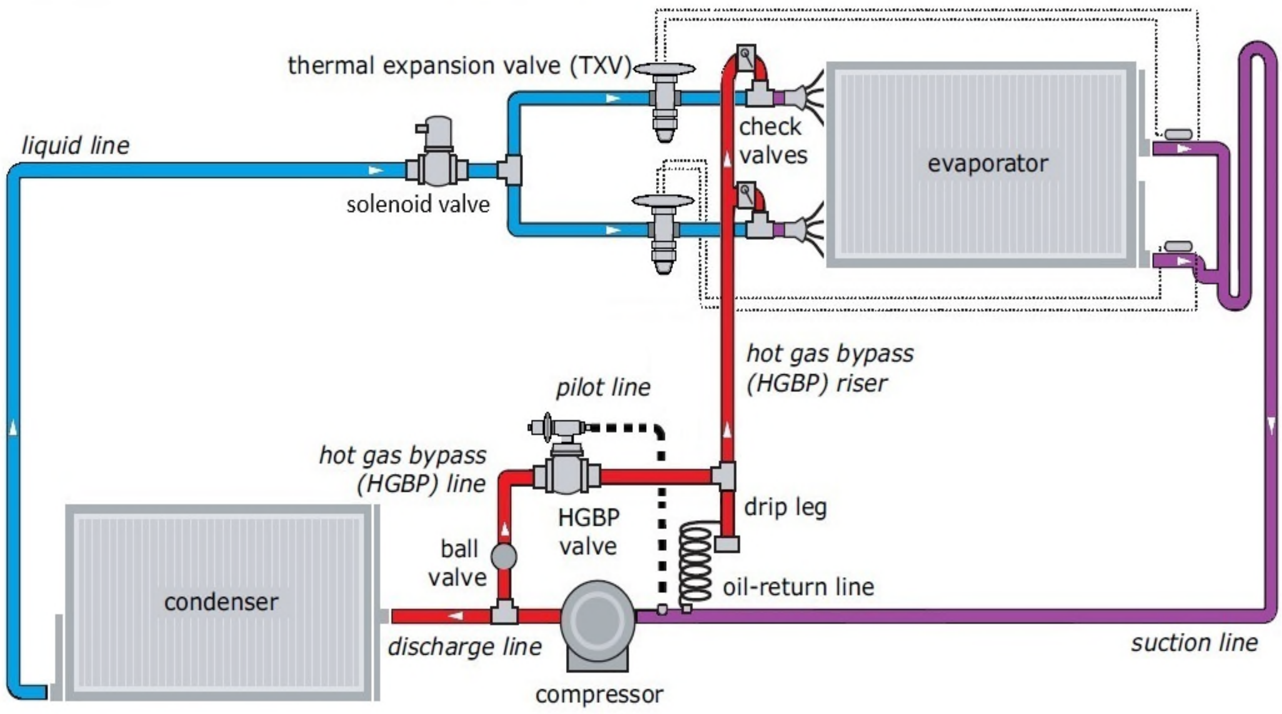
Application Guide

Hot Gas Bypass Installation Guidelines for R-454B Direct Expansion (DX) Split Systems



⚠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.

December 2025

APP-APG017F-EN

Preface

As a leading HVAC manufacturer, we deem it our responsibility to serve the building industry by regularly disseminating information that promotes the effective application of building comfort systems. For that reason, we regularly publish educational materials, such as this one, to share information gathered from laboratory research, testing programs, and practical experience.

This publication focuses on hot gas bypass guidelines for direct expansion (DX) split systems that use R-454B. (For systems that use R-410A, refer to the older version of this guide, APP-APG017D-EN.) While hot gas bypass might also be used in packaged DX equipment or packaged water chillers, this guide is focused on its use in DX split systems that include field-installed refrigerant piping.

We encourage engineering professionals who design building comfort systems to become familiar with the contents of this guide and to use it as a reference. Architects, building owners, equipment operators, and technicians may also find this publication of interest because it addresses system layout and control.

Trane® has a policy of continuous product and product data improvements and reserves the right to change design and specifications without notice. As such all data in this application guide should be considered for reference only, please consult with a Trane® sales associate for current equipment operating range and performance.

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Overview

A HGBP valve may come with or without an integral solenoid valve. This is determined by the product it is matched with. When a solenoid valve is required, it will likely be included with the manufacturer's kit.

HOT GAS BYPASS: WHAT IS IT AND WHAT DOES IT DO?

Hot Gas Bypass (HGBP) is a method to artificially influence the compressor/evaporator balance point in order to match the unit capacity to the system load, to prevent coil icing, and to reduce compressor cycling.

When controlling to a specified discharge-air temperature, diminishing loads may force a refrigeration system to operate at unstable conditions. The result is compressor and evaporator capacities balancing at ever-lower suction pressures, driving down the Saturated Suction Temperature (SST). If left unchecked, this may result in evaporator coil frosting, potential compressor flooding, poor system performance, and potential equipment reliability concerns.

