



Split System Refrigerant Piping Guide



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R-410A Refrigerant
Effective January 2017

Introduction

This manual is produced to provide guidelines and sufficient information for estimating refrigerant piping sizes and accessories required for United CoolAir split systems in the most common installations. It applies to R-410A refrigerant only.

Since refrigerant piping of split systems can affect the performance, reliability, cost, code compliance, and warranty of equipment, final piping design and configuration should only be done by qualified individuals trained in

the discipline and who bear responsibility for the installed design. Similarly, installation should always be done by a qualified contractor with the knowledge and skills associated with refrigerant piping design, installation and the product being installed.

For this reason, this guide is not intended to be a design manual nor a training tool on how to design and install refrigerant piping and accessories.

Limitations

The use of material contained in this guide has the following limitations:

- Tonnage Per Circuit = 1 thru 20 Tons Refrigeration
- Maximum Equivalent Line Length = 150 Ft.
- Maximum Vertical Rise = See Equipment Layouts, Pg 4
- Cannot be used for heat Pump Models

For assistance in estimating piping requirements and costs outside of these limitations, please contact the factory.

General Guidelines

In estimating refrigerant piping systems, several key guidelines should be kept in mind:

- All local, state, and national codes must be followed.
- Piping runs should always be kept as short as possible.
- The use of long-radius elbows over standard elbows is preferred.
- Only Type L or Type K copper lines are to be used.
- When selecting pipe sizes, always select the smallest diameter allowable.
- Refrigerant concentration limit compliance should conform to the latest edition of ANSI/ASHRAE Standard 15.

Line Size Estimating Procedure

There are 6 steps needed to arrive at a cost estimate for the R-410A split system refrigerant piping system on any project:

1. Determine the locations of both the evaporator and condenser sections within the structure and which section contains the compressor(s).
2. Determine the actual line lengths in feet for discharge, liquid, suction, and hot gas (if used) refrigerant lines.
3. Make a preliminary selection of nominal pipe sizes in inches for discharge, liquid, suction, and hot gas refrigerant lines from tables based on nominal compressor tonnage.
4. Calculate the equivalent line lengths in feet for elbows in each refrigerant line.
5. Add items 2 and 4 to arrive at total equivalent lengths and verify preliminary lines size selections are valid or make needed adjustments based on total equivalent length calculations.
6. Determine the need for any additional refrigerant line accessories based on line lengths and piping configurations.

The remainder of this guide is to provide the details of the step-by-step procedure for arriving at piping size estimates.

1. Determine Equipment Location

The location of the split system major components has an effect on piping sizes and the accessories that are needed for a properly operating system. There are four component configurations that are possible and they are shown in the following Layouts I through IV:

Equipment location and vertical height between components will be used to determine the needed refrigerant line accessories in Table 6. Select the Layout that represents your application and record vertical height for the project in the area provided.

2. Actual Line Lengths

From plans, estimates, and/or measurements, determine the actual line lengths in feet between the location of the evaporator and the condenser sections. Record these values for each line size on Table V, Line 1, Equiv-

alent Length and Pipe Size Summary on page 6. Page 9 provides a convenient location for sketching the layout of the project.

3. Preliminary Pipe Size Selection

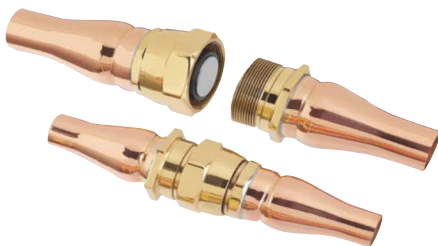
Pipe sizes are based on the amount of refrigerant flowing through them and, for that reason, preliminary pipe size selections can be made based on the nominal size of the unit's compressor (or in multiple compressor units based on the nominal compressor tonnage of each circuit).

falls between the 25 ft. increments on the chart select the smaller size for the preliminary selection. Record this OD size selected on Line 3 of Table V. Once the equivalent lengths of fittings has been determined, this same table will be reviewed for final size selections.

Using the actual line lengths recorded in Step 1, add 50% to this value and record this in Table V, Line 2, for each line.

