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Chapter 1

Isentropic Flow

Table 1.1: Isentropic Table $k = 1.4$

$\mathbf{M}$	$\frac{\mathbf{T}}{\mathbf{T_0}}$	$\frac{\rho}{\rho_0}$	$\frac{\mathbf{A}}{\mathbf{A^\star}}$	$\frac{\mathbf{P}}{\mathbf{P_0}}$	$\frac{\mathbf{A}\times\mathbf{P}}{\mathbf{A^*}\times\mathbf{P_0}}$	$\frac{\mathbf{F}}{\mathbf{F^*}}$
0.000	1.00000	1.00000	$5.8E{+}5$	1.0000	$5.8E+5$	$2.4E{+}5$
0.050	0.99950	0.99875	11.59	0.99825	11.57	4.838
0.100	0.99800	0.99502	5.822	0.99303	5.781	2.443
0.200	0.99206	0.98028	2.964	0.97250	2.882	1.268
0.300	0.98232	0.95638	2.035	0.93947	1.912	0.89699
0.400	0.96899	0.92427	1.590	0.89561	1.424	0.72632
0.500	0.95238	0.88517	1.340	0.84302	1.130	0.63535
0.600	0.93284	0.84045	1.188	0.78400	0.93155	0.58377
0.700	0.91075	0.79158	1.094	0.72093	0.78896	0.55425
0.800	0.88652	0.73999	1.038	0.65602	0.68110	0.53807
0.900	0.86059	0.68704	1.009	0.59126	0.59650	0.53039
1.00	0.83333	0.63394	1.000	0.52828	0.52828	0.52828
1.100	0.80515	0.58170	1.008	0.46835	0.47207	0.52989
1.200	0.77640	0.53114	1.030	0.41238	0.42493	0.53399
1.300	0.74738	0.48290	1.066	0.36091	0.38484	0.53974
1.400	0.71839	0.43742	1.115	0.31424	0.35036	0.54655
1.500	0.68966	0.39498	1.176	0.27240	0.32039	0.55401
1.600	0.66138	0.35573	1.250	0.23527	0.29414	0.56182
1.700	0.63371	0.31969	1.338	0.20259	0.27099	0.56976
1.800	0.60680	0.28682	1.439	0.17404	0.25044	0.57768

1.900	0.58072	0.25699	1.555	0.14924	0.23211	0.58549
2.000	0.55556	0.23005	1.688	0.12780	0.21567	0.59309
2.500	0.44444	0.13169	2.637	0.058528	0.15432	0.62693
3.000	0.35714	0.076226	4.235	0.027224	0.11528	0.65326
3.500	0.28986	0.045233	6.790	0.013111	0.089018	0.67320
4.000	0.23810	0.027662	10.72	0.00659	0.070595	0.68830
4.500	0.19802	0.017449	16.56	0.00346	0.057227	0.69983
5.000	0.16667	0.011340	25.00	0.00189	0.047251	0.70876
5.500	0.14184	0.00758	36.87	0.00107	0.039628	0.71578
6.000	0.12195	0.00519	53.18	0.000633	0.033682	0.72136
6.500	0.10582	0.00364	75.13	0.000385	0.028962	0.72586
7.000	0.092593	0.00261	$1.0E{+}2$	0.000242	0.025156	0.72953
7.500	0.081633	0.00190	$1.4E{+}2$	0.000155	0.022046	0.73257
8.000	0.072464	0.00141	$1.9E{+}2$	0.000102	0.019473	0.73510
8.500	0.064725	0.00107	$2.5E{+}2$	$6.90E{-}5$	0.017321	0.73723
9.000	0.058140	0.000815	$3.3E{+}2$	$4.74E{-}5$	0.015504	0.73903
9.500	0.052493	0.000631	$4.2E{+}2$	$3.31E{-}5$	0.013957	0.74058
10.00	0.047619	0.000495	$5.4E{+}2$	$2.36E{-}5$	0.012628	0.74192

Table 1.2: Isothermal Table

M	$\frac{\mathbf{T_0}}{\mathbf{T_0{}^\star}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0{}^\star}}$	$\frac{\mathbf{A}}{\mathbf{A^\star}}$	$\frac{\mathbf{P}}{\mathbf{P^\star}}$	$\frac{\mathbf{A}\times\mathbf{P}}{\mathbf{A^*}\times\mathbf{P_0}}$	$\frac{\mathbf{F}}{\mathbf{F^*}}$
0.00	0.52828	1.064	$5.0E+5$	2.014	$1.0E{+}6$	$4.2E{+}5$
0.05	0.52921	1.064	9.949	2.010	20.00	8.362
0.1	0.53199	1.064	5.001	2.000	10.00	4.225
0.2	0.54322	1.064	2.553	1.958	5.000	2.200
0.3	0.56232	1.063	1.763	1.891	3.333	1.564
0.4	0.58985	1.062	1.389	1.800	2.500	1.275
0.5	0.62665	1.059	1.183	1.690	2.000	1.125
0.6	0.67383	1.055	1.065	1.565	1.667	1.044
0.7	0.73278	1.047	0.99967	1.429	1.429	1.004
0.8	0.80528	1.036	0.97156	1.287	1.250	0.98750
0.9	0.89348	1.021	0.97274	1.142	1.111	0.98796
1.00	1.000	1.000	1.000	1.000	1.000	1.000
1.10	1.128	0.97376	1.053	0.86329	0.90909	1.020

