2.02286	1.72187	1.15132	0.36352
2.22	0.60433	0.35017	2.04094	1.72579	1.15262	0.36611
2.23	0.60163	0.34782	2.05923	1.72970	1.15392	0.36869
2.24	0.59895	0.34550	2.07773	1.73357	1.15521	0.37124
2.25	0.59627	0.34319	2.09644	1.73742	1.15649	0.37378
2.26	0.59361	0.34091	2.11535	1.74125	1.15777	0.37631
2.27	0.59096	0.33865	2.13447	1.74504	1.15905	0.37881
2.28	0.58833	0.33641	2.15381	1.74882	1.16032	0.38130
2.29	0.58570	0.33420	2.17336	1.75257	1.16158	0.38377
2.30	0.58309	0.33200	2.19313	1.75629	1.16284	0.38623
2.31	0.58049	0.32983	2.21312	1.75999	1.16409	0.38867
2.32	0.57790	0.32767	2.23332	1.76366	1.16533	0.39109
2.33	0.57532	0.32554	2.25375	1.76731	1.16657	0.39350
2.34	0.57276	0.32342	2.27440	1.77093	1.16780	0.39589
2.35	0.57021	0.32133	2.29528	1.77453	1.16903	0.39826
2.36	0.56767	0.31925	2.31638	1.77811	1.17025	0.40062
2.37	0.56514	0.31720	2.33771	1.78166	1.17147	0.40296
2.38	0.56262	0.31516	2.35928	1.78519	1.17268	0.40529
2.39	0.56011	0.31314	2.38107	1.78870	1.17388	0.40760
2.40	0.55762	0.31114	2.40310	1.79218	1.17508	0.40989
2.41	0.55514	0.30916	2.42537	1.79564	1.17627	0.41217
2.42	0.55267	0.30720	2.44787	1.79907	1.17746	0.41443
2.43	0.55021	0.30525	2.47062	1.80248	1.17864	0.41668
2.44	0.54777	0.30332	2.49360	1.80587	1.17981	0.41891
2.45	0.54533	0.30141	2.51683	1.80924	1.18098	0.42112
2.46	0.54291	0.29952	2.54031	1.81258	1.18214	0.42332
2.47	0.54050	0.29765	2.56404	1.81591	1.18330	0.42551
2.48	0.53810	0.29579	2.58801	1.81921	1.18445	0.42768
2.49	0.53571	0.29394	2.61224	1.82249	1.18559	0.42984



Perfect gas

 $K = 1.4$ 

M	T/T*	P/P*	Po/Po*	V/V*	F/F*	$\frac{4fL^*}{D}$
2.50	0.53333	0.29212	2.63672	1.82574	1.18673	0.43198
2.51	0.53097	0.29031	2.66146	1.82898	1.18787	0.43410
2.52	0.52862	0.28852	2.68645	1.83219	1.18899	0.43621
2.53	0.52627	0.28674	2.71171	1.83538	1.19011	0.43831
2.54	0.52394	0.28498	2.73723	1.83855	1.19123	0.44039
2.55	0.52163	0.28323	2.76301	1.84170	1.19234	0.44246
2.56	0.51932	0.28150	2.78906	1.84483	1.19344	0.44451
2.57	0.51702	0.27978	2.81538	1.84794	1.19454	0.44655
2.58	0.51474	0.27808	2.84197	1.85103	1.19563	0.44858
2.59	0.51247	0.27640	2.86884	1.85410	1.19672	0.45059
2.60	0.51020	0.27473	2.89598	1.85714	1.19780	0.45259
2.61	0.50795	0.27307	2.92339	1.86017	1.19888	0.45457
2.62	0.50571	0.27143	2.95109	1.86318	1.19995	0.45654
2.63	0.50349	0.26980	2.97907	1.86616	1.20101	0.45850
2.64	0.50127	0.26818	3.00733	1.86913	1.20207	0.46044
2.65	0.49906	0.26658	3.03588	1.87208	1.20312	0.46237
2.66	0.49687	0.26500	3.06472	1.87501	1.20417	0.46429
2.67	0.49469	0.26342	3.09385	1.87792	1.20521	0.46619
2.68	0.49251	0.26186	3.12327	1.88081	1.20625	0.46808
2.69	0.49035	0.26032	3.15299	1.88368	1.20728	0.46996
2.70	0.48820	0.25878	3.18301	1.88653	1.20830	0.47182
2.71	0.48606	0.25726	3.21333	1.88936	1.20932	0.47367
2.72	0.48393	0.25575	3.24395	1.89218	1.21033	0.47551
2.73	0.48182	0.25426	3.27488	1.89497	1.21134	0.47733
2.74	0.47971	0.25278	3.30611	1.89775	1.21235	0.47915
2.75	0.47761	0.25131	3.33766	1.90051	1.21334	0.48095
2.76	0.47553	0.24985	3.36952	1.90325	1.21433	0.48273
2.77	0.47345	0.24840	3.40169	1.90598	1.21532	0.48451
2.78	0.47139	0.24697	3.43418	1.90868	1.21630	0.48627
2.79	0.46933	0.24555	3.46699	1.91137	1.21728	0.48803
2.80	0.46729	0.24414	3.50012	1.91404	1.21825	0.48976
2.81	0.46526	0.24274	3.53358	1.91669	1.21921	0.49149
2.82	0.46323	0.24135	3.56737	1.91933	1.22017	0.49321
2.83	0.46122	0.23998	3.60148	1.92195	1.22113	0.49491
2.84	0.45922	0.23861	3.63593	1.92455	1.22208	0.49660
2.85	0.45723	0.23726	3.67072	1.92714	1.22302	0.49828
2.86	0.45525	0.23592	3.70584	1.92970	1.22396	0.49995
2.87	0.45328	0.23459	3.74131	1.93226	1.22489	0.50161
2.88	0.45132	0.23326	3.77711	1.93479	1.22582	0.50326
2.89	0.44937	0.23195	3.81327	1.93731	1.22674	0.50489
2.90	0.44743	0.23066	3.84977	1.93981	1.22766	0.50652
2.91	0.44550	0.22937	3.88662	1.94230	1.22858	0.50813
2.92	0.44358	0.22809	3.92383	1.94477	1.22948	0.50973
2.93	0.44167	0.22682	3.96139	1.94722	1.23039	0.51132
2.94	0.43977	0.22556	3.99932	1.94966	1.23128	0.51290
2.95	0.43788	0.22431	4.03760	1.95208	1.23218	0.51447
2.96	0.43600	0.22307	4.07626	1.95449	1.23307	0.51603
2.97	0.43413	0.22185	4.11527	1.95688	1.23395	0.51758
2.98	0.43226	0.22063	4.15467	1.95926	1.23481	0.51912
2.99	0.43041	0.21942	4.19443	1.96162	1.23570	0.52064



