REFRIGERANT PIPING APPLICATION GUIDE

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WARNINGS:

- · These instructions are intended as an aid to qualified, licensed service personnel for proper installation, adjustment, and operation of this unit. Read these instructions thoroughly before attempting installation or operation. Failure to follow these instructions result in improper may installation, adjustment. service. or maintenance possibly resulting in fire. electrical shock, property damage, equipment damage, personal injury, or death.
- The unit must be permanently grounded. Failure to do so can cause electrical shock resulting in severe personal injury or death.
- Turn off electric power at the fuse box or service panel before making any electrical connections.
- Complete the ground connection before making line voltage connections. Failure to do so can result in electrical shock, severe personal injury, or death.
- Disconnect all power to unit before starting maintenance. Failure to do so can cause electrical shock resulting in severe personal injury or death.
- Never assume the unit is properly wired and/or grounded. Always test the unit cabinet with a noncontact voltage detector available at most electrical supply houses or home centers before removing access panels or coming into contact with the unit cabinet.
- Do not use oxygen to purge lines or pressurize system for leak test. Oxygen reacts violently with oil, which can cause an explosion resulting in severe personal injury or death.
- The top of the scroll compressor shell is hot. Touching the compressor top may result in serious personal injury. (Inspection with infrared type thermometer is required)
- The manufacturer's warranty does not cover any damage or defect to the unit caused by the attachment or use of any components, accessories, or devices (other than those authorized by the manufacturer) into, onto, or in conjunction with the equipment. You should be aware that the use of unauthorized components, accessories, or devices may adversely affect the operation of the heat pump and may also endanger life and property. The manufacturer disclaims any responsibility for such loss or injury resulting from the use of such unauthorized components, accessories,

or devices

CAUTIONS:

- *R-410A systems operate at approximately 60%* higher pressures (1.6 times) than R-22 systems. Do not use R-22 service equipment or components on R-410A equipment. Use appropriate care when using this refrigerant. Failure to exercise care may result in equipment damage or personal injury.
- Only match this outdoor unit with a matched indoor coil or air handler approved for use with this outdoor unit per the unit manufacturer's specification sheet. The use of unmatched coils or air handler will likely result in a charge imbalance between the cooling and heating modes which can cause unsatisfactory operation including a high-pressure switch lockout condition.
- Only use indoor coils approved for use on R-410A systems. An R-22 coil will have a TXV or fixed restrictor device that is not designed to operate properly in an R-410A system and will result in serious operational issues. The R-22 coil could also contain mineral oil which is incompatible with the POE oil used in R-410A systems and could result in reliability issues with the compressor and TXVs.
- When indoor unit is installed over a finished ceiling and/or living area, it is required that a secondary sheet metal condensate pan be constructed and installed under the entire unit. Failure to do so can result in property damage.
- The compressor has an internal overload protector. Under some conditions, it can take up to 2 hours for this overload to reset. Make sure overload has had time to reset before condemning the compressor.

WARNING:

Single-pole contactors are used on all standard single-phase units through 5 tons. Caution must be exercised when servicing as only one leg of the power supply is broken by the contactor.

2.0 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. This guide is applicable to single stage, 2 stage and variable speed applications from 1 to 5 ton. 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.

Long line applications are clearly defined in this Guideline and must be treated differently from standard systems. This guideline will cover installation requirements and additional accessories needed for split system installations where long line set needs to be considered.

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 2a, 2b, 2c, 2d, 2e in this guideline can be used to properly size suction lines. Follow all suction/liquid line sizing recommendations to ensure system performance and adequate oil return for compressor lubrication.

3.0 DEFINITIONS

Air Conditioning System: It is a system designed to control the temperature, humidity, and air quality in indoor spaces by removing heat and moisture from the air.

Heat Pump System: It is a type of air conditioning system that can provide both heating and cooling by transferring heat from one location to another, depending on the desired temperature.

Subcooling: It is the process of cooling a liquid refrigerant below its saturation temperature, ensuring that it remains in a liquid state as it flows through the refrigeration system.

Superheat: It is the process of heating a vapor refrigerant above its saturation temperature, ensuring that it remains in a vapor state as it flows through the refrigeration system.

R410A: It is a type of refrigerant commonly used in air conditioning systems. It is an environmentally friendly alternative to older refrigerants due to its lower ozone depletion potential.

POE oil: It stands for Polyester oil and is a type of lubricant used in air conditioning and refrigeration systems that use HFC refrigerants like R410A.

Outdoor unit: It refers to the component of an air conditioning system located outside the building. It houses the compressor, condenser coil, and other key components.

Indoor unit: It refers to the component of an air conditioning system located inside the building. It includes the evaporator coil and the blower fan.

Thermal Expansion Valve: It is a device that controls the flow of refrigerant into the evaporator coil and regulates the refrigerant's temperature and pressure.

Electronic Expansion Valve: It is a more advanced version of the thermal expansion valve that uses electronic controls to precisely regulate the flow of refrigerant into the evaporator coil.

Liquid Line: It is a refrigerant line that carries highpressure liquid refrigerant from the condenser coil to the thermal expansion valve.

Suction Line: It is a refrigerant line that carries lowpressure refrigerant vapor from the evaporator coil to the compressor.

Liquid Line Solenoid Valve: It is an electronically controlled valve installed in the liquid line that can open or close to control the flow of refrigerant.

Crankcase or Compressor Sump Heater: It is an electric heater installed in the compressor's crankcase, Belly band or sump to prevent refrigerant from migrating and causing refrigerant slugging when the system is off.

Hard Start Kit: It is an electrical component used to assist the compressor during startup by providing an extra boost of power to overcome high initial resistance.

