March 2012 / **BULLETIN 10-10-8**

SPORLAN

Type R Valves

Thermostatic Expansion Valves

Parker

ENGINEERING YOUR SUCCESS.

TABLE OF **CONTENTS**

Refer to Bulletin 10-9 for a complete discussion on the **Theory of Operation and Application of Thermostatic Expansion Valves**.

Refer to Bulletin 10-11 for a complete discussion on **Installing and Servicing Thermostatic Expansion Valves**.

Refer to Bulletin 10-10 for a complete discussion on the full line of **Thermostatic Expansion Valves**.

FOR USE ON REFRIGERATION and/or AIR CONDITIONING SYSTEMS ONLY

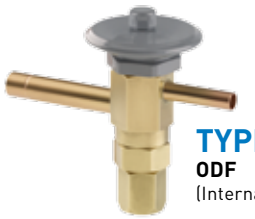
Bulletin 10-10-8, March 2012 supersedes Bulletin 10-10-8 dated January 2011 and all prior publications.

TYPE **R, ER, SR**

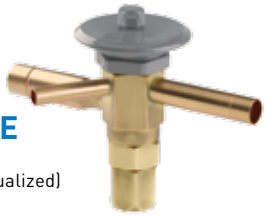
TYPE R
SAE
(Internally Equalized)

TYPE RE
SAE
(Externally Equalized)

Flare Connections



TYPE ER
ODF
(Internally Equalized)



TYPE ERE
ODF
(Externally Equalized)

Extended Solder Connections

TYPE SR
ODF
(Internally Equalized)

TYPE SRE
ODF
(Externally Equalized)

Extended Solder Connections with Forged Inlet and Replaceable Strainer

The Sporlan Type R Valve family features balanced port design, an external adjustment assembly and the replaceable element assembly. The Type R with extended copper connections has recently been expanded to include three conventional body styles, the R, ER, and SR plus new fractional capacity versions.

The ER with extended copper connections provides exceptional control in both flow directions making the ER an excellent choice for bi-flow heat pump applications. The ER also features the 60 x 50 mesh stainless steel wire cloth inlet strainer as a standard feature; the 100 mesh inlet strainer is an optional feature available for 5/8" ODF and larger fitting combinations.

The Type ER is available in two body sizes. The small body provides capacities up to 8 tons R-22 and R-410A, up to 5 tons R-134a, and up to 6 tons R-404A. Large body ER valves extend capacities to 12 tons R-22 and 15 tons R-410A.

The Sporlan Type R, with SAE flare connections, and the Type SR with the removable strainer assembly share the same balanced port construction as the ER. The R is complete with the 100 mesh inlet strainer as an integral part of the fitting while the SR has a 100 mesh removable strainer that can be cleaned or replaced while the valve remains soldered to the system tubing. These valves are ideally suited for small to large capacity refrigeration applications that could operate over widely varying operating conditions for refrigerants including R-22, R-134a, R-404A, and R-410A.

Type R valves may be applied in bi-directional applications.

Outlet Connections
3/8 SAE, 1/2" SAE, 3/8" ODF, 1/2" ODF, 5/8" ODF, 7/8" ODF, 1-1/8" ODF

Mating Distributors (See Bulletin 20-10)
D260, D262, 1620, 1622, 1112, 1113, 1115, 1116, 1603, 1605, 1606, 1608, 1650(R), 1651(R), 1653(R), 1655(R)

MATERIALS & DETAILS OF CONSTRUCTION

VALVE TYPE	BODY	SEAT	PIN	PIN CARRIER	PUSHROD(S)	TYPE OF JOINTS	CONNECTIONS	INLET STRAINER
R	Machined Brass Bar	Brass	Stainless Steel	Brass	Stainless Steel	Knife Edge to Metal	SAE Flare Fittings Silver Soldered to Body	Removable Strainer Screen
ER	Machined Brass Bar	Brass	Stainless Steel	Brass	Stainless Steel	Knife Edge to Metal	ODF Copper Fittings Silver Soldered to Body	
SR	Machined Brass Bar	Brass	Stainless Steel	Brass	Stainless Steel	Knife Edge to Metal	Extended Copper Fittings Silver Soldered to Body	Insert Strainer

SELECTION **PROCEDURE**

The following procedure should be used when selecting a Sporlan TEV:

1. Determine the liquid temperature of the refrigerant entering the valve.
The TEV capacity tables on pages 5-8 are based on a liquid temperature of 100°F (38°C) for R-22, R-134a, R-401A, R-404A, R-407C, R-408A, R-409A, R-410A, and R-422D. For other liquid temperatures, apply the correction factor given in the tables for each refrigerant. For example see Table B.

2. Determine pressure drop across valve.
The pressure drop correction factors are based on standard liquid temperature and pressure drop. The standard pressure drop is dependent on the evaporator temperature. To determine the pressure drop, subtract the saturated pressure equivalent to evaporator temperature from the condensing pressure. The condensing pressure used in this calculation should be the minimum operating condensing pressure of the system. From this value, subtract all other pressure losses to obtain the net pressure drop across the valve. Use this value to determine the pressure drop correction factor. For example see Table C. Be sure to consider all of the following possible sources of pressure drop:

1. Friction losses through refrigeration lines including the evaporator and condenser.
2. Pressure drop across liquid line accessories such as a solenoid valve and filter-drier.
3. Static pressure loss (gain) due to the vertical lift (drop) of the liquid line.
4. Pressure drop across a refrigerant distributor if used.

Refer to Bulletin 20-10 for information on refrigerant distributors.

3. Select valve from the capacity tables.
Select a valve based on the design evaporating temperature. If possible, the valve capacity should be equal or slightly exceed the design rating of the system. Be sure to apply the appropriate correction factors for liquid temperature and pressure drop. Once the desired valve capacity has been located, determine the nominal capacity of the valve from the table's second column. On multiple evaporator systems, select each valve on the basis of individual evaporator capacity. For example see Table A.

4. Determine if an external equalizer is required.
The amount of pressure drop between the valve outlet and bulb location will determine if an external equalizer is required. Refer to Bulletin 10-9 for further information on this subject.

5. Select body type.
Select the body type according to the style connections desired. For complete specifications on each TEV type including nominal ratings, refer to pages 9-19.

6. Select the Sporlan Selective Thermostatic Charge.
Select the charge according to the design evaporating temperature from the Table on page 4. Refer to Bulletin 10-9 for a complete discussion of the available Sporlan Selective Thermostatic Charges.

Selection Example – Refrigerant 410A

Application: air conditioning

Design evaporator temperature	40°F	5°C
Design condenser temperature	100°F	38°C
Refrigerant liquid temperature	90°F	30°C
Design system capacity	2 ton	7 kW
Available pressure drop across TEV:		
Condensing pressure - psig / bar	317	22.00
Evaporating pressure - psig / bar	119	8.36
	198	13.64
Liquid line and accessories loss - psi / bar	– 8	0.58
Distributor and tubes loss - psi / bar ①	– 30	2.06
	160	11.00
Refrigerant liquid correction factor	1.06	1.15
Pressure drop correction factor	1.00	1.00

Use the following formula to calculate TEV capacity:
TEV Capacity = TEV rating x CF liquid temperature x CF pressure drop

ERZE-2 has valve capacity of: 2.73 (9.38) x 1.06 (1.15) x 1.00 (1.00) = 2.89 tons (10.8 kW) at 40°F (30°C) evaporating temperature, 160 psi (11 bar) pressure drop and 90°F (30°C) liquid temperature.

Thermostatic charge (from table on page 4): ZGA ②

Selection:
ERZE-2-GA 3/8" x 1/2" x 1/4" ODF - 5'

① An externally equalized valve must be used on evaporators employing a refrigerant distributor due to the pressure drop created by the distributor. In addition, an externally equalized valve should always be used with air conditioning thermostatic charges to reduce the possibility of thermostatic charge migration.

② Please note that the refrigerant charge designation in the thermostatic charge ("Z" in this case) is dropped when it is incorporated into the valve model designation.

THERMOSTATIC EXPANSION VALVE
CAPACITIES for REFRIGERANTS - TONS

AIR CONDITIONING and HEAT PUMP APPLICATIO

VALVE TYPES	NOMINAL CAPACITY	REFRIGERANT 410A — RECOMMENDED THERMOSTATIC CHA ZCP 200, ZGA — EVAPORATOR TEMPERATURE °F		
		40°	20°	0°
ER	1/3	0.57	0.56	0.4
ER	1/2	0.73	0.79	0.7
ER	1	1.19	1.30	1.1
ER	1 1/2	2.09	2.27	2.0
ER	2	2.73	2.99	2.6
ER	3	3.80	4.16	3.7
ER	4	4.99	5.46	4.8

Table A

The valve capacity should equal or slightly exceed the tonnage rating of the system. (For complete R-410A capacity tables, see page 8.)

