
Thermo®-Expansion Valves

Expansion Valves

Basic Terms and Technical Information

Operating principles

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

Description of bulb charges

The application ranges of Thermo®-Expansion valves are heavily influenced by the charge selected.

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 fast response time and thus react quickly in the control circuit. Liquid charges cannot incorporate MOP functions. Maximum bulb temperatures shall not exceed 75°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 thermo expansion 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.

Adsorption charges

These charges feature control characteristics much like MOP charges but avoid the difficulties of cross-ambient interference. Response time is slow but perfectly suitable for common refrigeration systems. Maximum bulb temperature is 130°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 compressor from overload conditions.

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

Practical hint: Superheat adjustments influence the MOP:

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

Static superheat

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.

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 , $K_{\Delta p}$) should be modified accordingly. The field practice indicates the following correction factors can be used to compensate the effect of the subcooling (liquid hammering) in addition to the use of correction factors K_t and $K_{\Delta p}$.

Subcooling	20K	30K	40K	50K	60K
Correction factor	0,8	0,7	0,6	0,5	0,4

ALCO CONTROLS will be happy to assist you. Please contact application engineering department.

Dimensioning

To correctly select a Thermo®-Expansion valve on a system, the following design conditions must be available:

- Cooling capacity Q_o
- Effective pressure differential across Thermo®-Expansion valve Δp
- Evaporating temperature/pressure
- Lowest possible condensing temperature/pressure
- Liquid temperature
- Type of refrigerant

As opposed to single substances (e.g. R22, R134a 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.

To facilitate **valve dimensioning** for other than the standard conditions ALCO offers an Excel based **Selection Tool**. This can be ordered from all Emerson sales offices. See www.emersonclimate.eu for contact addresses, email or phone numbers.

Example

Cooling capacity of a system: 18 kW
 Refrigerant: R 407C
 Condensing temperature (saturated liquid): +35°C
 (Condensing pressure will be 15.5 bar)
 See appendix page 153 for
 Evaporating temperature (saturated vapour): 0°C
 (Evaporating pressure will be 4.61 bar)
 Subcooling: 1 K
 Pressure drops through liquid line: 2.2 bar
 Pressure drops through evaporator: 0.3 bar
 Required type of Thermo®-Expansion valve:T-series

To calculate the nominal capacity the following formula has to be used:

$$\text{Cooling capacity} \times K_t \times K_{\Delta p} = \text{Nominal capacity}$$

1. Selected **Kt-factor** according to refrigerant, liquid and evaporating temperature from table on page 76.

$$K_t = 0.98 \text{ (for this example)}$$

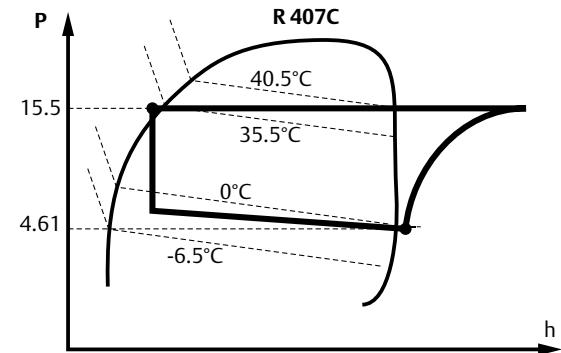
2. Determine pressure differential across the Thermo®-Expansion valve using condensing pressure, subtract evaporating pressure and all other possible pressure losses (pressure drops in evaporator, drier, solenoid valve, liquid distribution...).

For this example:

$$\Delta p = 15.5 - (4.61 + 2.2 + 0.3) = 8.39 \text{ bar}$$

Select **K_{Δp}** factor from table on page 76:

$$K_{\Delta p} = 1,15 \text{ (for this example)}$$



3. Multiply cooling capacity with **Kt** and **K_{Δp}**, to find nominal capacity for Thermo®-Expansion valve.

$$Q_n = 18 \times 0.98 \times 1.15 = 20.29 \text{ kW}$$

Select Thermo®-Expansion Valve from table on page 72: TCLE 550 NW (for this example).

Please note that all evaporating/condensing temperatures in this catalogue are based on saturated vapour/liquid temperatures.

Selection Guide for Expansion Valves

Series	Selection Criteria				Catalogue Page
	Capacity Range kW (R 404A)	Evaporating Temperature Range °C	Main Application	Features	
T1	0,5 to 14,2	+20 to -45	Refrig./Air-Cond. Heat Pumps	Interchangeable Orifices	66
TX3	0,8 to 15,0	+20 to -45	Refrig./Air-Cond. Heat Pumps	Hermetic, Superheat adjustable, optional with check valve	72
TX6	13,3 to 57,0	+20 to -45	Air-Cond. Heat Pumps	Hermetic Superheat adjustable	74
T	2 to 209	+30 to -45	Refrig./Air-Cond. Heat Pumps	Interchangeable Orifices, Power-Assembly and Flange	76
ZZ	1,9 to 81,2	-45 to -120	Low Temperature Application	Interchangeable Orifices, Power-Assembly and Flange	81
L	2 to 154	+30 to -50	Liquid Injection Superheat Control	Interchangeable Orifices, Power-Assembly and Flange	84
935	5,2 to 43,5	+30 to -45	Liquid Injection Temperature Control	Interchangeable Orifices, Power-Assembly and Flange	86

* Please ask your local Emerson sales office for datasheets or download from www.emersonclimate.eu

