GE APPLIANCES
a Haier *company*

Refrigerant Piping Guidelines

IMPORTANT

The intent of this manual is to represent generally accepted safe engineering practices. Specifications and limits outlined in this manual are subject to change. System design should conform to all codes, laws, and regulations applying at the site at the time of installation. Additional documents that should be followed include The Safety Code for Mechanical Refrigeration and the Code for Refrigeration Piping, both available from ASHRAE. In Addition, the procedures and limits outlined in this manual do no supersede local, state or national codes under any circumstances.

Introduction

The piping design of any air conditioning system will affect performance, reliability, and applied cost of that system. An application with long line sets or elevation differences between the outdoor unit and the indoor unit can require accessories and line set size optimization to ensure proper operation, performance and reliability. This guideline applies to all residential single and two-stage air conditioners and heat pumps.

Line set is considered “long” when it is longer than 50 ft. or has more than 10 ft. vertical separation. For variable speed air conditioners and heat pumps, please refer to the unit installation manual.

Piping Limits

The indoor coil must use a non-bleed TXV to control refrigerant migration during Off cycle. GEA add-on TXV kits H4TXV01, H4TXV02 and H4TXV03 are non-bleed TXVs. Also, GEA’s factory-installed TXV indoor coils are equipped with non-bleed TXVs and meet requirements for long line sets.

Accessories and piping requirements will be detailed based on three types of installations: outdoor unit and indoor unit on same level, outdoor unit below indoor unit and outdoor unit above indoor unit.

Air Conditioners

Total Equivalent Length (piping and all fittings)	240 ft.
Maximum Linear Length	200 ft.
Maximum Linear Liquid Lift	60 ft.
Maximum Vapor Riser	125 ft.
NOTE: *Length is a general guide. Lengths may be more or less, depending on remaining system design factors.*	

Heat Pumps

Total Equivalent Length (piping and all fittings)	240 ft.
Maximum Linear Length	200 ft.
Maximum Linear Liquid Lift	60 ft.
Maximum Vapor Riser	60 ft.
NOTE: *Length is a general guide. Lengths may be more or less, depending on remaining system design factors.*	
NOTE: *Because flow is reversed in heating mode vapor riser is limited by liquid lift requirement.*	

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(P) 508084-01G

*** Check that equipment complies with all applicable building codes, laws, and regulations for its intended use prior to installation.**

Recommended Components

- Pressure taps installed at the inlet and outlet of indoor coil for measuring pressures for calculating superheats and sub-cooling values
- Hard Start kit required if unit supply voltage is less than 230V
- Sight glass installed at indoor unit
- Anti-short cycle protection
  - On; at least 4 minutes
  - Off; usually 5 minutes

NOTE: *Most thermostats contain these features.*

Air Conditioner

Outdoor unit on same level as indoor unit

Up to 50 ft. linear	No additional requirements
51 to 80 ft. linear	Crankcase heater
81 to 200 ft. linear	Crankcase heater, non-bleed TXV and inverted trap at indoor

Outdoor unit below indoor unit (11-60 ft. vertical lift)

Up to 50 ft. linear	Crankcase heater and non-bleed TXV
51 to 200 ft. linear	Crank case heater, hard start kit, non-bleed TXV and inverted trap at indoor

Outdoor unit above indoor unit (21-125 ft. vapor riser)

Up to 50 ft. linear	Crankcase heater, non-bleed TXV. (May require vapor riser size reduction.) See Table 1.
51 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV. (May require vapor riser size reduction.) See Table 1.

Heat Pump

Outdoor unit on same level as indoor unit

Up to 50 ft. linear	No additional requirements
51 to 80 ft. linear	Crankcase heater, non-bleed TXV on indoor
81 to 200 ft. linear	Crankcase heater, non-bleed TXV on indoor, bi-flow liquid line solenoid* (field-provided) and inverted trap at indoor * Recommended bi-flow solenoid is Sporlan CE6-HP Series

Outdoor unit below indoor unit (11-60 ft. vertical lift)

Up to 80 ft. linear	No additional requirements
81 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV on indoor, bi-flow liquid line solenoid* (field-provided) and inverted trap at indoor * Recommended bi-flow solenoid is Sporlan CE6-HP Series

Outdoor unit above indoor unit (21-60 ft. vapor riser)

Up to 50 ft. linear	Crankcase heater, non-bleed TXV. (May require vapor riser size reduction.) See Table 1.
51 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV. (May require vapor riser size reduction.) See Table 1.

