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Tabulated Solutions of the Equilibrium Gas Properties behind the Incident and Reflected Normal Shock-Wave in a Shock-Tube

I - Nitrogen

II - Oxygen

By

L. Bernstein, B.Sc. Eng.

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Tabulated Solutions of the Equilibrium Gas Properties behind the Incident and Reflected Normal Shock-Wave in a Shock-Tube
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L. Bernstein, B.Sc.(Eng.)

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SUMMARY

Tabulated solutions are presented for the equilibrium gas properties behind the incident and reflected normal shock-waves in the shock-tube, for nitrogen and oxygen. They cover the range of shock-wave Mach numbers up to 12 at intervals of 0.2, for selected values of the undisturbed gas pressure between 1 and 2000 mm Hg.

The thermodynamic model of the gas used in the calculations is described in some detail, as is the method of solving the equations. The limitations of the assumption of thermodynamic equilibrium are discussed with regard to shock-tube applications, and the estimated accuracy of the tables is indicated.

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* Most of the work reported here was carried out at Queen Mary College and has been presented as part of a thesis for the degree of Ph.D. in the University of London.

Replaces A.R.C.22,778.

1. Introduction

In many cases in aerodynamic research it is found convenient to perform experiments in gases other than air. The simplification which results from using for example, one of the constituents of air, is considerable when account is taken of the chemical reactions which occur in the vicinity of a body travelling at hypersonic velocity. Considerations such as this have led to the extensive use of nitrogen as a test-gas in shock-tubes and shock-tunnels. In other applications, the properties of single gases have been measured directly in the shock-tube. In evaluating the performance of new experimental techniques it is often very convenient to carry out the measurements in a pure gas whose behaviour can be predicted with some confidence.

High-stagnation enthalpy gas streams are conveniently generated by means of the shock-tube, in which a diaphragm separating regions of high and low pressure gas is burst. The resulting wave system has been frequently described[1] and will not be considered here. It is sufficient to note that a shock-wave travels into the low pressure gas, compressing and heating it, and this shock-wave may then be reflected from the closed end of the tube, causing further heating and compression. Both the gas behind the incident shock-wave, and that behind the reflected shock-wave have been used as test samples. It is clear that if the experiments carried out in these gas samples are to be of maximum use a knowledge of the state properties of the shock-processed gas is required.

Such data are available for air[2] over a wide range of initial shock-tube conditions, but data for other gases are not readily available in a convenient form. For nitrogen, Waldron[3] has published the results of some calculations, but his graphical presentation is not sufficiently accurate, nor his data extensive enough, when it is realised that temperatures for example may be measured to within ±20°C (Ref. 4).

The results presented here in tabular form for the incident and reflected shock cases, have been computed for a range of incident shock-wave Mach number up to 12, in steps of 0.2, for selected values of the undisturbed gas pressure, between 1 mm Hg and 2000 mm Hg. The shock-processed gas is assumed to be in thermodynamic equilibrium - the effects of a finite relaxation time in the shock-tube are considered in Section 5.

2. Equations of Motion

The equations of motion for the two cases are identical when velocities are referred to axes moving with the shock-waves. Thus the laws of conservation of mass, momentum and energy are, respectively,

$$\rho_1 w_1 = \rho_2 (w_1 - u_2) \qquad \ldots(2.1)$$

$$p_1 + \rho_1 w_1^2 = p_2 + \rho_2 (w_1 - u_2)^2 \qquad \ldots(2.2)$$

$$H_1 + \tfrac{1}{2} w_1^2 = H_2 + \tfrac{1}{2} (w_1 - u_2)^2 \qquad \ldots(2.3)$$

for the incident shock-wave, where $u_1 = 0$ and for the reflected shock-wave case, in which $u_5 = 0$,

$$\rho_2 (w_2 + u_2) = \rho_5 w_2 \qquad \ldots(2.4)$$

$$p_2 + \rho_2 (w_2 + u_2)^2 = p_5 + \rho_5 (w_2)^2 \qquad \ldots(2.5)$$

$$H_2 + \tfrac{1}{2} (w_2 + u_2)^2 = H_5 + \tfrac{1}{2} w_2^2 . \qquad \ldots(2.6)$$

The/

Table 5 (contd.)

P_1 = 2 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	30.52
1.4	0.927	438	1.000	1.52	4.1	2.74	30.56
1.6	0.927	521	1.000	1.82	6.9	3.85	30.68
1.8	0.935	602	1.000	2.13	10.5	5.04	30.82
2.0	0.951	693	1.000	2.48	15.1	6.30	31.01
2.2	0.970	788	1.000	2.85	20.6	7.59	31.21
2.4	0.993	887	1.000	3.25	27.1	8.87	31.41
2.6	1.020	995	1.000	3.69	34.8	10.15	31.64
2.8	1.050	1111	1.000	4.17	43.7	11.40	31.88
3.0	1.079	1228	1.000	4.66	53.4	12.61	32.10
3.2	1.113	1356	1.000	5.20	64.2	13.73	32.34
3.4	1.147	1493	1.000	5.78	76.8	14.91	32.58
3.6	1.180	1629	1.000	6.37	89.7	15.97	32.80
3.8	1.216	1777	1.000	7.02	104.2	17.00	33.04
4.0	1.252	1931	1.000	7.69	119.9	17.99	33.28
4.2	1.280	2074	1.001	8.37	136.0	19.00	33.49
4.4	1.305	2218	1.002	9.10	153.8	20.06	33.71
4.6	1.325	2350	1.005	9.85	171.8	21.10	33.93
4.8	1.334	2468	1.009	10.61	191.5	22.30	34.14
5.0	1.340	2573	1.014	11.40	211.1	23.46	34.36
5.2	1.341	2665	1.020	12.19	231.7	24.72	34.57
5.4	1.336	2747	1.027	13.04	253.9	26.10	34.78
5.6	1.336	2828	1.036	13.89	276.5	27.38	35.02
5.8	1.333	2899	1.045	14.77	300.2	28.74	35.25
6.0	1.328	2968	1.055	15.70	326.3	30.23	35.48
6.2	1.325	3032	1.066	16.65	354.8	31.84	35.72
6.4	1.322	3094	1.077	17.64	385.4	33.53	35.96
6.6	1.320	3154	1.090	18.68	418.3	35.30	36.20
6.8	1.320	3212	1.103	19.74	454.2	37.19	36.45
7.0	1.320	3270	1.116	20.85	494.8	39.31	36.71
7.2	1.320	3326	1.131	21.99	538.9	41.55	36.96
7.4	1.323	3383	1.146	23.20	586.0	43.83	37.23
7.6	1.325	3439	1.162	24.44	638.4	46.33	37.50
7.8	1.330	3493	1.179	25.71	692.6	48.77	37.78
8.0	1.335	3547	1.196	27.02	750.3	51.29	38.06
8.2	1.340	3602	1.214	28.39	813.2	53.94	38.35
8.4	1.347	3655	1.232	29.76	878.0	56.53	38.64
8.6	1.355	3709	1.252	31.20	948.4	59.24	38.95
8.8	1.363	3761	1.271	32.64	1020.5	61.90	39.25
9.0	1.372	3813	1.291	34.10	1096.2	64.58	39.55
9.2	1.381	3866	1.312	35.65	1178.0	67.35	39.86
9.4	1.392	3919	1.333	37.20	1261.1	70.00	40.18
9.6	1.403	3971	1.355	38.79	1347.9	72.65	40.50
9.8	1.416	4025	1.378	40.46	1440.9	75.33	40.83
10.0	1.428	4078	1.401	42.10	1535.8	77.97	41.15
10.2	1.443	4132	1.424	43.81	1633.6	80.50	41.49
10.4	1.457	4187	1.448	45.54	1735.4	83.01	41.82
10.6	1.473	4242	1.472	47.30	1841.4	85.50	42.16
10.8	1.489	4298	1.497	49.09	1951.0	87.93	42.50
11.0	1.513	4362	1.527	50.97	2065.4	89.93	42.92
11.2	1.524	4414	1.548	52.82	2181.7	92.56	43.20
11.4	1.549	4481	1.578	54.78	2303.4	94.45	43.61
11.6	1.564	4538	1.602	56.71	2427.5	96.83	43.92
11.8	1.590	4607	1.632	58.73	2557.1	98.64	44.32
12.0	1.614	4677	1.660	60.78	2689.9	100.48	44.69

contd./

$$H = H(T,p) \qquad \ldots(2.16)$$

for the gas, these equations completely specify states 2 and 5. In region 2, the flow Mach number is

$$M_2 = \frac{u_2}{a_2} = U_{21}A_{12}. \qquad \ldots(2.17)$$

The methods of solution are described in Section 4, but it is first necessary to consider the form of equation (2.16) for the specific enthalpy.

3. Thermodynamic Properties of the Gas in Equilibrium

The range covered by the present calculations is such that at the higher shock strengths, molecular vibration, electronic excitation, and dissociation are all important energy absorption processes. Equation (2.16) is, therefore, no longer a simple expression such as equation (2.10), and no explicit solution of the shock-wave equations is possible, in terms of the undisturbed gas.

In order to take account of these energy absorption processes, a statistical-mechanical model of the gas is assumed[5]; since only at the extremes of the present range is the gas density very high, the effects of molecular interactions, usually accounted for by employing a virial equation of state[6], are ignored.

According to this model, there are two modes of energy absorption for an atom, and four for a molecule. Thus an atom is assumed to absorb energy in translation and electronic excitation, while in addition the molecules will absorb energy in rotational and vibrational modes.

All these absorption processes are here assumed to act independently. The diatomic molecule is assumed to behave as a "dumb-bell", with two degrees of freedom in rotation, and the vibration is assumed to be harmonic. At high temperatures this will lead to errors, since the rotational and vibrational modes interact, resulting in anharmonicity. The enthalpy will therefore be underestimated, but the errors are unlikely to be large.

The law governing the equilibrium concentrations in the dissociation process

$$A_2 \rightleftharpoons 2A \qquad \ldots(3.1)$$

is

$$\frac{n_A^2}{n_{A_2}} = \frac{Q_A^2}{Q_{A_2}} e^{-D/kT} \qquad \ldots(3.2)$$

where D is the dissociation energy per molecule

n_A is the number of A atoms in volume V at temperature T,

and Q_A is the partition function of A, i.e.,

$$Q_A = \Sigma\, e^{-\epsilon/kT} \qquad \ldots(3.3)$$

where the summation extends over all the energy levels, ϵ, of the A atom in volume V, and k is Boltzmann's constant.

The/

The quantities n_{A_2} and Q_{A_2} are similarly defined for the molecule A_2, but the energies ϵ, are measured from the ground states of the two species, so that ϵ_{o_A} and $\epsilon_{o_{A_2}}$ differ by $\frac{1}{2}D$ per atom.

The partition functions may be expressed in terms of the several partition functions associated with the various excitation modes of the component particles. Thus

$$Q_A = Q_A^T . Q_A^E \qquad \ldots(3.4(a))$$

$$Q_{A_2} = Q_{A_2}^T . Q_{A_2}^R . Q_{A_2}^V . Q_{A_2}^E \qquad \ldots(3.4(b))$$

where the superscripts denote the excitation modes. If m_o is the mass of the atom, the translational partition functions are

$$Q_A^T = \{2\pi m_o kT/h^2\}^{\frac{3}{2}} . V \qquad \ldots(3.5(a))$$

and

$$Q_{A_2}^T = \{2\pi . 2m_o kT/h^2\}^{\frac{3}{2}} . V \qquad \ldots(3.5(b))$$

for the atom and molecule respectively, where h is Planck's constant, and k, Boltzmann's constant.

The rotational partition function for the molecule is, assuming a rigid rotator,

$$Q_{A_2}^R = \frac{2IkT}{h^2} + \frac{1}{3} + \frac{1}{15}\left(\frac{h^2}{2IkT}\right) + \ldots\ldots$$

$$\approx \frac{T}{\theta_R \sigma} \qquad \ldots(3.6)$$

provided $T >> \theta_R$

where

$$\theta_R = \frac{h^2}{2Ik\sigma}$$

I is the molecular moment of inertia, and σ is a symmetry number equal to 2 if the atoms composing the molecule are similar, and one otherwise. The second form is convenient, in which a characteristic rotational temperature θ_R, is defined, only the first term of the previous expression being retained. This is justified, since in the range of interest, $T >> \theta_R$ (for example $\theta_R = 2.88°K$ for N_2; and $2.07°K$ for O_2).

By assuming the molecule to be a simple harmonic oscillator - a dumb-bell with freedom to vibrate along the axis - the vibrational partition function may be written

$$Q_{A_2}^V = \left\{1 - e^{-\frac{h\nu}{kT}}\right\}$$

$$= \left\{1 - e^{-\frac{\theta_v}{T}}\right\} \qquad \ldots(3.7)$$

where/

where it is assumed that the vibrational states differ from the ground state by energies 0, $h\nu$, $2h\nu$ ... etc., in arithmetic progression to infinity, and the frequency ν is the natural vibration frequency of the molecule obtained from vibration spectra. Equation (3.7) defines a characteristic temperature of vibration, θ_v.

The electronic partition functions Q_A^E and $Q_{A_2}^E$ are given by

$$Q_A^E = \sum_0 g_n \exp\left(-\frac{\epsilon_n}{kT}\right) \qquad \ldots(3.8)$$

and

$$Q_{A_2}^E = \sum_0 g_n' \exp\left(-\frac{\epsilon_n'}{kT}\right) \qquad \ldots(3.9)$$

where g_n and g_n' are the spectroscopic weight terms, or the degeneracy of the states of energy ϵ_n and ϵ_n' respectively. They consist normally of only a few terms, since the higher excitation states are filled to a negligible extent from a thermodynamic point of view.

The gas density is given by

$$\rho = m_o(n_A+2n_{A_2})/V \qquad \ldots(3.10)$$

and if α is the proportion by mass of atoms in the mixture,

$$\alpha = \frac{n_A}{n_A+2n_{A_2}}. \qquad \ldots(3.11)$$

Using equations (3.4) to (3.11), equation (3.2) becomes

$$\frac{\alpha^2}{1-\alpha} = \frac{m_o n_A^2}{2\rho V n_{A_2}}$$

or

$$K_d = \frac{4\alpha^2 p}{1-\alpha^2}$$

$$= R_o T.2m_o \left(\frac{\pi m_o kT}{h^2}\right)^{\frac{3}{2}} \left(\frac{2\theta_R}{T}\right)\left(1-e^{-\frac{\theta_V}{T}}\right)\frac{(Q_A^E)^2}{Q_{A_2}^E} e^{-\frac{\theta_D}{T}} \qquad \ldots(3.12)$$

where $\theta_D = D/k$ is a characteristic dissociation temperature

$R_o = k/2m_o$ is the molecular gas constant

K_d is the reaction rate constant, and is a function only of temperature for any gas,

and p is the total pressure of the mixture.

The last form of equation (3.12) is obtained using the equation of state,

$$p = kT(n_A+n_{A_2})/V = \frac{k}{2m_o}\rho T(1+\alpha). \qquad \ldots(3.13)$$

The/

The specific internal energy of the mixture is given by

$$E = \frac{kT^2}{\rho V}\left\{n_A \frac{\partial(\ell n Q_A)}{\partial T} + n_{A_2}\frac{\partial(\ell n Q_{A_2})}{\partial T}\right\} + \frac{\frac{1}{2}n_A D}{\rho V} \qquad \ldots(3.14)$$

the last term being necessary because the energies of the atoms and molecules are referred to different zeros, 2 atoms of A having D more energy than one molecule of A_2 at their respective zeros.

Using equations (3.10) and (3.11), this becomes

$$E = R_o T^2 \left\{2\alpha \frac{\partial(\ell n Q_A)}{\partial T} + (1-\alpha)\frac{\partial(\ell n Q_{A_2})}{\partial T}\right\} + \alpha R_o \theta_D. \qquad \ldots(3.15)$$

The specific enthalpy is

$$H = E + \frac{p}{\rho} = E + R_o T(1+\alpha)$$

so that

$$\frac{H}{R_o} = T\left\{(1+\alpha) + 2\alpha\frac{\partial(\ell n Q_A)}{\partial(\ell n\, T)} + (1-\alpha)\frac{\partial(\ell n Q_{A_2})}{\partial(\ell n T)}\right\} + \alpha\theta_D. \qquad \ldots(3.16)$$

The specific heats are then given by

$$C_p = \left(\frac{\partial H}{\partial T}\right)_p \qquad \ldots(3.17a)$$

$$C_v = C_p + \frac{T\left(\frac{\partial V}{\partial T}\right)_p^2}{\left(\frac{\partial V}{\partial p}\right)_T} \qquad \ldots(3.17b)$$

and the low frequency speed of sound by

$$a^2 = \left(\frac{\partial p}{\partial \rho}\right)_s = \gamma\left(\frac{\partial p}{\partial \rho}\right)_T \quad \text{where} \quad \gamma = \frac{C_p}{C_v}. \qquad \ldots(3.18)$$

$$\text{The entropy/mole} = s = R\left\{\ell n Q + T\left(\frac{\partial \ell n Q}{\partial T}\right)_p\right\} \qquad \ldots(3.19)$$

for a single component, and for the mixture

$$s_m = R\left\{\Sigma X_i \frac{s_i}{R} - \Sigma X_i \ell n X_i\right\}$$

where R is the universal gas constant, and X_i the mole fraction of component i. The second term arises as the entropy of mixing. Thus since

$$X_A = \frac{2\alpha}{1+\alpha}$$

and/

and $$X_{A_2} = \frac{1-\alpha}{1+\alpha}$$

the specific entropy is

$$S = R_o \left\{ (1-\alpha) \frac{s_{A_2}}{R} + 2\alpha \frac{s_A}{R} - 2\alpha \ln \left(\frac{2\alpha}{1+\alpha} \right) + (1-\alpha) \ln \left(\frac{1-\alpha}{1+\alpha} \right) \right\} .$$

Making use of the foregoing equations, and noting that equations (3.16) and (3.19) lead to

$$\frac{s_A}{R} = \ln Q_A + \frac{h_A - e_{o_A}}{RT} \qquad \ldots(3.20)$$

and $$\frac{s_{A_2}}{R} = \ln Q_{A_2} + \frac{h_{A_2} - e_{o_{A_2}}}{RT}$$

where h_i is the molar enthalpy of component i, and e_{o_A} and $e_{o_{A_2}}$, the ground states, differ by $\frac{1}{2}$ the energy of dissociation per mole, we may derive the following expressions for the binary mixture:

Specific entropy:

$$\frac{S}{R_o} = \frac{H}{R_o T} + \ln Q_{A_2} + \ln \left(\frac{1+\alpha}{1-\alpha} \right) . \qquad \ldots(3.21)$$

Specific enthalpy:

$$\frac{H}{R_o} = T \left\{ \frac{7}{2} + \frac{3}{2} \alpha + \frac{(1-\alpha) \frac{\theta_v}{T}}{e^{\frac{\theta_v}{T}} - 1} + 2\alpha \frac{\sum_o g_n \frac{\epsilon_n}{kT} e^{-\frac{\epsilon_n}{kT}}}{\sum_o g_n e^{-\frac{\epsilon_n}{kT}}} + (1-\alpha) \frac{\sum_o g'_n \frac{\epsilon'_n}{kT} e^{-\frac{\epsilon'_n}{kT}}}{\sum_o g'_n e^{-\frac{\epsilon'_n}{kT}}} \right\}$$

$$+ \alpha \theta_D . \qquad \ldots(3.22)$$

Specific/

Specific heat at constant pressure:

$$\frac{C_p}{R_o} = \frac{7}{2} + \frac{3}{2}\alpha + \frac{(1-\alpha)\left(\frac{\theta_v}{T}\right)^2 e^{\frac{\theta_v}{T}}}{\left(e^{\frac{\theta_v}{T}} - 1\right)^2} + 2\alpha\left\{\frac{\sum_0 g_n\left(\frac{\epsilon_n}{kT}\right)^2 e^{-\frac{\epsilon_n}{kT}}}{\sum_0 g_n e^{-\frac{\epsilon_n}{kT}}} - \left[\frac{\sum_0 g_n \frac{\epsilon_n}{kT} e^{-\frac{\epsilon_n}{kT}}}{\sum_0 g_n e^{-\frac{\epsilon_n}{kT}}}\right]^2\right\}$$

$$+ (1-\alpha)\left\{\frac{\sum_0 g'_n\left(\frac{\epsilon'_n}{kT}\right)^2 e^{-\frac{\epsilon'_n}{kT}}}{\sum_0 g'_n e^{-\frac{\epsilon'_n}{kT}}} - \left[\frac{\sum_0 g'_n \frac{\epsilon'_n}{kT} e^{-\frac{\epsilon'_n}{kT}}}{\sum_0 g'_n e^{-\frac{\epsilon'_n}{kT}}}\right]^2\right\}$$

$$+ \frac{\alpha(1-\alpha^2)}{2}\left\{\frac{3}{2} + \frac{\theta_D}{T} - \frac{\frac{\theta_v}{T}}{e^{\frac{\theta_v}{T}} - 1} + 2\frac{\sum_0 g_n \frac{\epsilon_n}{kT} e^{-\frac{\epsilon_n}{kT}}}{\sum_0 g_n e^{-\frac{\epsilon_n}{kT}}} - \frac{\sum_0 g'_n \frac{\epsilon'_n}{kT} e^{-\frac{\epsilon'_n}{kT}}}{\sum_0 g'_n e^{-\frac{\epsilon'_n}{kT}}}\right\}^2 \quad \ldots(3.23)$$

Specific heat at constant volume:

$$\frac{C_v}{R_o} = \frac{C_p}{R_o} - \frac{2}{2-\alpha}\left\{1 + \frac{\alpha(1-\alpha)}{2}\left[\frac{3}{2} + \frac{\theta_D}{T} - \frac{\frac{\theta_v}{T}}{e^{\frac{\theta_v}{T}} - 1} + 2\frac{\sum_0 g_n \frac{\epsilon_n}{kT} e^{-\frac{\epsilon_n}{kT}}}{\sum_0 g_n e^{-\frac{\epsilon_n}{kT}}} - \frac{\sum_0 g'_n \frac{\epsilon'_n}{kT} e^{-\frac{\epsilon'_n}{kT}}}{\sum_0 g'_n e^{-\frac{\epsilon'_n}{kT}}}\right]^2\right\} \quad \ldots(3.24)$$

The specific heat ratio:

$$\gamma = \frac{C_p}{C_v}. \quad \ldots(3.25)$$

The low frequency speed of sound:

$$a^2 = \frac{2\gamma R_o T}{2-\alpha}. \quad \ldots(3.26)$$

Compressibility factor:

$$Z = 1 + \alpha. \quad \ldots(3.27)$$

Thus equations (3.12) and (3.22) give an expression for the specific enthalpy of the partially dissociated gas in terms of the pressure and temperature, and these may be used in conjunction with equations (2.8), (2.9) and (2.11) to solve the incident shock equations. Correspondingly they may be used with equations (2.12) to (2.15) to obtain the solution of the reflected shock equations. The methods of solution are outlined in the next section.

4./

4. Methods of Solution

The approaches to the solution of these two problems, although basically the same, are sufficiently different to warrant separate treatment. In the case of the primary shock-wave, the gas in front is at rest and at room temperature, which allows considerable simplifications to be made. In the case of the reflected shock-wave however, the gas behind it is at rest, and it moves into a region which is far from thermodynamically perfect. In each case the solution is required in terms of the state of the undisturbed gas in region 1, and the primary shock velocity, since these are the quantities which are most readily measured.

(a) The incident shock-wave

By eliminating Γ_{12} from equations (2.8), (2.9) and (2.11), we obtain

$$T_2 Z_2 = P_{21} \left\{ 1 - \frac{P_{21}-1}{\gamma_1 W_{11}^2} \right\} T_1 \qquad \ldots (4.1)$$

and

$$P_{21} = \left[\frac{H_2 - H_1}{R_o T_1} - \frac{T_{21} Z_2 - 1}{2} \right] + \sqrt{\left[\frac{H_2 - H_1}{R_o T_1} - \frac{T_{21} Z_2 - 1}{2} \right]^2 + T_{21} Z_2} \qquad \ldots (4.2)$$

where only the positive root has been retained in equation (4.2) as being physically possible.

Then for specified values of p_1, T_1 and W_{11}, a first approximation to P_{21} is assumed, and the R.H.S. of equation (4.1) evaluated. With this value of $T_2 Z_2 = T_2(1+\alpha_2)$ and with $p_2 = P_{21} p_1$ the values of T_2 and α_2 are obtained using a simple iteration procedure* involving equation (3.12) in the form

$$\alpha_2 = \sqrt{\frac{K_d(T_2)}{4p_2 + K_d(T_2)}}. \qquad \ldots (4.3)$$

With these values of T_2 and α_2, H_2 is evaluated using equation (3.22), and since H_1 is known, a new value of P_{21} may be obtained using equation (4.2). Unfortunately this second value of P_{21} is very sensitive to changes in T_2, and hence to the initial assumption for P_{21}, so that a simple iteration procedure is divergent. The behaviour of the process is illustrated in Fig. 2. Point (a) is the initial approximation, and point (b) is obtained by the process already described. Point (c) is the mean of the two values of P_{21} already obtained and point (d) is then obtained using equation (4.1). A similar procedure then results in points (e), (f) and (g) ..... The iteration is seen to diverge from the required solution at (X). In the region of (X) however, the two curves are nearly straight lines, and a "second" approximation may be obtained by determining the junction of the diagonals of the quadrilateral formed by points (a), (b), (d) and (e).

Even this procedure, which requires only the calculation of the four points at each stage, can break down if the initial value of P_{21} is too far below X, since then the second value of P_{21} is so large, that the solution of equation (4.1) yields a negative value of $T_2 Z_2$. This difficulty was overcome in the following general way.

Equation/

---

* To increase the rate of convergence of the iteration, the mean of the current and previous values of α_2 is used in the succeeding approximation.

Equation (2.8) may be written

$$P_{21} = 1 + \gamma_1 W_{11}[W_{11} - W_{11}\Gamma_{12}]$$

$$= 1 + \gamma_1 W_{11}[W_{11} - U_{21}] \qquad \ldots(4.4)$$

where $$U_{21} = \frac{u_2}{a_1}.$$

Now $(W_{11}-U_{21})$ is very insensitive to changes in W_{11}. Accordingly, the calculation is begun at the first value of W_{11} (in this case at $W_{11} = 1.2$) using the perfect gas approximation

$$P_{21} = \frac{\gamma_1 - 1}{\gamma_1 + 1}\left[\frac{2\gamma_1}{\gamma_1 - 1} W_{11}^2 - 1\right] \qquad \ldots(4.5)$$

since real gas effects may be neglected here.

The complete solution is then calculated for this value of W_{11} and using the value of $(W_{11}-U_{21})$ so obtained, a first approximation to P_{21} may be obtained for the next value of W_{11} (in the present case $W_{11} = 1.4$), and so on.

This first approximation is very close to the solution and convergence using the described procedure is very rapid.

In order to speed the computation, the first approximation to α_2 in the first iteration at any value of W_{11} is taken as the solution at the previous value of W_{11}. Furthermore, having completed a solution for the range of values of W_{11} at a fixed value of p_1, the first approximation to P_{21} for any given value of W_{11} and a new value of p_1 is taken as the solution at the previous value of p_1, since P_{21} is very insensitive to the undisturbed gas pressure, p_1.

The problem has been programmed for solution on a Mercury digital computer, in such a way that it may be used for any homonuclear diatomic gas. The results, for the range of shock-wave Mach numbers, $W_{11} = 1.2(0.2)12$ and for initial gas pressures, $p_1 = 1, 2, 5, 10, 25, 50, 100, 200, 500,$ 1000 and 2000 mmHg with $T_1 = 290°K$ are presented for nitrogen in Table 2, and for oxygen in Table 4. The characteristic gas properties, and the values of the constants used are listed in Table 1.

