

# 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

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.

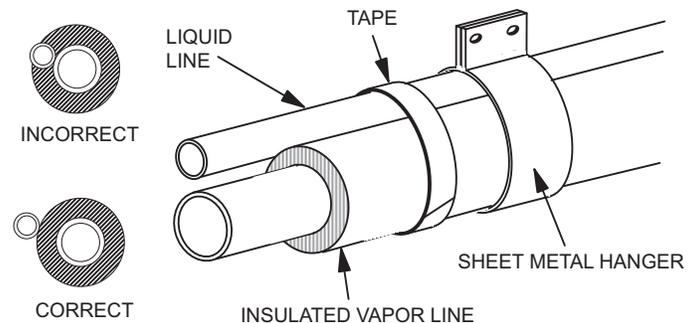
The tables and application data in this publication will help you to better apply split-system cooling and heat pump systems to achieve maximum efficiency and performance, improved reliability, and greater customer satisfaction. This guideline includes information for:

- 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

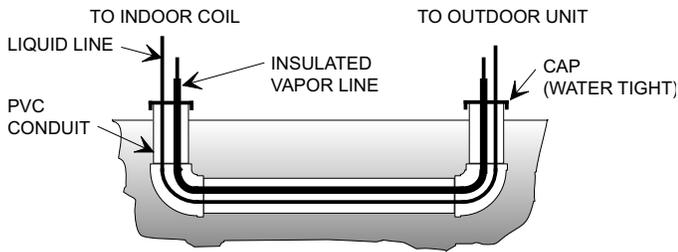
The following guidelines apply to the application on either factory line sets or field fabricated tubing for cooling only and heat pump systems:

- 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 1% for R-22 and 0.6% for R-410A per psi. 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).

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 3 psi for R-22 and 5 psi for R-410A. 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.

**TABLE 2: LINE CHARGE**

R-22 LINE CHARGE			
SUCTION	OZ./FT.	LIQUID	OZ./FT.
1/2	0.02	1/4	0.23
5/8	0.04	5/16	0.40
3/4	0.06	3/8	0.62
7/8	0.08	1/2	1.12
1-1/8	0.14	5/8	1.81
1-3/8	0.21	7/8	3.78
1-5/8	0.30	7/8	3.78
2-1/8	0.53	1-1/8	6.46
2-5/8	0.81	1-1/8	6.46

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		

\*. 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

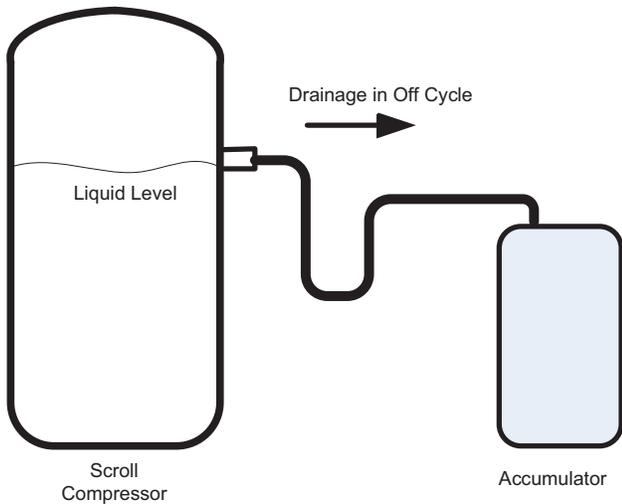
Ordinarily, suction line accumulators are not necessary on AC units if the system is piped correctly and all of the precautionary guidelines are followed. Refrigerant suction line accumulators should only be installed on systems where liquid flood back to the compressor(s) is highly likely. Accumulators 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**

**RECOMMENDED ORIFICE SIZE**

**ORIFICE SIZING**

Use the York® Comfort Cooling Piping software to determine liquid line pressure drop to select proper orifice sizing.

