



Freon™

Refrigerants

Transport Properties of Freon™ 134a (R-134a) and Freon™ 123 (R-123)

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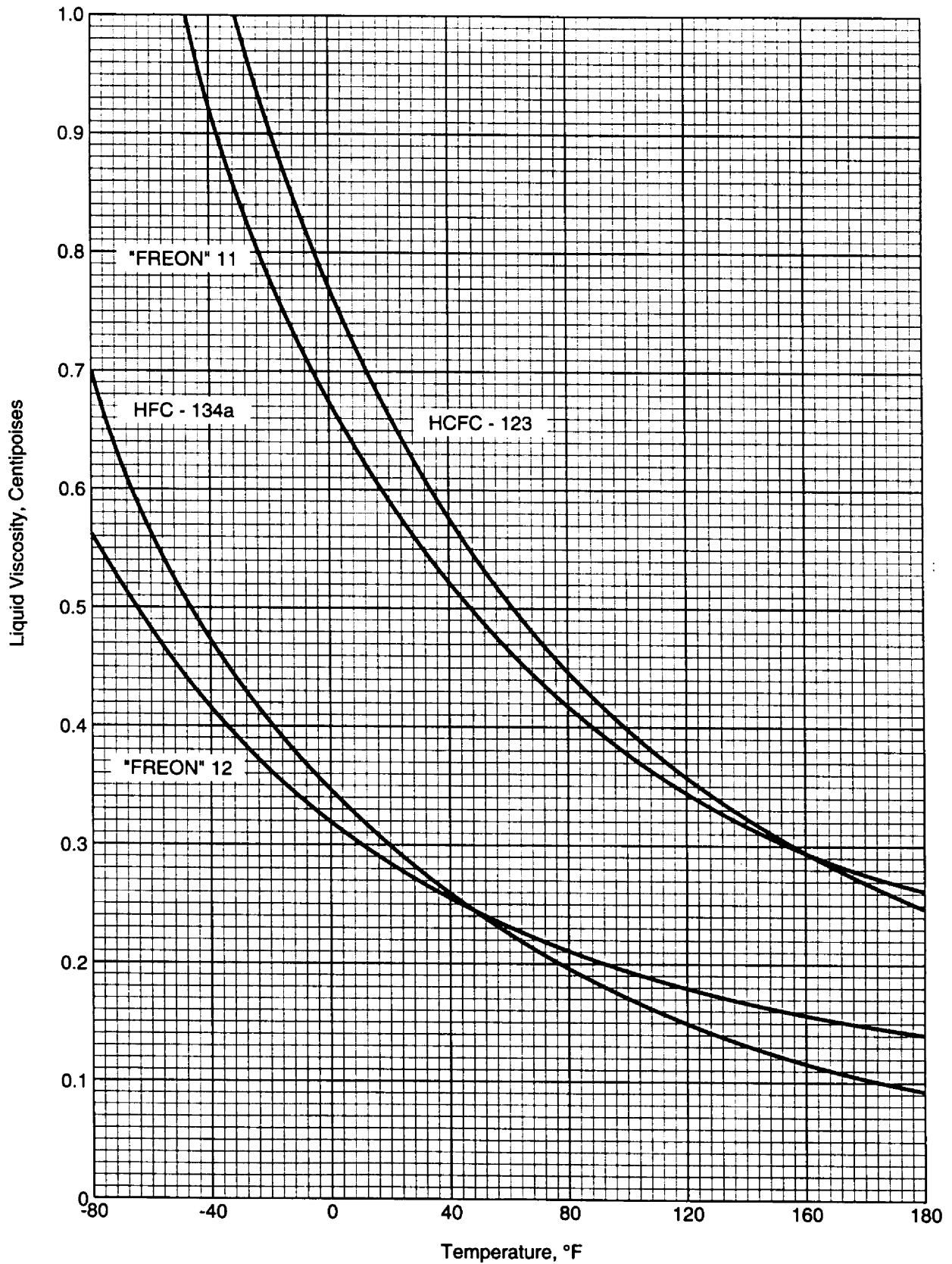
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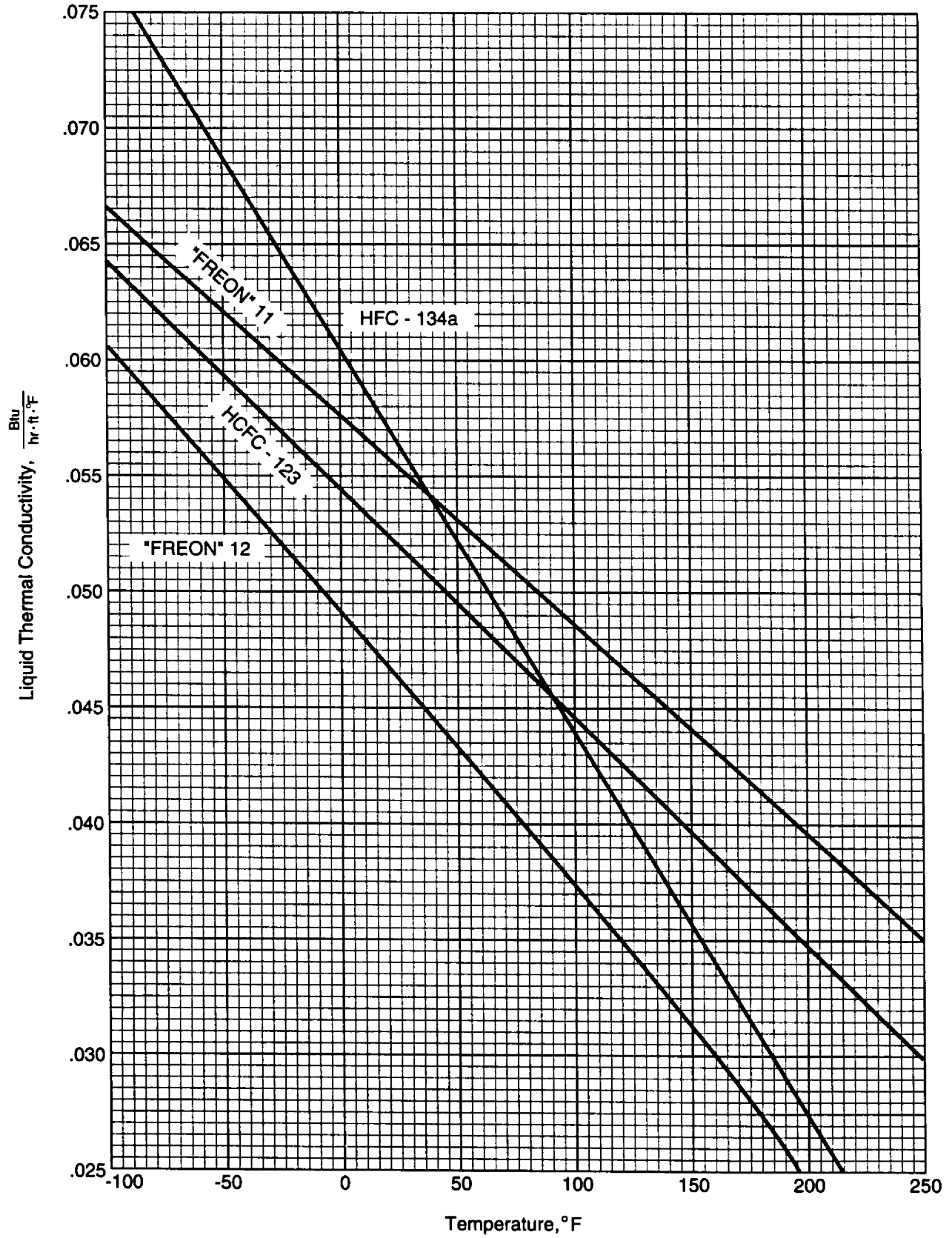


