

Residential Piping and Long Line Guideline

TABLE OF CONTENTS

A. Safety Considerations	2
B. Definitions	2
C. Introduction	3
D. General Limitations	3-4
E. Interconnecting Tubing and Fitting Losses	4
F. Metering Device — Long Line Set Cooling	5
G. Piston Sizing — Heat Pump Only	5
H. Liquid Line Solenoid — Heat Pump Only	5
I. Charging Information	5
J. General Requirements (Check List)	11
K. Puron® Refrigerant Quick Reference Guide	12

APPLICATIONS

EQUAL-LEVEL APPLICATIONS	8
OUTDOOR UNIT BELOW INDOOR UNIT	9
OUTDOOR UNIT ABOVE INDOOR UNIT	10

INDEX TO TABLES

TABLE 1	Long Line Accessory Requirements	4
TABLE 2	Fitting Losses in Equivalent Feet	4
TABLE 3A	Vapor Line Sizing and Cooling Capacity Loss — Single–Stage Air Conditioner Applications	6
TABLE 3B	Vapor Line Sizing and Cooling Capacity Loss — Single–Stage Heat Pump Applications	6
TABLE 4A	Vapor Line Sizing and Cooling Capacity Loss — Two–Stage Air Conditioner Applications	7
TABLE 4B	Vapor Line Sizing and Cooling Capacity Loss — Two–Stage Heat Pump Applications	7
TABLE 5	Refrigerant Charge Adjustments	7
TABLE 6	Maximum Total Equivalent Length; Equal Level or Outdoor Unit Below Indoor Unit	8
TABLE 7	Puron® Refrigerant Long Line Description - Outdoor and Indoor on Same Level	8
TABLE 8	Maximum Total Equivalent Length; Outdoor Unit Below Indoor Unit	9
TABLE 9	Puron® Refrigerant Long Line Description - Outdoor Unit Below Indoor Unit	9
TABLE 10	HP Outdoor Piston Change — Outdoor Unit Below Indoor Unit	9
TABLE 11	Maximum Total Equivalent Length; Outdoor Unit Above Indoor Unit	10
TABLE 12	Puron® Refrigerant Long Line Description - Outdoor Unit Above Indoor Unit	10
TABLE 13	HP Outdoor Piston Change — Outdoor Unit Above Indoor Unit	10
TABLE 14	Common AccuRater™ Piston Sizes Available Through RCD	11

A. Safety Considerations

Only trained service technicians familiar with standard service instructions and training materials should attempt installation, service, and repair of these units. Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause death, personal injury, or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory--authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing.

Follow all safety codes. Wear safety glasses, protective clothing, and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit. Consult local building codes and National Electrical Code (NEC) for special requirements.

Recognize safety information. This is the safety-alert symbol ⚠. When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury. Understand these signal words; DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **may** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

All equipment should be installed in accordance with accepted practices and unit Installation Instructions, and in compliance with all national and local codes. Power should be turned off when servicing or repairing electrical components. Extreme caution should be observed when troubleshooting electrical components with power on. Observe all warning notices posted on equipment and in instructions or manuals.

⚠ WARNING

EXPLOSION AND PERSONAL SAFETY HAZARD

Failure to follow this warning could result in personal injury, equipment damage or improper operation.

Refrigeration systems contain refrigerant under pressure. Puron® refrigerant (R-410A) systems operate at higher pressure than standard R-22 systems. Use only service equipment and components rated for Puron® refrigerant. Extreme caution should be observed when handling refrigerants. Wear safety glasses and gloves to prevent personal injury. During normal system operations, some components are hot and can cause burns. Rotating fan blades can cause personal injury. Appropriate safety considerations are posted throughout this manual where potentially dangerous techniques are addressed.

Refrigeration systems contain refrigerant under pressure. Extreme caution should be observed when handling refrigerants. Wear safety glasses and gloves to prevent personal injury. During normal system operations, some components are hot and can cause burns. Rotating fan blades can cause personal injury. Appropriate safety considerations are posted throughout this manual where potentially dangerous techniques are addressed.

B. Definitions

This Guideline covers **all** residential split system air conditioner and heat pump products using Puron® refrigerant **including two-stage models**.

C. Introduction

An application is considered Long Line, when the refrigerant level in the system requires the use of accessories to maintain acceptable refrigerant management for systems reliability. See Table 1 for required accessories. Defining a system as long line depends on the liquid line diameter, actual length of the tubing, and vertical separation between the indoor and outdoor units.

For Air Conditioner systems, the chart below shows when an application is considered Long Line.

**AC WITH PURON® REFRIGERANT LONG LINE DESCRIPTION ft (m)
Beyond these lengths, long line accessories are required**

Liquid Line Size	Units On Same Level	OD Below ID	OD Above ID
1/4	No accessories needed within allowed lengths	No accessories needed within allowed lengths	175 (53.3)
5/16	120 (36.6)	50 (15.2)	120 (36.6)
3/8	80 (24.4)	35 (10.7)	80 (24.4)

For Heat Pump systems, the chart below shows when an application is considered Long Line.

