Refrigerant Piping Guidelines - R454B

⚠ IMPORTANT

The intent of this manual is to represent generally accepted safe engineering practices. Specifications and limits outlined in this manual are subject to change. System design should conform to all codes, laws, and regulations applying at the site at the time of installation. Additional documents that should be followed include The Safety Code for Mechanical Refrigeration and the Code for Refrigeration Piping, both available from ASHRAE. In Addition, the procedures and limits outlined in this manual do no supersede local, state or national codes under any circumstances.

⚠ IMPORTANT

Pipe work, including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed.

⚠ IMPORTANT

Braze-Free fittings must conform with UL207 or ISO 14903 (latest edition).

⚠ IMPORTANT

After completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements:
- Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 0.2 oz. per year of refrigerant or better, under pressure. No leak shall be detected.

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⚠ CAUTION

Some soaps used for leak detection are corrosive to certain metals. Carefully rinse piping thoroughly after leak test has been completed. Do not use matches, candles, flame or other sources of ignition to check for gas leaks.

(P) 508822-01

*** Check that equipment complies with all applicable building codes, laws, and regulations for its intended use prior to installation.**

⚠ CAUTION

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25% maximum) is confirmed. Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work. If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut-off valves) in part of the system remote from the leak.

Introduction

The piping design of any air conditioning system will affect performance, reliability, and applied cost of that system. An application with long line sets or elevation differences between the outdoor unit and the indoor unit can require accessories and line set size optimization to ensure proper operation, performance and reliability. This guideline applies to all residential single and two-stage air conditioners and heat pumps.

Line set is considered “long” when it is longer than 50 ft. or has more than 10 ft. vertical separation. For variable speed air conditioners and heat pumps, please refer to the unit installation manual.

HFO-454B Refrigerant

HFO-454B is the refrigerant of choice to replace HFC-410A in residential and light commercial air conditioning equipment. HFO-454B is a zeotropic mixture of R-32 and R-1234yf refrigerants. HFO-454B operates at slightly lower pressures than HFC-410A. HFO-454B must not be used to retrofit existing HFC-410A equipment. HFO-454B can only be used in equipment designed for HFO-454B.

Proper joint brazing and maintenance becomes even more critical with HFO-454B. When servicing HFO-454B system, the contractor must make sure to use components specifically designed for HFO-454B.

Special service equipment required for working with HFO-454B includes:

- A2L rated electronic leak detector
- A2L rated recovery machine
- A2L rated recovery cylinder
- A2L rated vacuum pump
- Left hand thread adaptor

Piping Limits

The indoor coil must use a non-bleed TXV to control refrigerant migration during Off cycle. Allied add-on TXV kits are non-bleed TXVs. Also, Allied’s factory-installed TXV indoor coils are equipped with non-bleed TXVs and meet requirements for long line sets.

Table 1.

Indoor HFO-454B TXV	
Outdoor Unit Size	Catalog Number
1.5-Ton	26Z70
2-Ton	26Z70
2.5-Ton	26Z70
3-Ton	26Z70
3.5-Ton	26Z71
4-Ton	26Z71
5-Ton	26Z72

Accessories and piping requirements will be detailed based on three types of installations: outdoor unit and indoor unit on same level, outdoor unit below indoor unit and outdoor unit above indoor unit.

Air Conditioners

Total Equivalent Length (piping and all fittings)	240 ft.
Maximum Linear Length	200 ft.
Maximum Linear Liquid Lift	60 ft.
Maximum Vapor Riser	125 ft.
NOTE: *Length is a general guide. Lengths may be more or less, depending on remaining system design factors.*	

Heat Pumps

Total Equivalent Length (piping and all fittings)	240 ft.
Maximum Linear Length	200 ft.
Maximum Linear Liquid Lift	60 ft.
Maximum Vapor Riser	60 ft.
NOTE: *Length is a general guide. Lengths may be more or less, depending on remaining system design factors.*	
NOTE: *Because flow is reversed in heating mode vapor riser is limited by liquid lift requirement.*	

Recommended Components

- Pressure taps installed at the inlet and outlet of indoor coil for measuring pressures for calculating superheats and sub-cooling values.
- Hard Start kit required if unit supply voltage is less than 230V.
- Sight glass installed at indoor unit.
- Anti-short cycle protection
  - On; at least 4 minutes
  - Off; usually 5 minutes