M	T/T*	P/P*	Perfect gas		K = 1.4	
			Po/Po*	V/V*	F/F*	4fL/D
3.50	0.34783	0.16851	6.78962	2.06419	1.27432	0.58643
3.51	0.34642	0.16768	6.85315	2.06589	1.27497	0.58751
3.52	0.34502	0.16687	6.91723	2.06759	1.27562	0.58859
3.53	0.34362	0.16606	6.98186	2.06927	1.27627	0.58966
3.54	0.34224	0.16526	7.04705	2.07094	1.27691	0.59072
3.55	0.34086	0.16446	7.11281	2.07261	1.27755	0.59178
3.56	0.33949	0.16367	7.17912	2.07426	1.27818	0.59282
3.57	0.33813	0.16288	7.24601	2.07590	1.27881	0.59387
3.58	0.33677	0.16210	7.31346	2.07754	1.27944	0.59490
3.59	0.33542	0.16132	7.38150	2.07916	1.28006	0.59593
3.60	0.33408	0.16055	7.45011	2.08077	1.28068	0.59695
3.61	0.33274	0.15979	7.51931	2.08238	1.28130	0.59797
3.62	0.33141	0.15903	7.58910	2.08397	1.28191	0.59898
3.63	0.33009	0.15827	7.65948	2.08556	1.28252	0.59998
3.64	0.32877	0.15752	7.73045	2.08713	1.28313	0.60098
3.65	0.32747	0.15678	7.80203	2.08870	1.28373	0.60197
3.66	0.32616	0.15604	7.87421	2.09026	1.28433	0.60296
3.67	0.32487	0.15531	7.94700	2.09181	1.28493	0.60394
3.68	0.32358	0.15458	8.02041	2.09334	1.28552	0.60491
3.69	0.32230	0.15385	8.09443	2.09487	1.28611	0.60588
3.70	0.32103	0.15313	8.16907	2.09639	1.28670	0.60684
3.71	0.31976	0.15242	8.24433	2.09790	1.28729	0.60779
3.72	0.31850	0.15171	8.32023	2.09941	1.28787	0.60874
3.73	0.31724	0.15100	8.39676	2.10090	1.28844	0.60968
3.74	0.31600	0.15030	8.47393	2.10239	1.28902	0.61062
3.75	0.31475	0.14961	8.55174	2.10386	1.28959	0.61155
3.76	0.31352	0.14892	8.63020	2.10533	1.29016	0.61247
3.77	0.31229	0.14823	8.70931	2.10679	1.29072	0.61339
3.78	0.31107	0.14755	8.78907	2.10824	1.29128	0.61431
3.79	0.30985	0.14687	8.86950	2.10968	1.29184	0.61522
3.80	0.30864	0.14620	8.95058	2.11111	1.29240	0.61612
3.81	0.30744	0.14553	9.03234	2.11254	1.29295	0.61702
3.82	0.30624	0.14487	9.11477	2.11395	1.29350	0.61791
3.83	0.30505	0.14421	9.19788	2.11536	1.29405	0.61879
3.84	0.30387	0.14355	9.28167	2.11676	1.29459	0.61968
3.85	0.30269	0.14290	9.36614	2.11815	1.29513	0.62055
3.86	0.30151	0.14225	9.45131	2.11954	1.29567	0.62142
3.87	0.30035	0.14161	9.53717	2.12091	1.29620	0.62229
3.88	0.29919	0.14097	9.62373	2.12228	1.29674	0.62315
3.89	0.29803	0.14034	9.71100	2.12364	1.29726	0.62400
3.90	0.29688	0.13971	9.79897	2.12499	1.29779	0.62485
3.91	0.29574	0.13908	9.88766	2.12634	1.29831	0.62569
3.92	0.29460	0.13846	9.97707	2.12767	1.29883	0.62653
3.93	0.29347	0.13784	10.06720	2.12900	1.29935	0.62737
3.94	0.29235	0.13723	10.15806	2.13032	1.29987	0.62819
3.95	0.29123	0.13662	10.24965	2.13163	1.30038	0.62902
3.96	0.29011	0.13602	10.34198	2.13294	1.30089	0.62984
3.97	0.28900	0.13541	10.43504	2.13424	1.30140	0.63065
3.98	0.28790	0.13482	10.52886	2.13553	1.30190	0.63146
3.99	0.28681	0.13422	10.62343	2.13681	1.30240	0.63227



## Fanno-line flow

Perfect gas

$$K = 1.4 \quad \int_0^x \frac{dV}{V} = - \int_0^x \frac{V_{om}^2}{4 + m_2 + n_2} dz$$

M	T/T*	P/P*	P <sub>0</sub> /P <sub>0</sub> *	V/V*	F/F*	$\frac{4fL^*}{D}$
4.00	0.28571	0.13363	10.71875	2.13809	1.30290	0.61307
4.01	0.28463	0.13304	10.81484	2.13936	1.30339	0.61386
4.02	0.28355	0.13246	10.91168	2.14062	1.30389	0.61465
4.03	0.28247	0.13188	11.00931	2.14188	1.30438	0.61544
4.04	0.28140	0.13131	11.10770	2.14312	1.30487	0.61622
4.05	0.28034	0.13073	11.20688	2.14436	1.30535	0.61699
4.06	0.27928	0.13017	11.30684	2.14560	1.30583	0.61776
4.07	0.27823	0.12960	11.40760	2.14682	1.30631	0.61853
4.08	0.27718	0.12904	11.50915	2.14804	1.30679	0.61929
4.09	0.27614	0.12848	11.61150	2.14926	1.30727	0.62005
4.10	0.27510	0.12793	11.71465	2.15046	1.30774	0.62080
4.11	0.27407	0.12738	11.81862	2.15166	1.30821	0.62155
4.12	0.27305	0.12683	11.92340	2.15285	1.30868	0.62230
4.13	0.27202	0.12629	12.02900	2.15404	1.30914	0.62304
4.14	0.27101	0.12574	12.13543	2.15522	1.30960	0.62377
4.15	0.27000	0.12521	12.24269	2.15639	1.31006	0.62451
4.16	0.26899	0.12467	12.35079	2.15756	1.31052	0.62523
4.17	0.26799	0.12414	12.45973	2.15872	1.31098	0.62596
4.18	0.26699	0.12362	12.56951	2.15987	1.31143	0.62668
4.19	0.26600	0.12309	12.68015	2.16101	1.31188	0.62739
4.20	0.26502	0.12257	12.79164	2.16215	1.31233	0.62810
4.21	0.26404	0.12205	12.90400	2.16329	1.31277	0.62881
4.22	0.26306	0.12154	13.01722	2.16442	1.31322	0.62951
4.23	0.26209	0.12103	13.13132	2.16554	1.31366	0.63021
4.24	0.26112	0.12052	13.24629	2.16665	1.31410	0.63090
4.25	0.26016	0.12001	13.36215	2.16776	1.31453	0.63159
4.26	0.25921	0.11951	13.47891	2.16886	1.31497	0.63228
4.27	0.25825	0.11901	13.59655	2.16996	1.31540	0.63296
4.28	0.25731	0.11852	13.71509	2.17105	1.31583	0.63364
4.29	0.25637	0.11802	13.83454	2.17214	1.31626	0.63432
4.30	0.25543	0.11753	13.95491	2.17321	1.31668	0.63499
4.31	0.25450	0.11705	14.07618	2.17429	1.31710	0.63565
4.32	0.25357	0.11656	14.19839	2.17535	1.31753	0.63632
4.33	0.25264	0.11608	14.32151	2.17642	1.31794	0.63698
4.34	0.25172	0.11560	14.44558	2.17747	1.31836	0.63763
4.35	0.25081	0.11513	14.57057	2.17852	1.31877	0.63828
4.36	0.24990	0.11466	14.69652	2.17956	1.31919	0.63893
4.37	0.24899	0.11419	14.82342	2.18060	1.31960	0.63958
4.38	0.24809	0.11372	14.95127	2.18164	1.32000	0.64022
4.39	0.24720	0.11326	15.08008	2.18266	1.32041	0.64085
4.40	0.24631	0.11279	15.20987	2.18368	1.32081	0.64149
4.41	0.24542	0.11233	15.34062	2.18470	1.32121	0.64212
4.42	0.24453	0.11188	15.47236	2.18571	1.32161	0.64275
4.43	0.24366	0.11143	15.60508	2.18672	1.32201	0.64337
4.44	0.24278	0.11097	15.73879	2.18771	1.32241	0.64399
4.45	0.24191	0.11053	15.87349	2.18871	1.32280	0.64460
4.46	0.24105	0.11008	16.00921	2.18970	1.32319	0.64522
4.47	0.24018	0.10964	16.14592	2.19068	1.32358	0.64583
4.48	0.23933	0.10920	16.28366	2.19166	1.32397	0.64644
4.49	0.23847	0.10876	16.42241	2.19263	1.32435	0.64704



