



# Electric Pressure Regulating Valves

## CDS Series

SPORLAN



ENGINEERING YOUR SUCCESS.



The CDS-9, -16 and -17 are supplied with a hermetic cable connection. **CAUTION:** No attempt should be made to remove the hermetic cable. The CDS-2, -4 and -7 are supplied with a removable cable. All external parts of the valve are brass, copper or stainless steel, and meet or exceed ASTM standard B-117 for corrosion resistance.

Although 20 feet is the standard cable length, the leads can be supplied from 10 feet (3 meters) up to 40 feet (12 meters) to suit specific customer requirements. If a valve must be installed more than 40 feet from the controller, a short lead wire must be used with an extension of heavier (14-gauge) wire, due to voltage drop considerations. Unless otherwise specified, the terminal end of the wires will be supplied stripped and tinned.

Total power consumption is less than 4 watts when operating a rate of 200 steps per second with standard L/R drive circuitry. Faster step rates up to 400 steps per second may be obtained with properly configured current limited chopper drives. Refer to the motor specifications or contact Sporlan for more information.

The small CDS valves have a maximum rated pressure of 700 PSIG (48 bar), while the larger valves have an MRP of 680 PSIG (47 bar). Allowable ambient temperatures are -50°F to 140°F (-45°C to 60°C), while fluid temperatures up to 240°F (115°C) are acceptable.

## APPLICATION

The CDS valves are designed for precise and energy efficient control of evaporator temperatures, in addition to modulating temperature control of reclaim condensers, head pressure or liquid line differential control, and other applications where low pressure drop contribution is desirable. Modulation around a set point is obtained by regulating refrigerant flow in response to signals generated by an electronic controller and sensor combination.

Sporlan is not responsible for system design, for any damage arising from faulty system design, or for misapplication of its products. If these valves are applied in any manner other than as described in this bulletin, the Sporlan warranty is void. Please contact your Sporlan Sales Engineer for assistance with your specific application.

It is the responsibility of the controller manufacturer to provide suitable drive circuitry and power supply. Sporlan will assist where necessary, but accepts no liability for improper control of the valve. Careful consideration should be given to the interaction between the valve controller and system controller (if independent), to ensure proper behavior in all system conditions. Control strategy is a critical factor in determining valve duty cycle and control capability.

Power should be removed from the valve when not actively stepping. It is recommended to apply power for 25 ms prior and subsequent to stepping, and to pause 25 ms before reversing direction.

Conventional initialization routines, which include overdriving the motor closed to ascertain the zero step position, are acceptable. Overdriving open is not recommended. When properly controlled, Sporlan CDS valves should not lose steps, and therefore it is not recommended to perform a full initialization every time the valve is closed. It is however, reasonable to reinitialize the valve once per day using 10% of the valve's steps. This reinitialization often occurs during a system defrost or other time when the valve is fully closed.

## SELECTION EXAMPLE – SUCTION (TONS)

**Refrigerant:** R-404A

**Liquid Temperature:** 80°F

**Evaporator Temperature:** 20°F

**Evaporator Capacity:** 4 Tons

To select a valve for these system conditions, look at the suction capacity tables, and locate the set of columns applicable to R-404A. To apply a valve with minimal pressure drop, the 0.5 PSI column should be used. Adjust for the liquid temperature by multiplying the appropriate correction factor (shown at the bottom of the page) to each capacity value. For an evaporator capacity of 4 tons at 20°F, a CDS-16 with a capacity of  $5.93 * 0.87 = 5.16$  tons would be required. Note that this valve is available in angle configuration only, therefore a straight through CDS-17 (with a capacity of  $6.2 * 0.87 = 5.39$  tons) could also be selected. A more economical approach would be to select a CDS-9 at 1 PSI drop, which has a capacity of  $4.82 * 0.87 = 4.19$  tons. To extend the example, if a 3 PSI drop could be tolerated, the best cost solution would be to select a CDS-7 with a capacity of  $5.38 * 0.87 = 4.68$  tons.

## ORDERING INSTRUCTIONS/NOMENCLATURE

<b>CDS</b>	<b>T</b>	<b>-</b>	<b>9</b>	<b>1-1/8"</b>	<b>ODF</b>	<b>20'</b>	<b>-</b>	<b>S</b>	<b>M-12</b>	<b>ANGLE*</b>
Valve Family	Inlet Pressure Tap (Optional)		Valve Model	Fitting Size	Fitting Type	Cable Length		Stripped and Tinned Cable Ends (Custom Connectors Available)	Connection for CDS -2, -4, -7	Angle Configuration (CDS-16 only)

\*CDS-2, CDS-4, CDS-7, CDS-9 and CDS-17 are straight through valves. CDS-16 is the only angle valve.

## SPECIFICATIONS

	Valves CDS -2, -4, -7	Valves CDS -9, -16, -17
<b>Motor Type</b>	2 phase, bipolar wet motor	
<b>Compatible Refrigerant</b>	All common HCFC and HFC refrigerants including R-410A and subcritical R-744	
<b>Compatible Oils</b>	All common Mineral, Polyolester and Alkybenzene oils	
<b>Supply Voltage*</b>	12 VDC-5% +10% (measured at the valve leads)	
<b>Cable Type</b>	IP67 Removable (M12)	Hermetic
<b>Phase Resistance</b>	100 ohms ± 10%	75 ohms ± 10%
<b>Phase Inductance</b>	43 MHz ± 20%	62 MHz ± 20%
<b>Nominal Current*</b>	120 ma / winding	160 ma / winding
<b>Holding Current</b>	Evaluate to avoid step loss or damage to the valve**	
<b>Power Input*</b>	2.8 watts	3.8 watts
<b>Recommended Step Rate</b>	200 / second (L/R), up to 400 / second (properly configured current chopper)	
<b>Number of Steps</b>	2500	6386
<b>Full Motor Transit Time*</b>	12.5 seconds	32 seconds
<b>Resolution</b>	.00012 inches (.003 mm) / step	.000078 inches (.002 mm) / step
<b>Total Stroke</b>	0.297 inches	0.500 inches
<b>MRP</b>	700 psig (48 bar)	680 psig (47 bar)
<b>Max. Internal Leakage</b>	400 cc/min at 100 psid (6.9 bar), dry air	
<b>Max. External Leakage</b>	.10 oz/yr @ 300 psig (2.8 grams/yr @ 20 bar)	
<b>Ambient Temp. Range</b>	-50°F to 140°F (-45°C to 60°C)	
<b>Refrigerant Temp. Range</b>	-50°F to 240°F (-45°C to 116°C)	
<b>Materials of Construction</b>	Brass, copper, stainless steel, synthetic seals	

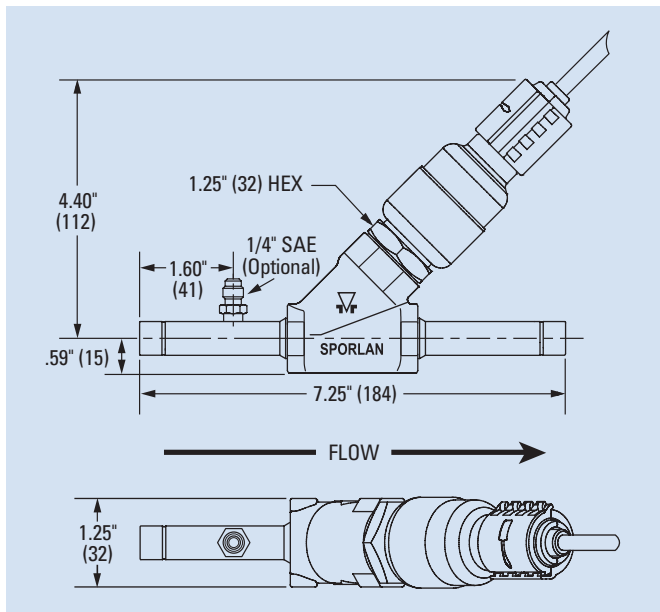
\*Specifications based upon L/R driver.

\*\*Contact Sporlan Application Engineering for qualification testing details.

## REFERENCE DIMENSIONS – Inches (mm)

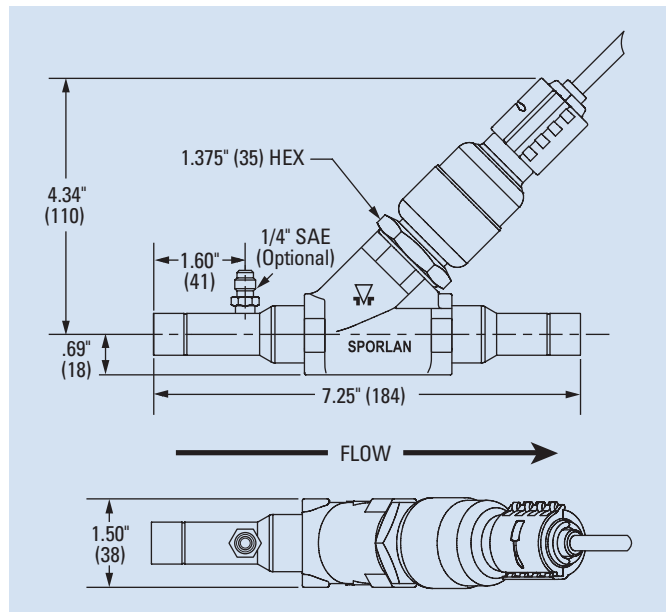
### CDS-2, -4

Available Fittings
1/2" ODF
5/8" ODF
7/8" ODF



### CDS-7

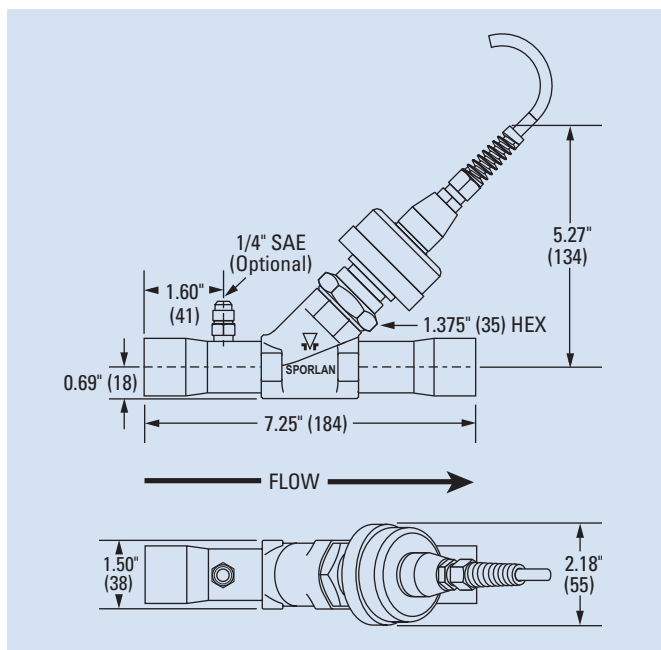
Available Fittings
5/8" ODF
7/8" ODF
1-1/8" ODF
1-3/8" ODF