Design Evaporating Temperature

Liquid Temperature

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °F									
	40	50	60	70	80	90	100	110	120	130
	CORRECTION FACTOR, LIQUID TEMPERATURE									
410A	1.39	1.31	1.23	1.17	1.12	1.06	1.00	0.94	0.88	0.82

Table B

TEV Pressure Drop

EVAPORATOR TEMPERATURE °F	PRESSURE DROP ACROSS TEV (psi)						
	80	120	160	200	240	280	320
	CORRECTION FACTOR, CF PRESSURE DRO						
40°	0.71	0.87	1.00	1.12	1.22	1.32	1.41
20° & 0°	0.63	0.77	0.90	1.00	1.10	1.18	1.26

Table C

SELECTION **PROCEDURE**

VALVE NOMENCLATURE EXAMPLE / ORDERING INSTRUCTIONS

ER	Z	E	–	2	–	GA	3/8" ODF SOLDER	x	1/2" ODF SOLDER	x	1/4" ODF SOLDER	-	5'
Valve Type **R, ER, SR** Internally Equalized **RE, ERE, SRE** Externally Equalized	**Sporlan Code** – Refrigerant Element Label Color Code **F** = R-12 Yellow; **E** = R-13 Blue; **V** = R-22 Green; **G** = R-23 Blue; **M** = R-124 Blue; **J** = R-134a Blue; **X** = R-401A Pink; **L** = R-402A Sand; **S** = R-404A Orange; **V** = R-407A Green; **N** = R-407C Lt. Brown; **S** = R-408A Purple; **F** = R-409A Yellow; **Z** = R-410A Rose; **V** = R-422D Green; **R** = R-502 Purple; **W** = R-503 Blue; **P** = R-507 Teal; **W** = R-508B Blue	"E" specifies external equalizer. Omission of letter "E" indicates valve with internal equalizer. e.g. ERV-1-C		Nominal Capacity in Tons		Thermostatic Charge	Inlet Connection Size and Style		Outlet Connection Size and Style		External Equalizer Connection Size and Style		Capillary Tubing Length Inches, Feet or Meters

RECOMMENDED THERMOSTATIC CHARGES*

SPORLAN SELECTIVE CHARGES ENGINEERED for PEAK PERFORMANCE for EACH SPECIFIC APPLICATION

APPLICATION	REFRIGERANT									ACTUAL THERMOSTATIC CHARGES
	12, 409A	22, 422D, 407A	410A	134a	401A	404A, 408A	407C	502	507	
Air Conditioning	FCP60	–	–	JCP60	XCP60	–	–	–	–	JCP60
	–	VCP100	–	–	–	–	NCP100	–	–	VCP100
	–	–	ZCP180	–	–	–	–	–	–	ZCP180
	–	VGA	–	–	–	–	NGA	–	–	VGA
	–	–	–	–	–	–	–	RCP115	–	SCP115
	–	–	ZGA	–	–	–	–	–	–	ZGA
Commercial Refrigeration 50°F to -10°F 10°C to -23.3°C	FC	–	–	JC	XC	–	–	–	–	JC
	–	VC	–	–	–	–	NC	–	–	VC
	–	–	–	–	–	SC	–	RC	–	SC
	–	–	–	–	–	–	–	–	PC	PC
Low Temperature Refrigeration 0°F to -40°F -17.8°C to -40°C	FZ	–	–	–	–	–	–	–	–	JZ
	FZP	–	–	–	–	–	–	–	–	JZP
	–	VZ	–	–	–	–	–	–	–	VZ
	–	VZP40	–	–	–	–	–	–	–	VZP40
	–	–	–	–	–	SZ	–	RZ	PZ	SZ
	–	–	–	–	–	SZP	–	RZP	PZP	SZP

***APPLICATION FACTORS:**

1. The Type ZP charges have essentially the same characteristics as the Type Z charge with one exception: they produce a pressure limit Maximum Operating Pressure (MOP). ZP charges are not intended as replacements for Z charges. Each should be selected for its own unique purpose.
2. All air conditioning and heat pump charges are intended for use with externally equalized valves.
3. If in doubt as to which charge to use, review the section on thermostatic charges in Bulletin 10-9 or contact Sporlan Division of Parker, Washington, Missouri with complete system data.
4. **For dual temperature applications, use the "C" charge.**
5. **The "C" charge may be used on applications down to -30°F on R-22, R-404A and R-507.**

TEV **CAPACITY RATINGS**

TEV capacity ratings for R-22, R-134a, R-401A, R-404A, R-407C, R-408A, R-410A, and R-422D are based on vapor free 100°F (37.8°C) liquid refrigerant entering the expansion valve, a maximum opening superheat of 7°F (4K), and a standard factory air test superheat setting. A discussion of the relationship between valve capacities and superheat settings can be found in Bulletin 10-9.

The ratings for evaporator temperatures 40°F, 20°F, -10°F, -40°F (5°C, -5°C, -20°C, -40°C) in the capacity tables are in accordance with ANSI/ARI Standard Number 750. TEVs are tested in accordance with ANSI/ASHRAE 17.

For TEV capacity ratings at operating conditions not shown in the following tables, contact Sporlan Division of Parker.

▼ CAPACITIES — 22, 422D, 407C

AIR CONDITIONING / HEAT PUMP and COMMERCIAL REFRIGERATION APPLICATIONS

TONS ▪ psi ▪ °F

VALVE TYPES	NOMINAL CAPACITY (Ton)	REFRIGERANT														
		22						422D①						407C		
		RECOMMENDED THERMOSTATIC CHARGE														
		VC, VCP100, VGA			VZ, VZP40			VC, VCP100, VGA			VZ, VZP40			NC, NCP100, NGA		
		EVAPORATOR TEMPERATURE °F														
		40°	20°	0°	-10°	-20°	-40°	40°	20°	0°	-10°	-20°	-40°	40°	20°	0°
R-ER-SR	1/3	0.43	0.47	0.41	0.34	0.30	0.22	0.31	0.33	0.28	0.22	0.20	0.14	0.39	0.42	0.37
R-ER-SR	1/2	0.61	0.67	0.60	0.55	0.49	0.37	0.44	0.46	0.40	0.33	0.29	0.21	0.56	0.60	0.53
R-ER-SR	1	1.00	1.09	0.97	0.86	0.77	0.57	0.71	0.76	0.66	0.53	0.47	0.34	0.91	0.98	0.86
R-ER	1-1/2	1.75	1.91	1.71	1.22	1.09	0.81	1.25	1.32	1.15	0.93	0.82	0.59	1.59	1.71	1.51
R-ER-SR	2	2.30	2.51	2.24	1.60	1.43	1.07	1.64	1.74	1.51	1.22	1.07	0.77	2.09	2.25	1.99
R-ER-SR	3	3.21	3.49	3.12	2.30	2.06	1.53	2.28	2.42	2.10	1.70	1.49	1.08	2.91	3.13	2.77
R-ER	4	4.21	4.58	4.09	3.00	2.69	2.00	2.99	3.17	2.75	2.23	1.96	1.41	3.81	4.11	3.63
R-ER-SR	5	5.01	5.45	4.87	3.43	3.07	2.29	3.56	3.78	3.27	2.65	2.33	1.68	4.54	4.89	4.32
R-ER	6	6.01	6.54	5.28	3.80	3.18	2.34	4.28	4.53	3.54	2.87	2.53	1.82	5.45	5.87	4.68
ER	8	8.01	8.73	7.80	4.40	3.68	2.71	5.70	6.04	5.24	4.24	3.73	2.69	7.26	7.83	6.92
ER	10	10.4	11.4	10.2	–	–	–	7.44	7.88	6.83	–	–	–	9.47	10.2	9.02
ER	12	12.1	13.2	11.8	–	–	–	8.62	9.14	7.92	–	–	–	11.0	11.8	10.5

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
422D	1.99	1.90	1.80	1.70	1.60	1.50	1.41	1.31	1.20	1.10	1.00	0.90	0.79	0.68	0.57
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

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.

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
-10° & -20°	0.45	0.58	0.71	0.82	0.91	1.00	1.08	1.15	1.22	1.29	1.35	1.41
-40°	0.41	0.53	0.65	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.25	1.31

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 2 ton R-22 Type R valve at 20°F evaporator, 100 psi pressure drop across the TEV, and 90°F liquid temperature entering the TEV = 2.51 (from rating chart) x 1.06 (CF liquid temperature) x 0.89 (CF pressure drop) = 2.37 tons.

① R-422D can be used in a system with R-22 valves, but the TEV capacity will be reduced. Please verify valve capacity will handle system load.

kW ▪ bar ▪ °C

VALVE TYPES	VALVE SIZE	NOMINAL CAPACITY (kW)	REFRIGERANT																		
			22							422D①							407C				
			RECOMMENDED THERMOSTATIC CHARGE																		
			VC, VCP100, VGA			VZ, VZP40				VC, VCP100, VGA			VZ, VZP40				NC, NCP100, NGA				
			EVAPORATOR TEMPERATURE °C																		
			10°	5°	-5°	-15°	-20°	-30°	-40°	10°	5°	-5°	-15°	-20°	-30°	-40°	10°	5°	-5°	-15°	-20°
R-ER-SR	1/3	1.2	1.16	1.15	1.12	1.01	0.87	0.63	0.45	0.74	0.72	0.79	0.69	0.66	0.45	0.34	1.04	1.02	1.14	1.01	0.97
R-ER-SR	1/2	1.75	1.99	1.96	1.92	1.73	1.50	1.08	0.77	1.27	1.24	1.36	1.18	1.12	0.78	0.58	1.78	1.75	1.95	1.73	1.66
R-ER-SR	1	3.5	3.31	3.28	3.20	2.94	2.63	1.99	1.42	2.12	2.07	2.26	2.00	1.97	1.44	1.07	2.97	2.92	3.25	2.93	2.91
R-ER	1-1/2	5.3	5.80	5.74	5.61	5.14	4.29	2.83	2.01	3.71	3.62	3.96	3.51	3.22	2.04	1.52	5.21	5.12	5.69	5.13	4.75
R-ER-SR	2	7	7.62	7.54	7.37	6.75	5.64	3.71	2.64	4.87	4.75	5.20	4.61	4.23	2.67	2.00	6.84	6.72	7.48	6.74	6.24
R-ER-SR	3	11	10.6	10.5	10.3	9.40	7.92	5.33	3.80	6.78	6.61	7.24	6.42	5.94	3.84	2.87	9.52	9.35	10.4	9.38	8.77
R-ER	4	14	13.9	13.8	13.5	12.3	10.4	6.95	4.95	8.89	8.68	9.50	8.42	7.78	5.01	3.74	12.5	12.3	13.7	12.3	11.5
R-ER-SR	5	18	16.6	16.4	16.0	14.7	12.2	7.95	5.66	10.6	10.3	11.3	10.0	9.15	5.73	4.28	14.9	14.6	16.3	14.7	13.5
R-ER	6	21	19.9	19.7	19.2	16.4	13.3	8.21	5.79	12.7	12.4	13.6	11.2	10.0	2.92	4.38	17.8	17.5	19.5	16.3	14.7
ER	8	28	26.5	26.2	25.6	23.5	18.3	9.51	6.70	16.9	16.5	18.1	16.0	13.8	6.86	4.63	23.8	23.4	26.0	23.4	20.3
ER	10	35	34.5	34.2	33.4	30.6	17.7	–	–	22.1	21.5	23.6	20.9	13.3	–	–	31.0	30.5	33.9	30.6	19.6
ER	12	42	40.1	39.7	28.8	35.5	20.6	–	–	25.6	25.0	27.4	24.3	15.4	–	–	36.0	35.4	39.3	35.5	22.8