Thermo®-Expansion Valves Series TI

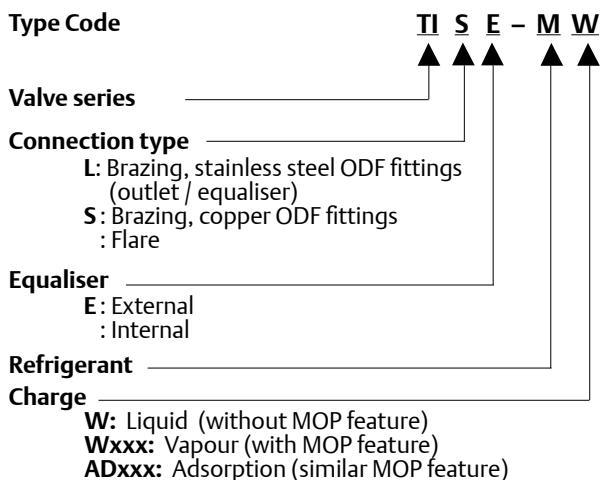
new valve design, exchangeable Orifices

Features

- Laser welded diaphragm with large diameter for high reliability and maximum life time
- Constant superheat across wide application ranges
- Easy and precise superheat setting by modified threads
- TIE with stainless steel fittings allow brazing without wet rags
- With capacities between 0.4 kW and 14.2 kW (R 404A) ideally suited for service work
- Internal or external equaliser
- Brazing and flare connections available
- Capillary tube length 1.5 m
- PS: 45 bar, TS: -45 ... +75°C
- No CE marking according art. 3.3 PED 97/23 EC



TI-E

Type Code

TI-E

Orifice assembly with strainer for inlet connection

Type Part No.	Nominal Capacity* (kW)							
	TIO-00X 800 532	TIO-000 800 533	TIO-001 800 534	TIO-002 800 535	TIO-003 800 536	TIO-004 800 537	TIO-005 800 538	TIO-006 800 539
R 134a	0,3	0,8	1,9	3,1	5,0	8,3	10,1	11,7
R 22	0,5	1,3	3,2	5,3	8,5	13,9	16,9	19,5
R 404A	0,4	1,0	2,3	3,9	6,2	10,1	12,3	14,2
R 407C	0,5	1,4	3,5	5,7	9,2	15,0	18,3	21,1
R 410A	0,6	1,5	3,7	6,2	9,9	16,2	19,7	22,8
R 507	0,4	1,0	2,3	3,9	6,2	10,1	12,3	14,2

Brazing Adapter for TIE and TIS(E)

Type	Part No.	Connection, ODF	
		mm	inch
TIA-M06	802 500	6,0	-
TIA-M10	802 501	10,0	-
TIA-014	802 502	-	1/4"
TIA-038	802 503	-	3/8"
Gasket Set	803 780	100 pieces	



*) Nominal capacity is based on the following conditions:

Refrigerant	Evaporating temperature	Condensing temperature	Sub-cooling
R 407C	+4°C dew point	+38°C bubble p. +43°C dew point	1K
R 22, R 134a, R 404A, R 410A, R 507	+4°C	+38°C	1K

Valve selection for other operating conditions see page 74, quick selection tables on page 65 or Excel based Selection Tool (download from www.emersonclimate.eu).

TI Valve bodies without cage and nut

Refrigerant	Outlet/ Equalizer Connection	Type	Part No.	Type	Part No.	MOP °C	Evaporating temperature range °C
		external Equalizer		internal Equalizer			
R 404A / R 507	Brazing stainless steel	TILE-SW (12mm)	802465			-	-45 ... +20
		TILE-SW (1/2“)	802466			-	-45 ... +20
	Brazing copper	TISE-SW (12mm)	802462	TIS-SW (12mm)	802461	-	-45 ... +20
		TISE-SW (1/2“)	802464	TIS-SW (1/2“)	802463	-	-45 ... +20
		TISE-SAD10 (1/2“)	802479	TIS-SAD10 (1/2“)	802478	+10	-45 ... 0
		TISE-SW75 (12mm)	802471			0	-45 ... -3
		TISE-SW75 (1/2“)	802472			0	-45 ... -3
		TISE-SAD-20 (12mm)	802474			-20	-45 ... -27
		TISE-SAD-20 (1/2“)	802475			-20	-45 ... -27
	Flare	TIE-SW	802460	TI-SW	802459	-	-45 ... +20
		TIE-SAD10	802477	TI-SAD10	802476	+10	-45 ... 0
		TIE-SW75	802470	TI-SW75	802469	0	-45 ... -3
		TIE-SAD-20	802473			-20	-45 ... -27
R 134a	Brazing stainless steel	TILE-MW (12mm)	802451			-	-45 ... +20
		TILE-MW (1/2“)	802452			-	-45 ... +20
	Brazing copper	TISE-MW (12 mm)	802448	TIS-MW (12 mm)	802447	-	-45 ... +20
		TISE-MW (1/2“)	802450	TIS-MW (1/2“)	802449	-	-45 ... +20
		TISE-MW55 (12mm)	802457			+14	-45 ... +11
		TISE-MW55 (1/2“)	802458			+14	-45 ... +11
	Flare	TIE-MW	802446	TI-MW	802445	-	-45 ... +20
		TIE-MW55	802456	TI-MW55	802455	+14	-45 ... +11
R 407C	Brazing stainless steel	TILE-NW (12mm)	802486			-	-45 ... +20
		TILE-NW (1/2“)	802485			-	-45 ... +20
	Brazing copper	TISE-NW (12mm)	802438	TIS-NW (12mm)	802437	-	-45 ... +20
		TISE-NW (1/2“)	802440	TIS-NW (1/2“)	802439	-	-45 ... +20
	Flare	TIE-NW	802436	TI-NW	802435	-	-45 ... +20
R 22	Brazing stainless steel	TILE-HW (12mm)	802426			-	-45 ... +20
		TILE-HW (1/2“)	802427			-	-45 ... +20
	Brazing copper	TISE-HW (12mm)	802423	TIS-HW (12mm)	802422	-	-45 ... +20
		TISE-HW (1/2“)	802425	TIS-HW (1/2“)	802424	-	-45 ... +20
		TISE-HW100 (12mm)	802431			+15	-45 ... +13
		TISE-HW100 (1/2“)	802432			+15	-45 ... +13
	Flare	TIE-HW	802421	TI-HW	802420	-	-45 ... +20
		TIE-HAD10	802430			+10	-45 ... 0
R 410A	Brazing stainless steel	TILE-ZW (12mm)	802488			-	-35 ... +20
		TILE-ZW (1/2“)	802489			-	-35 ... +20
		TILE-ZW175 (12mm)	802490			+16.4	-35 ... +15
		TILE-ZW175 (1/2“)	802491			+16.4	-35 ... +15