## REFERENCE DIMENSIONS – Inches (mm)

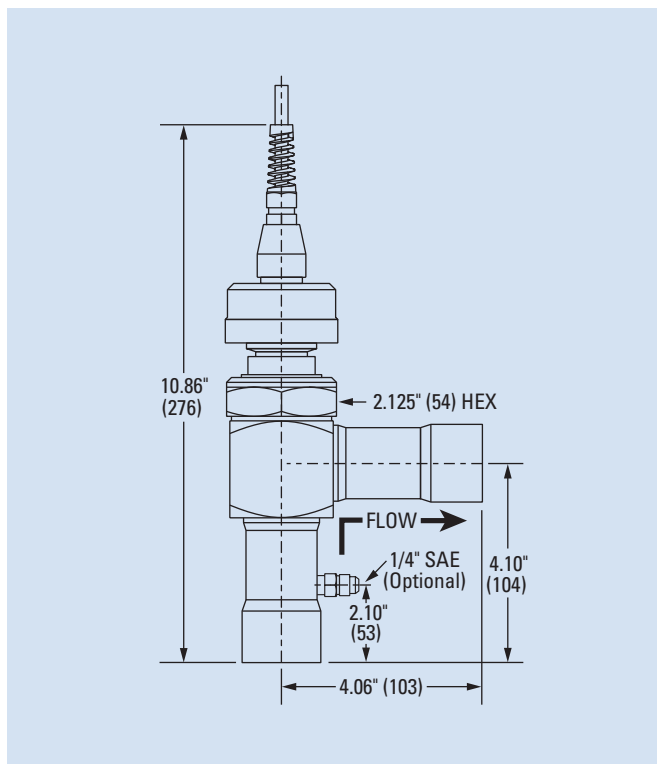
### CDS-9

Available Fittings
5/8" ODF
7/8" ODF
1-1/8" ODF
1-3/8" ODF



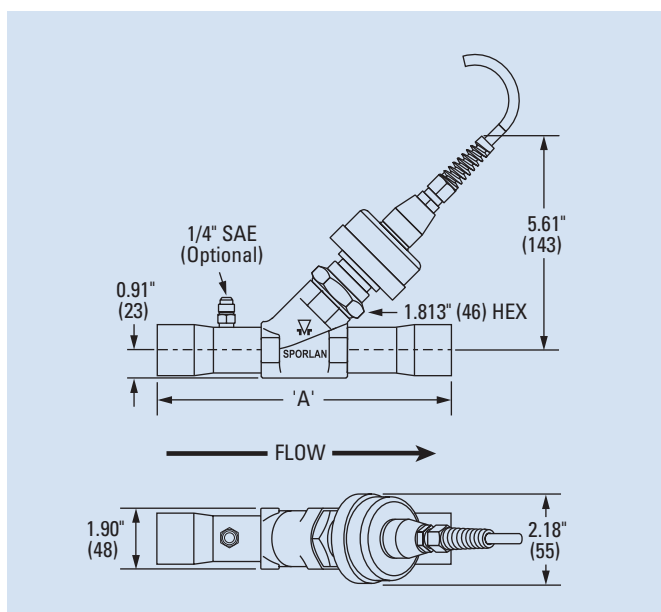
### CDS-16

Available Fittings
1-3/8" ODF



### CDS-17

Available Fittings	
1-3/8" ODF	9.88" (251)
1-5/8" ODF	9.88" (251)
2-1/8" ODF	10.62" (270)



## FLOW CAPACITY - SUCTION (TONS)

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (psid)																			
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	0.53	0.73	1.25	1.59	2.28	0.42	0.59	1.00	1.29	1.76	0.48	0.67	1.14	1.46	2.12	0.51	0.71	1.20	1.53	2.19
	20	0.43	0.61	1.03	1.32	1.84	0.34	0.47	0.79	1.01	1.35	0.39	0.55	0.93	1.19	1.68	0.41	0.57	0.97	1.26	1.73
	0	0.35	0.49	0.84	1.07	1.45	0.26	0.37	0.61	0.76	0.98	0.31	0.44	0.74	0.96	1.30	0.32	0.45	0.77	0.98	1.32
	-20	0.28	0.39	0.65	0.82	1.09	0.20	0.28	0.45	0.54	0.66	0.24	0.34	0.58	0.73	0.97	0.25	0.35	0.58	0.73	0.96
	-40	0.22	0.31	0.49	0.61	0.76	0.15	0.20	0.31	0.36	0.38	0.19	0.26	0.43	0.53	0.68	0.19	0.27	0.42	0.52	0.64
CDS-4	40	1.10	1.54	2.64	3.39	4.78	0.88	1.23	2.11	2.70	3.62	1.01	1.42	2.43	3.12	4.45	1.06	1.48	2.54	3.26	4.59
	20	0.91	1.27	2.18	2.79	3.82	0.70	0.98	1.67	2.09	2.71	0.82	1.15	1.97	2.53	3.51	0.85	1.20	2.05	2.65	3.58
	0	0.73	1.03	1.76	2.23	2.95	0.55	0.77	1.26	1.55	1.89	0.65	0.92	1.57	2.00	2.68	0.67	0.95	1.62	2.04	2.68
	-20	0.58	0.82	1.37	1.70	2.15	0.42	0.58	0.91	1.07	1.16	0.51	0.71	1.21	1.51	1.95	0.52	0.73	1.22	1.50	1.87
	-40	0.45	0.63	1.02	1.22	1.41	0.31	0.41	0.61	0.65	0.65	0.39	0.54	0.89	1.08	1.30	0.39	0.55	0.87	1.03	1.14
CDS-7	40	3.12	4.31	7.22	9.17	13.0	2.51	3.47	5.81	7.38	9.53	2.85	3.94	6.60	8.38	12.2	3.00	4.15	6.93	8.81	12.5
	20	2.59	3.58	5.99	7.61	10.2	2.02	2.79	4.57	5.60	6.82	2.33	3.22	5.38	6.84	9.5	2.44	3.37	5.64	7.27	9.5
	0	2.11	2.93	4.89	6.04	7.62	1.59	2.20	3.40	4.01	4.36	1.87	2.58	4.32	5.47	7.03	1.94	2.69	4.50	5.50	6.87
	-20	1.69	2.34	3.72	4.48	5.21	1.22	1.69	2.36	2.58	2.58	1.47	2.03	3.31	4.03	4.86	1.52	2.10	3.29	3.93	4.43
	-40	1.33	1.84	2.69	3.07	3.15	0.92	1.10	1.44	1.44	1.44	1.13	1.56	2.37	2.77	2.95	1.16	1.60	2.27	2.53	2.55
CDS-9	40	4.65	6.46	10.9	13.9	19.7	3.73	5.19	8.74	11.2	14.9	4.26	5.91	9.96	12.7	18.4	4.47	6.21	10.5	13.3	18.9
	20	3.85	5.35	9.01	11.5	15.7	2.99	4.16	6.89	8.6	11.0	3.47	4.82	8.11	10.3	14.5	3.62	5.03	8.48	10.9	14.7
	0	3.14	4.36	7.34	9.17	12.1	2.35	3.27	5.20	6.33	7.60	2.77	3.85	6.49	8.27	11.0	2.89	4.01	6.75	8.39	10.9
	-20	2.51	3.48	5.64	6.96	8.71	1.81	2.51	3.73	4.33	4.58	2.17	3.02	4.99	6.20	7.93	2.25	3.12	5.01	6.15	7.56
	-40	1.96	2.72	4.17	4.98	5.60	1.35	1.69	2.45	2.56	2.56	1.67	2.31	3.64	4.41	5.20	1.71	2.37	3.56	4.19	4.52
CDS-16	40	7.95	11.1	18.8	24.1	33.1	6.37	8.89	15.1	18.8	23.9	7.30	10.2	17.3	22.1	31.1	7.64	10.7	18.1	23.1	31.8
	20	6.57	9.17	15.6	19.9	25.8	5.09	7.11	11.7	14.1	16.7	5.93	8.27	14.0	17.9	24.0	6.19	8.63	14.6	18.6	24.0
	0	5.34	7.45	12.6	15.3	18.9	3.99	5.57	8.60	10.0	10.4	4.73	6.61	11.2	13.9	17.6	4.91	6.86	11.6	14.0	17.0
	-20	4.26	5.94	9.47	11.3	12.5	3.06	4.27	5.87	6.16	6.16	3.70	5.17	8.44	10.2	11.8	3.82	5.32	8.36	9.8	10.6
	-40	3.32	4.63	6.75	7.49	7.54	2.28	2.80	3.45	3.45	3.45	2.83	3.94	5.99	6.85	7.06	2.89	4.03	5.68	6.09	6.09
CDS-17	40	8.31	11.6	19.5	24.9	35.6	6.67	9.28	15.7	20.1	26.7	7.62	10.6	17.9	22.8	33.2	7.99	11.1	18.8	24.0	34.2
	20	6.88	9.57	16.2	20.6	28.3	5.34	7.43	12.5	15.5	19.7	6.20	8.62	14.6	18.6	26.1	6.47	9.01	15.2	19.8	26.5
	0	5.60	7.79	13.2	16.6	21.6	4.19	5.83	9.37	11.3	13.4	4.95	6.89	11.6	14.9	19.7	5.15	7.17	12.1	15.1	19.6
	-20	4.47	6.22	10.2	12.5	15.5	3.22	4.48	6.68	7.69	7.99	3.88	5.40	9.02	11.2	14.1	4.01	5.57	9.05	11.0	13.4
	-40	3.49	4.85	7.50	8.88	9.77	2.40	3.04	4.34	4.47	4.47	2.97	4.13	6.57	7.90	9.13	3.04	4.23	6.40	7.45	7.9

Capacities based upon 60°F liquid and 25°F superheated vapor. Reference page 14 for liquid temperature correction factors.

