ALCO's TX3 series of Thermo®-Expansion Valves are designed for air conditioning, heat pumps and commercial refrigeration applications. The TX3 is ideal for those applications requiring hermetic / compact size combined with stable and accurate control over wide load and evaporating temperature ranges.

TX3

Features

- Compact size
- Hermetic design
- Nine sizes up to 23kW
- Brazing connections with straight through configuration
- Stainless steel power element resists corrosion
- Large diaphragm provides smoother and consistent valve control
- Internal or external equalizer
- External superheat adjustment
- Version with internal check valve eliminates external check valve for heat pump applications
- Packaging units with 24 pieces, no single packs

Options

- Metric connections upon request
- Bleed function, minimum order quantity 100 pieces per batch and type

Introduction

Thermo®-Expansion Valves control the superheat of refrigerant vapour at the outlet of the evaporator. They act as a throttle device between the high and low pressure sides of refrigeration system and ensure the rate of refrigerant flow into the evaporator exactly matches the rate of evaporation of liquid refrigerant. Thus the evaporator is fully utilized and no liquid refrigerant may reach the compressor.

When the actual superheat is higher than the setpoint, thermo® expansion valve feeds the evaporator with more liquid refrigerant when the actual superheat is higher than the set point of the valve. Likewise, the valve decreases the refrigerant flow to the evaporator when the actual superheat is lower than the set point.

Description of bulb charges

The application ranges of thermo® expansion valves are heavily influenced by the selected charge.

Liquid charges

The behaviour of Thermo®-Expansion Valves with liquid charges is exclusively determined by temperature changes at the bulb and not subject to any cross-ambient interference. They feature a moderate response time and thus stabilize the control circuit. Liquid charges **cannot incorporate MOP functions.**

The maximum bulb temperatures shall not exceed the values in the following table:

Refrigerant	Maximum bulb temperature	
	TX3	TX3 with internal check valve
R 134a	88°C	-
R 22 / R 407C	71°C	120°C
R 404A / R 507	66°C	-
R 410A	66°C	-

Table 1: This table refers to the maximum dehydration temperature when the bulb and valve body are subjected to the same temperature.

TX3 with internal check valve are suitable for heat pump applications and incorporate special liquid charges and ballasted bulbs. Ballast in the bulb leads to slow opening and fast closure of the valve. Maximum bulb temperature is 120 °C.

Gas charges

The behaviour of thermo® expansion valves with gas charges will be determined by the lowest temperature at any part of the expansion valve (power assembly, capillary tube or bulb). If any parts other than the bulb are subject to the lowest temperature, malfunction of the expansion valve may occur (i.e. erratic low pressure or excessive superheat). ALCO TX3 valves with gas charges **always feature MOP functions** and include ballasted bulbs. Ballast in the bulb leads to slow opening and fast closure of the valve. Maximum bulb temperature is 120 °C.

MOP (Maximum Operating Pressure)

MOP functionality is somewhat similar to the application of a crankcase pressure regulator. Evaporator pressures are limited to a maximum value to protect compressors from overload conditions.

MOP selection should be within maximum allowed low pressure rating of the compressor and should be at approximately 3 K above maximum evaporating temperature.

MOP	Upper limit of evaporating temperature					
(bar)	**R 134a**	**R 22**	**R 407C**	**R 404A**	**R 410A**	**R 507**
2.3				-18°C		-18.7°C
3.3	+11°C					
6.4		+13°C	+14.5°C			
12.9					+17°C	

Table 2: (All pressures are gauge pressure)

Practical hints:

Superheat adjustments influence the MOP:

- Increase of superheat: Decrease of MOP
- Decrease of superheat: Increase of MOP

Subcooling

Subcooling generally increases the capacity of refrigeration system and may be accounted for when dimensioning an expansion valve by applying the correction factor K_t.

The capacity corrections for evaporating temperature, condensing temperature and subcooling are all incorporated in K_t. These are in particular the liquid density upstream from the expansion valve, the different enthalpies of liquid and vapour phase refrigerants as well as certain part of flash gas after expansion. The percentage of flash gas differs with various refrigerants and depends on system conditions.

Heavy subcooling results in very small flash gas amounts and therefore increases expansion valve capacities. These conditions are not covered by K_t. Likewise, small flash gas amounts lead to reduced evaporator capacities and may result in substantial discrepancies between the capacities of the thermo® expansion valve and the evaporator.

These effects must be considered during component selection when designing refrigeration circuits. In cases when subcooling exceeds 15 K sizing of components (K_t, $K_{\Delta p}$) shall be modified accordingly. ALCO CONTROLS will be happy to assist you. Please contact our application engineering department.

Bleed function

In systems with some type of single phase compressor (such as permanent split capacitor motor, small rotary compressor etc.), it is necessary to provide some means of equalization between high and low side pressure during “off” cycle, so that the motor of compressor can start with minimum torque.

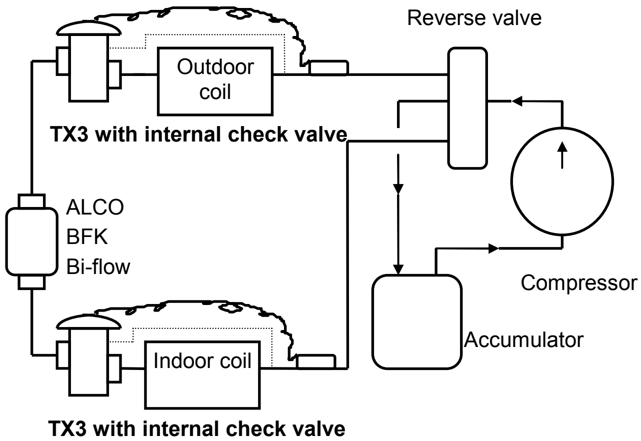
The required bleed hole size for a particular system is a function of the high side and low side volumes, the pressure difference across the valve at the time of shut-down, the required equalization time and the amount of refrigerant charge.

Due to the many variables, each application must be tested to determine the correct size of bleed hole. It should be remembered that bleed hole size adds to the total effective port area of the TXV and may affect size of valve. Final selection of bleed hole size should be made only after thorough testing.

Heat pump applications

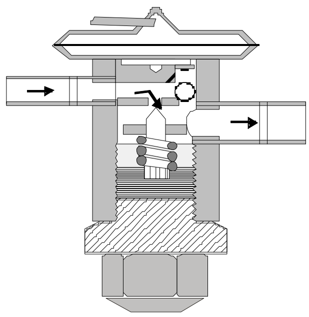
There are several ways to apply an expansion valve in a heat pump:

1) Thermo-Expansion Valves with internal check valves

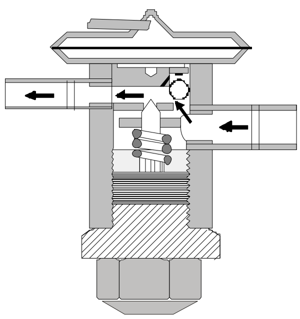


This system is very simple because TX3 expansion valves with integrated check valves have been used.

