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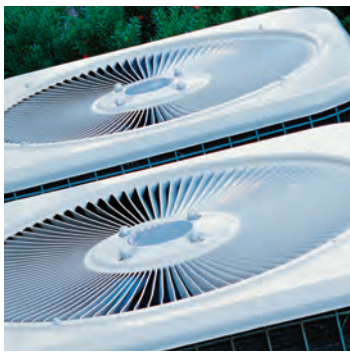
Accumulators and Receivers

Catalog C-1, May 2016



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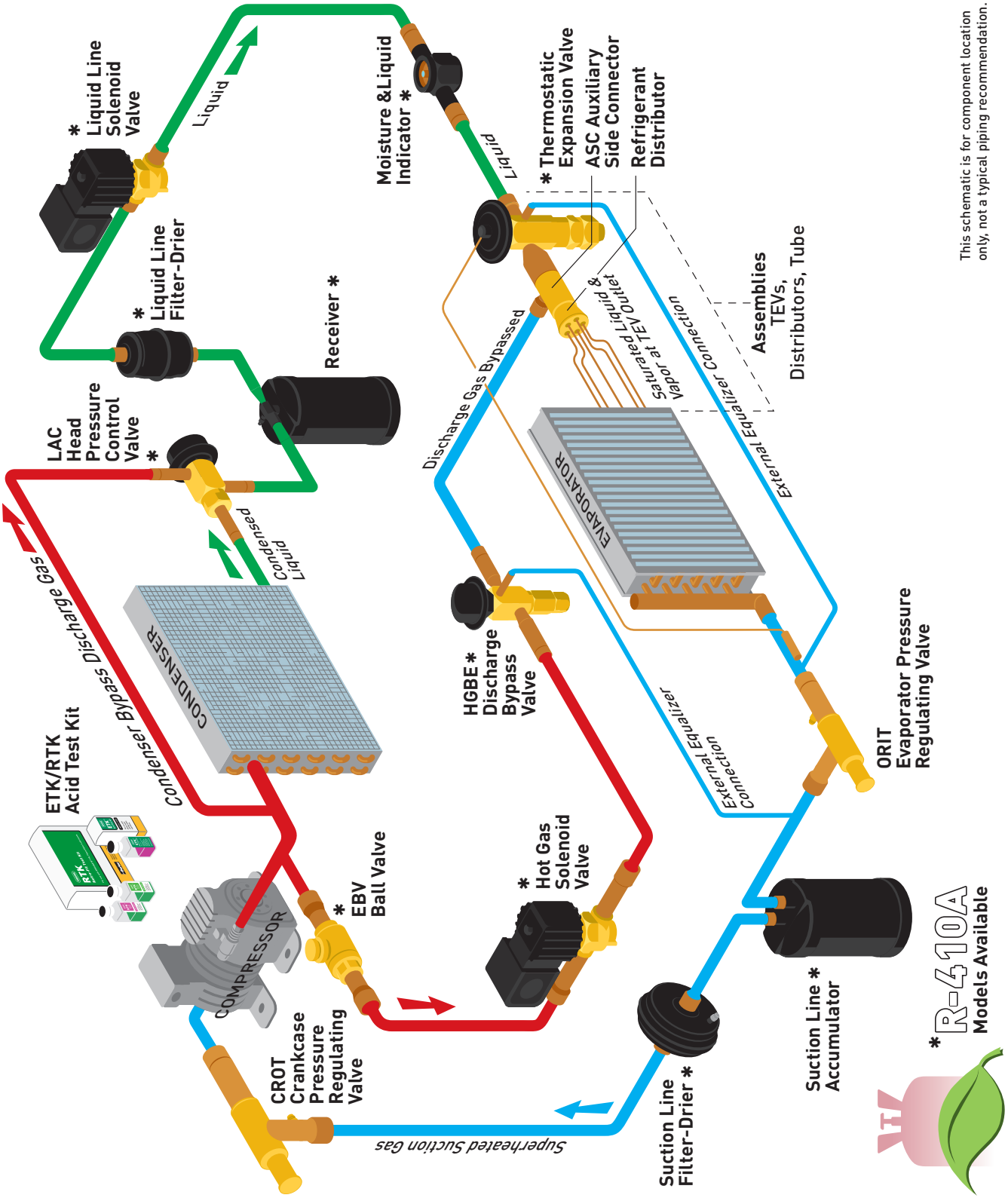
Accumulators and Receivers

Typical Piping Diagram



Steel Suction Line Accumulators

Design

The function of a suction line accumulator in a heat pump or refrigeration system is to catch and hold any unused portion of the system charge. The device must also prevent liquid slugging of the compressor and excessive refrigerant dilution of the compressor oil.

The accumulator must return refrigerant and oil to the compressor at a sufficient rate to maintain both system operating efficiency and proper crankcase oil level. To make sure these tasks are accomplished, system designers must consider the following items:

- A properly sized and protected oil return orifice is required to ensure positive oil (and refrigerant) return to the compressor
- The accumulator must have sufficient internal volume
- The pressure drop across the accumulator should be as low as possible

Oil return at a minimum flow rate is controlled by the outlet U-tube size. Refrigerant and oil will be returned to the compressor by pressure drop across the orifice metering area and the liquid head above the orifice. Other design requirements include safe working pressure, agency approvals and corrosion resistance.

Figure 1 illustrates a typical accumulator with an inlet defector. The shape of the deflector directs the inlet flow in a slightly downward tangential direction.

The inlet to the U-tube is located behind the inlet deflector to prevent liquid carryover and is bell-shaped to reduce the sudden contraction loss of the high-velocity gas. The U-tube diameter is selected to minimize pressure drop at high flow rates yet provide adequate oil return at low flow rates.

Other features include a 50 x 60 mesh screen to protect the oil return orifice, an anti-siphon hole and a fusible alloy plug in the accumulator. The anti-siphon hole located near the outlet of the U-tube prevents liquid from siphoning into the outlet tube and compressor during an off-cycle. The fusible alloy plug is generally a U.L. requirement since it is a safety device to protect against excessive pressure in the event of a fire.

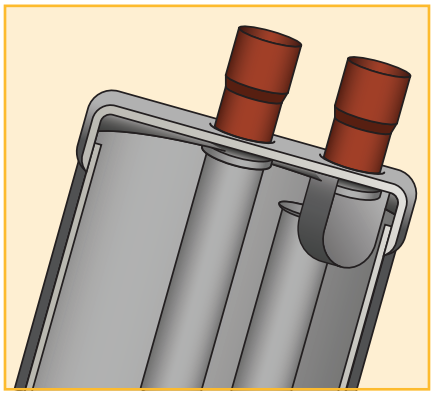


Figure 1
Typical accumulator with inlet deflector baffle.