\* R-744 capacities based upon 20°F liquid and 25°F superheat.



## FLOW CAPACITY - SUCTION (TONS) continued

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																								
		R-407C					R-410A					R-422D					R-507A					R-744*				
		Pressure Drop Across Valve (psid)																								
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	0.51	0.71	1.21	1.55	2.21	0.65	0.91	1.55	1.98	2.77	0.43	0.60	1.02	1.31	1.87	0.48	0.67	1.14	1.46	2.12	—	—	—	—	—
	20	0.41	0.58	0.98	1.27	1.74	0.54	0.76	1.29	1.64	2.36	0.35	0.48	0.82	1.07	1.46	0.39	0.55	0.93	1.19	1.69	—	—	—	—	—
	0	0.33	0.46	0.77	0.98	1.32	0.44	0.62	1.05	1.34	1.88	0.27	0.38	0.64	0.82	1.10	0.31	0.44	0.74	0.96	1.31	1.03	1.44	2.45	3.13	4.38
	-20	0.25	0.36	0.59	0.73	0.95	0.35	0.49	0.84	1.07	1.45	0.21	0.29	0.48	0.60	0.78	0.25	0.34	0.58	0.73	0.98	0.87	1.22	2.07	2.64	3.69
	-40	0.19	0.27	0.42	0.52	0.62	0.28	0.39	0.64	0.81	1.07	0.16	0.22	0.34	0.42	0.51	0.19	0.26	0.43	0.54	0.69	0.72	1.01	1.71	2.19	3.06
CDS-4	40	1.07	1.50	2.56	3.29	4.61	1.37	1.93	3.30	4.23	5.94	0.91	1.27	2.18	2.79	3.91	1.01	1.42	2.43	3.13	4.47	—	—	—	—	—
	20	0.86	1.21	2.07	2.66	3.58	1.13	1.59	2.73	3.50	4.97	0.72	1.01	1.74	2.24	3.01	0.82	1.15	1.97	2.53	3.53	—	—	—	—	—
	0	0.68	0.96	1.63	2.04	2.66	0.92	1.29	2.22	2.85	3.92	0.57	0.79	1.36	1.70	2.22	0.65	0.92	1.57	2.02	2.71	2.17	3.05	5.22	6.70	9.40
	-20	0.53	0.74	1.22	1.50	1.84	0.74	1.03	1.77	2.24	2.97	0.43	0.61	1.00	1.23	1.52	0.51	0.72	1.22	1.52	1.98	1.83	2.57	4.39	5.64	7.92
	-40	0.40	0.56	0.87	1.02	1.10	0.57	0.80	1.35	1.67	2.12	0.32	0.45	0.70	0.83	0.90	0.39	0.55	0.90	1.10	1.34	1.51	2.12	3.63	4.65	6.53
CDS-7	40	3.03	4.20	7.02	8.91	12.5	3.87	5.35	8.95	11.4	15.7	2.56	3.54	5.92	7.52	10.6	2.85	3.94	6.60	8.4	12.2	—	—	—	—	—
	20	2.47	3.41	5.71	7.29	9.5	3.22	4.46	7.45	9.47	13.6	2.06	2.85	4.76	6.13	7.97	2.33	3.22	5.39	6.8	9.5	—	—	—	—	—
	0	1.97	2.72	4.47	5.49	6.76	2.64	3.65	6.11	7.76	10.5	1.62	2.25	3.72	4.57	5.63	1.87	2.59	4.33	5.51	7.1	6.06	8.39	14.0	17.8	24.6
	-20	1.54	2.13	3.29	3.89	4.27	2.12	2.94	4.91	6.08	7.75	1.25	1.73	2.71	3.21	3.53	1.47	2.04	3.34	4.09	5.0	5.14	7.11	11.9	15.1	20.9
	-40	1.17	1.62	2.24	2.45	2.45	1.67	2.31	3.67	4.43	5.18	0.94	1.30	1.83	2.01	2.01	1.13	1.57	2.41	2.84	3.06	4.28	5.92	9.90	12.6	17.4
CDS-9	40	4.52	6.28	10.6	13.5	19.0	5.78	8.02	13.5	17.2	23.9	3.82	5.30	8.93	11.4	16.1	4.26	5.92	10.0	12.7	18.4	—	—	—	—	—
	20	3.67	5.09	8.58	11.0	14.7	4.80	6.67	11.2	14.3	20.5	3.06	4.26	7.17	9.24	12.4	3.47	4.82	8.12	10.4	14.5	—	—	—	—	—
	0	2.92	4.06	6.73	8.40	10.9	3.92	5.45	9.18	11.7	16.1	2.41	3.35	5.60	6.99	9.04	2.78	3.86	6.51	8.33	11.1	9.08	12.6	21.2	27.1	37.6
	-20	2.27	3.16	5.02	6.13	7.4	3.15	4.37	7.36	9.23	12.2	1.86	2.58	4.13	5.05	6.11	2.18	3.03	5.03	6.27	8.06	7.68	10.7	18.0	22.9	31.8
	-40	1.73	2.40	3.54	4.12	4.35	2.47	3.43	5.55	6.86	8.61	1.39	1.93	2.89	3.37	3.58	1.68	2.33	3.69	4.49	5.36	6.38	8.86	14.9	19.0	26.4
CDS-16	40	7.72	10.8	18.3	23.4	31.7	9.90	13.8	23.4	30.0	41.8	6.54	9.13	15.5	19.8	26.9	7.31	10.2	17.3	22.1	31.3	—	—	—	—	—
	20	6.25	8.73	14.8	18.6	23.8	8.21	11.5	19.4	24.8	34.7	5.24	7.31	12.4	15.6	20.0	5.94	8.29	14.1	18.0	24.2	—	—	—	—	—
	0	4.96	6.93	11.4	13.9	16.6	6.70	9.34	15.8	20.3	26.7	4.11	5.74	9.51	11.6	13.8	4.75	6.63	11.2	14.1	17.9	15.6	21.8	36.9	47.2	65.9
	-20	3.86	5.38	8.33	9.68	10.2	5.36	7.48	12.7	15.5	19.3	3.15	4.40	6.86	7.98	8.44	3.72	5.19	8.53	10.3	12.2	13.2	18.4	31.2	39.9	55.6
	-40	2.92	4.07	5.58	5.85	5.85	4.19	5.85	9.33	11.1	12.4	2.35	3.29	4.56	4.81	4.81	2.84	3.97	6.10	7.03	7.33	10.9	15.2	25.8	33.0	46.1
CDS-17	40	8.07	11.2	19.0	24.2	34.3	10.3	14.4	24.3	31.0	43.1	6.83	9.50	16.0	20.5	29.1	7.62	10.6	17.9	22.9	33.3	—	—	—	—	—
	20	6.55	9.11	15.4	19.8	26.5	8.58	11.9	20.2	25.7	37.0	5.48	7.62	12.9	16.7	22.2	6.21	8.64	14.6	18.6	26.2	—	—	—	—	—
	0	5.21	7.25	12.2	15.1	19.4	7.01	9.75	16.5	21.0	29.1	4.31	5.99	10.1	12.6	16.2	4.97	6.91	11.7	15.0	20.0	16.3	22.6	38.2	48.8	67.9
	-20	4.05	5.64	9.05	11.0	13.1	5.62	7.82	13.2	16.7	21.9	3.31	4.61	7.45	9.05	10.8	3.90	5.42	9.10	11.3	14.4	13.7	19.1	32.3	41.2	57.4
	-40	3.07	4.27	6.35	7.31	7.59	4.40	6.13	10.0	12.3	15.3	2.48	3.44	5.18	5.98	6.24	2.99	4.16	6.66	8.05	9.44	11.4	15.9	26.8	34.2	47.6

Capacities based upon 60°F liquid and 25°F superheated vapor. Reference page 14 for liquid temperature correction factors.

\* R-744 capacities based upon 20°F liquid and 25°F superheat.

