

Appendix B

Compressible Flow Tables

Table B.1
Isentropic Flow
of a Perfect Gas,
 $k = 1.4$

Ma	p/p_0	ρ/ρ_0	T/T_0	A/A^*	Ma	p/p_0	ρ/ρ_0	T/T_0	A/A^*
0.00	1.0000	1.0000	1.0000	∞	2.10	0.1094	0.2058	0.5313	1.8369
0.10	0.9930	0.9950	0.9980	5.8218	2.20	0.0935	0.1841	0.5081	2.0050
0.20	0.9725	0.9803	0.9921	2.9635	2.30	0.0800	0.1646	0.4859	2.1931
0.30	0.9395	0.9564	0.9823	2.0351	2.40	0.0684	0.1472	0.4647	2.4031
0.40	0.8956	0.9243	0.9690	1.5901	2.50	0.0585	0.1317	0.4444	2.6367
0.50	0.8430	0.8852	0.9524	1.3398	2.60	0.0501	0.1179	0.4252	2.8960
0.60	0.7840	0.8405	0.9328	1.1882	2.70	0.0430	0.1056	0.4068	3.1830
0.70	0.7209	0.7916	0.9107	1.0944	2.80	0.0368	0.0946	0.3894	3.5001
0.80	0.6560	0.7400	0.8865	1.0382	2.90	0.0317	0.0849	0.3729	3.8498
0.90	0.5913	0.6870	0.8606	1.0089	3.00	0.0272	0.0762	0.3571	4.2346
1.00	0.5283	0.6339	0.8333	1.0000	3.10	0.0234	0.0685	0.3422	4.6573
1.10	0.4684	0.5817	0.8052	1.0079	3.20	0.0202	0.0617	0.3281	5.1210
1.20	0.4124	0.5311	0.7764	1.0304	3.30	0.0175	0.0555	0.3147	5.6286
1.30	0.3609	0.4829	0.7474	1.0663	3.40	0.0151	0.0501	0.3019	6.1837
1.40	0.3142	0.4374	0.7184	1.1149	3.50	0.0131	0.0452	0.2899	6.7896
1.50	0.2724	0.3950	0.6897	1.1762	3.60	0.0114	0.0409	0.2784	7.4501
1.60	0.2353	0.3557	0.6614	1.2502	3.70	0.0099	0.0370	0.2675	8.1691
1.70	0.2026	0.3197	0.6337	1.3376	3.80	0.0086	0.0335	0.2572	8.9506
1.80	0.1740	0.2868	0.6068	1.4390	3.90	0.0075	0.0304	0.2474	9.7990
1.90	0.1492	0.2570	0.5807	1.5553	4.00	0.0066	0.0277	0.2381	10.7188
2.00	0.1278	0.2300	0.5556	1.6875					

Table B.2 Normal Shock Relations
for a Perfect Gas, $k = 1.4$

Ma_{n1}	Ma_{n2}	p_2/p_1	$V_1/V_2 = \rho_2/\rho_1$	T_2/T_1	p_{02}/p_{01}	A_2^*/A_1^*
1.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.10	0.9118	1.2450	1.1691	1.0649	0.9989	1.0011
1.20	0.8422	1.5133	1.3416	1.1280	0.9928	1.0073
1.30	0.7860	1.8050	1.5157	1.1909	0.9794	1.0211
1.40	0.7397	2.1200	1.6897	1.2547	0.9582	1.0436
1.50	0.7011	2.4583	1.8621	1.3202	0.9298	1.0755
1.60	0.6684	2.8200	2.0317	1.3880	0.8952	1.1171
1.70	0.6405	3.2050	2.1977	1.4583	0.8557	1.1686
1.80	0.6165	3.6133	2.3592	1.5316	0.8127	1.2305
1.90	0.5956	4.0450	2.5157	1.6079	0.7674	1.3032
2.00	0.5774	4.5000	2.6667	1.6875	0.7209	1.3872
2.10	0.5613	4.9783	2.8119	1.7705	0.6742	1.4832
2.20	0.5471	5.4800	2.9512	1.8569	0.6281	1.5920
2.30	0.5344	6.0050	3.0845	1.9468	0.5833	1.7144
2.40	0.5231	6.5533	3.2119	2.0403	0.5401	1.8514
2.50	0.5130	7.1250	3.3333	2.1375	0.4990	2.0039
2.60	0.5039	7.7200	3.4490	2.2383	0.4601	2.1733
2.70	0.4956	8.3383	3.5590	2.3429	0.4236	2.3608
2.80	0.4882	8.9800	3.6636	2.4512	0.3895	2.5676
2.90	0.4814	9.6450	3.7629	2.5632	0.3577	2.7954
3.00	0.4752	10.3333	3.8571	2.6790	0.3283	3.0456
3.10	0.4695	11.0450	3.9466	2.7986	0.3012	3.3199
3.20	0.4643	11.7800	4.0315	2.9220	0.2762	3.6202
3.30	0.4596	12.5383	4.1120	3.0492	0.2533	3.9483
3.40	0.4552	13.3200	4.1884	3.1802	0.2322	4.3062
3.50	0.4512	14.1250	4.2609	3.3151	0.2129	4.6960
3.60	0.4474	14.9533	4.3296	3.4537	0.1953	5.1200
3.70	0.4439	15.8050	4.3949	3.5962	0.1792	5.5806
3.80	0.4407	16.6800	4.4568	3.7426	0.1645	6.0801
3.90	0.4377	17.5783	4.5156	3.8928	0.1510	6.6213
4.00	0.4350	18.5000	4.5714	4.0469	0.1388	7.2069
4.10	0.4324	19.4450	4.6245	4.2048	0.1276	7.8397
4.20	0.4299	20.4133	4.6749	4.3666	0.1173	8.5227
4.30	0.4277	21.4050	4.7229	4.5322	0.1080	9.2591
4.40	0.4255	22.4200	4.7685	4.7017	0.0995	10.0522
4.50	0.4236	23.4583	4.8119	4.8751	0.0917	10.9054
4.60	0.4217	24.5200	4.8532	5.0523	0.0846	11.8222
4.70	0.4199	25.6050	4.8926	5.2334	0.0781	12.8065
4.80	0.4183	26.7133	4.9301	5.4184	0.0721	13.8620
4.90	0.4167	27.8450	4.9659	5.6073	0.0667	14.9928
5.00	0.4152	29.0000	5.0000	5.8000	0.0617	16.2032