Inlet:
Outlet:
Flare 5/8"-18UNF for 6mm, 8mm, 10mm, 1/4", 5/16" and 3/8" tubes
Flare 3/4"-16UNF for 12mm and 1/2" tubes,

Solder metric: ODF for 12mm tubes, Solder inch: ODF for 1/2" tubes

Ext. Equalizer: Flare 7/16"-20UNF for 6mm and 1/4" tubes,
Solder metric: ODF for 6mm tubes, Solder inch: ODF for 1/4" tubes

Quick Selection Tables

Published capacity data at 1 K subcooling at the inlet of the expansion valve and 1.5 bar pressure drop in the refrigeration system. For proper valve selection especially in case of high pressure drops, we recommend the use of correction factors (see page 74).

To facilitate valve dimensioning for other than the standard conditions ALCO offers an Excel based **Selection Tool** (www.emersonclimate.eu).

Condensing Temperature °C	Capacity kW Valve Type TI..-M....												Cage Size	
	Evaporating Temperature °C													
	+30	+20	+10	+5	0	-5	-10	-15	-20	-25	-30			
50	0,23	0,27	0,29	0,29	0,30	0,30	0,30	0,26	0,22	0,19	0,16		TIO-00X	
	0,60	0,71	0,76	0,78	0,79	0,79	0,79	0,68	0,59	0,50	0,43		TIO-000	
	1,42	1,68	1,81	1,85	1,87	1,88	1,87	1,63	1,39	1,20	1,01		TIO-001	
	2,32	2,74	2,96	3,02	3,05	3,07	3,06	2,65	2,27	1,95	1,66		TIO-002	
	3,74	4,42	4,77	7,87	4,92	4,94	4,93	4,28	3,66	3,15	2,67		TIO-003	
	6,21	7,34	7,93	8,08	8,17	8,21	8,19	7,10	6,08	5,23	4,43		TIO-004	
	7,56	8,93	9,64	9,84	9,95	9,99	9,97	8,64	7,40	6,36	5,39		TIO-005	
	8,76	10,34	11,17	11,40	11,52	11,57	11,55	10,01	8,57	7,37	6,25		TIO-006	
40	0,12	0,21	0,25	0,26	0,27	0,28	0,28	0,25	0,21	0,18	0,16		TIO-00X	
	0,33	0,56	0,67	0,70	0,73	0,74	0,75	0,66	0,57	0,49	0,42		TIO-000	
	0,79	1,34	1,60	1,67	1,73	1,76	1,78	1,56	1,35	1,17	1,00		TIO-001	
	1,29	2,18	2,60	2,73	2,82	2,88	2,91	2,55	2,20	1,91	1,63		TIO-002	
	2,08	3,52	4,20	4,40	4,45	4,64	4,69	4,11	3,56	3,08	2,63		TIO-003	
	3,45	5,84	6,97	7,31	7,55	7,70	7,79	6,83	5,90	5,12	4,37		TIO-004	
	4,19	7,10	8,48	8,90	9,19	9,38	9,48	8,31	7,18	6,23	5,32		TIO-005	
	4,86	8,23	9,83	10,31	10,64	10,86	10,98	9,63	8,32	7,22	6,16		TIO-006	
35	0,17	0,23	0,24	0,26	0,26	0,27	0,24	0,21	0,18	0,15			TIO-00X	
	0,44	0,60	0,65	0,68	0,70	0,72	0,63	0,55	0,48	0,41			TIO-000	
	1,06	10,43	1,54	1,61	1,67	1,70	1,50	1,31	1,14	0,98			TIO-001	
	1,72	2,33	2,50	2,63	2,72	2,78	2,45	2,13	1,86	1,59			TIO-002	
	2,78	3,75	4,04	4,24	4,39	4,48	3,95	3,44	3,00	2,57			TIO-003	
	4,62	6,23	6,71	7,05	7,28	7,43	6,56	5,71	4,97	4,27			TIO-004	
	5,62	7,58	8,16	8,57	8,86	9,05	7,99	6,95	6,05	5,19			TIO-005	
	6,51	8,79	9,45	9,93	10,26	10,48	9,25	8,05	7,01	6,01			TIO-006	
30	0,09	0,19	0,21	0,23	0,24	0,25	0,23	0,20	0,17	0,15			TIO-00X	
	0,25	0,51	0,57	0,62	0,65	0,67	0,60	0,52	0,46	0,40			TIO-000	
	0,60	1,20	1,35	1,46	1,54	1,59	1,42	1,25	1,09	0,94			TIO-001	
	0,98	1,96	2,21	2,39	2,51	2,60	2,32	2,03	1,78	1,54			TIO-002	
	1,58	3,16	3,57	3,85	4,05	4,19	3,74	3,28	2,87	2,48			TIO-003	
	2,63	5,25	5,92	6,39	6,73	6,96	6,21	5,44	4,77	4,11			TIO-004	
	3,20	6,39	7,20	7,78	8,19	8,47	7,56	6,62	5,81	5,00			TIO-005	
	3,71	7,40	8,34	9,01	9,49	9,82	8,75	7,67	6,73	5,80			TIO-006	
25	0,14	0,18	0,20	0,22	0,23	0,21	0,18	0,16	0,14				TIO-00X	
	0,37	0,47	0,54	0,58	0,61	0,56	0,49	0,43	0,38				TIO-000	
	0,89	1,12	1,27	1,38	1,46	1,32	1,17	1,03	0,90				TIO-001	