Table 1.2: Isothermal Table

M	$\frac{T_0}{T_0^\star}$	$\frac{P_0}{P_0^\star}$	$\frac{A}{A^\star}$	$\frac{P}{P^\star}$	$\frac{A \times P}{A^* \times P_0}$	$\frac{F}{F^*}$
1.20	1.281	0.94147	1.134	0.73492	0.83333	1.047
1.30	1.464	0.90302	1.247	0.61693	0.76923	1.079
1.40	1.681	0.85853	1.399	0.51069	0.71429	1.114
1.50	1.939	0.80844	1.599	0.41686	0.66667	1.153
1.60	2.245	0.75344	1.863	0.33554	0.62500	1.194
1.70	2.608	0.69449	2.209	0.26634	0.58824	1.237
1.80	3.035	0.63276	2.665	0.20846	0.55556	1.281
1.90	3.540	0.56954	3.271	0.16090	0.52632	1.328
2.00	4.134	0.50618	4.083	0.12246	0.50000	1.375
2.50	9.026	0.22881	15.78	0.025349	0.40000	1.625
3.000	19.41	0.071758	90.14	0.00370	0.33333	1.889
3.500	40.29	0.015317	$7.5E+2$	0.000380	0.28571	2.161
4.000	80.21	0.00221	$9.1E+3$	$2.75E{-}5$	0.25000	2.438
4.500	$1.5E+2$	0.000215	$1.6E+5$	$1.41E{-}6$	0.22222	2.718
5.000	$2.8E+2$	$1.41E{-}5$	$4.0E+6$	0.0	0.20000	3.000
5.500	$4.9E+2$	0.0	$1.4E+8$	0.0	0.18182	3.284
6.000	$8.3E+2$	0.0	$7.3E+9$	0.0	0.16667	3.569
6.500	$1.4E+3$	0.0	$5.3E{+}11$	0.0	0.15385	3.856
7.000	$2.2E+3$	0.0	$5.6E{+}13$	0.0	0.14286	4.143
7.500	$3.4E+3$	0.0	$8.3E{+}15$	0.0	0.13333	4.431
8.000	$5.2E+3$	0.0	$1.8E{+}18$	0.0	0.12500	4.719
8.500	$7.7E+3$	0.0	$5.4E{+}20$	0.0	0.11765	5.007
9.000	$1.1E+4$	0.0	$2.3E{+}23$	0.0	0.11111	5.296
9.500	$1.6E+4$	0.0	$1.4E{+}26$	0.0	0.10526	5.586
10.00	$2.2E+4$	0.0	$1.2E{+}29$	0.0	0.10000	5.875

Chapter 2

Normal Shock

$\mathbf{k}$	$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$
1.30	1073.25	0.33968	2.2645	169842.29
1.40	985.85	0.37797	1.8898	188982.96
1.50	922.23	0.40825	1.6330	204124.86
1.60	873.09	0.43301	1.4434	216507.05
1.70	833.61	0.45374	1.2964	226871.99
1.80	801.02	0.47141	1.1785	235702.93
1.90	773.54	0.48667	1.0815	243332.79
2.00	750.00	0.50000	1.00000	250000.64
2.10	729.56	0.51177	0.93048	255883.78
2.20	711.62	0.52223	0.87039	261117.09
2.30	695.74	0.53161	0.81786	265805.36
2.40	681.56	0.54006	0.77151	270031.44
2.50	668.81	0.54772	0.73029	273861.85

Table of maximum values of the shock-chocking phenomenon.

Table 2.1: The shock wave Table for k = 1.4

$\mathbf{M_x}$	$\mathbf{M_y}$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\rho_\mathbf{y}}{\rho_\mathbf{x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
1.00	1.00000	1.00000	1.00000	1.00000	1.00000
1.05	0.95313	1.03284	1.08398	1.11958	0.99985
1.10	0.91177	1.06494	1.16908	1.24500	0.99893

