Application Guide

Tube Size and Component Selection

TTA and TWA Split Systems (6-25 Tons)
R-410A Refrigerant

Model Numbers:

TTA073D	TTA120F	TTA240E	TWA073D
TTA090D	TTA150E	TTA240F	TWA090
TTA120D	TTA180E	TTA300F	TWA120D
TTA120E	TTA180F		TWA180E
			TWA240E

⚠ 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.

July 2012

SS-APG008-EN

Warnings, Cautions and Notices

Warnings, Cautions and Notices. Note that warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in death or personal injury. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

Read this manual thoroughly before operating or servicing this unit.

ATTENTION: Warnings, Cautions and Notices appear at appropriate sections throughout this literature. Read these carefully:

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	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.
NOTICE:	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—including industry replacements for CFCs such as HCFCs and HFCs.

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. The Federal Clean Air Act (Section 608) sets forth the requirements for the 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!

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

⚠WARNING

Personal Protective Equipment (PPE) Required!

Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.

- **Before installing/servicing this unit, technicians MUST put on all Personal Protective Equipment (PPE) recommended for the work being undertaken. ALWAYS refer to appropriate MSDS sheets and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS sheets and OSHA guidelines for information on allowable personal exposure levels, proper respiratory protection and handling recommendations.**
- **If there is a risk of arc or flash, technicians MUST put on all Personal Protective Equipment (PPE) in accordance with NFPA 70E or other country-specific requirements for arc flash protection, PRIOR to servicing the unit.**

Failure to follow recommendations could result in death or serious injury.

⚠WARNING

R-410A Refrigerant under Higher Pressure than R-22!

The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22 refrigerant. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.
Failure to use R-410A rated service equipment or components could result in equipment exploding under R-410A high pressures which could result in death, serious injury, or equipment damage.

Trademarks

Table of Contents

Overview

Trane's TTA and TWA 6- through 25-ton condensing unit product line (specific model numbers are listed on the cover) has been designed for use only with R-410A and POE oil. R-410A 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.

These piping practices are the same for R-410A and POE oil. However, because of the different mass flows and pressures, the line diameter required to carry the oil and refrigerant may not be the same as a similar tonnage R-22 unit. Also, the allowable pressure drop may be greater for R-410A than R-22.

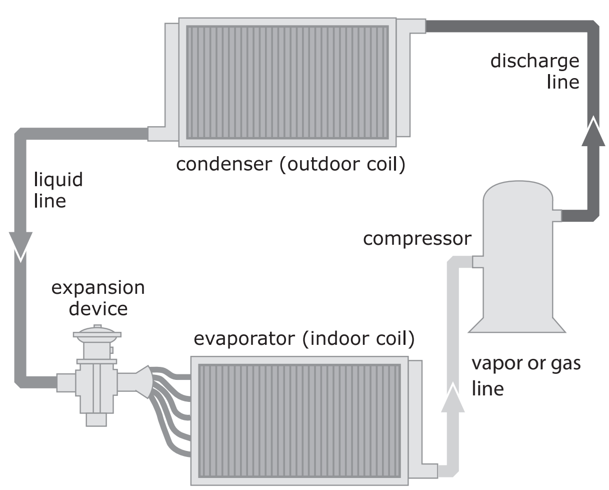
Evidence accumulated over years of observation demonstrates that the lower the refrigerant charge, the more reliably a split air-conditioning system performs. *Any* amount of refrigerant in excess of the minimum design charge becomes difficult to manage. The excess refrigerant tends to collect in areas 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 (Figure 1). 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. Since our objective is also to minimize the refrigerant charge to make the most reliable systems, we increased the allowable liquid pressure drop to 35 psid (R-22), which allows for the selection of a smaller liquid line while still maintaining refrigeration operation. With R-410A 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-410A is a high-pressure refrigerant and allows higher-pressure drops in the suction lines. With R-22, a 2°F loss in the suction line means a pressure drop of 3 psi. With R-410A refrigerant, that same 2°F loss is a 5 psi drop. Additional pressure drop may be tolerated in certain applications.

R-410A refrigerant suction lines must be sized to maintain oil-entrainment velocities in both the horizontal lines and vertical risers. Oil entrainment for R-410A is based on suction temperature as well as tube diameter. At the time of this writing, no known direct oil-entrainment tests have been published. Trane has used ASHRAE data to create equation-based formulas to predict the entrainment velocities of R-410A refrigerant and POE oil. These minimum velocities are reflected in the line sizes listed in the component selection summary tables (Table 2, p. 21, and Table 3, p. 22).

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 do not require Trane review, but only a limited amount may be in a riser (see Figure 2, Figure 3, and Figure 4).