(b) The reflected shock-wave

As a result of the previous calculations, both region 2 and region 1 may be regarded as known, and again a solution is only obtainable by an iterative procedure. For a given set of initial conditions, p_1, W_{11}, and T_1, a first approximation to the enthalpy ratio $[H_{51}]_{1a}$ is assumed and equation (2.12) entered to obtain a first approximation to Γ_{51} using the results of Section 4(a) for the properties in region 2. Equation (2.13) is then used to obtain $[P_{51}]_{1a}$ and thus p_5. $T_5 Z_5$ follows from the equation of state (2.15). In a manner similar to that described in Section 4(a), the enthalpy H_5 may then be determined uniquely using these values of p_5 and $T_5 Z_5$, thus yielding a second approximation, $[H_{51}]_{2a}$.

As in the previous sub-section, a simple iteration process is divergent. A second value is therefore chosen, such that

$$[H_{51}]_{1b} = [H_{51}]_{1a} + 0.1\left\{[H_{51}]_{1a} - [H_{51}]_{2a}\right\} \qquad \ldots(4.6)$$

and/

and the procedure is repeated, yielding $[H_{51}]_{2b}$. The factor 10% of the difference is arbitrary but convenient.

Now suppose $[H_{51}]_{1i}$ to be plotted against $[H_{51}]_{2i}$. The solution required is the point where this curve crosses the line $[H_{51}]_{1i} = [H_{51}]_{2i}$; that is, the solution is

$$H_{51} = \frac{[H_{51}]_{2a}[H_{51}]_{1b} - [H_{51}]_{1a}[H_{51}]_{2b}}{[H_{51}]_{1b} - [H_{51}]_{1a} + [H_{51}]_{2a} - [H_{51}]_{2b}} \qquad \ldots(4.7)$$

if a linear relation is assumed between $[H_{51}]_{1i}$ and $[H_{51}]_{2i}$ in the region of solution.

This value provides the starting point for further approximations, and the process may be continued to any desired degree of accuracy. The other state parameters then follow from the equations of Sections 2 and 3, the specific entropy also being of interest in connection with the operation of a hypersonic shock tunnel[7].

The first approximation to H_{51} has yet to be determined. Equation (2.12) may be written as

$$H_{51} = H_{21} + \frac{\gamma_1 - 1}{2} U_{21}[U_{21} + 2W_{21}]$$

$$= H_{21} + \frac{\gamma_1 - 1}{2} U_{21}^2 \left\{\frac{\Gamma_{52}+1}{\Gamma_{52}-1}\right\}. \qquad \ldots(4.8)$$

For any given value of the undisturbed gas pressure, p_1, the factor in curly brackets varies only slowly with incident shock velocity, W_{11} for W_{11} greater than about 6. Accordingly up to $W_{11} = 6$, the first approximation to H_{51} is obtained using the perfect gas assumptions, when

$$H_{51} = T_{51} = \frac{(W_{11}^2+2)(4W_{11}^2-1)}{9W_{11}^2} \quad \text{for} \quad \gamma = \frac{7}{5}$$

and thereafter, for $W_{11} > 6$, equation (4.8) is used, employing the value of $(\Gamma_{52}+1)/(\Gamma_{52}-1)$ obtained as the solution at the previous value of W_{11}.

This problem has also been programmed for solution on the Mercury digital computer, and employs as data, in addition to the characteristic gas properties (Table 1), the results of the calculations defining region 2. The solution for nitrogen is presented in Table 3, and that for oxygen in Table 5. The range of parameters is the same as that for the incident shock-wave case.

5. Relaxation Effects in Diatomic Gases

In the previous sections, the theory has been developed, and the calculations carried out on the assumption that the gas is in equilibrium. It remains to consider how this equilibrium is attained, and in consequence, how restrictive the previous assumption is in regard to the flow in a shock-tube.

The gas can only attain the equilibrium state - that is the state in which there will be an equipartition of energy among the various modes, or in the case of chemical reactions, when the net rate of formation of any species is zero - by a process which involves collisions between particles.

Adjustment/

Adjustment of the external mode - translation - to a new value, after a sudden compression, will take place rapidly since any collision will readjust the energy distribution. The rotational mode will take somewhat longer, since certain collisions - those nearly along the molecular axes - will not be very efficient at altering the rotational energy. The vibrational energy will take many more collisions, since only those more or less along the molecular axis, will produce a change in the vibrational energy. For a chemical reaction, such as dissociation, to take place, the particles involved must also possess sufficient energy to supply the heat of formation of the products, in this case, the dissociation energy of the molecule.

It is evident then, that the probabilities of energy being absorbed in a collision are higher for translational and rotational excitation than for the other modes. Accordingly, after a sudden compression, the translational mode will adjust rapidly to a new temperature, and the rotational modes will follow fairly quickly. Typical values are 2 to 3 collisions for translation and 4 to 6 collisions for rotation[8].

Subsequently, after many more collisions, the energy will be redistributed so that the vibrational energy is increased, and correspondingly the temperature will fall, energy being extracted from the translational and rotational modes in compensation. The other state properties will of course also be relaxed towards the equilibrium values.

Such a relaxation process will of course take place behind a shock-wave. The process by which equilibrium is attained does not affect the final state of the gas, so that the previous calculations are valid some distance aft of the shock-front. It remains to determine the extent of this non-equilibrium zone. If, as is usual, it is assumed that the rate of approach to vibrational equilibrium is proportional to the departure from equilibrium, the process will be an exponential one, and we can only define a characteristic time (or distance) during which the approach is made to within a specified (but arbitrary) limit. The usual assumption made is that

$$\frac{\partial E_i}{\partial t} = -\frac{1}{\tau}\left[E_i - E_i(T_e)\right] \qquad \ldots(5.1)$$

where E_i denotes the internal energy, and $E_i(T_e)$ the energy that would be possessed by the internal modes if they were in equilibrium with the "external" temperature, T_e. This equation defines the relaxation time, τ. When considering the vibrational relaxation of a gas, the "external" temperature is to be regarded as that of the translational and rotational modes. Thus after a sudden compression through a shock-wave, the temperature will jump to a value, T_2' which may be calculated ignoring the vibrational absorption mode; that is by assuming $\gamma = 1.4$ for a diatomic gas. Since the two temperatures, T_2' and T_2 (the equilibrium value) are independent of pressure for the case in which no dissociation occurs, the relaxation time τ_v for vibration, is simply inversely proportional to the pressure at a given temperature, since the number of collisions per second is proportional to the density. Thus only a single curve of $p\tau_v$ against T is necessary to define the process.

Blackman[9] has measured the vibrational relaxation times in oxygen and nitrogen behind shock-waves for a wide range of conditions. Figs. 3 and 4 have been constructed directly from a mean curve drawn through his experimental points and those of Ref. 10. They are plotted in carpet form rather than as a single curve to illustrate their importance in the

shock-tube./

shock-tube. It was assumed in constructing these curves that the pressure in the relaxation zone did not vary significantly. This is justified, since the temperature and density changes in the relaxation region oppose each other, producing only a small pressure relaxation.

In operating a shock-tube, the maximum pressures which may be employed are governed by structural considerations. The higher the pressures which may be employed, the lower will be the relaxation time. Theoretical criterion curves are shown in Figs. 3 and 4 for a shock-tube employing a hydrogen driver at 100 atmospheres to drive shocks in nitrogen, and a helium driver at 100 atmospheres to drive shocks in oxygen. Hydrogen is unlikely to be used with oxygen for safety reasons.

In practice these criterion curves will be somewhat more stringent, since the shock-strength realised at a given position in the shock-tube will be lower than the theoretical value for a particular diaphragm pressure ratio, due to imperfect diaphragm rupture and viscous attenuation. A typical curve is shown in Fig. 3 for a hydrogen/nitrogen shock-tube of $1\frac{1}{2}$ inches square cross-section extrapolated from results at lower chamber pressures[11] in which the shock velocity was measured at 112 hydraulic diameters from the diaphragm - a typical working position.

The dissociation relaxation time is somewhat more difficult to define, since the equilibrium temperature is pressure dependent[12]. Furthermore, if vibrational and dissociation relaxation occur at comparable rates, the process becomes even more complex[13]. Thus it is not possible to construct a chart on the basis of the available experimental results[14,15] (which only exist for oxygen) in the same way as those for vibrational relaxation. In addition, the process of approach to chemical equilibrium is not an exponential one (see Refs. 12, 14) so that there is no exponential decay constant which may be used, as in vibrational relaxation, to define the relaxation time.

In principle, since every point on a chart such as Figs. 3 and 4 represents a unique flow condition, it is possible to construct a carpet in which the ordinate is a measure of the approach to within a given arbitrary degree of equilibrium. However the paucity of experimental data precludes this being done at present. Fig. 5 shows the results of Byron[15] and two points calculated from Matthews' paper[14], for oxygen. In these cases, the relaxation time is assumed to be that time during which the density rises from the no-dissociation level to halfway between this value and the equilibrium value. No data exists for nitrogen dissociation.

6. Discussion of Results

The region in which the results may be expected to apply has been indicated in the previous section. It remains to consider the accuracy of the tabulated solutions. This will depend partly upon the adequacy of the model chosen to represent the gas. It will be recalled that effects due to molecular interactions and those due to vibrational-rotational interaction of the molecular species were ignored. In the conditions investigated, the effects of the former may be important for the highest values of initial channel pressure p_1 at the higher shock strengths. Such extreme conditions are unlikely to be realised in practice.

The effects of ignoring the vibrational-rotational interaction are difficult to estimate. They are likely to be most serious at the higher pressures and temperatures where little dissociation has taken place, and a considerable proportion of the total energy is absorbed in vibration and rotation. However a comparison of the entropy and enthalpy of nitrogen based on the model used here[16] with the data calculated at the National Bureau of Standards[17] shows less than 1% difference at 8000°K and 100 atmospheres. In the practical range of shock strengths it is not expected that the present model of the gas is unduly restrictive.

The/

The iteration procedures employed in solving the equations of Section 2 will also introduce errors, depending upon the convergence limits used. It will be recalled that for the incident shock-wave case, two iterations were involved, the first on the temperature and compressibility factor, and the second involving the shock pressure ratio. The first iteration was continued until successive values of Z agreed to within 0.0005, so that conditional upon P_{21} the temperature and compressibility are accurate to the last printed digit. The iteration on P_{21} was continued until it had converged to within 0.1%.

For the reflected shock case, similar limits were used, but since the computation uses the results of that for the incident shock-wave, the errors will be double those of the latter case. In both cases, all the tabulated data are estimated to be within 1% of the exact solution, and are probably within 0.5%. (These latter figures only refer to the arithmetic accuracy, of course.)

Note: The computations were originally carried out for the range $W_{11} = 2(1)20$ and $p_1 = 1, 2, 5, 10, 25, 50, 100, 200, 500,$ 760 mm Hg in nitrogen only. These are available from the author.

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7./

7. Notation

A, A_2	Atomic and molecular species, respectively
A_{ij}	speed of sound ratio, $\frac{a_i}{a_j}$
a	speed of sound
C_p, C_v	specific heats at constant pressure and constant volume, respectively
D	molecular dissociation energy-electron volts
E	specific internal energy
e	internal energy per mole
g_n, g'_n	spectroscopic weight terms for atom and molecule, respectively
H	specific enthalpy
h	Planck's constant - 6.62517×10^{-27} erg-second
K_d	reaction rate coefficient for dissociation process
k	Boltzmann's constant - 1.38044×10^{-16} erg/°K
M	flow Mach number
m_o	mass of atom
N	Avogadro's number - 6.02322×10^{23} molecules/mole
n_i	number of particles of species i in volume V
P_{ij}	pressure ratio, $\frac{p_i}{p_j}$
p	pressure
Q_i	partition function of species i
R	universal gas constant - 1.9872 cal/mole/°K
R_o	molecular gas constant = $Nk/2m_o$
S	specific entropy
s	entropy per mole
T	temperature - °K
T_o	273.16°K
t	time - seconds
U_{ij}	velocity ratio, $\frac{u_i}{a_j}$

V/

V	volume
W_{ij}	shock-wave velocity ratio, $\frac{w_i}{a_j}$ - note: W_{ii} is the shock-wave Mach number
X_i	mole fraction of species i
Z	compressibility factor $(1+\alpha)$
α	degree of dissociation by mass
Γ_{ij}	density ratio, $\frac{\rho_i}{\rho_j}$
γ	specific heat ratio, C_p/C_v
ϵ	energy level above ground state - ergs
ϵ_o	energy level of ground state - ergs
θ_R, θ_v, θ_D	characteristic temperatures of rotation, vibration and dissociation, respectively
ρ	density
σ	symmetry number, equals 2 for homonuclear diatomic gas, one otherwise
τ_v, τ_D	relaxation time for vibration and dissociation, respectively

Subscripts

1,2,3,4,5	Refer to regions so labelled in Fig. 1
v	vibrational mode
R	rotational mode
D	dissociation

References/

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Table 1/

Table 1

Characteristic Gas Properties Assumed for Computations

		Nitrogen	Oxygen
Atomic weight		14.008	16.0000
Characteristic rotational temperature,	θ_R	2.8785°K	2.0687°K
Characteristic vibrational temperature,	θ_v	3353.4°K	2239.3°K
Characteristic dissociation temperature,	θ_D	113,300°K	59,370°K
Electronic energy levels	ϵ_0/k	0	0
	ϵ_1/k	27,700°K	228.05°K
	ϵ_2/k	41,500°K	325.90°K
	ϵ_3/k	-	22,830°K
	ϵ_4/k	-	48,620°K
	ϵ'_0/k	0	0
	ϵ'_1/k	-	11,390°K
	ϵ'_2/k	-	18,990°K
	ϵ'_3/k	-	51,940°K
Statistical weight terms	g_0	4	5
	g_1	10	3
	g_2	6	1
	g_3	-	5
	g_4	-	1
	g'_0	1	3
	g'_1	-	2
	g'_2	-	1
	g'_3	-	3
Undisturbed gas state	T_1	290°K	290°K
	γ_1	1.3998	1.3957
	H_1/R_oT_o	3.71577	3.7194
	a_1	347.07 m/sec	324.26 m/sec

Table 2/

Table 2. Incident Normal Shock in Nitrogen

p_1 = 1 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.510
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.35	5.49	2.966	1.46	1.076
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	645	1.000	2.24	1.48	7.75	3.486	1.85	1.254
2.8	704	1.000	2.46	1.54	9.02	3.718	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.935	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.328	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.76	1.86	16.89	4.672	2.99	1.606
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1208	1.000	4.38	1.99	20.73	4.977	3.36	1.688
4.4	1292	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.248	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.374	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1661	1.000	6.24	2.32	32.09	5.602	4.27	1.844
5.4	1762	1.000	6.65	2.38	34.67	5.707	4.45	1.869
5.6	1865	1.000	7.09	2.45	37.34	5.807	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.302	5.72	2.003
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.435	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.496	6.26	2.046
7.6	3075	1.000	12.28	3.13	69.52	6.555	6.44	2.059
7.8	3214	1.000	12.89	3.20	73.29	6.613	6.62	2.072
8.0	3354	1.000	13.51	3.26	77.15	6.669	6.80	2.086
8.2	3496	1.000	14.15	3.32	81.13	6.728	6.98	2.102
8.4	3635	1.001	14.79	3.38	85.23	6.795	7.16	2.122
8.6	3780	1.001	15.47	3.43	89.42	6.853	7.35	2.141
8.8	3918	1.002	16.17	3.48	93.75	6.926	7.53	2.166
9.0	4051	1.003	16.87	3.52	98.21	7.011	7.72	2.195
9.2	4176	1.004	17.60	3.55	102.81	7.107	7.91	2.226
9.4	4291	1.006	18.31	3.58	107.56	7.224	8.10	2.260
9.6	4400	1.009	19.05	3.61	112.45	7.348	8.29	2.296
9.8	4501	1.011	19.82	3.64	117.47	7.483	8.49	2.332
10.0	4595	1.015	20.64	3.67	122.63	7.626	8.69	2.369
10.2	4681	1.018	21.42	3.70	127.92	7.782	8.89	2.405
10.4	4766	1.022	22.26	3.73	133.32	7.935	9.09	2.440
10.6	4843	1.027	23.12	3.75	138.86	8.098	9.29	2.475
10.8	4915	1.032	23.98	3.78	144.52	8.267	9.49	2.510
11.0	4983	1.036	24.86	3.81	150.31	8.440	9.70	2.544
11.2	5049	1.041	25.72	3.84	156.21	8.616	9.90	2.578
11.4	5112	1.047	26.68	3.87	162.22	8.788	10.10	2.611
11.6	5173	1.053	27.58	3.90	168.35	8.967	10.31	2.644
11.8	5230	1.058	28.51	3.93	174.60	9.147	10.51	2.676
12.0	5285	1.065	29.47	3.96	180.96	9.328	10.71	2.708

contd./

Table 2 (contd.)

p_1 = 2 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.033	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.364	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.674	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.966	1.46	1.076
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.719	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.328	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.75	1.86	16.89	4.672	2.99	1.606
4.0	1127	1.000	4.06	1.92	18.76	4.829	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.976	3.36	1.688
4.4	1293	1.000	4.72	2.05	22.80	5.115	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.249	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1661	1.000	6.24	2.32	32.09	5.602	4.27	1.844
5.4	1761	1.000	6.65	2.38	34.67	5.707	4.45	1.869
5.6	1865	1.000	7.08	2.45	37.34	5.807	4.64	1.893
5.8	1972	1.000	7.54	2.52	40.11	5.900	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.990	5.00	1.935
6.2	2193	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2309	1.000	8.97	2.72	49.02	6.156	5.36	1.972
6.6	2429	1.000	9.49	2.79	52.19	6.231	5.54	1.988
6.8	2551	1.000	10.01	2.85	55.46	6.305	5.72	2.004
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2939	1.000	11.69	3.06	65.86	6.498	6.26	2.046
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.058
7.8	3215	1.000	12.89	3.20	73.28	6.610	6.62	2.070
8.0	3356	1.000	13.51	3.26	77.15	6.665	6.80	2.083
8.2	3500	1.000	14.15	3.33	81.11	6.719	6.98	2.097
8.4	3646	1.000	14.81	3.39	85.19	6.774	7.16	2.113
8.6	3791	1.001	15.49	3.45	89.37	6.832	7.34	2.131
8.8	3930	1.001	16.16	3.49	93.70	6.905	7.53	2.154
9.0	4068	1.002	16.87	3.54	98.14	6.979	7.71	2.180
9.2	4200	1.003	17.58	3.58	102.72	7.068	7.90	2.207
9.4	4329	1.005	18.34	3.61	107.41	7.160	8.09	2.238
9.6	4448	1.007	19.09	3.65	112.25	7.267	8.28	2.270
9.8	4562	1.010	19.88	3.68	117.23	7.382	8.47	2.303
10.0	4664	1.012	20.65	3.71	122.35	7.515	8.67	2.337
10.2	4760	1.016	21.44	3.74	127.61	7.657	8.87	2.372
10.4	4852	1.019	22.26	3.77	132.99	7.801	9.07	2.406
10.6	4936	1.023	23.12	3.80	138.50	7.951	9.27	2.440
10.8	5014	1.028	23.96	3.83	144.15	8.114	9.47	2.474
11.0	5089	1.032	24.83	3.86	149.91	8.276	9.67	2.508
11.2	5161	1.037	25.72	3.89	155.79	8.440	9.87	2.540
11.4	5230	1.042	26.63	3.92	161.78	8.608	10.08	2.573
11.6	5294	1.048	27.55	3.95	167.90	8.778	10.28	2.605
11.8	5357	1.053	28.49	3.98	174.13	8.949	10.48	2.636
12.0	5415	1.060	29.47	4.01	180.48	9.123	10.68	2.667

contd./

Table 2 (contd.)

p_1 = 5 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.689	0.57	0.510
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.963	1.46	1.075
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	645	1.000	2.24	1.48	7.75	3.486	1.85	1.254
2.8	704	1.000	2.46	1.54	9.02	3.718	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.938	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.135	2.43	1.454
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	972	1.000	3.46	1.79	15.12	4.514	2.80	1.562
3.8	1048	1.000	3.76	1.86	16.89	4.672	2.99	1.606
4.0	1126	1.000	4.06	1.92	18.76	4.829	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.976	3.36	1.688
4.4	1292	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.249	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.493	4.09	1.818
5.2	1661	1.000	6.23	2.32	32.10	5.603	4.27	1.845
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.870
5.6	1864	1.000	7.08	2.45	37.34	5.810	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.902	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2194	1.000	8.48	2.65	45.95	6.074	5.18	1.953
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.231	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.302	5.72	2.003
7.0	2678	1.000	10.56	2.92	58.82	6.369	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.435	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.496	6.26	2.045
7.6	3077	1.000	12.28	3.13	69.51	6.552	6.44	2.057
7.8	3215	1.000	12.89	3.20	73.28	6.609	6.62	2.070
8.0	3357	1.000	13.51	3.27	77.14	6.663	6.80	2.082
8.2	3502	1.000	14.15	3.33	81.11	6.715	6.98	2.094
8.4	3649	1.000	14.81	3.40	85.18	6.768	7.16	2.108
8.6	3797	1.001	15.48	3.46	89.35	6.821	7.34	2.123
8.8	3945	1.001	16.17	3.51	93.64	6.877	7.52	2.140
9.0	4087	1.002	16.87	3.56	98.06	6.948	7.70	2.163
9.2	4228	1.002	17.58	3.61	102.60	7.021	7.89	2.186
9.4	4365	1.004	18.32	3.65	107.27	7.102	8.08	2.213
9.6	4496	1.005	19.09	3.69	112.07	7.191	8.27	2.241
9.8	4620	1.007	19.86	3.72	117.00	7.292	8.46	2.271
10.0	4739	1.010	20.66	3.76	122.06	7.399	8.65	2.302
10.2	4846	1.012	21.45	3.79	127.28	7.524	8.84	2.334
10.4	4947	1.015	22.25	3.82	132.63	7.657	9.04	2.366
10.6	5045	1.019	23.09	3.85	138.09	7.791	9.24	2.398
10.8	5134	1.023	23.92	3.88	143.70	7.938	9.44	2.431
11.0	5218	1.027	24.82	3.91	149.42	8.084	9.64	2.463
11.2	5300	1.032	25.71	3.95	155.27	8.235	9.84	2.494
11.4	5377	1.037	26.61	3.98	161.23	8.389	10.04	2.525
11.6	5449	1.042	27.52	4.01	167.33	8.551	10.24	2.556
11.8	5519	1.047	28.45	4.04	173.53	8.710	10.45	2.586
12.0	5587	1.052	29.40	4.07	179.85	8.871	10.65	2.616

contd./

Table 2 (contd.)

p_1 = 10 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.033	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.966	1.46	1.076
2.4	589	1.000	2.04	1.42	6.57	3.234	1.66	1.170
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.720	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1046	1.000	3.75	1.86	16.90	4.683	2.99	1.609
4.0	1127	1.000	4.06	1.92	18.76	4.829	3.17	1.649
4.2	1208	1.000	4.38	1.99	20.73	4.979	3.36	1.688
4.4	1293	1.000	4.73	2.05	22.80	5.112	3.54	1.723
4.6	1380	1.000	5.08	2.12	24.98	5.249	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1662	1.000	6.24	2.32	32.09	5.602	4.27	1.844
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.869
5.6	1865	1.000	7.09	2.45	37.34	5.807	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.902	4.82	1.915
6.0	2080	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2311	1.000	8.98	2.72	49.01	6.149	5.36	1.970
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2548	1.000	10.00	2.85	55.48	6.314	5.72	2.006
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2808	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.495	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3215	1.000	12.89	3.20	73.28	6.610	6.62	2.069
8.0	3358	1.000	13.51	3.27	77.14	6.663	6.80	2.081
8.2	3503	1.000	14.15	3.33	81.10	6.714	6.98	2.093
8.4	3651	1.000	14.81	3.40	85.17	6.764	7.16	2.105
8.6	3800	1.000	15.48	3.46	89.34	6.815	7.34	2.119
8.8	3951	1.001	16.17	3.52	93.62	6.868	7.52	2.134
9.0	4101	1.001	16.88	3.58	98.01	6.923	7.70	2.151
9.2	4244	1.002	17.59	3.63	102.54	6.995	7.88	2.174
9.4	4385	1.003	18.33	3.67	107.19	7.069	8.07	2.199
9.6	4523	1.004	19.06	3.72	111.96	7.150	8.26	2.222
9.8	4657	1.006	19.85	3.75	116.86	7.235	8.45	2.250
10.0	4782	1.008	20.66	3.79	121.89	7.334	8.64	2.280
10.2	4904	1.010	21.45	3.83	127.06	7.439	8.83	2.307
10.4	5014	1.013	22.26	3.86	132.37	7.558	9.02	2.338
10.6	5121	1.016	23.09	3.89	137.80	7.680	9.22	2.368
10.8	5219	1.019	23.93	3.93	143.38	7.815	9.42	2.399
11.0	5315	1.023	24.79	3.96	149.07	7.949	9.62	2.429
11.2	5400	1.028	25.70	3.99	154.90	8.094	9.82	2.460
11.4	5485	1.032	26.60	4.02	160.83	8.237	10.02	2.490
11.6	5566	1.037	27.52	4.05	166.89	8.384	10.22	2.520
11.8	5644	1.042	28.45	4.09	173.07	8.534	10.42	2.549
12.0	5718	1.047	29.41	4.12	179.36	8.685	10.62	2.578

contd./

Table 2 (contd.)

p_1 = 25 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.692	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.23	3.62	2.366	1.04	0.842
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.964	1.46	1.075
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.46	1.54	9.02	3.717	2.05	1.327
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.136	2.43	1.454
3.4	900	1.000	3.19	1.73	13.45	4.332	2.62	1.511
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.76	1.86	16.89	4.672	2.99	1.606
4.0	1126	1.000	4.06	1.92	18.76	4.829	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.977	3.36	1.688
4.4	1292	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.248	3.72	1.758
4.8	1470	1.000	5.45	2.18	27.25	5.376	3.91	1.789
5.0	1563	1.000	5.83	2.25	29.63	5.496	4.09	1.819
5.2	1661	1.000	6.23	2.32	32.10	5.604	4.27	1.845
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.869
5.6	1865	1.000	7.09	2.45	37.34	5.806	4.64	1.892
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2195	1.000	8.48	2.65	45.95	6.071	5.18	1.953
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.48	2.79	52.19	6.232	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.302	5.72	2.003
7.0	2678	1.000	10.56	2.92	58.82	6.369	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.435	6.08	2.032
7.4	2939	1.000	11.69	3.06	65.86	6.498	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3216	1.000	12.89	3.20	73.28	6.608	6.62	2.069
8.0	3358	1.000	13.51	3.27	77.14	6.661	6.80	2.080
8.2	3504	1.000	14.15	3.34	81.10	6.712	6.98	2.091
8.4	3652	1.000	14.80	3.40	85.16	6.761	7.16	2.103
8.6	3803	1.000	15.47	3.47	89.33	6.810	7.34	2.115
8.8	3956	1.000	16.16	3.53	93.60	6.859	7.52	2.128
9.0	4109	1.001	16.87	3.59	97.97	6.910	7.70	2.142
9.2	4262	1.001	17.59	3.65	102.46	6.963	7.88	2.159
9.4	4409	1.002	18.32	3.70	107.09	7.031	8.06	2.180
9.6	4556	1.003	19.07	3.75	111.83	7.099	8.25	2.201
9.8	4699	1.004	19.84	3.79	116.70	7.174	8.43	2.224
10.0	4837	1.006	20.63	3.83	121.69	7.256	8.62	2.249
10.2	4968	1.008	21.43	3.87	126.81	7.347	8.81	2.276
10.4	5095	1.010	22.26	3.91	132.06	7.443	9.00	2.303
10.6	5212	1.013	23.09	3.95	137.46	7.554	9.20	2.331
10.8	5327	1.016	23.94	3.98	142.97	7.665	9.39	2.359
11.0	5431	1.019	24.79	4.02	148.63	7.790	9.59	2.388
11.2	5534	1.023	25.67	4.05	154.40	7.913	9.78	2.416
11.4	5627	1.027	26.56	4.08	160.31	8.048	9.98	2.445
11.6	5718	1.031	27.50	4.12	166.33	8.181	10.18	2.473
11.8	5806	1.036	28.44	4.15	172.47	8.317	10.38	2.500
12.0	5890	1.041	29.39	4.19	178.73	8.456	10.58	2.528

contd./

Table 2 (contd.)