Inverted Trap: It is a refrigerant piping configuration that prevents the migration of oil from the compressor to the evaporator coil during the off cycle.

Liquid Line Filter Drier: It is a device installed in the liquid line to remove moisture, contaminants, and particles from the refrigerant.

Suction Line Filter Drier: It is a device installed in the suction line to remove moisture, contaminants, and particles from the refrigerant

4.0 Long Line Set Applications

This section is intended for long line applications as noted in the light grey shaded areas in the Line Sizing Charts. Long line set applications require accessories, unit specific requirements, and long line set installation considerations. The following are special considerations required when installing a line set that is a long line set.

- Long line Set Accessories
- Long Line Set Unit Requirements
- Fitting losses and maximum equivalent length considerations.
- Long Line Installations Considerations
- Capacity loss
- Additional Refrigerant Charge
- Additional Oil Level Adjustment
- Refrigerant Migration in the off cycle
- Oil Return to the compressor

ACCESSORIES	OUTDOO	R UNIT ABOVE	OUTDOOR U	INIT BELOW	NO ELEVATION CHANGE		
	AC	HP	AC	HP	AC	HP	
Crankcase Heater (If not, factory supplied)	See product specs	See product specs	See product specs	See product specs	See product specs	See product specs	
Hard Start Kit *	Yes, SK-A1	Yes, SK-A1	Yes, SK-A1	Yes, SK-A1	Yes, SK-A1	Yes, SK-A1	
Liquid Line Solenoid Valve	No	200RD2T3TVLC	No	200RD2T3TVLC	No	200RD2T3TVLC	
Non-Bleed TXVs (Indoor Coils)	Yes	Yes	Yes	Yes	Yes	Yes	
Inverted Trap	N/A	N/A	Yes	Yes	N/A	N/A	

*Hard start kit not required for Mid- Tier and High tier products.

Table 1: Long Line Set Unit Requirements & Accessories

GENRERAL NOTES:

- Crankcase Heater: Some models come from the factory with crankcase heaters already installed. Refer to the product-specific Installation & Operation Manual for the Crankcase Heater table to determine if the accessory needs to be ordered and field installed.
- Hard Start Kit: In applications with long line sets, one characteristic will be added refrigerant. Hard Start components will increase the starting torque of the compressor to overcome the pressure differential on the compressor. See the Hard Start Kit SK-A1 to order and field install. Applicable to Single/2 stage
- Liquid Line Solenoid Valve: This accessory should only be required for heat pump long line set applications. The solenoid valve should be installed

4.1 Relative Location of Indoor and Outdoor Units

For applications that are considered to have a long line set with the outdoor unit and indoor unit near the same level, the outdoor unit below the indoor unit, and the outdoor unit above the indoor unit the following is required:

- TXV on the indoor coil
- Start components may be required depending upon quality of voltage (consistently <200 vac at outdoor unit.
- Crankcase heater (Some models have factory installed CCH's. Refer to tables 1 in section 3.1)

in the liquid line in the outdoor section. Liquid line solenoid needs to be biflow.

- Non-Bleed TXVs on Indoor Coils: All indoor coils are shipped with factory installed non-bleed TXVs. If the TXV is to be replaced, it must be replaced with an equivalent non-bleed TXV
- Inverted Trap: Inverted traps should only be used when the outdoor unit is below the indoor unit. The trap increases suction line velocity to assist with oil return to the compressor. The trap must exceed the height of the indoor unit. Refer fig 2 from section 4.1.2

- Insulated liquid line in unconditioned space only.
 Insulate vapor line full length
- Vapor line should slope towards the indoor unit.
- Follow the proper line sizing, maximum linear and equivalent lengths, charging requirements, and oil level adjustments spelled out in this manual.
- Verify at least 5°F [2.8°C] liquid sub-cooling at the indoor unit prior to expansion device in the cooling mode.

4.1.1 Indoor and Outdoor Unit Near Same Level



Fig 1

4.1.2 Outdoor Unit Below Indoor Unit



4.1.3. Outdoor Unit Below Indoor Unit





4.2 Line set Selection4.2.1 Line Sets and Fitting Losses



Fig. 1 – Tube Bend Losses

	Equivalent Length for Fittings (ft)											
Line Size	90° Short	90° Long	45° Elbow	Solenoid	Check Valve	Sight Glass	Filter Drier					
(in)	Radius Elbow	Radius Elbow		Valve		-						
3/8	1.3	0.8	0.3	6	4	0.4	6					
1/2	1.4	0.9	0.4	9	5	0.6	6					
5/8	1.5	1	0.5	12	6	0.8	6					
3/4	1.9	1.3	0.6	14	7	0.9	6					
7/8	2.3	1.5	0.7	15	8	1	6					
1-1/8	2.7	1.8	0.9	22	12	1.5	6					

Refrigerant lines are measured in terms of actual length and equivalent length. Actual length is used for refrigerant charge applications and is the measurement of all the vertical and horizontal lines from the indoor and outdoor units.