Overview

Figure 2. Allowable elevation difference: Cooling-only TTA above indoor unit

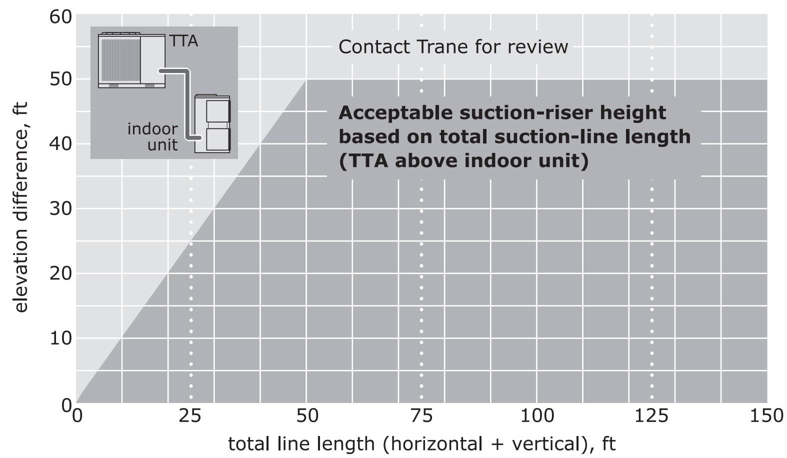


Figure 3. Allowable elevation difference: TWA heat pump above indoor unit

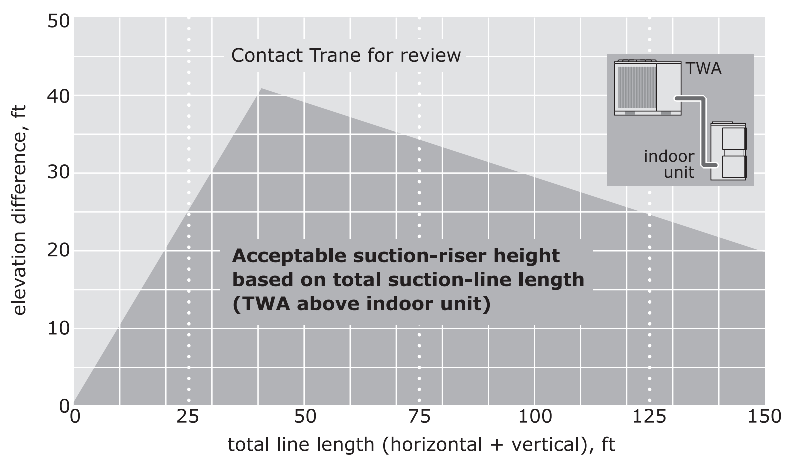
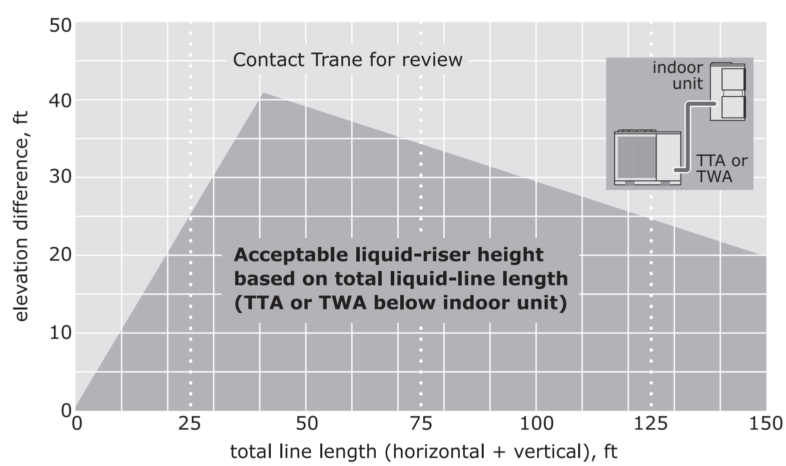


Figure 4. Allowable elevation difference: TTA or TWA below indoor unit



Line Sizing, Routing, and Component Selection

"Refrigerant Piping Examples," p. 14, provides illustrations of TTA/TWA split system component arrangement. Use them to determine the proper, relative sequence of the components in the refrigerant lines that connect the TTA/TWA outdoor unit to an evaporator coil. The TTA/TWA units are R-410A machines and all the selected components installed in the field must also be rated for use with R-410A.

Liquid Lines

Line Sizing

Properly sizing the liquid line is critical to a reliable split system application. Table 2, p. 21, and Table 3, p. 22, show the recommended liquid-line sizing for each TTA/TWA 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 TTA/TWA installation literature charging charts were generated (see IOM). 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.

A height limitation exists for liquid lines that include a liquid riser because of the loss of subcooling that accompanies the pressure loss in the height of the liquid column. Figure 3 and Figure 4, p. 4, depict the permissible rise in the liquid line (without excessive loss of subcooling). Again, system designs outside the application envelope of the TTA/TWA unit require Trane review.

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, moisture-indicating sight glass, and expansion valve(s). The examples in "Refrigerant Piping Examples," p. 14, illustrate the proper sequence for positioning the components in the liquid line. Position the components as close to the indoor unit as possible. Table 2, p. 21, and Table 3, p. 22, identify suitable components, by part number, of each TTA/TWA model. Note there are two access ports: one located at the TTA/TWA and one located at the evaporator. Table 4, p. 23, 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. The TTA/TWA outdoor units have a **filter drier pre-installed**. However, if the refrigerant line length exceeds 80 ft, this filter should be removed and a new one selected from Table 2 or Table 3 should be installed close to the indoor unit. If choosing a filter other than the one listed in Table 2 or Table 3, make sure its volume, filtering, and moisture-absorbing characteristics are equivalent.

Note that TWA units will require two liquid filters and two check valves due to the reverse flow nature of a heat pump (see Figure 8 and Figure 9, p. 16).

Access Port

The access port located at the TTA/TWA 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 TTA split systems, solenoid valves may be used to isolate the refrigerant from the evaporator during the off cycles. This is only done when the indoor unit is well below the outdoor unit. The solenoid valve on the TTA unit is a drop solenoid—open when the compressor is on, and off when the compressor is off. If used, the solenoid requires code compliant wiring to the TTA condensing unit. (The solenoid is not shown on the unit wiring diagram.)

Note: *Solenoids should not be used in the TWA heat pumps due to the reverse flow of the liquid.*

Note: *Solenoids are seldom used and not included in* *Table 2, p. 21**.*

⚠WARNING

Risk of Explosion with Refrigerant Line!

Liquid refrigerant trapped between two valves can become highly pressurized if the ambient temperature increases. DO NOT add a liquid line solenoid valve in a cooling-only system that is already equipped with a check valve. Failure to follow this recommendation could result in a refrigerant line exploding under pressure which could result in death or serious injury.

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 sightglass—to determine proper charge levels.*

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. Table 4, p. 23, identifies the part number of the valve recommended for TTA/TWA systems. The tonnage of the valve should represent the tonnage of the portion of coil that the TXV/distributor will feed.

Some expansion valve models have built-in check valves for heat pump operation and do not require additional external check valves for reverse flow operation. These valves are identified in Table 4, p. 23.

The expansion valve and heat pump check valve are inclusive when the indoor unit is a TWE.

Check Valves

Due to the reverse cycle of the TWA heat pump, a check valve is required to bypass refrigerant around the TXV while the unit is in heating mode. If the air handler is a TWE, it includes both the TXV and check valve.

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 2 and Table 3 are independent of total line length for properly charged 6- through 25-ton TTA/TWA 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 ¼ to 1 inch per 10 feet of run (1 cm per 3 m) toward the indoor coil.