p_1 = 50 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.966	1.46	1.076
2.4	590	1.000	2.05	1.42	6.56	3.228	1.66	1.168
2.6	644	1.000	2.24	1.48	7.75	3.491	1.86	1.255
2.8	704	1.000	2.45	1.54	9.02	3.720	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	974	1.000	3.47	1.80	15.11	4.497	2.80	1.558
3.8	1046	1.000	3.75	1.86	16.90	4.686	2.99	1.609
4.0	1127	1.000	4.06	1.92	18.76	4.829	3.17	1.649
4.2	1210	1.000	4.39	1.99	20.72	4.964	3.35	1.685
4.4	1291	1.000	4.72	2.05	22.81	5.123	3.54	1.725
4.6	1380	1.000	5.08	2.12	24.98	5.248	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1661	1.000	6.23	2.32	32.09	5.602	4.27	1.844
5.4	1762	1.000	6.65	2.38	34.66	5.705	4.45	1.869
5.6	1865	1.000	7.09	2.45	37.34	5.807	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2080	1.000	7.99	2.58	42.99	5.994	5.00	1.935
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2309	1.000	8.97	2.72	49.02	6.158	5.36	1.972
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2551	1.000	10.01	2.85	55.46	6.306	5.72	2.004
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.495	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3220	1.000	12.90	3.20	73.26	6.599	6.62	2.067
8.0	3358	1.000	13.51	3.27	77.14	6.662	6.80	2.080
8.2	3504	1.000	14.15	3.34	81.10	6.712	6.98	2.091
8.4	3653	1.000	14.80	3.41	85.16	6.760	7.16	2.102
8.6	3804	1.000	15.47	3.47	89.32	6.808	7.34	2.113
8.8	3958	1.000	16.16	3.54	93.59	6.855	7.52	2.124
9.0	4114	1.000	16.86	3.60	97.96	6.903	7.70	2.137
9.2	4270	1.001	17.59	3.66	102.44	6.952	7.88	2.151
9.4	4425	1.001	18.33	3.72	107.03	7.004	8.06	2.168
9.6	4574	1.002	19.07	3.77	111.76	7.072	8.24	2.188
9.8	4721	1.003	19.85	3.81	116.61	7.140	8.43	2.211
10.0	4867	1.004	20.60	3.86	121.58	7.214	8.61	2.231
10.2	5009	1.006	21.42	3.90	126.66	7.290	8.80	2.255
10.4	5143	1.008	22.26	3.94	131.88	7.378	8.99	2.280
10.6	5273	1.010	23.08	3.98	137.23	7.471	9.18	2.305
10.8	5398	1.013	23.94	4.02	142.70	7.570	9.37	2.331
11.0	5512	1.016	24.80	4.06	148.33	7.682	9.57	2.358
11.2	5625	1.019	25.68	4.09	154.06	7.794	9.76	2.384
11.4	5729	1.023	26.56	4.13	159.94	7.917	9.96	2.412
11.6	5831	1.027	27.48	4.17	165.92	8.038	10.16	2.438
11.8	5925	1.031	28.40	4.20	172.05	8.168	10.36	2.465
12.0	6016	1.036	29.37	4.24	178.28	8.297	10.55	2.492

contd./

Table 2 (contd.)

p_1 = 100 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.693	0.57	0.512
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	443	1.000	1.53	1.23	3.62	2.367	1.04	0.842
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.962	1.46	1.075
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.718	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	831	1.000	2.93	1.67	11.87	4.143	2.43	1.456
3.4	901	1.000	3.19	1.73	13.44	4.328	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.76	1.86	16.89	4.671	2.99	1.606
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.977	3.36	1.688
4.4	1293	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.250	3.72	1.758
4.8	1470	1.000	5.44	2.18	27.25	5.377	3.91	1.790
5.0	1564	1.000	5.83	2.25	29.62	5.492	4.09	1.818
5.2	1662	1.000	6.24	2.32	32.09	5.601	4.27	1.844
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.869
5.6	1863	1.000	7.08	2.45	37.35	5.814	4.64	1.894
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2193	1.000	8.48	2.65	45.95	6.078	5.18	1.954
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.302	5.72	2.003
7.0	2678	1.000	10.56	2.92	58.82	6.369	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.435	6.08	2.032
7.4	2939	1.000	11.69	3.06	65.86	6.499	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3216	1.000	12.89	3.20	73.28	6.608	6.62	2.069
8.0	3359	1.000	13.51	3.27	77.14	6.660	6.80	2.080
8.2	3505	1.000	14.15	3.34	81.10	6.710	6.98	2.090
8.4	3654	1.000	14.80	3.41	85.16	6.758	7.16	2.101
8.6	3806	1.000	15.47	3.47	89.32	6.805	7.34	2.111
8.8	3960	1.000	16.16	3.54	93.58	6.851	7.52	2.122
9.0	4117	1.000	16.86	3.61	97.94	6.897	7.70	2.134
9.2	4275	1.001	17.58	3.67	102.42	6.944	7.88	2.146
9.4	4434	1.001	18.32	3.73	107.00	6.992	8.06	2.160
9.6	4587	1.002	19.06	3.78	111.71	7.051	8.24	2.178
9.8	4742	1.002	19.83	3.84	116.53	7.109	8.42	2.196
10.0	4894	1.003	20.60	3.89	121.47	7.175	8.61	2.215
10.2	5041	1.004	21.40	3.93	126.54	7.246	8.79	2.236
10.4	5187	1.006	22.23	3.98	131.72	7.319	8.98	2.258
10.6	5325	1.008	23.08	4.02	137.03	7.403	9.17	2.283
10.8	5459	1.010	23.93	4.06	142.48	7.491	9.36	2.306
11.0	5588	1.013	24.80	4.10	148.04	7.584	9.55	2.330
11.2	5707	1.016	25.67	4.14	153.76	7.691	9.74	2.355
11.4	5825	1.019	26.57	4.18	159.58	7.795	9.94	2.380
11.6	5934	1.023	27.47	4.21	165.55	7.912	10.13	2.406
11.8	6041	1.027	28.40	4.25	171.62	8.025	10.33	2.431
12.0	6143	1.031	29.38	4.29	177.82	8.142	10.53	2.456

contd./

Table 2 (contd.)

p_1 = 200 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.50	2.674	1.25	0.967
2.2	537	1.000	1.86	1.36	5.49	2.966	1.46	1.076
2.4	588	1.000	2.04	1.42	6.57	3.240	1.66	1.172
2.6	645	1.000	2.24	1.48	7.75	3.485	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.719	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	973	1.000	3.46	1.80	15.12	4.506	2.80	1.560
3.8	1047	1.000	3.75	1.86	16.89	4.680	2.99	1.608
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1207	1.000	4.38	1.99	20.73	4.980	3.36	1.689
4.4	1293	1.000	4.73	2.05	22.80	5.112	3.54	1.723
4.6	1380	1.000	5.08	2.12	24.98	5.248	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1661	1.000	6.24	2.32	32.09	5.602	4.27	1.844
5.4	1756	1.000	6.63	2.38	34.69	5.729	4.46	1.874
5.6	1865	1.000	7.09	2.45	37.34	5.807	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2073	1.000	7.97	2.58	43.02	6.019	5.00	1.940
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2309	1.000	8.97	2.72	49.02	6.156	5.36	1.972
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.303	5.72	2.004
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.495	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3215	1.000	12.89	3.20	73.28	6.609	6.62	2.069
8.0	3360	1.000	13.51	3.27	77.13	6.658	6.80	2.079
8.2	3514	1.000	14.19	3.34	81.05	6.689	6.97	2.086
8.4	3654	1.000	14.80	3.41	85.15	6.757	7.16	2.100
8.6	3806	1.000	15.47	3.48	89.31	6.804	7.34	2.110
8.8	3961	1.000	16.16	3.54	93.57	6.849	7.52	2.121
9.0	4119	1.000	16.86	3.61	97.94	6.893	7.69	2.131
9.2	4279	1.000	17.58	3.68	102.40	6.938	7.87	2.142
9.4	4440	1.001	18.32	3.74	106.97	6.983	8.05	2.154
9.6	4601	1.001	19.07	3.80	111.65	7.030	8.23	2.168
9.8	4757	1.002	19.83	3.85	116.47	7.088	8.42	2.185
10.0	4916	1.002	20.61	3.91	121.38	7.144	8.60	2.202
10.2	5070	1.003	21.40	3.96	126.43	7.207	8.78	2.220
10.4	5221	1.005	22.21	4.00	131.59	7.275	8.97	2.240
10.6	5371	1.006	23.06	4.05	136.87	7.345	9.16	2.261
10.8	5512	1.008	23.92	4.09	142.28	7.423	9.35	2.283
11.0	5652	1.010	24.78	4.14	147.81	7.507	9.53	2.305
11.2	5785	1.013	25.67	4.18	153.47	7.594	9.73	2.328
11.4	5910	1.016	26.56	4.22	159.27	7.694	9.92	2.352
11.6	6033	1.019	27.48	4.26	165.18	7.792	10.11	2.375
11.8	6148	1.022	28.39	4.30	171.24	7.900	10.31	2.399
12.0	6261	1.026	29.34	4.34	177.40	8.008	10.50	2.422

contd./

Table 2 (contd.)

p_1 = 500 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.23	3.62	2.364	1.04	0.841
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	537	1.000	1.86	1.35	5.49	2.967	1.46	1.076
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.719	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	831	1.000	2.93	1.67	11.87	4.141	2.43	1.456
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.76	1.86	16.89	4.672	2.99	1.606
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.977	3.36	1.688
4.4	1293	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.250	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.372	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.492	4.09	1.818
5.2	1661	1.000	6.23	2.32	32.10	5.603	4.27	1.845
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.869
5.6	1864	1.000	7.08	2.45	37.34	5.808	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2193	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.231	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.301	5.72	2.003
7.0	2679	1.000	10.56	2.92	58.82	6.367	5.90	2.017
7.2	2808	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2941	1.000	11.69	3.06	65.85	6.493	6.26	2.044
7.6	3076	1.000	12.28	3.13	69.52	6.554	6.44	2.057
7.8	3216	1.000	12.89	3.20	73.28	6.609	6.62	2.069
8.0	3359	1.000	13.51	3.27	77.14	6.660	6.80	2.079
8.2	3505	1.000	14.15	3.34	81.10	6.710	6.98	2.090
8.4	3654	1.000	14.80	3.41	85.16	6.759	7.16	2.100
8.6	3807	1.000	15.47	3.48	89.31	6.803	7.34	2.109
8.8	3962	1.000	16.16	3.55	93.57	6.847	7.51	2.119
9.0	4121	1.000	16.86	3.61	97.93	6.890	7.69	2.129
9.2	4282	1.000	17.58	3.68	102.39	6.932	7.87	2.139
9.4	4445	1.000	18.31	3.75	106.95	6.974	8.05	2.149
9.6	4610	1.001	19.06	3.81	111.62	7.017	8.23	2.161
9.8	4775	1.001	19.83	3.87	116.40	7.062	8.41	2.173
10.0	4938	1.002	20.63	3.93	121.29	7.111	8.59	2.188
10.2	5100	1.003	21.43	3.98	126.30	7.163	8.78	2.204
10.4	5260	1.003	22.22	4.04	131.44	7.223	8.96	2.220
10.6	5418	1.004	23.05	4.09	136.69	7.284	9.14	2.237
10.8	5573	1.006	23.90	4.14	142.06	7.349	9.33	2.256
11.0	5724	1.008	24.77	4.18	147.54	7.418	9.52	2.275
11.2	5871	1.010	25.66	4.23	153.16	7.494	9.71	2.296
11.4	6014	1.012	26.56	4.27	158.89	7.572	9.89	2.316
11.6	6148	1.015	27.46	4.31	164.77	7.661	10.09	2.338
11.8	6281	1.017	28.40	4.36	170.76	7.749	10.28	2.359
12.0	6405	1.021	29.33	4.40	176.88	7.847	10.47	2.381

contd./

Table 2 (contd.)

p_1 = 1000 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.034	0.81	0.691
1.8	444	1.000	1.53	1.24	3.62	2.363	1.04	0.841
2.0	489	1.000	1.69	1.29	4.50	2.671	1.25	0.966
2.2	537	1.000	1.86	1.36	5.49	2.966	1.46	1.076
2.4	589	1.000	2.04	1.42	6.57	3.235	1.66	1.170
2.6	644	1.000	2.24	1.48	7.75	3.493	1.86	1.255
2.8	704	1.000	2.45	1.54	9.02	3.719	2.05	1.328
3.0	766	1.000	2.68	1.60	10.40	3.936	2.24	1.395
3.2	832	1.000	2.93	1.67	11.87	4.138	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.327	2.61	1.510
3.6	973	1.000	3.46	1.79	15.12	4.506	2.80	1.561
3.8	1046	1.000	3.75	1.86	16.90	4.683	2.99	1.609
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1208	1.000	4.38	1.99	20.73	4.979	3.36	1.688
4.4	1292	1.000	4.72	2.05	22.81	5.118	3.54	1.725
4.6	1380	1.000	5.08	2.12	24.98	5.248	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.373	3.91	1.789
5.0	1564	1.000	5.83	2.25	29.62	5.491	4.09	1.818
5.2	1661	1.000	6.23	2.32	32.10	5.603	4.27	1.845
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.869
5.6	1865	1.000	7.09	2.45	37.34	5.807	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2079	1.000	7.99	2.58	42.99	5.997	5.00	1.936
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.230	5.54	1.988
6.8	2552	1.000	10.01	2.86	55.46	6.302	5.72	2.004
7.0	2678	1.000	10.56	2.92	58.82	6.370	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.435	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.495	6.26	2.045
7.6	3076	1.000	12.28	3.13	69.51	6.553	6.44	2.057
7.8	3216	1.000	12.89	3.20	73.28	6.608	6.62	2.068
8.0	3360	1.000	13.52	3.27	77.13	6.657	6.80	2.079
8.2	3504	1.000	14.15	3.34	81.10	6.711	6.98	2.090
8.4	3654	1.000	14.80	3.41	85.15	6.758	7.16	2.100
8.6	3807	1.000	15.47	3.48	89.31	6.802	7.34	2.109
8.8	3963	1.000	16.16	3.55	93.57	6.847	7.51	2.118
9.0	4122	1.000	16.86	3.62	97.92	6.888	7.69	2.128
9.2	4284	1.000	17.58	3.68	102.38	6.930	7.87	2.137
9.4	4448	1.000	18.31	3.75	106.94	6.970	8.05	2.146
9.6	4614	1.000	19.06	3.82	111.60	7.011	8.23	2.157
9.8	4782	1.001	19.83	3.88	116.37	7.052	8.41	2.167
10.0	4951	1.001	20.61	3.94	121.25	7.095	8.59	2.179
10.2	5114	1.002	21.40	4.00	126.26	7.147	8.77	2.194
10.4	5281	1.002	22.22	4.06	131.36	7.196	8.95	2.208
10.6	5444	1.003	23.06	4.11	136.59	7.251	9.14	2.225
10.8	5607	1.004	23.88	4.16	141.93	7.309	9.32	2.239
11.0	5766	1.006	24.74	4.21	147.40	7.371	9.51	2.257
11.2	5924	1.007	25.64	4.26	152.97	7.433	9.69	2.275
11.4	6074	1.010	26.55	4.31	158.68	7.504	9.88	2.294
11.6	6223	1.012	27.46	4.35	164.50	7.577	10.07	2.312
11.8	6367	1.014	28.39	4.40	170.45	7.655	10.26	2.332
12.0	6503	1.017	29.33	4.44	176.53	7.741	10.45	2.352

contd./

Table 2 (contd.)

p_1 = 2000 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.342	0.31	0.288
1.4	364	1.000	1.25	1.12	2.12	1.690	0.57	0.511
1.6	402	1.000	1.39	1.18	2.82	2.033	0.81	0.691
1.8	444	1.000	1.53	1.24	3.61	2.360	1.04	0.840
2.0	489	1.000	1.69	1.29	4.51	2.675	1.25	0.967
2.2	536	1.000	1.86	1.35	5.49	2.971	1.46	1.078
2.4	589	1.000	2.04	1.42	6.57	3.236	1.66	1.171
2.6	644	1.000	2.24	1.48	7.75	3.487	1.85	1.254
2.8	704	1.000	2.45	1.54	9.02	3.720	2.05	1.328
3.0	767	1.000	2.69	1.61	10.39	3.929	2.24	1.393
3.2	832	1.000	2.93	1.67	11.87	4.139	2.43	1.455
3.4	901	1.000	3.19	1.73	13.44	4.328	2.61	1.510
3.6	973	1.000	3.46	1.80	15.11	4.505	2.80	1.560
3.8	1048	1.000	3.76	1.86	16.89	4.672	2.99	1.606
4.0	1127	1.000	4.06	1.92	18.76	4.828	3.17	1.649
4.2	1208	1.000	4.39	1.99	20.73	4.977	3.36	1.688
4.4	1293	1.000	4.72	2.05	22.80	5.116	3.54	1.724
4.6	1380	1.000	5.08	2.12	24.98	5.249	3.72	1.758
4.8	1471	1.000	5.45	2.18	27.25	5.372	3.91	1.789
5.0	1563	1.000	5.83	2.25	29.63	5.496	4.09	1.819
5.2	1661	1.000	6.23	2.32	32.09	5.602	4.27	1.844
5.4	1761	1.000	6.65	2.38	34.67	5.708	4.45	1.870
5.6	1864	1.000	7.08	2.45	37.34	5.808	4.64	1.893
5.8	1971	1.000	7.53	2.52	40.11	5.901	4.82	1.914
6.0	2081	1.000	8.00	2.58	42.98	5.991	5.00	1.935
6.2	2194	1.000	8.48	2.65	45.95	6.075	5.18	1.954
6.4	2310	1.000	8.97	2.72	49.02	6.155	5.36	1.971
6.6	2429	1.000	9.49	2.79	52.19	6.231	5.54	1.988
6.8	2553	1.000	10.02	2.86	55.45	6.300	5.72	2.003
7.0	2678	1.000	10.56	2.92	58.82	6.369	5.90	2.018
7.2	2807	1.000	11.12	2.99	62.29	6.434	6.08	2.032
7.4	2940	1.000	11.69	3.06	65.85	6.496	6.26	2.045
7.6	3075	1.000	12.27	3.13	69.52	6.557	6.44	2.058
7.8	3215	1.000	12.88	3.20	73.28	6.610	6.62	2.069
8.0	3359	1.000	13.51	3.27	77.14	6.660	6.80	2.079
8.2	3505	1.000	14.15	3.34	81.10	6.710	6.98	2.090
8.4	3655	1.000	14.80	3.41	85.15	6.757	7.16	2.099
8.6	3807	1.000	15.47	3.48	89.31	6.802	7.34	2.109
8.8	3964	1.000	16.16	3.55	93.57	6.846	7.51	2.118
9.0	4123	1.000	16.86	3.62	97.92	6.887	7.69	2.127
9.2	4285	1.000	17.57	3.69	102.38	6.928	7.87	2.136
9.4	4450	1.000	18.31	3.75	106.93	6.967	8.05	2.144
9.6	4617	1.000	19.06	3.82	111.59	7.006	8.23	2.154
9.8	4787	1.001	19.82	3.89	116.35	7.045	8.41	2.163
10.0	4958	1.001	20.61	3.95	121.22	7.085	8.59	2.174
10.2	5130	1.001	21.41	4.01	126.20	7.126	8.77	2.185
10.4	5297	1.002	22.21	4.07	131.30	7.175	8.95	2.198
10.6	5468	1.002	23.04	4.13	136.50	7.222	9.13	2.212
10.8	5635	1.003	23.90	4.18	141.83	7.274	9.32	2.227
11.0	5803	1.004	24.74	4.24	147.26	7.328	9.50	2.241
11.2	5967	1.006	25.61	4.29	152.82	7.386	9.68	2.257
11.4	6129	1.007	26.53	4.34	158.48	7.444	9.87	2.273
11.6	6288	1.009	27.45	4.39	164.27	7.508	10.06	2.290
11.8	6440	1.011	28.39	4.44	170.18	7.577	10.24	2.308
12.0	6592	1.014	29.33	4.49	176.21	7.648	10.43	2.325

Table 3/

Table 3. Reflected Normal Shock in Nitrogen

p_1 = 1 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_o
1.2	0.961	368	1.000	1.27	2.3	1.77	29.58
1.4	0.935	442	1.000	1.53	4.1	2.72	29.62
1.6	0.949	529	1.000	1.83	6.9	3.77	29.75
1.8	0.959	618	1.000	2.15	10.5	4.93	29.89
2.0	0.983	714	1.000	2.49	15.0	6.08	30.06
2.2	1.009	817	1.000	2.87	20.5	7.26	30.26
2.4	1.036	925	1.000	3.28	26.8	8.42	30.46
2.6	1.068	1038	1.000	3.71	34.1	9.53	30.67
2.8	1.100	1161	1.000	4.20	42.6	10.65	30.89
3.0	1.130	1285	1.000	4.70	52.0	11.73	31.10
3.2	1.166	1419	1.000	5.24	62.5	12.77	31.33
3.4	1.201	1557	1.000	5.81	73.7	13.73	31.55
3.6	1.237	1704	1.000	6.41	86.4	14.70	31.77
3.8	1.277	1863	1.000	7.07	100.3	15.61	32.00
4.0	1.312	2018	1.000	7.73	114.8	16.50	32.21
4.2	1.348	2184	1.000	8.45	130.9	17.38	32.42
4.4	1.392	2365	1.000	9.19	147.8	18.13	32.64
4.6	1.430	2542	1.000	9.97	165.7	18.90	32.84
4.8	1.470	2735	1.000	10.80	185.5	19.67	33.05
5.0	1.510	2929	1.000	11.64	205.7	20.37	33.25
5.2	1.552	3134	1.000	12.54	227.0	21.01	33.45
5.4	1.596	3349	1.000	13.45	249.6	21.62	33.65
5.6	1.632	3559	1.000	14.42	273.9	22.31	33.83
5.8	1.674	3782	1.001	15.40	298.7	22.89	34.02
6.0	1.706	3986	1.001	16.41	324.2	23.55	34.20
6.2	1.735	4188	1.003	17.44	350.6	24.21	34.37
6.4	1.760	4380	1.005	18.48	377.8	24.90	34.55
6.6	1.777	4554	1.007	19.56	405.7	25.65	34.73
6.8	1.788	4709	1.011	20.64	434.3	26.46	34.89
7.0	1.796	4853	1.015	21.75	463.7	27.30	35.07
7.2	1.798	4979	1.020	22.88	493.7	28.20	35.23
7.4	1.798	5097	1.025	24.02	524.5	29.11	35.40
7.6	1.796	5205	1.031	25.19	556.2	30.06	35.57
7.8	1.794	5306	1.037	26.40	588.9	31.02	35.74
8.0	1.790	5402	1.044	27.62	622.5	32.00	35.91
8.2	1.786	5491	1.052	28.87	657.4	33.02	36.09
8.4	1.783	5577	1.059	30.14	694.3	34.09	36.27
8.6	1.778	5662	1.067	31.49	733.0	35.18	36.45
8.8	1.776	5741	1.076	32.85	773.1	36.30	36.64
9.0	1.773	5820	1.085	34.25	817.4	37.55	36.82
9.2	1.771	5897	1.094	35.71	864.6	38.86	37.01
9.4	1.769	5971	1.104	37.15	915.9	40.30	37.20
9.6	1.768	6044	1.114	38.65	970.1	41.80	37.39
9.8	1.768	6118	1.124	40.23	1029.7	43.42	37.58
10.0	1.769	6193	1.135	41.88	1092.9	45.09	37.78
10.2	1.770	6264	1.146	43.51	1160.3	46.86	37.99
10.4	1.772	6335	1.158	45.22	1230.0	48.63	38.19
10.6	1.776	6406	1.170	46.97	1304.1	50.47	38.41
10.8	1.779	6475	1.182	48.73	1382.1	52.37	38.61
11.0	1.782	6545	1.195	50.58	1466.2	54.37	38.83
11.2	1.786	6612	1.207	52.38	1551.6	56.37	39.04
11.4	1.792	6681	1.221	54.31	1639.8	58.31	39.27
11.6	1.797	6749	1.234	56.24	1735.1	60.41	39.49
11.8	1.803	6815	1.248	58.17	1831.5	62.47	39.71
12.0	1.810	6881	1.262	60.15	1931.8	64.53	39.94

contd./

Table 3 (contd.)

p_1 = 2 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	28.89
1.4	0.935	442	1.000	1.53	4.1	2.72	28.93
1.6	0.949	529	1.000	1.83	6.9	3.77	29.06
1.8	0.956	616	1.000	2.14	10.5	4.94	29.19
2.0	0.983	714	1.000	2.49	15.0	6.07	29.37
2.2	1.009	817	1.000	2.87	20.5	7.26	29.56
2.4	1.036	925	1.000	3.28	26.8	8.42	29.76
2.6	1.068	1038	1.000	3.71	34.1	9.53	29.97
2.8	1.097	1158	1.000	4.19	42.6	10.67	30.19
3.0	1.130	1284	1.000	4.70	52.0	11.74	30.41
3.2	1.166	1419	1.000	5.24	62.5	12.77	30.64
3.4	1.201	1557	1.000	5.81	73.7	13.73	30.86
3.6	1.237	1704	1.000	6.41	86.4	14.70	31.08
3.8	1.276	1862	1.000	7.06	100.3	15.62	31.31
4.0	1.312	2018	1.000	7.73	114.8	16.50	31.51
4.2	1.325	2150	1.000	8.43	130.4	17.59	31.66
4.4	1.388	2358	1.000	9.19	147.7	18.16	31.94
4.6	1.431	2544	1.000	9.97	165.8	18.89	32.15
4.8	1.469	2733	1.000	10.80	185.4	19.67	32.35
5.0	1.509	2928	1.000	11.64	205.6	20.37	32.55
5.2	1.552	3133	1.000	12.53	227.0	21.01	32.75
5.4	1.594	3343	1.000	13.44	249.5	21.64	32.95
5.6	1.631	3557	1.000	14.41	273.9	22.33	33.13
5.8	1.676	3787	1.001	15.41	298.7	22.86	33.33
6.0	1.710	3998	1.001	16.42	324.3	23.50	33.50
6.2	1.742	4206	1.002	17.45	350.8	24.14	33.68
6.4	1.771	4411	1.004	18.51	378.4	24.79	33.86
6.6	1.793	4600	1.006	19.60	406.5	25.48	34.03
6.8	1.808	4769	1.009	20.69	435.5	26.25	34.20
7.0	1.819	4925	1.013	21.81	464.9	27.03	34.37
7.2	1.825	5065	1.017	22.94	495.1	27.87	34.54
7.4	1.828	5194	1.022	24.10	526.4	28.76	34.70
7.6	1.829	5314	1.028	25.28	558.1	29.64	34.87
7.8	1.828	5425	1.034	26.49	590.7	30.55	35.04
8.0	1.826	5529	1.040	27.72	624.4	31.48	35.21
8.2	1.824	5627	1.047	28.98	659.1	32.43	35.38
8.4	1.822	5721	1.055	30.27	695.0	33.40	35.56
8.6	1.819	5810	1.063	31.60	732.3	34.39	35.74
8.8	1.816	5899	1.071	32.96	773.9	35.53	35.91
9.0	1.815	5983	1.079	34.35	815.6	36.63	36.09
9.2	1.813	6065	1.088	35.78	861.9	37.86	36.27
9.4	1.813	6147	1.098	37.29	910.3	39.12	36.46
9.6	1.812	6226	1.108	38.79	962.3	40.47	36.65
9.8	1.813	6304	1.118	40.36	1017.3	41.86	36.84
10.0	1.815	6383	1.129	41.97	1078.6	43.42	37.03
10.2	1.815	6460	1.139	43.61	1143.5	45.07	37.22
10.4	1.818	6536	1.150	45.30	1211.4	46.72	37.42
10.6	1.822	6612	1.162	47.05	1282.9	48.41	37.62
10.8	1.825	6685	1.174	48.80	1359.1	50.21	37.83
11.0	1.830	6759	1.186	50.60	1438.2	52.01	38.03
11.2	1.834	6832	1.199	52.43	1520.6	53.85	38.24
11.4	1.839	6906	1.212	54.35	1609.5	55.78	38.45
11.6	1.846	6978	1.225	56.26	1699.6	57.66	38.67
11.8	1.853	7049	1.238	58.21	1793.2	59.57	38.88
12.0	1.860	7120	1.252	60.21	1890.8	61.50	39.10

contd./

Table 3 (contd.)