Equivalent length accounts for pressure losses from line lengths, fittings, vertical separations, accessories, and filter driers. Table 1 below provides equivalent lengths for different commonly used parts in refrigerant lines. Equivalent length is the sum of the actual length of all fittings, accessories, and filter driers. Equivalent length is used in determining proper line sizing and installation

4.2.2 Liquid Line Selection

The purpose of the liquid line is to transport warm subcooled liquid refrigerant from the outdoor unit to the indoor unit. It is important to maintain a column of liquid all the way to the expansion device and not to allow the refrigerant to flash into superheated vapor. The flashing of refrigerant can occur for the following reasons:

- Low refrigerant charge
- Improperly selected liquid line size
- Absorption of heat prior to expansion device
- Excessive vertical rise between the condenser and evaporator

The total pressure drop allowed for the liquid line is 50 PSI [345 kPa]. The procedure for selecting the proper liquid line size and length is as follows:

- Measure the total amount of vertical rise (elevation)
- Measure the actual amount of liquid line required
- Add all the equivalent lengths associated with any fittings or accessories using Table 1
- Add the actual length and equivalent lengths. This will equal your total equivalent length
- Reference the Line Sizing Chart that matches the application and the capacity size of the equipment
- Use the total equivalent length and the vertical rise in the application to determine the size and allowable lengths of the liquid line piping

General Notes:

Regardless of equivalent length, the actual linear length of the tubing shall not exceed 200'. Liquid lines must be sized to minimize refrigerant pressure change. Sufficient refrigerant sub-cooling must be maintained at the expansion device for proper system operation. R-410a loses 0.43 PSI for every foot of vertical lift as a liquid. Length of pipe, fittings, liquid line filter drier also add pressure drop thus limiting applications where the outdoor unit is below the indoor unit to much shorter distances than when the outdoor unit is above the indoor unit. When the outdoor unit is above the indoor unit, the vertical line experiences an increase in pressure (Static Gain) which will also lead to change in subcooling at the metering device. The maximum total pressure drop allowed for the liquid line is 50 PSI



4.2.3 Suction Line Selection

The purpose of the suction line is to return superheated vapor to the compressor from the evaporator. Suction line sizing and refrigerant velocity is important as they have a role in ensuring the return of oil to the compressor. An improperly sized suction line can reduce performance of the system.

The procedure for selecting the proper suction line size is the same as is previously explained for liquid line size selection.

General Notes:

- The Manufacturer does NOT require traps in the suction line when the condenser is above the evaporator, and recommends they not be used. The combination of miscibility of the POE oil and R-410A, along with compliance to the refrigerant line design instructions will ensure oil is properly returned without exceeding pressure drop limits in the vapor line. Recommended inverted traps at the ID unit for OD unit below ID unit.
- Refrigerant velocity for vertical suction risers must be maintained at 1600 FPM to ensure oil return. Horizontal

suction lines must maintain 800 FPM. This will often result in different size refrigerant lines between horizontal and vertical applications. While gravity has very little effect on the gas itself, oil and pressure drop are still key factors.

- It is acceptable to use the larger size suction line for shorter horizontal runs and in applications where the indoor unit is above the outdoor unit to prevent capacity losses. Refer table 2a, 2b, 2c, and 2d.
- Pressure drop within the suction line should be limited to 5 psi for R410A systems although the longest lines may slightly exceed this limit to maintain velocity. The maximum recommended pressure drop is 7 psi.
- Suction line pressure loss reduces capacity by 0.6% for R-410A per psi. To minimize capacity loss suction pressure loss must be minimized

4.2.4 Capacity Multiplier

Table 2a, 2b, 2c, 2d and 2e below lists multiplier values to recalculate system-cooling capacity as a function of a system's equivalent line length (as calculated from the suction line) and the selected suction tube size. Table 2 lists the equivalent length gained from adding bends to the suction line. Properly size the suction line to minimize capacity loss.