Selection

Accumulator selection can be fine-tuned for best performance. This involves the sizing of the accumulator and the sizing of the orifice. The controlling factor for both types is the type of metering device used in the system. In systems using a **fixed orifice**, the accumulator holding capacity should be about 70% of the system charge. This provides adequate holding capacity during operation with blocked or fouled heat exchanger coils. The resulting high discharge/low suction pressure condition will result in more liquid refrigerant in the accumulator. The oil return orifice size should be small to prevent excess liquid refrigerant being returned to the compressor. For these systems, a 0.040 inch (1.02 mm) diameter orifice is the recommended starting point.

For systems with a **thermostatic expansion valve (TEV),** the accumulator holding capacity should be approximately 50% of the system charge. At startup and after defrost the bulb of the TEV is warm. Until the valve regains control, the accumulator plays a role in preventing liquid slugging of the compressor. The accumulator must also contend with off cycle refrigerant migration. At shutdown, the accumulator is the coldest component in the system. This results in migration of liquid refrigerant to the device. This type of system needs to return the refrigerant to circulation more quickly than the fixed orifice system. For these systems, a 0.055 inch (1.4 mm) diameter orifice allows quick return of the liquid refrigerant. The recommended sizes of the orifices can be further tested for optimum results. Other size orifices are possible to satisfy the characteristics required by the system designer.

New Refrigerants

The introduction of alternative refrigerants and oils requires reviewing the design of components within the system, including suction accumulators. As previously stated, the accumulator is the coldest component in the system. The new refrigerants and oils may or may not be fully miscible in the temperature range the accumulator normally operates. The oil and refrigerant can separate into oil rich and refrigerant rich layers in the accumulator, with the refrigerant rich layer at the bottom. The oil return orifice would be located in the refrigerant rich layer.

The solution to this problem is to provide active mixing of the layers in the accumulator. This is accomplished by the shape and position of the inlet deflector and outlet U-tube. The inlet flow stream is directed tangentially into the liquid layers in the bottom of the accumulator. The resulting circulation of the liquid past the off center U-tube forces a mixing of the oil and refrigerant layers.

Field Replacement

The accumulator should be changed when a compressor is replaced. The old accumulator may contain contaminants from the problem that caused the compressor failure. There may also be considerable oil remaining from the first compressor if a gradual loss of refrigerant caused the failure. This amount coupled with the oil in the replacement compressor may create an oil overcharge condition.

Steel Suction Line Accumulators

U-Tube Style Accumulators – VA, PA and VPA Series

The U-tube accumulator design is a result of extensive laboratory testing of various designs. It takes into account essential requirements such as safe holding volume (relative to the system's total charge), protected flow control for positive refrigerant and oil return, and minimum pressure drop across the accumulator.

Parker offers standard accumulator models designed for application on heat pump and refrigeration systems from 1/4 ton (.88 kW) through 28.5 tons (100.2 kW). Liquid refrigerant holding requirements of suction accumulator may vary by application.

Features and Benefits

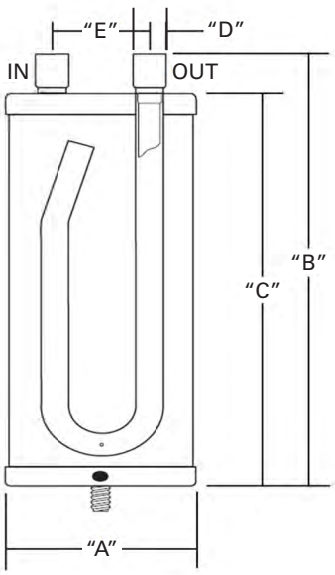
- Solid copper connections (except where noted in the following tables)
- U-tube design for maximum flow of refrigerant and minimum oil entrapment
- Inlet flow deflector guides refrigerant toward wall for smooth tangential flow and gradual expansion
- Baffled U-tube entrance is positioned behind the inlet flow deflector to prevent unwanted liquid refrigerant from entering and damaging compressor at all rated conditions
- Metering orifice matched to system capacity which optimizes liquid refrigerant and oil flow return back to compressor at all rated conditions
- Protective screen and orifice assembly on U-tube protects against contaminants affecting metering function
- Minimum pressure drop and Maximum refrigerant flow
- VA and VPA models are U.L. Listed for USA and Canada for 300 psig (20.7 bar) maximum working pressure under SA5764-SKXY/SKXY7
- PA models are U.L. Listed for USA and Canada for 355 psig (24.5 bar) maximum working pressure under SA5764-SKXY/SKXY7
- Powder coating surpasses 500 hour ASTM salt spray
- Integral 430°F (221°C) fuse plugs on larger models
- Compatible with CFC, HCFC and HFC refrigerants including R-22, R-134a, R-404A, R-407C, R-410A, R-500, R-502 and R-507

Dimensions and Flow Data

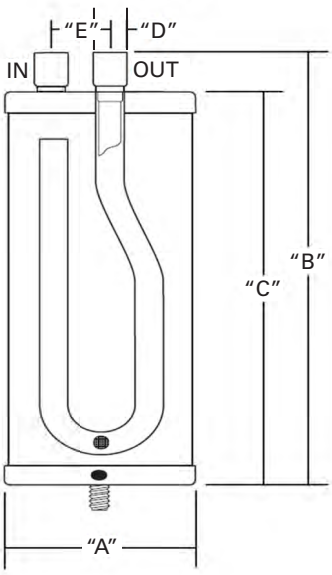
Refer to pages 6 through 10 for dimension values and flow data.

