Klea® 407A Physical Property Data Sheet – British Units

Klea® 407A is a blend of HFCs 32, 125 and 134a designed for low-temperature applications in new refrigeration equipment and also for retrofit in many existing systems. For information on the properties and safe handling of Klea® 407A, please refer to the Material Safety Data Sheet supplied with the product or available upon request.

The data presented here represents a combination of measurements and estimation. Mexichem does not guarantee its accuracy and reserves the right to update the information in the future, in the light of the best available knowledge at the time.

Physical Property Data for Klea® 407A

Property		Units	Value
Bubble Point	(1atm)	°F	-49.9
Dew Point	(1atm)	°F	-38.0
Bubble Point Pressure	(70°F)	psia	163.2
Estimated Critical Temperature		°F	181.4
Latent Heat Vaporization	(Tm=70°F)	Btu/lb	78.92
Trouton's Constant		Btu/lb R	0.251
Coeff. Vol. Therm. Exp.	(liquid, 32-68°F)	$°F^{-1}$	0.00178
Density (sat vapor) at 1atm		lb/ft^3	0.246

Equation of State (Martin-Hou)

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

$T_r = T/T_c$, $P_r = P/P_c$, $Vr = V/V_c$

B = 0.0
X = 3.61723
K = 5.475

T_c, P_c, V_c = 640.6 R, 658.6 psia. 0.032 cu.ft/lb

A_1, B_1, C_1 = -11.33191275, 6.8075753325, -12.83650902
A_2, B_2, C_2 = 9.1343011237, -5.94976187996, -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: 0-400 psia, 0-180 R superheat
Applicable Range: 0-30 bara, 0-100K superheat

Saturation Envelope — Bubble Point Temperatures

Bubble Point Temperature (T_b) = A + BX + CX^2 + DX^3

T_b = Bubble Point Temperature in °F
X = Ln(P)
P = Pressure in psia

A = - 136.5949
B = 31.7022
C = -1.479621
D = 0.62786

Saturation Envelope — Dew Point Temperatures

Bubble Point Temperature (T_d) = A + BX + CX^2 + DX^3

T_d = Dew Point Temperature in °F
X = Ln(P)
P = Pressure in psia

A = -117.658
B = 26.18071
C = 0
D = 0.475794

Saturation Envelope — Mid Point Temperatures

Mid Point Temperature (T_m) = A + BX + CX^2 + DX^3

T_m = Average of Dew and Bubble Point Temperatures in °F
X = Ln(P)
P = Pressure in psia

A = -126.9154
B = 28.77087
C = -0.696455
D = 0.548338

Latent Heat Vaporization

Dh_{latent} = A + BX + CX^2 + DX^3 + EX^4

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

A = -49.2509
B = 343.1947
C = -281.565
D = 140.195
E = 0 A = -114.4811

T_m= Mid Point Temperature R
T_c = Critical Temperature R
T_c = 640.6 R
dh_{latent} = Btu/lb

Ideal Gas Heat Capacity

C_p (ideal) = A + BT + CT^2 + D/T

A = 0
B = 0.00038745
C = -1.191E-07
D = 12.058506

T = Temperature R
Cp(ideal) = Btu/lb R

Saturated Liquid Enthalpy

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

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

A = 131.38117
B = -202.8418
C = 201.7119
D = -256.1254
E = 0

T_b = Bubble Point Temperature R
T_c = Critical Temperature R
T_c = 640.6 R
h_{liquid} = Btu/lb

Liquid Density

P_{liquid} = A + BX + CX^2 + DX^3 + EX^4

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

A = -22.2403
B = 324.5572
C = -416.6396
D = 249.6117
E = 0

T_b = Bubble Point Temperature R
T_c = Critical Temperature R
T_c = 640.6 R
P_{liquid} = lb/ft3

Liquid Viscosity

ln $(\mu)_{liquid}$ = A + B/T_m + CT_m

A = 3.148664
B = -327.43764
C = -0.0081733

μ_{liquid} = Cp
T_m = Mid Point Temperature R

Liquid Thermal Conductivity

K_{liquid} = A + BX + CX^2 +DX^3

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

A = 0.0352464
B = -0.0177842
C = 0.0391964
D = 0.0722151

T_c = 640.6 R
$K_{(liquid)}$ = Btu/hr.ft.R
T_m= Mid Point Temperature R
T_c = Critical Temperature R

Saturated Vapor Density

$P_{vapor} = A + BX + CX^2 + DX^3 + EX^4$

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

A = 33.90555
B = -76.47105
C = 21.41245
D = 27.51538
E = 0

T_d = Dew Point Temperature R
T_c = Critical Temperature R
T_c = 640.6 R
P_{vapor} = lb/ft3

