

LONG LINE SET APPLICATION R-32 LIGHT COMMERCIAL PRODUCTS

TECHNICAL PUBLICATION

TP-111

DAIKIN COMFORT TECHNOLOGIES MANUFACTURING, L.P.

This long-line set application guideline applies to all R-32 air-conditioner and heat pump split system matches of nominal capacity 90,000 Btuh to 120,000 Btuh.

This guideline will cover installation requirements and additional accessories needed for split system installations where the line set exceeds 25 feet (7.62 m) in actual length.

R-32 produces lower mass flows rates and resultant velocities in each tube diameter than R-410A systems. Do not use these instructions for R-410A systems nor use existing R-410A system tubing for retrofit R-32 systems without evaluating tube velocities across the operating range.

This guideline provides installation instructions based on the most common long line set applications. Installation variables may affect the system operation.

Contact Technical Services for variations or applications outside those outlined in this document.

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ATTENTION INSTALLING PERSONNEL

- Only qualified, experienced technicians shall install or service this system.
- Equipment must be installed in accordance with Regulations of the National Fire Protection Association and applicable local codes. Where local regulations are at a variance with instructions, installer should adhere to local codes.
- Before connecting tubing, read the outdoor unit installation manual.
- Prior to actual installation, thoroughly familiarize yourself with these guidelines.
- Pay special attention to all safety warnings posted on the equipment. Often during installation or repair it is possible to place yourself in a position which is more hazardous than when the unit is in operation.
- The precautions listed in this Technical Publication are intended as supplemental to existing Installation and Operation (IO) Manual practices. However, if there is a direct conflict between existing IO practices and the content of this manual, the precautions listed here take precedence.

SECTION 1. GENERAL REQUIREMENTS FOR ALL LONG LINE SET APPLICATIONS

Equivalent length must be used to determine acceptability of any long line set application. See Section 3 for equivalent length calculations.

For any light commercial split system installed with a long line set, 5/8" liquid line size must be used.

Limiting the liquid line size to 5/8" is critical since an increased refrigerant charge level from having a larger liquid line could possibly shorten a compressor's lifespan.

Suction/gas lines must be insulated with 3/8" (9.5 mm) thick insulation. For line sets over 80 feet (24.4m), if the line passes through a high ambient temperature zone, 1/2" (12.7 mm) thick suction line insulation is required. Insulate any portion of the liquid line that passes through an area with temperature 10°F (5.6°C) greater than ambient temperature. Never attach a liquid line to the bare copper of the suction line.

A crankcase heater (CCH) is required on all systems with refrigerant charges greater than 12 pounds (192 ounces). A crankcase heater is factory installed on each compressor of the tandem compressor sets and must be operable - Do Not Disconnect the CCH.

Heat Pump Systems have a factory installed suction accumulator.

The outdoor units are factory charged with a holding charge of 6.88 pounds (110 ounces) of R-32.

Use of a non-bleed thermostatic expansion valve (TXV) is required in all long line set applications. Refer to the Final Charge Adjustment section for superheat settings.

The maximum equivalent length of line set is 150 feet (45.7 m) for units with tandem scroll compressors.

The maximum linear length of line set is 150 feet (45.7 m) for tandem scroll compressors.

INSTALLATION REQUIREMENTS

Vibration and Noise: In long line set applications, refrigerant tubing is prone to transmit noise and vibration to the adjoining structure. Use adequate vibration-isolating hardware when mounting line set to structural members. See Figures 1-1, 1-2 and 1-3 for examples of proper mounting.