Dimensions

"VA" Series



"PA" and "VPA" Series



Dimensions

Catalog Number	Item Number	Unit Weight lbs. (KG)	"A" Diameter Inches (mm)	"B" Overall Length Inches (mm)	"C" Vessel Length Inches (mm)	"D" Connection Inches (mm)	"E" Fitting Inches (mm)	"F" Oil Orifice Inches (mm)	Internal Volume Cu. Ft. (liters)	Holding Capacities Ounces (liters)
VA304S[1]	470043	1.7 (0.8)	3 (76.0)	8-1/4 (210.0)	7-1/2 (191.0)	1/2 (12.7)	1-5/8 (41.0)	0.060 (1.5)	0.030 (0.85)	35 (1.02)
VA314S	470106	1.9 (0.9)	3 (76.0)	10-3/8 (264.0)	9-3/8 (238.0)	1/2 (12.7)	1-3/4 (44.0)	0.055 (1.4)	0.034 (0.96)	1.16 (39)
VA315S	470107	1.9 (0.9)	3 (76.0)	10-3/8 (264.0)	9-3/8 (238.0)	5/8 (15.9)	1-3/4 (44.0)	0.055 (1.4)	0.034 (0.96)	1.16 (39)
VA325S	470048	2.1 (1.0)	3 (76.0)	12-1/4 (311.0)	11-1/2 (292.0)	5/8 (15.9)	1-5/8 (41.0)	0.060 (1.5)	0.040 (1.13)	46 (1.36)
VA326S[1]	470136	2.1 (1.0)	3 (76.0)	12-5/8 (321.0)	11-1/2 (292.0)	3/4 (19.1)	1-5/8 (41.0)	0.060 (1.5)	0.040 (1.13)	46 (1.36)
VA355S	470049	2.7 (1.2)	3 (76.0)	15-1/16 (383.0)	13-3/4 (349.0)	5/8 (15.9)	1-5/8 (41.0)	0.055 (1.4)	0.051 (1.44)	59 (1.74)
VA356S	470093	2.7 (1.2)	3 (76.0)	15-1/16 (383.0)	13-3/4 (349.0)	3/4 (19.1)	1-5/8 (41.0)	0.055 (1.4)	0.051 (1.44)	59 (1.74)
VA445SRD[1]	470051	4.3 (2.0)	4 (102.0)	10-3/4 (273.0)	9-15/16 (252.0)	5/8 (15.9)	2-1/2 (64.0)	0.035 (0.9)	0.072 (2.04)	83 (2.45)
VA446SRD[1]	470094	4.3 (2.0)	4 (102.0)	10-5/8 (270.0)	9-3/4 (248.0)	3/4 (19.1)	2-1/2 (64.0)	0.055 (1.4)	0.072 (2.04)	83 (2.45)
PA4065-9-5C	960119	4.3 (2.0)	4 (102.0)	9-5/8 (244.0)	8-1/2 (216.0)	5/8 (15.9)	1-3/4 (44.0)	0.055 (1.4)	0.061 (1.73)	70 (2.08)
PA4065-9-6C	960120	4.3 (2.0)	4 (102.0)	9-5/8 (244.0)	8-1/2 (216.0)	3/4 (19.1)	1-3/4 (44.0)	0.055 (1.4)	0.061 (1.73)	70 (2.08)
VA546SRD	470052	5.2 (2.4)	5 (127.0)	9-5/8 (244.0)	8-1/2 (216.0)	3/4 (19.1)	2-3/4 (70.0)	0.063 (1.6)	0.09 (2.55)	104 (3.07)
VA547SRD	470054	5.2 (2.4)	5 (127.0)	9-3/4 (248.0)	8-1/2 (216.0)	7/8 (22.2)	2-3/4 (70.0)	0.063 (1.6)	0.09 (2.55)	104 (3.07)
VA557SRD	470055	7.0 (3.2)	5 (127.0)	10-3/4 (273.0)	9-1/2 (241.0)	7/8 (22.2)	3.0 (76.0)	0.055 (1.4)	0.11 (3.11)	127 (3.75)
VA566SRD	470056	7.9 (3.6)	5 (127.0)	12-3/4 (324.0)	11-5/8 (295.0)	3/4 (19.1)	2-3/4 (70.0)	0.063 (1.6)	0.13 (3.68)	150 (4.43)
VA567SRD	470058	7.9 (3.6)	5 (127.0)	13 (330.0)	11-3/4 (298.0)	7/8 (22.2)	2-3/4 (70.0)	0.063 (1.6)	0.13 (3.68)	150 (4.43)
VA577SRD	470059	8.1 (3.7)	5 (127.0)	14-5/8 (371.0)	13-3/8 (340.0)	7/8 (22.2)	2-3/4 (70.0)	0.063 (1.6)	0.14 (3.96)	161 (4.77)
VA579SRD	470060	8.1 (3.7)	5 (127.0)	14-13/16 (376.0)	13-3/8 (340.0)	1-1/8 (28.6)	2-3/4 (70.0)	0.063 (1.6)	0.14 (3.96)	161 (4.77)
VPA5896SRD	470110	5.1 (2.3)	5 (127.0)	9-5/8 (244.0)	8-5/16 (211.0)	3/4 (19.1)	1-3/4 (44.0)	0.055 (1.4)	0.085 (2.41)	98 (2.90)
VPA5897SRD	470111	4.9 (2.2)	5 (127.0)	9-5/8 (244.0)	8-1/8 (206.0)	7/8 (22.2)	1-3/4 (44.0)	0.055 (1.4)	0.083 (2.35)	96 (2.83)
VPA58116SRD	470112	6.8 (3.1)	5 (127.0)	11-5/16 (287.0)	10 (254.0)	3/4 (19.1)	1-3/4 (44.0)	0.055 (1.4)	0.103 (2.91)	119 (3.51)
VPA58117SRD	470069	6.0 (2.7)	5 (127.0)	11-5/16 (287.0)	9-13/16 (249.0)	7/8 (22.2)	1-3/4 (44.0)	0.055 (1.4)	0.101 (2.86)	116 (3.44)
VPA58127SRD	470070	7.7 (3.5)	5 (127.0)	12-7/8 (327.0)	11-3/8 (289.0)	7/8 (22.2)	1-3/4 (44.0)	0.055 (1.4)	0.117 (3.31)	135 (3.99)
VPA58157SRD	470115	8.4 (3.8)	5 (127.0)	15-3/8 (391.0)	13-13/16 (351.0)	7/8 (22.2)	1-3/4 (44.0)	0.055 (1.4)	0.143 (4.05)	165 (4.88)
VPA58177SRD	470116	9.6 (4.4)	5 (127.0)	17-1/4 (438.0)	15-3/4 (400.0)	7/8 (22.2)	1-3/4 (44.0)	0.055 (1.4)	0.163 (4.61)	188 (5.56)
VA599SRD	470062	8.4 (3.8)	5 (127.0)	18-3/8 (467.0)	16-15/16 (430.0)	1-1/8 (28.6)	2-3/4 (70.0)	0.063 (1.6)	0.18 (5.09)	207 (6.14)
VA5911SRD	470061	8.4 (3.8)	5 (127.0)	18-7/16 (468.0)	16-15/16 (430.0)	1-3/8 (34.9)	2-3/4 (70.0)	0.063 (1.6)	0.18 (5.09)	207 (6.14)
VA6107SRD[1]	470117	11.8 (5.4)	6 (152.0)	13-7/8 (352.0)	12-5/8 (321.0)	7/8 (22.2)	2-15/16 (75.0)	0.040 (1.0)	0.18 (5.09)	207 (6.14)
VA6109SRD[1]	470118	11.8 (5.4)	6 (152.0)	14 (356.0)	12-5/8 (321.0)	1-1/8 (28.6)	2-15/16 (75.0)	0.040 (1.0)	0.18 (5.09)	207 (6.14)
VA6119SRD	470065	12.4 (5.6)	6 (152.0)	15-1/4 (387.0)	13-3/4 (349.0)	1-1/8 (28.6)	2-15/16 (75.0)	0.075 (1.9)	0.20 (5.66)	230 (6.82)
VA61111SRD[1]	470063	12.4 (5.6)	6 (152.0)	15-1/4 (387.0)	13-3/4 (349.0)	1-3/8 (34.9)	2-15/16 (75.0)	0.060 (1.5)	0.20 (5.66)	230 (6.82)
VA61511SRD	470066	15.9 (7.2)	6 (152.0)	19-1/2 (495.0)	18 (457.0)	1-3/8 (34.9)	2-15/16 (75.0)	0.075 (1.9)	0.29 (8.21)	334 (9.89)
VA61613SRD[1]	470068	16.3 (7.4)	6 (152.0)	21-7/8 (556.0)	20-1/4 (514.0)	1-5/8 (41.3)	2-15/16 (75.0)	0.060 (1.5)	0.30 (8.49)	346 (10.23)

Holding capacities stated for R-410A at 40°F (4°C).
Multiply holding capacity by 1.1 to obtain R-22 data at 40°F (4°C).
Multiply total system charge by 0.7 to obtain recommended maximum holding capacity for fixed orifice systems.
Multiply total system charge by 0.5 to obtain recommended maximum holding capacity for systems with TEVs.
Catalog numbers in bold font are available as standard wholesale offering.
[1]These models have copper-plated steel connections. All other models have solid copper connections.

