Engineering Recommendation on:
Refrigerant Line Sizes for Remote Systems
R-22, R-134a, R-404A

No. ER-8
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In the selection of refrigerant line sizes, the design engineer should be guided by the following criteria:

1. Assurance of adequate velocity thus insuring oil return capability. As a general rule, the suction and discharge lines should be sized to maintain velocities no less than 750 fpm for horizontal and down flow sections and no less than 1500 fpm for vertical risers.
2. Assurance of acceptable pressure drop. The suction, liquid, and discharge lines should be sized such that the pressure loss is equivalent to 2°F or less.
3. Assurance of satisfactory sound level. The suction and discharge lines should be sized to maintain velocities no greater than 3000 fpm. The liquid line should be sized to maintain velocities no greater than 300 fpm.
4. Assurance of minimum tubing cost. The tube size should be as small as possible while satisfying the criteria mentioned above.

In an attempt to aid the engineer on this subject, we have prepared reference tables of suggested suction and liquid line sizes which follow the above criteria.

R-22, 45°F Evap Temp, 65°F Suction Vapor Temp, 105°F Condensing and Liquid Temp

	Line Size, Type L Copper OD (in)									
	Suction Lines					Liquid Lines				
	Line Length, Equivalent feet				Velocity =	Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *	10	25	50	100	100 fpm *
1000	1/4	1/4	5/16	5/16	3/16	3/16	3/16	3/16	3/16	~
2000	1/4	5/16	5/16	3/8	1/4	3/16	3/16	3/16	1/4	~
3000	5/16	5/16	3/8	1/2	5/16	3/16	3/16	1/4	1/4	3/16
4000	5/16	3/8	3/8	1/2	5/16	3/16	1/4	1/4	1/4	3/16
6000	3/8	3/8	1/2	1/2	3/8	3/16	1/4	1/4	5/16	1/4
8000	3/8	1/2	1/2	5/8	3/8	1/4	1/4	5/16	5/16	1/4
10,000	1/2	1/2	1/2	5/8	1/2	1/4	1/4	5/16	5/16	5/16
12,000	1/2	1/2	5/8	5/8	1/2	1/4	5/16	5/16	3/8	5/16
18,000	1/2	5/8	5/8	3/4	5/8	1/4	5/16	3/8	3/8	3/8
24,000	5/8	5/8	3/4	7/8	3/4	5/16	3/8	3/8	1/2	3/8
30,000	5/8	3/4	7/8	7/8	3/4	5/16	3/8	1/2	1/2	1/2
36,000	5/8	3/4	7/8	1-1/8	7/8	5/16	3/8	1/2	1/2	1/2
48000	3/4	7/8	1-1/8	1-1/8	7/8	3/8	1/2	1/2	5/8	5/8
60000	3/4	7/8	1-1/8	1-1/8	1-1/8	3/8	1/2	1/2	5/8	5/8
72000	7/8	7/8	1-1/8	1-3/8	1-1/8	1/2	1/2	5/8	5/8	3/4

R-22, 20°F Evap Temp, 40°F Suction Vapor Temp, 105°F Condensing and Liquid Temp											
	Line Size, Type L Copper OD (in)										
	Suction Lines						Liquid Lines				
	Line Length, Equivalent feet				Velocity =		Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *		10	25	50	100	100 fpm *
1000	1/4	5/16	5/16	3/8	1/4		3/16	3/16	3/16	3/16	~
2000	5/16	5/16	3/8	1/2	5/16		3/16	3/16	3/16	1/4	~
3000	5/16	3/8	1/2	1/2	3/8		3/16	3/16	3/16	1/4	3/16
4000	3/8	1/2	1/2	1/2	3/8		3/16	3/16	1/4	1/4	3/16
6000	3/8	1/2	1/2	5/8	1/2		3/16	1/4	1/4	5/16	1/4
8000	1/2	1/2	5/8	5/8	1/2		1/4	1/4	5/16	5/16	1/4
10,000	1/2	5/8	5/8	3/4	5/8		1/4	1/4	5/16	5/16	5/16
12,000	1/2	5/8	3/4	3/4	5/8		1/4	5/16	5/16	3/8	5/16
18,000	5/8	3/4	3/4	7/8	3/4		5/16	5/16	3/8	3/8	3/8
24,000	5/8	3/4	7/8	1-1/8	7/8		5/16	3/8	3/8	1/2	3/8
36,000	3/4	7/8	1-1/8	1-1/8	1-1/8		5/16	3/8	1/2	1/2	1/2
48,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8		3/8	1/2	1/2	5/8	5/8