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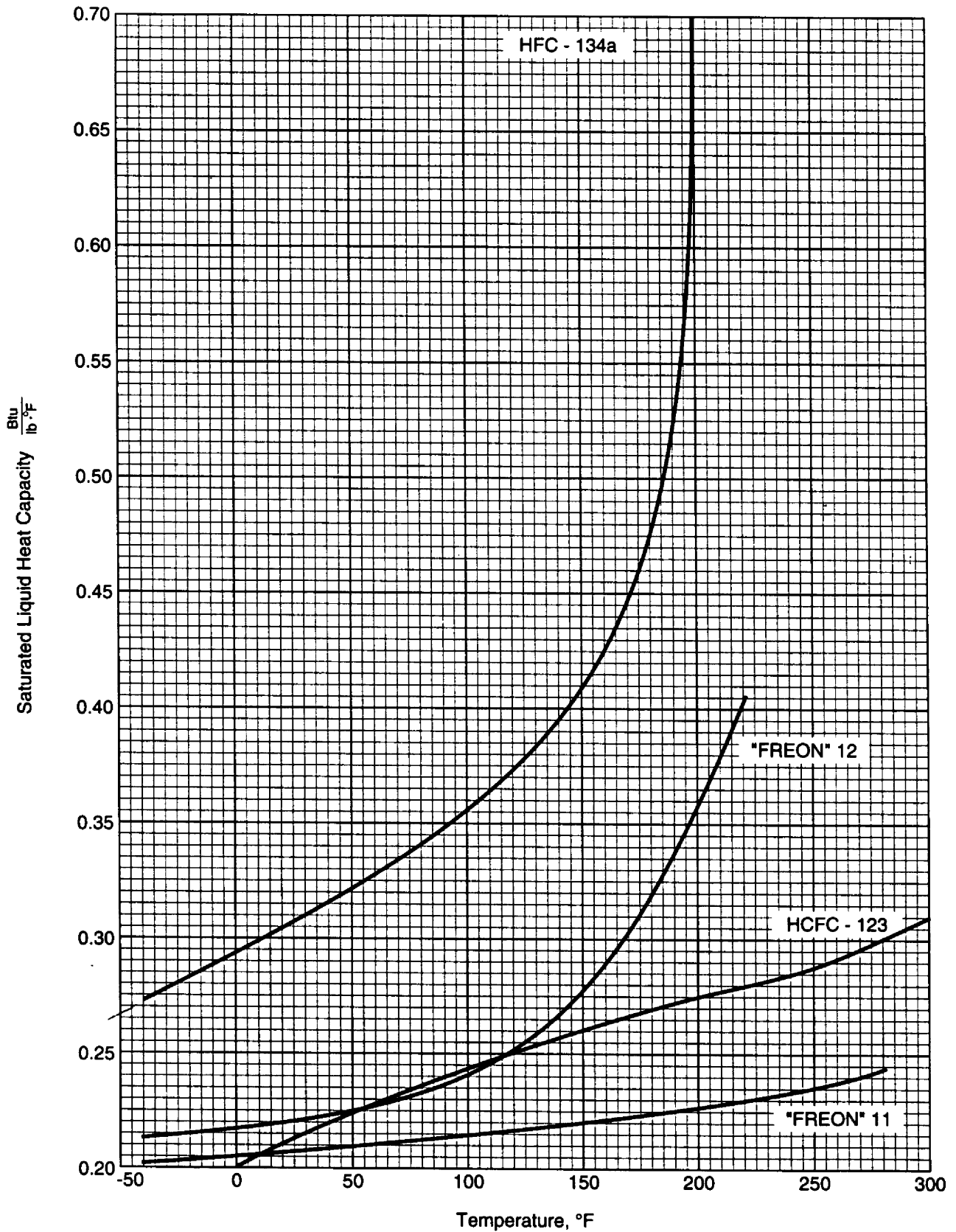
Liquid Viscosity