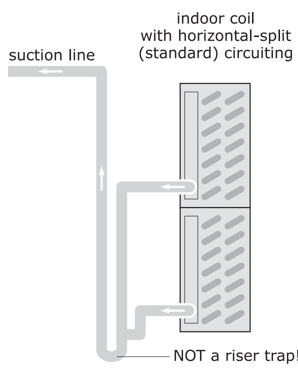
Do not install riser traps. With field-supplied air-handler coils, what appears to be a riser trap is located at the coil outlet; see Figure 5 for an example. This piping arrangement, which isn't a riser trap, is the result of two requirements:

- Drain the coil to the common low point.
- Rise at least 1 ft (30 cm) from the common low point to prevent any off-cycle condensed refrigerant in the coil from attempting to flow to the compressor.

Double risers must not be installed. All 6- through 25-ton TTA and TWA units unload such that a single gas line size, preselected in Table 2, p. 21, or Table 3, p. 22, provide sufficient velocity to push entrained 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.*

Figure 5. Gas-line arrangement at the outlet of a field-supplied indoor coil



Avoid Underground Refrigerant Lines

Refrigerant condensation during the off cycle, installation debris inside the line (including condensed ambient moisture), service access, and abrasion/corrosion can quickly impair reliability.

Insulation

Any heat that transfers from the surrounding air to the cooler gas 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 the gas lines to prevent heat gain and unwanted condensation.

Components

Adding a gas line filter is unnecessary—provided that good refrigerant practices (including nitrogen sweeping during brazing and proper system evacuation) are followed.

Access Port

Providing an access port in the gas line permits the servicer to check refrigerant pressure and determine superheat at the evaporator/indoor coil. This port is usually a Schraeder valve with a core.

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, the system won't make capacity and there may not be enough cooling for the compressor.

Note: Expansion valves are pre-installed on the TWE product and the superheat has been set properly.

Table 4, p. 23, lists 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 1: 10-ton coil (one refrigerant circuit) with two equal distributors

10 / 2 = 5

Each TXV should be selected for 5 tons.

Example 2: 10-ton coil (one refrigerant circuit) with two distributors and a 60/40 coil split

10 x .6 = 6 and 10 x .4 = 4

One TXV should be sized for 6 tons, and one TXV should be sized for 4 tons.

If the coil or distributors have a difference of only one circuit tube, the difference should be ignored.

The proper balance for feeding refrigerant for a TTA/TWA system is to provide 18°F of superheat—the difference between the saturated and actual refrigerant temperature leaving the evaporator. Expansion valve superheat is preset from the factory, but it isn't set to 18°F. Use the turns listed in Table 1 to adjust them to the correct 18°F superheat.

Table 1. Expansion valves

Sporlan					
Standard off-the-shelf nominal valve settings (90 PSIG air test setting)					Field adjust for 18°F
Valve	Superheat, °F	CW turns available	CCW turns available	Superheat change per turn	
ERZE or RCZE	12	4.5	4.5	2.4°F	2 1/2 CW
OZE				3.4°F	1 3/4 CW

Controls

The TTA/TWA unit is available with either ReliaTel™ or thermostat control. It is important to understand that if the staging of compressors is turned over to a third party, the compressor protection, provided through system stability, is also turned over to the third party. Simply stated, this means that when a compressor turns on, it shouldn't turn off until the expansion valve comes under control. And, once the compressor turns off, it should be allowed to stay off until the crank case heater has warmed up.

System stability must be programmed in the third party system control. To accomplish this, the system controls must incorporate a **5-minute-on**, a **5-minute-off,** and a **5-minute-interstage** differential on each compressor stage.

Hot Gas Bypass

Many years ago, hot gas bypass (HGBP) was successfully added to HVAC systems to correct a number of operational problems. Hoping to avoid such problems altogether, it eventually became common practice for designers to specify hot gas bypass in systems. Unfortunately, the practice often degraded rather than improved reliability.

Hot gas bypass increases the minimum refrigerant charge; it also inflates the first cost of the system. Besides adding more paths for potential refrigerant leaks, hot gas bypass increases the likelihood of refrigerant distribution problems. Finally, hot gas bypass uses excessive amounts of energy by preventing the compressors from cycling with fluctuating loads.

Trane now has several years of successful experience with Evaporator Defrost Control (EDC). Like hot gas bypass, the EDC system protects the coil from freezing, but it does so by turning off compressors when a sensor detects the formation of frost on the evaporator coil. The compressor is released to operate when the coil temperature rises a few degrees above the frost threshold. The EDC control strategy may reduce the overall energy consumption of the system while maintaining system control.

Systems should be designed to avoid HGBP whenever possible.

For more information, refer to the *Engineers Newsletter*, “Hot Gas Bypass – Blessing or a Curse?” (ADM-APM007-EN).

Remodel, Retrofit, or Replacement

Inevitably, older condensing unit/evaporator systems that are designed for use with a refrigerant other than R-410A will need to be upgraded. Due to the phase-out of many of these older refrigerants, the major components for those older condensing unit/evaporator systems may no longer be available. The only option will be to convert the system to R-410A, POE oil, and R-410A components.

When upgrading an existing refrigerant split system due to remodel, retrofit, or replacement, the entire system must be reviewed for compatibility with R-410A and POE oil. Each and every part of the split HVAC system MUST be compatible with the properties of R-410A refrigerant and POE oil. In addition, ensure the existing electrical service and protection are correct for the product being installed.

⚠WARNING

R-410A Refrigerant under Higher Pressure than R-22!

The units described in this manual use R-410A refrigerant which operates at higher pressures than R-22 refrigerant. Use ONLY R-410A rated service equipment or components with these units. For specific handling concerns with R-410A, please contact your local Trane representative.
Failure to use R-410A rated service equipment or components could result in equipment exploding under R-410A high pressures which could result in death, serious injury, or equipment damage.

Every part of an existing split system needs to be analyzed to determine if it can be reused in an R-410A and POE oil system:

- R-22 condensing units will not work with R-410A.
- Most older evaporator coils were not pressure and cycle rated for R-410A pressures. If they weren't, they will need to be replaced. Check with the manufacturer.
- Suction lines 2-5/8 OD and smaller of type L copper are suitable for use with R-410A. 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-410A. These same lines sized at 1-5/8 OD or 2-1/8 OD must use type K or thicker wall.
- R-410A refrigerant line sizes may be different than the existing line sizes. The lines need to be re-sized and compared to existing lines for reusability.
- Expansion valves need to be reselected. Expansion valves are refrigerant specific.
- Any gasket or o-ring should be replaced. Shrinkage of the original seal may occur after an HFC conversion, potentially causing a refrigerant leak. Components commonly affected are Schraeder cores, solenoid valves, ball valves, and flange seals. But *all* external seals in contact with refrigerant should be viewed as potential leak sources after a retrofit.
- All other valves, filters, valve packing, pressure controls, and refrigeration accessories must be researched through their manufacturer for compatibility with the pressures of an R-410A system, and for their compatibility with the newer POE oil.
- For the best performance and operation, the original mineral oil should be removed from the components of the system that are not being replaced. Any component of the system that is suspected of trapping oil (piping, traps, and coil), should be dismantled, drained, and reassembled. After all components have been drained, the amount of residual mineral oil will have a negligible effect on performance and reliability.

