

To get heat transfer coefficients

HEAT TRANSFER coefficients for fluids flowing over tube bundles are calculated with a slightly different equation than the one used in Parts 1 and 2. For a staggered arrangement of tubes, the equation is as follows:

$$NU = 0.33Re^{0.6} Pr^{0.33} \quad (1)$$

Expanding Equation 1 to include the terms making up the dimensionless numbers, defining the tube diameter in inches and rearranging gives the following:

$$h = 0.9(G^{0.6}/d^{0.4})(k^{0.67}Cp^{0.33}/\mu^{0.27}) \quad (2)$$

where Cp= fluid specific heat, Btu/ (lb) (°F)

d = tube outside diameter, inches

G = mass velocity, lb/ (hr) (sq ft)

h = heat transfer coeff., Btu/ (hr) (sq ft) (F)

k =thermal conductivity, Btu/ (hr) (sq ft) (°F/ft)

μ = fluid viscosity, lb/ (f t) (h r) = 2.42 (centipoise) . Fluid properties shown in Equation 2 are combined into a single term as follows:

$$F = (k^{0.67}Cp^{0.33}/\mu^{0.27}) \quad (3)$$

where the value for F for some common gases can be obtained directly from the accompanying figures. Take note that the powers for the physical properties in F are different from those used for C in Parts 1 and 2.

The figures for F are the results of a computer program in which pressure effect on specific heat is determined using Gambill's method and the effects on thermal conductivity and viscosity are by the method of Stiel and Thodos.

The figures cover a wide range of pressures; namely, 1 to 250 atmospheres. Hence they can be used for the more common cases at atmospheric pressure as well as for the higher pressures encountered in waste heat recovery applications.

For in-line arrangement of tubes, the value obtained for heat transfer coefficient by the equations herein should be multiplied by 0.8. For a baffled heat exchanger, an additional multiplier of 0.6 should be used.

BIBLIOGRAPHY

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Pressure effect on crossflow

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TO GET HEAT TRANSFER COEFFICIENTS