ALCO TX3 with internal check valve and special liquid charge is ideal for use in heat pump applications.

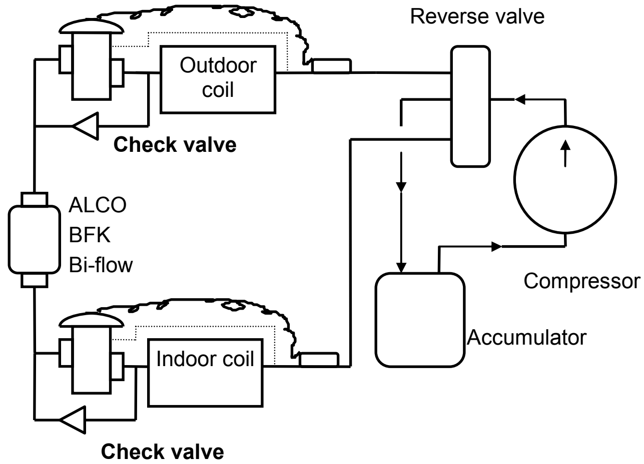


TX3 with internal check valve in normal flow



TX3 with internal check valve in reverse flow

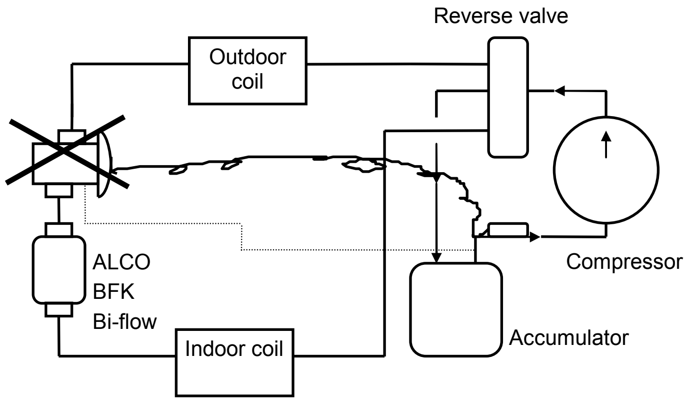
2) Thermo-Expansion valves with external check valves



This type of system employs two expansion valves and two check valves. In this type of application, the charge of expansion valves should be able to withstand the high temperatures during reverse flow.

Expansion valves with gas charge are not recommended in heat pumps with automatic operation between heating and cooling mode due to the cross ambient effect on TXV after reversing flow direction.

3) The TX3 are not designed to operate in Bi-flow accordance to the following circuit



Please contact ALCO CONTROLS for applications requiring Thermo®-Expansion Valves with Bi-flow capability.

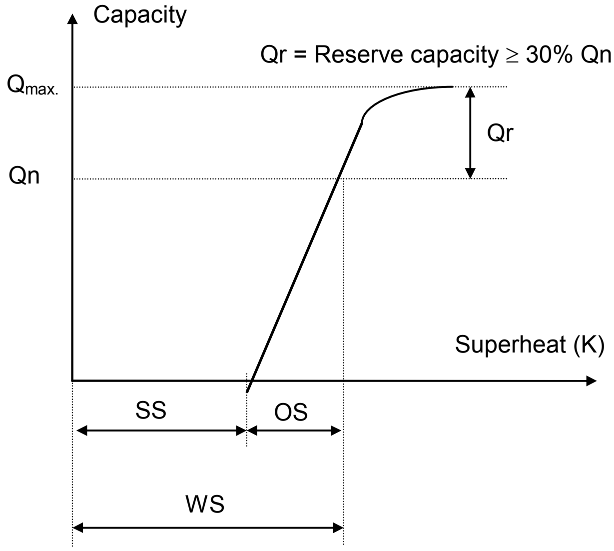
Superheat

The factory setting of TX3 is made with the valve pin just starting to move away from seat. The superheat increment necessary to get the pin ready to move is called static superheat (SS). A superheat increment over and beyond the static superheat (factory setting) is necessary for the valve pin to open to its rated capacity. This additional superheat is known as gradient or opening superheat (OS).

The working superheat, which can be measured in field, is the sum of static superheat and opening superheat (WS).

The opening superheat of TXV varies if the selected valve operates at higher or lower capacities than rated capacity. It is highly recommended to select the valve according to the rated capacity. Using reserve capacity leads to larger opening superheat and longer pull down time during start-up or after defrost.

Selecting a larger valve than required in system may lead to smaller opening superheat and/or hunting of TXV.



Static superheat setting

ALCO Thermo®-Expansion Valves are factory preset for optimum superheat settings. This setting should be modified only if absolutely necessary. The readjustment should be at the **lowest** expected evaporating temperature.

Standard superheat setting

Charge	Refrigerant	Conditions of setting: Inlet pressure into valve (bar)	Saturated evaporating temperature °C	Bulb temperature °C	Setting Nominal static superheat (SS), K	Given Nominal opening superheat (OS), K *)
Liquid (no MOP)	**R 134a**	7.6	-3.3	±0	3.3	2.7
	R 22	8.6				3.0
	R 407C					
	R 404A		-4.4		4.4	2.7
	R 507		-5.3		5.3	
Liquid (heat pumps)	**R 22**		-3.3		3.3	3.0
MOP 3.3 bar	**R 134a**	7.6				
MOP 6.4 bar	**R 22**	8.6				
	R 407C					
MOP 2.3 bar	**R 404A**		-22.2	-17.8	4.4	4.0
	R 507		-23.1	-17.8	5.3	
MOP 12.9 bar	**R 410A**	18.9	-3.3	±0	3.3	3.0

*) The given opening superheats valid when the capacity of selected valve is equal to the capacity of system at design / operating conditions.

Note : All given pressures are gauge pressure.

Dimensioning of Thermo®-Expansion Valves

To apply proper Thermo®-Expansion Valves on a system, the following design conditions must be available:

- Cooling capacity (Q_0)
- Effective pressure differential across TXV (Δp)
- Evaporating temperature / pressure
- Lowest possible condensing temperature / pressure
- Liquid temperature at the inlet of TXV
- Refrigerant

To facilate valve dimensioning for other than the standard conditions ALCO offers an **Excel based Selection Tool.** This can be downloaded from www.emersonclimate.eu .

Otherwise the following formula has to be used:

Cooling capacity x $K_{\Delta p}$ x K_t = Nominal capacity of TXV

- Select K_t-factor according to refrigerant, liquid and evaporating temperature from tables on pages 10-12.
- Determine effective pressure differential across the Thermo®-Expansion Valve using condensing pressure, subtract evaporating pressure and all other possible pressure losses. Select $K_{\Delta p}$-factor from tables on pages 10-12.

