



Application Guide

# Tube Size and Component Selection

IntelliCore™ Split Systems (20 to 120 Tons)

R-454B Refrigerant

Microchannel Condensers



## ⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

November 2024

**SS-APG018A-EN**

**TRANE**  
TECHNOLOGIES™



# Introduction

Read this manual thoroughly before operating or servicing this unit.

## Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.



Indicates a situation that could result in equipment or property-damage only accidents.

## Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants.

## Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

### **WARNING**

#### **Proper Field Wiring and Grounding Required!**

**Failure to follow code could result in death or serious injury.**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.**

**⚠ WARNING****Personal Protective Equipment (PPE) Required!**

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, **MUST** follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- Before installing/servicing this unit, technicians **MUST** put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). **ALWAYS** refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.
- When working with or around hazardous chemicals, **ALWAYS** refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.
- If there is a risk of energized electrical contact, arc, or flash, technicians **MUST** put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, **PRIOR** to servicing the unit. **NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

**⚠ WARNING****Follow EHS Policies!**

Failure to follow instructions below could result in death or serious injury.

- All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.
- Non-Trane personnel should always follow local regulations.

**⚠ WARNING****Refrigerant under High Pressure!**

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

**⚠ WARNING****Explosion Hazard!**

Failure to follow instructions below could result in an explosion which could result in death or serious injury, and equipment damage.

**NEVER** bypass system safeties in order to pump down the unit component's refrigerant into the microchannel heat exchanger (MCHE) coil. Do **NOT** depress the compressor contactor since it effectively bypasses the high-pressure control.



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## Overview

Trane's RAUK 20- through 120-ton condensing unit product line is designed for use only with R-454B and POE oil. R-454B is a higher pressure refrigerant that requires the other components of the system to be rated for the higher pressures. For compressor lubrication, the refrigerant requires POE oil.

Traditionally, refrigerant piping practices were guided by four principles:

- Return the oil to the compressor.
- Maintain a column of liquid at the expansion valve.
- Minimize the loss of capacity.
- Minimize the refrigerant charge in the system.

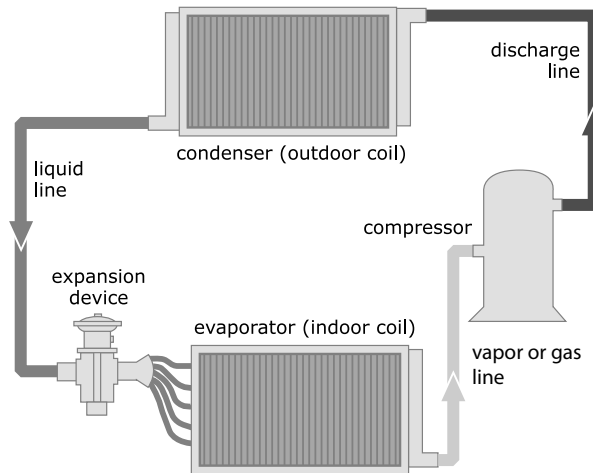
Evidence accumulated over years of observation demonstrates that the lower the refrigerant charge, the more reliably a split air-conditioning system performs. Any amount of refrigerant in excess of the minimum design charge becomes difficult to manage. The excess refrigerant tends to collect in areas that can interfere with proper operation and eventually shortens the service life of the system.

To successfully minimize the system refrigerant charge, the correct line size should be used and the line length must be kept to a minimum.

## Background

In a split air-conditioning system, the four major components of the refrigeration system are connected by field-assembled refrigerant piping. A vapor or gas line connects the evaporator to the compressor, the discharge line connects the compressor to the condenser, and the liquid line connects the condenser to the expansion device, which is located near the evaporator inlet. Operational problems can occur if these refrigerant lines are designed or installed improperly.

**Figure 1. Interconnecting refrigerant lines in a typical split air-conditioning system**



The origin of the requirements for equivalent line lengths of components, line pressure drop, and minimum and maximum refrigerant velocities is uncertain. It appears likely that at least some of the supporting data was derived from measurements and/or equations involving water. Some resource materials even show water components when illustrating refrigerant piping requirements.

Subsequent reviews of analytical and empirical data for refrigerant piping resulted in the publication of two research papers: *Pressure Losses in Tubing, Pipe, and Fittings* by R.J.S. Pigott and *Refrigerant Piping Systems — Refrigerants 12, 22, 500* by the American Society of Refrigeration Engineers (ASRE). In his paper, Pigott described his use of refrigerant as the fluid and his direct measurement of pressure drops. His findings indicated that the pressure drop of many line components is small and difficult to measure. For these components, he used experimental data to derive a formula relating the geometry of the component to its pressure drop. Overall, his calculated pressure loss of the components was less than originally determined.

The conclusion of the ASRE research paper stated that the minimum required velocity to maintain oil entrainment in vertical risers and horizontal lines will vary with the diameter of the tube and with the saturation temperature of the suction gas. In other words, the minimum required velocity for oil entrainment is not constant.

## Updated Guidelines

### Liquid Lines

Historically, liquid lines were sized to minimize the pressure losses within the piping circuit. Oil movement through the piping wasn't a concern (nor is it today) because oil is miscible in liquid refrigerant at normal liquid-line temperatures. The historic and traditional 6 psid liquid line pressure drop had the unintended consequence of requiring line sizes with large internal refrigerant volumes. With R-454B refrigerant and POE oil, this pressure drop can be as high as 50 psid. Within these guidelines, refrigeration operation is maintained while minimizing the refrigerant charge. It is still required to limit the liquid line velocity to 600 ft/min to help avoid issues with water hammer.

### Suction Lines

R-454B is a high-pressure refrigerant and allows higher-pressure drops in the suction lines. With R-454B refrigerant, that same 2°F loss is a 5 psi drop. Additional pressure drop may be tolerated in certain applications.

R-454B refrigerant suction lines must be sized to maintain oil-entrainment velocities in both the horizontal and vertical risers. Oil entrainment for R-454B is based on suction temperature as well as tube diameter. Trane has used ASHRAE data to create equation-based formulas to predict the entrainment velocities of R-454B refrigerant and POE oil. These minimum velocities are reflected in the line sizes listed in the component selection summary [Table 1, p. 31](#).

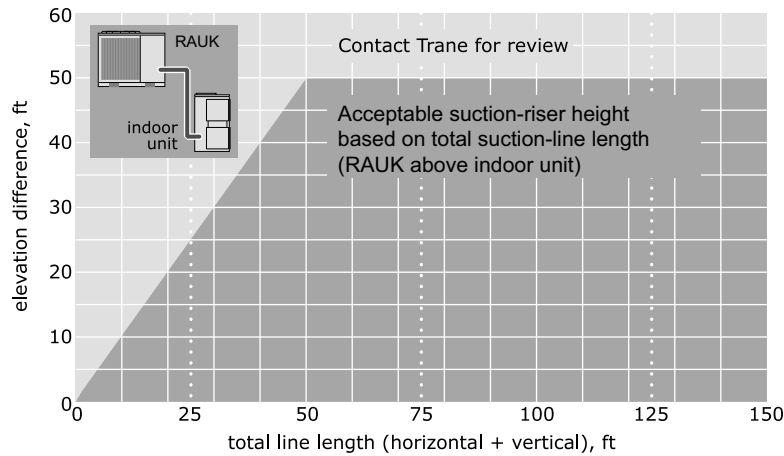
## Equipment Placement

### Minimize Distance Between Components

For a split air-conditioning system to perform as reliably and inexpensively as possible, the refrigerant charge must be kept to a minimum. To help accomplish this design goal:

- Site the outdoor unit (cooling-only condensing unit or heat pump) as close to the indoor unit as possible.
- Route each interconnecting refrigerant line by the shortest and most direct path so that line lengths and riser heights are no longer than absolutely necessary.
- Use only horizontal and vertical piping configurations.
- Determine whether the total length of each refrigerant line requires Trane review. Be sure to account for the difference in elevations of the indoor and outdoor units when calculating the total line length. Interconnecting lines of 150 lineal ft (45.7 m) or less that comply with the figures in the following section do not require Trane review. Reference the following section for the maximum liquid and suction riser elevation.

