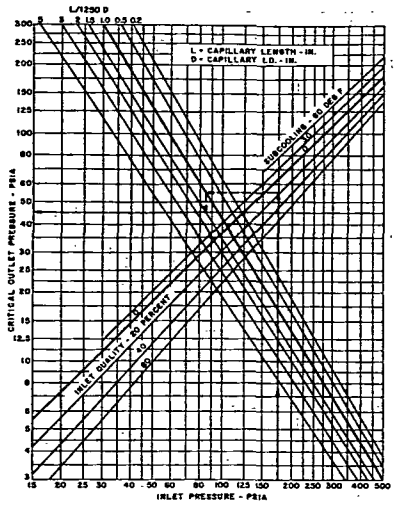

Fig. 39 .... Capillary Critical Pressure Chart (Refrigerants 12 and 22)

Fig. 39, then the correction factor is obtained from Fig. 40. The capacity obtained from Figs. 37 and 38 should be multiplied by the correction factor to obtain the final value of flow. It is seen that relatively high back pressures cause substantial reductions in flow below that given by the basic rating chart for critical outlet pressure.

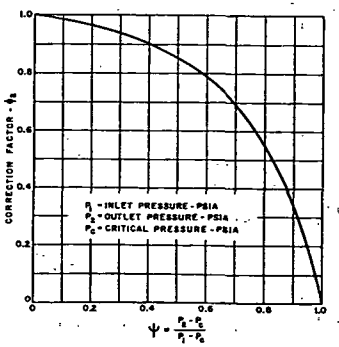

Fig. 40 .... Critical Correction Factor (Refrigerants 12 and 22)

The effect of a suction line heat exchanger can normally be taken into consideration by subtracting the liquid temperature drop through this element from the liquid temperature at capillary inlet. This method holds rigidly when the refrigerant bubble point comes after the heat exchanger. Fig. 41, which was derived mathematically for the latter condition, may be used to determine the heat exchanger liquid subcooling.

Fig. 42 may be used to determine liquid length or liquid pressure drop. Although in preparing this chart the Refrigerant 12 pressure drop values were calculated to be about 5.5 percent less than those for Refrigerant 22 at a given mass flow, the two sets of values were averaged for the purpose of simplification. Average values of densities between − 40 and 140 F were used.

Calculation procedures are illustrated in *Examples 1–6.*

Example 1: Determine the flow rate of Refrigerant 22 for a restrictor of 0.054 in. I.D., 111 in. long, operating without heat exchange at 100 F saturated condensing temperature with 10 F deg subcooling.

Solution: From Fig. 37, at 100 F saturated condensing temperature, or 212.6 psia pressure, and 10 F deg subcooling, the flow rate for an 80 in. length of 0.064 in. I.D. restrictor is found to be 97.0 lb per hr.

To correct for actual diameter and length the flow factor ϕ_1 is found from Fig. 38. For 0.054 in. I.D. and 111 in. length, $\phi_1 = 0.55$. Corrected flow rate is $97.0 \times 0.55 = 54.3$ lb per hr.

Example 2: Determine the condition of flow for the restrictor of *Example 1*, if the flow rate falls to 40 lb per hr at 120 F saturated condensing temperature, or 277.3 psia pressure.

Solution: The flow factor $\phi_1 = 0.55$ (from *Example 1*). With a flow rate of 40 lb per hr, the uncorrected flow rate to be used with Fig. 37 is $40/0.55 = 72.6$ lb per hr.

From Fig. 37, with a flow rate of 72.6 lb per hr and 277.3 psia condensing pressure, the flow condition is read as 12.0 percent inlet quality, at the restrictor entrance.

Example 3: Determine the length of 0.042 in. I.D. tube which is equivalent to 30 in. of 0.036 in. I.D. tube.

Solution: From Fig. 38, the flow factor for 30 in. of 0.036 in. I.D. tube is read as 0.35. For this value of flow factor, it is found from Fig. 38, that 73 in. of 0.042 in. I.D. tube are required.

Example 4: Determine the length of 0.054 I.D. capillary which will pass 50 lb per hr of Refrigerant 12, with no subcooling and no gas at the inlet, when the inlet pressure outside the capillary is 150 psig.

Solution: The absolute inlet pressure is 164.7 psia. From Fig. 37, the flow rate is 65.0 lb per hr.