NOTE: *Most thermostats contain these features.*

Air Conditioner

Outdoor unit on same level as indoor unit

Up to 50 ft. linear	No additional requirements
51 to 80 ft. linear	Crankcase heater
81 to 200 ft. linear	Crankcase heater, non-bleed TXV and inverted trap at indoor

Outdoor unit below indoor unit (11-60 ft. vertical lift)

Up to 50 ft. linear	Crankcase heater and non-bleed TXV
51 to 200 ft. linear	Crank case heater, hard start kit, non-bleed TXV and inverted trap at indoor

Outdoor unit above indoor unit (21-125 ft. vapor riser)

Up to 50 ft. linear	Crankcase heater, non-bleed TXV. (May require vapor riser size reduction.) See Table 2.
51 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV. (May require vapor riser size reduction.) See Table 2.

Heat Pump

Outdoor unit on same level as indoor unit

Up to 50 ft. linear	No additional requirements
51 to 80 ft. linear	Crankcase heater, non-bleed TXV on indoor
81 to 200 ft. linear	Crankcase heater, non-bleed TXV on indoor, and inverted trap at indoor

Outdoor unit below indoor unit (11-60 ft. vertical lift)

Up to 80 ft. linear	No additional requirements
81 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV on indoor, and inverted trap at indoor

Outdoor unit above indoor unit (21-60 ft. vapor riser)

Up to 50 ft. linear	Crankcase heater, non-bleed TXV. (May require vapor riser size reduction.) See Table 2.
51 to 200 ft. linear	Crankcase heater, hard start kit, non-bleed TXV. (May require vapor riser size reduction.) See Table 2.

Table 2. HFO-454B Vapor Lines

Residential Application					
Unit	**Unit Tons**	**Suction / Vapor Line Size**	**HFO-454B Pressure Drop PSI / 100 ft.**	**Preferred for Vertical Vapor Rises**	**Preferred for Horizontal Runs**
18	1.5	5/8"	1.67	X	
		3/4"	0.63		X
24	2	5/8"	2.83	X	
		3/4"	1.06		X
30	2.5	3/4"	1.6	X	
		7/8"	0.72		X
36	3	3/4"	2.25	X	
		7/8"	1		X
42	3.5	7/8"	1.33	X	
		1-1/8"	0.36		X
48	4	7/8"	1.71	X	
		1-1/8"	0.46		X
60	5	7/8"	2.59	X	
		1-1/8"	0.7		X
* Line reduction only for air handler/coil 21ft. or more below condenser					

Piping Method

One of the two methods of piping shown in Figure 1 should be used to prevent liquid migration in Off cycle.

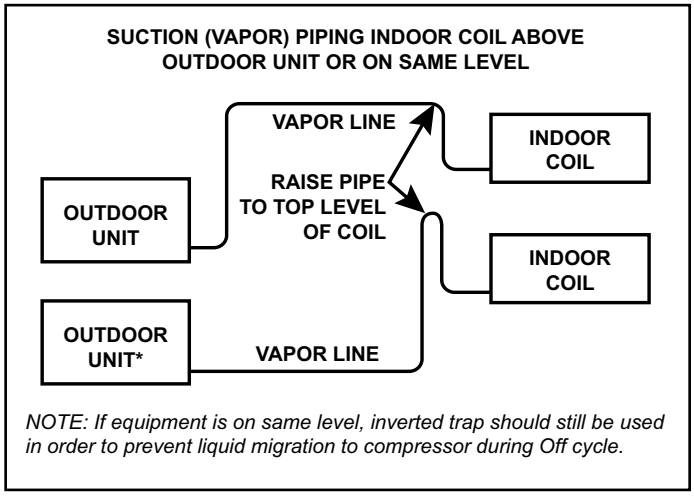


Figure 1. Outdoor Unit On Same Level or Outdoor Unit Below Indoor Unit

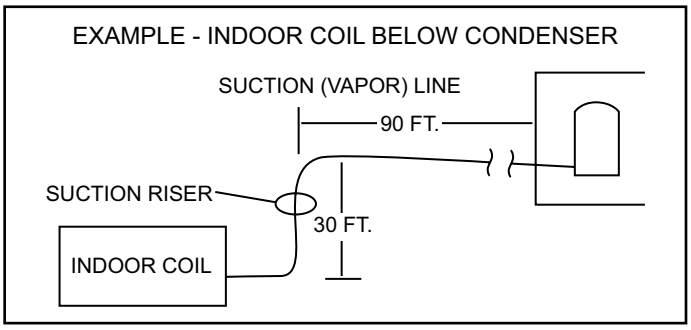


Figure 2. Outdoor Unit Above Indoor Unit

Figure 2 shows the piping method for an outdoor unit that is above an indoor unit. Suction riser and horizontal runs should be chosen based on the information in Table 2. Vapor riser should maintain minimum of 1200 fpm for oil return.

