ant ahead of the expansion valve. If the evaporator is to be located at a higher elevation than the condenser or receiver, account should be taken of the pressure drop for each foot of static liquid lift. Approximate values are 0.26 psi per foot for ammonia, 0.57 psi per foot for Freon-12, 0.51 psi per foot for Freon-22, and 0.64 psi per foot for Freon-11. Where there is a possibility of vaporization of some of the liquid before reaching the expansion valves, means for subcooling should be provided.

TABLE 6. MAXIMUM TONS OF COMPRESSOR CAPACITY FOR FREON-12 LINES
(Only for temperatures indicated)

| Line Size, Inches | Suction Lines Based on 105 F Condensing Temperature | | | | | | Discharge Lines | |
|---|---|---|---|---|---|---|---|---|
| | Psi Pressure Drop per 100 Ft Equivalent Length at 40 F Saturation | | | | | | Condensing Temperature | |
| | ¼ | 1 | 2 | 3 | 4 | 5 | 115 F | 90 F |
| ⅜ OD | 0.14 | 0.20 | 0.28 | 0.35 | 0.41 | 0.45 | | |
| ⅜ IPS | 0.17 | 0.24 | 0.34 | 0.42 | 0.49 | 0.54 | | |
| ½ OD | 0.25 | 0.35 | 0.51 | 0.62 | 0.73 | 0.81 | 1.43 | 1.15 |
| ½ IPS | 0.35 | 0.45 | 0.65 | 0.79 | 0.93 | 1.03 | 1.87 | 1.50 |
| ⅝ OD | 0.55 | 0.76 | 1.10 | 1.34 | 1.58 | 1.75 | 2.97 | 2.38 |
| ¾ IPS | 0.68 | 0.94 | 1.35 | 1.65 | 1.92 | 2.12 | 3.26 | 2.62 |
| 1⅛ OD | 1.26 | 1.80 | 2.57 | 3.17 | 3.76 | 4.15 | 5.05 | 4.05 |
| 1 IPS | 1.43 | 2.01 | 2.89 | 3.54 | 4.17 | 4.60 | 5.29 | 4.25 |
| 1⅜ OD | 2.21 | 3.12 | 4.45 | 5.50 | 6.38 | 7.05 | 7.72 | 6.19 |
| 1¼ IPS | 2.70 | 3.82 | 5.37 | 6.72 | 7.68 | 8.48 | 9.16 | 7.35 |
| 1⅝ OD | 3.40 | 4.78 | 6.79 | 8.42 | 9.77 | 10.8 | 10.92 | 8.75 |
| 1½ IPS | 4.05 | 5.75 | 8.10 | 10.12 | 11.6 | 12.8 | 12.5 | 10.0 |
| 2⅛ OD | 6.12 | 8.60 | 12.1 | 15.1 | 17.4 | 19.2 | 19.2 | 15.3 |
| 2 IPS | 7.66 | 10.9 | 15.3 | 19.2 | 32.2 | 24.5 | 20.6 | 16.5 |
| 2⅝ OD | 12.0 | 17.1 | 24.0 | 30.1 | 34.6 | 38.2 | 32.2 | 25.9 |
| 2½ IPS | 12.0 | 17.1 | 24.0 | 30.1 | 34.6 | 38.2 | 32.2 | 25.9 |
| 3⅛ OD | 19.1 | 27.2 | 38.2 | 47.8 | 55.0 | 60.7 | 51.5 | 39.8 |
| 3 IPS | 20.9 | 29.4 | 42.3 | 51.8 | 60.0 | 66.2 | 54.5 | 43.8 |
| 3⅝ OD | 27.8 | 39.7 | 55.7 | 69.8 | 80.3 | 88.7 | 72.0 | 57.6 |
| 3½ IPS | 30.2 | 43.2 | 61.0 | 76.1 | 87.0 | 96.0 | 78.8 | 63.3 |
| 4⅛ OD | 38.6 | 55.2 | 78.0 | 97.3 | 111 | 123 | 95.8 | 77.1 |
| 4 IPS | 40.7 | 58.6 | 83.0 | 103 | 118 | 130 | 101.6 | 81.6 |
| 5 IPS | 71.3 | 100 | 141 | 176 | 203 | 224 | 171.5 | 137.8 |
| 6 IPS | 126 | 183 | 257 | 322 | 366 | 403 | 266 | 214 |
| 8 IPS | 211 | 297 | 422 | 523 | 602 | 664 | 461 | 370 |
| 10 IPS | 352 | 503 | 712 | 887 | 1024 | 1130 | 725 | 582 |
| 12 IPS | 550 | 780 | 1106 | 1373 | 1582 | 1748 | 1041 | 836 |

