CAREL

I Guida alla selezione delle valvole elettroniche di espansione ExV

GB ExV Electronic expansion valves selection guide

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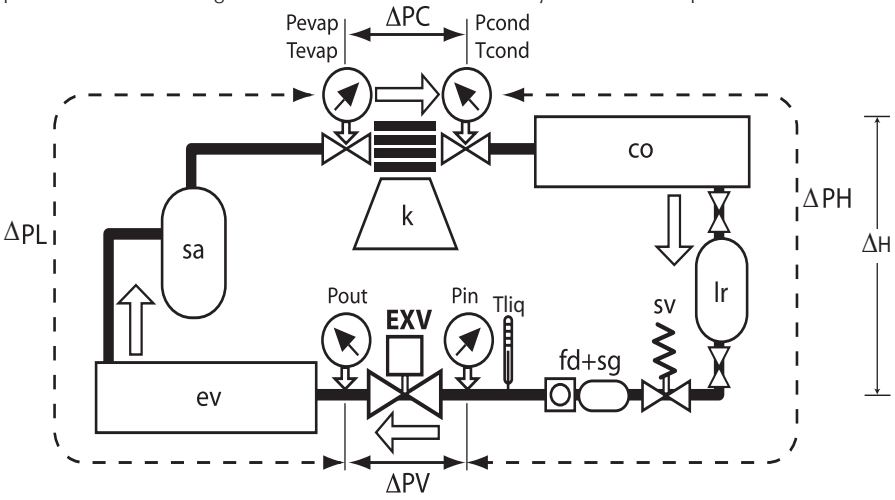
LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS

Contents

1. INTRODUCTION

The expansion capacity of a valve is determined by the pressure difference ΔPV immediately upstream and downstream of the valve.
The size of the valve must therefore be chosen based on the maximum flow-rate and the operating status in which the pressure head ΔPV at the ports is at the lowest value, and consequently with the **minimum** pressure **Pin** of the refrigerant at the inlet and simultaneously the **maximum** pressure **Pout** at the outlet.



EXV	Expansion valve
ev	Evaporator
sa	Liquid accumulator
k	Compressor
co	Condenser
lr	Liquid receiver
sv	Solenoid valve
fd+sg	Dewatering filter + flow indicator
Pcond	Compressor discharge pressure
Tcond	Saturated discharge temperature
Pevap	Compressor suction pressure
Tevap	Saturated suction temperature
Pin	Valve inlet pressure
Pout	Valve outlet pressure
Tliq	Effective liquid inlet temperature
ΔPC	Pressure head (Pcond – Pevap)
ΔPV	Pressure difference across the valve
ΔPL	Pressure drop in the low pressure branch
ΔPH	Pressure drop in the high pressure branch
ΔH	Condenser/valve height difference

It should be noted that the pressure difference **ΔPV (= Pin – Pout)** across the valve is often significantly different from the pressure head **ΔPC (= Pcond – Pevap)** generated by the compressor; this is due to:
the pressure drop **ΔPH** in the valves, the lines, the condenser and the dewatering filter between the compressor and the valve;
the pressure drop **ΔPL** in the equaliser, the evaporator, the lines, the valves, the liquid separator (if fitted);
the pressure column due to the water column of the pipes between the condenser and the valve, which is equal to the product of the difference in height **ΔH** by the density of the liquid, and is approximately equal to 0.1 bar per metre.

In addition, the liquid inlet temperature has a significant influence on the cooling capacity of the valve.
In fact, for the same mass flow-rate of expanded refrigerant and operating pressure, the cooling capacity

delivered increases considerably as the temperature of the liquid **Tliq** decreases (this must in any case be lower than the Saturated condensing temperature **Tcond**, due to subcooling, so as to prevent the valve from taking in vapour and causing a decline in performance).

2. DESIGN DATA

To size the valve using the Selection sheet, the following design data must be available:

a. **Type of refrigerant** used
b. **Tcond, Tevap** (°C) = Design saturated condensing and evaporating temperature (corresponding to Pcond, Pevap)
c. **CAP** (kW) = Cooling capacity of the unit in normal operating conditions
d. **ΔPH, ΔPL** (bar)= Pressure drop at design conditions in the high and low pressure branches respectively
e. **ΔH** (m)= Difference in height between the condenser and the expansion valve
f. **Tliq** (°C)= Temperature of the liquid refrigerant at the valve inlet

3. VALVE SELECTION PROCEDURE

1. Establish the design pressure head **ΔPC (= Pcond – Pevap)** in bars;
   The minimum outlet pressure **Pcond** and the maximum suction pressure **Pevap** available should be used. If, rather than the pressure, the saturated condensing temperature **Tcond** and saturated evaporating temperature **Tevap** are known, calculate **ΔPC** from Table 1 in the Selection sheet relating to the chosen refrigerating.
2. Calculate the pressure difference **ΔPV** across the valve by subtracting from the pressure drop **ΔPH** and **ΔPL** in the high and low pressure branches from the pressure head **ΔPC** (= **Pcond** – **Pevap**), and taking account of the pressure column, according to the following formula (**ΔH** is expressed in metres):

$$\Delta PV = \Delta PC - \Delta PH - \Delta PL + 0.1 \times \Delta H$$

   N.B.: the factor 0.1 × **ΔH** (to be neglected if **ΔH** < 3-4 m) must be added sif the condenser is higher than the valve and vice-versa subtracted
3. Determine the temperature of the liquid **Tliq** at the valve inlet and in Table 2 identify the Correction Factor **CF** to keep account of the cooling capacity of the refrigerant. If more precise information is not available, assume **Tliq = Tcond – 5°C**
4. Multiply the cooling capacity **CAP** by the coefficient **CF** getting the capacity **RATING** equal value of the valve
5. In Table 3 identify the cell relating to the pressure difference that is closest to the **ΔPV** calculated in point 2. Based on the saturated evaporating temperature **Tevap** determine the model of valve whose capacity is immediately higher than the **RATING** value calculated above.

3.1 SELECTION EXAMPLE

Assume a process chiller with a remote condenser located below the processing unit; operation is also required in winter and consequently with a low condensing temperature.
The evaporating temperature considered is the highest expected value corresponding to the condensing temperature in winter.

Design data

a.	Type of refrigerant	**R410A**		d1.	Pressure drop in high branch	**ΔPH**	= 0.6 bar
b1.	Condensing temperature	**Tcond**	= 37 °C	d2.	Pressure drop in low branch	**ΔPL**	= 0.8 bar
b2.	Evaporating temperature	**Tevap**	= 5 °C	e.	Height of condenser above valve	**ΔH**	= – 6 m
c.	Cooling capacity	**CAP**	= 9 kW	f.	Temperature of the liquid	**Tliq**	= unknown

Using the Selection sheet relating to R410A refrigerant, proceed as follows:

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1. Being initially unknown, use Table 1 to calculate the pressure head **ΔPC** corresponding to **Tcond** and **Tevap**.

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	12,7	14,7	17,1	19,6	22,4	25,5	28,8	32,5	36,6	41
-35	12,2	14,3	16,6	19,2	22	25	28,4	32,1	36,1	40,5
-30	11,7	13,8	16,1	18,7	21,5	24,5	27,9	31,6	35,6	40
-25	11,1	13,2	15,5	18,1	20,9	23,9	27,3	31	35	39,4
-20	10,4	12,5	14,8	17,4	20,2	23,2	26,6	30,3	34,3	38,7
-15	9,6	11,7	14	16,6	19,4	22,4	25,8	29,5	33,5	37,9
-10	8,7	10,8	13,1	15,6	18,4	21,5	24,9	28,6	32,6	37
-5	7,6	9,7	12,0	14,6	17,4	20,4	23,8	27,5	31,5	35,9
0	6,4	8,5	10,8	13,4	16,2	19,2	22,6	26,3	30,3	34,7
5	5,1	7,2	9,5	12	14,8	17,9	21,3	25	29	33,4
10		5,7	8	10,5	13,3	16,4	19,8	23,4	27,5	31,9
15			6,3	8,8	11,6	14,7	18,1	21,8	25,8	30,2

Table 1

The value is calculated by interpolation.

$$\Delta PC = 13.1 \text{ bar}$$

Determine the pressure difference **ΔPV** across the valve using the formula:

$$\Delta PV = \Delta PC - \Delta PH - \Delta PL + 0.1 \times \Delta H = 13.1 - 0.6 - 0.8 + 0.1 \times (-6) = 11.1 \text{ bar}$$

N.B.: the pressure exerted by the column of liquid is negative, as the condenser is installed below the valve.