**HP WITH PURON® REFRIGERANT LONG LINE DESCRIPTION ft (m)
Beyond these lengths, long line accessories are required**

Liquid Line Size	Units On Same Level	OD Below ID	OD Above ID
3/8	80 (24.4)	20 (6.1)	80 (24.4)

Long line applications are clearly defined in this Guideline, and must be treated differently from standard systems. A long line system requires special consideration for the following reasons:

- Additional refrigerant charge
- Refrigerant migration control
- Oil return concerns
- Capacity losses
- Metering device adjustments

Longer line sets require additional refrigerant charge that must be managed throughout the entire range of possible ambient conditions. Off-cycle refrigerant migration that results in excess refrigerant in the compressor at start up, or condensed liquid refrigerant in the suction line at start up must be avoided for compressor reliability. Follow all accessory requirements in this Guideline to control off-cycle refrigerant migration (see Table 1).

Another concern is proper line set sizing and construction to control oil return to the compressor, and minimize capacity losses. In residential applications, proper suction line sizing is critical to achieve adequate oil return, and maintain expected system performance. Oil return in heating mode is different from cooling mode thus, in some cases, heat pumps have additional line set limitations from air conditioning units. Tables 3a, 3b, 4a, and 4b in this guideline can be used to properly size suction lines. Follow all suction line sizing recommendations to ensure system performance and adequate oil return for compressor lubrication.

The third concern is refrigerant metering. Elevation changes affect pressure drop in refrigerant lines. These effects must be considered when sizing liquid lines and orifice-metering devices. Since all current products utilize a TXV for cooling mode metering, piston sizing is only a concern for heat pump heating operation. Follow piston change recommendations in this Guideline for proper heat pump heating operation (see Tables 10 & 13).

Since the last revision of this guideline, testing has been done to determine limitations for the application of 1/4 and 5/16 inch liquid lines in cooling only systems. The limiting factor when sizing liquid lines is pressure drop. Equivalent length and vertical separation both contribute to the pressure drop in a liquid line. The liquid line sizing charts in this guideline have been developed based on a TXV metering device on the indoor coil. Staying within these guidelines and charging to a minimum of 10°F (5.6°C) subcooling will ensure a column of liquid is present at the TXV. There are no capacity of efficiency changes to the system performance when staying within these guidelines.

NOTE: When an application is “Long Line” the accessories shown in Table 1 are required.

D. General Limitations

Liquid Lines - AC Only

Liquid line diameters of 1/4” and 5/16” and 3/8” are allowed for cooling only systems and limitations are provided. Using smaller liquid lines affects the maximum allowable equivalent length and when the application qualifies as long line. Elevation changes between the indoor and outdoor units also affect allowable equivalent lengths. See tables 6, 8, and 11 to properly size liquid lines.

NOTE: Using 1/4 and 5/16” liquid lines within the limits provided, result in no capacity or efficiency changes to the system.

Liquid Lines - Heat Pump

Liquid line sizing for heat pumps is currently limited to 3/8”. Future updates are planned to include alternate liquid line sizing for heat pump applications. Check HVAC Partners for updates.

Suction Lines

Use Tables 3a, 3b, 4a, and 4b to properly size suction lines. Acceptable suction line sizes are shown for each size and type system. Air conditioners and heat pumps have separate charts due to oil return needs for heat pumps in heating mode.

Table 1 - Long Line Accessory Requirements

ACCESSORY	OUTDOOR UNIT ABOVE		OUTDOOR UNIT BELOW		NO ELEVATION CHANGE	
	AC	HP	AC	HP	AC	HP
Liquid line solenoid (LLS) at outdoor	No	Yes KHALS0401LLS	No	Yes KHALS0401LLS	No	Yes KHALS0401LLS
TXV on indoor (Standard on all 13 SEER platform indoor coils and fan coils)	Yes	Yes	Yes	Yes	Yes	Yes
Crankcase heater (if not factory supplied)	Yes	Yes	Yes	Yes	Yes	Yes
Start capacitor and relay	Yes See Product Data for part number	Yes See Product Data for part number	Yes See Product Data for part number	Yes See Product Data for part number	Yes See Product Data for part number	Yes See Product Data for part number
Heating piston change	N/A	Yes see Table 13	N/A	Yes see Table 10	N/A	No
Inverted trap	N/A	N/A	Yes See Fig. 3	Yes See Fig. 3	N/A	N/A

CAUTION

COMPONENT FAILURE HAZARD

Failure to follow this caution may result in unit component failure.

For proper oil return and minimizing capacity losses, only use vapor line sizes listed in Tables 3a, 3b, 4a and 4b.

E. Interconnecting Tubing and Fitting Losses

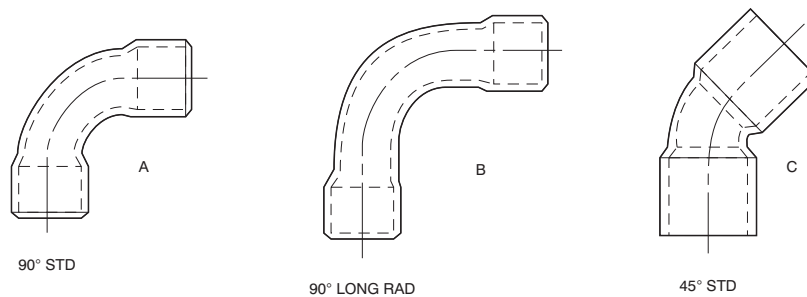
Choosing the proper tubing diameters is critical for reliable long line applications. For proper suction line sizing, see Table 3a, 3b, 4a, and 4b. These charts show all acceptable suction line diameters and related performance data based on total equivalent length. See Tables 6, 8, and 11 for the allowable liquid tubing diameters for both single-stage and two-stage.

