

APPENDIX C (continued)

Oblique Shock Charts ($\gamma = 1.4$)

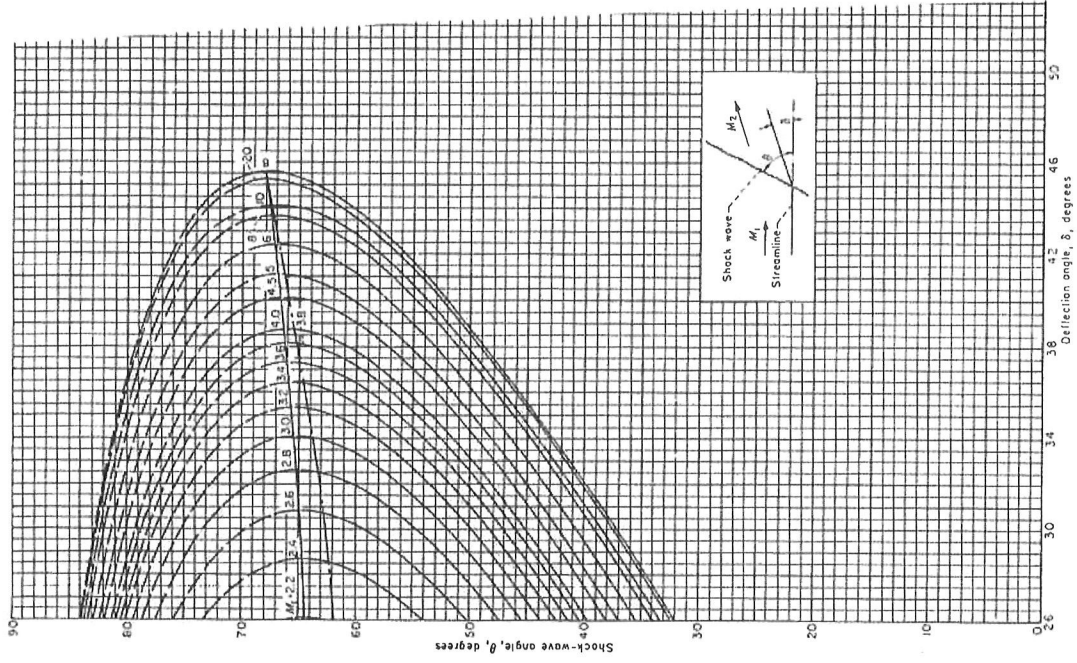


Figure C.1 continued

APPENDIX C

Oblique Shock Charts ($\gamma = 1.4$)

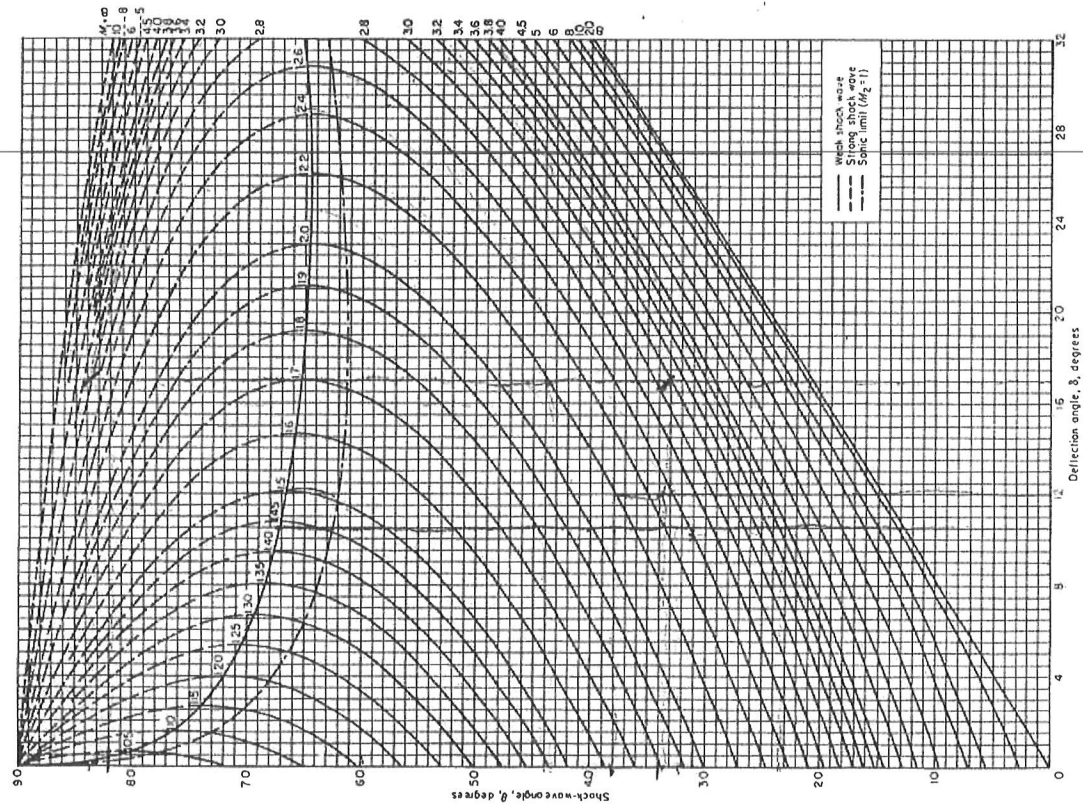


Figure C.1 Variation of shock-wave angle with flow-deflection angle for various upstream Mach numbers

APPENDIX D (continued)

Prandtl Meyer Functions ($\gamma = 1.4$)

