MAKING MODERN LIVING POSSIBLE

Thermostatic expansion valves

TCAE, TCBE, TCCE

Technical brochure

Contents

Introduction

The TC thermostatic expansion valve has been developed and designed for soldering into hermetic refrigeration systems. It is manufactured in stainless steel and is therefore very suitable for installation in refrigeration systems for the food industry.
TC can be used in many different forms of refrigeration system, in particular:
- Mobile refrigeration equipment
- Air conditioning units
- Heat pump systems
- Refrigeration appliances
- Liquid coolers
- Ice cube machines
- Traditional refrigeration systems

All variants are available in both singlepacks and industrial packs as required by the customer.

TCAE with interchangeable orifice assembly and adjustable superheat.
TCBE with fixed orifice assembly and adjustable superheat.
TCCE with fixed superheat, otherwise it is identical with TCBE.
All types are straightway versions.

TCCE is manufactured to order, and consequently this technical leaflet contains no description of standard range and code numbers.
TC is also available in a range of variants that give countless valve combination possibilities. Contact Danfoss for further information.

Features

- *Bimetal connections*
  - straightforward and fast soldering (no wet cloth or cooling pliers required)
- *Refrigerants*
  R22, R134a, R404A, R507, R407C, R410A and future refrigerants
- *Capacities from 17.5 to 26.5 kW (5.0 to 7.5 TR) for R22*
- *Stable regulation*
- *Biflow function (orifice 1 and 2)*
- *Compact design*
  - small dimensions and low weight
- *Stainless steel, hermetically tight solder version*
  - high connection strength
  - high corrosion resistance
  - capillary tube joints of high strength and vibration resistance.
- *Laser-welded, stainless steel thermostatic diaphragm element*
  - optimum function
  - long diaphragm life
  - high pressure resistance
- *Stainless steel double contact bulb*
  - straightforward and fast installation
  - good heat transfer from bulb to pipe
- *Adjustable superheat type (TCAE/TCBE)*
  - accurate setting
  - adjustable in operation
- *Fixed superheat type (TCCE)*
- *Filter with high dirt retention capacity*
- *Available with self-cleaning bleed*
- *Available with MOP*
  (Max. Operating Pressure)

Standard range, TCAE

Versions available in the standard range.

Ranges for R22, R134a, R404A, R507, R407C and R410A:
N *–40 → +10°C without MOP*
N *–40 → +10°C MOP + 15°C*
NM *–40 → –5°C MOP + 0°C*

Ranges for R404A og R507
B *–60 → –25°C without MOP*
B *–60 → –25°C MOP –20°C*

Static superheat (SS) for R22, R134a, R404A, R407C, R410A
Valves without MOP: 5 K
Valves with MOP: 4 K

Static superheat (SS) for R507
Valves without MOP: 6.4 K
Valves with MOP: 5.4 K

Capillary tube length 1.5 m

Connections:
Inlet $^{3}/_{8}$ in./10 mm
$^{1}/_{2}$ in./12 mm
Outlet $^{5}/_{8}$ in./16 mm

Standard range, TCBE

Versions available in the standard range:
Ranges
N –40 → +10°C without MOP
N –40 → +10°C MOP + 15°C

Static superheat (SS) for R22, R134a, R404A, R407C, R410A
Valves without MOP: 5 K
Valves with MOP: 4 K

Static superheat (SS) for R507
Valves without MOP: 6.4 K
Valves with MOP: 5.4 K

Capillary tube length: 0.9 m

Connections:

Inlet	Orifice	1	$^3/_8$ in./10 mm
	Orifice	1-3	$^1/_2$ in./12 mm
Outlet			$^5/_8$ in./16 mm

Variant range TCBE/TCCE

In addition to the standard range, TCBE and TCCE valves are also available in these variants and variant combinations:
Ranges
NM –40 → –5°C MOP 0°C
B –60 → –25°C without MOP
B –60 → –25°C MOP -20°C
Valves to special temperature ranges can be supplied.

Static superheat (SS)
2K, 3K, 4K, 5K or 6K for both TCBE and TCCE.

Capillary tube length: 1.5 m

Bleed: 15%

Connections:

Inlet	Orifice	2-3	$^3/_8$ in./10 mm
Outlet	Orifice	1-3	$^1/_2$ in./12 mm

Technical data

Max. bulb temperature	100°C
Max. valve body temperature	120°C
short-lived peak	150°C
Max. working pressure (excl. R410A)	PS/MWP = 34 bar
Max. working pressure, R410A	PS/MWP = 42.5 bar
Max. test pressure (excl. R410A)	p' = 37.5 bar
Max. test pressure, R410A	p' = 47 bar

Biflow operation
With flow in the opposite direction, the rated capacity is reduced by up to 15%.
TC with orifice no. 3, cannot be used for biflow operation.