Refrigerant tubing must be measured both in terms of actual length and equivalent length. Use actual length for limitations and refrigerant charge calculation. The maximum liquid line length will vary depending on diameter and elevation change between indoor and outdoor units. Equivalent length takes into account pressure losses from both tubing length and losses due to fittings and accessories, such as elbows, liquid line solenoid and filter drier. Losses from fittings are expressed in equivalent length, meaning the length of straight tubing that would have the same pressure loss as the fitting. See Table 2 for equivalent lengths of commonly used fittings and accessories; maximum equivalent length allowed is up to 250 ft (76.2 m). See Table 6, 8, and 11 for maximum total equivalent length.

Calculate total equivalent length by adding linear (actual) length of the tubing required and the equivalent length of all elbows and accessories used. See Tables 3a, 3b, 4a, and 4b to determine capacity loss of the system due to equivalent length losses and subtract them from the published system capacity for the particular outdoor/indoor unit combination. This data is found in the outdoor unit Product Data.

Example: A 4-ton system using 7/8 in. diameter line set has a total tubing length of 165 ft. The tubing configuration uses four standard 90° elbows and two 90° long-radius elbows. Checking Table 2, the total equivalent length is calculated as:

165 ft straight tubing + (four standard 90° elbows x 2 ft) + (two long-radius 90° elbows x 1.4 ft) = 165 ft. + 8 ft + 2.8 ft = 175.8 ft total equivalent length.



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Fig. 1 – Tube Bend Losses

Table 2 - Fitting Losses in Equivalent Feet

Tube Size O.D. (In.)	Fitting – Reference Diagram in Fig. 1		
	90° Std (A)	90° Long-Rad (B)	45° Std (C)
1/2	1.2	0.8	0.6
5/8	1.6	1.0	0.8
3/4	1.8	1.2	0.9
7/8	2.0	1.4	1.0
1 – 1/8	2.6	1.7	1.3
Liquid Line Solenoid	12		
Filter Drier	6		

F. Metering Device — Long Line Cooling

In current equipment, all indoor units use a hard-shutoff TXV for metering in the cooling mode. This provides adequate refrigerant migration protection for all cooling applications.

G. Piston Sizing — Heat Pumps Only

An AccuRater™ (fixed orifice) is used for refrigerant metering in the heating mode. This fixed expansion device must be changed from the factory-supplied AccuRater™ based on indoor/outdoor vertical separation and system capacity. For horizontal applications up to 200 ft (61 m) linear length and 250 ft (76 m) total equivalent length, no heating piston change is necessary.

When sizing the heating piston for installations where the outdoor unit is below the indoor unit, use Table 10. When outdoor unit is located above indoor unit, use Table 13.

Example: The factory supplied AccuRater™ for a single-stage 3-ton heat pump is a number 57. A system is installed with 200 equivalent ft of line set. Approximately 60 ft (18.3 m) is horizontal and the outdoor unit is 140 ft (42.7 m) above the indoor unit. Table 10 shows the AccuRater™ piston change to be +6. The new piston size is $57 + 6 = 63$. If a 63 is not produced, round up to the next larger available piston size.

On the same heat pump, if the outdoor unit was located 49 ft (14.9 m) below the indoor unit, Table 10 shows the piston change to be $57 - 2 = 55$. If a 55 piston is not produced, round up to the next available size.

H. Liquid Line Solenoid — Long Line Heat Pump Heating

Since AccuRater™ do not provide off-cycle refrigerant migration protection in the heating mode, a liquid line solenoid is required for single-stage and two-stage heat pump long line applications. Bi-flow solenoid valves provide flow control protection only in the direction of the arrow molded into the valve. **The arrow must point toward the outdoor unit** for off-cycle refrigerant control in the heating mode. The arrow shows the direction of flow control. The solenoid should be installed within 2 ft. of the outdoor unit. The liquid line solenoid kit number for a heat pump is KHALS0401LLS.

NOTE: Equivalent length of the liquid line solenoid should be added to the total equivalent length of the tubing. See Table 2.

I. Charging Information

Use subcooling as the primary method for charging longline applications. Outdoor units are pre-charged for 15 ft (4.6 m) of 3/8 liquid line. When using different length diameter liquid lines, charge adjustments are required. See Table 5 for charge adjustments required. The charge adjustment will depend on the liquid line diameter used. See unit installation instructions for proper charging procedure.

For all long line applications, pressure drop and subcooling loss become a concern. In these applications, a **minimum of 10°F (5.6°C) of subcooling** is required for all liquid line diameters to ensure no refrigerant flashing occurs before the TXV metering device. Systems should be charged to 10° subcooling or the rating plate subcooling, whichever is greater.