R-134a, 45°F Evap Temp, 65°F Suction Vapor Temp, 105°F Condensing and Liquid Temp											
	Line Size, Type L Copper OD (in)										
	Suction Lines						Liquid Lines				
	Line Length, Equivalent feet				Velocity =		Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *		10	25	50	100	100 fpm *
1000	1/4	5/16	5/16	3/8	1/4		3/16	3/16	3/16	3/16	~
2000	5/16	5/16	3/8	1/2	5/16		3/16	3/16	1/4	1/4	~
3000	5/16	3/8	1/2	1/2	5/16		3/16	1/4	1/4	1/4	3/16
4000	3/8	1/2	1/2	5/8	3/8		3/16	1/4	1/4	5/16	3/16
6000	1/2	1/2	5/8	5/8	1/2		1/4	1/4	5/16	5/16	1/4
8000	1/2	1/2	5/8	3/4	1/2		1/4	1/4	5/16	5/16	1/4
10,000	1/2	5/8	5/8	3/4	5/8		1/4	5/16	5/16	3/8	5/16
12,000	1/2	5/8	3/4	3/4	5/8		1/4	5/16	5/16	3/8	5/16
18,000	5/8	3/4	7/8	7/8	3/4		5/16	3/8	3/8	1/2	3/8

R-134a, 20°F Evap Temp, 40°F Suction Vapor Temp, 105°F Condensing and Liquid Temp											
	Line Size, Type L Copper OD (in)										
	Suction Lines						Liquid Lines				
	Line Length, Equivalent feet				Velocity =		Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *		10	25	50	100	100 fpm *
1000	5/16	5/16	3/8	1/2	1/4		3/16	3/16	3/16	3/16	~
2000	3/8	3/8	1/2	1/2	3/8		3/16	3/16	1/4	1/4	~
3000	3/8	1/2	1/2	5/8	3/8		3/16	1/4	1/4	1/4	3/16
4000	1/2	1/2	5/8	5/8	1/2		3/16	1/4	1/4	5/16	3/16
6000	1/2	5/8	5/8	3/4	5/8		1/4	1/4	5/16	5/16	1/4
8000	1/2	5/8	3/4	7/8	5/8		1/4	1/4	5/16	3/8	1/4
10,000	5/8	3/4	3/4	7/8	3/4		1/4	5/16	5/16	3/8	5/16
12,000	5/8	3/4	7/8	1-1/8	7/8		1/4	5/16	3/8	3/8	5/16
18,000	3/4	7/8	1-1/8	1-1/8	7/8		5/16	3/8	3/8	1/2	3/8

R-134a, -10°F Evap Temp, 40°F Suction Vapor Temp, 105°F Condensing and Liquid Temp											
	Line Size, Type L Copper OD (in)										
	Suction Lines						Liquid Lines				
	Line Length, Equivalent feet				Velocity =		Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *		10	25	50	100	100 fpm *
1000	3/8	1/2	1/2	1/2	3/8		3/16	3/16	3/16	3/16	~
2000	3/8	1/2	5/8	5/8	1/2		3/16	3/16	1/4	1/4	3/16
3000	1/2	5/8	3/4	3/4	5/8		3/16	1/4	1/4	1/4	3/16
4000	1/2	5/8	3/4	7/8	3/4		3/16	1/4	1/4	5/16	3/16
6000	5/8	3/4	7/8	1-1/8	7/8		1/4	1/4	5/16	5/16	1/4