					13/1	4 SEER2 AG	2					
	ALLOWABLE	ALLOWABLE				E	QUIVALEN'	T LENGTH	FEET)			
UNIT SIZE	LIQUID LINE	SUCTION LINE	<25	26-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250
	SIZE	SIZE	MAXI	MUM VE	RTICAL R	ISE (OUTD	OOR UNIT	BELOW IN	DOOR UNI	т) */ сара		TIPLIER
	1/4"	5/8"	25/1.00	50/0.99	56/0.99	38/0.98	20/0.99	1/0.98	0/0.98	0/0.97	0/0.97	0/0.97
	5/16"	5/8"	25/1.00	50/0.99	75/0.99	96/0.98	91/0.99	86/0.98	81/0.98	77/0.97	73/0.97	69/0.97
1 E Ton	3/8"	5/8"	25/1.00	50/0.99	75/0.99	100/0.98	109/0.99	107/0.98	106/0.98	104/0.97	103/0.97	102/0.97
1.5 1011	1/4"	3/4"	25/1.00	50/1.00	56/1.00	38/0.99	20/0.99	1/0.99	0/0.99	0/0.99	0/0.98	0/0.98
	5/16"	3/4"	25/1.00	50/1.00	75/1.00	96/0.99	91/0.99	86/0.99	81/0.99	77/0.99	73/0.98	69/0.98
	3/8"	3/4"	25/1.00	50/1.00	75/1.00	100/0.99	109/0.99	107/0.99	106/0.99	104/0.99	103/0.98	102/0.98
	1/4"	5/8"	25/1.00	50/0.99	23/0.99	0/0.98	0/0.97	0/0.96	0/0.98	0/0.96	0/0.95	0/0.95
	5/16"	5/8"	25/1.00	50/0.99	75/0.99	81/0.98	73/0.97	65/0.96	57/0.98	49/0.96	43/0.95	38/0.95
2 Ton	3/8"	5/8"	25/1.00	50/0.99	75/0.98	100/0.97	101/0.96	98/0.95	96/0.95	93/0.94	90/0.93	87/0.93
2 1011	1/4"	3/4"	25/1.00	50/0.99	23/0.99	0/0.99	0/0.99	0/0.98	0/0.98	0/0.99	0/0.98	0/0.97
	5/16"	3/4"	25/1.00	50/0.99	75/0.99	81/0.99	73/0.99	65/0.98	57/0.98	49/0.99	43/0.98	38/0.97
	3/8"	3/4"	25/1.00	50/0.99	75/0.99	100/0.99	101/0.99	98/0.98	96/0.98	93/0.99	90/0.98	87/0.97
	5/16"	5/8"	25/0.99	50/0.98	75/0.98	64/0.97	52/0.97	40/0.95	28/0.94	16/0.93	6/0.93	0/0.92
2 5 Ton	3/8"	5/8"	25/0.99	50/0.98	75/0.98	98/0.97	94/0.97	90/0.95	85/0.94	81/0.93	77/0.93	73/0.92
2.5 1011	5/16"	3/4"	25/1.00	50/0.99	75/0.99	64/0.98	52/0.99	40/0.98	28/0.98	16/0.98	6/0.97	0/0.97
	3/8"	3/4"	25/1.00	50/0.99	75/0.99	98/0.98	94/0.99	90/0.98	85/0.98	81/0.98	77/0.97	73/0.97
3 Ton	5/16"	5/8"	25/0.99	50/0.98	60/0.96	43/0.96	26/0.94	10/0.92	0/0.91	0/0.9	0/0.89	0/0.89
	3/8"	5/8"	25/0.99	50/0.98	75/0.96	90/0.96	85/0.94	79/0.92	73/0.91	67/0.9	61/0.89	55/0.89
	5/16"	3/4"	25/1.00	50/0.99	60/0.98	43/0.99	26/0.98	10/0.97	0/0.97	0/0.96	0/0.98	0/0.97
3 Ton	3/8"	3/4"	25/1.00	50/0.99	75/0.98	90/0.99	85/0.98	79/0.97	73/0.97	67/0.96	61/0.98	55/0.97
5 1011	1/2"	3/4"	25/1.00	50/0.99	75/0.98	100/0.99	110/0.98	109/0.97	107/0.97	107/0.96	106/0.98	105/0.97
	5/16"	7/8"	25/1.00	50/0.99	60/0.99	43/0.99	26/0.99	10/0.98	0/0.98	0/0.99	0/0.99	0/0.98
	3/8"	7/8"	25/1.00	50/0.99	75/0.99	90/0.99	85/0.99	79/0.98	73/0.98	67/0.99	61/0.99	55/0.98
	1/2"	7/8"	25/1.00	50/0.99	75/0.99	100/0.99	110/0.99	109/0.98	107/0.98	107/0.99	106/0.99	105/0.98
	3/8"	3/4"	25/0.99	50/0.99	75/0.99	82/0.98	75/0.97	67/0.96	59/0.97	51/0.95	44/0.95	36/0.94
2 E Ton	1/2"	3/4"	25/0.99	50/0.99	75/0.99	100/0.98	108/0.97	106/0.96	104/0.97	103/0.95	102/0.95	101/0.94
5.5 1011	3/8"	7/8"	25/1.00	50/0.99	75/0.99	82/0.99	75/0.98	67/0.99	59/0.98	51/0.98	44/0.98	36/0.98
	1/2"	7/8"	25/1.00	50/0.99	75/0.99	100/0.99	108/0.98	106/0.99	104/0.98	103/0.98	102/0.98	101/0.98
	3/8"	3/4"	25/0.99	50/0.98	75/0.98	73/0.97	63/0.98	53/0.96	43/0.95	33/0.93	23/0.93	13/0.93
4 Top	1/2"	3/4"	25/0.99	50/0.98	75/0.98	100/0.97	105/0.98	103/0.96	101/0.95	99/0.93	98/0.93	97/0.93
4 1011	3/8"	7/8"	25/1.00	50/0.99	75/0.99	73/0.98	63/0.99	53/0.98	43/0.98	33/0.97	23/0.97	13/0.97
	1/2"	7/8"	25/1.00	50/0.99	75/0.99	100/0.98	105/0.99	103/0.98	101/0.98	99/0.97	98/0.97	97/0.97
	3/8"	3/4"	25/0.99	50/0.98	65/0.96	51/0.96	36/0.94	21/0.92	6/0.91	0/0.89	0/0.88	0/0.88
4 Ton	1/2"	3/4"	25/0.99	50/0.98	75/0.96	100/0.96	100/0.94	97/0.92	94/0.91	91/0.89	88/0.88	86/0.88
5 Ton	3/8"	7/8"	25/0.99	50/0.99	65/0.99	51/0.98	36/0.97	21/0.97	6/0.96	0/0.97	0/0.96	0/0.95
5 1011	1/2"	7/8"	25/0.99	50/0.99	75/0.99	100/0.98	100/0.97	97/0.97	94/0.96	91/0.97	88/0.96	86/0.95
	3/8"	1-1/8"	25/1.00	50/1.00	65/1.00	51/0.99	36/0.99	21/0.99	6/0.99	0/0.99	0/0.98	0/0.98
	1/2"	1-1/8"	25/1.00	50/1.00	75/1.00	100/0.99	100/0.99	97/0.99	94/0.99	91/0.99	88/0.98	86/0.98

Table 2a: Suction/Vapor Line Sizing and Cooling Capacity Loss — Single--Stage Air Conditioner Applications

