

Klea® 407A Data Sheet – SI Units

Physical Property Data for Klea® 407A

Property		Units	Value
Bubble Point	1 (atm)	°C	-45.5
Dew Point	(1atm)	°C	-38.9
Bubble Point Pressure	(25°C)	bara	12.6
Estimated Critical Temperature		°C	83
Latent Heat of Vaporisation	(25°C)	kJ/kg	178.8
Trouton's Constant		kJ/kg.K	1.05
Volumetric Coefficient of Thermal Expansion	(LIQ,0-20°C)	K ⁻¹	0.0034
Saturated Vapour Density	@(1atm)	kg/m ³	3.94

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 :

$$T_r = T/T_c, P_r = P/P_c, V_r = V/V_c, V_c = 1/\rho_c$$

$$X = 3.61723$$

$$B = 0.0$$

$$K = 5.475$$

$$T_c, P_c, \rho_c = 355.9(\text{K}), 45.41(\text{bara}), 500.2(\text{kg/m}^3)$$

$$A_1, B_1, C_1 = -11.33191275, 6.8075753325, -12.83650902$$

$$A_2, B_2, C_2 = 9.1343011237, -5.9497618996, -107.94947217$$

$$A_3, B_3, C_3 = -3.925317714, 0.0, 0.0$$

$$A_4, B_4, C_4 = 0.0, 13.694712938, -1247.8526238$$

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

$$X = \ln(P)$$

P = Pressure in bara

$$A = 227.327$$

$$B = 20.90959$$

$$C = 1.827666$$

$$D = 0.3768882$$

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

$$A = 233.9652$$

$$B = 20.18983$$

$$C = 2.151637$$

$$D = 0.2567243$$

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

$$A = 230.6465$$

$$B = 20.54803$$

$$C = 1.990873$$

$$D = 0.316577$$

Latent Heat Vaporisation

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

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

$$A = -114.4811$$

$$B = 797.7376$$

$$C = -654.4821$$

$$D = 325.8758$$

$$E = 0$$

T_m = Mid point temperature K

T_c = Critical Temperature K

$T_c = 355.9$ K

$\Delta H_{\text{vap}} = \text{kJ/kg}$

Ideal Gas Heat Capacity

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

$$A = 0.0$$

$$B = 0.002918$$

$$C = -1.614E-6$$

$$D = 28.03$$

T = Temperature K

$C_p(\text{ideal}) = \text{Ideal gas heat capacity kJ/kg.K}$

Saturated Liquid Enthalpy

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

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

A = 351.06499	T_b = Bubble Point Temperature K
B = -471.4948	T_c = Critical Temperature K
C = 468.8684	$T_c = 355.9$ K
D = -5953497	H_{liq} = Enthalpy kJ/kg
E = 0	

Liquid Density

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

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

A = -356.2546	T_b = Bubble Point Temperature K
B = 5198.905	T_b = Bubble Point Temperature K
C = -6673.922	T_c = Critical Temperature K
D = -595.3497	$T_c = 355.9$ K
E = 0	ρ_{liq} = liquid density kg/m ³

Liquid Viscosity

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

A = 3.148664	T_m = Mid Point Temperature K
B = -181.9098	μ_{liq} = Viscosity cP
C = -0.014712	

Liquid Thermal Conductivity

$$K_{liq} = A + BC + CX^2 + DX^3$$

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

A = 0.060963	T_m = Mid Point Temperature K
B = -0.03076	T_c = Critical Temperature K
C = 0.067795	$T_c = 355.9$ K
D = 0.124905	K_{liq} = Thermal Conductivity W/m.K

Saturated Vapour Density

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

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

A = 543.1144	T _d = Dew Point Temperature K
B = -1224.948	T _c = Critical Temperature K
C = 342.9944	T _c = 355.9 K
D = 440.7539	ρ _{vap} = Density in kg/m ³
E = 0.0	

Vapour Viscosity (Ideal Vapour)

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

A = -0.001349	T = Temperature K
B = 5.3791E-5	μ _{vap} = Viscosity cP
C = 1.51515E-8	

