SUBMITTAL DATA

Order #: **Date:** 02/09/2026

Project:

Project #:

Date
02/09/2026
Project Name
Project Number
Client / Purchaser

Submittal Summary Page

Qty	Tag #	Model # / Material #	Description
1		HH860E2S11	Side Discharge, Heat Pump, 18 SEER2, 5.0 Tons, R-454B Refrigerant, 208/230-1-60, Standard (Conventional) Controls
1		JHE48C5CG2SS1	York Brand, Single Piece Air Handler, Constant Torque Motor, 4.0 Tons, R454B Refrigerant, 21.0" Cabinet Width, 208/230-1-60, TXV, 3R-28-12, Standard (Conventional) Controls, (RDS) A2L Sensor Factory Installed
1		S1-8HK26502006	20 kW 208/230-1-60 Electric Heat Kit w/ Circuit Breaker and Jumper Bar

Equipment start-up and commissioning by a factory trained technician is recommended.
Contact your supplying distributor or sales representative for additional information & guidance.

WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Residential Split

Split-System Outdoor

Project Name:

Unit Model #: **HH860E2S11**

Quantity: **1**

System: **HH860E2S11,JHE48C5CG2SS1**

No Performance Data Available

Run Performance to view metrics



5 Ton

Product Features

- Inverter driven compressor and modulating system will automatically adjust capacity, in heat or cool mode, to precisely match the comfort demands of the space providing closer temperature and humidity control.

Unit Features

- Easier Installation- Installation time is reduced by being factory charged for a 15-Ft line set. The small footprint and slim design along with reduced unit clearance requirements provide more retrofit applications.
- Durable Finish- The coated steel wire fan guard, coated external fasteners, and pre-treated galvanized steel chassis components resist corrosion and rust creep.
- Quality Coils- Enhanced aluminum fins are mechanically bonded to copper tubing and coated to shed water during defrost cycles.
- Protected Compressor - Compressors are protected by the system high pressure switch and low pressure sensor.
- Long Line Set – These models are factory capable for long line set installations up to 246ft.
- Reliable Operation – Ball bearing fan motors provide superior performance in extreme temperatures. Factory installed accumulator protects the compressor while operating across a wide range of conditions.
- Thin Profile – The thin profile allows for installation on narrow lots and allows compact location on multi-unit applications.
- Low Operating Sound Levels - Developed using CFD and FEA tools, the sturdy cabinet and top design provides sound performance as low as 56 dBA.

Warranty

- Standard 5-Years parts
- 10 Years compressor limited warranty
- Extended 10 Years parts limited warranty with registration

Project Name:

Unit Model #: **HH860E2S11**

Quantity: **1**

System: **HH860E2S11,JHE48C5CG2SS1**

Factory Installed Options

HH860E2S11

Equipment Options		Option(s) Selected
Brand :	**H**	Side Discharge
Unit Type :	**H**	Heat Pump
Efficiency :	**8**	18 SEER2
Capacity :	**60**	5.0 Tons
Refrigerant :	**E**	R-454B Refrigerant
Voltage :	**2**	208/230-1-60
Controls :	**S**	Standard (Conventional) Controls
Factory-Installed Options :	**1**	
Generation :	**1**	

Field Installed Accessories

- ○ S1-1HK0601 - Anchor Bracket Kit (1.4 lbs)
- ○ S1-ADDWIRE - Add-a-Wire allows 5-wire thermostats to use only 4 wires. (0.3 lbs)
- ○ S1-CTSDTS - CTS Wired Temperature Sensor for thermostat | Duct *Also works for LX Series (0.3 lbs)
- ○ S1-CTSHTS - CTS Hardwired Temperature Sensor for CTS Thermostats *Works with LX series as well (0.2 lbs)
- ○ S1-CTSPLATE - Wall Plate for CTS Thermostats *Also works for new platform LX series models below (0.0 lbs)
- ○ S1-CTSWFTS - CTS Temperature Sensor with WiFi for CTS Thermostats *Also works with LX Series (0.1 lbs)
- ○ S1-LXLOCK - Locking Ring For LX-Series Thermostats (0.4 lbs)
- ○ S1-LXPLATE - Wall Plate For LX-Series Thermostats (0.0 lbs)
- ○ S1-LXWFM - For LX Series Thermostats - WiFi Communication (0.1 lbs)
- ○ S1-THEC11NS - Source 1 Branded THE Value Series | 2.3" Display | 1 Stage Heating | 1 Stage Cooling | Non-Programmable | Hardwire/Battery Powered (0.6 lbs)
- ○ S1-THEC11P5S - Source 1 Branded THE Value Series | 2.3" Display | 1 Stage Heating | 1 Stage Cooling | 7-Day (5+2) Programmable | Hardwire/Battery Powered (1.1 lbs)
- ○ S1-THEPLATE - Wall Plate for THE Thermostats (0.1 lbs)
- ○ S1-THPU432-S - SOURCE 1 CTS SERIRES | 3/4 Stage Heating | 2 Stage Cooling | 7-day/5+2 Programmable | WiFi | Dual Fuel (0.7 lbs)
- ○ S1-THPU433-S - Source 1 Branded CTS Series | 3/4 Stage Heating | 2 Stage Cooling | 7-Day/5+2 Programmable | WiFi | Dual Fuel (0.7 lbs)
- ○ S1-THSU231-S - Source 1 Branded LX Series | 2.3" Display | 2 Stage Heating | 2 Stage Cooling | 7-day Programmable | WiFi On-Board (0.2 lbs)
- ○ S1-THSU301-S - Source 1 Branded LX Series | 3" Display | 2 Stage Heating | 1 Stage Cooling | (5+2) 7-day Programmable (1.0 lbs)
- ○ S1-THSU302-S - Source 1 Branded LX Series | 3" Display | 3/4 Stage Heating | 2 Stage Cooling | (5+2) 7-day Programmable (1.0 lbs)
- ○ S1-THSU303-S - Source 1 Branded LX Series | 3" Display | 3/4 Stage Heating | 2 Stage Cooling | (5+2) 7-day Programmable | Humidity On-Board (1.0 lbs)
- ○ S1-THXU430W - Wi-Fi Communicating Touchscreen Thermostat with Proprietary Hexagon Interface (White), with 4.3” display screen (0.9 lbs)

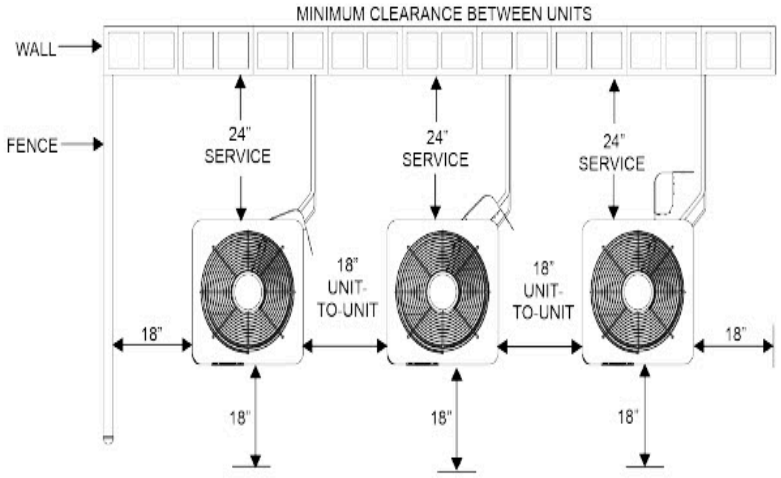
Project Name: Unit Model #: **HH860E2S11**

Quantity: **1**

Alternate Clearances

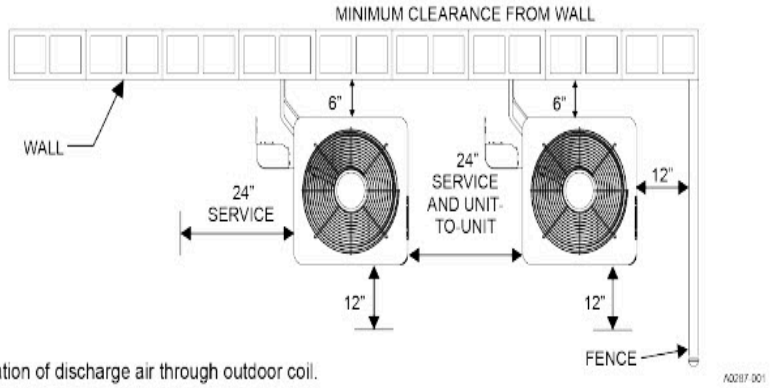
Alternative installation clearances

Figure 6: Alternative installation clearances



NOTE:
Clearance between two units may be reduced to 18" minimum provided the service access clearance is increased to 24" minimum, and the clearance on each remaining side is maintained at 18" minimum.

