March 2011 / **BULLETIN 90-40**

Discharge Bypass Valves

for System Capacity Control

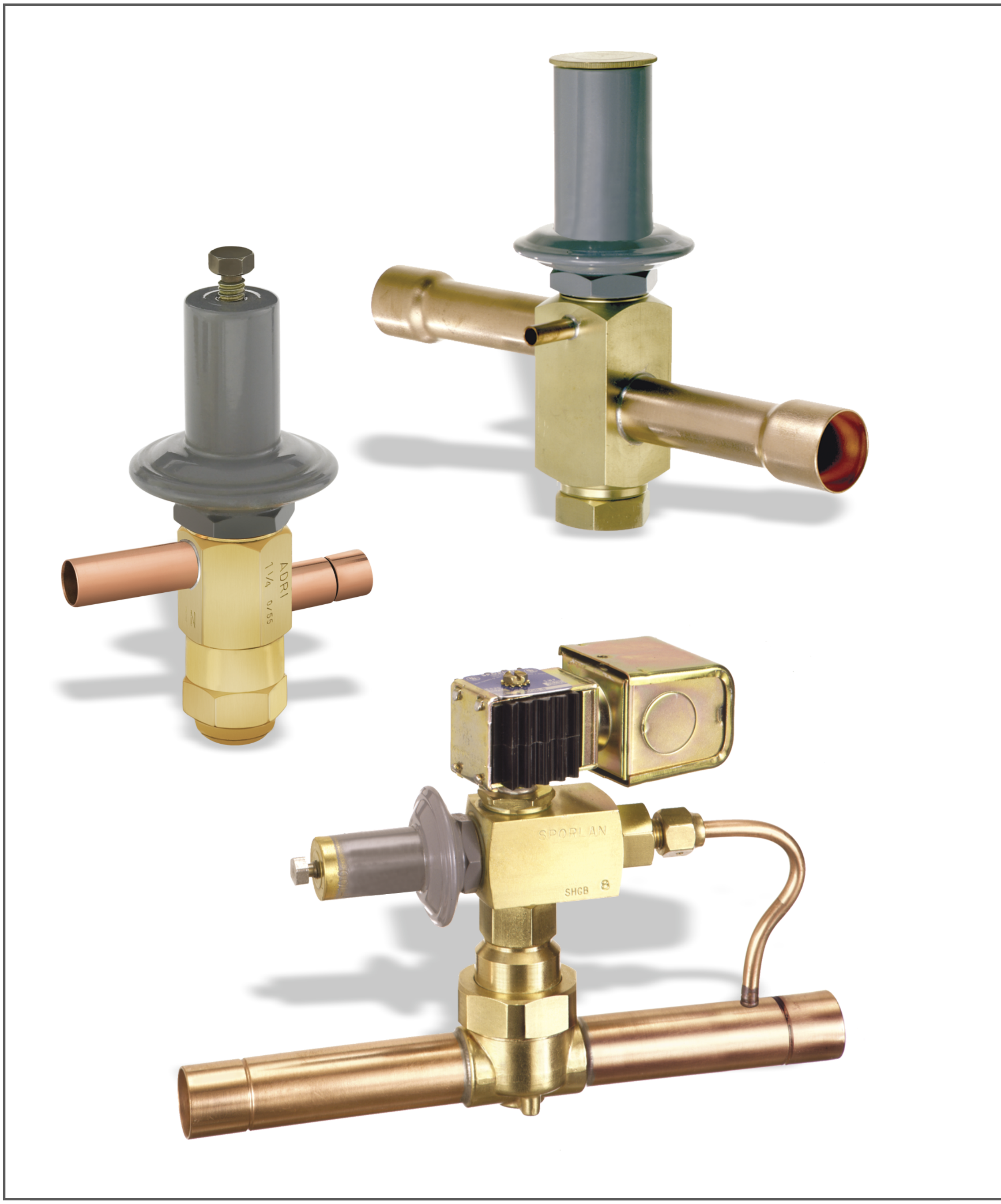

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TABLE OF CONTENTS

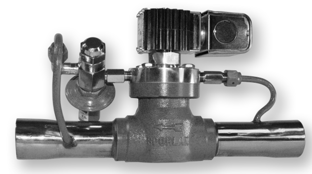
ADRHE-6

ADRI

DRHE-6

SHGB-8

SHGB-15



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Bulletin 90-40, March 2011, supersedes, Bulletin 90-40, January 2004, and all prior publications.

SYSTEM CAPACITY CONTROL

On many air conditioning and refrigeration systems it is desirable to limit the minimum evaporating pressure during periods of low load either to prevent coil icing or to avoid operating the compressor at a lower suction pressure than it was designed to operate. Various methods have been used to achieve this result — integral cylinder unloading, gas engines with variable speed control, or multiple smaller systems. Compressor cylinder unloading is used extensively on larger systems but is too costly on small equipment, usually 10 hp and below. Cycling the compressor with a low pressure cutout control is a method often used but is being re-evaluated for three reasons.

1. On-off control on air conditioning systems is uncomfortable and does a poor job of humidity and mold control.
2. Compressor cycling reduces equipment life.
3. In most cases, compressor cycling is not economical because of peak load demand charges.

One method that offers a practical and economical solution to the problem, is to bypass a portion of the hot discharge gas directly into the low side. This is done by a modulating control valve — commonly called a Discharge Bypass Valve (DBV). This valve, which opens on a decrease in suction pressure, can be set to automatically maintain a desired minimum evaporating pressure regardless of the decrease in evaporator load.

Sporlan manufactures a complete line of Discharge Bypass Valves including non-adjustable models, for specific customer requirements. Contact your Sporlan representative for assistance with special needs.

APPLICATION

Sporlan Discharge Bypass Valves provide an economical method of compressor capacity control in place of cylinder unloaders or the handling of unloading requirements below the last step of cylinder unloading.

On air conditioning systems, the minimum allowable evaporating temperature that will avoid coil icing depends on evaporator design and the amount of air passing over the coil. The refrigerant temperature may be below 32°F, but coil icing will not usually occur with high air velocities since the external surface temperature of the tube will be above 32°F. For most air conditioning systems the minimum evaporating temperature is 20°F to 25°F. However, when air velocities are reduced considerably, the minimum evaporating temperature should be 26°F to 28°F.

Sporlan Discharge Bypass Valves can be set so they start to open at an evaporating pressure equivalent to 32°F saturation temperature. Therefore, they would be at their ***rated*** capacity at 26°F evaporating temperature.

On refrigeration systems, discharge bypass valves are used to prevent the suction pressure from going below the minimum value recommended by the compressor manufacturer.

A typical application would be a low temperature compressor designed for operation at a minimum evaporating temperature of -40°F on Refrigerant 22. The required evaporating temperature at normal load conditions is -30°F. A discharge bypass valve would be selected which would start to open at the pressure equivalent to -34°F, and bypass enough hot gas at -40°F to prevent a further decrease in suction pressure. Valve settings are discussed completely later in this bulletin.

The discharge bypass valve is applied in a branch line, off the discharge line, as close to the compressor as possible. The bypassed vapor can enter the low side at one of the following locations:

1. Evaporator inlet with distributor.
2. Evaporator inlet without distributor.
3. Suction line.

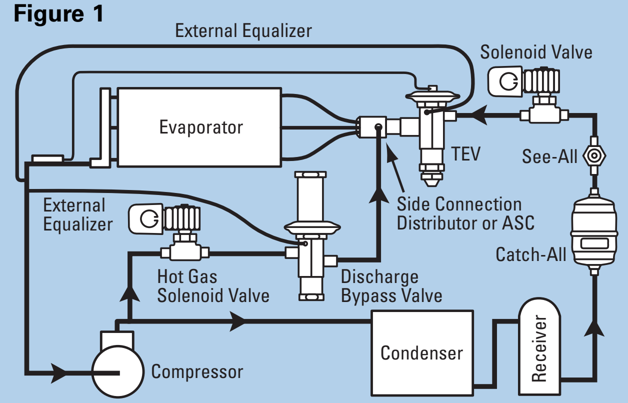
Each is illustrated and discussed below. While Figures 1, 2, and 3 show a specific type of discharge bypass valve, all types can be used in place of the one shown.

BYPASS TO EVAPORATOR INLET WITH DISTRIBUTOR

This method of application, illustrated in Figure 1, provides distinct advantages over the other methods, especially for unitary or field built-up units where the high and low side are close coupled.

This method is also applicable on systems with remote condensing units, especially when the evaporator is located below the condensing unit, see discussion below.

Figure 1



The primary advantage of this method is that the system thermostatic expansion valve will respond to the increased superheat of the vapor leaving the evaporator and will provide the liquid required for desuperheating. Also the evaporator serves as an excellent mixing chamber for the bypassed hot gas and the liquid-vapor mixture from the expansion valve. This ensures a dry vapor reaching the compressor. Oil return from the evaporator is also improved since the velocity in the evaporator is kept high by the hot gas.

Sporlan 1650R Series Distributor or ASC – Two refrigerant distribution methods are available to introduce hot gas in this manner:

1. Bypass to Sporlan 1650R series distributor with an auxiliary side connection.
2. Bypass to Sporlan ASC series Auxiliary Side Connector.

Method 1 is normally utilized on factory assembled or unitary systems where hot gas bypass is initially designed into the system. The 1650R series distributor allows the hot gas to enter downstream of the distributor nozzle. Method 2 is applicable on field built-up systems or on existing systems where the standard refrigerant distributor is already installed on the evaporator.

Some caution is necessary with either of these methods. If the distributor circuits are sized properly for normal cooling duty, the flow of hot gas through the circuits may cause excessive pressure drop and/or noise. Therefore, it is recommended that the distributor circuits be selected one size larger than for straight cooling duty. See Selection Procedures Section for selection information on this method of hot gas bypass. For complete technical details on the 1650R series distributor and the ASC series Auxiliary Side Connector, refer to Bulletin 20-10.

Valve/Equipment Location and Piping – When the evaporator is located ***below*** the compressor on a ***remote*** system, bypass to the evaporator inlet is still the best method of hot gas bypass to ensure sufficient oil return to the compressor. In order for the bypass to achieve rated capacity at the conditions for which it was selected, the bypass valve and hot gas solenoid valve (if used) must be located at the compressor, rather than at the evaporator. If the evaporator is above or on the same level as the compressor, this valve location will also eliminate the possibility of hot gas condensing in the long bypass line and running back into the compressor during the off cycle.

Whenever hot gas bypass to the evaporator inlet is necessary for a system with two or more evaporator ***sections,*** each with its own TEV (no liquid line solenoid valves), but handling the same load, two methods may be used to avoid operating interference between sections:

1. Use a separate discharge bypass valve for each evaporator section.
2. Use one discharge bypass valve to feed two bypass lines, each with a check valve between the bypass valve and the evaporator section inlet. The check valves will prevent interaction between the TEVs when the bypass valve is closed.

Externally Equalized Bypass Valves – Since the primary function of the DBV is to maintain suction pressure, the compressor suction pressure is the ***control*** pressure and must be exerted on the underside of the valve diaphragm. When the DBV is applied as shown in Figure 1, where there is an appreciable pressure drop between the valve outlet and the compressor suction, the externally equalized valve must be used. This is true because when the valve opens, a sudden rise in pressure occurs at the valve outlet. This creates a false ***control*** pressure, which causes the internally equalized valve to close.

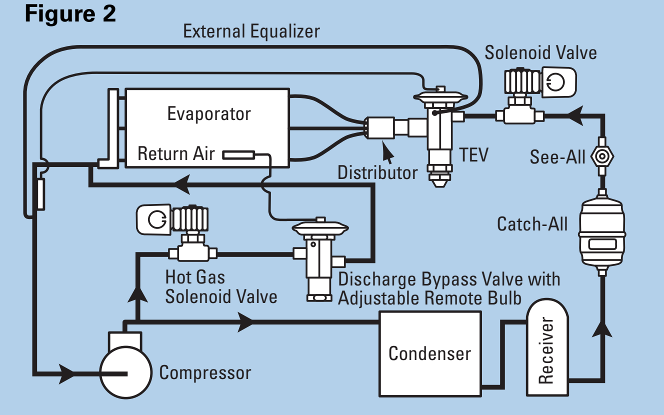
Caution – Introduction of the bypassed gas between the thermostatic expansion valve and the distributor is ***not*** generally recommended because of the large pressure drop caused by the hot gas flowing through the distributor nozzle, or throat, and the tube circuits, which have been sized for normal cooling flow rates. Careful evaluation and testing should precede any application where hot gas is bypassed between the TEV and the distributor.