## FLOW CAPACITY - SUCTION (kW)

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (bar)																			
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	1.75	2.44	4.36	6.09	8.18	1.40	1.96	3.50	4.92	6.32	1.61	2.24	4.01	5.60	7.60	1.68	2.35	4.20	5.86	7.87
	-5	1.47	2.06	3.68	5.22	6.76	1.15	1.60	2.86	3.94	4.99	1.33	1.86	3.33	4.65	6.20	1.39	1.94	3.47	4.93	6.37
	-15	1.23	1.71	3.06	4.26	5.46	0.93	1.29	2.26	3.06	3.79	1.09	1.53	2.73	3.85	4.95	1.13	1.58	2.83	3.94	5.02
	-25	1.00	1.40	2.48	3.40	4.28	0.73	1.02	1.74	2.29	2.71	0.88	1.23	2.20	3.03	3.84	0.91	1.27	2.24	3.06	3.82
	-35	0.81	1.13	1.95	2.63	3.20	0.57	0.76	1.28	1.61	1.73	0.70	0.97	1.71	2.31	2.86	0.71	1.00	1.71	2.28	2.75
CDS-4	5	3.65	5.12	9.23	13.0	17.1	2.92	4.10	7.39	10.3	13.0	3.36	4.72	8.51	12.0	16.0	3.51	4.93	8.89	12.5	16.5
	-5	3.07	4.31	7.77	11.0	14.0	2.38	3.35	6.02	8.1	10.1	2.79	3.92	7.06	9.91	12.9	2.90	4.07	7.34	10.4	13.2
	-15	2.55	3.58	6.45	8.90	11.2	1.92	2.69	4.72	6.24	7.4	2.28	3.20	5.77	8.06	10.2	2.36	3.31	5.97	8.20	10.3
	-25	2.08	2.92	5.21	7.01	8.56	1.51	2.12	3.57	4.52	4.93	1.83	2.57	4.64	6.29	7.78	1.89	2.65	4.69	6.28	7.59
	-35	1.67	2.35	4.06	5.30	6.13	1.17	1.59	2.57	2.98	2.99	1.45	2.03	3.57	4.72	5.60	1.48	2.07	3.54	4.57	5.16
CDS-7	5	10.4	14.4	25.2	34.9	46.6	8.38	11.6	20.4	28.0	34.2	9.51	13.2	23.1	32.0	43.7	10.0	13.8	24.3	33.6	44.8
	-5	8.79	12.2	21.4	30.1	37.6	6.89	9.54	16.5	21.7	25.5	7.93	11.0	19.3	26.7	34.9	8.31	11.5	20.2	28.4	35.3
	-15	7.35	10.2	17.9	24.1	29.2	5.58	7.73	12.8	16.1	17.4	6.53	9.03	15.9	22.0	27.0	6.81	9.42	16.6	22.1	26.6
	-25	6.06	8.38	14.3	18.5	21.3	4.45	6.15	9.45	11.0	11.0	5.29	7.32	12.9	16.8	19.8	5.49	7.59	12.8	16.5	18.6
	-35	4.90	6.79	10.9	13.4	14.0	3.47	4.35	6.46	6.65	6.65	4.21	5.82	9.67	12.2	13.2	4.34	6.00	9.5	11.4	11.6
CDS-9	5	15.5	21.5	38.0	52.8	70.6	12.4	17.3	30.6	42.4	53.3	14.2	19.7	34.9	48.5	65.9	14.9	20.7	36.6	50.9	67.9
	-5	13.1	18.2	32.1	45.3	57.7	10.2	14.2	24.9	33.5	41.0	11.8	16.4	29.1	40.4	53.3	12.4	17.2	30.4	42.7	54.3
	-15	10.9	15.2	26.8	36.7	45.8	8.26	11.5	19.4	25.5	29.8	9.70	13.5	23.9	33.3	41.9	10.1	14.0	24.8	33.8	42.0
	-25	8.96	12.5	21.5	28.8	34.8	6.56	9.11	14.7	18.3	19.5	7.84	10.9	19.3	25.9	31.8	8.12	11.3	19.4	25.7	30.8
	-35	7.24	10.1	16.7	21.6	24.6	5.10	6.55	10.5	11.8	11.8	6.23	8.65	14.7	19.3	22.6	6.40	8.89	14.6	18.6	20.6
CDS-16	5	26.4	36.9	65.8	91.8	119	21.2	29.6	52.8	71.2	85.8	24.3	33.9	60.5	84.5	112	25.4	35.5	63.4	88.4	114
	-5	22.3	31.1	55.5	77.0	94.9	17.4	24.3	42.3	54.8	62.6	20.2	28.2	50.3	70.2	88.6	21.1	29.4	52.5	72.4	89.0
	-15	18.6	25.9	46.2	61.2	72.7	14.0	19.6	32.5	39.9	41.6	16.6	23.1	41.2	56.0	67.7	17.2	24.0	42.8	56.1	66.0
	-25	15.2	21.2	36.4	46.6	51.8	11.1	15.5	23.7	26.3	26.3	13.3	18.6	33.2	42.4	48.7	13.8	19.2	32.7	41.2	44.7
	-35	12.3	17.1	27.6	33.0	33.5	8.61	11.1	15.8	15.9	15.9	10.6	14.7	24.6	30.3	31.7	10.8	15.1	23.9	27.7	27.7
CDS-17	5	27.6	38.4	68.3	95.0	127	22.2	30.9	54.9	76.6	95.9	25.4	35.3	62.7	87.3	119	26.6	37.0	65.7	91.5	123
	-5	23.3	32.5	57.7	81.9	104	18.2	25.4	45.0	60.3	73.3	21.1	29.4	52.2	72.6	96.1	22.1	30.7	54.5	77.3	98
	-15	19.5	27.1	48.1	66.1	82.2	14.7	20.5	35.1	45.7	52.7	17.3	24.1	42.8	60.1	75.4	18.0	25.1	44.5	60.9	75.2
	-25	16.0	22.2	38.9	51.8	62.1	11.7	16.2	26.4	32.6	34.0	14.0	19.5	34.6	46.6	56.8	14.5	20.1	35.0	46.2	54.8
	-35	12.9	17.9	30.1	38.6	43.3	9.07	11.8	18.7	20.6	20.6	11.1	15.4	26.5	34.6	40.0	11.4	15.9	26.2	33.1	35.9

Capacities based upon 15°C liquid and 15°C superheated vapor. Reference page 14 for liquid temperature correction factors.

\* R-744 capacities based upon -5°C liquid and 15°C superheat.



## FLOW CAPACITY - SUCTION (kW) continued

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																								
		R-407C					R-410A					R-422D					R-507A					R-744*				
		Pressure Drop Across Valve (bar)																								
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	1.70	2.37	4.24	5.92	7.91	2.17	3.03	5.42	7.57	9.92	1.44	2.01	3.59	5.02	6.73	1.61	2.24	4.01	5.60	7.63	–	–	–	–	–
	-5	1.41	1.96	3.51	4.96	6.39	1.84	2.57	4.59	6.41	8.66	1.18	1.65	2.95	4.18	5.39	1.34	1.87	3.33	4.66	6.23	–	–	–	–	–
	-15	1.15	1.60	2.86	3.95	5.03	1.53	2.14	3.83	5.35	7.09	0.95	1.33	2.38	3.30	4.20	1.10	1.53	2.73	3.87	4.99	3.46	4.84	8.65	12.1	15.8
	-25	0.92	1.28	2.25	3.06	3.81	1.26	1.76	3.15	4.41	5.67	0.76	1.06	1.86	2.53	3.15	0.88	1.23	2.21	3.05	3.88	2.99	4.18	7.46	10.4	13.7
	-35	0.72	1.01	1.71	2.27	2.71	1.02	1.42	2.53	3.47	4.39	0.59	0.82	1.40	1.86	2.23	0.70	0.98	1.72	2.34	2.91	2.54	3.55	6.34	8.86	11.6
CDS-4	5	3.55	4.98	8.97	12.6	16.5	4.55	6.39	11.5	16.2	21.3	3.01	4.23	7.63	10.7	14.1	3.37	4.73	8.53	12.0	16.0	–	–	–	–	–
	-5	2.93	4.11	7.41	10.4	13.2	3.84	5.40	9.73	13.7	18.2	2.47	3.46	6.24	8.77	11.1	2.80	3.92	7.07	9.93	13.0	–	–	–	–	–
	-15	2.38	3.34	6.03	8.21	10.2	3.20	4.49	8.10	11.4	14.8	1.98	2.79	5.02	6.86	8.53	2.29	3.21	5.79	8.12	10.3	7.28	10.2	18.4	25.9	34.0
	-25	1.90	2.67	4.71	6.26	7.50	2.63	3.69	6.64	9.23	11.7	1.57	2.20	3.90	5.18	6.21	1.84	2.58	4.66	6.35	7.88	6.27	8.81	15.9	22.3	29.3
	-35	1.49	2.09	3.54	4.52	5.00	2.12	2.97	5.32	7.18	8.84	1.22	1.71	2.90	3.71	4.13	1.46	2.04	3.60	4.79	5.72	5.32	7.46	13.5	18.9	24.8
CDS-7	5	10.1	14.0	24.6	34.0	44.8	12.9	17.8	31.3	43.3	56.2	8.54	11.8	20.8	28.7	38.0	9.51	13.2	23.1	32.0	43.9	–	–	–	–	–
	-5	8.41	11.6	20.4	28.4	35.1	10.9	15.1	26.6	36.8	49.8	7.04	9.74	17.1	23.9	29.6	7.94	11.0	19.3	26.7	35.2	–	–	–	–	–
	-15	6.89	9.53	16.8	22.1	26.2	9.17	12.7	22.3	30.8	39.9	5.71	7.90	13.9	18.4	21.9	6.54	9.05	15.9	22.1	27.3	20.4	28.2	49.5	68.5	89.0
	-25	5.55	7.68	12.8	16.3	18.0	7.58	10.5	18.4	25.1	30.8	4.55	6.30	10.6	13.5	14.9	5.31	7.34	12.9	17.0	20.2	17.7	24.4	42.9	59.4	77.1
	-35	4.39	6.07	9.40	11.1	11.2	6.16	8.52	14.6	19.1	22.3	3.56	4.92	7.71	9.12	9.21	4.23	5.85	9.79	12.5	13.7	15.1	20.8	36.6	50.7	65.9
CDS-9	5	15.0	20.9	37.0	51.4	68.1	19.2	26.7	47.2	65.6	85.6	12.7	17.7	31.3	43.5	57.9	14.2	19.7	34.9	48.5	66.2	–	–	–	–	–
	-5	12.5	17.4	30.7	42.9	54.3	16.3	22.6	40.1	55.7	75.1	10.5	14.5	25.8	36.2	45.7	11.8	16.4	29.1	40.4	53.6	–	–	–	–	–
	-15	10.2	14.2	25.1	33.8	41.8	13.6	18.9	33.5	46.6	60.9	8.48	11.8	20.8	28.2	34.9	9.73	13.5	23.9	33.5	42.3	30.5	42.3	75.0	104	136
	-25	8.21	11.4	19.4	25.6	30.3	11.2	15.6	27.7	38.1	47.9	6.74	9.37	16.1	21.2	25.1	7.87	10.9	19.4	26.1	32.2	26.4	36.6	64.9	90.1	118
	-35	6.47	8.99	14.5	18.3	19.8	9.12	12.7	22.0	29.5	36.0	5.25	7.30	11.9	15.1	16.4	6.26	8.70	14.9	19.6	23.2	22.5	31.2	55.3	76.8	100
CDS-16	5	25.7	35.9	64.0	89.3	114	32.9	45.9	81.9	114	150	21.8	30.4	54.3	75.7	96.6	24.3	34.0	60.6	84.5	112	–	–	–	–	–
	-5	21.3	29.7	53.0	72.5	88.4	27.8	38.9	69.3	96.7	127	17.9	25.0	44.5	61.1	74.4	20.2	28.2	50.4	70.3	89.4	–	–	–	–	–
	-15	17.4	24.2	43.3	55.8	64.9	23.3	32.5	57.9	80.8	101	14.4	20.2	36.0	46.6	54.2	16.6	23.2	41.3	56.5	68.7	52.4	73.1	130	182	238
	-25	13.9	19.4	32.6	40.6	43.1	19.1	26.7	47.6	63.9	77.1	11.5	16.0	27.0	33.7	35.8	13.4	18.7	33.4	43.0	49.9	45.2	63.1	113	157	206
	-35	10.9	15.3	23.6	26.7	26.7	15.5	21.6	37.3	48.2	54.6	8.90	12.4	19.4	22.0	22.0	10.6	14.8	24.9	31.0	32.8	38.5	53.7	95.7	134	175
CDS-17	5	26.9	37.4	66.5	92.5	123	34.4	47.8	84.9	118	154	22.8	31.7	56.3	78.3	104	25.4	35.3	62.8	87.4	120	–	–	–	–	–
	-5	22.3	31.0	55.1	77.5	97.7	29.1	40.5	71.9	100	136	18.7	26.0	46.2	65.4	82.3	21.2	29.4	52.3	72.8	96.7	–	–	–	–	–
	-15	18.2	25.4	45.0	60.9	74.8	24.3	33.9	60.2	83.7	110	15.1	21.1	37.4	50.9	62.4	17.4	24.2	42.9	60.5	76.1	54.6	76.0	135	188	245
	-25	14.6	20.4	35.1	46.0	53.8	20.1	27.9	49.6	68.8	86.1	12.0	16.7	29.0	38.1	44.6	14.0	19.6	34.7	47.1	57.6	47.2	65.7	117	162	212
	-35	11.5	16.0	26.2	32.6	34.6	16.2	22.6	39.7	53.1	64.3	9.35	13.0	21.5	26.8	28.6	11.2	15.5	26.8	35.2	41.1	40.2	55.9	99.3	138	180