During part-load operation, HGBP can stabilize the suction temperature of the system balance point by diverting hot, high-pressure refrigerant vapor (hot gas) from the discharge line directly to the low-pressure side of the system. By diverting the hot gas during part-load conditions, heat is mixed with two-phase refrigerant on the low-pressure side of the TXV. This process accelerates the conversion of two-phase refrigerant to a superheated gas, and reduces the amount of liquid refrigerant that is available to transfer heat in the evaporator. This results in an elevated SST, which may prevent frost from forming.

Traditionally, HGBP has been viewed as a cure all to control capacity at low loads. This has resulted in its indiscriminate use as a "prescriptive" measure. Unfortunately, this results in unrealistic expectations. For example, HGBP will have minimum impact on a system operating with space temperature control.

Additional concerns are that while HGBP may provide frost control and some semblance of capacity control in many applications, many cases exist where HGBP failed to safely stabilize the system, or undermined reliable operation by introducing problems stemming from oil and refrigerant logging in the HGBP line. And in *all* cases, hot gas bypass inflates the life-cycle cost of the system:

- HGBP increases the initial cost, as it requires an additional refrigerant line, which also increases the likelihood of refrigerant leaks and oil/refrigerant logging.
- HGBP greatly reduces operating efficiency because the bypassed vapor does no useful cooling.
- HGBP costs more to operate: As the load fluctuates, the compressor consumes more energy because it's forced to operate at a compression step that is likely one stage higher than the load demands.
- When used for dehumidification, if there is not a form of reheat, the system may subcool the applicable zones.
- HGBP likely only operates in first stage of cooling capacity, and will likely be inactive in later stages of cooling.
- HGBP can increase the cost to maintain the system.

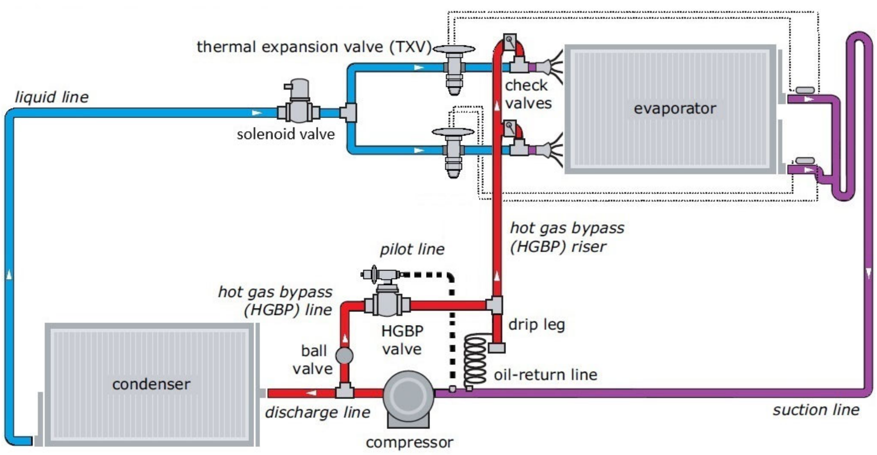
HGBP may be useful when a large amount of outdoor air reduces the mixed-air temperature entering the evaporator coil. HGBP may also help to provide more stable operation in systems with varying loads or excessive compressor on/off delays. If designed and installed properly, HGBP can:

- Prevent excessive compressor cycling
- Mitigate coil frosting
- Allow the system to operate at safe balance points during reduced loads
- Provide tighter control of discharge-air temperature at part-load conditions

TYPES OF HOT GAS BYPASS

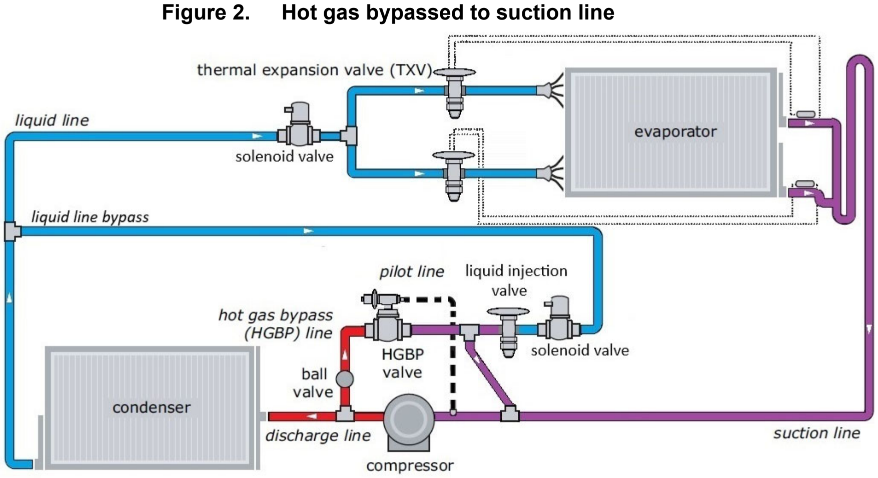
Hot gas bypass is arranged in one of two ways: either to the inlet of the evaporator (Figure 1) or to the suction line (Figure 2).

Figure 1. Hot gas bypassed to evaporator inlet (preferred arrangement)



Note: For illustration only, image not to scale. Actual placement of components may be closer or further away.

Figure 2. Hot gas bypassed to suction line



Note: For illustration only, image not to scale. Actual placement of components may be closer or further away.