Flow Capacity

Catalog Number	Flow Capacity in Tons (kW)					
	Refrigerant 22					
	+40°F	(+4°C)	+20°F	(-6°C)	0°F	(-17°C)
VA304S[1]	2.0	(7.0)	1.3	(4.6)	0.9	(3.1)
VA314S	2.0	(7.0)	1.3	(4.6)	0.9	(3.1)
VA315S	3.0	(10.6)	2.0	(6.9)	1.3	(4.7)
VA325S	3.0	(10.6)	2.0	(6.9)	1.3	(4.7)
VA326S[1]	4.0	(14.1)	2.6	(9.2)	1.8	(6.2)
VA355S	3.0	(10.6)	2.0	(6.9)	1.3	(4.7)
VA356S	4.0	(14.1)	2.6	(9.2)	1.8	(6.2)
VA445SRD[1]	3.0	(10.6)	2.0	(6.9)	1.3	(4.7)
VA446SRD[1]	4.0	(14.1)	2.6	(9.2)	1.8	(6.2)
PA4065-9-5C	3.0	(10.6)	2.4	(8.4)	1.9	(6.7)
PA4065-9-6C	3.0	(10.6)	2.5	(8.8)	2.0	(7.0)
VA546SRD	4.0	(14.1)	2.6	(9.2)	1.8	(6.2)
VA547SRD	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VA557SRD	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VA566SRD	4.0	(14.1)	2.6	(9.2)	1.8	(6.2)
VA567SRD	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VA577SRD	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VA579SRD	11.8	(41.5)	7.7	(27.0)	5.2	(18.4)
VPA5896SRD	4.0	(14.1)	2.6	(9.1)	1.8	(6.3)
VPA5897SRD	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VPA58116SRD	7.5	(26.4)	5.0	(17.6)	3.4	(12.0)
VPA58117SRD	7.3	(25.7)	4.8	(16.9)	3.2	(11.3)
VPA58127SRD	6.3	(22.2)	4.5	(15.8)	3.0	(10.6)
VPA58157SRD	10.4	(36.6)	6.9	(24.3)	3.7	(13.0)
VPA58177SRD	11.2	(39.4)	7.4	(26.0)	4.9	(17.2)
VA599SRD	11.8	(41.5)	7.7	(27.0)	5.2	(18.4)
VA5911SRD	18.8	(66.1)	12.3	(43.1)	8.3	(29.3)
VA6107SRD[1]	7.3	(25.7)	4.8	(16.7)	3.2	(11.4)
VA6109SRD[1]	11.8	(41.5)	7.7	(27.0)	5.2	(18.4)
VA61111SRD[1]	18.8	(66.1)	12.3	(43.1)	8.3	(29.3)
VA61511SRD	18.8	(66.1)	12.3	(43.1)	8.3	(29.3)
VA61613SRD[1]	28.5	(100.2)	18.6	(65.3)	12.6	(44.5)

Factors For Other Ratings

Evaporator Temperature	-20°F (-28°C)	-40°F (-40°C)
X Factor	0.28	0.18

To find the capacity for -20°F (-28°C) and -40°F (-40°C) evaporator temperatures in tons, multiply the 40°F (4°C) evaporator temperature by the X factor.

To find the minimum capacity in tons, multiply the 40°F (4°C) rating by 0.15.

Maximum recommended tons based on pressure drop through the accumulator equal to 1.0°F (-17°C) temperature drop.

Notes:

1. Minimum recommended tons should be no less than 15% of recommended tons to ensure positive oil return.
2. All data based on actual tons and is not related to horsepower.
3. Minimum evaporator temperature: -40°F (4°C). Minimum suction gas temperature through the accumulator: +10°F (-12°C). For operating conditions not within the rating data, please contact Parker before proceeding with installation.

