Table 6 .... Refrigerant Line Capacities for Intermediate or Low Stage Duty (Tons) for Refrigerants 12, 22, and Ammonia[1]

Refrigerant and ΔT Equivalent of Friction Drop[2]	Line Size Type L Copper OD	Suction Lines[3] Suction Temp F −90	−80	−70	−60	−50	−40	−30	Discharge Lines[3]	Line Size Type L Copper OD	Liquid Lines Condenser to Receiver V=100 fpm	Receiver to System[4]
Refrigerant 12	⅛									½		2.1
	⅜									⅝		3.9
	⅞				0.2	0.3	0.4	0.5	0.9	⅞		11.0
	1⅛	0.17	0.24	0.3	0.4	0.6	0.8	1.0	1.8	1⅛		21.5
	1⅜	0.30	0.42	0.6	0.8	1.1	1.4	1.7	3.2	1⅜		37.0
	1⅝	0.47	0.67	0.9	1.2	1.7	2.2	2.7	5.0	1⅝		60.0
	2⅛	1.00	1.40	1.9	2.5	3.5	4.6	5.7	10.5	2⅛		125.0
2 F ΔT Per 100 ft Equiv. Length	2⅝	1.7	2.4	3.3	4.5	6.1	8.0	10.0	18.5	2⅝		220.0
	3⅛	2.8	3.9	5.4	7.3	10.0	13.0	16.2	30.0	3⅛	See Table 2	350.0
	3⅝	4.1	5.9	8.2	10.8	15.0	19.5	24.3	44.0	3⅝		
	4⅛	6.0	8.5	11.7	15.6	21.5	28.0	35.0	65.0	4⅛		
	5⅛	10.6	15.1	20.8	27.8	38.5	50.0	62.5	113.0	5⅛		
	6⅛	18.1	25.8	35.4	47.2	65.4	85.0	106.0	180.0	6⅛		
	½									½		3.6
	⅝								0.6	⅝		7.0
Refrigerant 22	⅞	0.16	0.23	0.31	0.44	0.57	0.75	.094	1.5	⅞		18.0
	1⅛	0.34	0.48	0.65	0.91	1.19	1.55	1.93	3.0	1⅛		36.0
	1⅜	0.59	0.81	1.12	1.59	2.07	2.7	3.4	5.2	1⅜		63.0
	1⅝	0.93	1.34	1.8	2.5	3.3	4.3	5.4	8.5	1⅝		100.0
	2⅛	1.9	2.8	3.7	5.2	6.8	8.9	11.1	17.5	2⅛		210.0
2 F ΔT Per 100 ft Equiv. Length	2⅝	3.5	5.0	6.6	9.4	12.3	16.0	20.0	31.0	2⅝		375.0
	3⅛	5.5	8.0	10.6	15.0	19.6	25.5	32.0	50.0	3⅛	See Table 3	
	3⅝	8.4	12.0	16.0	22.6	29.5	38.5	48.0	75.0	3⅝		
	4⅛	12.0	17.2	22.9	32.3	42.3	55.0	68.8	105.0	4⅛		
	5⅛	21.2	30.6	41.0	57.5	75.0	98.0	122.0	190.0	5⅛		
	6⅛	34.8	50.0	66.5	94.0	123.0	160.0	200.0	305.0	6⅛		
	Steel IPS	SCH								Steel IPS	SCH	
						−60	−50	−40	−30			
	½	40				0.26	0.38	0.50	0.62	1.0	⅜ 80	17.0
	¾	40				0.55	0.76	1.05	1.30	2.1	½ 80	34.0
	1	40				1.05	1.53	2.00	2.50	4.1	¾ 80	75.0
Refrigerant 717 (Ammonia)	1¼	40				2.15	3.15	4.10	5.10	8.5	1 80	150.0
	1½	40				3.4	5.0	6.5	8.1	12.5	1¼ 80	305.0
	2	40				6.3	9.2	12.0	15.0	25.0	1½ 80	490.0
	2½	40				10.3	15.0	19.5	24.3	40.0	2 40	See Table 5
1 F ΔT Per 100 ft Equiv. Length	3	40				18.4	26.8	35.0	43.7	71.0	2½ 40	
	3½	40				27.3	39.8	52.0	65.0	105.0	3 40	
	4	40				37.8	55.2	72.0	90.0	145.0	3½ 40	
	5	40				68.3	100.0	130.0	162.0	260.0	4 40	
	6	40				110.0	161.0	210.0	262.0	425.0	5 40	
	8	40				258.0	376.0	490.0	610.0		6 40	
											8 40	

NOTES:

[1] (1) Values in this table are tons of refrigeration resulting in a line friction drop per 100 ft of equivalent pipe length corresponding to the change in saturation temp indicated under the refrigerant designation.

(2) Values based on 0 F saturated discharge temp. For capacities at other saturated discharge temp, multiply table value by proper line capacity multiplier from Table 7.