Table B.3 Adiabatic Frictional Flow in a Constant-Area Duct for $k = 1.4$

Ma	$\bar{f}L/D$	p/p^*	T/T^*	$\rho^*/\rho = V/V^*$	p_0/p_0^*
0.00	∞	∞	1.2000	0.0000	∞
0.10	66.9216	10.9435	1.1976	0.1094	5.8218
0.20	14.5333	5.4554	1.1905	0.2182	2.9635
0.30	5.2993	3.6191	1.1788	0.3257	2.0351
0.40	2.3085	2.6958	1.1628	0.4313	1.5901
0.50	1.0691	2.1381	1.1429	0.5345	1.3398
0.60	0.4908	1.7634	1.1194	0.6348	1.1882
0.70	0.2081	1.4935	1.0929	0.7318	1.0944
0.80	0.0723	1.2893	1.0638	0.8251	1.0382
0.90	0.0145	1.1291	1.0327	0.9146	1.0089
1.00	0.0000	1.0000	1.0000	1.0000	1.0000
1.10	0.0099	0.8936	0.9662	1.0812	1.0079
1.20	0.0336	0.8044	0.9317	1.1583	1.0304
1.30	0.0648	0.7285	0.8969	1.2311	1.0663
1.40	0.0997	0.6632	0.8621	1.2999	1.1149
1.50	0.1361	0.6065	0.8276	1.3646	1.1762
1.60	0.1724	0.5568	0.7937	1.4254	1.2502
1.70	0.2078	0.5130	0.7605	1.4825	1.3376
1.80	0.2419	0.4741	0.7282	1.5360	1.4390
1.90	0.2743	0.4394	0.6969	1.5861	1.5553
2.00	0.3050	0.4082	0.6667	1.6330	1.6875
2.10	0.3339	0.3802	0.6376	1.6769	1.8369
2.20	0.3609	0.3549	0.6098	1.7179	2.0050
2.30	0.3862	0.3320	0.5831	1.7563	2.1931
2.40	0.4099	0.3111	0.5576	1.7922	2.4031
2.50	0.4320	0.2921	0.5333	1.8257	2.6367
2.60	0.4526	0.2747	0.5102	1.8571	2.8960
2.70	0.4718	0.2588	0.4882	1.8865	3.1830
2.80	0.4898	0.2441	0.4673	1.9140	3.5001
2.90	0.5065	0.2307	0.4474	1.9398	3.8498
3.00	0.5222	0.2182	0.4286	1.9640	4.2346
3.10	0.5368	0.2067	0.4107	1.9866	4.6573
3.20	0.5504	0.1961	0.3937	2.0079	5.1210
3.30	0.5632	0.1862	0.3776	2.0278	5.6286
3.40	0.5752	0.1770	0.3623	2.0466	6.1837
3.50	0.5864	0.1685	0.3478	2.0642	6.7896
3.60	0.5970	0.1606	0.3341	2.0808	7.4501
3.70	0.6068	0.1531	0.3210	2.0964	8.1691
3.80	0.6161	0.1462	0.3086	2.1111	8.9506
3.90	0.6248	0.1397	0.2969	2.1250	9.7990
4.00	0.6331	0.1336	0.2857	2.1381	10.7187