HFC-410A Vapor Lines

Residential Application					
Unit	**Unit Tons**	**Suction / Vapor Line Size**	**HFC-410A Pressure Drop PSI / 100 ft.**	**Required for Vertical Vapor Rises***	**Preferred for Horizontal Runs**
12	1	1/2”	7.8	X	
		5/8”	1.9		X
18	1.5	5/8”	3.9	X	
		3/4”	1.4		X
24	2	5/8”	7.2	X	
		3/4”	2.5		X
30	2.5	3/4”	3.6	X	
		7/8”	1.9		X
36	3	3/4”	5.1	X	
		7/8”	2.8		X
42	3.5	7/8”	3.5	X	
		1-1/8”	0.8		X
48	4	7/8”	4.7	X	
		1-1/8”	1.1		X
60	5	7/8”	7.2	X	
		1-1/8”	1.7		X
* Line reduction only for air handler/coil 21ft. or more below condenser					

Table 1.

Piping Method

One of the two methods of piping shown in Figure 1 should be used to prevent liquid migration in Off cycle.

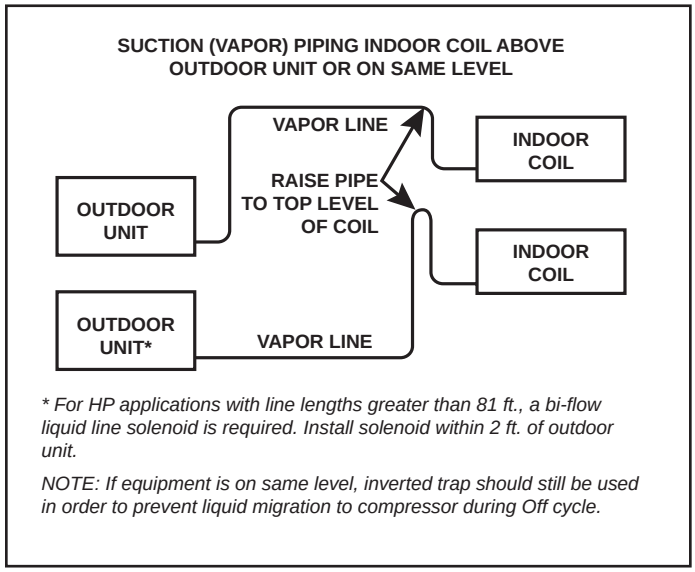


Figure 1. Outdoor Unit On Same Level or Outdoor Unit Below Indoor Unit

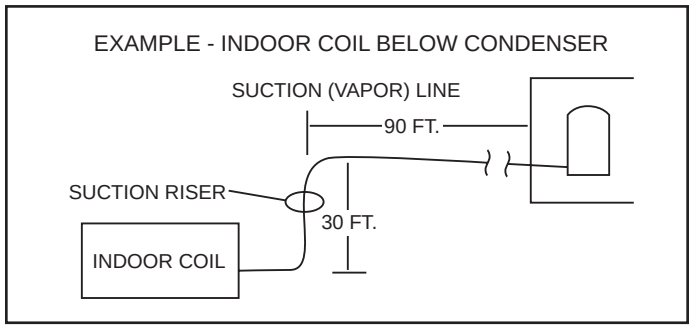
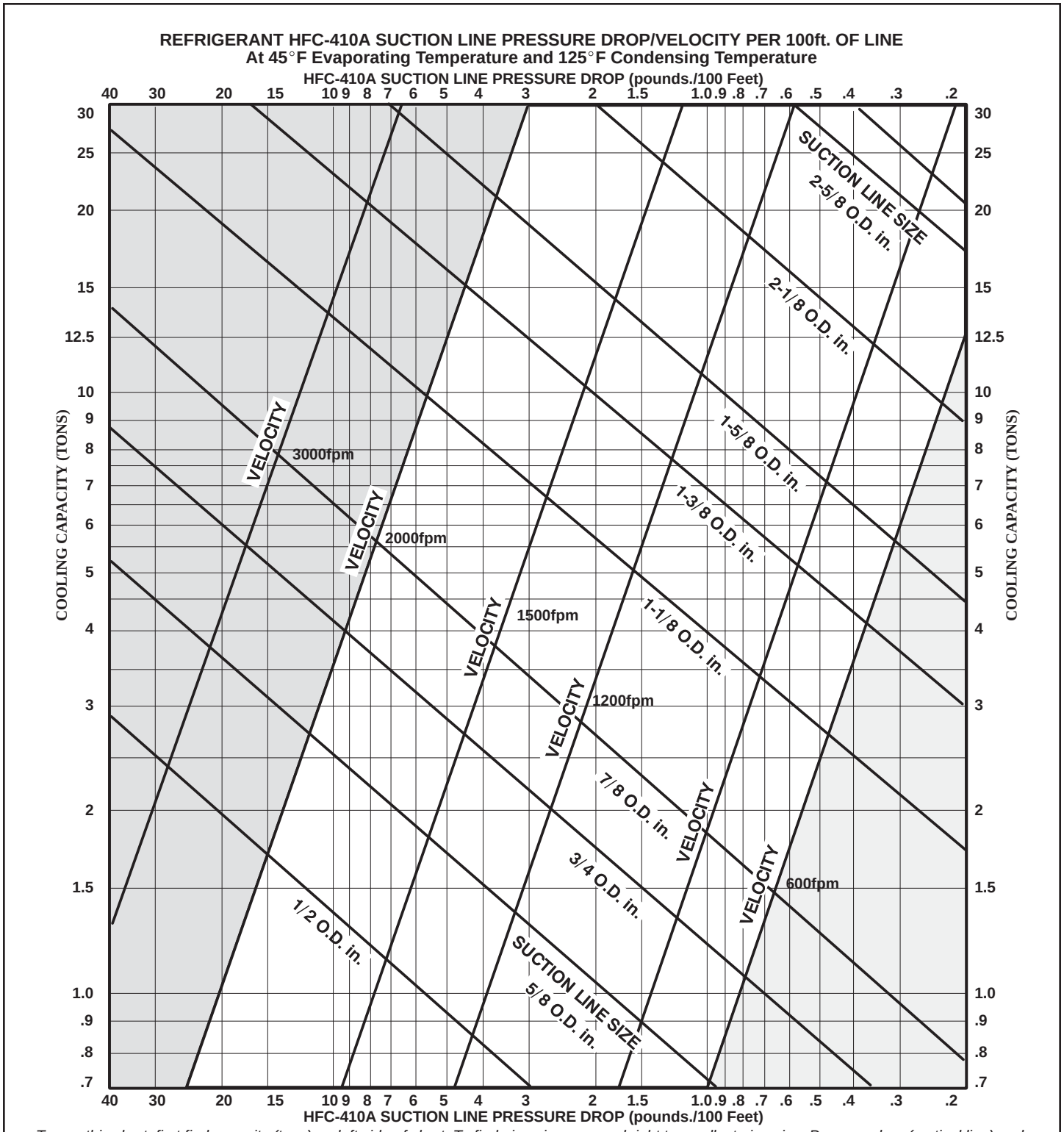


Figure 2. Outdoor Unit Above Indoor Unit

Figure 2 shows the piping method for an outdoor unit that is above an indoor unit. Suction riser and horizontal runs should be chosen based on the information in Table 1. Vapor riser should maintain minimum of 1200 fpm for oil return.

Example: A 4-ton unit would utilize 1-1/8” vapor line in horizontal runs. A 7/8” line would be utilized for the riser to aid in oil return but limit overall pressure drop and capacity loss.



To use this chart, first find capacity (tons) on left side of chart. To find pipe size, proceed right to smallest pipe size. Pressure drop (vertical line) and velocity (diagonal lines) can then be determined for the pipe size selected. For example, for 10 ton unit, select 1-3/8 in. outside diameter. line. NOTE—Shaded area denotes unacceptable velocity range.

Figure 3.