M	ν	μ	M	ν	μ
2.20	31.732	27.04	2.85	46.778	20.54
2.21	31.991	26.90	2.86	46.862	20.47
2.22	32.250	26.77	2.87	47.185	20.39
2.23	32.507	26.64	2.88	47.368	20.32
2.24	32.763	26.51	2.89	47.589	20.24
2.25	33.018	26.39	2.90	47.790	20.17
2.26	33.273	26.26	2.91	47.990	20.10
2.27	33.527	26.14	2.92	48.190	20.03
2.28	33.780	26.01	2.93	48.388	19.96
2.29	34.032	25.89	2.94	48.586	19.89
2.30	34.283	25.77	2.95	48.783	19.81
2.31	34.533	25.65	2.96	48.980	19.74
2.32	34.783	25.53	2.97	49.177	19.68
2.33	35.031	25.42	2.98	49.370	19.61
2.34	35.279	25.30	2.99	49.564	19.54
2.35	35.526	25.18	3.00	49.757	19.47
2.36	35.771	25.07	3.01	49.950	19.40
2.37	36.017	24.96	3.02	50.142	19.34
2.38	36.261	24.85	3.03	50.333	19.27
2.39	36.504	24.73	3.04	50.523	19.20
2.40	36.746	24.62	3.05	50.713	19.14
2.41	36.988	24.52	3.06	50.902	19.07
2.42	37.229	24.41	3.07	51.090	19.01
2.43	37.469	24.30	3.08	51.277	18.95
2.44	37.708	24.19	3.09	51.464	18.88
2.45	37.946	24.09	3.10	51.650	18.82
2.46	38.183	23.99	3.11	51.833	18.76
2.47	38.420	23.88	3.12	52.020	18.69
2.48	38.655	23.78	3.13	52.203	18.63
2.49	38.890	23.68	3.14	52.386	18.57
2.50	39.124	23.58	3.15	52.569	18.51
2.51	39.357	23.48	3.16	52.751	18.45
2.52	39.589	23.38	3.17	52.931	18.39
2.53	39.820	23.28	3.18	53.112	18.33
2.54	40.050	23.18	3.19	53.292	18.27
2.55	40.280	23.09	3.20	53.470	18.21
2.56	40.509	22.99	3.21	53.648	18.15
2.57	40.737	22.91	3.22	53.826	18.09
2.58	40.965	22.81	3.23	54.003	18.03
2.59	41.189	22.71	3.24	54.179	17.98
2.60	41.415	22.62	3.25	54.355	17.92
2.61	41.639	22.53	3.26	54.529	17.86
2.62	41.863	22.44	3.27	54.703	17.81
2.63	42.086	22.35	3.28	54.877	17.75
2.64	42.307	22.26	3.29	55.050	17.70
2.65	42.529	22.17	3.30	55.222	17.64
2.66	42.749	22.08	3.31	55.393	17.58
2.67	42.968	22.00	3.32	55.564	17.53
2.68	43.187	21.91	3.33	55.734	17.48
2.69	43.405	21.82	3.34	55.904	17.42
2.70	43.621	21.74	3.35	56.073	17.37
2.71	43.836	21.65	3.36	56.241	17.31
2.72	44.050	21.56	3.37	56.409	17.26
2.73	44.262	21.49	3.38	56.576	17.21
2.74	44.481	21.41	3.39	56.742	17.16
2.75	44.694	21.32	3.40	56.907	17.10
2.76	44.906	21.24	3.41	57.073	17.05
2.77	45.117	21.16	3.42	57.237	17.00
2.78	45.327	21.08	3.43	57.401	16.95
2.79	45.537	21.00	3.44	57.564	16.90
2.80	45.746	20.92	3.45	57.726	16.85
2.81	45.954	20.85	3.46	57.888	16.80
2.82	46.161	20.77	3.47	58.050	16.75
2.83	46.368	20.69	3.48	58.210	16.70
2.84	46.573	20.62	3.49	58.370	16.65

APPENDIX D

Prandtl Meyer Functions ($\gamma = 1.4$)

M	ν	μ	M	ν	μ
1.00	0	90.00	1.60	14.861	38.88
1.01	.04473	81.61	1.61	15.166	38.40
1.02	.1257	78.64	1.62	15.462	37.92
1.03	.2294	76.14	1.63	15.747	37.54
1.04	.3510	74.06	1.64	16.043	37.37
1.05	.4874	72.25	1.65	16.338	37.31
1.06	.6367	70.63	1.66	16.633	37.04
1.07	.7973	69.19	1.67	16.928	36.78
1.08	.9680	67.91	1.68	17.222	36.53
1.09	1.1488	66.85	1.69	17.516	36.28
1.10	1.336	65.38	1.70	17.810	36.03
1.11	1.532	64.28	1.71	18.103	35.79
1.12	1.735	63.23	1.72	18.397	35.55
1.13	1.944	62.25	1.73	18.689	35.31
1.14	2.160	61.31	1.74	18.981	35.08
1.15	2.381	60.41	1.75	19.273	34.85
1.16	2.607	59.55	1.76	19.565	34.62
1.17	2.839	58.73	1.77	19.856	34.40
1.18	3.074	57.94	1.78	20.146	34.18
1.19	3.314	57.18	1.79	20.436	33.96
1.20	3.558	56.44	1.80	20.725	33.75
1.21	3.806	55.74	1.81	21.014	33.54
1.22	4.057	55.06	1.82	21.302	33.33
1.23	4.312	54.39	1.83	21.590	33.12
1.24	4.569	53.75	1.84	21.877	32.92
1.25	4.830	53.13	1.85	22.163	32.72
1.26	5.083	52.53	1.86	22.449	32.52
1.27	5.349	51.94	1.87	22.735	32.33
1.28	5.627	51.38	1.88	23.019	32.13
1.29	5.987	50.82	1.89	23.303	31.94
1.30	6.170	50.28	1.90	23.586	31.76
1.31	6.445	49.76	1.91	23.869	31.57
1.32	6.721	49.25	1.92	24.151	31.39
1.33	7.000	48.75	1.93	24.432	31.21
1.34	7.280	48.27	1.94	24.712	31.03
1.35	7.561	47.79	1.95	24.992	30.85
1.36	7.843	47.33	1.96	25.271	30.68
1.37	8.128	46.88	1.97	25.549	30.51
1.38	8.413	46.44	1.98	25.827	30.33
1.39	8.699	46.01	1.99	26.104	30.17
1.40	8.987	45.58	2.00	26.380	30.00
1.41	9.276	45.17	2.01	26.655	29.84
1.42	9.565	44.77	2.02	26.929	29.67
1.43	9.855	44.37	2.03	27.203	29.51
1.44	10.146	43.98	2.04	27.476	29.35
1.45	10.438	43.60	2.05	27.748	29.20
1.46	10.731	43.23	2.06	28.020	29.04
1.47	11.023	42.86	2.07	28.290	28.89
1.48	11.317	42.51	2.08	28.560	28.74
1.49	11.611	42.16	2.09	28.829	28.59
1.50	11.905	41.81	2.10	29.097	28.44
1.51	12.200	41.47	2.11	29.364	28.29
1.52	12.494	41.14	2.12	29.631	28.14
1.53	12.789	40.81	2.13	29.897	28.00
1.54	13.086	40.49	2.14	30.161	27.86
1.55	13.381	40.18	2.15	30.425	27.72
1.56	13.677	39.87	2.16	30.689	27.58
1.57	13.973	39.56	2.17	30.951	27.44
1.58	14.269	39.27	2.18	31.212	27.30
1.59	14.564	38.97	2.19	31.473	27.17