NOTICE:

Compressor Damage!

POE oil is hygroscopic – it absorbs water directly from the air. This water is nearly impossible to remove from the compressor oil and can cause compressor failures. For this reason, the system should not be open for longer than necessary, dry nitrogen should flow in the system while brazing, and only new containers of oil should be used for service and maintenance.

All Codes take precedence over anything written here.

Refrigerant Piping Examples

Figure 6. TTA cooling-only unit and TWE air handler

Installation notes:

1. If the total length of the liquid line exceeds 80 ft (24 m), remove the liquid-line filter drier from the TTA and install a new one (Table 2, p. 21) at the TWE air handler.

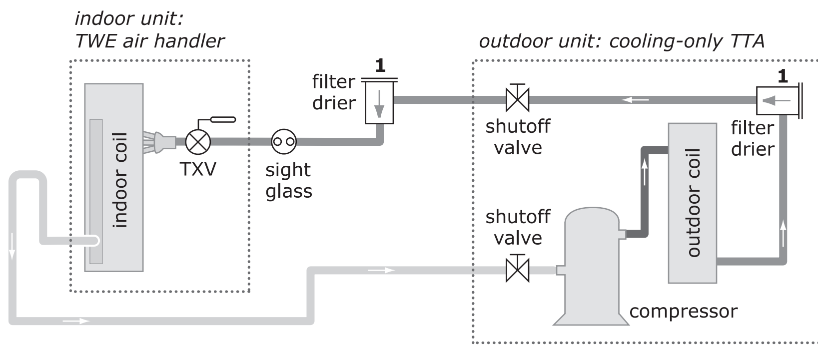


Figure 7. TTA cooling-only unit and matched indoor coil (typical arrangement)

1. If the total length of the liquid line exceeds 80 ft (24 m), remove the liquid-line filter drier from the TTA and install a new one (Table 2, p. 21) near the indoor coil.
2. Provide one expansion valve (TXV) per distributor; see Table 4, p. 23, for recommendations.

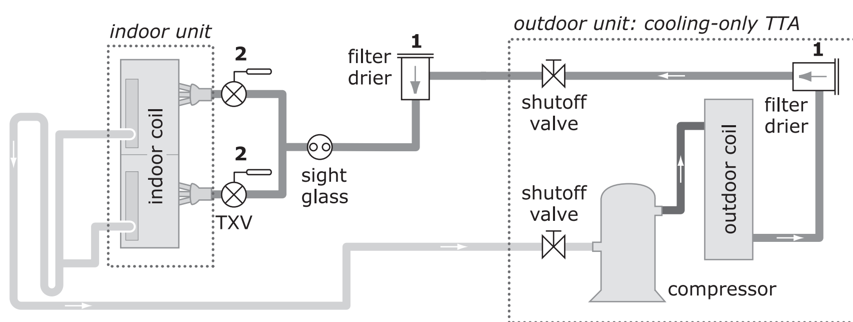


Figure 8. TWA heat pump and TWE air handler (typical arrangement shown in cooling mode)

1 For applications where the length of the liquid line exceeds 80 ft (24 m) *and the heat pump will start in the cooling mode,* remove the liquid-line filter driers from the TWA heat pump and install new filter driers and check valves at the TWE air handler.

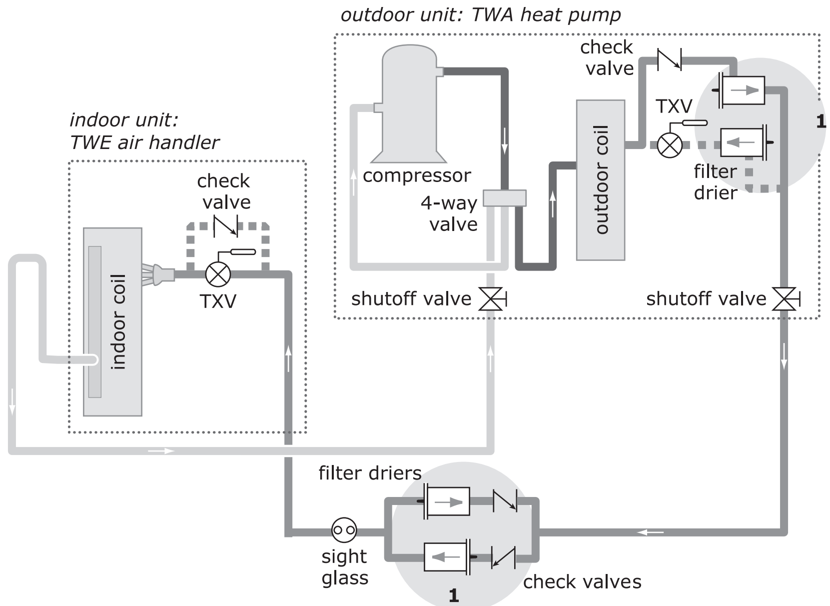


Figure 9. TWA heat pump and matched indoor coil (typical arrangement shown in cooling mode)

1 Each coil distributor requires one thermal expansion valve (TXV) and one check valve. See Table 3, p. 22, and Table 4, p. 23, for recommendations.

2 For applications where the length of the liquid line exceeds 80 ft (24 m) *and the heat pump will start in the cooling mode,* remove the liquid-line filter driers from the TWA heat pump and install new filter driers and check valves (Table 3) at the indoor unit.