Example: A 5-ton unit would utilize 1-1/8” vapor line in horizontal runs. A 7/8” line would be utilized for the riser to aid in oil return but limit overall pressure drop and capacity loss.

Table 3. Equivalent Length in Feet of Straight Pipe for Valves and Fittings

Line Size (Outside Diameter) (in.)	Solenoid / Global Globe Valve	Angle Valve	90° Long* Radius Elbow	45° Long* Radius Elbow	Tee Line	Tee Branch
3/8	7	4	0.8	0.3	0.5	1.5
1/2	9	5	0.9	0.4	0.6	2.0
5/8	12	6	1.0	0.5	0.8	2.5
3/4	14	7	1.3	0.6	0.9	3.0
7/8	15	8	1.5	0.7	1.0	3.5
1-1/8	22	12	1.8	0.9	1.5	4.5
1-3/8	28	15	2.4	1.2	1.8	6.0
* Long radius elbow. Multiply factor by 1.5 for short radius elbow equivalent length.						

Finding Pressure Drop in Vapor Line

Using the previous example of a 5-ton unit with 92 ft. horizontal run and 30 ft. vertical run using four (4) long radius 90° fittings. The 1-1/8” vapor line does not maintain the required velocity in the riser, so this requires the riser to be reduced to 7/8”.

- 5-ton unit utilizing 1-1/8” line has a pressure drop of 0.7 psi/100 ft.
- 5-ton unit utilizing 7/8” line has pressure drop of 2.59 psi/100 ft.
- 1-1/8” long radius 90° fitting has equivalent length of 1.8 ft. (see Table 3).
- Total equivalent length of 1-1/8” pipe is 4 X 1.8 = 7.2 ft. for fittings + 92 linear ft. = 99.2 ft.
- Find pressure drop: 0.7/100 X 99.2 = .694 psi for 1-1/8” line.
- Find pressure drop for 7/8” riser: 2.59/100 X 30 = .777 psi.
- Total pressure drop in vapor line: .694 + .777 = 1.47 psi.

  In this example, the total pressure drop is kept to a minimum while achieving the velocity required for oil return in the riser.
- Find capacity loss: Capacity loss is found by using the following calculation: .01 X pressure drop X Btu = Btu loss.

  For the above example, .01 X 1.47 X 60000 = 882.6 Btu. This number should be considered when sizing equipment.

Vapor Line

Vapor line pressure drop and velocity are both important aspects of ensuring systems operate reliably and with the least impact to performance. A pressure drop of 5 psi or less is acceptable. There is approximately 1% capacity loss per 1 psi pressure drop on the vapor line. See Table 4.

For 2-stage systems, use low capacity output for sizing vapor line risers (low capacity output on Allied 2-stage equipment is 75% of full load). Vapor line velocity is very important to ensure proper oil return. Minimum velocity should be approximately 800 fpm in horizontal runs and 1200 fpm in vertical runs.

Liquid Line

Liquid line should always be 3/8” line for residential units. Liquid line should be insulated when it passes through an environment with higher temperatures than subcooled refrigerant temps (105-115°F liquid temp at 95°F ambient). This will prevent sweating on systems that have 20 psi or more liquid pressure drop. Filter drier is required if outdoor unit does not have one factory installed.

Piping Installation

Refrigerant lines must not transmit equipment vibration to any part of the structure. Lines should be supported by isolation hangers. See Figure 3.

Refrigeration lines should NOT be left unsupported and free to touch the structure at any point. Where lines pass through roofs, walls, floors or sills, or where they come in contact with duct work, they should be properly isolated. If outside, the isolation material should be properly waterproofed.

The piping must be supported securely at the proper places. All piping should be supported with hangers that can withstand the combined weight of pipe, fittings, refrigerant and insulation. The hangers must be able to keep the pipe in proper alignment, preventing any droop.

Refrigeration lines must not be buried in the ground unless they are insulated and waterproofed. Un-insulated copper lines buried in wet soil or under concrete can cause serious capacity loss and erratic operation as well as early failure due to corrosion.