Flow Capacity

Catalog Number	Flow Capacity in Tons (kW)											
	Refrigerant 502						Refrigerant 134a					
	+40°F	(+4°C)	+20°F	(-6°C)	0°F	(-17°C)	+40°F	(+4°C)	+20°F	(-6°C)	0°F	(-17°C)
VA304S[1]	1.3	(4.5)	0.8	(2.9)	0.5	(1.9)	1.3	(4.5)	0.9	(3.0)	0.5	(1.8)
VA314S	1.3	(4.5)	0.8	(2.9)	0.5	(1.9)	1.3	(4.5)	0.9	(3.0)	0.5	(1.8)
VA315S	1.9	(6.8)	1.2	(4.3)	0.8	(2.8)	1.9	(6.7)	1.3	(4.5)	0.8	(2.8)
VA325S	1.9	(6.8)	1.2	(4.3)	0.8	(2.8)	1.9	(6.7)	1.3	(4.5)	0.8	(2.8)
VA326S[1]	2.6	(9.1)	1.6	(5.7)	1.1	(3.8)	2.5	(8.9)	1.7	(6.0)	1.0	(3.7)
VA355S	1.9	(6.8)	1.2	(4.3)	0.8	(2.8)	1.9	(6.7)	1.3	(4.5)	0.8	(2.8)
VA356S	2.6	(9.1)	1.6	(5.7)	1.1	(3.8)	2.5	(8.9)	1.7	(6.0)	1.0	(3.7)
VA445SRD[1]	1.9	(6.8)	1.2	(4.3)	0.8	(2.8)	1.9	(6.7)	1.3	(4.5)	0.8	(2.8)
VA446SRD[1]	2.6	(9.1)	1.6	(5.7)	1.1	(3.8)	2.5	(8.9)	1.7	(6.0)	1.0	(3.7)
PA4065-9-5C	2.2	(7.7)	1.8	(6.3)	1.6	(5.6)	2.5	(8.8)	1.6	(5.6)	1.4	(4.9)
PA4065-9-6C	2.2	(7.7)	1.9	(6.7)	1.7	(5.9)	2.5	(8.8)	1.7	(5.9)	1.5	(5.3)
VA546SRD	2.6	(9.1)	1.6	(5.7)	1.1	(3.8)	2.5	(8.9)	1.7	(6.0)	1.0	(3.7)
VA547SRD	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VA557SRD	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VA566SRD	2.6	(9.1)	1.6	(5.7)	1.1	(3.8)	2.5	(8.9)	1.7	(6.0)	1.0	(3.7)
VA567SRD	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VA577SRD	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VA579SRD	7.6	(26.7)	4.8	(16.9)	3.2	(11.1)	7.5	(26.4)	5.0	(17.7)	3.1	(10.9)
VPA5896SRD	2.6	(9.1)	1.6	(5.6)	1.1	(4.0)	2.5	(8.8)	1.7	(6.0)	1.0	(3.5)
VPA5897SRD	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VPA58116SRD	4.7	(16.5)	3.0	(10.6)	2.0	(7.0)	4.6	(16.2)	3.1	(10.9)	1.9	(6.7)
VPA58117SRD	4.5	(15.8)	2.8	(9.8)	1.8	(6.3)	4.4	(15.5)	2.8	(9.8)	1.7	(6.0)
VPA58127SRD	4.6	(16.2)	2.9	(10.2)	1.9	(6.7)	4.5	(15.8)	2.9	(10.2)	1.8	(6.3)
VPA58157SRD	4.8	(16.9)	3.2	(11.3)	2.2	(7.7)	4.7	(16.5)	3.2	(11.3)	2.0	(7.0)
VPA58177SRD	6.6	(23.2)	4.8	(16.9)	3.2	(11.3)	7.5	(26.4)	5.0	(17.6)	3.1	(10.9)
VA599SRD	7.6	(26.7)	4.8	(16.9)	3.2	(11.1)	7.5	(26.4)	5.0	(17.7)	3.1	(10.9)
VA5911SRD	12.1	(42.6)	7.7	(27.0)	5.1	(17.8)	12.0	(42.1)	8.0	(28.2)	4.9	(17.3)
VA6107SRD[1]	4.7	(16.5)	3.0	(10.5)	2.0	(6.9)	4.6	(16.3)	3.1	(11.0)	1.9	(6.7)
VA6109SRD[1]	7.6	(26.7)	4.8	(16.9)	3.2	(11.1)	7.5	(26.4)	5.0	(17.7)	3.1	(10.9)
VA61111SRD[1]	12.1	(42.6)	7.7	(27.0)	5.1	(17.8)	12.0	(42.1)	8.0	(28.2)	4.9	(17.3)
VA61511SRD	12.1	(42.6)	7.7	(27.0)	5.1	(17.8)	12.0	(42.1)	8.0	(28.2)	4.9	(17.3)
VA61613SRD[1]	18.4	(64.6)	11.6	(40.9)	7.7	(26.9)	18.1	(63.8)	12.2	(42.8)	7.5	(26.2)

Factors For Other Ratings

Evaporator Temperature	-20°F (-28°C)	-40°F (-40°C)
X Factor	0.28	0.18

To find the capacity for -20°F (-28°C) and -40°F (-40°C) evaporator temperatures in tons, multiply the 40°F (4°C) evaporator temperature by the X factor.

To find the minimum capacity in tons, multiply the 40°F (4°C) rating by 0.15.

Maximum recommended tons based on pressure drop through the accumulator equal to 1.0°F (-17°C) temperature drop.

Notes:

1. Minimum recommended tons should be no less than 15% of recommended tons to ensure positive oil return.
2. All data based on actual tons and is not related to horsepower.
3. Minimum evaporator temperature: -40°F (4°C). Minimum suction gas temperature through the accumulator: +10°F (-12°C). For operating conditions not within the rating data, please contact Parker before proceeding with installation.

Flow Capacity

Catalog Number	Flow Capacity in Tons (kW)											
	Refrigerant 407C						Refrigerant 404A/507C					
	+40°F	(+4°C)	+20°F	(-6°C)	0°F	(-17°C)	+40°F	(+4°C)	+20°F	(-6°C)	0°F	(-17°C)
VA304S[1]	1.9	(6.7)	1.2	(4.2)	0.8	(2.8)	1.4	(4.8)	0.8	(2.9)	0.6	(1.9)
VA314S	1.9	(6.7)	1.2	(4.2)	0.8	(2.8)	1.4	(4.8)	0.8	(2.9)	0.6	(1.9)
VA315S	2.8	(10.0)	1.8	(6.4)	1.2	(4.2)	2.0	(7.2)	1.3	(4.4)	0.8	(2.9)
VA325S	2.8	(10.0)	1.8	(6.4)	1.2	(4.2)	2.0	(7.2)	1.3	(4.4)	0.8	(2.9)
VA326S[1]	3.8	(13.4)	2.4	(8.5)	1.6	(5.6)	2.7	(9.6)	1.7	(5.9)	1.1	(3.9)
VA355S	2.8	(10.0)	1.8	(6.4)	1.2	(4.2)	2.0	(7.2)	1.3	(4.4)	0.8	(2.9)
VA356S	3.8	(13.4)	2.4	(8.5)	1.6	(5.6)	2.7	(9.6)	1.7	(5.9)	1.1	(3.9)
VA445SRD[1]	2.8	(10.0)	1.8	(6.4)	1.2	(4.2)	2.0	(7.2)	1.3	(4.4)	0.8	(2.9)
VA446SRD[1]	3.8	(13.4)	2.4	(8.5)	1.6	(5.6)	2.7	(9.6)	1.7	(5.9)	1.1	(3.9)
PA4065-9-5C	2.9	(10.2)	2.5	(8.8)	2.3	(8.0)	3.0	(10.6)	2.4	(8.4)	1.9	(6.7)
PA4065-9-6C	2.9	(10.2)	2.6	(9.1)	2.3	(8.0)	3.0	(10.6)	2.5	(8.8)	2.0	(7.0)
VA546SRD	3.8	(13.4)	2.4	(8.5)	1.6	(5.6)	2.7	(9.6)	1.7	(5.9)	1.1	(3.9)
VA547SRD	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VA557SRD	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VA566SRD	3.8	(13.4)	2.4	(8.5)	1.6	(5.6)	2.7	(9.6)	1.7	(5.9)	1.1	(3.9)
VA567SRD	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VA577SRD	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VA579SRD	11.2	(39.4)	7.1	(25.0)	4.7	(16.6)	8.1	(28.3)	4.9	(17.3)	3.3	(11.5)
VPA5896SRD	3.8	(13.4)	2.4	(8.4)	1.6	(5.6)	2.7	(9.5)	1.7	(6.0)	1.1	(3.9)
VPA5897SRD	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VPA58116SRD	6.9	(24.3)	4.4	(15.5)	2.9	(10.2)	5.0	(17.6)	3.0	(10.6)	2.0	(7.0)
VPA58117SRD	6.5	(22.9)	4.2	(14.8)	2.5	(8.8)	4.7	(16.5)	2.8	(9.8)	1.8	(6.3)
VPA58127SRD	6.8	(23.9)	4.3	(15.1)	2.8	(9.8)	4.8	(16.9)	2.8	(9.8)	1.8	(6.3)
VPA58157SRD	7.0	(24.6)	4.6	(16.2)	3.2	(11.3)	5.2	(18.3)	3.2	(11.3)	2.2	(7.7)
VPA58177SRD	12.1	(42.6)	8.0	(28.1)	5.6	(19.7)	9.0	(31.7)	5.8	(20.4)	4.1	(14.4)
VA599SRD	11.2	(39.4)	7.1	(25.0)	4.7	(16.6)	8.1	(28.3)	4.9	(17.3)	3.3	(11.5)
VA5911SRD	17.8	(62.7)	11.3	(39.9)	7.5	(26.4)	12.8	(45.2)	7.8	(27.6)	5.2	(18.3)
VA6107SRD[1]	6.9	(24.4)	4.4	(15.5)	2.9	(10.3)	5.0	(17.5)	3.0	(10.7)	2.0	(7.1)
VA6109SRD[1]	11.2	(39.4)	7.1	(25.0)	4.7	(16.6)	8.1	(28.3)	4.9	(17.3)	3.3	(11.5)
VA61111SRD[1]	17.8	(62.7)	11.3	(39.9)	7.5	(26.4)	12.8	(45.2)	7.8	(27.6)	5.2	(18.3)
VA61511SRD	17.8	(62.7)	11.3	(39.9)	7.5	(26.4)	12.8	(45.2)	7.8	(27.6)	5.2	(18.3)
VA61613SRD[1]	27.0	(95.1)	17.2	(60.4)	11.4	(40.1)	19.5	(68.4)	11.9	(41.8)	7.9	(27.7)