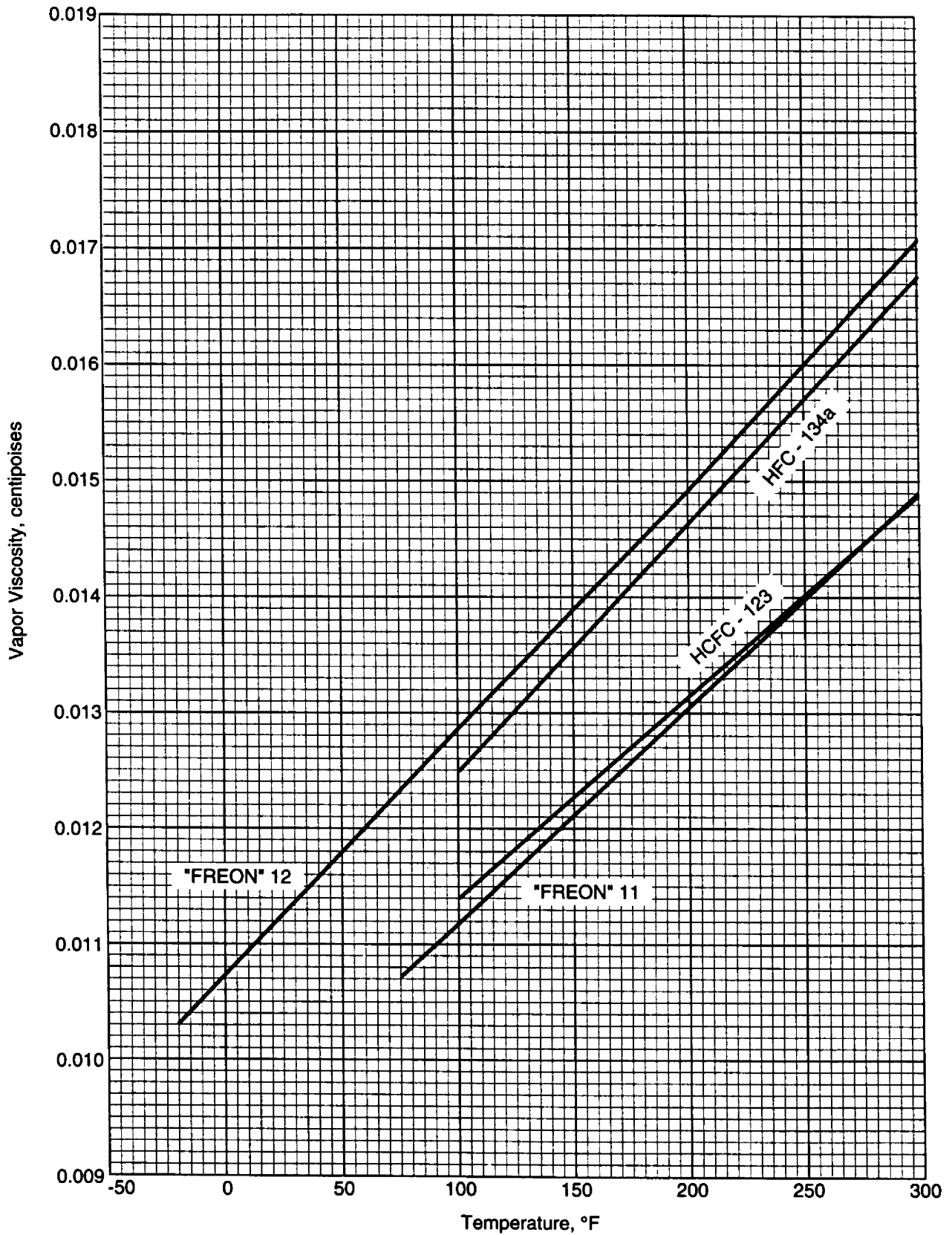
Liquid Thermal Conductivity



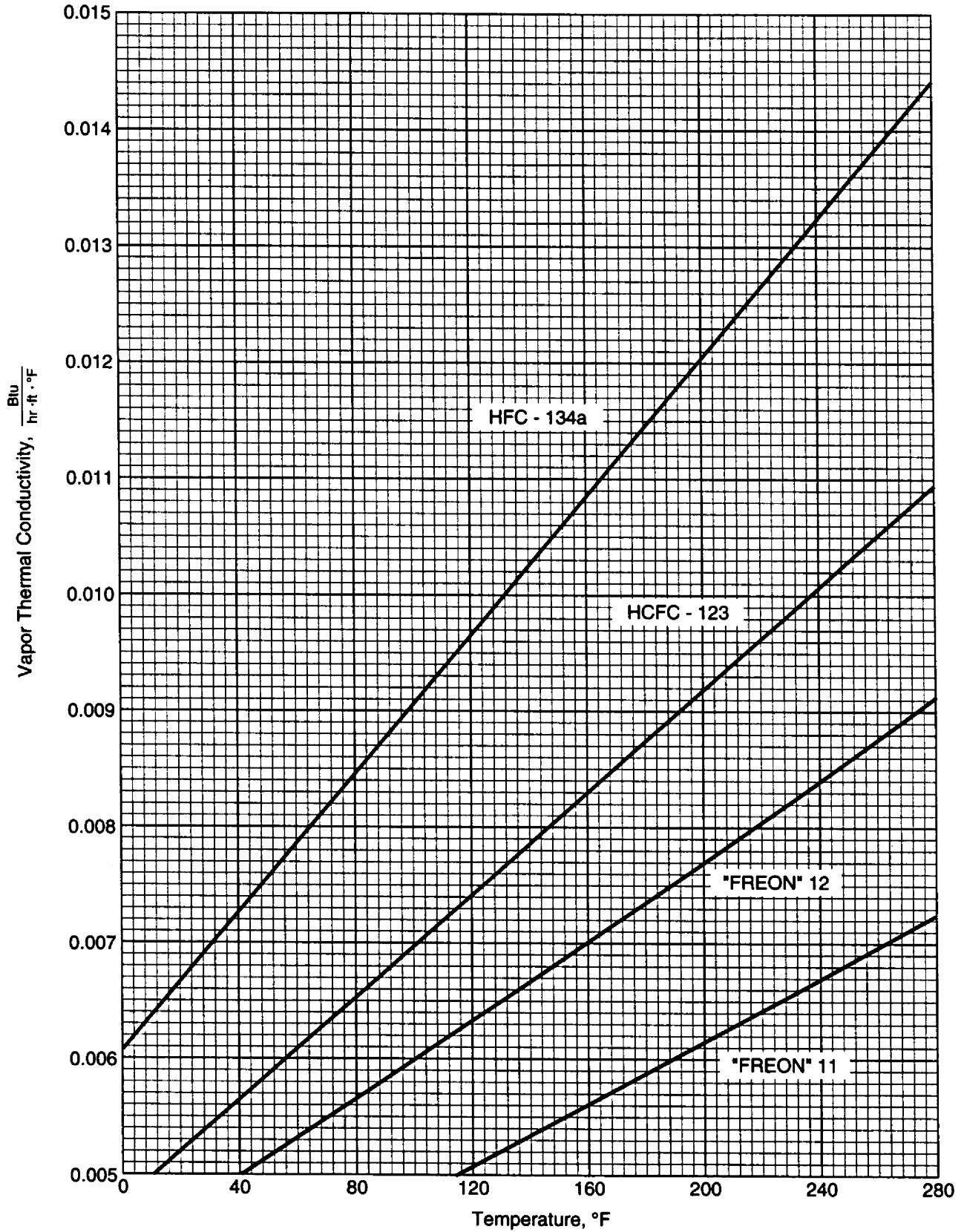
Saturated Liquid Heat Capacity



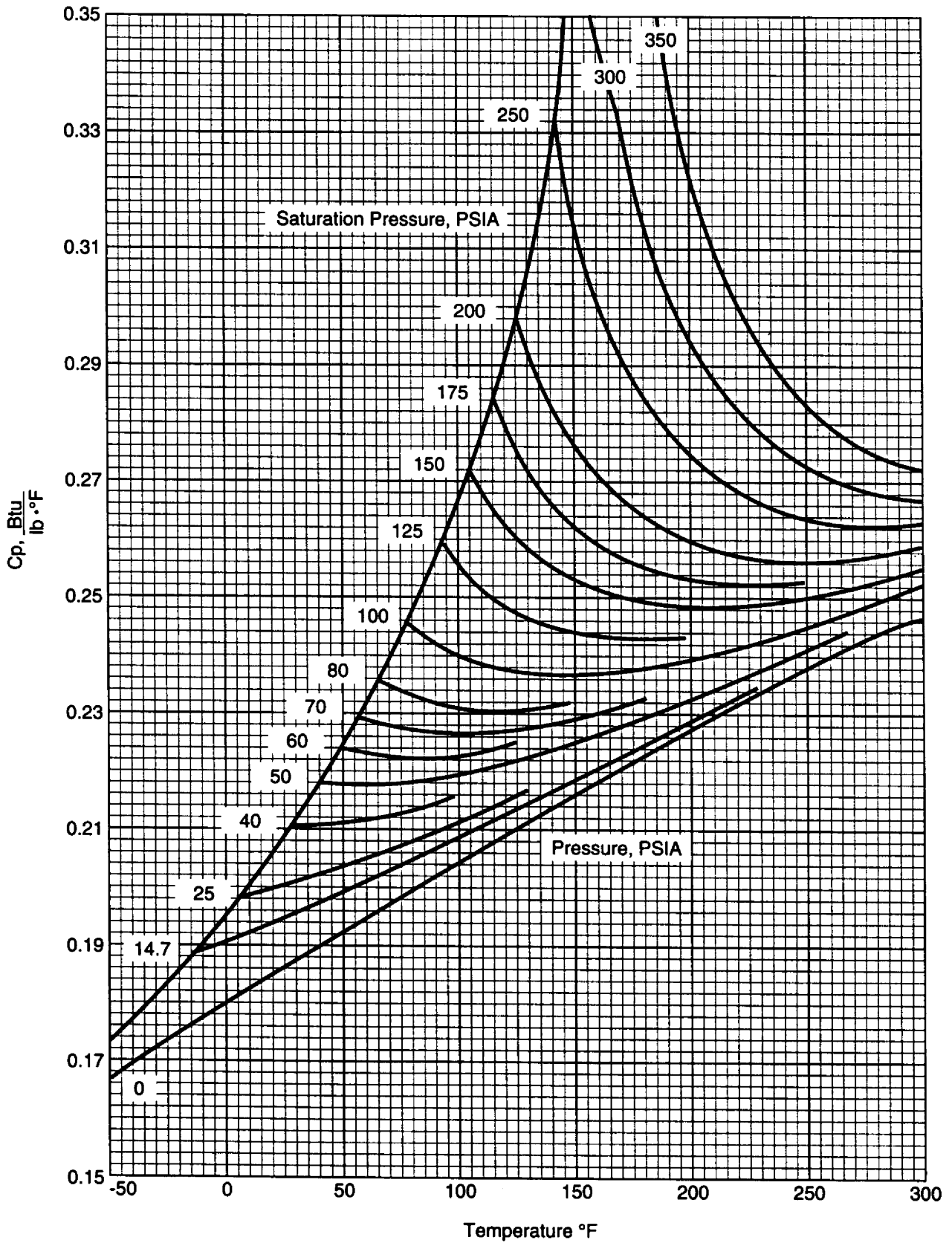
Vapor Viscosity at Atmospheric Pressure



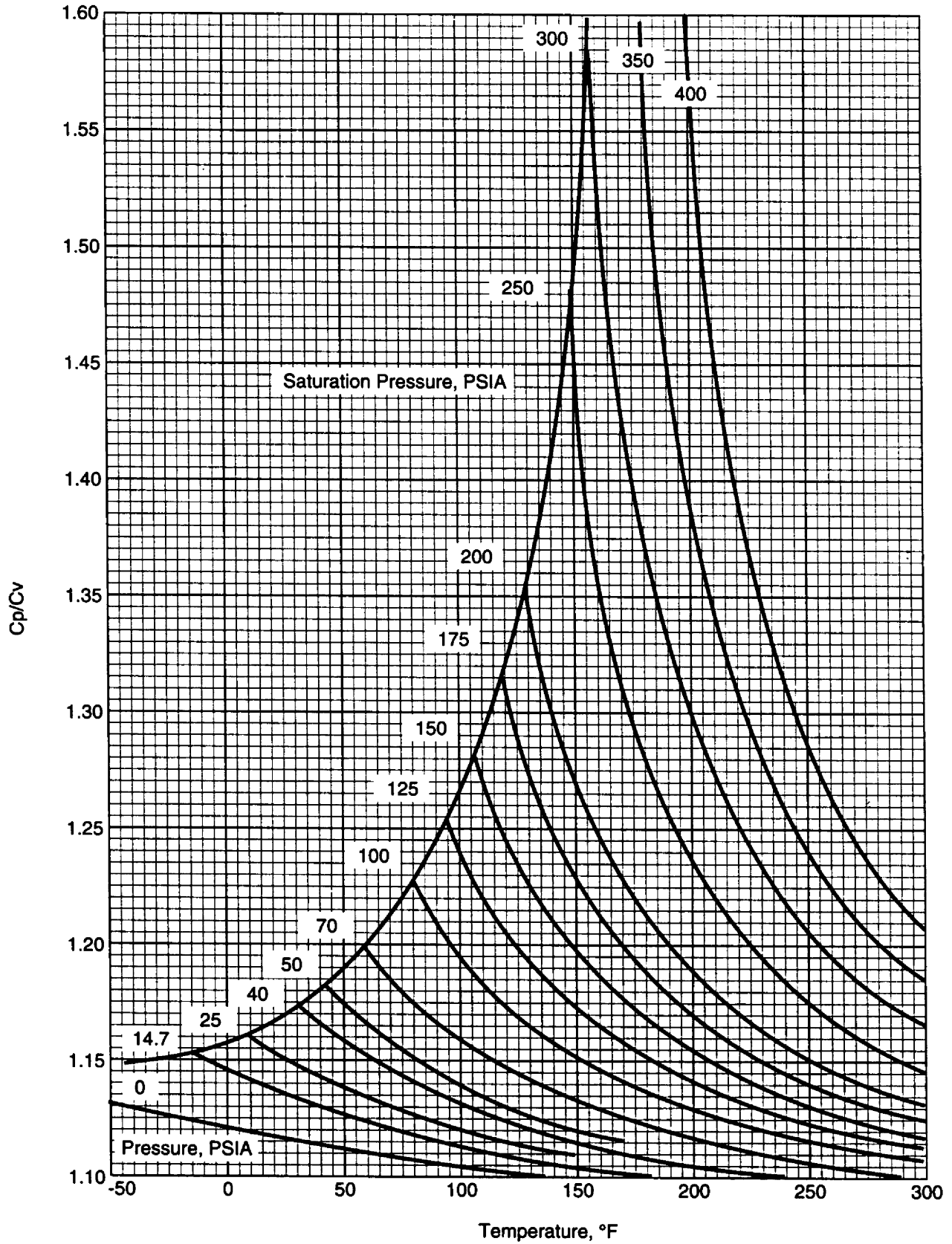
Vapor Thermal Conductivity at Atmospheric Pressure