p_1 = 5 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	27.97
1.4	0.935	442	1.000	1.53	4.1	2.72	28.01
1.6	0.949	529	1.000	1.83	6.9	3.77	28.14
1.8	0.959	618	1.000	2.15	10.5	4.93	28.28
2.0	0.983	714	1.000	2.49	15.0	6.08	27.57
2.2	1.008	817	1.000	2.87	20.4	7.26	28.64
2.4	1.036	925	1.000	3.28	26.8	8.42	28.85
2.6	1.068	1038	1.000	3.71	34.1	9.53	29.06
2.8	1.100	1161	1.000	4.20	42.6	10.65	29.28
3.0	1.132	1287	1.000	4.70	52.0	11.73	29.50
3.2	1.167	1421	1.000	5.24	62.5	12.75	29.73
3.4	1.203	1558	1.000	5.81	73.7	13.72	29.94
3.6	1.238	1704	1.000	6.41	86.6	14.73	30.16
3.8	1.277	1863	1.000	7.07	100.3	15.61	30.39
4.0	1.312	2019	1.000	7.73	114.8	16.49	30.60
4.2	1.353	2192	1.000	8.46	131.0	17.33	30.82
4.4	1.390	2362	1.000	9.19	147.8	18.14	31.03
4.6	1.429	2541	1.000	9.97	165.7	18.91	31.23
4.8	1.471	2736	1.000	10.81	185.5	19.66	31.44
5.0	1.509	2928	1.000	11.64	205.7	20.38	31.64
5.2	1.551	3130	1.000	12.52	227.0	21.03	31.83
5.4	1.593	3342	1.000	13.44	249.5	21.65	32.03
5.6	1.635	3565	1.000	14.42	274.1	22.30	32.22
5.8	1.674	3782	1.000	15.40	298.7	22.90	32.40
6.0	1.718	4016	1.001	16.43	324.7	23.43	32.60
6.2	1.750	4227	1.001	17.47	351.1	24.06	32.77
6.4	1.780	4438	1.002	18.53	378.8	24.69	32.94
6.6	1.810	4649	1.004	19.63	407.4	25.30	33.12
6.8	1.831	4838	1.007	20.74	436.5	25.99	33.29
7.0	1.847	5013	1.010	21.88	466.3	26.71	33.45
7.2	1.858	5173	1.014	23.03	497.0	27.49	33.62
7.4	1.866	5320	1.018	24.19	528.4	28.29	33.78
7.6	1.870	5454	1.023	25.38	560.3	29.12	33.95
7.8	1.873	5581	1.029	26.61	593.4	29.97	34.11
8.0	1.873	5696	1.035	27.85	627.2	30.85	34.27
8.2	1.874	5809	1.041	29.12	662.0	31.73	34.44
8.4	1.874	5915	1.049	30.42	698.0	32.63	34.61
8.6	1.873	6016	1.056	31.75	735.0	33.55	34.78
8.8	1.872	6113	1.064	33.10	773.6	34.50	34.96
9.0	1.872	6205	1.072	34.49	814.9	35.53	35.13
9.2	1.871	6297	1.081	35.93	859.5	36.63	35.31
9.4	1.871	6388	1.090	37.42	906.6	37.77	35.49
9.6	1.872	6477	1.099	38.95	956.4	38.95	35.67
9.8	1.873	6562	1.109	40.50	1009.3	40.22	35.85
10.0	1.876	6647	1.119	42.10	1065.1	41.52	36.04
10.2	1.879	6731	1.130	43.71	1125.3	42.92	36.22
10.4	1.881	6814	1.140	45.39	1190.8	44.45	36.41
10.6	1.885	6897	1.151	47.12	1259.2	45.98	36.60
10.8	1.889	6979	1.163	48.86	1332.1	47.60	36.79
11.0	1.895	7061	1.175	50.70	1407.8	49.20	36.99
11.2	1.901	7142	1.187	52.54	1487.1	50.86	37.19
11.4	1.907	7221	1.200	54.42	1569.8	52.55	37.39
11.6	1.915	7302	1.213	56.32	1657.1	54.28	37.60
11.8	1.920	7380	1.225	58.30	1749.6	56.11	37.79
12.0	1.928	7458	1.239	60.28	1843.3	57.86	38.00

contd./

Table 3 (contd.)

p_1 = 10 mm Hg T_1 = 290°K

W_{11}	W_{s1}	T_s °K	Z_s	H_{s1}	P_{s1}	Γ_{s1}	S_s/R_o
1.2	0.961	368	1.000	1.27	2.3	1.77	27.28
1.4	0.935	442	1.000	1.53	4.1	2.72	27.32
1.6	0.949	529	1.000	1.83	6.9	3.77	27.45
1.8	0.959	618	1.000	2.15	10.5	4.93	27.58
2.0	0.983	714	1.000	2.49	15.0	6.08	26.87
2.2	1.009	817	1.000	2.87	20.5	7.26	26.88
2.4	1.037	925	1.000	3.28	26.8	8.41	28.16
2.6	1.068	1038	1.000	3.71	34.1	9.53	28.37
2.8	1.098	1159	1.000	4.19	42.6	10.66	28.58
3.0	1.130	1284	1.000	4.70	52.0	11.74	28.80
3.2	1.166	1419	1.000	5.24	62.5	12.77	29.03
3.4	1.203	1558	1.000	5.81	73.7	13.72	29.25
3.6	1.237	1704	1.000	6.41	86.4	14.70	29.47
3.8	1.276	1862	1.000	7.06	100.5	15.66	29.69
4.0	1.309	2014	1.000	7.73	114.7	16.52	29.90
4.2	1.348	2185	1.000	8.45	131.0	17.39	30.12
4.4	1.391	2363	1.000	9.20	147.7	18.13	30.34
4.6	1.431	2544	1.000	9.97	165.8	18.89	30.54
4.8	1.470	2735	1.000	10.80	185.5	19.66	30.75
5.0	1.510	2928	1.000	11.64	205.7	20.37	30.94
5.2	1.552	3133	1.000	12.53	227.0	21.01	31.14
5.4	1.594	3343	1.000	13.44	249.6	21.65	31.34
5.6	1.636	3568	1.000	14.43	274.1	22.27	31.53
5.8	1.674	3783	1.000	15.40	298.7	22.90	31.71
6.0	1.719	4019	1.001	16.43	324.7	23.42	31.90
6.2	1.754	4240	1.001	17.48	351.4	24.01	32.07
6.4	1.788	4461	1.002	18.56	378.8	24.58	32.25
6.6	1.819	4676	1.003	19.65	407.7	25.21	32.42
6.8	1.845	4880	1.005	20.76	437.9	25.89	32.59
7.0	1.866	5071	1.008	21.92	467.4	26.52	32.76
7.2	1.881	5246	1.011	23.08	498.2	27.23	32.92
7.4	1.892	5407	1.015	24.26	529.8	27.98	33.09
7.6	1.900	5557	1.020	25.46	562.3	28.77	33.25
7.8	1.905	5695	1.025	26.69	595.5	29.58	33.41
8.0	1.909	5825	1.031	27.94	629.5	30.40	33.58
8.2	1.913	5951	1.037	29.23	664.5	31.22	33.74
8.4	1.911	6059	1.044	30.53	700.1	32.10	33.90
8.6	1.914	6174	1.051	31.87	737.3	32.95	34.07
8.8	1.915	6280	1.058	33.23	775.7	33.84	34.24
9.0	1.916	6382	1.066	34.63	815.5	34.75	34.41
9.2	1.917	6480	1.075	36.04	858.4	35.75	34.58
9.4	1.917	6578	1.083	37.54	904.7	36.82	34.75
9.6	1.919	6672	1.093	39.03	953.4	37.93	34.93
9.8	1.921	6766	1.102	40.61	1004.4	39.06	35.11
10.0	1.924	6860	1.112	42.23	1059.0	40.26	35.29
10.2	1.928	6949	1.122	43.84	1116.2	41.52	35.47
10.4	1.932	7038	1.132	45.49	1177.5	42.85	35.65
10.6	1.936	7127	1.143	47.22	1243.5	44.26	35.83
10.8	1.940	7215	1.154	48.98	1314.1	45.75	36.02
11.0	1.946	7302	1.166	50.77	1387.1	47.25	36.21
11.2	1.953	7391	1.178	52.64	1464.8	48.79	36.40
11.4	1.960	7477	1.190	54.52	1544.9	50.34	36.60
11.6	1.968	7562	1.203	56.44	1628.7	51.93	36.79
11.8	1.975	7647	1.215	58.38	1716.0	53.55	36.99
12.0	1.984	7732	1.228	60.38	1806.7	55.17	37.18

contd./

Table 3 (contd.)

P_1 = 25 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	26.36
1.4	0.937	443	1.000	1.53	4.2	2.72	26.40
1.6	0.949	529	1.000	1.83	6.9	3.77	26.53
1.8	0.960	618	1.000	2.15	10.5	4.93	26.67
2.0	0.983	714	1.000	2.49	15.0	6.08	26.84
2.2	1.011	819	1.000	2.88	20.5	7.24	27.05
2.4	1.036	925	1.000	3.28	26.8	8.42	27.24
2.6	1.068	1038	1.000	3.71	34.1	9.53	27.45
2.8	1.102	1163	1.000	4.20	42.6	10.63	27.68
3.0	1.130	1284	1.000	4.70	52.0	11.74	27.88
3.2	1.166	1420	1.000	5.24	62.5	12.75	28.11
3.4	1.203	1563	1.000	5.82	74.2	13.77	28.34
3.6	1.237	1704	1.000	6.41	86.4	14.70	28.55
3.8	1.276	1862	1.000	7.07	100.3	15.62	28.78
4.0	1.418	2173	1.000	7.87	117.1	15.63	29.29
4.2	1.350	2187	1.000	8.46	131.0	17.37	29.20
4.4	1.388	2358	1.000	9.19	147.7	18.17	29.41
4.6	1.428	2539	1.000	9.97	165.7	18.92	29.62
4.8	1.470	2734	1.000	10.80	185.5	19.68	29.83
5.0	1.509	2927	1.000	11.64	205.8	20.39	30.02
5.2	1.551	3131	1.000	12.52	227.1	21.03	30.22
5.4	1.594	3343	1.000	13.44	249.6	21.65	30.42
5.6	1.636	3568	1.000	14.43	274.0	22.27	30.61
5.8	1.678	3791	1.000	15.41	298.8	22.86	30.80
6.0	1.718	4017	1.000	16.43	324.7	23.43	30.98
6.2	1.758	4251	1.001	17.49	351.4	23.96	31.16
6.4	1.795	4479	1.001	18.56	379.4	24.54	31.33
6.6	1.828	4704	1.002	19.66	408.3	25.11	31.50
6.8	1.861	4928	1.004	20.81	438.0	25.68	31.68
7.0	1.887	5138	1.006	21.97	468.4	26.28	31.84
7.2	1.907	5332	1.009	23.15	499.7	26.95	32.01
7.4	1.924	5513	1.012	24.34	531.8	27.64	32.17
7.6	1.937	5683	1.016	25.56	564.4	28.35	32.33
7.8	1.947	5841	1.021	26.80	597.9	29.08	32.49
8.0	1.953	5987	1.026	28.06	632.1	29.85	32.65
8.2	1.960	6128	1.032	29.36	667.4	30.62	32.81
8.4	1.964	6259	1.038	30.67	703.4	31.41	32.97
8.6	1.968	6385	1.044	32.01	740.6	32.21	33.13
8.8	1.971	6505	1.051	33.39	778.9	33.03	33.30
9.0	1.974	6621	1.059	34.80	818.5	33.86	33.46
9.2	1.977	6732	1.067	36.23	859.5	34.71	33.63
9.4	1.980	6837	1.075	37.69	903.5	35.66	33.79
9.6	1.982	6944	1.083	39.21	950.7	36.65	33.96
9.8	1.986	7046	1.092	40.74	998.5	37.62	34.13
10.0	1.990	7149	1.102	42.34	1050.6	38.68	34.30
10.2	1.994	7249	1.111	43.97	1105.7	39.80	34.47
10.4	2.000	7349	1.122	45.65	1163.5	40.94	34.65
10.6	2.005	7449	1.132	47.38	1227.5	42.21	34.83
10.8	2.011	7543	1.143	49.12	1291.6	43.45	35.01
11.0	2.017	7640	1.154	50.91	1362.4	44.83	35.18
11.2	2.024	7734	1.165	52.71	1433.2	46.14	35.36
11.4	2.032	7828	1.177	54.58	1510.9	47.57	35.55
11.6	2.040	7924	1.188	56.52	1590.9	49.00	35.72
11.8	2.050	8019	1.201	58.49	1674.6	50.43	35.92
12.0	2.060	8113	1.214	60.48	1761.6	51.89	36.11

contd./

Table 3 (contd.)

p_1 = 50 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_o
1.2	0.961	368	1.000	1.27	2.3	1.77	25.67
1.4	0.935	442	1.000	1.53	4.1	2.72	25.71
1.6	0.949	529	1.000	1.83	6.9	3.77	25.84
1.8	0.959	618	1.000	2.15	10.5	4.93	25.98
2.0	0.983	714	1.000	2.49	15.0	6.08	25.26
2.2	1.009	817	1.000	2.87	20.5	7.26	25.27
2.4	1.041	929	1.000	3.29	26.8	8.37	26.56
2.6	1.068	1041	1.000	3.73	34.4	9.57	26.76
2.8	1.098	1159	1.000	4.19	42.6	10.66	26.97
3.0	1.130	1284	1.000	4.70	52.0	11.74	27.19
3.2	1.166	1419	1.000	5.24	62.5	12.77	27.42
3.4	1.203	1558	1.000	5.81	73.7	13.72	27.64
3.6	1.239	1707	1.000	6.42	86.3	14.66	27.87
3.8	1.276	1861	1.000	7.06	100.6	15.67	28.08
4.0	1.311	2017	1.000	7.73	114.8	16.51	28.29
4.2	1.351	2185	1.000	8.44	130.2	17.27	28.51
4.4	1.391	2363	1.000	9.19	148.0	18.16	28.72
4.6	1.429	2541	1.000	9.97	165.7	18.91	28.93
4.8	1.469	2734	1.000	10.80	185.4	19.67	29.14
5.0	1.509	2927	1.000	11.64	205.6	20.37	29.33
5.2	1.551	3131	1.000	12.52	227.0	21.03	29.53
5.4	1.593	3343	1.000	13.44	249.4	21.64	29.73
5.6	1.637	3569	1.000	14.43	274.1	22.27	29.92
5.8	1.678	3791	1.000	15.41	298.8	22.86	30.10
6.0	1.717	4015	1.000	16.42	324.8	23.45	30.28
6.2	1.761	4257	1.000	17.49	351.7	23.95	30.47
6.4	1.799	4491	1.001	18.57	379.8	24.50	30.64
6.6	1.836	4726	1.002	19.69	408.5	25.03	30.81
6.8	1.868	4951	1.003	20.82	438.6	25.62	30.98
7.0	1.900	5179	1.005	22.00	469.2	26.15	31.15
7.2	1.925	5389	1.007	23.19	500.6	26.76	31.32
7.4	1.945	5585	1.010	24.39	532.8	27.40	31.48
7.6	1.962	5770	1.013	25.62	565.9	28.07	31.63
7.8	1.976	5945	1.018	26.89	598.9	28.71	31.80
8.0	1.986	6107	1.022	28.15	634.3	29.47	31.95
8.2	1.994	6259	1.027	29.45	669.6	30.20	32.11
8.4	2.002	6404	1.033	30.78	705.9	30.94	32.27
8.6	2.008	6543	1.039	32.13	743.2	31.70	32.43
8.8	2.014	6677	1.046	33.52	781.5	32.45	32.59
9.0	2.018	6801	1.053	34.92	821.0	33.25	32.75
9.2	2.023	6924	1.061	36.38	861.8	34.04	32.91
9.4	2.027	7042	1.068	37.85	904.1	34.85	33.07
9.6	2.032	7155	1.076	39.34	949.6	35.76	33.23
9.8	2.036	7271	1.085	40.92	998.4	36.70	33.40
10.0	2.041	7377	1.094	42.44	1047.6	37.65	33.56
10.2	2.046	7487	1.103	44.10	1100.7	38.64	33.73
10.4	2.053	7596	1.113	45.79	1157.2	39.69	33.90
10.6	2.059	7701	1.123	47.48	1216.2	40.78	34.07
10.8	2.066	7806	1.133	49.23	1278.2	41.90	34.24
11.0	2.073	7911	1.144	51.04	1346.5	43.14	34.42
11.2	2.082	8013	1.155	52.84	1415.0	44.34	34.59
11.4	2.089	8115	1.166	54.71	1489.9	45.66	34.76
11.6	2.099	8218	1.178	56.64	1567.3	46.95	34.94
11.8	2.109	8321	1.190	58.59	1649.0	48.30	35.13
12.0	2.119	8419	1.202	60.56	1730.6	49.60	35.31

contd./

Table 3 (contd.)

p_1 = 100 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	T_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	24.98
1.4	0.937	442	1.000	1.53	4.2	2.72	25.02
1.6	0.949	529	1.000	1.83	6.9	3.77	25.14
1.8	0.959	618	1.000	2.14	10.5	4.93	25.28
2.0	0.983	714	1.000	2.49	15.0	6.08	24.57
2.2	1.007	817	1.000	2.87	20.4	7.25	25.65
2.4	1.036	925	1.000	3.28	26.8	8.42	25.85
2.6	1.068	1038	1.000	3.71	34.1	9.53	26.06
2.8	1.097	1158	1.000	4.19	42.6	10.66	26.28
3.0	1.130	1284	1.000	4.70	52.0	11.74	26.50
3.2	1.168	1422	1.000	5.25	62.6	12.76	26.73
3.4	1.201	1557	1.000	5.81	73.7	13.73	26.94
3.6	1.237	1704	1.000	6.41	86.4	14.70	27.17
3.8	1.276	1862	1.000	7.07	100.3	15.62	27.39
4.0	1.310	2016	1.000	7.73	114.7	16.51	27.61
4.2	1.353	2191	1.000	8.46	131.0	17.34	27.83
4.4	1.388	2359	1.000	9.19	147.7	18.16	28.03
4.6	1.430	2542	1.000	9.97	165.8	18.91	28.24
4.8	1.468	2732	1.000	10.79	185.5	19.69	28.44
5.0	1.509	2928	1.000	11.64	205.7	20.37	28.64
5.2	1.552	3134	1.000	12.53	227.0	21.01	28.84
5.4	1.594	3343	1.000	13.44	249.6	21.65	29.03
5.6	1.635	3565	1.000	14.42	274.3	22.31	29.22
5.8	1.678	3792	1.000	15.41	298.8	22.85	29.41
6.0	1.719	4022	1.000	16.43	324.7	23.41	29.59
6.2	1.762	4261	1.000	17.49	351.9	23.95	29.77
6.4	1.802	4498	1.001	18.57	379.7	24.47	29.95
6.6	1.841	4740	1.001	19.70	408.8	24.98	30.12
6.8	1.876	4975	1.002	20.84	438.7	25.52	30.29
7.0	1.908	5206	1.003	22.02	469.5	26.06	30.45
7.2	1.939	5436	1.005	23.22	501.5	26.61	30.62
7.4	1.964	5649	1.008	24.44	534.2	27.22	30.78
7.6	1.984	5849	1.011	25.68	567.2	27.83	30.94
7.8	2.002	6039	1.014	26.95	601.2	28.46	31.10
8.0	2.016	6218	1.019	28.24	636.0	29.12	31.26
8.2	2.029	6388	1.023	29.55	671.7	29.80	31.41
8.4	2.038	6545	1.029	30.88	708.1	30.51	31.56
8.6	2.047	6698	1.034	32.25	745.6	31.21	31.72
8.8	2.055	6845	1.041	33.65	784.1	31.92	31.88
9.0	2.062	6984	1.047	35.06	823.6	32.66	32.03
9.2	2.068	7118	1.054	36.51	864.4	33.40	32.19
9.4	2.074	7248	1.062	37.99	906.5	34.16	32.35
9.6	2.080	7372	1.069	39.49	951.0	34.98	32.51
9.8	2.086	7494	1.078	41.03	996.9	35.80	32.67
10.0	2.092	7616	1.086	42.62	1046.9	36.70	32.83
10.2	2.099	7732	1.095	44.22	1097.4	37.59	32.99
10.4	2.106	7850	1.104	45.91	1151.7	38.53	33.16
10.6	2.114	7968	1.114	47.64	1209.3	39.52	33.32
10.8	2.122	8081	1.124	49.38	1269.4	40.54	33.49
11.0	2.131	8193	1.134	51.17	1332.3	41.58	33.66
11.2	2.140	8303	1.145	52.97	1399.5	42.70	33.82
11.4	2.149	8415	1.156	54.86	1470.7	43.85	34.00
11.6	2.159	8528	1.155	56.73	1544.3	45.04	34.16
11.8	2.169	8634	1.178	58.69	1622.0	46.25	34.34
12.0	2.181	8745	1.190	60.72	1703.2	47.46	34.51

contd./

Table 3 (contd.)

p_1 = 200 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	24.28
1.4	0.935	442	1.000	1.53	4.1	2.72	24.32
1.6	0.949	529	1.000	1.83	6.9	3.77	24.45
1.8	0.959	618	1.000	2.15	10.5	4.93	24.59
2.0	0.985	715	1.000	2.49	15.0	6.07	23.88
2.2	1.009	817	1.000	2.87	20.5	7.26	23.88
2.4	1.039	926	1.000	3.28	26.9	8.42	23.90
2.6	1.068	1038	1.000	3.71	34.1	9.52	25.37
2.8	1.097	1158	1.000	4.19	42.6	10.67	25.58
3.0	1.130	1284	1.000	4.70	52.0	11.74	25.80
3.2	1.166	1419	1.000	5.24	62.5	12.77	26.03
3.4	1.203	1558	1.000	5.81	73.7	13.72	26.26
3.6	1.237	1704	1.000	6.41	86.4	14.71	26.47
3.8	1.275	1861	1.000	7.06	100.4	15.65	26.70
4.0	1.313	2020	1.000	7.73	114.8	16.48	26.91
4.2	1.350	2187	1.000	8.45	131.0	17.38	27.12
4.4	1.390	2362	1.000	9.20	147.7	18.13	27.34
4.6	1.428	2539	1.000	9.97	165.7	18.92	27.54
4.8	1.471	2736	1.000	10.81	185.5	19.66	27.75
5.0	1.510	2928	1.000	11.64	205.7	20.37	27.95
5.2	1.552	3134	1.000	12.54	227.0	21.01	28.15
5.4	1.591	3343	1.000	13.44	251.1	21.78	28.33
5.6	1.636	3568	1.000	14.43	274.1	22.27	28.53
5.8	1.678	3792	1.000	15.41	298.8	22.85	28.72
6.0	1.718	4018	1.000	16.40	326.0	23.53	28.89
6.2	1.763	4264	1.000	17.50	351.8	23.92	29.08
6.4	1.804	4506	1.000	18.58	379.9	24.44	29.26
6.6	1.845	4751	1.001	19.71	409.0	24.94	29.43
6.8	1.882	4993	1.002	20.85	439.1	25.46	29.60
7.0	1.917	5235	1.003	22.04	470.1	25.97	29.76
7.2	1.949	5471	1.004	23.25	502.0	26.50	29.93
7.4	1.979	5701	1.006	24.48	534.8	27.04	30.09
7.6	2.004	5917	1.009	25.73	568.4	27.62	30.25
7.8	2.026	6125	1.012	27.01	602.8	28.21	30.40
8.0	2.044	6320	1.015	28.31	637.6	28.81	30.56
8.2	2.062	6507	1.020	29.65	670.5	29.30	30.72
8.4	2.073	6683	1.024	30.98	710.4	30.09	30.87
8.6	2.084	6848	1.030	32.35	748.1	30.77	31.02
8.8	2.094	7009	1.035	33.76	786.7	31.44	31.17
9.0	2.105	7159	1.041	35.15	824.7	32.08	31.32
9.2	2.113	7308	1.048	36.61	865.5	32.77	31.48
9.4	2.122	7452	1.055	38.10	907.4	33.47	31.63
9.6	2.130	7590	1.062	39.62	950.7	34.19	31.79
9.8	2.137	7727	1.070	41.20	998.4	35.01	31.94
10.0	2.145	7857	1.078	42.77	1045.5	35.79	32.10
10.2	2.153	7985	1.087	44.37	1094.8	36.60	32.25
10.4	2.161	8113	1.095	46.04	1148.4	37.47	32.41
10.6	2.169	8239	1.105	47.78	1203.8	38.36	32.57
10.8	2.179	8365	1.114	49.54	1262.3	39.28	32.74
11.0	2.190	8486	1.124	51.28	1321.5	40.18	32.90
11.2	2.198	8608	1.134	53.15	1387.2	41.20	33.06
11.4	2.209	8728	1.145	54.99	1455.2	42.24	33.23
11.6	2.220	8846	1.155	56.89	1524.9	43.27	33.39
11.8	2.231	8965	1.166	58.83	1601.1	44.41	33.56
12.0	2.243	9081	1.177	60.80	1677.3	45.49	33.72

contd./

Table 3 (contd.)