Equivalent Length in Feet of Straight Pipe for Valves and Fittings

Line Size (Outside Diameter) (in.)	Solenoid / Global Globe Valve	Angle Valve	90° Long* Radius Elbow	45° Long* Radius Elbow	Tee Line	Tee Branch
3/8	7	4	0.8	0.3	0.5	1.5
1/2	9	5	0.9	0.4	0.6	2.0
5/8	12	6	1.0	0.5	0.8	2.5
3/4	14	7	1.3	0.6	0.9	3.0
7/8	15	8	1.5	0.7	1.0	3.5
1-1/8	22	12	1.8	0.9	1.5	4.5
1-3/8	28	15	2.4	1.2	1.8	6.0
* Long radius elbow. Multiply factor by 1.5 for short radius elbow equivalent length.						

Table 2.

Finding Pressure Drop in Vapor Line

Using the previous example of a 4-ton unit with 92 ft. horizontal run and 30 ft. vertical run using four (4) long radius 90° fittings. Using Figure 3, the 1-1/8" vapor line does not maintain required the velocity in the riser, so this requires the riser to be reduced to 7/8".

- 4-ton unit utilizing 1-1/8" line has a pressure drop of 1 psi/100 ft. (see Figure 3)
- 4-ton unit utilizing 7/8" line has pressure drop of 4 psi/100 ft. (see Figure 3)
- 1-1/8" long radius 90° fitting has equivalent length of 1.8 ft. (see Table 2)
- Total equivalent length of 1-1/8" pipe is 4 X 1.8 = 7.2 ft. for fittings + 92 linear ft. = 99.2 ft.
- Find pressure drop: 1/100 X 99.2 = .992 psi for 1-1/8" line
- Find pressure drop for 7/8" riser: 4/100 X 30 = 1.2 psi
- Total pressure drop in vapor line: .992 + 1.2 = 2.192 psi.

  In this example, the total pressure drop is kept to a minimum while achieving the velocity required for oil return in the riser.
- Find capacity loss: Capacity loss is found by using the following calculation: .01 X pressure drop X Btu = Btu loss

  For the above example, .01 X 2.192 X 48000 = 1052.16 Btu. This number should be considered when sizing equipment.

Vapor Line

Vapor line pressure drop and velocity are both important aspects of ensuring systems operate reliably and with the least impact to performance. A pressure drop of 5 psi or less is acceptable. There is approximately 1% capacity loss per 1 psi pressure drop on the vapor line. See Table 3.

For 2-stage systems, use low capacity output for sizing vapor line risers (low capacity output on GEA 2-stage equipment is 75% of full load). Vapor line velocity is very important to ensure proper oil return. Minimum velocity should be approximately 800 fpm in horizontal runs and 1200 fpm in vertical runs. Figure 3 should be used when finding these values.

Liquid Line

Liquid line should always be 3/8" line for residential units. Liquid line should be insulated when it passes through an environment with higher temperatures than subcooled refrigerant temps (105-115°F liquid temp at 95°F ambient). This will prevent sweating on systems that have 20 psi or more liquid pressure drop. For HP applications with line lengths greater than 81 ft., a field-provided bi-flow liquid line solenoid is required. Install solenoid within 2 ft. of liquid service valve. Filter drier is required if outdoor unit does not have one factory installed. Refer to Figure 5 for liquid line pressure drop.

Piping Installation

Refrigerant lines must not transmit equipment vibration to any part of the structure. Lines should be supported by isolation hangers. See Figure 4.

Refrigeration lines should NOT be left unsupported and free to touch the structure at any point. Where lines pass through roofs, walls, floors or sills, or where they come in contact with duct work, they should be properly isolated. If outside, the isolation material should be properly waterproofed.

The piping must be supported securely at the proper places. All piping should be supported with hangers that can withstand the combined weight of pipe, fittings, refrigerant and insulation. The hangers must be able to keep the pipe in proper alignment, preventing any droop.

