2.23 Methane(IUPAC Table)

Equations for thermodynamic properties have been cited from the IUPAC Table [1], and those for viscosity from Ely et al.[2], thermal conductivity from reference [3] and surface tension from Miller et al.[4].

2.23.1 Temperature Scale

International practical temperature scale 1968 (IPTS-1968)

2.23.2 The Names of Substance, Library File and Single Shot Program

Name of Substance:	Methane
Library File for UNIX:	libjch4.a
Library File for DOS,Windows95/NT:	JCH4.LIB
Single Shot Program for UNIX:	ch4-ss
Single Shot Program for DOS,Windows95/NT:	CH4–SS.EXE

2.23.3 Important Constants and Others

Molecular Formula:	CH_4
Relative Molecular Mass:	16.043
Gas Constant:	518.25 J/(kg·K)

Critical Constants:

Critical Pressure:	4.595×10^{6}Pa (45.95 bar)
Critical Temperature:	190.555 K (−82.595°C)
Critical Specific Volume:	6.1656×10^{-3}m^3/kg

Triple Point:

Pressure:	0.011719×10^{6}Pa (0.11719 bar)
Temperature:	90.68 K (−182.47°C)

Reference State:

The point at which the specific entropy and the specific enthalpy are assumed to be zero is that of the ideal gas at 25 °C(298.15 K) and 1.01325 bar (1 atm).

2.23.4 Formula

Equation of State:

Equation (24) in a function form of $P = P(\rho, T)$ in reference [1]. Here P=pressure, ρ=density and T=temperature. However the minus sign of the coefficient N_{32} in the Table G in reference [1] has been corrected to a plus sign.

Vapor Pressure:

Equation (50) in reference [1].

Properties at Vapor-Liquid Equilibrium:

Equation (24) for specific volume, equations (24) and (27) for specific entropy, equations (24) and (36) for specific enthalpy, and equations (24) and (43) for isobaric specific heat, respectively. All of these have been cited from reference [1]. However, the value of f_8=0.269386063023×10 in Table J has been corrected as f_8=−0.145719286035×10^{-10}. Further the third term in the right side of equation (43),

$$C_p(\rho,T) = C_p^{id}(T) - R + R[\sum_{i=1}^{32} N_i(XC)_i]_0^w + \cdots$$

has been corrected to

$$C_p(\rho,T) = C_p^{id}(T) - R - R[\sum_{i=1}^{32} N_i(XC)_i]_0^w + \cdots$$

Pressure and Temperature on Melting Line:
Equation (52) in the reference [1].

Transport Properties:
Equation in Table III in reference [2] for viscosity and equation (4) in reference [3] for thermal conductivity.

The Other Properties:
Equation (23-1) in reference [4] for surface tension.

References

[1] S.Angus and K.M.de Reuck, International Thermodynamic Table of the Fluid State-5 Methane, IUPAC, vol.5, (1976).
[2] J.F.Ely and H.J.M.Hanley, Ind. Eng. Chem. Fundam., vol.20, No.4, (1981), p.323.
[3] Survey of Physical Data, High Pressure Fluids, vol.5, Science and Technology Agency, Tokyo, (1977-3), p.97.
[4] J.W.Miller,Jr. and C.L.Yaws, Chem. Eng., 83-23, (1976), p.127.