1.15	0.87502	1.09658	1.25504	1.37625	0.99669
1.20	0.84217	1.12799	1.34161	1.51333	0.99280
1.25	0.81264	1.15938	1.42857	1.65625	0.98706
1.30	0.78596	1.19087	1.51570	1.80500	0.97937
1.35	0.76175	1.22261	1.60278	1.95958	0.96974
1.40	0.73971	1.25469	1.68966	2.12000	0.95819
1.45	0.71956	1.28720	1.77614	2.28625	0.94484
1.50	0.70109	1.32022	1.86207	2.45833	0.92979
1.55	0.68410	1.35379	1.94732	2.63625	0.91319
1.60	0.66844	1.38797	2.03175	2.82000	0.89520
1.65	0.65396	1.42280	2.11525	3.00958	0.87599
1.70	0.64054	1.45833	2.19772	3.20500	0.85572
1.75	0.62809	1.49458	2.27907	3.40625	0.83457
1.80	0.61650	1.53158	2.35922	3.61333	0.81268
1.85	0.60570	1.56935	2.43811	3.82625	0.79023
1.90	0.59562	1.60792	2.51568	4.04500	0.76736
1.95	0.58618	1.64729	2.59188	4.26958	0.74420
2.00	0.57735	1.68750	2.66667	4.50000	0.72087
2.05	0.56906	1.72855	2.74002	4.73625	0.69751
2.10	0.56128	1.77045	2.81190	4.97833	0.67420
2.15	0.55395	1.81322	2.88231	5.22625	0.65105
2.20	0.54706	1.85686	2.95122	5.48000	0.62814
2.25	0.54055	1.90138	3.01863	5.73958	0.60553
2.30	0.53441	1.94680	3.08455	6.00500	0.58329
2.35	0.52861	1.99311	3.14897	6.27625	0.56148
2.40	0.52312	2.04033	3.21190	6.55333	0.54014
2.45	0.51792	2.08846	3.27335	6.83625	0.51931
2.50	0.51299	2.13750	3.33333	7.12500	0.49901
2.75	0.49181	2.39657	3.61194	8.65625	0.40623
3.00	0.47519	2.67901	3.85714	10.33333	0.32834
3.25	0.46192	2.98511	4.07229	12.15625	0.26451
3.50	0.45115	3.31505	4.26087	14.12500	0.21295
3.75	0.44231	3.66894	4.42623	16.23958	0.17166
4.00	0.43496	4.04688	4.57143	18.50000	0.13876
4.25	0.42878	4.44891	4.69919	20.90625	0.11256
4.50	0.42355	4.87509	4.81188	23.45833	0.09170

4.75	0.41908	5.32544	4.91156	26.15625	0.07505
5.00	0.41523	5.80000	5.00000	29.00000	0.06172
5.25	0.41189	6.29878	5.07869	31.98958	0.05100
5.50	0.40897	6.82180	5.14894	35.12500	0.04236
5.75	0.40642	7.36906	5.21182	38.40625	0.03536
6.00	0.40416	7.94059	5.26829	41.83333	0.02965
6.25	0.40216	8.53637	5.31915	45.40625	0.02498
6.50	0.40038	9.15643	5.36508	49.12500	0.02115
6.75	0.39879	9.80077	5.40667	52.98958	0.01798
7.00	0.39736	10.46939	5.44444	57.00000	0.01535
7.25	0.39607	11.16229	5.47883	61.15625	0.01316
7.50	0.39491	11.87948	5.51020	65.45833	0.01133
7.75	0.39385	12.62095	5.53890	69.90625	0.00979
8.00	0.39289	13.38672	5.56522	74.50000	0.00849
8.25	0.39201	14.17678	5.58939	79.23958	0.00739
8.50	0.39121	14.99113	5.61165	84.12500	0.00645
8.75	0.39048	15.82978	5.63218	89.15625	0.00565
9.00	0.38980	16.69273	5.65116	94.33333	0.00496
9.25	0.38918	17.57997	5.66874	99.65625	0.00437
9.50	0.38860	18.49152	5.68504	105.12500	0.00387
9.75	0.38807	19.42736	5.70019	110.73958	0.00343
10.00	0.38758	20.38750	5.71429	116.50000	0.00304

Table 2.2: Table for Shock Reflecting from suddenly closed end (k=1.4)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0_y}}}{\mathbf{P_{0_x}}}$
1.006	0.99403	0.01	0.0	1.004	1.014	1.00000
1.012	0.98812	0.02	0.0	1.008	1.028	1.00000
1.018	0.98227	0.03	0.0	1.012	1.043	0.99999
1.024	0.97647	0.04	0.0	1.016	1.057	0.99998
1.030	0.97074	0.05	0.0	1.020	1.072	0.99997
1.037	0.96506	0.06	0.0	1.024	1.087	0.99994
1.043	0.95944	0.07	0.0	1.028	1.102	0.99991
1.049	0.95387	0.08	0.0	1.032	1.118	0.99986

