A Formulation of the Thermodynamic Properties of Ordinary Water Substance

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According to the International Formulation Committee of the International Conference on the Properties of Steam, a formulation of the properties of steam is determined in the present paper. The formulation covers the whole region of the International Skeleton Table of 1963, that extends in pressure from the ideal gas limit (at zero pressure) to a pressure of $10^8 N/m^2$ (1000 bar), and that extends in temperature from 273.16°K (0.01°C) to 1073.15°K (800°C).

This whole region is devided into seven sub-regions, and is expressed by the four major functions, namely, the function A (for liquid water region), the function B (for superheated steam region), the function C (for critical region above critical temperature) and the function D (for critical region below critical temperature).

The discontinuities of the properties at the boundaries between the sub-regions are calculated and discussed.

1. Introduction

Recent rapid advance of steam boilers and nuclear reactors has demanded accurate steam properties in wide range, and a number of experimental results of the thermodynamic properties of steam at high temperatures and pressures have been reported by various investigators. In 1963, the New International Skeleton Tables of the properties of compressed liquid water and superheated steam were determined at the Sixth International Conference on the Properties of Steam (ICPS) up to 800°C and 1000 bar, based on those experimental data. Since then it has been desirable to complete a formulation of the thermodynamic properties of water substance, which is convenient for calculations with digital computers relating to plant design and cycle optimisation. Some formulations were proposed at the Meeting of International Formulation Committee (IFC)[1,2,3].

In the above sentence, 'a formulation' means a set of equations and instructions which collectively describe the thermodynamic properties of water substance

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over the whole region covered by the International Skeleton Table 1963. A formulation may prove to be devided into a set of sub-formulations each of which is valid over a sub-region: In that event the formulation will comprise a statement of each of the sub-formulations as well as a specification of the inter-regional boundaries.

In this paper, the formulation consists of the four sub-formulations and a saturation function. The whole region of the Skeleton Table 1963 is devided inot the seven sub-regions, and is expressed by the four major functions and a saturation function as follows,

1. Function A for the liquid water region
2. Function B for superheated steam region
3. Function C for critical region above critical temperature
4. Function D for the critical region below critical temperature
5. Saturation function for saturation pressure

The sub-formulations are presented as a dimensionless form for easier comparison with other formulations.

The various thermodynamic properties are not independent of each other, but are given by the expressions in terms of derivatives of a single quantity. The formulation makes use of the thermodynamic relations in order to ensure thermodynamic consistency, and this consistency is realized automatically when the formulation is presented in terms of one or more of certain so-called canonical or characteristic functions.

When the pressure p and temperature T are chosen as the independent variables, the expressions (here called derived functions) for the specific volume, entropy, enthalpy and all other thermodynamic properties may be derived directly by partial differentiation of the canonical function $g=g(p,T)$, where g is the specific free enthalpy (Gibbs function). Similarly, when the specific volume v and temperature T are chosen as the independent variables, then the expressions for the pressure, specific entropy, enthalpy and all other thermodynamic properties may be directly derived by partial differentiation of the canonical function $f=f\ (v,T)$, where f is the specific free energy (Helmholtz function). The formulatioon is presented in terms of such canonical functions. For liquid water region and superheated steam region the specific free enthalpy g is chosen as the canonical function, and for critical region the specific free energy f is chosen as the canonical function.

2. Physical Quantities, Quantity Symbols, Units and Defined Constant Quantities

2.1 Physical Quantities (Properties)

According to the Recommendation of the International Formulation Committee, the physical quantities required for this formulation are listed below with the symbols used herein.

specific Helmholtz function (specific free energy)	f
specific Gibbs function (specific free enthalpy)	g
specific enthalpy	h
specific entropy	s
specific volume	v
pressure	p
temperature (thermodynamic temperature)	T
specific heat at constant volume	c_v
specific heat at constant pressure	c_p
quantities at the critical point	v_c, p_c, T_c
quantities for the saturated liquid	f_f, h_f, s_f, v_f
quantities for the saturated vapour	h_g, s_g, v_g
increments in quantities for evaporation from liquid to vapour	h_{fg}, s_{fg}, v_{fg}
quantities at the triple point	f_{ft}, s_{ft}, p_t, T_t
specific ideal-gas constant	R
saturation pressure	P_S
saturation temperature	T_S

2.2 Units

Quantities		*Unit Symbol*
f, g, h	joule per kilogramme	J/kg
v	metre cubed per kilogramme	m^3/kg
p	newton per metre squared,	N/m^2
	joule per metre cubed,	J/m^3
	pascal	Pa
T	degree Kelvin	°K
s, R, c_v, c_p	joule per kilogramme degree Kelvin	J/kg°K

The temperature at the triple point T_t=273.16°K exactly, and the Celsius temperature is exactly $T-T_0$, where T_0=273.15°K exactly.

2.3 Defined Constant Quantities

In accordance with the decisions of the ICPS, $s_{ft}=0$, $f_{ft}=0$. The IFC, at the First Meeting in Prague, 1965, defined certain constant quantities and their symbols. The followings are required herein.

$p_{t1}=611.2\ \mathrm{N/m^2}=611.2\ \mathrm{J/m^3}$
$T_{c1}=647.3°\mathrm{K}$
$p_{c1}=22120000\ \mathrm{N/m^2}=22120000\ \mathrm{J/m^3}$
$v_{c1}=0.00317\ \mathrm{m^3/kg}$
$R_1=46151\ \mathrm{J/kg°K}$

3. Reduced Dimensionless Variables and Thermodynamic Relations

3.1 Reduced Dimensionless Variables

a) In accordance with IFC,

$p/p_{c1}=\beta$, the reduced pressure
$T/T_{c1}=\theta$, the reduced temperature
$v/v_{c1}=\chi$, the reduced volume
$h/p_{c1}\cdot v_{c1}=\in$, the reduced enthalpy
$s/(p_{c1}\cdot v_{c1}/T_{c1})=\sigma$, the reduced entropy

b) Further the followings are used,

$\in-\theta\sigma=\zeta$, the reduced free enthalpy (Gibb's function)
$\zeta-\beta\chi=\psi$, the reduced free energy (Helmholtz function)
$R_1T_{c1}/p_{c1}v_{c1}=I_1$, the reduced ideal-gas constant
$p_S(T)/p_{c1}=\beta_S(\theta)$, the reduced saturation pressure
$T_S(p)/T_{c1}=\theta_S(\beta)$, the reduced saturation temperature
$p_t/p_{c1}=\beta_t$ the reduced triple-point pressure
$T_t/T_{c1}=\theta_t$ the reduced triple-point temperature

3.2 Thermodynamic Relations

The well-established relations,

$$s=-(\partial g/\partial T)_p=-(\partial f/\partial T)_v$$
$$v=+(\partial g/\partial p)_T$$
$$p=-(\partial f/\partial v)_T$$
$$h=g+Ts=f+pv+Ts$$

may be written in terms of the reduced dimensionless variables.

They become,

$$\sigma=-(\partial\zeta/\partial\theta)_\beta=-(\partial\psi/\partial\theta)_\chi$$

$$\chi = +(\partial\zeta/\partial\beta)_\theta$$
$$\beta = -(\partial\psi/\partial\chi)_\theta$$
$$\epsilon = \zeta + \theta\sigma = \psi + \beta\chi + \theta\sigma$$

Moreover,

$$\frac{c_p T_{c1}}{p_{c1} v_{c1}} = -\theta\left(\frac{\partial^2\zeta}{\partial\theta^2}\right)_\beta = -\theta\left(\frac{\partial^2\psi}{\partial\theta^2}\right)_\chi + \theta\left(\frac{\partial^2\psi}{\partial\chi\partial\theta}\right)^2 \Big/ \left(\frac{\partial^2\psi}{\partial\chi^2}\right)_\theta$$
$$\frac{c_v T_{c1}}{p_{c1} v_{c1}} = -\theta\left(\frac{\partial^2\psi}{\partial\theta^2}\right)_\chi = -\theta\left(\frac{\partial^2\zeta}{\partial\theta^2}\right)_\beta + \theta\left(\frac{\partial^2\zeta}{\partial\theta\partial\beta}\right)^2 \Big/ \left(\frac{\partial^2\zeta}{\partial\beta^2}\right)_\theta$$

4. Specification of Sub-regions and Identification of the Canonical Functions, of the Saturation Function and of the Derived Functions and Other Expressions for Use in the Sub-regions

4.1 Sub-regions

The sub-regions are specified precisely in Fig. 1 and are identified by the

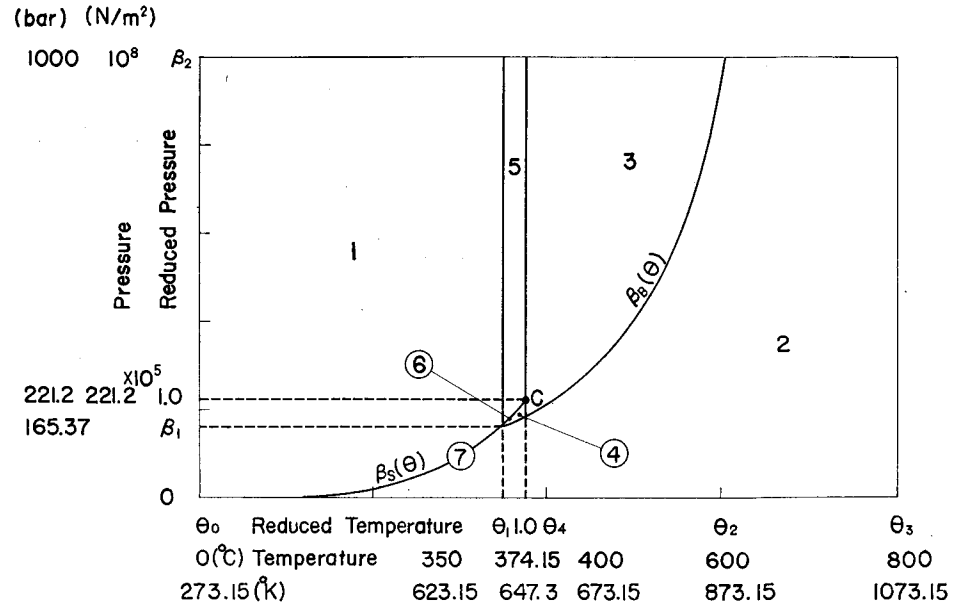

Fig. 1.

numbers 1, 2, 3, 4, 5, 6 and 7 as shown in Table 1. These sub-regions are illustrated on the pressure-temperature plane in Fig. 1.

Table 1.

Number identifying sub-region	Relevant canonical and saturation functions
1	A
2	B
3	C
4	D
5	D
6	D, S
7	A+B, S

4.2 Canonical and Saturation Functions

4.2.1 Canonical Functions

The principal canonical functions are identified by the letter A, B, C and D.

4.2.2 Saturation Function

The function specifying the saturation line on the pressre-temperature plane is identified by the letter S.

5. Specification, on the Pressure-Temperature Plane, of the Precise Extent of Each of the Sub-regions

The precise extent, on the pressure-temperature plane, of each of the sub-regions shown in Fig. 1 is specified in Table 2.

Table 2.

Temperature Range	Pressure Range	Sub-region
$\theta_t \leqslant \theta \leqslant \theta_1$	$0 \leqslant \beta < \beta_S(\theta)$	2
	$\beta = \beta_S(\theta)$	7
	$\beta_S(\theta) < \beta \leqslant \beta_2$	1
$\theta_1 < \theta < 1$	$0 \leqslant \beta \leqslant \beta_B(\theta)$	2
	$\beta_B(\theta) < \beta < \beta_S(\theta)$	4
	$\beta = \beta_S(\theta)$	6
	$\beta_S(\theta) < \beta \leqslant \beta_2$	5
$1 \leqslant \theta < \theta_2$	$0 \leqslant \beta \leqslant \beta_B(\theta)$	2
	$\beta_B(\theta) < \beta \leqslant \beta_2$	3
$\theta_2 \leqslant \theta \leqslant \theta_3$	$0 \leqslant \beta \leqslant \beta_2$	2

The expressions for $\beta_S(\theta)$ and $\beta_B(\theta)$ are given in Section 6.1 and Section 6.2.

6. Equations for the Boundaries between Sub-regions on the Pressure-Temperature Plane

6.1 Boundary between Sub-regions 1 and 2 and between Sub-regions 4 and 5. (Function S - Saturation Line)

The saturation line provides the boundary between these sub-regions. The equation for the reduced saturation pressure, β, as a function of the reduced saturation temperature, θ, is here described as function S; unlike the other boundaries, this boundary is not artificial but depends on the properties of the substance. The equation is:

$$\beta_S(\theta) = \exp\left(\sum_{\nu=0}^{10} a_\nu x^\nu\right) \quad \text{or} \quad \ln \beta_S(\theta) = \sum_{\nu=0}^{10} a_\nu x^\nu$$

where,

$$x = \theta - \theta_0,$$

and the values of the constants are given in Table 3.

6.2 Boundary between Sub-region 2 and Sub-regicns 3 and 4

This boundary is defined by the equation:

$$\beta_B(\theta) = \sum_{\nu=0}^{3} k_\nu \theta^\nu,$$

the values of the constants are given in Table 3.

6.3 Boundary between Sub-regions 3 and 4, and between Sub-region 3 and 5

This boundary is defined simply by the equation:

$$\theta = 1$$

6.4 Boundary between Sub-regions 5 and 1

This boundary is defined simply by the equation:

$$\theta = \theta_1$$

where the value of constant θ_1 is given in Table 3.

7. Expressions for the Canonical Functions and Derived Functions

7.1 Function A - Relevant to Sub-regions 1 and 7

Reduced free enthalpy (Gibbs function)

$$\zeta_A = W_1 + X_1\beta - Z_1(Y_1+\beta)\{\ln(Y_1+\beta)+m-1\}$$

Reduced volume

$$\chi_A = X_1 - Z_1\{\ln(Y_1+\beta)+m\}$$

Reduced entropy

$$\sigma_A = -W_2 - X_2\beta + Z_2(Y_2+\beta)\{\ln(Y_1+\beta)+m-1\} + Z_1 \cdot Y_2\{\ln(Y_1+\beta)+m\}$$

Reduced specific heat at constant pressure

$$\frac{c_p T_{c1}}{p_{c1} v_{c1}} = -\theta W_3 + \theta\Big[-X_3\beta + Z_3(Y_1+\beta)\{\ln(Y_1+\beta)+m-1\} + 2(Y_2 \cdot Z_2 + Y_3 \cdot Z_1)\{\ln(Y_1+\beta)+m\} + \frac{Z_1 \cdot Y_2^2}{Y_1+\beta}\Big]$$

where,

$$X_1 = A_0 + A_1 x + A_2 x^2 + A_3 x^4 + A_4 x^6 + A_5 x^8 + A_6 x^{10}$$

$$X_2 = \frac{dX_1}{d\theta} = A_1 + 2A_2 x + 4A_3 x^3 + 6A_4 x^5 + 8A_5 x^7 + 10A_6 x^9$$

$$X_3 = \frac{dX_2}{d\theta} = 2A_2 + \sum_{\nu=3}^{6} 2(\nu-1)(2\nu-3)A_\nu \cdot x^{2(\nu-2)}$$

$$Y_1 = \sum_{\nu=0}^{6} B_\nu x^\nu + B_7 x^8 + B_8 \cdot x^{10}$$

$$Y_2 = \frac{dY_1}{d\theta} = \sum_{\nu=1}^{6} \nu B_\nu x^{\nu-1} + 8B_7 x^7 + 10B_8 \cdot x^9$$

$$Y_3 = \frac{dY_2}{d\theta} = \sum_{\nu=2}^{6} \nu(\nu-1)B_\nu x^{\nu-2} + 56B_7 x^6 + 90B_8 x^8$$

$$Z_1 = \sum_{\nu=0}^{6} C_\nu x^\nu + \sum_{\nu=7}^{10} C_\nu x^{2(\nu-2)}$$

$$Z_2 = \frac{dZ_1}{d\theta} = \sum_{\nu=1}^{6} \nu C_\nu x^{\nu-1} + \sum_{\nu=7}^{10} 2(\nu-2)C_\nu x^{2\nu-5}$$

$$Z_3 = \frac{dZ_2}{d\theta} = \sum_{\nu=2}^{6} \nu(\nu-1)C_\nu x^{\nu-2} + \sum_{\nu=7}^{10} 2(\nu-2)(2\nu-5)C_\nu x^{2(\nu-3)}$$

$$W_1 = \sum_{\nu=0}^{15} D_\nu x^\nu$$

$$W_2 = \frac{dW_1}{d\theta} = \sum_{\nu=1}^{15} \nu D_\nu x^{\nu-1}$$

$$W_3 = \frac{dW_2}{d\theta} = \sum_{\nu=2}^{15} \nu(\nu-1)D_\nu x^{\nu-2}$$

$$x = \theta - \theta_0$$

7.2 Function B - Relevant to Sub-regions 2 and 7

Reduced free enthalpy (Gibbs function)

$$\zeta_B = s_{00} \cdot \theta \cdot \ln\theta + \sum_{\nu=0}^{4} s_\nu \cdot \theta^\nu + I_1 \cdot \theta \cdot \ln\beta + (\theta^{-5}\sum_{\nu=0}^{3} b_\nu \cdot \theta^\nu)\beta + (\theta^{-7}\sum_{\nu=0}^{3} c_\nu \cdot \theta^\nu)\beta^2 + (\theta^{-13}\sum_{\nu=0}^{3} d_\nu \cdot \theta^\nu)\beta^3 + (\theta^{-17}\sum_{\nu=0}^{4} e_\nu \cdot \theta^\nu)\beta^4 + (\theta^{-23}\sum_{\nu=0}^{9} f_\nu \cdot \theta^\nu)\beta^5 + (\theta^{-59}\sum_{\nu=0}^{8} g_\nu \cdot \theta^\nu)\beta^{10}$$