	1,45	1,82	2,08	2,25	2,38	2,15	1,91	1,68	1,46				TIO-002	
	2,33	2,94	3,35	3,64	3,84	3,47	3,07	2,72	2,36				TIO-003	
	3,87	4,88	5,56	6,03	6,37	5,76	5,10	4,51	3,91				TIO-004	
	4,71	5,94	6,76	7,34	7,75	7,01	6,21	5,49	4,76				TIO-005	
	5,45	6,88	7,84	8,51	8,98	8,12	7,19	6,36	5,52				TIO-006	
20	0,02	0,12	0,16	0,19	0,20	0,19	0,17	0,15	0,13				TIO-00X	
	0,04	0,33	0,43	0,50	0,54	0,50	0,45	0,40	0,35				TIO-000	
	0,10	0,77	1,02	1,18	1,29	1,19	1,07	0,96	0,84				TIO-001	
	0,17	1,26	1,66	1,92	2,10	1,94	1,75	1,56	1,37				TIO-002	
	0,27	2,04	2,68	3,10	3,39	3,13	2,82	2,52	2,20				TIO-003	
	0,44	3,38	4,45	5,14	5,62	5,20	4,68	4,18	3,66				TIO-004	
	0,54	4,11	5,41	6,25	6,84	6,33	5,69	5,09	4,45				TIO-005	
	0,62	4,76	6,27	7,24	7,92	7,33	6,59	5,89	5,15				TIO-006	
Condensing Temperature °C	Capacity kW Valve Type TI..-M....												Cage Size	
	+30	+20	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	Evaporating Temperature °C													
	+30	+20	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
50	0,27	0,32	0,34	0,35	0,35	0,34	0,30	0,25	0,22	0,18	0,15	0,13	0,10	TIO-00X
	0,71	0,82	0,88	0,89	0,89	0,88	0,77	0,65	0,56	0,47	0,39	0,33	0,27	TIO-000
	1,65	1,91	2,04	2,07	2,08	2,07	2,05	1,80	1,53	1,30	1,10	0,92	0,76	TIO-001
	2,82	3,28	3,50	3,55	3,57	3,55	3,52	3,08	2,62	2,24	1,88	1,58	1,30	TIO-002
	4,47	5,19	5,54	5,62	5,65	5,63	5,57	4,88	4,14	3,54	2,98	2,50	2,06	TIO-003
	7,29	8,47	9,05	9,17	9,21	9,18	9,09	7,96	6,76	5,78	4,86	4,07	3,37	TIO-004
	8,85	10,29	10,99	11,15	11,20	11,16	11,04	9,67	8,22	7,02	5,90	4,95	4,09	TIO-005
	10,26	11,93	12,74	12,92	12,98	12,93	12,80	11,21	9,53	8,13	6,84	5,74	3,89	TIO-006
40	0,20	0,29	0,34	0,35	0,36	0,37	0,33	0,28	0,24	0,21	0,18	0,15	0,12	TIO-00X
	0,51	0,75	0,87	0,91	0,93	0,95	0,95	0,84	0,73	0,63	0,54	0,46	0,38	TIO-000
	1,19	1,75	2,04	2,12	2,18	2,21	2,22	1,97	1,70	1,47	1,25	1,06	0,89	TIO-001
	2,03	3,00	3,49	3,64	3,73	3,78	3,80	3,38	2,91	2,52	2,14	1,82	1,53	TIO-002
	3,22	4,76	5,53	5,76	5,91	5,99	6,02	5,35	4,61	3,99	3,39	2,88	2,42	TIO-003
	5,25	7,76	9,02	9,40	9,64	9,78	9,83	8,73	7,52	6,50	5,54	4,70	3,94	TIO-004
	6,38	9,43	10,96	11,42	11,71	11,88	11,94	10,61	9,14	7,90	6,73	5,71	4,79	TIO-005
	7,40	10,93	12,71	13,23	13,58	13,77	13,84	12,30	10,78	9,38	8,03	6,86	5,78	TIO-006
35	0,25	0,32	0,34	0,36	0,36	0,37	0,33	0,29	0,25	0,21	0,18	0,15	0,13	TIO-00X
	0,65	0,83	0,88	0,92	0,94	0,95	0,85	0,74	0,64	0,55	0,47	0,40	0,33	TIO-000
	1,53	1,93	2,06	2,14	2,20	2,23	1,99	1,73	1,50	1,29	1,10	0,93	0,77	TIO-001
	2,62	3,32	3,52	3,67	3,76	3,82	3,42	2,96	2,58	2,21	1,88	1,59	1,33	TIO-002
	4,15	5,25	5,58	5,81	5,96	6,05	5,41	4,69	4,08	3,50	2,98	2,51	2,10	TIO-003
	6,77	8,56	9,10	9,48	9,72	9,86	8,83	7,65	6,66	5,70	4,87	4,10	3,43	TIO-004
	8,22	10,41	11,06	11,51	11,81	11,98	10,73	9,30	8,09	6,93	5,92	4,99	4,17	TIO-005
	9,53	12,06	12,82	13,35	13,69	13,89	12,44	10,78	9,38	8,03	6,86	5,78	4,83	TIO-006
30	0,19	0,29	0,32	0,34	0,36	0,36	0,33	0,29	0,25	0,22	0,19	0,16	0,13	TIO-00X
	0,49	0,75	0,83	0,88	0,91	0,94	0,85	0,74	0,65	0,56	0,48	0,41	0,34	TIO-000
	1,15	1,75	1,93	2,05	2,13	2,19	1,98	1,73	1,51	1,30	1,12	0,95	0,79	TIO-001
	1,97	3,01	3,30	3,51	3,66	3,75	3,39	2,96	2,59	2,23	1,92	1,62	1,36	TIO-002
	3,13	4,76	5,23	5,56	5,79	5,94	5,36	4,69	4,10	3,53	3,03	2,57	2,16	TIO-003