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °C						
	-10°C	0°	10°	20°	30°	50°	60°
	CORRECTION FACTOR, CF LIQUID TEMPERATURE						
22	1.52	1.42	1.32	1.21	1.11	0.89	0.87
422D	1.86	1.68	1.50	1.33	1.14	0.77	0.57
407C	1.73	1.59	1.45	1.30	1.15	0.84	0.67

These factors include corrections for liquid refrigerant density and net refrigerating effect and are based on an evaporator temperature of -17.8°C. However, they may be used for any evaporator temperature from -40°C to 10°C since the variation in the actual factors across this range is insignificant.

EVAPORATOR TEMPERATURE °C	PRESSURE DROP ACROSS TEV (bar)							
	2	4	6	8	10	12	14	16
	CORRECTION FACTOR, CF PRESSURE DROP							
5° & 10°	0.58	0.82	1.00	1.15	1.29	1.41	1.53	1.63
-5° & -15°	0.50	0.71	0.87	1.00	1.12	1.22	1.32	1.41
-20° & -30°	0.45	0.63	0.77	0.89	1.00	1.11	1.18	1.26
-40°	0.41	0.58	0.71	0.82	0.91	1.00	1.08	1.15

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 7 kW R-22 Type R valve at -5°C evaporator, 6 bar pressure drop across the TEV, and 30°C liquid temperature entering the TEV = 7.37 (from rating chart) x 1.11 (CF liquid temperature) x 0.71 (CF pressure drop) = 5.81 kW.

① R-422D can be used in a system with R-22 valves, but the TEV capacity will be reduced. Please verify valve capacity will handle system load.

▼ CAPACITIES 134a, 401A, 409A

AIR CONDITIONING / HEAT PUMP and COMMERCIAL REFRIGERATION APPLICATIONS

TONS ▪ psi ▪ °F

VALVE TYPES	NOMINAL CAPACITY (Tons)	REFRIGERANT								
		134a			401A			409A		
		RECOMMENDED THERMOSTATIC CHARGE								
		JC, JCP60			XC, XCP60			FC, FCP60		
		EVAPORATOR TEMPERATURE °F								
		40°	20°	0°	40°	20°	0°	40°	20°	0°
ER-SR	1/6	0.31	0.35	0.30	0.33	0.36	0.31	0.31	0.36	0.31
R-ER-SR	1/4	0.44	0.49	0.43	0.46	0.51	0.45	0.44	0.50	0.44
R-ER-SR	1/2	0.72	0.80	0.70	0.75	0.84	0.74	0.72	0.82	0.73
R-ER-SR	1	1.27	1.40	1.23	1.32	1.47	1.30	1.27	1.44	1.27
R-ER-SR	1-1/2	1.67	1.84	1.61	1.73	1.93	1.71	1.67	1.89	1.67
R-ER-SR	2	2.32	2.56	2.24	2.41	2.68	2.37	2.32	2.63	2.32
R-ER-SR	3	3.62	4.00	3.50	3.77	4.19	3.71	3.62	4.10	3.63
ER	4	4.35	4.80	3.79	4.52	5.03	4.01	4.35	4.92	3.93
ER	5	5.79	6.39	5.60	6.02	6.71	5.93	5.80	6.56	5.80

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														
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
409A	1.55	1.50	1.45	1.39	1.34	1.28	1.23	1.17	1.12	1.06	1.00	0.94	0.88	0.82	0.76

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 0°F to 40°F since the variation in the actual factors across this range is insignificant.

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-134a Type R valve at 20°F evaporator, 60 psi pressure drop across the TEV, and 60°F liquid temperature entering the TEV = 2.56 (from rating chart) x 1.36 (CF liquid temperature) x 0.87 (CF pressure drop) = 3.03 tons.

kW ▪ bar ▪ °C

VALVE TYPES	VALVE SIZE	NOMINAL CAPACITY (kW)	REFRIGERANT											
			134a				401A				409A			
			RECOMMENDED THERMOSTATIC CHARGE											
			JC, JCP60				XC, XCP60				FC, FCP60			
			EVAPORATOR TEMPERATURE °C											
			10°	5°	-5°	-15°	10°	5°	-5°	-15°	10°	5°	-5°	-15°
ER-SR	1/6	0.6	0.86	0.85	1.00	0.95	0.93	0.91	1.08	1.04	0.87	0.85	1.04	1.01
R-ER-SR	1/4	0.9	1.48	1.45	1.70	1.63	1.59	1.56	1.84	1.78	1.49	1.46	1.80	1.73
R-ER-SR	1/2	1.8	2.49	2.44	2.86	2.57	2.67	2.62	3.10	2.81	2.50	2.45	2.90	2.62
R-ER-SR	1	3.5	4.35	4.27	5.01	4.50	4.66	4.59	5.42	2.83	4.37	4.29	5.07	4.58
R-ER-SR	1-1/2	5.3	5.72	5.61	6.58	5.91	6.13	6.03	7.12	6.47	5.74	5.64	6.66	6.02
R-ER-SR	2	7	7.96	7.80	9.16	8.23	8.53	8.39	9.91	8.99	7.99	7.85	9.27	8.37
R-ER-SR	3	8.8	10.4	10.2	12.0	10.8	11.2	11.0	13.1	11.8	10.5	10.3	12.2	11.0
ER	4	11	12.4	12.2	14.3	12.9	13.3	13.1	15.5	14.1	12.5	12.3	14.5	13.1
ER	5	14	14.9	14.6	17.2	14.3	16.0	15.7	18.6	15.7	15.0	14.7	17.4	14.6

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °C							
	-10°	0°	10°	20°	30°	40°	50°	60°
	CORRECTION FACTOR, CF LIQUID TEMPERATURE							
134a	1.64	1.52	1.39	1.26	1.13	1.00	0.87	0.73
401A	1.52	1.42	1.31	1.20	1.09	0.98	0.86	0.74
409A	1.51	1.41	1.31	1.21	1.11	1.00	0.89	0.78

These factors include corrections for liquid refrigerant density and net refrigerating effect and are based on an evaporator temperature of -17.8°C. However, they may be used for any evaporator temperature from -15°C to 10°C since the variation in the actual factors across this range is insignificant.

EVAPORATOR TEMPERATURE °C	PRESSURE DROP ACROSS TEV (bar)					
	2	4	6	8	10	12
	CORRECTION FACTOR, CF PRESSURE DROP					
5° & 10°	0.71	1.00	1.22	1.41	1.58	1.73
-5° & -15°	0.58	0.82	1.00	1.15	1.29	1.41

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 7 kW R-134a Type R valve at -5°C evaporator, 4 bar pressure drop across the TEV, and 10°C liquid temperature entering the TEV = 9.16 (from rating chart) x 1.39 (CF liquid temperature) x 0.82 (CF pressure drop) = 10.4 kW.

CAPACITIES

404A, 408A

AIR CONDITIONING / HEAT PUMP and COMMERCIAL REFRIGERATION APPLICATIONS

TONS ▪ psi ▪ °F

VALVE TYPES	NOMINAL CAPACITY (Tons)	REFRIGERANT											
		404A						408A					
		RECOMMENDED THERMOSTATIC CHARGE											
		SC, SCP115			SZ, SZP			SC, SCP115			SZ, SZP		
		EVAPORATOR TEMPERATURE °F											
		40°	20°	0°	-10°	-20°	-40°	40°	20°	0°	-10°	-20°	-40°
ER-SR	1/6	0.27	0.29	0.25	0.34	0.30	0.22	0.35	0.38	0.33	0.27	0.24	0.17
R-ER-SR	1/4	0.39	0.41	0.36	0.55	0.49	0.37	0.50	0.54	0.48	0.43	0.39	0.28
R-ER-SR	1/2	0.63	0.67	0.58	0.86	0.77	0.57	0.81	0.88	0.78	0.68	0.60	0.44
R-ER-SR	1	1.10	1.17	1.02	1.22	1.09	0.81	1.42	1.54	1.36	0.96	0.86	0.63
R-ER-SR	1-1/2	1.45	1.54	1.33	1.60	1.43	1.07	1.87	2.02	1.78	1.26	1.13	0.83
R-ER-SR	2	2.02	2.14	1.86	2.30	2.06	1.53	2.60	2.81	2.48	1.82	1.62	1.19
R-ER-SR	3	2.65	2.81	2.44	3.00	2.69	2.00	3.42	3.69	3.26	2.37	2.11	1.55
ER	4	3.78	4.01	3.14	3.80	3.18	2.34	4.88	5.27	4.20	3.00	2.50	1.81
ER	6	5.04	5.35	4.64	4.40	3.68	2.71	6.51	7.02	6.20	3.48	2.89	2.10

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														
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
408A	1.66	1.60	1.54	1.47	1.40	1.34	1.27	1.21	1.14	1.07	1.00	0.93	0.86	0.79	0.71

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.