NOTE:
Clearance to one side of the unit may be reduced to 6" provided the clearance to each remaining side is increased to 12" minimum, the service access is increased to 24" minimum, and the clearances between any two units is maintained at 24" minimum.



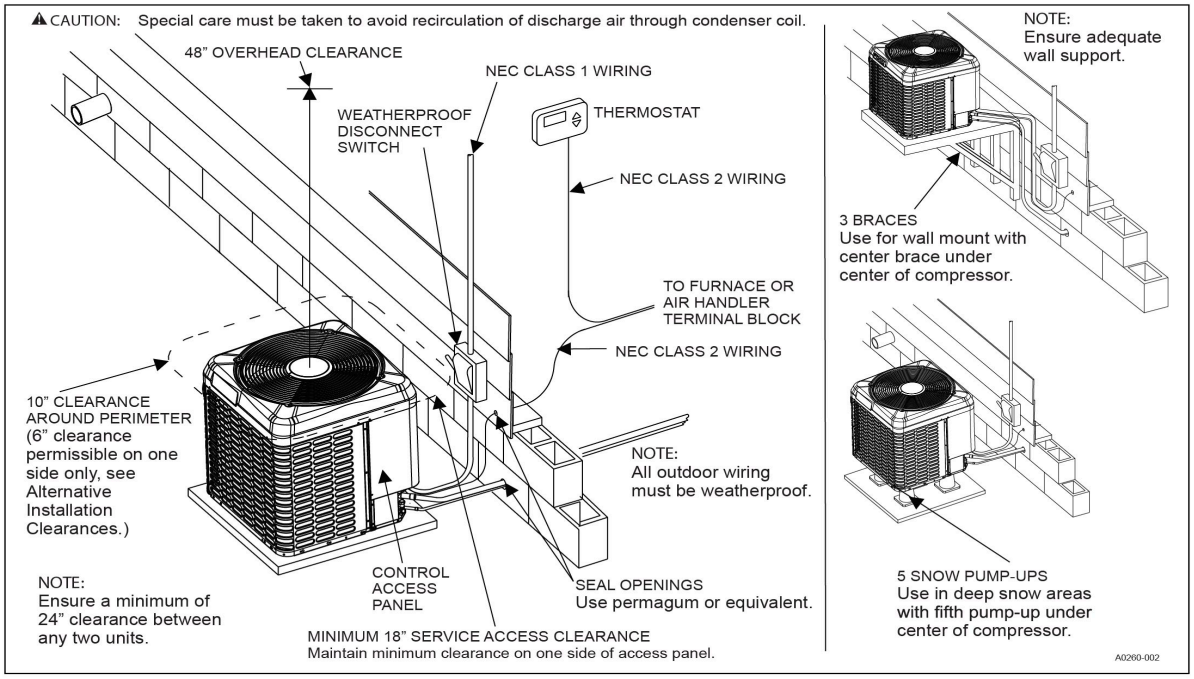
CAUTION:
Special care must be taken to avoid recirculation of discharge air through outdoor coil.

Project Name: Unit Model #: **HH860E2S11**

Quantity: **1**

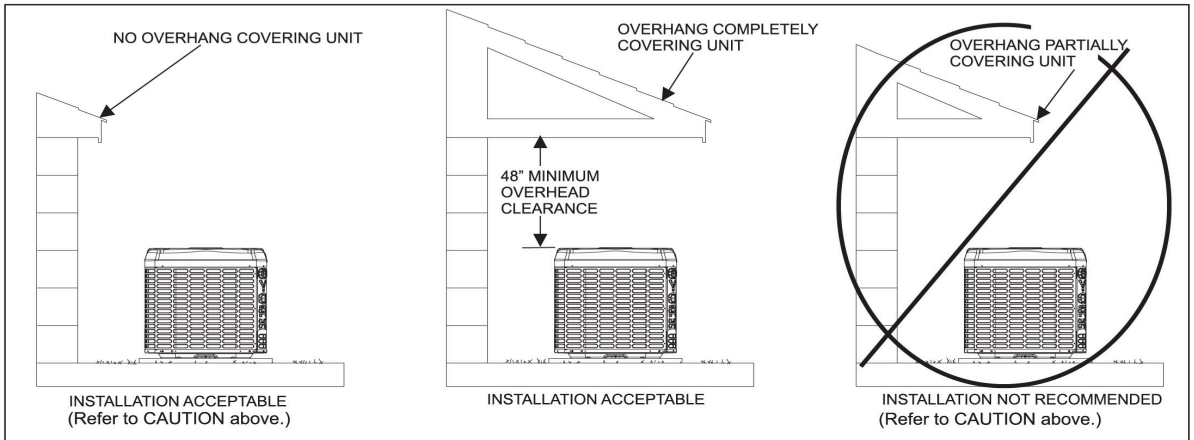
Typical Installation

TYPICAL INSTALLATION



⚠ CAUTION

Care must be taken to prevent ice from damaging the unit. Damage may occur from ice falling onto unit from a sloped roof or from a vertical drip line due to a partial overhang.



Project Name:

Unit Model #: **HH860E2S11**

Quantity: **1**

Dimensions and Physical Data

Tabular Data Sheet

HH8 Series - Horizontal Discharge Variable Speed Heat Pump

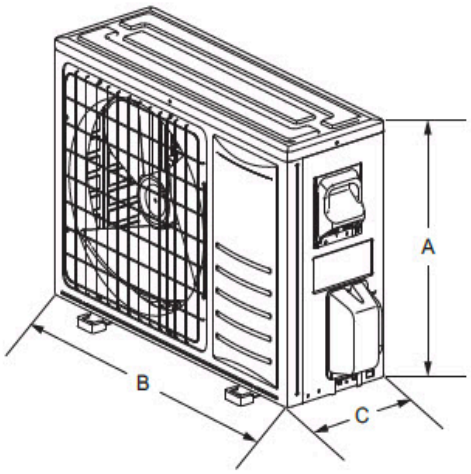
18 SEER2 - R-454B - 1 Phase - 2 nominal ton to 5 nominal ton

Models: HH824E2S11 to HH860E2S11

Physical and electrical data

Model		HH824E2S11	HH836E2S11	HH860E2S11
Unit supply voltage		208-230 V, 1 phase, 60 Hz		
Normal voltage range[1]		187 to 252		
Minimum circuit ampacity		24	28	37
Maximum overcurrent device (A)[2]		35	35	45
Compressor	Type	Twin rotary	Twin rotary	Twin rotary
	Rated load (A)	16.8	19	27
Crankcase heater (base heater)		Yes	Yes	Yes
Base pan heater		Yes	Yes	Yes
Fan diameter (in.)		21.89	24.4	21.85
Fan motor	Rated HP	1/7	1/3	1/5
	FLA (A)	0.8	1.5	1
	Nominal RPM	870	850	880
	Nominal CFM	2235	3620	4645
Coil	Face area (ft^2)	7.49	10.76	14.87
	Rows deep	2	2	2.6
	Fins per inch	17	18	18
Liquid refrigerant piping outdoor (field installed)		3/8	3/8	3/8
Vapor refrigerant piping outdoor (field installed)[3,4]		5/8	3/4	7/8
Unit charge (lb-oz)		5 - 01	7 - 07	11 - 00
Charge (oz/ft)		0.54	0.57	0.6
Operating weight (lb)		116.8	185.2	233.5

1. Rated in accordance with AHRI Standard 110-2016, utilization range A.
2. Dual element fuses or HACR circuit breaker. Maximum allowable overcurrent protection.
3. For applications with non-standard vapor line sizes, refer to the *Accessories* section in the *Technical Guide*.
4. The unit charge provided is correct for the outdoor unit, smallest matched indoor unit, and 15 ft of refrigerant piping. For refrigerant piping lengths other than 15 ft, add or subtract the amount of refrigerant, using the difference in actual refrigerant piping length (not the equivalent length) multiplied by the per foot value.