2. The temperature of the refrigerant at the valve inlet is not known; assume a subcooling value of 5 °C and consequently a temperature of the liquid **Tliq = Tcond – 5°C = 32 °C**. Table 2 is used to determine the Correction Factor:

$$CF = 0.92$$

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.56	0.58	0.61	0.64	0.67	0.71	0.75	0.80	0.86	0.92	1.00	1.10	1.22	1.39	1.63

Table 2

3. The expansion valve must have an equivalent capacity **RATING** determined by the product of the cooling capacity **CAP** by the Correction Factor **CF:**

$$RATING = CAP \times CF = 9 \times 0.92 = 8.3 \text{ kW}$$

4. In Table 3 identify the cell relating to the design saturated evaporating temperature **Tevap**. Determine, corresponding to the column with the pressure difference nearest to the **ΔPV** calculated in point 3 above, the model of valve whose capacity is immediately higher than the required equivalent value. The numbers in the table can be interpolated. In the case the model is: **E2V18**

Tevap. 5°C \ ΔPv [bar]	8	12	16	20	24	28	32
E2V09B	2.4	2.9	3.3	3.7	4.1	4.4	4.7
E2V11B	4.2	5.1	5.9	6.6	7.2	7.8	8.4
E2V14B	6.4	7.8	9.1	10.1	11.1	12	12.8
E2V18B	9.1	11.2	12.9	14.4	15.8	17	18.2
E2V24B	18.1	22.2	25.6	28.7	31.4	33.9	36.3
E2V35B	36.5	44.7	51.6	57.7	63.3	68.3	73
E4V55A	88.5	108.4	125.2	140	153	166	177
E4V65A	122	149	172	192	211	228	243
E4V85A	171	209	242	270	296	320	342
E4V95A	--	--	--	--	--	--	--

Table 3

3.2 ELECTRONIC EXPANSION VALVE SELECTION R22 REFRIGERANT

R22

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	8	9.4	10.9	12.5	14.3	16.2	18.4	20.7	23.2	25.9
-35	7.8	9.1	10.6	12.2	14	16	18.1	20.4	22.9	25.7
-30	7.5	8.8	10.3	11.9	13.7	15.6	17.8	20.1	22.6	25.4
-25	7.1	8.4	9.9	11.5	13.3	15.3	17.4	19.7	22.3	25
-20	6.7	8	9.5	11.1	12.9	14.8	17	19.3	21.8	24.6
-15	6.1	7.5	9	10.6	12.4	14.3	16.5	18.8	21.3	24
-10	5.6	6.9	8.4	10	11.8	13.8	15.9	18.2	20.7	23.5
-5	4.9	6.2	7.7	9.3	11.1	13.1	15.2	17.5	20.1	22.8
0	4.1	5.5	7	8.6	10.4	12.3	14.4	16.8	19.3	22
5		4.6	6.1	7.7	9.5	11.5	13.6	15.9	18.4	21.2
10			5.1	6.7	8.5	10.5	12.6	14.9	17.5	20.2
15			4	5.7	7.4	9.4	11.5	13.8	16.4	19.1

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant.

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.63	0.65	0.68	0.71	0.73	0.77	0.80	0.84	0.89	0.94	1.00	1.07	1.14	1.23	1.34

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar] 4	6	8	10	12	14	17
E2V09B	1.8	2.2	2.5	2.8	3.1	3.4	3.7
E2V11B	3.2	3.9	4.5	5	5.5	6	6.6
E2V14B	4.9	6	6.9	7.7	8.5	9.1	10.1
E2V18B	6.9	8.5	9.8	11	12	13	14.3
E2V24B	13.8	16.9	19.5	21.8	23.9	25.8	28.5
E2V35B	27.8	34.1	39.4	44	48.2	52.1	57.4
E3V45	48.6	59.5	68.7	77	84	91	100
E3V55	70	86	99	111	121	131	144
E3V65	99	121	140	156	171	185	204
E4V85	129	157	182	203	223	240	265
E4V95	179	219	253	283	309	334	368

Tevap. -10°C	ΔPv [bar] 6	8	10	12	14	17	20
E2V09B	2.1	2.4	2.7	2.9	3.2	3.5	3.8
E2V11B	3.7	4.2	4.7	5.2	5.6	6.2	6.7
E2V14B	5.6	6.5	7.3	8	8.6	9.5	10.3
E2V18B	8	9.2	10.3	11.3	12.2	13.5	14.6
E2V24B	15.9	18.4	20.6	22.5	24.3	26.8	29.1
E2V35B	32.1	37.1	41.4	45.4	49	54	58.6
E3V45	56	64.6	72.3	79	86	94	102
E3V55	80.8	93	104	114	123	136	147
E3V65	114	132	147	161	174	192	208
E4V85	148	171	191	210	226	249	271
E4V95	206	238	266	291	315	347	376

Tevap.	ΔPv [bar]						
10°C	4	6	8	10	12	14	17
E2V09B	1.8	2.2	2.5	2.8	3.1	3.3	3.7
E2V11B	3.2	3.9	4.5	5	5.5	5.9	6.5
E2V14B	4.8	5.9	6.8	7.6	8.4	9	10
E2V18B	6.9	8.4	9.7	10.9	11.9	12.9	14.2
E2V24B	13.7	16.8	19.3	21.6	23.7	25.6	28.2
E2V35B	27.6	33.8	39	43.6	47.7	51.6	56.8
E3V45	48.1	58.9	68	76	83	90	99
E3V55	69	85	98	110	120	130	143
E3V65	98	120	138	155	170	183	202
E4V85	127	156	180	201	220	238	262
E4V95	177	217	250	280	306	331	365

Tevap.	ΔPv [bar]						
-20°C	8	10	12	14	17	20	25
E2V09B	2.3	2.6	2.8	3.1	3.4	3.7	4.1
E2V11B	4.1	4.6	5.1	5.5	6	6.5	7.3
E2V14B	6.3	7.1	7.7	8.4	9.2	10	11.2
E2V18B	9	10.1	11	11.9	13.1	14.2	15.9
E2V24B	17.9	20	21.9	23.7	26.1	28.3	31.6
E2V35B	36.1	40.3	44.2	47.7	52.6	57	63.7
E3V45	62.9	70.3	77	83	92	99	111
E3V55	90.7	101	111	120	132	143	160
E3V65	128	143	157	169	187	202	226
E4V85	166	186	204	220	243	263	294
E4V95	231	259	283	306	337	366	409

Tevap.	ΔPv [bar]						
5°C	4	6	8	10	12	14	17
E2V09B	1.8	2.2	2.5	2.8	3	3.3	3.6
E2V11B	3.1	3.8	4.4	4.9	5.4	5.8	6.4
E2V14B	4.8	5.9	6.8	7.6	8.3	8.9	9.9
E2V18B	6.8	8.3	9.6	10.7	11.8	12.7	14
E2V24B	13.5	16.6	19.1	21.4	23.4	25.3	27.9
E2V35B	27.3	33.4	38.5	43.1	47.2	51	56.2
E3V45	47.5	58.2	67.2	75	82	89	98
E3V55	69	84	97	108	119	128	141
E3V65	97	119	137	153	168	181	200
E4V85	126	154	178	199	218	235	259
E4V95	175	214	247	277	303	327	361

Tevap.	ΔPv [bar]						
-30°C	8	10	12	14	17	20	25
E2V09B	2.3	2.5	2.8	3	3.3	3.6	4
E2V11B	4	4.5	4.9	5.3	5.9	6.4	7.1
E2V14B	6.2	6.9	7.5	8.1	9	9.7	10.9
E2V18B	8.8	9.8	10.7	11.6	12.8	13.8	15.5
E2V24B	17.4	19.5	21.3	23	25.4	27.5	30.8
E2V35B	35.1	39.2	43	46.4	51.2	55.5	62
E3V45	61.2	68.4	75	81	89	97	108
E3V55	88.3	99	108	117	129	140	156
E3V65	125	139	153	165	182	197	220
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
0°C	6	8	10	12	14	17	20
E2V09B	2.1	2.5	2.7	3	3.2	3.6	3.9
E2V11B	3.8	4.4	4.9	5.3	5.8	6.4	6.9
E2V14B	5.8	6.7	7.5	8.2	8.8	9.7	10.6
E2V18B	8.2	9.5	10.6	11.6	12.6	13.8	15
E2V24B	16.4	18.9	21.1	23.1	25	27.5	29.9
E2V35B	33	38.1	42.6	46.6	50.4	55.5	60.2
E3V45	57.5	66.4	74.2	81	88	97	105
E3V55	83	96	107	117	127	140	151
E3V65	117	135	151	166	179	197	214
E4V85	152	176	197	215	233	256	278
E4V95	212	244	273	299	323	356	386