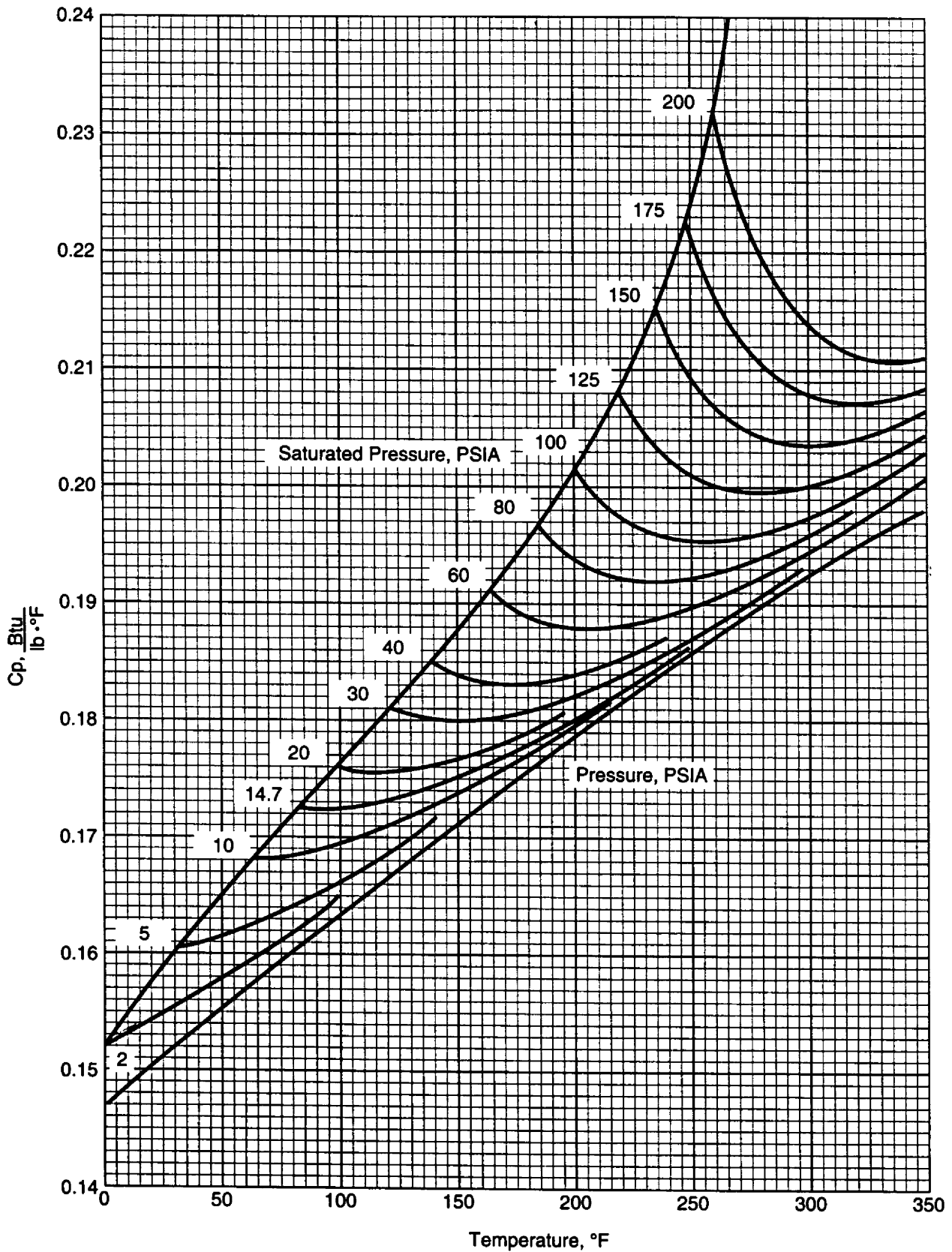
HFC - 134a Vapor Heat Capacity



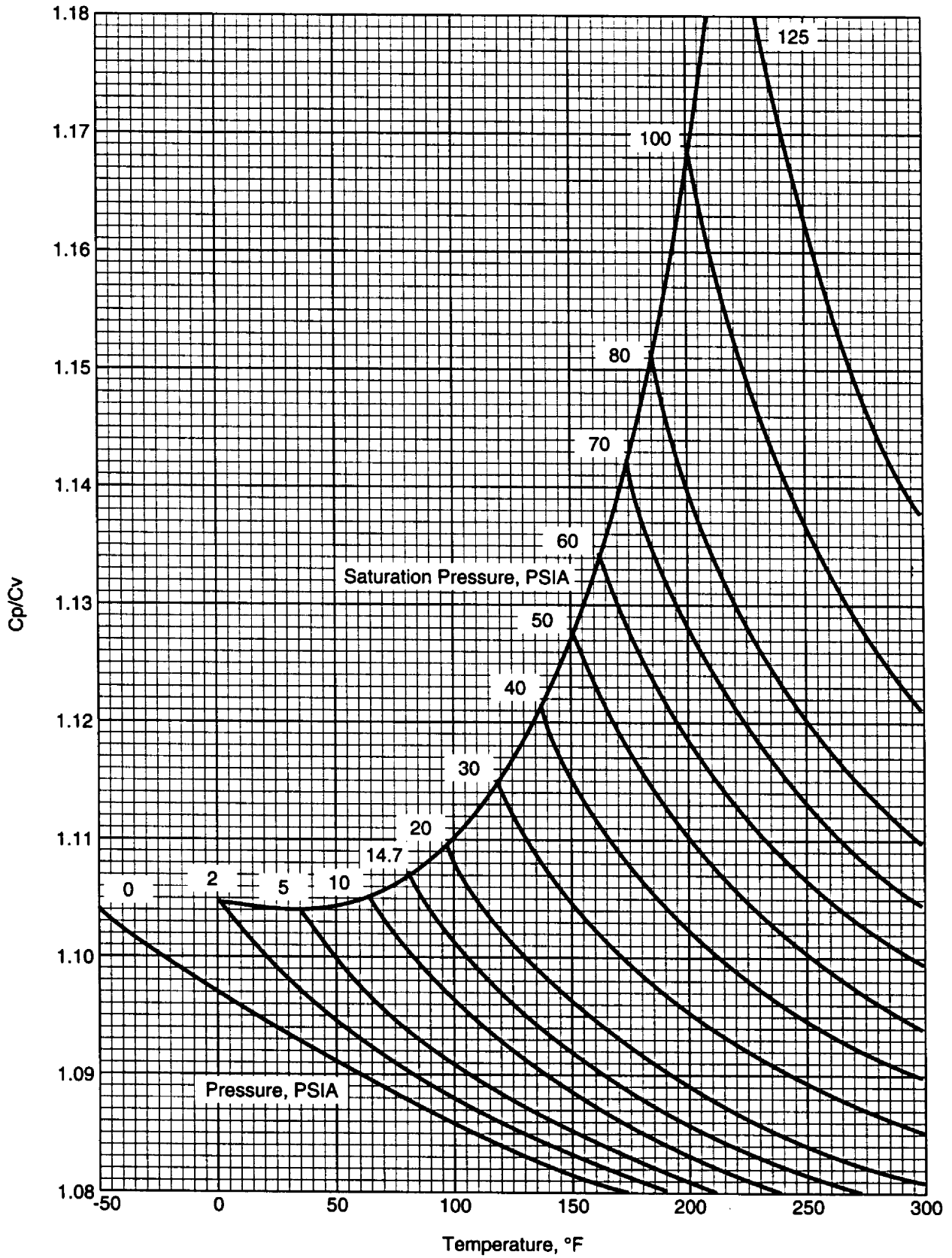
HFC - 134a Vapor Heat Capacity Ratio



HCFC - 123 Vapor Heat Capacity



HCFC - 123 Vapor Heat Capacity Ratio



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

$$\begin{aligned} \text{HCFC-123: } \mu_l &= -0.000000133T^3 + 0.00005259T^2 - 0.007978T + 0.79566 & (-70 \leq T \leq 200^\circ\text{F}) \\ \text{HFC-134a: } \mu_l &= -0.0000000376T^3 + 0.00001575T^2 - 0.00292T + 0.346317 \end{aligned}$$

Liquid Thermal Conductivity in Btu/hr ft °F

$$\begin{aligned} \text{HCFC-123: } k_l &= 0.0548 - 0.000104 T \quad (-76 \leq T \leq 248^\circ\text{F}) \\ \text{HFC-134a: } k_l &= 0.06041 - 0.000166 T \quad (-76 \leq T \leq 140^\circ\text{F}) \end{aligned}$$

Liquid Heat Capacity in Btu/lbm °F

$$\begin{aligned} \text{HCFC-123: } c_p &= 0.2016 + 0.0004125 T \quad (\text{for } T < 160^\circ\text{F}) \\ c_p &= \exp[-580.035 + 119.419 \ln T + \frac{8262.6}{T} - 0.5637 T + 0.000437 T^2] \\ &\quad (\text{for } 160 \leq T \leq 350^\circ\text{F}) \\ \text{HFC-134a: } c_p &= 0.2935 + 0.000729 T \quad (\text{for } T < 170) \\ c_p &= \exp[9776.1 - 1887.24 \ln T - \frac{168763}{T} + 5.40 T - 0.000334 T^2] \\ &\quad (\text{for } 170^\circ\text{F} \leq T \leq 210^\circ\text{F}) \end{aligned}$$