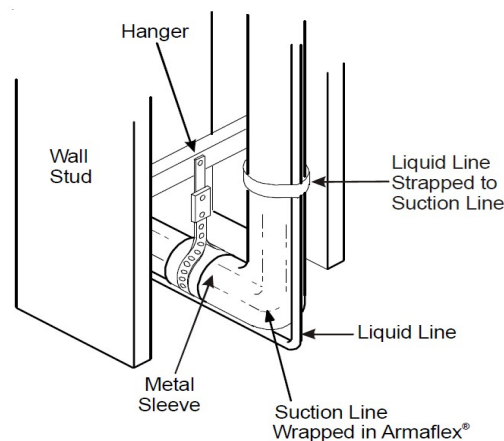


Figure 1-1

Installation of Refrigeration Piping from Vertical to Horizontal

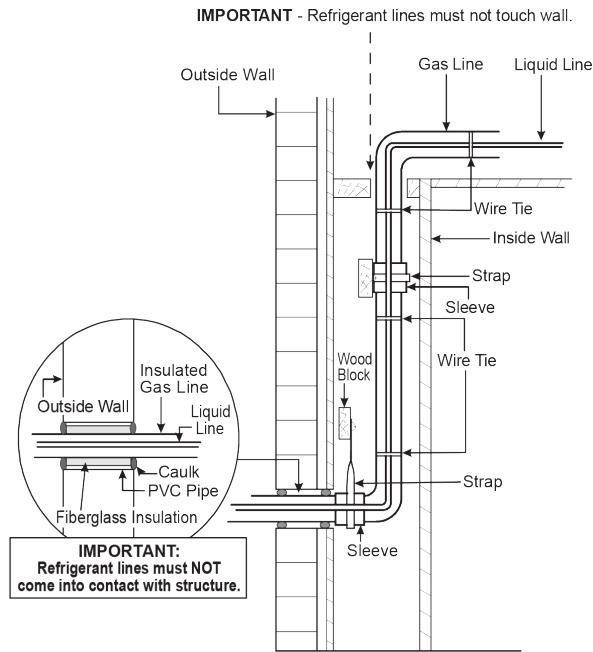


Figure 1-2 Installation of Refrigerant Piping (Vertical)

NOTE: If line set is installed on the exterior of an outside wall, similar installation practices are to be used.

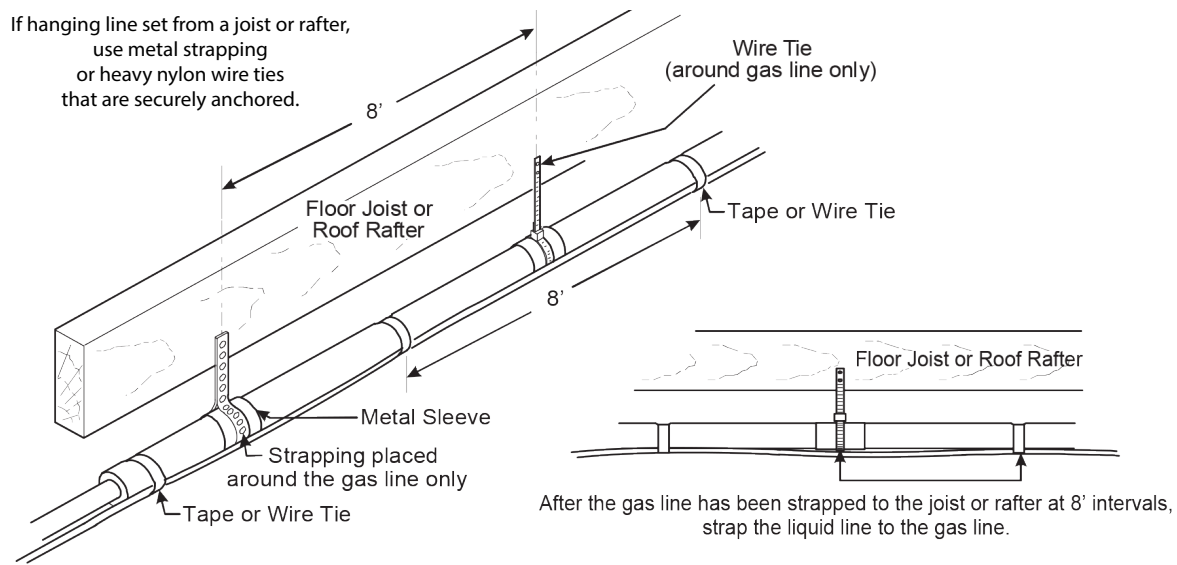


Figure 1-3. Installation of Refrigerant Piping (Horizontal)