Dimensions

Unit model	Dimensions (in.)			Refrigerant connection service valve size (in.)	
	A	B	C	Liquid	Vapor
HH824E2S11	29 1/2	35 3/7	13 2/5	3/8	5/8
HH836E2S11	34 4/9	43 1/3	17 5/7		3/4
HH860E2S11	57 1/2	38 2/5	13		7/8

Notes:

- All dimensions are in inches and are subject to change without notice.
- The overall height is from the bottom of the base pan to the top of the fan guard.
- The overall length and width include screw heads.

Project Name: Unit Model #: **HH860E2S11**

Quantity: **1**

Clearances

Clearance

During installation, maintain the required clearance from walls and adjacent equipment. See Figure 3. When installing multiple units, be careful to avoid intake of discharged air from adjacent units.

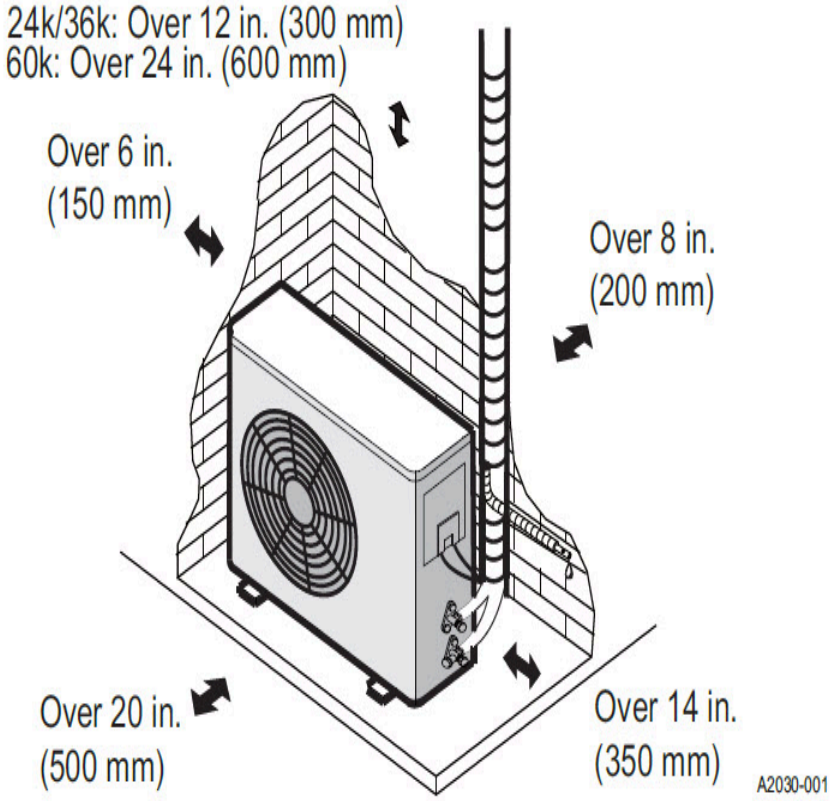


Figure 3: Minimum clearance

Residential Split

Split-System Indoor

Project Name:

Unit Model #: **JHE48C5CG2SS1**

Quantity: **1**

System: **HH860E2S11,JHE48C5CG2SS1**

No Performance Data Available

Run Performance to view metrics



Product Features

- The JHE Air Handler line offers the ultimate in comfort, sound and application flexibility. This unit may be used for upflow, downflow, horizontal right, or horizontal left applications. No special kits are required to install this product. All JHE Air Handler units come with a factory-installed TXV

Unit Features

- Next Generation 9-Speed Blower - Delivers increased airflow and reduced blower watts by 10%, using a standard ECM motor
- (RDS) A2L Sensor Factory Installed
- Two-Stage Operation - Provides flexibility in application with single and two-stage outdoor equipment
- MaxAlloyTM Coil - Long life aluminum coils built to deliver lasting performance, efficiency, and reliability
- A2L Refrigerant Design - For use with new R454 Refrigerant
- Next Generation Even-Flow Distributor - Designed for balanced refrigerant flow and even coil circuit performance
- Next Generation Insulation and Gasket Design - reduces thermal transmission paths and reduces sweating
- Electric Heat Kit - 8HK field-installed series available for easy installation and service application
- Tool-less Filter Access - Sliding latch design provides quick and easy access
- Designed For Easy Installation and Service - Casing size of 20.5 in., smooth sides, and rigid construction provide ease of attic access and tight applications. Front facing components, slide out blower, laser cut knock outs and integrated duct flanges shorten install time
- Cabinet Air Leakage - Less than 2% at 1 in. W.C. external static pressure when tested in accordance with ASHRAE Standard 193
- Long Lasting Quality - Structural components made of post-powder painted aluminum or galvanized steel to prevent corrosion
- Thermoset Drain Pan - Positive slope for drainage to reduce cause for potential mold or contaminants

Warranty

- Standard 5-year limited parts warranty.
- Extended 10-year limited parts warranty when product is registered online within 90 days of purchase for replacement or closing for new home construction.

Project Name:

Unit Model #: **JHE48C5CG2SS1**

Quantity: **1**

System: **HH860E2S11,JHE48C5CG2SS1**

Factory Installed Options

JHE48C5CG2SS1

Equipment Options		Option(s) Selected
Brand :	**J**	York Brand
Product Type :	**H**	Single Piece Air Handler
Motor Control Options :	**E**	Constant Torque Motor
Capacity :	**48**	4.0 Tons
Cabinet Width :	**C**	21.0" Cabinet Width
Refrigerant :	**5**	R454B Refrigerant
Refrigerant / TXV :	**C**	TXV
Slab Size :	**G**	3R-28-12
Voltage :	**2**	208/230-1-60
Controls :	**S**	Standard (Conventional) Controls
Options :	**S**	(RDS) A2L Sensor Factory Installed
Generation :	**1**	