Repeat the process for both the suction & liquid line using Table II and Table III and the actual pipe lengths + 50% between the condenser and evaporator sections. When completed, record the selected line size OD's for each line in Table V, Line 3 If hot gas bypass is being installed, select this line size in the same manner-using Table II and 50% of the circuit tonnage to make the selection.

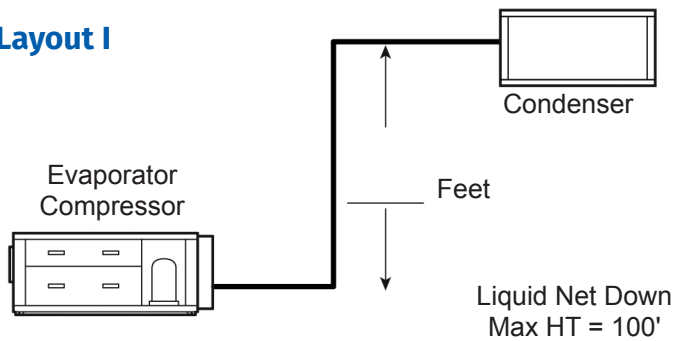
Using the nominal compressor tons per circuit, select the discharge line size (Not required for a condensing unit) based on the actual line length +50% between the compressor and condenser sections using the Equivalent Lengths shown in Table I. When the actual line length



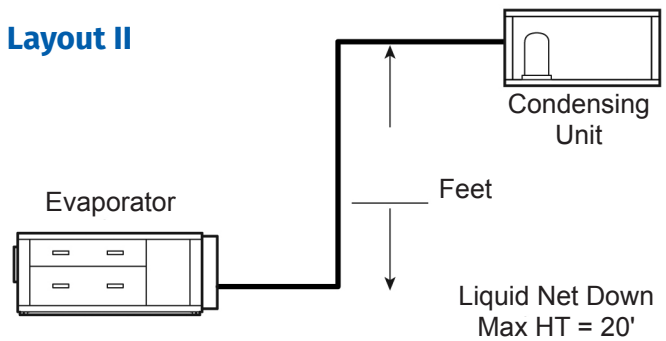
Resealable Refrigerant Fittings

Most models feature Resealable Refrigerant Fittings. Unit sections can be shipped split or split in the field without losing the factory charge resulting in no field brazing and a total installed cost advantage.

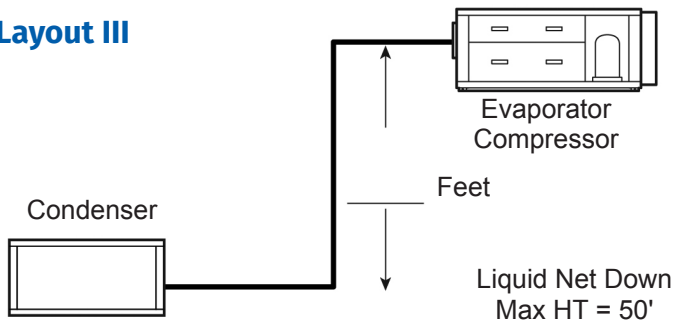
Layout I



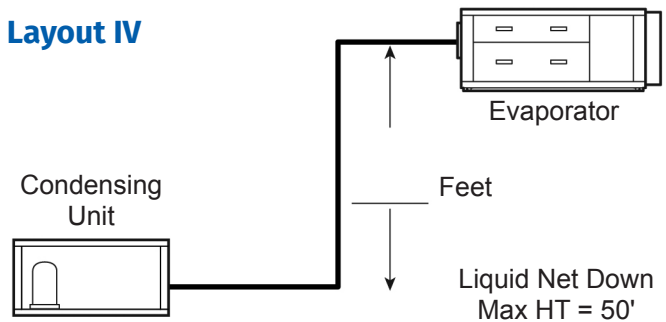
Layout II



Layout III



Layout IV



Note: If actual weights exceed the maximum shown, contact the factory.