MOP-Valves

To avoid charge migration when MOP valves are used, the bulb temperature must be lower than the thermostatic element temperature.

MOP points

Refrigerant	Range **N** –40 → +10°C	Range **NM** –40 → –5°C	Range **B** –60 → –25°C
	MOP point for evaporating temperature t_0 and evaporating pressure p_0 [1]		
	t_e = +15°C/+60°F	t_e = 0°C/+32°F	t_e = –20°C/–4°F
R22	p_e = 100 psig/6.9 bar	p_e = 60 psig/4.0 bar	p_e = 20 psig/1.5 bar
R134a	p_e = 55 psig/3.9 bar	p_e = 30 psig/1.9 bar	
R404A / R507	p_e = 120 psig/8.4 bar	p_e = 75 psig/5.0 bar	p_e = 30 psig/2.0 bar
R407C	p_e = 95 psig/6.6 bar	p_e = 50 psig/3.6 bar	p_e = 15 psig/1.1 bar
R410A	p_e = 165 psig/11.5 bar	p_e = 100 psig/7.0 bar	p_e = 45 psig/3.0 bar

[1]) p_e in bar gauge

Identification

Main valve data is given on the element (fig. 1) on the valve body (fig. 2), or on the orifice assembly (fig. 3)

Valves with bleed are marked on the element or orifice assembly: BP 15 (=15% bleed of nominal capacity).

For valves with fixed superheat setting (type TCCE) the superheat is printed on the element (e.g. SS 5°C / 9°F).

Main valve data example, fig. 1

TCBE	=	Type (E = external pressure equalisation)
68U4204	=	Code numbers
R22	=	Refrigerant
MOP 100 / +15°C	=	MOP-point in psig and in °C
–40 / +10°C	=	Evaporating temperature range in °C
–40 / +50°F	=	Evaporating temperature range in °F
PB 34 bar/ MWP 500 psig	=	Max. working pressure in bar and psig
182B	=	Date marking (week **18**, year 2002, weekday **B** = Tuesday)

Main valve data example, fig. 2

⇒	=	Normal flow direction
IN	=	Connection in inches (MM = millimetres)
ORIF1	=	Orifice number 1
5.0 TR	=	Rated capacity Q_{nom}. in Tons of Refrigeration
17.5 kW	=	Rated capacity Q_{nom}. in kW

Example orifice assembly

TC	=	Valve type
1	=	Orifice number
68U4100 assembly	=	Code no., orifice with filter and gasket
327	=	Date marking (week **32**, year 199**7**)

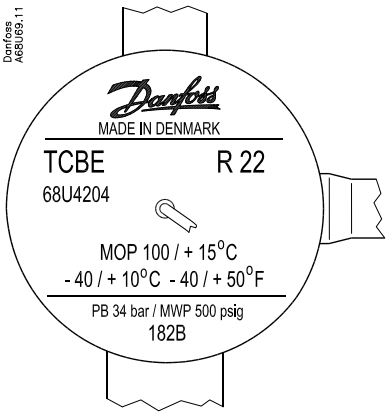


Fig. 1 Power element

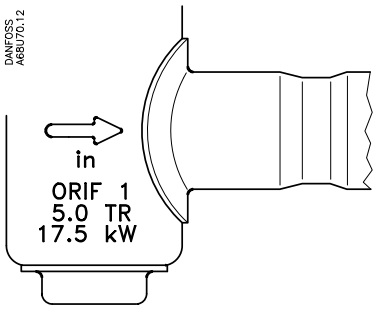


Fig. 2 Valve body

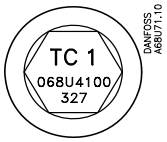
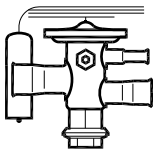


Fig. 3 Orifice assembly

Ordering
TCAE, straightway
Thermostatic element without orifice and with bulb strap