Capacities based upon 15°C liquid and 15°C superheated vapor. Reference page 14 for liquid temperature correction factors.

\* R-744 capacities based upon -5°C liquid and 15°C superheat.

## FLOW CAPACITY - LIQUID (TONS)

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (psid)																			
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	3.37	4.71	8.41	11.7	15.4	3.24	4.53	8.09	11.3	14.8	2.46	3.44	6.15	8.59	11.3	3.10	4.33	7.73	10.8	14.1
	0	3.21	4.49	8.02	11.2	14.7	3.00	4.19	7.49	10.5	13.7	2.27	3.17	5.66	7.91	10.4	2.90	4.05	7.24	10.1	13.2
	-40	3.04	4.24	7.58	10.6	13.9	2.75	3.84	6.87	9.59	12.6	2.05	2.86	5.12	7.15	9.36	2.68	3.74	6.69	9.34	12.2
CDS-4	40	7.24	10.2	18.3	25.7	33.8	6.97	9.78	17.6	24.8	32.6	5.30	7.4	13.4	18.8	24.7	6.66	9.35	16.9	23.7	31.1
	0	6.91	9.70	17.5	24.6	32.3	6.46	9.06	16.3	22.9	30.2	4.87	6.84	12.3	17.3	22.8	6.24	8.76	15.8	22.2	29.1
	-40	6.53	9.17	16.5	23.2	30.5	5.92	8.31	15.0	21.0	27.6	4.40	6.18	11.1	15.6	20.6	5.76	8.09	14.6	20.5	26.9
CDS-7	40	19.0	26.2	46.1	63.7	82.8	18.2	25.2	44.3	61.3	79.7	13.9	19.2	33.8	46.7	60.7	17.4	24.1	42.4	58.7	76.2
	0	18.1	25.0	44.0	60.8	79.0	16.9	23.4	41.0	56.8	73.8	12.8	17.7	31.1	43.0	55.9	16.3	22.6	39.7	54.9	71.4
	-40	17.1	23.6	41.5	57.5	74.7	15.5	21.4	37.6	52.0	67.6	11.6	16.0	28.1	38.8	50.5	15.1	20.9	36.7	50.7	65.9
CDS-9	40	28.9	40.2	71.2	98.9	129	27.8	38.7	68.4	95.1	124	21.2	29.4	52.1	72.4	94.4	26.6	37.0	65.5	91.0	119
	0	27.6	38.3	67.9	94.3	123	25.8	35.8	63.4	88.1	115	19.5	27.1	47.9	66.6	86.9	24.9	34.6	61.3	85.2	111
	-40	26.1	36.2	64.1	89.1	116	23.6	32.8	58.1	80.7	105	17.6	24.5	43.3	60.2	78.5	23.0	32.0	56.6	78.7	103
CDS-16	40	50.7	70.8	126	176	231	48.8	68.1	122	170	222	37.1	51.8	92.4	129	169	46.7	65.1	116	162	212
	0	48.4	67.5	121	168	220	45.2	63.1	113	157	206	34.2	47.7	85.1	119	155	43.7	61.0	109	152	199
	-40	45.7	63.8	114	159	208	41.4	57.8	103	144	188	30.9	43.1	76.9	107	140	40.4	56.3	101	140	184
CDS-17	40	52.2	72.7	129	180	235	50.2	69.9	124	173	226	38.2	53.2	94.5	132	172	48.0	66.9	119	165	216
	0	49.8	69.3	123	171	224	46.5	64.8	115	160	209	35.2	49.0	87.0	121	158	45.0	62.6	111	155	202
	-40	47.1	65.5	116	162	211	42.6	59.4	105	147	192	31.8	44.3	78.6	109	143	41.6	57.8	103	143	187

Capacity based upon 60°F liquid. Reference page 14 for liquid temperature correction factors.

\* R-744 capacity based upon 20°F liquid.

## FLOW CAPACITY - LIQUID (kW)

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (bar)																			
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	11.9	16.6	29.7	41.5	54.4	11.5	16.0	28.6	40.0	52.4	8.74	12.2	21.8	30.5	39.9	11.0	15.3	27.4	38.2	50.1
	-15	11.4	16.0	28.5	39.8	52.2	10.7	15.0	26.8	37.4	48.9	8.12	11.3	20.3	28.3	37.1	10.4	14.5	25.8	36.1	47.3
	-35	10.9	15.2	27.1	37.9	49.6	9.93	13.9	24.8	34.6	45.3	7.44	10.4	18.6	25.9	34.0	9.66	13.5	24.1	33.7	44.1
CDS-4	5	25.6	36.0	64.8	91.0	120	24.7	34.6	62.4	87.7	115	18.8	26.4	47.5	66.7	87.7	23.6	33.1	59.7	83.8	110
	-15	24.6	34.5	62.2	87.3	115	23.1	32.4	58.3	81.9	108	17.4	24.5	44.1	62.0	81.5	22.3	31.2	56.3	79.1	104
	-35	23.4	32.8	59.2	83.1	109	21.4	30.0	54.0	75.9	99.8	16.0	22.4	40.4	56.8	74.6	20.8	29.2	52.6	73.8	97.0
CDS-7	5	67.0	92.7	163	225	293	64.5	89.3	157	217	282	49.2	68.1	120	166	215	61.7	85.4	150	208	270
	-15	64.3	88.9	156	216	281	60.3	83.4	147	203	264	45.8	63.3	111	154	200	58.3	80.6	142	196	255
	-35	61.2	84.6	149	206	267	55.9	77.3	136	188	244	41.9	58.0	102	141	183	54.4	75.2	132	183	238
CDS-9	5	102	142	252	350	456	98.5	137	242	337	439	75.1	104	185	257	335	94.2	131	232	322	420
	-15	98.1	136	241	335	437	92.1	128	226	315	410	69.8	97.0	172	239	311	88.9	124	219	304	396
	-35	93.4	130	230	319	416	85.3	118	210	291	380	63.9	88.8	157	218	285	83.0	115	204	284	370
CDS-16	5	179	250	447	623	816	173	241	430	600	786	132	184	328	457	598	165	231	411	574	751
	-15	172	240	428	598	782	161	225	402	561	734	122	171	305	425	556	156	218	388	542	709
	-35	164	229	408	569	745	150	209	372	520	680	112	156	279	389	509	146	203	362	506	662
CDS-17	5	185	257	456	635	829	178	248	440	612	799	136	189	335	466	609	170	237	420	585	764
	-15	177	247	438	609	796	166	231	411	572	746	126	175	311	433	566	161	223	397	552	721
	-35	169	235	417	580	757	154	214	380	530	691	115	161	285	397	518	150	209	370	515	673

Capacity based upon 15°C liquid. Reference page 14 for liquid temperature correction factors.