Table I

System Capacity BTU/Hr.	System Capacity Tons/Hr.	Discharge Line				
		Maximum Equivalent line length in Feet				
		25	50	75	100	150
18,000	1.5	1/2	1/2	1/2	5/8	5/8
24,000	2	1/2	5/8	5/8	5/8	5/8
30,000	2.5	1/2	5/8	5/8	5/8	3/4
36,000	3	5/8	5/8	5/8	3/4	3/4
42,000	3.5	5/8	5/8	3/4	3/4	3/4
48,000	4	5/8	3/4	3/4	3/4	7/8
60,000	5	3/4	3/4	7/8	7/8	7/8
92,000	7.5	3/4	7/8	7/8	1 1/8	1 1/8
120,000	10	7/8	1 1/8	1 1/8	1 1/8	1 1/8
150,000	12.5	7/8	1 1/8	1 1/8	1 1/8	1 3/8
180,000	15	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8
240,000	20	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8

Table II

System Capacity BTU/Hr.	System Capacity Tons/Hr.	Suction Line				
		Maximum Equivalent line length in Feet				
		25	50	75	100	150
18,000	1.5	1/2	5/8	5/8	5/8	3/4
24,000	2	1/2	5/8	3/4	3/4	3/4
30,000	2.5	5/8	3/4	3/4	3/4	7/8
36,000	3	5/8	3/4	3/4	7/8	7/8
42,000	3.5	3/4	3/4	7/8	7/8	1 1/8
48,000	4	3/4	7/8	7/8	7/8	1 1/8
60,000	5	7/8	7/8	1 1/8	1 1/8	1 1/8
92,000	7.5	7/8	1 1/8	1 1/8	1 1/8	1 3/8
120,000	10	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8
150,000	12.5	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8
180,000	15	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8
240,000	20	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8

Table III

System Capacity BTU/Hr.	System Capacity Tons/Hr.	Liquid Line				
		Maximum Equivalent line length in Feet				
		25	50	75	100	150
18,000	1.5	3/8	3/8	3/8	3/8	3/8
24,000	2	3/8	3/8	3/8	1/2	1/2
30,000	2.5	3/8	3/8	1/2	1/2	1/2
36,000	3	3/8	3/8	1/2	1/2	1/2
42,000	3.5	3/8	1/2	1/2	1/2	1/2
48,000	4	1/2	1/2	1/2	1/2	5/8
60,000	5	1/2	1/2	1/2	5/8	5/8
92,000	7.5	1/2	5/8	5/8	5/8	3/4
120,000	10	1/2	5/8	5/8	3/4	3/4
150,000	12.5	5/8	5/8	3/4	3/4	7/8
180,000	15	5/8	3/4	3/4	7/8	7/8
240,000	20	3/4	3/4	7/8	7/8	1 1/8

4. Equivalent Length of Elbows

The next step is to account for the pressure drop attributable to fittings in each refrigerant line. For simplification, counting 90° elbows is sufficient for estimating line sizes.

For each refrigerant line, and from plans or schematics, count the number of elbows in each refrigerant line and record the number on Line 4 of Table V.

Using the preliminary line sizes selected in Step 3, go to Table IV, Equivalent Length of Elbows, and record the equivalent feet for each elbow size on Line 5 of Table V.

Then multiply the number of elbows times the equivalent line length of each elbow as shown on Line 6 of Table V.

5. Total Equivalent Line Length

Using Table V, add the equivalent length of elbows (Line 6) to the actual line lengths (Line 1) to arrive at the Total Equivalent Line Length for each refrigerant line as shown on Line 7.

The last step in the process is to verify that the sizes of refrigerant lines selected in Step 3 are valid for the calculated Total Equivalent Lengths of each line.

Using the Nominal Compressor Tons and the line sizes selected, refer to Tables I - III and verify that the Total Equivalent Line Length is below the Maximum Total

Table IV - Equivalent Length of Elbows*

Line OD (inches)	Equivalent Feet
3/8	0.8
1/2	1.1
5/8	1.4
3/4	1.7
7/8	2
1-1/8	2.6
1-3/8	3.2
1-5/8	3.8

* Based on long radius elbows.

Equivalent Line Length shown in the table. If it is not, select the next larger line size and record this on Line 3 of Table V as your Final selection.

Since the calculated Total Equivalent Line Lengths may be significantly smaller than the actual line length + 50% used in the preliminary selection, you may be able to reduce the line size from the preliminary selection. In this case, use the table to select the smallest diameter line that falls just below the maximum equivalent length shown in the tables. Record this on Line 3 of Table V as your final selections for each line.