**TABLE 3: RECOMMENDED ORIFICE SIZE**

LIQUID LINE PRESSURE GAINS (PSI)					STANDARD ORIFICE SIZE	LIQUID LINE PRESSURE LOSSES (PSI)	
51	41	31	21	11		11	21
Thru	Thru	Thru	Thru	Thru		Thru	Thru
60	50	40	30	20		20	30
CORRECTED ORIFICE SIZE						CORRECT ORIFICE SIZE	
-	-	-	-	39	41	43	45
-	-	-	39	41	43	45	47
41	43	45	47	49	51	53	55
43	45	47	49	51	53	55	57
45	47	49	51	53	55	57	59
47	49	51	53	55	57	59	61
49	51	53	55	57	59	61	63
51	53	55	57	59	61	63	65
53	55	57	59	61	63	65	67
55	57	59	61	63	65	67	69
57	59	61	63	65	67	69	71
59	61	63	65	67	69	71	73
61	63	65	67	69	71	73	75
63	65	67	69	71	73	75	78
65	67	69	71	73	75	78	81
69	71	73	75	75	78	81	84
71	73	75	78	78	81	84	87
75	75	78	81	81	84	87	90
78	78	81	84	84	87	90	93
81	81	84	87	87	90	93	96
84	84	87	90	90	93	96	99
87	87	90	93	93	96	99	102
90	90	93	96	96	99	102	105
93	93	96	99	99	102	105	105

## 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-22 Maximum Pressure Drop is 35 psig
- R-410A 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 4: R22 LIQUID LINE, MAXIMUM RISE CHART**

Tons	Line Size	Maximum Total Equivalent Length								Velocity FPM
		75	100	125	150	175	200	225	250	
1.5	5/16	60	55	50	50	45	40	35	30	186
	3/8	65	65	65	60	60	60	55	55	115
2.0	5/16	50	45	35	30	25	20	15	5	248
	3/8	60	60	60	55	55	50	45	45	154
2.5	3/8	60	55	55	50	45	40	35	35	192
	1/2	65	65	65	65	65	60	60	60	103
3.0	3/8	55	50	45	40	35	30	25	20	231
	1/2	65	65	65	65	60	60	60	55	124
3.5	3/8	50	45	35	30	25	20	10	5	269
	1/2	65	65	60	60	60	55	55	55	145
4.0	3/8	45	35	30	20	15	10	-	-	308
	1/2	65	60	60	60	55	55	50	50	165
5.0	3/8	30	20	10	-	-	-	-	-	385
	1/2	60	60	55	50	50	45	45	40	207
7.5	1/2	50	45	40	35	30	25	15	10	310
	5/8	65	60	60	60	55	55	55	50	193
10	5/8	60	55	55	50	50	45	40	40	257
	3/4	65	65	65	60	60	60	55	55	175
12.5	5/8	55	50	45	40	35	30	25	25	322
	3/4	65	60	60	55	55	55	50	50	219
15	3/4	60	60	55	55	50	50	45	45	263
	7/8	65	65	65	60	60	60	60	55	186
20	3/4	55	50	45	45	40	35	30	25	351
	7/8	65	60	60	55	55	55	50	50	248
25	7/8	60	55	55	50	50	45	40	40	310
	1-1/8	65	65	65	65	65	60	60	60	182

Shaded area indicates system needs oil added (Refer to Oil Addition section on page 8).

**TABLE 5: R-410A LIQUID LINE, MAXIMUM RISE CHART**

Tons	Line Size	Maximum Total Equivalent Length								Velocity FPM
		75	100	125	150	175	200	225	250	
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 6: R22 SUCTION LINE, CAPACITY REDUCTION CHART (%)**