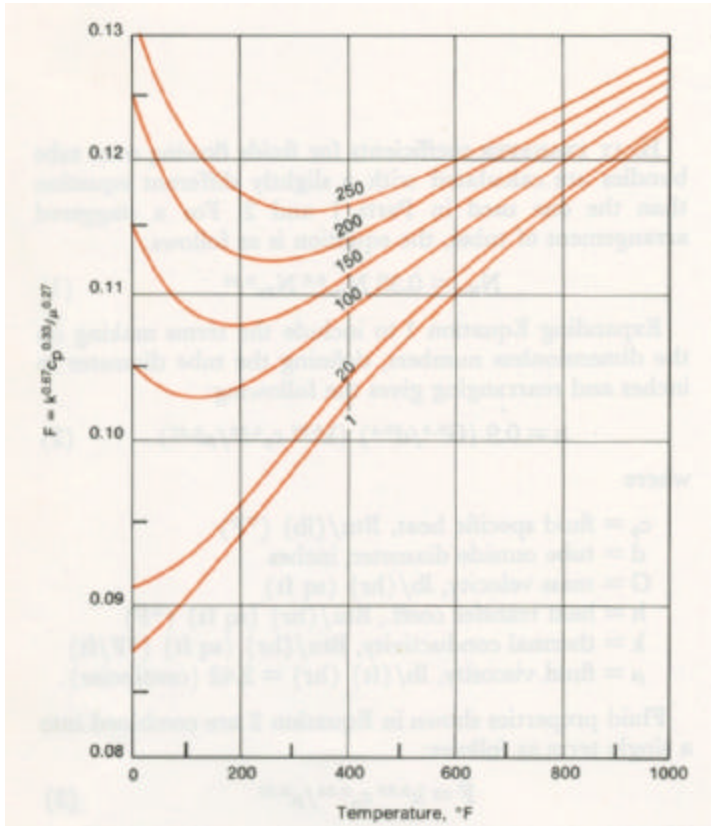


Fig. 1—Air

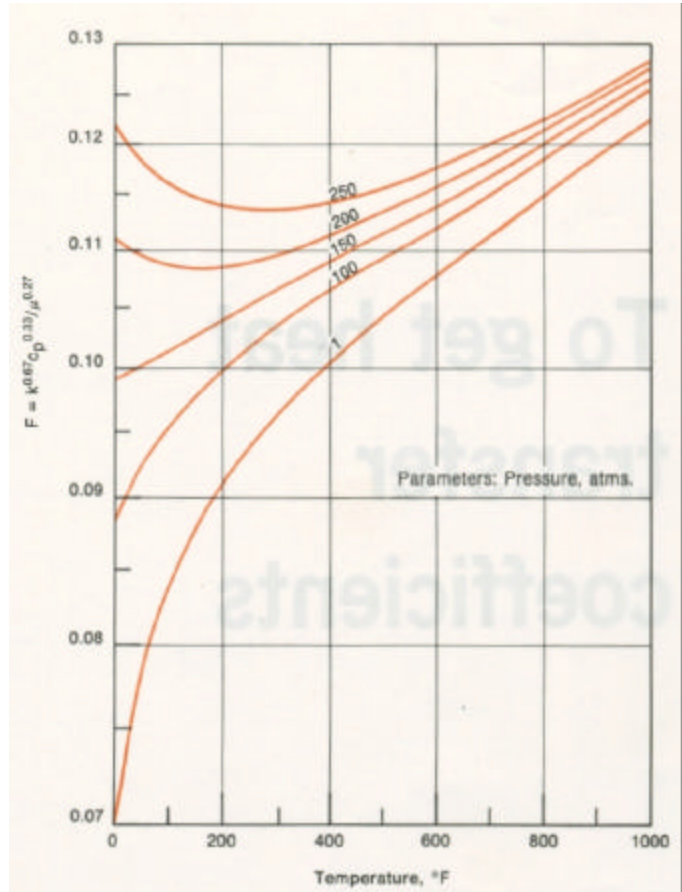


Fig. 2—Oxygen

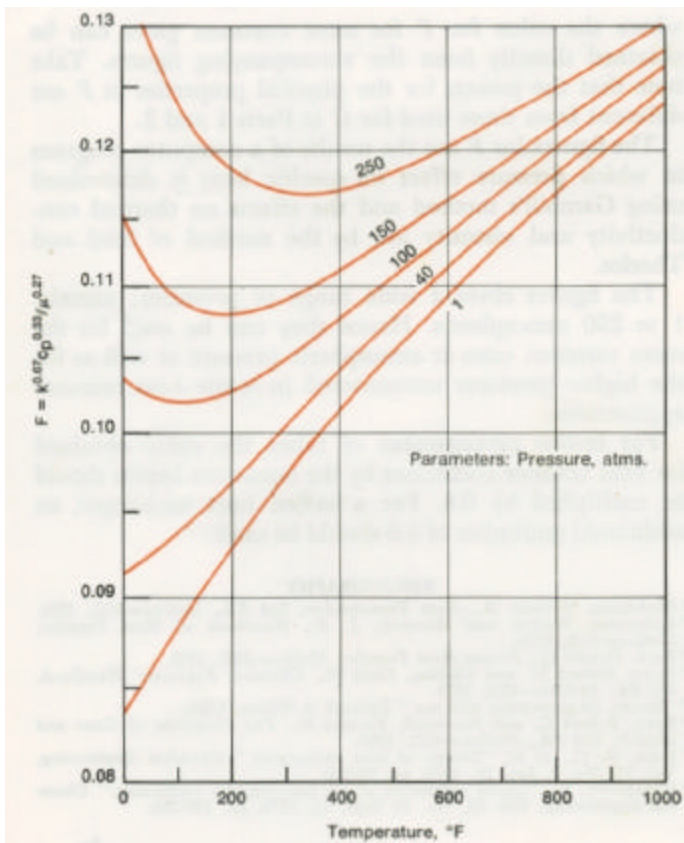