Table 2.2: Table for Shock Reflecting from suddenly closed end (k=1.4)(continue)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
1.055	0.94836	0.09	0.0	1.036	1.133	0.99980
1.062	0.94291	0.100	0.0	1.040	1.149	0.99973
1.127	0.89128	0.200	0.0	1.082	1.316	0.99790
1.196	0.84463	0.300	0.0	1.126	1.502	0.99317
1.268	0.80251	0.400	0.0	1.171	1.710	0.98446
1.344	0.76452	0.500	0.0	1.219	1.941	0.97099
1.423	0.73029	0.600	0.0	1.269	2.195	0.95231
1.505	0.69946	0.700	0.0	1.323	2.475	0.92832
1.589	0.67171	0.800	0.0	1.381	2.780	0.89918
1.676	0.64673	0.900	0.0	1.442	3.112	0.86537
1.766	0.62425	1.000	0.0	1.506	3.473	0.82755
1.858	0.60401	1.100	0.0	1.576	3.862	0.78652
1.952	0.58578	1.200	0.0	1.649	4.280	0.74316
2.048	0.56935	1.300	0.0	1.727	4.728	0.69834
2.146	0.55453	1.400	0.0	1.810	5.206	0.65290
2.245	0.54114	1.500	0.0	1.897	5.715	0.60761
2.346	0.52904	1.600	0.0	1.990	6.256	0.56312
2.448	0.51808	1.700	0.0	2.087	6.827	0.51996
2.552	0.50814	1.800	0.0	2.189	7.431	0.47855
2.656	0.49912	1.900	0.0	2.297	8.066	0.43921
2.762	0.49092	2.000	0.0	2.410	8.734	0.40213
3.859	0.43894	3.000	0.0	3.831	17.21	0.15637
5.000	0.41523	4.000	0.0	5.800	29.00	0.061716
6.162	0.40284	5.000	0.0	8.325	44.14	0.026517
7.336	0.39566	6.000	0.0	11.41	62.62	0.012492
8.517	0.39116	7.000	0.0	15.05	84.47	0.00639
9.703	0.38817	8.000	0.0	19.25	$1.1E{+}2$	0.00350
10.89	0.38608	9.000	0.0	24.01	$1.4E{+}2$	0.00204
12.08	0.38457	10.00	0.0	29.33	$1.7E{+}2$	0.00125

Table 2.3: Table for Shock Propagating From suddenly **open** valve (k=1.4)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
1.006	0.99402	0.0	0.01	1.004	1.014	1.00000
1.012	0.98807	0.0	0.02	1.008	1.028	1.00000
1.018	0.98216	0.0	0.03	1.012	1.043	0.99999
1.024	0.97629	0.0	0.04	1.016	1.058	0.99998
1.031	0.97045	0.0	0.05	1.020	1.073	0.99996
1.037	0.96465	0.0	0.06	1.024	1.088	0.99994
1.044	0.95888	0.0	0.07	1.029	1.104	0.99990
1.050	0.95315	0.0	0.08	1.033	1.120	0.99985
1.057	0.94746	0.0	0.09	1.037	1.136	0.99979
1.063	0.94180	0.0	0.10	1.041	1.152	0.99971
1.133	0.88717	0.0	0.20	1.086	1.331	0.99763
1.210	0.83607	0.0	0.30	1.134	1.541	0.99181
1.295	0.78840	0.0	0.40	1.188	1.791	0.98019
1.390	0.74403	0.0	0.50	1.248	2.087	0.96069
1.495	0.70283	0.0	0.60	1.317	2.441	0.93133
1.613	0.66462	0.0	0.70	1.397	2.868	0.89039
1.745	0.62923	0.0	0.80	1.491	3.387	0.83661
1.896	0.59649	0.0	0.90	1.604	4.025	0.76940
2.068	0.56619	0.0	1.00	1.744	4.823	0.68907
2.269	0.53817	0.0	1.100	1.919	5.840	0.59699
2.508	0.51223	0.0	1.200	2.145	7.171	0.49586
2.799	0.48823	0.0	1.300	2.450	8.975	0.38974
3.167	0.46599	0.0	1.400	2.881	11.54	0.28412
3.658	0.44536	0.0	1.500	3.536	15.45	0.18575
4.368	0.42622	0.0	1.600	4.646	22.09	0.10216
5.551	0.40843	0.0	1.700	6.931	35.78	0.040812
8.293	0.39187	0.0	1.800	14.32	80.07	0.00721
8.821	0.39028	0.0	1.810	16.07	90.61	0.00544
9.457	0.38870	0.0	1.820	18.33	$1.0E+2$	0.00395
10.24	0.38713	0.0	1.830	21.35	$1.2E+2$	0.00272
11.25	0.38557	0.0	1.840	25.57	$1.5E+2$	0.00175
12.62	0.38402	0.0	1.850	31.92	$1.9E+2$	0.00101

Table 2.3: Table for Shock Propagating from suddenly **open** valve (k=1.4)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
14.62	0.38248	0.0	1.860	42.53	$2.5E+2$	0.000497
17.99	0.38096	0.0	1.870	63.84	$3.8E+2$	0.000181
25.62	0.37944	0.0	1.880	$1.3E{+}2$	$7.7E+2$	$3.18E{-}5$
61.31	0.37822	0.0	1.888	$7.3E{+}2$	$4.4E+3$	0.0
62.95	0.37821	0.0	1.888	$7.7E{+}2$	$4.6E+3$	0.0
64.74	0.37820	0.0	1.888	$8.2E{+}2$	$4.9E+3$	0.0
66.69	0.37818	0.0	1.888	$8.7E{+}2$	$5.2E+3$	0.0
68.83	0.37817	0.0	1.888	$9.2E{+}2$	$5.5E+3$	0.0
71.18	0.37816	0.0	1.889	$9.9E{+}2$	$5.9E+3$	0.0
73.80	0.37814	0.0	1.889	$1.1E{+}3$	$6.4E+3$	0.0
76.72	0.37813	0.0	1.889	$1.1E{+}3$	$6.9E+3$	0.0
80.02	0.37812	0.0	1.889	$1.2E{+}3$	$7.5E+3$	0.0
83.79	0.37810	0.0	1.889	$1.4E{+}3$	$8.2E+3$	0.0