R22, R134a, R404A, R507, R407C, R410A

Refrigerant	Type	Pressure equlisation	Connection Inlet × outlet		Code no.				
					Range **N** –40/+10°C		Range **NM** –40/–5°C	Range **B** –60/–25°C	
			in.	mm	without MOP	with MOP	MOP 0°C	without MOP	with MOP
R22	TCAE	ext.	3/8 × 5/8		**068U4280**	**068U4282**	**068U4288**		
	TCAE	1/4 in.	1/2 × 5/8		**068U4281**	**068U4283**	**068U4289**		
	TCAE	ext.		10 × 16	**068U4284**	**068U4286**	**068U4290**		
	TCAE	6 mm		12 × 16	**068U4285**	**068U4287**	**068U4291**		
R134a	TCAE	ext.	3/8 × 5/8		**068U4292**	**068U4294**	**068U4300**		
	TCAE	1/4 in.	1/2 × 5/8		**068U4293**	**068U4295**	**068U4301**		
	TCAE	ext.		10 × 16	**068U4296**	**068U4298**	**068U4302**		
	TCAE	6 mm		12 × 16	**068U4297**	**068U4299**	**068U4303**		
R404A R507	TCAE	ext.	3/8 × 5/8		**068U4304**	**068U4306**	**068U4312**	**068U4316**	**068U4318**
	TCAE	1/4 in.	1/2 × 5/8		**068U4305**	**068U4307**	**068U4313**	**068U4317**	**068U4319**
	TCAE	ext.		10 × 16	**068U4308**	**068U4310**	**068U4314**	**068U4320**	**068U4322**
	TCAE	6 mm		12 × 16	**068U4309**	**068U4311**	**068U4315**	**068U4321**	**068U4323**
R407C	TCAE	ext.	3/8 × 5/8		**068U4324**	**068U4326**	**068U4332**		
	TCAE	1/4 in.	1/2 × 5/8		**068U4325**	**068U4327**	**068U4333**		
	TCAE	ext.		10 × 16	**068U4328**	**068U4330**	**068U4334**		
	TCAE	1/4 in.		12 × 16	**068U4329**	**068U4331**	**068U4335**		
R410A	TCAE	ext.	3/8 × 5/8		**068U4336**	**068U4338**	**068U4344**		
	TCAE	1/4 in.	1/2 × 5/8		**068U4337**	**068U4339**	**068U4345**		
	TCAE	ext.		10 × 16	**068U4340**	**068U4342**	**068U4346**		
	TCAE	6 mm		12 × 16	**068U4341**	**068U4343**	**068U4347**		

Capillary tube length 1.5 m

Ordering
TCAE, orifice assembly
with filter and gasket

Orifice [1]	Bleed%	Code no.
1	0	**068U4100**
1	15	**068U4097**
2	0	**068U4101**
2	15	**068U4098**
3	0	**068U4102**
3	15	**068U4099**

[1] TC with orifice no. 3, cannot be used for biflow operation.

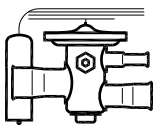
Spare parts

TCAE gaskets*) (24-off) **code no. 068U0015**

TCAE filter (24-off) **code no. 068U0016**

*) To secure tightness the orifice gasket must be exchanged each time the orifice assembly is unscrewed.

Ordering
TCBE, straightway
Thermostatic expansion valve with bulb strap



R22, R134a, R404A, R507, R407C, R410A

Refrigerant	Type	Rated capacity [2]		Orifice no.	Pressure equalisation	Code no.				
						Connection inlet × outlet	Range **N** –40/+10°C		Connection inlet × outlet	Range **N** –40/+10°C	
		kW	TR			in. × in.	without MOP	with MOP	mm × mm	without MOP	with MOP
R22	TCBE	17.5	5	1	ext.	3/8 × 5/8	**068U4200**	**068U4204**	10 × 16	**068U4208**	**068U4212**
	TCBE	17.5	5	1	ext.	1/2 × 5/8	**068U4201**	**068U4205**	12 × 16	**068U4209**	**068U4213**
	TCBE	21.0	6	2	ext.	1/2 × 5/8	**068U4202**	**068U4206**	12 × 16	**068U4210**	**068U4214**
	TCBE	26.5	7.5	3[1]	ext.	1/2 × 5/8	**068U4203**	**068U4207**	12 × 16	**068U4211**	**068U4215**
R134a	TCBE	12.0	3.5	1	ext.	3/8 × 5/8	**068U4216**	**068U4220**	10 × 16	**068U4224**	**068U4228**
	TCBE	12.0	3.5	1	ext.	1/2 × 5/8	**068U4217**	**068U4221**	12 × 16	**068U4225**	**068U4229**
	TCBE	14.5	4.1	2	ext.	1/2 × 5/8	**068U4218**	**068U4222**	12 × 16	**068U4226**	**068U4230**
	TCBE	18.0	5.2	3[1]	ext.	1/2 × 5/8	**068U4219**	**068U4223**	12 × 16	**068U4227**	**068U4231**
R404A R507	TCBE	13.5	3.8	1	ext.	3/8 × 5/8	**068U4232**	**068U4236**	10 × 16	**068U4240**	**068U4244**
	TCBE	13.5	3.8	1	ext.	1/2 × 5/8	**068U4233**	**068U4237**	12 × 16	**068U4241**	**068U4245**
	TCBE	16.0	4.5	2	ext.	1/2 × 5/8	**068U4234**	**068U4238**	12 × 16	**068U4242**	**068U4246**
	TCBE	20.0	5.7	3[1]	ext.	1/2 × 5/8	**068U4235**	**068U4239**	12 × 16	**068U4243**	**068U4247**
R407C	TCBE	19.0	5.4	1	ext.	3/8 × 5/8	**068U4248**	**068U4252**	10 × 16	**068U4256**	**068U4260**
	TCBE	19.0	5.4	1	ext.	1/2 × 5/8	**068U4249**	**068U4253**	12 × 16	**068U4257**	**068U4261**
	TCBE	23.0	6.5	2	ext.	1/2 × 5/8	**068U4250**	**068U4254**	12 × 16	**068U4258**	**068U4262**
	TCBE	28.5	8.1	3[1]	ext.	1/2 × 5/8	**068U4251**	**068U4255**	12 × 16	**068U4259**	**068U4263**
R410A	TCBE	23.0	6.5	1	ext.	3/8 × 5/8	**068U4264**	**068U4268**	10 × 16	**068U4272**	**068U4276**
	TCBE	23.0	6.5	1	ext.	1/2 × 5/8	**068U4265**	**068U4269**	12 × 16	**068U4273**	**068U4277**
	TCBE	27.5	7.8	2	ext.	1/2 × 5/8	**068U4266**	**068U4270**	12 × 16	**068U4274**	**068U4278**
	TCBE	34.0	9.8	3[1]	ext.	1/2 × 5/8	**068U4267**	**068U4271**	12 × 16	**068U4275**	**068U4279**