Systems with buried refrigerant lines can experience significant or total capacity loss if allowed to transmit heat to the surroundings. In addition, buried lines are susceptible to corrosion which can shorten the life of the system. For this reason, buried lines must rest inside a sealed, watertight, thermally insulated conduit. The lines must not contact the soil for any reason and the conduit must be designed so it cannot collect and retain water.

NOTE - Pipe work, including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52 . All field joints shall be accessible for inspection prior to being covered or enclosed. Requirements for A2L refrigerants are located in these standards and codes for residential, multi-family, and commercial applications.

Line Set Joints – Furnace Application

Evaporator primary line set joints in all applications shall have a line set joint sleeve.

Evaporator primary line sets should not have additional joints not covered by line set joint sleeve.

If additional joints are present, the system installation shall comply with one of the options below:

Option 1 - Furnace is installed as a direct vent appliance;

Option 2 - Furnace/Evaporator installation is in a space greater than the minimum conditioned area (Amin);

Option 3 - Furnace/Evaporator installation is connected to a space greater than the minimum conditioned area (Amin) through an opening of at least 15 in² (4-inch diameter hole equivalent) located below the level of the furnace burners;

Option 4 - Have a second refrigerant detection sensor installed below the level of the burners (see Secondary Sensor Installation section).

Multiple Systems Installed in Same Space

For any A2L refrigerant system with additional joints not covered by line set joint sleeves, each system in the same space must have refrigerant detection sensor installed below the level of the burners (see Secondary Sensor Installation section). If all the systems in the same space are installed with direct vent application, then additional refrigerant detection sensor is not needed.

Secondary Sensor Installation

If secondary refrigerant sensor is required, it shall be mounted as follows:

Upflow Applications: Mounted on an unused side furnace return air connection at least 9 inches above the floor and within 9 inches from front of furnace.

Downflow Applications: Mounted on one side of the evaporator coil 9 inches above the floor and within 9 inches from front of coil.

Horizontal Applications: Mounted on the bottom side return furnace air connection within 9 inches of both the blower deck and front of furnace.

Connect the refrigerant sensor to the second sensor input on the RDS Control. Refer to the instructions provided with the sensor or the RDS controller to enable the second sensor.

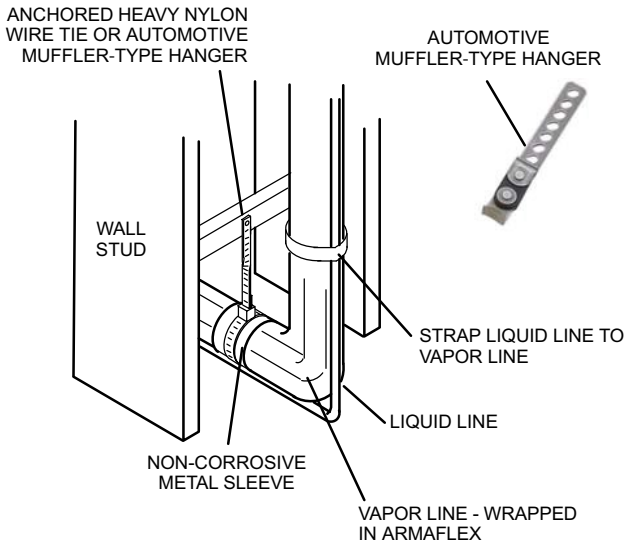
LINE SET

IMPORTANT — Refrigerant lines must not contact structure.

INSTALLATION

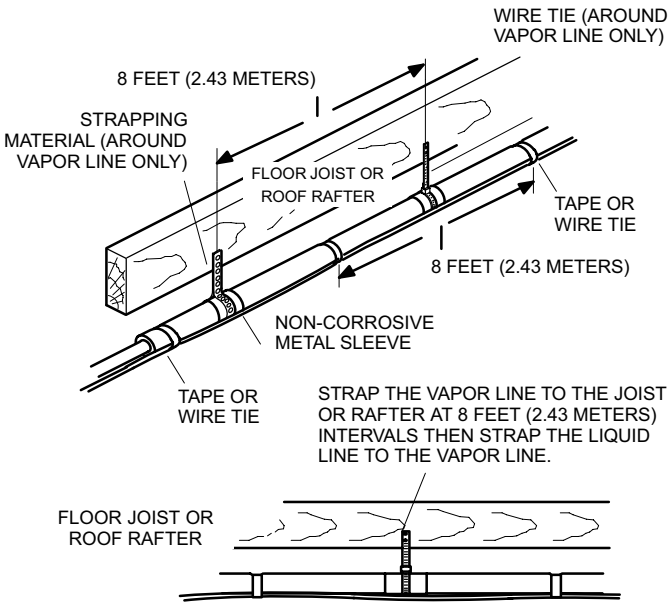
Line Set Isolation — The following illustrations are examples of proper refrigerant line set isolation:

REFRIGERANT LINE SET — TRANSITION FROM VERTICAL TO HORIZONTAL



REFRIGERANT LINE SET — INSTALLING HORIZONTAL RUNS

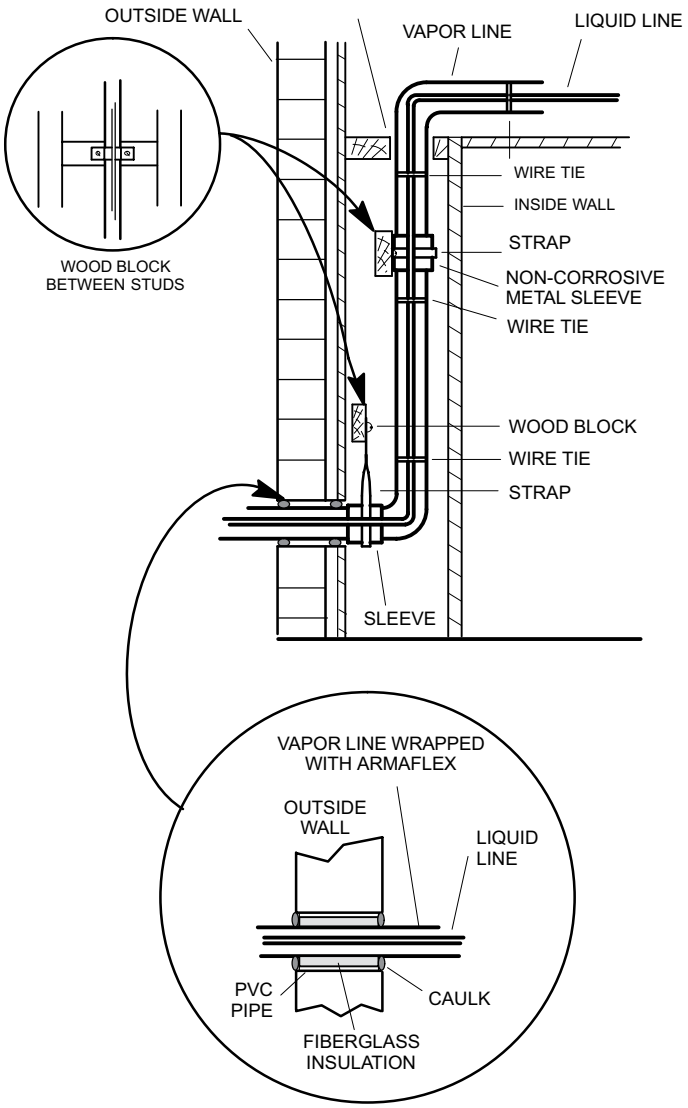
To hang line set from joist or rafter, use either metal strapping material or anchored heavy nylon wire ties.



REFRIGERANT LINE SET — INSTALLING VERTICAL RUNS (NEW CONSTRUCTION SHOWN)

NOTE — Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

IMPORTANT — Refrigerant lines must not contact wall



***NOTE** — Similar installation practices should be used if line set is to be installed on exterior of outside wall.*

WARNING — Polyol ester (POE) oils used with R-454B refrigerant absorb moisture very quickly. It is very important that the refrigerant system be kept closed as much as possible. DO NOT remove line set caps or service valve stub caps until you are ready to make connections.

Figure 3.

Table 4.