Field Installed Accessories

- ○ S1-02435670000 - Single Source Power Kit (single-phase) 2 disconnects (0.6 lbs)
- ○ S1-02435671000 - Single Source Power Kit (single-phase) 3 disconnects (1.0 lbs)
- ○ S1-02435672000 - Service Disconnect Opening Seal Cover (0.2 lbs)
- ○ S1-1BR01121 - Filter Rack (9.2 lbs)
- ○ S1-1FB1921 - Combustible Floor Base For Downflow W /Electric Heat (8.2 lbs)
- ○ S1-1FR06702020 - Color matched filter box and merv 11 filter. Accepts 4" and 1" filters (16.0 lbs)
- ○ S1-32436041000 - Single Point Wiring Kit for 3 Ph 6HK (0.9 lbs)
- ○ S1-8HK06500206 - 2.5 kW 208/230-1-60 Electric Heat without Circuit Breaker (1.0 lbs)
- ○ S1-8HK06500506 - 5 kW 208/230-1-60 Electric Heat without Circuit Breaker (4.7 lbs)
- ○ S1-8HK06500806 - 7.5 kW 208/230-1-60 Electric Heat without Circuit Breaker (5.3 lbs)
- ○ S1-8HK06501006 - 10 kW 208/230-1-60 Electric Heat without Circuit Breaker (5.4 lbs)
- ○ S1-8HK06501025 - 10 kW 208/230-3-60 Electric Heat without Circuit Breaker (5.9 lbs)
- ○ S1-8HK06501525 - 15 kW 208/230-3-60 Electric Heat without Circuit Breaker (6.2 lbs)
- ○ S1-8HK16500206 - 2.5 kW 208/230-1-60 Electric Heat with Circuit Breaker (1.0 lbs)
- ○ S1-8HK16500506 - 5 kW 208/230-1-60 Electric Heat with Circuit Breaker (5.2 lbs)
- ○ S1-8HK16500806 - 7.5 kW 208/230-1-60 Electric Heat with Circuit Breaker (6.0 lbs)
- ○ S1-8HK16501006 - 10 kW 208/230-1-60 Electric Heat with Circuit Breaker (5.9 lbs)
- ○ S1-8HK16501506 - 15 kW 208/230-1-60 Electric Heat with Circuit Breaker (7.7 lbs)
- ○ S1-8HK16502006 - 20 kW 208/230-1-60 Electric Heat with Circuit Breaker (8.6 lbs)
- ○ S1-8HK16502025 - 20 kW 208/230-3-60 Electric Heat with Circuit Breaker (10.8 lbs)
- ○ S1-8HK26501506 - 15 kW 208/230-1-60 Electric Heat Kit w/ Circuit Breaker and Jumper Bar (7.6 lbs)
- ● S1-8HK26502006 - 20 kW 208/230-1-60 Electric Heat Kit w/ Circuit Breaker and Jumper Bar (5.0 lbs)

Project Name:

Unit Model #: **JHE48C5CG2SS1**

Quantity: **1**

Dimensions

Figure 7: Dimensions and duct connection dimensions

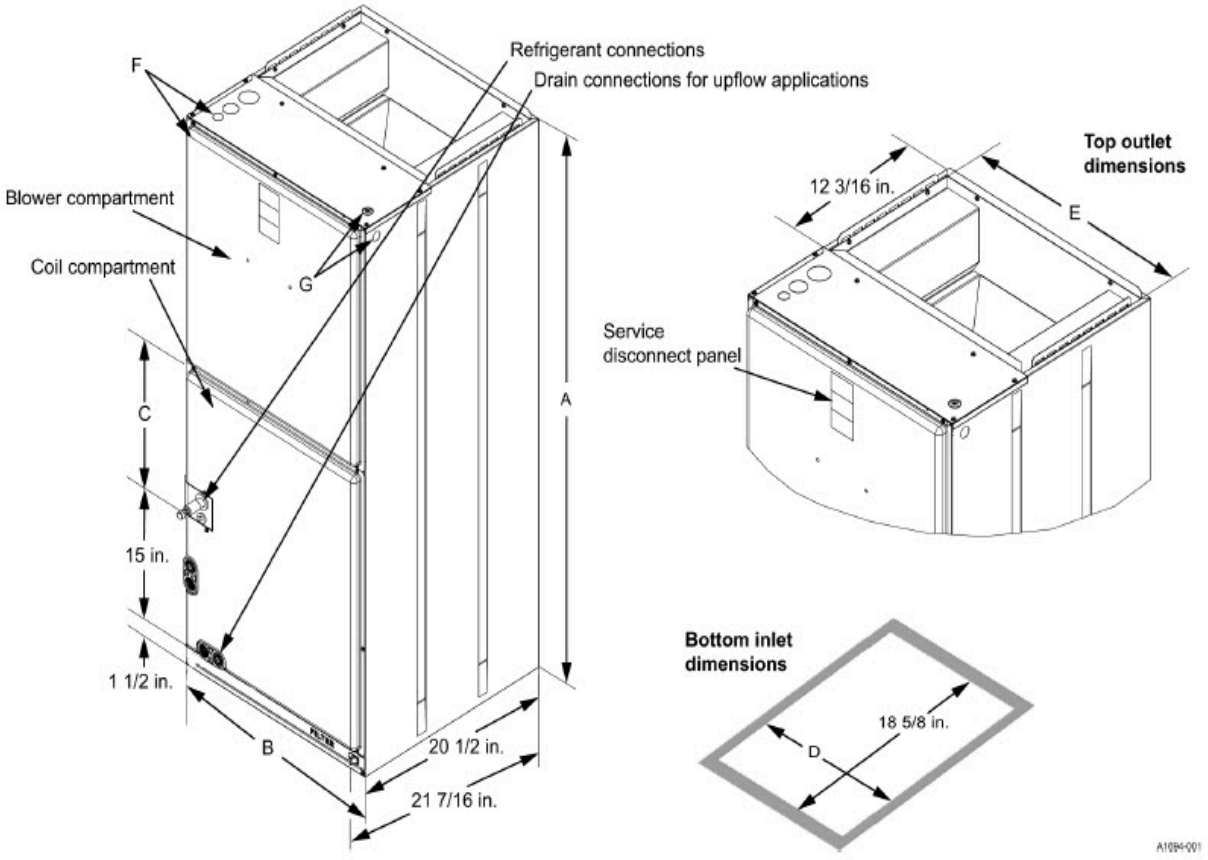


Table 9: Dimensions

Models	Dimensions					Wiring knockouts (actual conduit size)		Refrigerant connections line size	
	A	B	C	D	E	F	G		
	Height (in.)	Width (in.)	Opening widths (in.)			Power (in.)	Control (in.)	Liquid (in.)	Vapor (in.)
JHE18B5*B2SS	45 5/8	17 1/2	7 1/2	16 1/2	16 1/2	7/8 (1/2) 1 3/8 (1) 1 23/32 (1 1/4)	7/8 (1/2)	3/8	3/4
JHE24B5*C2SS	48 3/8	17 1/2	10	16 1/2	16 1/2				
JHE30B5*D2SS	48 3/8	17 1/2	10	16 1/2	16 1/2				
JHE36B5*D2SS	48 3/8	17 1/2	10	16 1/2	16 1/2				
JHE36C5*D2SS	49 5/8	21	11 1/2	20	20				
JHE42C5*F2SS	55 5/8	21	17 1/2	20	20				7/8
JHE48C5*G2SS	60	21	21 3/4	20	20				
JHE48D5*G2SS	60	24 1/2	21 3/4	23 1/2	23 1/2				
JHE60C5*H2SS	61 6/8	21	23 1/2	20	20				
JHE60D5*H2SS	61 6/8	24 1/2	23 1/2	23 1/2	23 1/2				
JHE60D5*J2SS	60	24 1/2	21 3/4	23 1/2	23 1/2				

PIPING APPLICATION DATA SHEET

General Piping Recommendations and Refrigerant Line Length for Split-System Air Conditioners and Heat Pumps

⚠ CAUTION

This Split-System (Air Conditioning Condensing/Heat Pump) unit is one component of an entire system. As such it requires specific application considerations with regard to the rest of the system (air handling unit, duct design, refrigerant piping and control scheme).

Failure to properly apply this equipment with the rest of the system may result in premature failure and/or reduced performance/increased costs. Warranty coverage specifically excludes failures due to improper application and UP specifically disclaims any liability resulting from improper application.

Please refer to the equipment Technical Guide, Installation Manual and the following publication for further information.

INTRODUCTION

NOTE: This document has been **updated for R-454B** equipment.