Condensing dew point °C	Temperature bubble point °C	R 407C		Capacity kW Valve Type TI...-N....								Cage Size
		+20	+10	+5	0	-5	-10	-15	-20	-25		
54	50	0,49	0,52	0,52	0,53	0,53	0,53	0,46	0,38	0,32	TIO-00X	
		1,27	1,34	1,36	1,37	1,37	1,36	1,19	1,00	0,83	TIO-000	
		3,17	3,35	3,39	3,42	3,42	3,41	2,99	2,49	2,07	TIO-001	
		5,16	5,45	5,53	5,57	5,57	5,55	4,86	4,06	3,37	TIO-002	
		8,33	8,80	8,92	8,98	9,00	8,96	7,85	6,55	5,44	TIO-003	
		13,58	14,35	14,55	14,65	14,67	14,61	12,80	10,69	8,87	TIO-004	
		16,57	17,50	17,75	17,87	17,89	17,82	15,61	13,04	10,82	TIO-005	
		19,11	20,18	20,46	20,60	20,63	20,55	18,00	15,03	12,47	TIO-006	
45	40	0,44	0,49	0,51	0,52	0,53	0,53	0,47	0,39	0,33	TIO-00X	
		1,14	1,28	1,32	1,34	1,36	1,37	1,21	1,02	0,85	TIO-000	
		2,86	3,19	3,29	3,36	3,4	3,42	3,02	2,54	2,13	TIO-001	
		4,66	5,19	5,36	5,47	5,54	5,58	4,93	4,14	3,46	TIO-002	
		7,52	8,38	8,65	8,83	8,95	9,00	7,95	6,69	5,59	TIO-003	
		12,25	13,66	14,10	14,40	14,58	14,67	12,96	10,91	9,11	TIO-004	
		14,95	16,67	17,20	17,57	17,79	17,90	15,82	13,31	11,12	TIO-005	
		17,24	19,22	19,83	20,25	20,52	20,64	18,24	15,34	12,82	TIO-006	
40	35	0,40	0,47	0,49	0,50	0,51	0,52	0,46	0,39	0,33	TIO-00X	
		1,03	1,21	1,26	1,30	1,33	1,34	1,19	1,01	0,85	TIO-000	
		2,58	3,02	3,15	3,25	3,32	3,36	2,99	2,52	2,12	TIO-001	
		4,20	4,91	5,14	5,30	5,41	5,47	4,86	4,11	3,45	TIO-002	
		6,78	7,93	8,29	8,55	8,73	8,84	7,85	6,63	5,56	TIO-003	
		11,06	12,93	13,52	13,94	14,23	14,41	12,79	10,81	9,07	TIO-004	
		13,49	15,77	16,49	17,01	17,36	17,58	15,61	13,19	11,06	TIO-005	
		15,56	18,19	19,02	19,61	20,02	20,27	18,00	15,21	12,75	TIO-006	
35	30	0,34	0,43	0,46	0,48	0,49	0,50	0,45	0,38	0,32	TIO-00X	
		0,88	1,11	1,18	1,24	1,28	1,30	1,16	0,99	0,83	TIO-000	
		2,19	2,78	2,96	3,09	3,19	3,25	2,91	2,47	2,08	TIO-001	
		3,57	4,53	4,82	5,04	5,20	5,30	4,74	4,02	3,39	TIO-002	
		5,76	7,30	7,78	8,13	8,39	8,56	7,64	6,49	5,47	TIO-003	
		9,39	11,91	12,69	13,26	13,67	13,95	12,46	10,58	8,92	TIO-004	
		11,46	14,53	15,48	16,18	16,68	17,02	15,21	12,91	10,88	TIO-005	
		13,22	16,75	17,85	18,66	19,23	19,62	17,53	14,89	12,54	TIO-006	
30	25	0,38	0,42	0,44	0,46	0,48	0,48	0,43	0,37	0,31	TIO-00X	
		0,98	1,08	1,15	1,21	1,24	1,24	1,12	0,96	0,81	TIO-000	
		2,46	2,70	2,88	3,01	3,11	3,20	2,39	2,02	1,80	TIO-001	
		4,01	4,40	4,70	4,91	5,06	5,06	4,55	3,89	3,29	TIO-002	
		6,47	7,11	7,58	7,92	8,16	7,35	6,28	5,32	4,52	TIO-003	
		10,55	11,59	12,36	12,91	13,31	11,98	10,24	8,67	7,89	TIO-004	
		12,87	14,14	15,07	15,75	16,24	14,62	12,49	10,58	9,77	TIO-005	
		14,84	16,31	17,38	18,17	18,72	16,86	14,40	12,19	11,71	TIO-006	
26	20										TIO-00X	
											TIO-000	
											TIO-001	
											TIO-002	
											TIO-003	
											TIO-004	
											TIO-005	
											TIO-006	