Table 2.4: Table for Shock Propagating from suddenly **open** valve (k=1.3)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
1.0058	0.99427	0.0	0.010	1.003	1.013	1.00000
1.012	0.98857	0.0	0.020	1.006	1.026	1.00000
1.017	0.98290	0.0	0.030	1.009	1.040	0.99999
1.023	0.97726	0.0	0.040	1.012	1.054	0.99998
1.029	0.97166	0.0	0.050	1.015	1.067	0.99997
1.035	0.96610	0.0	0.060	1.018	1.081	0.99995
1.042	0.96056	0.0	0.070	1.021	1.096	0.99991
1.048	0.95506	0.0	0.080	1.024	1.110	0.99987
1.054	0.94959	0.0	0.090	1.028	1.125	0.99981
1.060	0.94415	0.0	0.100	1.031	1.140	0.99975
1.126	0.89159	0.0	0.200	1.063	1.302	0.99792
1.197	0.84227	0.0	0.300	1.098	1.489	0.99288
1.275	0.79611	0.0	0.400	1.136	1.706	0.98290
1.359	0.75301	0.0	0.500	1.177	1.959	0.96631

Table 2.4: Table for Shock Propagating from suddenly **open** valve (k=1.3)

$\mathbf{M_x}$	$\mathbf{M_y}$	$\mathbf{M_x}'$	$\mathbf{M_y}'$	$\frac{\mathbf{T_y}}{\mathbf{T_x}}$	$\frac{\mathbf{P_y}}{\mathbf{P_x}}$	$\frac{\mathbf{P_{0y}}}{\mathbf{P_{0x}}}$
1.452	0.71284	0.0	0.600	1.223	2.252	0.94156
1.553	0.67546	0.0	0.700	1.274	2.595	0.90734
1.663	0.64073	0.0	0.800	1.333	2.997	0.86274
1.785	0.60847	0.0	0.900	1.400	3.471	0.80734
1.919	0.57853	0.0	1.00	1.478	4.034	0.74136
2.069	0.55074	0.0	1.100	1.570	4.707	0.66575
2.236	0.52495	0.0	1.200	1.681	5.522	0.58223
2.426	0.50100	0.0	1.300	1.815	6.523	0.49333
2.644	0.47875	0.0	1.400	1.980	7.772	0.40226
2.898	0.45807	0.0	1.500	2.191	9.367	0.31281
3.202	0.43882	0.0	1.600	2.467	11.46	0.22904
3.576	0.42089	0.0	1.700	2.842	14.32	0.15495
4.053	0.40418	0.0	1.800	3.381	18.44	0.093988
4.109	0.40257	0.0	1.810	3.448	18.95	0.088718
4.166	0.40097	0.0	1.820	3.519	19.49	0.083607
4.225	0.39938	0.0	1.830	3.592	20.05	0.078654
4.286	0.39780	0.0	1.840	3.669	20.64	0.073863
4.349	0.39624	0.0	1.850	3.749	21.25	0.069233
4.415	0.39468	0.0	1.860	3.834	21.90	0.064766
4.482	0.39314	0.0	1.870	3.923	22.58	0.060462
4.553	0.39160	0.0	1.880	4.016	23.30	0.056322
4.611	0.39037	0.0	1.888	4.096	23.91	0.053088
4.612	0.39035	0.0	1.888	4.097	23.91	0.053053
4.613	0.39034	0.0	1.888	4.098	23.92	0.053018
4.613	0.39033	0.0	1.888	4.099	23.93	0.052984
4.614	0.39031	0.0	1.888	4.099	23.93	0.052949
4.615	0.39030	0.0	1.889	4.100	23.94	0.052914
4.615	0.39029	0.0	1.889	4.101	23.95	0.052879
4.616	0.39027	0.0	1.889	4.102	23.95	0.052844
4.616	0.39026	0.0	1.889	4.103	23.96	0.052809
4.617	0.39025	0.0	1.889	4.104	23.97	0.052775