Installation of residential and commercial split-systems should be performed by qualified service technicians with proper training in the installation, service and repair of these units.

This document should serve as a guideline for proper split-system piping installation. Read these instructions along with the unit installation instructions carefully and adhere to all cautions, warnings and general practice guidelines. Consult local building codes for special requirements.

The tables and application data in this publication will help you to better apply split-system cooling and heat pump systems to achieve maximum efficiency and performance, improved reliability, and greater customer satisfaction. This guideline includes information for:

- General Guidelines
- Indoor Unit Above the Outdoor Unit
- Outdoor Unit Above the Indoor Unit
- Total line length
- Line Sizing
- Additional Refrigerant
- Refrigerant Oil Management
- Accumulator Use and Misuse
- Recommended Orifice Sizing Chart
- Long Line Set Applications

GENERAL GUIDELINES

The following guidelines apply to the application on either factory line sets or field fabricated tubing for cooling only and heat pump systems:

- Many service problems can be avoided by taking adequate precautions to provide an internally clean and dry system and by using procedures and materials that conform with established standards.
- The lines should be installed so that they will not obstruct service access to the indoor coil, air handling system or filter. Install the lines with as few bends as possible. Care must be taken not to damage the couplings or kink the tubing. Care must also be used to isolate the refrigerant lines to minimize noise transmission from the equipment to the structure.
- Never solder vapor and liquid lines together. They can be taped together for convenience and support purposes, but they must be completely insulated from each other.
- Support all refrigerant lines at minimum intervals with suitable hangers and brackets. Tape and suspend the refrigerant lines as shown in Figure 1. **DO NOT ALLOW METAL-TO-METAL CONTACT**.

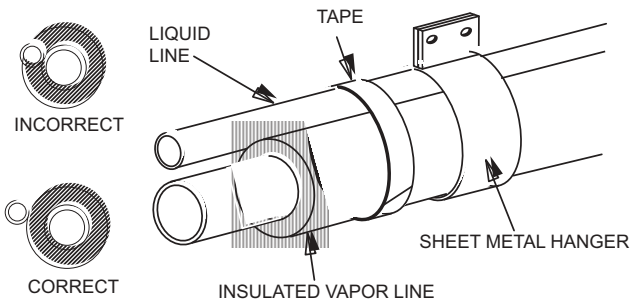


FIGURE 1: Refrigerant Line Support

- Slope horizontal suction lines on cooling only systems approximately 1 inch every 20 feet toward the outdoor unit to facilitate proper oil return. Since the flow of refrigerant is bi-directional on heat pumps, all horizontal vapor lines should be level. Pre-charged lines with excess tubing should be coiled horizontally in an inconspicuous location to avoid oil trapping. Never coil excess tubing vertically.
- Use long radius elbows wherever possible.
- Use PVC piping as a conduit for all underground installations. See Figure 2. Buried lines must be kept as short as possible to minimize the build up of liquid refrigerant in the vapor line during long periods of shutdown.

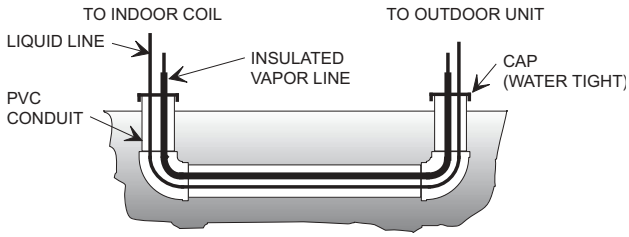


FIGURE 2: Underground Application

- Pack fiberglass insulation and a sealing material such as permagum around refrigerant lines where they penetrate a wall to reduce vibration and to retain some flexibility. If multiple line sets are routed through a common conduit, then all lines must be insulated.
- Insulate all vapor lines with a minimum of 1/2 inch of foam rubber. Liquid lines that will be exposed to direct sunlight or high ambient temperatures such as an attic must also be insulated.

The following additional guidelines apply to field fabricated piping:

- Use hard drawn refrigeration type copper tubing where no appreciable amount of bending around pipes or obstructions is necessary. If soft copper must be used, care should be taken to avoid sharp bends which may cause a restriction.
- Braze all copper to copper joints with Silfos-5 or equivalent brazing material. **DO NOT USE SOFT SOLDER**.
- During brazing operations, flow an inert gas such as nitrogen through the system to prevent internal scaling and contamination.

TRAPS

Traps are not required if the piping is properly sized. Traps will only add pressure drop to the system, further reducing capacity.

INDOOR UNIT ABOVE OUTDOOR UNIT

NOTE: Lift applications where micro-channel condensers are lower than evaporators check valves should be employed at the outlet of the condenser to minimize startup pressure spiking on cooling only systems. This effects starting of reciprocating compressors with orifice or TXV.

With this configuration, a common problem with the cooling cycle (air conditioning or heat pump) is that the amount of liquid sub-cooling varies as operating conditions change (such as outdoor ambient). Under some conditions, it is possible that flashing will actually occur in the liquid riser. As long as only liquid is present in the liquid riser, the liquid static pressure loss can be calculated at 1/2 psi per foot of rise. However, as soon as flashing starts, the rate of pressure loss increases and continues to increase as the amount of gas increases. For this reason, the restrictions on elevation differences for this configuration must be based on the entire range of operating conditions.

When the indoor unit is above the outdoor unit, the pressure loss in the liquid line during the cooling cycle will limit the amount of elevation difference allowed. Since both friction and static head contribute to pressure loss, it can be stated that the elevation difference allowed decreases as the total equivalent line length (horizontal plus vertical) increases.

OUTDOOR UNIT ABOVE INDOOR UNIT

COOLING CYCLE

When the outdoor unit is above the indoor unit, the static pressure gain in the liquid line vertical drop (1/2 psi per foot) may overcome the frictional pressure loss resulting in a total pressure gain. A pressure gain in the liquid line is not detrimental to the performance of the system.

On cooling only systems where the outdoor unit is located high above the indoor coil, it may even be possible to reduce the size of the liquid line. The static gain in the vertical drop will offset the increased friction loss caused by smaller tubing. In addition, the reduction in the total system charge due to the smaller liquid line will enhance the reliability of the system.

With this configuration, gas velocity in the vapor riser must be kept above 1000 feet per minute for proper oil return and below 3000 feet per minute to avoid noise and vibration problems.

HEATING CYCLE (Heat Pumps Only)

In the heating mode, liquid will travel from the indoor unit up the liquid riser to the outdoor unit. This will result in a liquid line pressure drop and a starved outdoor coil. Since heat pumps have a defrost cycle, coil freeze-up is not a problem. However, the resulting lower suction pressure will decrease the capacity and efficiency of the system.

TOTAL LINE LENGTH

The total length of interconnecting tubing is the sum of all horizontal and vertical runs from the indoor unit to the outdoor unit. Total measured line lengths are limited to:

- The limiting factor on heat pumps is the storage capacity of the accumulator. The limiting factor on cooling units is oil sump capacity in the compressor.
- Total equivalent line lengths must only be used when calculating pressure drop. Therefore use Table 1 to calculate equivalent lengths for elbows.

TABLE 1: EQUIVALENT LENGTHS OF ELBOWS IN FEET

LINE SIZE INCHES (O.D.)	90° SHORT RADIUS ELBOW (FT.)*	90° LONG RADIUS ELBOW (FT.)
1/4	0.7	0.6
5/16	0.8	0.7
3/8	0.9	0.8
1/2	1.2	1.0
5/8	1.5	1.3
3/4	1.6	1.4
7/8	1.8	1.6
1-1/8	2.4	2.0
1-3/8	3.2	2.2
1-5/8	3.8	2.6
2-1/8	5.2	3.4
2-5/8	6.5	4.2

***. Two 45° radius ells equals one 90° radius ell.**

LINE SIZING

Every split-system unit is shipped with a factory-mounted sweat fitting.

