



SPORLAN

Refrigerant Distributors



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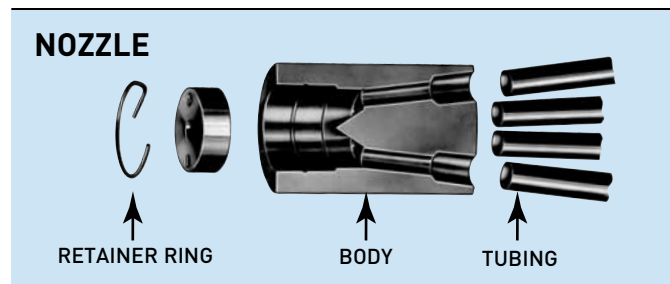
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A SPORLAN REFRIGERANT DISTRIBUTOR FOR MOST REQUIREMENTS

Thoroughly engineered, continually improved and laboratory and field tested for over 60 years!

- Reliable Sporlan machining quality.
- Sizes and capacities for most applications.
- Easy to solder. Steel models feature trepanned circuits for simplified welding.
- Interchangeable nozzle permits custom selection.
- Can be installed in any position.
- Adapts to, and compliments, Sporlan quality expansion valves.
- Can be applied to any make multi-circuit evaporator coil.
- Allows visual inspection of solder joints.
- Permits use of a probe wire or air jet to test for plugged circuits at distributor or evaporator coil.



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REFRIGERANT DISTRIBUTOR

What is it?

The refrigerant distributor is a device connected to the outlet of a thermostatic expansion valve (TEV). The outlet of the distributor is machined to accept tubing which connects the distributor to each evaporator coil circuit.

What is its function?

The refrigerant distributor equally distributes refrigerant flow from the thermostatic expansion valve (TEV) into each circuit of a multi-circuit evaporator coil.

FINNED COIL

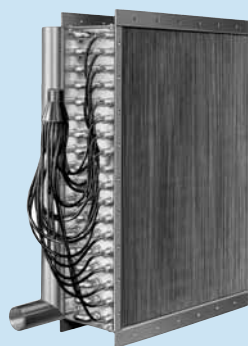
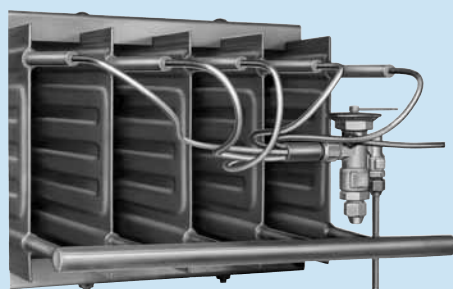


PLATE EVAPORATOR



THE DISTRIBUTION PROBLEM

A portion of the liquid refrigerant passing through the thermostatic expansion valve (TEV) normally flashes, resulting in two-phase (liquid and vapor) flow at the valve outlet, see Figure 1. This mixture is predominately liquid by weight, but the vapor occupies most of the volume. For a typical R-410A application, the percentage, by weight and volume, of liquid and vapor flow entering the evaporator coil are listed below:

REFRIGERANT	% WEIGHT	% VOLUME
Liquid	87	29
Vapor	13	71

The above values are based on 100°F liquid refrigerant entering the TEV, and a 50°F evaporating temperature. In this example, liquid represents 87% of the flow by weight, though it only amounts to 29% of the flow volume.

An additional problem arises due to the fact that liquid and vapor move at different velocities. This is sometimes referred to as slip, since gravity has a greater influence on the liquid portion of the flow.

If a simple header is used to divide the flow into each of the evaporator circuits, the circuits will not receive equal

amounts of refrigerant. The lower circuits of the evaporator invariably receive the most liquid, possibly causing TEV hunting and floodback problems. The upper circuits are then starved, reducing the effective evaporator surface, see Figure 2.

Figure 1

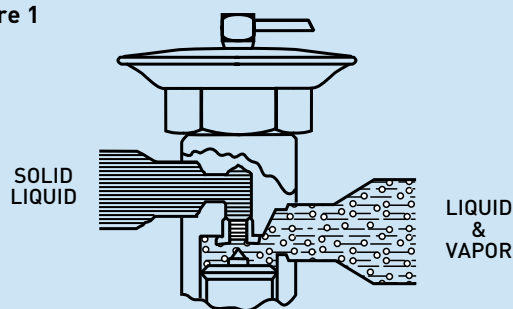
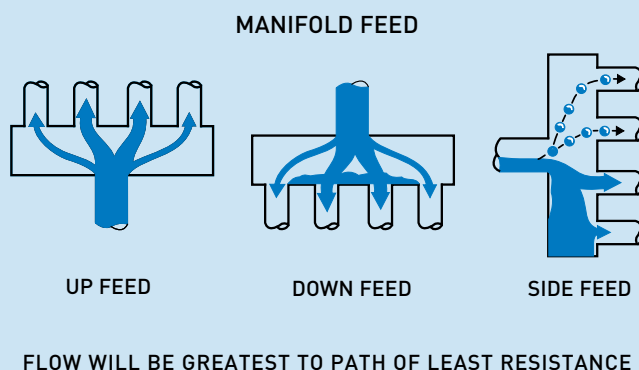


Figure 2



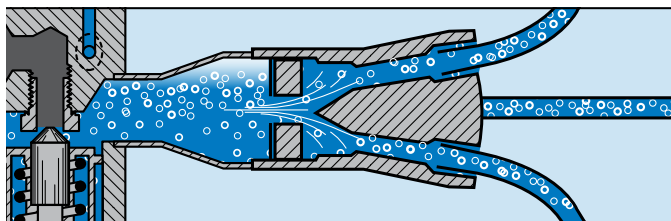
To achieve proper distribution, the liquid portion of the two-phase flow must be divided equally to each evaporator coil circuit. The solution: [1] mix the liquid and vapor portions of the refrigerant flow; and [2] maintain a homogeneous two-phase mixture until equal portions of the flow are divided into each evaporator circuit.

HOW A SPORLAN DISTRIBUTOR SOLVES THIS PROBLEM

The two-phase refrigerant flow leaving the TEV enters the distributor nozzle. The nozzle increases the velocity of the two-phase flow, mixing its liquid and vapor components. Furthermore, the nozzle is positioned such that flow is focused onto the dispersion cone, equally dividing the mixture into passageways spaced evenly around the cone. The refrigerant is then conveyed, by the distributor tube, to each evaporator circuit.

Pressure drop across the Sporlan distributor creates the high velocity necessary to distribute the refrigerant flow effectively. High velocity is the key to the distributor's success. Pressure drop across the nozzle focuses the flow, and provides the necessary mixing. Pressure drop across the distributor tubes assists in balancing the flow as it enters the distributor passageways. As a result, distributor tube and nozzle sizing is critical to proper distributor operation.

OPERATION OF SPORLAN PRESSURE DROP TYPE DISTRIBUTORS



1. Velocity of refrigerant LIQUID-VAPOR MIXTURE increased by flow through nozzle orifice
2. Orifice provides homogeneous MIXING through turbulence created by pressure drop
3. Refrigerant MIXTURE divided by conical button while still at high velocity
4. MIXTURE fed equally to circuits

Distributor pressure drop does not reduce system capacity. The distributor creates pressure drop in the section of the system where it is required to drop the refrigerant pressure down to the saturated temperature and pressure of the evaporator.

In addition the higher pressure at the TEV outlet created by the distributor nozzle elevates the valve body temperature. This keeps the thermostatic diaphragm case warmer than the sensing bulb.

On systems using valves with MOP type charges, also known as Gas-Cross charges, the charge can migrate from the bulb to the diaphragm case. This occurs if the diaphragm case becomes colder than the sensing bulb. When this happens the valve loses control and is known as 'charge migration.'

Using a Sporlan distributor prevents charge migration by elevating the diaphragm case considerably above the sensing bulb temperature.

GENERAL ENGINEERING DATA

The function of the refrigerant distributor is to equally distribute refrigerant flow from the thermostatic expansion valve (TEV) into each circuit of a multi-circuit evaporator coil. This function is vital to proper system performance since refrigerant distribution directly affects the operation of the thermostatic expansion valve and the evaporator coil. If the refrigerant is poorly distributed through the evaporator coil, the thermostatic expansion valve will often hunt and may result in occasional floodback to the compressor. Evaporator performance will also decrease since the circuits in the coil will not remain fully active.

Refrigerant distributors for the following refrigerants may be selected from the ratings provided on pages 8-10, in Tables A, B, and C: R-22, R-134a, R-401A, R-404A, R-407C, R-409A, R-410A, R-422D, R-422A, and R-507. Distributor tube ratings are based on a 30 inch tube length, 100°F refrigerant liquid temperature entering the TEV, and a 10 psi pressure drop across the tubes and the internal passageways of the distributor. Nozzle ratings are based on a 100°F refrigerant liquid temperature entering the TEV, and the pressure drop

values listed in Table B. For distributor tube lengths other than 30 inches, apply the appropriate correction factor, shown in Table A, to the distributor tube ratings. Similarly, apply the appropriate correction factor, shown in Table A, for refrigerant liquid temperatures other than 100°F. The liquid temperature correction factor applies to both distributor tube and nozzle ratings. The distributor tube length correction factor only applies to the distributor ratings.

The table below lists distributor tube and nozzle pressure drops at rated capacities (100% loading).

REFRIGERANT	TUBE AP (psi)	NOZZLE AP (psi)	TOTAL AP * (psi)
R-134a, R-401A, R-409A	10	15	25
R-22, R-404A, R-407C, R-422A, R-422D, R-507	10	25	35
R-410A	10	35	45

*For systems that regularly operate between 50% and 100% of full load capacity, it is common to select a nozzle and tubes that have a combined pressure drop of 10 psi greater than this table. This is a good practice. The only precaution is to verify the thermostatic expansion valve capacity at the reduced pressure drop across its port.

The percentage of distributor tube and nozzle loadings are determined by dividing the actual capacity by the rated capacity provided in the tables. This value allows estimating of the pressure drop across the distributor from Table C. For both the distributor tubes and nozzle, the percentage of loading should fall between 50% and 200% for all system operating conditions. Loading less than 50% can result in poor distribution. The nozzle loading is generally more critical to optimum distributor performance. Loading greater than 200% results in a high pressure drop across the distributor, making proper TEV sizing difficult.

An example of a distributor selection is provided on page 6. When determining pressure drop across a TEV, it is necessary to first determine the pressure drop across the distributor and tube assembly. This value is then subtracted from the available pressure drop across the TEV.

VARIABLE SYSTEM CAPACITY

Certain refrigeration systems operate over wide ranges of evaporator temperatures. For these systems, the distributor tube and nozzle selection should be checked over the entire range of system operation. For systems using compressors with capacity reduction, the distributor tube and nozzle sizing should be checked for both the minimum and maximum load conditions. The nozzle should be at least 50% loaded at the minimum load condition.

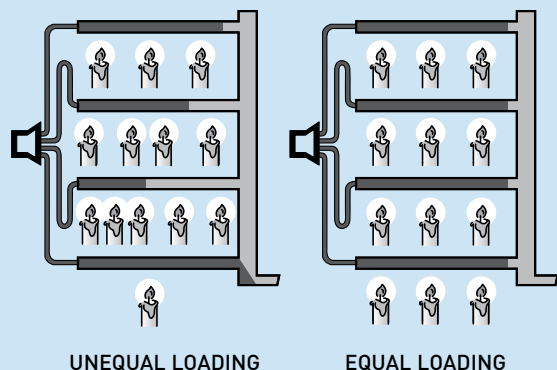
If the distributor nozzle cannot be maintained with 50% to 200% loading due to load variation, consider using two or more TEVs to control the load. Refer to Bulletin 10-9 for further information.