Unit BTU's	Tonnage	Vapor Line Size (in.)	Pressure Drop psi / 100 ft.	Equivalent Length / Cooling Capacity Loss (%)								
				25 ft.	50 ft.	80 ft.	100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	240 ft.
18000	1.5	5/8"	1.67	0.4%	0.8%	1.3%	1.7%	2.1%	2.5%	2.9%	3.3%	4.0%
		3/4"	0.63	0.2%	0.3%	0.5%	0.6%	0.8%	0.9%	1.1%	1.3%	1.5%
24000	2	5/8"	2.83	0.7%	1.4%	2.3%	2.8%	3.5%	4.2%	5.0%	5.7%	6.8%
		3/4"	1.06	0.3%	0.5%	0.8%	1.1%	1.3%	1.6%	1.9%	2.1%	2.5%
30000	2.5	5/8"	1.6	0.4%	0.8%	1.3%	1.6%	2.0%	2.4%	2.8%	3.2%	3.8%
		3/4"	0.72	0.2%	0.4%	0.6%	0.7%	0.9%	1.1%	1.3%	1.4%	1.7%
36000	3	3/4"	2.25	0.6%	1.1%	1.8%	2.3%	2.8%	3.4%	3.9%	4.5%	5.4%
		7/8"	1	0.3%	0.5%	0.8%	1.0%	1.3%	1.5%	1.8%	2.0%	2.4%
42000	3.5	7/8"	1.33	0.3%	0.7%	1.1%	1.3%	1.7%	2.0%	2.3%	2.7%	3.2%
		1 1/8"	0.36	0.1%	0.2%	0.3%	0.4%	0.5%	0.5%	0.6%	0.7%	0.9%
48000	4	7/8"	1.71	0.4%	0.9%	1.4%	1.7%	2.1%	2.6%	3.0%	3.4%	4.1%
		1 1/8"	0.46	0.1%	0.2%	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	1.1%
60000	5	7/8"	2.59	0.6%	1.3%	2.1%	2.6%	3.2%	3.9%	4.5%	5.2%	6.2%
		1 1/8"	0.7	0.2%	0.4%	0.6%	0.7%	0.9%	1.1%	1.2%	1.4%	1.7%

System Charge

Allied Air split residential units come precharged for 15ft. or 30ft. see nameplate for value of line set. Additional charge is required over 15ft. or 30ft. For 3/8" liquid line, charge should be added at .60 ounces per foot.

Charge unit in ambient at 70°F or above. For low ambient charging below 70°F, restrict condenser airflow to achieve 400 psi liquid pressure for proper charging.

For longer line sets and line sets with vertical liquid lift, subcooling should be checked at the indoor unit using ports installed at evaporator inlet and outlet or sight glass installed at indoor unit. Minimum of 4°F subcooling should be measured at the evaporator to insure 100% liquid to TXV. If flashing occurs in liquid line units performance will be significantly affected.

It is required that charging with HFO-454B be done in the liquid phase. Use a commercial-type metering device in the manifold hose. Charge into the suction line with the compressor running. See OEM installation instructions for more details on proper charging procedures.

Verify the unit is electrically grounded before charging the system. Extreme care shall be taken not to overfill the refrigerating system.

Charge should be checked and adjusted using information outlined in this section and in the tables provided on the charging label on the unit's control access panel.

R-454B is a zeotropic blend of two refrigerants. At any given refrigerant pressure, R-454B will have two saturation temperatures, a saturated liquid temperature and a saturated vapor temperature. See R-454B Refrigerant Pressure Temperature Chart in the installation and service manual for saturation temperatures.

R-454B Units must be charged with liquid refrigerant. Follow conventional charging procedures when charging the system. The technician is required to mark the total charge of the installed system on the unit nameplate, which includes the nameplate charge (factory charge) and additional charge that is added to the system at the time of installation.

The R-454B refrigerant cylinders are provided with a ¼" LH flare connection, therefore a ¼" LH female flare adapter will be required. Connect manifold gauges and hoses following conventional charging procedures. Position the R-454B refrigerant cylinder to deliver liquid refrigerant.

The unit is factory charged with R454B. Refer to unit Charging Label for baseline line set length for factory unit charge and charge adder guidance.