Table V - Equivalent Length and Pipe Size Summary

	Discharge Line		Suction Line		Liquid Line		Ext. HGBP Line	
1. Actual Line Length								
2. Actual Line Length + 50% (1 x 1.5)								
3. Preliminary Line Size OD" (from Tables I through IV)		Final		Final		Final		Final
4. Number of Elbows in Refrigerant Line								
5. Equivalent Length per Elbows (Table VI)								
6. Equivalent Length for ALL Elbows (lines 3 x 4)								
7. Total Equivalent Length (Lines 1 + 6)*								

*Note: If any equivalent length exceeds 150 Ft. contact factory.

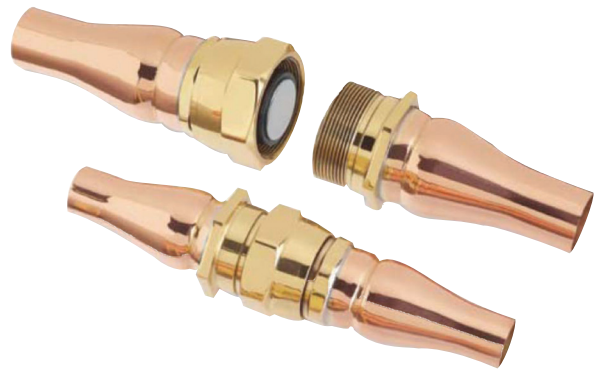
6. Refrigerant Line Accessory Requirements

Depending on the location of the equipment within the building, there may be a need for optional components for the protection of the compressors and for efficient flow of refrigerant and oil throughout the system. Most of these accessories are factory mounted and all should be ordered with the equipment once their need is determined.

The most common refrigerant circuit accessories include:

Resealable Refrigerant Fittings

Major components of the unit are fitted with resealable refrigerant fittings as standard. When sections are split, loose resealable fittings or interconnecting kits are available to facilitate installation. Kits include both the needed fittings as well as schraeder connections to simplify charging of the refrigerant lines after connections are made.



Oil Separator

Installed in the discharge line of the compressor to capture most of the oil leaving the compressor and to return it back to the compressor. At the same time, it allows a small amount of oil to continue to circulate through the system to provide the needed lubrication to other devices throughout the system.

Accumulator

Installed in the suction line near the compressor and provides a liquid reservoir to capture any liquid returning in the suction line in order to protect the compressor from damage due to liquid “slugging”.

Quench Valve

Is located near the compressor and is used to lower the suction gas temperature by injecting liquid refrigerant into the suction line to protect the compressor from damage due to excessive heat. It is generally required when hot gas bypass or long suction lines are present. When used, an accumulator must also be included.

Liquid Line Solenoid Valve

Installed in the refrigerant liquid line to shut off flow in order to allow the compressor to pump liquid refrigerant out of the evaporator (pumpdown) and store it in the condenser prior to shut-down. This protects the compressor from “slugging” on start-up.