Table II–2.23–1 Methane Function

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
1	AIPPT(P,T)		
94	AJTPT(P,T)	AJTPT: Joule-Thomson Coefficient [K/Pa] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
8A	AKPD(P)		
8B	AKPDD(P)		
82	AKPT(P,T)	AKPT: Isentropic Exponent [–] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
8C	AKTD(T)		
8D	AKTDD(T)		
2	ALAPP(P)		
3	ALAPT(T)		
4	ALHP(P)	ALHP: Latent Heat of Vaporization [J/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
5	ALHT(T)	ALHT: Latent Heat of Vaporization [J/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
6	ALMPD(P)		
7	ALMPDD(P)		
8	ALMPT(P,T)	ALMPT: Thermal Conductivity [W/(m·K)] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$100\times10^3\leq P\leq70\times10^6$ [Pa] 298.15≤T≤423.15 [K] 1.0≤P≤700 [bar] 25≤T≤150 [°C]
9	ALMTD(T)		
10	ALMTDD(T)		
11	AMUPD(P)	AMUPD: Coefficient of Viscosity of Saturated Liquid [Pa·s] P∗: Pressure [Pa], [bar]	PST(95K)≤P≤4.595×10^6 [Pa] PST(−178.15°C)≤P≤45.95 [bar]
12	AMUPDD(P)	AMUPDD: Coefficient of Viscosity of Saturated Vapor [Pa·s] P∗: Pressure [Pa], [bar]	PST(95K)≤P≤4.595×10^6 [Pa] PST(−178.15°C)≤P≤45.95 [bar]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
13	AMUPT(P,T)	AMUPT: Coefficient of Viscosity [Pa·s] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$100\times10^3\leq P\leq$PMLT(95K) [Pa] $95\leq T\leq500$ [K] PMLT(95K)$<P\leq40\times10^6$ [Pa] TMLP(P)$\leq T\leq500$ [K] $40\times10^6<P\leq50\times10^6$ [Pa] TMLP(P)$\leq T\leq470$ [K] $50\times10^6<P\leq75\times10^6$ [Pa] $205\leq T\leq470$ [K] $1.0\leq P\leq$PMLT(-178.15°C) [bar] $-178.15\leq T\leq226.85$ [°C] PMLT(-178.15°C)$<P\leq400$ [bar] TMLP(P)$\leq T\leq226.85$ [°C] $400<P\leq500$ [bar] TMLP(P)$\leq T\leq196.85$ [°C] $500<P\leq750$ [bar] $-68.15\leq T\leq196.85$ [°C]
14	AMUTD(T)	AMUTD: Coefficient of Viscosity of Saturated Liquid [Pa·s] T∗: Temperature [K], [°C]	$95\leq T\leq190.555$ [K] $-178.15\leq T\leq-82.595$ [°C]
15	AMUTDD(T)	AMUTDD: Coefficient of Viscosity of Saturated Vapor [Pa·s] T∗: Temperature [K], [°C]	$95\leq T\leq190.555$ [K] $-178.15\leq T\leq-82.595$ [°C]
92	BPPT(P,T)	BPPT: Volumetric Coefficient of Expansion [1/K] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)$\leq T\leq620$ [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)$\leq T\leq470$ [K] $0.11719\leq P\leq400$ [bar] TMLP(P)$\leq T\leq346.85$ [°C] $400<P\leq10000$ [bar] TMLP(P)$\leq T\leq196.85$ [°C]
90	BSPT(P,T)	BSPT: Isentropic Compressibility [1/Pa] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)$\leq T\leq620$ [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)$\leq T\leq470$ [K] $0.11719\leq P\leq400$ [bar] TMLP(P)$\leq T\leq346.85$ [°C] $400<P\leq10000$ [bar] TMLP(P)$\leq T\leq196.85$ [°C]
91	BTPT(P,T)	BTPT: Isothermal Compressibility [1/Pa] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)$\leq T\leq620$ [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)$\leq T\leq470$ [K] $0.11719\leq P\leq400$ [bar] TMLP(P)$\leq T\leq346.85$ [°C] $400<P\leq10000$ [bar] TMLP(P)$\leq T\leq196.85$ [°C]
93	BVPT(P,T)	BVPT: Pressure Coefficient [1/K] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)$\leq T\leq620$ [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)$\leq T\leq470$ [K] $0.11719\leq P\leq400$ [bar] TMLP(P)$\leq T\leq346.85$ [°C] $400<P\leq10000$ [bar] TMLP(P)$\leq T\leq196.85$ [°C]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
16	CPPD(P)	CPPD: Isobaric Specific Heat of Saturated Liquid [J/(kg·K)] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
17	CPPDD(P)	CPPDD: Isobaric Specific Heat of Saturated Vapor [J/(kg·K)] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