For split systems, interconnecting refrigerant lines should be sized to match the factory supplied fittings unless the application dictates different line sizes due to pressure drop, refrigerant velocity constraints and/or line set lengths.

For cooling systems where the indoor and outdoor sections are installed at the same elevation, refrigerant line sizes can usually be matched with the factory supplied fittings. There are exceptions for total line lengths exceeding 75 feet where pressure drop limitations are exceeded. Refer to Long Line Set section.

In some applications, especially where elevation differences exist between the indoor and outdoor sections, suction and liquid line sizes can be increased (or decreased) to minimize pressure loss (or gain) and improve oil return to the compressor. When sizing refrigerant lines for split-system cooling units, the following factors must be considered:

1. Suction line pressure loss due to friction.
2. Suction line velocity for oil return.
3. Liquid line pressure loss due to friction.
4. Liquid line pressure loss (or gain) due to static head.

The effect that each of these factors have on a cooling system depends on the orientation of the indoor and outdoor sections; e.g., indoor unit above the outdoor unit. Before we discuss the various orientations, it is important to understand a few things about suction and liquid lines.

First, lets consider suction lines. Suction pressure loss reduces system capacity by 0.6% per psi for R-410A and R-454B. This can be a serious problem if suction lines are not sized properly and pressure loss is 8 or 9 psi. Therefore, in order to minimize capacity loss and maximize efficiency, suction pressure loss must be minimized. This is achieved by increasing the size of the suction line. As a good achievable guideline, suction pressure loss should not be allowed to exceed 3 psi (5 psi for R-410A and R-454B).

Another important consideration when sizing suction lines is refrigerant gas velocity in a suction riser. Velocity of at least 1000 feet per minute is required to carry oil up a suction riser. Of course, this is only a factor when the outdoor unit is above the indoor unit and the oil must overcome the pull of gravity to return to the compressor. Greater refrigerant velocities are obtained by decreasing the size of the suction line. In applications where smaller tubing is required for a suction riser and larger tubing is needed to minimize pressure drop, the riser must be sized to achieve a velocity of at least 1000 feet per minute while the horizontal runs can be sized larger to minimize pressure drop.

NOTE: Must maintain 800 fpm minimum velocity on all horizontal pipe runs.

Liquid lines must also be sized to minimize pressure change. The total pressure change in a liquid line is the sum of the loss due to friction and the loss (or gain) due to static head in the vertical line. Liquid pressure loss reduces the amount of liquid sub-cooling at a rate of 1 degree for every 5 psi for R-410A and R-454B. Sufficient sub-cooling must be maintained at the expansion valve to provide proper operation. If the liquid pressure drop is high enough to deplete all of the liquid sub-cooling in the system, liquid will begin to flash reducing the refrigerant flow through the indoor coil expansion valve. However, as soon as flashing begins, the rate of pressure loss increases and continues to increase as the amount of gas increases. Careful consideration must be given to liquid line sizing to minimize pressure drop and system charge. Liquid lines should be sized as small as possible without exceeding the **recommended maximum pressure drop**. The maximum recommended liquid line velocity is 400 fpm. Velocities exceeding 400 fpm can result in higher than acceptable noise levels.

ADDITIONAL REFRIGERANT

In many applications, additional refrigerant will have to be added to the system. The actual amount of charge that must be added is determined by adding the following:

1. The indoor coil charge adjustment from the Installation Manual.
2. The additional charge required for the interconnecting piping and the size of the vapor and liquid lines.

Example: For a system using a 3/8 liquid line and a 3/4 suction line with a total measured length of 50 feet,

Liquid line	50 - 15 feet x 0.62 oz./foot	= 21.7 oz.
Suction line	50 - 15 feet x 0.06 oz./foot	= 2.1 oz.
Charge add for interconnecting tubing		= 23.8 oz.

NOTE: On residential equipment 15 feet of line is included on nameplate charge.

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TABLE 2: LINE CHARGE

R-410A LINE CHARGE*			
SUCTION	OZ./FT.	LIQUID	OZ./FT.
1/2	0.04	1/4	0.19
5/8	0.06	5/16	0.33
3/4	0.09	3/8	0.51
7/8	0.12	1/2	1.01
1-1/8	0.20	5/8	1.64
1-3/8	0.31	3/4	2.46
1-5/8	0.43	7/8	3.27
2-1/8	0.76	1-1/8	5.58
2-5/8	1.17		

R-454B LINE CHARGE*			
SUCTION	OZ./FT.	LIQUID	OZ./FT.
1/2	0.02	1/4	0.16
5/8	0.04	5/16	0.29
3/4	0.05	3/8	0.44
7/8	0.07	1/2	0.87
1-1/8	0.12	5/8	1.42
1-3/8	0.19	3/4	2.13
1-5/8	0.26	7/8	2.83
2-1/8	0.46	1-1/8	4.83
2-5/8	0.71		

*. Charges are based upon 40°F suction temperature and 105°F liquid temperature.

REFRIGERANT OIL MANAGEMENT

Inherent to all refrigeration systems is the presence of refrigerant oil required for proper and continuous lubrication of the compressor(s) bearings. All refrigeration systems, whether they are packaged or split-systems circulate oil throughout the system due to the miscibility of refrigerant oil. Split-systems, due to their propensity for long piping lengths, can circulate more refrigerant oil than packaged units, which can become a problem if not recognized and managed. It is not unusual for a given system to circulate as much as 15% of the original compressor oil charge. Yet another side-effect of long piping runs on split-systems is the aspect of system oil logging which can occur even in the best of installations. Even the best piping practices can inadvertently create oil traps in the system especially when elevation differences between the indoor and outdoor units occur. Refer to the section on **Long Line Set Applications** for determining if refrigerant oil should be added to the system.

Oil separation may be the answer to keep oil in the compressor where it belongs. In package equipment where piping lengths are very short and system volumes are smaller than split installations, oil return is less of an issue. Manufacturing concerns, cost and properly sized piping in split systems all come into play with regard to separators and their use. In systems that have had a history of failures due to lubrication, problems will need to be verified visually and separators incorporated within system repair to eliminate lubrication failures. In split systems where failures have occurred piping should always be suspect and examined, velocities evaluated, elevational changes noted and provided for, along with possible riser considerations. Compressor staging should also be noted with the line sizing requirements so at lower capacities system velocities can be maintained at a level high enough for proper oil return.

ACCUMULATOR USE AND MISUSE

Ordinarily, suction line accumulators are not necessary on AC units if the system is piped correctly and all of the precautionary guidelines are followed. Refrigerant suction line accumulators should only be installed on systems where liquid flood back to the compressor(s) is highly likely. Accumulators are a standard item on all heat pumps to avoid liquid flood back to the compressor when switching from heat to cooling, reversal before and after defrost and during low ambient heating operation. If applied incorrectly suction line accumulators can log oil or not provide the necessary liquid protection especially when under sized.

The compressor suction line size should never be used as a guideline for sizing the suction line accumulator. Matching the accumulator piping size to the suction line size can often times result in an undersized accumulator. Normally the accumulator is sized for not less than 50% of the total system capacity.

Careful consideration must be given when attempting to apply an accumulator to a split-system. On any given unit approximately 80% of the system charge can be found between the compressor and the expansion device during operation. When the system shuts down the refrigerant is trapped between the compressor check valve and the non-bleed expansion device used on all York split-systems. During long periods of shut down the refrigerant will migrate to the low side of the system possibly accumulating in the evaporator coil and horizontal suction lines.

If it has been determined that an accumulator must be installed in the system proper positioning with respect to the compressor suction line level is shown in Figure 3. It may become necessary in many cases to elevate the outdoor unit to accommodate proper piping and drainage back to the accumulator during the off cycle. Multiple accumulators whether piped in series or parallel are not recommended.