Low voltage control wiring: Verify low voltage wire gauge is adequate for the length used due to potential voltage drop for long wire lengths. 18 AWG thermostat wiring is recommended up to 75 feet. For longer distances see wire size chart to ensure sufficient voltage at the outdoor unit.

Wire Size (AWG)	Distance (Ft.)
18	75
16	125
14	200

CHARGE ADJUSTMENTS

Final Charge Adjustment (Cooling Mode):

All systems must have the refrigerant charge and TXV adjustment verified by ensuring that superheat and subcool are within their specified ranges.

- a. System must be charged to 14° to 18°F subcooling at the indoor unit
- b. TXV must be adjusted to achieve the superheat value that is specified in the outdoor unit's Installation Instructions.
- c. For heat pumps, superheat must be measured at true compressor suction pressure at the access port and temperature at 4-6" from the compressor's suction port.

NOTE: Verify air flow before making any charge or TXV adjustment.

Final Charge Adjustment (Heating Mode):

If a system must be charged in heating mode, the proper method is by weight with additional charge adjustments for line size, line length, and other system components.

The outdoor TXV should be adjusted to achieve the superheat value specified in the outdoor unit's Installation Instructions (typically 7° to 11°F).

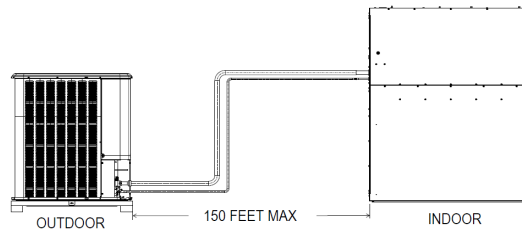
NOTE: Refer to table 1 for charging information.

SECTION 2. APPLICATION CONFIGURATIONS

Long line sets can have three different application configurations:

1. Outdoor unit and Indoor unit are at the same elevation.
2. Outdoor unit is above the Indoor unit.
3. Outdoor unit is below the Indoor unit.

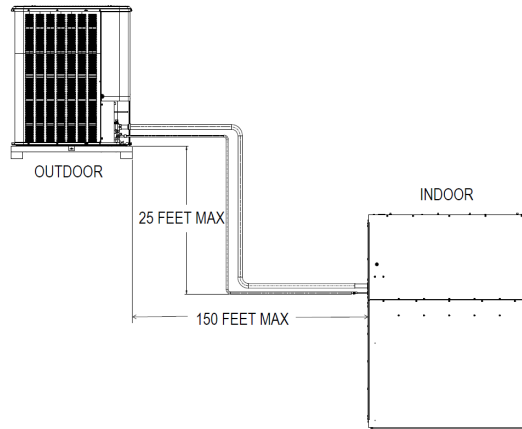
APPLICATION 1 - OUTDOOR UNIT AND INDOOR UNIT ARE AT THE SAME ELEVATION



APPLICATION-1 OUTDOOR UNIT ON SAME LEVEL AS INDOOR UNIT

1. In a completely horizontal installation with a long line set where the indoor unit is at the same elevation as (or slightly above or below) the outdoor unit, the line set should be sloped continuously towards the indoor unit. This helps reduce refrigerant migration to the outdoor unit during a system's off-cycle.
2. The maximum elevation (vertical) difference for this section to be applicable is 5 feet (1.52 m) separation between outdoor unit and indoor unit.
 - a. If the outdoor unit is more than 5 feet (1.52 m) above the indoor unit use Application 2 and Example-2.
 - b. If the outdoor unit is more than 5 feet (1.52 m) below the indoor unit use Application 3 and Example-3.
3. An inverted suction loop is not required at either unit.
4. An oil trap at the indoor unit is not required.