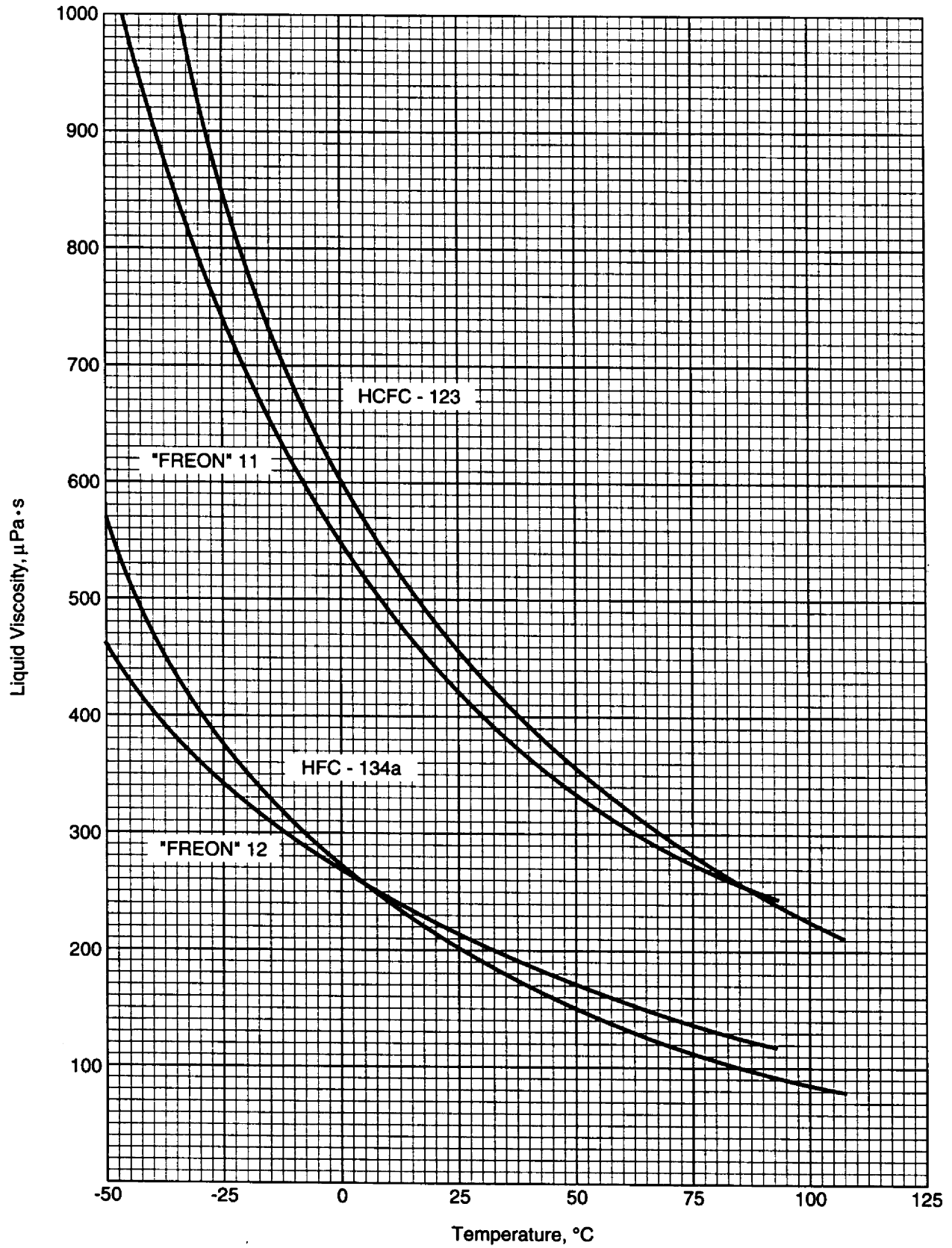
Vapor Viscosity in cP

$$\begin{aligned} \text{HCFC-123: } \mu_v &= 0.00956 + 0.0000179T \\ \text{HFC-134a: } \mu_v &= 0.010338 + 0.0000214T \quad (100 \leq T \leq 300^\circ\text{F}) \end{aligned}$$

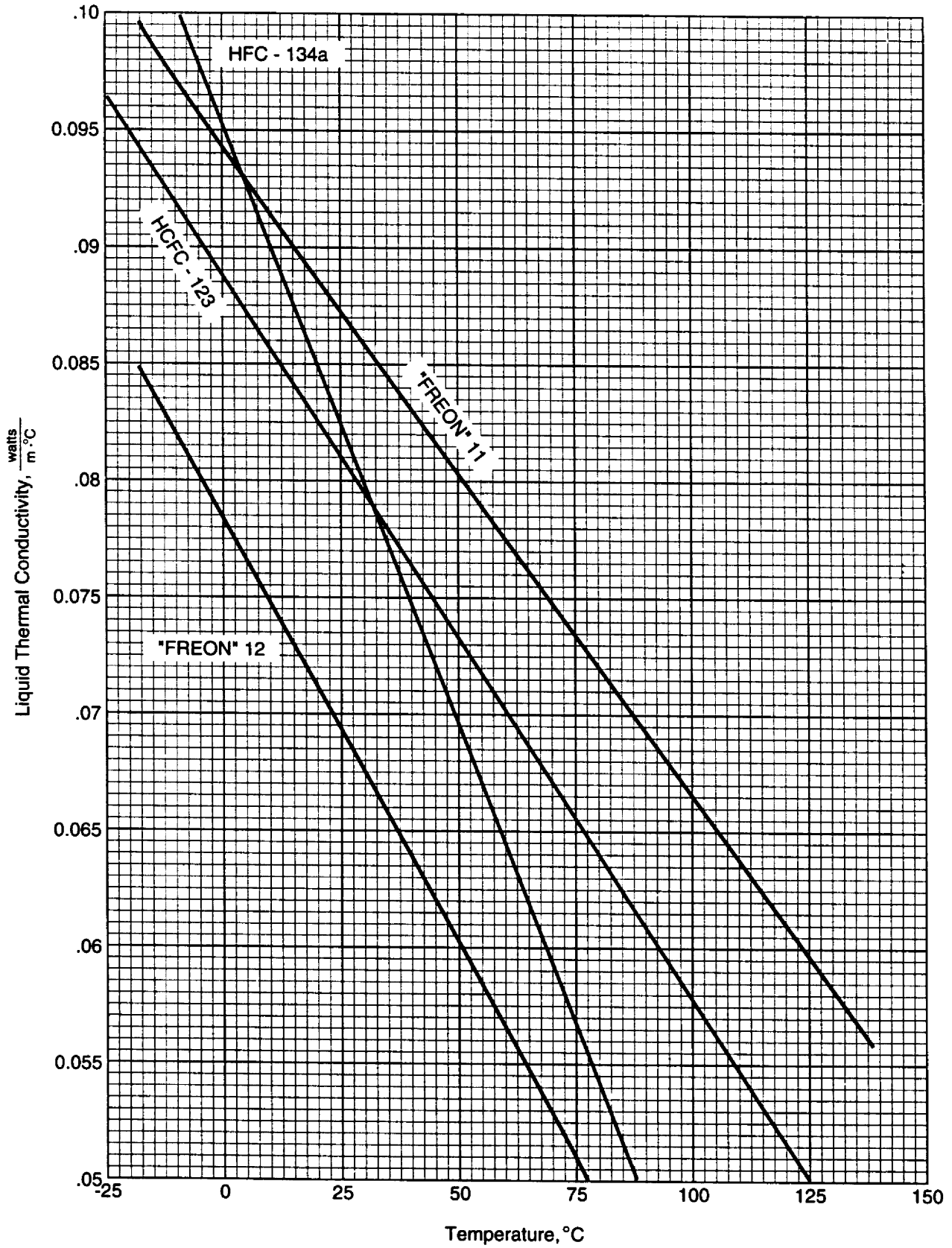
Vapor Thermal Conductivity in Btu/Lb ft °F

$$\begin{aligned} \text{HCFC-123: } k_v &= 0.004465 + 0.000025 T \quad (104 \leq T \leq 248^\circ\text{F}) \\ \text{HFC-134a: } k_v &= 0.006006 + 0.000031 T \quad (32 \leq T \leq 248^\circ\text{F}) \end{aligned}$$