BYPASS TO EVAPORATOR INLET WITHOUT DISTRIBUTOR Many refrigeration systems and water chillers do not use refrigerant distributors, but may require some method of compressor capacity control. This type of application provides the same advantages as bypassing hot gas to the evaporator inlet with a distributor. All information relating to bypassing hot gas to the evaporator inlet with a distributor, **except that concerning distributors or ASCs,** also applies to bypassing to the evaporator inlet without a distributor.

BYPASS TO SUCTION LINE On many applications, it is necessary to bypass directly into the suction line. This is generally true of systems with multi-evaporators or remote condensing units, as well as on existing systems where it is easier to connect to the suction line than the evaporator inlet. The latter situation involves systems fed by TEVs or capillary tubes. When hot gas is bypassed directly into the suction line, the danger exists of overheating the compressor and trapping the oil in the evaporator. As the suction temperatures rise, the discharge temperature likewise starts to increase. This can cause breakdown of the oil and refrigerant with the possible result being a compressor burnout. On close-coupled systems, this can be eliminated by locating the main expansion valve bulb downstream of the bypass connection as illustrated in Figure 2.

Advantages and Disadvantages – The method illustrated in Figure 2 allows the application of hot gas bypass to an existing system with only minor piping changes. And in most cases, the operation of the system will be satisfactory. However, on some systems the interaction between the DBV and the TEV may result in undesirable hunting and poor system performance. Also, there may not be sufficient length of suction line available to get good mixing of the hot gas vapor and the cool evaporator vapor before reaching the bulb location. If ***at least*** 3 feet of suction line, preferably with an elbow between the two locations, is ***not*** available, the method in Figure 3 is strongly recommended instead. This method offers added flexibility for multi-evaporator systems or remote systems because the hot gas bypass components can be located at the condensing unit. However, neither method, Figure 2 or 3, ensures oil return unless special care is taken in the system piping to accomplish satisfactory oil return to the compressor from the low side.

Figure 2



Desuperheating Thermostatic Expansion Valve – On those applications where the hot gas must be bypassed directly into the suction line downstream of the main expansion valve's bulb, an auxiliary thermostatic expansion valve — commonly called a desuperheating TEV or a liquid injection valve — is required.

The purpose of this valve is to supply enough liquid refrigerant to cool the hot discharge gas to the recommended suction temperature. Most compressor manufacturers specify a maximum suction gas temperature of 65°F. For these requirements, special desuperheating thermostatic charges are available which will control at the proper superheat to maintain the suction gas at or below 65°F. For applications requiring suction gas temperatures appreciably below 65°F, contact Sporlan Valve Company or the compressor manufacturer for assistance. In all cases **the maximum permissible suction gas temperature published by the compressor manufacturer must be followed**. These special charges, along with the correct selection methods, are given in the Selection Procedures Section.

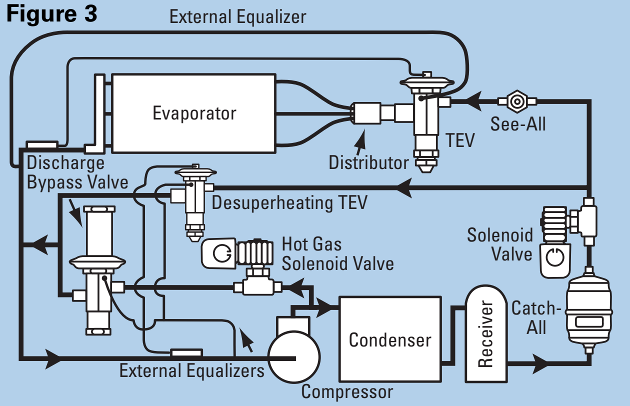
Figure 3 illustrates an externally equalized desuperheating TEV. And in most cases it is the recommended selection. However, if the outlet piping from the expansion valve and the bypass valve is adequately sized and the distance from the connection where the bypass line enters the suction line to the compressor is close coupled, the internally equalized type may be used. ***If there is any doubt, use the externally equalized valve.*** See Bulletin 10-9 for a complete analysis on this subject.

Valve/Equipment Location and Piping – As indicated earlier, the bypass valve and hot gas solenoid valve (if used) must be located as near to the compressor as possible to ensure rated capacity is obtained from the DBV at the conditions for which it was selected. On some systems with remote condensing units, the evaporator will be located ***below*** the compressor. When this is the case, serious consideration should be given to bypassing the hot gas to the evaporator inlet to keep the compressor oil from being trapped in the evaporator or suction line. Consult with the compressor manufacturer for additional application data.

One of the most important points to remember when piping the discharge bypass valve and the desuperheating thermostatic expansion valve is that a homogenous mixture of liquid and gas must be obtained before reaching the bulb location. Otherwise, the system operation may become unstable and the thermostatic expansion valve will ***hunt.*** Mixing can be accomplished two ways: use a suction line accumulator downstream of both connections with the auxiliary thermostatic expansion valve bulb downstream of the accumulator; tee the liquid-vapor mixture from the thermostatic expansion valve and the hot gas from the bypass valve together before connecting a common line to the suction line. The latter method is illustrated in Figure 3.

Externally Equalized DBV – While an internally equalized bypass valve can be used for most applications as illustrated in Figure 2, the final selection depends on the specific system. The deciding factor is the amount of pressure drop between the bypass valve outlet and the compressor suction. Since most applications, (Figures 1 and 3), require externally equalized valves, this model will be the most readily available one in the field. Therefore, it is suggested that in all cases, the externally equalized DBV be applied.

Figure 3



PARALLELING VALVES If the hot gas bypass requirement on any system is greater than the capacity of the largest discharge bypass valve, these valves can be applied in parallel. The pressure settings of the paralleled valves should be the same to get the most sensitive performance, and the piping to each valve should be identical to keep the pressure drop across each valve the same.

PIPING SUGGESTIONS Figures 1, 2, and 3 are piping schematics only to illustrate the general location of the discharge bypass valves in the system. Sporlan recommends that recognized piping references, such as equipment manufacturers' literature and the ASHRAE Handbook, be consulted for assistance. Sporlan is not responsible for system design, any damage arising from faulty system design, or for misapplication of its products. If these valves are applied in any manner other than as described in this bulletin, the Sporlan warranty is void. Actual system piping must be done so as to protect the compressor at all times. This includes protection against overheating, slugging with liquid refrigerant, and trapping of oil in various system locations.

The inlet connection on the discharge bypass valve should be sized to match system piping requirements. If a hot gas solenoid valve is used, its connection size will help determine the necessary connections on the bypass valve. Whether piping the hot gas to the evaporator inlet or the suction line, matching connections is easy if all components are reviewed in light of the most efficient system operation: side connection on distributor or ASC, hot gas solenoid valve, discharge line, suction line, desuperheating TEV, etc.

Inlet strainers are available for all solder type bypass valves. The need for an inlet strainer is a function of system cleanliness. Moisture and particles too small for the strainer are harmful to the system and must also be removed. Therefore, it is recommended that a Catch-All Filter-Drier be applied in the liquid line and suction line (if required). See Bulletin 40-10.

HOT GAS SOLENOID VALVE Each of the schematic drawings in this application section shows a solenoid valve in a hot gas bypass line. Systems that operate on a pump down cycle require a solenoid valve in the hot gas bypass line in addition to the liquid line solenoid valve, since the bypass valve will open as the suction pressure is reduced. The two solenoid valves, hot gas and liquid line, should be wired in parallel so they are de-energized by a thermostat or any of the compressor safety devices, after which the compressor will shut down.

Even if the system is not on a pump down cycle, it is usually best to have a shut-off valve in the hot gas bypass line so the system can be pumped down for service.

When the hot gas is bypassed into the suction line, a hot gas solenoid valve is also needed if the compressor does not have an integral temperature protection device. The valve serves as a safety measure against an extremely high superheat condition at the compressor suction. This condition can occur if the system experiences a malfunction of the thermostatic expansion valve, which is serving to desuperheat the bypassed hot gas; or, if the system is short of refrigerant. The hot gas solenoid valve is wired in series with a bi-metal thermostat fastened to the discharge line close to the compressor. This causes the solenoid valve to close if the discharge line temperature becomes excessive.

Complete selection information is given in the Selection Procedures Section.

DBV WITH OTHER PRESSURE REGULATING VALVES

A discharge bypass valve can be applied on any system that experiences undesirable compressor cycling during periods of low load. However, when other pressure regulating valves are also used, some consideration should be given to prevent undesirable operation. For example, when the bypass valve is required on a system with an evaporator pressure regulating valve (ORIT or other type), less hunting will probably occur if the hot gas is bypassed directly to the suction line along with a desuperheating TEV. However, this may leave oil trapped in the evaporator due to the low velocity flow when the ORIT is throttled. Therefore, depending on the specific system involved, the hot gas may be bypassed either to the evaporator inlet or directly to the suction line.

If the discharge bypass valve is required on a system with a crankcase pressure regulating valve (CRO or other type), the DBV can bypass to the low side at any one of the locations shown in Figures 1, 2, or 3, and the decision on whether an internal or external valve is required will depend on the method used. The pressure setting of the DBV must be ***lower*** than the CRO valve setting for each valve to function properly.

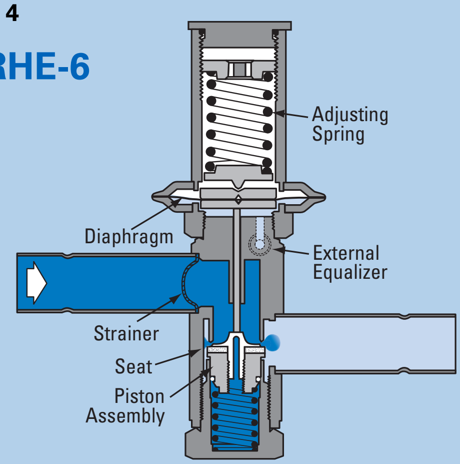
Normally, when hot gas bypass is used for capacity control during periods of low load, the outdoor ambient drops below 70°F. Therefore, all air cooled systems that utilize hot gas bypass for capacity control should have some type of head pressure control to maintain satisfactory performance.

For information on other Sporlan pressure regulating valves refer to the following bulletins: 90-10 Crankcase Pressure Regulating Valves, 90-20 Evaporator Pressure Regulating Valves, and 90-30 Head Pressure Control Valves.

OPERATION

DIRECT ACTING VALVES – ADRI, ADRS, ADRP, and ADRH Sporlan DBVs respond to changes in downstream or suction pressure. See Figure 4. When the evaporating pressure is above the valve setting, the valve remains closed. As the suction pressure drops below the valve setting, the valve responds and begins to open. As with all modulating type valves, the amount of opening is proportional to the change in the variable being controlled — in this case the suction pressure. As the suction pressure continues to drop, the valve continues to open until the limit of the valve stroke is reached. However, on normal applications there is not sufficient pressure change to open these valves to the limit of their stroke. The amount of pressure change from the point at which it is desired to have the valve closed, to the point at which it is to open, varies widely with the type of refrigerant used and the evaporating temperature. For this reason Sporlan DBVs are rated on the basis of allowable evaporator temperature change from closed position to rated opening. A 6°F change is considered normal for most applications and is the basis of our capacity ratings. Multipliers for other temperature changes are given in the Selection Procedures section.

Figure 4



These factors must be considered in the application and selection of all DBV's. Therefore, the following sections completely explain how the various factors are utilized in determining the proper valve to use, and the correct method of application.

PILOT OPERATED VALVE – SHGB(E)-8 During normal system operation, the solenoid coil is energized, which allows the SHGB(E)-8 to modulate in response to changes in its outlet pressure or suction pressure, see Figure 5. De-energizing the solenoid coil will cause the valve to close so that no discharge gas is bypassed, see Figure 6.

As illustrated in Figure 5, the main piston of this valve is controlled by a pilot valve. The outlet pressure or suction pressure (P1) acts as a closing force on the pilot valve and is opposed by the adjustment spring which acts in an opening direction. High pressure gas (P2) bleeds into the chamber above the main piston through a restrictor in the piston. The pilot valve controls the position of the main piston by regulating the amount of gas that bleeds out of the chamber. As this pressure on top of the main piston (P3) increases and decreases, it causes the main piston to modulate closed and open.