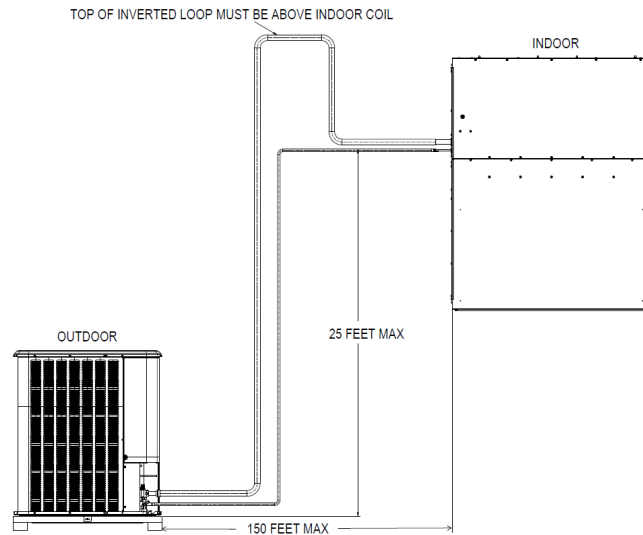
APPLICATION 2 - OUTDOOR UNIT IS ABOVE THE INDOOR UNIT



APPLICATION-2 OUTDOOR UNIT ABOVE INDOOR UNIT

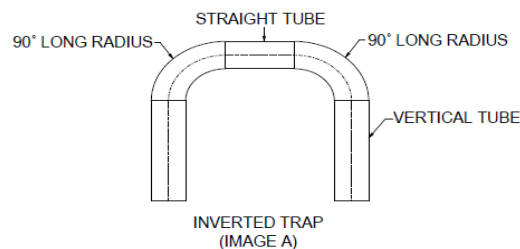
1. The suction line must be sloped continuously towards the indoor unit.
2. The maximum elevation (vertical) difference between the outdoor unit and indoor unit is 25 feet (7.6 meters).
3. An inverted suction loop is not required at either unit.

APPLICATION 3. OUTDOOR UNIT IS BELOW THE INDOOR UNIT



APPLICATION-3 OUTDOOR UNIT BELOW INDOOR UNIT

1. The maximum elevation (vertical) difference between the outdoor unit and the indoor unit is 25 feet (7.62 m).
2. The suction line must be installed in a manner to prevent liquid migration to the outdoor unit from the indoor unit.
3. An inverted suction line trap must be installed on the suction line just before the inlet to the indoor unit.
4. The top of the inverted loop must be slightly above the top of the indoor unit coil and can be created simply by brazing two 90° long radius elbows together if a bending tool is unavailable.
5. Properly support and secure the inverted loop to the nearest point on the indoor unit or adjacent structure.



SECTION 3. CALCULATIONS - REFRIGERANT CHARGE, OIL CHARGE, TUBING EQUIVALENT LENGTH, AND CAPACITY REDUCTION

The following instructions are used to determine the system refrigerant charge, additional oil charge, the line set equivalent length and capacity reductions for the system with a long line set.

Table-1 indicates the total system charge for various line set lengths.

Table-1 TOTAL SYSTEM REFRIGERANT CHARGE - R-32 (Oz.)							
Model Size & Type	Refrig. Charge per lineal foot - Liquid & Gas Line Set (Oz)	R-32 System Charge for Line Set Length					
		25 ft	50 ft	75 ft	100 ft	125 ft	150 ft
7-1/2 Ton AC (5/8" Liquid Line + 1-1/8" Gas Line)	1.54	275	314	352	391	429	468
7-1/2 Ton HP (5/8" Liquid Line + 1-1/8" Gas Line)	1.54	258	297	335	374	412	451
10 Ton AC (5/8" Liquid Line + 1-3/8" Gas Line)	1.62	305	345	386	426	467	507
10 Ton HP (5/8" Liquid Line + 1-3/8" Gas Line)	1.62	308	348	389	429	470	510

The charge amount includes the outdoor unit, indoor unit, and the line set. For systems with line sets longer than 25 feet, use the initial 25ft charge in this table and add charge for each additional foot of line set.