18	CPPT(P,T)	CPPT: Isobaric Specific Heat [J/(kg·K)] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] $0.11719\leq P\leq400$ [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
19	CPTD(T)	CPTD: Isobaric Specific Heat of Saturated Liquid [J/(kg·K)] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
20	CPTDD(T)	CPTDD: Isobaric Specific Heat of Saturated Vapor [J/(kg·K)] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
21	CRP('A')	CRP: Critical Constants H: 'A'='H': -492.05×10^3 [J/kg] Specific Enthalpy P∗: 'A'='P': 4.595×10^6 [Pa], 45.95 [bar] Pressure S: 'A'='S': -4.098×10^3 [J/(kg·K)] Specific Entropy T∗: 'A'='T': 190.555 [K], −82.595 [°C] Temperature V: 'A'='V': 6.1656×10^{-3} [m^3/kg] Specific Volume	one of 'H', 'P', 'S', 'T' and 'V'
7A	CVPD(P)		
76	CVPDD(P)	CVPDD: Isochoric Specific Heat of Saturated Vapor [J/(kg·K)] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
77	CVPT(P,T)	CVPT: Isochoric Specific Heat [J/(kg·K)] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] $0.11719\leq P\leq400$ [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
7B	CVTD(T)		
78	CVTDD(T)	CVTDD: Isochoric Specific Heat of Saturated Vapor [J/(kg·K)] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
2A	EPSPD(P)		
2B	EPSPDD(P)		
22	EPSPT(P,T)		
2C	EPSTD(T)		
2D	EPSTDD(T)		
89	FC('A')	FC: Fundamental Constants M: 'A'='M': 16.043 Relative Molecular Mass R: 'A'='R': 518.25 [J/(kg·K)] Gas Constant	one of 'M' and 'R'
9A	GAMPD(P)		
96	GAMPDD(P)	GAMPDD: Ratio of Specific Heats of Saturated Vapor [–] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
95	GAMPT(P,T)	GAMPT: Ratio of Specific Heats [–] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
9B	GAMTD(T)		
97	GAMTDD(T)	GAMTDD: Ratio of Specific Heats of Saturated Vapor [–] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
23	HPD(P)	HPD: Specific Enthalpy of Saturated Liquid [J/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
24	HPDD(P)	HPDD: Specific Enthalpy of Saturated Vapor [J/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
71	HPS(P,S)	HPS: Specific Enthalpy [J/kg] P∗: Pressure [Pa], [bar] S: Specific Entropy [J/(kg·K)]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] SPT(P,TMLP(P))≤S≤ SPT(P,620K) [J/(kg·K)] $40\times10^6<P\leq10^9$ [Pa] SPT(P,TMLP(P))≤S≤ SPT(P,470K) [J/(kg·K)] 0.11719≤P≤400 [bar] SPT(P,TMLP(P))≤S≤ SPT(P,346.85°C) [J/(kg·K)] 400<P≤10000 [bar] SPT(P,TMLP(P))≤S≤ SPT(P,196.85°C) [J/(kg·K)]
25	HPT(P,T)	HPT: Specific Enthalpy [J/kg] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6<P\leq10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
26	HPX(P,X)	HPX: Specific Enthalpy of Mixture [J/kg] P∗: Pressure [Pa], [bar] X: Dryness Fraction [–]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar] 0≤X≤1.0 [–]
27	HTD(T)	HTD: Specific Enthalpy of Saturated Liquid [J/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
28	HTDD(T)	HTDD: Specific Enthalpy of Saturated Vapor [J/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
29	HTX(T,X)	HTX: Specific Enthalpy of Mixture [J/kg] T∗: Temperature [K], [°C] X: Dryness Fraction [–]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C] 0≤X≤1.0 [–]
84	IDENTF('A')	IDENTF: CHARACTER TYPE FUNCTION for Package Identification (Length 20) C: 'A'='C': 'CH4' Molecular Formula S: 'A'='S': 'METHANE' Name of Substance V: 'A'='V': '10.1' Version Number	one of 'C', 'S' and 'V'
66	PLDT(T)		
68	PMLT(T)	PMLT∗: Pressure on Melting Curve [Pa], [bar] T∗: Temperature [K], [°C]	90.68≤T≤260 [K] −182.47≤T≤−13.15 [°C]
85	PRPD(P)		
86	PRPDD(P)		