As the suction pressure (P1) falls below the pilot valve's setting, the pilot port modulates open. This bleeds refrigerant from the chamber above the piston through the pilot valve at a faster rate than it is entering, so the pressure decreases. As this pressure (P3) plus the pressure from the spring (Ps) falls below the inlet pressure (P2), the inlet pressure pushes the piston up, modulating the valve open. As the suction pressure rises above the setting of the pilot valve, the pilot port modulates closed. This allows pressure to build on top of the main piston. As this pressure (P3) approaches the inlet pressure (P2), the force combined with the force from the spring (Ps) pushes the piston down, modulating the valve closed.

To close the valve, the solenoid coil is de-energized. As illustrated in Figure 6, when the solenoid coil is de-energized, the solenoid plunger closes the port to the pilot valve, which prevents refrigerant from leaving the piston chamber. The incoming hot gas (P2)

Figure 5 **Solenoid Coil Energized Valve Modulating**

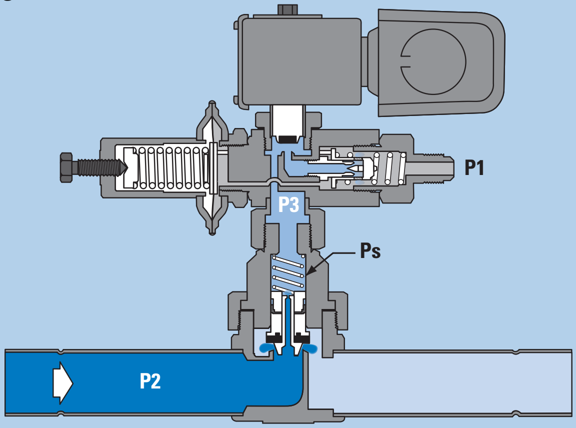
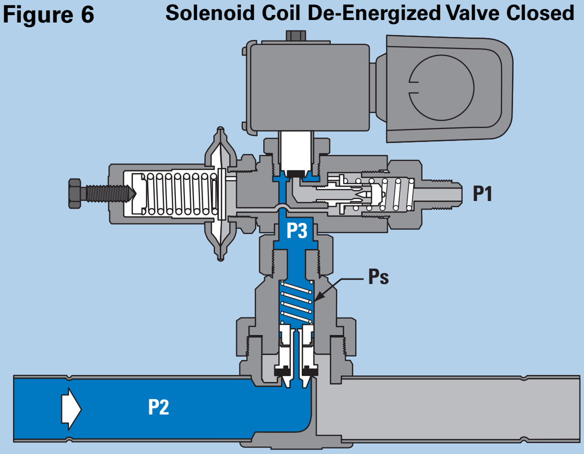


Figure 6 **Solenoid Coil De-Energized Valve Closed**



bleeds through the piston to the chamber above the piston. However, since the hot gas cannot bleed through the pilot valve, the pressure on top of the main piston (P3) increases, driving the piston down and closing the main port.

PILOT OPERATED VALVE – SHGB(E)-15 In normal operation the solenoid coil is energized which allows the SHGB(E)-15 to modulate in response to changes in its outlet or suction pressure, see Figure 7. De-energizing the solenoid coil will close the valve so that no hot gas is bypassed, see Figure 8.

As illustrated in Figure 7, the main piston of this valve is controlled by a pilot valve. The outlet pressure or suction pressure (P1) acts as a closing force on the pilot valve and is opposed by the adjustment spring that acts in an opening direction. High pressure gas (P2) bleeds into the main valve through a restrictor to the top of the main piston. The pilot valve controls the position of this piston by regulating the amount of gas that bleeds out of the main valve, thus varying the pressure on top of the main piston (P3). As this pressure on top of the main piston increases and decreases, it causes the main piston to modulate closed and open.

As the suction pressure (P1) falls below the pilot valve's setting, the pilot port modulates open. This bleeds refrigerant from the piston chamber at a faster rate than it is entering, so the pressure decreases. As this pressure (P3) plus the pressure from the spring (P4) falls below the inlet pressure (P2), the inlet pressure pushes the piston up, modulating the valve open. As the suction pressure rises above the setting of the pilot valve, the pilot port modulates closed. This allows pressure to build on top of the main piston. As this pressure (P3) approaches the inlet pressure (P2), the force, combined with the force from the spring (P4), pushes the piston down, modulating the valve closed.

As illustrated in Figure 8, when the solenoid coil is de-energized, the solenoid plunger closes the port to the pilot valve, which prevents refrigerant from leaving the piston chamber. Since this incoming hot gas (P2) cannot be bled out through the pilot valve, the pressure on top of the main piston (P3) increases, driving the piston down and closing the main port.

Figure 7 **Solenoid Coil Energized Valve Modulating**

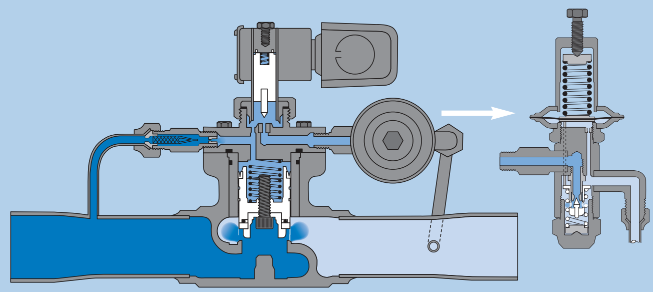
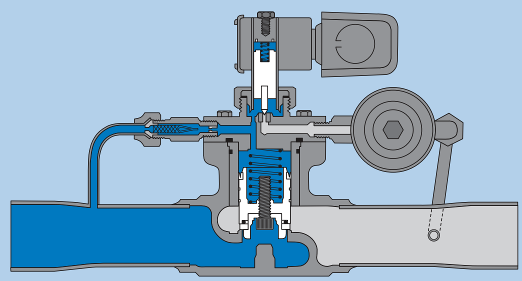


Figure 8 **Solenoid Coil De-Energized Valve Closed**



ADJUSTMENT RANGES PRESSURE SETTINGS

ADJUSTABLE SPRING HEADS ON DIRECT ACTING VALVES The fully adjustable type utilizes a spring assembly which can be fixed at the desired pressure setting (opening pressure). This setting will not be affected by other factors such as ambient or hot gas temperatures. The ADRP(E)-3 and ADRH(E)-6 are available with two adjustment ranges — 0/30 and 0/80 psig. The ADRI(E) is available with a 0/55 psig, 0/75 psig and 0/100 psig adjustment ranges. The standard factory settings for all the fully adjustable types are listed in the table below.

STANDARD FACTORY SETTINGS FOR FULLY ADJUSTABLE VALVES		
VALVE MODEL	**ADJUSTMENT RANGE**	**STANDARD SETTING**
ADRI(E)	0/55	28
	0/75	38
	0/100	50
ADRS(E)-2 ADRP(E)-3 ADRHE-6	0/30	20
ADRS(E)-2 ADRP(E)-3 ADRHE-6	0/80	60

The 0/30 range on the ADRS(E), ADRP(E) and ADRHE models is intended primarily for refrigeration applications, while the 0/80 range is generally required for air conditioning systems. The capacity table shows the evaporating temperatures at which each range can be applied. Where capacities are given for both the 0/30 and 0/80, the 0/30 psig range should be used because of its greater capacity. There is generally a small difference in capacity on the ADRI(E) valves with the 0/55, 0/75 and 0/100 psig adjustment ranges. Due to the difference in gradient among the ADRI(E) adjustment ranges and greater capacity, it is best to choose the lowest adjustment range that provides the desired set point.

ADJUSTABLE REMOTE BULB HEADS ON DIRECT ACTING VALVES This type of adjustable head is generally applied only on air conditioning systems, and has limited adjustment ranges of 10 psi for Refrigerant 134a and 15 psi for other refrigerants. It utilizes an adjustable bellows assembly in the remote bulb of an air charged "cap tube/remote bulb" element. By changing the volume of the remote bulb, pressure settings within the adjustment ranges can be set. Because of the air charge, these models are affected by ambient temperatures at the remote bulb. (Although the remote bulb is affected by ambient temperature, it is strictly a pressure regulating valve and not a temperature control device.) Therefore, it is necessary to locate the remote bulb in as nearly constant ambient as possible to maintain a constant pressure setting. Figure 2 shows the remote bulb located in the return air. Any other location that has a nearly constant ambient temperature year-round can also be used. Since these models are set in 80°F ambient, any appreciable variation from this temperature will cause the pressure setting to vary. The actual pressure setting change is 1 psi for every 7°F increase or decrease in the ambient temperature.

The table below lists the standard pressure settings and adjustment ranges for these valves.

STANDARD PRESSURE SETTINGS
For Adjustable Remote Bulb Type on Air Conditioning Systems

REFRIGERANT	*VALVE OPENING PRESSURE – psig	STANDARD VALVE ADJUSTMENT RANGE – psi
22, 407C	60	55-70
134a	30	25-35
401A	38	32-44
404A	70	65-80

*Normal factory setting for a valve selected to start bypassing at an evaporator rating temperature of 32°F - 34°F.

The fully adjustable type has the definite advantage of being more flexible than the adjustable remote bulb type. However, the capacity ratings of the ADRHE-6 are considerably less than the ratings of the DRHE-6 adjustable remote bulb type. Therefore, when applying discharge bypass valves, the specific system involved will help determine which valve type is the best one for the job.

PILOT OPERATED VALVES The SHGB(E)-8 and SHGB(E)-15 are adjustable from 0 to 100 psig. The standard factory setting is 69 psig. Adjustment is made by turning the adjustment screw on the pilot valve. Turning this screw clockwise will increase the valve's setting and a counterclockwise rotation will decrease the valve's setting.

Adjusting these valves can be complicated because the load must be varied during the setting procedure. The load on the system must be decreased to lower the suction pressure so that the valve can control. The valve should then be adjusted to maintain the desired pressure. The load on the system should then be increased to raise the suction pressure above the valve setting to close the valve. Once this is accomplished, the valve setting can be checked by slowly decreasing the load until the discharge bypass valve begins to open (a hissing sound and/or an accompanying pressure rise at the outlet connection will indicate that the bypass valve has opened).

SPECIFICATIONS

Sporlan Discharge Bypass Valves utilize many of the proven construction features of our line of thermostatic expansion valves. The valves are constructed of the finest materials — those best suited for the specific purpose intended for each valve component. This ensures long life and dependable service.

Since there are numerous models available, valve designations have been made distinctly different to aid in specifying each type properly. Refer to the Ordering Instructions on Page 11 for an explanation of the valve designations.

ELEMENT DESIGNATIONS The table below lists the element and spring part numbers for each valve type. When ordering any element, the adjustment range and the valve type ***must*** be specified.

REPLACEMENT ELEMENTS

REPLACEMENT ELEMENT TYPE		FITS VALVE TYPE	STANDARD ADJUSTMENT RANGES – psig
Non-Adjustable Dome Type	D-8-①	DRS-2	Non-Adjustable
	D-3P-①	DRP-3	
	D-3H-①	DRH-6	
*Non-Adjustable Remote Bulb Type	R-8-①	DRS-2	Non-Adjustable
	R-3P-①	DRP-3	
	R-3H-①	DRH-6	
*Adjustable Remote Bulb Type	B-3P-①AR	DRP-3	25/35, 32/44 55/70, 65/80
	B-3H-①AR	DRH-6	
Adjustable Spring Type	A-4-①	ADRI-1-1/4	0/55, 0/75, 0/100
	A-8-①	ADRS-2	0/30 0/80
	A-3-①	ADRP-3	
	A-3-①	ADRH-6	

① Specify desired Pressure Setting or Range of Adjustment.
*Remote bulb element has 0.88" OD x 4.5" bulb with 5' of capillary tubing. Other lengths are available on special order and are priced the same as for special length TEV capillary tubing.

REPLACEMENT SPRING KITS

USED ON VALVE TYPE	ELEMENT PART NUMBERS (Include Standard Adjustment Ranges)	ADJUSTMENT SPRINGS	
		PART NUMBER	WIRE SIZE
ADRS-2 ADRSE-2	A-8-0/30	K-1800E-1	.156"
	A-8-0/80	K-1800E-2	.112" and .178"
ADRP-3 ADRPE-3 ADRHE-6	A-3-0/30	K-1800E-1	.156"
	A-3-0/80	K-1800E-2	.112" and .178"

The fully adjustable elements for the ADRS(E)-2, ADRP(E)-3, and ADRHE-6 are available with a choice of two adjustment ranges, 0/30 or 0/80 psig. By merely changing the adjustment spring in the element, either adjustment range can be obtained from one element. The adjustable element for the ADRI(E)-1-1/4 must be replaced if a different range of adjustment is required. However prior to 1994, the element was integral and is not replaceable. In this case, the entire valve must be replaced.