Notes for LC Split Systems:

1. Light Commercial split system outdoor units have a factory holding charge of 6.88 lbs. (110 ounces).
 - a. Determine total charge required and subtract this amount for field charge requirements.
2. The Standard line set length used for performance rating purposes is 25 feet.
3. The Maximum line set length is 150 feet.
4. The Maximum vertical lift is 25 feet.

Total System charge

For line set lengths between those in Table-1 use the Refrigerant Charge per lineal foot and multiply by the line set length difference

Example: For a 10 Ton HP system with a Line set length of 112 ft. Use 100 ft charge and add $12 \times 1.62 \Rightarrow 429 + (12 \times 1.62) = 448$ Oz.

Field Charge = Total System Charge minus Factory Installed holding Charge of Outdoor unit.

Example: use System Charge from example	448	
Holding charge 110 Oz.	-110	
Field Charge	338	Oz

Horizontal Line Sets:

1. 7-1/2 Ton unit \Rightarrow 5/8" liquid line and 1-1/8" suction/gas line
2. 10 Ton unit \Rightarrow 5/8" liquid line and 1-3/8" suction/gas line

Vertical Line Sets:

1. Maximum vertical rise length between indoor unit and outdoor unit is 25 Ft.
2. Maximum upflow vertical riser diameter is 1-1/8 inch to maintain line velocities at part load conditions.
3. 7-1/2 Ton unit \Rightarrow 5/8" liquid line and 1-1/8" suction/gas line horizontal and vertical upflow
4. 10 Ton unit \Rightarrow 5/8" liquid line and 1-3/8" horizontal suction/gas line and 1-1/8" vertical upflow suction/gas line

Compressor Oil Charge:

1. If a system contains more than 20 pounds (320 ounces) of refrigerant, add 0.3 oz. oil per pound of refrigerant over the initial 20 lb. refrigerant charge. Refer to Additional Oil Charge Table
2. Polyol Ester (POE) Oil is used in the scroll compressors.
Use Lubrizol, Icematic NXG 5020 (IBC) 999-5171-63 or equivalent.
3. Charge additional oil to compressor discharge line using an oil pump while under vacuum. Then charge refrigerant through normal practice.

Additional Oil Charge													
Initial Refrigerant Charge (Lb)	20	21	22	23	24	25	26	27	28	29	30	31	32
Initial Refrigerant Charge (Ounce)	320	336	352	368	384	400	416	432	448	464	480	496	512
Additional Oil Charge (Ounce)	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3	3.3	3.6

Equivalent Length:

1. Equivalent length is the sum of all straight pipe lengths plus all elbow fittings (bends), or adapters shown in Table-2 in equivalent feet of pipe.
2. Equivalent length is used to determine capacity reduction based on pressure losses.
3. Use refrigerant piping design best practices. While there is no limit on the number of elbows or fittings, their use should be minimized to reduce the total equivalent length. Do not exceed the maximum equivalent length.

Table-2 Fitting Losses in Equivalent Feet of Pipe					
Fitting Type	5/8	7/8	1-1/8	1-3/8	1-5/8
Elbow - 90° Short Radius	1.6	2.0	2.6	3.3	4.0
Elbow - 90° Long Radius	1.0	1.4	1.7	2.3	2.6
Elbow - 45°	0.8	0.9	1.3	1.7	2.1
Adapter - one size larger	0.4	0.5	0.7	1.0	1.2
Adapter - one size smaller	0.4	0.5	0.7	1.0	1.2
Liquid Line Filter Drier (5/8")	5.8				
Liquid Line Solenoid (5/8")	9.5				

NOTE: Liquid line drier and sight glass pressure drop should be included in the equivalent length calculation. Use the values provided from the supplier of those components.