[1] TC with orifice no. 3, cannot be used for biflow operation.

[2] Rated capacity is based on:
Evaporating temperature
t_e = +5°C
Condensing temperature
t_c = +32°C
Refrigerant liquid temperature
t_l = +28°C
Opening superheat
OS = 4 K

Capillary tube length 0.9 m
Valves with inch connections have 1/4 in. pressure equalisation.
Valves with mm connections have 6 mm pressure equalisation.

Design/ Function

1. Bulb with capillary tube
2. Thermostatic element with diaphragm
3. Setting spindle for adjustment of static superheat SS
4. Orifice assembly
5. Filter

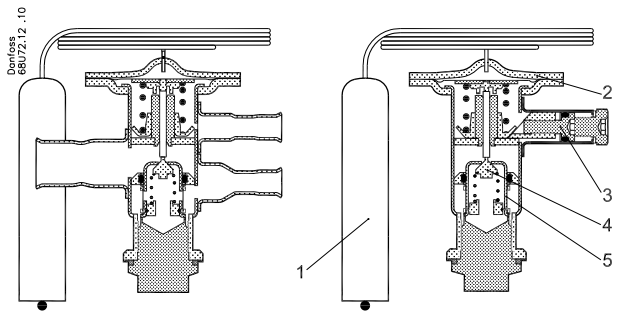


Fig. 4. TCAE, straightway

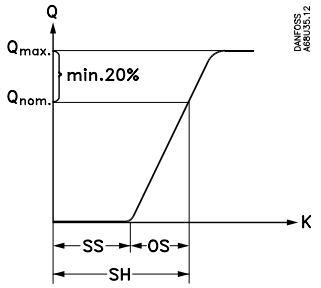


Fig. 5. Superheat

Superheat, TC
See fig. 5.

SS	=	static superheat
OS	=	opening superheat
SH	=	SS + OS = total superheat
$Q_{nom.}$	=	rated capacity of the valve
$Q_{max.}$	=	maximum capacity of the valve

Static superheat SS can be adjusted with setting spindle 3, see fig. 4 (TCAE/TCBE). Static superheat cannot be adjusted on TCCE.

The standard superheat setting SS is 5 K for valves without MOP and 4 K for valve with MOP.
The opening superheat OS is 4 K from when opening begins to where the valve gives its rated capacity $Q_{nom.}$.

Example

Static superheat	SS = 5 K
Opening superheat	OS = 4 K
Total superheat	SH = 5 + 4 = 9 K

Capacity

Correction for subcooling Δt_{sub}
The evaporator capacity used must be corrected if subcooling deviates from 4 K. The corrected capacity can be obtained by dividing the evaporator capacity by the correction factor given below.

Note:
Insufficient subcooling can produce flash gas.

	Δt_{sub}									
Correction factor	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R22	1.00	1.06	1.11	1.15	1.2	1.25	1.3	1.35	1.39	1.44
R134a	1.00	1.08	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.54
R404A / R507	1.00	1.1	1.2	1.29	1.37	1.46	1.54	1.63	1.7	1.78
R407C	1.00	1.08	1.14	1.21	1.27	1.33	1.39	1.45	1.51	1.57
R410A	1.00	1.08	1.15	1.21	1.27	1.33	1.39	1.45	1.50	1.56

Example
Refrigerant = R22
Evaporating temperature t_e = –10 °C
Pressure drop in valve Δp = 10 bar
Subcooling Δt_{sub} = 15 K
Evaporator capacity = 18 kW
Correction factor (table) = 1.11
The corrected evaporator capacity thus becomes 18 divided by 1.11 = 16.2 kW

Since the expansion valve capacity must be equal to or lightly more than the corrected evaporator capacity of 16.2 kW, a TC with orifice 1 and a table capacity of 16.3 would be a suitable choice.