If an accumulator has been installed into a system and the compressor experiences a burn out the accumulator must be replaced. The debris from the burn out will clog the orifice in the accumulator resulting in oil return starvation to the replacement compressor.

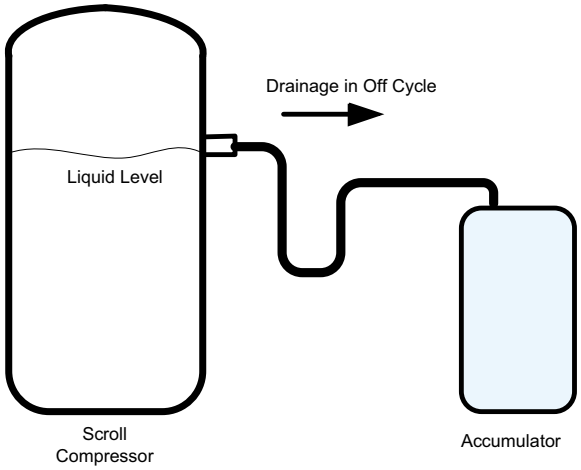


FIGURE 3: Accumulator Field Piping

LONG LINE SET APPLICATIONS

This section is intended for long line applications that exceed 75'. When sizing line sets under 75', always use factory supplied connections. If your application is outside of the selection charts, your application must be approved through the Application Engineering group.

LIQUID LINE SIZING CRITERIA

The following considerations have already been accounted for when relating to the selection charts.

- R-410A and R-454B Maximum Pressure Drop is 60 psig
- Increased charge levels
- Maximum recommended velocity of 400 fpm
- Minimum velocity of 100 fpm

Liquid Line Selection Chart: The charts below show the line sizes that can be selected for each tonnage of unit and the maximum equivalent length and maximum rise of the line. ***The maximum actual line length is 200 feet. Equivalent line lengths would include elbows and other components that would increase the equivalent length***.

TABLE 3: R-410A AND R-454B LIQUID LINE, MAXIMUM RISE CHART

Tons	Line Size	Maximum Total Equivalent Length								Velocity
		75	100	125	150	175	200	225	250	FPM
1.5	5/16	75	90	85	85	80	75	75	70	223
	3/8	75	100	95	95	95	95	90	90	138
2.0	5/16	75	80	75	70	65	60	55	50	297
	3/8	75	95	90	90	85	85	85	80	184
2.5	3/8	75	90	85	85	80	80	75	70	230
	1/2	75	100	100	100	100	95	95	95	123
3.0	3/8	75	85	85	80	75	70	65	60	276
	1/2	75	100	100	95	95	95	90	90	148
3.5	3/8	75	80	75	70	65	60	55	50	322
	1/2	75	95	95	95	95	90	90	90	173
4.0	3/8	75	75	70	60	55	45	40	35	368
	1/2	75	95	95	95	90	90	90	85	198
5.0	3/8	70	60	50	40	30	20	10	0	*460
	1/2	75	95	90	90	85	85	80	80	247
7.5	1/2	75	80	80	75	70	65	60	55	370
	5/8	75	95	95	95	90	90	90	85	231
10	5/8	75	90	90	85	85	80	80	75	307
	3/4	75	100	95	95	95	95	90	90	210
12.5	5/8	75	85	85	80	75	70	65	65	384
	3/4	75	95	95	90	90	90	90	85	262
15	3/4	75	95	90	90	85	85	85	80	315
	7/8	75	100	95	95	95	95	95	90	222
20	3/4	75	85	85	80	75	70	70	65	419
	7/8	75	95	95	90	90	90	85	85	296
25	7/8	75	95	90	90	85	85	80	75	371
	1-1/8	75	100	100	100	95	95	95	95	217

***Note**: Exceeds recommended maximum velocity of 400 fpm, consider noise when selecting this pipe size.

Example: 3 Ton cooling unit with 175' of equivalent length, condensing unit is below the evaporator with 80' of vertical rise to the evaporator.

Answer: You should have selected 1/2”. Why did you select this size? Because at 175' equivalent length with a 3 ton system, the maximum rise is 75’ for 3/8” and 95’ for 1/2".

Multi Stage Refrigeration Systems: When sizing the liquid line for a system with either a 2 stage scroll compressor (residential) or when a **single** refrigeration system utilizes compressor staging for capacity reduction (commercial). **ALWAYS** calculate the liquid line size with the **maximum** tonnage rating of the unit.

SUCTION LINE SIZING CRITERIA

The following considerations have already been accounted for when relating to the selection charts.

- Minimum velocity of 1000 fpm for vertical lines and 800 fpm for horizontal lines guarantee proper oil return
- Minimal pressure drop to minimize capacity loss

Suction Line Selection Chart: The charts below show the line sizes that can be selected for each tonnage of unit and the percent of capacity reduction the system will have because of the long line set application. ***The maximum actual line length is 200 feet, equivalent line lengths would include elbows and other components that would increase the equivalent length***.

TABLE 4: R-410A AND R-454B SUCTION LINE, CAPACITY REDUCTION CHART (%)

Tons	Line Size	Total Equivalent Length								Velocity
		75	100	125	150	175	200	225	250	FPM
1.5	5/8	3	4	5	7	8	10	12	13	1185
	3/4	3	4	5	6	8	10	11	12	808*
2.0	5/8	2	4	6	7	-	-	-	-	1582
	3/4	3	4	4	5	6	7	8	10	1078
2.5	3/4	2	3	4	5	6	7	8	10	1346
	7/8	2	3	4	5	6	6	7	8	952*
3.0	3/4	2	2	4	5	6	8	-	-	1616
	7/8	2	3	3	4	5	5	6	7	1143
3.5	3/4	2	3	4	6	-	-	-	-	1887
	7/8	2	2	3	3	4	5	6	7	1333
4.0	3/4	2	4	5	-	-	-	-	-	2155
	7/8	1	2	2	3	5	6	7	8	1523
5.0	7/8	1	2	3	5	6	-	-	-	1905
	1-1/8	1	2	2	3	3	4	4	5	1117
7.5	1-1/8	1	1	2	2	3	4	5	5	1676
	1-3/8	1	1	2	2	3	3	3	4	1100
10	1-3/8	1	1	1	2	2	2	3	3	1467
	1-5/8	1	1	1	2	2	2	3	3	1036
12.5	1-3/8	1	1	1	1	2	2	3	4	1834
	1-5/8	1	1	1	1	2	2	2	3	1295
15	1-3/8	1	1	1	2	3	4	5	-	2200
	1-5/8	1	1	1	1	1	2	2	2	1554
20	1-5/8	1	1	1	1	1	2	3	3	2073
	2-1/8	1	1	1	1	1	1	2	2	1191
25	1-5/8	1	1	1	2	3	4	-	-	2591
	2-1/8	1	1	1	1	1	1	1	2	1489

*Velocity is below 1000 fpm, should only be used on horizontal line.

Multi Stage Refrigeration Systems: When sizing the suction line for a system with either a 2 stage scroll compressor (residential) or when a **single** refrigeration system utilizes compressor staging for capacity reduction (commercial). **ALWAYS** select the largest available pipe size from the minimum tonnage of capacity reduction.

Example: 10 ton R-410A and R-454B 2 pipe system that reduces capacity to 5 tons. Select 1-1/8” suction line, this is the largest available suction line size for a 5 ton suction line.

Note: 2 stage scroll compressors operate at 67% of full load capacity.

LONG LINE SET ACCESSORIES

All long line set applications must have the following accessories installed if they are not already installed from the factory.