Fig. 3—Nitrogen

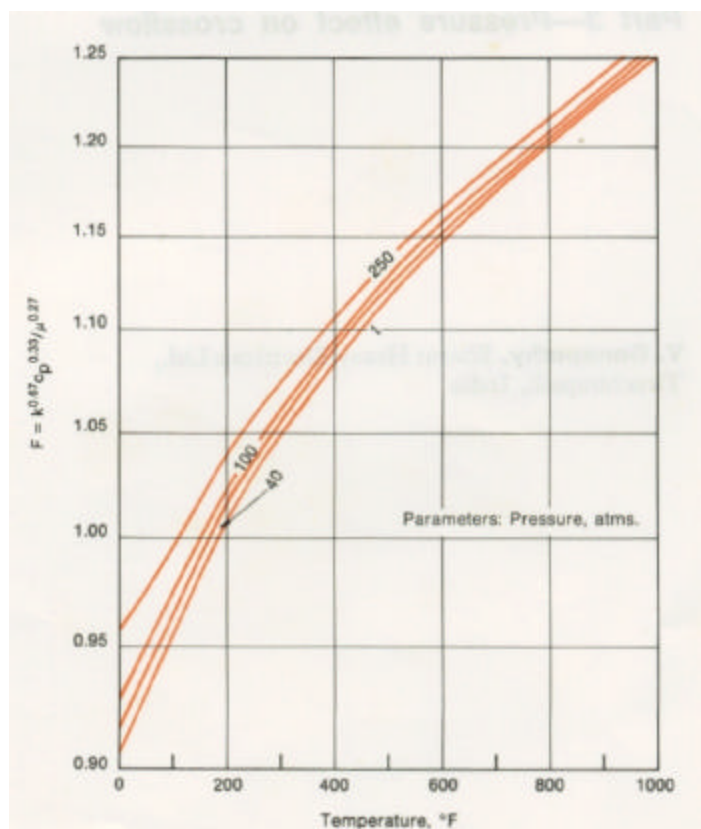


Fig. 4—Hydrogen

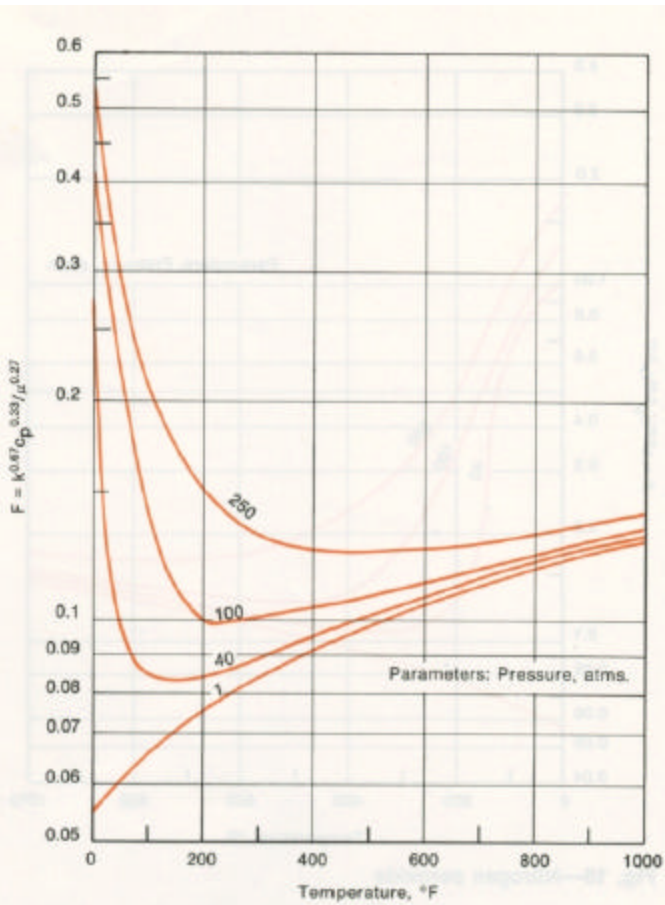


Fig. 5—Carbon dioxide