Chapter 3

Isothermal Flow

Table 3.1: The Isothermal Flow basic parameters

$\mathbf{M}$	$\frac{\mathbf{4fL}}{\mathbf{D}}$	$\frac{\mathbf{P}}{\mathbf{P^*}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0}^*}$	$\frac{\rho}{\rho^*}$	$\frac{\mathbf{T_0}}{\mathbf{T_0}^*}$
0.03000	785.97	28.1718	17.6651	28.1718	0.87516
0.04000	439.33	21.1289	13.2553	21.1289	0.87528
0.05000	279.06	16.9031	10.6109	16.9031	0.87544
0.06000	192.12	14.0859	8.8493	14.0859	0.87563
0.07000	139.79	12.0736	7.5920	12.0736	0.87586
0.08000	105.89	10.5644	6.6500	10.5644	0.87612
0.09000	82.7040	9.3906	5.9181	9.3906	0.87642
0.10000	66.1599	8.4515	5.3334	8.4515	0.87675
0.20000	13.9747	4.2258	2.7230	4.2258	0.88200
0.25000	7.9925	3.3806	2.2126	3.3806	0.88594
0.30000	4.8650	2.8172	1.8791	2.8172	0.89075
0.35000	3.0677	2.4147	1.6470	2.4147	0.89644
0.40000	1.9682	2.1129	1.4784	2.1129	0.90300
0.45000	1.2668	1.8781	1.3524	1.8781	0.91044
0.50000	0.80732	1.6903	1.2565	1.6903	0.91875
0.55000	0.50207	1.5366	1.1827	1.5366	0.92794
0.60000	0.29895	1.4086	1.1259	1.4086	0.93800
0.65000	0.16552	1.3002	1.0823	1.3002	0.94894
0.70000	0.08085	1.2074	1.0495	1.2074	0.96075
0.75000	0.03095	1.1269	1.0255	1.1269	0.97344

Table 3.1: The Isothermal Flow basic parameters (continue)