Reduced volume

$$\chi_B = I_1 \cdot \theta \cdot \beta^{-1} + \theta^{-5} \sum_{\nu=0}^{3} b_\nu \cdot \theta^\nu + 2(\theta^{-7} \sum_{\nu=0}^{3} c_\nu \cdot \theta^\nu)\beta + 3(\theta^{-13} \sum_{\nu=0}^{3} d_\nu \cdot \theta^\nu)\beta^2$$
$$+ 4(\theta^{-17} \sum_{\nu=0}^{4} e_\nu \cdot \theta^\nu)\beta^3 + 5(\theta^{-23} \sum_{\nu=0}^{9} f_\nu \cdot \theta^\nu)\beta^4 + 10(\theta^{-59} \sum_{\nu=0}^{8} g_\nu \cdot \theta^\nu)\beta^9$$

Reduced entropy

$$\sigma_B = -s_{00}(\ln \theta + 1) - \sum_{\nu=1}^{4} \nu \cdot s_\nu \cdot \theta^{\nu-1} - I_1 \ln \beta - \{\theta^{-6} \sum_{\nu=0}^{3} (\nu-5) b_\nu \cdot \theta^\nu\} \beta$$
$$- \{\theta^{-8} \sum_{\nu=0}^{3} (\nu-7) c_\nu \cdot \theta^\nu\} \beta^2 - \{\theta^{-14} \sum_{\nu=0}^{3} (\nu-13) d_\nu \cdot \theta^\nu\} \beta^3$$
$$- \{\theta^{-18} \sum_{\nu=0}^{4} (\nu-17) e_\nu \cdot \theta^\nu\} \beta^4 - \{\theta^{-24} \sum_{\nu=0}^{9} (\nu-23) f_\nu \cdot \theta^\nu\} \beta^5$$
$$- \{\theta^{-60} \sum_{\nu=0}^{8} (\nu-59) g_\nu \cdot \theta^\nu\} \beta^{10}$$

Reduced specific heat at constant pressure

$$\frac{c_p T_{c1}}{p_{c1} v_{c1}} = -s_{00} - \sum_{\nu=2}^{4} \nu(\nu-1) s_\nu \cdot \theta^{\nu-2} - \{\theta^{-6} \sum_{\nu=0}^{3} (\nu-5)(\nu-6) b_\nu \cdot \theta^\nu\} \beta$$
$$- \{\theta^{-8} \sum_{\nu=0}^{3} (\nu-7)(\nu-8) c_\nu \cdot \theta^\nu\} \beta^2 - \{\theta^{-14} \sum_{\nu=0}^{3} (\nu-13)(\nu-14) d_\nu \cdot \theta^\nu\} \beta^3$$
$$- \{\theta^{-18} \sum_{\nu=0}^{4} (\nu-17)(\nu-18) e_\nu \cdot \theta^\nu\} \beta^4 - \{\theta^{-24} \sum_{\nu=0}^{9} (\nu-23)(\nu-24) f_\nu \cdot \theta^\nu\} \beta^5$$
$$- \{\theta^{-60} \sum_{\nu=0}^{8} (\nu-59)(\nu-60) g_\nu \cdot \theta^\nu\} \beta^{10}$$

7.3 Function C - Relevant to Sub-regions 3, 4, 5 and 6

Reduced free energy (Helmholtz function)

$$\Psi_C = s_{30} \cdot \theta + \sum_{\nu=1}^{4} s_{3\nu} \cdot \theta^{1-\nu} - \chi - \{F_0 \chi + F_1(\ln \chi + n) + \sum_{\nu=2}^{9} F_\nu \chi^{1-\nu}\}$$
$$- (\theta-1)\{G_0 \chi + G_1(\ln \chi + n) + \sum_{\nu=2}^{9} G_\nu \chi^{1-\nu}\}$$
$$- (\theta-1)(\theta_2-\theta)[\theta^{-2}\{K_0 \chi + K_1(\ln \chi + n) + \sum_{\nu=2}^{5} K_\nu \chi^{1-\nu}\}$$
$$+ (\theta-\theta_4)(L_1 \chi^{-4} + L_2 \chi^{-5})]$$

Reduced volume

$$\beta_C = 1 + \{F_0 + F_1 \chi^{-1} + \sum_{\nu=2}^{9} (1-\nu) F_\nu \chi^{-\nu}\} + (\theta-1)\{G_0 + G_1 \chi^{-1} + \sum_{\nu=2}^{9} (1-\nu) G_\nu \chi^{-\nu}\}$$
$$+ (\theta-1)(\theta_2-\theta)[\theta^{-2}\{K_0 + K_1 \chi^{-1} + \sum_{\nu=2}^{5} (1-\nu) K_\nu \chi^{-\nu}\}$$
$$+ (\theta-\theta_4)(-4L_1 \chi^{-5} - 5L_2 \chi^{-6})]$$

Reduced entropy

$$\sigma_C = -s_{30} - \sum_{\nu=2}^{4} (1-\nu)s_{3\nu}\theta^{-\nu} + \{G_0\chi + G_1(\ln\chi + n) + \sum_{\nu=2}^{9} G_\nu \chi^{1-\nu}\}$$
$$+ \{-(1+\theta_2)\theta^{-2} + 2\theta_2 \cdot \theta^{-3}\}\ \{K_0\chi + K_1(\ln\chi + n) + \sum_{\nu=2}^{5} K_\nu \chi^{1-\nu}\}$$
$$+ \{-3\theta^2 + 2(1+\theta_2+\theta_4)\theta - (\theta_2+\theta_4+\theta_2\cdot\theta_4)\}\{(L_1\chi^{-4} + L_2\chi^{-5})$$

Reduced specific heat at constant pressure

$$\frac{c_p T_{c1}}{p_{c1} v_{c1}} = \sum_{\nu=2}^{4} \nu(1-\nu)s_{3\nu}\cdot\theta^{-\nu} + \{2(1+\theta_2)\theta^{-2} - 6\theta_2\cdot\theta^{-3}\}$$
$$\times\{K_0\chi + K_1(\ln\chi + n) + \sum_{\nu=2}^{5} K_\nu\chi^{1-\nu}\} + \{-6\theta^2 + 2(1+\theta_2+\theta_4)\theta\}$$
$$\times(L_1\chi^{-4} + L_2\chi^{-5}) + \theta[-\{G_0 + G_1\chi^{-1} + \sum_{\nu=2}^{9}(1-\nu)G_\nu\chi^{-\nu}\}$$
$$-\{-(\theta_2+1)\theta^{-2} + 2\theta_2\cdot\theta^{-3}\}\ \{K_0 + K_1\chi^{-1} + \sum_{\nu=2}^{5}(1-\nu)K_\nu\chi^{-\nu}\}$$
$$-\{-3\theta^2 + 2(1+\theta_2+\theta_4)\theta - (\theta_2+\theta_4+\theta_2\cdot\theta_4)\}(-4L_1\chi^{-5} - 5L_2\chi^{-6})]^2$$
$$\Big/\Big\{-\{-F_1\chi^{-2} + \sum_{\nu=2}^{9}(-\nu)(1-\nu)F_\nu\chi^{-\nu-1}\}$$
$$-(\theta-1)\{-G_1\chi^{-2} + \sum_{\nu=2}^{9}(-\nu)(1-\nu)G_\nu\chi^{-\nu-1}\}$$
$$-(\theta-1)(\theta_2-\theta)[\theta^{-2}\{-K_1\chi^{-2} + \sum_{\nu=2}^{5}(-\nu)(1-\nu)K_\nu\chi^{-\nu-1}\}$$
$$+(\theta-\theta_4)(20L_1\chi^{-6} + 30L_2\chi^{-7})]\Big\}$$

7.4 Function D - Relevant to Sub-regions 4, 5 and 6

The equation β_D given below, when solved numerically for the reduced volume, $\chi = v/v_{c1}$, may have more than one solution. The greatest solution is $\chi_4(\theta, \beta)$ in sub-region 4, and the least is $\chi_5(\theta, \beta)$ in sub-region 5.

Reduced free energy (Helmholtz function)

$$\Psi_D = s_{40} + s_{41}\cdot\theta\cdot\ln\theta + s_{42}\cdot\theta - \chi - \{F_0\chi + F_1(\ln\chi + n) + \sum_{\nu=2}^{9} F_\nu\chi^{1-\nu}\}$$
$$-(\theta-1)\{J_0\chi + J_1(\ln\chi + n) + \sum_{\nu=2}^{10} J_\nu\chi^{1-\nu}\}$$

Reduced volume

$$\beta_D = 1 + \{F_0 + F_1\chi^{-1} + \sum_{\nu=2}^{9}(1-\nu)F_\nu\chi^{-\nu}\} + (\theta-1)\{J_0 + J_1\chi^{-1} + \sum_{\nu=2}^{10}(1-\nu)J_\nu\chi^{-\nu}\}$$

Reduced entropy

$$\sigma_D = -(s_{41}+s_{42}) - s_{41}\cdot\ln\theta + \{J_0\chi + J_1(\ln\chi + n) + \sum_{\nu=2}^{10} J_\nu\chi^{1-\nu}\}$$

Reduced specific heat at constant pressure

$$\frac{c_p T_{c1}}{p_{c1} v_{c1}} = -s_{41} + \theta[-\{J_0 + J_1\chi^{-1} + \sum_{\nu=2}^{10}(1-\nu)J_\nu\chi^{-\nu}\}]^2$$
$$/[-\{-F_1\chi^{-2} + \sum_{\nu=2}^{9}(-\nu)(1-\nu)F_\nu\chi^{-\nu-1}\}$$
$$-(\theta-1)\{-J_1\chi^{-2} + \sum_{\nu=2}^{10}(-\nu)(1-\nu)J_\nu\chi^{-\nu-1}\}]$$

For sub-regions 6 and 7, the reduced pressure is given by

$$\beta = \beta_S(\theta)$$

where the expression for $\beta_S(\theta)$ is expressed in Section 6.1. For constant reduced temperature θ, and therefore also for constant reduced pressure β, the reduced volume χ, reduced entropy σ and reduced enthalpy $\in$ are interrelated by the following expression:

$$\text{dryness fraction} = \frac{\chi-\chi_f}{\chi_g-\chi_f} = \frac{\sigma-\sigma_f}{\sigma_g-\sigma_f} = \frac{\in-\in_f}{\in_g-\in_f},$$

where subscripts f and g correspond to the saturated liquid and saturated vapor respectively.

8. Discussions

The formulation is composed of the four sub-formulations, namely, function A, B, C and D, and a saturation function S. A comparison of the calculated values of specific volume with Skeleton Table ones is shown in Table 4. The calculated values of specific enthalpy are compared with the Skeleton Table ones in Table 5. The calculated specific entropy and the calculated specific heat at constant pressure are tabulated in Tables 6 and 7 respedtively. The properties of saturated water and saturated steam are tabulated and compared with Sekleton Table ones in Table 8. Calculated properties at the boundary between Sub-regions 5 and 1, are shown in Table 9. Calculated properties at the boundary between Sub-regions 3 and 4, and between Sub-regions 3 and 5 are shown in Table 10. Calculated properties at the boundary between Sub-regions 2 and Sub-regions 3 and 4 are shown in Table 11. Calculated values of specific free enthalpy at the boundary between Sub-regions 1 and 2 and between Sub-regions 4 and 5 are shown in Table 12. As shown in Tables 9–12, the discontinuities of the properties at the boundaries are very large as compared with the recommended values of Prague. Those discontinuities are especially remarkable in the low pressure region along critical temperature isotherm. However, it is very difficult to decrease the discontinuities smaller than the recommended values of Prague, and in this paper, no auxiliary functions are proposed in order to obtain smooth continuities at the boundaries.

Table 3. Values of the Constants.

$a_0 = -1.049\,722\,316 \times 10^{1}$
$a_1 = 4.702\,615\,547 \times 10^{1}$
$a_2 = -1.255\,372\,580 \times 10^{2}$
$a_3 = 3.137\,173\,111 \times 10^{2}$
$a_4 = -7.413\,769\,969 \times 10^{2}$
$a_5 = 1.541\,195\,099 \times 10^{3}$
$a_6 = -2.271\,487\,781 \times 10^{3}$
$a_7 = 1.435\,365\,307 \times 10^{3}$
$a_8 = 1.448\,517\,320 \times 10^{3}$
$a_9 = -3.248\,786\,257 \times 10^{3}$
$a_{10} = 1.708\,251\,159 \times 10^{3}$

$b_0 = -2.021\,075\,000 \times 10^{0}$
$b_1 = 6.598\,222\,000 \times 10^{0}$
$b_2 = -8.164\,534\,000 \times 10^{0}$
$b_3 = 2.123\,155\,000 \times 10^{0}$
$c_0 = -2.252\,685\,876 \times 10^{0}$
$c_1 = 5.563\,597\,025 \times 10^{0}$
$c_2 = -5.017\,794\,730 \times 10^{0}$
$c_3 = 1.558\,540\,043 \times 10^{0}$
$d_0 = -3.822\,162\,603 \times 10^{0}$
$d_1 = 9.945\,677\,480 \times 10^{0}$
$d_2 = -8.982\,384\,350 \times 10^{0}$
$d_3 = 2.724\,426\,242 \times 10^{0}$
$e_0 = -3.179\,131\,670 \times 10^{1}$
$e_1 = 1.130\,801\,878 \times 10^{2}$
$e_2 = -1.492\,868\,547 \times 10^{2}$
$e_3 = 8.621\,577\,903 \times 10^{1}$
$e_4 = -1.827\,330\,565 \times 10^{1}$
$f_0 = -5.637\,595\,839\,4 \times 10^{3}$
$f_1 = 4.606\,457\,380\,3 \times 10^{4}$
$f_2 = -1.656\,158\,878\,2 \times 10^{5}$
$f_3 = 3.440\,283\,472\,1 \times 10^{5}$
$f_4 = -4.551\,621\,731\,1 \times 10^{5}$
$f_5 = 3.978\,264\,365\,7 \times 10^{5}$
$f_6 = -2.297\,423\,379\,2 \times 10^{5}$
$f_7 = 8.454\,427\,428\,8 \times 10^{4}$
$f_8 = -1.799\,358\,169\,9 \times 10^{4}$
$f_9 = 1.687\,960\,574\,8 \times 10^{3}$
$g_0 = -5.207\,179\,726\,9 \times 10^{3}$
$g_1 = 4.067\,272\,851\,0 \times 10^{4}$
$g_2 = -1.380\,088\,788\,3 \times 10^{5}$
$g_3 = 2.656\,150\,161\,4 \times 10^{5}$
$g_4 = -3.170\,251\,060\,9 \times 10^{5}$
$g_5 = 2.401\,921\,294\,6 \times 10^{5}$
$g_6 = -1.127\,671\,879\,3 \times 10^{5}$
$g_7 = 2.998\,465\,685\,2 \times 10^{4}$
$g_8 = -3.456\,216\,660\,6 \times 10^{3}$
$s_{00} = -1.961\,874\,611 \times 10^{1}$
$s_0 = 2.803\,107\,226 \times 10^{1}$
$s_1 = -4.047\,919\,596 \times 10^{1}$
$s_2 = 5.379\,788\,150 \times 10^{0}$
$s_3 = -2.434\,885\,365 \times 10^{0}$
$s_4 = 3.815\,859\,375 \times 10^{-1}$
$I_1 = 4.260\,321\,147 \times 10^{0}$