p_1 = 500 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	23.37
1.4	0.935	442	1.000	1.53	4.1	2.72	23.41
1.6	0.949	529	1.000	1.83	6.9	3.77	23.54
1.8	0.956	616	1.000	2.14	10.5	4.94	23.66
2.0	0.983	714	1.000	2.49	15.0	6.08	22.96
2.2	1.012	819	1.000	2.88	20.5	7.25	24.05
2.4	1.036	925	1.000	3.28	26.8	8.42	24.24
2.6	1.068	1038	1.000	3.71	34.1	9.53	24.45
2.8	1.097	1158	1.000	4.19	42.6	10.67	24.67
3.0	1.130	1284	1.000	4.70	52.0	11.74	24.89
3.2	1.166	1419	1.000	5.24	62.5	12.77	25.11
3.4	1.203	1558	1.000	5.81	73.7	13.72	25.34
3.6	1.237	1704	1.000	6.41	86.4	14.70	25.56
3.8	1.276	1862	1.000	7.07	100.3	15.62	25.78
4.0	1.313	2020	1.000	7.73	114.8	16.48	26.00
4.2	1.352	2190	1.000	8.46	131.0	17.35	26.21
4.4	1.388	2358	1.000	9.19	147.7	18.17	26.41
4.6	1.428	2540	1.000	9.97	165.7	18.92	26.62
4.8	1.470	2735	1.000	10.80	185.4	19.66	26.84
5.0	1.510	2929	1.000	11.64	205.7	20.37	27.03
5.2	1.551	3131	1.000	12.52	227.0	21.03	27.23
5.4	1.593	3343	1.000	13.44	249.6	21.65	27.42
5.6	1.635	3566	1.000	14.42	274.1	22.29	27.61
5.8	1.678	3792	1.000	15.41	298.8	22.85	27.80
6.0	1.722	4028	1.000	16.44	324.8	23.39	27.99
6.2	1.764	4266	1.000	17.50	351.8	23.91	28.16
6.4	1.806	4510	1.000	18.58	379.9	24.43	28.34
6.6	1.848	4761	1.001	19.72	409.2	24.91	28.51
6.8	1.887	5010	1.001	20.87	439.3	25.40	28.68
7.0	1.926	5263	1.002	22.06	470.3	25.87	28.85
7.2	1.961	5510	1.003	23.28	502.6	26.38	29.01
7.4	1.994	5753	1.004	24.51	535.5	26.88	29.17
7.6	2.026	5994	1.006	25.79	569.7	27.39	29.33
7.8	2.052	6222	1.009	27.08	604.4	27.93	29.49
8.0	2.076	6440	1.012	28.40	639.8	28.48	29.64
8.2	2.096	6649	1.015	29.74	676.2	29.05	29.79
8.4	2.115	6848	1.019	31.10	713.5	29.64	29.94
8.6	2.131	7039	1.024	32.49	751.3	30.24	30.09
8.8	2.146	7217	1.029	33.88	788.6	30.81	30.24
9.0	2.158	7389	1.034	35.32	828.3	31.44	30.39
9.2	2.171	7559	1.040	36.79	869.2	32.06	30.54
9.4	2.182	7721	1.046	38.29	911.0	32.71	30.69
9.6	2.193	7879	1.053	39.81	954.2	33.35	30.84
9.8	2.203	8032	1.060	41.38	998.7	34.02	30.99
10.0	2.215	8183	1.068	42.99	1045.1	34.69	31.14
10.2	2.225	8332	1.076	44.65	1095.1	35.43	31.30
10.4	2.234	8470	1.084	46.27	1145.5	36.20	31.44
10.6	2.237	8596	1.090	47.93	1197.0	37.04	31.56
10.8	2.255	8750	1.101	49.71	1254.0	37.75	31.75
11.0	2.267	8889	1.110	51.51	1312.7	38.58	31.91
11.2	2.279	9026	1.120	53.35	1374.3	39.43	32.07
11.4	2.291	9158	1.130	55.17	1435.8	40.25	32.22
11.6	2.303	9293	1.140	57.10	1505.7	41.23	32.38
11.8	2.316	9426	1.150	59.04	1575.3	42.14	32.54
12.0	2.329	9556	1.161	60.99	1648.9	43.12	32.69

contd./

Table 3 (contd.)

p_1 = 1000 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	T_{51}	S_5/R_o
1.2	0.961	368	1.000	1.27	2.3	1.77	22.67
1.4	0.935	442	1.000	1.53	4.1	2.72	22.71
1.6	0.949	529	1.000	1.83	6.9	3.77	22.84
1.8	0.959	618	1.000	2.15	10.5	4.93	22.98
2.0	0.983	714	1.000	2.49	14.9	6.07	23.16
2.2	1.009	817	1.000	2.87	20.5	7.26	22.27
2.4	1.038	926	1.000	3.28	26.9	8.41	23.55
2.6	1.068	1041	1.000	3.73	34.4	9.58	23.76
2.8	1.097	1158	1.000	4.19	42.6	10.67	23.97
3.0	1.130	1284	1.000	4.70	52.0	11.74	24.20
3.2	1.166	1419	1.000	5.24	62.5	12.77	24.42
3.4	1.203	1558	1.000	5.81	73.7	13.72	24.65
3.6	1.237	1704	1.000	6.41	86.4	14.71	24.86
3.8	1.276	1862	1.000	7.06	100.5	15.66	25.09
4.0	1.313	2020	1.000	7.73	114.8	16.48	25.31
4.2	1.349	2186	1.000	8.45	131.0	17.38	25.51
4.4	1.389	2360	1.000	9.19	147.8	18.16	25.73
4.6	1.431	2544	1.000	9.97	165.7	18.89	25.94
4.8	1.470	2735	1.000	10.80	185.5	19.66	26.14
5.0	1.510	2928	1.000	11.64	205.7	20.37	26.34
5.2	1.551	3132	1.000	12.52	227.1	21.02	26.54
5.4	1.593	3343	1.000	13.44	249.5	21.65	26.73
5.6	1.637	3569	1.000	14.43	274.1	22.27	26.92
5.8	1.679	3794	1.000	15.41	298.8	22.84	27.11
6.0	1.721	4025	1.000	16.43	325.1	23.42	27.29
6.2	1.765	4269	1.000	17.50	351.9	23.90	27.47
6.4	1.807	4512	1.000	18.58	380.0	24.42	27.65
6.6	1.849	4766	1.000	19.72	409.2	24.89	27.82
6.8	1.890	5019	1.001	20.87	439.5	25.37	27.99
7.0	1.931	5278	1.001	22.07	470.8	25.83	28.16
7.2	1.969	5535	1.002	23.30	503.1	26.31	28.32
7.4	2.004	5786	1.003	24.54	536.2	26.79	28.48
7.6	2.037	6036	1.005	25.81	570.3	27.27	28.63
7.8	2.069	6284	1.007	27.13	605.3	27.75	28.79
8.0	2.096	6519	1.009	28.46	640.9	28.25	28.95
8.2	2.121	6744	1.012	29.81	677.9	28.80	29.10
8.4	2.143	6960	1.016	31.18	715.2	29.34	29.25
8.6	2.163	7169	1.020	32.59	753.4	29.89	29.40
8.8	2.181	7365	1.024	33.98	791.1	30.42	29.54
9.0	2.198	7559	1.029	35.44	831.0	30.99	29.69
9.2	2.213	7746	1.034	36.92	872.2	31.57	29.84
9.4	2.225	7920	1.040	38.43	914.0	32.18	29.98
9.6	2.239	8095	1.046	39.97	957.2	32.78	30.13
9.8	2.252	8263	1.053	41.54	1001.5	33.39	30.27
10.0	2.264	8426	1.060	43.14	1047.2	34.01	30.42
10.2	2.276	8586	1.067	44.76	1095.4	34.68	30.57
10.4	2.287	8739	1.074	46.41	1144.4	35.36	30.70
10.6	2.309	8917	1.084	48.20	1198.7	35.96	30.90
10.8	2.314	9051	1.091	49.86	1251.2	36.75	31.01
11.0	2.327	9206	1.100	51.67	1308.9	37.49	31.17
11.2	2.341	9353	1.109	53.48	1365.9	38.20	31.32
11.4	2.354	9499	1.118	55.36	1428.3	39.00	31.47
11.6	2.367	9645	1.127	57.26	1492.8	39.81	31.62
11.8	2.381	9789	1.137	59.20	1560.2	40.64	31.77
12.0	2.396	9933	1.147	61.17	1631.1	41.50	31.92

contd./

Table 3 (contd.)

p_1 = 2000 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_6	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.961	368	1.000	1.27	2.3	1.77	21.98
1.4	0.935	442	1.000	1.53	4.1	2.72	22.02
1.6	0.949	529	1.000	1.83	6.9	3.77	22.15
1.8	0.959	618	1.000	2.15	10.5	4.92	22.29
2.0	0.983	714	1.000	2.49	15.0	6.08	21.57
2.2	1.009	817	1.000	2.88	20.5	7.27	22.65
2.4	1.036	935	1.000	3.28	26.8	8.42	22.86
2.6	1.068	1038	1.000	3.71	34.1	9.53	23.07
2.8	1.098	1159	1.000	4.19	42.6	10.66	23.28
3.0	1.132	1287	1.000	4.71	51.9	11.70	23.51
3.2	1.167	1421	1.000	5.24	62.5	12.76	23.73
3.4	1.201	1557	1.000	5.81	73.7	13.73	23.95
3.6	1.237	1704	1.000	6.41	86.4	14.70	24.17
3.8	1.277	1863	1.000	7.07	100.3	15.61	24.40
4.0	1.313	2020	1.000	7.73	114.8	16.48	24.61
4.2	1.350	2188	1.000	8.46	131.0	17.36	24.82
4.4	1.391	2363	1.000	9.19	147.8	18.14	25.04
4.6	1.431	2544	1.000	9.97	165.8	18.90	25.24
4.8	1.470	2735	1.000	10.80	185.4	19.66	25.45
5.0	1.510	2929	1.000	11.64	205.8	20.38	25.65
5.2	1.551	3132	1.000	12.52	227.0	21.02	25.84
5.4	1.593	3343	1.000	13.44	249.5	21.65	26.04
5.6	1.636	3567	1.000	14.42	274.1	22.28	26.23
5.8	1.678	3792	1.000	15.41	298.8	22.85	26.41
6.0	1.722	4028	1.000	16.44	324.8	23.39	26.60
6.2	1.766	4270	1.000	17.50	351.9	23.90	26.78
6.4	1.807	4514	1.000	18.59	380.0	24.41	26.95
6.6	1.851	4770	1.000	19.73	409.3	24.88	27.13
6.8	1.893	5028	1.001	20.89	439.5	25.33	27.30
7.0	1.934	5289	1.001	22.08	470.9	25.80	27.46
7.2	1.974	5552	1.001	23.31	503.3	26.25	27.63
7.4	2.012	5813	1.002	24.56	536.7	26.71	27.79
7.6	2.046	6070	1.004	25.83	571.1	27.19	27.94
7.8	2.080	6327	1.005	27.15	606.2	27.65	28.09
8.0	2.113	6583	1.007	28.50	642.2	28.09	28.25
8.2	2.142	6826	1.010	29.87	679.1	28.58	28.40
8.4	2.167	7061	1.012	31.25	716.8	29.08	28.55
8.6	2.191	7287	1.016	32.67	755.4	29.59	28.70
8.8	2.213	7502	1.020	34.08	793.3	30.08	28.84
9.0	2.233	7713	1.024	35.55	833.5	30.61	28.99
9.2	2.251	7917	1.029	37.03	874.8	31.15	29.13
9.4	2.269	8117	1.034	38.57	917.0	31.69	29.28
9.6	2.283	8304	1.040	40.11	960.1	32.26	29.42
9.8	2.298	8488	1.045	41.69	1004.5	32.82	29.56
10.0	2.314	8672	1.052	43.31	1050.2	33.38	29.71
10.2	2.327	8845	1.059	44.95	1097.0	33.98	29.85
10.4	2.341	9016	1.065	46.60	1146.2	34.61	29.98
10.6	2.356	9186	1.073	48.30	1196.6	35.21	30.13
10.8	2.375	9370	1.081	50.11	1251.6	35.82	30.29
11.0	2.388	9528	1.089	51.85	1305.7	36.49	30.43
11.2	2.402	9687	1.097	53.64	1362.0	37.16	30.57
11.4	2.417	9851	1.106	55.54	1422.1	37.84	30.72
11.6	2.432	10012	1.116	57.46	1485.1	38.56	30.87
11.8	2.448	10165	1.125	59.37	1548.2	39.28	31.01
12.0	2.463	10321	1.134	61.35	1615.9	40.03	31.16

Table 4/

Table 4. Incident Normal Shock in Oxygen

p_1 = 1 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.26	1.12	2.12	1.695	0.57	0.514
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.310	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.837	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.073	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	872	1.000	3.19	1.69	13.55	4.505	2.65	1.566
3.6	941	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.666
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.208	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1327	1.000	5.08	2.07	25.16	5.497	3.76	1.820
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.750	4.13	1.881
5.2	1597	1.000	6.23	2.26	32.31	5.866	4.31	1.908
5.4	1693	1.000	6.65	2.32	34.89	5.978	4.50	1.936
5.6	1790	1.000	7.08	2.38	37.58	6.088	4.68	1.965
5.8	1886	1.001	7.52	2.43	40.39	6.207	4.87	1.998
6.0	1985	1.001	7.99	2.48	43.29	6.317	5.05	2.033
6.2	2078	1.002	8.48	2.52	46.33	6.450	5.24	2.075
6.4	2166	1.004	8.98	2.56	49.51	6.600	5.43	2.123
6.6	2245	1.007	9.47	2.59	52.83	6.779	5.63	2.174
6.8	2318	1.010	10.00	2.62	56.28	6.972	5.82	2.227
7.0	2383	1.014	10.55	2.64	59.87	7.184	6.03	2.280
7.2	2445	1.019	11.14	2.67	63.57	7.399	6.23	2.332
7.4	2500	1.025	11.72	2.70	67.41	7.632	6.43	2.384
7.6	2552	1.031	12.34	2.73	71.37	7.867	6.63	2.433
7.8	2600	1.037	12.94	2.75	75.45	8.113	6.84	2.483
8.0	2645	1.044	13.57	2.78	79.64	8.363	7.04	2.531
8.2	2687	1.052	14.21	2.81	83.95	8.615	7.25	2.579
8.4	2727	1.060	14.88	2.84	88.38	8.869	7.45	2.625
8.6	2765	1.068	15.56	2.87	92.91	9.124	7.66	2.670
8.8	2802	1.077	16.25	2.90	97.56	9.380	7.86	2.714
9.0	2836	1.086	16.96	2.92	102.32	9.637	8.07	2.758
9.2	2871	1.095	17.68	2.95	107.19	9.889	8.27	2.799
9.4	2903	1.105	18.44	2.98	112.16	10.140	8.47	2.840
9.6	2935	1.115	19.19	3.01	117.25	10.394	8.68	2.880
9.8	2965	1.125	19.96	3.04	122.45	10.643	8.88	2.919
10.0	2995	1.136	20.75	3.07	127.75	10.890	9.08	2.957
10.2	3024	1.147	21.56	3.10	133.17	11.135	9.28	2.994
10.4	3054	1.158	22.38	3.13	138.69	11.373	9.49	3.029
10.6	3082	1.170	23.22	3.16	144.31	11.610	9.69	3.064
10.8	3110	1.182	24.07	3.19	150.05	11.844	9.89	3.097
11.0	3137	1.194	24.93	3.22	155.90	12.076	10.09	3.130
11.2	3163	1.206	25.82	3.25	161.85	12.303	10.29	3.162
11.4	3189	1.219	26.72	3.29	167.90	12.526	10.49	3.193
11.6	3216	1.232	27.63	3.32	174.07	12.743	10.69	3.222
11.8	3241	1.245	28.58	3.35	180.34	12.957	10.89	3.251
12.0	3267	1.259	29.52	3.38	186.72	13.167	11.09	3.279

contd./

Table 4 (contd.)

p_1 = 2 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.57	0.515
1.6	401	1.000	1.39	1.17	2.83	2.045	0.82	0.699
1.8	441	1.000	1.53	1.22	3.62	2.384	1.04	0.853
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.016	1.47	1.101
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.090	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.96	4.290	2.45	1.507
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	940	1.000	3.46	1.75	15.24	4.700	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.881	3.02	1.667
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.208	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.358	3.58	1.787
4.6	1328	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1414	1.000	5.44	2.13	27.45	5.631	3.95	1.852
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1597	1.000	6.23	2.26	32.30	5.865	4.31	1.908
5.4	1693	1.000	6.65	2.32	34.89	5.975	4.50	1.934
5.6	1791	1.000	7.08	2.39	37.57	6.081	4.68	1.961
5.8	1891	1.000	7.53	2.44	40.36	6.186	4.86	1.990
6.0	1991	1.001	8.00	2.50	43.26	6.295	5.05	2.022
6.2	2086	1.002	8.47	2.54	46.30	6.425	5.24	2.062
6.4	2178	1.003	8.97	2.58	49.46	6.565	5.43	2.105
6.6	2265	1.005	9.49	2.61	52.74	6.715	5.62	2.152
6.8	2346	1.008	10.03	2.64	56.16	6.885	5.81	2.200
7.0	2419	1.012	10.57	2.67	59.73	7.077	6.01	2.250
7.2	2485	1.016	11.12	2.70	63.42	7.285	6.21	2.300
7.4	2546	1.021	11.72	2.73	67.24	7.498	6.41	2.350
7.6	2602	1.027	12.30	2.76	71.18	7.727	6.62	2.400
7.8	2654	1.033	12.92	2.79	75.24	7.958	6.82	2.448
8.0	2703	1.040	13.56	2.82	79.42	8.195	7.02	2.495
8.2	2749	1.047	14.21	2.84	83.72	8.435	7.23	2.541
8.4	2792	1.055	14.88	2.87	88.13	8.678	7.43	2.586
8.6	2834	1.063	15.56	2.90	92.66	8.922	7.64	2.630
8.8	2873	1.071	16.25	2.93	97.29	9.168	7.84	2.674
9.0	2911	1.080	16.95	2.96	102.04	9.413	8.04	2.716
9.2	2948	1.089	17.67	2.99	106.90	9.658	8.25	2.757
9.4	2983	1.098	18.42	3.02	111.87	9.901	8.45	2.797
9.6	3017	1.108	19.18	3.05	116.94	10.142	8.65	2.835
9.8	3051	1.119	19.97	3.08	122.13	10.378	8.86	2.873
10.0	3083	1.129	20.74	3.11	127.43	10.619	9.06	2.910
10.2	3114	1.140	21.56	3.14	132.83	10.850	9.26	2.945
10.4	3145	1.151	22.38	3.17	138.33	11.080	9.46	2.980
10.6	3176	1.162	23.21	3.21	143.95	11.309	9.66	3.014
10.8	3207	1.174	24.05	3.24	149.68	11.534	9.86	3.047
11.0	3235	1.186	24.93	3.27	155.51	11.754	10.06	3.078
11.2	3265	1.198	25.80	3.30	161.45	11.972	10.26	3.109
11.4	3293	1.211	26.72	3.33	167.50	12.183	10.46	3.139
11.6	3322	1.223	27.63	3.37	173.65	12.392	10.66	3.167
11.8	3350	1.237	28.56	3.40	179.91	12.597	10.86	3.195
12.0	3377	1.250	29.51	3.43	186.28	12.797	11.06	3.222

Table 4 (contd.)

p_1 = 5 mm Hg T_1 = 290°K

W_{11}	T_2°K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.13	1.699	0.58	0.516
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	941	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.667
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1328	1.000	5.08	2.07	25.16	5.494	3.76	1.820
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1505	1.000	5.83	2.20	29.82	5.748	4.13	1.880
5.2	1597	1.000	6.23	2.26	32.31	5.865	4.31	1.908
5.4	1694	1.000	6.65	2.33	34.89	5.973	4.50	1.933
5.6	1792	1.000	7.08	2.39	37.57	6.079	4.68	1.959
5.8	1893	1.000	7.53	2.45	40.36	6.181	4.86	1.985
6.0	1995	1.001	8.00	2.51	43.25	6.284	5.05	2.014
6.2	2094	1.001	8.47	2.55	46.27	6.401	5.23	2.048
6.4	2192	1.002	8.97	2.60	49.40	6.522	5.42	2.085
6.6	2285	1.004	9.48	2.64	52.66	6.658	5.61	2.127
6.8	2373	1.006	10.03	2.67	56.06	6.808	5.80	2.173
7.0	2456	1.009	10.57	2.70	59.58	6.971	6.00	2.217
7.2	2531	1.013	11.13	2.74	63.24	7.156	6.19	2.264
7.4	2599	1.017	11.70	2.77	67.04	7.355	6.39	2.311
7.6	2662	1.022	12.30	2.80	70.96	7.562	6.60	2.359
7.8	2721	1.028	12.91	2.83	74.99	7.775	6.80	2.404
8.0	2777	1.034	13.54	2.86	79.15	7.993	7.00	2.449
8.2	2830	1.041	14.19	2.89	83.42	8.216	7.20	2.493
8.4	2878	1.048	14.84	2.92	87.82	8.447	7.41	2.538
8.6	2924	1.055	15.52	2.95	92.33	8.676	7.61	2.580
8.8	2968	1.064	16.23	2.98	96.95	8.905	7.81	2.621
9.0	3011	1.072	16.93	3.01	101.68	9.135	8.01	2.662
9.2	3052	1.081	17.68	3.04	106.51	9.361	8.22	2.701
9.4	3092	1.090	18.41	3.07	111.47	9.590	8.42	2.739
9.6	3130	1.099	19.17	3.11	116.53	9.818	8.62	2.777
9.8	3168	1.109	19.94	3.14	121.70	10.044	8.82	2.813
10.0	3204	1.120	20.73	3.17	126.98	10.267	9.03	2.848
10.2	3239	1.130	21.54	3.20	132.36	10.487	9.23	2.882
10.4	3274	1.141	22.36	3.23	137.86	10.704	9.43	2.916
10.6	3308	1.152	23.20	3.27	143.46	10.918	9.63	2.948
10.8	3342	1.163	24.05	3.30	149.16	11.128	9.83	2.979
11.0	3374	1.175	24.92	3.33	154.98	11.337	10.03	3.010
11.2	3406	1.187	25.80	3.37	160.91	11.542	10.23	3.039
11.4	3438	1.199	26.69	3.40	166.94	11.742	10.43	3.067
11.6	3470	1.212	27.61	3.43	173.07	11.937	10.63	3.095
11.8	3501	1.225	28.55	3.47	179.31	12.129	10.83	3.121
12.0	3532	1.238	29.49	3.50	185.66	12.316	11.03	3.147

contd./

Table 4 (contd.)

p_1 = 10 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.57	0.515
1.6	400	1.000	1.39	1.17	2.83	2.050	0.82	0.701
1.8	441	1.000	1.53	1.22	3.63	2.388	1.05	0.855
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.018	1.47	1.101
2.4	579	1.000	2.04	1.39	6.61	3.311	1.68	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.073	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.297	2.46	1.508
3.4	872	1.000	3.19	1.69	13.55	4.506	2.65	1.566
3.6	941	1.000	3.47	1.75	15.24	4.698	2.83	1.618
3.8	1012	1.000	3.76	1.81	17.02	4.879	3.02	1.666
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1243	1.000	4.72	2.00	22.98	5.363	3.58	1.788
4.6	1328	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1415	1.000	5.45	2.13	27.44	5.625	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1598	1.000	6.23	2.26	32.30	5.864	4.31	1.907
5.4	1693	1.000	6.64	2.33	34.89	5.974	4.50	1.933
5.6	1792	1.000	7.08	2.39	37.57	6.078	4.68	1.958
5.8	1894	1.000	7.53	2.45	40.35	6.179	4.86	1.983
6.0	1997	1.000	7.99	2.51	43.24	6.278	5.04	2.009
6.2	2100	1.001	8.48	2.56	46.24	6.380	5.23	2.038
6.4	2199	1.002	8.97	2.61	49.37	6.500	5.42	2.074
6.6	2296	1.003	9.48	2.65	52.62	6.626	5.60	2.111
6.8	2390	1.005	10.01	2.69	55.99	6.760	5.79	2.152
7.0	2478	1.008	10.57	2.73	59.49	6.912	5.99	2.196
7.2	2561	1.011	11.13	2.76	63.13	7.074	6.18	2.238
7.4	2636	1.014	11.70	2.79	66.89	7.256	6.38	2.283
7.6	2705	1.019	12.29	2.83	70.79	7.449	6.58	2.328
7.8	2771	1.024	12.92	2.86	74.81	7.645	6.78	2.372
8.0	2831	1.030	13.54	2.89	78.95	7.854	6.98	2.417
8.2	2888	1.036	14.18	2.92	83.21	8.064	7.18	2.459
8.4	2942	1.043	14.84	2.95	87.58	8.277	7.39	2.501
8.6	2994	1.050	15.52	2.98	92.07	8.493	7.59	2.542
8.8	3043	1.058	16.21	3.02	96.68	8.711	7.79	2.582
9.0	3089	1.066	16.93	3.05	101.39	8.929	7.99	2.621
9.2	3134	1.074	17.65	3.08	106.22	9.148	8.19	2.659
9.4	3177	1.083	18.40	3.11	111.16	9.366	8.40	2.696
9.6	3219	1.093	19.16	3.15	116.20	9.582	8.60	2.733
9.8	3260	1.102	19.93	3.18	121.36	9.797	8.80	2.768
10.0	3299	1.112	20.72	3.21	126.63	10.009	9.00	2.802
10.2	3338	1.122	21.53	3.25	132.00	10.219	9.20	2.835
10.4	3376	1.133	22.35	3.28	137.48	10.425	9.40	2.867
10.6	3413	1.143	23.17	3.31	143.07	10.633	9.60	2.899
10.8	3449	1.155	24.04	3.35	148.76	10.831	9.80	2.928
11.0	3485	1.166	24.91	3.38	154.57	11.028	10.00	2.957
11.2	3521	1.178	25.79	3.42	160.48	11.222	10.20	2.986
11.4	3555	1.190	26.69	3.45	166.49	11.414	10.40	3.013
11.6	3589	1.202	27.61	3.49	172.62	11.601	10.60	3.040
11.8	3623	1.215	28.54	3.52	178.84	11.783	10.80	3.065
12.0	3657	1.228	29.48	3.56	185.18	11.962	11.00	3.090

contd./

Table 4 (contd.)

p_1 = 25 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.58	0.516
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.835	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	941	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.667
4.0	1086	1.000	4.06	1.88	18.91	5.048	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1326	1.000	5.07	2.07	25.17	5.504	3.76	1.822
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1505	1.000	5.83	2.20	29.82	5.748	4.13	1.880
5.2	1598	1.000	6.23	2.26	32.30	5.864	4.31	1.907
5.4	1694	1.000	6.65	2.33	34.88	5.973	4.50	1.933
5.6	1793	1.000	7.08	2.39	37.57	6.077	4.68	1.957
5.8	1894	1.000	7.53	2.45	40.35	6.176	4.86	1.981
6.0	1998	1.000	7.99	2.52	43.24	6.273	5.04	2.005
6.2	2103	1.001	8.47	2.57	46.23	6.370	5.23	2.031
6.4	2206	1.001	8.97	2.62	49.34	6.478	5.41	2.062
6.6	2308	1.002	9.47	2.67	52.57	6.591	5.60	2.095
6.8	2409	1.003	10.01	2.72	55.92	6.709	5.79	2.130
7.0	2504	1.005	10.56	2.76	59.39	6.841	5.98	2.168
7.2	2595	1.008	11.12	2.79	62.99	6.985	6.17	2.208
7.4	2681	1.011	11.71	2.83	66.72	7.138	6.36	2.248
7.6	2759	1.015	12.30	2.86	70.59	7.311	6.56	2.290
7.8	2832	1.019	12.89	2.90	74.58	7.494	6.76	2.332
8.0	2900	1.024	13.52	2.93	78.70	7.682	6.96	2.374
8.2	2965	1.030	14.17	2.96	82.93	7.874	7.16	2.415
8.4	3026	1.036	14.83	3.00	87.28	8.070	7.36	2.454
8.6	3085	1.043	15.51	3.03	91.74	8.268	7.56	2.493
8.8	3139	1.050	16.20	3.07	96.33	8.474	7.76	2.532
9.0	3192	1.058	16.91	3.10	101.02	8.676	7.96	2.569
9.2	3243	1.066	17.63	3.13	105.83	8.879	8.16	2.606
9.4	3292	1.074	18.38	3.17	110.74	9.082	8.36	2.641
9.6	3340	1.083	19.14	3.20	115.77	9.280	8.57	2.675
9.8	3386	1.092	19.92	3.24	120.90	9.481	8.77	2.709
10.0	3431	1.102	20.71	3.27	126.15	9.680	8.97	2.741
10.2	3474	1.112	21.51	3.31	131.51	9.877	9.17	2.773
10.4	3517	1.121	22.32	3.34	136.97	10.071	9.37	2.804
10.6	3558	1.132	23.17	3.38	142.54	10.262	9.57	2.833
10.8	3599	1.143	24.02	3.41	148.22	10.450	9.77	2.862
11.0	3639	1.154	24.88	3.45	154.00	10.635	9.97	2.890
11.2	3679	1.165	25.77	3.49	159.89	10.815	10.16	2.916
11.4	3719	1.177	26.67	3.52	165.88	10.992	10.36	2.942
11.6	3757	1.189	27.60	3.56	171.98	11.165	10.56	2.967
11.8	3794	1.201	28.52	3.60	178.20	11.337	10.76	2.992
12.0	3832	1.214	29.47	3.63	184.51	11.504	10.96	3.015

contd./

Table 4 (contd.)