The amount of factory-charge can be found on the unit rating plate or in the Product Data literature. Long line applications do not require additional oil charge.

VAPOR LINE SIZING AND COOLING CAPACITY LOSS

Acceptable vapor line diameters provide adequate oil return to the compressor while avoiding excessive capacity loss. The suction line diameters shown in Tables 3a, 3b, 4a, and 4b are acceptable for AC and HP systems with Puron refrigerant:

Table 3a - Vapor Line Sizing and Cooling Capacity Losses — Puron® Refrigerant 1-Stage Air Conditioner Applications

Unit Nominal Size (Btuh)	Maximum Liquid Line Diameters (In. OD)	Vapor Line Diameters (In. OD)	Cooling Capacity Loss (%) Total Equivalent Line Length ft. (m)								
			26-50 (7.9-15.2)	51-80 (15.5-24.4)	81-100 (24.7-30.5)	101-125 (30.8-38.1)	126-150 (38.4-45.7)	151-175 (46.0-53.3)	176-200 (53.6-61.0)	201-225 (61.3-68.6)	226-250 (68.9-76.2)
18000 1 Stage AC with Puron	3/8	1/2	1	2	3	5	6	7	8	9	11
		5/8	0	1	1	1	2	2	2	3	3
		3/4	0	0	0	0	1	1	1	1	1
24000 1 Stage AC with Puron	3/8	5/8	0	1	2	2	3	3	4	5	5
		3/4	0	0	1	1	1	1	1	2	2
		7/8	0	0	0	0	0	1	1	1	1
30000 1 Stage AC with Puron	3/8	5/8	1	2	3	3	4	5	6	7	8
		3/4	0	0	1	1	1	2	2	2	3
		7/8	0	0	0	0	1	1	1	1	1
36000 1 Stage AC with Puron	3/8	5/8	1	2	4	5	6	8	9	10	12
		3/4	0	1	1	2	2	3	3	4	4
		7/8	0	0	0	1	1	1	1	2	2
42000 1 Stage AC with Puron	3/8	3/4	0	1	2	2	3	4	4	5	6
		7/8	0	0	1	1	1	2	2	2	3
		1 1/8	0	0	0	0	0	0	0	0	0
48000 1 Stage AC with Puron	3/8	3/4	0	1	2	3	4	5	5	6	7
		7/8	0	0	1	1	2	2	2	3	3
		1 1/8	0	0	0	0	0	0	0	1	1
60000 1 Stage AC with Puron	3/8	3/4	1	2	4	5	6	7	9	10	11
		7/8	0	1	2	2	3	4	4	5	5
		1 1/8	0	0	0	1	1	1	1	1	1

Applications in this area may be long line and may have height restrictions. See pages 8, 9, and 10.

Table 3b - Vapor Line Sizing and Cooling Capacity Losses - Puron® Refrigerant 1- Stage Heat Pump Applications

Unit Nominal Size (Btuh)	Maximum Liquid Line Diameters (In. OD)	Vapor Line Diameters (In.) OD	Cooling Capacity Loss (%) Total Equivalent Line Length ft. (m)								
			Standard Application		Long Line Application Requires Accessories						
			26-50 (7.9-15.2)	51-80 (15.5-24.4)	81-100 (24.7-30.5)	101-125 (30.8-38.1)	126-150 (38.4-45.7)	151-175 (46.0-50.3)	176-200 (53.6-60.0)	201-225 (61.3-68.6)	226-250 (68.9-76.2)
18,000 1-Stage HP with Puron	3/8	1/2	1	2	3	4	6	7	8	9	10
		5/8	0	0	1	1	1	2	2	3	3
24,000 1-Stage HP with Puron	3/8	5/8	0	1	1	2	3	3	4	4	5
		3/4	0	0	0	0	1	1	1	1	1
30,000 1-Stage HP with Puron	3/8	5/8	1	2	3	3	4	5	6	7	8
		3/4	0	0	1	1	1	2	2	2	3
		7/8	0	0	0	0	1	1	1	1	1
36,000 1-Stage HP with Puron	3/8	5/8	1	2	4	5	6	7	9	10	11
		3/4	0	0	1	1	2	2	3	3	4
		7/8	0	0	0	0	1	1	1	1	2
42,000 1-Stage HP with Puron	3/8	3/4	0	1	2	2	3	4	4	5	6
		7/8	0	0	1	1	1	2	2	2	3
48,000 1-Stage HP with Puron	3/8	3/4	0	1	2	3	4	5	5	6	7
		7/8	0	0	1	1	2	2	2	3	3
60,000 1-Stage HP with Puron	3/8	3/4	1	2	4	5	6	7	9	10	11
		7/8	0	1	2	2	3	4	4	5	5
		1-1/8	0	0	0	1	1	1	1	1	1

Standard Length = 80 ft. (24.4 m) or less total equivalent length

Applications in this area are long line. Accessories are required as shown recommended on Long Line Application Guidelines

Applications in this area may have height restrictions that limit allowable total equivalent length, when outdoor unit is below indoor unit See Long Line Application Guidelines

Table 4a - Vapor Line Sizing and Cooling Capacity Losses — Puron® Refrigerant 2-Stage Air Conditioner Applications