Tevap.	ΔPv [bar]						
-40°C	8	10	12	14	17	20	25
E2V09B	2.2	2.5	2.7	2.9	3.2	3.5	3.9
E2V11B	3.9	4.4	4.8	5.2	5.7	6.2	6.9
E2V14B	6	6.7	7.3	7.9	8.7	9.5	10.6
E2V18B	8.5	9.5	10.4	11.2	12.4	13.4	15
E2V24B	16.9	18.9	20.7	22.4	24.7	26.7	29.9
E2V35B	34.1	38.1	41.7	45.1	49.7	53.9	60.3
E3V45	59.4	66.5	72.8	79	87	94	105
E3V55	85.7	96	105	113	125	136	152
E3V65	121	135	148	160	176	191	214
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.3 ELECTRONIC EXPANSION VALVE SELECTION

R407C

R407C refrigerant

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C)	Tcond – Saturated condensing temperature (°C)									
	20	25	30	35	40	45	50	55	60	65
-40	9.1	10.7	12.3	14.2	16.2	18.5	20.9	23.5	26.4	29.5
-35	8.8	10.4	12	13.9	15.9	18.2	20.6	23.2	26.1	29.2
-30	8.5	10	11.7	13.5	15.6	17.8	20.2	22.9	25.7	28.9
-25	8.0	9.6	11.3	13.1	15.1	17.4	19.8	22.4	25.3	28.4
-20	7.5	9.1	10.8	12.6	14.6	16.9	19.3	21.9	24.8	27.9
-15	7	8.5	10.2	12	14.1	16.3	18.7	21.4	24.2	27.4
-10	6.3	7.8	9.5	11.4	13.4	15.6	18.1	20.7	23.6	26.7
-5	5.5	7.1	8.7	10.6	12.6	14.9	17.3	19.9	22.8	25.9
0	4.7	6.2	7.9	9.7	11.8	14	16.4	19.1	22	25.1
5		5.2	6.9	8.8	10.8	13	15.4	18.1	21	24.1
10			5.8	7.7	9.7	11.9	14.3	17	19.9	23
15				6.4	8.5	10.7	13.1	15.8	18.6	21.8

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant.

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.58	0.60	0.63	0.66	0.69	0.73	0.77	0.81	0.87	0.93	1.00	1.08	1.19	1.31	1.47

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap.	ΔPv [bar]						
15°C	4	6	8	10	12	14	17
E2V09B	1.7	2.1	2.4	2.7	2.9	3.2	3.5
E2V11B	3	3.7	4.3	4.8	5.2	5.6	6.2
E2V14B	4.6	5.7	6.5	7.3	8	8.6	9.5
E2V18B	6.6	8.1	9.3	10.4	11.4	12.3	13.6
E2V24B	13.1	16	18.5	20.7	22.7	24.5	27
E2V35B	26.4	32.3	37.3	41.7	45.7	49.3	54.4
E3V45	46	56.3	65	73	80	86	95
E3V55	66	81	94	105	115	124	137
E3V65	94	115	132	148	162	175	193
E4V85	122	149	172	192	211	228	251
E4V95	169	207	239	268	293	317	349

Tevap.	ΔPv [bar]						
-10°C	6	8	10	12	14	17	20
E2V09B	1.9	2.2	2.5	2.7	2.9	3.2	3.5
E2V11B	3.4	3.9	4.4	4.8	5.2	5.8	6.2
E2V14B	5.2	6	6.8	7.4	8	8.8	9.6
E2V18B	7.4	8.6	9.6	10.5	11.4	12.5	13.6
E2V24B	14.8	17.1	19.1	20.9	22.6	24.9	27
E2V35B	29.9	34.5	38.5	42.2	45.6	50.2	54.5
E3V45	52.1	60.1	67.2	74	80	88	95
E3V55	75.1	87	97	106	115	126	137
E3V65	106	122	137	150	162	178	194
E4V85	138	159	178	195	210	232	252
E4V95	192	221	247	271	293	322	350

Tevap.	ΔPv [bar]						
10°C	4	6	8	10	12	14	17
E2V09B	1.7	2.1	2.4	2.7	2.9	3.1	3.5
E2V11B	3	3.6	4.2	4.7	5.2	5.6	6.1
E2V14B	4.6	5.6	6.5	7.2	7.9	8.5	9.4
E2V18B	6.5	7.9	9.2	10.3	11.2	12.1	13.4
E2V24B	12.9	15.8	18.3	20.4	22.4	24.1	26.6
E2V35B	26	31.9	36.8	41.1	45.1	48.7	53.6
E3V45	45.4	55.6	64.2	72	79	85	94
E3V55	65	80	93	103	113	122	135
E3V65	92	113	131	146	160	173	190
E4V85	120	147	170	190	208	225	248
E4V95	167	204	236	264	289	312	344

Tevap.	ΔPv [bar]						
-20°C	6	8	10	12	14	17	20
E2V09B	1.9	2.1	2.4	2.6	2.8	3.1	3.4
E2V11B	3.3	3.8	4.2	4.7	5	5.5	6.0
E2V14B	5	5.8	6.5	7.1	7.7	8.5	9.2
E2V18B	7.2	8.3	9.3	10.1	11	12.1	13.1
E2V24B	14.3	16.5	18.4	20.2	21.8	24	26
E2V35B	28.7	33.2	37.1	40.7	43.9	48.4	52.5
E3V45	50.1	57.9	64.7	71	77	84	92
E3V55	72.3	84	93	102	110	122	132
E3V65	102	118	132	144	156	172	186
E4V85	133	153	171	188	203	223	242
E4V95	184	213	238	261	282	311	337

Tevap.	ΔPv [bar]						
5°C	4	6	8	10	12	14	17
E2V09B	1.7	2	2.3	2.6	2.9	3.1	3.4
E2V11B	2.9	3.6	4.2	4.6	5.1	5.5	6.1
E2V14B	4.5	5.5	6.4	7.1	7.8	8.4	9.3
E2V18B	6.4	7.8	9	10.1	11.1	12	13.2
E2V24B	12.7	15.6	18	20.1	22	23.8	26.2
E2V35B	25.6	31.4	36.9	40.5	44.4	48	52.8
E3V45	44.7	54.8	63.2	71	77	84	92
E3V55	64	79	91	102	112	121	133
E3V65	91	111	129	144	158	170	188
E4V85	118	145	167	187	205	221	244
E4V95	164	201	233	260	285	308	339

Tevap.	ΔPv [bar]						
-30°C	8	10	12	14	17	20	25
E2V09B	2.1	2.3	2.5	2.7	3	3.3	3.6
E2V11B	3.7	4.1	4.5	4.8	5.3	5.8	6.5
E2V14B	5.6	6.3	6.9	7.4	8.2	8.8	9.9
E2V18B	8	8.9	9.7	10.5	11.6	12.6	14.1
E2V24B	15.8	17.7	19.4	20.9	23.1	25	28
E2V35B	31.9	35.7	39.1	42.2	46.5	50.5	56.4
E3V45	55.7	62.2	68.2	74	81	88	98
E3V55	80.3	90	98	106	117	127	142
E3V65	113	127	139	150	165	179	200
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
0°C	6	8	10	12	14	17	20
E2V09B	2	2.3	2.6	2.8	3	3.4	3.6
E2V11B	3.5	4.1	4.6	5	5.4	6	6.5
E2V14B	5.4	6.3	7	7.7	8.3	9.1	9.9
E2V18B	7.7	8.9	9.9	10.9	11.8	13	14.1
E2V24B	15.3	17.7	19.8	21.7	23.4	25.8	28
E2V35B	30.9	35.7	39.9	43.7	47.2	52	56.4
E3V45	53.9	62.2	69.6	76	82	91	98
E3V55	78	90	100	110	119	131	142
E3V65	110	127	142	155	168	185	200
E4V85	143	165	184	202	218	240	260
E4V95	198	229	256	280	303	334	362