\* R-744 capacity based upon -5°C liquid.

## FLOW CAPACITY - LIQUID (TONS) continued

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																								
		R-407C					R-410A					R-422D					R-507A					R-744*				
		Pressure Drop Across Valve (psid)																								
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	3.31	4.63	8.27	11.6	15.1	3.39	4.73	8.45	11.8	15.5	2.49	3.47	6.21	8.67	11.4	2.41	3.36	6.01	8.39	11.0	—	—	—	—	—
	0	3.11	4.35	7.77	10.9	14.2	3.25	4.54	8.12	11.3	14.9	2.27	3.16	5.66	7.90	10.3	2.21	3.09	5.52	7.71	10.1	4.03	5.63	10.1	14.1	18.4
	-40	2.89	4.04	7.22	10.1	13.2	3.08	4.30	7.69	10.7	14.1	2.03	2.83	5.06	7.07	9.26	2.00	2.79	4.98	6.96	9.11	4.01	5.60	10.0	14.0	18.3
CDS-4	40	7.12	10.0	18.0	25.3	33.3	7.28	10.2	18.4	25.9	34.0	5.35	7.5	13.5	19.0	25.0	5.17	7.26	13.1	18.4	24.2	—	—	—	—	—
	0	6.70	9.40	16.9	23.8	31.3	6.99	9.81	17.7	24.8	32.7	4.87	6.84	12.3	17.3	22.8	4.75	6.67	12.0	16.9	22.2	8.65	12.1	21.9	30.7	40.4
	-40	6.22	8.73	15.7	22.1	29.0	6.62	9.29	16.7	23.5	30.9	4.36	6.12	11.0	15.5	20.4	4.29	6.02	10.9	15.2	20.0	8.60	12.1	21.8	30.6	40.2
CDS-7	40	18.7	25.8	45.4	62.7	81.5	19.1	26.4	46.4	64.2	83.4	14.0	19.4	34.0	47.1	61.2	13.6	18.8	33.0	45.6	59.3	—	—	—	—	—
	0	17.5	24.3	42.6	59.0	76.6	18.3	25.4	44.6	61.6	80.1	12.8	17.6	31.0	42.9	55.7	12.5	17.2	30.3	41.9	54.5	22.8	31.5	55.3	76.5	99.4
	-40	16.3	22.5	39.6	54.8	71.2	17.4	24.0	42.2	58.3	75.8	11.4	15.8	27.8	38.4	49.9	11.2	15.6	27.3	37.8	49.1	22.6	31.3	55.0	76.1	98.9
CDS-9	40	28.5	39.6	70.0	97.3	127	29.1	40.4	71.6	99.5	130	21.4	29.7	52.6	73.0	95.2	20.7	28.8	50.9	70.7	92.2	—	—	—	—	—
	0	26.8	37.2	65.8	91.4	119	28.0	38.8	68.8	95.5	125	19.5	27.0	47.9	66.5	86.7	19.0	26.4	46.8	65.0	84.7	34.7	48.2	85.3	119	155
	-40	24.9	34.5	61.1	84.9	111	26.5	36.8	65.1	90.4	118	17.4	24.2	42.9	59.5	77.6	17.2	23.8	42.2	58.6	76.4	34.5	47.9	84.8	118	154
CDS-16	40	49.9	69.7	124	173	227	51.0	71.2	127	177	232	37.5	52.3	93.3	130	170	36.3	50.6	90.3	126	165	—	—	—	—	—
	0	46.9	65.5	117	163	213	49.0	68.4	122	170	223	34.1	47.6	85.0	119	155	33.3	46.5	83.0	116	152	60.7	84.7	151	211	276
	-40	43.6	60.8	108	151	198	46.4	64.7	115	161	211	30.6	42.6	76.1	106	139	30.1	42.0	74.8	104	137	60.4	84.2	150	210	275
CDS-17	40	51.4	71.5	127	177	231	52.5	73.1	130	181	236	38.6	53.7	95.3	133	173	37.3	52.0	92.3	128	168	—	—	—	—	—
	0	48.3	67.2	119	166	217	50.5	70.2	125	174	227	35.1	48.9	86.8	121	158	34.3	47.8	84.8	118	154	62.6	87.1	155	215	281
	-40	44.9	62.4	111	154	201	47.8	66.5	118	164	215	31.5	43.8	77.7	108	141	31.0	43.1	76.5	106	139	62.2	86.6	154	214	279

Capacity based upon 60°F liquid. Reference page 14 for liquid temperature correction factors.

\* R-744 capacity based upon 20°F liquid.

## FLOW CAPACITY - LIQUID (kW) continued

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																								
		R-407C					R-410A					R-422D					R-507A					R-744*				
		Pressure Drop Across Valve (bar)																								
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	11.7	16.4	29.3	40.9	53.5	12.0	16.7	29.9	41.8	54.7	8.82	12.3	22.0	30.8	40.3	8.53	11.9	21.3	29.8	39.0	—	—	—	—	—
	-15	11.1	15.5	27.7	38.7	50.7	11.6	16.2	28.9	40.3	52.8	8.12	11.3	20.3	28.3	37.1	7.92	11.1	19.8	27.6	36.2	13.9	19.4	34.6	48.4	63.3
	-35	10.4	14.5	26.0	36.3	47.5	11.0	15.4	27.5	38.5	50.4	7.38	10.3	18.4	25.7	33.7	7.25	10.1	18.1	25.3	33.1	13.9	19.4	34.6	48.3	63.3
CDS-4	5	25.2	35.4	63.8	89.6	118	25.7	36.1	65.1	91.4	120	19.0	26.6	48.0	67.4	89.0	18.3	25.7	46.4	65.2	86	—	—	—	—	—
	-15	23.9	33.5	60.4	84.8	112	24.9	34.9	62.9	88.3	116	17.5	24.5	44.2	62.0	82.0	17.0	23.9	43.1	60.5	80	29.8	41.8	75.4	106	139
	-35	22.4	31.4	56.6	79.5	105	23.7	33.3	60.0	84.2	111	15.9	22.3	40.1	56.3	74.0	15.6	21.9	39.4	55.3	72.7	29.8	41.8	75.3	106	139
CDS-7	5	66.0	91.4	161	222	289	67.5	93.4	164	227	295	49.7	68.7	121	167	217	48.1	66.5	117	162	210	—	—	—	—	—
	-15	62.5	86.5	152	210	273	65.2	90.2	158	219	285	45.7	63.2	111	154	200	44.7	61.8	109	150	195	78.3	108	190	263	342
	-35	58.6	81.1	142	197	256	62.2	86.0	151	209	272	41.5	57.4	101	140	181	40.8	56.5	99.3	137	178	78.3	108	190	263	342
CDS-9	5	101	140	248	344	449	103	143	253	352	459	75.8	105	186	259	338	73.4	102	180	251	327	—	—	—	—	—
	-15	95.4	133	235	326	425	99.4	138	244	340	443	69.8	96.9	172	238	311	68.1	94.6	168	233	303	119	166	294	408	532
	-35	89.4	124	220	306	399	94.8	132	233	324	423	63.4	88.0	156	217	282	62.3	86.5	153	213	278	119	166	293	408	532
CDS-16	5	177	247	440	614	803	180	252	449	627	820	133	185	331	462	604	129	179	320	447	585	—	—	—	—	—
	-15	167	233	416	581	761	174	243	434	605	792	122	171	305	425	556	119	167	297	415	543	209	292	520	726	951
	-35	157	219	390	545	713	166	232	414	578	756	111	155	277	386	505	109	152	272	379	496	209	291	520	726	950
CDS-17	5	182	253	450	626	817	186	259	459	639	834	137	190	338	470	614	132	184	327	455	595	—	—	—	—	—
	-15	172	240	426	592	773	179	250	443	617	806	126	175	311	433	566	123	171	304	423	552	215	300	532	741	968
	-35	161	225	399	555	725	171	238	423	589	769	114	159	283	393	514	112	156	278	387	505	215	300	532	740	967

Capacity based upon 15°C liquid. Reference page 14 for liquid temperature correction factors.

\* R-744 capacity based upon -5°C liquid.