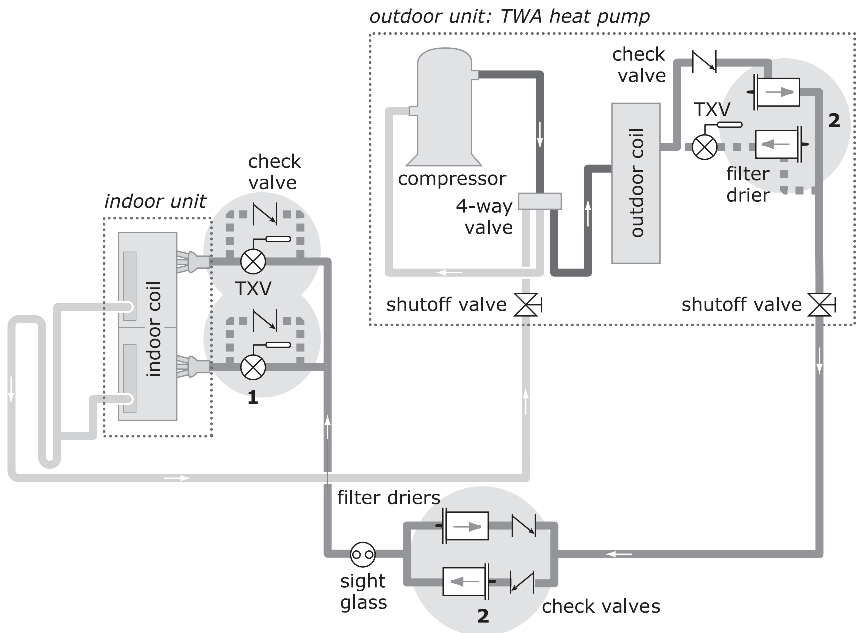


Figure 10. Indoor coil (non-TWE) with one distributor (single-circuit TTA/TWA units)

1 Pitch the liquid line 1 inch per 10 feet (1 cm per 3 m) so that the liquid refrigerant drains toward the indoor coil. Use the liquid-line size recommended in Table 2, p. 21 or Table 3, p. 22.

2 Provide one expansion valve (TXV) per distributor.

TWA heat pumps only: Provide one check valve for each expansion valve.

3 Pitch the gas line leaving the coil so that it slopes *away* from the coil by 1 inch per 10 feet (1 cm per 3 m).

4 For vertical risers, use the tube diameter recommended in Table 2 or Table 3. Ensure that the top of the riser is at least 1 foot (30 cm) above the lowest point.

5 Pitch the gas line 1 inch per 10 feet (1 cm per 3 m) *toward* the indoor coil.

6 Insulate the gas line.

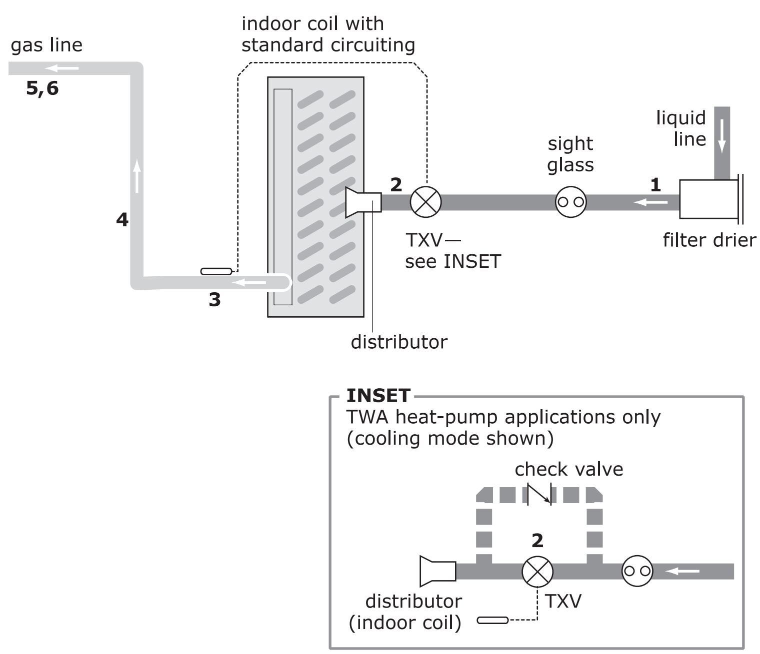


Figure 11. Indoor coil with two distributors (single-circuit TTA/TWA units)

1 Pitch the liquid line 1 inch per 10 feet (1 cm per 3 m) so that the liquid refrigerant drains toward the indoor coil. Use the liquid-line size recommended in Table 2, p. 21, or Table 3, p. 22.

2 Provide one expansion valve (TXV) per distributor.

TWA heat pumps only: Provide one check valve for each expansion valve.

3 Pitch the gas line leaving the coil so that it slopes *away* from the coil by 1 inch per 10 feet (1 cm per 3 m).

4 Arrange the gas line so that suction gas leaving the coil flows downward, *past the lowest gas-header outlet,* before turning upward. Use a double-elbow configuration on all lower branch circuits to isolate the TXV bulb from suction-header conditions. See "Gas Line: Routing," p. 7.

5 For all coil branch circuits in the gas line, use a tube diameter that is one size smaller than the gas-line size recommended in Table 2 or Table 3.

6 For vertical risers, use the tube diameter recommended in Table 2 or Table 3. Ensure that the top of the riser is at least 1 foot (30 cm) above the lowest point.