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
81	PRPT(P,T)	PRPT: Prandtl Number [–] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$100\times10^3\leq P\leq50\times10^6$ [Pa] $300\leq T\leq423.15$ [K] $1.0\leq P\leq500$ [bar] $26.85\leq T\leq150$ [°C]
87	PRTD(T)		
88	PRTDD(T)		
99	PSBT(T)		
30	PST(T)	PST∗: Saturation Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
72	PSTD(T)		
73	PSTDD(T)		
31	SIGP(P)	SIGP: Surface Tension [N/m] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
32	SIGT(T)	SIGT: Surface Tension [N/m] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
33	SPD(P)	SPD: Specific Entropy of Saturated Liquid [J/(kg·K)] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
34	SPDD(P)	SPDD: Specific Entropy of Saturated Vapor [J/(kg·K)] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar]
35	SPT(P,T)	SPT: Specific Entropy [J/(kg·K)] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] $TMLP(P)\leq T\leq620$ [K] $40\times10^6<P\leq10^9$ [Pa] $TMLP(P)\leq T\leq470$ [K] $0.11719\leq P\leq400$ [bar] $TMLP(P)\leq T\leq346.85$ [°C] $400<P\leq10000$ [bar] $TMLP(P)\leq T\leq196.85$ [°C]
36	SPX(P,X)	SPX: Specific Entropy of Mixture [J/(kg·K)] P∗: Pressure [Pa], [bar] X: Dryness Fraction [–]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] $0.11719\leq P\leq45.95$ [bar] $0\leq X\leq1.0$ [–]
37	STD(T)	STD: Specific Entropy of Saturated Liquid [J/(kg·K)] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
38	STDD(T)	STDD: Specific Entropy of Saturated Vapor [J/(kg·K)] T∗: Temperature [K], [°C]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C]
39	STX(T,X)	STX: Specific Entropy of Mixture [J/(kg·K)] T∗: Temperature [K], [°C] X: Dryness Fraction [–]	$90.68\leq T\leq190.555$ [K] $-182.47\leq T\leq-82.595$ [°C] $0\leq X\leq1.0$ [–]
67	TLDP(P)		
69	TMLP(P)	TMLP∗: Temperature on Melting Curve [K], [°C] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq10^9$ [Pa] $0.11719\leq P\leq10000$ [bar]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
64	TPH(P,H)	TPH∗: Temperature [K], [°C] P∗: Pressure [Pa], [bar] H: Specific Enthalpy [J/kg]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] HPT(P,TMLP(P))≤H≤ HPT(P,620K) [J/kg] $40\times10^6<P\leq10^9$ [Pa] HPT(P,TMLP(P))≤H≤ HPT(P,470K) [J/kg] 0.11719≤P≤400 [bar] HPT(P,TMLP(P))≤H≤ HPT(P,346.85°C) [J/kg] 400<P≤10000 [bar] HPT(P,TMLP(P))≤H≤ HPT(P,196.85°C) [J/kg]
6H	TPH2(P,H)		
65	TPS(P,S)	TPS∗: Temperature [K], [°C] P∗: Pressure [Pa], [bar] S: Specific Entropy [J/(kg·K)]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] SPT(P,TMLP(P))≤S≤ SPT(P,620K) [J/(kg·K)] $40\times10^6<P\leq10^9$ [Pa] SPT(P,TMLP(P))≤S≤ SPT(P,470K) [J/(kg·K)] 0.11719≤P≤400 [bar] SPT(P,TMLP(P))≤S≤ SPT(P,346.85°C) [J/(kg·K)] 400<P≤10000 [bar] SPT(P,TMLP(P))≤S≤ SPT(P,196.85°C) [J/(kg·K)]
6S	TPS2(P,S)		
98	TPSEUP(P)	TPSEUP∗: Pseudo Boiling Point [K], [°C] P∗: Pressure [Pa], [bar]	$4.595\times10^6<P\leq50\times10^6$ [Pa] 45.95<P≤500 [bar]
70	TPV(P,V)	TPV∗: Temperature [K], [°C] P∗: Pressure [Pa], [bar] V: Specific Volume [m^3/kg]	$11.719\times10^3\leq P\leq40\times10^6$ [Pa] VPT(P,TMLP(P))≤V≤ VPT(P,620K) [m^3/kg] $40\times10^6<P\leq10^9$ [Pa] VPT(P,TMLP(P))≤V≤ VPT(P,470K) [m^3/kg] 0.11719≤P≤400 [bar] VPT(P,TMLP(P))≤V≤ VPT(P,346.85°C) [m^3/kg] 400<P≤10000 [bar] VPT(P,TMLP(P))≤V≤ VPT(P,196.85°C) [m^3/kg]
41	TRPL('A')	TRPL∗: Properties at Triple Point P∗: 'A'='P': 11.719×10^3 [Pa],0.11719 [bar] Pressure T∗: 'A'='T': 90.68 [K],−182.47 [°C] Temperature	one of 'P' and 'T'
100	TSBP(P)		
40	TSP(P)	TSP∗: Saturation Temperature [K], [°C] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
74	TSPD(P)		
75	TSPDD(P)		
42	UPD(P)	UPD: Specific Internal Energy of Saturated Liquid [J/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
43	UPDD(P)	UPDD: Specific Internal Energy of Saturated Vapor [J/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3\leq P\leq4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
79	UPS(P,S)		
44	UPT(P,T)	UPT: Specific Internal Energy [J/kg] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3 \le P \le 40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6 < P \le 10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
45	UPX(P,X)	UPX: Specific Internal Energy of Mixture [J/kg] P∗: Pressure [Pa], [bar] X: Dryness Fraction [–]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar] 0≤X≤1.0 [–]
46	UTD(T)	UTD: Specific Internal Energy of Saturated Liquid [J/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
47	UTDD(T)	UTDD: Specific Internal Energy of Saturated Vapor [J/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
48	UTX(T,X)	UTX: Specific Internal Energy of Mixture [J/kg] T∗: Temperature [K], [°C] X: Dryness Fraction [–]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C] 0≤X≤1.0 [–]
49	VPD(P)	VPD: Specific Volume of Saturated Liquid [m^3/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
50	VPDD(P)	VPDD: Specific Volume of Saturated Vapor [m^3/kg] P∗: Pressure [Pa], [bar]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar]
80	VPS(P,S)		
51	VPT(P,T)	VPT: Specific Volume [m^3/kg] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3 \le P \le 40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6 < P \le 10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]
52	VPX(P,X)	VPX: Specific Volume of Mixture [m^3/kg] P∗: Pressure [Pa], [bar] X: Dryness Fraction [–]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] 0.11719≤P≤45.95 [bar] 0≤X≤1.0 [–]
53	VTD(T)	VTD: Specific Volume of Saturated Liquid [m^3/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
54	VTDD(T)	VTDD: Specific Volume of Saturated Vapor [m^3/kg] T∗: Temperature [K], [°C]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C]
55	VTX(T,X)	VTX: Specific Volume of Mixture [m^3/kg] T∗: Temperature [K], [°C] X: Dryness Fraction [–]	90.68≤T≤190.555 [K] −182.47≤T≤−82.595 [°C] 0≤X≤1.0 [–]
8E	WPD(P)		
8F	WPDD(P)		
83	WPT(P,T)	WPT: Velocity of Sound [m/s] P∗: Pressure [Pa], [bar] T∗: Temperature [K], [°C]	$11.719\times10^3 \le P \le 40\times10^6$ [Pa] TMLP(P)≤T≤620 [K] $40\times10^6 < P \le 10^9$ [Pa] TMLP(P)≤T≤470 [K] 0.11719≤P≤400 [bar] TMLP(P)≤T≤346.85 [°C] 400<P≤10000 [bar] TMLP(P)≤T≤196.85 [°C]