Example 1

A valve has to be selected for the following conditions:

• Refrigerant	R 134a
• System cooling capacity	6 kW
• Evaporating temperature	-10°C
• Lowest condensing temperature	+25°C
• Liquid temperature	+20°C
• Valve with adjustable superheat	

Calculation:

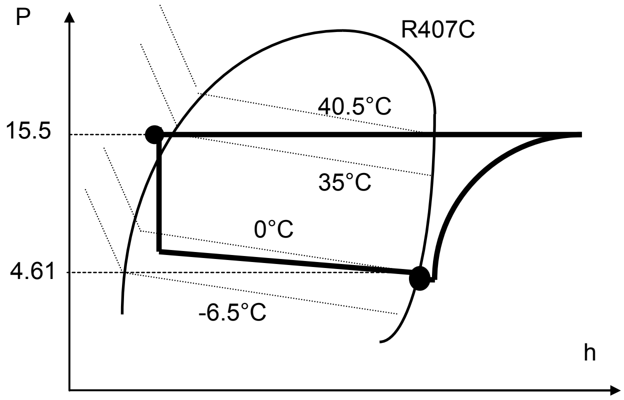
1. Theoretical pressure differential:
   Condensing pressure P_c = 5.65 bar at +25°C
   Evaporating pressure P_0 = 1.01 bar at -10°C
   Differential pressure $P_c - P_0$ = 5.65 - 1.01 = 4.64 bar
2. Pressure losses:
   across distributor = 1.0 bar
   in piping, solenoid valve, drier, sight glass, fitting, etc. = 0.84 bar
   Total pressure losses = 1 + 0.84 = 1.84 bar
3. Effective pressure differential across valve:
   4.64 - 1.84 = 2.8 bar
4. Correction factors:
   Correction factor $K_{\Delta p}$ for the pressure differential 2.8 bar from table on page 13 for R 134a
   Δp = 2.8 **$K_{\Delta p}$ = 1.5**
   Correction factor K_t for liquid and evaporating temperature from table on page 13 for R 134a
   at +20°C / -10°C **K_t = 0.88**
5. Calculation of nominal capacity Q_0 x $K_{\Delta p}$ x K_t = Qn
   6.0 x 1.5 x 0.88 = 7.92 kW.
   You can select the valve from table on page 6.

It is a TX3-M26 with a nominal capacity of 8.3 kW.

Dimensioning of Thermo®-Expansion Valves for systems with refrigerant R 407C

As opposed to single substances (e.g. R 22, R 134a etc.) where the phase change takes place at a constant temperature /pressure, the evaporation and condensation of zeotropic blend R407C is in a “gliding” form (e.g. at a constant pressure the temperature varies within a certain range) through evaporators and condensers.

The evaporating / condensing pressure must be determined at saturated temperatures (bubble / dew points) for dimensioning of Thermo®-Expansion Valves.



Example 2

• Refrigerant	R 407C
• System cooling capacity	13 kW
• Evaporating temperature (saturated vapour)	0°C
• Lowest condensing temperature (saturated liquid)	+35°C
• Liquid temperature	+34°C
• Non-adjustable valve with MOP	

Calculation:

1. Theoretical pressure differential:
   Differential pressure is $P_c - P_0$ = 15.5 - 4.61 = 10.89 bar
2. Pressure losses:
   across evaporator = 0.3 bar
   in piping, solenoid valve, drier, sight glass, fitting, etc. = 1.2 bar
   Total pressure losses = 0.3 + 1.2 = 1.5 bar
3. Effective pressure differential across valve:
   10.89 - 1.5 = 9.39 bar
4. Correction factors:
   Correction factor $K_{\Delta p}$ for the pressure differential 9.39 bar from table on page 11 for R 407C
   Δp = 9.39 **$K_{\Delta p}$ = 1.09**
   Correction factor K_t for liquid and evaporating temperature from table on page 11 for R 407C
   at +34°C / 0°C **K_t = 0.98**
5. Calculation of nominal capacity Q_0 x $K_{\Delta p}$ x K_t = Qn
   13 x 1.09 x 0.98 = 13.88
   You can select the valve from table on page 6.

It is a TX3-N37 with a nominal capacity of 14.2 kW.

Selection table

Refrigerant	Nominal capacity kW	without MOP Type	without MOP Part No.	with MOP *) Type	with MOP *) Part No.	Connection size Equalizer	Connection size Inlet x Outlet
R 134a	0,6	TX3-M01	801765M	TX3-M11	801777M	Internal	1/4" x 3/8"
	1,8	TX3-M02	801766M	TX3-M12	801778M	Internal	1/4" x 3/8"
	2,8	TX3-M03	801767M	TX3-M13	801779M	Internal	1/4" x 3/8"
	4,0	TX3-M04	801768M			Internal	3/8" x 1/2"
	1,8	TX3-M22	801769M	TX3-M32	801781M	Ext. 1/4"	1/4" x 3/8"
	2,8	TX3-M23	801770M	TX3-M33	801782M	Ext. 1/4"	1/4" x 3/8"
	4,0	TX3-M24	801771M	TX3-M34	801783M	Ext. 1/4"	3/8" x 1/2"
	6,1	TX3-M25	801772M	TX3-M35	801784M	Ext. 1/4"	3/8" x 1/2"
	8,3	TX3-M26	801773M	TX3-M36	801785M	Ext. 1/4"	3/8" x 1/2"
	10,2	TX3-M27	801774M	TX3-M37	801786M	Ext. 1/4"	1/2" x 5/8"
	12,1	TX3-M28	801775M	TX3-M38	801787M	Ext. 1/4"	1/2" x 5/8"
	16,5	TX3-M29	801776M	TX3-M39	801788M	Ext. 1/4"	1/2" x 5/8"
R 22	0,8			TX3-H11	801730M	Internal	1/4" x 3/8"
	2,3			TX3-H12	801731M	Internal	1/4" x 3/8"
	3,6	TX3-H03	801728M	TX3-H13	801732M	Internal	1/4" x 3/8"
	5,2	TX3-H04	801729M	TX3-H14	801733M	Internal	3/8" x 1/2"
	0,8	TX3-H21	801738M			Ext. 1/4"	1/4" x 3/8"
	2,3	TX3-H22	801739M			Ext. 1/4"	1/4" x 3/8"
	3,6	TX3-H23	801740M	TX3-H33	801749M	Ext. 1/4"	1/4" x 3/8"
	5,2	TX3-H24	801741M	TX3-H34	801750M	Ext. 1/4"	3/8" x 1/2"
	7,8	TX3-H25	801742M	TX3-H35	801751M	Ext. 1/4"	3/8" x 1/2"
	10,7	TX3-H26	801743M	TX3-H36	801752M	Ext. 1/4"	3/8" x 1/2"
	13,1	TX3-H27	801744M	TX3-H37	801753M	Ext. 1/4"	1/2" x 5/8"
	15,6	TX3-H28	801745M	TX3-H38	801754M	Ext. 1/4"	1/2" x 5/8"
	21,3	TX3-H29	801746M	TX3-H39	801755M	Ext. 1/4"	1/2" x 5/8"
R 407C	0,9	TX3-N01	801813M			Internal	1/4" x 3/8"
	2,5	TX3-N02	801814M	TX3-N12	801827M	Internal	1/4" x 3/8"
	3,9	TX3-N03	801815M	TX3-N13	801828M	Internal	1/4" x 3/8"
	5,6			TX3-N14	801829M	Internal	3/8" x 1/2"
	0,9	TX3-N21	801817M			Ext. 1/4"	1/4" x 3/8"
	2,5	TX3-N22	801818M	TX3-N32	801831M	Ext. 1/4"	1/4" x 3/8"
	3,9	TX3-N23	801819M	TX3-N33	801832M	Ext. 1/4"	1/4" x 3/8"
	5,6	TX3-N24	801820M	TX3-N34	801833M	Ext. 1/4"	3/8" x 1/2"
	8,4	TX3-N25	801821M	TX3-N35	801834M	Ext. 1/4"	3/8" x 1/2"
	11,6	TX3-N26	801822M	TX3-N36	801835M	Ext. 1/4"	3/8" x 1/2"
	14,2	TX3-N27	801823M	TX3-N37	801836M	Ext. 1/4"	1/2" x 5/8"
	16,9	TX3-N28	801824M	TX3-N38	801837M	Ext. 1/4"	1/2" x 5/8"
	23,0	TX3-N29	801825M	TX3-N39	801838M	Ext. 1/4"	1/2" x 5/8"