Capacity

R22

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	11.6	15.4	17.7	19.3	20.5	21.3	21.8	22.2	10.8	14.1	16.2	17.6	18.6	19.2	19.7	20.1
	2	14.0	18.7	21.3	23.3	24.8	25.7	26.5	27.0	12.9	16.9	19.4	21.1	22.3	23.2	23.9	24.3
	3	17.4	23.0	26.5	28.9	30.7	31.9	32.8	33.4	16.2	21.2	24.4	26.4	27.8	29.1	30.0	30.6
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	9.6	12.5	14.2	15.4	16.3	16.9	17.3	17.5		10.7	21.1	13.1	13.8	14.2	14.5	14.8
	2	11.4	14.9	17.3	18.5	19.5	20.2	20.8	21.2		12.6	14.3	15.5	16.3	17.0	17.4	17.7
	3	14.4	18.8	21.4	23.3	24.7	25.7	26.5	27.1		16.0	18.2	19.8	21.2	21.8	22.5	23.0
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1		8.7	9.9	10.6	11.1	11.5	11.8	11.9			7.7	8.3	8.7	8.9	9.1	9.3
	2		10.2	11.6	12.5	13.2	13.7	14.0	14.3			9.0	9.7	10.2	10.6	10.8	11.0
	3		13.1	14.9	16.1	17.1	17.8	18.3	18.7			11.6	12.6	13.3	13.9	14.3	14.6

Capacity in kW for range B: –60°C to –25°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TC	1	8.1	10.5	11.9	12.9	13.6	14.2	14.6	14.8	7.4	9.5	10.8	11.7	12.3	12.8	13.1	13.4
	2	10.4	13.4	15.3	16.7	17.8	18.6	19.3	19.9	9.4	12.1	13.9	15.1	16.1	16.8	17.4	17.9
	3	13.6	17.3	19.8	21.7	23.1	24.3	25.3	26.1	12.2	15.7	18.0	19.7	21.0	22.1	23.0	23.8
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TC	1	5.9	7.5	8.5	9.2	9.7	10.1	10.3	10.5	4.5	5.7	6.4	6.9	7.3	7.6	7.8	7.9
	2	7.4	9.5	10.9	11.9	12.6	13.2	13.7	14.1	5.6	7.2	8.2	8.9	9.5	9.9	10.3	10.6
	3	9.7	12.5	14.3	15.7	16.8	17.7	18.4	19.1	7.4	9.5	10.8	11.9	12.7	13.4	14.0	14.5
		Evaporating temperature –60°C															
TC	1	3.2	4.1	4.6	5.0	5.2	5.4	5.6	5.6								
	2	4.0	5.1	5.9	6.4	6.8	7.1	7.4	7.6								
	3	5.3	6.8	7.8	8.6	9.2	9.7	10.1	10.5								

Correction factors for subcooling Δt_{sub}

Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R22	1.00	1.06	1.11	1.15	1.20	1.25	1.30	1.35	1.39	1.44

Capacity

R134a

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	9.0	11.4	12.8	13.6	13.9	14.1			8.0	10.1	11.2	11.6	12.1	12.3		
	2	11.3	14.5	16.2	17.2	17.8	18.0			10.1	12.7	14.1	14.9	15.4	15.6		
	3	14.5	18.5	20.6	21.9	22.7	23.1			13.0	16.5	18.2	19.3	19.9	20.3		
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	6.8	8.5	9.4	9.9	10.2	10.2				6.9	7.6	8.0	8.1	8.2		
	2	8.6	10.7	11.8	12.5	12.8	13.0				8.6	9.5	10.0	10.3	10.4		
	3	11.2	13.9	15.4	16.3	16.8	17.1				11.3	12.5	13.2	13.6	13.8		
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1		5.4	5.9	6.1	6.2	6.2				4.0	4.3	4.5	4.6	4.5		
	2		6.5	7.3	7.6	7.8	7.9				4.9	5.3	5.6	5.7	5.7		
	3		8.8	9.7	10.2	10.5	10.7				6.5	7.2	7.5	7.7	7.8		

Correction factors for subcooling Δt_{sub}

Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R134a	1.00	1.08	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.54