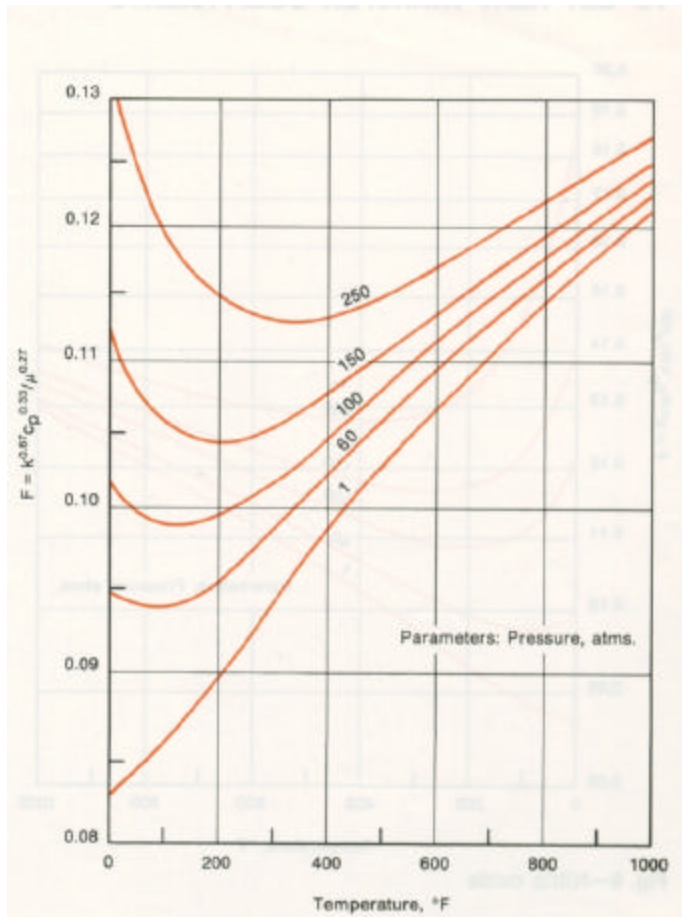


Fig. 6—Carbon monoxide

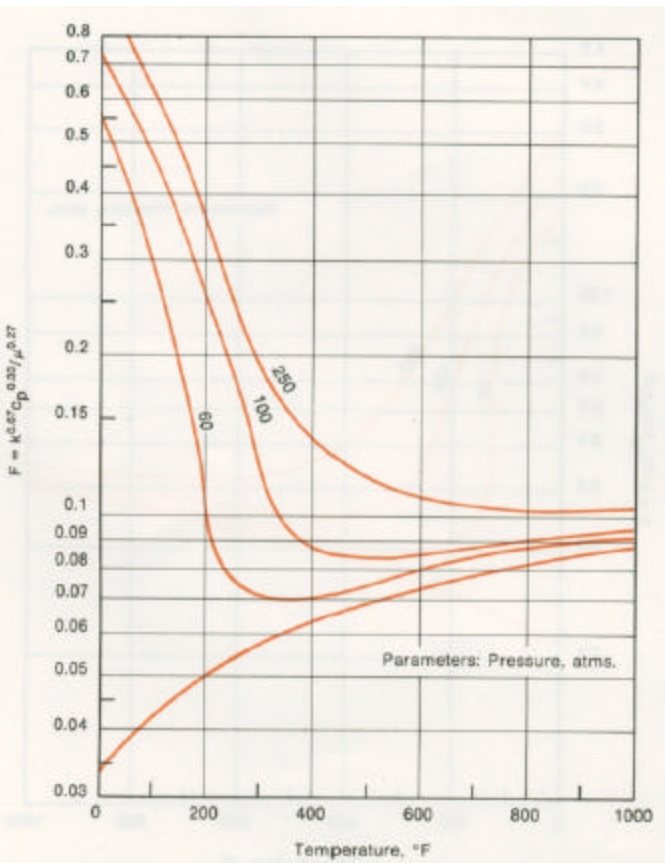


Fig. 7—Sulfur dioxide