APPLICATION INSTRUCTIONS

For each circuit to offer equal resistance distributor tube lengths must be the same. Furthermore, the distributor tubes should be bent carefully. Sharp bends and kinks reduce the cross sectional area of the tube, increasing resistance to refrigerant flow.

Since the distributor is designed to disperse equal amounts of refrigerant to each circuit, it is essential the heat load on all circuits of the evaporator coil be the same. Otherwise, the effect is the same as poor distribution. The circuits with the greatest loading are starved, while the circuits with the least loading are overfed, see Figure 3. This condition often causes the expansion valve to hunt, resulting in occasional floodback to the compressor.

Figure 3



Optimum distributor performance is obtained when the distributor is mounted directly to the TEV outlet. If the distributor cannot be mounted directly to the valve outlet, it can be connected by a piece of **straight** tubing or pipe. The tubing or pipe should not exceed **two** feet, and it should be sized to maintain high refrigerant velocities. Elbows located between the TEV and distributor hinder proper distribution, and are **not** recommended.

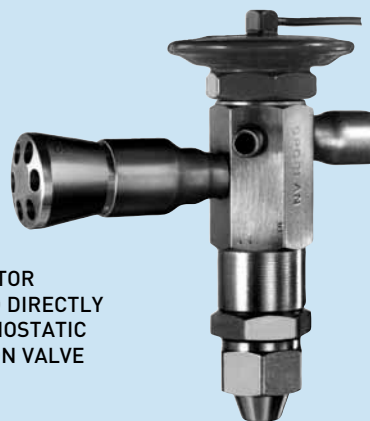
The distributor can be positioned in any direction. If the system operates over widely varying conditions, best performance is usually obtained when the distributor feeds vertically upward or downward, see Figure 4. For applications where the distributor is not mounted directly to the TEV, the vertical feed arrangement is recommended.

Plugging one or more distributor outlets is not recommended because it ordinarily results in poor distribution. If it is absolutely necessary to plug circuits, it should be done symmetrically.

For applications requiring hot gas bypass, hot gas defrost, or reverse cycle defrost, the Sporlan 1650 series distributor can be used. This type of distributor is available with one or two side connections. Refer to pages 17-19 for further information. Standard type Sporlan distributors can be used for the above applications if used with a Sporlan auxiliary side connector (ASC). Refer to page 20 for further information.

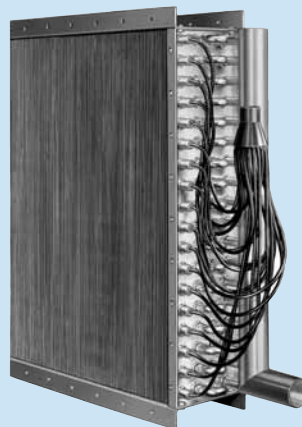
THERMOSTATIC EXPANSION VALVE SELECTION

When selecting a thermostatic expansion valve (TEV) for use with a Sporlan type distributor, an **externally equalized** valve **must** be used to compensate for the distributor pressure drop. The distributor pressure drop also reduces the available pressure drop across the valve. As a result, the distributor pressure drop must be estimated before selecting the TEV. The distributor selection example on page 6 provides the proper method for estimating distributor pressure drop.



DISTRIBUTOR
MOUNTED DIRECTLY
TO THERMOSTATIC
EXPANSION VALVE

Figure 4



DISTRIBUTOR
IN VERTICAL,
DOWN-FEED,
POSITION

When a system uses two or more distributors, each distributor must be fed by its own TEV. If one valve feeds two distributors, the refrigerant flow will not be divided evenly into the distributors.

BRAZING, TESTING, and INSTALLATION PROCEDURES

Brazing is a technique for joining metals with the use of a filler metal. The metals are heated above 800°F. The filler metal melts below the melting temperature of the metals being joined. Many brazing applications require a flux to remove oxides on the metal surfaces of the joint, and to prevent oxidation during the brazing process.

Sporlan brass body distributors are machined from either #360 brass rod or #377 brass forgings. Refer to page 7 for a list of the materials used to manufacture the distributors in this bulletin. Since distributor tubes are typically copper, as is the outlet fitting of the TEV, the majority of brazed distributor connections are brass to copper.

For a brass to copper connection, a flux must normally be used. The flux should be applied sparingly to the male end of the connection. The distributor body should be uniformly heated prior to applying the filler metal to the joint. For large, brass distributors, preheat the body before soldering. Large, brass distributor bodies are more prone to stress-cracking. Heating large brass

distributor bodies quickly creates steep thermal gradients, stressing the brass. After brazing, allow the distributor to cool slowly. Quenching a hot distributor can crack it.

Avoid overheating brass distributor bodies, particularly the larger distributors. Overheating causes the zinc portion of the brass to migrate toward the surface of the distributor body. This leaves passageways in the brass for refrigerant leakage.

Phos/copper or silver/phos/copper (BCuP class) filler metals are suitable for most brass to copper connections. Silver (BAg class) filler metals can also be used. Please refer to manufacturers of filler metals for additional information on this subject.

Appropriate low temperature solders (e.g., Stay-Brite® from J.W. Harris) may also be used to install the distributor. The advantage of this type of solder is the reduced possibility of overheating the distributor or TEV body. One useful approach is brazing the distributor tubes to the distributor, and using a low temperature solder to connect the distributor and TEV. With a small body distributor, this practice reduces the possibility of accidentally undoing the distributor tube joints, or overheating the TEV body.

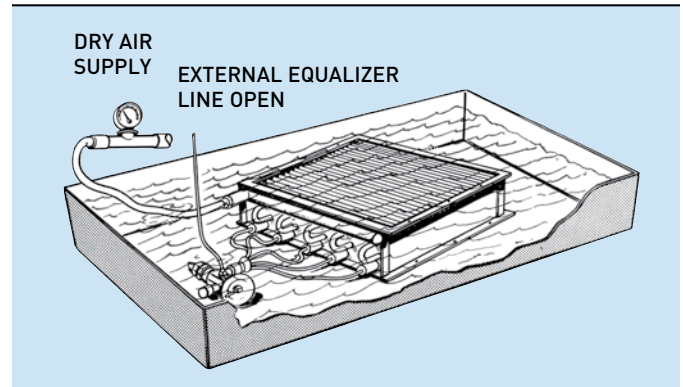
On replaceable nozzle type distributors, a visual inspection can be made after the distributor tubes are soldered in place. By removing the nozzle, restrictions in the tubing or distributor, as a result of the soldering, can be visually located or identified by use of a wire probe or an air jet.

When soldering tubes to the evaporator coil, extend the tubes into the coil far enough to prevent coil plugging from excess solder.

A leak check of the coil will not reveal a plugged circuit. Therefore, each circuit should be individually checked with a probe wire or an air jet. A flow meter strategically placed can detect a restricted circuit.

The typical method to leak check an evaporator coil is to submerge the coil under water and administer pressure. If the TEV is mounted on the coil, excessive test pressure should not be used in leak testing the coil. Refer to Bulletin 10-11 for maximum allowable low side pressures for Sporlan TEVs. If the test pressure exceeds these limits, the external equalizer line of the expansion valve can

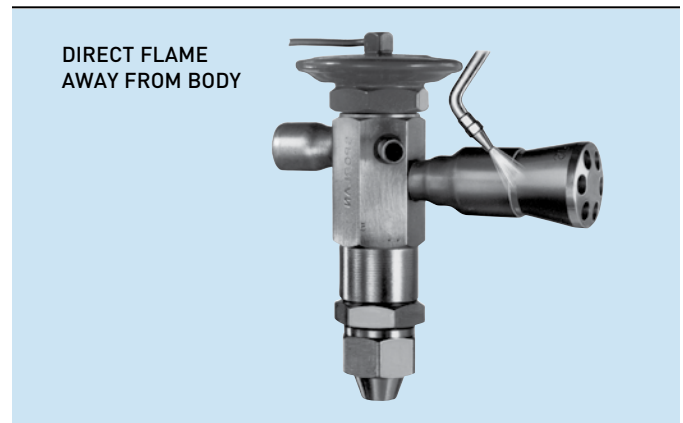
be disconnected and left open to atmosphere above the water level. This procedure prevents test pressure from reaching the valve diaphragm.



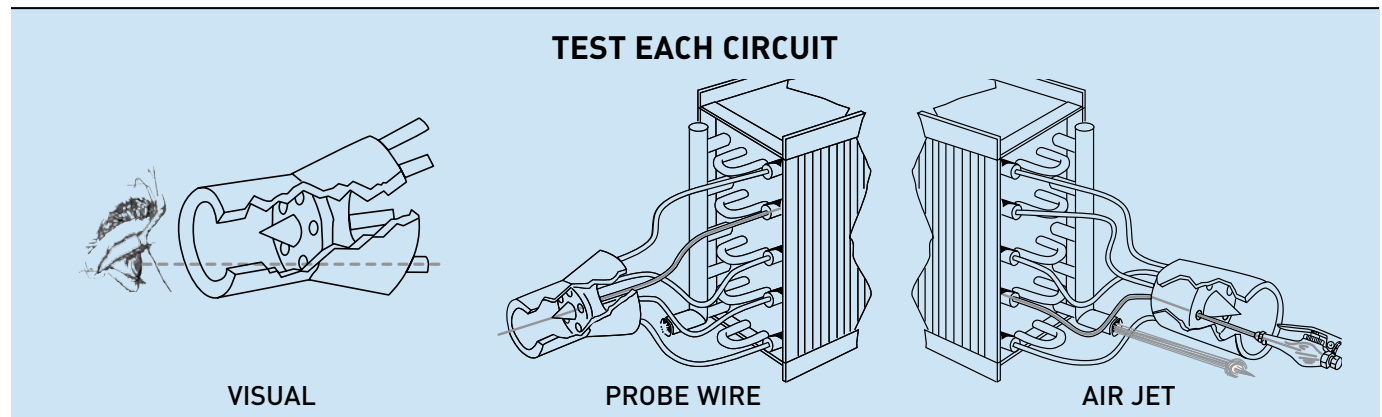
Exercise caution when soldering the TEV to the distributor. Direct the flame away from the valve body to avoid overheating it. As an extra precaution, a wet cloth should be wrapped around the valve body and thermostatic element during the soldering operation.

The nozzle and retainer ring for each replaceable nozzle type distributor are identified with a code letter. The nozzles and retainer rings with the same letter are physically interchangeable. The code letter, along with the available nozzle orifice numbers, are shown in the distributor specification tables.

With the exception of the size L nozzle, all nozzles have two drilled and tapped holes to aid in removal. See table on following page for the thread size.