M	T/T*	P/P*	Po/Po*	V/V*	F/F*	$\frac{4fL^*}{D}$
5.00	0.20000	0.08944	25.00000	2.23607	1.34164	0.69380
5.10	0.19349	0.08625	27.06957	2.24334	1.34455	0.69826
5.20	0.18727	0.08322	29.28332	2.25026	1.34733	0.70249
5.30	0.18132	0.08034	31.64906	2.25685	1.34997	0.70652
5.40	0.17564	0.07761	34.17481	2.26314	1.35250	0.71035
5.50	0.17021	0.07501	36.86896	2.26913	1.35491	0.71400
5.60	0.16502	0.07254	39.74018	2.27484	1.35722	0.71748
5.70	0.16004	0.07018	42.79743	2.28030	1.35942	0.72080
5.80	0.15528	0.06794	46.05000	2.28552	1.36153	0.72397
5.90	0.15072	0.06580	49.50748	2.29051	1.36355	0.72699
6.00	0.14634	0.06376	53.17978	2.29528	1.36548	0.72988
6.10	0.14215	0.06181	57.07717	2.29984	1.36733	0.73264
6.20	0.13812	0.05994	61.21022	2.30421	1.36910	0.73528
6.30	0.13426	0.05816	65.58987	2.30840	1.37080	0.73780
6.40	0.13055	0.05646	70.22736	2.31241	1.37243	0.74022
6.50	0.12698	0.05482	75.13432	2.31626	1.37400	0.74254
6.60	0.12356	0.05326	80.32270	2.31996	1.37550	0.74477
6.70	0.12026	0.05176	85.80486	2.32351	1.37695	0.74690
6.80	0.11710	0.05032	91.59352	2.32691	1.37833	0.74895
6.90	0.11405	0.04894	97.70169	2.33019	1.37967	0.75091
7.00	0.11111	0.04762	104.14290	2.33333	1.38095	0.75280
7.10	0.10828	0.04635	110.93080	2.33636	1.38219	0.75462
7.20	0.10556	0.04512	118.07990	2.33927	1.38338	0.75636
7.30	0.10293	0.04395	125.60460	2.34208	1.38453	0.75804
7.40	0.10040	0.04282	133.52000	2.34478	1.38563	0.75966
7.50	0.09796	0.04173	141.84150	2.34738	1.38669	0.76121
7.60	0.09560	0.04068	150.58497	2.34989	1.38772	0.76271
7.70	0.09333	0.03967	159.76650	2.35231	1.38871	0.76416
7.80	0.09113	0.03870	169.40300	2.35464	1.38967	0.76555
7.90	0.08901	0.03776	179.51150	2.35690	1.39059	0.76689
8.00	0.08696	0.03686	190.10940	2.35907	1.39148	0.76819
8.10	0.08497	0.03599	201.21480	2.36117	1.39235	0.76944
8.20	0.08306	0.03515	212.84600	2.36320	1.39318	0.77065
8.30	0.08120	0.03433	225.02210	2.36516	1.39398	0.77182
8.40	0.07941	0.03355	237.76210	2.36706	1.39476	0.77295
8.50	0.07767	0.03279	251.08620	2.36889	1.39552	0.77404
8.60	0.07599	0.03205	265.01430	2.37067	1.39625	0.77509
8.70	0.07436	0.03134	279.56710	2.37238	1.39695	0.77611
8.80	0.07278	0.03066	294.76610	2.37405	1.39763	0.77710
8.90	0.07125	0.02999	310.63270	2.37566	1.39830	0.77806
9.00	0.06977	0.02935	327.18930	2.37722	1.39894	0.77899
9.10	0.06833	0.02873	344.45850	2.37873	1.39956	0.77988
9.20	0.06693	0.02812	362.46320	2.38020	1.40016	0.78075
9.30	0.06558	0.02754	381.22750	2.38162	1.40075	0.78159
9.40	0.06427	0.02697	400.77520	2.38300	1.40132	0.78241
9.50	0.06299	0.02642	421.13140	2.38433	1.40187	0.78320
9.60	0.06175	0.02589	442.32100	2.38563	1.40240	0.78397
9.70	0.06055	0.02537	464.36980	2.38689	1.40292	0.78472
9.80	0.05938	0.02487	487.30430	2.38811	1.40343	0.78544
9.90	0.05825	0.02438	511.15090	2.38930	1.40392	0.78615
10.00	0.05714	0.02390	535.93750	2.39046	1.40439	0.78683



**RAYLEIGH - LINE**  
**TABLE**  
**( HEAT TRANSFER )**



E-1

Rayleigh-line flow  
Perfect gas  $K = 1.4$

M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
0.01	0.00048	0.00038	2.39866	1.26779	0.00024
0.02	0.00192	0.00230	2.39866	1.26752	0.00096
0.03	0.00431	0.00517	2.39698	1.26708	0.00216
0.04	0.00765	0.00917	2.39464	1.26646	0.00383
0.05	0.01192	0.01430	2.39163	1.26567	0.00598
0.06	0.01712	0.02053	2.38797	1.26470	0.00860
0.07	0.02322	0.02784	2.38365	1.26356	0.01168
0.08	0.03022	0.03621	2.37869	1.26226	0.01522
0.09	0.03807	0.04562	2.37309	1.26078	0.01922
0.10	0.04678	0.05602	2.36686	1.25915	0.02367
0.11	0.05630	0.06739	2.36002	1.25735	0.02856
0.12	0.06661	0.07970	2.35257	1.25539	0.03388
0.13	0.07768	0.09290	2.34453	1.25329	0.03962
0.14	0.08947	0.10695	2.33590	1.25103	0.04578
0.15	0.10196	0.12181	2.32671	1.24863	0.05235
0.16	0.11511	0.13743	2.31696	1.24608	0.05931
0.17	0.12888	0.15377	2.30667	1.24340	0.06666
0.18	0.14324	0.17078	2.29586	1.24059	0.07439
0.19	0.15814	0.18841	2.28454	1.23766	0.08247
0.20	0.17355	0.20661	2.27273	1.23460	0.09091
0.21	0.18943	0.22533	2.26044	1.23142	0.09969
0.22	0.20574	0.24452	2.24770	1.22814	0.10879
0.23	0.22244	0.26413	2.23451	1.22475	0.11821
0.24	0.23948	0.28411	2.22091	1.22126	0.12792
0.25	0.25684	0.30440	2.20690	1.21767	0.13793
0.26	0.27446	0.32496	2.19250	1.21400	0.14821
0.27	0.29231	0.34573	2.17774	1.21025	0.15876
0.28	0.31035	0.36667	2.16263	1.20642	0.16955
0.29	0.32855	0.38774	2.14719	1.20252	0.18058
0.30	0.34686	0.40887	2.13144	1.19855	0.19183
0.31	0.36525	0.43004	2.11540	1.19452	0.20329
0.32	0.38369	0.45119	2.09908	1.19045	0.21495
0.33	0.40214	0.47228	2.08250	1.18632	0.22678
0.34	0.42056	0.49327	2.06569	1.18215	0.23879
0.35	0.43894	0.51413	2.04866	1.17795	0.25096
0.36	0.45723	0.53482	2.03142	1.17371	0.26327
0.37	0.47541	0.55529	2.01400	1.16946	0.27572
0.38	0.49346	0.57553	1.99641	1.16518	0.28828
0.39	0.51134	0.59549	1.97866	1.16088	0.30095
0.40	0.52903	0.61515	1.96078	1.15658	0.31373
0.41	0.54651	0.63448	1.94279	1.15227	0.32658
0.42	0.56376	0.65346	1.92468	1.14796	0.33951
0.43	0.58076	0.67205	1.90649	1.14366	0.35251
0.44	0.59748	0.69025	1.88822	1.13936	0.36556
0.45	0.61393	0.70804	1.86989	1.13509	0.37865
0.46	0.63007	0.72538	1.85151	1.13082	0.39178
0.47	0.64589	0.74228	1.83310	1.12659	0.40493
0.48	0.66139	0.75871	1.81466	1.12238	0.41810
0.49	0.67655	0.77466	1.79622	1.11820	0.43127