Factors For Other Ratings

Evaporator Temperature	-20°F (-28°C)	-40°F (-40°C)
X Factor	0.28	0.18

To find the capacity for -20°F (-28°C) and -40°F (-40°C) evaporator temperatures in tons, multiply the 40°F (4°C) evaporator temperature by the X factor.

To find the minimum capacity in tons, multiply the 40°F (4°C) rating by 0.15.

Maximum recommended tons based on pressure drop through the accumulator equal to 1.0°F (-17°C) temperature drop.

Notes:

1. Minimum recommended tons should be no less than 15% of recommended tons to ensure positive oil return.
2. All data based on actual tons and is not related to horsepower.
3. Minimum evaporator temperature: -40°F (4°C). Minimum suction gas temperature through the accumulator: +10°F (-12°C). For operating conditions not within the rating data, please contact Parker before proceeding with installation.

Copper Vertical, Horizontal and Stand-Pipe Accumulators - OEM only

Parker's Vertical, Horizontal, and Stand-Pipe Copper Accumulators hold unused system charge to prevent liquid slugging of the compressor and excessive refrigerant dilution of the compressor oil.

Applications

- Low temperature refrigeration and heat-pump applications
- Residential air conditioning systems

Features and Benefits

- Accumulators available in vertical (inlet and outlet on same end), horizontal (inlet and outlet on opposite ends), and stand-pipe designs
- Stand-pipe design can be made with or without an orifice to meter oil return to the compressor
- Systems using a rotary compressor should use a stand-pipe accumulator including a screened baffle and an oil-return orifice for maximum system performance
- A wide variety of O.D. and volume sizes are designed to meet the unique requirements of a system
- Bifurcated ODF solder in a variety of sizes provide for easy installation
- Copper Accumulator models are UL recognized for maximum working pressures listed under SA5764-SKXY/SKXY7

1-1/8" Copper Accumulator

Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
032185-00	450	31.0	3/8	1/4	8.25	210	1.97	32.3	1.13	28.7

1-3/16" Copper Accumulator

Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
056268-00	450	31.0	3/8	3/8	5	127	4.75	77.8	1.19	30.2
051639-03	450	31.0	3/8	3/8	6.5	165	4.75	77.8	1.19	30.2
056039-01	450	31.0	3/8	5/16	6.5	165	4.75	77.8	1.19	30.2
056039-02	450	31.0	5/16	5/16	6.5	165	4.75	77.8	1.19	30.2

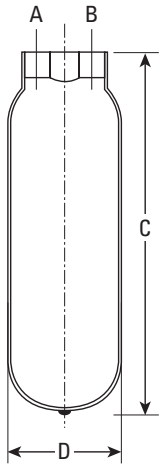
1-3/8" Copper Accumulator

Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
057375-00	450	31.0	3/8	3/8	7.06	179	2.52	41.3	1.38	35.1
056380-01	450	31.0	3/8	3/8	6	152	6.86	112	1.38	35.1

1-5/8" Copper Accumulator

Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
056238-01	450	31.0	5/16	1/4	4	102	5.41	88.7	1.63	41.4
056689-02	450	31.0	3/8	3/8	4	102	5.41	88.7	1.63	41.4
057337-00	450	31.0	1/2	1/2	5	127	7.29	119.5	1.63	41.4
058489-01	450	31.0	5/16	5/16	5	127	7.29	119.5	1.63	41.4
057995-00	450	31.0	3/8	3/8	5.5	140	2.59	42.4	1.63	41.4
056326-03	450	31.0	1/4	1/4	7	178	11.15	182.7	1.63	41.4
056472-01	450	31.0	3/8	3/8	8	203	12.902	211.4	1.63	41.4
056463-03	450	31.0	1/2	1/2	10	254	16.55	271.2	1.63	41.4
056463-02	450	31.0	3/8	3/8	10	254	16.55	271.2	1.63	41.4

Dimensions



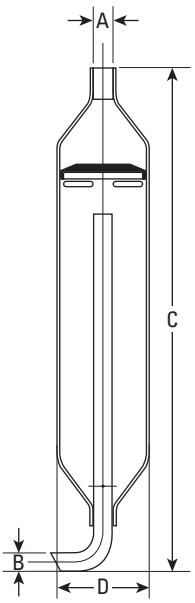
1-7/8" Copper Stand Pipe Accumulator

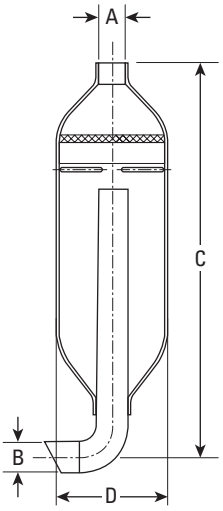
Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
071442-00	450	31.0	3/8	3/8	10.2	259	13.44	220.2	1.88	47.6

2-1/4" Copper Stand Pipe Accumulator

Part Number	Maximum Rated Pressure		Standard Nominal Sizes (Inches)		Overall Length (C)		Internal Volume		Diameter (D)	
	PSIG	bar	Inlet (A)	Outlet (B)	Inches	mm	Cu. In.	cm^3	Inches	mm
032236-00	450	31.0	1/2	0.616	8.19	208	12.63	207.0	2.25	57.2

Dimensions





Steel Receivers

Design

The RT series receiver tanks are multi-functional in a refrigeration system. It provides a reservoir for refrigerant during normal operation of a refrigeration system, ensures availability of a reserve quantity of refrigerant during periods of high load demands and provides a place to store the refrigerant charge during either automatic or service pump downs.