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T*	P/P*	P_1/P_1^*	V/V*	f_{max}/D
.75	1.07865	1.3848	1.06242	.77893	.12728
.76	1.07573	1.3647	1.05700	.78825	.11446
.77	1.07279	1.3451	1.05188	.79753	.10262
.78	1.06982	1.3260	1.04705	.80677	.09167
.79	1.06684	1.3074	1.04250	.81598	.08159
.80	1.06383	1.2892	1.03823	.82514	.07229
.81	1.06080	1.2715	1.03422	.83426	.06375
.82	1.05775	1.2542	1.03047	.84334	.05593
.83	1.05468	1.2373	1.02696	.85239	.04878
.84	1.05160	1.2208	1.02370	.86140	.04226
.85	1.04849	1.2047	1.02067	.87037	.03632
.86	1.04537	1.1889	1.01787	.87929	.03097
.87	1.04223	1.1735	1.01529	.88818	.02613
.88	1.03907	1.1584	1.01294	.89703	.02180
.89	1.03589	1.1436	1.01080	.90583	.01793
.90	1.03270	1.1291	1.00887	.91459	.01451
.91	1.02950	1.1150	1.00714	.92332	.01151
.92	1.02627	1.1014	1.00560	.93201	.00891
.93	1.02304	1.0875	1.00426	.94065	.00669
.94	1.01978	1.0743	1.00311	.94925	.00481
.95	1.01652	1.0612	1.00215	.95782	.00328
.96	1.01324	1.0485	1.00137	.96634	.00206
.97	1.00995	1.0360	1.00076	.97481	.00113
.98	1.00664	1.0237	1.00033	.98324	.00049
.99	1.00333	1.0117	1.00008	.99164	.00012
1.00	1.00000	1.0000	1.00000	1.00000	0
1.01	.99666	.9884	1.00008	1.00831	.00014
1.02	.99331	.9771	1.00033	1.01658	.00045
1.03	.98995	.9659	1.00073	1.02481	.00103
1.04	.98658	.9550	1.00130	1.03300	.00171
1.05	.98320	.9443	1.00203	1.04115	.00271
1.06	.97982	.9338	1.00291	1.04925	.00383
1.07	.97642	.9234	1.00394	1.05731	.00512
1.08	.97302	.9133	1.00512	1.06533	.00658
1.09	.96960	.9033	1.00645	1.07331	.00818
1.10	.96618	.8935	1.00793	1.08124	.00993
1.11	.96276	.8839	1.00955	1.08913	.01183
1.12	.95933	.8745	1.01131	1.09698	.01382
1.13	.95589	.8652	1.01322	1.10479	.01594
1.14	.95244	.8560	1.01527	1.11256	.01817
1.15	.94899	.8471	1.01746	1.1203	.02053
1.16	.94554	.8382	1.01978	1.1280	.02298
1.17	.94208	.8298	1.02224	1.1356	.02552
1.18	.93862	.8210	1.02484	1.1432	.02814
1.19	.93515	.8126	1.02757	1.1508	.03085

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T*	P/P*	P_1/P_1^*	V/V*	f_{max}/D
.80	1.1788	3.6190	2.0351	32572	5.2992
.81	1.1774	3.5002	1.9765	33637	4.8507
.82	1.1759	3.3888	1.9219	34700	4.4468
.83	1.1744	3.2840	1.8708	35762	4.0821
.84	1.1729	3.1853	1.8229	36822	3.7520
.85	1.1713	3.0922	1.7780	37880	3.4525
.86	1.1697	3.0042	1.7358	38935	3.1801
.87	1.1680	2.9209	1.6961	39988	2.9320
.88	1.1663	2.8420	1.6587	41039	2.7055
.89	1.1646	2.7671	1.6234	42087	2.4983
.90	1.1628	2.6958	1.5901	43133	2.3085
.91	1.1610	2.6280	1.5587	44177	2.1344
.92	1.1591	2.5634	1.5289	45218	1.9744
.93	1.1572	2.5017	1.5007	46257	1.8272
.94	1.1553	2.4428	1.4739	47293	1.6915
.95	1.1533	2.3865	1.4486	48326	1.5664
.96	1.1513	2.3326	1.4246	49357	1.4509
.97	1.1492	2.2809	1.4018	50385	1.3442
.98	1.1471	2.2314	1.3801	51410	1.2453
.99	1.1450	2.1838	1.3595	52433	1.1539
1.00	1.1429	2.1381	1.3399	53453	1.06908
1.01	1.1407	2.0942	1.3212	54469	.99042
1.02	1.1384	2.0519	1.3034	55482	.91741
1.03	1.1362	2.0112	1.2864	56493	.84963
1.04	1.1339	1.9719	1.2702	57501	.78662
1.05	1.1315	1.9341	1.2549	58506	.72805
1.06	1.1292	1.8976	1.2403	59507	.67357
1.07	1.1268	1.8623	1.2263	60505	.62286
1.08	1.1244	1.8282	1.2130	61500	.57568
1.09	1.1219	1.7952	1.2003	62492	.53174
1.10	1.1194	1.7634	1.1882	63481	.49081
1.11	1.1169	1.7325	1.1766	64467	.45270
1.12	1.1144	1.7026	1.1656	65449	.41720
1.13	1.1118	1.6737	1.1551	66427	.38411
1.14	1.1091	1.6456	1.1451	67402	.35330
1.15	1.10650	1.6183	1.1356	68374	.32460
1.16	1.10383	1.5919	1.1265	69342	.29785
1.17	1.10114	1.5662	1.1179	70306	.27295
1.18	1.09842	1.5413	1.1097	71267	.24978
1.19	1.09567	1.5170	1.1018	72225	.22821
1.20	1.09290	1.4934	1.09436	73179	.20814
1.21	1.09010	1.4705	1.08729	74129	.18949
1.22	1.08727	1.4482	1.08057	75076	.17215
1.23	1.08442	1.4265	1.07419	76019	.15606
1.24	1.08155	1.4054	1.06815	76958	.14113