Unit Nominal Size (Btuh)	Maximum Liquid Line Diameters (In. OD)	Vapor Line Diameters (In.) OD	Cooling Capacity Loss (%) Total Equivalent Line Length ft. (m)								
			26-50 (7.9-15.2)	51-80 (15.5-24.4)	81-100 (24.7-30.5)	101-125 (30.8-38.1)	126-150 (38.4-45.7)	151-175 (46.0-50.3)	176-200 (53.6-60.0)	201-225 (61.3-68.6)	226-250 (68.9-76.2)
24000 2-Stage Puron AC	3/8	5/8	0	1	1	2	3	3	4	4	5
		3/4	0	0	0	0	1	1	1	1	1
36000 2-Stage Puron AC	3/8	5/8	1	2	4	5	6	7	9	10	11
		3/4	0	0	1	1	2	2	3	3	4
		7/8	0	0	0	0	1	1	1	1	2
48000 2-Stage Puron AC	3/8	3/4	0	1	2	3	4	5	5	6	7
		7/8	0	0	1	1	2	2	2	3	3
60000 2-Stage Puron AC	3/8	3/4	1	2	4	5	6	7	9	10	11
		7/8	0	1	2	2	3	4	4	5	5
		1-1/8	0	0	0	1	1	1	1	1	1

Applications in this area may be long line and may have height restrictions. See pages 8, 9, and 10.

Table 4b - Vapor Line Sizing and Cooling Capacity Losses - Puron® Refrigerant 2-Stage Heat Pump Applications

Unit Nominal Size (Btuh)	Maximum Liquid Line Diameters (In. OD)	Vapor Line Diameters (In.) OD	Cooling Capacity Loss (%) Total Equivalent Line Length ft. (m)								
			Standard Application			Long Line Application Requires Accessories					
			26-50 (7.9-15.2)	51-80 (15.5-24.4)	81-100 (24.7-30.5)	101-125 (30.8-38.1)	126-150 (38.4-45.7)	151-175 (46.0-50.3)	176-200 (53.6-60.0)	201-225 (61.3-68.6)	226-250 (68.9-76.2)
24,000 2-Stage HP with Puron	3/8	5/8	0	1	1	2	3	3	4	4	5
		3/4	0	1	1	1	1	1	1	1	1
36,000 2-Stage HP with Puron	3/8	5/8	1	2	4	5	6	7	9	10	11
		3/4	0	0	1	1	2	2	3	3	4
48,000 2-Stage HP with Puron	3/8	3/4	0	1	2	3	4	5	5	6	7
		7/8	0	0	1	1	2	2	2	3	3
60,000 2-Stage HP with Puron	3/8	3/4	1	2	4	5	6	8	9	10	11
		7/8	0	1	2	2	3	4	4	5	5
		1-1/8	0	0	—	—	—	—	—	—	—

Standard Length = 80 ft. (24.4 m) or less total equivalent length

— Applications in this area are not recommended due to insufficient oil return.

Applications in this area are long line. Accessories are required as shown recommended on Long Line Application Guidelines

Applications in this area may have height restrictions that limit allowable total equivalent length, when outdoor unit is below indoor unit.

Table 5 - Refrigerant Charge Adjustments

Liquid Line Size	Puron Charge (oz/ft)
3/8	0.60 (Factory charge for lineset = 9 oz)
5/16	0.40
1/4	0.27

Units are factory-charged for 15 ft (4.6 m) of 3/8" lineset. Factory charge for 3/8 lineset is 9 oz. When using other length or diameter liquid lines, charge adjustments are required per chart above.

Charging Formula:

$[(\text{Lineset oz/ft} \times \text{total length}) - (\text{factory charge for lineset})] = \text{charge adjustment}$

Example 1: System has 15 ft of line set using existing 1/4" liquid line. What charge adjustment is required?

Formula: $(.27 \text{ oz/ft} \times 15\text{ft}) - (9 \text{ oz}) = (-4.95) \text{ oz.}$

Net result is to remove 4.95 oz of refrigerant from the system

Example 2: System has 45 ft of existing 5/16" liquid line. What is the charge adjustment?

Formula: $(.40 \text{ oz/ft.} \times 45\text{ft}) - (9 \text{ oz.}) = 9 \text{ oz.}$

Net result is to add 9 oz of refrigerant to the system

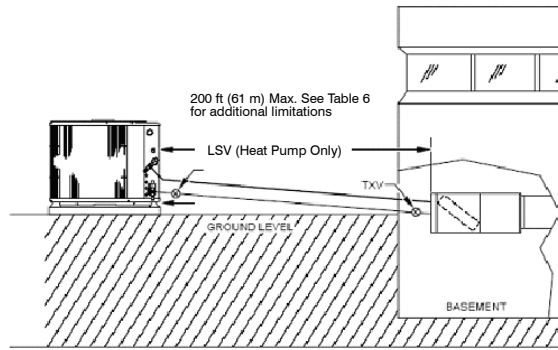


Fig. 2 – Equal-Level Outdoor/Indoor Unit

- A hard-shutoff TXV must be installed at indoor unit when application qualifies as long line. See Table 7.
- Hard Start Kit (start capacitor and relay) must be installed on outdoor unit when application qualifies as long line. See Table 7.
- A crankcase heater must be installed on compressor when the application qualifies as long line. See Table 7.
- Vapor line should slope towards indoor unit
- Maximum actual liquid line is up to 200 ft (61 m). See Table 6.
- Maximum total equivalent length is up to 250 ft (76.2 m). See Table 6.
- Heat pump only – Bi-flow liquid line solenoid must be installed within 2 ft (0.61 m) of outdoor unit with arrow pointing towards outdoor unit.
- Heat pump only – Outdoor AccuRater™ adjustment not required
- Use vapor line per Tables 3a, 3b, 4a, and 4b.
- Use liquid lines per Table 6.