CAPACITY REDUCTION AT 80°F DB/67°F WB INDOOR, 95°F OUTDOOR:

Unit Size (Nominal BTU/Hr)	Suction Line (In)	Table-3 Capacity Multiplier for Equivalent Length (Ft)					
		25	50	75	100	125	150
7-1/2 Ton (90,000 BTUH)	5/8	Not Recommended					
	7/8	1.00	0.99	0.98	0.97	0.96	0.95
	1-1/8	1.00	0.99	0.98	0.97	0.96	0.95
10 Ton (120,000 BTUH)	1-1/8	1.00	0.99	0.98	0.97	0.96	0.95
	1-3/8	1.00	0.99	0.98	0.97	0.96	0.95
	1-5/8	Not Recommended					

CHARGE DETERMINATION EXAMPLES

EXAMPLE-1: OUTDOOR UNIT LOCATED ON SAME LEVEL AS INDOOR UNIT

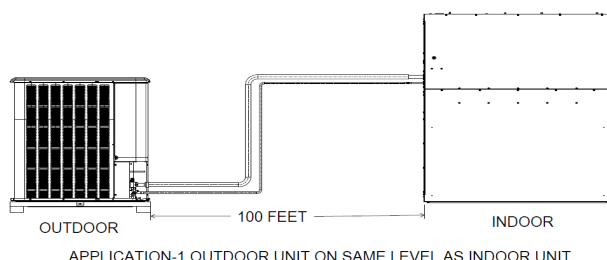
Reference Application-1

Outdoor Unit is located at same elevation as indoor unit with a horizontal line length of 100 feet, a vertical rise of 0 feet and (6) 90° elbows.

System Size - 10 Ton Heat Pump

- Step-1: Determine Total Refrigerant System Charge in ounces for the system.
- Step-2: Determine additional oil charge.
- Step-3: Determine Field Charge (Total Charge minus Factory Holding Charge)
- Step-4: Calculate Equivalent Length.
- Step-5: Determine Capacity Reduction

Application-1 - Outdoor unit located at same elevation as Indoor unit:



Refrigerant Charge Estimate:

Step-1: Total Charge

Use Linear Length for charge determination.

10T HP System Charge with 100 ft line set (Table-1) 429 oz

Step-2:

Oil Charge Check (See Compressor Oil Charge Section) 2.04 oz

Total Refrigerant charge at 429 oz. (26.8 lb.) requires an additional oil charge of 2.04 oz.

Step-3:

Field Charge = Total Charge - Factory Holding Charge

Total Charge	429	oz
Factory Holding Charge -	110	oz
Field Charge.	319	oz

Step-4 Equivalent Length:

Line or Fitting Type	Pipe Size	Qty (Ft)	Eq L (Ft)	Total Eq L	
Gas/Suction Line	1-3/8	1	100	100	
Gas/Suction Line	1-1/8	0	0	0	
90° Elbows		6	2.3	13.8	
Line size Reduction		0	1.0	0	
Equivalent Length				113.8	==>113.8'<150' OK

Step-5:

Use Equivalent Length for Capacity Reduction

Capacity Adjustment:

Using Chart-7 Find multiplier for nearest Equivalent Length and multiply factor times rated capacity.