p_1 = 50 mm Hg T_1 = 290°K

W_{11}	T_2°K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.57	0.515
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.388	1.05	0.855
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.017	1.47	1.101
2.4	579	1.000	2.04	1.39	6.61	3.308	1.67	1.203
2.6	631	1.000	2.24	1.45	7.80	3.583	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.69	1.57	10.48	4.073	2.26	1.444
3.2	807	1.000	2.93	1.63	11.97	4.298	2.46	1.508
3.4	872	1.000	3.19	1.69	13.55	4.505	2.65	1.566
3.6	941	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1011	1.000	3.75	1.81	17.03	4.883	3.02	1.667
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1241	1.000	4.71	2.00	22.99	5.372	3.58	1.790
4.6	1328	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1415	1.000	5.45	2.13	27.44	5.623	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1599	1.000	6.23	2.26	32.30	5.859	4.31	1.906
5.4	1693	1.000	6.64	2.33	34.89	5.975	4.50	1.933
5.6	1793	1.000	7.08	2.39	37.57	6.076	4.68	1.957
5.8	1895	1.000	7.53	2.46	40.35	6.174	4.86	1.980
6.0	1999	1.000	7.99	2.52	43.23	6.270	5.04	2.003
6.2	2105	1.000	8.47	2.58	46.22	6.365	5.23	2.028
6.4	2212	1.001	8.97	2.63	49.32	6.460	5.41	2.054
6.6	2316	1.001	9.48	2.68	52.54	6.569	5.60	2.085
6.8	2420	1.003	10.01	2.73	55.88	6.680	5.78	2.117
7.0	2519	1.004	10.54	2.78	59.34	6.803	5.97	2.152
7.2	2616	1.006	11.12	2.82	62.91	6.931	6.16	2.188
7.4	2707	1.009	11.70	2.85	66.62	7.074	6.35	2.226
7.6	2794	1.012	12.30	2.89	70.46	7.224	6.55	2.265
7.8	2874	1.016	12.90	2.93	74.42	7.390	6.74	2.304
8.0	2949	1.021	13.52	2.96	78.52	7.565	6.94	2.344
8.2	3022	1.026	14.16	3.00	82.72	7.741	7.14	2.382
8.4	3087	1.032	14.83	3.03	87.06	7.927	7.34	2.421
8.6	3151	1.038	15.50	3.07	91.50	8.113	7.54	2.458
8.8	3213	1.044	16.20	3.10	96.06	8.302	7.74	2.495
9.0	3271	1.052	16.90	3.14	100.74	8.492	7.94	2.531
9.2	3327	1.059	17.63	3.17	105.53	8.683	8.14	2.566
9.4	3381	1.067	18.37	3.21	110.43	8.874	8.34	2.600
9.6	3433	1.076	19.13	3.24	115.44	9.065	8.54	2.633
9.8	3484	1.084	19.91	3.28	120.56	9.254	8.74	2.665
10.0	3533	1.094	20.70	3.32	125.79	9.442	8.94	2.696
10.2	3581	1.103	21.50	3.35	131.13	9.628	9.14	2.727
10.4	3627	1.113	22.32	3.39	136.57	9.812	9.34	2.756
10.6	3674	1.123	23.15	3.43	142.13	9.993	9.54	2.785
10.8	3718	1.133	24.01	3.46	147.79	10.171	9.74	2.812
11.0	3763	1.144	24.87	3.50	153.55	10.344	9.94	2.839
11.2	3805	1.155	25.76	3.54	159.43	10.518	10.14	2.865
11.4	3849	1.167	26.66	3.58	165.41	10.684	10.33	2.889
11.6	3891	1.178	27.57	3.61	171.49	10.849	10.53	2.913
11.8	3933	1.190	28.50	3.65	177.69	11.010	10.73	2.936
12.0	3974	1.202	29.45	3.69	183.98	11.166	10.93	2.958

contd./

Table 4 (contd.)

p_1 = 100 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.343	0.31	0.289
1.4	363	1.000	1.25	1.12	2.12	1.696	0.57	0.515
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	940	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.667
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1325	1.000	5.07	2.07	25.17	5.507	3.76	1.823
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1598	1.000	6.23	2.26	32.30	5.864	4.31	1.907
5.4	1694	1.000	6.65	2.33	34.88	5.973	4.50	1.932
5.6	1793	1.000	7.08	2.39	37.57	6.076	4.68	1.956
5.8	1895	1.000	7.53	2.46	40.35	6.174	4.86	1.979
6.0	2000	1.000	7.99	2.52	43.23	6.268	5.04	2.002
6.2	2106	1.000	8.47	2.58	46.22	6.361	5.23	2.025
6.4	2215	1.001	8.97	2.64	49.31	6.453	5.41	2.049
6.6	2321	1.001	9.48	2.69	52.52	6.555	5.59	2.077
6.8	2428	1.002	10.01	2.74	55.84	6.657	5.78	2.106
7.0	2532	1.003	10.54	2.79	59.29	6.769	5.97	2.137
7.2	2633	1.005	11.10	2.84	62.85	6.890	6.15	2.171
7.4	2732	1.007	11.69	2.88	66.53	7.014	6.34	2.206
7.6	2824	1.010	12.29	2.92	70.34	7.152	6.54	2.241
7.8	2913	1.013	12.90	2.96	74.28	7.297	6.73	2.278
8.0	2995	1.017	13.52	2.99	78.35	7.457	6.93	2.315
8.2	3073	1.022	14.16	3.03	82.54	7.624	7.12	2.352
8.4	3148	1.027	14.81	3.07	86.84	7.791	7.32	2.388
8.6	3218	1.032	15.48	3.10	91.27	7.968	7.52	2.424
8.8	3284	1.039	16.19	3.14	95.81	8.143	7.72	2.459
9.0	3349	1.046	16.90	3.18	100.47	8.321	7.92	2.494
9.2	3411	1.053	17.62	3.21	105.23	8.500	8.12	2.527
9.4	3470	1.060	18.36	3.25	110.12	8.679	8.32	2.560
9.6	3528	1.068	19.12	3.29	115.11	8.858	8.52	2.591
9.8	3583	1.077	19.90	3.32	120.21	9.037	8.72	2.622
10.0	3637	1.085	20.68	3.36	125.42	9.214	8.91	2.652
10.2	3690	1.094	21.49	3.40	130.74	9.389	9.11	2.681
10.4	3741	1.104	22.31	3.44	136.17	9.562	9.31	2.709
10.6	3793	1.113	23.13	3.48	141.71	9.733	9.51	2.737
10.8	3842	1.123	23.99	3.51	147.35	9.902	9.71	2.763
11.0	3890	1.134	24.87	3.55	153.10	10.064	9.91	2.788
11.2	3937	1.145	25.75	3.59	158.96	10.228	10.10	2.813
11.4	3985	1.156	26.65	3.63	164.92	10.385	10.30	2.837
11.6	4031	1.167	27.56	3.67	170.99	10.542	10.50	2.860
11.8	4077	1.179	28.49	3.71	177.16	10.692	10.70	2.882
12.0	4123	1.190	29.44	3.75	183.44	10.840	10.89	2.903

contd./

Table 4 (contd.)

p_1 = 200 mm Hg T_1 = 290°K

W_{11}	T_2 °K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.57	0.515
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.019	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.316	1.68	1.205
2.6	631	1.000	2.24	1.45	7.81	3.591	1.88	1.295
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.69	1.57	10.48	4.073	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.502	2.64	1.566
3.6	941	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1013	1.000	3.76	1.81	17.01	4.869	3.02	1.664
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.208	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.358	3.58	1.787
4.6	1328	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1416	1.000	5.45	2.13	27.43	5.617	3.95	1.849
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1597	1.000	6.23	2.26	32.31	5.868	4.31	1.908
5.4	1693	1.000	6.64	2.33	34.89	5.974	4.50	1.932
5.6	1793	1.000	7.08	2.39	37.56	6.075	4.68	1.956
5.8	1895	1.000	7.53	2.46	40.35	6.173	4.86	1.979
6.0	2000	1.000	7.99	2.52	43.23	6.267	5.04	2.001
6.2	2107	1.000	8.47	2.58	46.21	6.358	5.22	2.023
6.4	2216	1.000	8.97	2.64	49.30	6.448	5.41	2.045
6.6	2327	1.001	9.48	2.70	52.50	6.538	5.59	2.069
6.8	2435	1.001	10.00	2.75	55.82	6.640	5.78	2.097
7.0	2543	1.002	10.55	2.80	59.24	6.741	5.96	2.125
7.2	2648	1.004	11.10	2.85	62.79	6.852	6.15	2.156
7.4	2752	1.005	11.69	2.90	66.46	6.966	6.34	2.187
7.6	2851	1.008	12.29	2.94	70.25	7.090	6.53	2.221
7.8	2946	1.011	12.89	2.98	74.16	7.224	6.72	2.254
8.0	3037	1.014	13.53	3.02	78.19	7.362	6.91	2.288
8.2	3122	1.018	14.16	3.06	82.36	7.515	7.11	2.323
8.4	3202	1.023	14.81	3.10	86.65	7.673	7.31	2.358
8.6	3281	1.028	15.49	3.14	91.04	7.831	7.50	2.391
8.8	3354	1.034	16.19	3.18	95.56	7.993	7.70	2.425
9.0	3424	1.040	16.89	3.21	100.20	8.163	7.90	2.458
9.2	3493	1.046	17.61	3.25	104.95	8.329	8.10	2.490
9.4	3558	1.053	18.35	3.29	109.81	8.496	8.29	2.521
9.6	3622	1.061	19.11	3.33	114.78	8.664	8.49	2.551
9.8	3684	1.069	19.88	3.37	119.86	8.831	8.69	2.581
10.0	3743	1.077	20.68	3.41	125.06	8.996	8.89	2.609
10.2	3801	1.086	21.48	3.45	130.36	9.161	9.09	2.637
10.4	3859	1.094	22.29	3.49	135.77	9.323	9.28	2.664
10.6	3914	1.104	23.13	3.53	141.29	9.484	9.48	2.690
10.8	3969	1.113	23.97	3.57	146.91	9.642	9.68	2.715
11.0	4020	1.123	24.81	3.60	152.66	9.807	9.88	2.741
11.2	4074	1.134	25.74	3.65	158.48	9.949	10.07	2.763
11.4	4126	1.144	26.63	3.69	164.42	10.098	10.27	2.785
11.6	4178	1.155	27.56	3.73	170.47	10.241	10.47	2.807
11.8	4228	1.167	28.48	3.77	176.62	10.385	10.66	2.828
12.0	4278	1.178	29.42	3.81	182.89	10.525	10.86	2.848

contd./

Table 4 (contd.)

p_1 = 500 mm Hg T_1 = 290°K

W_{11}	T_2°K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.698	0.58	0.516
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.297	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	940	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.667
4.0	1089	1.000	4.07	1.88	18.89	5.033	3.21	1.707
4.2	1164	1.000	4.39	1.94	20.89	5.206	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1327	1.000	5.07	2.07	25.16	5.499	3.76	1.821
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1598	1.000	6.23	2.26	32.30	5.864	4.31	1.907
5.4	1694	1.000	6.65	2.33	34.88	5.972	4.50	1.932
5.6	1793	1.000	7.08	2.39	37.57	6.076	4.68	1.956
5.8	1895	1.000	7.52	2.46	40.35	6.173	4.86	1.978
6.0	2000	1.000	7.99	2.52	43.23	6.266	5.04	2.000
6.2	2108	1.000	8.47	2.59	46.21	6.356	5.22	2.021
6.4	2218	1.000	8.96	2.65	49.30	6.444	5.41	2.042
6.6	2330	1.000	9.48	2.71	52.49	6.530	5.59	2.064
6.8	2443	1.001	10.01	2.77	55.78	6.618	5.77	2.087
7.0	2553	1.002	10.55	2.82	59.21	6.716	5.96	2.113
7.2	2664	1.002	11.11	2.87	62.73	6.812	6.14	2.140
7.4	2773	1.004	11.68	2.92	66.38	6.916	6.33	2.167
7.6	2880	1.005	12.28	2.97	70.14	7.025	6.52	2.197
7.8	2982	1.008	12.89	3.01	74.02	7.142	6.71	2.228
8.0	3083	1.010	13.52	3.06	78.03	7.264	6.90	2.258
8.2	3180	1.014	14.17	3.10	82.15	7.391	7.09	2.288
8.4	3270	1.018	14.82	3.14	86.40	7.531	7.28	2.320
8.6	3356	1.022	15.48	3.18	90.78	7.677	7.48	2.352
8.8	3441	1.027	16.17	3.22	95.26	7.821	7.67	2.382
9.0	3520	1.032	16.87	3.26	99.87	7.973	7.87	2.413
9.2	3599	1.038	17.59	3.30	104.59	8.122	8.07	2.443
9.4	3673	1.044	18.35	3.34	109.42	8.273	8.26	2.472
9.6	3745	1.051	19.10	3.38	114.36	8.425	8.46	2.500
9.8	3815	1.058	19.88	3.42	119.41	8.577	8.66	2.528
10.0	3884	1.066	20.67	3.47	124.58	8.728	8.85	2.554
10.2	3950	1.074	21.47	3.51	129.85	8.878	9.05	2.580
10.4	4015	1.082	22.29	3.55	135.23	9.026	9.25	2.606
10.6	4078	1.091	23.12	3.59	140.73	9.173	9.44	2.630
10.8	4141	1.100	23.96	3.63	146.32	9.318	9.64	2.653
11.0	4202	1.109	24.84	3.68	152.03	9.459	9.84	2.676
11.2	4261	1.119	25.72	3.72	157.84	9.599	10.03	2.698
11.4	4321	1.129	26.62	3.76	163.75	9.736	10.23	2.719
11.6	4379	1.139	27.53	3.81	169.78	9.869	10.42	2.739
11.8	4437	1.150	28.46	3.85	175.90	9.999	10.62	2.758
12.0	4494	1.161	29.41	3.89	182.13	10.126	10.81	2.777

Table 4 (contd.)

p_1 = 1000 mm Hg T_1 = 290°K

W_{11}	T_2°K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.697	0.57	0.515
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.386	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.711	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.019	1.47	1.102
2.4	580	1.000	2.04	1.39	6.61	3.306	1.67	1.202
2.6	631	1.000	2.24	1.45	7.80	3.585	1.87	1.294
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.073	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.296	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	941	1.000	3.47	1.75	15.24	4.698	2.83	1.618
3.8	1010	1.000	3.75	1.81	17.03	4.888	3.02	1.668
4.0	1086	1.000	4.06	1.88	18.91	5.050	3.21	1.710
4.2	1163	1.000	4.38	1.94	20.89	5.209	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.358	3.58	1.787
4.6	1328	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1415	1.000	5.45	2.13	27.44	5.621	3.95	1.850
5.0	1505	1.000	5.83	2.20	29.82	5.748	4.13	1.880
5.2	1596	1.000	6.22	2.26	32.31	5.870	4.31	1.908
5.4	1694	1.000	6.65	2.33	34.88	5.971	4.50	1.932
5.6	1793	1.000	7.08	2.39	37.56	6.075	4.68	1.956
5.8	1895	1.000	7.53	2.46	40.34	6.172	4.86	1.978
6.0	2001	1.000	7.99	2.52	43.23	6.265	5.04	1.999
6.2	2109	1.000	8.47	2.59	46.21	6.355	5.22	2.020
6.4	2219	1.000	8.96	2.65	49.29	6.441	5.41	2.041
6.6	2331	1.000	9.48	2.71	52.48	6.526	5.59	2.061
6.8	2445	1.001	10.00	2.77	55.77	6.611	5.77	2.083
7.0	2560	1.001	10.55	2.83	59.18	6.696	5.95	2.105
7.2	2672	1.002	11.10	2.88	62.70	6.793	6.14	2.131
7.4	2785	1.003	11.68	2.93	66.33	6.887	6.33	2.156
7.6	2896	1.004	12.27	2.98	70.08	6.990	6.51	2.182
7.8	3005	1.006	12.88	3.03	73.94	7.093	6.70	2.210
8.0	3111	1.008	13.51	3.08	77.93	7.205	6.89	2.238
8.2	3214	1.011	14.15	3.12	82.03	7.322	7.08	2.267
8.4	3314	1.014	14.81	3.17	86.25	7.443	7.27	2.295
8.6	3408	1.018	15.48	3.21	90.60	7.575	7.46	2.325
8.8	3500	1.022	16.17	3.25	95.06	7.705	7.66	2.353
9.0	3588	1.027	16.87	3.30	99.64	7.844	7.85	2.382
9.2	3674	1.032	17.59	3.34	104.33	7.982	8.05	2.410
9.4	3757	1.038	18.33	3.38	109.14	8.120	8.24	2.437
9.6	3836	1.044	19.07	3.42	114.06	8.263	8.44	2.464
9.8	3912	1.051	19.86	3.47	119.09	8.404	8.63	2.490
10.0	3988	1.057	20.65	3.51	124.23	8.543	8.83	2.516
10.2	4061	1.065	21.45	3.55	129.48	8.682	9.03	2.540
10.4	4133	1.073	22.27	3.60	134.84	8.820	9.22	2.564
10.6	4204	1.081	23.10	3.64	140.31	8.956	9.42	2.587
10.8	4273	1.089	23.96	3.68	145.89	9.091	9.61	2.609
11.0	4341	1.098	24.82	3.73	151.57	9.222	9.81	2.630
11.2	4406	1.107	25.71	3.77	157.36	9.352	10.00	2.651
11.4	4473	1.117	26.61	3.82	163.25	9.478	10.20	2.670
11.6	4536	1.127	27.53	3.86	169.25	9.602	10.39	2.690
11.8	4601	1.137	28.45	3.91	175.35	9.723	10.59	2.708
12.0	4665	1.147	29.39	3.96	181.56	9.841	10.78	2.725

contd./

Table 4 (contd.)

p_1 = 2000 mm Hg T_1 = 290°K

W_{11}	T_2°K	Z_2	H_{21}	A_{21}	P_{21}	Γ_{21}	U_{21}	M_2
1.2	327	1.000	1.13	1.06	1.51	1.344	0.31	0.290
1.4	363	1.000	1.25	1.12	2.12	1.698	0.58	0.516
1.6	401	1.000	1.39	1.17	2.83	2.047	0.82	0.700
1.8	441	1.000	1.53	1.22	3.63	2.387	1.05	0.854
2.0	484	1.000	1.69	1.28	4.52	2.712	1.26	0.987
2.2	530	1.000	1.86	1.34	5.52	3.020	1.47	1.102
2.4	579	1.000	2.04	1.39	6.61	3.309	1.67	1.203
2.6	632	1.000	2.24	1.45	7.80	3.581	1.87	1.293
2.8	687	1.000	2.46	1.51	9.09	3.836	2.07	1.372
3.0	746	1.000	2.68	1.57	10.48	4.074	2.26	1.444
3.2	808	1.000	2.93	1.63	11.97	4.297	2.46	1.508
3.4	873	1.000	3.19	1.69	13.55	4.504	2.65	1.566
3.6	940	1.000	3.46	1.75	15.24	4.699	2.83	1.619
3.8	1012	1.000	3.76	1.81	17.02	4.880	3.02	1.667
4.0	1088	1.000	4.07	1.88	18.90	5.040	3.21	1.708
4.2	1163	1.000	4.38	1.94	20.89	5.208	3.39	1.750
4.4	1244	1.000	4.72	2.00	22.98	5.357	3.58	1.787
4.6	1327	1.000	5.08	2.07	25.16	5.496	3.76	1.820
4.8	1414	1.000	5.44	2.13	27.44	5.626	3.95	1.851
5.0	1504	1.000	5.83	2.20	29.82	5.749	4.13	1.880
5.2	1598	1.000	6.23	2.26	32.30	5.864	4.31	1.907
5.4	1694	1.000	6.65	2.33	34.88	5.972	4.50	1.932
5.6	1790	1.000	7.06	2.39	37.58	6.090	4.68	1.958
5.8	1895	1.000	7.52	2.46	40.35	6.175	4.86	1.978
6.0	2001	1.000	7.99	2.52	43.22	6.264	5.04	1.999
6.2	2109	1.000	8.47	2.59	46.21	6.354	5.22	2.020
6.4	2219	1.000	8.96	2.65	49.29	6.440	5.41	2.040
6.6	2332	1.000	9.47	2.71	52.48	6.523	5.59	2.059
6.8	2447	1.000	10.00	2.77	55.77	6.605	5.77	2.080
7.0	2564	1.001	10.55	2.83	59.16	6.688	5.95	2.100
7.2	2678	1.001	11.10	2.89	62.68	6.778	6.14	2.123
7.4	2795	1.002	11.68	2.95	66.30	6.866	6.32	2.146
7.6	2910	1.003	12.27	3.00	70.03	6.958	6.51	2.171
7.8	3023	1.004	12.87	3.05	73.88	7.056	6.69	2.195
8.0	3135	1.006	13.50	3.10	77.84	7.156	6.88	2.221
8.2	3244	1.008	14.15	3.15	81.92	7.261	7.07	2.247
8.4	3350	1.011	14.81	3.19	86.12	7.372	7.26	2.274
8.6	3454	1.014	15.48	3.24	90.44	7.486	7.45	2.300
8.8	3553	1.018	16.16	3.28	94.88	7.609	7.64	2.327
9.0	3650	1.022	16.87	3.33	99.43	7.730	7.84	2.353
9.2	3742	1.027	17.59	3.37	104.10	7.859	8.03	2.380
9.4	3833	1.031	18.32	3.42	108.88	7.986	8.22	2.405
9.6	3922	1.037	19.08	3.46	113.77	8.113	8.42	2.430
9.8	4006	1.043	19.83	3.51	118.79	8.245	8.61	2.455
10.0	4090	1.049	20.62	3.55	123.90	8.373	8.81	2.479
10.2	4172	1.056	21.42	3.60	129.13	8.501	9.00	2.502
10.4	4250	1.063	22.26	3.64	134.46	8.628	9.19	2.524
10.6	4328	1.071	23.09	3.69	139.91	8.754	9.39	2.546
10.8	4405	1.079	23.94	3.73	145.46	8.878	9.58	2.566
11.0	4481	1.087	24.80	3.78	151.12	9.000	9.78	2.586
11.2	4555	1.095	25.68	3.83	156.88	9.120	9.97	2.606
11.4	4627	1.104	26.59	3.87	162.75	9.236	10.17	2.624
11.6	4698	1.114	27.50	3.92	168.72	9.352	10.36	2.642
11.8	4769	1.123	28.44	3.97	174.80	9.463	10.55	2.659
12.0	4840	1.133	29.38	4.02	180.98	9.571	10.75	2.675

Table 5/

Table 5. Reflected Normal Shock in Oxygen

p_1 = 1 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_o
1.2	0.957	366	1.000	1.27	2.2	1.78	31.21
1.4	0.937	442	1.000	1.54	4.2	2.73	31.28
1.6	0.928	521	1.000	1.82	6.9	3.86	31.38
1.8	0.933	604	1.000	2.14	10.6	5.07	31.52
2.0	0.951	693	1.000	2.48	15.1	6.30	31.70
2.2	0.971	788	1.000	2.85	20.6	7.59	31.90
2.4	0.993	887	1.000	3.25	27.2	8.88	32.11
2.6	1.020	995	1.000	3.69	34.8	10.15	32.33
2.8	1.051	1111	1.000	4.17	43.7	11.40	32.57
3.0	1.079	1228	1.000	4.66	53.4	12.61	32.79
3.2	1.113	1359	1.000	5.21	64.7	13.80	33.04
3.4	1.147	1493	1.000	5.78	76.8	14.92	33.27
3.6	1.180	1628	1.000	6.37	89.7	15.97	33.50
3.8	1.216	1776	1.000	7.02	104.1	17.00	33.73
4.0	1.249	1925	1.000	7.68	119.8	18.03	33.96
4.2	1.277	2067	1.001	8.37	135.9	19.04	34.18
4.4	1.297	2204	1.003	9.09	153.5	20.14	34.40
4.6	1.314	2329	1.006	9.83	171.5	21.22	34.62
4.8	1.320	2439	1.011	10.59	190.9	22.46	34.84
5.0	1.323	2534	1.016	11.37	210.5	23.71	35.06
5.2	1.321	2619	1.023	12.16	231.0	25.00	35.28
5.4	1.316	2697	1.031	13.00	253.3	26.41	35.50
5.6	1.311	2766	1.040	13.84	275.8	27.81	35.72
5.8	1.305	2832	1.049	14.73	300.9	29.36	35.96
6.0	1.301	2894	1.059	15.64	326.1	30.84	36.19
6.2	1.297	2953	1.071	16.60	354.7	32.52	36.45
6.4	1.293	3010	1.083	17.59	385.8	34.32	36.69
6.6	1.289	3066	1.095	18.61	421.4	36.39	36.93
6.8	1.288	3120	1.109	19.67	458.8	38.48	37.19
7.0	1.287	3175	1.123	20.81	502.3	40.85	37.45
7.2	1.288	3229	1.138	21.99	547.3	43.18	37.73
7.4	1.290	3280	1.154	23.18	596.2	45.68	38.00
7.6	1.293	3331	1.170	24.43	648.1	48.20	38.30
7.8	1.295	3383	1.187	25.70	705.5	50.95	38.57
8.0	1.300	3432	1.204	27.00	764.9	53.66	38.86
8.2	1.304	3483	1.223	28.35	829.7	56.50	39.17
8.4	1.311	3532	1.242	29.73	896.3	59.28	39.47
8.6	1.317	3582	1.261	31.16	968.6	62.19	39.78
8.8	1.324	3629	1.281	32.59	1042.6	65.05	40.09
9.0	1.332	3679	1.301	34.10	1122.9	68.01	40.41
9.2	1.341	3727	1.322	35.60	1204.2	70.87	40.73
9.4	1.352	3776	1.344	37.16	1289.5	73.68	41.07
9.6	1.361	3825	1.366	38.77	1381.7	76.66	41.40
9.8	1.373	3874	1.389	40.39	1474.9	79.48	41.74
10.0	1.385	3924	1.412	42.04	1572.0	82.28	42.08
10.2	1.398	3973	1.436	43.73	1673.1	85.06	42.43
10.4	1.411	4025	1.460	45.50	1780.8	87.86	42.79
10.6	1.426	4076	1.485	47.26	1889.6	90.53	43.14
10.8	1.441	4128	1.510	49.06	2002.5	93.15	43.50
11.0	1.457	4181	1.536	50.89	2119.5	95.72	43.86
11.2	1.480	4241	1.566	52.79	2241.5	97.86	44.29
11.4	1.492	4292	1.589	54.69	2365.3	100.59	44.60
11.6	1.516	4355	1.619	56.65	2494.7	102.61	45.02
11.8	1.538	4418	1.648	58.67	2627.9	104.69	45.42
12.0	1.560	4481	1.676	60.70	2764.8	106.77	45.80

contd./

Table 5 (contd.)