Tevap.	ΔPv [bar]						
-40°C	8	10	12	14	17	20	25
E2V09B	2	2.2	2.4	2.6	2.9	3.1	3.5
E2V11B	3.5	3.9	4.3	4.6	5.1	5.5	6.2
E2V14B	5.4	6	6.6	7.1	7.8	8.5	9.5
E2V18B	7.6	8.5	9.3	10.1	11.1	12.1	13.5
E2V24B	15.2	17	18.6	20.1	22.1	24	26.8
E2V35B	30.6	34.2	37.5	40.5	44.6	48.4	54.1
E3V45	53.4	59.7	65.3	71	78	84	94
E3V55	77	86	94	102	112	122	136
E3V65	109	121	133	144	158	172	192
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity

3.4 ELECTRONIC EXPANSION VALVE SELECTION

R410A

R410A refrigerant

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	12.7	14.7	17.1	19.6	22.4	25.5	28.8	32.5	36.6	41
-35	12.2	14.3	16.6	19.2	22	25	28.4	32.1	36.1	40.5
-30	11.7	13.8	16.1	18.7	21.5	24.5	27.9	31.6	35.6	40
-25	11.1	13.2	15.5	18.1	20.9	23.9	27.3	31	35	39.4
-20	10.4	12.5	14.8	17.4	20.2	23.2	26.6	30.3	34.3	38.7
-15	9.6	11.7	14	16.6	19.4	22.4	25.8	29.5	33.5	37.9
-10	8.7	10.8	13.1	15.6	18.4	21.5	24.9	28.6	32.6	37
-5	7.6	9.7	12.0	14.6	17.4	20.4	23.8	27.5	31.5	35.9
0	6.4	8.5	10.8	13.4	16.2	19.2	22.6	26.3	30.3	34.7
5	5.1	7.2	9.5	12	14.8	17.9	21.3	25	29	33.4
10		5.7	8	10.5	13.3	16.4	19.8	23.4	27.5	31.9
15			6.3	8.8	11.6	14.7	18.1	21.8	25.8	30.2

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.56	0.58	0.61	0.64	0.67	0.71	0.75	0.80	0.86	0.92	1.00	1.10	1.22	1.39	1.63

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar]						
	5	8	12	16	20	24	28
E2V09B	1.9	2.4	2.9	3.3	3.7	4.1	4.4
E2V11B	3.3	4.2	5.1	5.9	6.6	7.3	7.9
E2V14B	5.1	6.4	7.9	9.1	10.2	11.1	12
E2V18B	7.2	9.1	11.2	12.9	14.5	15.8	17.1
E2V24B	14.4	18.2	22.3	25.7	28.8	31.5	34
E2V35B	29	36.7	44.9	51.8	58	63.5	68.6
E3V45	50.5	63.9	78.3	90	101	111	120
E3V55	73	92	113	130	146	160	173
E3V65	103	130	159	184	206	225	243
E4V85	134	169	207	239	268	293	317
E4V95	--	--	--	--	--	--	--

Tevap. -10°C	ΔPv [bar]						
	8	12	16	20	24	28	32
E2V09B	2.3	2.8	3.2	3.6	3.9	4.2	4.5
E2V11B	4	4.9	5.7	6.3	6.9	7.5	8
E2V14B	6.1	7.5	8.7	9.7	10.6	11.5	12.3
E2V18B	8.7	10.7	12.4	13.8	15.1	16.3	17.5
E2V24B	17.4	21.3	24.6	27.5	30.1	32.5	34.8
E2V35B	35	42.9	49.5	55.4	60.7	65.5	70.1
E3V45	61.1	75	86	97	106	114	122
E3V55	88	108	125	139	153	165	176
E3V65	124	152	176	197	215	233	249
E4V85	162	198	229	256	280	302	323
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
10°C	5	8	12	16	20	24	28
E2V09B	1.9	2.3	2.9	3.3	3.7	4.1	4.4
E2V11B	3.3	4.2	5.1	5.9	6.6	7.2	7.8
E2V14B	5	6.4	7.8	9	10.1	11.1	12
E2V18B	7.2	9.1	11.1	12.8	14.4	15.7	17
E2V24B	14.3	18.1	22.1	25.6	28.6	31.3	33.8
E2V35B	28.8	36.4	44.6	51.5	57.6	63.1	68.2
E3V45	50.2	63.5	77.8	90	100	110	119
E3V55	72	92	112	130	145	159	171
E3V65	102	129	158	183	205	224	242
E4V85	133	168	206	238	266	291	315
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
-20°C	12	16	20	24	28	32	38
E2V09B	2.7	3.1	3.5	3.8	4.1	4.4	4.8
E2V11B	4.8	5.5	6.2	6.8	7.3	7.8	8.5
E2V14B	7.3	8.5	9.5	10.4	11.2	12	13
E2V18B	10.4	12	13.4	14.7	15.9	17	18.5
E2V24B	20.7	23.9	26.8	29.3	31.7	33.8	36.9
E2V35B	41.8	48.2	53.9	59.1	63.8	68.2	74.3
E3V45	72.8	84	94	103	111	119	130
E3V55	105	121	136	149	160	172	187
E3V65	148	171	191	210	227	242	264
E4V85	193	223	249	273	295	315	343
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
5°C	8	12	16	20	24	28	32
E2V09B	2.3	2.9	3.3	3.7	4	4.4	4.7
E2V11B	4.1	5.1	5.9	6.5	7.2	7.7	8.3
E2V14B	6.3	7.8	9	10	11	11.9	12.7
E2V18B	9	11	12.7	14.3	15.6	16.9	18
E2V24B	17.9	22	25.4	28.4	31.1	33.6	35.9
E2V35B	36.1	44.3	51.1	57.2	62.6	67.6	72.3
E3V45	63	77.2	89.2	100	109	118	126
E3V55	91	111	129	144	158	170	182
E3V65	128	157	182	203	222	240	257
E4V85	167	204	236	264	289	312	334
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
-30°C	12	16	20	24	28	32	38
E2V09B	2.6	3	3.4	3.7	4	4.3	4.7
E2V11B	4.6	5.4	6	6.6	7.1	7.6	8.3
E2V14B	7.1	8.2	9.2	10.1	10.9	11.6	12.7
E2V18B	10.1	11.7	13.1	14.3	15.4	16.5	18
E2V24B	20.1	23.2	26	28.5	30.7	32.9	35.8
E2V35B	40.6	46.8	52.4	57.4	62	66.2	72.2
E3V45	70.7	82	91	100	108	116	126
E3V55	102	118	132	144	156	167	182
E3V65	144	166	186	204	220	235	256
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
0°C	8	12	16	20	24	28	32
E2V09B	2.3	2.8	3.3	3.7	4	4.3	4.6
E2V11B	4.1	5	5.8	6.5	7.1	7.7	8.2
E2V14B	6.3	7.7	8.9	9.9	10.9	11.8	12.6
E2V18B	8.9	10.9	12.6	14.1	15.5	16.7	17.9
E2V24B	17.8	21.8	25.1	28.1	30.8	33.3	35.5
E2V35B	35.8	43.9	50.7	56.6	62	67	71.6
E3V45	62.5	76.5	88.4	99	108	117	125
E3V55	90	110	127	142	156	169	180
E3V65	127	156	180	201	220	238	254
E4V85	165	203	234	261	286	309	331
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
-40°C	12	16	20	24	28	32	38
E2V09B	2.5	2.9	3.3	3.6	3.9	4.1	4.5
E2V11B	4.5	5.2	5.8	6.4	6.9	7.3	8
E2V14B	6.9	8	8.9	9.7	10.5	11.2	12.3
E2V18B	9.8	11.3	12.6	13.9	15	16	17.4
E2V24B	19.5	22.5	25.2	27.6	29.8	31.8	34.7
E2V35B	39.3	45.4	50.7	55.6	60	64.2	69.9
E3V45	68.5	79	88	97	105	112	122
E3V55	99	114	128	140	151	161	176
E3V65	139	161	180	197	213	228	248
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.5 ELECTRONIC EXPANSION VALVE SELECTION
R134a refrigeration

R134a

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	--	--	--	--	--	--	--	--	--	--
-35	--	--	--	--	--	--	--	--	--	--
-30	--	--	--	--	--	--	--	--	--	--
-25	--	--	--	--	--	--	--	--	--	--
-20	--	--	--	--	--	--	--	--	--	--
-15	--	--	--	--	--	--	--	--	--	--
-10	--	--	--	--	--	--	--	--	--	--
-5	--	4.2	5.3	6.5	7.7	9.2	10.8	12.5	14.4	16.5
0	--	--	4.8	6.0	7.3	8.7	10.3	12.0	13.9	16.0
5	--	--	4.2	5.4	6.7	8.1	9.7	11.4	13.3	15.4
10	--	--	--	4.7	6.0	7.5	9.0	10.8	12.7	14.7
15	--	--	--	4.0	5.3	6.7	8.3	10.0	11.9	14.0