Condensing Temperature °C	R 410A		Capacity kW Valve Type TI...-Z....								Cage Size			
	+15	+10	+5	0	-5	-10	-15	-20	-25	-30	-35			
50	50	0,53	0,55	0,57	0,58	0,59	0,60	0,53	0,47	0,40	0,33	0,28	0,23	0,20
		1,38	1,44	1,49	1,52	1,54	1,56	1,39	1,21	1,03	0,87	0,73	0,61	0,51
		3,40	3,55	3,66	3,74	3,80	3,84	3,41	2,98	2,54	2,14	1,79	1,49	1,25
		5,64	5,87	6,06	6,20	6,29	6,36	5,65	4,94	4,21	3,54	2,96	2,48	2,08
		9,04	9,42	9,72	9,94	10,09	10,20	9,06	7,92	6,75	5,68	4,75	3,97	3,33
		14,79	15,41	15,89	16,25	16,51	16,67	14,82	12,94	11,03	9,28	7,76	6,49	5,44
		17,98	18,73	19,32	19,76	20,07	20,27	18,02	15,74	13,42	11,28	9,44	7,89	6,62
		20,75	21,61	22,29	22,79	23,16	23,39	20,79	18,16	15,48	13,02	10,89	9,11	7,63
40	40	0,49	0,53	0,55	0,58	0,59	0,61	0,54	0,48	0,41	0,35	0,29	0,25	0,21
		1,28	1,37	1,44	1,50	1,54	1,58	1,41	1,24	1,07	0,90	0,76	0,64	0,54
		3,14	3,37	3,55	3,69	3,80	3,88	3,48	3,06	2,63	2,22	1,88	1,57	1,32
		5,20	5,58	5,88	6,11	6,29	6,42	5,76	5,07	4,35	3,68	3,10	2,60	2,19
		8,35	8,95	9,43	9,81	10,09	10,30	9,24	8,13	6,98	5,91	4,97	4,18	3,52
		13,65	14,64	15,42	16,04	16,50	16,85	15,11	13,30	11,41	9,66	8,13	6,83	5,76
		16,60	17,80	18,75	19,50	20,06	20,48	18,37	16,17	13,88	11,75	9,88	8,31	7,00
		19,15	20,54	21,64	22,50	23,15	23,64	21,20	18,66	16,01	13,55	11,40	9,58	8,07
35	35	0,45	0,49	0,53	0,56	0,58	0,60	0,54	0,47	0,41	0,35	0,29	0,25	0,21
		1,17	1,28	1,38	1,45	1,51	1,55	1,40	1,23	1,06	0,90	0,76	0,64	0,54
		2,87	3,16	3,39	3,57	3,70	3,81	3,44	3,04	2,62	2,22	1,88	1,58	1,34
		4,75	5,23	5,61	5,91	6,14	6,31	5,69	5,03	4,34	3,68	3,11	2,62	2,21
		7,62	8,39	9,00	9,47	9,84	10,12	9,13	8,07	6,96	5,91	4,99	4,20	3,55
		12,46	13,73	14,72	15,49	16,09	16,55	14,93	13,20	11,38	9,66	8,15	6,87	5,80
		15,15	16,69	17,89	18,84	19,57	20,12	18,15	16,05	13,83	11,75	9,91	8,35	7,05
		17,48	19,26	20,65	21,73	22,58	23,22	20,94	18,52	15,96	13,55	11,44	9,64	8,14
30	30	0,39	0,45	0,49	0,53	0,55	0,58	0,52	0,47	0,40	0,34	0,29	0,25	0,21
		1,00	1,16	1,28	1,37	1,44	1,50	1,36	1,21	1,05	0,89	0,76	0,64	0,54
		2,47	2,86	3,15	3,37	3,55	3,69	3,35	2,98	2,58	2,20	1,86	1,57	1,33
		4,10	4,73	5,21	5,59	5,88	6,10	5,55	4,93	4,27	3,64	3,08	2,61	2,21
		6,57	7,59	8,36	8,96	9,43	9,79	8,89	7,91	6,85	5,84	4,94	4,18	3,54
		10,74	12,41	13,67	14,66	15,42	16,01	14,54	12,94	11,20	9,55	8,09	6,83	5,79
		13,06	15,09	16,63	17,82	18,75	19,46	17,68	15,73	13,62	11,61	9,83	8,31	7,04
		15,07	17,41	19,18	20,5									