EVAPORATOR TEMPERATURE °F	PRESSURE DROP ACROSS TEV (psi)										
	30	50	75	100	125	150	175	200	225	250	275
	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
20° & 0°	0.49	0.63	0.77	0.89	1.00	1.10	1.18	1.26	1.34	1.41	1.48
-10° & -20°	0.45	0.58	0.71	0.82	0.91	1.00	1.08	1.15	1.22	1.29	1.35
-40°	0.41	0.53	0.65	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.25

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 2 ton R-404A Type R valve at -20°F evaporator, 125 psi pressure drop across the TEV, and 60°F liquid temperature entering the TEV = 2.06 (from rating chart) x 1.43 (CF liquid temperature) x 0.91(CF pressure drop) = 2.68 tons.

kW ▪ bar ▪ °C

VALVE TYPES	VALVE SIZE	NOMINAL CAPACITY (kW)	REFRIGERANT											
			404A						408A					
			RECOMMENDED THERMOSTATIC CHARGE											
			SC, SCP115			SZ, SZP			SC, SCP115			SZ, SZP		
			EVAPORATOR TEMPERATURE °C											
			5°	-5°	-15°	-20°	-30°	-40°	5°	-5°	-15°	-20°	-30°	-40°
ER-SR	1/6	0.6	0.71	0.78	0.74	0.80	0.66	0.57	0.91	1.02	0.99	1.08	0.91	0.8
R-ER-SR	1/4	0.9	1.21	1.34	1.27	1.35	1.07	0.85	1.57	1.75	1.69	1.81	1.47	1.18
R-ER-SR	1/2	1.8	1.88	2.07	1.85	1.88	1.45	1.09	2.43	2.71	2.46	2.52	1.99	1.53
R-ER-SR	1	3.5	3.57	3.94	3.51	3.23	2.06	1.55	4.61	5.15	4.67	4.33	2.82	2.17
R-ER-SR	1-1/2	5.3	4.70	5.18	4.61	4.23	2.68	2.01	6.06	6.77	6.14	5.68	3.67	2.82
R-ER-SR	2	7	6.52	7.18	6.40	5.94	3.87	2.91	8.40	9.39	8.51	7.98	5.30	4.08
R-ER-SR	3	11	8.58	9.45	8.42	7.81	5.06	3.80	11.1	12.4	11.2	10.5	6.93	5.33
ER	4	14	12.3	13.5	11.2	10.1	6.06	4.51	15.8	17.7	14.9	13.5	8.30	6.32
ER	6	21	16.3	18.0	16.0	13.8	6.92	5.15	21.1	23.5	21.3	18.5	9.48	7.22

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °C							
	-10°	0°	10°	20°	30°	40°	50°	60°
	CORRECTION FACTOR, CF LIQUID TEMPERATURE							
404A	1.89	1.72	1.56	1.37	1.19	1.00	0.79	0.56
408A	1.58	1.46	1.34	1.22	1.10	0.97	0.85	0.71

These factors include corrections for liquid refrigerant density and net refrigerating effect and are based on an evaporator temperature of -17.8°C. However, they may be used for any evaporator temperature from -40°C to 5°C since the variation in the actual factors across this range is insignificant.

EVAPORATOR TEMPERATURE °C	PRESSURE DROP ACROSS TEV (bar)							
	2	4	6	8	10	12	14	16
	CORRECTION FACTOR, CF PRESSURE DROP							
5°	0.58	0.82	1.00	1.15	1.29	1.41	1.53	1.63
-5° & -15°	0.50	0.71	0.87	1.00	1.12	1.22	1.32	1.41
-20° & -30°	0.45	0.63	0.77	0.89	1.00	1.10	1.18	1.26
-40°	0.41	0.58	0.71	0.82	0.91	1.00	1.08	1.15

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 7 kW R-404A Type R valve at -30°C evaporator, 8 bar pressure drop across the TEV, and 20°C liquid temperature entering the TEV = 3.87 (from rating chart) x 1.37 (CF liquid temperature) x 0.89 (CF pressure drop) = 4.72 kW.

CAPACITIES 410A

AIR CONDITIONING / HEAT PUMP

TONS ▪ psi ▪ °F

VALVE TYPES	NOMINAL CAPACITY (Tons)	REFRIGERANT 410A RECOMMENDED THERMOSTATIC CHARGE ZCP180, ZGA EVAPORATOR TEMPERATURE °F		
		40°	20°	0°
ER	1	1.19	1.30	1.16
ER	1-1/2	2.08	2.27	2.03
ER	2	2.73	2.99	2.67
ER	3	3.80	4.16	3.72
ER	4	4.99	5.46	4.88
ER	5	5.94	6.50	5.81
ER	6	7.13	7.79	6.29
ER	8	9.50	10.4	9.29
ER	12-1/2	12.4	13.5	12.1
ER	15	14.4	15.7	14.1

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °F										
	40	50	60	70	80	90	100	110	120	130	140
	CORRECTION FACTOR, CF LIQUID TEMPERATURE										
410A	1.39	1.31	1.23	1.17	1.12	1.06	1.00	0.94	0.88	0.82	0.76

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 0°F to 40°F since the variation in the actual factors across this range is insignificant.

EVAPORATOR TEMPERATURE °F	PRESSURE DROP ACROSS TEV (psi)							
	80	120	160	200	240	280	320	360
	CORRECTION FACTOR, CF PRESSURE DROP							
40°	0.71	0.87	1.00	1.12	1.22	1.32	1.41	1.50
20° & 0°	0.63	0.77	0.89	1.00	1.10	1.18	1.26	1.34

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 2 ton R-410A Type R valve at 20°F evaporator, 160 psi pressure drop across the TEV, and 90°F liquid temperature entering the TEV = 2.99 (from rating chart) x 1.06 (CF liquid temperature) x 0.89 (CF pressure drop) = 2.82 tons.

kW ▪ bar ▪ °C

VALVE TYPES	VALVE SIZE	NOMINAL CAPACITY (kW)	REFRIGERANT 410A RECOMMENDED THERMOSTATIC CHARGE ZCP180, ZGA EVAPORATOR TEMPERATURE °C			
			10°	5°	-5°	-15°
ER	1	3.5	4.12	4.08	4.50	4.12
ER	1-1/2	5.3	7.21	7.14	7.88	7.21
ER	2	7	9.47	9.38	10.4	9.48
ER	3	11	13.2	13.1	14.4	13.2
ER	4	14	17.3	17.1	18.9	17.3
ER	5	18	20.6	20.4	22.5	20.6
ER	6	21	24.7	24.5	27.0	23.0
ER	8	28	33.0	32.6	36.0	33.0
ER	10	44	43.0	42.5	46.9	43.0
ER	15	53	49.8	49.4	54.4	49.9

REFRIGERANT	LIQUID TEMPERATURE ENTERING TEV °C				
	20°	30°	40°	50°	60°
	CORRECTION FACTOR, CF LIQUID TEMPERATURE				
410A	1.30	1.15	1.00	0.84	0.65

These factors include corrections for liquid refrigerant density and net refrigerating effect and are based on an evaporator temperature of -17.8°C. However, they may be used for any evaporator temperature from -15°C to 10°C since the variation in the actual factors across this range is insignificant.

EVAPORATOR TEMPERATURE °C	PRESSURE DROP ACROSS TEV (bar)				
	8	11	14	17	20
	CORRECTION FACTOR, CF PRESSURE DROP				
5° & 10°	0.85	1.00	1.13	1.24	1.35
-5° & -15°	0.76	0.89	1.00	1.10	1.20

TEV Capacity = TEV Rating x CF Liquid Temperature x CF Pressure Drop — Example: Actual capacity of a nominal 7 kW R-410A Type R valve at -5°C evaporator, 11 bar pressure drop across the TEV, and 30°C liquid temperature entering the TEV = 10.4 (from rating chart) x 1.15 (CF liquid temperature) x 0.89 (CF pressure drop) = 10.6 kW.

TYPE **R**

For Refrigerants 22, 134a, 404A, 507
SAE Flare Connections

FEATURES

- Small brass body
- Replaceable thermostatic element with gray epoxy coating
- SAE Flare connections in a variety of common sizes
- 100 mesh inlet strainer integral to fitting
- Available in single lot or case quantities
- Option for 15% bleed port
  (Other bleed port rates available with OEM version only)

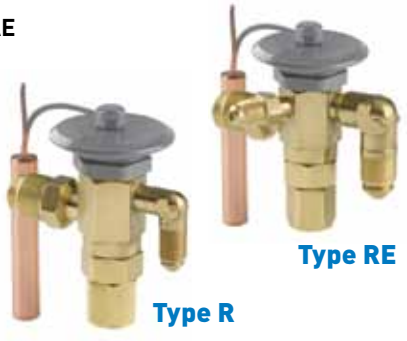
SPECIFICATIONS

- Operating Temperature Range: -40°F (-40°C) through 50°F (10°C)
- Maximum Ambient Temperature: 140°F (60°C)
- Maximum Rated Pressure (UL): 450 psig (31 bar)
- Maximum Low Side Test Pressure: 450 psig (31 bar)
- Agency Certifications: UL Recognized under file SA5410.
  Covered under CE and the PED (Pressure Equipment Directive)

For complete details of construction, see page 2.