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.59	0.61	0.64	0.67	0.70	0.74	0.78	0.82	0.87	0.93	1.00	1.08	1.17	1.28	1.42

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar] 4	6	8	10	12	14	16
E2V09B	1.7	2.1	2.4	2.7	3	3.2	3.4
E2V11B	3	3.7	4.3	4.8	5.2	5.7	6.1
E2V14B	4.6	5.7	6.6	7.3	8	8.7	9.3
E2V18B	6.6	8.1	9.3	10.4	11.4	12.3	13.2
E2V24B	13.1	16.1	18.6	20.7	22.7	24.5	26.2
E2V35B	26.4	32.4	37.4	41.8	45.8	49.5	52.9
E3V45	46.1	56.5	65.2	73	80	86	92
E3V55	67	81	94	105	115	124	133
E3V65	94	115	133	148	163	176	188
E4V85	122	150	173	193	211	228	244
E4V95	170	208	240	268	294	317	339

Tevap. 5°C	ΔPv [bar] 4	6	8	10	12	14	16
E2V09B	1.6	2	2.3	2.6	2.8	3.1	3.3
E2V11B	2.9	3.6	4.1	4.6	5	5.5	5.8
E2V14B	4.5	5.5	6.3	7.1	7.7	8.3	8.9
E2V18B	6.3	7.8	9	10	11	11.9	12.7
E2V24B	12.6	15.5	17.9	20	21.9	23.6	25.3
E2V35B	25.4	31.2	36	40.2	44.1	47.6	50.9
E3V45	44.4	54.4	62.8	70	77	83	89
E3V55	64	78	91	101	111	120	128
E3V65	90	111	128	143	157	169	181
E4V85	117	144	166	186	203	220	235
E4V95	163	200	231	258	283	306	327

Tevap. 10°C	ΔPv [bar]						
	4	6	8	10	12	14	16
E2V09B	1.7	2.1	2.4	2.6	2.9	3.1	3.3
E2V11B	3	3.6	4.2	4.7	5.1	5.6	5.9
E2V14B	4.6	5.6	6.4	7.2	7.9	8.5	9.1
E2V18B	6.5	7.9	9.2	10.2	11.2	12.1	12.9
E2V24B	12.9	15.8	18.2	20.4	22.3	24.1	25.8
E2V35B	26	31.8	36.7	41	45	48.6	51.9
E3V45	45.3	55.4	64	72	78	85	91
E3V55	65	80	92	103	113	122	131
E3V65	92	113	130	146	160	172	184
E4V85	120	147	169	189	208	224	240
E4V95	167	204	236	263	289	312	333

Tevap. 0°C	ΔPv [bar]						
	4	6	8	10	12	14	16
E2V09B	1.6	2	2.3	2.5	2.8	3	3.2
E2V11B	2.9	3.5	4	4.5	4.9	5.3	5.7
E2V14B	4.4	5.4	6.2	6.9	7.6	8.2	8.7
E2V18B	6.2	7.6	8.8	9.8	10.8	11.6	12.4
E2V24B	12.4	15.1	17.5	19.6	21.4	23.1	24.7
E2V35B	24.9	30.5	35.2	39.4	43.2	46.6	49.8
E3V45	43.5	53.2	61.5	69	75	81	87
E3V55	63	77	89	99	109	117	125
E3V65	88	108	125	140	153	166	177
E4V85	115	141	163	182	199	215	230
E4V95	160	196	226	253	277	299	320

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.6 ELECTRONIC EXPANSION VALVE SELECTION

R404A

R404A refrigerant

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	9.6	11.2	13	14.9	17	19.2	21.8	24.5	27.5	30.7
-35	9.3	10.9	12.6	14.5	16.6	18.9	21.4	24.2	27.2	30.4
-30	8.9	10.5	12.2	14.1	16.2	18.5	21	23.8	26.8	30
-25	8.5	10	11.8	13.7	15.8	18.1	20.6	23.3	26.3	29.6
-20	7.9	9.5	1.2	13.1	15.2	17.5	20	22.8	25.8	29
-15	7.3	8.9	10.6	12.5	14.6	16.9	19.4	22.2	25.1	28.4
-10	6.6	8.2	9.9	11.8	13.9	16.2	18.7	21.4	24.4	27.7
-5	5.8	7.4	9.1	11	13.1	15.4	17.9	20.6	23.6	26.9
0	4.9	6.4	8.2	10.1	12.2	14.5	17	19.7	22.7	26
5	--	5.4	7.2	9.1	11.2	13.5	16	18.7	21.7	24.9
10	--	4.3	6	7.9	10	12.3	14.8	17.6	20.5	23.8
15	--	--	4.7	6.6	8.7	11	13.5	16.3	19.3	22.5

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.50	0.52	0.55	0.58	0.62	0.66	0.71	0.76	0.83	0.90	1.00	1.12	1.28	1.52	1.89

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar] 4	6	8	10	12	15	18
E2V09B	1.2	1.4	1.7	1.9	2	2.3	2.5
E2V11B	2.1	2.6	3	3.3	3.6	4.1	4.4
E2V14B	3.2	3.9	4.5	5.1	5.6	6.2	6.8
E2V18B	4.6	5.6	6.4	7.2	7.9	8.8	9.7
E2V24B	9.1	11.1	12.8	14.3	15.7	17.6	19.3
E2V35B	18.3	22.4	25.9	28.9	31.7	35.4	38.8
E3V45	31.9	39.1	45.1	50	55	62	68
E3V55	46	56	65	73	80	89	98
E3V65	65	80	92	103	112	126	138
E4V85	84	103	119	133	146	163	179
E4V95	117	144	166	186	203	227	249

Tevap. -10°C	ΔPv [bar] 8	10	12	15	18	22	26
E2V09B	1.5	1.7	1.8	2	2.2	2.5	2.7
E2V11B	2.6	3	3.2	3.6	4	4.4	4.8
E2V14B	4.1	4.5	5	5.6	6.1	6.7	7.3
E2V18B	5.8	6.5	7.1	7.9	8.7	9.6	10.4
E2V24B	11.5	12.8	14.1	15.7	17.2	19	20.7
E2V35B	23.1	25.9	28.3	31.7	34.7	38.4	41.7
E3V45	40.4	45.1	49.4	55	61	67	73
E3V55	58.2	65	71	80	87	97	105
E3V65	82	92	101	113	123	136	148
E4V85	107	119	131	146	160	177	193
E4V95	148	166	182	203	223	246	268

Tevap. 10°C	ΔPv [bar]						
	4	6	8	10	12	15	18
E2V09B	1.2	1.4	1.6	1.8	2	2.2	2.5
E2V11B	2.1	2.5	2.9	3.2	3.6	4	4.4
E2V14B	3.1	3.9	4.5	5	5.5	6.1	6.7
E2V18B	4.5	5.5	6.3	7.1	7.8	8.7	9.5
E2V24B	8.9	10.9	12.6	14.1	15.4	17.2	18.9
E2V35B	17.9	22	25.4	28.4	31.1	34.8	38.1
E3V45	31.3	38.3	44.3	49	54	61	66
E3V55	45	55	64	71	78	87	96
E3V65	64	78	90	101	110	123	135
E4V85	83	101	117	131	144	160	176
E4V95	115	141	163	182	199	223	244

Tevap. -20°C	ΔPv [bar]						
	8	10	12	15	18	22	26
E2V09B	1.4	1.6	1.7	1.9	2.1	2.3	2.5
E2V11B	2.5	2.8	3.1	3.4	3.8	4.2	4.5
E2V14B	3.8	4.3	4.7	5.3	5.8	6.4	6.9
E2V18B	5.5	6.1	6.7	7.5	8.2	9.1	9.8
E2V24B	10.9	12.1	13.3	14.9	16.3	18	19.6
E2V35B	21.9	24.5	26.8	30	32.8	36.3	39.5
E3V45	38.2	42.7	46.8	52	57	63	69
E3V55	55.1	62	67	75	83	91	99
E3V65	78	87	95	106	117	129	140
E4V85	101	113	124	138	152	168	182
E4V95	140	157	172	192	211	233	253