7 Pitch the gas line by 1 inch per 10 feet (1 cm per 3 m) *toward* the indoor coil.

8 Insulate the gas line.

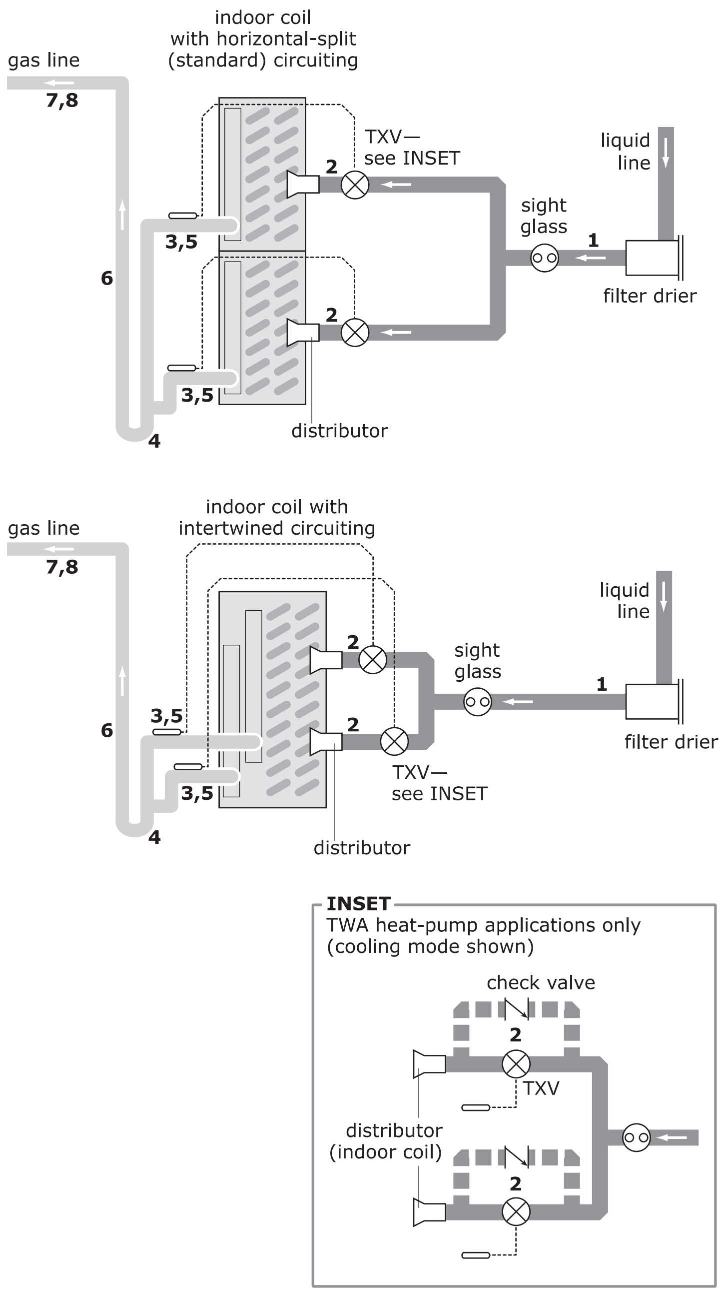


Figure 12. Indoor coil with two distributors (dual-circuit TTA/TWA units)

1 Pitch the liquid line 1 inch per 10 feet (1 cm per 3 m) so that the liquid refrigerant drains toward the indoor coil. Use the liquid-line size recommended in Table 2, p. 21, or Table 3, p. 22.

2 Provide one expansion valve (TXV) per distributor.

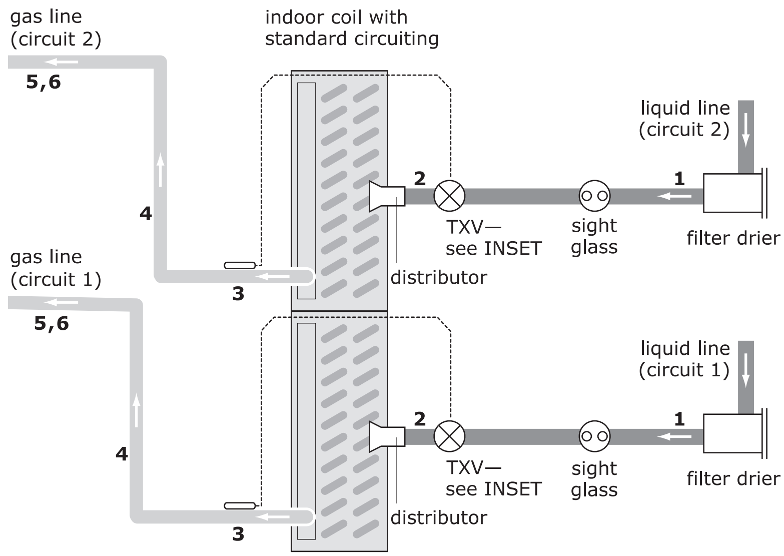
TWA heat pumps only: Provide one check valve for each expansion valve.

3 Pitch the gas line leaving the coil so that it slopes *away* from the coil by 1 inch per 10 feet (1 cm per 3 m).

4 For vertical risers, use the tube diameter recommended in Table 2 or Table 3. Ensure that the top of the riser is at least 1 foot (30 cm) above the lowest point.

5 Pitch the gas line 1 inch per 10 feet (1 cm per 3 m) *toward* the indoor coil.

6 Insulate the gas line.



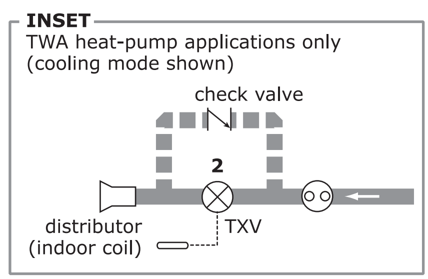


Figure 13. Type UF evaporator coil with four distributors

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. This looks like a trap, but is actually due to the requirement that the refrigerant gas leaving the coil flows downward, *past the lowest suction-header outlet,* before turning upward. Use a double-elbow configuration to isolate the TXV bulb from other suction headers.
5. Use the "horizontal" tube diameter identified in Table 2, p. 21.
6. Use the tube diameter recommended for a vertical rise in Table 2. Ensure that the top of the riser is higher than 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.