## FLOW CAPACITY - DISCHARGE (TONS)

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (psid)																			
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	0.74	1.04	1.77	2.27	3.20	0.64	0.89	1.53	1.97	2.79	0.69	0.97	1.65	2.12	2.99	0.74	1.04	1.77	2.28	3.21
	0	0.69	0.96	1.64	2.11	2.98	0.59	0.82	1.40	1.80	2.56	0.63	0.89	1.51	1.94	2.74	0.69	0.96	1.63	2.10	2.96
	-40	0.63	0.88	1.50	1.93	2.72	0.53	0.74	1.26	1.63	2.31	0.57	0.79	1.35	1.73	2.44	0.62	0.87	1.48	1.90	2.68
CDS-4	40	1.56	2.19	3.76	4.85	6.88	1.34	1.88	3.25	4.19	5.99	1.46	2.05	3.53	4.55	6.45	1.56	2.20	3.78	4.87	6.91
	0	1.45	2.04	3.5	4.51	6.40	1.23	1.73	2.98	3.85	5.49	1.34	1.88	3.23	4.16	5.90	1.44	2.03	3.48	4.49	6.37
	-40	1.32	1.86	3.20	4.12	5.85	1.11	1.56	2.69	3.47	4.96	1.19	1.68	2.88	3.71	5.26	1.30	1.83	3.15	4.06	5.75
CDS-7	40	4.36	6.03	10.1	12.9	18.0	3.76	5.21	8.78	11.2	15.8	4.06	5.62	9.43	12.0	16.8	4.36	6.04	10.1	12.9	18.1
	0	4.05	5.61	9.43	12.0	16.8	3.46	4.79	8.06	10.3	14.5	3.71	5.13	8.62	11.0	15.3	4.02	5.57	9.36	11.9	16.7
	-40	3.71	5.14	8.63	11.0	15.4	3.12	4.32	7.28	9.30	13.1	3.31	4.59	7.70	9.82	13.7	3.64	5.04	8.46	10.8	15.1
CDS-9	40	6.52	9.07	15.3	19.6	27.5	5.62	7.83	13.3	17.0	24.0	6.08	8.46	14.3	18.3	25.7	6.54	9.09	15.4	19.7	27.6
	0	6.07	8.44	14.3	18.3	25.6	5.16	7.19	12.2	15.6	22.0	5.56	7.74	13.1	16.7	23.5	6.03	8.38	14.2	18.1	25.4
	-40	5.55	7.72	13.1	16.7	23.4	4.66	6.49	11.0	14.1	19.9	4.97	6.91	11.7	14.9	20.9	5.45	7.58	12.8	16.4	23.0
CDS-16	40	11.2	15.7	26.7	34.2	48.2	9.65	13.5	23.0	29.6	42.0	10.5	14.6	24.9	32.0	45.1	11.2	15.7	26.7	34.3	48.4
	0	10.4	14.6	24.8	31.8	44.9	8.86	12.4	21.1	27.2	38.6	9.58	13.4	22.8	29.2	41.2	10.4	14.5	24.7	31.6	44.6
	-40	9.53	13.3	22.7	29.1	41.0	8.0	11.2	19.1	24.6	34.8	8.56	12.0	20.4	26.1	36.8	9.37	13.1	22.3	28.6	40.3
CDS-17	40	11.7	16.3	27.6	35.3	49.7	10.1	14.0	23.9	30.6	43.3	10.9	15.2	25.8	33.0	46.3	11.7	16.3	27.7	35.4	49.8
	0	10.9	15.1	25.7	32.9	46.2	9.24	12.9	21.9	28.1	39.8	9.97	13.9	23.5	30.2	42.4	10.8	15.0	25.5	32.7	45.9
	-40	9.94	13.8	23.5	30.1	42.3	8.34	11.6	19.8	25.4	35.9	8.91	12.4	21.0	26.9	37.8	9.76	13.6	23.1	29.5	41.5

Capacities based upon 100°F condensing temperature, 60°F liquid entering expansion valve, isentropic compression plus 50°F, evaporator temperature as shown plus 25°F superheat suction gas. Reference page 14 for liquid temperature correction factors.

## FLOW CAPACITY - DISCHARGE (kW)

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																			
		R-22					R-134a					R-404A					R-407A				
		Pressure Drop Across Valve (bar)																			
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	2.36	3.30	5.93	8.33	11.0	2.02	2.83	5.10	7.19	9.56	2.21	3.08	5.53	7.78	10.3	2.36	3.30	5.93	8.33	11.0
	-15	2.22	3.10	5.56	7.82	10.3	1.88	2.63	4.73	6.67	8.87	2.04	2.85	5.12	7.19	9.49	2.20	3.08	5.52	7.76	10.3
	-35	2.05	2.87	5.15	7.24	9.57	1.72	2.40	4.33	6.10	8.11	1.85	2.59	4.64	6.52	8.61	2.02	2.82	5.06	7.11	9.40
CDS-4	5	4.96	6.96	12.6	17.8	23.6	4.24	5.96	10.8	15.4	20.5	4.64	6.52	11.8	16.7	22.1	4.96	6.97	12.6	17.8	23.7
	-15	4.65	6.53	11.8	16.7	22.2	3.93	5.53	10.0	14.2	19.0	4.29	6.03	10.9	15.4	20.4	4.62	6.49	11.8	16.6	22.0
	-35	4.30	6.05	10.9	15.5	20.5	3.60	5.06	9.19	13.0	17.4	3.89	5.47	9.9	14.0	18.6	4.23	5.95	10.8	15.2	20.2
CDS-7	5	13.9	19.3	34.0	47.4	62.1	12.0	16.6	29.4	41.0	54.1	12.9	17.9	31.6	44.0	57.6	13.9	19.2	34.0	47.3	62.0
	-15	13.1	18.1	31.9	44.5	58.3	11.1	15.4	27.2	38.0	50.2	12.0	16.6	29.2	40.7	53.3	12.9	17.9	31.6	44.0	57.7
	-35	12.1	16.8	29.6	41.2	54.0	10.2	14.1	24.9	34.8	45.9	10.9	15.0	26.5	36.9	48.3	11.9	16.4	29.0	40.4	53.0
CDS-9	5	20.8	28.9	51.5	71.9	94.7	17.9	24.9	44.3	62.2	82.3	19.4	27.0	47.9	67.0	88.1	20.8	28.9	51.4	71.9	94.6
	-15	19.5	27.2	48.3	67.5	88.9	16.6	23.1	41.1	57.7	76.4	17.9	24.9	44.3	61.9	81.4	19.4	26.9	47.9	67.0	88.1
	-35	18.1	25.2	44.8	62.6	82.3	15.2	21.1	37.6	52.8	69.9	16.3	22.6	40.2	56.2	73.9	17.8	24.7	43.9	61.4	80.8
CDS-16	5	35.7	49.9	89.4	126	166	30.6	42.8	76.9	108	144	33.4	46.6	83.5	117	155	35.7	49.9	89.4	126	166
	-15	33.5	46.8	83.9	118	156	28.4	39.7	71.3	101	134	30.8	43.1	77.1	108	143	33.3	46.5	83.3	117	154
	-35	31.0	43.4	77.7	109	144	26.0	36.3	65.3	92.0	122	28.0	39.1	70.0	98	130	30.5	42.6	76.3	107	142
CDS-17	5	37.2	51.9	92.6	130	171	32.0	44.6	79.7	112	148	34.7	48.4	86.3	121	159	37.2	51.9	92.5	130	171
	-15	35.0	48.7	86.9	122	160	29.7	41.3	73.9	104	138	32.1	44.7	79.8	112	147	34.7	48.3	86.2	121	159
	-35	32.4	45.1	80.5	113	149	27.1	37.8	67.7	95.1	126	29.1	40.6	72.4	101	133	31.8	44.3	79.0	111	146

Capacities based upon 35°C condensing temperature, 15°C liquid entering expansion valve, isentropic compression plus 30°C, evaporator temperature as shown plus 15°C superheat suction gas. Reference page 14 for liquid temperature correction factors.

### FLOW CAPACITY - DISCHARGE (TONS) continued

Valve Model	Evaporator Temp. (°F)	REFRIGERANT																			
		R-407C					R-410A					R-422D					R-507A				
		Pressure Drop Across Valve (psid)																			
		0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10	0.5	1	3	5	10
CDS-2	40	0.75	1.05	1.80	2.31	3.26	0.91	1.28	2.18	2.79	3.93	0.64	0.90	1.53	1.97	2.78	0.69	0.97	1.65	2.12	2.98
	0	0.70	0.97	1.66	2.13	3.01	0.86	1.20	2.04	2.61	3.68	0.58	0.81	1.39	1.78	2.52	0.63	0.88	1.51	1.93	2.73
	-40	0.63	0.88	1.50	1.93	2.73	0.79	1.10	1.87	2.40	3.37	0.52	0.72	1.23	1.58	2.23	0.56	0.79	1.34	1.73	2.43
CDS-4	40	1.58	2.23	3.83	4.93	7.00	1.93	2.71	4.65	5.99	8.46	1.35	1.90	3.27	4.21	5.98	1.46	2.05	3.52	4.54	6.43
	0	1.46	2.05	3.53	4.56	6.46	1.80	2.53	4.35	5.60	7.91	1.23	1.72	2.96	3.82	5.43	1.33	1.87	3.22	4.15	5.88
	-40	1.32	1.86	3.20	4.13	5.86	1.65	2.32	3.99	5.13	7.25	1.09	1.53	2.62	3.39	4.81	1.19	1.67	2.87	3.70	5.24
CDS-7	40	4.43	6.13	10.3	13.1	18.3	5.35	7.41	12.4	15.8	22.0	3.75	5.20	8.74	11.1	15.6	4.04	5.60	9.40	12.0	16.7
	0	4.09	5.66	9.51	12.1	17.0	5.02	6.94	11.6	14.8	20.6	3.41	4.72	7.92	10.1	14.1	3.69	5.11	8.59	10.9	15.3
	-40	3.71	5.14	8.63	11.0	15.4	4.60	6.37	10.7	13.6	18.9	3.02	4.18	7.02	8.96	12.5	3.30	4.56	7.66	9.77	13.6
CDS-9	40	6.63	9.21	15.6	19.9	28.0	8.03	11.2	18.9	24.1	33.7	5.63	7.83	13.2	17.0	23.8	6.07	8.44	14.3	18.2	25.6
	0	6.12	8.51	14.4	18.4	25.9	7.52	10.5	17.7	22.6	31.5	5.11	7.10	12.0	15.4	21.6	5.54	7.71	13.0	16.7	23.4
	-40	5.55	7.72	13.1	16.7	23.4	6.90	9.59	16.2	20.7	28.9	4.53	6.30	10.6	13.6	19.1	4.95	6.88	11.6	14.9	20.8
CDS-16	40	11.4	15.9	27.1	34.8	49.1	13.8	19.3	32.8	42.1	59.1	9.69	13.5	23.1	29.6	41.8	10.5	14.6	24.9	31.9	44.9
	0	10.5	14.7	25.0	32.1	45.3	12.9	18.1	30.7	39.4	55.4	8.79	12.3	20.9	26.9	37.9	9.55	13.3	22.7	29.2	41.1
	-40	9.53	13.3	22.7	29.1	41.1	11.9	16.6	28.2	36.1	50.8	7.79	10.9	18.5	23.8	33.6	8.52	11.9	20.3	26.0	36.6
CDS-17	40	11.9	16.5	28.0	35.9	50.5	14.4	20.0	33.9	43.4	60.8	10.1	14.1	23.9	30.6	43.0	10.9	15.2	25.7	32.9	46.2
	0	11.0	15.3	25.9	33.2	46.7	13.5	18.8	31.8	40.7	57.0	9.15	12.8	21.6	27.7	39.0	9.94	13.8	23.5	30.1	42.2
	-40	9.94	13.8	23.5	30.1	42.3	12.4	17.2	29.2	37.3	52.2	8.11	11.3	19.2	24.6	34.6	8.87	12.4	20.9	26.8	37.7

Capacities based upon 100°F condensing temperature, 60°F liquid entering expansion valve, isentropic compression plus 50°F, evaporator temperature as shown plus 25°F superheat suction gas. Reference page 14 for liquid temperature correction factors.