The adjustable "remote bulb" elements contain a charge of dry air as the operating pressure. The adjustability feature is a valve assembly built into the remote bulb. Since the adjustment range is limited by the air pressure in the element and bulb assembly, standard valves have been set up for "air conditioning" conditions only. However, special adjustment ranges will be considered on ***special*** order. Contact your Sporlan Representative or Sporlan, Washington, Missouri.

The fully adjustable spring elements, A3-0/80 and A3-0/30, are interchangeable between the ADRPE and ADRHE valve models. The ***air charged elements are not interchangeable*** between the DRPE and DRHE valve models.

DIRECT ACTING VALVES – MATERIALS and CONSTRUCTION DETAILS

VALVE TYPE	PORT SIZE Inches	ELEMENT TYPE and MATERIAL	CONNECTIONS		BODY MATERIAL	SEATING MATERIAL	TYPE OF JOINTS
			Type	Material			
ADRI(E)-1-1/4	5/32	Diaphragm - Stainless Steel	Solder	Copper	Brass	Metal-to-Metal	Knife Edge Metal-to-Metal
ADRS(E)-2	1/4		Solder	Copper			
			Flare	Brass			
ADRP(E)-3	3/8		Solder	Copper			
			Flare	Brass			
DRHE-6	3/4		Solder	Copper		Synthetic-to-Metal	
ADRHE-6							

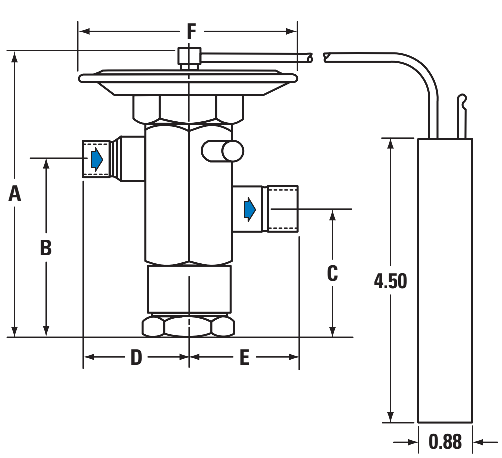
The (A)DRI(E), (A)DRS(E), (A)DRP(E) and (A)DRHE valves are all recognized components under Underwriter's Laboratories Guide Number SFJQ2, File Number SA5460. The maximum rated pressure for all models is 500 psig (3448 kPa).

DIRECT ACTING VALVES – DIMENSIONS

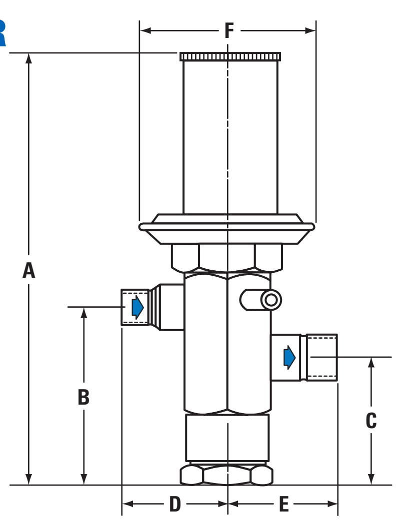
VALVE TYPE		CONNECTIONS Inches Standard Connections in **BOLD**	DIMENSIONS – Inches							WEIGHT – Pounds		INLET STRAINER Part Number
Internally Equalized	Externally Equalized①		A	B	C	D	E	F	Socket Depth	Net	Shipping	
ADJUSTABLE MODELS												
ADRI-1-1/4	ADRIE-1-1/4	**3/8 ODF**③	4.86 Max	1.79	1.38	1.69	1.33	1.94	0.31	1.25	1.50	1524-000
ADRS-2	ADRSE-2	3/8 ODF	6.44	2.50	1.94	1.44		2.75	0.31	2.00	2.25	877-3
		1/2 ODF				1.37			0.37			877-4
		5/8 ODF				1.50			0.50			877-5
		3/8 SAE				1.69	1.75		--	2.25	2.50	Not Available
		1/2 SAE				1.87	1.94		--			
		5/8 SAE				2.06	2.12		--			
ADRP-3	ADRPE-3	1/2 ODF	6.94	2.81	2.06	1.69	1.62	2.75	0.37	2.75	3.00	877-4
		5/8 ODF				1.81	1.75		0.50			877-5
		1/2 SAE				2.06			--	3.25	3.50	Not Available
		5/8 SAE				2.19			--			
Not Available	ADRHE-6	5/8 ODF	7.06	2.88	1.88	4.62		2.75	0.50	3.50	4.00	877-5
		7/8 ODF							0.75			877-7
		1-1/8 ODF							0.91			825-9
ADJUSTABLE "REMOTE BULB" MODEL ② ④												
Not Available	DRHE-6	5/8 ODF	4.88	2.88	1.88	4.62		3.62	0.50	3.50	4.00	877-5
		7/8 ODF							0.75			877-7
		1-1/8 ODF							0.91			825-9

① Standard External Equalizer connection is 1/4" ODF. 1/4" SAE Flare connection is available on request.
② The DRP(E)-3 adjustable remote bulb model is obsolete. It may be replaced by the ADRP(E)-3 adjustable model.
③ Multiple combinations of straight through and angle configurations are available. Specify connection sizes and body configurations if other than standard.
④ Air charges 0.88" OD x 4.50" bulb with 5' of capillary tubing. Other lengths are available on special order and are priced the same as for special length TEV capillary tubing.

DR



ADR



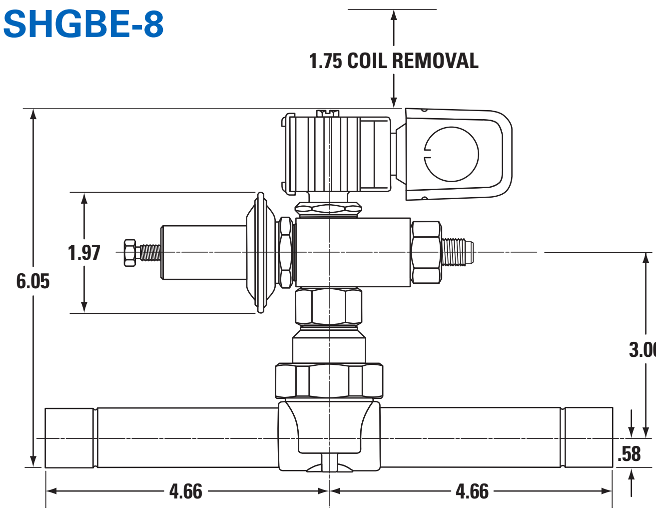
PILOT OPERATED VALVES – SPECIFICATIONS and DIMENSIONS

VALVE TYPES	PORT SIZE Inches	ADJUSTMENT RANGE – psi	CONNECTIONS ODF COPPER Inches		BODY MATERIAL	SEATING MATERIAL	SOCKET DEPTH	EXTERNAL EQUALIZER SAE	COIL	NET WEIGHT with Coil – pounds	SHIPPING WEIGHT with Coil – pounds
SHGB-8 SHGBE-8	0.43	0/100	7/8 x 7/8		Brass	Synthetic to Metal	.75	1/4"	MKC-1	3.3	3.8
			1-1/8 x 1-1/8				.91				
SHGB-15 SHGBE-15	1	0/75	1-1/8 INLET	1-1/8 OUTLET	Cast Steel		.91	–	MKC-2	5.75	6.25
			1-3/8 INLET	1-3/8 OUTLET			1.00				

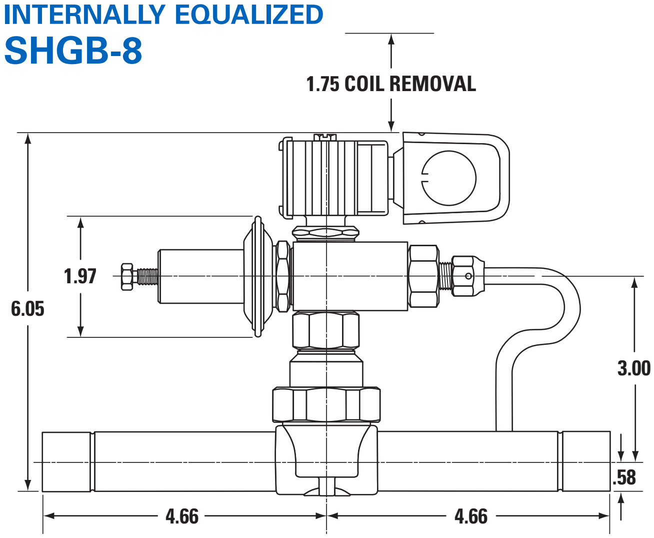
SHGB(E)-8 valves are listed by Underwriters Laboratories UL and UL_C (UL Guide Number YIOZ, File Number MH4576) for a maximum working pressure of 450 psig, MOPD = 300 psi, Maximum Fluid Temperature = 240°F, and Maximum Ambient Temperature = 120°F. For use with common refrigerants excluding ammonia.

SHGB(E)-15 valves are listed by Underwriters Laboratories (UL File Number MH4576) and Canadian Standards Association (CSA File No. LR19953-24 and LR81662-2) for a Safe Working Pressure of 450 psig Maximum Operating Pressure Differential of 300 psig. Maximum fluid temperature = 240°F, Maximum Ambient Temperature = 120°F.

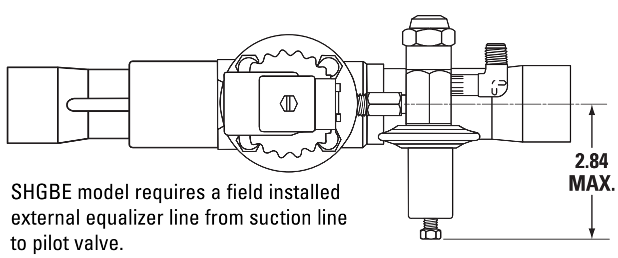
EXTERNALLY EQUALIZED
SHGBE-8



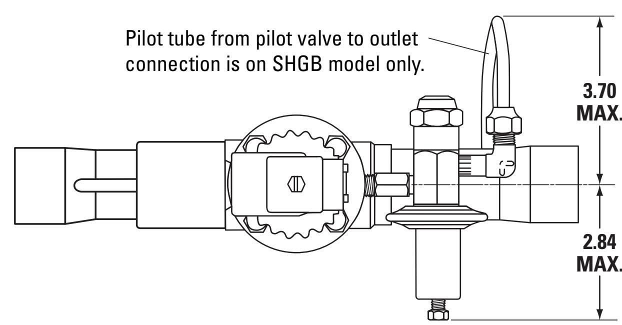
INTERNALLY EQUALIZED
SHGB-8

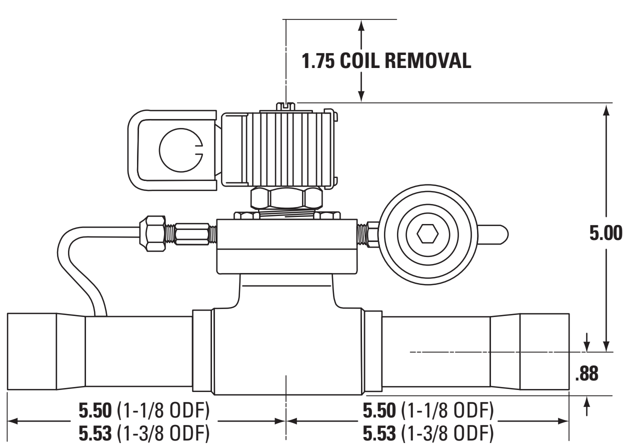


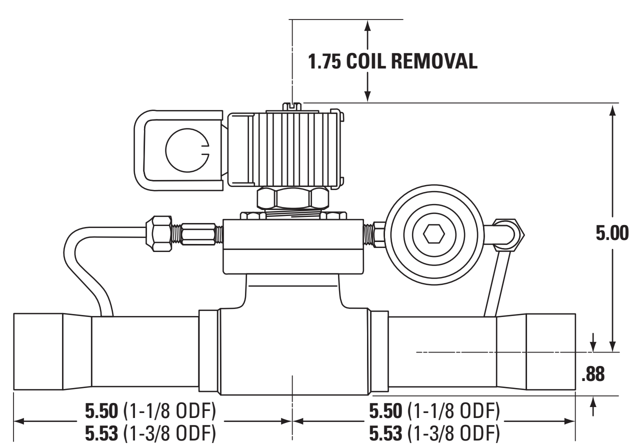
EXTERNALLY EQUALIZED
SHGBE-15



INTERNALLY EQUALIZED
SHGB-15







SELECTION PROCEDURES

The selection of a discharge bypass valve, and the necessary companion devices, is simplified ***if complete system information is available.*** This will result in the most economical selection because the components will match the system requirements.