E-2

Rayleigh-line flow

Perfect gas

 $K = 1.4$ 

M	$T_0/T_0^*$	$\rho/\rho^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
0.50	0.69136	0.79012	1.77778	1.11405	0.44444
0.51	0.70581	0.80509	1.75935	1.10995	0.45761
0.52	0.71990	0.81955	1.74095	1.10588	0.47075
0.53	0.73361	0.83351	1.72258	1.10186	0.48387
0.54	0.74695	0.84695	1.70426	1.09789	0.49696
0.55	0.75991	0.85987	1.68599	1.09397	0.51001
0.56	0.77249	0.87227	1.66778	1.09011	0.52302
0.57	0.78468	0.88416	1.64964	1.08630	0.53597
0.58	0.79648	0.89552	1.63159	1.08256	0.54887
0.59	0.80789	0.90637	1.61362	1.07887	0.56170
0.60	0.81892	0.91670	1.59575	1.07525	0.57447
0.61	0.82957	0.92653	1.57797	1.07170	0.58716
0.62	0.83983	0.93584	1.56031	1.06822	0.59978
0.63	0.84970	0.94466	1.54275	1.06481	0.61232
0.64	0.85920	0.95298	1.52532	1.06148	0.62477
0.65	0.86833	0.96081	1.50801	1.05821	0.63713
0.66	0.87708	0.96816	1.49083	1.05503	0.64941
0.67	0.88547	0.97503	1.47379	1.05193	0.66158
0.68	0.89350	0.98144	1.45688	1.04890	0.67366
0.69	0.90118	0.98739	1.44011	1.04596	0.68564
0.70	0.90850	0.99290	1.42349	1.04310	0.69751
0.71	0.91548	0.99796	1.40701	1.04033	0.70928
0.72	0.92212	1.00260	1.39069	1.03764	0.72093
0.73	0.92843	1.00682	1.37452	1.03504	0.73248
0.74	0.93442	1.01062	1.35851	1.03253	0.74392
0.75	0.94009	1.01404	1.34266	1.03010	0.75524
0.76	0.94546	1.01706	1.32696	1.02777	0.76645
0.77	0.95052	1.01970	1.31143	1.02553	0.77755
0.78	0.95528	1.02198	1.29606	1.02337	0.78853
0.79	0.95975	1.02390	1.28086	1.02131	0.79939
0.80	0.96395	1.02548	1.26582	1.01934	0.81013
0.81	0.96787	1.02672	1.25095	1.01747	0.82075
0.82	0.97152	1.02763	1.23625	1.01569	0.83125
0.83	0.97492	1.02824	1.22171	1.01400	0.84164
0.84	0.97807	1.02853	1.20734	1.01241	0.85190
0.85	0.98097	1.02854	1.19314	1.01091	0.86204
0.86	0.98363	1.02826	1.17911	1.00951	0.87207
0.87	0.98607	1.02771	1.16524	1.00820	0.88197
0.88	0.98828	1.02689	1.15154	1.00699	0.89175
0.89	0.99028	1.02583	1.13801	1.00588	0.90142
0.90	0.99207	1.02452	1.12465	1.00486	0.91097
0.91	0.99366	1.02297	1.11145	1.00393	0.92039
0.92	0.99506	1.02120	1.09842	1.00311	0.92970
0.93	0.99627	1.01922	1.08555	1.00238	0.93889
0.94	0.99729	1.01702	1.07285	1.00175	0.94797
0.95	0.99814	1.01463	1.06031	1.00122	0.95693
0.96	0.99883	1.01205	1.04793	1.00078	0.96577
0.97	0.99935	1.00929	1.03571	1.00044	0.97450
0.98	0.99971	1.00636	1.02365	1.00019	0.98311
0.99	0.99993	1.00326	1.01175	1.00005	0.99161



E-3

## Rayleigh-line flow

Perfect gas

 $K = 1.4$ 

M	$T_0 / T_0^*$	$T / T^*$	$P / P^*$	$P_0 / P_0^*$	$V / V^*$
1.00	1.00000	1.00000	1.00000	1.00000	1.00000
1.01	0.99993	0.99659	0.98841	1.00005	1.00828
1.02	0.99973	0.99304	0.97698	1.00019	1.01645
1.03	0.99940	0.98936	0.96569	1.00044	1.02450
1.04	0.99895	0.98554	0.95456	1.00078	1.03246
1.05	0.99838	0.98161	0.94358	1.00122	1.04030
1.06	0.99769	0.97755	0.93275	1.00175	1.04804
1.07	0.99690	0.97339	0.92206	1.00238	1.05567
1.08	0.99601	0.96913	0.91152	1.00311	1.06320
1.09	0.99501	0.96477	0.90112	1.00394	1.07063
1.10	0.99392	0.96031	0.89087	1.00486	1.07795
1.11	0.99275	0.95577	0.88075	1.00588	1.08518
1.12	0.99148	0.95115	0.87078	1.00700	1.09230
1.13	0.99013	0.94645	0.86094	1.00821	1.09933
1.14	0.98871	0.94169	0.85123	1.00952	1.10626
1.15	0.98721	0.93685	0.84166	1.01093	1.11310
1.16	0.98564	0.93196	0.83222	1.01243	1.11984
1.17	0.98400	0.92701	0.82292	1.01403	1.12649
1.18	0.98230	0.92200	0.81374	1.01573	1.13305
1.19	0.98054	0.91695	0.80468	1.01752	1.13951
1.20	0.97872	0.91185	0.79576	1.01942	1.14589
1.21	0.97684	0.90671	0.78695	1.02140	1.15218
1.22	0.97492	0.90153	0.77827	1.02349	1.15838
1.23	0.97294	0.89632	0.76971	1.02567	1.16449
1.24	0.97092	0.89108	0.76127	1.02795	1.17052
1.25	0.96886	0.88581	0.75294	1.03033	1.17647
1.26	0.96675	0.88052	0.74473	1.03280	1.18234
1.27	0.96461	0.87521	0.73663	1.03537	1.18812
1.28	0.96243	0.86988	0.72865	1.03804	1.19382
1.29	0.96022	0.86453	0.72078	1.04080	1.19945
1.30	0.95798	0.85917	0.71301	1.04366	1.20499
1.31	0.95571	0.85380	0.70536	1.04662	1.21046
1.32	0.95341	0.84843	0.69780	1.04968	1.21585
1.33	0.95108	0.84305	0.69036	1.05283	1.22117
1.34	0.94873	0.83766	0.68301	1.05608	1.22642
1.35	0.94637	0.83227	0.67577	1.05943	1.23159
1.36	0.94398	0.82689	0.66863	1.06288	1.23669
1.37	0.94157	0.82151	0.66158	1.06642	1.24173
1.38	0.93914	0.81613	0.65464	1.07007	1.24669
1.39	0.93671	0.81076	0.64778	1.07381	1.25158
1.40	0.93425	0.80539	0.64103	1.07765	1.25641
1.41	0.93179	0.80004	0.63436	1.08159	1.26117
1.42	0.92931	0.79469	0.62779	1.08563	1.26587
1.43	0.92683	0.78936	0.62130	1.08977	1.27050
1.44	0.92434	0.78405	0.61491	1.09401	1.27507
1.45	0.92184	0.77874	0.60860	1.09835	1.27957
1.46	0.91933	0.77346	0.60237	1.10279	1.28402
1.47	0.91682	0.76819	0.59623	1.10732	1.28840
1.48	0.91431	0.76294	0.59018	1.11196	1.29273
1.49	0.91179	0.75771	0.58421	1.11670	1.29700



M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
1.50	0.90928	0.75250	0.57831	1.12155	1.30121
1.51	0.90676	0.74732	0.57250	1.12649	1.30536
1.52	0.90424	0.74215	0.56677	1.13153	1.30945
1.53	0.90172	0.73701	0.56111	1.13668	1.31350
1.54	0.89921	0.73189	0.55552	1.14193	1.31748
1.55	0.89669	0.72680	0.55002	1.14729	1.32142
1.56	0.89418	0.72173	0.54458	1.15274	1.32530
1.57	0.89168	0.71669	0.53922	1.15830	1.32913
1.58	0.88917	0.71168	0.53393	1.16397	1.33291
1.59	0.88668	0.70669	0.52871	1.16974	1.33664
1.60	0.88419	0.70174	0.52356	1.17561	1.34031
1.61	0.88170	0.69680	0.51848	1.18159	1.34395
1.62	0.87922	0.69190	0.51346	1.18768	1.34753
1.63	0.87675	0.68703	0.50851	1.19387	1.35106
1.64	0.87429	0.68219	0.50363	1.20017	1.35455
1.65	0.87184	0.67738	0.49881	1.20657	1.35800
1.66	0.86939	0.67259	0.49405	1.21309	1.36140
1.67	0.86696	0.66784	0.48935	1.21971	1.36475
1.68	0.86453	0.66312	0.48472	1.22644	1.36806
1.69	0.86212	0.65843	0.48014	1.23328	1.37133
1.70	0.85971	0.65377	0.47562	1.24024	1.37455
1.71	0.85731	0.64914	0.47117	1.24730	1.37774
1.72	0.85493	0.64455	0.46677	1.25447	1.38088
1.73	0.85256	0.63999	0.46242	1.26175	1.38398
1.74	0.85019	0.63545	0.45813	1.26915	1.38705
1.75	0.84784	0.63095	0.45390	1.27666	1.39007
1.76	0.84551	0.62649	0.44972	1.28428	1.39306
1.77	0.84318	0.62205	0.44559	1.29202	1.39600
1.78	0.84087	0.61765	0.44152	1.29987	1.39891
1.79	0.83857	0.61328	0.43750	1.30784	1.40179
1.80	0.83628	0.60894	0.43353	1.31593	1.40462
1.81	0.83400	0.60464	0.42960	1.32413	1.40743
1.82	0.83174	0.60036	0.42573	1.33244	1.41019
1.83	0.82949	0.59612	0.42191	1.34088	1.41292
1.84	0.82726	0.59191	0.41813	1.34943	1.41562
1.85	0.82504	0.58774	0.41440	1.35811	1.41829
1.86	0.82283	0.58359	0.41072	1.36690	1.42092
1.87	0.82064	0.57948	0.40708	1.37582	1.42352
1.88	0.81845	0.57540	0.40349	1.38486	1.42608
1.89	0.81629	0.57136	0.39994	1.39402	1.42862
1.90	0.81414	0.56734	0.39643	1.40330	1.43112
1.91	0.81200	0.56336	0.39297	1.41271	1.43359
1.92	0.80987	0.55941	0.38955	1.42224	1.43604
1.93	0.80776	0.55549	0.38617	1.43190	1.43845
1.94	0.80567	0.55160	0.38283	1.44168	1.44083
1.95	0.80358	0.54774	0.37954	1.45160	1.44319
1.96	0.80152	0.54392	0.37628	1.46164	1.44552
1.97	0.79946	0.54012	0.37306	1.47181	1.44781
1.98	0.79742	0.53636	0.36988	1.48210	1.45008
1.99	0.79540	0.53263	0.36674	1.49253	1.45233