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T*	P/P*	P ₁ /P ₁ *	V/V*	f _{max} /D
1.20	.93168	.80436	1.03044	1.1583	.03364
1.21	.92820	.79623	1.03344	1.1658	.03650
1.22	.92473	.78822	1.03657	1.1732	.03942
1.23	.92125	.78034	1.03983	1.1806	.04241
1.24	.91777	.77258	1.04323	1.1879	.04547
1.25	.91429	.76495	1.04676	1.1952	.04858
1.26	.91080	.75743	1.05041	1.2025	.05174
1.27	.90732	.75003	1.05419	1.2097	.05494
1.28	.90383	.74274	1.05809	1.2169	.05820
1.29	.90035	.73556	1.06213	1.2240	.06150
1.30	.89686	.72848	1.06630	1.2311	.06483
1.31	.89338	.72152	1.07060	1.2382	.06820
1.32	.88989	.71465	1.07502	1.2452	.07161
1.33	.88641	.70789	1.07957	1.2522	.07504
1.34	.88292	.70123	1.08424	1.2591	.07850
1.35	.87944	.69466	1.08904	1.2660	.08199
1.36	.87596	.68818	1.09397	1.2729	.08550
1.37	.87249	.68180	1.09902	1.2797	.08904
1.38	.86901	.67551	1.10419	1.2864	.09259
1.39	.86554	.66931	1.10948	1.2932	.09616
1.40	.86207	.66320	1.1149	1.2999	.09974
1.41	.85860	.65717	1.1205	1.3065	.10333
1.42	.85514	.65122	1.1262	1.3131	.10694
1.43	.85168	.64536	1.1320	1.3197	.11056
1.44	.84822	.63958	1.1379	1.3262	.11419
1.45	.84477	.63387	1.1440	1.3327	.11782
1.46	.84133	.62824	1.1502	1.3392	.12146
1.47	.83788	.62269	1.1565	1.3456	.12510
1.48	.83445	.61722	1.1629	1.3520	.12875
1.49	.83101	.61181	1.1695	1.3583	.13240
1.50	.82759	.60648	1.1762	1.3646	.13605
1.51	.82416	.60122	1.1830	1.3708	.13970
1.52	.82075	.59602	1.1899	1.4335	.14335
1.53	.81734	.59089	1.1970	1.3832	.14699
1.54	.81394	.58583	1.2043	1.3894	.15063
1.55	.81054	.58084	1.2116	1.3955	.15427
1.56	.80715	.57591	1.2190	1.4015	.15790
1.57	.80376	.57104	1.2266	1.4075	.16152
1.58	.80038	.56623	1.2343	1.4135	.16514
1.59	.79701	.56148	1.2422	1.4195	.16876
1.60	.79365	.55679	1.2502	1.4254	.17236
1.61	.79030	.55216	1.2583	1.4313	.17595
1.62	.78695	.54759	1.2666	1.4371	.17953
1.63	.78361	.54308	1.2750	1.4429	.18311
1.64	.78028	.53862	1.2835	1.4487	.18667

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T*	P/P*	P ₁ /P ₁ *	V/V*	f _{max} /D
1.65	.77695	.53421	1.2922	1.4544	.19022
1.66	.77363	.52986	1.3010	1.4601	.19376
1.67	.77033	.52556	1.3099	1.4657	.19729
1.68	.76703	.52131	1.3190	1.4713	.20081
1.69	.76374	.51711	1.3282	1.4769	.20431
1.70	.76046	.51297	1.3376	1.4825	.20780
1.71	.75718	.50887	1.3471	1.4880	.21128
1.72	.75392	.50482	1.3567	1.4935	.21474
1.73	.75067	.50082	1.3665	1.4989	.21819
1.74	.74742	.49686	1.3764	1.5043	.22162
1.75	.74419	.49295	1.3865	1.5097	.22504
1.76	.74096	.48909	1.3967	1.5150	.22844
1.77	.73774	.48527	1.4070	1.5203	.23183
1.78	.73453	.48149	1.4175	1.5256	.23520
1.79	.73134	.47776	1.4282	1.5308	.23855
1.80	.72816	.47407	1.4390	1.5360	.24189
1.81	.72498	.47042	1.4499	1.5412	.24521
1.82	.72181	.46681	1.4610	1.5463	.24851
1.83	.71865	.46324	1.4723	1.5514	.25180
1.84	.71551	.45972	1.4837	1.5564	.25507
1.85	.71238	.45623	1.4952	1.5614	.25832
1.86	.70925	.45278	1.5069	1.5664	.26156
1.87	.70614	.44937	1.5188	1.5714	.26478
1.88	.70304	.44600	1.5308	1.5763	.26798
1.89	.69995	.44266	1.5429	1.5812	.27116
1.90	.69686	.43936	1.5552	1.5861	.27433
1.91	.69379	.43610	1.5677	1.5909	.27748
1.92	.69074	.43287	1.5804	1.5957	.28061
1.93	.68769	.42967	1.5932	1.6005	.28372
1.94	.68465	.42651	1.6062	1.6052	.28681
1.95	.68162	.42339	1.6193	1.6099	.28989
1.96	.67861	.42030	1.6326	1.6146	.29295
1.97	.67561	.41724	1.6461	1.6193	.29599
1.98	.67262	.41421	1.6597	1.6239	.29901
1.99	.66964	.41121	1.6735	1.6284	.30201
2.00	.66667	.40825	1.6875	1.6330	.30499
2.01	.66371	.40532	1.7017	1.6375	.30796
2.02	.66076	.40241	1.7160	1.6420	.31091
2.03	.65783	.39954	1.7305	1.6465	.31384
2.04	.65491	.39670	1.7452	1.6509	.31675
2.05	.65200	.39389	1.7600	1.6553	.31965
2.06	.64910	.39110	1.7750	1.6597	.32253
2.07	.64621	.38834	1.7902	1.6640	.32538
2.08	.64333	.38562	1.8056	1.6683	.32822
2.09	.64047	.38292	1.8212	1.6726	.33104