Table II–2.23–1 Methane Function (cont'd)

No.	Name of Function	Function and Argument(s)	Range of Argument(s)
8G	WTD(T)		
8H	WTDD(T)		
56	XPH(P,H)	XPH: Dryness Fraction [–] P∗: Pressure [Pa], [bar] H: Specific Enthalpy of Mixture [J/kg]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] $0.11719 \le P \le 45.95$ [bar] HPD(P)≤H≤HPDD(P) [J/kg]
57	XPS(P,S)	XPS: Dryness Fraction [–] P∗: Pressure [Pa], [bar] S: Specific Entropy of Mixture [J/(kg·K)]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] $0.11719 \le P \le 45.95$ [bar] SPD(P)≤S≤SPDD(P) [J/(kg·K)]
58	XPU(P,U)	XPU: Dryness Fraction [–] P∗: Pressure [Pa], [bar] U: Specific Internal Energy of Mixture [J/kg]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] $0.11719 \le P \le 45.95$ [bar] UPD(P)≤U≤UPDD(P) [J/kg]
59	XPV(P,V)	XPV: Dryness Fraction [–] P∗: Pressure [Pa], [bar] V: Specific Volume of Mixture [m^3/kg]	$11.719\times10^3 \le P \le 4.595\times10^6$ [Pa] $0.11719 \le P \le 45.95$ [bar] VPD(P)≤V≤VPDD(P) [m^3/kg]
60	XTH(T,H)	XTH: Dryness Fraction [–] T∗: Temperature [K], [°C] H: Specific Enthalpy of Mixture [J/kg]	$90.68 \le T \le 190.555$ [K] $-182.47 \le T \le -82.595$ [°C] HTD(T)≤H≤HTDD(T) [J/kg]
61	XTS(T,S)	XTS: Dryness Fraction [–] T∗: Temperature [K], [°C] S: Specific Entropy of Mixture [J/(kg·K)]	$90.68 \le T \le 190.555$ [K] $-182.47 \le T \le -82.595$ [°C] STD(T)≤S≤STDD(T) [J/(kg·K)]
62	XTU(T,U)	XTU: Dryness Fraction [–] T∗: Temperature [K], [°C] U: Specific Internal Energy of Mixture [J/kg]	$90.68 \le T \le 190.555$ [K] $-182.47 \le T \le -82.595$ [°C] UTD(T)≤U≤UTDD(T) [J/kg]
63	XTV(T,V)	XTV: Dryness Fraction [–] T∗: Temperature [K], [°C] V: Specific Volume of Mixture [m^3/kg]	$90.68 \le T \le 190.555$ [K] $-182.47 \le T \le -82.595$ [°C] VTD(T)≤V≤VTDD(T) [m^3/kg]