The nominal capacity (Qn) is based on the following conditions:

Refrigerant	Evaporating temperature	Condensing temperature	Subcooling
R 22, R 134a, R 404A, R 410A, R507	+4°C	+38°C	1K
R 407C	+4°C dew point	+38°C bubble / +43°C dew point	

Valve selection for other operating conditions see pages 5 and 10 to 13.

*) see table 2 on page 2 for MOP values.

Selection table

Refrigerant	Nominal capacity kW	without MOP Type	without MOP Part No.	with MOP *) Type	with MOP *) Part No.	Connection size Equalizer	Connection size Inlet x Outlet
R 404A R 507	0,6	TX3-S21	801865M			Ext. 1/4"	1/4" x 3/8"
	1,6	TX3-S22	801866M	TX3-S32	801875M	Ext. 1/4"	1/4" x 3/8"
	2,5	TX3-S23	801867M			Ext. 1/4"	1/4" x 3/8"
	3,7	TX3-S24	801868M	TX3-S34	801877M	Ext. 1/4"	3/8" x 1/2"
	5,5	TX3-S25	801869M			Ext. 1/4"	3/8" x 1/2"
	7,6	TX3-S26	801870M	TX3-S36	801879M	Ext. 1/4"	3/8" x 1/2"
	9,2	TX3-S27	801871M			Ext. 1/4"	1/2" x 5/8"
	11,0	TX3-S28	801872M			Ext. 1/4"	1/2" x 5/8"
	15,0	TX3-S29	801873M	TX3-S39	801882M	Ext. 1/4"	1/2" x 5/8"
R 410A	2,8			TX3-Z32	801942M	Ext. 1/4"	1/4" x 3/8"
	4,3			TX3-Z33	801943M	Ext. 1/4"	1/4" x 3/8"
	6,3			TX3-Z34	801944M	Ext. 1/4"	3/8" x 1/2"
	9,4			TX3-Z35	801945M	Ext. 1/4"	3/8" x 1/2"
	12,9			TX3-Z36	801946M	Ext. 1/4"	3/8" x 1/2"
	15,8			TX3-Z37	801947M	Ext. 1/4"	1/2" x 5/8"
	18,8			TX3-Z38	801948M	Ext. 1/4"	1/2" x 5/8"

The nominal capacity (Qn) is based on the following conditions:

Refrigerant	Evaporating temperature	Condensing temperature	Subcooling
R 22, R 134a, R 404A, R 410A, R507	+4°C	+38°C	1K
R 407C	+4°C dew point	+38°C bubble / +43°C dew point	

Valve selection for other operating conditions see pages 5 and 10 to 13.

*) see table 2 on page 2 for MOP values.

Selection table for Heat Pump Applications

Refrigerant	Nominal capacity kW	Adjustable with internal check valve and special liquid charge for heat pump applications – without MOP Type	Part No.			Connection size Equalizer	Connection size Inlet x Outlet
R 407C	0,9	TX3-N61	806799M			Ext. 1/4"	1/4" x 3/8"
	2,5	TX3-N62	806800M			Ext. 1/4"	1/4" x 3/8"
	3,9	TX3-N63	806801M			Ext. 1/4"	1/4" x 3/8"
	5,6	TX3-N64	806802M			Ext. 1/4"	3/8" x 1/2"
	8,4	TX3-N65	806803M			Ext. 1/4"	3/8" x 1/2"
	11,6	TX3-N66	806804M			Ext. 1/4"	3/8" x 1/2"
	14,2	TX3-N67	806805M			Ext. 1/4"	1/2" x 5/8"
	16,9	TX3-N68	806806M			Ext. 1/4"	1/2" x 5/8"
	23,0	TX3-N69	806807M			Ext. 1/4"	1/2" x 5/8"

The nominal capacity (Qn) is based on the following conditions:

Refrigerant	Evaporating temperature	Condensing temperature	Subcooling
R 407C	+4°C dew point	+38°C bubble / +43°C dew point	1 K

Valve selection for other operating conditions see pages 5 and 13.