Hot gas bypass to the evaporator inlet delivers hot refrigerant vapor between the expansion valve and the distributor (Figure 1). During HGBP operation, the expansion valve meters enough liquid refrigerant to both desuperheat the bypassed vapor and satisfy the evaporator load. The resulting refrigerant flow rate is sufficient to carry oil through the coil and suction line.

Hot gas bypass to the suction line bypasses the evaporator. Liquid refrigerant is diverted to a liquid-injection valve and mixed with bypassed hot refrigerant vapor (Figure 2). The resulting desuperheated vapor (gas) is then returned to the suction line.

Table 1. Comparison of common HGBP arrangements

To Evaporator Inlet (Figure 1)	To Suction Line (Figure 2)
Advantages of Evaporator Inlet • Merging the bypassed load with the system load in the evaporator helps the expansion valve maintain the desired superheat control. • Sustaining a higher gas velocity in the evaporator and suction line at low loads may enable more reliable oil return. • When introducing large amounts of outdoor air at part-load conditions, HGBP to the evaporator inlet may mitigate coil frosting better than HGBP to the suction line. • Simple installation using factory-provided HGBP connections does not require field modification to the refrigerant circuit.	**Advantages of Suction Line** • Modulating the mass flow of refrigerant through the evaporator coil helps the expansion valve to maintain the desired superheat control. • May be less expensive to install because it requires less piping, particularly if the condensing unit and evaporator are far apart. • Third party kits available that include a liquid line solenoid valve, an expansion valve, and a mixing tank.
Disadvantages of Evaporator Inlet • Installation cost is directly proportional to the distance between the condensing unit and evaporator. • Requires an additional HGBP line, with associated refrigerant specialties, to be run to the condensing unit. • To prevent logging oil, the HGBP line should be limited to 75 feet.	**Disadvantages of Suction Line** • At low evaporator loads, liquid mass flow rate is reduced, which will reduce velocity in the suction line and may create oil recovery concerns. Reducing the size of the suction line to compensate, or using an oil separator, may void the manufacturer's compressor defect warranty. • May allow liquid refrigerant to bypass back into the suction line, resulting in compressor damage. • May provide less capacity modulation than HGBP to the evaporator inlet. • Field modification of the condensing unit increases installer risk. • To prevent logging oil, the suction line should be limited to 75 feet in total length.

Application Considerations

ASHRAE® 90.1 AND HOT GAS BYPASS

ASHRAE® Standard 90.1 limits the allowable amount of HGBP. Section 6.5.9 (from the 2022 version) states:

> *"Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table 6.5.9 for VAV units. Hot gas bypass shall not be used on constant-volume units."*

Table 6.5.9 lists the maximum HGBP as a percent of total capacity. For units 20 tons and smaller, HGBP shall not exceed 15 percent of total unit capacity; for units larger than 20 tons, HGBP shall not exceed 10 percent of total unit capacity.

Rated Capacity	Maximum HGBP as a Percent of Total Capacity
<= 240,000 Btu/h	15 percent
>240,000 Btu/h	10 percent

HGBP tonnage can be limited by the HGBP valve selection or size of the HGBP line.

HOT GAS BYPASS IN CHILLED-WATER SPLIT SYSTEMS

When a DX condensing unit is paired with a chilled-water evaporator, certain process cooling applications may require hot gas bypass to match chiller capacity to an instantaneous load. In such cases, the system is designed to operate continuously, and hot gas bypass neutralizes the refrigeration effect when loads are non-existent.

For comfort cooling, however, the addition of hot gas bypass is seldom necessary. That's because a properly-designed chilled-water loop can provide an effective buffer between system load and chiller capacity. The key is to establish a loop time that equals the *greater* of two values: either the minimum "compressor off" time for the last stage of cooling, *or* the minimum loop time permitted by the chiller controller. This can be accomplished by changing the design flow rate and/or adding a buffer tank.

The simplicity of this approach will benefit the owner, as will the operating cost savings, since a chilled-water system *without* hot gas bypass requires less power than one that operates the compressors with hot gas bypass.

HOT GAS BYPASS FOR HUMIDITY CONTROL

As part of an applied DX system using discharge-air temperature control, HGBP may be used to help control space humidity when off-design conditions occur. However, when humidity is the primary concern, there may be superior alternatives. These may include unloading or modulating compression, reducing the fan airflow (CFM), adding hot gas reheat, or using VAV terminal units with reheat.

HOT GAS REHEAT WITH HOT GAS BYPASS

Hot gas reheat (HGRH) coils are part of the condenser system because they take heat away from the hot refrigerant. HGBP also takes mass away from the condenser system. When HGRH and HGBP are used together, they take both heat and mass from the high-side refrigerant. The result is a system which is very easily unstable because the condenser ends up so large (cold) that the liquid coming out if it, and going to the TXV, has no subcooling. Therefore, simultaneous use of HGRH and HGBP should be avoided.

OIL SEPARATOR LIMITATIONS

A challenge with HGBP is that during reduced HGBP operation some oil will log in inconvenient locations. If sufficient oil logs, the low oil condition at the compressor may cause failure. At first analysis, an oil separator would seem to be a solution.