Vapor Viscosity (Ideal Vapor)

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

A = -0.001349
B = 0.00002988
C = -4.676E-09
T = Temperature

μ_{vapor} = Cp

Vapor Viscosity (Sat Vapor)

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

A = -0.079123
B = 0.00053269
C = -1.09023E-06
D = 7.84820E-10

μ_{vapor} = Cp
T_d = Dew Point Temperature R

Vapor Thermal Conductivity (Ideal Vapor)

$K_{vapor} = A + BT + CT^2$

A = -0.0025242
B = 0.00001397
C = 1.12407E-08

T = Temperature R
K(vapor) = Btu/hr.ft.R

Vapor Thermal Conductivity (Sat Vapor)

$K_{vapor} = A + BT_d + CT_d^2 + D/T_d^3$

A = -0.0559971
B = 0.00035354
C = -7.11567E-07
D = 5.17638E-10

$K_{(vapor)}$ = Btu/hr.ft.R
T_d = Dew Point Temperature R

Speed of Sound (Sat Vapor)

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

A = -2993.2087
B = 9.38958151
C = -0.0079965
D = 416651.575

$\mu_{(vapor)}$ = ft/s
T_d = Dew Point Temperature R

Saturation Envelope

Pressure	Temperatures °F		
psia	BUB pnt	MID pnt	DEW pnt
10.0	-63.8	-57.7	-51.6
14.7	-49.9	-44.0	-38.0
20.0	-38.0	-32.2	-26.4
30.0	-21.2	-15.5	-9.9
50.0	2.4	7.8	13.2
70.0	19.5	24.8	30.1
100.0	39.3	44.4	49.4
150.0	64.1	68.7	73.4
200.0	83.2	87.5	91.8
250.0	99.0	103.0	107.0
300.0	112.6	116.3	120.0
350.0	124.6	127.9	131.3
400.0	135.3	138.4	141.5

Liquid Properties

Temp °F	Liquid Density lb/ft^3	Liquid Enthalpy Btu/lb	Latent Heat Btu/lb	Liquid Viscosity cP	Liq Therm Cond Btu/hr.ft.R
-60	88.83	-6.27	104.5	0.39	0.07
-40	86.55	0	101.3	0.35	0.067
-20	84.23	6.34	97.9	0.3	0.064
0	81.85	12.79	94.3	0.27	0.061
20	79.38	19.36	90.4	0.23	0.058
40	76.77	26.09	86.2	0.2	0.055
60	73.96	33.05	81.4	0.18	0.052
68	72.76	35.91	79.4	0.17	0.05
80	70.84	40.31	76.1	0.15	0.048
100	67.25	48.03	69.8	0.13	0.045
120	62.84	56.46	62.1	0.12	0.042

The temperatures used for liquid density and liquid enthalpy are bubble point temperatures. The rest are mid point temperatures.

Ideal Gas Properties

Temp °F	ID. Gas Heat Cap. Btu/lb R	ID. Gas Viscosity cP	ID. Gas Therm Cond Btu/hr.ft.R
-60.00	0.166	0.0098	0.0049
-40.00	0.170	0.0104	0.0053
-20.00	0.175	0.0109	0.0058
0.00	0.179	0.0114	0.0063
20.00	0.184	0.0119	0.0068
40.00	0.188	0.0124	0.0073
60.00	0.192	0.0129	0.0078
68.00	0.194	0.0131	0.0080
80.00	0.197	0.0134	0.0083
100.00	0.201	0.0139	0.0088
120.00	0.205	0.0144	0.0094

Saturated Vapor Properties

Temp °F	Sat Vap Density Lb/ft^3	Sat Vap Viscosity cP	Sat Vap Therm. Cond Btu/hr.ft.R	Speed of Sound ft/s
-60.00	0.212	0.0097	0.0047	524.7
-40.00	0.298	0.0104	0.0053	531.8
-20.00	0.463	0.0110	0.0059	536.9
0.00	0.721	0.0116	0.0064	539.7
20.00	1.091	0.0122	0.0070	539.4
40.00	1.598	0.0128	0.0076	535.8
60.00	2.278	0.0134	0.0082	528.5
68.00	2.610	0.0137	0.0085	524.5
80.00	3.185	0.0142	0.0089	517.2
100.00	4.402	0.0151	0.0097	501.6
120.00	6.077	0.0162	0.0107	481.4

The Temperatures used are dew point temperatures.

Standard States

Enthalpy (-40°F, liquid = 0)

Entropy (-40°F, liquid = 0)

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