**Table 6 - Maximum Total Equivalent Length
Equal Level or Outdoor Unit Below Indoor**

Size	System Type	Liquid Line Diameter w/ TXV	Maximum Total Equivalent Length†: Outdoor unit BELOW Indoor Vertical Separation ft (m)								
			0–5 (0–1.5)	6–10 (1.8–3.0)	11–20 (3.4–6.1)	21–30 (6.4–9.1)	31–40 (9.4–12.2)	41–50 (12.5–15.2)	51–60 (15.5–18.3)	61–70 (18.6–21.3)	71–80 (21.6–24.4)
18000	AC Only	1/4	150	150	125	100	100	75	--	--	--
	AC Only	5/16	250*	250*	250*	250*	250*	250*	250*	225*	150
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
24000	AC Only	1/4	75	75	75	50	50	--	--	--	--
	AC Only	5/16	250*	250*	250*	250*	250*	225*	175	125	100
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
30000	AC Only	1/4	30	--	--	--	--	--	--	--	--
	AC Only	5/16	175	225*	200	175	125	100	75	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
36000	AC Only	5/16	175	150	150	100	100	100	75	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
42000	AC Only	5/16	125	100	100	75	75	50	--	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	150
48000	AC/HP	3/8	250*	250*	250*	250*	250*	250*	230	160	--
60000	AC/HP	3/8	250*	250*	250*	225*	190	150	110	--	--

* Maximum actual length not to exceed 200 ft (61 m)

† Total equivalent length accounts for losses due to elbows or fitting. See the Long Line Guideline for details.

-- = outside acceptable range

**Table 7 - AC / HP with Puron® Refrigerant Long Line Description ft (m)
Beyond these lengths, long line accessories are required**

AC	AC Liquid Line Size	Units On Same Level
	1/4	No accessories needed within allowed lengths
	5/16	120 (36.6)
	3/8	80 (24.4)

HP	HP Liquid Line Size	Units On Same Level
	3/8	80 (24.4)

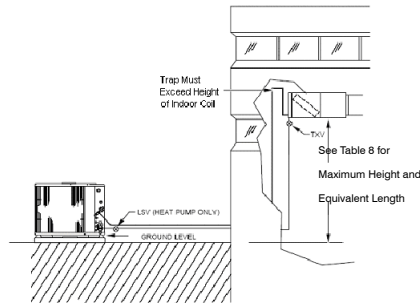


Fig. 3 – Outdoor Unit Below Indoor Unit

- Unit must be charged to 10° subcooling or nameplate subcooling, whichever is greater.
- A hard-shutoff TXV must be installed at indoor unit when application qualifies as long line. See Table 9.
- A crankcase heater must be installed on compressor when the application qualifies as long line. See Table 9.
- Hard Start Kit (start capacitor and relay) must be installed in outdoor unit when the application qualifies as long line. See Table 9.
- An inverted vapor-line trap must be installed at indoor unit. The top peak of trap must be greater than height of indoor coil.
- Maximum actual liquid line length is up to 200 ft (61 m) See Table 8 for maximum total equivalent length.
- Heat pump only – Bi-flow liquid line solenoid must be installed within 2 ft (0.61 m) of outdoor unit with arrow pointing towards outdoor unit.
- Heat pump only – Adjust outdoor piston per Table 10.
- Use vapor line per Tables 3a, 3b, 4a, and 4b.
- Use liquid lines per Table 8.

**Table 8 - Maximum Total Equivalent Length†
Outdoor Unit Below Indoor Unit**

Size	System Type	Liquid Line Diameter w/ TXV	Maximum Total Equivalent Length†: Outdoor unit BELOW Indoor Vertical Separation ft (m)								
			0–5 (0–1.5)	6–10 (1.8–3.0)	11–20 (3.4–6.1)	21–30 (6.4–9.1)	31–40 (9.4–12.2)	41–50 (12.5–15.2)	51–60 (15.5–18.3)	61–70 (18.6–21.3)	71–80 (21.6–24.4)
18000	AC Only	1/4	150	150	125	100	100	75	--	--	--
	AC Only	5/16	250*	250*	250*	250*	250*	250*	250*	225*	150
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
24000	AC Only	1/4	75	75	75	50	50	--	--	--	--
	AC Only	5/16	250*	250*	250*	250*	250*	225*	175	125	100
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
30000	AC Only	1/4	30	--	--	--	--	--	--	--	--
	AC Only	5/16	175	225*	200	175	125	100	75	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
36000	AC Only	5/16	175	150	150	100	100	100	75	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
42000	AC Only	5/16	125	100	100	75	75	50	--	--	--
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	150
48000	AC/HP	3/8	250*	250*	250*	250*	250*	250*	230	160	--
60000	AC/HP	3/8	250*	250*	250*	225*	190	150	110	--	--

* Maximum actual length not to exceed 200 ft (61 m)

† Total equivalent length accounts for losses due to elbows or fitting. See the Long Line Guideline for details.