E-5

## Rayleigh-line flow

Perfect gas

 $K = 1.4$ 

M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$\rho_0/\rho_0^*$	$V/V^*$
2.00	0.79339	0.52893	0.36364	1.50310	1.45435
2.01	0.79139	0.52525	0.36057	1.51379	1.45674
2.02	0.78941	0.52161	0.35754	1.52462	1.45890
2.03	0.78744	0.51800	0.35454	1.53558	1.46104
2.04	0.78549	0.51442	0.35158	1.54668	1.46315
2.05	0.78355	0.51087	0.34866	1.55791	1.46524
2.06	0.78162	0.50735	0.34577	1.56928	1.46731
2.07	0.77971	0.50386	0.34291	1.58079	1.46935
2.08	0.77782	0.50040	0.34009	1.59244	1.47136
2.09	0.77593	0.49696	0.33730	1.60423	1.47336
2.10	0.77406	0.49356	0.33454	1.61616	1.47533
2.11	0.77221	0.49018	0.33182	1.62823	1.47728
2.12	0.77037	0.48684	0.32912	1.64045	1.47920
2.13	0.76854	0.48352	0.32646	1.65281	1.48110
2.14	0.76673	0.48023	0.32382	1.66531	1.48298
2.15	0.76493	0.47696	0.32122	1.67796	1.48484
2.16	0.76314	0.47373	0.31865	1.69076	1.48668
2.17	0.76137	0.47052	0.31610	1.70371	1.48850
2.18	0.75961	0.46734	0.31359	1.71680	1.49030
2.19	0.75787	0.46418	0.31110	1.73005	1.49207
2.20	0.75613	0.46106	0.30864	1.74345	1.49383
2.21	0.75442	0.45796	0.30621	1.75700	1.49556
2.22	0.75271	0.45488	0.30381	1.77070	1.49728
2.23	0.75102	0.45184	0.30143	1.78456	1.49898
2.24	0.74934	0.44882	0.29908	1.79858	1.50066
2.25	0.74768	0.44582	0.29675	1.81275	1.50232
2.26	0.74602	0.44285	0.29446	1.82708	1.50396
2.27	0.74438	0.43990	0.29218	1.84158	1.50558
2.28	0.74276	0.43699	0.28993	1.85623	1.50719
2.29	0.74114	0.43409	0.28771	1.87104	1.50878
2.30	0.73954	0.43122	0.28551	1.88602	1.51035
2.31	0.73795	0.42838	0.28334	1.90116	1.51190
2.32	0.73638	0.42555	0.28118	1.91647	1.51344
2.33	0.73482	0.42276	0.27905	1.93195	1.51496
2.34	0.73326	0.41998	0.27695	1.94759	1.51647
2.35	0.73173	0.41723	0.27487	1.96340	1.51795
2.36	0.73020	0.41451	0.27281	1.97939	1.51942
2.37	0.72868	0.41181	0.27077	1.99554	1.52088
2.38	0.72718	0.40913	0.26875	2.01187	1.52232
2.39	0.72569	0.40647	0.26676	2.02838	1.52375
2.40	0.72421	0.40384	0.26478	2.04506	1.52515
2.41	0.72275	0.40122	0.26283	2.06191	1.52655
2.42	0.72129	0.39864	0.26090	2.07895	1.52793
2.43	0.71985	0.39607	0.25899	2.09614	1.52930
2.44	0.71842	0.39352	0.25710	2.11353	1.53065
2.45	0.71699	0.39100	0.25522	2.13114	1.53198
2.46	0.71559	0.38850	0.25337	2.14891	1.53331
2.47	0.71419	0.38602	0.25154	2.16686	1.53462
2.48	0.71280	0.38356	0.24973	2.18499	1.53591
2.49	0.71142	0.38112	0.24793	2.20332	1.53719



M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
2.50	0.71006	0.37870	0.24615	2.22183	1.53846
2.51	0.70871	0.37630	0.24440	2.24054	1.53972
2.52	0.70736	0.37392	0.24266	2.25944	1.54096
2.53	0.70603	0.37157	0.24093	2.27853	1.54219
2.54	0.70471	0.36923	0.23923	2.29782	1.54341
2.55	0.70340	0.36691	0.23754	2.31730	1.54461
2.56	0.70210	0.36461	0.23587	2.33699	1.54581
2.57	0.70081	0.36233	0.23422	2.35687	1.54699
2.58	0.69953	0.36007	0.23258	2.37696	1.54816
2.59	0.69826	0.35783	0.23096	2.39725	1.54931
2.60	0.69700	0.35561	0.22936	2.41774	1.55046
2.61	0.69575	0.35341	0.22777	2.43844	1.55159
2.62	0.69451	0.35122	0.22620	2.45935	1.55272
2.63	0.69328	0.34906	0.22464	2.48047	1.55383
2.64	0.69206	0.34691	0.22310	2.50180	1.55493
2.65	0.69084	0.34478	0.22158	2.52334	1.55602
2.66	0.68964	0.34266	0.22007	2.54509	1.55710
2.67	0.68845	0.34057	0.21857	2.56706	1.55816
2.68	0.68727	0.33849	0.21709	2.58925	1.55922
2.69	0.68610	0.33643	0.21562	2.61166	1.56027
2.70	0.68494	0.33439	0.21417	2.63429	1.56131
2.71	0.68378	0.33236	0.21273	2.65714	1.56233
2.72	0.68264	0.33035	0.21131	2.68021	1.56335
2.73	0.68150	0.32836	0.20990	2.70351	1.56436
2.74	0.68037	0.32638	0.20850	2.72704	1.56536
2.75	0.67926	0.32442	0.20712	2.75080	1.56634
2.76	0.67815	0.32248	0.20575	2.77478	1.56732
2.77	0.67705	0.32055	0.20439	2.79900	1.56829
2.78	0.67595	0.31864	0.20305	2.82346	1.56925
2.79	0.67487	0.31674	0.20172	2.84815	1.57020
2.80	0.67380	0.31486	0.20040	2.87308	1.57114
2.81	0.67273	0.31299	0.19910	2.89825	1.57208
2.82	0.67167	0.31114	0.19780	2.92366	1.57300
2.83	0.67062	0.30931	0.19652	2.94931	1.57391
2.84	0.66958	0.30749	0.19525	2.97521	1.57482
2.85	0.66855	0.30568	0.19399	3.00136	1.57572
2.86	0.66752	0.30389	0.19275	3.02775	1.57661
2.87	0.66651	0.30211	0.19152	3.05440	1.57749
2.88	0.66550	0.30035	0.19029	3.08129	1.57836
2.89	0.66450	0.29860	0.18908	3.10845	1.57923
2.90	0.66350	0.29687	0.18788	3.13585	1.58009
2.91	0.66252	0.29515	0.18669	3.16352	1.58093
2.92	0.66154	0.29344	0.18552	3.19145	1.58178
2.93	0.66057	0.29175	0.18435	3.21963	1.58261
2.94	0.65960	0.29007	0.18319	3.24809	1.58344
2.95	0.65865	0.28841	0.18205	3.27680	1.58425
2.96	0.65770	0.28675	0.18091	3.30579	1.58506
2.97	0.65676	0.28512	0.17979	3.33505	1.58587
2.98	0.65583	0.28349	0.17867	3.36457	1.58666
2.99	0.65490	0.28188	0.17757	3.39438	1.58745