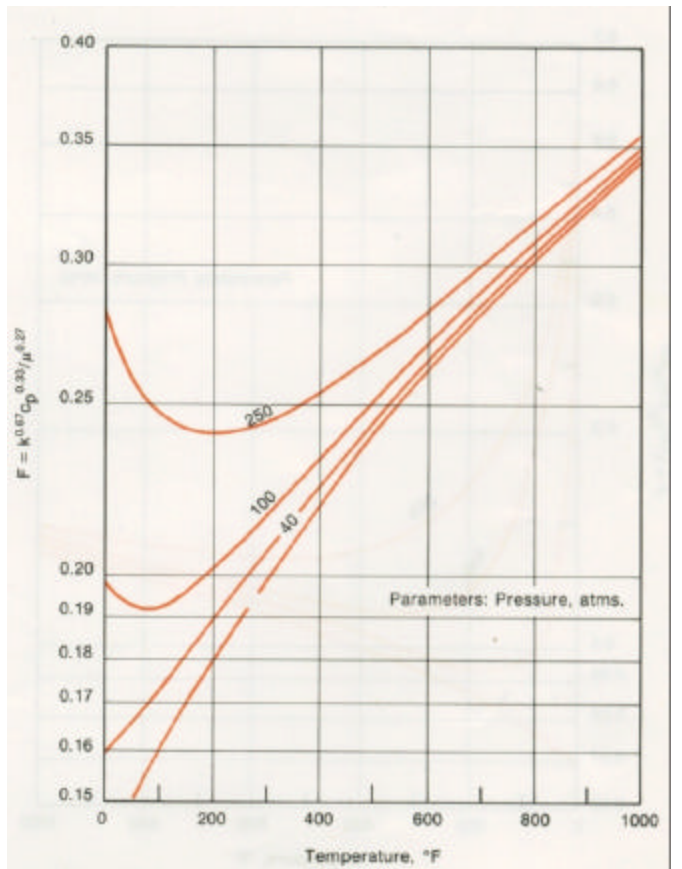


Fig. 8—Methane

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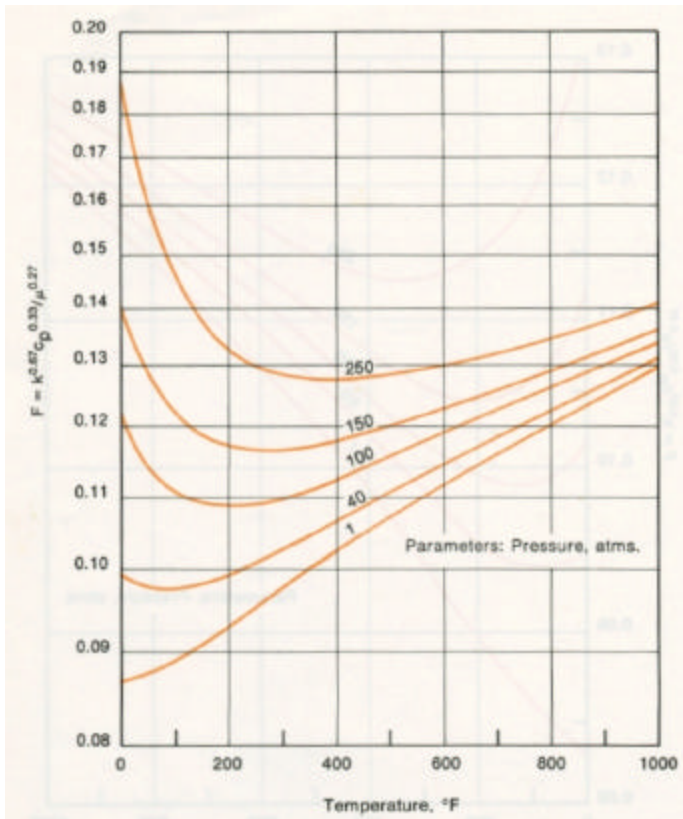