Receiver tank storage capacities are based on 80% of the internal volume of the tank when the temperature of the refrigerant is 90°F (32°C) per ARI standard 495. Receiver selection should be based on the vessels ability to hold 100% of the total system refrigerant charge.

Four different styles of receiver connections are available: one with a sweat inlet and a rotolock outlet spud, one with sweat by sweat connections, one with a sweat inlet with a sweat outlet service valve brazed onto the top closure and one with a sweat inlet with a sweat outlet service valve brazed onto body tube. Additionally, Parker offers vertical and horizontal models to provide greater flexibility in different applications.

Applications

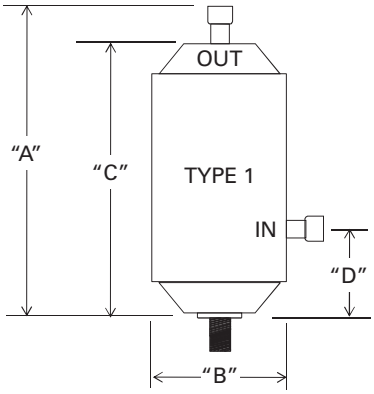
Designed for installation in the liquid line of any refrigeration or air conditioning application which requires a storage vessel for liquid refrigerant either for system pump downs or as a safeguard to ensure that a solid column of liquid is in the liquid line.

CAUTION: Do not exceed design pressure. Fasten receiver and piping securely before use.

Features and Benefits

- Available with 1/4" - 5/8" ODF sweat solid copper connections
- Vertical, horizontal and custom designed models available
- Models from 2-1/2" through 6" diameters with maximum lengths of 35"
- Vertical models are provided with 3 different types of connections
- Horizontal models have sweat connections
- 500 psig (35 bar) maximum working pressure
- Compatible with CFC, HCFC, HFC refrigerants, mineral oils, alkylbenzene (AB), polyolester (POE) and polyalkylene glycol (PAG) lubricants.
- Integral 430°F (221°C) fuse plug in 5" and 6" diameter models
- Valve is shipped unassembled
- PTFE gasket seal for valve
- UL listed for USA and Canada under SA5915-SOJV/SOJV7
- Manufactured in ISO 9001/ISO 14001 registered facility
- Valves can be brazed to the body or connected via rotolock stub with PTFE seal
- Receivers available with or without isolation valves
- Powder coating surpasses 500 hour ASTM salt spray

Dimensions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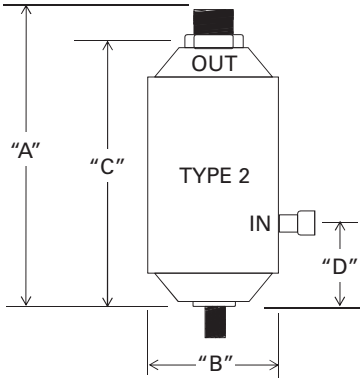
IN
"D"
"B"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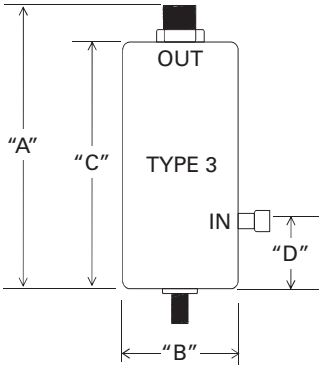
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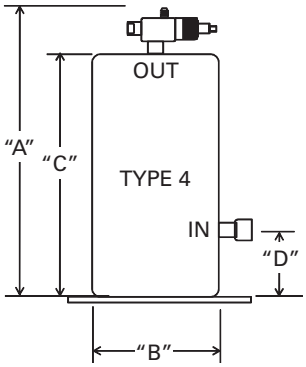
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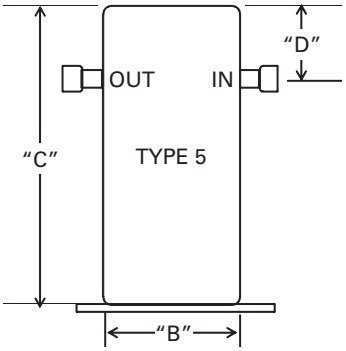
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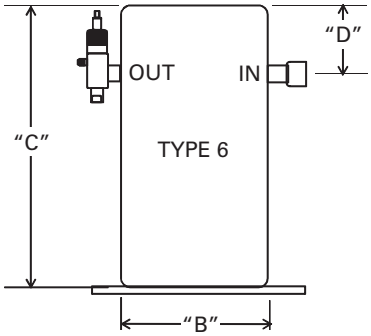
"D"
OUT
IN
"C"
TYPE 6
"B"