p_1 = 2 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	30.52
1.4	0.927	438	1.000	1.52	4.1	2.74	30.56
1.6	0.927	521	1.000	1.82	6.9	3.85	30.68
1.8	0.935	602	1.000	2.13	10.5	5.04	30.82
2.0	0.951	693	1.000	2.48	15.1	6.30	31.01
2.2	0.970	788	1.000	2.85	20.6	7.59	31.21
2.4	0.993	887	1.000	3.25	27.1	8.87	31.41
2.6	1.020	995	1.000	3.69	34.8	10.15	31.64
2.8	1.050	1111	1.000	4.17	43.7	11.40	31.88
3.0	1.079	1228	1.000	4.66	53.4	12.61	32.10
3.2	1.113	1356	1.000	5.20	64.2	13.73	32.34
3.4	1.147	1493	1.000	5.78	76.8	14.91	32.58
3.6	1.180	1629	1.000	6.37	89.7	15.97	32.80
3.8	1.216	1777	1.000	7.02	104.2	17.00	33.04
4.0	1.252	1931	1.000	7.69	119.9	17.99	33.28
4.2	1.280	2074	1.001	8.37	136.0	19.00	33.49
4.4	1.305	2218	1.002	9.10	153.8	20.06	33.71
4.6	1.325	2350	1.005	9.85	171.8	21.10	33.93
4.8	1.334	2468	1.009	10.61	191.5	22.30	34.14
5.0	1.340	2573	1.014	11.40	211.1	23.46	34.36
5.2	1.341	2665	1.020	12.19	231.7	24.72	34.57
5.4	1.336	2747	1.027	13.04	253.9	26.10	34.78
5.6	1.336	2828	1.036	13.89	276.5	27.38	35.02
5.8	1.333	2899	1.045	14.77	300.2	28.74	35.25
6.0	1.328	2968	1.055	15.70	326.3	30.23	35.48
6.2	1.325	3032	1.066	16.65	354.8	31.84	35.72
6.4	1.322	3094	1.077	17.64	385.4	33.53	35.96
6.6	1.320	3154	1.090	18.68	418.3	35.30	36.20
6.8	1.320	3212	1.103	19.74	454.2	37.19	36.45
7.0	1.320	3270	1.116	20.85	494.8	39.31	36.71
7.2	1.320	3326	1.131	21.99	538.9	41.55	36.96
7.4	1.323	3383	1.146	23.20	586.0	43.83	37.23
7.6	1.325	3439	1.162	24.44	638.4	46.33	37.50
7.8	1.330	3493	1.179	25.71	692.6	48.77	37.78
8.0	1.335	3547	1.196	27.02	750.3	51.29	38.06
8.2	1.340	3602	1.214	28.39	813.2	53.94	38.35
8.4	1.347	3655	1.232	29.76	878.0	56.53	38.64
8.6	1.355	3709	1.252	31.20	948.4	59.24	38.95
8.8	1.363	3761	1.271	32.64	1020.5	61.90	39.25
9.0	1.372	3813	1.291	34.10	1096.2	64.58	39.55
9.2	1.381	3866	1.312	35.65	1178.0	67.35	39.86
9.4	1.392	3919	1.333	37.20	1261.1	70.00	40.18
9.6	1.403	3971	1.355	38.79	1347.9	72.65	40.50
9.8	1.416	4025	1.378	40.46	1440.9	75.33	40.83
10.0	1.428	4078	1.401	42.10	1535.8	77.97	41.15
10.2	1.443	4132	1.424	43.81	1633.6	80.50	41.49
10.4	1.457	4187	1.448	45.54	1735.4	83.01	41.82
10.6	1.473	4242	1.472	47.30	1841.4	85.50	42.16
10.8	1.489	4298	1.497	49.09	1951.0	87.93	42.50
11.0	1.513	4362	1.527	50.97	2065.4	89.93	42.92
11.2	1.524	4414	1.548	52.82	2181.7	92.56	43.20
11.4	1.549	4481	1.578	54.78	2303.4	94.45	43.61
11.6	1.564	4538	1.602	56.71	2427.5	96.83	43.92
11.8	1.590	4607	1.632	58.73	2557.1	98.64	44.32
12.0	1.614	4677	1.660	60.78	2689.9	100.48	44.69

contd./

Table 5 (contd.)

p_1 = 5 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	29.60
1.4	0.922	439	1.000	1.53	4.2	2.77	29.64
1.6	0.930	522	1.000	1.82	6.9	3.85	29.77
1.8	0.933	604	1.000	2.14	10.6	5.07	29.91
2.0	0.954	695	1.000	2.48	15.1	6.30	30.10
2.2	0.970	788	1.000	2.85	20.6	7.60	30.29
2.4	0.991	886	1.000	3.25	27.1	8.88	30.49
2.6	0.997	974	1.000	3.67	34.6	10.30	30.64
2.8	1.052	1113	1.000	4.17	43.7	11.39	30.96
3.0	1.077	1226	1.000	4.65	53.4	12.62	31.18
3.2	1.113	1360	1.000	5.21	64.7	13.79	31.43
3.4	1.148	1495	1.000	5.78	76.8	14.90	31.67
3.6	1.181	1629	1.000	6.37	89.7	15.96	31.89
3.8	1.217	1777	1.000	7.02	104.2	16.99	32.12
4.0	1.253	1932	1.000	7.69	119.9	17.99	32.36
4.2	1.284	2079	1.001	8.38	136.1	18.97	32.57
4.4	1.312	2231	1.002	9.11	153.9	19.98	32.80
4.6	1.334	2370	1.004	9.86	172.0	20.97	33.01
4.8	1.350	2503	1.007	10.64	191.8	22.08	33.23
5.0	1.361	2620	1.011	11.43	211.8	23.19	33.44
5.2	1.367	2725	1.016	12.24	232.6	24.36	33.65
5.4	1.370	2825	1.023	13.10	255.1	25.60	33.88
5.6	1.368	2909	1.030	13.95	277.7	26.87	34.09
5.8	1.364	2984	1.038	14.83	301.3	28.20	34.28
6.0	1.366	3067	1.049	15.77	327.4	29.52	34.54
6.2	1.364	3137	1.059	16.71	354.4	30.94	34.77
6.4	1.363	3207	1.070	17.70	384.0	32.46	35.00
6.6	1.362	3273	1.081	18.73	416.1	34.09	35.23
6.8	1.363	3339	1.094	19.81	450.8	35.79	35.48
7.0	1.363	3403	1.107	20.93	489.4	37.66	35.73
7.2	1.366	3465	1.121	22.06	530.4	39.59	35.97
7.4	1.368	3526	1.136	23.24	575.9	41.71	36.22
7.6	1.372	3589	1.151	24.50	626.3	43.95	36.48
7.8	1.377	3649	1.167	25.76	678.4	46.17	36.75
8.0	1.383	3709	1.184	27.07	733.8	48.45	37.01
8.2	1.390	3769	1.202	28.41	792.7	50.76	37.29
8.4	1.397	3828	1.220	29.80	857.2	53.24	37.57
8.6	1.407	3888	1.238	31.21	923.2	55.60	37.85
8.8	1.414	3943	1.256	32.67	992.3	58.08	38.12
9.0	1.426	4003	1.277	34.14	1065.4	60.44	38.42
9.2	1.437	4064	1.298	35.72	1143.7	62.89	38.73
9.4	1.449	4122	1.318	37.27	1223.7	65.31	39.02
9.6	1.462	4180	1.340	38.86	1307.4	67.70	39.33
9.8	1.475	4239	1.361	40.48	1394.7	70.09	39.62
10.0	1.490	4300	1.384	42.19	1488.2	72.50	39.94
10.2	1.505	4359	1.407	43.89	1582.6	74.82	40.25
10.4	1.521	4421	1.431	45.63	1680.7	77.05	40.58
10.6	1.539	4483	1.455	47.41	1782.5	79.23	40.90
10.8	1.556	4545	1.480	49.22	1887.6	81.41	41.22
11.0	1.582	4616	1.508	51.10	1997.8	83.22	41.60
11.2	1.595	4674	1.530	52.96	2109.7	85.55	41.88
11.4	1.621	4746	1.559	54.90	2226.9	87.28	42.26
11.6	1.639	4811	1.582	56.86	2345.8	89.38	42.54
11.8	1.666	4887	1.611	58.89	2470.3	90.98	42.92
12.0	1.692	4963	1.639	60.95	2597.7	92.60	43.27

contd./

Table 5 (contd.)

p_1 = 10 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_o
1.2	0.957	366	1.000	1.27	2.2	1.78	28.91
1.4	0.927	438	1.000	1.52	4.1	2.74	28.95
1.6	0.927	520	1.000	1.82	6.9	3.86	29.07
1.8	0.934	604	1.000	2.14	10.6	5.07	29.22
2.0	0.954	695	1.000	2.48	15.1	6.30	29.41
2.2	0.970	788	1.000	2.85	20.6	7.59	29.59
2.4	0.990	888	1.000	3.26	27.3	8.93	29.80
2.6	1.019	994	1.000	3.69	34.8	10.15	30.03
2.8	1.049	1110	1.000	4.17	43.7	11.40	30.26
3.0	1.078	1227	1.000	4.65	53.4	12.61	30.49
3.2	1.123	1371	1.000	5.22	64.8	13.71	30.77
3.4	1.149	1496	1.000	5.78	76.9	14.90	30.98
3.6	1.183	1632	1.000	6.38	89.7	15.94	31.20
3.8	1.217	1778	1.000	7.02	104.2	16.99	31.43
4.0	1.250	1929	1.000	7.69	119.8	18.01	31.66
4.2	1.284	2081	1.000	8.38	136.1	18.96	31.88
4.4	1.316	2238	1.001	9.12	154.2	19.95	32.10
4.6	1.342	2385	1.003	9.87	172.3	20.89	32.32
4.8	1.362	2528	1.005	10.67	192.2	21.93	32.54
5.0	1.376	2652	1.009	11.45	212.3	23.01	32.75
5.2	1.385	2766	1.014	12.27	233.2	24.12	32.96
5.4	1.389	2872	1.020	13.12	255.8	25.33	33.17
5.6	1.394	2971	1.027	13.99	278.7	26.49	33.40
5.8	1.393	3057	1.035	14.88	302.4	27.73	33.60
6.0	1.393	3138	1.043	15.79	327.3	29.00	33.82
6.2	1.394	3221	1.053	16.78	354.7	30.32	34.05
6.4	1.393	3296	1.064	17.77	384.4	31.79	34.28
6.6	1.394	3366	1.075	18.77	414.8	33.24	34.51
6.8	1.395	3436	1.087	19.84	448.5	34.82	34.74
7.0	1.397	3508	1.100	20.98	486.4	36.54	34.98
7.2	1.400	3575	1.113	22.11	525.6	38.30	35.22
7.4	1.404	3642	1.128	23.30	569.8	40.22	35.47
7.6	1.409	3708	1.143	24.52	617.3	42.25	35.71
7.8	1.415	3774	1.158	25.81	667.6	44.28	35.97
8.0	1.422	3839	1.175	27.11	721.8	46.42	36.23
8.2	1.429	3903	1.191	28.44	778.9	48.57	36.49
8.4	1.438	3969	1.209	29.85	841.2	50.82	36.76
8.6	1.447	4032	1.227	31.26	905.1	53.04	37.03
8.8	1.457	4096	1.246	32.71	972.5	55.27	37.30
9.0	1.469	4159	1.265	34.21	1043.3	57.49	37.58
9.2	1.481	4222	1.285	35.72	1117.5	59.73	37.86
9.4	1.494	4288	1.306	37.33	1197.6	62.02	38.15
9.6	1.508	4351	1.327	38.93	1278.8	64.21	38.45
9.8	1.523	4416	1.349	40.56	1363.5	66.40	38.74
10.0	1.538	4479	1.370	42.22	1451.5	68.58	39.03
10.2	1.555	4546	1.393	43.94	1543.3	70.67	39.33
10.4	1.573	4612	1.416	45.68	1638.2	72.73	39.64
10.6	1.591	4678	1.440	47.45	1737.4	74.80	39.94
10.8	1.610	4747	1.464	49.29	1839.1	76.75	40.25
11.0	1.637	4823	1.492	51.17	1945.7	78.40	40.61
11.2	1.652	4887	1.514	53.04	2053.9	80.51	40.88
11.4	1.680	4965	1.542	55.00	2167.8	82.09	41.24
11.6	1.705	5043	1.569	56.99	2284.6	83.72	41.57
11.8	1.730	5121	1.596	59.01	2404.4	85.32	41.90
12.0	1.756	5201	1.622	61.06	2527.9	86.88	42.22

contd./

Table 5 (contd.)

p_1 = 25 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	27.99
1.4	0.925	440	1.000	1.53	4.2	2.76	28.04
1.6	0.930	522	1.000	1.82	6.9	3.85	28.16
1.8	0.933	604	1.000	2.14	10.6	5.07	28.30
2.0	0.954	695	1.000	2.48	15.1	6.30	28.49
2.2	0.970	788	1.000	2.85	20.6	7.60	28.68
2.4	0.991	886	1.000	3.25	27.1	8.88	28.88
2.6	1.022	997	1.000	3.69	34.8	10.13	29.12
2.8	1.051	1112	1.000	4.17	43.7	11.39	29.35
3.0	1.080	1229	1.000	4.66	53.4	12.60	29.58
3.2	1.112	1359	1.000	5.21	64.7	13.80	29.82
3.4	1.147	1493	1.000	5.78	76.8	14.91	30.05
3.6	1.181	1629	1.000	6.37	89.7	15.96	30.28
3.8	1.218	1779	1.000	7.02	104.2	16.98	30.52
4.0	1.250	1928	1.000	7.69	119.8	18.01	30.74
4.2	1.289	2089	1.000	8.38	136.2	18.90	30.97
4.4	1.321	2248	1.001	9.13	154.2	19.87	31.20
4.6	1.348	2398	1.002	9.87	172.7	20.85	31.40
4.8	1.371	2547	1.004	10.67	192.5	21.83	31.62
5.0	1.392	2689	1.007	11.48	212.8	22.80	31.83
5.2	1.406	2816	1.010	12.30	233.9	23.84	32.04
5.4	1.415	2936	1.016	13.18	256.8	24.97	32.25
5.6	1.422	3045	1.022	14.05	279.8	26.08	32.46
5.8	1.429	3149	1.029	14.95	303.8	27.18	32.69
6.0	1.430	3238	1.037	15.87	328.7	28.39	32.89
6.2	1.434	3332	1.047	16.85	356.1	29.61	33.12
6.4	1.434	3412	1.056	17.83	384.1	30.92	33.32
6.6	1.436	3495	1.066	18.86	415.0	32.29	33.55
6.8	1.439	3575	1.078	19.94	447.9	33.70	33.78
7.0	1.443	3652	1.090	21.05	483.2	35.20	34.01
7.2	1.447	3727	1.103	22.19	521.2	36.77	34.24
7.4	1.453	3802	1.117	23.37	561.8	38.38	34.47
7.6	1.459	3876	1.131	24.60	607.4	40.18	34.71
7.8	1.465	3948	1.146	25.85	656.2	42.07	34.95
8.0	1.472	4021	1.161	27.16	708.0	43.99	35.18
8.2	1.483	4094	1.178	28.51	763.0	45.89	35.44
8.4	1.493	4165	1.195	29.90	821.2	47.86	35.70
8.6	1.504	4237	1.212	31.32	882.5	49.83	35.95
8.8	1.516	4308	1.230	32.77	947.6	51.86	36.21
9.0	1.529	4379	1.249	34.26	1015.6	53.84	36.48
9.2	1.542	4450	1.268	35.78	1086.9	55.86	36.74
9.4	1.557	4522	1.288	37.36	1161.6	57.85	37.01
9.6	1.572	4595	1.309	39.00	1241.6	59.86	37.29
9.8	1.589	4668	1.330	40.65	1323.1	61.80	37.57
10.0	1.606	4740	1.352	42.33	1407.9	63.73	37.85
10.2	1.625	4813	1.374	44.04	1496.1	65.62	38.13
10.4	1.643	4887	1.396	45.78	1587.5	67.49	38.41
10.6	1.664	4963	1.419	47.59	1682.4	69.27	38.70
10.8	1.685	5039	1.443	49.42	1780.6	71.02	38.99
11.0	1.714	5124	1.470	51.31	1883.1	72.50	39.33
11.2	1.731	5195	1.491	53.15	1983.6	74.28	39.58
11.4	1.761	5282	1.518	55.12	2092.4	75.66	39.91
11.6	1.789	5368	1.545	57.14	2204.1	77.08	40.22
11.8	1.816	5455	1.571	59.16	2319.4	78.50	40.53
12.0	1.844	5545	1.596	61.23	2437.7	79.87	40.82

contd./

Table 5 (contd.)

p_1 = 100 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_6	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.956	366	1.000	1.27	2.2	1.78	26.61
1.4	0.927	438	1.000	1.52	4.1	2.74	26.65
1.6	0.928	521	1.000	1.82	6.9	3.86	26.77
1.8	0.933	604	1.000	2.14	10.6	5.07	26.91
2.0	0.951	693	1.000	2.48	15.1	6.30	27.10
2.2	0.971	788	1.000	2.85	20.6	7.59	27.29
2.4	0.993	887	1.000	3.25	27.1	8.87	27.50
2.6	1.020	995	1.000	3.69	34.8	10.15	27.73
2.8	1.050	1111	1.000	4.17	43.7	11.40	27.96
3.0	1.079	1228	1.000	4.66	53.4	12.61	28.19
3.2	1.113	1359	1.000	5.21	64.7	13.80	28.43
3.4	1.147	1493	1.000	5.78	76.8	14.91	28.67
3.6	1.181	1629	1.000	6.37	89.7	15.96	28.89
3.8	1.218	1780	1.000	7.02	104.2	16.98	29.13
4.0	1.252	1932	1.000	7.69	119.9	17.99	29.36
4.2	1.287	2086	1.000	8.38	136.2	18.93	29.58
4.4	1.326	2257	1.000	9.13	154.3	19.82	29.81
4.6	1.356	2413	1.001	9.89	173.0	20.77	30.02
4.8	1.385	2576	1.002	10.69	192.9	21.67	30.24
5.0	1.410	2729	1.004	11.51	213.4	22.59	30.44
5.2	1.432	2878	1.007	12.35	234.8	23.51	30.65
5.4	1.448	3019	1.010	13.24	258.0	24.53	30.86
5.6	1.462	3148	1.015	14.12	281.3	25.53	31.07
5.8	1.472	3268	1.021	15.03	305.5	26.56	31.27
6.0	1.480	3379	1.028	15.97	330.7	27.61	31.48
6.2	1.489	3493	1.036	16.96	358.2	28.71	31.70
6.4	1.495	3595	1.044	17.96	385.8	29.80	31.91
6.6	1.502	3692	1.053	18.98	415.2	30.96	32.11
6.8	1.507	3788	1.064	20.07	447.2	32.18	32.33
7.0	1.513	3880	1.075	21.17	481.3	33.48	32.54
7.2	1.520	3968	1.086	22.28	516.5	34.76	32.76
7.4	1.528	4057	1.098	23.48	554.9	36.11	32.98
7.6	1.537	4147	1.112	24.73	597.6	37.59	33.21
7.8	1.546	4233	1.125	25.98	641.5	39.06	33.43
8.0	1.556	4320	1.140	27.29	690.4	40.66	33.66
8.2	1.568	4405	1.155	28.61	740.8	42.23	33.89
8.4	1.580	4490	1.171	29.99	795.3	43.88	34.12
8.6	1.593	4576	1.187	31.41	853.4	45.57	34.35
8.8	1.608	4661	1.204	32.89	914.2	47.24	34.59
9.0	1.624	4748	1.222	34.40	978.3	48.90	34.84
9.2	1.640	4833	1.240	35.94	1045.4	50.58	35.08
9.4	1.658	4919	1.259	37.51	1115.7	52.24	35.33
9.6	1.676	5006	1.278	39.13	1189.1	53.88	35.58
9.8	1.696	5093	1.299	40.80	1265.8	55.50	35.84
10.0	1.716	5178	1.318	42.44	1343.0	57.05	36.08
10.2	1.738	5266	1.340	44.17	1425.7	58.61	36.34
10.4	1.760	5356	1.361	45.94	1511.6	60.14	36.60
10.6	1.783	5446	1.383	47.73	1600.7	61.64	36.86
10.8	1.815	5547	1.408	49.62	1693.9	62.89	37.16
11.0	1.834	5633	1.429	51.49	1787.9	64.44	37.39
11.2	1.865	5732	1.453	53.39	1884.1	65.61	37.68
11.4	1.896	5832	1.478	55.37	1985.7	66.80	37.96
11.6	1.926	5933	1.502	57.37	2090.7	68.02	38.23
11.8	1.956	6035	1.527	59.42	2198.0	69.18	38.50
12.0	1.986	6134	1.551	61.46	2304.9	70.27	38.76

contd./

Table 5 (contd.)

p_1 = 200 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	25.91
1.4	0.927	438	1.000	1.52	4.1	2.74	25.95
1.6	0.930	522	1.000	1.82	6.9	3.85	26.08
1.8	0.933	604	1.000	2.14	10.6	5.07	26.22
2.0	0.954	695	1.000	2.48	15.1	6.30	26.41
2.2	0.970	788	1.000	2.85	20.6	7.59	26.60
2.4	0.993	890	1.000	3.26	27.4	8.93	26.81
2.6	1.021	998	1.000	3.70	35.1	10.21	27.04
2.8	1.050	1111	1.000	4.17	43.7	11.40	27.27
3.0	1.080	1229	1.000	4.67	53.4	12.60	27.50
3.2	1.111	1357	1.000	5.21	64.6	13.81	27.73
3.4	1.147	1490	1.000	5.77	76.4	14.87	27.97
3.6	1.181	1630	1.000	6.37	89.7	15.96	28.20
3.8	1.218	1780	1.000	7.02	104.0	16.94	28.44
4.0	1.253	1932	1.000	7.69	119.9	17.99	28.66
4.2	1.288	2088	1.000	8.38	136.2	18.91	28.89
4.4	1.326	2257	1.000	9.13	154.3	19.82	29.12
4.6	1.363	2426	1.001	9.91	172.9	20.66	29.34
4.8	1.390	2587	1.002	10.71	192.8	21.58	29.55
5.0	1.417	2745	1.003	11.52	213.6	22.51	29.75
5.2	1.444	2905	1.005	12.37	235.4	23.38	29.97
5.4	1.461	3051	1.008	13.25	258.6	24.37	30.17
5.6	1.478	3191	1.012	14.15	281.9	25.31	30.37
5.8	1.493	3324	1.017	15.07	306.3	26.27	30.58
6.0	1.504	3447	1.023	16.01	331.7	27.27	30.78
6.2	1.515	3567	1.030	16.99	358.2	28.26	30.99
6.4	1.524	3683	1.038	18.02	386.9	29.34	31.20
6.6	1.532	3790	1.047	19.05	415.8	30.39	31.40
6.8	1.540	3895	1.057	20.13	447.9	31.56	31.61
7.0	1.549	3995	1.067	21.23	480.3	32.68	31.82
7.2	1.561	4100	1.079	22.38	516.3	33.86	32.06
7.4	1.567	4194	1.089	23.57	553.8	35.15	32.25
7.6	1.577	4290	1.102	24.80	594.1	36.45	32.47
7.8	1.587	4383	1.115	26.04	637.0	37.81	32.68
8.0	1.600	4478	1.129	27.35	682.4	39.16	32.90
8.2	1.612	4572	1.143	28.70	732.8	40.66	33.12
8.4	1.626	4667	1.158	30.08	786.2	42.18	33.35
8.6	1.641	4759	1.174	31.49	840.3	43.63	33.57
8.8	1.658	4855	1.191	32.97	899.4	45.11	33.81
9.0	1.673	4947	1.207	34.47	961.8	46.71	34.03
9.2	1.691	5041	1.225	36.01	1026.8	48.24	34.26
9.4	1.710	5134	1.242	37.56	1092.8	49.68	34.50
9.6	1.730	5230	1.261	39.18	1164.0	51.18	34.74
9.8	1.751	5326	1.281	40.84	1238.2	52.65	34.98
10.0	1.774	5423	1.301	42.56	1315.4	54.08	35.23
10.2	1.797	5520	1.321	44.29	1395.7	55.50	35.47
10.4	1.821	5616	1.341	46.01	1476.2	56.84	35.71
10.6	1.846	5716	1.363	47.84	1562.6	58.18	35.96
10.8	1.879	5826	1.387	49.71	1652.7	59.32	36.24
11.0	1.899	5919	1.406	51.55	1745.6	60.82	36.46
11.2	1.933	6027	1.431	53.50	1836.8	61.79	36.73
11.4	1.965	6138	1.455	55.48	1935.4	62.86	37.00
11.6	1.998	6249	1.478	57.53	2036.3	63.91	37.26
11.8	2.029	6356	1.501	59.52	2137.2	64.95	37.50
12.0	2.063	6471	1.526	61.62	2244.5	65.94	37.76

contd./

Table 5 (contd.)

p_1 = 500 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	25.00
1.4	0.925	440	1.000	1.53	4.2	2.76	25.04
1.6	0.930	522	1.000	1.82	6.9	3.85	25.17
1.8	0.933	604	1.000	2.14	10.6	5.07	25.30
2.0	0.954	695	1.000	2.48	15.1	6.30	25.49
2.2	0.970	788	1.000	2.85	20.6	7.60	25.68
2.4	0.992	887	1.000	3.25	27.1	8.88	25.89
2.6	1.022	997	1.000	3.69	34.8	10.13	26.12
2.8	1.052	1113	1.000	4.17	43.7	11.38	26.36
3.0	1.080	1230	1.000	4.66	53.4	12.60	26.58
3.2	1.112	1358	1.000	5.21	64.7	13.81	26.82
3.4	1.148	1495	1.000	5.78	76.8	14.90	27.06
3.6	1.181	1629	1.000	6.37	89.7	15.96	27.28
3.8	1.218	1780	1.000	7.02	104.2	16.98	27.52
4.0	1.254	1935	1.000	7.70	119.6	17.92	27.76
4.2	1.290	2091	1.000	8.39	136.2	18.88	27.98
4.4	1.324	2255	1.000	9.13	154.3	19.84	28.19
4.6	1.363	2426	1.000	9.89	173.0	20.67	28.42
4.8	1.393	2594	1.001	10.70	193.2	21.58	28.63
5.0	1.424	2760	1.002	11.53	213.9	22.42	28.84
5.2	1.451	2923	1.004	12.38	235.5	23.28	29.04
5.4	1.481	3098	1.006	13.29	259.2	24.12	29.27
5.6	1.498	3242	1.009	14.19	282.7	25.06	29.46
5.8	1.515	3386	1.013	15.11	307.3	25.98	29.65
6.0	1.532	3527	1.018	16.07	332.9	26.88	29.85
6.2	1.548	3664	1.024	17.06	359.6	27.79	30.06
6.4	1.558	3791	1.031	18.09	388.4	28.81	30.26
6.6	1.571	3915	1.039	19.14	417.3	29.77	30.47
6.8	1.582	4032	1.047	20.21	447.6	30.75	30.67
7.0	1.594	4150	1.056	21.34	481.2	31.83	30.87
7.2	1.605	4261	1.066	22.47	514.9	32.87	31.07
7.4	1.617	4373	1.077	23.66	552.0	33.99	31.28
7.6	1.629	4482	1.088	24.89	591.1	35.15	31.49
7.8	1.642	4590	1.100	26.16	632.7	36.33	31.70
8.0	1.656	4697	1.113	27.46	676.6	37.53	31.91
8.2	1.671	4803	1.127	28.80	722.9	38.75	32.12
8.4	1.687	4908	1.140	30.17	772.6	40.03	32.33
8.6	1.703	5015	1.155	31.59	826.8	41.39	32.54
8.8	1.722	5120	1.170	33.03	881.6	42.66	32.76
9.0	1.740	5226	1.186	34.54	941.5	44.04	32.97
9.2	1.760	5335	1.203	36.10	1003.9	45.36	33.20
9.4	1.785	5446	1.221	37.68	1067.5	46.55	33.44
9.6	1.806	5553	1.238	39.31	1135.6	47.89	33.66
9.8	1.827	5658	1.256	40.98	1206.6	49.24	33.87
10.0	1.850	5764	1.274	42.64	1278.1	50.48	34.09
10.2	1.878	5879	1.294	44.40	1355.3	51.67	34.33
10.4	1.904	5991	1.314	46.19	1435.0	52.87	34.56
10.6	1.938	6110	1.336	47.99	1515.8	53.86	34.81
10.8	1.961	6217	1.354	49.82	1600.7	55.13	35.02
11.0	1.996	6342	1.378	51.77	1689.6	56.08	35.28
11.2	2.029	6461	1.399	53.68	1778.2	57.05	35.52
11.4	2.063	6584	1.421	55.68	1872.6	58.02	35.76
11.6	2.096	6703	1.443	57.65	1966.1	58.94	35.99
11.8	2.131	6831	1.466	59.73	2065.7	59.83	36.22
12.0	2.166	6956	1.488	61.80	2164.6	60.65	36.45

contd./

Table 5 (contd.)