$A_0 = 6.297\,223\,974 \times 10^{-1}$
$A_1 = 1.533\,868\,982 \times 10^{-1}$
$A_2 = -2.424\,203\,231 \times 10^{-1}$
$A_3 = 2.615\,033\,956 \times 10^{0}$
$A_4 = -3.010\,677\,023 \times 10^{1}$
$A_5 = 1.313\,303\,317 \times 10^{2}$
$A_6 = -1.535\,605\,515 \times 10^{2}$
$B_0 = 1.107\,594\,936 \times 10^{1}$
$B_1 = 6.422\,775\,472 \times 10^{1}$
$B_2 = -8.569\,708\,273 \times 10^{2}$
$B_3 = 5.296\,704\,954 \times 10^{3}$
$B_4 = -2.252\,930\,191 \times 10^{4}$
$B_5 = 5.577\,405\,301 \times 10^{4}$
$B_6 = -6.357\,077\,514 \times 10^{4}$
$B_7 = 5.088\,496\,023 \times 10^{4}$
$B_8 = -3.193\,808\,747 \times 10^{4}$
$C_0 = 4.026\,204\,416 \times 10^{-2}$
$C_1 = -7.959\,247\,043 \times 10^{-3}$
$C_2 = 2.599\,576\,837 \times 10^{-1}$
$C_3 = -2.528\,825\,524 \times 10^{0}$
$C_4 = 1.335\,889\,037 \times 10^{1}$
$C_5 = -3.720\,879\,754 \times 10^{1}$
$C_6 = 4.399\,660\,845 \times 10^{1}$
$C_7 = -4.127\,556\,613 \times 10^{2}$
$C_8 = 2.390\,599\,716 \times 10^{3}$
$C_9 = -6.078\,090\,203 \times 10^{3}$
$C_{10} = 5.865\,340\,091 \times 10^{3}$
$m = 5.399\,067\,211 \times 10^{0}$
$D_0 = 3.034\,108\,516 \times 10^{0}$
$D_1 = 1.958\,202\,190 \times 10^{1}$
$D_2 = -2.939\,182\,250 \times 10^{2}$
$D_3 = 1.652\,691\,406 \times 10^{3}$
$D_4 = -1.355\,992\,020 \times 10^{4}$
$D_5 = 1.879\,567\,643 \times 10^{5}$
$D_6 = -2.462\,037\,233 \times 10^{6}$
$D_7 = 2.260\,231\,848 \times 10^{7}$
$D_8 = -1.419\,932\,691 \times 10^{8}$
$D_9 = 6.203\,694\,709 \times 10^{9}$
$D_{10} = -1.903\,378\,775 \times 10^{9}$
$D_{11} = 4.086\,945\,721 \times 10^{9}$
$D_{12} = -6.014\,988\,227 \times 10^{9}$
$D_{13} = 5.782\,518\,821 \times 10^{9}$
$D_{14} = -3.271\,778\,827 \times 10^{9}$
$D_{15} = 8.264\,739\,120 \times 10^{8}$

$F_0 = -1.301\,920\,218 \times 10^{0}$
$F_1 = 7.764\,791\,188 \times 10^{0}$
$F_2 = 2.313\,973\,841 \times 10^{1}$
$F_3 = -2.288\,289\,749 \times 10^{1}$
$F_4 = 2.121\,292\,444 \times 10^{1}$
$F_5 = -1.524\,257\,858 \times 10^{1}$
$F_6 = 7.710\,290\,034 \times 10^{0}$
$F_7 = -2.520\,459\,196 \times 10^{0}$
$F_8 = 4.708\,855\,738 \times 10^{-1}$
$F_9 = -3.805\,318\,381 \times 10^{-2}$
$G_0 = 2.119\,217\,701 \times 10^{-1}$
$G_1 = 2.491\,206\,538 \times 10^{0}$
$G_2 = -1.194\,824\,197 \times 10^{1}$
$G_3 = -1.740\,900\,734 \times 10^{0}$
$G_4 = 1.594\,171\,557 \times 10^{1}$
$G_5 = -2.014\,294\,870 \times 10^{1}$
$G_6 = 1.343\,353\,600 \times 10^{1}$
$G_7 = -5.246\,295\,948 \times 10^{0}$
$G_8 = 1.130\,628\,016 \times 10^{0}$
$G_9 = -1.039\,940\,925 \times 10^{-1}$
$K_0 = 7.457\,979\,521 \times 10^{-1}$
$K_1 = -9.759\,050\,882 \times 10^{0}$
$K_2 = -5.490\,862\,062 \times 10^{1}$
$K_3 = 4.366\,872\,120 \times 10^{1}$
$K_4 = -1.688\,563\,040 \times 10^{1}$
$K_5 = 2.445\,224\,102 \times 10^{0}$
$L_1 = -1.161\,880\,000 \times 10^{0}$
$L_2 = 4.501\,173\,000 \times 10^{-1}$
$s_{30} = -6.775\,758\,723 \times 10^{1}$
$s_{31} = 1.416\,689\,663 \times 10^{2}$
$s_{32} = -1.269\,653\,824 \times 10^{2}$
$s_{33} = 6.661\,593\,990 \times 10^{1}$
$s_{34} = -5.011\,009\,857 \times 10^{0}$
$J_0 = 2.119\,217\,701 \times 10^{-1}$
$J_1 = 2.491\,206\,538 \times 10^{0}$
$J_2 = -3.957\,193\,788 \times 10^{1}$
$J_3 = 7.859\,531\,600 \times 10^{1}$
$J_4 = -1.393\,349\,853 \times 10^{2}$
$J_5 = 1.783\,273\,141 \times 10^{2}$
$J_6 = -1.509\,978\,757 \times 10^{2}$
$J_7 = 8.188\,628\,895 \times 10^{1}$
$J_8 = -2.736\,723\,155 \times 10^{1}$
$J_9 = 5.133\,645\,282 \times 10^{0}$
$J_{10} = -4.134\,448\,316 \times 10^{-1}$
$s_{40} = 3.331\,342\,000 \times 10^{1}$
$s_{41} = -2.676\,495\,000 \times 10^{1}$
$s_{42} = -2.476\,175\,000 \times 10^{1}$
$\theta_0 = 4.219\,836\,242 \times 10^{-1}$
$\theta_1 = 9.626\,911\,787 \times 10^{-1}$
$\theta_2 = 1.348\,910\,860 \times 10^{0}$
$\theta_3 = 1.657\,886\,605 \times 10^{0}$
$\theta_4 = 1.039\,935\,115 \times 10^{0}$
$\beta_1 = 7.476\,039\,783 \times 10^{-1}$
$\beta_2 = 4.520\,795\,660 \times 10^{0}$
$k_0 = -1.092\,599\,100 \times 10^{1}$
$k_1 = 4.142\,611\,500 \times 10^{1}$
$k_2 = -5.066\,247\,300 \times 10^{1}$
$k_3 = 2.101\,072\,700 \times 10^{1}$
$n = 1.153\,731\,670 \times 10^{0}$

Note:

$$\theta_0 = \frac{273.15}{273.15+374.15} = \frac{273.15}{647.3}$$

$$\theta_1 = \frac{273.15+350.0}{273.15+374.15} = \frac{623.15}{647.3}$$

$$\theta_2 = \frac{273.15+600.0}{273.15+374.15} = \frac{873.15}{647.3}$$

$$\theta_3 = \frac{273.15+800.0}{273.15+374.15} = \frac{1073.15}{647.3}$$

$$\theta_4 = \frac{273.15+400.0}{273.15+374.15} = \frac{673.15}{647.3}$$

$$\beta_1 = \frac{165.37}{221.2}$$

$$\beta_2 = \frac{1000.0}{221.2}$$

Table 4. Specific Volume of Compressed Water and Superheated Steam (cm^3/g)

The first line gives the calculated value, the second line gives the 1963 Skeleton Table value, and in the third line the difference between these two value is compared with the Skeleton Table tolerance.

Pressure bar	Temperature °C																			Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
1	1.00016 1.0002 −0.4/1	1.01206 1.0121 −0.4/2	1695.3 1696 −0.7/1	1936.6 1936 0.6/1	2172.5 2173 −0.5/2	2406.1 2406.0 0.1/2	2638.7 2639 −0.3/2	2870.8 2871 −0.2/2	2986.6 2987 −0.2/2	3102.5 3103 −0.5/2	3218.3 3218 0.3/2	3334.0 3334 0.0/2	3449.7 3450 −0.3/2	3565.3 3565 0.3/2	3796.6 3797 −0.4/2	4027.7 4028 −0.3/2	4258.8 4259 −0.2/2	4489.8 4490 −0.2/2	4720.8 4721 −0.2/2	4951.7 4952 −0.3/2	1
5	0.99995 0.9999 0.5/2	1.01188 1.0119 −0.2/2	1.04329 1.0433 −0.1/2	1.09058 1.0906 −0.2/3	425.19 425.1 0.9/4	474.45 474.4 0.5/4	522.52 522.5 0.2/4	570.01 570.1 −0.9/2	593.61 593.7 −0.9/4	617.14 617.2 −0.6/4	640.62 640.6 0.2/4	664.05 664.1 −0.5/4	687.44 687.5 −0.6/4	710.80 710.8 0.0/4	757.43 757.4 0.3/4	803.97 803.9 0.7/4	850.44 850.4 0.4/4	896.86 896.9 −0.4/4	943.23 943.2 0.3/4	989.57 989.6 −0.3/4	5
10	0.99969 0.9997 −0.1/2	1.01165 1.0117 −0.5/2	1.04304 1.0431 −0.6/2	1.09025 1.0903 −0.5/3	206.18 206.0 1.8/3	232.82 232.7 1.2/2	257.94 257.9 0.4/2	282.38 282.4 −0.2/2	294.46 294.5 −0.4/2	306.46 306.5 −0.4/2	318.40 318.4 0.0/2	330.30 330.3 0.0/2	342.16 342.2 −0.4/2	353.98 354.0 −0.2/2	377.54 377.5 0.4/2	401.00 401.0 0.0/2	424.40 424.4 0.0/2	447.74 447.7 0.4/2	471.04 471.1 −0.6/2	494.30 494.3 0.0/2	10
25	0.99891 0.9989 0.1/2	1.01097 1.0110 −0.3/2	1.04226 1.0423 −0.4/2	1.08927 1.0894 −1.6/3	1.15554 1.1556 −0.6/3	87.12 87.0 1.2/2	98.95 98.9 0.5/1	109.72 109.7 −0.2/1	114.90 114.9 0.0/1	120.01 120.0 0.1/1	125.04 125.0 0.4/1	130.03 130.0 0.3/1	134.97 135.0 0.3/1	139.87 139.9 −0.3/1	149.59 149.6 −0.1/1	159.22 159.2 0.2/1	168.77 168.8 −0.3/2	178.27 178.3 −0.3/2	187.72 187.7 0.2/2	197.14 197.2 −0.6/4	25
50	0.99763 0.9976 0.3/2	1.00985 1.0099 −0.5/2	1.04099 1.0410 −0.1/2	1.08758 1.0878 −2.2/3	1.15303 1.1531 −0.7/3	1.24935 1.2495 −1.5/4	45.380 45.34 4.0/7	51.954 51.93 2.4/8	54.919 54.90 1.9/9	57.765 57.76 0.5/9	60.528 60.53 0.2/1	63.226 63.24 −1.4/9	65.875 65.89 −1.5/9	68.483 68.50 −1.7/10	73.601 73.61 −0.9/10	78.621 78.62 0.1/10	83.57 83.6 −0.3/1	88.45 88.4 0.5/1	93.29 93.3 −0.1/1	98.09 98.1 −0.1/1	50
75	0.99636 0.9964 −0.4/2	1.00873 1.0088 −0.7/2	1.03973 1.0398 −0.7/3	1.08593 1.0862 −2.7/4	1.15056 1.1507 −1.4/4	1.24493 1.2452 −2.7/4	26.744 26.71 3.4/5	32.459 32.44 1.9/7	34.775 34.75 2.5/8	36.923 36.91 1.3/8	38.959 38.96 −0.1/8	40.916 40.93 −1.4/8	42.814 42.83 −1.6/8	44.666 44.69 −2.4/8	48.262 48.28 −1.8/8	51.751 51.76 −0.9/8	55.162 55.16 0.2/8	58.513 58.52 −0.7/8	61.815 61.82 −0.5/8	65.080 65.09 −1.0/8	75
100	0.99510 0.9952 −1.0/2	1.00763 1.0077 −0.7/2	1.03847 1.0386 −1.3/4	1.08431 1.0846 −2.9/4	1.14814 1.1483 −1.6/4	1.24066 1.2409 −2.4/4	1.3974 1.397 0.4/1	22.456 22.44 1.6/5	24.556 24.53 2.6/5	26.411 26.40 1.1/5	28.117 28.12 −0.3/5	29.723 29.73 −0.7/5	31.259 31.26 −0.1/6	32.740 32.76 −2.0/7	35.584 35.61 −2.6/7	38.314 38.32 −0.6/7	40.961 40.96 0.1/8	43.545 43.55 −0.5/8	46.081 46.09 −0.9/8	48.578 48.58 −0.2/8	100
125	0.99386 0.9940 −1.2/2	1.00653 1.0066 −0.7/2	1.03724 1.0373 −0.6/4	1.08271 1.0380 −2.9/4	1.14576 1.1460 −2.4/4	1.23653 1.2367 −1.7/5	1.3871 1.387 0.1/1	16.151 16.14 1.1/5	18.273 18.25 2.3/4	20.015 20.01 0.5/4	21.557 21.56 −0.3/4	22.973 22.98 −0.7/4	24.303 24.31 −0.7/4	25.570 25.59 −2.0/5	27.973 27.99 −1.7/5	30.250 30.26 −1.0/5	32.441 32.44 0.1/6	34.567 34.56 0.7/6	36.642 36.64 0.2/7	38.679 38.68 −0.1/7	125
150	0.99263 0.9928 −1.7/2	1.00544 1.0055 −0.6/2	1.03601 1.0361 −0.9/4	1.08113 1.0813 −1.7/4	1.14343 1.1436 −1.7/4	1.23252 1.2327 −1.8/5	1.3774 1.378 −0.6/1	11.466 11.49 −2.4/4	13.913 13.91 0.3/4	15.663 15.65 1.3/4	17.132 17.14 −0.8/4	18.441 18.45 −0.9/4	19.646 19.65 −0.4/4	20.778 20.80 −2.2/4	22.893 22.91 −1.7/4	24.873 24.88 −0.7/4	26.761 26.77 −0.9/5	28.582 28.59 −0.8/6	30.352 30.35 0.2/6	32.082 32.09 −0.8/7	150
175	0.99140 0.9915 −1.0/2	1.00436 1.0044 −0.4/2	1.03479 1.0348 −0.1/4	1.07957 1.0798 −2.3/4	1.14114 1.1414 −2.6/4	1.22863 1.2288 −1.7/5	1.3685 1.369 −0.5/1	1.7167 1.716 0.7/2	10.566 10.57 −0.4/4	12.463 12.46 0.3/4	13.921 13.93 −0.9/3	15.174 15.19 −1.6/3	16.302 16.31 −0.8/3	17.344 17.36 −1.6/4	19.261 19.28 −1.9/4	21.032 21.04 −0.8/4	22.705 22.71 −0.5/4	24.309 24.31 −0.1/5	25.861 25.86 0.1/5	27.372 27.38 −0.8/6	175
200	0.99019 0.9904 −2.1/2	1.00330 1.0033 0.0/2	1.03359 1.0336 −0.1/4	1.07802 1.0782 −1.8/4	1.13888 1.1391 −2.2/4	1.22486 1.2251 −2.4/5	1.3601 1.360 0.1/1	1.6672 1.665 2.2/2	7.683 7.68 0.3/3	9.958 9.95 0.8/4	11.465 11.47 −0.5/3	12.697 12.71 −1.3/3	13.778 13.79 −1.2/3	14.759 14.78 −2.1/3	16.534 16.55 −1.6/3	18.150 18.16 −1.0/4	19.664 19.67 −0.6/4	21.106 21.11 −0.4/5	22.494 22.50 −0.6/5	23.841 23.85 −0.9/6	200
225	0.98900 0.9892 −2.0/2	1.00224 1.0023 −0.6/2	1.03239 1.0324 −0.1/4	1.07650 1.0766 −1.0/4	1.13667 1.1369 −2.3/4	1.22119 1.2215 −3.1/5	1.3522 1.352 0.2/1	1.6299 1.630 −0.1/2	2.501 2.49 1.1/4	7.871 7.86 1.1/3	9.508 9.51 −0.2/3	10.746 10.76 −1.4/3	11.801 11.81 −0.9/3	12.741 12.76 −1.8/3	14.411 14.42 −0.9/3	15.909 15.92 −1.1/3	17.299 17.31 −1.1/4	18.616 18.62 −0.4/5	19.877 19.88 −0.3/5	21.097 21.10 −0.3/5	225
250	0.98781 0.9880 −1.9/2	1.00119 1.0012 −0.1/2	1.03121 1.0313 −0.9/4	1.07499 1.0751 −1.1/4	1.13449 1.1347 −2.1/4	1.21762 1.2179 −2.8/5	1.3448 1.3450 −0.2/1	1.5999 1.600 −0.1/2	1.979 1.98 −0.1/2	6.000 6.00 0.0/3	7.893 7.89 0.3/2	9.164 1.17 −0.6/2	10.207 10.22 −1.3/2	11.120 11.14 −2.0/2	12.711 12.72 −0.9/2	14.116 14.12 −0.4/2	15.409 15.42 −1.1/3	16.625 16.63 −0.5/4	17.785 17.79 −0.5/5	18.903 18.91 −0.7/5	250
275	0.98663 0.9868 −1.7/2	1.00014 1.0002 −0.6/2	1.03004 1.0301 −0.6/4	1.07350 1.0736 −1.0/4	1.13235 1.1326 −2.5/4	1.21414 1.2144 −2.6/5	1.3377 1.3380 −0.3/1	1.5748 1.576 −1.2/2	1.8629 1.865 −2.1/10	4.190 4.19 0.0/3	6.512 6.50 1.2/2	7.851 7.85 0.1/2	8.895 8.90 −0.5/2	9.789 9.79 −0.1/2	11.320 11.32 0.0/2	12.651 12.65 0.1/2	13.863 13.86 0.3/3	14.998 15.00 −0.2/3	16.075 16.08 −0.5/4	17.109 17.11 −0.1/4	275