$\mathbf{M}$	$\frac{\mathbf{4fL}}{\mathbf{D}}$	$\frac{\mathbf{P}}{\mathbf{P^*}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0}^*}$	$\frac{\rho}{\rho^*}$	$\frac{\mathbf{T_0}}{\mathbf{T_0}^*}$
0.80000	0.00626	1.056	1.009	1.056	0.98700
0.81000	0.00371	1.043	1.007	1.043	0.98982
0.81879	0.00205	1.032	1.005	1.032	0.99232
0.82758	0.000896	1.021	1.003	1.021	0.99485
0.83637	0.000220	1.011	1.001	1.011	0.99741
0.84515	0.0	1.000	1.000	1.000	1.000

```
To produce this table rum program with:\\
variableName =  machV;
int isRange = yes;
whatInfo = infoStandard ;
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Table 3.2: The flow parameters for unchoked flow

$\mathbf{M_1}$	$\mathbf{M_2}$	$\left.\frac{\mathbf{4fL_{max}}}{\mathbf{D}}\right\|_{\mathbf{1}}$	$\frac{\mathbf{4fL}}{\mathbf{D}}$	$\frac{\mathbf{P_2}}{\mathbf{P_1}}$
0.7272	0.84095	0.05005	0.05000	0.10000
0.6934	0.83997	0.08978	0.08971	0.10000
0.6684	0.84018	0.12949	0.12942	0.10000
0.6483	0.83920	0.16922	0.16912	0.10000
0.5914	0.83889	0.32807	0.32795	0.10000
0.5807	0.83827	0.36780	0.36766	0.10000
0.5708	0.83740	0.40754	0.40737	0.10000

Chapter 4

Fanno Flow

Table 4.1: Fanno Flow Standard basic Table

$\mathbf{M}$	$\frac{\mathbf{4fL}}{\mathbf{D}}$	$\frac{\mathbf{P}}{\mathbf{P^*}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0}^*}$	$\frac{\rho}{\rho^*}$	$\frac{\mathbf{U}}{\mathbf{U^*}}$	$\frac{\mathbf{T}}{\mathbf{T^*}}$
0.030	787.08	36.5116	19.3005	30.4318	0.03286	1.1998
0.040	440.35	27.3817	14.4815	22.8254	0.04381	1.1996
0.050	280.02	21.9034	11.5914	18.2620	0.05476	1.1994
0.060	193.03	18.2508	9.6659	15.2200	0.06570	1.1991
0.070	140.66	15.6416	8.2915	13.0474	0.07664	1.1988
0.080	106.72	13.6843	7.2616	11.4182	0.08758	1.1985
0.090	83.4961	12.1618	6.4613	10.1512	0.09851	1.1981
0.100	66.9216	10.9435	5.8218	9.1378	0.10944	1.1976
0.200	14.5333	5.4554	2.9635	4.5826	0.21822	1.1905
0.250	8.4834	4.3546	2.4027	3.6742	0.27217	1.1852
0.300	5.2993	3.6191	2.0351	3.0702	0.32572	1.1788
0.350	3.4525	3.0922	1.7780	2.6400	0.37879	1.1713
0.400	2.3085	2.6958	1.5901	2.3184	0.43133	1.1628
0.450	1.5664	2.3865	1.4487	2.0693	0.48326	1.1533
0.500	1.0691	2.1381	1.3398	1.8708	0.53452	1.1429
0.550	0.72805	1.9341	1.2549	1.7092	0.58506	1.1315
0.600	0.49082	1.7634	1.1882	1.5753	0.63481	1.1194
0.650	0.32459	1.6183	1.1356	1.4626	0.68374	1.1065
0.700	0.20814	1.4935	1.0944	1.3665	0.73179	1.0929
0.750	0.12728	1.3848	1.0624	1.2838	0.77894	1.0787

0.800	0.07229	1.2893	1.0382	1.2119	0.82514	1.0638
0.850	0.03633	1.2047	1.0207	1.1489	0.87037	1.0485
0.900	0.01451	1.1291	1.0089	1.0934	0.91460	1.0327
0.950	0.00328	1.061	1.002	1.044	0.95781	1.017
1.000	0.0	1.00000	1.00000	1.00000	1.000	1.00000
2.000	0.30500	0.40825	1.688	0.61237	1.633	0.66667
3.000	0.52216	0.21822	4.235	0.50918	1.964	0.42857
4.000	0.63306	0.13363	10.72	0.46771	2.138	0.28571
5.000	0.69380	0.089443	25.00	0.44721	2.236	0.20000
6.000	0.72988	0.063758	53.18	0.43568	2.295	0.14634
7.000	0.75280	0.047619	$1.0E{+}2$	0.42857	2.333	0.11111
8.000	0.76819	0.036860	$1.9E{+}2$	0.42390	2.359	0.086957
9.000	0.77899	0.029348	$3.3E{+}2$	0.42066	2.377	0.069767
10.00	0.78683	0.023905	$5.4E{+}2$	0.41833	2.390	0.057143
20.00	0.81265	0.00609	$1.5E{+}4$	0.41079	2.434	0.014815
25.00	0.81582	0.00390	$4.6E{+}4$	0.40988	2.440	0.00952
30.00	0.81755	0.00271	$1.1E{+}5$	0.40938	2.443	0.00663
35.00	0.81860	0.00200	$2.5E{+}5$	0.40908	2.445	0.00488
40.00	0.81928	0.00153	$4.8E{+}5$	0.40889	2.446	0.00374
45.00	0.81975	0.00121	$8.6E{+}5$	0.40875	2.446	0.00296
50.00	0.82008	0.000979	$1.5E{+}6$	0.40866	2.447	0.00240
55.00	0.82033	0.000809	$2.3E{+}6$	0.40859	2.447	0.00198
60.00	0.82052	0.000680	$3.6E{+}6$	0.40853	2.448	0.00166
65.00	0.82066	0.000579	$5.4E{+}6$	0.40849	2.448	0.00142
70.00	0.82078	0.000500	$7.8E{+}6$	0.40846	2.448	0.00122

Chapter 5

Rayleigh Flow

Table 5.1: Rayleigh Flow k=1.4

M	$\frac{\mathbf{T}}{\mathbf{T}^*}$	$\frac{\mathbf{T_0}}{\mathbf{T_0}^*}$	$\frac{\mathbf{P}}{\mathbf{P}^*}$	$\frac{\mathbf{P_0}}{\mathbf{P_0}^*}$	$\frac{\rho^*}{\rho}$
0.03	0.00517	0.00431	2.397	1.267	0.00216
0.040	0.00917	0.00765	2.395	1.266	0.00383
0.050	0.014300	0.011922	2.392	1.266	0.00598
0.060	0.020529	0.017119	2.388	1.265	0.00860
0.070	0.027841	0.023223	2.384	1.264	0.011680