**Figure 2. Allowable elevation difference: cooling-only RAUK above indoor unit**

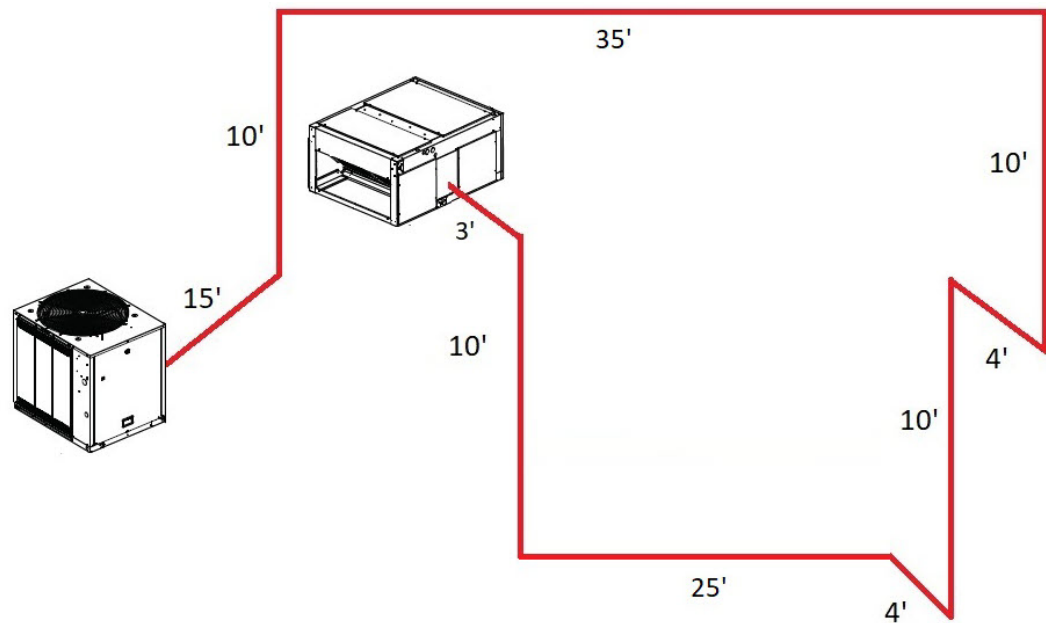


**Notes:**

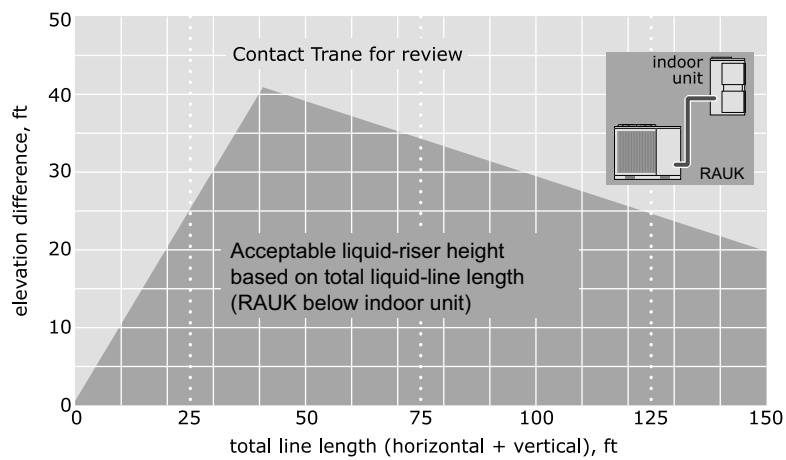
- Regardless of orientation, hot gas bypass (HGBP) lines are limited to 75 feet. See Hot Gas Bypass Installation Guideline for Direct Expansion (DX) Equipment APP-APG017\*-EN for more details.
- In Figure 3, p. 9 the total pipe length is 126 feet. This is plotted across the bottom of Figure 2, p. 8 and Figure 4, p. 9. The red line represents suction and liquid lines. As it is assumed they are piped side by side, only one line is shown for simplicity.
- When evaluating Figure 2, p. 8, all liquid lines and suction drops are ignored. In the Piping Example there are three 10 foot sections of suction pipe that flow upwards. This is a suction line lift of 30 feet. Plotting the total line length of 126 feet on the horizontal axis of Figure 2, p. 8, and plotting the 30 feet of suction lift on the vertical axis of Figure 2, p. 8, the final result is in the dark shaded area of Figure 2, p. 8. This complies with Figure 2, p. 8. The user can use the line sizes in Table 1, p. 31.
- When evaluating Figure 4, p. 9, all suction lines and liquid drops are ignored. In the Piping Example, there are two 10 foot liquid lines flowing upwards. This is a liquid line lift of 20 feet. Plotting the total line length of 126 feet on the horizontal axis of Figure 4, p. 9, and plotting the 20 feet of liquid lift on the vertical axis of Figure 4, p. 9. The final result is in the dark shaded area of Figure 4, p. 9. This complies with Figure 4, p. 9. The user can use the line sizes in Table 1, p. 31.



**Figure 3. Piping Example**



**Figure 4. Allowable elevation difference: cooling-only RAUK below indoor unit**

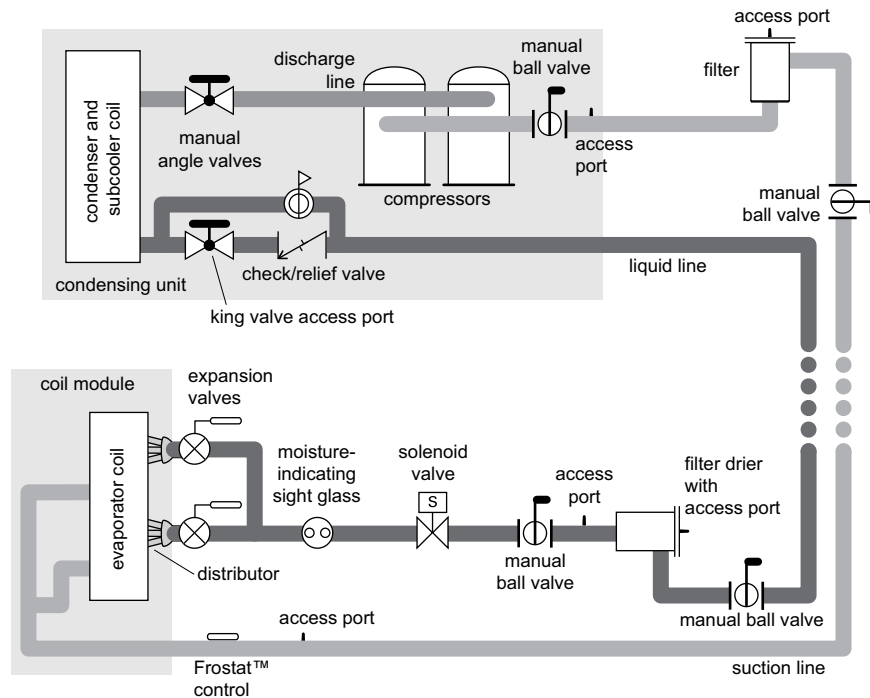


**Note:** All liquid piping rises are cumulative and ignore drops.

# Line Sizing, Routing, and Component Selection

The figure below illustrates an example of an RAUK split-system component arrangement. Use it to determine the proper, relative sequence of the components in the refrigerant lines that connect the RAUK condensing unit to an evaporator coil. Refer to “[Examples of Field-Installed Evaporator Piping](#),” p. 20 for more detailed schematics of evaporator piping. The RAUK units are R-454B machines, and all the selected components installed in the field must also be rated for use with R-454B.

**Figure 5. Example of placement for split-system components**



**Notes:**

1. Shutoff valves are a field installed option and no longer come standard from the factory. Field installed shutoff valves should have an integral access port.
2. RAUK condensing units ship with three integral access ports. Each TXV requires an additional field installed access port installed between the TXV and sight glass.
3. A field installed access port is also required at each evaporator suction line.

## Liquid Lines

### Line Sizing

Properly sizing the liquid line is critical to a reliable split-system application. [Table 1, p. 31](#) shows the recommended liquid-line sizing for each RAUK model based on its nominal capacity. Using the preselected tube diameter to uniformly size the liquid line will maintain operating requirements and is the line size around which the RAUK installation literature charging charts were generated. Increasing the line size will not increase the allowable line length.

### Routing

Install the liquid line with a slight slope in the direction of flow so that it can be routed with the suction line. Due to the normal force of gravity, there is a maximum liquid riser height limitation. As the liquid riser grows in height, gravity produces a pressure drop that may result in a loss of subcooling. [Figure 2, p. 8](#) and [Figure 4, p. 9](#) show the permissible rise in the liquid line (without excessive loss of subcooling). System designs outside the application envelope of the unit require Trane review.

The RAUK unit design includes a liquid line check/relief assembly at the outlet of the subcooler to prevent liquid refrigerant from being drawn back to the compressor during the off cycle. The relief valve discharges to the condenser to prevent excessive pressures from developing in the liquid line during the off cycle, due to a temperature change of the trapped column of liquid between the solenoid valve and check valve.

## Insulation

The liquid line is generally warmer than the surrounding air, so it does not require insulation. In fact, heat loss from the liquid line improves system capacity because it provides additional subcooling. If the liquid line is routed through a high temperature area, such as an attic or mechanical room, insulation would be required.