Tevap. 5°C	ΔPv [bar]						
	4	6	8	10	12	15	18
E2V09B	1.1	1.4	1.6	1.8	2	2.2	2.4
E2V11B	2	2.5	2.8	3.2	3.5	3.9	4.3
E2V14B	3.1	3.8	4.4	4.9	5.3	6	6.5
E2V18B	4.4	5.4	6.2	6.9	7.6	8.5	9.3
E2V24B	8.7	10.7	12.3	13.8	15.1	16.9	18.5
E2V35B	17.6	21.5	24.9	27.8	30.5	34.1	37.3
E3V45	30.7	37.6	43.4	48	53	59	65
E3V55	44	54	63	70	77	86	94
E3V65	62	76	88	99	108	121	132
E4V85	81	99	115	128	141	157	172
E4V95	113	138	160	178	195	218	239

Tevap. -30°C	ΔPv [bar]						
	10	12	15	18	22	26	30
E2V09B	1.5	1.6	1.8	2	2.2	2.4	2.6
E2V11B	2.6	2.9	3.2	3.5	3.9	4.3	4.6
E2V14B	4	4.4	5	5.4	6	6.5	7
E2V18B	5.7	6.3	7	7.7	8.5	9.3	10
E2V24B	11.4	12.5	14	15.3	17	18.4	19.8
E2V35B	23.1	25.3	28.2	30.9	34.2	37.2	39.9
E3V45	40.2	44	49.2	54	60	65	70
E3V55	58	64	71	78	86	94	100
E3V65	82	90	100	110	121	132	142
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap. 0°C	ΔPv [bar]						
	6	8	10	12	15	18	22
E2V09B	1.4	1.6	1.8	1.9	2.1	2.4	2.6
E2V11B	2.4	2.8	3.1	3.4	3.8	4.2	4.6
E2V14B	3.7	4.3	4.8	5.2	5.8	6.4	7.1
E2V18B	5.3	6.1	6.8	7.4	8.3	9.1	10.1
E2V24B	10.5	12.1	13.5	14.8	16.5	18.1	20
E2V35B	21.1	24.3	27.2	29.8	33.3	36.5	40.3
E3V45	36.7	42.4	47.4	52	58	64	70
E3V55	53	61	68	75	84	92	101
E3V65	75	86	97	106	118	130	143
E4V85	97	112	126	137	154	168	186
E4V95	135	156	174	191	214	234	259

Tevap. -40°C	ΔPv [bar]						
	10	12	15	18	22	26	30
E2V09B	1.4	1.5	1.7	1.9	2.1	2.2	2.4
E2V11B	2.5	2.7	3	3.3	3.7	4	4.3
E2V14B	3.8	4.2	4.6	5.1	5.6	6.1	6.6
E2V18B	5.4	5.9	6.6	7.2	8	8.7	9.3
E2V24B	10.7	11.8	13.1	14.4	15.9	17.3	18.6
E2V35B	21.6	23.7	26.5	29	32.1	34.9	37.4
E3V45	37.7	41.3	46.2	51	56	61	65
E3V55	54.4	60	67	73	81	88	94
E3V65	77	84	94	103	114	124	133
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.7 ELECTRONIC EXPANSION VALVE SELECTION

R507A

R507A refrigerant

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	9,9	11,5	13,2	15,2	17,3	19,7	22,2	25,0	28,1	31,4
-35	9,5	11,1	12,9	14,8	17	19,3	21,9	24,7	27,8	31,1
-30	9,1	10,7	12,5	14,4	16,6	18,9	21,5	24,3	27,3	30,7
-25	8,6	10,3	12	14,0	16,1	18,5	21	23,8	26,9	30,2
-20	8,1	9,7	11,5	13,4	15,6	17,9	20,5	23,3	26,3	29,7
-15	7,5	9,1	10,8	12,8	14,9	17,3	19,8	22,6	25,7	29
-10	6,7	8,3	10,1	12,1	14,2	16,5	19,1	21,9	25	28,3
-5	5,9	7,5	9,3	11,2	13,4	15,7	18,3	21,1	24,1	27,5
0	5,0	6,6	8,4	10,3	12,4	14,8	17,4	20,2	23,2	26,5
5		5,5	7,3	9,3	11,4	13,7	16,3	19,1	22,2	25,5
10		4,4	6,1	8,1	10,2	12,6	15,1	17,9	21	24,3
15			4,8	6,8	8,9	11,3	13,8	16,6	19,7	23

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.49	0.52	0.54	0.58	0.61	0.65	0.70	0.76	0.82	0.90	1.00	1.13	1.30	1.55	1.96

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar] 4	6	8	10	12	15	18
E2V09B	1.1	1.4	1.6	1.8	2	2.2	2.4
E2V11B	2	2.5	2.9	3.2	3.5	3.9	4.3
E2V14B	3.1	3.8	4.4	4.9	5.4	6	6.6
E2V18B	4.4	5.4	6.2	7	7.7	8.6	9.4
E2V24B	8.8	10.8	12.4	13.9	15.2	17	18.7
E2V35B	17.7	21.7	25.1	28	30.7	34.3	37.6
E3V45	30.9	37.8	43.7	49	54	60	66
E3V55	45	55	63	70	77	86	95
E3V65	62	77	89	99	109	122	133
E4V85	82	100	116	129	142	158	174
E4V95	114	139	161	180	197	220	241

Tevap. -10°C	ΔPv [bar] 8	10	12	15	18	22	26
E2V09B	1.4	1.6	1.8	2	2.2	2.4	2.6
E2V11B	2.6	2.9	3.1	3.5	3.8	4.2	4.6
E2V14B	3.9	4.4	4.8	5.4	5.9	6.5	7.1
E2V18B	5.6	6.2	6.8	7.6	8.4	9.3	10.1
E2V24B	11.1	12.4	13.6	15.2	16.7	18.4	20
E2V35B	22.4	25	27.4	30.6	33.6	37.1	40.3
E3V45	39	44	48	53	59	65	70
E3V55	56	63	69	77	84	93	101
E3V65	79	89	97	109	119	132	143
E4V85	103	115	127	141	155	171	186
E4V95	144	161	176	197	215	238	259

Tevap. 10°C	ΔPv [bar]						
	4	6	8	10	12	15	18
E2V09B	1.1	1.4	1.6	1.8	1.9	2.2	2.4
E2V11B	2	2.4	2.8	3.1	3.4	3.9	4.2
E2V14B	3	3.7	4.3	4.8	5.3	5.9	6.5
E2V18B	4.3	5.3	6.1	6.9	7.5	8.4	9.2
E2V24B	8.6	10.6	12.2	13.6	14.9	16.7	18.3
E2V35B	17.4	21.3	24.6	27.5	30.1	33.7	36.9
E3V45	30.3	37.2	42.9	48	53	59	64
E3V55	44	54	62	69	76	85	93
E3V65	62	76	87	98	107	120	131
E4V85	80	98	114	127	139	155	170
E4V95	112	137	158	176	193	216	237

Tevap. -20°C	ΔPv [bar]						
	10	12	15	18	22	26	30
E2V09B	1.5	1.7	1.9	2	2.3	2.5	2.6
E2V11B	2.7	3	3.3	3.6	4	4.4	4.7
E2V14B	4.1	4.5	5.1	5.6	6.1	6.7	7.2
E2V18B	5.9	6.4	7.2	7.9	8.7	9.5	10.2
E2V24B	11.7	12.8	14.3	15.7	17.4	18.9	20.3
E2V35B	23.6	25.9	28.9	31.7	35	38.1	40.9
E3V45	41.2	45	50	55	61	66	71
E3V55	59	65	73	80	88	96	103
E3V65	84	92	103	112	124	135	145
E4V85	109	119	133	146	162	176	189
E4V95	152	166	186	203	225	244	262

Tevap. 5°C	ΔPv [bar]						
	4	6	8	10	12	15	18
E2V09B	1.1	1.3	1.6	1.7	1.9	2.1	2.3
E2V11B	2	2.4	2.8	3.1	3.4	3.8	4.1
E2V14B	3	3.7	4.2	4.7	5.2	5.8	6.3
E2V18B	4.2	5.2	6	6.7	7.4	8.2	9
E2V24B	8.5	10.4	12	13.4	14.6	16.4	17.9
E2V35B	17	20.9	24.1	26.9	29.5	33	36.1
E3V45	29.7	36.4	42	47	51	58	63
E3V55	43	52	61	68	74	83	91
E3V65	61	74	86	96	105	117	128
E4V85	79	96	111	124	136	152	167
E4V95	109	134	155	173	189	212	232