Outlet Connections - SAE
3/8", 1/2"

Mating Distributors
(See Bulletin 20-10)
1603, 1605, 1606, 1608, 1650(R)

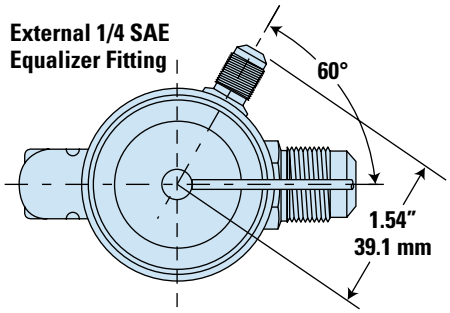


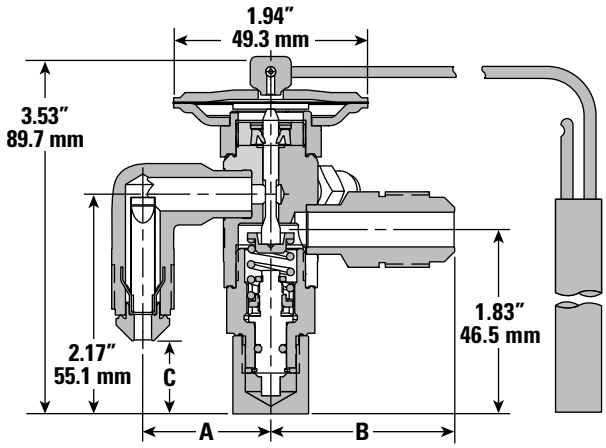
MAXIMUM DEHYDRATION and BULB TEMPERATURE

REFRIGERANT	THERMOSTATIC CHARGE			
	C	Z	GA	P TYPE, ZP SERIES
12, 134a	190°F 88°C	250°F 121°C	–	250°F 121°C
22, 407C	160°F 71°C	185°F 85°C	250°F 121°C	250°F 121°C
404A, 502, 507	150°F 66°C	170°F 77°C	–	250°F 121°C

DIMENSIONS – TYPE RE with NUMBER 43 ELEMENT

Top View





1/4 SAE Inlet Strainer - P/N 3008-000
3/8 SAE Inlet Strainer - P/N 1538-000

CONNECTIONS

FITTING SIZE Inches		Inches			mm		
Inlet	Outlet	A	B	C	A	B	C
1/4	3/8	1.09	1.63	1.13	27.7	41.4	28.7
3/8	1/2	1.27	1.82	0.71	38.1	46.2	18.0

BULB SIZES

REFRIGERANT	STANDARD CHARGE	BULB DIMENSION		REPLACEMENT	PART NUMBER	
					CAPILLARY TUBE LENGTH	
		Inches	mm		30" 760 mm	60" 1500 mm
R-404A R-408A R-502	C	0.50 OD x 3.00	12.7 OD x 76.2	KT-43-SC	179943	180204
R-402A R-507	C			KT-43-PC	180288	180338
R-402A R-404A R-408A R-502 R-507	Z			KT-43-SZ	180228	180318
	ZP			KT-43-SZP	180230	180060
R-22 R-407C R-422D	C			KT-43-VC	180269	180319
R-134a R-401A R-409A	C			KT-43-JC	180314	180310

TYPE **R**

For Refrigerants 22, 134a, 404A, 507
SAE Flare Connections

SPECIFICATIONS - CONTINUED

VALVE NOMENCLATURE

R	S	E	–	1/4	–	ZP	–	1/4	x	1/2	x	1/4	–	30"
Valve Type	Refrigerant Code	Externally Equalized		Nominal Capacity in Tons		Thermostatic Charge		Inlet Connection Size		Outlet Connection Size		External Equalizer Connection Size		Capillary Tube Length

R-404A, R-408A, R-507

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE		
							C*	Z	ZP
							TYPE R with 404A (S) Refrigerant		
		Inlet	Outlet		Inches	mm	Part Number		
R	RS-1/6	1/4 SAE	3/8 SAE	NO	30	760	169739	169740	169741
	RS-1/6	1/4 SAE	1/2 SAE	NO	30	760	169742	169473	169744
	RS-1/4	1/4 SAE	3/8 SAE	NO	30	760	169745	169746	169747
	RS-1/4	1/4 SAE	1/2 SAE	NO	30	760	169308	169310	169309
	RS-1/2	1/4 SAE	1/2 SAE	NO	60	1500	169305	169306	169307
	RS-1/2	3/8 SAE	1/2 SAE	NO	60	1500	169337	169335	169336
	RS-1	3/8 SAE	1/2 SAE	NO	60	1500	169330	169331	169329
	RS-1-1/2	3/8 SAE	1/2 SAE	NO	60	1500	169332	169334	169333
	RSE-1/4	1/4 SAE	1/2 SAE	YES	30	760	169319	169320	169321
	RSE-1/2	1/4 SAE	1/2 SAE	YES	60	1500	169318	169317	169316
	RSE-1/2	3/8 SAE	1/2 SAE	YES	60	1500	169364	169365	169363
	RSE-1	3/8 SAE	1/2 SAE	YES	60	1500	169352	169353	169351
	RSE-1-1/2	3/8 SAE	1/2 SAE	YES	60	1500	169359	169358	169357
	RSE-2	3/8 SAE	1/2 SAE	YES	60	1500	169356	169355	169354
	RSE-3	3/8 SAE	1/2 SAE	YES	60	1500	169362	169360	169361

* For C charge on R-507 or R-402A, use element kit 180288 (30") or 180338 (60") KT-43-PC.

R-22, R-407C, R-422D

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE
							C
							TYPE R with 22 (V) Refrigerant
		Inlet	Outlet		Inches	mm	Part Number
R	RV-1/3	1/4 SAE	1/2 SAE	NO	30	760	169313
	RV-1/2	1/4 SAE	1/2 SAE	NO	30	760	169312
	RV-1/2	3/8 SAE	1/2 SAE	NO	30	760	169345
	RV-1	1/4 SAE	1/2 SAE	NO	60	1500	169311
	RV-1	3/8 SAE	1/2 SAE	NO	60	1500	169338
	RV-1-1/2	3/8 SAE	1/2 SAE	NO	60	1500	169342
	RV-2	3/8 SAE	1/2 SAE	NO	60	1500	169340
	RVE-1/3	1/4 SAE	1/2 SAE	YES	30	760	169324
	RVE-1/2	3/8 SAE	1/2 SAE	YES	30	760	169380
	RVE-1	1/4 SAE	1/2 SAE	YES	60	1500	169322
	RVE-1	3/8 SAE	1/2 SAE	YES	60	1500	169366
	RVE-1-1/2	3/8 SAE	1/2 SAE	YES	60	1500	169378
	RVE-2	3/8 SAE	1/2 SAE	YES	60	1500	169368
	RVE-3	3/8 SAE	1/2 SAE	YES	60	1500	169370
	RVE-4	3/8 SAE	1/2 SAE	YES	60	1500	169372
	RVE-5	3/8 SAE	1/2 SAE	YES	60	1500	169374
	RVE-6	3/8 SAE	1/2 SAE	YES	60	1500	169376

TYPE R

For Refrigerants 22, 134a, 404A, 507
SAE Flare Connections

SPECIFICATIONS - CONTINUED

R-134a, R-401A, R-409A

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE C TYPE R with 134a (J) Refrigerant
		Inlet	Outlet		Inches	mm	Part Number
R	**RJ-1/6**	1/4 SAE	3/8 ODF	NO	30	760	169737
	RJ-1/6	1/4 SAE	1/2 ODF	NO	30	760	169738
	RJ-1/4	1/4 SAE	3/8 SAE	NO	30	760	169298
	RJ-1/4	1/4 SAE	1/2 SAE	NO	30	760	169302
	RJ-1/4	3/8 SAE	1/2 SAE	NO	30	760	169328
	RJ-1/2	1/4 SAE	3/8 SAE	NO	60	1500	169297
	RJ-1/2	1/4 SAE	1/2 SAE	NO	60	1500	169299
	RJ-1/2	3/8 SAE	1/2 SAE	NO	60	1500	169327
	RJ-1	3/8 SAE	1/2 SAE	NO	60	1500	169325
	RJ-1-1/2	3/8 SAE	1/2 SAE	NO	60	1500	169326
	RJ-1-1/2	1/4 SAE	1/2 SAE	YES	30	760	169315
	RJE-1/2	1/4 SAE	1/2 SAE	YES	60	1500	169314
	RJE-1/2	3/8 SAE	1/2 SAE	YES	60	1500	169350
	RJE-1	3/8 SAE	1/2 SAE	YES	60	1500	169346
	RJE-1-1/2	3/8 SAE	1/2 SAE	YES	60	1500	169349
	RJE-2	3/8 SAE	1/2 SAE	YES	60	1500	166347
	RJE-3	3/8 SAE	1/2 SAE	YES	60	1500	169348

▼ TYPE **ER**

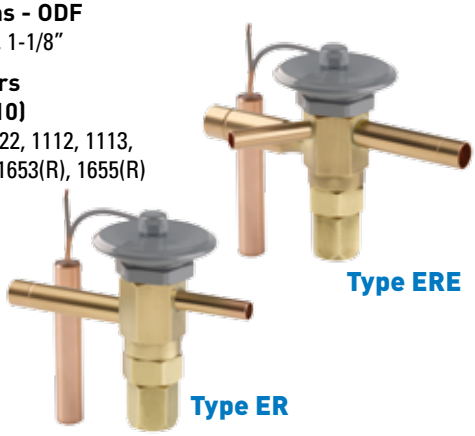
For Refrigerants 22, 134a, 404A, 410A, 507
ODF Solder Connections