### FLOW CAPACITY - DISCHARGE (kW) continued

Valve Model	Evaporator Temp. (°C)	REFRIGERANT																			
		R-407C					R-410A					R-422D					R-507A				
		Pressure Drop Across Valve (bar)																			
		0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7	0.03	0.06	0.2	0.4	0.7
CDS-2	5	2.39	3.34	6.00	8.44	11.2	2.91	4.07	7.30	10.2	13.5	2.04	2.85	5.12	7.20	9.52	2.20	3.08	5.52	7.76	10.2
	-15	2.23	3.12	5.60	7.87	10.4	2.75	3.84	6.89	9.66	12.7	1.87	2.61	4.70	6.61	8.74	2.03	2.84	5.10	7.17	9.46
	-35	2.05	2.87	5.15	7.23	9.57	2.55	3.57	6.40	8.97	11.8	1.69	2.36	4.23	5.95	7.88	1.84	2.58	4.63	6.50	8.58
CDS-4	5	5.02	7.06	12.8	18.1	24.0	6.13	8.61	15.6	21.9	29.0	4.28	6.02	10.9	15.4	20.5	4.63	6.51	11.8	16.6	22.1
	-15	4.68	6.58	11.9	16.8	22.4	5.78	8.13	14.7	20.7	27.4	3.93	5.53	10.0	14.2	18.8	4.28	6.02	10.9	15.4	20.4
	-35	4.30	6.04	10.9	15.5	20.5	5.37	7.54	13.6	19.2	25.4	3.54	4.98	9.02	12.8	17.0	3.88	5.45	9.87	13.9	18.5
CDS-7	5	14.1	19.5	34.5	48.0	62.9	17.1	23.7	41.7	57.9	75.7	12.0	16.6	29.3	40.8	53.5	12.9	17.9	31.5	43.8	57.4
	-15	13.2	18.2	32.2	44.8	58.7	16.2	22.4	39.4	54.7	71.5	11.0	15.2	26.9	37.4	49.1	11.9	16.5	29.1	40.5	53.1
	-35	12.1	16.7	29.6	41.2	54.0	15.0	20.8	36.6	50.9	66.5	9.90	13.7	24.2	33.7	44.3	10.8	15.0	26.4	36.7	48.1
CDS-9	5	21.1	29.3	52.1	72.9	96.0	25.6	35.6	63.2	88.2	116	17.9	24.9	44.3	62.0	81.7	19.3	26.9	47.8	66.8	87.8
	-15	19.7	27.4	48.6	68.0	89.6	24.2	33.6	59.7	83.3	109	16.4	22.9	40.7	56.9	75.0	17.9	24.8	44.2	61.7	81.1
	-35	18.1	25.1	44.7	62.5	82.3	22.5	31.2	55.5	77.4	102	14.8	20.6	36.7	51.3	67.6	16.2	22.5	40.0	55.9	73.6
CDS-16	5	36.2	50.5	90.6	127	168	44.0	61.5	110	154	203	30.8	43.0	77.2	108	143	33.3	46.5	83.3	117	154
	-15	33.7	47.1	84.5	119	157	41.6	58.1	104	146	192	28.3	39.5	70.8	100	132	30.7	42.9	76.9	108	142
	-35	31.0	43.3	77.6	109	144	38.6	53.9	96.5	135	178	25.5	35.6	63.8	89.7	119	27.9	38.9	69.8	97.9	129
CDS-17	5	37.7	52.6	93.8	131	173	45.9	63.9	114	159	209	32.1	44.7	79.8	112	148	34.6	48.3	86.1	120	159
	-15	35.2	49.0	87.5	123	162	43.3	60.3	107	150	197	29.5	41.0	73.2	103	135	32.0	44.6	79.5	111	147
	-35	32.3	45.1	80.4	113	148	40.3	56.1	99.8	140	183	26.5	37.0	66.0	92.5	122	29.0	40.4	72.1	101	133

Capacities based upon 35°C condensing temperature, 15°C liquid entering expansion valve, isentropic compression plus 30°C, evaporator temperature as shown plus 15°C superheat suction gas. Reference page 14 for liquid temperature correction factors.

## CORRECTION FACTORS - SUCTION & DISCHARGE

REFRIGERANT	Liquid Temperature Entering Expansion Valve °F										
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
	Correction Factor, CF Liquid Temperature										
R-22	1.22	1.18	1.15	1.11	1.07	1.04	1.0	0.96	0.92	0.88	0.84
R-134a	1.27	1.22	1.18	1.14	1.09	1.05	1.0	0.95	0.91	0.86	0.81
R-404A	1.34	1.29	1.23	1.17	1.12	1.06	1.0	0.94	0.88	0.81	0.74
R-407A	1.28	1.23	1.19	1.14	1.10	1.05	1.0	0.95	0.90	0.85	0.79
R-407C	1.26	1.22	1.18	1.13	1.09	1.05	1.0	0.95	0.91	0.86	0.81
R-410A	1.26	1.22	1.18	1.13	1.09	1.05	1.0	0.95	0.90	0.85	0.80
R-422D	1.34	1.29	1.23	1.17	1.12	1.06	1.0	0.94	0.88	0.81	0.75
R-507A	1.35	1.29	1.24	1.18	1.12	1.06	1.0	0.94	0.87	0.81	0.74
R-744	1.09	1.05	1.0	0.95	0.90	–	–	–	–	–	–

REFRIGERANT	Liquid Temperature Entering Expansion Valve °C										
	-15°	-10°	-5°	0°	5°	10°	15°	20°	25°	30°	35°
	Correction Factor, CF Liquid Temperature										
R-22	1.19	1.16	1.13	1.10	1.07	1.03	1.0	0.97	0.93	0.90	0.86
R-134a	1.24	1.20	1.16	1.12	1.08	1.04	1.0	0.96	0.92	0.87	0.83
R-404A	1.30	1.25	1.20	1.15	1.10	1.05	1.0	0.95	0.89	0.83	0.77
R-407A	1.25	1.21	1.17	1.13	1.09	1.04	1.0	0.96	0.91	0.87	0.82
R-407C	1.23	1.20	1.16	1.12	1.08	1.04	1.0	0.96	0.92	0.87	0.83
R-410A	1.23	1.20	1.16	1.12	1.08	1.04	1.0	0.96	0.92	0.87	0.83
R-422D	1.30	1.25	1.20	1.15	1.10	1.05	1.0	0.95	0.89	0.84	0.78
R-507A	1.31	1.26	1.21	1.16	1.11	1.05	1.0	0.94	0.89	0.83	0.77
R-744	1.08	1.04	1.0	0.96	0.91	–	–	–	–	–	–

## CORRECTION FACTORS - LIQUID

REFRIGERANT	Liquid Temperature Entering Expansion Valve °F										
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
	Correction Factor, CF Liquid Temperature										
R-22	1.27	1.22	1.18	1.14	1.09	1.05	1.0	0.95	0.91	0.86	0.81
R-134a	1.32	1.27	1.21	1.16	1.11	1.05	1.0	0.95	0.89	0.84	0.78
R-404A	1.41	1.35	1.28	1.21	1.14	1.07	1.0	0.93	0.86	0.78	0.70
R-407A	1.34	1.29	1.23	1.17	1.12	1.06	1.0	0.94	0.88	0.82	0.76
R-407C	1.32	1.27	1.22	1.16	1.11	1.05	1.0	0.94	0.89	0.83	0.77
R-410A	1.33	1.28	1.22	1.17	1.11	1.06	1.0	0.94	0.88	0.82	0.76
R-422D	1.41	1.34	1.27	1.21	1.14	1.07	1.0	0.93	0.86	0.79	0.71
R-507A	1.42	1.35	1.28	1.21	1.14	1.07	1.0	0.93	0.85	0.78	0.70
R-744	1.12	1.06	1.0	0.94	0.88	–	–	–	–	–	–

REFRIGERANT	Liquid Temperature Entering Expansion Valve °C										
	-15°	-10°	-5°	0°	5°	10°	15°	20°	25°	30°	35°
	Correction Factor, CF Liquid Temperature										
R-22	1.24	1.20	1.16	1.12	1.08	1.04	1.0	0.96	0.92	0.88	0.83
R-134a	1.28	1.24	1.19	1.14	1.10	1.05	1.0	0.95	0.90	0.86	0.81
R-404A	1.37	1.31	1.25	1.19	1.12	1.06	1.0	0.94	0.87	0.81	0.74
R-407A	1.30	1.25	1.20	1.15	1.10	1.05	1.0	0.95	0.90	0.84	0.79
R-407C	1.29	1.24	1.19	1.15	1.10	1.05	1.0	0.95	0.90	0.85	0.80
R-410A	1.29	1.25	1.20	1.15	1.10	1.05	1.0	0.95	0.90	0.84	0.79
R-422D	1.36	1.30	1.24	1.18	1.12	1.06	1.0	0.94	0.88	0.81	0.75
R-507A	1.37	1.31	1.25	1.19	1.13	1.06	1.0	0.94	0.87	0.80	0.73
R-744	1.11	1.05	1.0	0.94	0.88	–	–	–	–	–	–

These correction factors correct for net refrigerating effect and are based on an evaporator temperature of 0°F (-15°C), however they may be used for any evaporator temperature because the variation in the factors across the range is insignificant.



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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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