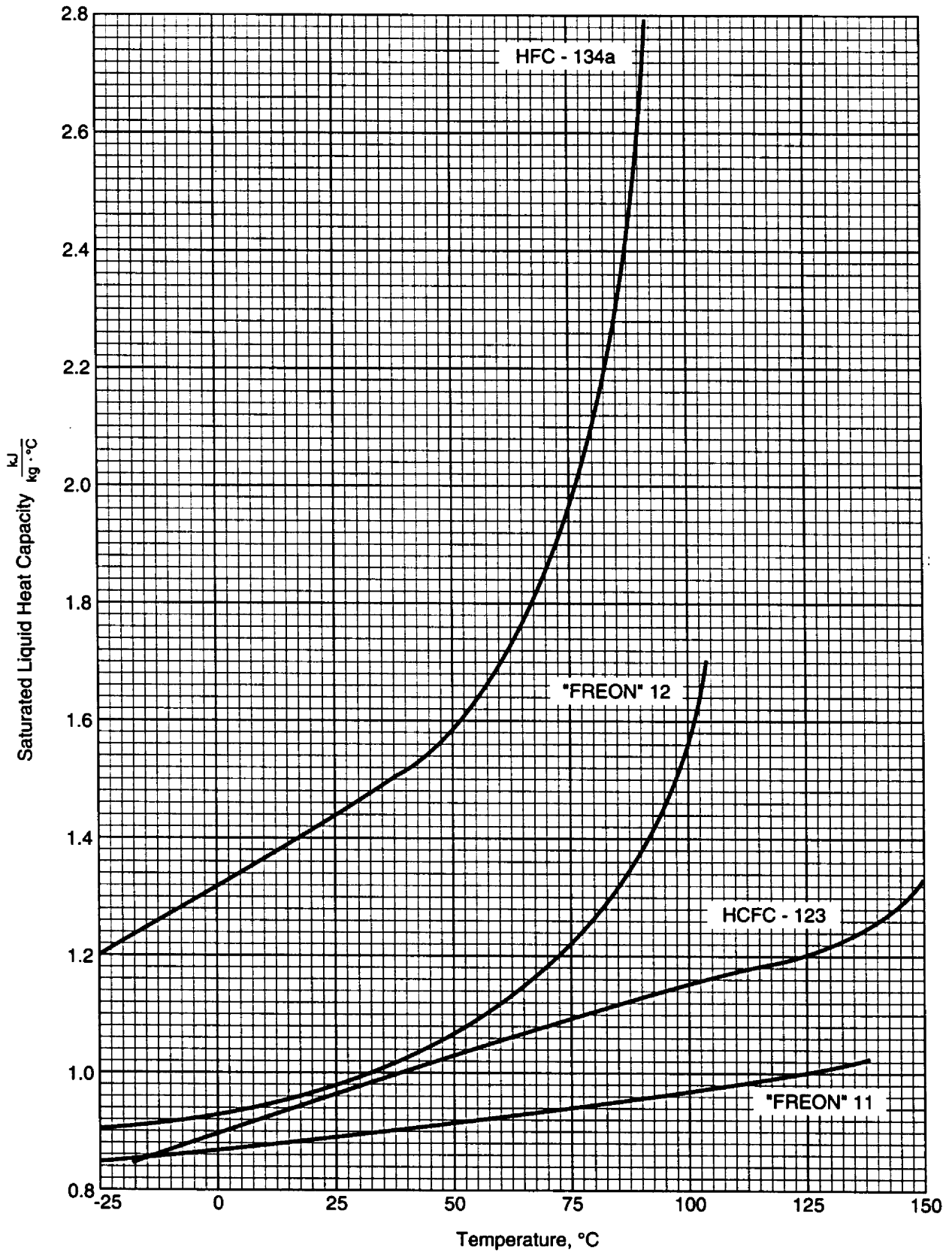
Liquid Viscosity



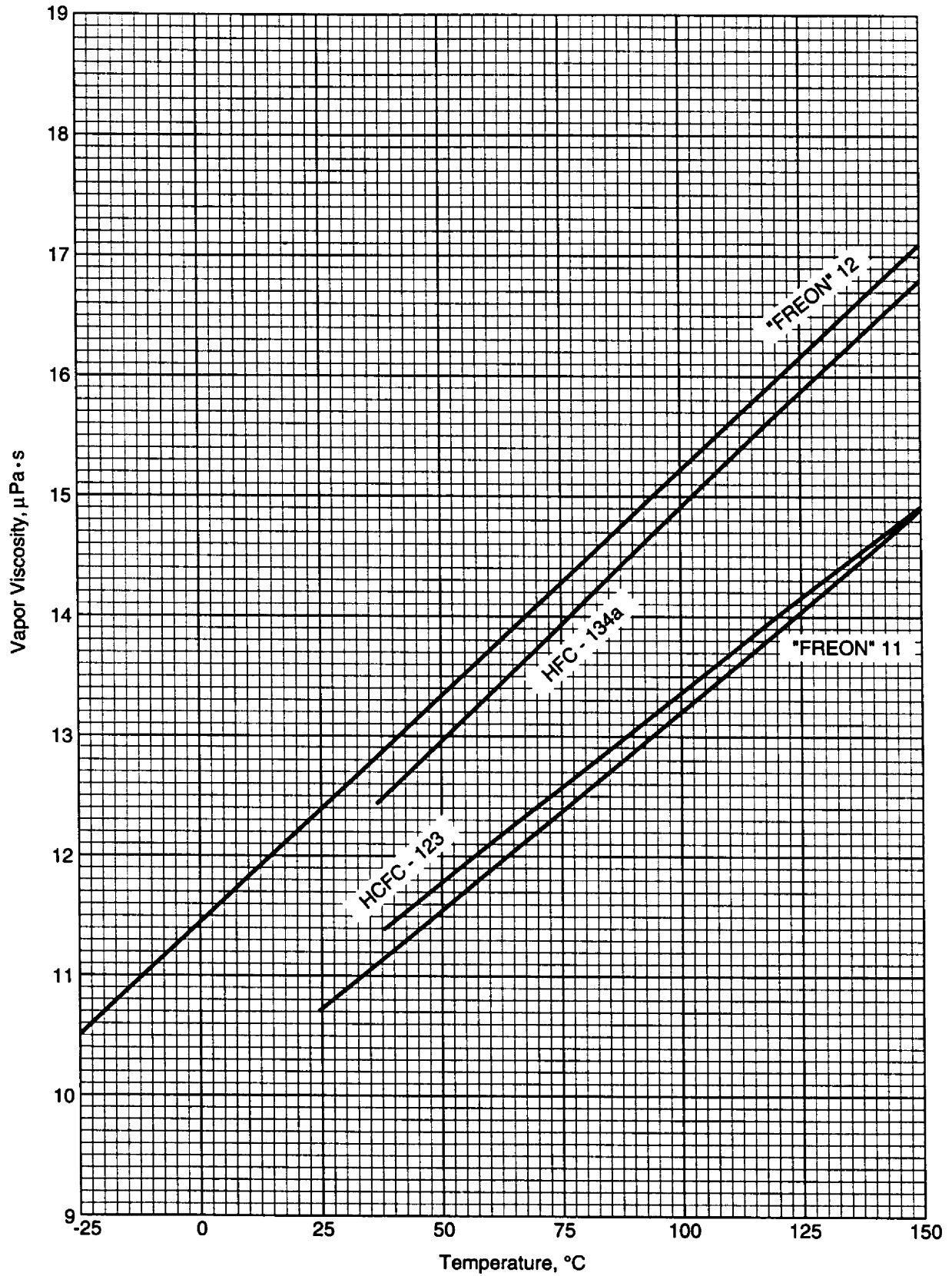
Liquid Thermal Conductivity



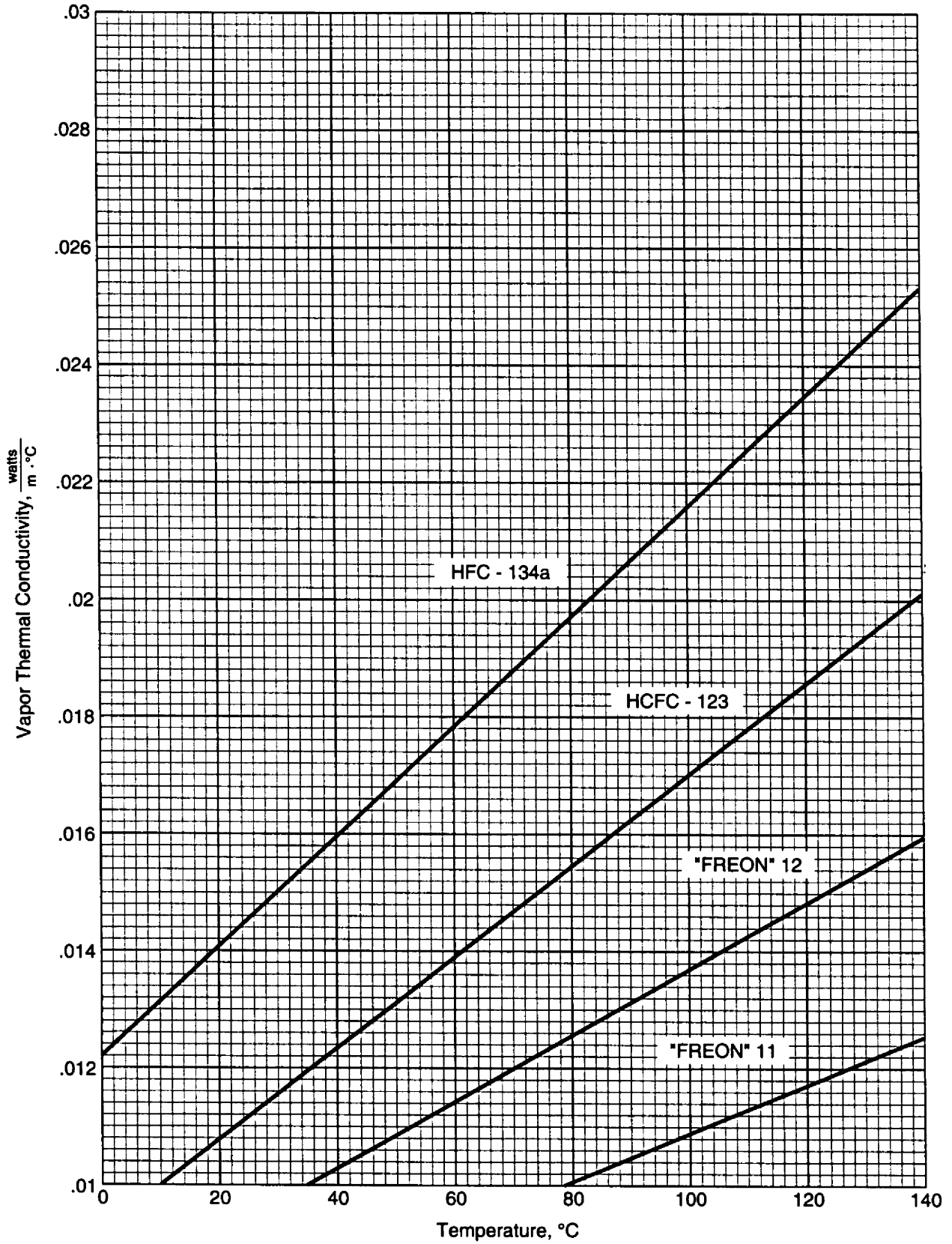
Saturated Liquid Heat Capacity