Table B.4 Frictionless Duct Flow
with Heat Transfer for $k = 1.4$

Ma	T_0/T_0^*	p/p^*	T/T^*	$\rho^*/\rho = V/V^*$	p_0/p_0^*
0.00	0.0000	2.4000	0.0000	0.0000	1.2679
0.10	0.0468	2.3669	0.0560	0.0237	1.2591
0.20	0.1736	2.2727	0.2066	0.0909	1.2346
0.30	0.3469	2.1314	0.4089	0.1918	1.1985
0.40	0.5290	1.9608	0.6151	0.3137	1.1566
0.50	0.6914	1.7778	0.7901	0.4444	1.1141
0.60	0.8189	1.5957	0.9167	0.5745	1.0753
0.70	0.9085	1.4235	0.9929	0.6975	1.0431
0.80	0.9639	1.2658	1.0255	0.8101	1.0193
0.90	0.9921	1.1246	1.0245	0.9110	1.0049
1.00	1.0000	1.0000	1.0000	1.0000	1.0000
1.10	0.9939	0.8909	0.9603	1.0780	1.0049
1.20	0.9787	0.7958	0.9118	1.1459	1.0194
1.30	0.9580	0.7130	0.8592	1.2050	1.0437
1.40	0.9343	0.6410	0.8054	1.2564	1.0777
1.50	0.9093	0.5783	0.7525	1.3012	1.1215
1.60	0.8842	0.5236	0.7017	1.3403	1.1756
1.70	0.8597	0.4756	0.6538	1.3746	1.2402
1.80	0.8363	0.4335	0.6089	1.4046	1.3159
1.90	0.8141	0.3964	0.5673	1.4311	1.4033
2.00	0.7934	0.3636	0.5289	1.4545	1.5031
2.10	0.7741	0.3345	0.4936	1.4753	1.6162
2.20	0.7561	0.3086	0.4611	1.4938	1.7434
2.30	0.7395	0.2855	0.4312	1.5103	1.8860
2.40	0.7242	0.2648	0.4038	1.5252	2.0451
2.50	0.7101	0.2462	0.3787	1.5385	2.2218
2.60	0.6970	0.2294	0.3556	1.5505	2.4177
2.70	0.6849	0.2142	0.3344	1.5613	2.6343
2.80	0.6738	0.2004	0.3149	1.5711	2.8731
2.90	0.6635	0.1879	0.2969	1.5801	3.1359
3.00	0.6540	0.1765	0.2803	1.5882	3.4245
3.10	0.6452	0.1660	0.2650	1.5957	3.7408
3.20	0.6370	0.1565	0.2508	1.6025	4.0871
3.30	0.6294	0.1477	0.2377	1.6088	4.4655
3.40	0.6224	0.1397	0.2255	1.6145	4.8783
3.50	0.6158	0.1322	0.2142	1.6198	5.3280
3.60	0.6097	0.1254	0.2037	1.6247	5.8173
3.70	0.6040	0.1190	0.1939	1.6293	6.3488
3.80	0.5987	0.1131	0.1848	1.6335	6.9256
3.90	0.5937	0.1077	0.1763	1.6374	7.5505
4.00	0.5891	0.1026	0.1683	1.6410	8.2268

Table B.5 Prandtl-Meyer
Supersonic Expansion Function
for $k = 1.4$

Ma	ω , deg	Ma	ω , deg	Ma	ω , deg	Ma	ω , deg
1.00	0.00	3.10	51.65	5.10	77.84	7.10	91.49
1.10	1.34	3.20	53.47	5.20	78.73	7.20	92.00
1.20	3.56	3.30	55.22	5.30	79.60	7.30	92.49
1.30	6.17	3.40	56.91	5.40	80.43	7.40	92.97
1.40	8.99	3.50	58.53	5.50	81.24	7.50	93.44
1.50	11.91	3.60	60.09	5.60	82.03	7.60	93.90
1.60	14.86	3.70	61.60	5.70	82.80	7.70	94.34
1.70	17.81	3.80	63.04	5.80	83.54	7.80	94.78
1.80	20.73	3.90	64.44	5.90	84.26	7.90	95.21
1.90	23.59	4.00	65.78	6.00	84.96	8.00	95.62
2.00	26.38	4.10	67.08	6.10	85.63	8.10	96.03
2.10	29.10	4.20	68.33	6.20	86.29	8.20	96.43
2.20	31.73	4.30	69.54	6.30	86.94	8.30	96.82
2.30	34.28	4.40	70.71	6.40	87.56	8.40	97.20
2.40	36.75	4.50	71.83	6.50	88.17	8.50	97.57
2.50	39.12	4.60	72.92	6.60	88.76	8.60	97.94
2.60	41.41	4.70	73.97	6.70	89.33	8.70	98.29
2.70	43.62	4.80	74.99	6.80	89.89	8.80	98.64
2.80	45.75	4.90	75.97	6.90	90.44	8.90	98.98
2.90	47.79	5.00	76.92	7.00	90.97	9.00	99.32
3.00	49.76						