However, the challenge with this approach is that even the very best oil separators are not 100 percent efficient. Some oil will always leak past. With extended operation, it may be possible for sufficient oil to leak past. Should the oil become trapped in inconvenient locations, it may damage the compressor.

In order for an oil separator to be an effective mitigation strategy, additional components are required. This usually includes a properly-sized suction line accumulator and an oil recovery control sequence. An oil separator should never be used with HGBP without an oil recovery sequence.

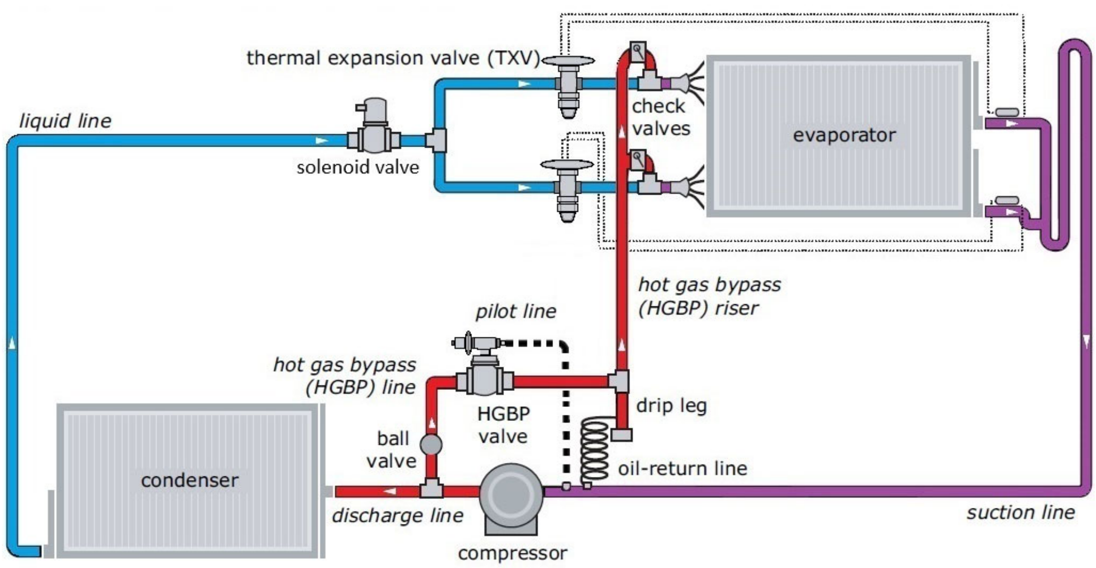
SELECTING THE APPROPRIATE HGBP VALVE

HGBP valves originally controlled suction pressure. These valves were a proportional control system with a very wide operational band that is still used in a number of existing HGBP valves. This wide control band implies that it should not be used for close system control or systems that are designed close to a critical operating condition. There are newer HGBP valves with tighter control bands, as well as electronic HGBP valves. The electronic HGBP valves in particular control through algorithms, which makes them much more suitable in applications requiring tighter control tolerance. These electronic valves may control to either suction pressure or discharge-air temperature.

If the system controls the compressors to discharge-air temperature, it may be best to control the HGBP valve by suction pressure to avoid control conflict. If the system controls the compressors to space temperature, the HGBP valve control can likely be either suction pressure or discharge-air temperature. The correct valve should be chosen dependent on project-specific requirements.

Hot Gas Bypass Design

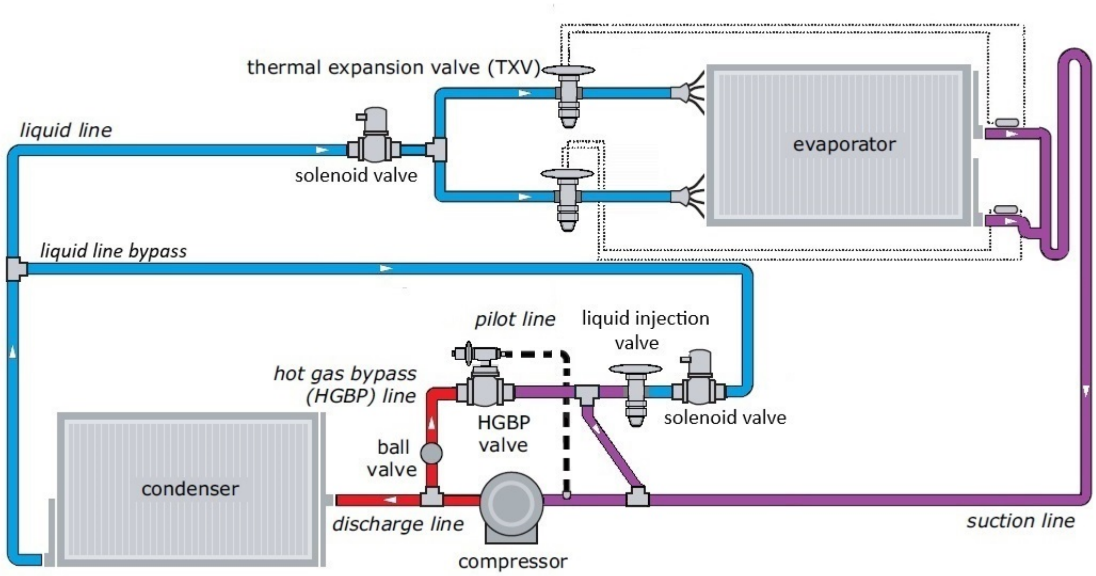
Figure 3. Hot gas bypassed to evaporator inlet (preferred arrangement)