Besides the discharge bypass valve, a specific application may require a hot gas solenoid valve, an auxiliary side connection distributor or ASC adapter, and a desuperheating TEV with a companion liquid line solenoid valve. Once the type of application (review Application Section) is determined, the necessary valves can be selected from the information discussed in this section.

DISCHARGE BYPASS VALVES The selection of a Sporlan Discharge Bypass Valve involves five basic items:

1. **Refrigerant** - valve capacities vary considerably for different refrigerants.
2. **Minimum allowable evaporating temperature at the reduced load condition** - depending on the system, this value must be set to prevent coil icing and/or compressor short cycling. For example, this may be 32°F - 34°F for a water chiller; 26°F - 28°F for a normal air conditioning system; and, the freezing temperature of the specific product for a refrigeration system.
3. **Compressor capacity (tons) at minimum allowable evaporating temperature** - consult compressor capacity ratings for this value.
4. **Minimum evaporator load (tons) at which the system is to be operated** - most systems are **not** required to operate down to zero load but this value will depend on the type of system. For example, most air conditioning systems only need to operate down to 15-25% of full load. However, air conditioning systems for data processing and "white" rooms, and most refrigeration systems may be required to bypass to zero load conditions.
5. **Condensing temperature when minimum load exists** - since the capacity ratings of the bypass valves are a function of condensing temperature, it is vital that proper head pressure is maintained, especially during low load operation. As the capacity table indicates, a condensing temperature of 80°F is considered the minimum allowable for satisfactory system operation. See Bulletin 90-30 for information on Sporlan's Head Pressure Control Valves.

The discharge bypass valve must be selected to handle the difference between items 3 and 4 above. If the minimum evaporator load (item 4) is zero, the hot gas bypass requirement is simply the compressor capacity at the minimum allowable evaporating temperature (item 3). The following discussion on Capacity Ratings and the Example show how these factors affect a selection on a typical air conditioning system.

Capacity Ratings – As the Discharge Bypass Valve Capacity Table indicates, valve ratings are dependent on the evaporating and condensing temperature ***at the reduced load condition*** and the refrigerant used. Therefore, once this information and the hot gas bypass requirement in tons is determined, a discharge bypass valve can be selected.

Where two valve capacities are shown for the same conditions — one for the 0/30 adjustment range and another for the 0/80 adjustment range — the "0/30 psig" valve should be used because of its greater capacity. Both values are listed as an aid in selecting a valve for a system with operating conditions between those shown.

As the capacity table heading indicates, these are ***valve*** capacities, ***not*** the system capacity on which the valve is applied. The ratings are the sum of the hot gas bypassed and the liquid refrigerant for desuperheating, regardless of whether the liquid is fed through the system TEV or the auxiliary desuperheating TEV. The capacities are based on an evaporator temperature change of 6°F from a closed position to the rated opening. This is a nominal rating value based on years of application experience. Since a discharge bypass valve is actually a ***pressure*** regulating valve, it should be pointed out that the capacity ratings based on a 6°F evaporator temperature change take into account that a 6°F change @ 40°F on Refrigerant 22 is a 9.1 psi change, while on Refrigerant 12 it is only 5.7 psi. The 6°F nominal change is used so all the various pressure changes do not need to be shown in the table. If additional capacity is required and a greater evaporator temperature change can be tolerated, these valves are capable of opening further. The following table lists various capacity multipliers for this purpose. For example, an ADRHE-6-0/80 rated for 9.58 tons at a 26°F evaporating temperature will start to open at 32°F (26° + 6°); and, when the evaporating temperature has dropped to 26°F, the valve will be open far enough to bypass 9.9 tons of hot gas. If a temperature change of 8°F can be tolerated, the valve would start opening at 34°F (26° + 8°) and be open far enough to bypass 9.9 times 1.15 or 11.39 tons of hot gas.

Occasionally, a bypass valve is selected for an evaporator temperature change of less than 6°F. Multipliers for those situations are also given in the table below.

CAPACITY MULTIPLIERS
for Evaporator Temperature Changes Other Than 6°F Nominal Change

EVAPORATOR TEMPERATURE CHANGE – °F	REFRIGERANT	EVAPORATOR TEMPERATURE – °F			
		40	26	20	0 and below
2	134a, 401A	0.65	0.65	0.65	0.65
	22, 402A, 404A, 407C, 507	0.72	0.70	0.70	
4	134a, 401A	0.80	0.80	0.80	0.74
	22, 402A, 404A, 407C, 507	0.87	0.85	0.85	
8	134a, 401A	1.11	1.11	1.11	1.09
	22, 402A, 404A, 407C, 507	1.17	1.15		
10	134a, 401A	1.22	1.20	1.19	1.11
	22, 402A, 404A, 407C, 507	1.34	1.27	1.25	

Example – Select a discharge bypass valve for a 30 ton Refrigerant 22 air conditioning system with 67% cylinder unloading (4 of 6 cylinders unloaded). Normal operating conditions are 45°F evaporating temperature and 120°F condensing temperature with a ***minimum*** condensing temperature of 80°F due to head pressure control.

When the evaporator load drops below the last step of cylinder unloading, it is necessary to keep the system on-the-line to maintain proper space temperatures, and avoid frosting of the coil. From the compressor manufacturer's capacity table, the compressor capacity in tons at the minimum allowable evaporating temperature is approximately 10 tons. If the system had to be on-the-line down to zero load, the bypass valve would have to bypass 10 tons of hot gas. With the necessary system factors — R-22, 26°F evaporating temperature at the reduced load condition, and 80°F condensing temperature — the capacity table is checked for a valve which can handle the ***10 tons bypass capacity:***

The DRHE-6-55/70 AR has a capacity of 13.1 tons at these conditions. Therefore, if the system must operate to zero load, this would be the proper selection.

However, if the minimum evaporator load is 4.5 tons (15% of total system capacity), an ADRPE-3-0/80 would be the proper selection (valve capacity of 4.86 tons). The only additional information necessary is the valve connections. While various connections are available, the proper valve connections must be selected to match the system's piping requirements.

DIRECT ACTING DISCHARGE BYPASS VALVE CAPACITIES – Tons

Capacities based on discharge temperatures 50°F above isentropic compression, 25°F superheat at the compressor, 10°F subcooling, and includes both the hot gas bypassed and liquid refrigerant for desuperheating, regardless of whether the liquid is fed through the system thermostatic expansion valves or an auxiliary desuperheating thermostatic expansion valve.

REFRIGERANT	VALVE TYPE	ADJUSTMENT RANGE psig	MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE AT THE REDUCED LOAD – °F																	
			40			26			20			0			-20			-40		
			CONDENSING TEMPERATURE – °F																	
			80	100	120	80	100	120	80	100	120	80	100	120	80	100	120	80	100	120
ADJUSTABLE MODELS																				
22	ADRI-1-1/4 ADRIE-1-1/4	0/55	–	–	–	0.34	0.44	0.56	0.41	0.52	0.66	0.49	0.63	0.79	0.46	0.59	0.75	0.43	0.56	0.70
		0/75	0.45	0.58	0.73	0.50	0.64	0.81	0.50	0.65	0.81	0.47	0.60	0.76	0.39	0.50	0.63	0.33	0.42	0.54
		0/100	0.41	0.53	0.67	0.42	0.54	0.67	0.41	0.53	0.66	0.38	0.49	0.62	0.34	0.44	0.56	0.31	0.40	0.50
	ADRS-2 ADRSE-2	0/30	–	–	–	–	–	–	–	–	–	3.02	3.90	4.91	2.91	3.75	4.74	2.81	3.63	4.58
		0/80	2.73	3.51	4.42	2.77	3.57	4.50	2.79	3.59	4.53	2.84	3.66	4.61	2.83	3.65	4.60	2.71	3.50	4.42
	ADRP-3 ADRPE-3	0/30	–	–	–	–	–	–	–	–	–	5.73	7.38	9.31	5.78	7.45	9.41	5.47	7.07	8.94
		0/80	4.65	5.99	7.54	4.86	6.26	7.88	4.95	6.37	8.03	5.13	6.61	8.34	5.14	6.64	8.38	4.98	6.43	8.13
	ADRHE-6	0/30	–	–	–	–	–	–	–	–	–	10.8	13.9	17.6	10.9	14.1	17.8	10.5	13.5	17.1
		0/80	7.12	9.16	11.5	7.69	9.90	12.5	7.92	10.2	12.8	8.44	10.9	13.7	8.55	11.0	13.9	8.24	10.6	13.5
134a	ADRI-1-1/4 ADRIE-1-1/4	0/55	0.30	0.40	0.51	0.31	0.41	0.53	0.31	0.41	0.53	0.29	0.38	0.49	–	–	–	–	–	–
		0/75	0.32	0.43	0.55	0.30	0.39	0.50	0.28	0.37	0.48	0.23	0.31	0.40	–	–	–	–	–	–
		0/100	0.26	0.34	0.44	0.24	0.32	0.41	0.24	0.31	0.40	0.21	0.28	0.36	–	–	–	–	–	–
	ADRS-2 ADRSE-2	0/30	–	–	–	1.97	2.60	3.34	1.94	2.56	3.30	1.87	2.46	3.18	–	–	–	–	–	–
		0/80	2.02	2.67	3.43	1.85	2.44	3.15	1.85	2.44	3.15	–	–	–	–	–	–	–	–	–
	ADRP-3 ADRPE-3	0/30	–	–	–	3.75	4.95	6.38	3.76	4.96	6.39	3.70	4.89	6.31	–	–	–	–	–	–
		0/80	3.74	4.94	6.37	3.35	4.42	5.70	3.36	4.43	5.71	–	–	–	–	–	–	–	–	–
	ADRHE-6	0/30	–	–	–	7.09	9.36	12.1	7.09	9.37	12.1	7.12	9.41	12.1	–	–	–	–	–	–
		0/80	7.07	9.34	12.0	5.50	7.26	9.36	5.53	7.31	9.41	–	–	–	–	–	–	–	–	–
401A	ADRI-1-1/4 ADRIE-1-1/4	0/55	0.34	0.45	0.57	0.36	0.47	0.60	0.36	0.47	0.59	0.34	0.44	0.56	–	–	–	–	–	–
		0/75	0.37	0.48	0.61	0.34	0.45	0.57	0.33	0.42	0.54	0.27	0.36	0.45	–	–	–	–	–	–
		0/100	0.30	0.39	0.49	0.28	0.37	0.47	0.27	0.36	0.45	0.25	0.32	0.41	–	–	–	–	–	–
	ADRS-2 ADRSE-2	0/30	–	–	–	2.28	2.97	3.77	2.26	2.93	3.72	2.18	2.83	3.59	–	–	–	–	–	–
		0/80	2.12	2.76	3.50	2.14	2.79	3.54	2.15	2.79	3.54	2.11	2.74	3.48	–	–	–	–	–	–
	ADRP-3 ADRPE-3	0/30	–	–	–	4.36	5.66	7.19	4.36	5.67	7.20	4.32	5.62	7.14	–	–	–	–	–	–
		0/80	3.81	4.95	6.28	3.88	5.04	6.40	3.90	5.06	6.43	3.85	5.01	6.36	–	–	–	–	–	–
	ADRHE-6	0/30	–	–	–	8.23	10.7	13.6	8.24	10.7	13.6	8.30	10.8	13.7	–	–	–	–	–	–
		0/80	6.15	7.99	10.1	6.36	8.26	10.5	6.41	8.32	10.6	6.40	8.32	10.6	–	–	–	–	–	–
402A	ADRI-1-1/4 ADRIE-1-1/4	0/55	–	–	–	–	–	–	–	–	–	0.52	0.66	0.81	0.55	0.69	0.85	0.51	0.64	0.78
		0/75	–	–	–	0.52	0.65	0.80	0.55	0.70	0.85	0.57	0.72	0.88	0.50	0.63	0.77	0.41	0.52	0.63
		0/100	0.43	0.54	0.65	0.47	0.60	0.73	0.48	0.60	0.74	0.46	0.57	0.70	0.41	0.52	0.64	0.37	0.47	0.57
	ADRS-2 ADRSE-2	0/30	–	–	–	–	–	–	–	–	–	–	–	–	3.35	4.22	5.17	3.22	4.06	4.98
		0/80	–	–	–	3.10	3.91	4.79	3.12	3.93	4.81	3.18	4.00	4.90	3.21	4.04	4.96	3.14	3.96	4.85
	ADRP-3 ADRPE-3	0/30	–	–	–	–	–	–	–	–	–	–	–	–	6.44	8.11	9.94	6.41	8.08	9.91
		0/80	–	–	–	5.29	6.66	8.16	5.38	6.78	8.30	5.69	7.16	8.77	5.82	7.33	8.98	5.73	7.23	8.86
	ADRHE-6	0/30	–	–	–	–	–	–	–	–	–	–	–	–	12.2	15.3	18.6	12.3	15.5	18.8
		0/80	–	–	–	8.16	10.3	12.6	8.43	10.6	13.0	9.26	11.7	14.3	9.65	12.2	14.9	9.59	12.1	14.8
404A & 507	ADRI-1-1/4 ADRIE-1-1/4	0/55	–	–	–	–	–	–	–	–	–	0.53	0.67	0.83	0.54	0.68	0.84	0.49	0.63	0.77
		0/75	–	–	–	0.53	0.67	0.83	0.55	0.71	0.87	0.56	0.71	0.87	0.48	0.61	0.75	0.39	0.50	0.62
		0/100	0.43	0.55	0.68	0.47	0.60	0.74	0.47	0.60	0.74	0.44	0.56	0.70	0.40	0.51	0.63	0.36	0.45	0.56
	ADRS-2 ADRSE-2	0/30	–	–	–	–	–	–	–	–	–	–	–	–	3.29	4.17	5.15	3.16	4.01	4.95
		0/80	–	–	–	3.08	3.91	4.82	3.10	3.93	4.85	3.15	4.00	4.93	3.17	4.02	4.96	3.08	3.90	4.82
	ADRP-3 ADRPE-3	0/30	–	–	–	–	–	–	–	–	–	–	–	–	6.38	8.08	9.97	6.27	7.95	9.81
		0/80	–	–	–	5.28	6.70	8.26	5.38	6.81	8.41	5.65	7.16	8.84	5.75	7.28	9.00	5.63	7.13	8.80
	ADRHE-6	0/30	–	–	–	–	–	–	–	–	–	–	–	–	12.0	15.3	18.7	12.1	15.4	18.9
		0/80	–	–	–	8.19	10.4	12.8	8.45	10.7	13.2	9.23	11.7	14.4	9.53	12.1	14.9	9.4	11.9	14.7
407C	ADRI-1-1/4 ADRIE-1-1/4	0/55	–	–	–	0.48	0.61	0.77	0.54	0.69	0.86	0.58	0.74	0.93	0.53	0.68	0.85	–	–	–
		0/75	0.61	0.78	0.97	0.61	0.78	0.97	0.60	0.77	0.96	0.53	0.68	0.85	0.43	0.56	0.69	–	–	–
		0/100	0.51	0.65	0.81	0.50	0.63	0.79	0.48	0.62	0.77	0.44	0.56	0.70	0.39	0.50	0.62	–	–	–
	ADRS-2 ADRSE-2	0/30	–	–	–	–	–	–	–	–	–	3.52	4.51	5.63	3.38	4.33	5.41	–	–	–
		0/80	3.32	4.25	5.30	3.32	4.25	5.30	3.33	4.27	5.32	3.36	4.31	5.38	3.30	4.23	5.28	–	–	–
	ADRP-3 ADRPE-3	0/30	–	–	–	–	–	–	–	–	–	6.74	8.63	10.8	6.74	8.64	10.8	–	–	–
		0/80	5.86	7.50	9.36	5.86	7.50	9.36	5.95	7.61	9.50	6.10	7.81	9.75	6.02	7.71	9.63	–	–	–
	ADRHE-6	0/30	–	–	–	–	–	–	–	–	–	12.7	16.3	20.3	12.8	16.5	20.5	–	–	–
		0/80	9.43	12.1	15.1	9.43	12.1	15.1	9.67	12.4	15.5	10.1	13.0	16.2	10.1	12.9	16.1	–	–	–

