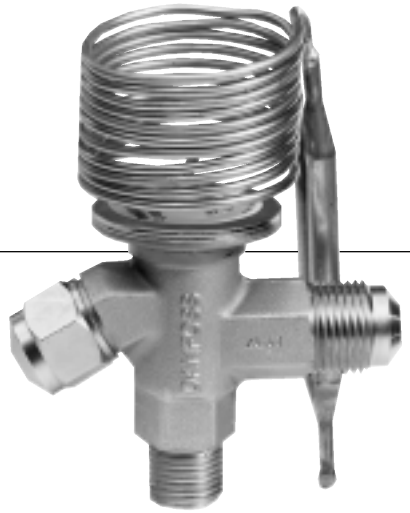
Refrigeration and Air Conditioning
Technical leaflet



# Injection valve
# Type TXI 2

## Introduction

Danfoss has developed a injection valve type TXI 2 for desuperheating in 2-stage refrigeration systems operating on R 22 where the hot gas temperature and the intermediate pressure are the controlling variables.

## Application

In principle there are two different ways in which to setup 2-stage refrigeration systems as far as temperature signal to the liquid injection valve is concerned.

## Application examples

*Example 1*
2-stage refrigeration system built up with a combined LP/HP compressor.

In this case the discharge gas temperature on the HP side is used as temperature signal and the intermediate pressure as pressure signal to the injection valve.

In this example a TXI 2 injection valve is used, see fig. 1.

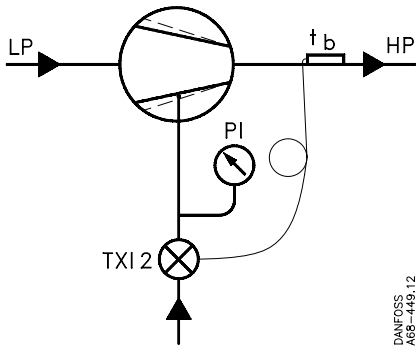



Fig. 1

*LP: Low pressure*
*HP: High pressure*
*PI: intermediate pressure*

**Application examples continued**

*Example 2*
2-stage refrigeration system with 2 separate refrigerating compressors in series. In this set up a solution with injection valve type TXI 2 can be used, because the discharge gas temperature on the HP side can be used as temperature signal and the intermediate pressure as pressure signal to the injection valve, see fig. 2.

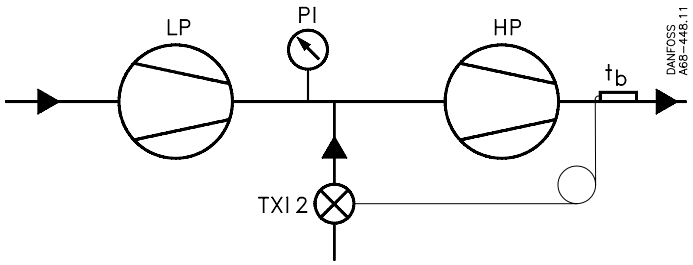



Fig. 2

*LP: Low pressure compressor*
*HP: High pressure compressor*
*PI: Intermediate pressure*

*Example 3*
Same setup as in example 2 with 2 separate refrigerating compressors in series. As in this setup there is an accessible control signal where there is correspondence between pressure and temperature, regulation of the strongly superheated condition of the refrigerant can be undertaken by a traditional thermostatic expansion valve e.g. Danfoss type TX 2 for R 22 refrigeration systems, see fig. 3.

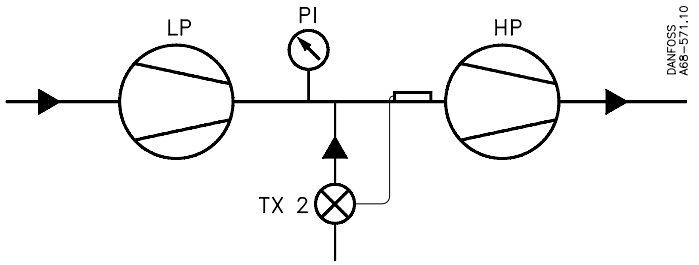



Fig. 3

*LP: Low pressure compressor*
*HP: High pressure compressor*
*PI: Intermediate pressure*

## Operation

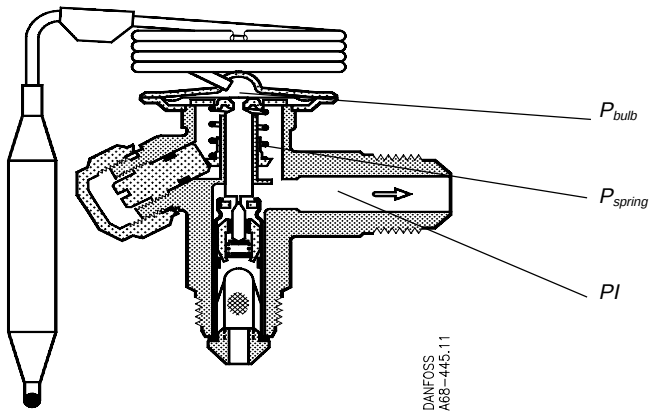



Fig. 4

The valve function is controlled by the intermediate pressure (PI) acting under the diaphragm and the bulb pressure derived from the discharge gas temperature across the diaphragm (fig. 4).