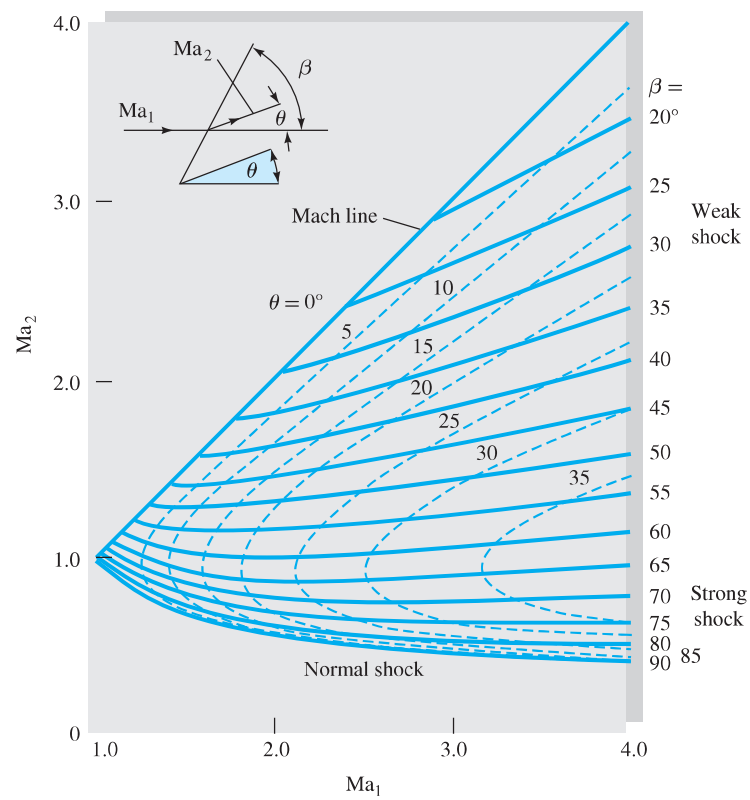


Fig. B.1 Mach number downstream of an oblique shock for $k = 1.4$.

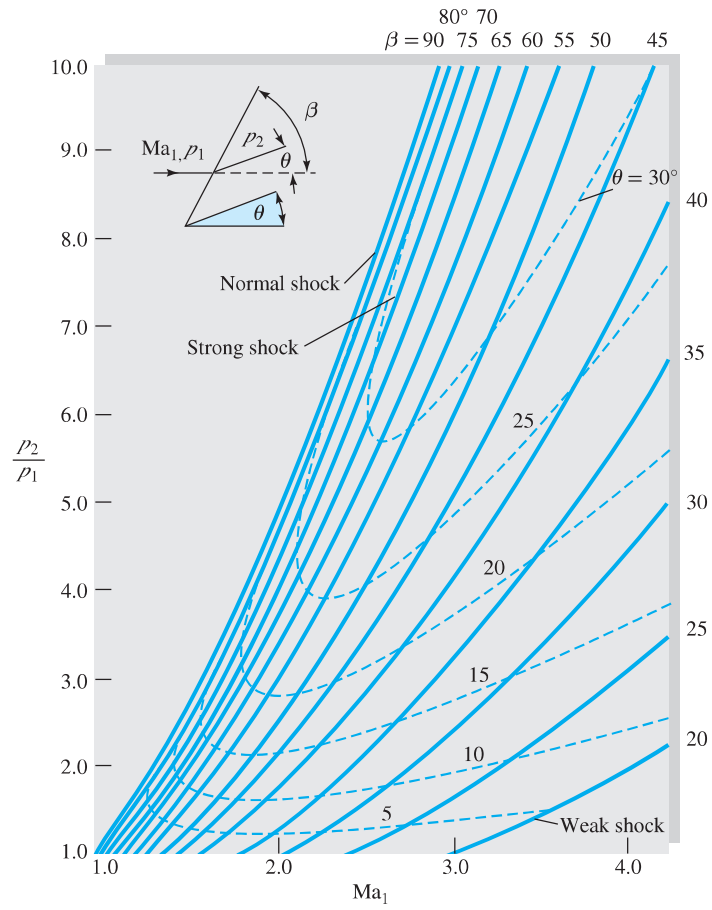


Fig. B.2 Pressure ratio downstream of an oblique shock for $k = 1.4$.