Design keys to successful implementation (Figure 3):

1. Position the HGBP valve *above* the discharge line, near the compressor. If the system includes high-side isolation, provide a means to shut off refrigerant flow.
2. Pitch the line *upstream* of the HGBP valve to drain oil back into the discharge line.
3. Pitch the line *downstream* of the HGBP valve toward the evaporator, away from the valve.
4. If the HGBP line includes a riser(s), regardless of height, provide a 12 in. drip leg of the same diameter as the riser(s). Install the drip leg regardless of the height of the riser(s). Add an oil-return line 1 in. (25 mm) from the bottom of the trap; use tubing that is 1/8 in. (6 mm) and at least 5 ft (300 mm) long. Pre-charge the trap with appropriate oil.
5. Divert hot gas to each active distributor at the expected operating points for hot gas bypass.
6. Provide a check valve for each distributor, and install an auxiliary side connector on each distributor to mix hot gas and liquid.
7. Insulate the *entire* length of the HGBP line.

Figure 4. Hot gas bypassed to suction line



Design keys to successful implementation (Figure 4):

1. Position the HGBP valve *above* the discharge line, near the compressor. If the system includes high-side isolation, provide a means to shut off refrigerant flow.
2. Pitch the line *upstream* of the HGBP valve to drain oil back into the discharge line.
3. Pitch the line *downstream* of the HGBP valve toward the suction line, away from the valve.
4. Size the HGBP valve and suction line to allow for oil return.
5. Site the suction-line HGBP connection upstream of the pilot-line tap for the HGBP valve and at least 5 ft (1.5 m) upstream from the compressor inlet. Angle the connection into the suction flow.
6. Attach the remote bulb for the liquid-injection valve to the suction line, downstream of the HGBP connection.
7. Provide a solenoid valve upstream of the liquid-injection valve, and synchronize the operation of the HGBP and liquid-line solenoid valves.
8. Insulate the *entire* length of the HGBP line.
9. HGBP to a suction line is typically provided as a prepackaged kit from a third party manufacturer, follow all additional instructions from the kit manufacturer.

HGBP REFRIGERANT LINE DESIGN CONSIDERATIONS

Make gravity work for you—a typical HGBP valve can infinitely vary the rate of hot gas flow. The resulting refrigerant velocity can become so low that it “traps” oil in the HGBP line. Gravity then becomes the sole means for returning oil to the compressor. It is therefore critical to design the refrigerant piping system so that all oil (and condensed refrigerant) drains freely out of the HGBP line.

Suction-line lift and the design of the evaporator coil particularly limit the use of HGBP to the suction line. Because this arrangement bypasses the evaporator and part of the suction line, the refrigerant flow rate upstream of the HGBP point of entry may become too low to move oil. To overcome this limitation, restrict the minimum amount of HGBP to a quantity that maintains sufficient refrigerant velocity for oil entrainment in this particular arrangement.

Independent of which HGBP arrangement is applied, the HGBP line must connect to the *top* of both the discharge line and the evaporator inlet (or suction line). Otherwise, a mixture of oil and refrigerant will pour into the HGBP line, starving the compressor of oil and causing a liquid slug when the HGBP valve opens. The refrigerant that collects in the HGBP line also reduces the refrigerant charge available to the system, which may lower the suction pressure. Ironically, the HGBP valve may respond by opening and allowing bypass flow of hot gas. The repetitive, unstable operation and slugging that result will promote an unstable system.

KEEP THE HGBP LINE SHORT

Refrigerant vapor will condense in and fill any portion of the HGBP line that is colder than the saturated temperature of the suction or discharge gas. The likelihood of this occurring will increase with the length of the HGBP line. Oil return also can be a problem in properly designed HGBP lines because the HGBP valve can reduce the flow of bypassed gas to nearly zero—well below the minimum flow rate needed to carry oil back to the compressor. Gravity will be *very* slow to bring the oil that deposits along the length of the HGBP line back to the compressor. The longer the HGBP line, the more oil it will collect. It is imperative to keep the oil charge in the system, not in the HGBP line.

Note: If the refrigeration system includes pump-down, ensure the HGBP system includes a means to prevent refrigerant flow during the pump-down cycle.