TEST EACH CIRCUIT



SIMPLIFIED NOZZLE
REMOVAL

NOZZLE	EXTRACTION HOLE (Thread Size)
J, JR	4-40
G, GR, E, ER, C, CR	6-32

SELECTION & ORDERING PROCEDURE

For uniform refrigerant distribution, the distributor tubes and distributor nozzle orifice must be correctly sized. Sporlan's sizing & selection program can be used or follow this procedure:

1. Select Distributor Tube Size – Divide the total load by the number of evaporator circuits. This provides the load per circuit in tons of refrigeration. Using Table A, page 8, select a distributor tube size with a capacity approximately equal to the load per circuit at the desired evaporator temperature. Be sure to multiply the tube rating, shown in the table, by the refrigerant liquid temperature correction factor and/or the distributor tube length correction factor, page 8, if either applies. The distributor tube ratings are based on a 100°F liquid temperature and 30 inch tube lengths.

The actual tube loading, as a percent of the published rating, is determined by dividing the actual load per circuit, by the published tube rating, corrected for liquid refrigerant temperature and distributor tube length. The pressure drop across the distributor tubes is determined using Table C, page 10. The calculated value should fall between 50% and 200%. A 10 psi pressure drop across the distributor tubes equates to 100% tube loading, and is the normal sizing recommendation.

Example:

- R-410A
- 40°F evaporating temperature
- 90°F liquid refrigerant temperature
- 8 circuits, 24" tube lengths
- 10 tons
- Select a tube size and determine pressure drop across the tubes.
- Tons per circuit: $10/8 = 1.25$ tons
- 1/4" OD tube rating in Table A: 1.21 tons
- Tube rating corrected for liquid refrigerant temperature and tube length: $1.21 \times 1.17 \times 1.07 = 1.51$ tons
- Actual load as percentage of published rating: $1.25/1.51 = 0.83$ or 83%
- Pressure drop across tubes from Table C: 8 psi

2. Select Distributor Model – Using the specification tables in this bulletin, select the distributor body style that accommodates the tube size selected, the number of circuits, and the TEV outlet size. The specification tables list the number of circuits and tubing sizes for each distributor. Contact Sporlan regarding applications requiring special type distributors.

SPECIFICATION TABLES FOR DISTRIBUTORS

Brass - SAE flare models	Page 12
Brass - ODF solder models	Pages 13 & 14
Brass - Flange models	Page 15
Aluminum - Flange models	Page 16
Brass - SAE flare and ODF solder side connection models	Pages 19 & 20

In the above example, the Type 1113 distributor may be used.

3. Select Distributor Nozzle – Using Table B, pages 9 & 10, select an orifice number with a capacity approximately equal to the total system load at the desired evaporator temperature. Be sure to multiply the nozzle rating, shown in Table B, by the appropriate refrigerant liquid temperature correction factor, page 8. The distributor tube length correction factors do not apply with nozzle ratings.

The actual nozzle loading, as a percent of the published rating, is determined by dividing the actual system load by the published nozzle rating, corrected for refrigerant liquid temperature. The pressure across the nozzle is determined using Table C, page 10. The calculated value should fall between 50% and 200%.

Example:

- R-410A
- 40°F evaporating temperature
- 90°F liquid refrigerant temperature
- 8 circuits, 24" tube lengths
- 10 tons
- Total system capacity: 10 tons
- #5 nozzle rating in Table B: 7.25 tons
- Nozzle rating corrected for refrigerant temperature: $7.25 \times 1.17 = 8.48$ tons
- Actual load as percentage of published rating: $10/8.48 = 1.18$ or 118%
- Pressure drop across nozzle from Table C: 43 psi
- Total pressure drop across distributor: $43 + 8 = 51$ psi
- Suggested distributor: 1113-8-1/4-5

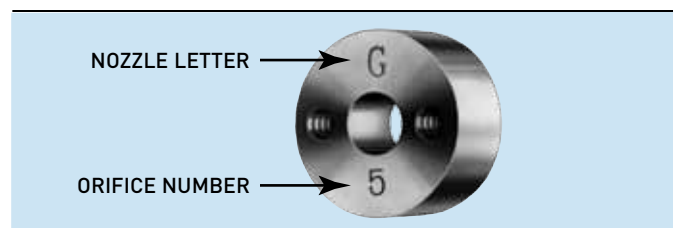
NOZZLE IDENTIFICATION

The nozzles have several different outside diameters. The sizes are designated by a letter code. Each nozzle is interchangeable between certain distributor bodies. For replaceable type nozzles, except the Type L, both the orifice number and letter are stamped on the nozzle. For the Type L nozzle, only the orifice number is stamped on the nozzle.

Table 1 below lists the designations for replaceable type nozzles and the distributors they are used with. Table 2 on below lists distributors using nonreplaceable nozzles.

Nonreplaceable nozzles do not carry a letter designation, and their orifice number is stamped on the distributor body.

The nozzle orifice number itself does not imply a specific capacity rating.



OEM CONSIDERATIONS

Often manufacturers of evaporator coils design and apply their coils to systems using different refrigerants, and operating at various evaporating temperatures and load conditions. For these applications, the replaceable nozzle type distributor has distinct benefits.

The distributor, without the nozzle, can be installed on the evaporator coil during coil production. The nozzle is added to the distributor once the coil application has been specified. Alternatively, assorted nozzles can be shipped with the coil. Instructions on how to select the correct nozzle would need to be sent with the assorted nozzles.

If the manufacturer prefers to install the nozzle during production, a satisfactory nozzle can often be selected to meet the majority of the coil applications.

DISTRIBUTOR QUICK REFERENCE GUIDE - Removeable Nozzles

TABLE 1

REFRIGERANT DISTRIBUTORS										
CONNECTION TYPE	TEV MODEL (1)	DISTRIBUTOR TYPE	MAXIMUM NO. OF CIRCUITS				NOZZLE TYPE	SIDE CONNECTION	MATERIAL	
			3/16	1/4	5/16	3/8				
1/2 SAE	(B)BI, BF, (B)Q, F, FB, G, R, RC	1605	6	4	---	---	L	-	#360 BRASS	
		1608	9	6	4	---				
1/2 ODM	(B)BI, EBF, E(B)Q, EF, EG, FB, RC, SBF, S(B)Q	D260	6	4	---	---				
		D262	9	6	4	---				
5/8 ODM	(B)BI, EBF, E(B)Q, ER, FB, RC, RI, S, SBF, SR	1620	6	4	---	---	J			
		1622	9	7	4	---				
7/8 ODM	(B)BI, EBS, E(B)Q, ER, O, R, S	1112	7	6	4	2	G			
		1113	12	8	6	4				
		1135	17	13	---	---				
		1136	24	18	---	---				
		1137	32	25	---	---				
1-1/8 ODM	EBS, O, S	1115	15	10	9	6	E			
		1116	20	15	---	---				
1-3/8 ODM	EBS, O	1117	18	15	9	7	C	-		#377 BRASS
		1126	24	18	15	12				
		1128	28	25	21	16				
1-5/8 ODM	O	1125	28	24	20	16	A	-	#360 BRASS	
		1127	37	30	26	20				
		1143	40	36	30	24				
TYPE H VALVE FLANGE	H	1109	10	8	6	4	G			-
		1124	30	23	18	15	E			
		1192	11	10	6	6	G			
TYPE M/V VALVE FLANGE	M, V	1121	34	24	20	16	C	-	6061-T6 ALUMINUM	
		1193	26	21	18	16		-	#360 BRASS	
5/8 ODM	(B)BI, EBF, E(B)Q, ER, FB, RC, RI, S, SBF	1651(R)	7	5	---	---	J(R)	3/8 or 1/2 ODF	#360 BRASS	
7/8 ODM	(B)BI, E(B)Q, EBS, O, R, S	1653(R)	12	9	6	4	G(R)			
1-1/8 ODM	EBS, O, R, S	1655(R)	20	12	10	7	E(R)	1/2 or 5/8 ODF		
1-3/8 ODM	EBS, O	1657(R)	26	18	14	11	C(R)	5/8 or 7/8 ODF		
1-5/8 ODM	O	1659(R)	32	24	18	14	A(R)	7/8 or 1-1/8 ODF		

(1) TEV models in blue are OEM-type thermostatic expansion valves.

DISTRIBUTOR QUICK REFERENCE GUIDE - Permanent Nozzles

TABLE 2

REFRIGERANT DISTRIBUTORS WITH PERMANENT NOZZLE							
CONNECTION TYPE	TEV MODEL (1)	DISTRIBUTOR TYPE	MAXIMUM NO. OF CIRCUITS				MATERIAL
			3/16	1/4	5/16	3/8	
1/2 SAE	BF (B)BI, (B)Q, F, FB, G, RC	1603	6	4	---	---	#360 BRASS
		1606	8	6	4	---	

(1) TEV models in blue are OEM-type thermostatic expansion valves.

QUICK REFERENCE GUIDE - Replacing Obsolete Distributors

TABLE 3

OBSOLETE REFRIGERANT DISTRIBUTORS							
CONNECTION SIZE	DISTRIBUTOR TYPE	MAXIMUM NO. OF CIRCUITS				NOZZLE TYPE	REPLACEMENT DISTRIBUTOR
		3/16	1/4	5/16	3/8		
5/8 ODM	1102	4	3	---	---	J	1620
5/8 ODF	1105	7	6	---	---		1622 (3)
1-1/8 ODM	1111	---	8	6	4	G	1115
TYPE H VALVE FLANGE	1107 (2)	9	8	6	4		1109
	1108 (2)	7	6	4	2		
	1110	12	10	7	6		1124
	1190 (2)	8	6	5	4		1192
TYPE M/V VALVE FLANGE	1119	16	12	9	7	C	1121

(2) Uses old Type H valve male flange (1.099" OD x 0.776" ID). Use K-1178 adaptor kit to connect to current Type H valve.

(3) Requires adaptation.

DISTRIBUTOR CAPACITIES - Distributor Tube Capacities – Tons of Refrigeration

TABLE A ⁽⁸⁾Refrigerants 134a, 401A, 409A ⁽⁴⁾

DISTRIBUTOR TUBE OD - Inches	REFRIGERANT											
	134a				401A				409A			
	EVAPORATOR TEMPERATURE (°F)											
	40°	20°	0°	-20°	40°	20°	0°	-20°	40°	20°	0°	-20°
3/16	0.30	0.21	0.16	0.12	0.33	0.26	0.20	0.16	0.27	0.20	0.16	0.12
1/4	0.85	0.62	0.47	0.36	0.96	0.73	0.57	0.46	0.77	0.58	0.45	0.36
5/16	1.73	1.26	0.95	0.73	1.94	1.48	1.16	0.93	1.57	1.19	0.92	0.72
3/8	3.12	2.27	1.70	1.31	3.47	2.65	2.07	1.65	2.84	2.14	1.65	1.30

Refrigerants 22 ⁽⁵⁾, 407C ⁽⁵⁾, 410A ⁽⁷⁾, 422D ⁽⁵⁾

DISTRIBUTOR TUBE OD - Inches	REFRIGERANT																			
	22					407C					410A					422D				
	EVAPORATOR TEMPERATURE (°F)																			
	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°
3/16	0.40	0.30	0.23	0.18	0.14	0.32	0.23	0.18	0.14	0.11	0.42	0.31	0.23	0.18	0.14	0.24	0.18	0.13	0.10	0.07
1/4	1.15	0.86	0.66	0.51	0.40	0.91	0.68	0.51	0.40	0.31	1.21	0.90	0.68	0.52	0.40	0.70	0.51	0.38	0.28	0.21
5/16	2.33	1.75	1.34	1.04	0.82	1.86	1.38	1.05	0.80	0.63	2.46	1.83	1.39	1.06	0.81	1.44	1.04	0.77	0.58	0.44
3/8	4.21	3.16	2.41	1.87	1.48	3.36	2.50	1.89	1.45	1.14	4.44	3.32	2.51	1.91	1.47	2.60	1.89	1.39	1.04	0.79