Condensing Temperature °C	Capacity kW Valve Type TI..S....													Cage Size	
	Evaporating Temperature °C														
R 507															
+30	+20	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45		
50	0,29	0,34	0,36	0,37	0,37	0,37	0,32	0,27	0,23	0,19	0,16	0,13	0,11	TIO-00X	
	0,73	0,85	0,91	0,92	0,93	0,93	0,92	0,80	0,68	0,58	0,49	0,40	0,33	0,26	
	1,68	1,95	2,09	2,12	2,13	2,13	2,11	1,83	1,57	1,33	1,12	0,92	0,76	0,61	
	2,85	3,31	3,54	3,59	3,62	3,61	3,58	3,10	2,66	2,26	1,89	1,57	1,28	1,03	
	4,54	5,26	5,63	5,71	5,75	5,74	5,69	4,93	4,23	3,59	3,01	2,49	2,04	1,64	
	7,39	8,57	9,17	9,31	9,36	9,35	9,28	8,04	6,88	5,85	4,90	4,06	3,32	2,67	
	9,00	10,44	11,16	11,33	11,40	11,39	11,30	9,79	8,38	7,12	5,97	4,94	4,04	3,26	
	10,39	12,05	12,89	13,08	13,16	13,15	13,04	11,31	9,68	8,22	6,89	5,70	4,66	3,76	
40	0,21	0,31	0,36	0,37	0,38	0,39	0,34	0,30	0,26	0,22	0,18	0,15	0,12	TIO-00X	
	0,52	0,77	0,89	0,93	0,96	0,97	0,98	0,86	0,75	0,64	0,54	0,46	0,38	0,31	
	1,20	1,77	2,05	2,14	2,20	2,23	2,25	1,98	1,71	1,47	1,25	1,05	0,87	0,71	
	2,04	3,00	3,48	3,63	3,73	3,79	3,82	3,35	2,91	2,50	2,12	1,78	1,47	1,20	
	3,24	4,76	5,54	5,77	5,93	6,02	6,07	5,33	4,62	3,97	3,37	2,82	2,34	1,91	
	5,28	7,76	9,02	9,40	9,66	9,81	9,88	8,68	7,53	6,47	5,49	4,60	3,80	3,10	
	6,43	9,45	10,99	11,45	11,76	11,95	12,04	10,57	9,17	7,88	6,68	5,60	4,63	3,78	
	7,42	10,91	12,68	13,22	13,58	13,79	13,90	12,20	10,59	9,10	7,72	6,46	5,35	4,36	
35	0,27	0,34	0,36	0,37	0,38	0,39	0,35	0,30	0,26	0,22	0,19	0,16	0,13	TIO-00X	
	0,67	0,84	0,90	0,94	0,96	0,98	0,86	0,75	0,65	0,56	0,47	0,39	0,32	TIO-000	
	1,53	1,94	2,06	2,15	2,21	2,25	1,99	1,74	1,50	1,28	1,08	0,90	0,73	TIO-001	
	2,60	3,29	3,50	3,65	6,75	3,81	3,37	2,94	2,55	2,17	1,83	1,52	1,25	TIO-002	
	4,14	5,23	5,56	5,80	5,96	6,06	5,36	4,68	4,05	3,45	2,90	2,41	1,98	TIO-003	
	6,74	8,52	9,06	9,45	9,71	9,87	8,73	7,62	6,59	5,62	4,73	3,93	3,23	TIO-004	
	8,21	10,38	11,04	11,50	11,82	12,02	10,63	9,28	8,03	6,84	5,76	4,79	3,93	TIO-005	
	9,47	11,98	12,74	13,28	13,65	13,87	12,27	10,72	9,27	7,90	6,65	5,53	4,54	TIO-006	
30	0,20	0,31	0,34	0,36	0,37	0,38	0,34	0,30	0,26	0,22	0,19	0,16	0,13	TIO-00X	
	0,50	0,76	0,84	0,89	0,93	0,96	0,85	0,75	0,65	0,56	0,47	0,40	0,33	TIO-000	
	1,16	1,75	1,93	2,05	2,14	2,20	1,96	1,73	1,50	1,29	1,09	0,91	0,75	TIO-001	
	1,96	2,98	3,27	3,48	3,63	3,73	3,33	2,93	2,55	2,19	1,85	1,54	1,27	TIO-002	
	3,12	4,73	5,19	5,53	5,77	5,93	5,29	4,66	4,05	3,47	2,94	2,45	2,02	TIO-003	
	5,08	7,71	8,46	9,01	9,40	9,66	8,62	7,59	6,60	5,66	4,79	4,00	3,29	TIO-004	
	6,18	9,38	10,30	10,97	11,44	11,76	10,50	9,24	8,04	6,89	5,83	4,87	4,01	TIO-005	
	7,14	10,83	11,90	12,66	13,21	13,58	12,12	10,67	9,28	7,96	6,73	5,62	4,63	TIO-006	
25	0,26	0,30	0,33	0,35	0,37	0,33	0,29	0,26	0,22	0,19	0,16	0,13	0,13	TIO-00X	
	0,64	0,75	0,82	0,88	0,92	0,83	0,73	0,64	0,56	0,47	0,40	0,33	0,33	TIO-000	
	1,48	1,72	1,90	2,02	2,11	1,90	1,69	1,48	1,28	1,09	0,91	0,75	0,75	TIO-001	
	2,50	2,92	3,21	3,43	3,58	3,23	2,87	2,51	2,17	1,84	1,55	1,28	1,28	TIO-002	