Capacity 10T HP unit	120000 BTUH
Multiplier Chart-7	x 0.965
Adjusted Capacity	115800 BTUH

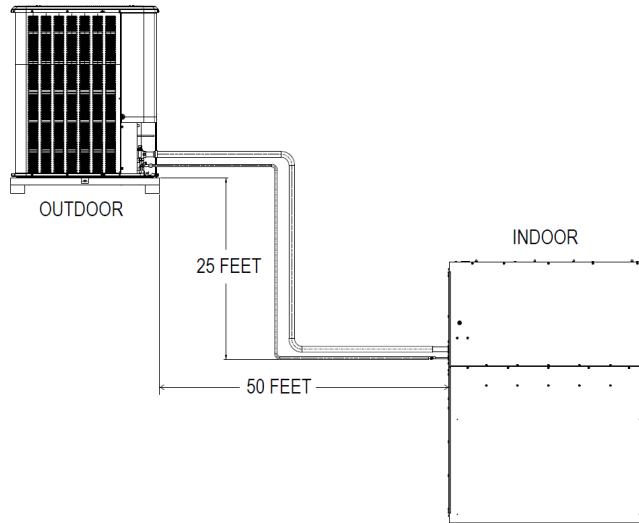
EXAMPLE-2: OUTDOOR UNIT LOCATED ABOVE INDOOR UNIT

Reference Application-2

System Size - 10 Ton AC

Outdoor Unit is located above indoor unit with a horizontal line length of 50 feet, a vertical rise of 25 feet and (8) 90° elbows.

1. Maximum elevation difference is 25 feet.
2. Maximum line length is 150 feet.



APPLICATION-2 OUTDOOR UNIT ABOVE INDOOR UNIT

- Step-1: Determine Total Refrigerant System Charge in ounces for the system.
- Step-2: Determine additional oil charge.
- Step-3: Determine Field Charge (Total Charge minus Factory Holding Charge)
- Step-4: Calculate Equivalent Length
- Step-5: Determine Capacity Reduction

Refrigerant Charge Estimate:

Step-1: Total Charge

Use Linear Length for charge determination.

10T AC System Charge with 75 ft line set (Chart-5) 386 oz

Step-2:

Oil Charge Check (See Compressor Oil Charge) 1.2 oz

Total Refrigerant charge at 386 oz. requires an additional oil charge of 1.2 oz.

Step-3:

Field Charge = Total Charge - Factory Holding Charge

Total Charge	386	oz
Factory Holding Charge	-110	oz
Field Charge	276	oz

Step-4 Equivalent Length:

Line Type or Fitting Type	Pipe Size	Qty	Eq L (Ft)	Total Eq L (Ft)	
Gas/Suction Line	1-3/8	1	50	50	
Gas/Suction Line	1-1/8	1	25	25	
90° Elbow (Chart-6)			8	2.3	18.4
Line size Reduction (Chart-6)		1	1.0	1	
Equivalent Length			94.4		==>94.4'<150' OK

Step-5:

Use Equivalent Length for Capacity Reduction

Capacity Adjustment:

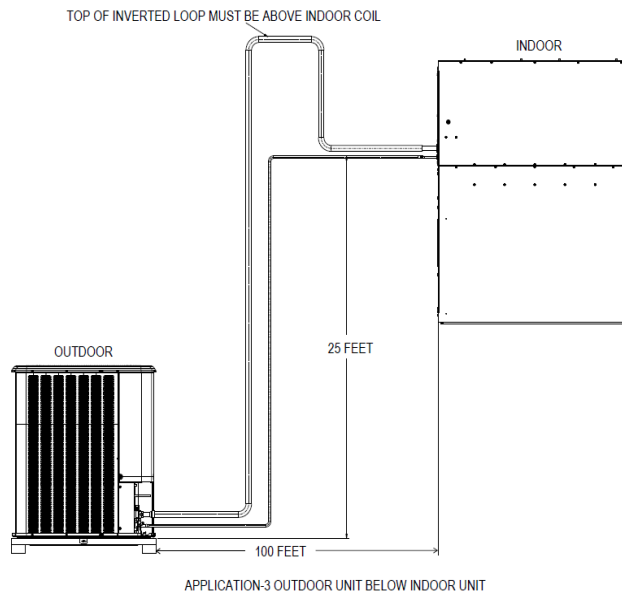
Using Table-3, Find multiplier for nearest Equivalent Length and multiply factor x rating capacity.