(Continued)

Pressure bar	Temperature C°																			Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
300	0.98547 0.9856 −1.3/2	0.99911 0.9992 −0.9/2	1.02888 1.0289 −0.2/4	1.07202 1.0721 −1.8/4	1.13024 1.1304 −1.6/4	1.21076 1.2111 −3.4/5	1.3310 1.331 0.0/1	1.5532 1.555 −1.8/2	1.7932 1.797 −3.8/8	2.8200 2.820 0.0/20	5.3076 5.298 9.6/20	6.7411 6.736 5.1/20	7.7939 7.799 −5.1/20	8.6765 8.682 −5.5/20	10.160 10.16 0.0/2	11.340 11.43 0.0/2	12.577 12.58 −0.3/2	13.643 13.64 0.3/3	14.651 14.65 0.1/3	15.616 15.62 −0.4/4	300
350	0.98317 0.9834 −2.3/2	0.99707 0.9972 −1.3/2	1.02659 1.0267 −1.1/4	1.06912 1.0692 −0.8/4	1.12612 1.1264 −2.8/4	1.20425 1.2046 −3.5/6	1.3186 1.319 −0.4/1	1.5175 1.519 −1.5/3	1.7038 1.705 −1.2/6	2.1110 2.111 0.0/10	3.4250 3.430 −5.0/12	4.9659 4.956 9.9/14	6.0567 6.054 2.7/14	6.9261 6.928 −1.7/15	8.3392 8.340 −0.8/16	9.5155 9.516 −0.5/18	10.559 10.56 0.1/2	11.518 11.52 −0.2/3	12.418 12.42 −0.2/3	13.273 13.27 0.3/4	350
400	0.98091 0.9811 −1.9/2	0.99505 0.9951 −0.5/2	1.02434 1.0244 −0.6/2	1.06628 1.0664 −1.2/4	1.12213 1.1224 −2.7/4	1.19804 1.1984 −3.6/6	1.3072 1.308 −0.8/1	1.4885 1.489 −0.5/3	1.6440 1.644 0.0/5	1.9134 1.912 1.4/7	2.5410 2.546 −5.0/9	3.6836 3.686 −2.4/12	4.7656 4.758 7.6/12	5.6225 5.620 2.5/13	6.9809 6.980 0.9/14	8.0863 8.086 0.3/16	9.0524 9.051 1.4/18	9.930 9.93 0.0/2	10.747 10.75 −0.3/3	11.520 11.52 0.0/3	400
450	0.97869 0.9788 −1.1/2	0.99307 0.9932 −1.3/2	1.02212 1.0222 −0.8/4	1.06351 1.0636 −0.9/4	1.11825 1.1186 −3.5/4	1.19212 1.1925 −3.8/6	1.2968 1.297 −0.2/1	1.4641 1.464 0.1/3	1.5989 1.599 −0.1/5	1.8069 1.804 2.9/6	2.1888 2.191 −2.2/7	2.9088 2.916 −7.2/9	3.8122 3.814 −1.8/10	4.6339 4.628 5.9/10	5.9363 5.934 2.3/11	6.9829 6.982 0.9/13	7.8871 7.885 2.1/15	8.701 8.70 0.1/2	9.453 9.45 0.3/2	10.162 10.16 0.2/3	450
500	0.97651 0.9766 −0.9/2	0.99112 0.9912 −0.8/2	1.01995 1.0200 −0.5/4	1.06079 1.0690 −1.1/5	1.11449 1.1148 −3.1/5	1.18646 1.1868 −3.4/6	1.2870 1.288 −1.0/1	1.4431 1.443 0.1/3	1.5626 1.564 −1.4/5	1.7350 1.731 4.0/5	2.0095 2.010 −0.5/6	2.4866 2.492 −5.4/6	3.1644 3.170 −5.6/8	3.8835 3.884 −0.5/8	5.1172 5.114 3.2/10	6.1101 6.108 2.1/12	6.9621 6.960 2.1/14	7.723 7.72 0.3/2	8.422 8.42 0.2/2	9.078 9.07 −0.8/3	500
550	0.97436 0.9745 −1.4/3	0.98920 0.9892 0.0/3	1.01781 1.0178 0.1/4	1.05812 1.0582 −0.8/5	1.11083 1.1111 −2.7/5	1.18103 1.1813 −2.7/6	1.2780 1.278 0.0/1	1.4246 1.424 0.6/3	1.5323 1.533 −0.7/5	1.6809 1.677 3.9/5	1.8976 1.896 1.6/5	2.2412 2.245 −3.8/5	2.7456 2.750 −4.4/6	3.3377 3.342 −4.3/7	4.4682 4.464 4.2/8	5.4072 5.404 3.2/10	6.2132 6.209 4.2/12	6.929 6.93 −0.1/2	7.584 7.58 0.4/2	8.196 8.19 0.6/2	550
600	0.97225 0.9723 −0.5/3	0.98731 0.9873 0.1/3	1.01570 1.0157 0.0/4	1.05551 1.0556 −0.9/5	1.10727 1.1075 −2.3/5	1.17582 1.1670 −1.8/6	1.2695 1.270 −0.5/1	1.4081 1.407 1.1/3	1.5063 1.507 −0.7/5	1.6377 1.634 3.7/4	1.8184 1.816 2.4/4	2.0842 2.085 −0.8/4	2.4696 2.474 −4.4/5	2.9488 2.950 −1.2/6	3.9521 3.950 2.1/8	4.8340 4.831 3.0/9	5.5971 5.592 5.1/11	6.273 6.27 0.3/2	6.889 6.89 −0.1/2	7.465 7.46 0.5/2	600
650	0.97017 0.9703 −1.3/3	0.98545 0.9854 0.5/3	1.01363 1.0137 −0.7/4	1.05296 1.0530 −0.4/5	1.10380 1.1040 −2.0/5	1.17081 1.1709 −0.9/7	1.2616 1.261 −0.6/1	1.3932 1.393 0.2/3	1.4836 1.484 −0.4/5	1.6018 1.599 2.8/4	1.7579 1.756 1.9/4	1.9746 1.976 −1.4/4	2.2794 2.283 −3.6/5	2.6693 2.672 −2.7/5	3.5430 3.543 0.0/7	4.3623 4.360 2.3/8	5.0843 5.080 4.3/10	5.724 5.72 0.4/2	6.306 6.31 −0.4/2	6.849 6.85 −0.1/2	650
700	0.96813 0.9682 −0.7/3	0.98361 0.9836 0.1/3	1.01159 1.0116 −0.1/4	1.05044 1.0505 −0.6/5	1.10042 1.1006 −1.8/5	1.16598 1.1660 −0.2/7	1.2541 1.254 0.1/1	1.3796 1.380 −0.4/3	1.4635 1.464 −0.5/5	1.5711 1.569 2.1/4	1.7091 1.706 3.1/4	1.8927 1.892 0.7/4	2.1420 2.144 −2.0/4	2.4635 2.466 −2.5/5	3.2215 3.221 0.5/6	3.9722 3.971 1.2/7	4.6533 4.648 5.3/9	5.260 5.26 0.0/1	5.811 5.81 0.1/2	6.325 6.32 0.5/2	700
750	0.96612 0.9662 −0.8/3	0.98179 0.9818 −0.1/3	1.00958 1.0096 −0.2/4	1.04798 1.0480 −0.2/5	1.09713 1.0973 −1.7/5	1.16133 1.1614 −0.7/8	1.2470 1.246 1.0/1	1.3671 1.367 0.1/3	1.4454 1.446 −0.6/4	1.5443 1.543 1.3/4	1.6685 1.665 3.5/4	1.8283 1.828 0.3/4	2.0384 2.040 −1.6/4	2.3078 2.310 −2.2/5	2.9665 2.965 1.5/6	3.6485 3.648 0.5/7	4.2882 4.283 5.2/8	4.863 4.86 0.3/1	5.385 5.39 −0.5/2	5.874 5.87 0.4/2	750
800	0.96415 0.9642 −0.5/3	0.98001 0.9800 0.1/3	1.00761 1.0076 0.1/4	1.04556 1.0456 −0.4/5	1.09392 1.0941 −1.8/5	1.15684 1.1568 0.4/8	1.2402 1.239 1.2/1	1.3556 1.355 0.6/3	1.4290 1.430 −1.0/4	1.5207 1.519 1.7/3	1.6337 1.631 2.7/3	1.7757 1.775 0.7/4	1.9572 1.958 −0.8/4	2.1868 2.189 −2.2/4	2.7617 2.760 1.7/6	3.3794 3.380 −0.6/7	3.9772 3.972 5.2/8	4.522 4.52 0.2/1	5.017 5.02 −0.3/1	5.482 5.48 0.2/2	800
850	0.96220 0.9622 0.0/3	0.97825 0.9782 0.5/3	1.00566 1.0057 −0.4/4	1.04319 1.0432 −0.1/5	1.09078 1.0910 −2.2/5	1.15250 1.1524 1.0/8	1.2338 1.232 1.8/2	1.3448 1.345 −0.2/4	1.4141 1.415 −0.9/4	1.4995 1.498 1.5/3	1.6034 1.602 1.4/3	1.7315 1.731 0.5/3	1.8914 1.892 −0.6/4	2.0904 2.092 −1.6/4	2.5951 2.594 1.1/5	3.1553 3.155 0.3/6	3.7111 3.706 5.1/8	4.226 4.22 0.6/1	4.696 4.70 −0.4/1	5.139 5.14 −0.1/2	850
900	0.96028 0.9603 −0.2/3	0.97651 0.9765 0.1/3	1.00374 1.0038 −0.6/4	1.04086 1.0409 −0.4/5	1.08772 1.0879 −1.8/5	1.14829 1.1481 1.9/9	1.2277 1.226 1.7/2	1.3348 1.334 0.8/4	1.4004 1.401 −0.6/4	1.4804 1.480 0.4/3	1.5767 1.576 0.7/3	1.6935 1.693 0.5/3	1.8366 1.837 −0.4/4	2.0119 2.014 −2.1/4	2.4579 2.458 −0.1/5	2.9678 2.966 1.8/6	3.4824 3.478 4.4/7	3.968 3.97 −0.2/1	4.414 4.42 −0.6/1	4.838 4.84 −0.2/2	900
950	0.95839 0.9584 −0.1/3	0.97479 0.9748 −0.1/3	1.00185 1.0019 −0.5/4	1.03856 1.0386 −0.4/5	1.08473 1.0848 −0.7/5	1.14422 1.1439 3.2/10	1.2218 1.220 1.8/3	1.3254 1.324 1.4/4	1.3877 1.388 −0.3/4	1.4630 1.463 0.0/3	1.5527 1.552 0.7/3	1.6603 1.660 0.3/3	1.7901 1.790 0.1/4	1.9465 1.948 −1.5/4	2.3435 2.344 −0.5/5	2.8087 2.806 2.7/6	3.2853 3.282 3.3/7	3.743 3.74 0.3/1	4.166 4.17 −0.4/1	4.571 4.57 0.1/2	950
1000	0.95652 0.9566 −0.8/3	0.97310 0.9731 0.0/3	0.99999 1.0000 −0.1/4	1.03631 1.0363 0.1/5	1.08180 1.0818 0.0/5	1.14027 1.1398 4.7/10	1.2162 1.214 2.2/3	1.3165 1.314 2.5/4	1.3760 1.376 0.0/4	1.4470 1.447 0.0/3	1.5310 1.530 1.0/3	1.6309 1.630 0.9/3	1.7497 1.950 −0.3/4	1.8911 1.892 −0.9/4	2.2470 2.248 −1.0/5	2.6700 2.670 0.0/5	3.1147 3.111 3.7/6	3.545 3.54 0.5/1	3.946 3.95 −0.4/1	4.333 4.34 −0.7/2	1000

Table 5. Specific Enthalpy of Compressed Water and Superheated Steam (J/g)

The first line gives the calculated value, the second line gives the 1963 Skeleton Table value, and in the third line the difference between these two values is compared with the Skeleton Table tolerance.