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T^*	P/P^*	P_i/P_i^*	V/V^*	f_{max}/D
2.10	.63762	.38024	1.8369	1.6769	.33385
2.11	.63478	.37760	1.8528	1.6811	.33664
2.12	.63195	.37498	1.8690	1.6853	.33950
2.13	.62914	.37239	1.8853	1.6895	.34215
2.14	.62633	.36982	1.9018	1.6936	.34488
2.15	.62354	.36728	1.9185	1.6977	.34760
2.16	.62076	.36476	1.9354	1.7018	.35034
2.17	.61799	.36227	1.9525	1.7059	.35298
2.18	.61523	.35980	1.9698	1.7099	.35564
2.19	.61249	.35736	1.9873	1.7139	.35828
2.20	.60976	.35494	2.0050	1.7179	.36091
2.21	.60704	.35254	2.0228	1.7219	.36352
2.22	.60433	.35017	2.0409	1.7258	.36611
2.23	.60163	.34782	2.0592	1.7297	.36868
2.24	.59895	.34550	2.0777	1.7336	.37124
2.25	.59627	.34319	2.0964	1.7374	.37378
2.26	.59361	.34091	2.1154	1.7412	.37630
2.27	.59096	.33865	2.1345	1.7450	.37881
2.28	.58833	.33641	2.1538	1.7488	.38130
2.29	.58570	.33420	2.1733	1.7526	.38377
2.30	.58309	.33200	2.1931	1.7563	.38623
2.31	.58049	.32983	2.2131	1.7600	.38867
2.32	.57790	.32767	2.2333	1.7637	.39109
2.33	.57532	.32554	2.2537	1.7673	.39350
2.34	.57276	.32342	2.2744	1.7709	.39589
2.35	.57021	.32133	2.2953	1.7745	.39826
2.36	.56767	.31925	2.3164	1.7781	.40062
2.37	.56514	.31720	2.3377	1.7817	.40296
2.38	.56262	.31516	2.3593	1.7852	.40528
2.39	.56011	.31314	2.3811	1.7887	.40760
2.40	.55762	.31114	2.4031	1.7922	.40989
2.41	.55514	.30916	2.4254	1.7956	.41216
2.42	.55267	.30720	2.4479	1.7991	.41442
2.43	.55021	.30525	2.4706	1.8025	.41667
2.44	.54776	.30332	2.4936	1.8059	.41891
2.45	.54533	.30141	2.5168	1.8092	.42113
2.46	.54291	.29952	2.5403	1.8126	.42333
2.47	.54050	.29765	2.5640	1.8159	.42551
2.48	.53810	.29579	2.5880	1.8192	.42768
2.49	.53571	.29395	2.6122	1.8225	.42983
2.50	.53333	.29212	2.6367	1.8257	.43197
2.51	.53097	.29031	2.6615	1.8290	.43410
2.52	.52862	.28852	2.6865	1.8322	.43621
2.53	.52627	.28674	2.7117	1.8354	.43831
2.54	.52394	.28498	2.7372	1.8386	.44040

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T^*	P/P^*	P_i/P_i^*	V/V^*	f_{max}/D
2.55	.52163	.28323	2.7630	1.8417	.44247
2.56	.51932	.28150	2.7891	1.8448	.44452
2.57	.51702	.27978	2.8154	1.8479	.44655
2.58	.51474	.27808	2.8420	1.8510	.44857
2.59	.51247	.27640	2.8689	1.8541	.45059
2.60	.51020	.27473	2.8960	1.8571	.45259
2.61	.50795	.27307	2.9234	1.8602	.45457
2.62	.50571	.27143	2.9511	1.8632	.45654
2.63	.50349	.26980	2.9791	1.8662	.45850
2.64	.50127	.26818	3.0074	1.8691	.46044
2.65	.49906	.26658	3.0359	1.8721	.46237
2.66	.49687	.26499	3.0647	1.8750	.46429
2.67	.49469	.26342	3.0938	1.8779	.46619
2.68	.49251	.26186	3.1234	1.8808	.46807
2.69	.49035	.26032	3.1530	1.8837	.46996
2.70	.48820	.25878	3.1830	1.8865	.47182
2.71	.48606	.25726	3.2133	1.8894	.47367
2.72	.48393	.25575	3.2440	1.8922	.47551
2.73	.48182	.25426	3.2749	1.8950	.47734
2.74	.47971	.25278	3.3061	1.8978	.47915
2.75	.47761	.25131	3.3376	1.9005	.48095
2.76	.47553	.24985	3.3695	1.9032	.48274
2.77	.47346	.24840	3.4017	1.9060	.48452
2.78	.47139	.24697	3.4342	1.9087	.48628
2.79	.46933	.24555	3.4670	1.9114	.48803
2.80	.46729	.24414	3.5001	1.9140	.48976
2.81	.46526	.24274	3.5336	1.9167	.49148
2.82	.46324	.24135	3.5674	1.9193	.49321
2.83	.46122	.23997	3.6015	1.9220	.49491
2.84	.45922	.23861	3.6359	1.9246	.49660
2.85	.45723	.23726	3.6707	1.9271	.49828
2.86	.45525	.23592	3.7058	1.9297	.49995
2.87	.45328	.23458	3.7413	1.9322	.50161
2.88	.45132	.23326	3.7771	1.9348	.50326
2.89	.44937	.23196	3.8133	1.9373	.50489
2.90	.44743	.23066	3.8498	1.9398	.50651
2.91	.44550	.22937	3.8866	1.9423	.50812
2.92	.44358	.22809	3.9238	1.9448	.50973
2.93	.44167	.22682	3.9614	1.9472	.51133
2.94	.43977	.22556	3.9993	1.9497	.51291
2.95	.43788	.22431	4.0376	1.9521	.51447
2.96	.43600	.22307	4.0763	1.9545	.51603
2.97	.43413	.22185	4.1153	1.9569	.51758
2.98	.43226	.22063	4.1547	1.9592	.51912
2.99	.43041	.21942	4.1944	1.9616	.52064

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_1/T_1^*	T/T^*	P/P^*	P_1/P_1^*	V/V^*	f_{max}/D
.25	2.5684	.30440	2.2069	1.2177	1.3793	
.26	.27446	.32496	2.1925	1.2140	1.4821	
.27	.29231	.34573	2.1777	1.2102	1.5876	
.28	.31035	.36667	2.1626	1.2064	1.6955	
.29	.32855	.38773	2.1472	1.2025	1.8058	
.30	.34686	.40887	2.1314	1.1985	1.9183	
.31	.36525	.43004	2.1154	1.1945	2.0329	
.32	.38369	.45119	2.0991	1.1904	2.1494	
.33	.40214	.47228	2.0825	1.1863	2.2678	
.34	.42057	.49327	2.0657	1.1821	2.3879	
.35	.43894	.51413	2.0487	1.1779	2.5096	
.36	.45723	.53482	2.0314	1.1737	2.6327	
.37	.47541	.55530	2.0140	1.1695	2.7572	
.38	.49346	.57553	1.9964	1.1652	2.8828	
.39	.51134	.59549	1.9787	1.1609	3.0095	
.40	.52903	.61515	1.9608	1.1566	3.1372	
.41	.54651	.63448	1.9428	1.1523	3.2658	
.42	.56376	.65345	1.9247	1.1480	3.3951	
.43	.58075	.67205	1.9065	1.1437	3.5251	
.44	.59748	.69025	1.8882	1.1394	3.6556	
.45	.61393	.70803	1.8699	1.1351	3.7865	
.46	.63007	.72538	1.8515	1.1308	3.9178	
.47	.64589	.74228	1.8331	1.1266	4.0493	
.48	.66139	.75871	1.8147	1.1224	4.1810	
.49	.67655	.77466	1.7962	1.1182	4.3127	
.50	.69136	.79012	1.7778	1.1140	4.4445	
.51	.70581	.80509	1.7594	1.1099	4.5761	
.52	.71990	.81955	1.7410	1.1059	4.7075	
.53	.73361	.83351	1.7226	1.1019	4.8387	
.54	.74695	.84695	1.7043	1.0979	4.9696	
.55	.75991	.85987	1.6860	1.0939	5.1001	
.56	.77248	.87227	1.6678	1.09010	5.2302	
.57	.78467	.88415	1.6496	1.08630	5.3597	
.58	.79647	.89552	1.6316	1.08255	5.4887	
.59	.80789	.90637	1.6136	1.07887	5.6170	
.60	.81892	.91670	1.5957	1.07525	5.7447	
.61	.82956	.92653	1.5780	1.07170	5.8716	
.62	.83982	.93585	1.5603	1.06821	5.9978	
.63	.84970	.94466	1.5427	1.06480	6.1232	
.64	.85920	.95298	1.5253	1.06146	6.2477	
.65	.86833	.96081	1.5080	1.05820	6.3713	
.66	.87709	.96816	1.4908	1.05502	6.4941	
.67	.88548	.97503	1.4738	1.05190	6.6159	
.68	.89350	.98144	1.4569	1.04892	6.7367	
.69	.90117	.98739	1.4401	1.04596	6.8564	