Capacity 10T AC unit	120000	BTUH
Multiplier Chart-7	x	0.97
Adjusted Capacity	116400	BTUH

EXAMPLE-3: OUTDOOR UNIT LOCATED BELOW INDOOR UNIT

Reference Application-3

System Size 7-1/2 Ton Heat Pump



Outdoor Unit is located below indoor unit with a horizontal line length of 100 feet, a vertical rise of 25 feet and (6) Long Radius (L.R.) 90° elbows and (4) Short Radius (S.R.) elbows.

- Step-1: Determine Total Refrigerant System Charge in ounces for the system .
- Step-2: Determine additional oil charge.
- Step-3: Determine Field Charge (Total Charge minus Factory Holding Charge)
- Step-4: Calculate Equivalent Length.
- Step-5: Determine Capacity Reduction

Refrigerant Charge Estimate:

Step-1: Total Charge

Use Linear Length for charge determination.

7-1/2 Ton HP System Charge with 125 ft line set 412 oz

Step-2:

Oil Charge Check (See Compressor Oil Charge) 1.6 oz
 Total Refrigerant charge at 412 oz. requires an additional oil charge of 1.6 oz.

Step-3:

Field Charge = Total Charge - Factory Holding Charge

Total Charge		412	oz
Factory Holding Charge	-	110	oz
Field Charge		302	oz

Step-4 Equivalent Length:

Line Type or Fitting Type	Pipe Size	Qty	Eq L (Ft)	Total Eq L (Ft)	
Gas/Suction Line	1-3/8	0	50	0	
Gas/Suction Line	1-1/8	1	125	125	
90° SL.R. Elbows			6	1.7	10.2
90° L.R. Elbows		4	2.6	10.4	
Equivalent Length				145.6	==>146'<150' OK

Step-5:

Use Equivalent Length for Capacity Reduction

Capacity Adjustment:

Using Table-3, Find multiplier for nearest Equivalent Length and multiply factor x rating capacity.

Capacity 7.5T HP unit		90000	BTUH
Multiplier Chart-7	x	0.95	
Adjusted Capacity		85500	BTUH

Section 4. DEFROST CYCLE

Defrost: (on Heatpump Models only)				
Defrost settings	Period	Maximum Duration	Activation Temp	Termination Temp
Interval	Min.	Min.	°F	°F
Short	30	10	30	60
Medium (Factory Default)	60			
Long	90			

- The defrost cycle occurs only on heat pump units while in heating mode by reversing compressor discharge gas through the outdoor coil.
- There are three defrost interval periods available. Short, Medium, and Long.
 - Daikin recommends the Medium setting period of 60 minutes for most installations.
 - The Medium period is the factory default setting.
 - If a Short or Long interval setting is desired, a witness test of several complete defrost cycles is required by the installer to assure proper system operation.
- For applications with line sets between 75 feet and 150 feet, the Medium (60 minute) setting is required to assure adequate oil return.
- The maximum Duration is 10-minutes based on an internal timer within the defrost controller PCB.
- Defrost cycle occurs when the defrost thermostat reaches 30°F or below and the runtime Period is met.
- The defrost thermostat sensor is located on the outdoor coil, bottom return bend entering air side of coil and is held in place by a spring steel tube clamp.
- Defrost cycle terminates when the defrost thermostat rises to 60°F or higher or the Maximum Duration timer occurs.

NOTE: SPECIFICATIONS AND PERFORMANCE DATA LISTED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE

Quality Makes the Difference!

All of our systems are designed and manufactured with the same high quality standards regardless of size or efficiency. We have designed these units to significantly reduce the most frequent causes of product failure. They are simple to service and forgiving to operate. We use quality materials and components. Finally, every unit is run tested before it leaves the factory.

That's why we know...There's No Better Quality.

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