Pressure bar	Temperature °C																			Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
0	2502.0 2502 0.0/2	2595.8 2595 0.8/2	2689.8 2689 0.8/2	2784.4 2784 0.4/2	2880.0 2880 0.0/2	2977.0 2978 −1.0/2	3075.6 3077 −1.4/2	3176.0 3178 −2.0/2	3226.9 3229 −2.1/2	3278.4 3280 −1.6/2	3330.3 3332 −1.7/2	3382.7 3384 −1.3/2	3435.6 3436 −0.4/2	3489.0 3489 0.0/2	3597.2 3597 0.2/3	3707.2 3706 1.2/3	3818.6 3817 1.6/4	3931.4 3929 2.4/4	4045.0 4043 2.0/4	4159.0 4159 0.0/4	0
1	0.060 0.06 0.0/1	209.38 209.3 0.8/1	2675.8 2676 −0.2/2	2777.0 2777 0.0/2	2875.5 2876 −0.5/2	2973.8 2975 −1.2/2	3073.2 3074 −0.8/3	3174.1 3175 −0.9/3	3225.2 3227 −1.8/3	3276.8 3278 −1.2/3	3328.8 3330 −1.2/3	3881.4 3383 −1.6/3	3434.4 3435 −0.6/3	3487.9 3488 −0.1/3	3596.3 3596 0.3/3	3706.4 3705 1.4/3	3817.9 3816 1.9/4	3930.8 3928 2.8/4	4044.4 4043 1.4/4	4158.5 4159 −0.5/4	1
5	0.470 0.47 0.0/2	209.72 209.6 1.2/2	419.40 419.4 0.0/2	632.22 632.2 0.2/3	2856.3 2857 −0.7/3	2960.8 2961 −0.2/3	3063.5 3064 −0.5/4	3166.4 3168 −1.6/4	3218.3 3220 −1.7/4	3270.5 3272 −1.5/4	3323.1 3325 −1.9/4	3376.2 3377 −0.8/4	3429.6 3430 −0.4/4	3483.5 3484 −0.5/4	3592.5 3592 0.5/4	3703.1 3702 1.1/4	3815.1 3813 2.1/4	3928.3 3926 2.3/4	4042.3 4040 2.3/4	4156.7 4157 −0.3/4	5
10	0.981 0.98 0.1/2	210.15 210.1 0.5/2	419.77 419.7 0.7/4	632.52 632.4 1.2/4	2829.1 2830 −0.9/4	2943.7 2943 0.7/3	3051.1 3051 0.1/4	3156.7 3158 −1.3/4	3209.6 3211 −1.4/4	3262.6 3264 −1.4/4	3316.0 3317 −1.0/4	3369.6 3371 −1.4/4	3423.6 3425 −1.4/4	3477.9 3478 −0.1/4	3587.8 3587 0.8/5	3699.0 3698 1.0/5	3811.6 3810 1.6/5	3925.3 2923 2.3/5	4039.7 4038 1.7/6	4154.4 4155 −0.6/6	10
25	2.513 2.50 1.3/5	211.45 211.3 1.5/2	429.90 421.0 —1.0/4	633.45 633.4 0.5/4	852.78 852.8 0.2/4	2882.4 2881 1.4/5	3010.8 3009 1.8/5	3126.4 3126 0.4/4	3182.6 3184 1.4/4	3238.4 3240 −1.6/4	3294.0 3295 −1.0/4	3349.6 3350 −0.4/4	3405.3 3406 −0.7/4	3461.1 3462 −0.9/4	3573.5 3574 −0.5/5	3686.8 3686 0.8/5	3801.1 3799 2.1/5	3916.1 3914 2.1/6	4031.7 4030 1.7/6	4147.5 4147 0.5/6	25
50	5.056 5.05 0.6/10	213.60 213.5 1.0/2	422.78 422.8 −0.2/4	635.00 634.9 1.0/4	853.82 853.8 0.2/4	1085.78 1085.8 −0.2/5	2928.4 2925 3.4/5	3070.9 3068 2.9/5	3134.5 3134 0.5/4	3195.9 3196 −0.1/4	3255.9 3257 −1.1/4	3315.2 3317 −1.8/4	3374.0 3375 −1.0/4	3432.5 3434 −1.5/4	3549.3 3550 −0.7/5	3666.1 3666 0.1/5	3783.3 3782 1.3/5	3900.8 3898 2.8/6	4018.4 4016 2.4/6	4135.9 4136 −0.1/6	50
75	7.589 7.58 0.9/15	215.75 215.7 0.5/2	424.66 424.7 −0.4/4	636.56 636.5 0.6/4	854.88 855.0 −1.2/5	1085.78 1085.9 −1.2/5	2815.5 2814 1.5/6	3006.3 3003 3.3/5	3081.0 3079 2.0/4	3149.9 3149 0.9/4	3215.6 3216 −0.4/4	3279.2 3280 −0.8/4	3341.5 3342 −0.5/4	3403.0 3404 −1.0/4	3524.6 3526 −1.4/5	3645.2 3645 0.2/6	3765.4 3764 1.4/6	3885.4 3883 2.4/6	4005.1 4003 2.1/6	4124.4 4124 0.4/6	75
100	10.11 10.1 0.1/2	217.90 217.9 0.0/2	426.54 426.6 −0.6/4	638.12 638.1 0.2/4	855.96 856.1 −1.4/5	1085.84 1086 −1.6/5	1343.4 1343 0.4/1	2928.7 2924 4.7/5	3020.1 3017 3.1/4	3099.4 3098 1.4/4	3172.3 3172 0.3/4	3241.2 3242 −0.8/4	3307.7 3309 −1.3/4	3372.6 3374 −1.4/4	3499.4 3501 −1.6/6	3623.9 3625 −1.1/8	3747.3 3747 0.3/8	3869.8 3868 1.8/8	3991.7 3990 1.7/8	4112.7 4112 0.7/8	100
125	12.62 12.6 0.2/3	220.05 220.0 0.5/2	428.43 428.5 −0.7/4	639.70 639.7 0.0/4	857.06 857.2 −1.4/5	1085.98 1086.1 −1.2/6	1340.6 1340 0.6/1	2831.2 2826 5.2/6	2949.4 2946 3.4/6	3043.4 3041 2.4/5	3125.5 3125 0.5/4	3201.0 3201 0.0/4	3272.4 3273 −0.6/4	3341.1 3343 −1.9/5	3473.7 3476 −2.3/8	3602.4 3604 −1.6/10	3729.0 3729 0.0/10	3854.2 3852 2.2/10	3978.2 3976 2.2/10	4101.1 4100 1.1/10	125
150	15.12 15.1 0.2/3	222.20 222.1 1.0/2	430.31 430.4 −0.9/4	641.28 641.3 −0.2/4	858.18 858.3 −1.2/5	1086.17 1086.3 −1.3/6	1338.2 1338 0.2/1	2695.3 2692 3.3/8	2865.1 2861 4.1/8	2980.3 2978 2.3/6	3074.5 3073 1.5/5	3158.1 3157 1.1/5	3235.3 3235 0.3/5	3308.4 3310 −1.6/5	3447.3 3450 −2.7/8	3580.5 3582 −1.5/10	3710.5 3711 −0.5/10	3838.4 3836 2.4/10	3964.7 3962 2.7/10	4089.4 4089 0.4/10	150
175	17.61 17.6 0.1/4	224.34 224.3 0.4/3	432.20 432.3 −1.0/4	642.86 642.9 −0.4/4	859.32 859.5 −1.8/5	1086.42 1086.5 −0.8/6	1336.1 1336 0.1/1	1663.4 1663 0.4/3	2758.3 2755 3.3/8	2908.4 2905 3.4/6	3018.7 3017 1.7/6	3112.2 3111 1.2/6	3196.3 3196 0.3/6	3274.5 3277 −2.5/6	3420.4 3423 −2.6/8	3558.3 3560 −1.7/10	3691.9 3692 −0.1/10	3822.6 3821 1.6/11	3951.1 3949 2.1/11	4077.7 4077 0.7/11	175
200	20.09 20.1 0.1/4	226.48 226.5 −0.2/3	434.08 434.2 −1.2/4	644.46 644.5 −0.4/4	860.48 860.6 −1.2/6	1086.72 1086.8 −0.8/6	1334.3 1334 0.3/1	1646.4 1646 0.4/3	2611.9 2605 6.9/8	2824.1 2819 5.1/8	2957.2 2955 2.2/6	3062.9 3062 0.9/6	3155.2 3155 0.2/6	3239.1 3241 −1.9/6	3392.8 3396 −3.2/8	3535.9 3538 −2.1/10	3673.1 3673 0.1/10	3806.6 3806 1.6/11	3923.8 3922 1.8/11	4066.0 4065 1.0/11	200
225	22.56 22.6 −0.4/5	228.62 228.6 0.2/3	435.97 436.1 −1.3/4	646.05 646.1 −0.5/4	861.66 861.8 −1.2/6	1087.07 1087.3 −2.3/7	1332.7 1332 0.7/1	1633.5 1633 0.5/3	1986.0 1980 6.0/12	2717.8 2715 2.8/-	2888.9 2885 3.9/6	3010.1 3009 1.1/6	3111.7 3112 −0.3/6	3202.3 3205 −2.7/6	3364.6 3368 −3.4/8	3513.1 3515 −1.9/10	3654.1 3654 0.1/10	3790.6 3789 1.6/11	3937.5 3949 2.1/11	4054.3 4053 1.3/12	225
250	25.02 25.1 −0.8/5	230.76 230.7 0.6/3	437.86 438.0 −1.4/4	647.66 647.7 −0.4/4	862.85 863.0 −1.5/6	1087.47 1087.7 −2.3/8	1331.2 1331 0.2/1	1623.3 1623 0.3/3	1852.8 1850 2.8/8	2581.3 2580 1.3/8	2812.0 2807 5.0/6	2953.2 2952 1.2/6	3066.0 3066 0.0/6	3164.1 3167 −2.9/6	3335.7 3339 −3.3/8	3490.0 3492 −2.0/10	3635.0 3635 0.0/10	3774.5 3773 1.5/12	3910.1 3908 2.1/12	4042.6 4041 1.6/13	250
275	27.47 27.5 −0.3/5	232.90 232.8 1.0/3	439.75 439.9 −1.5/4	649.27 649.3 −0.3/4	864.06 864.2 −1.4/6	1087.91 1088.2 −2.9/8	1330.0 1330 0.0/1	1614.9 1615 −0.1/3	1817.0 1814 3.0/8	2382.9 2383 −0.1/8	2718.2 2718 0.2/6	2892.0 2890 2.0/6	3017.9 3018 −0.1/6	3124.3 3125 −0.7/6	3306.2 3308 −1.8/8	3466.6 3467 −0.4/10	3615.8 3615 0.8/10	3758.4 3757 1.4/12	3896.4 3894 2.4/13	4030.8 4030 0.8/13	275

(Continued)

Pressure bar	Temperature °C																				Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
300	29.91 30.0 −0.9/5	235.03 235.0 0.3/3	441.64 441.8 −1.6/4	650.89 650.9 −0.1/4	865.28 865.4 −1.2/6	1088.39 1088.7 −3.1/8	1328.9 1329 −0.1/1	1607.8 1609 −1.2/3	1794.5 1791 3.5/6	2195.5 2157 2.5/8	2614.1 2614 0.1/6	2826.1 2822 4.1/6	2967.3 2967 0.3/6	3083.1 3084 −0.9/6	3276.2 3278 −1.8/8	3442.9 3444 −1.1/10	3596.5 3596 0.5/10	3742.2 3740 2.2/13	3882.7 3880 2.7/13	4019.1 4018 1.1/13	300
350	34.76 34.9 −1.4/6	239.30 239.2 1.0/3	445.42 445.6 −1.8/4	654.14 654.1 0.4/4	867.78 867.9 −1.2/6	1089.5 1090 −0.5/1	1327.1 1327 0.1/1	1596.3 1598 −1.7/3	1764.3 1762 2.7/6	1993.5 1992 0.5/8	2372.8 2375 −2.2/6	2673.6 2672 1.6/6	2859.3 2858 1.3/6	2996.6 2998 −1.4/6	3214.4 3216 −1.6/8	3394.9 3396 −1.1/10	3557.5 3557 0.5/10	3709.7 3708 1.7/13	3855.2 3853 2.2/13	3995.6 3994 1.6/13	350
400	39.58 39.7 −1.2/7	243.56 243.5 0.6/3	449.21 449.4 −1.9/4	657.41 657.4 0.1/4	875.33 870.4 −0.7/6	1090.7 1091 −0.3/1	1325.9 1325 0.9/1	1587.5 1590 −2.5/3	1744.5 1743 1.5/6	1935.7 1934 1.7/8	2202.0 2203 −1.0/6	2512.3 2514 −1.7/6	2743.0 2741 2.0/6	2905.8 2906 −0.2/6	3150.8 3153 −2.2/8	3346.2 3374 −0.8/10	3518.2 3518 0.2/10	3677.2 3676 1.2/13	3827.7 3826 1.7/13	3972.2 3971 1.2/14	400
450	44.36 44.6 −2.4/8	247.81 247.7 1.1/4	453.00 453.2 −2.0/4	660.70 660.7 0.0/4	872.93 873.0 −0.7/6	1092.0 1092 0.0/1	1324.9 1324 0.9/1	1580.4 1582 −1.6/3	1729.4 1729 0.4/6	1902.4 1901 1.4/8	2114.5 2115 −0.5/6	2378.3 2380 −1.7/6	2624.9 2624 0.9/6	2813.0 2813 0.0/6	3086.3 3088 −1.7/8	3297.0 3298 −1.0/10	3478.9 3478 0.9/10	3644.8 3643 1.8/13	3800.4 3798 2.4/13	3948.9 3948 0.9/13	450
500	49.10 49.3 −2.0/8	252.05 252.0 0.5/4	456.80 457.0 −2.0/4	664.01 664.0 0.1/4	875.58 875.6 −0.2/6	1093.5 1094 −0.5/1	1324.4 1324 0.4/2	1574.8 1577 −2.2/3	1717.7 1717 0.6/6	1879.5 1878 1.5/8	2064.1 2064 0.1/6	2287.0 2288 −1.0/6	2521.2 2522 −0.8/6	2724.4 2723 1.4/6	3021.8 3023 −1.2/8	3247.9 3249 −1.1/10	3439.7 3439 0.7/10	3612.6 3611 1.6/13	3773.3 3771 2.3/13	3925.7 3925 0.7/14	500
550	53.81 54.1 −2.9/8	256.28 256.2 0.8/4	460.59 460.8 −2.1/4	667.33 667.3 0.3/4	878.28 878.4 −1.2/6	1095.0 1096 1.0/1	1324.1 1323 1.1/2	1570.1 1572 −1.9/3	1707.9 1709 −1.1/6	1862.2 1860 2.2/8	2030.7 2031 −0.3/8	2225.6 2228 −2.4/8	2439.6 2439 0.6/8	2642.0 2641 1.0/8	2958.5 2960 −1.5/8	3199.1 3200 −0.9/10	3400.9 3400 0.9/10	3580.7 3579 1.7/13	3746.4 3744 2.4/13	3902.7 3902 0.7/14	550
600	58.49 58.8 −3.1/9	260.51 260.4 1.1/4	464.39 464.6 −2.1/4	670.68 670.6 0.8/4	881.01 881.1 −0.9/7	1096.7 1097 −0.3/1	1324.1 1323 1.1/2	1566.4 1568 −1.6/3	1700.0 1702 −2.0/6	1848.6 1847 1.6/8	2006.5 2005 1.5/8	2182.7 2183 −0.3/8	2377.6 2378 −0.4/8	2572.2 2571 1.2/8	2897.9 2900 −2.1/8	3151.3 3153 −1.7/10	3362.5 3362 0.5/10	3549.3 3547 2.3/13	3720.0 3718 2.0/13	3880.0 3879 1.0/13	600
650	63.14 63.5 −3.6/10	264.73 264.6 1.3/4	468.20 468.4 −2.0/4	674.04 674.0 0.4/5	883.79 883.8 −0.1/8	1098.4 1099 −0.6/1	1324.3 1323 1.3/2	1563.3 1565 −1.7/3	1693.3 1696 −2.7/6	1837.5 1836 1.5/8	1987.9 1986 1.9/8	2151.2 2151 0.2/8	2330.3 2330 0.3/8	2515.0 2514 1.0/8	2841.6 2844 −2.4/10	3105.0 3107 −2.0/10	3325.0 3324 1.0/10	3518.5 3516 2.5113	3693.9 3692 1.9/13	3857.5 3857 0.5/15	650
700	67.76 68.1 −3.4/10	268.95 268.8 1.5/5	472.00 472.1 −1.0/5	677.41 677.3 1.1/5	886.61 886.6 0.1/8	1100.2 1101 −0.8/1	1324.7 1323 1.7/2	1560.8 1562 −1.2/3	1687.8 1691 −3.2/6	1828.2 1828 0.2/8	1972.9 1971 1.9/8	2127.1 2126 1.1/8	2293.8 2294 −0.2/8	2468.3 2468 0.3/8	2795.0 2793 2.0/8	3060.8 3062 −1.2/10	3288.4 3288 0.4/10	3488.4 3486 2.4/13	3668.5 3666 2.5/14	3835.3 3836 −0.7/16	700
750	72.34 72.7 −3.6/11	273.16 273.0 1.6/6	475.80 476.0 −2.0/5	680.80 680.7 1.0/5	889.46 889.3 1.6/9	1102.1 1103 −0.9/1	1325.2 1324 1.2/2	1558.9 1560 −1.1/4	1683.1 1687 −3.9/6	1820.5 1820 0.5/8	1960.7 1958 2.7/8	2107.9 2106 1.9/8	2265.0 2265 0.0/8	2430.3 2430 0.3/8	2750.1 2748 2.1/8	3019.2 3021 −1.8/10	3253.0 3253 0.0/10	3459.3 3456 2.3/13	3643.6 3641 2.6/15	3813.4 3814 −0.6/17	750
800	76.90 77.3 −4.0/12	277.36 277.1 2.6/7	479.61 479.8 −1.9/7	684.21 684.0 2.1/7	892.34 892.2 1.4/9	1104.0 1105 −1.0/1	1325.9 1324 1.9/2	1557.3 1559 −1.7/4	1679.1 1684 −4.9/6	1813.9 1814 −0.1/8	1950.4 1948 2.4/8	2092.2 2090 2.2/8	2241.9 2241 0.9/8	2399.0 2399 0.0/8	2710.6 2709 1.6/8	2980.8 2983 −2.2/10	3219.2 3219 0.2/10	3431.1 3428 3.1/10	3619.4 3617 2.4/15	3791.9 3793 −1.1/18	800
850	81.42 81.9 −4.8/12	281.55 281.3 2.5/8	483.42 483.6 −1.8/8	687.62 687.4 2.2/8	895.25 895.0 2.5/10	1106.0 1107 −1.0/2	1326.8 1325 1.8/2	1556.2 1557 −0.8/4	1675.8 1681 −5.2/6	1808.4 1808 0.4/8	1941.7 1938 3.7/8	2079.1 2077 2.1/8	2222.9 2222 0.9/9	2373.2 2373 0.2/8	2676.0 2674 2.0/8	2945.7 2948 −2.3/10	3187.0 3187 0.0/10	3404.0 3400 4.0/13	3596.0 3593 3.0/16	3770.8 3773 −2.2/19	850
900	85.92 86.5 −5.8/12	285.74 285.4 3.4/9	487.23 478.3 −0.7/9	691.05 690.8 2.5/9	898.19 898.0 1.9/10	1108.1 1109 −0.9/2	1327.8 1326 1.8/2	1555.4 1557 −1.6/4	1673.1 1678 −4.9/6	1803.6 1804 −0.4/8	1934.3 1932 2.3/8	2068.1 2065 3.1/8	2207.1 2206 1.1/8	2351.7 2351 0.7/8	2645.7 2644 1.7/8	2913.9 2916 −2.1/10	3156.6 3157 −0.4/10	3378.1 3373 5.1/13	3573.5 3570 3.5/16	3750.1 3753 −2.9/20	900
950	90.40 91.1 −7.0/12	289.92 289.6 3.2/10	491.04 491.2 −1.6/10	694.49 694.2 2.9/10	901.16 900.9 2.6/13	1110.2 1111 −0.8/2	1328.9 1327 1.9/3	1554.9 1556 −1.1/5	1670.8 1676 −5.2/6	1799.6 1799 0.6/8	1927.9 1925 2.9/8	2058.7 2056 2.7/8	2193.7 2193 0.7/8	2333.5 2333 0.5/8	2619.2 2618 1.2/8	2884.8 2887 −2.2/10	3128.3 3129 −0.7/10	3353.4 3348 5.4/13	3551.8 3548 3.8/16	3729.8 3734 −4.2/20	950
1000	94.84 95.7 −8.6/12	294.10 293.7 4.0/12	494.85 495.0 −1.5/12	697.94 697.6 3.4/12	904.16 903.8 3.6/15	1112.3 1114 −1.7/2	1330.1 1328 2.1/3	1554.7 1555 −0.3/5	1669.0 1674 −5.0/6	1796.1 1976 0.1/8	1922.3 1920 2.3/8	2050.5 2047 3.5/8	2182.2 2181 1.2/8	2318.0 2318 0.0/8	2596.0 2595 1.0/8	2861.0 2861 0.0/10	3102.1 3103 −0.9/10	3330.2 3324 6.2/13	3531.0 3527 4.0/16	3709.9 3715 −5.1/20	1000

Table 6. Calculated Values of Specific Entropy (J/g°K)