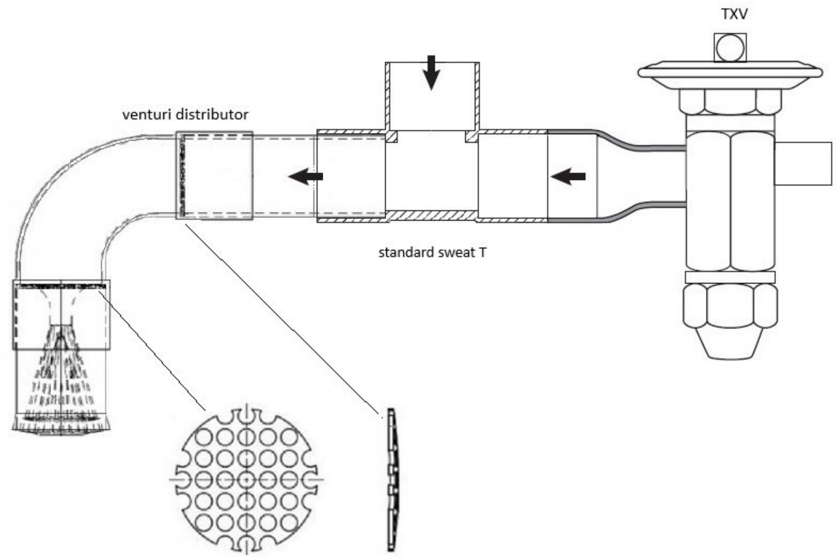
ADD LOW AMBIENT/HEAD-PRESSURE CONTROL

Diverting hot gas from the discharge line and around the condenser reduces the head pressure of the system. As head pressure decreases, operation may become unstable and unreliable. To avoid this risk, include a method for low ambient/head-pressure control in every HGBP application.

VENTURI STYLE DISTRIBUTORS

Venturi distributors have a packed elbow with small screens inside (Figure 5). These screens work as diffusers to evenly distribute refrigerant. The added benefit is that the screens create turbulence to mix hot gas with the two-phase refrigerant. This eliminates the need for specialized components, and allows a venturi distributor to use a standard refrigeration tee fitting to mix hot gas with the two-phase refrigerant.

Figure 5. Venturi distributor with packed elbow



It is the responsibility of the installer to confirm the type of DX coil distributor. This may require contacting the equipment manufacturer. Examples of air-handling units that use a venturi distributor for DX coils include Trane® CSAA, UCCA, PCC, and BCU product lines.

SPORLAN STYLE DISTRIBUTORS

Some air-handling unit manufacturers use a Sporlan style distributor that contains a nozzle to induce turbulence and mix the liquid-vapor refrigerant before it enters the distributor tubes. When a Sporlan style distributor is used, a Sporlan Auxiliary Side Connector (ASC) is installed upstream of the nozzle-type distributor (Figure 6). The nozzle is removed from the inlet of the distributor and relocated to the inlet of the ASC (Figure 7).

Figure 6. Sporlan (nozzle-type) distributor with ASC

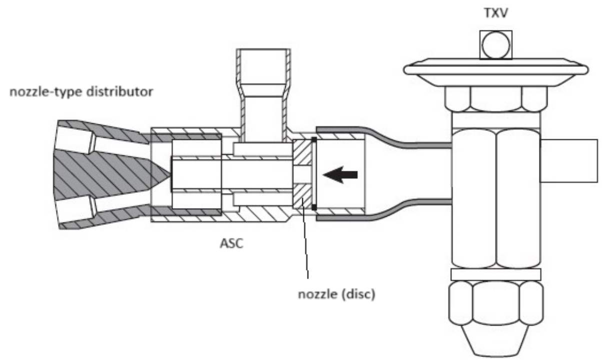
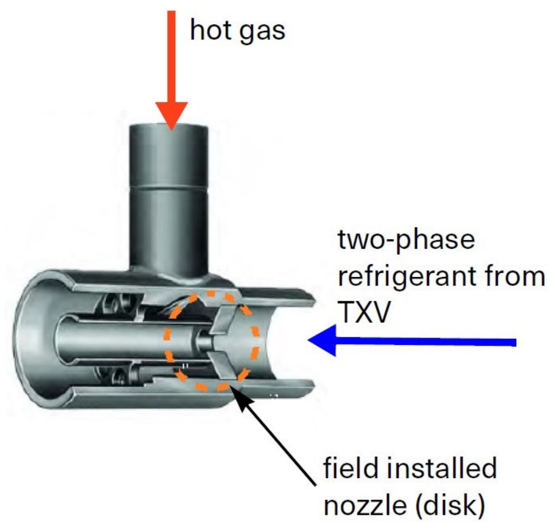


Figure 7. Sporlan ASC

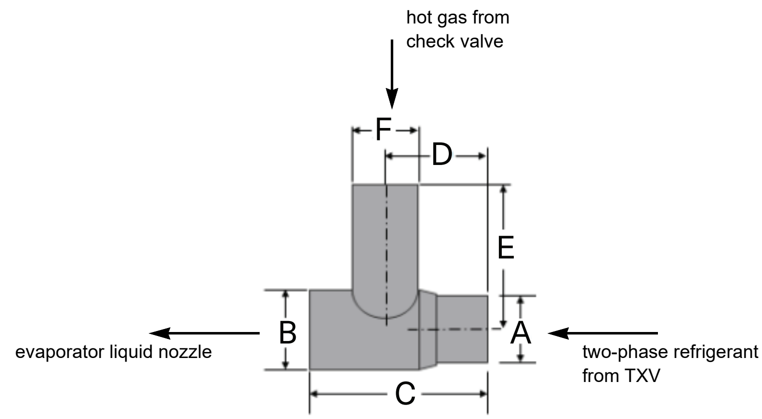


Note: Images, content, and tables in this section courtesy of Sporlan.