Tons	Line Size	Total Equivalent Length								Velocity FPM
		75	100	125	150	175	200	225	250	
1.5	5/8	5	7	9	12	-	-	-	-	1682
	3/4	4	5	6	7	9	11	12	13	1147
2.0	3/4	3	4	6	8	9	11	-	-	1529
	7/8	3	4	5	6	7	8	9	10	1081
2.5	3/4	3	5	7	-	-	-	-	-	1911
	7/8	2	3	4	5	7	8	9	10	1351
3.0	3/4	5	7	8	-	-	-	-	-	2294
	7/8	2	3	5	6	8	9	10	11	1621
3.5	7/8	2	4	6	7	-	-	-	-	1892
	1-1/8	2	3	4	4	5	5	6	7	1109
4.0	7/8	3	5	7	-	-	-	-	-	2162
	1-1/8	2	2	3	4	4	5	6	7	1268
5.0	7/8	5	-	-	-	-	-	-	-	2703
	1-1/8	1	2	3	4	5	6	6	7	1585
	1-3/8	1	2	3	3	4	4	5	6	1048
7.5	1-3/8	1	2	2	2	3	4	5	5	1561
	1-5/8	1	2	2	2	3	3	4	4	1103
10	1-3/8	1	1	2	3	4	5	6	-	2082
	1-5/8	1	1	2	2	2	3	3	3	1471
12.5	1-5/8	1	1	1	2	2	3	3	4	1839
	2-1/8	1	1	1	1	2	2	3	3	1057
15	1-5/8	1	1	2	3	3	4	4	5	2207
	2-1/8	1	1	1	2	2	2	2	3	1268
20	2-1/8	1	1	1	1	2	2	2	2	1691
	2-5/8	1	1	1	1	1	2	2	2	1096
25	2-1/8	1	1	1	1	1	2	2	3	2114
	2-5/8	1	1	1	1	1	2	2	2	1370

Note: (-) Indicates unacceptable pressure drop in suction line

**TABLE 7: R-410A SUCTION LINE, CAPACITY REDUCTION CHART (%)**

Tons	Line Size	Total Equivalent Length								Velocity FPM
		75	100	125	150	175	200	225	250	
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.

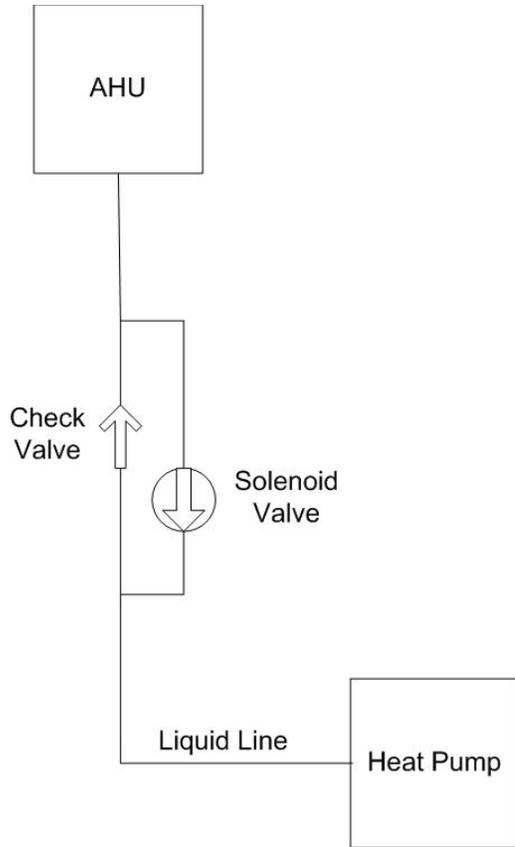
**Example:** 10 ton R-22 2 pipe system that reduces capacity to 5 tons. Select 1-3/8" suction line, this is the largest available suction line size for a 5 ton suction line.

**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.



**FIGURE 4: Heat Pump Solenoid/Check Valve Installation Arrangement**

**OIL ADDITION**

If the line set you selected is in the shaded area of Table 4, (R22 Liquid Line, Maximum Rise Chart) oil needs to be added to the compressors. The formula below determines the amount of oil to add to the compressors.

**(TSC x .03 x 16) - (SOC x .1) = AOR**

- TSC = Total System Charge in pounds
- SOC = System Oil Charge in ounces
- AOR = Additional Oil Required in ounces

**ROTARY COMPRESSOR**

If you are selecting a unit with a rotary compressor, the maximum actual line set is 100 ft.

<span style="font-size: 1.2em; font-weight: bold; padding-left: 5px;">CAUTION</span>
<p>Any application that falls outside standard limits should be referred to Unitary Products application Engineering @ 1-877-UPG-SERV.</p>

**TABLE 8: 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
Bristol H23A	S1-02533474460	460	90	28.75	35.75
	S1-02533474575	575	90	28.75	35.75
Bristol Recips (Remainder)	S1-02537399240	240	70	21.81	29
	S1-02537399480	460	70	21.81	29
	S1-02537399575	575	70	21.81	29

**TABLE 9: HP SOLENOID VALVE**

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

**TABLE 10: 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.