Capacity

R404A

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	8.2	10.6	11.9	12.6	12.9	13.0	12.8	12.5	7.7	9.9	11.1	11.7	12.0	12.0	11.9	11.6
	2	10.4	13.5	15.1	16.1	16.4	16.5	16.3	15.9	9.8	12.6	14.0	14.8	15.2	15.2	15.1	14.7
	3	13.2	17.0	19.0	20.2	20.7	20.8	20.6	20.1	12.6	16.0	17.8	18.9	19.3	19.4	19.2	18.8
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	7.0	8.9	9.9	10.4	10.6	10.7	10.3	10.2		7.7	8.5	8.9	9.1	9.1	8.9	8.7
	2	8.9	11.3	12.7	13.1	13.4	13.5	13.3	13.0		9.6	10.7	11.2	11.4	11.4	11.3	11.0
	3	11.4	14.5	16.1	16.9	17.3	17.4	17.2	16.8		12.6	13.8	14.5	14.8	14.9	14.7	14.5
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1			7.0	7.3	7.4	7.4	7.2	7.0			5.5	5.7	5.8	5.7	5.6	5.4
	2			8.7	9.1	9.2	9.2	9.1	8.9			6.8	7.1	7.2	7.2	7.0	6.8
	3			11.4	11.9	12.2	12.2	1.2.0	11.8			9.1	9.5	9.6	9.6	9.5	9.3

Capacity in kW for range B: –60°C to –25°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TC	1	7.2	9.1	10.0	10.4	10.6	10.6	10.4	10.1	6.7	8.3	9.1	9.5	9.6	9.6	9.4	9.2
	2	9.1	11.4	12.6	13.3	13.6	13.6	13.5	13.2	8.4	10.4	11.5	12.0	12.3	12.3	12.2	12.0
	3	11.9	14.8	16.4	17.2	17.7	17.9	17.8	17.6	10.3	13.6	15.0	15.8	16.2	16.4	16.3	16.1
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TC	1	5.4	6.6	7.2	7.5	7.6	7.6	7.4	7.2		5.1	5.5	5.7	5.7	5.7	5.6	5.4
	2	6.8	8.5	9.1	9.6	9.7	9.8	9.6	9.4		6.3	6.9	7.2	7.3	7.3	7.2	7.0
	3	8.9	11.0	12.1	12.7	13.1	13.2	13.1	12.9		8.4	9.2	9.7	10.0	10.0	10.0	9.8
		Evaporating temperature –60°C															
TC	1			3.9	4.1	4.1	4.0	3.9	3.8								
	2			4.9	5.1	5.2	5.2	5.1	4.9								
	3			6.7	7.0	7.2	7.3	7.2	7.0								

Correction factors for subcooling Δt_{sub}

Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R404A	1.00	1.10	1.20	1.29	1.37	1.46	1.54	1.63	1.70	1.78

Capacity

R407C

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	11.5	15.0	17.0	18.4	19.2	19.7	19.9	19.9	10.6	13.7	15.5	16.6	17.0	17.7	17.9	17.9
	2	14.5	18.8	21.6	23.2	24.3	25.0	25.3	25.4	13.3	17.2	19.5	21.0	21.9	22.4	22.7	22.8
	3	18.3	23.9	27.1	29.2	30.5	31.4	31.9	31.9	16.8	21.9	24.7	26.6	27.8	28.6	29.9	29.2
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	9.3	12.0	13.5	14.5	15.1	15.4	15.5	15.5	7.9	10.1	11.3	12.1	12.5	12.8	12.9	12.9
	2	11.7	15.1	17.0	18.2	18.9	19.4	19.7	19.7	9.9	12.6	14.2	15.1	15.7	16.1	16.3	16.3
	3	15.3	19.3	21.8	23.3	24.3	25.0	25.4	25.6	12.9	16.3	18.3	19.6	20.5	21.0	21.4	21.5
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1		8.2	9.1	9.7	10.0	10.2	103	10.3			7.0	7.4	7.7	7.8	7.8	7.8
	2		10.1	11.3	12.0	12.5	12.8	12.9	13.0			8.6	9.2	9.5	9.7	9.8	9.8
	3		13.2	14.8	15.8	16.5	16.9	17.2	17.3			11.4	12.2	12.7	13.0	13.2	13.3