## Components

Liquid-line refrigerant components necessary for a successful job include a filter drier, access port, solenoid valve, moisture-indicating sight glass, expansion valve(s), and ball shutoff valves. [Figure 5, p. 10](#) illustrates how to sequence the components properly in the liquid line. Position the components as close to the evaporator as possible. [Table 1, p. 31](#), identifies suitable components, by part number, for each RAUK model. Note that there are two access ports: one located at the RAUK and one located at the evaporator. [“Parts,” p. 31](#) lists suitable expansion valves.

### Liquid Filter Drier

There is no substitute for cleanliness during system installation. The liquid filter drier prevents residual contaminants, introduced during installation, from entering the expansion valve and solenoid valve. If choosing a filter other than the one listed in [“Parts,” p. 31](#), make sure its volume, filtering, and moisture-absorbing characteristics are equivalent, and that it is the replaceable core type.

### Access Port

The access port located at the RAUK allows the unit to be charged with liquid refrigerant and is used to determine charge level. This port is usually a Schraeder valve with a core.

### Solenoid Valve

In RAUK split systems with MCHE, solenoid valves isolate the refrigerant from the evaporator during the off cycles. Trim solenoids cannot be used with MCHE (refer to [“Microchannel Heat Exchanger Condensers,” p. 19](#)).

**Note:** RAUK units with MCHE no longer employ pump-down, but refrigerant isolation solenoids are required. The suggested solenoid uses a 120-volt service and requires code-compliant wiring to the RAUK condensing unit. For more information, see [“Microchannel Heat Exchanger Condensers,” p. 19](#).

### Moisture-Indicating Sightglass

Be sure to install one moisture-indicating sight glass in the main liquid line.

**Note:** The sole value of the glass is its moisture-indicating ability. Use the Installation manual charging curves—not the sight glass—to determine proper charge levels. A properly charged RAUK unit may show bubbles in the sight glass.

### Expansion Valve

The expansion valve is the throttling device that meters the refrigerant into the evaporator coil. Metering too much refrigerant floods the compressor; metering too little elevates the compressor temperature. Choosing the correct size and type of expansion valve is critical to ensure that it will correctly meter refrigerant into the evaporator coil throughout the entire operating envelope of the system. **Correct refrigerant distribution into the coil requires an expansion valve for each distributor.**

For improved modulation, choose expansion valves with balanced port construction and external equalization. [“Parts,” p. 31](#) identifies the part numbers of the valves suggested for commercial RAUK MCHE systems.

The tonnage of the valve should represent the tonnage of the portion of coil that the TXV/distributor will feed. IntelliCore™ with microchannel condenser coils with fin and tube evaporators require a TXV with a bleed port to prevent high-pressure control trips.



## Line Sizing, Routing, and Component Selection

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### Ball Shutoff Valves

Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core. [Table 1, p. 31](#) lists only one of the numerous manufacturers of these valves. If you choose a valve by another manufacturer, ensure that its specifications are equivalent to the valve identified in this guide. Angle valves may be substituted for liquid line ball valves. Refer to [Table 1, p. 31](#), Component selection summary.

## Gas Line Line Sizing

Proper line sizing is required to guarantee that the oil returns to the compressor throughout the system's operating envelope. At the same time, the line must be sized so that the pressure drop does not excessively affect capacity or efficiency. To accomplish both objectives, it may be necessary to use two different line diameters: one for the horizontal run and for the vertical drops, and another for the vertical lifts (risers).

**Note:** *Preselected suction-line diameters shown in [Table 1, p. 31](#) are independent of total line length for properly charged 20 to 120 ton RAUK units in normal air-conditioning applications.*

## Routing

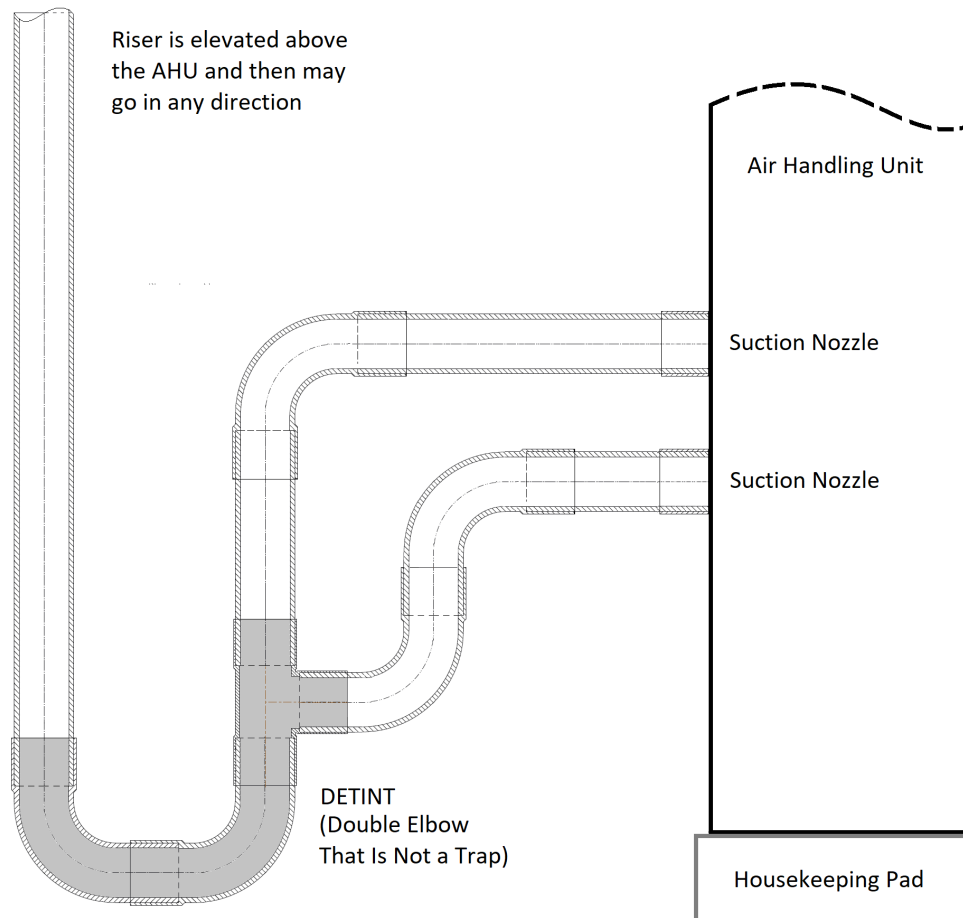
Route the line as straight (horizontally and vertically) as possible. Avoid unnecessary changes of direction. To prevent residual or condensed refrigerant from "free-flowing" toward the compressor, install the gas line so that it slopes by  $\frac{1}{4}$  to 1 inch per 10 feet of run (1 cm per 3 m) toward the indoor coil.

Do not install suction riser oil traps. With field-supplied air-handler coils, what appears to be a riser trap is located at the coil outlet. This is actually a DETINT. See [Figure 6, p. 13](#) for an example. This piping arrangement is the result of two requirements:

- Drain the coil to the common low point.
  - Preventing any off-cycle condensed refrigerant in the coil from attempting to flow to the compressor.
- Double suction risers **MUST NOT** be installed. All 6 – 25 ton TTA and TWA units unload such that a single gas line size, preselected in the Component Selection tables found in [Table 1, p. 31](#), provide sufficient velocity to return oil up the permissible riser height.

**Note:** *If a gas riser is properly sized, oil will return to the compressor regardless of whether a trap is present. If a gas riser is oversized, adding a trap will not restore proper oil entrainment, and may damage the compressor.*

**Figure 6. Gas-line arrangement at the outlet of a field-supplied indoor coil**



### DETINT

The riser DETINT (Double-Elbow That Is Not a Trap) does not retain oil during unit operation. When the unit is off, the DETINT prevents liquid oil or refrigerant from draining in either direction. It also allows sub-cooled oil and liquid refrigerant to drain past the TXV bulb. This promotes stable TXV operation. The DETINT riser should be extended above the AHU. It may then continue up, down, or side to side in any direction.

### Avoid Underground Refrigerant Lines

Underground lines create risk due to refrigerant condensing during the off cycle, ground water migration, damage from wildlife, expansion and contraction, service access, and abrasion/corrosion. These hazards can quickly impair reliability. Installation of underground refrigerant lines is deemed an installation error. It is difficult to separate underground piping installation damage from manufacturing defects. Compressor damage may not be covered under the manufacturers defect warranty.

## Insulation

Any heat that transfers from the surrounding air to the cooler suction lines increases the load on the condenser (reducing the system's air-conditioning capacity) and promotes condensate formation. After operating the system and testing all fittings and joints to verify that the system is leak-free, insulate suction lines to prevent heat gain and unwanted condensation.



### Components

The suction line requires field installation of these components: a filter, access port, Froststat™ control for coil frost protection, and ball shutoff valve. Position them as close to the compressor as possible. [Table 1, p. 31](#), identifies suitable components by part number for each RAUK model.