Refrigerants 404A, 422A, 507 ⁽⁵⁾

DISTRIBUTOR TUBE OD - Inches	REFRIGERANT														
	404A					422A					507				
	EVAPORATOR TEMPERATURE (°F)														
	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°
3/16	0.28	0.21	0.15	0.12	0.09	0.23	0.17	0.12	0.09	0.07	0.28	0.20	0.15	0.11	0.09
1/4	0.81	0.59	0.44	0.33	0.26	0.67	0.49	0.36	0.26	0.20	0.81	0.59	0.44	0.33	0.25
5/16	1.66	1.21	0.90	0.68	0.52	1.37	0.99	0.73	0.54	0.40	1.65	1.21	0.89	0.67	0.50
3/8	2.99	2.18	1.62	1.22	0.94	2.48	1.79	1.31	0.97	0.72	2.99	2.18	1.61	1.20	0.91

Correction Factors for Other Distributor Tube Lengths

TUBE LENGTH - Inches	12	18	24	30	36	42	48	54	60	66	72
CORRECTION FACTOR	1.36	1.16	1.07	1.00	0.95	0.90	0.86	0.82	0.79	0.76	0.73

Correction Factors for Other Liquid Temperatures for Nozzle and Tubes ⁽⁶⁾

LIQUID TEMPERATURE °F	50°	60°	70°	80°	90°	100°	110°	120°
CORRECTION FACTOR	2.10	1.83	1.59	1.37	1.17	1.00	0.85	0.72

(4) Ratings based on 100°F liquid entering TEV, 15 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.

(5) Ratings based on 100°F liquid entering TEV, 25 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.

(6) For direct expansion applications with liquid temperatures lower than tabulated values or for flooded liquid recirculation systems - Contact Sporlan.

(7) Ratings based on 100°F liquid entering TEV, 35 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.

(8) For information on applications and capacities at evaporator temperatures below minus 40°F, contact Sporlan.

DISTRIBUTOR CAPACITIES - Distributor Nozzle Capacities – Tons of Refrigeration

TABLE B

Refrigerants 134a, 401A, 401B, 409A (4)

DISTRIBUTOR NOZZLE NUMBER	REFRIGERANT											
	134a				401A				409A			
	EVAPORATOR TEMPERATURE (°F)											
	40°	20°	0°	-20°	40°	20°	0°	-20°	40°	20°	0°	-20°
1/9	0.08	0.06	0.05	0.04	0.08	0.06	0.05	0.04	0.07	0.05	0.04	0.04
1/6	0.12	0.09	0.07	0.06	0.13	0.10	0.08	0.07	0.11	0.09	0.07	0.06
1/4	0.20	0.15	0.12	0.10	0.20	0.16	0.13	0.11	0.17	0.14	0.11	0.09
1/3	0.26	0.20	0.15	0.13	0.26	0.20	0.17	0.14	0.23	0.18	0.14	0.12
1/2	0.36	0.27	0.21	0.17	0.36	0.28	0.23	0.19	0.31	0.25	0.20	0.17
3/4	0.54	0.41	0.32	0.26	0.55	0.43	0.34	0.29	0.47	0.37	0.30	0.25
1	0.72	0.54	0.43	0.35	0.74	0.57	0.46	0.38	0.64	0.50	0.40	0.34
1-1/2	1.05	0.79	0.62	0.51	1.07	0.83	0.67	0.56	0.92	0.73	0.59	0.49
2	1.44	1.09	0.86	0.70	1.47	1.14	0.92	0.77	1.27	1.00	0.81	0.67
2-1/2	1.79	1.35	1.07	0.88	1.83	1.42	1.15	0.95	1.58	1.24	1.01	0.84
3	2.15	1.63	1.28	1.05	2.20	1.70	1.38	1.15	1.90	1.49	1.21	1.01
4	2.88	2.18	1.72	1.41	2.94	2.28	1.84	1.53	2.54	1.99	1.62	1.35
5	3.55	2.68	2.12	1.73	3.62	2.81	2.27	1.89	3.13	2.46	1.99	1.67
6	4.26	3.22	2.54	2.08	4.35	3.37	2.72	2.27	3.76	2.95	2.39	2.00
8	5.13	3.88	3.06	2.51	5.24	4.06	3.28	2.73	4.54	3.55	2.88	2.41
10	5.75	4.35	3.43	2.81	5.87	4.55	3.68	3.06	5.07	3.98	3.23	2.70
12	7.10	5.36	4.23	3.47	7.25	5.61	4.54	3.78	6.26	4.92	3.99	3.33
15	8.81	6.65	5.25	4.30	8.99	6.96	5.63	4.69	7.77	6.10	4.94	4.13
17	9.85	7.44	5.87	4.81	10.1	7.79	6.29	5.24	8.68	6.82	5.53	4.62
20	11.9	8.96	7.07	5.80	12.1	9.38	7.59	6.33	10.5	8.22	6.66	5.57
25	14.9	11.3	8.90	7.29	15.2	11.8	9.54	7.96	13.2	10.3	8.38	7.00
30	17.1	12.9	10.2	8.33	17.4	13.5	10.9	9.09	15.0	11.8	9.57	8.00
35	20.5	15.5	12.2	10.0	20.9	16.2	13.1	10.9	18.1	14.2	11.5	9.62
40	23.0	17.4	13.7	11.2	23.5	18.2	14.7	12.3	20.3	15.9	12.9	10.8
50	29.9	22.5	17.8	14.6	30.5	23.6	19.1	15.9	26.3	20.7	16.7	14.0

TABLE B

Refrigerants 22 (5), 407C (5), 410A (7), 422D (5)

DISTRIBUTOR NOZZLE NUMBER	REFRIGERANT																			
	22					407C					410A					422D				
	EVAPORATOR TEMPERATURE (°F)																			
	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°
1/9	0.14	0.11	0.09	0.07	0.06	0.11	0.08	0.07	0.06	0.05	0.16	0.13	0.10	0.08	0.07	0.08	0.06	0.05	0.04	0.03
1/6	0.21	0.16	0.13	0.11	0.09	0.17	0.13	0.10	0.09	0.07	0.25	0.20	0.16	0.13	0.11	0.13	0.10	0.07	0.06	0.05
1/4	0.34	0.26	0.21	0.18	0.15	0.27	0.21	0.17	0.14	0.12	0.40	0.31	0.25	0.21	0.17	0.20	0.15	0.12	0.10	0.08
1/3	0.44	0.34	0.28	0.23	0.20	0.35	0.27	0.22	0.18	0.15	0.53	0.41	0.33	0.27	0.23	0.26	0.20	0.16	0.13	0.10
1/2	0.61	0.48	0.38	0.32	0.27	0.48	0.38	0.30	0.25	0.21	0.73	0.57	0.46	0.37	0.31	0.37	0.28	0.22	0.17	0.14
3/4	0.92	0.72	0.58	0.48	0.41	0.72	0.57	0.46	0.38	0.32	1.10	0.86	0.69	0.57	0.47	0.55	0.42	0.33	0.26	0.22
1	1.23	0.96	0.78	0.64	0.55	0.97	0.76	0.61	0.50	0.43	1.47	1.15	0.92	0.76	0.64	0.74	0.56	0.44	0.35	0.29
1-1/2	1.79	1.40	1.13	0.94	0.80	1.41	1.10	0.89	0.73	0.62	2.14	1.67	1.34	1.10	0.92	1.07	0.82	0.64	0.51	0.42
2	2.46	1.92	1.55	1.29	1.10	1.94	1.51	1.22	1.00	0.85	2.93	2.30	1.84	1.51	1.27	1.47	1.12	0.88	0.70	0.58
2-1/2	3.06	2.39	1.93	1.60	1.37	2.41	1.88	1.52	1.25	1.06	3.66	2.86	2.30	1.88	1.58	1.83	1.40	1.09	0.88	0.72
3	3.68	2.87	2.32	1.92	1.65	2.90	2.26	1.82	1.50	1.28	4.39	3.44	2.76	2.26	1.90	2.20	1.68	1.31	1.05	0.87
4	4.92	3.84	3.10	2.58	2.20	3.88	3.03	2.43	2.01	1.71	5.88	4.60	3.69	3.02	2.54	2.95	2.24	1.75	1.41	1.16
5	6.07	4.74	3.82	3.18	2.72	4.78	3.73	3.00	2.48	2.11	7.25	5.67	4.55	3.73	3.13	3.63	2.77	2.16	1.74	1.43
6	7.28	5.68	4.58	3.81	3.26	5.73	4.48	3.60	2.98	2.53	8.69	6.80	5.45	4.47	3.76	4.36	3.32	2.60	2.08	1.71
8	8.77	6.84	5.52	4.59	3.92	6.91	5.39	4.34	3.58	3.05	10.5	8.19	6.57	5.39	4.53	5.25	3.99	3.13	2.51	2.06
10	9.83	7.67	6.19	5.14	4.40	7.74	6.05	4.86	4.02	3.42	11.7	9.18	7.36	6.04	5.07	5.88	4.48	3.50	2.81	2.31
12	12.1	9.47	7.64	6.35	5.43	9.56	7.47	6.00	4.96	4.22	14.5	11.3	9.09	7.46	6.26	7.26	5.53	4.33	3.47	2.85
15	15.0	11.7	9.48	7.88	6.73	11.9	9.26	7.45	6.15	5.23	18.0	14.1	11.3	9.25	7.77	9.01	6.86	5.37	4.31	3.54
17	16.8	13.1	10.6	8.81	7.53	13.3	10.4	8.33	6.88	5.85	20.1	15.7	12.6	10.3	8.69	10.1	7.67	6.00	4.81	3.96
20	20.3	15.8	12.8	10.6	9.08	16.0	12.5	10.0	8.29	7.05	24.2	19.0	15.2	12.5	10.5	12.1	9.24	7.23	5.80	4.77
25	25.5	19.9	16.1	13.4	11.4	20.1	15.7	12.6	10.4	8.87	30.5	23.8	19.1	15.7	13.2	15.3	11.6	9.10	7.30	6.00
30	29.1	22.7	18.4	15.3	13.0	23.0	17.9	14.4	11.9	10.1	34.8	27.2	21.8	17.9	15.0	17.4	13.3	10.4	8.34	6.86
35	35.1	27.4	22.1	18.4	15.7	27.6	21.6	17.3	14.3	12.2	41.9	32.8	26.3	21.5	18.1	21.0	16.0	12.5	10.0	8.25
40	39.3	30.7	24.8	20.6	17.6	31.0	24.2	19.5	16.1	13.7	47.0	36.7	29.5	24.2	20.3	23.5	17.9	14.0	11.2	9.25
50	51.0	39.8	32.1	26.7	22.8	40.2	31.4	25.2	20.9	17.7	60.9	47.7	38.2	31.3	26.3	30.5	23.2	18.2	14.6	12.0