The intermediate pressure (PI), setting spring and bulb temperature form a working range which, expressed in a co-ordinate system, makes up a working area, see fig. 5.

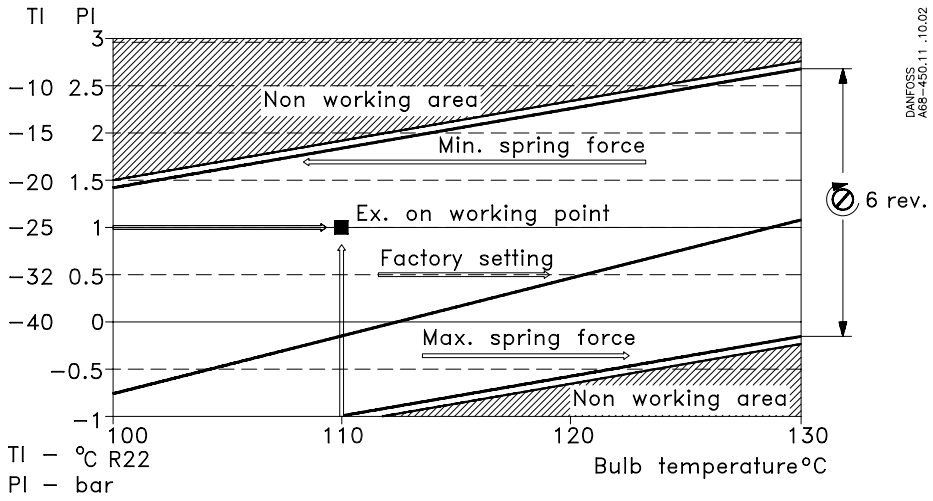



Fig. 5 Valid for code no. 068-3249 only

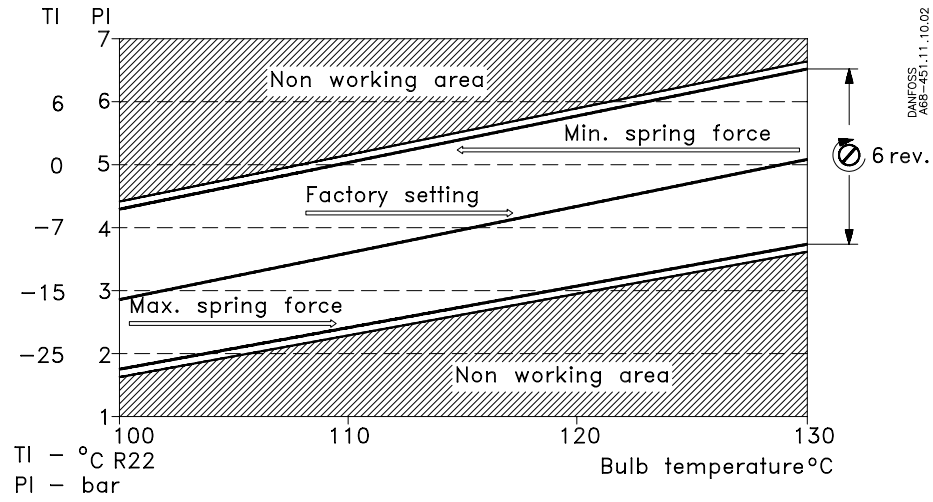



Fig. 5 Valid for code no. 068-3258 only

Within the limits of this area, the working point required is found (PI/$t_{bulb}$).

The location of the working point depends on the spring force set and in addition to that dependent on the proportional band (the superheat) and the valve capacity (size of orifice).

Therefore, the sizing is decisive for a satisfactory result.

## Sizing

To size TXI 2 the refrigerating capacity required to remove the superheat at the intermediate stage must be known as well as the required discharge gas temperature on the discharge side.

Besides this the pressure drop Δp across the injection valve must be determined as the difference between the condensing pressure and the pressure at the intermediate stage.

With the values for the required capacity, the evaporating temperature $t_0$ (PI) of the intermediate stage and the pressure drop across TXI 2, the correct orifice size can be determined.