**Note:** Placement of the Froststat control is illustrated in [Figure 5, p. 10](#).

#### Filter

The suction filter prevents contaminants, introduced during installation, from entering the compressor. For this reason, the suction filter should be the replaceable-core type, and a clean core should be installed after the system is cleaned up.

To prevent oil logging, confirm the filter is oriented to free drain.

[Table 1, p. 31](#) lists only one of the many manufacturers of suction-line filters. If you choose a filter by another manufacturer, ensure that its capability and volume are equivalent to the suction filter identified in this guide.

#### Access Port

The access port is used to determine suction pressure. This port is usually a Schraeder valve with a core.

#### Service Valve

Service Valves may be convenient for servicing the condensing unit. However, they may not be used for pump down refrigerate isolation. If a field installed service valve is added to the system, it must be full port and should have a factory installed access port.

#### Froststat DX Fin Tube Coil Frost Protection

The Froststat™ control is the preferred method for protecting the evaporator coils from freezing on typical comfort cooling applications. It senses the suction-line temperature and temporarily disables mechanical cooling if it detects frost conditions. The control is mechanically attached to the outside of the refrigerant line, near the evaporator, and wired to the unit control panel. A Froststat is recommended for each Condensing Unit Circuit.

#### Ball Shutoff Valve

Adding manual, ball-type shutoff valves upstream and downstream of the filter simplifies replacement of the filter core.

[Table 1, p. 31](#) lists only one of the numerous manufacturers of these valves. If you choose a valve by another manufacturer, ensure that its specifications are equivalent to the valve identified in this guide.

#### Solenoid Isolation Valves

RAUK condensing units use bleed port TXVs. Solenoid isolation valves should be installed to prevent refrigerant migration when the unit is off. The solenoid isolation valves should not be used for capacity control or refrigerate pump down.



## Expansion Valves

Expansion valves meter refrigerant into the evaporator under controlled conditions. If there is too much refrigerant, the refrigerant will not completely vaporize and the remaining liquid will slug the compressor. If there is too little refrigerant, there may not be enough cooling for the compressor.

There are two types of valves:

- Standard valves are used on the RAUK MCHE systems with braze plate chilled-water evaporators.
- Bleed port valves are used on RAUK MCHE systems with fin tube DX evaporators. They have an internal port that shunts the refrigerant around the modulating portion of the valve.

, , AND list the correct expansion valves. Each evaporator distributor requires a dedicated expansion valve in order to maintain proper coil distribution. The expansion valve should be selected to match the capacity of the coil that the distributor feeds.

**Example: 20 tons coil with two equal distributors**

$$20 / 2 = 10$$

Each TXV should be selected for 10 tons.

Occasionally, the coil or distributors have a difference of only one circuit tube. This may result in a different size evaporator distributors. However, this difference is negligible, and the difference should be ignored.

The proper balance for feeding refrigerant for an RAUK system is to provide 18°F of superheat—the difference between the saturated and actual refrigerant temperature leaving the evaporator. On bleed port valves, the expansion valve superheat is set high from the manufacturer. These valves will need to be adjusted to 18°F superheat.



## Controls

The RAUK unit is available with different control options. These control options include No System Control, Supply Air VAV, and EVP Control. The No System Control option is often selected when a controls contractor wants to stage the RAUK compressors.

For details regarding Symbio™ 800 control sequence of operation, please refer to IntelliCore™ Split System Installation, Operation, and Maintenance (SS-SVX091\*, -EN) or IntelliCore™ Split System Product Catalog (ACDS-PRC005\*-EN) .





## Hot Gas Bypass

Hot gas bypass (HGBP) is added to HVAC systems to correct a number of operational problems. Unfortunately, the practice will increase energy consumption and may decrease reliability.

Trane has more than 15 years experience in the successful use of systems *without hot gas bypass* in commercial comfort-cooling applications. To prevent evaporator freeze-up, the installed AHUs require a Trane Froststat™ coil frost protection.

Like hot gas bypass, the Froststat system protects the coil from freezing, but it does so by turning off compressors when the Froststat sensor detects the conditions suitable for evaporator coil frosting. The compressor is released to operate when the coil temperature rises a few degrees above the frost threshold. The Froststat control strategy reduces the overall energy consumption of the system while maintaining system control. This method is often all that is required for standard comfort cooling.

The amount of HGBP allowed is limited by Energy Codes such as ASHRAE 90.1, the IEEC, and California Title 24. Units less than 20 tons may use up to 10% HGBP. Units 20 tons and larger may use up to 15% HGBP.

Because of the lower evaporator entering air conditions, HGBP is almost always required for 100% OA systems. HGBP may also be beneficial for systems with tighter humidity or discharge air requirements.

When using HGBP, the total "linear" line length should be limited to 75 feet. Field installed oil separator are not 100% efficient and may not have an oil recovery cycle. An oil separator may not be used to extend HGBP lines beyond 75 feet.

Liquid line bypass mixed with hot gas and routed to the suction line is an alternative form of HGBP. This goes by various trade names, such as "APR". While these devices may offer a lower cost installation, theoretical performance is the same as traditional HGBP. These devices are also limited to 75 feet of total system line length.

## Chilled-Water Systems

Chilled-water systems may require HGBP because of widely and quickly varying loads. Chilled-water comfort cooling applications, however, seldom need HGBP.

One way to mitigate the necessity of HGBP is to include a supply tank that has five-minute storage. In all cases, the loop time of the system should be five minutes.

## Additional Resources

- Refer to the Trane Application Guide "Hot Gas Bypass Installation Guideline for Direct Expansion (DX) Equipment" (APP-APG017\*- EN) for more information such as design, pipe size, and maximum hot gas bypass length.
- Refer to the Engineers Newsletter, "Hot Gas Bypass – Blessing or a Curse?" (ADM-APN007\*-EN).



## Remodel, Retrofit, or Replacement

Inevitably, older condensing unit/evaporator systems that are designed for use with a refrigerant other than R-454B will need to be upgraded. As of this document, current building codes and EPA regulations do not permit mixing and matching any components designed for an A1 refrigerant, such as R-410A with any components designed for an A2L refrigerant such as R-454B. This includes air handling unit components. Should the installer replace any A1 system with one containing A2Ls, the installer must also confirm that all connected refrigerant piping and and refrigerant specialties are also certified and listed for use with the specific A2L refrigerant. Failure to do so will create a hazardous and unsafe condition.

Every part of an existing split system needs to be analyzed to determine if it can be reused in an R-454B and POE oil system:

- Suction lines 2-5/8 OD and smaller of type L copper are suitable for use with R-454B. Suction lines 3-1/8 OD must use type K or thicker wall.
- Discharge lines, liquid lines, heat pump vapor lines, and hot gas bypass lines 1-3/8 OD and smaller of type L copper are suitable for use with R-454B. These same lines sized at 1-5/8 OD or 2-1/8 OD must use type K or thicker wall.
- The installer is responsibly for confirming recycled refrigerant lines are clean of any contaminants that may impact compressor reliability.

### ***NOTICE***

#### **Equipment Damage!**

**This is POE oil, which readily absorbs moisture. Always use new oil and never leave containers open to atmosphere while not in use.**

All Codes take precedence over anything written here.

## Microchannel Heat Exchanger Condensers

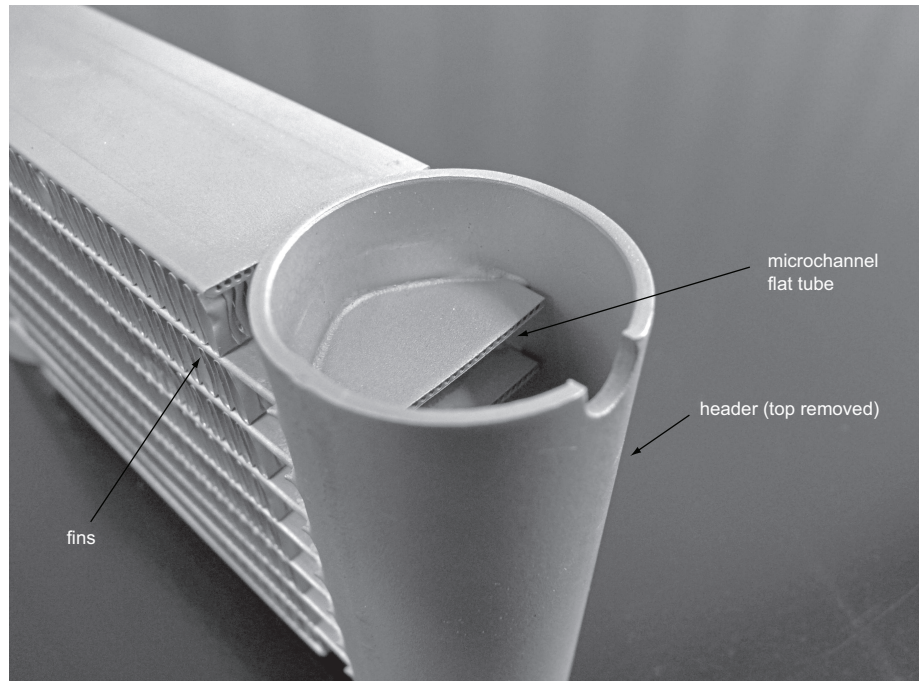
The microchannel heat exchanger (MCHE) condenser design is quite similar to the design of an automobile radiator. Refrigerant is distributed to very small channels in thin plates. The plates are one above the other, separated by fins [Figure 7, p. 19](#).