Tevap. -30°C	ΔPv [bar]						
	10	12	15	18	22	26	30
E2V09B	1.4	1.6	1.8	1.9	2.1	2.3	2.5
E2V11B	2.5	2.8	3.1	3.4	3.8	4.1	4.4
E2V14B	3.9	4.3	4.8	5.2	5.8	6.3	6.7
E2V18B	5.5	6.1	6.8	7.4	8.2	8.9	9.6
E2V24B	11	12.1	13.5	14.8	16.3	17.8	19.1
E2V35B	22.2	24.3	27.2	29.8	32.9	35.8	38.5
E3V45	38.7	42	47	52	57	62	67
E3V55	56	61	68	75	83	90	97
E3V65	79	86	97	106	117	127	137
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap. 0°C	ΔPv [bar]						
	6	8	10	12	15	18	22
E2V09B	1.3	1.5	1.7	1.9	2.1	2.3	2.5
E2V11B	2.3	2.7	3	3.3	3.7	4	4.5
E2V14B	3.6	4.1	4.6	5.1	5.7	6.2	6.9
E2V18B	5.1	5.9	6.6	7.2	8	8.8	9.7
E2V24B	10.1	11.7	13.1	14.3	16	17.5	19.4
E2V35B	20.4	23.6	26.3	28.9	32.3	35.3	39.1
E3V45	35.6	41.1	45.9	50	56	62	68
E3V55	51	59	66	73	81	89	98
E3V65	72	84	94	102	115	125	139
E4V85	94	109	122	133	149	163	180
E4V95	131	151	169	185	207	227	251

Tevap. -40°C	ΔPv [bar]						
	10	12	15	18	22	26	30
E2V09B	1.3	1.5	1.6	1.8	2	2.2	2.3
E2V11B	2.4	2.6	2.9	3.2	3.5	3.8	4.1
E2V14B	3.7	4	4.5	4.9	5.4	5.9	6.3
E2V18B	5.2	5.7	6.4	7	7.7	8.4	9
E2V24B	10.3	11.3	12.7	13.9	15.3	16.7	17.9
E2V35B	20.8	22.8	25.5	27.9	30.9	33.6	36.1
E3V45	36.3	40	44	49	54	59	63
E3V55	52	57	64	70	78	84	91
E3V65	74	81	91	99	110	119	128
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.8 ELECTRONIC EXPANSION VALVE SELECTION

R417A

R417A refrigerant

ΔPC (bar) - Pressure head according to the temperature

Tevap – Saturated evaporating temperature (°C) \ Tcond – Saturated condensing temperature (°C)	20	25	30	35	40	45	50	55	60	65
-40	7	8,2	9,6	11,1	12,8	14,6	16,6	18,8	21,3	23,9
-35	6,8	8	9,4	10,9	12,5	14,4	16,4	18,6	21	23,7
-30	6,5	7,8	9,1	10,6	12,3	14,1	16,1	18,4	20,8	23,5
-25	6,2	7,5	8,8	10,3	12	13,8	15,8	18,1	20,5	23,2
-20	5,9	7,1	8,5	10	11,6	13,5	15,5	17,7	20,1	22,8
-15	5,5	6,7	8,0	9,5	11,2	13,0	15,1	17,3	19,7	22,4
-10	5	6,2	7,5	9	10,7	12,5	14,6	16,8	19,2	21,9
-5	4,4	5,6	7,0	8,5	10,1	12,0	14	16,2	18,6	21,3
0		4,9	6,3	7,8	9,5	11,3	13,3	15,5	18	20,6
5			5,5	7	8,7	10,5	12,5	14,8	17,2	19,9
10			4,7	6,2	7,8	9,7	11,7	13,9	16,3	19
15				5,2	6,8	8,7	10,7	12,9	15,4	18

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

CF – Correction factor for the temperature (°C) of the liquid at the valve inlet

Tliq [°C]	-22	-16	-10	-4	2	8	14	20	26	32	38	44	50	56	62
CF	0.53	0.56	0.58	0.61	0.65	0.69	0.73	0.78	0.84	0.92	1	1.10	1.22	1.38	1.59

Table 2: identify the Correction Factor CF at the temperature nearest to Tliq (if no certain data is available, assume Tliq = Tcond – 5°C)

RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. 15°C	ΔPv [bar] 4	6	8	10	12	14	17
E2V09B	1.3	1.6	1.9	2.1	2.3	2.5	2.8
E2V11B	2.4	2.9	3.4	3.8	4.1	4.5	4.9
E2V14B	3.7	4.5	5.2	5.8	6.3	6.8	7.5
E2V18B	5.2	6.4	7.4	8.2	9	9.7	10.7
E2V24B	10.3	12.7	14.6	16.4	17.9	19.4	21.3
E2V35B	20.8	25.5	29.5	33	36.1	39	43
E3V45	36.4	44.5	51.4	57	63	68	75
E3V55	52	64	74	83	91	98	108
E3V65	74	91	105	117	128	138	153
E4V85	96	118	136	152	167	180	198
E4V95	134	164	189	211	232	250	276

Tevap. -10°C	ΔPv [bar] 8	10	12	14	17	20	25
E2V09B	1.7	1.9	2.1	2.2	2.5	2.7	2.9
E2V11B	3	3.3	3.7	4	4.4	4.7	5.2
E2V14B	4.6	5.1	5.6	6.1	6.7	7.2	7.9
E2V18B	6.5	7.3	8	8.6	9.5	10.3	11.3
E2V24B	12.9	14.5	15.9	17.1	18.9	20.5	22.4
E2V35B	26.1	29.2	31.9	34.5	38	41.2	45.2
E3V45	45.5	50.9	55.7	60	66	72	79
E3V55	65.6	73	80	87	96	104	114
E3V65	93	104	113	123	135	146	160
E4V85	120	135	147	159	176	190	209
E4V95	167	187	205	221	244	265	290

Tevap.	ΔPv [bar]						
10°C	4	6	8	10	12	14	17
E2V09B	1.3	1.6	1.9	2.1	2.3	2.5	2.7
E2V11B	2.3	2.9	3.3	3.7	4	4.4	4.8
E2V14B	3.6	4.4	5.1	5.7	6.2	6.7	7.4
E2V18B	5.1	6.2	7.2	8.1	8.8	9.5	10.5
E2V24B	10.1	12.4	14.3	16	17.5	19	20.9
E2V35B	20.4	25	28.9	32.3	35.4	38.2	42.1
E3V45	35.6	43.6	50.4	56	62	67	73
E3V55	51	63	73	81	89	96	106
E3V65	73	89	103	115	126	136	149
E4V85	94	115	133	149	163	176	194
E4V95	131	160	185	207	227	245	270

Tevap.	ΔPv [bar]						
-20°C	8	10	12	14	17	20	25
E2V09B	1.6	1.8	1.9	2.1	2.3	2.5	2.8
E2V11B	2.8	3.2	3.5	3.7	4.1	4.5	4.9
E2V14B	4.3	4.8	5.3	5.7	6.3	6.8	7.5
E2V18B	6.1	6.9	7.5	8.1	9	9.7	10.6
E2V24B	12.2	13.7	15	16.2	17.8	19.3	21.2
E2V35B	24.6	27.6	30.2	32.6	35.9	39	42.7
E3V45	43	48.1	52.6	57	63	68	74
E3V55	62	69	76	82	90	98	107
E3V65	87	98	107	116	128	138	152
E4V85	114	127	139	150	166	180	197
E4V95	158	177	194	209	230	250	274

Tevap.	ΔPv [bar]						
5°C	6	8	10	12	14	17	20
E2V09B	1.6	1.8	2	2.2	2.4	2.7	2.9
E2V11B	2.8	3.2	3.6	4	4.3	4.7	5.1
E2V14B	4.3	4.9	5.5	6.1	6.5	7.2	7.8
E2V18B	6.1	7	7.9	8.6	9.3	10.3	11.1
E2V24B	12.1	14	15.7	17.2	18.5	20.4	22.1
E2V35B	24.4	28.2	31.6	34.6	37.3	41.1	44.6
E3V45	42.6	49.2	55	60	65	72	78
E3V55	61	71	79	87	94	104	112
E3V65	87	100	112	123	133	146	158
E4V85	113	130	146	160	172	190	206
E4V95	157	181	203	222	240	264	286