It is the responsibility of the installer to confirm the type of DX coil distributor. This may require contacting the equipment manufacturer. For example, the Trane® Odyssey (TWE) air-handling unit is shipped from the factory with both a Sporlan style distributor and a factory-installed ASC. The nozzle is already located in the correct location (in the ASC), so no additional components are required. Simply pipe the HGBP to the factory-installed ASC.

The HGBP line must connect to the ASC from above. The ASC should be sized to match the TXV connection. If the HGBP pipe size or TXV connection do not match, simply use a reducer. This is not a concern since the ASC is only being used to create turbulence and promote mixing. When this occurs, it may be necessary to size and purchase an appropriate ASC nozzle (see following example).

Table 2. ASC and nozzle selection



Note: Piping adapters (reducers) will likely be needed for connections A and F.

Type	Connection Sizes - inches			Used with distributor type	Nozzle size	Dimensions - inches					
	Inlet ODM Solder	Outlet ODF Solder	Auxiliary ODF Solder			A	B	C	D	E	F
ASC-4-3	½	½	3/8	D260, D262	L	½ ODM	½ ODF	1.75	0.85	1.04	3/8 ODF
ASC-5-4	5/8	5/8	½	1620, 1622	J	5/8 ODM	5/8 ODF	1.91	0.95	1.25	½ ODF
ASC-7-4	7/8	7/8	½	1112, 1113	G	7/8 ODM	7/8 ODF	2.25	1.06	1.38	½ ODF
ASC-9-5	1-1/8	1-1/8	5/8	1115, 1116	E	1-1/8 ODM	1-1/8 ODF	2.81	1.47	1.62	5/8 ODF
ASC-11-7	1-3/8	1-3/8	7/8	1117, 1126, 1128	C	1-3/8 ODM	1-3/8 ODF	3.53	1.89	2.19	7/8 ODF
ASC-13-9	1-5/8	1-5/8	1-1/8	1125, 1127, 1143	A	1-5/8 ODM	1-5/8 ODF	3.85	1.95	2.75	1-1/8 ODF

Occasionally, it may not be possible to reuse the nozzle from the original Sporlan distributor. When this occurs, it is necessary to size and purchase the appropriate nozzle. The following example illustrates proper selection of this separate, field-installed nozzle.

First, the ASC and nozzle are selected by matching the size of the evaporator's distributor liquid connection to dimension B in Table 2. For example, if the distributor liquid connection is 7/8 inch, then select an ASC-7-4 and nozzle size G. Note that piping adapters (reducers) will likely be needed for connections A and F.

Note: The evaporator may have more than one size of distributor, each with different connection sizes, so be sure to size each ASC according to the distributor it will be connected to.

Table 3. Refrigerant 454B nozzle orifice sizes

Nozzle Orifice Size	Refrigerant 454B tons per distributor
	40°F SST
1/9	0.182
1/6	0.281
1/4	0.453
1/3	0.593
1/2	0.820
3/4	1.24
1	1.66
1-1/2	2.41
2	3.31
2-1/2	4.13
3	4.95
4	6.63
5	8.18
6	9.81
8	11.8
10	13.2
12	16.4
15	20.3
17	22.7
20	27.3
25	34.4
30	39.3
35	47.2
40	53.0
50	68.7

Next, the proper size orifice in the nozzle is determined by the larger of:

1. The first stage of cooling capacity divided by the number of distributors, or
2. 40 percent of the circuit capacity divided by the number of distributors.

This value is then rounded down to the next available size nozzle orifice. This nozzle is only used to create refrigerant turbulence, so precision in selection is not required.

Note: To simplify the ASC and nozzle selection process, the 40ºF SST column in Table 3 may be used for applications ranging from 40ºF to 55ºF SST.

Example 1: A 30-ton, R-454B evaporator has four distributors. It is connected to a single, 30-ton refrigeration circuit, with first stage of capacity equal to 15 tons at 45°F SST.

The first stage of capacity is 15 tons, which is *larger* than 40 percent of the circuit capacity (30 tons x 0.40 = 12 tons), so each nozzle orifice is sized for 3.75 tons (15 tons/4 distributors). Looking in the 40°F SST column of Table 3, there is not an option for 3.75 tons, so round down to 3.31 tons and select the number 2 nozzle orifice. For this example, the installer needs an ASC-7-4 and a separate G 2 nozzle. Repeat this for each liquid distributor that is to receive the bypassed hot gas.