RP14 Heat pump

Single and Two Stage Heat Pumps													
						(Outdoor U	nit ABOVE	or BELOW	Indoor Uni	it		
Linit Size	Store	Liquid Line Size	Suction Line Size				Ec	quivalent L	ength in Fe	et			
Unit Size	Stage	uquid une size	Suction Line Size	0-25	26-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250
						Max	kimum Vert	tical Separa	ation / Cap	acity Multi	plier		
		1/4"	1/2"	25/0.99	50/0.99	56/0.99	38/0.97	20/0.95	1/0.93	0/0.92	0/0.91	0/0.9	0/0.88
		5/16"	1/2"	25/0.99	50/0.99	75/0.99	96/0.97	91/0.95	86/0.93	81/0.92	77/0.91	73/0.9	69/0.88
		3/8"	1/2"	25/0.99	50/0.99	75/0.99	100/0.97	109/0.95	107/0.93	106/0.92	104/0.91	103/0.9	102/0.88
		1/4"	5/8"	25/1	50/0.99	56/0.99	38/0.98	20/0.99	1/0.98	0/0.98	0/0.97	0/0.97	0/0.97
1.5Ton	1Stage	5/16"	5/8"	25/1	50/0.99	75/0.99	96/0.98	91/0.99	86/0.98	81/0.98	77/0.97	73/0.97	69/0.97
		3/8"	5/8"	25/1	50/0.99	75/0.99	100/0.98	109/0.99	107/0.98	106/0.98	104/0.97	103/0.97	102/0.97
		1/4"	3/4"	25/1	50/1	56/1	38/0.99	20/0.99	1/0.99	0/0.99	0/0.99	0/0.98	0/0.98
		5/16"	3/4"	25/1	50/1	75/1	96/0.99	91/0.99	86/0.99	81/0.99	77/0.99	73/0.98	69/0.98
		3/8"	3/4"	25/1	50/1	75/1	100/0.99	109/0.99	107/0.99	106/0.99	104/0.99	103/0.98	102/0.98
		1/4"	1/2"	25/0.99	50/0.98	56/0.98	38/0.94	20/0.93	1/0.91	0/0.89	0/0.88	0/0.87	0/0.85
		5/16"	1/2"	25/0.99	50/0.98	75/0.98	96/0.94	91/0.93	86/0.91	81/0.89	77/0.88	73/0.87	69/0.85
		3/8"	1/2"	25/0.99	50/0.98	75/0.98	100/0.94	109/0.93	107/0.91	106/0.89	104/0.88	103/0.87	102/0.85
		1/4"	5/8"	25/1	50/0.99	56/0.99	38/0.98	20/0.98	1/0.98	0/0.98	0/0.96	0/0.96	0/0.96
1.5Ton	2Stage	5/16"	5/8"	25/1	50/0.99	75/0.99	96/0.98	91/0.98	86/0.98	81/0.98	77/0.96	73/0.96	69/0.96
		3/8"	5/8"	25/1	50/0.99	75/0.99	100/0.98	109/0.98	107/0.98	106/0.98	104/0.96	103/0.96	102/0.96
		1/4"	3/4"	25/1	50/1	56/1	38/0.99	20/0.99	1/0.99	0/0.99	0/0.99	0/0.98	0/0.98
		5/16"	3/4"	25/1	50/1	75/1	96/0.99	91/0.99	86/0.99	81/0.99	77/0.99	73/0.98	69/0.98
		3/8"	3/4"	25/1	50/1	75/1	100/0.99	109/0.99	107/0.99	106/0.99	104/0.99	103/0.98	102/0.98
		1/4"	5/8"	25/1	50/0.99	23/0.98	0/0.97	0/0.96	0/0.95	0/0.95	0/0.94	0/0.93	0/0.93
		5/16"	5/8"	25/1	50/0.99	75/0.98	81/0.97	73/0.96	65/0.95	57/0.95	49/0.94	43/0.93	38/0.93
2Ton 2	264	3/8"	5/8"	25/1	50/0.99	75/0.98	100/0.97	101/0.96	98/0.95	96/0.95	93/0.94	90/0.93	87/0.93
	ZStage	1/4"	3/4"	25/1	50/0.99	23/0.99	0/0.99	0/0.99	0/0.98	0/0.98	0/0.99	0/0.98	0/0.97
		5/16"	3/4"	25/1	50/0.99	75/0.99	81/0.99	73/0.99	65/0.98	57/0.98	49/0.99	43/0.98	38/0.97
		3/8"	3/4"	25/1	50/0.99	75/0.99	100/0.99	101/0.99	98/0.98	96/0.98	93/0.99	90/0.98	87/0.97
		1/4"	5/8"	25/0.99	28/0.98	0/0.97	0/0.96	0/0.94	0/0.93	0/0.92	0/0.91	0/0.9	0/0.89
		5/16"	5/8"	25/0.99	50/0.98	75/0.97	64/0.96	52/0.94	40/0.93	28/0.92	16/0.91	6/0.9	0/0.89
2.57	264	3/8"	5/8"	25/0.99	50/0.98	75/0.97	98/0.96	94/0.94	90/0.93	85/0.92	81/0.91	77/0.9	73/0.89
2.510n	Zstage	1/4"	3/4"	25/1	28/0.99	0/0.99	0/0.98	0/0.98	0/0.97	0/0.97	0/0.97	0/0.96	0/0.96
		5/16"	3/4"	25/1	50/0.99	75/0.99	64/0.98	52/0.98	40/0.97	28/0.97	16/0.97	6/0.96	0/0.96
		3/8"	3/4"	25/1	50/0.99	75/0.99	98/0.98	94/0.98	90/0.97	85/0.97	81/0.97	77/0.96	73/0.96
		5/16"	5/8"	25/0.99	50/0.97	60/0.95	43/0.94	26/0.92	10/0.9	0/0.88	0/0.87	0/0.86	0/0.86
		5/16"	3/4"	25/1	50/0.99	60/0.98	43/0.98	26/0.97	10/0.96	0/0.96	0/0.95	0/0.95	0/0.94
		3/8"	5/8"	25/0.99	50/0.97	75/0.95	90/0.94	85/0.92	79/0.9	73/0.88	67/0.87	61/0.86	55/0.86
3Ton	2Stage	3/8"	3/4"	25/1	50/0.99	75/0.98	90/0.98	85/0.97	79/0.96	73/0.96	67/0.95	61/0.95	55/0.94
		3/8"	7/8"	25/1	50/0.99	75/0.99	90/0.99	85/0.99	79/0.98	73/0.98	67/0.98	61/0.98	55/0.97
		1/2"	3/4"	25/1	50/0.99	75/0.98	100/0.98	110/0.97	109/0.96	107/0.96	107/0.95	106/0.95	105/0.94
		1/2"	7/8"	25/1	50/0.99	75/0.99	100/0.99	110/0.99	109/0.98	107/0.98	107/0.98	106/0.98	105/0.97
		3/8"	3/4"	25/0.99	50/0.99	75/0.98	82/0.97	75/0.96	67/0.95	59/0.94	51/0.93	44/0.93	36/0.92
2.57	264	3/8"	7/8"	25/1	50/0.99	75/0.99	82/0.99	75/0.98	67/0.98	59/0.97	51/0.97	44/0.97	36/0.97
3.510n	ZStage	1/2"	3/4"	25/0.99	50/0.99	75/0.98	100/0.97	108/0.96	106/0.95	104/0.94	103/0.93	102/0.93	101/0.92
		1/2"	7/8"	25/1	50/0.99	75/0.99	100/0.99	108/0.98	106/0.98	104/0.97	103/0.97	102/0.97	101/0.97
		3/8"	3/4"	25/0.99	50/0.98	75/0.97	73/0.96	63/0.95	53/0.94	43/0.93	33/0.91	23/0.91	13/0.9
47	264	3/8"	7/8"	25/1	50/0.99	75/0.99	73/0.98	63/0.98	53/0.97	43/0.97	33/0.96	23/0.96	13/0.96
4Ton	ZStage	1/2"	3/4"	25/0.99	50/0.98	75/0.97	100/0.96	105/0.95	103/0.94	101/0.93	99/0.91	98/0.91	97/0.9
4Ton		1/2"	7/8"	25/1	50/0.99	75/0.99	100/0.98	105/0.98	103/0.97	101/0.97	99/0.96	98/0.96	97/0.96
		3/8"	3/4"	25/0.99	50/0.97	65/0.95	51/0.94	36/0.92	21/0.9	6/0.88	0/0.86	0/0.85	0/0.85
	204	3/8"	7/8"	25/0.99	50/0.99	65/0.98	51/0.97	36/0.96	21/0.96	6/0.95	0/0.94	0/0.94	0/0.93
5100	25tage	1/2"	3/4"	25/0.99	50/0.97	75/0.95	100/0.94	100/0.92	97/0.9	94/0.88	91/0.86	88/0.85	86/0.85
		1/2"	7/8"	25/0.99	50/0.99	75/0.98	100/0.97	100/0.96	97/0.96	94/0.95	91/0.94	88/0.94	86/0.93