M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
3.00	0.65398	0.27021	0.17647	3.42443	1.58824
3.01	0.65307	0.27069	0.17539	3.43481	1.58901
3.02	0.65216	0.27111	0.17431	3.44544	1.58978
3.03	0.65126	0.27153	0.17324	3.45636	1.59054
3.04	0.65037	0.27200	0.17219	3.46756	1.59129
3.05	0.64949	0.27246	0.17114	3.47903	1.59204
3.06	0.64861	0.27294	0.17010	3.49082	1.59278
3.07	0.64774	0.27342	0.16908	3.50289	1.59352
3.08	0.64687	0.27392	0.16806	3.51524	1.59425
3.09	0.64601	0.27443	0.16703	3.52790	1.59497
3.10	0.64516	0.27495	0.16604	3.54084	1.59568
3.11	0.64432	0.27549	0.16503	3.55409	1.59639
3.12	0.64348	0.27603	0.16407	3.56764	1.59710
3.13	0.64265	0.27659	0.16309	3.58149	1.59779
3.14	0.64182	0.27715	0.16212	3.59563	1.59848
3.15	0.64100	0.27773	0.16117	3.61011	1.59917
3.16	0.64018	0.27832	0.16022	3.62488	1.59985
3.17	0.63938	0.27892	0.15927	3.63997	1.60052
3.18	0.63857	0.27953	0.15834	4.01537	1.60119
3.19	0.63778	0.28015	0.15741	4.03108	1.60185
3.20	0.63699	0.28078	0.15649	4.08712	1.60250
3.21	0.63621	0.28143	0.15558	4.12347	1.60315
3.22	0.63543	0.28208	0.15468	4.16013	1.60380
3.23	0.63465	0.28274	0.15379	4.19716	1.60444
3.24	0.63389	0.28341	0.15290	4.23449	1.60507
3.25	0.63313	0.28410	0.15202	4.27213	1.60570
3.26	0.63237	0.28479	0.15115	4.31014	1.60632
3.27	0.63162	0.28549	0.15028	4.34847	1.60694
3.28	0.63088	0.28621	0.14942	4.38714	1.60756
3.29	0.63014	0.28693	0.14857	4.42614	1.60816
3.30	0.62940	0.28766	0.14773	4.46549	1.60877
3.31	0.62868	0.28840	0.14689	4.50518	1.60936
3.32	0.62795	0.28915	0.14606	4.54522	1.60996
3.33	0.62724	0.28991	0.14524	4.58561	1.61054
3.34	0.62652	0.29068	0.14442	4.62633	1.61113
3.35	0.62582	0.29146	0.14361	4.66744	1.61170
3.36	0.62512	0.29225	0.14281	4.70889	1.61228
3.37	0.62442	0.29305	0.14201	4.75070	1.61285
3.38	0.62373	0.29385	0.14123	4.79287	1.61341
3.39	0.62304	0.29467	0.14044	4.83540	1.61397
3.40	0.62236	0.29549	0.13966	4.87830	1.61453
3.41	0.62168	0.29632	0.13889	4.92157	1.61508
3.42	0.62101	0.29717	0.13813	4.96522	1.61562
3.43	0.62034	0.29801	0.13737	5.00923	1.61616
3.44	0.61968	0.29887	0.13662	5.05362	1.61670
3.45	0.61902	0.29974	0.13587	5.09839	1.61723
3.46	0.61837	0.30061	0.13513	5.14353	1.61776
3.47	0.61772	0.30150	0.13440	5.18909	1.61829
3.48	0.61708	0.30239	0.13367	5.23501	1.61881
3.49	0.61644	0.30329	0.13295	5.28133	1.61932



M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
3.50	0.61580	0.21419	0.13223	5.32804	1.61984
3.51	0.61517	0.21311	0.13152	5.37514	1.62034
3.52	0.61455	0.21203	0.13081	5.42264	1.62085
3.53	0.61393	0.21096	0.13011	5.47054	1.62135
3.54	0.61331	0.20990	0.12942	5.51852	1.62184
3.55	0.61270	0.20885	0.12873	5.56756	1.62234
3.56	0.61209	0.20780	0.12805	5.61668	1.62282
3.57	0.61149	0.20676	0.12737	5.66621	1.62331
3.58	0.61089	0.20573	0.12670	5.71615	1.62379
3.59	0.61029	0.20470	0.12603	5.76652	1.62427
3.60	0.60970	0.20369	0.12537	5.81730	1.62474
3.61	0.60911	0.20268	0.12471	5.86850	1.62521
3.62	0.60852	0.20167	0.12406	5.92013	1.62567
3.63	0.60795	0.20068	0.12341	5.97219	1.62614
3.64	0.60738	0.19969	0.12277	6.02468	1.62660
3.65	0.60681	0.19871	0.12213	6.07761	1.62705
3.66	0.60624	0.19773	0.12150	6.13097	1.62750
3.67	0.60568	0.19677	0.12087	6.18477	1.62795
3.68	0.60512	0.19581	0.12024	6.23902	1.62840
3.69	0.60456	0.19485	0.11963	6.29371	1.62884
3.70	0.60401	0.19390	0.11901	6.34885	1.62928
3.71	0.60346	0.19296	0.11840	6.40444	1.62971
3.72	0.60292	0.19203	0.11780	6.46048	1.63014
3.73	0.60238	0.19110	0.11720	6.51698	1.63057
3.74	0.60184	0.19018	0.11660	6.57395	1.63100
3.75	0.60131	0.18926	0.11601	6.63137	1.63142
3.76	0.60078	0.18836	0.11543	6.68927	1.63184
3.77	0.60025	0.18745	0.11484	6.74763	1.63226
3.78	0.59973	0.18656	0.11427	6.80646	1.63267
3.79	0.59921	0.18567	0.11369	6.86578	1.63308
3.80	0.59870	0.18478	0.11312	6.92557	1.63348
3.81	0.59819	0.18391	0.11256	6.98584	1.63389
3.82	0.59768	0.18303	0.11200	7.04660	1.63429
3.83	0.59717	0.18217	0.11144	7.10784	1.63469
3.84	0.59667	0.18131	0.11089	7.16958	1.63508
3.85	0.59617	0.18045	0.11034	7.23181	1.63547
3.86	0.59568	0.17961	0.10979	7.29454	1.63586
3.87	0.59519	0.17876	0.10925	7.35777	1.63625
3.88	0.59470	0.17793	0.10871	7.42151	1.63663
3.89	0.59421	0.17709	0.10818	7.48575	1.63701
3.90	0.59373	0.17627	0.10765	7.55051	1.63739
3.91	0.59325	0.17545	0.10713	7.61577	1.63777
3.92	0.59278	0.17463	0.10661	7.68156	1.63814
3.93	0.59231	0.17383	0.10609	7.74786	1.63851
3.94	0.59184	0.17302	0.10557	7.81469	1.63888
3.95	0.59137	0.17222	0.10506	7.88205	1.63924
3.96	0.59091	0.17141	0.10456	7.94993	1.63960
3.97	0.59045	0.17064	0.10405	8.01835	1.63996
3.98	0.58999	0.16986	0.10355	8.08731	1.64032
3.99	0.58954	0.16908	0.10306	8.15681	1.64067



