

Klea® 407C Data Sheet – SI Units

Physical Property Data for Klea® 407C

Property		Units	Value
Bubble Point	1 (atm)	°C	-44.0
Dew Point	(1atm)	°C	-36.8
Bubble Point Pressure	(25°C)	Bara	11.9
Estimated Critical Temperature		°C	86
Latent Heat of Vaporisation	(T _m =25°C)	kJ/kg	193.9
Trouton's Constant		kJ/kg.K	1.08
Coefficient of Volumeric Thermal Expansion	(LIQ,0-20°C)	K ⁻¹	0.0037
Density (saturated vapour)	@(1atm)	kg/m ³	4.57

Equation of State (Martin-Hou)

$$Pr = \frac{XT_r}{V_r - B} + \sum_{i=1, 4} \frac{(A_i + B_i T_r + C_i \exp(-KT_r))}{(V_r - B)^{(i+1)}}$$

Where :

$$T_r = T/T_c, P_r = P/P_c, V_r = V/V_c = V \times RHO_c$$

$$X = 3.649216$$

$$B = 0.0$$

$$K = 5.475$$

$$T_c, P_c, RHO_c = 359.2(K), 46.52(\text{bara}), 490(\text{kg/m}^3)$$

$$A_1, B_1, C_1 = -11.576411672, 6.9516394791, -12.992106787$$

$$A_2, B_2, C_2 = 9.108927853, -5.8551996466, -101.85219827$$

$$A_3, B_3, C_3 = -4.2674117378, 0.0, 0.0$$

$$A_4, B_4, C_4 = 17.976354749, 0.0, -1992.5643203$$

Applicable Range: 0-30 bara, 0-100K superheat

Saturation Envelope — Bubble Point Temperatures

$$\text{Bubble Point Temperature } (T_b) = A + BX + CX^2 + DX^3$$

T_b = Bubble Point Temperature in K

$$X = \text{Ln}(P)$$

P = Pressure in bara

$$A = 228.9073$$

$$B = 20.99838$$

$$C = 1.855389$$

$$D = 0.37783$$

Saturation Envelope — Dew Point Temperatures

$$\text{Bubble Point Temperature } (T_d) = A + BX + CX^2 + DX^3$$

T_d = Dew Point Temperature in K

$X = \ln(P)$

P = Pressure in bara

A = 236.0528

B = 20.37606

C = 2.17732

D = 0.250429

Saturation Envelope — Mid Point Temperatures

$$\text{Mid Point Temperature } (T_m) = A + BX + CX^2 + DX^3$$

T_m = Average of Dew and Bubble Point Temperatures in K

$X = \ln(P)$

P = Pressure in bara

A = 232.4902

B = 20.64264

C = 2.047962

D = 0.3082967

Latent Heat Vaporisation

$$DH_{\text{vap}} = A + BX + CX^2 + DX^3 + EX^4$$

Where $x = (1 - (T_m/T_c))^{(1/3)}$

A = 218.8494

B = -1683.2244

C = 6325.3877

D = -8231.939

E = 3884.46

T_m = Mid point temperature K

T_c = Critical Temperature K

$T_c = 359.2\text{K}$

$DH_{\text{vap}} = \text{kJ/kg}$

Ideal Gas Heat Capacity

$$C_p (\text{ideal}) = A + BT + CT^2 + D/T$$

A = -0.083843

B = 0.00321516

C = -1.94062E-06

D = 36.35655

T = Temperature K

$C_p (\text{ideal}) \text{ kJ/kg.K}$

Saturated Liquid Enthalpy

$$H_{liq} = A + BX + CX^2 + DX^3 + EX^4$$

$$\text{where } x = (1 - (T_b/T_c))^{(1/3)}$$

A = 131.7716	T_b = Bubble Point Temperature K
B = 1224.77	T_c = Critical Temperature K
C = -4212.446	$T_c = 359.2$ K
D = 5045.1332	H_{liq} = kJ/kg
E = -2528.57	

Liquid Density

$$d_{liq} = A + BX + CX^2 + DX^3 + EX^4$$

$$\text{Where } x = (1 - (T_b/T_c))^{(1/3)}$$

A = -650.4582	T_b = Bubble Point Temperature K
B = 7861.656	T_c = Critical Temperature K
C = -15312.36	$T_c = 359.2$ K
D = 15705.71	d_{liq} = kJ/m ³
E = -5734.191	

Liquid Viscosity

$$\ln(\mu_{liq}) = A + B/T_m + CT_m + D/T^2$$

A = 15.66442	T_m = Mid point temperature K
B = -1283.053	μ_{liq} cP
C = -0.061504	
D = 5.81907E-5	

Liquid Thermal Conductivity

$$K_{liq} = A + BT_m + CT_m^2 + DT_m$$

A = 0.11898	T = Mid point temperature K
B = 0.0	K_{liq} W/m K
C = -6.71955E-7	
D = 9.039943	

Saturated Vapour Density

$$d_{vap} = A + BX + CX^2 + DX^3 + EX^4$$

$$\text{Where } x = (1 - (T_d/T_c))^{(1/3)}$$

A = 315.4088	T_d = Dew Point Temperature K
B = 343.5035	T_c = Critical Temperature K
C = -3883.4765	$T_c = 359.2$ K
D = 5587.518	d_{vap} = kg/m ³
E = -2353.113	