(3) For other ΔT's and Equivalent Lengths, L_e

$$\text{Line Capacity (Tons)} = \text{Table Tons} \times \left(\frac{100}{L_e} \times \frac{\text{Actual } \Delta T \text{ Loss Desired}}{\text{Table } \Delta T \text{ Loss}}\right)^{0.55}$$

(4) For other Tons and Equivalent Lengths in a given pipe size,

$$\Delta T = \text{Table } \Delta T \times \frac{L_e}{100} \times \left(\frac{\text{Actual Tons}}{\text{Table Tons}}\right)^{1.8}$$

(5) For pressure drop (psi) corresponding to ΔT, refer to Figs. 1, 2, and 4.

Table 7 .... Line Capacity Multipliers

Sat. Discharge Temp, F	Refrigerant 12 Suction	Refrigerant 12 Discharge	Refrigerant 22 Suction	Refrigerant 22 Discharge	Ammonia Discharge
−30	1.12	0.55	1.09	0.58	
−20	1.07	0.70	1.06	0.71	
−10	1.03	0.85	1.03	0.85	0.77
0	1.00	1.00	1.00	1.00	1.00
10	0.96	1.25	0.97	1.20	1.23
20	0.93	1.50	0.94	1.45	1.45
30	0.90	1.80	0.90	1.80	1.67

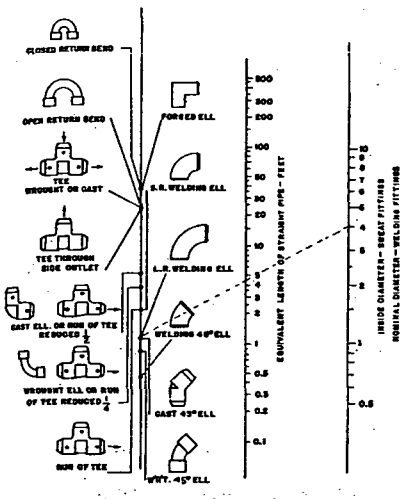


Fig. 5 .... Equivalent Lengths of Various Soldered and Welded Fittings

low stage applications and the Refrigerant 500 table are based on calculations using Fanning's equation for friction loss.

Equivalent Lengths of Valves and Fittings

Refrigerant line capacity tables are set up on the basis of a unit pressure drop per 100 ft length of straight pipe; or a combination of straight pipe, fittings and valves having a friction drop equivalent to a 100 ft length of straight pipe.

One of the common methods of determining pressure drop through valves and fittings is to establish the equivalent straight length of pipe of the same size having the same friction drop. This permits resolving the entire length of line, including valves and fittings, into an equivalent length of straight pipe, so that the line sizing tables can be used directly.

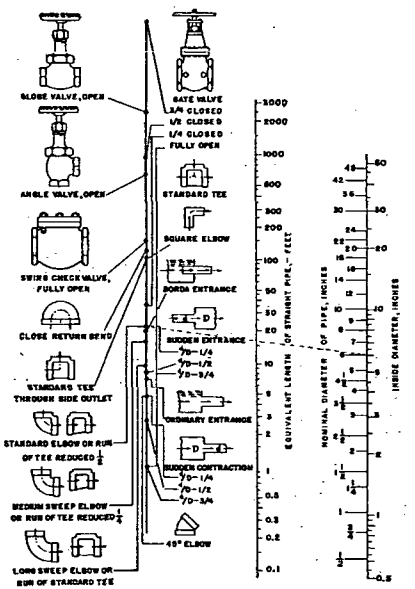
Figs. 5 and 6 give equivalent lengths of straight pipe for various fittings and valves, based on nominal pipe sizes.

REFRIGERANT LINE SIZING EXAMPLE

Example 1 illustrates the use of the various tables and charts in the sizing of refrigerant lines.

Example 1: Determine the line size and pressure drop equivalent (in degrees) for the suction line of a 30 ton Refrigerant 12 system, operating at 40 F suction and 100 F condensing temperatures. The suction line is to be copper tubing, with 50 ft of straight pipe and 6 elbows.

Solution: Add 50 percent to the straight length of pipe to establish a trial equivalent length. At a trial equivalent length of 75 ft (50 × 1.5), from Table 2, the line size for a capacity of 31.4 tons at 2 F deg loss for 100 ft equivalent length is 2⅝ in. OD. This size is used to establish the actual equivalent length.



Example: 6 in. elbow is equivalent to 16½ ft of straight pipe.

Fig. 6 .... Equivalent Lengths of Various Screwed Fittings

Straight pipe length	= 50 ft
6 Elbows at 6 ft each (Fig. 5)	= 36 ft
Total Equivalent Length	= 86 ft

The actual pressure loss in degrees (Note 3, Table 2)

$$\Delta T = 2 \times \frac{86}{100}\left(\frac{30}{31.4}\right)^{1.8} = 1.6 \text{ F deg}$$

From Fig. 1, the corresponding pressure drop is 1.4 psi.

REFRIGERANT FLOW

Refrigerant Line Velocities

Practical design velocities in refrigerant lines are based on a combined consideration of economics, pressure drop, noise, and oil entrainment.[2,3] A composite of various recommendations indicates certain velocity brackets (Table 8) although the maximum pressure drops and minimum gas velocities for oil return, as noted later in this section, must be limiting factors.

Refrigerant Flow Rates

Refrigerant flow rates, in lb per min per ton of refrigeration, are indicated in Figs. 7, 8, and 9 for Refrigerants 12, 22, and 717 (ammonia).