ADJUSTABLE "REMOTE BULB" DISCHARGE BYPASS VALVE CAPACITIES – Tons

Capacities based on discharge temperatures 50°F above isentropic compression, 25°F superheat at the compressor, 10°F subcooling, and includes both the hot gas bypassed and liquid refrigerant for desuperheating, regardless of whether the liquid is fed through the system thermostatic expansion valves or an auxiliary desuperheating thermostatic expansion valve.

REFRIG-ERANT	VALVE TYPE	ADJUST-MENT RANGE psig	MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE AT THE REDUCED LOAD – °F																	
			40			26			20			0			-20			-40		
			CONDENSING TEMPERATURE – °F																	
			80	100	120	80	100	120	80	100	120	80	100	120	80	100	120	80	100	120
*ADJUSTABLE "REMOTE BULB" MODELS																				
22	DRHE-6	55/70	14.9	19.8	24.6	13.1	16.9	21.2	These models are recommended for air conditioning temperature ranges only.											
134a	DRHE-6	25/35	7.30	9.64	12.4	6.29	8.31	10.7												
401A	DRHE-6	32/44	8.43	11.0	13.9	7.30	9.49	12.0												
404A	DRHE-6	65/80	–	–	–	16.9	21.4	25.3												
407C	DRHE-6	55/70 or 32/44	17.7	22.9	27.9	15.1	19.3	23.9												

*The DRP(E) adjustable remote bulb is obsolete. It may be replaced with the ADRP(E) adjustable model.

PILOT OPERATED DISCHARGE BYPASS VALVE CAPACITIES – Tons

Capacities based on discharge temperatures 50°F above isentropic compression, 25°F superheat at the compressor, 10°F subcooling, and includes both the hot gas bypassed and liquid refrigerant for desuperheating, regardless of whether the liquid is fed through the system thermostatic expansion valves or an auxiliary desuperheating thermostatic expansion valve. Valve capacity is based on the valve stroked fully open.

REFRIGERANT	VALVE TYPE	MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE AT THE REDUCED LOAD – °F																	
		40			26			20			0			-20			-40		
		CONDENSING TEMPERATURE – °F																	
		80	100	120	80	100	120	80	100	120	80	100	120	80	100	120	80	100	120
ADJUSTABLE MODELS																			
22	SHGB-8 SHGBE-8	11.5	15.5	19.9	12.1	15.8	20.1	12.2	15.9	20.1	12.4	16.1	20.3	12.5	16.2	20.5	12.7	16.4	20.8
	SHGB-15 SHGBE-15	43.0	61.0	80.9	47.4	64.7	84.5	48.7	65.9	85.6	52.6	69.6	89.3	55.3	72.5	92.3	57.4	74.9	95.1
134a	SHGB-8 SHGBE-8	7.9	10.8	14.0	8.2	10.9	14.0	8.2	10.9	14.0	8.3	11.0	14.1	–	–	–	–	–	–
	SHGB-15 SHGBE-15	30.6	44.2	59.5	33.2	46.4	61.3	34.1	47.1	62.0	36.4	49.2	64.1	–	–	–	–	–	–
401A	SHGB-8 SHGBE-8	7.8	10.6	13.8	8.0	10.7	13.9	8.1	10.7	13.9	8.2	10.8	14.0	–	–	–	–	–	–
	SHGB-15 SHGBE-15	29.6	42.9	58.1	32.4	45.4	60.2	33.3	46.1	60.9	35.7	48.3	63.3	–	–	–	–	–	–
402A	SHGB-8 SHGBE-8	12.7	16.9	21.1	13.4	17.2	21.2	13.5	17.2	21.2	13.6	17.3	21.4	13.8	17.4	21.5	13.9	17.6	21.7
	SHGB-15 SHGBE-15	47.6	66.6	85.8	52.5	70.4	88.8	54.0	71.6	90.1	57.7	75.2	93.8	60.8	77.9	96.5	62.9	80.1	98.9
404A & 507	SHGB-8 SHGBE-8	13.0	17.2	21.5	13.5	17.5	21.6	13.6	17.5	21.6	13.8	17.6	21.8	13.9	17.6	21.8	14.0	17.7	22.0
	SHGB-15 SHGBE-15	48.6	67.9	87.8	53.2	71.6	90.9	54.8	72.9	91.9	58.8	76.6	95.5	61.5	78.9	97.7	63.4	80.8	100.0
407C	SHGB-8 SHGBE-8	11.7	15.9	20.5	12.2	16.1	20.6	12.2	16.1	20.6	12.4	16.3	20.8	12.5	16.4	21.0	–	–	–
	SHGB-15 SHGBE-15	44.6	64.0	85.5	48.8	67.7	88.8	50.1	68.8	89.7	53.8	72.1	93.3	56.3	74.7	96.1	–	–	–

VALVE DESIGNATION/ORDERING INSTRUCTIONS

When ordering **any** Discharge Bypass Valve, completely specify the valve by including all the applicable information:

DIRECT ACTING VALVE

A	DR	H	E	6	0/80	AR	7/8” ODF
Fully Adjustable 0/30 or 0/80 psig or 0/55 psig (ADRI)	**Valve Type** **D**ischarge **R**egulating	**Body Style** I, S, P or H	**External Equalizer** Omit if Internally Equalized	**Port Size** in Eighths of an Inch	**Adjustment Range** 0/30, 0/80, 55/70, etc.	**Adjustable** Remote Bulb	**Connections** Solder or SAE Flare

PILOT OPERATED VALVE

S	HGB	E	– 8	– 0/100	– 7/8"
Solenoid Stop Feature	**Valve Type - Hot Gas Bypass**	**External Equalizer - 1/4" SAE** Omit if Internally Equalized	**Valve Size**	**Adjustment Range - psi**	**Connections - ODF Solder** 7/8” ODF 1-1/8" ODF

HOT GAS SOLENOID VALVES The selection of a Sporlan Hot Gas Solenoid Valve involves some of the same basic items already determined for the selection of the discharge bypass valve plus one additional factor:

1. **Refrigerant.**
2. **Minimum allowable evaporating temperature at the reduced load condition.**
3. **Hot gas bypass requirement in tons** - this is **not** the bypass valve capacity.
4. **Allowable pressure drop across valve port** - since excessive pressure drop across the solenoid valve reduces the capacity of the DBV, the maximum pressure drop for a Refrigerant 134a system should be approximately 5 psi and for a Refrigerant 22 system approximately 10 psi.

Capacity Ratings – Once the data listed above is determined, the appropriate solenoid valve can be easily selected from the capacity table. Since the capacities for a given solenoid valve vary considerably with a ***slight*** change in pressure drop, the best selection is the one which keeps the pressure drop as low as possible while matching the solenoid valve and bypass valve connections.

Example – Based on the data for the earlier DBV selection: Refrigerant 22, 26°F minimum allowable evaporating temperature at the reduced load condition, and either 10 tons or 4.5 tons as the hot gas bypass requirement, the best solenoid valve selection for each case would be:

For 10 tons: MB25S2, 7/8" or 1-1/8" ODF connections, and the necessary voltage and cycles.

For 4.5 tons: MB14S2, 5/8" ODF connections, and the necessary voltage and cycles.

The MB25S2 and MB14S2 would have a pressure drop of less than 5 psi. Both selections depend on whether adequate condensing pressure is maintained year round with some form of head pressure control. See Bulletin 90-30 for Sporlan's Head Pressure Control Systems.

HOT GAS SOLENOID VALVE CAPACITIES – Tons

Capacities based on 100°F condensing temperature, isentropic compression plus 50°F, 40°F evaporator and 65°F suction gas. For other evaporator conditions use the multipliers in the table below.