Example:

Required refrigerating capacity Q= 5 kW
Evaporating temperature at intermediate state $t_0$ = -25°C
Pressure drop across TXI 2 Δp= 12 bar
Discharge gas temperature (HP)= 110°C

| Valve type | Orifice No. | Evaporating temperature -25°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | 0.69 | 0.83 | 0.94 | 1.02 | 1.08 | 1.12 | 1.14 | 1.15 |
| TXI 2 - 0.3 | 01 | 1.21 | 1.51 | 1.71 | 1.85 | 1.96 | 2.04 | 2.09 | 2.11 |
| TXI 2 - 0.6 | 02 | 1.66 | 2.13 | 2.42 | 2.62 | 2.77 | 2.87 | 2.94 | 2.97 |
| TXI 2 - 0.8 | 03 | 2.98 | 3.82 | 4.33 | 4.69 | 4.96 | 5.15 | 5.27 | 5.33 |
| TXI 2 - 1.2 | 04 | 4.36 | 5.59 | 6.35 | 6.89 | 7.30 | 7.60 | 7.80 | 7.91 |
| TXI 2 - 1.5 | 05 | 5.55 | 7.10 | 8.06 | 8.74 | 9.26 | 9.64 | 9.89 | 10.02 |
| TXI 2 - 2.0 | 06 | 6.80 | 8.68 | 9.84 | 10.67 | 11.30 | 11.77 | 12.08 | 12.25 |

TXI 2 with orifice 03 fits that example as the values in the capacity tables are shown with a proportional band of 6 K.

## Capacity in kW

| Valve type | Orifice No. | Evaporating temperature (PI) -10°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | 0.79 | 0.96 | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 |
| TXI 2 - 0.3 | 01 | 1.6 | 2.0 | 2.3 | 2.5 | 2.6 | 2.7 | 2.8 | 2.8 |
| TXI 2 - 0.6 | 02 | 2.2 | 2.9 | 3.3 | 3.6 | 3.8 | 4.0 | 4.1 | 4.1 |
| TXI 2 - 0.8 | 03 | 3.9 | 5.1 | 5.9 | 6.4 | 6.8 | 7,1 | 7.3 | 7.3 |
| TXI 2 - 1.2 | 04 | 5.8 | 7.6 | 8.7 | 9.5 | 10.1 | 10.5 | 10.8 | 10.9 |
| TXI 2 - 1.5 | 05 | 7.4 | 9.6 | 11.0 | 12.0 | 12.8 | 13.3 | 13.6 | 13.8 |
| TXI 2 - 2.0 | 06 | 9.1 | 11.8 | 13.5 | 14.7 | 15.6 | 16.2 | 16.6 | 16.8 |

| Valve type | Orifice No. | Evaporating temperature (PI) -20°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | | 0.88 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 |
| TXI 2 - 0.3 | 01 | | 17 | 1.9 | 2.0 | 2.2 | 2.3 | 2.3 | 2.3 |
| TXI 2 - 0.6 | 02 | | 2.4 | 2.7 | 2.9 | 3.1 | 3.2 | 3.3 | 3.3 |
| TXI 2 - 0.8 | 03 | | 4.2 | 4.8 | 5.2 | 5.5 | 5.8 | 5.9 | 6.0 |
| TXI 2 - 1.2 | 04 | | 6.2 | 7.1 | 7.7 | 8.2 | 8.5 | 8.7 | 8.8 |
| TXI 2 - 1.5 | 05 | | 7.9 | 9.0 | 9.8 | 10.3 | 10.8 | 11.0 | 11.2 |
| TXI 2 - 2.0 | 06 | | 9.6 | 11.0 | 11.9 | 12.6 | 13.1 | 13.5 | 13.7 |

| Valve type | Orifice No. | Evaporating temperature (PI) -25°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | 0.69 | 0.83 | 0.94 | 1.02 | 1.08 | 1.12 | 1.14 | 1.15 |
| TXI 2 - 0.3 | 01 | 1.21 | 1.51 | 1.71 | 1.85 | 1.96 | 2.04 | 2.09 | 2.11 |
| TXI 2 - 0.6 | 02 | 1.66 | 2.13 | 2.42 | 2.62 | 2.77 | 2.87 | 2.94 | 2.97 |
| TXI 2 - 0.8 | 03 | 2.98 | 3.82 | 4.33 | 4.69 | 4.96 | 5.15 | 5.27 | 5.33 |
| TXI 2 - 1.2 | 04 | 4.36 | 5.59 | 6.35 | 6.89 | 7.30 | 7.60 | 7.80 | 7.91 |
| TXI 2 - 1.5 | 05 | 5.55 | 7.10 | 8.06 | 8.74 | 9.26 | 9.64 | 9.89 | 10.02 |
| TXI 2 - 2.0 | 06 | 6.80 | 8.68 | 9.84 | 10.67 | 11.30 | 11.77 | 12.08 | 12.25 |