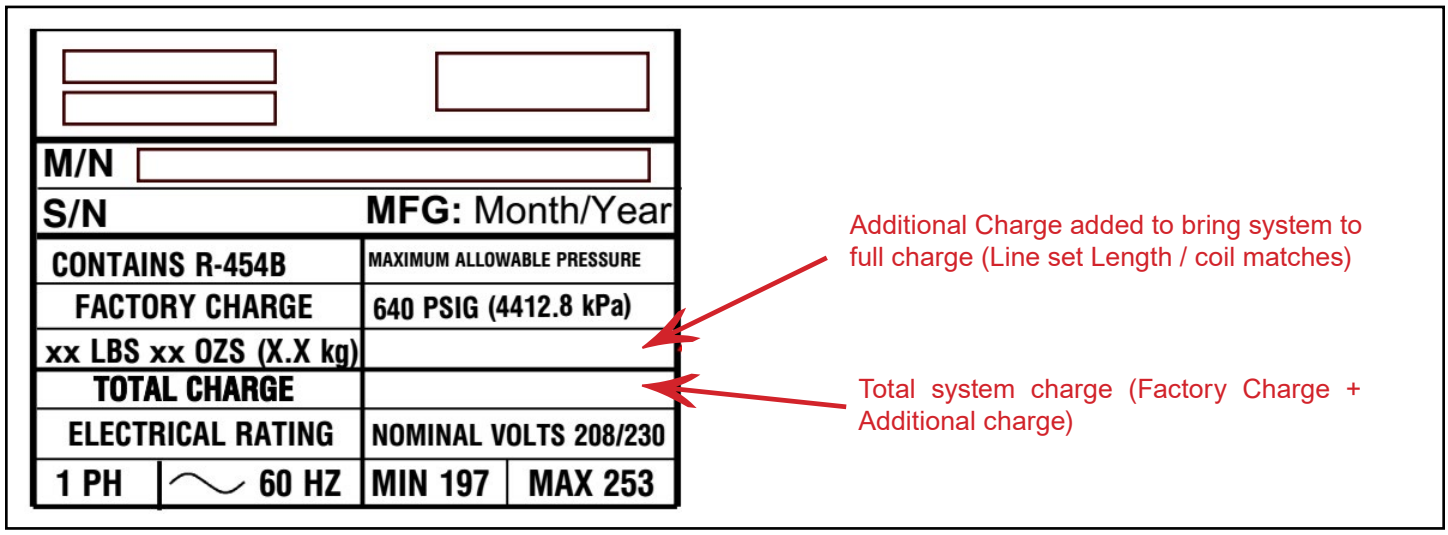
Initiate a call for cooling and allow the refrigerant pressures and temperatures to stabilize. Adjust the charge to using the subcooling method. The unit charging label provides the target Subcooling Values. Record the liquid line temperature. Measure the liquid line pressure and use the value to determine the Saturated Liquid Temperature. Calculate subcooling by subtracting the liquid line temperature from the Saturated liquid temperature.

Subcooling = Saturated Liquid Temperature – Liquid Line Temperature

Compare the results with the unit charging label.

Once system charging has been completed, the additional charge and total charge must be marked on the unit nameplate. Total Charge = Factory Charge + Additional charge. The total charge is marked on the space adjacent to “Total Charge”. See nameplate below.

Detailed information is given in the Installation and Service Procedures manual, which is available on AlliedConnect™.



*(**NOTE** - The nameplate is shown for illustration purposes only. Go to actual nameplate on outdoor unit for charge information.)*

Table 5. Refrigerant Charge (Pounds) in 100 feet of type L copper tubing

Line Size	3/8"	1/2"	5/8"	5/8"	3/4"	3/4"	7/8"	7/8"	1-1/8"
	Liquid	Liquid	Liquid	Suction	Liquid	Suction	Liquid	Suction	Suction
HFO-454B	3.3	6.2	10.0	0.5	15.4	0.7	20.7	1.1	1.8

Safety

- Only licensed and trained service technicians should perform the installation and service of air conditioning and heat pump equipment. Electrical shock, injury, death, fire and explosion can occur if proper procedures are not followed.
- Wear protective safety equipment to prevent injuries at all times.
- Electrical power must be disconnected before working on any equipment.
- Refrigeration systems contain refrigerants under high pressure; caution must be observed at all times.
- It is a federal violation to vent refrigerants into the atmosphere; proper equipment must be used to recover/reclaim refrigerants.

Warranty

Any installations that do not comply with the guidelines in this manual shall lose warranty coverage. For unique installations outside of the guidelines, a written approval may be granted after review by the Technical Service and Engineering department. Contact Allied Air Technical Services at 1-800-515-3501.