Determining of pressure drop across internal check valve

		Reverse flow liquid capacity of internal check valve R 407C, kW										
		Liquid temperature °C										
Pressure drop (bar)	Evaporating temperature °C	10	15	20	25	30	35	40	45	50	55	60
0,2	-20	8,6	8,2	7,8	7,5	7,2	6,8	6,5	6,2	5,8	5,4	5,1
	-10	8,7	8,4	8,1	7,7	7,3	7,0	6,7	6,3	5,9	5,6	5,3
	0	8,9	8,6	8,2	7,9	7,5	7,2	6,8	6,5	6,1	5,8	5,4
	10	9,0	8,7	8,4	8,0	7,6	7,3	7,0	6,6	6,3	5,9	5,6
0,4	-20	12,8	12,2	11,7	11,2	10,7	10,2	9,8	9,2	8,7	8,2	7,6
	-10	13,0	12,5	12,1	11,6	11,0	10,5	10,0	9,5	8,9	8,4	7,9
	0	13,3	12,8	12,2	11,8	11,2	10,7	10,2	9,8	9,2	8,6	8,1
	10	13,5	13,0	12,5	12,0	11,4	11,0	10,4	9,9	9,4	8,8	8,4
0,6	-20	17,1	16,3	15,6	14,9	14,3	13,6	13,0	12,3	11,6	10,9	10,2
	-10	17,3	16,7	16,1	15,4	14,6	14,0	13,4	12,6	11,9	11,2	10,6
	0	17,8	17,1	16,3	15,8	14,9	14,3	13,6	13,0	12,2	11,5	10,8
	10	18,0	17,3	16,7	16,0	15,3	14,6	13,9	13,2	12,5	11,8	11,1
0,8	-20	18,8	17,9	17,1	16,4	15,7	15,0	14,3	13,5	12,7	11,9	11,2
	-10	19,0	18,3	17,7	16,9	16,0	15,4	14,7	13,9	13,1	12,3	11,6
	0	19,5	18,8	17,9	17,3	16,4	15,7	15,0	14,3	13,4	12,6	11,8
	10	19,7	19,0	18,3	17,5	16,7	16,0	15,2	14,5	13,8	12,9	12,2
1	-20	21,4	20,4	19,5	18,7	17,9	17,0	16,3	15,4	14,5	13,6	12,7
	-10	21,7	20,9	20,2	19,3	18,3	17,6	16,7	15,8	14,9	14,0	13,2
	0	22,2	21,4	20,4	19,7	18,7	17,9	17,0	16,3	15,3	14,4	13,5
	10	22,5	21,7	20,9	19,9	19,1	18,3	17,4	16,6	15,7	14,7	13,9
1,2	-20	23,5	22,4	21,5	20,5	19,7	18,7	17,9	16,9	16,0	15,0	14,0
	-10	23,8	23,0	22,2	21,2	20,1	19,3	18,4	17,4	16,4	15,4	14,5
	0	24,4	23,5	22,4	21,7	20,5	19,7	18,7	17,9	16,8	15,8	14,9
	10	24,8	23,8	23,0	21,9	21,0	20,1	19,1	18,2	17,2	16,2	15,3
1,4	-20	25,7	24,5	23,4	22,4	21,5	20,4	19,5	18,5	17,4	16,3	15,3
	-10	26,0	25,1	24,2	23,1	21,9	21,1	20,1	19,0	17,8	16,8	15,8
	0	26,7	25,7	24,5	23,7	22,4	21,5	20,4	19,5	18,3	17,3	16,2
	10	27,0	26,0	25,1	23,9	22,9	21,9	20,9	19,9	18,8	17,7	16,7
1,6	-20	27,3	26,0	24,9	23,8	22,9	21,7	20,7	19,6	18,5	17,4	16,2
	-10	27,7	26,7	25,7	24,6	23,3	22,4	21,3	20,2	19,0	17,9	16,8
	0	28,4	27,3	26,0	25,2	23,8	22,9	21,7	20,7	19,5	18,4	17,2
	10	28,7	27,7	26,7	25,5	24,3	23,3	22,2	21,1	20,0	18,8	17,8
1,8	-20	28,8	27,4	26,2	25,1	24,1	22,9	21,9	20,7	19,5	18,3	17,1
	-10	29,1	28,1	27,1	25,9	24,6	23,6	22,5	21,3	20,0	18,9	17,7
	0	29,9	28,8	27,4	26,5	25,1	24,1	22,9	21,9	20,5	19,3	18,2
	10	30,3	29,1	28,1	26,8	25,7	24,6	23,4	22,3	21,1	19,8	18,7

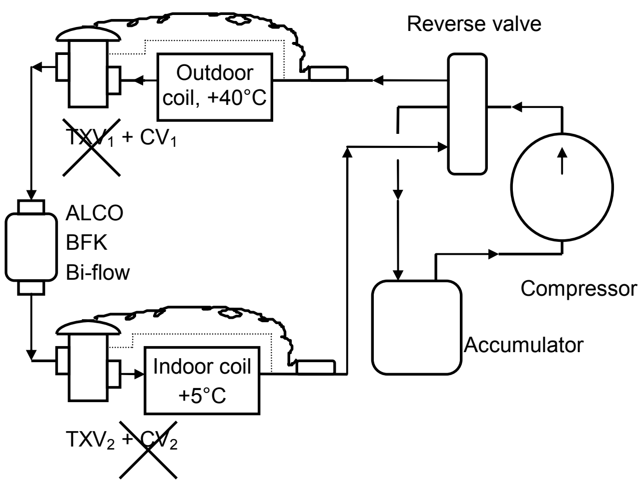
1. Select the liquid temperature.
2. Go vertically to find a capacity equal to the capacity of the system.
3. Read the corresponding pressure drop.

Example 3 for heat pump applications

A heat pump with following design conditions:

Cooling mode

- Cooling capacity, R 407C 9,8 kW
- Condensing temperature +40°C
- Evaporating temperature +5°C
- TXV_2 with internal check valve (CV_2)



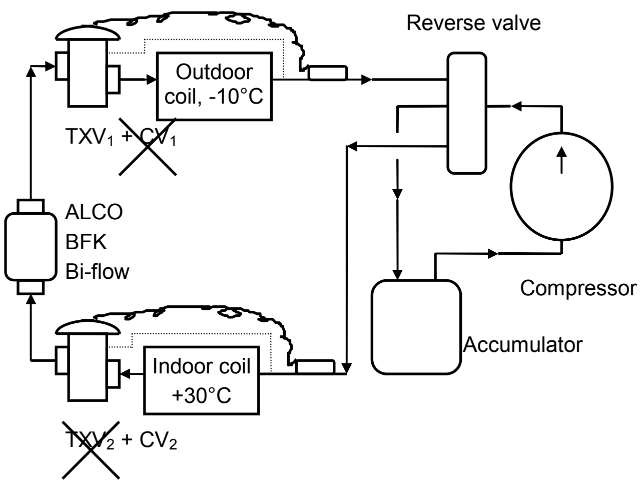
1. Determine pressure drop across check valve CV_1 from table on page 8
   at +40°C / +5°C $CV_1 \leq 0.4$ bar
2. Theoretical pressure differential:
   Condensing pressure Pc = 16.45 bar at +40°C
   Evaporating pressure P_0 = 4.47 bar at +5°C
   Differential pressure $Pc - P_0$ = 16.45 - 4.47 = 11.98 bar
3. Pressure losses:
   Across check valve CV_1 = 0.4 bar
   Others - in piping, drier, sight glass, fitting, etc. = 0.8 bar
   Total pressure losses = 0.4 + 0.8 = 1.2 bar
4. Effective pressure differential across valve:
   11.98 - 1.2 = 10.78 bar
5. Correction factors:
   Correction factor $K_{\Delta p}$ for the pressure differential 10.78 bar from table on page 10 for R 407C
   Δp = 10.78 **$K_{\Delta p}$ = 1.01**
   Correction factor K_t for liquid and evaporating temperature from table on page 10 for R 407C
   at +40°C / +5°C **K_t = 1.02**
6. Calculation of nominal capacity $Q_0 \times K_{\Delta p} \times K_t$ = Qn
   9.8 x 1.01 x 1.02 = **10.1 kW**

Select the valve from the table on page 8.