Pressure bar	Temperature °C																				Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
0	6.80490	7.03167	7.39071	7.62860	7.79964	8.03700	8.21699	8.38494	8.46506	8.54290	8.61863	8.69240	8.76433	8.83454	8.97015	9.09982	9.22396	9.34286	9.45669	9.56552	0
1	−0.0001461	0.70365	7.36022	7.61499	7.83491	8.03253	8.21394	8.38271	8.46313	8.54121	8.61741	8.69107	8.76315	8.83348	8.96929	9.09911	9.22338	9.34238	9.45629	9.56518	1
5	−0.0001114	0.70346	1.30710	1.84158	7.06129	7.27132	7.45877	7.63096	7.71257	7.79162	7.86835	7.94297	8.01562	8.08645	8.22307	8.35352	8.47882	8.59768	8.71190	8.82106	5
10	−0.0000692	0.70323	1.30670	1.84102	6.69635	6.92679	7.12286	7.29964	7.38280	7.46311	7.54088	7.61636	7.68975	7.76121	7.89886	8.03010	8.15548	8.27537	8.38999	8.49947	10
25	0.0000503	0.70254	1.30553	1.83935	2.32959	6.41267	6.64725	6.84082	6.92926	7.01368	7.09477	7.17299	7.24868	7.32210	7.46290	7.59655	7.72382	7.84522	7.96105	8.07151	25
50	0.0002258	0.70139	1.30359	1.83658	2.32568	2.79112	6.21486	6.45358	6.55372	6.64665	6.73423	6.81761	6.89752	6.97446	7.12081	7.25864	7.38915	7.51310	7.63098	7.74310	50
75	0.0003723	0.70024	1.30166	1.83385	2.32183	2.78516	5.86567	6.18568	6.30325	6.40767	6.50343	6.59298	6.67773	6.75859	6.91096	7.05319	7.18705	7.31363	7.43361	7.54741	75
100	0.0004904	0.69909	1.29974	1.83113	2.31804	2.77853	3.24866	5.95279	6.09669	6.21691	6.32318	6.42023	6.51064	6.59594	6.75487	6.90176	7.03912	7.16840	7.29052	7.40604	100
125	0.0005806	0.69795	1.29783	1.82845	2.31431	2.77369	3.23787	5.71981	5.90598	6.04823	6.16807	6.27434	6.37142	6.46179	6.62793	6.77978	6.92078	7.05284	7.17714	7.29442	125
150	0.0006434	0.69681	1.29594	1.82579	2.31063	2,76816	3.22770	5.44656	5.71429	5.88877	6.02628	6.14390	6.24887	6.34504	6.51917	6.67629	6.82108	6.95601	7.08254	7.20159	150
175	0.0007695	0.69567	1.29405	1.82315	2.30701	2.76275	3.21807	3.76363	5.50241	5.72994	5.89101	6.02260	6.13692	6.23975	6.42270	6.58545	6.73419	6.87207	7.00087	7.12173	175
200	0.0006892	0.69453	1.29218	1.82054	2.30343	2.75747	3.20892	3.72943	5.24180	5.56335	5.75763	5.90651	6.03186	6.14231	6.33502	6.50378	6.65664	6.79754	6.92867	7.05135	200
225	0.0006730	0.69340	1.29032	1.81796	2.29991	2.75229	3.20018	3.70223	4.25344	5.37273	5.62235	5.79297	5.93127	6.05040	6.25388	6.42904	6.58618	6.73019	6.86368	6.98820	225
250	0.0006314	0.69226	1.28847	1.81540	2.29643	2.74722	3.19182	3.67938	4.03976	5.14424	5.48114	5.67999	5.83346	5.96243	6.17772	6.35968	6.52129	6.66848	6.80437	6.93077	250
275	0.0005650	0.69114	1.28663	1.81286	2.29300	2.74226	3.18380	3.65950	3.97716	4.83055	5.32112	5.56601	5.73726	5.87728	6.10549	6.29465	6.46089	6.61134	6.74966	6.87795	275
300	0.0004740	0.69001	1.28480	1.81034	2.28961	2.73738	3.17608	3.64098	3.93535	4.48601	5.15096	5.44962	5.64185	5.79417	6.03638	6.23314	6.40418	6.55796	6.69875	6.82894	300
350	0.0002205	0.68776	1.28117	1.80537	2.28296	2.72790	3.16145	3.61111	3.87591	4.22174	4.77454	5.19861	5.45145	5.63214	5.90541	6.11848	6.29959	6.46024	6.60603	6.74006	350
400	−0.0001259	0.68552	1.27758	1.80048	2.27647	2.71874	3.14774	3.58484	3.83189	4.12102	4.50902	4.94590	5.25988	5.47428	5.78189	6.01246	6.20417	6.37191	6.52278	6.66066	400
450	−0.0005620	0.68329	1.27403	1.79568	2.27013	2.70988	3.13481	3.56171	3.79610	4.05784	4.36695	4.73811	5.07359	5.32120	5.66438	5.91316	6.11584	6.29085	6.44684	6.58856	450
500	−0.0010847	0.68107	1.27052	1.79095	2.26393	2.70129	3.12255	3.54093	3.76558	4.01061	4.27978	4.59327	4.91171	5.17912	5.55250	5.81945	6.03326	6.21564	6.37674	6.52223	500
550	−0.0016912	0.67886	1.26704	1.78629	2.25787	2.69295	3.11087	3.52201	3.73878	3.97228	4.21803	4.49212	4.78300	5.04919	5.44658	5.73072	5.95554	6.14531	6.31145	6.46063	550
600	−0.0023787	0.67665	1.26360	1.78171	2.25194	2.68483	3.09971	3.50460	3.71480	3.93969	4.17004	4.41789	4.68276	4.93874	5.34749	5.64670	5.88209	6.07918	6.25026	6.40299	600
650	−0.0031447	0.67445	1.26019	1.77719	2.24613	2.67693	3.08901	3.48843	3.69303	3.91117	4.13052	4.36034	4.60377	4.84660	5.25641	5.56739	5.81251	6.01675	6.19263	6.34872	650
700	−0.0039868	0.67226	1.25681	1.77274	2.24043	2.66921	3.07871	3.47334	3.67306	3.88570	4.09672	4.31357	4.54022	4.76969	5.17944	5.49292	5.74657	5.95769	6.13815	6.29738	700
750	−0.0049026	0.67008	1.25347	1.76835	2.23484	2.66168	3.06878	3.45916	3.65460	3.86263	4.06706	4.27417	4.48781	4.70504	5.10613	5.42352	5.68411	5.90172	6.08652	6.24862	750
800	−0.0058898	0.66790	1.25016	1.76403	2.22936	2.65431	3.05918	3.44579	3.63743	3.84150	4.04053	4.24005	4.44355	4.65012	5.04076	5.35936	5.62505	5.84867	6.03751	6.20215	800
850	−0.0069463	0.66573	1.24687	1.75976	2.22397	2.64710	3.04987	3.43313	3.62137	3.82200	4.01648	4.20989	4.40533	4.60291	4.98245	5.30046	5.56936	5.79837	5.99093	6.15776	850
900	−0.0080700	0.66357	1.24362	1.75555	2.21868	2.64004	3.04085	3.42110	3.60629	3.80388	3.99444	4.18279	4.37173	4.56179	4.93031	5.24652	5.51702	5.75072	5.94662	6.11523	900
950	−0.0092591	0.66141	1.24039	1.75139	2.21348	2.63311	3.03208	3.40966	3.59208	3.78694	3.97408	4.15814	4.34171	4.52550	4.88356	5.19669	5.46799	5.70562	5.90447	6.07442	950
1000	−0.0105117	0.65926	1.23719	1.74728	2.20836	2.62631	3.02354	3.39873	3.57863	3.77106	3.95514	4.13550	4.31457	4.49309	4.84152	5.15416	5.42224	5.66298	5.86437	6.03515	1000

Table 7. Calculated Values of Specific Heat at Constant Pressure (J/g°K)

Pressure bar	Temperature °C																				Pressure bar
	0	50	100	150	200	250	300	350	375	400	425	450	475	500	550	600	650	700	750	800	
0	1.878	1.876	1.884	1.901	1.925	1.955	1.990	2.027	2.047	2.067	2.087	2.107	2.126	2.146	2.182	2.215	2.243	2.264	2.278	2.282	0
1	4.226	4.185	2.091	1.983	1.963	1.975	2.002	2.035	2.054	2.073	2.092	2.111	2.130	2.149	2.185	2.218	2.245	2.266	2.279	2.284	1
5	4.223	4.184	4.209	4.311	2.136	2.061	2.052	2.068	2.081	2.096	2.112	2.129	2.146	2.164	2.197	2.227	2.253	2.273	2.285	2.289	5
10	4.220	4.183	4.207	4.309	2.451	2.190	2.121	2.112	2.118	2.127	2.139	2.152	2.167	2.182	2.212	2.239	2.263	2.282	2.293	2.295	10
25	4.210	4.180	4.204	4.304	4.498	2.836	2.391	2.262	2.237	2.226	2.223	2.225	2.230	2.238	2.257	2.276	2.294	2.308	2.315	2.314	25
50	4.195	4.174	4.198	4.296	4.484	4.839	3.212	2.610	2.492	2.424	2.383	2.359	2.345	2.338	2.335	2.340	2.347	2.352	2.352	2.346	50
75	4.180	4.168	4.193	4.289	4.471	4.806	4.791	3.155	2.851	2.681	2.579	2.515	2.474	2.448	2.419	2.407	2.402	2.398	2.391	2.379	75
100	4.166	4.162	4.188	4.281	4.458	4.776	5.673	4.024	3.364	3.021	2.823	2.702	2.623	2.570	2.508	2.477	2.548	2.444	2.430	2.412	100
125	4.152	4.157	4.182	4.274	4.445	4.747	5.558	5.559	4.115	3.473	3.130	2.926	2.795	2.708	2.605	2.550	2.516	2.492	2.470	2.445	125
150	4.138	4.151	4.177	4.267	4.433	4.720	5.458	9.061	5.312	4.083	3.516	3.195	2.996	2.864	2.709	2.627	2.577	2.541	2.510	2.479	150
175	4.125	4.146	4.172	4.260	4.421	4.694	5.371	9.020	7.587	4.950	4.003	3.520	3.229	3.040	2.822	2.708	2.639	2.591	2.551	2.514	175
200	4.112	4.140	4.167	4.253	4.410	4.669	5.293	7.644	12.67	6.304	4.628	3.908	3.499	3.239	2.944	2.793	2.703	2.642	2.593	2.549	200
225	4.100	4.135	4.162	4.246	4.399	4.646	5.223	6.828	103.9	8.497	5.462	4.375	3.810	3.462	3.076	2.882	2.770	2.694	2.636	2.584	225
250	4.088	4.130	4.157	4.239	4.388	4.624	5.161	6.285	14.08	13.19	6.644	4.936	4.168	3.712	3.218	2.976	2.838	2.747	2.679	2.620	250
275	4.076	4.124	4.152	4.233	4.378	4.602	5.104	5.897	10.42	24.43	8.502	5.619	4.574	3.989	3.370	3.074	2.909	2.801	2.722	2.656	275
300	4.065	4.119	4.147	4.227	4.367	4.582	5.052	5.609	8.969	24.50	10.97	6.473	5.033	4.295	3.533	3.177	2.981	2.857	2.766	2.692	300
350	4.044	4.109	4.137	4.214	4.348	4.544	4.960	5.213	7.625	11.76	15.66	9.037	6.123	4.984	3.885	3.394	3.132	2.969	2.855	2.765	350
400	4.025	4.099	4.128	4.203	4.329	4.508	4.882	4.968	6.957	8.690	12.60	11.08	7.661	5.757	4.269	3.624	3.289	3.084	2.945	2.838	400
450	4.007	4.090	4.119	4.191	4.311	4.475	4.813	4.813	5.542	7.465	9.717	10.75	8.730	6.546	4.669	3.863	3.451	3.201	3.034	2.910	450
500	3.990	4.080	4.110	4.180	4.294	4.444	4.753	4.720	6.253	6.799	8.119	9.499	8.919	7.315	5.065	4.104	3.616	3.319	3.122	2.982	500
550	3.975	4.071	4.102	4.170	4.278	4.415	4.699	4.672	6.036	6.373	7.205	8.352	8.519	7.563	5.427	4.338	3.781	3.436	3.209	3.051	550
600	3.961	4.062	4.094	4.160	4.263	4.387	4.651	4.657	5.864	6.073	6.628	7.486	7.953	7.494	5.720	4.556	3.944	3.552	3.293	3.118	600
650	3.948	4.053	4.085	4.150	4.248	4.361	4.607	4.670	5.724	5.847	6.232	6.864	7.390	7.266	5.900	4.745	4.102	3.666	3.373	3.181	650
700	3.936	4.044	4.077	4.141	4.233	4.336	4.567	4.704	5.606	5.668	5.943	6.413	6.896	6.974	5.947	4.896	4.250	3.776	3.449	3.239	700
750	3.926	4.036	4.070	4.131	4.219	4.312	4.531	4.756	5.505	5.521	5.721	6.077	6.487	6.667	5.954	5.001	4.385	3.881	3.519	3.292	750
800	3.917	4.028	4.062	4.123	4.206	4.289	4.497	4.823	5.417	5.398	5.543	5.819	6.157	6.373	5.912	5.059	4.502	3.981	3.582	3.339	800
850	3.909	4.020	4.055	4.114	4.193	4.267	4.466	4.904	5.340	5.292	5.397	5.614	5.891	6.107	5.838	5.078	4.599	4.074	3.638	3.378	850
900	3.901	4.012	4.048	4.106	4.180	4.245	4.438	4.996	5.272	5.199	5.273	5.448	5.676	5.875	5.742	5.086	4.673	4.160	3.686	3.409	900
950	3.895	4.004	4.040	4.098	4.168	4.224	4.411	5.099	5.210	5.116	5.167	5.309	5.499	5.675	5.634	5.140	4.722	4.238	3.726	3.431	950
1000	3.890	3.997	4.034	4.090	4.156	4.204	4.386	5.211	5.156	5.042	5.073	5.191	5.351	5.506	5.521	5.019	4.747	4.307	3.755	3.443	1000

Table 8. Thermodynamic Properties of Saturated Water and Saturated Steam

For pressure, specific volume and specifific enthalpy, the first column gives the values calculated by this formulation, the second column gives the 1963 Skeleton Table values, and in the third column the differences between these values are compared with the Skeleton Table tolerances. For specific entropy and specific heat at constant pressure, the calculated values are tabulated.