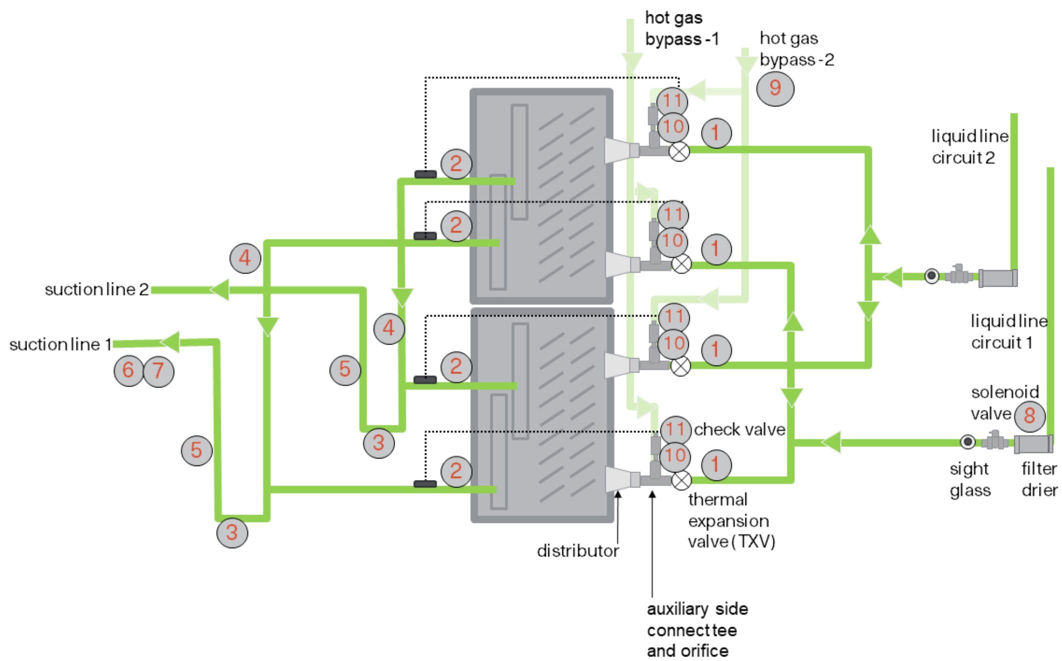
Example 2: A 100-ton, R-454B evaporator has eight total distributors. It is connected to two, 50-ton refrigeration circuits, with first stage of capacity equal to 15 tons at 45°F SST. The HGBP line will be connected to all four distributors on circuit #1.

The first stage of capacity is 15 tons, which is *smaller* than 40 percent of the circuit capacity (50 tons x 0.40 = 20 tons), so each nozzle orifice is sized for 5 tons (20 tons/4 distributors). Looking in the 40°F SST column of Table 3, there is not an option for 5 tons, so round down to 4.95 tons and select the number 3 nozzle orifice. For this example, the installer needs an ASC-7-4 and a separate G 3 nozzle. Repeat this for each liquid distributor that receives hot gas.

HOT GAS BYPASS PIPING AT THE COIL

It is recommended that HGBP be piped to each part of the active evaporator coil when HGBP is used (Figure 8).

Figure 8. Typical piping for a multi-circuit system



1. Provide one expansion valve per distributor.
2. Slightly pitch the outlet line from the suction header toward the suction riser in direction of flow. Use the tube diameter that matches the suction header outlet.
3. Arrange the suction line so that the refrigerant leaving the coil flows downward past the lowest suction header outlet, before turning upward. Use a DETINT (Double Elbow That Is Not a Trap) configuration to prevent oil and refrigerant migration when the unit is off. (See Trane refrigerant piping application guides SS-APG017*-EN and SS-APG018*-EN for more information.)
4. Use the horizontal tube diameter identified in the appropriate application guide.
5. Use the tube diameter recommended in the appropriate application guide for a vertical rise. This riser should be at least 2 feet.
6. Pitch the suction line 1 inch per 10 feet so that the refrigerant flows toward the evaporator.
7. Insulate the suction line.
8. Install a single isolation solenoid valve between the liquid line filter and the sight glass if required by the appropriate application guide.
9. Pipe HGBP to each coil of the active circuit. Pitch the line in direction of flow.
10. Install an ASC at the inlet of each distributor and a nozzle at the inlet of the ASC. The HGBP line MUST enter from the top.
11. Install a check valve in each branch of the HGBP line to prevent reverse flow during the off cycle.

SELECT THE APPROPRIATE HGBP TUBE DIAMETER

Table 4 and Table 5 list the required tube sizes to bypass tonnage at conditions listed next to each table. The HGBP valve modulates based on pressure and temperature. It is rare for the HGBP valve to open if two or more stages of cooling are operational. To minimize oil loss in the HGBP line, the HGBP line should be sized based on the smallest stage of cooling.

Table 4. Hot gas bypass tube size by tonnage of minimum step of unloading (use this table when unit has low ambient/head pressure control)

Distance not to exceed 75 feet	
tonnage	HGBP pipe size, in.
2.5	1/2
5	5/8
6	5/8
7.5	3/4
10	3/4
12.5	3/4
15	7/8
20	1-1/8
25	1-1/8
30	1-1/8

Saturated condensing temperature	100°F
Actual HGBP temperature	160°F
Required refrigerant velocity	<3500 ft/min
HGBP pressure drop (to be between)	10 < psig < 20

Table 5. Hot gas bypass tube size by tonnage of minimum step of unloading

Distance not to exceed 75 feet	
tonnage	HGBP pipe size, in.
2.5	1/2
5	5/8
6	3/4
7.5	3/4
10	3/4
12.5	7/8
15	1-1/8
20	1-1/8
25	1-1/8
30	1-3/8

Saturated condensing temperature	80°F
Actual HGBP temperature	130°F
Required refrigerant velocity	<3500 ft/min
HGBP pressure drop (to be between)	10 < psig < 20

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Supersedes APP-APG017E-EN 25 Sep 2025