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Liquid Viscosity

Temperature, °F

Liquid Viscosity, Centipoises

*FREON* 11
HFC - 134a
HCFC - 123

*FREON* 12
Vapor Viscosity at Atmospheric Pressure

Temperature, °F

Vapor Viscosity, centipoises

-FREON® 12
-FREON® 11
-HCFC-123
-HFC-134a
Vapor Thermal Conductivity at Atmospheric Pressure

Temperature, °F

Vapor Thermal Conductivity, \( \frac{Btu}{hr \cdot ft \cdot \mathbf{F}} \)

- HFC - 134a
- HCFC - 123
- "FREON" 12
- "FREON" 11
Equations for Property Estimation

**English Units**

The measured data has been curve-fitted to obtain the following equations for estimation of properties within the ranges specified.

**Liquid Viscosity in cP**

- **HCFC-123**: \( \mu_f = -0.000000133 T^3 + 0.00005259 T^2 - 0.0079787 T + 0.79566 \) \((-70 \leq T \leq 200^\circ F)\)
- **HFC-134a**: \( \mu_f = -0.0000000376 T^3 + 0.00001575 T^2 - 0.00292 T + 0.346317 \)

**Liquid Thermal Conductivity in Btu/hr ft °F**

- **HCFC-123**: \( k_f = 0.0548 - 0.000104 T \) \((-76 \leq T \leq 248^\circ F)\)
- **HFC-134a**: \( k_f = 0.06041 - 0.000166 T \) \((-76 \leq T \leq 140^\circ F)\)

**Liquid Heat Capacity in Btu/lbm °F**

- **HCFC-123**: \( c_p = 0.2016 + 0.0004125 T \) \(\text{for } T < 160^\circ F\)
  \(c_p = \exp [-580.035 + 119.419 \ln T + \frac{8262.6}{T} - 0.5637 T + 0.000437 T^3]\) \(\text{for } 160 \leq T \leq 350^\circ F\)
- **HFC-134a**: \( c_p = 0.2935 + 0.000729 T \) \(\text{for } T < 170\)
  \(c_p = \exp [9776.1 - 1887.24 \ln T - \frac{168763}{T} + 5.40 T - 0.000334 T^3]\) \(\text{for } 170^\circ F \leq T \leq 210^\circ F\)

**Vapor Viscosity in cP**

- **HCFC-123**: \( \mu_v = 0.00956 + 0.0000179 T \) \(100 \leq T \leq 300^\circ F\)
- **HFC-134a**: \( \mu_v = 0.010338 + 0.0000214 T \) \(100 \leq T \leq 300^\circ F\)

**Vapor Thermal Conductivity in Btu/Lb ft °F**

- **HCFC-123**: \( k_v = 0.004465 + 0.000025 T \) \(104 \leq T \leq 248^\circ F\)
- **HFC-134a**: \( k_v = 0.006006 + 0.000031 T \) \(32 \leq T \leq 248^\circ F\)
Saturated Liquid Heat Capacity

Temperature, °C

Freon™ Refrigerants
Vapor Viscosity at Atmospheric Pressure

Vapor Viscosity, μPa·s

Temperature, °C
Vapor Thermal Conductivity at Atmospheric Pressure

Vapor Thermal Conductivity, watts m⁻¹°C

Temperature, °C

HFC - 134a
HCFC - 123
"FREON" 12
"FREON" 11
HFC - 134a Vapor Heat Capacity

Saturation Pressure, kPa

Pressure, kPa

Temperature, °C
HCFC - 123 Vapor Heat Capacity

Temperature, °C

Pressure, kPa

Saturation Pressure, kPa
Equations for Property Estimation

**Metric Units**

The measured data has been curve-fitted to obtain the following equations for estimation of properties within the ranges specified.

**Liquid Viscosity in \( \mu \text{Pa's} \)**

- HCFC-123:  \( \mu_l = -0.0007765T^3 + 0.12886T^2 - 9.0295T + 589.72 \quad (-57 \leq T \leq 93^\circ \text{C}) \)
- HFC-134a:  \( \mu_l = -0.0002191T^3 + 0.039304T^2 - 3.6494T + 267.67 \)

**Liquid Thermal Conductivity in W/m°C**

- HCFC-123:  \( k_l = 0.08908 - 0.0003244T \quad (-60 \leq T \leq 120^\circ \text{C}) \)
- HFC-134a:  \( k_l = 0.09537 - 0.000517T \quad (-60 \leq T \leq 60^\circ \text{C}) \)

**Liquid Heat Capacity in kJ/kg °C**

- HCFC-123:  \( c_p = 0.9104 + 0.00257T \quad (\text{for } T < 90^\circ \text{C}) \)
  \[ c_p = \exp[-1515.07 + 354.086 \ln T + \frac{13952.48}{T} - 2.95702 + 0.004074T^2] \]
  \( \quad (\text{for } 90 \leq T \leq 176.7^\circ \text{C}) \)
- HFC-134a:  \( c_p = 1.327 + 0.005509T \quad (\text{for } T \leq 75^\circ \text{C}) \)
  \[ c_p = \exp[1979.525 - 374.95752 \ln T - \frac{24459.904}{T} - 1.62846 + 0.015674T^2] \]
  \( \quad (\text{for } 75^\circ \text{C} < T \leq 100^\circ \text{C}) \)

**Vapor Viscosity in \( \mu \) Pa's**

- HCFC-123:  \( \mu_v = 10.131 + 0.03224T \quad (38 \leq T \leq 149^\circ \text{C}) \)
- HFC-134a:  \( \mu_v = 11.021 + 0.038599T \)

**Vapor Thermal Conductivity in W/m°C**

- HCFC-123:  \( k_v = 0.009171 + 0.000077T \quad (40 \leq T \leq 120^\circ \text{C}) \)
- HFC-134a:  \( k_v = 0.01212 + 0.000096T \quad (0 \leq T \leq 120^\circ \text{C}) \)
For more information on the Freon™ family of refrigerants, or other refrigerant products, visit freon.com or call (800) 235-7882.

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