Temp. °C	Pressure bar			Specific Volume cm³/g						Specific Enthalpy J/g						Specific Entropy J/g°K		Specific Heat J/g°K		Temp. °C
				Water			Steam			Water			Steam			Water	Steam	Water	Steam	
	$p_{calc.}$	$p_{S.T.}$	Δp/Tol.	$(v_f)_{calc.}$	$(v_f)_{S.T.}$	Δv_f/Tol.	$(v_g)_{calc.}$	$(v_g)_{S.T.}$	Δv_g/Tol.	$(h_f)_{calc.}$	$(h_f)_{S.T.}$	Δh_f/Tol.	$(h_g)_{calc.}$	$(h_g)_{S.T.}$	Δh_g/Tol.	s_f	s_g	c_{pf}	c_{pg}	
0	0.0061080	0.006108	0.0/6	1.000210	1.00021	0.0/5	206261.6	206288	−26.4/210	−0.04165	−0.0416	0.5/4	2501.5	2501	0.5/3	−0.0001548	9.15623	4.226	1.889	0
0.01	0.0061124	0.006112	0.4/6	1.000209	1.00021	−0.1/5	206119.3	206146	−26.7/210	0.0006111	0.000611	0.1/1	2501.5	2501	0.5/3	0	9.15597	4.226	1.889	0.01
10	0.0122711	0.012271	0.1/10	1.00031	1.0004	−0.9/1	106388.0	106422	−34.0/110	41.989	41.99	−0.1/4	2519.9	2519	0.9/3	0.15099	8.90087	4.191	1.894	10
20	0.0233680	0.023368	0.0/20	1.00184	1.0018	0.4/1	57811.1	57836	−24.9/58	83.861	83.86	0.1/8	2538.3	2538	0.3/2	0.29631	8.66752	4.184	1.902	20
30	0.0424173	0.042418	−0.7/30	1.00441	1.0044	0.1/1	32912.4	32929	−16.6/33	125.673	125.66	1.3/8	2556.4	2556	0.4/2	0.43656	8.45369	4.179	1.913	30
40	0.0737508	0.073750	0.8/38	1.00786	1.0079	−0.4/1	19536.0	19546	−10.0/19	167.469	167.47	−0.1/8	2574.3	2574	0.3/2	0.57220	8.25726	4.181	1.927	40
50	0.123350	0.12335	0.0/6	1.01210	1.0121	0.0/2	12039.4	12045	−5.6/12	209.303	209.23	7.3/10	2592.0	2592	0.0/2	0.70369	8.07634	4.186	1.945	50
60	0.199196	0.19919	0.6/10	1.01708	1.0171	−0.2/2	7674.56	7677.6	−30.4/77	251.19	251.1	0.9/1	2609.4	2609	0.4/2	0.83133	7.90932	4.190	1.967	60
70	0.311612	0.31161	0.2/16	1.02274	1.0228	−0.6/2	5043.81	5045.3	−14.9/50	293.11	293.0	1.1/1	2626.5	2626	0.5/2	0.95536	7.75476	4.192	1.992	70
80	0.473591	0.47358	1.1/24	1.02905	1.0290	−0.5/3	3407.67	3408.3	−6.3/34	335.06	334.9	1.6/2	2643.3	2643	0.3/2	1.07592	7.61138	4.194	2.022	80
90	0.701085	0.70109	−0.5/36	1.03597	1.0359	0.7/3	2360.59	2360.9	−3.1/24	377.04	376.9	1.4/2	2659.6	2660	−0.4/2	1.19319	7.47804	4.199	2.055	90
100	1.013250	1.01325	0/0	1.04350	1.0435	0.0/3	1672.78	1673.0	−2.2/17	419.10	419.1	0.0/2	2675.6	2676	−0.4/2	1.30741	7.35373	4.209	2.094	100
110	1.43265	1.4327	−0.5/10	1.05163	1.0515	1.3/4	1210.03	1210.0	0.3/12	461.30	416.3	0.0/2	2691.0	2691	0.0/2	1.41884	7.23749	4.225	2.138	110
120	1.98538	1.9854	−0.2/13	1.06038	1.0603	0.8/4	891.794	891.71	8.4/89	503.69	503.7	−0.1/2	2705.8	2706	−0.2/2	1.52776	7.12846	4.245	2.189	120
130	2.70121	2.7011	−1.1/16	1.06977	1.0697	0.7/4	668.491	668.32	17.1/67	546.30	546.3	0.0/3	2720.0	2720	0.0/2	1.63441	7.02581	4.267	2.248	130
140	3.61360	3.6136	0.0/21	1.07983	1.0798	0.3/4	508.864	508.66	20.4/51	589.14	589.1	0.4/3	2733.5	2734	−0.5/2	1.73897	6.92878	4.288	2.318	140
150	4.75970	4.7597	0.0/32	1.09060	1.0906	0.0/4	392.790	392.57	22.0/39	632.20	632.2	0.0/3	2746.0	2747	−1.0/3	1.84161	6.83664	4.311	2.401	150
160	6.18035	6.1804	−0.5/42	1.10210	1.1021	0.0/4	307.045	306.85	19.5/31	675.52	675.5	0.2/3	2757.6	2758	−0.4/3	1.94247	6.74875	4.336	2.499	160
170	7.92002	7.9202	−1.8/53	1.11439	1.1144	0.1/4	242.779	242.62	15.9/24	719.13	719.1	0.3/4	2768.1	2769	−0.9/3	2.04170	6.66449	4.367	2.614	170
180	10.0267	10.027	−0.3/7	1.12750	1.1275	0.0/4	193.962	193.85	11.2/19	673.09	763.1	−0.1/4	2777.3	2778	−0.7/4	2.13945	6.58335	4.405	2.746	180
190	12.5518	12.553	−1.2/8	1.14151	1.1415	0.1/4	156.422	156.35	7.2/16	807.49	807.5	−0.1/4	2785.3	2786	−0.7/4	2.23586	6.50486	4.452	2.894	190
200	15.5500	15.550	0.0/8	1.15650	1.1565	0.0/4	127.223	127.19	3.3/13	852.40	852.4	0.0/4	2791.8	2793	−1.2/4	2.33108	6.42867	4.504	3.055	200
210	19.0793	19.080	−0.7/8	1.17259	1.1726	−0.1/4	104.2712	104.265	6.2/104	897.84	897.8	0.4/4	2796.9	2798	−1.1/4	2.42523	6.35444	4.560	3.224	210
220	23.2008	23.202	−1.2/9	1.18992	1.1900	−0.8/4	86.0533	86.062	−8.7/86	943.86	943.7	1.6/4	2800.5	2802	−1.5/4	2.51842	6.28187	4.619	3.396	220
230	27.9786	27.979	−0.4/10	1.20866	1.2087	−0.4/4	71.4588	71.472	−13.2/71	990.47	990.3	1.7/4	2802.4	2803	−0.6/4	2.61074	6.21068	4.683	3.568	230
240	33.4801	33.480	0.1/12	1.22900	1.2291	−1.0/4	59.6643	59.674	−9.7/60	1037.74	1037.6	1.4/5	2802.6	2803	−0.4/4	2.70239	6.14048	4.758	3.742	240
250	39.7760	39.776	0.0/13	1.25120	1.2512	0.0/4	50.0524	50.056	−3.6/50	1085.80	1085.8	0.0/5	2800.9	2801	−0.1/4	2.79360	6.07084	4.853	3.925	250
260	46.9405	46.941	−0.5/15	1.27552	1.2755	0.2/4	42.1550	42.149	6.0/42	1134.83	1135.0	−1.7/7	2797.0	2796	1.0/4	2.88474	6.00123	4.973	4.135	260
270	55.0517	55.052	−0.3/17	1.30233	1.3023	0.3/4	35.6144	35.599	15.4/36	1185.07	1185.2	−1.3/8	2790.6	2790	0.6/4	2.97616	5.93100	5.122	4.395	270
280	64.1921	64.191	1.1/22	1.33210	1.3321	0.0/4	30.1548	30.133	21.8/30	1236.74	1236.8	−0.6/8	2781.3	2780	1.3/4	3.06820	5.85942	5.298	4.735	280
290	74.4494	74.449	0.4/22	1.36553	1.3655	0.3/5	25.5612	25.537	24.2/30	1290.0	1290	0.0/1	2768.6	2766	2.6/4	3.16109	5.78563	5.501	5.194	290
300	85.9170	85.917	0.0/24	1.40359	1.4036	−0.1/7	21.6652	21.643	22.2/35	1345.0	1345	0.0/1	2751.8	2749	2.8/4	3.25506	5.70861	5.746	5.816	300
310	98.6958	98.694	1.8/30	1.44768	1.4475	1.8/7	18.3330	18.316	17.0/35	1402.0	1402	0.0/2	2730.2	2727	2.8/5	3.35062	5.62711	6.073	6.657	310
320	112.896	112.89	0.6/3	1.49965	1.4992	4.5/7	15.4588	15.451	7.8/35	1462.0	1462	0.0/2	2702.6	2700	2.6/6	3.44895	5.53961	6.558	7.789	320
330	128.641	128.64	0.1/4	1.5620	1.562	0.0/1	12.9586	12.967	−8.4/35	1526.1	1526	0.1/2	2667.9	2666	1.9/6	3.55207	5.44428	7.282	9.297	330
340	146.074	146.08	−0.6/4	1.6388	1.639	−0.2/1	10.7659	10.779	−13.1/35	1595.9	1596	−0.1/3	2624.4	2623	1.4/7	3.66216	5.33899	8.295	11.29	340
350	165.370	165.37	0.0/4	1.7410	1.741	0.0/1	8.8294	8.805	−24.4/35	1671.9	1672	−0.1/3	2570.5	2565	5.5/8	3.77979	5.22126	9.849	13.90	350
360	186.752	186.74	1.2/5	1.8941	1.894	0.1/4	6.9471	6.943	4.1/40	1762.1	1762	0.1/3	2483.4	2481	2.4/8	3.91728	5.05648	14.30	23.81	360
370	210.530	210.53	0.0/5	2.212	2.22	−0.8/2	4.900	4.93	−3.0/10	1888.7	1892	−3.3/6	2325.3	2331	−5.7/12	4.10794	4.78678	44.09	79.56	370
371	213.055	213.06	−0.5/10	2.279	2.29	−1.1/2	4.649	4.68	−3.1/10	1909.0	1913	−4.0/6	2299.0	2305	−6.0/14	4.13855	4.74411	59.57	104.0	371
372	215.609	215.63	−2.1/11	2.368	2.38	−1.2/3	4.362	4.40	−3.8/11	1933.7	1937	−3.3/9	2266.6	2273	−6.4/16	4.17595	4.69192	90.89	153.2	372
373	218.19	218.2	−0.1/1	2.513	2.51	−0.3/4	4.030	4.05	−2.0/12	1969.5	1969	0.5/14	2225.5	2230	−4.5/18	4.23054	4.62674	193.2	280.3	373
374	220.805	220.9	−0.95/1	2.906	2.80	10.6/15	3.516	3.47	4.6/12	2050.5	2032	18.5/20	2153.4	2146	7.4/30	4.35468	4.51361	2605.0	1524.4	374
374.15	221.20	221.2	0.0/1	3.170	3.17	0.0/15	3.170	3.170	0.0/15	2097.7	2095	2.7/30	2097.7	2095	2.7/30	4.42733	4.42733	—	—	374.15

Table 9. Calculated Properties at the Boundary between Sub-regions 5 and 1.

Pressure	Specific volume				Specific entropy			Specific enthalpy		
P bar	v_1 cm³/g	v_5 cm³/g	$\Delta v \times 10^4$	$\frac{\Delta v}{v} \times 10^4$	s_1 J/g°K	s_5 J/g°K	$\Delta s \times 10^4$	h_1 J/g	h_5 J/g	Δh
Prague value				5			2			0.2
165.37	1.74100	1.74070	3.0	1.7	3.77815	3.71863	−34.8	1671.85	1673.00	−1.15
175	1.71670	1.71600	7.0	4.1	3.76363	3.76548	−18.5	1663.44	1664.59	−1.15
200	1.66725	1.66667	5.8	3.5	3.72943	3.73144	−20.1	1646.36	1647.61	−1.25
225	1.62990	1.62978	1.2	0.7	3.70223	3.70429	−20.6	1633.53	1634.81	−1.28
250	1.59988	1.60013	−2.5	−1.6	3.67938	3.61832	−19.4	1623.33	1624.53	−1.20
275	1.57477	1.57527	−5.0	−3.2	3.65950	3.66122	−17.2	1614.91	1615.98	−1.07
300	1.55320	1.55385	−6.5	−4.2	3.64098	3.64325	−22.7	1607.79	1608.68	−0.89
350	1.51745	1.51821	−7.6	−5.0	3.61111	3.61192	−8.1	1596.33	1596.84	−0.51
400	1.48846	1.48918	−7.2	−4.8	3.58484	3.58504	−2.0	1587.48	1587.61	−0.13
450	1.46410	1.46469	−5.9	−4.0	3.56171	3.56136	3.5	1580.44	1580.23	0.21
500	1.44308	1.44351	−4.3	−3.0	3.54093	3.54009	8.4	1574.76	1574.25	0.51
550	1.42458	1.42485	−2.7	−1.9	3.52201	3.52075	12.6	1570.14	1569.36	0.78
600	1.40808	1.40818	−1.0	−0.7	3.50460	3.50295	16.5	1566.37	1565.36	1.01
650	1.39318	1.39312	0.6	0.4	3.48843	3.48642	20.1	1653.30	1562.06	1.24
700	1.37959	1.37490	1.9	1.4	3.47334	3.47097	23.7	1650.82	1559.36	1.46
750	1.36711	1.36679	3.2	2.3	3.45916	3.45642	27.3	1558.85	1557.16	1.69
800	1.35557	1.35512	4.5	3.3	3.44579	3.44262	31.7	1557.33	1555.36	1.97
850	1.34484	1.34428	5.6	4.2	3.43313	3.42948	36.5	1556.19	1555.92	0.27
900	1.33480	1.33414	6.6	4.9	3.42110	3.41688	42.2	1555.39	1552.77	2.62
950	1.32539	1.32463	7.6	5.7	3.40966	3.40476	49.9	1554.91	1551.86	3.05
1000	1.31651	1.31567	8.4	6.4	3.39873	3.39304	56.9	1554.70	1551.16	3.54

(Continued)

Pressure	Specific free enthalpy			Specific heat			
P bar	g_1 J/g	g_5 J/g	Δg	c_{p1} J/g°K	c_{p5} J/g°K	Δc_p	$\Delta c_p/c_p$
Prague value			0.2				0.01
165.37	−683.53	−683.53	0.00	9.849	10.133	−0.284	−0.03
175	−681.86	−681.86	0.00	9.020	9.394	−0.374	−0.04
200	−677.64	−677.64	0.00	7.644	8.239	−0.595	−0.08
225	−673.52	−673.52	0.00	6.829	7.573	−0.744	−0.11
250	−669.48	−669.48	0.00	6.285	7.124	−0.839	−0.13
275	−665.51	−665.52	0.01	5.897	6.794	−0.897	−0.15
300	−661.60	−661.61	0.01	5.609	6.535	−0.926	−0.17
350	−653.93	−653.93	0.00	5.213	6.150	−0.937	−0.18
400	−646.42	−646.41	−0.01	4.968	5.868	−0.900	−0.18
450	−639.04	−639.03	−0.01	4.813	5.650	−0.837	−0.17
500	−631.77	−631.76	−0.01	4.720	5.474	−0.754	−0.16
550	−624.60	−624.59	−0.01	4.672	5.330	−0.658	−0.14
600	−617.52	−617.51	−0.01	4.657	5.210	−0.533	−0.12
650	−610.52	−610.51	−0.01	4.670	5.111	−0.441	−0.09
700	−603.59	−603.59	−0.02	4.704	5.029	−0.325	−0.07
750	−596.72	−596.72	−0.01	4.756	4.961	−0.205	−0.04
800	−589.92	−589.92	−0.02	4.823	4.907	−0.084	−0.02
850	−583.16	−583.16	0.00	4.904	4.865	0.039	0.01
900	−576.47	−576.46	−0.01	4.996	4.835	0.161	0.03
950	−569.82	−569.81	−0.01	5.099	4.816	0.283	0.06
1000	−563.21	−563.21	0.00	5.211	4.807	0.404	0.08

Table 10. Calculated Properties at the Boundary between Sub-regions 3 and 4, and between Sub-regions 3 and 5.

Pressure	Specific volume				Specific entropy			Specific enthalpy		
p bar	v_3 cm³/g	v_4 or v_5 cm³/g	$\Delta v \times 10^4$	$\frac{\Delta v}{v} \times 10^4$	s_3 J/g°K	s_4 or s_5 J/g°K	$\Delta s \times 10^4$	h_3 J/g	h_4 or h_5 J/g	Δh
Prague value				5			2			0.2
175	10.49264	10.49264	0.0	0.0	5.49646	5.48378	126.8	2754.18	2746.03	8.16
200	7.56759	7.56759	0.0	0.0	5.22474	5.19713	276.1	2600.88	2583.06	17.82
225	2.28040	2.28040	0.0	0.0	4.16845	4.15316	152.9	1930.96	1921.11	9.85
250	1.95219	1.95219	0.0	0.0	4.02181	4.01125	105.6	1841.20	1834.42	6.78
275	1.84666	1.84666	0.0	0.0	3.96366	3.95546	82.0	1808.30	1803.04	5.26
300	1.78111	1.78111	0.0	0.0	3.92367	3.91716	65.1	1786.94	1782.78	4.16
350	1.69541	1.69541	0.0	0.0	3.86594	3.86181	41.3	1758.25	1755.62	2.63
400	1.63737	1.63737	0.0	0.0	3.82278	3.82025	25.3	1738.63	1737.04	1.59
450	1.59333	1.59333	0.0	0.0	3.78753	3.78614	13.9	1723.89	1723.04	0.85
500	1.55781	1.55781	0.0	0.0	3.75738	3.75685	5.3	1712.25	1711.96	0.29
550	1.52806	1.52806	0.0	0.0	3.73087	3.73100	−1.3	1702.80	1702.94	−0.14
600	1.50248	1.50248	0.0	0.0	3.70711	3.70776	−6.5	1694.99	1695.47	−0.48
650	1.48009	1.48009	0.0	0.0	3.68552	3.68660	−10.8	1688.47	1689.23	−0.76
700	1.46020	1.46020	0.0	0.0	3.66570	3.66715	−14.5	1683.00	1683.99	−0.99
750	1.44234	1.44234	0.0	0.0	3.64738	3.64915	−17.7	1678.39	1679.59	−1.20
800	1.42617	1.42617	0.0	0.0	3.63032	3.63238	−20.6	1674.52	1675.91	−1.39
850	1.41141	1.41141	0.0	0.0	3.61436	3.61668	−23.2	1671.28	1672.84	−1.56
900	1.39787	1.39787	0.0	0.0	3.59937	3.60193	−25.6	1668.60	1670.31	−1.71
950	1.38538	1.38538	0.0	0.0	3.58523	3.58800	−27.7	1666.41	1668.25	−1.84
1000	1.37381	1.37381	0.0	0.0	3.57186	3.57481	−29.5	1664.65	1666.61	−1.96

(Continued)

Pressure	Specific free enthalpy			Specific heat			
p bar	g_3 J/g	g_4 or g_5 J/g	Δg	c_{p3} J/g°K	c_{p4} or c_{p5} J/g°K	Δc_p	$\Delta c_p/c_p$
Prague value			0.2				0.01
175	−803.68	−803.63	−0.05	7.034	8.060	−1.026	−0.15
200	−781.10	−781.05	−0.05	13.339	13.734	−0.395	−0.03
225	−767.28	−767.23	−0.05	44.026	41.421	2.605	0.06
250	−762.12	−762.06	−0.06	13.295	12.255	1.040	0.08
275	−757.38	−757.33	−0.05	10.160	9.361	0.799	0.08
300	−752.85	−752.80	−0.05	8.834	8.167	0.667	0.08
350	−744.18	−744.13	−0.05	7.570	7.056	0.514	0.07
400	−735.86	−735.80	−0.06	6.929	6.504	0.425	0.06
450	−727.78	−727.73	−0.05	6.526	6.157	0.369	0.06
500	−719.91	−718.15	−0.06	6.244	5.909	0.335	0.05
550	−712.20	−712.14	−0.06	6.031	5.716	0.315	0.05
600	−704.62	−704.57	−0.05	5.862	5.557	0.305	0.05
650	−697.17	−697.11	−0.06	5.724	5.422	0.302	0.05
700	−689.82	−689.76	−0.06	5.608	5.303	0.305	0.05
750	−682.56	−682.51	−0.05	5.508	5.198	0.310	0.06
800	−675.39	−675.33	−0.06	5.421	5.104	0.317	0.06
850	−668.30	−668.24	−0.06	5.345	5.020	0.325	0.06
900	−661.27	−661.22	−0.05	5.277	4.944	0.333	0.06
950	−654.32	−654.26	−0.06	5.217	4.877	0.340	0.07
1000	−647.42	−647.36	−0.06	5.163	4.817	0.346	0.07

Table 11. Calculated Properties at the Boundary between Sub-regions 2 and Sub-regions 3 and 4.

