condenser. These losses result in a greater compression ratio, and therefore greater power requirements, as well as a lower volumetric efficiency and higher displacement requirements. Pressure losses in the liquid line between condenser or receiver and the expansion valve may result in some flashing of the liquid refrigerant, unless the liquid is subcooled. In all cases, frictional losses should be kept to a minimum, and piping should be selected which will give the smallest loss consistent with overall economy in the system.

Refrigerant liquid lines from the receiver to the expansion valve should be preferably designed with a pressure drop of less than 5 psi, and with 10 psi as the maximum. A velocity of 100 to 250 fpm is recommended to prevent a pressure drop great enough to cause vaporization of the refrigerant 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

TABLE 5. FREON-12 LIQUID LINES, TONS CAPACITY PER 100 FT EQUIVALENT LENGTH

LINE SIZE, INCHES	PRESSURE DROP PER 100 FT EQUIVALENT LENGTH, PSI			
	3	5	10	20
⅜ OD	0.88	1.14	1.80	2.58
½ OD	2.89	3.64	5.56	8.50
½ IPS	4.86	6.81	10.2	15.8
⅝ OD	4.86	6.81	10.2	15.8
¾ IPS	9.73	12.6	18.5	27.0
⅞ OD	10.5	14.1	21.8	33.0
1 IPS	21.4	28.2	41.3	60.8
1⅛ OD	21.4	28.2	41.3	60.8
1¼ IPS	36.9	48.1	70.5	101.
1⅜ OD	36.9	48.1	70.5	101.
1½ IPS	62.0	80.2	114.	160.
1⅝ OD	62.0	80.2	114.	160.
2 IPS	124.	161.	231.	328.
2½ IPS	230.	297.	426.	607.
3 IPS	364.	469.	676.	972.
3½ IPS	539.	704.	1005.	1430.
4 IPS	753.	972.	1385.	1945.

Note: Tonnage values above those underlined give velocities of 300 fpm or less.

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.

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

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 — Psi Pressure Drop per 100 Ft Equivalent Length at 40 F Saturation						DISCHARGE LINES — Condensing Temperature	
	½	1	2	3	4	5	115 F	90 F
⅜ OD	0.14	0.20	0.28	0.35	0.41	0.45		
½ IPS	0.17	0.24	0.34	0.42	0.49	0.54		
⅝ OD	0.25	0.35	0.51	0.62	0.73	0.81	1.43	1.15
¾ IPS	0.35	0.45	0.65	0.79	0.93	1.03	1.87	1.50
⅞ OD	0.55	0.76	1.10	1.34	1.58	1.75	2.97	2.38
1 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
1¼ 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
1½ 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

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 permis-

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