R-404A, 45°F Evap Temp, 65°F Suction Vapor Temp, 105°F Condensing and Liquid Temp											
	Line Size, Type L Copper OD (in)										
	Suction Lines						Liquid Lines				
	Line Length, Equivalent feet				Velocity =		Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *		10	25	50	100	100 fpm *
1000	1/4	1/4	5/16	5/16	3/16		3/16	3/16	3/16	3/16	~
2000	1/4	5/16	5/16	3/8	1/4		3/16	3/16	1/4	1/4	3/16
3000	5/16	3/8	3/8	1/2	5/16		3/16	1/4	1/4	1/4	3/16
4000	5/16	3/8	1/2	1/2	5/16		3/16	1/4	1/4	5/16	1/4
6000	3/8	1/2	1/2	5/8	3/8		1/4	1/4	5/16	5/16	5/16
8000	3/8	1/2	1/2	5/8	3/8		1/4	5/16	5/16	3/8	5/16
10,000	1/2	1/2	5/8	5/8	1/2		1/4	5/16	5/16	3/8	3/8
12,000	1/2	1/2	5/8	3/4	1/2		1/4	5/16	3/8	3/8	3/8
18,000	1/2	5/8	3/4	3/4	5/8		5/16	3/8	3/8	1/2	1/2
24,000	5/8	3/4	3/4	7/8	3/4		5/16	3/8	1/2	1/2	1/2
30,000	5/8	3/4	7/8	1-1/8	3/4		3/8	1/2	1/2	1/2	5/8
36,000	5/8	3/4	7/8	1-1/8	7/8		3/8	1/2	1/2	5/8	5/8
42,000	3/4	7/8	1-1/8	1-1/8	7/8		3/8	1/2	1/2	5/8	3/4

R-404A, 20°F Evap Temp, 40°F Suction Vapor Temp, 105°F Condensing and Liquid Temp										
	Line Size, Type L Copper OD (in)									
	Suction Lines					Liquid Lines				
	Line Length, Equivalent feet				Velocity =	Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *	10	25	50	100	100 fpm *
1000	1/4	5/16	5/16	3/8	1/4	3/16	3/16	3/16	3/16	~
2000	5/16	3/8	3/8	1/2	5/16	3/16	3/16	1/4	1/4	3/16
3000	3/8	3/8	1/2	1/2	3/8	3/16	1/4	1/4	1/4	1/4
4000	3/8	1/2	1/2	5/8	3/8	3/16	1/4	1/4	5/16	1/4
6000	1/2	1/2	5/8	5/8	1/2	1/4	1/4	5/16	5/16	5/16
8000	1/2	5/8	5/8	3/4	1/2	1/4	5/16	5/16	3/8	5/16
10,000	1/2	5/8	3/4	3/4	5/8	1/4	5/16	5/16	3/8	3/8
12,000	1/2	5/8	3/4	7/8	5/8	1/4	5/16	3/8	3/8	3/8
18,000	5/8	3/4	7/8	1-1/8	3/4	5/16	3/8	3/8	1/2	1/2
24,000	3/4	7/8	7/8	1-1/8	7/8	5/16	3/8	1/2	1/2	1/2
30,000	3/4	7/8	1-1/8	1-1/8	7/8	3/8	1/2	1/2	1/2	5/8
36,000	3/4	7/8	1-1/8	1-3/8	1-1/8	3/8	1/2	1/2	5/8	5/8
48,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1/2	1/2	5/8	5/8	3/4
60,000	1-1/8	1-1/8	1-3/8	1-3/8	1-3/8	1/2	1/2	5/8	5/8	7/8

R-404A, -10°F Evap Temp, 40°F Suction Vapor Temp, 105°F Condensing and Liquid Temp										
	Line Size, Type L Copper OD (in)									
	Suction Lines					Liquid Lines				
	Line Length, Equivalent feet				Velocity =	Line Length, Equivalent feet				Velocity =
Btu/h	10	25	50	100	1500 fpm *	10	25	50	100	100 fpm *
1000	5/16	3/8	3/8	1/2	5/16	3/16	3/16	3/16	3/16	~
2000	3/8	1/2	1/2	5/8	3/8	3/16	3/16	1/4	1/4	3/16
3000	1/2	1/2	5/8	5/8	1/2	3/16	1/4	1/4	1/4	1/4
4000	1/2	5/8	5/8	3/4	1/2	1/4	1/4	1/4	5/16	1/4
6000	1/2	5/8	3/4	7/8	5/8	1/4	1/4	5/16	5/16	5/16
8000	5/8	3/4	3/4	7/8	3/4	1/4	5/16	5/16	3/8	3/8
10,000	5/8	3/4	7/8	1-1/8	7/8	1/4	5/16	3/8	3/8	3/8
12,000	3/4	7/8	7/8	1-1/8	7/8	5/16	5/16	3/8	1/2	3/8
18,000	3/4	7/8	1-1/8	1-1/8	1-1/8	5/16	3/8	1/2	1/2	1/2

* Largest line size that will maintain the stated refrigerant velocity. Please consult industry references such as the ASHRAE Refrigeration Handbook for additional information regarding how to properly size suction line risers and condenser to receiver condensate lines.