APPENDIX E (continued)

Fanno Line Flow ($\gamma = 1.4$)

M	T/T^*	P/P^*	P_1/P_1^*	V/V^*	f_{max}/D
3.0	4.2857	.21822	4.2346	1.9640	.52216
3.5	.34783	.16850	6.7896	2.0642	.58643
4.0	.28571	.13363	10.719	2.1381	.63306
4.5	.23762	.10833	16.562	2.1936	.66764
5.0	.20000	.08944	25.000	2.2361	.69381
6.0	.14634	.06376	53.180	2.2953	.72987
7.0	.11111	.04762	104.14	2.3333	.75281
8.0	.08696	.03686	190.11	2.3591	.76820
9.0	.06977	.02935	327.19	2.3772	.77898
10.0	.05714	.02390	535.94	2.3905	.78683
∞	0	0	∞	2.4495	.82153

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APPENDIX F

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_1/T_1^*	T/T^*	P/P^*	P_1/P_1^*	V/V^*
0	0	0	2.4000	1.2679	0
0.01	.000480	.000576	2.3997	1.2678	.000240
0.02	.00192	.00230	2.3987	1.2675	.000959
0.03	.00431	.00516	2.3970	1.2671	.00216
0.04	.00765	.00917	2.3946	1.2665	.00383
0.05	.01192	.01430	2.3916	1.2657	.00598
0.06	.01712	.02053	2.3880	1.2647	.00860
0.07	.02322	.02784	2.3837	1.2636	.01168
0.08	.03021	.03621	2.3787	1.2623	.01522
0.09	.03807	.04562	2.3731	1.2608	.01922
0.10	.04678	.05602	2.3669	1.2591	.02367
0.11	.05630	.06739	2.3600	1.2573	.02856
0.12	.06661	.07970	2.3526	1.2554	.03388
0.13	.07768	.09290	2.3445	1.2533	.03962
0.14	.08947	.10695	2.3359	1.2510	.04578
0.15	.10196	.12181	2.3267	1.2486	.05235
0.16	.11511	.13743	2.3170	1.2461	.05931
0.17	.12888	.15377	2.3067	1.2434	.06666
0.18	.14324	.17078	2.2959	1.2406	.07438
0.19	.15814	.18841	2.2845	1.2377	.08247
0.20	.17355	.20661	2.2727	1.2346	.09091
0.21	.18943	.22533	2.2604	1.2314	.09969
0.22	.20574	.24452	2.2477	1.2281	.10879
0.23	.22244	.26413	2.2345	1.2248	.11820
0.24	.23956	.28411	2.2209	1.2213	.12792

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_0/T_1^*	T/T^*	P/P^*	P_0/P_1^*	V/V^*
.70	.90850	.99289	1.4235	1.04310	.69751
.71	.91548	.99796	1.4070	1.04033	.70927
.72	.92212	1.00260	1.3907	1.03764	.72093
.73	.92843	1.00682	1.3745	1.03504	.73248
.74	.93442	1.01062	1.3585	1.03253	.74392
.75	.94009	1.01403	1.3427	1.03010	.75525
.76	.94546	1.01706	1.3270	1.02776	.76646
.77	.95052	1.01971	1.3115	1.02552	.77755
.78	.95528	1.02198	1.2961	1.02337	.78852
.79	.95975	1.02390	1.2809	1.02131	.79938
.80	.96394	1.02548	1.2658	1.01934	.81012
.81	.96786	1.02672	1.2509	1.01746	.82075
.82	.97152	1.02763	1.2362	1.01569	.83126
.83	.97492	1.02823	1.2217	1.01399	.84164
.84	.97807	1.02853	1.2073	1.01240	.85190
.85	.98097	1.02854	1.1931	1.01091	.86204
.86	.98363	1.02826	1.1791	1.00951	.87206
.87	.98607	1.02771	1.1652	1.00819	.88196
.88	.98828	1.02690	1.1515	1.00698	.89175
.89	.99028	1.02583	1.1380	1.00587	.90142
.90	.99207	1.02451	1.1246	1.00485	.91097
.91	.99366	1.02297	1.1114	1.00393	.92039
.92	.99506	1.02120	1.09842	1.00310	.92970
.93	.99627	1.01921	1.08555	1.00237	.93889
.94	.99729	1.01702	1.07285	1.00174	.94796
.95	.99814	1.01463	1.06030	1.00121	.95692
.96	.99883	1.01205	1.04792	1.00077	.96576
.97	.99935	1.00929	1.03570	1.00043	.97449
.98	.99972	1.00636	1.02364	1.00019	.98311
.99	.99993	1.00326	1.01174	1.00004	.99161
1.00	1.00000	1.00000	1.00000	1.00000	1.00000
1.01	.99993	.99659	.98841	1.00004	1.00828
1.02	.99973	.99304	.97697	1.00019	1.01644
1.03	.99940	.98936	.96569	1.00043	1.02450
1.04	.99895	.98553	.95456	1.00077	1.03246
1.05	.99838	.98161	.94358	1.00121	1.04030
1.06	.99769	.97755	.93275	1.00175	1.04804
1.07	.99690	.97339	.92206	1.00238	1.05567
1.08	.99600	.96913	.91152	1.00311	1.06320
1.09	.99501	.96477	.90112	1.00394	1.07062
1.10	.99392	.96031	.89086	1.00486	1.07795
1.11	.99274	.95577	.88075	1.00588	1.08518
1.12	.99148	.95115	.87078	1.00699	1.09230
1.13	.99013	.94646	.86094	1.00820	1.09933
1.14	.98871	.94169	.85123	1.00951	1.10626