FEATURES

- Small brass body
- Replaceable thermostatic element with gray epoxy coating
- Internally and externally equalized versions available
- Two body sizes:
  Small - For capacities less than 8 tons R-22, 6 tons R-404A, 5 tons R-134a and 8 tons R-410A
  Large - For capacities 10 to12 tons R-22, 12-1/2 to15 tons R-410A
- ODF connections in a variety of common sizes
- Inlet strainer available
- Available in single lot or case quantities
- Option for 15% bleed port
  (Other bleed port rates available with OEM version only)

Outlet Connections - ODF
3/8", 1/2", 5/8", 7/8", 1-1/8"

Mating Distributors
(See Bulletin 20-10)
D260, D262, 1620, 1622, 1112, 1113, 1115, 1116, 1651(R), 1653(R), 1655(R)



SPECIFICATIONS

- Operating Temperature Range: -40°F (-40°C) through 50°F (10°C)
- Maximum Ambient Temperature: 140°F (60°C)
- Maximum Rated Pressure (UL): 450 psig (31 bar)
  700 psig (48.3 bar) for R-410A Only
- Maximum Low Side Test Pressure: 450 psig (31 bar)
  700 psig (48.3 bar) for R-410A Only
- Agency Certifications: UL Recognized under file SA5410.
  Covered under CE and the PED (Pressure Equipment Directive)

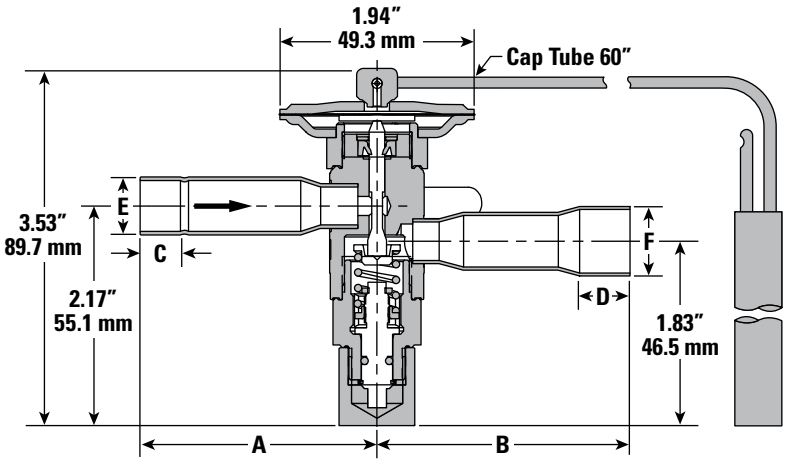
For complete details of construction, see page 2.

MAXIMUM DEHYDRATION and BULB TEMPERATURE

REFRIGERANT	THERMOSTATIC CHARGE			
	C	Z	GA	P TYPE, ZP SERIES
12, 134a	190°F 88°C	250°F 121°C	–	250°F 121°C
22, 407C	160°F 71°C	185°F 85°C	250°F 121°C	250°F 121°C
404A, 502, 507	150°F 66°C	170°F 77°C	–	250°F 121°C
410A	–	–	250°F* 121°C*	250°F* 121°C*

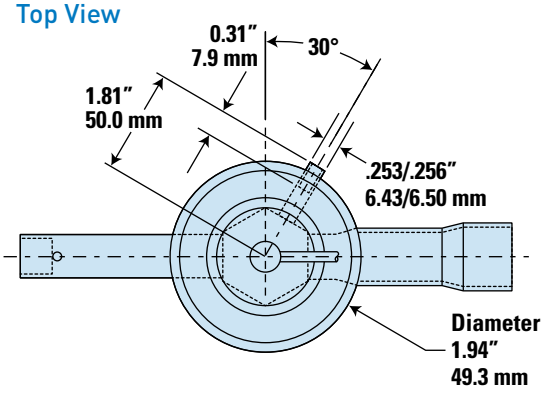
* Bulb temperature can not exceed 160°F (71°C).

DIMENSIONS – TYPE ERE (SMALL BODY) with NUMBER 43 and 45 ELEMENT



1/4 ODF Insert Strainer - P/N 1543-002
3/8 ODF Insert Strainer - P/N 1524-000

Top View



CONNECTIONS

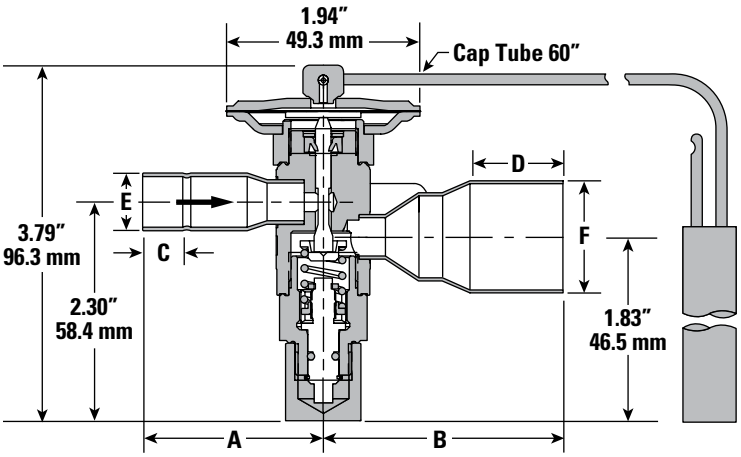
FITTING SIZE Inches		Inches						mm					
Inlet	Outlet	A	B	C	D	E	F	A	B	C	D	E	F
1/4	3/8	1.69	2.42	0.31	0.31	.253/.256	.377/.381	42.9	61.5	7.87	7.87	6.43/6.50	9.58/9.68
3/8	1/2	2.42	2.51	0.31	0.40	.377/.381	.502/.506	61.5	63.8	7.90	10.2	9.58/9.68	12.8/12.9
1/2	5/8	2.35	2.51	0.40	0.50	.502/.506	.627/.632	59.7	63.8	10.2	12.7	12.8/12.9	15.9/16.1
	7/8		2.41		0.78		.877/.882		61.2		19.8		22.3/22.4
5/8	1-1/8	2.35	2.41	0.50	0.91	.627/.632	1.128/1.135	59.7	61.2	12.7	23.1	15.9/16.1	28.7

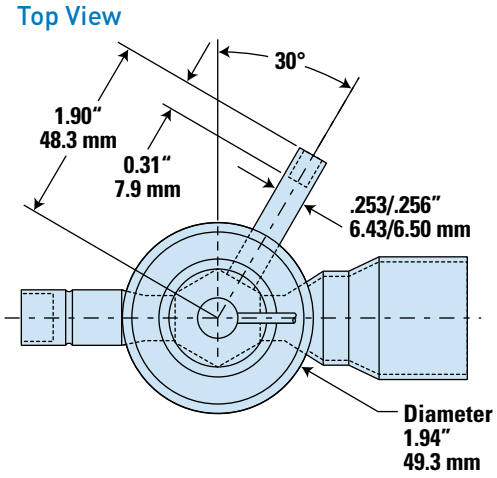
TYPE **ER**

For Refrigerants 22, 134a, 404A, 410A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

DIMENSIONS – TYPE ERE (LARGE BODY) with NUMBER 45-5 ELEMENT





CONNECTIONS

FITTING SIZE Inches		Inches						mm					
		A	B	C	D	E	F	A	B	C	D	E	F
Inlet	Outlet												
5/8	7/8	2.48	2.51	0.50	0.78	.627/.632	.877/.882	63.0	63.8	12.7	19.8	15.9/16.1	22.3/22.4
	1-1/8				0.91		1.128/1.135				23.1		28.7/28.8

BULB SIZES

REFRIGERANT	STANDARD CHARGE	BULB DIMENSION		REPLACEMENT	PART NUMBER	
					CAPILLARY TUBE LENGTH	
		Inches	mm		30" 760 mm	60" 1500 mm
R-404A R-408A R-502	C	0.50 OD x 3.00	12.7 OD x 76.2	KT-43-SC	179943	180204
R-402A R-507	C			KT-43-PC	180288	180338
R-402A R-404A R-408A R-502 R-507	Z			KT-43-SZ	180228	180318
	ZP			KT-43-SZP	180230	180060
R-22 R-407C R-422D	C			KT-43-VC	180269	180319
	CP100			KT-43-VCP100	180270	180272
	GA	0.75 OD x 2.00	19.5 OD x 50.8	KT-43-VGA	180284	180276
R-134a R-401A R-409A	C	0.50 OD x 3.00	12.7 OD x 76.2	KT-43-JC	180314	180310
	CP60			KT-43-JCP60	180206	180312
R-410A	ZGA	0.75 OD x 2.00	19.5 OD x 50.8	KT-45-ZGA	181209	181212
				KT-45-5-ZGA	—	180298
	ZCP180	0.50 OD x 3.00	12.7 OD x 76.2	KT-45-ZCP180	181355	181213
				KT-45-5-ZCP180	—	181216

TYPE **ER**

For Refrigerants 22, 134a, 404A, 410A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

VALVE NOMENCLATURE

ER	Z	E	–	1	–	GA	–	3/8	x	1/2	x	1/4	–	60″
Valve Type	Refrigerant Code	Externally Equalized		Nominal Capacity in Tons		Thermostatic Charge		Inlet Connection Size		Outlet Connection Size		External Equalizer Connection Size		Capillary Tube Length