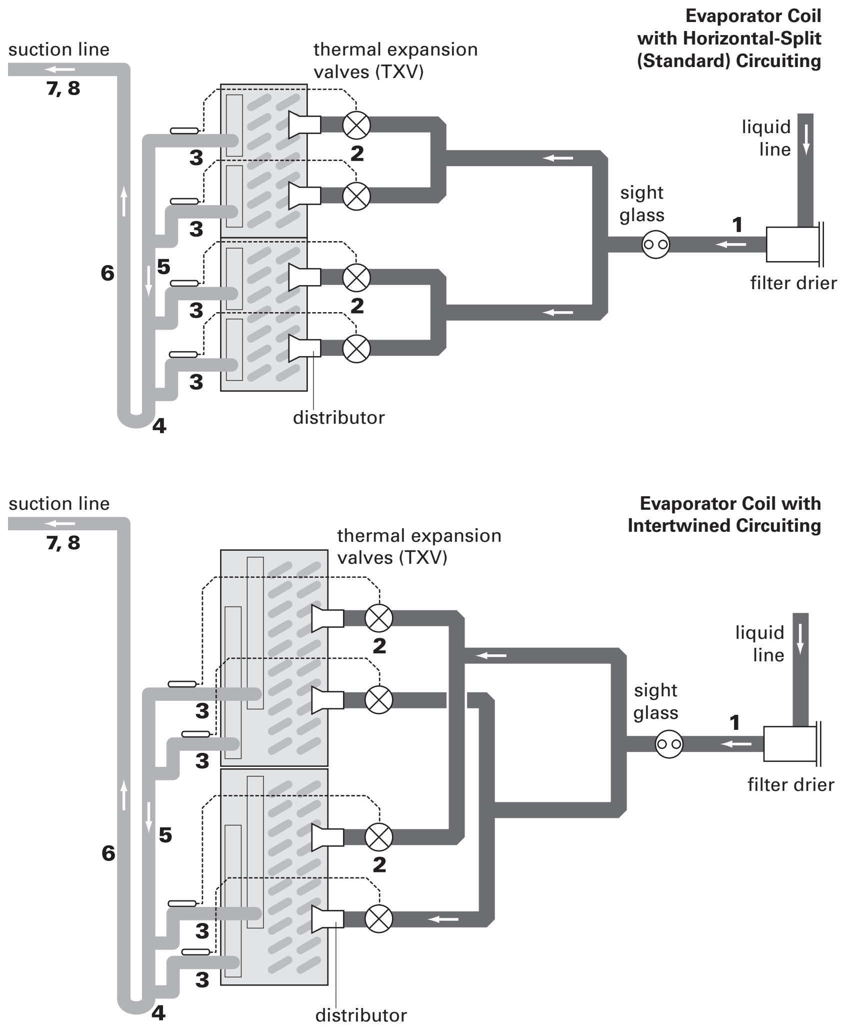


Figure 14. Indoor coil with four distributors (dual-circuit TTA/TWA units)

1 Pitch the liquid line 1 inch per 10 feet (1 cm per 3 m) so that the liquid refrigerant drains toward the indoor coil. Use the liquid-line size recommended in Table 2, p. 21 or Table 3, p. 22.

2 Provide one expansion valve (TXV) per distributor.

TWA heat pumps only: Provide one check valve for each expansion valve (see inset).

3 Pitch the gas line leaving the coil so that it slopes *away* from the coil by 1 inch per 10 feet (1 cm per 3 m).

4 Arrange the gas line so that suction gas leaving the coil flows downward, *past the lowest gas-header outlet,* before turning upward. Use a double-elbow configuration on all lower branch circuits to isolate the TXV bulb from suction-header conditions. See "Gas Line: Routing," p. 7

5 For all coil branch circuits in the gas line, use a tube diameter that is one size smaller than the gas-line size recommended in Table 2 or Table 3.

6 For vertical risers, use the tube diameter recommended in Table 2 or Table 3. Ensure that the top of the riser is at least 1 foot (30 cm) above the lowest point.