-- = outside acceptable range

**Table 9 - AC / HP with Puron® Refrigerant Long Line Description ft (m)
Beyond these lengths, long line accessories are required**

AC	AC Liquid Line Size	Outdoor Below Indoor
	1/4	No accessories needed within allowed lengths
5/16	50 (15.2)	
3/8	35 (10.7)	
HP	HP Liquid Line Size	Outdoor Below Indoor
	3/8	20 (6.1)

Table 10- Puron® Refrigerant Heat Pump Outdoor Piston Change – Outdoor Unit BELOW Indoor Unit

Btuh	Vertical Separation ft (m) – Outdoor BELOW Indoor Unit						
	0–19 (0–5.8)	20–29 (6.1–8.8)	30–39 (9.1–11.9)	40–49 (12.2–14.9)	50–59 (15.2–18.0)	60–69 (18.3–21.0)	70–80 (21.3–24.4)
18,000	0	-1	-1	-2	-2	-2	-2
24,000	0	-1	-1	-2	-2	-3	-3
30,000	0	-1	-1	-2	-2	-3	-3
36,000	0	-1	-2	-2	-2	-3	-3
42,000	0	-1	-2	-2	-3	-3	-4
48,000	0	-1	-2	-2	-3	-3	--
60,000	0	-1	-2	-3	-3	--	--

NOTE: (—) Indicates vertical separation exceeds allowable limits.

Example 1: On a 4 ton system the outdoor unit is 60 ft. below the indoor unit. This is acceptable only if the total equivalent length is 230 ft. or less. The heating piston must be re-sized -3.

Example 2: On a 3-ton system the outdoor unit is 80 ft. below the indoor unit. This is acceptable up to 250 ft. total equivalent length. The heating piston must be re-sized -3.

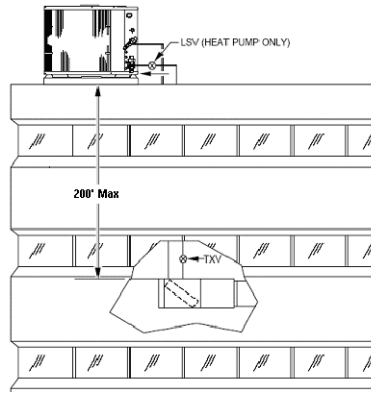


Fig. 4 – Outdoor Unit Above Indoor Unit

- A hard-shutoff TXV must be installed at indoor unit when the application qualifies as long line. See Table 12.
- A crankcase heater must be installed on compressor when the application qualifies as long line. See Table 12.
- Hard Start Kit (start capacitor and relay) must be installed in outdoor unit when the application qualifies as long line. See Table 12.
- Heat pump only – Heating piston must be changed as shown in Table 13.
- Maximum actual liquid line length is up to 200 ft (61 m). See Table 11.
- Maximum total equivalent length is up to 250 ft (61 m). See Table 11.
- Heat pump only – Bi-flow liquid line solenoid must be installed within 2 ft (0.61 m) of outdoor unit with arrow pointing towards outdoor unit.
- Use vapor line sizes per Tables 3a, 3b, 4a, and 4b.
- Use liquid lines per Table 11.
- Vapor line traps are not required.

Table 11 – Puron Refrigerant Maximum Total Equivalent Length Outdoor Unit ABOVE Indoor Unit

Size	System Type	Liquid Line Diameter	Vertical Separation ft (m) Outdoor unit ABOVE indoor unit								
			25 (7.6)	26–50 (7.9–15.2)	51–75 (15.5–22.9)	76–100 (23.2–30.5)	101–125 (30.8–38.1)	126–150 (38.4–45.7)	151–175 (46.0–53.3)	176–200 (53.6–61.0)	
18000	AC Only	1/4	175	250*	250*	250*	250*	250*	250*	250*	250*
	AC Only	5/16	250*	250*	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
24000	AC Only	1/4	100	125	175	200	225*	250*	250*	250*	250*
	AC Only	5/16	250*	250*	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
30000	AC Only	1/4	30	--	--	--	--	--	--	--	--
	AC Only	5/16	250*	250*	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
36000	AC Only	5/16	225*	250*	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
42000	AC Only	5/16	175	200	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
48000	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*
	AC/HP	3/8	250*	250*	250*	250*	250*	250*	250*	250*	250*

***Maximum Actual Length Not to Exceed 200ft (61 m)**

**Table 12 – AC / HP with Puron® Refrigerant Long Line Description ft (m)
Beyond these lengths, long line accessories are required**

AC	AC Liquid Line Size	Outdoor Above Indoor
	1/4	175 (53.3)
5/16	120 (36.6)	
3/8	80 (24.4)	