TABLE 2b: Suction/Vapor Line Sizing and Cooling Capacity Loss — Single/2-stage Heat Pump Applications

				RP15AZ DUAL	HEAT PUMPS							
	MAX.	SUCTION	OUTDOOR UNIT ABOVE OR BELOW INDOOR UNIT SUCTION EQUIVALENT LENGTH IN FEET									
UNIT SIZE	LINE SIZE	LINE SIZE	0-15	16-25	26-50	51-80	81-100	101-125	126-150			
			MAXIMUM VERTICAL SEPARATION/CAPACITY MULTIPLIER									
		1/2"	15 / 1	25 / 1	50 / 0.99	80 / 0.97	100 / 0.97	115 / 0.96	115 / 0.95			
1.5 TON	3/8"	5/8"	15 / 1	25 / 1	50 / 1	80 / 0.99	100 / 0.99	115 / 0.99	115 / 0.98			
		3/4"	15 / 1	25 / 1	50 / 1	80 / 0.99	100 / 0.99	115 / 0.99	115 / 0.98			
	2/0"	5/8"	15 / 1	25 / 1	50 / 0.99	80 / 0.98	100 / 0.97	100 / 0.96	95 / 0.95			
ZION	3/0	3/4"	15 / 1	25 / 1	50 / 1	80 / 0.99	100 / 0.99	100 / 0.99	95 / 0.98			
	2/0"	5/8"	15 / 1	25 / 0.99	50 / 0.98	80 / 0.97	95 / 0.96	90 / 0.94	85 / 0.93			
2 TON 3/8" 2.5 TON 3/8" 3 TON 3/8"	3/0	3/4"	15 / 1	25 / 1	50 / 0.99	80 / 0.99	95 / 0.98	90 / 0.98	85 / 0.97			
		5/8"	15 / 1	25 / 0.99	50 / 0.97	80 / 0.95	85 / 0.94	80 / 0.92	75 / 0.9			
3 TON	3/8"	3/4"	15 / 1	25 / 1	50 / 0.99	80 / 0.98	85 / 0.98	80 / 0.97	75 / 0.96			
		7/8"	15 / 1	25 / 1	50 / 1	80 / 0.99	85 / 0.99	80 / 0.99	75 / 0.98			
	2/0"	3/4"	15 / 1	25 / 0.99	50 / 0.98	80 / 0.97	80 / 0.97	70 / 0.96	65 / 0.95			
3.5 TON	3/0	7/8"	15 / 1	25 / 1	50 / 0.99	80 / 0.99	80 / 0.99	70 / 0.98	65 / 0.98			
	2/0"	3/4"	15 / 1	25 / 0.99	50 / 0.98	75 / 0.97	70 / 0.96	60 / 0.95	50 / 0.94			
4 10N	3/0	7/8"	15 / 1	25 / 1	50 / 0.99	75 / 0.99	70 / 0.98	60 / 0.98	50 / 0.97			
5 TON	2/0"	3/4"	15/1	25 / 0.99	50 / 0.97	65 / 0.95	45 / 0.94	30 / 0.92	15 / 0.9			
9 TON	3/0	7/8"	15/1	25 / 0.99	50 / 0.99	65 / 0.98	45 / 0.97	30 / 0.96	15 / 0.96			