| Valve type | Orifice No. | Evaporating temperature (PI) -30°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | | 0.79 | 0.90 | 0.96 | 1.0 | 1.1 | 1.1 | 1.1 |
| TXI 2 - 0.3 | 01 | | 1.4 | 1.5 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 |
| TXI 2 - 0.6 | 02 | | 1.9 | 2.2 | 2.7 | 2.5 | 2.6 | 2.6 | 2.7 |
| TXI 2 - 0.8 | 03 | | 3.4 | 3.9 | 4.2 | 4.4 | 4.6 | 4.7 | 4.8 |
| TXI 2 - 1.2 | 04 | | 5.0 | 5.7 | 6.2 | 6.5 | 6.8 | 7.0 | 7.1 |
| TXI 2 - 1.5 | 05 | | 6.4 | 7.2 | 7.8 | 8.3 | 8.6 | 8.8 | 9.0 |
| TXI 2 - 2.0 | 06 | | 7.8 | 8.8 | 9.6 | 10.1 | 10.5 | 10.8 | 11.0 |

| Valve type | Orifice No. | Evaporating temperature (PI) -40°C | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pressure drop across valve Δp bar | | | | | | | |
| | | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| TXI 2 - 0.2 | 00 | 0.60 | 0.71 | 0.80 | 0.86 | 0.92 | 0.95 | 0.98 | 0.99 |
| TXI 2 - 0.3 | 01 | 0.90 | 1.11 | 1.25 | 1.35 | 1.43 | 1.49 | 1.53 | 1.55 |
| TXI 2 - 0.6 | 02 | 1.23 | 1.55 | 1.74 | 1.88 | 1.97 | 2.05 | 2.09 | 2.12 |
| TXI 2 - 0.8 | 03 | 2.20 | 2.78 | 3.12 | 3.36 | 3.54 | 3.68 | 3.77 | 3.81 |
| TXI 2 - 1.2 | 04 | 3.20 | 4.04 | 4.56 | 4.93 | 5.21 | 5.43 | 5.58 | 5.67 |
| TXI 2 - 1.5 | 05 | 4.07 | 5.14 | 5.79 | 6.26 | 6.62 | 6.90 | 7.09 | 7.20 |
| TXI 2 - 2.0 | 06 | 4.98 | 6.28 | 7.07 | 7.65 | 8.09 | 8.44 | 8.68 | 8.82 |

## Setting

TXI 2 cannot be set until the refrigerant system is started up. Setting after start-up is carried out when the discharge gas temperature has been recorded and the intermediate pressure is known or measured. By means of the diagram, fig. 5, the actual working point is found. From the location of the working point in the diagram, fig. 5, it should be decided whether to increase or decrease the spring force.

Alteration of the spring from slack to tight setting corresponds to 6 revolutions of the TXI 2 setting screw.

## Technical data

| | |
|---|---|
| Perm. working pressure PBIMWP: | 28 bar |
| Max. test pressure: | 36 bar |
| Capillary tube: | 1.5 m. |

## Ordering valve

| Type | Connections [in.] | Temp. range | Pressure range (pi) | Weight KG | Code No. |
|---|---|---|---|---|---|
| TXI-2 | 3/8 × 1/2 SAE flare | +100 → +130°C | 0 - 2 bar | 0.3 | **068-3249** |
| TXI-2 | 3/8 × 1/2 SAE flare | +100 → +130°C | 1 - 5 bar | 0.3 | **068-3258** |
| TXI-2 | 3/8 SAE flare × 1/2 solder | +100 → +130°C | 0 - 2 bar | 0.3 | **068-3342** |
| TXI-2 | 3/8 SAE flare × 1/2 solder | +100 → +130°C | 1 - 5 bar | 0.3 | **068-3343** |
| TXI-2 | 3/8 SAE flare × 1/2 solder | +80 → +110°C | 1 - 5 bar | 0.3 | **068-3344** |
| TXI-2 | 3/8 × 1/2 SAE flare | +80 → +110°C | 1 - 5 bar | 0.3 | **068-3360** |

## Ordering accessories

*Orifice assembly*

| Orifice no. | Code no. TE 2 |
|---|---|
| 00 | **068-2003** |
| 01 | **068-2010** |
| 02 | **068-2015** |
| 03 | **068-2006** |
| 04 | **068-2007** |
| 05 | **068-2008** |
| 06 | **068-2009** |

*Flare nuts*

| Symbol | Connection for copper tubing with outside cam. | | Reducer for copper tubing with outside diam. | | Code no. |
|---|---|---|---|---|---|
| | in. | mm. | in. | mm. | |
|  | 1/4 | 6 | | | **011L1201** |
| | 3/8 | 10 | | | **011L1235** |
| | 1/2 | 12 | | | **011L1203** |
| | 3/8 | 10 | 1/4 | 6 | **011L1207** |



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