VALVE TYPE		CONNECTIONS Inches	REFRIGERANTS													
"A" & "B" Series	"E" Series Extended Connections		22		134a		401A		402A		404A		407C		507	
			PRESSURE DROP ACROSS VALVE PORT – psi													
			5	10	5	10	5	10	5	10	5	10	5	10	5	10
A3F1	–	1/4 SAE	0.38	0.52	0.31	0.42	0.34	0.47	0.33	0.47	0.34	0.48	0.39	0.54	0.33	0.46
A3S1	–	1/4 or 3/8 ODF														
–	E5S120	1/4 ODF	0.89	1.25	0.74	1.02	0.80	1.12	0.79	1.12	0.81	1.14	0.75	1.07	0.79	1.10
–	E5S130	3/8 ODF														
MB6F1	–	3/8 SAE	1.55	2.15	1.27	1.74	1.39	1.91	1.38	1.92	1.41	1.96	1.38	1.94	1.37	1.90
MB6S1	ME6S130	3/8 ODF														
MB6S1	ME6S140	1/2 ODF														
MB9F2	–	3/8 SAE	2.22	3.11	1.84	2.55	2.00	2.79	1.97	2.77	2.02	2.83	2.24	3.16	1.95	2.74
–	ME9S230	3/8 ODF														
MB9S2	ME9S240	1/2 ODF														
MB10F2	–	1/2 SAE	3.45	4.81	2.84	3.92	3.10	4.29	3.07	4.28	3.13	4.38	3.05	4.31	3.04	4.24
–	ME10S240	1/2 ODF														
MB10S2	ME10S250	5/8 ODF														
MB14S2	ME14S250	5/8 ODF	4.69	6.55	3.87	5.36	4.22	5.86	4.17	5.83	4.26	5.96	4.34	6.13	4.13	5.78
MB19S2	ME19S250	5/8 ODF	6.93	9.69	5.72	7.93	6.24	8.68	6.15	8.62	6.29	8.81	6.57	9.31	6.10	8.54
MB25S2	ME19S270	7/8 ODF														
MB25S2	ME25S270	7/8 ODF	11.1	15.5	9.14	12.7	9.96	13.9	9.83	13.8	10.1	14.1	11.3	15.9	9.74	13.6
MB25S2	ME25S290	1-1/8 ODF														

CORRECTION FACTORS

for evaporator temperatures at the reduced load condition

EVAPORATOR TEMPERATURE °F	40	26	20	0	-20	-40
MULTIPLIER	1.00	.95	.93	.87	.81	.75

For complete specifications on these solenoid valves, refer to Bulletin 30-10.

DESUPERHEATING THERMOSTATIC EXPANSION VALVES The proper selection procedure for a Sporlan Desuperheating TEV involves some of the same items already determined for the selection of the discharge bypass valve plus one additional item:

1. **Refrigerant.**
2. **Minimum allowable evaporating temperature at the reduced load condition.**
3. **Hot gas bypass requirement in tons** - this is ***not*** the bypass valve capacity.
4. **Capacity multiplier from bottom of DBV capacity table** - Since a small amount of **liquid** refrigerant controlled by the TEV can desuperheat the bypassed hot gas, this multiplier determines the amount necessary for the specific operating conditions.

The required capacity of the desuperheating TEV is item 3 multiplied by item 4. Once this capacity is determined, the valve can be selected from the capacity table on pages 14 and 15. The proper thermostatic charge is selected from the table below. Each charge is applicable over the range of evaporating temperatures shown in the table for various refrigerants.

Capacity Ratings – As the TEV capacity table shows, valve ratings are based on the evaporating temperature at the reduced load condition and the pressure drop that exists across the valve. The actual pressure drop available is a function of the condensing pressure and the equivalent evaporating pressure, plus any pressure losses in the liquid line. Or, the difference between the inlet pressure of the TEV and the pressure equivalent to the evaporating temperature at the reduced load condition.

The condensed capacity table on pages 14 and 15 covers the air conditioning temperature range only with models having both SAE and ODF connections (G and C valves have SAE connections and EG and S valves have ODF connections). The models shown are applicable to the majority of hot gas bypass requirements. For applications beyond the temperature range and capacity sizes, refer to Bulletin 10-10.

CAPACITY MULTIPLIERS – DESUPERHEATING THERMOSTATIC EXPANSION VALVES

REFRIGERANT	MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE AT THE REDUCED LOAD – °F																	
	40			26			20			0			-20			-40		
	CONDENSING TEMPERATURE – °F																	
	80	100	120	80	100	120	80	100	120	80	100	120	80	100	120	80	100	120
22	0.19	0.24	0.28	0.22	0.26	0.31	0.23	0.27	0.32	0.27	0.31	0.36	0.31	0.36	0.41	0.35	0.40	0.45
134a & 401A	0.21	0.26	0.31	0.24	0.29	0.33	0.25	0.30	0.35	0.29	0.34	0.39	–	–	–	–	–	–
402A, 404A & 507	0.24	0.30	0.37	0.28	0.34	0.42	0.29	0.35	0.43	0.33	0.40	0.48	0.38	0.44	0.53	0.43	0.49	0.58
407C	0.25	0.30	0.35	0.28	0.33	0.38	0.29	0.34	0.39	0.33	0.38	0.43	0.37	0.42	0.48	–	–	–

Example – Based on the data for the DBV selection example: Refrigerant 22, 26°F minimum allowable evaporating temperature at the reduced load condition (50 psig), 80°F condensing temperature (144 psig), and either 10 tons or 4.5 tons as the hot gas bypass requirement, the following selection procedures are used:

For 10 tons: Required TEV capacity is 10 tons times .22 (capacity multiplier from bottom of DBV Capacities Table) or 2.2 tons. The pressure drop across valve would be approximately 144 minus 50 or 94 psi.

Assuming the system required an externally equalized, solder type valve, the best selection is the SVE-2. On systems bypassing to zero load, it is better to use the valve that has a capacity nearest to the desuperheating requirement rather than the larger model. From the Thermostatic Charge Selection Table, an L1 charge is selected for Refrigerant 22 at 26°F evaporating temperature and 25°F suction gas superheat. Therefore, the complete valve specification is SVE-2-L1, 1/2” x 5/8” ODF - 5’.

For 4.5 tons: Required capacity is 4.5 tons times .22 or .99 tons. The pressure drop would be approximately the same as for ***10 ton*** requirement, 94 psi. Therefore, the complete valve specification is EGVE-1-L1, 3/8” x 1/2” ODF - 5’.

***THERMOSTATIC CHARGES**
for desuperheating thermostatic expansion valves

<table>
<tr><th rowspan="2">REFRIGERANT</th><th rowspan="2">*SUCTION GAS SUPERHEAT °F</th><th colspan="2">MINIMUM ALLOWABLE EVAPORATING TEMPERATURE at Reduced Load Condition °F</th></tr>
<tr><th>40 thru -15</th><th>-16 thru -40</th></tr>
<tr><td rowspan="3">134a, 401A</td><td>25</td><td rowspan="2">L2</td><td>L1</td></tr>
<tr><td>35</td><td rowspan="2">L2</td></tr>
<tr><td>45</td><td>L3</td></tr>
<tr><td rowspan="3">22, 407C</td><td>25</td><td rowspan="2">L1</td><td rowspan="2">L1</td></tr>
<tr><td>35</td></tr>
<tr><td>45</td><td>L2</td><td>L2</td></tr>
<tr><td rowspan="2">402A, 404A, 507</td><td>35</td><td rowspan="2">L1</td><td rowspan="2">L1</td></tr>
<tr><td>45</td></tr>
</table>

*For suction gas temperatures that require superheats other that those listed above, contact Sporlan, or the compressor manufacturer for assistance.

Bulb Size for desuperheating thermostatic expansion valve types G, EG, C, and S is 1/2” x 3-1/2” for thermostatic charges L1, L2, and L3.

Liquid Line Solenoid Valve – On some systems it may be necessary to add a small solenoid valve ahead of the desuperheating TEV for pump down control. This occurs when the main liquid line solenoid valve is located near the system TEV, and it is impractical to connect the liquid line for the desuperheating TEV downstream of the main solenoid valve. In these cases the small solenoid valve can be selected from the table on page 16 by matching the connections with the inlet connection of the desuperheating TEV. Complete details on solenoid valves are given in Bulletin 30-10.

DISTRIBUTOR WITH AUXILIARY SIDE CONNECTION OR AUXILIARY SIDE CONNECTOR (ASC) – Many times the distributor with an auxiliary side connection (Series 1650R) is selected and installed by the original equipment manufacturer. When it is applied in the field, its selection depends on the system's main thermostatic expansion valve and the evaporator coil. This is discussed in the Application Section.

The ASC is normally selected and applied in the field. The basic requirement is that it match the TEV and the distributor on the system. If the part number of the refrigerant distributor is available, the ASC can be selected from the table to the right by matching the appropriate numbers.

DISTRIBUTORS and AUXILIARY SIDE CONNECTORS

DISTRIBUTOR TYPE NUMBER	ASC TYPE NUMBER	ASC CONNECTION SIZES Inches		
		INLET ODM	OUTLET ODF	AUXILIARY ODF
1620, 1622	ASC-5-4	5/8	5/8	1/2
1112, 1113	ASC-7-4	7/8	7/8	1/2
1115, 1116	ASC-9-5	1-1/8	1-1/8	5/8
1117, 1126, 1128	ASC-11-7	1-3/8	1-3/8	7/8
1125, 1127, 1143	ASC-13-9	1-5/8	1-5/8	1-1/8

DESUPERHEATING THERMOSTATIC EXPANSION VALVE CAPACITIES – Tons

VALVE TYPE				MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE – °F		STANDARD CONNECTIONS Inches	
INTERNALLY EQUALIZED		EXTERNALLY EQUALIZED				G & C	EG & S
SAE	ODF	SAE	ODF	40	20	SAE	ODF
REFRIGERANT 22							
GV-1/5	EGV-1/5	GVE-1/5	EGVE-1/5	0.20	0.22	1/4 X 1/2	3/8 X 1/2
GV-1/3	EGV-1/3	GVE-1/3	EGVE-1/3	0.35	0.38		
GV-1/2	EGV-1/2	GVE-1/2	EGVE-1/2	0.45	0.49	3/8 X 1/2	
GV-3/4	EGV-3/4	GVE-3/4	EGVE-3/4	0.75	0.82		
GV-1	EGV-1	GVE-1	EGVE-1	1.00	1.09		
GV-1-1/2	EGV-1-1/2	GVE-1-1/2	EGVE-1-1/2	1.60	1.74		
CV-2	SV-2	GVE-2	SVE-2	2.00	2.18		1/2 X 5/8
CV-3	SV-3	GVE-3	SVE-3	3.20	3.49		
CV-4	SV-4	CVE-4	SVE-4	4.50	4.90		1/2 X 7/8
CV-5	SV-5	CVE-5	SVE-5	5.20	5.67		
–	–	CVE-8	SVE-8	8.00	8.72	1/2 X 5/8	5/8 X 7/8
REFRIGERANT 134a							
GJ-1/8	EGJ-1/8	GJE-1/8	EGJE-1/8	0.15	0.15	1/4 X 1/2	3/8 X 1/2
GJ-1/6	EGJ-1/6	GJE-1/6	EGJE-1/6	0.25	0.28		
GJ-1/4	EGJ-1/4	GJE-1/4	EGJE-1/4	0.31	0.35		
GJ-1/2	EGJ-1/2	GJE-1/2	EGJE-1/2	0.60	0.60	3/8 X 1/2	
GJ-1	EGJ-1	GJE-1	EGJE-1	1.21	1.20		
GJ-1-1/2	EGJ-1-1/2	GJE-1-1/2	EGJE-1-1/2	1.93	1.91		
CJ-2	SJ-2	GJE-2	SJE-2	2.41	2.39		1/2 X 5/8
CJ-2-1/2	SJ-2-1/2	CJE-2-1/2	SJE-2-1/2	3.01	2.99		1/2 X 7/8
CJ-3	SJ-3	CJE-3	SJE-3	3.62	3.59		
–	–	CJE-5	SJE-5	6.03	4.98	1/2 X 5/8	5/8 X 7/8
–	–	–	SJE-6	7.23	5.98	–	
REFRIGERANT 401A							
GX-1/8	EGX-1/8	GXE-1/8	EGXE-1/8	0.16	0.16	1/4 X 1/2	3/8 X 1/2
GX-1/6	EGX-1/6	GXE-1/6	EGXE-1/6	0.27	0.30		
GX-1/4	EGX-1/4	GXE-1/4	EGXE-1/4	0.34	0.37		
GX-1/2	EGX-1/2	GXE-1/2	EGXE-1/2	0.65	0.65	3/8 X 1/2	
GX-1	EGX-1	GXE-1	EGXE-1	1.29	1.29		
GX-1-1/2	EGX-1-1/2	GXE-1-1/2	EGXE-1-1/2	2.07	2.07		
CX-2	SX-2	CXE-2	SXE-2	2.59	2.59		1/2 X 5/8
CX-2-1/2	SX-2-1/2	CXE-2-1/2	SXE-2-1/2	3.23	3.24		1/2 X 7/8
CX-3	SX-3	CXE-3	SXE-3	3.88	3.88		
–	–	CXE-5	SXE-5	6.47	5.39	1/2 X 5/8	5/8 X 7/8
–	–	–	SXE-6	7.76	6.47	–	
REFRIGERANT 402A							
GL-1/8	EGL-1/8	GLE-1/8	EGLE-1/8	0.15	0.16	1/4 X 1/2	3/8 X 1/2
GL-1/6	EGL-1/6	GLE-1/6	EGLE-1/6	0.23	0.24		
GL-1/4	EGL-1/4	GLE-1/4	EGLE-1/4	0.29	0.31		
GL-1/2	EGL-1/2	GLE-1/2	EGLE-1/2	0.56	0.59	3/8 X 1/2	
GL-1	EGL-1	GLE-1	EGLE-1	1.02	1.10		
GL-1-1/2	EGL-1-1/2	GLE-1-1/2	EGLE-1-1/2	1.52	1.61		
CL-2	SL-2	GLE-2	SLE-2	2.03	2.14		1/2 X 5/8
CL-3	SL-3	CLE-3	SLE-3	2.85	3.00		1/2 X 7/8
CL-4	SL-4	CLE-4	SLE-4	4.07	4.28		
–	SL-6	CLE-6	SLE-6	5.59	5.12	1/2 X 5/8	5/8 X 7/8
–	–	–	SLE-7	7.12	6.51	–	