Perfect gas

 $K = 1.4$ 

M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
4.00	0.58909	0.16831	0.10256	8.22683	1.64103
4.01	0.58864	0.16754	0.10207	8.29744	1.64138
4.02	0.58819	0.16678	0.10159	8.36858	1.64172
4.03	0.58775	0.16602	0.10111	8.44027	1.64207
4.04	0.58731	0.16527	0.10063	8.51253	1.64241
4.05	0.58687	0.16453	0.10015	8.58534	1.64275
4.06	0.58644	0.16378	0.09968	8.65872	1.64309
4.07	0.58601	0.16305	0.09921	8.73266	1.64342
4.08	0.58558	0.16231	0.09875	8.80718	1.64375
4.09	0.58516	0.16159	0.09828	8.88227	1.64408
4.10	0.58473	0.16086	0.09782	8.95794	1.64441
4.11	0.58431	0.16014	0.09737	9.03420	1.64474
4.12	0.58390	0.15943	0.09691	9.11104	1.64506
4.13	0.58348	0.15872	0.09646	9.18847	1.64538
4.14	0.58307	0.15802	0.09602	9.26649	1.64570
4.15	0.58266	0.15732	0.09557	9.34511	1.64602
4.16	0.58225	0.15662	0.09513	9.42433	1.64633
4.17	0.58185	0.15593	0.09470	9.50416	1.64665
4.18	0.58145	0.15524	0.09426	9.58458	1.64696
4.19	0.58105	0.15456	0.09383	9.66563	1.64727
4.20	0.58065	0.15388	0.09340	9.74729	1.64757
4.21	0.58026	0.15321	0.09297	9.82957	1.64788
4.22	0.57987	0.15254	0.09255	9.91247	1.64818
4.23	0.57948	0.15187	0.09213	9.99599	1.64848
4.24	0.57909	0.15121	0.09171	10.08015	1.64878
4.25	0.57870	0.15055	0.09129	10.16494	1.64907
4.26	0.57832	0.14990	0.09087	10.25037	1.64937
4.27	0.57794	0.14926	0.09048	10.33644	1.64966
4.28	0.57757	0.14861	0.09007	10.42316	1.64995
4.29	0.57719	0.14797	0.08967	10.51052	1.65024
4.30	0.57682	0.14734	0.08927	10.59855	1.65052
4.31	0.57645	0.14670	0.08887	10.68722	1.65081
4.32	0.57608	0.14607	0.08847	10.77656	1.65109
4.33	0.57571	0.14545	0.08808	10.86656	1.65137
4.34	0.57535	0.14483	0.08769	10.95723	1.65165
4.35	0.57499	0.14421	0.08730	11.04858	1.65193
4.36	0.57463	0.14360	0.08691	11.14060	1.65220
4.37	0.57427	0.14299	0.08653	11.23330	1.65248
4.38	0.57392	0.14239	0.08615	11.32669	1.65275
4.39	0.57357	0.14178	0.08577	11.42077	1.65302
4.40	0.57322	0.14119	0.08540	11.51554	1.65329
4.41	0.57287	0.14059	0.08502	11.61100	1.65355
4.42	0.57252	0.14000	0.08465	11.70717	1.65382
4.43	0.57218	0.13941	0.08428	11.80404	1.65408
4.44	0.57183	0.13883	0.08392	11.90163	1.65434
4.45	0.57149	0.13825	0.08356	11.99993	1.65460
4.46	0.57116	0.13767	0.08319	12.09894	1.65486
4.47	0.57082	0.13710	0.08284	12.19868	1.65512
4.48	0.57049	0.13653	0.08248	12.29914	1.65537
4.49	0.57015	0.13597	0.08212	12.40033	1.65563



Perfect gas

 $K = 1.4$ 

M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
4.30	0.36982	0.13540	0.08177	12.50226	1.65588
4.31	0.36950	0.13484	0.08142	12.60493	1.65613
4.32	0.36917	0.13429	0.08107	12.70834	1.65638
4.33	0.36885	0.13374	0.08073	12.81250	1.65662
4.34	0.36852	0.13319	0.08039	12.91740	1.65687
4.35	0.36820	0.13264	0.08004	13.02307	1.65711
4.36	0.36789	0.13210	0.07970	13.12949	1.65735
4.37	0.36757	0.13156	0.07937	13.23668	1.65759
4.38	0.36726	0.13102	0.07903	13.34464	1.65783
4.39	0.36694	0.13049	0.07870	13.45337	1.65807
4.40	0.36663	0.12996	0.07837	13.56288	1.65831
4.41	0.36632	0.12943	0.07804	13.67318	1.65854
4.42	0.36602	0.12891	0.07771	13.78425	1.65878
4.43	0.36571	0.12839	0.07739	13.89613	1.65901
4.44	0.36541	0.12787	0.07707	14.00879	1.65924
4.45	0.36510	0.12736	0.07675	14.12226	1.65947
4.46	0.36480	0.12685	0.07643	14.23652	1.65969
4.47	0.36451	0.12634	0.07611	14.35161	1.65992
4.48	0.36421	0.12583	0.07580	14.46750	1.66015
4.49	0.36391	0.12533	0.07548	14.58421	1.66037
4.70	0.36362	0.12483	0.07517	14.70174	1.66059
4.71	0.36333	0.12434	0.07486	14.82011	1.66081
4.72	0.36304	0.12384	0.07456	14.93930	1.66103
4.73	0.36275	0.12335	0.07425	15.05933	1.66125
4.74	0.36246	0.12286	0.07395	15.18020	1.66147
4.75	0.36218	0.12238	0.07365	15.30192	1.66168
4.76	0.36190	0.12190	0.07335	15.42449	1.66189
4.77	0.36161	0.12142	0.07305	15.54791	1.66211
4.78	0.36133	0.12094	0.07275	15.67220	1.66232
4.79	0.36106	0.12047	0.07246	15.79735	1.66253
4.80	0.36078	0.12000	0.07217	15.92337	1.66274
4.81	0.36050	0.11953	0.07188	16.05026	1.66295
4.82	0.36023	0.11906	0.07159	16.17803	1.66315
4.83	0.35996	0.11860	0.07130	16.30669	1.66336
4.84	0.35969	0.11814	0.07101	16.43624	1.66356
4.85	0.35942	0.11768	0.07073	16.56667	1.66376
4.86	0.35915	0.11722	0.07045	16.69802	1.66397
4.87	0.35888	0.11677	0.07017	16.83026	1.66417
4.88	0.35862	0.11632	0.06989	16.96341	1.66437
4.89	0.35836	0.11587	0.06961	17.09747	1.66456
4.90	0.35809	0.11543	0.06934	17.23246	1.66476
4.91	0.35783	0.11499	0.06906	17.36836	1.66496
4.92	0.35758	0.11455	0.06879	17.50520	1.66515
4.93	0.35732	0.11411	0.06852	17.64296	1.66534
4.94	0.35706	0.11367	0.06825	17.78167	1.66554
4.95	0.35681	0.11324	0.06798	17.92132	1.66573
4.96	0.35655	0.11281	0.06772	18.06192	1.66592
4.97	0.35630	0.11238	0.06745	18.20347	1.66611
4.98	0.35605	0.11196	0.06719	18.34598	1.66629
4.99	0.35580	0.11153	0.06693	18.48945	1.66648



Perfect gas

 $K = 1.4$ 

M	$T_0/T_0^*$	$T/T^*$	$P/P^*$	$P_0/P_0^*$	$V/V^*$
5.00	0.55556	0.11111	0.06667	18.63390	1.66667
5.10	0.55315	0.10703	0.06415	20.13279	1.66847
5.20	0.55088	0.10316	0.06177	21.73439	1.67017
5.30	0.54872	0.09950	0.05951	23.44420	1.67178
5.40	0.54667	0.09602	0.05738	25.26788	1.67330
5.50	0.54473	0.09272	0.05536	27.21133	1.67474
5.60	0.54288	0.08958	0.05345	29.28063	1.67611
5.70	0.54112	0.08660	0.05163	31.48210	1.67741
5.80	0.53944	0.08376	0.04990	33.82228	1.67864
5.90	0.53785	0.08106	0.04826	36.30790	1.67982
6.00	0.53633	0.07849	0.04669	38.94595	1.68093
6.10	0.53488	0.07603	0.04520	41.74362	1.68200
6.20	0.53349	0.07369	0.04378	44.70837	1.68301
6.30	0.53217	0.07145	0.04243	47.84788	1.68398
6.40	0.53091	0.06931	0.04114	51.17004	1.68490
6.50	0.52970	0.06726	0.03990	54.68303	1.68579
6.60	0.52854	0.06531	0.03872	58.39526	1.68663
6.70	0.52743	0.06343	0.03759	62.31540	1.68744
6.80	0.52637	0.06164	0.03651	66.45238	1.68821
6.90	0.52535	0.05991	0.03547	70.81536	1.68895
7.00	0.52438	0.05826	0.03448	75.41380	1.68966
7.10	0.52344	0.05668	0.03353	80.25739	1.69033
7.20	0.52254	0.05516	0.03262	85.35616	1.69099
7.30	0.52167	0.05370	0.03174	90.72038	1.69161
7.40	0.52084	0.05229	0.03090	96.36053	1.69221
7.50	0.52004	0.05094	0.03009	102.28750	1.69279
7.60	0.51927	0.04964	0.02932	108.51230	1.69335
7.70	0.51853	0.04839	0.02857	115.04650	1.69388
7.80	0.51782	0.04719	0.02785	121.90180	1.69439
7.90	0.51713	0.04603	0.02716	129.09000	1.69489
8.00	0.51647	0.04491	0.02649	136.62350	1.69536
8.10	0.51583	0.04383	0.02585	144.51510	1.69582
8.20	0.51521	0.04279	0.02523	152.77740	1.69627
8.30	0.51462	0.04179	0.02463	161.42390	1.69669
8.40	0.51404	0.04082	0.02405	170.46790	1.69711
8.50	0.51349	0.03988	0.02349	179.92360	1.69750
8.60	0.51295	0.03898	0.02296	189.80510	1.69789
8.70	0.51243	0.03810	0.02244	200.12670	1.69826
8.80	0.51193	0.03726	0.02193	210.90360	1.69862
8.90	0.51145	0.03644	0.02145	222.15080	1.69897
9.00	0.51098	0.03565	0.02098	233.88390	1.69930
9.10	0.51052	0.03488	0.02052	246.11890	1.69963
9.20	0.51008	0.03414	0.02008	258.87190	1.69994
9.30	0.50966	0.03342	0.01966	272.15970	1.70024
9.40	0.50925	0.03273	0.01925	285.99890	1.70054
9.50	0.50885	0.03205	0.01885	300.40720	1.70082
9.60	0.50846	0.03140	0.01846	315.40220	1.70110
9.70	0.50808	0.03076	0.01808	331.00170	1.70137
9.80	0.50772	0.03015	0.01772	347.22450	1.70163
9.90	0.50736	0.02955	0.01736	364.08970	1.70188
10.00	0.50702	0.02897	0.01702	381.61490	1.70213