7 Pitch the gas line by 1 inch per 10 feet (1 cm per 3 m) *toward* the indoor coil.

8 Insulate the gas line.

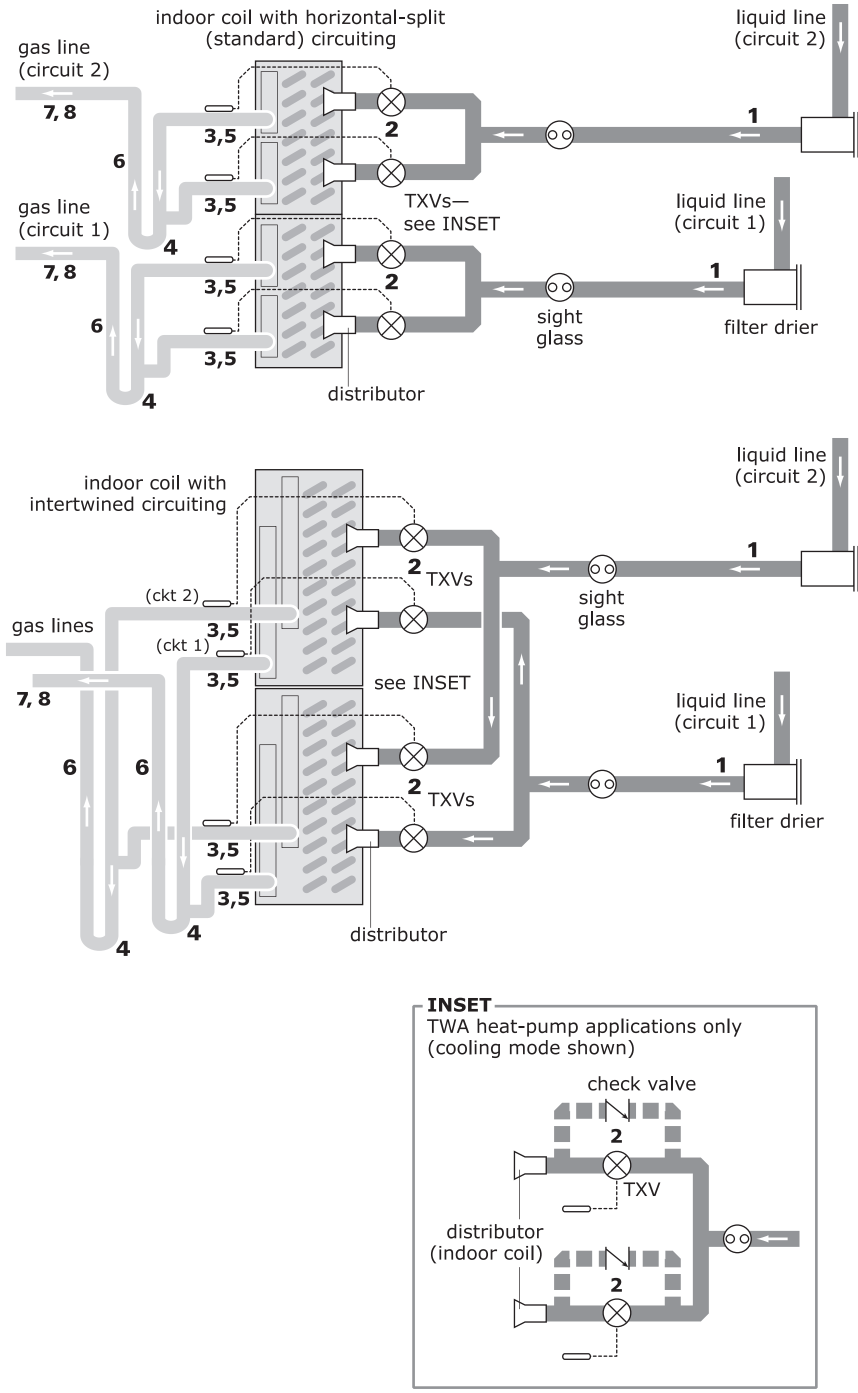


Table 2. TTA component selection summary

UNIT	TTA073D	TTA090D	TTA120D	TTA120E	TTA120F	TTA150E	TTA180E	TTA180F	TTA240E	TTA240F	TTA300F
Refrigerant ckts	1	1	1	2	1 (Manifold)	2	2	1 (Manifold)	2	1 (Manifold)	1 (Manifold)
Minimum step (tons)	6	7.5	10	5	5	6.25	7.5	7.5	10	10	15
GAS LINE					**GAS LINE**						
Tube diameter (in.)											
Horizontal (& drops)	**1 1/8**	**1 3/8**	**1 3/8**	**1 1/8**	**1 3/8**	**1 1/8**	**1 3/8**	**1 5/8**	**1 3/8**	**1 5/8**	**2 1/8**
Vertical (up)	**1 1/8**	**1 3/8**	**1 3/8**	**1 1/8**	**1 1/8**	**1 1/8**	**1 3/8**	**1 3/8**	**1 3/8**	**1 5/8**	**1 5/8**
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	Schraeder valve w/core	Schraeder valve w/core
LIQUID LINE					**LIQUID LINE**						
Tube diameter (in.)	**1/2**	**1/2**	**1/2**	**1/2**	**1/2**	**1/2**	**1/2**	**5/8**	**1/2**	**5/8**	**3/4**
Filter drier[b]	DHY01123	DHY01232	DHY01123	DHY01123	DHY01123	DHY01123	DHY01123	DHY01131	DHY01123	DHY01132	DHY01501
Sight glass 1/ckt	GLS00853	GLS00830	GLS00853	GLS00853	GLS00853	GLS00853	GLS00853	GLS00830	GLS00853	GLS00830	GLS00830
Access port 2/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	Schraeder valve w/core	Schraeder valve w/core

Check valve selections (see "Check Valves," p. 6)

3/8 - VAL08459
1/2 - VAL08460
5/8 - VAL01722

(a) Valve body VAL01483, valve core COR00006, valve cap CAP00072
(b) For units with line lengths in excess of 80 ft, the included filter must be removed and a filter from the table must be installed close to the air handler. See "Liquid Filter Drier," p. 5.

Table 3. TWA component selection summary

UNIT	TWA073D	TWA090D	TWA120D	TWA180E	TWA240E
Refrigerant ckts	1	1	1	2	2
Minimum step (tons)	6	7.5	10	7.5	10
GAS LINE					
Tube diameter (in.)					
Horizontal (& drops)	**1 1/8**	**1 3/8**	**1 3/8**	**1 3/8**	**1 3/8**
Vertical (up)	**1 1/8**	**1 3/8**	**1 3/8**	**1 3/8**	**1 3/8**
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
LIQUID LINE					
Tube diameter (in.)	**1/2**	**5/8**	**1/2**	**1/2**	**5/8**
Filter drier[(b)]	DHY01123 (QTY 2)	DHY01232 (QTY 2)	DHY01123 (QTY 2)	DHY01123 (QTY 2)	DHY01232 (QTY 2)
Sight glass 1/ckt	GLS00853	GLS00830	GLS00853	GLS00853	GLS00853
Access port 2/ckt[(a)]	Schraeder valve w/core	Schraeder valve w/core	Schraeder valve w/core	Schraeder valve w/core	Schraeder valve w/core

Check valve selections (see "Check Valves," p. 6)

3/8 - VAL08459
1/2 - VAL08460
5/8 - VAL01722

(a) Valve body VAL01483, valve core COR00006, valve cap CAP00072
(b) The heat pump products require two filters and two check valves: one set-oriented for liquid in the cooling direction, and one set-oriented for liquid in the heating direction. For units with line lengths in excess of 80 ft, the included filters must be removed and filters from the table must be installed close to the air handler. See "Liquid Filter Drier," p. 5.

Table 4. Expansion valves for TTA/TWA 6- through 25-ton applications[a]

Refrigerant	Manufacturer	Tonnage Range	Model Number	Trane Part	Model Number w/Check Valve	Trane Part
R-410A	Sporlan	2-3	ERZE-2-ZGA	VAL09476	RCZE-2.0-ZGA	VAL08085
R-410A	Sporlan	3-4	ERZE-3-ZGA	VAL09477	RCZE-3.0-ZGA	VAL08086
R-410A	Sporlan	4-5	ERZE-4-ZGA	VAL09478	RCZE-4.0-ZGA	VAL08087
R-410A	Sporlan	5-6	ERZE-5-ZGA	VAL09479	RCZE-5.0-ZGA	VAL08088
R-410A	Sporlan	6-8	ERZE-6-ZGA	VAL09480	RCZE-6.0-ZGA	VAL08089
R-410A	Sporlan	8-11	ERZE-8-ZGA	VAL09481	-----------------	-----------------
R-410A	Sporlan	11-14	ERZE-12-1/2-ZGA	VAL09482	-----------------	-----------------
R-410A	Sporlan	14-17	ERZE-15-ZGA	VAL09483	-----------------	-----------------
R-410A	Sporlan	17-23	OZE-20-ZGA	VAL09585	-----------------	-----------------
R-410A	Sporlan	23-28	OZE-25-ZGA	VAL09583	-----------------	-----------------

(a) See "Expansion Valves," p. 9.

Table 5. R-410A charge per 100 ft[a]

OD	Suction	Liquid	Discharge
1/4	0.04	1.25	0.18
5/16	0.07	2.15	0.31
3/8	0.12	3.45	0.51
1/2	0.22	6.43	0.94
5/8	0.36	10.33	1.51
3/4	0.53	15.42	2.26
7/8	0.74	21.42	3.14
1 1/8	1.26	36.52	5.36
1 3/8	1.93	55.63	8.16
1 5/8	2.73	78.74	11.55
2 1/8	4.74	136.97	20.08
2 5/8	7.32	211.22	30.97

(a) Type L or ACR tube
Suction: Saturated at 40°F
Liquid: Saturated at 90°F
Discharge: Saturated at 125°F

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