TABLE 2c: Suction/Vapor Line Sizing and Cooling Capacity Loss — RP15AZ DUAL HEAT PUMP

		1	5/16/18 SEER2 Va	riable Speed Air C	onditioners							
		Allowable	Outdoor Unit ABOVE or BELOW Indoor Unit Equivalent Length (Feet)									
Unit Size	Allowable Liquid Line Size	Vapor	< 25	26-50	51-75	76-100	101-125	126-150				
		Line Size	Maximum Vertical Separation / Capacity Multiplier									
	1/4"	5/8"	25/1.00	50/0.99	32/0.98	40/0.97	NR	NR				
	5/16"	5/8"	25/1.00	50/0.99	50/0.98	50/0.97	50/0.96	50/0.95				
2.0 Ton	3/8"	5/8"	25/1.00	50/0.99	50/0.98	50/0.97	50/0.96	50/0.95				
SEE	1/4"	3/4"	25/1.00	50/1.00	32/0.99	40/0.99	NR	NR				
NOTE 5	5/16"	3/4"**	25/1.00	50/1.00	50/0.99	50/0.99	50/0.99	50/0.98				
	3/8"	3/4"**	25/1.00	50/1.00	50/0.99	50/0.99	50/0.99	50/0.98				
	5/16"	5/8"	25/0.99	50/0.97	50/0.95	50/0.93	37/0.91	NR				
	3/8"	5/8"	25/0.99	50/0.97	50/0.95	50/0.93	50/0.91	NR				
3 Ton	5/16"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	37/0.97	22/0.96				
	3/8"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.97	50/0.96				
	1/2"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.97	50/0.96				
	3/8"	3/4"	25/0.99	50/0.98	50/0.97	50/0.96	50/0.94	50/0.93				
4.7	1/2"	3/4"	25/0.99	50/0.98	50/0.97	50/0.96	50/0.94	50/0.93				
4 Ion	3/8"	7/8"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.98	50/0.97				
	1/2"	7/8"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.98	50/0.97				
	3/8"	3/4"	25/0.99	50/0.97	50/0.95	50/0.93	50/0.91	NR				
5 T	1/2"	3/4"	25/0.99	50/0.97	50/0.95	50/0.93	50/0.91	NR				
5 I ON	3/8"	7/8"	25/1.00	50/0.99	50/0.98	50/0.98	50/0.97	38/0.96				
	1/2"	7/8"	25/1.00	50/0.99	50/0.98	50/0.98	50/0.97	50/0.96				

TABLE 2d: Vapor Line Sizing and Cooling Capacity Loss - Variable Speed Air Conditioner Applications

	16/18 SEER2 VARIABLE SPEED HEAT PUMPS IT SIZE ALLOWABLE LIQUID LINE SIZE ALLOWABLE VAPOR LINE SIZE ALLOWABLE VAPOR LINE SIZE ALLOWABLE VAPOR LINE SIZE ALLOWABLE VAPOR LINE SIZE OUTDOOR UNIT ABOVE OR BELOW INDOOR UNIT EQUIVALENT LENGTH (FEET) 0 TON *SEE 01E 3 1/4" 5/8" 25/1.00 50/0.99 33/0.98 60/0.97 NR NR 5/16" 5/8" 25/1.00 50/0.99 50/0.98 50/0.97 50/0.96 50/0.95 3/8" 5/8" 25/1.00 50/0.99 50/0.98 50/0.97 50/0.96 50/0.95 3/8" 5/8" 25/1.00 50/1.00 33/0.99 60/0.99 NR NR 3/8" 3/4"* 25/1.00 50/1.00 33/0.99 60/0.99 NR NR 3/8" 3/4"* 25/1.00 50/1.00 50/0.99 50/0.99 50/0.98 50/0.99 50/0.98 50/0.99 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0.98 50/0											
	ALLOWABLE	ALLOWABLE		OUTDOOR UNIT ABOVE OR BELOW INDOOR UNIT EQUIVALENT LENGTH (FEET)								
UNIT SIZE	LIQUID		< 25	26-50	51-75	76-100	101-125	126-150				
			MAXIMUM VERTICAL SEPARATION/CAPACITY MULTIPLIER									
	1/4"	5/8"	25/1.00	50/0.99	33/0.98	60/0.97	NR	NR				
	5/16"	5/8"	25/1.00	50/0.99	50/0.98	50/0.97	50/0.96	50/0.95				
2.0 TON	3/8"	5/8"	25/1.00	50/0.99	50/0.98	50/0.97	50/0.96	50/0.95				
NOTE 3	1/4"	3/4"*	25/1.00	50/1.00	33/0.99	60/0.99	NR	NR				
	5/16"	3/4"*	25/1.00	50/1.00	50/0.99	50/0.99	50/0.99	50/0.98				
	3/8"	3/4"*	25/1.00	50/1.00	50/0.99	50/0.99	50/0.99	50/0.98				
	5/16"	5/8"	25/0.99	50/0.97	50/0.95	50/0.93	36/0.91	NR				
	3/8"	5/8"	25/0.99	50/0.97	50/0.95	50/0.93	50/0.91	NR				
3 TON	5/16"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	36/0.97	20/0.96				
	3/8"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.97	50/0.96				
	1/2"	3/4"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.97	50/0.96				
	3/8"	3/4"	25/0.99	50/0.98	50/0.96	50/0.95	50/0.93	50/0.92				
4 TON	1/2"	3/4"	25/0.99	50/0.98	50/0.96	50/0.95	50/0.93	50/0.92				
4 I ON	3/8"	7/8"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.98	50/0.97				
	1/2"	7/8"	25/1.00	50/0.99	50/0.99	50/0.98	50/0.98	50/0.97				
	3/8"	3/4"	25/0.98	50/0.97	50/0.95	50/0.93	46/0.91	NR				
	1/2"	3/4"	25/0.98	50/0.97	50/0.95	50/0.93	50/0.91	NR				
5 TON	3/8"	7/8"	25/0.99	50/0.99	50/0.98	50/0.97	50/0.96	38/0.95				
5 I UN	1/2"	7/8"	25/0.99	50/0.99	50/0.98	50/0.97	50/0.96	50/0.95				
	3/8"	1-1/8"**	25/1.00	50/1.00	50/1.00	50/0.99	50/0.99	38/0.99				
	1/2"	1-1/8"**	25/1.00	50/1.00	50/1.00	50/0.99	50/0.99	50/0.99				