This design improves heat transfer and the refrigerant that enters the coil quickly turns to liquid. The MCHE tube volume holds very little refrigerant, so the refrigerant charge of the system is reduced. However, the tube volume is so small that if the flow of refrigerant out of the MCHE condenser is slowed much more than the flow of refrigerant into the MCHE condenser, the condenser may quickly fill with liquid and cause a high-pressure control trip. To avoid this condition, three system design requirements have been made on the RAUK unit with MCHE:

- **No pump-down:** The storage capacity of the MCHE will not support pump-down. A liquid solenoid is still required and closes simultaneously as the circuit cooling shuts off.
- **No trim solenoid:** The storage capacity of the MCHE will not support partial shut-off of the evaporator coil.
- **Bleed port TXVs:** As the TXV modulates to find the proper superheat, the liquid restriction caused by the modulating of a non-bleed TXV can excessively slow the refrigerant. A bleed port TXV allows enough refrigerant to pass through the valve bleed port to prevent high-pressure issues.

**Exception:** The RAUK unit that uses braze plate chilled-water evaporators does not need a bleed port TXV. This type evaporator doesn't hold enough refrigerant to cause the highpressure issue described. Because of the low refrigerant volume, the control system does not need to pump down but will still require a liquid line solenoid for charge isolation.

**Figure 7. MCHE condenser**



# Examples of Field-Installed Evaporator Piping

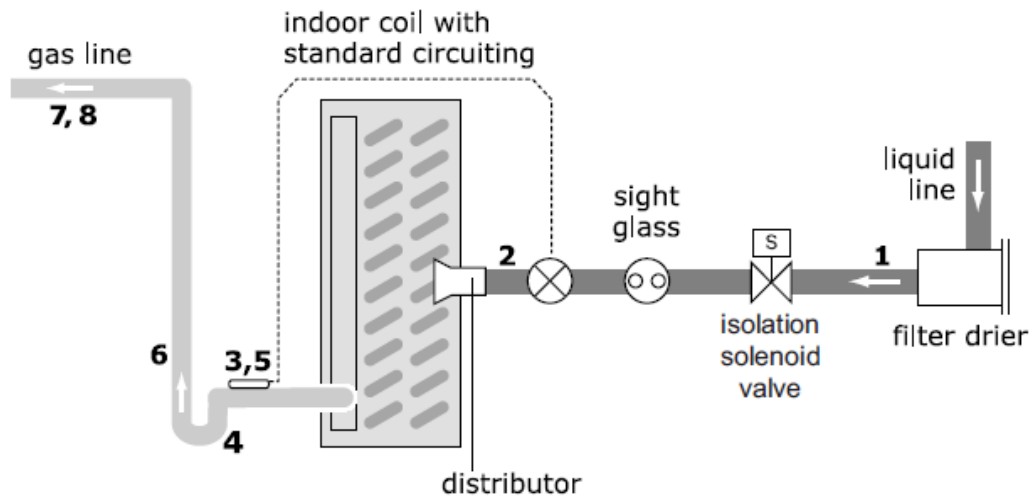
## Single Circuit RAUK Systems

### Type UF Evaporator Coil with One Distributor

1. Pitch the liquid line slightly — 1 in. / 10 ft (1 cm / 3 m) — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser — that is, 1 in. / 10 ft (1 cm / 3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See “[Line Sizing, Routing, and Component Selection](#),” p. 10.
5. For down flowing risers, use the horizontal tube diameter recommended in the Component selection table, found in [Table 1](#), p. 31
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in [Table 1](#), p. 31. Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft (1 cm / 3 m) — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

**Figure 8. Type UF evaporator coil with one distributor**

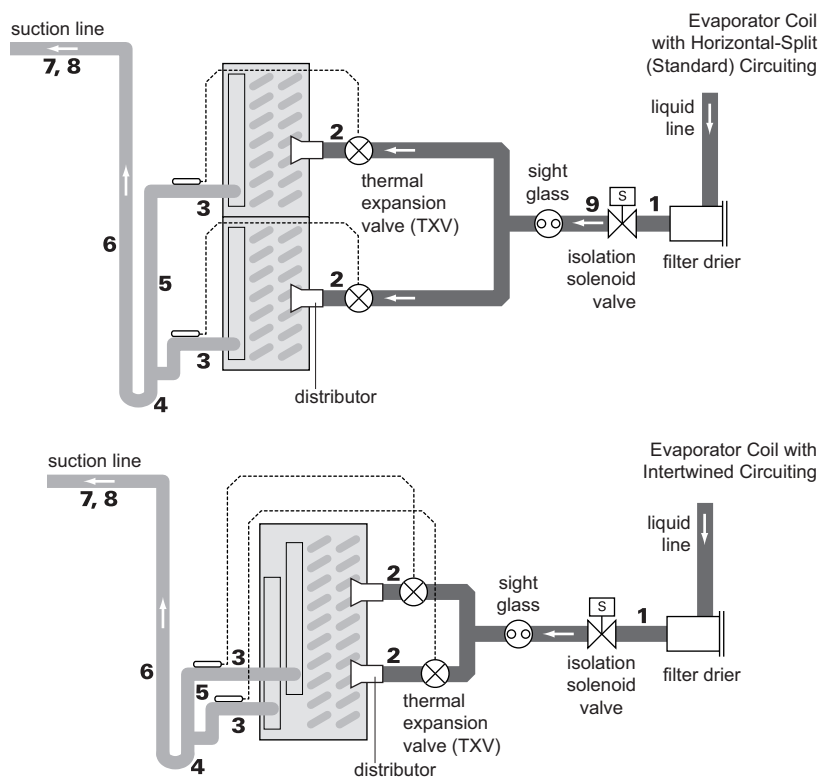


### Type UF Evaporator Coil with Two Distributors

1. Pitch the liquid line slightly — 1 in. / 10 ft cm / 3 m — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser — that is, 1 in. / 10 ft (1 cm / 3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection. Use a double-elbow configuration to isolate the TXV bulb from other suction headers.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See “Line Sizing, Routing, and Component Selection,” p. 10.
5. For down flowing risers, use one size smaller than the horizontal tube diameter recommended in the Component selection table, found in [Table 1, p. 31](#).
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in [Table 1, p. 31](#). Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft cm / 3 m — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

**Figure 9. Type UF evaporator coil with two distributors**





## Examples of Field-Installed Evaporator Piping

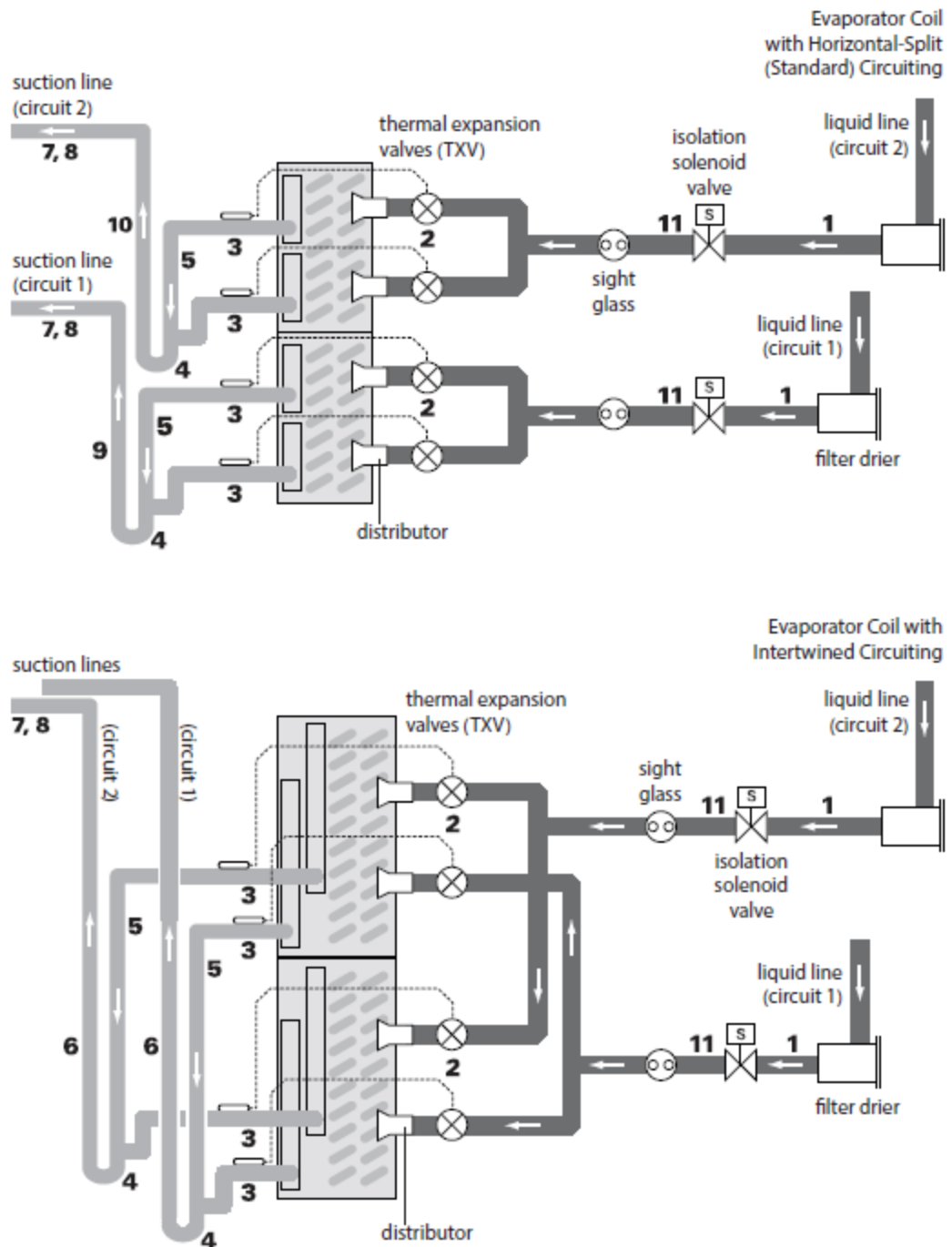
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### Type UF Evaporator Coil with Four Distributors