Capacity in kW for range B: –60°C to –25°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TC	1	7.5	9.5	10.6	11.5	11.8	12.1	12.2	12.3	6.7	8.5	9.5	10.2	10.6	10.8	10.9	10.9
	2	9.4	12.0	13.5	14.5	15.2	15.7	16.0	16.1	8.5	10.8	12.1	13.0	13.6	14.0	14.2	14.4
	3	12.5	15.9	18.0	19.4	20.5	21.2	21.8	22.2	11.2	14.3	16.1	17.4	18.4	19.1	19.6	20.0
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TC	1	5.3	6.6	7.4	7.8	8.2	8.3	8.4	8.4	3.9	4.9	5.5	5.8	6.0	6.1	6.2	6.2
	2	6.6	8.3	9.3	10.0	10.5	10.8	11.0	11.1	4.9	6.1	6.9	7.4	7.7	7.9	8.1	8.1
	3	8.8	11.1	12.6	13.6	14.4	14.9	15.4	15.7	6.6	8.3	9.4	10.1	10.7	11.1	11.4	11.7
		Evaporating temperature –60°C															
TC	1	2.8	3.5	3.9	4.1	4.2	4.3	4.3	4.3								
	2	3.5	4.3	4.9	5.2	5.4	5.6	5.6	5.7								
	3	4.7	5.9	6.7	7.2	7.6	7.9	8.1	8.3								

Correction factors for subcooling Δt_{sub}

Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R407C	1.00	1.08	1.14	1.21	1.27	1.33	1.39	1.45	1.51	1.57

Capacity

R507

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	8.1	10.6	12.1	13.0	13.4	13.7	13.8	13.6	7.6	9.9	11.2	11.9	12.4	12.6	12.6	12.5
	2	10.3	13.5	15.3	16.5	17.1	17.4	17.6	17.4	9.7	12.5	13.9	15.1	15.8	16.0	16.1	16.0
	3	13.0	17.1	19.2	20.8	21.6	22.1	22.1	22.0	12.4	15.9	18.0	19.3	20.0	20.4	20.5	20.4
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	7.0	8.9	10.0	10.6	11.0	11.1	11.2	11.1		7.7	8.6	9.1	9.4	9.5	9.5	9.4
	2	8.7	11.2	12.6	13.4	13.9	14.1	14.2	14.1		9.7	10.8	11.4	11.8	12.0	12.0	11.9
	3	11.3	14.4	16.2	17.3	17.9	18.2	18.3	18.2		12.6	14.0	14.8	15.3	15.6	15.7	15.6
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1			7.1	7.5	7.7	7.7	7.7	7.6			5.6	5.9	6.0	6.0	6.0	5.9
	2			8.8	9.3	9.6	9.7	9.7	9.6			7.0	7.3	7.5	7.6	7.5	7.5
	3			11.5	12.2	12.6	12.8	12.9	12.8			9.2	9.7	10.0	10.1	10.1	10.0

Capacity in kW for range B: –60°C to –25°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		2	4	6	8	10	12	14	16	2	4	6	8	10	12	14	16
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TC	1	7.4	9.3	10.3	10.8	11.2	11.3	11.3	11.2	6.8	8.5	9.4	9.9	10.2	10.3	10.3	10.2
	2	9.2	11.9	13.2	14.0	14.5	14.8	14.9	14.8	8.7	10.9	12.0	12.8	13.2	13.4	13.5	13.5
	3	12.3	15.4	17.1	18.3	19.0	19.4	19.7	19.7	11.4	14.2	15.7	16.8	17.4	17.8	18.1	18.1
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TC	1	5.6	6.9	7.5	7.9	8.1	8.2	8.2	8.1		5.3	5.8	6.0	6.1	6.2	6.1	6.0
	2	7.1	8.8	9.6	10.2	10.5	10.7	10.7	10.7		6.7	7.3	7.7	7.9	8.1	8.1	8.0
	3	9.4	11.5	12.8	13.6	14.1	14.5	14.6	14.7		8.9	9.8	10.4	10.8	11.1	11.2	11.3
		Evaporating temperature –60°C															
TC	1			4.2	4.3	4.4	4.4	4.4	4.3								
	2			5.3	5.5	5.7	5.8	5.7	5.7								
	3			7.2	7.6	7.9	8.1	8.1	8.1								

Correction factors for subcooling Δt_{sub}

Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R507	1.00	1.10	1.20	1.29	1.37	1.46	1.54	1.63	1.70	1.78