Fig. 9—Nitric oxide

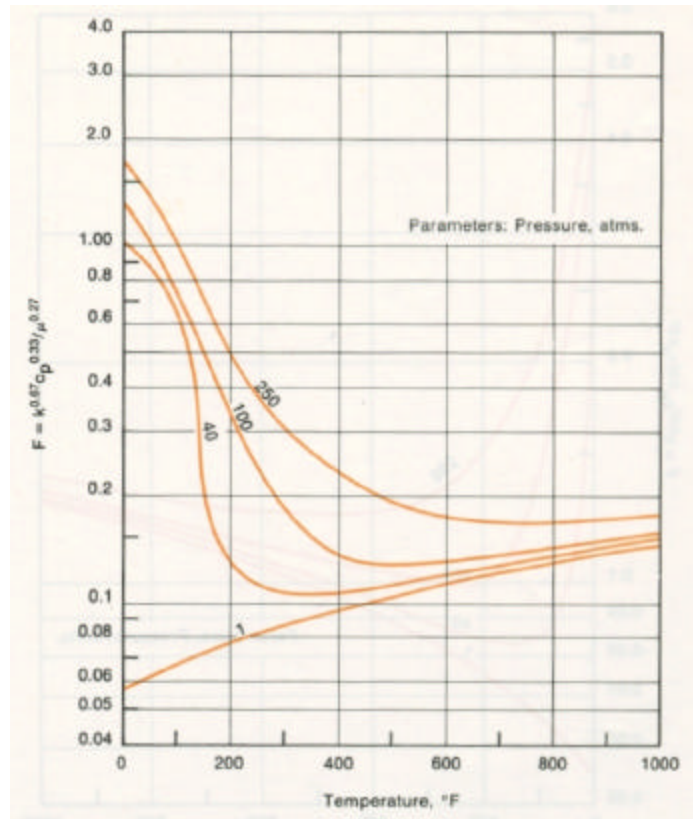


Fig. 10—Nitrogen peroxide

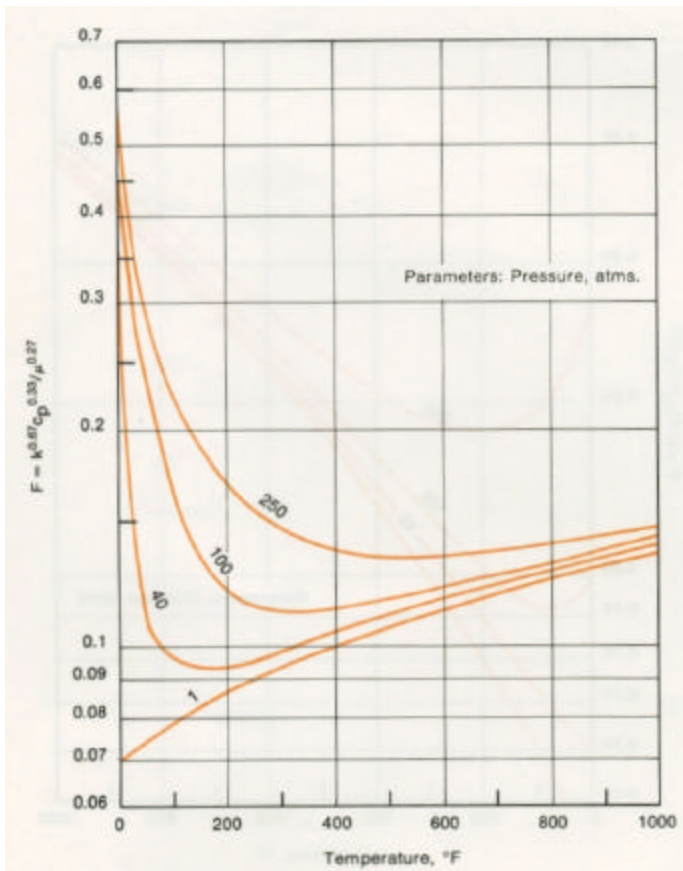


Fig. 11—Nitrous oxide

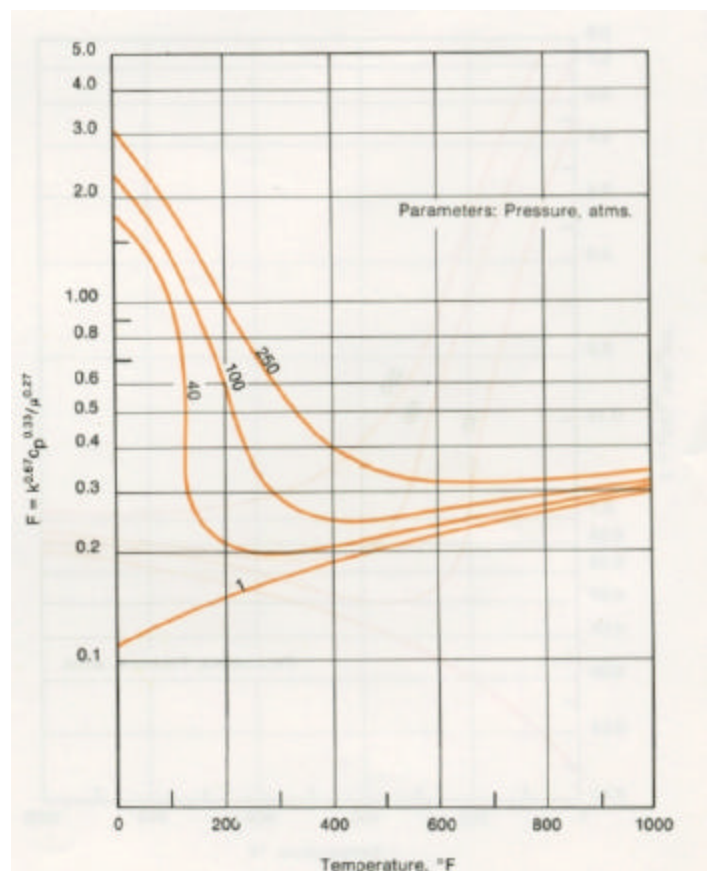


Fig. 12—Ammonia