R-22, R-407C, R-422D

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		STRAINER INCLUDED	WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE		
								C	CP100	GA
								TYPE R with 22 (V) Refrigerant		
		Inlet	Outlet			Inches	mm	Part Number		
ER	ERV-1/3	1/4 ODF	3/8 ODF	YES	NO	30	760	169159	—	—
	ERV-1/3	1/4 ODF	1/2 ODF	YES	NO	30	760	169173	—	—
	ERV-1/3	3/8 ODF	1/2 ODF	YES	NO	30	760	169209	—	—
	ERV-1/2	1/4 ODF	3/8 ODF	YES	NO	30	760	169158	—	—
	ERV-1/2	1/4 ODF	1/2 ODF	YES	NO	30	760	169172	—	—
	ERV-1/2	3/8 ODF	1/2 ODF	YES	NO	30	760	169208	—	—
	ERV-1	3/8 ODF	1/2 ODF	YES	NO	60	1500	169206	—	—
	ERV-2	3/8 ODF	1/2 ODF	YES	NO	60	1500	169207	—	—
	ERVE-1/3	1/4 ODF	1/2 ODF	YES	YES	30	760	169187	—	—
	ERVE-1/2	1/4 ODF	1/2 ODF	YES	YES	30	760	169186	—	—
	ERVE-1/2	3/8 ODF	1/2 ODF	YES	YES	30	760	169246	—	—
	ERVE-1	1/4 ODF	1/2 ODF	YES	YES	60	1500	169185	—	—
	ERVE-1	3/8 ODF	1/2 ODF	YES	YES	60	1500	169230	168796	168798
	ERVE-1-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169243	168742	168743
	ERVE-2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169231	168744	168745
	ERVE-3	3/8 ODF	1/2 ODF	YES	YES	60	1500	169234	168746	168748
	ERVE-3	1/2 ODF	5/8 ODF	NO	YES	60	1500	169265	168747	168749
	ERVE-4	3/8 ODF	1/2 ODF	YES	YES	60	1500	169238	168750	168753
	ERVE-4	1/2 ODF	5/8 ODF	NO	YES	60	1500	169268	168751	168754
	ERVE-4	1/2 ODF	7/8 ODF	NO	YES	60	1500	169282	168752	168755
	ERVE-5	3/8 ODF	1/2 ODF	YES	YES	60	1500	169241	168756	168759
	ERVE-5	1/2 ODF	5/8 ODF	NO	YES	60	1500	169271	168757	168760
	ERVE-5	1/2 ODF	7/8 ODF	NO	YES	60	1500	169283	168758	168761
	ERVE-6	1/2 ODF	5/8 ODF	NO	YES	60	1500	169274	168762	168766
	ERVE-6	1/2 ODF	7/8 ODF	NO	YES	60	1500	169284	168763	168767
	ERVE-6	5/8 ODF	7/8 ODF	NO	YES	60	1500	169293	168764	168768
	ERVE-8	1/2 ODF	7/8 ODF	NO	YES	60	1500	—	168769	168772
	ERVE-8	5/8 ODF	7/8 ODF	NO	YES	60	1500	169294	168770	168773
	ERVE-8	5/8 ODF	1-1/8 ODF	NO	YES	60	1500	—	168771	168774
	ERVE-10	5/8 ODF	7/8 ODF	NO	YES	60	1500	169295	168775	168777
	ERVE-10	5/8 ODF	1-1/8 ODF	NO	YES	60	1500	—	168776	168778
	ERVE-12	5/8 ODF	7/8 ODF	NO	YES	60	1500	169296	168779	168781
	ERVE-12	5/8 ODF	1-1/8 ODF	NO	YES	60	1500	—	168780	168782

TYPE **ER**

For Refrigerants 22, 134a, 404A, 410A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

R-404A, R-408A, R-507

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		STRAINER INCLUDED	WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE		
								C*	Z	ZP
								TYPE R with 404A (S) Refrigerant		
		Inlet	Outlet			Inches	mm	Part Number		
ER	ERS-1/6	1/4 ODF	3/8 ODF	YES	NO	30	760	169155	169156	169157
	ERS-1/6	1/4 ODF	1/2 ODF	YES	NO	30	760	169169	169170	169171
	ERS-1/6	3/8 ODF	1/2 ODF	YES	NO	30	760	169203	169204	169205
	ERS-1/4	1/4 ODF	3/8 ODF	YES	NO	30	760	169152	169153	169154
	ERS-1/4	1/4 ODF	1/2 ODF	YES	NO	30	760	169166	169167	169168
	ERS-1/4	3/8 ODF	1/2 ODF	YES	NO	30	760	169200	169201	169202
	ERS-1/2	1/4 ODF	3/8 ODF	YES	NO	60	1500	169149	169150	169151
	ERS-1/2	1/4 ODF	1/2 ODF	YES	NO	60	1500	169163	169165	169164
	ERS-1/2	3/8 ODF	1/2 ODF	YES	NO	60	1500	169198	169197	169199
	ERS-1	3/8 ODF	1/2 ODF	YES	NO	60	1500	169191	169192	169193
	ERS-1-1/2	3/8 ODF	1/2 ODF	YES	NO	60	1500	169195	169196	169194
	ERSE-1/6	1/4 ODF	1/2 ODF	YES	YES	30	760	169184	—	—
	ERSE-1/4	1/4 ODF	1/2 ODF	YES	YES	30	760	169181	169183	169182
	ERSE-1/2	1/4 ODF	1/2 ODF	YES	YES	60	1500	169178	169180	169179
	ERSE-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169228	169229	169227
	ERSE-1	1/4 ODF	1/2 ODF	YES	YES	60	1500	169177	169176	—
	ERSE-1	3/8 ODF	1/2 ODF	YES	YES	60	1500	169216	169217	169215
	ERSE-1-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169224	169223	169222
	ERSE-2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169219	169220	169218
	ERSE-3	3/8 ODF	1/2 ODF	YES	YES	60	1500	169226	169221	169225
	ERSE-3	1/2 ODF	5/8 ODF	NO	YES	60	1500	169260	169261	169262
	ERSE-4	1/2 ODF	7/8 ODF	NO	YES	60	1500	169278	169280	169279
	ERSE-6	5/8 ODF	7/8 ODF	NO	YES	60	1500	169287	169288	169289

* For C charge on R-507 or R-402A, use element kit 180288 (30") or 180338 (60") KT-43-PC.

▼ TYPE **ER**

For Refrigerants 22, 134a, 404A, 410A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

R-134a, R-401A, R-409A

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		STRAINER INCLUDED	WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE	
								C	CP60
								TYPE R with 134a (J) Refrigerant	
		Inlet	Outlet			Inches	mm	Part Number	
ER	ERJ-1/6	1/4 ODF	1/2 ODF	YES	NO	30	760	169162	—
	ERJ-1/4	1/4 ODF	3/8 ODF	YES	NO	30	760	169147	—
	ERJ-1/4	1/4 ODF	1/2 ODF	YES	NO	30	760	169161	—
	ERJ-1/2	1/4 ODF	3/8 ODF	YES	NO	60	1500	169146	—
	ERJ-1/2	1/4 ODF	1/2 ODF	YES	NO	60	1500	169160	—
	ERJ-1/2	3/8 ODF	1/2 ODF	YES	NO	60	1500	169190	—
	ERJ-1	3/8 ODF	1/2 ODF	YES	NO	60	1500	169188	—
	ERJ-1-1/2	3/8 ODF	1/2 ODF	YES	NO	60	1500	169189	—
	ERJE-1/4	3/8 ODF	1/2 ODF	YES	YES	30	760	169175	—
	ERJE-1/2	1/4 ODF	1/2 ODF	YES	YES	60	1500	169174	—
	ERJE-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169214	—
	ERJE-1	3/8 ODF	1/2 ODF	YES	YES	60	1500	169210	—
	ERJE-1-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169213	—
	ERJE-2	3/8 ODF	1/2 ODF	YES	YES	60	1500	169211	—
	ERJE-2	1/2 ODF	5/8 ODF	NO	YES	60	1500	—	169257
	ERJE-3	3/8 ODF	1/2 ODF	YES	YES	60	1500	169212	—
	ERJE-3	1/2 ODF	5/8 ODF	NO	YES	60	1500	—	169258
	ERJE-4	1/2 ODF	5/8 ODF	NO	YES	60	1500	—	169259
	ERJE-4	1/2 ODF	7/8 ODF	NO	YES	60	1500	—	169277
	ERJE-5	5/8 ODF	7/8 ODF	NO	YES	60	1500	—	169285

R-410A

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		STRAINER INCLUDED	WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE	
								CP180	GA
								TYPE R with 410A (Z) Refrigerant	
		Inlet	Outlet			Inches	mm	Part Number	
ER	ERZE-1	3/8 ODF	1/2 ODF	YES	YES	60	1500	168878	168790
	ERZE-1-1/2	3/8 ODF	1/2 ODF	YES	YES	60	1500	168783	168784
	ERZE-2	3/8 ODF	1/2 ODF	YES	YES	60	1500	168737	168786
	ERZE-3	3/8 ODF	1/2 ODF	YES	YES	60	1500	168787	168788
	ERZE-4	3/8 ODF	1/2 ODF	YES	YES	60	1500	168789	168718
	ERZE-5	3/8 ODF	1/2 ODF	YES	YES	60	1500	168791	168792
	ERZE-6	1/2 ODF	5/8 ODF	NO	YES	60	1500	168793	168794
	ERZE-8	1/2 ODF	7/8 ODF	NO	YES	60	1500	168795	168797
	ERZE-8	5/8 ODF	7/8 ODF	NO	YES	60	1500	168736	168719
	ERZE-12-1/2	5/8 ODF	7/8 ODF	NO	YES	60	1500	168799	168801
	ERZE-12-1/2	5/8 ODF	1-1/8 ODF	NO	YES	60	1500	168800	168802
	ERZE-15	5/8 ODF	7/8 ODF	NO	YES	60	1500	168803	168720
	ERZE-15	5/8 ODF	1-1/8 ODF	NO	YES	60	1500	168804	168807