Capacity

R410A

Capacity in kW for range N: –40°C to +10°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		3	6	9	12	15	18	21	24	3	6	9	12	15	18	21	24
		Evaporating temperature +10°C								**Evaporating temperature 0°C**							
TC	1	13.9	18.2	20.6	22.2	23.0	23.4	23.3	22.9	12.7	16.6	18.9	20.2	21.0	21.4	21.4	21.2
	2	17.6	23.1	26.3	28.2	29.3	29.8	29.8	29.4	16.1	21.1	23.9	25.7	26.7	27.2	27.3	27.0
	3	22.2	29.2	33.2	35.6	37.0	37.7	37.6	36.9	20.8	26.9	30.6	32.8	34.2	34.9	35.0	34.7
		Evaporating temperature –10°C								**Evaporating temperature –20°C**							
TC	1	11.3	14.6	16.6	17.7	18.4	18.7	18.8	18.6		12.4	13.8	14.9	15.5	15.7	15.8	15.6
	2	14.1	18.4	20.9	22.4	23.3	23.8	23.9	23.7		15.5	17.5	18.8	19.5	19.9	20.0	19.9
	3	18.4	23.8	27.0	29.0	30.2	30.8	31.1	30.9		20.3	22.9	24.5	25.6	26.1	26.3	26.3
		Evaporating temperature –30°C								**Evaporating temperature –40°C**							
TC	1		10.1	11.3	12.0	12.5	12.7	12.7	12.6			8.8	9.3	9.7	9.8	9.8	9.7
	2		12.4	14.0	15.1	15.6	16.0	16.0	15.9			10.9	11.6	12.1	12.3	12.3	12.3
	3		16.5	18.6	19.9	20.7	21.2	21.4	21.3			14.5	15.5	16.1	16.5	16.6	16.6

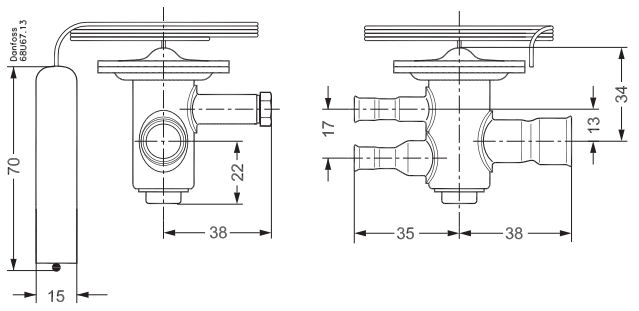
Capacity in kW for range B: –60°C to –25°C and opening superheat OS = 4 K

Type	Orifice no.	Pressure drop across the valve Δp bar								Pressure drop across the valve Δp bar							
		3	6	9	12	15	18	21	24	3	6	9	12	15	18	21	24
		Evaporating temperature –25°C								**Evaporating temperature –30°C**							
TC	1	12.7	16.4	18.5	19.8	20.5	20.9	21.0	20.9	11.8	15.1	17.0	18.2	18.9	19.3	19.4	19.3
	2	16.3	21.0	23.8	25.6	26.7	27.4	27.7	27.7	15.1	19.3	21.8	23.5	24.6	25.2	25.6	25.6
	3	21.2	27.2	30.9	33.3	34.9	35.9	36.6	36.6	19.7	25.3	28.6	30.9	32.4	33.5	34.1	34.3
		Evaporating temperature –40°C								**Evaporating temperature –50°C**							
TC	1	9.8	12.4	13.9	14.9	15.5	15.8	15.9	15.8	7.7	9.7	10.9	11.6	12.0	12.3	12.3	12.3
	2	12.4	15.8	17.8	19.2	20.1	20.7	21.0	21.0	9.6	12.2	13.8	14.9	15.6	16.1	16.3	16.4
	3	16.3	20.9	23.7	25.6	27.0	28.0	28.6	28.9	12.9	16.4	18.7	20.2	21.4	22.2	22.7	23.0
		Evaporating temperature –60°C															
TC	1		7.2	8.0	8.5	8.9	9.0	9.1	9.0								
	2		9.0	10.2	11.0	11.5	11.8	12.0	12.1								
	3		12.2	13.9	15.1	16.0	16.6	17.0	17.3								

Correction factors for subcooling Δt_{sub}

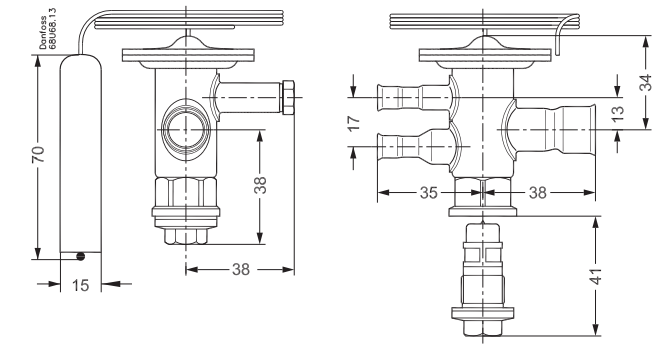
Δt_{sub}	4 K	10 K	15 K	20 K	25 K	30 K	35 K	40 K	45 K	50 K
R410A	1.00	1.08	1.15	1.21	1.27	1.33	1.39	1.45	1.50	1.56

Dimensions and weight



Dimensions connections, see table page 6
Fig. 6. TCBE, straightway

Weight
0.15 kg



Dimensions connections, see table page 6
Fig. 7. TCAE, straightway

Weight
0.23 kg