Refrigeration lines must not be buried in the ground unless they are insulated and waterproofed. Un-insulated copper lines buried in wet soil or under concrete can cause serious capacity loss and erratic operation as well as early failure due to corrosion

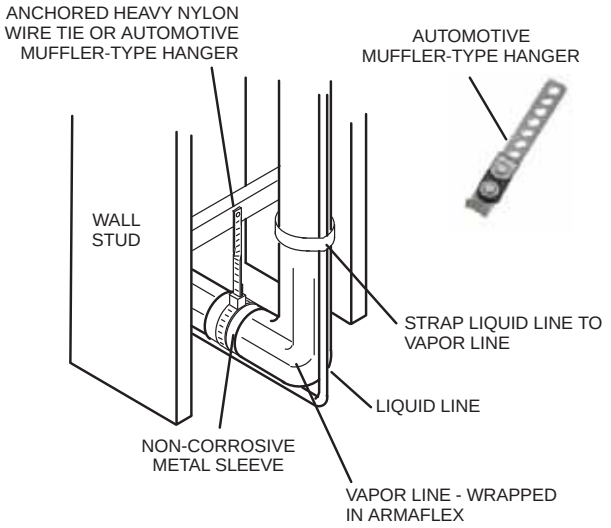
LINE SET

IMPORTANT — Refrigerant lines must not contact structure.

INSTALLATION

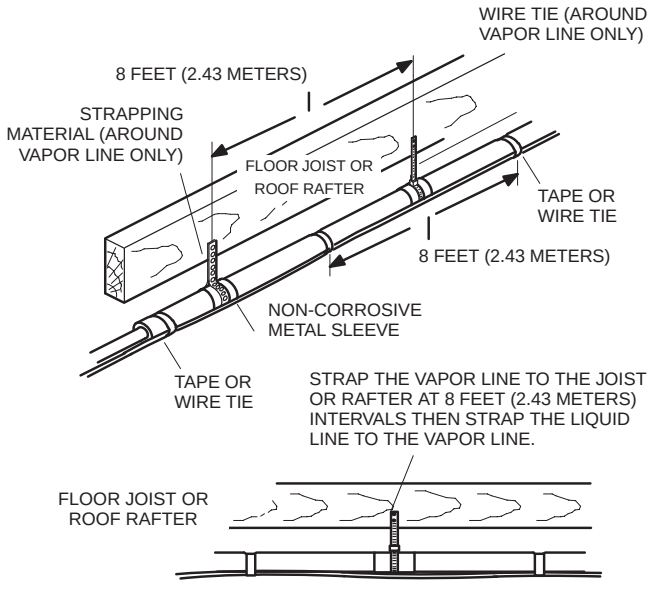
Line Set Isolation — The following illustrations are examples of proper refrigerant line set isolation:

REFRIGERANT LINE SET — TRANSITION FROM VERTICAL TO HORIZONTAL



REFRIGERANT LINE SET — INSTALLING HORIZONTAL RUNS

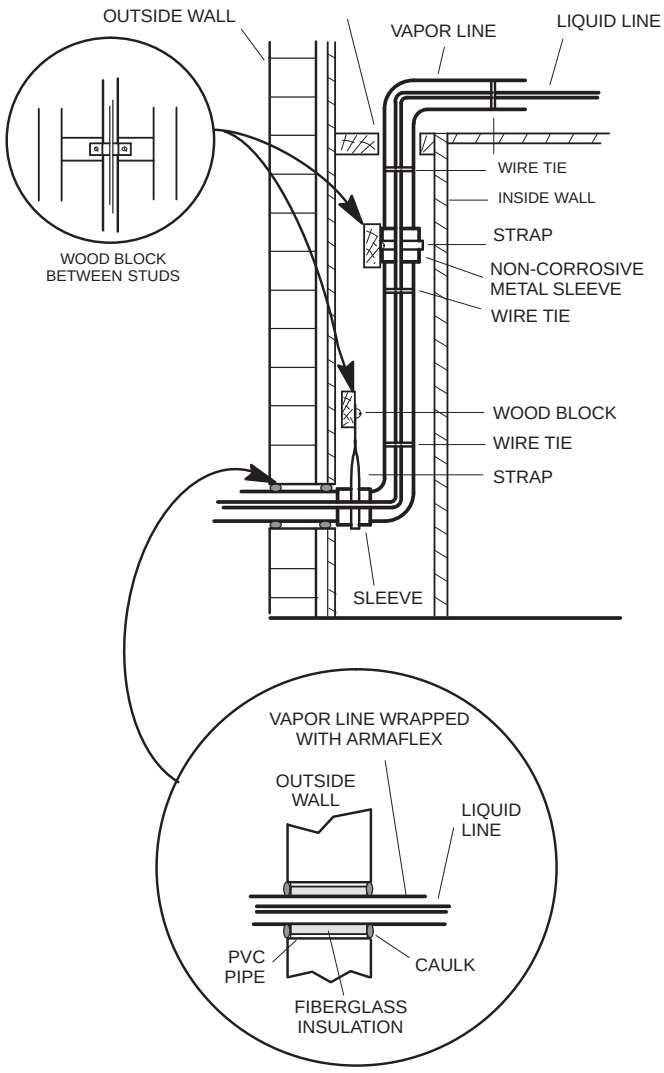
To hang line set from joist or rafter, use either metal strapping material or anchored heavy nylon wire ties.