Dimensions

Catalog Number	Item No.	Inches (mm)	Fitting Type	Inches (mm)	Fitting Type	Dimensions: Inches (mm)				Internal Volume	Type	Holding Capacity
						"A"	"B"	"C"	"D"	Cu. In. (liters)		lbs. (liters)
RT256V	469988	1/4 (6.0)	Solder x	1/4 (6.0)	Solder	6-3/4 (171)	2-1/2 (64)	5-7/8 (149)	2 (51)	29.4 (0.482)	1	1.1 (0.52)
RT306V-TS	470122	1/4 (6.0)	Solder x	1/4 (6.0)	Solder	6-3/4 (171)	3 (76)	5-7/8 (149)	2 (51)	43.2 (0.708)	1	1.6 (0.76)
RT306V-TR	469993	1/4 (6.0)	Solder x	3/4 (19.0)	Rotolock	6-3/4 (171)	3 (76)	5-7/8 (149)	2 (51)	43.2 (0.708)	2	1.6 (0.76)
RT308V-TR	469996	1/4 (6.0)	Solder x	3/4 (19.0)	Rotolock	8-3/8 (213)	3 (76)	7-1/2 (191)	2 (51)	51.9 (0.851)	2	1.9 (0.91)
RT308V-TS	470137	3/8 (10.0)	Solder x	3/8 (10.0)	Solder	8-3/8 (213)	3 (76)	7-1/2 (191)	2 (51)	51.9 (0.851)	1	1.9 (0.91)
RT312V-TS	470139	3/8 (10.0)	Solder x	3/8 (10.0)	Solder	14 (356)	3 (76)	13-1/8 (333)	2 (51)	82.9 (1.360)	1	3.1 (1.45)
RT3510V2S-KS	470123	3/8 (10.0)	Solder x	1/4 (6.0)	Valve	11-1/8 (283)	3-1/2 (89)	10 (254)	2 (51)	84.7 (1.389)	4	3.1 (1.48)
RT3510V2S	450220	3/8 (10.0)	Solder x	1/4 (6.0)	Solder	—	3-1/2 (89)	10 (254)	2-1/2 (64)	84.7 (1.389)	5	3.1 (1.48)
RT3510V3S	469999	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	11-1/8 (283)	3-1/2 (89)	10 (254)	2 (51)	84.7 (1.389)	4	3.1 (1.48)
RT3510V	470087	3/8 (10.0)	Solder x	3/8 (10.0)	Solder	—	3-1/2 (89)	10 (254)	2-1/2 (64)	94.2 (1.545)	5	3.5 (1.65)
RT507V	470002	1/4 (6.0)	Solder x	3/4 (19.0)	Rotolock	8-5/8 (219)	5 (127)	7-3/4 (197)	2-1/2 (64)	136.5 (2.239)	3	5.1 (2.39)
RT508V3S	470000	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	—	5 (127)	8 (203)	2-1/2 (64)	126.6 (2.076)	6	4.7 (2.22)
RT510V3S	470124	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	11-1/8 (283)	5 (127)	10 (254)	2-1/2 (64)	177.9 (2.918)	4/6	6.6 (3.12)
RT510V3S-KS	470004	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	—	5 (127)	10 (254)	2-1/2 (64)	177.9 (2.918)	5	6.6 (3.12)
RT512V	470010	3/8 (10.0)	Solder x	3/4 (19.0)	Rotolock	12-7/8 (327)	5 (127)	12 (305)	2-1/2 (64)	214.3 (3.515)	3	7.9 (3.76)
RT512V3S	470008	3/8 (10.0)	Solder x	3/4 (19.0)	Rotolock	13-1/8 (333)	5 (127)	12 (305)	2-1/2 (64)	214.3 (3.515)	4	7.9 (3.76)
RT612V	470019	3/8 (10.0)	Solder x	3/4 (19.0)	Rotolock	12-7/8 (327)	6 (152)	12 (305)	2-1/2 (64)	298.9 (4.902)	3	11.1 (5.24)
RT612V3S-KS	470125	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	—	6 (152)	12 (305)	4 (102)	298.9 (4.902)	6	11.1 (5.24)
RT612V3S	470013	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	13-1/8 (333)	6 (152)	12 (305)	2-1/2 (64)	298.9 (4.902)	4/5	11.1 (5.24)
RT612V4S	470089	3/8 (10.0)	Solder x	1/2 (13.0)	Valve	13-1/8 (333)	6 (152)	12 (305)	2-1/2 (64)	298.9 (4.902)	4	11.1 (5.24)
RT615V	470022	3/8 (10.0)	Solder x	1 (25.0)	Rotolock	15-7/8 (403)	6 (152)	15 (381)	2-1/2 (64)	376.7 (6.178)	3	13.9 (6.60)
RT616V3S-KS	470126	3/8 (10.0)	Solder x	3/8 (10.0)	Valve	17-1/8 (435)	6 (152)	16 (406)	2-1/2 (64)	416.4 (6.829)	4	15.4 (7.30)
RT616V3S	470024	3/8 (10.0)	Solder x	3/8 (10.0)	Solder	—	6 (152)	16 (406)	2-1/2 (64)	416.4 (6.829)	5	15.4 (7.30)
RT616V4S	470025	3/8 (10.0)	Solder x	1/2 (13.0)	Valve	17-3/8 (441)	6 (152)	16 (406)	2-1/2 (64)	416.4 (6.829)	4	15.4 (7.30)
RT616V4S	470138	1/2 (13.0)	Solder x	1/2 (13.0)	Valve	17-3/8 (441)	6 (152)	16-1/8 (410)	2-1/2 (64)	418.4 (6.862)	4	15.5 (7.33)
RT617V4S	470026	1/2 (13.0)	Solder x	1/2 (13.0)	Valve	—	6 (152)	17-1/8 (435)	3-3/4 (95)	480.4 (7.879)	6	17.8 (8.42)
RT618V4S-KS	470127	1/2 (13.0)	Solder x	1/2 (13.0)	Valve	19-3/8 (492)	6 (152)	18 (457)	2-1/2 (64)	470.0 (7.708)	4	17.4 (8.24)
RT619V	470033	1/2 (13.0)	Solder x	1 (25.0)	Rotolock	20 (508)	6 (152)	19 (483)	2-1/2 (64)	480.4 (7.879)	3	17.8 (8.42)
RT623V4S-KS	470128	1/2 (13.0)	Solder x	1/2 (13.0)	Valve	24-3/8 (619)	6 (152)	23 (584)	2-1/2 (64)	601.3 (9.861)	4	22.2 (10.54)
RT623V5S	470034	1/2 (13.0)	Solder x	5/8 (16.0)	Valve	24-3/8 (619)	6 (152)	23 (584)	2-1/2 (64)	601.3 (9.861)	4	22.2 (10.54)
RT627V4S	470036	1/2 (13.0)	Solder x	1/2 (13.0)	Valve	—	6 (152)	27-1/8 (689)	3-3/4 (95)	709.1 (11.629)	6	26.2 (12.43)
RT630V5S	470038	5/8 (16.0)	Solder x	5/8 (16.0)	Solder	—	6 (152)	30 (762)	5 (127)	784.3 (12.863)	6	29.0 (13.74)
RT634V4S	470040	1/2 (13.0)	Valve x	1/2 (13.0)	Valve	—	6 (152)	35 (876)	4-1/8 (105)	915.0 (15.006)	6	33.9 (16.03)

Select receiver with holding capacity equal to or greater than 90% of system charge.
Holding capacities stated for R-410A at 90°F (32°C).
Multiply holding capacity by 1.1 to obtain R-22 data at 90°F (32°C).
Catalog numbers in bold font are available as standard wholesale offering.

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7. 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 based upon data or specifications provided by the user, 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.

8. 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, will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the items 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.

9. 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 has the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller retains a security interest in all Products delivered to Buyer and this agreement is deemed to be 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.

11. Improper Use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), 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, application, design, specification 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 Products; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. Cancellations and Changes. Buyer may not cancel or modify or cancel any order 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.

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

14. Force Majeure. Seller does not assume the risk and is not liable for delay or failure to perform any of Seller's obligations by reason of events or circumstances beyond its reasonable control (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. Waiver and Severability. Failure to enforce any provision of this agreement will not invalidate 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.

16. Termination. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate this agreement, in writing, if Buyer: (a) breaches any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.

17. Governing Law. This agreement and the sale and delivery of all Products are 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.

18. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable 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 refund the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller is not liable 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 constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. 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 sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged. The terms contained herein may not be modified unless in writing and signed by an authorized representative of Seller.

20. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards of care, including those of the United Kingdom, the United States of America, and the country or countries in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act") and the U.S. Food Drug and Cosmetic Act ("FDCA"),each as currently amended, and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that it is familiar with the provisions of the U. K. Bribery Act, the FCPA, the FDA, and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller.

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