1. Pitch the liquid line slightly — 1 in. / 10 ft cm / 3 m — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— that is, 1 in./10 ft (1 cm/3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See [“Line Sizing, Routing, and Component Selection,” p. 10.](#)
5. For down flowing risers, use one size smaller than the horizontal tube diameter recommended in the Component selection table, found in [Table 1, p. 31.](#)
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in [Table 1, p. 31.](#) Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft cm / 3 m — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

Figure 10. Type UF evaporator coil with four distributors



## Dual Circuit RAUK Systems

### Type UF Evaporator Coil with Two Distributors

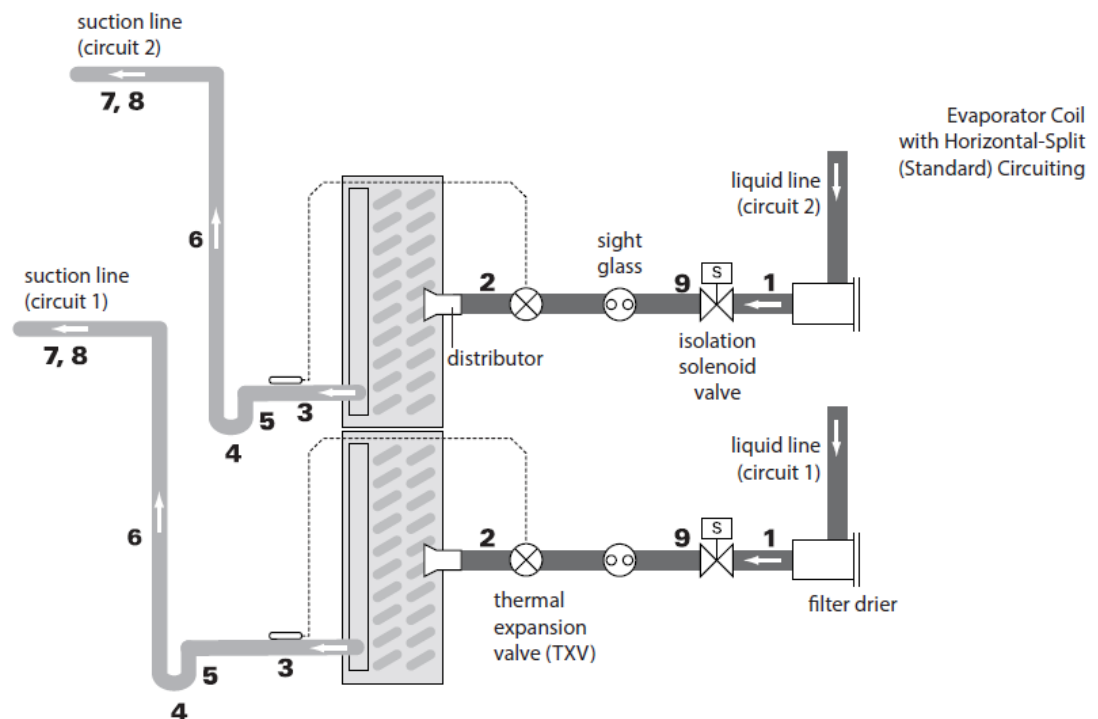
1. Pitch the liquid line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.

## Examples of Field-Installed Evaporator Piping

3. Slightly pitch the outlet line from the suction header toward the suction riser— that is, 1 in./10 ft (1 cm/3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See “Line Sizing, Routing, and Component Selection,” p. 10.
5. For down flowing risers, use one size smaller than the horizontal tube diameter recommended in the Component selection table, found in Table 1, p. 31.
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in Table 1, p. 31. Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

**Figure 11. Type UF evaporator coil with two distributors**



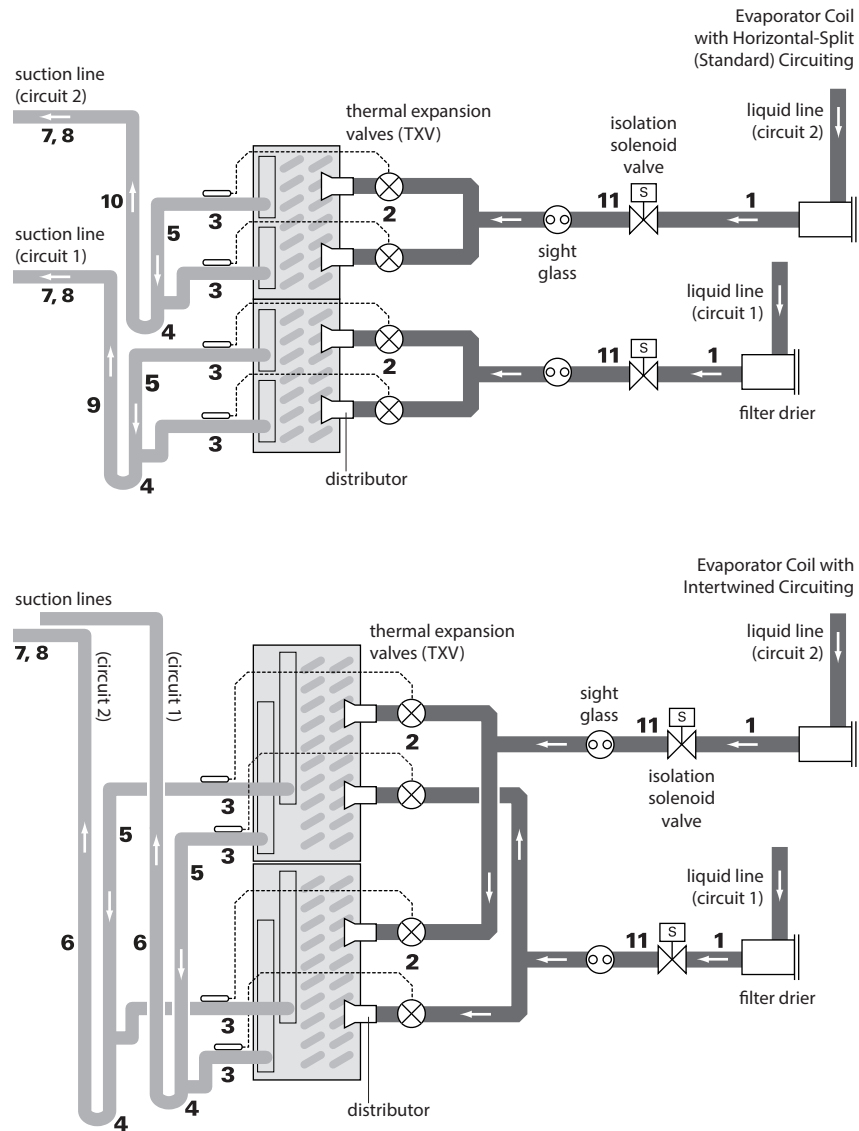


**Type UF Evaporator Coil with Four Distributors**

1. Pitch the liquid line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— that is, 1 in./10 ft (1 cm/3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See “[Line Sizing, Routing, and Component Selection](#),” p. 10.
5. For down flowing risers, use one size smaller than the horizontal tube diameter recommended in the Component selection table, found in [Table 1, p. 31](#).
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in [Table 1, p. 31](#). Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. The top of the Circuit 1 suction riser must be higher than the bottom evaporator coil. Use the tube diameter recommended for a vertical rise in [Table 1, p. 31](#).
10. The top of the Circuit 2 suction riser must be higher than the top evaporator coil. Use the tube diameter recommended for a vertical rise in [Table 1, p. 31](#).
11. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