- **Crankcase Heater** - A crankcase heater will warm the compressor sump and prevent the refrigerant from migrating to the compressor in the off cycle.
- **Non Bleed TXV's on all ID Coils** - Prevents refrigerant from bleeding into the low side of the system through the evaporator in the off cycle.
- **Hard Start Kit** - A hard start kit is necessary to increase the compressor starting torque anytime a TXV is used in a system. This is necessary to overcome the pressure difference across the compressor.
- **Cooling Only Units** - Require **liquid line check valve** placed in the liquid line near the condensing unit. This is used to lock the refrigerant in the liquid line between the TXV and the condensing unit to reduce off cycle migration.
- **Heat Pumps with Orifice in OD Coil** - Require **check valve and solenoid valve** placed in liquid line to prevent off cycle migration, refer to Figure 4 for proper placement.
- **Heat Pumps with TXV’s on both Coils** - Do not require additional check valves and solenoid valves.
- **Pump Out Accessory** - This is required on commercial applications where available.

⚠ CAUTION

Any application that falls outside standard limits should be referred to Unitary Products application Engineering @ 1-877-UPG-SERV.

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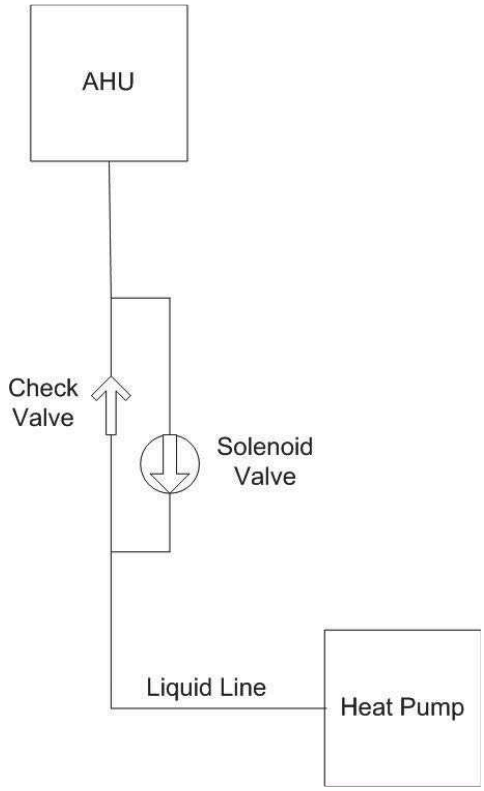


FIGURE 4: Heat Pump Solenoid/Check Valve Installation Arrangement

TABLE 5: CRANKCASE HEATERS FOR SPLIT UNITS

Model	Part #	Voltage	Watts	Min. Circum	Max. Circum
Danfoss Scrolls (All)	S1-02541100000	240	70	19.625	27.125
	S1-02541101000	460	70	19.625	27.125
	S1-02541102000	575	70	19.625	27.125
Copeland Scrolls (Residential)	S1-02531959000	240	80	22	26
	S1-02531960000	460	80	22	26
	S1-02531958000	575	80	22	26
Copeland Scrolls (Commercial)	S1-02533474240	240	90	28.75	35.75

TABLE 6: HP SOLENOID VALVE

Model	Part#	Voltage
3/8" Liquid Line Solenoid Valve	S1-02541203000	24V

TABLE 7: MAGNETIC CHECK VALVES

Pipe Diameter	Part #
3/8”	S1-02222498000
1/2”	S1-02211519000
5/8”	S1-02209099000
3/4”	S1-02211520000
7/8”	S1-02211481000
1-1/8”	S1-02211521000

⚠ CAUTION

Any application that falls outside standard limits should be referred to Unitary Products application Engineering @ 1-877-UPG-SERV.

OIL SEPARATORS

Oil separators are recommended by the Ducted Systems technical service team for commercial split applications with more than 75 feet of horizontal line connections or more than 25 vertical feet in the condensing unit high configuration. Additionally, any third-party air handlers used in conjunction with Johnson Controls condensing units require oil separators. The offered models are as follows:

TABLE 8: OIL SEPARATOR MODELS

Source 1 Part #	Description
S1-092300000	OIL SEPARATOR WITH FILTER KIT, MODEL 923
S1-092500000	OIL SEPARATOR WITH FILTER KIT, MODEL 925
S1-62034000	KIT, FILTER, REPL, FOR 923 OIL SEPARATOR
S1-62037000	KIT, FILTER, REPL, FOR 925 OIL SEPARATOR

CONSIDERATIONS WHEN COMPARING R-410A AND R-454B PIPING DESIGNS

The specific gravity of refrigerants can vary slightly based on temperature and pressure, but generally; R-410A has a specific gravity of approximately 0.85, and R-454B has a specific gravity of approximately 0.90. This means that R-454B is slightly heavier than R-410A in terms of specific gravity. Specific gravity is an important property for evaluating the behavior of refrigerants in various applications, including their buoyancy, or lift, as well as potential for leak detection.

Oil entrainment

The following factors can affect oil entrainment:

- Specific gravity: The difference in specific gravity can impact how well the refrigerant carries oil through the system. A refrigerant with higher specific gravity, such as R-454B, may affect the oil's ability to stay suspended and

circulate, potentially leading to oil logging in certain system components.

- Oil type compatibility: The type of oil used, for example, mineral oil, POE, or PAG, and its compatibility with the refrigerant is also important. Different refrigerants may require different oils, and their properties can influence oil entrainment.
- System design: The design of the system, including the compressor type, evaporator, and condenser, can affect oil return and entrainment. Systems designed for R-410A may need adjustments when switching to R-454B to ensure proper oil management.
- Operating conditions: Factors such as temperature and pressure can influence oil behavior and its ability to mix with the refrigerant, affecting overall performance.

Oil carryover

The following factors can affect oil carryover:

- Specific gravity: A 0.05 difference in specific gravity between refrigerants like R-410A and R-454B does not cause a significant or visible change in oil carryover in most systems.
- System design: The overall design and configuration of the HVAC system can amplify or mitigate the effects of specific gravity differences. Systems that are well-designed for oil management should not show noticeable changes.
- Operating conditions: Temperature, pressure, and flow rates can significantly affect how oil is carried with the refrigerant. Under certain conditions, even a small difference could lead to variations in oil return.
- Oil type and viscosity: The specific oil used and its viscosity can be crucial. Oils with different properties may behave differently in the presence of refrigerants, potentially leading to varying levels of oil carryover.
- Length of operation: Over time, even small differences can accumulate, potentially leading to noticeable changes in oil levels, especially if the system is not designed for optimal oil return.

While a 0.05 difference in specific gravity alone is unlikely to cause a visible change in oil carryover, it can be one of many factors which, when combined, may impact oil management in a refrigeration system. Regular monitoring and maintenance are essential to ensure proper oil circulation, regardless of the specific refrigerant used.

Differences in piping design between R-410A and R-454B

While R-410A and R-454B are both refrigerants used in similar applications, there are some considerations that could lead to differences in piping design, although they are not typically marked. When transitioning from one refrigerant to another, here are some factors to consider:

- Pressure levels: R-410A operates at higher pressures compared to R-454B. This could necessitate using thicker-walled pipes or fittings for R-410A systems to accommodate the higher pressure, while R-454B may allow for lighter materials.
- Oil management: The specific gravity and oil entrainment characteristics of the two refrigerants may influence how piping is designed, particularly in ensuring proper oil return. Systems with R-454B may require modifications to ensure efficient oil management, depending on the geometry of system.
- Temperature: Different refrigerants can have varying temperature glide and saturation properties. This could influence the sizing and layout of the piping to optimize heat exchange efficiency.
- Compatibility with materials: While both refrigerants are generally compatible with common refrigerant piping materials, the long-term effects on materials can vary. Ensure that the materials used in the piping are compatible with the specific refrigerant being utilized.
- System efficiency: Depending on the efficiency characteristics of the two refrigerants, there may be a need to adjust the design to optimize performance, including considerations for pipe length, bends, and fittings.

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