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_0/T_1^*	T/T^*	P/P^*	P_0/P_1^*	V/V^*
1.15	.98721	.93685	.84166	1.01092	1.1131
1.16	.98564	.93195	.83222	1.01243	1.1198
1.17	.98400	.92700	.82292	1.01403	1.1264
1.18	.98230	.92200	.81374	1.01572	1.1330
1.19	.98054	.91695	.80468	1.01752	1.1395
1.20	.97872	.91185	.79576	1.01941	1.1459
1.21	.97685	.90671	.78695	1.02140	1.1522
1.22	.97492	.90153	.77827	1.02348	1.1584
1.23	.97294	.89632	.76971	1.02566	1.1645
1.24	.97092	.89108	.76127	1.02794	1.1705
1.25	.96886	.88581	.75294	1.03032	1.1764
1.26	.96675	.88052	.74473	1.03280	1.1823
1.27	.96461	.87521	.73663	1.03536	1.1881
1.28	.96243	.86988	.72865	1.03803	1.1938
1.29	.96022	.86453	.72078	1.04080	1.1994
1.30	.95798	.85917	.71301	1.04365	1.2050
1.31	.95571	.85380	.70535	1.04661	1.2105
1.32	.95341	.84843	.69780	1.04967	1.2159
1.33	.95108	.84305	.69035	1.05283	1.2212
1.34	.94873	.83766	.68301	1.05608	1.2264
1.35	.94636	.83227	.67577	1.05943	1.2316
1.36	.94397	.82698	.66863	1.06288	1.2367
1.37	.94157	.82151	.66159	1.06642	1.2417
1.38	.93915	.81613	.65464	1.07006	1.2467
1.39	.93671	.81076	.64778	1.07380	1.2516
1.40	.93425	.80540	.64102	1.07765	1.2564
1.41	.93178	.80004	.63436	1.08159	1.2612
1.42	.92931	.79469	.62779	1.08563	1.2659
1.43	.92683	.78936	.62131	1.08977	1.2705
1.44	.92434	.78405	.61491	1.09400	1.2751
1.45	.92184	.77875	.60860	1.0983	1.2796
1.46	.91933	.77346	.60237	1.1028	1.2840
1.47	.91682	.76819	.59623	1.1073	1.2884
1.48	.91431	.76294	.59018	1.1120	1.2927
1.49	.91179	.75771	.58421	1.1167	1.2970
1.50	.90928	.75250	.57831	1.1215	1.3012
1.51	.90676	.74731	.57250	1.1264	1.3054
1.52	.90424	.74215	.56677	1.1315	1.3095
1.53	.90172	.73701	.56111	1.1367	1.3135
1.54	.89920	.73189	.55553	1.1420	1.3175
1.55	.89669	.72680	.55002	1.1473	1.3214
1.56	.89418	.72173	.54458	1.1527	1.3253
1.57	.89167	.71669	.53922	1.1582	1.3291
1.58	.88917	.71168	.53393	1.1639	1.3329
1.59	.88668	.70669	.52871	1.1697	1.3366

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_1/T_2^*	T/T^*	P/P^*	P_1/P_2^*	V/V^*
1.60	.88419	.70173	.52356	1.1756	1.3403
1.61	.88170	.69680	.51848	1.1816	1.3439
1.62	.87922	.69190	.51346	1.1877	1.3475
1.63	.87675	.68703	.50851	1.1939	1.3511
1.64	.87429	.68219	.50363	1.2002	1.3546
1.65	.87184	.67738	.49881	1.2066	1.3580
1.66	.86940	.67259	.49405	1.2131	1.3614
1.67	.86696	.66784	.48935	1.2197	1.3648
1.68	.86453	.66312	.48471	1.2264	1.3681
1.69	.86211	.65843	.48014	1.2332	1.3713
1.70	.85970	.65377	.47563	1.2402	1.3745
1.71	.85731	.64914	.47117	1.2473	1.3777
1.72	.85493	.64455	.46677	1.2545	1.3809
1.73	.85256	.64002	.46242	1.2618	1.3840
1.74	.85020	.63546	.45813	1.2692	1.3871
1.75	.84785	.63096	.45390	1.2767	1.3901
1.76	.84551	.62649	.44972	1.2843	1.3931
1.77	.84318	.62205	.44559	1.2920	1.3960
1.78	.84087	.61765	.44152	1.2998	1.3989
1.79	.83857	.61328	.43750	1.3078	1.4018
1.80	.83628	.60894	.43353	1.3159	1.4046
1.81	.83400	.60463	.42960	1.3241	1.4074
1.82	.83174	.60036	.42573	1.3324	1.4102
1.83	.82949	.59612	.42191	1.3408	1.4129
1.84	.82726	.59191	.41813	1.3494	1.4156
1.85	.82504	.58773	.41440	1.3581	1.4183
1.86	.82283	.58359	.41072	1.3669	1.4209
1.87	.82064	.57948	.40708	1.3758	1.4235
1.88	.81846	.57540	.40349	1.3848	1.4261
1.89	.81629	.57135	.39994	1.3940	1.4286
1.90	.81414	.56734	.39643	1.4033	1.4311
1.91	.81200	.56336	.39297	1.4127	1.4336
1.92	.80987	.55941	.38955	1.4222	1.4360
1.93	.80776	.55549	.38617	1.4319	1.4384
1.94	.80567	.55160	.38283	1.4417	1.4408
1.95	.80359	.54774	.37954	1.4516	1.4432
1.96	.80152	.54391	.37628	1.4616	1.4455
1.97	.79946	.54012	.37306	1.4718	1.4478
1.98	.79742	.53636	.36988	1.4821	1.4501
1.99	.79540	.53263	.36674	1.4925	1.4523
2.00	.79339	.52893	.36364	1.5031	1.4545
2.01	.79139	.52526	.36057	1.5138	1.4567
2.02	.78941	.52161	.35754	1.5246	1.4589
2.03	.78744	.51800	.35454	1.5356	1.4610
2.04	.78549	.51442	.35158	1.5467	1.4631