TABLE B
 Refrigerants 404A, 422A, 507 ⁽⁵⁾

DISTRIBUTOR NOZZLE NUMBER	REFRIGERANT														
	404A					422A					507				
	EVAPORATOR TEMPERATURE (°F)														
	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°	40°	20°	0°	-20°	-40°
1/9	0.09	0.07	0.05	0.04	0.04	0.07	0.06	0.04	0.03	0.03	0.09	0.07	0.05	0.04	0.03
1/6	0.14	0.11	0.08	0.07	0.05	0.12	0.09	0.07	0.05	0.04	0.14	0.11	0.08	0.07	0.05
1/4	0.23	0.17	0.13	0.11	0.09	0.19	0.14	0.11	0.09	0.07	0.23	0.17	0.13	0.11	0.09
1/3	0.30	0.23	0.18	0.14	0.11	0.24	0.18	0.14	0.11	0.09	0.29	0.22	0.17	0.14	0.11
1/2	0.41	0.31	0.24	0.19	0.16	0.34	0.25	0.20	0.15	0.12	0.41	0.31	0.24	0.19	0.16
3/4	0.62	0.47	0.37	0.29	0.24	0.51	0.38	0.30	0.23	0.19	0.61	0.47	0.36	0.29	0.23
1	0.83	0.63	0.49	0.39	0.32	0.68	0.51	0.40	0.31	0.25	0.82	0.62	0.49	0.39	0.31
1-1/2	1.20	0.92	0.71	0.57	0.46	0.99	0.74	0.58	0.45	0.36	1.20	0.91	0.71	0.56	0.46
2	1.65	1.26	0.98	0.78	0.64	1.35	1.02	0.79	0.62	0.50	1.64	1.25	0.97	0.77	0.62
2-1/2	2.06	1.57	1.22	0.97	0.79	1.69	1.27	0.98	0.78	0.62	2.05	1.56	1.21	0.96	0.78
3	2.47	1.88	1.47	1.17	0.95	2.03	1.53	1.18	0.93	0.75	2.46	1.87	1.45	1.15	0.93
4	3.31	2.52	1.96	1.56	1.27	2.71	2.05	1.58	1.25	1.00	3.29	2.50	1.94	1.54	1.25
5	4.08	3.11	2.42	1.93	1.57	3.34	2.53	1.95	1.54	1.23	4.06	3.08	2.40	1.90	1.54
6	4.89	3.72	2.91	2.31	1.88	4.01	3.03	2.34	1.84	1.48	4.86	3.69	2.87	2.28	1.85
8	5.89	4.49	3.50	2.79	2.27	4.83	3.65	2.82	2.22	1.78	5.86	4.45	3.46	2.75	2.23
10	6.60	5.03	3.92	3.12	2.54	5.42	4.09	3.16	2.49	2.00	6.57	4.99	3.88	3.08	2.50
12	8.16	6.21	4.84	3.86	3.14	6.69	5.05	3.90	3.07	2.47	8.11	6.16	4.79	3.80	3.08
15	10.1	7.70	6.01	4.78	3.89	8.29	6.26	4.84	3.81	3.06	10.1	7.64	5.94	4.72	3.83
17	11.3	8.61	6.72	5.35	4.35	9.27	7.00	5.41	4.26	3.42	11.2	8.54	6.64	5.27	4.28
20	13.6	10.4	8.10	6.45	5.24	11.2	8.44	6.52	5.13	4.12	13.6	10.3	8.01	6.36	5.16
25	17.1	13.1	10.2	8.11	6.60	14.1	10.6	8.20	6.46	5.19	17.1	12.9	10.1	8.00	6.48
30	19.6	14.9	11.6	9.27	7.54	16.1	12.1	9.37	7.38	5.93	19.5	14.8	11.5	9.13	7.41
35	23.6	17.9	14.0	11.1	9.07	19.3	14.6	11.3	8.88	7.13	23.4	17.8	13.8	11.0	8.91
40	26.4	20.1	15.7	12.5	10.2	21.7	16.4	12.6	9.95	8.00	26.3	20.0	15.5	12.3	9.99
50	34.3	26.1	20.4	16.2	13.2	28.1	21.2	16.4	12.9	10.4	34.1	25.9	20.1	16.0	13.0

(4) Ratings based on 100°F liquid entering TEV, 15 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.
 (5) Ratings based on 100°F liquid entering TEV, 25 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.
 (7) Ratings based on 100°F liquid entering TEV, 35 psi ΔP across nozzle, 10 psi ΔP across distributor tubes, 30" tube length.

PRESSURE DROP vs. DISTRIBUTOR LOADING

TABLE C

ACTUAL LOAD as a % of PUBLISHED RATING (Corrected for Liquid Temperature and/or Tube Length if Necessary)	REFRIGERANT					
	134a, 401A, 409A		22, 404A, 407C, 422A, 422D, 507		410A	
	ΔP NOZZLE (psi)	ΔP TUBES and PASSAGES (psi)	ΔP NOZZLE (psi)	ΔP TUBES and PASSAGES (psi)	ΔP NOZZLE (psi)	ΔP TUBES and PASSAGES (psi)
50	4	3	7	3	12	3
60	6	4	10	4	17	4
70	8	5	13	5	21	6
80	10	6	16	6	26	7
90	12	8	20	8	30	9
100	15	10	25	10	35	10
110	18	12	30	12	40	12
120	20	14	35	14	44	13
130	22	16	38	16	49	15
140	24	18	40	18	53	16
150	27	21	43	21	58	18
160	29	23	46	24	62	20
170	31	25	49	27	67	21
180	33	27	52	30	71	23
190	36	29	54	32	76	25
200	38	31	57	34	80	26

See nozzle loading recommendation on page 6 for operation on systems with capacity reductions.

ORDERING INSTRUCTIONS

Proper ordering instructions for any distributor comprises four items:

- **Distributor Type**
See Specification Tables, Pages 12 to 19
- **Number of Circuits**
Depends on evaporator design
- **Size of Circuits**
See Table-A, Page 8, for 5/32” circuit capacity information, contact Sporlan
- **Nozzle Orifice Number**
See Table-B, Page 9 & 10

Example:

A coil requires 16 circuits for .69 ton load per circuit at 0°F; R-410A evaporating temperature; total load 11 tons. Distributor order would read: One Distributor, Type 1126, with 16, 1/4 inch circuits and a 15 Nozzle Orifice Number, or simplified...

QUANTITY		TYPE		NUMBER CIRCUITS		SIZE CIRCUITS		NOZZLE ORIFICE NUMBER
One	-	1126	-	16	-	1/4"	-	15

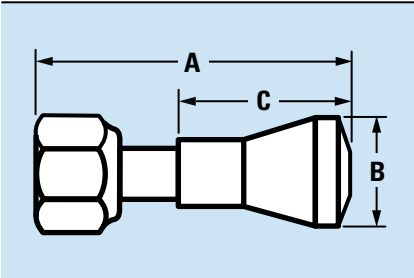
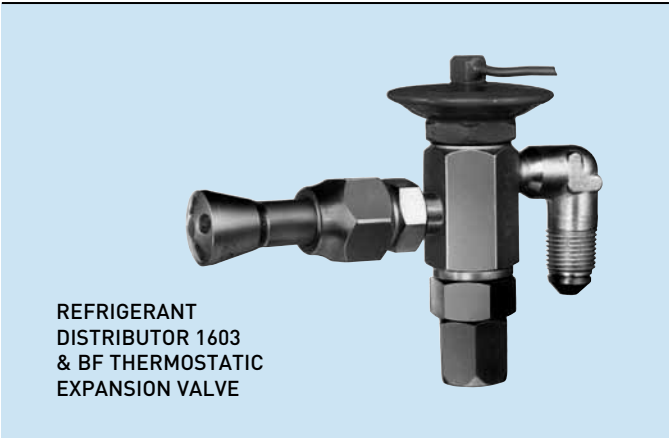
SPECIFICATIONS





SAE Flare Connections – Brass Body

The distributors listed on this page are suitable for TEVs with 1/2” SAE male outlet connections, e.g., Sporlan types BF, (B)Q, F, G, R, and RC.

These distributors can also be applied to Sporlan OEM type thermostatic expansion valves having the same outlet connections. The distributor inlet is a standard 45° short flare nut, and complies with SAE standard J513f.

Material: body and flare nut - brass
inlet tube - copper



NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	NOZZLE	EXPANSION VALVE OUTLET CONNECTION Inches	DISTRIBUTORS	DIMENSIONS Inches		
					A	B	C
TYPE 1603	Furnished with 1/2" OD copper tubing and standard short 1/2" SAE flare nut. Net Weight - Approximately 3 oz.				2.05	0.81	---
2 to 6 - 3/16"	1/9 thru 8	Permanent Not Replaceable	1/2 SAE Flare				
2 to 4 - 1/4"							
TYPE 1606	Furnished with 1/2" OD copper tubing and standard short 1/2" SAE flare nut. Net Weight - Approximately 5 oz.				2.44	1.00	---
7 to 8 - 3/16"	1/9 thru 8	Permanent Not Replaceable	1/2 SAE Flare				
5 to 6 - 1/4"							
2 to 4 - 5/16"							
TYPE 1605	Net Weight - Approximately 3 oz.				2.46	0.81	1.17
2 to 6 - 3/16"	1/9 thru 10	L	1/2 SAE Flare				
2 to 4 - 1/4"							
TYPE 1608	Net Weight - Approximately 5 oz.				2.94	1.00	1.66
2 to 9 - 3/16"	1/9 thru 10	L	1/2 SAE Flare				
5 to 6 - 1/4"							
2 to 4 - 5/16"							

To fulfill manufacturers’ special requirements, additional distributors are available on quantity orders. Contact Sporlan. READ ORDERING INSTRUCTIONS page 11.

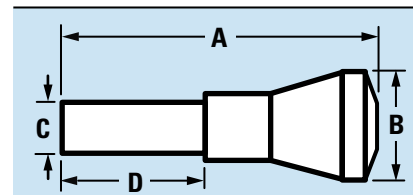
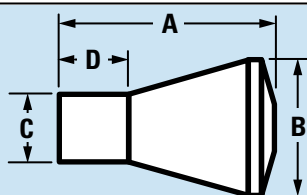
SPECIFICATIONS








ODF Solder Connections – Brass Body

The refrigerant distributors listed on pages 13 & 14 are for use with Sporlan thermostatic expansion valves with ODF solder connections. These include the following valve types: EBF, E(B)Q, EBS, EF, EG, EMC, ER, O, RC, S, SBF, S(B)Q. These distributors can also be applied to Sporlan OEM type thermostatic expansion valves, or any other thermostatic expansion valve having an ODF outlet connection. If a properly sized refrigerant distributor has a connection size different than the valve outlet, a reducing coupling can be used to connect them.