It is a TX3-N66 with a nominal capacity of 11.6 kW.
($TXV_2 + CV_2$ = TX3-N66)

Heating mode

- Heating capacity, R 407C 5.8 kW
- Condensing temperature +30°C
- Evaporating temperature -10°C
- TXV_1 with internal check valve (CV_1)



1. Determine pressure drop across check valve CV_2 from table on page 8
   at +30°C / -10°C $CV_2 \leq 0.2$ bar
2. Theoretical pressure differential:
   Condensing pressure Pc = 12.56 bar at +30°C
   Evaporating pressure P_0 = 2.20 bar at -10°C
   Differential pressure $Pc - P_0$ = 12.56 - 2.20 = 10.26 bar
3. Pressure losses:
   Across check valve CV_2 = 0.2 bar
   Others - in piping, drier, sight glass, fitting, etc. = 0.8 bar
   Total pressure losses = 0.2 + 0.8 = 1.0 bar
4. Effective pressure differential across valve:
   10.26 - 1.0 = 9.26 bar
5. Correction factors:
   Correction factor $K_{\Delta p}$ for the pressure differential 9.26 bar from table on page 10 for R 407C
   Δp = 9.26 **$K_{\Delta p}$ = 1.11**
   Correction factor K_t for liquid and evaporating temperature from table on page 10 for R 407C
   at +30°C / -10°C **K_t = 0.95**
6. Calculation of nominal capacity $Q_0 \times K_{\Delta p} \times K_t$ = Qn
   5.8 x 1.11 x 0.95 = **6.12 kW**

Select the valve from the table on page 8.

It is a TX3-N65 with a nominal capacity of 8.4 kW.
($TXV_1 + CV_1$ = TX3-N65)

Correction Tables

Liquid temperature entering valve °C	R22		Correction factor K_t Evaporating temperature °C													
			+20	+ 15	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
+ 60			1,24	1,25	1,26	1,28	1,30	1,31	1,38	1,58	1,84	2,16	2,56	3,04	3,55	4,23
+ 55			1,16	1,17	1,19	1,20	1,22	1,23	1,29	1,42	1,72	2,02	2,39	2,83	3,30	3,94
+ 50			1,10	1,11	1,12	1,13	1,15	1,16	1,21	1,39	1,62	1,89	2,24	2,66	3,10	3,68
+ 45			1,04	1,05	1,06	1,07	1,08	1,10	1,15	1,31	1,52	1,79	2,11	2,50	2,91	3,46
+ 40			0,99	1,00	1,01	1,02	1,03	1,04	1,09	1,24	1,45	1,69	2,00	2,37	2,75	3,27
+ 35			0,94	0,95	0,96	0,97	0,98	0,99	1,03	1,18	1,37	1,61	1,89	2,24	2,60	3,09
+ 30			0,90	0,91	0,92	0,93	0,94	0,95	0,99	1,13	1,31	1,55	1,83	2,13	2,47	2,93
+ 25			0,86	0,87	0,88	0,89	0,89	0,90	0,94	1,08	1,25	1,46	1,72	2,03	2,36	2,80
+ 20			0,83	0,83	0,84	0,85	0,86	0,87	0,90	1,03	1,19	1,40	1,64	1,94	2,25	2,66
+ 15				0,80	0,81	0,81	0,82	0,83	0,87	0,99	1,14	1,34	1,57	1,86	2,15	2,55
+ 10					0,78	0,78	0,79	0,80	0,83	0,95	1,10	1,28	1,51	1,78	2,06	2,44
+ 5						0,75	0,76	0,77	0,80	0,91	1,06	1,23	1,45	1,71	1,98	2,34
0							0,73	0,74	0,77	0,88	1,02	1,19	1,39	1,65	1,90	2,25
- 5								0,71	0,74	0,85	0,98	1,14	1,34	1,58	1,83	2,17
- 10									0,72	0,82	0,95	1,10	1,30	1,53	1,77	2,09
Correction factor $K_{\Delta p}$																
Δp (bar)	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	8	9
$K_{\Delta p}$	4,25	3,00	2,46	2,13	1,90	1,74	1,61	1,50	1,42	1,35	1,28	1,23	1,18	1,14	1,06	1,00
Δp (bar)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
$K_{\Delta p}$	0,95	0,91	0,87	0,83	0,80	0,78	0,75	0,73	0,71	0,69	0,67	0,66	0,64	0,63	0,61	0,60

Liquid temperature entering valve °C	R407C		Correction factor K_t Evaporating temperature °C													
			+20	+15	+10	+5	0	-5	-10	-15	-20	-25				
+ 55			1,23	1,26	1,28	1,31	1,34	1,37	1,40	1,63	1,98	2,42				
+ 50			1,13	1,15	1,17	1,19	1,22	1,24	1,27	1,48	1,79	2,18				
+ 45			1,05	1,06	1,08	1,10	1,12	1,14	1,17	1,35	1,64	2,00				
+ 40			0,98	0,99	1,01	1,02	1,04	1,06	1,08	1,25	1,52	1,84				
+ 35			0,92	0,93	0,94	0,96	0,98	0,99	1,01	1,17	1,41	1,71				
+ 30			0,87	0,88	0,89	0,90	0,92	0,93	0,95	1,10	1,32	1,60				
+ 25			0,82	0,83	0,84	0,85	0,87	0,88	0,90	1,03	1,25	1,51				
+ 20			0,78	0,79	0,80	0,81	0,82	0,84	0,85	0,98	1,18	1,43				
+ 15				0,75	0,76	0,77	0,78	0,80	0,81	0,93	1,12	1,35				
+ 10					0,73	0,74	0,75	0,76	0,77	0,89	1,07	1,29				
+ 5						0,71	0,72	0,73	0,74	0,85	1,02	1,23				
0							0,69	0,70	0,71	0,81	0,98	1,18				
Correction factor $K_{\Delta p}$																
Δp (bar)	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	8	9
$K_{\Delta p}$	4,78	3,33	2,72	2,36	2,11	1,92	1,78	1,67	1,57	1,49	1,42	1,36	1,31	1,26	1,18	1,11
Δp (bar)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
$K_{\Delta p}$	1,05	1,01	0,96	0,92	0,89	0,86	0,83	0,81	0,79	0,76	0,75	0,73	0,71	0,70	0,68	0,67