Temp.	Pressure	Specific volume				Specific entropy			Specific enthalpy		
t °C	P bar	v_2 cm³/g	v_4 cm³/g	$\Delta v \times 10^4$	$\frac{\Delta v}{v} \times 10^4$	s_2' J/g°K	s_4 J/g°K	$\Delta s \times 10^4$	h_2 J/g	h_4 J/g	Δh
Prague value					5			2			0.2
350	165.37	8.82934	8.80657	227.7	25.78	5.22125	5.22113	1.2	2570.47	2570.08	0.39
355	169.43	8.96628	8.95457	117.1	13.06	5.26183	5.25893	29.0	2599.48	2597.34	2.14
360	173.77	9.03928	9.03485	44.3	4.90	5.29582	5.28974	60.8	2624.82	2620.67	4.15
365	178.40	9.05871	9.06380	−50.9	−5.62	5.32419	5.31535	88.4	2647.04	2641.14	5.90
370	183.33	9.03307	**9.05171**	−186.4	−20.63	5.34770	5.33681	108.9	2666.56	2659.35	7.21
t °C	P bar	v_2 cm²/g	v_3 cm³/g	$\Delta v \times 10^4$	$\frac{\Delta v}{v} \times 10^4$	s_2 J/g°K	s_3 J/g°K	$\Delta s \times 10^4$	h_2 J/g	h_3 J/g	Δh
375	188.58	8.96946	8.99952	−300.6	−33.51	5.36699	5.37577	−87.8	2683.74	2689.23	−5.49
380	194.15	8.87391	8.89404	−201.3	−22.68	5.38263	5.38780	−51.7	2698.89	2702.05	−3.16
385	200.07	8.75160	8.76343	−118.3	−13.52	5.39504	5.39714	−21.3	2712.24	2713.39	−1.15
390	206.34	8.60704	8.61320	−61.6	−7.16	5.40461	5.40422	3.9	2724.00	2723.52	0.48
395	212.98	8.44414	8.44617	−20.3	−2.40	5.41165	5.40927	23.8	2734.35	2732.54	1.81
400	220.00	8.26630	8.26600	3.0	0.36	5.41645	5.41254	39.1	2743.44	2740.60	2.84
405	227.41	8.07660	8.07473	18.7	2.32	5.41925	5.41417	50.8	2751.39	2747.76	3.63
410	235.23	7.87769	7.87515	25.4	3.22	5.42026	5.41435	59.1	2758.31	2754.11	4.20
415	243.47	7.67203	7.66938	26.5	3.45	5.41966	5.41323	64.3	2764.30	2759.75	4.55
420	252.14	7.46171	7.45956	21.5	2.88	5.41763	5.41095	66.8	2769.46	2764.73	4.73
425	261.25	7.24863	7.24756	10.7	1.48	5.41432	5.40765	66.7	2773.85	2769.13	4.72
430	270.82	7.03447	7.03400	4.7	0.6	5.40987	5.40335	65.2	2777.57	2772.95	4.62
435	280.86	6.82070	6.82185	−11.5	−1.68	5.40441	5.39833	60.8	2780.67	2776.36	4.31
440	291.38	6.60862	6.61099	−23.7	−3.58	5.39807	5.39253	55.4	2783.23	2779.31	3.92
445	302.40	6.39932	6.40259	−32.7	−5.10	5.39098	5.38607	49.1	2785.32	2781.85	3.47
450	313.93	6.19379	6.19769	−39.0	−6.30	5.38323	5.37904	41.9	2786.99	2784.05	2.94
455	325.97	5.99286	5.99752	−46.0	−7.78	5.37495	5.37159	33.6	2788.31	2785.98	2.33
460	338.56	5.79716	5.80175	−45.9	−7.92	5.36621	5.36366	25.5	2787.35	2787.62	1.73
465	351.69	5.60733	5.61173	−44.0	−7.85	5.35714	5.35544	17.0	2790.16	2789.06	1.10
470	365.38	5.42377	5.47268	−39.1	−7.21	5.34782	5.34697	8.5	2790.81	2790.34	0.47
475	379.64	5.24678	5.25005	−32.7	−6.23	5.33834	5.33832	0.2	2791.35	2791.50	−0.15
480	394.49	5.07665	5.07896	−23.1	−4.55	5.32880	5.32954	−7.4	2791.85	2792.58	−0.73
485	409.94	4.91357	4.91474	−11.7	−2.38	5.31926	5.32072	−14.6	2792.36	2793.63	−1.27
490	426.00	4.75757	4.75761	−0.4	−0.08	5.30980	5.31192	−21.2	2792.92	2794.71	−1.79
495	442.68	4.60872	4.60772	10.0	2.17	5.30049	5.30323	−27.4	2793.61	2795.86	−2.25
500	460.00	4.46695	4.46498	19.7	4.41	5.29140	5.29468	−32.8	2794.46	2797.12	−2.66
505	477.97	4.33205	4.32939	26.6	6.14	5.28259	5.28633	−37.4	2795.52	2798.55	−3.03
510	496.60	4.20408	4.20090	31.8	7.56	5.27408	5.27824	−41.6	2796.83	2800.18	−3.35
515	515.91	4.08262	4.07925	33.7	8.25	5.26593	5.27043	−45.0	2798.43	2802.04	−3.61
520	535.91	3.96768	3.96426	34.2	8.62	5.25817	5.26295	−47.8	2800.34	2804.16	−3.82
525	556.61	3.85881	3.85572	30.9	8.01	5.25084	5.25582	−49.8	2802.60	2806.58	−3.98
530	578.02	3.75598	3.75334	26.4	7.03	5.24395	5.24907	−51.2	2805.24	2809.32	−4.08
535	600.16	3.56859	3.65672	18.7	5.11	5.23746	5.24269	−52.3	2808.22	2812.38	−4.16
540	623.04	3.56662	3.56555	10.7	3.00	5.23147	5.23669	−52.2	2811.62	2815.78	−4.16
545	646.68	3.47962	3.47942	2.0	0.57	5.22585	5.23105	−52.0	2815.35	2819.50	−4.15
550	671.07	3.39755	3.39814	−5.9	−1.74	5.22070	5.22580	−51.0	2819.52	2823.58	−4.06
555	696.25	3.31996	3.32118	−12.2	−3.67	5.21598	5.22088	−49.0	2824.08	2827.98	−3.90
560	722.22	3.24631	3.42831	−20.0	−6.16	5.21156	5.21631	−47.5	2828.93	2832.71	−3.78
565	748.99	3.17692	3.17921	−22.9	−7.21	5.20756	5.21207	−45.1	2834.18	2837.77	−3.59
570	776.58	3.11109	3.11356	−24.7	−7.93	5.20391	5.20814	−42.3	2839.78	2843.14	−3.36
575	805.00	3.04850	3.05110	−26.0	−8.53	5.20048	5.20450	−40.2	2845.63	2848.83	−3.20
580	834.26	2.98915	2.99159	−24.4	−8.16	5.19734	5.20114	−38.0	2851.79	2854.81	−3.02
585	364.38	2.93291	2.93476	−18.5	−6.31	5.19448	5.19806	−35.8	2858.25	2861.09	−2.84
590	895.37	2.87928	2.88042	−11.4	−3.96	5.19178	5.19523	−34.5	2864.97	2867.67	−2.70
595	927.24	2.82832	2.82838	−0.6	−0.21	5.18933	5.19265	−33.2	2871.92	2874.53	−2.61
600	960.00	2.77953	2.77848	10.5	3.78	5.18700	5.19031	−33.1	2879.09	2881.68	−2.59
605	993.67	2.73312	2.73053	25.9	9.48	5.18494	5.18821	−32.7	2886.57	2889.12	−2.55

Table 11 (Continued)

Temp.	Pressure	Specific free enthalpy			Specific heat			
t °C	p bar	g_2 J/g	g_4 J/g	Δg	c_{p2} J/g°K	c_{p4} J/g°K	Δc_p	$\Delta c_p/c_p$
Prague value				0.2				0.01
350	165.37	−683.15	−683.46	0.31	13.901	13.981	0.080	0.01
355	169.43	−705.74	−706.06	0.32	12.784	12.447	0.337	0.03
360	173.77	−728.23	−728.53	0.30	11.844	11.468	0.376	0103
365	178.40	−750.59	−750.85	0.26	11.055	10.790	0.735	0.06
370	183.33	−772.81	−773.01	0.20	10.390	10.298	0.092	0.09
t °C	p bar	g_2 J/g	g_3 J/g	Δg	c_{p2} J/g°K	c_{p3} J/g°K	Δc_p	$\Delta c_p/c_p$
375	188.58	−795.07	−795.07	0.00	9.831	9.120	0.711	0.07
380	194.15	−816.77	−817.00	0.23	9.359	8.753	0.606	0.06
385	200.07	−838.50	−838.74	0.24	8.960	8.467	0.493	0.06
390	206.34	−860.06	−860.29	0.23	8.624	8.239	0.385	0.04
395	212.98	−881.44	−881.66	0.22	8.339	8.055	0.283	0.03
400	220.00	−902.64	−902.85	0.21	8.099	7.906	0.193	0.02
405	227.41	−923.68	−923.86	0.18	7.896	7.784	0.112	0.01
410	235.23	−944.54	−944.70	0.16	7.724	7.684	0.040	0.01
415	243.47	−965.24	−965.37	0.13	7.580	7.600	−0.020	−0.00
420	252.14	−985.77	−985.87	0.10	7.459	7.530	−0.071	−0.01
425	261.25	−1006.15	−1006.22	0.07	7.358	7.471	−0.113	−0.02
430	270.82	−1026.38	−1026.41	0.03	7.273	7.421	−0.148	−0.02
435	280.86	−1046.46	−1046.46	0.00	7.202	7.376	−0.174	−0.02
440	291.38	−1066.40	−1066.37	−0.03	7.143	7.337	−0.194	−0.03
445	302.40	−1086.21	−1086.15	−0.06	7.093	7.302	−0.209	−0.03
450	313.93	−1105.90	−1105.80	−0.10	7.050	7.269	−0.219	−0.03
455	325.97	−1125.45	−1125.34	−0.11	7.013	7.237	−0.224	−0.03
460	338.56	−1144.88	−1144.75	−0.13	6.979	7.205	−0.226	−0.03
465	351.69	−1164.21	−1164.06	−0.15	6.948	7.172	−0.224	−0.03
470	365.38	−1183.42	−1183.26	−0.16	6.918	7.138	−0.220	−0.03
475	379.64	−1202.53	−1202.36	−0.17	6.888	7.100	−0.212	−0.03
480	394.49	−1221.54	−1221.36	−0.18	6.857	7.057	−0.200	−0.03
485	409.94	−1240.44	−1240.27	−0.17	6.822	7.010	−0.188	−0.03
490	426.00	−1259.25	−1259.09	−0.16	6.785	6.957	−0.172	−0.03
495	442.68	−1277.96	−1277.82	−0.14	6.743	6.898	−0.155	−0.02
500	460.00	−1296.58	−1296.45	−0.13	6.696	6.831	−0.135	−0.02
505	477.97	−1315.13	−1315.01	−0.12	6.643	6.758	−0.115	−0.02
510	496.60	−1333.56	−1333.47	−0.09	6.585	6.679	−0.094	−0.01
515	515.91	−1351.91	−1351.85	−0.06	6.522	6.594	−0.072	−0.01
520	535.91	−1370.17	−1370.14	−0.03	6.451	6.504	−0.053	−0.01
525	556.61	−1388.35	−1388.35	−0.00	6.376	6.409	−0.033	−0.01
530	578.02	−1406.44	−1406.47	0.03	6.294	6.312	−0.018	−0.00
535	600.16	−1424.43	−1424.50	0.07	6.209	6.213	−0.004	−0.00
540	623.04	−1442.34	−1442.43	0.09	6.119	6.112	0.007	0.00
545	646.68	−1460.17	−1460.28	0.11	6.026	6.012	0.014	0.00
550	671.07	−1477.89	−1478.03	0.14	5.931	5.912	0.019	0.00
555	696.25	−1495.53	−1495.69	0.16	5.834	5.813	0.021	0.00
560	722.22	−1513.08	−1513.25	0.17	5.739	5.717	0.022	0.00
565	748.99	−1530.53	−1530.72	0.19	5.645	5.622	0.023	0.00
570	776.58	−1547.89	−1548.09	0.20	5.554	5.529	0.025	0.00
575	805.00	−1565.15	−1565.37	0.22	5.469	5.440	0.029	0.01
580	834.26	−1582.32	−1582.54	0.22	5.389	5.352	0.037	0.01
585	864.38	−1599.39	−1599.62	0.23	5.317	5.268	0.049	0.01
590	895.37	−1616.32	−1616.59	0.27	5.265	5.186	0.070	0.01
595	927.24	−1633.20	−1633.46	0.26	5.204	5.107	0.097	0.02
600	960.00	−1649.94	−1650.24	0.30	5.163	5.031	0.132	0.03
605	993.67	−1666.58	−1666.91	0.33	5.135	4.957	0.178	0.03

Table 12. Calculated Values of Specific Free Enthalpy at the Boundary between Sub-regions 1 and 2 and Sub-regions 4 and 5.

Temp.	Specific free enthalpy		
t °C	g_1 J/g	g_2 J/g	Δg
Prague value			0.2
0	0.00	0.46	−0.46
0.01	0.00	0.46	−0.46
10	−0.76	−0.34	−0.42
20	−3.00	−2.63	−0.37
30	−6.67	−6.35	−0.32
40	−11.72	−11.44	−0.28
50	−18.09	−17.87	−0.22
60	−25.77	−25.57	−0.20
70	−34.72	−34.52	−0.20
80	−44.90	−44.68	−0.22
90	−56.27	−56.01	−0.26
100	−68.76	−68.48	−0.28
110	−82.33	−82.06	−0.27
120	−96.95	−96.71	−0.24
130	−112.61	−112.42	−0.19
140	−129.32	−129.16	−0.16
150	−147.08	−146.90	−0.18
160	−165.87	−165.63	−0.24
170	−185.65	−185.31	−0.34
180	−206.40	−205.93	−0.47
190	−228.04	−227.48	−0.56
200	−250.56	−249.92	−0.64
210	−273.91	−273.25	−0.66
220	−298.10	−297.44	−0.66
230	−323.12	−322.49	−0.63
240	−348.99	−348.36	−0.63
250	−375.68	−375.05	−0.63
260	−403.17	−402.53	−0.64
270	−431.43	−430.78	−0.65
280	−460.44	−459.80	−0.64
290	−490.18	−489.57	−0.61
300	−520.66	−520.06	−0.60
310	−551.87	−551.28	−0.59
320	−583.77	−583.21	−0.56
330	−616.34	−615.85	−0.49
340	−649.58	−649.17	−0.41
350	−683.53	−683.15	−0.38

Temp.	Specific free enthalpy		
t °C	g_4 J/g	g_5 J/g	Δg
Prague value			0.2
360	−718.13	−718.09	−0.04
370	−753.34	−753.33	−0.01
371	−756.89	−756.88	−0.01
372	−760.45	−760.44	−0.01
373	−764.03	−764.03	0.00
374	−767.61	−767.62	0.00
374.15	−768.15	−768.15	0.00

9. Conclusion

According to the International Formulation Committee of the International Conference on the Properties of Steam, a formulation of the properties of steam has been determined. The formulation covers the whole region of the International Skeleton Table of 1963, that extends in pressure from the ideal gas limit (at zero pressure) to a pressure of $10^8 N/m^2$ (1000 bar), and that extends in temperature from 273.16°K (0.01°C) to 1073.15°K (800°C). All calculated values by this formulation satisfy the Skeleton Table in the extents of the tolerances.

References

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