Table 6. R-454B Refrigerant Pressure-Temperature Chart

Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)
0	-58.9	-57.1	158	58.9	61.3	272	93.0	95.4	362	113.4	115.6
25	-19.2	-17.2	160	59.6	62.0	274	93.5	95.9	364	113.8	116.0
30	-13.9	-11.8	165	61.4	63.8	276	94.0	96.4	366	114.2	116.4
35	-9.0	-6.9	170	63.1	65.5	278	94.5	96.9	368	114.6	116.8
40	-4.4	-2.3	175	64.9	67.3	280	95.0	97.4	370	115.0	117.2
45	-0.2	1.9	180	66.6	69.0	282	95.5	97.9	372	115.4	117.6
50	3.7	5.9	185	68.2	70.6	284	96.0	98.4	374	115.8	118.0
55	7.5	9.7	190	69.8	72.2	286	96.5	98.8	376	116.2	118.4
60	11.0	13.2	195	71.4	73.8	288	97.0	99.3	378	116.6	118.8
65	14.4	16.6	200	73.0	75.4	290	97.5	99.8	380	117.0	119.2
70	17.6	19.8	202	73.6	76.0	292	97.9	100.3	382	117.4	119.6
75	20.6	22.9	204	74.2	76.6	294	98.4	100.7	384	117.7	119.9
80	23.6	25.9	206	74.9	77.3	296	98.9	101.2	386	118.1	120.3
85	26.4	28.7	208	75.5	77.9	298	99.4	101.7	388	118.5	120.7
90	29.1	31.4	210	76.1	78.5	300	99.8	102.2	390	118.9	121.1
95	31.7	34.0	212	76.7	79.1	302	100.3	102.6	392	119.3	121.5
100	34.3	36.6	214	77.3	79.7	304	100.8	103.1	394	119.7	121.9
102	35.3	37.6	216	77.9	80.2	306	101.2	103.5	396	120.1	122.2
104	36.2	38.6	218	78.4	80.8	308	101.7	104.0	398	120.5	122.6
106	37.2	39.5	220	79.0	81.4	310	102.1	104.4	400	120.8	123.0
108	38.1	40.5	222	79.6	82.0	312	102.6	104.9	405	121.8	123.9
110	39.1	41.4	224	80.2	82.6	314	103.0	105.4	410	122.7	124.9

NOTE:

1. R-454B is a zeotropic blend and must be charged with liquid refrigerant only.
2. Saturated liquid temperature is used to calculate liquid subcooling.
3. Saturated vapor temperature is used to calculate suction superheat.
4. See unit charging label for subcooling values and additional charging information.

Table 6. R-454B Refrigerant Pressure-Temperature Chart (Continued)

Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)	Pressure (psig)	Saturated Liquid Temp (°F)	Saturated Vapor Temp (°F)
112	40.0	42.4	226	80.8	83.1	316	103.5	105.8	415	123.6	125.8
114	40.9	43.3	228	81.3	83.7	318	103.9	106.2	420	124.6	126.7
116	41.8	44.2	230	81.9	84.3	320	104.4	106.7	425	125.5	127.6
118	42.7	45.1	232	82.4	84.8	322	104.8	107.1	430	126.4	128.5
120	43.6	46.0	234	83.0	85.4	324	105.3	107.6	435	127.3	129.4
122	44.5	46.9	236	83.6	86.0	326	105.7	108.0	440	128.2	130.2
124	45.4	47.7	238	84.1	86.5	328	106.2	108.5	445	129.0	131.1
126	46.2	48.6	240	84.7	87.1	330	106.6	108.9	450	129.9	132.0
128	47.1	49.4	242	85.2	87.6	332	107.0	109.3	460	131.6	133.7
130	47.9	50.3	244	85.8	88.1	334	107.5	109.7	470	133.3	135.3
132	48.8	51.1	246	86.3	88.7	336	107.9	110.2	480	135.0	137.0
134	49.6	51.9	248	86.8	89.2	338	108.3	110.6	490	136.7	138.6
136	50.4	52.8	250	87.4	89.7	340	108.8	111.0	500	138.3	140.2
138	51.2	53.6	252	87.9	90.3	342	109.2	111.5	510	139.9	141.8
140	52.0	54.4	254	88.4	90.8	344	109.6	111.9	520	141.5	143.3
142	52.8	55.2	256	88.9	91.3	346	110.0	112.3	530	143.0	144.8
144	53.6	56.0	258	89.5	91.8	348	110.5	112.7	540	144.5	146.3
146	54.3	56.7	260	90.0	92.4	350	110.9	113.1	550	146.1	147.8
148	55.1	57.5	262	90.5	92.9	352	111.3	113.5	560	147.5	149.2
150	55.9	58.3	264	91.0	93.4	354	111.7	114.0	570	149.0	150.7
152	56.6	59.0	266	91.5	93.9	356	112.1	114.4	580	150.5	152.1
154	57.4	59.8	268	92.0	94.4	358	112.5	114.8	590	151.9	153.5
156	58.1	60.5	270	92.5	94.9	360	112.9	115.2	600	153.3	154.8

NOTE:

1. R-454B is a zeotropic blend and must be charged with liquid refrigerant only.
2. Saturated liquid temperature is used to calculate liquid subcooling.
3. Saturated vapor temperature is used to calculate suction superheat.
4. See unit charging label for subcooling values and additional charging information.