TABLE 2e: Vapor Line Sizing and Cooling Capacity Loss - Variable Speed Heat Pump Applications

5.0 Refrigerant Level Adjustment

The residential outdoor units (ODU) are R-410A factory charged. The factory charge amount accounts for the ODU volume and an additional 15 feet of refrigerant tubing with a liquid line diameter of 3/8". This factory charge does not account for the volume of the factory supplied field installed liquid line filter drier. Final adjustment of the refrigerant charge may be necessary during the system commissioning even if the application has exactly 15 feet of line set due to other installation

1/4" line diameter	0.3 oz per foot of line
5/16" line diameter	0.4 oz per foot of line
3/8" line diameter	0.6 oz per foot of line
1/2" line diameter	1.2 oz per foot of line
Filter drier	Additional 6.0 oz of refrigerant
	TABLE 5

Note: The factory provided charge to account for the 15 feet of line set is 9 oz. (based on 3/8" line, 0.6 oz. per foot)

variables such as the filter drier and pressure drops due to vertical separation. If additional refrigerant charge is needed, run the system for 15 mins and adjust charge as per sub cool requirement.

Adjust the refrigerant charge by using the **actual** liquid line length and the table below that indicates refrigerant charge in ounces per foot of the indicated liquid line size:

Charge Adjustment = (Line Diameter oz. per ft.) x Total Actual Length) – Factory Charge + Filter Drier

Example:

A 3-ton unit with 50' of 5/16' liquid line (**actual** length) and the factory provided filter drier. In this case 5/16" diameter line requires 0.4 ounces per foot of liquid line length.

- 1. Multiply 50 ft. x 0.4 ounces per foot = 20 ounces
- 2. Add 6.0 ounces needed for the field installed drier

 Subtract the 9.0 ounces of the factory charge that is already in the system and was designated for the 15' of refrigerant line. Answer: 20 oz. + 6.0 oz. - 9.0 oz. = 17 ounces of additional refrigerant charge is required

6.0 ADDITIONAL OIL REQUIREMENT

RA15/16 and RP16

	RA15/RA16 Additional Oil, Oz.													
Line set Length	50	60	70	80	90	100	110	120	130	140	150			
2T	N/A	N/A	N/A	N/A	N/A	1	2	3	5	6	7			
3T	N/A	N/A	N/A	N/A	N/A	N/A	1	2	3	5	6			
4T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
5T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			

RP16 ADDITIONAL POE OIL, Oz.													
Line set length	50	60	70	80	90	100	110	120	130	140	150		
2T	N/A	1	3	4	5	7	8	9	11	12	13		
3T	N/A	N/A	N/A	N/A	1	2	3	5	6	7	9		
4T	N/A	0	1										
5T	2	3	4	6	7	8	10	11	12	14	15		

General Requirements (Check list)

- The Maximum Actual Linear Length of the refrigerant lines shall not exceed 200 ft. [61 m].
- Equivalent Length shall not exceed 250 ft. [76.2 m].
- Maximum Vertical Separation may not exceed 200 ft. [61 m].
- Maximum Vertical Separation may not exceed 90% of the total actual length.
- Maximum Vertical Lift on liquid line may not exceed 80 ft. [24.5 m] (Outdoor Unit Below and all Heat Pumps).
- Follow Refrigerant Line Sizing Charts do not exceed lengths, vertical separation, line diameters or total actual length described in these charts.
- Understand the difference between Actual and Equivalent Lengths. Refrigerant lines are measured in terms of actual length and equivalent length. Actual length is used for refrigerant charge applications. This is the actual line set distance between the indoor and outdoor units. Equivalent length considers pressure losses from refrigerant

line lengths, fittings, vertical separation, accessories, and filter dryers. Table 1 references different commonly used equivalent lengths for fittings and parts.

- Heat pump line sizing charts only apply to Heat Pumps. Because refrigerant flows both directions, depending on operating mode or defrost, vertical separation is limited to 80 ft. [24.5 m]. DO NOT attempt to install a heat pump using the cooling only charts.
- Applications in the grey shaded areas of the Line Size Charts (Long Line Set) require the use of appropriate accessories, unit requirements, and installation considerations.
- Additional refrigerant may be required depending on the system application.
- Additional refrigerant line insulation may be required on the vapor line and/or liquid line.
- Inverted Traps are used when the indoor coil is above the outdoor coil. This prevents oil from draining out of the evaporator in the off cycle which can accumulate near the compressor