Material: body - brass
inlet tube - (D260 and D262 only) copper


COMBINATION
1113 DISTRIBUTOR
& TYPE S
THERMOSTATIC
EXPANSION VALVE



NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	NOZZLE & RETAINER RING SIZE	INLET CONNECTION Inches	DISTRIBUTOR	DIMENSIONS Inches			
					A	B	C	D
TYPE D260	Net Weight - Approximately 2 oz.				1.96	0.81	.503 .507	0.79
2 to 6 - 3/16"	1/9 thru 8	L	1/2 ODM Solder					
2 to 4 - 1/4"								
TYPE D262	Net Weight - Approximately 3 oz.				2.44	1.00	.503 .507	0.79
7 to 9 - 3/16"	1/9 thru 8	L	1/2 ODM Solder					
5 to 6 - 1/4"								
2 to 4 - 5/16"								
TYPE 1620	Net Weight - Approximately 2 oz.				1.14	0.81	.622 .626	0.69
2 to 6 - 3/16"	1/9 thru 10	J	5/8 ODM Solder					
2 to 4 - 1/4"								
TYPE 1622	Net Weight - Approximately 3 oz.				1.63	1.00	.622 .626	0.63
7 to 9 - 3/16"	1/9 thru 10	J	5/8 ODM Solder					
5 to 7 - 1/4"								
2 to 4 - 5/16"								
TYPE 1112	Net Weight - Approximately 4 oz.				1.72	0.91	.872 .875	1.00
5 to 7 - 3/16"	1/6 thru 20	G	7/8 ODM Solder					
4 to 6 - 1/4"								
2 to 4 - 5/16"								
2 - 3/8"								
TYPE 1113	Net Weight - Approximately 5 oz.				1.78	1.16	.872 .876	0.88
8 to 12 - 3/16"	G - 1/6 thru 20	G	7/8 ODM Solder					
7 to 8 - 1/4"								
5 to 6 - 5/16"								
3 to 4 - 3/8"								
TYPE 1135	Net Weight - Approximately 10 oz.				1.88	1.75	.872 .876	0.46
13 to 17 - 3/16"	2 thru 20	G	7/8 ODM Solder					
9 to 13 - 1/4"								

To fulfill manufacturers' special requirements, additional distributors are available on quantity orders. Contact Sporlan. READ ORDERING INSTRUCTIONS page 11.

SPECIFICATIONS – ODF Solder Connections – Brass Body (continued)

NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	NOZZLE & RETAINER RING SIZE	INLET CONNECTION Inches	DISTRIBUTOR	DIMENSIONS Inches			
					A	B	C	D
TYPE 1136	Net Weight - Approximately 1 lb., 4 oz.				2.48	2.25	$\frac{.872}{.876}$	0.46
18 to 24 - 3/16"	2 thru 20	G	7/8 ODM Solder					
14 to 18 - 1/4"								
TYPE 1137	Net Weight - Approximately 1 lb., 15 oz.				3.01	3.00	$\frac{.872}{.876}$	0.75
25 to 32 - 3/16"	2 thru 20	G	7/8 ODM Solder					
19 to 25 - 1/4"								
TYPE 1115	Net Weight - Approximately 9 oz.				2.44	1.50	$\frac{1.122}{1.127}$	1.12
11 to 15 - 3/16"	1/4 thru 30	E	1-1/8 ODM Solder					
9 to 10 - 1/4"								
7 to 9 - 5/16"								
5 to 6 - 3/8"								
TYPE 1116	Net Weight - Approximately 9 oz.				2.44	1.75	$\frac{1.122}{1.127}$	1.12
16 to 20 - 3/16"	1/4 thru 30	E	1-1/8 ODM Solder					
9 to 15 - 1/4"								
TYPE 1117	Net Weight - Approximately 1 lb.				2.56	1.75	$\frac{1.372}{1.377}$	1.31
10 to 18 - 3/16"	1/2 thru 50	C	1-3/8 ODM Solder					
9 to 15 - 1/4"								
7 - 5/16"								
7 - 3/8"								
TYPE 1126	Net Weight - Approximately 1 lb., 6 oz.				2.81	2.38	$\frac{1.372}{1.377}$	1.12
19 to 24 - 3/16"	1/2 thru 50	C	1-3/8 ODM Solder					
15 to 18 - 1/4"								
10 to 15 - 5/16"								
8 to 12 - 3/8"								
TYPE 1128	Net Weight - Approximately 1 lb., 10 oz.				3.12	3.00	$\frac{1.372}{1.377}$	1.38
25 to 28 - 3/16"	1/2 thru 50	C	1-3/8 ODM Solder					
19 to 25 - 1/4"								
16 to 21 - 5/16"								
13 to 16 - 3/8"								
TYPE 1125	Net Weight - Approximately 1 lb., 14 oz.				3.12	3.00	$\frac{1.621}{1.627}$	$\frac{1.25}{1.26}$
25 to 28 - 3/16"	2 thru 50	A	1-5/8 ODM Solder					
19 to 24 - 1/4"								
16 to 20 - 5/16"								
13 to 16 - 3/8"								
TYPE 1127	Net Weight - Approximately 2 lb., 4 oz.				3.31	3.50	$\frac{1.621}{1.627}$	1.25
29 to 37 - 3/16"	2 thru 50	A	1-5/8 ODM Solder					
25 to 30 - 1/4"								
22 to 26 - 5/16"								
19 to 20 - 3/8"								
TYPE 1143	Net Weight - Approximately 3 lb.				3.69	4.00	$\frac{1.621}{1.627}$	1.44
29 to 40 - 3/16"	2 thru 50	A	1-5/8 ODM Solder					
31 to 36 - 1/4"								
27 to 30 - 5/16"								
21 to 24 - 3/8"								

To fulfill manufacturers' special requirements, additional distributors are available on quantity orders. Contact Sporlan. READ ORDERING INSTRUCTIONS page 11.

SPECIFICATIONS

Flange Connections – Brass Body

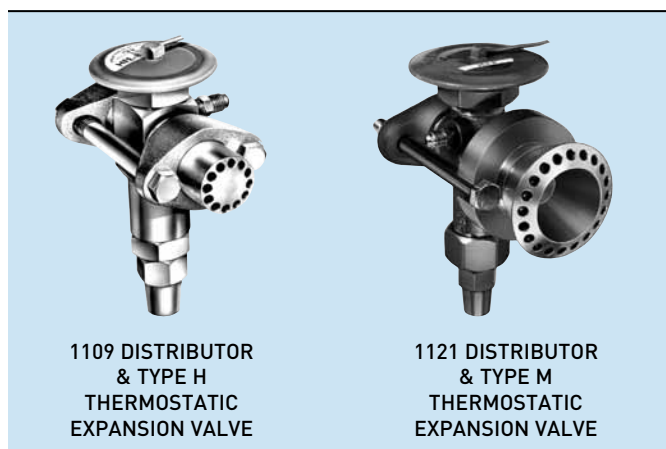
The distributors listed below are used with Sporlan Types H, M, and V thermostatic expansion valves.

The Types 1109 and 1124 refrigerant distributors have a male flange ring inlet connection, and bolt directly to the outlet of the Sporlan Type H valve. The Type 1109 refrigerant distributor is supplied with a 2-bolt flange P/N 576-000. This flange is also used for the H valve with 5/8" and 7/8" ODF outlet brass bushings. The Type 1124 refrigerant distributor has an integral 2-bolt flange. It does not require a separate flange.

Gasket P/N 123-002 is used when bolting these distributors to the valve body.

The female flange ring of the Type 1121 distributor mates directly to the Sporlan Types M and V valve outlet.

Gasket P/N 123-000 is used when bolting this distributor to the valve body.



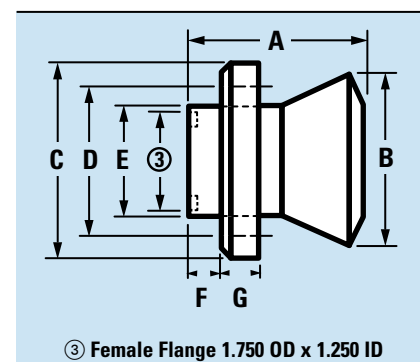
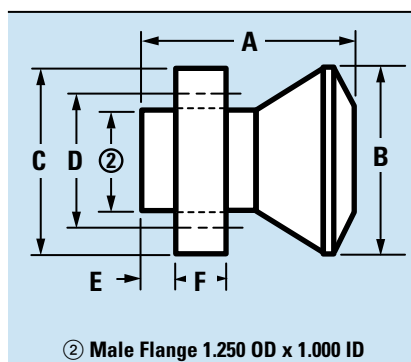
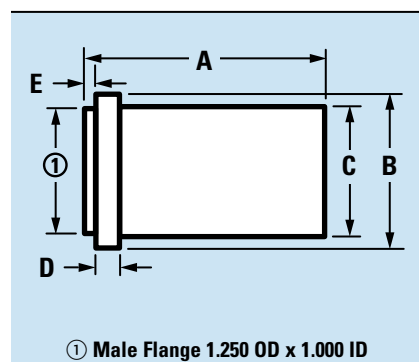
Bolt specifications for each distributor are listed below:




1109 with P/N 576-000 flange: (2) 7/16" 14 THD x 4-1/2" with nuts

1124: (2) 7/16" - 14 THD x 4" with nuts

1121: (2) 1/2" - 13 THD x 5" with nuts

Material: body - brass; 2 bolt flange for Type 1109 distributor - grey cast iron



NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	NOZZLE & RETAINER RING SIZE	DISTRIBUTOR	DIMENSIONS Inches						
				A	B	C	D	E	F	G
TYPE 1109	Net Weight - Approximately 10 oz.			2.44	1.37	1.12	0.25	0.12	---	---
2 to 10 - 3/16"	1/6 thru 20	G (Used in combination with Sporlan Type H)								
2 to 8 - 1/4"										
2 to 6 - 5/16"										
2 to 4 - 3/8"										
TYPE 1124	Net Weight - Approximately 1 lb., 14 oz.			3.12	2.75	2.75	2.00	0.50	0.75	---
13 to 30 - 3/16"	1/4 thru 30	E (Used in combination with Sporlan Type H)								
11 to 23 - 1/4"										
8 to 18 - 5/16"										
7 to 15 - 3/8"										
TYPE 1121	Net Weight - Approximately 3 lb., 12 oz.			3.12	3.06	3.35	2.69	2.00	0.56	0.75
17 to 34 - 3/16"	1/2 thru 50	C (Used in combination with Sporlan Types M and V)								
13 to 24 - 1/4"										
10 to 20 - 5/16"										
8 to 16 - 3/8"										

To fulfill manufacturers' special requirements, additional distributors are available on quantity orders. Contact Sporlan. READ ORDERING INSTRUCTIONS page 11.

ALUMINUM REFRIGERANT DISTRIBUTORS

Sporlan aluminum distributors are identical in function, and incorporate the same features as the brass models. General information and sizing recommendations also apply to the aluminum models.

Use Tables A, B, and C on pages 8 through 10 to select distributor nozzles and tubes.

Aluminum does not solder or braze to copper or brass TEV connections. As a result, Sporlan aluminum distributors bolt to Sporlan flanged connection TEVs. This connection provides a logical transition from a copper liquid line to an aluminum evaporator coil.

The Type 1192 distributor bolts directly to the Sporlan Type H valve. The flange gasket is P/N 123-002.

The Type 1193 distributor bolts directly to Sporlan Types M and V valves. The flange gasket is P/N 123-000.

Aluminum Brazing – Aluminum brazing requires close temperature control because of the narrow range of melting points between the filler metals and the base metal. To maintain close temperature control, oven brazing is often used instead of torch brazing.