**Figure 12. Type UF evaporator coil with four distributors**

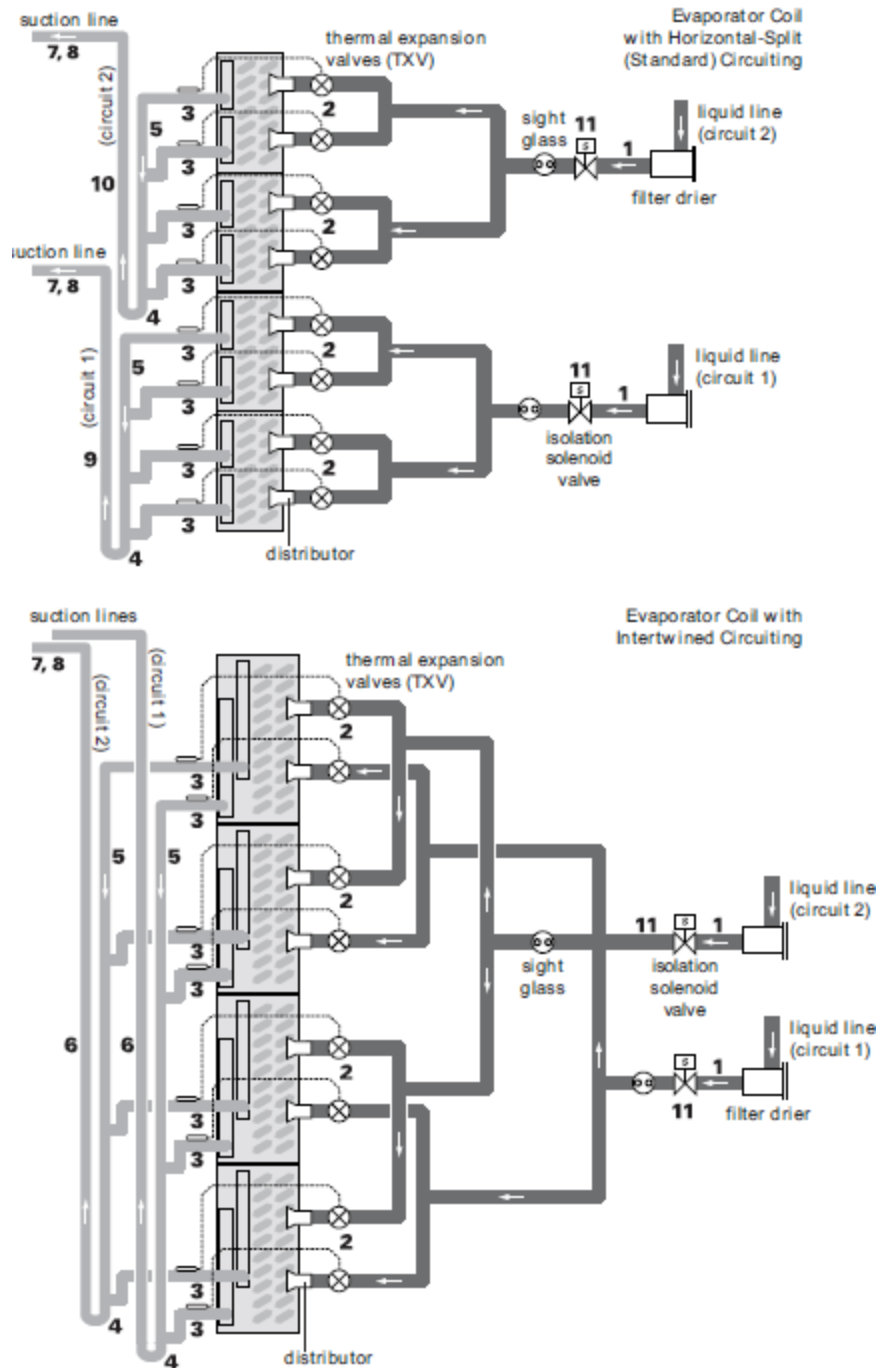


## **Type UF Evaporator Coil with Eight Distributors**

1. Pitch the liquid line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
2. Provide one expansion valve per distributor.
3. Slightly pitch the outlet line from the suction header toward the suction riser— that is, 1 in./10 ft (1 cm/3 m) in the direction of flow. Use the tube diameter that matches the suction-header connection.
4. Use the DETINT to prevent oil and refrigerant migration when the unit is off. The DETINT also serves to isolate the TXV bulb from suction-header conditions. See [“Line Sizing, Routing, and Component Selection,” p. 10.](#)
5. For down flowing risers, use one size smaller than the horizontal tube diameter recommended in the Component selection table, found in [Table 1, p. 31.](#)
6. For vertical risers, use the vertical tube diameter recommended in the Component selection table, found in [Table 1, p. 31.](#) Ensure that the top of the riser is above the evaporator coil.
7. Pitch the suction line slightly — 1 in. / 10 ft cm / 3 m) — so that the refrigerant drains toward the evaporator.
8. Insulate the suction line.
9. The top of the Circuit 1 suction riser must be higher than the bottom evaporator coil. Use the tube diameter recommended for a vertical rise in [Table 1, p. 31.](#)
10. The top of the Circuit 2 suction riser must be higher than the top evaporator coil. Use the tube diameter recommended for a vertical rise in [Table 1, p. 31.](#)
11. Install a single isolation solenoid valve between the liquid-line filter drier and the sight glass.

**Note:** Due to reduced Microchannel condenser volumes, do not use “trim” solenoid valves.

Figure 13. Type UF evaporator coil with eight distributors



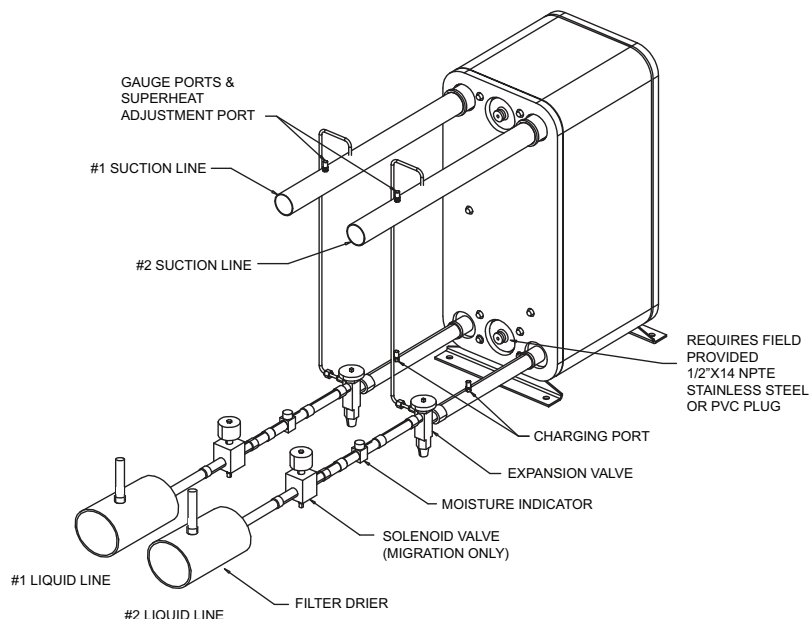
## RAUK With Braze Plate Chilled-Water Heat Exchanger

### TXV for Remote Chiller

Piping between the TXV and chiller, a braze plate heat exchanger (BPHE), must be 8 to 12-inch long and the same size as BPHE inlet ID. Field supplied reducer(s) may be required at TXV. A bleed port valve is not required with brazed plate heat exchanger applications.