Since a reduction of suction pressure at the compressor results in an appreciable reduction in capacity and more power input per ton of refrigeration, great care should be given to the proper sizing of suction lines between the evaporator and the compressor. Although comparatively high velocities, 500 to 5000 fpm, may be used, the optimum value will depend upon the refrigerant and the operating pressure range. Since return of the oil to the compressor must be considered in the case of Freon and methyl chloride, for these refrigerants the minimum velocity should be 500 fpm for horizontal runs and 1000 fpm for vertical runs. For the Freons, the



usual design velocities range between 1000 and 2000 fpm. Too high velocities create noise problems and excessive pressure drops. The total pressure drop in the suction line should be between one and two psi, if the velocity can be kept to within the specified limits.

Compressor discharge or hot gas lines may be designed with velocities from 1000 to 5000 fpm, except for dense gases such as carbon dioxide, where noise considerations will reduce the upper limit. A pressure drop of 2 to 4 psi is recommended for the discharge lines. Extensive tables are available in the literature for the determination of pressure drops through refrigerant lines with various refrigerants. The capacities listed in Tables 5, 6 and 7 are published in ACRMA Equipment Standards-1946, of the *Air Conditioning and Refrigerating Machinery Association*, and are used by permission. Table 5 shows the tonnage capacity normally allowed for Freon-12 liquid lines per foot equivalent length of pipe, and Table 6 the maximum tonnage for suction and discharge Freon-12 lines. Table 7 presents suction-line capacity factors for equal pressure drop.

TABLE 7. APPROXIMATE SUCTION-LINE CAPACITY FACTORS FOR EQUAL PRESSURE DROP OF FREON-12

| Saturated Suction Temperature, F. | 50 | 40 | 30 | 20 | 10 | 0 | −10 | −20 |
|---|---|---|---|---|---|---|---|---|
| Factor | 1.09 | 1.00 | 0.92 | 0.86 | 0.80 | 0.74 | 0.66 | 0.56 |

## ACCESSORIES

Dehydrators, oil separators, strainers, vibration eliminators, sight glasses, and various types of valves are accessories frequently needed for the proper installation and operation of refrigeration systems. Refrigerant-line dehydrators or dryers usually consist of copper containers fitted with tubing connections at either end, and contain a desiccant such as silica gel, activated alumina, or calcium chloride. The liquid refrigerant is circulated through the dryer during operation of the system, and the moisture content of the refrigerant charge is thus kept to a minimum.

Oil separators are installed between the compressor and condenser to prevent excessive oil removal from the compressor crankcase and its passage into the condenser and evaporator. The oil is separated from the gaseous refrigerant by gravity during its passage through a chamber of sufficient size to reduce the velocity. A float-operated valve maintains a maximum oil level in the separator, and additional oil is forced by pressure difference through a line back to the crankcase.

Screen strainers are frequently installed in the liquid line piping before solenoid valves and expansion valves, as well as before regulating valves in water lines leading to water cooled condensers. Sight glasses which permit visual inspection of the condition of the refrigerant are sometimes installed on factory assembled commercial unit systems. It is particularly advisable to place such a fitting before the expansion valve, if the evaporator is located above the condenser.

Flexible vibration eliminators, usually consisting of a bellows design covered with woven copper wire, are sometimes installed in copper lines where units such as compressors are installed on flexible mountings, or