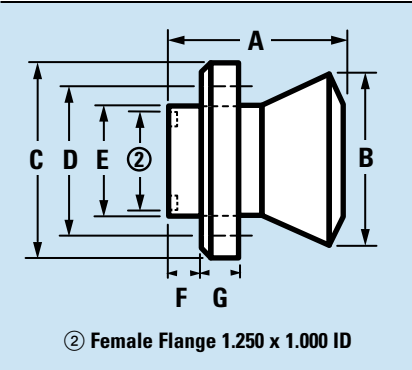
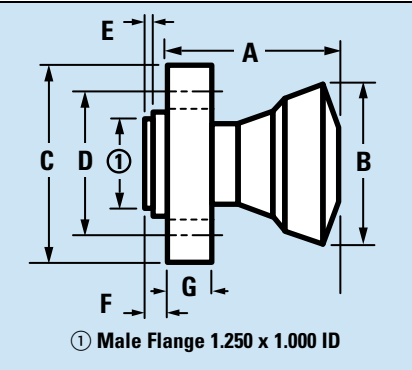
Since it is more difficult brazing aluminum tubes to an aluminum distributor, than brazing copper tubes to a brass distributor, Sporlan aluminum distributors have additional space between circuits, reducing the maximum number of circuits.



Brazing copper distributor tubes to an aluminum distributor is not recommended.

Sporlan aluminum distributors are made from 6061-T6 aluminum, and suitable for brazing.

Bolt specifications for each distributor are listed below:

- 1192: (2) 7/16" - 14 THD x 4-1/2" with nuts
- 1193: (2) 1/2" - 13 THD x 5" with nuts



NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	NOZZLE & RETAINER RING SIZE	DISTRIBUTOR	DIMENSIONS Inches						
				A	B	C	D	E	F	G
TYPE 1192	Net Weight - Approximately 10 oz.			2.69	2.25	2.75	2.00	0.12	0.31	0.62
2 to 11 - 3/16"	1/6 thru 20	G (Used in combination with Sporlan Type H)								
2 to 10 - 1/4"										
2 to 6 - 5/16"										
2 to 6 - 3/8"										
TYPE 1193	Net Weight - Approximately 1 lb., 4 oz.			3.12	3.06	3.50	2.69	2.00	0.56	0.75
12 to 26 - 3/16"	1/2 thru 50	C (Used in combination with Sporlan Type M and V)								
9 to 21 - 1/4"										
7 to 18 - 5/16"										
7 to 16 - 3/8"										

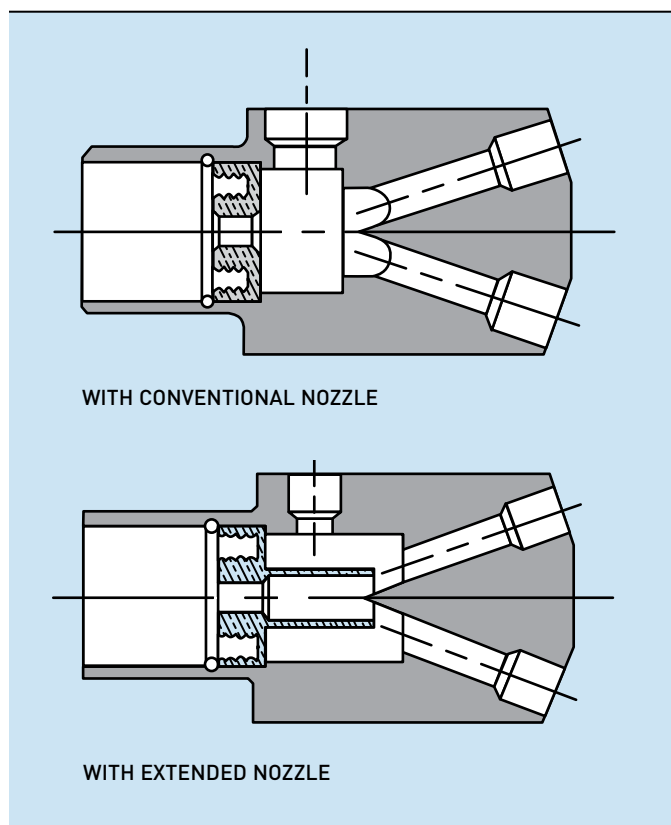
To fulfill manufacturers' special requirements, additional distributors are available on quantity orders. Contact Sporlan. READ ORDERING INSTRUCTIONS page 11.

REFRIGERANT DISTRIBUTORS WITH AUXILIARY SIDE CONNECTIONS

DISCHARGE BYPASS APPLICATIONS

When bypassing discharge gas through the distributor side connection for capacity control, the main stream of liquid refrigerant issuing from the nozzle may be deflected, affecting refrigerant distribution.

In 1964, Sporlan developed a special extended (Type R) nozzle. The Type R transmits refrigerant flow from the TEV, to the dispersion cone, without influence from the discharge gas flow entering through the side connection.



To distinguish side connection distributors with the extended type nozzles from the conventional distributors, the letter "R" is stamped after the designation on the body. For example, the Type **1653R** distributor employs the extended type nozzle. The extended nozzles are also similarly marked: the **GR** nozzle is the extended nozzle used in the Type **1653R** distributor.

The extended nozzle should not be used with the conventional side connection distributors. The standard nozzle, however, can be used with distributors designed for the extended nozzle.

SIDE CONNECTIONS

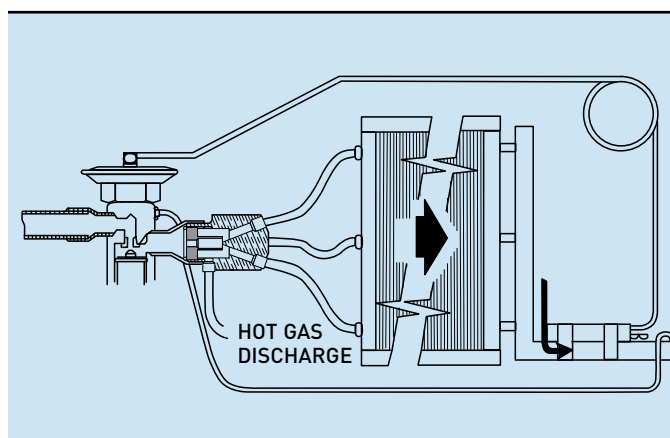
The maximum size of the side connection is limited by the distributor's internal dimensions. Two side connections located 180° apart can be provided if needed for increased flow. Side connection outlets are drilled to receive standard tubing.

SELECTION

1. Nozzle Orifice Size – The nozzle orifice size is selected based on the evaporator coil capacity from Table B, pages 9 & 10. See example on below.

2. Distributor Tube and Side Connection Size – are selected as follows:

Hot gas defrost and hot gas bypass applications – Initially, the tube circuits are selected based on the evaporator coil capacity from Table A, page 8. If the actual load, as a percentage of the tube's published rating, exceeds 100%, then use the next larger tube size. This minimizes pressure drop when the tubes are handling hot gas.



Example:

- R-410A
- 40°F evaporating temperature
- 100°F liquid refrigerant temperature
- 8 circuits, 24" tube lengths
- 12 tons
- Select a tube size assuming hot gas bypass is used for capacity control.
- Tons per circuit: $12/8 = 1.5$ tons
- 1/4" OD tube rating in Table A: 1.21 tons
- Tube rating corrected for tube length:
 $1.21 \times 1.07 = 1.29$ tons
- Actual load as percentage of published rating:
 $1.5/1.29 = 1.16$ or 116%
- Select next larger size tube: 5/16" OD since 1/4" OD tube loading is greater than 100%.
- Type 1655R-8-5/16 distributor may be used.
- The side outlet connection may be selected to match the hot gas line.

Heat pump or reverse cycle applications – For heat pump and reverse cycle applications the refrigerant distributor needs sufficient capacity for both the refrigeration and reverse cycles. When selecting a 1650 series distributor, the reverse liquid flow capacity is the first consideration. If the distributor is correctly chosen for the reverse cycle, the selection will have ample capacity for the refrigeration cycle. To meet reverse cycle requirements, use Table 4 below to select distributor circuit sizes.

Example:

Select tube size for an outdoor coil assuming the following reverse cycle (cooling mode) conditions:

Example:

- R-410A
- 40°F evaporating temperature
- 100°F liquid refrigerant temperature
- 5 circuits, 24" tube lengths
- 5 tons
- Tons per circuit: $5/5 = 1.0$ tons
- Looking at Table 4 below, we see pressure drop across 1/4" OD tube is 2 psi. This is an acceptable pressure drop.
- Type 1653 distributor may be used.
- The side outlet connection can be selected from Table 5. In the above example, the smallest acceptable side connection is 1/2" OD.

TABLE 5

Maximum Number of Circuits for Various Sizes of Side Connections REFRIGERANTS 22, 134a, and 410A				
SIDE CONNECTIONS ODF SOLDER - Inches (10)	3/16" OD TUBE	1/4" OD TUBE	5/16" OD TUBE	3/8" OD TUBE
3/8	6	3	2	---
1/2	9	5	3	2
5/8	16	8	5	3
7/8	28	15	9	5
1-1/8	---	26	16	10

For two side connections, number of circuits may be doubled.

(10) In some cases it may be necessary to reduce the line size at the distributor to utilize one of the side outlet connections available.

3. Side Connections – are selected as follows:

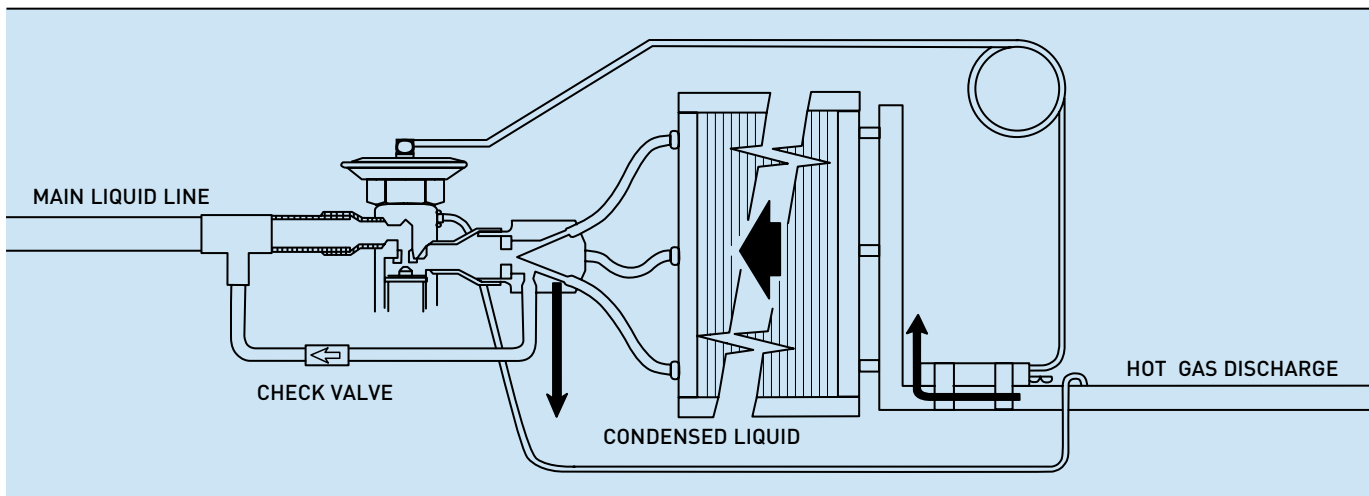
Hot gas defrost and hot gas bypass applications – For hot gas defrost or hot gas bypass applications the hot gas bypass line size is approximately equal to the discharge line. Choose the side connection(s) to match the bypass line.