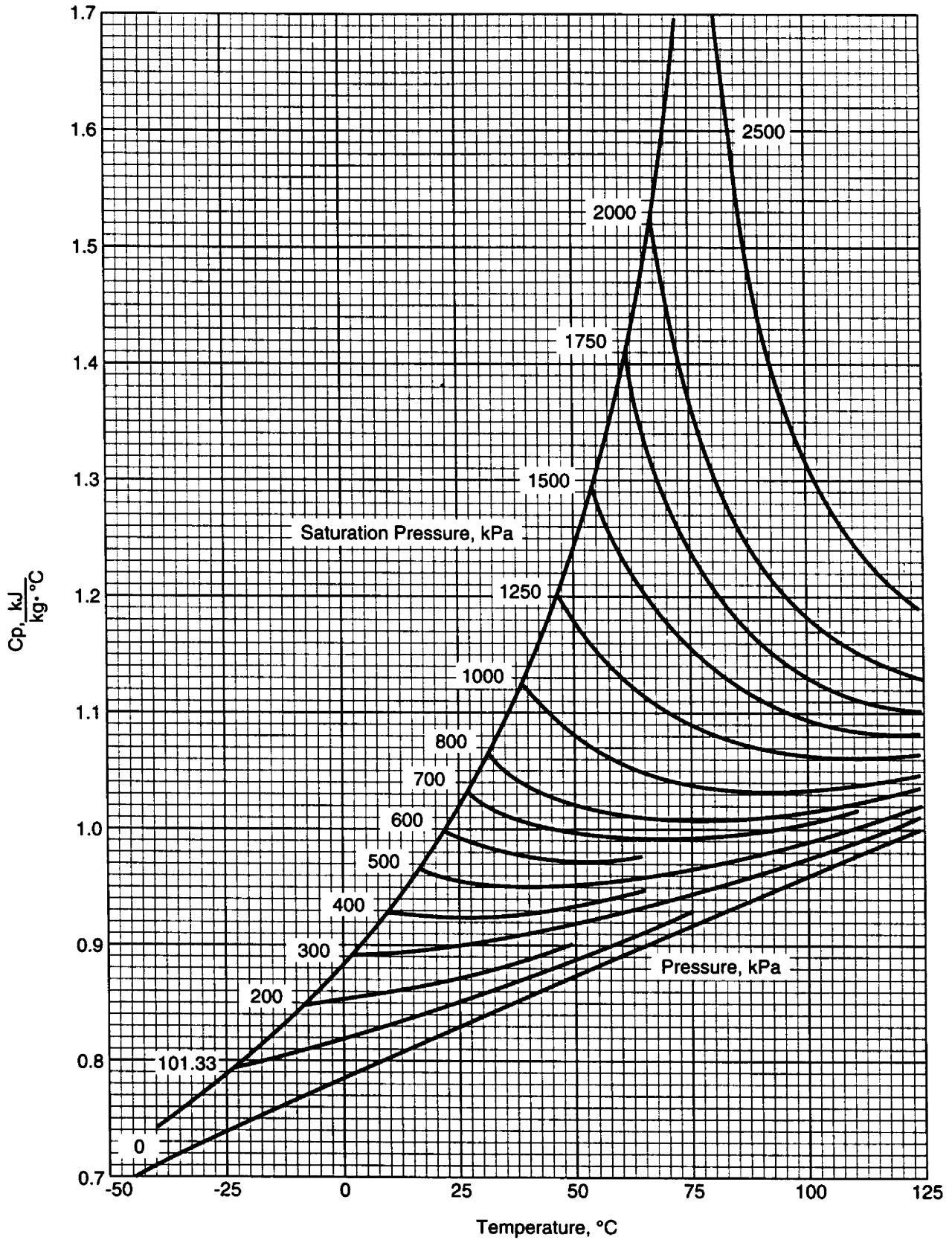
Vapor Viscosity at Atmospheric Pressure



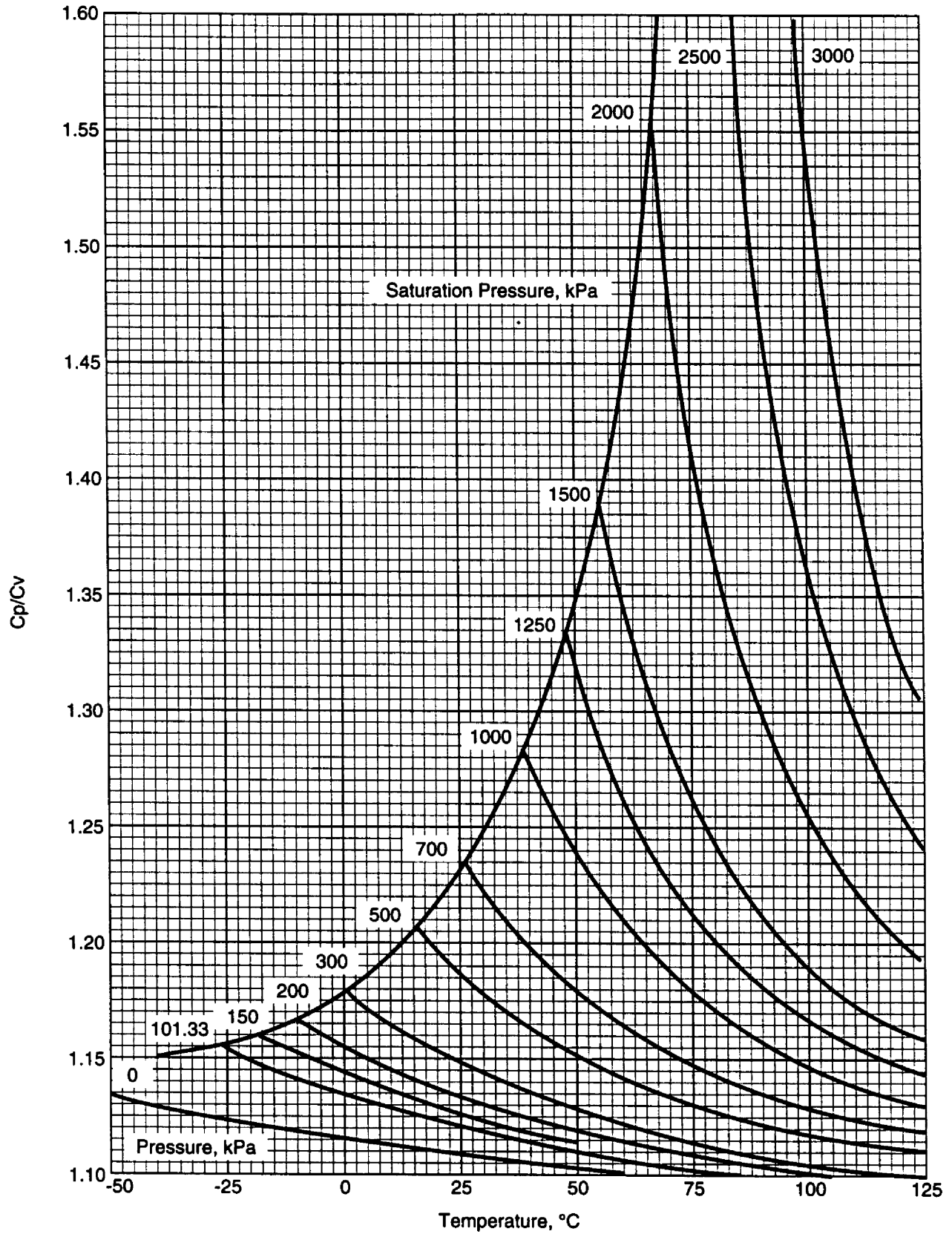
Vapor Thermal Conductivity at Atmospheric Pressure