Vapour Viscosity (Ideal Vapour)

$$\mu_{\text{vap}} = A + BT + CT^2$$

$$A = -0.0013724$$

$$B = 5.359E-5$$

$$C = -1.53122E-8$$

$$T_m = \text{Temperature K}$$

$$\mu_{\text{vap}} \text{ cP}$$

Vapour Viscosity (Saturated Vapour)

$$\mu_{\text{vap}} = A + BT_d + CT_d^2 + D/T_d$$

$$A = 0.375554$$

$$B = -1.36789E-3$$

$$C = 1.77845E-6$$

$$D = -33.3749$$

$$T_d = \text{Dew point temperature K}$$

$$\mu_{\text{vap}} \text{ cP}$$

Vapour Thermal Conductivity (Ideal Vapour)

$$K_{\text{gas}} = A + BT + CT^2$$

$$A = -3.5565E-3$$

$$B = 3.5848E-5$$

$$C = 7.74837E-8$$

$$T_d = \text{Temperature K}$$

$$K_{\text{gas}} \text{ W/m.K}$$

Saturated Vapour Thermal Conductivity

$$K_{\text{gas}} = A + BT_d + CT_d^2 + D/T_d$$

$$A = 0.42538$$

$$B = -1.56445E-3$$

$$C = 2.08498E-6$$

$$D = -38.54645$$

$$T_d = \text{Temperature K}$$

$$K_{\text{gas}} \text{ W/m.K}$$

Speed of Sound (Saturated Vapour)

$$\mu_{\text{vap}} = A + BT_d + CT_d^2 + D/T_d$$

$$A = -869.9$$

$$B = 4.927595$$

$$C = -7.5007E-3$$

$$D = 68779.76$$

$$T_d = \text{Dew point temperature K}$$

$$\mu_{\text{vap}} = \text{m/s}$$

Saturation Envelope

Pressure	Temperatures		
	Bara	BUB pnt	MID pnt
1.0	-44.2	-40.7	-37.1
2.0	-28.7	-25.3	-21.8
3.0	-18.4	-15.1	-11.8
4.0	-10.6	-7.3	-4.0
6.0	1.5	4.7	7.8
8.0	10.8	13.9	16.9
10.0	18.6	21.5	24.4
12.0	25.2	28.0	30.8
15.0	33.7	36.4	39.0
20.0	45.5	47.8	50.2
25.0	55.2	57.3	59.4
30.0	63.5	65.4	67.2

Liquid Properties

Temp °C	Liquid Density Kg/M ³	Liquid Enthalpy kJ/kg	Latent Heat kJ/kg	Liquid Viscosity cP	Liq Thermal Conductivity W/m.K
-50.0	1399	30.7	258.9	0.40	0.126
-40.0	1369	44.5	251.3	0.36	0.121
-30.0	1337	58.2	243.7	0.32	0.116
-20.0	1305	72.0	235.9	0.29	0.112
-10.0	1271	85.9	227.8	0.25	0.107
0.0	1235	100.0	219.2	0.23	0.102
10.0	1197	114.0	209.9	0.20	0.097
20.0	1157	129.0	199.6	0.18	0.092
25.0	1135	137.0	193.9	0.16	0.090
30.0	1113	145.0	187.8	0.15	0.087
40.0	1063	162.0	174.1	0.14	0.082
50.0	1005	180.0	157.7	0.12	0.077

For Liquid Density and Liquid Enthalpy the bubble point temperatures are used. For Latent Heat, Liquid Viscosity and Liquid Thermal Conductivity mid point temperatures are used.

Ideal Gas Properties

Temp °C	ID Gas Cp kJ/kg.K	ID Gas Viscosity Cp	ID Gas Therm Cond W/m.K
-50.0	0.700	0.0098	0.0083
-40.0	0.716	0.0103	0.0090
-30.0	0.733	0.0108	0.0097
-20.0	0.749	0.0112	0.0105
-10.0	0.766	0.0117	0.0112
0.0	0.783	0.0121	0.0120
10.0	0.799	0.0126	0.0128
20.0	0.816	0.0130	0.0136
25.0	0.824	0.0132	0.0140
30.0	0.832	0.0135	0.0144
40.0	0.849	0.0139	0.0153
50.0	0.865	0.0143	0.0161

Saturated Vapour Properties

Temp °C	Sat Vap Density Kg/m ³	Sat Vap Viscosity cP	Sat Vap Therm Cond W/M.K	Speed of Sound m/s
-50.0	-	0.0093	0.0074	164.0
-40.0	3.94	0.0102	0.0086	166.0
-30.0	6.17	0.0108	0.0097	168.0
-20.0	9.31	0.0114	0.0107	169.0
-10.0	13.57	0.0119	0.0116	169.0
0.0	19.24	0.0124	0.0125	168.0
10.0	26.67	0.0130	0.0134	167.0
20.0	36.35	0.0135	0.0144	165.0
25.0	42.24	0.0139	0.0150	163.0
30.0	48.95	0.0142	0.0156	161.0
40.0	65.45	0.0150	0.0168	157.0
50.0	87.38	0.0160	0.0183	152.0

The temperatures used are Dew Point Temperatures

The correlations in this document should not be used outside the applicable ranges quoted.
Please contact Mexichem for further advice.

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