Heat pump or reverse cycle applications – For heat pump applications select the side connection(s) from Table 5.

TABLE 4

Reverse Liquid Flow Capacities Per Circuit of Side Outlet Distributors (BTU/HR) at Various Pressure Drops												
DISTRIBUTOR CIRCUIT SIZE												
TOTAL PRESSURE DROP - psi DISTRIBUTOR and TUBES (9)	3/16" OD TUBE			1/4" OD TUBE			5/16" OD TUBE			3/8" OD TUBE		
	REFRIGERANT											
	22	407C	410A	22	407C	410A	22	407C	410A	22	407C	410A
1/2	1900	1800	1900	5800	5500	5600	11900	11300	11500	21800	20600	21000
1	2900	2700	2800	8500	8100	8200	17500	16600	16900	31900	30300	30700
1-1/2	3600	3400	3500	10700	10100	10300	21900	20800	21100	39900	37800	38300
2	4300	4000	4100	12500	11800	12000	25700	24300	24600	46700	44300	44800
2-1/2	4800	4600	4700	14100	13400	13600	29000	27500	27800	52800	50000	50500

(9) Assumes 30" distributor tube length. Total DP includes the side connection, 2 short radius elbows, and the liquid line tee.



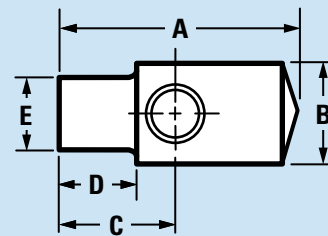
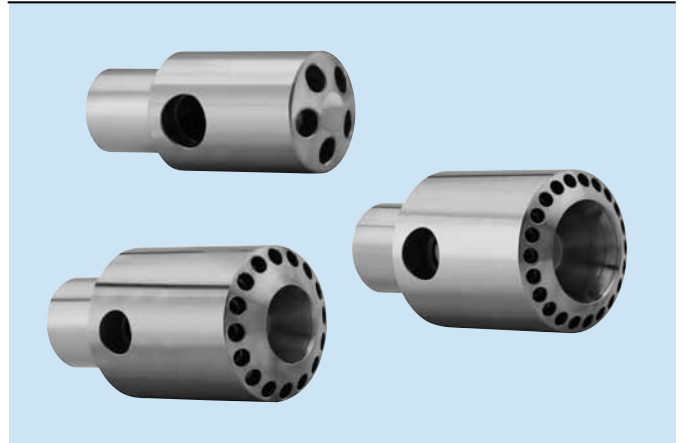
SPECIFICATIONS

ODF Solder Connections – Brass Body with Auxiliary Side Connections

ORDERING INSTRUCTIONS

Proper ordering requires five items:

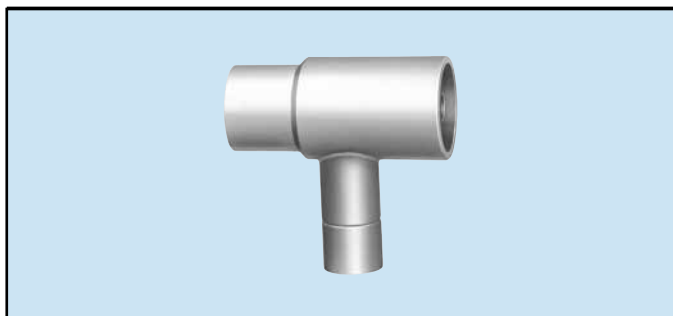
- **Distributor Type**
See Specification Table below
- **Number of Circuits**
Depends on evaporator design
- **Size Circuits**
See Table-A, Page 8
- **Nozzle Orifice Number**
See Table-B, Pages 9 & 10
- **Number and Size of Side Connections**
See Specification Table below



NO. CIRCUITS & TUBING SIZES AVAILABLE	NOZZLE ORIFICE NUMBERS AVAILABLE	SIDE CONNECTIONS		NOZZLE & RETAINER RING SIZE	EXPANSION VALVE OUTLET CONNECTION Inches	DIMENSIONS Inches				
		NUMBER	SIZE Inches			A	B	C	D	E
TYPE 1651 & 1651R	Net Weight - Approximately 4 oz.					1.97	0.88	0.98	0.66	<u>.622</u> .626
2 to 7 - 3/16"	1/9-R thru 5-R or 1/9 thru 5	1 or 2	3/8 or 1/2 ODF Solder	JR	5/8 ODF Solder					
2 to 5 - 1/4"				J						
TYPE 1653 & 1653R	Net Weight - Approximately 10 oz.					2.52	1.25	1.22	0.91	<u>.872</u> .876
8 to 12 - 3/16"	1/6-R thru 10-R or 1/6 thru 20	1 or 2	3/8 or 1/2 ODF Solder	GR	7/8 ODF Solder					
5 to 9 - 1/4"				G						
2 to 6 - 5/16"										
2 to 4 - 3/8"										
TYPE 1655 & 1655R	Net Weight - Approximately 11lb., 4 oz.					3.25	1.62	1.47	1.06	<u>1.122</u> 1.127
13 to 20 - 3/16"	2-R thru 20-R or 1/4 thru 30	1 or 2	1/2 or 5/8 ODF Solder	ER	1-1/8 ODF Solder					
10 to 12 - 1/4"				E						
7 to 10 - 5/16"										
5 to 7 - 3/8"										
TYPE 1657 & 1657R	Net Weight - Approximate3lb., 2 oz.					4.25	2.25	1.88	1.31	<u>1.372</u> 1.377
17 to 26 - 3/16"	3-R thru 30-R or 1/2 thru 50	1 or 2	5/8 or 7/8 ODF Solder	CR	1-3/8 ODF Solder					
13 to 18 - 1/4"				C						
10 to 14 - 5/16"										
8 to 11 - 3/8"										
TYPE 1659 & 1659R	Net Weight - Approximately 4lb., 14 oz.					4.88	2.75	2.31	1.62	<u>1.621</u> 1.627
27 to 32 - 3/16"	3-R thru 30-R or 2 thru 50	1 or 2	7/8 or 1-1/8 ODF Solder	AR	1-5/8 ODF Solder					
19 to 24 - 1/4"				A						
15 to 18 - 5/16"										
12 to 14 - 3/8"										

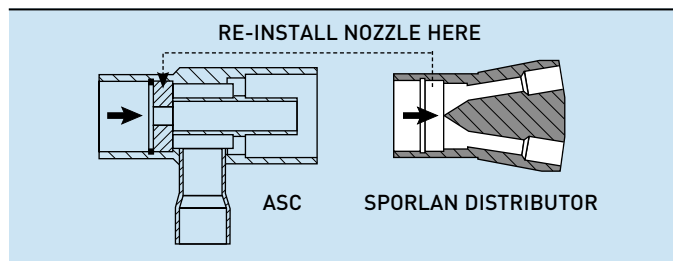
READ ORDERING INSTRUCTIONS above.

AUXILIARY SIDE CONNECTORS



Sporlan auxiliary side connectors (ASCs) permit removable nozzle type Sporlan refrigerant distributors, without side connections, to be used for hot gas bypass, hot gas defrost, or reverse cycle applications, see Figure 5.

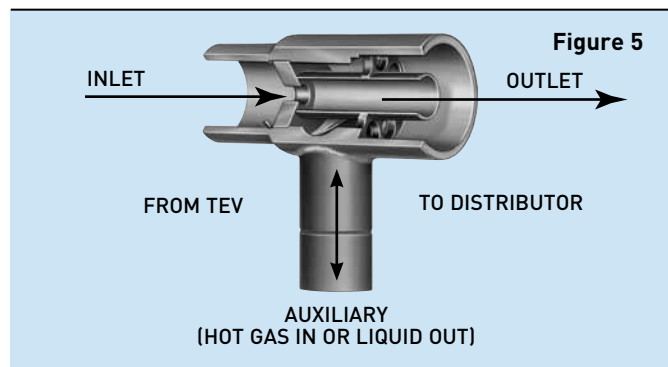
The ASC is installed between the TEV and distributor. First, the nozzle and retainer ring are removed from the distributor and reinstalled in the ASC inlet. The ASC outlet is then connected to the distributor inlet. The inlet of the ASC is connected to the TEV outlet.



As with side connection type Sporlan distributors, the ASC allows hot gas or liquid refrigerant in the reverse cycle to bypass the nozzle. In addition, the two-phase refrigerant flowing from the TEV passes through the nozzle, and a nozzle tube extension, which terminates at the distributor's dispersion cone. This tube eliminates

any interference in TEV flow from hot gas flow entering through the side connection. The tube is supported by a perforated web allowing hot gas or liquid refrigerant in the reverse cycle to flow through with minimal pressure drop.

Due to its small size, the ASC-4-3, does not employ any type nozzle tube extension. As a result, it is not suited for hot gas bypass applications. The ASC-4-3, however, is suitable for reverse cycle applications and hot gas defrost.



SELECTION

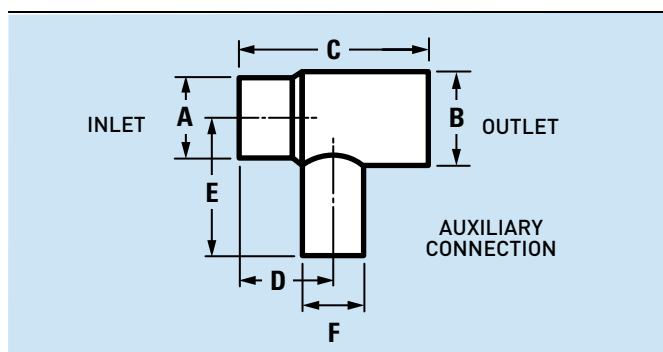
1. Select an ASC which matches the size of the distributor inlet. The table below lists Sporlan distributors and their matching ASC.
2. If the ASC is installed on an existing system, confirm the distributor nozzle orifice size. In addition, verify the distributor tube size is adequate for the application. See examples on pages 17 and 18.

SPECIFICATIONS

ASC-4-3, ASC-5-4, ASC-7-4, ASC-9-5, ASC-11-7, and ASC-13-9

ORDERING INSTRUCTIONS

For proper distributor type, order by complete Sporlan type listed below. E.g., an 1126 distributor requires an ASC-11-7 Auxiliary Side Connector. Do not use an ASC that is smaller or larger than recommended. Bushing up or down at the outlet defeats the purpose of the internal nozzle tube extension.



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	1/2	1/2	3/8	D260, D262	L	1/2 ODM	1/2 ODF	1.75	0.85	1.04	3/8 ODF
ASC-5-4	5/8	5/8	1/2	1620, 1622	J	5/8 ODM	5/8 ODF	1.91	0.95	1.25	1/2 ODF
ASC-7-4	7/8	7/8	1/2	1112, 1113	G	7/8 ODM	7/8 ODF	2.25	1.06	1.38	1/2 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

OFFER OF SALE

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. **Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is expressly conditioned on Buyer's assent to these Terms and Conditions and to the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional term or condition of Buyer's order or any other document issued by Buyer.

2. **Price Adjustments; Payments.** Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. **Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. **Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. This warranty is made only to Buyer and does not extend to anyone to whom Products are sold after purchased from Seller. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. **Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

6. **LIMITATION OF LIABILITY.** UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN**

IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.

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, VEVRRA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.



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