Vapour Viscosity (Saturated Vapour)

$$\mu_{\text{vap}} = A + BT_d + CT_d^2 + D/T_d^3$$

A = -0.079123	T _d = Dew Point Temperature K
B = 9.5884E-4	μ _{vap} = Viscosity cP
C = -3.53236E-6	
D = 4.57707E-9	

Vapour Thermal Conductivity (Ideal Vapour)

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

A = -0.004366	T = Temperature K
B = 4.3505E-5	K _{gas} = Thermal Conductivity W/m.K
C = 6.29925E-8	

Saturated Vapour Thermal Conductivity

$$K_{\text{gas}} = A + BT_d + CT_d^2 + D/T_d^3$$

A = -0.096854	T _d = Dew Point Temperature K
B = 1.10069E-3	K _{gas} = Thermal Conductivity W/m.K
C = -3.98761E-6	
D = 5.2215E-9	

Speed of Sound (Saturated Vapour)

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

A = -912.33

B = 5.1515

C = -7.897E-3

D = 70553

T_d = Dew Point Temperature K

μ_{vap} = Speed of Sound m/s

Saturation Envelope

Pressure	Temperatures		
	Bara	BUB pnt	MID pnt
1.0	-45.8	-42.5	-39.2
2.0	-30.3	-27.2	-24.1
3.0	-20.1	-17.1	-14.1
4.0	-12.3	-9.3	-6.4
6.0	-0.3	2.5	5.4
8.0	8.9	11.7	14.4
10.0	16.6	19.2	21.8
12.0	23.2	25.7	28.2
15.0	31.7	34.0	36.4
20.0	43.4	45.4	47.5
25.0	53.0	54.8	56.7
30.0	61.3	62.9	64.5

Liquid Properties

Temp °C	Liquid Density Kg/m ³	Enthalpy kJ/kg	Latent Heat kJ/kg	Viscosity cP	Thermal Conductivity W/m.K
-50.0	1419	32.6	242.2	0.39	0.121
-40.0	1386	45.7	235.5	0.35	0.116
-30.0	1353	58.9	228.4	0.31	0.111
-20.0	1319	72.4	221.0	0.27	0.106
-10.0	1284	86.0	213.0	0.24	0.102
0.0	1247	100.0	204.4	0.22	0.097
10.0	1208	114.3	194.9	0.19	0.092
20.0	1165	129.1	184.5	0.17	0.087
25.0	1143	136.8	178.8	0.16	0.085
30.0	1119	144.6	172.7	0.15	0.082
40.0	1064	161.1	158.9	0.13	0.077
50.0	999	179.0	142.3	0.11	0.072

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	Heat Capacity kJ/kg.K	Viscosity cP	Therm Cond W/m.K
-50.0	0.696	0.0099	0.0085
-40.0	0.713	0.0104	0.0092
-30.0	0.729	0.0108	0.0099
-20.0	0.746	0.0113	0.0107
-10.0	0.763	0.0118	0.0114
0.0	0.779	0.0122	0.0122
10.0	0.796	0.0127	0.0130
20.0	0.812	0.0131	0.0138
25.0	0.821	0.0133	0.0142
30.0	0.829	0.0136	0.0146
40.0	0.845	0.0144	0.0154
50.0	0.861	0.0145	0.0163

Saturated Vapour Properties

Temp °C	Density Kg/m ³	Viscosity cP	Therm Cond W/m.K	Speed of Sound m/s
-50.0	3.48	0.0098	0.0082	160.2
-40.0	4.77	0.0104	0.0092	162.1
-30.0	7.09	0.0110	0.0101	163.5
-20.0	10.6	0.0115	0.0109	164.4
-10.0	15.5	0.0120	0.0118	164.5
0.0	22.0	0.0125	0.0127	163.9
10.0	30.6	0.0131	0.0136	162.4
20.0	41.8	0.0137	0.0147	159.9
25.0	48.5	0.0141	0.0152	158.2
30.0	56.2	0.0144	0.0158	156.3
40.0	75.2	0.0153	0.0171	151.8
50.0	101	0.0163	0.0186	146.1

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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