	3,98	4,64	5,11	5,45	5,68	5,13	4,56	3,99	3,45	2,93	2,46	2,03	1,80	TIO-003	
	6,48	7,56	8,32	8,87	9,26	8,36	7,42	6,51	5,61	4,77	4,01	3,32	2,82	TIO-004	
	7,89	9,20	10,13	10,80	11,28	10,18	9,04	7,92	6,84	5,82	4,88	4,04	3,29	TIO-005	
	9,11	10,63	11,70	12,47	13,02	11,76	10,44	9,15	7,89	6,71	5,63	4,66	3,76	TIO-006	
20	0,18	0,25	0,29	0,32	0,34	0,31	0,28	0,25	0,22	0,19	0,16	0,13	0,13	TIO-00X	
	0,45	0,62	0,73	0,80	0,86	0,79	0,71	0,63	0,54	0,46	0,39	0,33	0,33	TIO-000	
	1,04	1,42	1,67	1,85	1,97	1,81	1,63	1,44	1,25	1,07	0,90	0,75	0,75	TIO-001	
	1,76	2,41	2,84	3,13	3,34	3,07	2,76	2,44	2,12	1,81	1,53	1,27	1,27	TIO-002	
	2,80	3,84	4,51	4,98	5,32	4,88	4,38	3,88	3,37	2,88	2,43	2,02	1,80	TIO-003	
	4,57	6,25	7,34	8,11	8,66	7,95	7,14	6,31	5,49	4,70	3,96	3,29	2,82	TIO-004	
	5,56	7,61	8,94	9,88	10,55	9,68	8,69	7,69	6,68	5,72	4,82	4,01	3,29	TIO-005	
	6,42	8,78	10,32	11,40	12,18	11,17	10,04	8,88	7,71	6,60	5,57	4,63	3,76	TIO-006	
Condensing Temperature °C	Capacity kW Valve Type TI..H....													Cage Size	
+30	+20	+10	+5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45		
R 22															
Evaporating Temperature °C															
50	0,38	0,45	0,50	0,51	0,52	0,53	0,53	0,46	0,41	0,35	0,30	0,26	0,22	0,19	TIO-00X
	0,98	1,17	1,29	1,33	1,35	1,38	1,36	1,20	1,05	0,91	0,78	0,66	0,57	0,48	TIO-000
	2,40	2,86	3,16	3,26	3,32	3,39	3,33	2,95	2,58	2,24	1,91	1,62	1,40	1,19	TIO-001
	4,03	4,78	5,29	4,47	5,56	5,67	5,57	4,95	4,32	3,75	3,20	2,72	2,35	2,00	TIO-002
	6,41	7,64	8,42	8,70	8,85	9,03	8,87	7,88	6,87	5,97	5,10	4,34	3,45	3,18	TIO-003
	10,50	12,51	13,79	14,26	14,50	14,80	14,53	12,90	11,26	9,79	8,35	7,10	6,14	5,21	TIO-004
	12,80	15,24	16,81	17,37	17,67	18,03	17,70	15,72	13,72	11,93	10,18	8,66	7,49	6,35	TIO-005
	14,76	17,58	19,38	20,04	20,38	20,79	20,42	18,14	15,82	13,76	11,74	9,98	8,64	7,32	TIO-006
40	0,24	0,37	0,44	0,46	0,48	0,50	0,49	0,44	0,39	0,34	0,29	0,25	0,22	0,18	TIO-00X
	0,61	0,95	1,14	1,20	1,25	1,29	1,27	1,15	1,01	0,88	0,75	0,64	0,56	0,47	TIO-000
	1,51	2,33	2,78	2,94	3,07	3,17	3,12	2,82	2,47	2,16	1,85	1,58	1,38	1,17	TIO-001
	2,52	3,90	4,66	4,92	5,13	5,30	5,23	4,73	4,14	3,62	3,10	2,65	2,31	1,96	TIO-002
	4,02	6,21	7,42	7,84	8,18	8,44	8,33	7,53	6,59	5,76	4,94	4,23	3,68	3,12	TIO-003
	6,59	10,17	12,16	12,85	13,39	13,83	13,65	12,33	10,79	9,44	8,10	6,92	6,03	5,12	TIO-004
	8,03	12,40	14,82	15,65	16,32	16,85	16,63	15,03	13,15	11,50	9,87	8,44	7,35	6,23	TIO-005
	9,26	14,30	17,09	18,05	18,82	19,43	19,18	17,33	15,17	13,26	11,38	9,73	8,48	7,19	TIO-006
35	0,30	0,40	0,43	0,47	0,48	0,43	0,43	0,38	0,33	0,29	0,24	0,21	0,18	0,15	TIO-00X
	0,79	1,03	1,11	1,17	1,22	1,23	1,23	1,11	0,98	0,85	0,74	0,63	0,55	0,47	TIO-000
	1,93	2,53	2,72	2,88	3,00	3,01	2,71	2,40	2,09	1,81	1,55	1,35	1,15	1,01	TIO-001
	3,24	4,23	4,56	4,82	5,02	5,03	4,54	4,02	3,50	3,03	2,60	2,27	1,93	1,63	TIO-002
	5,16	6,74	7,27	7,68	8,00	8,01	7,23	6,40	5,57	4,83	4,14	3,61	3,07	2,63	TIO-003
	8,45	11,04	11,90	1											