p_1 = 1000 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	24.30
1.4	0.927	438	1.000	1.52	4.1	2.74	24.34
1.6	0.930	522	1.000	1.82	6.9	3.85	24.48
1.8	0.933	604	1.000	2.14	10.6	5.07	24.61
2.0	0.953	694	1.000	2.48	15.1	6.29	24.80
2.2	0.970	788	1.000	2.85	20.6	7.59	24.99
2.4	0.992	886	1.000	3.25	27.1	8.87	25.20
2.6	1.018	993	1.000	3.69	34.8	10.17	25.41
2.8	1.044	1105	1.000	4.16	43.6	11.45	25.64
3.0	1.078	1227	1.000	4.65	53.4	12.61	25.88
3.2	1.112	1358	1.000	5.21	64.7	13.80	26.13
3.4	1.147	1494	1.000	5.78	76.8	14.91	26.36
3.6	1.184	1633	1.000	6.38	89.7	15.93	26.60
3.8	1.217	1778	1.000	7.01	104.3	17.02	26.82
4.0	1.253	1933	1.000	7.69	119.9	17.99	27.06
4.2	1.289	2090	1.000	8.38	136.2	18.90	27.28
4.4	1.325	2256	1.000	9.13	154.3	19.83	27.50
4.6	1.365	2429	1.000	9.91	173.0	20.64	27.73
4.8	1.400	2606	1.001	10.72	193.2	21.48	27.95
5.0	1.430	2774	1.001	11.54	214.0	22.35	28.15
5.2	1.460	2942	1.003	12.38	236.0	23.20	28.36
5.4	1.486	3113	1.004	13.30	259.4	24.05	28.56
5.6	1.512	3278	1.007	14.21	283.2	24.88	28.77
5.8	1.531	3430	1.010	15.15	307.9	25.76	28.96
6.0	1.550	3581	1.015	16.11	333.7	26.63	29.16
6.2	1.570	3730	1.020	17.10	360.6	27.49	29.37
6.4	1.584	3872	1.026	18.14	389.5	28.44	29.56
6.6	1.598	4004	1.033	19.20	418.5	29.35	29.76
6.8	1.611	4132	1.040	20.27	448.8	30.28	29.95
7.0	1.625	4258	1.048	21.38	480.4	31.21	30.15
7.2	1.637	4381	1.057	22.54	515.4	32.27	30.34
7.4	1.653	4508	1.067	23.75	552.0	33.27	30.55
7.6	1.671	4631	1.079	24.96	589.6	34.23	30.77
7.8	1.682	4746	1.089	26.22	629.9	35.34	30.96
8.0	1.699	4865	1.101	27.53	673.0	36.43	31.16
8.2	1.715	4982	1.114	28.87	718.4	37.55	31.36
8.4	1.733	5098	1.127	30.25	766.2	38.67	31.57
8.6	1.751	5214	1.141	31.66	817.1	39.84	31.77
8.8	1.771	5333	1.155	33.15	871.9	41.04	31.99
9.0	1.792	5450	1.170	34.63	928.2	42.21	32.19
9.2	1.813	5568	1.186	36.18	988.8	43.43	32.40
9.4	1.835	5685	1.201	37.75	1050.0	44.59	32.61
9.6	1.857	5802	1.218	39.37	1116.3	45.82	32.82
9.8	1.885	5925	1.236	41.03	1183.5	46.88	33.04
10.0	1.908	6042	1.253	42.74	1254.8	48.08	33.25
10.2	1.945	6181	1.274	44.53	1330.4	48.99	33.51
10.4	1.967	6292	1.291	46.27	1404.6	50.16	33.70
10.6	2.004	6429	1.312	48.13	1485.5	51.06	33.95
10.8	2.030	6546	1.330	49.95	1565.2	52.13	34.14
11.0	2.067	6683	1.352	51.88	1651.2	52.99	34.39
11.2	2.101	6813	1.373	53.81	1736.9	53.86	34.61
11.4	2.137	6949	1.394	55.82	1827.9	54.71	34.84
11.6	2.172	7083	1.415	57.82	1918.5	55.53	35.05
11.8	2.210	7223	1.436	59.90	2014.8	56.32	35.28
12.0	2.247	7361	1.458	61.97	2110.5	57.04	35.49

contd./

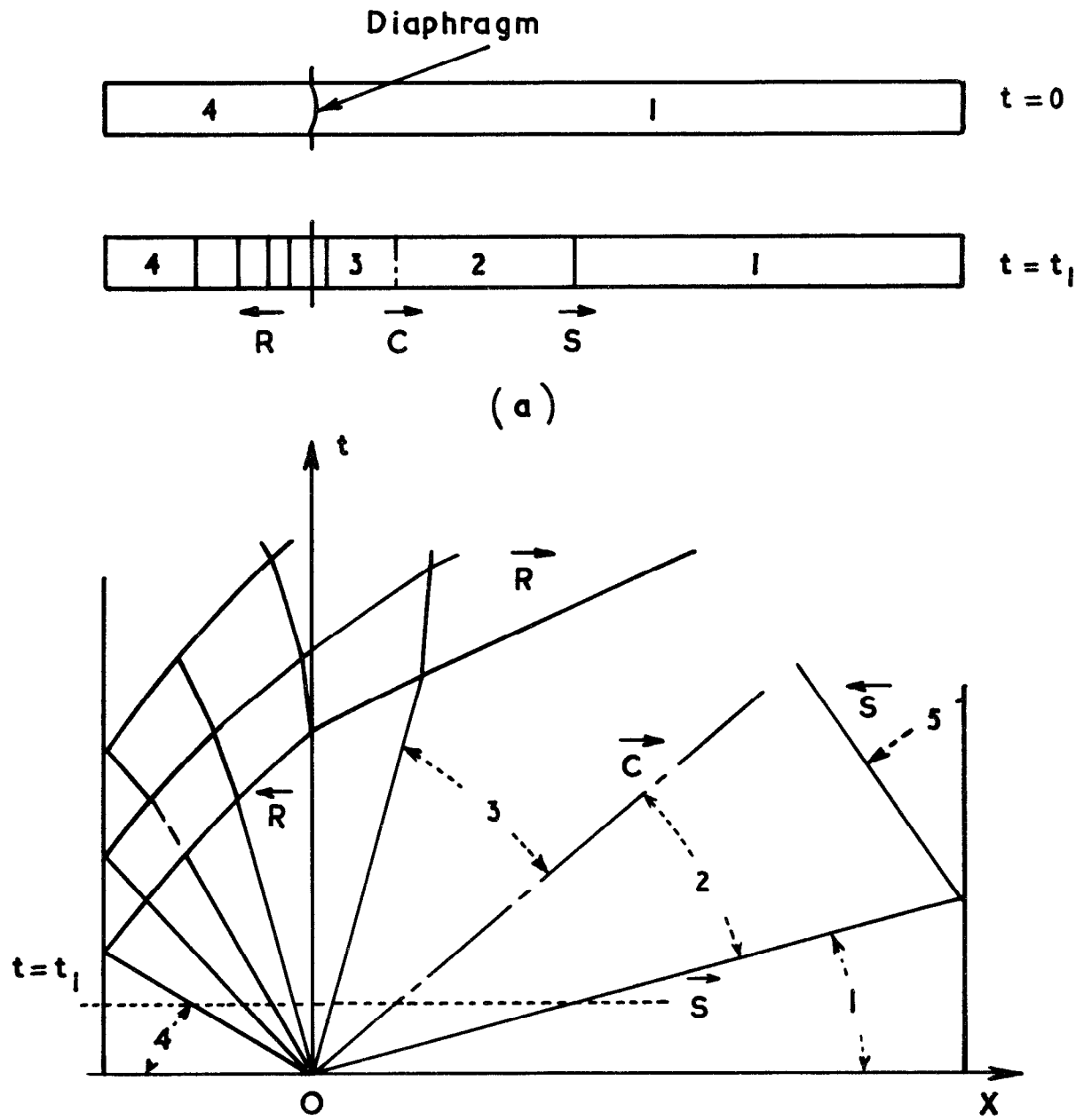
Table 5 (contd.)

p_1 = 2000 mm Hg T_1 = 290°K

W_{11}	W_{21}	T_5 °K	Z_5	H_{51}	P_{51}	Γ_{51}	S_5/R_0
1.2	0.957	366	1.000	1.27	2.2	1.78	23.61
1.4	0.925	440	1.000	1.53	4.2	2.76	23.65
1.6	0.930	522	1.000	1.82	6.9	3.85	23.78
1.8	0.933	604	1.000	2.14	10.6	5.07	23.92
2.0	0.954	695	1.000	2.48	15.1	6.30	24.11
2.2	0.970	788	1.000	2.85	20.6	7.60	24.30
2.4	0.992	887	1.000	3.25	27.1	8.88	24.50
2.6	1.022	997	1.000	3.69	34.8	10.13	24.74
2.8	1.057	1118	1.000	4.17	43.7	11.35	24.99
3.0	1.079	1228	1.000	4.66	53.4	12.61	25.19
3.2	1.114	1361	1.000	5.21	64.7	13.79	25.44
3.4	1.147	1494	1.000	5.78	76.8	14.91	25.67
3.6	1.181	1630	1.000	6.37	89.7	15.96	25.90
3.8	1.218	1780	1.000	7.02	104.2	16.98	26.14
4.0	1.255	1936	1.000	7.70	119.7	17.93	26.37
4.2	1.289	2090	1.000	8.38	136.2	18.90	26.58
4.4	1.325	2257	1.000	9.13	154.3	19.83	26.81
4.6	1.363	2427	1.000	9.91	172.9	20.66	27.03
4.8	1.399	2606	1.001	10.71	193.4	21.51	27.25
5.0	1.435	2784	1.001	11.55	214.2	22.29	27.47
5.2	1.463	2952	1.002	12.40	235.9	23.14	27.66
5.4	1.495	3135	1.003	13.32	259.7	23.95	27.88
5.6	1.518	3296	1.005	14.20	284.1	24.87	28.06
5.8	1.544	3466	1.008	15.16	308.6	25.61	28.27
6.0	1.565	3626	1.011	16.14	334.3	26.43	28.46
6.2	1.588	3788	1.016	17.14	361.4	27.24	28.67
6.4	1.607	3943	1.021	18.19	390.5	28.13	28.87
6.6	1.624	4089	1.027	19.24	419.6	28.98	29.06
6.8	1.641	4232	1.034	20.33	450.0	29.83	29.25
7.0	1.655	4366	1.041	21.45	481.6	30.73	29.44
7.2	1.669	4502	1.049	22.61	516.3	31.71	29.62
7.4	1.686	4636	1.058	23.80	551.2	32.60	29.82
7.6	1.709	4781	1.069	25.06	589.6	33.47	30.05
7.8	1.724	4906	1.078	26.29	628.2	34.44	30.23
8.0	1.741	5036	1.089	27.60	670.2	35.44	30.42
8.2	1.759	5165	1.101	28.96	714.5	36.45	30.62
8.4	1.778	5294	1.113	30.35	761.3	37.47	30.82
8.6	1.799	5422	1.126	31.76	810.3	38.49	31.02
8.8	1.820	5550	1.139	33.21	862.4	39.55	31.22
9.0	1.842	5682	1.154	34.75	918.4	40.63	31.42
9.2	1.866	5812	1.168	36.28	975.7	41.68	31.62
9.4	1.890	5941	1.183	37.84	1035.2	42.72	31.82
9.6	1.917	6076	1.199	39.49	1099.3	43.76	32.03
9.8	1.944	6207	1.216	41.12	1164.5	44.76	32.24
10.0	1.966	6333	1.230	42.83	1233.3	45.90	32.42
10.2	2.004	6481	1.250	44.58	1304.2	46.67	32.66
10.4	2.029	6609	1.266	46.35	1376.1	47.70	32.84
10.6	2.069	6761	1.287	48.22	1454.5	48.49	33.08
10.8	2.104	6903	1.306	50.07	1532.4	49.30	33.30
11.0	2.132	7037	1.323	51.97	1614.5	50.29	33.48
11.2	2.170	7185	1.343	53.91	1697.6	51.02	33.70
11.4	2.210	7339	1.364	55.95	1785.7	51.74	33.92
11.6	2.248	7487	1.384	57.95	1873.6	52.45	34.13
11.8	2.287	7638	1.404	60.01	1963.5	53.11	34.33
12.0	2.329	7797	1.425	62.15	2059.1	53.75	34.55

ES

FIG. 1

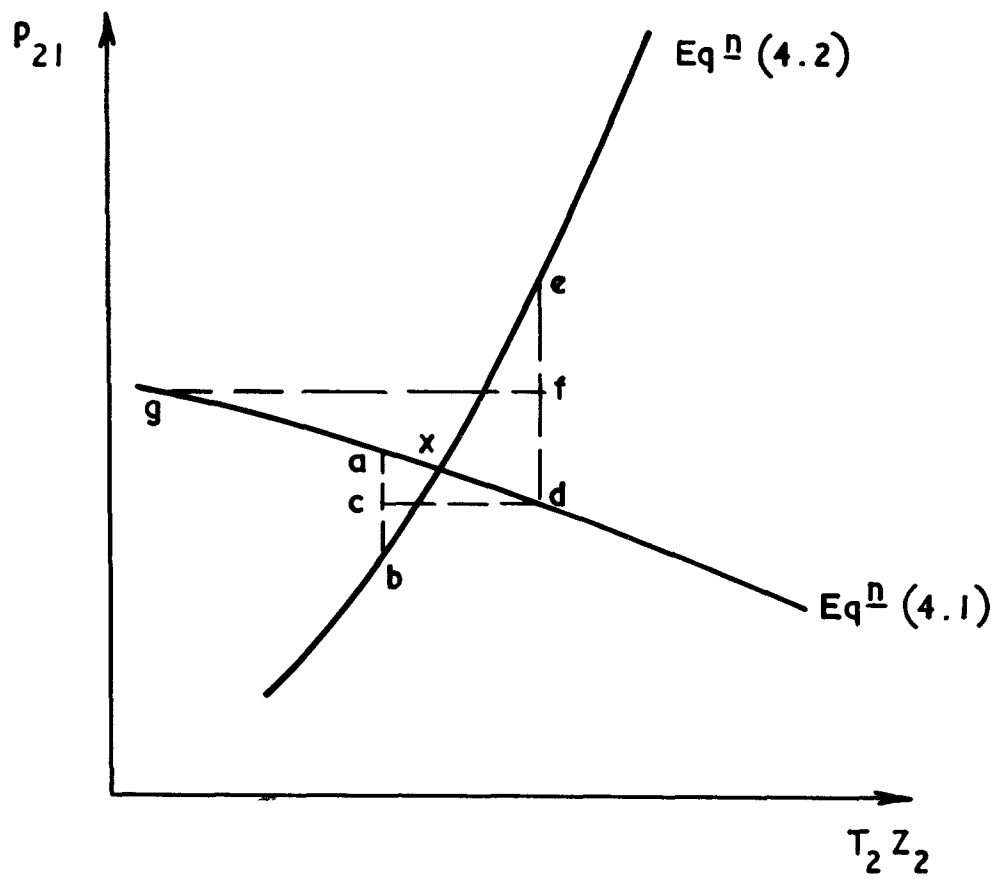


Idealised shock-tube flow.

(a) Physical plane.

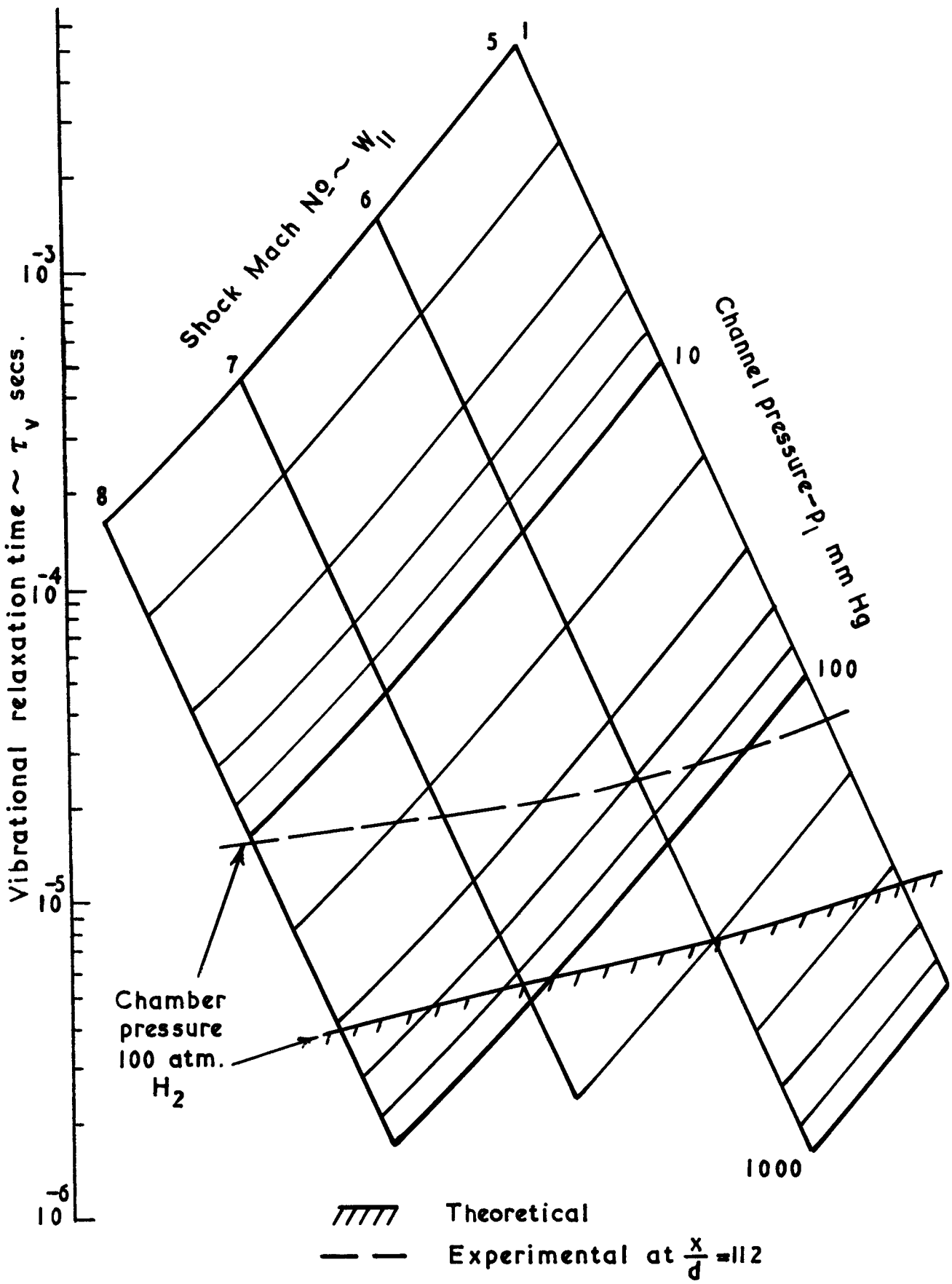
(b) Distance-time plane.

FIG. 2



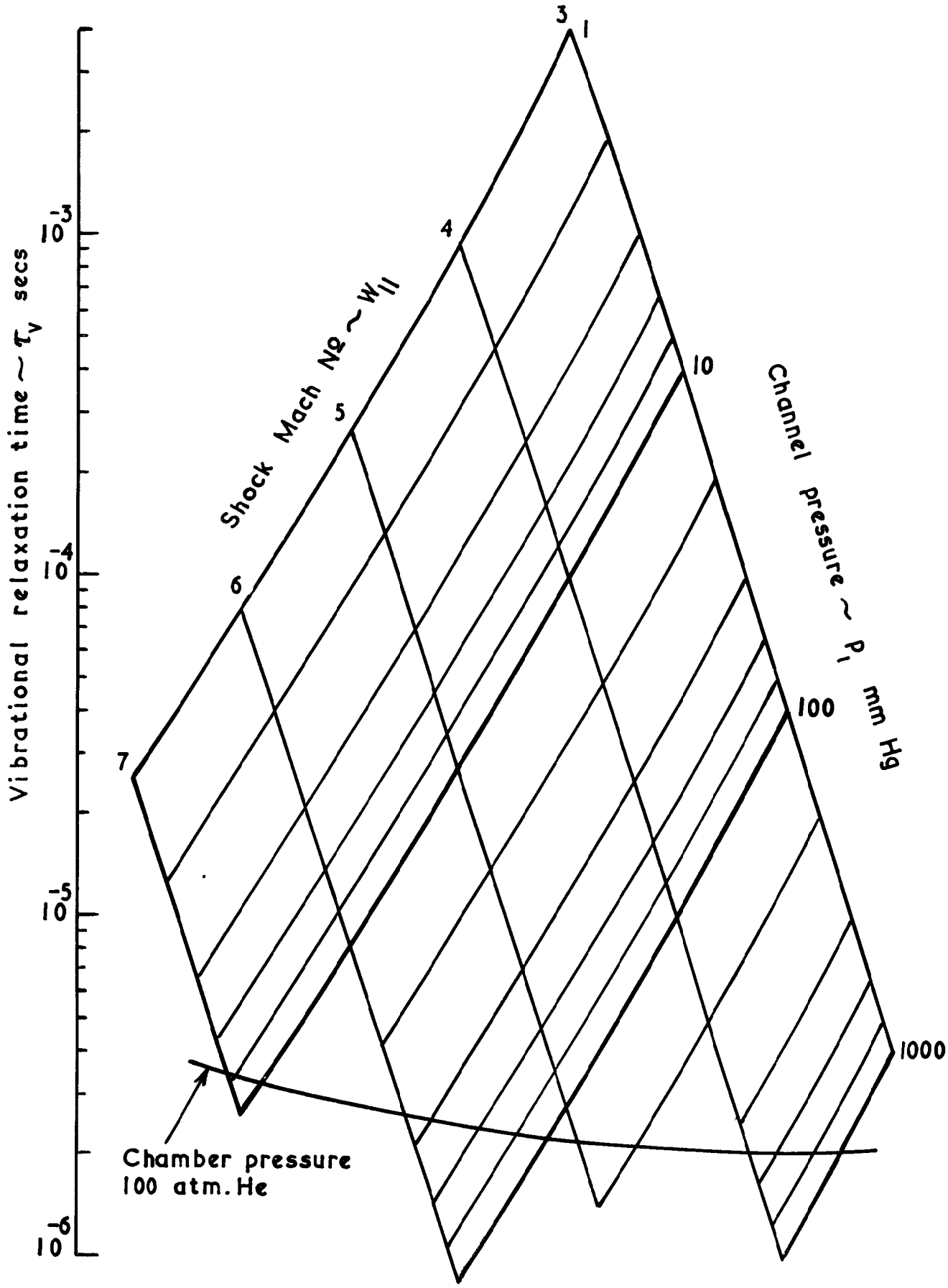
Sketch illustrating iteration procedure.

FIG. 3



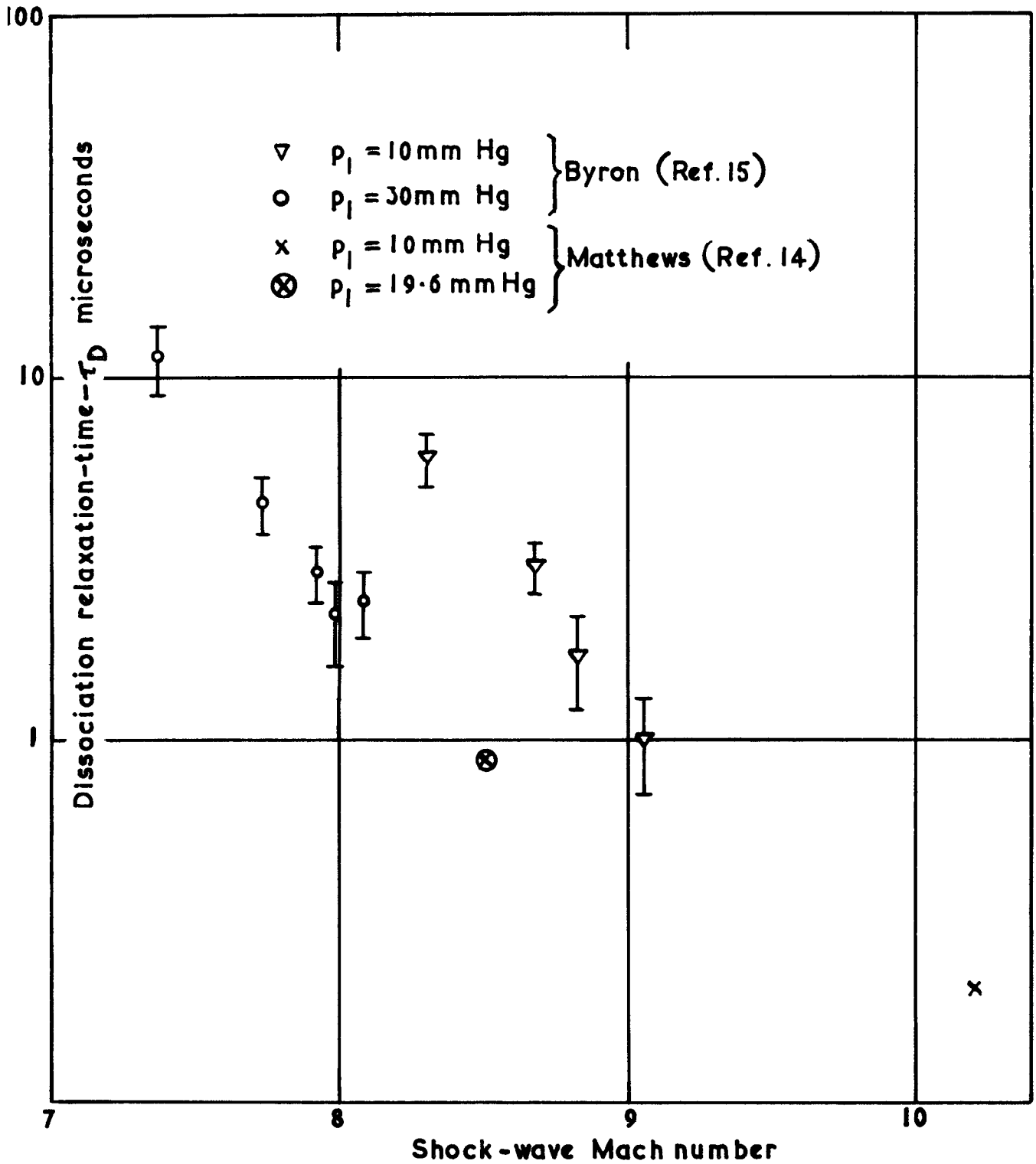
Vibrational relaxation time in H_2/N_2 shock-tube.

FIG. 4



Vibrational relaxation time in He/O_2 shock-tube.

FIG. 5



Dissociation "relaxation-time" in Oxygen.

A.R.C. C.P. No.626
April, 1961
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Tabulated solutions are presented for the equilibrium gas properties behind the incident and reflected normal shock-waves in the shock-tube, for nitrogen and oxygen. They cover the range of shock-wave Mach numbers up to 12 at intervals of 0.2, for selected values of the undisturbed gas pressure between 1 and 2000 mm Hg.

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