REFRIGERANT LINE SET — INSTALLING VERTICAL RUNS (NEW CONSTRUCTION SHOWN)

NOTE — Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

IMPORTANT — Refrigerant lines must not contact wall



***NOTE** — Similar installation practices should be used if line set is to be installed on exterior of outside wall.*

WARNING — Polyol ester (POE) oils used with HFC-410A refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. DO NOT remove line set caps or service valve stub caps until you are ready to make connections.

Figure 4.

Unit BTU	Tonnage	Vapor Line Size (in.)	Pressure Drop psi / 100 ft.	Equivalent Length / Cooling Capacity Loss (%)								
				25 ft.	50 ft.	80 ft.	100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	240 ft.
18000	1.5	5/8	3.9	1.0	2.0	3.1	3.9	4.9	5.9	6.8	7.8	9.4
		3/4	1.4	0.4	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.4
24000	2	5/8	7.2	1.8	3.6	5.8	7.2	9.0	10.8	12.6	14.4	17.3
		3/4	2.5	0.6	1.3	2.0	2.5	3.1	3.8	4.4	5.0	6.0
30000	2.5	5/8	3.6	0.9	1.8	2.9	3.6	4.5	5.4	6.3	7.2	8.6
		3/4	1.9	0.5	1.0	1.5	1.9	2.4	2.9	3.3	3.8	4.6
36000	3	3/4	5.1	1.3	2.6	4.1	5.1	6.4	7.7	8.9	10.2	12.2
		7/8	2.8	0.7	1.4	2.2	2.8	3.5	4.2	4.9	5.6	6.7
42000	3.5	7/8	3.5	0.9	1.8	2.8	3.5	4.4	5.3	6.1	7.0	8.4
		1-1/8	0.08	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2
48000	4	7/8	4.7	1.2	2.4	3.8	4.7	5.9	7.1	8.2	9.4	11.3
		1-1/8	1.1	0.3	0.6	0.9	1.1	1.4	1.7	1.9	2.2	2.6
60000	5	7/8	7.2	1.8	3.6	5.8	7.2	9.0	10.8	12.6	14.4	17.3
		1-1/8	1.7	0.4	0.9	1.4	1.7	2.1	2.6	3.0	3.4	4.1

Table 3.

System Charge

GEA split residential units come precharged for 15 ft. of line set. Additional charge is required over 15 ft. For 3/8" liquid line, charge should be added at .60 ounces per foot.

Charge unit in ambient at 70°F or above. For low ambient charging below 70°F, restrict condenser airflow to achieve 400 psi liquid pressure for proper charging.