TYPE **SR**

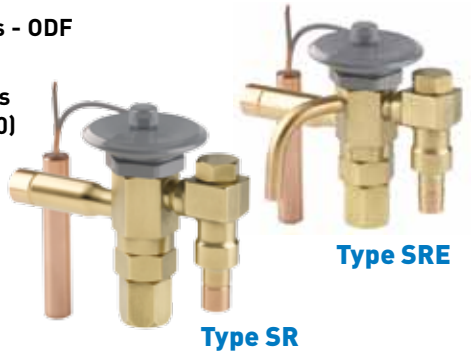
For Refrigerants 22, 134a, 404A, 507
ODF Solder Connections

FEATURES

- Small brass body
- Replaceable thermostatic element with gray epoxy coating
- Externally adjustable
- Balanced port construction
- Internally and externally equalized versions available
- Available with extended ODF fittings
- 100 mesh removable strainer, can be cleaned or replaced without removing the valve from the system
- Available in single lot or case quantities
- Option for 15% bleed port
  (Other bleed port rates available with OEM version only)

Outlet Connections - ODF
1/2″

Mating Distributors
(See Bulletin 20-10)
D260, D262



SPECIFICATIONS

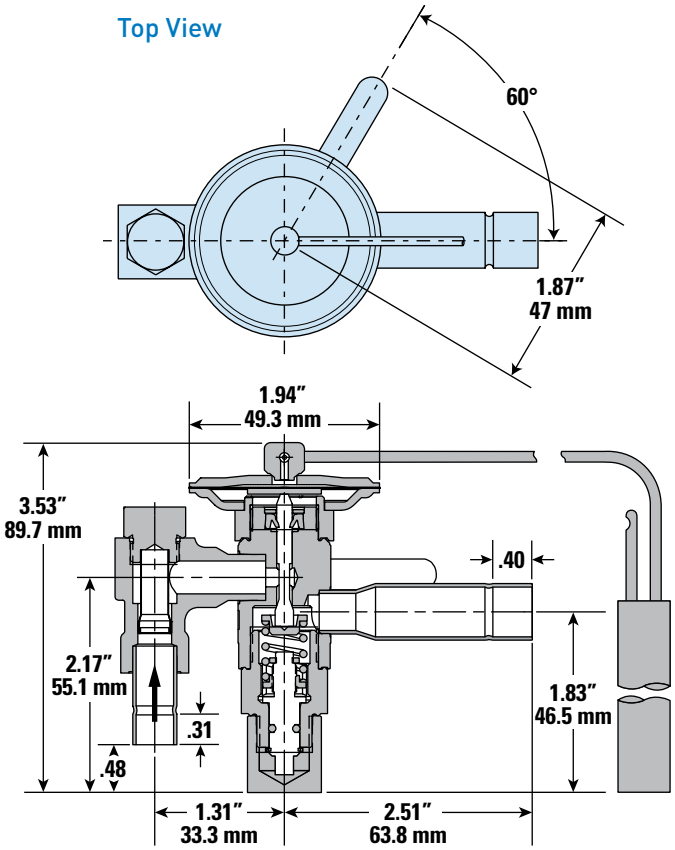
- Operating Temperature Range: -40°F (-40°C) through 50°F (10°C)
- Maximum Ambient Temperature: 140°F (60°C)
- Maximum Rated Pressure (UL): 450 psig (31 bar)
- Maximum Low Side Test Pressure: 450 psig (31 bar)
- Agency Certifications: UL Recognized under file SA5410.
  Covered under CE and the PED (Pressure Equipment Directive)

For complete details of construction, see page 2.

MAXIMUM DEHYDRATION and BULB TEMPERATURE

REFRIGERANT	THERMOSTATIC CHARGE		
	C	Z	P TYPE, ZP SERIES
12, 134a	190°F 88°C	250°F 121°C	250°F 121°C
22, 407C	160°F 71°C	185°F 85°C	250°F 121°C
404A, 502, 507	150°F 66°C	170°F 77°C	250°F 121°C

DIMENSIONS – TYPE SRE with NUMBER 43 ELEMENT



Removable Strainer - P/N 3427-000

BULB SIZES

REFRIGERANT	STANDARD CHARGE	BULB DIMENSION		REPLACEMENT	PART NUMBER	
		Inches	mm		CAPILLARY TUBE LENGTH	
					30″ 760 mm	60″ 1500 mm
R-404A R-408A R-502	C	0.50 OD x 3.00	12.7 x 76.2	KT-43-SC	179943	180204
R-402A R-507	C			KT-43-PC	180288	180338
R-402A R-404A R-408A R-502 R-507	Z			KT-43-SZ	180228	180318
	ZP			KT-43-SZP	180230	180060
R-22 R-407C R-422D	C			KT-43-VC	180269	180319
R-134a R-401A R-409A	C			KT-43-JC	180314	180310

TYPE **SR**

For Refrigerants 22, 134a, 404A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

VALVE NOMENCLATURE

SR	S	E	–	1/6	–	ZP	–	3/8	x	1/2	x	1/4	–	30″
Valve Type	Refrigerant Code	Externally Equalized		Nominal Capacity in Tons		Thermostatic Charge		Inlet Connection Size		Outlet Connection Size		External Equalizer Connection Size		Capillary Tube Length

R-22, R-407C, R-422D

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE C TYPE R with 22 (V) Refrigerant Part Number
		Inlet	Outlet		Inches	mm	
SR	**SRV-1/3**	3/8 ODF	1/2 ODF	NO	60	1500	169405
	SRV-1/2	3/8 ODF	1/2 ODF	NO	60	1500	169404
	SRV-1	3/8 ODF	1/2 ODF	NO	60	1500	169402
	SRV-2	3/8 ODF	1/2 ODF	NO	60	1500	169403
	SRVE-1/3	3/8 ODF	1/2 ODF	YES	30	760	169446
	SRVE-1/2	3/8 ODF	1/2 ODF	YES	30	760	169445
	SRVE-1	3/8 ODF	1/2 ODF	YES	60	1500	169435
	SRVE-2	3/8 ODF	1/2 ODF	YES	60	1500	169438
	SRVE-3	3/8 ODF	1/2 ODF	YES	60	1500	169441
	SRVE-5	3/8 ODF	1/2 ODF	YES	60	1500	169444

R-404A, R-408A, R-507

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE C* TYPE R with 404 (S) Refrigerant Part Number	Z	ZP
		Inlet	Outlet		Inches	mm			
SR	**SRS-1-1/2**	3/8 ODF	1/2 ODF	NO	60	1500	169390	169391	169392
	SRSE-1/6	3/8 ODF	1/2 ODF	YES	30	760	169432	169433	169434
	SRSE-1/4	3/8 ODF	1/2 ODF	YES	30	760	169429	169431	169430
	SRSE-1/2	3/8 ODF	1/2 ODF	YES	60	1500	169426	169427	169428
	SRSE-1	3/8 ODF	1/2 ODF	YES	60	1500	169413	169415	169414
	SRSE-1-1/2	3/8 ODF	1/2 ODF	YES	60	1500	169423	169424	169425
	SRSE-2	3/8 ODF	1/2 ODF	YES	60	1500	169417	169419	169418
	SRSE-3	3/8 ODF	1/2 ODF	YES	60	1500	169420	169422	169421

* For C charge on R-507 or R-402A, use element kit 180288 (30″) or 180338 (60″) KT-43-PC.

TYPE **SR**

For Refrigerants 22, 134a, 404A, 507
ODF Solder Connections

SPECIFICATIONS - CONTINUED

R-134a, R-401A, R-409A

VALVE TYPE	VALVE SIZE	CONNECTIONS Inches		WITH EXTERNAL EQUALIZER	CAPILLARY TUBE LENGTH		THERMOSTATIC CHARGE C TYPE R with 134a (J) Refrigerant
		Inlet	Outlet		Inches	mm	Part Number
SR	**SRJ-1/6**	3/8 ODF	1/2 ODF	NO	30	760	169386
	SRJ-1/4	3/8 ODF	1/2 ODF	NO	30	760	169385
	SRJ-1/2	3/8 ODF	1/2 ODF	NO	60	1500	169384
	SRJ-1	3/8 ODF	1/2 ODF	NO	60	1500	169383
	SRJ-1-1/2	3/8 ODF	1/2 ODF	NO	60	1500	169382
	SRJE-1/6	3/8 ODF	1/2 ODF	YES	30	760	169410
	SRJE-1/4	3/8 ODF	1/2 ODF	YES	30	760	169411
	SRJE-1	3/8 ODF	1/2 ODF	YES	60	1500	169412
	SRJE-1/2	3/8 ODF	1/2 ODF	YES	60	1500	169408
	SRJE-1-1/2	3/8 ODF	1/2 ODF	YES	60	1500	169409
	SRJE-2	3/8 ODF	1/2 ODF	YES	60	1500	169406
	SRJE-3	3/8 ODF	1/2 ODF	YES	60	1500	169407

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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, SERVICING, 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, 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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