Tevap.	ΔPv [bar]						
-30°C	8	10	12	14	17	20	25
E2V09B	1.5	1.7	1.8	2	2.2	2.4	2.6
E2V11B	2.7	3	3.3	3.5	3.9	4.2	4.6
E2V14B	4.1	4.6	5	5.4	6	6.5	7.1
E2V18B	5.8	6.5	7.1	7.7	8.5	9.2	10.1
E2V24B	11.6	12.9	14.2	15.3	16.8	18.3	20
E2V35B	23.3	26	28.5	30.8	34	36.8	40.3
E3V45	40.6	45.4	49.8	54	59	64	70
E3V55	58.6	66	72	78	85	93	101
E3V65	83	92	101	109	121	131	143
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Tevap.	ΔPv [bar]						
0°C	6	8	10	12	14	17	20
E2V09B	1.5	1.8	2	2.2	2.3	2.6	2.8
E2V11B	2.7	3.2	3.5	3.9	4.2	4.6	5
E2V14B	4.2	4.8	5.4	5.9	6.4	7	7.6
E2V18B	5.9	6.9	7.7	8.4	9.1	10	10.9
E2V24B	11.8	13.7	15.3	16.7	18.1	19.9	21.6
E2V35B	23.8	27.5	30.8	33.7	36.4	40.1	43.5
E3V45	41.6	48	53.7	59	64	70	76
E3V55	60	69	77	85	92	101	110
E3V65	85	98	109	120	129	143	155
E4V85	110	127	142	156	168	185	201
E4V95	153	177	198	216	234	258	279

Tevap.	ΔPv [bar]						
-40°C	8	10	12	14	17	20	25
E2V09B	1.4	1.6	1.7	1.9	2.1	2.2	2.5
E2V11B	2.5	2.8	3.1	3.3	3.7	4	4.4
E2V14B	3.8	4.3	4.7	5.1	5.6	6.1	6.7
E2V18B	5.5	6.1	6.7	7.2	8	8.7	9.5
E2V24B	10.9	12.2	13.3	14.4	15.9	17.2	18.9
E2V35B	21.9	24.5	26.9	29	32	34.7	38
E3V45	38.3	42.8	46.9	51	56	61	66
E3V55	55.2	62	68	73	80	87	96
E3V65	78	87	95	103	114	123	135
E4V85	--	--	--	--	--	--	--
E4V95	--	--	--	--	--	--	--

Table 3: The equivalent cooling capacity values in the table refer to a liquid temperature at the valve inlet = 38°C. For temperatures other than 38°C, in the table identify the valve with the equivalent capacity RATING that is higher than or equal to the required rated cooling capacity CAP multiplied by the coefficient shown in Table 2. To allow for any uncertainty in the design data, the values in the tables correspond to 80% of the maximum effective cooling capacity.

3.9 ELECTRONIC EXPANSION VALVE SELECTION

R744 (CO_2) refrigerant

R744 (CO_2)

ΔPC (bar) - Pressure head according to the temperature

Tcond – Saturated condensing temperature (°C)

Tevap – Saturated evaporating temperature (°C))	-15	-10	-5	0	5
-40	12,8	16,4	20,4	24,8	29,6
-35	10,9	14,4	18,4	22,8	27,6
-30	8,6	12,2	16,2	20,6	25,4
-25	6,1	9,7	13,6	18	22,8

Table 1: determine the design pressure head ΔP from the saturated evaporating temperature Tevap and condensing temperature Tcond for the chosen refrigerant

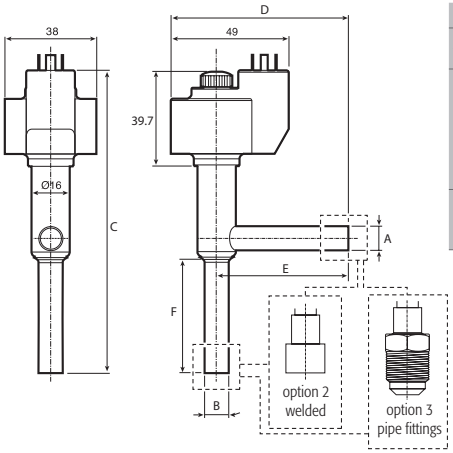
RATING (kW) – Equivalent cooling capacity of the CAREL valves

Tevap. -30°C	ΔPv [bar] 12	16	20	24
E2V09B	4.9	5.3	5.7	5.9
E2V11B	8.7	9.5	10	10.4
E2V14B	13.3	14.5	15.4	15.9
E2V18B	18.9	20.7	21.9	22.7
E2V24B	37.6	41.1	43.5	45.1
E2V35B	75.8	82.9	87.7	90.9
E3V45	--	--	--	--
E3V55	--	--	--	--
E3V65	--	--	--	--
E4V85	--	--	--	--
E4V95	--	--	--	--

Tevap. -40°C	ΔPv [bar] 16	20	24	29
E2V09B	5.6	6	6.2	6.4
E2V11B	10	10.6	11	11.3
E2V14B	15.3	16.2	16.8	17.3
E2V18B	21.8	23.1	24	24.6
E2V24B	43.4	46	47.7	48.9
E2V35B	87.5	92.7	96.1	98.6
E3V45	--	--	--	--
E3V55	--	--	--	--
E3V65	--	--	--	--
E4V85	--	--	--	--
E4V95	--	--	--	--

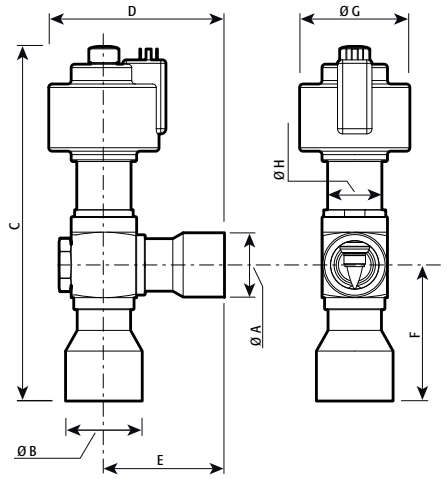
Table 3: the data are calculated with subcooling set at 5 °C.

4. DIMENSIONS



	Type of valve	A	B	C	D	E	F
opt. 1	E2V**BS000 st. steel 10-10	127.0 (5.0)	73.7 (2.90)	54.7 (2.15)	48.5 (1.98)	ID9/OD10 (in 0.35/out 0.39)	ID9/OD10 (in 0.35/out 0.39)
option 2	E2V**BSF00 copper 12-12 mm ODF	121.9 (4.79)	68.7 (2.70)	49.7 (1.95)	43.4 (1.71)	ID12.1/OD14 (in 0.47/out 0.55)	ID12.1/OD14 (in 0.47/out 0.55)
	E2V**BSM00 copper 16-16 mm ODF	123.9 (4.87)	70.7 (2.78)	51.7 (2.03)	45.4 (1.79)	ID16.1/OD18 (in 0.63/out 0.71)	ID16.1/OD18 (in 0.63/out 0.71)
option 3	E2V**BRB00 brass 3/8"-1/2" SAE	139.9 (5.51)	86.7 (3.41)	67.7 (2.66)	61.4 (2.42)	ID9/thread 3/4" (in 0.35 th. 3/4")	ID9/thread 3/4" (in 0.35 th. 3/4")

Figure 1: E^2V dimensions in mm (inches)



Type of valve	A	B	C	D	E	F	G	H
E3V45ASR00	18 (0.71)	22 (0.87)	139 (5.47)	67 (2.64)	39 (1.50)	46 (1.81)	56 (2.20)	22,5 (0.88)
E3V55ASR00	18 (0.71)	22 (0.87)	139 (5.47)	67 (2.64)	39 (1.50)	46 (1.81)	56 (2.20)	22,5 (0.88)
E3V65ASS00	22 (0.87)	28 (1.10)	149 (5.87)	76 (2.99)	48 (1.89)	56 (2.20)	56 (2.20)	22,5 (0.88)
E4V85AST00/10	28 (1.10)	35 (1.38)	198 (7.80)	88 (3.46)	56 (2.20)	71 (2.80)	64 (2.52)	31,5 (1.24)
E4V95AST00/10	35 (1.38)	42 (1.65)	206 (8.11)	102 (4.02)	70 (2.76)	79 (3.11)	64 (2.52)	31,5 (1.24)
E4V85ASU00/10*	35 (1.38)	42 (1.65)	206 (8.11)	102 (4.02)	70 (2.76)	79 (3.11)	64 (2.52)	31,5 (1.24)
E4V95ASU00/10*	28 (1.10)	35 (1.38)	198 (7.80)	88 (3.46)	56 (2.20)	71 (2.80)	64 (2.52)	31,5 (1.24)

* Available upon request

Note: codes E3V*****00 refer to E3V without inspection port
codes E4V*****00 refer to E4V with inspection port;
codes E4V*****10 refer to E4V without inspection port.

Figure 2: E^3V - E^4V dimensions in mm (inches)

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