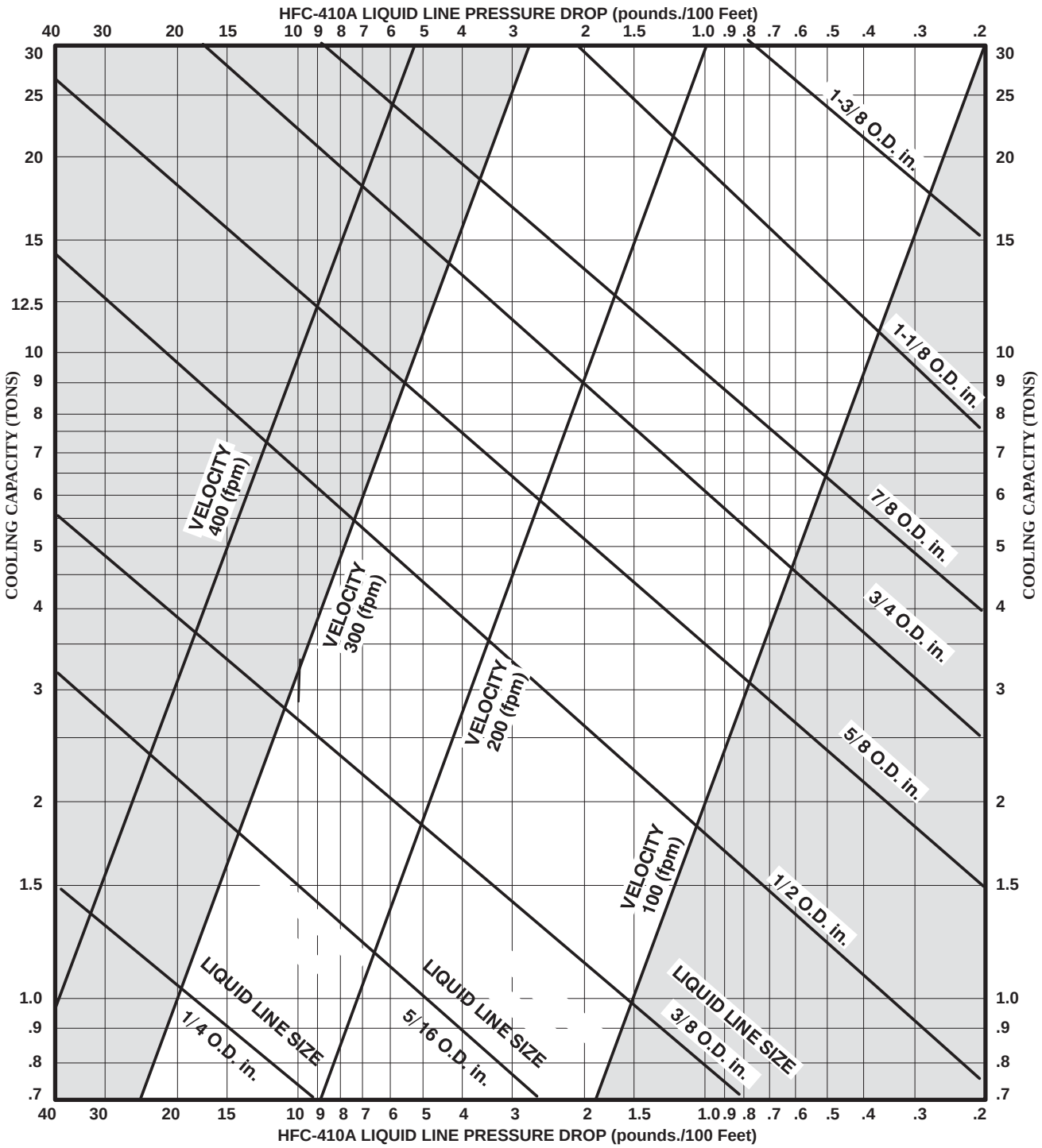
For longer line sets and line sets with vertical liquid lift, subcooling should be checked at the indoor unit using ports installed at evaporator inlet and outlet or sight glass installed at indoor unit. Minimum of 4°F subcooling should be measured at the evaporator to insure 100% liquid to TXV. If flashing occurs in liquid line units performance will be significantly affected.

Safety

- Only licensed and trained service technicians should perform the installation and service of air conditioning and heat pump equipment. Electrical shock, injury, death, fire and explosion can occur if proper procedures are not followed.
- Wear protective safety equipment to prevent injuries at all times.
- Electrical power must be disconnected before working on any equipment
- Refrigeration systems contain refrigerants under high pressure; caution must be observed at all times
- It is a federal violation to vent refrigerants into the atmosphere; proper equipment must be used to recover/reclaim refrigerants

Warranty

Any installations that do not comply with the guidelines in this manual shall lose warranty coverage. For unique installations outside of the guidelines, a written approval may be granted after review by the Technical Service and Engineering department. Call the HVAC Tech team at 1.866.814.3633.



To use this chart, first find capacity (tons) on left side of chart. To find pipe size, proceed right to smallest pipe size. Pressure drop (vertical line) and velocity (diagonal lines) can then be determined for the pipe size selected. For example, for 10 ton unit, select 5/8 in. outside diameter. line.

NOTE—Shaded area denotes unacceptable velocity range.

Figure 5.