HP	AC Liquid Line Size	Outdoor Above Indoor
	3/8	80 (24.4)

Table 13 – Heat Pump Outdoor Piston Change - Outdoor Unit ABOVE Indoor Unit

Btuh	Vertical Separation ft (m) – Outdoor Above Indoor Unit							
	20–25 (6.1–7.6)	26–50 (7.9–15.2)	51–75 (15.5–22.9)	76–100 (23.2–30.5)	101–125 (30.8–38.1)	126–150 (38.4–45.7)	151–175 (46.0–53.3)	176–200 (53.6–61.0)
18,000	+1	+1	+2	+3	+3	+4	+5	+6
24,000	+1	+1	+2	+3	+4	+5	+6	+7
30,000	+1	+2	+2	+4	+5	+6	+8	+9
36,000	+1	+2	+2	+4	+5	+6	+8	+9
42,000	+1	+2	+3	+4	+5	+7	+8	+10
48,000	+1	+2	+3	+4	+5	+7	+9	+10
60,000	+1	+2	+3	+5	+6	+8	+10	+12

J. General Requirements (Check List)

All Long Line Applications

- Hard-shutoff TXV must be installed at indoor unit.
- Hard Start Kit (start capacitor and relay) must be installed on outdoor unit.
- Crankcase heater must be installed on compressor.
- Use liquid line per Tables 6, 8, and 11.
- Use only vapor line sizes listed in Tables 3a, 3b, 4a, and 4b.
- Adjust charge per Table 5.
- Charge system to 10° subcooling or rating plate subcooling, whichever is greater.

Heat Pumps Only

- Bi-flow liquid line solenoid must be installed within 2 ft (0.61 m) of outdoor unit with arrow pointing towards outdoor unit.

Equal-level Outdoor/Indoor unit

- Outdoor unit and indoor unit must be within +/- 20 ft (6.1 m) vertical separation.
- Vapor line should slope towards indoor unit.

Heat Pumps Only

- No outdoor AccuRater™ adjustment required with less than 20 ft (6.1 m) vertical separation.

Outdoor unit BELOW indoor unit

- See Tables 7, 9, and 12 for longline thresholds.
- An inverted vapor-line trap must be installed at indoor unit. The top peak of trap must be greater than height of indoor coil. See Fig. 3.
- Vertical separation and line set equivalent length must not exceed requirements listed in Tables 6, 8, or 11.

Heat Pumps Only

- Adjust outdoor AccuRater™ per Table 10.

Outdoor unit ABOVE indoor unit

- Maximum vertical separation is 200 ft (61 m)
- Maximum actual line length is 200 ft (61 m)
- Maximum total equivalent length is 250 ft (76.2 m). See Table 11.
- Vapor line traps are not required.

Heat Pumps Only

- Adjust outdoor AccuRater™ per Table 13.

**Table 14 - Common AccuRater™ - Piston Sizes Available through RCD
(Part numbers are all EA52PHxxx. The last 3 digits represent size.)**

EA52PH032	063	093
035	065	096
037	067	098
038	068	101
040	070	104
042	073	106
043	076	109
046	078	110
049	080	113
052	082	116
055	084	120
057	086	125
059	088	128
061	090	

K. Air Conditioner and Heat Pump with Puron® Refrigerant — Quick Reference Guide

- Puron refrigerant operates at 50-70 percent higher pressures than R-22. Be sure that servicing equipment and replacement components are designed to operate with Puron refrigerant
- Puron refrigerant cylinders are rose colored.
- Recovery cylinder service pressure rating must be 400 psig, DOT 4BA400 or DOT BW400.
- Puron refrigerant systems should be charged with liquid refrigerant. Use a commercial type metering device in the manifold hose when charging into suction line with compressor operating
- Manifold sets should be 700 psig high side and 180 psig low side with 550 psig low-side retard.
- Use hoses with 700 psig service pressure rating.
- Leak detectors should be designed to detect HFC refrigerant.
- Puron refrigerant, as with other HFCs, is only compatible with POE oils.
- Vacuum pumps will not remove moisture from oil.
- Do not use liquid-line filter driers with rated working pressures less than 600 psig.
- Do not leave Puron suction line filter driers in line longer than 72 hours.
- Do not install a suction-line filter drier in liquid line.
- POE oils absorb moisture rapidly. Do not expose oil to atmosphere.
- POE oils may cause damage to certain plastics and roofing materials.
- Wrap all filter driers and service valves with wet cloth when brazing.
- A factory approved liquid-line filter drier is required on every unit.
- Do NOT use an R-22 TXV.
- If indoor unit is equipped with an R-22 TXV or piston metering device, it must be changed to a hard shutoff Puron TXV.
- Never open system to atmosphere while it is under a vacuum.
- When system must be opened for service, recover refrigerant, evacuate then break vacuum with dry nitrogen and replace filter driers. Evacuate to 500 microns prior to recharging.
- Do not vent Puron refrigerant into the atmosphere.
- Do not use capillary tube coils.
- Observe all **warnings**, **cautions**, and **bold** text.
- All indoor coils must be installed with a hard shutoff Puron TXV metering device.