TABLE 2 NORMAL SHOCK (Concluded)

Perfect Gas,  $k = 1.4$ 

$M_x$	$M_y$	$p_y/p_x$	$V_x/V_y$ and $\rho_y/\rho_x$	$T_y/T_x$	$A_x^*/A_y^*$ and $p_{0y}/p_{0x}$	$p_{0y}/p_x$
2.80	.48817	8.9800	3.6635	2.4512	.38946	10.569
2.81	.48746	9.0454	3.6737	2.4622	.38618	10.641
2.82	.48676	9.1111	3.68	2.4733	.38293	10.714
2.83	.48607	9.1770	3.6939	2.4844	.37970	10.787
2.84	.48538	9.2432	3.7039	2.4955	.37649	10.860
2.85	.48470	9.3096	3.7139	2.5067	.37330	10.933
2.86	.48402	9.3762	3.7238	2.5179	.37013	11.006
2.87	.48334	9.4431	3.7336	2.5292	.36700	11.080
2.88	.48268	9.5102	3.7434	2.5405	.36389	11.154
2.89	.48203	9.5775	3.7532	2.5518	.36080	11.228
2.90	.48138	9.6450	3.7629	2.5632	.35773	11.302
2.91	.48074	9.7127	3.7725	2.5746	.35469	11.377
2.92	.48010	9.7808	3.7821	2.5860	.35167	11.452
2.93	.47946	9.8491	3.7917	2.5975	.34867	11.527
2.94	.47883	9.9176	3.8012	2.6090	.34570	11.603
2.95	.47821	9.9863	3.8106	2.6206	.34275	11.679
2.96	.47760	10.055	3.8200	2.6322	.33982	11.755
2.97	.47699	10.124	3.8294	2.6438	.33692	11.831
2.98	.47638	10.194	3.8387	2.6555	.33404	11.907
2.99	.47578	10.263	3.8479	2.6672	.33118	11.984
3.00	.47519	10.333	3.8571	2.6790	.32834	12.061
3.50	.45115	14.125	4.2608	3.3150	.21295	16.242
4.00	.43496	18.500	4.5714	4.0469	.13876	21.068
4.50	.42355	23.458	4.8119	4.8751	.09170	26.539
5.00	.41523	29.000	5.0000	5.8000	.06172	32.654
6.00	.40416	41.833	5.2683	7.9406	.02965	46.815
7.00	.39736	57.000	5.4444	10.469	.01535	63.552
8.00	.39289	74.500	5.5652	13.387	.00849	82.865
9.00	.38980	94.333	5.6512	16.693	.00496	104.753
10.00	.38757	116.500	5.7143	20.388	.00304	129.217
$\infty$	.37796	$\infty$	6.0000	$\infty$	0	$\infty$

See Notes at beginning of this table.



Perfect gas						
M	T/T*	P/P*	Po/Po*	V/V*	F/F*	$\frac{V_0 \rho_n}{4 \Gamma L^*} \frac{M + m_n}{M}$
						D
4.50	0.23762	0.10833	16.56219	2.19360	1.32474	0.66763
4.51	0.23678	0.10789	16.70301	2.19456	1.32512	0.66823
4.52	0.23594	0.10746	16.84486	2.19552	1.32550	0.66882
4.53	0.23510	0.10704	16.98776	2.19647	1.32587	0.66941
4.54	0.23427	0.10661	17.13170	2.19742	1.32625	0.67000
4.55	0.23344	0.10619	17.27671	2.19836	1.32662	0.67058
4.56	0.23262	0.10577	17.42277	2.19930	1.32700	0.67116
4.57	0.23180	0.10535	17.56991	2.20023	1.32737	0.67174
4.58	0.23098	0.10494	17.71812	2.20116	1.32773	0.67231
4.59	0.23017	0.10452	17.86742	2.20208	1.32810	0.67288
4.60	0.22936	0.10411	18.01779	2.20300	1.32846	0.67345
4.61	0.22855	0.10370	18.16927	2.20391	1.32883	0.67401
4.62	0.22775	0.10330	18.32184	2.20482	1.32919	0.67457
4.63	0.22696	0.10289	18.47553	2.20573	1.32955	0.67513
4.64	0.22616	0.10249	18.63032	2.20662	1.32990	0.67569
4.65	0.22537	0.10209	18.78624	2.20752	1.33026	0.67624
4.66	0.22459	0.10170	18.94328	2.20841	1.33061	0.67679
4.67	0.22381	0.10130	19.10145	2.20929	1.33096	0.67733
4.68	0.22303	0.10091	19.26076	2.21017	1.33131	0.67788
4.69	0.22225	0.10052	19.42122	2.21105	1.33166	0.67842
4.70	0.22148	0.10013	19.58282	2.21192	1.33201	0.67895
4.71	0.22072	0.09975	19.74560	2.21278	1.33235	0.67949
4.72	0.21995	0.09936	19.90952	2.21365	1.33270	0.68002
4.73	0.21919	0.09898	20.07463	2.21450	1.33304	0.68055
4.74	0.21844	0.09860	20.24091	2.21536	1.33338	0.68107
4.75	0.21769	0.09823	20.40838	2.21621	1.33371	0.68159
4.76	0.21694	0.09785	20.57704	2.21705	1.33405	0.68211
4.77	0.21619	0.09748	20.74689	2.21789	1.33438	0.68263
4.78	0.21545	0.09711	20.91795	2.21873	1.33472	0.68315
4.79	0.21471	0.09674	21.09022	2.21956	1.33505	0.68366
4.80	0.21398	0.09637	21.26371	2.22038	1.33538	0.68417
4.81	0.21325	0.09601	21.43842	2.22121	1.33571	0.68467
4.82	0.21252	0.09564	21.61437	2.22202	1.33603	0.68518
4.83	0.21180	0.09528	21.79156	2.22284	1.33636	0.68568
4.84	0.21108	0.09492	21.96999	2.22365	1.33668	0.68618
4.85	0.21036	0.09457	22.14967	2.22446	1.33700	0.68667
4.86	0.20965	0.09421	22.33062	2.22526	1.33732	0.68717
4.87	0.20894	0.09386	22.51282	2.22605	1.33764	0.68766
4.88	0.20823	0.09351	22.69631	2.22685	1.33796	0.68814
4.89	0.20753	0.09316	22.88107	2.22764	1.33827	0.68863
4.90	0.20683	0.09281	23.06712	2.22842	1.33859	0.68911
4.91	0.20613	0.09247	23.25446	2.22921	1.33890	0.68959
4.92	0.20543	0.09212	23.44311	2.22998	1.33921	0.69007
4.93	0.20474	0.09178	23.63306	2.23076	1.33952	0.69055
4.94	0.20406	0.09144	23.82434	2.23153	1.33983	0.69102
4.95	0.20337	0.09110	24.01693	2.23229	1.34013	0.69149
4.96	0.20269	0.09077	24.21086	2.23306	1.34044	0.69196
4.97	0.20201	0.09043	24.40611	2.23382	1.34074	0.69242
4.98	0.20134	0.09010	24.60272	2.23457	1.34104	0.69289
4.99	0.20067	0.08977	24.80068	2.23532	1.34134	0.69335