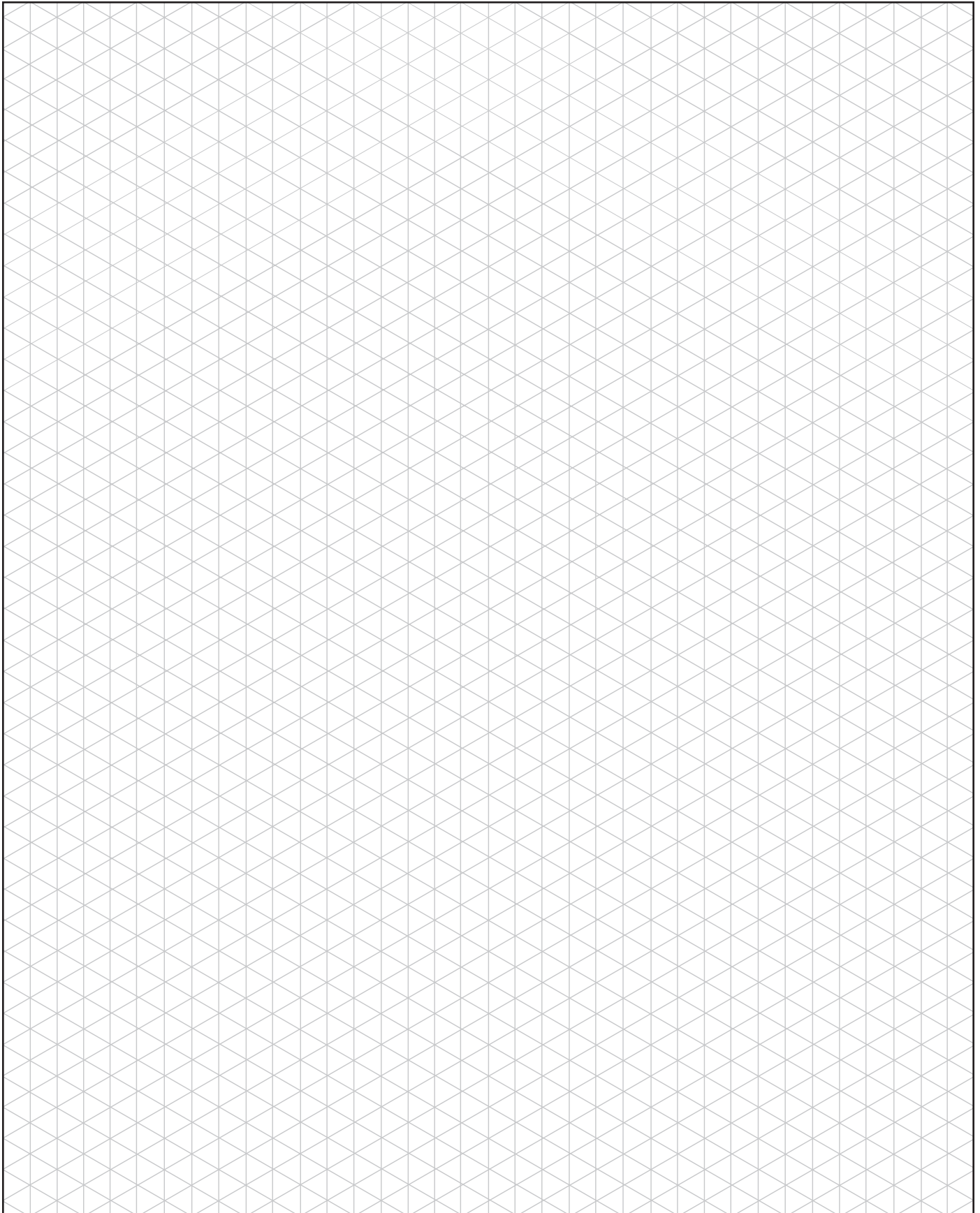
The simplest way to determine the need for any of these accessories is to refer to Table VI, Accessory “Tests”. Using the vertical height between sections from Layouts I - IV, and the equivalent lengths of each line from Table V, conduct the six tests shown in Table VI. As you do so, make note of the accessory items required and be sure to include them in your project quotation.

Table - VI Accessory “Tests”

			Equivalent Feet	Requirements (a) (b)			
				Oil Separator	Accumulator	Quench Valve	Liquid Line Solenoid Valve
1.	Discharge line greater than	>	100	X			
2.	External Hot Gas Bypass line greater than	>	50	X			
3.	Liquid line net down and greater than	>	50				X
4.	Suction line greater than	>	100	X	X	X	
5.	Suction line in ambient greater than 100°F and greater than	>	50		X	X	
6.	Suction line net down and greater than	>	50		X		

(a) Additional information on accessories can be found in price books and at www.unitedcoolair.com

(b) Some accessories are included with other options available on units. Refer to the applicable price book.



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OmegaAir Vertical
100% Outside Air, 1 - 15 Tons



Portable Cooling and Heating Units
3-30 Tons



C13-Series Horizontal
2 - 10 Tons



C-Series Horizontal
1 - 15 Tons
Special Configuration
Engineered to Order



OmegaAir Horizontal,
100% Outside Air, 1 - 15 Tons

Authorized Distributor:



LIMITED WARRANTY

United CoolAir Units are backed by a 1 year limited warranty on parts and a 5 year limited warranty on the compressor (labor not included). Maintenance items such as filters and belts are excluded under this limited warranty.

FACTORY TESTED

All units are functionally run tested before shipment to ensure a trouble-free start-up and unit commissioning. Industry proven components are used throughout to enhance system reliability and peace of mind.



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