0.080	0.036212	0.030215	2.379	1.262	0.015224
0.090	0.045616	0.038075	2.373	1.261	0.019222
0.100	0.056020	0.046777	2.367	1.259	0.023669
0.20	0.20661	0.17355	2.273	1.235	0.090909
0.25	0.30440	0.25684	2.207	1.218	0.13793
0.30	0.40887	0.34686	2.131	1.199	0.19183
0.35	0.51413	0.43894	2.049	1.178	0.25096
0.40	0.61515	0.52903	1.961	1.157	0.31373
0.45	0.70804	0.61393	1.870	1.135	0.37865
0.50	0.79012	0.69136	1.778	1.114	0.44444
0.55	0.85987	0.75991	1.686	1.094	0.51001
0.60	0.91670	0.81892	1.596	1.075	0.57447
0.65	0.96081	0.86833	1.508	1.058	0.63713
0.70	0.99290	0.90850	1.423	1.043	0.69751
0.75	1.014	0.94009	1.343	1.030	0.75524

Table 5.1: Rayleigh Flow k=1.4 (continue)

M	$\frac{\mathbf{T}}{\mathbf{T^*}}$	$\frac{\mathbf{T_0}}{\mathbf{T_0{}^*}}$	$\frac{\mathbf{P}}{\mathbf{P^*}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0{}^*}}$	$\frac{\rho^*}{\rho}$
0.80	1.025	0.96395	1.266	1.019	0.81013
0.85	1.029	0.98097	1.193	1.011	0.86204
0.90	1.025	0.99207	1.125	1.005	0.91097
0.95	1.015	0.99814	1.060	1.001	0.95693
1.0	1.00	1.00	1.00	1.00	1.000
1.1	0.96031	0.99392	0.89087	1.005	1.078
1.2	0.91185	0.97872	0.79576	1.019	1.146
1.3	0.85917	0.95798	0.71301	1.044	1.205
1.4	0.80539	0.93425	0.64103	1.078	1.256
1.5	0.75250	0.90928	0.57831	1.122	1.301
1.6	0.70174	0.88419	0.52356	1.176	1.340
1.7	0.65377	0.85971	0.47562	1.240	1.375
1.8	0.60894	0.83628	0.43353	1.316	1.405
1.9	0.56734	0.81414	0.39643	1.403	1.431
2.0	0.52893	0.79339	0.36364	1.503	1.455
2.1	0.49356	0.77406	0.33454	1.616	1.475
2.2	0.46106	0.75613	0.30864	1.743	1.494
2.3	0.43122	0.73954	0.28551	1.886	1.510
2.4	0.40384	0.72421	0.26478	2.045	1.525
2.5	0.37870	0.71006	0.24615	2.222	1.538
2.6	0.35561	0.69700	0.22936	2.418	1.550
2.7	0.33439	0.68494	0.21417	2.634	1.561
2.8	0.31486	0.67380	0.20040	2.873	1.571
2.9	0.29687	0.66350	0.18788	3.136	1.580
3.0	0.28028	0.65398	0.17647	3.424	1.588
3.5	0.21419	0.61580	0.13223	5.328	1.620
4.0	0.16831	0.58909	0.10256	8.227	1.641
4.5	0.13540	0.56982	0.081772	12.50	1.656
5.0	0.11111	0.55556	0.066667	18.63	1.667
5.5	0.092719	0.54473	0.055363	27.21	1.675
6.0	0.078487	0.53633	0.046693	38.95	1.681
6.5	0.067263	0.52970	0.039900	54.68	1.686
7.0	0.058264	0.52438	0.034483	75.41	1.690

Table 5.1: Rayleigh Flow k=1.4 (continue)

M	$\frac{\mathbf{T}}{\mathbf{T^*}}$	$\frac{\mathbf{T_0}}{\mathbf{T_0}^*}$	$\frac{\mathbf{P}}{\mathbf{P^*}}$	$\frac{\mathbf{P_0}}{\mathbf{P_0}^*}$	$\frac{\rho^*}{\rho}$
7.5	0.050943	0.52004	0.030094	$1.0E{+}2$	1.693
8.0	0.044910	0.51647	0.026490	$1.4E{+}2$	1.695
8.5	0.039883	0.51349	0.023495	$1.8E{+}2$	1.698
9.0	0.035650	0.51098	0.020979	$2.3E{+}2$	1.699
9.5	0.032053	0.50885	0.018846	$3.0E{+}2$	1.701
10.0	0.028972	0.50702	0.017021	$3.8E{+}2$	1.702
20.0	0.00732	0.49415	0.00428	$1.1E{+}4$	1.711
25.0	0.00469	0.49259	0.00274	$3.2E{+}4$	1.712
30.0	0.00326	0.49174	0.00190	$8.0E{+}4$	1.713
35.0	0.00240	0.49122	0.00140	$1.7E{+}5$	1.713
40.0	0.00184	0.49089	0.00107	$3.4E{+}5$	1.714
45.0	0.00145	0.49066	0.000846	$6.0E{+}5$	1.714
50.0	0.00117	0.49050	0.000686	$1.0E{+}6$	1.714
55.0	0.000971	0.49037	0.000567	$1.6E{+}6$	1.714
60.0	0.000816	0.49028	0.000476	$2.5E{+}6$	1.714
65.0	0.000695	0.49021	0.000406	$3.8E{+}6$	1.714
70.0	0.000600	0.49015	0.000350	$5.5E{+}6$	1.714

Chapter 6

Prandtl-Meyer Function

Table 6.1: ??

$\mathbf{M}$	ν	$\frac{\mathbf{P}}{\mathbf{P_0}}$	$\frac{\mathbf{T}}{\mathbf{T_0}}$	$\frac{\rho}{\rho_\mathbf{0}}$	μ
1.0000	0.0	0.52828	0.83333	0.63394	45.00
1.100	1.336	0.46835	0.80515	0.58170	47.73
1.200	3.558	0.41238	0.77640	0.53114	50.19
1.300	6.170	0.36091	0.74738	0.48290	52.43
1.400	8.987	0.31424	0.71839	0.43742	54.46
1.500	11.91	0.27240	0.68966	0.39498	56.31
1.600	14.86	0.23527	0.66138	0.35573	57.99
1.700	17.81	0.20259	0.63371	0.31969	59.53
1.800	20.73	0.17404	0.60680	0.28682	60.95
1.900	23.59	0.14924	0.58072	0.25699	62.24
2.000	26.38	0.12780	0.55556	0.23005	63.43
3.000	49.76	0.027224	0.35714	0.076226	71.57
4.000	65.78	0.00659	0.23810	0.027662	75.96
5.000	76.92	0.00189	0.16667	0.011340	78.69
6.000	84.96	0.000633	0.12195	0.00519	80.54
7.000	90.97	0.000242	0.092593	0.00261	81.87
8.000	95.62	0.000102	0.072464	0.00141	82.87
9.000	99.32	$4.74E{-}05$	0.058140	0.000815	83.66
10.00	$1.0E{+}02$	$2.36E{-}05$	0.047619	0.000495	84.29