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_1/T_2^*	T/T^*	P/P^*	P_1/P_2^*	V/V^*
2.05	.78355	.51087	.34866	1.5579	1.4652
2.06	.78162	.50735	.34577	1.5693	1.4673
2.07	.77971	.50386	.34291	1.5808	1.4694
2.08	.77781	.50040	.34009	1.5924	1.4714
2.09	.77593	.49697	.33730	1.6042	1.4734
2.10	.77406	.49356	.33454	1.6161	1.4753
2.11	.77221	.49018	.33181	1.6282	1.4773
2.12	.77037	.48683	.32912	1.6404	1.4792
2.13	.76854	.48351	.32646	1.6528	1.4811
2.14	.76673	.48022	.32383	1.6653	1.4830
2.15	.76493	.47696	.32122	1.6780	1.4849
2.16	.76314	.47373	.31864	1.6908	1.4867
2.17	.76137	.47052	.31610	1.7037	1.4885
2.18	.75961	.46734	.31359	1.7168	1.4903
2.19	.75787	.46419	.31110	1.7300	1.4921
2.20	.75614	.46106	.30864	1.7434	1.4939
2.21	.75442	.45796	.30621	1.7570	1.4956
2.22	.75271	.45489	.30381	1.7707	1.4973
2.23	.75102	.45184	.30143	1.7846	1.4990
2.24	.74934	.44882	.29908	1.7986	1.5007
2.25	.74767	.44582	.29675	1.8128	1.5024
2.26	.74602	.44285	.29445	1.8271	1.5040
2.27	.74438	.43990	.29218	1.8416	1.5056
2.28	.74275	.43698	.28993	1.8562	1.5072
2.29	.74114	.43409	.28771	1.8710	1.5088
2.30	.73954	.43122	.28551	1.8860	1.5104
2.31	.73795	.42837	.28333	1.9012	1.5119
2.32	.73638	.42555	.28118	1.9165	1.5134
2.33	.73482	.42276	.27905	1.9320	1.5150
2.34	.73327	.41999	.27695	1.9476	1.5165
2.35	.73173	.41724	.27487	1.9634	1.5180
2.36	.73020	.41451	.27281	1.9794	1.5195
2.37	.72868	.41181	.27077	1.9955	1.5209
2.38	.72718	.40913	.26875	2.0118	1.5223
2.39	.72569	.40647	.26675	2.0283	1.5237
2.40	.72421	.40383	.26478	2.0450	1.5252
2.41	.72274	.40122	.26283	2.0619	1.5266
2.42	.72129	.39863	.26090	2.0789	1.5279
2.43	.71985	.39606	.25899	2.0961	1.5293
2.44	.71842	.39352	.25710	2.1135	1.5306
2.45	.71700	.39100	.25523	2.1311	1.5320
2.46	.71559	.38850	.25337	2.1489	1.5333
2.47	.71419	.38602	.25153	2.1669	1.5346
2.48	.71280	.38356	.24972	2.1850	1.5359
2.49	.71142	.38112	.24793	2.2033	1.5372

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_i/T_i^*	T/T^*	P/P^*	P_i/P_i^*	V/V^*
2.95	.65865	.28841	.18205	3.2768	1.5843
2.96	.65770	.28676	.18091	3.3058	1.5851
2.97	.65676	.28512	.17978	3.3351	1.5859
2.98	.65583	.28349	.17867	3.3646	1.5867
2.99	.65490	.28188	.17757	3.3944	1.5875
3.00	.65398	.28028	.17647	3.4244	1.5882
3.50	.61580	.21419	.13223	5.3280	1.6198
4.00	.58909	.16831	.10256	8.2268	1.6410
4.50	.56983	.13540	.08177	12.502	1.6559
5.00	.55555	.11111	.06667	18.634	1.6667
6.00	.53633	.07849	.04669	38.946	1.6809
7.00	.52437	.05826	.03448	75.414	1.6896
8.00	.51646	.04491	.02649	136.62	1.6954
9.00	.51098	.03565	.02098	233.88	1.6993
10.00	.50702	.02897	.01702	381.62	1.7021
∞	.48980	0	0	∞	1.7143

This table has been adapted from J. H. Keenan and J. Kaye, *Gas Tables*, John Wiley and Sons, Inc., New York, 1948, and is reprinted by permission of the publisher.

APPENDIX F (continued)

Rayleigh Line Flow ($\gamma = 1.4$)

M	T_i/T_i^*	T/T^*	P/P^*	P_i/P_i^*	V/V^*
2.50	.71005	.37870	.24616	2.2218	1.5385
2.51	.70870	.37630	.24440	2.2405	1.5398
2.52	.70736	.37392	.24266	2.2594	1.5410
2.53	.70603	.37157	.24094	2.2785	1.5422
2.54	.70471	.36923	.23923	2.2978	1.5434
2.55	.70340	.36691	.23754	2.3173	1.5446
2.56	.70210	.36461	.23587	2.3370	1.5458
2.57	.70081	.36233	.23422	2.3569	1.5470
2.58	.69953	.36007	.23258	2.3770	1.5482
2.59	.69825	.35783	.23096	2.3972	1.5494
2.60	.69699	.35561	.22936	2.4177	1.5505
2.61	.69574	.35341	.22777	2.4384	1.5516
2.62	.69450	.35123	.22620	2.4593	1.5527
2.63	.69327	.34906	.22464	2.4804	1.5538
2.64	.69205	.34691	.22310	2.5017	1.5549
2.65	.69084	.34478	.22158	2.5233	1.5560
2.66	.68964	.34267	.22007	2.5451	1.5571
2.67	.68845	.34057	.21857	2.5671	1.5582
2.68	.68727	.33849	.21709	2.5892	1.5593
2.69	.68610	.33643	.21562	2.6116	1.5603
2.70	.68494	.33439	.21417	2.6342	1.5613
2.71	.68378	.33236	.21273	2.6571	1.5623
2.72	.68263	.33035	.21131	2.6802	1.5633
2.73	.68150	.32836	.20990	2.7035	1.5644
2.74	.68038	.32638	.20850	2.7270	1.5654
2.75	.67926	.32442	.20712	2.7508	1.5663
2.76	.67815	.32248	.20575	2.7748	1.5673
2.77	.67704	.32055	.20439	2.7990	1.5683
2.78	.67595	.31864	.20305	2.8235	1.5692
2.79	.67487	.31674	.20172	2.8482	1.5702
2.80	.67380	.31486	.20040	2.8731	1.5711
2.81	.67273	.31299	.19909	2.8982	1.5721
2.82	.67167	.31114	.19780	2.9236	1.5730
2.83	.67062	.30931	.19652	2.9493	1.5739
2.84	.66958	.30749	.19525	2.9752	1.5748
2.85	.66855	.30568	.19399	3.0013	1.5757
2.86	.66752	.30389	.19274	3.0277	1.5766
2.87	.66650	.30211	.19151	3.0544	1.5775
2.88	.66549	.30035	.19029	3.0813	1.5784
2.89	.66449	.29860	.18908	3.1084	1.5792
2.90	.66350	.29687	.18788	3.1358	1.5801
2.91	.66252	.29515	.18669	3.1635	1.5809
2.92	.66154	.29344	.18551	3.1914	1.5818
2.93	.66057	.29175	.18435	3.2196	1.5826
2.94	.65961	.29007	.18320	3.2481	1.5834