Liquid temperature entering valve °C	R404A		Correction factor K_t Evaporating temperature °C													
			+20	+ 15	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
+ 55			1,38	1,42	1,46	1,50	1,55	1,61	1,68	1,96	2,36	2,83	3,43	4,16	5,12	6,34
+ 50			1,20	1,23	1,26	1,30	1,34	1,38	1,43	1,67	1,99	2,37	2,85	3,43	4,18	5,14
+ 45			1,07	1,10	1,12	1,15	1,18	1,22	1,26	1,46	1,74	2,05	2,46	2,95	3,57	4,35
+ 40			0,97	0,99	1,02	1,04	1,07	1,09	1,13	1,30	1,55	1,82	2,17	2,59	3,13	3,80
+ 35			0,90	0,91	0,93	0,95	0,97	1,00	1,02	1,18	1,40	1,64	1,96	2,33	2,80	3,38
+ 30			0,83	0,84	0,86	0,88	0,90	0,92	0,94	1,08	1,28	1,50	1,78	2,11	2,53	3,05
+ 25			0,77	0,79	0,80	0,82	0,83	0,85	0,87	1,00	1,18	1,39	1,64	1,94	2,32	2,79
+ 20			0,73	0,74	0,75	0,77	0,78	0,80	0,81	0,94	1,10	1,29	1,52	1,80	2,15	2,58
+ 15				0,70	0,71	0,72	0,73	0,75	0,76	0,88	1,03	1,21	1,42	1,68	2,00	2,40
+ 10					0,67	0,68	0,69	0,71	0,72	0,83	0,97	1,13	1,34	1,58	1,88	2,25
+ 5						0,65	0,66	0,67	0,68	0,78	0,92	1,07	1,26	1,49	1,77	2,11
0							0,63	0,64	0,65	0,75	0,88	1,02	1,20	1,41	1,67	2,00
- 5								0,61	0,62	0,71	0,83	0,97	1,14	1,34	1,59	1,90
- 10									0,60	0,68	0,80	0,93	1,09	1,28	1,52	1,81
Correction factor $K_{\Delta p}$																
Δp (bar)	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	8	9
$K_{\Delta p}$	4,55	3,21	2,62	2,27	2,03	1,86	1,72	1,61	1,52	1,44	1,37	1,31	1,26	1,21	1,14	1,07
Δp (bar)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
$K_{\Delta p}$	1,02	0,97	0,93	0,89	0,86	0,83	0,80	0,78	0,76	0,74	0,72	0,70	0,69	0,67	0,66	0,64

Liquid temperature entering valve °C	R507		Correction factor K_t Evaporating temperature °C													
			+20	+15	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
+ 55			1,36	1,39	1,43	1,47	1,52	1,57	1,62	1,92	2,29	2,75	3,35	4,11	5,11	6,44
+ 50			1,19	1,22	1,24	1,28	1,31	1,35	1,40	1,64	1,95	2,33	2,81	3,43	4,23	5,29
+ 45			1,07	1,09	1,11	1,14	1,17	1,20	1,23	1,45	1,71	2,04	2,45	2,97	3,64	4,53
+ 40			0,97	0,99	1,01	1,03	1,06	1,08	1,11	1,30	1,53	1,82	2,18	2,63	3,22	3,98
+ 35			0,90	0,91	0,93	0,95	0,97	0,99	1,01	1,18	1,39	1,65	1,97	2,37	2,89	3,56
+ 30			0,83	0,85	0,86	0,88	0,89	0,91	0,93	1,09	1,28	1,51	1,80	2,17	2,63	3,23
+ 25			0,78	0,79	0,80	0,82	0,83	0,85	0,87	1,01	1,18	1,40	1,66	1,99	2,42	2,97
+ 20			0,73	0,74	0,75	0,77	0,78	0,79	0,81	0,94	1,10	1,30	1,54	1,85	2,24	2,74
+ 15				0,70	0,71	0,72	0,73	0,75	0,76	0,88	1,03	1,21	1,44	1,73	2,09	2,55
+ 10					0,67	0,68	0,69	0,70	0,72	0,83	0,97	1,14	1,35	1,62	1,95	2,38
+ 5						0,64	0,65	0,67	0,68	0,78	0,92	1,07	1,27	1,52	1,83	2,23
0							0,62	0,63	0,64	0,74	0,87	1,02	1,20	1,43	1,73	2,10
- 5								0,60	0,61	0,70	0,82	0,96	1,14	1,35	1,63	1,98
- 10									0,58	0,67	0,78	0,91	1,08	1,28	1,54	1,87
Correction factor $K_{\Delta p}$																
Δp (bar)	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	8	9
$K_{\Delta p}$	4,63	3,27	2,67	2,31	2,07	1,89	1,75	1,64	1,54	1,46	1,40	1,34	1,28	1,24	1,16	1,09
Δp (bar)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
$K_{\Delta p}$	1,03	0,99	0,94	0,91	0,87	0,85	0,82	0,79	0,77	0,75	0,73	0,71	0,70	0,68	0,67	0,65

Liquid temperature entering valve °C	R134a		Correction factor K_t Evaporating temperature °C													
			+20	+ 15	+10	+5	0	-5	-10	-15	-20	-25				
+ 60			1,27	1,30	1,33	1,36	1,40	1,44	1,48	1,75	2,08	2,46				
+ 55			1,18	1,21	1,23	1,26	1,29	1,33	1,36	1,60	1,90	2,25				
+ 50			1,10	1,13	1,15	1,17	1,20	1,23	1,26	1,48	1,76	2,07				
+ 45			1,04	1,06	1,08	1,10	1,12	1,15	1,17	1,38	1,63	1,92				
+ 40			0,98	0,99	1,01	1,03	1,05	1,08	1,10	1,29	1,52	1,79				
+ 35			0,92	0,94	0,96	0,97	0,99	1,01	1,03	1,21	1,43	1,68				
+ 30			0,88	0,89	0,91	0,92	0,94	0,96	0,98	1,14	1,35	1,58				
+ 25			0,83	0,85	0,86	0,87	0,89	0,91	0,92	1,08	1,27	1,49				
+ 20			0,80	0,81	0,82	0,83	0,85	0,89	0,88	1,02	1,21	1,41				
+ 15				0,77	0,78	0,79	0,81	0,82	0,84	0,97	1,15	1,34				
+ 10					0,75	0,76	0,77	0,78	0,80	0,93	1,09	1,28				
+ 5						0,73	0,74	0,75	0,76	0,89	1,04	1,22				
0							0,71	0,72	0,73	0,85	1,00	1,17				
- 5								0,69	0,70	0,82	0,96	1,12				
- 10									0,68	0,79	0,92	1,07				
Correction factor $K_{\Delta p}$																
Δp (bar)	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8
$K_{\Delta p}$	3,50	2,48	2,02	1,75	1,57	1,43	1,32	1,24	1,17	1,11	1,06	1,01	0,97	0,94	0,90	0,88
Δp (bar)	8,5	9	9,5	10	10,5	11	11,5	12	13	14	15	16	17	18	19	20
$K_{\Delta p}$	0,85	0,83	0,80	0,78	0,76	0,75	0,73	0,72	0,69	0,66	0,64	0,62	0,60	0,58	0,57	0,55