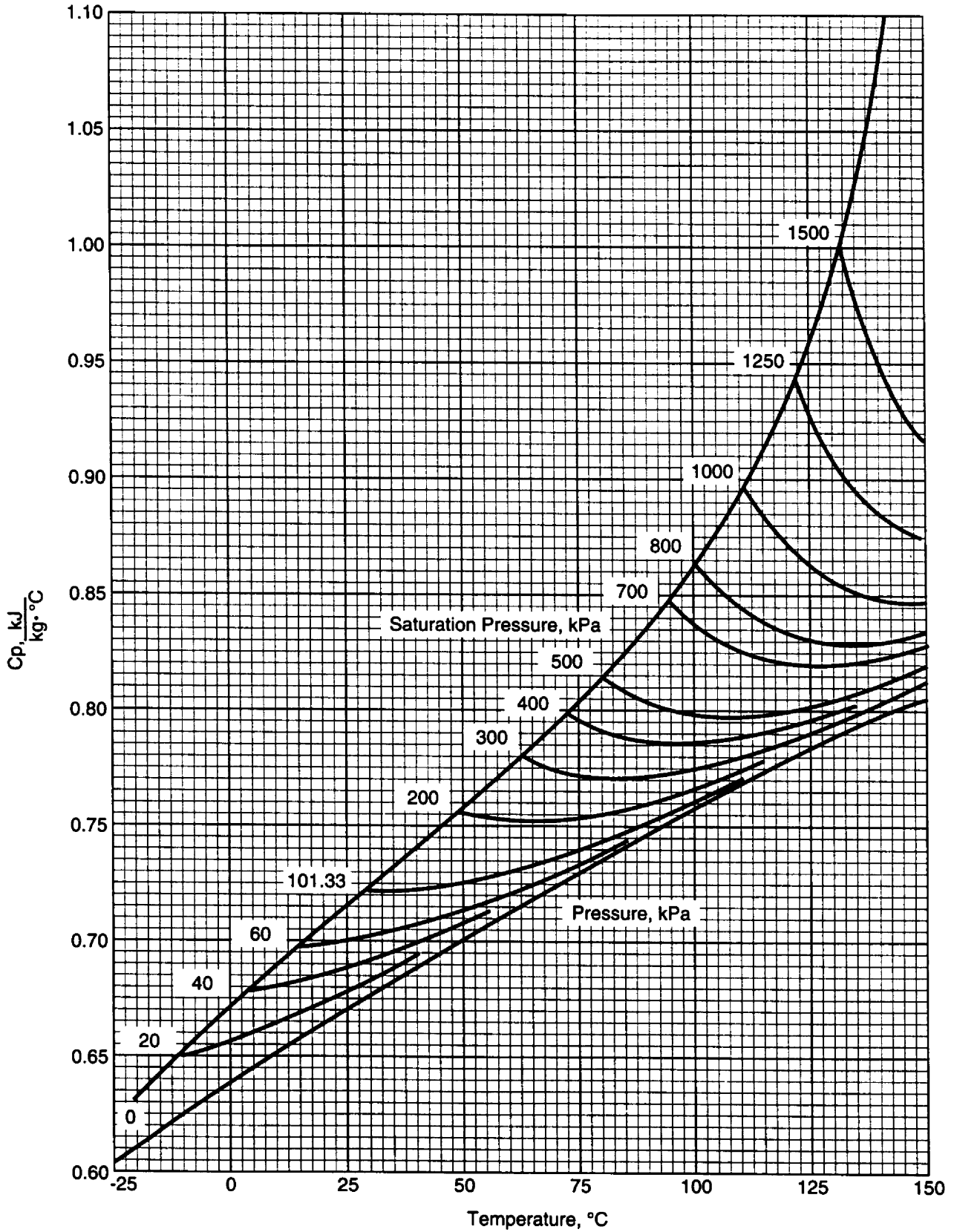
HFC - 134a Vapor Heat Capacity



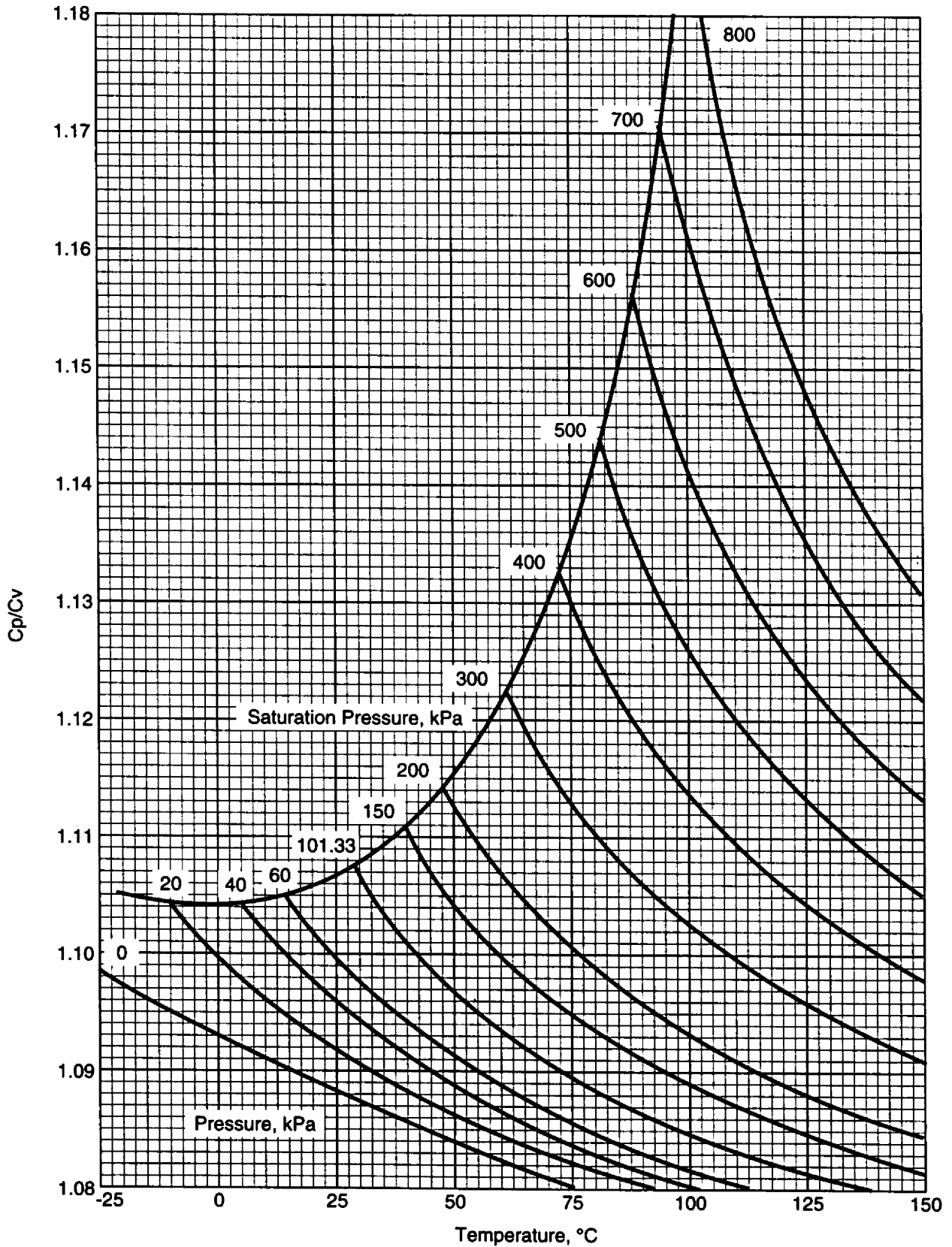
HFC - 134a Vapor Heat Capacity Ratio



HCFC - 123 Vapor Heat Capacity



HCFC - 123 Vapor Heat Capacity Ratio



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 $\mu\text{Pa}'\text{s}$

$$\text{HCFC-123: } \mu_l = -0.0007765T^3 + 0.12886T^2 - 9.0295T + 589.72 \quad (-57 \leq T \leq 93^\circ\text{C})$$

$$\text{HFC-134a: } \mu_l = -0.0002191T^3 + 0.039304T^2 - 3.6494T + 267.67$$

Liquid Thermal Conductivity in $\text{W}/\text{m}^\circ\text{C}$

$$\text{HCFC-123: } k_l = 0.08908 - 0.000324 T \quad (-60 \leq T \leq 120^\circ\text{C})$$

$$\text{HFC-134a: } k_l = 0.09537 - 0.000517 T \quad (-60 \leq T \leq 60^\circ\text{C})$$

Liquid Heat Capacity in $\text{kJ}/\text{kg } ^\circ\text{C}$

$$\text{HCFC-123: } c_p = 0.9104 + 0.00257 T \quad (\text{for } T < 90^\circ\text{C})$$

$$c_p = \exp \left[-1515.07 + 354.086 \ln T + \frac{13952.48}{T} - 2.95702T + 0.004074T^2 \right] \\ (\text{for } 90 \leq T \leq 176.7^\circ\text{C})$$

$$\text{HFC-134a: } c_p = 1.327 + 0.005509T \quad (\text{for } T \leq 75^\circ\text{C})$$

$$c_p = \exp \left[1979.525 - 374.95752 \ln T - \frac{24459.904}{T} - 1.62846T + 0.015674T^2 \right] \\ (\text{for } 75^\circ\text{C} < T \leq 100^\circ\text{C})$$

Vapor Viscosity in $\mu \text{Pa}'\text{s}$

$$\text{HCFC-123: } \mu_v = 10.131 + 0.03224T \quad (38 \leq T \leq 149^\circ\text{C})$$

$$\text{HFC-134a: } \mu_v = 11.021 + 0.038599T$$

Vapor Thermal Conductivity in $\text{W}/\text{m}^\circ\text{C}$

$$\text{HCFC-123: } k_v = 0.009171 + 0.000077 T \quad (40 \leq T \leq 120^\circ\text{C})$$

$$\text{HFC-134a: } k_v = 0.01212 + 0.000096 T \quad (0 \leq T \leq 120^\circ\text{C})$$

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