**Note:** If necessary, install reducers at the TXV outlet. Do not install reducers at the braze plate evaporator.

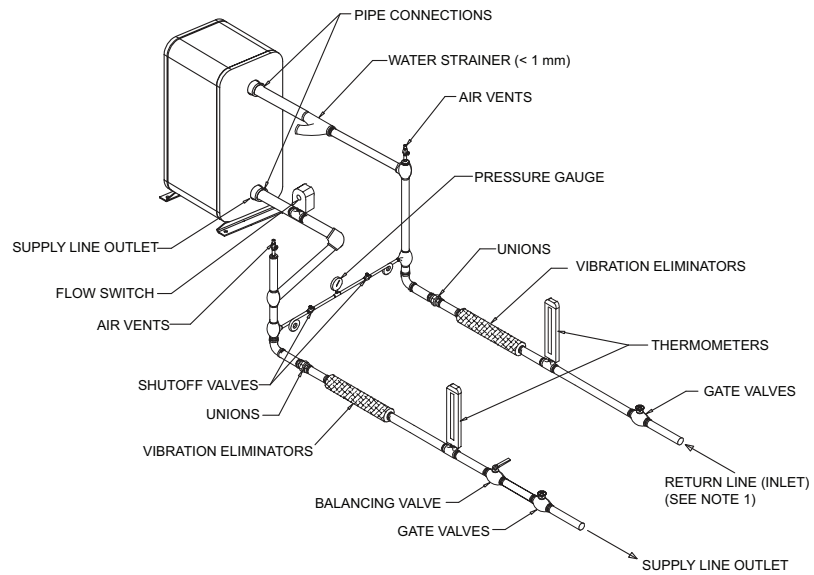
**Figure 14. Evaporator (EVP) chiller, typical refrigerant piping (2 circuit system)**



**Notes:**

- Shutoff valves are required for evaporator servicing.
- Evaporator is shown for illustration purposes only.
- Water inlet and outlet diameter and dimensional locations depends on unit size.
- Water connections at the evaporator are grooved.
- Field supplied 1/2" x 14 NPTE stainless steel or PVC plug required.
- Locate freeze-stat and discharge temperature sensors close to the water outlet.
- Install drain with shutoff valve at low point in leaving piping before system valve.

**Figure 15. EVP chiller, typical water piping**





# Parts

**Table 1. Component selection summary**

UNIT	RAUK20	RAUK25	RAUK30	RAUK40	RAUK50	RAUK60	RAUK80	RAUK100	RAUK120
Refrigerant ckts	1	1	1	2	2	2	2	2	2
Minimum step (tons)	5	5.5	7.5	10	11.7	15	15	15	20
SUCTION LINE									
Tube diameter, horizontal and downflow (in.)	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8
Tube diameter, vertical upflow (in.)	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8
Filter shell 1/ckt	DHY01086	FLR06122	FLR06122	DHY01086	FLR06122	FLR06122	FLR06123	FLR06124	FLR06124
Filter core per shell	ELM03572	ELM03572	ELM03572	ELM03572	ELM03572	ELM03572	ELM03572	ELM03572	ELM03572
Access port 3/ckt(a)	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/core	Schraeder valve w/ core
Frostat™ control	KIT01387	KIT01387	KIT01387	KIT01387	KIT01387	KIT01387	KIT01387	KIT01387	KIT01387
Ball valve 2/ckt (in.)	VAL09077	VAL09078	VAL09078	VAL09077	VAL09078	VAL09078	VAL09078	VAL06647	VAL06647
LIQUID LINE									
Tube diameter (in.)	5/8	7/8	7/8	5/8	7/8	7/8	1 1/8	1 1/8	1 1/8
Filter shell 1/ckt(a)	DHY01263	DHY01263	DHY01263	DHY01263	DHY01263	DHY01263	DHY01151	DHY01151	DHY01151
Filter core per shell	COR00102	COR00102	COR00102	COR00102	COR00102	COR00102	COR00102 (QTY 2)	COR00102 (QTY 2)	COR00102 (QTY 2)
Solenoid valve, coil 1/ ckt(b)	VAL09133 COL01884	VAL09133 COL01884	VAL09100 COL01884	VAL09133 COL01884	VAL09133 COL01884	VAL09100 COL01884	VAL09135 COL01884	VAL09135 COL01884	VAL09485 COL12786
Sight glass 1/ckt	GLS00830	GLS00831	GLS00831	GLS00830	GLS00831	GLS00831	GLS00832	GLS00832	GLS00832
Access port 2/ckt(c)	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/ core	Schraeder valve w/core	Schraeder valve w/ core
Ball valve 2/ckt (in.) <sup>(d)</sup>	VAL07197	VAL07198	VAL07198	VAL07197	VAL07198	VAL07198	VAL07337	VAL07337	VAL07337
	RAUK20	RAUK25	RAUK30	RAUK40	RAUK50	RAUK60	RAUK80	RAUK100	RAUK120

**Note:** Per ASHRAE 90.1 HGBP may not be more than 10 % for units less than 20 tons, and may not be more than 15% for units 20 tons and larger

(a) 7/8" connection size.

(b) For outdoor application, request junction box conduit boss, NEMA 4 watertight.

(c) Valve body VAL01483, valve core COR00006, valve cap CAP00072.

(d) Angle valves may be substituted for liquid line ball valves, 1 1/8 – VAL02336, 5/8 – VAL02475, 7/8 – VAL02575.

**Table 2. Expansion valve selection, 20 to 60 ton MCHE (30% bleed)**

Min Tonnage	Max Tonnage	Manufacturer	Selection <sup>(a)</sup>	Trane Part
2.0	3.0	Sporlan	BBIYE 1.5-CP (BP/30)	VAL21647
2.5	3.5	Sporlan	BBIYE 2.5-CP (BP/30)	VAL21648
3.5	5.0	Sporlan	BBIYE 3-CP (BP/30)	VAL21469
4.5	7.0	Sporlan	BBIYE 4.5-CP (BP/30)	VAL21650
6.0	8.5	Sporlan	BBIYE 6-CP (BP/30)	VAL 21651
7.0	10.0	Sporlan	BBIYE 7-CP (BP/30)	VAL21652
8.0	13.5	Sporlan	BBIYE 8.5-CP (BP/30)	VAL21653
11.0	17.5	Sporlan	BBIYE 11.5-CP (BP/30)	VAL21654

**Table 2. Expansion valve selection, 20 to 60 ton MCHE (30% bleed) (continued)**

Min Tonnage	Max Tonnage	Manufacturer	Selection <sup>(a)</sup>	Trane Part
14.0	21.5	Sporlan	BBIYE 15.5-CP (BP/30)	VAL21655
17.0	28.5	Sporlan	OYE 20-CP (BP/30)	VAL21657
22.0	30.0	Sporlan	OYE 25-CP (BP/30)	VAL21658

<sup>(a)</sup> Valve part numbers with "-ZGA" in place of "-GA", may be used interchangeably.

**Note:** When sizing TXVs, select the TXV where the design tonnage is close to the middle of the device.

**Table 3. Expansion valve selection, 80 to 120 ton MCHE (15% bleed)**

Min Tonnage	Max Tonnage	Manufacturer	Selection <sup>(a)</sup>	Trane Part
2.5	3.0	Sporlan	BBIYE 2.5-CP (BP/15)	VAL21660
3.0	4.5	Sporlan	BBIYE 3-CP (BP/15)	VAL21661
4.0	6.0	Sporlan	BBIYE 4.5-CP (BP/15)	VAL21662
5.0	7.5	Sporlan	BBIYE 6-CP (BP/15)	VAL21663
6.0	9.0	Sporlan	BBIYE 7-CP (BP/15)	VAL21664
7.0	12.0	Sporlan	BBIYE 8.5-CP (BP/15)	VAL21665
9.5	15.5	Sporlan	BBIYE 11.5-CP (BP/15)	VAL21666
12.5	19.0	Sporlan	BBIYE 15.5-CP (BP/15)	VAL21667
15.0	25.0	Sporlan	OYE-20-CP (BP/15)	VAL21669
19.5	30.0	Sporlan	OYE-25-CP (BP/15)	VAL21670
23.5	45.0	Sporlan	OYE-35-CP (BP/15)	VAL21671
35.0	68.0	Sporlan	OYE-55-CP (BP/15)	VAL21672

<sup>(a)</sup> Valve part numbers with "-ZGA" in place of "-GA", may be used interchangeably.

**Note:** When sizing TXVs, select the TXV where the design tonnage is close to the middle of the device.

**Table 4. Expansion valve selection, any BPHE**

Min Tonnage	Max Tonnage	Selection <sup>(a)</sup>	Alternate
13.0	22.0	OYE 20-CP	n/a
17.0	26.0	OYE 25-CP	n/a
20.5	39.0	OYE 35-CP	n/a
30.5	59.0	OYE 55-CP	n/a

<sup>(a)</sup> Valve part numbers with "-ZGA" in place of "-GA", may be used interchangeably.

**Table 5. R-454B lbs charge per 100 ft**

OD	Suction	Liquid	Discharge
1/4	0.04	1.23	0.16
5/16	0.06	2.13	0.28
3/8	0.09	3.30	0.43
1/2	0.18	6.40	0.84
5/8	0.29	9.99	1.31
3/4	0.43	15.00	1.97
7/8	0.57	19.99	2.62
1 1/8	0.98	34.08	4.47
1 3/8	1.49	51.91	6.82
1 5/8	2.11	73.48	9.65
2 1/8	3.67	127.83	16.78
2 5/8	5.65	197.11	25.88

**Note:** Type L or ACR tube. Suction: Saturated at 40°F, Liquid: Saturated at 90°F, Discharge: Saturated at 125°F









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