The flow factor ϕ_1 is $50/65 = 0.77$. From Fig. 38, for $\phi_1 = 0.77$ and 0.054 I.D., the length of capillary required is 53 in.

Example 5: What will be the flow rate for either Refrigerant 12 or Refrigerant 22 for an 0.070 in. I.D. capillary 131 in. long with an inlet pressure of 175 psia, 20 percent inlet quality, and an outlet pressure of 150 psia?

Solution: From Fig. 37 the basic rating is 41.0 lb per hr. From Fig. 38, $\phi_1 = 0.98$. The basic flow is then $0.98 \times 41.0 = 40.1$ lb per hr. The L/1250 D value is 1.5.

Enter Fig. 39 at 175 psia inlet pressure and proceed vertically to 20 percent inlet quality. Proceed horisontally to the *L*/1250D line of unity. Proceed vertically to the *L*/1250D line of 1.5. Proceed horisontally to a critical outlet pressure of 45 psia.

The value of ψ for Fig. 40 is $\frac{150 - 45}{175 - 45} = 0.808$. From Fig. 40, $\phi_2 = 0.53$. The corrected flow is $40.1 \times 0.53 = 21.3$ lb per hr.

Example 6: Determine the amount of subcooling obtained in a counterflow heat exchanger having a 0.43 in. I.D. suction tube, 2 ft long. The flow rate of Refrigerant 12 is 200 lb per hr, and the temperature difference between the inlet liquid and inlet gas is 60 F deg.

Solution: Enter Fig. 41 at 0.43 I.D. suction line and proceed vertically to the diagonal Refrigerant 12 line. Proceed horizontally from the intersection to the 200 lb per hr flow rate line. From this point, drop vertically to the 2 ft length curve and proceed horizontally to the 60 F deg temperature difference line. The

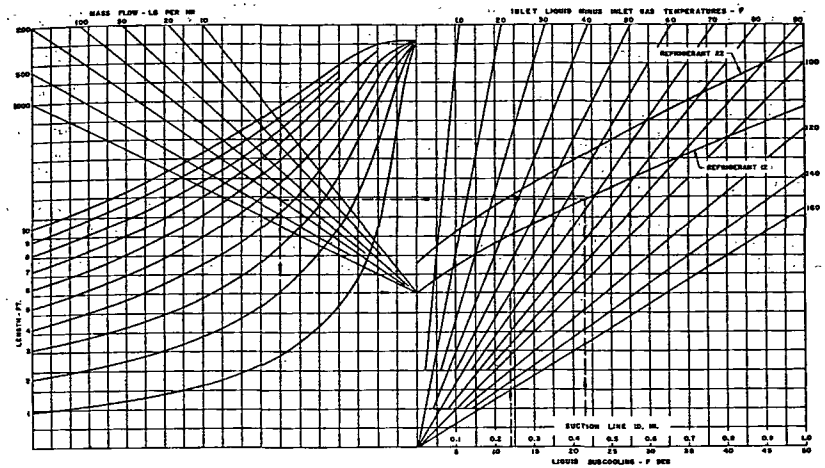

Fig. 41 .... Performance Chart for Suction Line and Capillary Heat Exchanger (Liquid-to-Gas Counterflow)

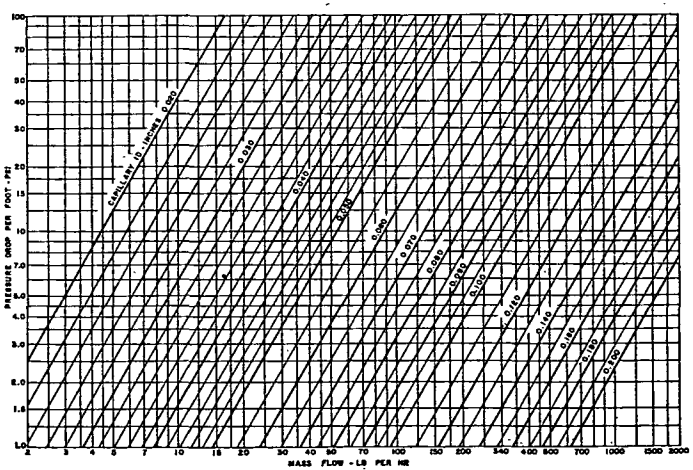

Fig. 42 .... Pressure Drop Chart for Capillary Liquid (Refrigerants 12 and 22)