Liquid temperature entering valve °C	R410A		Correction factor K_t Evaporating temperature °C													
			+20	+15	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
+ 60			1,54	1,56	1,58	1,60	1,63	1,66	1,69	1,98	2,28	2,80	3,28	3,93	4,85	5,95
+ 55			1,35	1,36	1,38	1,40	1,42	1,44	1,46	1,71	1,96	2,41	2,81	3,36	4,13	5,05
+ 50			1,21	1,22	1,23	1,25	1,26	1,28	1,30	1,52	1,74	2,13	2,48	2,96	3,63	4,42
+ 45			1,10	1,11	1,12	1,14	1,15	1,16	1,18	1,38	1,57	1,92	2,24	2,66	3,26	3,96
+ 40			1,02	1,02	1,03	1,04	1,06	1,07	1,08	1,26	1,44	1,76	2,04	2,43	2,97	3,60
+ 35			0,95	0,95	0,96	0,97	0,98	0,99	1,00	1,17	1,33	1,62	1,88	2,24	2,73	3,31
+ 30			0,89	0,89	0,90	0,91	0,92	0,93	0,94	1,09	1,24	1,51	1,75	2,08	2,54	3,07
+ 25			0,84	0,84	0,85	0,85	0,86	0,87	0,88	1,02	1,17	1,42	1,64	1,95	2,37	2,87
+ 20			0,79	0,79	0,80	0,81	0,81	0,82	0,83	0,97	1,10	1,34	1,55	1,83	2,23	2,69
Correction factor $K_{\Delta p}$																
Δp (bar)			0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7
$K_{\Delta p}$			5,31	3,75	3,07	2,66	2,37	2,17	2,01	1,88	1,77	1,68	1,60	1,53	1,47	1,42
Δp (bar)			7,5	8	8,5	9	9,5	14	15	16	17	18	19	20	21	22
$K_{\Delta p}$			1,37	1,33	1,29	1,25	1,22	1,00	0,97	0,94	0,91	0,89	0,86	0,84	0,82	0,80

Technical data

Compatibility *)	CFC, HCFC, HFC, Mineral and POE lubricants
Maximum working pressure	PS: 45 bar
Factory test pressure	PT: 48.3 bar
Burst pressure	207 bar
Medium temperature range	-45 to 120°C

Seat leakage	≤ 1% nominal capacity
Connection	ODF, copper
Charges	CFC free
Protection	salt spray test
Weight	~ 0.5 kg (individual)

*) TX3 are not released for use with inflammable substances.

Charge	Refrigerant	Recommended evaporating temperature range °C
Liquid (no MOP)	**R 22, R 404A, R 507**	-45 to +20
Liquid (no MOP)	**R 134a, R 407C**	-25 to +20
Liquid (heat pump)	**R 22**	-35 to +20
MOP 3.3 bar	**R 134a**	-25 to +9
MOP 6.4 bar	**R 22**	-45 to +10
MOP 6.4 bar	**R 407C**	-25 to +12
MOP 2.3 bar	**R 404A**	-45 to -21
MOP 2.3 bar	**R 507**	-45 to -20
MOP 12.9 bar	**R 410A**	-30 to +17

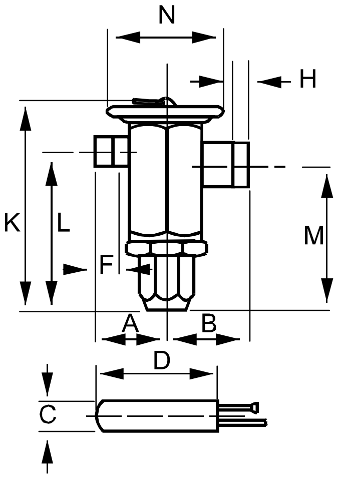
Shipping weights and pack quantities

	TX3 with standard setting
Pack quantity	24 (no single pack)
Minimum order quantity	24
Shipping weight (pack)	12 kg

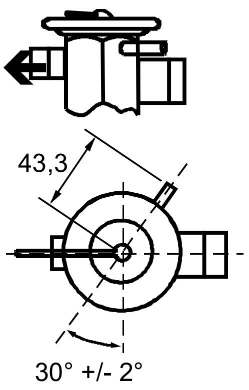
Dimensions

'

TX3



External Equalize
Configuration View



Body:

Type	Connection size (inch)		Roughing in dimensions (mm)							
	Inlet	Outlet	A	B	F	H	N	K	L	M
TX3-...1	1/4"	3/8"	43.3	44.1	7.9	7.9				
TX3-...2	1/4"	3/8"	43.3	44.1	7.9	7.9				
TX3-...3	1/4"	3/8"	43.3	44.1	7.9	7.9				
TX3-...4	3/8"	1/2"	44.1	44.1	7.9	9.5	44.5	86.5	64.7	54.4
TX3-...5	3/8"	1/2"	44.1	44.1	7.9	9.5				
TX3-...6	3/8"	1/2"	44.1	44.1	7.9	9.5				
TX3-...7	1/2"	5/8"	44.1	44.5	9.5	12.7				
TX3-...8	1/2"	5/8"	44.1	44.5	9.5	12.7				
TX3-...9	1/2"	5/8"	44.1	44.5	9.5	12.7				

Bulb:

Charge	Refrigerant	Dimensions of bulb (mm)		Capillary tube
		D (length)	Ø C	length
All charges	all	53.2	12.8	1.5 m
Special liquid charge (TX3 with check valve)	R 407C	58.7	19.2	1.5 m

Emerson Electric GmbH & Co OHG
ALCO CONTROLS
Postfach 1251
Heerstraße 111
D-71332 Waiblingen
Germany
Phone ...49-7151-509-0
Fax ...49-7151-509-200

www.emersonclimate.eu

	Phone:	Fax:
Benelux	+31 (0)77 324 0 234	+31 (0)77 324 0 235
Germany, Austria & Switzerland	+49 (0)6109 6059 -0	+49 (0)6109 6059 40
France, Greece, Maghreb	+33 (0)4 78 66 85 70	+33 (0)4 78 66 85 71
Italia	+39 02 961 781	+39 02 961 788 888
Spain & Portugal	+34 93 41 23 752	+34 93 41 24 2
UK & Ireland	+44 (0) 1635 876 161	+44 (0) 1635 877 111
Sweden, Denmark, Norway & Finland	+49 (0)2408 929 0	+49 (0)2408 929 528
Eastern Europe & Turkey	+49 (0)2408 929 0	+49 (0)2408 929 525
Poland	+48 (0)22 458 9205	+48 (0)22 458 9255
Russia & Cis	+7 495 981 9811	+7 495 981 9816
Balkan	+385 (0) 1560 38 75	+385 (0) 1 560 3879
Romania	+40 364 73 11 72	+40 364 73 12 98
Ukraine	+38 44 4 92 99 24	+38 44 4 92 99 28