DESUPERHEATING THERMOSTATIC EXPANSION VALVE CAPACITIES – Tons

VALVE TYPE				MINIMUM ALLOWABLE EVAPORATOR TEMPERATURE – °F		STANDARD CONNECTIONS Inches	
INTERNALLY EQUALIZED		EXTERNALLY EQUALIZED				G & C	EG & S
SAE	ODF	SAE	ODF	40	20	SAE	ODF
REFRIGERANT 404A							
GS-1/8	EGS-1/8	GSE-1/8	EGSE-1/8	0.15	0.16	1/4 X 1/2	3/8 X 1/2
GS-1/6	EGS-1/6	GSE-1/6	EGSE-1/6	0.23	0.24		
GS-1/4	EGS-1/4	GSE-1/4	EGSE-1/4	0.29	0.31		
GS-1/2	EGS-1/2	GSE-1/2	EGSE-1/2	0.56	0.59	3/8 X 1/2	
GS-1	EGS-1	GSE-1	EGSE-1	1.02	1.10		
GS-1-1/2	EGS-1-1/2	GSE-1-1/2	EGSE-1-1/2	1.53	1.60		
CS-2	SS-2	GSE-2	SSE-2	2.04	2.14		1/2 X 5/8
CS-3	SS-3	CSE-3	SSE-3	2.86	3.00		1/2 X 7/8
CS-4	SS-4	CSE-4	SSE-4	4.08	4.28		
–	SS-6	CSE-6	SSE-6	5.61	5.11	1/2 X 5/8	5/8 X 7/8
–	–	–	SSE-7	7.14	6.51	–	
REFRIGERANT 407C							
GN-1/5	EGN-1/5	GNE-1/5	EGNE-1/5	0.18	0.20	1/4 X 1/2	3/8 X 1/2
GN-1/3	EGN-1/3	GNE-1/3	EGNE-1/3	0.32	0.35		
GN-1/2	EGN-1/2	GNE-1/2	EGNE-1/2	0.41	0.44	3/8 X 1/2	
GN-3/4	EGN-3/4	GNE-3/4	EGNE-3/4	0.69	0.74		
GN-1	EGN-1	GNE-1	EGNE-1	0.92	0.99		
GN-1-1/2	EGN-1-1/2	GNE-1-1/2	EGNE-1-1/2	1.47	1.58		
CN-2	SN-2	GNE-2	SNE-2	1.84	1.97		1/2 X 5/8
CN-3	SN-3	GNE-3	SNE-3	2.94	3.16		
CN-4	SN-4	CNE-4	SNE-4	4.14	4.44		1/2 X 7/8
CN-5	SN-5	CNE-5	SNE-5	4.78	5.13		
–	–	CNE-8	SNE-8	7.35	7.89	1/2 X 5/8	5/8 X 7/8
REFRIGERANT 507							
GP-1/8	EGP-1/8	GPE-1/8	EGPE-1/8	0.14	0.15	1/4 X 1/2	3/8 X 1/2
GP-1/6	EGP-1/6	GPE-1/6	EGPE-1/6	0.22	0.24		
GP-1/4	EGP-1/4	GPE-1/4	EGPE-1/4	0.29	0.30		
GP-1/2	EGP-1/2	GPE-1/2	EGPE-1/2	0.55	0.58	3/8 X 1/2	
GP-1	EGP-1	GPE-1	EGPE-1	1.00	1.08		
GP-1-1/2	EGP-1-1/2	GPE-1-1/2	EGPE-1-1/2	1.50	1.57		
CP-2	SP-2	GPE-2	SPE-2	2.00	2.09		1/2 X 5/8
CP-3	SP-3	CPE-3	SPE-3	2.79	2.93		1/2 X 7/8
CP-4	SP-4	CPE-4	SPE-4	3.99	4.19		
–	SP-6	CPE-6	SPE-6	5.49	5.00	1/2 X 5/8	5/8 X 7/8
–	–	–	SPE-7	6.99	6.36	–	

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV – °F														
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140
	CORRECTION FACTOR, CF LIQUID TEMPERATURE														
22	1.56	1.51	1.45	1.40	1.34	1.29	1.23	1.17	1.12	1.06	1.00	0.94	0.88	0.82	0.76
134a	1.70	1.63	1.56	1.49	1.42	1.36	1.29	1.21	1.14	1.07	1.00	0.93	0.85	0.78	0.71
401A	1.60	1.54	1.48	1.43	1.36	1.31	1.25	1.19	1.13	1.06	1.00	0.94	0.87	0.80	0.74
402A	2.01	1.91	1.82	1.72	1.62	1.52	1.42	1.32	1.22	1.11	1.00	0.89	0.77	0.65	0.53
404A	2.04	1.94	1.84	1.74	1.64	1.54	1.43	1.33	1.22	1.11	1.00	0.89	0.77	0.65	0.53
407C	1.69	1.62	1.55	1.49	1.42	1.35	1.28	1.21	1.14	1.07	1.00	0.93	0.85	0.77	0.69
507	1.99	1.89	1.79	1.69	1.59	1.50	1.40	1.30	1.20	1.10	1.00	0.89	0.78	0.66	0.51

These factors include corrections for liquid refrigerant density and net refrigerating effect and are based on an evaporator temperature of 0°F. However, they may be used for any evaporator temperature from -40°F to 40°F since the variation in the actual factors across this range is insignificant.

FOR REFRIGERANTS 134a, 402A

EVAPORATOR TEMPERATURE °F	PRESSURE DROP ACROSS TEV – psi							
	20	40	60	80	100	120	140	160
	CORRECTION FACTOR, CF PRESSURE DROP							
40	0.58	0.82	1.00	1.15	1.29	1.41	1.53	1.63
20 & 0	0.50	0.71	0.87	1.00	1.12	1.22	1.32	1.41

TEV capacity = TEV rating x CF liquid temperature x CF pressure drop—Example: Actual capacity of a nominal 2 ton R-22 Type S valve at 20°F evaporator, 100 psi pressure drop across the TEV, and 90°F liquid temperature entering the TEV = 2.18 (from rating chart) x 1.06 (CF liquid temperature) x 0.89 (CF pressure drop) = 2.06 tons.

FOR REFRIGERANTS 22, 401A, 404A, 407C, 507

EVAPORATOR TEMPERATURE °F	PRESSURE DROP ACROSS TEV – psi											
	30	50	75	100	125	150	175	200	225	250	275	300
	CORRECTION FACTOR, CF PRESSURE DROP											
40	0.55	0.71	0.87	1.00	1.12	1.22	1.32	1.41	1.50	1.58	1.66	1.73
20 & 0	0.49	0.63	0.77	0.89	1.00	1.10	1.18	1.26	1.34	1.41	1.48	1.55

TEV capacity = TEV rating x CF liquid temperature x CF pressure drop—Example: Actual capacity of a nominal 1-1/2 ton R-404A Type EG valve at -20°F evaporator, 125 psi pressure drop across the TEV, and 60°F liquid temperature entering the TEV = 1.26 (from rating chart) x 1.43 (CF liquid temperature) x 0.91 (CF pressure drop) = 1.64 tons.

LIQUID LINE SOLENOID VALVE CAPACITY SELECTION TABLE

TYPE NUMBER				CONNECTION Inches	PORT SIZE Inches	TONS of REFRIGERATION						
"A" and "B" SERIES		"E" SERIES EXTENDED CONNECTIONS										
WITH MANUAL LIFT STEM												
NORMALLY CLOSED						22	134a	401A	402A	404A	407C	507
PRESSURE DROP 1 psi												
A3P1	–	–	–	3/8 NPT Female	.101	0.9	0.8	0.9	0.6	0.6	0.8	0.6
A3F1	–	–	–	1/4 SAE Flare								
A3S1	–	E3S120	–	1/4 ODF Solder								
A3S1	–	E3S130	–	3/8 ODF Solder								
–	–	E5S120	–	1/4 ODF Solder	.150	1.6	1.5	1.6	1.0	1.0	1.5	1.0
–	–	E5S130	–	3/8 ODF Solder								
–	MB6P1	–	–	3/8 NPT Female	3/16	2.9	2.7	2.9	1.9	1.9	2.7	1.9
–	MB6F1	–	–	3/8 SAE Flare								
–	MB6S1	–	ME6S130	3/8 ODF Solder								
–	MB6S1	–	ME6S140	1/2 ODF Solder								
–	MB9P2	–	–	3/8 NPT Female	9/32	4.7	4.4	4.7	3.1	3.1	4.3	3.0
–	MB9F2	–	–	3/8 SAE Flare								
–	–	–	ME9S230	3/8 ODF Solder								
–	MB9S2	–	ME9S240	1/2 ODF Solder								
PRESSURE DROP 2 psi												
A3P1	–	–	–	3/8 NPT Female	.101	1.3	1.2	1.3	0.9	0.9	1.2	0.8
A3F1	–	–	–	1/4 SAE Flare								
A3S1	–	E3S120	–	1/4 ODF Solder								
A3S1	–	E3S130	–	3/8 ODF Solder								
–	–	E5S120	–	1/4 ODF Solder	.150	2.3	2.1	2.3	1.5	1.5	2.1	1.5
–	–	E5S130	–	3/8 ODF Solder								
–	MB6P1	–	–	3/8 NPT Female	3/16	4.1	3.8	4.1	2.7	2.7	3.7	2.6
–	MB6F1	–	–	3/8 SAE Flare								
–	MB6S1	–	ME6S130	3/8 ODF Solder								
–	MB6S1	–	ME6S140	1/2 ODF Solder								
–	MB9P2	–	–	3/8 NPT Female	9/32	6.6	6.2	6.6	4.4	4.4	6.1	4.3
–	MB9F2	–	–	3/8 SAE Flare								
–	–	–	ME9S230	3/8 ODF Solder								
–	MB9S2	–	ME9S240	1/2 ODF Solder								
PRESSURE DROP 3 psi												
A3P1	–	–	–	3/8 NPT Female	.101	1.6	1.5	1.6	1.1	1.1	1.5	1.0
A3F1	–	–	–	1/4 SAE Flare								
A3S1	–	E3S120	–	1/4 ODF Solder								
A3S1	–	E3S130	–	3/8 ODF Solder								
–	–	E5S120	–	1/4 ODF Solder	.150	2.8	2.6	2.8	1.7	1.7	2.6	1.8
–	–	E5S130	–	3/8 ODF Solder								
–	MB6P1	–	–	3/8 NPT Female	3/16	4.9	4.6	5.0	3.3	3.3	4.5	3.2
–	MB6F1	–	–	3/8 SAE Flare								
–	MB6S1	–	ME6S130	3/8 ODF Solder								
–	MB6S1	–	ME6S140	1/2 ODF Solder								
–	MB9P2	–	–	3/8 NPT Female	9/32	8.1	7.5	8.1	5.4	5.4	7.4	5.2
–	MB9F2	–	–	3/8 SAE Flare								
–	–	–	ME9S230	3/8 ODF Solder								
–	MB9S2	–	ME9S240	1/2 ODF Solder								

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7. **Contingencies.** Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. **User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

9. **Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

10. **Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

11. **Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. **Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

13. **Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

14. **Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

15. **Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. **Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

17. **Termination.** This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. **Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. **Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

20. **Taxes.** Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. **Equal Opportunity Clause.** For the performance of government contracts and where dollar value of the Products exceed $10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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